CMCC - EFI WEBINAR

March 21, 2019 - h. 3.00 pm CET

Forests: solutions and perspectives to fight climate change

***Marco Marchetti*- Presenter**
University of Molise

***Donatella Spano* - Presenter**
University of Sassari and Euro-Mediterranean Centre on Climate Change Foundation (CMCC)

***Hans Verkerk* - Presenter**
European Forest Institute (EFI)

***Valentina Bacciu* - Moderator**
Euro-Mediterranean Center on Climate Change Foundation (CMCC), IAFES Division

cmcc EFI

www.cmcc.it

To investigate and model our **climate system** and its interactions with **society** to provide reliable, rigorous, and timely **scientific results**, which will in turn stimulate sustainable growth, protect the **environment**, and **develop science driven** adaptation and **mitigation policies** in a **changing climate**

cmcc
Centro Euro-Mediterraneo sui Cambiamenti Climatici

MISSION

NETWORK

RESEARCH DIVISIONS

Advanced Scientific Computing (ASC)

Climate Simulation and Prediction (CSP)

Economic analysis of Climate Impacts and Policy (ECIP)

Impacts on Agriculture, Forests and Ecosystem Services (IAFES)

Ocean modeling and Data Assimilation (ODA)

Ocean Predictions and Applications (OPA)

Risk Assessment and Adaptation Strategies (RAAS)

REgional Models and geo-Hydrological Impacts (REMHI)

Sustainable Earth Modelling Economics (SEME)

TOPICS


Modelling
Policy
Adaptation
Agriculture
Society
Predictions
Impacts
Hydrogeology
Forests
Simulations
Oceans
Ecosystems
Computing
Services

Publications

Events

Education

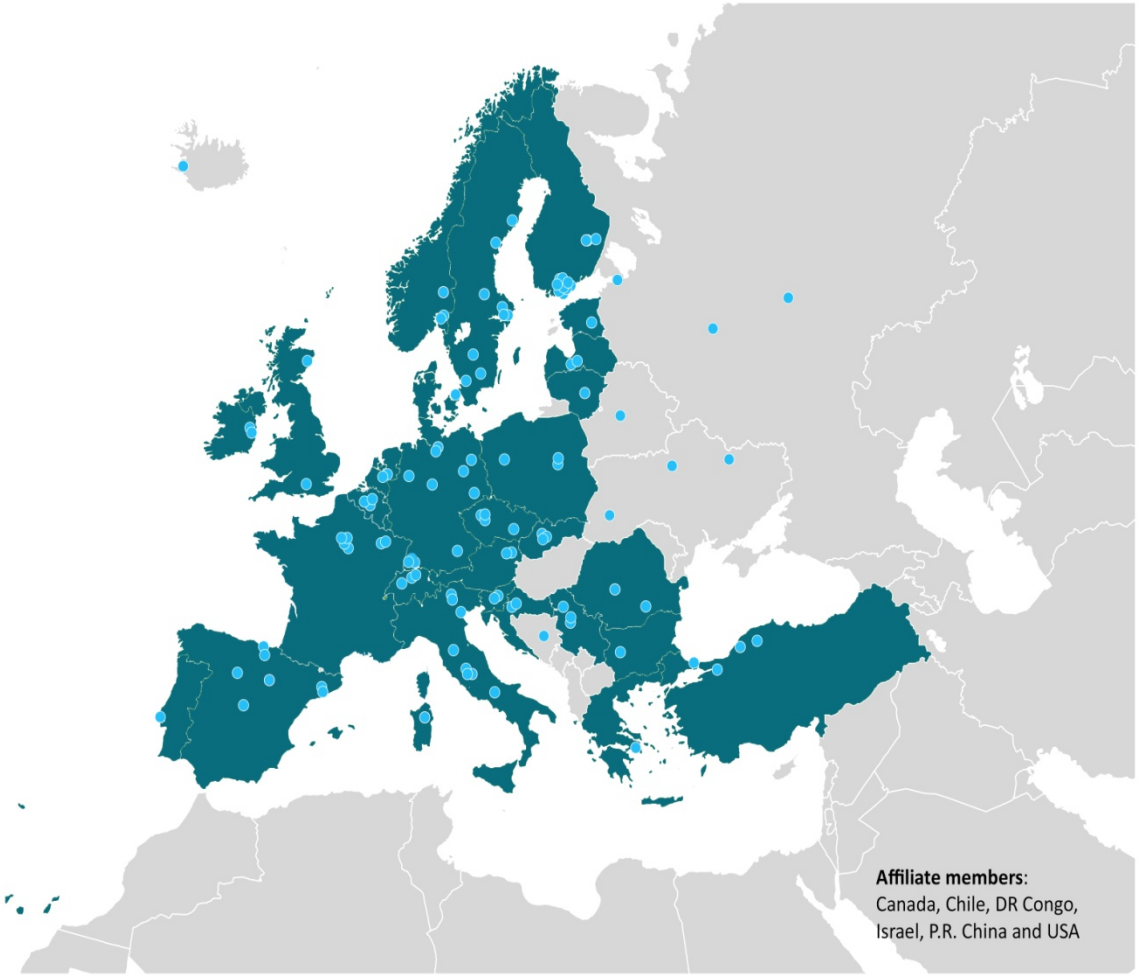
Communication

OUTREACH

European Forest Institute

About EFI

- International organization established by European states
- Currently, a total of 29 European States have ratified the Convention on EFI.
- EFI has c. 120 member organisations in 40 countries.



Vision

A world where forests significantly contribute to sustainable wellbeing

Mission statement

Connecting knowledge to action

Thematic framework

- Bioeconomy
- Resilience
- Governance

Siraanamwong, Larisa Lofitskaya, Stephan Leyk/Fotolia

Strategic goals

- An ambitious forest research and innovation area
- Science informed policies
- Awareness in society

Q&A session

To participate in the Q&A Session, please use the “Questions” menu provided by the Go-to-Webinar system

Forests: solutions and perspectives to fight climate change

Centro Euro-Mediterraneo sui Cambiamenti Climatici

EFI

Challenges and perspectives for a long-term vision in managing forests under climate change: the Italian case

Marco Marchetti

Università degli Studi del Molise

March 21, 2019

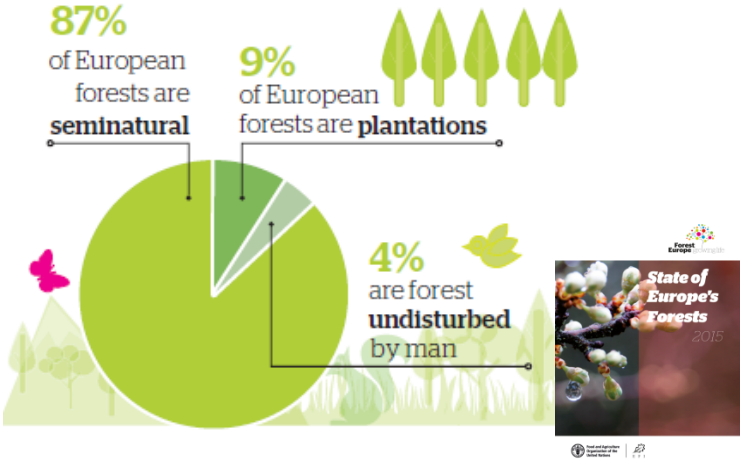
SISEF

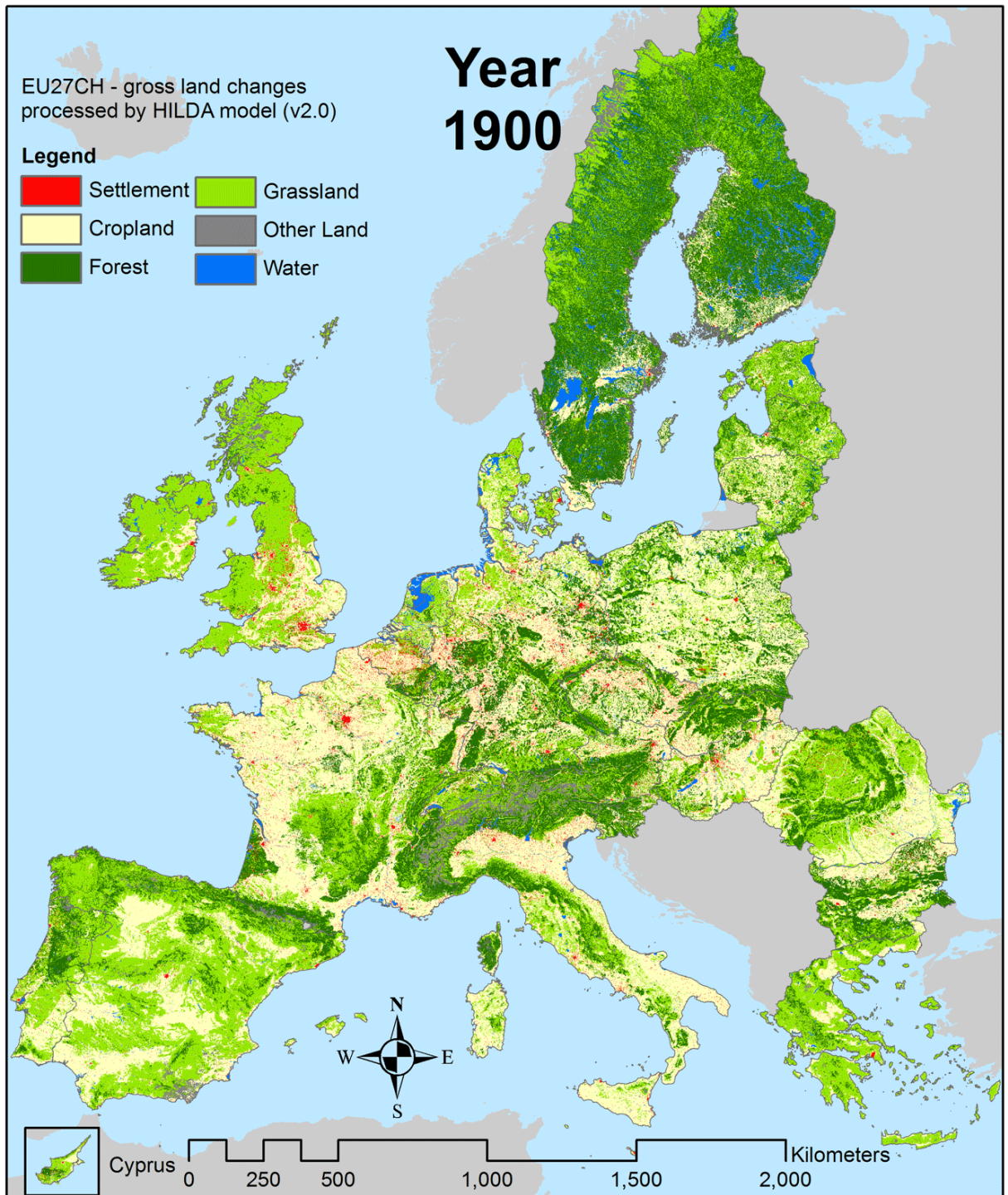
A long-time history of Human-Nature co-evolution

1) **Europe is the Continent with the lowest coverage of pristine forests**
2) **Cultural/historical/working landscapes**
3) **High Landscapes variability**

Fire

Agriculture and grazing





100 years of landscape evolution in Europe

In France, Spain and Italy, reforestation was particularly visible

re-forestation/natural re-growth processes soon had a visible impact as well as more people moved into urban areas

Scandinavian forests recovered to supply other countries

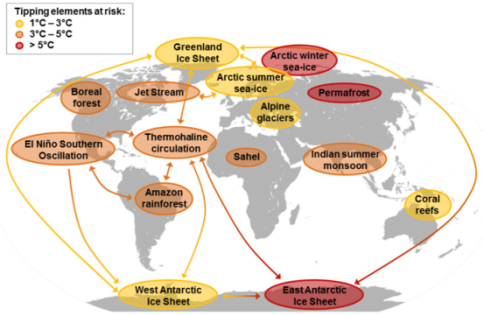
The end of communism also led to forest growth in eastern Europe

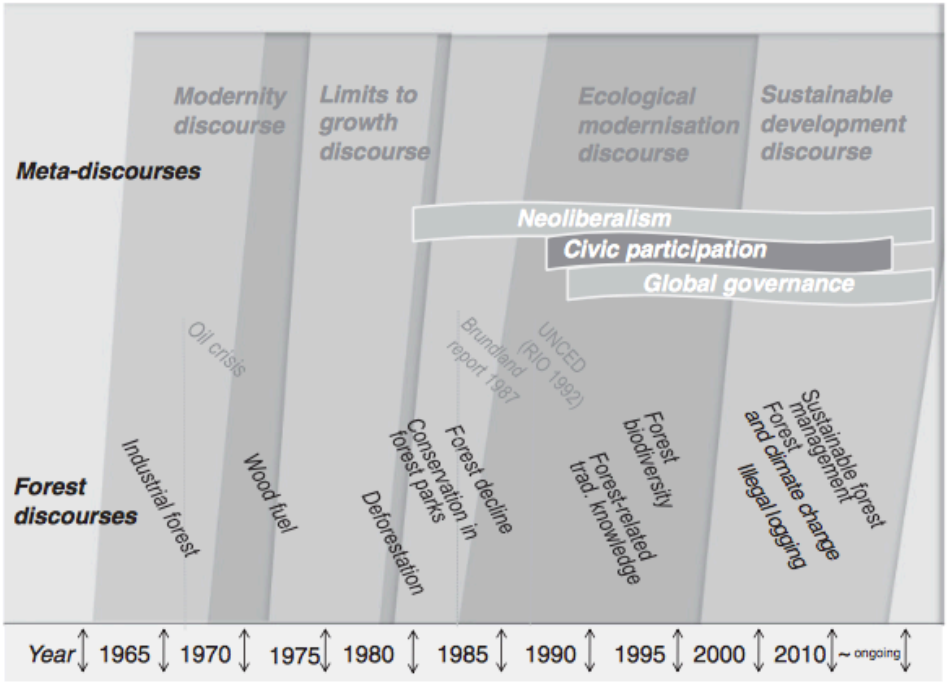
Credits to Fuchs et al.
(http://www.geo-informatie.nl/fuchs003/#)

Time of great changes and acceleration

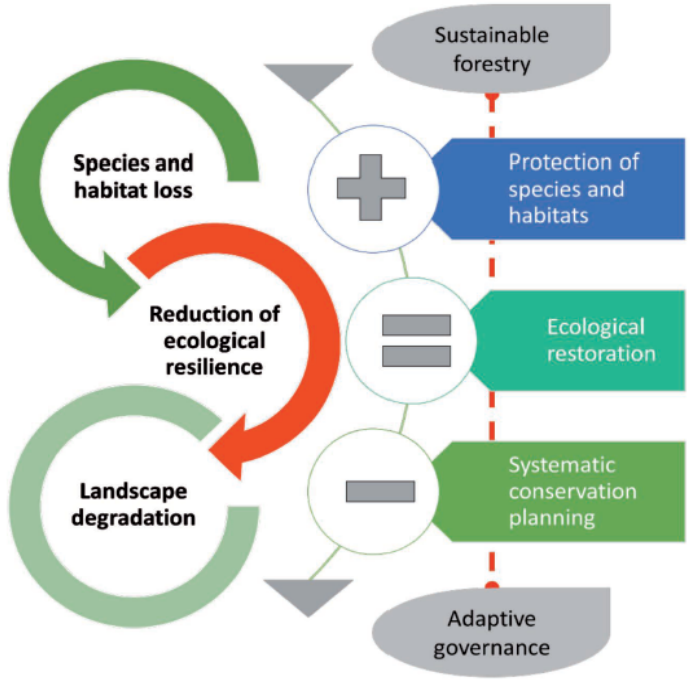
- Land cover, land use and land management
- Threats and challenges: CC, megafires, extreme events, biodiversity loss…
- Societal demands and needs

Vision and perspective. Responsibility





. Global meta and forest discourses.
Adapted from Arts et al. (2010).



Frontiers for forest conservation: securing the future ecosystem services balance

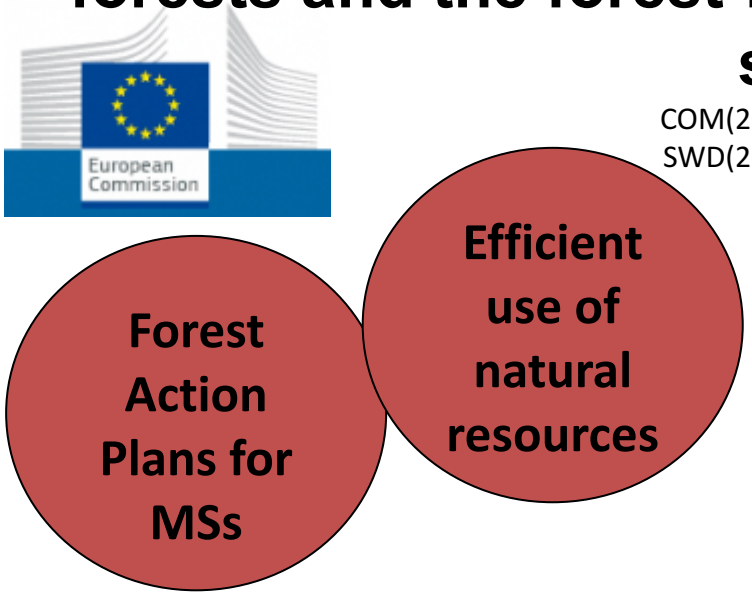
MARCO MARCHETTI, LORENZO SALLUSTIO, MATTEO VIZZARRI

Centro di Ricerca per le Aree Interne e gli Appennini (ARIA), Dipartimento di Bioscienze e Territorio (DiBT)
Università degli Studi del Molise, Pesche (IS), Italy

Opportunities for Adaptive governance and bioeconomy

A new EU Forest Strategy: for forests and the forest-based sector

COM(2013) 659 final
SWD(2013) 343 final



- Enhancing **multifunctionality** and maximizing **ecosystem services** for local communities
- Improving demand in **bioeconomy** and **bioenergy** sectors
- Improving **efficiency** in the forestry sector (climate actions to 2020)
- Protecting **forest resources** and **biodiversity** against climate change-related effects

Verkerk *et al. Forest Ecosystems* (2019) 6:5
https://doi.org/10.1186/s40663-019-0163-5

Forest Ecosystems

RESEARCH Open Access

Spatial distribution of the potential forest biomass availability in Europe

Pieter Johannes Verkerk[1*], Joanne Brighid Fitzgerald[1], Pawan Datta[2], Matthias Dees[2], Geerten Martijn Hengeveld[3], Marcus Lindner[4] and Sergey Zudin[1]

- Monitoring **potential effects** from climate and land use change (abandonment phenomena)
- Diversifying **land uses** at landscape scale (segregation vs. integration)
- Implementing **adaptive governance** for improving resilience and ecosystem services availability

A new vision for a transforming sector

GAZZETTA UFFICIALE
DELLA REPUBBLICA ITALIANA

Atto Completo | Avviso di rettifica Errata corrige | Lavori Preparatori | Direttive UE recepite

DECRETO LEGISLATIVO 3 aprile 2018, n. 34

Testo unico in materia di foreste e filiere forestali. (18G00060) (GU Serie Generale n.92 del 20-04-2018)

note: Entrata in vigore del provvedimento: 05/05/2018

Home » Archives » Vol. 13 » pp. 90-90

doi: 10.3832/efor0079-013

Forest@
vol. 13, pp. 90-90 (Dec 2016)

EDITORIALS

Who will lead the Italian forest policy?

