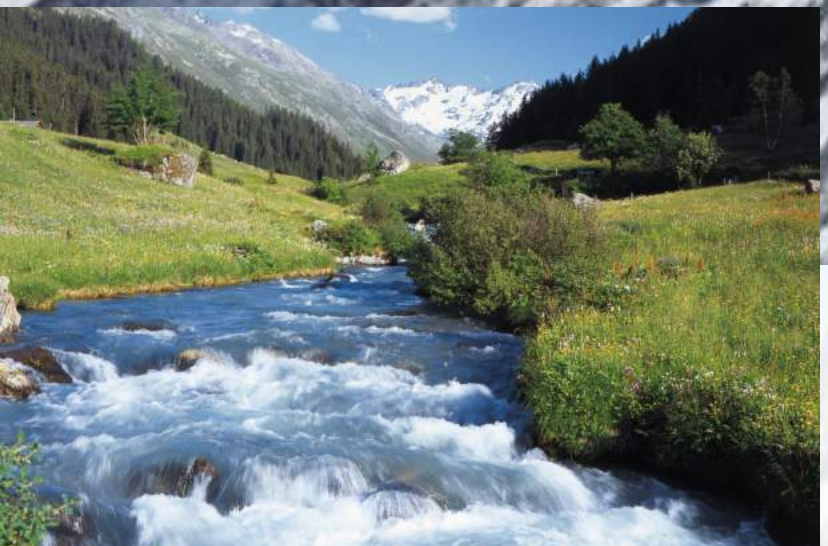
Impatti dei cambiamenti climatici sugli eventi estremi in Europa e sulla catena Alpina

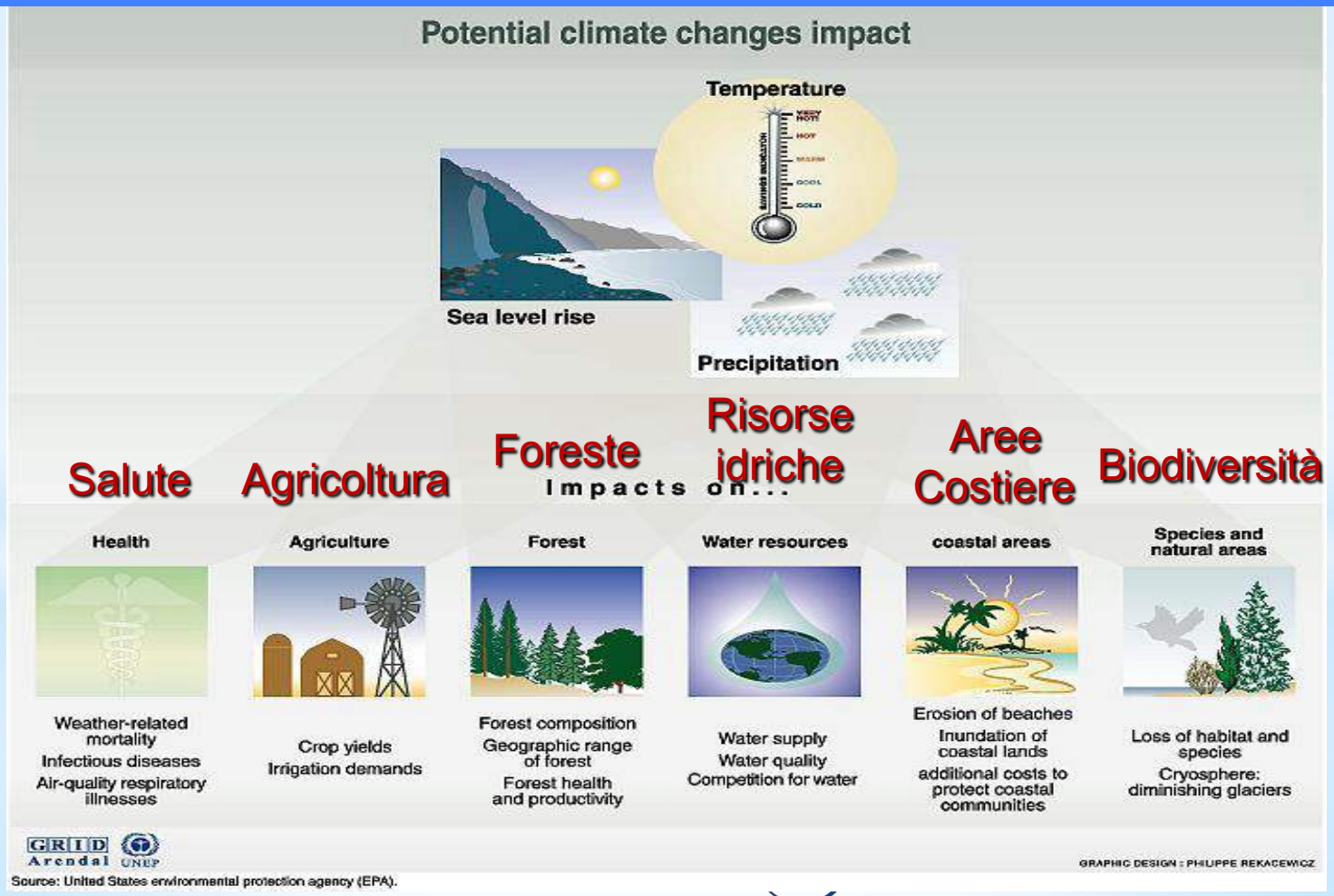
Erika Coppola
ICTP, Trieste



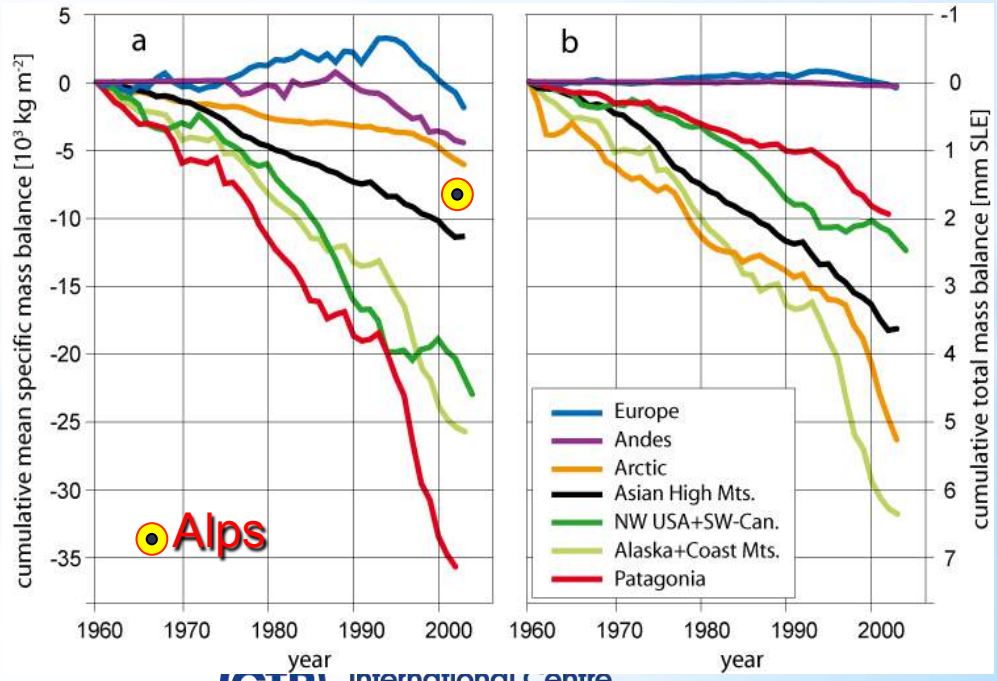
The Abdus Salam International Centre for Theoretical Physics

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



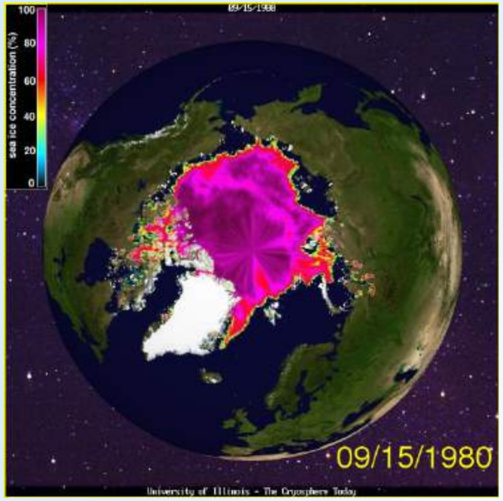
Il riscaldamento globale provoca lo scioglimento dei ghiacciai



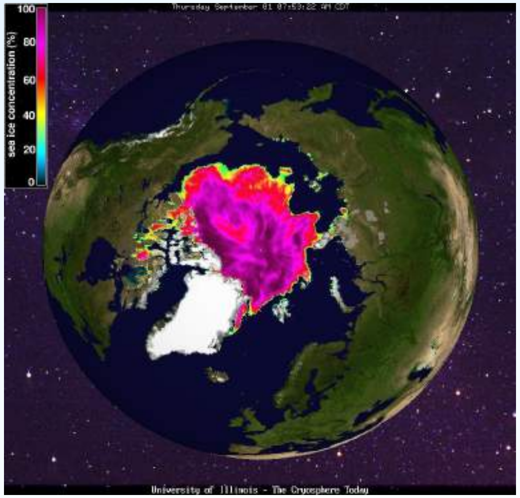
ICTP International Centre for Theoretical Physics

