

Assessing the reliability of changes in precipitation extremes

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Contents



- Role of validation: examples for extreme precipitation and small scale application
- Climate change and robustness of responses

Validation and applications



- Validation of model output can provide guide to how well variables are simulated
- Detailed investigation of model biases can aid interpretation of reliability of changes
- Results of validation can provide guidance on how to apply climate scenarios
- Outcome of validation should allow expert assessment of reliability of impacts

Control simulation:

- 30 years
- fixed $[CO_2]$, 1990 level
- HadCM2 SST

Greenhouse gas forced simulation:

- 20 years (2080-2100)
- 1% annual increase $[CO_2]$ from 1990
- HadCM2 SST

Sulphur cycle not included in HadRM3

Precipitation extreme analysis



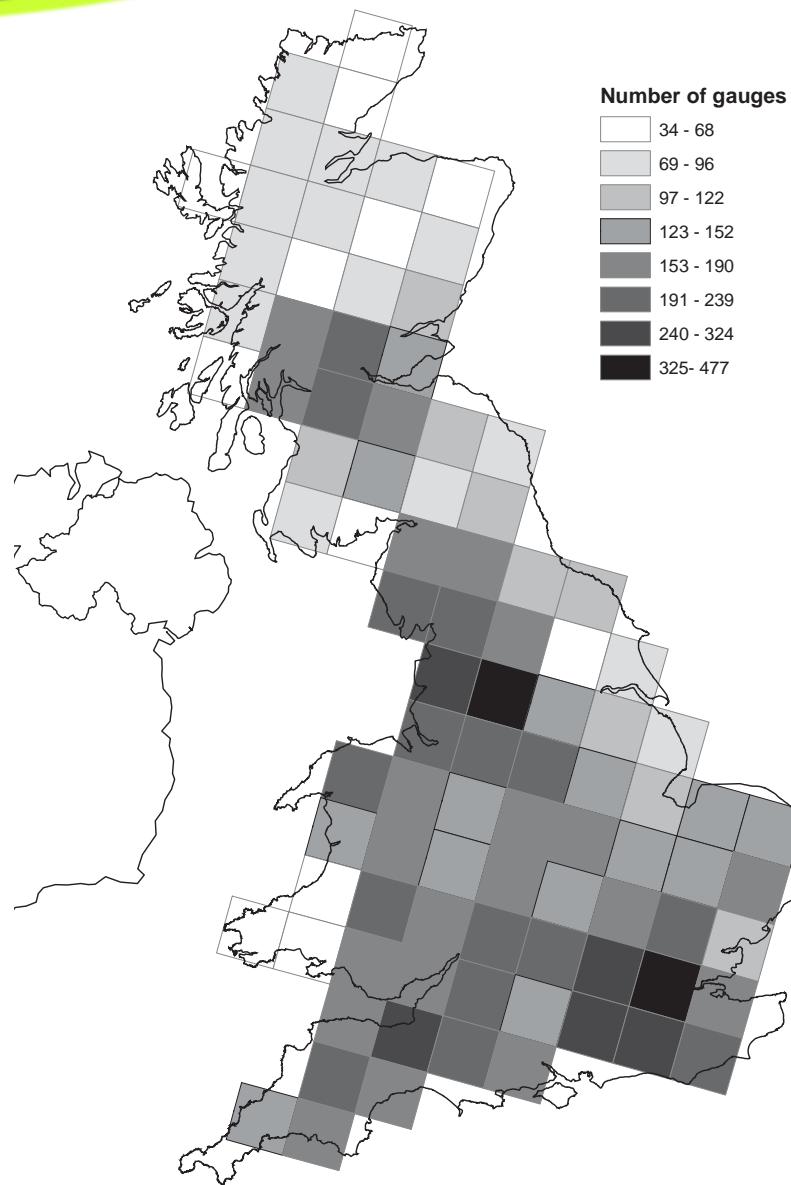
- Analysis of precipitation extremes from annual maxima, 1- and 30-days accumulation periods
- Comparison of return levels (GEV parameters from MLE, 95% confidence interval from profile likelihood)
- Validation over the UK: comparison with CEH observational dataset of daily rainfall with rain gauge data aggregated over the RCM grid.
- Climate change response comparison

- Theory: S. Coles, *An introduction to Statistical Modeling of Extreme Values*, Springer-Verlag, London
- R statistical package: www.r-project.org
(documentation and binaries), cran.r-project.org
(packages)
- GEV parameter estimate from the package **evd** (A. Stephenson, C. Ferro)
- PP IO package available on request (PRECIS user)

