Scenari climatici sull'Europa

Paola Mercogliano[1,2] Veronica Villani[1], Giuliana Barbato[1],

- *1 CMCC – Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici – Divisione REMHI*
- *2 CIRA - Centro Italiano Ricerche Aerospaziali*

Who we are

The Euro-Mediterranean Center on Climate Change (CMCC) is a non-profit research institution established in 2005; CMCC's Mission is to investigate and model our climate system and its interactions with society and the environment to guarantee reliable, rigorous, and timely scientific results to stimulate sustainable growth, protect the environment, and to develop science driven adaptation and mitigation policies in a changing climate.

Offices

Partners

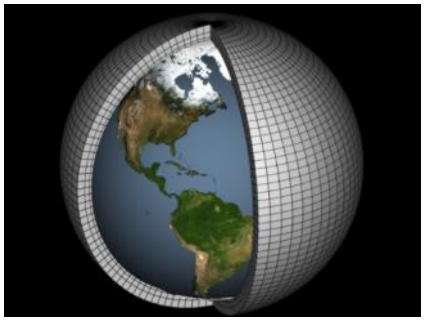
European Institute on Economics and the Environment

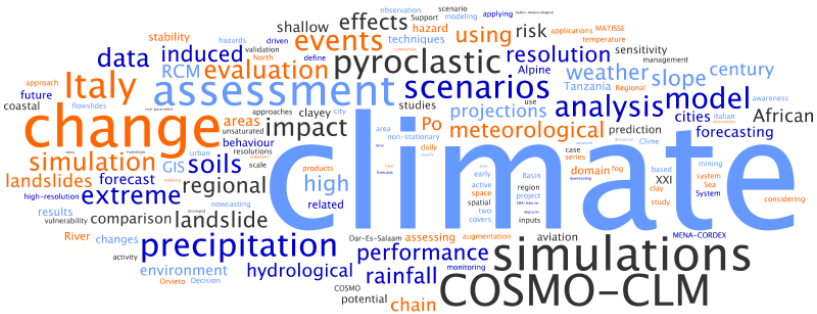
Centro Italiano Ricerche Aerospaziali

Divisione REMHI

REgional Models (REM)

Regionalization of the climate signal through statistical and dynamical downscaling





Impacts (I)

Qualitative and quantitative assessment of the expected impact of climate and land use change on different types of impacts (landslides, floods, drought, heat waves) in terms of frequency and magnitude.

Coupling Climate with Impact models (CCI)

Implementation of tools for climate data analysis (including the web platform DATACLIME www.dataclime.com) for their wide and correct use

dataclime.com

Climate change projections

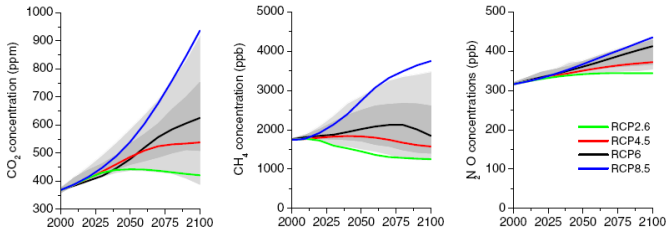
Model projections provide guidance on **potential climate variations over the next decades**, which are related to various scenarios of global socio-economic development.
In order to obtain climate change projections, the climate models use information described in scenarios of GHG and air pollutant emissions and land use patterns. Key factors driving changes in anthropogenic GHG emissions are **economic and population growth**, **lifestyle** and **behavioural changes**, associated **changes in energy use and land use**, **technology and climate policy**.

FUTURE GLOBAL SCENARIOS (known as come **Representative Concentration Pathways – RCPs**):

- They provide information on the potential evolution of the various **radiative forcing components** (**greenhouse gas and air pollutants emissions, land-use**) to be used as input for climate models.

- They include a **stringent mitigation scenario** (**RCP2.6**), **two intermediate scenarios** (**RCP4.5** and **RCP6.0**), and **one scenario with very high GHG emissions** (**RCP8.5**).
- Following analysis are performed with **RCP4.5** and **RCP8.5**

Provide local climate scenarios



Global model

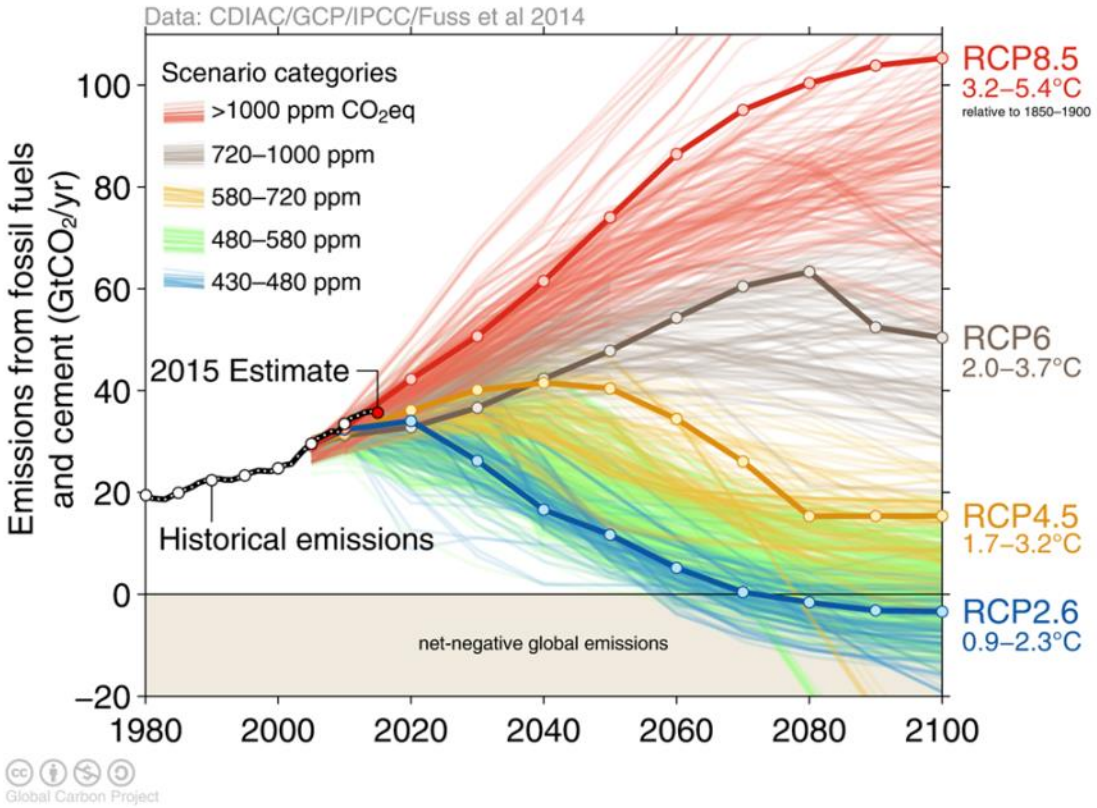
Regional model

Urban climate model

Climate models are subject to uncertainties. Following collins (2007), these uncertainties can be divided into 3 components:

1) The uncertainty due to the fact that the atmosphere is a highly complex system
2) The uncertainty present in the GHG scenarios
3) The uncertainty due to the imperfect simulation by the models of the climate system

IPCC scenarios: RCP4.5 and RCP8.5



RCP4.5 → increase in radiative forcing of 4.5 W/m^2 by 2100 (intermediate scenario). Such a scenario is consistent with a reduction of future emissions: it assumes a decrease of CO2 emissions below current levels by 2070 and a stabilization at twice above pre-industrial levels by 2100.

