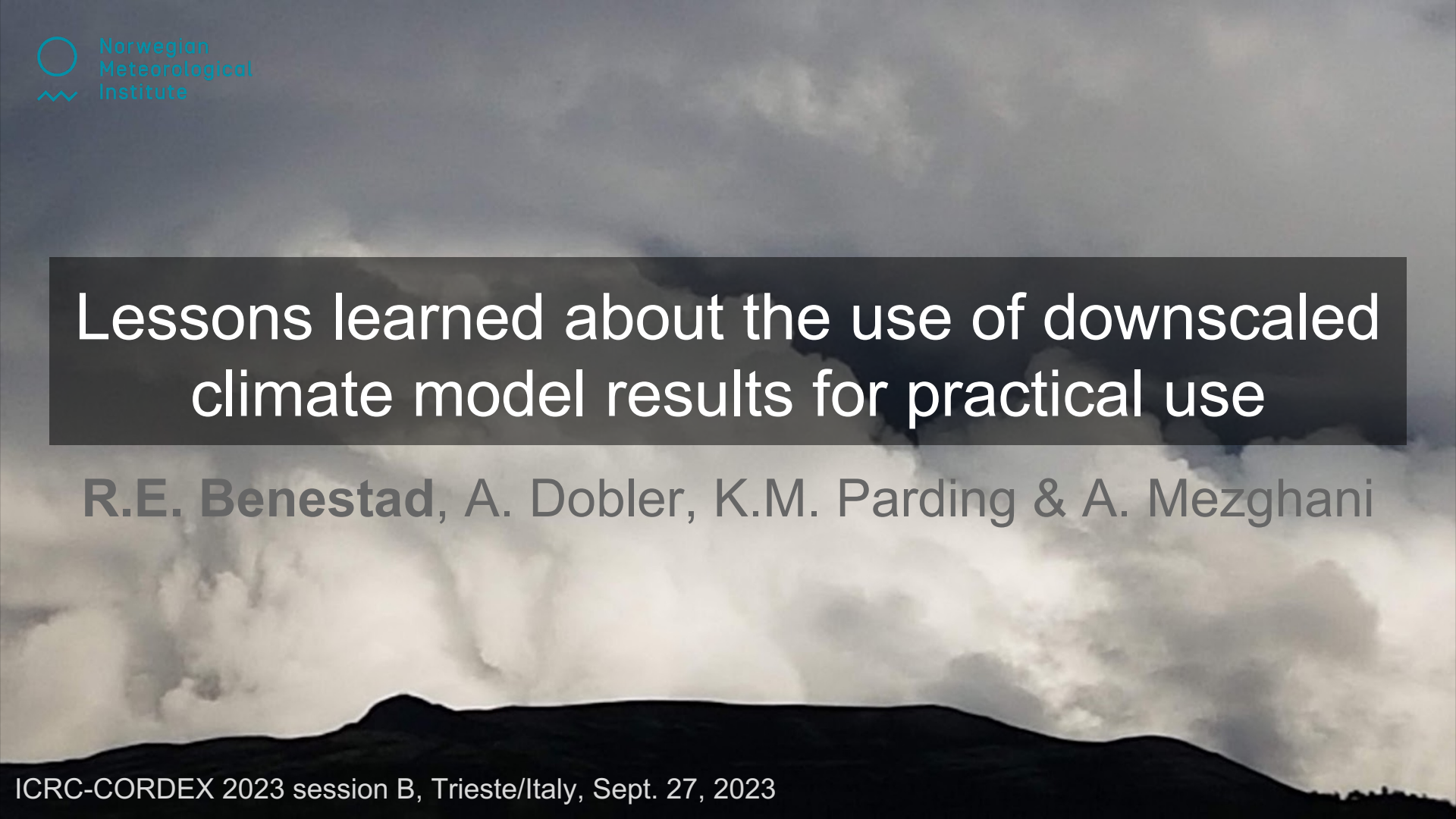


Lessons learned about the use of downscaled climate model results for practical use

