



**GDIS and GHP**  
**Welcome to Cal Tech & Southern  
California**

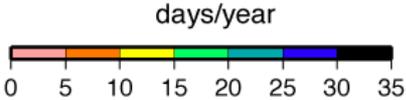
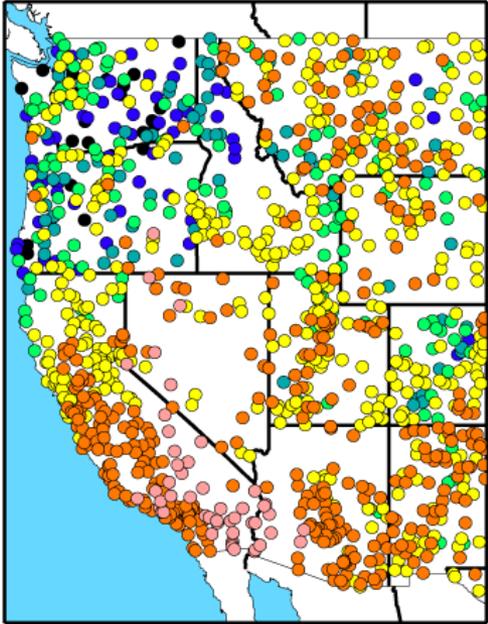
**It never rains in California**

**GEVEX** **JPL**

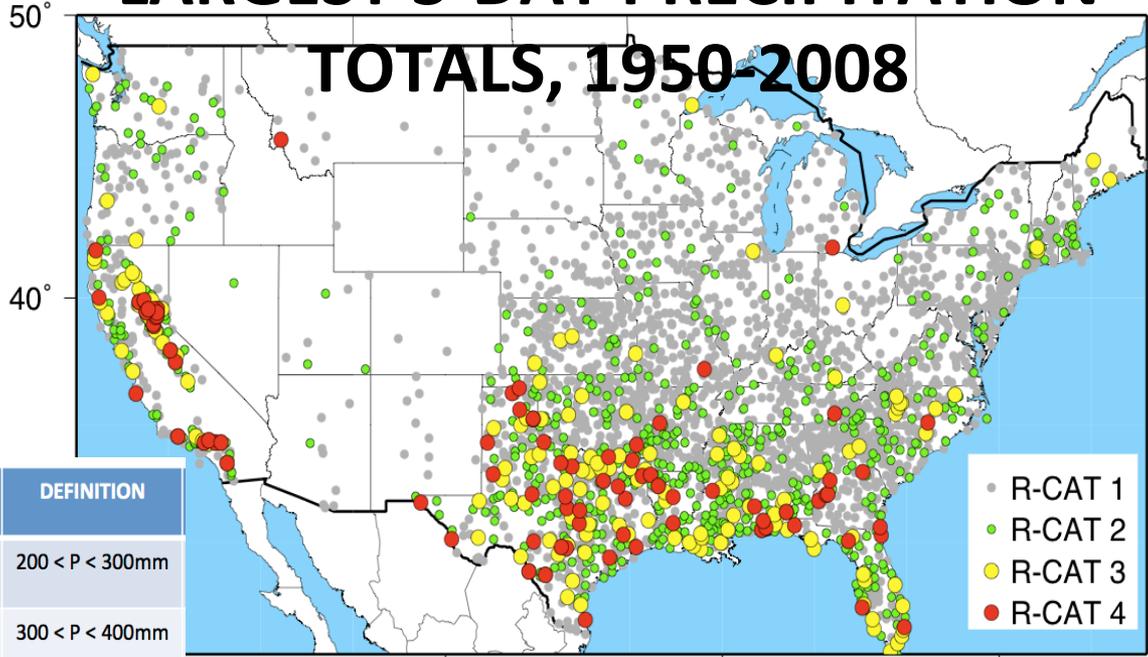


.....but girl, don't they warn ya  
It pours, man, it pours

c) AVERAGE NUMBER OF DAYS/YR TO OBTAIN HALF OF TOTAL PRECIPITATION, WY 1951-2008



# LARGEST 3-DAY PRECIPITATION TOTALS, 1950-2008



R-CAT	DEFINITION
1	200 < P < 300mm
2	300 < P < 400mm
3	400 < P < 500mm
4	P > 500mm