Marco Borghetti ✉

Home » Archives » Vol. 15 » pp. 71-74

doi: 10.3832/efor0072-015

Forest@
vol. 15, pp. 71-74 (Aug 2018)

EDITORIALS

Landscape, bioeconomy and wildfire management: a challenge to face very soon

Marco Marchetti[(1)] ✉, Davide Ascoli[(2)]

Home » Archives » Vol. 15 » pp. 18-19

doi: 10.3832/efor0074-015

Forest@
vol. 15, pp. 18-19 (Feb 2018)

EDITORIALS

The new National Forest Law, a very encouraging step forward

Marco Marchetti ✉

Home » Archives » Vol. 16 » pp. 26-31

doi: 10.3832/efor3001-016

Forest@
vol. 16, pp. 26-31 (Apr 2019)

COMMENTARIES & PERSPECTIVES

Agricultural and forest biomass production for energy use

Piermaria Corona[(1)], Roberto Tognetti[(2)], Andrea Monti[(3)], Serenella Nardi[(4)], Massimo Faccoli[(4)], Silvio Salvi[(3)], Leonardo Casini[(5)], Marco Antonio Pantaleo[(6)], Gianfranco Pergher[(7)], Raffaele Cavalli[(8)], Giuseppe Corti[(9)], Pietro Buzzini[(10)], Fabio Terribile[(11)], Renzo Motta[(12)], Giustino Tonon[(13)], Raoul Romano[(14)], Manuela Plutino[(1)] ✉, Alessandro Paletto[(1)], Lorenzo Sallustio[(15)], Rinaldo Comino[(16)], Claudio Garrone[(17)], Graziano Martello[(17)], Paolo Angelini[(18)], Danilo Monarca[(19)], Giuseppe Zimbalatti[(20)]

General Directorate for forests MIPAAFT (DiFor)

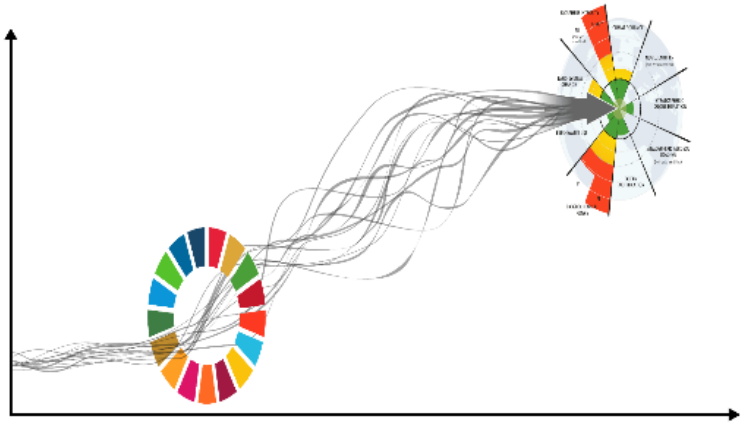
D. Lgs. 19 agosto 2016, n. 177

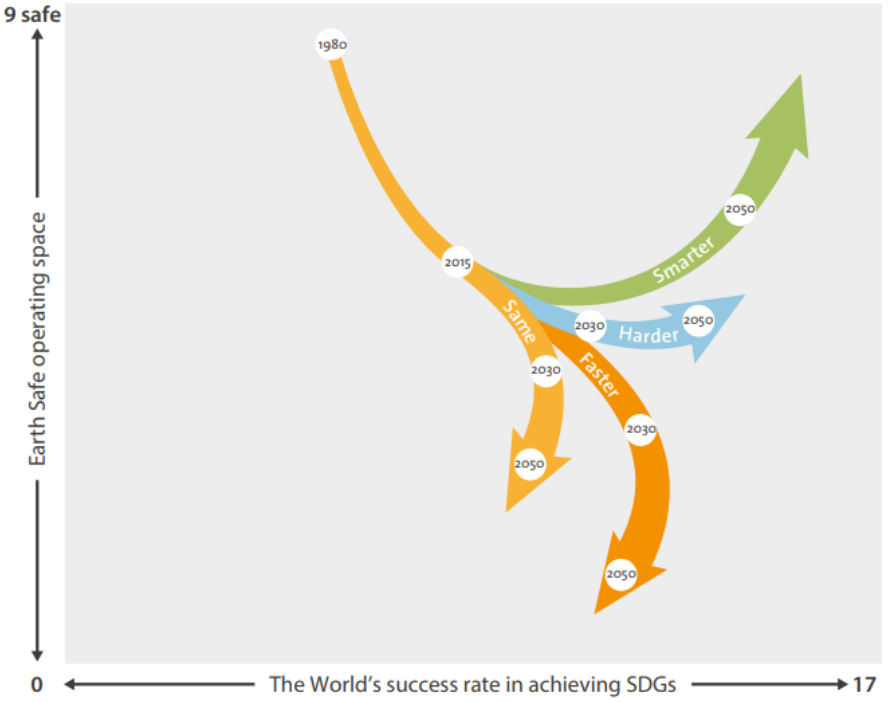
D.P.C.M. 17 luglio 2017, n. 143

D.M. 07 marzo 2018, n. 2481

- DIFOR 1 – Generic issues and coordination
- DIFOR 2 – National and International forest policies
- DIFOR 3 – Valorization of forests goods and value chains
- DIFOR 4 – Ecosystem services and biodiversity

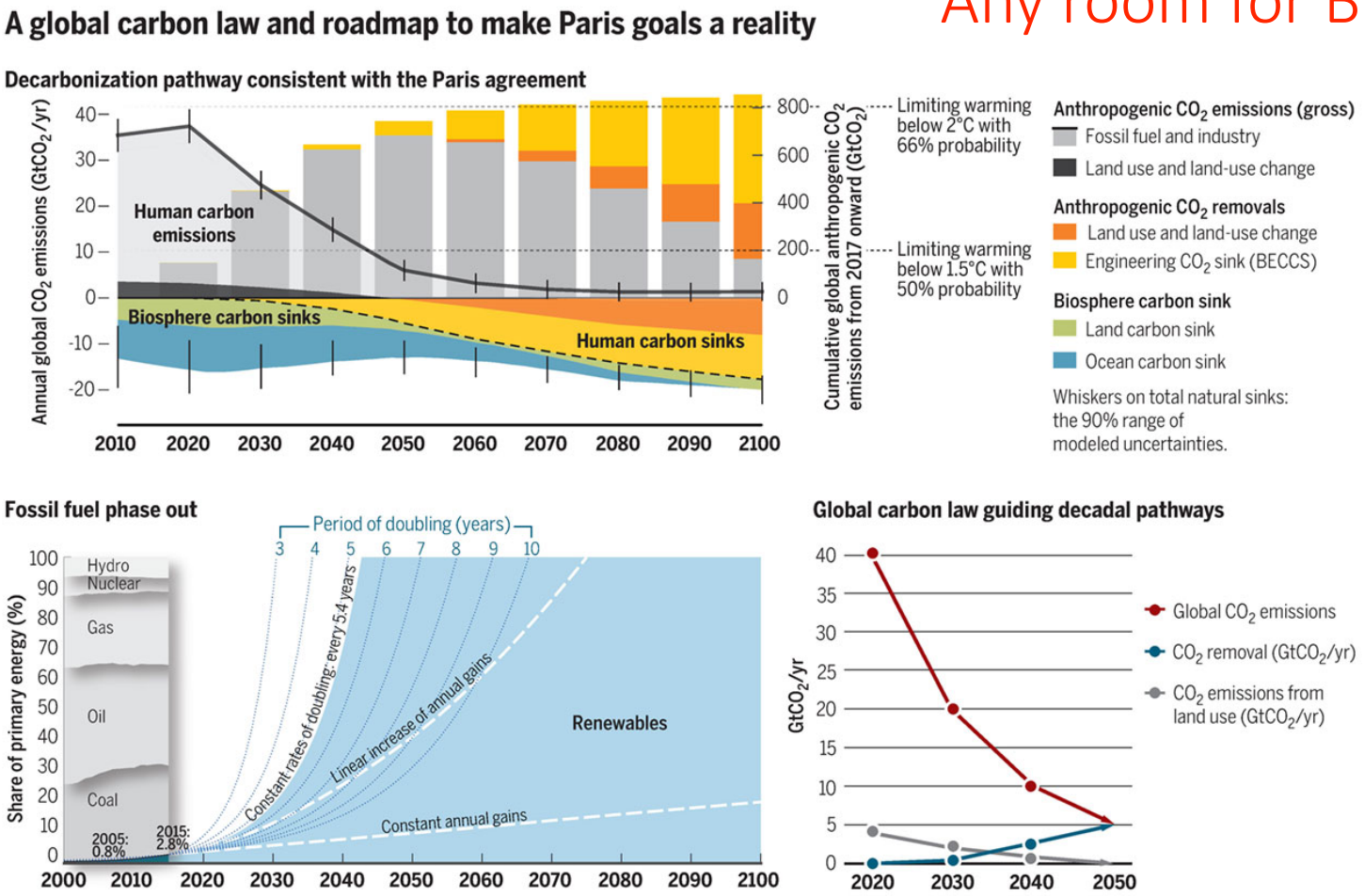
A feasible transformation in 5 steps





1. **Rapid renewable energy growth**
2. **Accelerated sustainable food chains**
3. **New development models in the poorer countries**
4. **Active inequality reduction**
5. **Investment in education to all, gender equality, health, family planning**

Any room for Bioeconomy?

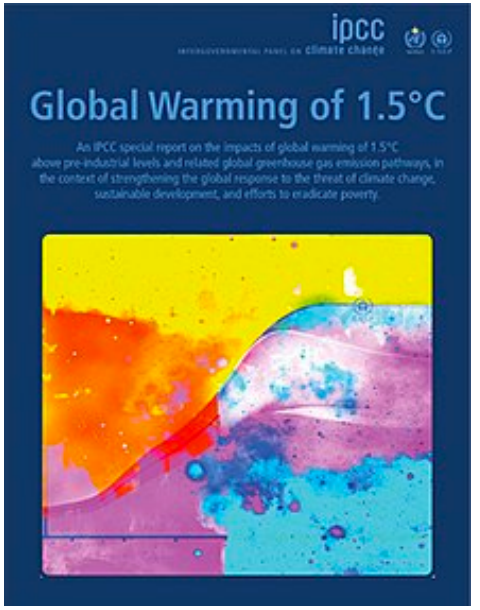


- Increasing **carbon pricing** will change global economy
- **Renewable fuels and energy** will completely replace fossil
- **Decarbonizing long-distance** transport will be key, through e.g. renewable fuels

- Combination of **second- and third-generation bioenergy** with CCS (BECCS) or direct air CCS (DACCS)
- After 2030, all **building construction** must be **carbon-neutral** or carbon-negative
- Financial impetus for **afforestation of degraded land**, **reduced emissions from fires and disturbances**, increase forests' **resistance and resilience** (active C sink)

Do Forests matter?

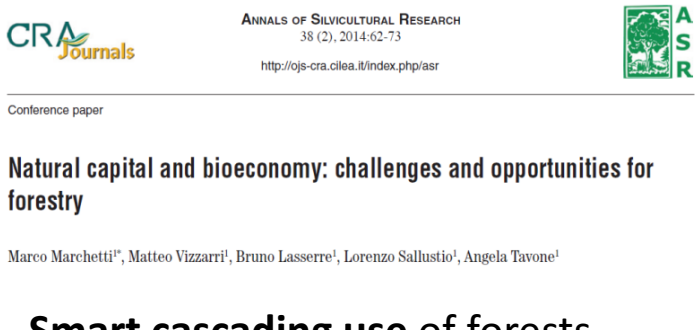
Climate and Land Use Alliance
Cultivating solutions for people and the planet



1. **Avoiding forest carbon emissions is just as urgent as halting fossil fuel use**.
2. **Forests currently remove around a quarter of the CO2 humans add** to the atmosphere
3. Achieving the 1.5° C goal also requires **REDD** and **massive forest restoration**
4. **Tropical forests cool** the air around them and the **entire planet**, as well as creating the rainfall
5. **Bioenergy is not the <u>PRIMARY</u> solution…**

In responding to the IPCC report, our message as scientists is simple: **Our planet's future climate is inextricably tied to the future of its forests**.

Increased use of **sustainably produced wood** in longer-lived products to **substitute energy-intensive materials** (e.g., concrete and steel)



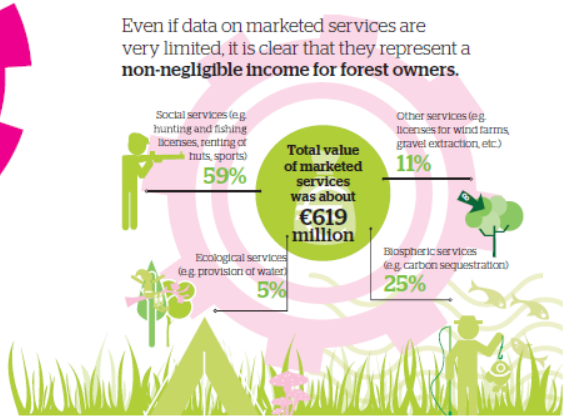
Smart cascading use of forests products and empowerment of the **forest-based sector value chain**

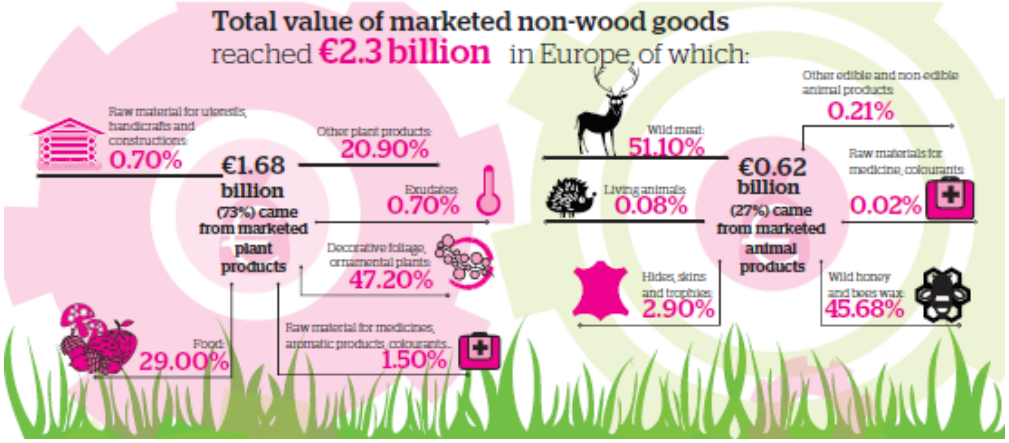
It's time to scale-up local experiences and lessons learned

"The good news is that some of the kinds of actions that would be needed to limit global warming to 1.5ºC are already underway around the world, but they would need to accelerate" Valerie Masson-Delmotte, IPCC WG I

The Nature Conservancy

Gross value added by the forest sector amounted to **€103 billion** (0.8% GDP in the region)



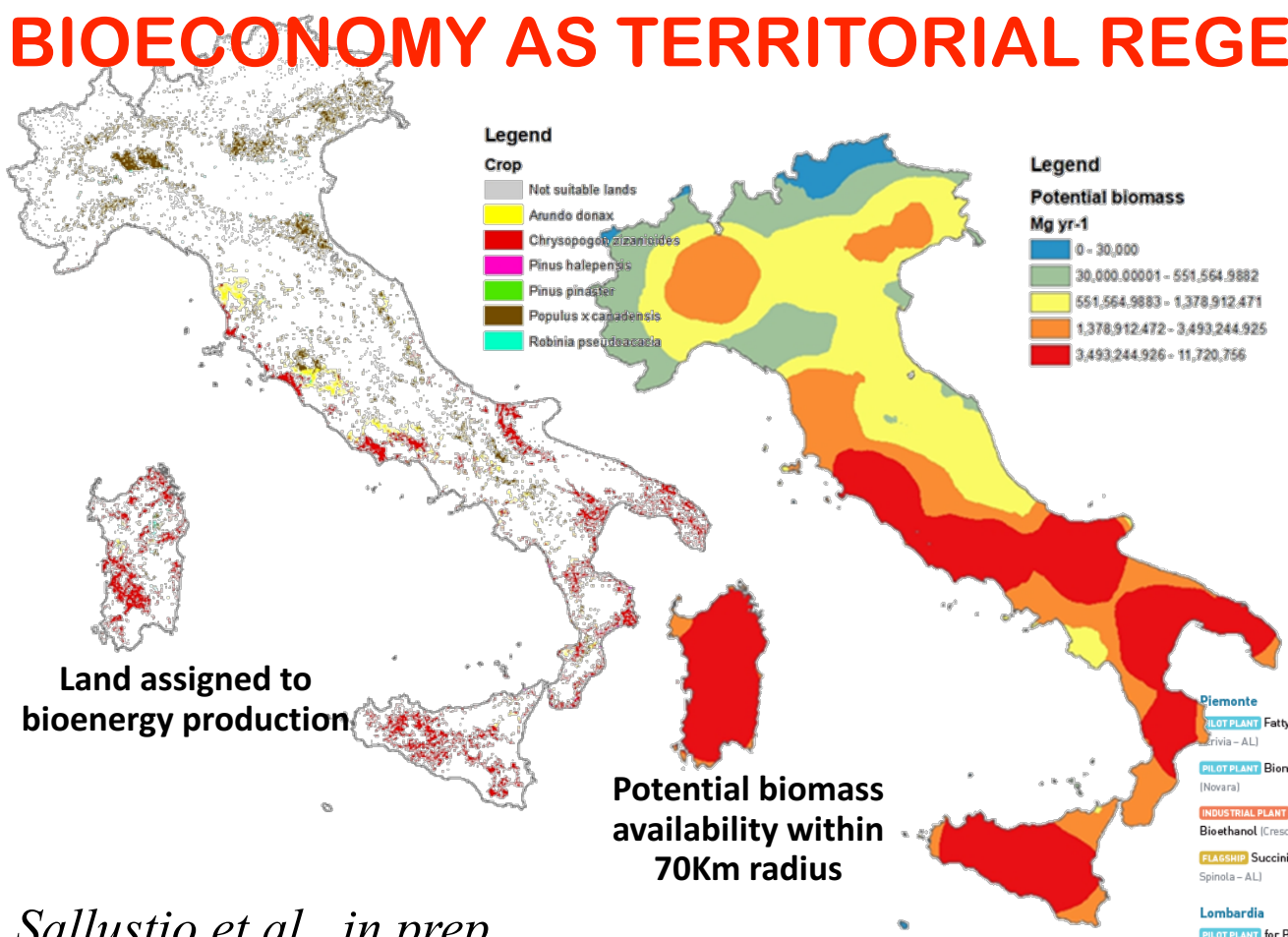


Forestry carbon offsets create opportunities for rural landowners

October 3, 2018 by Caleb Diehl Published in Energy and Environment

Forest transition and "overconservation" in one country can lead to over-exploitation and negative externalities somewhere else (displacement effects)

BIOECONOMY AS TERRITORIAL REGENERATION



Land assigned to bioenergy production

Potential biomass availability within 70Km radius

BIT
Bioeconomy in Italy

A unique opportunity to reconnect ECONOMY, SOCIETY and the ENVIRONMENT

CONSULTATION DRAFT

Sallustio et al., in prep

Crop	Potential Area available (ha)	Potential Biomass Yield (Mg dm year^{-1})	Potential bioethanol production (Bl year-1)	Percentage to Italian liquid fuel consumption
Arundo donax	195,614	5,105,124	1.5	3.9%
Chrysopogon zizanioides	1,565,896	75,163,026	22.5	57.8%
Pinus halepensis	6,139	6,139	0.0	0.0%
Pinus pinaster	35	35	0.0	0.0%
Populus x canadensis	1,026,765	11,147,964	3.3	8.6%
Robinia pseudoacacia	22,789	238,425	0.1	0.2%
Total	**2,817,237**	**91,660,712**	**27.5**	70.5%

- **2.8M ha** of marginal lands potentially available for bioenergy
- **92M Mg** dry biomass yr^{-1}
- **27.5 Bl** of bioethanol yr^{-1}
- **70.5%** of the current national consumption

Sallustio et al., in prep

Multi-Criteria Evaluation

Selection of bioenergy crops

Start

Environmental factors and fuzzy membership functions
- Climate
- Morphology
- Soil

Land suitability

GIS

SCENARIO X

Potential biorefineries location

Potential biomass production

Land assignment
(maximizing potential biomass productivity)

Land availability
(food, energy, and environment trilemma)

Limited competition with:
- **Food production**
- **Biodiversity conservation**

EU RED 2009/28/EC


Contents lists available at ScienceDirect

Land Use Policy

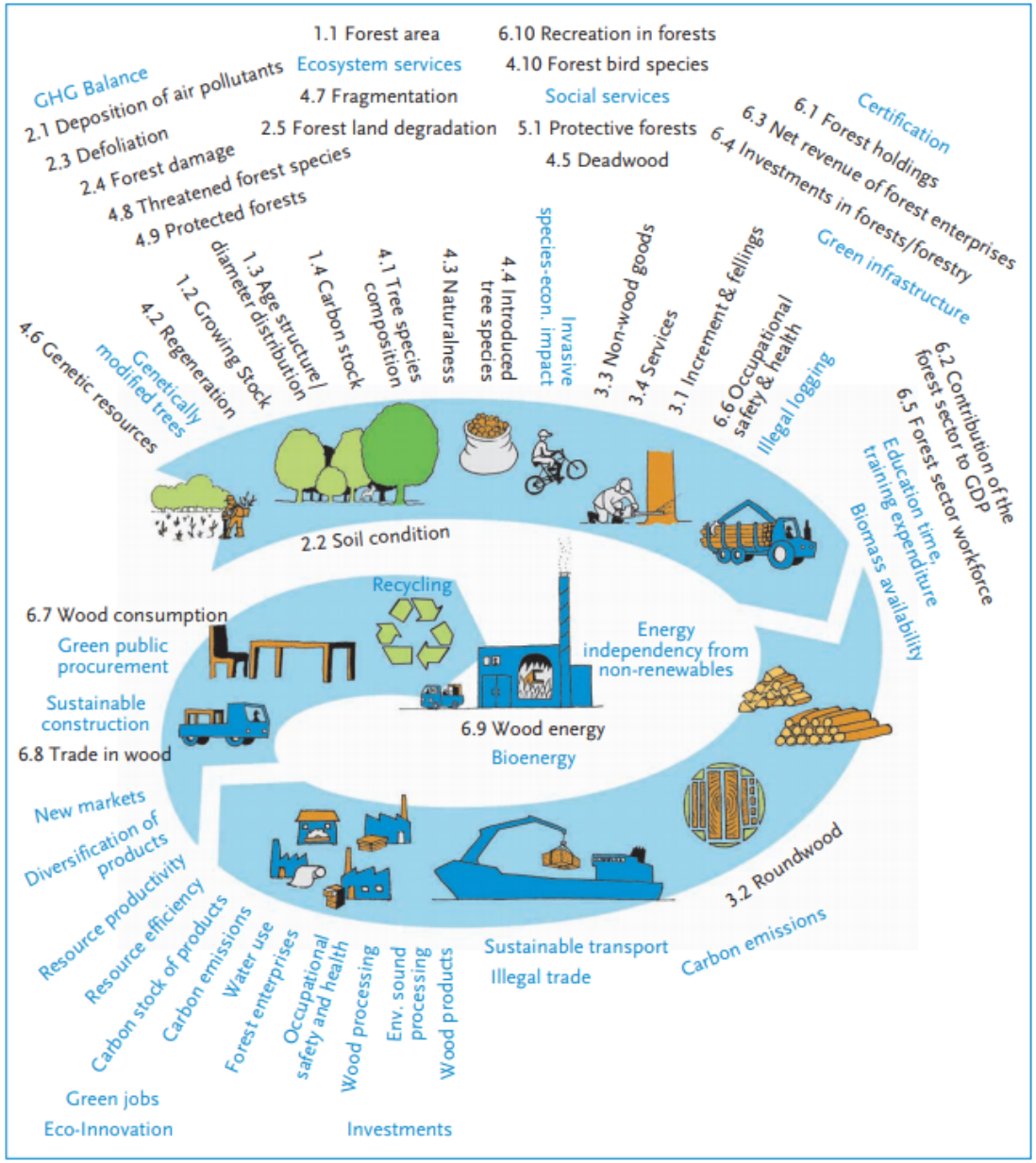
journal homepage: www.elsevier.com/locate/landusepol

