

Pan-European HCLIM Climate Simulations: Hydrostatic AROME versus ALADIN

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Introduction

The HARMONIE-Climate (HCLIM) consortium, comprising nine ACCORD meteorological institutes, develops and runs HARMONIE in climate mode for regional and national climate simulations. The HCLIM consortium recently ran a set of Pan-Euro simulations to address the following question:

Can HCLIM-AROME in hydrostatic mode serve as a replacement for HCLIM-ALADIN?

Performed 5 HCLIM43 experiments on a Pan-Euro domain (Figure 1), 3 of which at 12km resolution:

- HCLIM-ALADIN hydrostatic, timestep=300s 2000 – 2023 (spin-up 1999)
- HCLIM-AROME hydrostatic, timestep=300s 2000 – 2023 (spin-up 1999)
- HCLIM-AROME hydrostatic, timestep=90s 2000 – 2023 (spin-up 1999)
- HCLIM-AROME hydrostatic & non-hydrostatic at 5km, timestep=90s, 2009-2010 (not shown here)

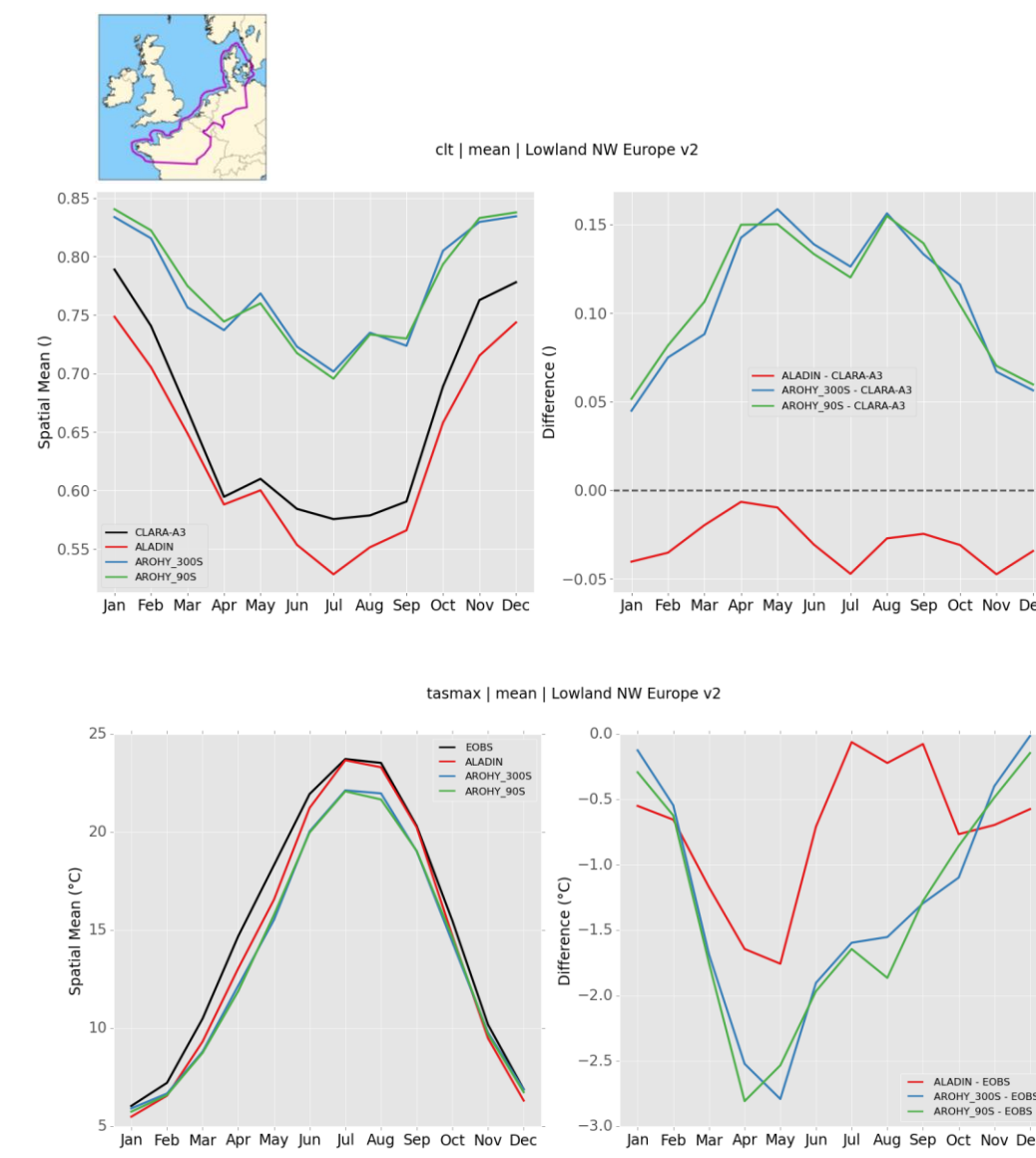
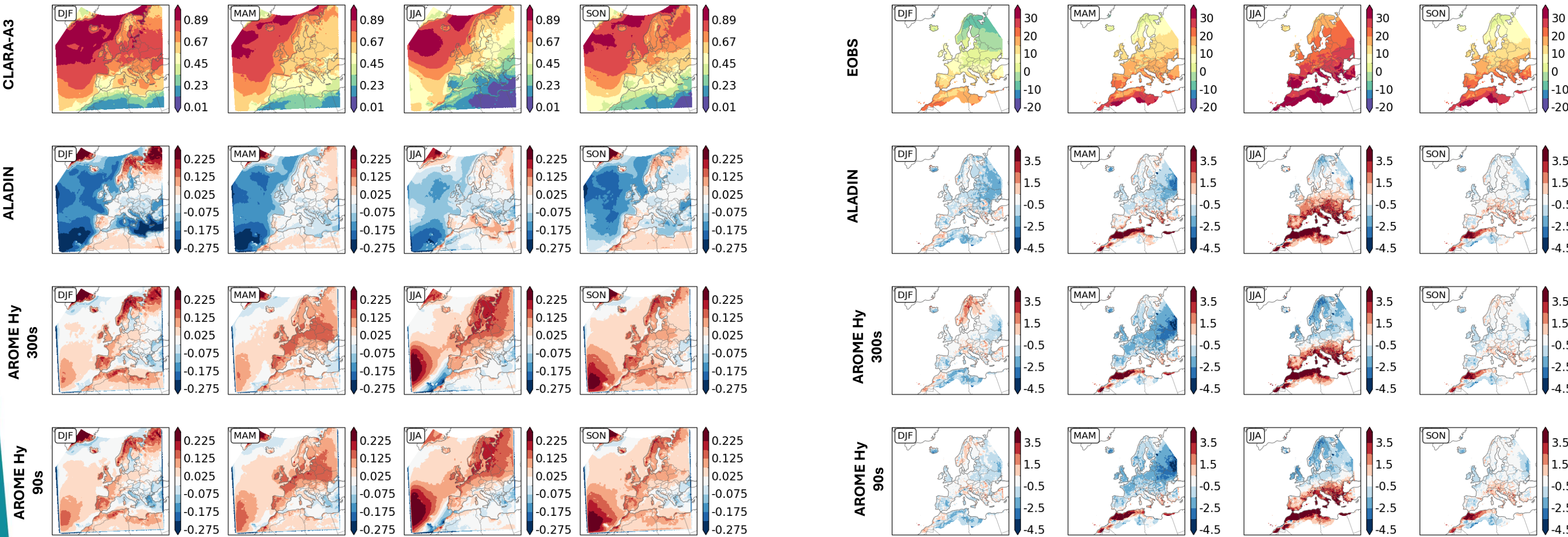


