A new generation of regional climate model scenarios for the Baltic Sea area

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Motivation

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- **New scenarios (SRES -> RCPs)**
- **New GCM runs (CMIP3 -> CMIP5)**
- **Updated regional climate model (RCA3 -> RCA4)**

- **Will the new scenarios change our idea of future climate change in the Baltic Sea region?**
- **How do RCM scenarios differ from the underlying GCM scenarios?**

Experiment design

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19 simulations with RCA4 on the Euro-CORDEX domain at 0.44° (~50 km) horizontal resolution

- ✓ **9 CMIP5 GCMs provide boundary conditions**
- ✓ **Transient 1961-2100 climate change runs with historical (1961-2005) forcing and one each of RCP4.5/8.5-scenarios (2006-2100)**
- ✓ **1 reference (1979-2010) ERA-INTERIM-driven run**

Also, 10 runs 0.11° (~12.5 km) runs (1 reference ERA-interim-driven, 5 RCP8.5, 3 RCP4.5 and 1 RCP2.6 scenario)

Radiative forcing in RCA4 is implemented in terms of equivalent CO2 concentrations (no explicit treatment of aerosol changes). Land use is constant in the simulations. Atmosphere-only runs.

1. Reanalysis-driven simulation

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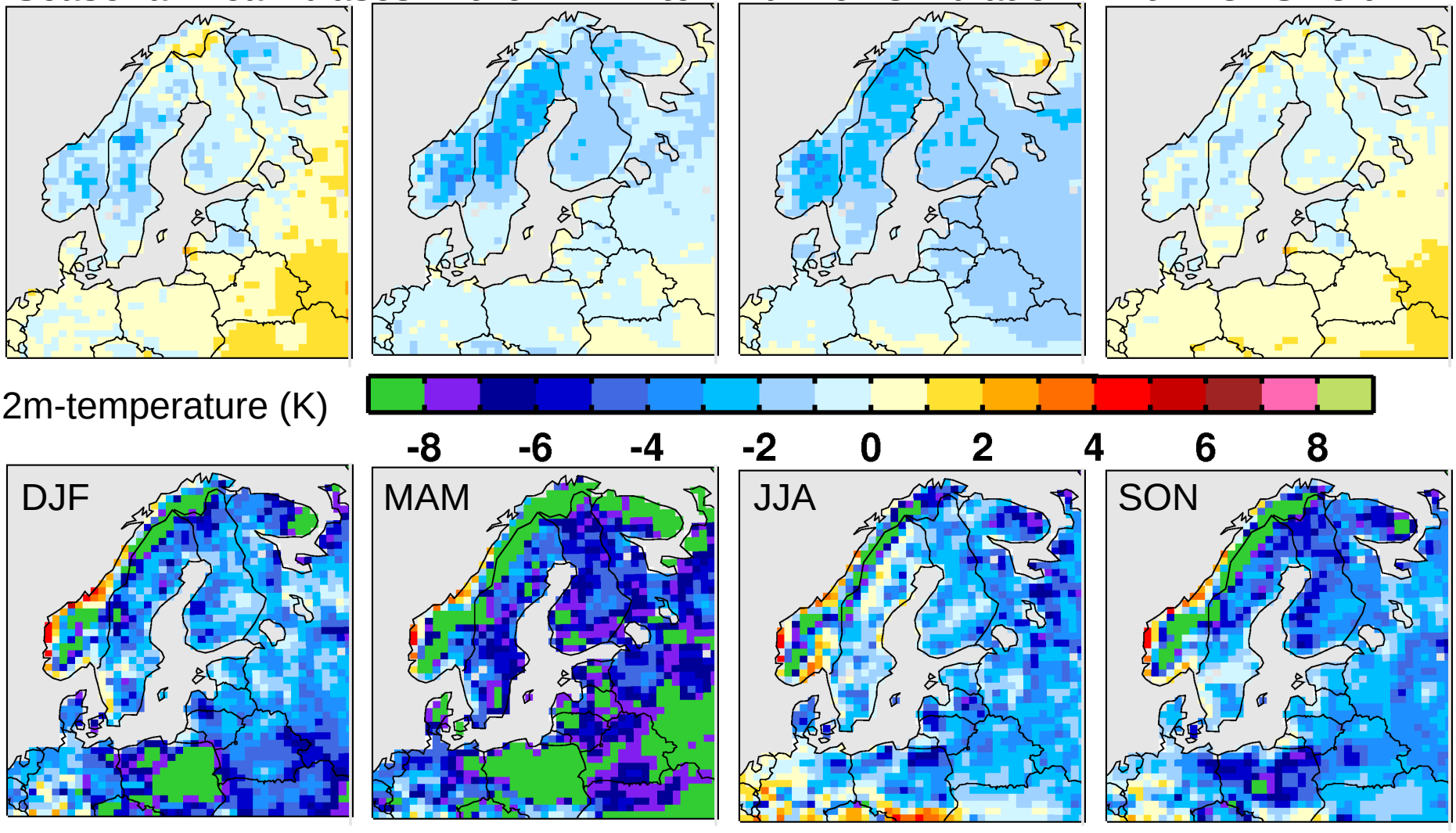
Seasonal mean biases in the ERA-Interim driven simulation w.r.t. E-OBS v8.0



RCA4(ERA-INTERIM) performance

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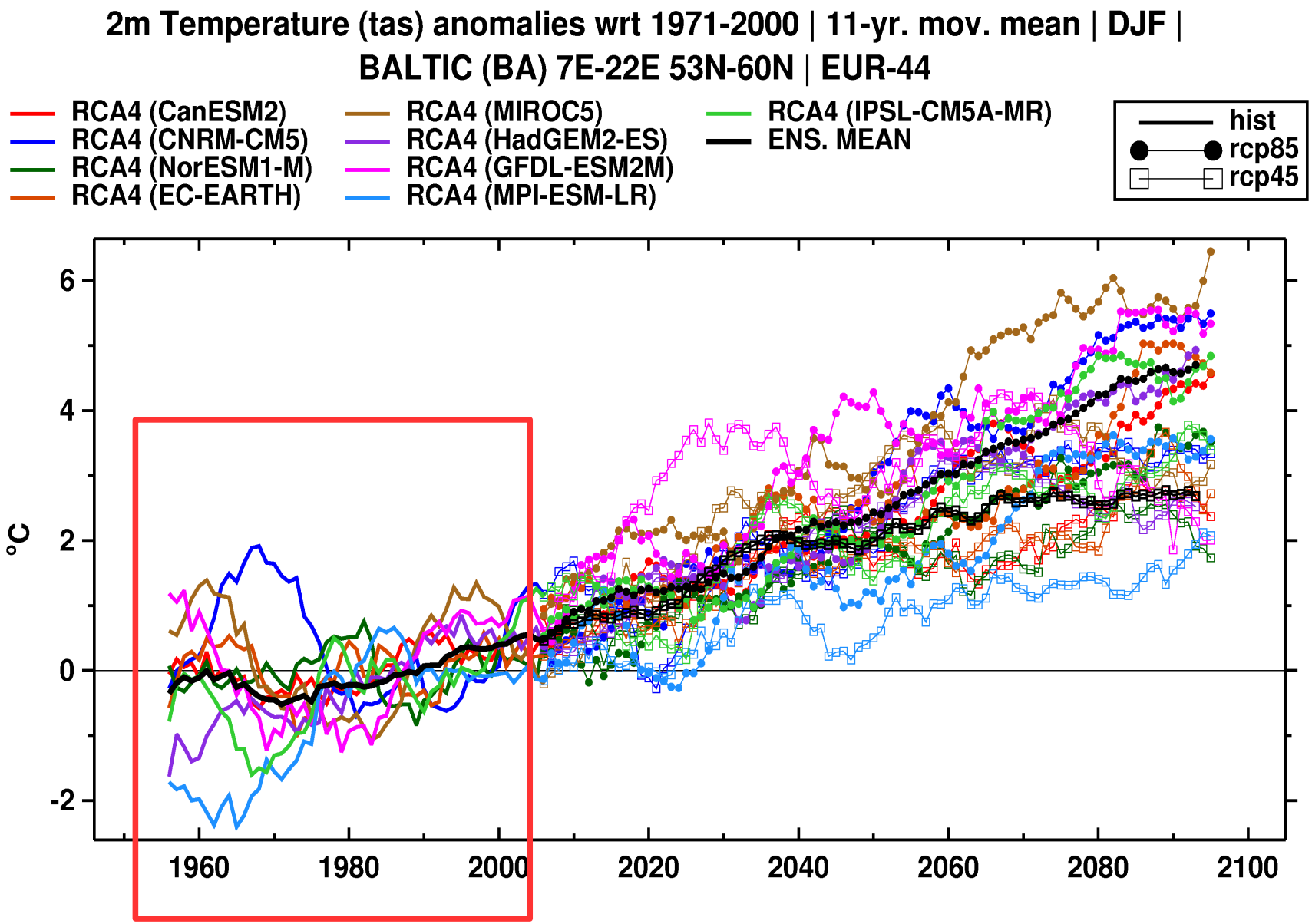
- MSLP close to ERA-Interim indicating good agreement for the large-scale circulation. However, tendency for too low pressure in E and NE Europe (not JJA)
- Seasonal mean temperature biases over the Baltex area are most often less than 2°C but locally up to 3-4°C. Mostly cold biases, most pronounced in summer.
- Precipitation tends to be overestimated in all seasons, most notably in spring. Possibly related to ”low pressure bias”
- On the European scale there are improvements compared to previous model version RCA3 – RCA4 is more physically consistent (better energy fluxes, less of compensating errors, better representation of the diurnal cycle in temperature)

2. Historical simulations



Large-scale circulation (DJF)

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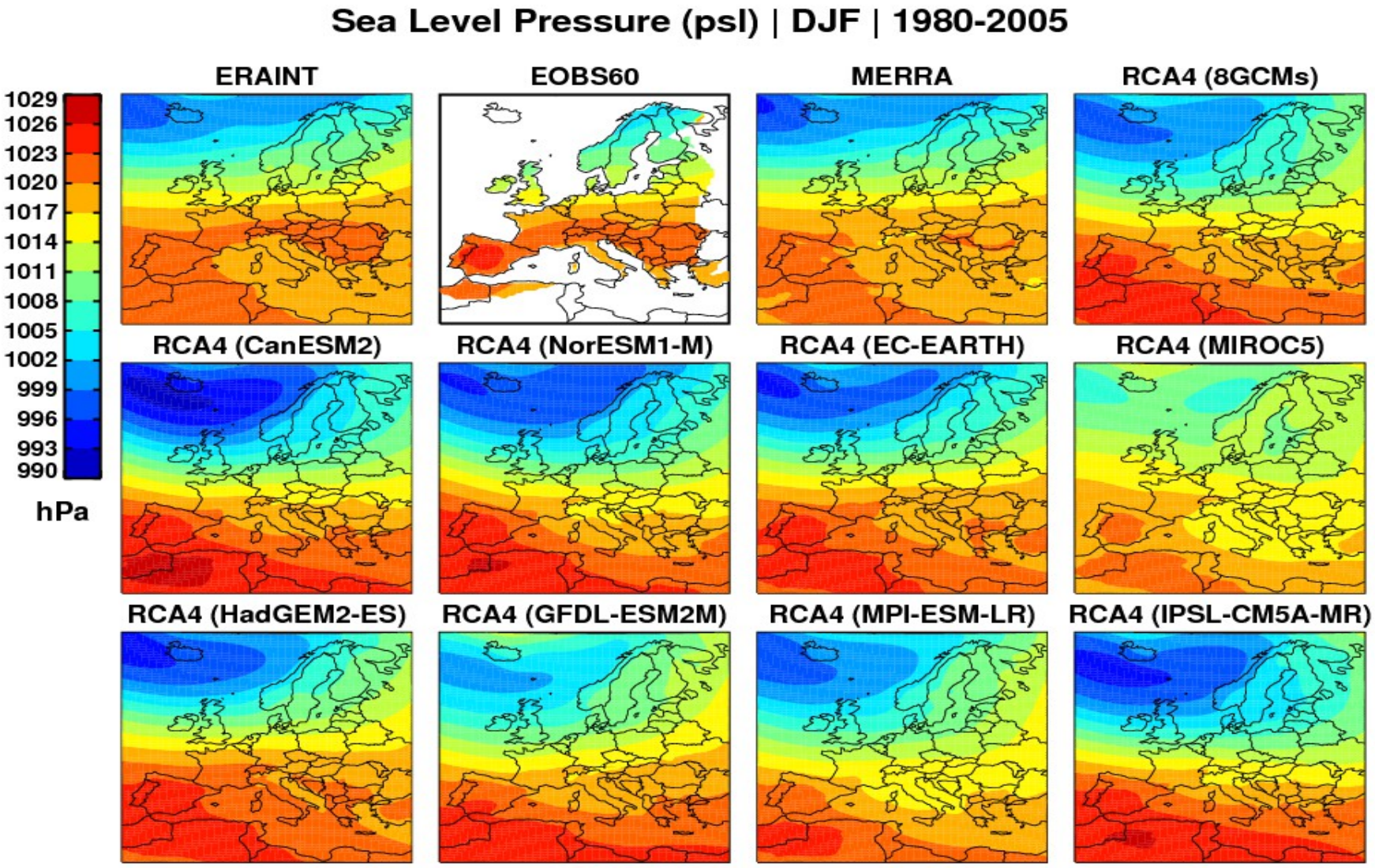