ELSEVIER

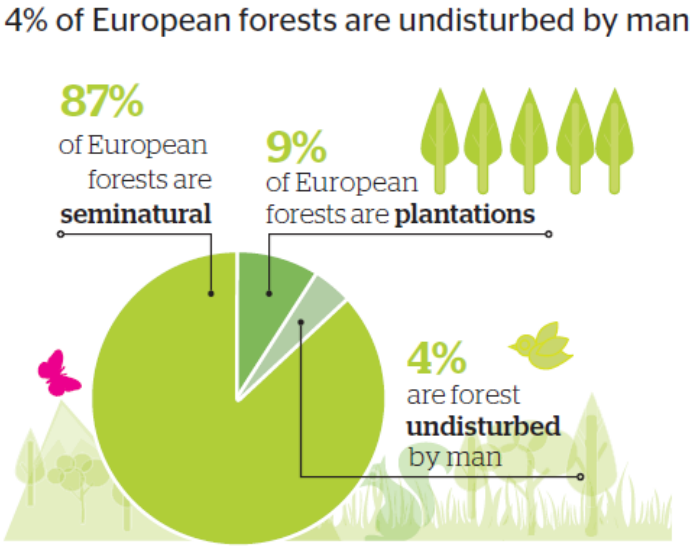
Assessing the economic marginality of agricultural lands in Italy to support land use planning

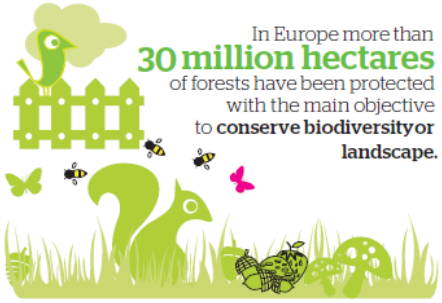
Lorenzo Sallustio[a,*], Davide Pettenella[b], Paolo Merlini[a], Raoul Romano[c], Luca Salvati[a], Marco Marchetti[d], Piermaria Corona[a]

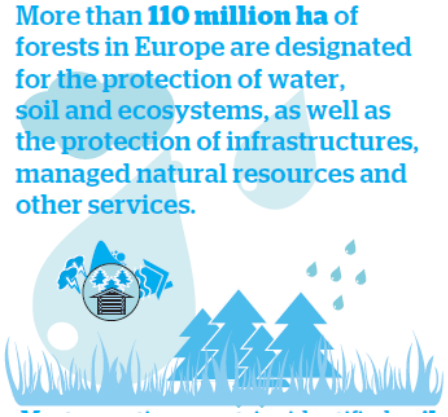
3M law: monitoring, minimizing and mitigating possible risks and drawbacks



Is there a real risk for biodiversity?







- **Forest covers 215M ha and still expanding**
- **Increments in forests exceed fellings**

Contents lists available at ScienceDirect

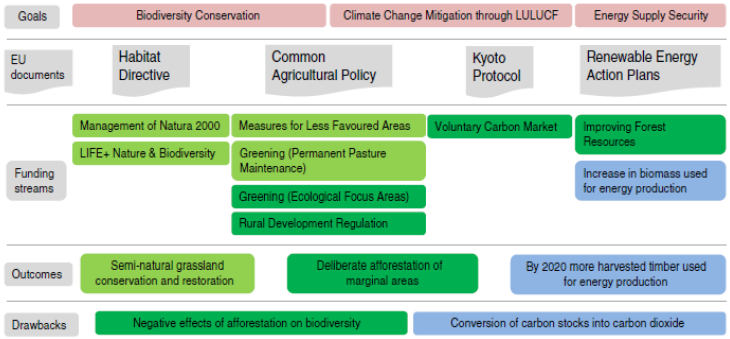
Biological Conservation

journal homepage: www.elsevier.com/locate/bioc

Discussion

Current European policies are unlikely to jointly foster carbon sequestration and protect biodiversity

Sabina Burrascano [a,*], Milan Chytrý [b], Tobias Kuemmerle [c,d], Eleonora Giarrizzo [a], Sebastiaan Luyssaert [e,f], Francesco Maria Sabatini [c], Carlo Blasi [a]



Rewilding is not always the best (and only) solution… even for biodiversity and ES provisioning!

Forest Ecology and Management

Volume 432, 15 January 2019, Pages 707-717

Biodiversity response to forest structure and management: Comparing species richness, conservation relevant species and functional diversity as metrics in forest conservation

Chiara Lelli [a], Hans Henrik Bruun [b], Alessandro Chiarucci [a], Davide Donati [a], Fabrizio Frascaroli [a], Örjan Fritz [c], Irina Goldberg [d], Juri Nascimbene [a], Anders P. Tøttrup [d], Carsten Rahbek [d], Jacob Heilmann-Clausen [d]

OPEN ACCESS Freely available online

PLOS ONE

The Impact of Land Abandonment on Species Richness and Abundance in the Mediterranean Basin: A Meta-Analysis

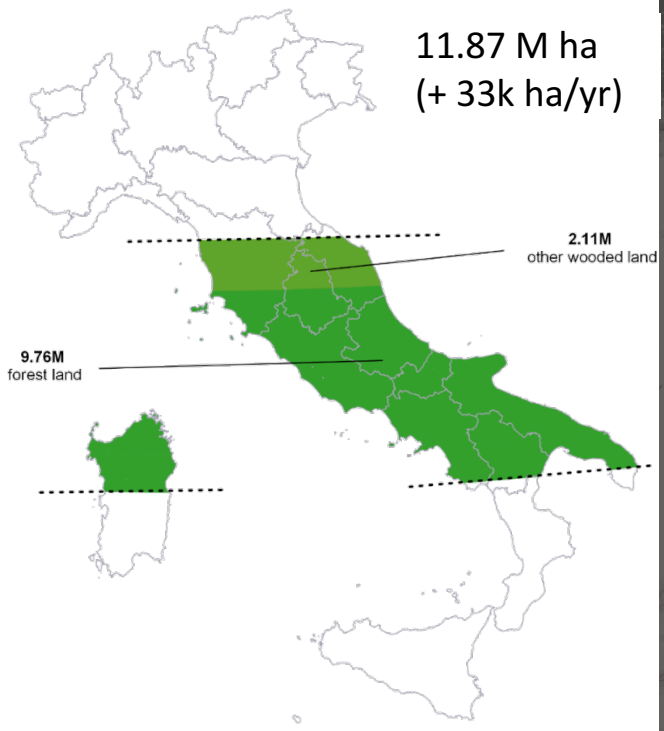
Tobias Plieninger[1]*, Cang Hui[2,3], Mirijam Gaertner[2], Lynn Huntsinger[4]

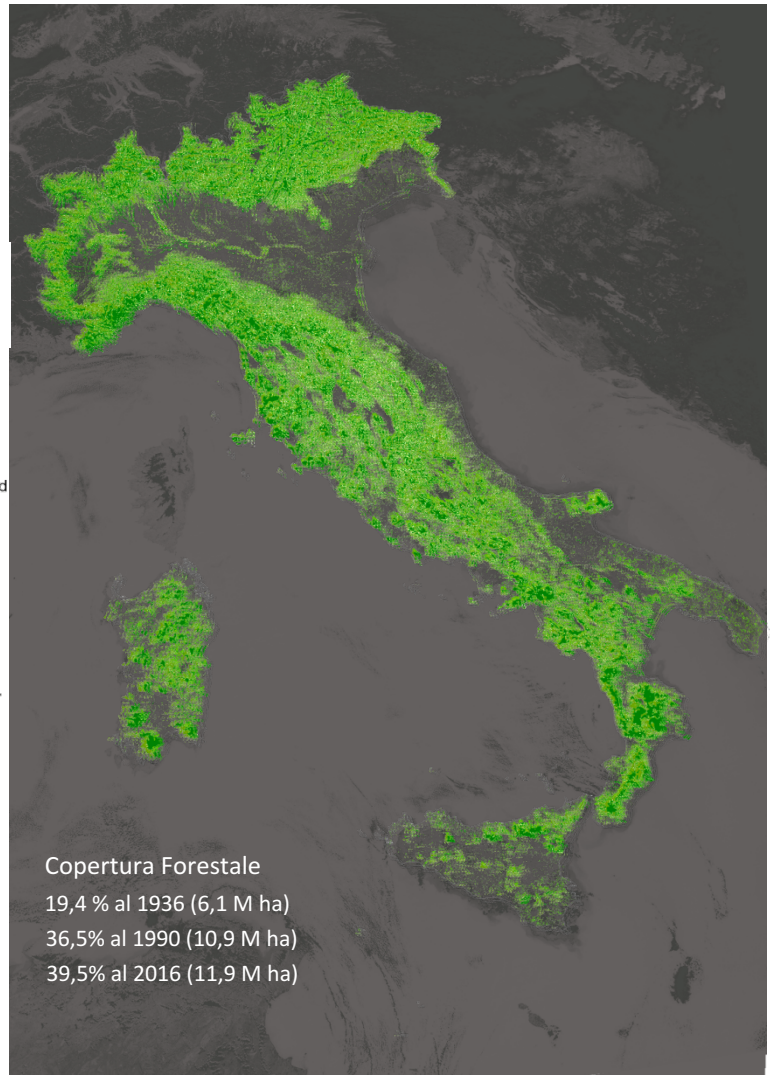
1 Department of Geosciences and Natural Resource Management, University of Copenhagen, Frederiksberg, Denmark, 2 Centre for Invasion Biology, Department of Mathematical Sciences, Stellenbosch University, Matieland, South Africa, 3 Mathematical and Physical Biosciences, African Institute for Mathematical Sciences, Cape Town, South Africa, 4 Department of Environmental Science, Policy, and Management, University of California, Berkeley, California, United States of America

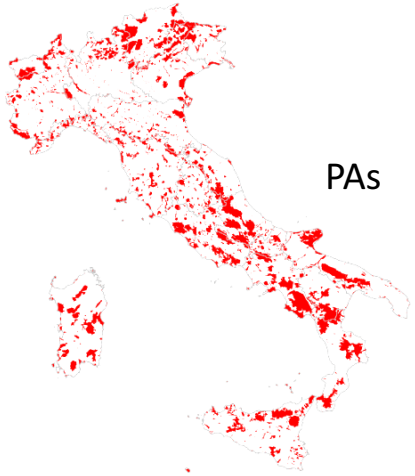
Abstract

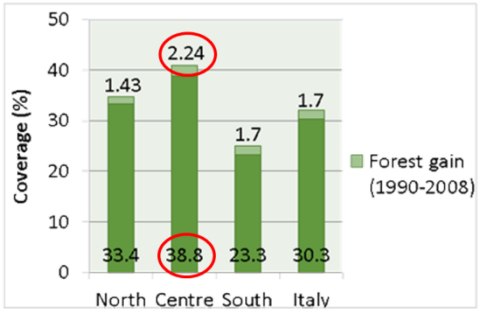
Land abandonment is common in the Mediterranean Basin, a global biodiversity hotspot, but little is known about its impacts on biodiversity. To upscale existing case-study insights to the Pan-Mediterranean level, we conducted a meta-analysis of the effects of land abandonment on plant and animal species richness and abundance in agroforestry, arable

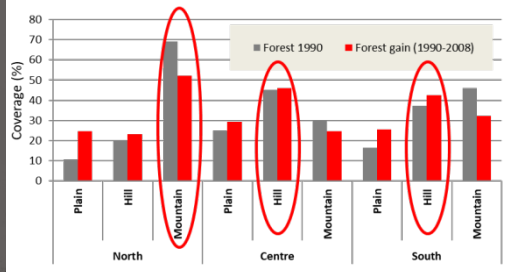
Forest area 1936 - 2016





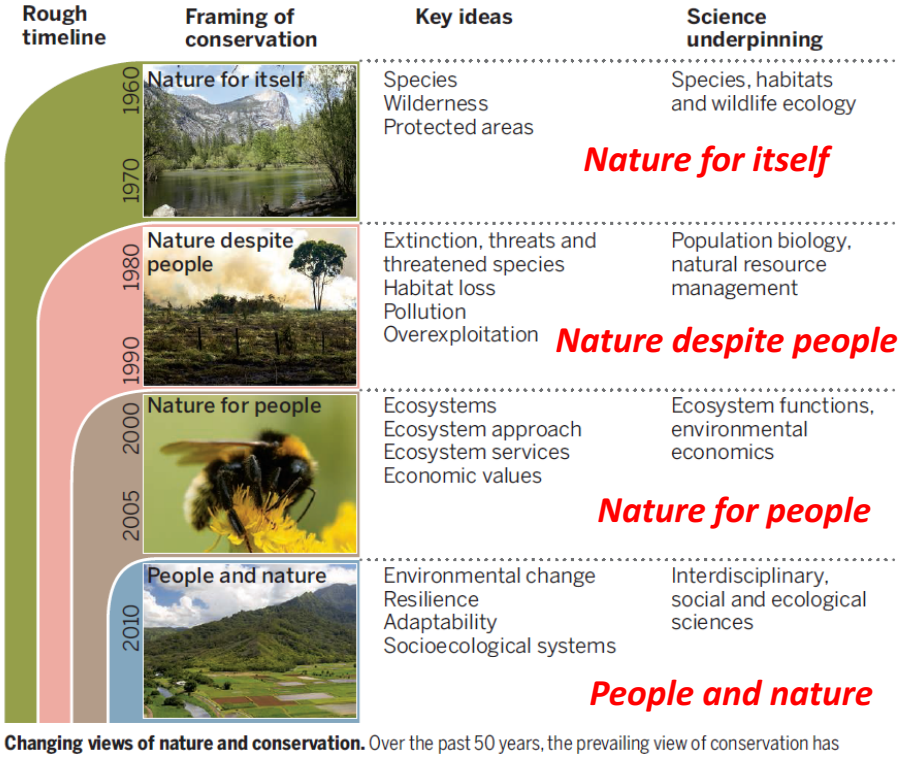






Rediscuss roles and opportunities for protected areas in a changing World

Mace (2014)

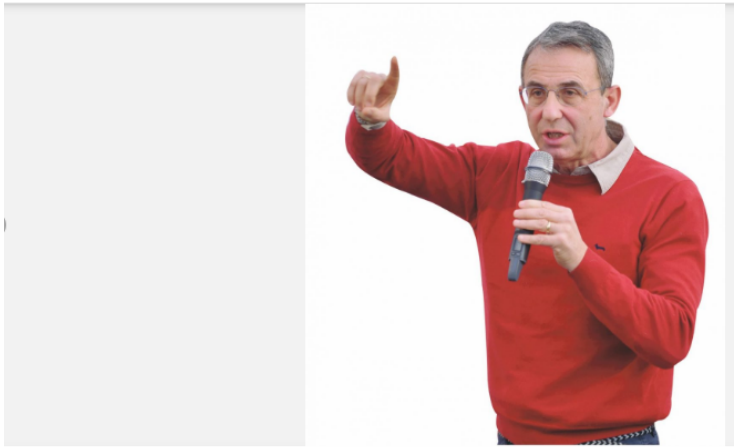


Changing views of nature and conservation. Over the past 50 years, the prevailing view of conservation has

» ITALIA

Ambiente, intervista al ministro Costa: "I giovani salveranno il clima. Ora sogno un Paese-Parco"

Incentivi fiscali e meno burocrazia per chi voglia entrare nelle aree tutelate: "Stiamo diventando un traino per l'Europa"



di Virginia Della Sala | 11 Marzo 2019

"***To handle the Anthropocene's triple challenge: preventing biodiversity loss, mitigating - adapting to climate change, sustainably providing resources for a growing human population?***" (Kremen and Merenlender, 2018)

Working lands conservation emphasizes the critical role of managing the matrix for species conservation to complement PAs

PAs as a «model» for sustainable development and intensification?

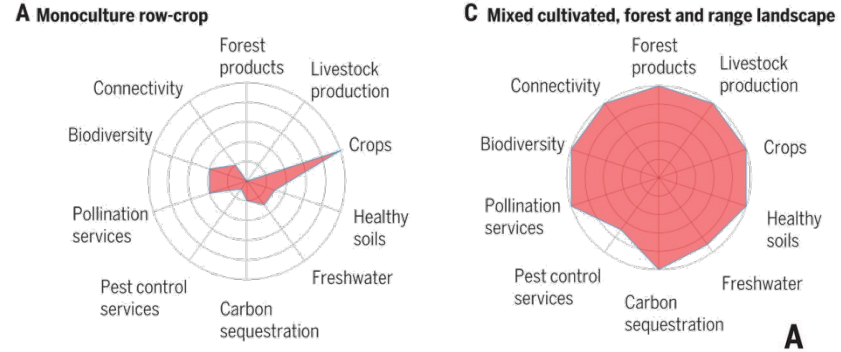
How to deal with working landscape

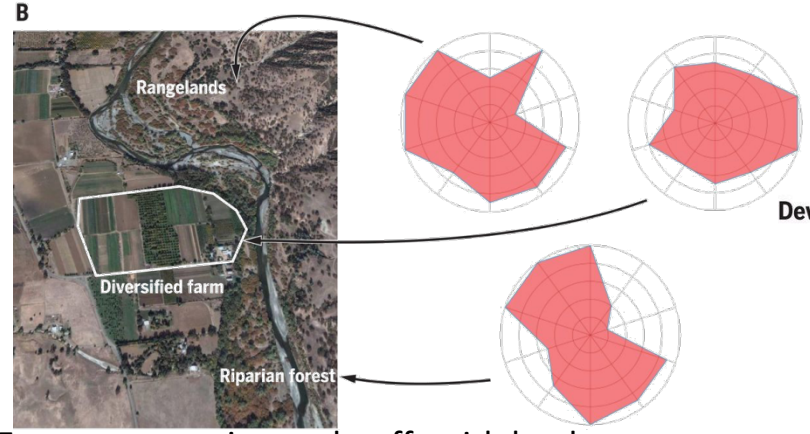
REVIEW SUMMARY

CONSERVATION

Landscapes that work for biodiversity and people

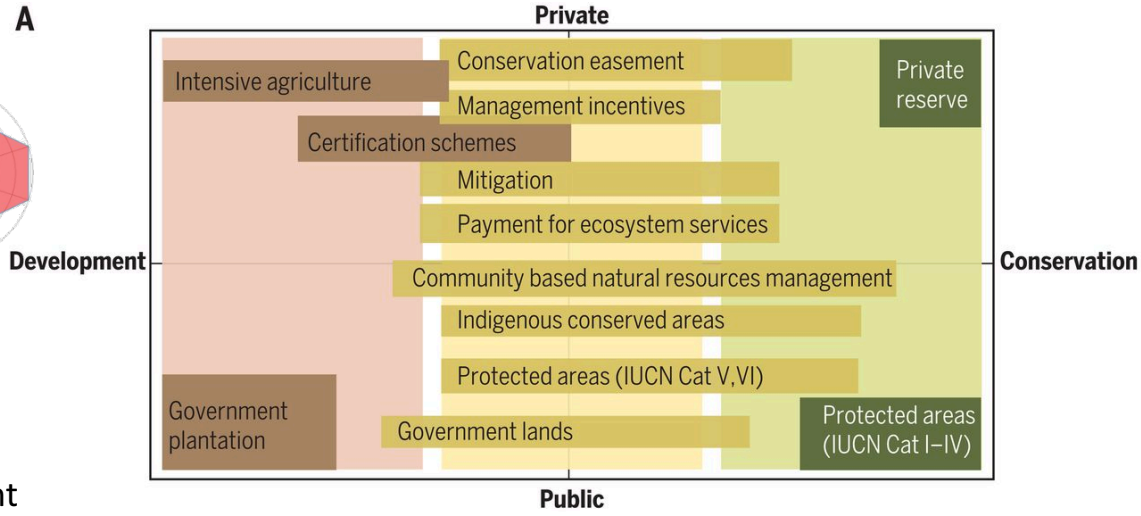
C. Kremen* and A. M. Merenlender

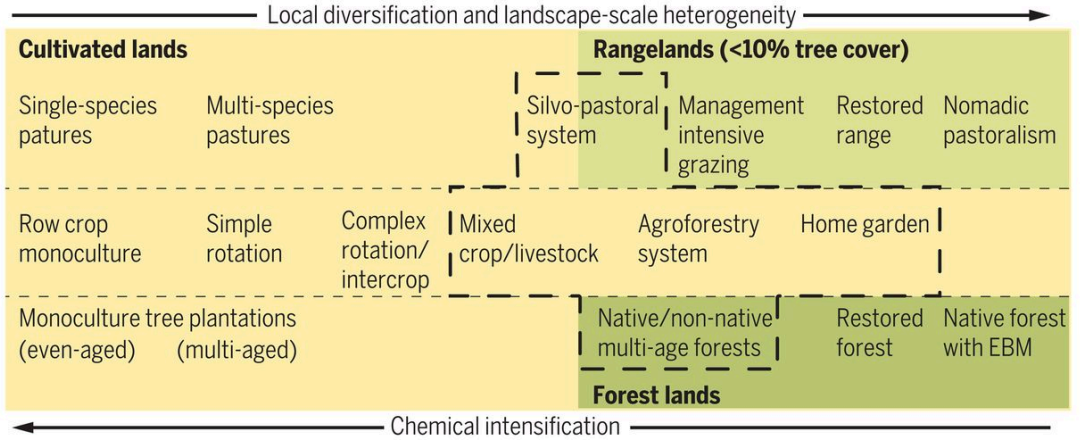




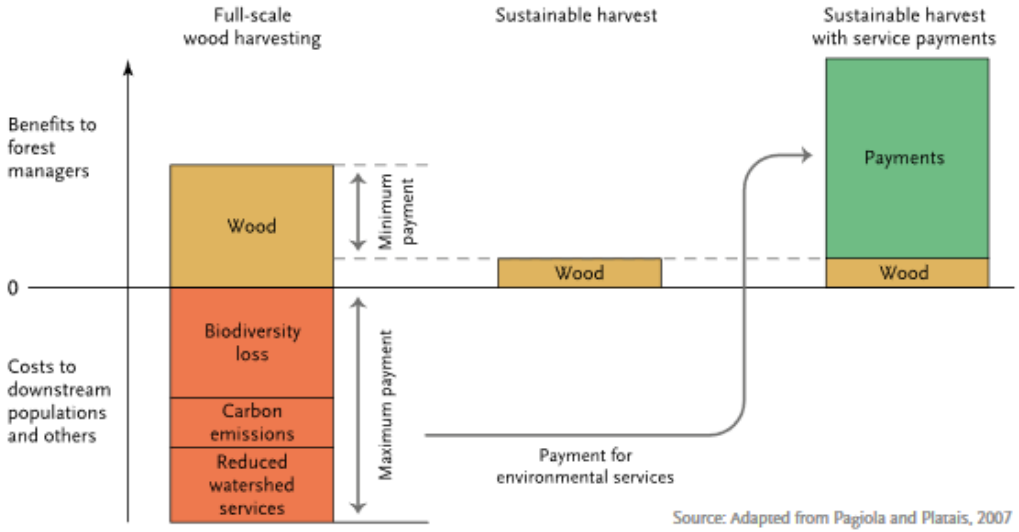
Ecosystem service trade-offs with land management