- R-CAT 1
- R-CAT 2
- R-CAT 3
- R-CAT 4

# WCRP Organization

**Joint Scientific Committee**

**Joint Planning Staff**

**Modeling Advisory Council**

**Data Advisory Council**

**Working Groups on:** Couple Modeling (WGCM), Region Climate (WGRC), Seasonal to Interannual Prediction (WGSIP), Numerical Experimentation (WGNE)

**CLIC**

**CLIVAR**

## Grand Challenges

**GEWEX**

**SPARC**

Cryosphere-Climate Interactions

Ocean-Atmosphere Interactions

Actionable Regional Climate Information

Regional Sea-Level Rise

Cryosphere in a Changing Climate

Changes in Water Availability

Aerosols, Precipitation & Cloud Systems

Climate Extremes

Land-Atmosphere Interactions

Troposphere-Stratosphere Interactions

# **(2) Where does all the fresh water go?**

Julia Slingo  
Darmstadt, 2014

# 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?**

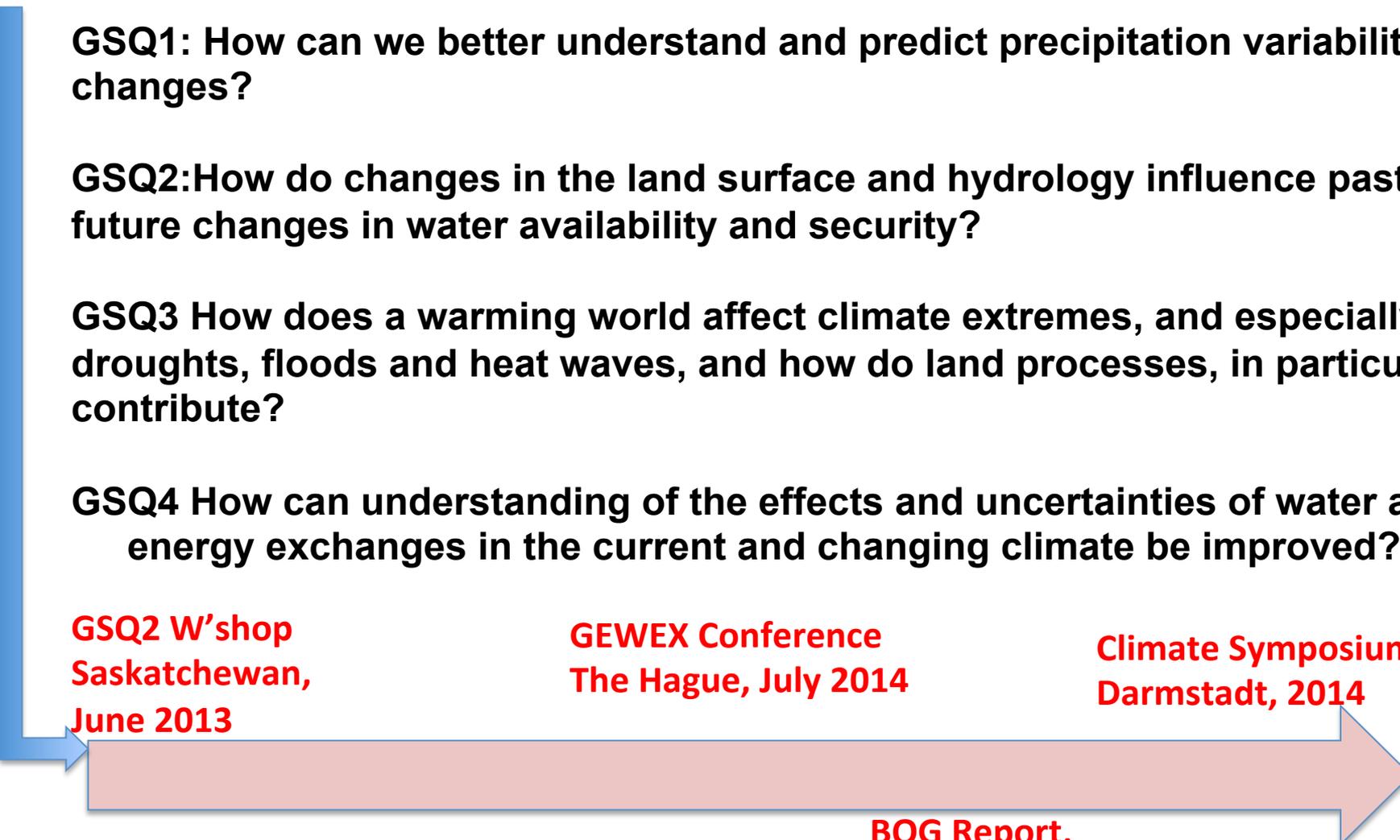
**GSQ2 W'shop**  
Saskatchewan,  
June 2013

