Regional climate model projections for North-East Italy

Giovanni Massaro[1,*] and Piero Lionello[2]

[1] *ARPA Veneto, Servizio Centro Meteorologico, Teolo (PD), Italy;* [2] *Università del Salento, Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Lecce (LE), Italy*

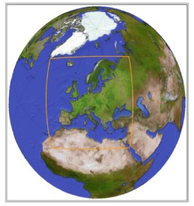
Abstract

This study has analyzed an ensemble of EURO-CORDEX high resolution (0.11 degs) regional climate model (RCM) simulations of the low emission RCP2.6 and high emission RCP8.5 scenarios for North-Eastern Italy for the 21st century covering. It has considered the seasonal anomalies of temperature, precipitation and annual anomalies of heat-wave duration (HWDI) and intense precipitation totals (R95pTOT). Three 30-year periods have been selected: a baseline period (from 1976 to 2005), near future (2021-2050) and far future (2071-2100). Results show the large differences between a low and a high emission scenario for climate change in North-East Italy. In the former case temperature and precipitation changes tends to stop in the second part of the 21st century. In the latter climate change continues along the whole century and substantial warming (+5°C in summer, +4°C in winter), increase of winter precipitation (+15%) and decrease of summer precipitation (-10%) are expected in the far future. Warming is larger in Alpine regions than in coastal and flat areas. Further, particularly in the mountain areas there is an increase of duration of heat waves and of intense precipitations.

Motivation

The **Mediterranean region** is expected to be a climate change **hot spot** at global scale, with differences between North and South areas. Global Climate Models (GCMs), with typical resolution of 100 km, do not properly catch many orographically-induced fine scale structures in the precipitation change signal. On the other hand, **Regional climate models (RCMs)** can achieve a resolution one order of magnitude larger than GCMs by dynamical downscaling. A good assessment of climate change at regional scale is essential for evaluating potential impacts, developing adaptation strategies and assessing the importance of mitigation actions.

Dataset

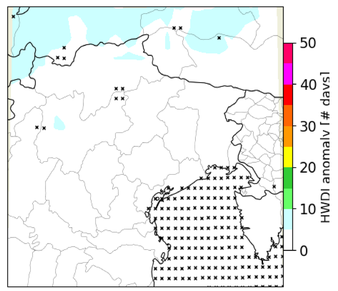


- European state-of-the-art RCMs: EURO-CORDEX **0.11degs**. CMIP5 GCMs
- Daily mean/max **temperature**, **precipitation**. Not perturbed ensemble members
- Historical: 1950-2005. Scenarios: 2006-2100
- Representative Concentration Pathhways **RCP2.6**, RCP4.5, **RCP8.5**

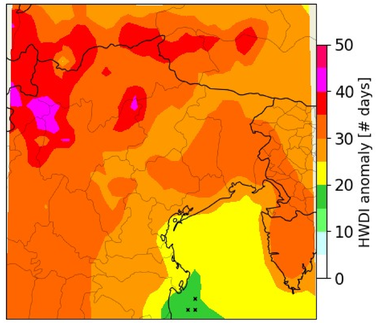
Methodology

- Regridding at 0.10 degs (about 12.5 km), area Triveneto (LAT: 44.55°-47.35° LON: 10.10°-14.20°)
- Annual and 30-year seasonal anomaly: reference **1976-2005**
  'near-future' **2021-2050**
  'far-future' **2071-2100**
- Average over the domain and geographical distribution
- Ensemble mean: best future projection. Ensemble spread: uncertainty
- Climate change is significant when: ensemble mean anomaly > inter-model st.dev.
- **Extreme events**: Heat Wave Duration Index TX>5°C for 5 consecutive days (**HWDI**); annual total precipitation RR>95th percentile (**R95pTOT**)

2071-2100 JJA rcp26



2071-2100 JJA rcp85

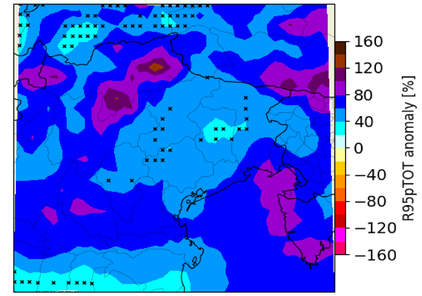


Extreme events

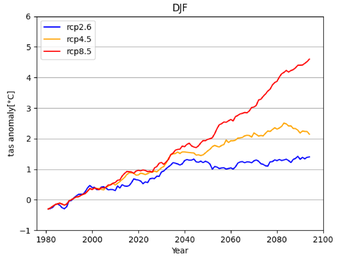
A high emission scenario would very likely imply much larger changes of mean temperature, precipitation and their extremes than a low emission one.