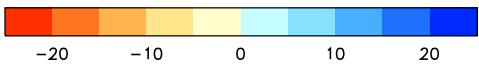
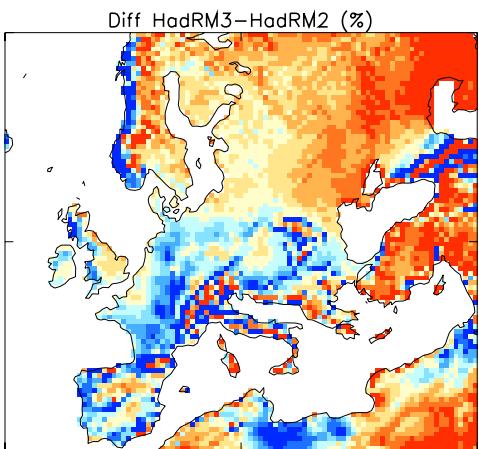
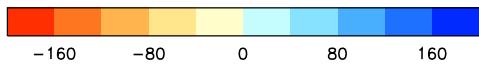
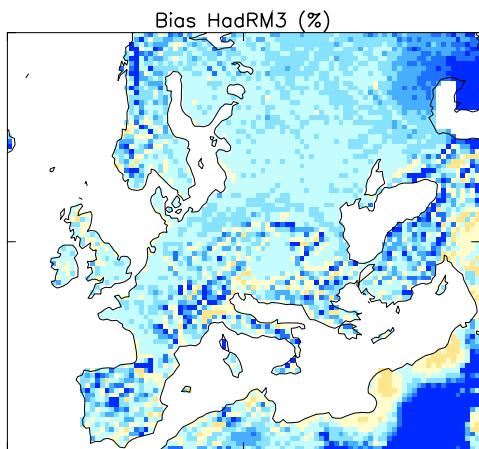
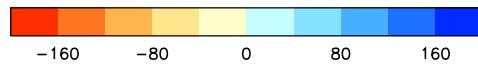
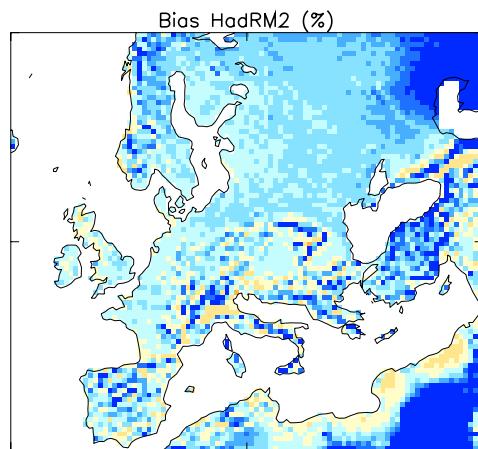
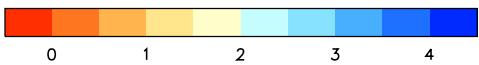
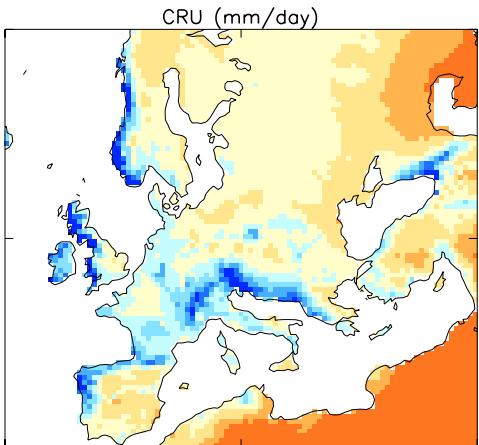
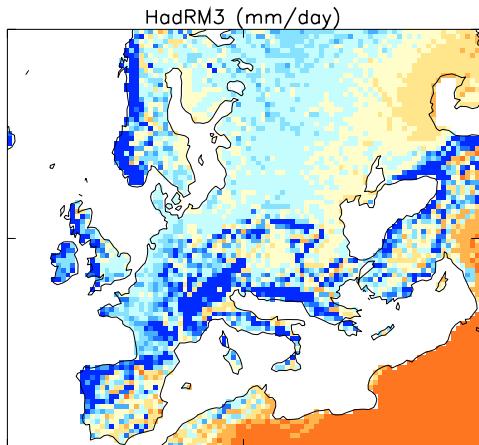
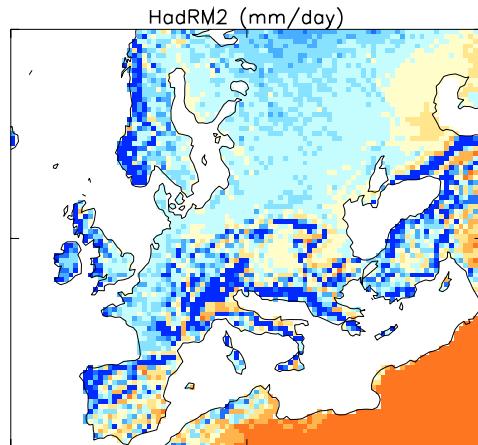
Obs aggregation on RCM grid



