Water availability GC

GSQ1: How can we better understand and predict precipitation variability and changes?

GSQ2:How do changes in the land surface and hydrology influence past and future changes in water availability and security?

GSQ3 How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land processes, in particular, contribute?

GSQ4 How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved?

GSQ2 W'shop
Saskatchewan,
June 2013

GSQ1 W'shop
Ft Collins, July, 2013

GEWEX Conference
The Hague, July 2014

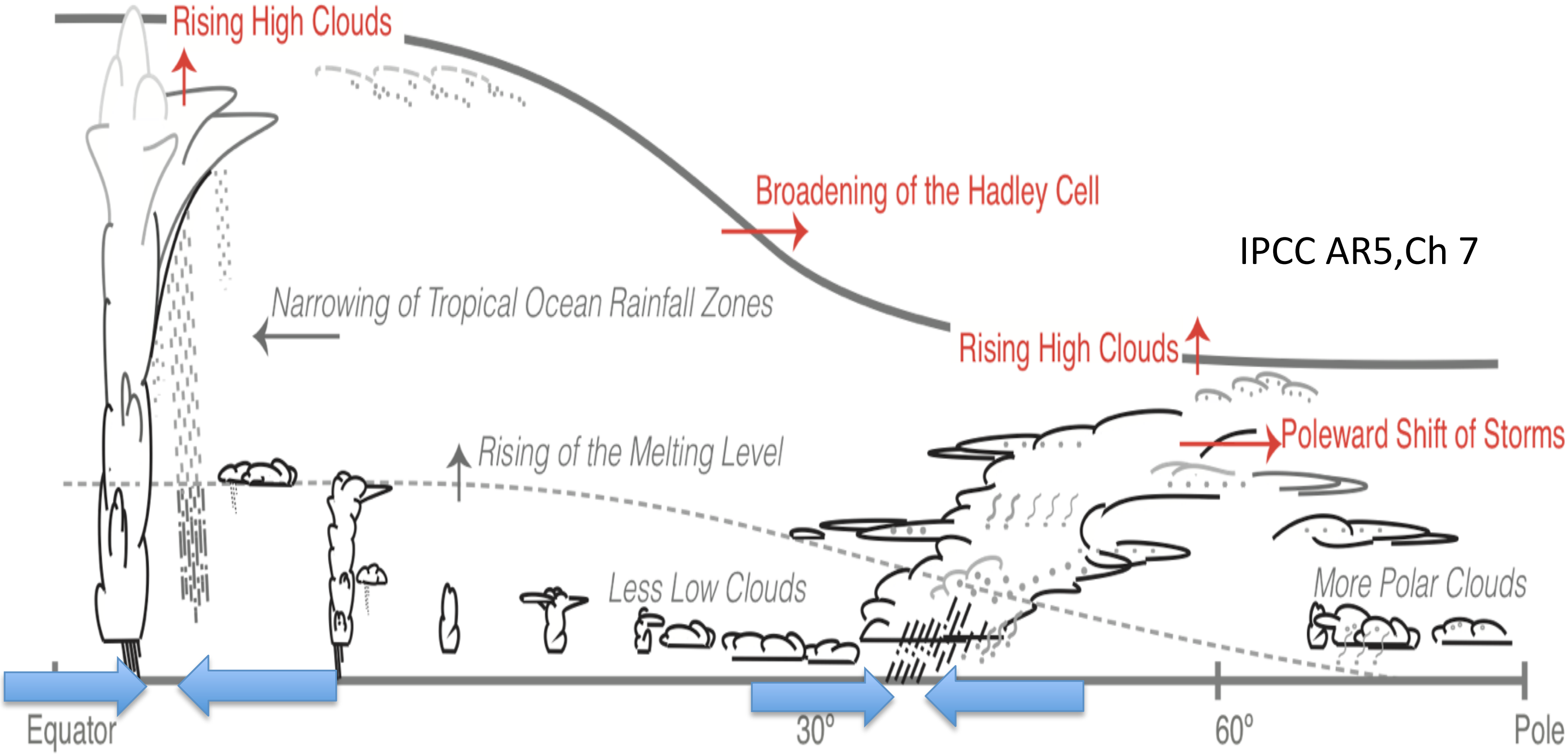
BOG Report,
post AR5 workshop
Geneva, Sept 2014

Climate Symposium
Darmstadt, 2014

- Which characteristics of precipitation affect water availability, and how are they changing?
  - **what sets the spatial pattern of precipitation change? (wet wetter, dry drier? Is this primarily circulation driven?)**
  - **What determines the regional changes to precipitation intensity (e.g. @7%/K? Super CC? land surface feedbacks?)**

- What are the role of land surface processes and human water use in affecting water availability, including feedbacks to precipitation?

