Water2Adapt

Resilience enhancement and water demand management for climate change adaptation

Temperature and Precipitation Trends in Emilia Romagna

Temperature

Data proposed by Arpa Emilia Romagna (Cacciamani et al., 2010), graphed in figure 1, show an increase in temperature trends from the '80s to present, estimating a +2°C in the last 40 years, that is an average of +0.5°C every ten years. In details, the last 20 years result to be the warmest of the whole series. This trend is common to every period of the year, but appears to be more marked during summer.

In a previous document (Cacciamani & Tibaldi, 2007) statistical and deterministic tools were employed to try to regionalize climatic data from European projects Stardex and Ensembles to derive the climate change scenarios for Emilia Romagna. From the analysis of time series regarding temperature and precipitation, some forecasting about the future were obtained: we should expect a further increase in temperature measures (both minimal and maximal), an increase in catastrophic events frequency and duration (especially heat waves in summer) and some reduction in winter's freezing frequency and duration.

Projections from IPCC 2007 report (Solomon et al, 2007) quantify the future warming by an increase of 0.2°C every ten years for a wide range of predictive models about atmospheric circulation (AOGCM), employed to define global scenarios of climate change. Ipcc also notes that, for concentration of GHG and aerosol settled to levels of year 2000, there will be anyway an increment in temperature quantified in 0.1°C every ten years.

Maximal temperature (1961-2008)

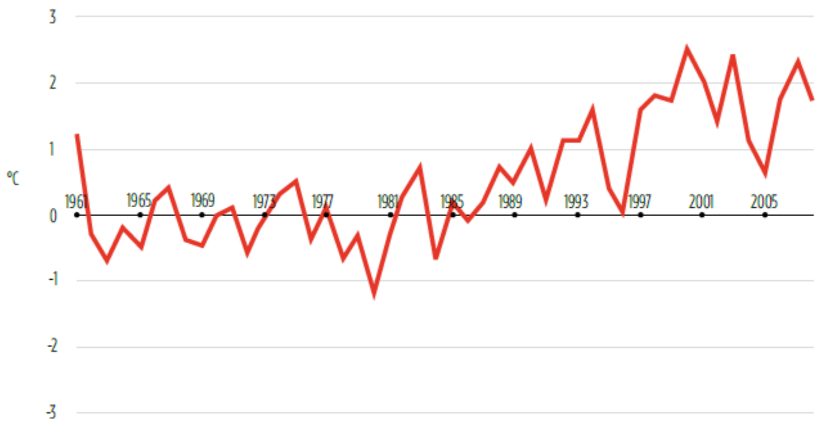

Figure 1. Trends in maximal daily temperature in the last 40 years. (Cacciamani, 2010)

Water2Adapt Project

Water2Adapt (September 2010-August 2012) is an applied-research project which seeks to produce policy-relevant knowledge and recommendations for water management and the implementation of the EU Water Framework Directive. In particular, the project will contribute to the economic analysis of water uses, efforts to set up efficient and socially equitable prices for water and water services, and to assess programmes of measures in the river basins. In addition, capacity workshops will be organised in the case study regions to increase awareness of the topics to which this project seeks to contribute.

Water2Adapt aims to:

- identify 'social drivers' of water scarcity - i.e., the practices which lead to unsustainable consumption and inefficient allocation of water;
- assess the magnitude and mediating factors of water scarcity- and drought-induced impacts;
- revisit the performance and wider impacts of the water demand management policies.

Resilience and adaptive capacity, that is the ability to withstand and recover from significant disruptions (or to absorb and cushion against damage), will be translated into practical management tool applicable at river basin scale.

www.feem-project.net/water2adapt/

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Through the analysis of thermometric time series carried out in about 100 Italian meteorological stations (Brunetti, 2007), a less significant increase in temperature is deduct. Data shows an increment of 1°C every 100 years, uniformly distributed through all Italian regions.

This analysis takes in exam the regional mean series instead the single stations, to make the statistical signal more solid and less prone to casual errors.

Time series shown in figure 2 show a stationary trend until 1970, followed by a rapid increase leading to 2003, the warmest year of the whole series. Observing seasonal series, significant differences can be highlighted; in particular, the strong warming increase in the last part of the series is noticeable during spring and summer, but not during autumn and winter, seasons in which this trend is less marked.