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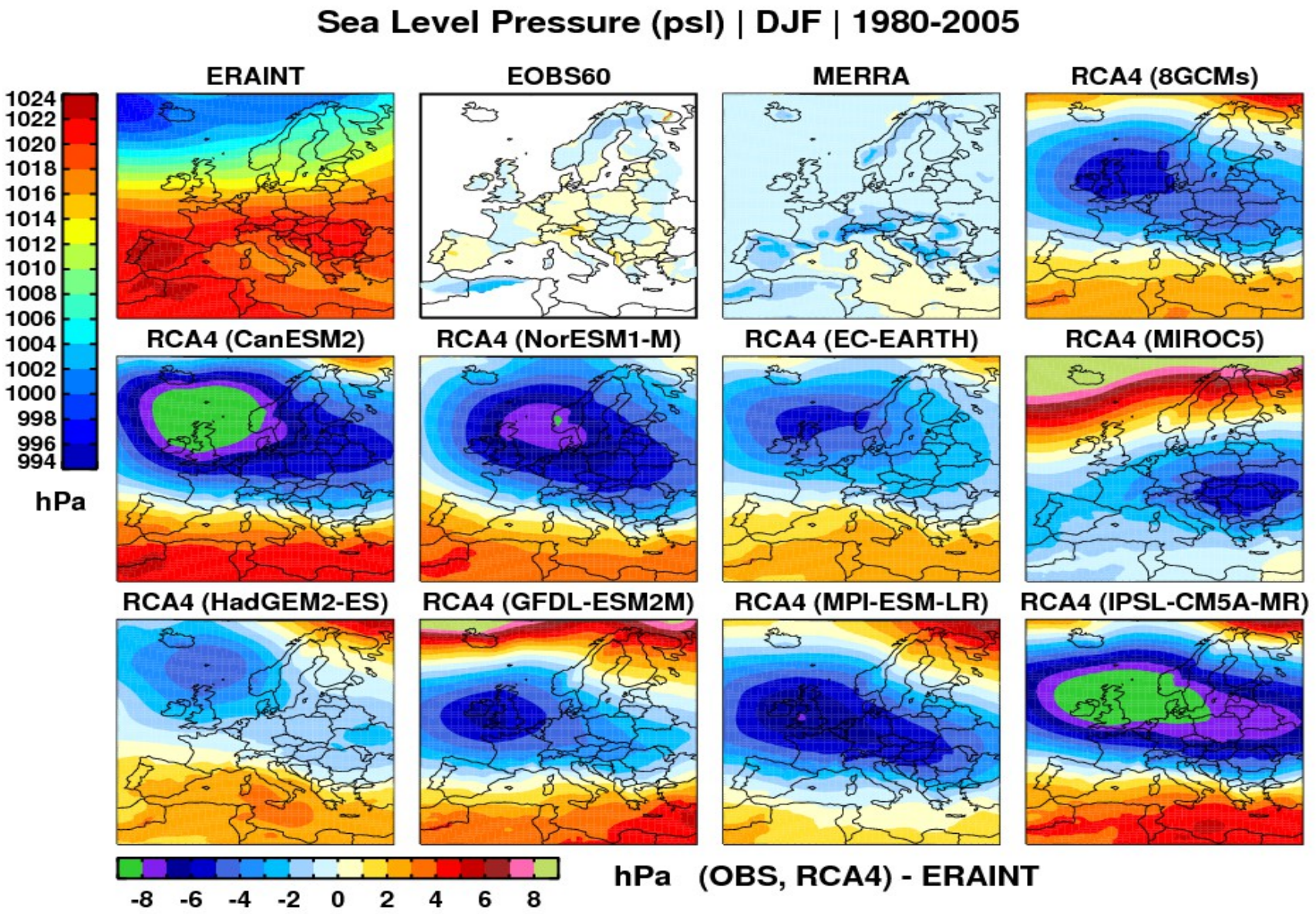

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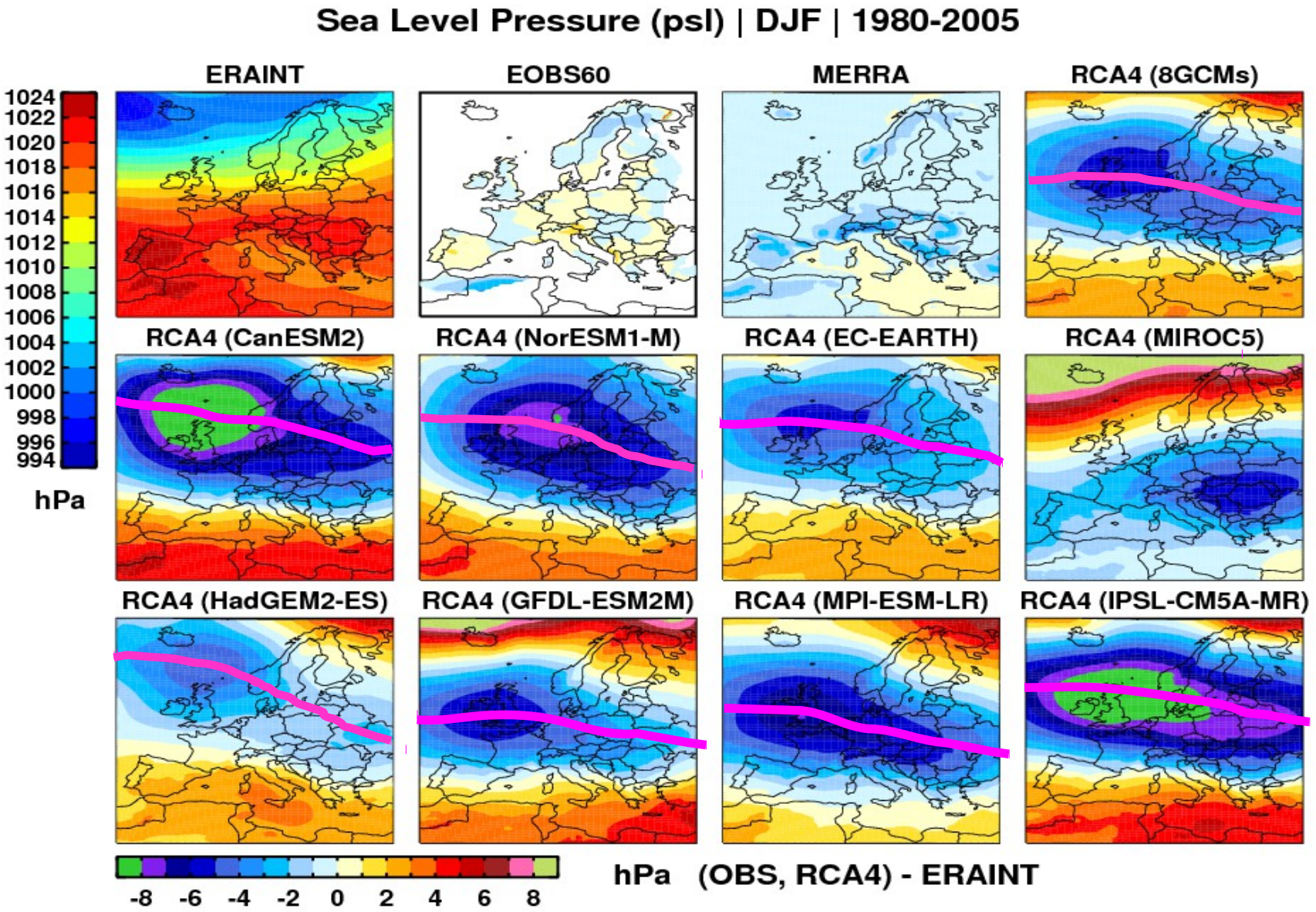

Temperature (DJF)

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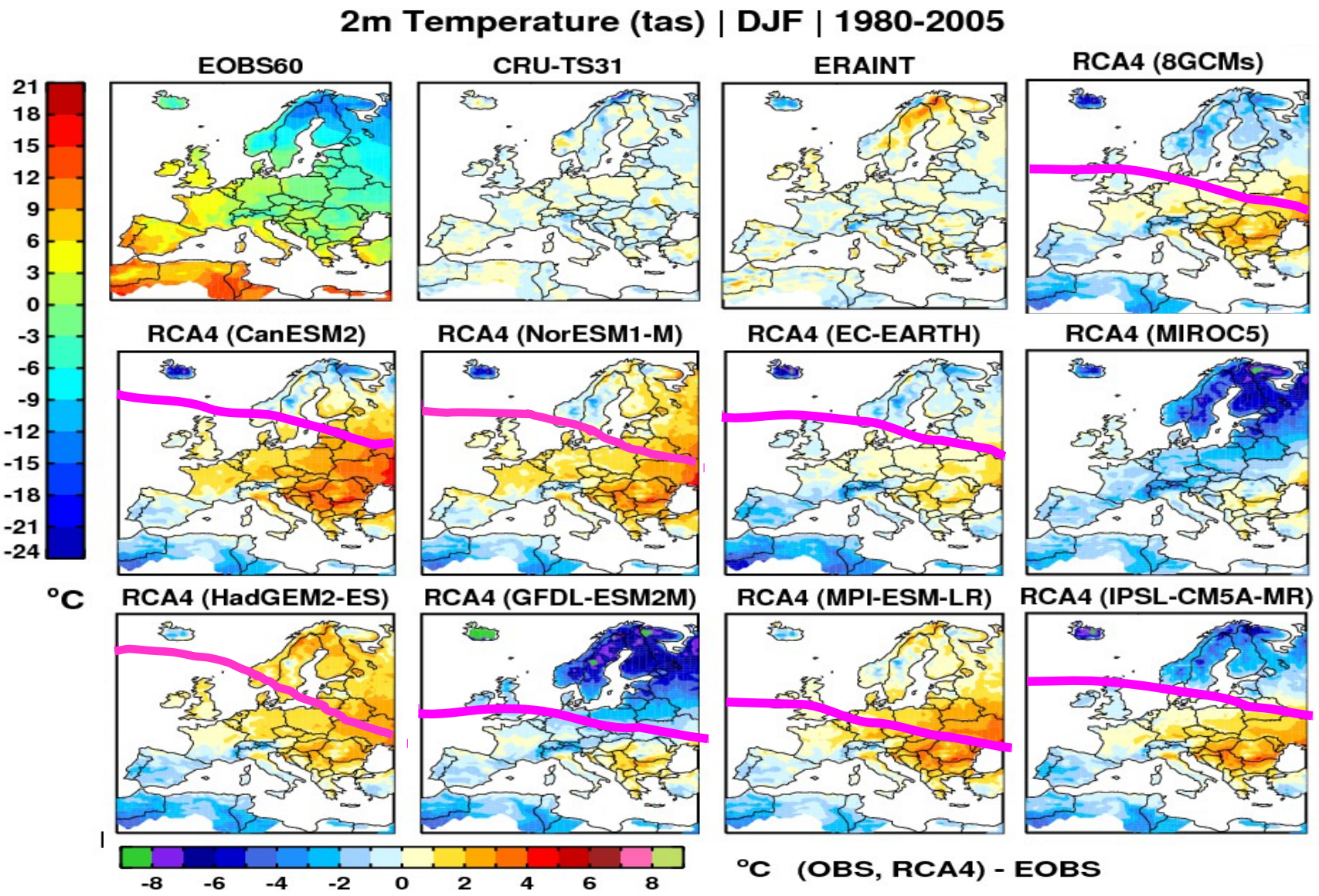

