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A robust shift towards higher intensity convective and orographic rainfall over the Alps in a warmer climate

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WCRP CORDEX FLAGSHIP PILOT STUDIES

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Changes in local to regional hydroclimate are among the most impactful consequences of a rapidly changing climate

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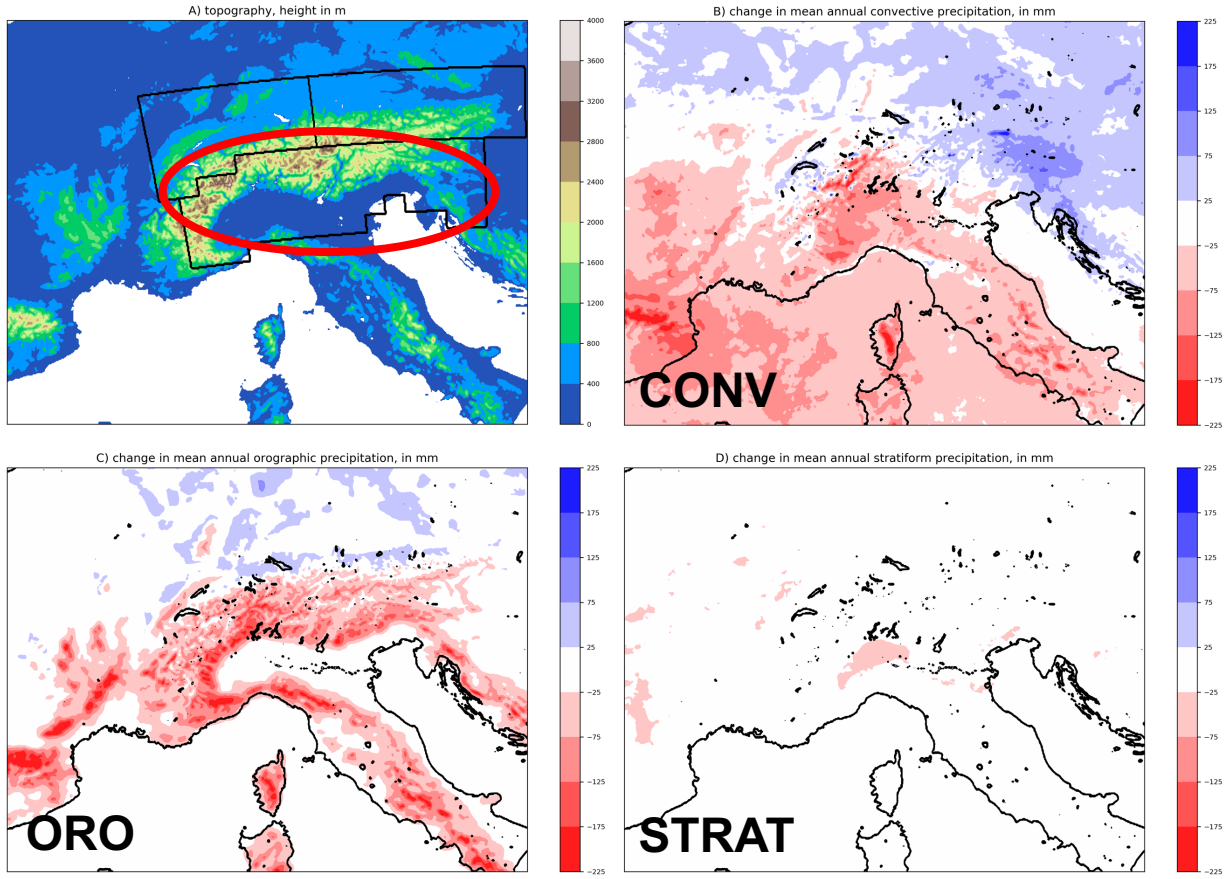
We show that despite overall drying all precipitation types shift towards higher intensities with robust increases in extreme events