**GEWEX Conference**  
The Hague, July 2014

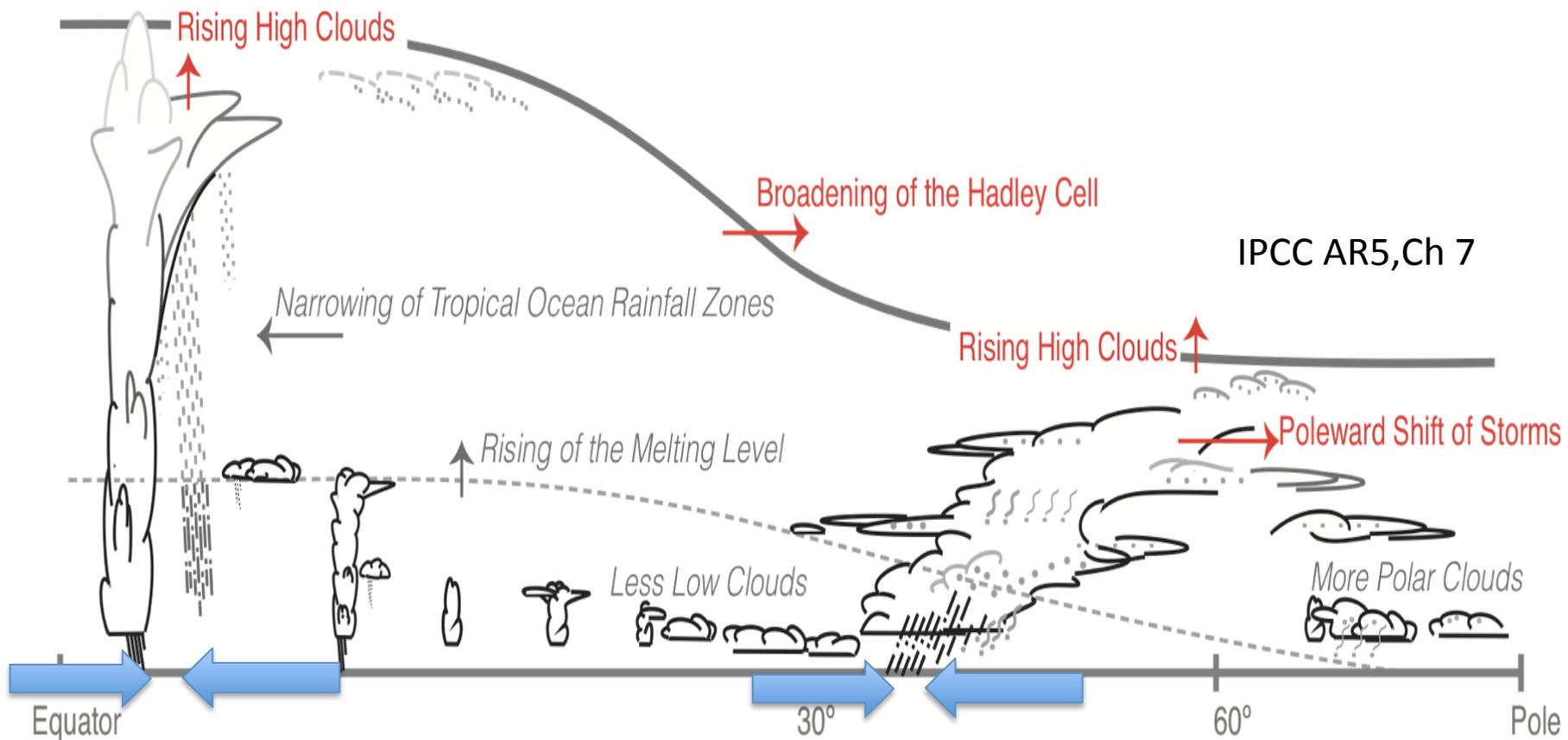
**Climate Symposium**  
Darmstadt, 2014

**GSQ1 W'shop**  
Ft Collins, July, 2013

**BOG Report,**  
post AR5 workshop  
Geneva, Sept 2014



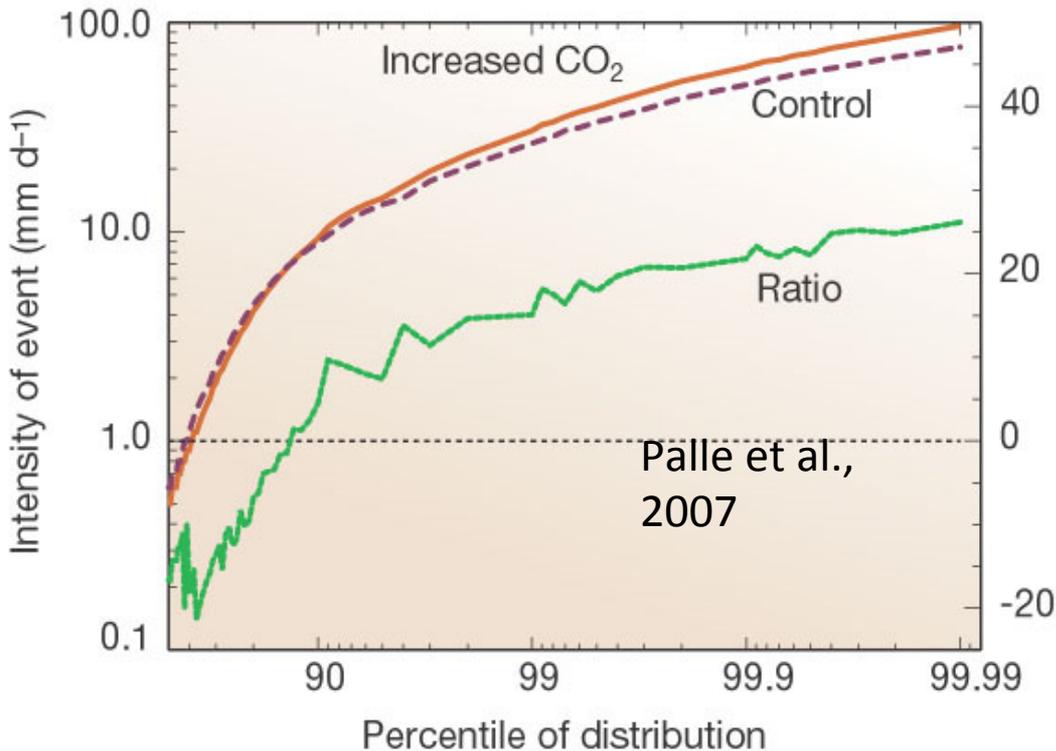
- Which characteristics of precipitation affect water availability, and how are they changing?
  - **what sets the spatial pattern of precipitation change? (wet wetter, dry drier? Is this primarily circulation driven?)**
  - **What determines the regional changes to precipitation intensity (e.g. @7%/K?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



