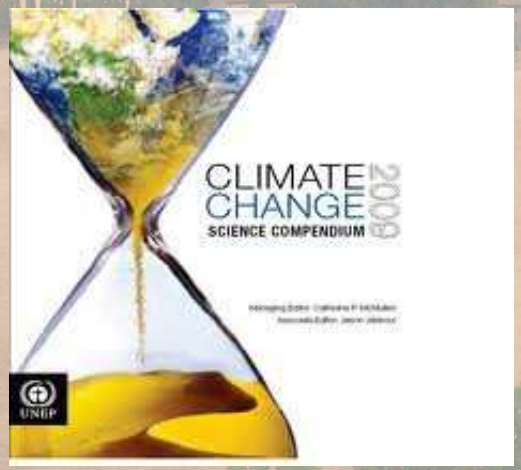
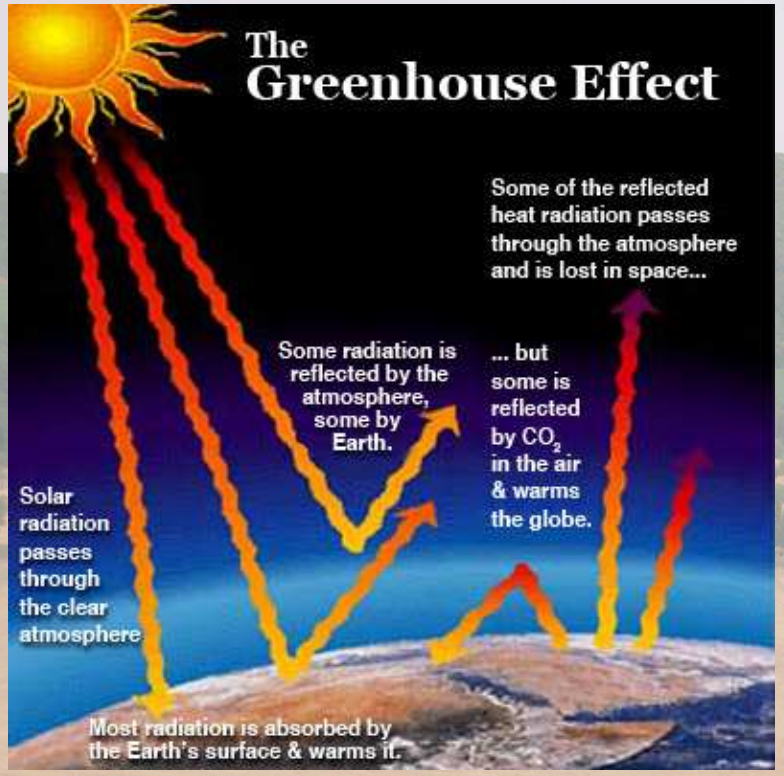
Climate change and Agriculture



Giampiero Maracchi

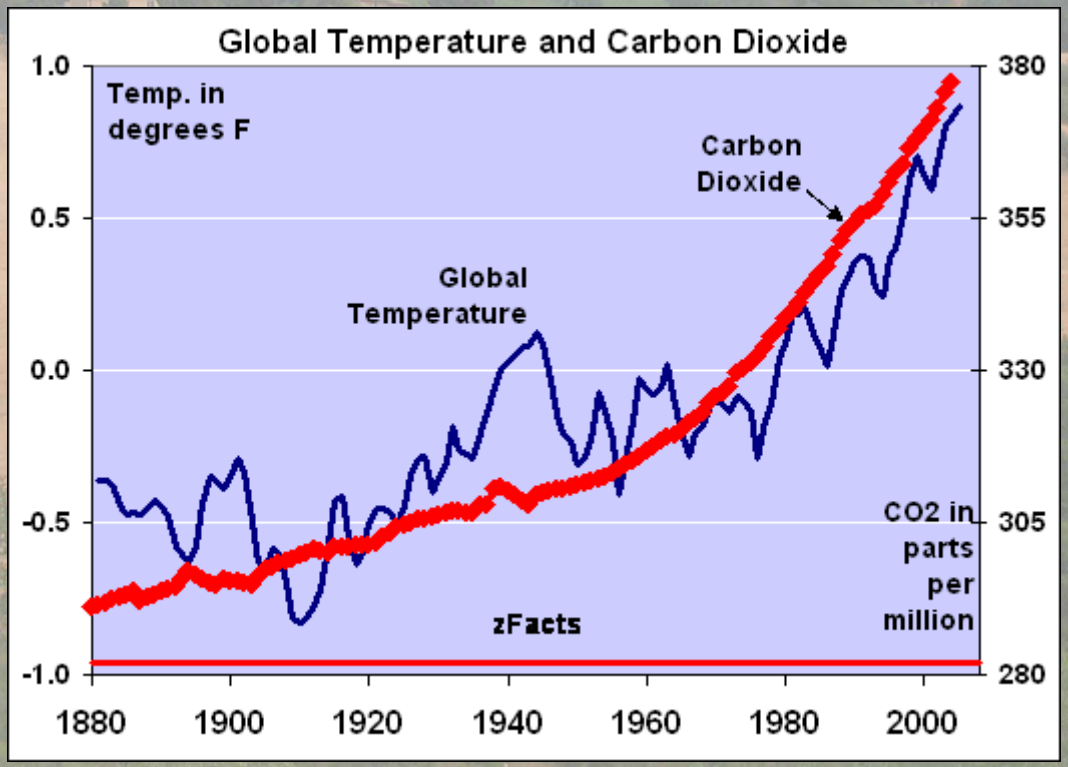
Academy of Georgofili

Paris, 11.10.2016



Source: Bill Ganzel, the Ganzel Group, 2009

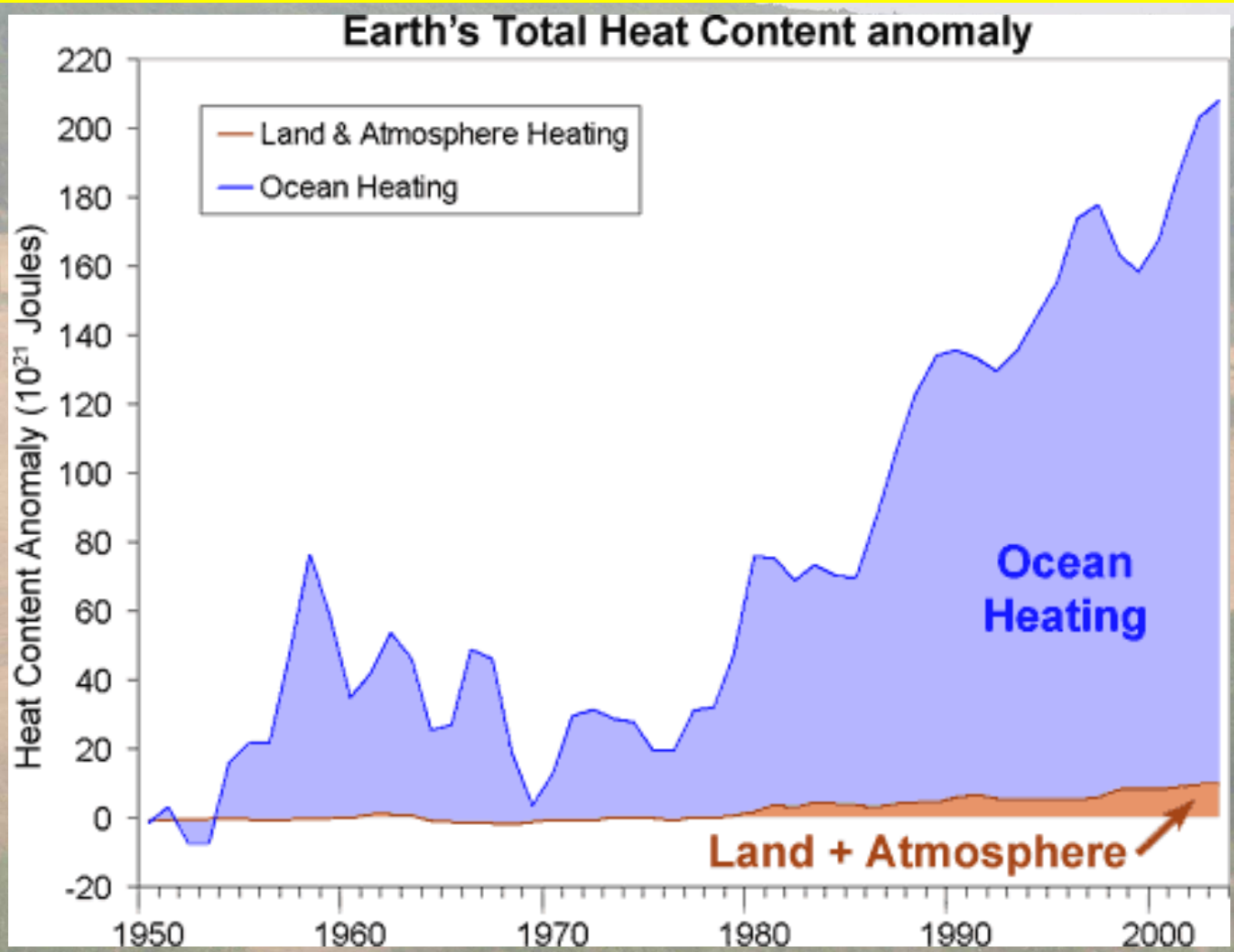
ABNORMAL ENERGY from 1880 to 2000



Source: Zfacts.com

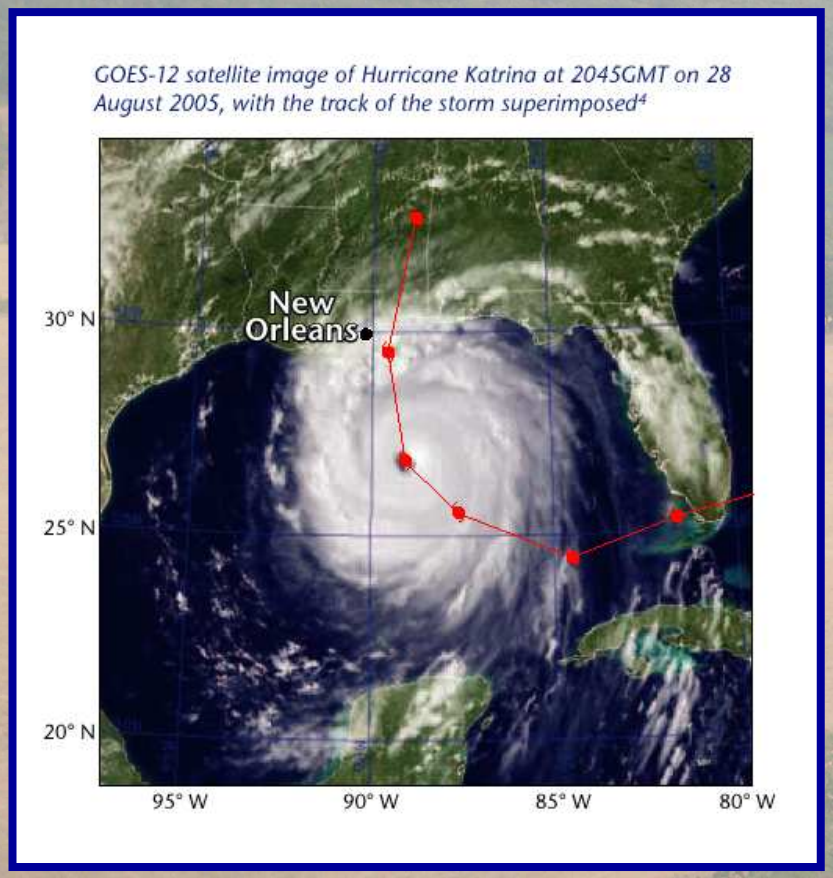

The main consequences:
1) Intense rainfall

Ocean Heat Content increase



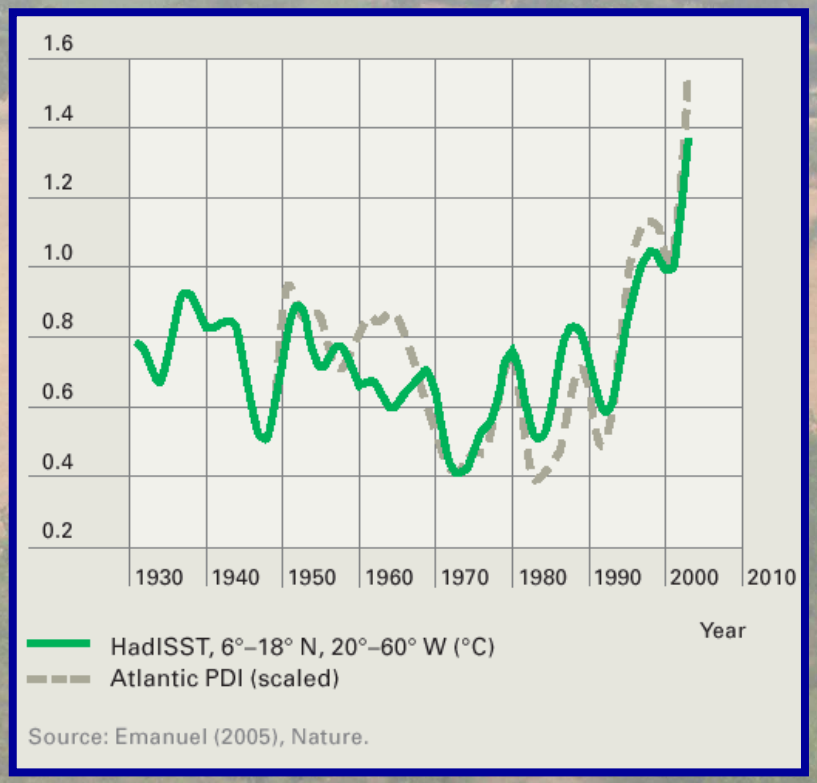
Source: Journal of Geophysical Research, 114, 2009, Murphy et al.

PDI is increasing with the hurricane intensity



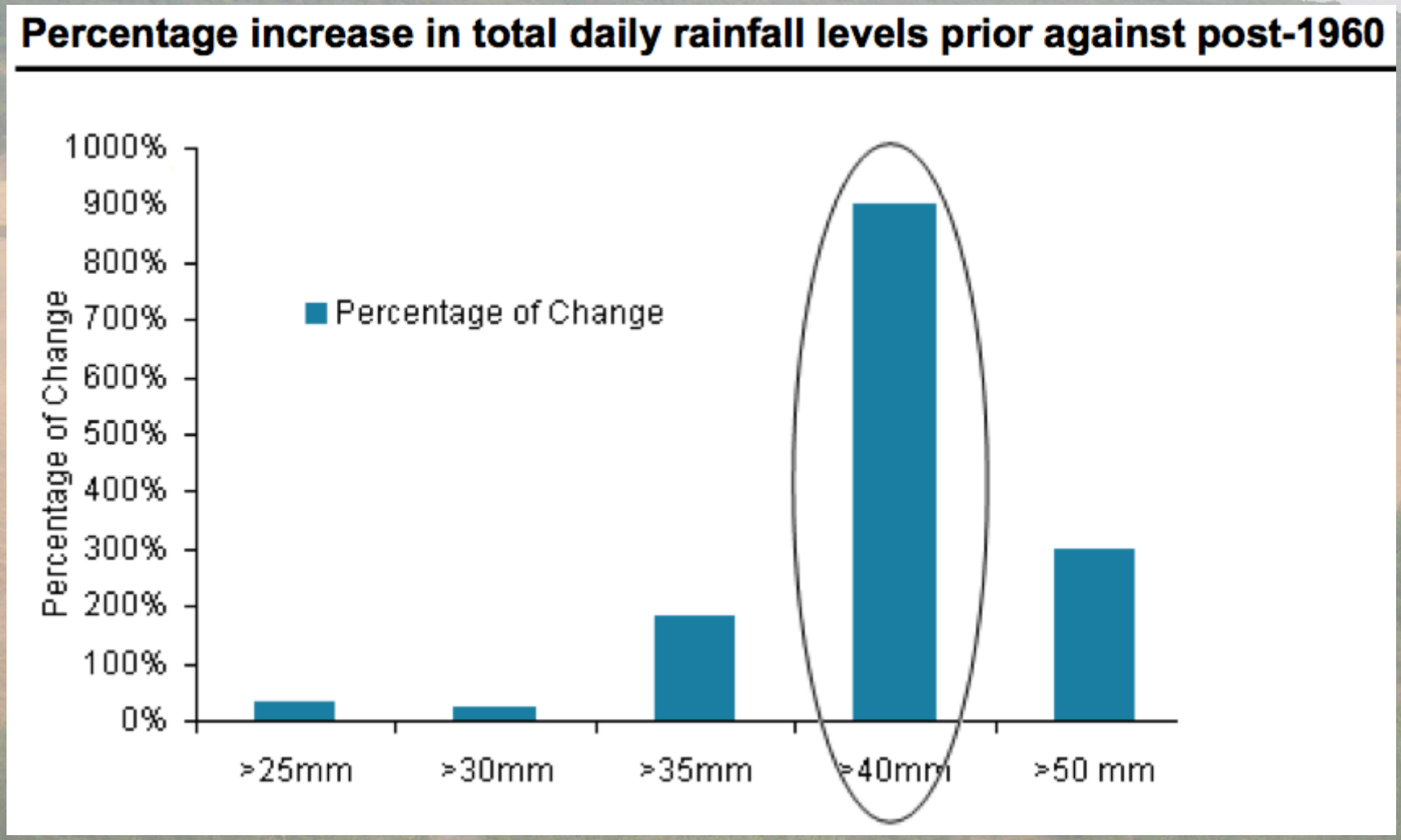
Source: Murphy 2009, Domingues et al. 2008

