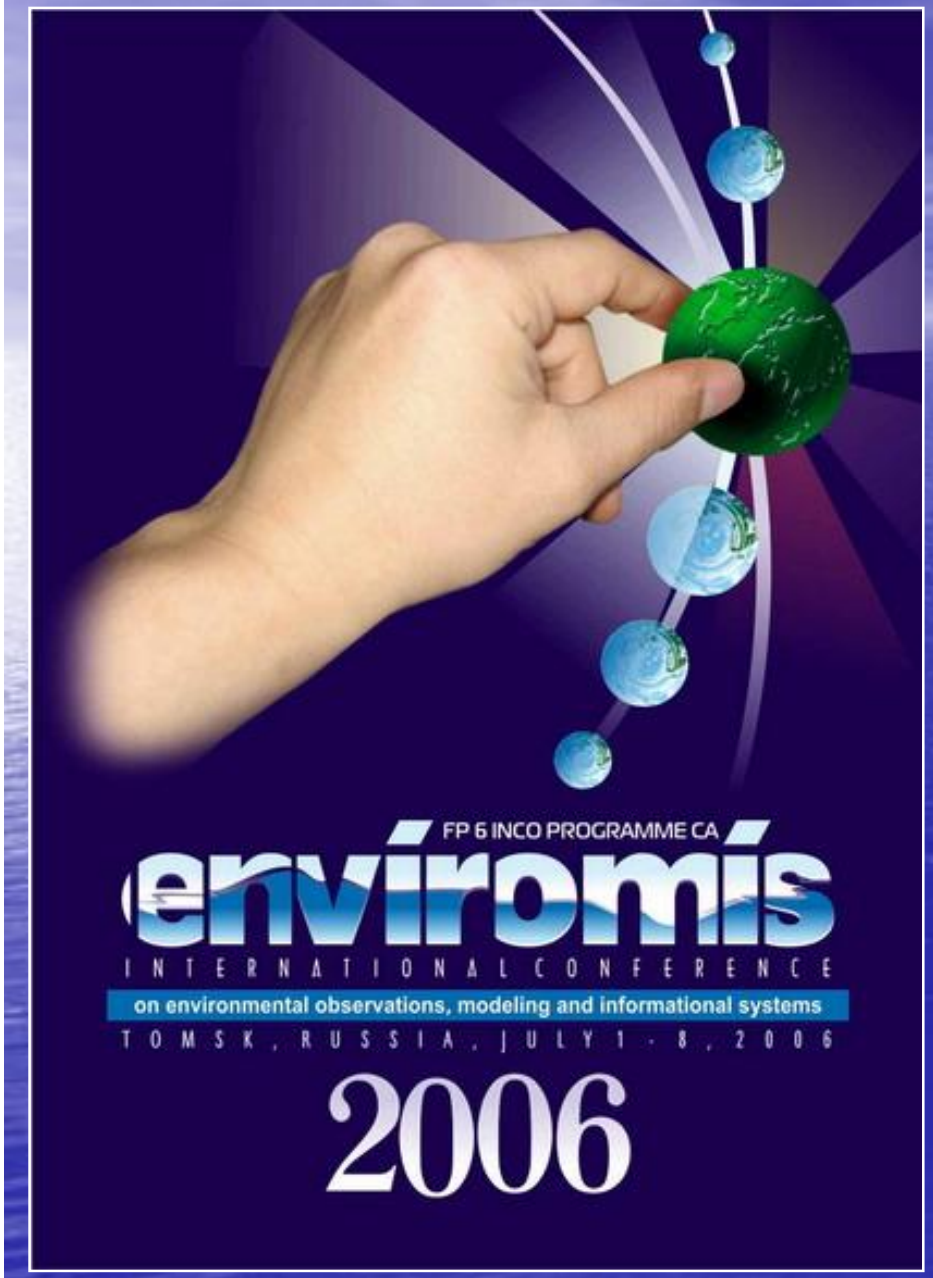

Climate change and related impacts in the Mediterranean at regional and national scales. Lessons learnt from GICC & SIAM programmes. Concerted ways to the future.

Climate change and related impacts in the Mediterranean at regional and national scales. Lessons learnt from GICC & SIAM programmes. Concerted ways to the future.

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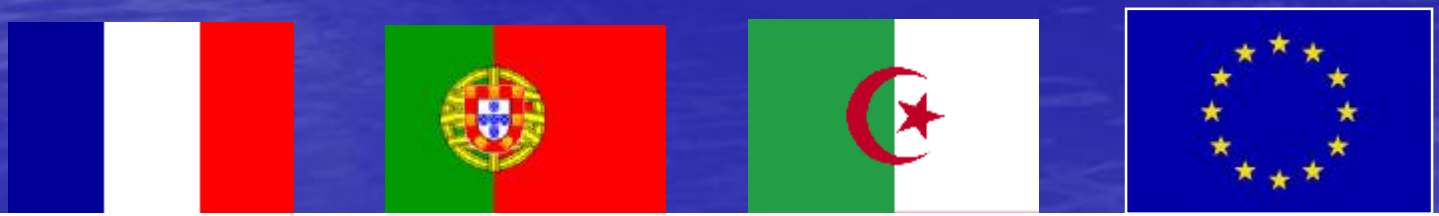
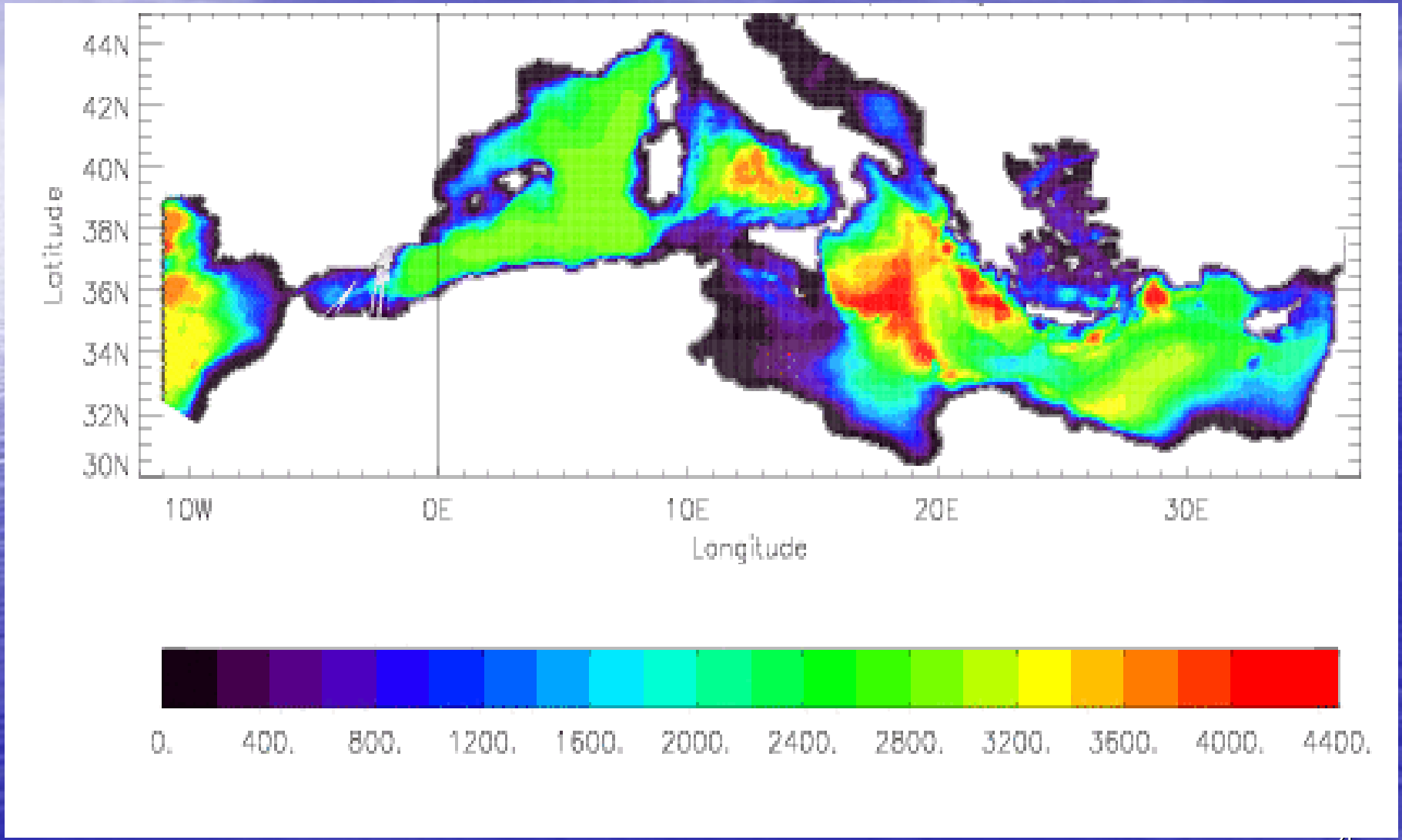


Courtesy of DLR and IPSL/LMD

Climate change & impacts in the Med.