Stiamo assistendo al graduale scioglimento della calotta artica

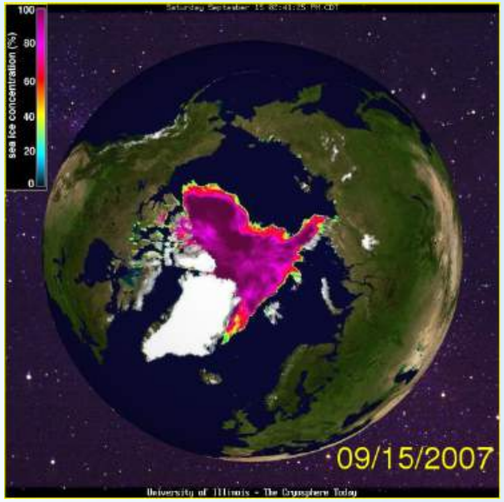
15 Settembre 1980

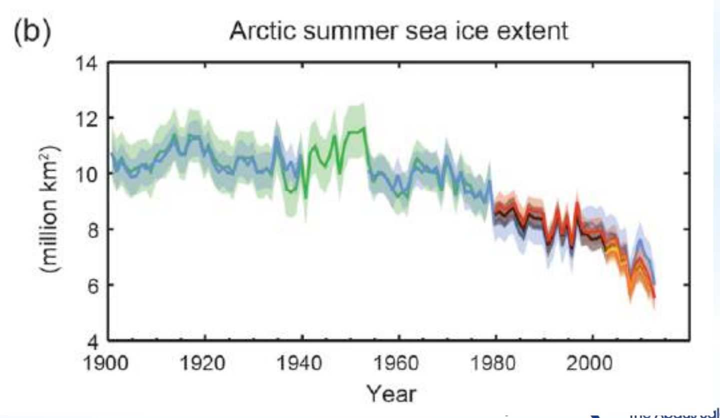


15 Settembre 2005

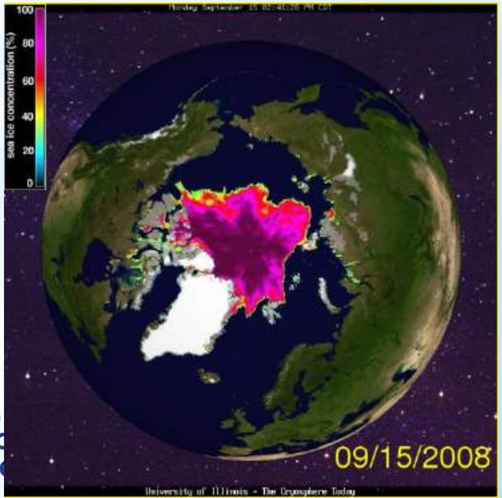


15 Settembre 2007

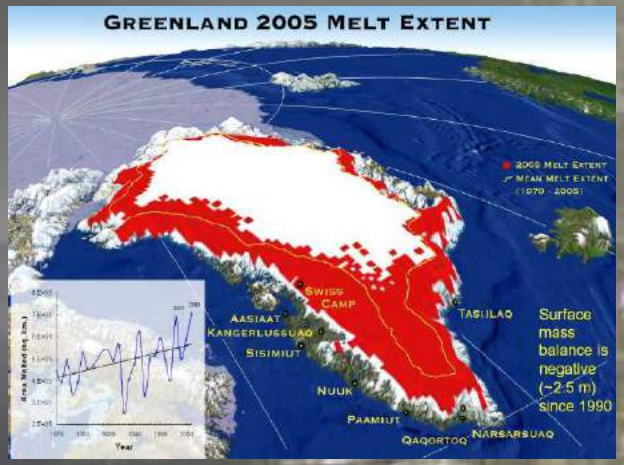




15 Settembre 2008



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

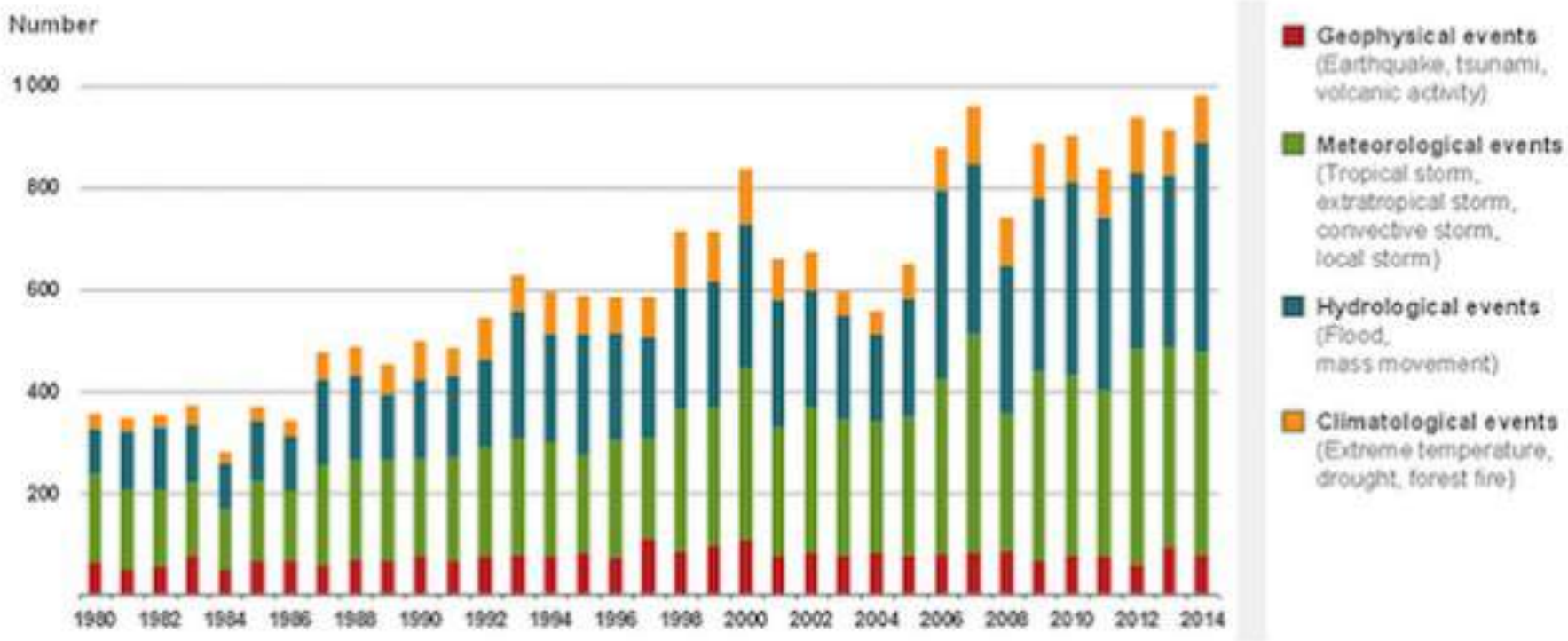
Aumento delle intensita' delle precipitazioni

"Piove meno frequentemente ma piu' intensamente"

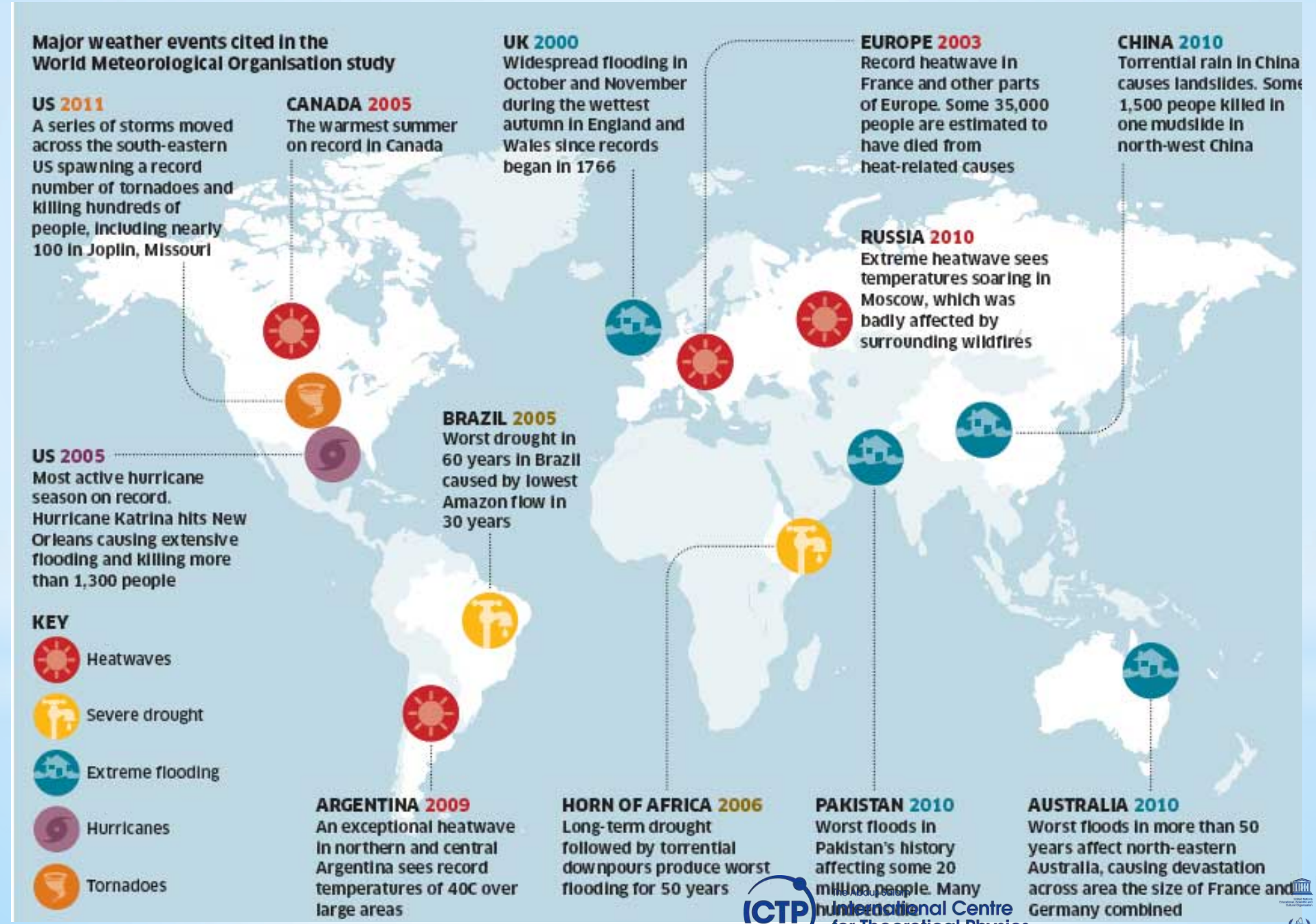
Aumento di siccita' e ondate di calore

WORLD NATURAL CATASTROPHES, 1980–2014

(Number of events)



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

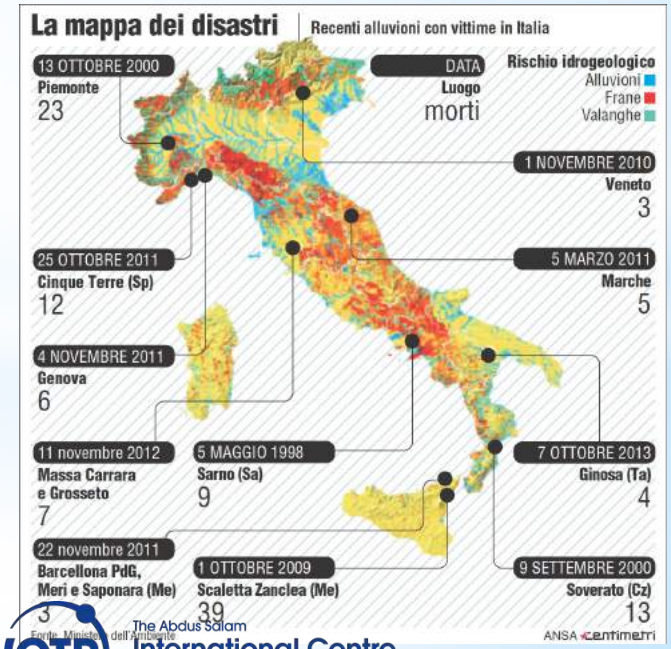


E in Italia?

Genova
Novembre 2011

“Cleopatra”, Sardegna
18 Novembre 2013

Genova
Ottobre 2014



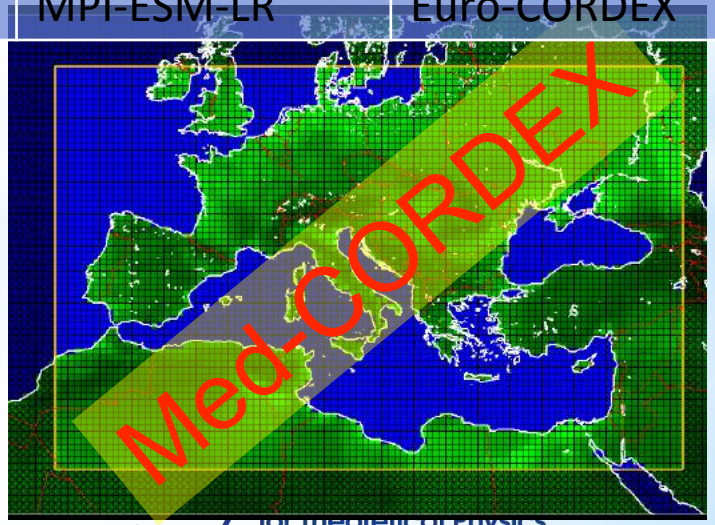
The Abdus Salam International Centre for Theoretical Physics

