

Climate research in Enea

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Italian National Agency for New Technologies, Energy and the Environment

ENEA is a public agency operating in the fields of energy, the environment and new technologies

ENEA research activities are carried out by **five Departments and 11 Research Centers with about 3000 scientists and technicians:**

- 1. Advanced physical technologies and new materials**
- 2. Biotechnologies, agro-industry and health protection**
- 3. Energy technologies, efficiency and renewable sources**
- 4. Environment, global change and sustainable development**
- 5. Nuclear Fusion and Fission, and related technologies.**

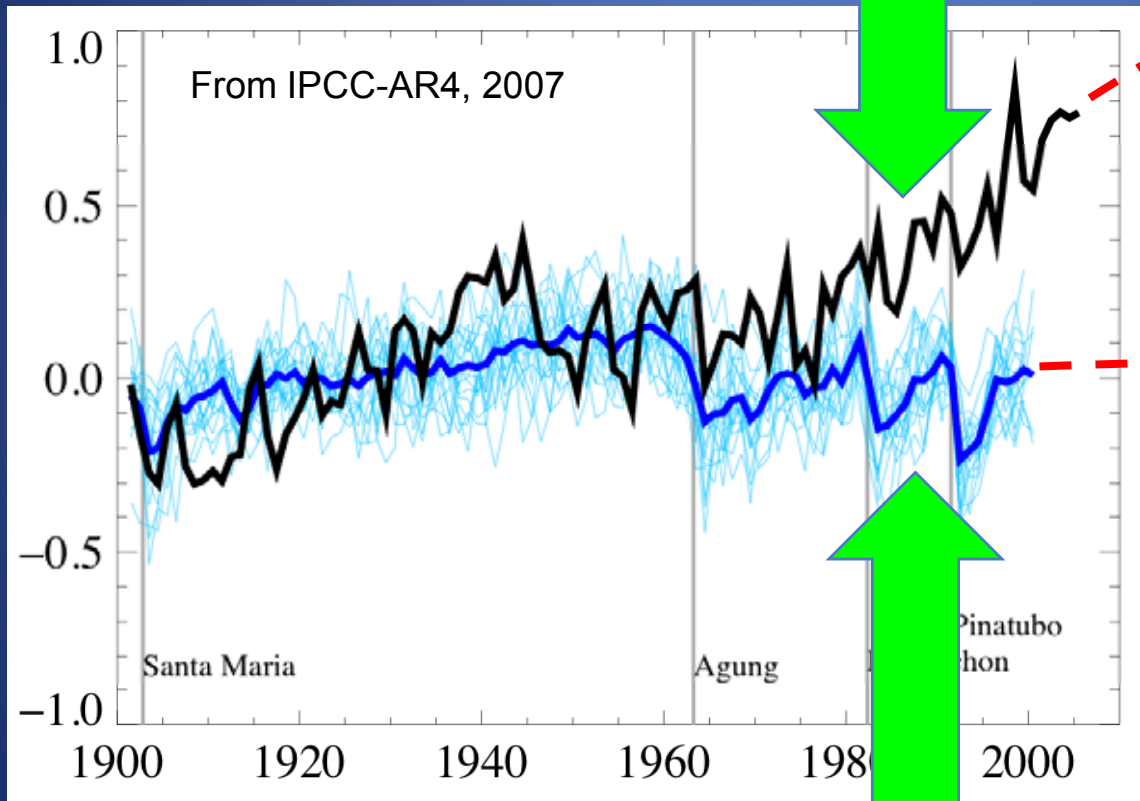
The climate problem in few words....

Various atmospheric gases contribute to the green house effect, whose impact in clear skies is 60% from water vapor, 25% from carbon dioxide, 8% from ozone and the rest from trace gases including methane and nitrous dioxide

on average the energy from the sun received at the top of the Earth's atmosphere amounts to 175 petawatts of which 31% is reflected by clouds and from surface, the rest 120 PW is absorbed by the climate system and ultimately emitted back to space as infrared radiation