PDI (Power Dissipation Index)
Energia accumulata dal vento nei cicloni su base annuale



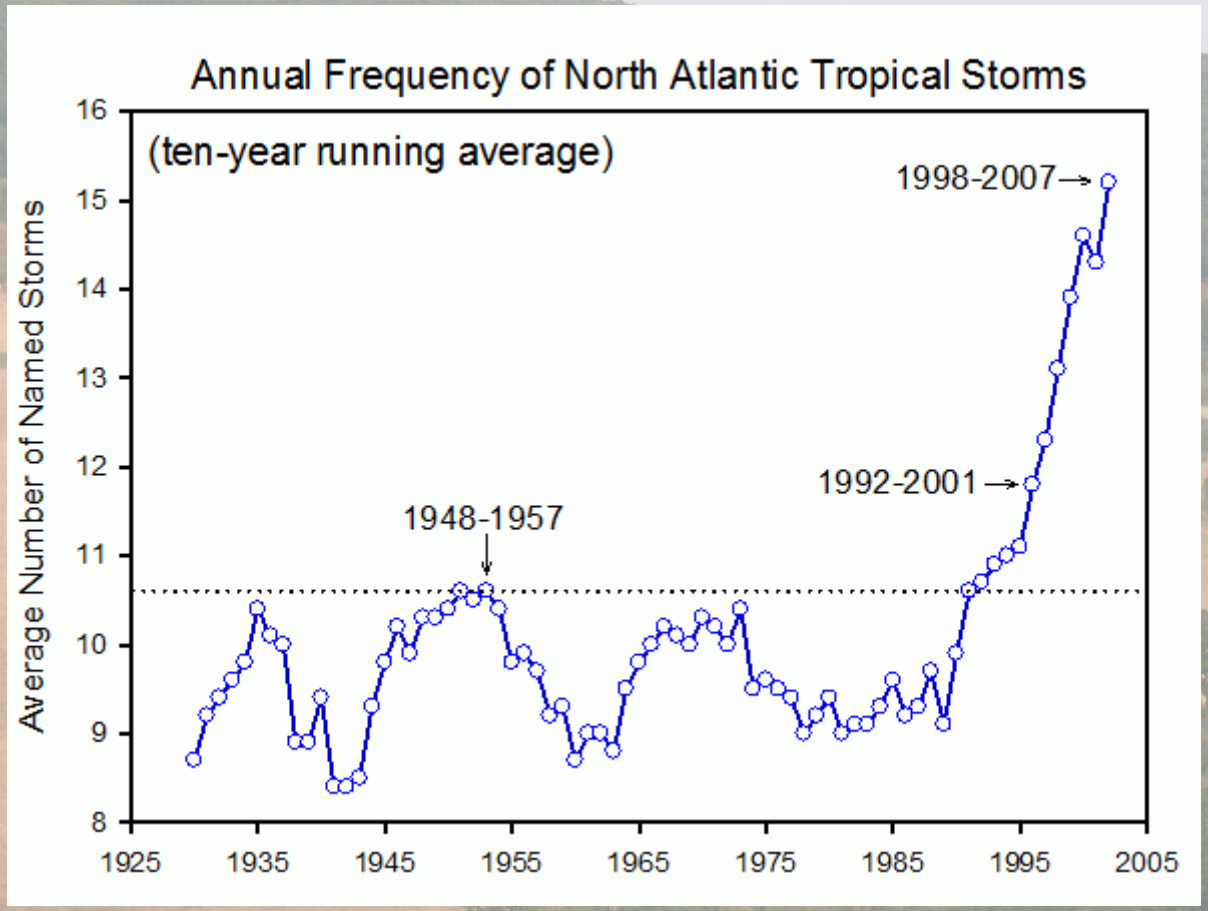
MunichRE 2006 "Hurricanes – More intense, more frequent, more expensive

Rainfall intensity increase up 900%!



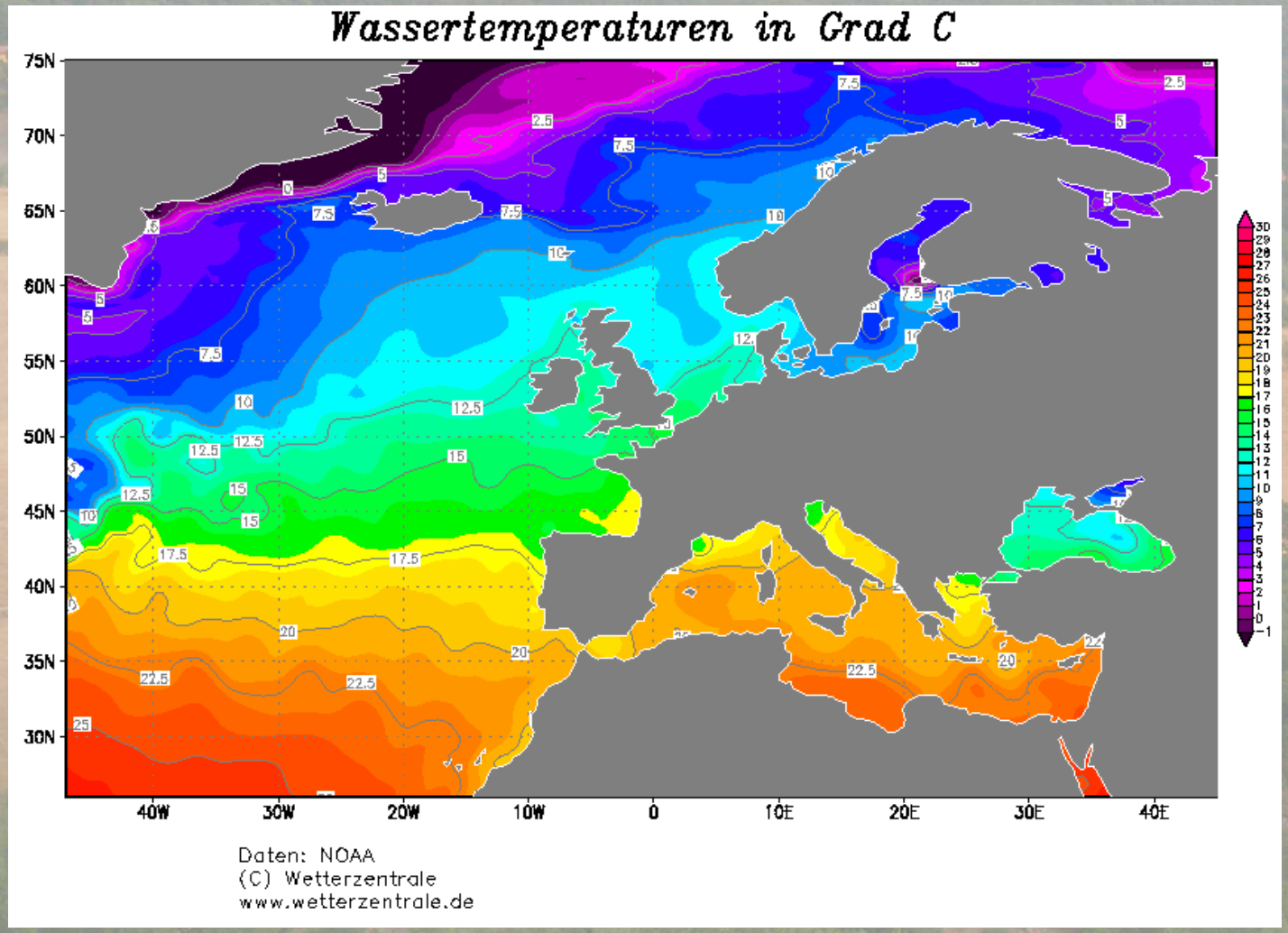
Source: East London Extreme Rainfall Importance of granular data, Lloyd's emerging risks team report, 2010

