



DÉPARTEMENT
DE GÉOSCIENCES



**Investigating the changing characteristics of precipitation
in the mid- to high-latitudes
An example from Norway**

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Introduction

Projected changes in extreme precipitation over Scotland and Northern England using a high-resolution regional climate model

Steven C. Chan¹ · Ron Kahana² · Elizabeth J. Kendon² · Hayley J. Fowler¹

Geophysical Research Letters

RESEARCH LETTER
10.1002/2014GL062588

Key Point:
• Extreme hourly precipitation intensifies with the Clausius-Clapeyron

Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster?

Nikolina Ban¹, Juerg Schmidli¹, and Christoph Schär¹
¹Atmospheric and Climate Science, ETH Zürich, Zürich, Switzerland

LETTERS

<https://doi.org/10.1038/s41558-017-0007-7>

nature
climate change

Increased rainfall volume from future convective storms in the US

Andreas F. Prein[✉], Changhai Liu, Kyoko Ikeda, Stanley B. Trier, Roy M. Rasmussen, Greg J. Holland and Martyn P. Clark

LETTERS

PUBLISHED ONLINE: 1 JUNE 2014 | DOI: 10.1038/NCLIMATE2258

Heavier summer downpours with climate change revealed by weather forecast resolution model

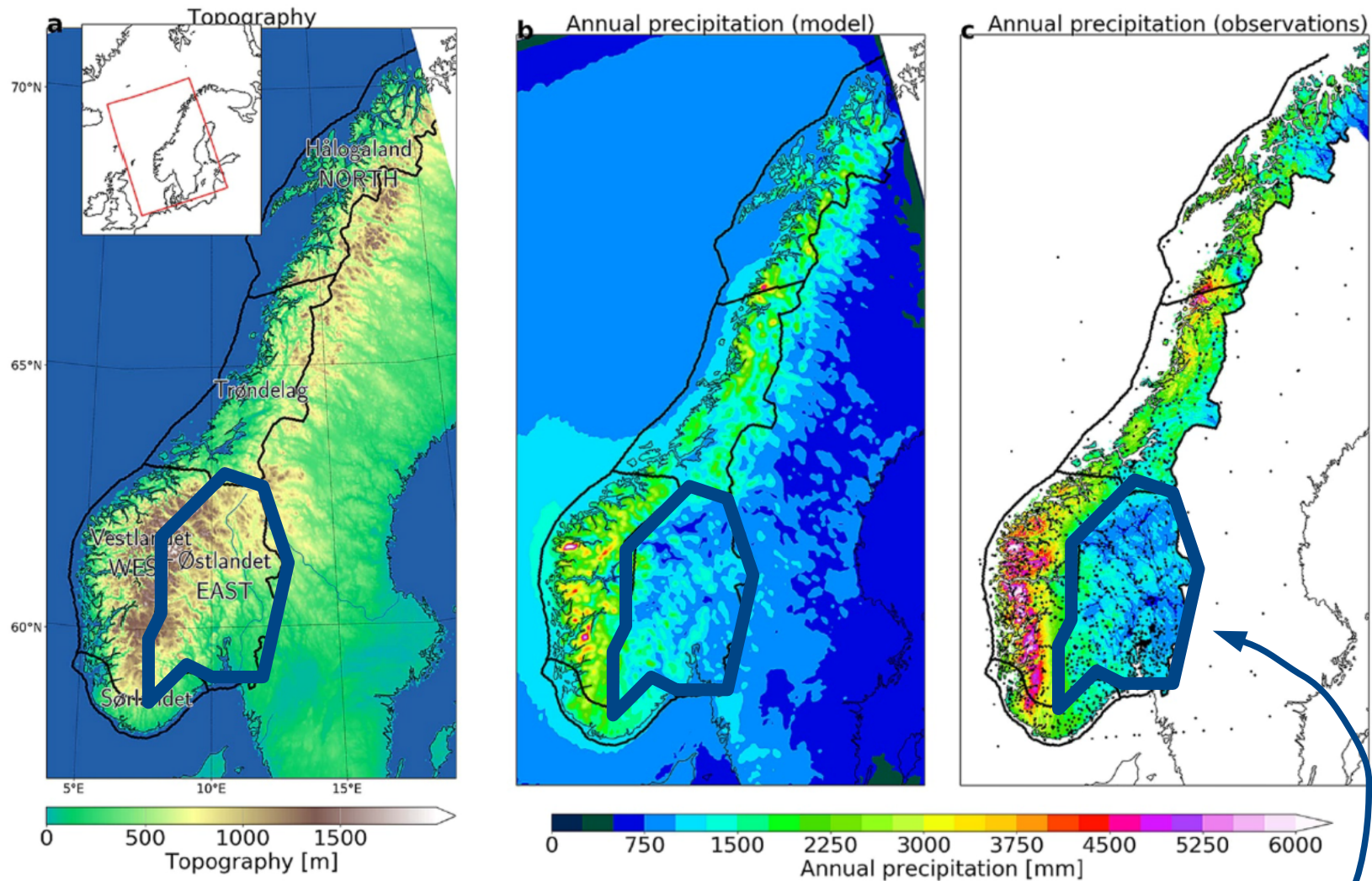
Elizabeth J. Kendon^{1*}, Nigel M. Roberts², Hayley J. Fowler³, Malcolm J. Roberts¹, Steven C. Chan³ and Catherine A. Senior¹

