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Overview of the main international climate services

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SUMMARY As the demand for tailored climate information by decision makers, stakeholders and the general public is growing worldwide, together with the awareness of the challenges posed to society and environment by climate variability and change, Climate Services plays a crucial role as providers of standard as well as customized climate information systems and products. Relevant information concerns climate change impacts, vulnerability, risks and uncertainties as well as the possible response (mitigation and adaptation) measures and strategies and their management. This report provides an overview (not intended to be exhaustive) of the relevant activities carried out by the existing international Climate Services and Consulting Agencies and of their main products and services.

Keywords: climate services, climate tools, climate consulting agencies, climate advice

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OVERVIEW OF THE MAIN INTERNATIONAL CLIMATE SERVICES

1 Introduction

The demand for tailored climate information by the public and a variety of specific users (such as decision makers and stakeholders in key business sectors, private companies, political institutions and planning agencies as well as scientists) has recently grown worldwide together with the awareness of the challenges posed to society and environment by climate variability and change.

Climate Services play a crucial role in developing and disseminating relevant standard as well as customized climate information systems and products to stakeholders, including on climate change impacts, vulnerability, risks and uncertainties as well as on the possible response measures and strategies (mitigation and adaptation) and their management.

For this reasons, in 2009 the *World Climate Conference-3 (WCC-3)* convened by the *World Meteorological Organization (WMO)* decided to establish a *Global Framework for Climate Services (GFCS)* "to strengthen the provision and use of climate predictions, products and information worldwide". The GFCS aims at "building climate-resilient societies" and at ensuring that "all sectors of society have user-friendly climate products that enable them to plan ahead in the face of changing climate conditions"[1].

The present report has been developed in the framework of the *GEMINA* Project, a collaboration effort by the Euro-Mediterranean Centre for Climate Change (*CMCC*) and the Italian Ministry of Environment Land and Sea (*IMELS*) including the development of "*Climate services for society and industry*" (*Action A.2*) and provides an overview (not intended to be exhaustive) of the relevant activities carried out by the existing international (in the world and in Europe) Climate Services and Consulting Agencies and of their main products and services.

The range of activities encompasses: observations and research, generation and provision of information systems, maps, guidance and management tools (based on past, present and future climate and its impacts on natural and human systems) and of advice on climate change related issues (for managing the risks and making use of opportunities for mitigation and adaptation).

2 Overview of the main international and European Climate Services

This section presents an overview (not intended to be exhaustive) of the activities carried out by the main international and European Climate Services identified by our research[2] through the description of these Organizations' mission, main (and also ancillary) climate products and services and staff composition.

[1] Source: WMO (2009) World Climate Conference-3 (WCC-3) outcomes.

[2] Main sources: International Conference on Climate Services (ICCS) (2011), WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS) and Web search.

2.1 List of main international and European Climate Services

Existing

CLIMATE SERVICE	ORG. LOGO	COUNTRY	WEBSITE	SCALE / PERSPECTIVE
International				
WMO Climate Services		/	http://www.wmo.int/pages/themes/climate/climate_services.php	Global, Regional
FAO climate change resources		/	http://www.fao.org/climatechange/59898/en/	Global, Regional
Red Cross/Red Crescent Climate Centre (RC/RC CC)		/	http://climatelab.org/Red_Cross_Red_Crescent_Climate_Centre	Global (developing countries)
NOAA Climate Services Portal (NCS Portal)		USA	http://www.climate.gov/#climateWatch	Global, Regional, National
NOAA RCCs Climate services		USA	http://www.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html	Global, Regional, National
NOAA National Weather Service (NWS) Climate Services Web Page		USA	http://www.nws.noaa.gov/om/csd/	Regional, National
OFFICE OF THE FEDERAL COORDINATOR FOR METEOROLOGY Climate Information and Services[3]		USA	www.climateservices.gov	Regional, National
AUSTRALIA National Climate Centre		Australia	http://www.bom.gov.au/climate/	Global, Regional, National
CHINA METEOROLOGICAL ADMINISTRATION (CMA) Climate		China	http://www.cma.gov.cn/en/	Regional, National

[3] Currently being updated and not accessible.

Services				
CARIBBEAN COMMUNITY Climate Change Centre (CCCCC)		Caribbean Community (CARICOM)	http://caribbeanclimate.bz/	Regional, National
FIJI METEOROLOGICAL SERVICE Climate Services		Fiji	http://www.met.gov.fj/	Regional, National
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY Climate Services Centre (SADC CSC)		South African	http://www.sadc.int/english/regional-integration/is/csc/	Regional, sub-regional
European				
UK MET OFFICE Climate Services		UK	http://www.metoffice.gov.uk/services/climate-services	Global, Regional, National, Local
UKCIP website		UK	http://www.ukcip.org.uk/	International, National, Local
Climate Service Center (CSC) Germany		D	http://www.climate-service-center.de/	Global, Regional, National, Local
KNMI Climate Services		NL	http://www.knmi.nl/research/climate_services/	National, Local
Météo-France Climate Section		FR	http://france.meteofrance.com/france/accueil/	Global, National,
National Climate Research The Netherlands.		NL	http://www.climateresearchnetherlands.nl/research-programmes	National, Local

Under development

CLIMATE SERVICE	LOGO	COUNTRY	WEBSITE	APPROACH / PERSPECTIVE
International				

ClimDev-Africa[4]		Africa	http://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/climate-for-development-in-africa-climdev-africa-initiative/	National
European				
Climate Service Centre Austria[5]		Austria	Unit of the Climate Change Centre Austria (CCCA) hosted by BOKU University (Vienna) http://ccca.boku.ac.at/?lang=en	N.A.
CLIMATE INFORMATION SERVICE of the UK Environment Agency's *Adapting to Climate Change Delivery Programme*[6]		UK	http://www.environment-agency.gov.uk/research/132325.aspx	National, Local

[4] "An important initiative taking place in Africa is the implementation of the *Climate for Development in Africa* project, which aims to enhance the capacity of African climate centres for generating and making widely available relevant climate-related information to end users". "The interaction of different users and providers of climate services through the various Climate Outlook Forums to be supported by the project will also provide a platform for sharing knowledge and for building stronger networks. Climate information will be disseminated to end users throughout Africa by way of existing networks, along with print and electronic media including community radio stations broadcasting in local languages." [Source: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS).]

"The goal of the CDSF is to pool resources to contribute to sustainable development and, in particular, poverty reduction by preparing and implementing climate-resilient development programs that mainstream climate change information at all levels in Africa. The objective of the CDSF is to strengthen the institutional capacities of national and sub-regional bodies to formulate and implement effective climate-sensitive policies". The fund is not operational yet but steps are well underway. [Source: ClimDev-Africa]

[5] "The **CCCA** has been officially established in July 2011 as a coordinating facility to promote and support climate research in Austria with particular focus on: strengthening the climate research landscape in Austria, facilitating the education of a new generation of researchers and supporting knowledge transfer, advising politics and society. In this context, the term "climate research" encompasses the scientific examination of: climate change, the causes of climate change (physical, political, economic, cultural, social), consequences of climate change for society, economy, environment, climate mitigation / adaptation strategies, identification of vulnerabilities / capacities". [Source: CCCA]

[6] From 1 October 2011, the UK Environment Agency took on a new role as the Government's delivery body for climate change adaptation in England. This role will build on the work of UKCIP. A part of their new *Adapting to Climate Change Programme* will be a ***Climate information service***, providing an overview of the core information service and links to useful tools and case studies and tailored advice to help key sectors build resilience to climate change, with a focus on the themes: "business and services, infrastructure and built environment, health and wellbeing, natural environment and forestry and farming, local government."

The UK Environment Agency is currently working with UKCIP to ensure that existing services continue to be available and later it will start developing further types of tools and advice. Currently the Web site contains links to UKCIP's and Defra's Web pages.

2.2 WMO Climate Services

Figure 2.1 WMO Climate Services home page

Mission

The World Meteorological Organization (WMO)[7] "provides world leadership in expertise and international cooperation in weather, climate, hydrology and water resources and related environmental issues".

"WMO members provide a number of climate services at the global, regional and national level to a large variety of users including individual decision and policy makers as well as organizations such as National Meteorological and Hydrological Services (NMHS), universities, and humanitarian organizations".

The current mission of the WMO related to Climate Services is the establishment of the **Global Framework for Climate Services (GFCS)**[8] in order "to strengthen the provision and use of climate predictions, products and information worldwide".

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[7] The World Meteorological Organization (WMO) is a specialized agency of the United Nations focussing on the "state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources".

[8] **The Global Framework for Climate Services (GFCS)** has the following five main components [source and further information: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS)]:

1. the **User Interface Platform** to provide a means for users, user representatives, climate researchers and climate service providers to interact;
2. the **Climate Services Information System** to protect and distribute climate data and information according to the procedures agreed by governments and other data providers;
3. the **Observations and Monitoring** component to ensure that the climate observations necessary to meet the needs of climate services are generated;
4. the **Research, Modelling and Prediction** component will assess and promote the needs of climate services within research agendas;

Main products and services

- **Climate Monitoring Products**
    - Global Monitoring Products
        - WMO Statement on the Status of the Global Climate;
        - El Niño Southern Oscillation (ENSO) Updates (approximately once in three months);
        - Global Atmospheric Constituent Bulletins (Greenhouse Gases, Ozone);
    - Regional Monitoring Products
        - **Climate Watches** - systems providing advisories to inform and alert users, especially on "natural hazards preparedness, mitigation and response related to evolving or foreseen climate anomalies and extremes at the regional and national levels", in support to decision making;
        - **Climate Monitoring Products from WMO Regional Climate Centres** (RCCs) - Centres of Excellence assisting WMO Members in a given region to deliver better climate services and products including climate data services, monitoring products and long-range forecasts, and to strengthen their capacity to meet national climate information needs;
    - National Monitoring Products from the National Meteorological and Hydrological Service (NMHS) – "most HMHSs continuously monitor the national climate to help with forecasting and predictions";
- **Climate Data and Data Related Products** from the *World Climate Data and Monitoring Programme (WCDMP)* program of the WMO *World Climate Programme (WCP)* "that facilitates the effective collection and management of climate data and the monitoring of the global climate system"
    - Global Climate Data Sets (Climate Normals, World Weather Records, World Weather and Climate Extremes Records, Global Surface Temperature Data Sets, Global Precipitation Data Sets, Other Global Data Sets such as aerosols and Ozone);
    - Regional Climate Data Sets from WMO RCCs;
    - National Climate Data Sets from the NMHSs;
- **Climate Prediction Products**
    - Global Climate Prediction products
        - products from WMO *Global Producing Centres for Long-Range Forecasts (GPCLRFs)* - climate predictions from 30 days up to two years;
        - El Niño Southern Oscillation (ENSO) Updates;
    - Regional Climate Prediction Products
        - predictions from WMO RCCs;

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5. the **Capacity Building** component to support systematic development of the necessary institutions, infrastructure and human resources".

        - products from Climate Outlook Forums (RCOF) - forums gathering experts from climatologically similar regions to "provide consensus-based climate predictions and information"; "the information is applied to reducing climate-related risks and supporting sustainable development";
    - National Climate Prediction Products from the NMHSs - many NMHSs carry out predictions on a seasonal scale as well as projections for climate change impacts;
- **Climate Change Services** - Climate Change Assessments (e.g. IPCC), Climate Change Research (e.g. WCRP), Global Climate Change Data (e.g. IPCC, Coupled Model Inter-comparison Project - CMIP, Program for Climate Model Diagnosis and Inter-comparison - PCMDI), Regional Climate Change Data (e.g. the COordinated Regional climate Downscaling Experiment - CORDEX), Climate Projections (e.g. IPCC);
- **Climate (sectoral) Applications** - Water, Agriculture, Health, Energy, Tourism, Urban building, planning and design , Transportation, Humanitarian sector.

Ancillary products and services

The Climate section of the WMO Web site presents information on the following related issues:

- **Climate System** - Understanding Climate, Past climates, Climate Variability and extremes, Significant natural climate fluctuations;
- **Climate Data and Monitoring** - Climate observation networks and systems, Climate data management and exchange, Statistical depictions of climate, Status of global climate, Climate watch and alert systems;
- **Climate Change** - Causes of Climate Change, Elements of climate change, Emission Scenarios, Climate projections;
- **Climate Research** - Climate Models, International Coordination in Climate Research;
- **Climate Risk Management** - WMO Disaster Risk Reduction (DRR) Programme;
- **International Collaborations and Partnerships on Climate Change**;
- **World Climate Programme (WCP)** – aiming at improving climate services and their user interaction and facilitating useful applications of climate information for the most socio-economic benefits, thus supporting the **GFCS**, including the (2 of 4) components:
    - **World Climate Data and Monitoring Programme (WCDMP)** sub-programme – providing "an international coordination of the *WMO Climate System Monitoring*" and offering a "platform for international collaboration on fostering high quality climate data sets and their exchange and undertaking capacity building and training with particular emphasis on *Data Rescue* (DARE), *Climate Data Management Systems* (CDMS), and the use of approved scientific methods and tools for the analysis of climate trends and extremes".
    - **World Climate Services Programme (WCSP)** project – "to foster effective application of climate knowledge and information for the benefit of society and the provision of climate services"; "the scope of WCSP spans across four inter-related areas: climate data and analysis, climate monitoring, watch and prediction, climate system operation and infrastructure, climate adaptation and risk management, thereby serving as the ***Climate***

Services Information System and a part of the ***User Interface Platform*** components of the **GFCS**".

- **Commission for Climatology** - advises and guides the activities of the WCP.
- **Media centre** – News, Press releases, Media calendar, Media advisories, Statements & announcements, Fact sheets, News from Members, Multimedia & podcast;
- **Publications** - WMO Bulletin, MeteoWorld, Bookstore, Mandatory publications, World Climate News, Showcase, Composition of WMO;
- **e-learning and training** Websites;
- **Youth corner**.

Staff

N/A.

2.3 FAO climate change resources

Figure 2.2 FAO climate change resources page

Mission

The Food and Agriculture Organization of the United Nations (FAO)'s mandate is to "raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy".

FAO's work on climate change involves all departments and covers all agricultural sectors as well as cross-sectoral topics: Agriculture, Biodiversity, Bioenergy, Children & Youth; Climate risk management, Forestry, Fisheries, Gender & Social issues, Livestock, Monitoring & Assessment, Regions, Soil & Water, Tenure, UNFCCC process.

Main products and services

The climate change section of the FAO Website presents a catalogue of resources including:

- **Climate-Smart Agriculture practices** - examples of "climate-smart" production systems "being used by farmers and food producers to reduce greenhouse gas emissions, adapt to climate change and reduce vulnerability", including:
    - rice production systems;
    - conservation agriculture;
    - livestock production efficiency and resilience;
    - agroforestry;
    - fisheries and aquaculture;
    - urban and peri-urban agriculture;
    - diversified and integrated food - energy systems;
- **FAO-MOSAICC (MOdelling System for Agricultural Impacts of Climate Change)** – "a system of models designed to carry out each step of the impact assessment from climate scenarios downscaling to economic impact analysis at national level. The four main components of the methodology are a statistical downscaling method for processing GCMs output data, a hydrological model for estimating water resources for irrigation, a crop growth model to simulate future crop yields and finally a CGE (Computable General Equilibrium) model to assess the effect of changing yields on national economies";
- **Climate change (software) data and tools** – "a wide range of climate change data and tools provided by FAO for the monitoring and assessment of climate change impacts and vulnerabilities, and for adaptation and mitigation planning concerning agriculture and food security" (from "***Climpag***, a project aimed at bringing together the various tools, methods and various aspects on interactions between weather, climate and agriculture in the general context of food security" and "***TECA***", a "FAO initiative that aims at improving access to information and knowledge about available proven technologies in order to enhance their adoption in agriculture, livestock, fisheries and forestry thus contributing to food security, poverty alleviation and sustainable development"). They include:
    - **Data**

      Monitoring and impact assessment
        - New_LocClim (local climate estimates) FAOCLIM2 (agroclimatic data);
        - GeoNetwork (geographically referenced thematic information);

- CLIMWAT (climate database for use with CROPWAT);
- Net primary production of biomass;
- Guide to climate data and maps;
- Koeppen's climate classification;
- Web LocClim (local climate estimates) Agroclimatic Hotspots;
- Agroclimatic data for tsunami affected countries;
- Impacts of Sea level rise;
- CountrySTAT (statistical agriculture and food data);
- Country Profiles and Mapping Information System;
- AQUASTAT (water and agriculture data and information);

Adaptation and/or mitigation

- ECOCROP (crop environmental requirements database);
- Land resources information systems;
- REDD+ database;

- **Tools and Platforms**

Monitoring and impact assessment

- Climpag Platform;
- Crop forecasting;
- GIEWS (GIS mapping tool for food security and early warning data);
- AgroMetShell (crop yield forecasting);
- ADDAPIX (pixel-by-pixel classification for zoning and monitoring);
- ADDATI (multivariate analysis);
- Windisp (mapping, image display and analysis);

Adaptation and/or mitigation

- TECA platform - Technologies for Agriculture;
- Water and Soil Conservation (WOCAT);
- Planning community-based adaptation;
- The EX-ante Appraisal Carbon-balance Tool (EX-ACT);
- Lifecycle assessment from livestock sector;
- CROPWAT irrigation management).

Ancillary products and services

- **FAO coarse resolution spatial datasets** – Geographic Information System (GIS) datasets produced by FAO for "monitoring, assessment and analysis of environmental and socio-economic factors causing poverty and food insecurity. Particular relevance is given to malnutrition, farming systems and crops, livestock production systems, fishery and forestry sectors, agro-ecological zoning, land

and water resources management and climate related issues". Main features: "Coarse resolution data, between 30 arc-sec and 10 arc-min for the rasters, and between 1:1 million and 1:10 million scale for the vectors. Related to a global, continental or regional ((sub)continental) level. Country data are not considered at this stage. FAO is the main producer of the data or with publication rights as partner of a group that released the data. Primary (observed, mapped) and modelled data qualify. Data release and access is unrestricted (public domain)".

- **Publications** - FAO key documents on climate change and other relevant publications (e.g. reports, factsheets, papers);
- **Climate change projects** – database of FAO climate change and food security projects "targeted towards providing better solution for climate related risks in member countries", including Adaptation Projects, Mitigation Projects, UN-REDD National Programmes;
- **Learning** – "wide range of learning materials and learning services for capacity development on climate change";
- Terminology - glossaries;
- News - FAO news on climate change;
- Events - FAO and partners climate change events;
- Multimedia - VIDEO / CD-ROM, AUDIO, WEBCASTS, MAPS AND PHOTO GALLERIES.

Staff

FAO employs more than 1800 professional staff (including Associate Professional Officers and National Professional Officers) and over 1800 support staff. Figures only refer to staff holding fixed term and continuing appointments.

2.4 Red Cross/Red Crescent Climate Centre (RC/RC CC)

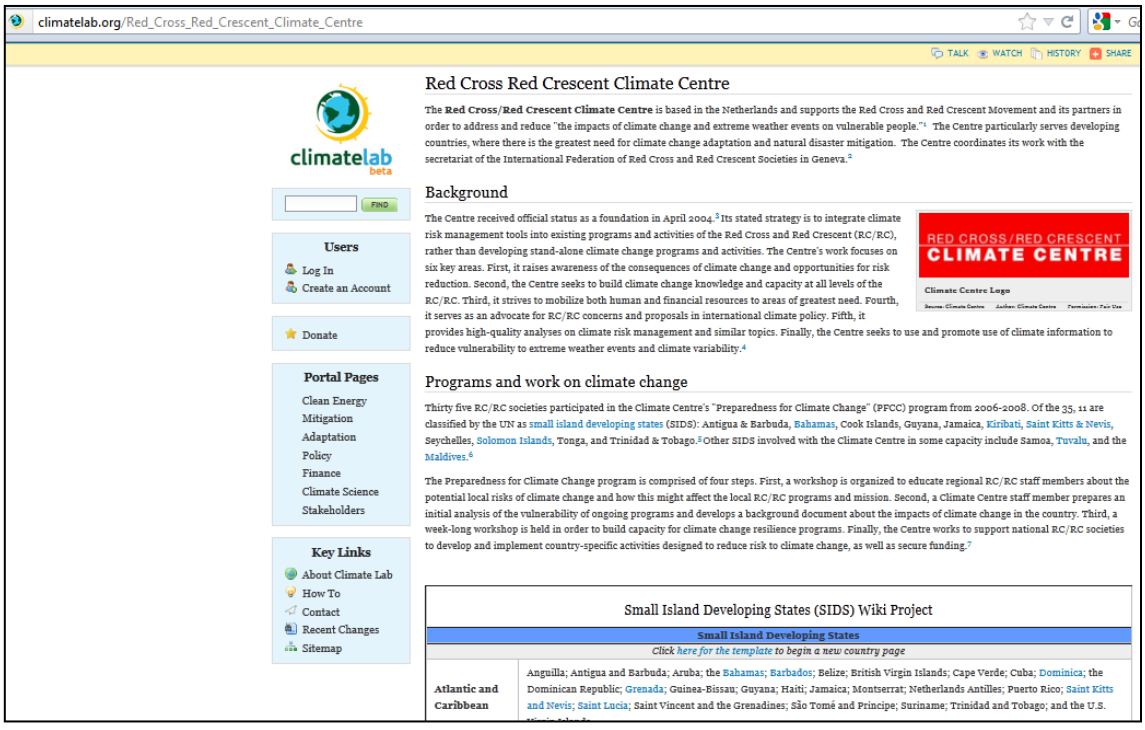

Figure 2.3 Red Cross/Red Crescent Climate Centre home page

Mission

"The Red Cross/Red Crescent Climate Centre (RC/RC CC) is based in the Netherlands and supports the Red Cross and Red Crescent Movement and its partners in order to **understand, address and reduce the impacts of climate change and extreme weather events on vulnerable people**. The Centre particularly serves developing countries, where there is the greatest need for climate change adaptation and natural disaster mitigation. The Centre coordinates its work with the secretariat of the International Federation of Red Cross and Red Crescent Societies in Geneva".

Main products and services

- The main topics addressed are the following:
    - "Disaster Management – information on the activities by the IRI "(conducting strategic and applied research, education, capacity building, and providing forecasts and information products, including assistance to the interpretation of observed and projected weather conditions, with an emphasis on practical and verifiable utility and partnership) to enhance society's capability to understand, anticipate and manage the impacts of seasonal climate fluctuations in order to improve human welfare and the environment, especially in developing countries;
    - Health and Care – "scientific information to improve the health and lives of the vulnerable people";
    - Early warning early action – "early warning early action scientific information (publications, guidance, practical implementation examples) on all timescales to be fully used by people-centred early warning systems so that their early action (preparedness and mitigation/prevention) are suited to face the rising risks of extreme weather events as a result of climate change";
    - Advocacy - information on the Red Cross / Red Crescent activities of support and speak out for the most vulnerable, for ex. under the United Nations Framework Convention on Climate Change (UNFCCC);
    - Communications material;
    - Community risk reduction – "information on risk reduction and resilience increase" (e.g. guidance note for practitioners to consider climate change in Vulnerability Capacity Assessments (VCAs) in their work with communities);
    - Youth – information on how Youth can take action to reduce the impacts of climate change;
    - Getting started – "information on how to use The Red Cross / Red Crescent body of experience working on addressing climate change. to get started".
- Red Cross / Red Crescent climate change activities are searchable on an interactive worldmap and include:
    - **step to step guidance to the "Preparedness for climate change programme" (PfCC)** - 2010 Web-based guide;
    - **(Forecasting tools) forecast-based humanitarian decisions - designing tools and processes to link knowledge with action**: **"**a joint project of the Red Cross / Red Crescent Climate Centre, START, and UNISDR, supported by the Climate and Development Knowledge Network aiming to manage climate risks and promote development in Africa by embedding science into humanitarian work through forecast-based decisions";

- **(Climate-smart resilience) "facilitating innovative learning and policy dialogues, building upon delivery at scale in 'Partners for Resilience (PfR)**' - project in Asia seeking to derive and use evidence-based lessons learnt from PfR experiences to design policies to improve community resilience in the context of disasters and climate change";
- **(Mozambique and Malawi) "strengthening the resilience of people living in high risk urban and semi-urban areas to weather-related disasters** – project targeting the settlements of urban and semi-urban cities located along the coastline or in lakeshore areas (Beira in Mozambique and Salima-Boma in Malawi)" both with limited capacity and abilities to cope with and respond to climatic events;
- **(IDAMS dengue project) International Consortium on Dengue Risk Assessment, Management and Surveillance (IDAMS)** - research project aiming to "assemble a consortium of international experts working together to develop new and innovative tools to be applied to the control of dengue in a global context".

Ancillary products and services

- The resources of the RC/RC CC include:
  - "News - an overview of climate change related news items relevant to the work of the Red Cross and Red Crescent;
  - Publications - a list of publications issued by either a team member of the Climate Centre or the Secretariat of the International Federation of Red Cross and Red Crescent Societies (IFRC) (Annual Report, **Case Studies**, **Climate Guide**, EWEA/Using Climate Data, Addressing Climate Risks/VCA, Shelter/Reconstruction/Migration, Health, World Disaster Report, Evaluations);
  - Science - background information about the science of climate change, with a focus on the Fourth Assessment Report of the IPCC, the Intergovernmental Panel on Climate Change, and the impacts of climate change on the risk of natural disasters;
  - **Good practices** - information about climate risk reduction programmes (programmes and Climate Centre support, communication materials, programmes supported by the Climate Centre) in *inter alia* the Solomon Islands, Seychelles, Vietnam, Indonesia, Mozambique, Nicaragua, Colombia and the Pacific;
  - Newsletter archive - a record of the Climate Centre's quarterly newsletter;
  - Links - a source of information about tools and country profiles, climate change adaptation, disaster risk reduction and early warning".

Staff

Experiences and roles of staff and consultants include: programme directors, research scientists; policies and communication specialists; technical advisors; climate advisors; international relations specialist; expert/technical advisor in the fields of disaster risk reduction, climate change adaptation and ecological monitoring, surveys and assessments; climate and public health specialist; expert in climate risk management and early warning/early action mechanisms and natural resources management; Regional technical advisor; administrative responsible.

background examples include: Ph.D. in atmospheric science; environmental science degree; international relations degree; MA in Climate & Society; Dual Bachelors of Science in Hydrogeology and Geology; environment, international development and climate science degree; Masters degree in global politics; English language and culture degree.

2.5 NOAA Climate Services

Figure 2.4 NOAA Climate Services home page

Mission

The goal of the *US National Oceanic and Atmospheric Administration (NOAA)*[9] Climate Services Portal (*NCS Portal*) is "to become the "go-to" website for NOAA's climate data, products, and services for all users" and has been built to fulfil the "need to enhance NOAA's Web presence in response to customer requirements, emerging needs for improved decision-making capabilities across all sectors of society facing impacts from climate variability and change, and the importance of leveraging climate data and services to support research and public education".

Main products and services

The NCS Portal (currently a prototype version) illustrates some of the most popular datasets/products based on customer use of the data (e.g. from NOAA's National Climatic Data Centre, Coastal Services Centre, and Climate Prediction Centre). These initial **climate datasets and products** represent only a small part of the climate information available across NOAA, and will be extend in the longer term with a broader spectrum of climate information[10].

[9] The National Oceanic and Atmospheric Administration (NOAA) is a science-based US federal agency within the Department of Commerce with regulatory, operational, and information service responsibilities with a presence in every US state and territories.

[10] Datasets not accessible via the NCS portal can be obtained by directly accessing NOAA's data centres and other resources:

- **Climate Data Integrated Map Aplication** - a tool in the form of an **interactive map** allowing (free) access to multiple layers of global, regional and local searchable climate data (including meta data) on:
    - **observations** (annual, monthly, daily and sub-daily worldwide surface weather observations, climatological normals, climate records - including daily maximum and minimum temperature, temperature at the time of observation, precipitation (i.e., rainfall and snow water equivalent), snowfall and snow depth);
    - **climate themes** (climate indices, CPC model/forecast, drought, extremes data, historical hurricane tracks, marine data, 1981-2010 US normals data, precipitation data, temperature data, quality controlled local climatological data, sea level rise and coastal flooding impacts, surface data - annual climatological summary, surface data - global hourly summary, US historical daily snowfall, US historical monthly and seasonal snowfall, regional snowfall impact scale (ReSIS));
- **Global Maps** - Observation maps covering records across the world (Global Hourly Surface Data; Global Hourly Summaries, Global Summary of the Day (GSOD), Monthly Summaries, Historical Hurricane Tracks, Climate Prediction Center Models/Forecasts);
- **US Maps** - Maps covering the United States and surrounding territories (15 Minute Precipitation Data, Hourly Precipitation Data, Daily Surface Data, Local Climatological Data (LCD), Monthly Summaries, NIDIS North American Drought Monitor, Monthly Extremes, NEXRAD Radar, Climate Reference Network (CRN), Climate Indices, Annual Climatological Summary, Historical Daily Snowfall, Historical Monthly & Seasonal Snowfall);
- **Regional Maps** - Observational data grouped by specific region: Gulf Sea Level Rise, Snowfall Impact Scale, NOAA Partners);
- **NOAA Partners** (climate services and products developed by NOAA experts for specific regions in the US and in the world, including the 6 **NOAA Regional Climate Centres** (see the next section).
- **Climate Data Sets and Products Database** (with 280 entries) including:
    - **Applications** (2)
        - **Pacific Regional Integrated Science and Assessment Program (Pacific RISA)** in support to managing climate risk, climate change mitigation and adaptation for US Pacific islands and coastal communities; it includes: Decision support tools for droughts, hazards, monitoring, adaptation; Climate Forecasts and Applications for ENSO and climate-related forecasts (precipitation, climate indices, temperature, wind speed, sea level, and monsoon data) for planning and risk reduction;
        - **Pacific Climate Information System (PaCIS) "**building integrated partnerships for end-to-end climate services" - a framework "for the development and implementation of an integrated program of climate observations, operational

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http://www.ncdc.noaa.gov http://csc.noaa.gov
http://www.ngdc.noaa.gov http://www.ncddc.noaa.gov
http://www.cpc.ncep.noaa.gov http://www.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html
http://oceanservice.noaa.gov http://www.noaa.gov/climate.html.
http://www.nodc.noaa.gov

forecasting services and climate projections, research, assessment, data management, outreach, and education (**an integrated system of climate services)** to address the needs of the Pacific Islands" for developing resilient and sustainable communities; examples of products and services focused on Regional issues developed by PaCIS include: the Pacific Islands Regional Climate Assessment (PIRCA), a collaborative effort aimed at assessing the state of climate knowledge, impacts, and adaptive capacity in Hawaii and the U.S.-Affiliated Pacific Islands; the Pacific Storms Climatology Products, a website that provides access to an integrated set of products that delineate patterns and trends of storm frequency and intensity ("storminess") within the Pacific; the PacificIslandsClimate.org website, a gateway to a broad range of information related to climate in the Pacific Islands, including summaries of programs, projects and activities, as well as products and services).