Approaches for conservation of working lands occupy the space (yellow) between highly developed (brown) and highly conserved (green) land uses



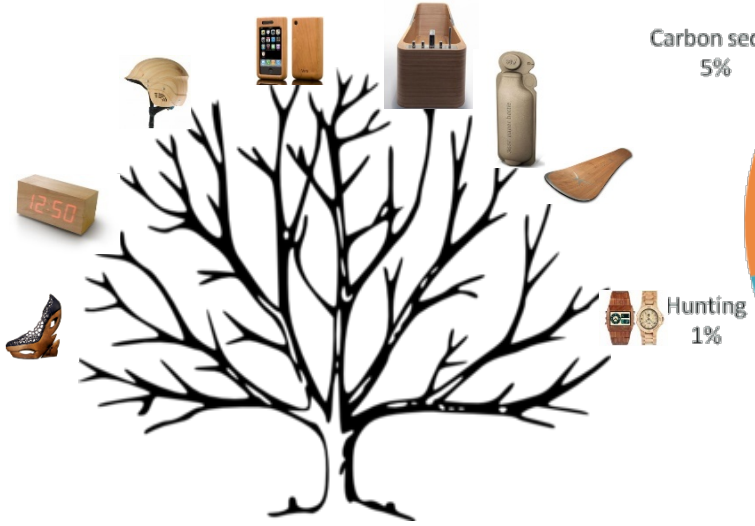


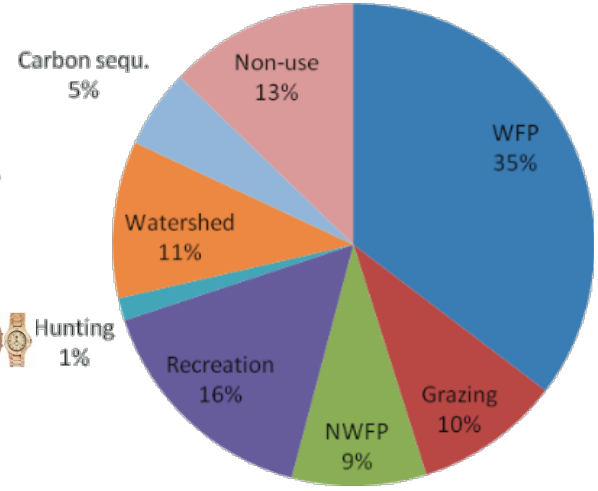
Opportunities for sustainability purposes



*Instruments able to **support forest management** in **balancing ecosystems services and their trade-offs** to improve promote **sustainable development** through **bioeconomy***

A wide range of products and services supporting **human wellbeing** and **local economies**

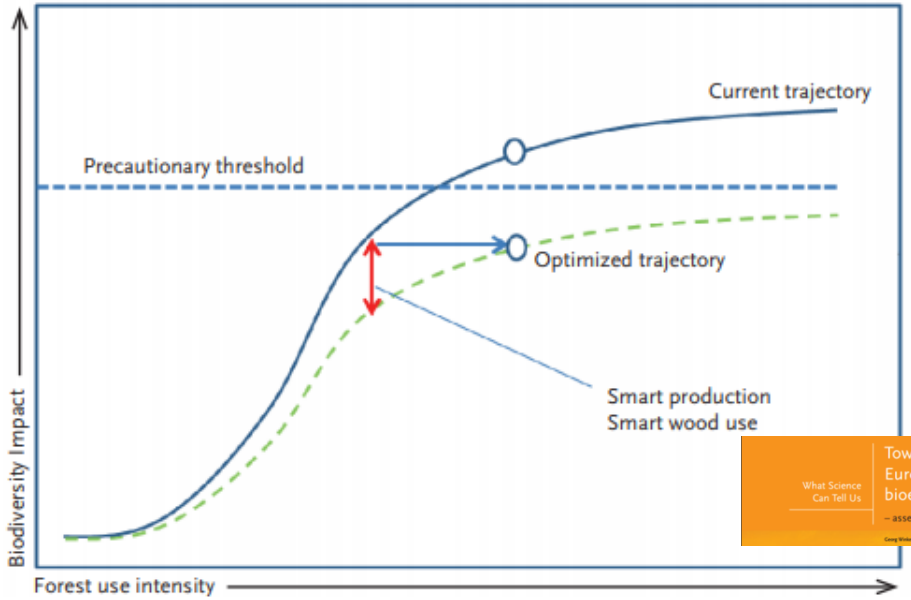




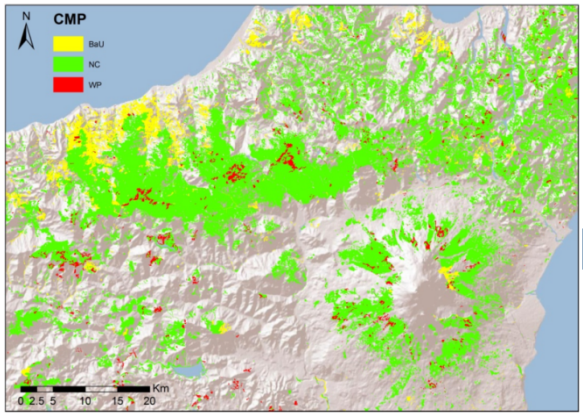
Composition of the Total Economic Value of Mediterranean Forests (source: Merlo & Croitoru 2005)

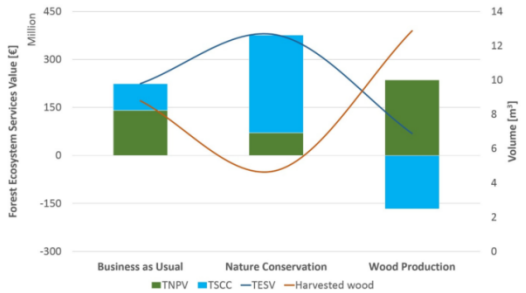
- ***NWP- non wood forest products;***
- ***WFP- wood forest products;***
- ***non- use: bequest and existence value***

The possibility to consider a sustainable intensification in forestry

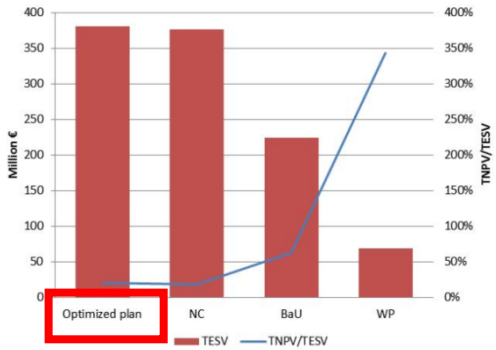


Optimized Forest Management Plan





1. Use of **mixed-species forests** (**> productivity**, **resistance**, **resilience and complexity**)
2. **Intensification** in **selected parts** of forest landscape for the **best balance and trade-offs** among multiple ES (**from parcel to landscape sustainability**)
3. **More efficient use of wood** to **reduce forest harvesting**
4. **I**mplementation of **new technologies and approaches to Smart Forestry** (http://climo.unimol.it/) (big data, RS, Lidar, DSS etc.)




sustainability
MDPI
Article
The MIMOSE Approach to Support Sustainable Forest Management Planning at Regional Scale in Mediterranean Contexts
Matteo Vizzarri [1], Lorenzo Sallustio [1,*], Davide Travaglini [2], Francesca Bottalico [2], Gherardo Chirici [2], Vittorio Garfì [3], Raffaele Lafortezza [3,4], Donato Salvatore La Mela Veca [5], Fabio Lombardi [6], Federico Maetzke [5] and Marco Marchetti [1]

The need of improving data availability (and quality) to support national forest strategy

RaFITALIA

mipaaft
ministero delle politiche agricole alimentari, forestali e del turismo

RETERURALE NAZIONALE 20142020

Presentazione del rapporto nazionale sullo stato delle foreste e del settore forestale - RaF

(evento riservato alla stampa)

In occasione della **Giornata internazionale delle foreste** il Ministero delle politiche agricole al
e del turismo presenta il primo Rapporto nazionale sullo stato delle foreste e del settor

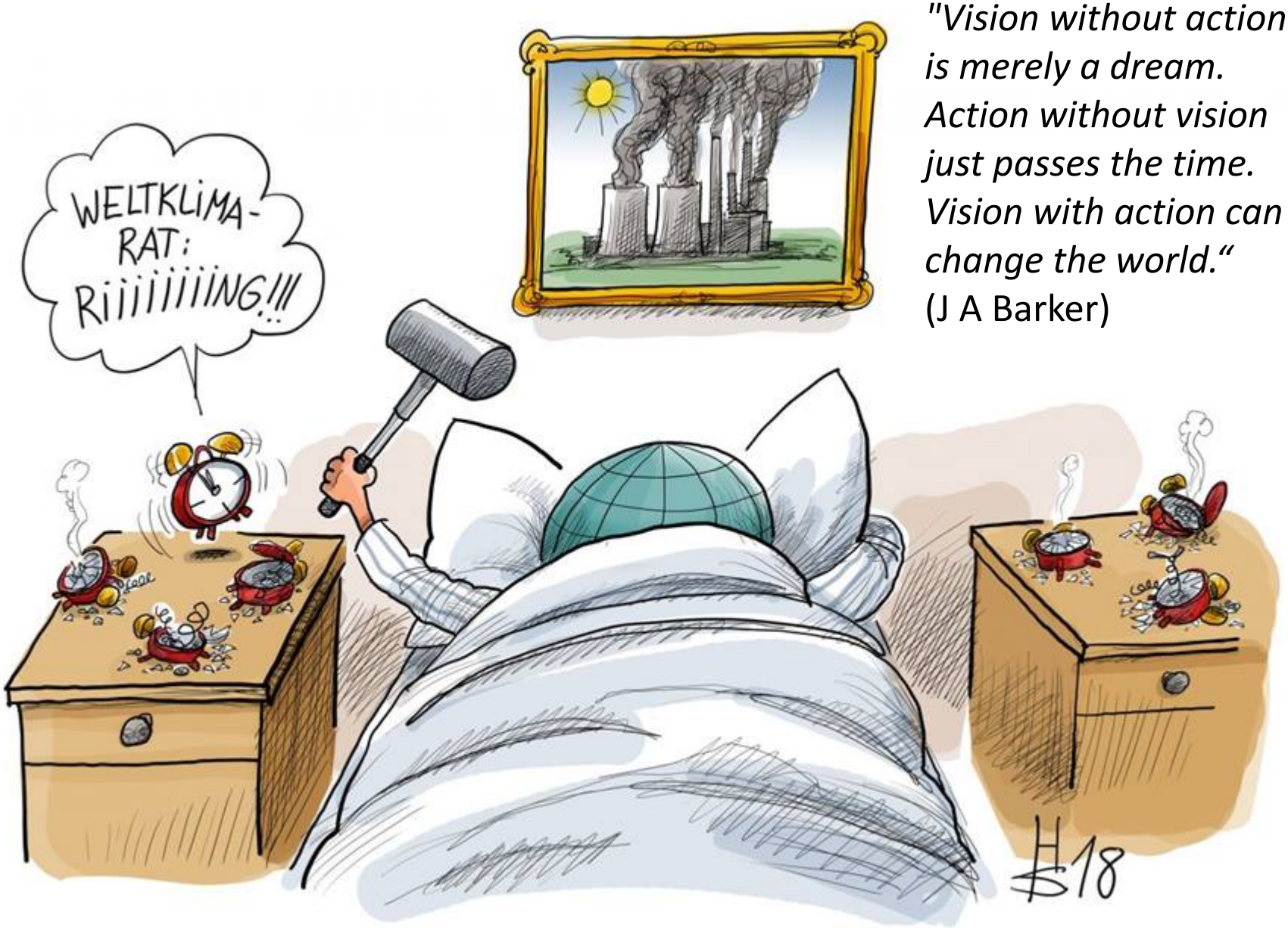
Giovedì 21 Marzo 2019 alle ore 10,30 presso il Mipaaft,
Roma, via XX settembre n. 20, Sala Cavour, ore 10:30

The State of Italian Forests, 2018

Forest Europe growing life

Food and Agriculture Organization of the United Nations

EFI



"Vision without action is merely a dream. Action without vision just passes the time. Vision with action can change the world."
(J A Barker)

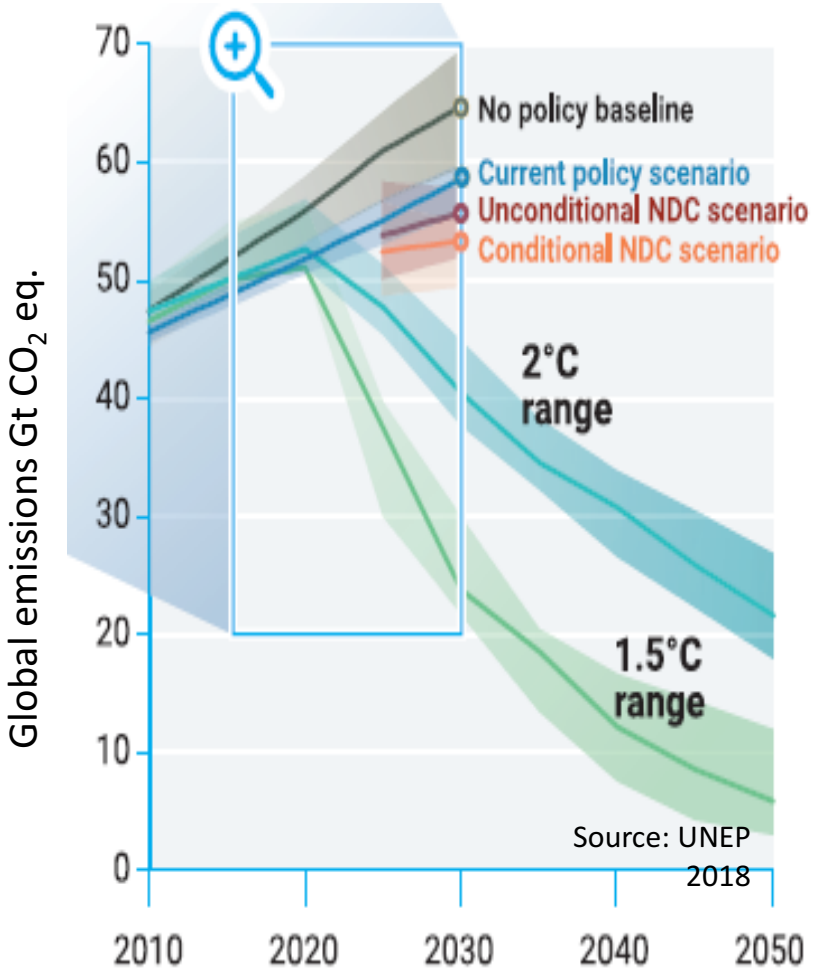
EUROPEAN FOREST INSTITUTE

Climate-Smart Forestry: the missing link

Hans Verkerk

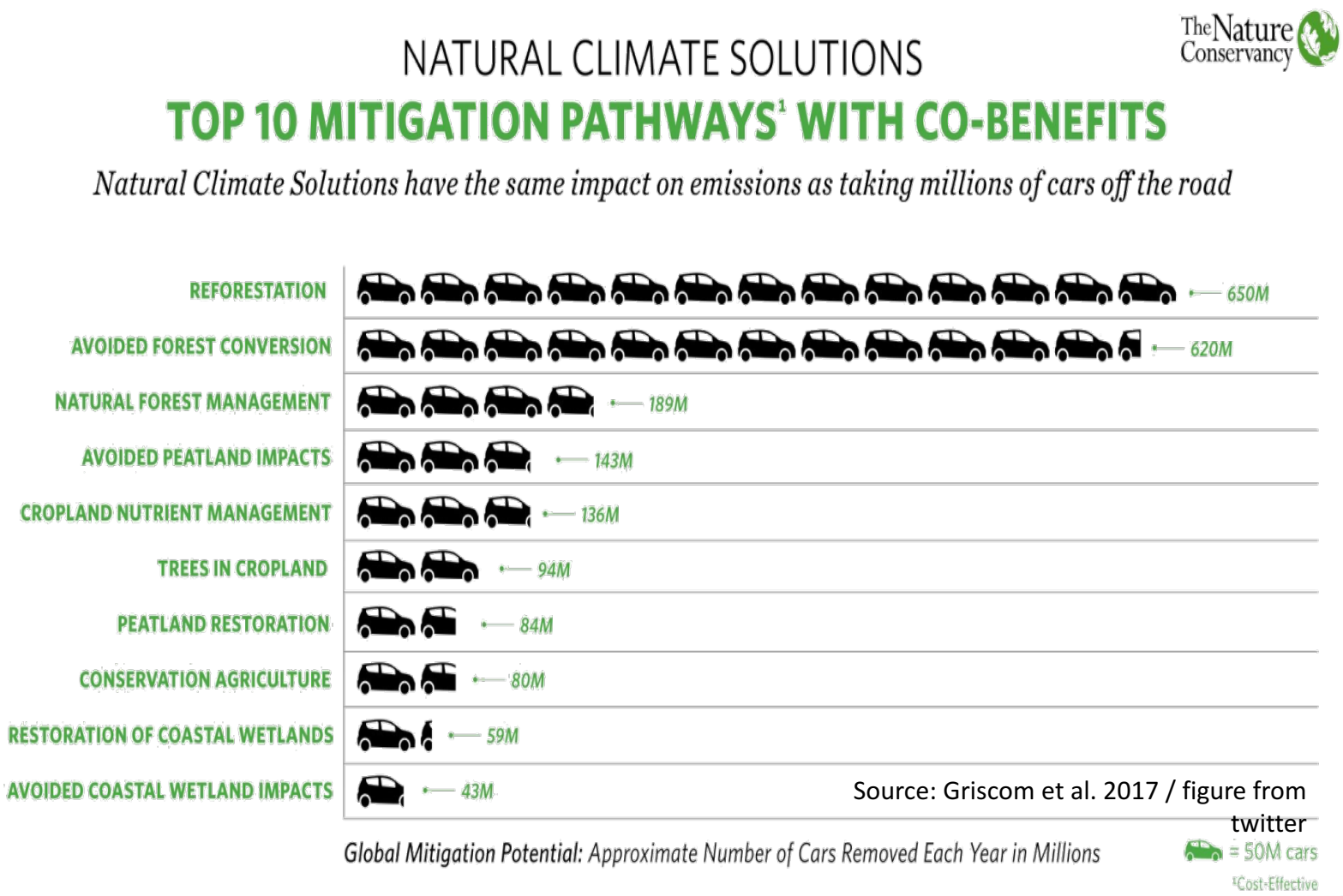
CMCC-EFI webinar, 21 March 2019

Global greenhouse gas emission trajectories



- Current policies and plans are inadequate to bridge the emission gap between *"where we are likely to be"* and *"where we need to be"*
- Urgent action needed to reduce CO_2 emissions (and increase removals)
- Even if 1.5 or 2˚C targets are met, there will still be impacts on society, forests and other ecosystems