Tropical Storms are growing

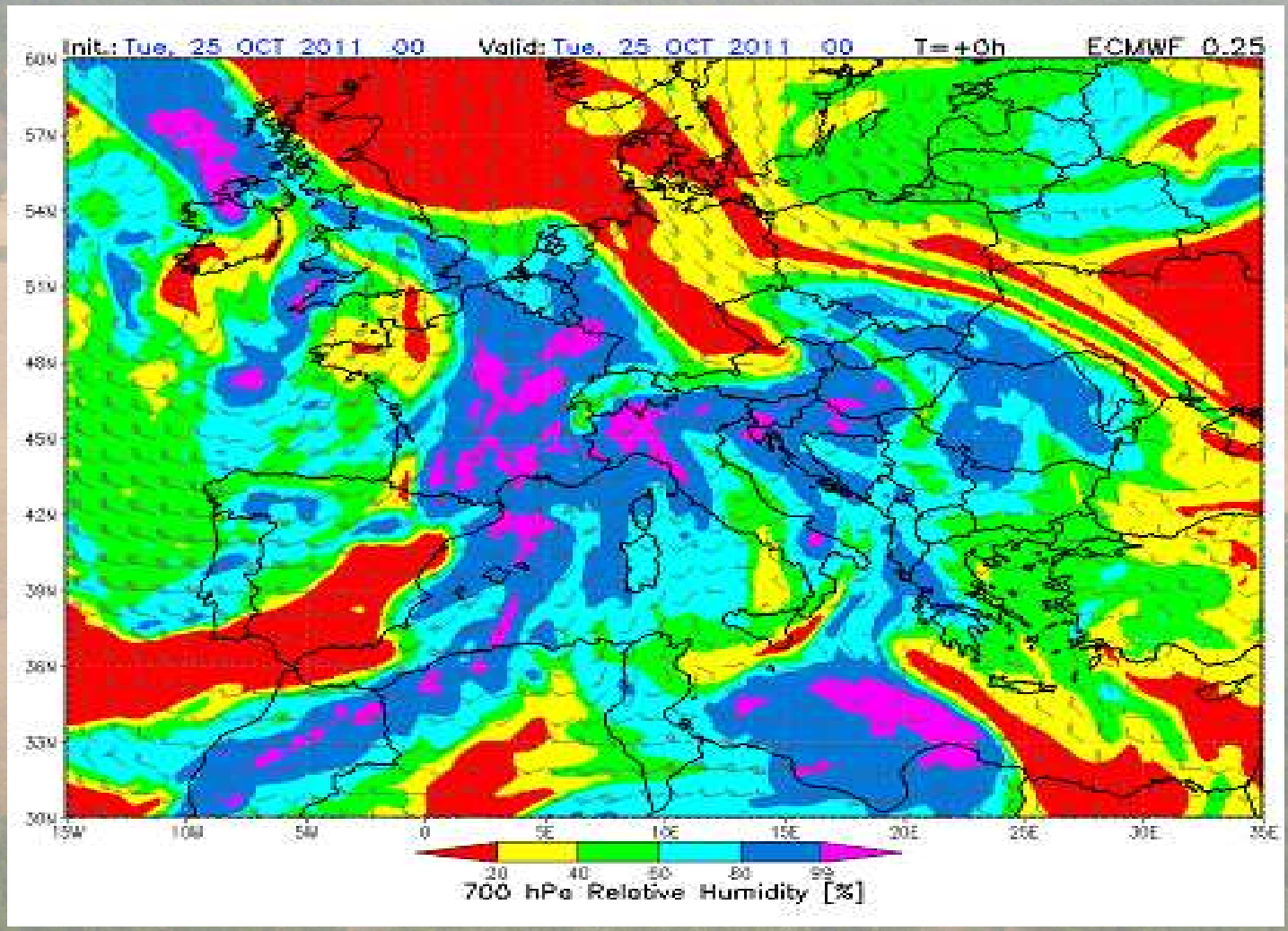


Source: PEW Centre

October 2011 - SST

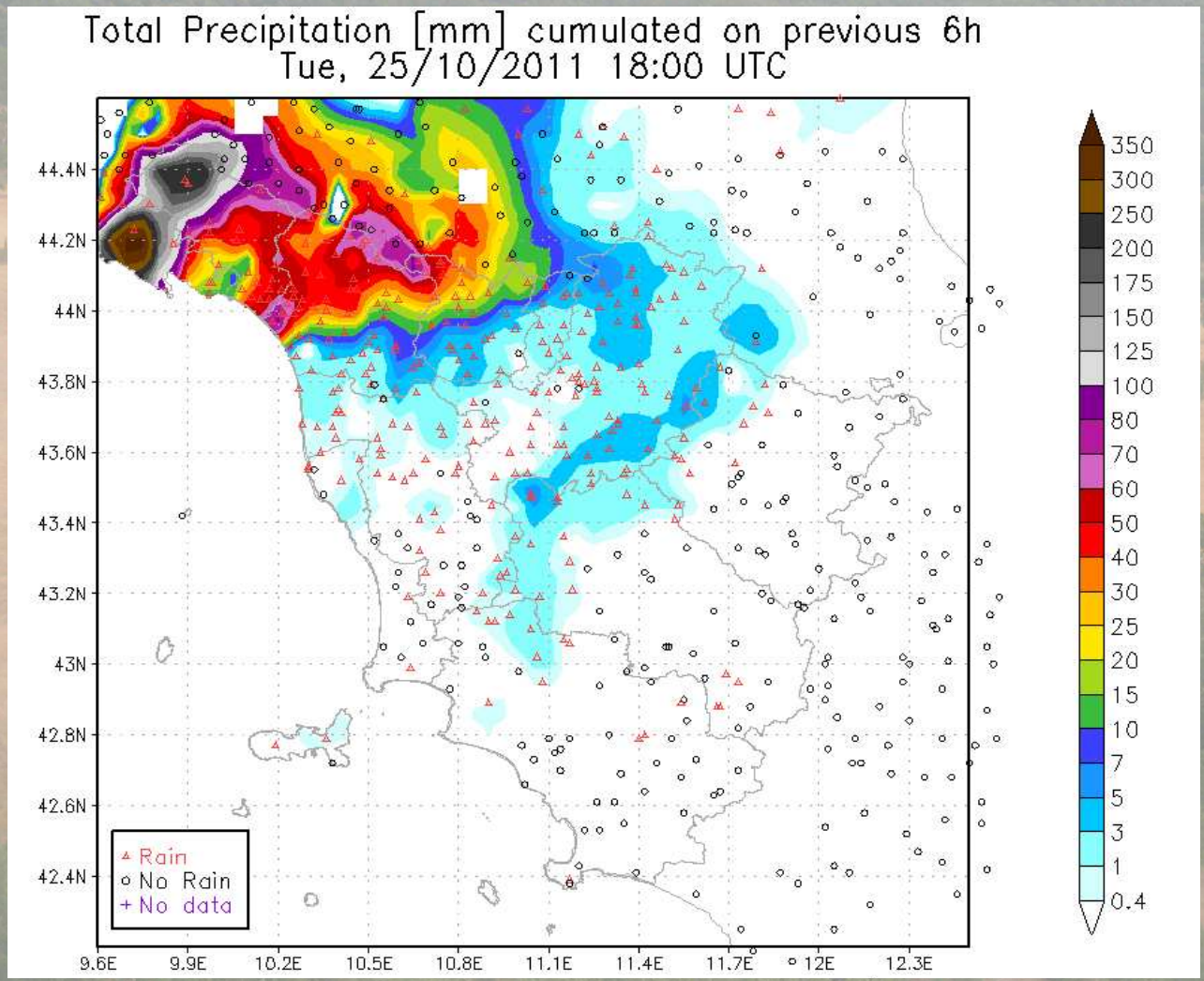


Moist Air Mass

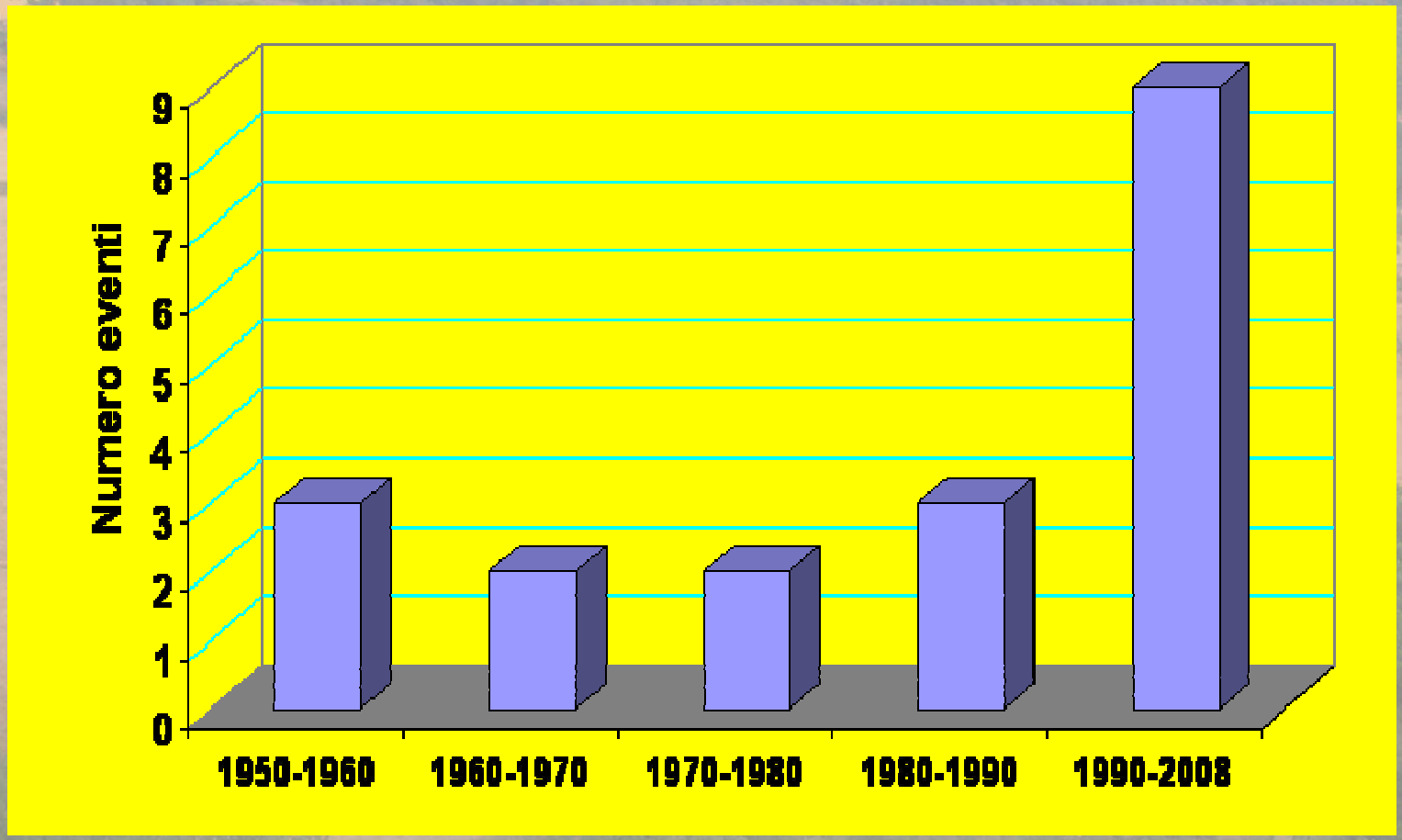


View from satellite

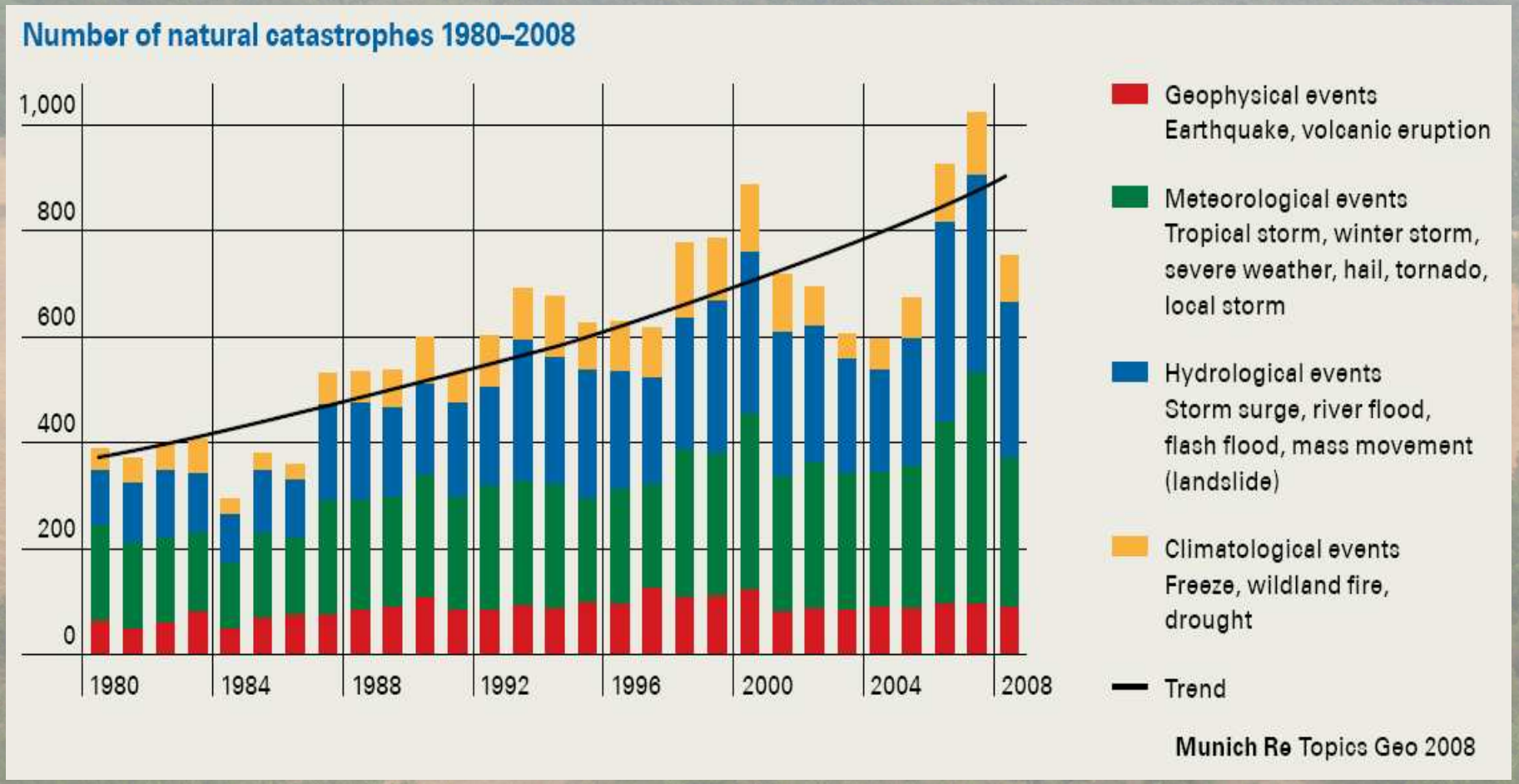
Aulla – October 25-10-2011



Floods increase in Italy three times



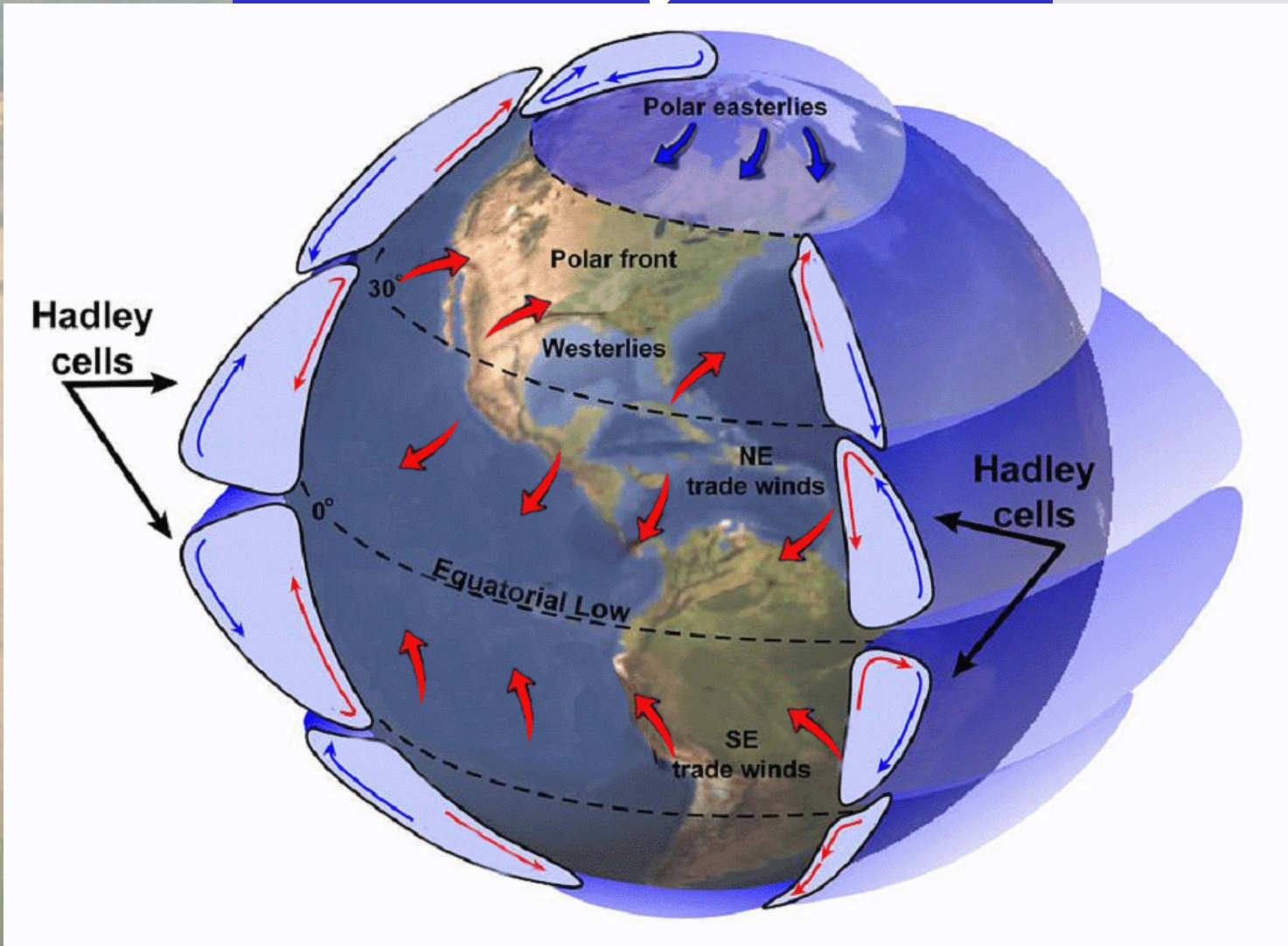
Everywhere grow the natural catastrophes



2) The heat waves

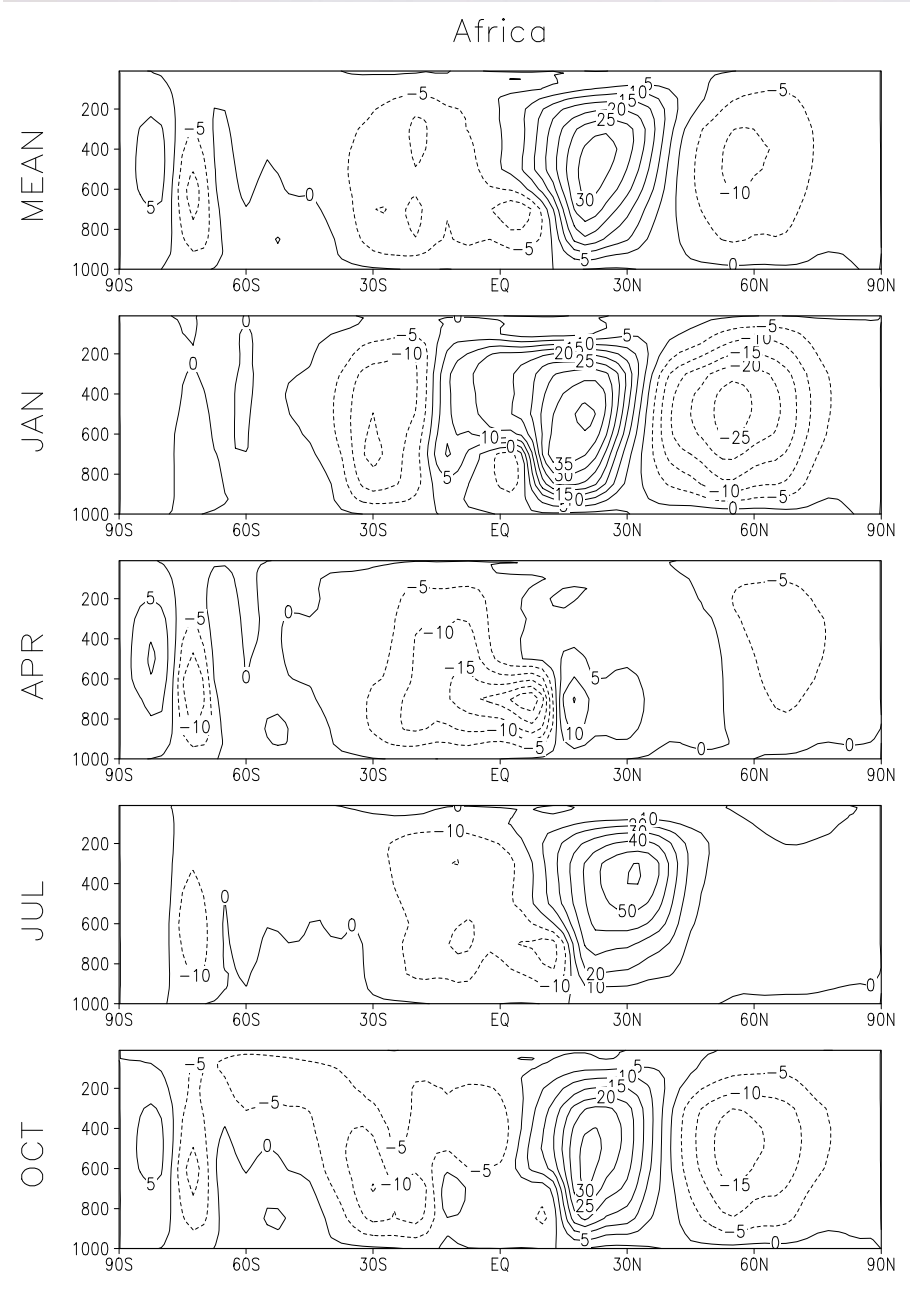
Global circulation is affected by changes

Hadley Cell



Source: Kevin Trenberth NCAR

Global circulation is affected



Northern hemisphere circulation is more intense than zonal average

Winter

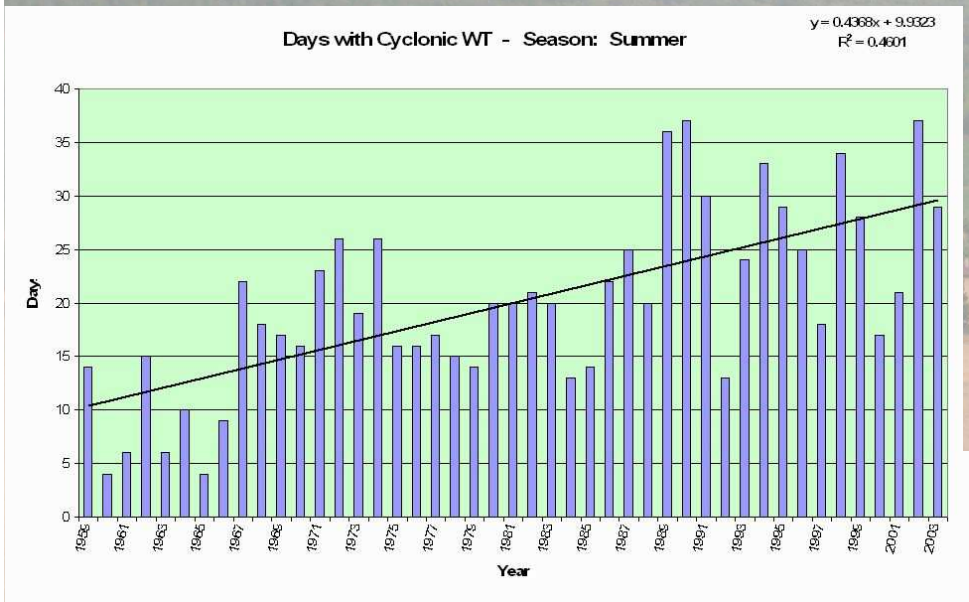
Congo basin =>
Anomaly in equatorial circulation