Total human energy use is about a factor of 9000 less than the natural flow

Observation

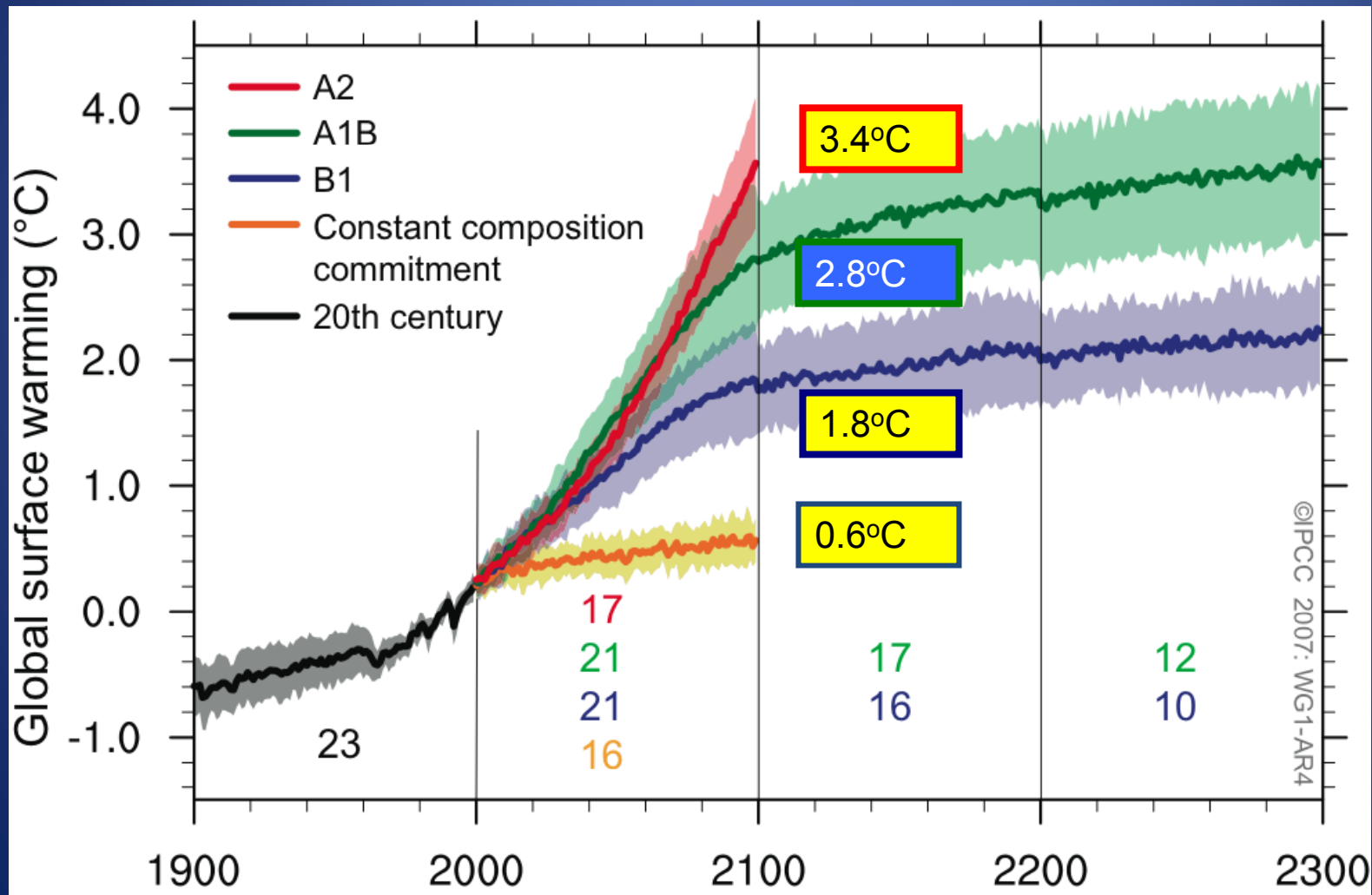


Human contribution on climate variability 0.7°C

Numerical simulation without anthropogenic contribution

What's in the pipeline and what could come

Warming will increase if GHG increase. If GHG were kept fixed at current levels, a committed 0.6 °C of further warming would be expected by 2100. More warming would accompany more emission.



CO2 Eq

850

600

400

Is the climate change only a physical problem?