CEH rain gauges
distribution, 1961-1990

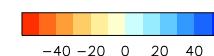
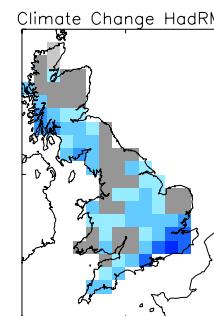
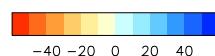
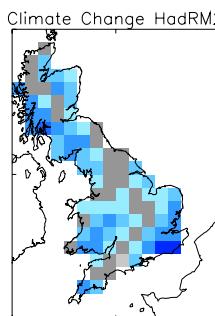
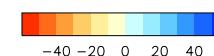
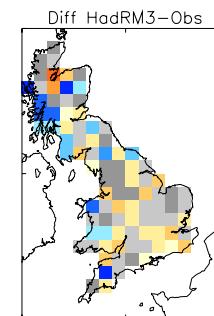
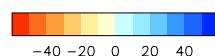
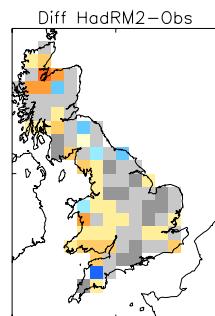
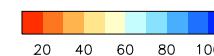
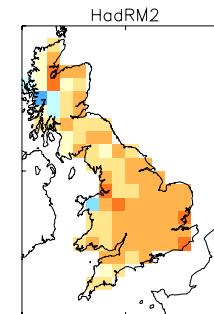
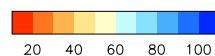
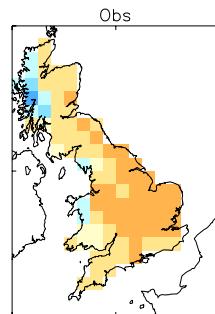


Average annual precipitation



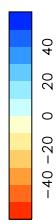
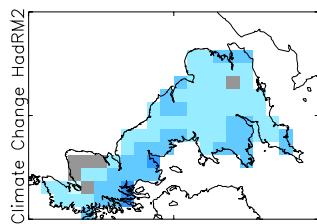
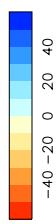
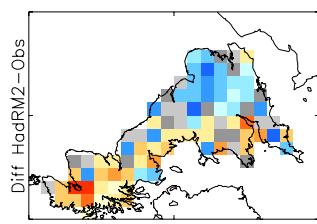
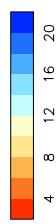
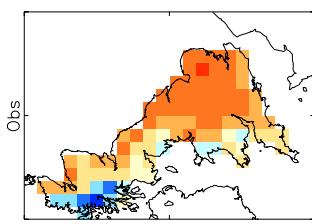
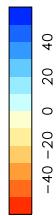
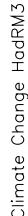
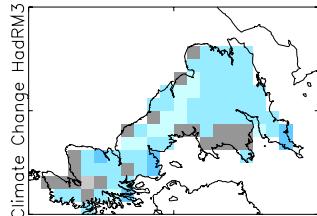
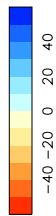
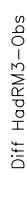
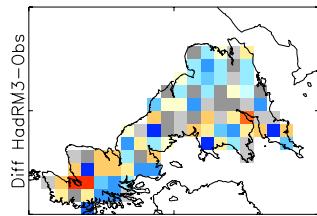
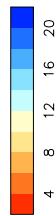
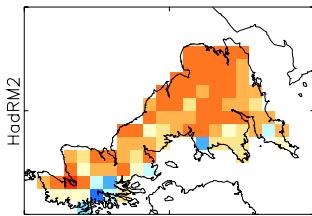
Extremes, 1-day acc.

5 years return values,
annual maxima



Extremes, 30-days acc.

