The sensitivity of atmospheric blocking to changes in upstream latent heating

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Setup of the study

- **Objective**: Explicitly study the causal relationship between latent heating in clouds and atmospheric blocking based on model experiments.

- **Approach**:
  - Case studies of 5 blocking events with the global ECMWF IFS model.
  - Sensitivity experiments in which latent heating is artificially eliminated (denoted as NOLH) or modified in a region upstream of the blocking anticyclone.

For more details, see https://www.weather-clim-dynam-discuss.net/wcd-2020-5/

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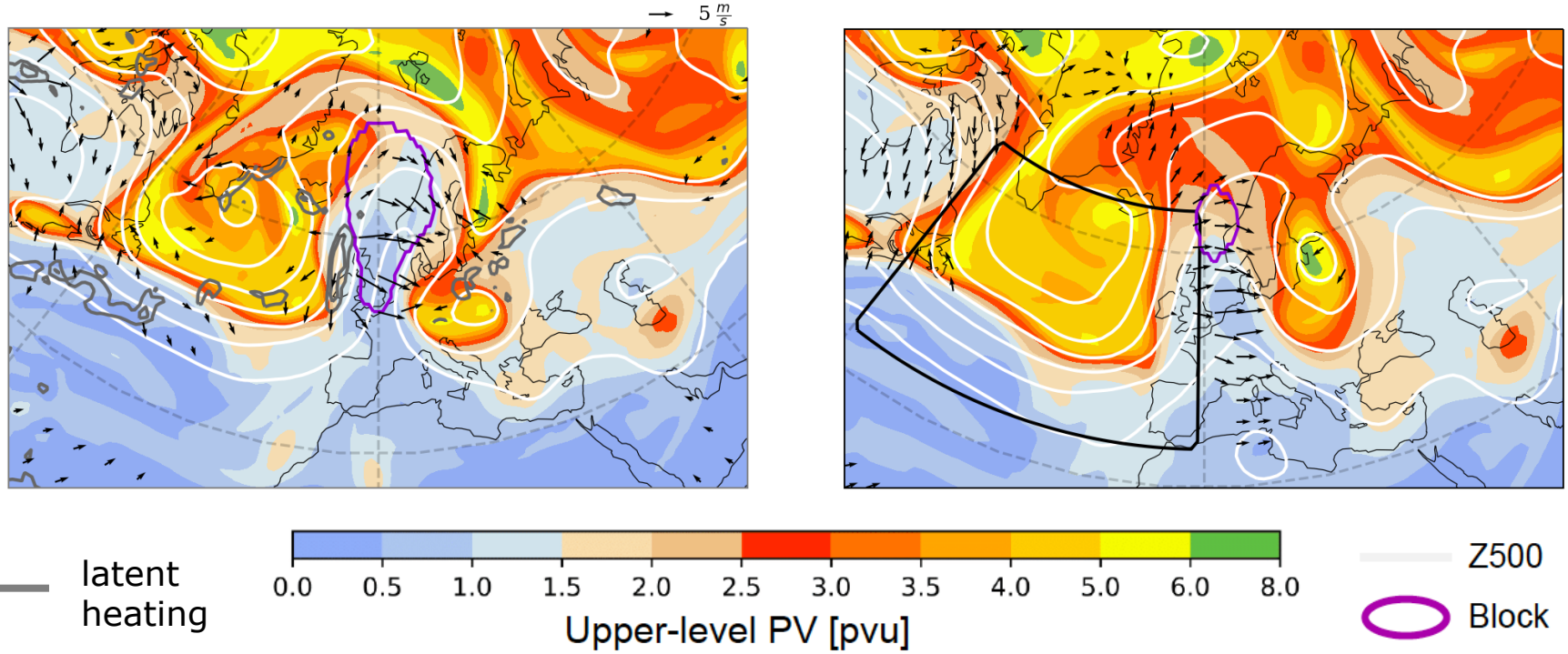
Case study “Thor”



PV and divergent wind at upper levels (500-150 hPa), objectively identified blocking and latent heating in clouds for block “Thor” at 00 UTC, 4. October 2016 from the reference simulation.

