Convection in future winter storms over northern Europe

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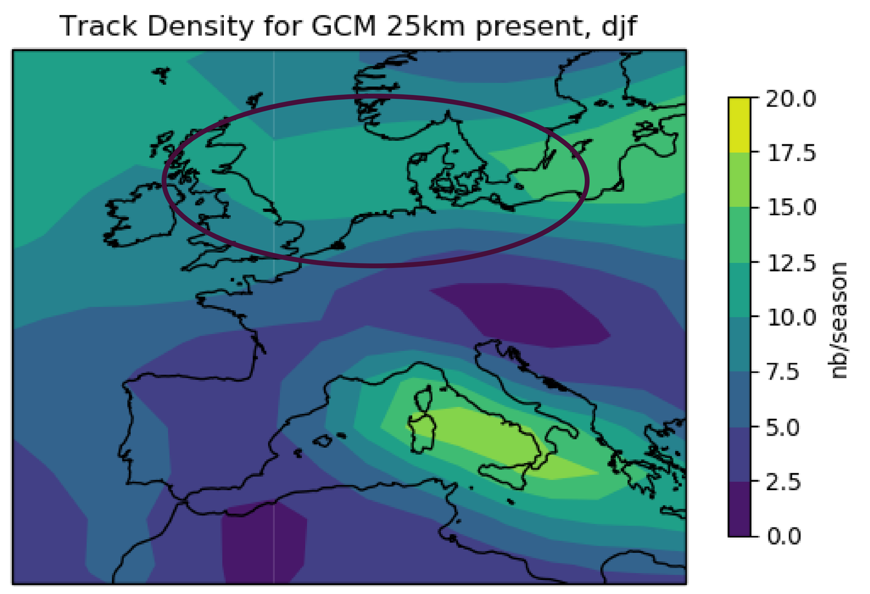
Introduction:
We use a convection-permitting climate simulations at 2.2km over Europe, which can only be run for 10 years: the climate change signal is mixed with natural variability.

Therefore, we propose a storm-by-storm analysis, to see how the thermodynamical characteristics of storms and especially their embedded convection may change in the future.

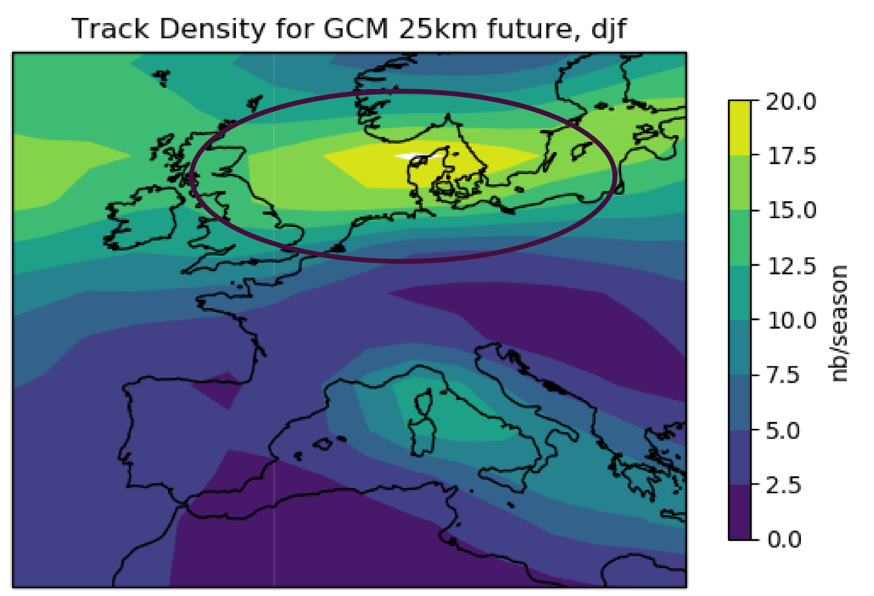
Tools:

2.2km convection-permitting climate simulation over Europe (Berthou et al. 2018, Chan et al. 2020):
10 years present-day (1998-2007)
10 years future (end-of-century, RCP8.5)
Driven by ~25km global simulations (HadGEM3-GC3.1) – forced with present-day SSTs or future SSTs from HadGEM2-ES.
Storm tracking algorithm: TRACK (Hodges et al. 2010): 220 storms in present-day; 256 storms in the future in Northern Europe

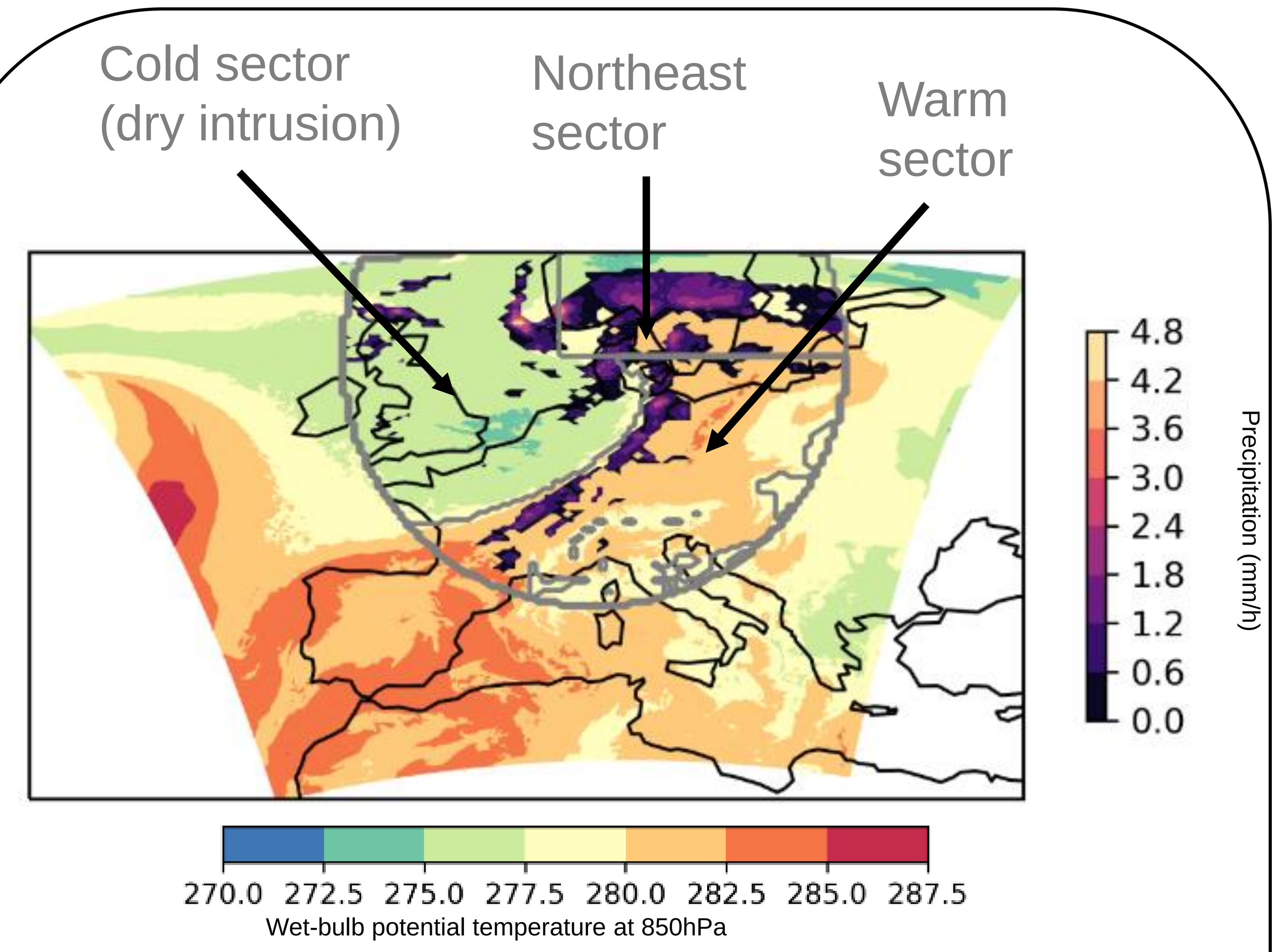
Present # of storms



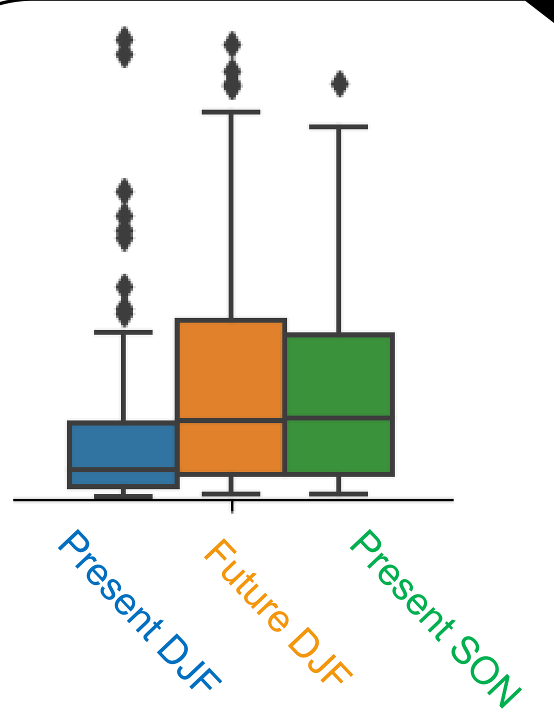
Future # of storms



1) Number of storms is given by the GCM: **25% increase in northern Europe.**

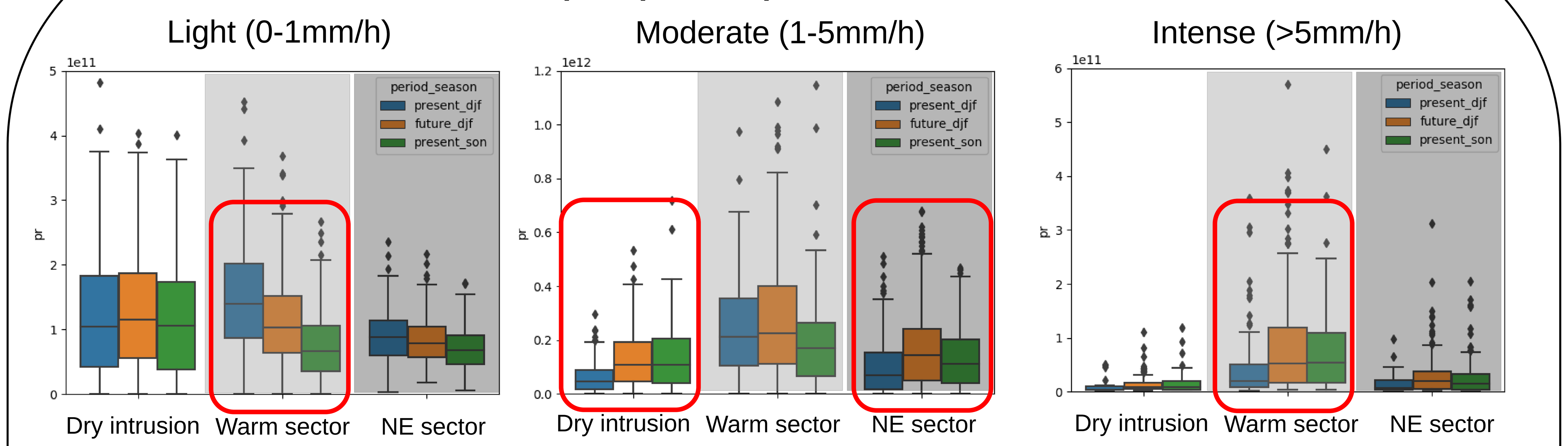


2) For each storm in northern Europe at time of minimum sea level pressure, we define 3 sectors based on a wet-bulb potential temperature threshold (which has the maximum density of fronts)