Figure 1: Pan-Euro domain

Clouds and Temperature

clt [] | mean | 2000-2022 ANN

tasmax [°C] | mean | 2000-2023 ANN



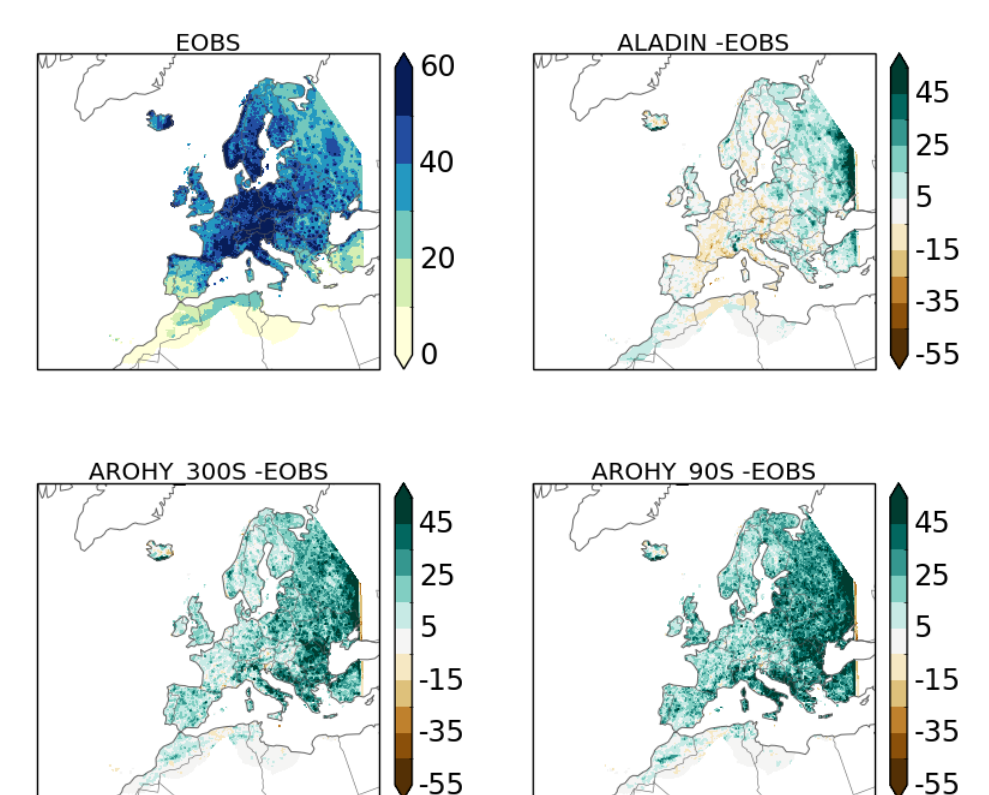
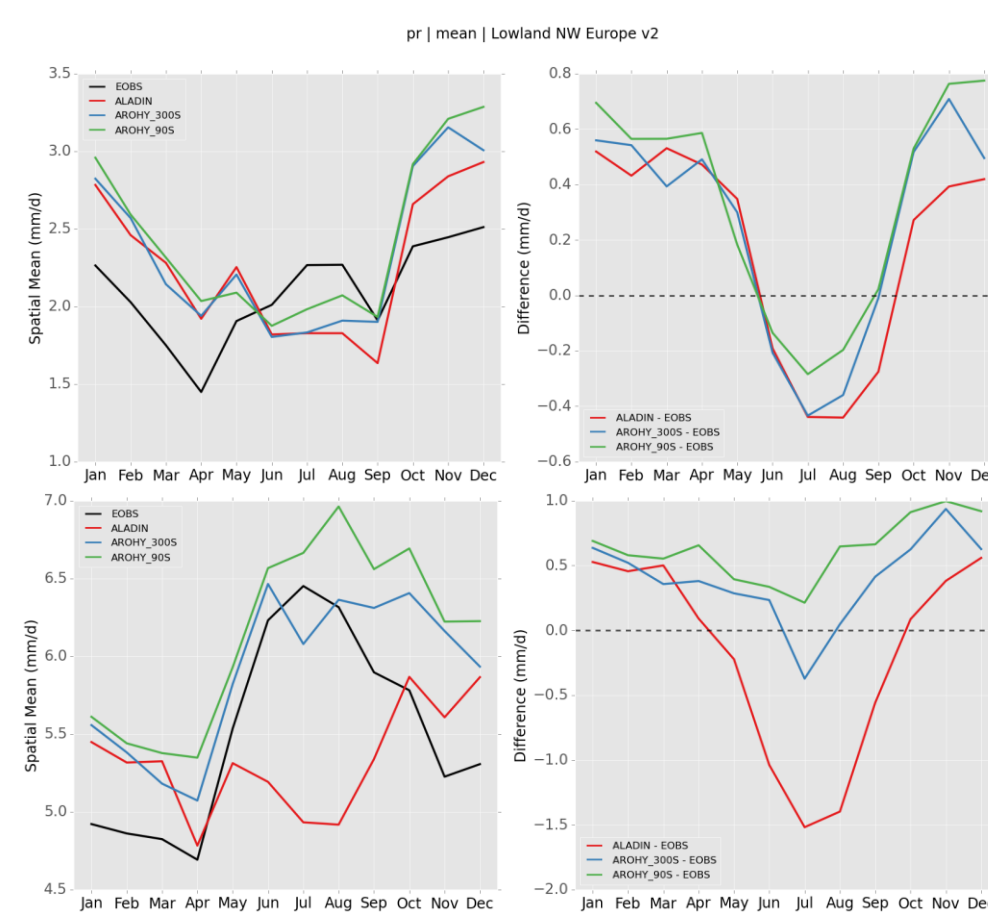
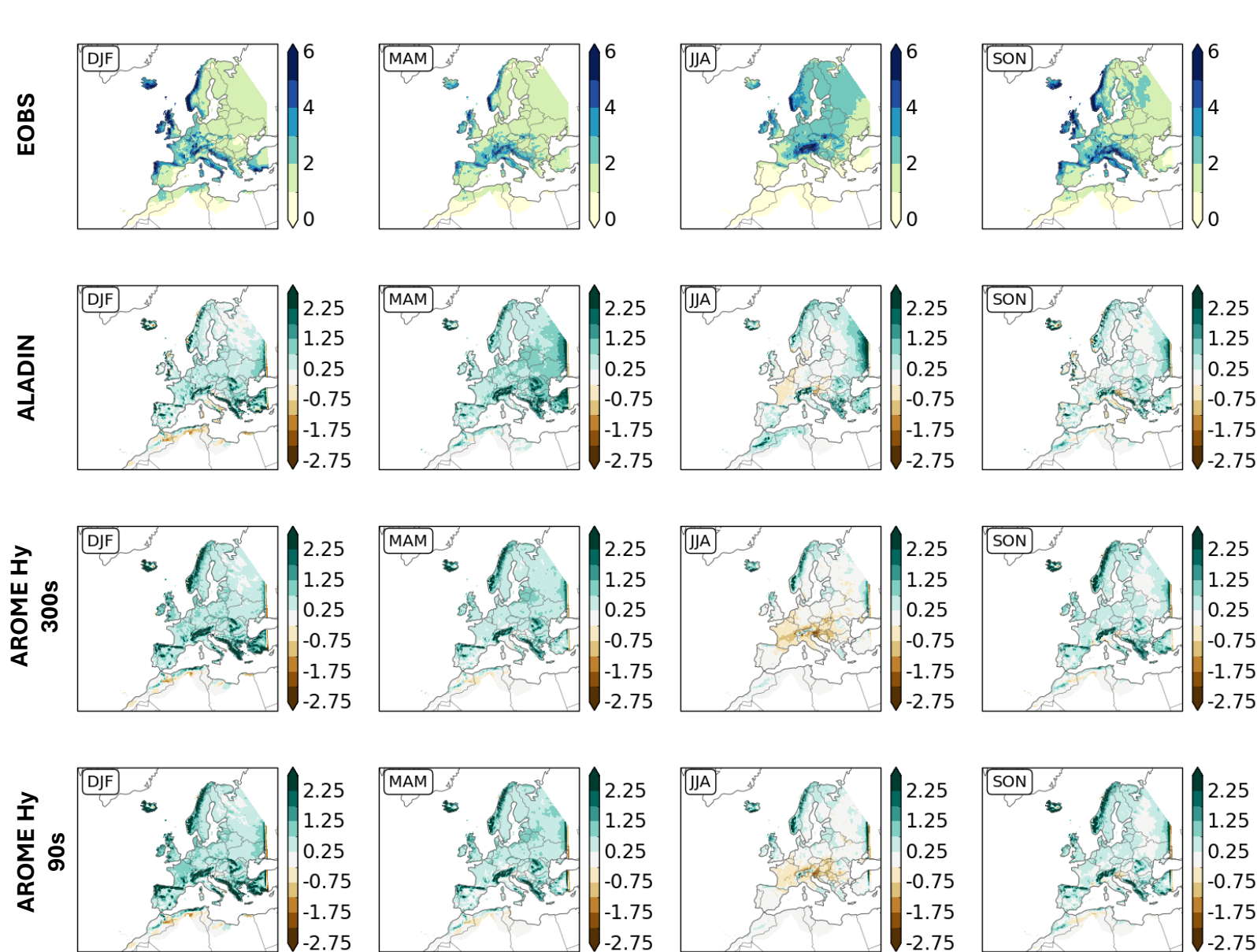
- Find bias in AROME hydrostatic cloud cover independent of resolution and timestep stemming mostly from low clouds.
- This in turn leads to a negative bias in temperature in AROME hydrostatic, particularly in Tasmx.
- Biases in cloud cover and temperature are reduced in cycle 46 compared to cycle 43 but still exist.

Precipitation

pr [mm/d] | mean | 2000-2023 ANN

pr | mean | Lowland NW Europe v2

pr [mm/d] | percentile 99.9 | 2000 – 2023 JJA



- AROME hydrostatic overestimates precipitation, while ALADIN exhibits well-known drizzle problem.
- ALADIN underestimates high precipitation amounts but does not show a clear bias for extremes of daily precipitation.

Conclusion

- Results suggest that HCLIM-ALADIN remains the most suitable option for Pan-European downscaling at 12 km resolution, although high-res regional HCLIM-AROME hydrostatic simulations may also be feasible.
- Future research question: Can HCLIM-ALADIN precipitation bias be improved via parametrisation tuning?