Participatory LAB:

Laboratory of Spatial, Urban and Environmental Participatory Planning for Climate Change Adaptation

I session: public online thematic workshop

Paola Mercogliano
Fondazione CMCC

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Centro Euro-Mediterraneo sui Cambiamenti Climatici

The CMCC Foundation

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**

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MISSION

The CMCC Foundation

NETWORK

UNIVERSITÀ DEL SALENTO

UNIVERSITÀ DEGLI STUDI DELLA Tuscia

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ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

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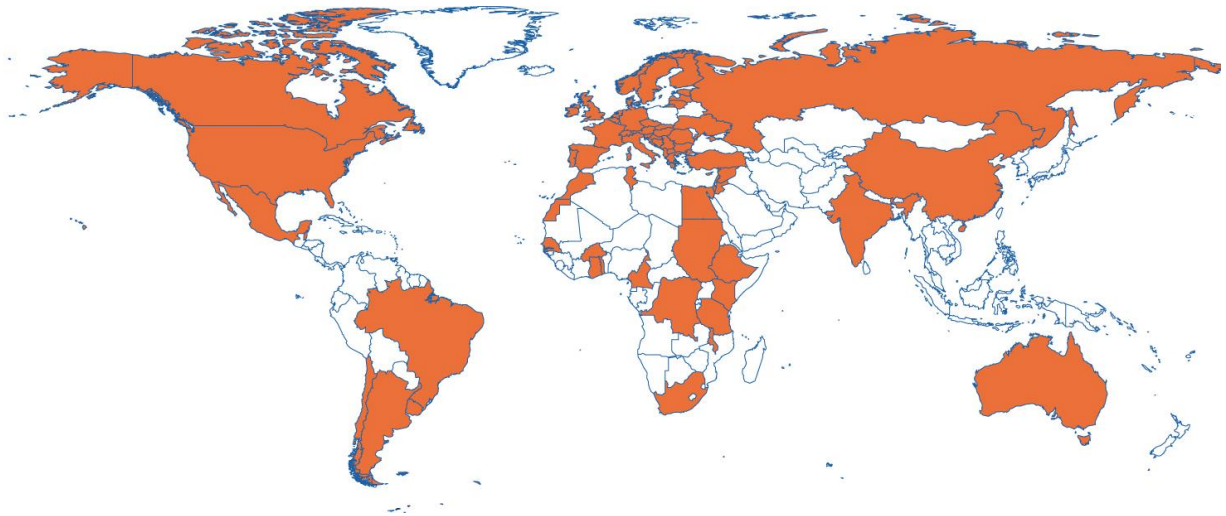
RFF cmcc
European Institute on Economics and the Environment

CIRA
Centro Italiano Ricerche Aerospaziali

International Collaboration

The CMCC collaborates with the best international centers specialized in advanced and applied climate research and has participated in cutting-edge projects in collaboration with over **700 institutions di 71 nations**



IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP

Since 2006 CMCC is the ITALIAN FOCAL point for IPCC https://ipccitalia.cmcc.it/

IPCC

The IPCC is the leading international body for the assessment of climate change. It was established by the United Nations Environment Program (UNEP) and the Word Meteorological Organization (WMO) to provide the word with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio economic impacts.

The IPCC is a scientific body. It reviews and assess the most recent scientific, technical and socio-economic information produced wordwide relevanto to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

The IPCC is an intergovernamental body. It is open to all members countries of the United Nations (UN) and WMO. Currently 194 countries are members of the IPCC

IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
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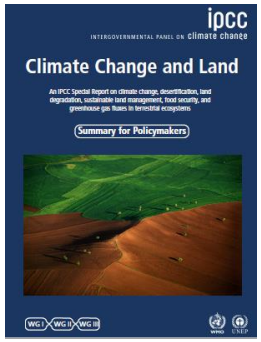
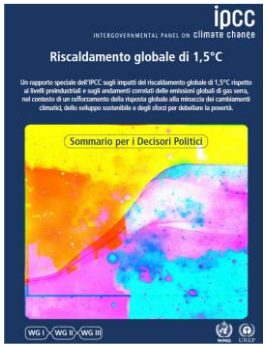
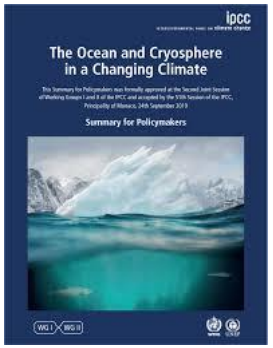
IPCC

The main activity of IPCC is the publication of special reports, on which are based the global agreements such as the United Nations Framework Convention on Climate Change and the Kyoto Protocol which implements the finding of the report. IPCC reports are politically neutral.

A very large number of scientists from all over the world contribute to the IPCC. The selection of scientists is performed to guarantee high scientific standards and also to try to have a balanced geographical representation.



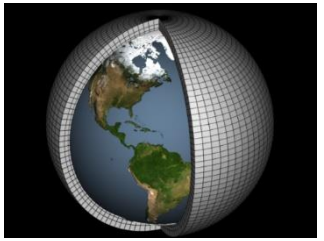


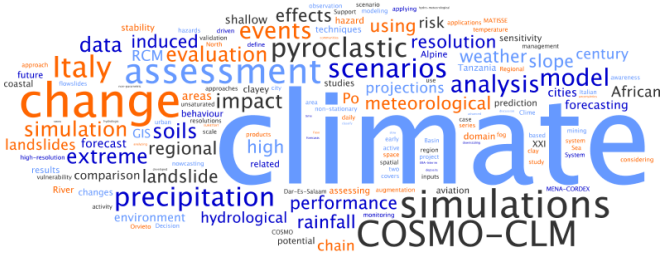


REMHI Division: Mission

REgional Models (REM)

Statistical and **dynamical downscaling of weather information up to very local scale**.





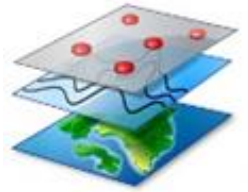
Impacts (HI)

Qualitative and quantitative evaluation of the effects of climate and land use changes on geo-hydrological (**floods, drought and landslide**) hazards and impacts on the population (**heat waves, health**).

Coupling Climate with Impact models (CCI)

Procedures to properly link weather with impacts. Leverage of data and expertise for tailored climate services.

dataclime.com



REMHI Division: DNA

Main features and approaches to evaluate climate and related impacts at local levels:

- Physically-based and statistical models and tools
- Quantitative estimations including uncertainty evaluation
- Deep involvement of stakeholders

REMHI VISION:

- Develop Models and Approaches to bridge the gap among climate research and practitioners

- Mainstreaming climate change assessment and adaptation in day-by-day issues through an «enginering» approach

Climate and climate change: general concepts

I part

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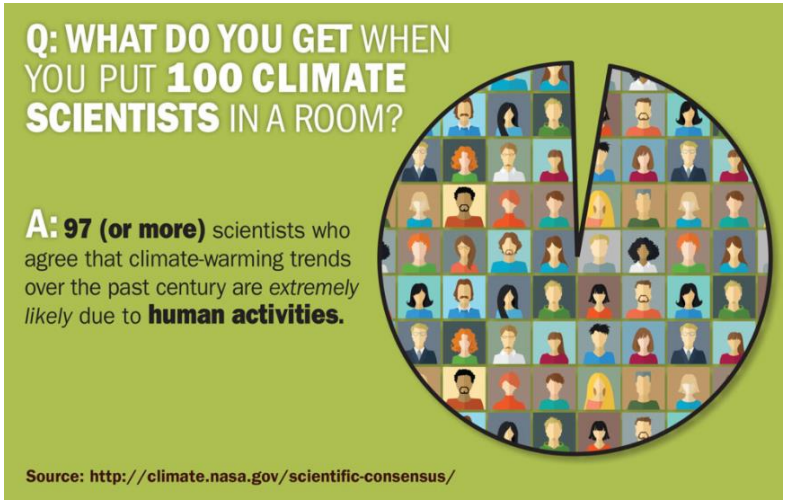
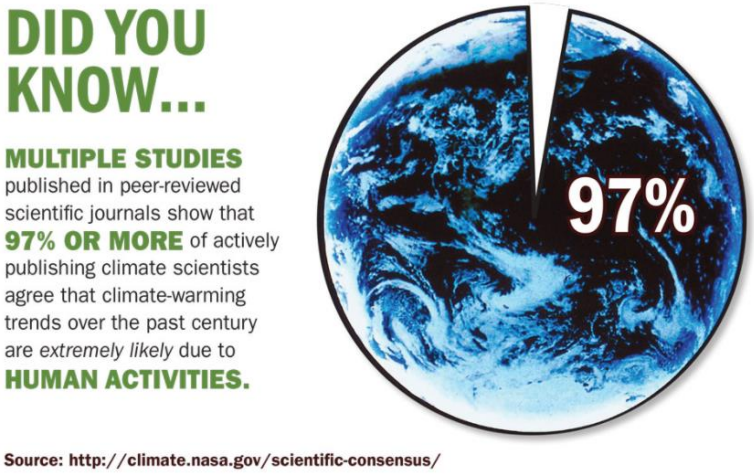
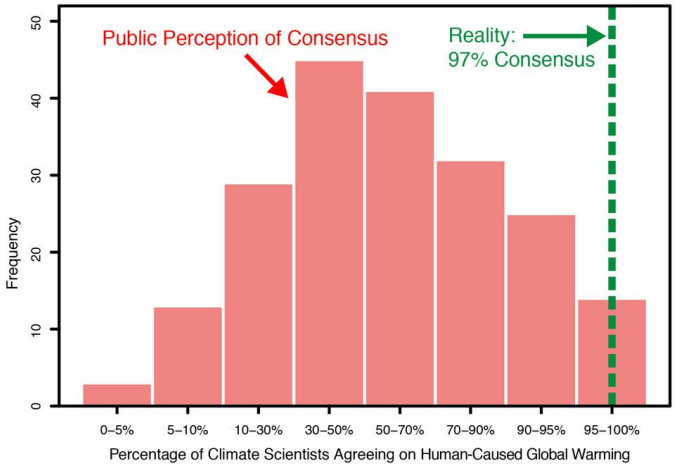
The consensus on climate change







In trying to achieve "balance“, the media has actually created a very unbalanced perception of reality.

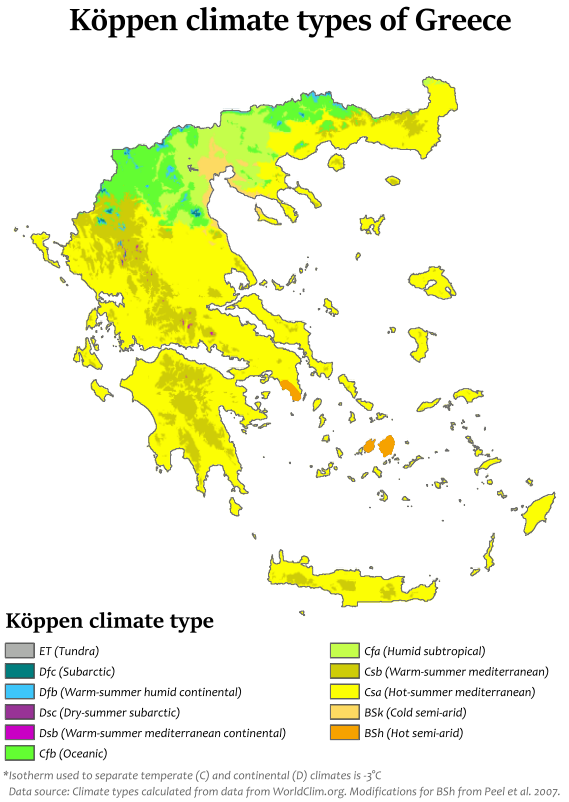
As a result, people believe scientists are still split about what's causing global warming, and therefore there is not enough public support or motivation to solve the problem.

Differences between meteorological condition or Climate

Meteorology studies the day-by-day atmospheric conditions: for example, windy day, sunny afternoon, cloudy morning.

When we refer to the weather conditions in a specific a location, we always give precise temporal indications.

The climate is different : **this is the set of weather conditions in a given place over a long period (at least 30 years); therefore, is the average of the meteorological values.**

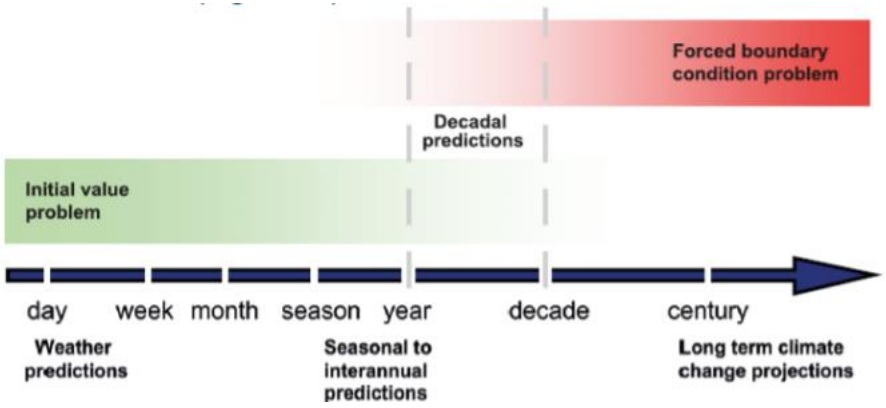


In the East, it could be the COLDEST New Year's Eve on record. Perhaps we could use a little bit of that good old Global Warming that our Country, but not other countries, was going to pay TRILLIONS OF DOLLARS to protect against. Bundle up!

— Donald J. Trump (@realDonaldTrump) 29 dicembre 2017

Weather Forecast are different from climate projections

Climate projections They typically start their simulations in the past, ranging from pre-industrial, to 1950 or even more recent times. These historical simulations are driven (or forced) by estimates of past human-induced and natural climate forcing agents (concentrations of GHGs), and the projections are obtained by forcing the climate models with scenarios for future GHG emissions or concentrations. These GHG emission or concentration are unknown. Climate projections evaluate the variation of the future climate with respect to the current climate comparing 30 years period.



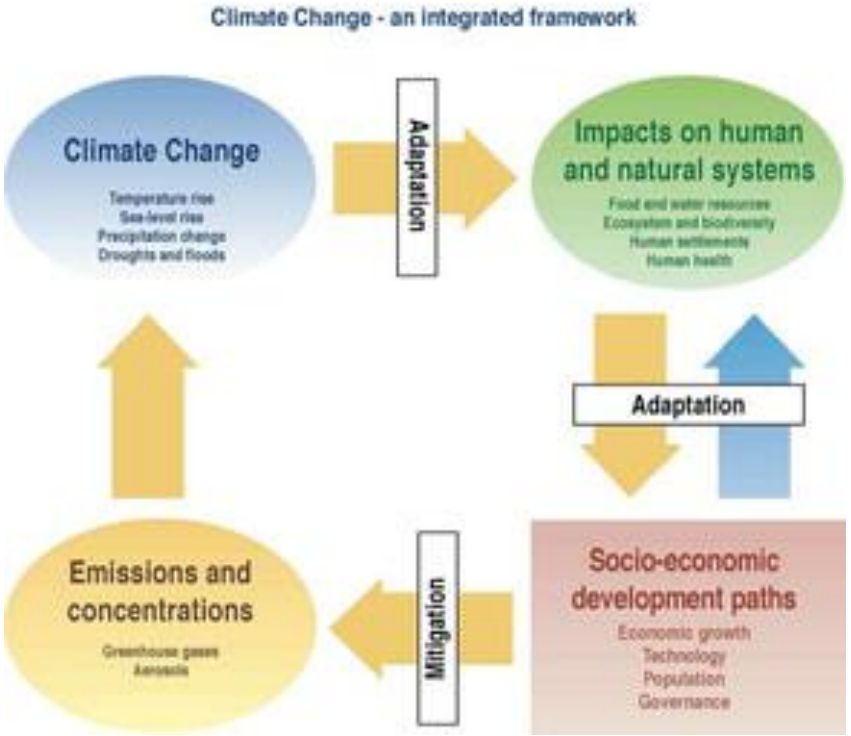
Weather forecast predicts the condition of the atmosphere for a given location and time. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere at a given place and using a set of equation to project how the atmosphere will change. Results can be deterministic or probabilistic

2 Important concepts : Mitigation and Adaptation

Global responses have focused more on reducing greenhouse gas (GHG) emissions in the atmosphere than on reducing the vulnerability of societies and ecosystems to climate change.