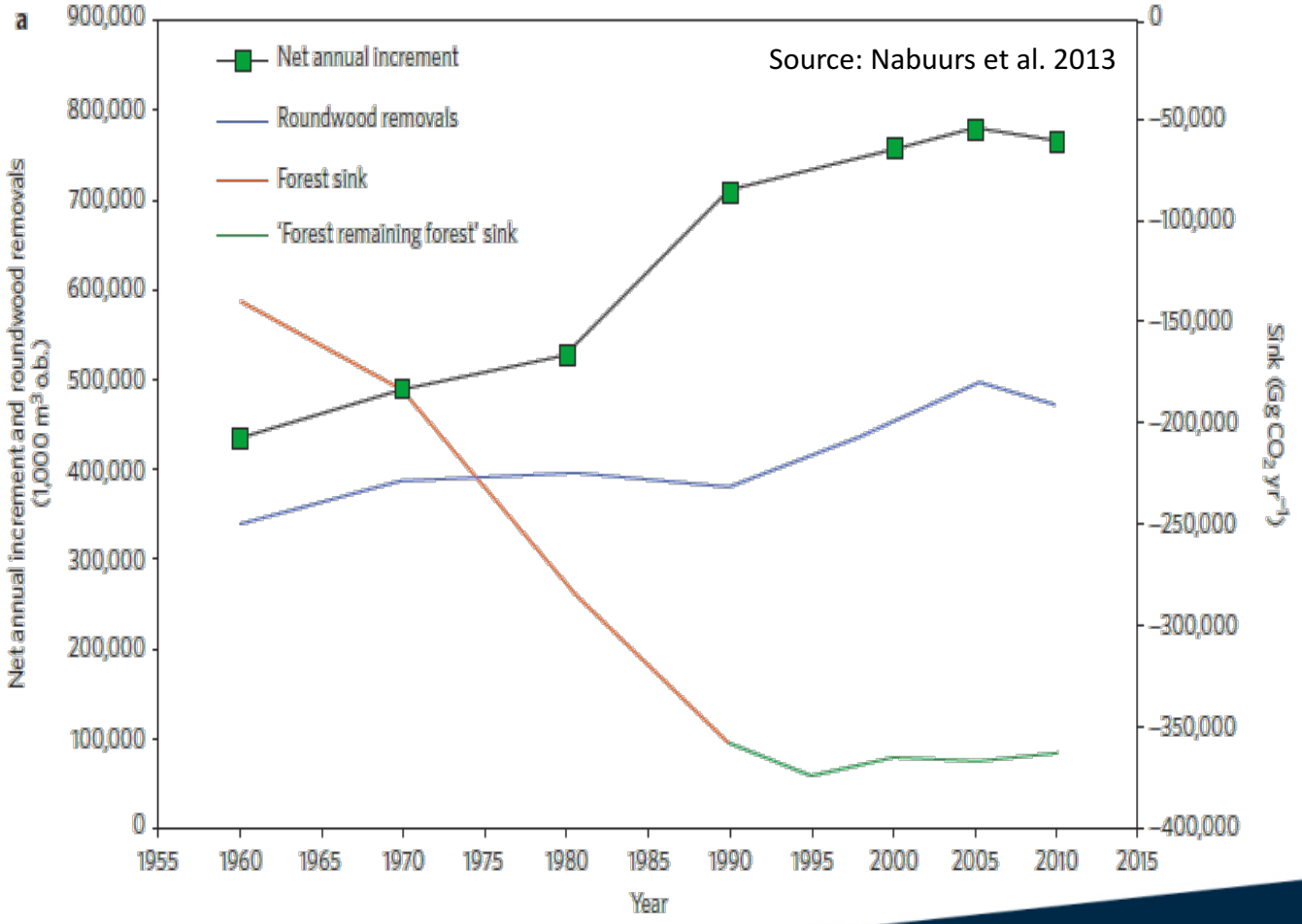
Natural climate solutions



Source: Griscom et al. 2017 / figure from twitter

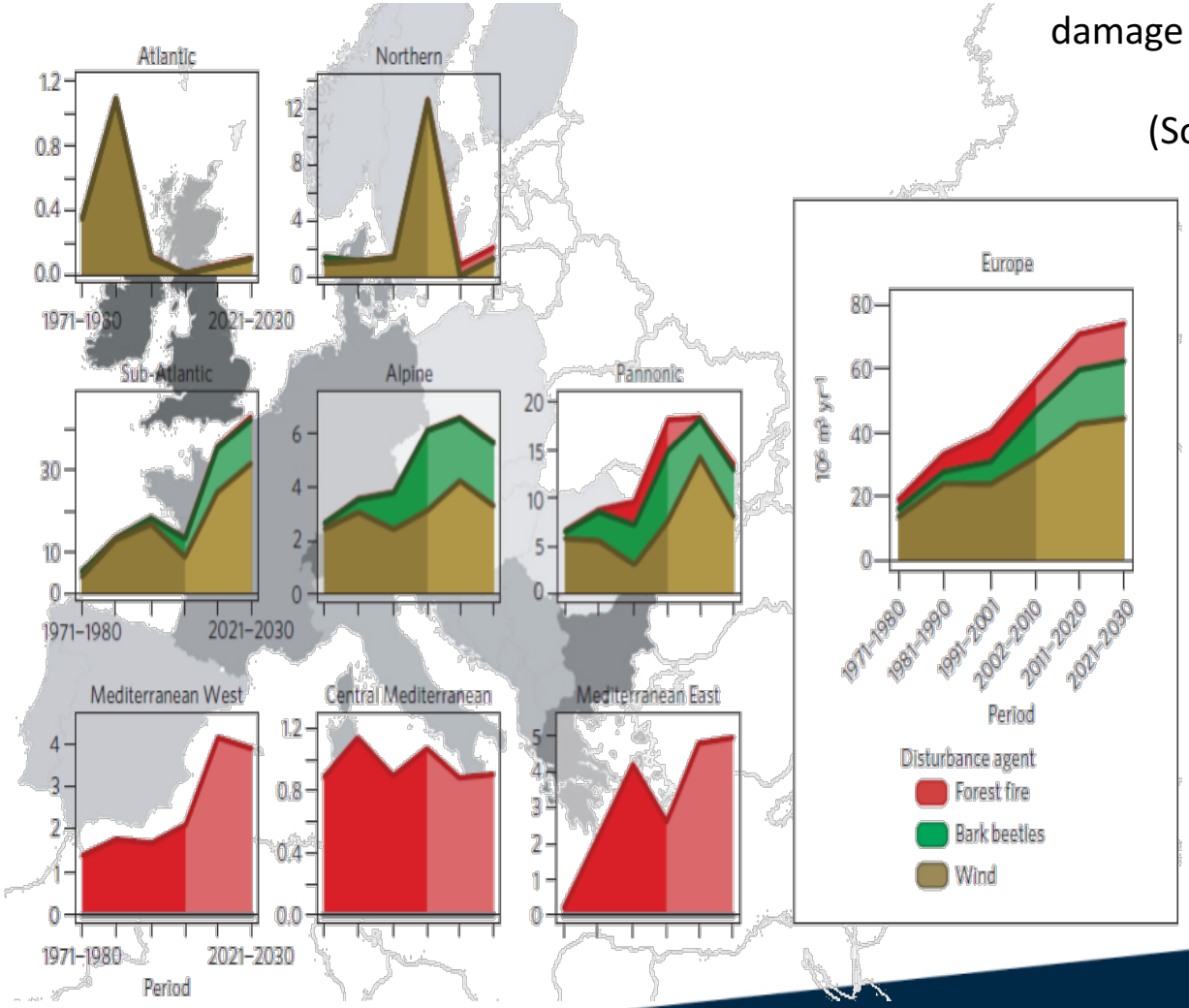
Natural climate solutions, but….

- A biological sink will eventually saturate



Natural climate solutions, but….

- Storing carbon in the forest is not free of risk



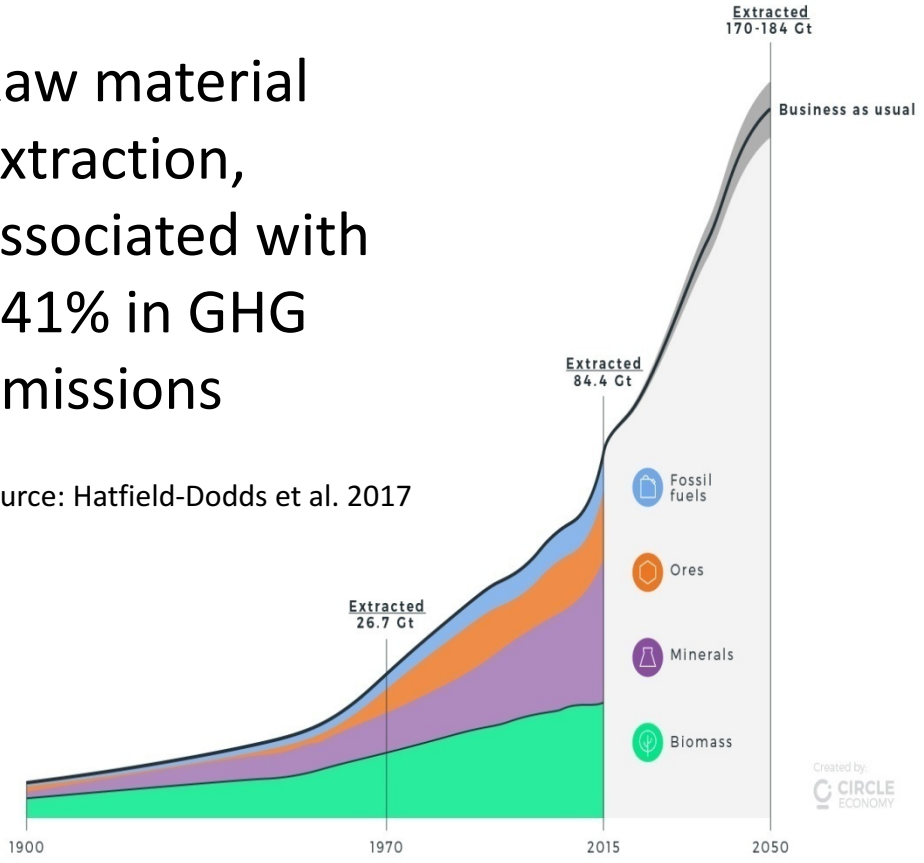
Forest disturbance damage in Europe 1971–2030 (Source: Seidl et al. 2014)

Natural climate solutions, but….

- There will be an increasing demand for materials to meet the demands by a growing and increasingly rich global population

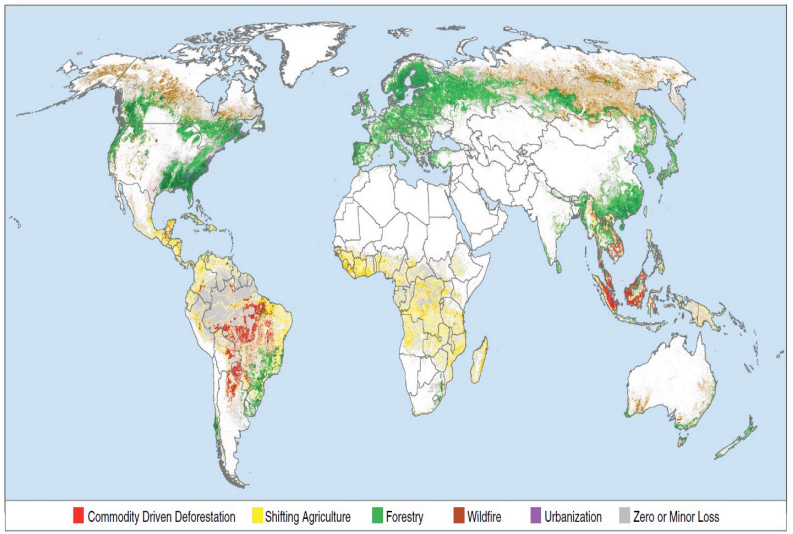
Raw material extraction, associated with +41% in GHG emissions

Source: Hatfield-Dodds et al. 2017



Climate-Smart Forestry

- Smart approaches are needed that are spatially diversified and combine mitigation and adaption;
- CSF builds on the concepts of sustainable forest management, but has a clear climate focus



Drivers of forest cover loss (source: Curtis et al. 2018)

- Key messages:

1. Enhance carbon storage in forest ecosystems;
2. Combine mitigation and adaptation measures in the management of forests;
3. Use wood sustainably and substitute non-renewable carbon-intensive materials.

Increasing carbon storage in forest ecosystems

- ”No brainers”
  - Increase global afforestation
  - Decrease global deforestion

- Improved management practices
  - Tree species and provenance selection, tending, thinning,….
  - Improved spatial planning of practices
  - Reduce / mitigate effects of disturbances
  - Some measures may take long to have effect, but should not be ignored!

Combine mitigation and adaptation measures

- Examples of CSF management options (Nabuurs et al. 2013; Astrup et al. 2018):


Photo: Snežana

- Conserve high carbon stocks in old forests that are not at a high risk of disturbance;
- Conserve high carbon stocks on sensitive sites, high soil carbon sites and steep slopes


Photo: Cameron Strandberg

- Activate and improve the management and protection of fire-prone forests to safeguard their carbon stocks;

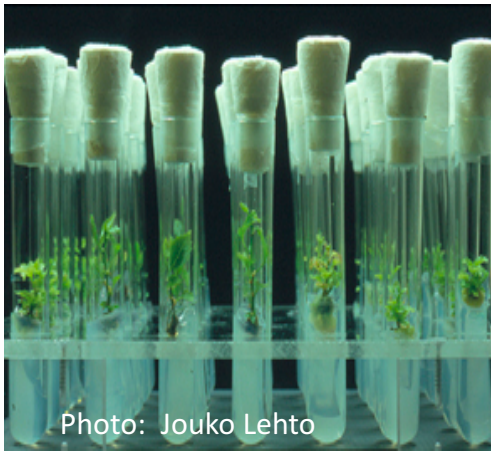


Photo: Jouko Lehto

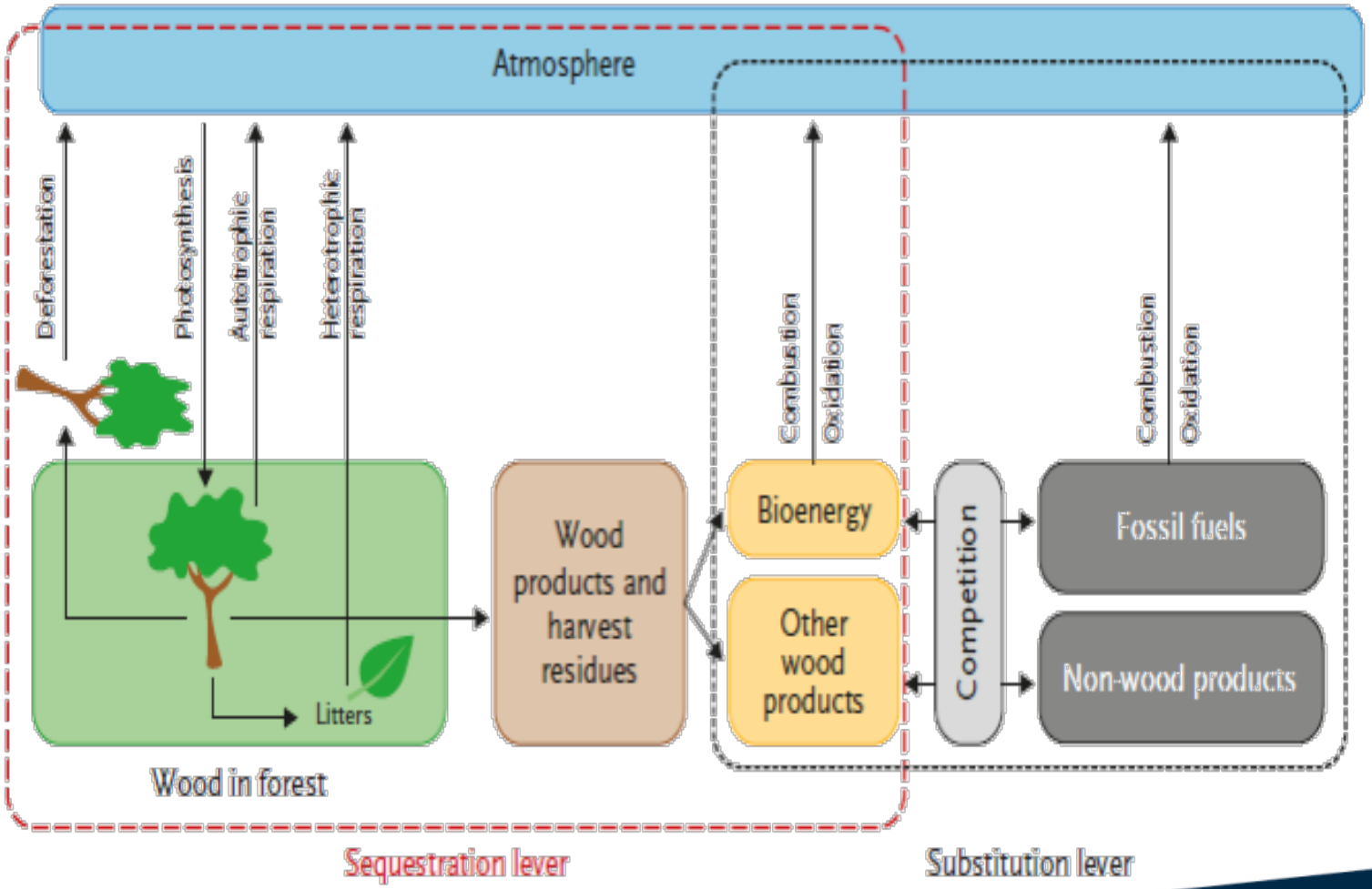
- Optimize silvicultural techniques (breeding material, planting, tending and harvesting) to arrive at a carbon-efficient management scheme in forests that are grown primarily for timber


Photo: Magnifica Comunita di Fiemme

- Actively manage (mature) forests that are at high risk of disturbance;
- Increase share of broadleaves to increase resilience to disturbances

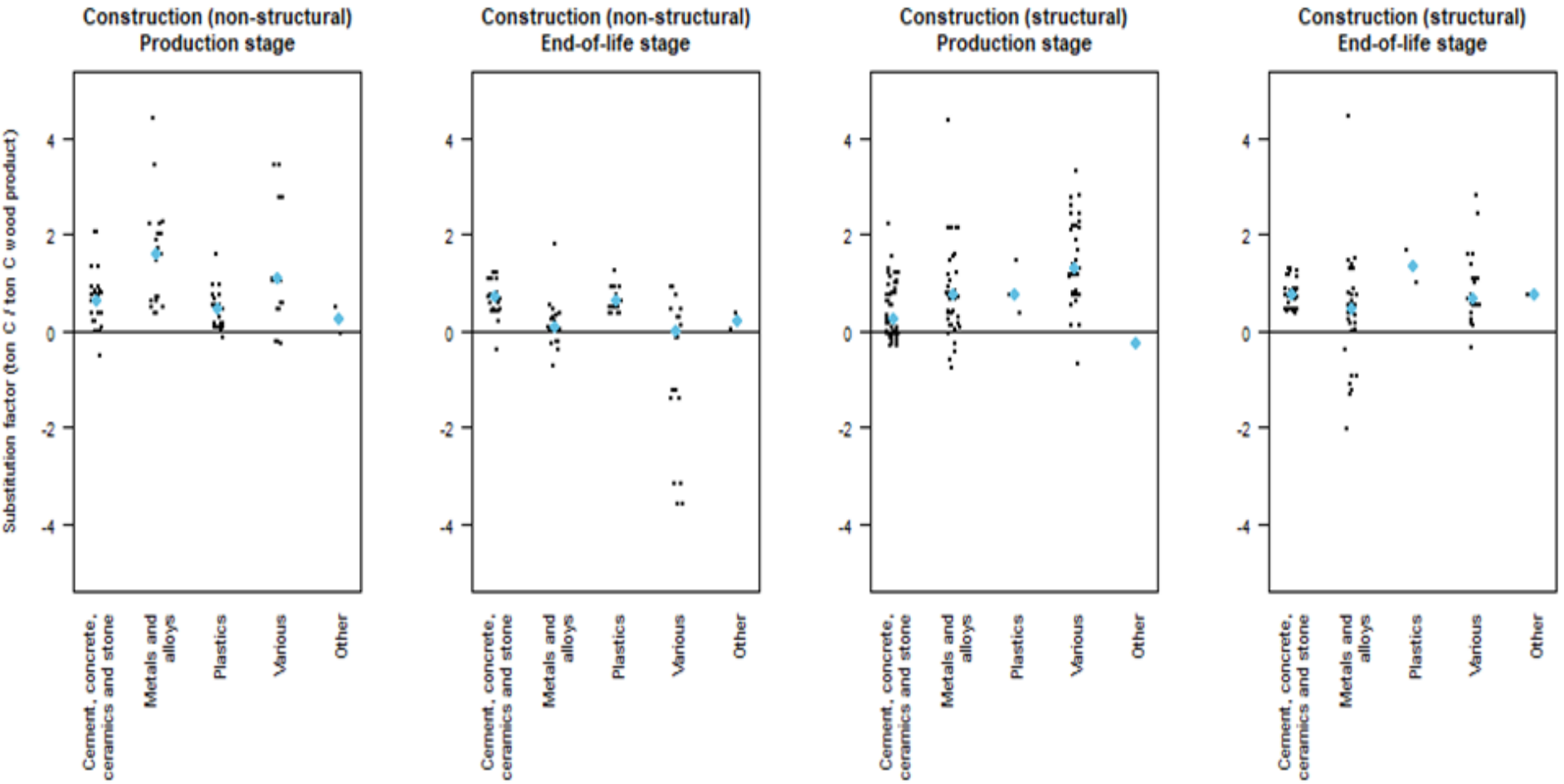
Sustainable use and substitution

Source: Nabuurs et al. 2015



Sustainable use and substitution

- New evidence from a meta-review the literature (Leskinen et al. / Verkerk et al.) :
  - Average substitution around 1.2 kg C / kg C (or 2.2 kg CO_2 / kg product)



Sustainable use and substitution

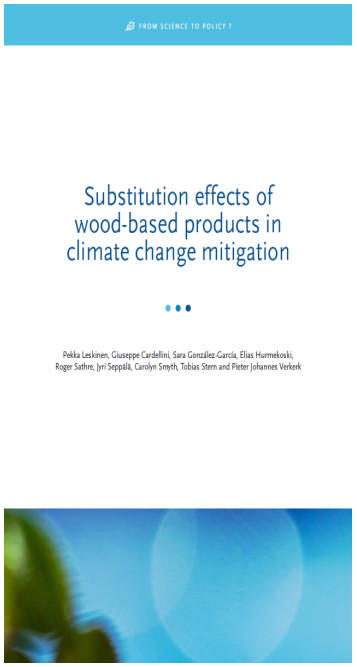
- Role of new wood-based products:
  - Provide new value chains and revenues;
  - Substitute fossil-intensive materials and reduce emisisons;
  - Activate forest management (through new value chains and investments).


