

Impatti dei cambiamenti climatici sugli eventi estremi in Europa e sulla catena Alpina

Erika Coppola
ICTP, Trieste



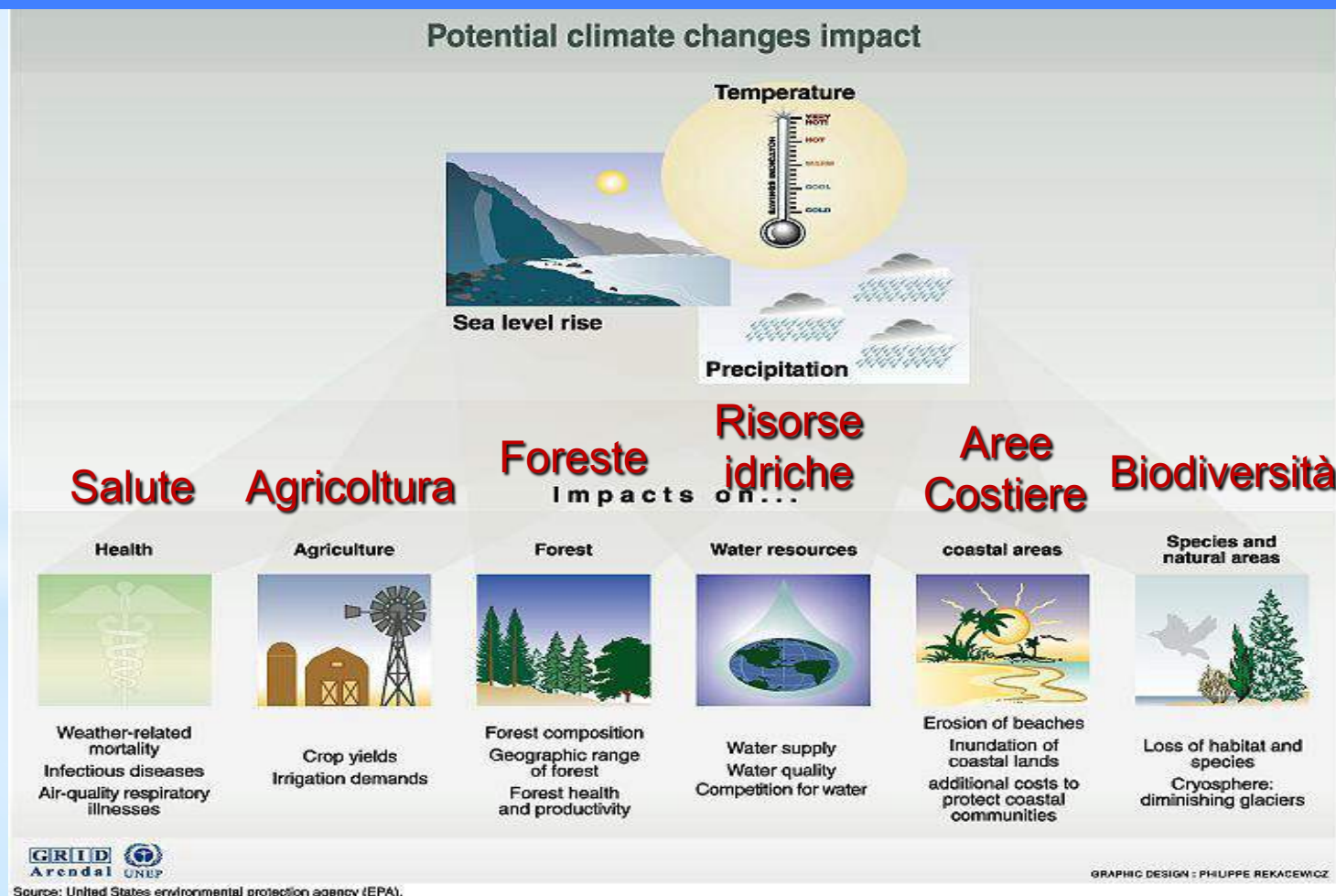
The Abdus Salam
International Centre
for Theoretical Physics



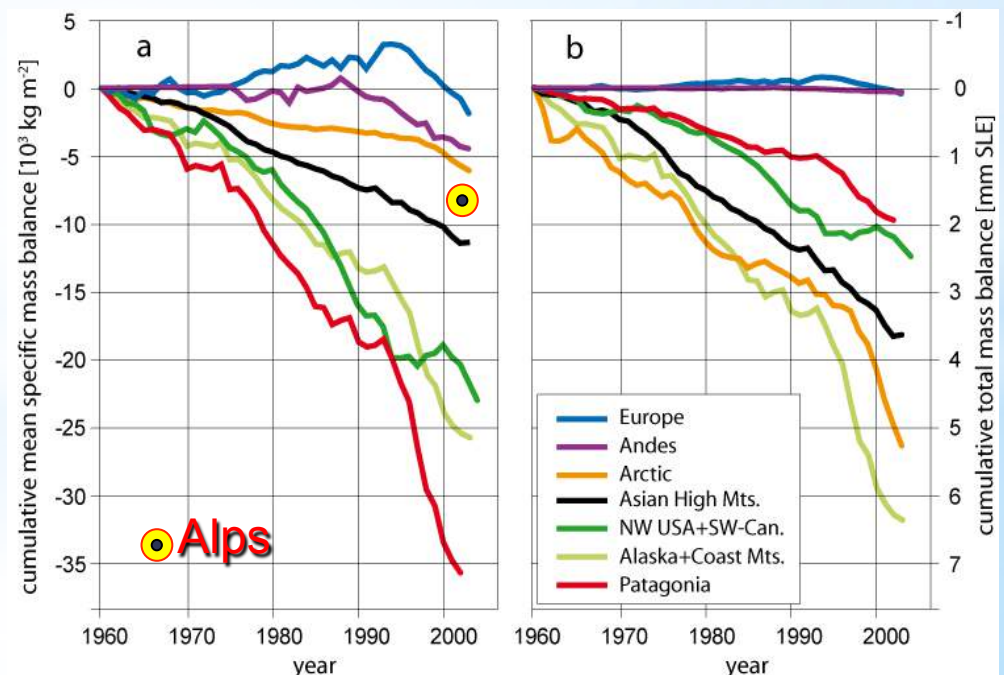
The background of the slide is a composite image. The upper portion shows a bright, glowing sun partially obscured by a dark, silhouetted horizon, with rays of light emanating from it. The lower portion of the image is a turbulent, fiery sea of orange and red, resembling a volcanic eruption or a massive fire. The overall color palette is dominated by reds, oranges, and yellows, creating a sense of intense heat and danger.

Perche' preoccuparci del
riscaldamento globale ?

I cambiamenti climatici legati al riscaldamento globale hanno effetti importanti su molti settori della società, sugli ecosistemi naturali e sullo sviluppo sostenibile del pianeta

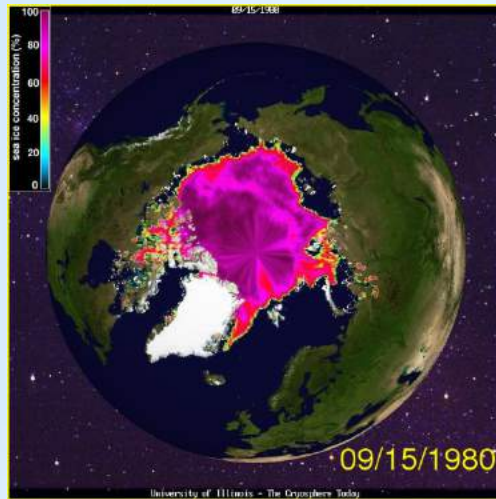


Il riscaldamento globale provoca lo scioglimento dei ghiacciai

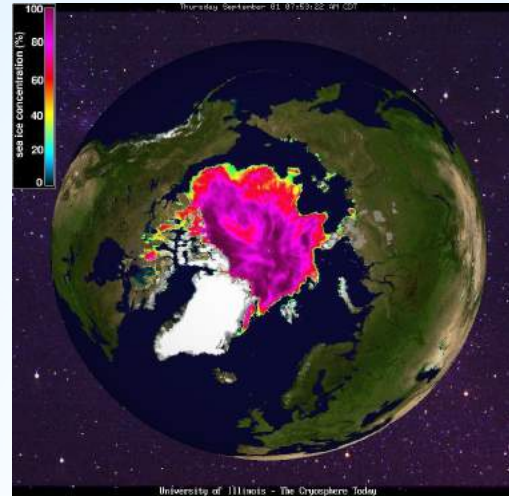


Stiamo assistendo al graduale scioglimento della calotta artica

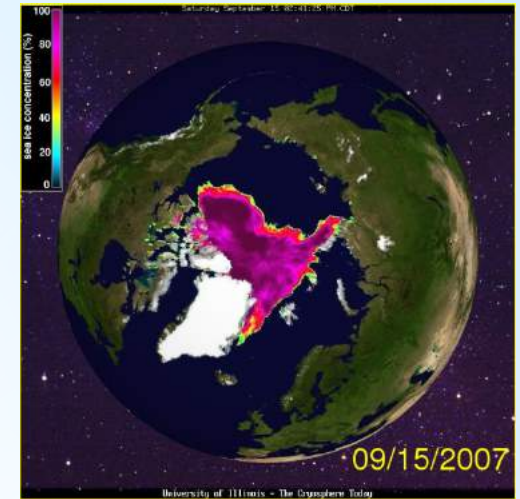
15 Settembre 1980



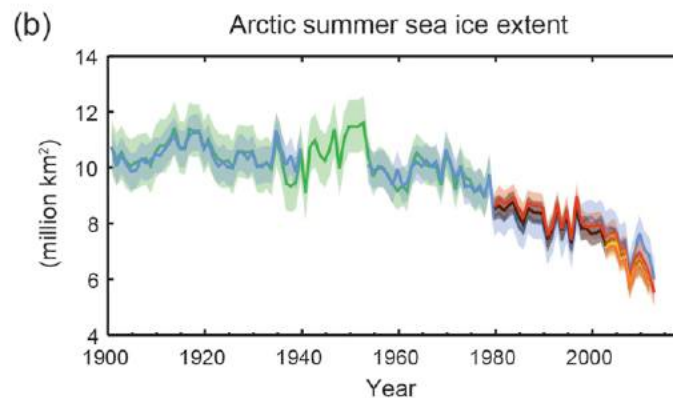
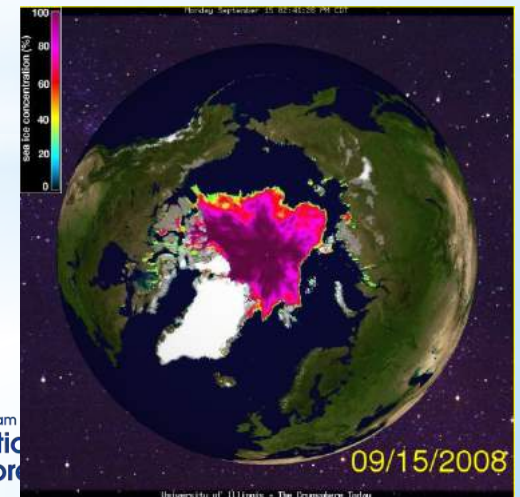
15 Settembre 2005



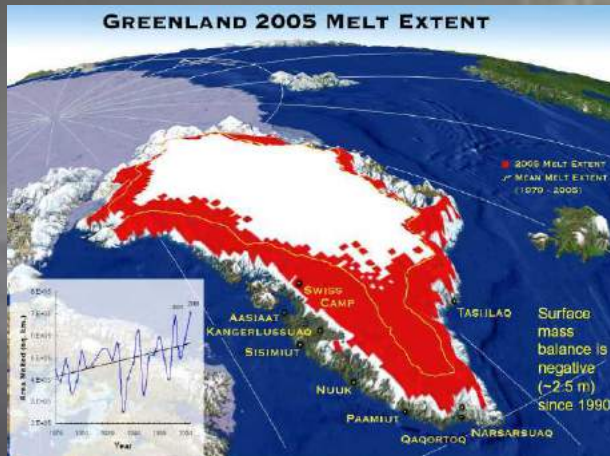
15 Settembre 2007



15 Settembre 2008



Il riscaldamento globale causa l'innalzamento del livello del mare



Il livello del mare globale si e' alzato di circa 20 cm dal 1880 e potrebbe innalzarsi ancora fino ad 1 metro entro il 2100

Il riscaldamento globale porta ad un aumento di eventi estremi: Il maggiore contenuto di energia e vapor d'acqua in atmosfera genera l'intensificazione del ciclo idrologico

Aumento delle intensita' delle precipitazioni



“Piove meno frequentemente ma piu' intensamente”

Aumento di siccita' e ondate di calore

WORLD NATURAL CATASTROPHES, 1980–2014

(Number of events)

Number

1000

800

600

400

200

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014

- **Geophysical events**
(Earthquake, tsunami, volcanic activity)
- **Meteorological events**
(Tropical storm, extratropical storm, convective storm, local storm)
- **Hydrological events**
(Flood, mass movement)
- **Climatological events**
(Extreme temperature, drought, forest fire)

Source: © 2015 Munich Re, Geo Risks Research, NatCatSERVICE. As of January 2015.