Precipitation (DJF)

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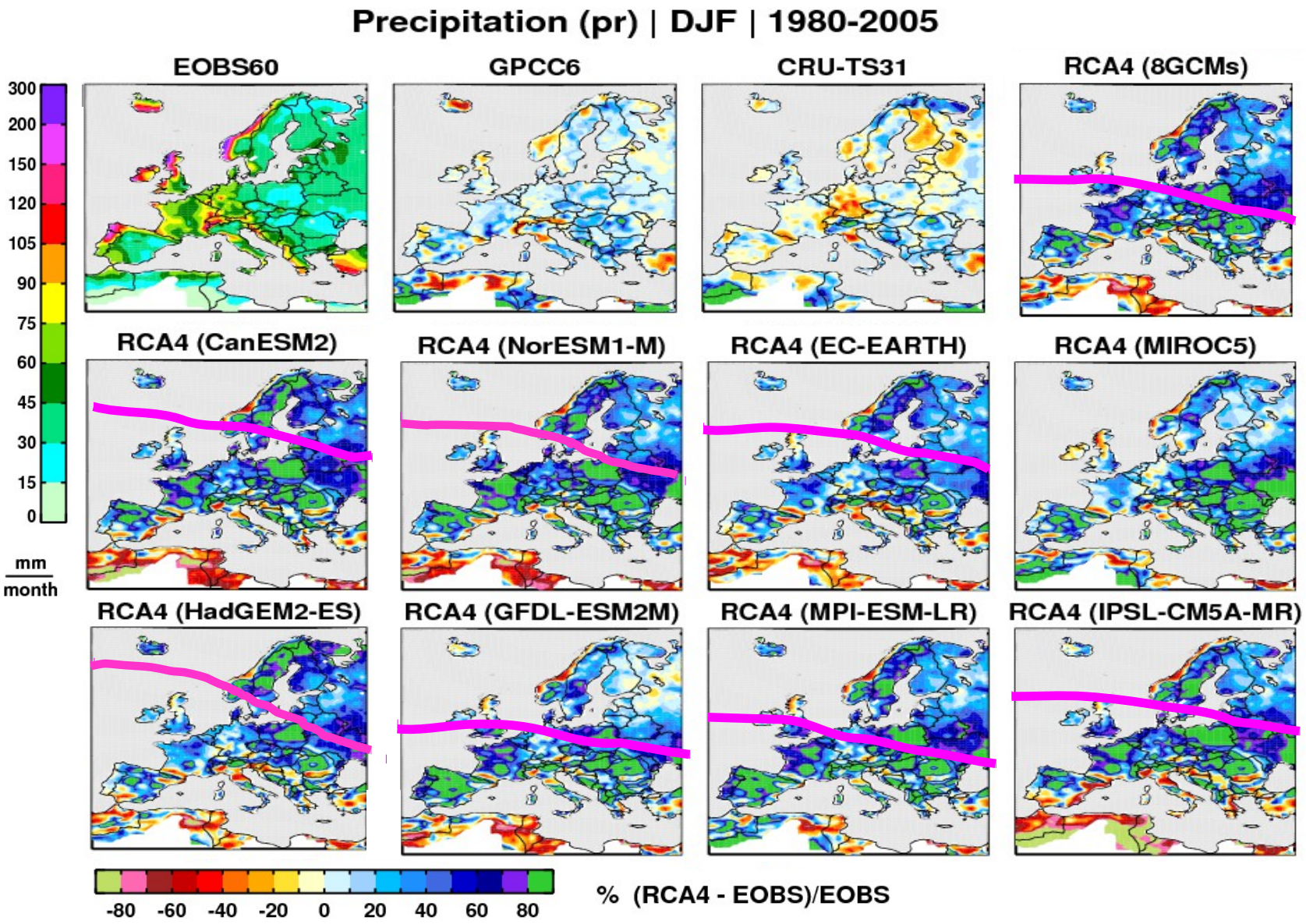
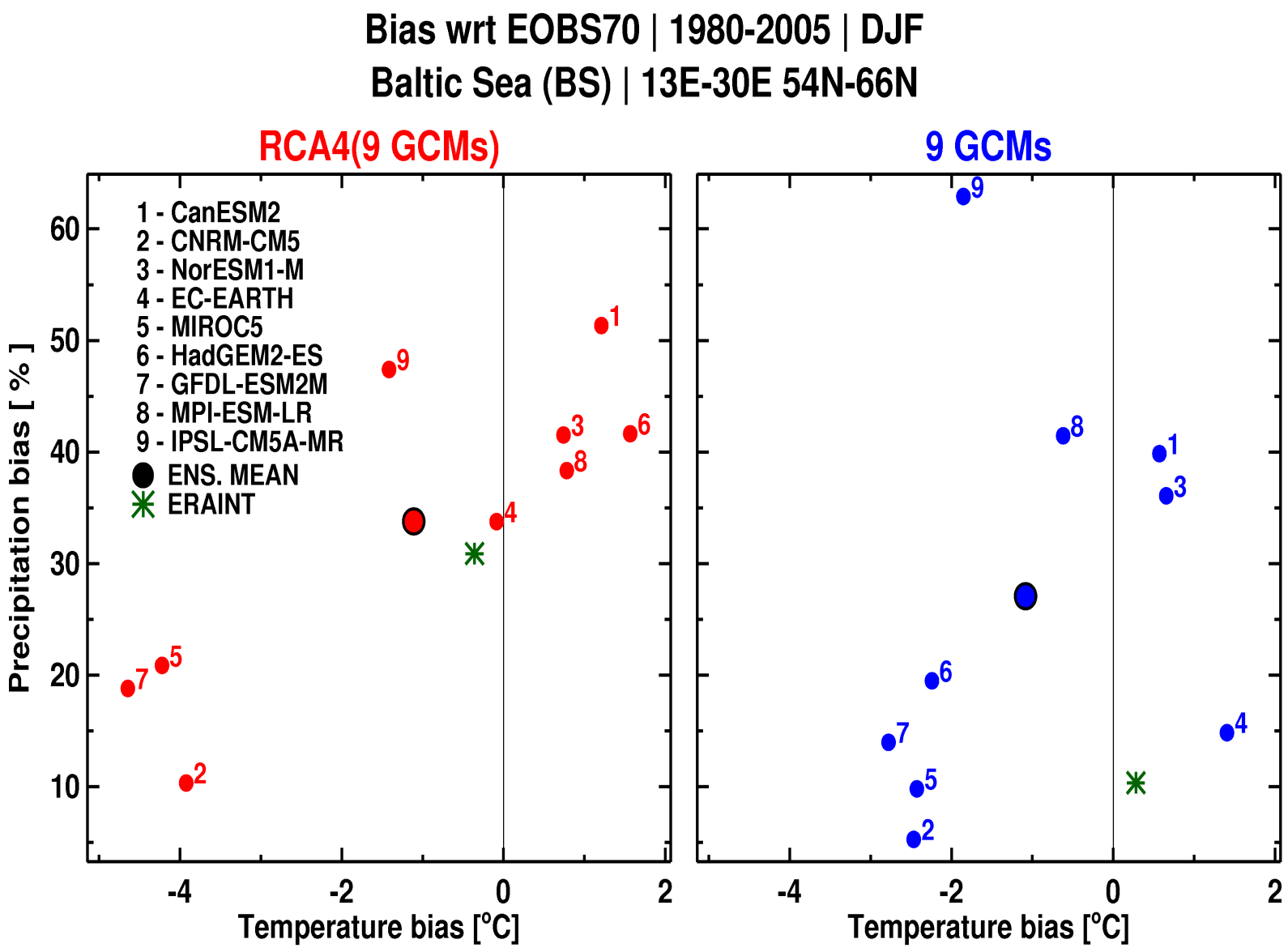


Performance in the Baltic area



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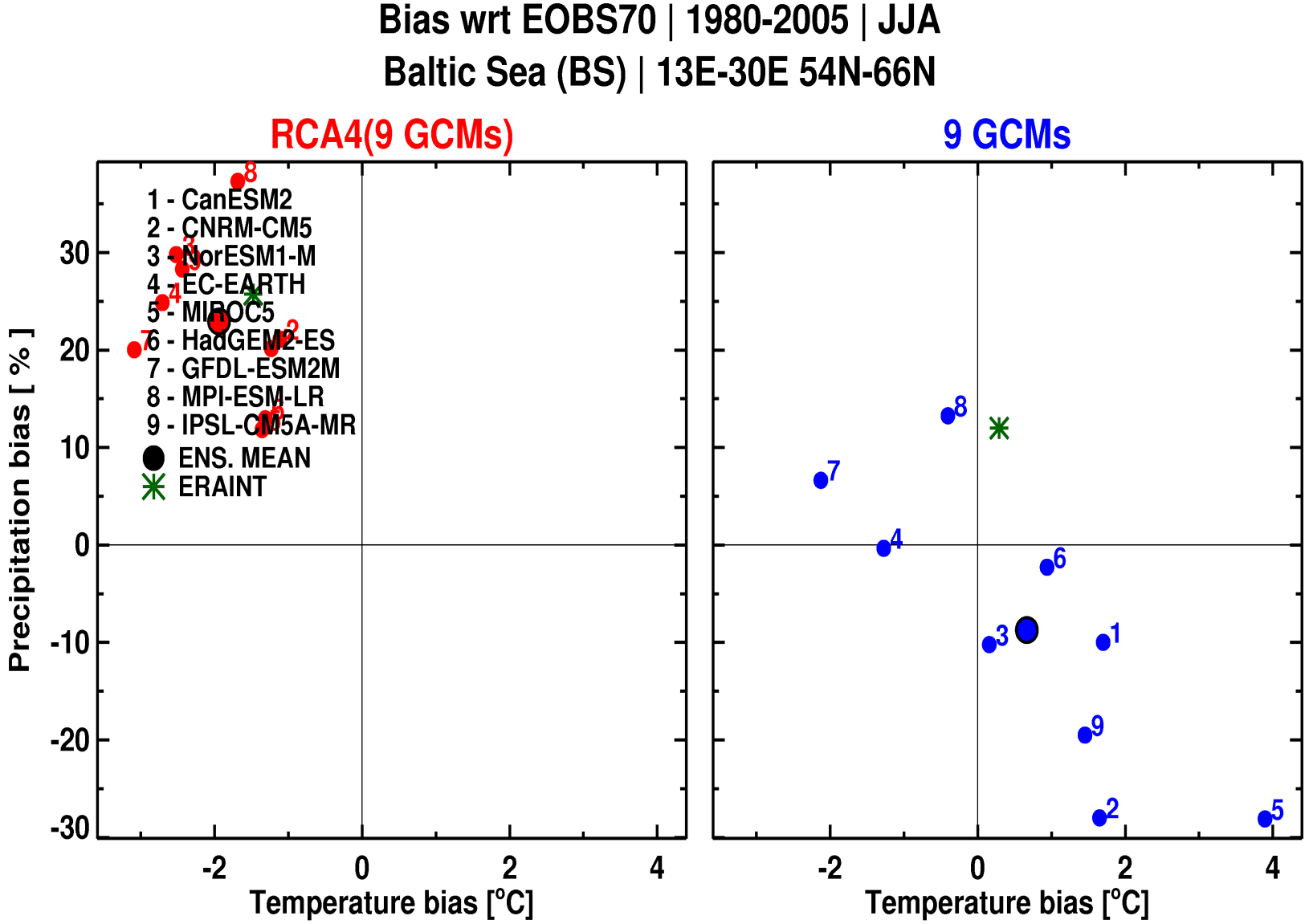