- Documents (8)
- Geographic Services (1)
- Data (58)
- Static Map Images (2)
- Uncategorized items (209).

Ancillary products and services

- Latest News
- Climate Watch Magazine (Articles, Images, Videos)
- Understanding Climate (Assessment Reports, Presentation Library, Fact Sheets, Calendar of Events)
- Education (Teaching Resources, Professional Development, Multimedia)
- Global Climate Dashboard (on climate change and variability).

Staff

The staff consists of the experts from the following key contributor centres:

- **National Weather Service**
  - Climate Prediction Centre
  - Climate Services Division
  - Performance and Awareness Division
  - Office of the CIO
- **National Environmental, Satellite, Data and Information Service**
  - National Climatic Data Centre, including the IDEA Centre
  - NOAA Regional Climate Centres
- **Oceanic and Atmospheric Research**
  - NOAA Climate Program Office
  - Earth System Research Lab
  - Geophysical Fluid Dynamics Laboratory

    - Pacific Marine Environmental Laboratory
    - Sea Grant
- **National Ocean Service**
    - Coastal Services Centre
    - Office of National Marine Sanctuaries
    - National Estuarine Research Reserve System
    - NOS Education
    - Coral Program
- **National Marine Fisheries Service**
    - NMFS Education
- **NOAA Office of the CIO**
- **NOAA Office of Education**
- **NOAA Information Architect, Office of the Under Secretary**.

2.6 NOAA RCCs Climate services

The NOAA NCS Portal (described in the previous section) links to the **6 NOAA Regional Climate Centres (RCCs)**[11], each with its own Web Portal:

- Western Regional Climate Center
- High Plains Regional Climate Center
- Midwestern Regional Climate Center
- Northeast Regional Climate Center
- Southeast Regional Climate Center
- Southern Regional Climate Center.

[11] Source: NOAA Regional Climate Centres (RCCs).

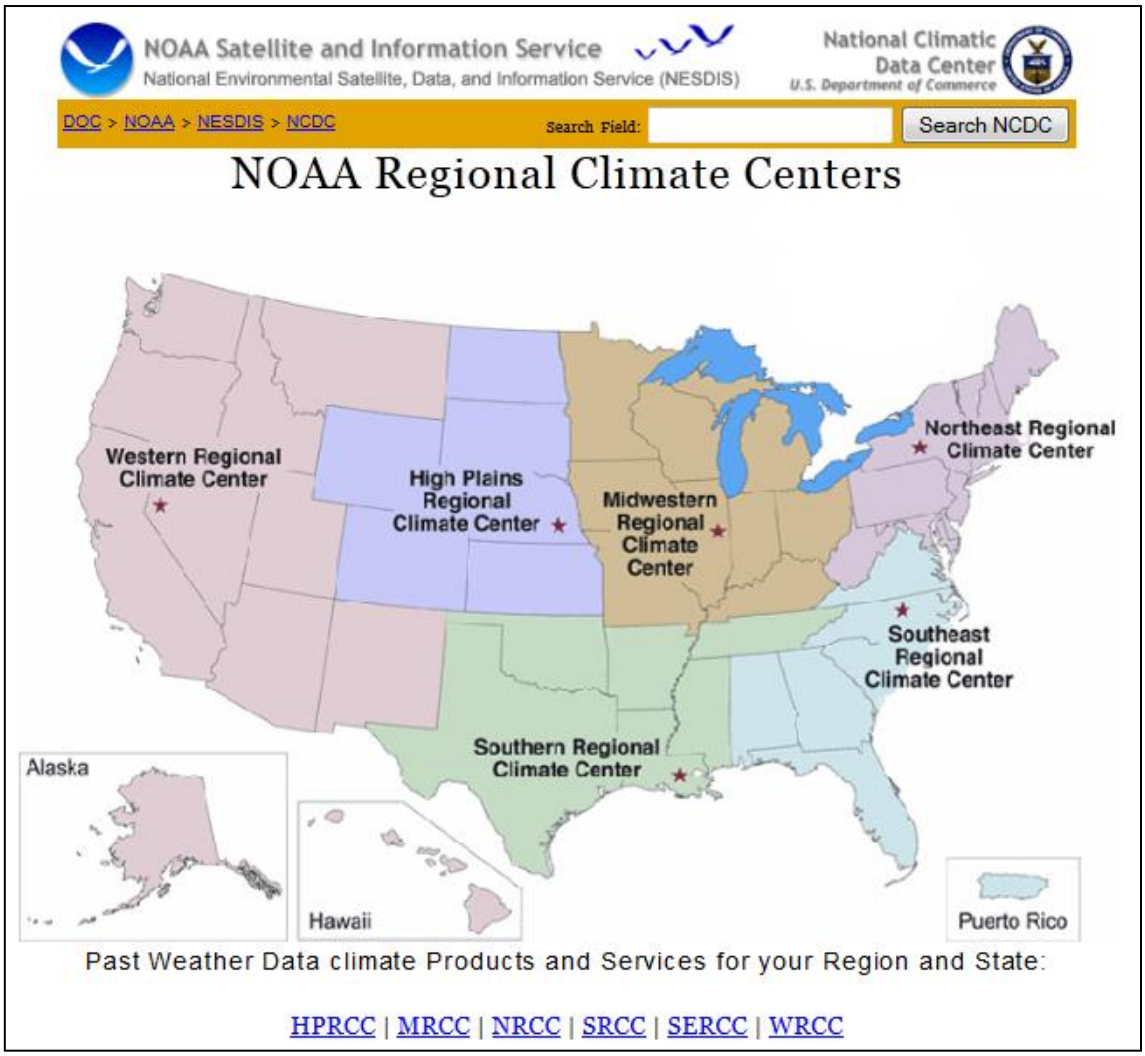

Figure 2.5 Overview of the 6 NOAA Regional Climate Centres

Mission

The six RCCs[12] are engaged in the "timely production and delivery of climate data, information and knowledge for decision makers and other users at the local, state, regional and national levels". Their long term mission is "to collect, enhance and deliver climate data and products to the citizens and industries in their region, provide personalized service and outreach, and conduct applied climate research and development to enhance data quality, product utility, and promote a better understanding of the interaction between climate information and societal needs".

The RCCs support the NOAA in providing **climate information and operational services**, with activities related to:

- "**data and monitoring** (measurement, maintenance, acquisition, quality control, archival, access, and distribution through the NOAA climate observation systems);
- **products** (summary, manipulation, synthesis, visualization, dissemination);

[12] RCCs are funded within a Regional Climate Centre Program (from 1986) and serves six geographi;c regions in the US. They work also in collaboration with NOAA partners in the *National Climatic Data Center, National Weather Service, the American Association of State Climatologist,* and *NOAA Research Institutes*.

- **information** (delivery and interpretation, interaction with users, and outreach);
- **research** (basic research on the behaviour of the physical climate system, applied research to meet specific user needs, and basic research on the social dimensions of service provision)."

In particular, the RCCs carry out **applied research** in the fields: "Climate and Hydrology, Agriculture, Drought, Climate observation and instrumentation, Climate change and variability, Data quality control and assurance, Complex terrain effects on climate, Public health and climate, Regional climate issues and problems, Tropical storm climatologies, Atmospheric teleconnections, Environmental water quality, Climate information technology systems, Extreme climate events".

The RCCs support the NOAA also with the **development of operational support systems**: the **Applied Climate Information System (ACIS)** is the foundation for the RCCs **data management and electronic information delivery** to partners and end users and also a host of regional and state climate data. ACIS has been designed to provide data to Web servers and services, automated data delivery systems and on-demand data from remote users and user applications.

Main products and services

The range of **ACIS climate products** is wide and include "tabular data listing, complicated statistical analysis, station metadata summary or graphical display" as well as "a wide array of standard products that adhere to rigid standards for data quality, use of certified statistical analysis routines, compliance to rules for interpreting data flags, and commonly accepted output formatting". Any new product submitted for inclusion into ACIS undergoes a review process to ensure compliance with these quality standards.

- "The **CLimate Information for Management and Operational Decisions (CLIMOD)** (subscription-based) system is geared toward users who need climate data and information (powered by the ACIS developed by the RCCs) on an ongoing monthly or daily basis on:
    - Temperature, precipitation and snowfall observations, normals and records for a day;
    - Daily temperature, precipitation and snowfall data for a month;
    - Daily data lister;
    - Daily degree day listing;
    - Monthly time series summary;
    - Precipitation summary and historical context;
    - Monthly and seasonal temperature and precipitation distributions;
    - Activity Planner (one day for a period of years);
    - Frost Statistics (time series of first and last temperature occurrences);
    - Frost Summary (distribution of first and last freeze dates);
    - 1971-2000 Monthly temperature, precipitation and degree day normals;
    - Seasonal ranking for a period of years;
    - Multiple station summarized temperature and precipitation data;
    - Multiple station summarized snowfall and snow depth data".

"ACIS provides three distinct types of **user interfaces** that include standard or custom Web browser access to data and products, a scripting interface using XML-RPC (eXtensible Markup Language - Remote Procedure Call), and direct programming to the ACIS application programming interface (API). At the advanced access level a user can utilize the ACIS API to dynamically link decision support models to ACIS data resources".

The following sections report the **main products and services offered by each RCC** as they are presented by the relevant Web Portals.

2.2.1. Western Regional Climate Center (WRCC)

- "Historical Climate Information (Western US Historical Summaries, Precipitation Maps, Station Inventories, Wind and Evaporation Data, Coastal Water Table, State Narratives, Station Descriptions, Anomalies);
- Current Observations, Forecasts and Monitoring (National Weather Service Current and Past 24-hour Reports, Snotel Data, Climate Prediction Centre Outlooks, Satellite and Radar Imagery, SPI, Anomalies, Divisional Climate Plots, ACIS, CoCoRaHS - Community Collaborative Rain, Hail and Snow Network);
- WRCC Projects (El Nino & La Nina; CEMP; WET; BLM RAWS; Yucca Mtn; Current Weather Plots; NSOE; Snotel Data; CoCoRaHS; California Climate Data Archive; Photo Gallery; Webcam; WxCoder);
- More Climate Information (Solar Radiation; Sunrise/Sunset Information (USNO); WGA data and information; National Climatic Data Centre; Climate Prediction Centre; CEFA; National Drought Mitigation Centre);
- Educational and Travel Pages (Terms; More about Weather and Climate - for teachers and kids, Climate for resorts and National parks around the West)".

2.2.2. High Plains Regional Climate Center (HPRCC)

- **Website Products**
  - "Climate Summary Maps (Total Precipitation, Precipitation Departure from Normal, Precipitation % of Normal, Average Temperature, Temperature Departure from Normal, Heating Degree Days, Heating Degree Days Departure from Normal, Cooling Degree Days, Cooling Degree Days Departure from Normal, Standardized Precipitation Index (SPI);
  - 30 Year Normals Maps - High Plains Region (Precipitation, Average Temperature, Maximum Temperature, Minimum Temperature, Heating Degree Days, Cooling Degree Days);
  - Climate Atlas - High Plains Region (Mean Maximum Temperature, Mean Minimum Temperature, # Days of Precipitation > 0.01 in, # Days of Precipitation > 0.10 in, # Days of Precipitation > 0.25 in, # Days of Precipitation > 0.50 in, # Days of Precipitation > 1.00 in, Last Spring Freeze, First Fall Freeze, Growing Degree Days - Base 50, Total Precipitation, Total Snowfall, Heating Degree Days, Cooling Degree Days);
  - AWDN Soil Moisture - Nebraska (Soil Moisture at depths of 10, 25, 50, and 100 cm, Time series graphs - current and archived, Maps of Percent of Maximum Available Water at 10 cm);

- AWDN Wind Roses - Nebraska (% occurrence of prevailing winds and speeds);
- AWDN Maps - High Plains Region (Soil Temperature, Maximum Temperature, Minimum Temperature, Total Precipitation, Relative Humidity, Solar Radiation, Wind Speed, Potential Evapotranspiration);
- Historical Climate Data Summaries (Lists historical climate data, normals, extremes, metadata, etc.; CO, IA, KS, MN, MO, MT, ND, NE, SD, WY);
- Station Search and Time-Series Graphs - National (Search for NWS/COOP, HCN, or AWDN stations near an input location, Time-series graphs for the past year)";

- **Online User Based Systems**
  - "**CLimate Information for Management and Operational Decisions (CLIMOD)** system;
  - Classic Online Services (Raw Data Report - daily or hourly, Ag Data Report, Single Variable Report, Crop Dependent Climate Report - includes seasonal evapotranspiration, weekly evapotranspiration, and weekly growing degree days for various crops, Insect Report, State Summary Report, Autopilot - system allows user to specify stations, data, and dates to pull data automatically to save time);
- **Climate Data Services:** full service (data requests, data analysis, certification) for Maximum Temperature, Minimum Temperature, Precipitation, Hourly Precipitation, Snowfall, Snow Depth, Winds, Average Soil Temp at 10cm, Global Solar Radiation, Average Relative Humidity, Evaporation and/or Evapotranspiration)".

2.2.3. Midwestern Regional Climate Center (MRCC)

The MACS subscription-based service "provides access to real-time climate information and derived products focused specifically on the needs of the Midwest". Products and services provided include:

- "**Online data** – real time and historical climate information that combined with research models of important physical processes, enables the MRCC to produce a suite of products that allows users to **monitor the climate on a near real-time basis**)
  - **Station Data** (Hourly Unedited (Top of Hour, All Reports, Daily Summary, One-day Summary Multi Stations, Multi-day Summary Multi Stations, One-Day Summary All Midwest Stations), Hourly Raw METAR, Hourly Decoded METAR, Hourly CRN Data, Daily Data (Between Two Dates, Single Month, Degree Data, This Date in History, Almanac for a Day, Threshold Searches (2), Ranking), Weekly Summaries, Monthly (Between Two Dates, NCDC Normals, Ranking), Seasonal (Growing Season Statistics, Growing Degree Days, Ranking, Frost Statistics, Temp or Snowfall), Annual Summary by Month);
  - **Climate Division** (Between 2 Dates, Monthly by Year, Ranked Palmer Indices);
  - **Maps** (Gridded Daily Data, Long Term Averages);
  - **State Data** (Preliminary Averaged Temperature or Precipitation, Averaged Temperature or Precipitation, Ranked Temperature or Precipitation);
- **Climate data services**

- **Daily climate data** for over twenty-four thousand stations (high, low and mean temperatures; precipitation; snowfall; snow depth and degree days); many of these stations go back to 1948, although some stations go back to the turn of the century;
- **Surface hourly observations** for over 1,000 sites in the U.S (air temperature, dew point, wet-bulb, pressure, relative humidity, wind speed and wind direction. Coming soon will be solar radiation and PET);
- **Hourly precipitation** for select Midwestern sites;
- **Local Climatological Data** for most major Midwestern cities (summary of the day data, hourly precipitation, and 3-hourly observations including cloud cover and visibility);
- **Storm Data** (flood, hail, high wind, tornado, blizzard and any other strange or unusual weather reports);
- **Historical Climate Division data** back to 1895 (temperature, precipitation, degree days and Palmer drought indices on a monthly basis);
- **Solar radiation data** for select sites available on a daily, monthly or annual basis;
- **Potential evapotranspiration data** for select sites available on a daily, monthly or annual basis;
- **Modelled soil moisture data** for Midwestern climate divisions back to 1949 on a weekly basis;
- **CD-ROM Products** (Thunderstorm Database for the U.S. and Hail Database for the US)".

2.2.4. Northeast Regional Climate Center (NRCC)

- "**Data Services** (Temperature, precipitation, and snowfall observations, normals and records for a day, Daily temperature, precipitation, and snowfall data for a month, Daily degree day listing, Monthly time series summary, Precipitation summary and historical context, Monthly and seasonal temperature precipitation distributions, Activity Planner (one day for a period of years), Frost Statistics (time series of first and last temperature occurrences), Frost Summary (distribution of first and last freeze dates), 1971-2000 Monthly temperature, precipitation, and degree day normals, Seasonal ranking for a period of years, Multiple station summarized temperature and precipitation data, Multiple station summarized snowfall and snow depth data). Data and information are disseminated to NRCC clients via the internet, telephone, facsimile, and the mail. In addition, direct access to the database is provided by the **CLimate Information for Management and Operational Decisions (CLIMOD)** system;
- **Climate Databases** (historical climate data for the north-eastern United States as well as continually updated National Weather Service weather observations and forecasts; daily and hourly data from a number of special state and local networks that measure additional climatic variables that are useful in studies of agricultural production, hydrology, and environmental impacts; models that estimate variables such as solar radiation and evapotranspiration that are not widely observed);
- **Climate change links** (Reports on Northeast Climate Change Impacts Assessment and adaptation, technical papers, assessment of sectoral impacts of climate change and key options for mitigation and adaptation for Agriculture, Coastal Zones, Ecosystems, Energy, Public Health, Telecommunications, Transportation, Water Resources);
- **Specialty Pages**

- Turf Grass - a specialized climate and weather tool for the turf industry);
- Lawn Watering (An interactive tool that uses recent data to plan lawn watering and irrigation needs);
- Mosquito Control (A resource for those who monitor and predict mosquito borne diseases);
- NY Precipitation Extremes (Maps and graphs containing information on intensity, duration, and frequency of extreme precipitation events in New York);
- Stewart's Disease Risk (Map of the risk of Stewart's Wilt of corn during the upcoming growing season);
- Precision Nitrogen Model (A tool for calculating corn sidedress nitrogen rates);
- East Coast Winter Storms (Seasonal forecasts and climatological data on winter storms along the east coast of North America)".

2.2.5. Southeast Regional Climate Center (SERCC)

- "**Climate Data**
  - Historical Climate Summaries (temperature and precipitation for over 1,000 daily weather stations across the Southeast including averages, extremes and official NCDC 1971-2000 monthly normals for temperature, precipitation, and heating and cooling degree days. Many of the data are available in both tabular and graphical formats. Summaries of monthly average data are available for selected locations across the southeast for: Relative Humidity, Cloudiness, Sunshine, Wind Speed, Maximum Wind Speed, Coastal Water Temperatures, Record High Temperatures, Record Low Temperatures, Mean Days Equal to or Above 90 Degrees, Mean Days Equal to or Below 32 Degrees, Mean Days of Precipitation Greater than or Equal to 0.01", Average Total Snowfall);
  - Monthly/Seasonal Climate Information;
  - Precipitation Maps;
  - Temperature Maps;
  - Local Storm Reports;
  - SE Climate Perspectives (Ranks a period of observations against: Climate normals (1971-2000) at cities along the U.S. East Coast and Southeast; Historical observations for the same periods at the same station (or closest station with a period of record));
  - SE Forecast Perspectives;
  - NOAA U.S. Climate Reference Network (USCRN) ;
- **Weather and Climate Events** - past and current conditions, forecasts and outlooks, background information, articles, maps, case studies (Drought, Heavy Rain and Flooding, Hurricanes, Heavy Snow Events and Snowfall, Ice Storms and Freezing Rain, Thunderstorms: High Wind and Hail, Lightning, Tornadoes, Extreme Heat)
- **Special Topics** (pages of external or internal links providing information on Air Quality, Agricultural Weather, Climate Change & Human Health, Hydrology Resources, **Sporting Events Climatology**, Coastal Weather, Astronomical Viewing, Fall Foliage, Sunrise/Sunset Times, Wind Energy)".

2.2.6. Southern Regional Climate Center (SRCC)

- **Publicly accessible products** on the website, providing general information about the physical state of the atmosphere across the southern region of the United States, including but not limited to drought monitors, tropical conditions and archived storm reports (displayed through interactive maps) and data from individual climate stations (Maximum Temperature, Minimum Temperature, Precipitation, Hourly Precipitation, Snowfall, Snow Depth, Winds, Average Soil Temp. at 10cm, Global Solar Radiation, Average Relative Humidity, Evaporation and/or Evapotranspiration);
- **Professional Services** (fee-based)
    - Specific climatic information that cannot be readily found on public information servers (such as certified hourly data for trials, daily and monthly precipitation data for insurance or construction applications, or precipitation frequency analyses for design engineers);
    - Data product in a specific digital format for use in an analysis or management application (such as a ".csv" file to use as initialization data for an operational model or a software application);
    - Consultation with a climatologist, to determine the best information that helps solve specific business problems;
    - Development of a climate data product that will be used on a recurring basis;
    - Applied research directed to a solution of a domain-specific problem;
    - Daily Precipitation Calendar, Daily Maximum and Minimum Temperature Calendar, Monthly f6 Report;
- **Subscription services** (fee-based) available on a daily, weekly, or monthly basis for customers that require a regularly delivered product for one or a set of stations:
    - "**The CLimate Information for Management and Operational Decisions (CLIMOD)**."

Information and data delivery by RCCs is achieved by "RCC online data systems (a combination of near-real time relational databases and web-based information resources) as well as direct customer interaction" (such as fulltime User Service Climatologists and contractual agreements with public and private customers that includes consulting meteorologists and climatologists).

Targeted customers include: citizens, state and federal agencies and weather-sensitive businesses (risk management, energy production, agricultural planning, transportation services, as well as insurance companies, attorneys, construction companies, universities, consultants and engineering firms).

Ancillary products and services

Most of the RRCs Web Portals offer:

- Background information/resources;
- News/events;
- Educational resources.

Staff

Experts working at the RCCS include: climatologists, Regional climatologist, computer systems Analysts, Research Support Specialists, Professors and Researchers in Geography and Anthropology, IT Managers, Systems Administrators, NWS Data Liaisons, Atmospheric Scientists, Meteorologists, Web and Applications Software Developers, Electronics Technicians, Applications/Systems Programmers, Research Climate Applications Specialists, Data Administrators.

2.7 NOAA National Weather Service (NWS) Climate Services

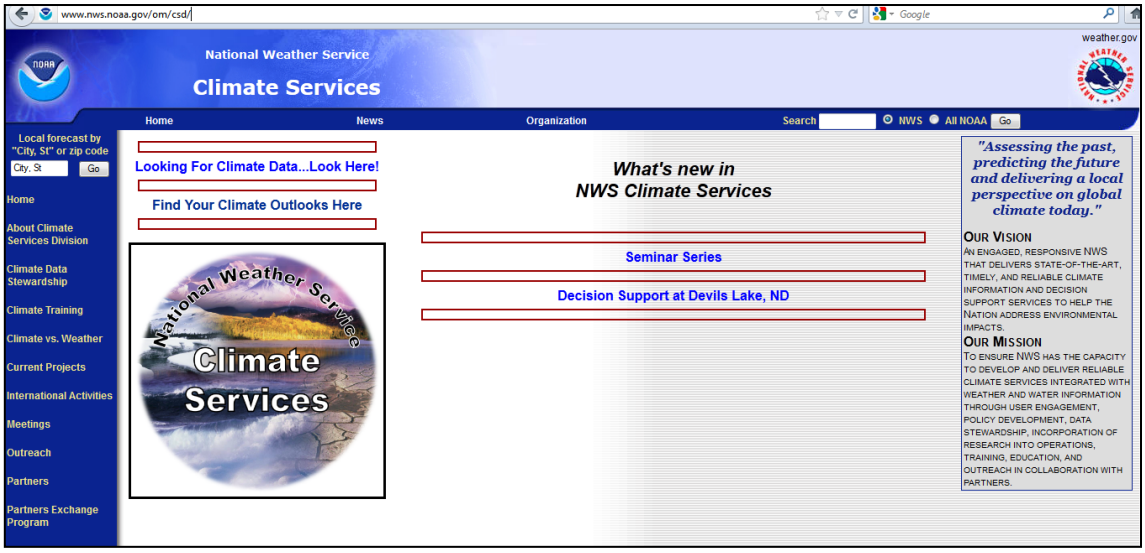

Figure 2.6 NOAA NWS Climate Services

Mission

"The NOAA National Weather Service (NWS) Climate Services (USA) operates **surface and upper air observing systems, monitors climate variability in real time over a broad range of time scales, and provides an extensive array of climate products and information, including forecasts and outlooks**. Its mission is to ensure NWS has the capacity to develop and deliver reliable climate services integrated with weather and water information through user engagement, policy development, data stewardship, incorporation of research into operations, training, education, and outreach in collaboration with partners."

Main products and services

- **Local Climate Data Products**

  "NWS weather forecast offices maintain the surface and upper air observing systems and provide preliminary daily climate data to the public (all data collected through observation networks are transmitted to the National Climatic Data Center (NCDC), where they are quality-controlled, archived, and disseminated as final certifiable data to users in a variety of formats)", including:

  - A **selection of climatological data** for more than 260 stations across the USA (information on daily and monthly climate summaries as well as extreme reports are available on all local office's climate websites);

- A **broad array of climate data products for individual stations** (accessible through the local office's climate website), including **climate observations and statistics (normals and extremes)** for a variety of weather elements, including temperature, precipitation, snow, and degree days over a range of time periods;

- **Monitoring Climate Variability and Change**
  - The Climate Prediction Centre (CPC) performs extensive **real-time monitoring of climate variability on seasonal to inter-annual time scales**;
  - A coordinated program monitors, assesses and predicts climate phenomena and their linkage to weather events: ENSO Cycle (El Niño/La Nina), Madden/Julian Oscillation (MJO), Teleconnections, Blocking;
  - The Drought Monitor - one of CPC's most popular products;

- **Outlooks and Predictions**

  National and Local Climate outlook products range from 6 to10-day and 8 to14-day to monthly and 3-month outlooks. The seasonal temperature outlooks are downscaled to the local station level and made available on local office's climate websites (the CPC is the primary provider of the NWS climate national outlooks). Provided NWS Local outlook products include:
  - Hazard Assessment – composite outlook for potential climate related severe events such as drought, flooding, storms, wind, and fire;
  - Extended Range Outlook, including 6 to 10-day and 8 to 14-day averages for temperature and precipitation;
  - Monthly Temperature and Precipitation Outlook;
  - Month Temperature and Precipitation Outlook, including Local 3 Month Temperature Outlook;

- **Special projects that have an impact on a local, regional and national scale**
  - **Decision Support at Devils Lake, ND**
    - **Current conditions** (Current Weather, River and Lake Levels, Satelitte Imagery, Local Climatology, Map/Data Viewer, Overview, Geographical Setting);
    - **Forecasts** (Local Weather Forecast, Streamflow Forecasts, Wave Height Forecasts, Climate Forecasts);
    - **Assessments** (Routine Climate Assessment Products - US Climate Hazards Assessment - Monthly State of the Climate - Integrated US Drought Monitoring and Assessment - US Drought Assessments, Climate Variability Impacts, Climate Change Impacts, Flood Risk Analysis, Regional and Local Climate Trends, Reports, Inundation Maps);
    - **Background targeted information**;

- **Information on Regional & Local Programs**
  - **Alaska Region** – observations, monitoring and assessments to provide new climate products for local and regional decision makers and the general public (sea ice melt and retreat; glacier melt; warming temperatures; thawing permafrost with loss of infrastructure; precipitation pattern shifts, coastal erosion and flooding; ecosystem shifts; and potential health epidemics)";

- **Central Region** - climate information, including climate change, weather/climate data, water and drought planning information (agriculture, bio-energy, drought impacts and planning) and pertinent climate information for decision makers;
- **Eastern Region** - guidelines and tools to enhance climate services, observations and metadata for the climate record, improvement of regional and local climate information, education and outreach to regional and local customers of climate services, regional and local climate services;
- **Pacific Region** - climate information for Hawaii and Pacific Island residents (including water managers and other critical users); research on climate variability and effects on tropical/extra-tropical rainfall and sea-levels; materials and tools for public outreach and education);
- **Southern Region -** gathering and compilation of climate data for stations throughout all 32 Weather Forecast Offices (WFOs) and 4 River Forecast Centres (RFCs); long-term historical averages and record information for various stations from a weather and water perspective; information, guidance, and analysis to assist decision support on extreme events (such as storms, freezes, droughts, floods, hurricanes, and heat waves); facilitating local knowledge on El Niño-Southern Oscillation (ENSO) and climate variability with expert insight into local, state, and regional climate trends;
- **Western Region** – "setting programmatic policy; providing resources and guidance to field offices; ensuring quality climate data services; facilitating the exchange and interpretation of climate information and prediction products and services; providing information and facts about climate change (droughts, water supply, coastal environments, agriculture, deserts, mountains, freezes, heat waves, and diverse impacts from the El Niño-Southern Oscillation (ENSO)).

Ancillary products and services

- "**Climate Training Programme** - NOAA Climate Services Infrastructure, Climate Variability and Change, NWS CPC Climate Products and Methodologies, Local Applications of NWS Climate Products and Services, Climate Services Outreach, Quality of NOAA Climate Observations;
- Newsroom;
- User Requirements and Customer Satisfaction
  - Climate Prediction Application Science (CPAS) Annual Workshop – This workshop brings together a broad spectrum of climate experts, including climate applications researchers, climate product producers, and users to share developments in research and applications related to the use of climate predictions in societal decision-making;
  - Periodical customer satisfaction surveys;
  - User engagement activities with NWS field offices;
  - Application of Regional Integrated Sciences and Assessments (RISA) research findings".