Bathymetry



Climate change & impacts in the Med.

Key features

- Mediterranean basin is a small (at global scale) but quite contrasted region in physical, climatic and socio-economic terms.
- It is an almost an enclosed region that can be considered as a natural incubator.
- Climate change is driven my many factors including global warming, teleconnections (NAO, AO, NAWA, Monsoon), and anthrogenic influence (emissions, land use changes...).

Climate change & impacts in the Med.

Key features

- Climate change features may vary greatly from one sub-region to another. In particular, the N/S gradients are very important.
- As a consequence, climate change impacts are also very diverse.
- Planning impacts mitigation in a realistic way must take into account socio-economic factors: public and private funding availability, public policies & societal practices flexibility. Such factors also greatly vary at various scales.

Climate change & impacts in the Med.
Up to now, an uncoordinated approach

- Research about this topic is led at a **national level**, with specific goals, specific methods and organizations – up to now in an **uncoordinated way** at European or Mediterranean level
- Two examples will be presented here: **GICC** (France) and **SIAM** (Portugal). Drawing a tentative synthesis from these programs and other sources of information will be attempted.
- Some projects within these programs address the Mediterranean, in particular GICC/**Medwater** and GICC/**Implit**.

Climate change & impacts in the Med.

Coordination is on the right way

- **Coordination is on its way** :UBA-A will present the CIRCLE Concerted Action during this session of ENVIROMIS-2006.
- Within CIRCLE, a **Mediterranean sub-network has been built**.
- The authors of the present paper are deeply involved in the CIRCLE/MED sub-network, led by the French Ministry of Environment, with MEDIAS-France as subcontractor. Work is in rapid progress. A coordinated call is planned for 2007.

Climate change & impacts in the Med.

Some words about GICC (France)

- GICC is the French research program about impacts of Climate Change. It is led by the Ministry of Ecology & Sustainable Development (MEDD).
- GICC works through yearly calls for proposals led by the demand. The proposals are scientifically peer-reviewed. Typical projects duration are 2-to-3 years (about 10 projects accepted per call).
- GICC has been divided into two overlapping phases: GICC-1 (1999-2006, last call 2002) and GICC-2 (began in 2003).

Climate change & impacts in the Med.

The 9 themes of GICC

1. Scenarios for the 21st Century climate features trends (mean and extreme values);
2. Interactions between climate, economy and society; managing time scales;
3. Role of carbon forest sequestration and agricultural practices in climate policies;
4. Links between national and international actions;
5. Towards new GHG & areosols direct & indirect net emissions balances;
6. Impacts on terrestrial biosphere;
7. Impacts on hydrosystems;
8. Impacts on health;
9. Impacts on biodiversity.

Climate change & impacts in the Med.

Some words about SIAM (Portugal)

- The **SIAM** project is a comprehensive, multi-sectoral and integrated assessment of climate change impacts and adaptation measures in Portugal. Just as GICC, it has been divided into two phases.
- Its key goals were to obtain climate scenarios for the 21st Century from GCMs and RCMs, to determine the impacts of climate change on a core set of socio-economic and biophysical systems, to propose adaptation measures and to lead proper outreach activities.

Climate change & impacts in the Med.

The main themes of SIAM

- Water Resources
- Coastal Zones
- Agriculture
- Human Health
- Energy
- Forests and Biodiversity
- Fisheries
- Case Study of the Sado river basin
- Outreach

Climate change & impacts in the Med.

Some words about ARCE (Algeria)

- ARCE is a a non-governmental association of laboratories studying climate and environment in Algeria and in wider areas such as the Med.
- One of its key activities is the Observatory of Climate Changes and its impacts on development and society in Algeria.
- ARCE is involved in national and international projects especially within EC and ESA). It could be pivotal in the region for CIRCLE/Med.
- ARCE & MEDIAS-France signed a MoU in May, 2006 which should ease the way to CIRCLE/Med

Climate change & impacts in the Med.

Water budget of the Mediterranean Sea

(annual estimation, mm/yr)

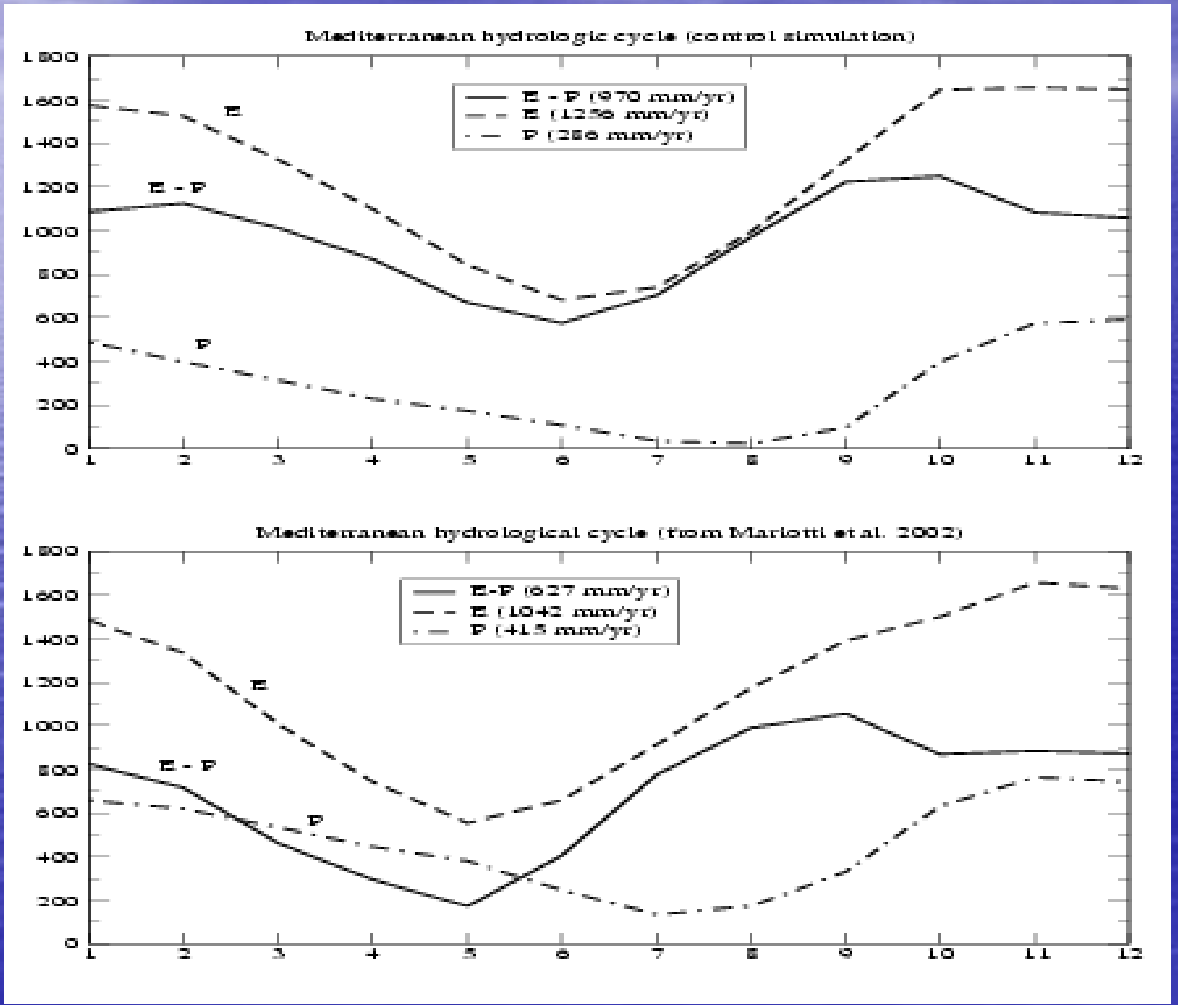
- E, evaporation: 1100
- P, precipitation: 400
- **E-P: 700**