R.E. Benestad, A. Dobler, K.M. Parding & A. Mezghani

ICRC-CORDEX 2023 session B, Trieste/Italy, Sept. 27, 2023

The objective

To derive **robust** and **reliable** information about future climatic outlooks on **regional** and **local** scales

“Actionable” information - still not widely discussed. E.g. often only Euro-CORDEX ensemble (RCMs)


#ConCord Oslo 2022

Relevant factors for practitioners

Sensitive to methodology (models' **minimum skillful scale)**

Nondeterministic ("chaotic") internal variability

Climate sensitivity - GCM-dependent - skill?

Different future emissions

“... at least for present day climates, dynamical downscaling methods provide little advantage over statistical techniques.” (Fowler et al. 2007)

“RCMs … do not include all possible Earth system processes and therefore neglect important processes … which may influence regional climate projections.”
Chapter 10, IPCC AR6 (2021)

“Bias adjustment is a statistical post-processing technique used to pragmatically reduce the mismatch between the statistics of climate model output and observations.” Chapter 10, IPCC AR6 (2021)

“Several problems have been identified that may arise from an uncritical use of bias adjustment, and that may result in misleading impact assessments… In the light of these issues, several authors dismiss the use of bias adjustment for climate change studies” Cross-Chapter Box 10.2, IPCC AR6 (2021)

Empirical-statistical downscaling

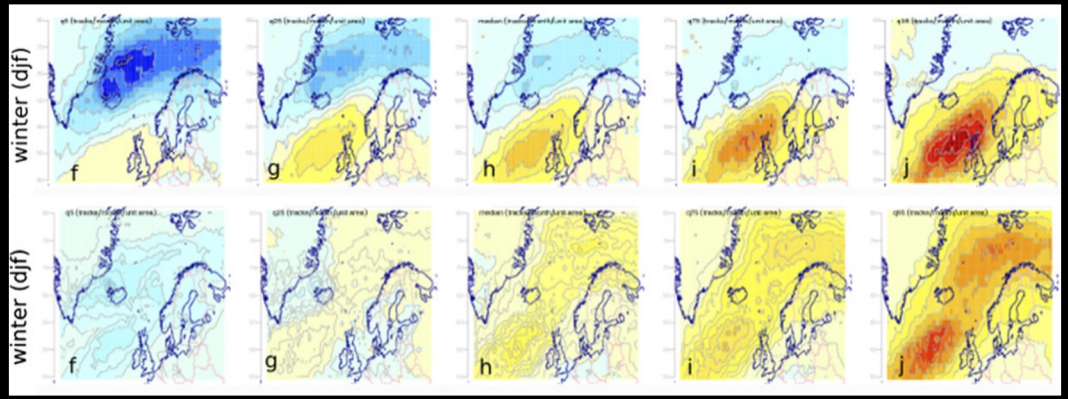
Weather predictions and climate projections require different strategies

- “Downscaling **weather**” (actual outcomes)
- “Downscaling **climate**” (statistics)

Not the same as bias adjustment - grab **large-scale** climatic aspects that GCMs **skillfully reproduce** and **add information** about **dependencies** linking local climate.

Multiple-variable predictors

Suitable for weather, but not for climate.