Staff

Roles of the staff include: Division Chief, Training, Strategic Planning, CPC Scientific Liaison, Regional and Field Liaison, Education, Communication, Outreach, Budget, User Requirements Process Lead,

Outreach Coordinator, Partners Exchange Program Coordinator, GIS Lead, Data and Products, Data Lead, Data Stewardship and Continuity, Webmaster, Consulting Scientist, Program Support

2.8 Australian National Climate Centre

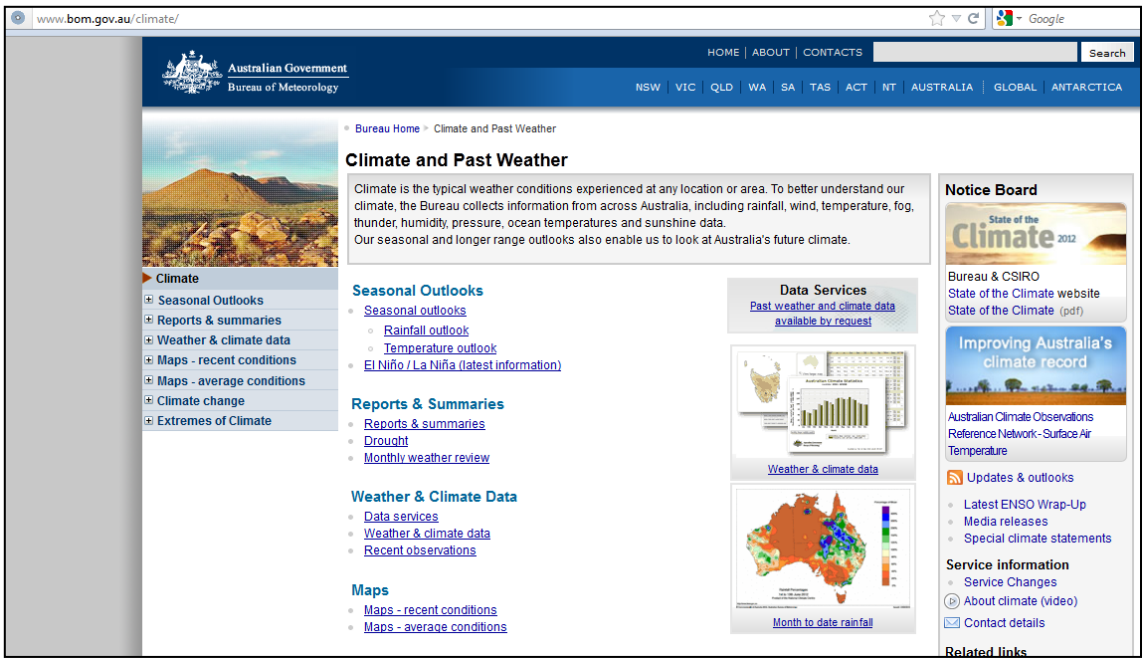

Figure 2.7 Australian National Climate Centre home page

Mission

The National Climate Centre of the Australian Government's Bureau of Meteorology[13] manages Australia's climate record, provides climate data services, conducts climate monitoring and provides predictions, while supporting climate policy development, in association with its seven Regional Climate Service Centres. Climate change information products are developed through the *Centre for Australian Weather and Climate Research*, a partnership between the Bureau of Meteorology and the *Commonwealth Scientific and Industrial Research Organization* (CSIRO). [14]

Main products and services

"**Climate information services in Australia are amongst the most advanced and effective in the world"**. "The model for a responsive, relevant climate service as practised in Australia is that of a national institution making freely available climate data and basic products in such a way that a wide array of

[13] The Bureau of Meteorology is Australia's national weather, climate and water agency.

[14] Source: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS).

sectorally-focused, value-adding intermediaries such as universities, state governments and private sector consultants can develop client specific climate services."[15]

Climate Services include the following:

- **Seasonal outlooks** - predictions (only) at seasonal timescales with the forecasts expressed as probabilities of exceeding the median for (Rainfall outlook and Temperature outlook) and also El Niño/La Niña (latest information), Seasonal Streamflow Forecasts, Australian Tropical Cyclone Seasonal Outlook , Climate model summary;
- **Reports & summaries on recent climate -** links to the various (weekly, monthly, seasonal and annual) statements regularly issued by the National Climate Centre and the occasional statements (such as the ENSO Wrap-Up and Special Climate Statements) including on Drought and the Monthly weather review;
- **Weather & Climate Data**
    - Climate Data Online - Climate Data Online provides free access to a range of statistics, historical weather observations, climatology maps, and other Australian climate data such as: weather, rainfall, temperature and solar exposure history and statistics (available as data, tables and graphs for respective weather stations). Any additional specific custom requests for data and analyses are charged on a fee-for-service basis.
    - **Other Data Services -** Weather Data Services (Forecasts, Warnings and real-time data including Latest Observations, Satellite, Radar); Water Information (Rain, river and water storage data); Station data & Gridded data (Bulk Data on USB).
- **Maps**
    - Maps - recent & past conditions - high resolution maps and data, ranging from the most recent day, back to 1900 for rainfall and 1910 for temperature; gridded datasets for rainfall, temperature, vapour pressure, solar exposure and Normalised Difference Vegetation Index (NDVI), over time periods ranging from daily, weekly, monthly to 3-yearly; grids and archives can be downloaded for many of the map selections;
        - Rainfall ("Australian rainfall starting in the year 1900, available in spatial scales down to 0.05° resolution for daily or monthly time scales; Map types include Rainfall Totals, Percentages, Deciles, Drought, Anomalies, 1 Year Difference, 2 Year Difference, 3 Year Difference");
        - Temperature ("Australian temperature starting in the year 1910, available in spatial scales down to 0.05° resolution for daily or monthly time scales. Map types include Mean Maximum, Mean Minimum, Maximum Anomaly, Highest Maximum, Highest Minimum, Lowest Maximum, Lowest Minimum, Mean Temperature, Mean Anomaly, Maximum Decile, Minimum Decile, Mean Decile, 9am - 3pm Maximum");
        - Vapour pressure, Solar exposure, Vegetation index (NDVI) ("vapour pressure (1971-present), solar exposure (1990-present) and Normalised Difference Vegetation Index (NDVI) (1992-present) at 0.05° resolution for daily or monthly time scales. Vapour Pressure maps include 9am Vapour Pressure, 3pm Vapour Pressure, 9am Vapour Pressure Anomaly, 3pm Vapour Pressure Anomaly. Solar

[15] Source: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS).

Exposure maps include Solar Exposure. NDVI maps include NDVI Average, NDVI Anomaly");

        - Atmospheric circulation - Atmospheric Circulation Patterns by region and by month;
    - Maps - average conditions - climate maps to explore the variability of the Australian climate
        - **Rainfall** (Mean rainfall, Decadal & multi-decadal rainfall, Rainfall percentiles, Rainfall percentages, Rainfall variability, Days of rain and related maps);
        - **Temperature** (Average max, min & mean temperature, Decadal & multi-decadal temperature, Indoor apparent temperature, Temperature percentiles, Potential frost days, Heating & cooling degree days, and related maps);
        - **Other elements** - Humidity, Evaporation, Wind, Sunshine, radiation & cloud, Cyclones & thunderstorms;
- **Extremes of climate** - Australian Climate and Weather Extremes Monitoring System Website providing comprehensive and timely information about climate and weather extremes of temperature and rainfall (Daily extremes tables; Climate extremes maps; Average recurrence interval; Extremes graphs - monthly; Extremes graphs - annual and Climate records).

Ancillary products and services

- **Climate Change** - accurate observations and information about a changing climate
    - Australian climate variability and change - climate trends and variations in the Australian records, and the used data and observation networks;
    - Global climate variability and change - observed trends and variations in the global climate;
    - Observing Australian climate change - Australian data for monitoring climate change, including the new Australian Climate Observations Reference Network - Surface Air Temperature dataset;
    - Future Australian Climate Change - Australian climate projections for managing future climate change (external site);
    - Climate Change in the Pacific - understanding past and future climate change in the Pacific (external site);
- **(General climate descriptions)** Climate classifications - climate tips for travellers;
- **News** - Media Releases; Events, Severe Weather Events, Quarterly Focus;
- **Educational material** – on weather and climate for students, teachers and the general public, including a library and various kinds of publications;
- Links;
- **Other services**
    - Weather and Warnings services;
    - Commercial Weather Services;
    - Services to Agriculture;
    - Oceanographic Services;
    - Water Information;

- Environmental Information.

Staff

The staff of the Centre comprises about 1500 employers in more than 60 workplaces across Australia (in capital cities, regional and remote locations as well as offshore islands and Antarctica).

The fields of expertise include *inter alia*: natural environment, water, weather, climate, Antarctica, drought, floods, fires, storms, tsunami and tropical cyclones.

2.9 CHINA METEOROLOGICAL ADMINISTRATION (CMA) Climate Services

Figure 2.8 CHINA METEOROLOGICAL ADMINISTRATION (CMA) home page

Mission

The China Meteorological Administration (CMA) is a major government body responsible for organizational and operational management of the national meteorological services as a whole, including the delivery of a range of climate services. The meteorological service is designed on the basis of the public "service" concept and oriented to decision making.

CMA **response to climate change** includes[16]:

- "improving organizational structure to strengthen the overall deployment of meteorological services in response to climate change";
- "participation in the work of *China's National Leading Group to Address Climate Change* for strengthening communication and cooperation between governmental departments";

[16] Source: CMA brochure.

- "actively conducting research on climate change to provide scientific support for domestic and foreign affairs in response to climate change";
- "actively conducting education, training and outreach of climate change science".

Main products and services

Main climate related products provided by CMA are: "Monthly Climate Trend Prediction; Drought and Flood Trend Prediction; Annual Climate Trend Prediction; Monthly Climate Monitoring Bulletin; Monthly Climate Impact Assessment; China' Climate Bulletin on Drought and Flood; Seasonal Climate Monitoring Bulletin; Seasonal Climate Impact Assessment; Agrometeorology-based Annual Crop Yield Forecasts."[17]

Among the institutions under the CMA, the National Climate Centre (NCC) is responsible for the provision of :

- "analyses of climate change, judgment and prediction, evaluation and application service of climate effect, analyses and evaluation of climate material and application, global climate change and its effects of month, season, year and even longer time";
- "meteorological decision-making service product for the government and public meteorological information";
- "monthly, seasonal and yearly climate dynamic model business prediction system and related products";
- "observation and monitoring on climate, forecast and early warning on monsoon, snow cower, sea surface temperature, drought and other disasters, monitoring and forecast on ecology and environment, city climate monitoring and analyses";
- "protection and development of climate resources";
- " study on climate and international exchange and cooperation activities".

The NCC of the CMA was founded in 1995 and has then gained capability and function of a WMO/regional climate centre. To better fulfil this duty, in 2003 the Beijing Climate Centre (BCC) was set up and it provides a range of products including:

- **Long Range Forecasts**
  - monthly forecast of: mean of sea temperature of Pacific and Global Ocean, mean of currency, mean of Salty, Nino Index, "30 days" forecast;
  - seasonal forecast by CGCM and by RegCM for EastAsia (RegCM nested with CGCM), ENSO Prediction;
  - forecast Verification (monthly, seasonal);
- **Climate Monitoring and Diagnosis**
  - (monthly, seasonal, annual) Climate System Monitoring Bulletin;
  - major Weather-Climate Events – precipitation, maximum air temperature, minimum air temperature;
  - (irregular) ENSO report;

[17] Source: CMA brochure.

- (irregular) East Asian Monsoon Monitoring report;
- (irregular) Snow Cover Monitoring;
- Drought Monitoring;

- **Data Service –** climate database for precipitation and temperature;
- **Projection of Climate Change Scenarios**
  - China - annual climate change over China by RegCM2 under doubled CO_2, projections of precipitation and temperature changes over China in the 21st century;
  - East Asia - projections of precipitation and temperature changes over East Asia in the 21st century;
  - Global - projections of precipitation and temperature changes over the globe in the 21st century;
- **Climate Impact Assessment of China**.

Ancillary products and services

- **News** releases and BCC Newsletter;
- **Education and training** - Scientific training, Post-Graduate Education Programme, Summer School.

Staff

CMA is employing 52988 staff members, out of which 6 are Academicians of the Chinese Academy of Sciences or the Chinese Academy of Engineering, 26 are entitled with PH.D tutors, and 4415 area warded senior professional titles, mainly in atmospheric science, followed by IT technology, other branches of Earth science, and other.

BCC staff degree includes 43.8% doctors, 22.3% masters, 21.5% bachelors and 12.4 % others. BCC technical post include: 14.9% professors, 39.7 associated professors, 35.5 professors assistants and 9,9% others.

2.10 Caribbean Community Climate Change Centre (CCCCC) Climate Services

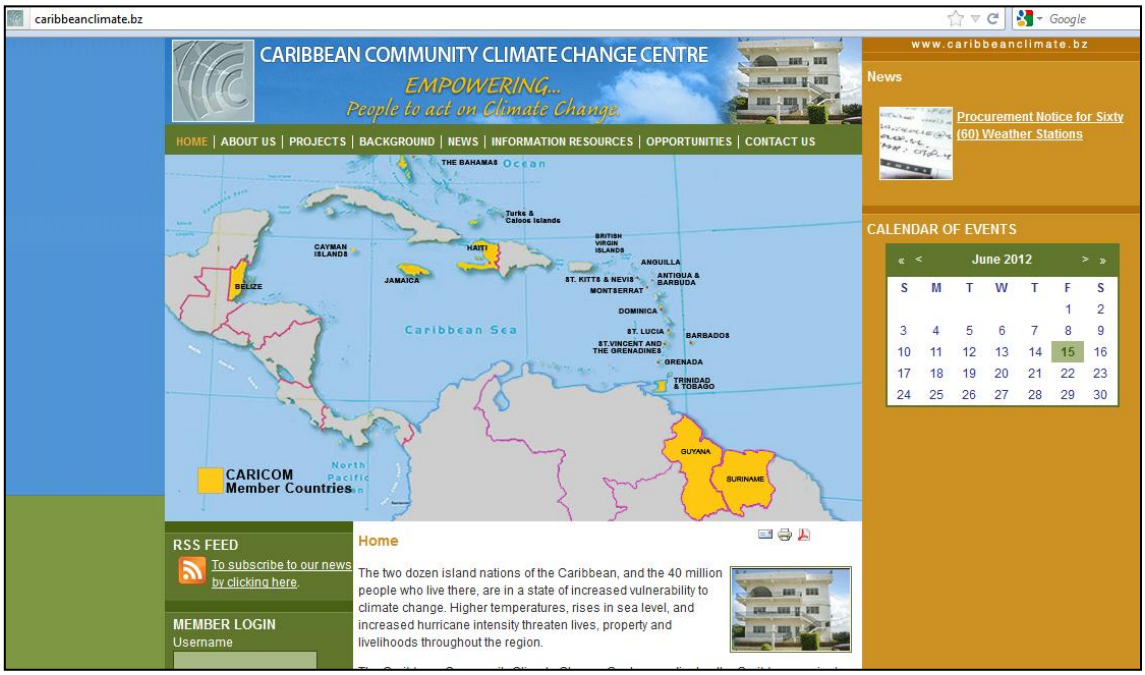

Figure 2.9 Template Climate Services home page

Mission

Established in 2005, the Caribbean Community Climate Change Centre (CCCCC) coordinates the Caribbean region's response to climate change and represents the "key node for information on climate change issues".

Its mission is: "to support the people of the Caribbean as they address the impact of climate variability and change on all aspects of economic development through the provision of timely forecasts and analyses of potentially hazardous impacts of both natural and man-induced climatic changes on the environment, and the development of special programmes which create opportunities for sustainable development".

Main products and services

The Centre's services are designed "to improve knowledge of climate change and foster adaptation to the effects of climate change" and they include:

- **Clearing House** – official repository, database, resource centre and clearing house for regional climate change data, providing "climate change-related policy advice and guidelines to the Caribbean Community (CARICOM) Member States through the CARICOM Secretariat"[18] including the following items:
    - **stock take of climate change adaptation and mitigation Programmes, Projects, Strategies and Plans** being carried out in the various CARICOM countries and regionally (especially in the areas of Health, Tourism, Agriculture, and Renewable Energy);

[18] In this role, the Centre is recognised by the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Environment Programme (UNEP), and other international agencies as the focal point for climate change issues in the Caribbean.

- **documents collection for CARICOM** countries in the themes: "Background on Climate Change, Impacts of Climate Change (Sea Level Rise, Coral Bleaching, Ocean Acidification, Storms and Hurricanes, Droughts and Floods), Modeling & Monitoring (Climate Modelling Scenarios & Downscaling, Geodata), Case StudiesVulnerability & Capacity, Education, Disaster Management, Economics of Climate Change)";
- **Regional Climate Model** – "the CCCCC provides regional and country-oriented results from modelling and projection experiments online:
  - for every country in the region, maps of projections calculated on the basis of the ECHAM4 (1991-2100) model for the emission scenarios A2 and B2 at a resolution of 50x50km (Data);
  - for every country in the region, maps of projections calculated on the basis of the HadAM3P (2010-2100, with 2010-2069 pattern scaled) model for the emission scenarios B1 and A2 at a resolution of 50x50km (Data, Method);
  - detailed output data (PRECIS data files) of experiments based on the HadAM3P and ECHAM4 global models and the emission scenarios A2 and B2 at a resolution of 50x50km for every grid point by country and the parameters temperature (min, max, mean), precipitation, humidity, cloud cover (Output data, Explanation Notes).
  - (Currently they are calculating new projections with the ECHAM5 global model and various versions of HADAM3 with different variations in parameter physics)".

- **Environmental Scanning –** identification of climate-related threats and use of this information "to help stakeholders, including regional governments, private sector businesses, financial institutions, and voluntary organizations, to develop and implement adaptation strategies based on scenarios developed by the Centre. The Centre would also be an integral part of any regional early-warning system";
- **Climate Change Curricula programmes – "**curricula-related programmes from concept to implementation" as well as programmes monitoring and evaluation;
- **Training –** "courses for different organisations and levels of management in issues related to climate change including technical areas like proposal writing and negotiations";
- **Consultancy Services** – "conceptualise, plan, develop, implement, monitor, and evaluate projects and programmes in areas related to climate change" ranging from biodiversity to alternative energy;
- **Trust Fund –** a funding mechanism established by the Centre to provide financial support when external funds are not readily available or difficult to be mobilised.

Ancillary products and services

- News;
- Info on the UNFCCC Conference of the Parties;
- Education & Public Awareness section.

Staff

N/A.

2.11 FIJI METEOROLOGICAL SERVICE Climate Services

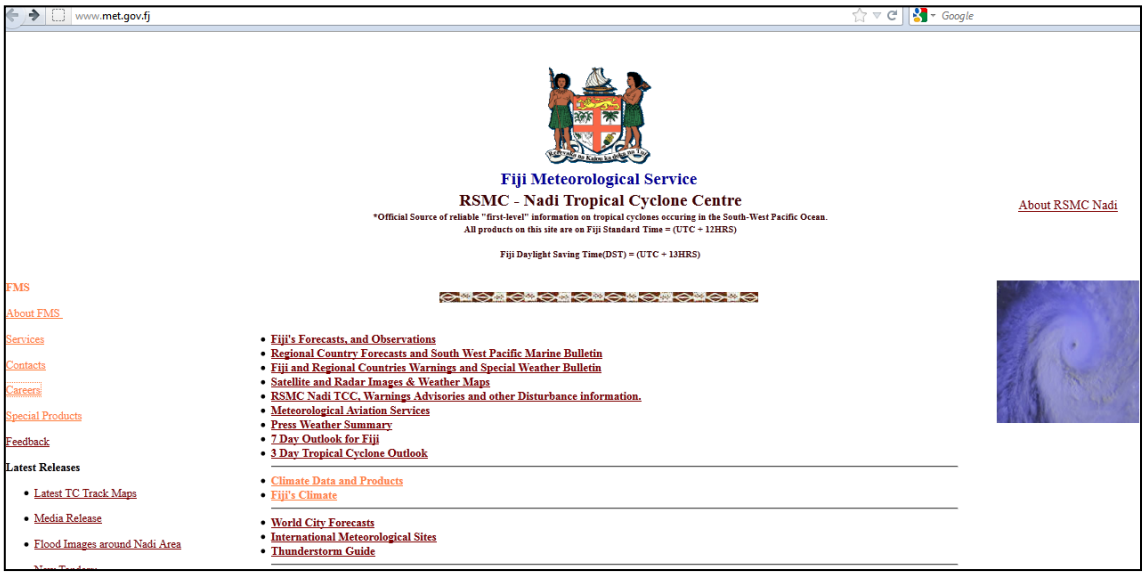

Figure 2.10 FIJI METEOROLOGICAL SERVICE home page

Mission

The Fiji Meteorological Service (FMS) "functions as a Department under the Government of Fiji Islands and has the responsibility to provide an essential service to the country but it also serves on a regional scale providing weather forecasting and tropical cyclone warning services to many other countries and a vast area of the tropical South-west Pacific".

Its mission is: "to observe and understand regional weather and Fiji's climate and provide meteorological services in support of well being of communities, economic growth, environmental sustainability and international obligations".

FMS "Climate Services Division (CSD) is responsible for meeting Fiji' s needs for climatological data and expertise, and for promoting the effective use of this data and expertise. It is the national repository for climatological data. It responds to user enquires, it prepares and supplies data products, it develops and implements new user services and data applications and it provides consultative services".

Main products and services

Main climate data and products include FIJI **climate forecast and observations**:

- Climate Outlook - seasonal forecasts (on a three to six month timescale) for rainfall and temperature, ENSO current status and prediction;
- Climate Summary - monthly weather observations of weather patterns, rainfall, maximum daytime air temperatures, minimum night-time air temperatures, relative humidity at 9:00 hours, sunshine, wind, evaporation, SST, cloud cover, sea level;
- Sugar Outlook - three and the extended three month rainfall outlooks for the Fiji sugar cane "belt";
- Monasavu Outlook - Climate Outlook for Monasavu;
- ENSO Update - History and Current Situation, ENSO Outlook, Observations of Climate Anomalies, Rainfall/Temperature Outlook, Past La Niña Events and Effects, Drought Monitor;

- Annual Climate Summary – annual observations of weather patterns, rainfall, winds, mean air temperature, minimum temperature, sunshine and solar radiation, forecast verification, maximum temperature, SST, SOI and sea level, new records, tropical cyclones, ENSO, hailstorm events.

Ancillary products and services

Beside weather forecast and warning services for Fiji and many Pacific Island nations:

- Fiji's Climate;
- Link to Australian Government's South Pacific Sea Level and Climate Monitoring Project AND/OR Tide-Calenders;
- Releases - Latest TC Track Maps, Media Release.

Staff

Staff is composed by meteorologists, climatologists, technical officer/meteorological observers, analysts/programmers and engineers/electrical/electronic technicians.

2.12 Southern African Development Community Climate Services Centre (SADC CSC)

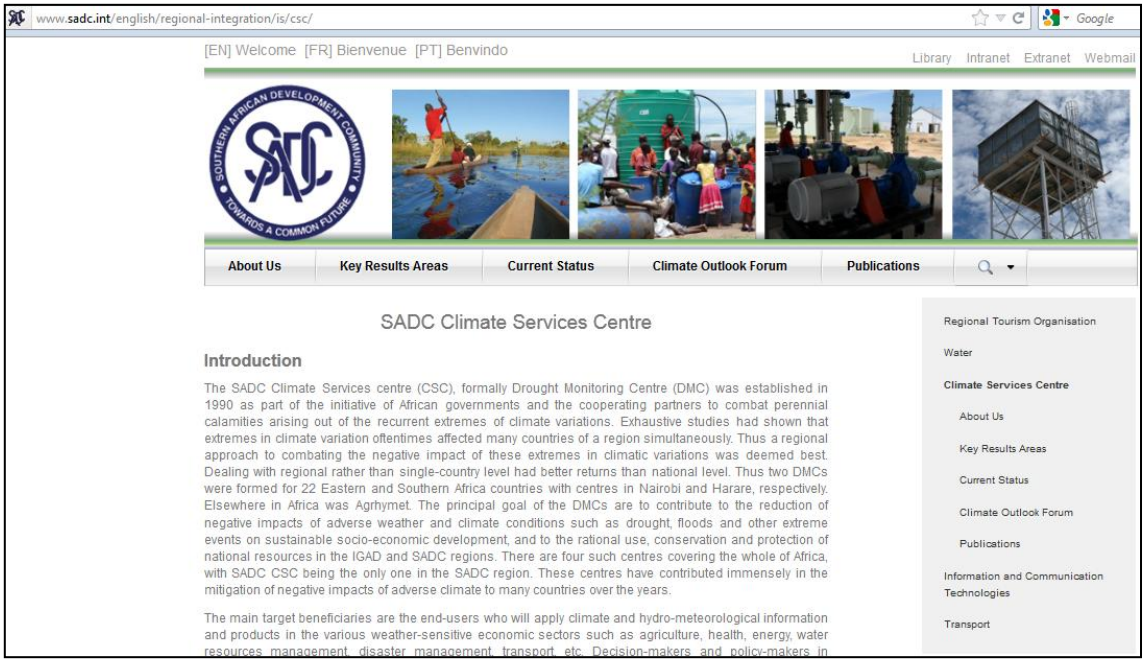

Figure 2.11 SADC Climate Services Centre home page

Mission

The Southern African Development Community (SADC) Climate Services Centre (CSC) was established in 1990 (as Drought Monitoring Centre (DMC)) by initiative of African governments and cooperating partners to "contribute to the reduction of negative impacts of adverse weather and climate conditions such as drought, floods and other extreme events on sustainable socio-economic development, and to the rational

use, conservation and protection of national resources" in SADC regions. ("There are four such centres covering the whole of Africa, with SADC CSC being the only one in the SADC region").

The mission of the SADC CSC is "to ensure that a sub-regional mechanism for monitoring and predicting extremes in climate condition is operational. The CSC carries its mandate through development, generation and dissemination of meteorological, other environmental and hydro-meteorological products".

"The main target beneficiaries are the end-users who will apply climate and hydro-meteorological information and products in the various weather-sensitive economic sectors such as agriculture, health, energy, water resources management, disaster management, transport, etc. Decision-makers and policy-makers in various government departments and NGOs will also be expected to use the products and services to devise strategies for mitigating the impacts of climate extremes".

Main products and services

"The SADC CSC has continued to provide services and outreach products in weather and climate monitoring and prediction for the benefit of the SADC Member States and regional and international institutions. In particular those in programmes of Early Warning for Food Security, Disaster Preparedness, Health and Water Management Sectors".

- **Southern Africa Regional Climate Outlook Forum (SARCOF)** – **seasonal forecast for rainfall** over the SADC region produced by **consensus** of a forum of climate scientists meeting "to determine the likelihoods of above-normal, normal and below-normal rainfall for the area"; the process include workshops "to strengthen capacity of the SADC NMHSs in generating and communicating seasonal forecasts in their respective countries". ("This is part of a global effort to coordinate forecasting activities of respective regions for the benefit of the user community"; "this collective and inter-disciplinary process of training, technical analysis and preparedness seminars formulate appropriate strategies to combat the adverse effects of climate extremes on various socio-economic sectors such as agriculture, disaster management, health, water resources, media, etc". "Many decision-makers, from a variety of socio-economic sectors, right up to the highest levels of government do use the SARCOF products." "Climate Outlooks" and "final statements" are collected in the "Publications" page together with the "Climate Update", informing about tropical cyclones.

Ancillary products and services

- News: "CSC continues to provide guidance in the dissemination and communication of climate information through various channels, notably the media. This has been made more effective through the nascent SADC-Network of Climate Journalists";
- Library - a range of items (books, leaflets, CD, periodicals, photographs, reference, video) on climate, climate change, carbon and climate change, climate assessments, climate instability, prediction, climate variations, global climate.

Staff

The core group of permanent personnel comprises the Coordinator and Climate Expert and five support staff: three Information Technology (IT) Technical Assistants, Administrative Secretary and Clerk/Driver. In addition sometimes there are a few Visiting Scientists from the Member States.

2.13 UK Met Office Climate Services

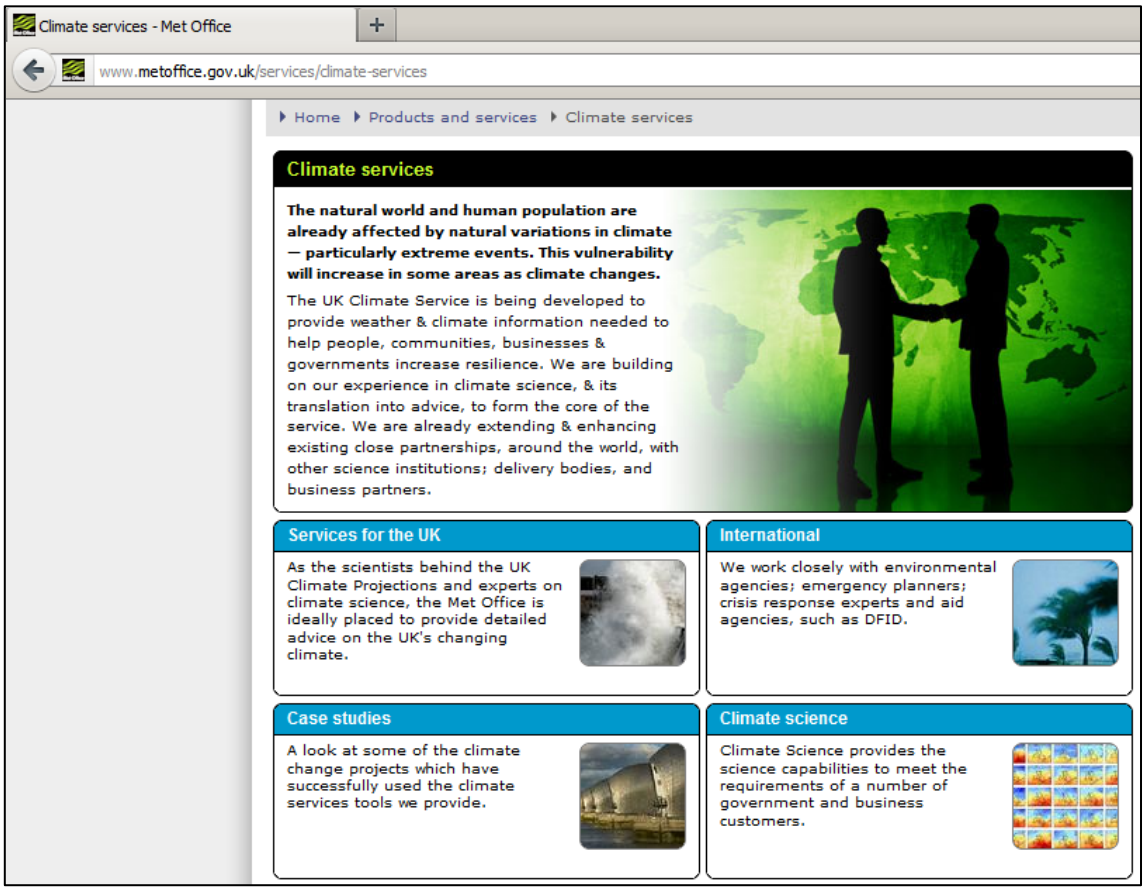

Figure 2.12 UK Met Office Climate Services home page

Mission

The UK Climate Service centre, namely ***UK MET OFFICE*** ***Climate Services*** hosted by the UK Met Office (MO[19]) Web site provides "weather and climate information needed to help people, communities, businesses and governments increase resilience" to climate change.