(GICC/Medwater)

- R, river discharge: 100 (8100 m^3/s)
- B, Black Sea: 75
- G, Gibraltar: 525
- **R+G+B = 700**
- **WBD = E-P-R = 600**

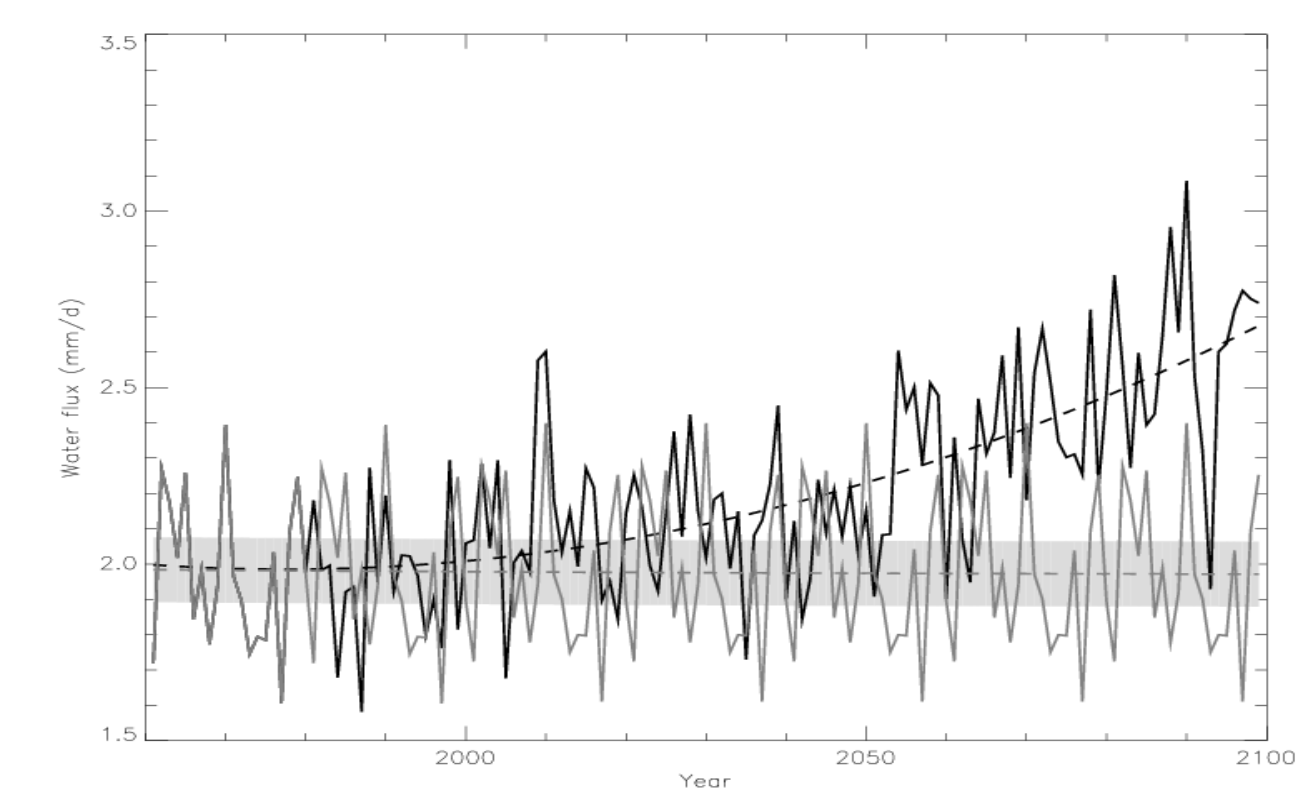
Climate change & impacts in the Med.

Seasonal water budget of the Mediterranean Sea



Climate change & impacts in the Med.

Evolution of Mediterranean water budget deficit (E-P-R)

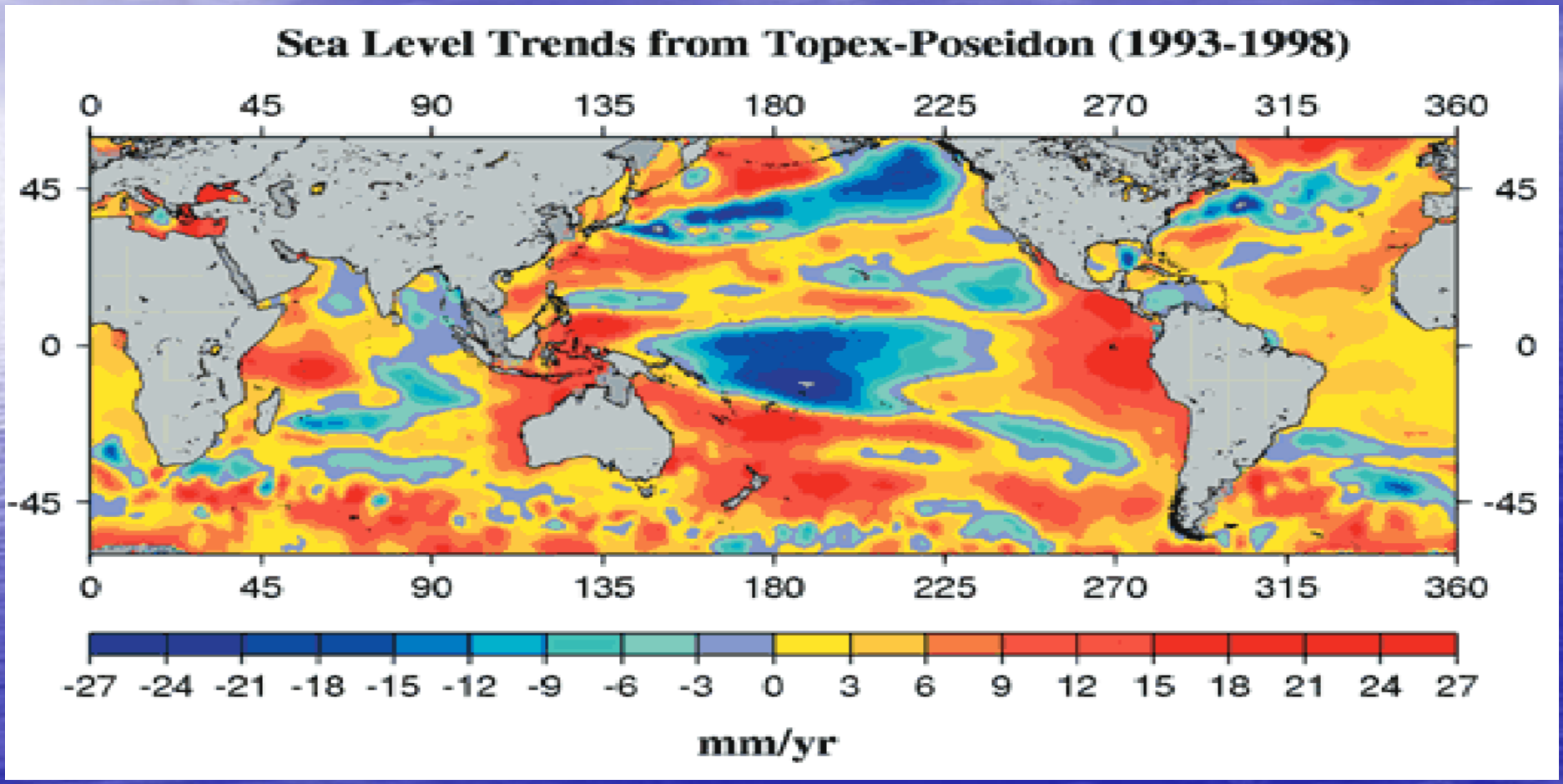


Arpege model
Source:
Medwater project

=> Decrease of both inflow and outflow in the Gibraltar Strait.
Warmer and saltier outflow water exported from the Med. Sea

Climate change & impacts in the Med.