Summary for the historical simulations

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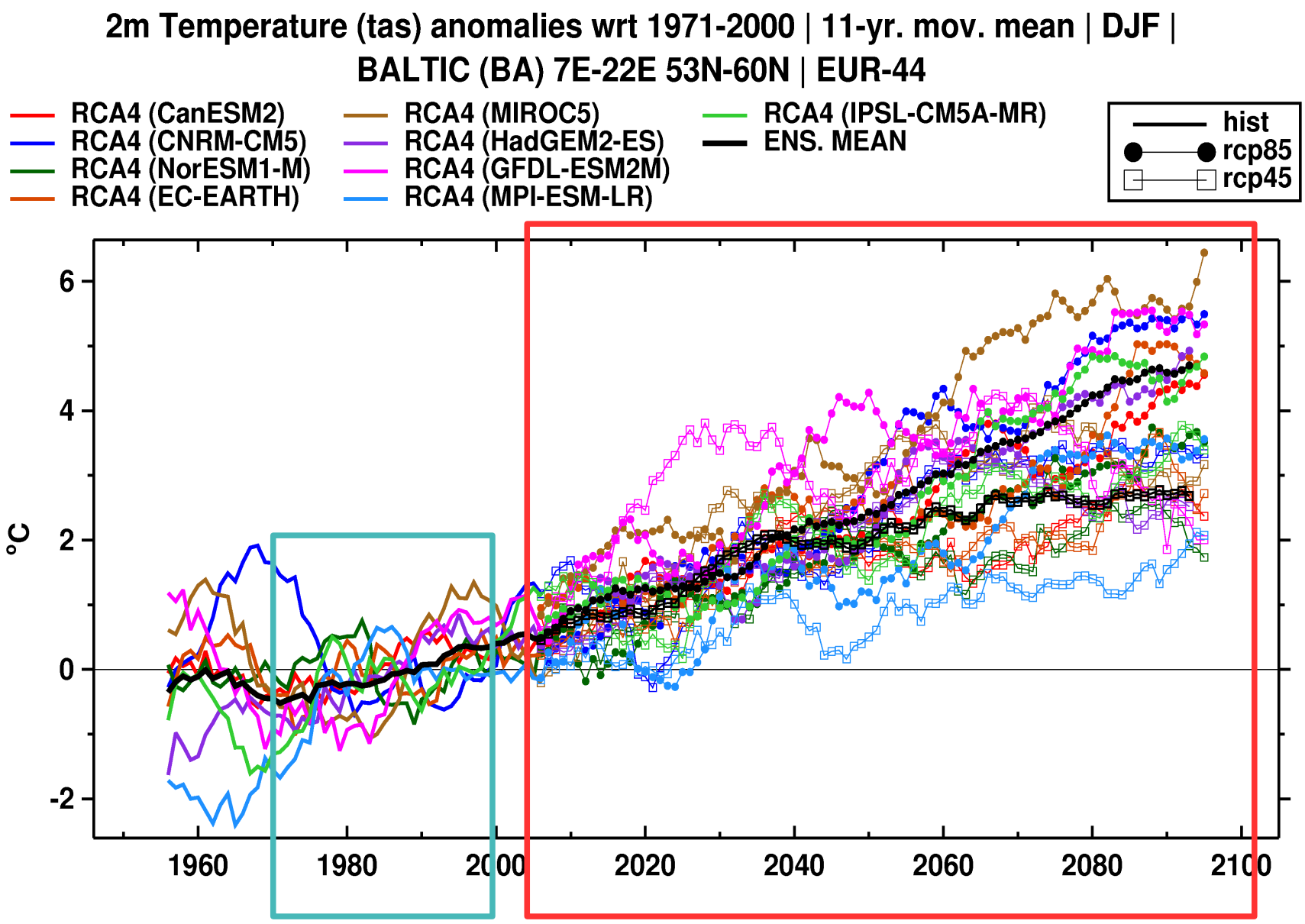
- Larger T and Precipitation biases for GCM-driven simulations than in RCA4(ERA-Interim)
- GCM-driven runs have a tendency of being too zonal except in summer
- Relation between errors in the large-scale circulation in the GCMs and biases in temperature and precipitation in RCA4
- RCA4 show more wet biases (all year) compared to the GCMs and more cold biases in summer
- RCA4 sometimes reduces biases compared to those in the underlying GCMs, sometimes amplifies them

3. Future climate change



Changes in annual mean T and precip

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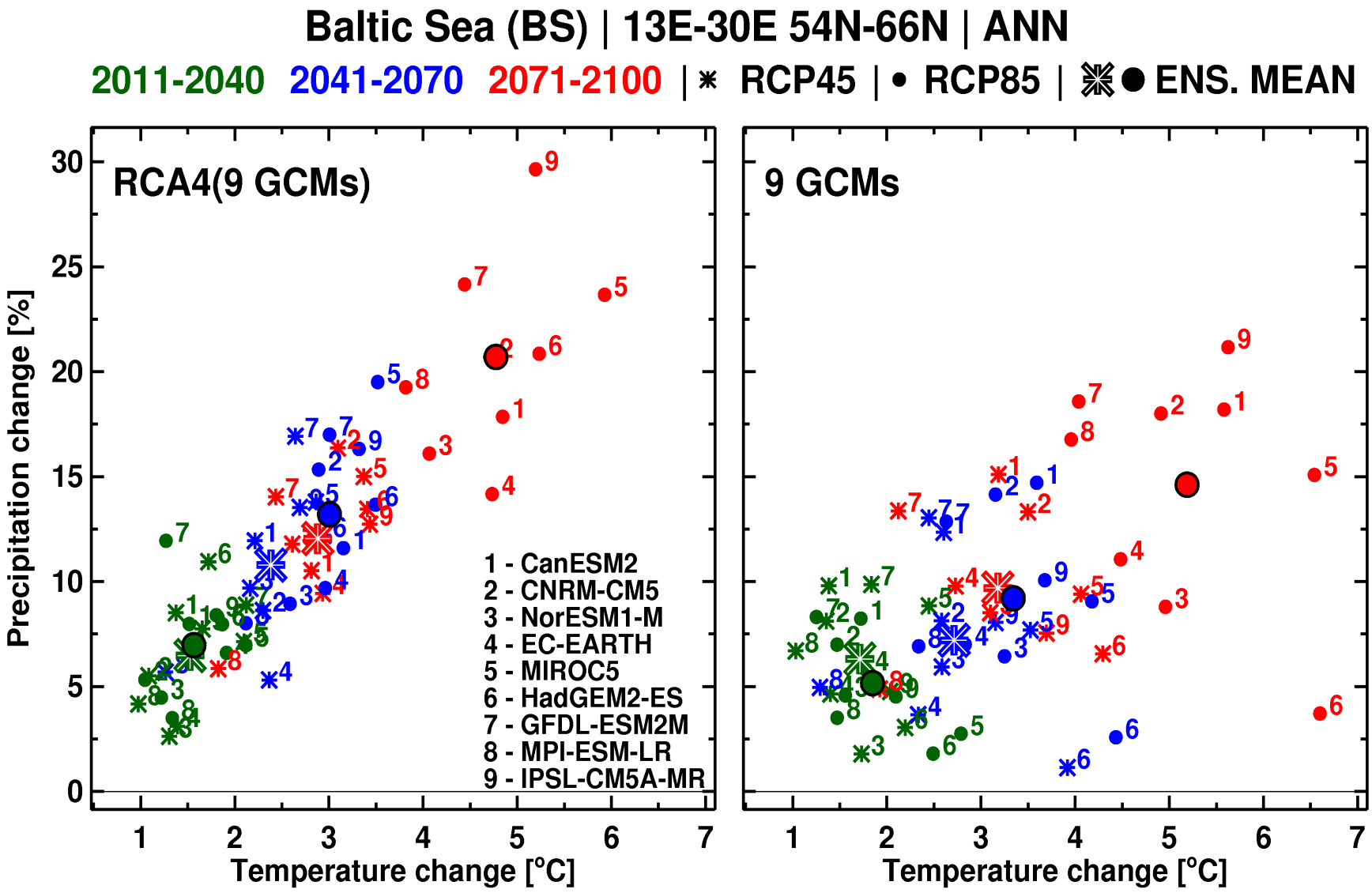

Changes in winter temperatures

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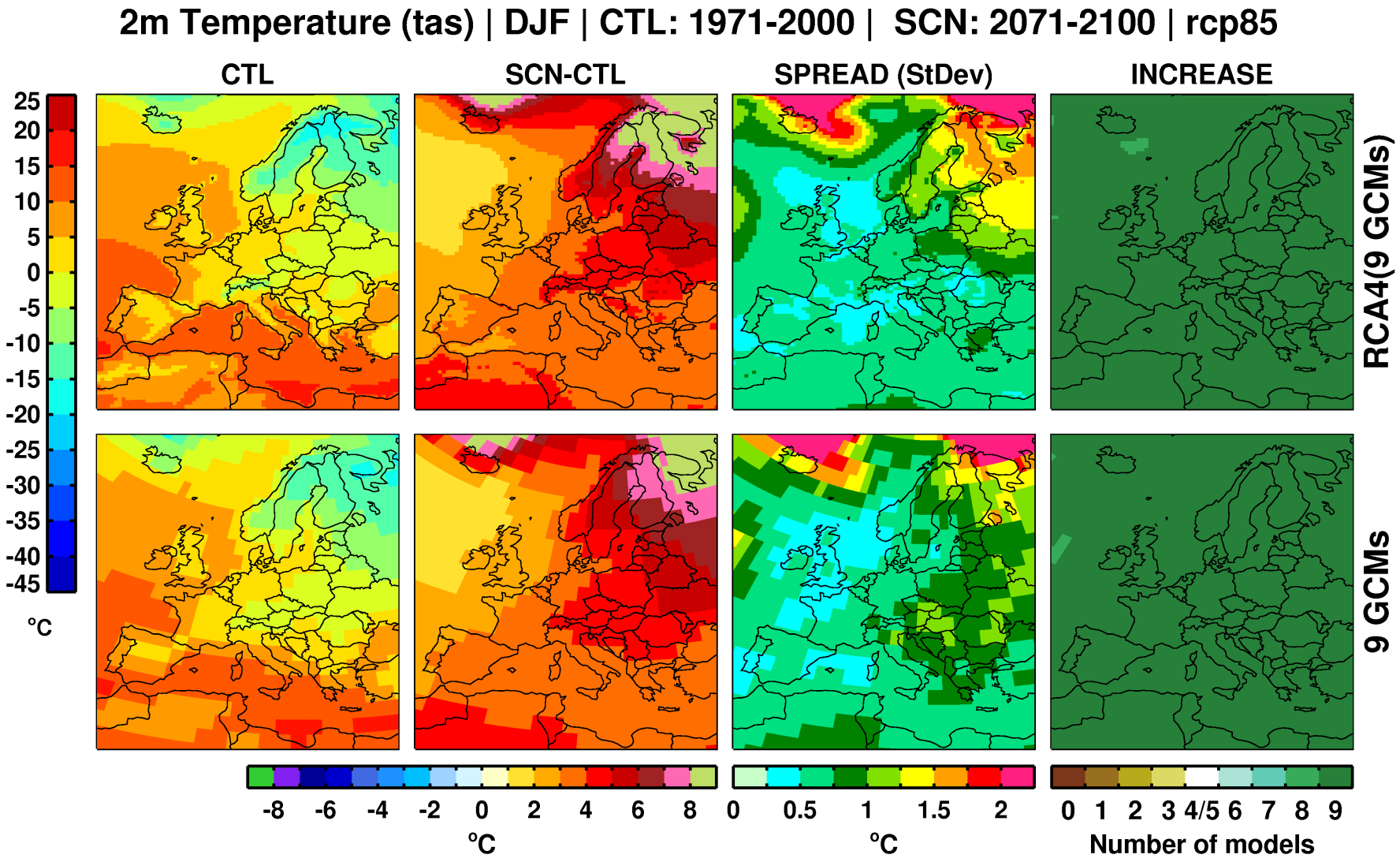