Main products and services

Provided products and services are presented split into three main categories: "Services for the UK", "International climate services", "Climate services case studies" and further subdivided as in the following list.

- **Services for the UK**: detailed advice on the UK's changing climate.
    - **UK Climate Projections 2009 (UKCP09)**: a climate analysis tool, funded by Defra[20], for comprehensive projections of changes to the UK climate (at a regional level across the UK; in probabilistic form, thus illustrating the potential range of changes and the level of

[19] The Met Office is the UK's National Weather Service.

[20] Defra (Department for Environment, Food and Rural Affairs) is the is the UK government department responsible for policy and regulations on the environment, food and rural affairs.

confidence). "The Projections are presented for three different future scenarios (High, Medium and Low greenhouse gas emissions); free climate information provided are:

- **Observed climate data** (20th and 21st century historical information about temperature, precipitation, storminess, sea surface temperatures and sea level);
- **Climate change projections** (for temperature, precipitation, air pressure, cloud and humidity);
- **Marine & coastal projections** (for sea level rise, storm surge, sea surface and sub-surface temperature, salinity, currents, and waves)";

- **UK Climate Projections impacts** to advise government, businesses, and individuals on how to prepare and adapt for the future in the following sectors:[21]
  - Transport (Impacts on the rail industry; Impacts on the road industry);
  - Energy (Impacts on the UK energy industry; Impacts on small scale wind power generation);
  - Water (Impacts on the water industry);
  - Public sector (Impacts on social welfare; Impacts on defence and global security);
  - Rural (Impacts on animal disease);
  - Coastline (Impacts on the Thames Barrier; Impacts on critical national infrastructure);
- **Business consulting** - advise to companies in their business decision making about weather and climate change impacts (e.g. by determining climate change impacts on their business, tailoring data and model for their business, providing risk analysis and long range forecasting for their business, keeping them up-to-date on new findings relevant for their business, and offering a 24-hour Customer Centre);
- **Government and public services advice**
  - (**Policy relevant science**) the UK government funds the MO to carry out key research in support of practical decision-making, thus providing advice to Government and public services in making strategic decisions about weather and climate change impacts (e.g. through risk analysis and long-range forecasting);
  - (**Climate Science**) provision of advice in strengthening mitigation and adaptation policy formation and decision making for government and business customers "(e.g. through the development of climate datasets based on observations, the use of these datasets in climate change monitoring and attribution, and the use of Earth System Models to make future predictions from months to centuries into the future)";
  - **Seminars** - climate change seminars and tailored workshops for organisations in support to their decision making process addressing climate change (e.g. climate proof, mitigation and adaptation);

- **International climate services** aimed at working (with environmental agencies, emergency planners, crisis response experts and aid agencies) to promote capacity building in developing countries (observations and applications) and develop climate risk management strategies, including:

[21] *This section does not provide actually detailed information on impacts, but rather presents examples of what MO can provide and refers to the consulting@metoffice.gov.uk "for more information on how climate change may affect your business".*

    - **PRECIS (Providing Regional Climates for Impacts Studies)** - system developed at the MO Hadley Centre to provide a tool for predictions on a regional scale;
    - **The Climate Service for Reinsurance** managing the risks of the next five years (global view of the likelihood of catastrophic events, such as tropical storms and extreme rainfall);
- **Climate services case studies** - an overview of the climate change projects that have successfully used the climate services tools provided by MO (such as: climate modelling in Bangladesh, the impact of 2 and 4 degree temperatures rises, an energy project, CBI Task Force, Thames Barrier).

(The **Services** section of the MO Web site presents all the MO services for each specific sector (industry, transport, government, health, defence, multi-media, public) including the above mentioned "climate services" targeted to a range of people and organisations, from the general public, government and local authorities, to the armed forces, civil aviation, utilities, transport, media and other industry sectors.

Therefore, the climate products and services provided by ***UK MET OFFICE Climate Services*** can be accessed either from the (both mentioned above) climate services centre's main section either from the specific sectors' pages in the broader "Services" section of the MO web site).

Ancillary products and services

Ancillary products and services provided by the MO Web site hosting the Climate Service Centre (not inside the Climate Service Centre Web site) include:

- **Documentation**
    - **Weather** (UK, Europe, world, aviation, marine, events);
    - **Climate change** (climate change guide, news, **policy relevant science**, related resources, climate change newsletter);
- **Research** (overview, modelling systems, foundation science, **climate science**, weather science, publications, collaboration, research news);
- **News** (latest news releases from the MO on climate change issues, with an hot topics section on top news and comments from around the world, in-depth articles, media links and social media);
- **Learning** (education, science, training, library and archive).

Staff

The MO (not specific for the climate services centre) team is made up of scientists in the following fields: Earth System, Climate Process, Climate Impacts, Climate Monitoring, Cryosphere and Oceans, Assimilation/Ensembles, Dynamics Research, Global Modelling, Numerical Modelling, Observational Studies, Ocean Forecasting, Parametrization, Satellite Applications, Seasonal to Decadal, Observations Research, Weather Consultancy and Applied Research, Science Partnerships.

2.14 UKCIP Climate Services

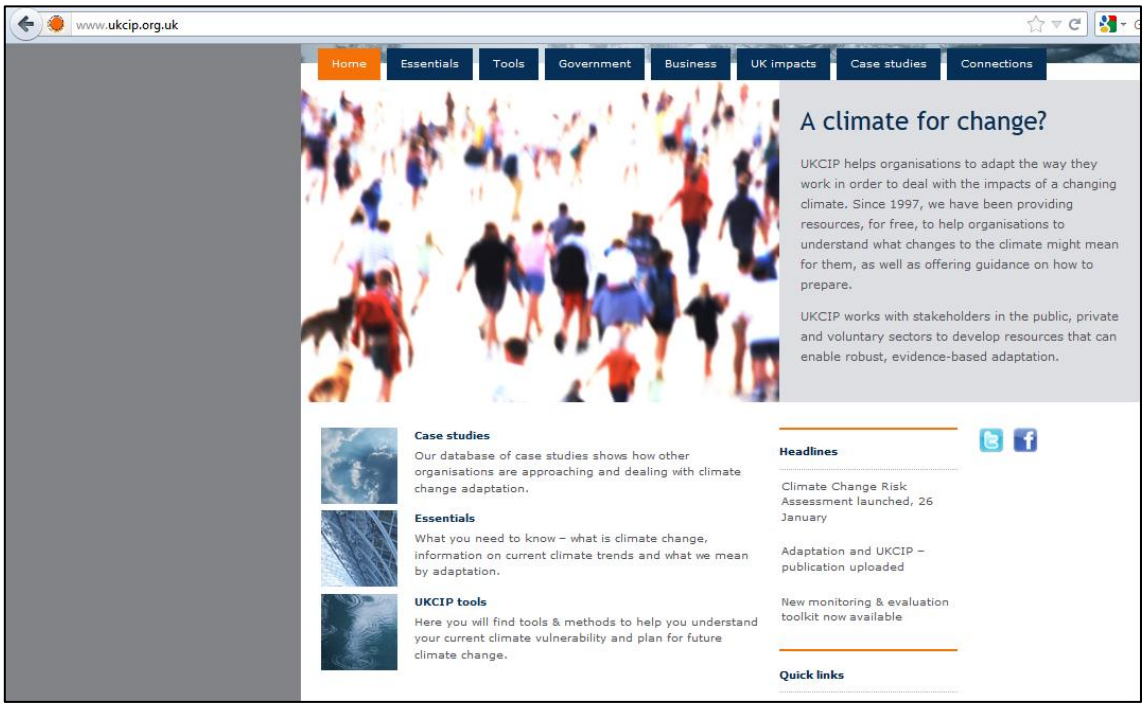

Figure 2.13 UKCIP web site home page

Mission

Since 1997 the UK Climate Impacts Programme (UKCIP) supports the "coordination of scientific research on climate change impacts to help organisations in their adaptation efforts; it works at the boundary between scientific research, policymakers and stakeholders (people working in the public, private and voluntary sectors interested in the impacts of climate change)".[22]

The UKCIP Website is hosted at the Environmental Change Institute (ECI), University of Oxford[23].

Main product and services

- **UK climate change impacts** at national and sub-national level - UK maps & key findings outlining likely changes in future climate based on information from UKCP09, and featured maps with key findings in table form for each UK sub-area:

[22] UKCIP works with the national network of climate change partnerships Climate UK co-ordinating local efforts to develop local adaptation strategies and actions.

[23] On 30 September 2011 the UKCIP contract with Defra expired, marking the start of a new stage of work for UKCIP. From 1 October, the Environment Agency became the Government's delivery body in England for advice on climate adaptation, helping key sectors build resilience to the expected impacts of climate change (Environment Agency's web pages).

New arrangements for UKCIP kick in from April. UKCIP will continue as a programme at the Environmental Change Institute, supporting action on climate change adaptation in the UK and internationally. However, some staff are transferring to the Environment Agency, along with a proportion of UKCIP's current workload on UK adaptation, so there may be some changes to your contacts and to the UKCIP services you currently use (source: UKCIP E-news for March 2012 n.1 "Changes at UKCIP").

All UKCIP's existing tools and resources will continue to be available online, for free.

- "Maps are displayed in groups of three to show the range of possible outcomes; these show the 10, 50 and 90% probability levels for the Medium emissions scenario for the 2050s, for a range of climate variables (Temperature, Precipitation);
- Key findings are shown as aggregated values for each of the 16 UK administrative regions, and are available in table form as UK-wide findings, or as text for the regions";

  (Information on the main impacts for each area of the UK, as well key findings and maps of future climate change are accessible either through the left navigation column either by clicking on the relevant area in the interactive map of the country);

- **UKCIP Tools** – an assortment of "**tools, methods and guidance to help organisations identify how they might be affected by climate change and what they can do to minimise their risks or exploit the opportunities**"; (this Tools portfolio is also shown in an interactive diagram illustrating "how the tools fit into a typical risk-based planning process");
  - **Adaptation Wizard** – a tool "designed to take the user through a process to determine individual vulnerability to climate change, identify key climate risks, and develop a climate change adaptation strategy. It is also a guide to all of UKCIP's information, tools and resources"; (it includes Wizard Offline version, Wizard Notepad to capture users' answers to an *ad hoc* questionnaire, Wizard Guiding principles, Wizard Resources, Wizard Feedback form for any comments and suggestions);
  - **AdOpt (Identifying adaptation options)** – a tool providing "guidance on identifying and selecting adaptation options for use in responding to climate risks. It builds on the UKCIP Risk, Uncertainty and Decision-making Framework (Willows and Connell, 2003) and Measuring Progress (West and Gawith, 2005), providing information on the range of adaptation options available, along with practical examples";
  - **BACLIAT (Business Areas Climate Impacts Assessment Tool**) – a tool helping users "explore the implications of climate change for their business or sector" through a set of workshops for business (it includes Assessing past weather, Business areas & future climate, Identifying adaptation options, Climate change impacts & responses, Spotting business opportunities);
  - **CLARA (Climate Adaptation Resource for Advisors)** – a resource "aimed at helping business advisors to support small and medium enterprises (SMEs) in understanding and preparing for the impacts of climate change";
  - **Costing the impacts of climate change** – a methodology for assessment of the costs of climate impacts and the comparison of these to the costs of adaptation measures. "The methodology can be applied across a wide range of sectors and geographical scales; the implementation guidelines include a case study on agriculture and irrigation, but further group of case studies are available" (e.g. for agricultural crops, road maintenance, dwellings and health associated with overheating and flooding). The guidance is directed to decision-makers and is recommended to be used together with a decision-making framework to consider climate risks and uncertainties;
  - **LCLIP (Local Climate Impacts Profile)** – a resource that local authorities and organisations can compile to better assess their exposure to weather and climate. The LCLIP process (Why do an LCLIP? - How to do an LCLIP - Outputs - Next steps - Case studies) "highlights a locality's vulnerability to severe weather events and how these events affect local communities as well as local authority assets, infrastructure and capacity to deliver services";

- **Risk framework** – a step-by-step decision-making framework helping the user evaluating the importance of his climate change risk with respect to other risks he may face, so as to identify the most appropriate adaptation measures for his organisation or business;
- **SES (Socio-economic scenarios)** – a set of scenarios supporting the investigation of possible future worlds and the consideration of their different range of climate change vulnerabilities and adaptation responses. "A set of four national level socio-economic scenarios have been developed for use in UK-wide climate impacts and adaptation assessments (they are included in a report providing rationale and guidance on their application at a regional level);
- **UKCP09 (UK Climate Projections)** – background and key findings on projections of future climate change for the UK until the end of this century, based on simulations from climate models (the same provided by the *MO climate services*) and relevant Training pages;
- **AdaptME toolkit** – a collection of tools for the monitoring and evaluation of user's current adaptation activities (with the subsections: Fundamentals, Adaptation challenges, Measuring performance, Background);

- **Case studies** – "examples of climate change adaptation in action from a range of sectors and areas of the UK, as part of a planned programme or as a response to a particular event. Each result contains a summary of the case study, details of geographical region, relevant sector and a note of the Adaptation Wizard steps completed, where appropriate. Links to further information are also included. The entries include summaries of the local authority, business, Adaptation Wizard, UKCP09 and LCLIP case studies that are featured in more detail in the relevant sections";
- **Business advice –** a section targeted to the business sector with three main sub-sections: Business-facing organisations, SMEs and Business case studies, including also a selection of the above tools plus reference to the following items:
  - **Adapting and Resilience to a Changing Climate (ARCC)** research programme on UKCIP research in "business and climate change impacts and adaptation";
  - **Business and climate change adaptation forum (UKCIP/RCCP)** – an online community "to share experience, knowledge, publications and plans with respect to the impacts of climate change on business for UKCIP, the regional climate change partnerships and others";
  - **A changing climate for business report** devoted to business and organisation managers "presenting an overview of climate change impacts and adaptation for business" based on UKCIP's experience;
- **Government advice** – a section targeted to the government with four main sub-sections (central government, devolved administrations, local authorities and reporting powers authorities) focusing on the policy and regulatory context for organisations and businesses to implement adaptation and climate change risk assessment (for ex. it includes links to Climate Change Act, Adaptation Sub-Committee, Defra's Adapting to Climate Change Programme and The Stern Review).

The climate products and services provided by UKCIP are often equipped with **use guidance** ("How to use"), relevant "**resources**" and podcasts and can be accessed either from the (both mentioned above) Tools section either from the specific sections for business and government.

(User registration is needed to access all the UKCIP Tools and the publications pages. Access to all UKCIP tools and resources is free).

Ancillary products and services

- **Background documentation** about general climate change information:
  - **Essentials** "from what the term means to details of recent climate trends" (including: "What is climate change?; Adaptation ; Mitigation; Climate impacts; Climate modelling; Recent climate trends; Climate indicators; What can I do?");
  - **Connections** – links to external pages, publications, resources and information by sector;
  - Publications;
  - Glossary;
- **Training** (including "Online learning, Webinars, Courses, Presentations and FAQ");
- **News**
  - UKCIP Climate Digest – a summary of recent research relevant to climate change impacts and adaptation;
  - News – e-news and a monthly newsletter on the latest adaptation news and events.

Staff

Expertise of UKCIP staff include the fields: climate change impacts and adaptation; impacts, vulnerability, risk and adaptation assessments; sector-specific adaptation options in the built environment and its infrastructure; communication with stakeholders to promote their engagement in adaptation processes; design guidance and tools on adaptation to be used by building professionals; strategies to support public understanding and engagement with climate change science; design of Website, publications and layout of tools.

2.15 Climate Service Center (CSC) Germany

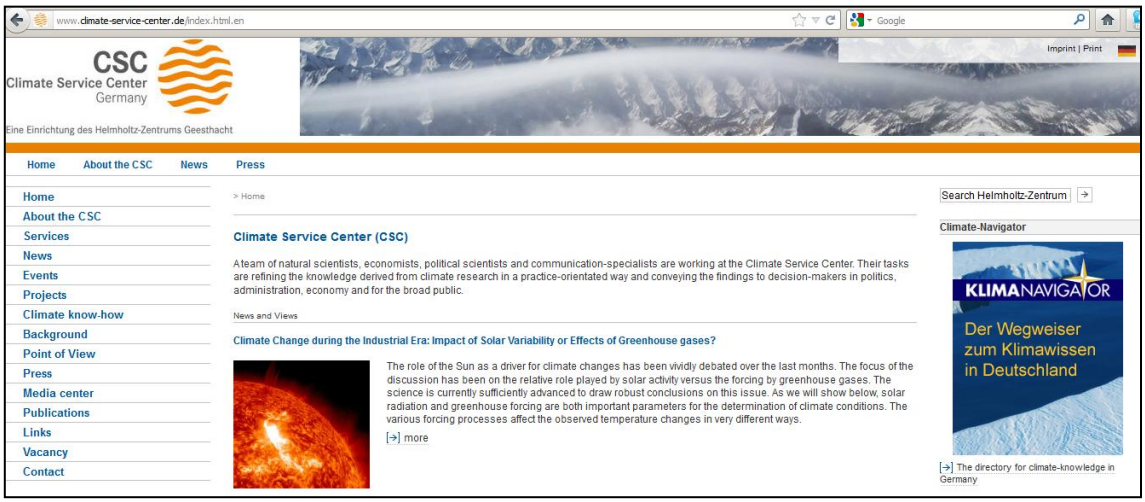

Figure 2.14 CSC Germany home page

Mission

The German Climate Services Centre, namely ***Climate Service Center (CSC) Germany*** (an Initiative of the German Government and an Institution at the Helmholtz-Zentrum Geesthacht who also hosts its dedicated Web site) since July 2009 "refines the knowledge derived from climate research in a practice-orientated way and convey the findings to decision-makers in politics, administration, economy and for the broad public." With this aim, the main tasks of the centre are:

- "investigating the need of society for advice regarding questions related to the climate;
- being a link between climate-researchers and climate-advisors in Germany;
- integrate research data on the climate-system and preparing this for the needs of clients;
- providing this information to customers via products, which are sector-specific and tailored to suit client needs;
- coordinating feedback from practitioners to scientists".

Main products and services

- **General services**:
    - "responding to individual enquiries;
    - identifying client-needs regarding questions on climate and in-house production of climate-simulations for replying to customers requests;
    - to initiate practice oriented research projects;
    - supporting the interpretation of climate-simulations;
    - consultation regarding uncertainties of models;
    - arranging expert-workshops;
    - initializing cooperation in the CSC-network;
    - to provide data and information regarding climate questions."
- **Services for KLIMZUG-Projects** - advice and support to the multidisciplinary joint projects from KLIMZUG (*Managing climate change in the regions for the future*) of the German Federal Ministry of Education and Research (BMBF), studying how to cope with climate change impacts at the local level in different German regions and to develop possible adaptation strategies. Support to the (five-year) project included: supplying regional climate model data, handling and interpreting data, answering questions on the operation of impact models, communicating to public, industry and policy-makers. A section on Climate model data for Germany and Europe is included with background and guidance for data users (German only) on:
    - climate and climate change;
    - climate modelling;
    - climate projections with Regional climate model data (temperature and precipitation) for Germany (CLM regional model; REMO model; WETTREG model; STAR II model) and Europe);

- link to the web pages of the former Service Group Adaptation (SGA)[24] of the Model and Data group at the Max Planck Institute for Meteorology (MPI-M) providing information on climate model data and data download as well as climatologic maps of model simulations.

Ancillary products and services

- **News**
  - News - miscellaneous news on international scientific research and CSC news;
  - **CSC News-Scan** - an overview of the latest scientific findings about climate, climate change and its consequences (German only);
- **Events** – upcoming events at CSC;
- **Projects** – overview climate change relevant EU and German projects;
- **Documentation**
  - Climate know-how and Background – background information on climate;
  - Publications – mainly CSC publications;
  - Link to the "**Climate-Navigator**" – an on-line directory for climate-knowledge in Germany, from more than 30 German scientific institutions working in the fields of climate, climate change and climate adaptation; it gives an overview of climate relevant research in Germany as well as insight in the current state of climate-knowledge (external web site; German only);
- **Dissemination**
  - Press – CSC press releases and CSC press review (German only);
  - Media centre – animations and videos;
  - Point of View – comments by CSC-experts on current questions on climate-policy, energy related themes and other subject areas closely related to climate change topics;
  - **Ask the CSC-Experts** corner – advice given by the CSC-Service team on scientific climate information for economy, science and media about future climate trends (German only).

Staff

The CSC team is made up of natural scientists, economists, political scientists and communication-specialists from five departments:

[24] This is actually a temporary and static web site (mirroring the original M&D Web site) pointing in turn to the new DKRZ Web site, which offers the following services related to climate research (and targeted to scientists only):

Provision of computing power	Consultancy	Guided Tour
Data Management	Visualization	Consortium Simulations

- **Department of the director** ("development of the CSC strategy and CSC management");

- **Climate system department** ("provision of climate change data and information for industry and administration customers in support to their decision making processes; provision of assistance in accessing, handling and interpreting climate model data; development of close cooperation with the German Climate Computing Centre (DKRZ) on the access to the CERA database of the World Data Centre for Climate (WDCC); focus on regional and local climate changes; generation of further products necessary for climate impact research, vulnerability studies and adaptation to climate change; development of products for seasonal forecasts);

- **Management of natural resources department** ("study of the impacts of environment and climate changes on natural resources in an integrated cross-sectoral way, with a focus on demand-oriented concepts of climate change adaptation and climate protection; main topics addressed: biodiversity protection, agriculture and forestry, water management");

- **Economics and policy department** (communication of knowledge about climate policies and the economic implications of climate change to target groups, with a focus on the social impact of climate change, in support to developing protection and adaptation strategies; main topics addressed: energy - renewable energies and emissions trading, transport and infrastructure, financial services and insurance, civil defence and environmental safety, international climate policies and foreign trade);

- **Communication department** ("public relations; development of print products, Websites, educational media and implementation of a climate TV-channel; set up of a national internet platform on climate change initiatives and actors, also in a view to help future investigation for climate change related information. Target groups: policy-makers, economists and scientists plus laymen, students and schoolchildren").

(Furthermore a CSC Strategic Advisory Panel (SAP) advises the CSC Director and his staff on strategic directions and their implementation. The (currently 15) members of the SAP are representatives of the economy, private and public sectors, climate services and scientific research and acknowledged climate change mitigation and adaptation experts).

2.16 KNMI Climate Services

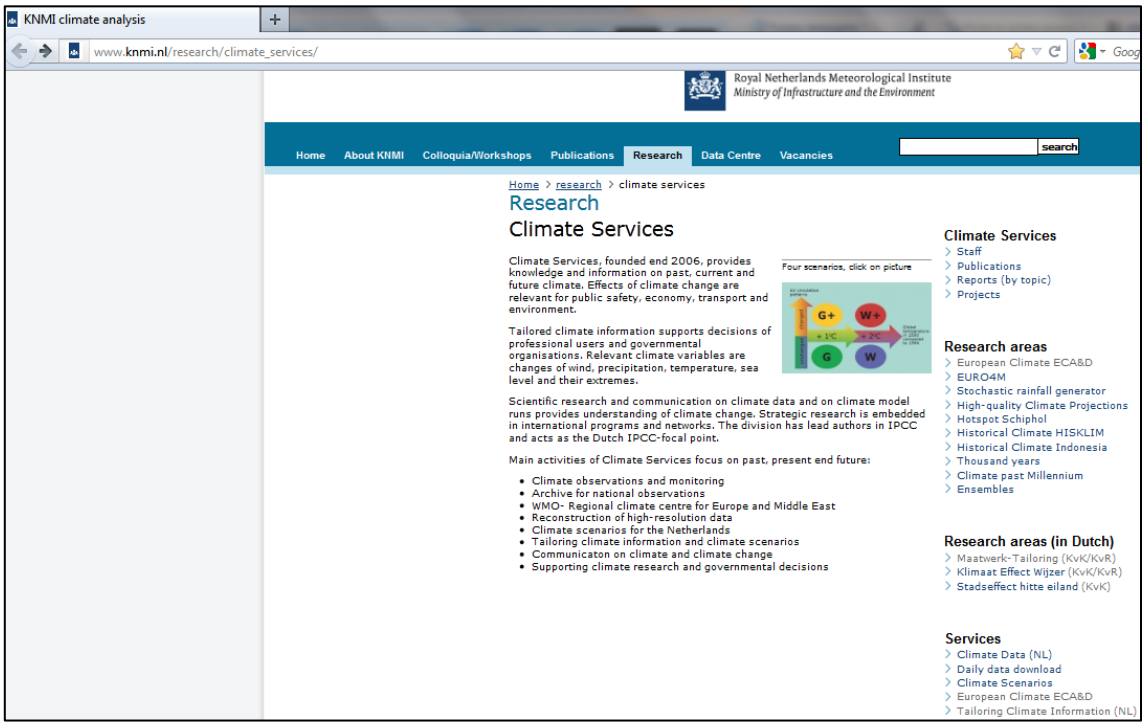

Figure 2.15 KNMI Climate Services home page

Mission

The Dutch Climate Services Centre, namely ***KNMI Climate Services*** (hosted by the KNMI[25] Web site) since 2006 "provides knowledge and information on past, current and future climate", including the "effects of climate change that are relevant for public safety, economy, transport and environment" and "tailored climate information supporting decisions of professional users and governmental organisations."

"The main activities of the KNMI Climate Services focus on past, present and future:

- climate observations and monitoring;
- archive for national observations;
- WMO-Regional climate centre for Europe and Middle East;
- reconstruction of high-resolution data;
- climate scenarios for the Netherlands;
- tailoring climate information and climate scenarios;
- communication on climate and climate change;
- supporting climate research and governmental decisions".

Main products and services

- **Climate data** – climatology, weather in the past, climate atlas (Dutch only);

[25] KNMI is the Royal Netherlands Meteorological Institute.

- **KNMI climate scenarios for The Netherlands** – four *KNMI'06* climate scenarios for the Netherlands (for Temperature, Precipitation, Windstorms and Sea level) as well as Previous generation scenarios, Future generation scenarios, Additional and foreign scenarios (equipped with Suggestions for usage and FAQs on scenarios);
- **Overview of observed climate changes** – observed changes worldwide and in the Netherlands for each of the scenario variables (Temperature, Precipitation, Windstorms and Sea level);
- **Sector-tailored climate information** – tailored climate information in support to decision making of stakeholders (professional users and governmental organisations) customized by sector (water, energy and industry, infrastructure, nature ecosystems and agriculture, planning, recreation and health); relevant climate variables: changes of wind, precipitation, temperature, sea level and their extremes (Dutch only);
- **European Climate ECA&D** – Web site of the *European Climate Assessment & Dataset* project, hosted by the KNMI, "presenting information on changes in weather and climate extremes, as well as daily dataset needed to monitor and analyse these extremes";
- **Climate Impact Guide** – a collection of "data and information about climate and climate effects in the Netherlands (e.g. background and documentation, calculation tools for data processing, advice on data generation and use), help in finding information for climate impact and adaptation studies from different research institutes" (Dutch only);
- **Climate Explorer** – a KNMI scientific Web application to analyse climate data statistically (a research tool to investigate the climate including several climate data and analysis tools);
- **Urban heat island effect** – monitoring (Dutch only).

Ancillary products and services

- Daily weather data (temperature, sunshine, cloud cover and visibility, air pressure, wind and precipitation, for the specific stations in the Netherlands);
- **Documentation** – Publications and Reports by topic;
- **Research - "**The KNMI climate research department is the national research and information centre for climate and climate change" conducting observations, developing models and performing fundamental research on the climate system, also in support to policy decision makers. KNMI Climate Research areas include: Climate Observations; Chemistry and Climate; Climate Services; Global Climate; Regional Climate.
    - **Projects;**
    - **Areas** – strategic research embedded in international programs and networks
        - European Climate ECA&D;
        - EURO4M – external website of the EU funded *European Reanalysis and Observations for Monitoring* project, providing "timely and reliable information on the state and evolution of the European climate, combining observations from satellites, ground-based stations and results from comprehensive model-based regional reanalyses";
        - Stochastic rainfall generator;

- **High-quality Climate Projections on regional climate in the Netherlands** – external joint Website of the Dutch *Climate* changes *Spatial Planning Programme* and the *Knowledge for Climate Research Programme* lead by KNMI, supporting the development of national and regional adaptation strategies and the generation of tailored data on climate change and the impacts on hydrology, nature, agriculture, land use and air quality;
- Hotspot Schiphol – external Website of the Knowledge for Climate (Kennis voor Klimaat) program, aiming at updating the climatology of Schiphol and at investigating the impact of climate change (the Amsterdam Airport Schiphol is defined as one of the hotspots in the Netherlands for adaptation to climate change);
- Historical Climate HISKLIM;
- Historical Climate Indonesia;
- Thousand years;
- Climate past Millennium:
- Ensembles.

Staff

The Climate Services division of the KNMI has lead authors in IPCC and acts as the Dutch IPCC focal point. The KNMI's Climate Research staff is from five divisions:

- "Climate Observations (satellite observations of the atmospheric composition, for application in research on climate, air quality, and stratospheric ozone);
- Chemistry and Climate (quantify, understand and predict anthropogenic and natural changes in atmospheric composition and their consequences for climate, air quality and ultraviolet radiation);
- Climate Services (provides knowledge and information on past, current and future climate);
- Global Climate (study of large-scale climate variability, including the effects of climate change);
- Regional Climate (model development, observations and fundamental research to address current issues in climate research on the regional scale)".