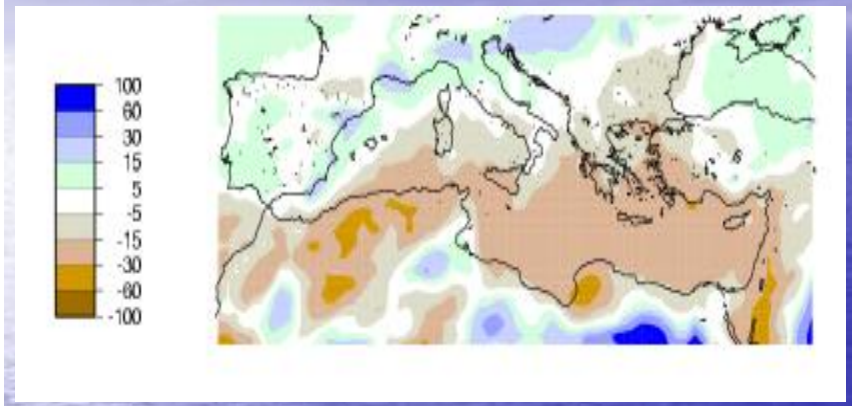
Global Sea level trends observed by satellite

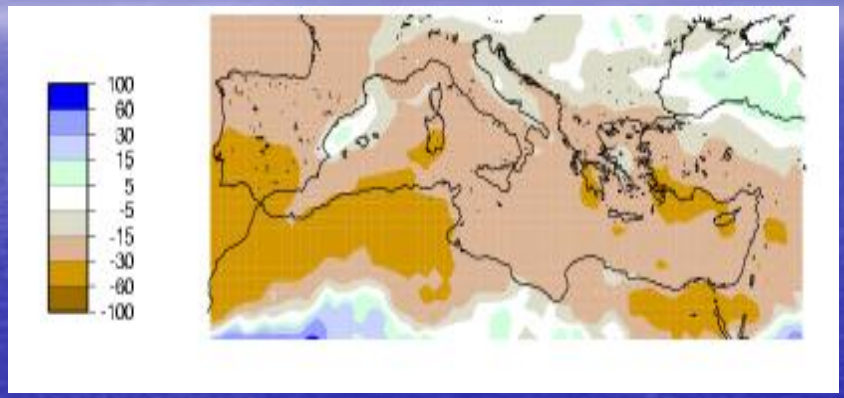


The Mediterranean sea level rise is one of the largest ones in the world

Climate change & impacts in the Med.

Seasonal rainfall forecast (2100)



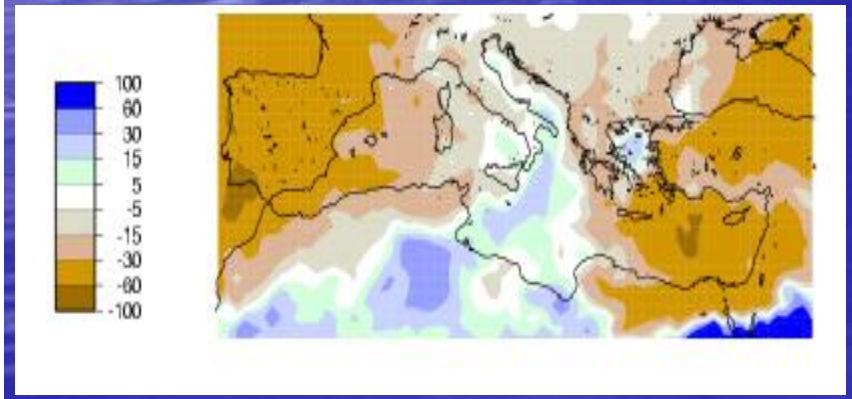


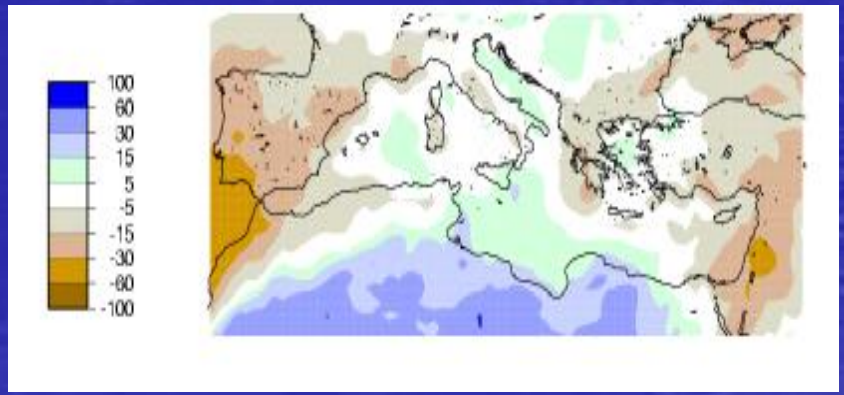
Winter *Spring*

Winter Spring

Summer *Autumn*

Summer Autumn





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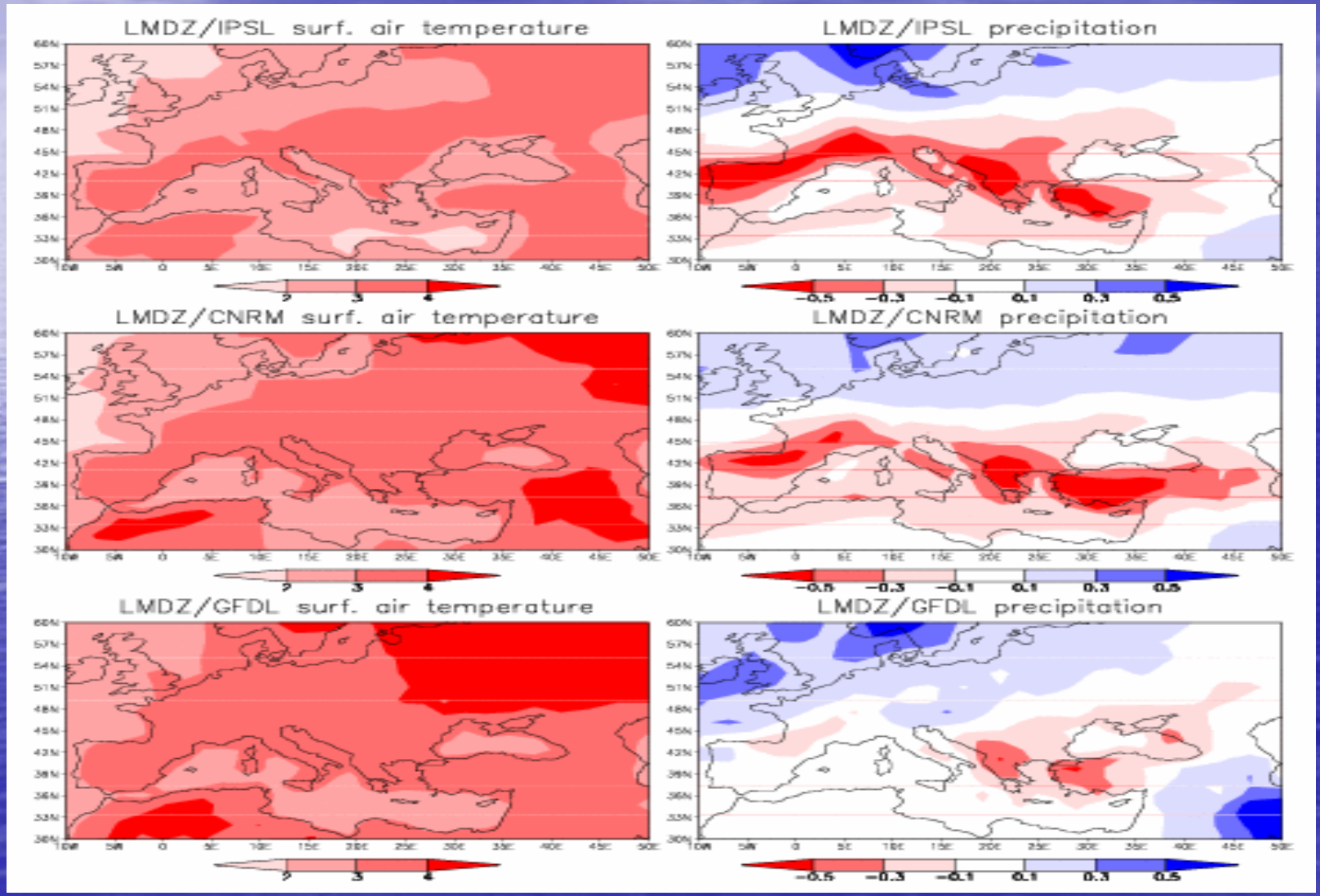
Air T & P forecast (LMD) – IPCC/A2, 2099