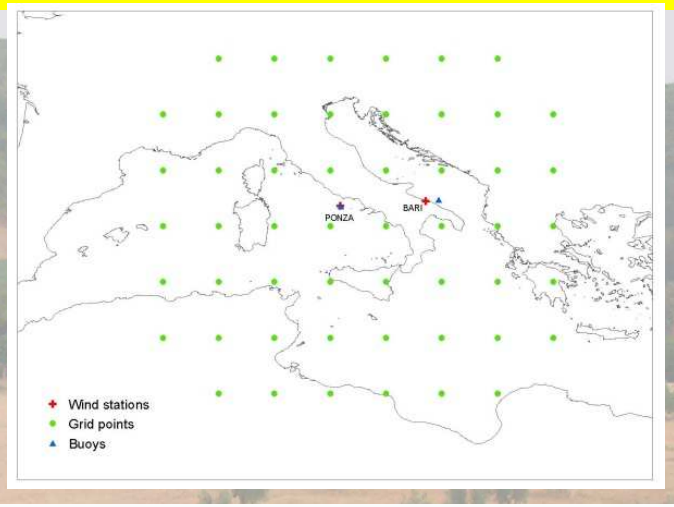
Summer

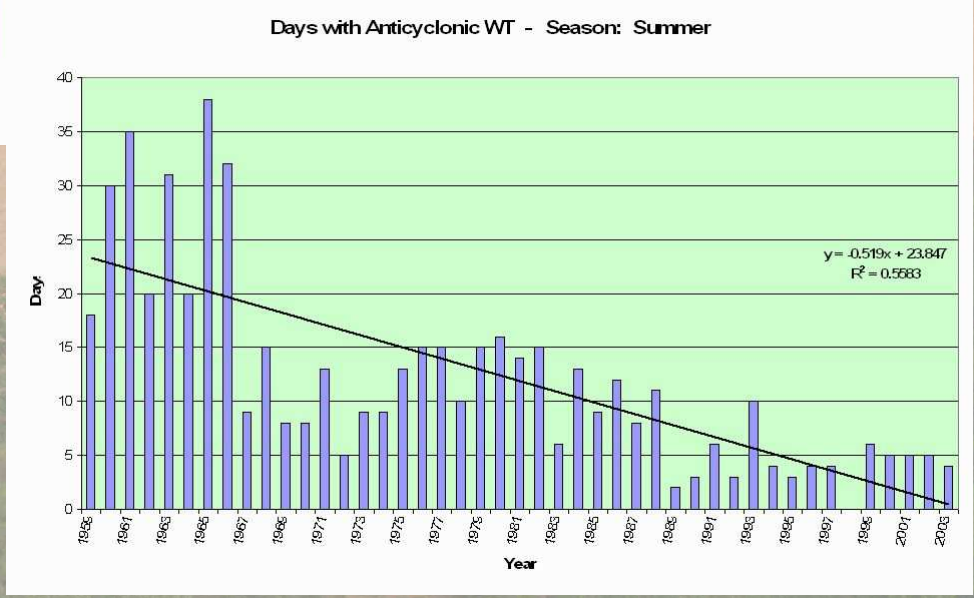
Hadley cell extends up to 45°N (Mediterranean basin)

Charney mechanisms => anomaly in Hadley cell intensity

Summer Atlantic high pressure leaves the place to Lybian anticyclone

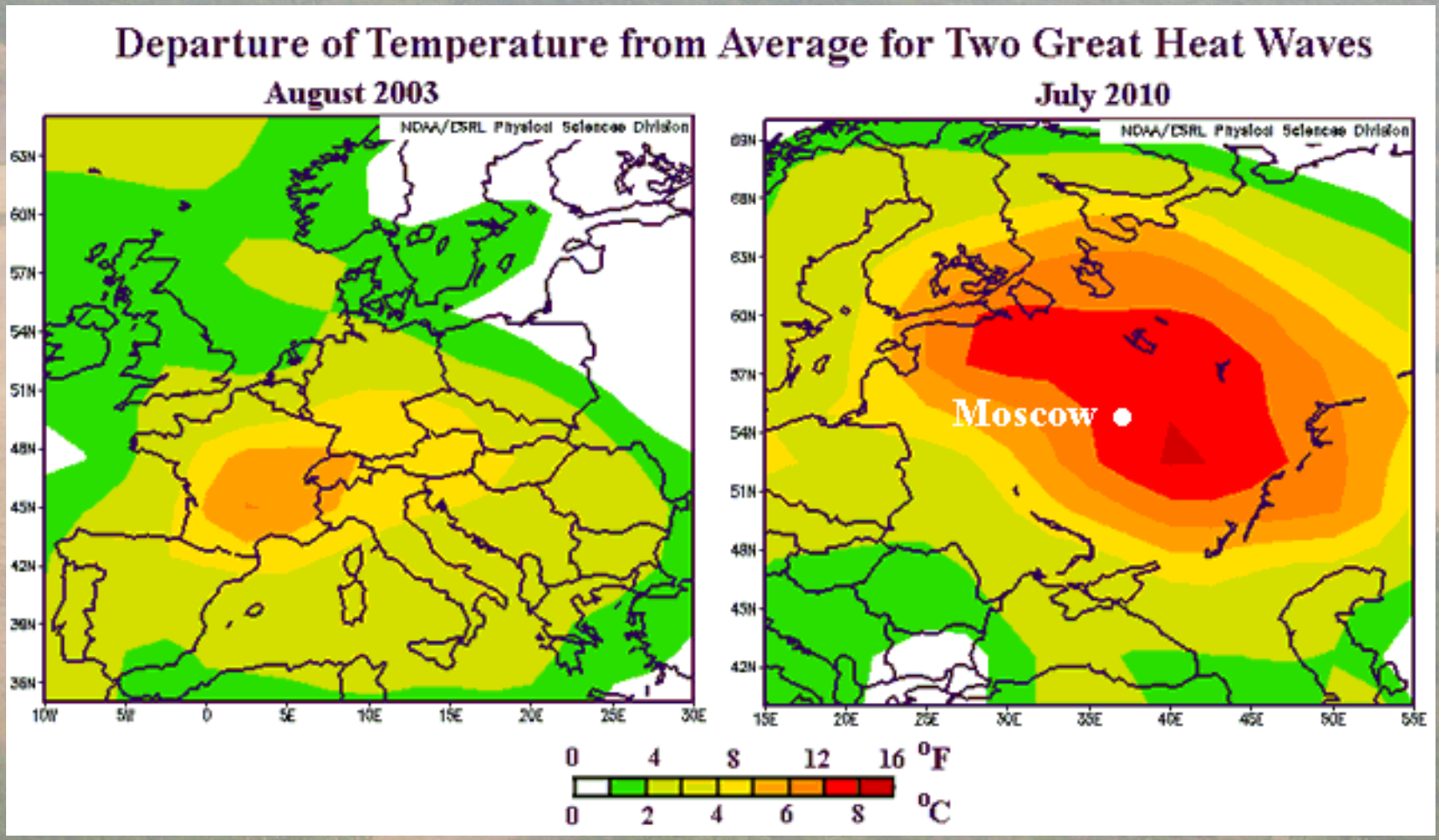






Source: CNR IBIMET

Heat waves at high latitudes

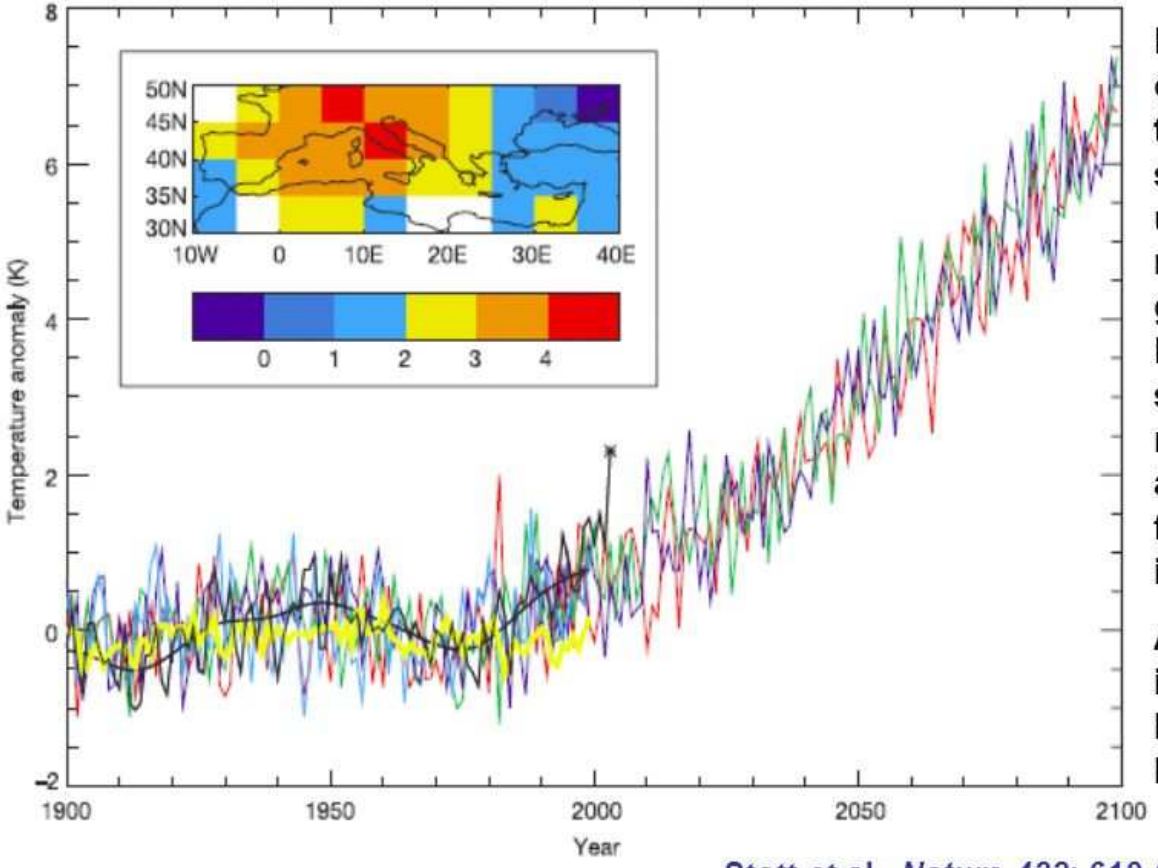


Source: Jeff Masters, as generated by NOAA/ESRL

...and the perspective

Where we're headed: Heat waves

Extreme heat waves in Europe, already 2X more frequent because of global warming, will be "normal" in mid-range scenario by 2050



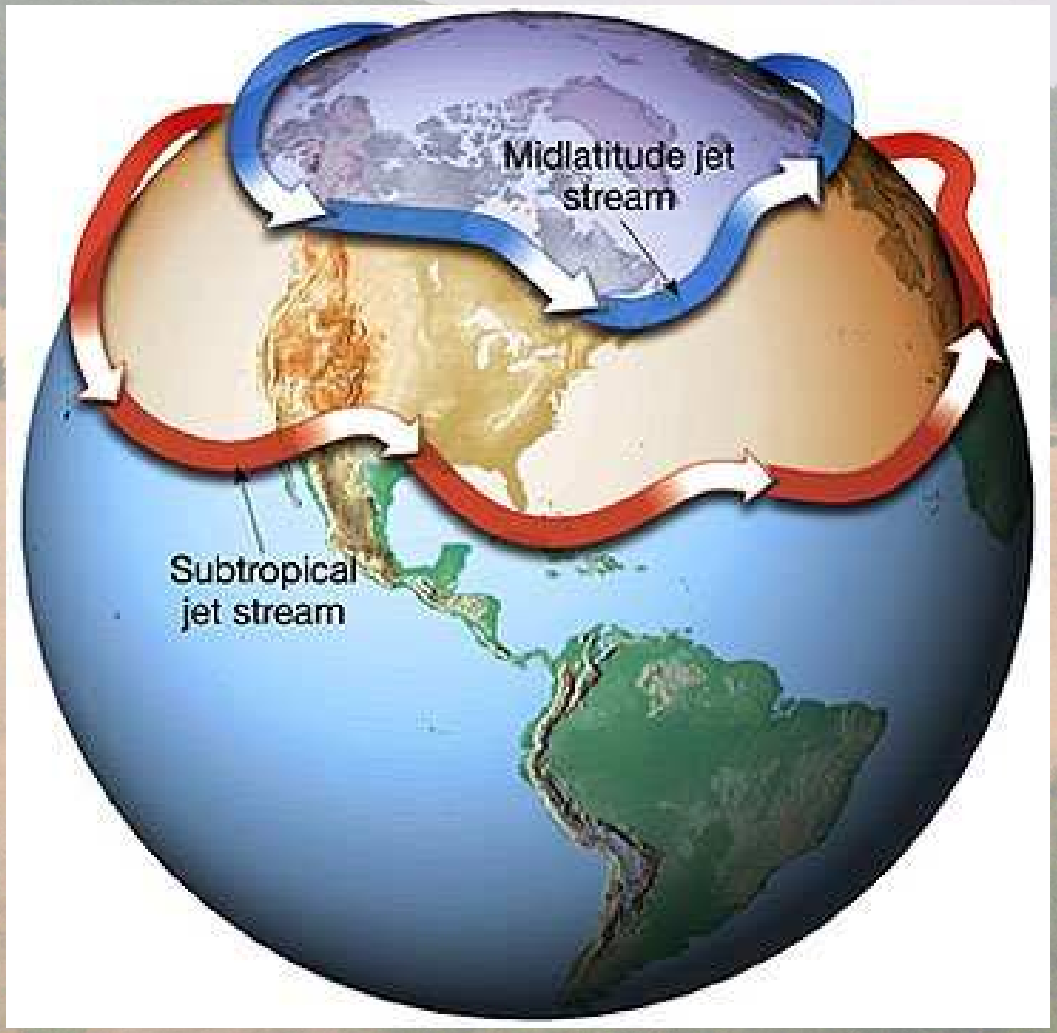
Black lines are observed temps, smoothed & unsmoothed; red, blue, & green lines are Hadley Centre simulations w natural & anthropogenic forcing; yellow is natural only.

Asterisk and inset show 2003 heat wave that killed 35,000.