RCP8.5 → increase in radiative forcing of 8.5 W/m^2 by 2100 (high emissions). Such a scenario is consistent with the lack of future policies on emissions reduction: it assumes an increase of atmospheric concentrations of CO2 of three or four times higher than pre-industrial levels by 2100.

CLIMATE Scenarios in the CLIMAERA region

Presentation of climate scenarios for the 21st century, in terms of average and extreme values, for the main reference variables (temperature, precipitation) using different IPCC scenarios.

Results are obtained by considering all the EURO-CORDEX regional climate models currently available at about 12 km and IPCC RCP4.5 and RCP8.5 scenarios

Area to be analysed

The EURO-CORDEX initiative

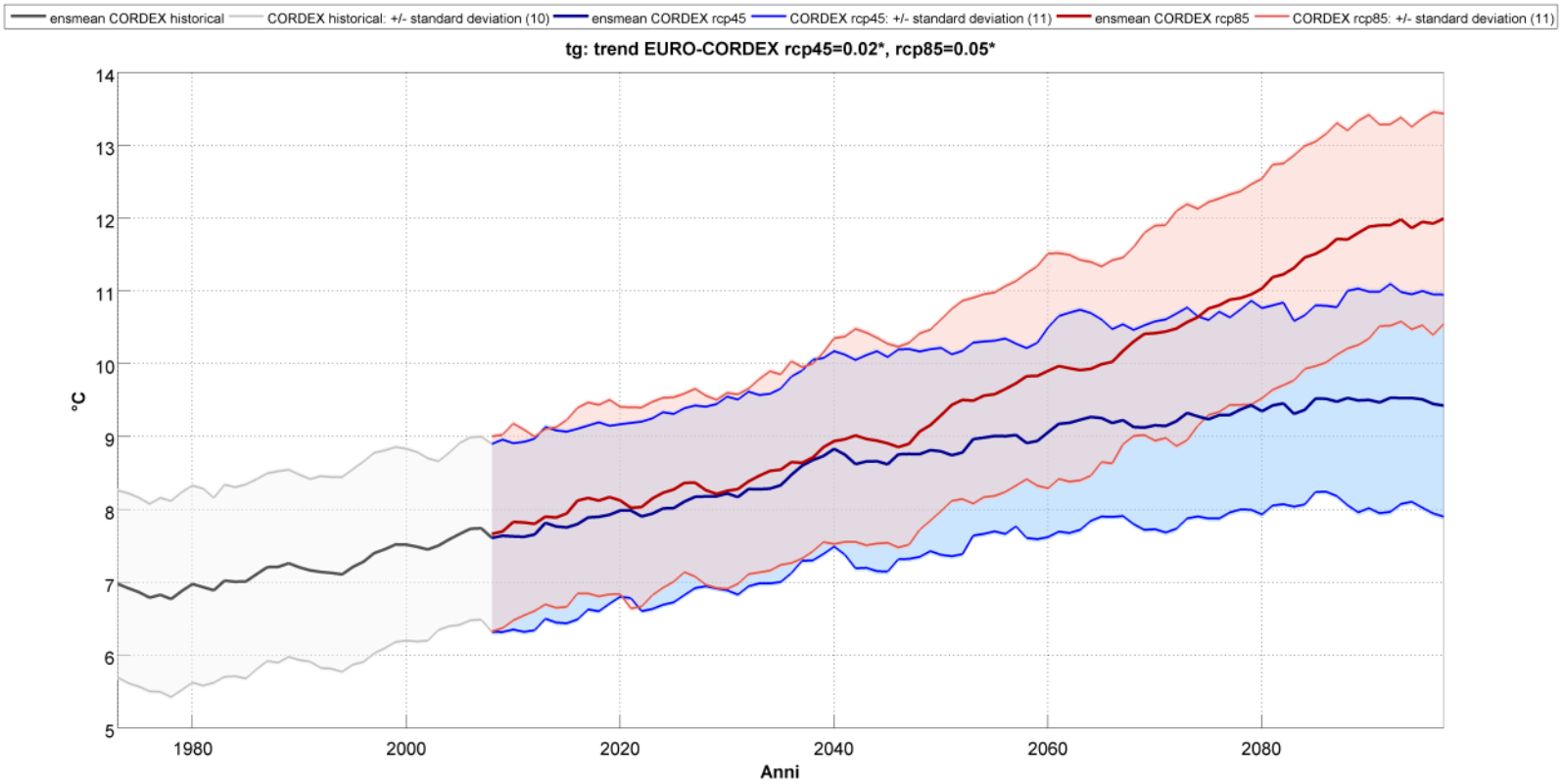
EURO-CORDEX is the European branch of the international CORDEX initiative, which is a program sponsored by the World Climate Research Program (WRCP) to organize an **internationally coordinated framework to produce improved regional climate change projections for all land regions world-wide**.

The CORDEX regional climate model (RCM) simulations for the European domain (EURO-CORDEX) are conducted at two different spatial resolutions: the **finer resolution is 0.11 degree** (EUR-11, ~12.5km). The available simulations adopt IPCC scenarios of greenhouse gas emissions as input.

Several researches (e.g. Kotlarski et al., 2014) confirm the **ability of regional climate models to reproduce the main characteristics of European climate**, considering also its spatial and temporal variability. However, in some areas and seasons there are limitations that require further improvements.

EURO-CORDEX - Coordinated Downscaling Experiment - European Domain

Climate projections over CLIMAERA Alcotra area: mean daily temperature



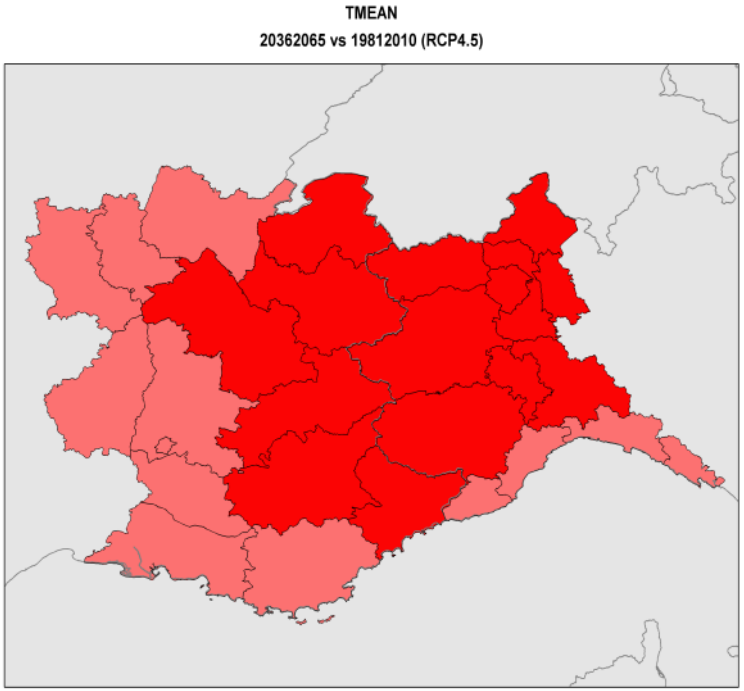
Increase of the mean daily temperature

The increase in the average value of the models is always positive: 2 °C in 100 years under RCP4.5 scenario and 4 °C in 100 years under RCP8.5.