$$q \cdot \nabla v$$

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

$$q \cdot \nabla v$$



Percentage increase

A model example -  
difference 2XCO<sub>2</sub>-1XCO<sub>2</sub>

**GCM CO<sub>2</sub> vs Control**

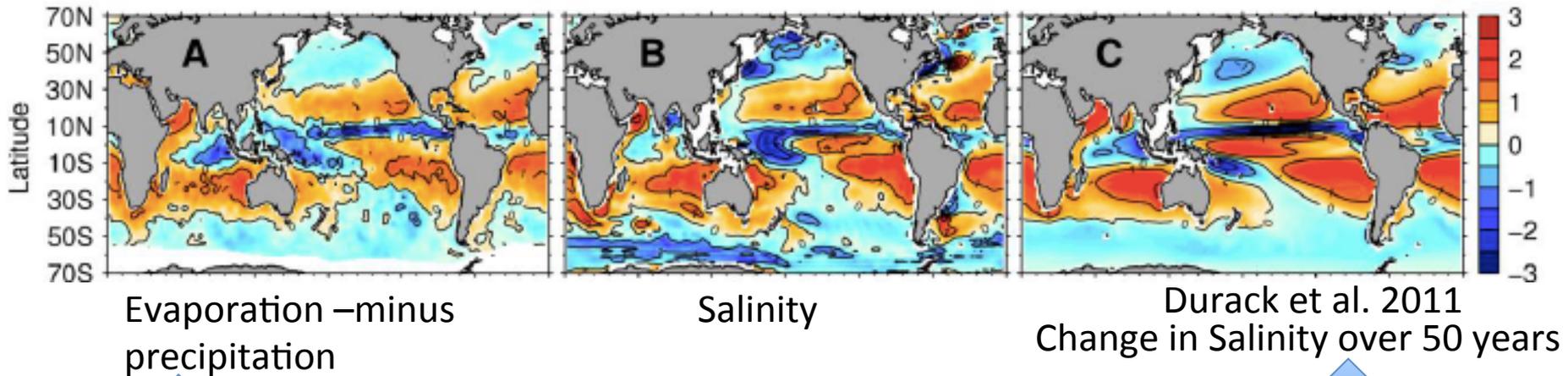
$\Delta T = 3.6\text{K}$  (2090s)

$\Delta P_{99.99} = 25\%$

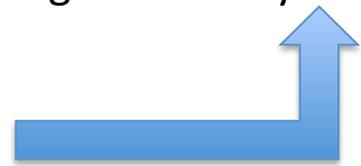
$\Delta P_{99.99} / \Delta T \sim 7\%/K$  C-C

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

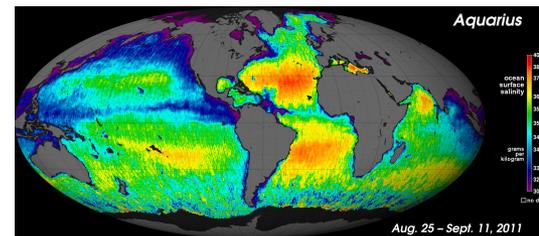
Changes to the saltiness of the oceans supports the notion that wet areas get wetter and the dry areas drier. Is this wetting merely following water vapor changes within main convergence zones?