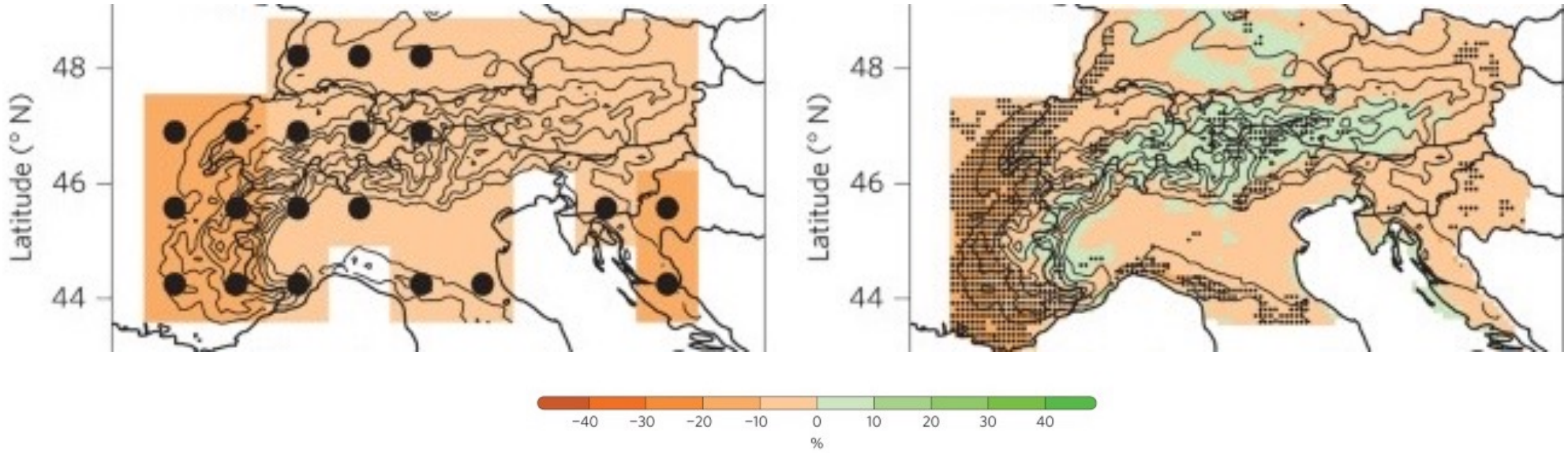
- The entire distributions of precipitation types shift towards higher intensities
- This shift comes with a strong decline in moderate intensity events and a strong increase in extremes
- These changes can be explicity linked to processes underlying convective and orographic precipitation



Building on previous work we ask: What happens to the full distribution of specific precipitation types at convection permitting scales?

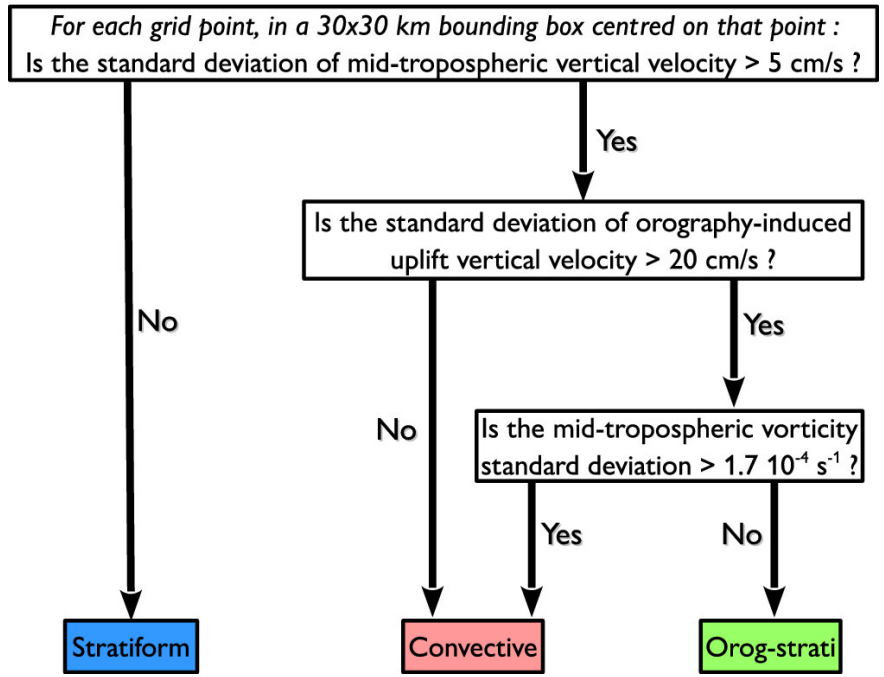
Global models

Regional models (~12km)