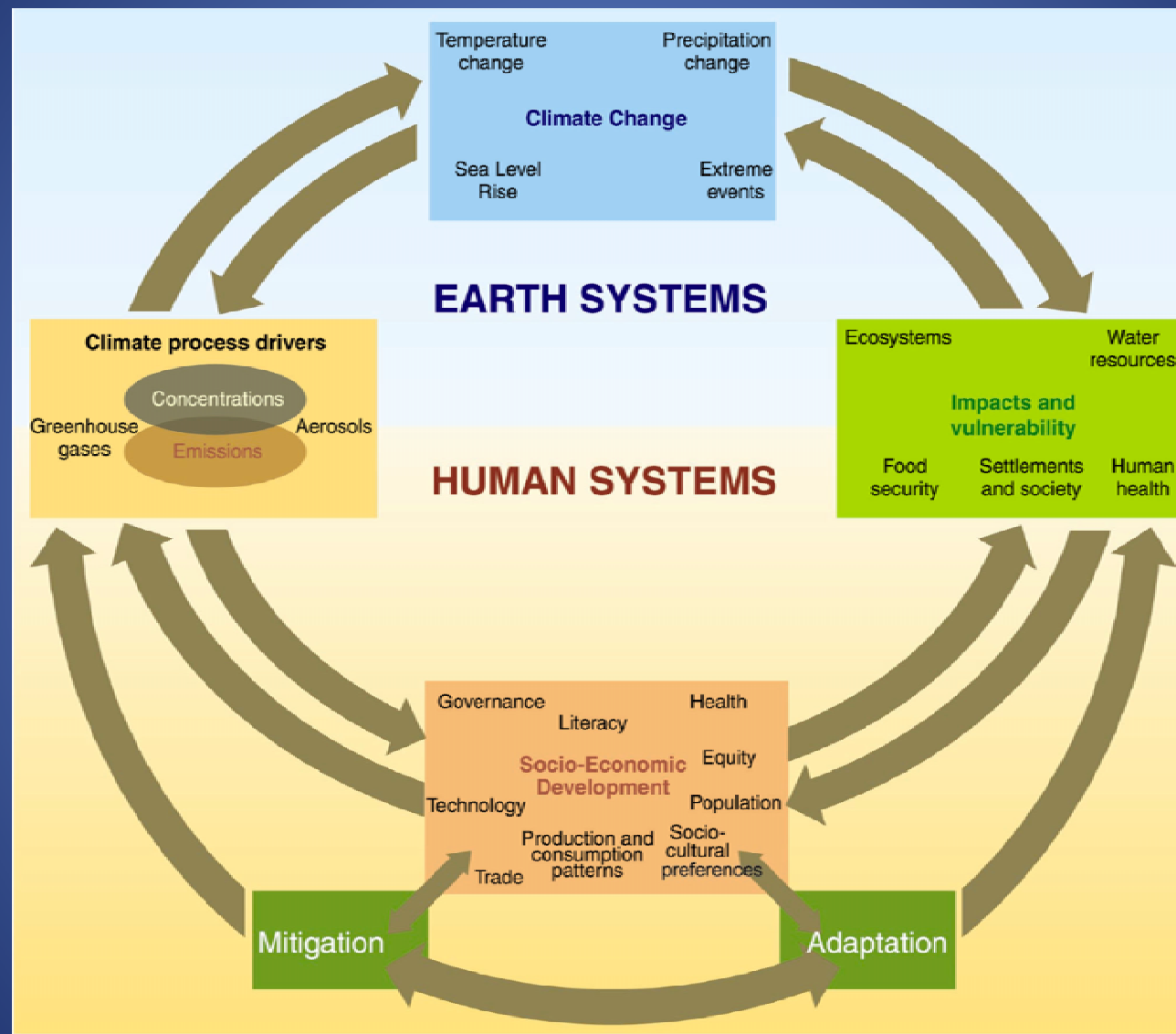
We have to achieve to the following key scientific issues

improve our comprehension on the climate processes by observation, theory and modelling in order to define the assessment and vulnerability of the climate system
define mitigation actions or socio-economics questions

