Factors driving the Mediterranean water cycle from a cold and wet glacial past to a warm and dry future

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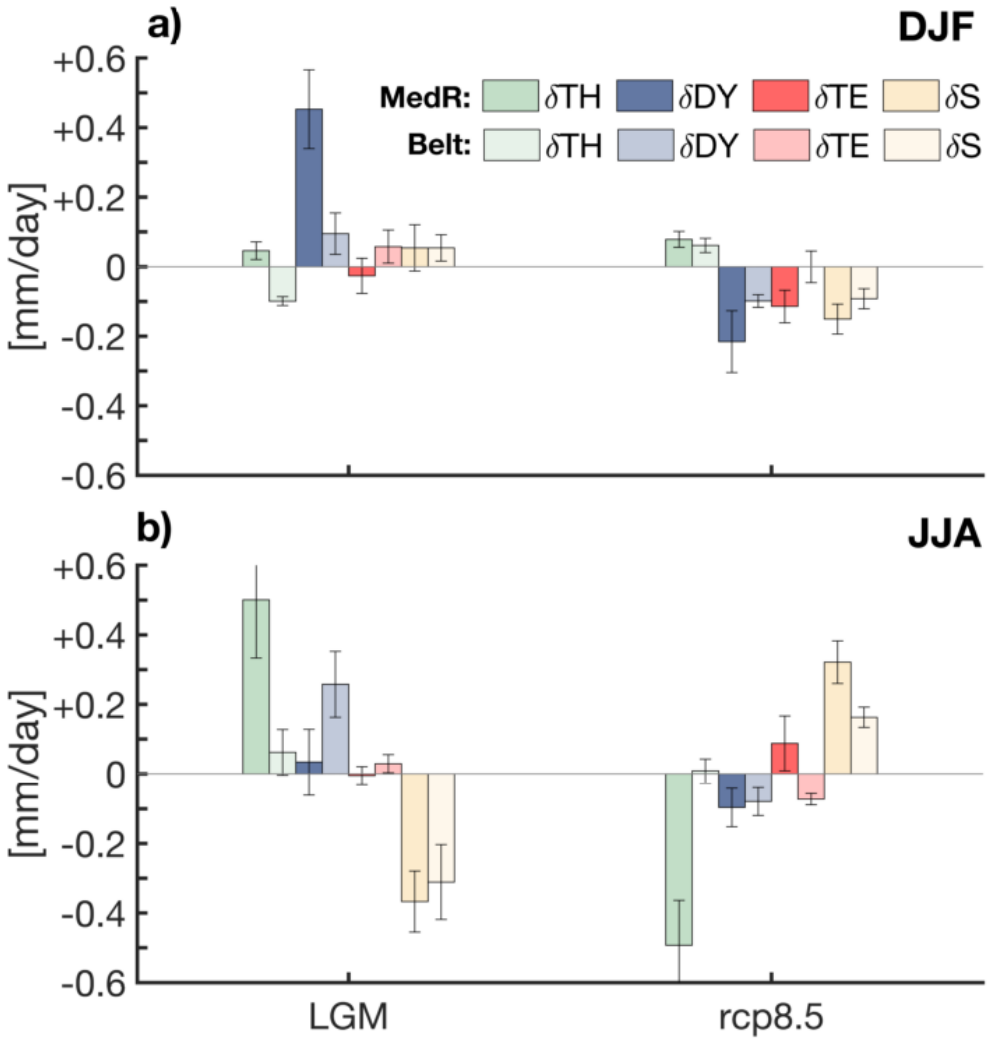
- Model simulations of the Mediterranean atmospheric moisture budget in the last glacial maximum (LGM) and RCP8.5 suggest that **factors responsible for past and future changes in the Mediterranean region are different**.
- In both cases, the Mediterranean region appears to be **more sensitive to climate change** than the rest of areas within the same latitudinal range, particularly considering the hydrological cycle, whose characteristics in winter exhibit large changes between these two different climates.
- These **changes are mainly caused by atmospheric dynamics** (changes of mean atmospheric circulation) **in WINTER** and **by the atmospheric thermodynam**ics (reduction of mean moisture content) in **SUMMER.**
- These conclusions emerge from the **substantial consensus among six PMIP3 and CMIP5 models**, simulating LGM, pre-Industrial and rcp8.5 climate conditions.
- The complex spatial interplay of the atmospheric moisture budget contributions results in **reduced precipitation in the rcp8.5 and reduced evaporation in the LGM relative to PreIndustrial.**
- This analysis shows that **past (LGM) and future (rcp8.5) atmospheric moisture budget changes have very different basic mechanisms**, which cannot be simply linked to changes of global mean temperature.