Source: https://www.nature.com/articles/ngeo2761

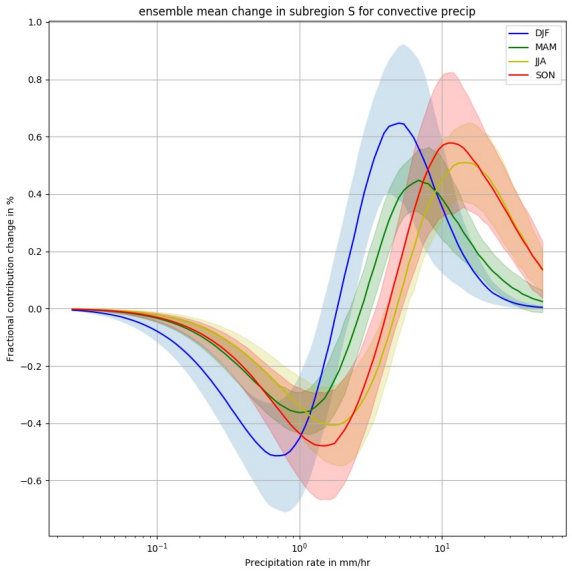
We employ a physically based algorithm to separate out convective, orographic and stratiform precipitation types



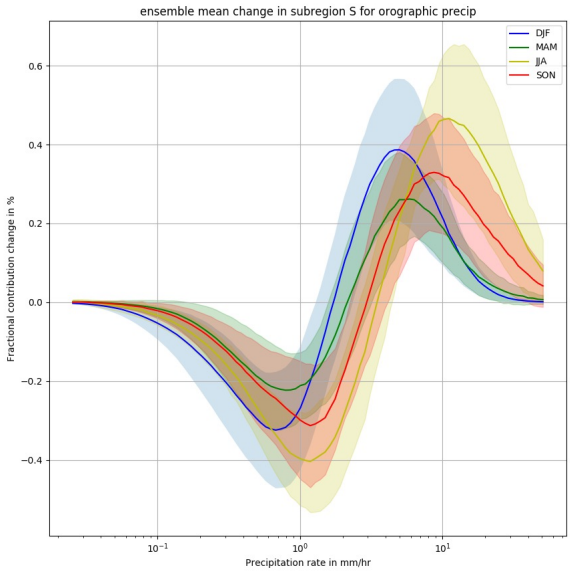
Poujol, B., Sobolowski, S. P., Mooney, P. A., & Berthou, S. (2020). A physically based precipitation separation algorithm for convection-permitting models over complex topography. *Quarterly Journal of the Royal Meteorological Society*, *146*(727), 748–761. https://doi.org/10.1002/qj.3706

The entire distribution of precipitation shifts towards higher intensities and this change is dominated by convective precipitation