Major weather events cited in the World Meteorological Organisation study

US 2011

A series of storms moved across the south-eastern US spawning a record number of tornadoes and killing hundreds of people, including nearly 100 in Joplin, Missouri

CANADA 2005

The warmest summer on record in Canada

UK 2000

Widespread flooding in October and November during the wettest autumn in England and Wales since records began in 1766

EUROPE 2003

Record heatwave in France and other parts of Europe. Some 35,000 people are estimated to have died from heat-related causes

CHINA 2010

Torrential rain in China causes landslides. Some 1,500 people killed in one mudslide in north-west China

US 2005

Most active hurricane season on record. Hurricane Katrina hits New Orleans causing extensive flooding and killing more than 1,300 people

BRAZIL 2005

Worst drought in 60 years in Brazil caused by lowest Amazon flow in 30 years

RUSSIA 2010

Extreme heatwave sees temperatures soaring in Moscow, which was badly affected by surrounding wildfires

KEY



Heatwaves



Severe drought



Extreme flooding



Hurricanes



Tornadoes

ARGENTINA 2009

An exceptional heatwave in northern and central Argentina sees record temperatures of 40°C over large areas

HORN OF AFRICA 2006

Long-term drought followed by torrential downpours produce worst flooding for 50 years

PAKISTAN 2010

Worst floods in Pakistan's history affecting some 20 million people. Many

AUSTRALIA 2010

Worst floods in more than 50 years affect north-eastern Australia, causing devastation across area the size of France and Germany combined

E in Italia?

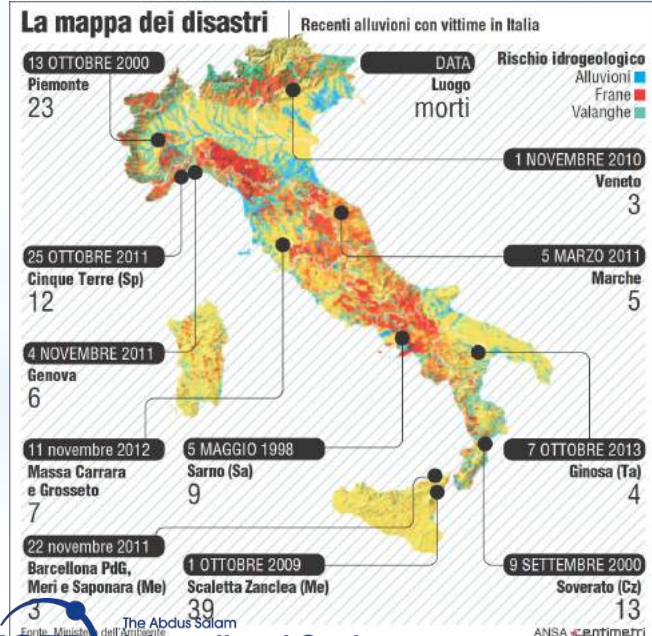
**Genova
Novembre 2011**



**Genova
Ottobre 2014**



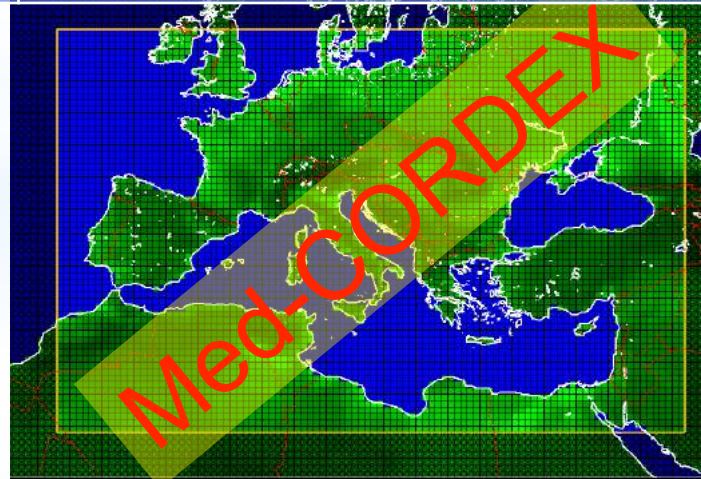
**“Cleopatra”, Sardegna
18 Novembre 2013**



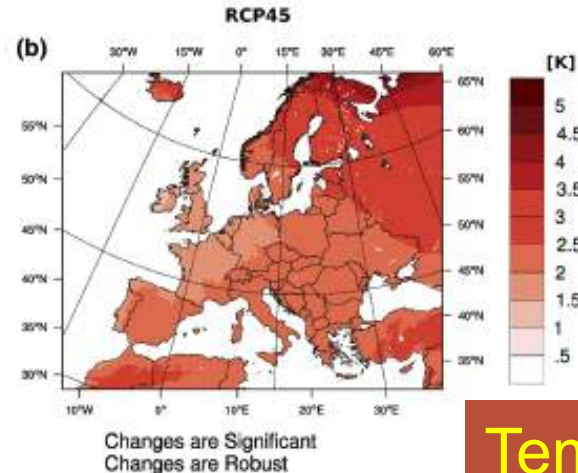
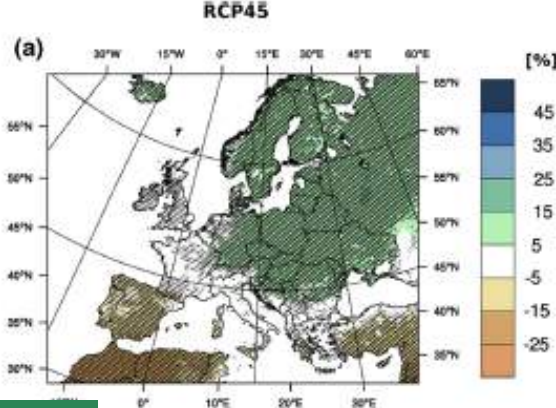
Progetti Europei



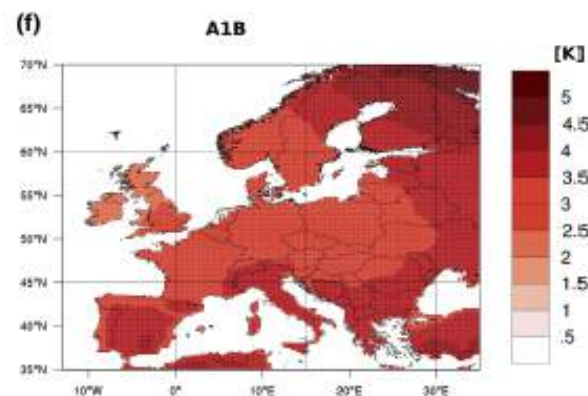
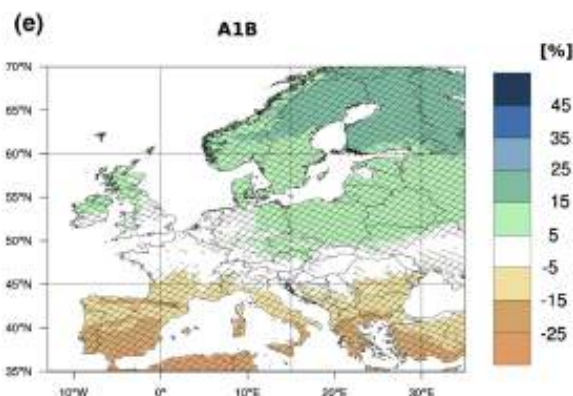
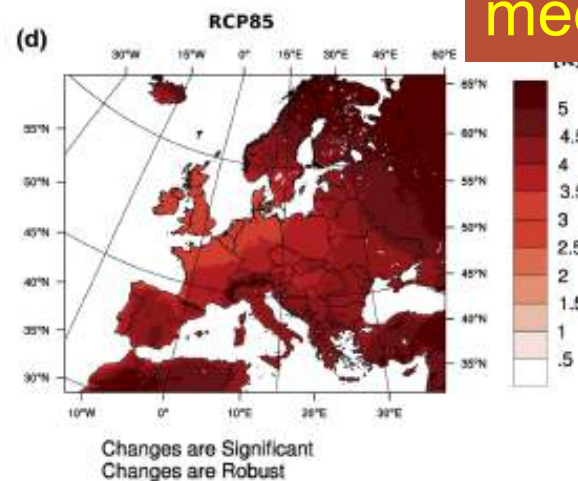
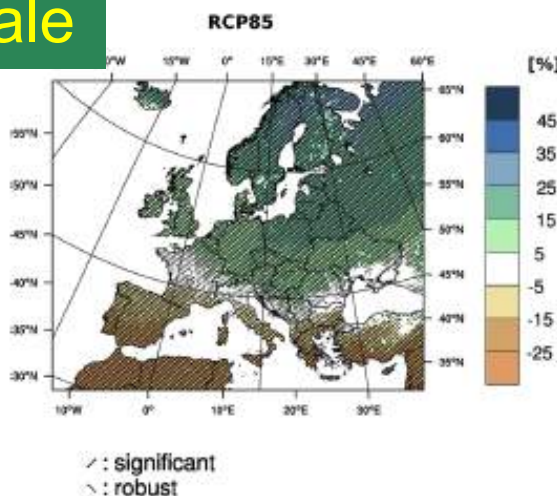
Model	Resolution	Driven-model	Domain
ALADIN	0.11 deg – 0.44 deg	CNRM-CM5	Med-CORDEX
RegCM	0.11 deg – 0.44 deg	HadGEM	Med-CORDEX
RACMO22E	0.11 deg – 0.44 deg	EC-EARTH	Euro-CORDEX
CCLM4-8-17	0.11 deg – 0.44 deg	MPI-ESM-LR	Euro-CORDEX