However due to the observed impact of climate change adaptation is therefore becoming increasingly important in international and national policies, as well as in local initiatives.

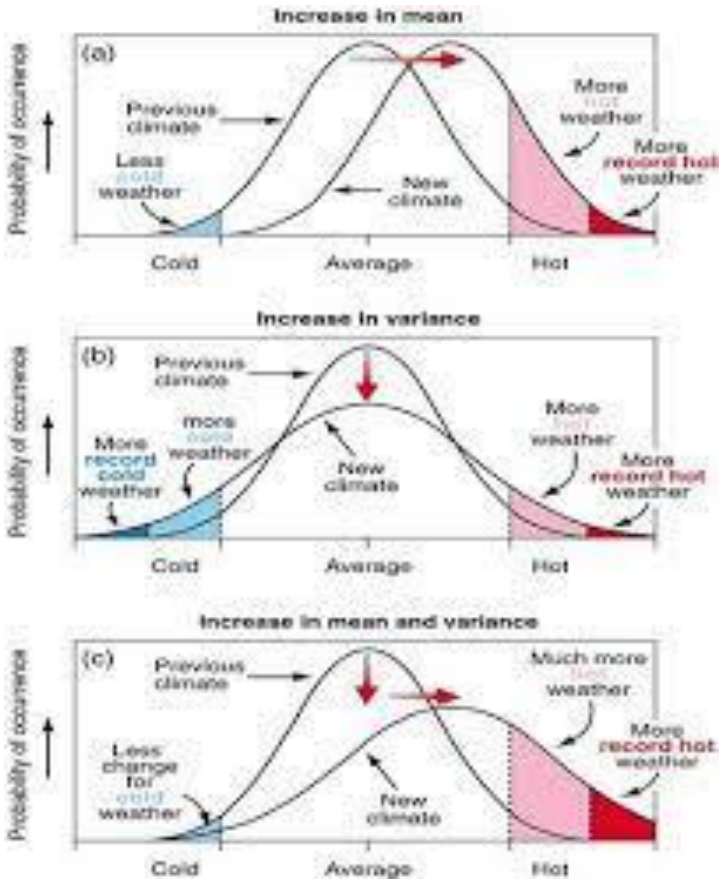
Policies address mitigation and adaptation separately, yet they are complementary and must both be implemented at different levels, from the international to the local.



- Mitigation attempts to reduce the causes of climate change

- Adaptation attempts to manage the impacts of climate change.

What is the Climate change ??



CLIMATE CHANGE is a statistically significant variations in the average state and variability of the climate persisting for an extended period.

The recorded CLIMATE CHANGE so far depends on the change of concentration of climate-altering gases in the atmosphere, due to anthropogenic activities.

it varies geographically, the impact and also the impacts are different depending on the atmospheric variable / indicator considered.

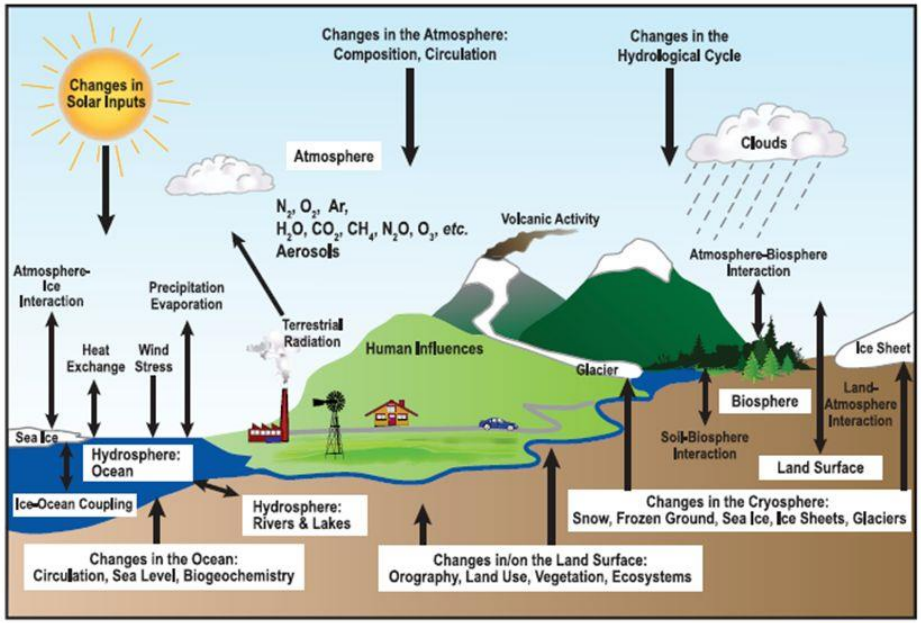
The evaluation of these changes needs appropriate tools to be evaluated. These tools are represented by models simulating the present behaviour (dynamics) of the Earth system, but also able to provide reliably evaluation of the evolution of the climate in the next decades, not only in terms of average properties, but also in terms of extreme events.

Climate Change VS Climate Variability

By climatic variability we mean the fluctuation of a specific climatic variable (for example the average temperature of the earth's surface) around its average value, obtained from long-term measurements, at least thirty years.

More specifically, the fluctuations are linked to the year-by-year variations (interannual and seasonal) and to the ten-year fluctuations, which overlap the average value of the quantity.

Forcings and Feedbacks in the Climate System

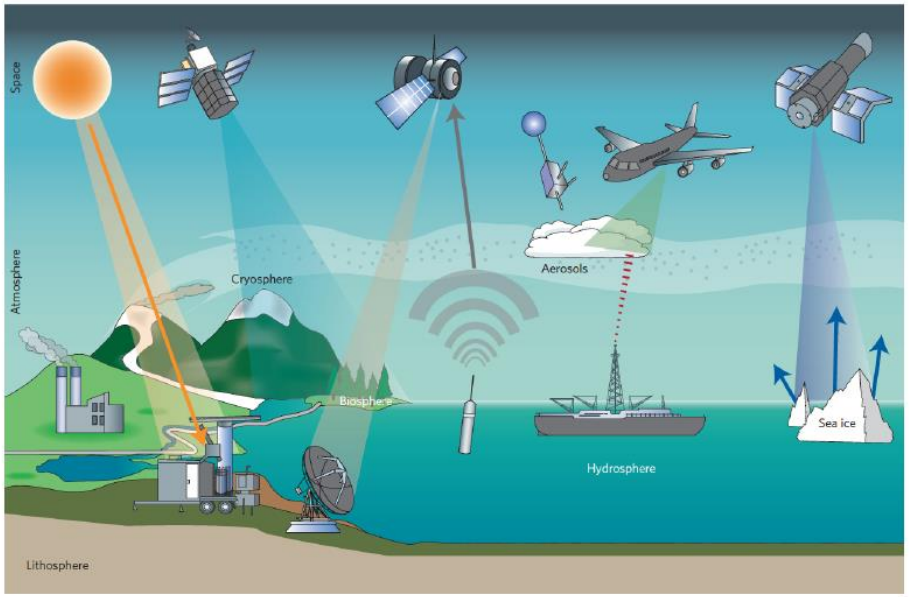


Schematic view of the components of the climate system, their processes and interactions.

Image credit: *IPCC Assessment Report 4*

How we have evidences that a climate change is happening?

In recent decades, new observation systems, particularly those based on satellite measurements, have increased the number of observations on the Earth's climate system by an order of magnitude.



IPCC AR5 Working Group I
Climate Change 2013: The Physical Science Basis

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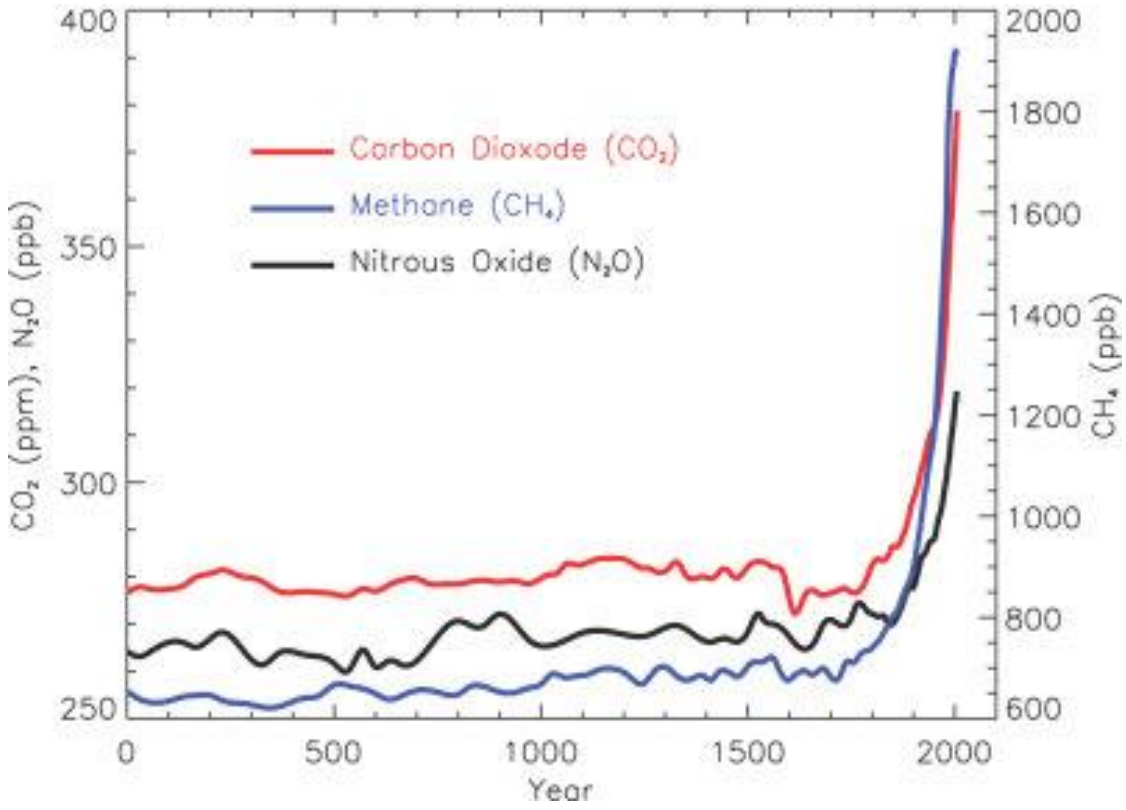
Instrumental data: more precise reconstruction of short-term variations (homogenization processes). Limited in time

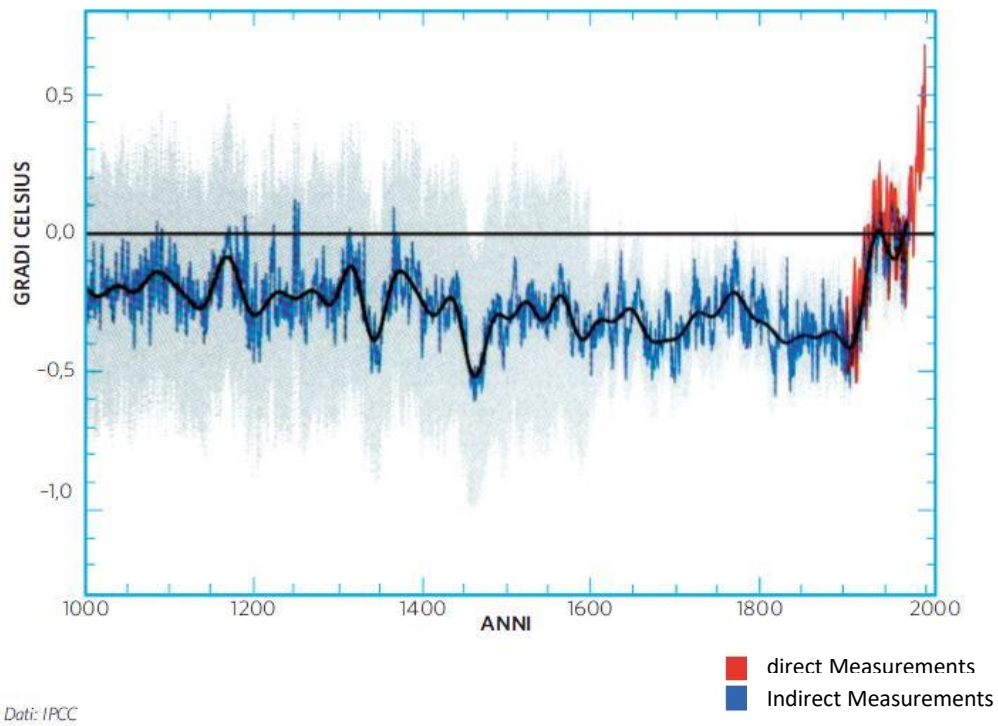
Evidence: increasing of greenhouse gases concentration in the atmosphere



Atmospheric concentrations of important greenhouse gases over the last 2,000 years. Increases since about 1750 are attributed to human activities in the industrial era. Source: IPCC 2007.

Evidence: temperature evolution in the past

Differences for the mean years temperatures with respect to the average temperature over the period 1961-1990



Dati: IPCC

Reconstruction of the global average temperature of the last 1000 years, obtained through direct (last 100 years, in red) and indirect (in blue) measurements.

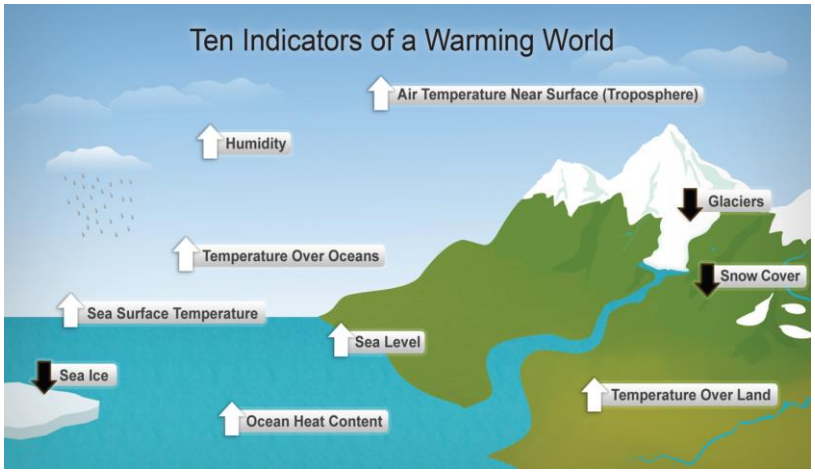
The overlapping of the small natural variability is clearly evident, with respect to which the increase of almost one degree centigrade that is observed in the last 100 years is distinguished by range and speed.