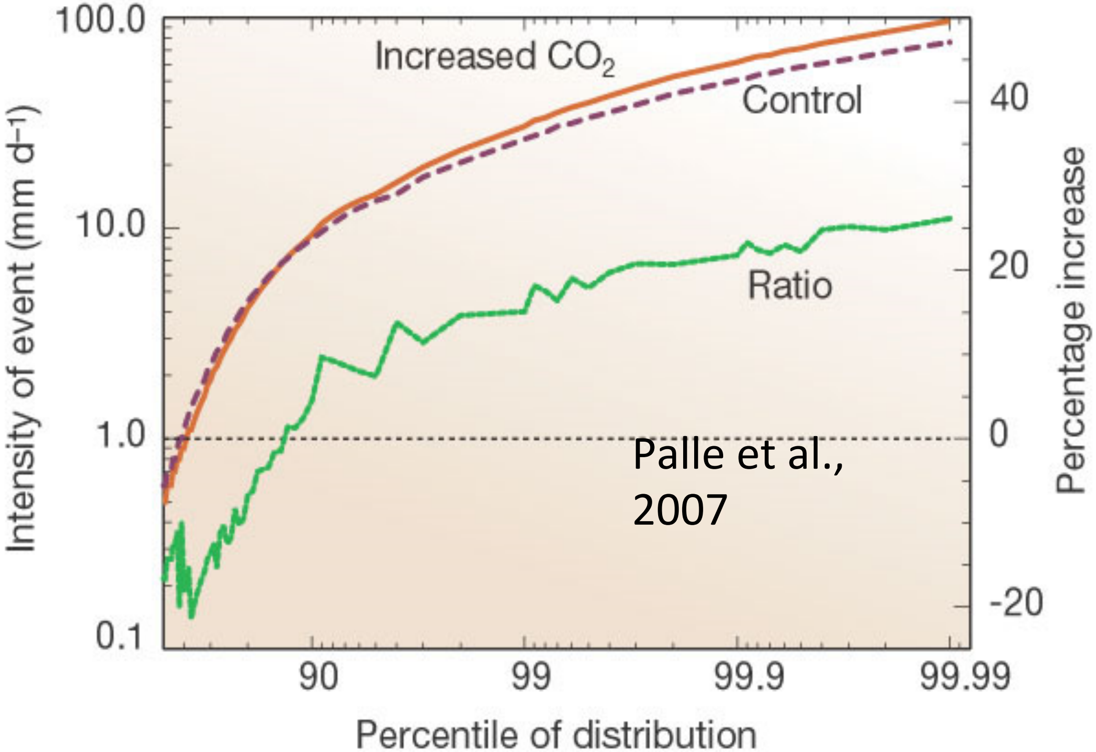
- What new observations are required to advance understanding of processes that shape water availability and our ability to predict changes to it ?
  - **How well do we observe precipitation, what are the gaps, what improvements ? Are we fully exploiting available information**
- How predictable are the key drivers of water availability on subseasonal to decadal time scales?



$$q \bullet \nabla v$$

$$q \bullet \nabla v$$

$$\frac{1}{q}\frac{\Delta q}{\Delta t} \sim 7\% / K$$



A model example - difference 2XCO2-1XCO2

GCM CO_2 vs Control

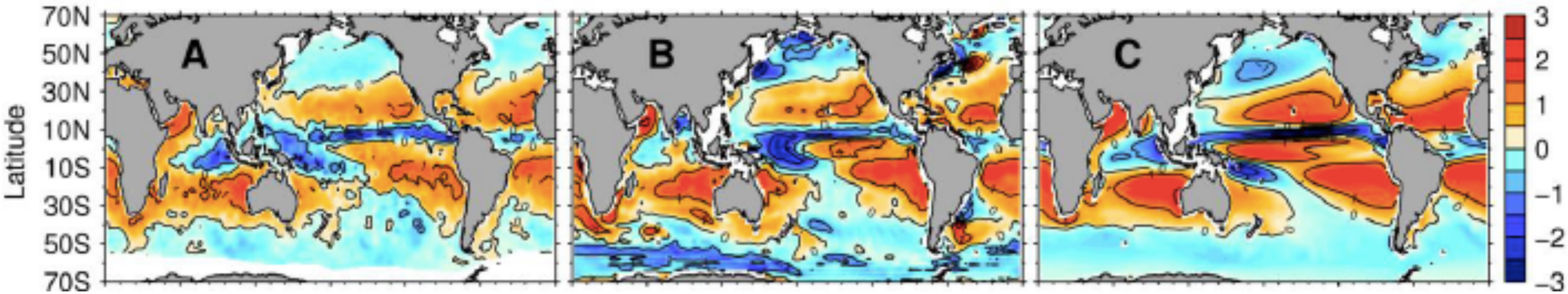
ΔT = 3.6K (2090s)