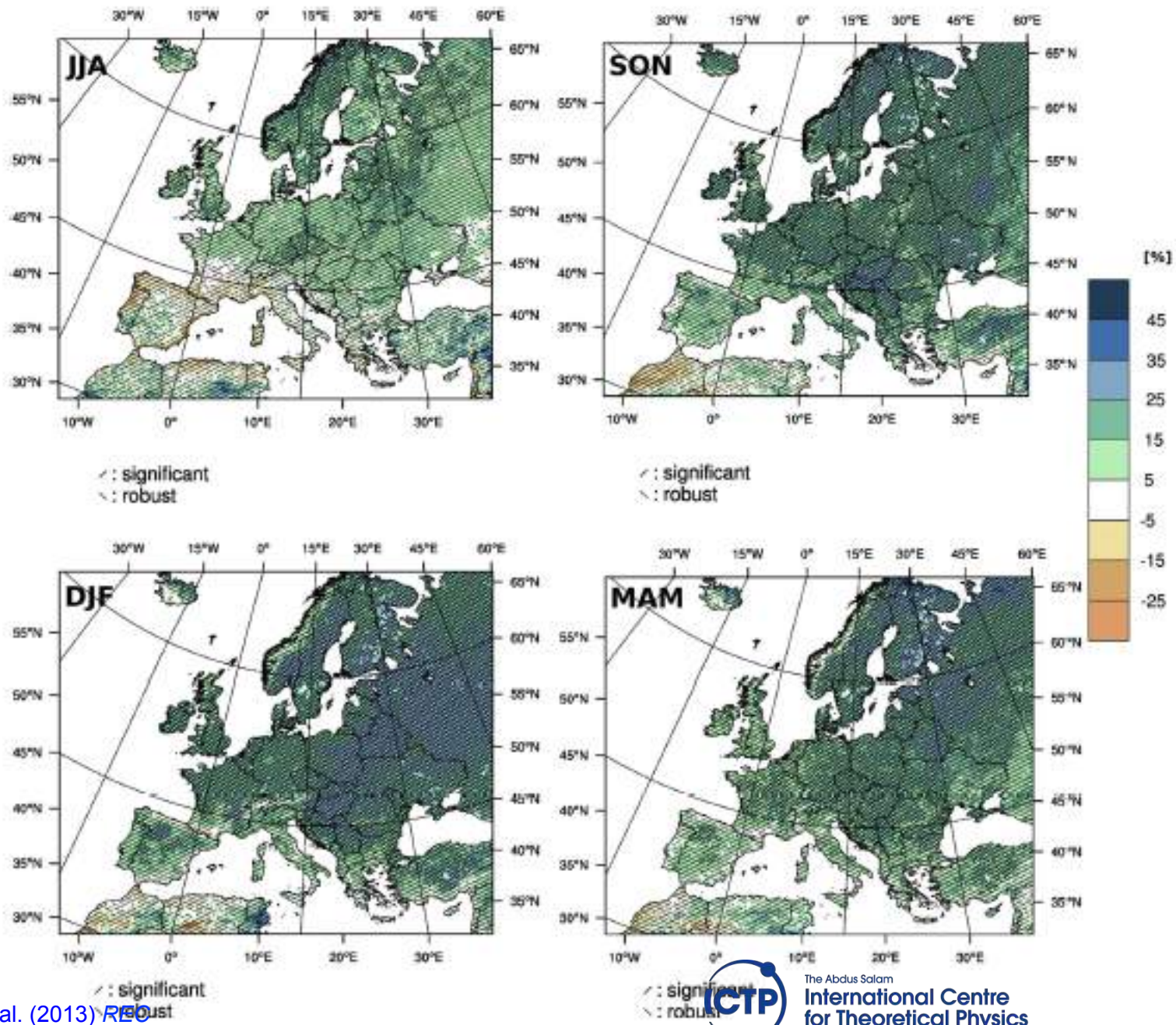
Precipitazione media annuale



Temperatura media annuale



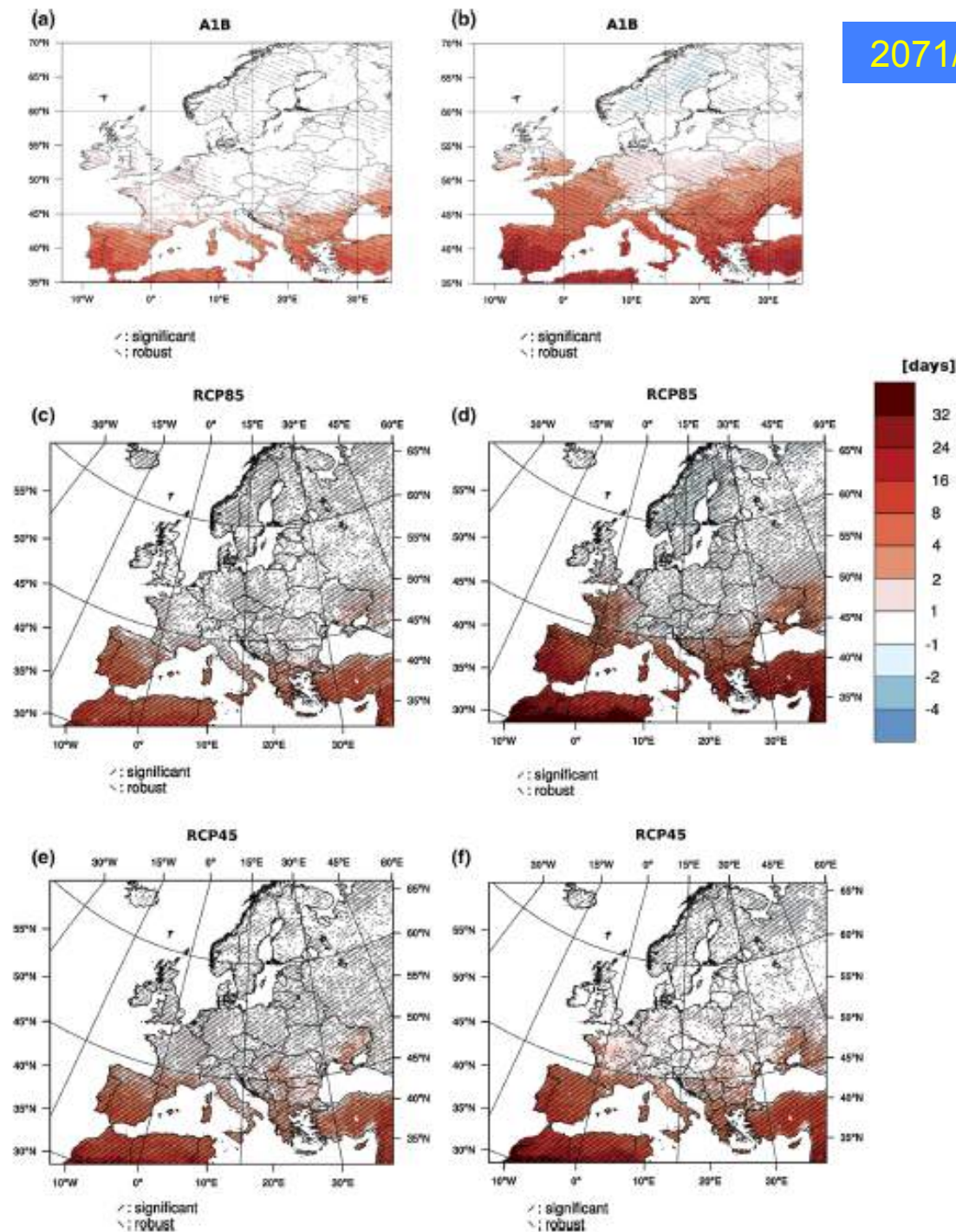
Precipitazione estrema



2021/50-1971/2000

2071/2100-1971/2000

Periodi di siccità



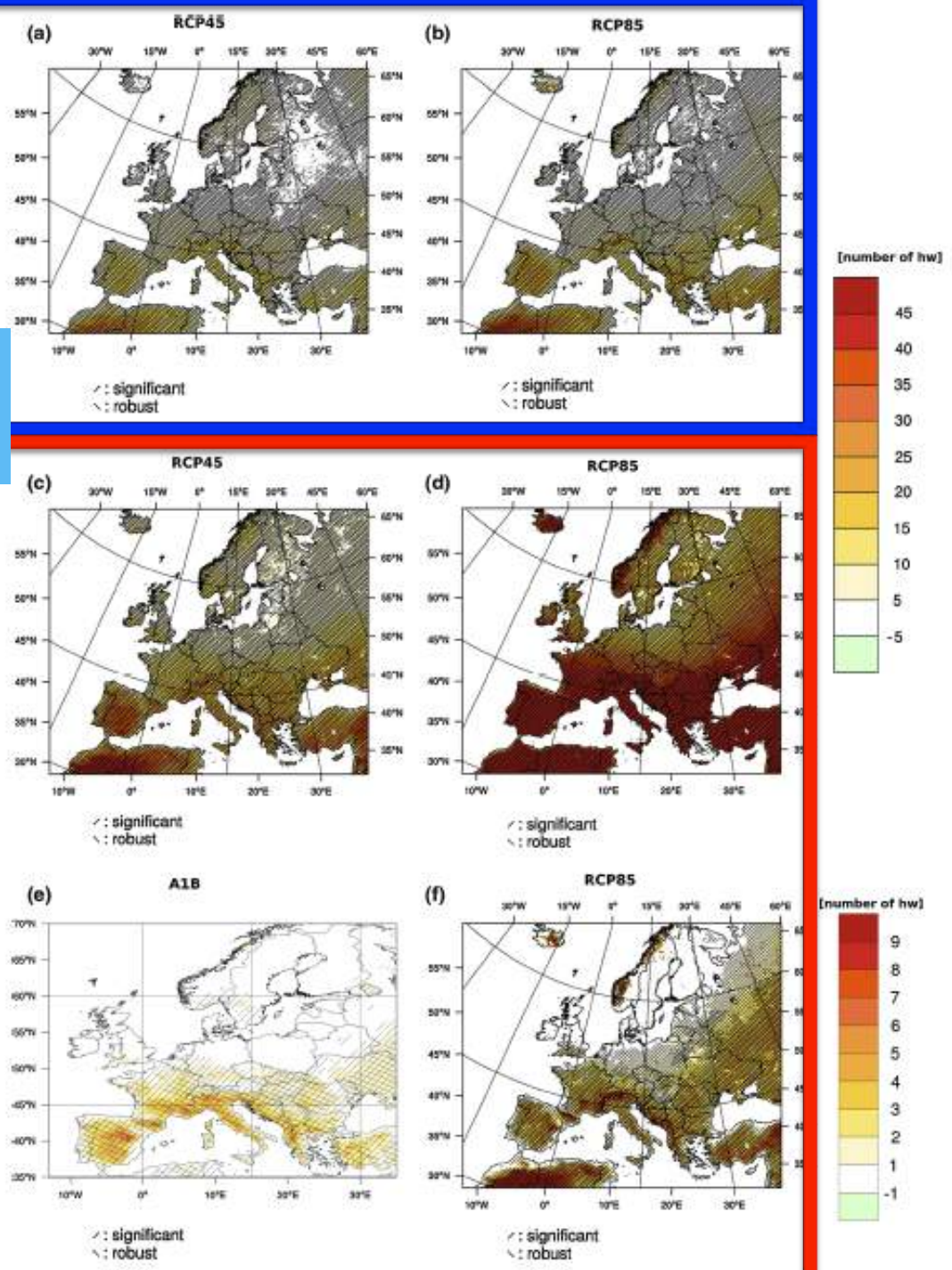
May-September
2021/50-1971/2000

3 giorni consecutivi
max T > T₉₉
May-September

Ondate di calore

May-September
2071/2100-1971/2000

5 giorni consecutivi
max T > T_{media}
May-September



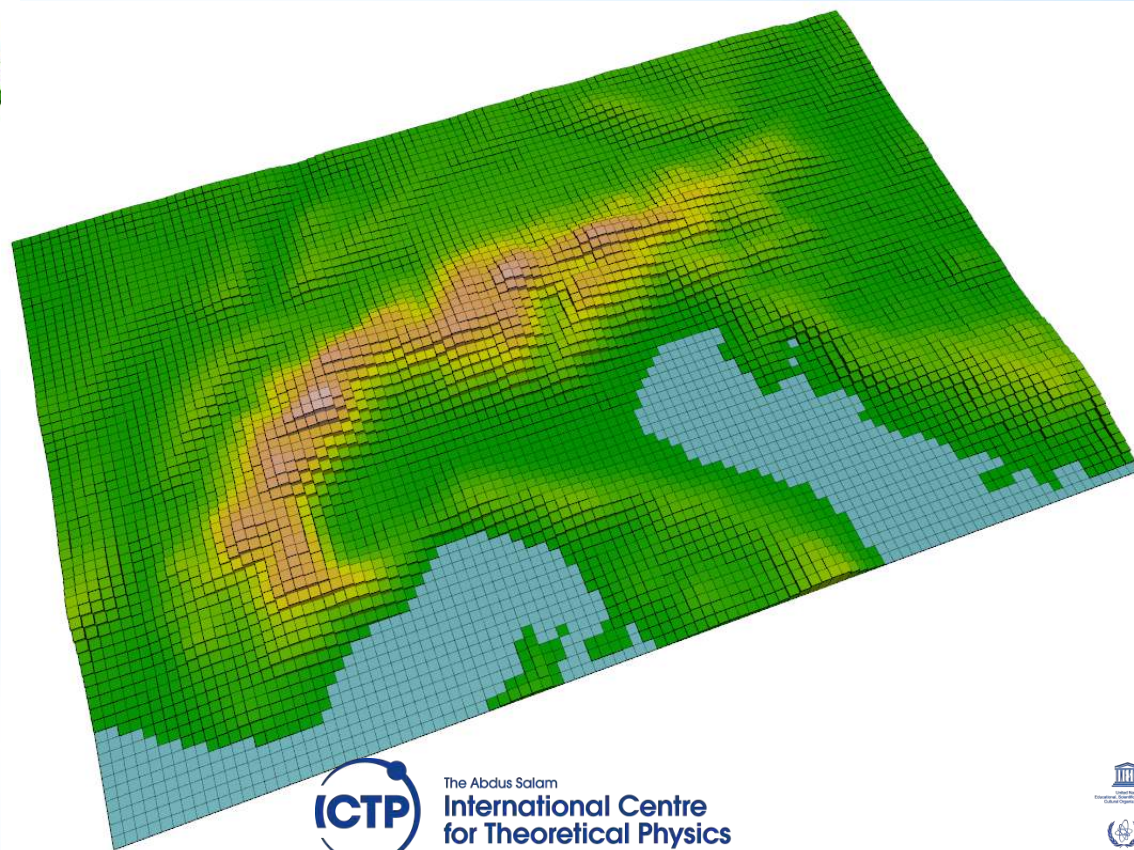
Alta risoluzione perchè



Alta risoluzione perchè

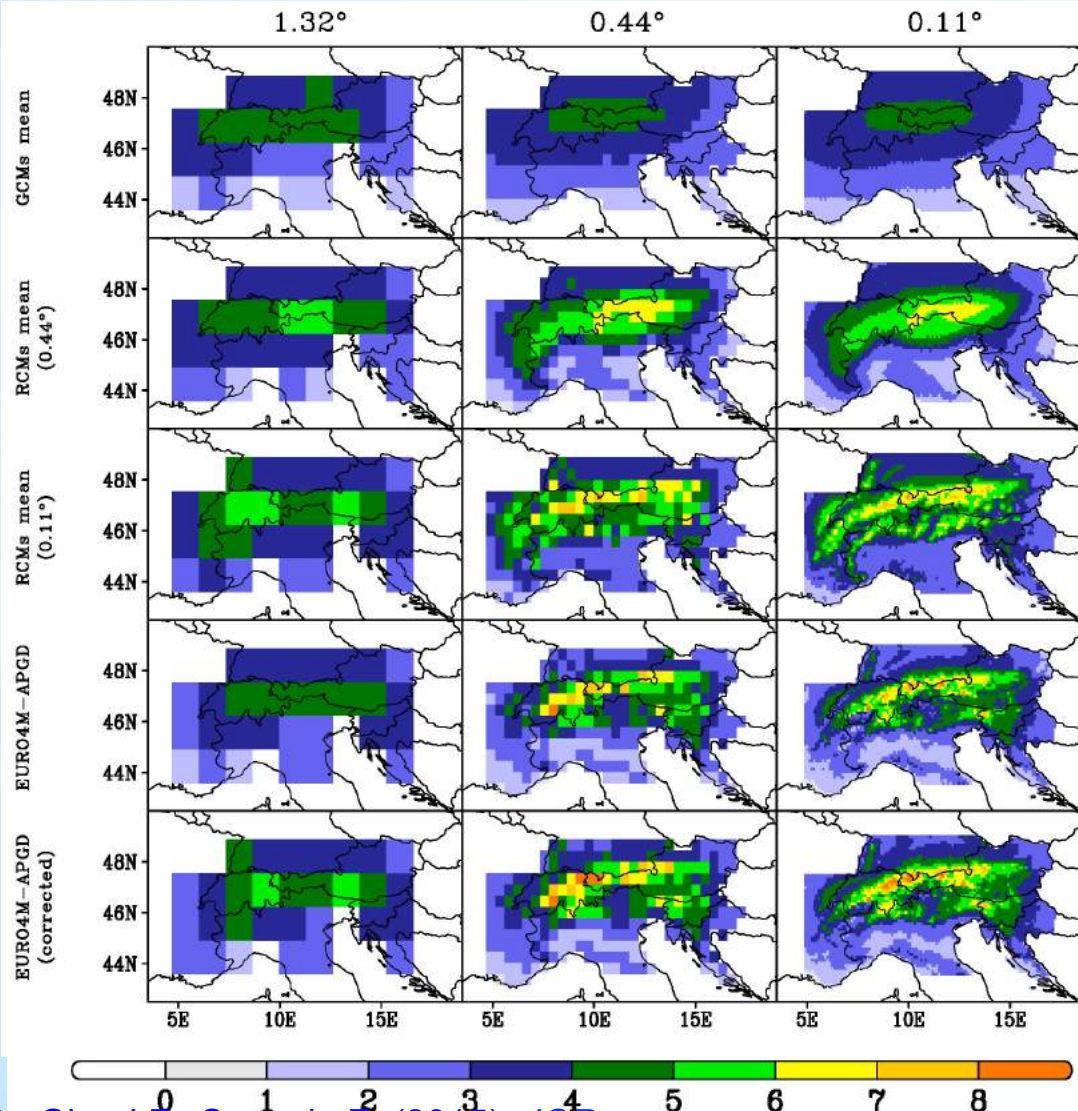
0.44

0.11

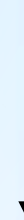


Distribuzione spaziale della precipitazione estiva

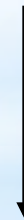