nature
climate change

Dynamic processes leading to precipitation formation are **explicit**.

Can we use this to build **process understanding** in future precipitation changes ?

Study region



This presentation focuses on Eastern Norway
Drier, more continental climate

Study setup

WRF convection-permitting simulations

3km resolution

Historical :

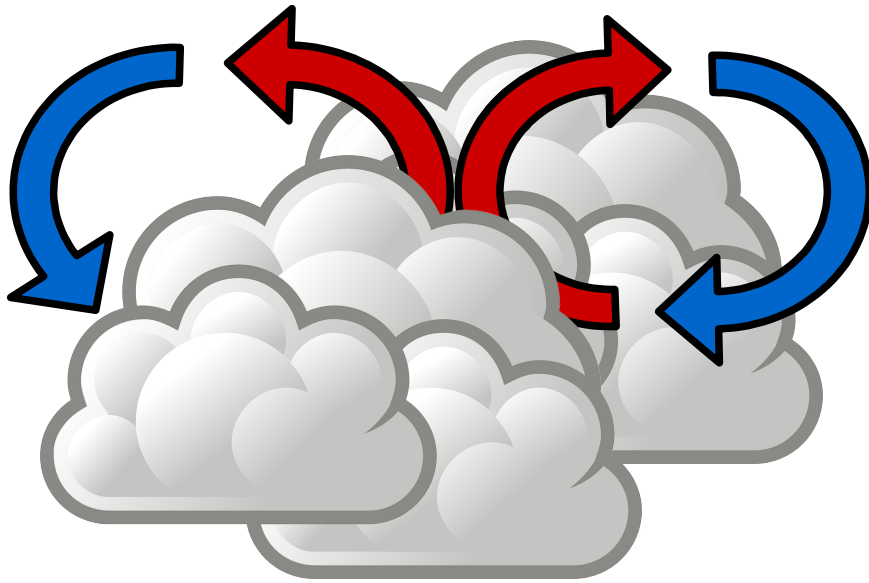
Forced by ERA-Interim

1996-2005

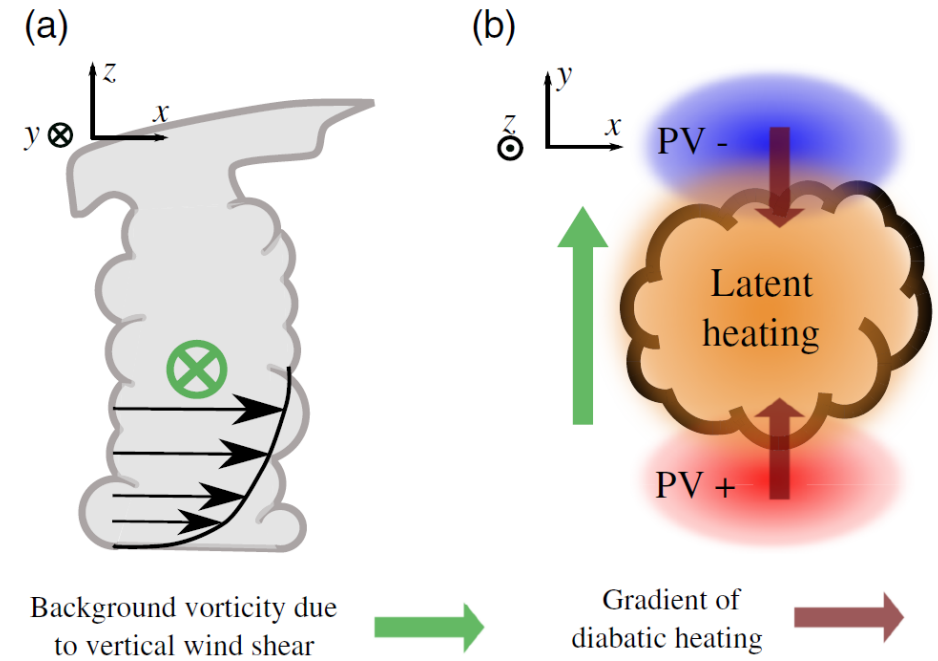
Pseudo-global warming :