Concluding remarks

- Diverse forest management practices need to consider both mitigation and adaptation and local conditions;
- Succesful strategies need to consider carbon balances of forest ecosystems, wood products and substitution effects, in the long-term;
- Better understanding needed of substitution effects, especially of newly emerging wood-based products;
- Better understanding needed on all effects on climate, not just carbon or CO_2

PublicDomainPictures; Pixabay

Further reading



https://efi.int/publications-bank

EUROPEAN FOREST INSTITUTE

Thank you!

hans.verkerk@efi.int

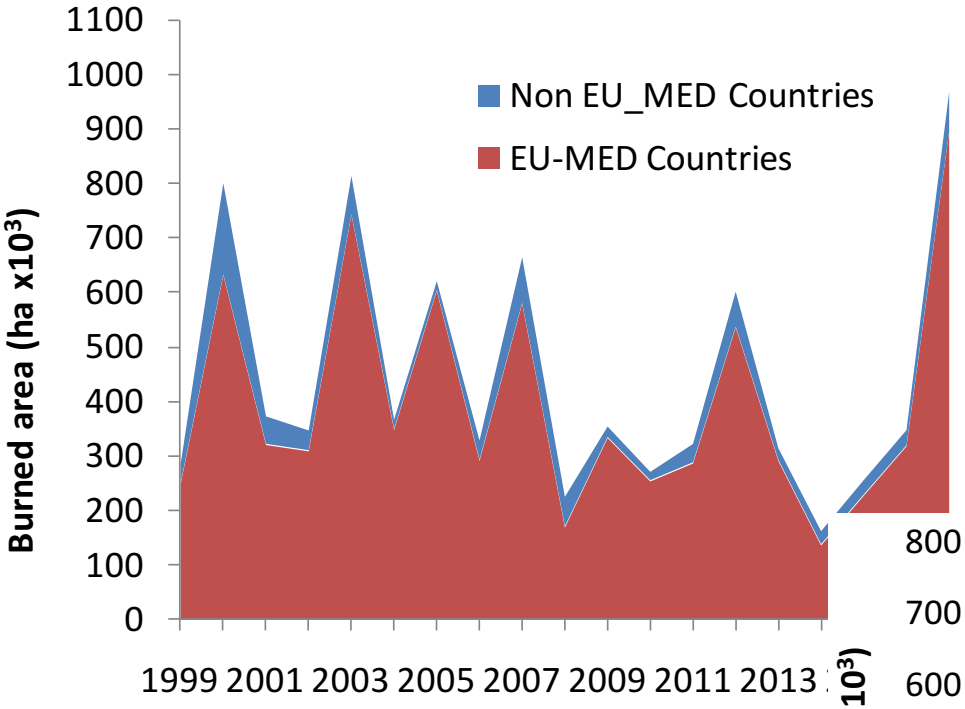
Managing forest fire to cope with climate change: adaptation and mitigation strategies

Donatella Spano,
University of Sassari and CMCC Foundation

CMCC-EFI Webinar "Forests: solutions and perspectives to fight climate change"
21-03-2019

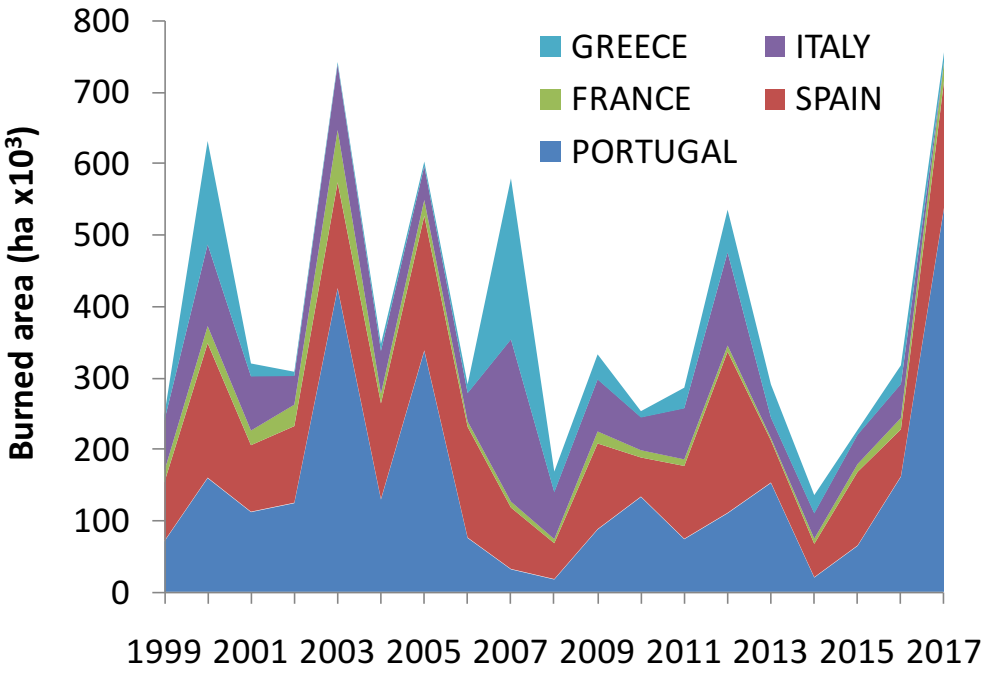
Centro Euro-Mediterraneo sui Cambiamenti Climatici

SETTING THE SCENE



← *Annual burned area (ha) EU-Med countries (PT, ES, IT, GR, FR) compared with other Non EU-Med countries*

Annual burned area (ha) by country →



Source: our elaboration from EFFIS data

SETTING THE SCENE

Wildfire' impacts in the EU (2000-2017)

8.5 mln ha

480.000 ha/yr

611 people

34 people /yr

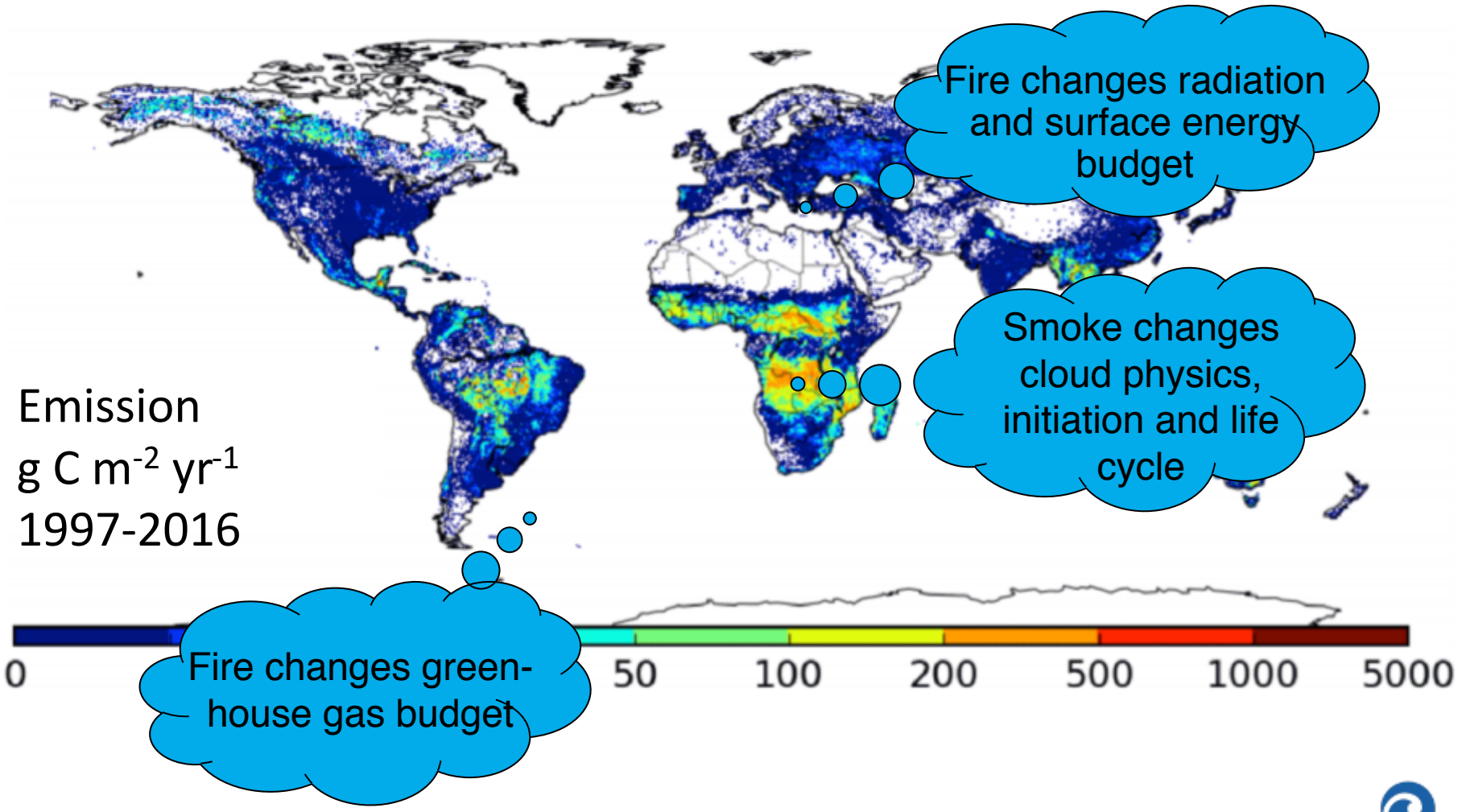
54 bn euros

3000 mln/yr

Source: San-Miguel-Ayanz et al., 2018

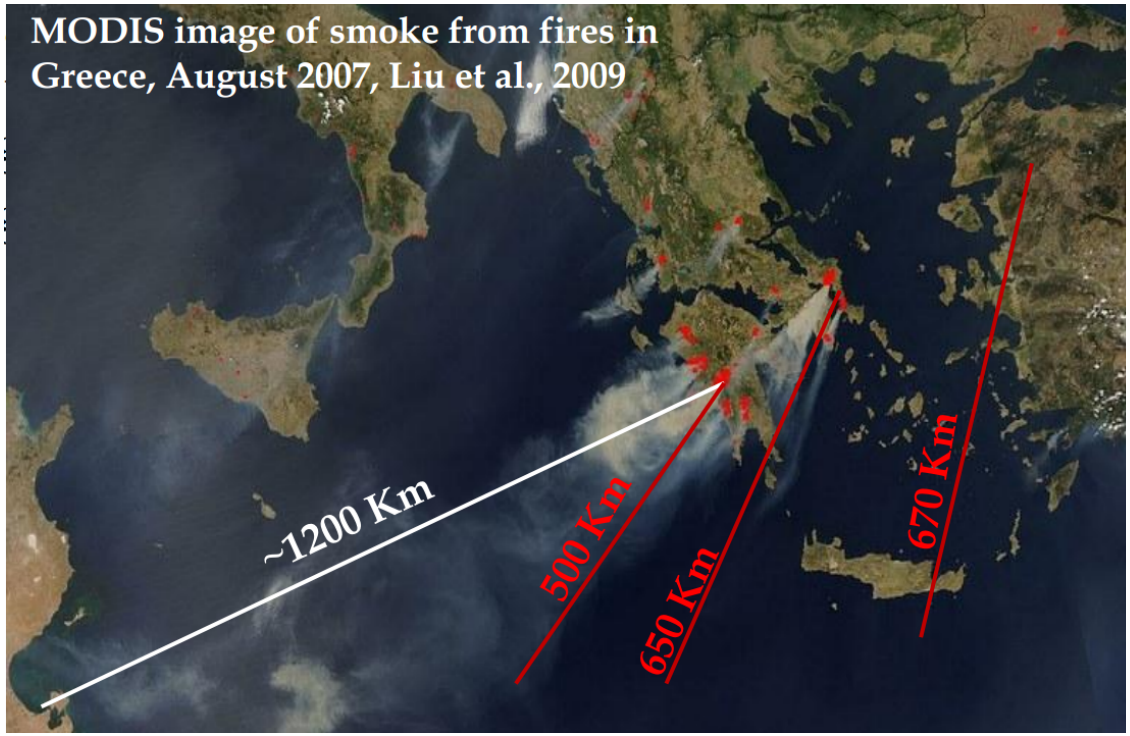
FIRE IMPACTS

Significant source of C emissions → 2160 Tg C year^{-1}



Source: Van der Werf et al., 2017

FIRE IMPACTS ON AIR QUALITY

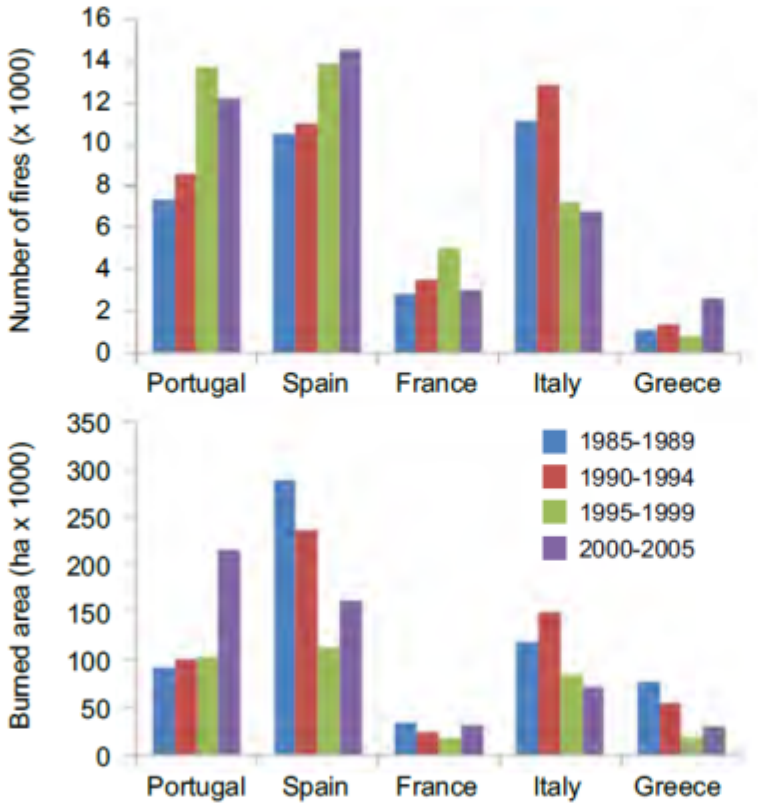


- Public health and safety
  - -Nuisance
  - -Visibility
  - -Ozone generation
  - -Regional haze impacts

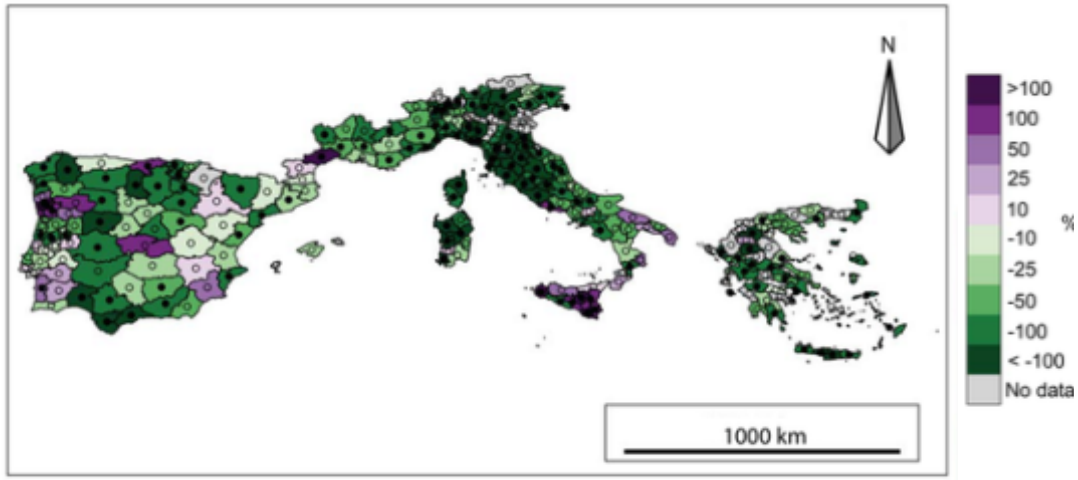
RECENT CHANGES

Trends of the annual burned area

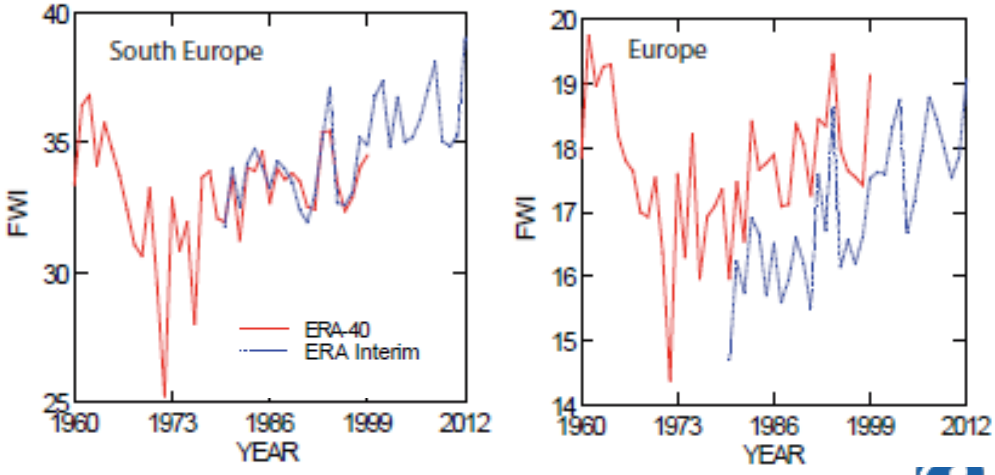
1985-2011



Evolution of average fire number and area burned



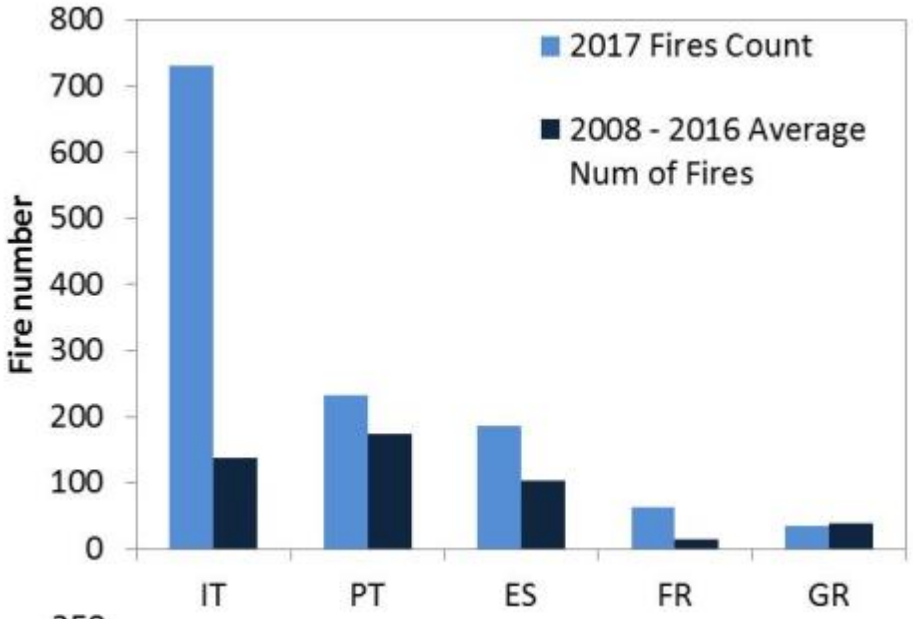
Year-to-year variation of March–September mean FWI from ERA-40 and ERA Interim data sets