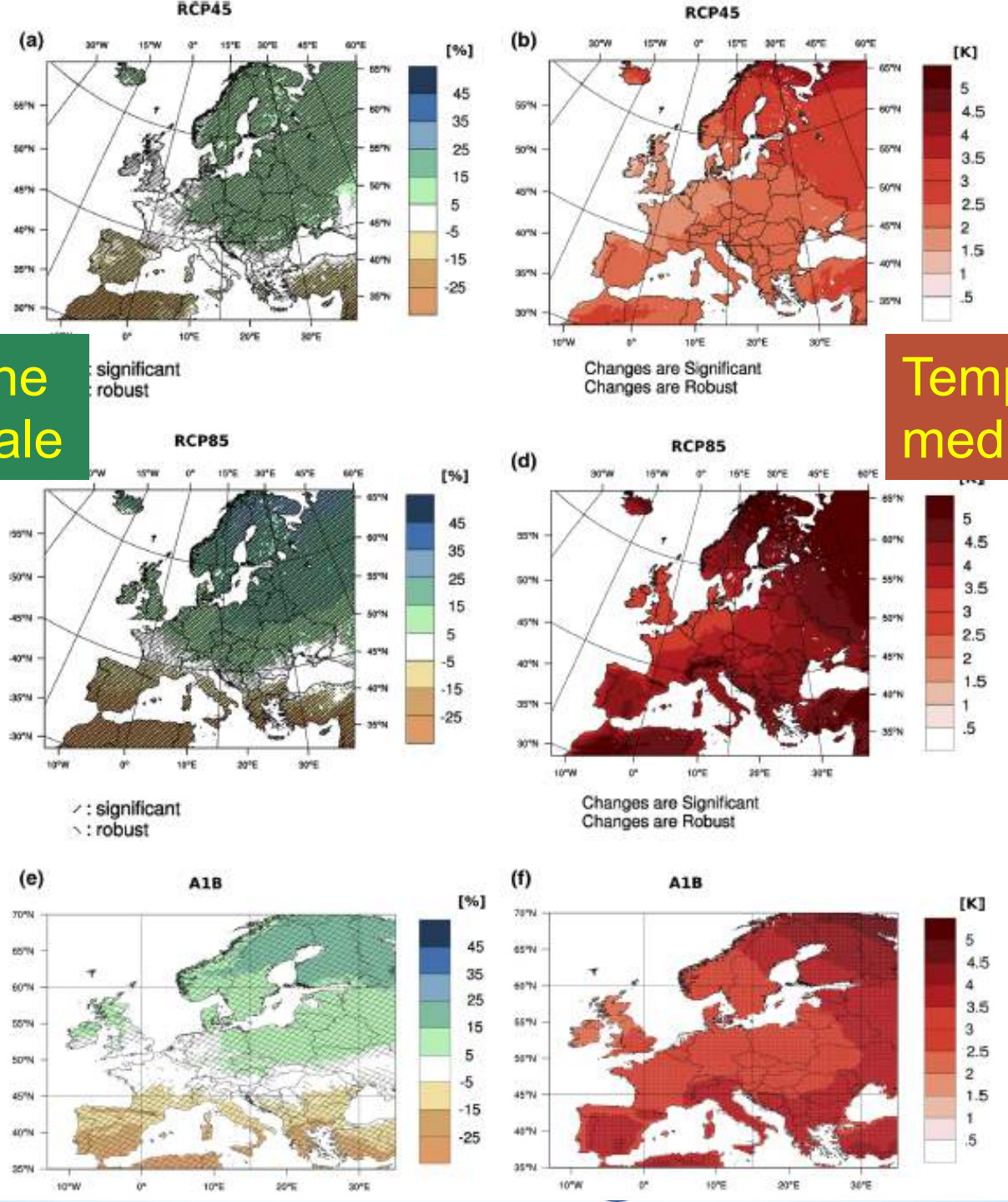
Progetti Europei

ENSEMBLES

PRUDENCE

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



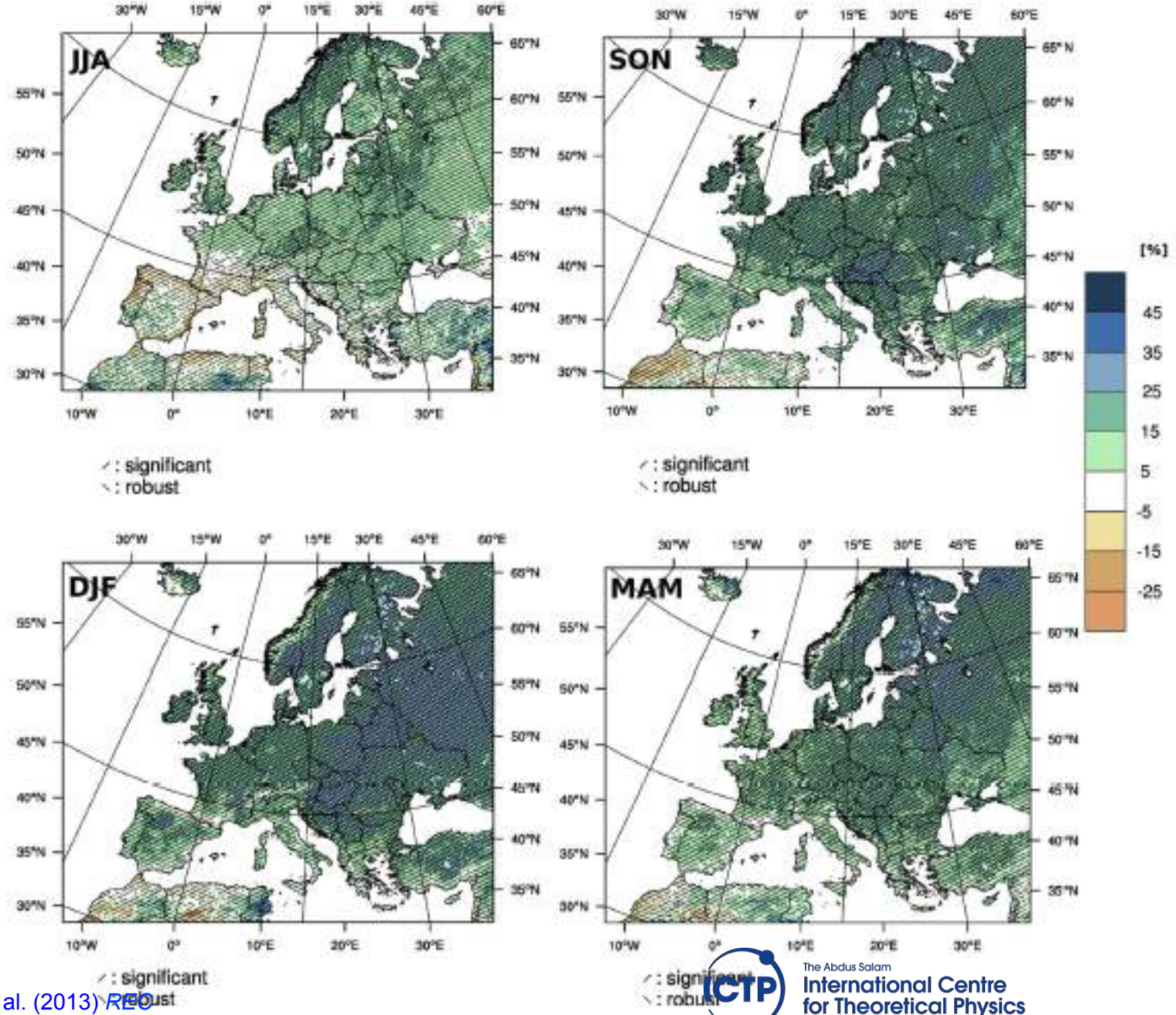


Precipitazione media annuale

Temperatura media annuale

Jacob D. et al. (2013) *REC*

Precipitazione estrema



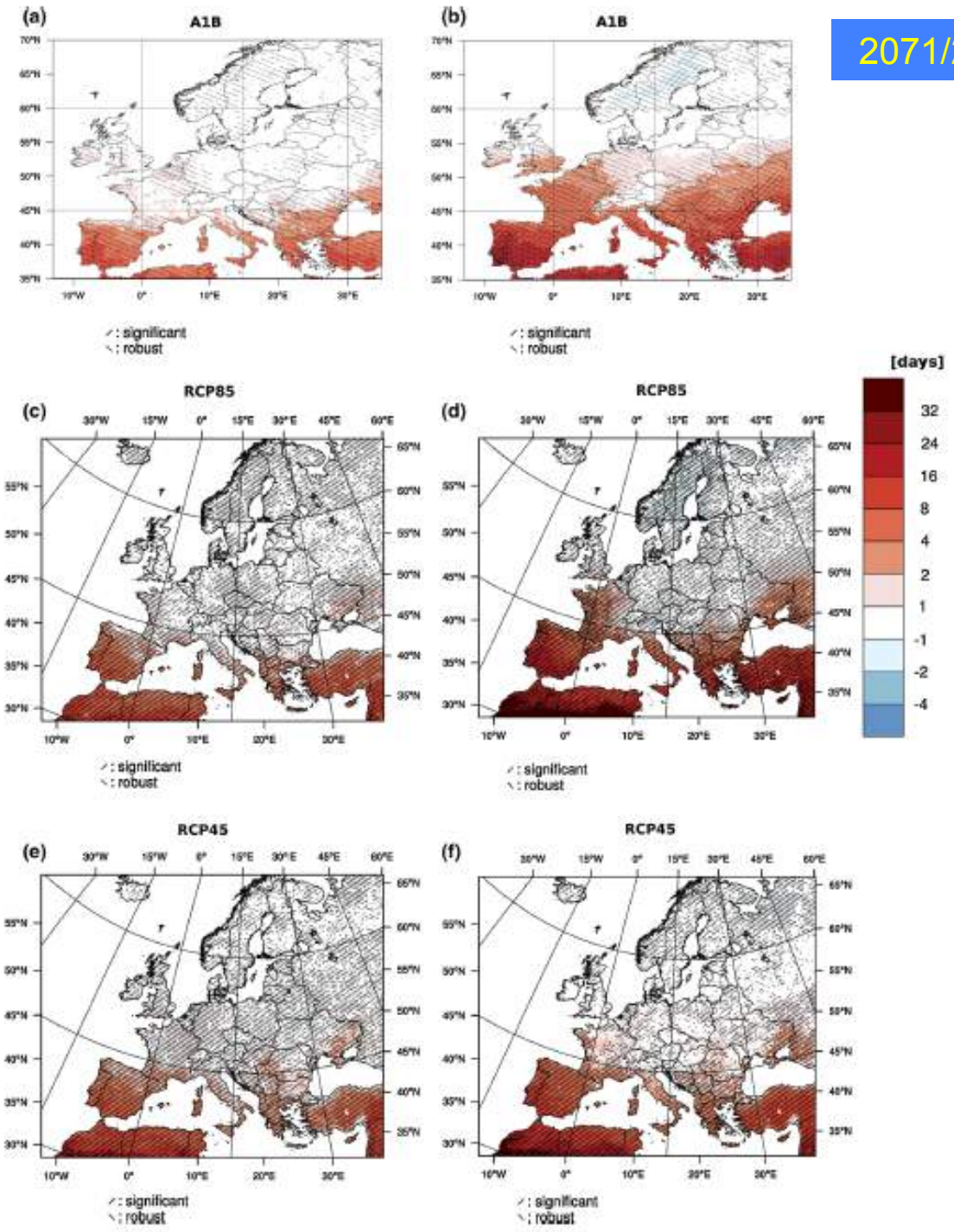
Jacob D. et al. (2013) *REC*

The Abdus Salam International Centre for Theoretical Physics

2021/50-1971/2000

2071/2100-1971/2000

Periodi di siccità



Jacob D. et al. (2013) *REC*

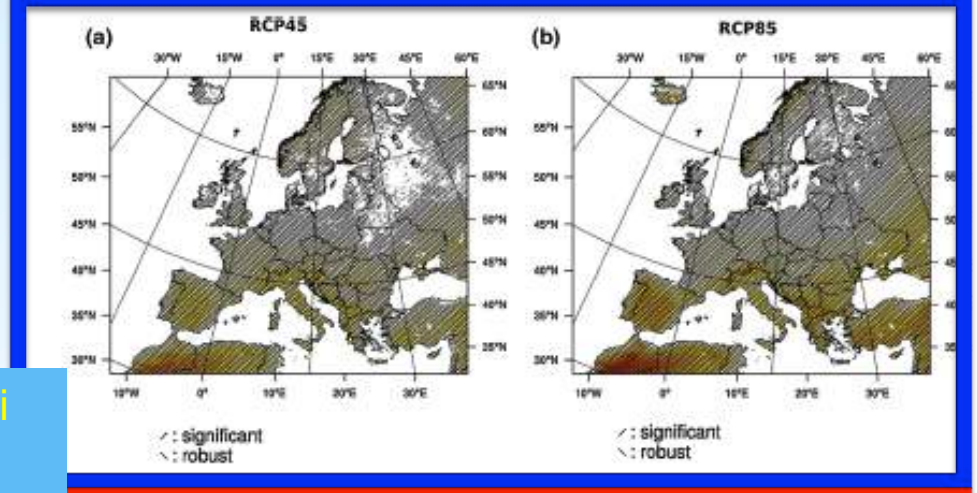
May-September
2021/50-1971/2000

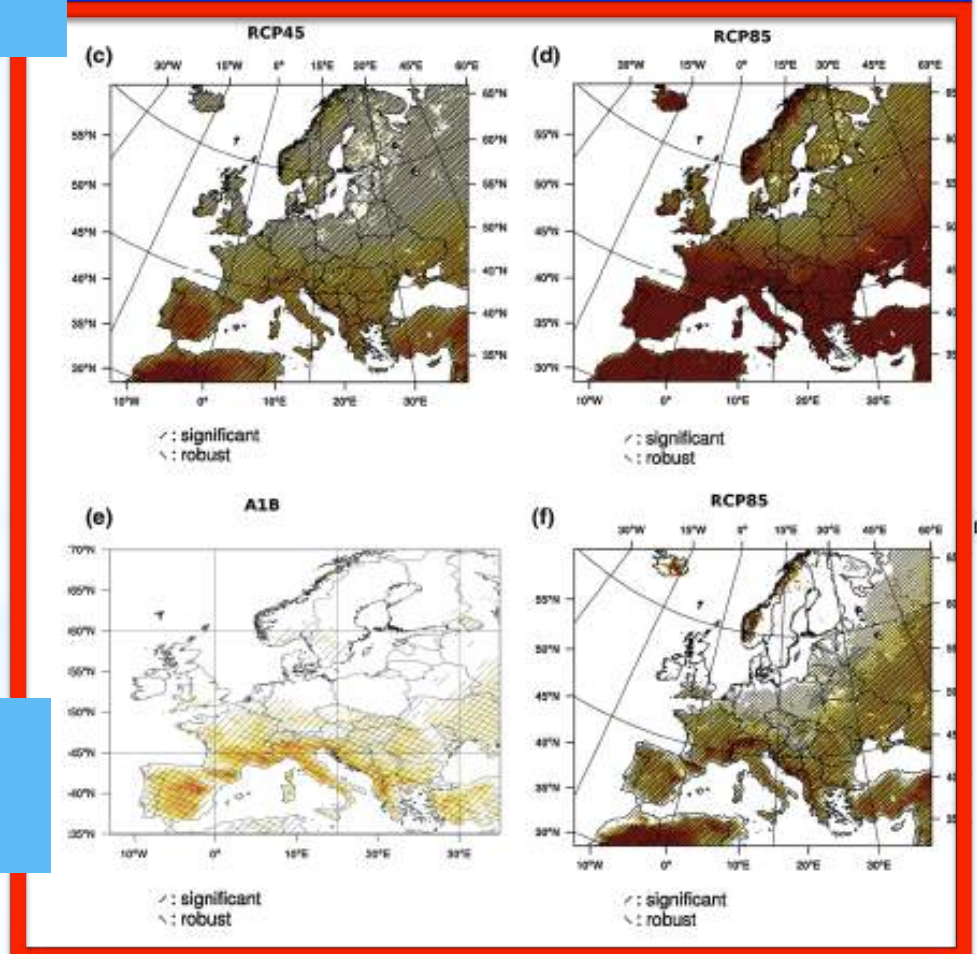
3 giorni consecutivi
max T > T 99
May-September