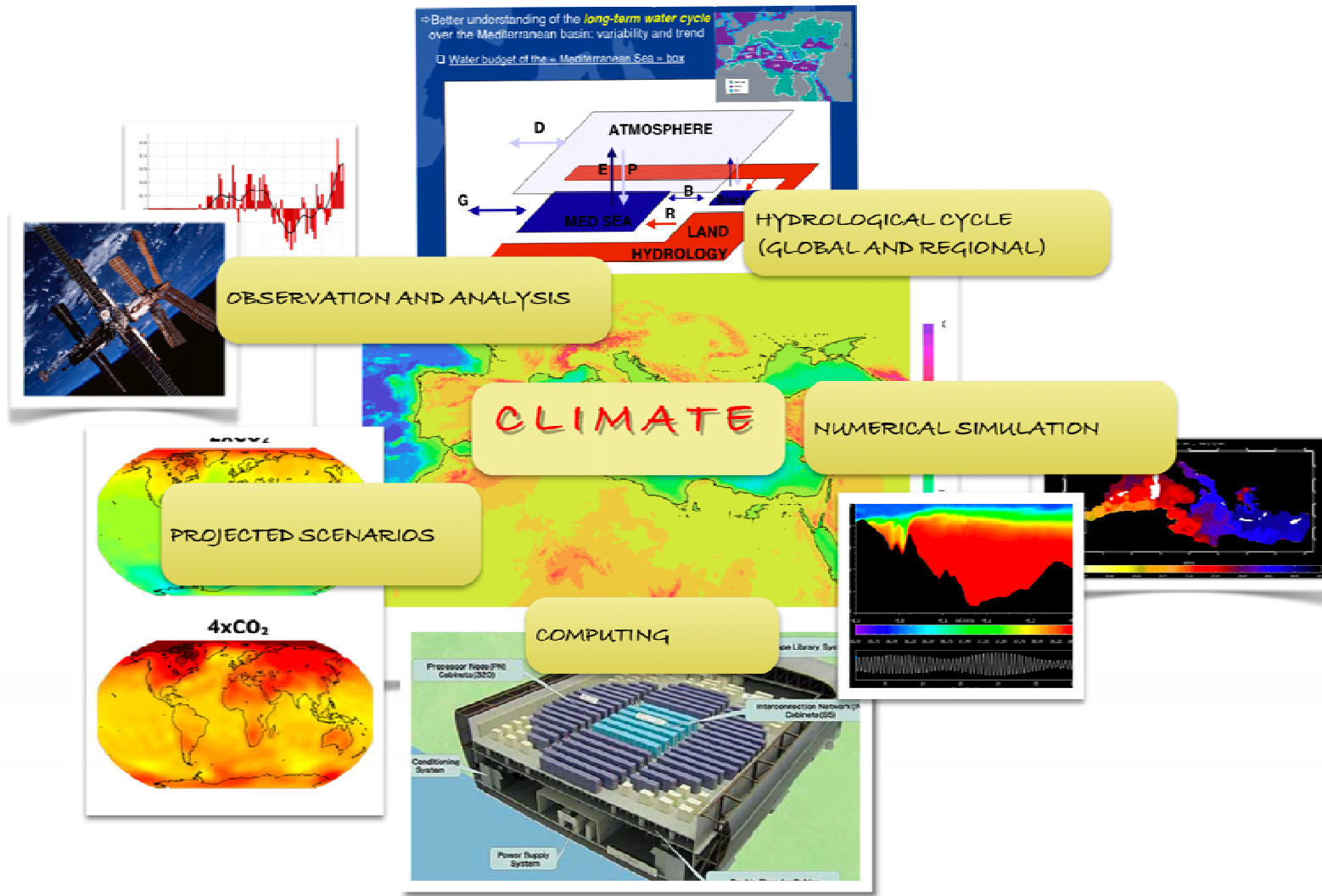
How can a global accord for climate protection be reached that goes significantly beyond the Kyoto Protocol?