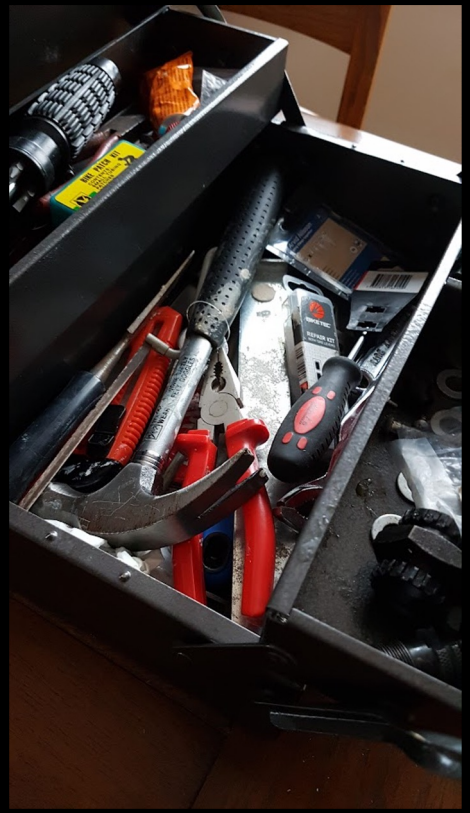
Parding et al. (2019) https://doi.org/10.1175/JAMC-D-17-0348.1