5 years return values,
annual maxima



Model Validation, Alps

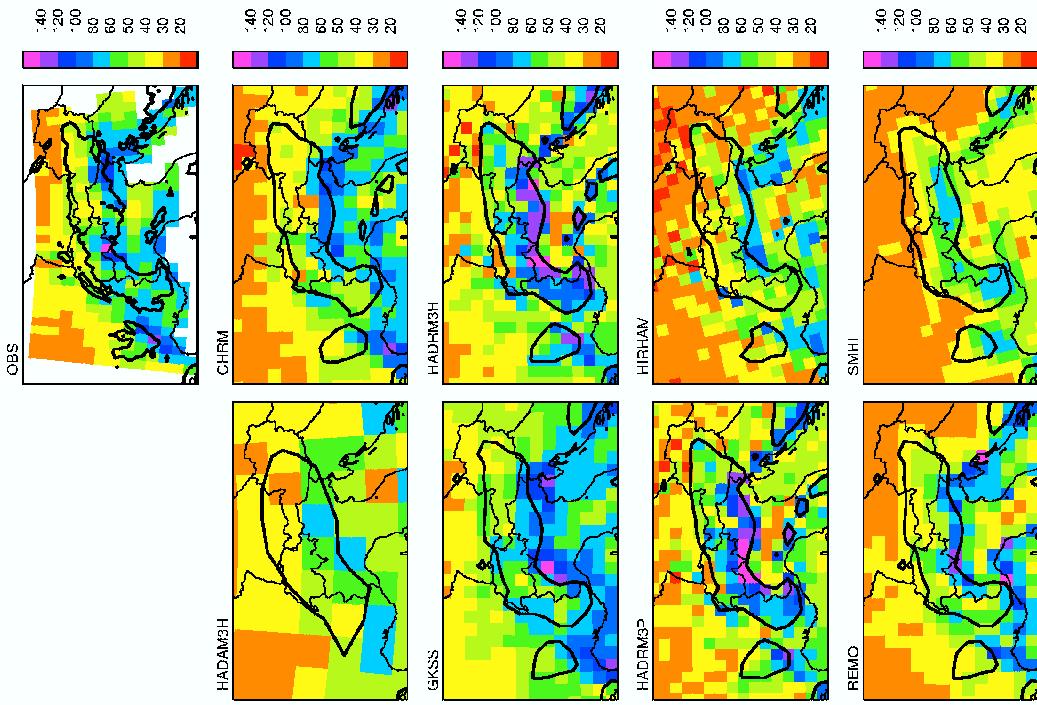
Frei et al, JGR, 2006



FREI ET AL.: FUTURE CHANGE IN PRECIPITATION EXTREMES

PRUDENCE experiments

5-years return level
from one-day
precipitation, SON

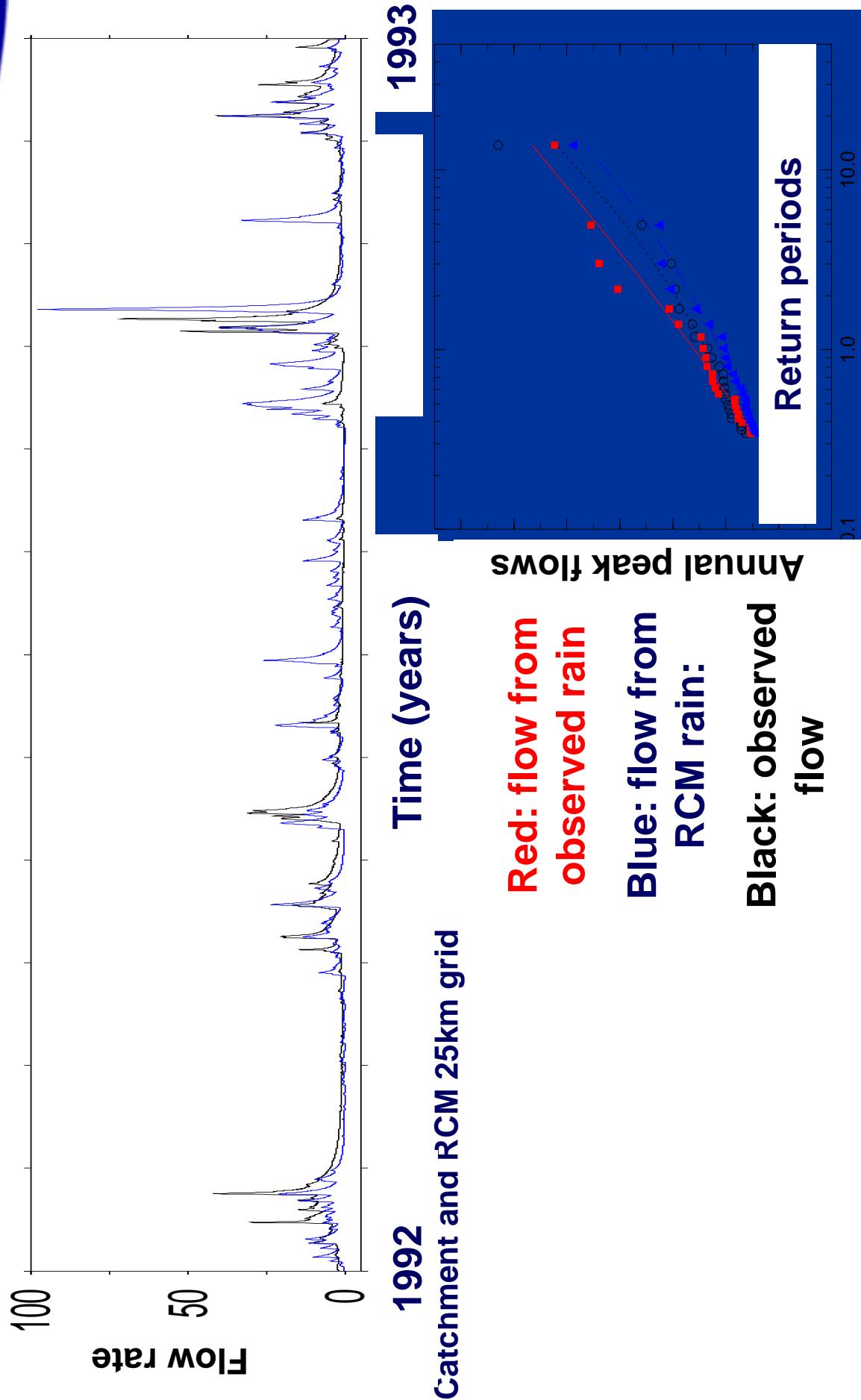