Perturbation corresponding to
2035-2065 under RCP8.5

Precipitation separation algorithm



Over flat terrain

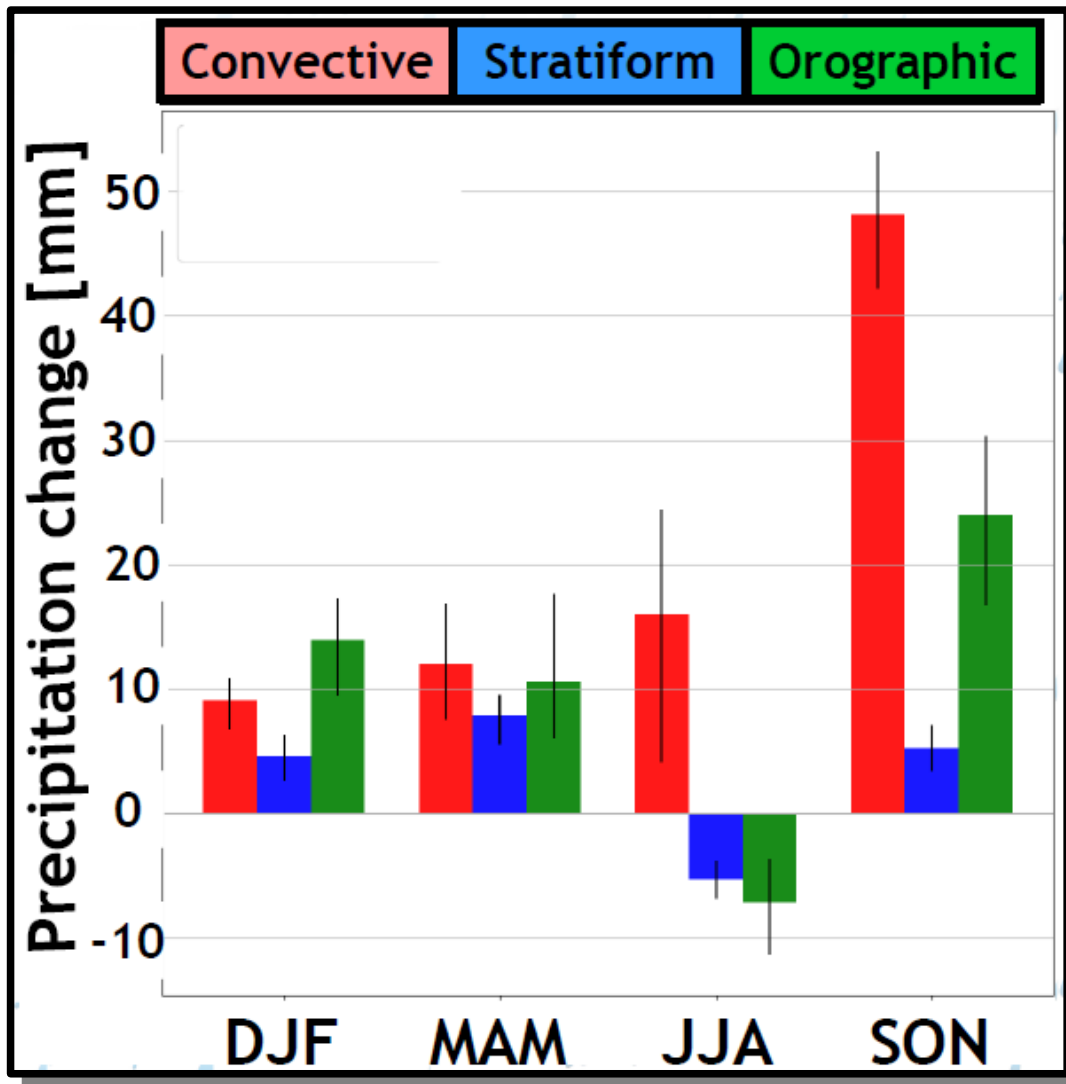


Over complex terrain

Algorithm described in : 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.

