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Identifying sources of changed precipitation in paleoclimate studies through moisture tracking: A case study for orbital extremes over the Mediterranean Sea

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Enhanced winter precipitation over the Mediterranean Sea at times of minimum precession and maximum obliquity could provide freshwater required to form orbitally-paced sedimentary cycles across the Mediterranean Sea floor, offering an alternative to monsoonal runoff. We investigate the sources of the enhanced winter precipitation by applying a moisture tracking model (WAM-2layers) on the results of idealized orbital extreme experiments with a state-of-the-art climate model (EC-Earth).

Tracking the moisture sources of the enhanced winter precipitation over the Mediterranean Sea shows that the source differs during the winter half year. In fall, the majority of the precession-induced precipitation increase originates from the Mediterranean itself. However, in late winter, the increase can be attributed to enhanced moisture advection from the Atlantic. This agrees with changes in evaporation and air-sea temperature differences over the Mediterranean. The obliquity-induced precipitation increase shows much less differences, with an equal contribution of local and Atlantic sources.

The mechanism behind the Atlantic source of moisture is not related to storm track activity, but to a weakened Azores High and slightly higher surface pressure over North Africa. The resulting anomalous circulation patterns generate enhanced Atlantic moisture transport towards the Mediterranean. Our combined climate and moisture tracking modelling approach thus provides an alternative mechanism for Atlantic sources of orbitally-paced Mediterranean precipitation changes.

The results of this study have been published in:

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The atmospheric moisture tracking through WAM-2layers revealed concrete information about the evaporative sources of enhanced/reduced precipitation. This method has not been previously applied in paleoclimate studies, but thus proved to be a powerful tool in attributing reasons for precipitation changes in addition to climate model experiments and classical meteorological analyses. New ideas for collaborations to apply this method in other (paleo)climate studies are welcome.