Proxy data: suitable for studying long-term climatic variations (up to geological scales). They allow us to trace the climate of remote times but have greater uncertainty than the instrumental data

Evidence : changes in the climate system

Together with this increase of GHG concentration in the atmosphere, some changes have been observed since 1950 in all sectors of the Earth's climate system:

- **Atmosphere and ocean warmed**
- **The extent and volume of the ice has reduced**
- **The sea level has risen**
- **The increase in CO2 has caused a decrease in the pH of the ocean (ocean acidification)**
- **Snow cover in the northern hemisphere has decreased**



Many of these changes have not been observed in the past two millennia

This is why global warming is defined in the AR5 * "Virtually certain" (probability> 99%)

Climate change: an anthropic phenomenon

Certainty on the human causes of the CC

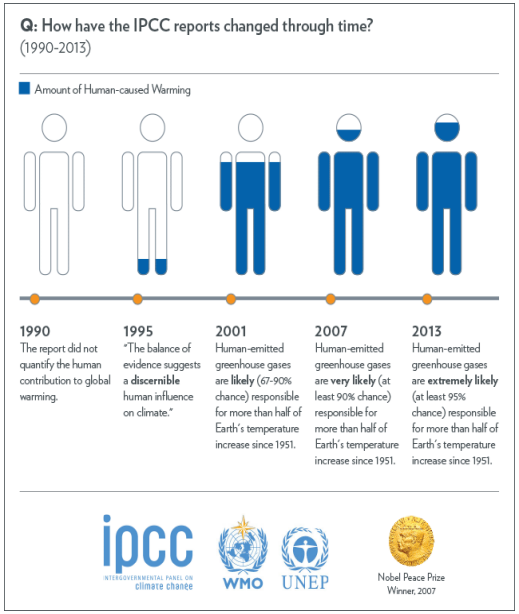
1990. "[...] emissions from human activities are substantially increasing the concentration of greenhouse gases in the atmosphere" (1st IPCC Report**)**

1995. "These trends [of increased concentration of greenhouse gases in the atmosphere] can be largely attributed to human activities" (2nd IPCC Report)

2001. "Considering of the new evidence and taking into account the remaining uncertainties; it is possible to say that the observed warming over the last 50 years is due to the increase in the concentration of greenhouse gases "(3rd IPCC Report)

2007. "Most of the observed increase in global average temperatures since the mid-twentieth century is most likely due to the observed increase in concentrations of anthropogenic greenhouse gases" (4th IPCC Report)

2013. "Human influence on the climate system is clear and recent anthropogenic emissions of greenhouse gases are the highest in history with widespread impacts on human and natural systems" (5th IPCC Report)



Climate and climate change: general concepts

I part

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How will change the climate in the next years?

II part

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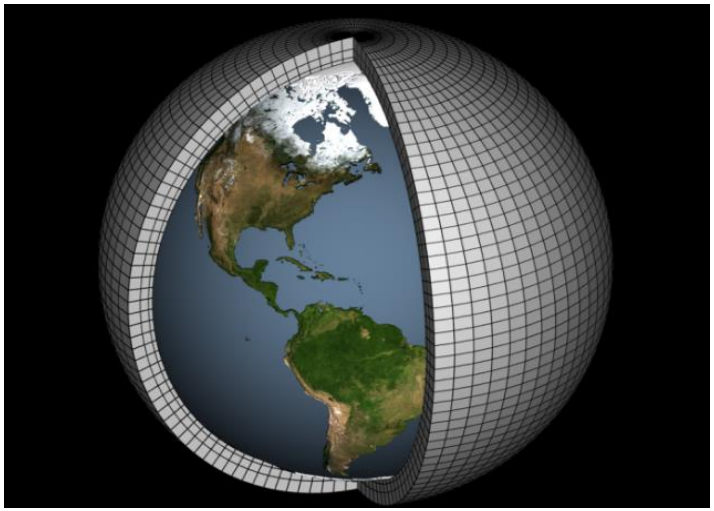
Climate models

In the first part we have understood that climate depends by human activities…
The only hope we have to be able to understand and predict the evolution, considering natural and anthropogenic forcing effect on the climate system, are the numerical climate models.

What is a CLIMATE MODEL? A set of mathematical equations representing the physical laws describing the evolution of the climate system.
Depending on how inclusive we want to be, climate models can be very simple to very complex, including all components of the system (Atmosphere, Ocean, Earth, Cryosphere and Biosphere) and all dynamics, physical processes and interactions between the component of the system.



What are the models?

Simplification: A model must be simpler than its real counterpart.

Idealization: A model must emphasize the main features and neglect the less important ones

Subjectivity: the scientist establishes the importance of the various components.

How do the models works?

INPUT
current state of the atmosphere

→

Algoritms:
partial differential equations

→

OUTPUT
future state of the atmosphere

These models allow a schematic and simplified representation of reality, using a set of equations simulating the behaviour of Earth System.

The ability to predict changes in the climate in the future is entrusted to mathematical models simulating the main physical processes of the Earth system and whose functionality is tested by comparing simulations of the past climate with currently available data.

Climate models: evidences of climate change

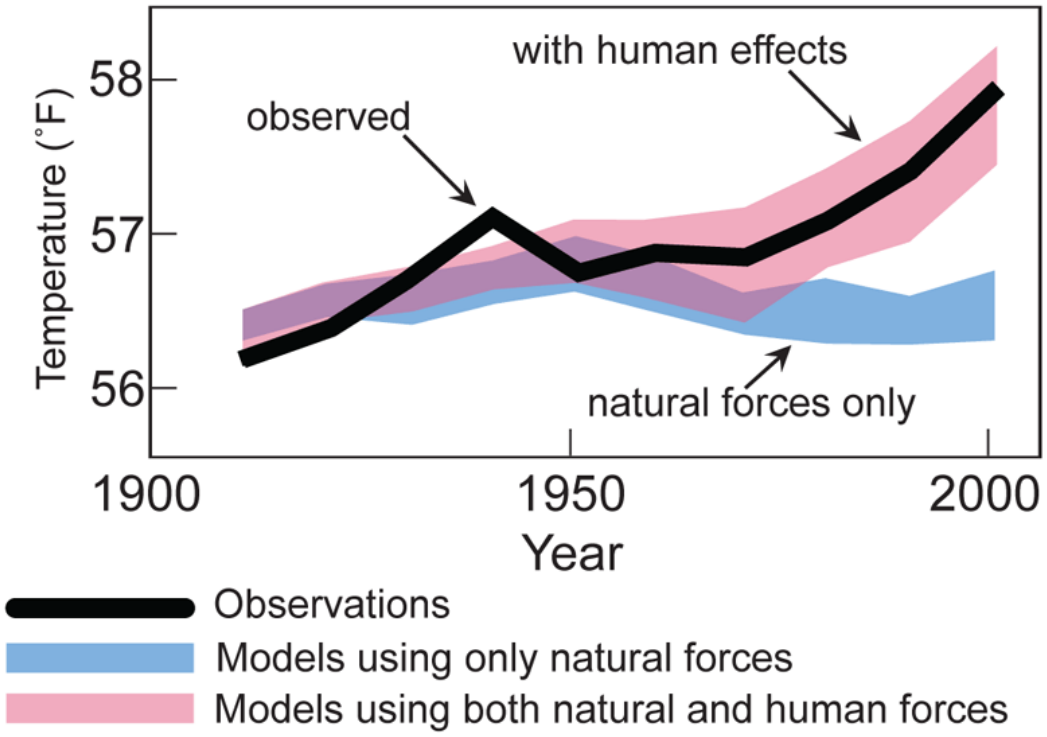
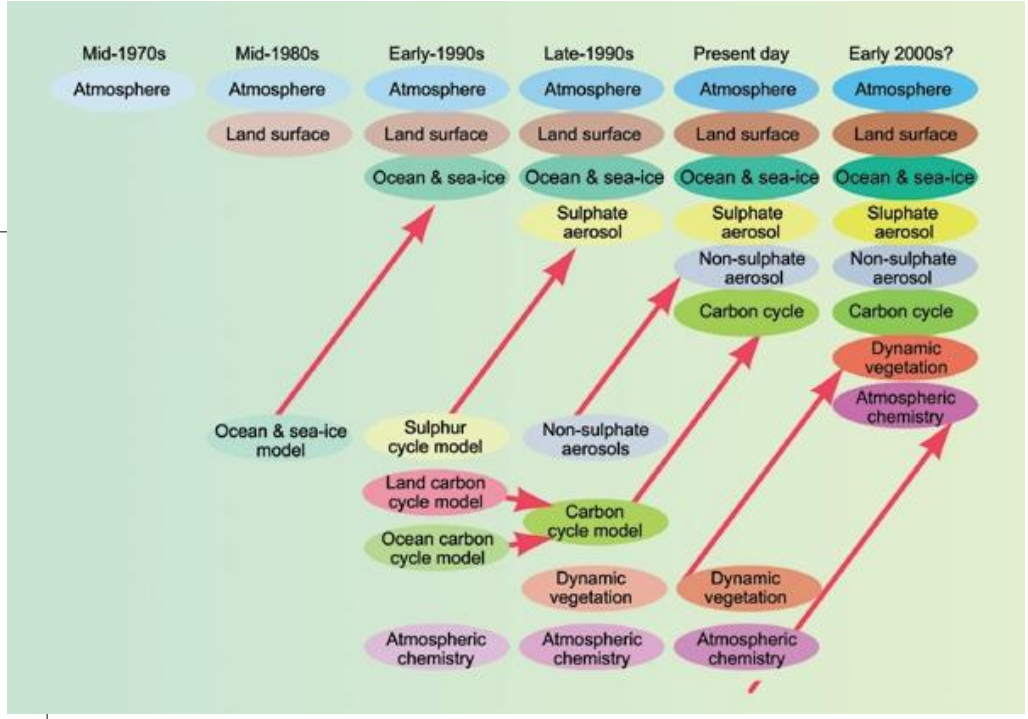


Figure from the IPCC's Fourth Assessment Report (Hegerl et al 2007).

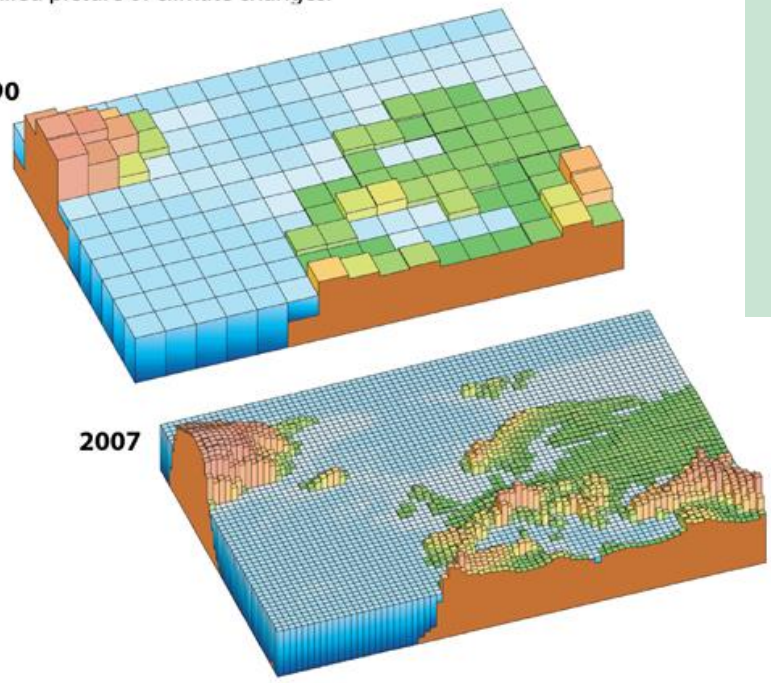
Natural-only runs only include natural factors such as changes in the sun's output and volcanoes, but they assume greenhouse gases and other human factors remain unchanged at pre-industrial levels. Human-only runs hold natural factors unchanged and only include the effects of human activities, such as increasing atmospheric greenhouse gas concentrations.

Advances in the development of climate models



The Difference Resolution Makes

From the first Intergovernmental Panel on Climate Change (IPCC) report in 1990 to the fourth assessment in 2007, the resolution of climate modeling improved significantly, allowing scientists to get a more detailed picture of climate changes.



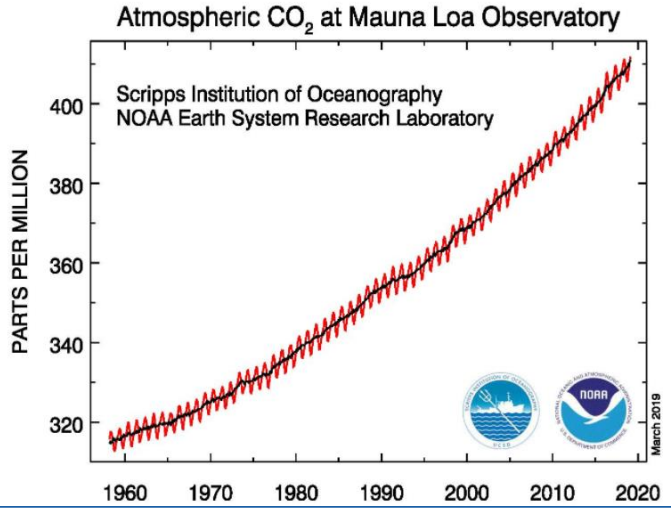
SOURCE: University Corporation for Atmospheric Research (UCAR) InsideClimate News

Scenarios of greenhouse gas and aerosol concentrations

We have climate models that are able to “evaluate” the effect on the climate system of the natural and anthropogenic forcing (Co2 equivalent concentration)…..

But we need to know how will change the concentration of Co2 equivalent in the atmosphere….we need a scenario of greenhouse gas concentration. This is a very hard task!

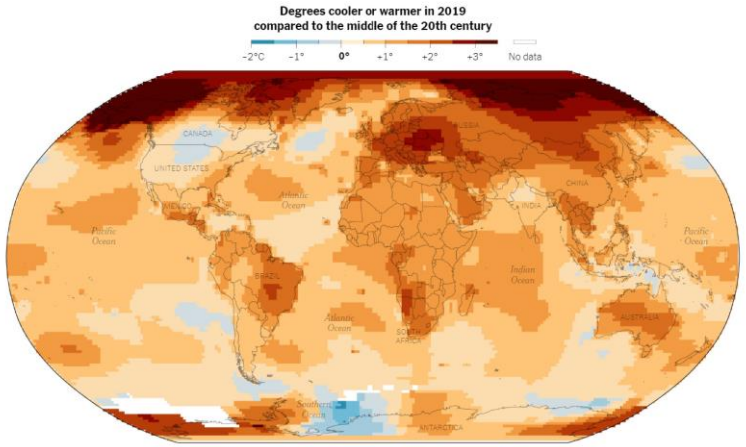
Global carbon dioxide growth in 2018 reached 4th

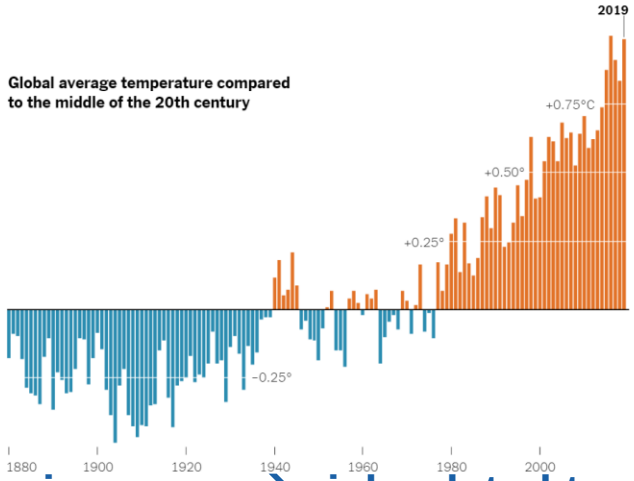


That means three of the four highest annual increases have occurred in the past four years, said Pieter Tans, senior scientist with GMD.“At a time when there’s all this talk about how we should be decreasing CO_2 emissions, the amount of CO_2 we’re putting into the atmosphere is clearly accelerating,” Tans said. “It’s no coincidence that the last four years also had the highest CO_2 emissions on record.”