JJA



Higher resolution



Increasing details
in precipitation
spatial distribution

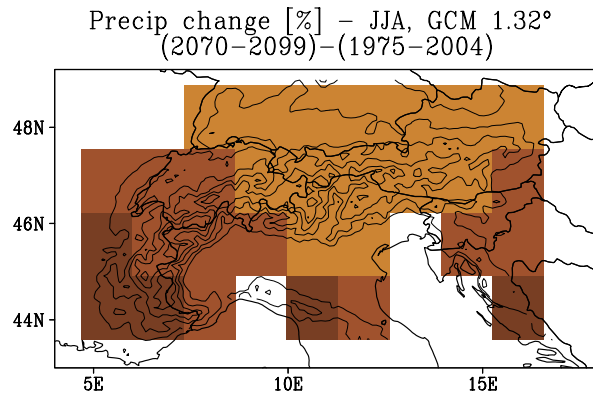


Fine scale AV

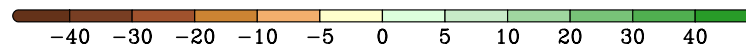
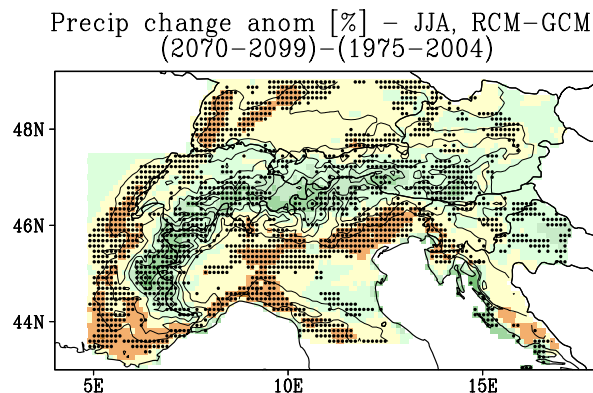
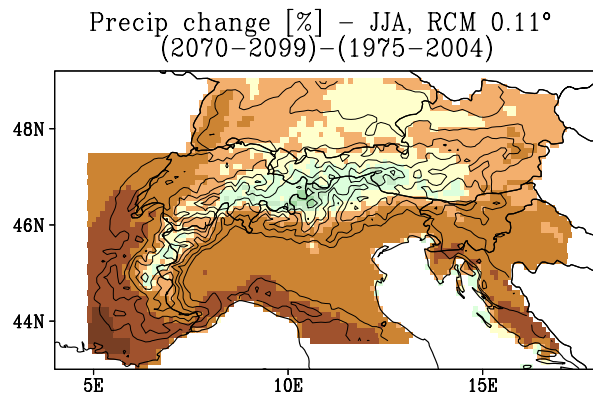


The Abdus Salam
International Centre
for Theoretical Physics

GCMs



RCMs
0.11°

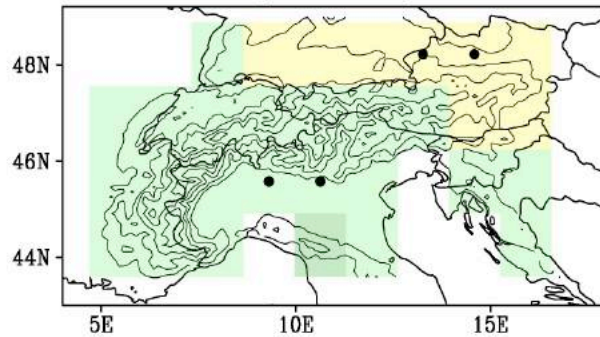


mm/day/century

Summer
precipitation
change

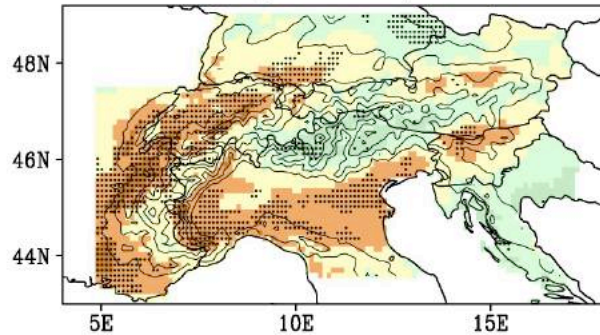
RCM - GCM
Anomaly

Precip trend - JJA, GCM 1.32°
(1975-2004)



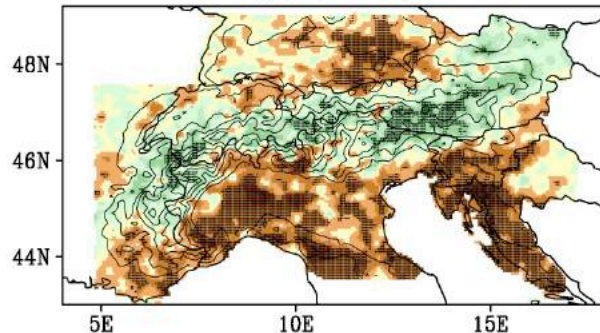
GCMs

Precip trend - JJA, RCM 0.11°
(1975-2004)

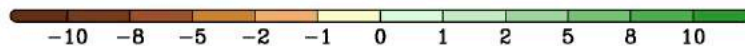


RCMs
0.11°

Precip trend - JJA, EURO4M-APGD 5 km
(1975-2004)