$\Delta P_{99.99}$ = 25%

$\Delta P_{99.99} / \Delta T$ ~ 7%/K C-C

The pdf shifts from light to heavier rains that appear to follow the rate of change of water supply (7%/K) (in models).

Changes to the saltiness of the oceans supports the notion that wet areas get wetter and the dry areas drier. Is this wetting merely following water vapor changes within main convergence zones?



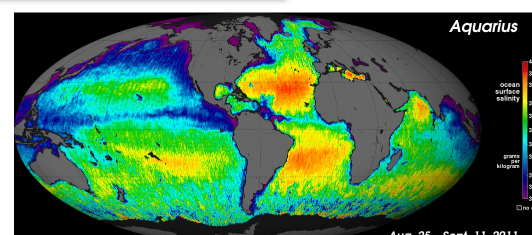
Evaporation –minus precipitation

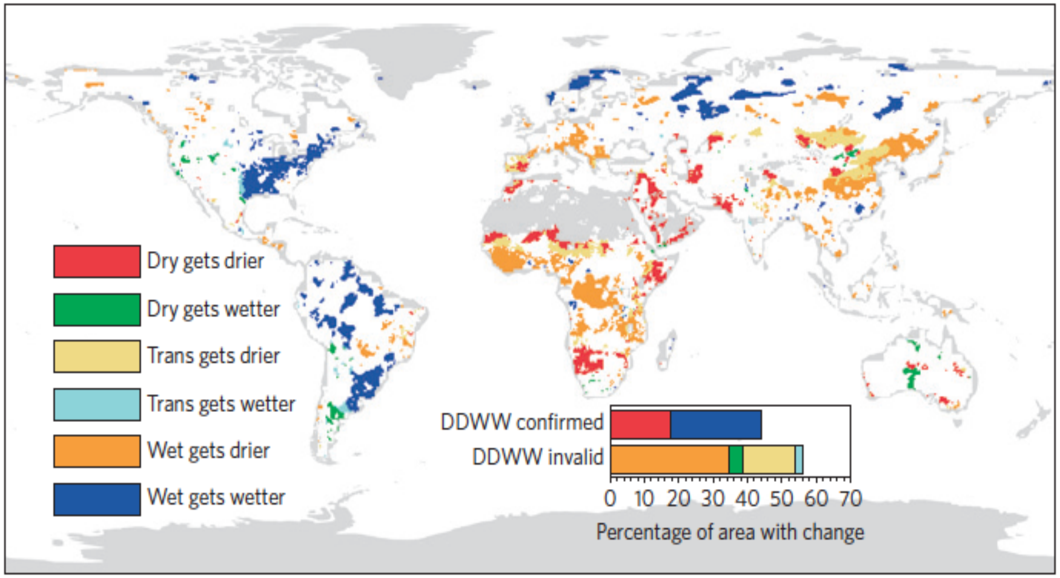
Salinity

Durack et al. 2011
Change in Salinity over 50 years

These look a like

First global map of salinity from Aquarius, Launched in 2011





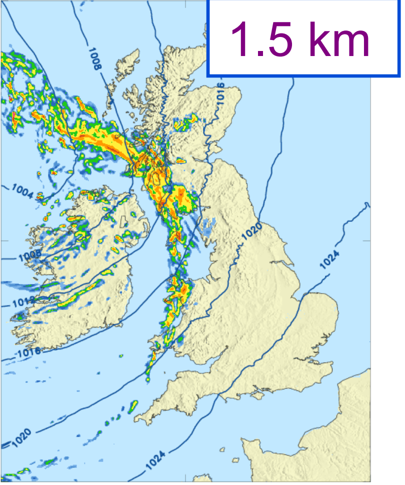
(Greve et al. 2014, Nature Geoscience)

Assessment of changes in drought over land (comparison of 1948-1968 and 1985-2005 periods, annual changes)