Every point used in the box plot is a single storm at the stage of minimum sea level pressure in Northern Europe

Total precipitation per storm sector

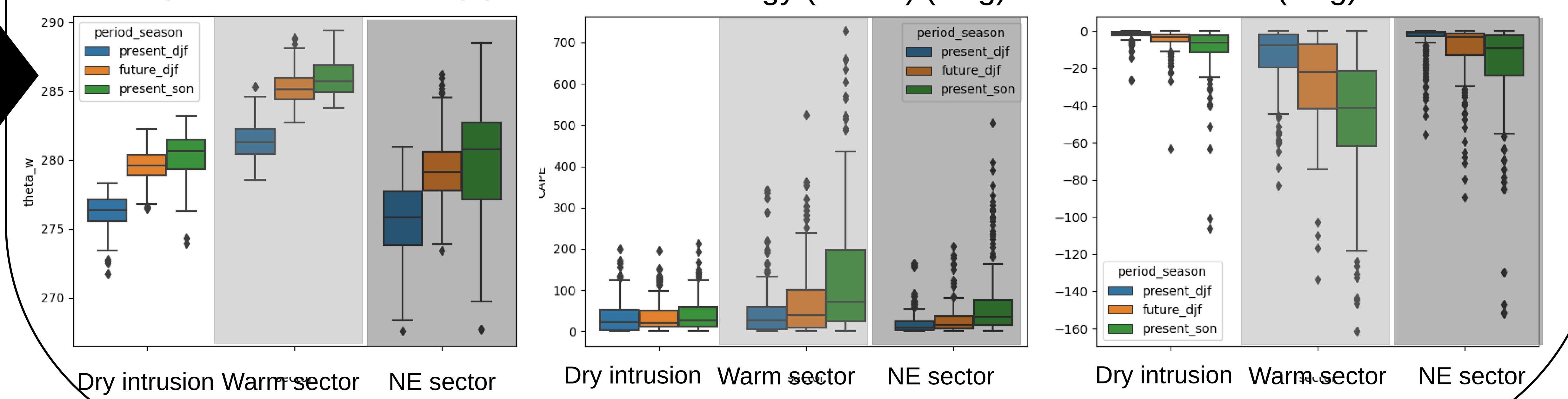


Less light rainfall in warm and northeast sectors

More moderate rainfall in dry intrusion and northeast sectors

More intense rainfall in the warm sector

Orange distribution (future winter storms) gets closer to green distribution (present autumn)
Greater temperature and moisture content lead to more moderate precipitation in all sectors.
Greater CIN and CAPE in the warm sector may be linked with more intense rainfall there: more convective rainfall



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Berthou, S., Kendon, E. J., Chan, S. C., Ban, N., Leutwyler, D., Schär, C., & Fosser, G. (2018). Pan-European climate at convection-permitting scale: a model intercomparison study. *Climate Dynamics*. https://doi.org/10.1007/s00382-018-4114-6

Chan et al. 2020 Europe-wide precipitation projections at convection permitting scale with the Unified Model, Climate Dynamics

Hodges, K.I., R.W. Lee, and L. Bengtsson, 2011: A Comparison of Extratropical Cyclones in Recent Reanalyses ERA-Interim, NASA MERRA, NCEP CFSR, and JRA-25. J. Climate, 24, 4888–4906, https://doi.org/10.1175/2011JCLI4097.1