CMCC ICC Workshop on AI for Carbon

June 30th - July 2nd
Lake Como School of Advanced Studies, Villa Grumello

Background

Climate change is one of the defining challenges of our time, driven by the accumulation of greenhouse gases—particularly carbon dioxide—in the atmosphere. At the heart of this challenge lies the **global carbon cycle**, a dynamic system that regulates the flow of carbon between the Earth's atmosphere, oceans, ecosystems, and geological reservoirs. While natural processes have maintained this balance for millennia, human activities—from fossil fuel combustion to land-use changes—now release nearly 40 gigatons of CO_2 annually, overwhelming the planet's natural sinks and accelerating global warming. To mitigate and adapt to these changes, we need unprecedented innovation in how we **monitor, model,** and **manage** carbon fluxes and their interactions with the climate and socio-economic systems.

This workshop will explore the potential of Artificial Intelligence (AI) in advancing carbon science and its benefits to society. We will explore cutting-edge AI applications across six thematic sessions:

1. **Earth System Modeling and Climate Dynamics**, exploring AI-driven advancements in Earth system models, from improving parameterizations to enhancing the representation of biogeochemical feedbacks. Discussions will focus on how AI can bridge gaps between high-resolution simulations and computational efficiency.

2. **Climate Predictions and Extremes**, leveraging AI to improve climate projections, early warning systems, and the attribution of extreme events and of their impacts. This session will highlight techniques for analyzing complex climate interactions and improving predictive accuracy.

3. **Carbon Cycle and Earth System Monitoring**, advancing AI applications for real-time carbon flux monitoring, integrating multi-source data (satellite, in situ, and IoT sensors), and enhancing carbon accounting frameworks to reduce uncertainties in emissions tracking.

4. **Remote Sensing and Geospatial Applications**, harnessing AI to process vast amounts of satellite and aerial imagery for carbon stock assessments, deforestation detection, and ocean carbon sequestration monitoring. Innovations in computer vision and deep learning for environmental surveillance will be a key focus.

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5. **Ecosystems and Biodiversity**, applying AI to assess the impacts of climate change on ecosystems, model species distribution shifts, and optimize nature-based solutions (e.g., reforestation, soil carbon enhancement) for climate mitigation.

6. **Economics, Policy, and Society**, exploring AI-driven tools for adapting to climate hazards, promoting climate policies, and designing effective and inclusive of low-carbon transitions. Discussions will cover AI's role in climate policies, adaptation strategies, and scalable decarbonization solutions.

The main objective of the meeting will be to discuss the latest AI carbon science, identify research gaps and priorities and lay out a vision for the future of AI science to serve society. A **final brainstorming session** will identify research priorities and define the building blocks of a position paper summarizing the needs across the six thematic sessions.

About the CMCC Foundation

The CMCC Foundation (Euro-Mediterranean Center on Climate Change) is an international, independent, multi-disciplinary research center that studies the interaction between climate change and society founded in 2025. CMCC produces advanced climate research developing cross-cutting and multidisciplinary analyses and data that combine first-class climate modeling with climate change impact modeling and environmental economics. CMCC is among the world leaders and reference points in advanced scientific research, integrating all aspects of social, economic, and environmental systems affected by climate change. CMCC organizes its research activities through a structure that allows the collaboration and interaction of expertise from the multiple disciplines involved in research and decision-making processes aimed at finding answers to the challenges that will characterize the coming decades. This organization of research ensures an interdisciplinary dimension that makes CMCC a unique global player in climate studies and enables the center to work on the entire climate research chain, as well as on social, economic, and technological dimensions.

About the ICC Program

The Integration of the planetary biogeochemical and industrial Carbon Cycle (ICC) Program is one of four strategic research programs within CMCC, focusing on understanding and shaping the new paradigm of building a net-zero carbon economy which is essential to providing quantitative and narrative analyses of socio-economic systems in the context of a sustainable and resilient future.

About the EUNICE project

EUNICE is a project funded from the European Research Council (ERC) to explore deep uncertainties in climate change. It leverages AI methods to quantify the physical and socio-economic repercussions of climate extremes and to identify robust strategies towards climate neutrality.