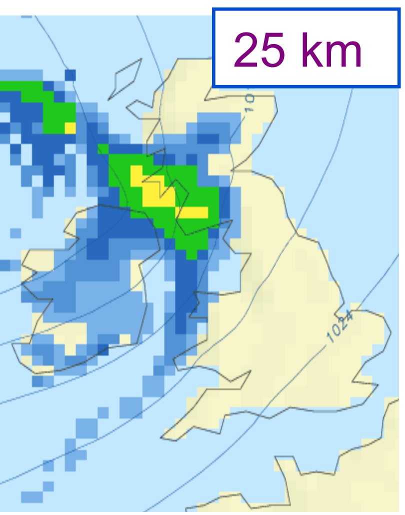
4 P datasets, 11 Ep datasets, 7 E datasets

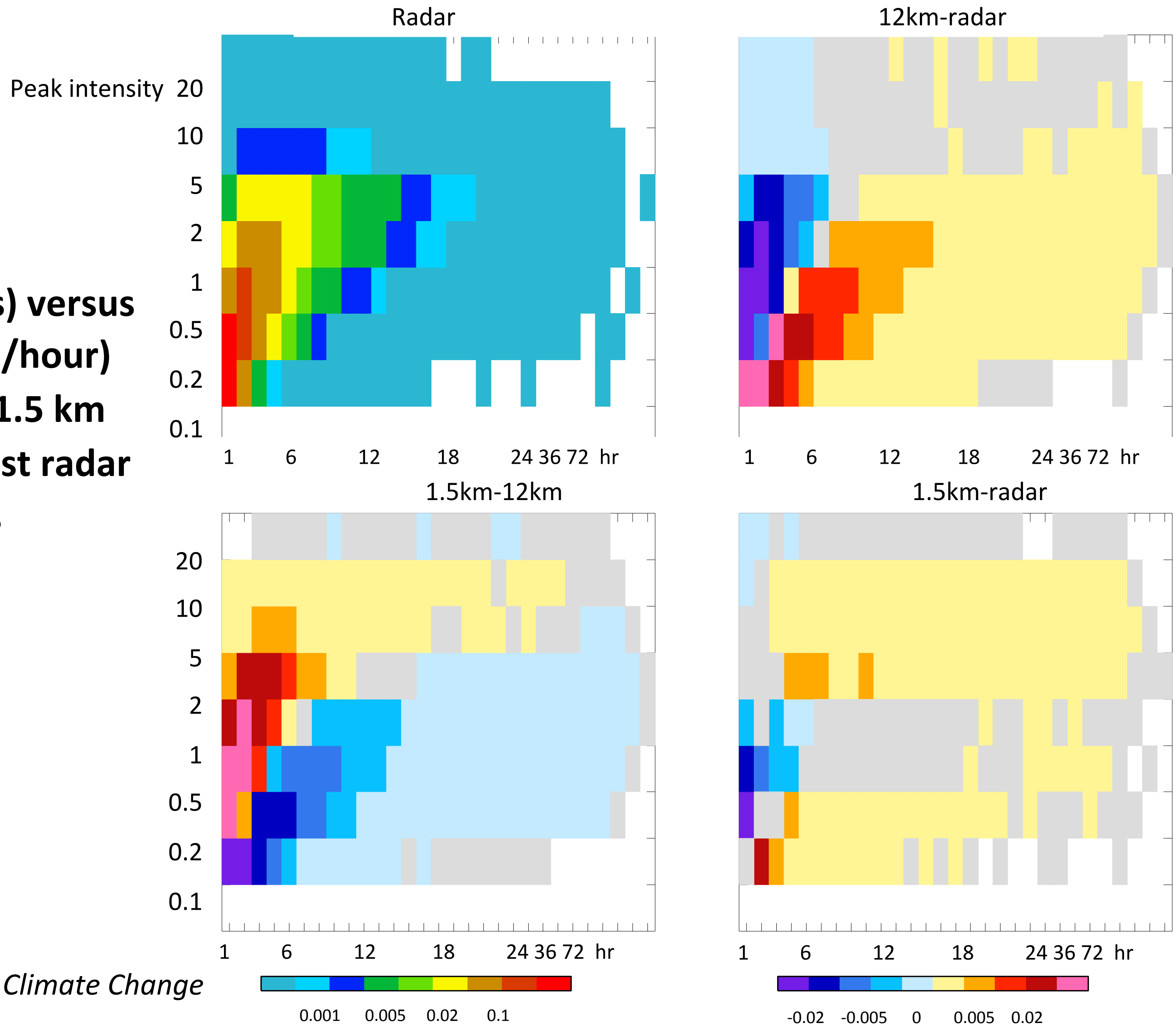
Few regions with robust changes
No clear support for "dry gets drier, wet gets wetter" paradigm