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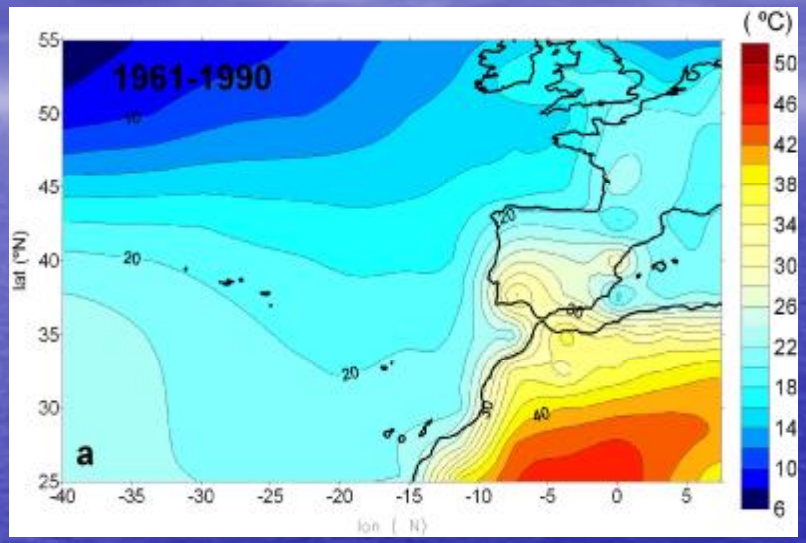
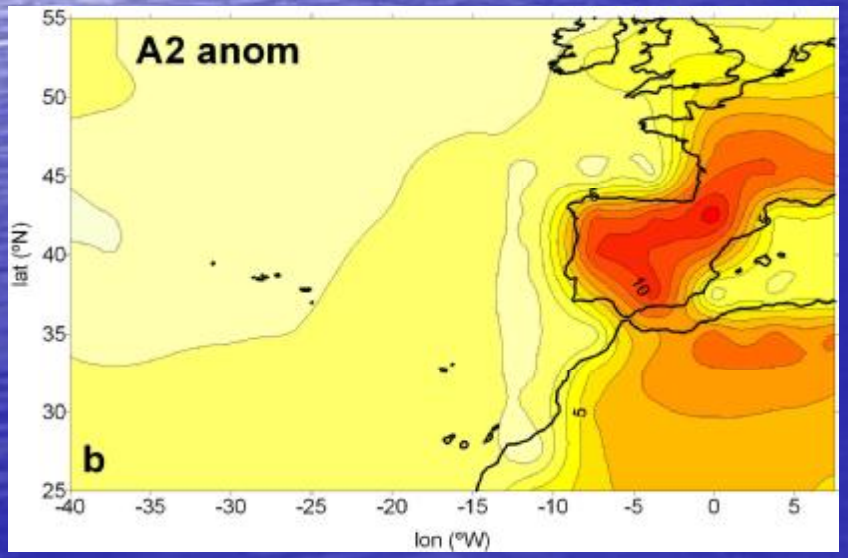
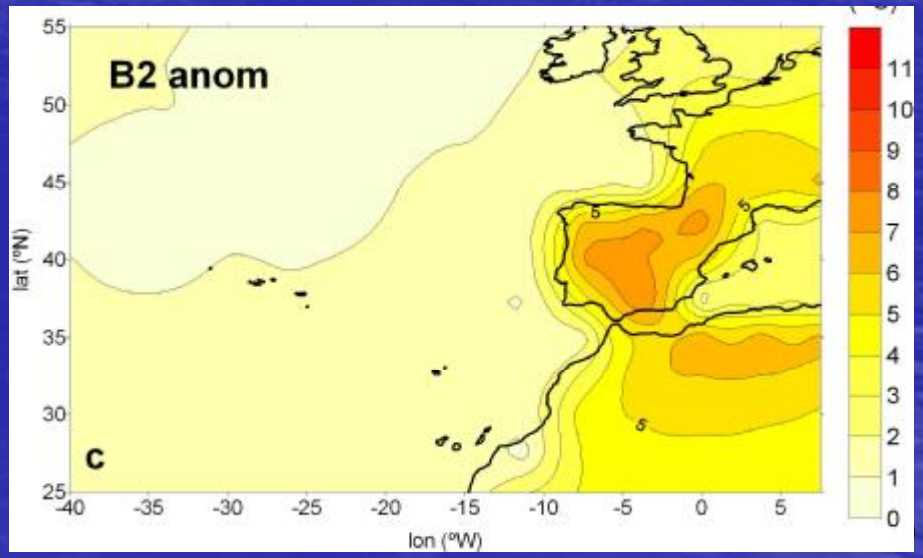
Max. T forecast on summer in the West (HadCM3)