Coupling climate and impacts models

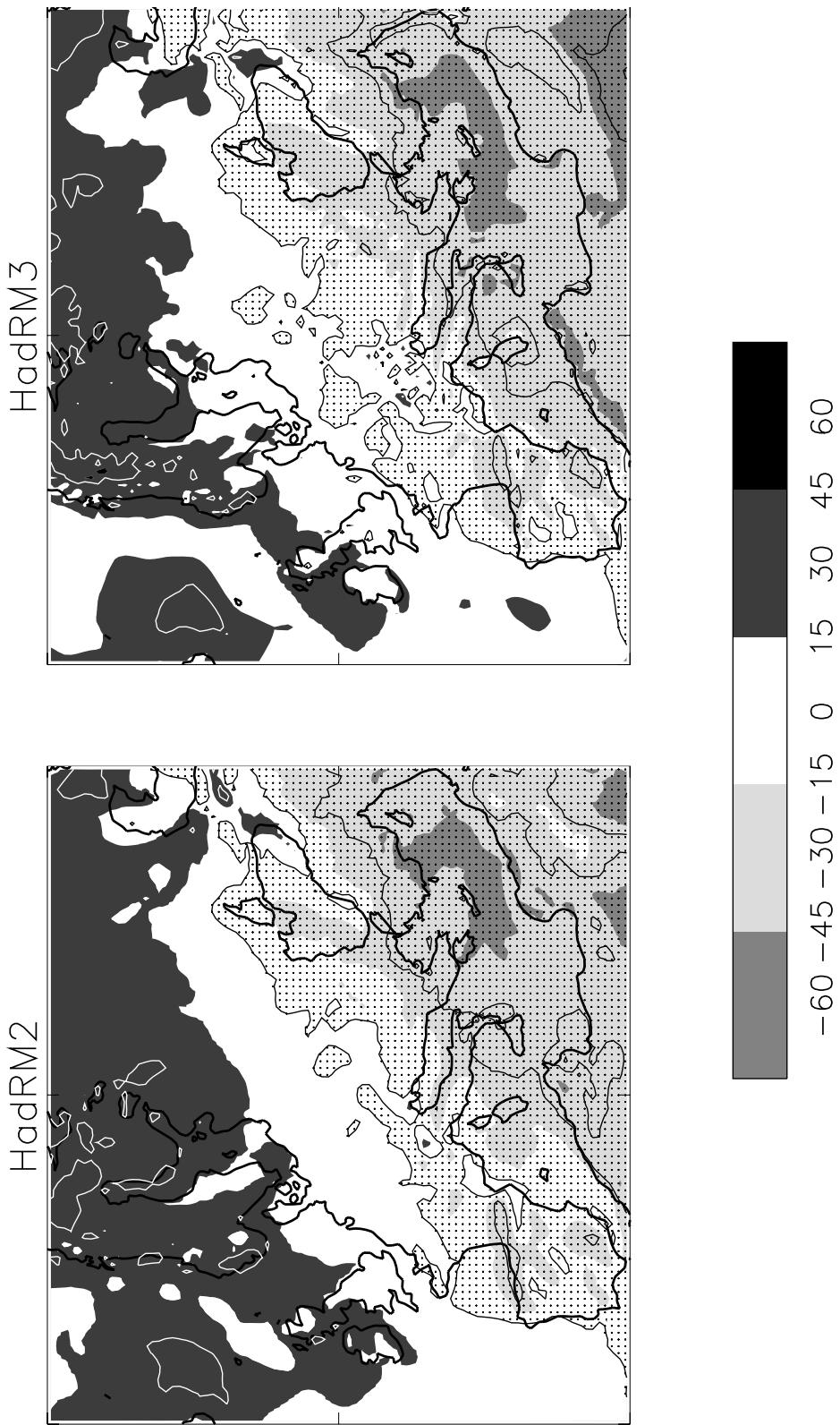


- Impacts models simulate the response of physical (or other) systems to varying climate drivers
- Impacts models will be derived using observed climate variables as inputs
