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Causes of future Mediterranean precipitation decline depend on the season

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Motivation

- The Mediterranean is a **climate change hot-spot**.
- The projected year-round **precipitation decline** is a central factor.
- We aim to **determine the causes** of the Mediterranean precipitation decline throughout the year.

Method

An ensemble of 2 **regional climate simulations** is used to simulate the end of century precipitation change (1971-2000 vs. 2070-2099) assuming RCP8.5. The ensemble is based on the GCMs MPI-ESM-LR and HadGEM2-ES and the mean is analyzed. By performing simulations with modified lateral boundary conditions we can **assess the importance of four different drivers** of climate change. The four different drivers are extracted from future climate projections and each driver is imposed on simulations of the current climate. The following drivers are assessed:

1) Thermodynamics & Lapse-rate (TDLR): Warming, moistening & stability change. No dynamic changes.

2) Sea surface temperature (SSTE): Land-sea warming contrast. No dynamic changes. Includes TDLR.

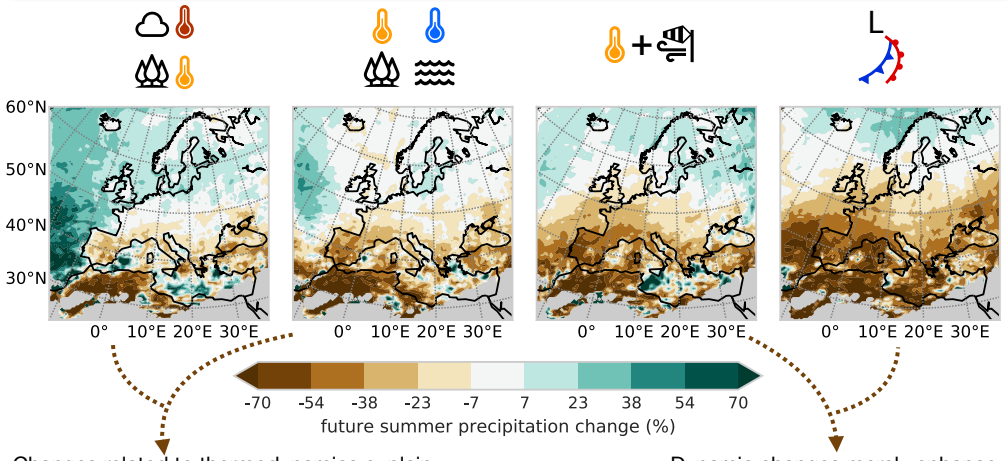
3) Mean state and circulation (MEA): Slowly evolving changes in mean circulation (e.g. jet shift). Includes SSTE.

4) Full climate change (FCC): Changes in weather systems (e.g. cyclone frequency). Includes MEA.

Conclusions

- In **summer, thermodynamic and lapse-rate changes**, as well as the **land-sea warming contrast, explain most** of the precipitation decline. Dynamic changes are of secondary importance. This is consistent with findings for temperature changes from a previous study[1].
- In **winter, dynamic changes are the primary cause** for the precipitation decline.
- The **reliability** of the respective causes in climate simulations is considered **higher for summer than for winter**.

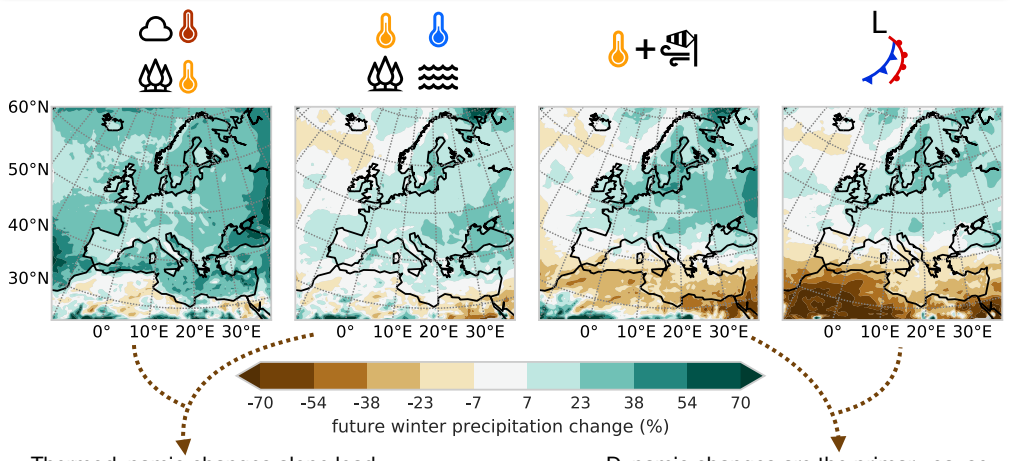
Causes of mean summer precipitation change



Changes related to thermodynamics explain ~2/3 of the summer precipitation decline.

Dynamic changes merely enhance the summer precipitation decline.

Causes of mean winter precipitation change



Thermodynamic changes alone lead to a winter precipitation increase.

Dynamic changes are the primary cause of the winter precipitation decline.

Get the full story:

Brogli, R., Sørland, S. L., Kröner, N., & Schär, C. (2019). Causes of future Mediterranean precipitation decline depend on the season. Environ. Res. Lett., 14, 114017.

[1] Brogli, R., Kröner, N., Sørland, S. L., Lüthi, D., & Schär, C. (2019). The Role of Hadley Circulation and Lapse-Rate Changes for the Future European Summer Climate. J. Climate, 32, 385–404.