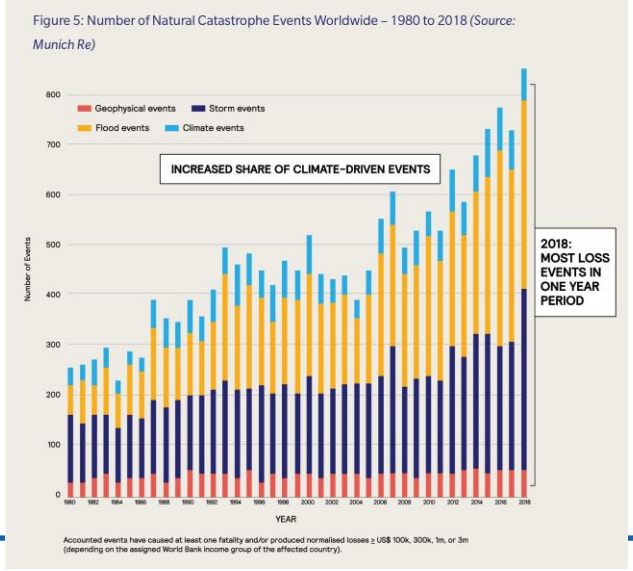
A chart showing the steadily increasing concentrations of carbon dioxide in the atmosphere (in parts per million) observed at NOAA's Mauna Loa Observatory over the course of 60 years. Measurements of the greenhouse gas began in 1959. (NOAA)

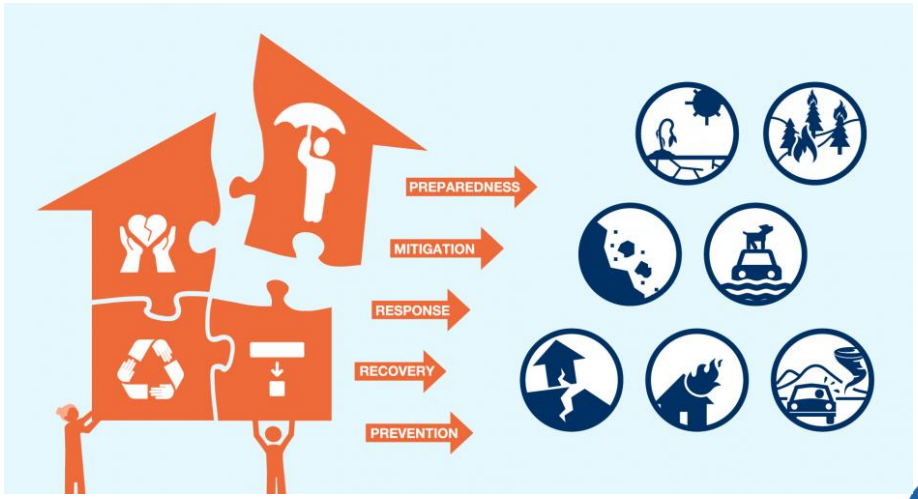
Observed CO2 increase → Global temperature increase





Observed CO2 increases → Global temperature increases→ risk related to climate increases→ we need to know to reduce the risk (fatalities, damages, losses)





IPCC Scenarios

IPCC releases scenarios, or plausible descriptions of **how society may evolve in the future; each of them represents a possible demographic, socio-economic, technological and environmental development, which can be seen positively by some and negatively by others.**

It should be emphasized that scenarios are neither forecasts nor predictions. The scenarios describe the evolution of various factors closely connected with climate change in the 21st century.

These factors include emission levels of 10 greenhouse gases, economy, energy, technology in use, resources in use, land use, fossil fuel use.

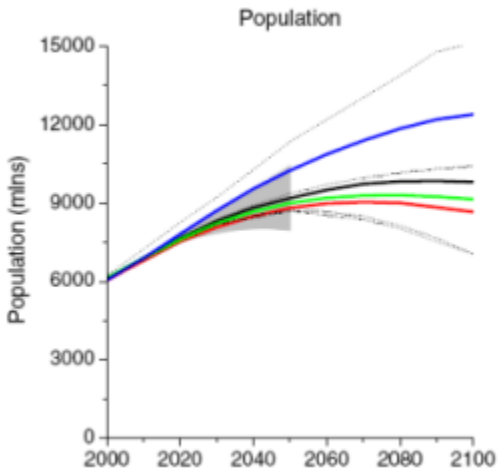
IPCC scenarios are hypothesis…we don’t know what will happen in the reality but thanks to scenarios we can simulate the effect on the climate system of this scenario

IPCC: RCP2.6, RCP4.5 e RCP8.5

Emissions scenario	Trend
RCP 8.5	Continuation of business as usual
RCP 4.5	Reduced emissions beginning in 2050
RCP 2.5	Strong reduction in emissions starting now

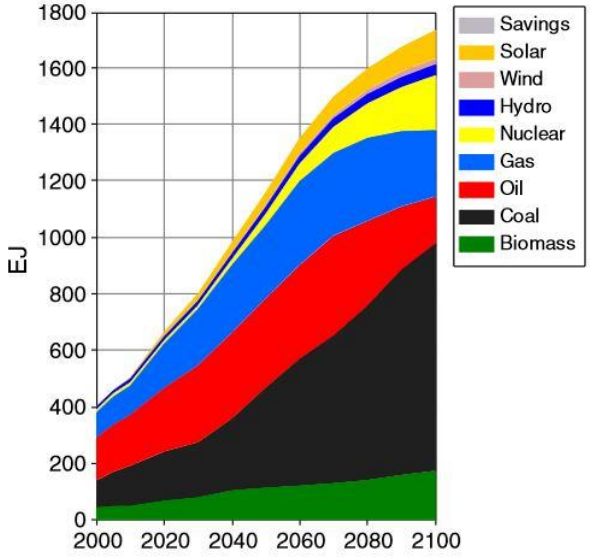
The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high GHG emissions (RCP8.5).

RCP2.6 is representative of a scenario that aims to keep global warming *likely* below 2°C above pre-industrial temperatures.



Detlef P. van Vuuren et al, Climatic Change, Nov 2011.

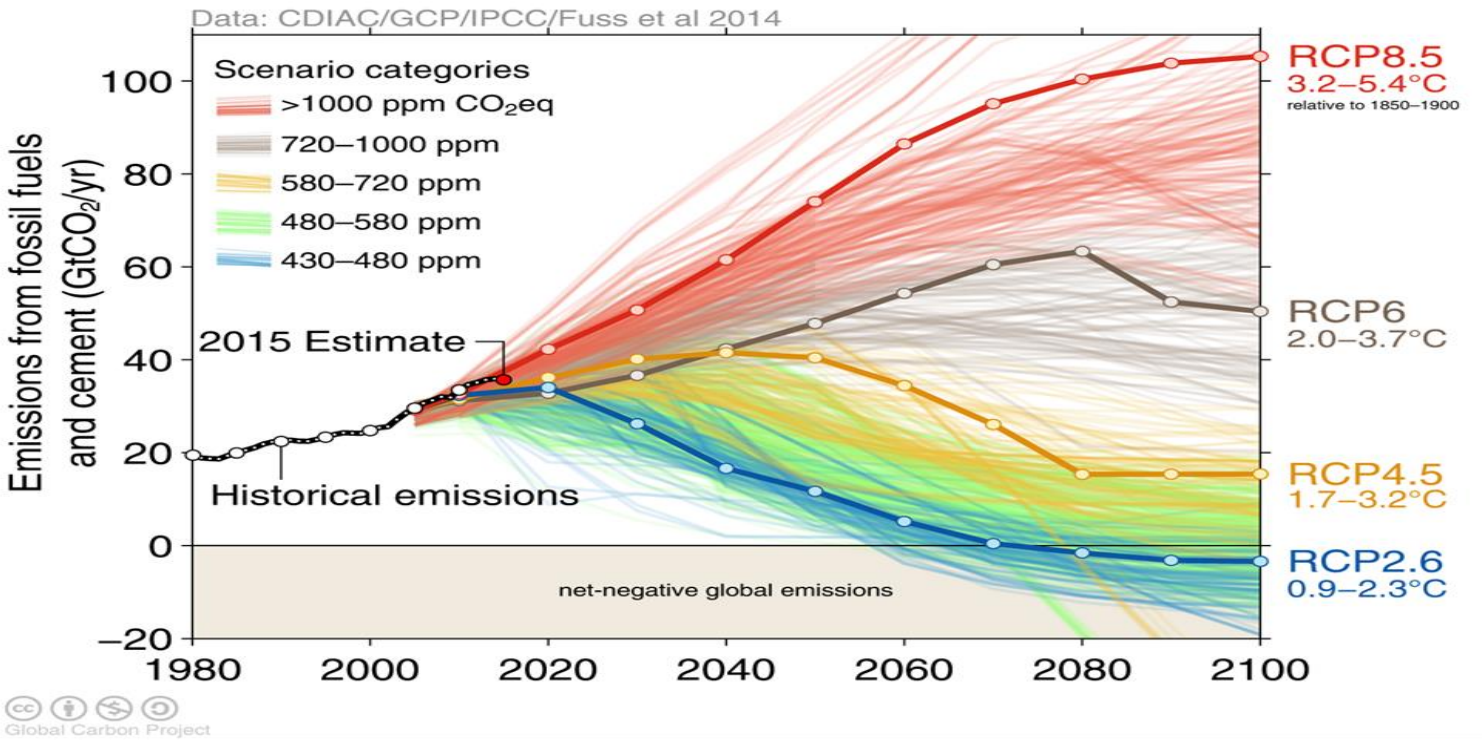
RP8.5 assumes more relevant population growth



Keywan Riahi et al in Climate Change, November 2011

RCP8.5 describes a hot dirty future for the world, in which coal use increases to become the major source of power for the world

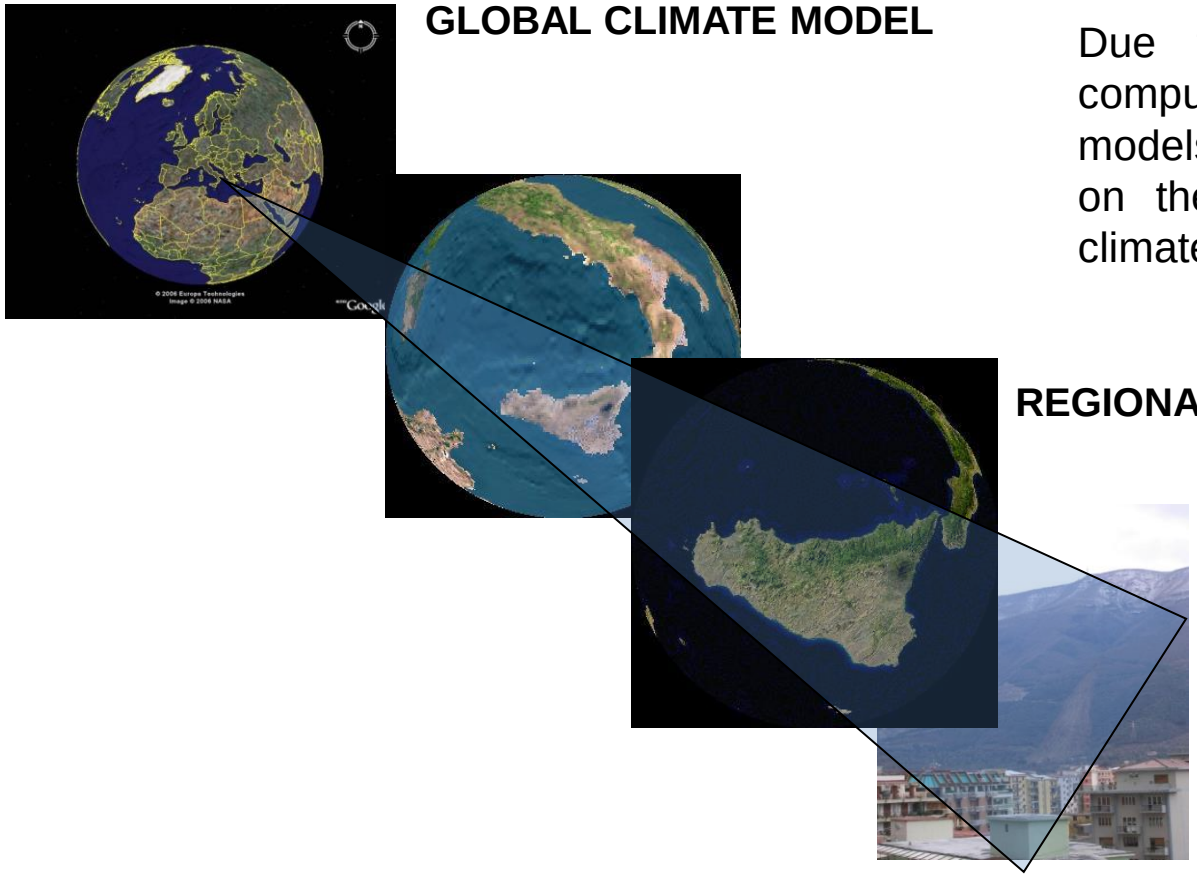
General Circulation Models permits to evaluate evolution of global temperature considering different scenarios



General circulation models are the most advanced tools currently available to simulate the response of the global climate system to rising greenhouse gas concentrations.