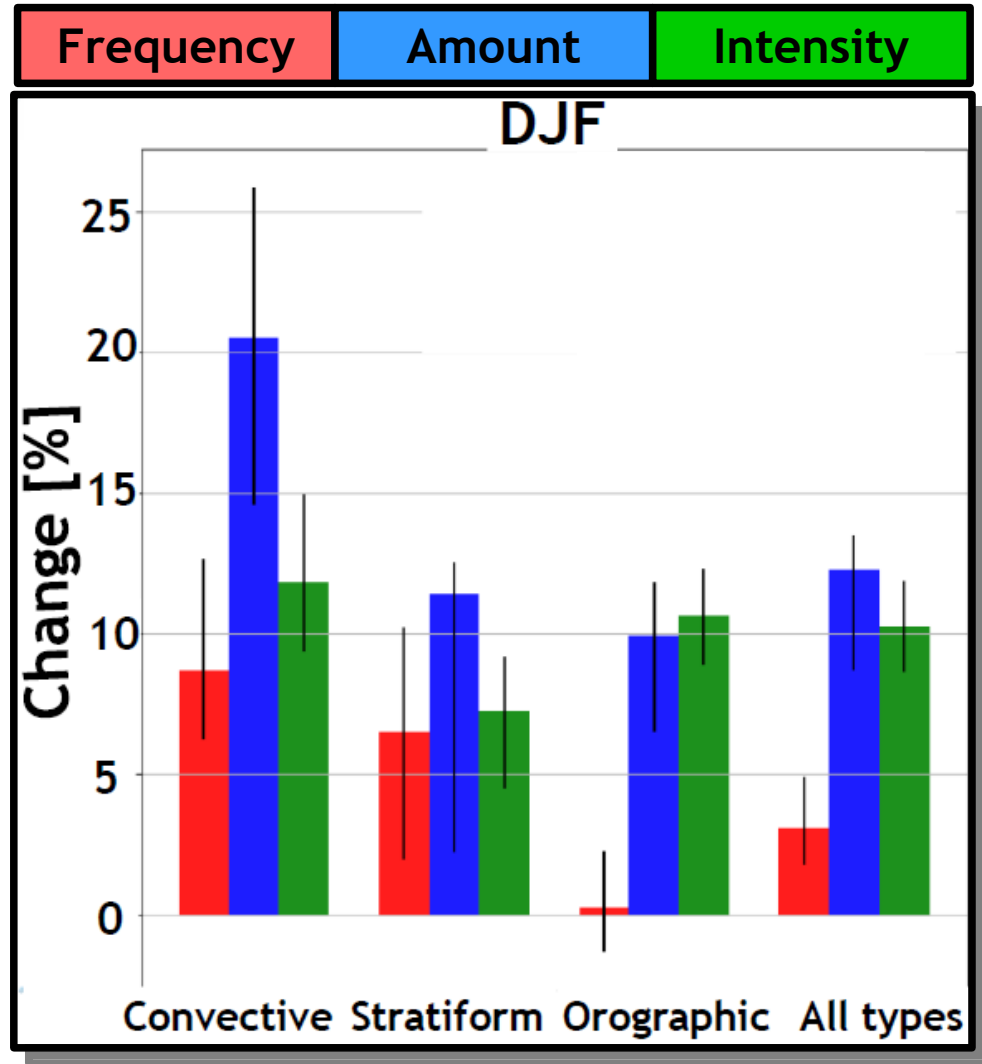
NB : In the results histograms that follow, wind speed was taken at 500hPa instead of 700hPa for estimating upwind vertical velocity, which is not exactly the algorithm version described in the above paper.