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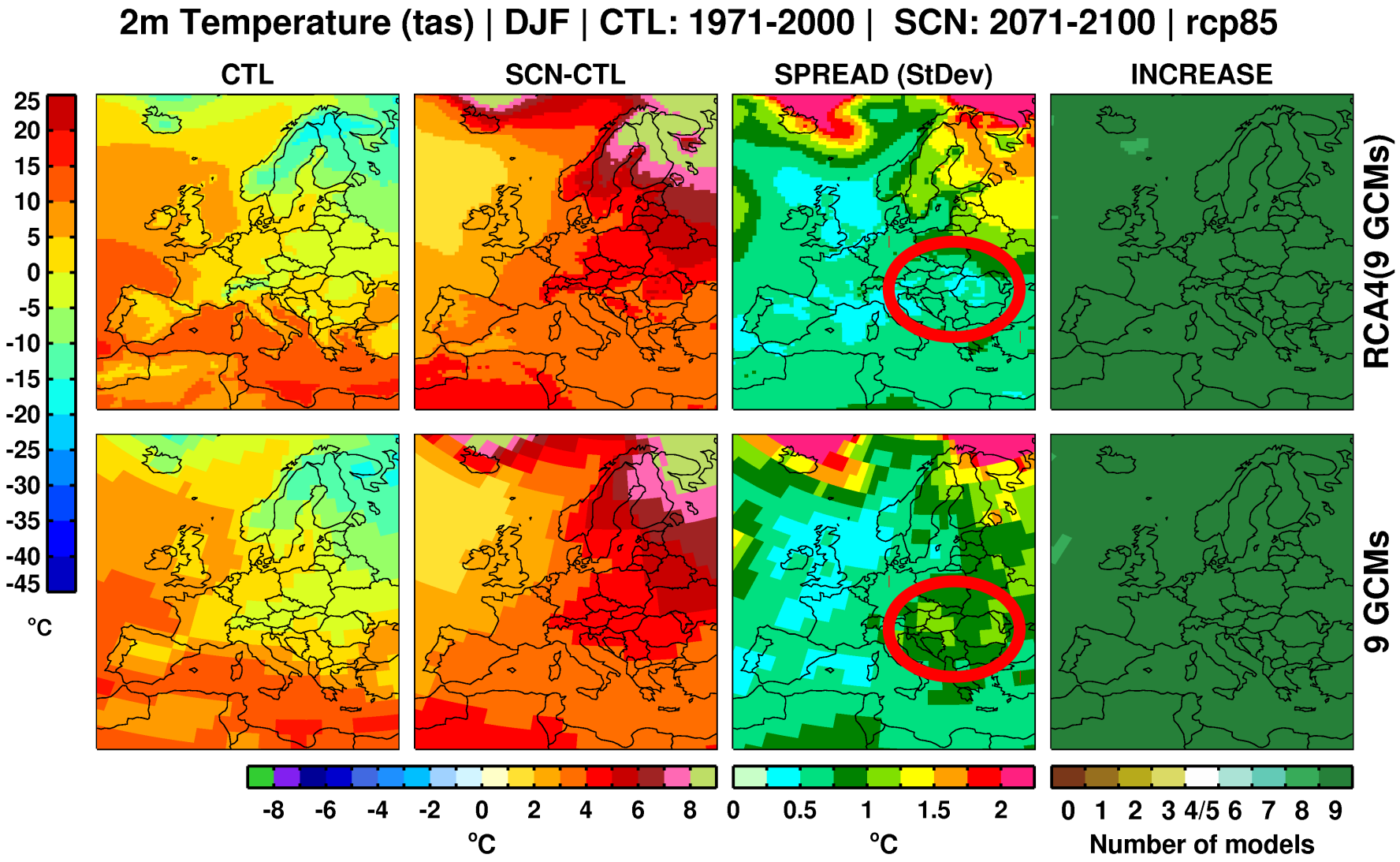

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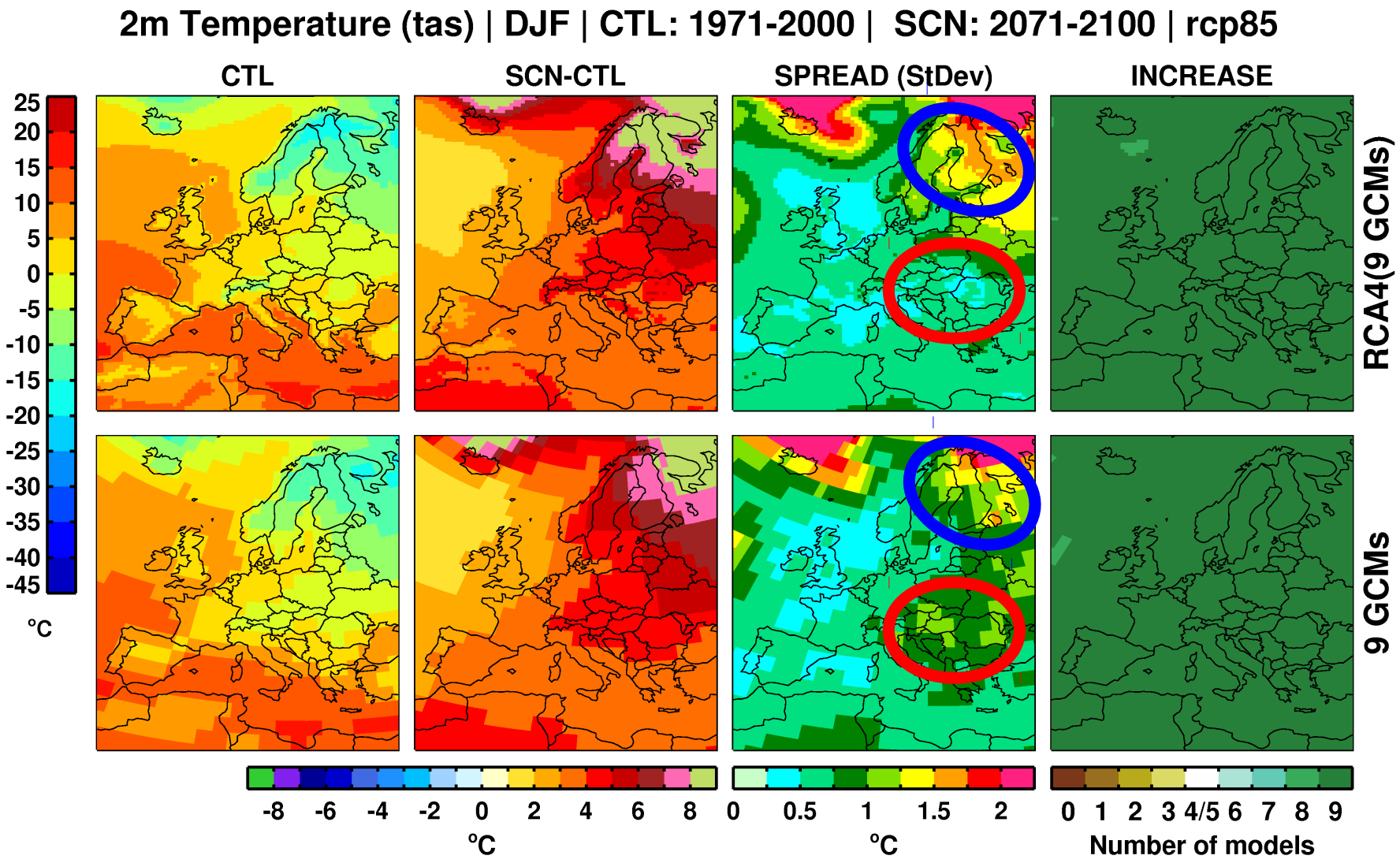

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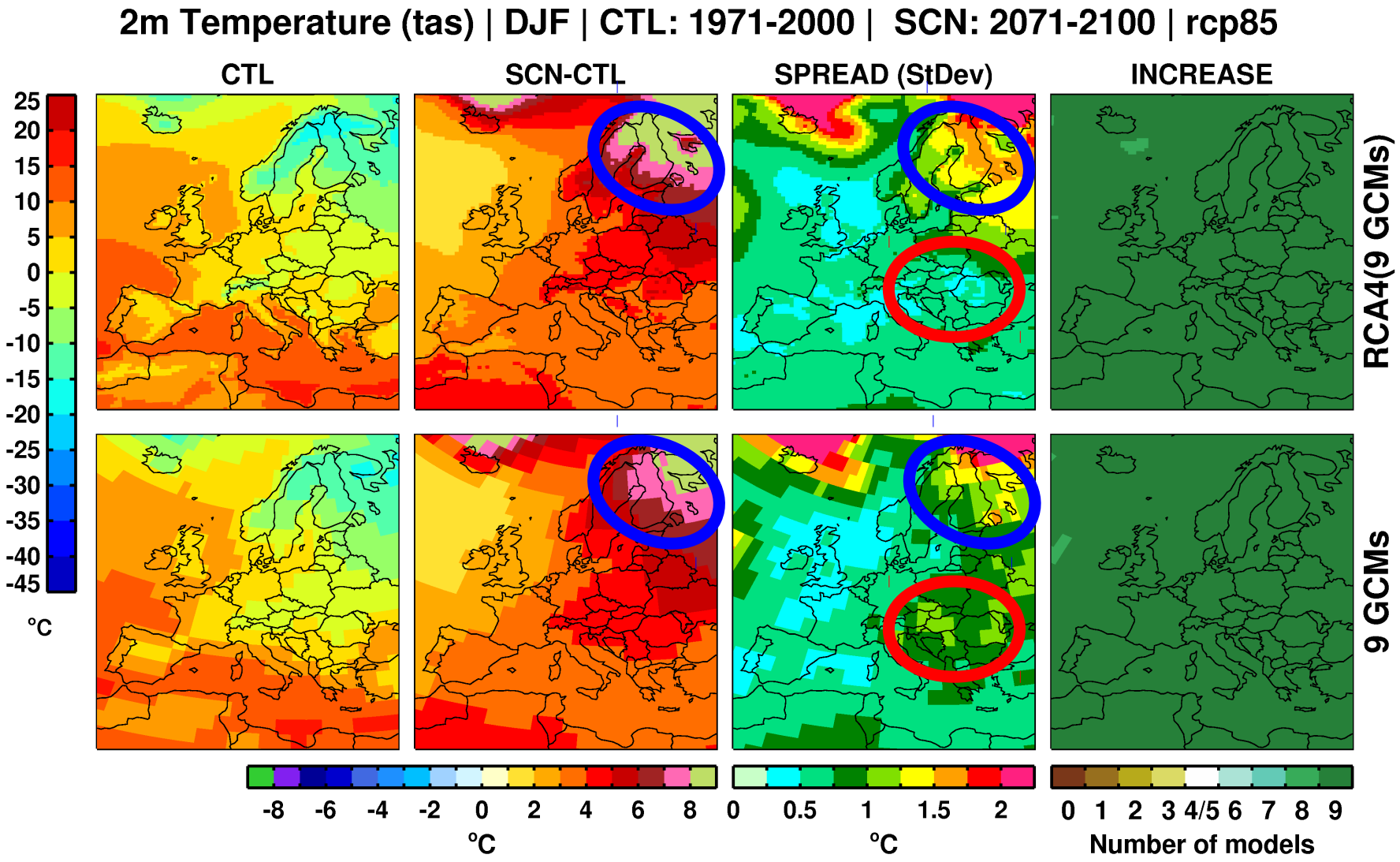