GCMs support definition of the mitigation policies but unfortunately they are not adequate to support impact studies and adaptation strategies;

Regional Climate models



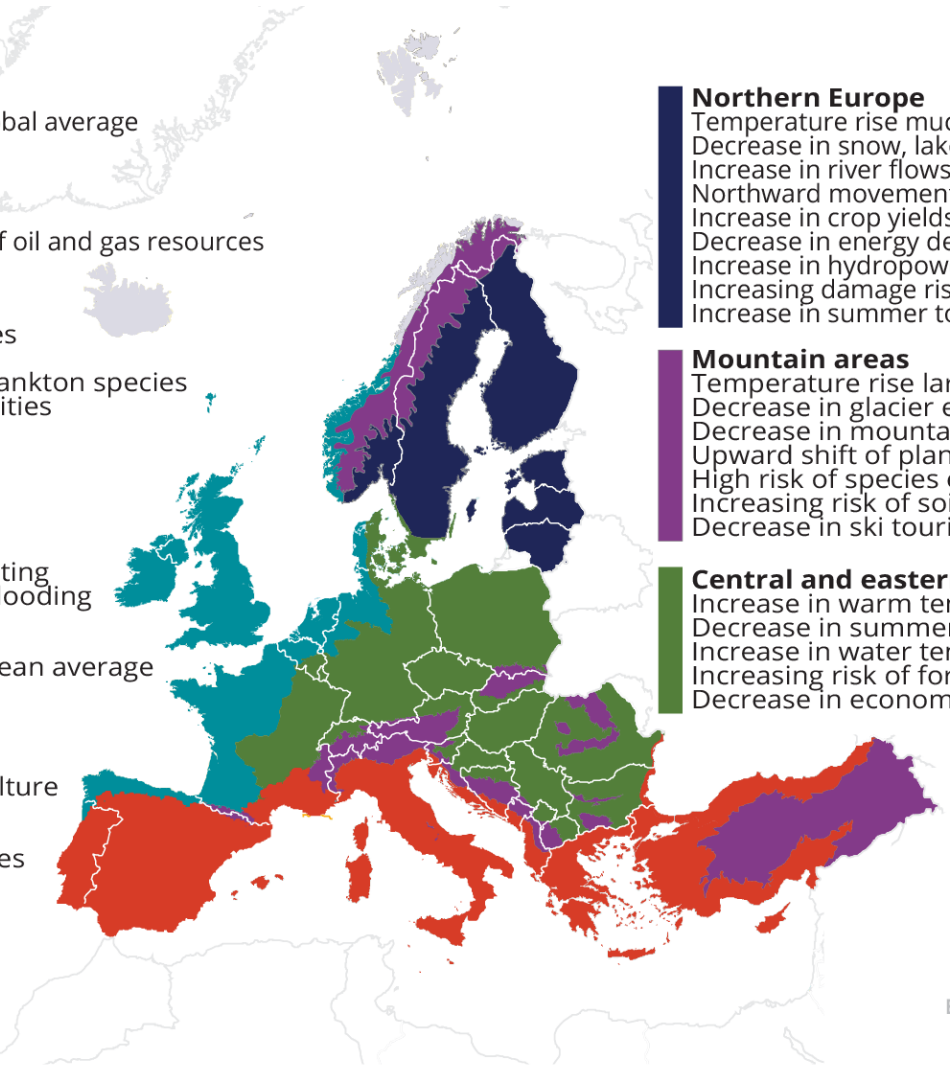
GLOBAL CLIMATE MODEL

Due to the limitation of current computational resources, global models are unable to give indications on the local characteristics of the climate and its variations.

REGIONAL CLIMATE MODEL

In order to simulate the characteristics of the climate on a local scale, more detail is required, for this purpose regional models have been created, which simulate the climate of a limited part of the Earth. These models are the most largely tools adopted to evaluate local climate condition and evolution and then to support adaptation actions.

Climate change impacts in Europe



Arctic
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
Intensified shipping and exploitation of oil and gas resources

Coastal zones and regional seas
Sea-level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward expansion of fish and plankton species
Changes in phytoplankton communities
Increasing risk for fish stocks

North-western Europe
Increase in winter precipitation
Increase in river flow
Northward movement of species
Decrease in energy demand for heating
Increasing risk of river and coastal flooding

Mediterranean region
Temperature rise larger than European average
Decrease in annual precipitation
Decrease in annual river flow
Increasing risk of biodiversity loss
Increasing risk of desertification
Increasing water demand for agriculture
Decrease in crop yields
Increasing risk of forest fire
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decrease in hydropower potential
Decrease in summer tourism and potential increase in other seasons

Northern Europe
Temperature rise much larger than global average
Decrease in snow, lake and river ice cover
Increase in river flows
Northward movement of species
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increasing damage risk from winter storms
Increase in summer tourism

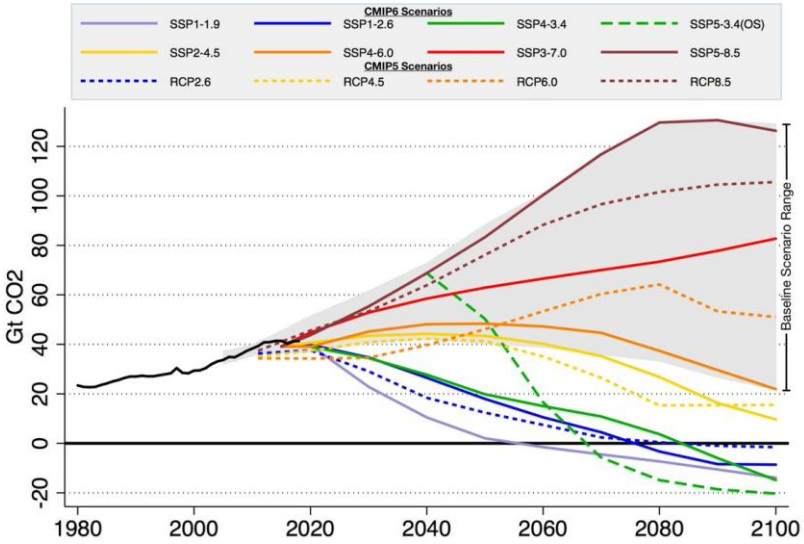
Mountain areas
Temperature rise larger than European average
Decrease in glacier extent and volume
Decrease in mountain permafrost areas
Upward shift of plant and animal species
High risk of species extinction in Alpine regions
Increasing risk of soil erosion
Decrease in ski tourism

Central and eastern Europe
Increase in warm temperature extremes
Decrease in summer precipitation
Increase in water temperature
Increasing risk of forest fire
Decrease in economic value of forests

European Environment Agency

The IPCC 2021 (AR6) scenarios

- In the Fifth Assessment Report, four Representative Concentration Pathways (RCPs) were used to simulate future climate change.
- In the Sixth Assessment Report IPCC uses Shared Socio-Economic Pathways (SSPs) that look at a far great range of options / scenarios.
- There's a greater focus on lower degrees of warming because of these scenarios. Levels of warming like 1.5°C and 2°C can be assessed more rigorously than in AR5



Source: https://www.ipcc.ch/site/assets/uploads/2021/06/Fact_sheet_AR6.pdf

How will change the climate in the next years?

II part

Please write your questions and comments in the chat!

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Expected climate condition over Greece

III part

EURO-MEDITERRANEAN CENTRE ON CLIMATE CHANGE (CMCC)
REMHI Division

cmcc
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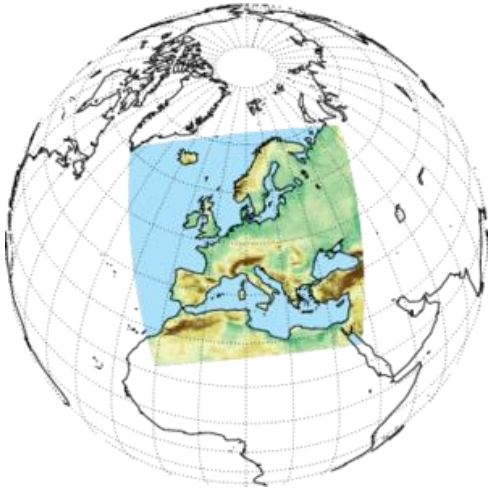
Introduction

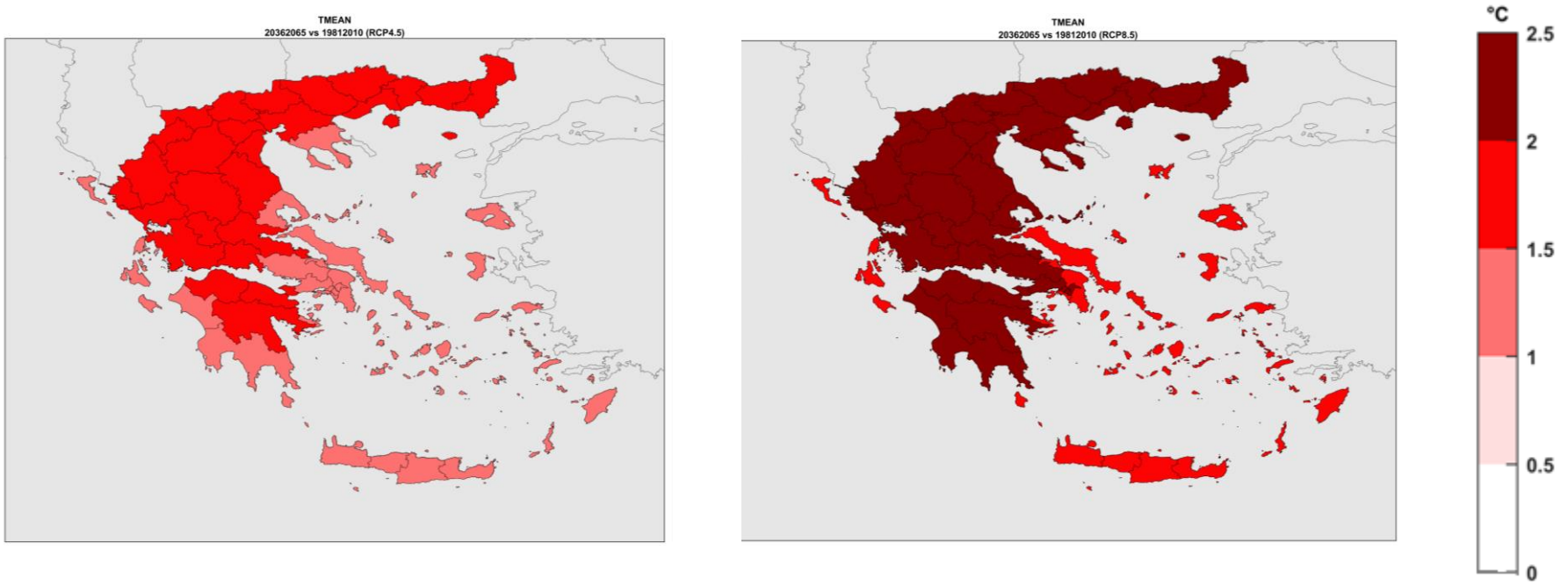


Perform climate analysis using **CORDEX regional climate model (RCM) simulations available over the European domain (EURO-CORDEX) with resolution 0.11 degree** (about 12 km) forced by **different global climate models**.

Such simulations are obtained according to the IPCC **scenarios RCP4.5 and RCP8.5** and evaluated over the future **period 2036-2065 with respect to the control period 1981-2010.**

Analysis are performed at NUT3 level within the Greek territory

Multi - model ensemble mean of the mean annual temperature anomaly at Nuts3 level (RCP4.5 and RCP8.5)



Mean annual temperature anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 (left) and RCP8.5 (right) over 2036–2065 (2050) period compared to 1981–2010.

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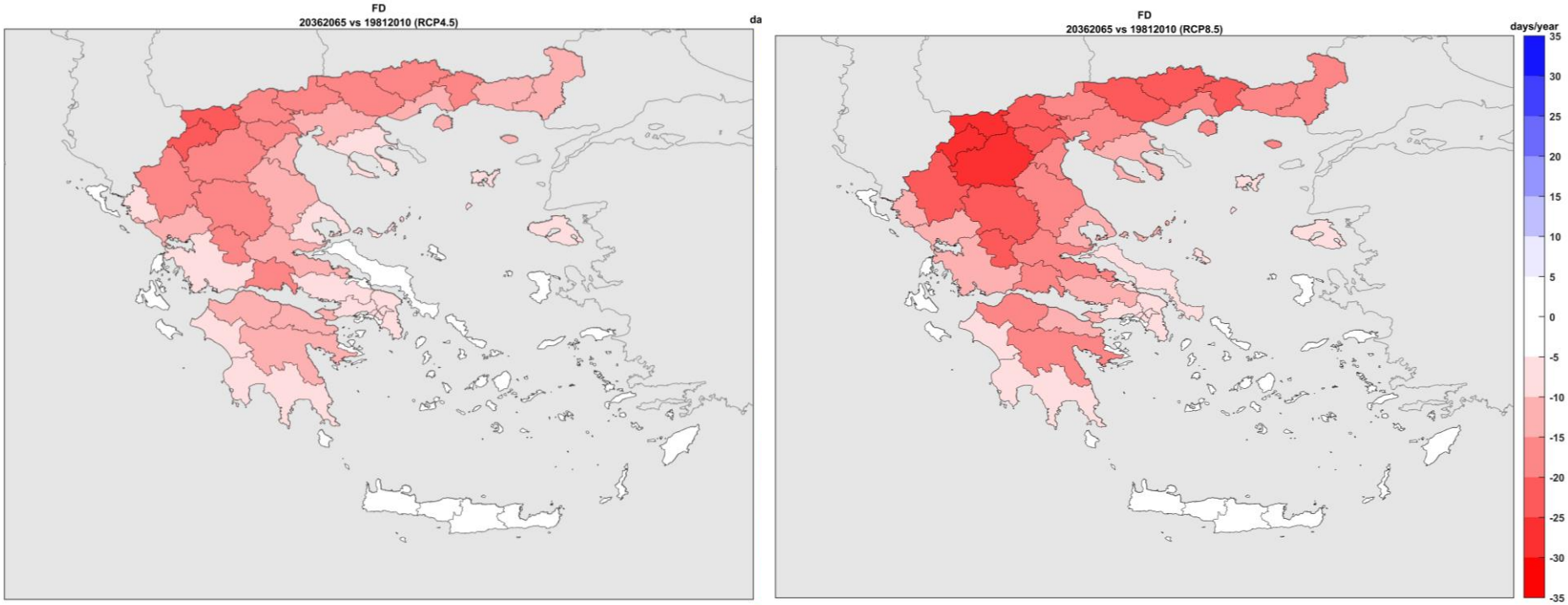
Multi - model ensemble mean of the Frost Days (FD) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Number of days with minimum temperature<0°C



Frost days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and RCP8.5 over 2036–2065 (2050) period compared to 1981–2010.

Impact on snow cover, agricolture.