- Climate model data are area-averaged quantities which may not match with impacts model inputs
- Interpolation or dis-aggregation techniques may need to be applied to climate model data

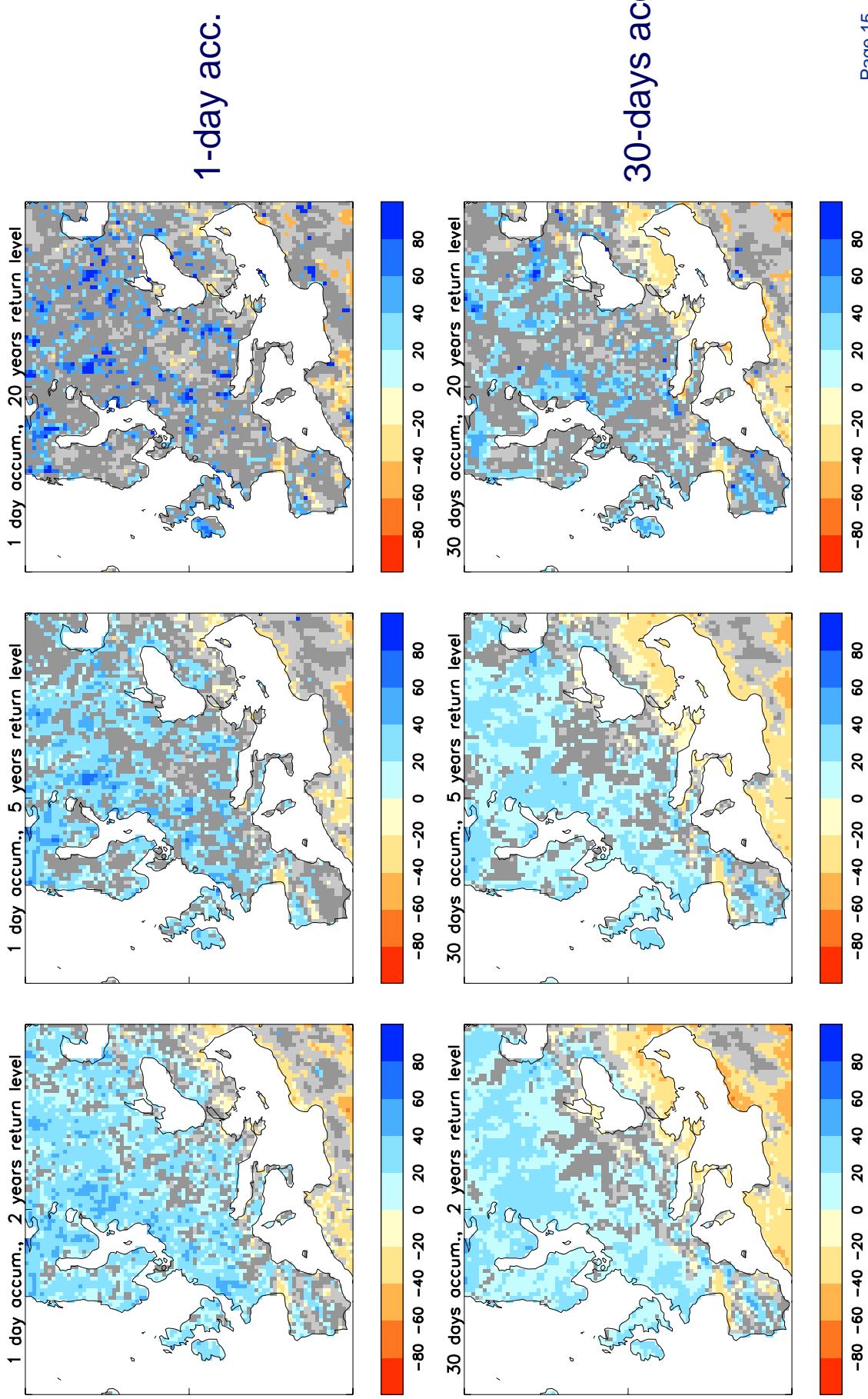
Example of flow from RCM rainfall (Kay et al, J. Hydrol, 2006)