Changes in winter precipitation

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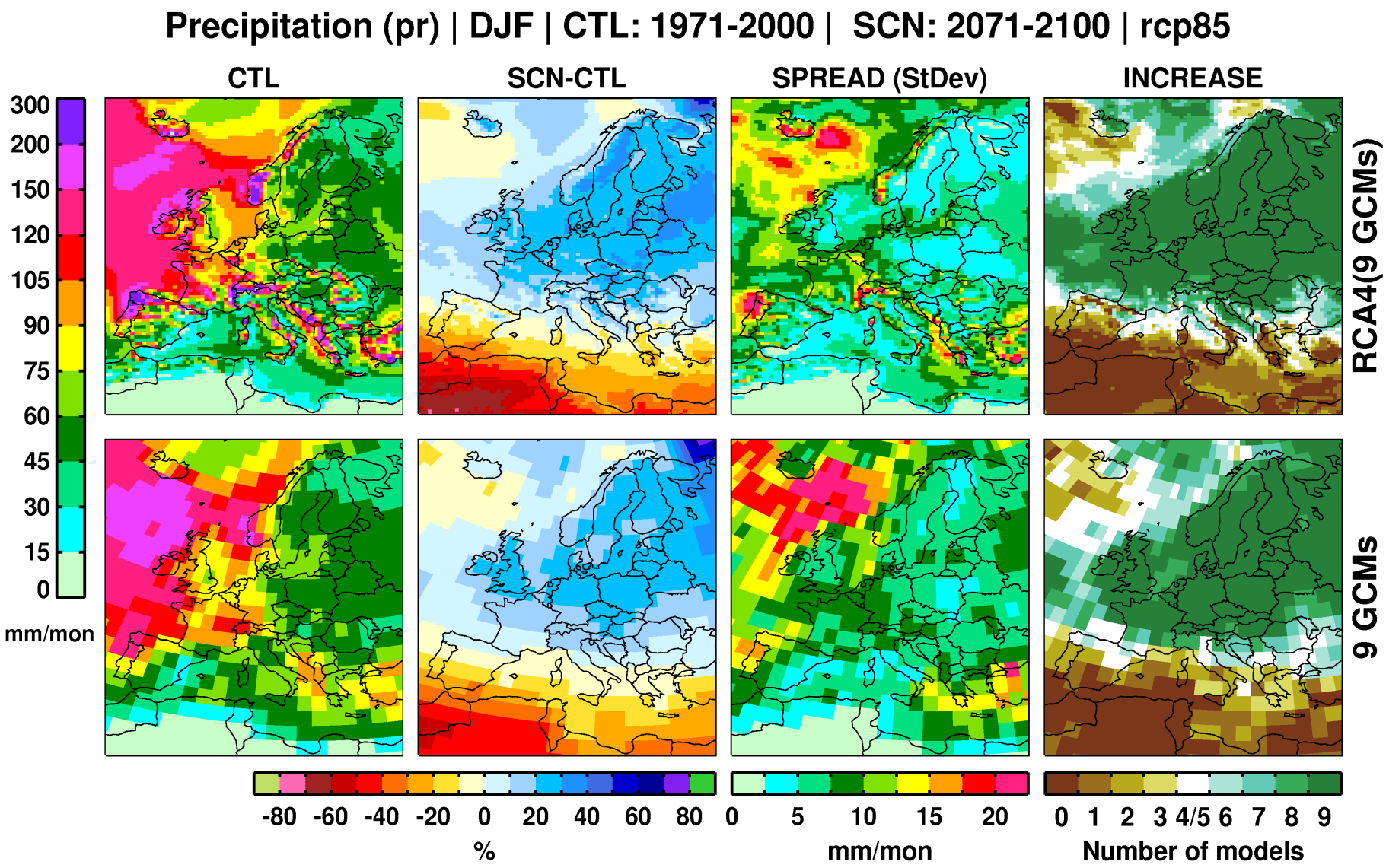
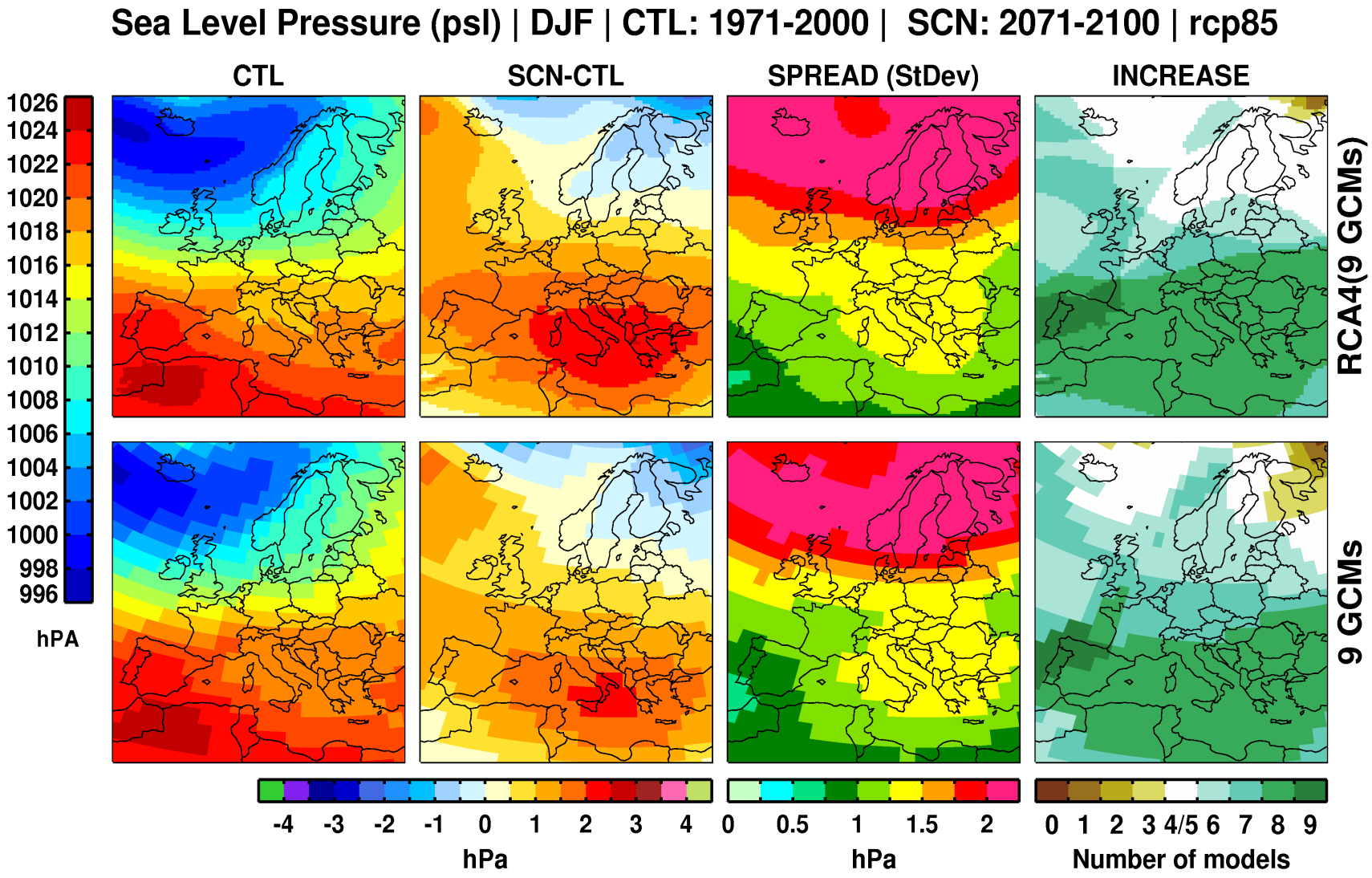


Changes in winter MSLP



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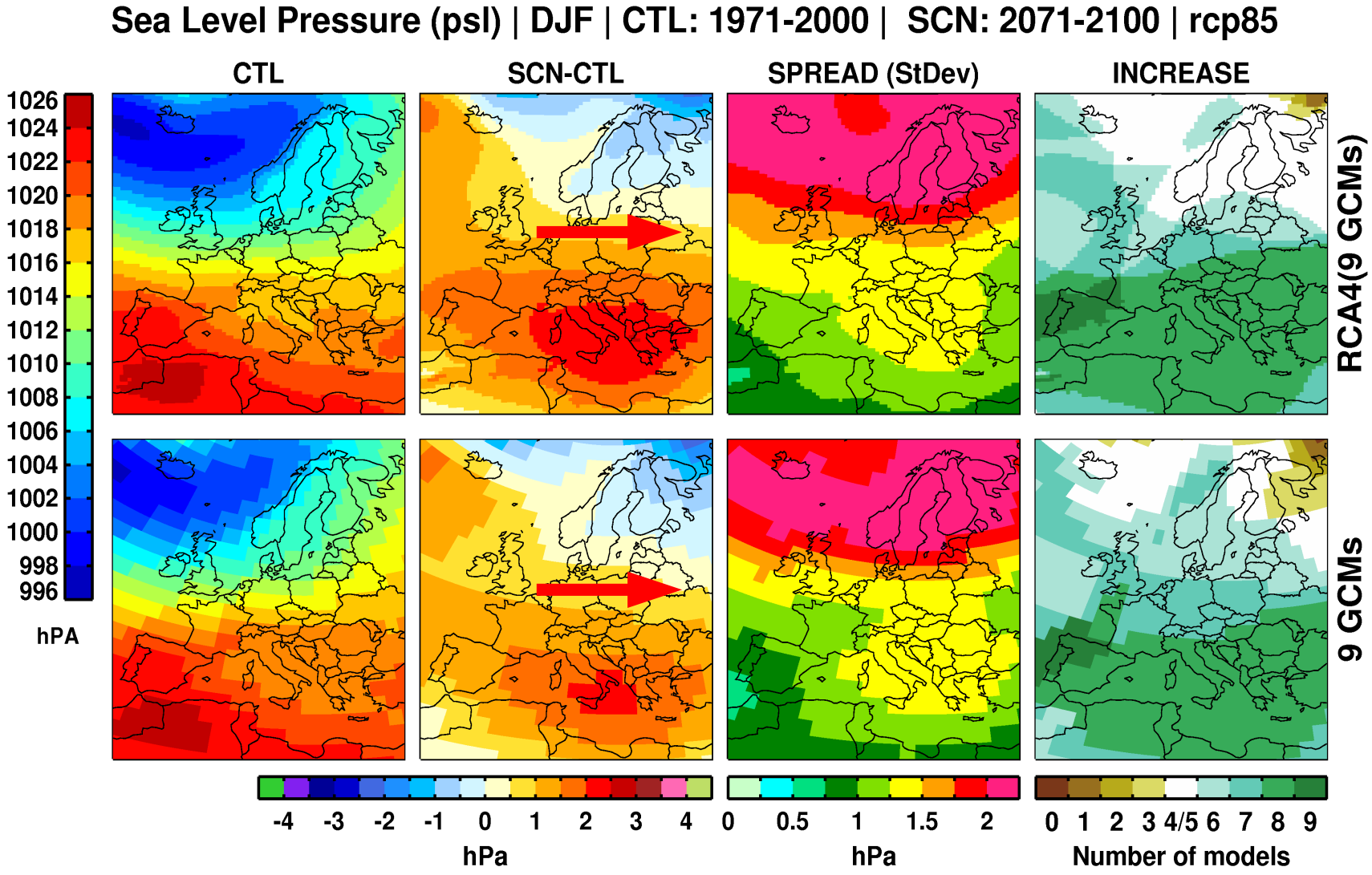