The same fields from the NOLH sensitivity simulation in which latent heating in clouds has been switched off over the North Atlantic (black box).

Case study “Thor”

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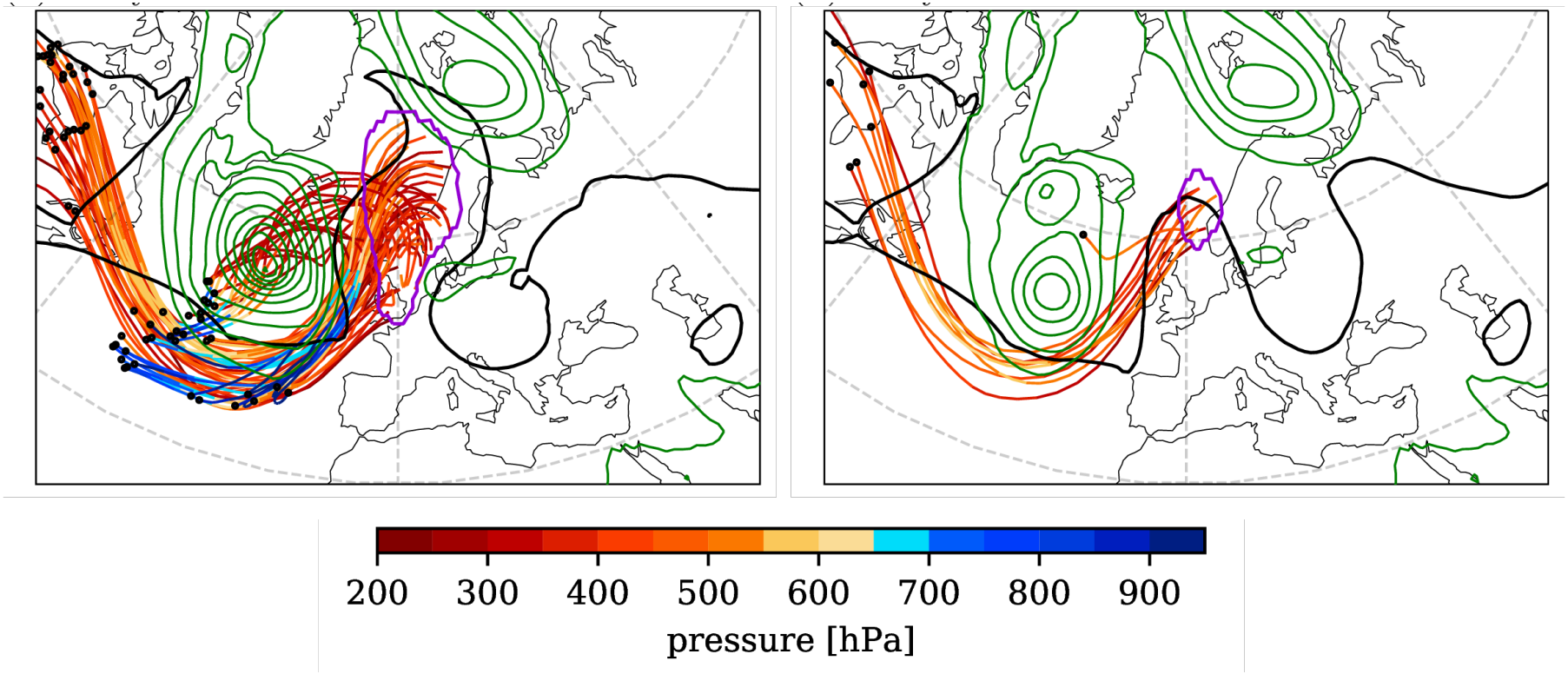
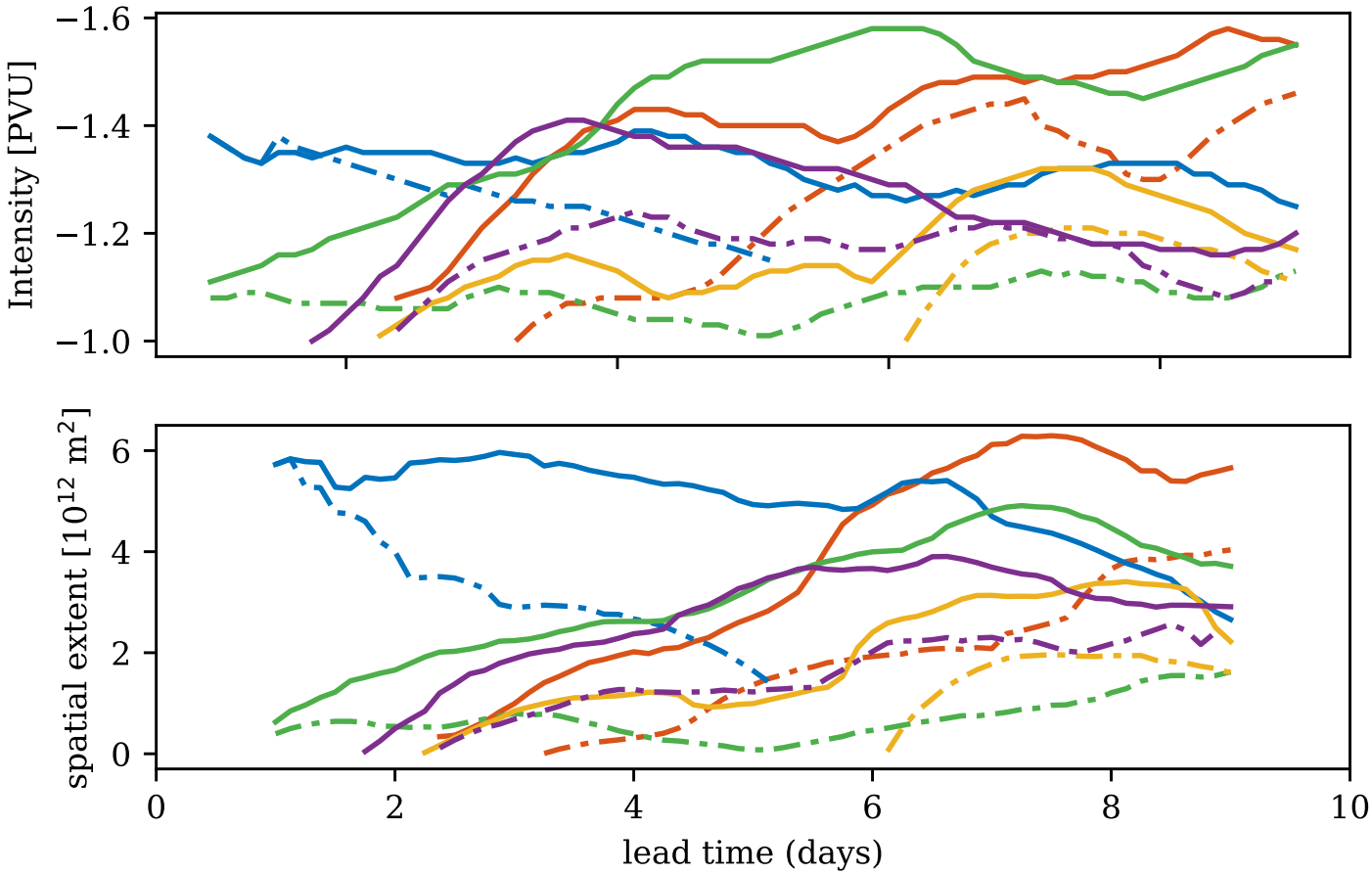
reference simulation

NOLH



2-pvu contour, sea level pressure and 3-day backward trajectories initialized at 00 UTC, 4. October 2016

Blocking characteristics



Blocking intensity (PV anomaly, upper panel) and size (lower panel) for five case studies from the reference simulations (solid lines) and NOLH experiments (dashed lines).

Conclusions

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- Elimination of upstream latent heating has strong effects on blocking dynamics, but there is also substantial case-to-case variability.
- These effects are due to the injection of air masses with low PV into the upper troposphere in strongly ascending airstreams and the interaction of the associated divergent outflow with the upper-level PV structure.
- An accurate parameterization of cloud processes in atmospheric models is crucial for adequately representing blocking dynamics.