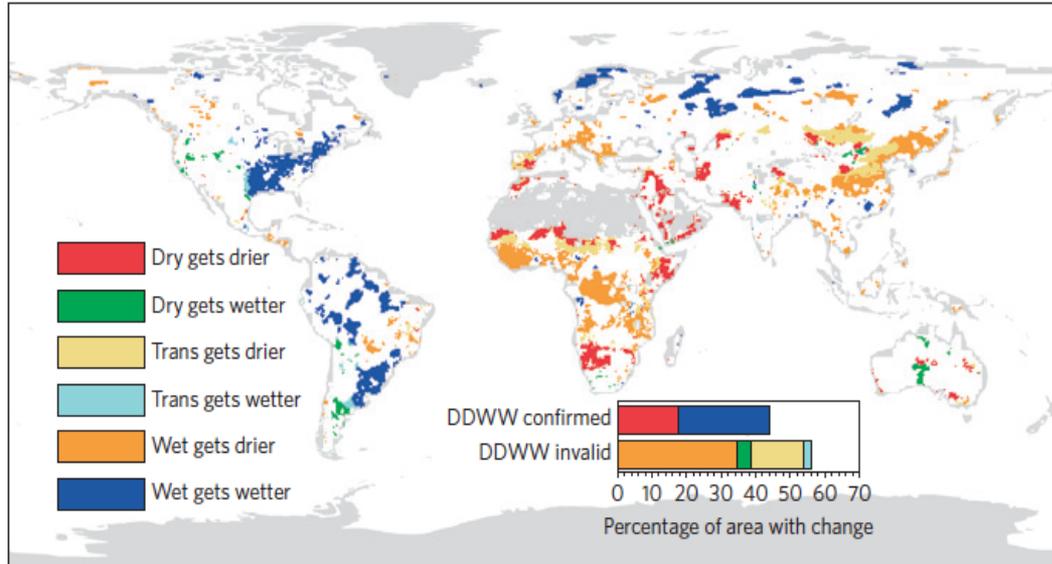


These look a like



First global map of salinity from Aquarius, Launched in 2011





(Greve et al. 2014, *Nature Geoscience*)

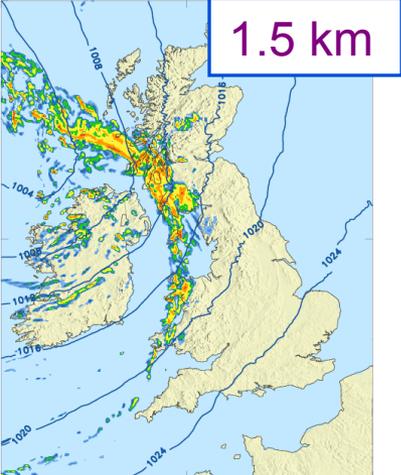
## Assessment of changes in drought over land (comparison of 1948-1968 and 1985-2005 periods, annual changes)

4 P datasets, 11 Ep datasets, 7 E datasets

Few regions with robust changes

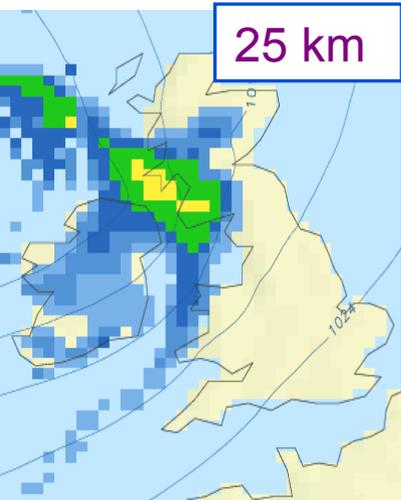
**No clear support for “dry gets drier, wet gets wetter” paradigm**

