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Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

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WGCM Day 3 – global to regional modelling

Malcolm Roberts, Rein Haarsma
Marie-Estelle Demory, Ségolène Berthou

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What we have from the HighResMIP side

- HighResMIP global simulations (atmosphere-only + coupled), 1950-2050, at low and high (50-25km) resolutions
  - Data on ESGF, lots of analysis ongoing, hires is similar resolution to older CORDEX simulations
- Begun to compare global and CORDEX models, also feeding into IPCC Ch10
  - Demory et al., GMD 2020, “European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP)”
  - global models give complementary information over Europe
  - Strandberg and Lind, 2020, in discussion: 50km atmosphere necessary for European precipitation, then select ensemble of best performing models
- Several groups beginning to use ~25km models to drive regional CPMs
  - e.g. H2020 EUCP, Met Office (inc. with 1/12° ocean)
  - but data volumes are extremely challenging

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I) Mean differences

6 HighResMIP
26 EUR-44
43 EUR-11

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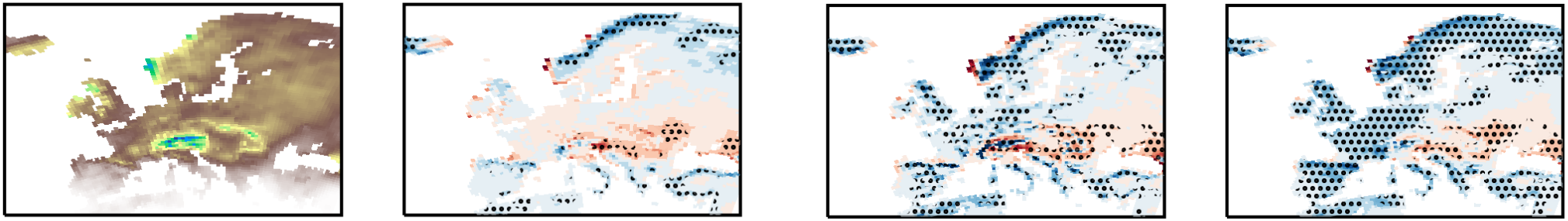
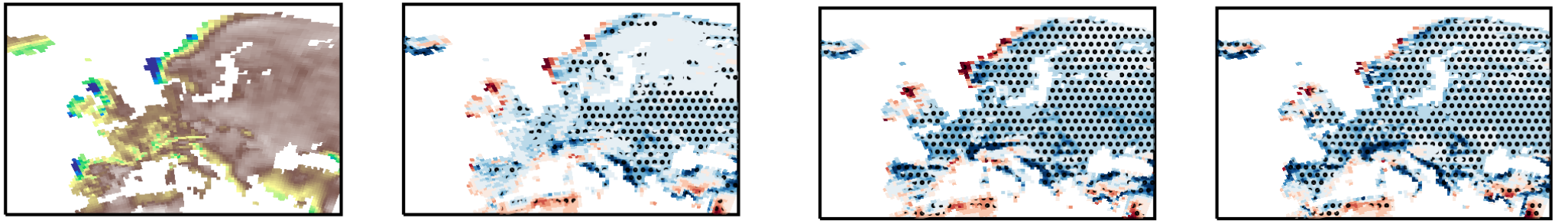
summer

a. observations (JJA) | b. PRIMAVERA - observations | c. EUR-44 - observations | d. EUR-11 - observations