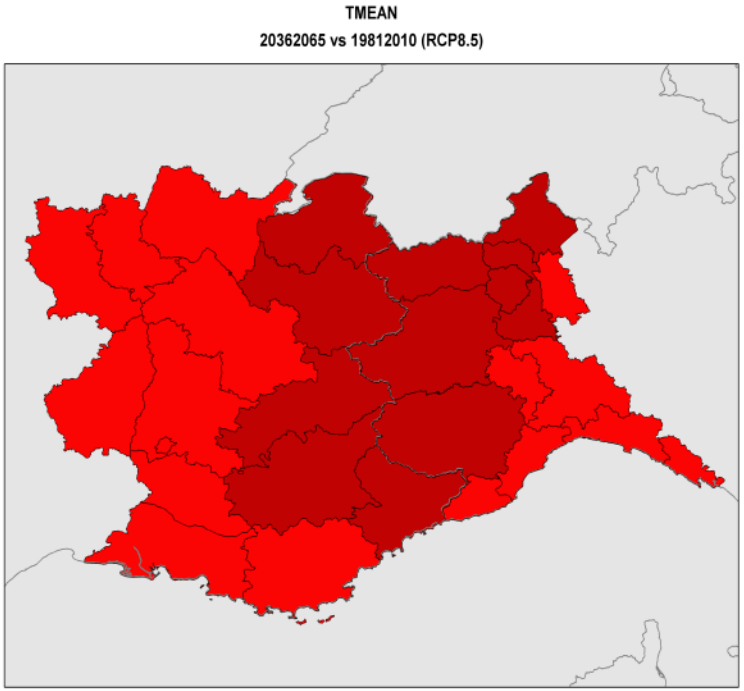
The trend is statistically significant.

Climate projections over CLIMAERA Alcotra area: mean daily temperature

RCP4.5



RCP8.5

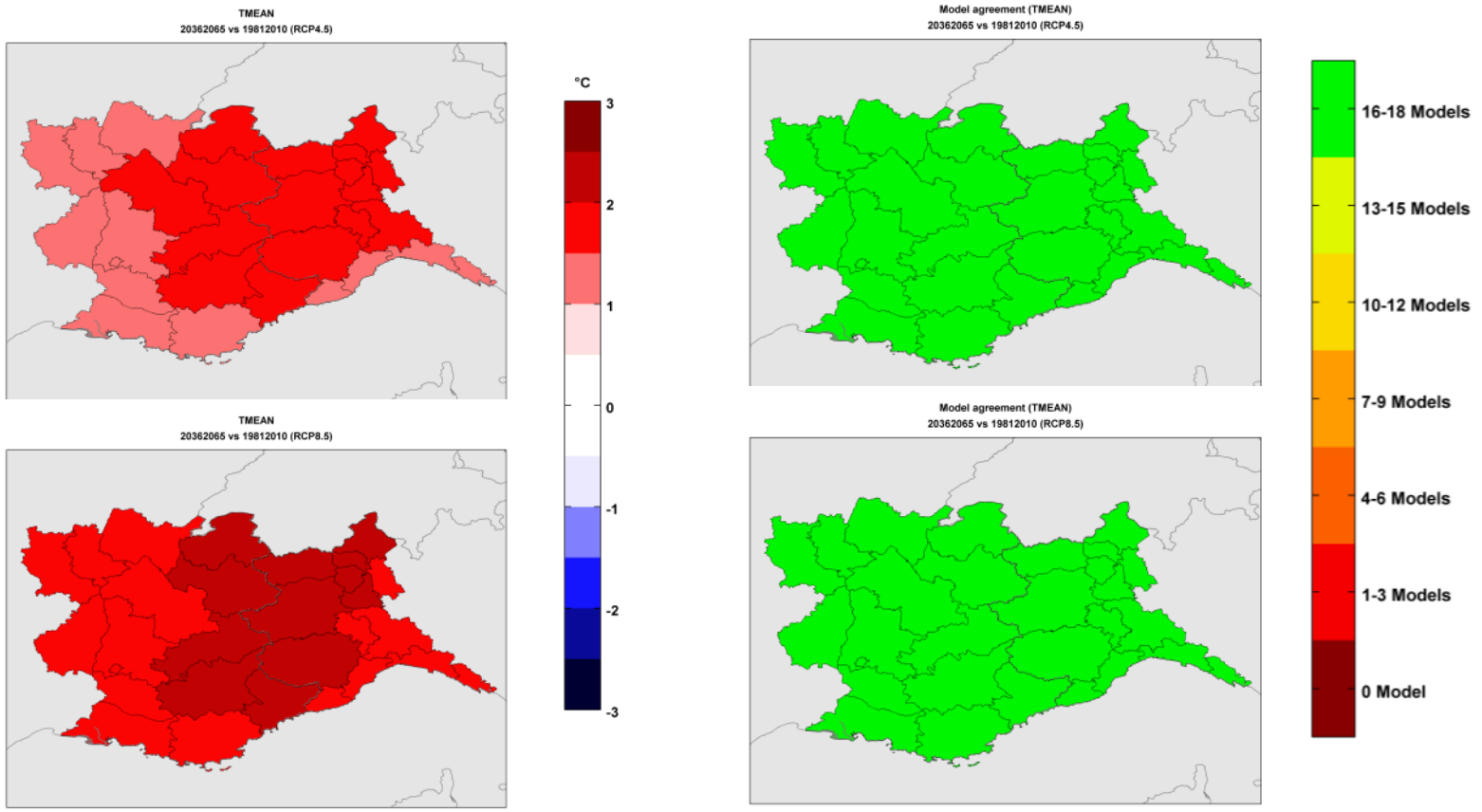


Ensemble mean climate anomaly
2036–2065 period compared to 1981–2010.