Stott et al., *Nature 432*: 610-613 (2004)


3) Drought

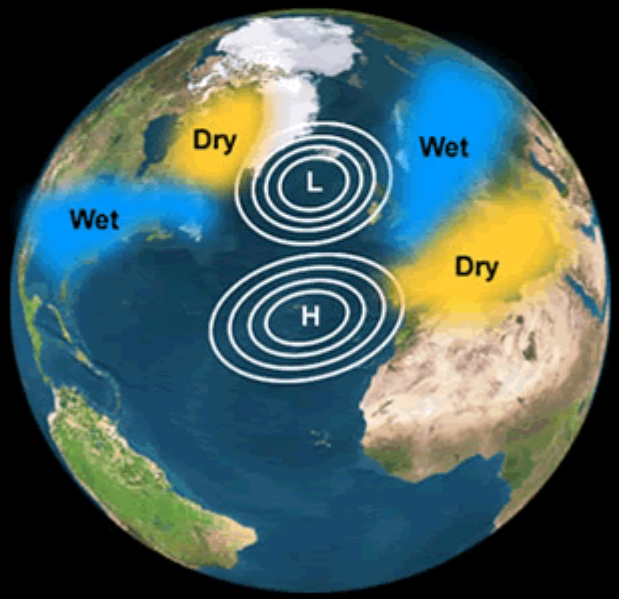
The jet stream



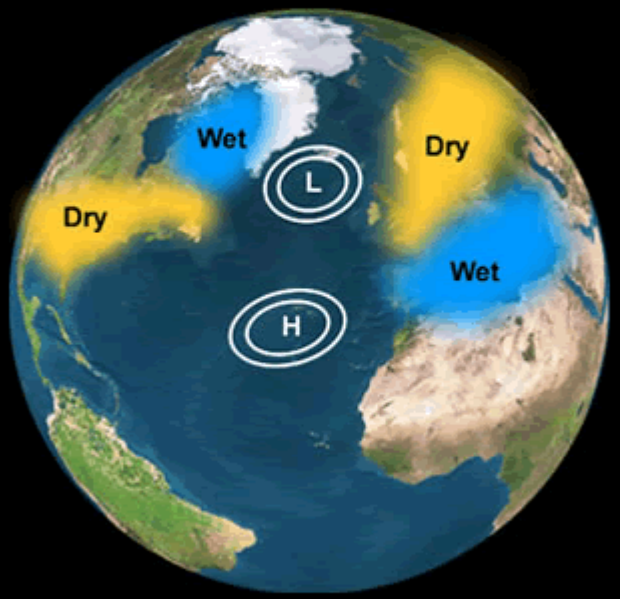
Source: Lutgens and Tarbuck

The North Atlantic Oscillation

Positive Phase

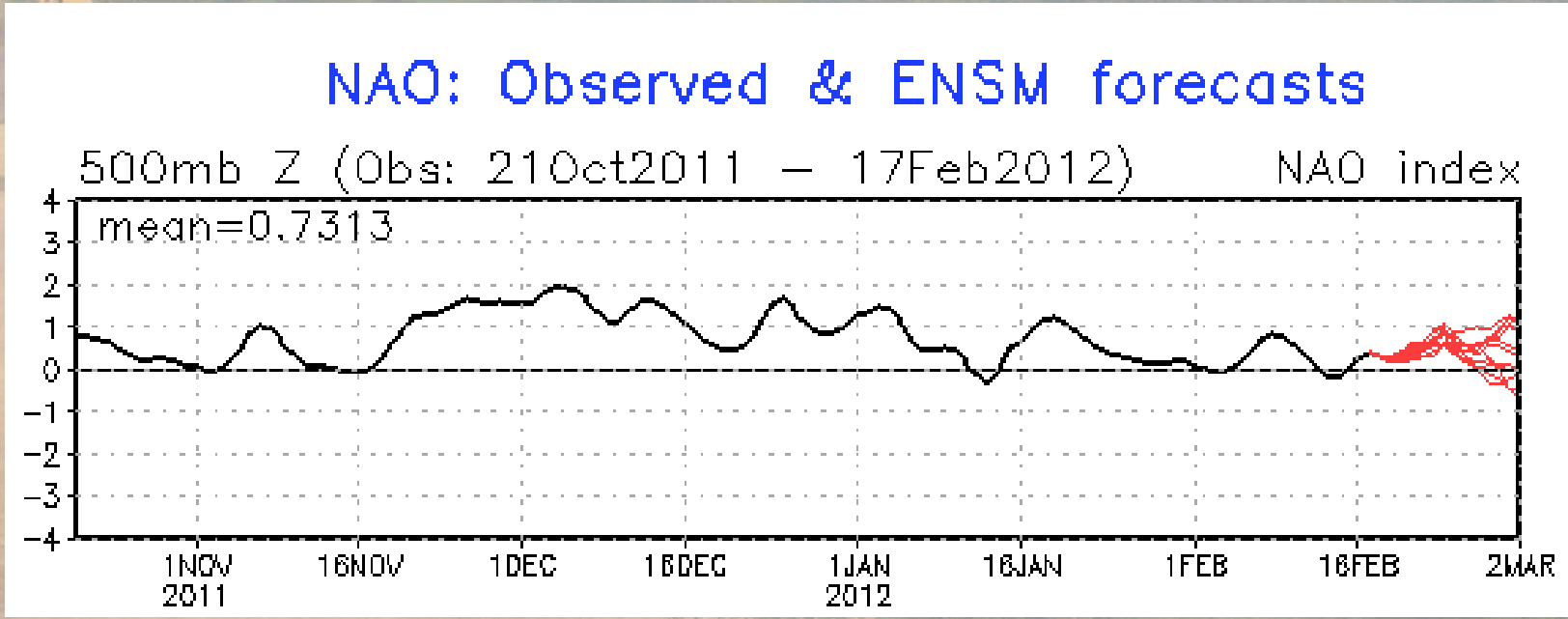


Negative Phase



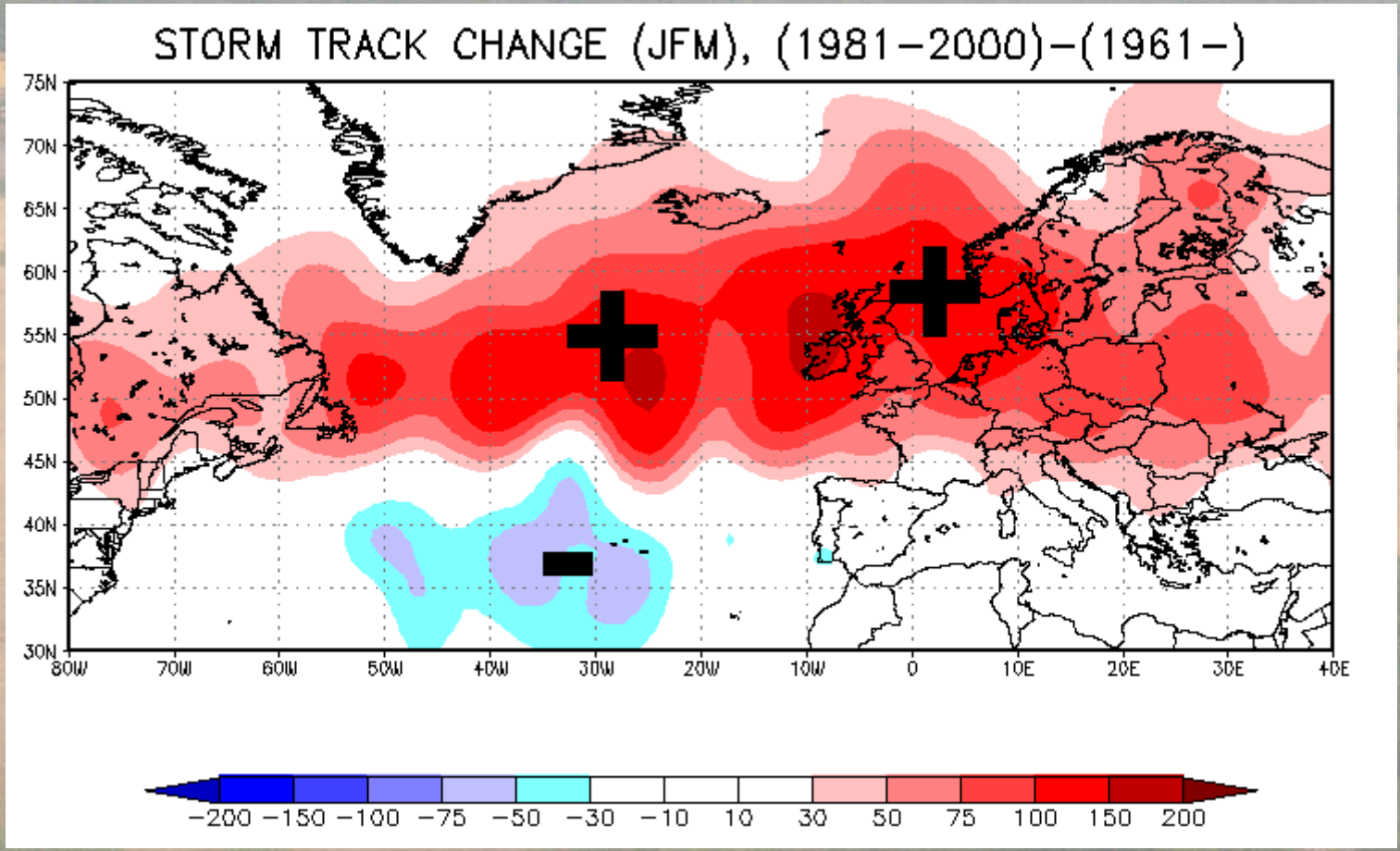
Source: UCAR

Nao + = drought autumn- winter



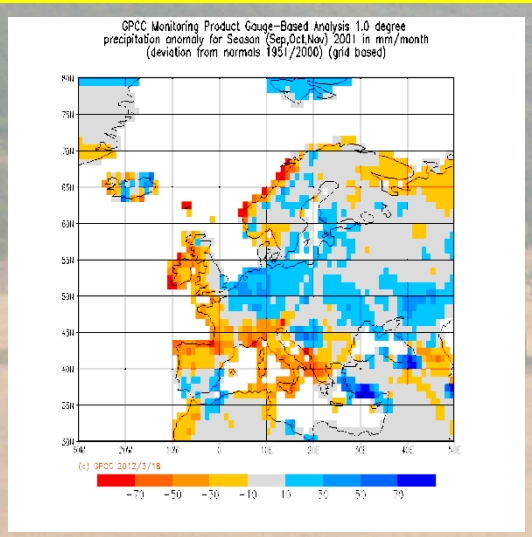
Source: NOAA Center for Weather and Climate Prediction

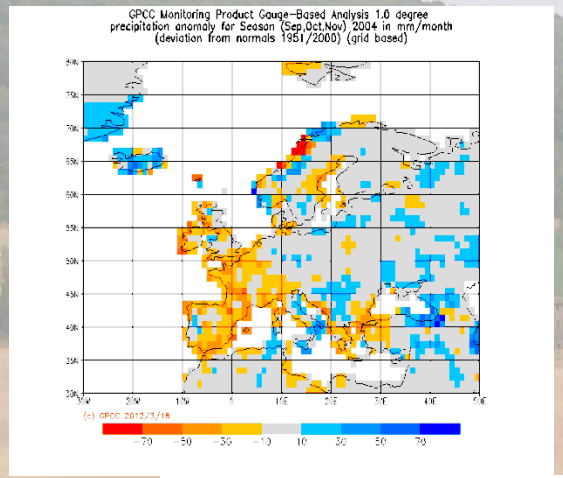
Storm Track Change to northward 1961-1980 → 1981-2000

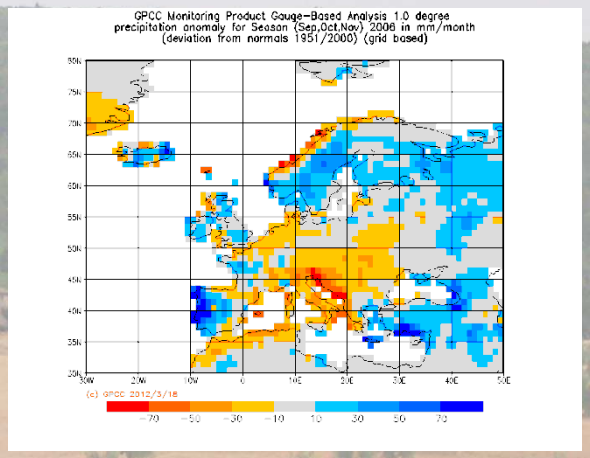


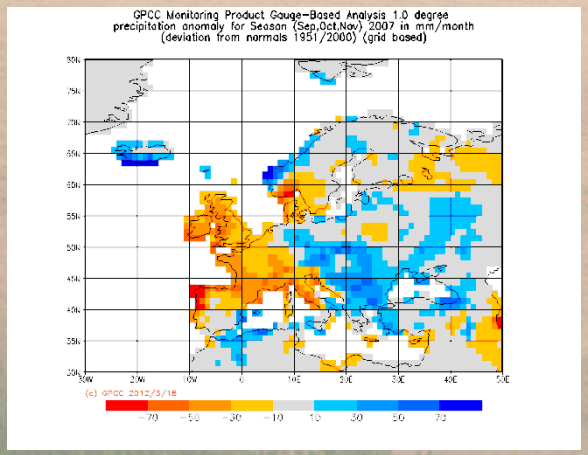
Source: CNR IBIMET

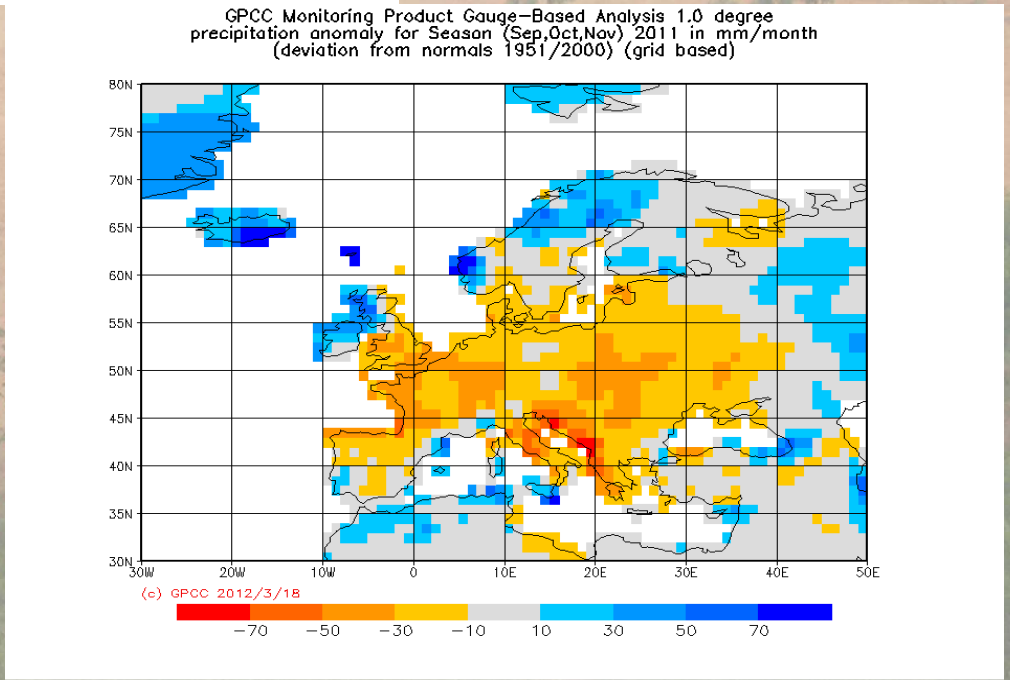
Since 2000 1 year on two there was an huge lack of water