Ondate di calore

May-September
2071/2100-1971/2000

5 giorni consecutivi
max T > T media
May-September

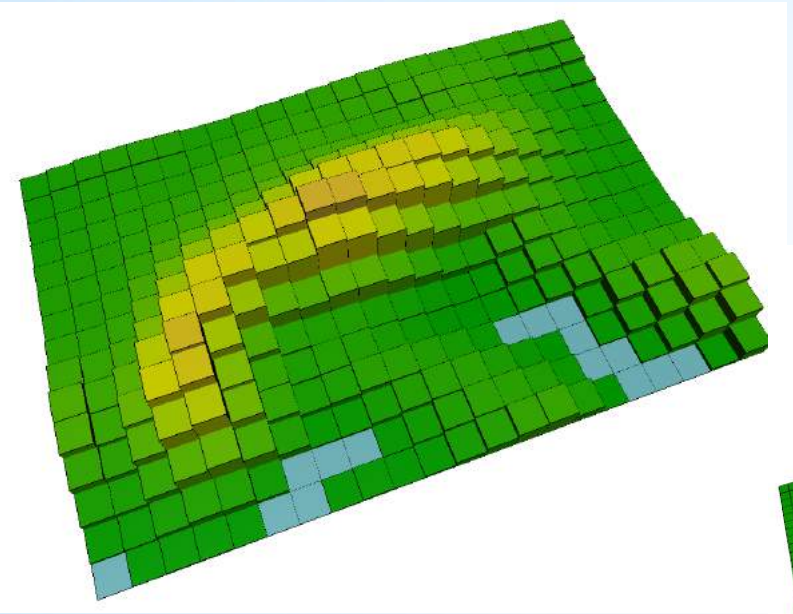




Jacob D. et al. (2013) *REC*

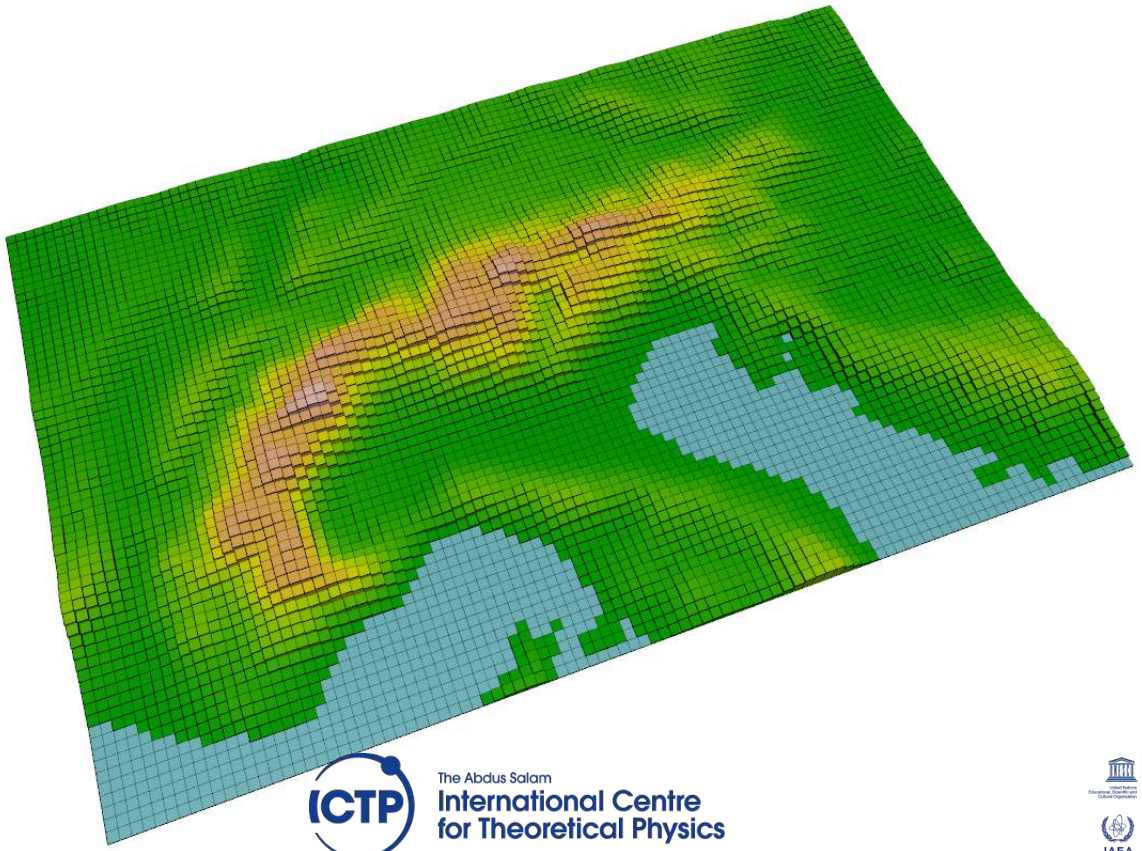
Alta risoluzione perchè

Alta risoluzione perchè



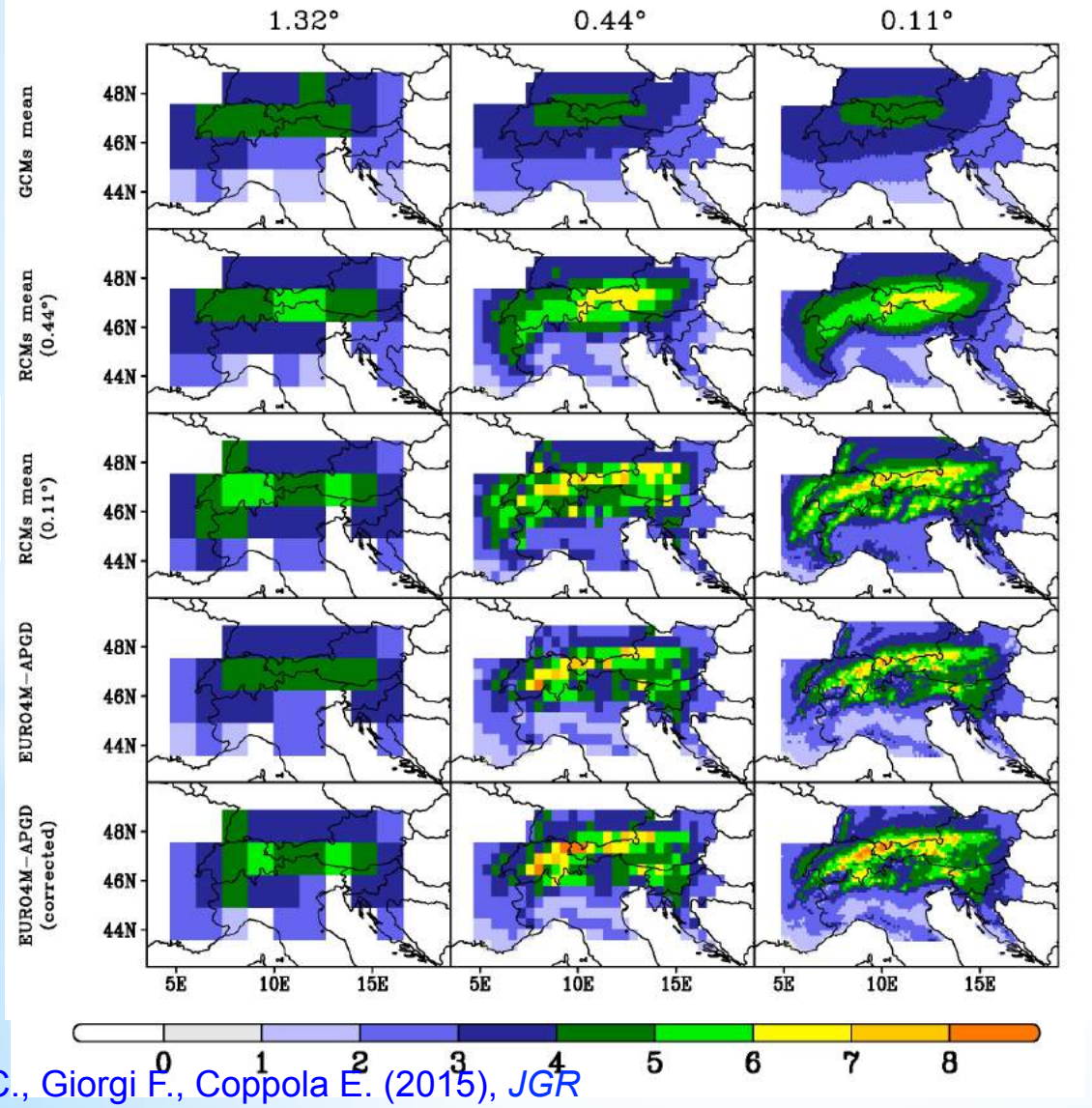
0.44

0.11



The Abdus Salam
International Centre
for Theoretical Physics

Distribuzione spaziale della precipitazione estiva

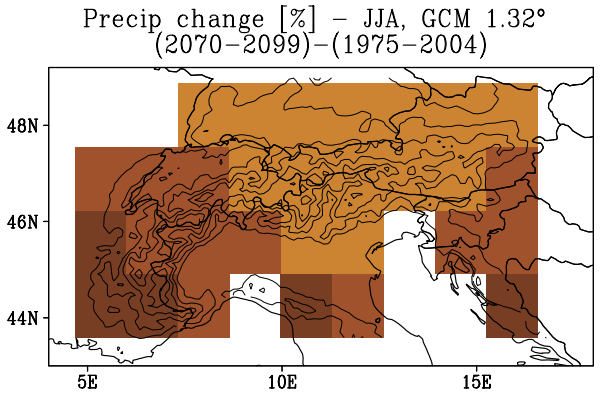


Higher resolution

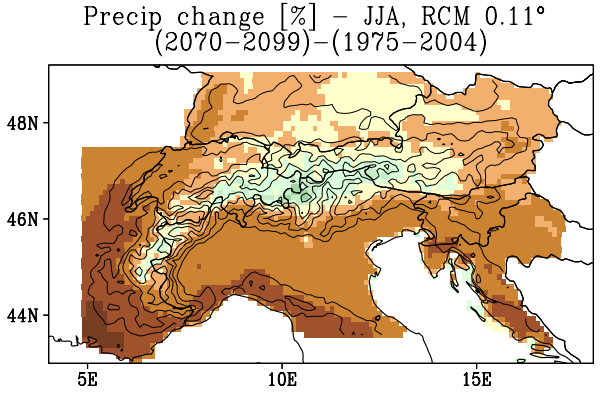
Increasing details in precipitation spatial distribution

Fine scale AV

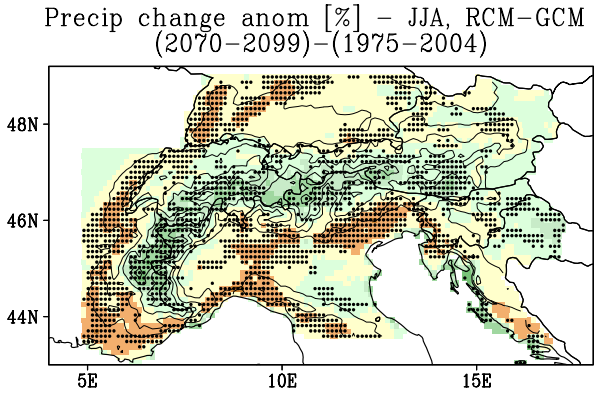
Torma C., Giorgi F., Coppola E. (2015), *JGR*