Based on D'Agostino R and Lionello P (2020) The atmospheric moisture budget in the Mediterranean: mechanisms for seasonal changes in the Last Glacial Maximum and future warming scenario (submitted)



Bars on the left/right parts shows variations in LGM/rcp8.5 with respect to preindustrial. Top panels for winter, bottom panels for summer

Contributions to the atmosheric moisture budget variations with respect to pre-Industrial

(spatial averages over the Mediterranean and all areas between 30°N--46 ° N except the Mediterranean, denoted as Belt)

δTH represents the local change of atmospheric moisture budget that is caused by the change of mean humidity

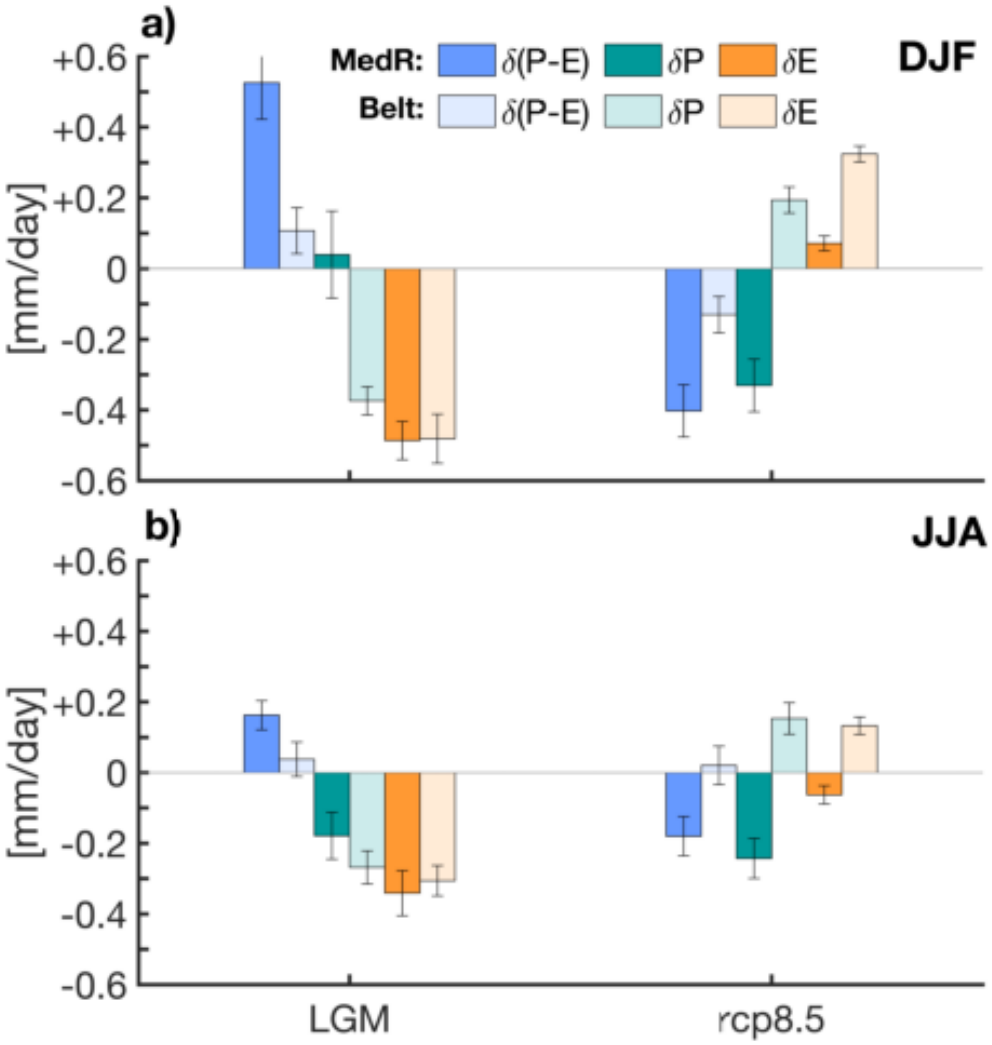
δDY is caused by the local change in the mean flow

δTE effect of the transient eddies, including all fluctuation of humidity and wind speed at sub-seasonal scale (such as cyclones and anticyclones)

δS Change of the surface moisture transport along the surface pressure gradient

This figure shows that changes in the Mediterranean region are caused by atmospheric dynamics (changes of mean atmospheric circulation) in WINTER and by the atmospheric thermodynamics (reduction of mean moisture content) in SUMMER

The behaviors of Belt and Mediterranean are quite different



Bars on the left/right parts shows variations in LGM/rcp8.5 with respect to preindustrial. Top panels for winter, bottom panels for summer

Changes of P-E, Precipitation, Evaporation with respect to pre-Industrial

(spatial averages over the Mediterranean and all areas between 30°N--46 ° N except the Mediterranean, denoted as Belt)

This figure shows that:

In the Mediterranean the wet LGM conditions are determined mainly by low evaporation (with some increase of precipitation in the western areas) while dry rcp8.5 conditions are driven by a reduction of precipitation over the whole region.

The behavior of the Mediterranean is different from the Belt. In the Belt, increased/ decreased precipitation corresponds to increased/ decreased evaporation, so that changes of precipitation and evaporation partially compensate each and produce small P-E variations

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