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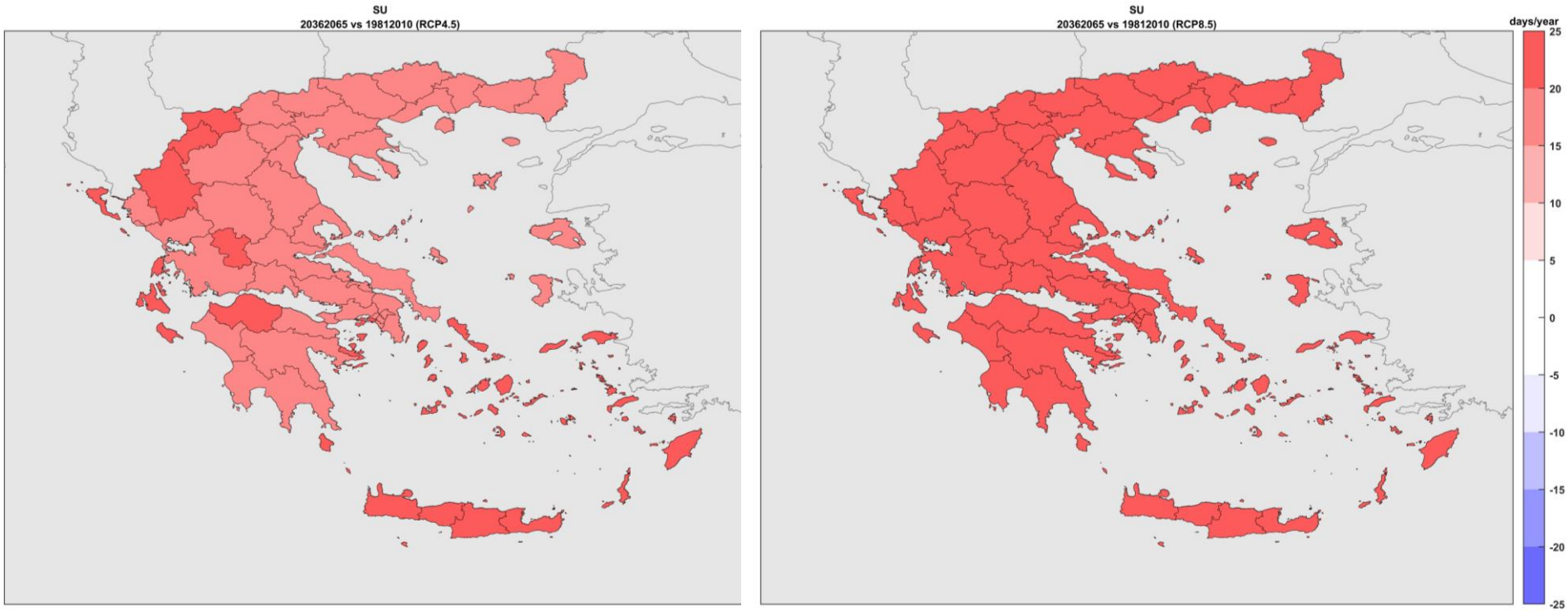
Multi - model ensemble mean of the Summer Days (SU) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Number of days with maximum temperature>25°C



Summer Days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and RCP8.5 over 2036–2065 (2050) period compared to 1981–2010. Extreme heat is an important hazard for many sectors and activities, including human health, agriculture, construction, transport and energy.

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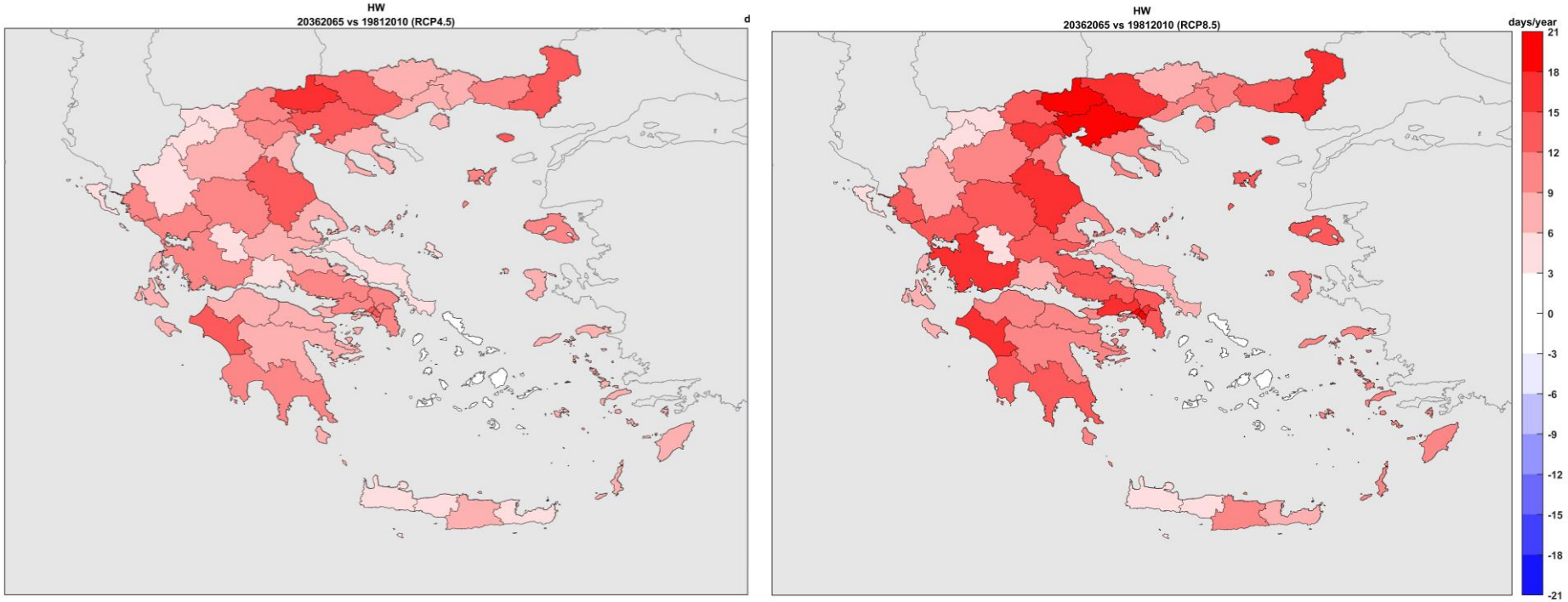
Multi - model ensemble mean of the Heat Waves (HW) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Number of days with maximum temperature>35°C



Heat Waves anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and scenario over 2036–2065 period compared to 1981–2010.
Extreme heat is an important hazard for many sectors and activities, including human health, agriculture, construction, transport and energy

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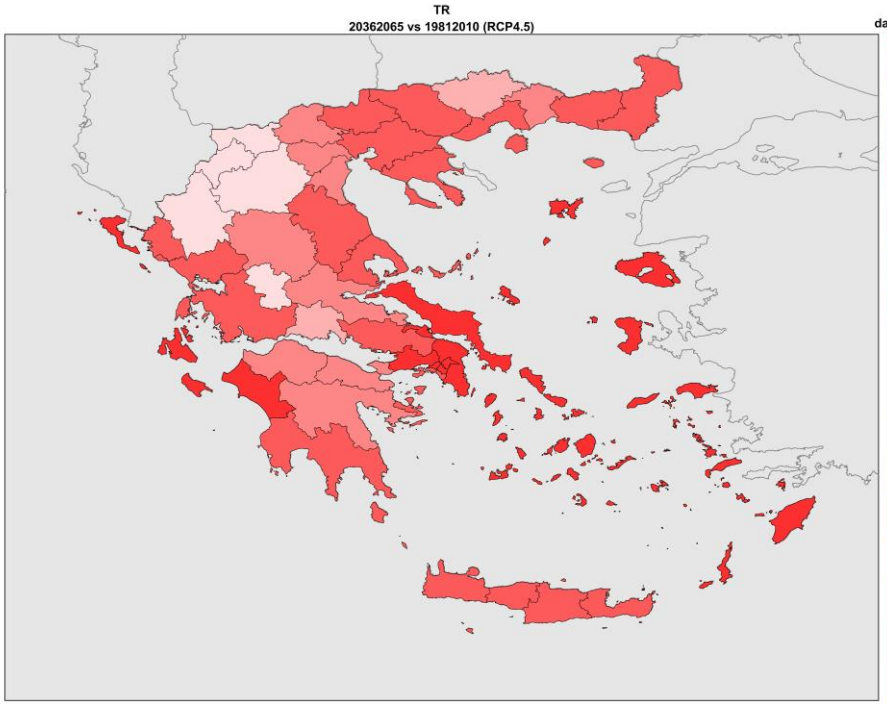
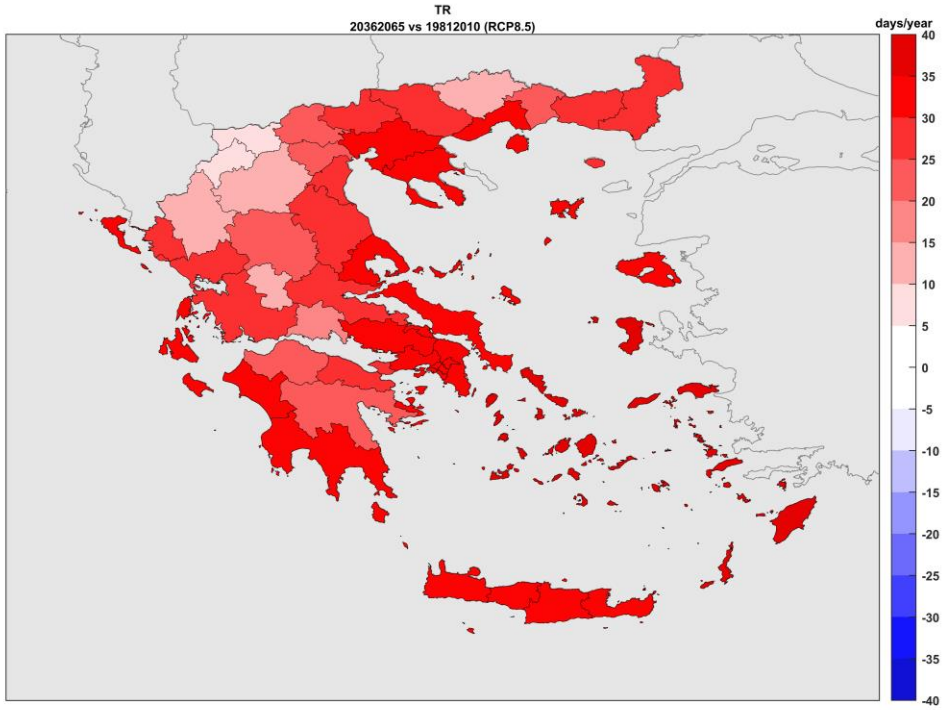
Multi - model ensemble mean of the Tropical Nights (TR) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Number of days with minimum temperature>20°C





Tropical Nights anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 scenario over 2036–2065 period compared to 1981–2010.
If the temperature doesn't decrease below a certain threshold during the night this can have important repercussions for health. The body cannot regenerate itself from hot daytime temperatures

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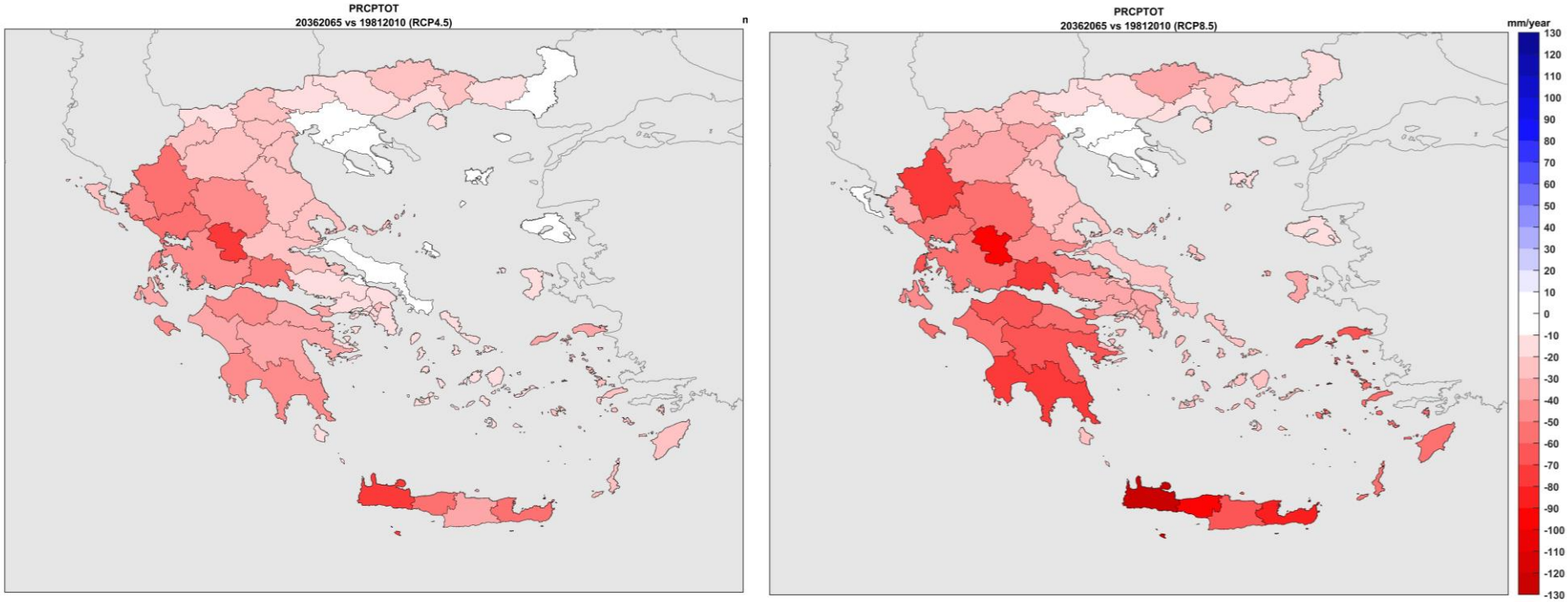
Multi - model ensemble mean of the Total Wet-Day Precipitation anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Cumulated precipitation for days with prec.>=1mm



Total Wet-Day Precipitation anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and RCP 8.5 over 2036–2065 (2050) period compared to 1981–2010.

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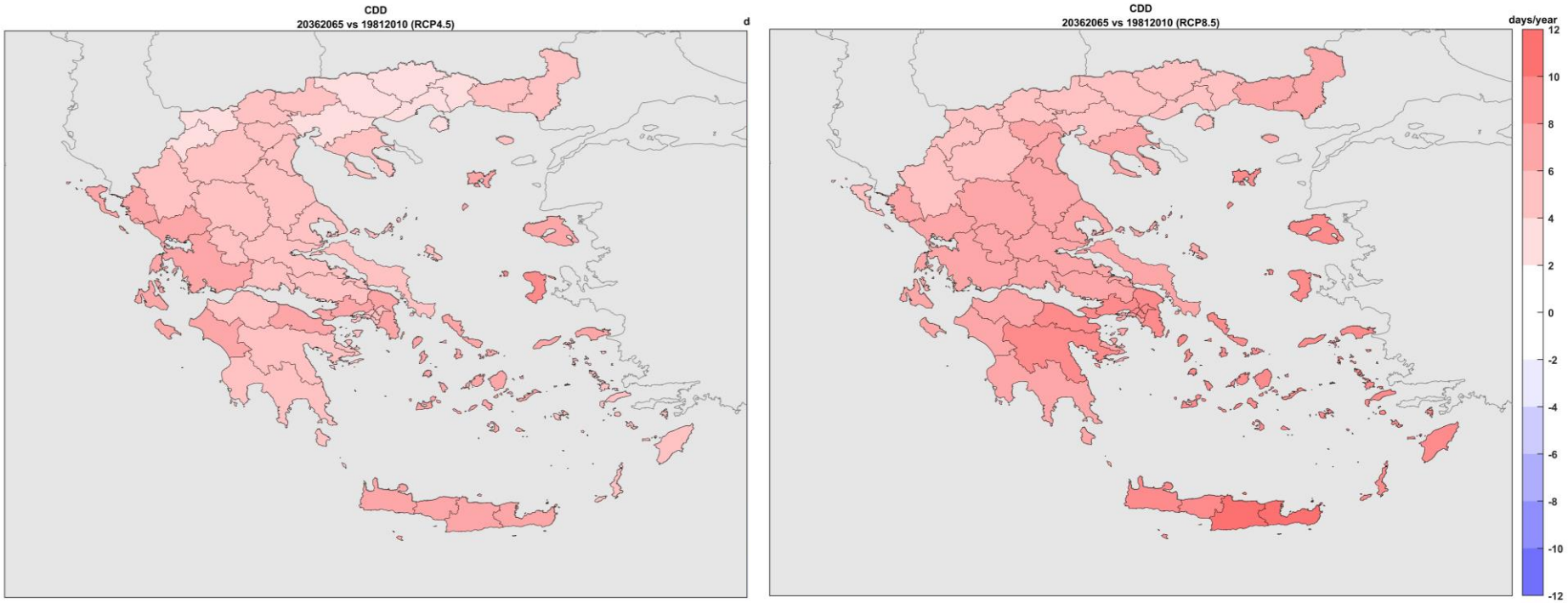
Multi - model ensemble mean of the Consecutive Dry Days (CDD) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Consecutive Dry Days:
Number of consecutive dry days (with prec.<1mm)



Consecutive Dry Days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and RCP8.5 over 2036–2065 (2050) period compared to 1981–2010. The index is mainly applicable in agriculture and water management.