Annual mean temperature (1800-2007)

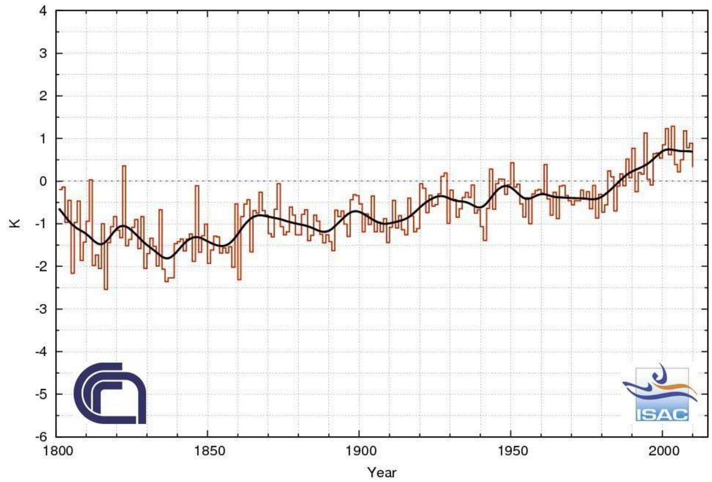

Figure 2. Temperature time series for the past 200 years. (Brunetti 2007)

Ingv (National Institute of Geophysical and Volcanology), assisted by Cmcc, created a model about long-term temperature mean variation, with an atmospheric resolution of 100 km (Navarra, 2007). Results from this simulation for the Mediterranean basin based on the Ipcc scenario A1B are shown in figure 3.

This model agrees with previous analysis, forecasting an increase of some degrees in the next summers temperatures. Other models (Ukmo) give even higher warming values.

At a glance, during next 100 years we can expect a general increase in mean surface temperature, geographically distributed like the past warming anomalies of 2003 summer, and a size of 3.5-4°C on seasonal basis.

Surface temperature differences JAS (2061-2090 minus 1961-1990)

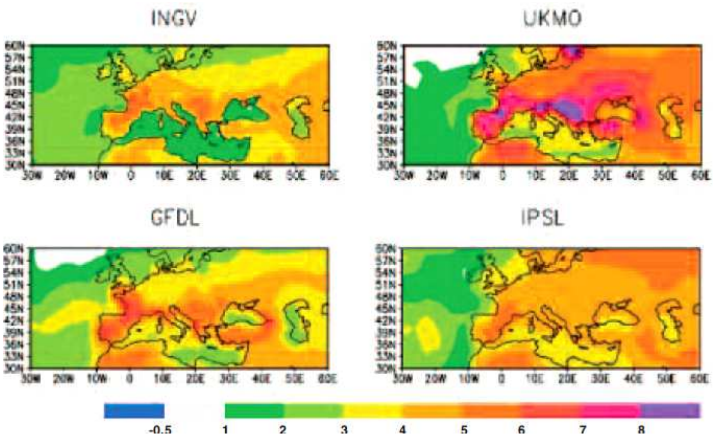

Figure 3. Difference of mean summer surface temperature for A1B scenario. Four different models.(Navarra, 2007)

Precipitation

Analysis from Arpa (Cacciamani & Tibaldi, 2008) quantify the reduction of annual mean precipitation in the last 30 years by 20%. This analysis detect an overall decrease of rainfall and, in parallel, an increase in important rain episodes by some degrees. The decline is estimated to 50% during spring and summer, while it is much less marked during autumn. Snow precipitation in winter result to be equally decreasing, so as the volume of glaciers and snow cover, as a consequence of the shorter duration of the snow accumulation season (which starts later and ends earlier). A prosecution of the actual negative trend is expected for the future, with an increase of interannual and interregional variability.

This trend, joint with the progressive increase in water consumption, provoke a significant reduction in the mean water flow of Po river, especially in the final section part of the basin (Pontelagoscuro sector), by 20% on annual basis and by 45% during summer season (1975-2006).

In a more recent research (Cacciamani et al., 2010) it is highlighted how the general reduction of precipitation happens with a sudden negative shift of the values from the beginning of the ‘80s compared to the ‘60s-‘90s thirty mean (see figure 4).