Model AGREEMENT: mean daily temperature

RCP4.5

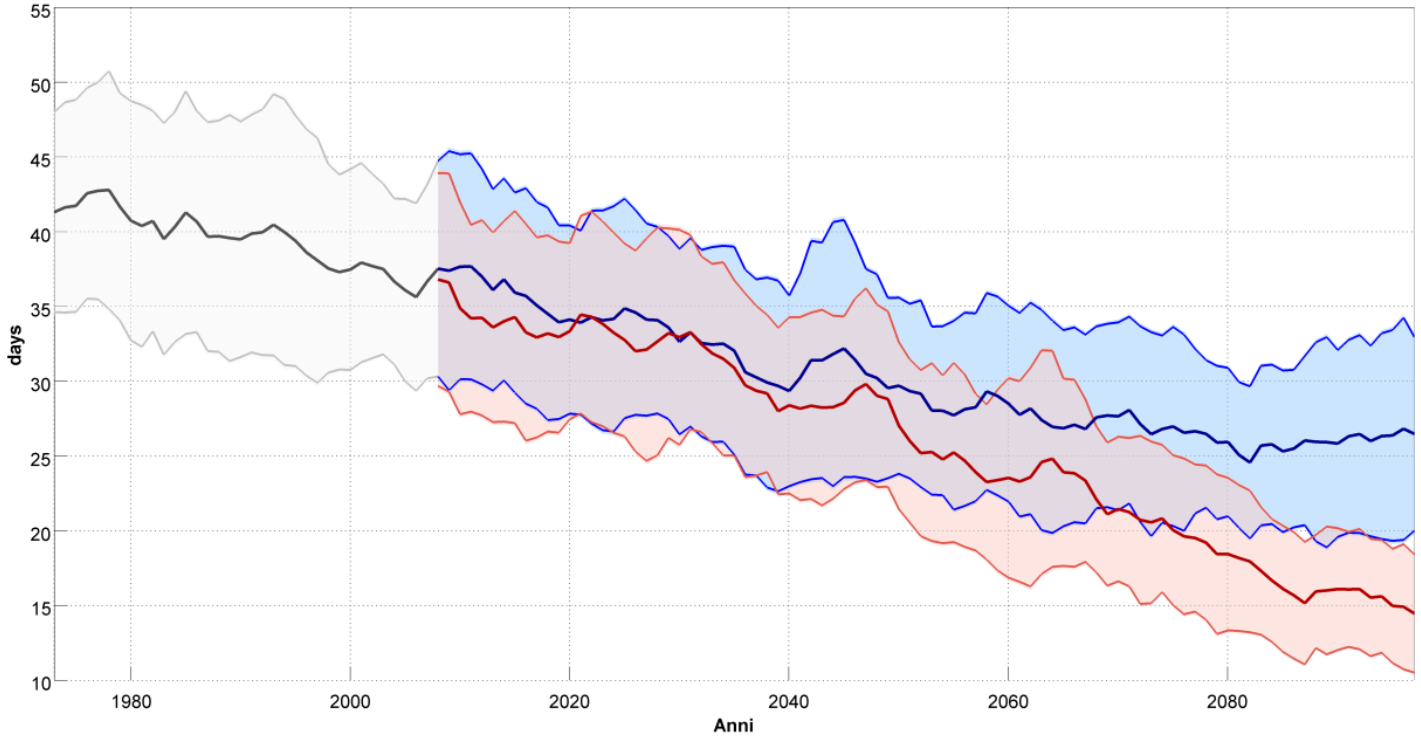
RCP8.5



2036–2065 period compared to 1981–2010.

Climate projections over CLIMAERA Alcotra area: Ice Days

Ice Days : number of days with maximum temperature<0°C



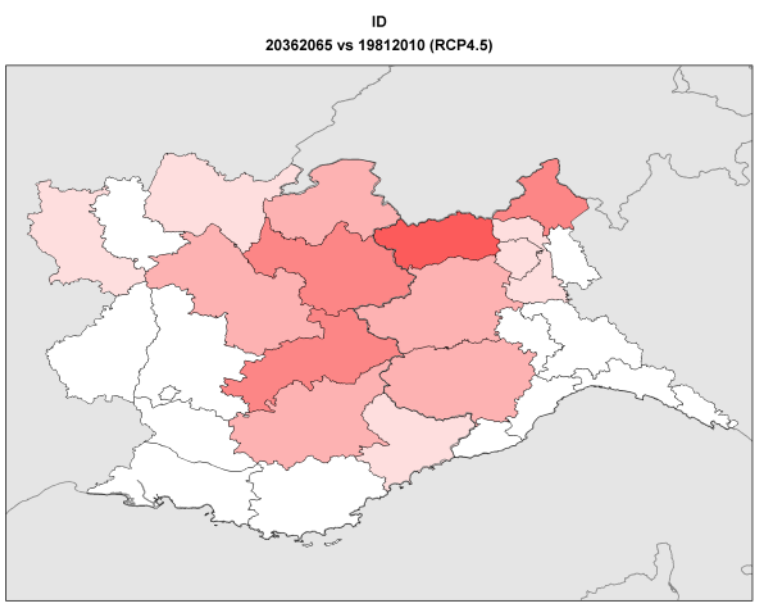
Decrease of Ice Days

The decrease in the average value of the models is always negative: 10 days in 100 years under RCP4.5 scenario and 20 days in 100 years under RCP8.5 scenario. The trend is statistically significant.

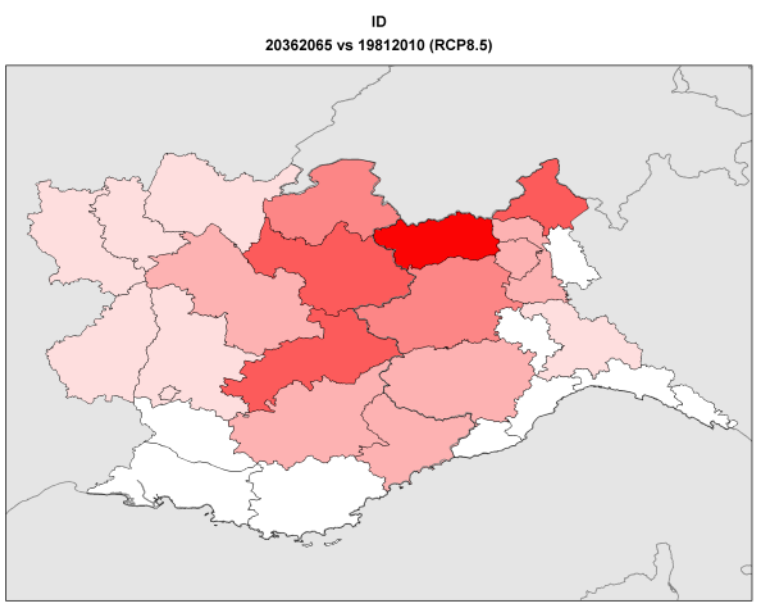
Climate projections over CLIMAERA Alcotra area: Ice Days

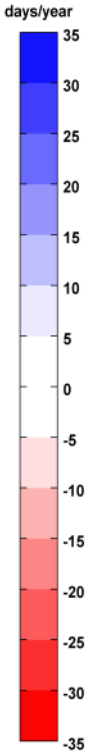
Ice Days : Number of days with maximum temperature<0°C

RCP4.5



RCP8.5



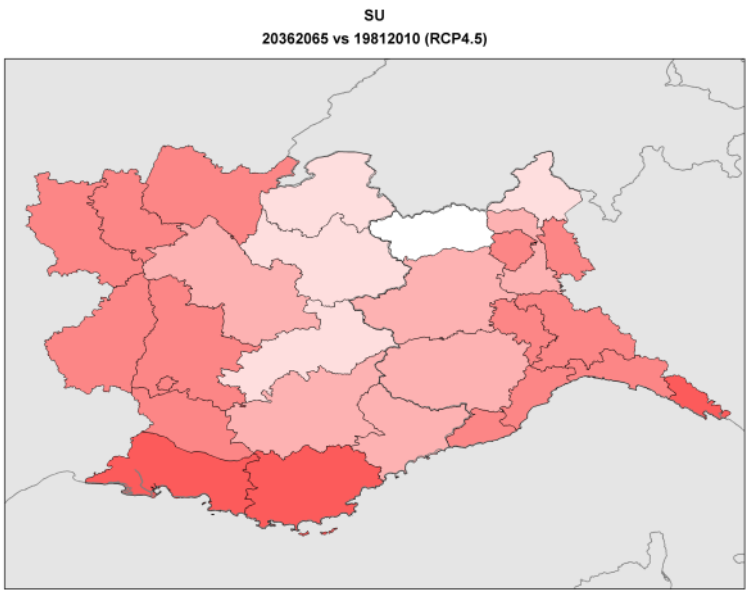


Ensemble mean climate anomaly
2036–2065 period compared to 1981–2010.