2.17 Météo-France Climate Section

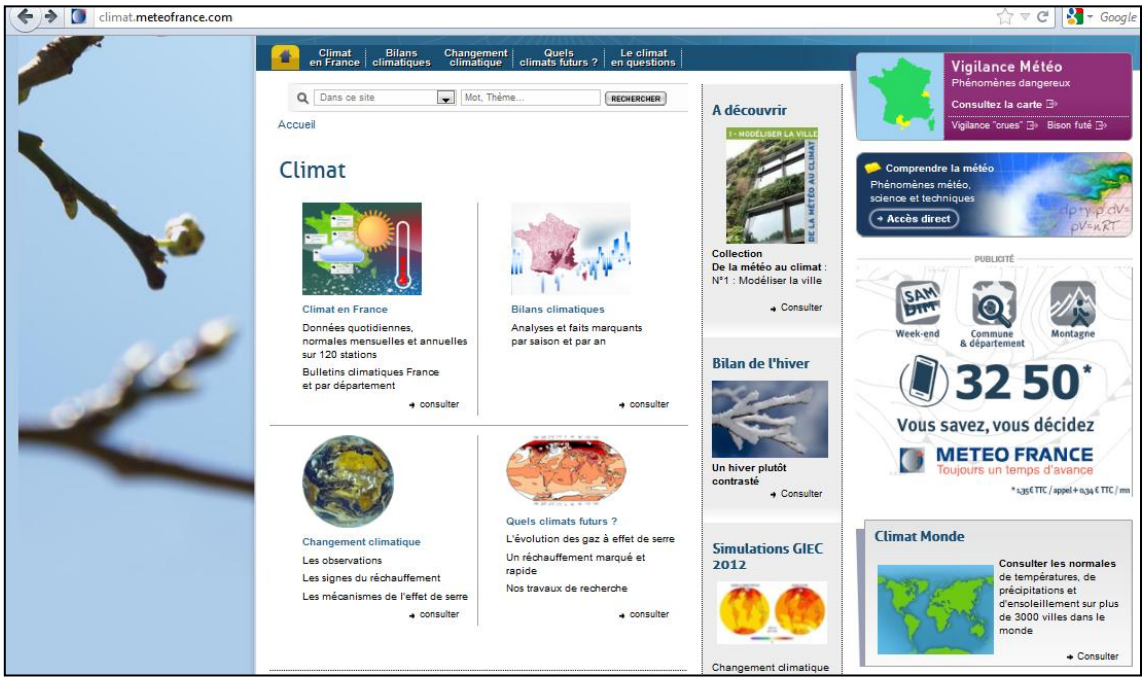

Figure 2.16 Météo-France web site home page

Mission

Being the French national weather service, the main mission of Météo-France is to alert the authorities and people of severe weather. This mission requires monitoring 24h/24 and 365 days a year from the atmosphere, snow cover and ocean surface. Météo-France is also conducting research on past climate and its future evolution.

Main products and services

The section on climate of Météo-France Web site presents the following products and services:

- **Climate in France** – "Daily, monthly and annual data of 120 stations; reconstruction (map) of average temperature trend over the entire twentieth century, obtained after processing of data to make them homogeneous and comparable; Climate bulletin; with analysis and highlights by season and year)";
- **Future climate**
  - Climate Change in Eastern Europe west and in France – projections of temperature and precipitation for the end of the twenty-first century (scenarios A2 and B2 IPCC);
  - increase in the frequency of summer heat waves in France – simulation with IPCC A2 scenario;
  - Information on a possible multiplication of extreme events;
  - The French contribution to 2007 IPCC AR4 (study of climate scenarios by IPSL and Météo-France under the FENCING project):

- **Modeling global climate change** – simulations with two climate models (one developed by Météo-France and CERFACS, the other by IPSL) covering climate change from 1860 to today, as well as projections for the 21st century for temperature and precipitation;
- **Feedbacks and climate variability** (Feedback and clouds, Carbon Cycle, Hydrological cycle, Cryosphere, Modes of variability);
- **Regionalization and extremes** – assessment of the impact of climate change on the frequency of extreme wind, temperature and precipitation over France for the SRES-A2 scenario, with emphasis on the frequency of heat waves, storms and heavy rainfall events and droughts in the metropolitan area, but also the impact on the frequency of tropical cyclones in the North Atlantic;
- **Detection and attribution of climate change** (minimum temperature and precipitation);

- **The climate simulator** – "a reproduction of climate impacts in France for the period 2050-2100 under IPCC A2 and B2 scenarios with five parameters to characterize climate change (maximum temperature, minimum temperature, rainfall, sunlight, soil moisture). The results are compared to a reference value, consisting of the simulated average for the period 1960-1990. Two consultation methods are proposed (the changing seasons by region or, in expert mode, changing a week on 360 areas). It is equipped with a guide to interpret the results of the simulator".
- **The "Climathèque"** – "a restricted 'Space Professional Services' application devoted to society, government, associations to access commercial climatological products (data and information) for the professional sectors: energy (heating), agriculture, hydrometeorology, statistics (precipitations) and information on weather stations".

Ancillary products and services

Météo-France offers the following ancillary products and services relevant to climate:

- climate bulletins;
- background information – main findings on climate change (e.g. observations, Evolution of greenhouse gases: possible scenarios, Evolution of the climate in different regions of the world);
- the climate issues – replies to some questions under debate;
- educational activities and material (e.g. interactive animations) on climate science and climate change;
- publications.

Staff

Météo-France is organized around central departments:

- department in charge of observation and information systems (weather and climate);
- department in charge of forecasting and climatology (operational implementation models and databases that supply forecasting and climate analyzes);

- National Centre for Meteorological Research;
- Directorate for Trade;
- National School of Meteorology (higher education institution which, in Météo-France, provides both the initial training of technical staff that their professional training);
- territorial network of nationally coordinated offices across the country, gathered in eleven inter-regional branches, 7 for the country (north, west, southwest, southeast, east-central, northeast, Ile de France Centre) and 4 for overseas (Antilles-Guyane, Réunion, New Caledonia, French Polynesia).

2.18 National Climate Research The Netherlands

Figure 2.17 National Climate Research The Netherlands homepage

Mission

The two research programmes: "**Climate changes Spatial Planning**[26]" (CcSP) and "**Knowledge for Climate**[27]" (KfC) have been funded by the Dutch Government (*Economic Structure Enhancing Fund - FES*) and by participating organizations and stakeholders in the Netherlands with the aim to implement an integral approach where science, governmental organizations and private companies jointly invest and operate to develop climate change adaptation strategies supported by high quality technology.

Main features of both the programmes include:

- "the ***climate proofing*** concept - a combination of (i) **targeted new infrastructural adaptation measures**, (ii) **risk management and coping strategies** in sectors like the bank/insurers, legislation

[26] The ***Climate changes Spatial Planning*** Programme aims at enhancing joint-learning between communities and people in practice within spatial planning, with the themes: climate scenarios, mitigation, adaptation, integration and communication.

[27] The ***Knowledge for Climate*** Research Programme develops knowledge and services, focusing on eight Hotspots, enabling the climate proofing of the Netherlands.

schemes, governance and institutional transitions in spatial planning, and (iii) **opportunities for technological, institutional and societal innovations**;

- the enhancement of ***joint-learning*** between science and practice in coping with climate issues in local, regional and (inter)national developments, both in public and private domains;
- *the **hotspots*** -places or regions where science and practice meet and collaborate during the entire cycle of a project, from its definition phase through to its execution and final valorisation of outcomes in terms of prototyping and implementing climate proof solutions"; selected[28] hotspots include major infrastructural and economic pillars in the Netherlands.

Main products and services[29]

The joint web site of the two above mentioned programmes: National Climate Research The Netherlands focuses on the following themes:

- (Water safety) Climate Proof Flood Risk Management - no relevant products so far, except for some publications;
- (Freshwater supply) Climate Proof Fresh Water Supply - no relevant products so far, except for some publications;
- (rural areas) Climate Adaptation for Rural Areas - no relevant products so far, except for some publications;
- (urban areas) Climate Proof Cities - relevant products are a few case studies on Building and Street; Neighbourhoods; Integrated Water Management; Region / Climate Buffers;
- Infrastructure and Networks - no relevant products so far;
- **(Climate Projections and Scenarios) High-quality Climate Projections** – "high quality **information on** present and future **regional climate in the Netherlands**, in support to developing national and regional adaptation strategies; **data and background information for climate impact analysis** through the ***Climate Impact Guide*** (Dutch) pilot Web site, targeted to researchers in five sectors: climate, nature, agriculture, water and land use";
- (Governance and economy) Governance of Adaptation – "**publications** and actions on how to integrate existing knowledge from the fields of public administration, economics, political science, spatial planning, law, environmental studies and psychology to develop and test governance arrangements for developing and implementing adaptation options (research and analysis); collaborative action research; organizing connectivity; (re)allocating responsibility and risks; dealing with controversies; normative principles for adaptation; comparative analysis; products include also results of Adaptation projects";
- **Decision support tools** – "**tools for design and evaluation of adaptation strategies** with a special focus on spatial planning and cross cutting issues with the following three core elements:

[28] "**Hotspots** are chosen based on (i) economic importance and the importance of the investment agenda, (ii) expected impact of climate change, (iii) ambitions relating to innovation and adaptation and (iv) national and international transferability. In order to ensure that research activities are demand-driven, a mixed team from the local authorities and business and science communities is put together for each hotspot project".

[29] *This is not actually a climate service: it is more about climate change and adaptation research in The Netherlands. A few relevant products have been marked in bold.*

- tools for formulation of the adaptation task, based on climate scenarios and economic development;
- tools for development and visualization of adaptation strategies in general and in particular related to hotspots and case study areas of KvK;
- evaluation and monitoring tools for assessing adaptation strategies in terms of various indicators such as costs and benefits, side effects, equity issues; efficiency and temporal and spatial scales";

- Mitigation (projects);
- Communication and Knowledge Transfer - products include publications; it's worth mentioning the 2012 "Interactive document Tools for Adaptation" (in Dutch) and Social Media ClimateNL;
- International and Delta-Alliance (participation to the Delta Alliance) – "an initiative to promote international cooperation of experts, water managers, other practitioners and their governments. It aims to raise awareness, share information and develop tools for sustainable development of low-lying areas in times of a changing world and a changing climate".

The following **Hotspots** could be useful as **case studies**: Schiphol Mainport; Haaglanden Region; Rotterdam Region; Major Rivers; South-West Netherlands Delta; Shallow waters and peat meadow areas; Dry rural areas; Wadden Sea.

Ancillary products and services

- **News** - latest climate change news articles, programme and project news and an archive;
- **research highlights** - a publication of the research programmes Climate changes Spatial Planning and Knowledge for Climate offering a broad spectrum of Dutch Climate Change research while highlighting the topics they work on, results so far and ongoing research;
- **meetings**;
- the **publications database** – a database of all project publications, searchable on the basis of one or more criteria, such as project, theme, publication type, meeting;
- the **projects database** – a database of all projects and activities, searchable by theme, project, group or by the user's search criteria.

Staff

Experts in the themes: climate scenarios, mitigation, adaptation, integration and communication (Climate changes Spatial Planning) and climate proof Flood Risk Management; climate Proof Fresh Water Supply; Climate Adaptation for Rural Areas, Climate Proof Cities; Infrastructure and Networks, High-quality Climate Projections; Governance of Adaptation, Decision support tools" (Knowledge for Climate).

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3 Overview of the main international Climate Consulting Agencies

This section presents an overview (not intended to be exhaustive) of the activities carried out by the most visible international Climate Consulting Agencies according to our search[30] through the description of these Agencies' mission, main (and also ancillary) climate products and services and staff composition.

3.1 List of main international Climate Consulting Agencies

CLIMATE CONSULTING AGENCIES	LOGO	COUNTRY	WEBSITE	SCALE / PERSPECTIVE
CLIMsystems		New Zeeland	http://www.climsystems.com/	Global, Regional, National and local
CH_2M Hill		USA	http://www.ch2m.com/corporate/default.asp	Global, National
ENVIRON		USA	http://www.environcorp.com/home.aspx	Global, National
Environmental Resources Management (ERM)		USA	http://www.erm.com/Service/	Global, National
ICF International		USA	http://www.icfi.com/	Global, National
McKinsey & Company		USA	http://www.mckinsey.com/	Global, National
Deloitte		USA	http://www.deloitte.com/view/en_GX/global/index.htm	Global, National
PwC		USA	http://www.pwc.com/	Global, National
World Climate Service		USA	http://www.worldclimateservice.com	Global, National
ENERGY DESIGN TOOLS by UCLA Department of Architecture and Urban Design	N/A	California	http://www.energy-design-tools.aud.ucla.edu/	Global, National

[30] Free Web Google search: "*climate consultant advice*".

Climate Consulting Ltd		United Kingdom	http://www.climate-consulting.co.uk/index.php	Global, National
SQ Consult		The Netherlands	http://www.sqconsult.com/	Global, National
ThinkClimate consulting		Australia	http://www.thinkclimateconsulting.com.au/	Global, National
WSP Group - Climate change consultancy		United Kingdom	http://www.wspgroup.com/en/Services/Services-Container/Climate-change-consultancy/	Global, National
ATKINS - Climate change consultancy		United Kingdom	http://www.atkinsglobal.com/	Global, National
WeatherNet		United Kingdom	http://www.weathernet.pipeten.co.uk/index.asp	Global, National

3.2 CLIMsystems

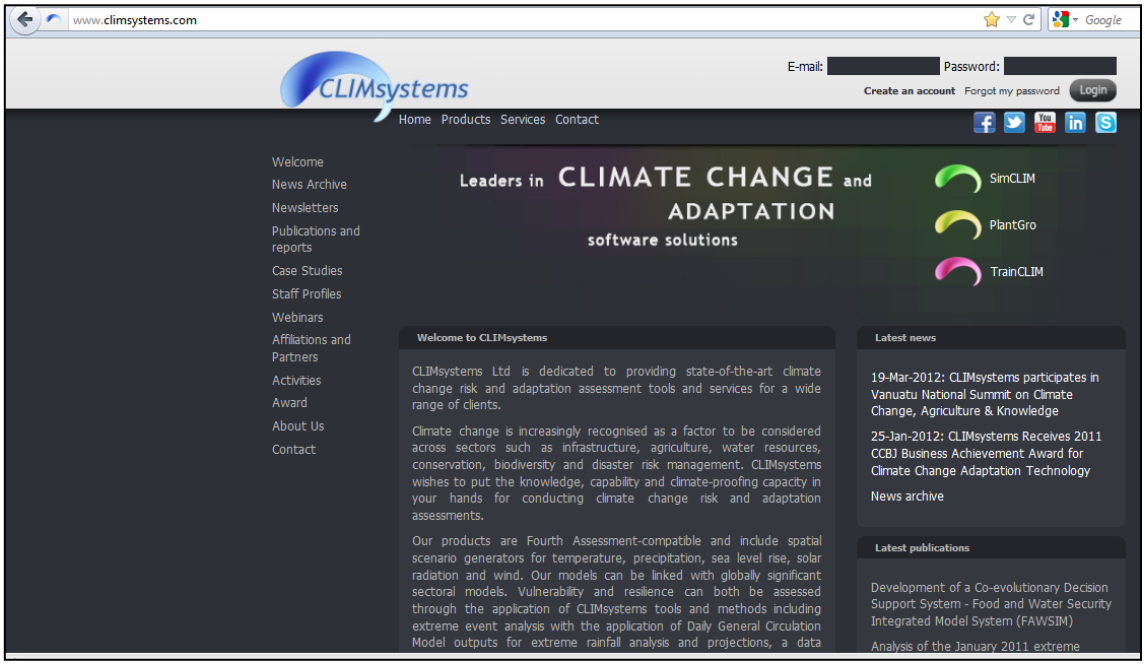

Figure 3.1 CLIMsystems homepage

Mission

CLIMsystems Ltd "designs, develops and markets advanced, user-friendly software systems for assessing impacts and adaptation to climate variability and change" with a focus on "**climate change risk and adaptation assessments**".

CLIMsystems offers software licenses and associated training services, technical assistance and consultation to a range of national and local governments, planners, educators, students, international

agencies, private consultants and companies throughout the world in order to meet their needs for addressing climate risks."

"CLIMsystems range of services include:

- SimCLIM training – beginners, intermediate and advanced;
- Data manipulation and compatibility testing;
- Data acquisition;
- Customised corporate training;
- Project development;
- Project implementation – independent and collaborative;
- On-line support and technical assistance;
- Software development;
- Impact model partnerships."

Main products and services

- **SimCLIM**[31] - a climate change impact assessment software system; it is a "computer model system for examining the effects of climate variability and change over time and space", to assist in climate proofing across various sectors including: water, agriculture, health, ecosystems, coastal zone issues (sea-level rise and coastal erosion)"; "it is a customised GIS which includes tools for the spatial analysis of climate variability and change and associated impacts on various social-economic sectors".
    - "SimCLIM is **designed to support decision making and climate proofing** in a wide range of situations where climate and climate change pose risk and uncertainty". "It is specifically designed for bridging the gap between science and policy/planning".
    - A user customised SimCLIM ***Open Framework System software package*** has the capacity to **assess baseline climates and current variability and extremes**. This "open framework feature allows users to customise the model for their own geographical area and spatial resolution and to attach impact models". SimCLIM allow you to use your own data, but CLIMsystems offers also the possibility to build a customised version of SimCLIM that suit clients' requirements.
    - SimCLIM can be used to perform:
        - description of **baseline climates**;
        - examination of **current climate variability and extremes**;
        - (present and future) **risks assessment**
        - (present and future) **adaptation investigation** - adaptation measures can be tested for present day conditions and under future scenarios of climate change and variability;

[31] Additional source: UNFCCC sheet on SimCLIM.

- **scenarios of climate and sea-level change**[32] - *Spatial Climate Change Scenarios; synthetic scenario*; *Site Specific Climate Change Scenarios; Global Sea-level Scenarios* ("a total of **six emission scenarios (SRES)** are included in the software package and they can be queried for their associated changes in temperature, sea level (total and thermal expansion only) and CO_2 concentration as produced by the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC). For each SRES the software program produces a graph of projections from 1990 to 2100 with low, medium and high estimates. The latest Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report data comes pre-loaded in SimCLIM"; **variable types** currently handled by SimCLIM are: precipitation, minimum, mean and maximum temperature and wind).
- **sensitivity analyses** - SimCLIM allows multiple runs and sensitivity analyses; it has the flexibility to construct numerous scenarios under various assumptions and uncertainties concerning GHG emission scenarios, AOGCM model results, and climate sensitivities emanating from climate feedbacks; **the scenario generation tools are linked to impact models**, so that impact analyses can be conducted in a seamless manner; therefore analyses can be run quickly and efficiently in an internally-consistent fashion; there is complete scope for re-running the system under different assumptions and to explore alternative scenarios."
- **projection of sectoral impacts of climate and sea level change**
- **integrated impact analysis** at various scales (a key feature is the *integration* of data and models that allow simulations of the effects of climate variability and change (from global to local); SimCLIM can provide the users with the capacity to add a "climate change layer" to their existing assessments in a range of fields (land use planning, water resource planning, flood risk reduction, health risk, crop yield assessments, etc.)

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[32] "The most commonly used approach for **developing Spatial Climate Change Scenarios** in the SimCLIM system involves the **scaling of the standardised, downscaled patterns of climate change with the time-dependent projections of global-mean temperature change** - a **linked-model** approach (for methods see *Santer et al., 1989; Hulme et al.,2001*). These changes are used to perturb the present climate (1990 baseline) and thereby create climate scenarios for the year of interest (e.g. 2100)." [Source: CLIMsystems (2011) "SimCLIM Essentials Guide 1"]

"At its core, every SimCLIM has a "climate scenario generator" used to create scenarios of future climate and sea-level changes. **For generating scenarios of future climates, SimCLIM generally employs the commonly-used method of "pattern scaling"** (*Santer et al., 1990; Hulme et al., 2000; Carter and La Rovere, 2001*). It involves the scaling of "standardized", spatial patterns of climate change from very complex, computationally-demanding 3-D global climate models (General Circulation Models, or GCMs) with the time-dependent (e.g. year-by-year) projections of global-mean climate changes from simpler models. These changes are used to perturb the present climate (whether time-series data or a spatial climatology) and thereby create climate scenarios for a year of interest (e.g. 2050)." [Source: Warrick, R.A. 2007 "SimCLIM: Recent Developments of an Integrated Model for Multi-scale, Risk-based Assessments of Climate Change Impacts and Adaptation"]

Quoted publications:

- *Santer, B.D., T.M.L. Wigley, M.E. Schlesinger and J.F.B. Mitchell, (1990). Developing Climate Scenarios from Equilibrium GCM Results. Report No. 47, Max-Planck-Institut-fur-Meteorologie, Hamburg, Germany*
- *Hulme, M., T. Wigley, E. Barrow, S. Raper, A. Centella, S. Smith, A. Chipanshi (2000). Using a Climate Scenario Generator for Vulnerability and Adaptation Assessments: MAGICC and SCENGEN Version 2.4 Workbook, Climatic Research Unit, Norwich, UK, 52pp.*
- *Carter, T.R. and La Rovere, E.l. (2001). Developing and Applying Scenarios, Chapter 3 in **Climate Change 2001: Impacts, Adaptation, and Vulnerability. The IPCC WG 2 Third Assessment Report**, J.J. McCarthy et al. (eds), Cambridge University Press, Cambridge.*

        - risks and uncertainties examination.
    - SimCLIM allows **easy update** - easily updating SimCLIM by importing new spatial and time-series data and by modifying component impact models. The implications of such changes can then be easily examined by re-running the system.

- **PlantGro** - "a software program for exploring plant, soil and climate relationships. This program can assist farmers, foresters, agronomists, consultants, horticulturalists, aid agencies, teachers and students to meet the challenge of matching plants to soils and climates." It **helps assessing "the suitability of various climates and soils for different plants"**.
    - "The program is preloaded with over 1700 plant files (including annuals, perennials and tree species), over 40 soil files and more than 180 site specific climate files;
    - a total of 23 parameters can be used in an analysis ranging from pH and cation exchange capacity to salinity and slope";
    - "the integration of **SimCLIM** with **PlantGro** allows you to do powerful **analysis of the impact of climate change on plant suitability with soils**. Climate change can thereby be factored into decision-making with regard to potential changes to cropping systems and tree growth."
- **TrainCLIM** – a software enabling "a wide range of potential users (from school teachers and students to environmentalists and local governments) to gain a broader understanding of the real world implications of climate change to local areas and societies. TrainCLIM is a software-supported training package, consisting of a hard-wired (as opposed to an open-framework) software program and supportive manuals, training modules and exercises. Main features include:
    - "global climate scenario generator;
    - global sea level scenario generator;
    - extreme events analysis tool;
    - climate data browser;
    - malaria epidemic potential tool;
    - dengue fever epidemic potential tool;
    - shoreline change model;
    - coastal inundation model;
    - tropical cyclone risk model;
    - PlantGro agricultural potential model;
    - river flow analysis & flooding model;
    - rainwater collection (tank size) model".
- **Adaptation to Climate Change Monitoring and Evaluation of Projects (M & E) -** conducting monitoring and evaluation of climate change risk and adaptation projects from its very earliest stages of development around the world to its implementation.
- **Consulting -** implementation of a climate risk assessment program, including examination of individual's or organisation's climate change risk assessments and advise on their appropriateness depending on clients' requirements; CLIMsystems offers also customized study areas for ingestion

in the SimCLIM modeling system, various statistical downscaling products for end users and normalized RCM models for driving SimCLIM modelling.

Ancillary products and services

- **Training Program** (presentations and application of the SimCLIM modelling system for climate change risk and adaptation assessment to a range of topics as well as customized courses on climate change risk and adaptation assessments methodologies and concepts);
- **Backgorund information (**Case Studies, Publications and reports);
- **News (**News Archive, Newsletters);
- **Communication - CLIMsystems Google Group**: the SimCLIM on-line forum to get the latest news of SimCLIM and other CLIMsystems products and services.

Staff

CLIMsystems team on climate change adaptation and risk assessment has expertise in climate science, planning and policy, audit and accounting, community development, engineering, agriculture, water supply and other sectoral areas.

- "Six members of staff and Associates are Nobel Laureates;
- five members of staff are registered in the UNDP National Communications Support Programme (NCSP) Roster of Experts;
- staff have worked in over 50 countries and is multilingual (English, French, Dutch, German, Spanish, Filipino, Cantonese, and Mandarin);
- in addition, CLIMsystems maintains an array of international associates and has an extensive **network of data and model providers**, spanning across the public and private sectors, academia and non-government organisations (key relationships: affiliations and partners page)".

3.3 CH_2M Hill

Figure 3.2 CH_2M Hill home page

Mission

CH2M Hill is a world company (with more than 30000 employees in offices worldwide offices in Asia, Australia/New Zealand, Canada, Europe, Latin America, Middle East/Africa, United States) for "consulting, design, design-build, operations, and program management" providing government and industry engineering or consulting solutions for a more sustainable world.

The company's experience cover multiple markets: Energy, Environment, Facilities, Resources, Transportation, Water.

Main products and services

The whole range of services offered by CH2M Hill addresses the complete project lifecycle ("plan, design, build, upgrade, expand, modernize, renovate, retool, optimize, and operate infrastructure and facilities", "decommission, decontaminate, demolish, restore the environment for new uses") and covers a number of industry practices.

The company does not have a section devoted to climate services/products. The main products and services pertinent to climate issues within the various sectors refer mainly to s**ustainable/green building design, carbon management and renewable energy services**.

- **high-performance/sustainable/green building design** (within Architecture & Planning) – "architectural and engineering design and analytical services necessary for high-performance solutions2 (including for patents for energy conserving equipment) and includes: "planning; site selection, restoration, and conservation; sustainable architectural design, energy conservation; materials and resources; indoor environment; commissioning and certification";

- **carbon management** (within Energy Management & Planning) – identification and implementation of projects that reduce clients' carbon emissions, generating carbon emission reduction credits with a project-based emissions reductions approach providing verifiable carbon credits in the context of the Kyoto Protocol;
- **renewable energy services** (within Energy Management & Planning) – "development of energy infrastructure projects that make use of bioenergy, solar thermal, photovoltaic, wind, hydro, and geothermal resources"; "analysis, design, and construction of ground-breaking renewable energy facilities"; "solutions that improve operational efficiency, manage price risk, increase security and reliability, and create valuable markets for tradable credits".

Ancillary products and services

- CH2M HILL News Room – "CH2M HILL News Coverage, Press Releases, Press Kit, Industry Experts, Image Library, Video Library, Awards and Recognition, Industry Rankings: 2012, Leadership, Events, Community Investment, For Students K-12".

Staff

Staff include experts in *inter alia* the fields: finance and accounting, energy, transportation, water, building, architecture, engineering, environment and ecosystems, law, Technology and IT.

3.4 ENVIRON

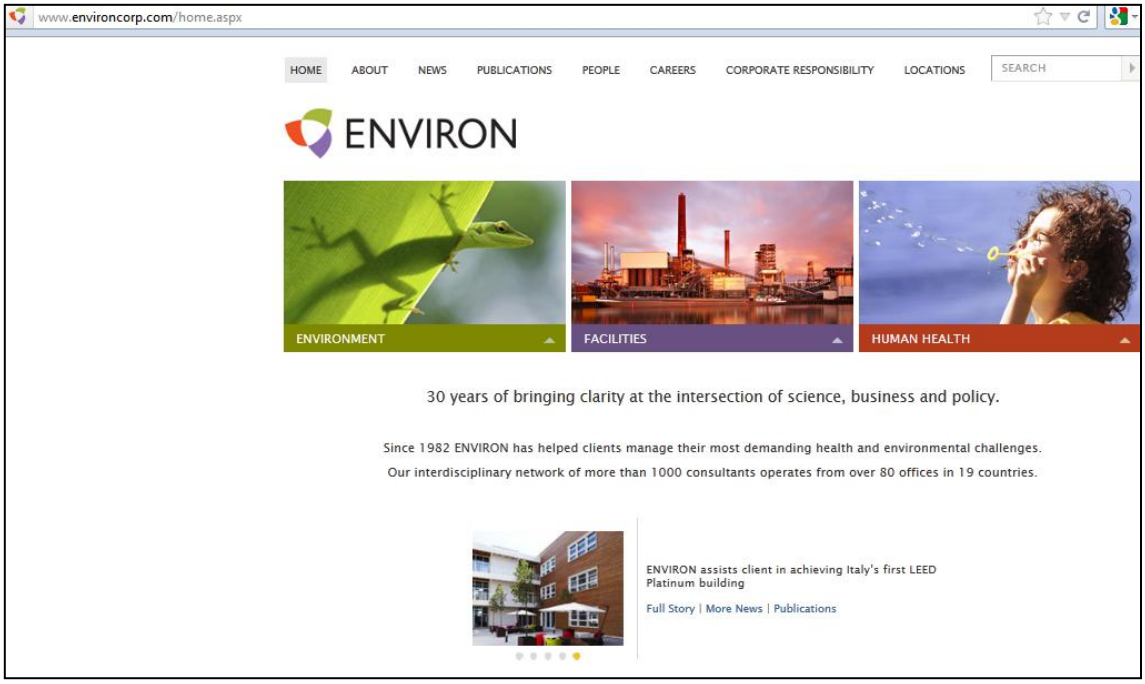

Figure 3.3 ENVIRON home page

Mission

Since 1982, ENVIRON provides worldwide "consulting services at the edge of science and technology related to environmental and human health issues" in the context of "bringing clarity at the intersection of science, business and policy".

ENVIRON's assistance in assessing and mitigating potential environmental risks aims to "enables clients to respond more effectively to current business, regulatory and legal challenges, and to reduce or eliminate future liabilities".