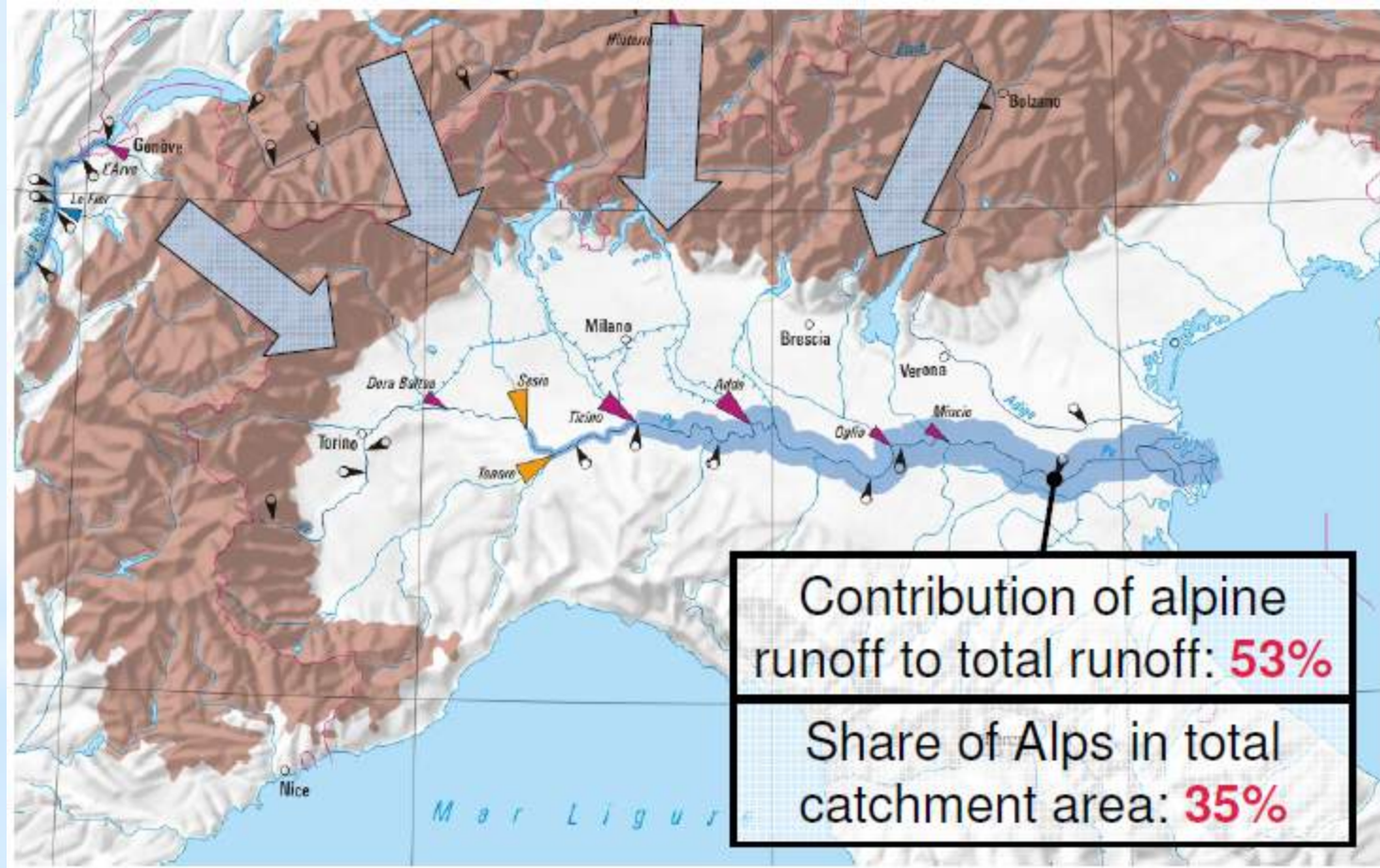
Observations
EURO4M-APGD



mm/day/century

Summer
precipitation
trend during
1975-2004

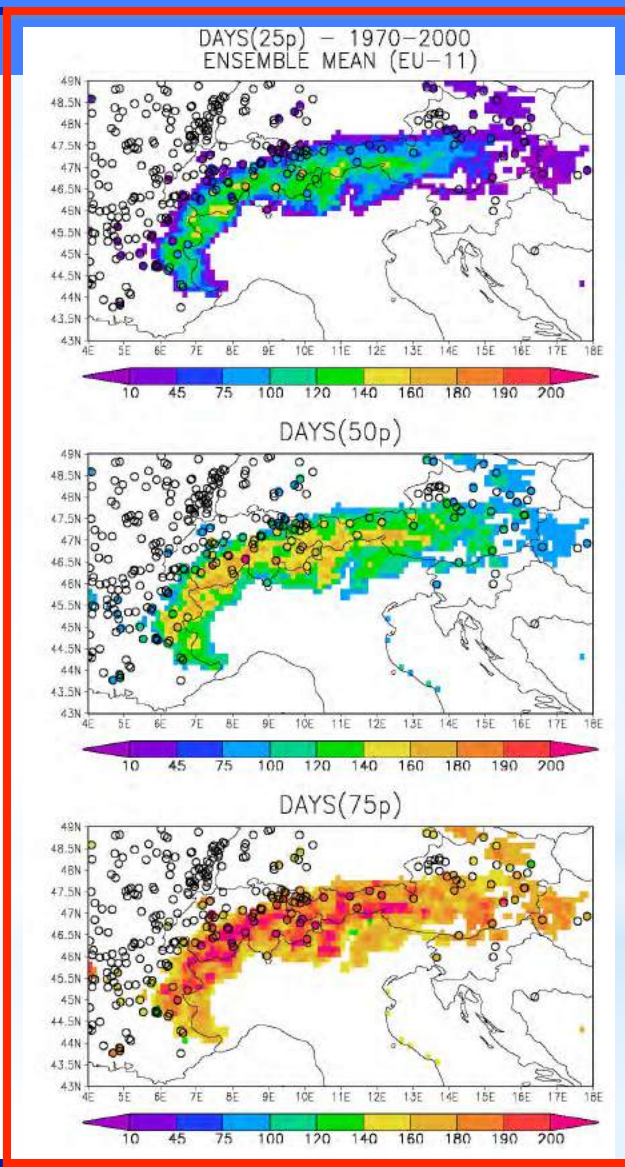
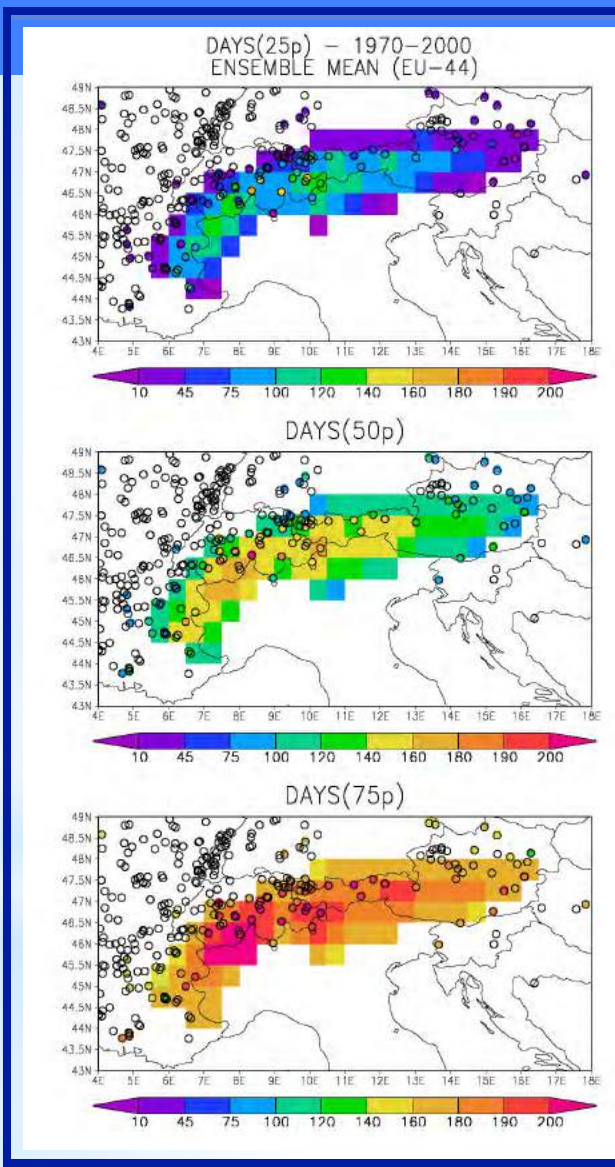
* The Alps water tower of Europe the river Po