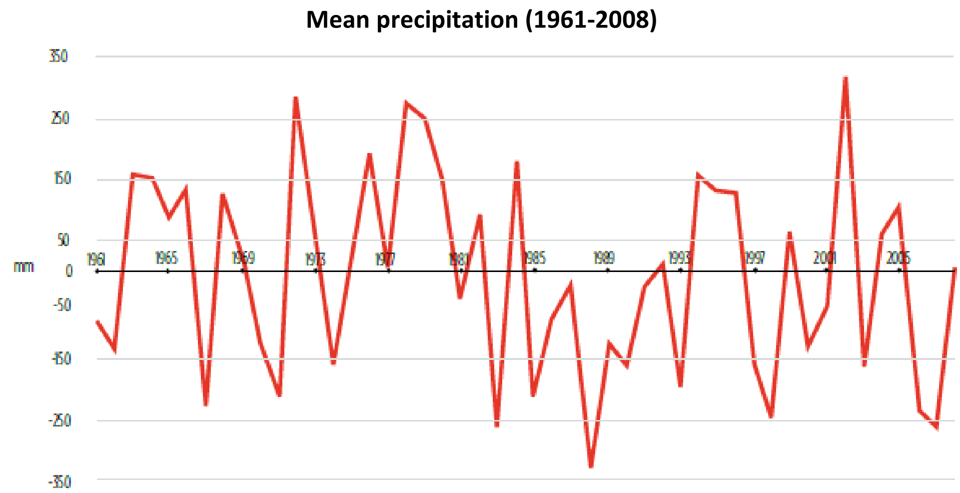

Figura 4. Trends in mean annual precipitation anomalies in Emilia Romagna in the last 40 years. The anomaly is calculated compared to reference climate of 1961-1990. (Cacciamani, 2010)

The difference in mean rainfall quantities in the last 25 years is estimated to be about 100 mm. It is a noticeable measure, corresponding to 10% of the mean annual rain in Emilia Romagna.

However, these conclusions disagree with analysis complied by CNR (Brunetti, 2007). This research focus on secular time series measured in 100 Italian stations. The decrease in precipitation is still visible, but it is defined as "minor and statistically little significant".

As shown in figure 5, the sequence of relative maximum and minimum in annual precipitation does not highlight any significant tendency towards an increase or decrease. As for the thermometric series, also in this case there is a good correspondence between different regional series.

The trends values are slightly negative, but this is caused by a particularly high value of rainfalls in the first decades of the series; while if we consider the series from 1900, this trend tends to be not important. However, it notes how the trends tend to become slightly more negative in the last 50 years.

Taking in account the Ingv/Cmcc model again (Navarra, 2007), it is forecasted that winter precipitation will be probably quite less intense.

Values shown in figure 6 speach for a reduction of 20% of the actual precipitation on seasonal basis. This, together with temperature rising, will cause a sharp shift in the solid/liquid precipitation ratio, especially on the Alps.

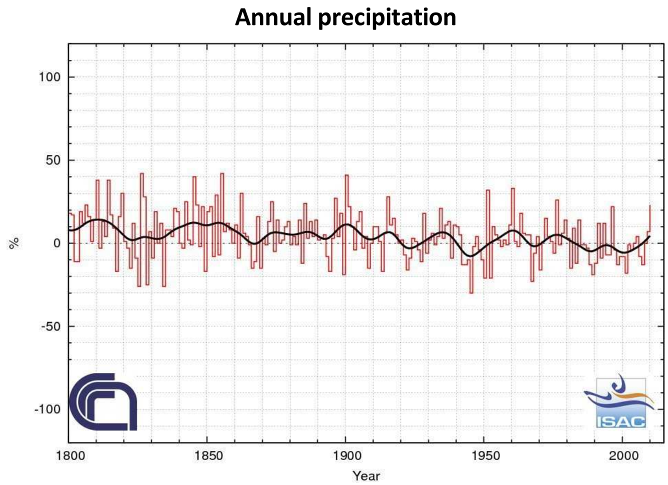

Figure 5. Precipitation time series for the past 200 years. (Brunetti 2007)

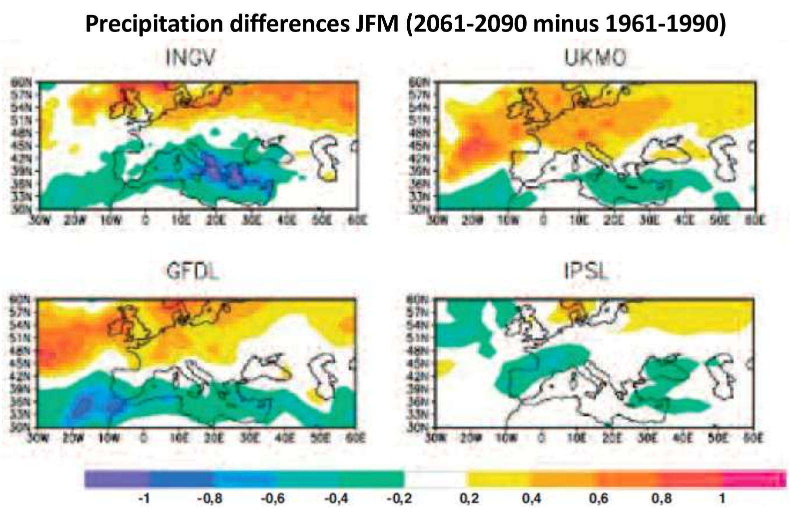

Figure 6. Difference of mean winter precipitation for A1B scenario. Four different models.

Models concords describing a shift of the rainbands to north. However, we should note how the major changes happen above and under our area of interest, while the area of the Po river basin itself seems to remain stable.

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Water2Adapt Project

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