Changes in winter wind conditions

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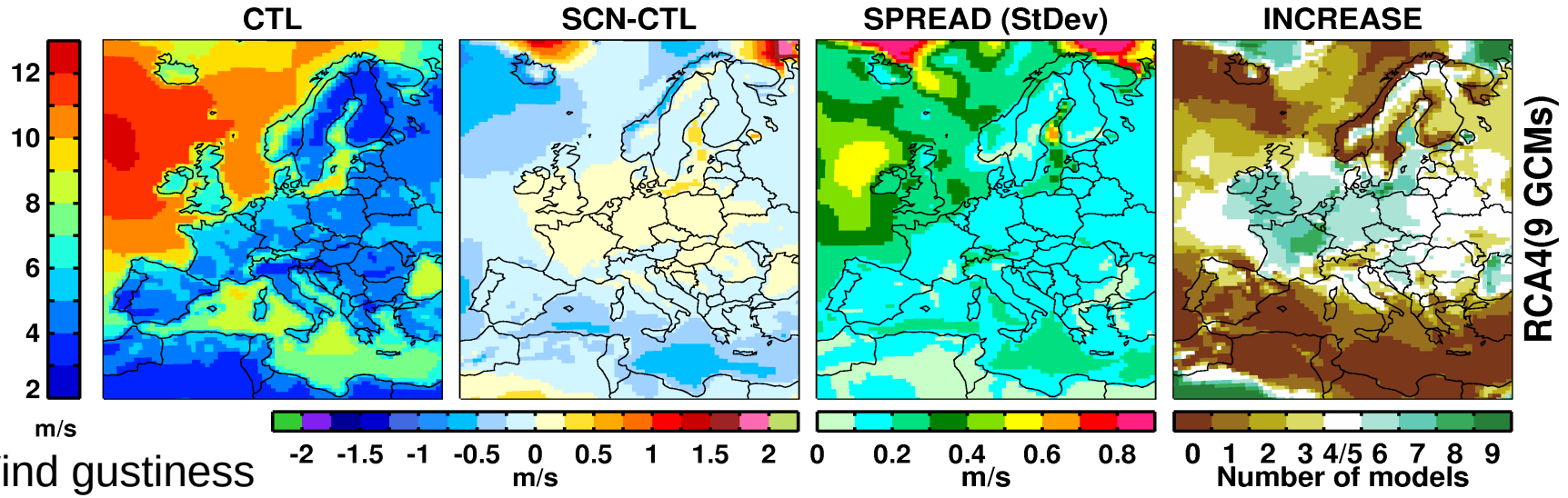
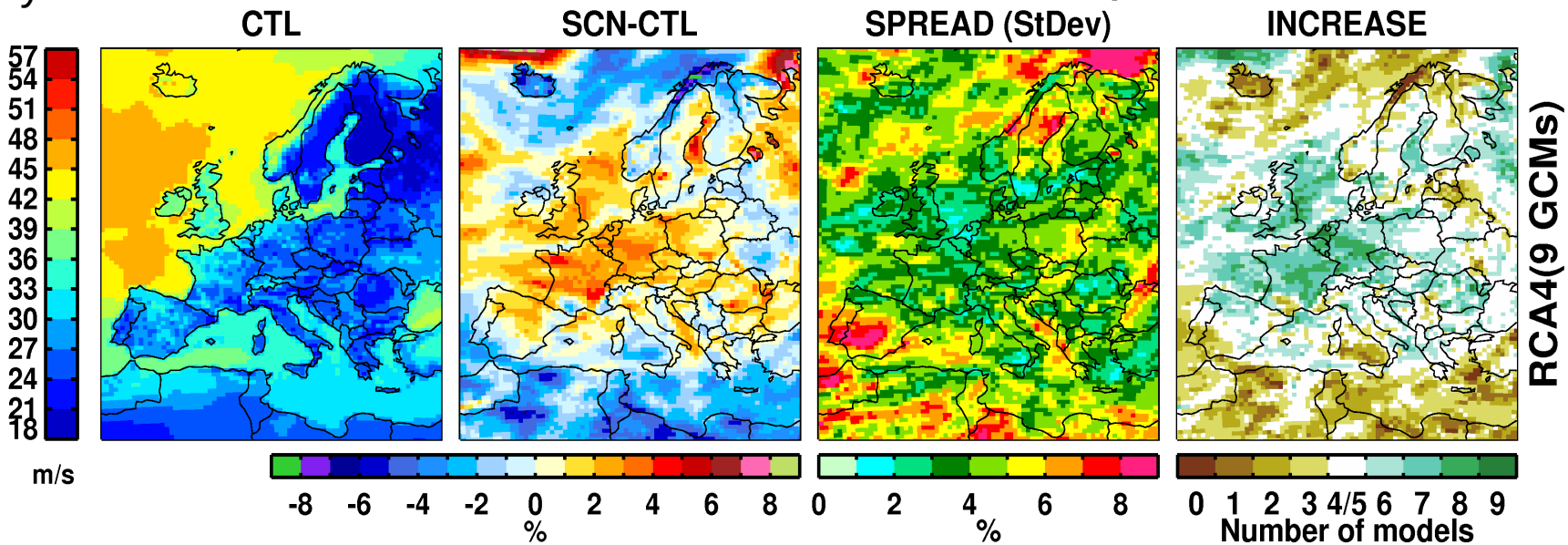
Mean wind



Wind gustiness
20-yr return levels



Changes in summer temperatures

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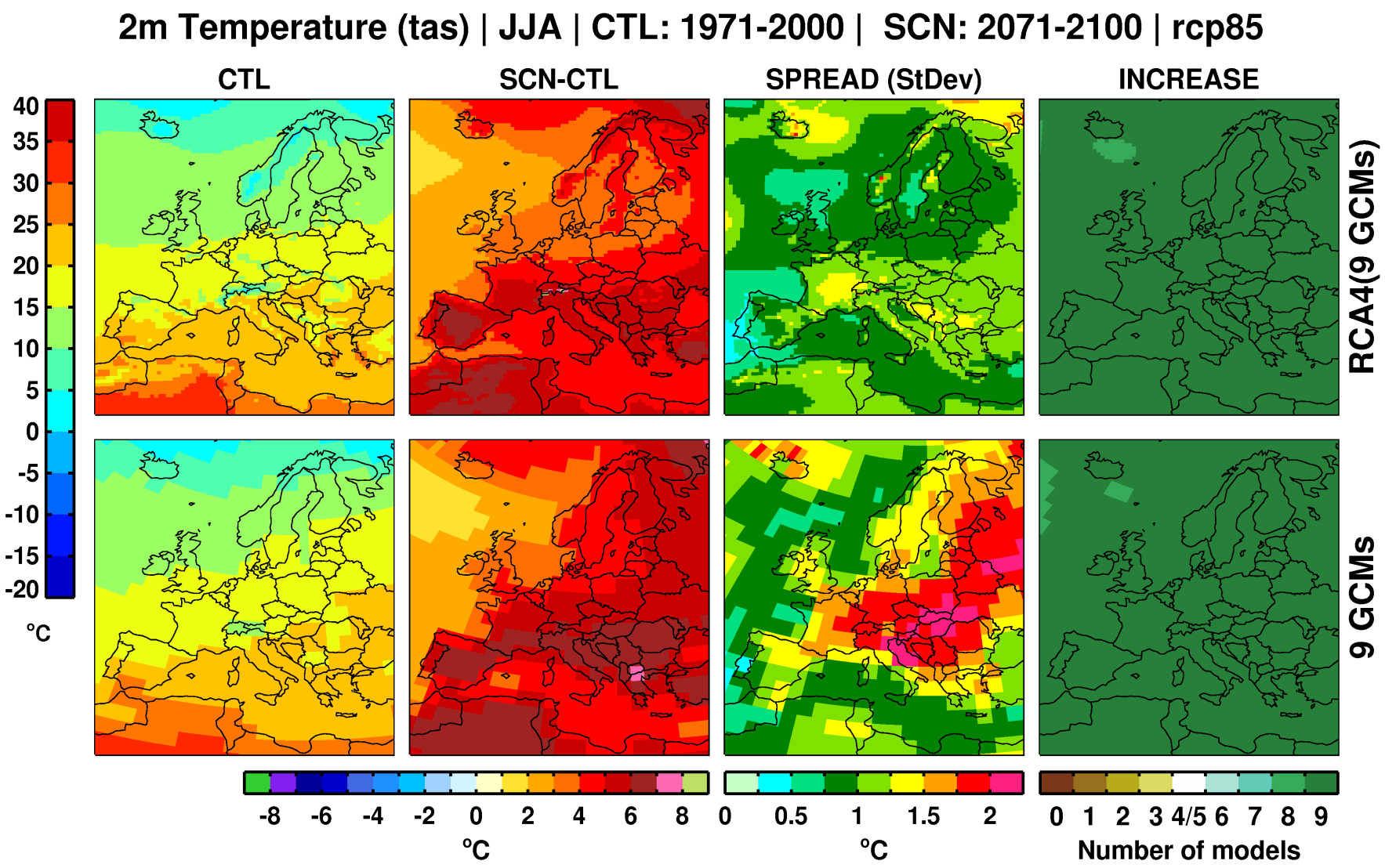

Changes in summer precipitation

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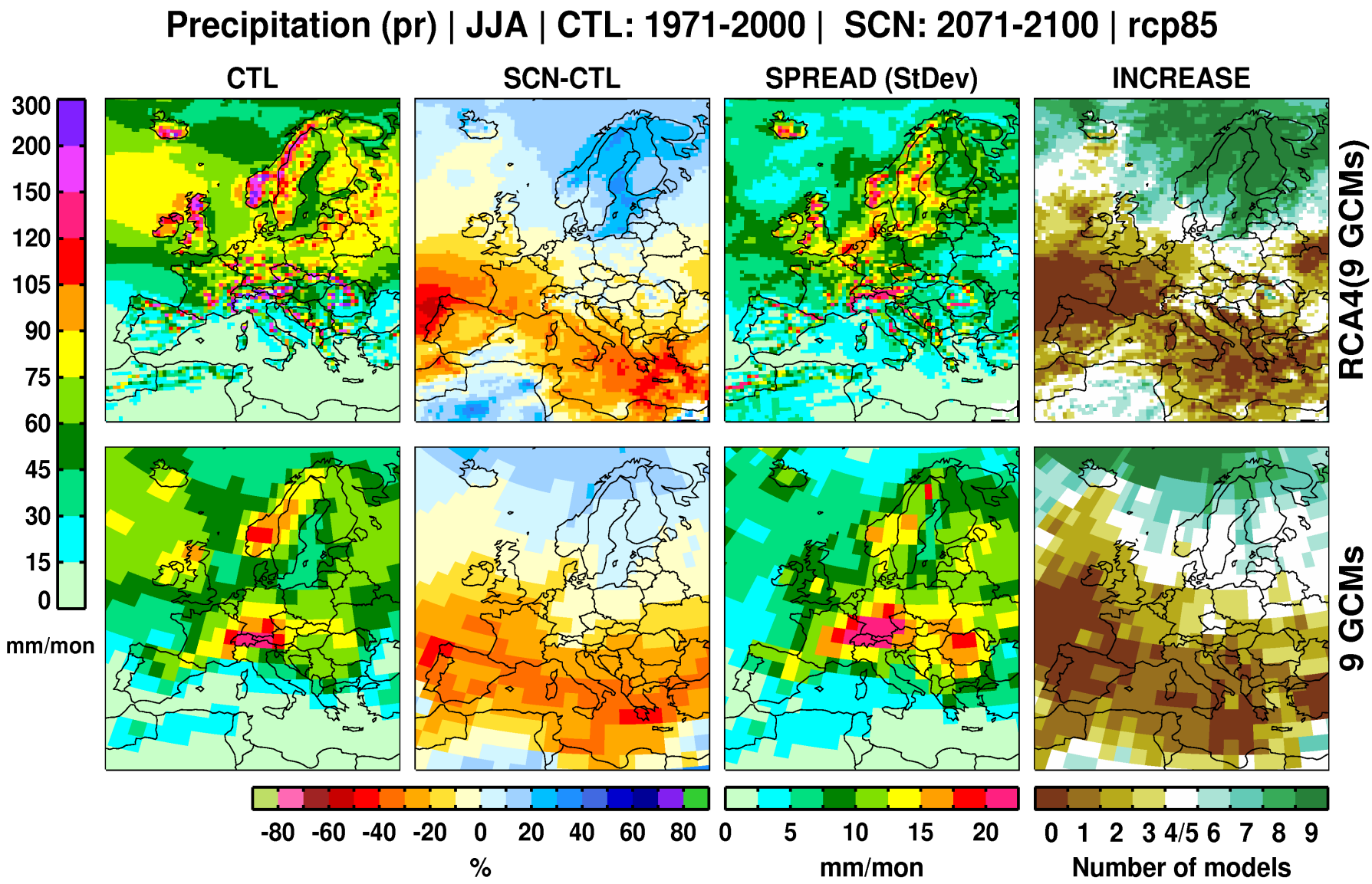