Main products and services

Key ENVIRON's services in the area of Climate Change & Energy Management are related to the development of a "**sustainable climate change and energy management program**" and include:

- **GHG/Carbon management -** "from strategy to technology, from compliance to sustainability, ENVIRON helps clients meet their greenhouse gas (GHG) business objectives by managing carbon risks and taking advantage of business opportunities around the world" in all the relevant business sectors; services include e.g.: "analysis of the cost implications of carbon regulations, calculation of baseline carbon footprints, development and deployment of emission-control strategies to reduce these footprints; managing GHG inventory data; optimization of engagement in the carbon markets and integration of carbon management into everyday business operations"; examples of work include:
    - "development for the Fleet Services Division of a major metropolis a Green Vehicle Emission and Selection Tool to allow fleet managers to compare effects of alternative fuels/vehicle technologies on GHG and criteria emissions and cost, both direct and lifecycle, based on specifics of the fleet;
    - development of a web-based data management tool to manage GHG inventory data from hundreds of sources around the world for the creation of the GHG inventory for one of the world's largest media and entertainment companies;
    - California Greenhouse Gas Mandatory Reporting and Verification Services;
    - low-Carbon building";
- **evaluation of climate change vulnerabilities and design of adaptation responses** – an example of work include: "assisting a major port with development of climate scenarios focusing on future sea level rise and storm intensification for inclusion in an overall climate change strategy".

Ancillary products and services

- News (Headlines and events);
- Publications (Articles & Papers).

Staff

"ENVIRON's global staff of more than 1000 consultants represents a wide variety of engineering, scientific, public health and regulatory affairs disciplines" and in particular "environmental engineers and scientists with education and experience in a variety of areas, some of which include: "Air Quality, Water Resources,

Environmental Due Diligence, Geology / Hydrogeology, Risk Assessment, Epidemiology & Toxicology, Environment, Health & Safety, Remediation".

3.5 Environmental Resources Management (ERM)

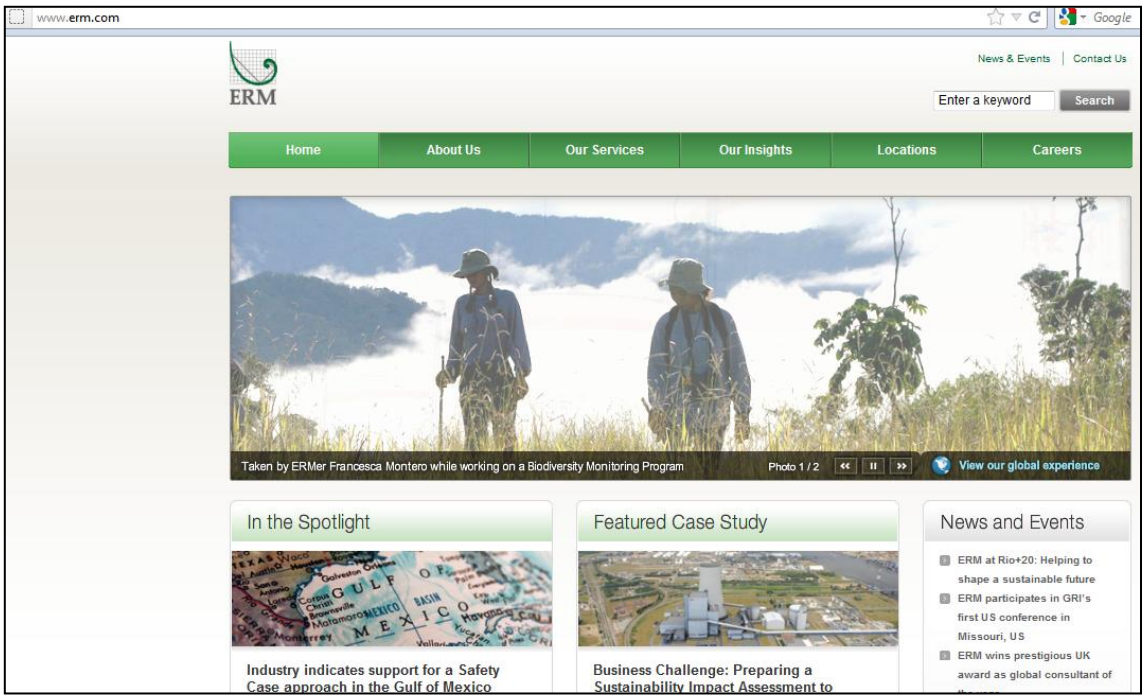

Figure 3.4 Environmental Resources Management (ERM) home page

Mission

Founded in the UK in 1971, "Environmental Resources Management (ERM) has today about 4000 employees based in 140 offices in 40 countries around the world. The company is an environmental consultancy and a global provider of "environmental, health and safety, risk, and social consulting services" to business and government customers by "helping them to improve their business, organizational and environmental performance" in the broad framework of sustainability.

Sectors covered are: "Aerospace, Automotive, Chemical, Consumer Products and Retailers, Engineering Procurement and Construction, Financial, Food and Drink, Government, High Tech and Telecommunications, Legal, Manufacturing, Metals, Mining, Oil and Gas, Pharmaceuticals and Healthcare, Power, Printing and Publishing, Pulp and Paper, Real Estate and Land Development, Service and Entertainment, Textiles and Apparel, Transportation, Waste Management Services".

Main products and services

Main products and services related to climate change issues deal mainly (but not only) with **energy efficiency** and **carbon management**. In particular, "ERM's Core Air Quality and Climate Change Services" include the following ones:

- "ambient air impact assessments and monitoring;
- air pollution dispersion modeling;

- Carbon footprinting;
- Carbon management and strategy including marginal abatement cost curves;
- emissions trading, carbon credits and carbon liability advisory services;
- emissions inventories;
- energy and resource mapping and efficiency;
- emissions measurement, CEM systems, stack testing, GHG measurement, LDAR and smart LDAR;
- climate change risk, adaptation, mitigation strategy and implementation;
- catastrophic release modeling and upset assessment;
- facility licensing and siting;
- emissions trading support and strategy".

A selection of Case studies relevant to "Air Quality and Climate Change" are also presented, including:

- "identifying opportunity for Chongqing to become a low carbon, high growth economy;
- identifying opportunities to implement programs supporting the global challenges of climate change;
- identifying energy consumption sources, and efficiency and process improvement opportunities".

Ancillary products and services

- News
  - "Air Quality and Climate Change" news;
  - Spotlight Articles - ERM in-depth look at the issues facing their clients;
- ERM Publications – "White papers, published articles, publications and other thought leadership pieces on all the environmental issues addressed by the company".

Staff

ERM's Air Quality and Climate Change expertise includes more than 500 engineers, scientists, meteorologists and economists.

Expertise on "Air Quality and Climate Change" cover the themes: "air quality issues management for government and industry, air quality and climate change consulting and engineering, corporate strategy, GHG inventory and management systems, emission reduction strategies and carbon markets, to GHG verification, sustainable production and consumption and climate change, energy efficiency and climate change".

3.6 ICF International

Figure 3.5 ICF International home page

Mission

Founded in 1969 with headquarters in Washington, D.C. and more than 4500 employees in more than 50 offices worldwide, ICF International is a "Technology, Policy, and Management Consultancy" providing expertise in the fields: "aviation and transportation; climate, energy and environment; health, education and social programs; homeland security and defence".

Main products and services

Concerning climate change consulting and solutions, ICF International "helps public- and private-sector clients worldwide develop climate change policy, interpret and comply with regulations, reduce greenhouse gas (GHG) emissions, evaluate risks, and identify opportunities".

- Services for federal, regional, and international agencies in the development of climate change policy:
    - "modelling potential climate change impacts;
    - providing technical assistance for program implementation;
    - offering guidance on cap and trade programs, voluntary programs, and sector-based mechanisms".
- "Services for the private-sector to reduce GHG emissions and comply with climate change regulations:
    - modelling regulatory and policy scenarios for GHG and conventional pollutants;
    - providing guidance with existing and potential climate change regulations, laws, and standards;

- analyzing climate change impacts on infrastructure, ecosystems, and communities;
- tracking environmental performance, including energy use, costs, GHG, waste, and water;
- evaluating options for participation in the GHG allowance and offset markets;
- support in integrating economics, compliance, and other issues into climate change strategy;
- aiding implementation of government compliance programs and voluntary initiatives.

- Climate offerings/products:
  - GHG Allowance + Offset Market Analysis – support in developing "smart GHG allowance and offset market strategies" especially for utilities, manufacturers, and other emissions-intensive companies, including with:
    - Carbon Tools – "a suite of proprietary climate change strategy tools to help manage greenhouse gas (GHG) emissions, create inventories, estimate the price of carbon, and assess Clean Development Mechanism (CDM) projects":
      - AHEF - Atmospheric Health Effect Framework Model;
      - Climate CHECK - Climate CHange Emission Calculator Kit;
      - CLIP - Climate Leadership in Parks;
      - CPM™ - Carbon Planning Model;
      - GEMS® - Greenhouse Gas Emissions Management System;
      - GHGPortfolio™;
      - InCaP™ - International Carbon Pricing Tool;
      - MAC - Marginal Abatement Cost;
      - RESPIRE® - Rating and Evaluation System for Prioritising Investments in Reducing Emissions;
      - Vintaging Model;
  - GHG Mitigation – "state-of-the-art GHG mitigation and compliance support and environmental strategy guidance" especially to power companies and other large-scale GHG emitters;
  - Green Investing - Services to the Financial Sector including: "comprehensive analysis (including a full toolkit of historic data, scenario modelling tools, and base-case assumptions), guidance (informed insights into the forward prices of carbon, natural gas, and other commodities), complete understanding of existing and looming regional, federal, and global regulations for greenhouse gas and conventional pollutants, assistance leveraging savings through energy efficiency tactics";
  - Impacts, Vulnerability, + Adaptation – "modelling incremental effects on infrastructure and operations, assessing vulnerabilities, evaluating climate risk mitigation options, engaging stakeholders through pilots and workshops";
  - Support for Regulatory + Policy Development – "GHG inventories, analytics, simulations, and scenario modelling, on-the-ground program implementation, communications and outreach support" for organizations involved in regulatory and policy development;

- Sustainability – support to "property owners and managers in evaluating portfolios and identifying sustainability initiatives to optimize environmental performance, energy efficiency, and return on investment", including:
  - Green Business – "Corporate Sustainability Solutions including: Corporate Sustainability Strategy, Corporate Performance Analysis, employee engagement programs, performance tracking and reporting, strategic communications";
  - Green Government – "Federal Sustainability Leadership Services for federal, state, and local agencies to develop, implement, evaluate, communicate, and continuously improve their Green Strategies, including *inter alia*: climate change and ozone protection, GHG inventories/protocols, mitigation strategies, and climate change adaptation, energy, water, and fleet efficiency, renewable energy and green power, transportation planning and smart growth)";
  - National Environmental Policy Act (NEPA) + Climate Change – "environmental impact assessment and climate change" (impacts, adaptation and mitigation) analysis;
- International Development – "dealing with the challenges of climate change, global health, food security, and clean energy including, *inter alia* inter: energy efficiency policy and implementation, smart grid, renewable energy markets, technology deployment, Enhancing Capacity for Low Emission Development Strategies (EC-LEDS)".

Ancillary products and services

- News;
- Events;
- Insights - articles + books, presentations, products + tools, projects, reports, video + podcasts, Webinars, white paper.

All the above items can be filtered by theme.

Staff

ICF International expertise cover the following fields: energy, climate change, environment, infrastructure, health, social program, consumer/financial, public safety, and defence issues, information technology, program management and communications.

3.7 McKinsey & Company

Figure 3.6 McKinsey & Company home page

Mission

McKinsey & Company is a "global management consulting firm", with more than 90 offices in more than 50 countries in the world with the mission to advises the world's leading businesses, governments and institutions "making distinctive, lasting, and substantial improvements in their performance and building a great firm that attracts, develops, excites, and retains exceptional people."

Main products and services

The wide range of services offered by McKinsey & Company include solutions, analytical tools and specialist expertise covering most of industry practices and business functions.

The company does not have a section devoted to climate services/products. Examples of products and services pertinent to climate issues within the various sectors refer mainly to **carbon management, clean technologies, renewable energy services, adaptation and mitigation strategies and sustainability strategies**.

- Carbon & Energy Economics
    - **green growth and carbon mitigation** – support to governments "shape pathways to a low-carbon economy using own greenhouse gas abatement cost curve to provide an integrated view across the whole carbon system";
    - **adaptation strategies** – "support to public and private sector clients (governments, financial institutions, and other partners) assess the risks of climate change and develop cost-effective adaptation strategies, including: modelling climate scenarios and weather patterns, developing innovative methods to quantify the economic value at risk, and apply rigorous cost/benefit analyses to adaptation measures";

- **climate change regulation** – "constructing a fact base and options for governments as they develop regulation, and for companies as they analyze its likely impact, drawing on knowledge of regulatory strategy and deep experience in climate policy at national and international level";
- **Carbon markets –** "develop strategies to manage clients' exposure to carbon markets, including with a scenario-based perspective on future market developments, operational support at the level of the trading desk, identification of opportunities in financial intermediation and carbon-offset development and advise on the design of emissions trading systems";
- **climate finance** – "advise on investing in international climate finance by *inter alia*: conducting detailed opportunity scans across asset classes, taking into account technology, geography, and risk profiles and designing delivery mechanisms";
- **long-term energy strategies** – "formulate companies' long-term energy and investment strategies based on systems-level understanding of carbon, greenhouse gas mitigation, and energy"; "helping government departments find untapped opportunities to improve energy efficiency in an industry or sector, identify barriers to capturing them, and develop policies and actions to reduce energy consumption without damaging productivity or growth";

- Clean Technologies
  - **"power** - such as renewables (solar photovoltaic, solar thermal, and wind), clean coal, carbon capture and sequestration, smart-grid and metering technologies, energy-storage solutions, energy efficiency, and waste-to-energy opportunities;
  - **transport** - such as clean vehicles, electric vehicles (hybrid, plug-in hybrid, and battery), fuel cells, and batteries;
  - **buildings and infrastructure** - such as automation, HVAC, windows, insulation, home energy management, appliances, and LED lighting;
  - **water** - such as wastewater treatment and desalination/membranes";
- Biosystems - biofuel, bioenergy, and bio-based materials (work examples include: "alternative energy and go-to-market strategies for major fuel, chemical, and energy players to market entry and improvement strategies for small biofuels start-ups"; support to "utilities that generate power and heat from biomass to understand the impact of new regulation on strategy, market dynamics, and the capital costs associated with different technologies");
- Sustainable Cities – "work with mayors, urban planners, foundations, non-profits, utilities, and businesses to help create sustainable cities" including with the design of sustainability measures delivering multiple benefits (in transport logistics, for example, increase traffic speeds and reduce greenhouse gas emissions);
- Sustainable Enterprise – development of sustainability strategies (including CO_2 emissions reductions) and "support in pursuing green growth through portfolio investment decisions, green products and technologies, and opportunities in new markets and segments";
- Tools - development of "special-purpose diagnostic tools like:
  - the US low carbon economics tool, a suite of models designed to estimate the economic implications of energy and climate policies for the United States;
  - the Climate Desk, a simulation platform and expert service to support strategic, investment, and policy decisions on climate change. It builds on McKinsey's proprietary **greenhouse gas**

(GHG) abatement cost curve model to deliver insights on the **impact and costs of emissions reduction measures across sectors, regions, and technologies**. This tool is offered as a subscription service and consists of a web-enabled simulation model complemented by a comprehensive service package including:

- full access to the Climate Desk simulation platform, start-up training, and technical support;
- Web-enabled access to the climate economics simulation model with interactive input ability and comprehensive ready-to-use outputs;
- comprehensive model support material including a methodology and assumptions guide and a technical manual;
- access to an extensive expert and knowledge network via participation in McKinsey's annual climate conference;
- privileged access to McKinsey's climate-related knowledge documents;
- on-demand, fee-based expert services tailored to the specific needs of each client".

Ancillary products and services

- Insights & Publications - McKinsey's business journal (*McKinsey Quarterly)*, reports from McKinsey's business and economics research arm and the collection titled *What Matters.*

Staff

Staff background include MDs, PhDs, MAs and JDs as we do MBAs; staff roles include: "Consulting Roles (Generalist and practice consulting roles and Subject matter expert consultants) across a range of industries and functions and Non-consulting Roles (Knowledge and research roles and Support roles such as: administration, information technology, professional development, and others)".

3.8 Deloitte

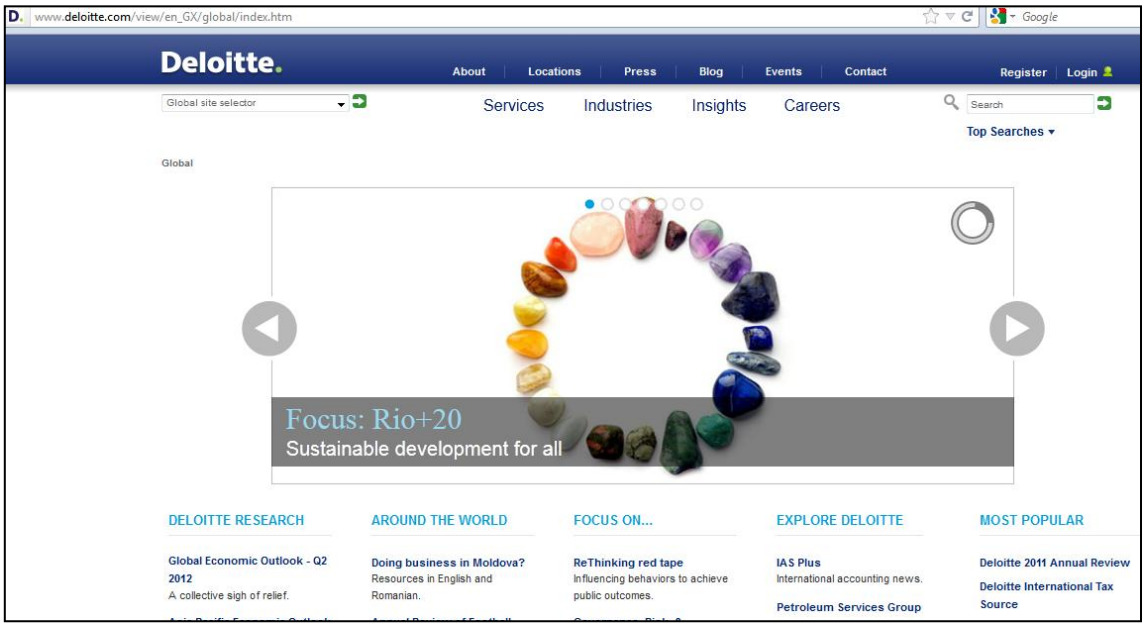

Figure 3.7 Deloitte home page

Mission

"Deloitte is the brand under which tens of thousands of dedicated professionals in independent firms throughout the world collaborate to provide audit, consulting, financial advisory, risk management, and tax services to selected clients. These firms are members of Deloitte Touche Tohmatsu Limited (DTTL), a UK private company limited by guarantee. Each member firm provides services in a particular geographic area"; ("DTTL does not itself provide services to clients. DTTL and each DTTL member firm are separate and distinct legal entities").

Main products and services

Among its wide range of services encompassing "almost every aspect of business today, from corporate responsibility and sustainability to advanced analytics" in a variety of industry sectors, Deloitte provides "assistance in developing and executing effective strategies on sustainability and climate change" including the following issues:

- cleantech – assisting Cleantech companies (solar, hydropower, geothermal, wind, smart grid, materials, transport, biomass, agriculture, energy efficiency, energy storage, CO_2 reduction, emerging technology, water treatment, biofuels and green chemistry) "innovate toward a more sustainable future at every stage of development (from fundraising and going to market to IPO services to tax optimization to operational advisory)"; more info at: Cleantech at Deloitte;
- energy and resources management – "helping organizations optimize their use of energy, water, carbon, and other key resources, while efficiently meeting reporting requirements"; service offerings include:
    - "alternative and renewable energy;
    - energy accounting, finance, tax, and risk;
    - enterprise carbon and energy management;

    - water management";
- information technology for sustainability - helping "plan, design, build, and deploy IT to support planning, monitoring, reporting, analysis, and decision making"; service offerings include:
    - "Green IT (data center efficiency, tax incentives);
    - climate change and sustainability software implementation;
    - automation of sustainability reporting";
- sustainability and climate change strategy - helping "companies create roadmaps to compete effectively in this new world of sustainable business practices"; service offerings include:
    - "climate change and sustainability strategy;
    - energy strategy;
    - Carbon management strategy;
    - reporting strategy;
    - Green IT strategy";
- sustainability governance and risk intelligence - assisting "organizations in hammering out sustainability strategies that appropriately recognize and deal with these new dimensions of risk"; service offerings include "Carbon management governance";
- sustainable operations and supply chain – helping "ensure the sustainability of operations throughout the product lifecycle by helping companies address such diverse issues as supplier codes of conduct, e-waste, and lifecycle labelling"; service offerings include "energy efficiency of manufacturing and green warehousing";
- sustainability reporting, assurance, and compliance - helping "organizations both comply with regulators' demands and report compellingly to key audiences on the results of their sustainability initiatives"; service offerings include "climate change and sustainability reporting, assurance and verification".

Deloitte stands outs especially for supporting large companies "on how to **exploit new climate and energy regulations** for financial advantage", thanks to "their expertise in tax, regulations and financial management[33].

Ancillary products and services

- Research and Insights directly within each thematic section;
- insights (browsable by industry and service)
    - focus on the issues;
    - Deloitte Research;
    - Deloitte Review;
    - books;
    - email Alerts;

[33] Source: Verdantix (2009) "*Verdantix: Climate Change Consultants In The US Face A Make Or Break Year*".

    - podcasts;
    - tools;
    - video library.
- Press room
    - analyst Relations;
    - as One Press Room;
    - CEO Communications;
    - facts & Figures;
    - highlights Archive;
    - innovation;
    - media Contacts;
    - press Releases;
    - RSS News Feeds;
    - global blog
    - global podcasts
    - social media.

Staff

N.A. (The Sustainability and Climate change global leader profile includes: “bachelor’s degree in business administration; “certified public accountant in the United States”; “member of the Institute of Chartered Accountants of British Columbia and the Canadian Institute of Chartered Accountants”).

3.9 PwC

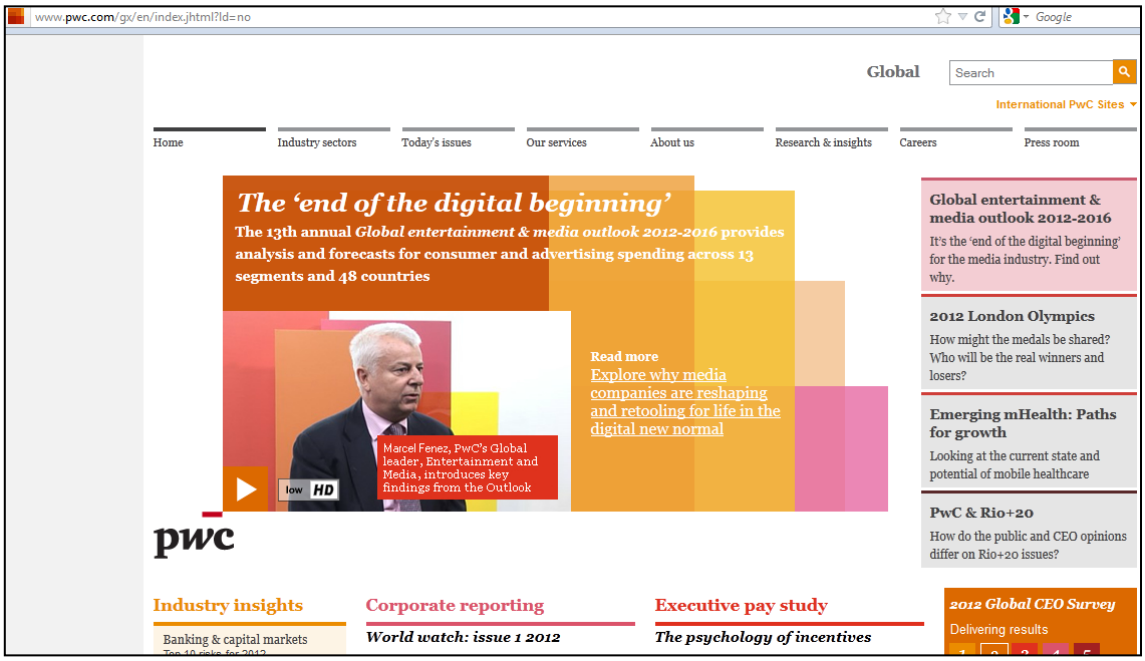

Figure 3.8 PwC home page

Mission

PricewaterhouseCoopers (PwC) is a network of firms in 158 countries with about 169000 people who "deliver quality in assurance, tax and advisory services". ("Member firms of PricewaterhouseCoopers International Limited (PwCIL) are separate legal entity and does not act as agent of PwCIL. PwCIL does not provide any services to clients").

Main products and services

PwC offers a wide range of services ("Audit and assurance, Consulting, Deals, Human resources, Legal, Middle market and private companies, Tax") encompassing almost all the industry sectors. Concerning climate related issues, PwC stands outs especially for supporting large companies "on how to **exploit new climate and energy regulations** for financial advantage", thanks to "their expertise in tax, regulations and financial management[34], such as in **carbon management, energy efficiency and renewable energy**. In particular PwC provides the following services on "sustainability and climate change":

- strategic sustainability - identify and prioritise clients' issues and goals, likely pressures risks and gaps, and "develop and deliver a robust sustainability programme that includes prioritised initiatives, enablers, milestones, key performance indicators, and measurable targets".
    - Examples/case studies – "development of a comprehensive **CSR and climate change strategy for** a Danish shipping and cargo company; qualification for key sustainability benchmarks such as the Dow Jones Sustainability Index, FTSE4GOOD, and the Climate Disclosure Leadership Index for an international oil and gas company based in Italy"; "a 100% renewable electricity vision and roadmap for Europe and North Africa by 2050";

[34] Source: Verdantix (2009) "*Verdantix: Climate Change Consultants In The US Face A Make Or Break Year*".

- assurance & reporting
    - "provide independent assurance of the data in customers' sustainability report as well as assurance for regulatory performance purposes, such as **EU ETS**, RTFO, **GHG emissions**;
    - support clients submissions to sustainability indices by helping to interpret the questionnaire before submission; identify any gaps to improve your position in the rankings;
    - review clients' current reporting against best practices, identify operational improvements and move it beyond compliance to include future-looking analysis and strategy;
    - verify and certify clients data against social and environmental benchmarks in line with market standards like the Global Reporting Initiative (GRI), **Gas House Gases (GHG) Protocol**, AA1000".
    - Examples/case studies - "independent assurance over a selection of sustainability disclosures, including **GHG emissions**, safety and health, water and communities for a global mining company";
- governance, risk & compliance – "manage risk and regulatory compliance to understand their impact on a company's strategy and operations; examine all sustainable development legal requirements, company policies, and industry/voluntary codes to assess compliance levels, improvement options";
- supply chain & operations – "monitor and manage environmental, social and governance risks associated with clients' supply chain; measure the financial cost or **potential impact of carbon**, water and other usage **on the environment**, and local communities; redesign global supply chains to be cost-efficient, minimising their impact on the environment and delivering products and services on time";
- policy & economics – "**support companies addressing climate change through the low carbon agenda bringing new opportunities for both the public and private sectors**; address green growth, green jobs and green stimulus packages to turn climate change and environmental threats into sustainable advantage"; services include:
    - "**help organisations (public and private sector) become 'climate smart'**; that means taking full advantage of cost saving opportunities and making sure that business models are resilient to change: climate change, economic change or regulatory change;
    - **manage organizations' low carbon and climate change goals** by analysing their carbon/environmental footprint as well as undertaking valuations and due diligence;
    - meet compliance obligations through solid energy reporting, transfer pricing for financing structures and assuring carbon-related data;
    - quantify the environmental and social benefits and costs of organisations' current operations and practices;
    - perform robust and transparent **economic modelling to develop and implement sustainable green growth strategies** that consider social and environmental impacts;
    - interpret the impact on customers' proposed or ongoing **low carbon business opportunities** of ongoing policy announcements".
    - Examples/case studies – "Carbon Disclosure Project: how are the world' s largest companies responding to climate change";
- sustainability and climate change tax & the regulatory environment

- "assess customers' current global exposure to environmental taxes and regulations; help managing risks and optimising tax position from a sustainability perspective;
- understand customers' sustainability compliance obligations and take advantage of subsidies, grants, taxes and other incentives; **develop strategies that optimise the impacts of carbon, climate change and resource scarcity on customers' tax position**; prepare for future policy developments";

Ancillary products and services

- Global Green Policy Insights - Up-to-date news alerts on green tax and regulation;
- PwC @ Rio+20;
- Research & insights (searchable by issue, industry, service, region) – "PwC's research and insights take a comprehensive look at the environmental, social and governance issues impacting companies, and how sound sustainability initiatives can strengthen customer relationships while driving growth".

Staff

Executive team leaders cover the following fields of expertise: clients and markets, transformation, operations, assurance, risk and quality, advisory, technology, people, tax, strategy, corporate and international taxation, corporate restructurings, corporate trading models, mergers and acquisitions, marketing, communication and business development.

Background include: BS in accounting, joint degree in economics & politics; degree in business management, degree in engineering science and economics, studies on nuclear and chemical plant operations, Master's degree in business administration, Bachelor's of Arts degree in economics, Master's degree in business management, undergraduate degree in mechanical engineering, Master's degree in business administration, Bachelor's of arts degree in history and political science, law and doctorate in law, B.S. economics, finance, B.S. applied science, computer engineering, undergraduate degree in political science and economics, Masters in public administration, juris Doctor' degree.