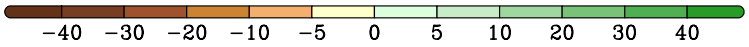
GCMs



RCMs
0.11°



RCM – GCM
Anomaly

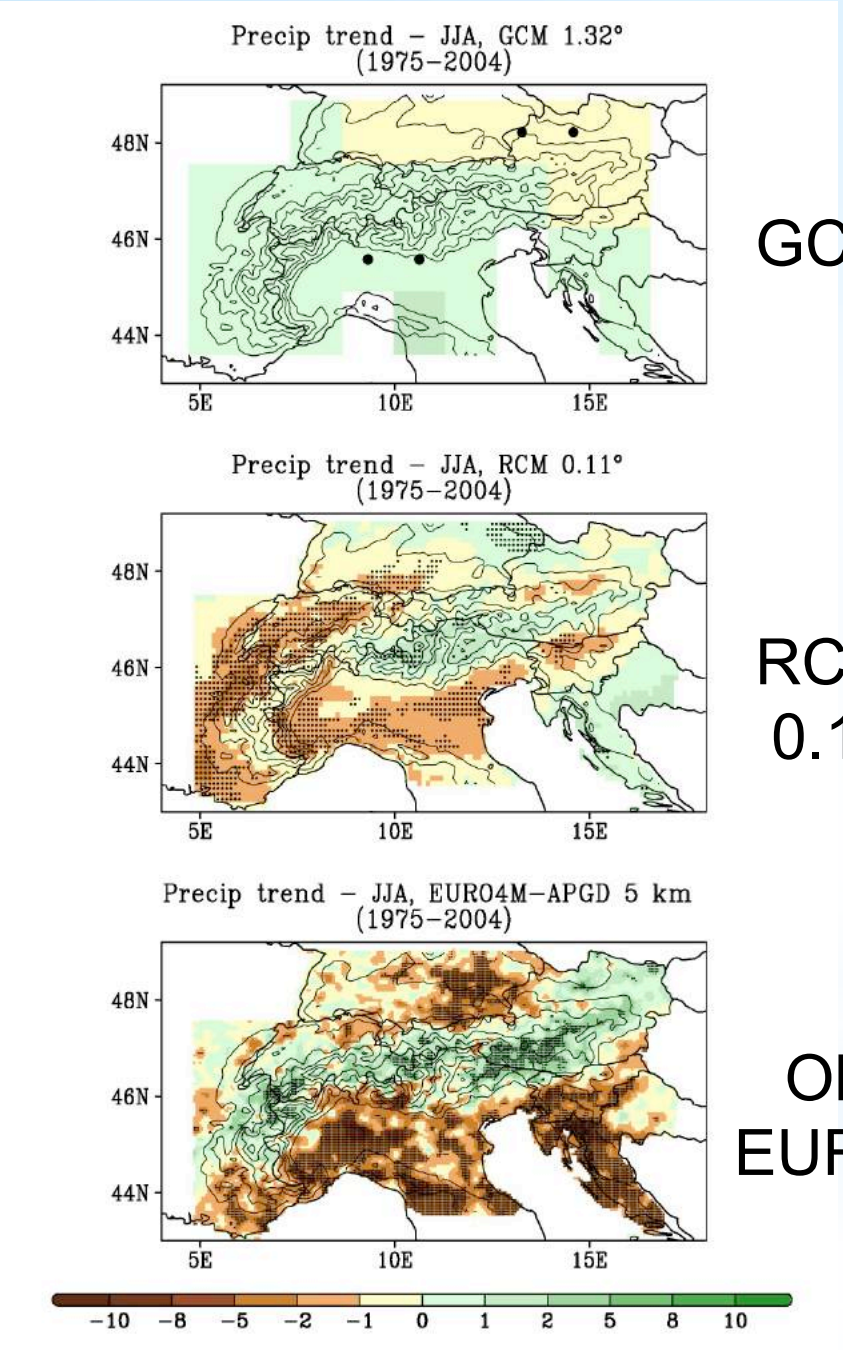


mm/day/century

Giorgi F., Torma C., Coppola E. et al. (2016) *Nature CC*

Summer precipitation change

The Abdus Salam International Centre for Theoretical Physics



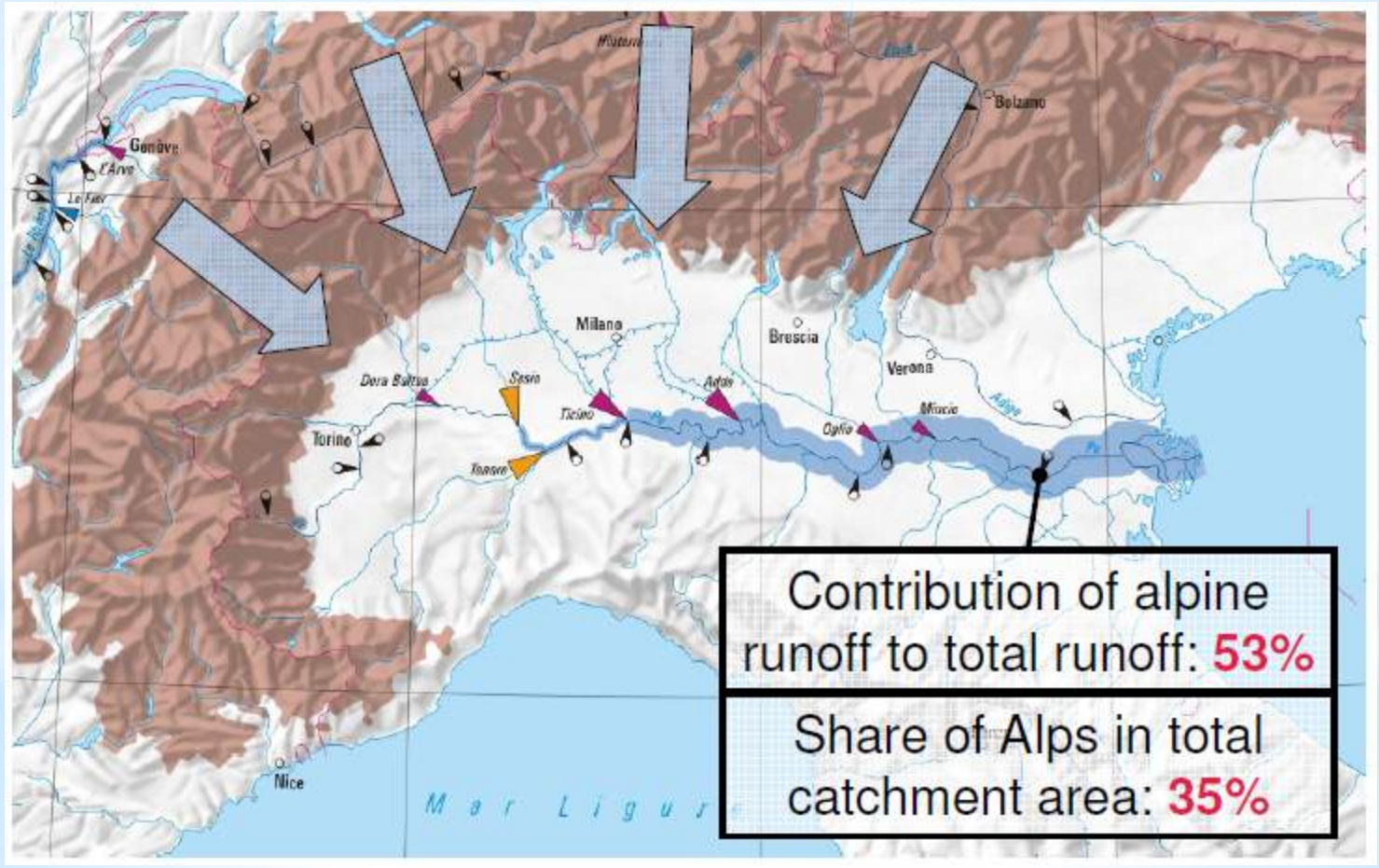
GCMs

RCMs
0.11°

Observations
EURO4M-APGD

Summer precipitation trend during 1975-2004

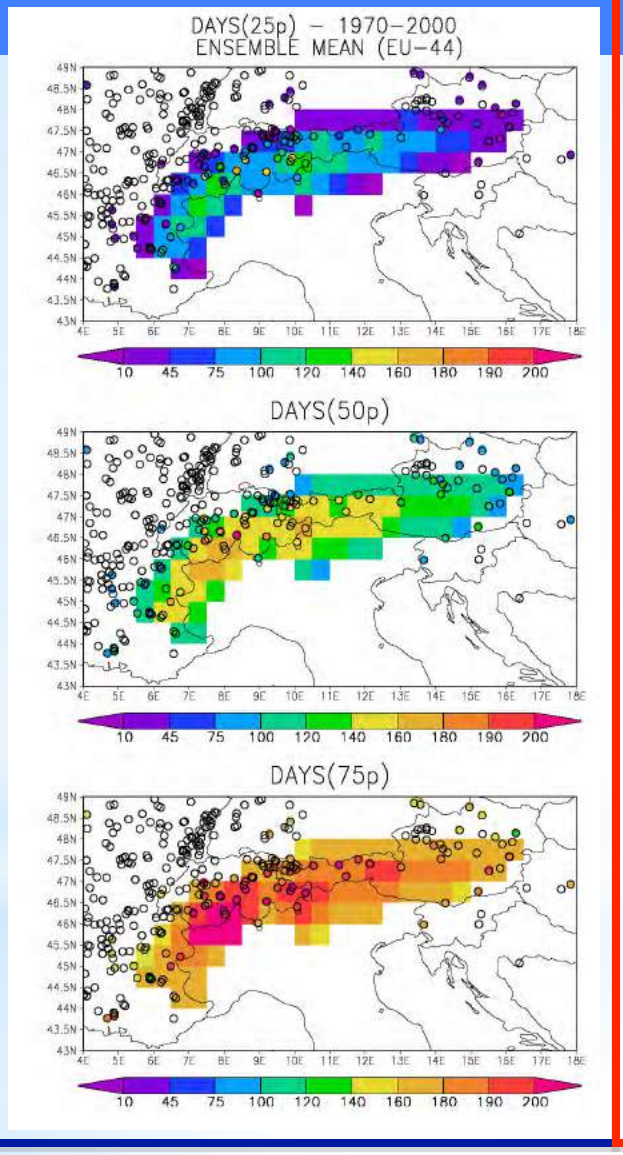
*The Alps water tower of Europe the river Po