HadCM3 Control



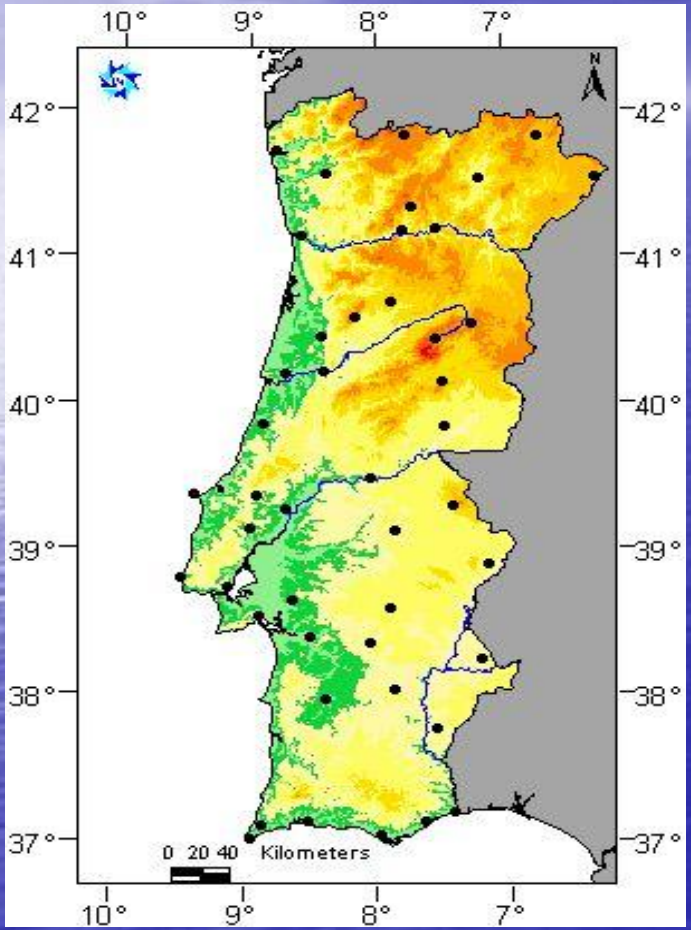
HadCM3 2071-2100

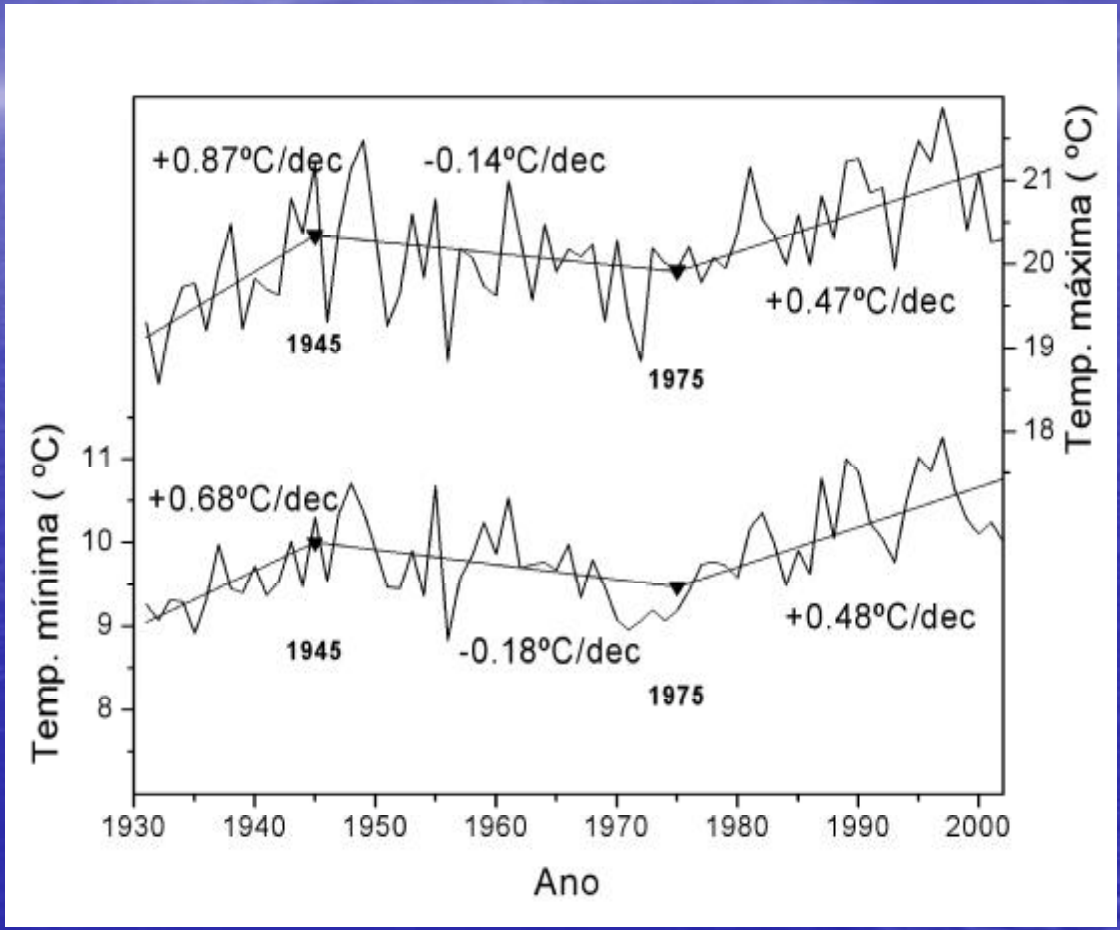




Climate change & impacts in the Med.

Need to focusing /downscaling at national/regional scales

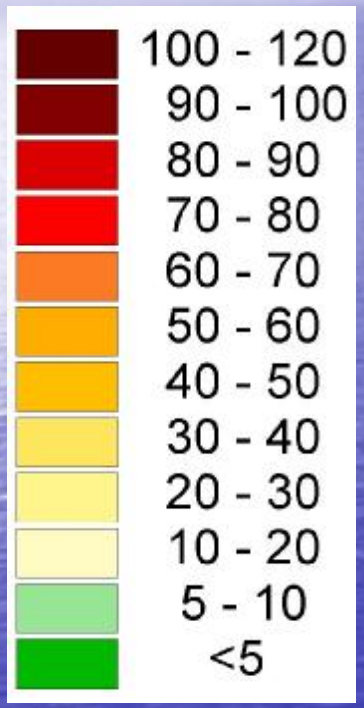


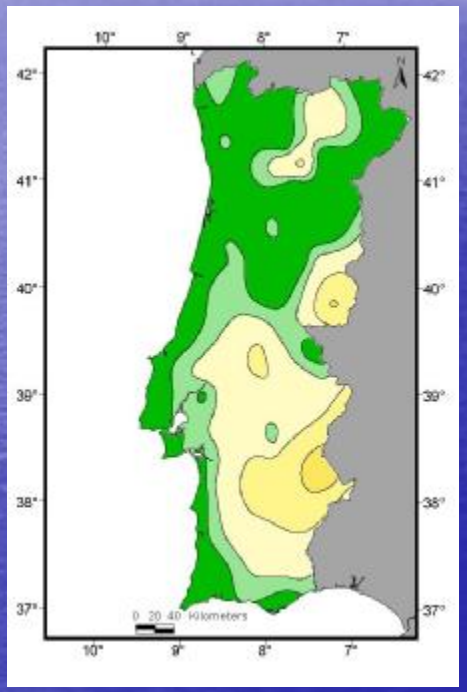


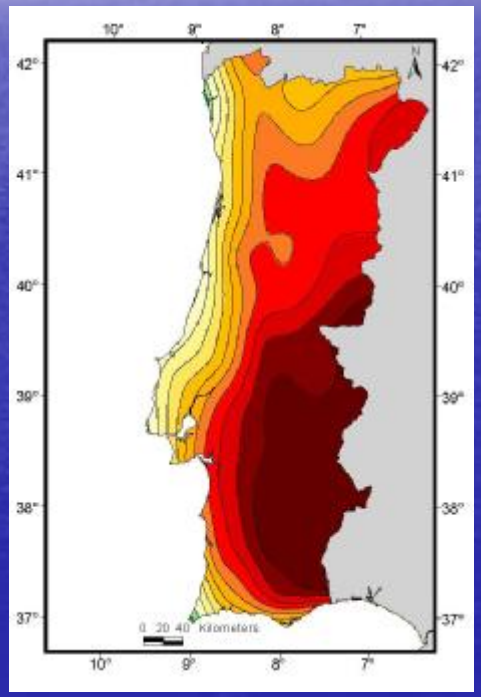
Historical series of temperature observations in continental Portugal

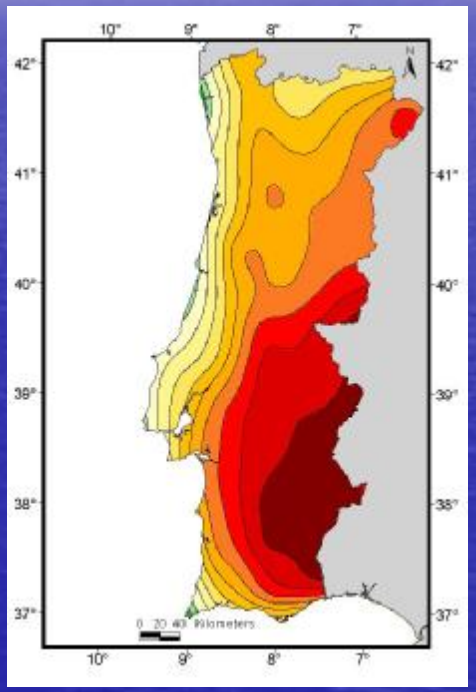
Climate change & impacts in the Med.