Both **dynamical** and **empirical-statistical** downscaling

Different sets of assumptions

Different strengths and weaknesses

Different tools

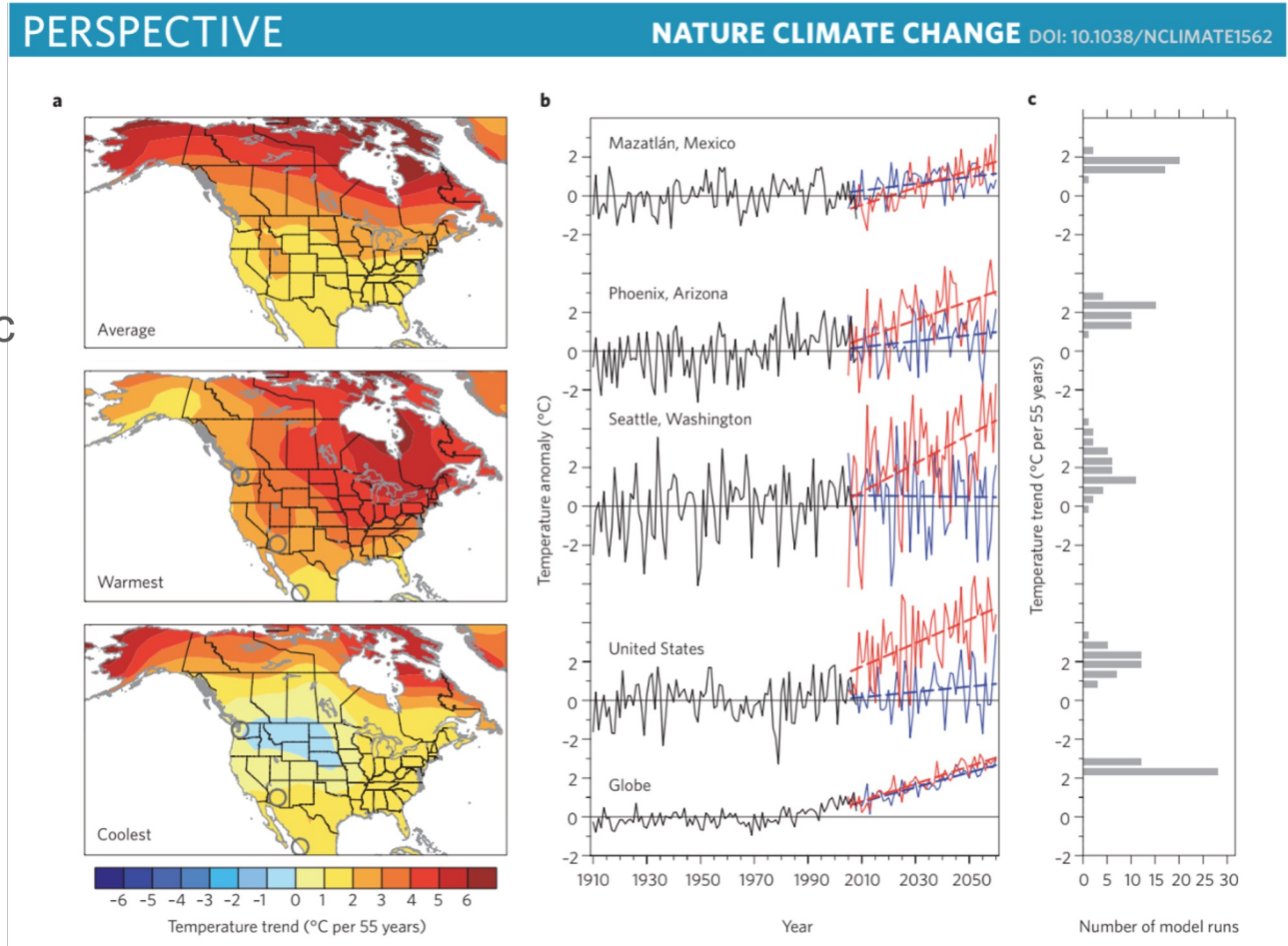


Regional climate projections

Deser et al. (2012)

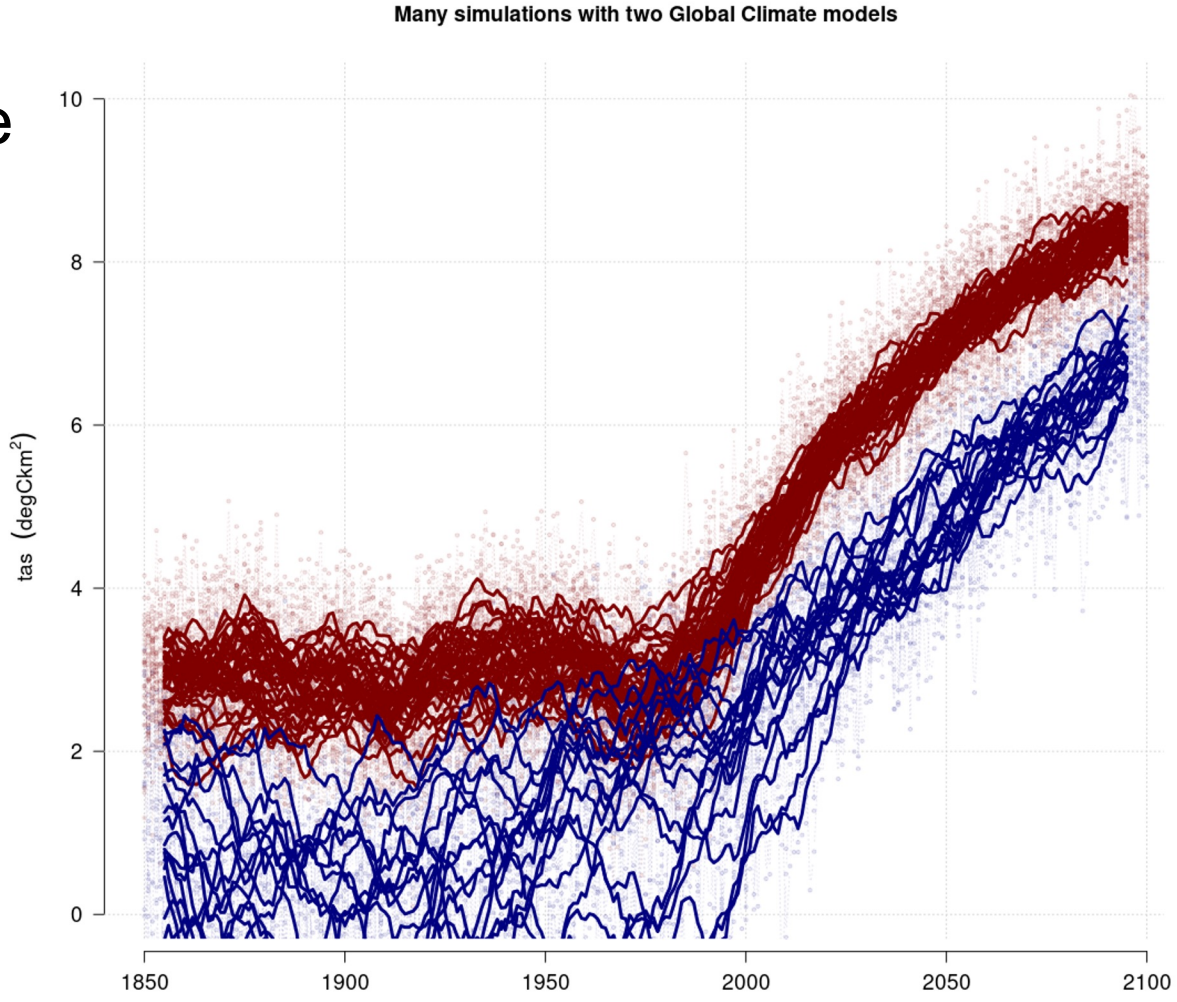
One single model - a **range** of different non-deterministic outlooks.