3.10 World Climate Service

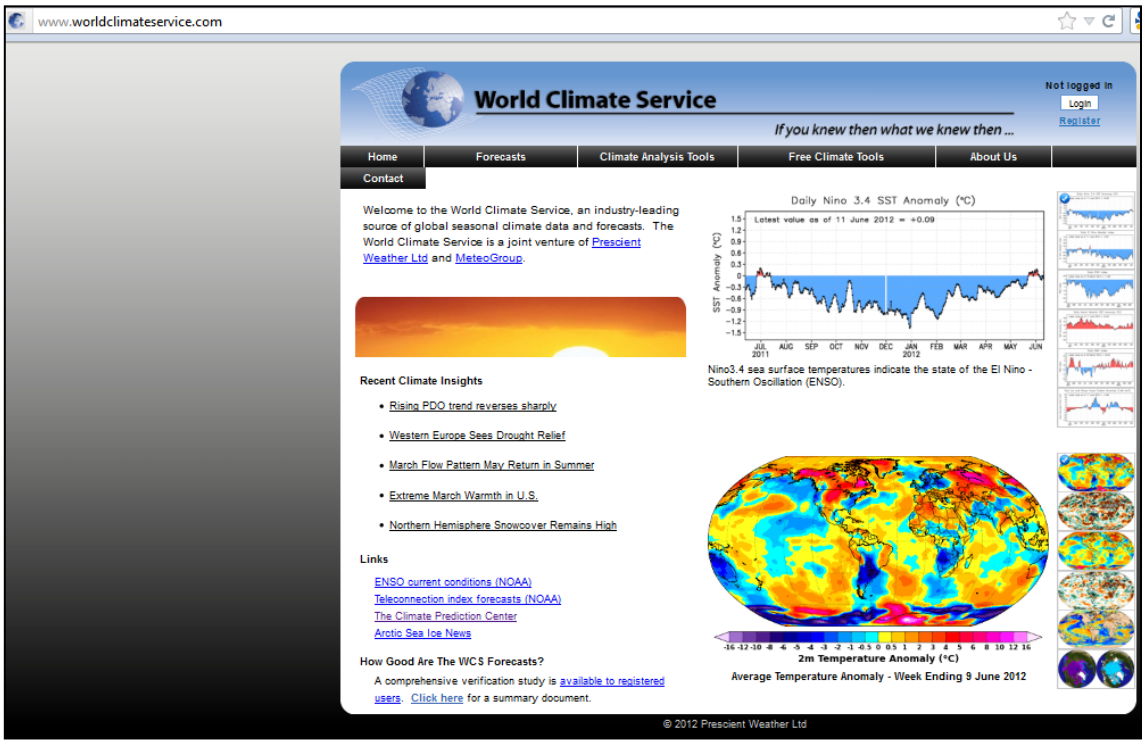

Figure 3.9 World Climate Service home page

Mission

The World Climate Service is "an industry-leading source of global seasonal climate data and forecasts" by a joint venture of Prescient Weather Ltd and MeteoGroup:

- **Prescient Weather Ltd** "provides **information and strategies to manage weather and climate risk and to exploit related opportunities in today's global economy**. The latest scientific understanding, data sets, and advanced technology are combined to create weather and climate products that confer advantage to industries and activities sensitive to atmospheric events and trends";
- **MeteoGroup** is "Europe's largest private sector **weather company** with a worldwide customer base and operations in eight European countries and the USA. It is a full-service weather business providing tailored products to a wide range of professional markets from the shipping industry to energy traders and construction companies to highway operators".

Main products and services[35]

Products provided on World climate services include:

- **Seasonal forecasts – "**monthly detailed document containing climate diagnostics and forecasts of seasonal climate anomalies with a particular emphasis on the outlook for the next three months in North America and Europe" (for subscribers only)
    - WCS Forecast for JAS;

[35] Further information for subscribers only.

    - interactive mapping - interactive view of "the latest monthly forecasts of the ECMWF model and the U.S. CFS model; temperature and precipitation maps can be generated for user-selected regions, and the latest forecasts can be compared with those of previous months. Anomaly and probability forecasts are available, as well as verification data for past months;
    - NAO Ensemble forecasts;
    - historical NAO forecasts;
    - forecast documents;
    - forecast verification;
- **Climate Analysis Tools** – "a suite of on-line tools developed for the evaluation of the state of seasonal climate, to investigate the impacts of climate indices such as the Pacific Decadal Oscillation and the Arctic Oscillation; a separate page displays the likelihood of persistence of temperature and precipitation anomalies around the globe" (for subscribers only)
    - climate indices;
    - climate index analogs;
    - U.S. climate index analogs;
    - persistence climatology;
- **Free Climate Tools**
    - (Global) daily-updated sea surface temperature maps;
    - Pacific subsurface temperature charts;
    - daily-updated global thickness animations.
- High-resolution numerical modelling – "among the models used by Prescient Weather are the Weather Research and Forecasting Model, the Cloud Resolving Model of George Bryan (CM1), and MM5".

Other relevant products (by Prescient Weather Ltd) include:

- crop yield and production forecasts – "innovative forecast systems for anticipating yield and production of U.S. crops using proven statistical techniques";
- energy – examples include: "monthly accumulating cooling degree-day probabilities for Washington D.C. computed from daily temperature maxima and minima from the CFSv2 ensemble forecasts" and "CFSv2 monthly CDD probability forecast from an ensemble of 40 forecasts";
- wildfire risk - fire risk forecasts and fire weather modelling;
- high-resolution weather modelling – "high-resolution weather simulations for both research and forecast purposes" (sub 1-km resolution forecasts, severe weather risk assessment, global forecast coverage);
- retail climate insights – "forecasts of year-over-year change according to the retail week calendar, with proven reliability to one year in the future" (because weather risk exposure is governed principally by the year-over-year change in climate variables.

Ancillary products and services

- Recent climate insights;
- links;

- how Good Are The WCS Forecasts? – a verification study.

Staff

Background of the management team include: Ph.D in atmospheric science and academic administration; B.S, M.S. and Ph.D. degrees in meteorology; B.A. degree in natural sciences; M.S. and Ph.D. degrees related to meteorology and finance.

3.11 ENERGY DESIGN TOOLS by UCLA Department of Architecture and Urban Design

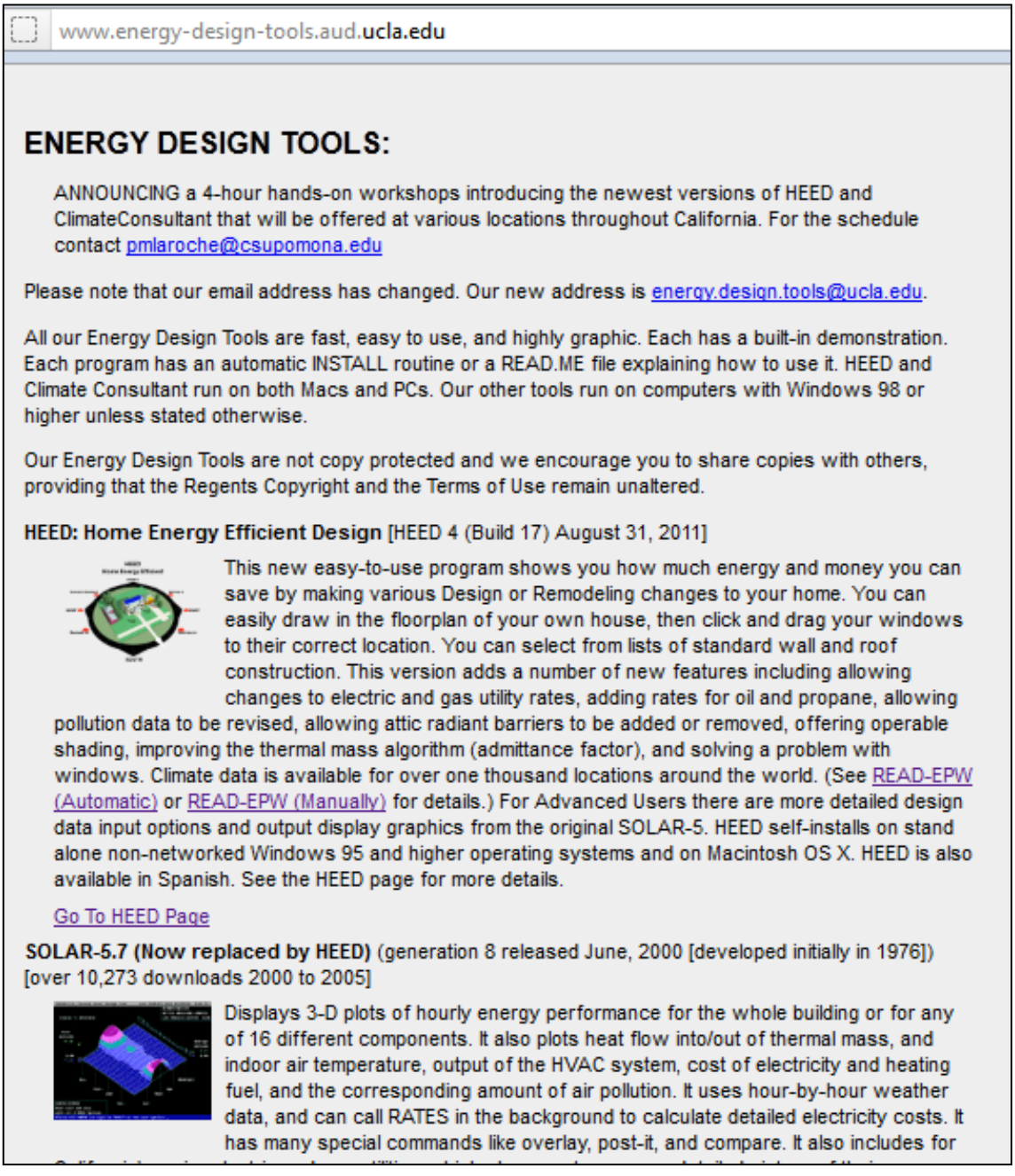

Figure 3.10 UCLA ENERGY DESIGN TOOLS page

Mission

The University of California (UCLA) Department of Architecture and Urban Design (Los Angeles, California) provides citizens (builders, homeowners, architects and students of architecture) free, fast, easy to use, and highly graphic **Energy Design Tools**.

Each tool is intended to be self instructional and has a built-in demonstration and each program has an automatic INSTALL routine or a READ.ME file explaining how to use it. They are not copy protected and are welcome to be shared (providing that the Regents Copyright and the Terms of Use remain unaltered).

Main products and services

- **HEED: Home Energy Efficient Design** - "free, easy-to-use, graphic-based computer program showing you **how much energy and money you can save by making various Design or Remodeling changes to your home.** You can easily draw in the floorplan of your own house, then click and drag your windows to their correct location. You can select from lists of standard wall and roof construction. This version adds a number of new features including allowing changes to electric and gas utility rates, adding rates for oil and propane, allowing pollution data to be revised, allowing attic radiant barriers to be added or removed, offering operable shading, improving the thermal mass algorithm (admittance factor), and solving a problem with windows".
- **Climate Consultant** - "free, easy-to-use, graphic-based computer program that **displays climate data in dozens of ways useful to architects, builders, contractors, and homeowners, including temperatures, humidity, wind velocity, sky cover, and solar radiation** in both 2-D and 3-D graphics for every hour of the year" to understand the unique attributes of the **local climate and how it impacts building's energy consumption**; features include: Comfort Models; Sun Shading plot (allowing the user to click and drag shading masks for fins and overhangs); shading overlays for distant objects (trees, buildings) or nearby objects (chimneys); calculation and display of the number of unshaded hours when shading is needed, when solar gain is needed, and when solar gain is not useful, as modified by the shading of remote objects, fins and overhangs; plot of radiation on a tilted surface (such as a solar collector) on a Radiation Range Chart; display on the Psychrometric Chart the daily evolution of temperature and humidity). Climate data are available for all of California's 16 climate zones.
- **Climate Data** for HEED and Climate Consultant is available for over one thousand locations around the world on the EnergyPlus web site.
- Solar-2 – a tool plotting "sunlight penetrating through a window with any combination of rectangular fins and overhangs", and also "hour-by-hour 3-D suns-eye view movie of the building"; it "prints annual tables of percent of window in full sun, radiation on glass, etc".
- Opaque – a tool to "draw a detail of wall or roof sections, calculate U-value, Time Lag, and Decrement Factor. It plots temperature drop through the section. Draws 2-D daily and 3-D annual plots of Outdoor and Sol-Air Temperatures, Normal and Total Surface Radiation, and Heat Flow through the envelope".

It is worth mentioning that these tools are included within the Building Energy Software Tools Directory of the **US Department of Energy (DOE)** – Energy efficiency and Renewable Energy (EERE) - Building Technologies Program, collecting **406 building software tools for evaluating energy efficiency, renewable energy, and sustainability in buildings**. The energy tools listed in this directory include databases, spreadsheets, component and systems analyses, and whole-building energy performance simulation programs. (A short description is provided for each tool along with other information including expertise

required, users, audience, input, output, computer platforms, programming language, strengths, weaknesses, technical contact, and availability).

Ancillary products and services

- Psychrometric Chart Tutorial – "a dynamic graphic and audio presentation that shows the relationship between air temperature and humidity, and how this influences human thermal comfort";
- A Course in CLIMATE RESPONSIVE BUILDING DESIGN – "class materials for a college level architectural course in Building Climatology that use the various Energy Design Tools; it also contains ten "Problem Sets" that taken together give the student the experience of using these computer programs to design a small energy efficient building in any climate";
- ENERGY DESIGN TOOLS USERS MANUALS BIBLIOGRAPHY;
- TECHNICAL PAPERS BIBLIOGRAPHY;
- THESES.

Staff

The staff is the one of the Energy Design Tools Group at the UCLA Department of Architecture and Urban Design (lead by Professor Murray Milne).

3.12 Climate Consulting Ltd

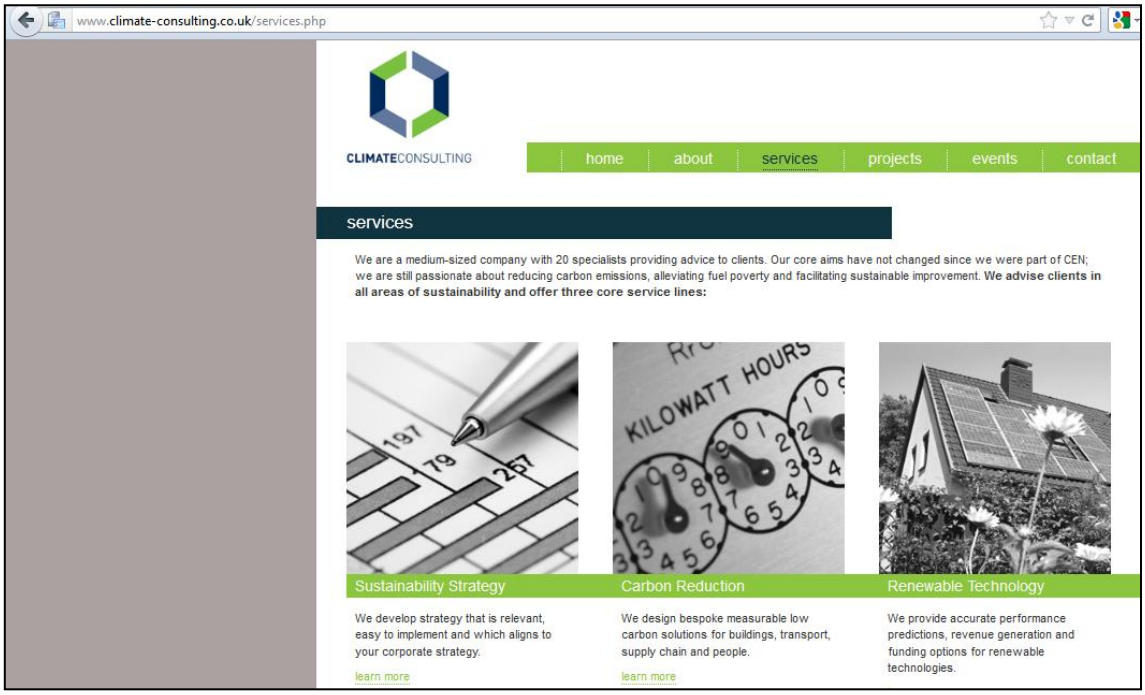

Figure 3.11 Climate Consulting Ltd home page

Mission

Climate Consulting Ltd (part of the Climate Energy Group) based in Witham (UK) is a medium-sized company with 20 specialists providing advice to public sector and commercial organisations about reducing carbon emissions, alleviating fuel poverty and facilitating sustainability.

Main products and services

Advise to clients in all areas of sustainability along three "core service lines":

- **sustainability strategy** – "development of strategy that is relevant, easy to implement and which aligns to customer' corporate strategy (review an existing strategy which involves monitoring utility usage and analysing bills; identification of areas of improvement and design a tailored action plan which increases efficiencies in terms of reducing carbon and saving money; develop a sustainability strategy from scratch, starting from an audit to assess a client's performance, looking at water, waste, energy, carbon, travel plans, supply chain and people to the provision of recommendations about what measures to adopt which will improve efficiency in terms of reducing carbon emissions and utility bills). Other services offered in this category include: Sustainability policy and process; sustainable training and development; developing strategy for social housing and communities; schools strategy; merging sustainability departments; energy strategy; sustainable travel plans; energy resource planning and management; climate change strategy; climate change mitigation advice; climate change adaptation; Corporate Social Responsibility; environmental accreditation; master planning".
- **Carbon reduction** – "design of tailored measurable low carbon solutions for buildings, transport, supply chain and people and construction related services (Code assessment; Stock assessment; Sustainable design and construction; Energy options appraisal; SAP assessment; SBEM assessment; Energy performance assessment; BREEAM assessment; Environmental Management Systems(EMS); Community workshops; Resource efficiency; Waste management; Water efficiency; Education programmes for schools, communities and companies)".
- **Renewable technology** – "provision of accurate performance predictions, revenue generation and funding options for renewable technologies; support to all stages of the renewable energy decision making and investment strategy from initial feasibility, resources measurement, business and technical risks assessments, planning advice through to implementation and commissioning (complete installation programme with tendering and funding options available; advise on applications to built assets and developments, as strategic investments and on Feed In Tariffs (FiT) and Renewable Heat Incentives (RHI) as well as on the forthcoming Green Deal). In addition: Renewable energy options appraisal; Energy monitoring; System monitoring and management; Small scale wind; Biomass heating; Grant management; Funding options; Installation procurement and management; Installation operation management".

The website only lists the offered services, but does not show them; some case studies are presented.

Ancillary products and services

N/A.

Staff

Expertise covered by the Climate Consulting Ltd team include the following fields: strategic planning and operation management in the energy sector; public relations; professional services marketing across industry

sectors; sustainable planning and policy, sustainable transport and energy efficiency and renewable retrofit; low carbon technology solutions for local authorities, educational institutions and housing providers; legislation compliance, resource efficiency auditing, carbon foot-printing; environmental management systems, sustainability reporting and employee engagement, behaviour change and training; environmental support to the planning and policy departments of local authorities; consultancy to housing providers; Environmental Health, Engineering Management and Waste Management; qualitative and quantitative research, statistical analysis; business strategy development and coordination.

Beside in field experience the background education of experts include: Degree level in Mechanical Engineering (Hons), Physics Masters degree on solar photovoltaic technology and market development; Professional Trainer's Certificate from the CIEH and CIWM for the Environmental Principals and Best Practice Course and the Waste Awareness Certificate; BBA Management; BSc and MSc.

3.13 SQ Consult

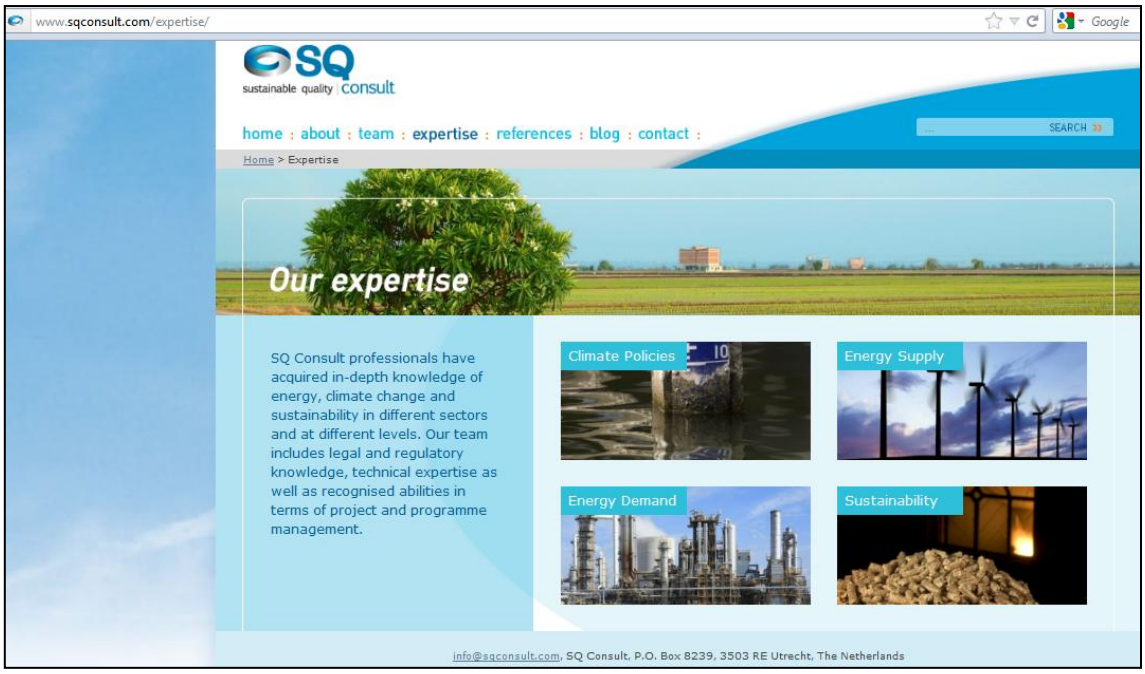

Figure 3.12 SQ Consult homepage

Mission

SQ Consult (based in Utrecht, The Netherlands) is an international consultancy fully dedicated to supporting both public and private clients in meeting the challenges of climate change, sustainability and energy transition. SQ Consult supports policy makers and provides market players with strategic advice, regulatory support and project management.

Main products and services

SQ Consult services range from strategic advice to techno-economic analysis, from capacity building to market analysis, and from policy design to project management in the areas of: climate policies/strategies, energy supply (renewable energy), energy demand (energy efficiency) and sustainability.

- **Climate policies/strategies**
    - designing and evaluating climate policy and strategy to maximize efficiency and effectiveness;
    - carbon strategy design and optimization of activities across the carbon value chain;
    - implementation of response strategies and capacity building within the organization;
    - project and process management;
    - market assessments for optimal market positioning.
    - Expertise areas include: **emissions trading systems, carbon market analysis, JI and CDM project advisory, carbon finance, and Corporate Sustainability Reporting (CSR)**.
    - Examples of activities - Climate **job orders** (development of climate change policies for public bodies, support to NGOs in identifying technological opportunities for deeper greenhouse gas reductions, support to international corporate clients in the formulation and implementation of their carbon response strategies):
        - Framework contract Climate Policy European Commission - **DG Clima;**
        - Support to 3rd periodic verification: biogas CDM project – JAREMAR;
        - Evaluation of the NIMS (National Implementation Measures) European Commission - **DG Clima;**
        - Evaluation of industrial energy efficiency and GHG policy - Institute for Industrial Productivity;
        - Sectoral approaches in China through lessons learned from EU ETS - UK Foreign & Commonwealth Office;
        - Supporting negotiations: 2nd generation Climate Savers Partnership - **WWF European Policy Office;**
        - Greenhouse gas policy built environment - Bouwfonds REIM;
        - NER 300 Application - Air Liquide;
        - EU-UNDP Climate change programme – **UNDP;**
        - Validation & registration of a CDM project for biogas recovery (Honduras) – **UNDP.**
- **Energy supply (renewable energy)**
    - Advise to public customers either in the design phase of their policy-plans (provinces, municipalities) or during the evaluation (European Commission, Evaluation of the Energy Services Directive);
    - support to the private sector with portfolio analysis and risk diagnosis, provision of market and technology benchmarks. They also provide benchmarks across different regions for investors looking to expand their business presence;
    - Expertise areas include: **renewable and clean fossil** (technical knowledge and accurate assessment of technologies' degree of maturity, economic modelling for the realisation of scenarios and price curves, legal and regulatory expertise to not only analyse regulatory frameworks and policies but also anticipate on changes).
    - Examples of activities - energy supply **job orders.**

- **Energy demand (energy efficiency)**
    - Support to public clients in shaping or improving the policy landscape in energy saving, energy efficiency and rationalisation of energy use (from the basis of understanding the actual implications of these policies at the level of individual businesses or people);
    - support to industrial clients to effectively plan, develop and implement programs and policies as well as measure, evaluate and assess options for enhancements and improvements;
    - Program planning;
    - Project management;
    - market strategies and analysis;
    - energy demand monitoring;
    - benchmarking;
    - design of new energy services;
    - business case development.
    - Expertise areas include: **gas storage** and **electricity storage**.
    - Examples of activities - energy demand **job orders**:
        - Review of ESD and CHP Directive - European Commission, DG Energy;
        - Energy Efficiency & Renewable Energy Legislation (Kazakhstan) - Agentschap NL;
        - Evaluation Electricity and Gas Act - North-West European utility;
        - Energy efficiency and proposed bill on energy self-supply - North-West European Utility.
- **Sustainability**
    - Corporate Sustainability Report (CSR), ranging from organising a stakeholder consultation to taking on full responsibility for the report;
    - support to companies in setting up sustainable purchasing processes and addressing their need to monitor the entire product/value chain;
    - support to Government agencies in setting up national sustainability criteria for biofuels.
    - Expertise areas include: **biomass and biofuels sustainability**.
    - Examples of sustainability **job orders:**
        - Factsheets bioenergy countries and crops - Agentschap NL;
        - Sustainable heat map Dutch industry - Agentschap NL;
        - Greenhouse gas savings determination of planned bioethanol plant - International bioethanol developer and operator;
        - Certification systems of bioenergy: a thorough comparison - Agentschap NL;
        - GBEP biofuels indicators for the Netherlands - Agentschap NL;
        - Level of assurance, costs and benefits of certification systems for bio-energy - Agentschap NL;

- Sustainability policies impacting biofuels trading in the EU - ED&F MAN;
- Technical assistance: biomass sustainability assessments - Agentschap NL;
- Implementation of sustainability criteria for biofuels (Spain) - Comisión Nacional de la Energía – España;
- Corporate Sustainability Report (CSR) reporting - n.v. Nuon Energy;
- Reviewing sustainability systems - Agentschap NL.

Ancillary products and services

Blog/news on the latest facts about: climate policies, energy supply, energy demand, sustainability.

Staff

Experts with a solid track record in energy transition, climate policies and strategies, and sustainability, as well as legal and regulatory knowledge, with technical expertise and recognised abilities in terms of project and programme management. SQ Consult work as an international team, with local project managers.

3.14 ThinkClimate consulting

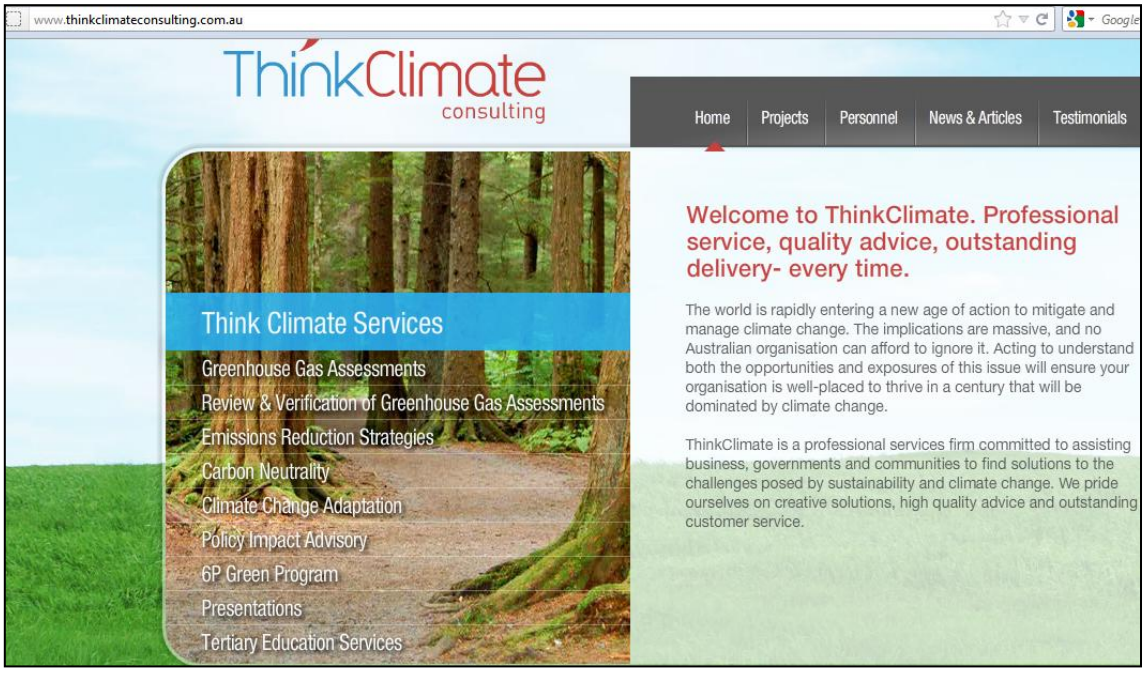

Figure 3.13 ThinkClimate home page

Mission

ThinkClimate consulting (based in Australia) is a professional services firm committed to assisting business, governments and communities to find solutions to the challenges posed by climate change.

Main products and services

- **Climate policies/strategies**
    - **GHGs Assessments**: assessment of GHG emissions for organizations and projects based on Australian endorsed reporting standards and protocols;
    - **review and verification of GHGs Assessments**: independent review and verification of GHGs Assessments undertaken for voluntary or mandatory reporting;
    - **emission reduction strategies**: tailored emission reduction strategies for organizations to manage their carbon footprint;
    - **carbon neutrality:** assistance to clients in understanding and negotiate the pathways to carbon neutrality, with ongoing efforts to reduce GHG emissions before undertaking offsets;
    - **climate change adaptation:** support in identifying potential climate change impacts, risks and exposures and plan an adaptation strategy to cope with them and develop opportunities;
    - **policy impact advisory:** tailored analysis and advice on potential policy impacts for business and government organizations;
    - **6P Green Programme:** tailored Environmental Management System in 6 steps for all sizes organizations, including workshops, carbon footprint estimate, carbon management software, energy assessment at organization's premises;
    - **presentations:** tailored presentations on climate change and sustainability for an event or a group;
    - **tertiary education service**: guest lecturers, short term contract lecturing or casual tutoring.