Need to focusing /downscaling at national/regional scales









Number of days with T>35° in continental Portugal:
Present situation, projected trend according to A2 & B2 scenarios
(SIAM project, Had RM model)

Climate change & impacts in the Med.

Sectoral impacts: GHG and aerosol balances

- A comprehensive analysis methodology (bottom-up vs. top-down, regional vs. global) is mandatory to orient negotiation processes.
- Quantification of uncertainties is a key issue.
- Regional aspects have to be properly understood.
- A better integration with economic aspects and stakeholders dialogue is mandatory.
- Promote operational emission monitoring and control – Identify proper stakeholders.

Climate change & impacts in the Med.

Sectoral impacts: agriculture

- Summer rainfall should become more scarce. This will have substantial implications on water supplies and food productivity (i.e., wheat, maize, rice ...).
- It will cause an increase in irrigation water requirements (e.g. 37% in Portugal).
- Adaptation measures are needed to avoid the negative impacts of climate change:
  - Advances in the sowing date;
  - Select crop varieties better adapted to high temperatures and more resistant to water stress;
  - Revise the irrigation water policy (including pricing).
- Milder winters allow the cultivation of horticultural crops in regions where it is not possible at present.

Climate change & impacts in the Med.

Sectoral impacts: biosphere & biodiversity

- Better understand impacts on phoenology & productivity.
- Some of the present biodiversity in protected areas will be under increasing environmental stress; some landscapes will be disloged under future climate scenarios.
- Populations with limited geographical distributions, small habitat areas, or low number of individuals, are more vulnerable to rapid climate changes.
- Extinction may occur in populations with low reproductive and dispersal capacity.
- Anthropogenic pressure (overgrazing, deforestation) amplifies threats on valuable species (e.g. Alfa in Maghreb).
- In most cases, the effects of land use changes induced by human society are likely to override the long-term effects of climate change on biodiversity.

Climate change & impacts in the Med.

Sectoral impacts: forests (facts)

- In Europe, there is a decline in productivity in most territories and shift of the physical optimal plant distribution to North;
- There is a substantial increase of fire risks, both in severity and in length of the fire season;
- Carbon sink strength in the future may be lower than today;
- Biotic invasions may be favored by climate change.

Climate change & impacts in the Med.

Sectoral impacts: forests (adaptation)

- The choice of the species should take into account the local productive potential, especially the length of the growing station and the dry period duration.
- The genetic improvement program should promote the adaptation to higher temperatures and larger water stress, especially to species with large economic importance on all Mediterranean rims.
- The forestation actions must be planned taking into account the fire risk.
- In a high fire risk environment the management policies need to focus more on prevention, which has smaller costs, than on fire combat.

Climate change & impacts in the Med.

Sectoral impacts: desertification

- In the Southern rim, climate change trends and demographic pressure (overgrazing, overexploitation) will generate a negative feedback leading to a severe increase of soil degradation.
- Similar phenomena may occur in the Southern Europe, due to coupling between climate change and such bad practices as land abandonment, salinization, abusive use of chemicals, deforestation & forest fires.
- Hotter and drier conditions would extend endangered areas to areas not at risk under normal conditions.
- Today, the annual costs of desertification in Tunisia and Spain are ~100 million and 200 million Euros.
- Endangered 'buffer zones': North Africa; South Portugal, Italy & Greece; Spain, Turkey.

Climate change & impacts in the Med.

Sectoral impacts: water resources

- There will be a progressive reduction in the annual river runoff during the 21st century;
- The concentration of precipitation in winter and the estimated general increase in the frequency of heavy precipitation events is likely to increase the flood intensity and frequency and the soil erosion;
- Water scarcity in summer will cause damages to various sectors: agriculture, soil degradation, tourism...
- Water quality will be degraded by higher water temperatures and by river flow reduction in the summer,
- Water management authorities must start considering climate change as a decision variable.

Climate change & impacts in the Med.

Sectoral impacts: water systems

- A proper methodology has been set up.
- Preliminary results are being obtained (river fishes, water quality...)
- Anthropogenic parameters strongly impact hydrologic modeling.

Climate change & impacts in the Med.

Sectoral impacts: fisheries

- Significant modifications in factors such as temperature, upwelling and turbulence may alter the values of parameters used to estimate the optimal production, yield and levels of stocks;
- Significant changes in the geographical distribution range of species with commercial value are due to increases in sea temperature.
- Changes in Atlantic ocean temperature and upwelling is important for some Mediterranean countries (Morocco, Spain, Portugal, France) and has been carefully studied in the SIAM programme (sardine, bluefin tuna ...)

Climate change & impacts in the Med.

Sectoral impacts: coastal zones

- Sea level has been rising since the 1900s at approximately 1.5mm/yr and this average trend is expected to increase non-linearly in the near future and especially in the last quarter of the 21st century. Sea level could rise by as much as 1 m at the end of 21st Century
- This will lead to flooding, coastal erosion salinization of aquifers and rivers, economic damages in harbours and other coastal buildings.
- Increase in extreme events (storms) in sensitive areas will lead to quite severe coastal erosion (GICC/Implit).
- The most endangered areas are: the Nile delta (considerable loss of agricultural land and damage in Alexandria), Venice, Thessaloniki area.

Climate change & impacts in the Med.

Sectoral impacts: human health

- Better understand how scenario-derived climate changes may affect human health. Swich from satistical to interdisciplinary mechanist mthods;
- Interdisciplinay teams have been set up.
- Assess the manner how potental climate change health impacts may be avoided or reduced, especially for most vulnerable populations;
- Identify knowledge gaps that need to be investigated further to fully understand the possible impacts of climate change on human health in the Med.
- Switch to animal and vegetal diseases and indirect impacts (food, biodiversity).

Climate change & impacts in the Med.