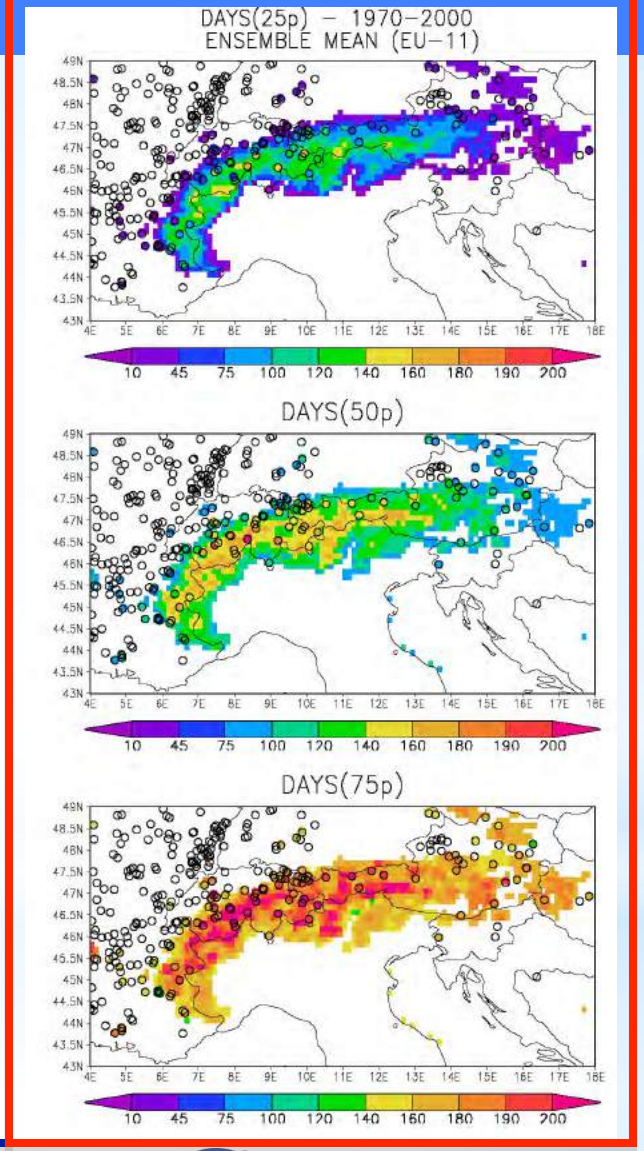


The Abdus Salam International Centre for Theoretical Physics

* Giorno giuliano del 25, 50 e 75 percentile della portata

0.44



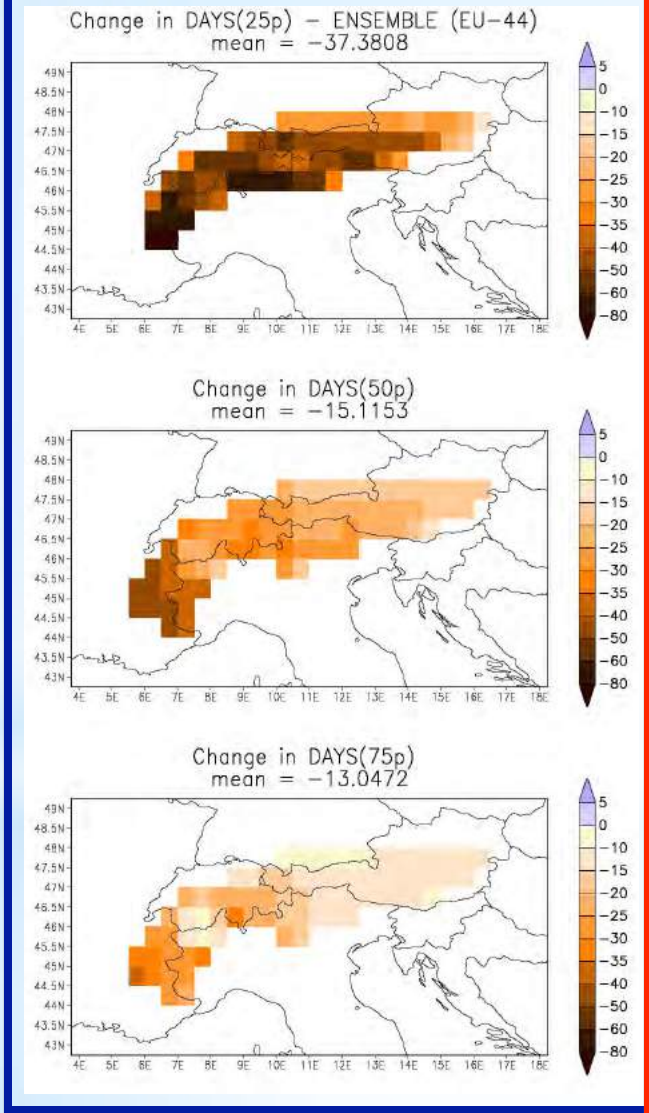


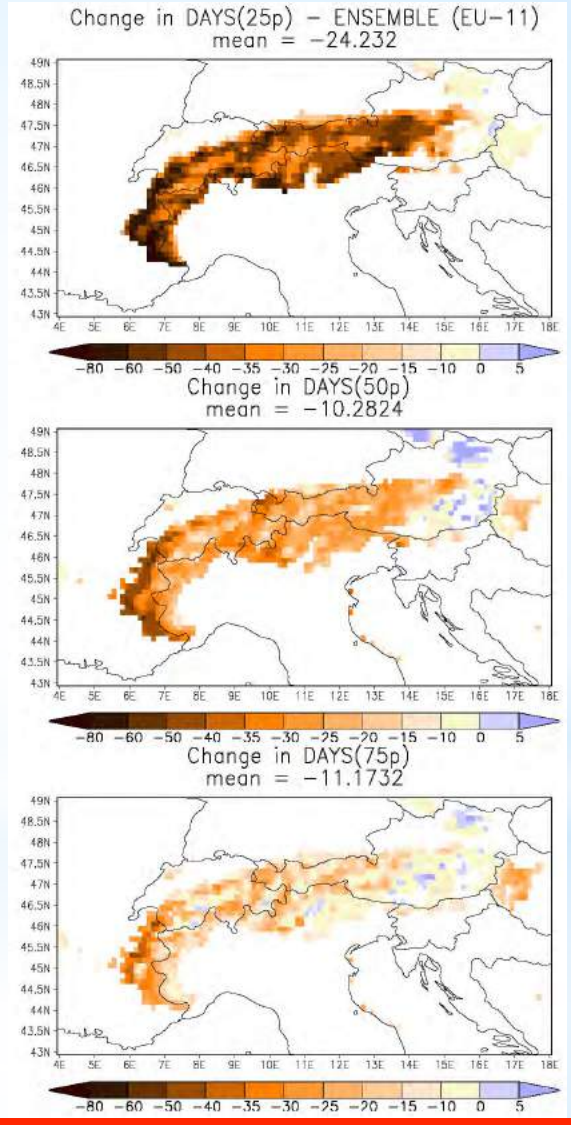
0.11

The Abdus Salam International Centre for Theoretical Physics

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

0.44





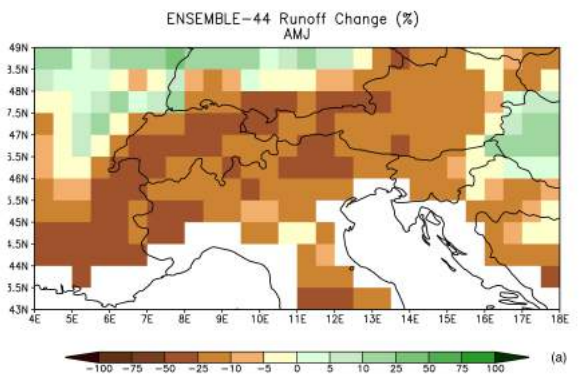
0.11

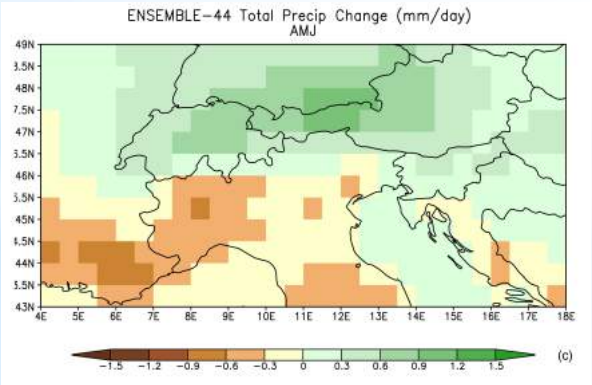
Coppola E. et al. (2016) *Climate Dyn.*

for Theoretical Physics

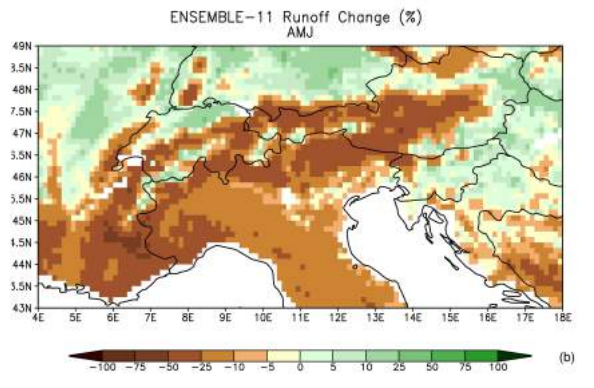
* Discussion- Runoff and precipitation change

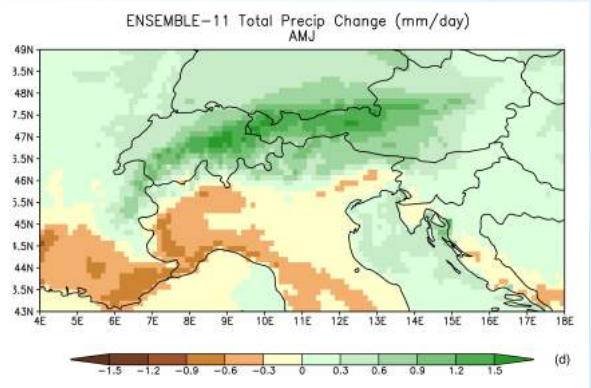
0.44





0.11



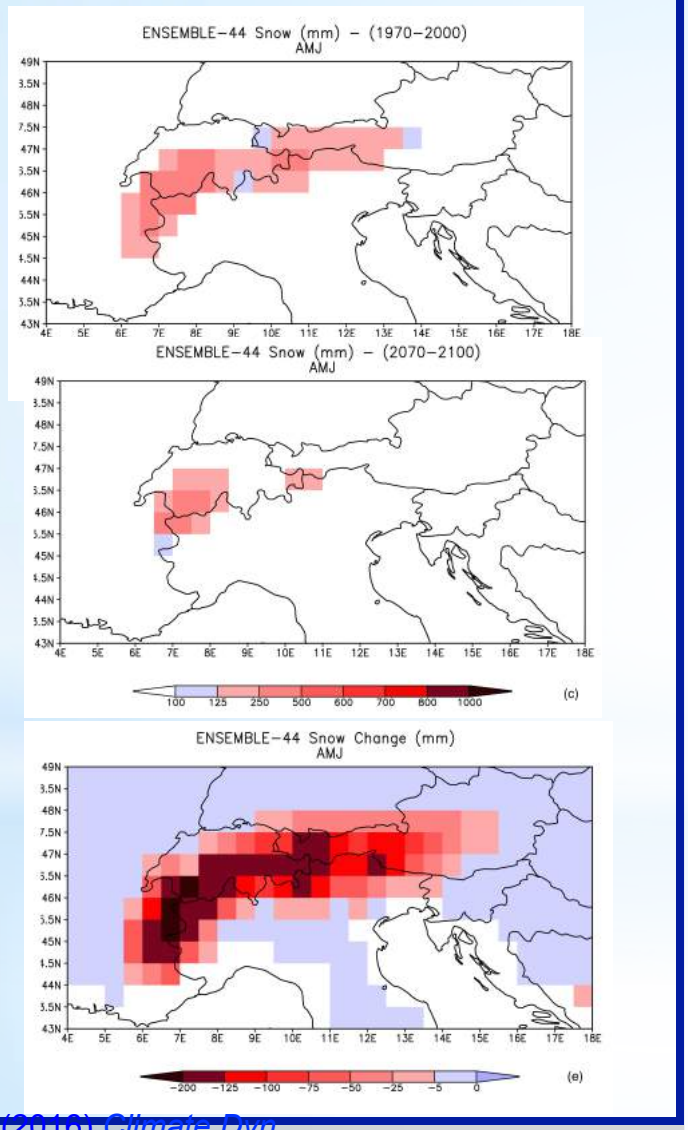


Coppola E. et al. (2016) *Climate Dyn.*

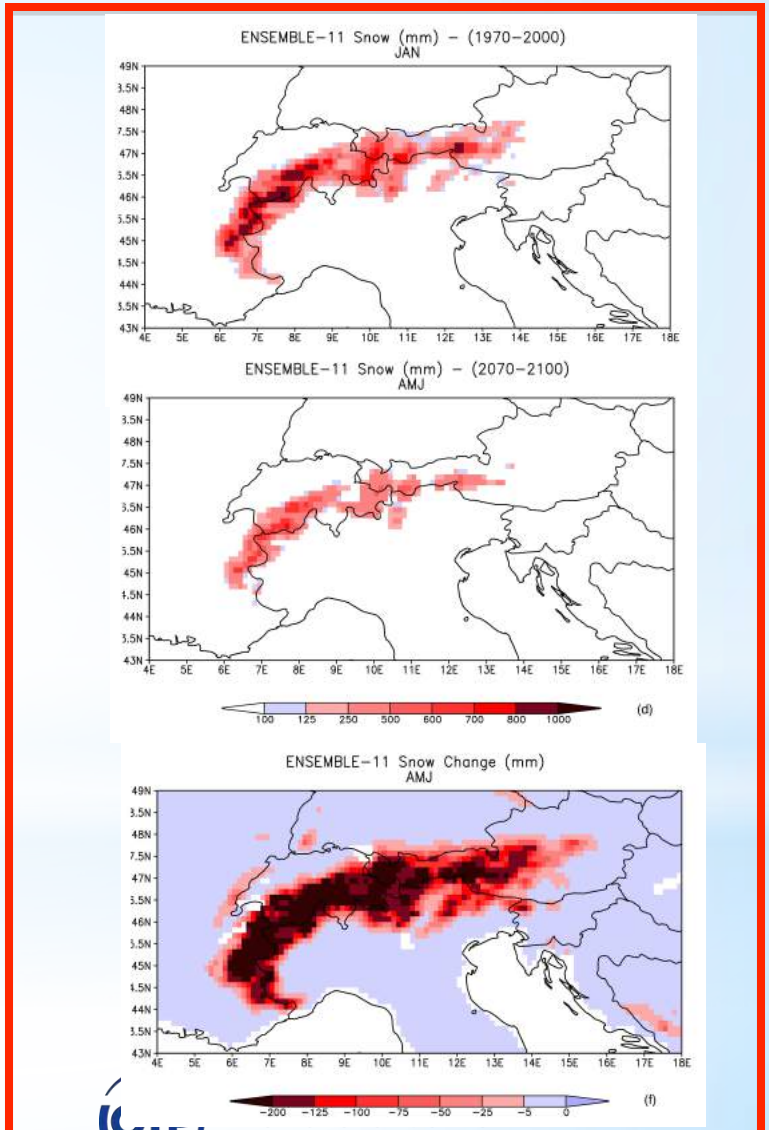
The Abdus Salam International Centre for Theoretical Physics

* Discussion-Snow change

0.44



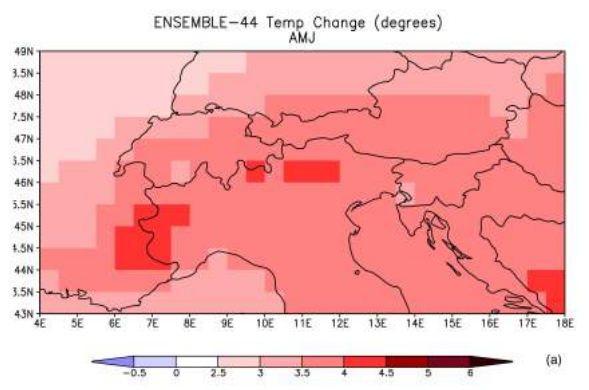
0.11

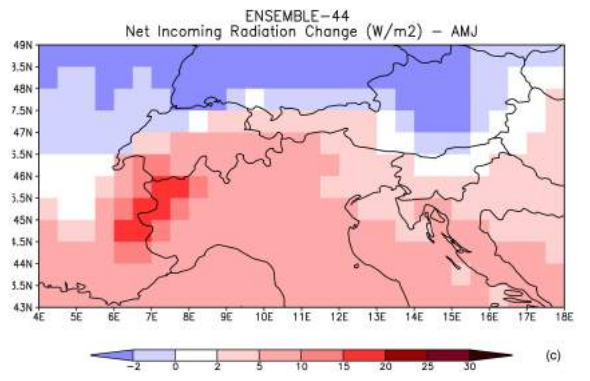


Coppola E. et al. (2016) *Climate Dyn.*

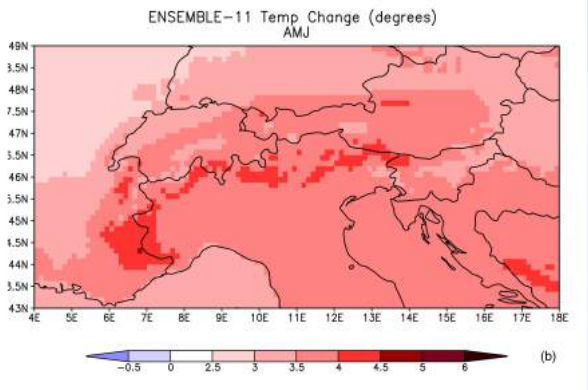
* Discussion- Temperature and Net surface shortwave radiation change