Giorno giuliano del 25, 50 e 75 percentile della portata

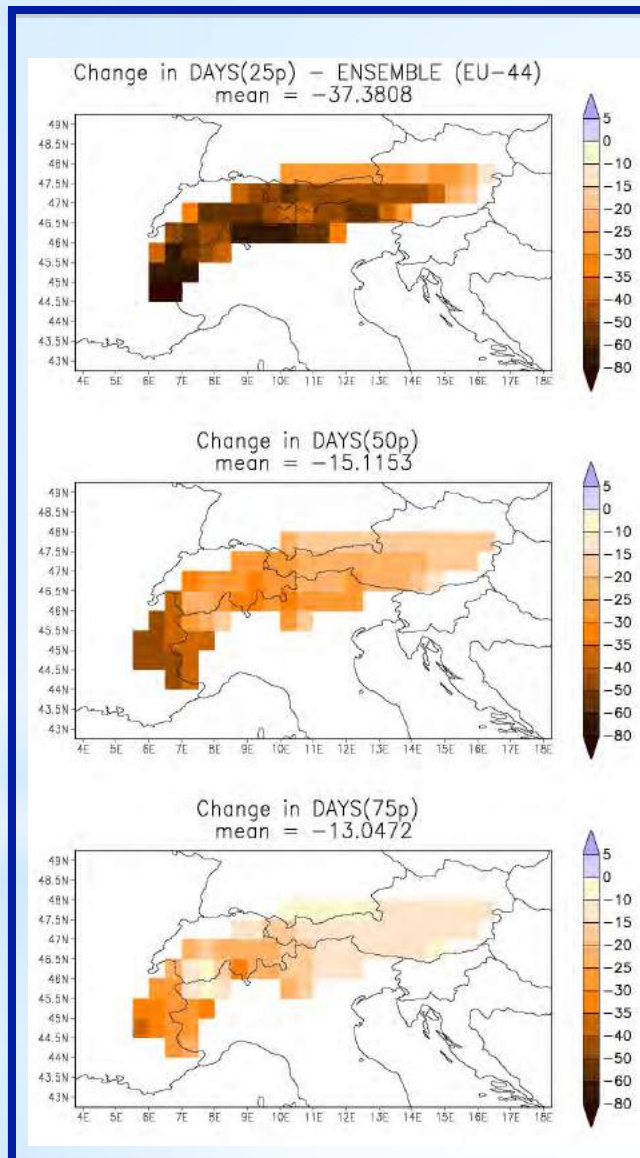
0.44



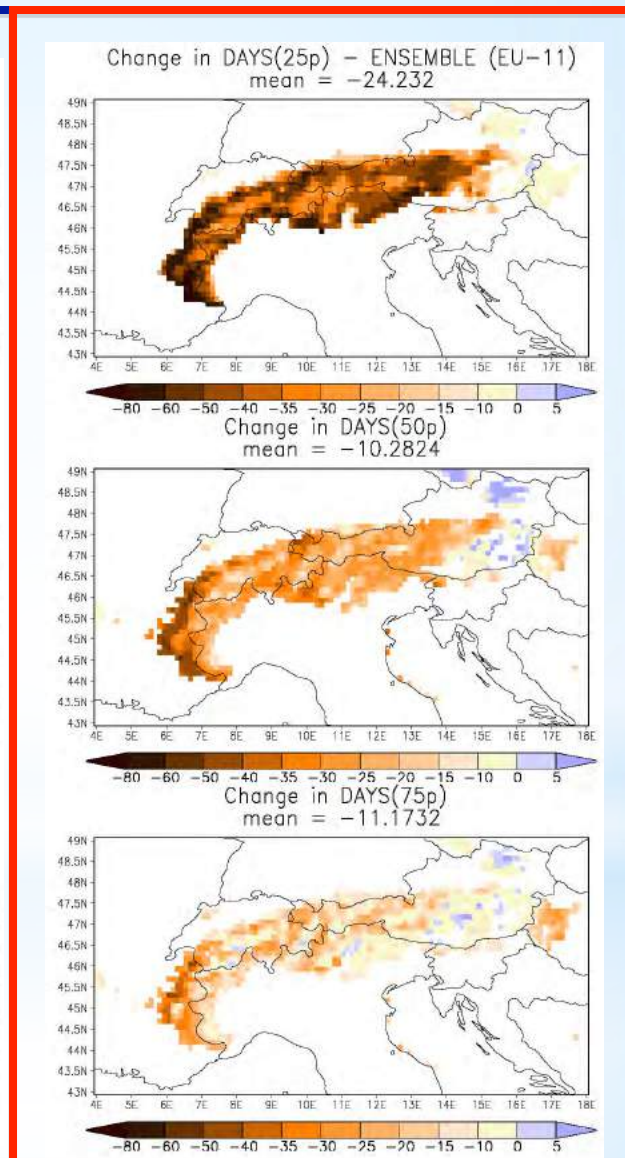
0.11

* Shift del giorno giuliano del 25, 50 e 75 percentile della portata

0.44



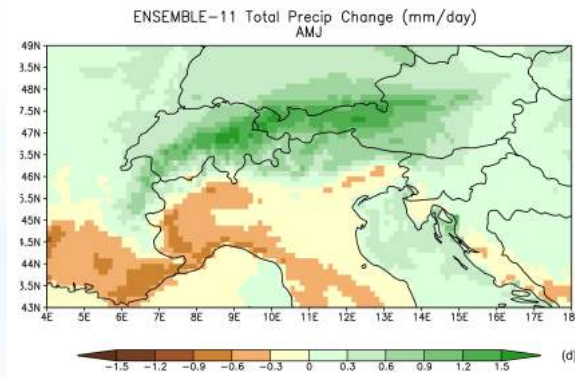
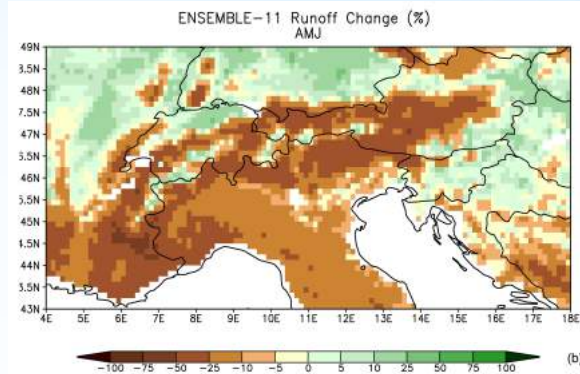
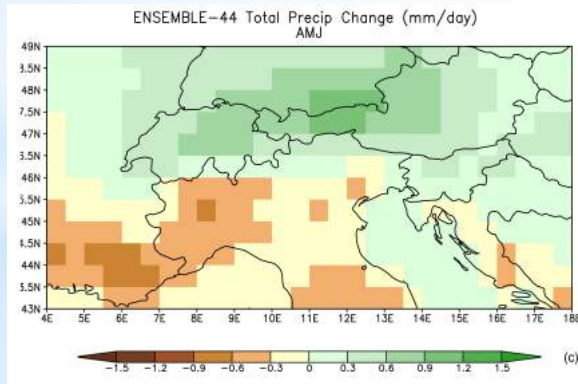
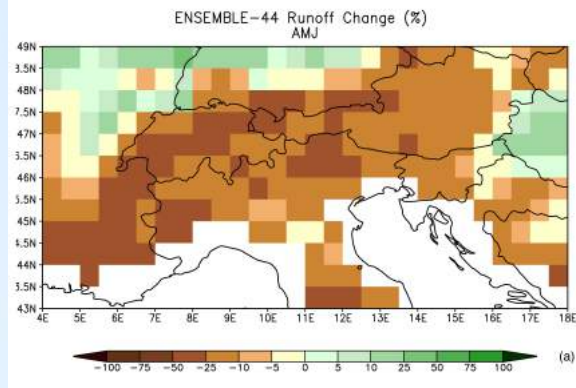
0.11



* Discussion- Runoff and precipitation change

0.44

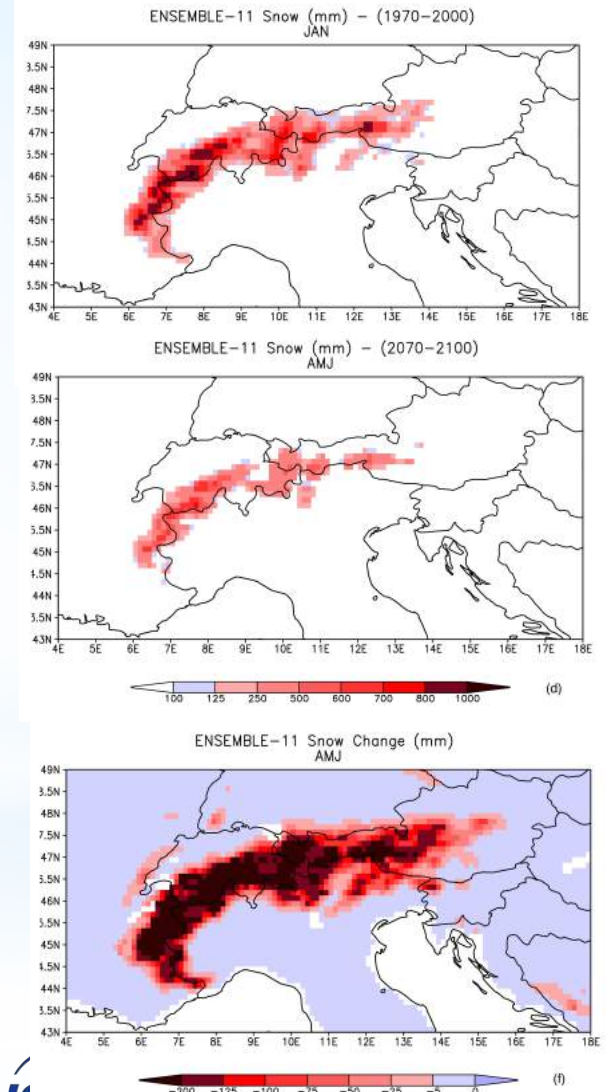
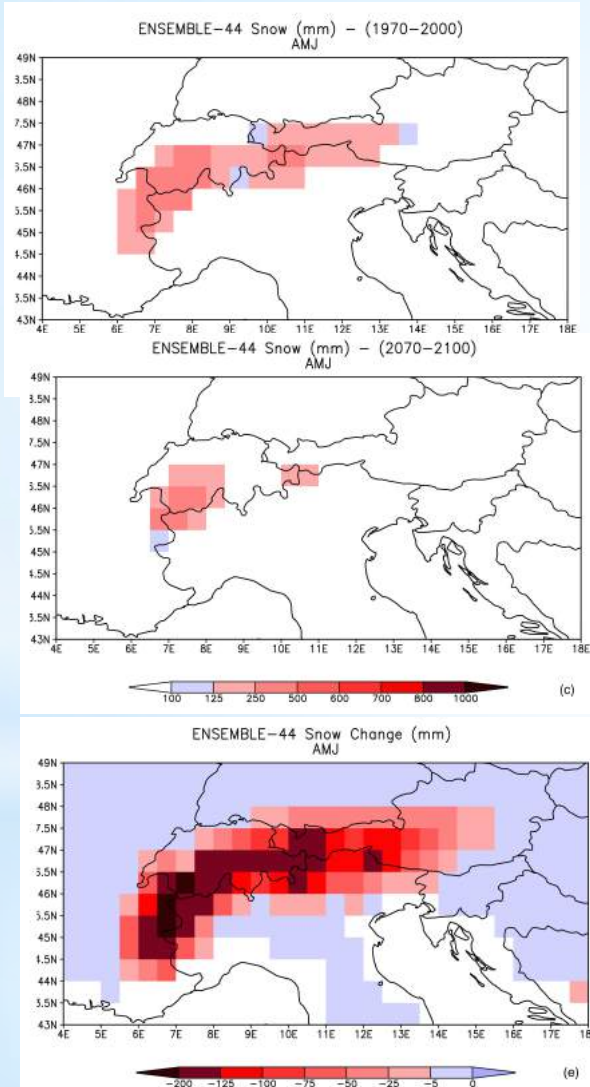
0.11



* Discussion-Snow change

0.44

0.11

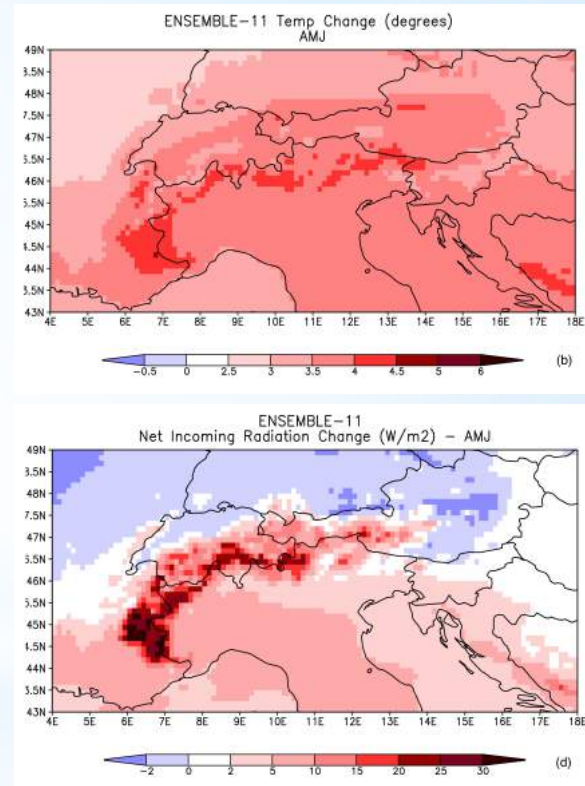
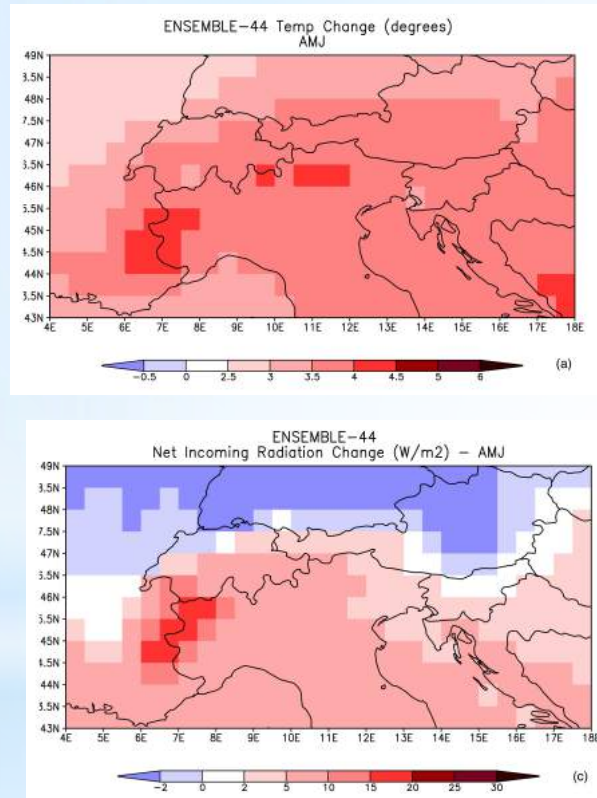