Ocean trends apparently do not apply on land



Spell duration (hours) versus peak intensity (mm/hour) from 12km versus 1.5 km model verified against radar observations



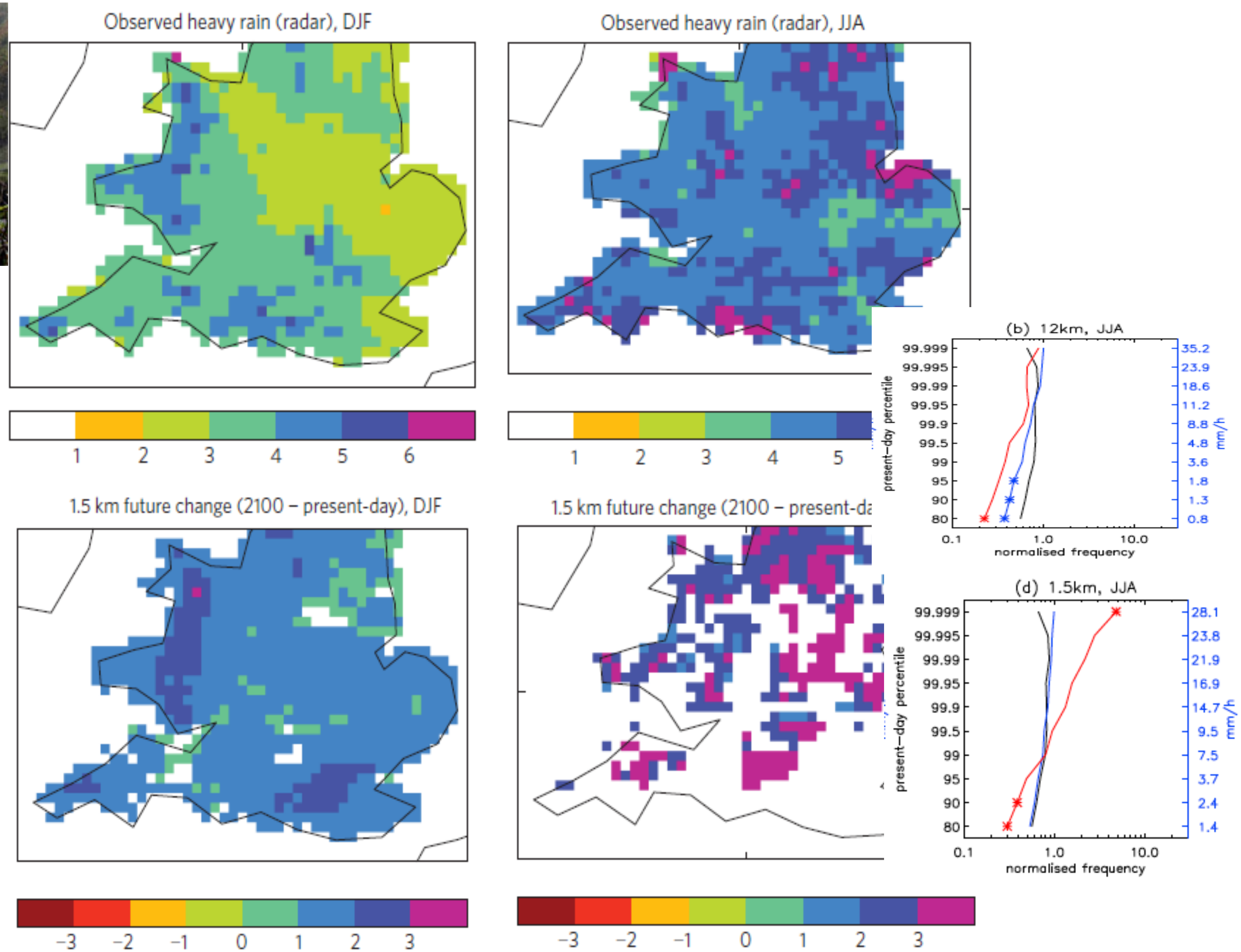


Kendon et al., 2014: Nature Climate Change

Next generation UK Climate Projections

Future change in heavy hourly rainfall (upper 5%)

Winter storms follow CC, summer (convective) storms are super CC



Kendon et al., 2014: Nature Climate Change

Water Availability Activities (partial)

- GDAP-led assessment on precipitation
- GHP RHPs and cross cut activities (e.g. mountain precipitation, development of a US RHP)
- GEWEX-led CMIP6 landMip
- Plannign for a HiRes modeling workshop