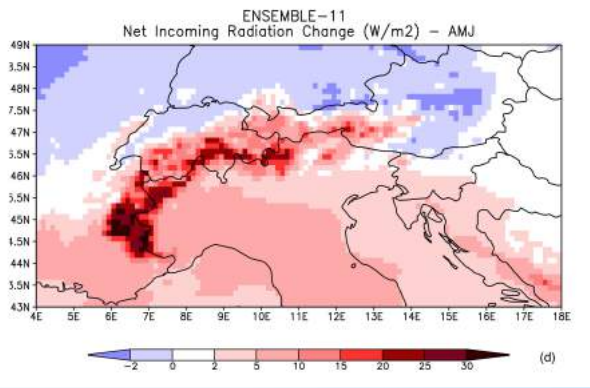
0.44



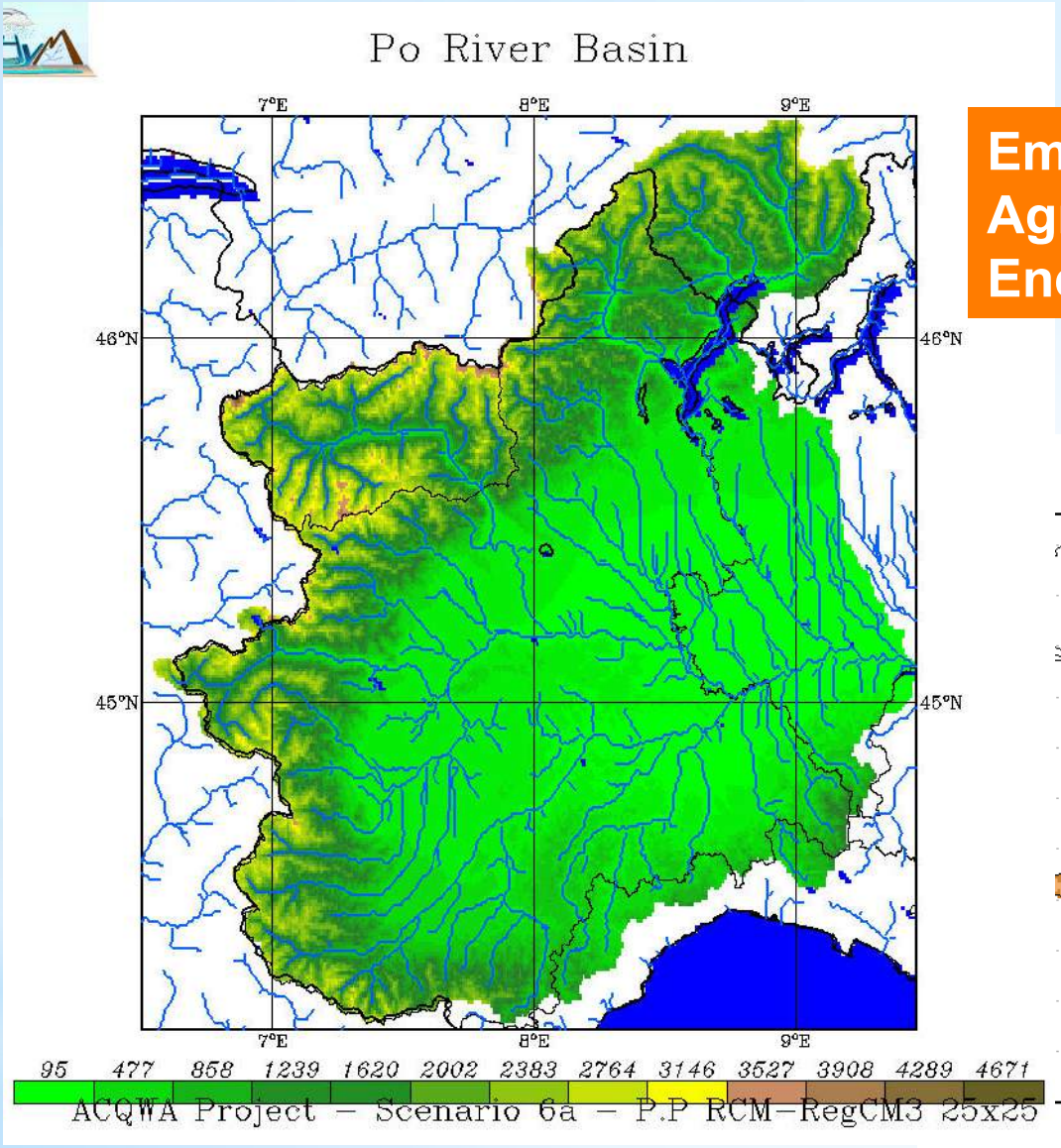


0.11

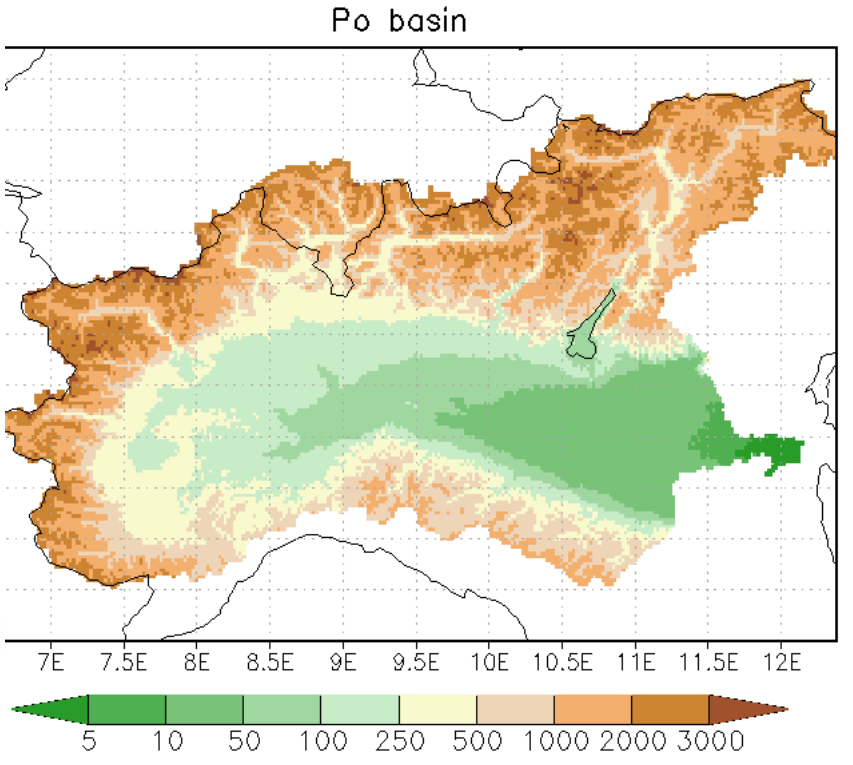




Coppola E. et al. (2016) *Climate Dyn.*

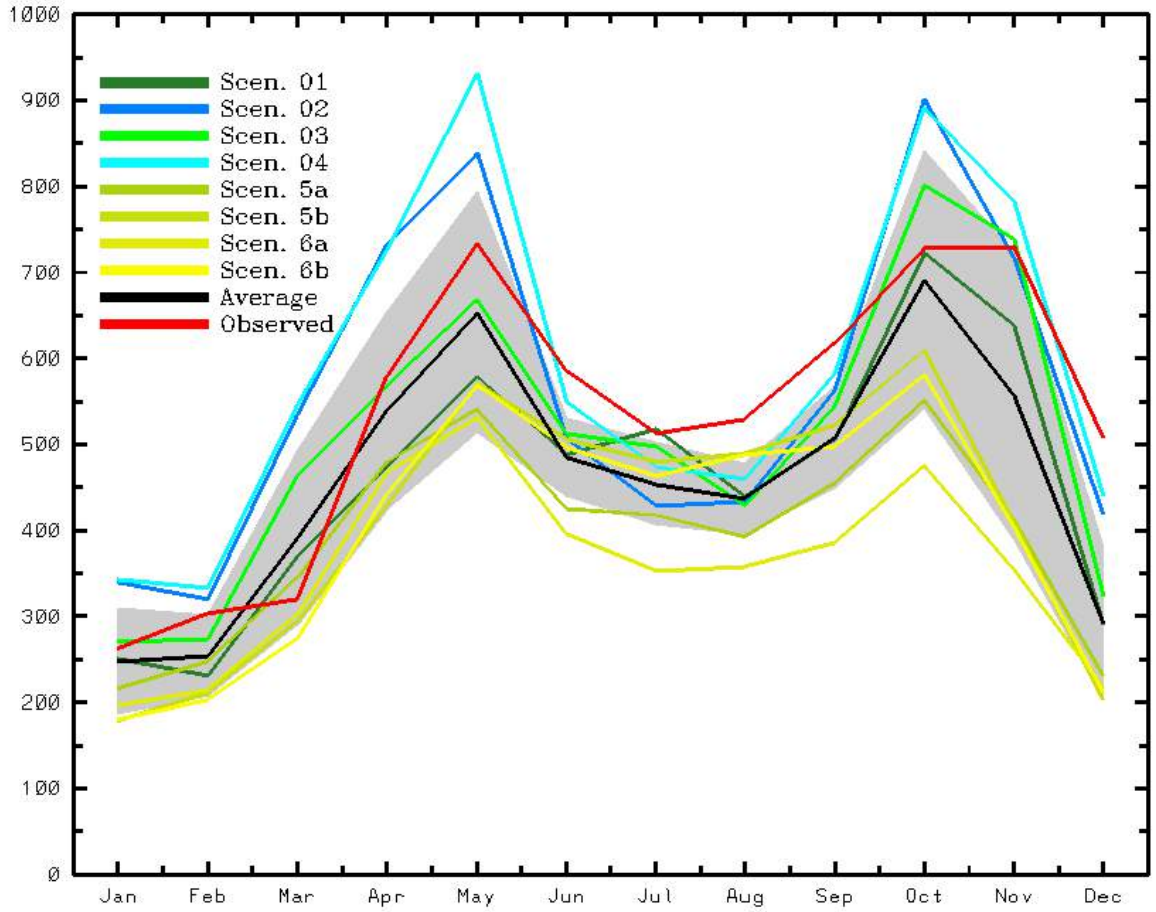


Employment	**46%**
Agricultural production	**35%**
Energy consumption	**48%**



The Abdus Salam International Centre for Theoretical Physics

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

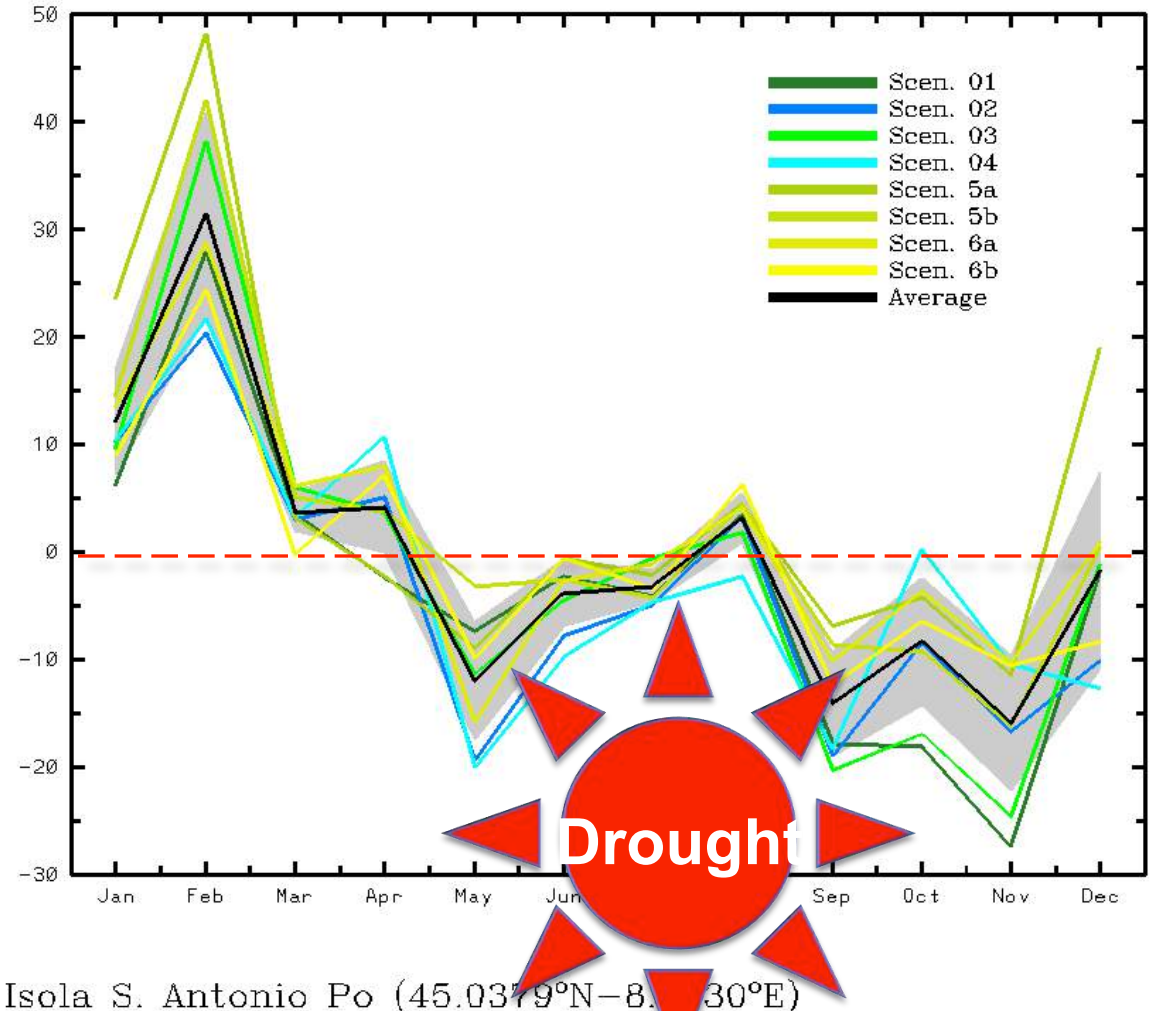


Isola S. Antonio Po (45.0379°N–8.8230°E)

Coppola E. et al. (2014) *Science of the Total Environment* .