for Theoretical Physics

* Discussion- Temperature and Net surface shortwave radiation change

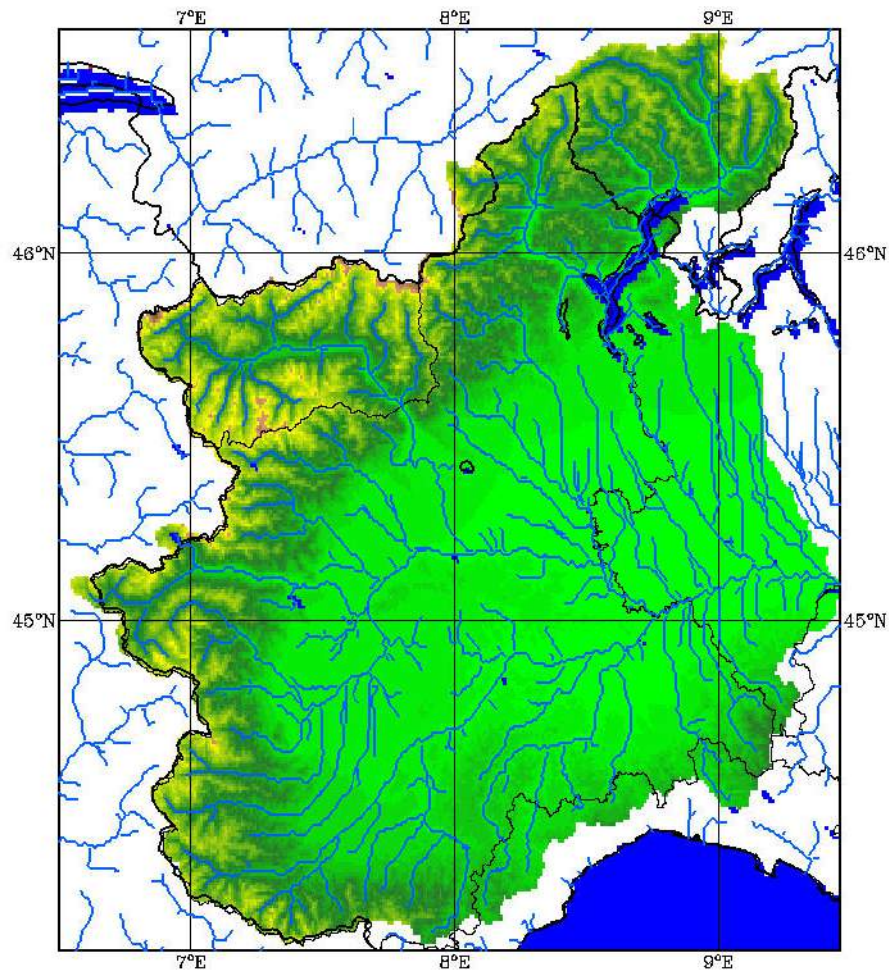
0.44

0.11



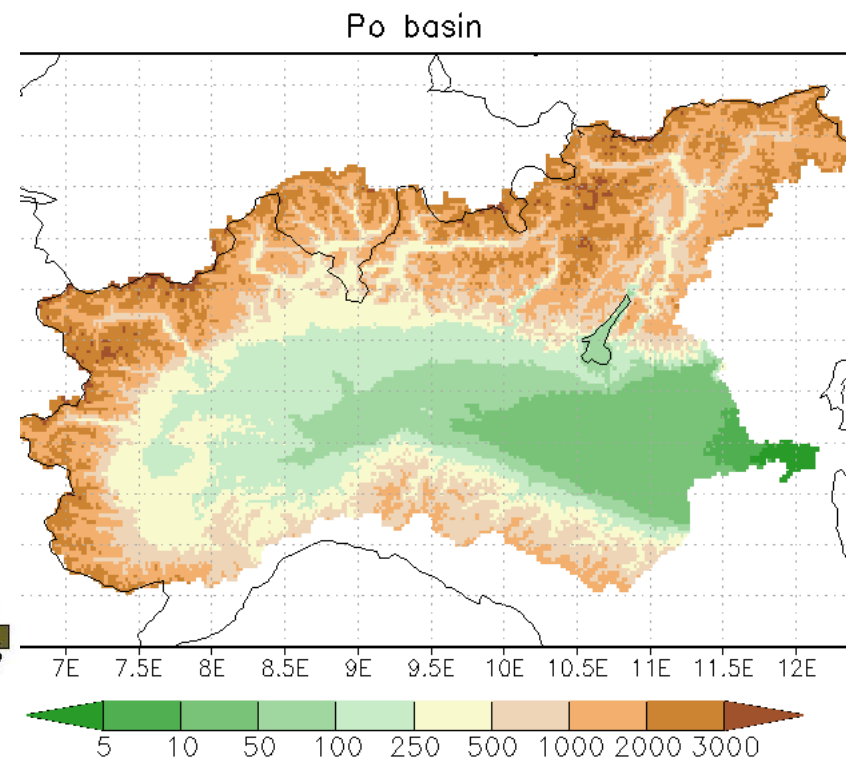


Po River Basin



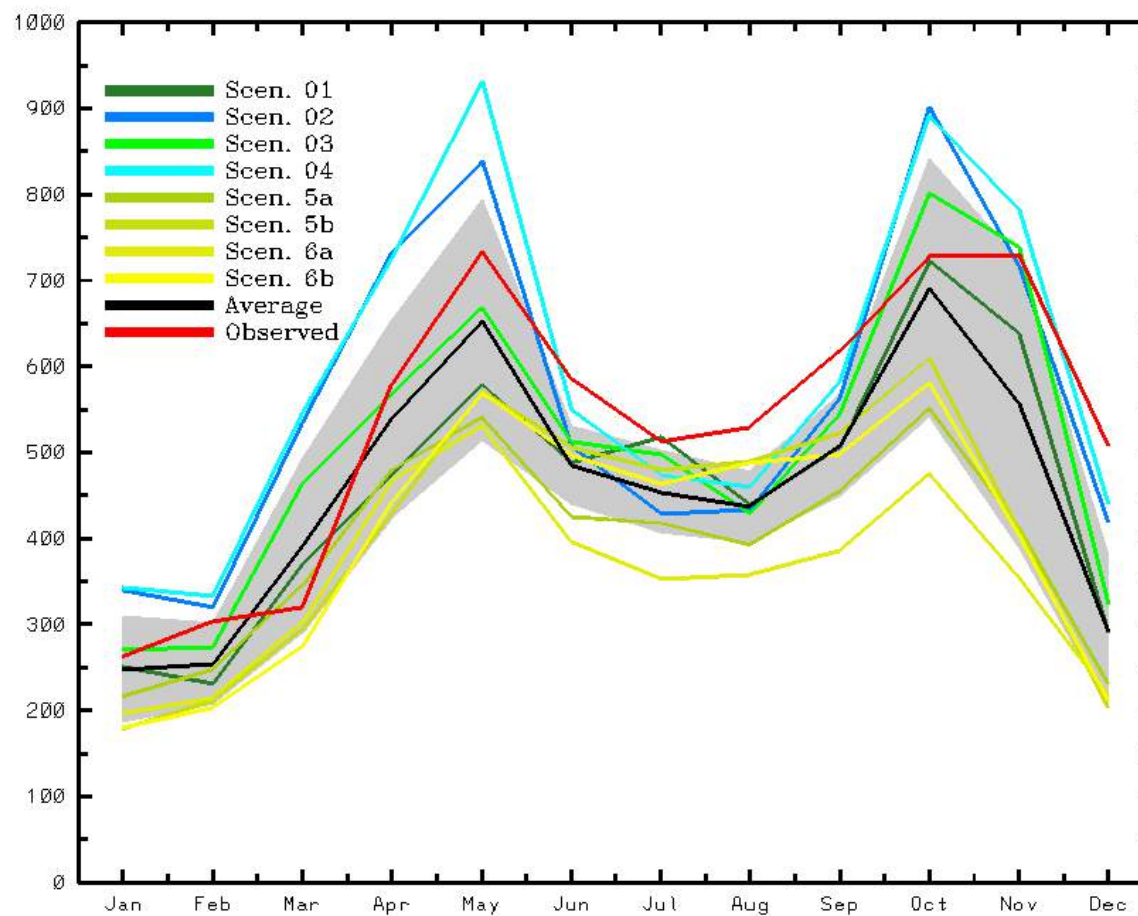
95 477 858 1239 1620 2002 2383 2764 3146 3527 3908 4289 4671
ACQWA Project - Scenario 6a - P.P RCM-RegCM3 25x25

Employment	46%
Agricultural production	35%
Energy consumption	48%





Monthly average discharge (m^3/sec) 1960–1990



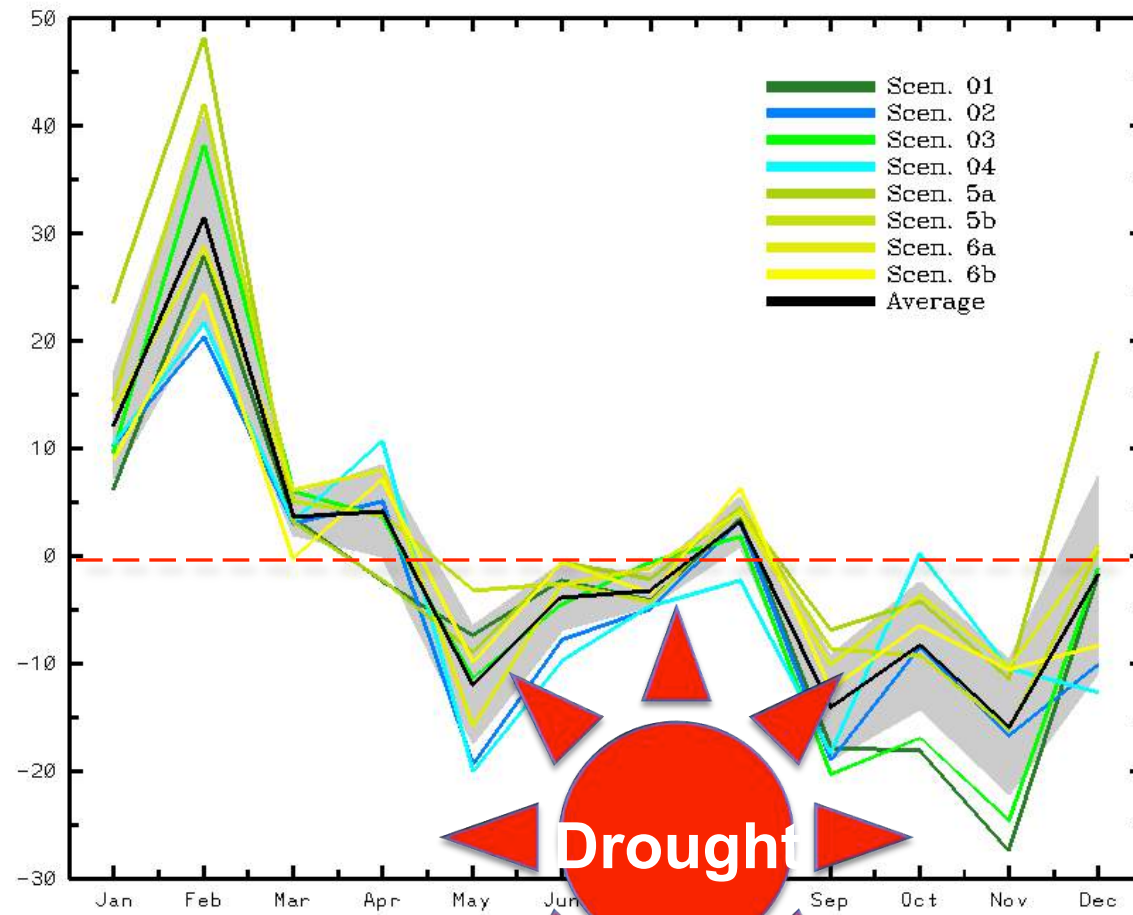
Isola S. Antonio Po (45.0379°N – 8.8230°E)



The Abdus Salam
International Centre
for Theoretical Physics



Discharge differences (%) 2020/2050–1960/1990



Isola S. Antonio Po (45.0379°N–8.130°E)



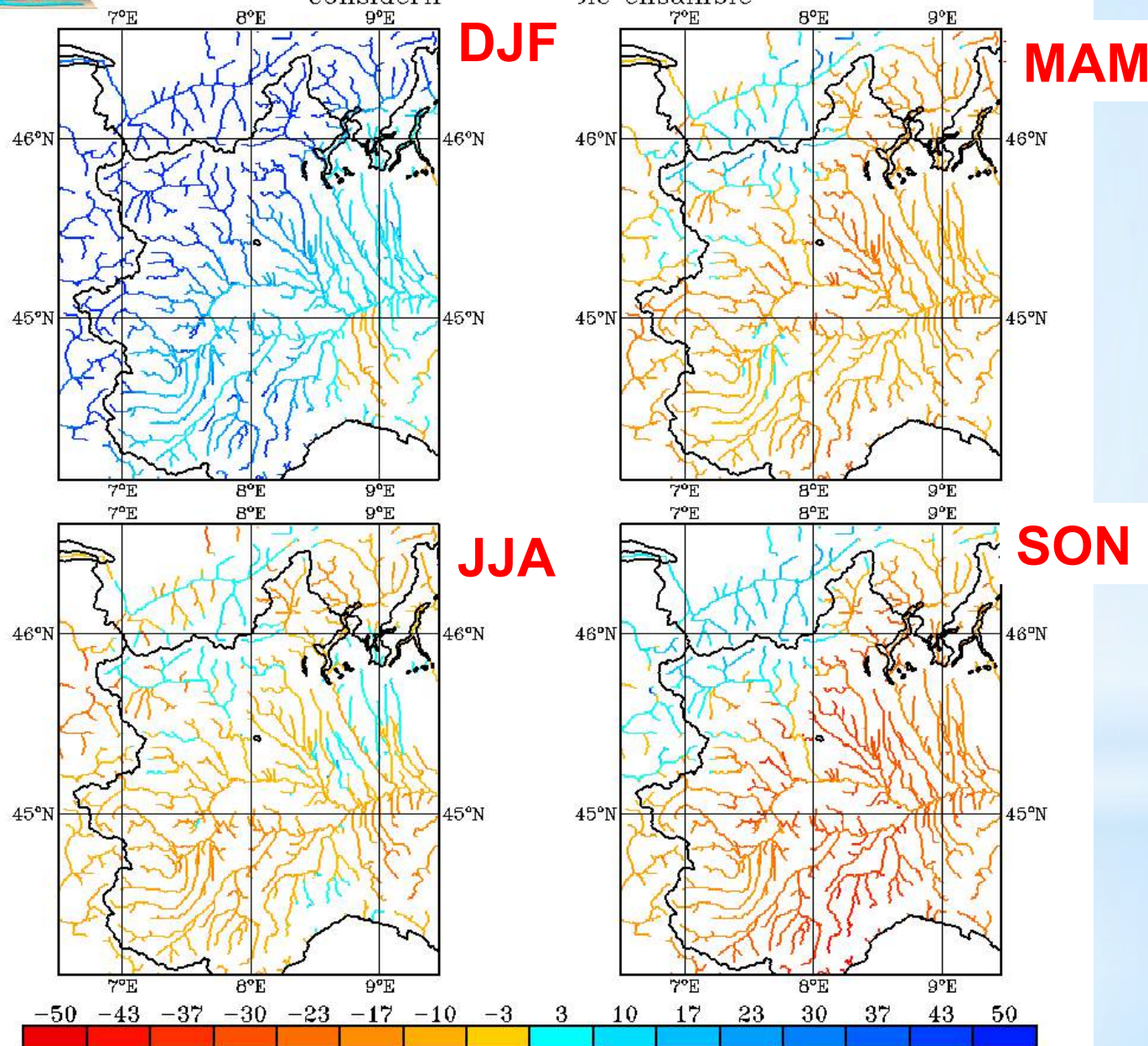
The Abdus Salam
International Centre
for Theoretical Physics