Results



Large dependence on the precipitation type

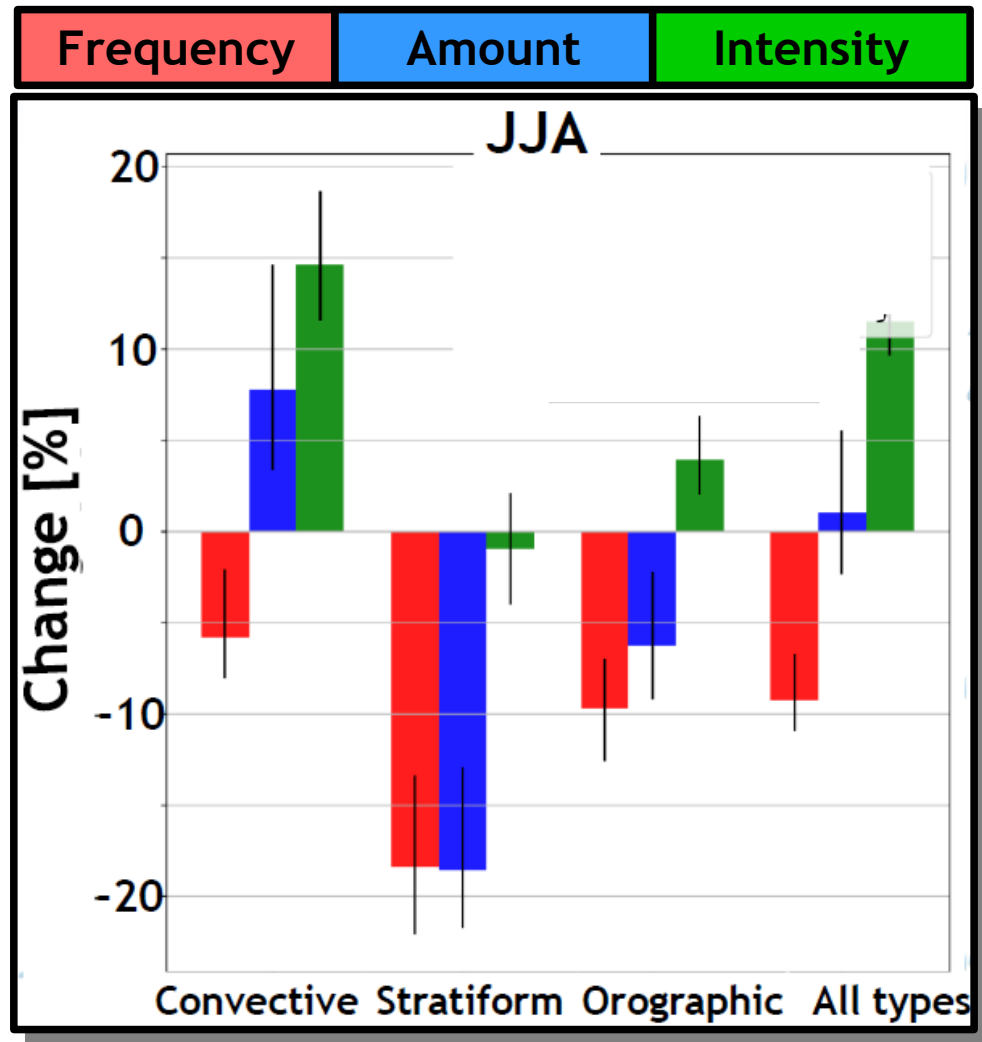
Results



Increase in precipitation intensity
(close to CC scaling)