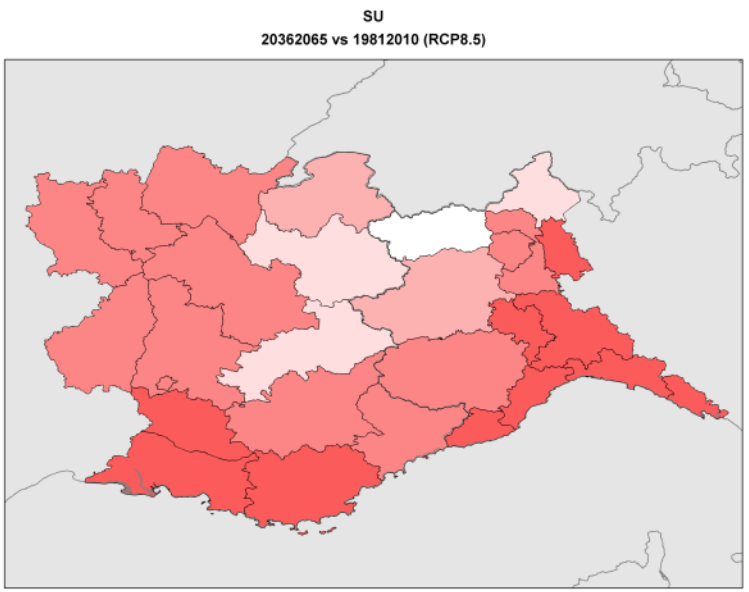
Climate projections over CLIMAERA Alcotra area: Summer days

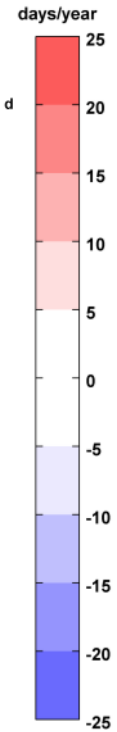
Summer Days: number of days with maximum temperature>25°C

RCP4.5



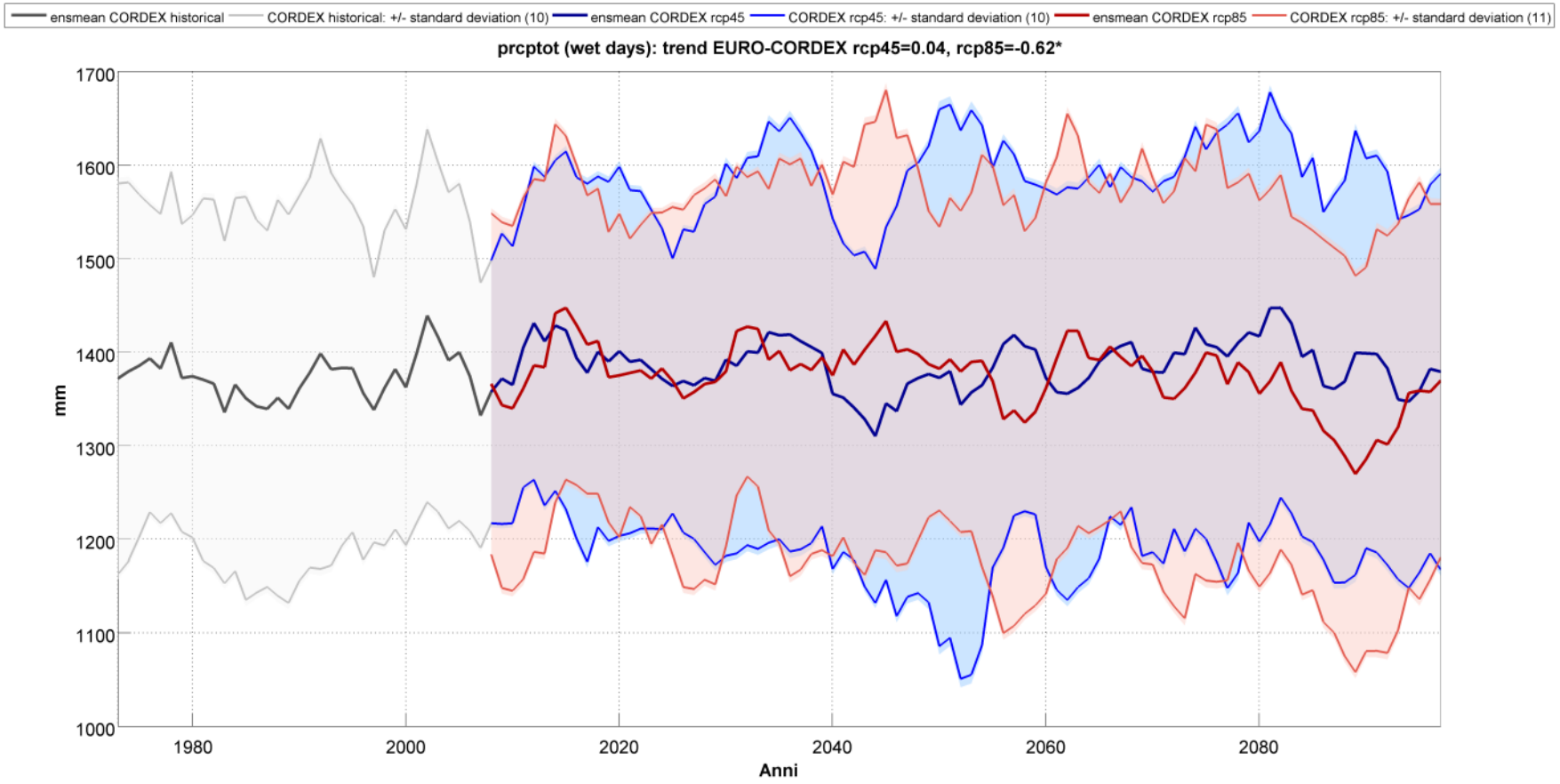
RCP8.5





Ensemble mean climate anomaly
2036–2065 period compared to 1981–2010.