Discharge average variation (%) 2020/2050–1960/1990

considering the whole ensemble



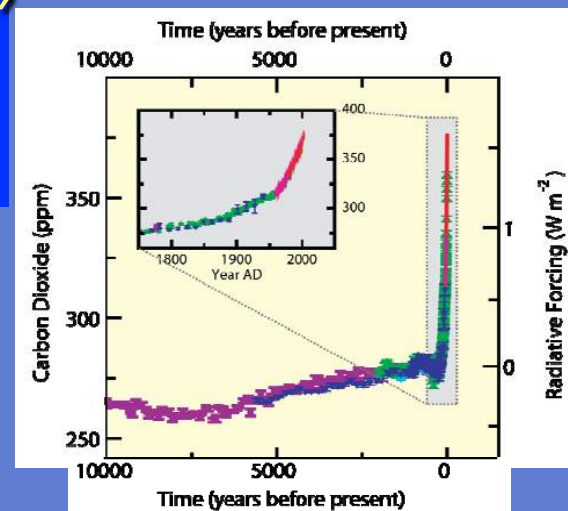
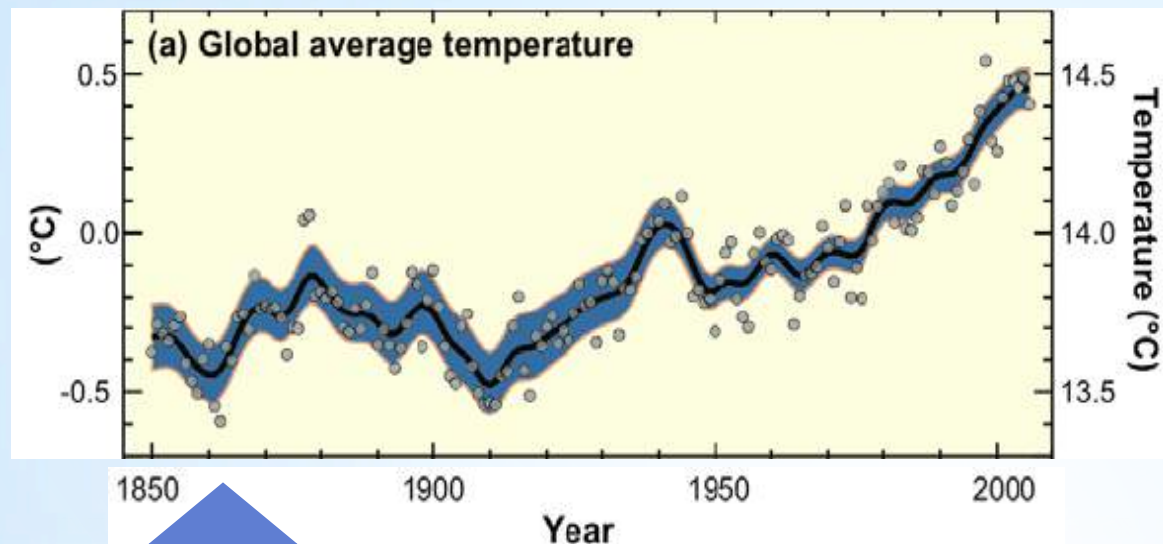
Considerazioni finali

- Stiamo assistendo ad un riscaldamento globale dovuto principalmente alle emissioni di gas serra dall'uso di combustibili fossili
- Il riscaldamento globale ha effetti su molti settori della società
 - Scioglimento dei ghiacciai – Risorse idriche
 - Aumento del livello del mare – Zone costiere
 - Aumento di eventi estremi - Siccita', ondate di calore, alluvioni
 - Diversi effetti sulla salute
- Il riscaldamento globale probabilmente continuerà nelle prossime decadi e richiederà politiche di adattamento, ma bisogna contenerlo al di sotto del livello di pericolo con una riduzione delle emissioni di gas serra
 - Gestire l'inevitabile ed evitare l'ingestibile

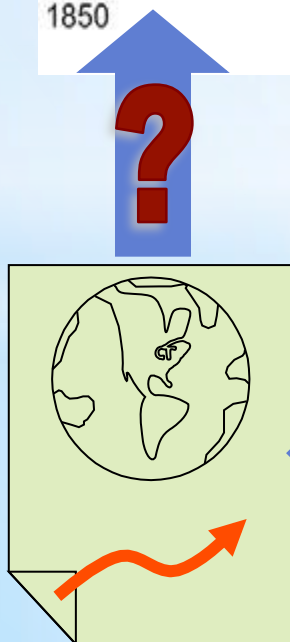
Cosa rende difficile il dibattito?

- La riduzione delle emissioni di gas serra deve coinvolgere tutti i paesi
 - I paesi emergenti sono sempre piu' i maggiori emittori ma hanno diritto al loro sviluppo economico
- I gas serra rimangono in atmosfera per decine di anni, come il calore assorbito dagli oceani
 - Le decisioni che prendiamo oggi avranno ripercussioni nel lontano futuro
- C'e' una grande difficolta' nel comunicare i rischi associati al riscaldamento globale, specialmente perche' hanno una prospettiva a lungo termine
 - Se c'e' un'alluvione, questo e' dovuto al riscaldamento globale?
 - Perche' investire oggi per evitare danni che potrebbero accadere fra 20-30-40 anni?

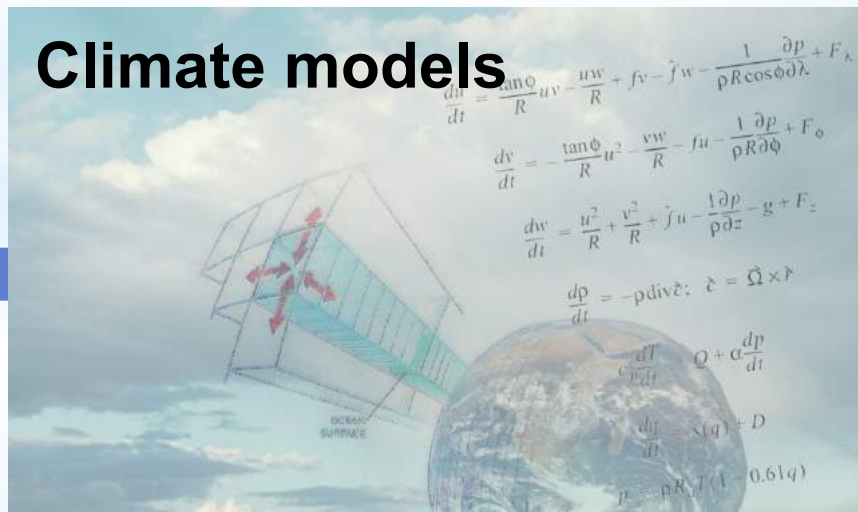
Come si identifica “l’ impronta” umana sul clima



- other GHGs
- aerosols
- volcanic
- solar
- natural internal

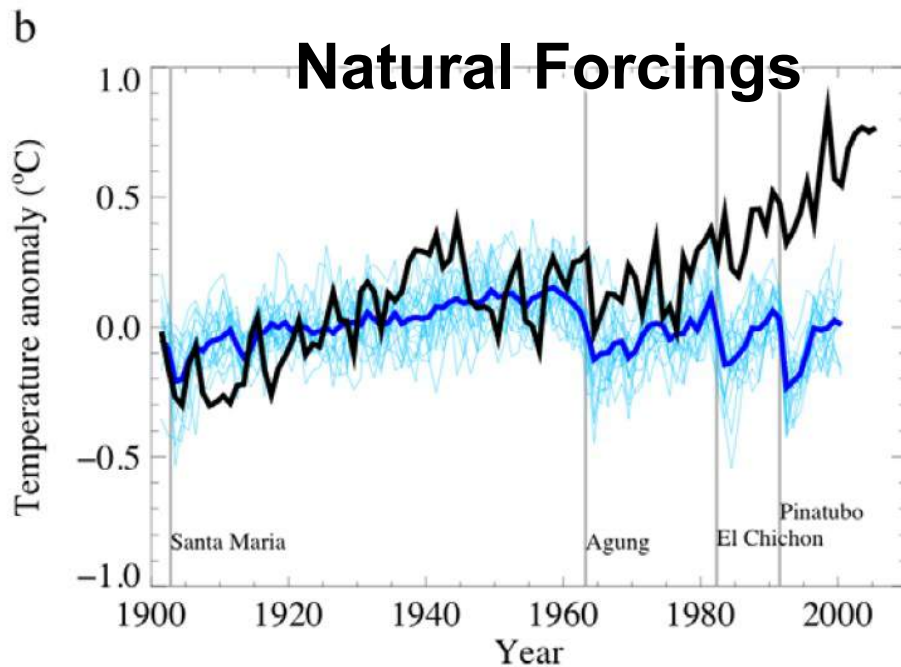
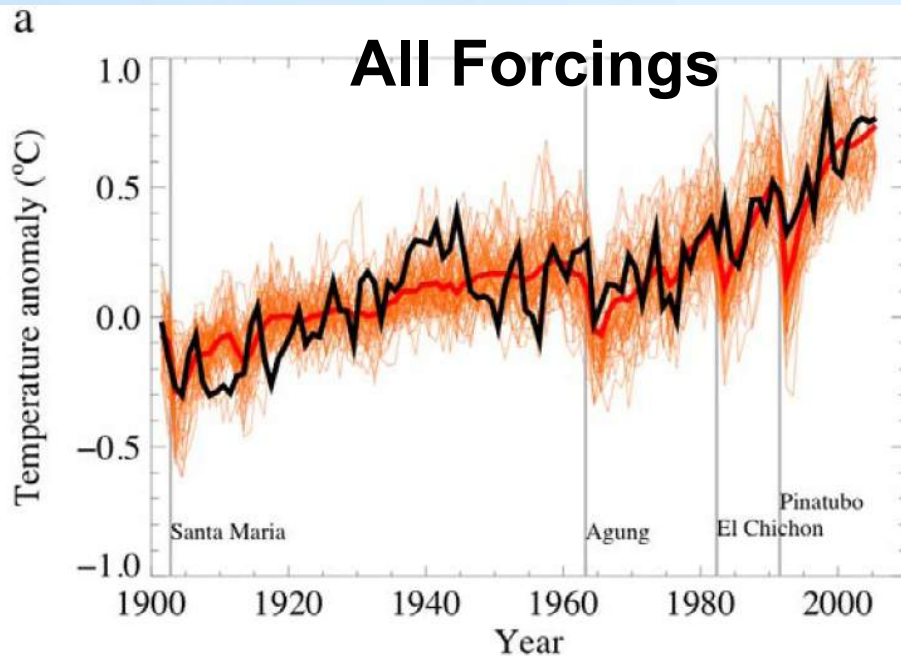


Climate models



Impronta umana sul clima

Solo quando si considera l'effetto dei gas serra da attività umane si riesce a riprodurre il riscaldamento osservato negli ultimi 50 anni



Il contributo umano al forcing radiativo dal 1750 e' molto maggiore di quello naturale