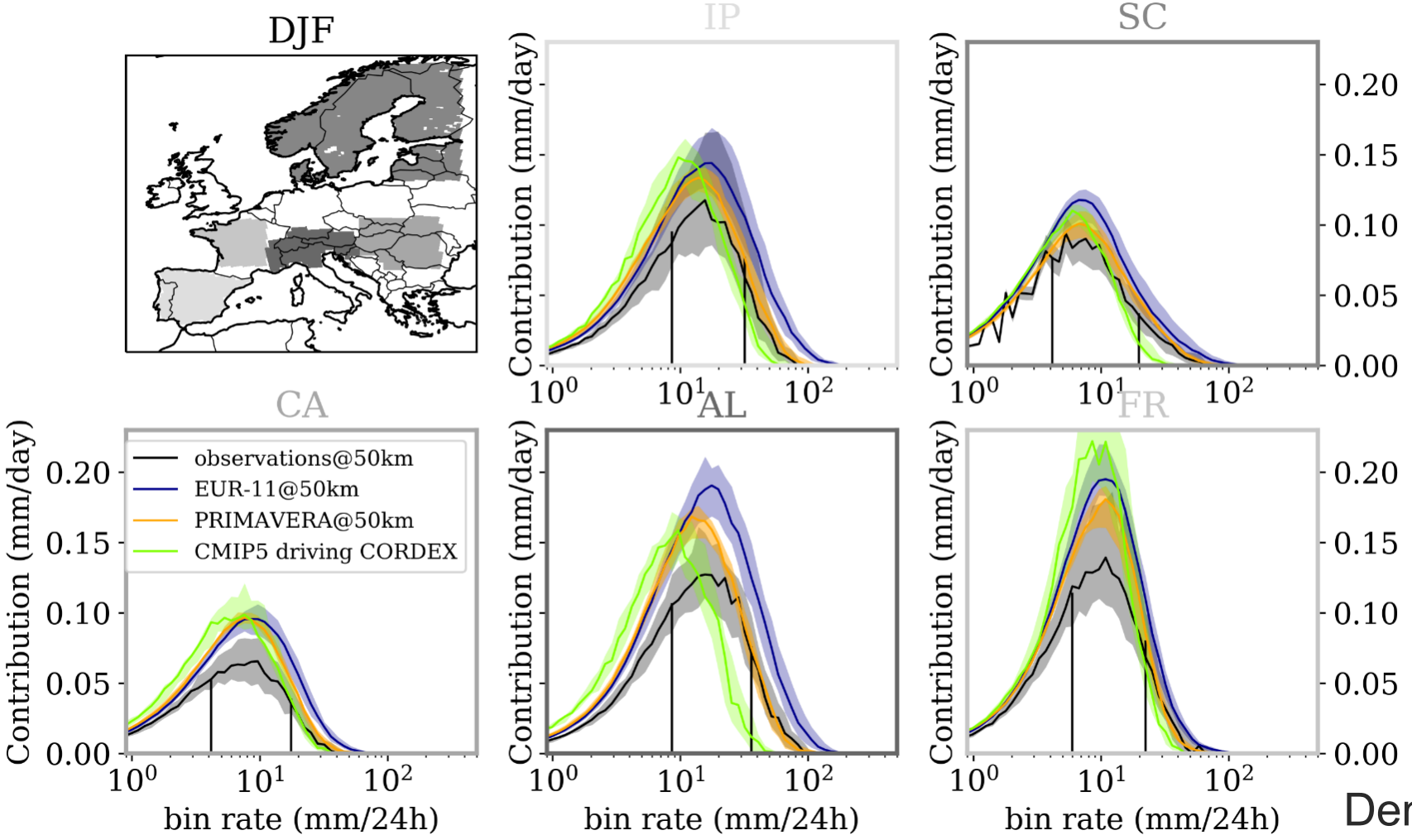
winter

a. observations (DJF) | b. PRIMAVERA - observations | c. EUR-44 - observations | d. EUR-11 - observations



Demory, Berthou et al

II) Precipitation distributions



Clear added-value of higher resolution models to represent European precipitation distributions

HighResMIP has less intense and moderate precipitation than CORDEX, in better agreement with observations

Observations may underestimate winter precipitation

Demory, Berthou et al

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Some current issues

- Temperature trends:
  - global models have trouble matching spatial patterns
  - Because EURO-CORDEX use constant aerosol forcing (Boé et al., 2020)
    - present-day trends in surface temperatures are not good
    - future warming is lower than CMIP5 (which have decreasing aerosols).
    - evaporation over the Mediterranean Sea increases much more in EURO-CORDEX compared to CMIP5, potentially because of the lack of coupling with the Mediterranean sea. This also dampens the increase in temperature in EURO-CORDEX.
- So aerosol forcing and coupling are important, as are mismatches in forcing of CMIP and CORDEX:
  - potential to do something with HighResMIP, which uses specified aerosol forcing EasyAerosol (MacV2-SP)
  - perhaps make links with MED-CORDEX using regional coupled models vs HighResMIP

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What could we do?

- Further comparisons of global and regional models
  - more systematic comparisons of CORDEX and HighResMIP are needed, use the complementary information from both, common analyses and metrics of performance
  - we could extract regions from global models and (somehow/where) make them available for coordinated analysis (may not want to add to CORDEX database to save confusion)
  - better understand key processes/uncertainties in driving models
- Drive CORDEX models with HighResMIP output (after further comparison)
  - perhaps as part of HighResMIP2/CMIP7, need to save LBCs
  - better understand the role of driving model vs downscaling processes
  - what new information do we need, how best to use this combination?
- Are there ways to reduce the data volumes required for LBCs
  - e.g. 10 years of 3 hourly global LBCs are 155TB in size for 25km model (out of 187TB of total diagnostics for 23 year simulation). Ongoing studies suggest 1 hourly forcing may be important for predictability
- How to make the data we already have as useful to users as possible
  - combining CORDEX and HighResMIP, for example by resolution or by some other metric that relates to user needs

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Papers

- Strandberg and Lind: The importance of model resolution on simulated precipitation in Europe – from global to regional model https://wcd.copernicus.org/preprints/wcd-2020-31/#discussion
- Boé, J., Somot, S., Corre, L., & Nabat, P. (2020). Large discrepancies in summer climate change over Europe as projected by global and regional climate models: causes and consequences. *Climate Dynamics*, *54*(5), 2981–3002. https://doi.org/10.1007/s00382-020-05153-1
- Demory, M.-E., Berthou, S., Fernández, J., Sørland, S. L., Brogli, R., Roberts, M. J., et al. (2020). European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP). *Geoscientific Model Development*, *13*(11), 5485–5506. https://doi.org/10.5194/gmd-13-5485-2020

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