External Speakers

1. **Dr. Sara Beery,** Homer A. Burnell Career Development Professor in the MIT Faculty of Artificial Intelligence and Decision-Making.
2. **Mr. Vitus Benson**, ELLIS PhD candidate at Max Planck Institute for Biogeochemistry, ELLIS Unit Jena and ETH Zürich.
3. **Dr. Laure Berti-Equille,** Research Director (DR1) in Data Analytics and Applied Machine Learning at IRD, the French research institute on Sustainable Development.
4. **Dr. Gustau Camps-Valls**, Full Professor in Electrical Engineering at Universitat de València and Group Leader in Image and Signal Processing (ISP).
5. **Dr. Millie Chapman,** visiting faculty researcher at Google Research, a postdoc at the National Center for Ecological Analysis and Synthesis (NCEAS) and a core team member at Climate Change AI (CCAI).
6. **Dr. Ioana Colfescu**, Principal Research Fellow in Climate and Machine Learning, University of St. Andrews
7. **Mr. Miguel Jiménez**, CTO of Devera
8. **Dr. Konstantin Klemmer,** machine learning researcher at Microsoft Research Redmond.
9. **Dr. Raphaela Andrea Kotsch**, Researcher at ZHAW School of Management and Law Center for Energy and Environment.
10. **Dr. Vipin Kumar,** Regents Professor, William Norris Land Grant Chair in Large-Scale Computing, and Data Science Initiative Director at University of Minnesota.
11. **Dr. Christian Lessig,** Professor at Otto-von-Guericke Universität Magdeburg.
12. **Dr. Claire Monteleoni,** Choose France Chair in AI and Research Director at INRIA Paris & Professor in the Department of Computer Science at the University of Colorado Boulder (on leave).
13. **Dr. Amirpasha Mozaffari**, postdoctoral researcher in the Earth Artificial Intelligence group at the Earth Science Department of the Barcelona Supercomputing Center (BSC-CNS).
14. **Dr. S. Karthik Mukkavilli**, Group Head of AI at Mercuria Energy Trading
15. **Dr. Arthur Ouaknine**, postdoctoral researcher fellow at McGill University and Mila (Quebec Artificial Intelligence Institute)
16. **Dr. Maria Perez Ortiz**, Associate Professor of Artificial Intelligence for Sustainable Development at the Department of Computer Science at University College London.
17. **Dr. Quentin Paletta**, Research fellow at the Climate Office of the European Space Agency (ESA)
18. **Dr. Esther Rolf**, assistant professor of computer science at the University of Colorado, Boulder
19. **Dr. Bruno Sanchez-Andrade Nuño**, Executive Director of Clay
20. **Dr. Katarzyna (Kasia) B. Tokarska de los Santos,** Principal Climate Risk Modeller at CarbonPool.

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CMCC Speakers

1. **Dr. Guido Ascenso,** CMCC expert in AI-based computer vision, specifically the development and application of image-to-image methods.
2. **Dr. Manuela Balzarolo**, CMCC senior researcher in remote sensing applications for terrestrial ecosystem monitoring, with a focus on modelling the impact of climate change and extremes on ecosystem functions and carbon cycle.
3. **Dr. Annalisa Bracco**, CMCC Senior Scientist in computational fluid dynamics and physical oceanography
4. **Dr. Italo Epicoco,** Assistant Professor at the University of Salento, Lecce and the CMCC principal scientist regarding machine learning approaches for climate modelling.
5. **Dr. Ronan McAdam**, Researcher working on predictions of the ocean and extreme events.
6. **Dr. Carlos Rodriguez Pardo**, Researcher at Politecnico di Milano and CMCC, working on deep learning for climate change mitigation.