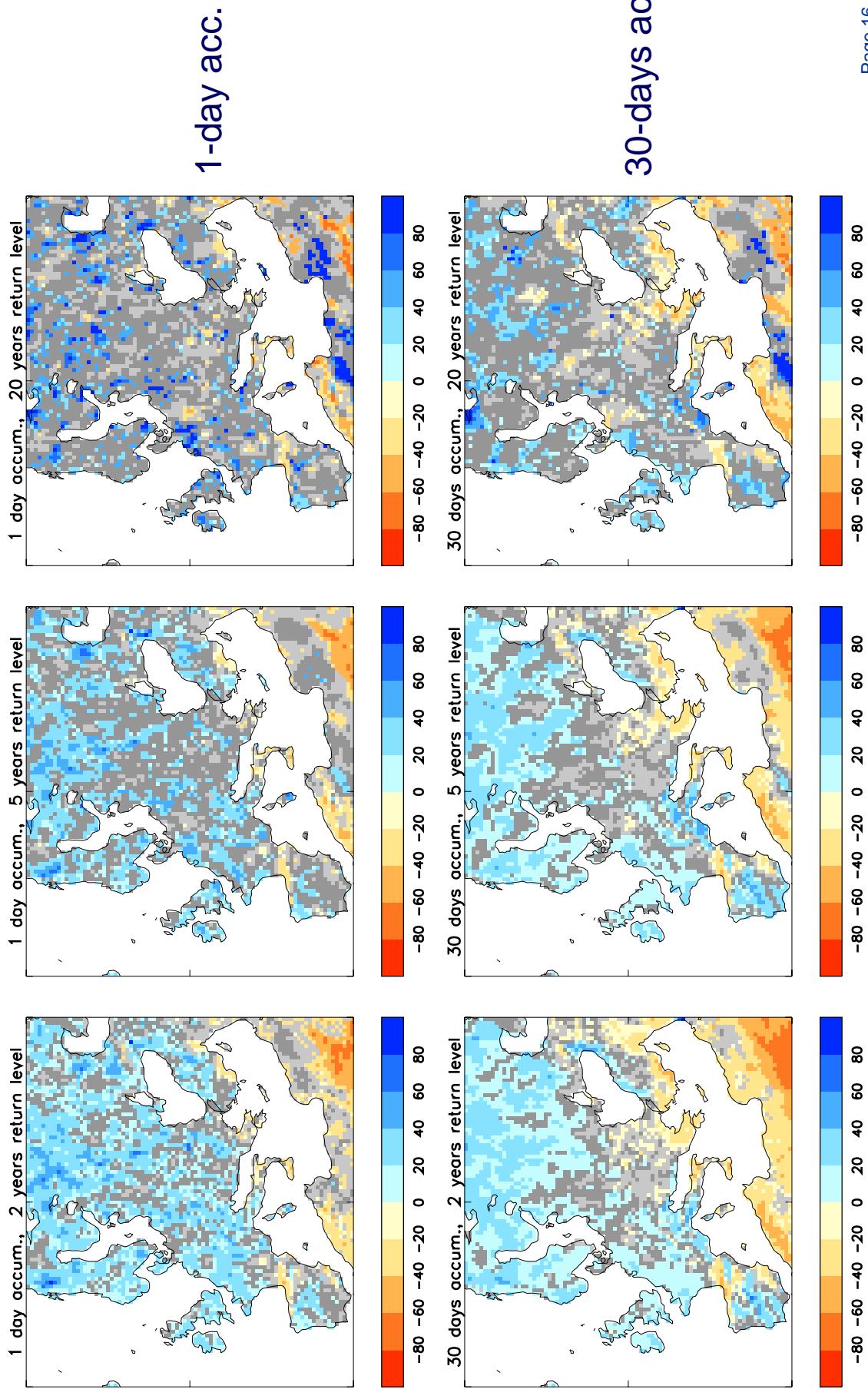
Climate change, average precip



HadRM2 extremes



HadRM2 extremes



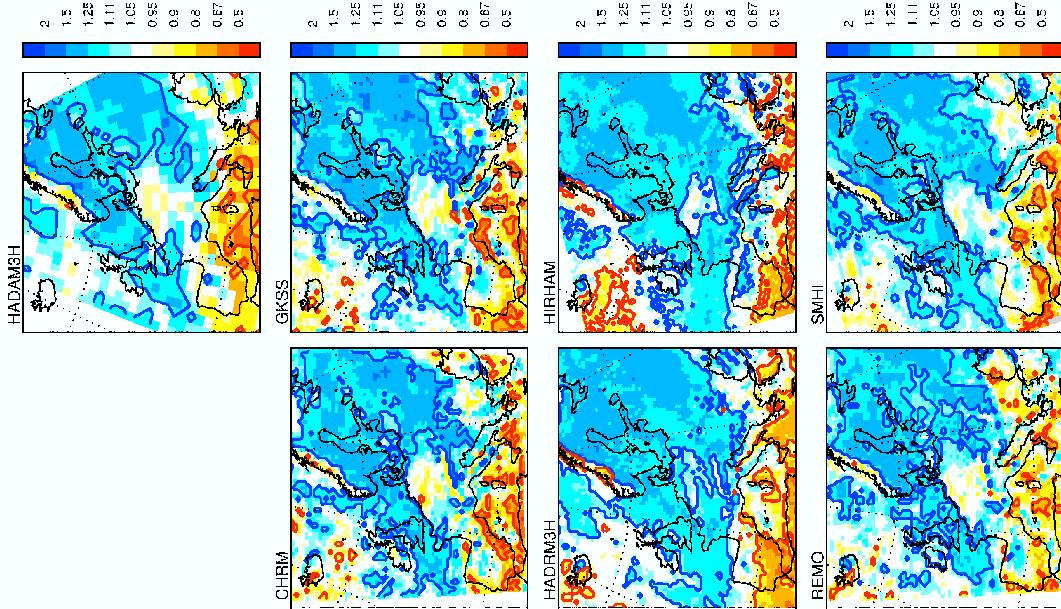
Climate change, HadAM3H A2

Frei et al, JGR, 2006



FREI ET AL.: FUTURE CHANGE IN PRECIPITATION EXTREMES

PRUDENCE experiments, 5-
years return values, DJF



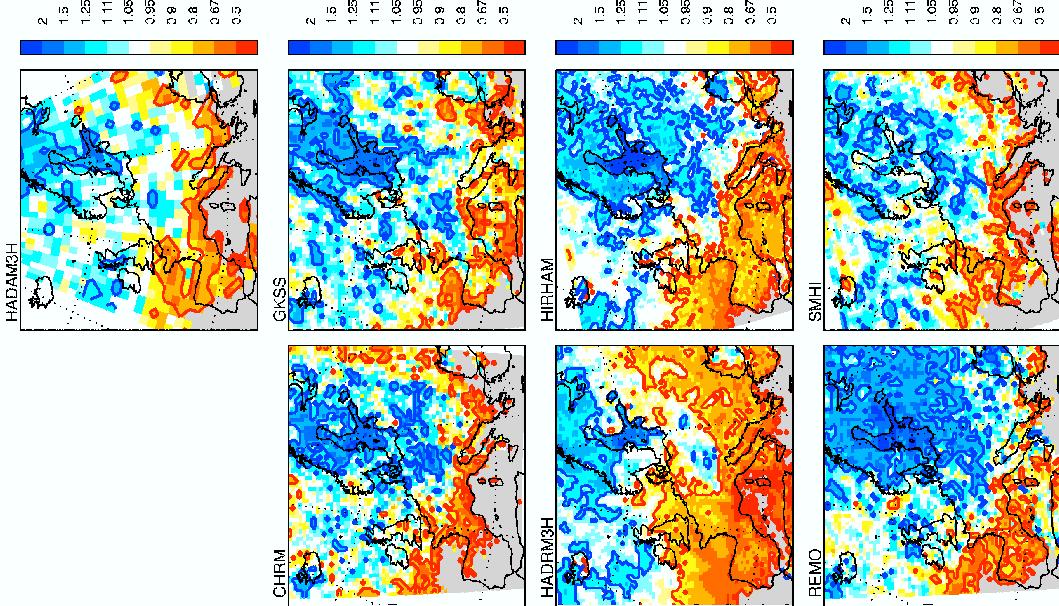
Climate change, HadAM3H A2

Frei et al, JGR, 2006



FREI ET AL.: FUTURE CHANGE IN PRECIPITATION EXTREMES

PRUDENCE experiments, 5-
years return values, JJA



Summary



- The validation show extreme precipitation are at least as good as the averages
- However, the model results are still showing biases with respect to observations.
- The model deficiencies leading to the biases have to be understood to understand the reliability of the climate responses.
- Robustness of climate change responses is an indication of reliability of the results.

Thanks!

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