Particularly, considering RCP8.5, in the mountain areas and the period 2071-2100 it is expected an increase of duration of heat waves (reaching **45 days**), entailing many potential negative impacts such as physical discomfort. Further, it is also expected an increase of intense precipitations especially in the Alpine region (up to **+140%**), suggesting increasing risks of river floods.

2071-2100 DJF rcp85

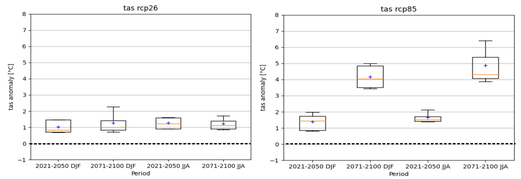


Temperature



Considering the most conservative scenario **RCP2.6** and most extreme scenario **RCP8.5**, the temperature anomaly is between 1.5°C and 4.5°C at 2100 in winter, and between 1.5°C and 5.5°C at 2100 in summer.

Large agreement among ensemble members, which indicate significant **heating** for both future periods and RCPs.

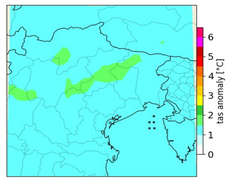


Large differences between RCP2.6 and RCP8.5 temperature anomalies. For RCP2.6, the anomaly is between **1°C** and **1.5°C** both in the near and far future and winter and summer. For RCP8.5, the anomaly is within 1°C and 2°C in the near future; in the far future it is between **3.5°C** and **5°C** and from **4°C** to **5.5°C** in winter and summer, respectively.

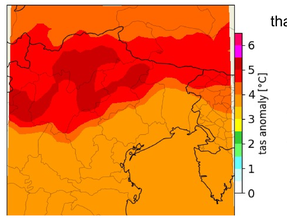
Temperature anomaly is larger in summer than winter.

Coastal and flat areas are much less affected by the warming than mountain areas.

2071-2100 DJF rcp26

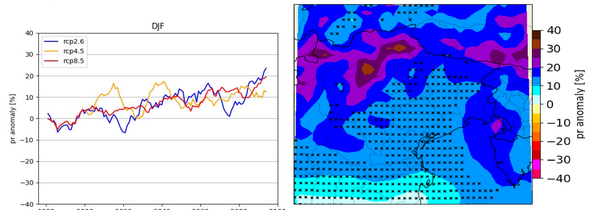


2071-2100 DJF rcp85



Precipitation

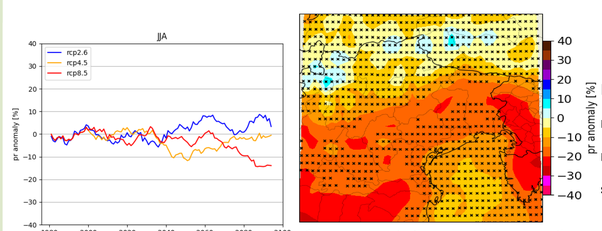
2071-2100 DJF rcp85



Good agreement among models exists only for the RCP8.5 and far future.

In **winter** the precipitation anomaly is positive, larger for inner Alps (from +15% to +35%) than flat areas.

2071-2100 JJA rcp85



In **summer**, the anomaly is negative, with a maximum in the range from -15% to -25% in southern Alps.

Crosses denote the grid points where the agreeemeent among models is low.

Conclusions

- **Warming in all seasons**, stronger in summer than winter and in the mountain than flat areas, **much larger in a high emission than in a low emission scenario**. For RCP8.5 **increase of heat-wave duration**.
- Minor significant changes of precipitation in a low emission scenario. Contrasting seasonal change in a high emission scenario with **increased precipitation in winter** and **decreased in summer. Extreme precipitations increase** in winter.

A future low or high emission scenario will make a large difference for climate change in North-East Italy

* *Contacts: Giovanni Massaro, giovanni.massaro@arpa.veneto.it*