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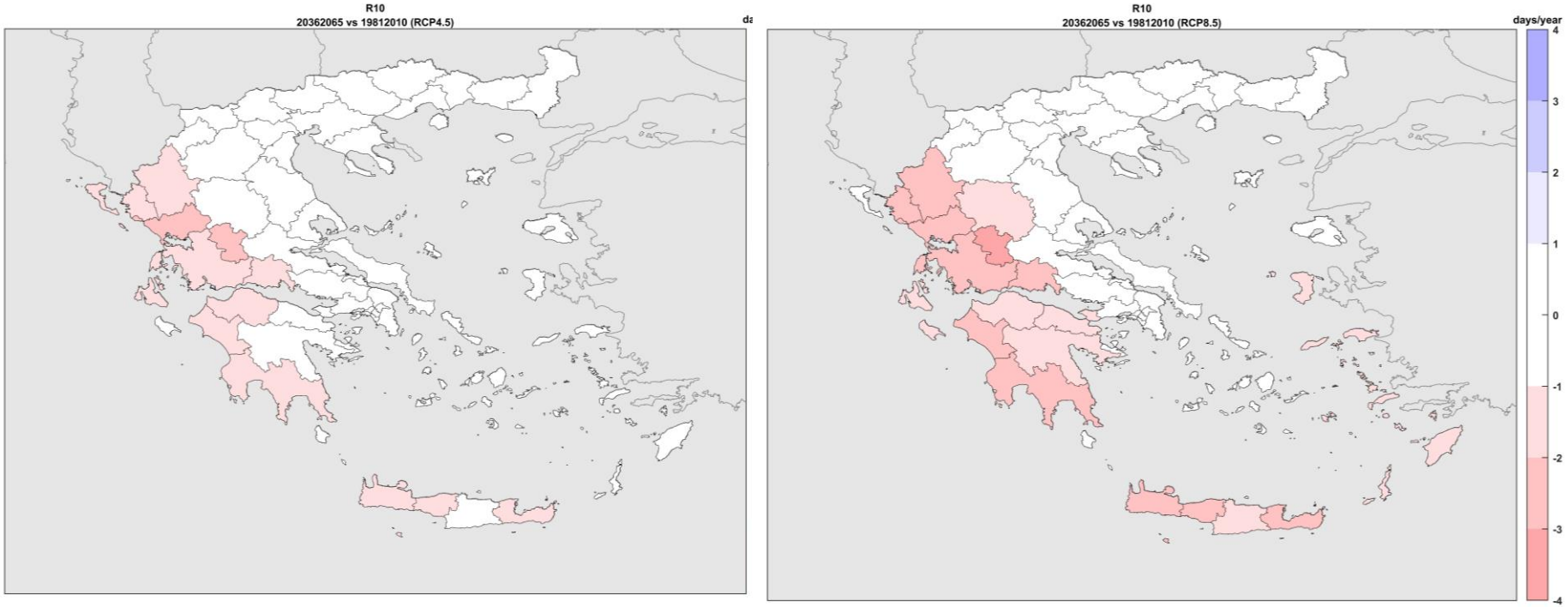
Multi - model ensemble mean of the Heavy Precipitation Days (R10) anomaly at Nuts3 level (RCP4.5 and RCP8.5)

Number of Heavy Precipitation Days:
Number of days with prec.>=10mm



Heavy Precipitation Days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 and RCP8.5 over 2036–2065 (2050) period compared to 1981–2010.

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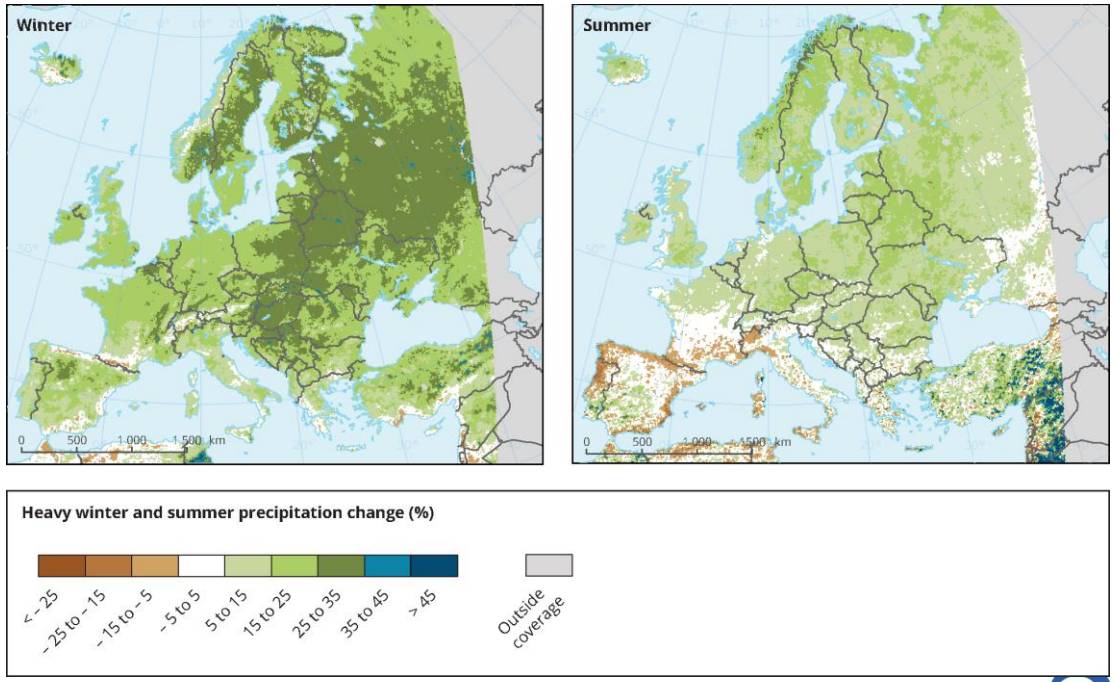
General consideration for Heavy Precipitation Days

Global warming is projected to lead to a higher intensity of precipitation and longer dry periods in Europe. About heavy precipitation they are expected to decrease over summer and increase over winter.

The continued increase in the spatial and temporal resolution of global and regional climate models has generally improved the representation of extreme precipitation and increased confidence in model-based projections.

However, regional climate models with spatial resolutions of between 10 and 30 km typically used in climate change studies are still too coarse to explicitly represent sub-daily localised heavy precipitation events



Source: [Heavy precipitation in Europe — European Environment Agency (europa.eu)]

Expected climate condition over Greece

III part

Questions

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Climate services

IV part

Questions

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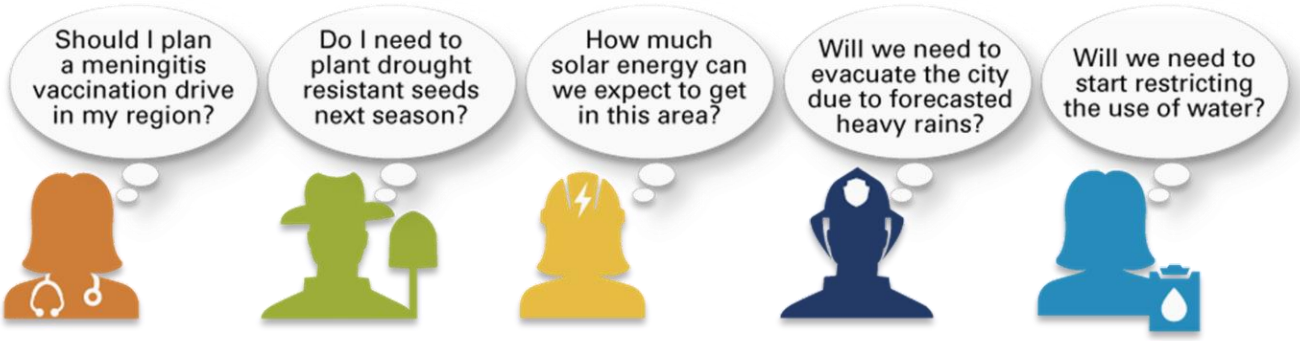
Climate services and their role: from data to information

What are climate services?

Climate services provide and process climate data to improve decision making process. Climate services must respond to user needs, rely on consolidated scientific information and expertise, and require continuous exchange between users and suppliers.

Climate services transform climate data from various national and international databases into customized products.



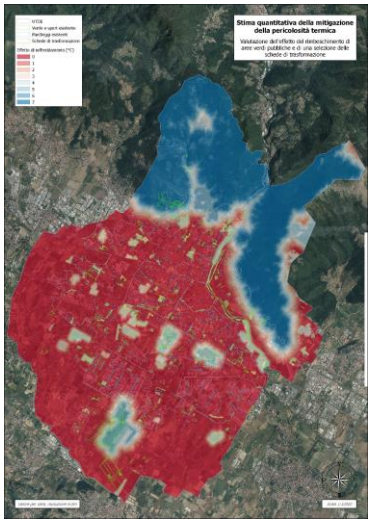
Fonte: https://www.wmo.int/gfcs/what-are-climate-services

Estimation of the variation of heat waves in an urban environment

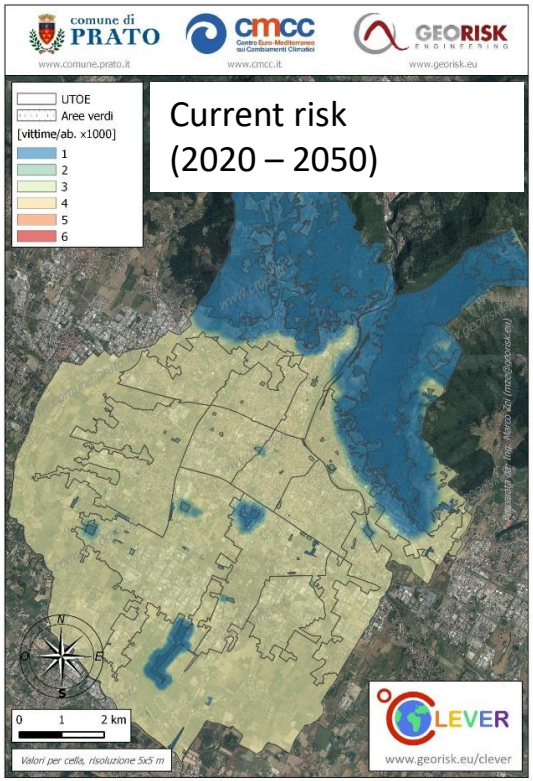
Development of approaches for updating planning tools taking into account the potential effect of Climate Change (in order to propose appropriate local adaptation actions).

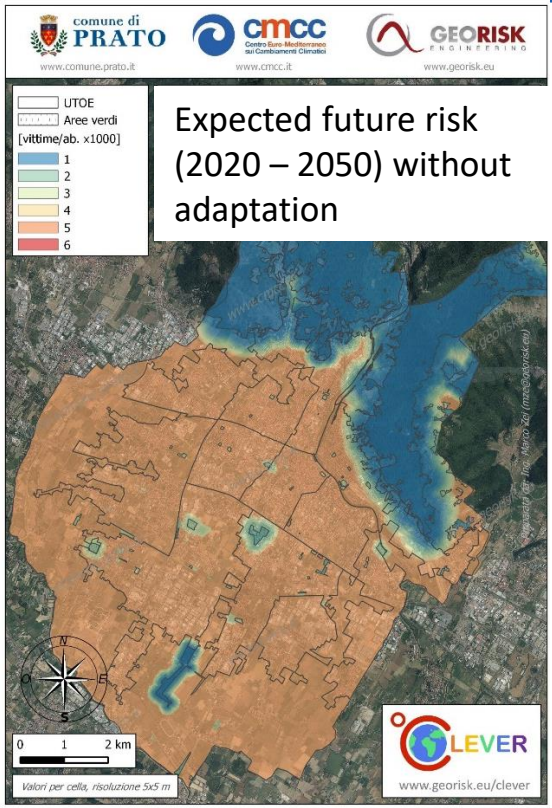
In the high risk (classes 5-6) areas higher impact (fatalities, hospitalizations) on the population are expected during heath waves

In this study has been evaluated the future expected risk and then the effect of including more green areas (as adaptation strategy)



Green areas cooling effect evaluation

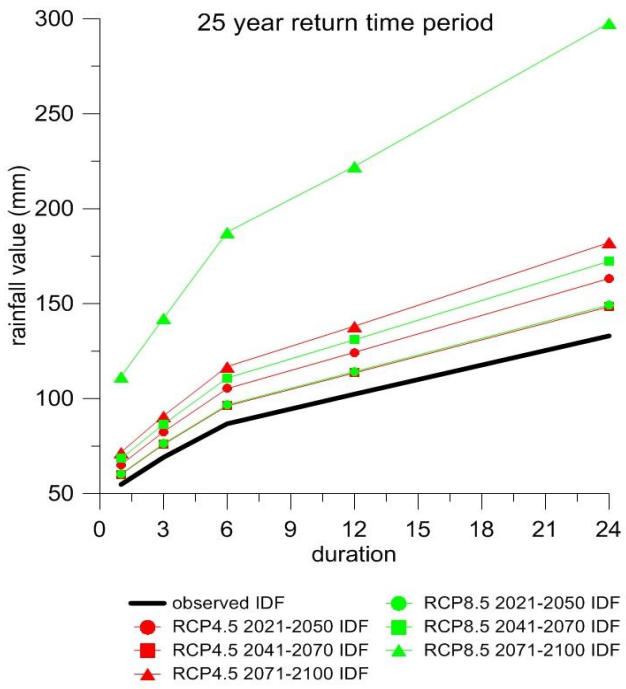




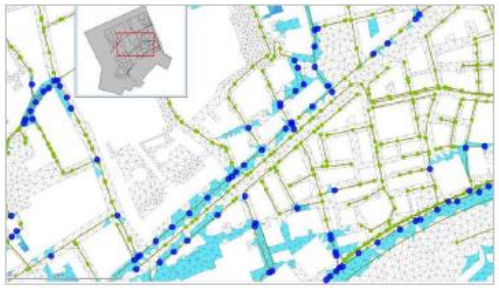
Estimation of the variation in precipitation maxima on the urban scale due to climate change

Expected increasing of extreme precipitation events at local level can cause the the malfunctioning of urban drainage networks.

An accurate assessment of how rainfall maxima change can help to understand how to modify such networks so that they are able to be resilient to these increases, in intensity and frequency, of precipitation events localized in space and time.