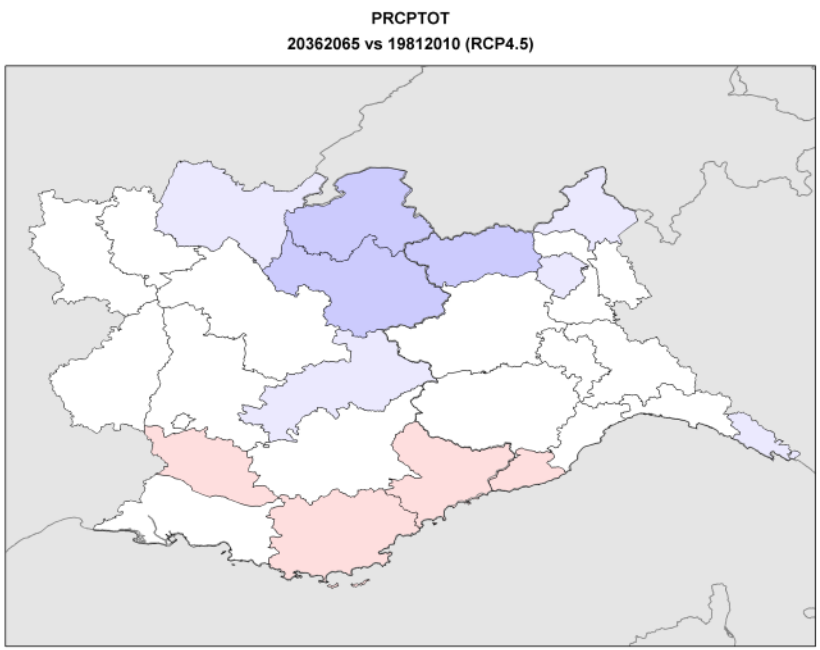
Climate projections over CLIMAERA Alcotra area: cumulated annual precipitation



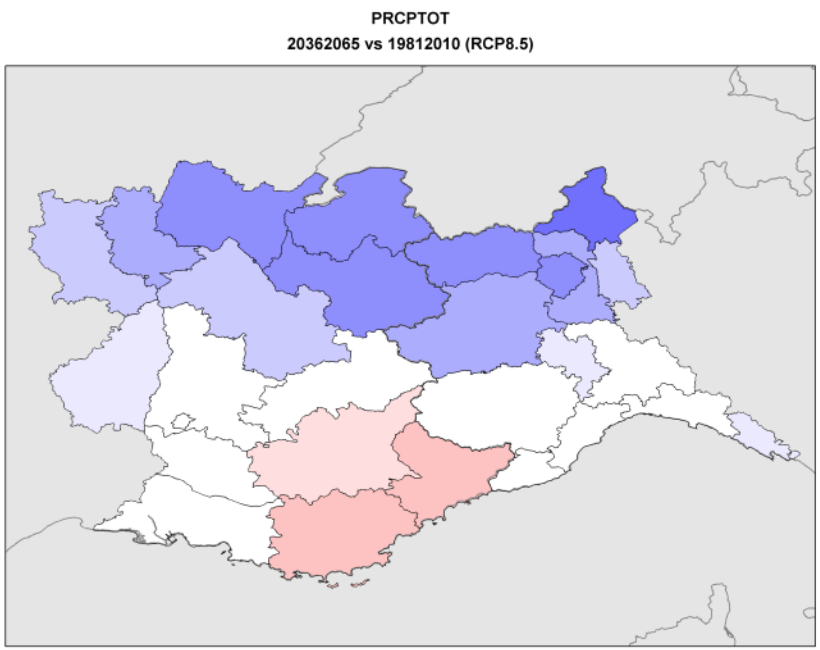
The decrease in the average value of the models is negative: 100 mm in 100 years under RCP8.5 scenario. The trend is statistically significant only under RCP8.5 scenario.

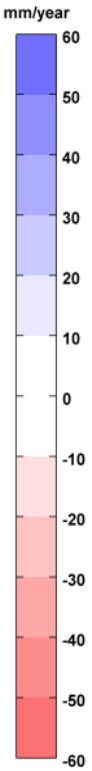
Climate projections over CLIMAERA Alcotra area: cumulated annual precipitation

RCP4.5



RCP8.5



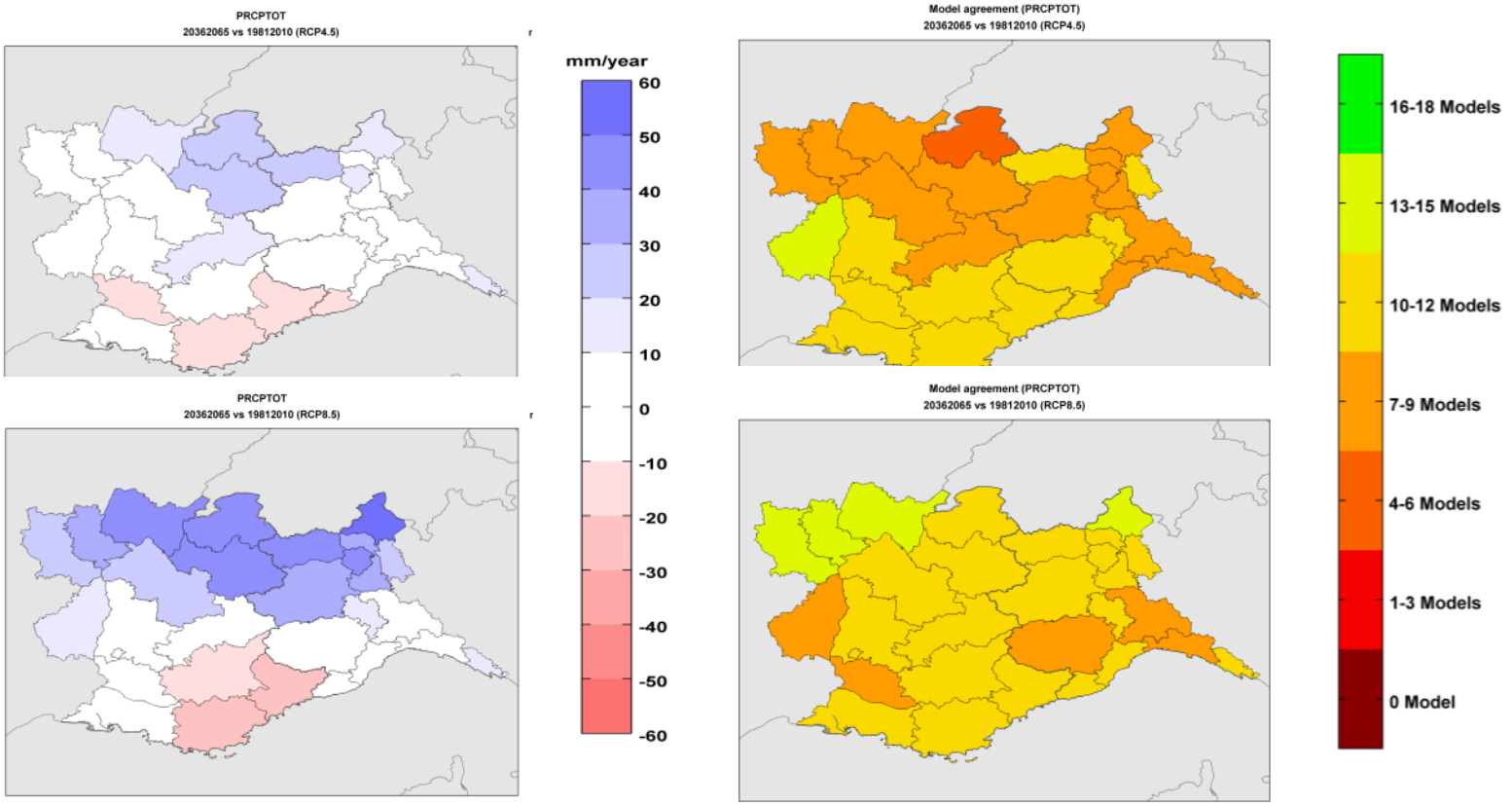


Ensemble mean climate anomaly
2036–2065 period compared to 1981–2010.