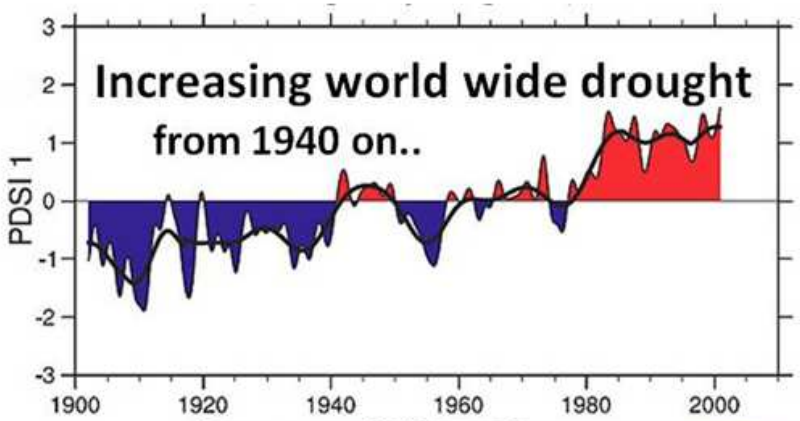




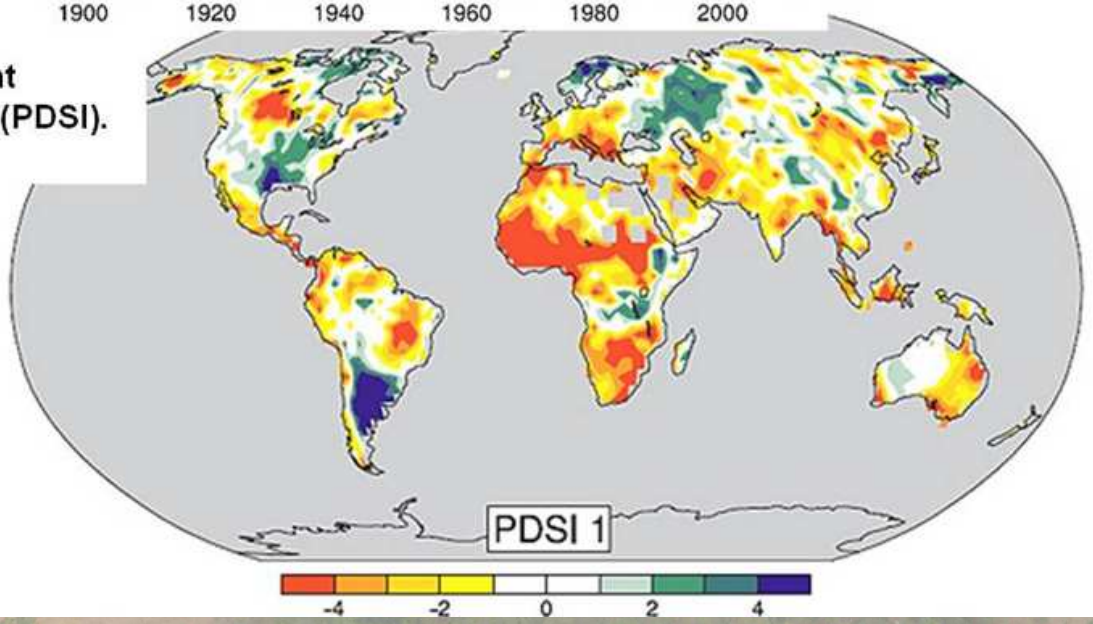




PDSI Increasing Drought

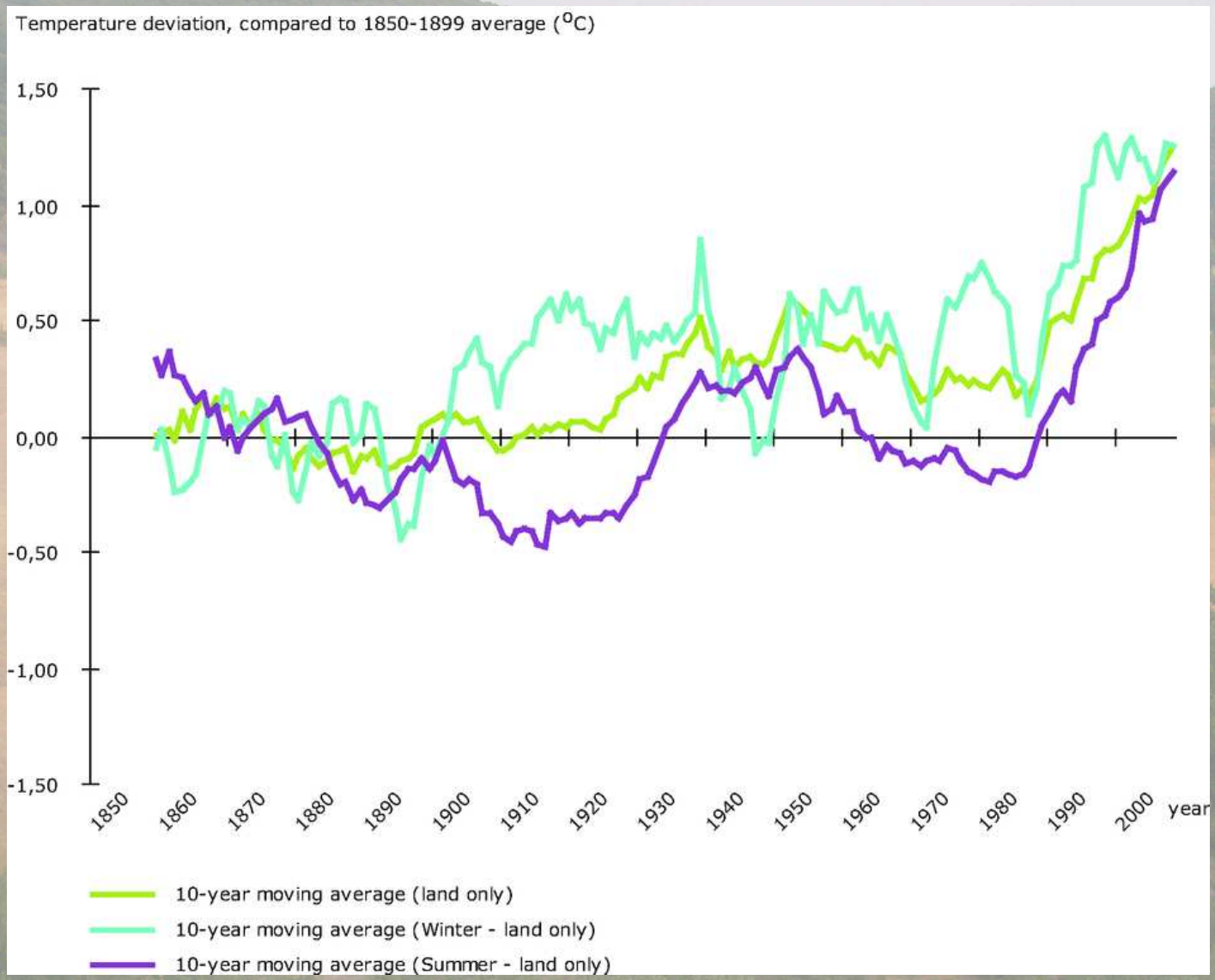


(IPCC, 2007)
Palmer Drought
Severity Index (PDSI).



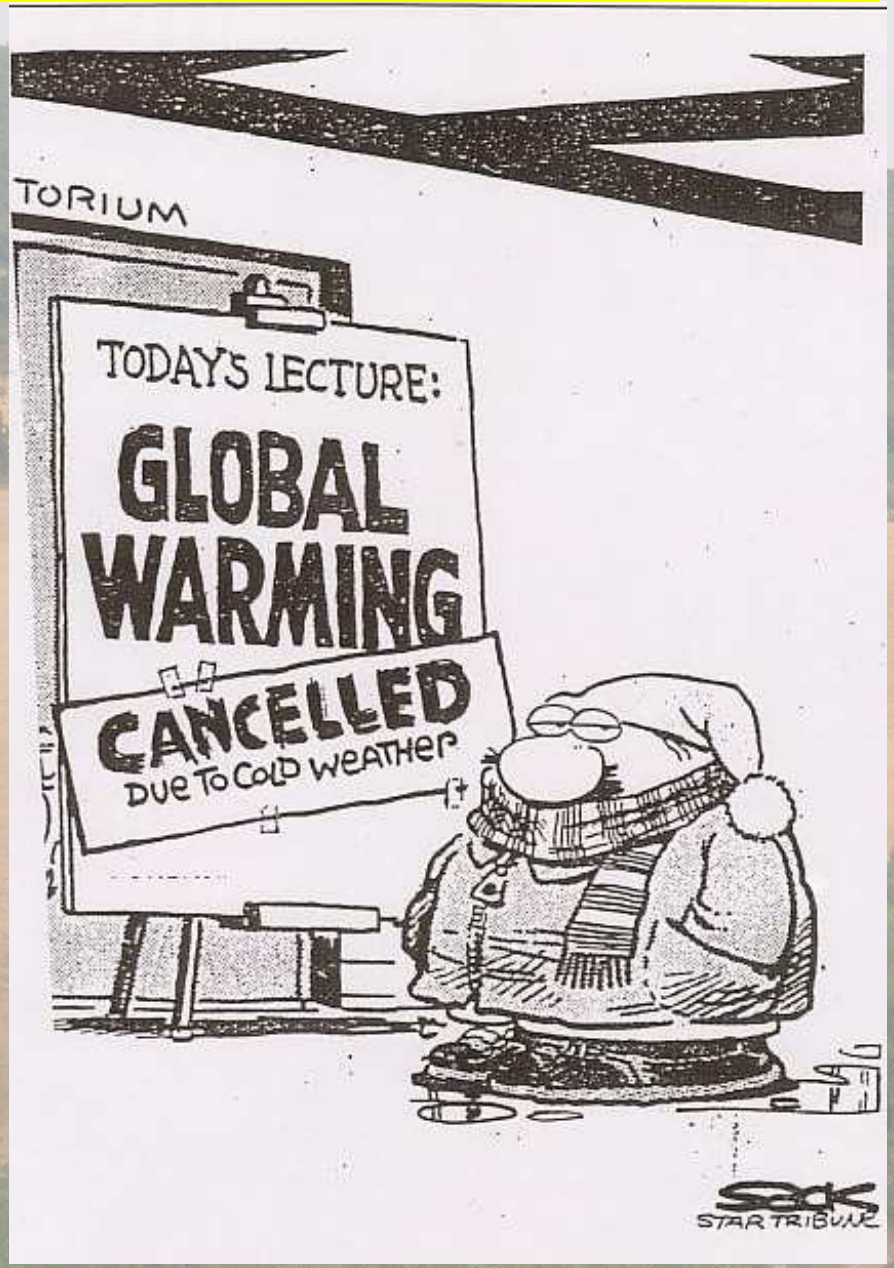

Increase of cold waves

Average temperature increase but……



Source: EEA, based on CRU HadCRU3 and CRUTEM3 datasets

can happen……..


TORIUM
TODAY'S LECTURE:
GLOBAL WARMING
CANCELLED
DUE TO COLD WEATHER
STAR TRIBUNE

Source: Journal of Cosmology, 2010, Vol 7, 1750-1770

up 3 mt of snow!

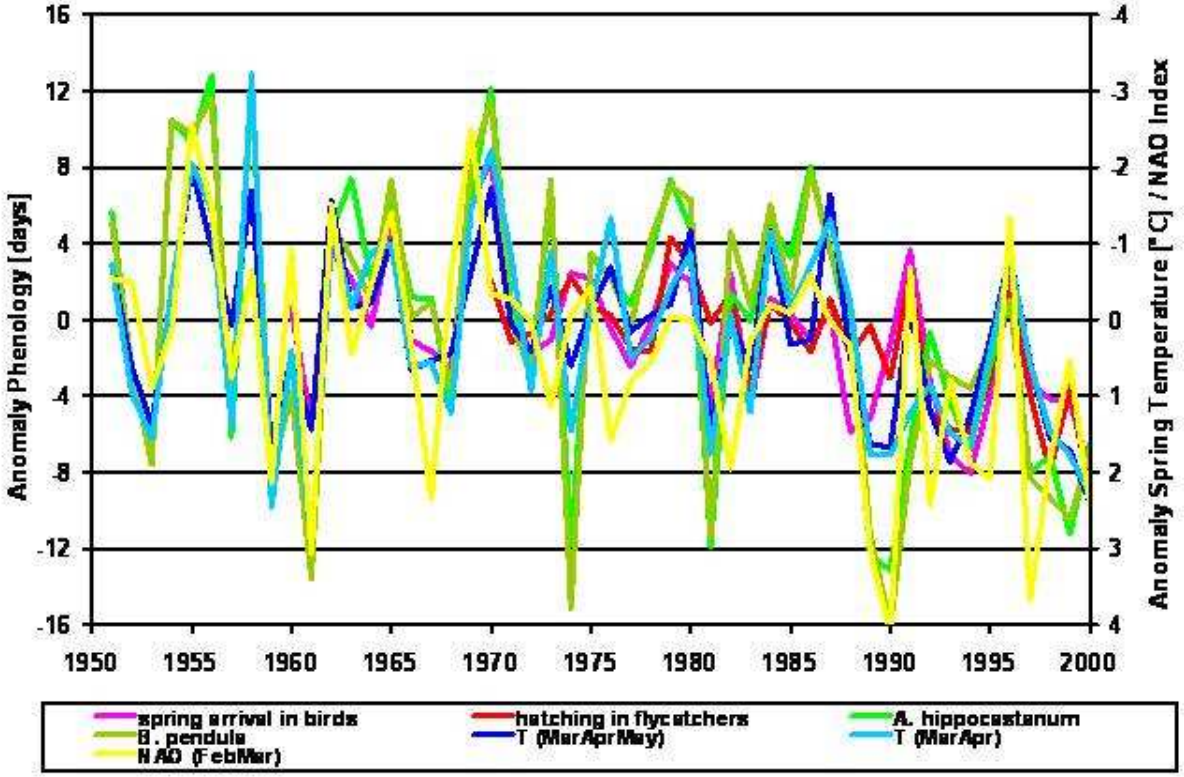
Source: David Duprey, 2001


What about agriculture?

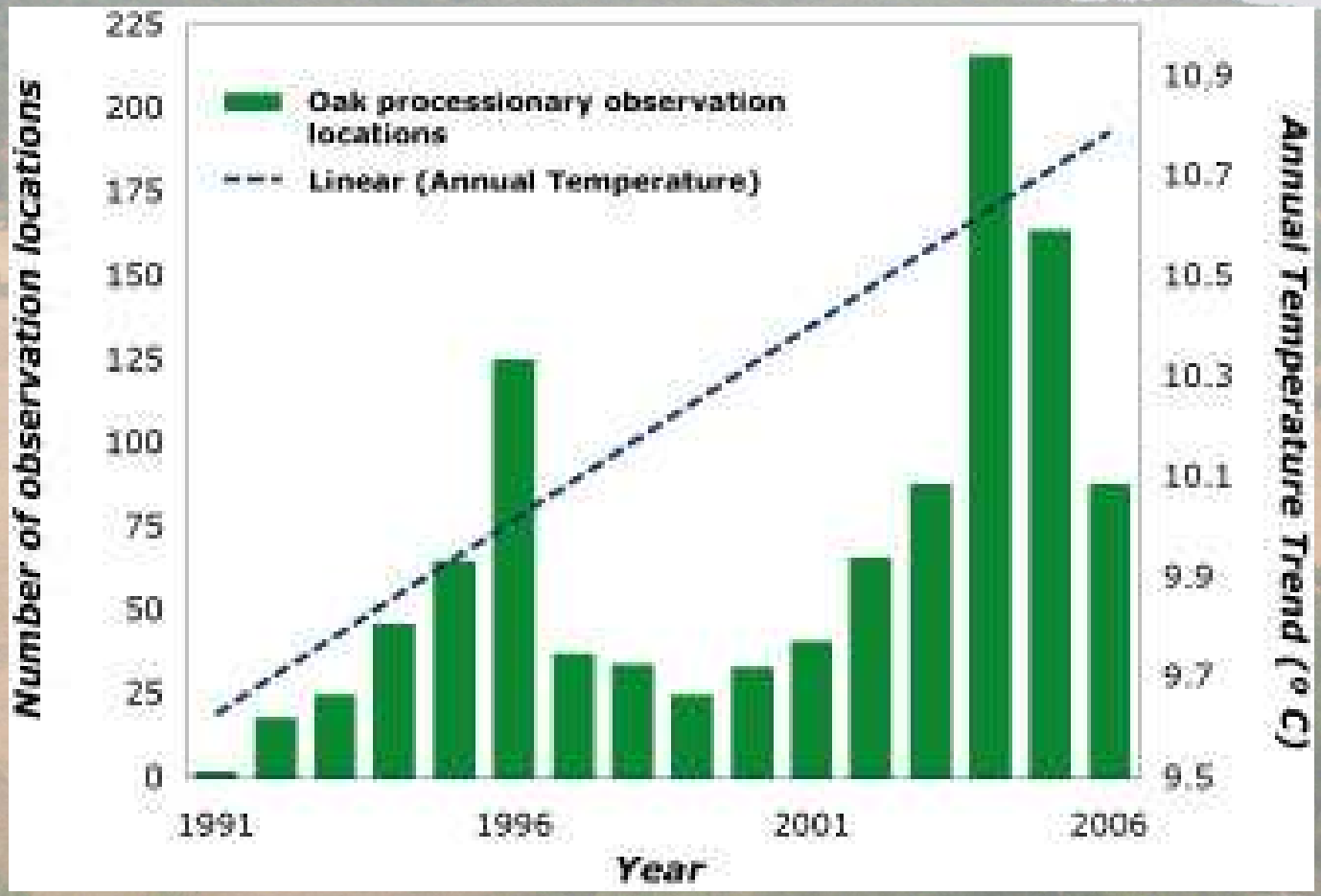
Phenology is changing

Spring Phenological Phases, Temperature and North Atlantic Oszillation (NAO) in Germany