Future projections of IDF (intensity – duration - frequency curves) can be used to improve the design phase of hydraulic works and urban area planning.

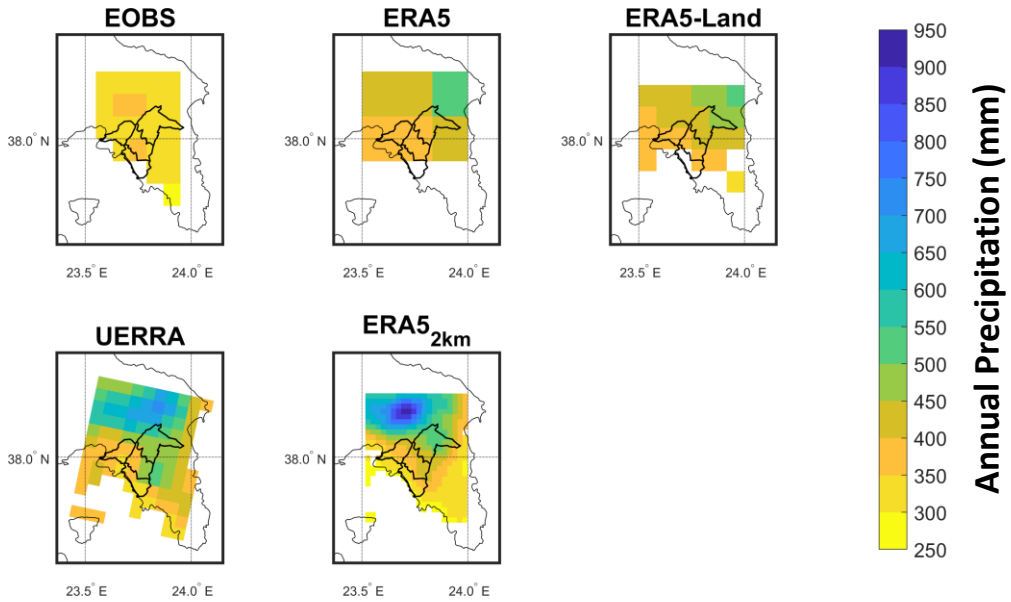


RCP8.5 2071-2100 IDF 5-year return period

Characterization of precipitation features over Athens with the new very high-resolution climate simulation ERA5@2km

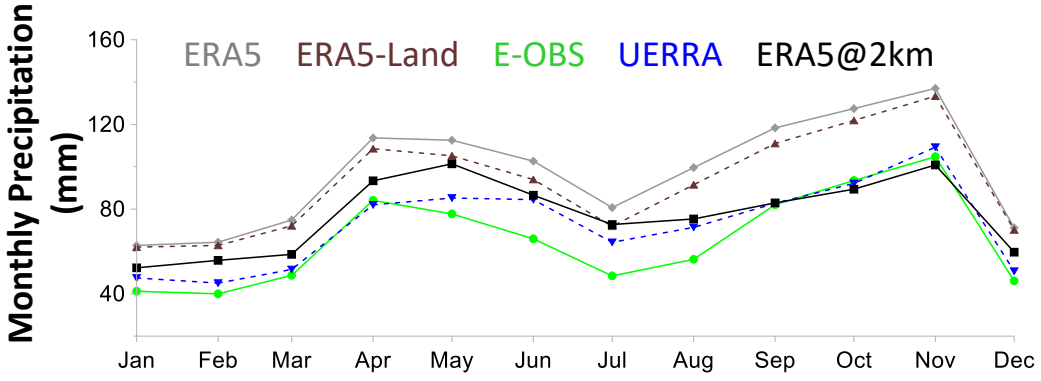
1

Average annual precipitation (1989-2018)



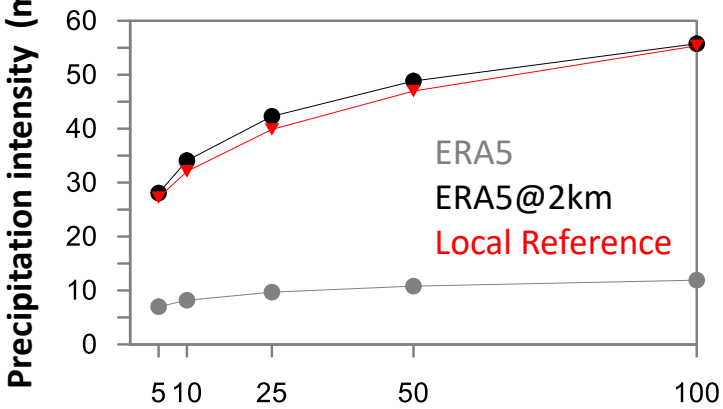
2

Annual cycle of monthly precipitation (1989-2018)



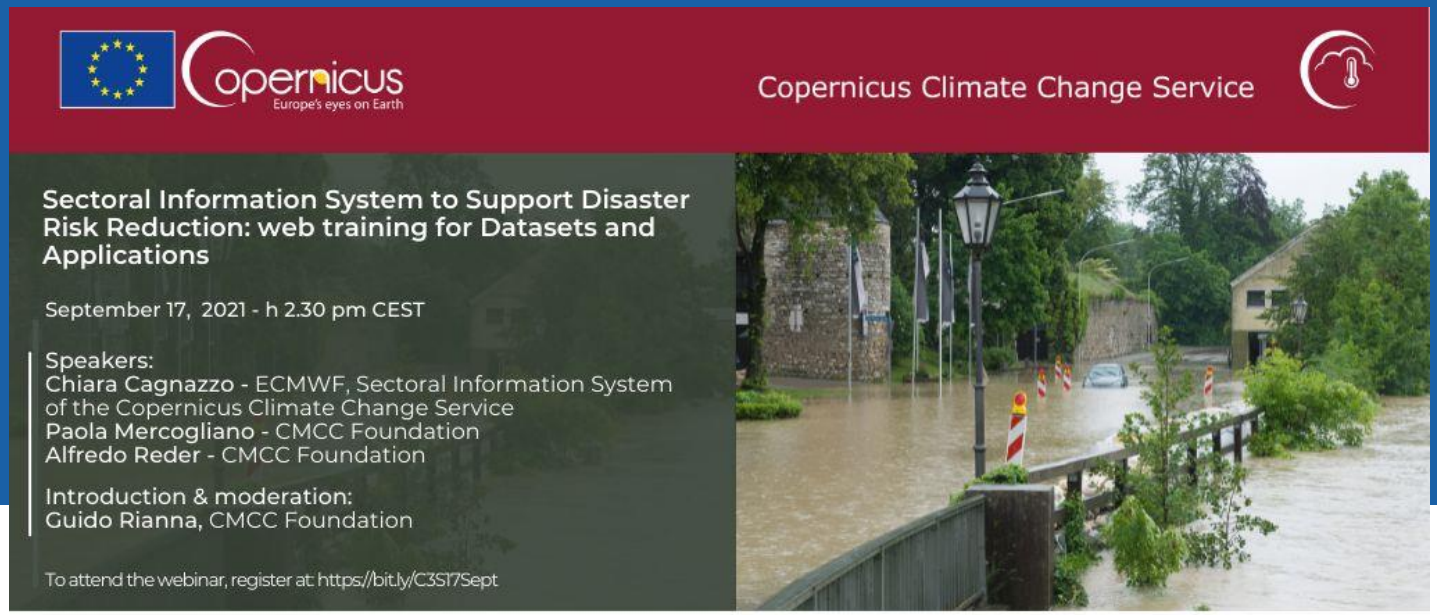
3

1-hr annual maxima for different return periods



intensity-duration-frequency curve are usually used for the assessment of urban-scale impacts of heavy rainfall and the design of hydraulic infrastructures

Thanks for your attention



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Climate analysis details (temperature)

Climate analysis is performed for the following:

- **Temperature climate indicators (CI):**

TMEAN (°C)	Mean Temperature
FD (days/year)	Frost days: Number of days with minimum temperature<0°C
SU (days/year)	Summer Days: Number of days with maximum temperature>25°C
TR (days/year)	Tropical Nights: Number of days with minimum temperature>20°C
ID (days/year)	Ice Days: Number of days with maximum temperature<0°C
HW (days/year)	Heat Waves: Number of days with maximum temperature>35°C

Climate analysis details (precipitation)

Climate analysis is performed for the following:

- **Precipitation climate indicators (CI):**

PRCPTOT (mm/year)	**Total Wet-Day Precipitation: Cumulated precipitation for days with prec.>=1mm**
CDD (days/year)	**Consecutive Dry Days: Number of consecutive dry days (with prec.<1mm)**
R10 (days/year)	**Number of Heavy Precipitation Days: Number of days with prec.>=10mm**

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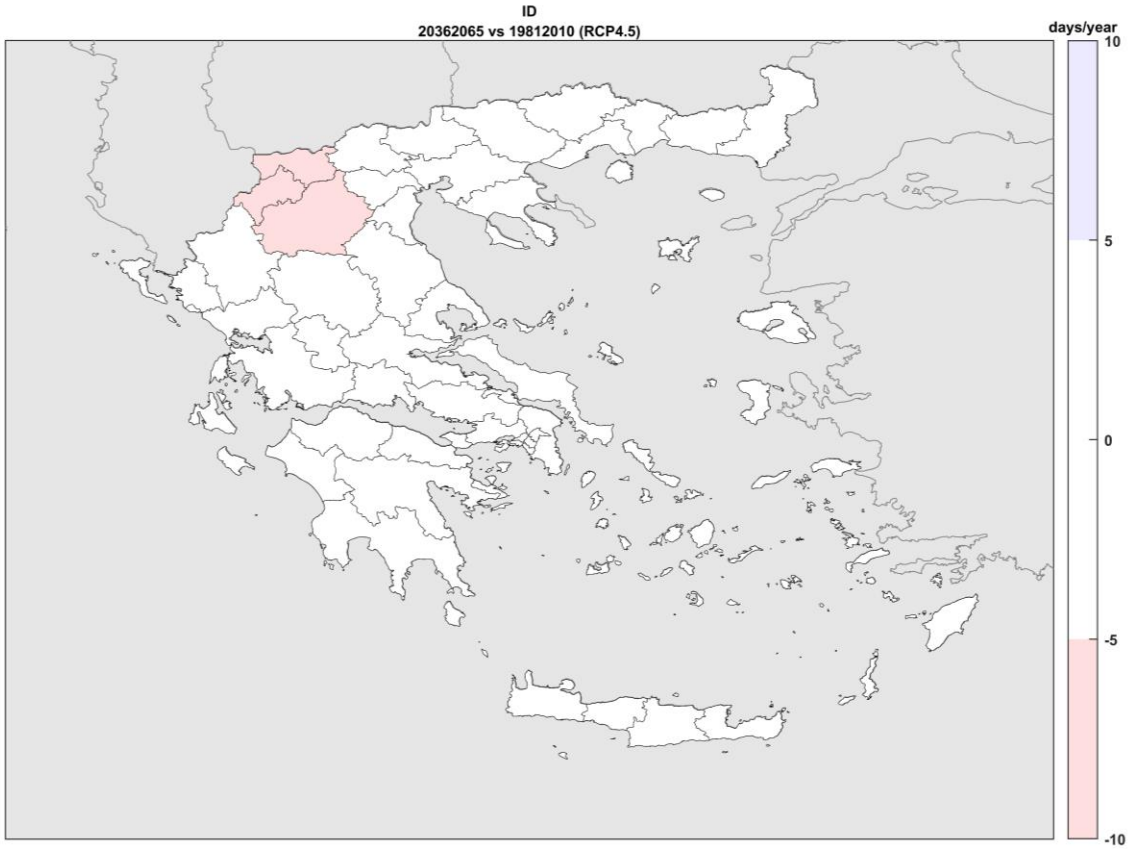
Multi - model ensemble mean of the Ice Days (ID) anomaly at Nuts3 level (RCP4.5)



Ice Days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP4.5 scenario over 2036–2065 period compared to 1981–2010.

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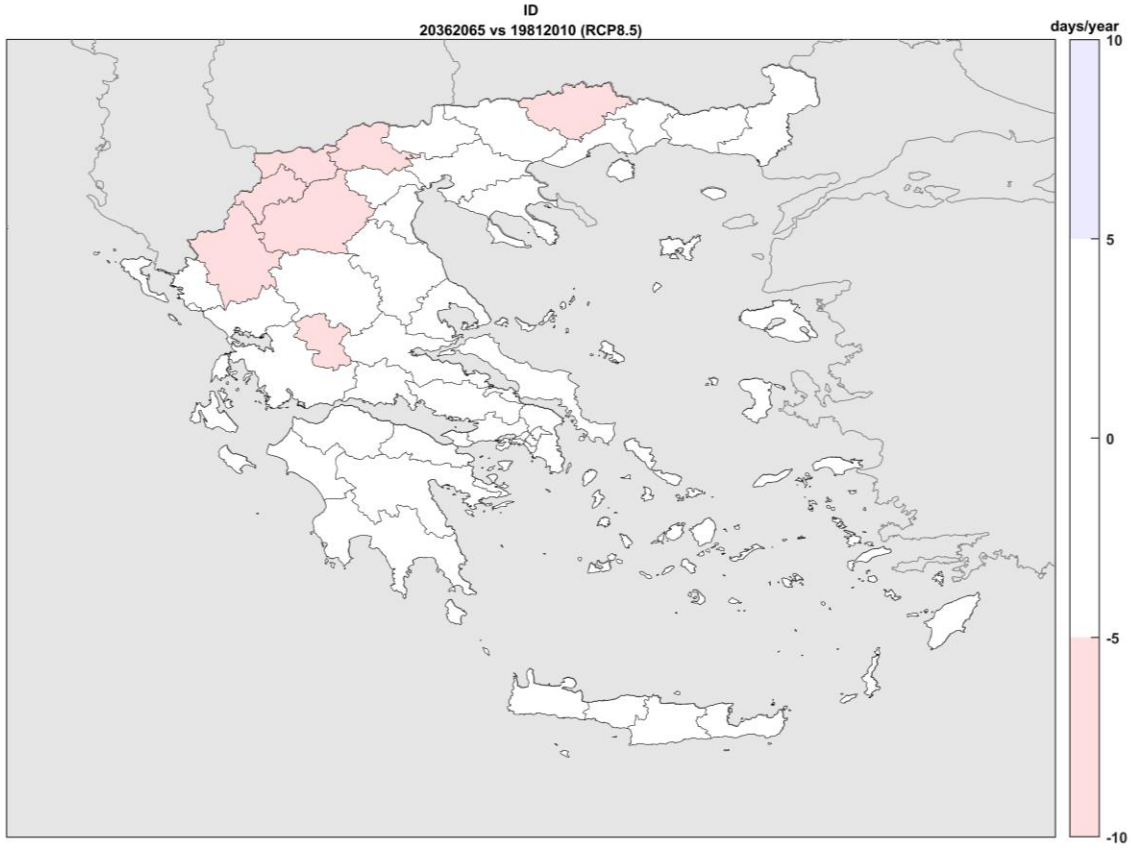
Multi - model ensemble mean of the Ice Days (ID) anomaly at Nuts3 level (RCP8.5)



Ice Days anomaly provided by the EURO CORDEX-11 multi-model ensemble mean for RCP8.5 scenario over 2036–2065 period compared to 1981–2010.

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