The ***law of small numbers*** becomes relevant



Regional temperature

5-25°E/58-70°N



Evalu

ensembles

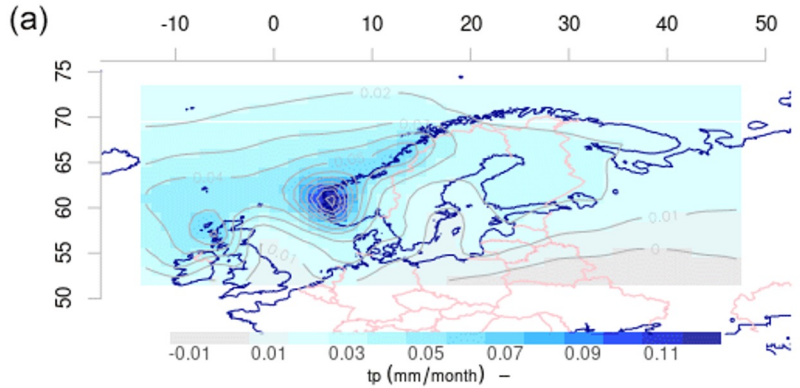
patterns of variability

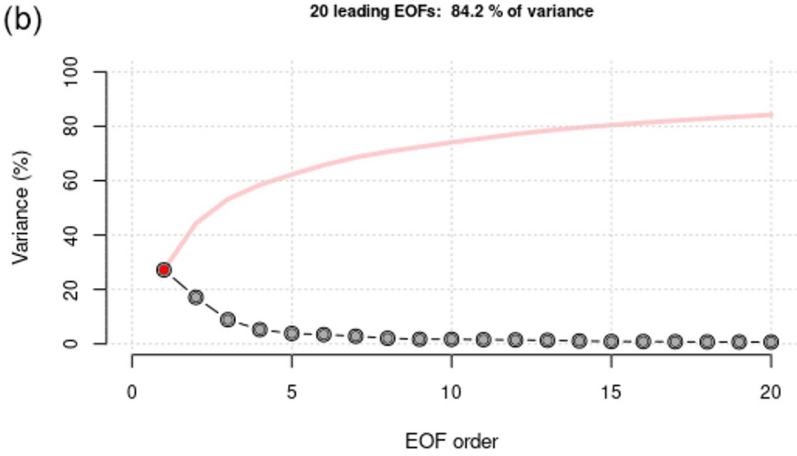
(“covariance structure”)