What are the costs of these strategies, how can politics and business be alerted to the economic and societal consequences if no action is taken, or if action is not taken early enough

Connect the EARTH SYSTEM with the HUMAN SYSTEM



Enea contribution on climate research (Mediterranean Region)



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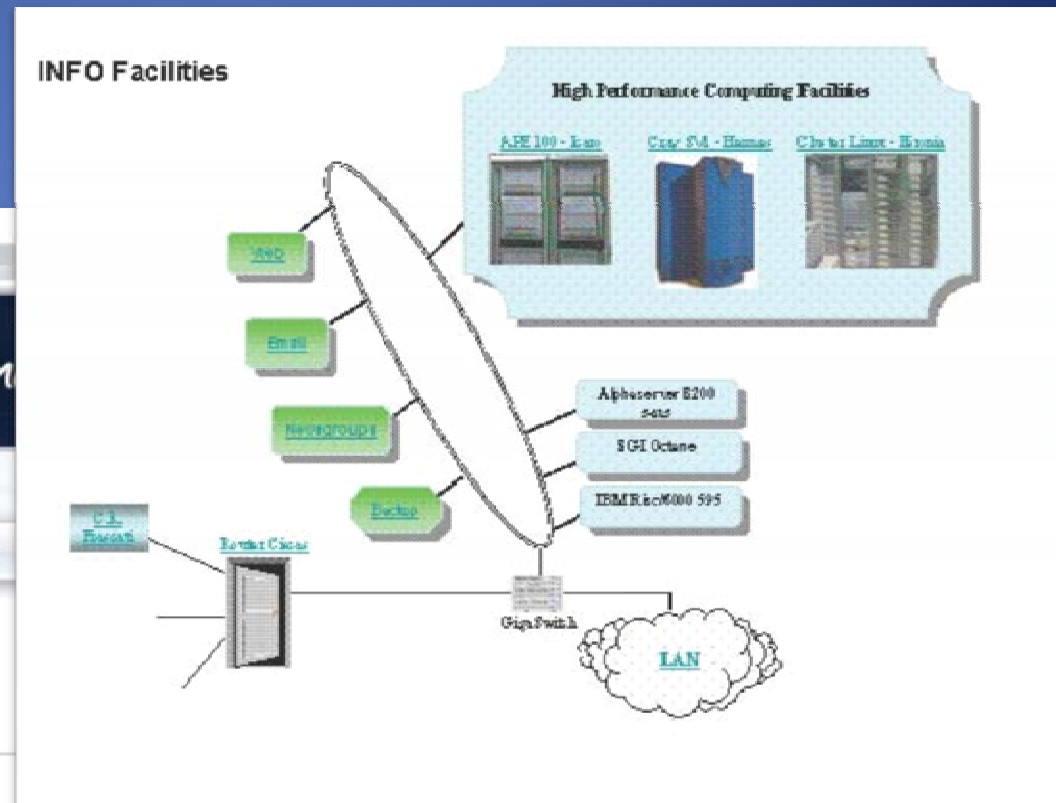
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Details | **Installed Systems** | Site history

In November 2007, 1 systems appeared in the TOP500 list.

Rank	System	Procs	Memory(GB)	Rmax (GFlops)	Rpeak (GFlops)	Vendor
180	BladeCenter HS21 Cluster, Xeon quad core 2.33 GHz, Infiniband	2560	N/A	9287	23889.9	IBM