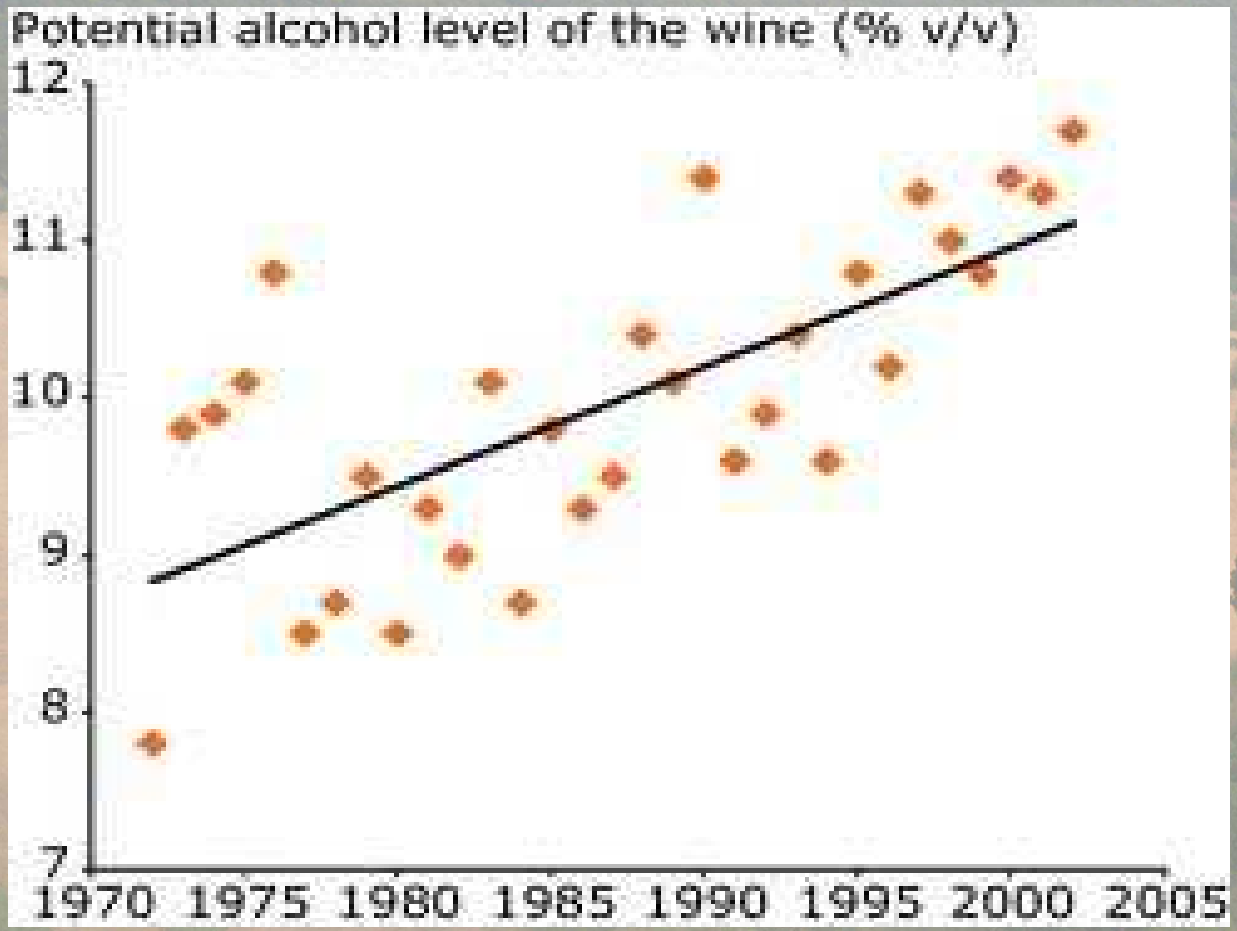
graph modified after **Walther et al. (2002) Ecological responses to recent climate change. *Nature* 416, 389-395.**



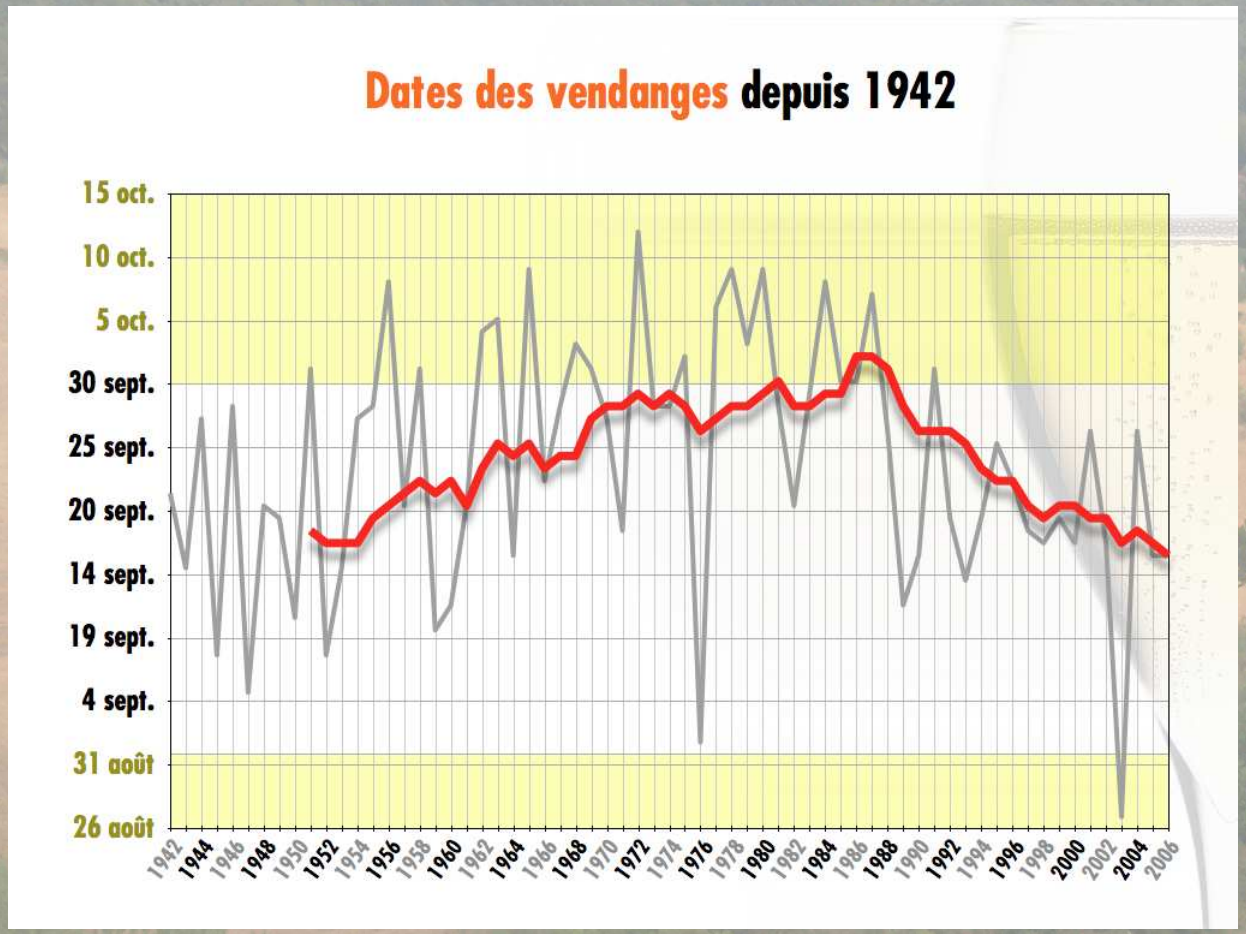
Some insects population are increasing



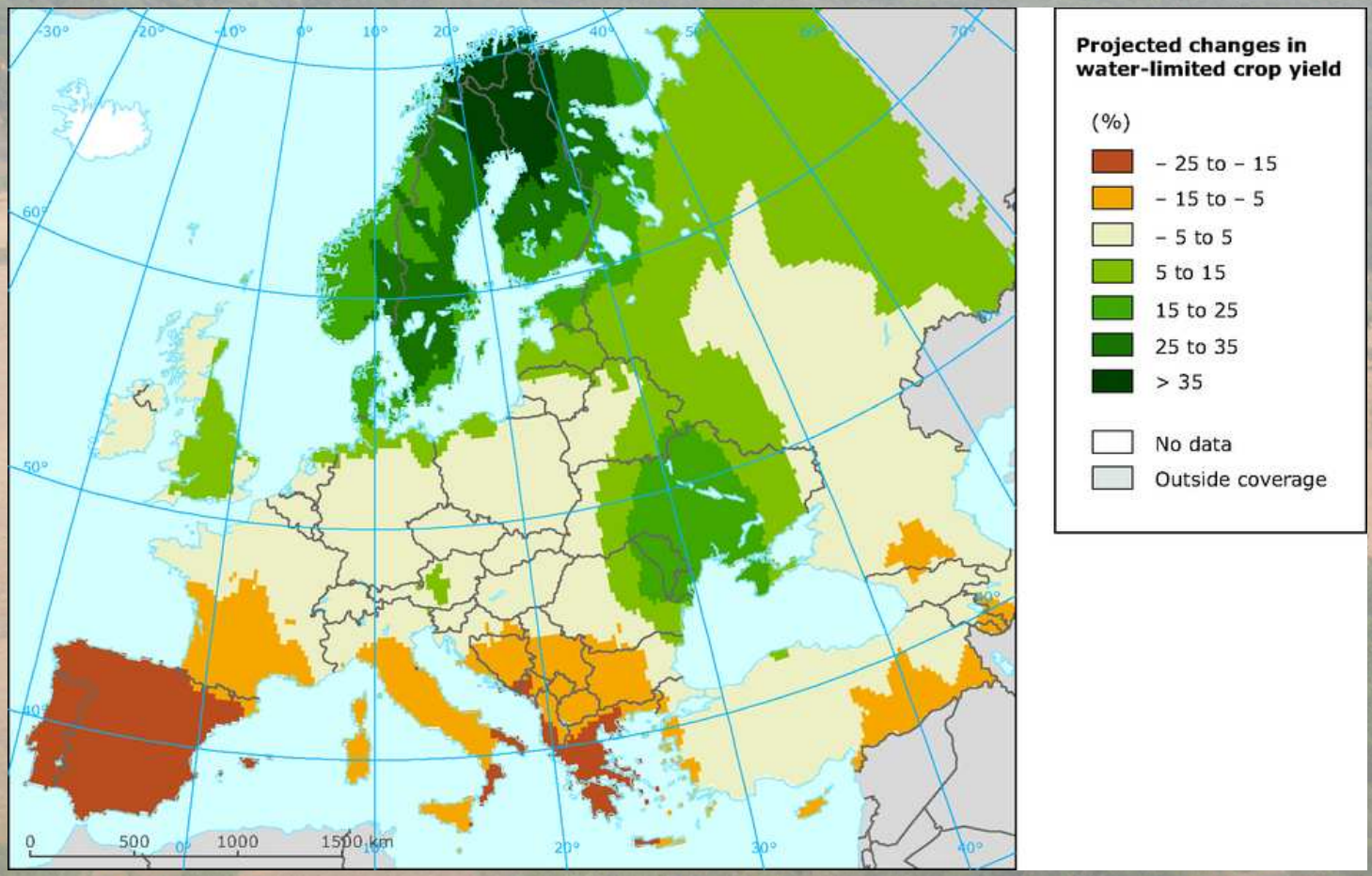
Quality of some products is changing



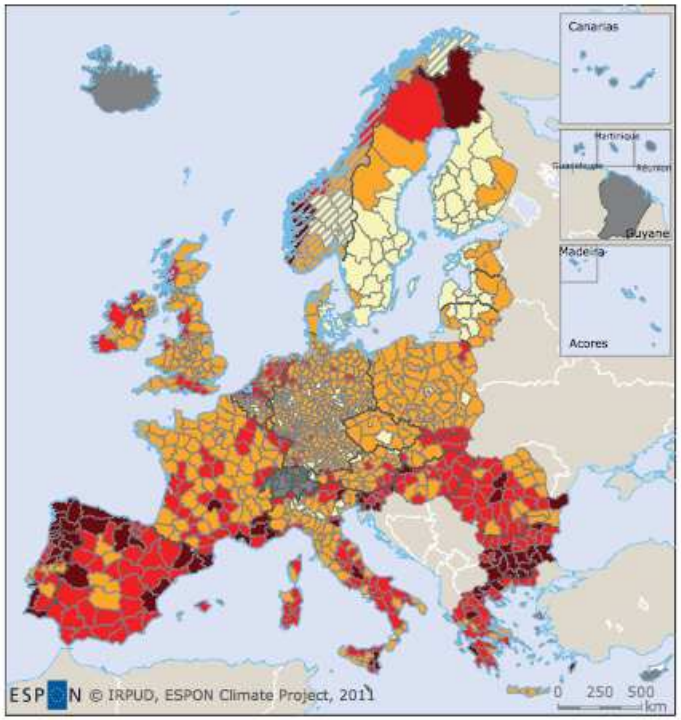
Some dates of cultural practices are changing

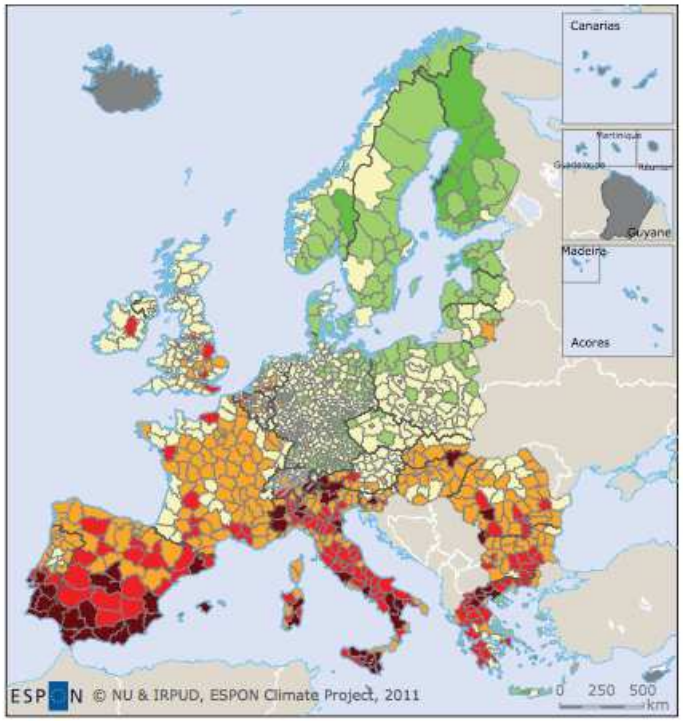


Drought in Southern Europe



Map 5.4 Potential environmental and economic impact of climate change





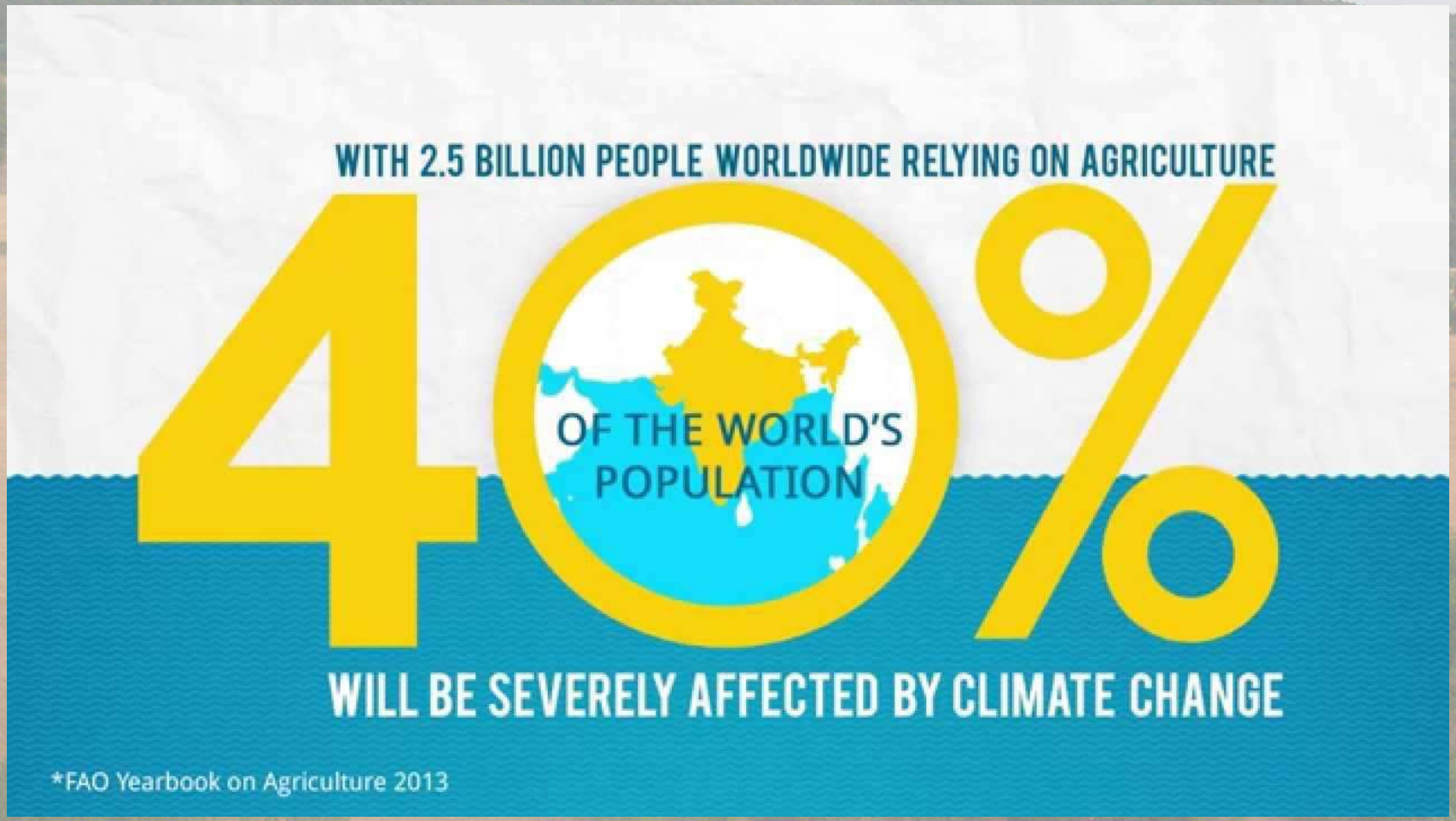
Potential environmental impact of climate change