More frequent
wintertime convection

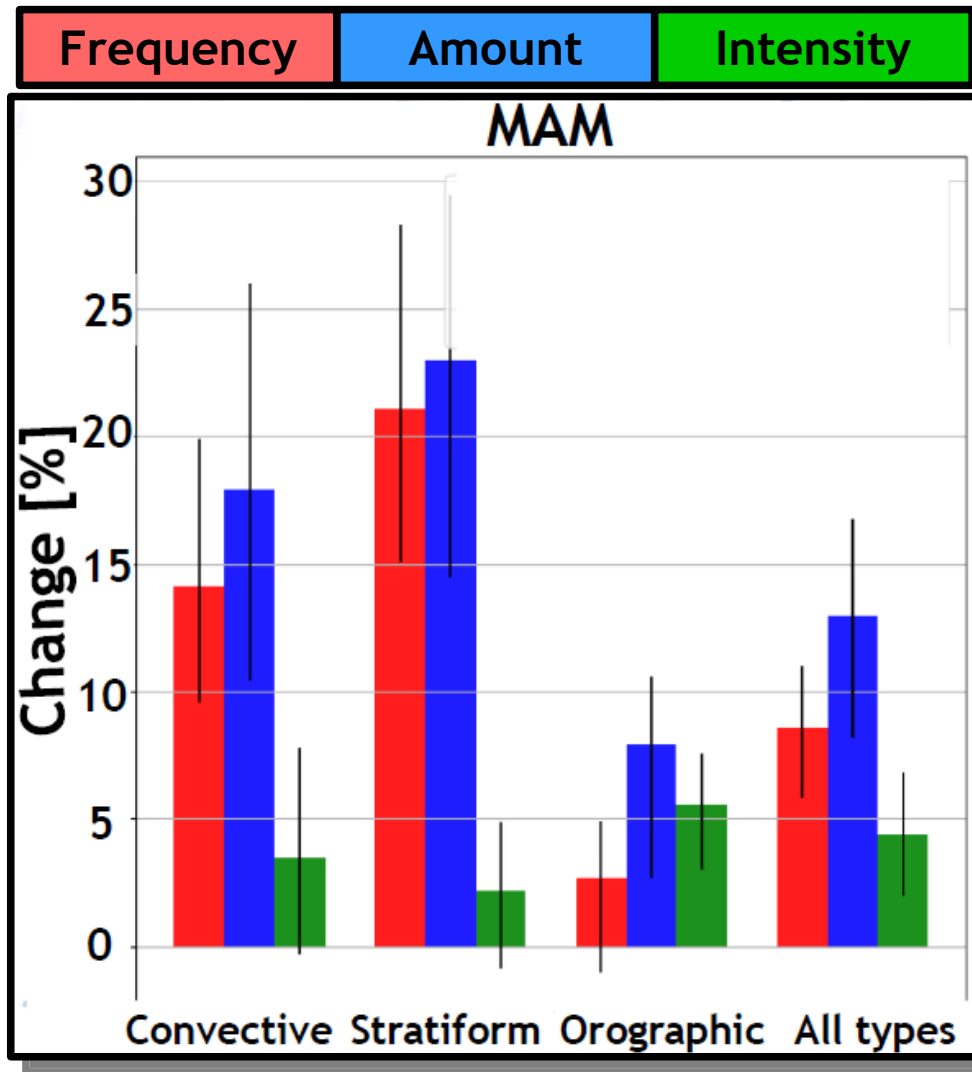
Results



Increase in convective precip
intensity (larger CAPE)

Decrease in precipitation
frequency (drier, larger CIN)