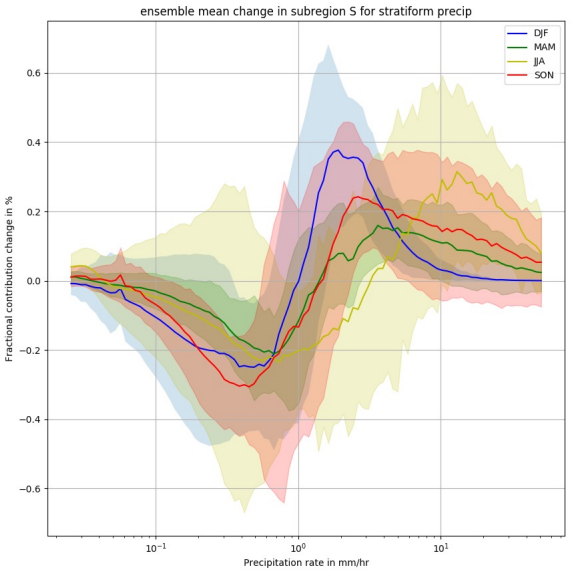
Convective



Orographic



Stratiform



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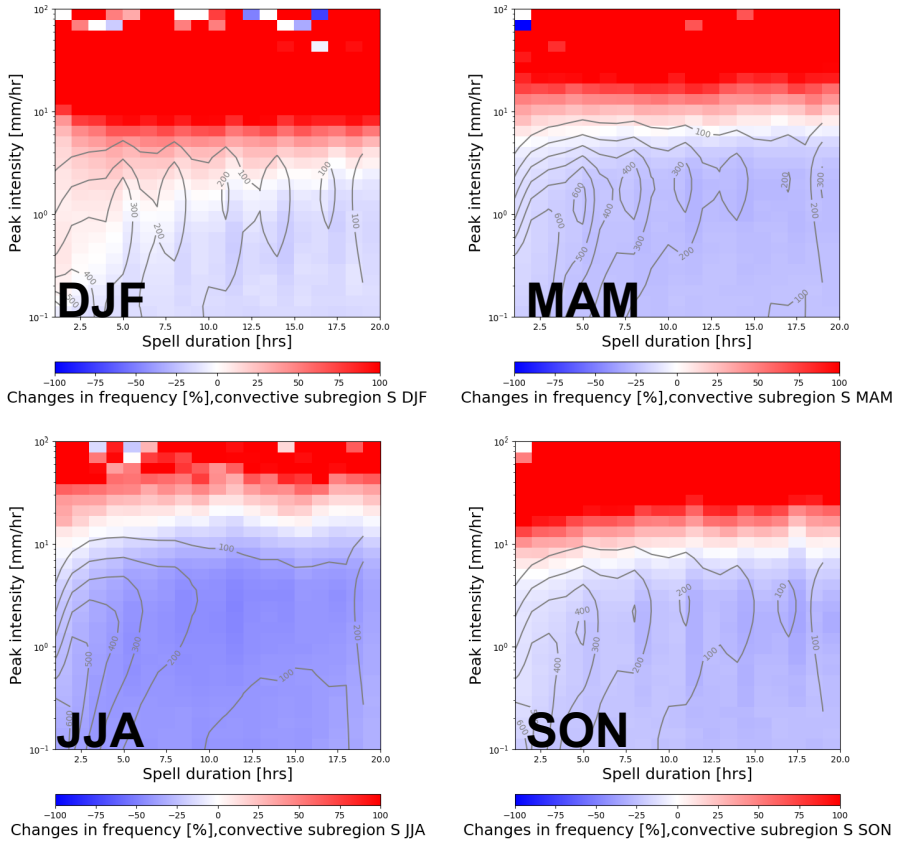
The shift is accompanied by an *increase* in frequency, intensity and duration of convective extreme events and a *decrease* in more moderate precipitation events



Sobolowski et al., (in-prep)

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Recap: Despite overall drying the all precipitation types shift towards higher intensities with robust increases in extreme events

- The entire distribution of precipitation exhibits shifts towards higher intensities
- This shift comes with a strong decline in moderate intensity events and a strong increase in extremes
- These changes can be explicity linked to processes underlying convective and orographic precipitation

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Ban, N., et al. (2021). The first multi-model ensemble of regional climate simulations at kilometer-scale resolution, part I: Evaluation of precipitation. *Climate Dynamics*, 1–28. https://doi.org/10.1007/s00382-021-05708-w

Pichelli, E., et al. (2021). The first multi-model ensemble of regional climate simulations at kilometer-scale resolution part 2: Historical and future simulations of precipitation. *Climate Dynamics*. https://doi.org/10.1007/s00382-021-05657-4

Coppola, E., et al. (2018). A first-of-its-kind multi-model convection permitting ensemble for investigating convective phenomena over Europe and the Mediterranean. *Climate Dynamics*. https://doi.org/10.1007/s00382-018-4521-8

Special issue in *Climate Dynamics* open now. Simulations on ESGF end of 2022.