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Agenda at a glance

Day 1 - Monday, June 30th		
Time (CEST)	**Topic**	**Presenter**
09:00 - 09:30	**Registration**	
09:30 - 10:00	Welcoming and setting the scene	Giulio **Boccaletti**, Scientific Director (CMCC) Massimo **Tavoni**, EIEE Institute Director (CMCC) Soheil **Shayegh**, ICC Program Director (CMCC)
10:00 - 11:00	**Kick-start Panel discussion**	Vipin **Kumar**, Antonio **Navarra**
11:00 - 11:30	**Coffee break**	
11:30 - 12:00	**Session 1 - Earth System Modelling**	Christian **Lessig**
12:00 - 12:30	**Session 1 - Earth System Modelling**	Ioana **Colfescu**
12:30 - 13:00	**Session 1 - Earth System Modelling**	Italo **Epicoco**
13:00 - 14:00	**Lunch break**	
14:00 - 14:30	**Session 2 - Climate Predictions**	Claire **Monteloni**
14:30 - 15:00	**Session 2 - Climate Predictions**	Amirpasha **Mozaffari**
15:00 - 15:30	**Session 2 - Climate Predictions**	Karthik **Mukkavilli**
15:30 - 16:00	**Coffee break**	
16:00 - 16:30	**Session 2 - Climate Predictions**	Guido **Ascenso**
16:30 - 17:00	**Session 2 - Climate Predictions**	Ronan **McAdam**
17:00 - 18:30	**Poster Session and Networking**	
20:00	**Dinner**	

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Day 2 - Tuesday, July 1st		
Time (CET)	**Topic**	**Presenter**
09:00 - 09:30	**Session 3 - Remote Sensing and Geospatial Applications**	Esther **Rolf**
09:30 - 10:00	**Session 3 - Remote Sensing and Geospatial Applications**	Laure **Berti-Equille**
10:00 - 10:30	**Session 3 - Remote Sensing and Geospatial Applications**	Konstantin **Klemmer**
10:30 - 11:00	**Session 3 - Remote Sensing and Geospatial Applications**	Quentin **Paletta**
11:00 - 12:00	**Coffee break**	
12:00 - 12:30	**Session 4 - Carbon Cycle and Earth System Monitoring**	Gustau **Camps**
12:30 - 13:00	**Session 4 - Carbon Cycle and Earth System Monitoring**	Laure **Berti-Equille**
13:00 - 14:00	**Lunch break**	
14:00 - 14:30	**Session 4 - Carbon Cycle and Earth System Monitoring**	Vipin **Kumar**
14:30 - 15:00	**Session 4 - Carbon Cycle and Earth System Monitoring**	Vitus **Benson**
15:00 - 15:30	**Session 4 - Carbon Cycle and Earth System Monitoring**	Manuela **Balzarolo**
15:30 - 16:00	**Coffee break**	
16:00 - 17:30	**Industry Views**	Climate Data Factory Clay, Mercuria, Devera
17:30 - 18:30	**Poster Session and Networking**	
20:00	**Dinner**	

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Day 3 - Wednesday, July 2nd		
Time (CET)	**Topic**	**Presenter**
09:00 - 09:30	**Session 5 - Ecosystems and Biodiversity**	Sara **Beery**
10:00 - 10:30	**Session 5 - Ecosystems and Biodiversity**	Millie **Chapman**
10:30 - 11:00	**Session 5 - Ecosystems and Biodiversity**	Arthur **Ouaknine**
10:30 - 11:00	**Session 5 - Ecosystems and Biodiversity**	Annalisa **Bracco**
11:00 - 11:30	**Coffee break**	
11:30 - 12:00	**Session 6 - Economics, Policy and Society**	Maria **Perez Ortiz**
12:00 - 12:30	**Session 6 - Economics, Policy and Society**	Raphaela **Andrea Kotsch**
12:30 - 13:00	**Session 6 - Economics, Policy and Society**	Carlos **Rodriguez Pardo**
13:00 - 14:00	**Lunch break**	
14:00 - 15:00	**Breakout Group Discussion**	Monitoring
		Modelling
		Managing
15:00 - 15:30	**Coffee break**	
15:30 - 16:30	BoG report-back	BoG reps
16:30 - 17:30	AI4C roadmap	Panel discussion
17:30 - 17:45	Final remarks and conclusion	Soheil **Shayegh**

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