Ocean trends apparently do not apply on land

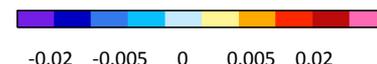
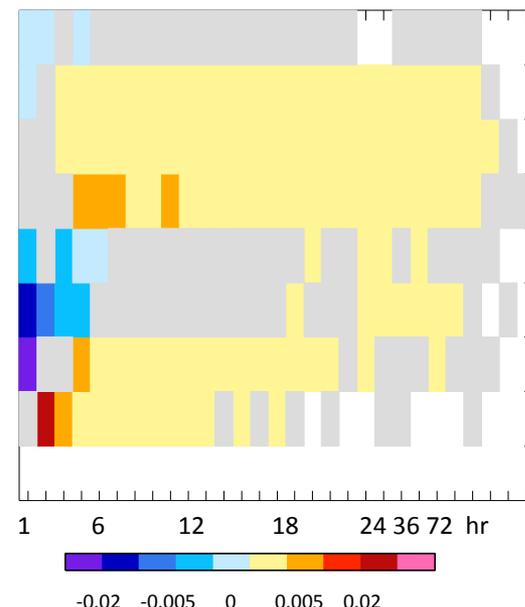
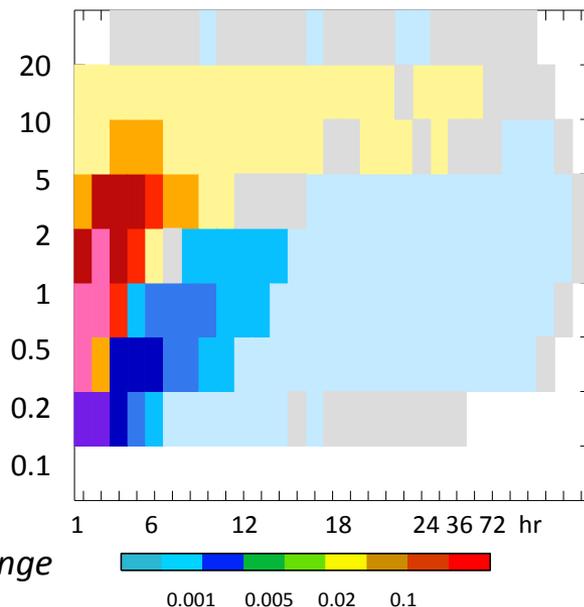
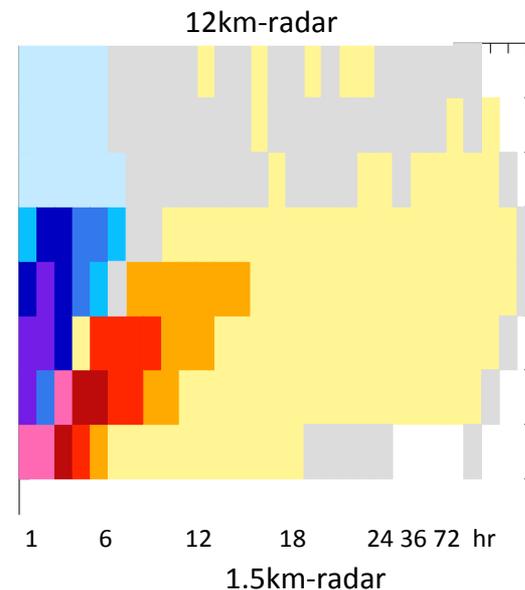
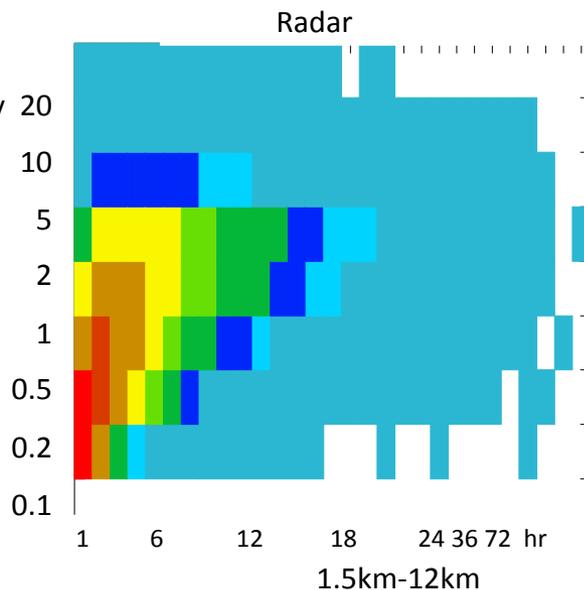