MODEL AGREEMENT:
cumulated annual precipitation

RCP4.5

RCP8.5



2036–2065 period compared to 1981–2010.

The Impact of climate change (EEA, 2016)

Arctic region
Temperature rise much larger than global average
Decrease in Arctic sea ice coverage
Decrease in Greenland ice sheet
Decrease in permafrost areas
Increasing risk of biodiversity loss
Some new opportunities for the exploitation of natural resources and for sea transportation
Risks to the livelihoods of indigenous peoples

Atlantic region
Increase in heavy precipitation events
Increase in river flow
Increasing risk of river and coastal flooding
Increasing damage risk from winter storms
Decrease in energy demand for heating
Increase in multiple climatic hazards

Mountain regions
Temperature rise larger than European average
Decrease in glacier extent and volume
Upward shift of plant and animal species
High risk of species extinctions
Increasing risk of forest pests
Increasing risk from rock falls and landslides
Changes in hydropower potential
Decrease in ski tourism

Coastal zones and regional seas
Sea level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward migration of marine species
Risks and some opportunities for fisheries
Changes in phytoplankton communities
Increasing number of marine dead zones
Increasing risk of water-borne diseases

Boreal region
Increase in heavy precipitation events
Decrease in snow, lake and river ice cover
Increase in precipitation and river flows
Increasing potential for forest growth and increasing risk of forest pests
Increasing damage risk from winter storms
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increase in summer tourism

Continental region
Increase in heat extremes
Decrease in summer precipitation
Increasing risk of river floods
Increasing risk of forest fires
Decrease in economic value of forests
Increase in energy demand for cooling

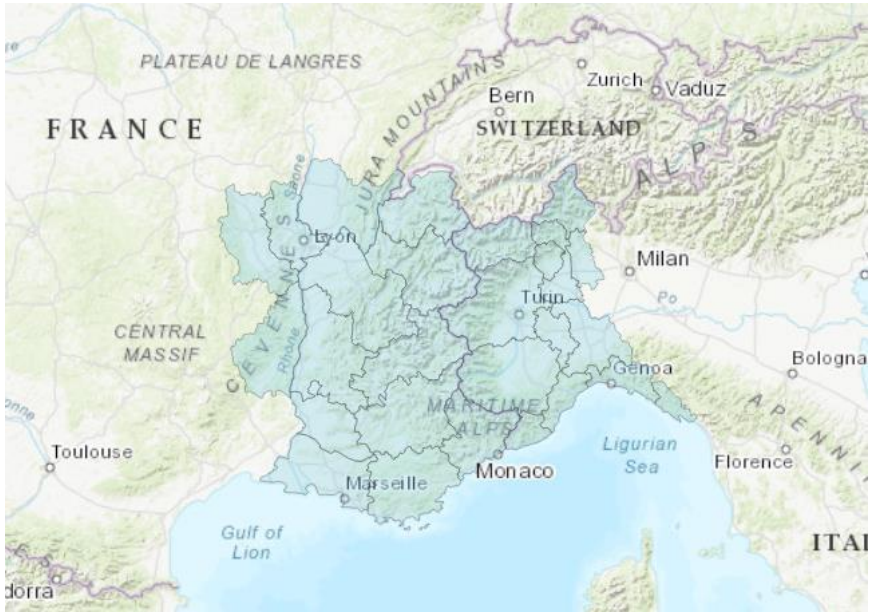
Mediterranean region
Large increase in heat extremes
Decrease in precipitation and river flow
Increasing risk of droughts
Increasing risk of biodiversity loss
Increasing risk of forest fires
Increased competition between different water users
Increasing water demand for agriculture
Decrease in crop yields
Increasing risks for livestock production
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decreasing potential for energy production
Increase in energy demand for cooling
Decrease in summer tourism and potential increase in other seasons
Increase in multiple climatic hazards
Most economic sectors negatively affected
High vulnerability to spillover effects of climate change from outside Europe

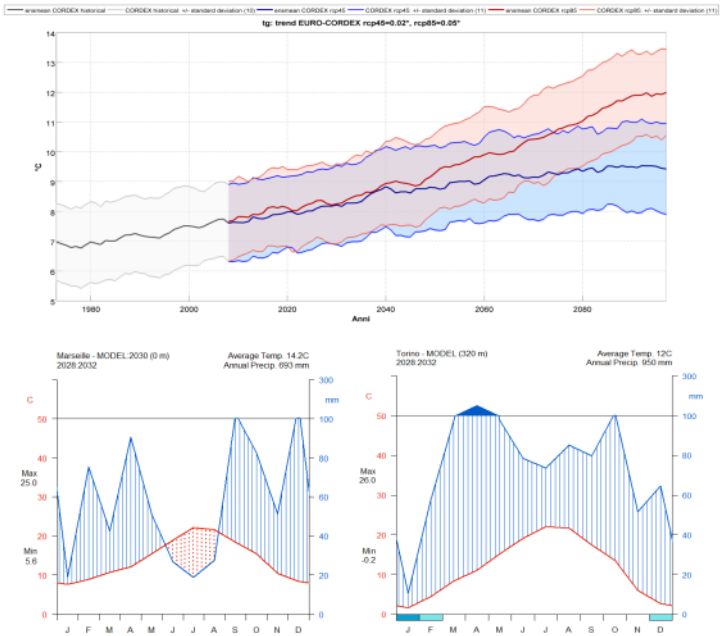
Mountain regions
Temperature rise larger than European average
Decrease in glacier extent and volume
Upward shift of plant and animal species
High risk of species extinctions
Increasing risk of forest pests
Increasing risk from rock falls and landslides
Changes in hydropower potential
Decrease in ski tourism

Diminuzione dei raccolti, aumento della richiesta d'acqua a scopi irrigui, aumento del rischio incendi

European Environment Agency

Regional climate projections over CLIMAERA domain (2030s and 2050s)





Christian Ronchi[1] , Stefano Bande[1] , Veronica Villani[2],Giuliana Barbato[2], Paola Mercogliano[2,3]

1 Arpa Piemonte – Dipartimento Rischi Naturali ed Ambientali

2 CMCC – Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici – Divisione REMHI

3 CIRA - Centro Italiano Ricerche Aerospaziali

WP 3 : Impacts synergiques des CC et de la pollution de l'air sur le territoire ALCOTRA

WP3: Impatti dei Cambiamenti Climatici e dell'inquinamento atmosferico sul territorio ALCOTRA

Action 3.2
Construction de **scénarios** émissifs et **météorologique** futurs

Azione 3.2
Costruzione degli **scenari** emissivi e **meteorologici** futuri .