- Highest negative impact
- Medium negative impact
- Low negative impact
- No/marginal impact
- No data
- Reduced data

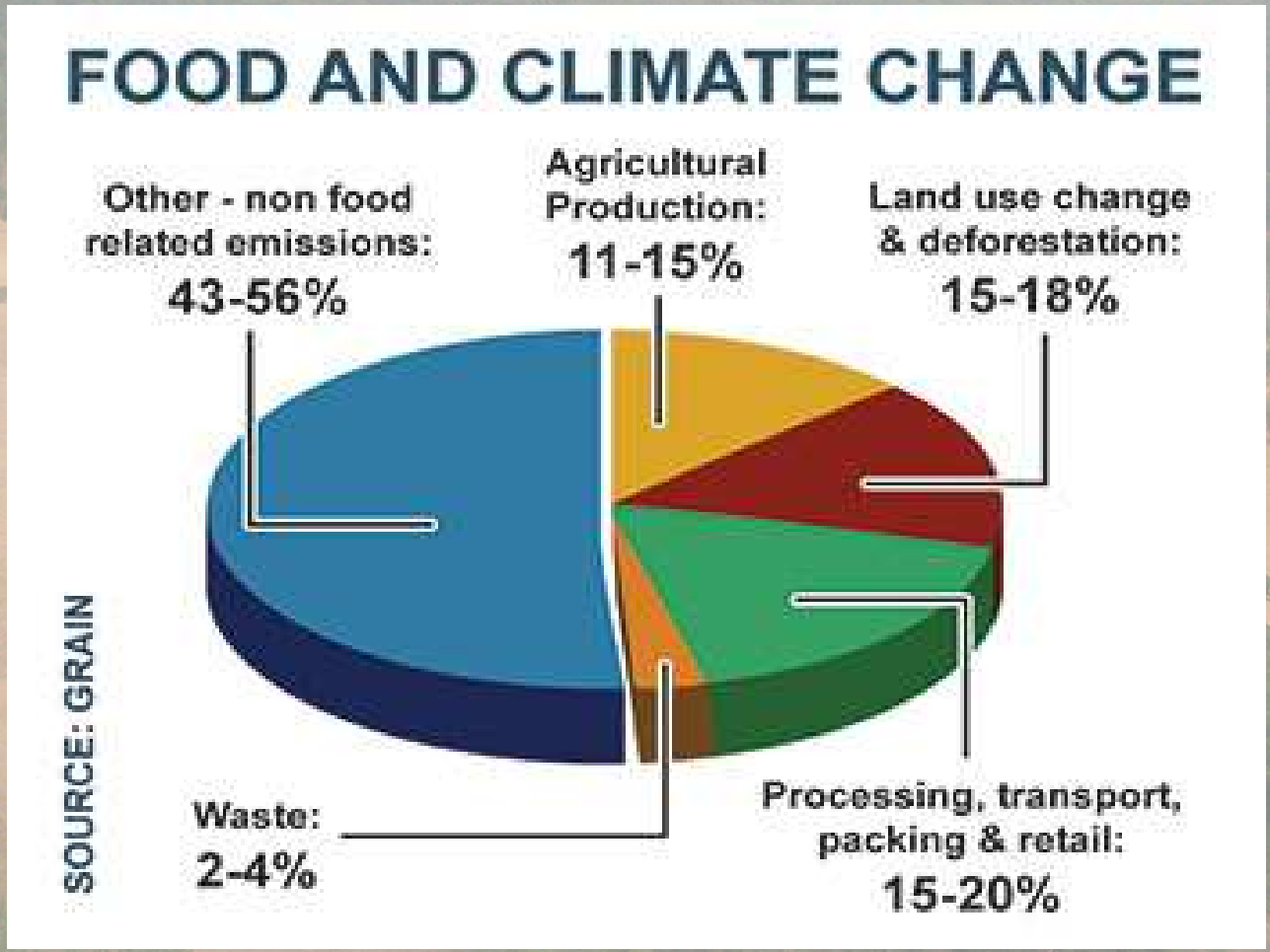
Potential economic impact of climate change

- Highest negative impact
- Medium negative impact
- Low negative impact
- No/marginal impact
- Low positive impact
- Medium positive impact
- High positive impact
- No data
- Reduced data

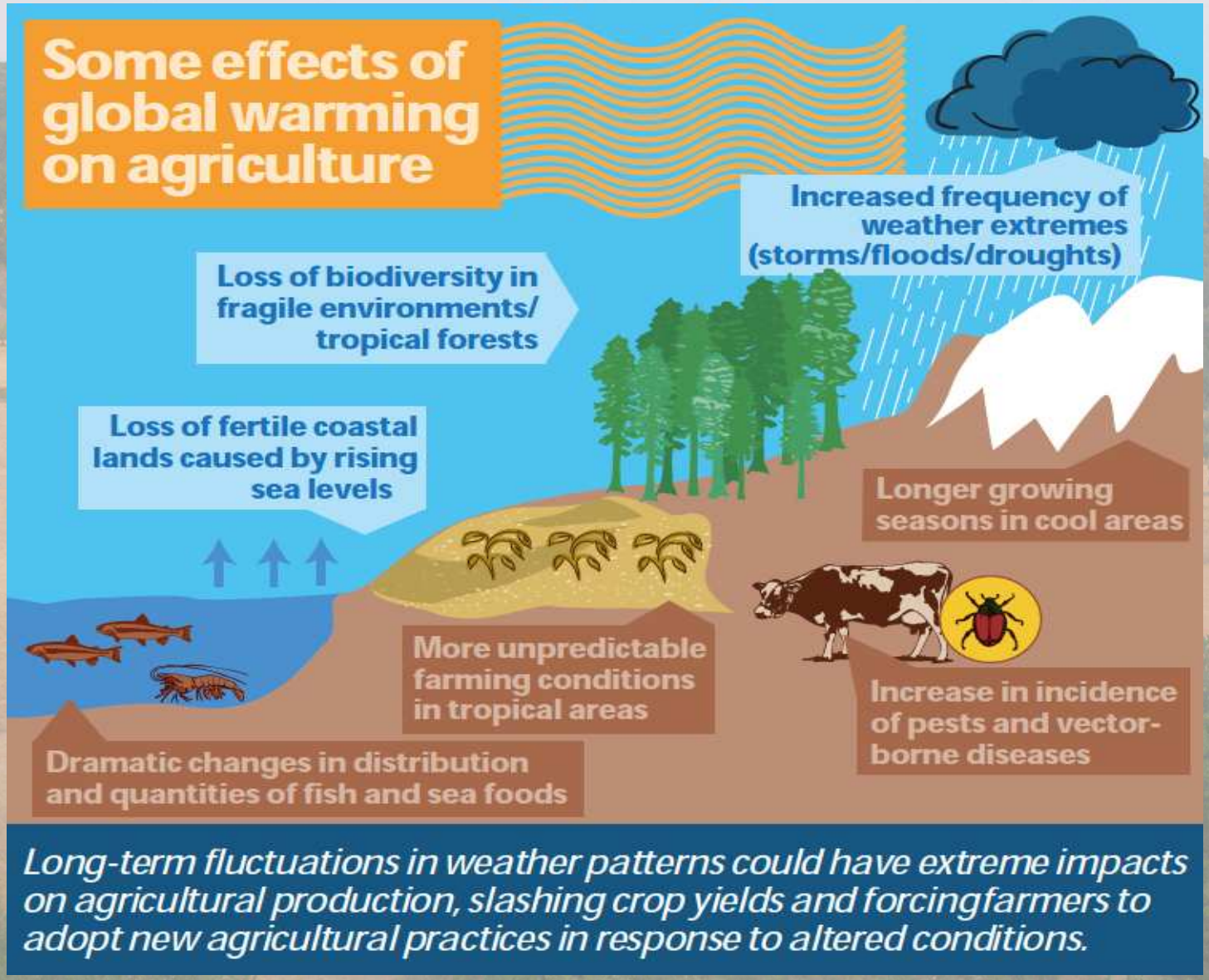
In the future…..



In which way agriculture affects climate change

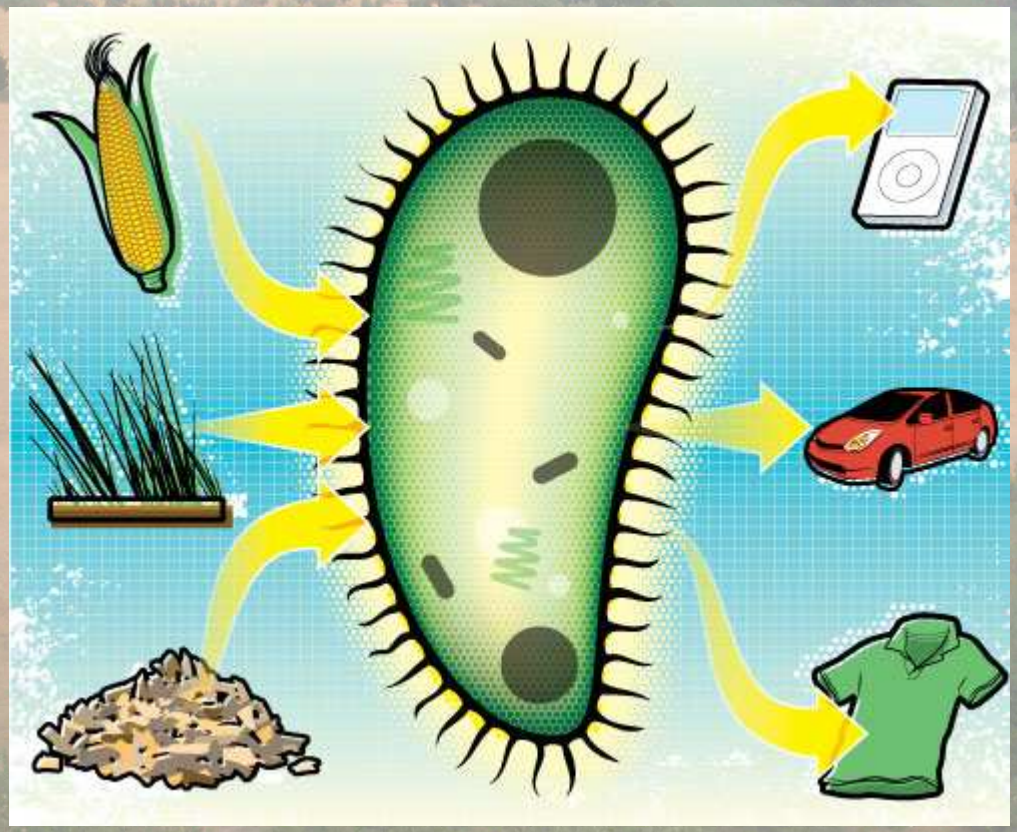


Source: Nyan Zinn


Some effects of global warming on agriculture
Increased frequency of weather extremes (storms/floods/droughts)
Loss of biodiversity in fragile environments/ tropical forests
Loss of fertile coastal lands caused by rising sea levels
Longer growing seasons in cool areas
More unpredictable farming conditions in tropical areas
Increase in incidence of pests and vector-borne diseases
Dramatic changes in distribution and quantities of fish and sea foods
Long-term fluctuations in weather patterns could have extreme impacts on agricultural production, slashing crop yields and forcing farmers to adopt new agricultural practices in response to altered conditions.

Source: FAO

But agriculture is the only human "technology" that converts solar energy into food and no food raw materials



Agriculture = Bioeconomy (EU) is a solution if.....

Modern Agriculture Supposed to be Sustainable Agriculture

Modern agricultural practices enable farmers to meet ALL three goals of sustainability: conserve and protect natural resources; meet the food and fuel needs of a growing population; and be financially viable for both growers and consumers.

Source: Wiki

Agroforesty products could offer a new solution at 0 Km for ecological problems

Bioplastics

Biomass

Biofuels

Dyes

Textile fibers

… and more

What is the obstacle?

Prices of imported products

The Solution?

Price of local product

<

Price of imported product

+

Externalities

(An economic side effect of a market failure)

Examples of Negative Production Externalities

Negative production externalities include pollution generated by a factory that imposes costs on others

When answering any question on negative externalities – consider **whether the external costs are significant** and if so, whether they can be measured and valued accurately

Air pollution from factories

Pollution from fertilizers

Industrial waste

Noise pollution

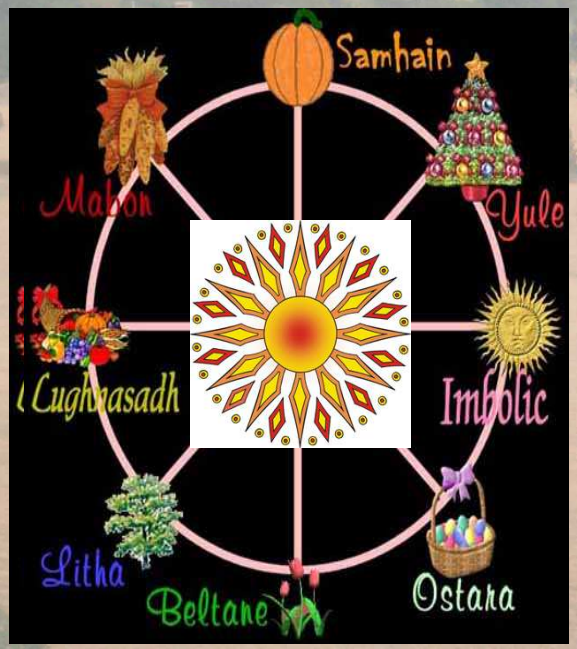
Collapsing fish stocks

Methane emissions

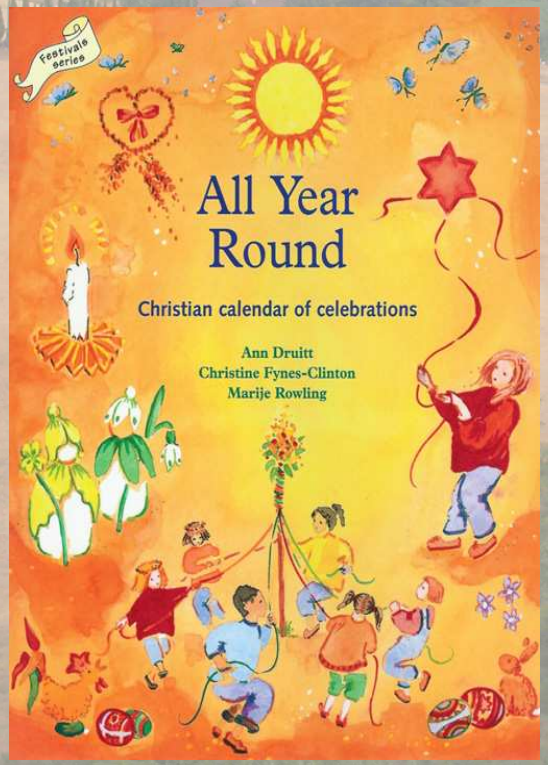
tutor2u

Source: GeoffRiley

Thank you for the attention and……
I'd like to finish my presentation reminding you our traditional calendars, symbol of the relationship with nature



Celtic calendar



Christian calendar

Medieval agricultural calendar