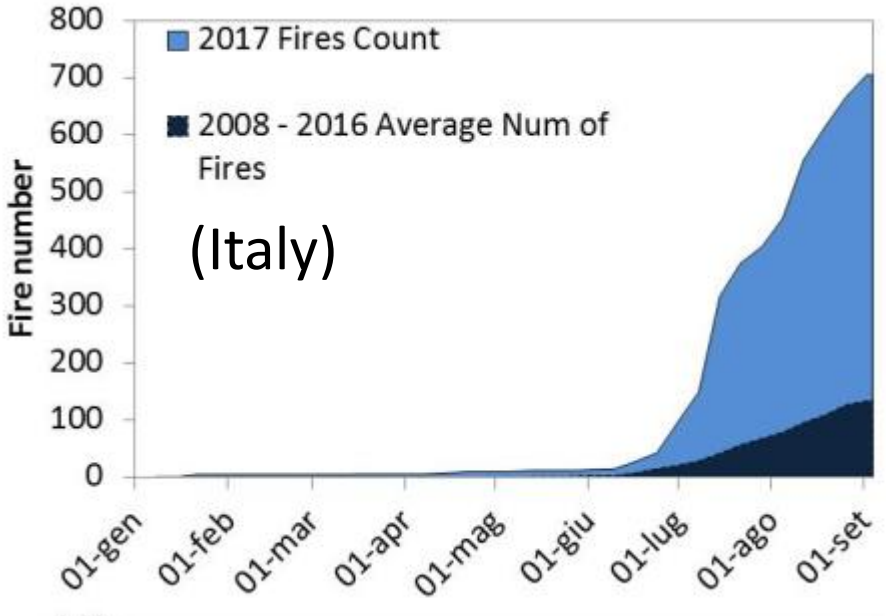


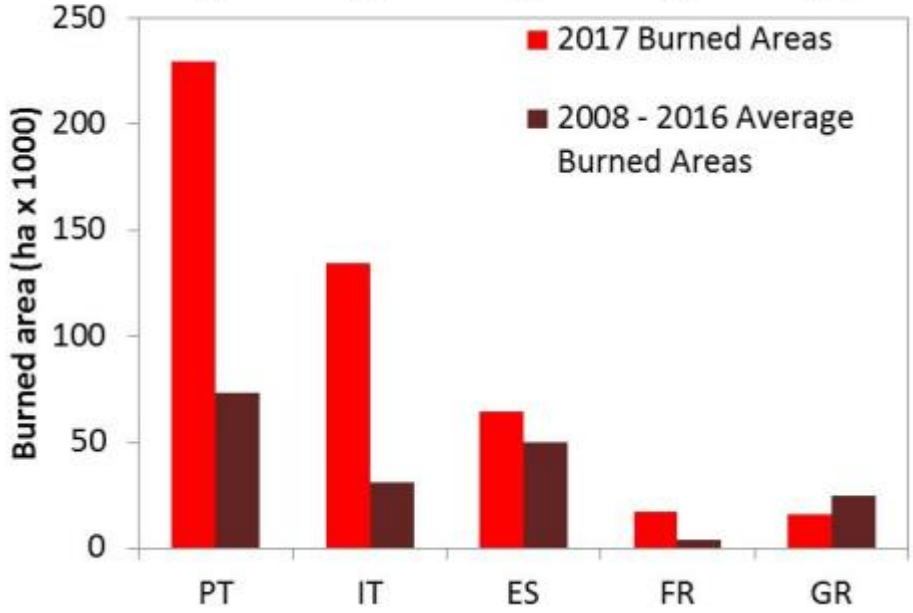
Source: Spano et al., 2014; Turco et al., 2016; Venäläinen et al., 2014

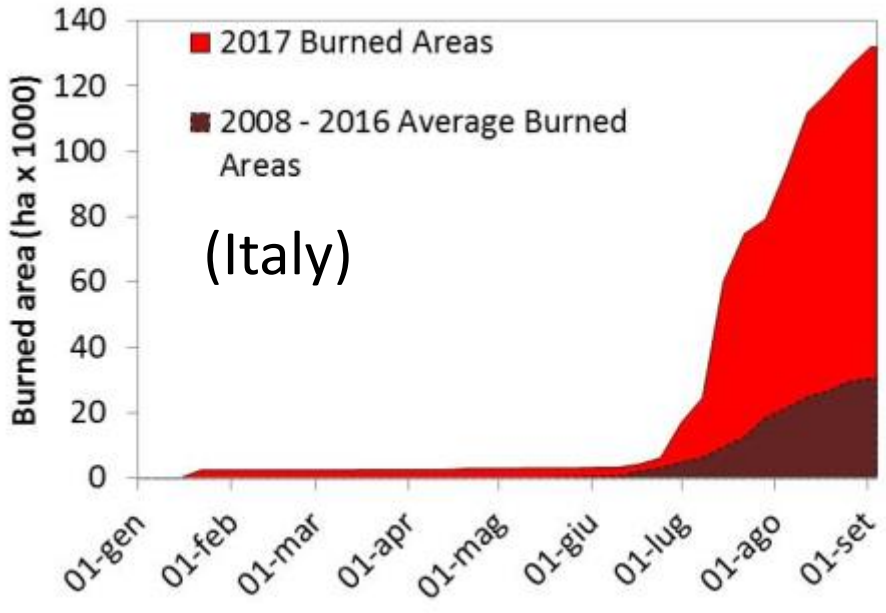
EXTREME EVENTS

Source: http://effis.jrc.ec.europa.eu





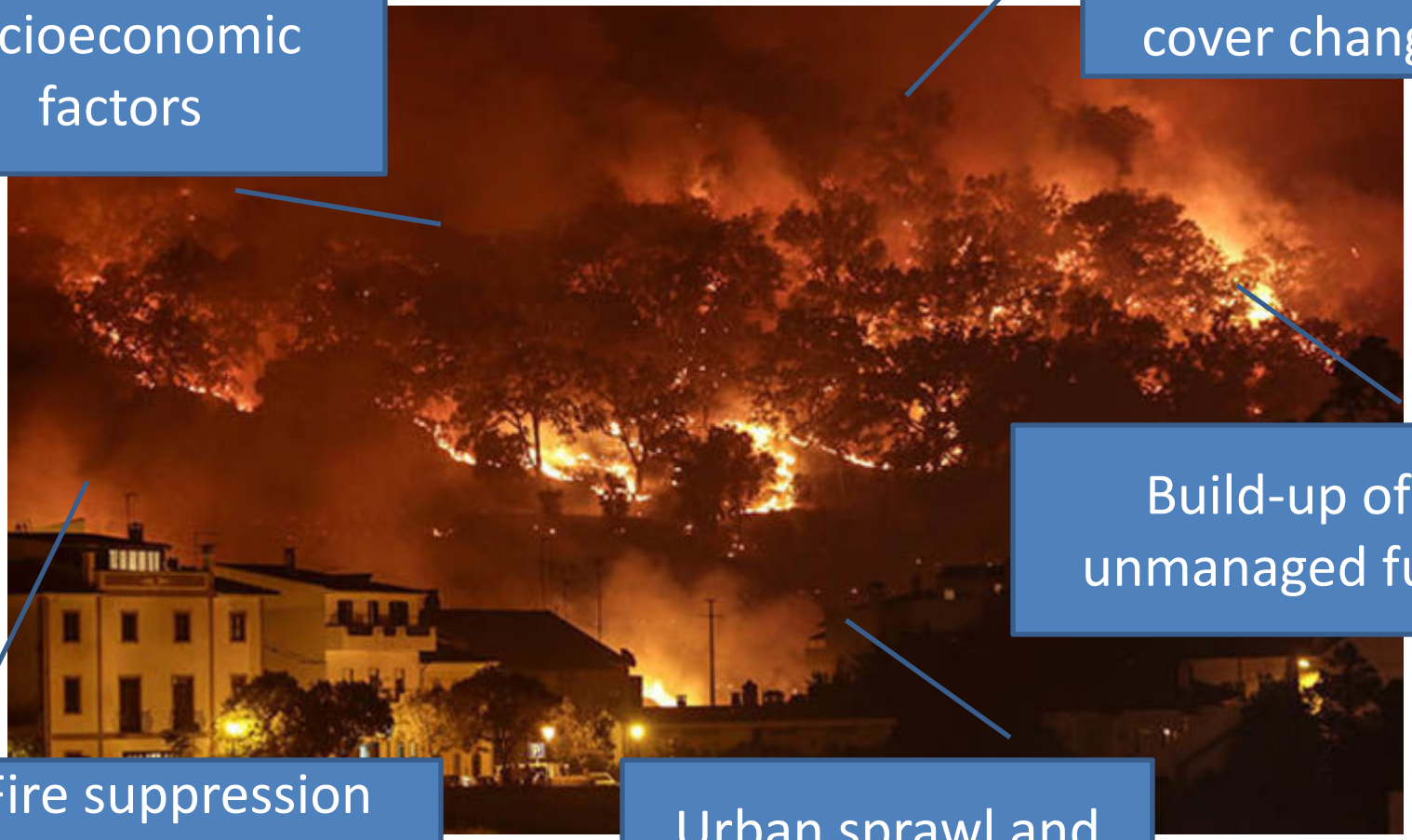




RECENT CHANGES

Socioeconomic factors

Land use/Land cover changes



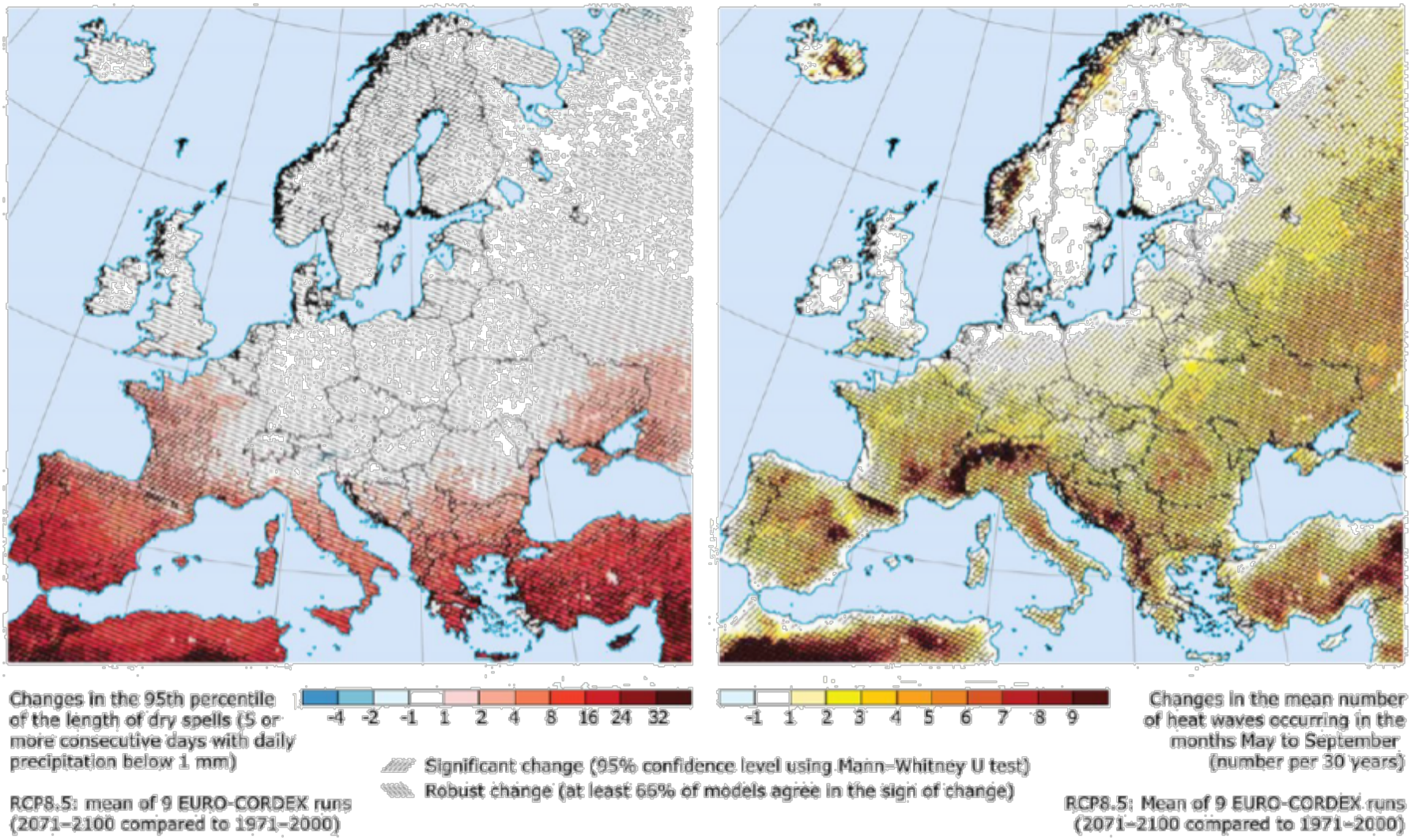
Build-up of unmanaged fuel

Fire suppression and exlusion policies

Urban sprawl and WUI

Image: EPA

CLIMATE CHANGE IMPACTS ON FIRE REGIME



Source: Peseta III Project

CLIMATE CHANGE IMPACTS ON FIRE REGIME

Source	Impact	Scenarios	Control & Future periods	Results
Moriondo et al. (2006)	Mean fire danger	B2 and A2	C: 1960-1990 F: 2071-2100	+21-23%
Amatulli et al. (2013)	Mean seasonal severity Burned area	B2 and A2	C: 1985–2004 F: 2071-2100	+ 28-38% + 66-140%
Migliavacca et al. (2013)	Burned area C emissions	A1B	C: 1960-1990 F: 2071-2100	+ 37% +94%
Khabarov et al. (2016)	Burned area	A2	C: 2000 F: 2090	+150–220%
Wu et al. (2015)	Burned area	RCP 2.6 RCP 8.5	C:1981–2000 F: 2081–2100	+14–17% +60–71%
Turco et al. (2018)	Burned area	1.5, 2, and 3 °C global warming scenarios		~40% to ~100%

Updated from: Bacciu et al., 2017

MANAGING FOREST FIRE

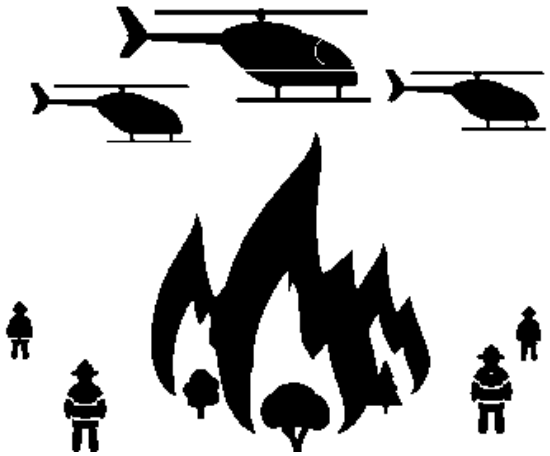
Fire management

2.5 bln/yr

Fire detection and suppression

Preventive action

NEW PARADIGM



Reactive **fire-fighting**

Sustainable fire and forest management

Source: Birot & Mavsar, 2009

INTEGRATING ADAPTATION AND MITIGATION TO COPE CC

Greenhouse gas concentrations

Climate change

Impacts

Responses

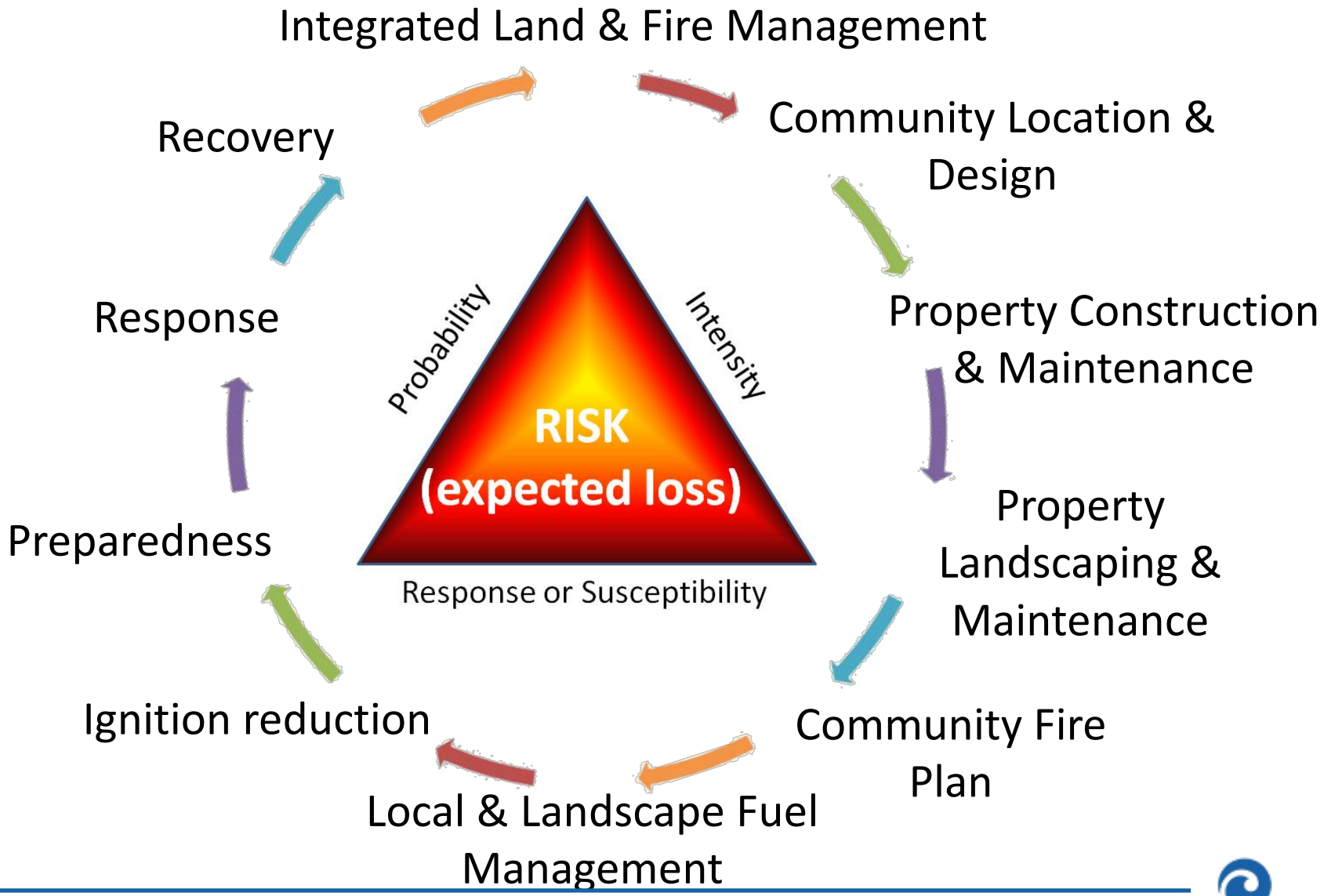
MITIGATE CLIMATE CHANGE BY ENHANCING FOREST CARBON STORES

FOSTER ADAPTATION BY ENHANCING RESISTENCE AND RESILIENCE

Integrate effectively and efficiently mitigation and adaptation, that offer two different solution but complementary to the same problem

Reducing the potential fire risk

INTEGRATED FIRE MANAGEMENT [IFM]



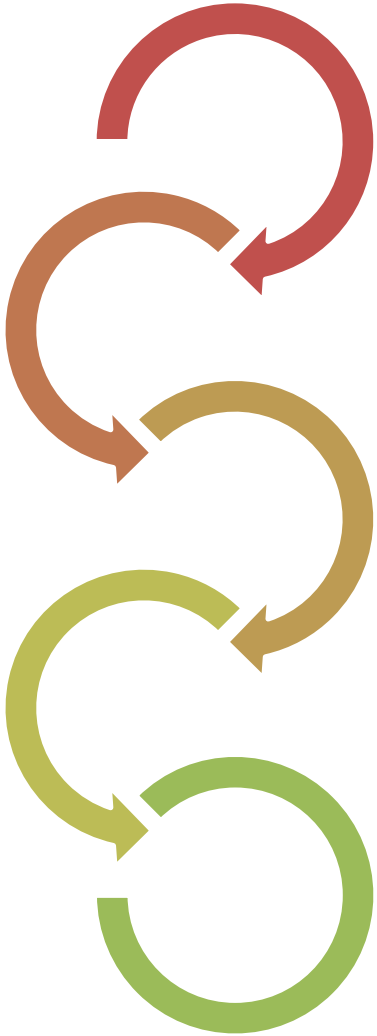
Adapted from Corona et al., 2015

PROMOTING MITIGATION & ADAPTIVE CAPACITY

ACTIVE FIRE MANAGEMENT	FUEL MANAGEMENT	EDUCATION, POLICY, GOVERNANCE
Improvement of fire fighting coordination	Conversion of uneven aged to even aged stands	Improvement of public education and awareness
Increase of surveillance and warning systems	Fuel management • Reduction of surface fuels • Increased use of grazing • Reduction of stand density • Increased use of prescribed burning	Improvement of education and training of fire fighters
Increase of water supply points		Increased use of decision support systems
Increase of forest roads and paths		Improvement of patrolling and law enforcement
	Increase of plant cover with species of reduced flammability/fire tolerant	Landscape, Land use, & Urban planning
	Improvement of post fire recovery and restoration phases to better prepare prevention for the next fire	

Adapted from Raftoyannis et al., 2014; Bacciu et al., 2017; SNAC-MATTM, 2018

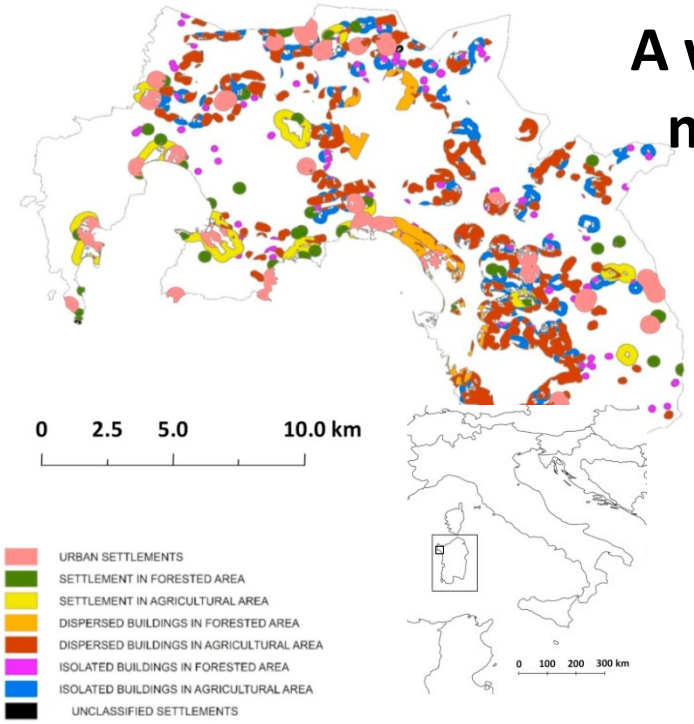
NEW APPROACHES TO DECISION MAKING



- Management objectives
- Adaptation and mitigation strategies identification and application
- Variability & uncertainties quantification
- Trade-off analysis of alternatives
- Investments prioritization