Changes in wet daily summer extremes

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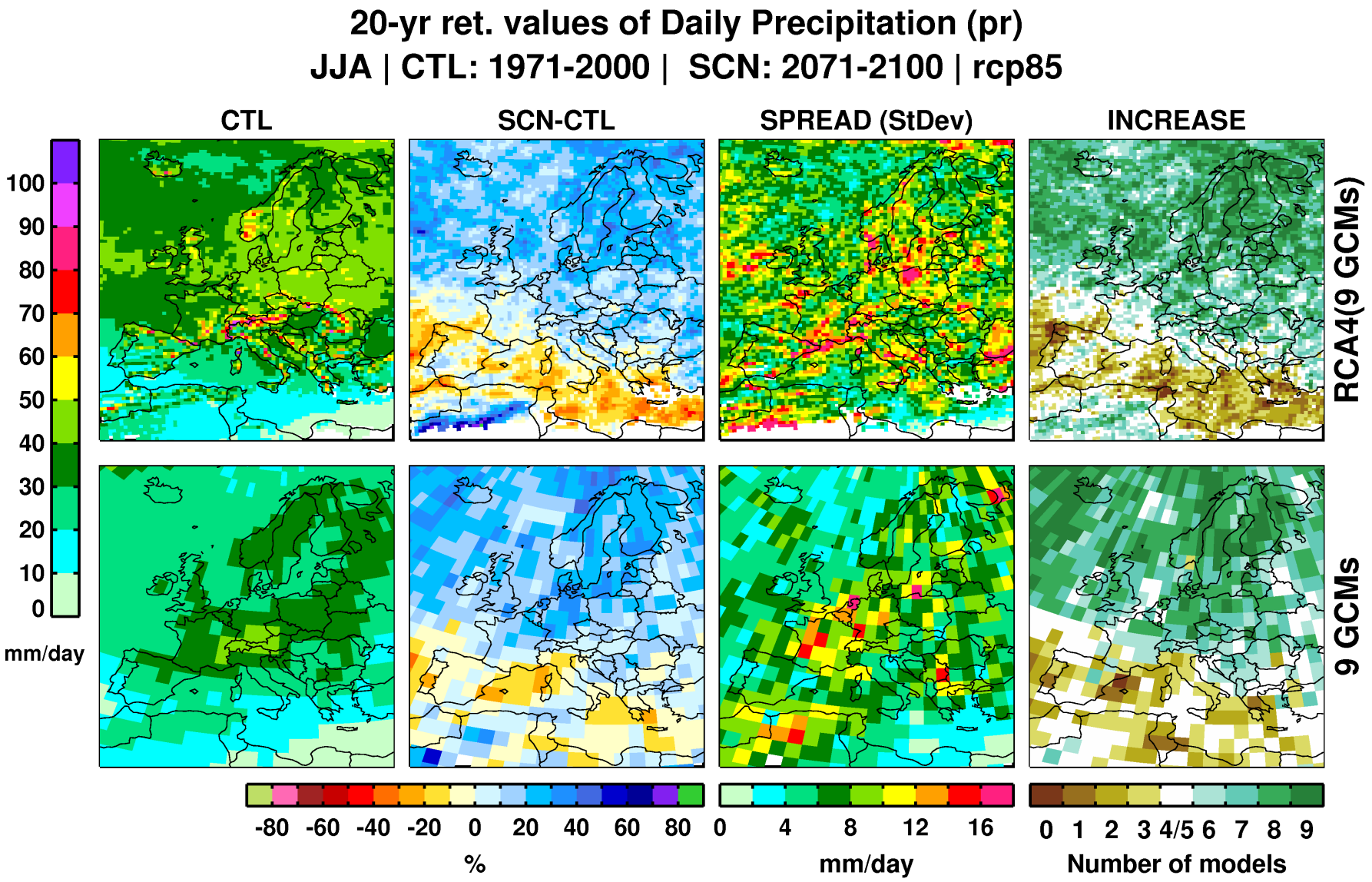

Increasing the horizontal resolution

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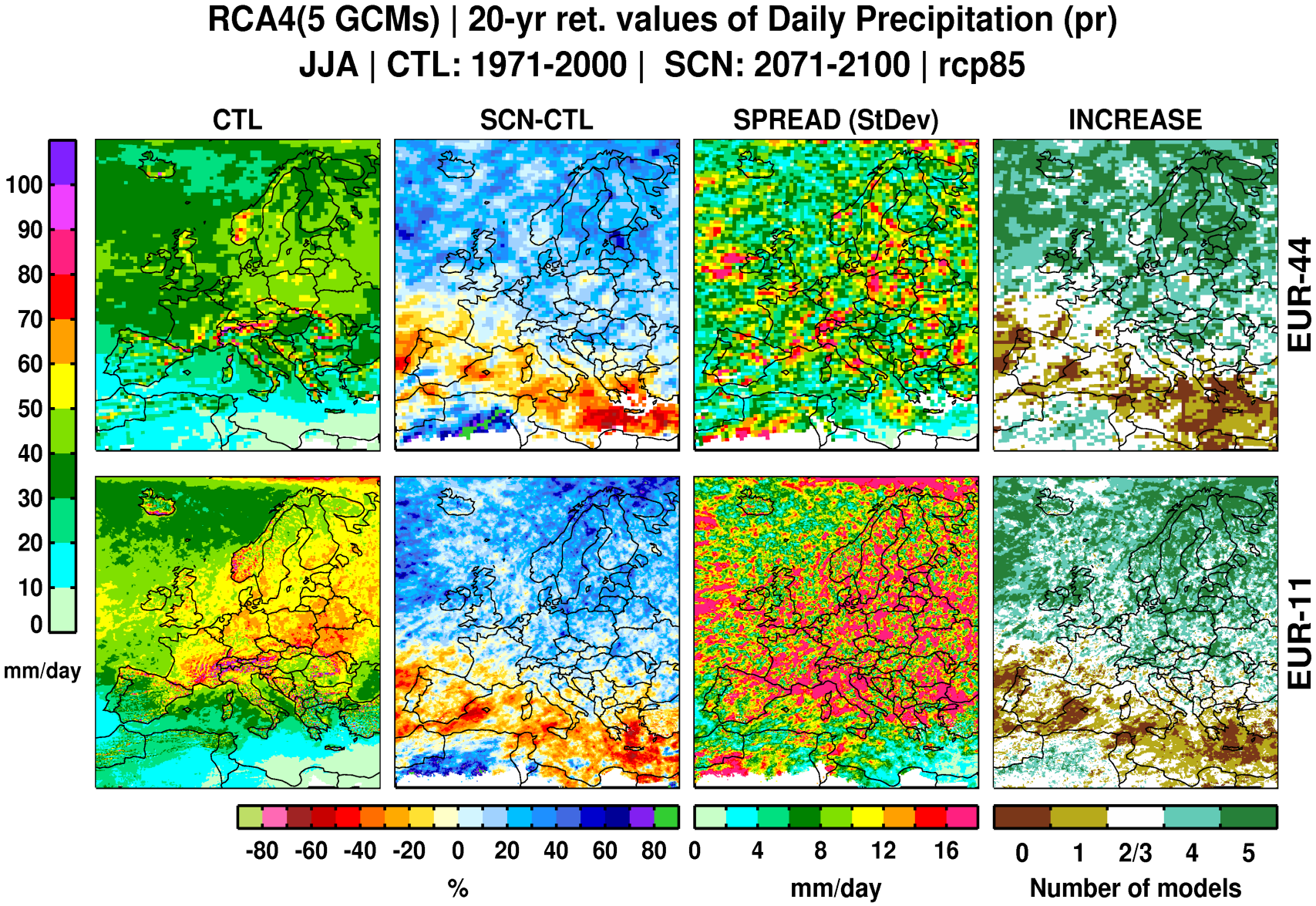

Summary of the simulated CC (1)

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- **Future changes largely depends on the GCMs and how they simulate changes in the large-scale circulation**
- **RCA4 tends to reduce the spread compared to that in the underlying AOGCMs in some regions and some seasons but this is not generally applicable**
- **Some tendency for RCA4 to show larger increases in precipitation in the Baltic sea area (where it is biased wet in the ERA-Interim-driven runs)**
- **The ensemble shows tendencies for the next few decades in the direction of what the climate change scenarios show for the end of the century**

Summary of the simulated CC (2)

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- **Wind speed decreases in large parts of Europe but tends to increase in several of the scenarios over the Baltic Sea**
- **Changes in extremes often stronger than changes in corresponding means in all variables (pr, tasmin, tasmax, wss)**
- **Higher resolution (12.5 vs 50 km vs GCM) does not change large-scale climate change signal in extremes. However, precipitation intensities are higher.**

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Thanks for your attention!

Acknowledgements:

- CMIP5 for providing the AOGCM data
- Part of the simulations and analysis work presented here is funded from the EU FP7 projects IMPACT2C and ECLISE

Changes in winter cold extremes

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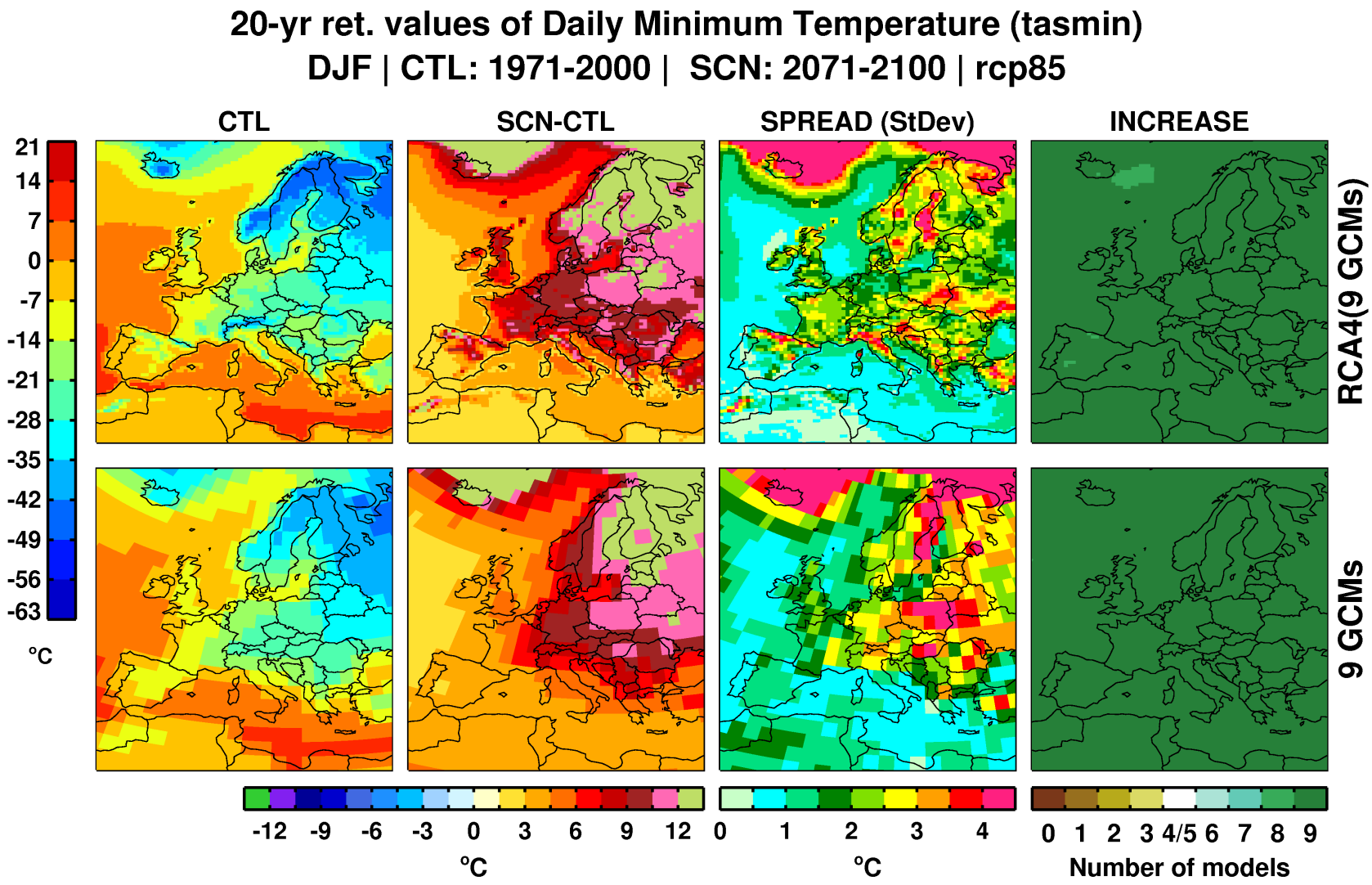

Changes in warm summer extremes

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