Research on impact of climate change

desertification



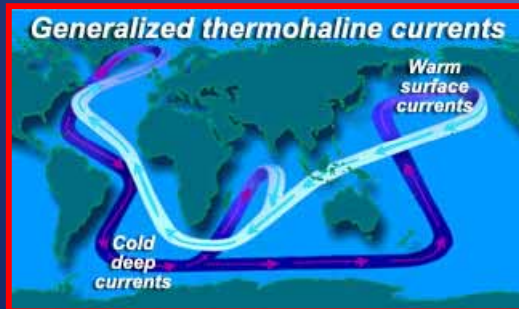
agricoultar



hydrological cycle



thermohaline circulation



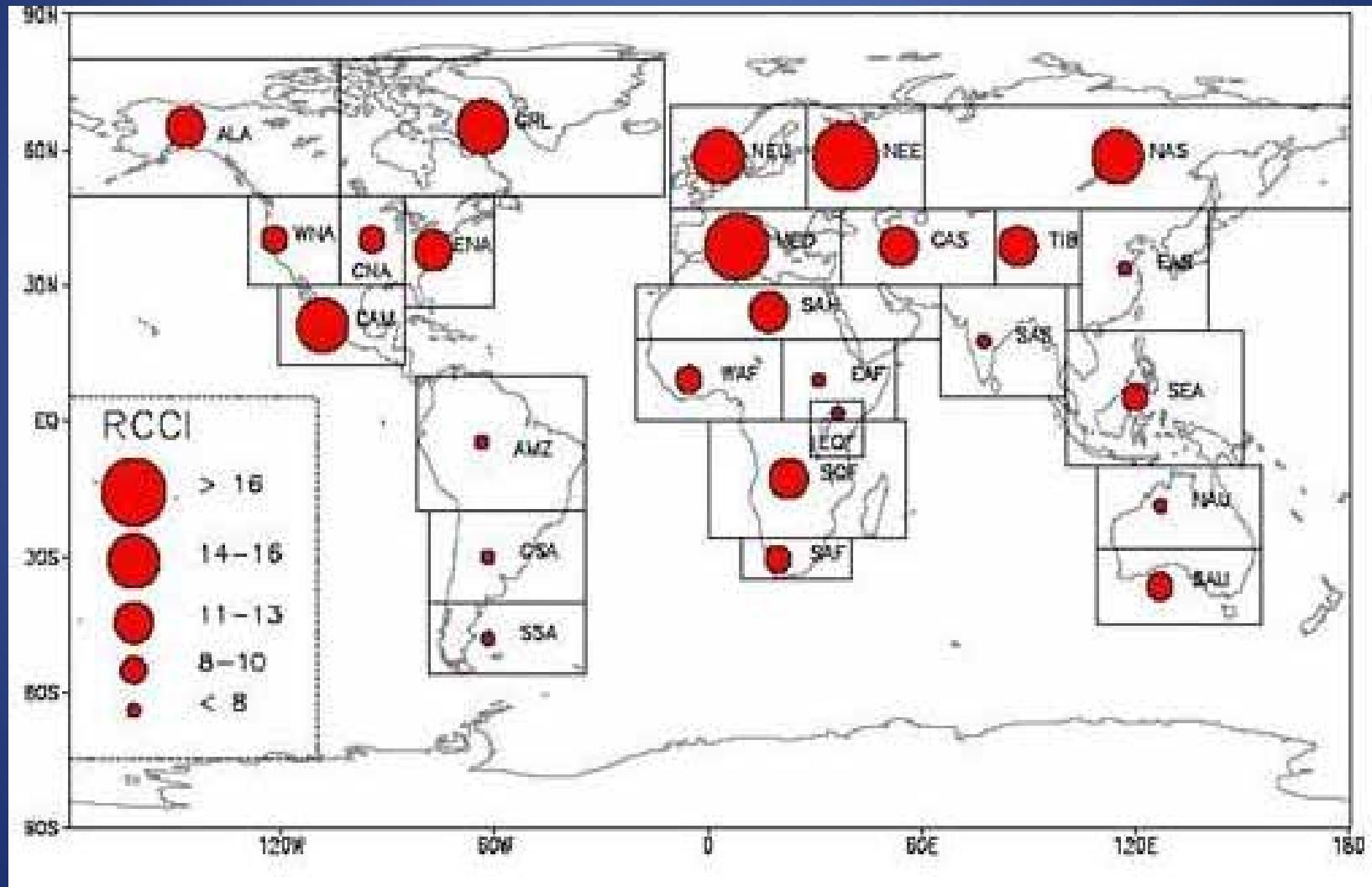
biodiversity



costal area



Vulnerability of the different region from Giorgi, 2005



Climate Change is a global problem and needs an international consensus, however important decision have to be taken at regional level therefore we have to develop an integrated regional models

A Regional Earth System
Model for climate change and
impact studies



Why we need a Regional Earth System Model?

- To represent the hydrological cycle (rivers, glaciers, vegetation, ocean-atmosphere interaction)
- To represent the regional radiative forcing (different aerosols sources, complete chemistry)
- To integrate more and more complex geo-physical and human processes

The coupling system

Newly developed
model interfaces

MITgcm

dT = 900s

Hres: 9-12Km

42 Z-levels

Atl. Box: Levitus Clim

RegCM

dT = 900s

Hres: 30Km

18 σ -levels

B.C. : 6-hourly

OASIS3

Bilin. Interp.