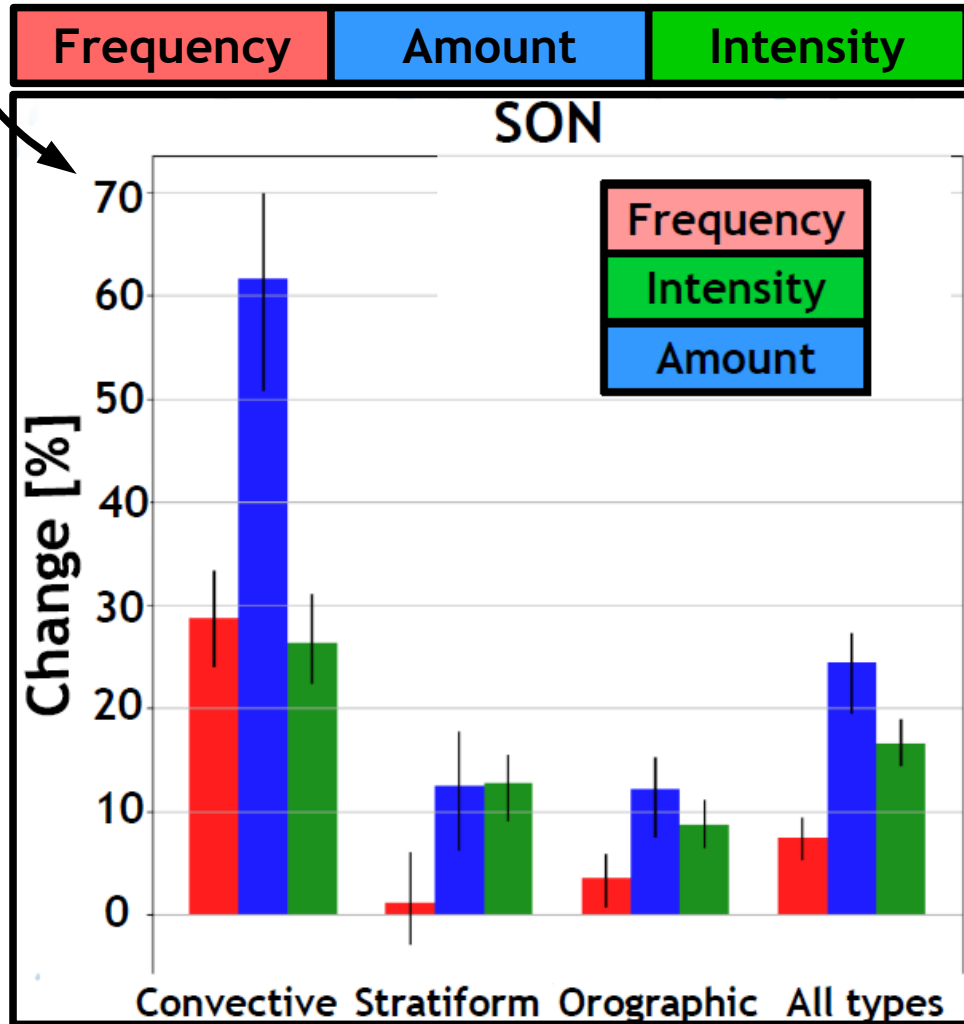
Results



More frequent
spring convection

Results

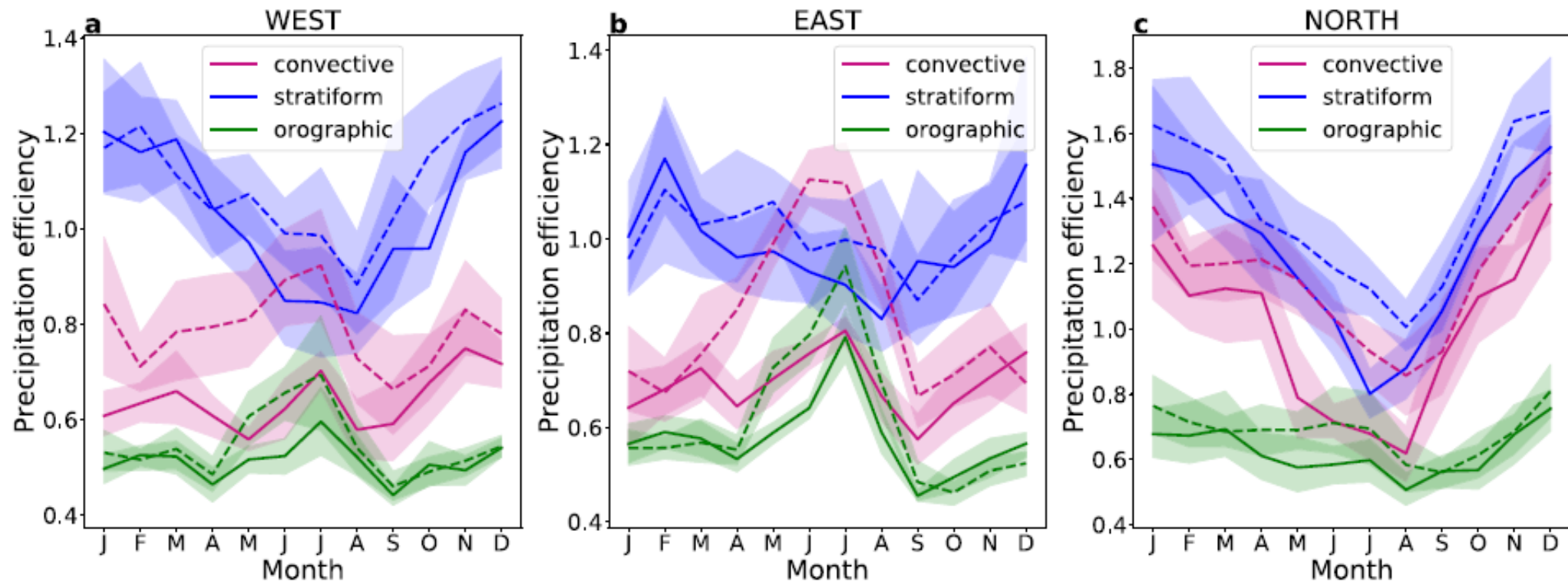
Note the scale



Intensification of convection
(well above CC scaling)

Also more frequent
autumn convection

Results



Clear increases in summertime convective precipitation efficiency

Conclusions

Large dependence of future precipitation changes on the precipitation type

Brings possible insight into the processes

Currently applied over other European mountain ranges with complex terrain

Figures for other subregions, precipitation distributions :

Poujol, B., Mooney, P. A., & Sobolowski, S. P. (2021). *Physical processes driving intensification of future precipitation in the mid-to high latitudes*. Environmental Research Letters, 16(3), 034051.

Same method on the Alpine region : Torge Lorenz's talk at end of the session