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Evolution of the Mediterranean climate in the last 7000 years in coupled model simulations with ECHO-G

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Two simulations with the atmosphere-ocean general circulation model ECHO-G have been analyzed for temperature and precipitation changes over the last 7.000 years over the Mediterranean area (11° E – 41° W and 29° N – 42.5° N). The first simulation has been driven with changes in orbital forcing (ORB), the second with additional changes in solar activity and changes in greenhouse gas concentrations (ORBSG).

On an annual basis the evolution of the near-surface temperatures averaged over the Mediterranean domain shows for both simulations a negative temperature trend throughout the Holocene. This trend is most likely caused by changes in orbital forcing.
Seasonally resolved analysis shows distinct differences compared to the annual means. For example, temperatures show no clear trends for the winter and spring season in the ORB simulation, whereas summer and autumn show very clear negative temperature trends, in accordance with changes in external orbital forcing. For summer this trend is not linear, i.e. temperatures already reach a present-day level around 3,000 years BP, whereas autumn temperatures show a more linear trend. Differences between the ORB and he ORBSG simulation are evident in terms of increasing temperatures in ORBSG during winter and spring. This increase is most likely due to the increase in CO_2 in the ORBSG simulation in the course of the Holocene. Moreover, in ORBSG at decadal time scales weak correlations with changes in solar activity are evident.

Whereas the link between external forcing and temperature is clear, this is not the case for precipitation despite a long term negative trend on an annual basis. This negative trend most likely results on the negative trends during spring and autumn. An interesting feature pertains to summer precipitation with a precipitation maximum around 3,000 years BP in both simulations.

The simulations can be used to compare results with climate indices based on proxy reconstructions. A virtue of the simulations is also to test on the stability in the climate-circulation relationship, for example between the North Atlantic Oscillation (NAO) and temperature and precipitation fields. This is important to test the assumption of the stability of statistical transfer functions trained with recent observational data for longer time periods.