Frq: 6h

SST

$T_x; T_y$

H+L+R

E-P

SST

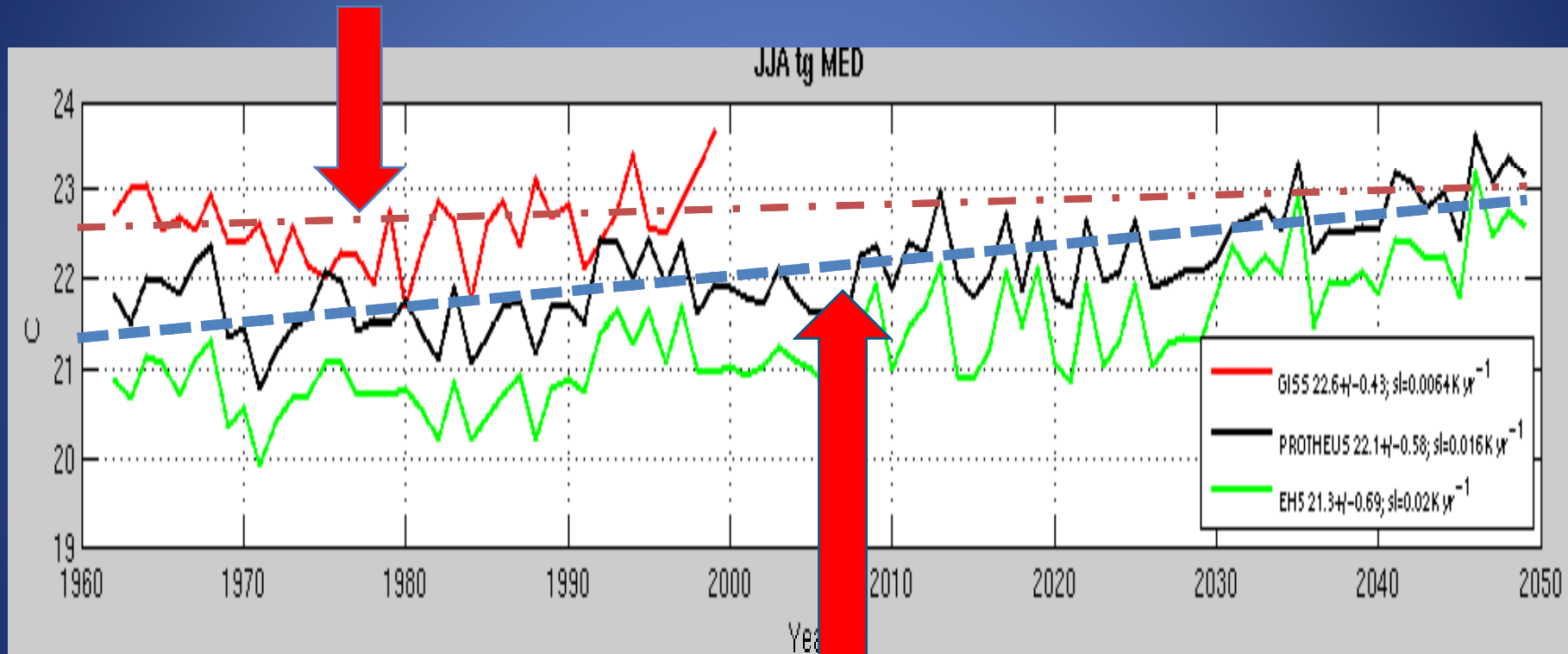
$T_x; T_y$

H+L+R

E-P

SST AVERAGED OVER THE WHOLE BASIN IN SUMMER

0.02-0.03/decade from the past observation or 0.06/decade for the last 50 yrs



0.16/decade from our scenario

Some Conclusion

From a review of all available data set for the Mediterranean Sea we found an warming trend of $0.022 \text{ } ^\circ \text{C/decade}$ in SST over the last 150 yrs, moreover in the Gulf of Cadiz the MOW displays a trend of $0.16 \text{ } ^\circ \text{C/decade}$ and $0.05/\text{decade}$ in salinity over the last 50 yrs;

The Mediterranean isn't a isolated basin, but is a relevant component of the North Atlantic climate system

From future scenario, A1B, our couple model (Protheus System) predicts significant interannual variability and acceleration of warming in particular after the 2020 with an average value of $0.16 \text{ } ^\circ \text{C/decade}$;

The Mediterranean area is one of the more vulnerable area in the world and needs a urgent policy of mitigation and adaptation

Protheus will be applied for impact studies and their economical evaluation at regional and local level not only for the Mediterranean region