Meteorological (climatic) Scenarios

✓ Action completed

The meteorological scenarios for the 2030s and 2050s were commissioned and implemented by the CMCC (Euro-Mediterranean Center for the CC)

ALCOTRA-CLIMAERA experimental setup

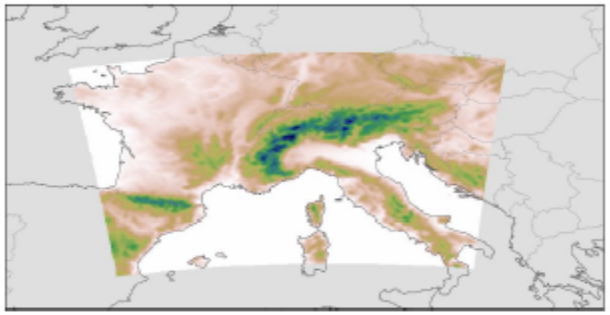
RCM version

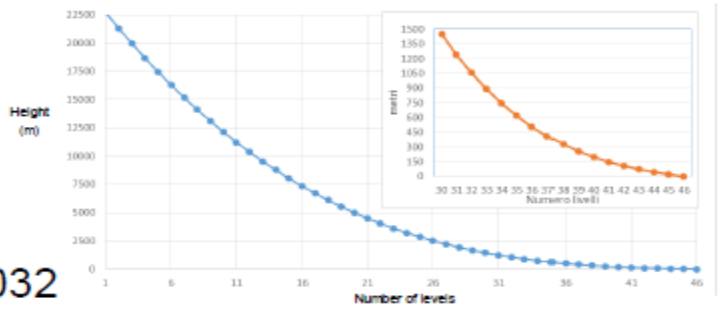
- COSMO-CLM v 5.00 clm9

Computational Domain

- Alpine Region 3.9°W -19.1°E, 38.9°N - 50.48°N

  Nx=208, Ny=152, Nz = 45
- Resolution 0.0715°, ~8 km
- Sponge zone: 15 grid points





Experiments:

- Historical, (2010) 2011 – 2015
- Near Future Scenario, (2027) 2028 - 2032
- Medium Future Scenario, (2047) 2048 - 2052

Forcing data:

- EC-EARTH Global Model, IPCC RCP4.5

EUROPEAN experimental setup

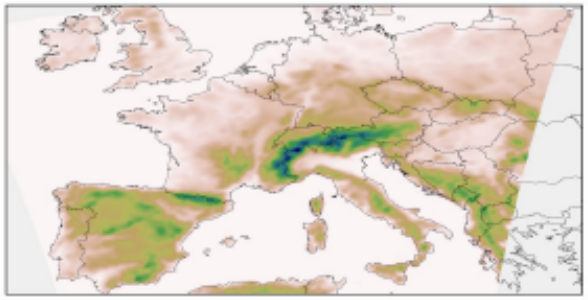
RCM version

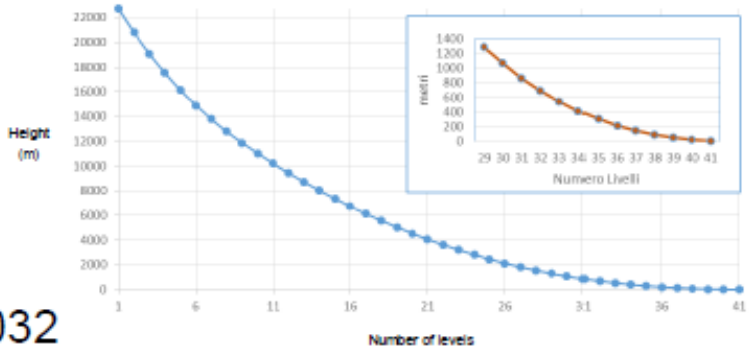
- COSMO-CLM v 5.00 clm9

Computational Domain

- European domain 16.9°W -27.0°E, 32.0°N - 56.7°N

  Nx=202, Ny=184, Nz = 40
- Resolution 0.125°, ~14 km
- Sponge zone: 15 grid points





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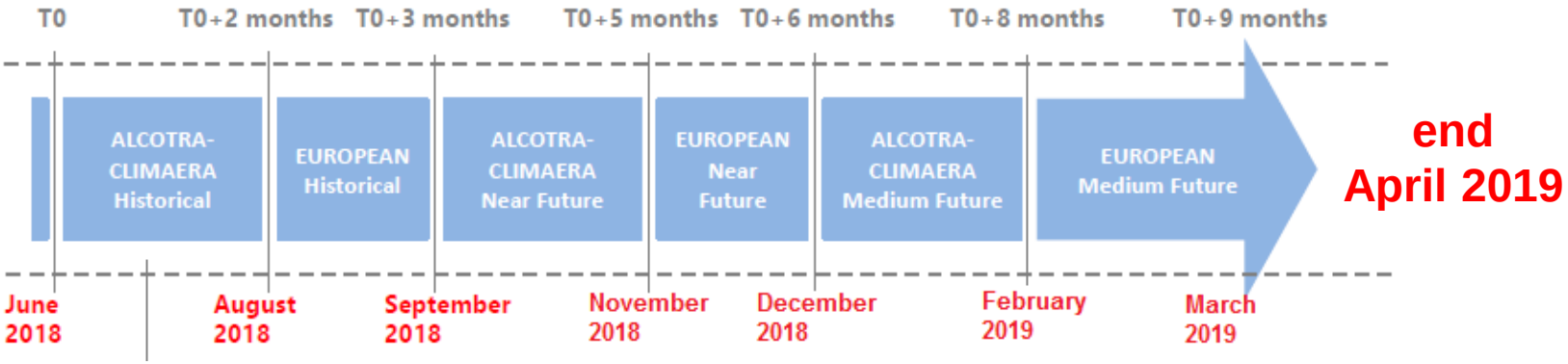
Forcing data:

- EC-EARTH Global Model, IPCC RCP4.5

Data dissemination for partners

Data are available (download) at: ftp.cmcc.it

✓ Action completed 90%



Case Study	*Domain*	*Release Data*	*Data size (tar.gz)*
Baseline: **2011-2015**	ALCOTRA CLIMAREA	Aug 2018	1.60 Tb
	EUROPE	Sep 2018	1.54 Tb
Near Future: **2028-2032**	ALCOTRA CLIMAREA	Nov 2018	1.51 Tb
	EUROPE	Dec 2018	1.65 Tb
Medium Future: **2048-2052**	ALCOTRA CLIMAREA	Feb 2019	1.52 Tb
	EUROPE	Mar 2019	1.65 Tb
		Total	**9.5 Tb**

Thanks for your attention!

veronica.villani@cmcc.it
Paola.mercogliano@cmcc.it

CLIMAERA

Arpa Piemonte Agenzia Regionale per la Protezione Ambientale

ARPA Valle d'Aosta

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

Interreg ALCOTRA
Fondo europeo di sviluppo regionale