Sectoral impacts: human health

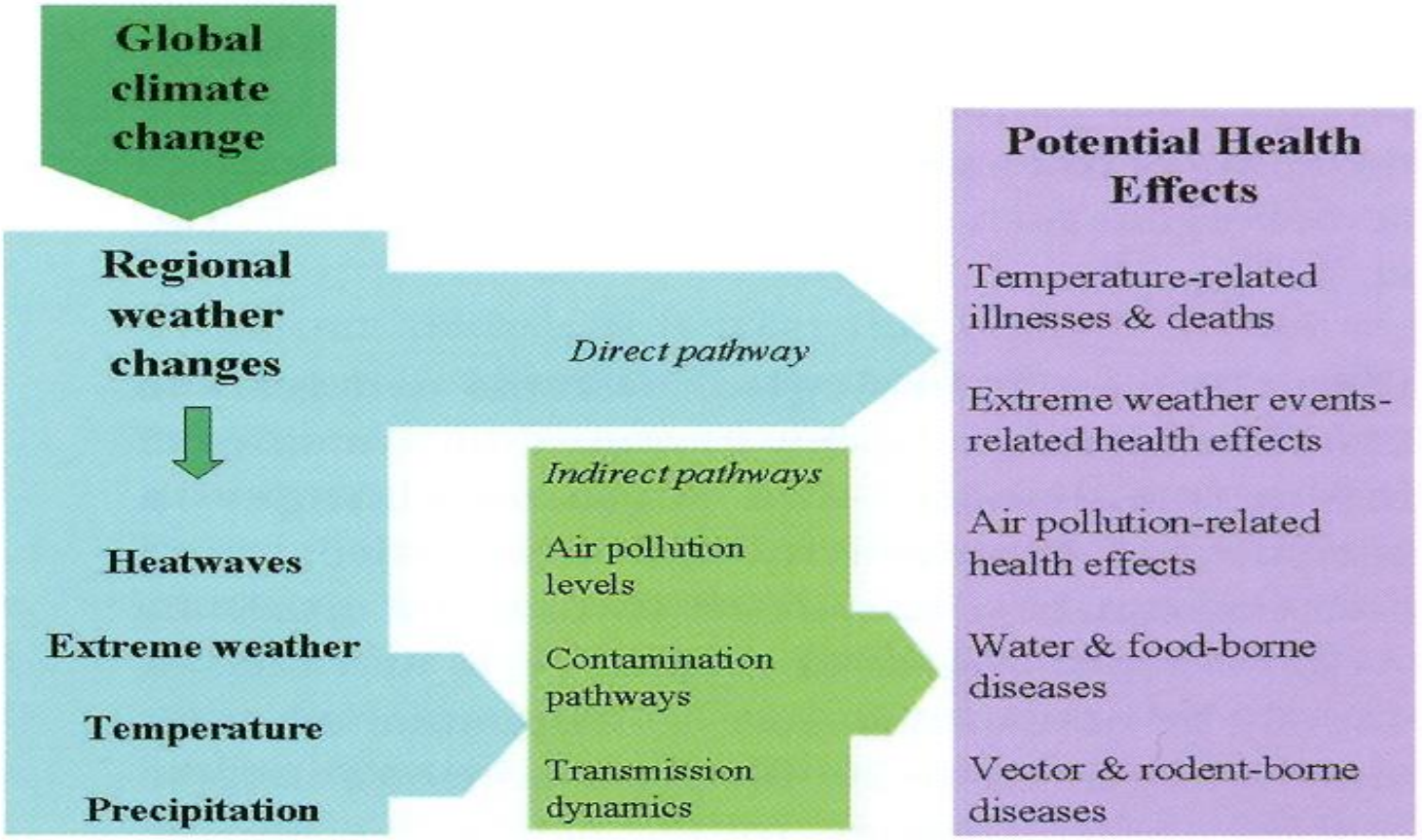


Figure 8.4 – Potential health effects of climate change.

CC and health flowchart - SIAM vision

Climate change & impacts in the Med.

Sectoral impacts: human health

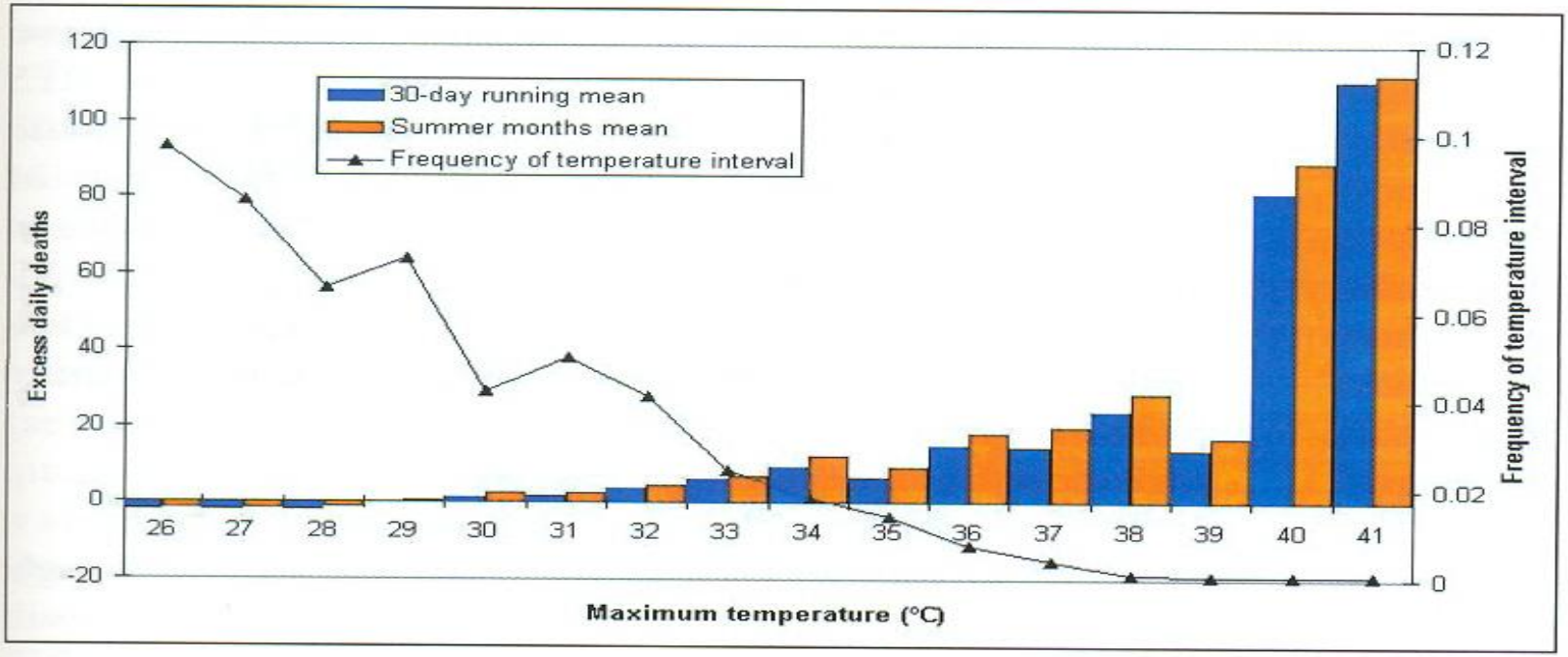


Figure 8.2 – Excess heat-related daily deaths in Lisbon during the summers of 1980-98. Added difference between observed and expected number of deaths, according to temperature intervals of 1°C, using a 30-day running mean and a summer months mean as expected values. The black line represents the frequency of occurrence of the temperature interval during the period. (data from INE 2000 & IM 2000).

Climate change & impacts in the Med.

Sectoral impacts: economic aspects

- It is important to properly compare the economic tools to combat climate change.
- Studying trajectories is important to orient decision making processes.
- Studying the agricultural sector is quite important – including GES balance (CH_4 is important) – compared with other sectors.
- Wood business is poorly analyzed.
- Retroactions have to be taken into account.
- Damages have to be properly quantified.
- Switch from scenarios building to uncertainties quantitative evaluation.
- Consolidate negotiation processes, governance good practices – Integrate societal and political sciences.

Climate change & impacts in the Med.

Some overall conclusions - Facts and findings

- Small changes in local climate may have major impacts on population and ecosystems.
- Climate change could critically undermine efforts for sustainable development in the Med introducing new threats to human health, ecosystems and national economies.
- The most serious impacts are likely to be felt in North Africa and Eastern Mediterranean countries. Some European directives should be adopted/adapted as well.

Climate change & impacts in the Med.

Some overall conclusions - Going forward (1).

- Temperature and precipitation patterns and related impacts appear well documented – Efforts should focus on uncertainties and occurrence of extreme events, as well as scenarios refinement and innovative topics.
- Downscaling to European region scales is mandatory, which means having proper tools and involving regional scientists and policy-makers.
- 'Strategic upscaling' to the Med dimension and to the European dimension (at large) is mandatory. Take full advantage of EC FP6 & 7.
- Awareness of decision/policy makers is very poor, especially in terms of severity & timescales for action.

Climate change & impacts in the Med.

Some overall conclusions - Going forward (2) ...

- As already explained, **coordination is on the right way** through the CIRCLE Concerted Action, which includes a **Mediterranean sub-network**. Work is in (fast) progress. A joint GICC/CIRCLE conference, then a coordinated call is planned in 2007.
- Other instruments of FP6/7 could be used for specific purposes – including to reinforce stakeholders' involvement .
- **CIRCLE is not limited to EC countries**. The Mediterranean is involved, but also **Russia** (mainly through cooperation between SCERT & Médias-France). This will be deepened during the ENVIROMIS-2006 Conference. So...

Climate change & impacts in the Med.

... Towards the CIRCLE Concerted Action

General de Gaulle spoke about

“Europe from the Atlantic to the Urals”

Climate change & impacts in the Med.

Towards the CIRCLE Concerted Action

… But the UBA-A CIRCLE team

and SCERT

went up to the Bering Strait !