Examples of projects/job orders are listed at the "Projects" page.

Ancillary products and services

News and articles.

Staff

Info are reported only about the Director: Master in Corporate Environmental and Sustainability Management plus 8 year experience in consulting on climate change and sustainability, stakeholder management and workplace safety in major Australian consulting firms.

3.15 WSP Group - Climate change consultancy

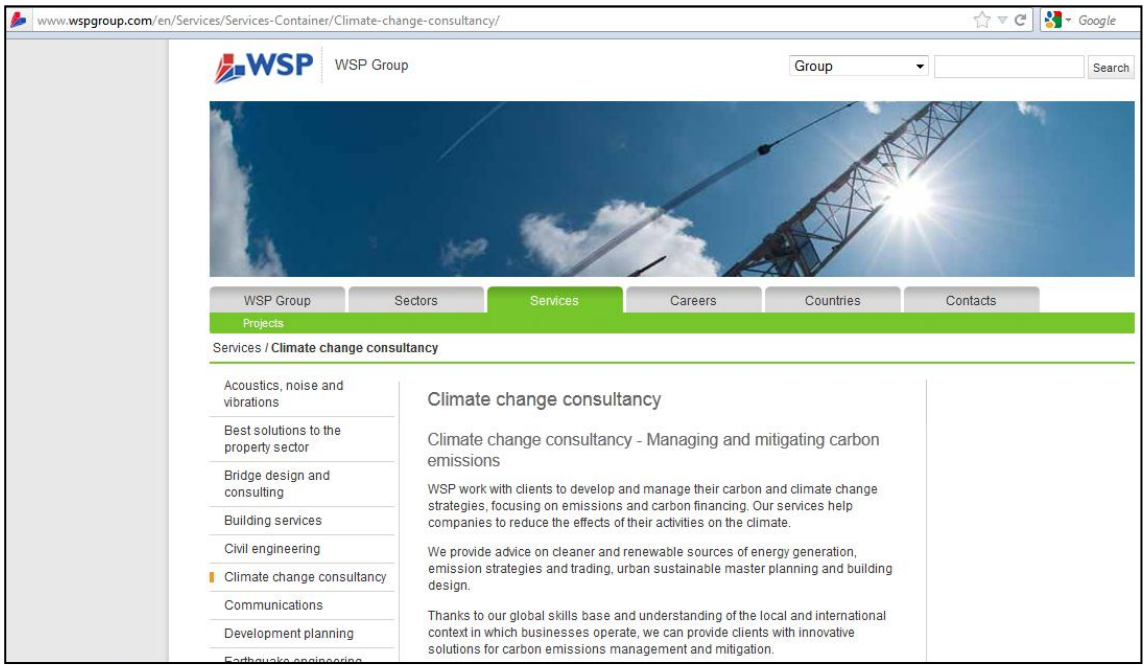

Figure 3.14 WSP Group - Climate change consultancy home page

Mission

Founded in 1995 the WSP Group is now a "global design engineering and management consultancy with 9000 people operating from 200 locations" and "one of the top global environmental and sustainability consultancies", working on "clients' sustainability, environmental, energy and health & safety issues", addressing "their risks, reducing their costs and creating commercial opportunities and competitive strength".

WSP Group provides advice on "all aspects of environmental, energy, sustainability, climate change, and business risk issues. Its diverse offer ranges from acoustical design to corporate foot-printing, and from land remediation to renewable energy strategies".

The **targeted clients** are businesses of all shapes and sizes (e.g. "regional businesses or public and government bodies, through to major multi-national organisations") that want to respond to and prepare for climate change.

Main products and services

Climate change consultancy provided by WSP Group include services related to **managing and mitigating carbon emissions**, including:

- development and management of clients' carbon and climate change strategies, with a focus on GHG emissions and carbon finance to reduce their carbon footprint and the impacts of their activities on the climate;
- advice on "cleaner and renewable sources of energy generation, emission strategies and trading, urban sustainable master planning and building design";
- "innovative solutions for carbon emissions management and mitigation";
- support to either owners and participants in Kyoto Protocol **Clean Development Mechanisms (CDM) projects and Joint Implementation (JI) initiatives**, based on broad project experience in

delivering JI projects and emissions trading worldwide (their "projects include renewable energy installations, green or low-energy building design, greenhouse gas destruction in industrial plants and power generation projects switching to a cleaner-burning fuel mix").

Climate related services are classified in the following 6 categories:

- **Greenhouse Gas Inventories & Reporting**
    - support to the US Environmental Protection Agency (EPA)'s *Climate Leaders Program*, a private-public partnership developing comprehensive companies' climate change strategies; WSP supports over 80 companies in developing GHGs inventories and Inventory Management Plans and in completing their reporting requirements;
    - combining a proper methodology with some on-line technology to produce user-friendly Carbon Calculators;
    - design of a GHG methodology for "abandoned, closed, decommissioned and inactive coal mines, enabling owners to earn revenue from the sale of credits" which has been "validated by the Voluntary Carbon Standard (VCS) Program";
- **Lifecycle Assessments (LCA) & Footprinting**
    - white paper assessing product carbon foot-printing, based on life cycle assessment (LCA);
    - testing new standards under the GHG Protocol Initiative;
    - Mars LCA case study (on assessing how much energy it takes to make a cup of coffee);
- **Climate Change Planning & Mitigation** - including the development of appropriate responses and their communication to clients' stakeholders;
- **Low Carbon Product Design**
    - "from those in technology to furnishings, and from food and drink to textiles" (more information: track record);
    - an "online tool (called Ecofly) to help producers of electronic products implement more eco-friendly designs";
    - using Carbon Calculators;
- **Trading, Offsetting & Regulations**
    - Emissions Trading and Offsetting concerning "the major international and domestic emission trading and offsetting schemes, and climate change regulations (e.g. EU ETS, California Global Warming Solutions Act, Australian National Greenhouse & Energy Reporting Act, international Carbon Disclosure Project);
    - regulatory Compliance (e.g. "Compliance audits, Regulatory impact assessments, Management systems, Management programmes, Online compliance databases, Staff training, Regulator liaison");
- **Low Carbon Building Design** - to "reduce environmental impacts without limiting the choices, quality or economics of the design" including:
    - for "designers, architects, developers and investors focussing more on low carbon buildings and portfolios";
    - "Masdar in Abu Dhabi, the world's first zero carbon city";

- “the carbon neutral Graylingwell scheme (that includes the UK's largest domestic PV installation”.

Ancillary products and services

- Case Studies by theme (Future Energy, Energy efficiency in buildings, Green urban development, Property new build, Property refurbishment, Industry; Land remediation);
- Corporate Services related to sustainability;
- Press centre (Quick facts; News archive, Publications; Press office contacts; Imagery and logos)

Staff

Experts in all the areas related to climate change and carbon management, including Certified GHG Inventory Quantifiers, and the wider environmental and energy issues.

The whole staff expertise “ranges from devising strategies for greenhouse gas emissions management to land remediation and site regulatory closure; from M&A due diligence to acoustic design; and from life cycle assessments of products and supply chain management to designing energy, waste and water infrastructures. We employ scientists, toxicologists, ecologists, corporate strategists, occupational therapists, risk managers, financiers, architects, and project managers amongst others”.

3.16 ATKINS - Climate change consultancy

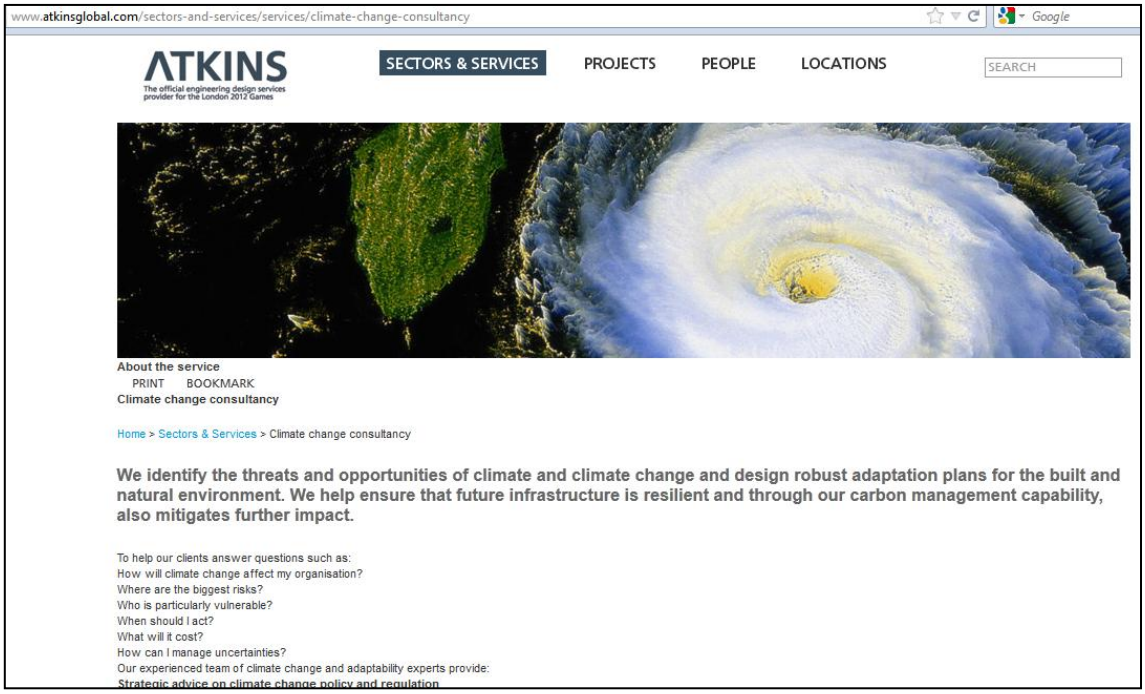

Figure 3.15 ATKINS - Climate change consultancy home page

Mission

Established in 1938 ATKINS[36] is a major world engineering and design consultancy for big infrastructure projects "encompassing buildings, transport and utilities (including energy and water) as well as for national and local governments and other industrial clients", with offices in the UK and around the world and 17700 employees worldwide.

Concerning climate change consultancy, ATKINS' mission is to "identify the threats and opportunities of climate and climate change and design robust adaptation plans for the built and natural environment. They help ensure that future infrastructure is resilient and through their carbon management capability, also mitigates further impact".

Main products and services

Climate change consultancy provided by ATKINS include products and services related to: **Strategic advice on climate change policy and regulation, Climate change risk assessment, Adaptation advice; Climate change tools, Mitigation advice**.

- **Strategic advice on climate change policy and regulation**
    - development of "socio-economic scenarios alongside climate change scenarios to help government bodies and private sector organisations understand the true impact of climate change";
    - development and implementation of climate change mitigation and adaptation policies and assessment of the effects of emissions reduction pathways on economic sectors;
- **climate change risk assessment -** assessments of "the threats and opportunities of climate change based on: assessment of weather-related risks, interpretation and development of future scenarios, data analysis and modelling including use of probabilistic projections and weather generators and risk assessment";
- **adaptation advice –** "evidence-based advice on the practicality, affordability and delivery of adaptation at policy, programme and project/operational level, including: methods to increase adaptive capacity, solutions for realising adaptation, prioritisation and optimisation of responses, advice on the management of uncertainties";
- **climate change tools –** development of **"**a range of tools to help businesses and stakeholders understand, manage and monitor climate change, impacts and adaptation, including: **Databases, indicator development, GIS (geographical information systems)**";
- **mitigation advice - carbon management** aimed at reducing carbon footprint but also at improving carbon performance, with the "full spectrum of mitigation opportunities from renewable energy sources for buildings to spatial planning that reduces transport demand". Services include:
    - **carbon measurement, auditing and foot-printing;**
    - **voluntary disclosure** – "for instance in the production of Environmental Product Declarations or returns to the Carbon Disclosure Project (CDP)";
    - **low carbon strategy design** – "a range of low carbon options from renewable and energy efficiency solutions for an entire building portfolio to travel planning, behavioural change

[36] "the engineering design expert behind London 2012".

and carbon offsetting"; and also development and marketing of low carbon products and services or support to enter the traded sector;

- **advice on the EU Emissions Trading Scheme and Carbon Reduction Commitments;**
- **low carbon strategy implementation** – running of programmes "within an organisation or across the supply chain" and establishment of a long term monitoring system for continuous management of carbon footprint (including through the Atkins Remote Technology collecting data on and manage energy use);
- **carbon critical design and engineering** – **carbon tools** helping the optimisation of the (embodied and operational) carbon credentials of a project, structure or scheme.

- **Covered sectors**:
  - aerospace ;
  - buildings;
  - defence;
  - education;
  - environment;
  - marine & coastal;
  - mass transit;
  - nuclear;
  - rail;
  - renewables;
  - roads;
  - tourism & leisure;
  - urban development;
  - water.

Ancillary products and services

Media services: News releases, Features, Events, Multimedia library.

Staff

The multidisciplinary staff (for the whole company, not specific to the climate change consultancy sector) includes: Architects, Consultants, Engineers, Graduates, Planners; Programme and Project Managers, Scientists, Surveyors, Technical Specialists, Business support.

3.17 WeatherNet

Figure 3.16 WeatherNet homepage

Mission

Established in the UK in 1995, WeatherNet is a professional provider of "post-coded weather information to UK insurers to help them verify claims for storm, freeze and flood" with the mission to supply "on-line weather applications, data sets, reports, consultancy and advice". Although the main target business sector is the insurance's one, WeatherNet's diversified offer includes services for various industry sectors. From the technical side, WeatherNet has its own network of "manned and automatic weather stations located throughout the UK's major urban areas".

Main products and services

Main services include "on-line weather applications, data sets, reports, consultancy and advice" mainly targeted to the insurance sector but also for a range of business sectors.

Products & Services

- Historic Weather Data - raw weather data from WeatherNet network of urban based weather stations;
- Claims Validation Application - local or on-line facility for insurers to validate the weather at any postcode on any day;

- Historic Weather Reports - reports of past weather, averages, and deviations, from individual stations, as tabulations and graphs
    - Historical Weather Reports describe the day by day weather of previous months;
    - Incident Reports describe the weather for a specific postcode or place, and date or time;
    - Climate Reports give averages for each month for temperature, rain, sun and wind etc;
- Expert Witness - WeatherNet meteorologists can act as expert witness in cases of dispute, civil and criminal litigation;
- Consultancy - research and presentation of specific weather related studies, and general weather related investigation and analysis;
- Forecasts & Weather Warnings - **"**regular numeric, descriptive and graphic forecasts and weather warnings for industry, broadcast, and printed media";
- Weather Risk Insurance - provision of support in understanding how the weather affects the performance of a business, and in protecting against these effects;
- Telephone Consultancy - verbally provision of historic weather information and advice;
- Talk to a Weatherman - verbally provision of local, regional, national or international forecasts for up to 15 days ahead;
- Books & Non-Exclusive Reports - publication of books and articles of general and specialist interest;
- World Weather
    - "Weather and climate data for around the world;
    - Latest weather news;
    - Climate guides for travellers and tourists;
    - Live forecast advice for Europe and the world";
- Forecasting
    - "Industry Specific Forecasts for Media, Aviation, Construction, Retail & Film Industry;
    - Local, regional, national & international weather forecasts;
    - UK forecasts 0-16 days ahead;
    - Descriptive, graphic and numeric formats;
    - Weather monitoring and warnings;
    - Live weather forecast advice;
    - 7am - 11pm, 7 days a week Telephone Consultancy".

Products & Services by sector

- Insurance
    - "Weather Data from Exclusive Urban Based Weather Stations;
    - Post-coded Weather Data for Validation, Underwriting & Risk Analysis;
    - Control Leakage; Reduce Claims Cost; Improve Customer Service;
    - Catastrophe Planning";

- Construction
    - “Reports & Studies of Wind & Climate;
    - Regular Historical Reports & Deviations from Average;
    - Detailed Reports & consultancy;
    - Talk to a Weatherman”;
- Legal
    - “Legal Weather Reports;
    - Certified Witness Statements;
    - Forensic Meteorologist & Expert Witness For Court Appearances;
    - Telephone Consultancy Service;
    - Online Access to Historical Weather Data by Postcode”;
- Utilities & Power
    - “Historical Weather Data from Urban Areas;
    - Consultancy for New Schemes of Renewable Energy;
    - Incident Reports;
    - Forecasts for Demand Models;
    - Warnings & Alerts;
    - Weather Risk Insurance”;
- Leisure & Tourism
    - “Reports on Local Climate;
    - Historical Weather Reports;
    - Talk to a WeatherMan;
    - Data for Visitor Analysis;
    - Weather Risk Insurance”;
- Retail & Manufacturing
    - “Reports, & Data for Weather Sensitivity Studies;
    - Full Consultancy Service;
    - Custom Weather Forecasts for up to 14 Days Ahead;
    - Talk to a WeatherMan;
    - Weather Risk Insurance”;
- Public
    - “Weather Reports to Substantiate Claims for Property Damage or Injury;
    - Weather Guide to Event Planning - the best dates for Holiday, Parties & Weddings;
    - Climate Guides for where you Live, Holiday, or are Planning Your Retirement;

    - Talk to a Weatherman";
- Agriculture
    - "Reports on Local Climate;
    - Historical Weather Reports;
    - Talk to a WeatherMan;
    - Warnings & Alerts;
    - Weather Risk Insurance;
    - Data for Agronomy & Field Trials";
- Education
    - Colourful Weather Reports from a Local Station;
    - Data Sets for Classroom Analysis;
    - Research Archive;
    - Advice on Setting up your own Weather Station;
- Media
    - "Custom Forecasts;
    - Talk to a Weatherman;
    - Weather Risk Insurance";
- Weather Risk Insurance - products suited to all types of UK nationals business;
- Weather and Sales forecasting - "econometric analysis and causal modelling for forecasting including price sensitivity" "forecast accuracy measurement and improvement, training courses and workshops, stock planning, weather sensitivity analysis and econometric modelling".

Examples of offered products are described with some more details in the relevant sectoral **Case Studies.**

Ancillary products and services

- On-line Reference (Conversion Factors; Weather Glossary; UK Climate; Weather Lore; Sunrise/Sunset Calculator; UK Extremes; Beaufort Scale; Wind Chill Chart; Heat Index);
- On-line News (WeatherNet News; UK Weather News; World Weather News).

Staff

N/A.

4 Notes

4.1 WMO Definition of Climate Service[37]

"'**National Climate Service or National Climate Centre**' can be and often is an entity within a National Meteorological Service (NMS) or a National Meteorological and Hydrological Service (NMHS), to, inter alia, carry out climate studies, conduct climate prediction and projection and to develop and provide climate services. It is recognized that in some countries, climate functions can be mandated to other national entities, including other government agencies, universities or research institutions, in addition to NMHSs. It is assumed that in most cases the NMHS will be the principal official national entity for most operational climate functions, and that the full suite of climate efforts developed across multiple mandated agencies for adaptation to climate variability and change will be coordinated at national levels."

4.2 ICCS Objective of Climate Services [38]

"Easily accessible and timely scientific information can help societies not only limit the economic and social damage caused by climate-related disasters, but also take advantage of opportunities provided by favourable conditions. Climate services are meant to fill this need. They will ensure that the best available climate science is effectively communicated with agriculture, water, health and other sectors, to develop and evaluate mitigation and adaptation strategies."

4.3 WMO Definition of Climate product[39]

"A climate product is a management tool for all climate data which allows access to useful climate information that is suited to particular needs of the end-users as well as practical guidance on how they can use it. It encompasses a range of activities that deal with generating and providing information based on past, present and future climate and on its impacts on natural and human systems."

4.4 International framework for Climate Services: WMO Global Framework for Climate Services (GFCS)

"Heads of State and Government, Ministers and senior government officials of 160 countries participating in the High-level Segment of **World Climate Conference-3 (WCC-3)**, 31 August to 4 September 2009, decided to establish a **Global Framework for Climate Services (GFCS**) to strengthen the provision and use of climate predictions, products and information worldwide. The agreement was the culmination of the UN-wide Conference, convened by WMO and partners, which brought together more than 2 500 scientists, sector experts and decision-makers to discuss the urgent need for accurate and timely climate information. The

[37] Source: World Meteorological Organization (WMO) (2009) "DRAFT Global Framework: Concept Note Ver 3.4, 11.03.2009".

[38] Source: International Conference on Climate Services (ICCS) (2011), aiming at "ultimately establish a climate services pilot program or network, with support from an international set of partners with experience in the implementation, design or use of climate information and services."

[39] Source: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS).

Global Framework will be crucial for building climate-resilient societies. Through strengthened observations, research and information systems, as well as new interaction mechanisms for climate information users and providers, the Framework will ensure that all sectors of society have user-friendly climate products that enable them to plan ahead in the face of changing climate conditions".[40]

The WMO **World Climate Services Programme (WCSP)** serves as *the Climate Services Information System* and as a part of the *User Interface Platform* components of the GFCS; it spans across four inter-related areas:

(i) climate data and analysis;

(ii) climate monitoring, watch and prediction;

(iii) climate system operation and infrastructure;

(iv) climate adaptation and risk management.[41]

4.5 ICCS Elements of successful Climate Services[42]

- "Identifying the Demand for Climate Services;
- Creating, Accessing and Using Data;
- Facilitating Systematic Knowledge Exchange;
- Engaging the Scientific Community;
- Designing Policies and Institutional Partnerships;
- Establishing Innovative Funding Mechanisms".

[40] Source: WMO (2009) World Climate Conference-3 (WCC-3) outcomes.

[41] Source: WMO World Climate Services Programme (WCSP).

[42] Source: ICCS (2011).

4.6 WMO Essential climate related capabilities and expected outputs of a national meteorological or climate service participating in the Global Framework for Climate Services[43]

REQUIRED CAPABILITIES	Observations	• Conduct data management including quality assurance/quality control, using Quality Management Framework principles; • Develop and maintain data archives; • Conduct data rescue; • Design and conduct life-cycle management of national observing systems for climate purposes; • Provide oversight on adherence to climate standards for observations (e.g. Global Climate Observing System climate monitoring principles) and instruments for measurement; • Historical as well as real time observations in the atmosphere, the oceans, over land and ice of the Essential Climate Variables prepared by Global Climate Observing System and partners for climate purposes, exchanged freely for use in Regional Climate Centres, for at least one Global Surface Network site; • Contribute to interoperable access via WIS to all appropriate climate observations and metadata; • Undertake to improve station density for climate studies of temperature and precipitation; • Improve observations based on user feedback.
	Research	• Participate in funded projects, field experiments; • Some engagement in applied climate research using local and other datasets.
	Capacity building	• Participate in training, as required, for data management, Quality Management Framework, data rescue, basic analysis (using, e.g., Climate Database Management System), fundamentals of climatology, preliminary training for use of climate prediction products, etc.; • Participate as appropriate in Regional Climate Outlook Forums; • Participate in training for climate services specialties, including for seasonal prediction, basic downscaling techniques, climate applications, advanced statistical procedures, etc; • Conduct training for data management, data rescue and basic climate data analysis.
	User Interface	• Interact with users, to meet requests (for basic climatology questions) and gather feedback on products; • Conduct or contribute to regional and national climate outlook forums (Regional Climate Outlook Forums and National Climate Outlook Forums) and outlook communication; • Interact with users in one or more sectors to identify their requirements for, and provide advice on, climate information and products for their application; • Assist users to interpret/use climate predictions and products; • Get feedback from users on the usefulness and effectiveness of the information and services provided.

[43] Source: WMO (2011) "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES – EMPOWERING THE MOST VULNERABLE" THE REPORT OF THE HIGH-LEVEL TASKFORCE (HLT) FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES (GFCS).

EXPECTED OUTPUTS	Products	• Datasets (land-based atmospheric and terrestrial, coastal/marine, some remotely sensed); • Time series for single parameters; • Long term trend maps; • Basic statistics (graphs, counts, etc.) on extremes, frequency of occurrence, spatial means for temperature (Max, Min, Mean), precipitation, and possibly relative humidity, evapotranspiration, thunder days, sunshine duration, cyclones, etc.), climatological norms; • Map analysis of T, P etc, and anomalies (weekly, monthly, etc.), showing spatial patterns and climate zones; • Some assessments and analyses of spatial and temporal factors and processes involved in observed climate patterns (e.g. diagnostics on Tropical cyclones, monsoon, synoptic-scale storms, etc.); • Hazards monitoring and Climate Watch products (basic assessments, advisories, analysis of climate extremes and extreme 'events', maps, graphs, imagery (e.g. satellite), observations on current (monthly) climate conditions vis-à-vis means, variance, thresholds, percentiles and weekly, 10-day, monthly, seasonal and annual basis, etc.; • Reviews and assessments of past climate patterns, e.g. World Meteorological Organization annual and multi-year reports on the State of the Climate • Application products including probable maximum precipitation, probable maximum floods , Intensity duration frequency , etc.; • National scale monthly and seasonal (generally three-monthly) climate forecasts and outlooks, plus related information on uncertainty, skill, etc. including maps of expected anomalies (e.g. for temperature or precipitation), in probabilistic format; consensus summary assessments of key features and, at national levels, may include advisories and warnings; • Improve services and products based on feedback from users.
	Services	• Data services (where permitted under current mandate and legislation); • Conduct basic climate diagnostics and climate analysis (staff will have some proficiency in climate statistics, or be able to reliably use statistical software (e.g. Climate Database Management System); • Perform basic climate assessment; • Contribute to Regional Climate Outlook Forums; • Disseminate climate products (i.e. those based on data; regional and national climate monitoring products if available; seasonal outlooks provided by Regional Climate Outlook Forums and Regional Climate Centres); • Conduct advanced statistical activities including analysis and diagnostics; homogeneity testing and adjustment; regression, development of climate indices, etc.; • Develop and/or provide (have access to and can effectively work with) monthly and longer climate predictions including seasonal climate outlooks, both statistical and model-based (down-scaled); • Add value from national perspectives to the products received from Regional Climate Centres and in some cases Global Producing Centres ; • Conduct climate watch programmes and disseminate early warnings.

4.7 A Verdantix (2009) analysis of the US climate change consulting market[44]

Verdantix, an independent analyst firm providing "data, analysis and advice to help our clients resolve their energy, environment and sustainability challenges" focussing on "climate change, carbon markets and business sustainability" published in 2009 a report **analysing the US climate change consulting market** through the assessment of **19 climate change and sustainability consulting and professional services firms** (AT Kearney, Bain & Company, Boston Consulting Group (BCG), Blu Skye, Booz & Company, CH2M Hill, Clear Carbon Consulting, Deloitte, ENVIRON, ERM, Ernst & Young, GreenOrder, ICF International, Jacques Whitford, KPMG, McKinsey & Company, PA Consulting, PwC, The Shaw Group).

The report is intended "**to clarify the alternatives for buyers in a confusing and fast-changing market"** and "to shortlist and hire consulting firms that best meet their needs for external expertise" for services on "GHG inventories, carbon management plans, regulatory advice, climate change strategy development and clean technology advisory".

Based on dozens of interviews with practice leaders and buyers of consulting services, the Verdantix report *Green Quadrant Climate Change Consulting 2009 (US)* (by David Metcalfe, Verdantix Director) "reveals that some advisory firms lack the depth of expertise to help, so they need to invest despite the recession".

Figure 4.1 Verdantix Analysis of Climate Change Consulting USA

[44] Source: Verdantix (January 2009) "*Verdantix: Climate Change Consultants In The US Face A Make Or Break Year*".

The Verdantix analysis finds that[45]:

- **Seven consulting firms stand out as Leaders**: Skye, Booz & Company, CH2M Hill, Deloitte, ENVIRON, ERM, ICF International, McKinsey & Company, PwC. **CH2M Hill and McKinsey & Company** stand out – even among the leaders – due to the breadth and depth of their capabilities and proven track record over the last 2 years. Two Big Four firms, Deloitte and PwC, and environmental consultancies ENVIRON, ERM and ICF International are also positioned in the Leaders Quadrant.
- **Consulting firms with specialist skills will surge forward in 2009.** Buyers of consulting services should turn to Ernst & Young for cleantech advice, AT Kearney for sustainability strategy projects and Booz & Company for climate change strategy. Blu Skye and GreenOrder are an ideal choice for change programs. PA Consulting Group has the capability to deliver transformational energy efficiency and climate change programs.
- **Many advisors need to bulk up their climate change expertise.** Not all consulting firms have invested in the development of their climate change services. Notably Bain & Company, Boston Consulting Group and KPMG US have done little to market their capabilities and credentials on sustainability and climate change.

Carbon management is their top priority: 73 per cent identified it as a significant initiative

Sixty per cent of the interviewed buyers of climate change advice (all working for $5 billion revenue US firms) said they invested in **climate change strategy advice** and **greenhouse gas inventory projects** in 2008. In terms of future spend, **energy efficiency** is top of the agenda for 2009."

The analysis concludes that "**buyers of sustainability consulting projects will need to select a portfolio of advisory partners due to the wide-ranging challenges triggered by sustainability and climate change.** Specifically buyers should:

- **Target management consultancies for strategy development.** International strategy consulting firms like McKinsey & Company, Booz & Company and AT Kearney – score well in our analysis – and are best placed to advise on corporate climate change strategy. Environmental consulting firms, despite their deep climate change expertise, often lack strategy consulting skills.
- **Hire specialist expertise for opportunity identification.** Despite having less than 30 employees, boutiques like BluSkye and GreenOrder are well-aligned with climate change and sustainability product development and opportunity identification. For cleantech products CH2M Hill, Ernst & Young and The Shaw Group are good choices.
- **Invest in advice that combines policy and financial performance.** Deloitte and PwC stand out as the top choices for advice on policy and regulatory developments. Through their expertise in tax, regulations and financial management these firms can advise large corporates on how to exploit new climate and energy regulations for financial advantage.
- **Source industry expertise for operational analysis.** Firms in sectors with significant energy demands and emissions to manage, such as oil, gas, mining, power generation, chemicals and metals, should turn to consulting providers like CH2M Hill, ENVIRON, ERM and ICF International due to their deep knowledge of industrial processes."

[45] Source: Verdantix (January 2009) "*Verdantix: Climate Change Consultants In The US Face A Make Or Break Year*".

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