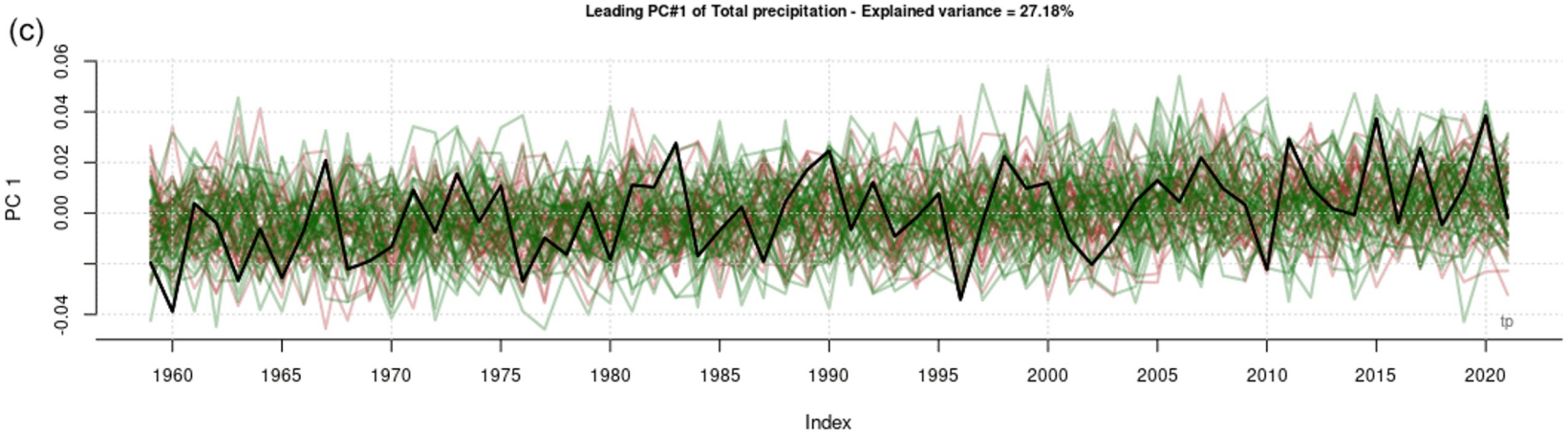
“Common E

(T.P. Barnett, 1

ERA5
CMIP5
CMIP6







Making use of available information

- **Combine** dynamical downscaling with empirical-statistical downscaling:

  Bias-corrected Euro-CORDEX

  vs

  Empirical-statistical downscaling (ESD)

- **Many** climate model simulations
- **Extends** the RCM outputs to cover the full ensemble of opportunities