1.5 km

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



25 km

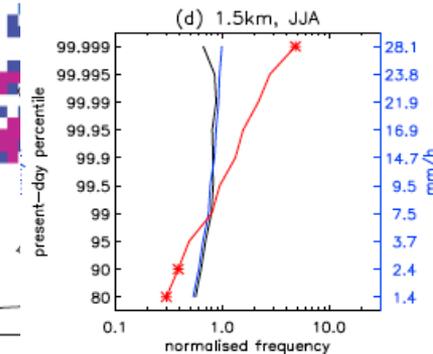
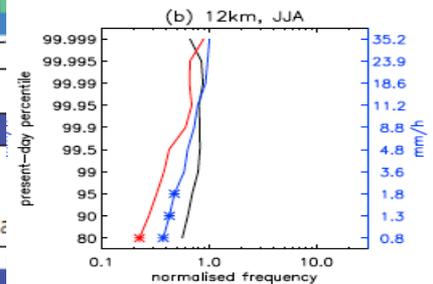
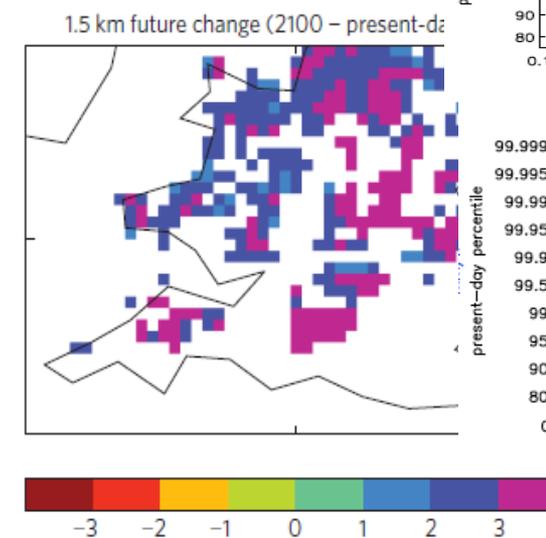
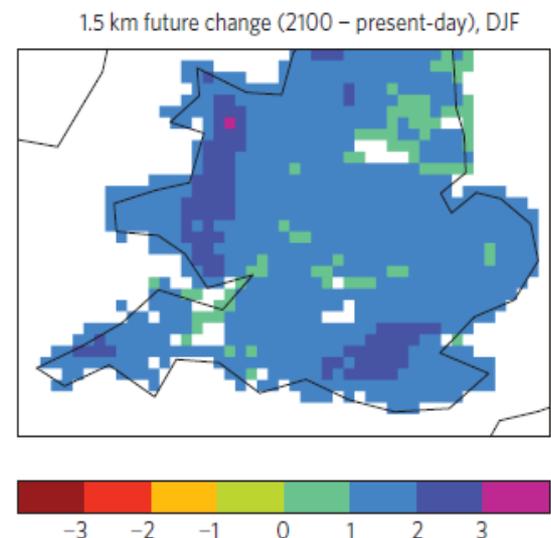
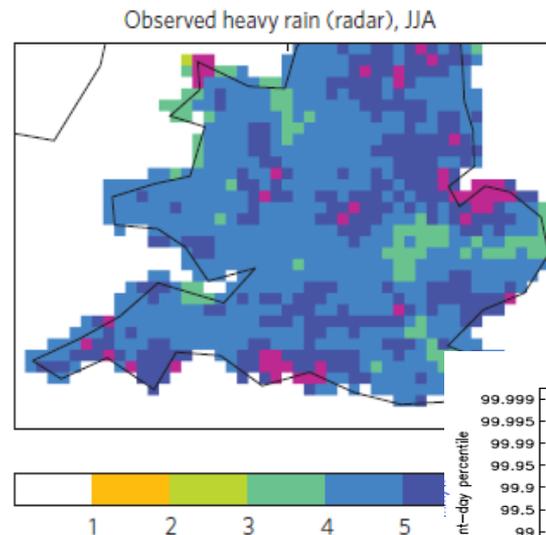
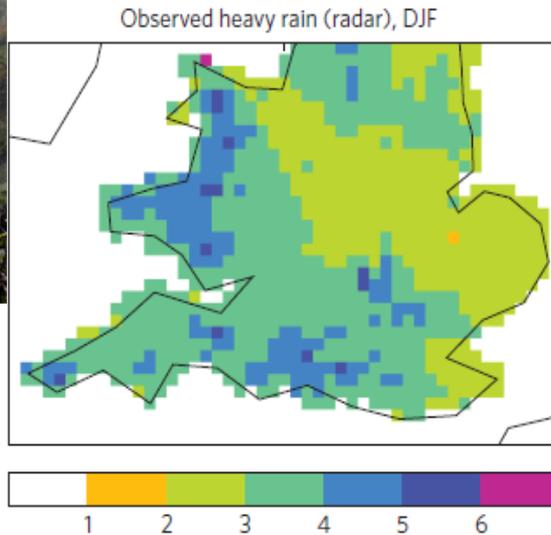


# Next generation UK Climate Projections

## Future change in heavy hourly rainfall (upper 5%)



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



# 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