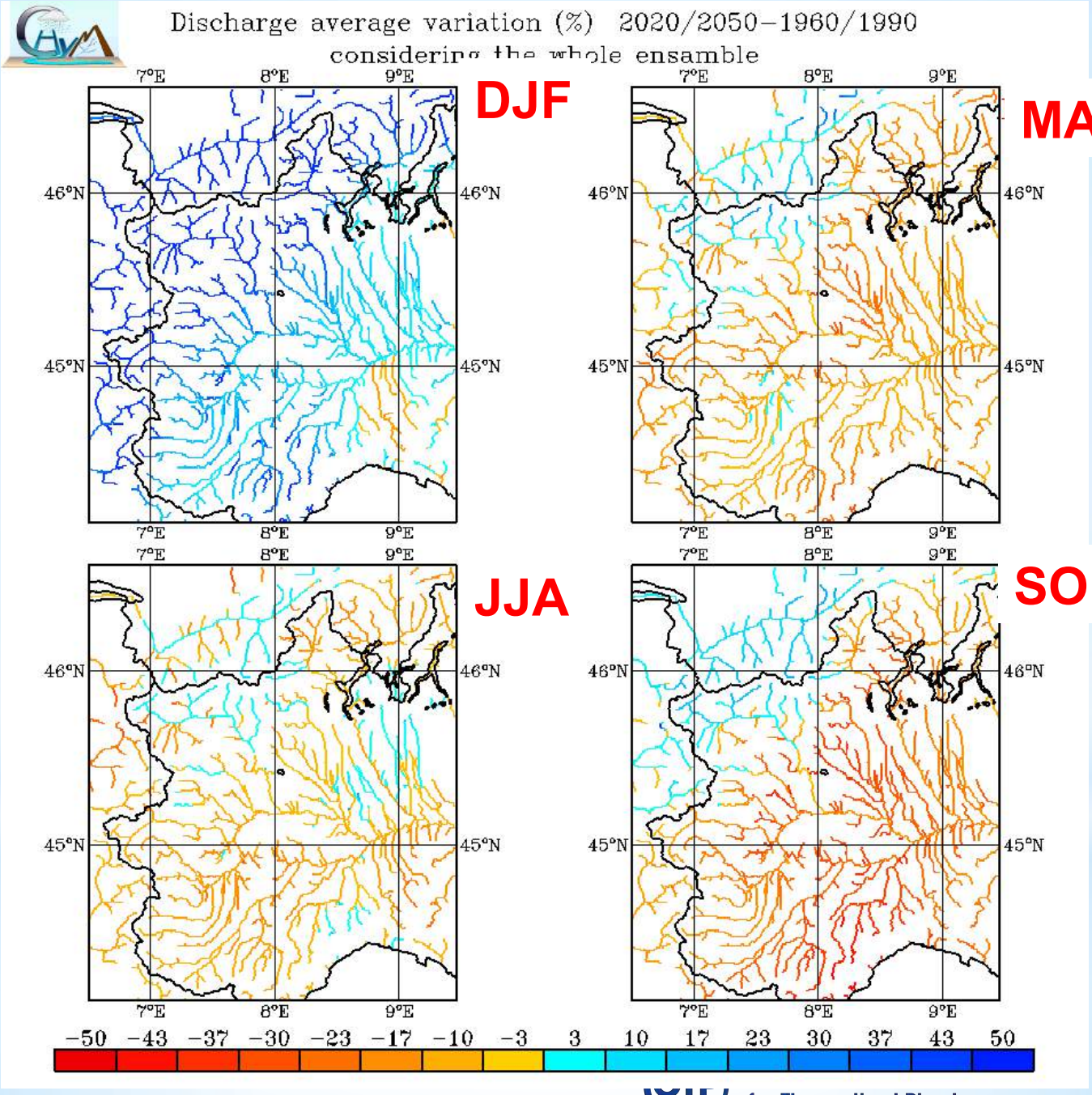
The Abdus Salam International Centre for Theoretical Physics

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



Coppola E. et al. (2014) *Science of the Total Environment .*

The Abdus Salam International Centre for Theoretical Physics



Coppola E. et al. (2014) *Science of the Total Environment* .

for Theoretical Physics

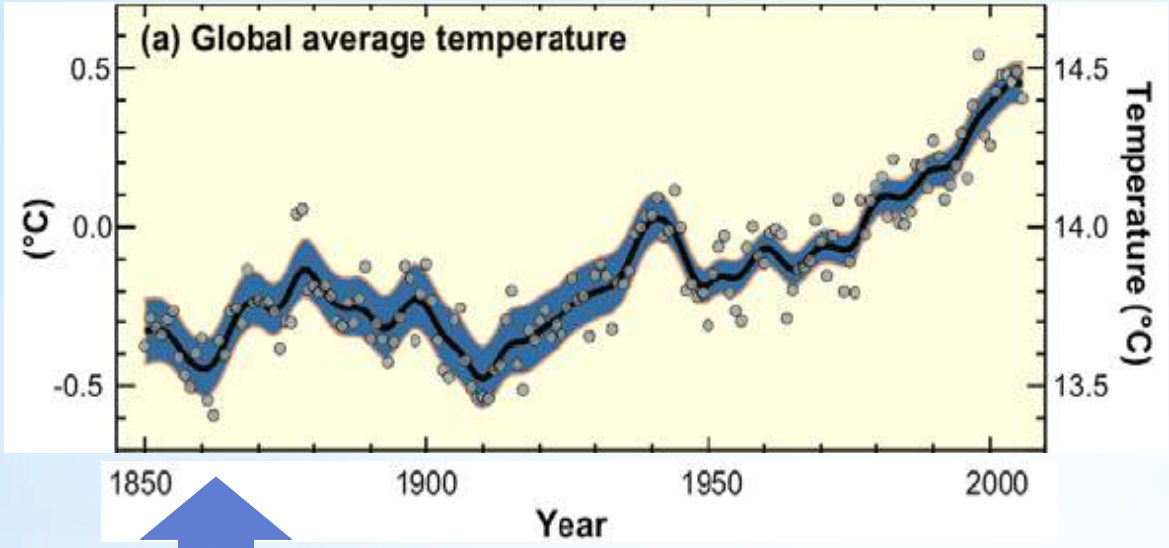
Considerazioni finali

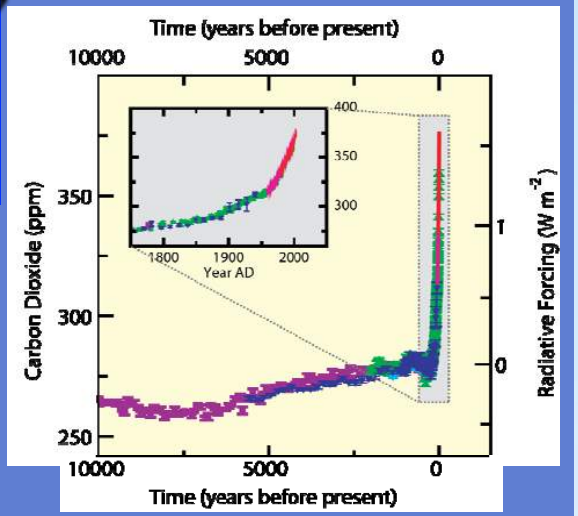
- Stiamo assistendo ad un riscaldamento globale dovuto principalmente alle emissioni di gas serra dall'uso di combustibili fossili
- Il riscaldamento globale ha effetti su molti settori della società
  - Scioglimento dei ghiacciai – Risorse idriche
  - Aumento del livello del mare – Zone costiere
  -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

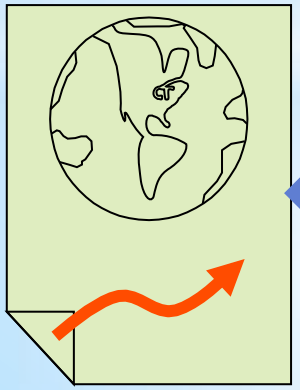
Come si identifica "l' impronta" umana sul clima

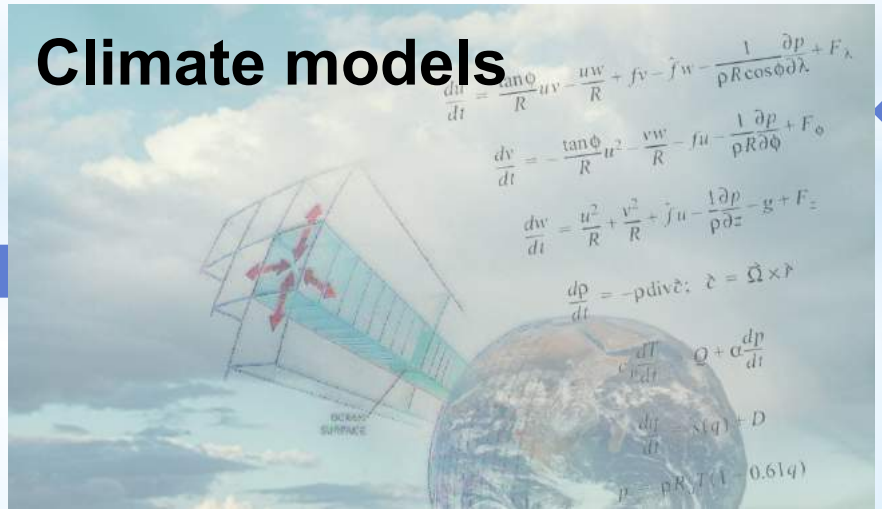




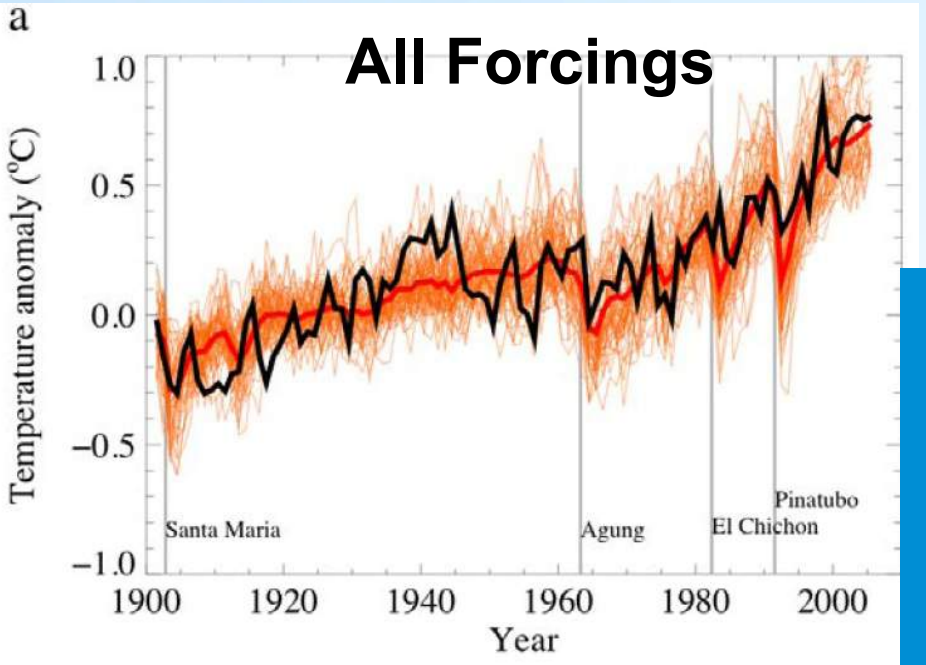
- other GHGs
- aerosols
- volcanic
- solar
- natural internal

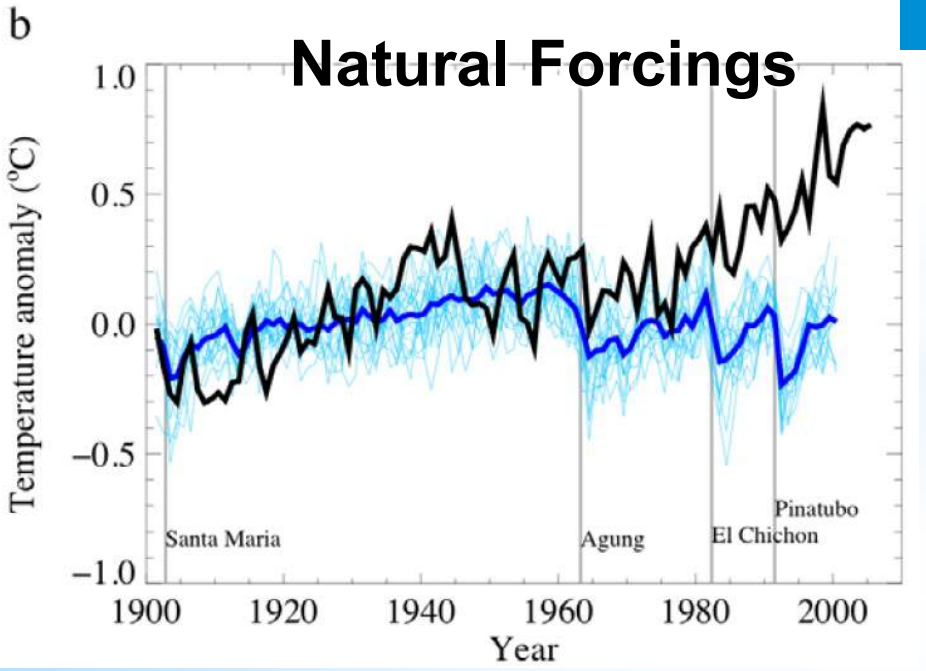
?





Impronta umana sul clima





Solo quando si considera l'effetto dei gas serra da attivita' 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