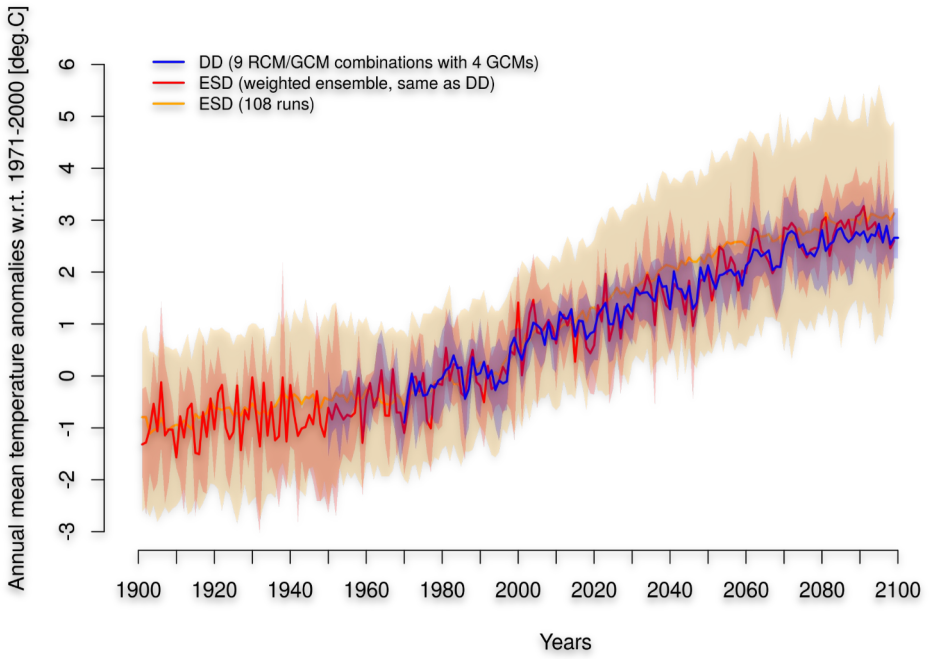


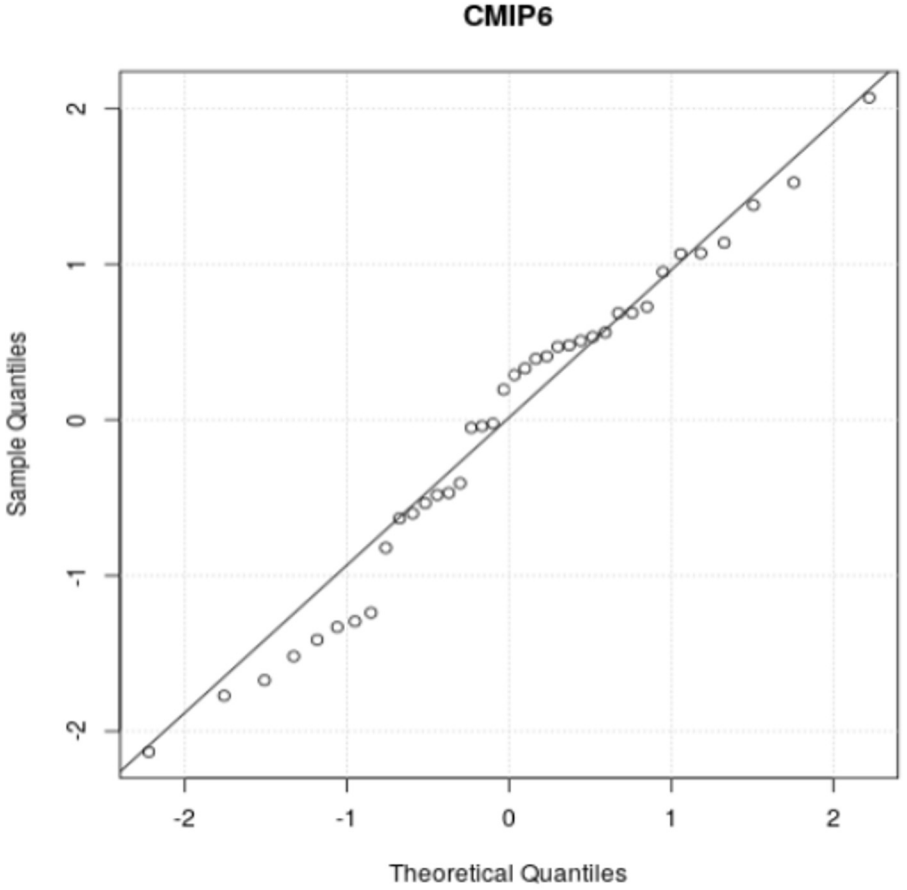
Figure: Downscaling of annual mean temperature anomalies over Norway assuming CMIP5 scenarios based on empirical-statistical and bias-corrected dynamical downscaling. The ensembles include the full set and subsets of CMIP5 global model simulations.

Information - *as opposed to* **data**

Summary statistics

Approximately normally distributed? pdf ~ $N(\mu,\sigma^2)$

The ***law of small numbers*** - minimum ensemble size



Summary & connection to society

A basis for providing climate information to society

Adoption of climate information for real-word decisions? Overcoming *the law of small numbers* and models' minimum skillful scales

Understand user needs and capacities…?

Capacity building: training, education and interaction

Norwegian Meteorological Institute

References

Norwegian Meteorological Institute

Linking climate change modelling to impacts studies: recent advances in downscaling techniques for hydrological modelling https://doi.org/10.1002/joc.1556

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A Norwegian Approach to Downscaling https://doi.org/10.5194/gmd-2021-176

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