Apply risk science

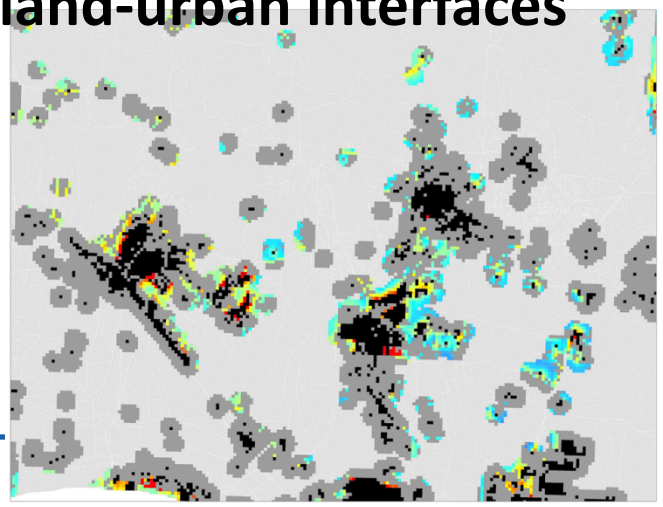
SUPPORTING TOOLS FOR DECISION MAKING

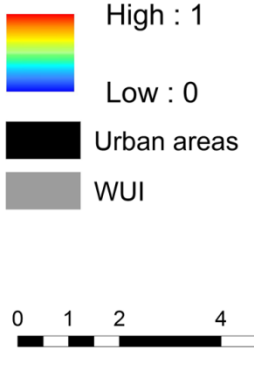


A wildfire risk oriented GIS tool for mapping Rural-Urban Interfaces

← *RUI mapping (Sirca et al., 2017) improves knowledge on RUI characteristics, supporting the effectiveness of fire risk prevention and dwelling expansion plans in RUI areas*

A streamlined approach for the spatial allocation of fuel removals in wildland-urban interfaces

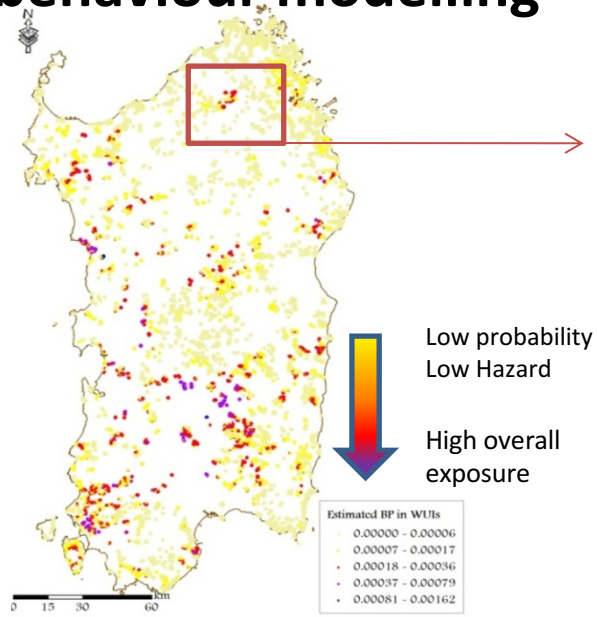




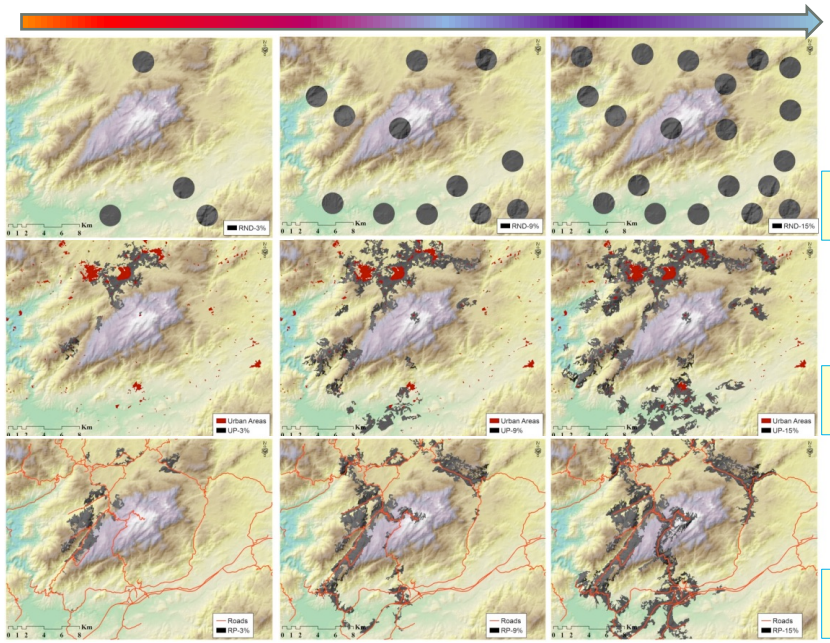
Map of the Spatial Allocation Index (Elia et al., 2014) revealing where and what type of forest areas may be eligible for fuel removal across the WUI interface →

SUPPORTING TOOLS FOR DECISION MAKING

Fire spread and behaviour modelling



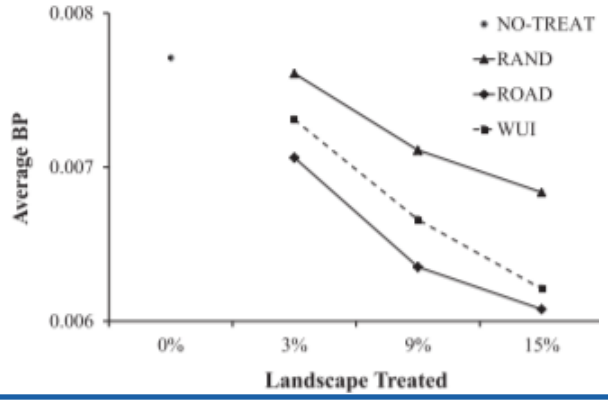
Area Treated, Cost, Risk reduction, Teams, Time , Work

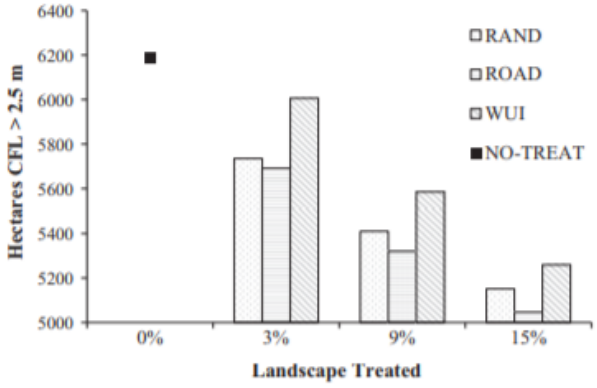


No Priorities: Random Areas

Priority: Urban Protection

Priority: Road Protection





- Tradeoffs among alternative fuel management strategies
- Importance of careful prioritization

Source: Salis et al., 2016 Forest Ecology and Management

SUPPORTING TOOLS FOR DECISION MAKING

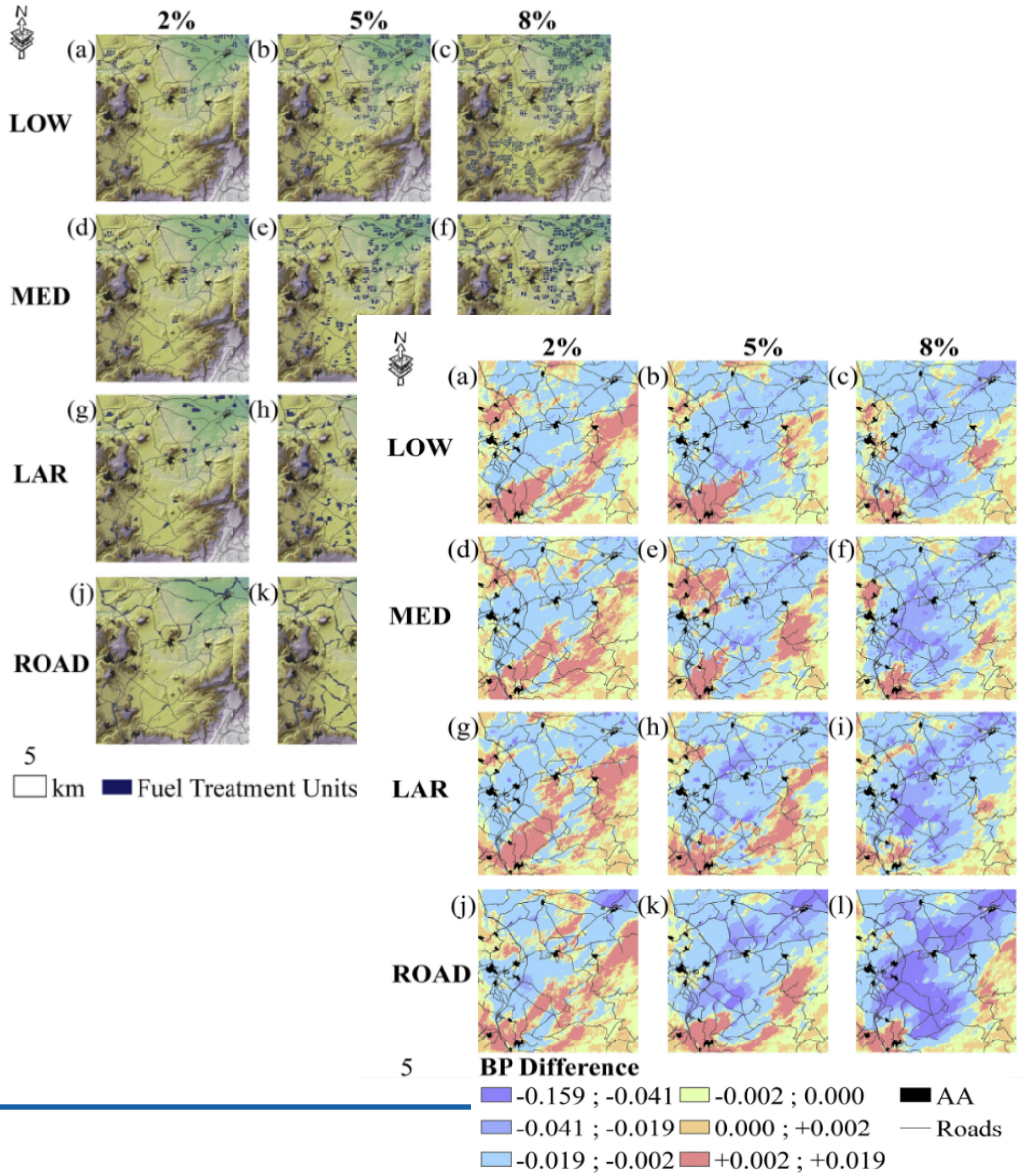
Fire spread and behaviour modelling

Fuel treatment alternatives tested
- ➢ low size units (LOW)
- ➢ medium size units (MED)
- ➢ large size units (LAR)
- ➢Units nearby roads (ROAD)

2% - 5% - 8% of the landscape treated

wind speed scenarios (16, 24 and 32 km h^{-1}) and the driest fuel moisture conditions

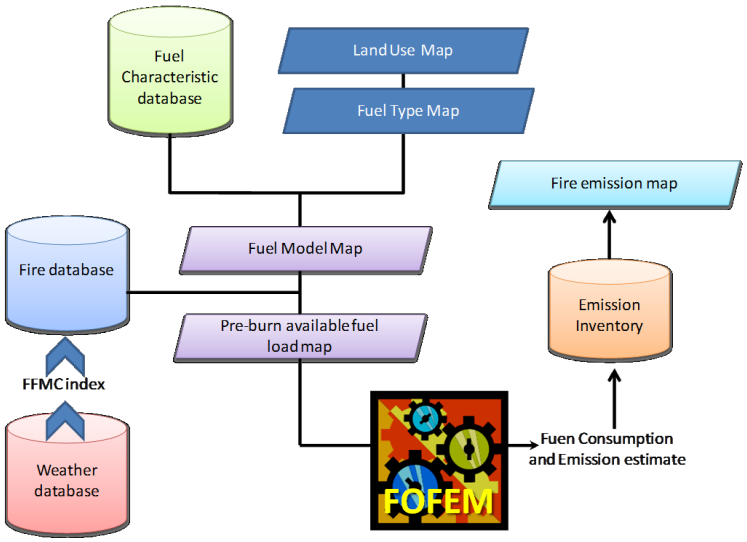
- ➢identify wildfire preferential pathways and hot-spot areas during extreme condition
- ➢prioritizing the most exposed areas
- ➢designing optimized fuel management strategies and spatial arrangements

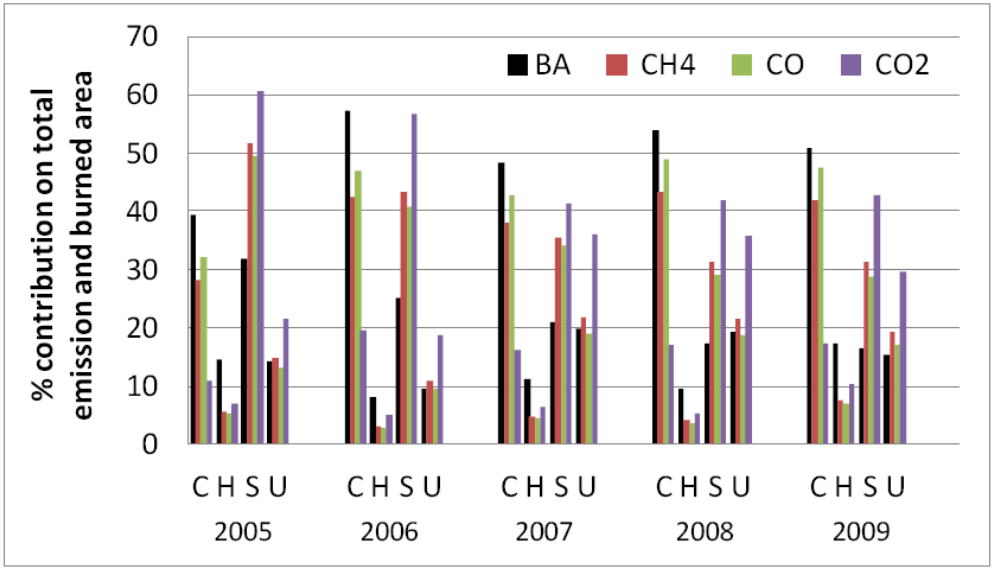


Source: Salis et al., 2018 JEMA

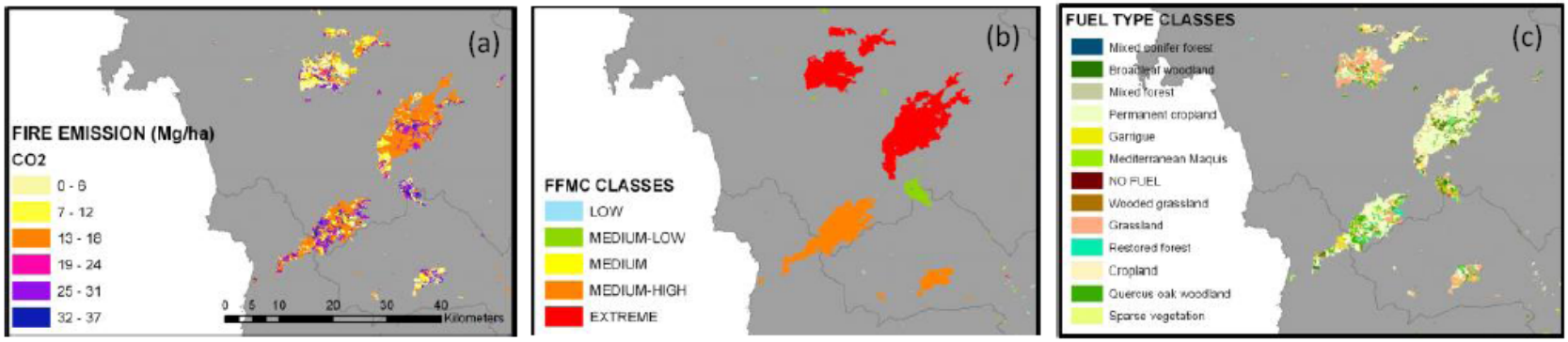
SUPPORTING TOOLS FOR DECISION MAKING

Modeling fire emission



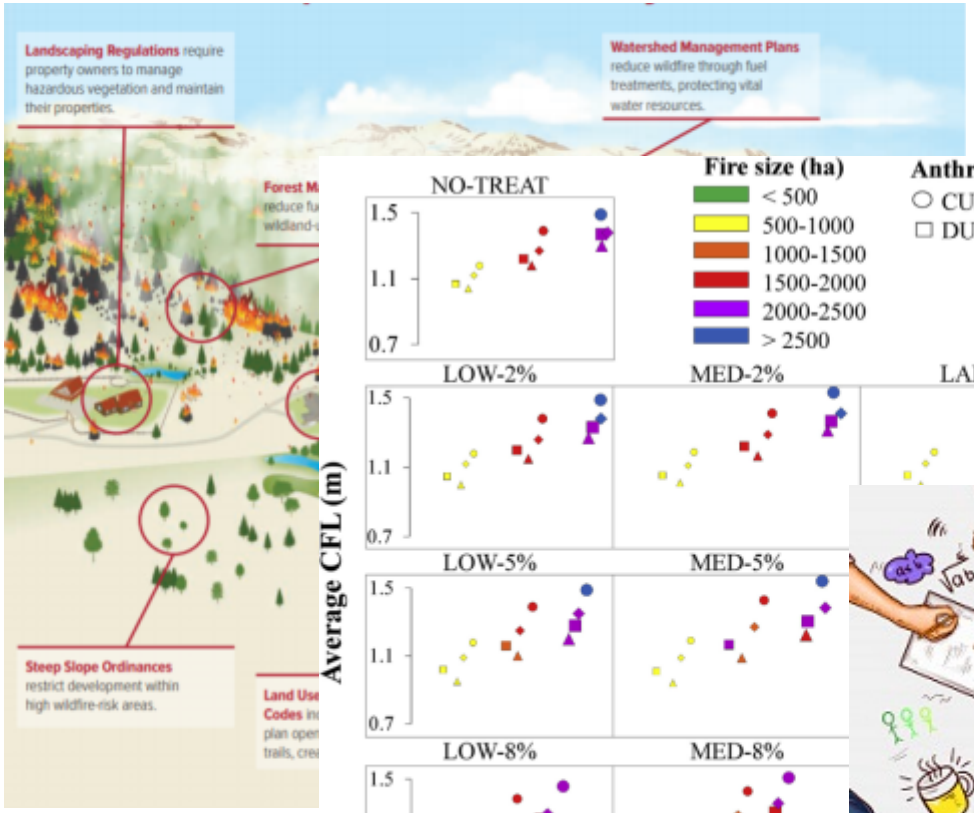


Contributions of C=crop, H=herbaceous, S=shrub, U=understorey to total burned area, and to total emissions of CH_4, CO_2, and CO



Source: Bacciu et al., 2012

INTEGRATING TOOLS, MANAGEMENT, & PLANNING



Fire simulation modeling / Fire risk modelling tools

+

Community's resources & values

➢ Fire smart management of the landscape

Source: http://planningforwildfire.org

FUTURE CHALLENGES

- Implementing **climate modeling** on fire behavior, hazard, risk, and exposure
- Comprehension of **climate-vegetation-fuel-fire-socio-economy nexus**
- Integrating the **decision making chain to maintain and optimize forest functions**
- Implement an agreed balance among the various forest actors towards adaptive governance

WORKING TOWARD SUSTAINABLE DEVELOPMENT GOALS

Integrating fire management into agriculture, pastoralism and forestry reduces the risk of damages and loss that locks people into poverty and a cycle of food insecurity

Smoke reduction from large fires;
Access to reliable supplies of fuel

Reducing unwanted fires and their emissions, contributing to the nationally determined contributions that countries made in Paris in 2015

Reducing the risk of impacts, damage and loss on forest, terrestrial ecosystem, and biodiversity

Adapted from van Lierop and Moore, 2016

Thanks

Q&A session

To participate in the Q&A Session, please use the “Questions” menu provided by the Go-to-Webinar system

Forthcoming CMCC Webinar

IMMERSE User Remote Workshop on Interfaces
April 5, 2019 – h. 03:00 pm CEST

Presenters:
Yann Drillet, Mercator Ocean International
Stefania Ciliberti, CMCC
Jeff Polton, National Oceanography Center (UK)
James Harle, National Oceanography Center (UK)
Moderator: Dorotea Iovino, CMCC

cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici

Thank you for attending this CMCC webinar.

The slides used for this webinar will be uploaded to the CMCC website: www.cmcc.it

If you have any further question about the webinar, please email: webinar@cmcc.it

cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici