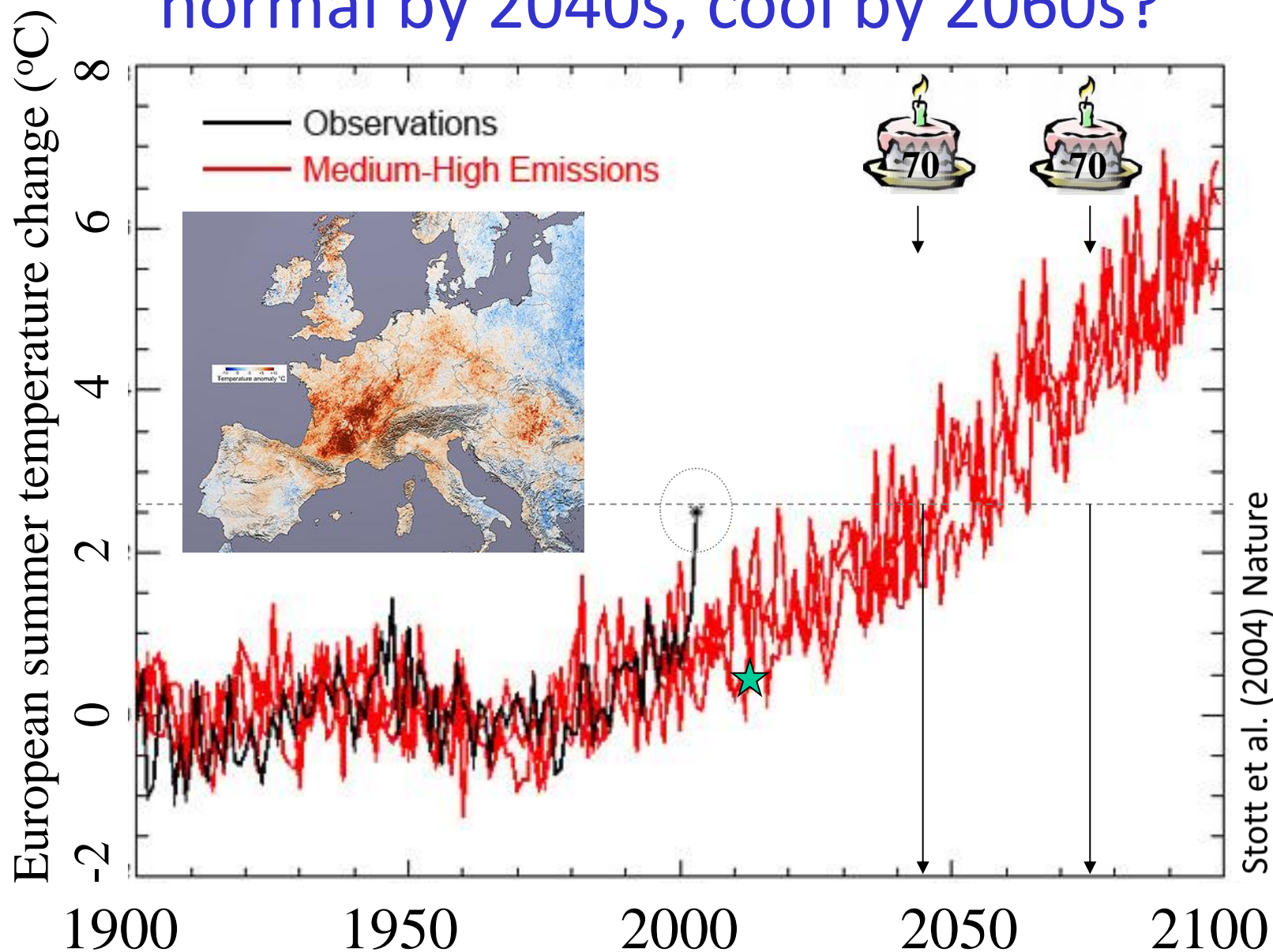


Weird weather – is this the new normal?

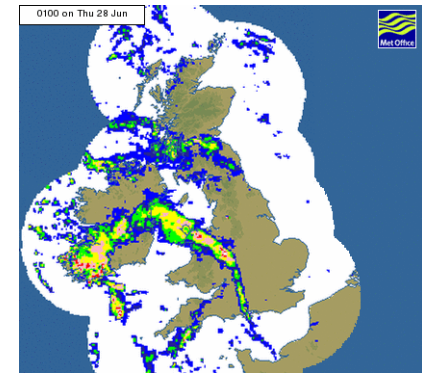
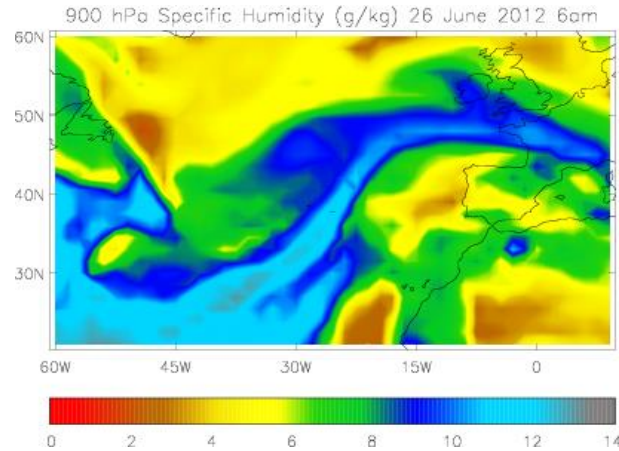
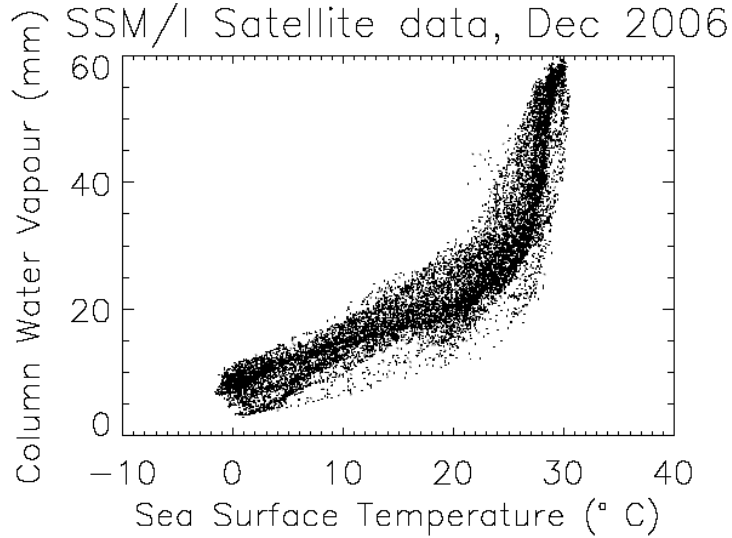


Dr Richard P. Allan r.p.allan@reading.ac.uk @rpallanuk
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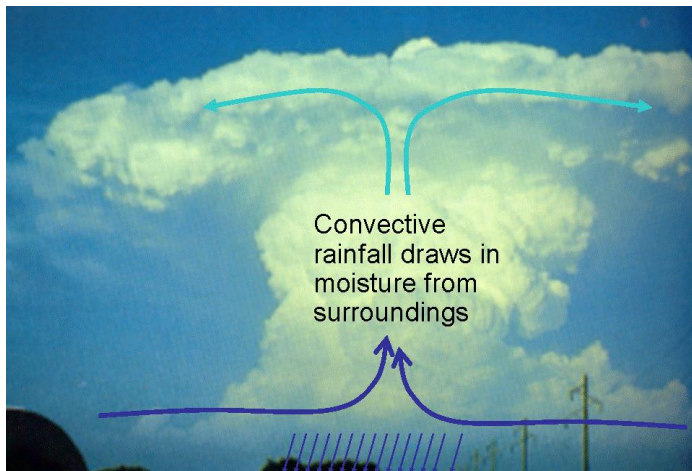
Europe 2003 extreme summer temperature: normal by 2040s, cool by 2060s?



Intensification of rainfall

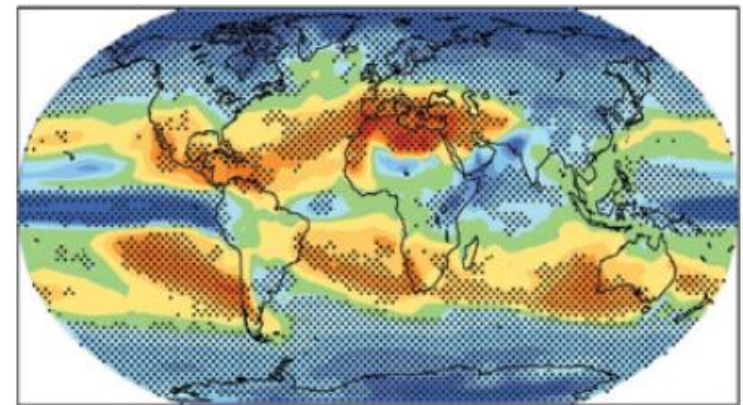


- Atmospheric **moisture** increases with warming (observations/basic physics)
- Moisture is the *fuel* for heavy rainfall [e.g. Lavers et al. \(2011\)](#)
- **Observations**, **physics** and detailed **simulations** indicate intensification of rainfall with warming [e.g. Allan & Soden \(2008\)](#)



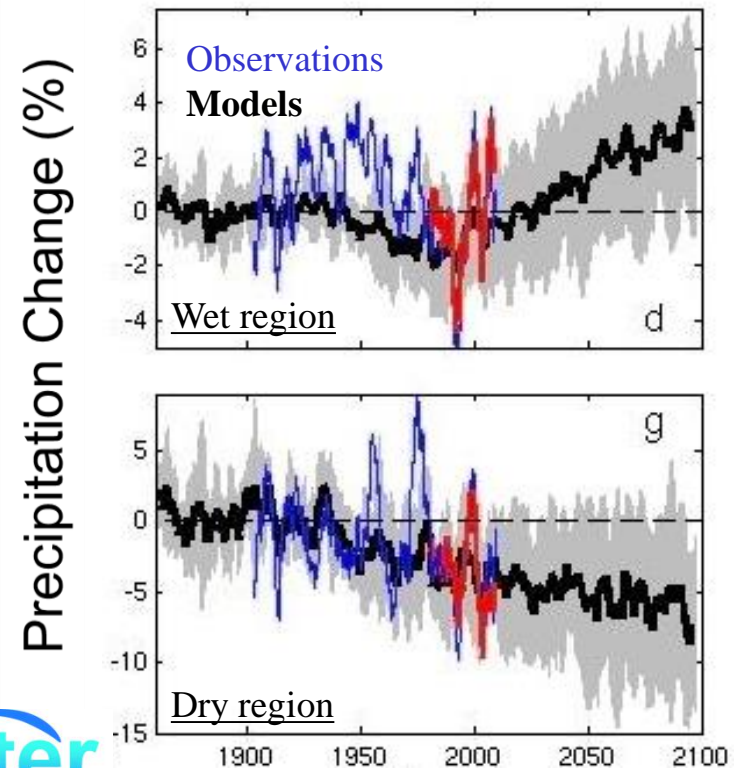
The rich get richer...

- Warming enhances **moisture flows** from dry regions to wet regions
- Physics, observations and simulations indicate **wet** regions will become **wetter** and **dry** regions increasingly **drier**
- More **flooding** and more **drought** likely, especially across the tropics



Precipitation Change (%) IPCC (2007)

-25 -20 -15 -10 -5 0 5 10 15 20 25

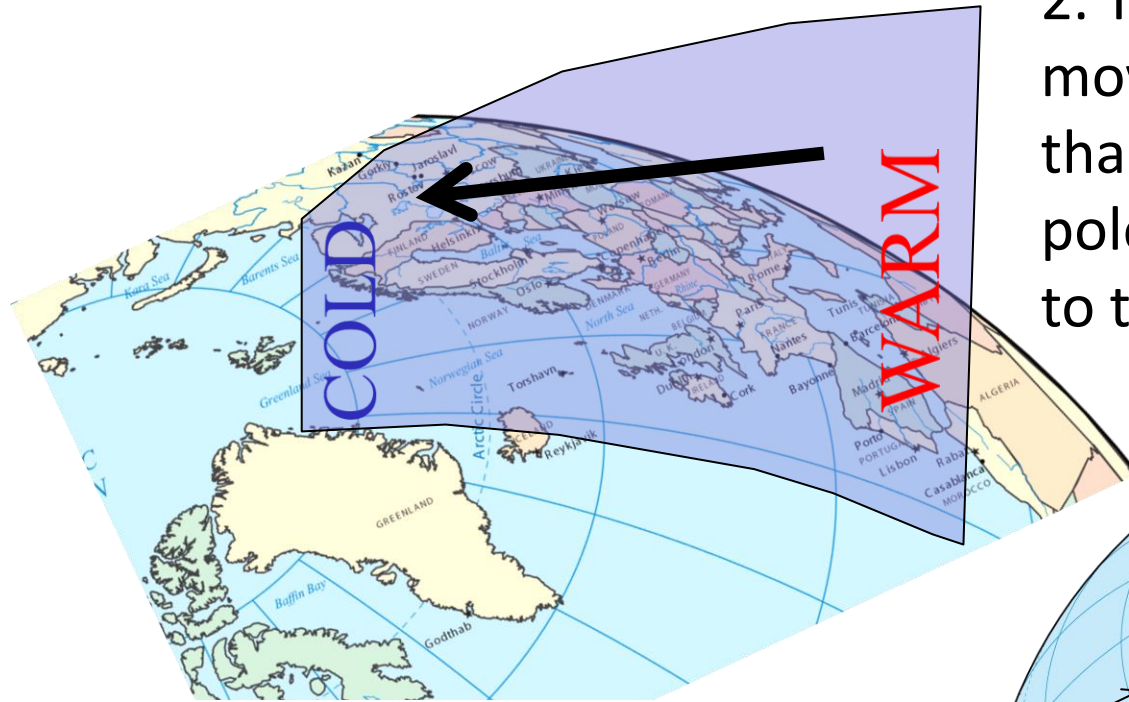


Liu & Allan (2013) submitted

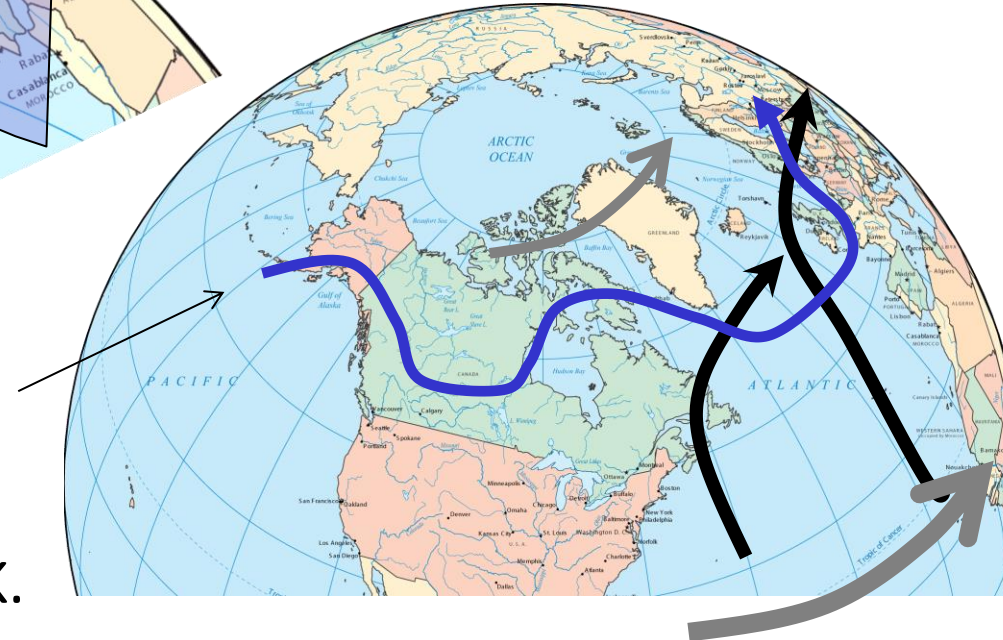
1. Air is **warmer** closer to the tropics (air expands) than at the poles (air contracts). This generates a **poleward flow of air** high up in the atmosphere

Weather patterns

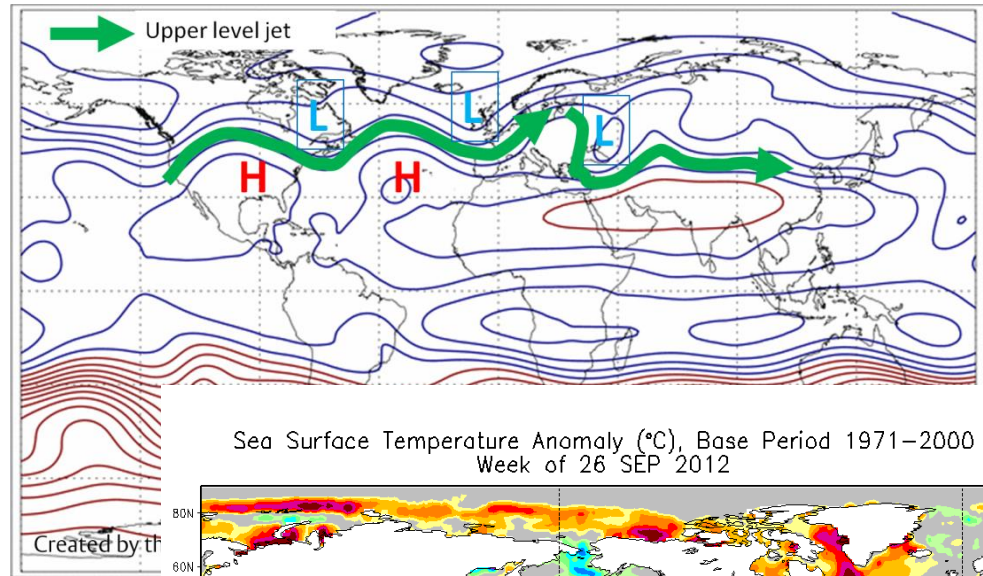
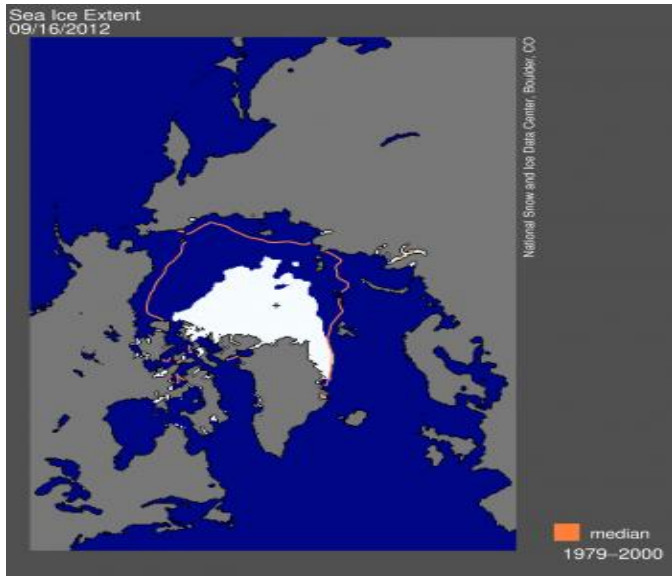
2. The Earth spins: the surface moves quicker near the equator than at higher latitudes. So poleward-flowing air is deflected to the **east** (direction of spin)



3. This high altitude (5-7km) fast moving ribbon of air is called the **jet stream**. It steers weather systems over or away from the UK.

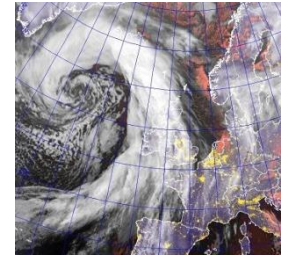


Arctic Ice, ocean temperature and the jet stream

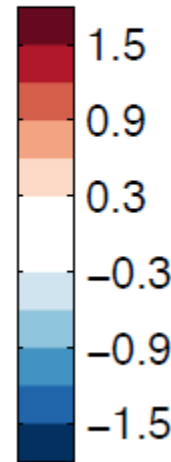
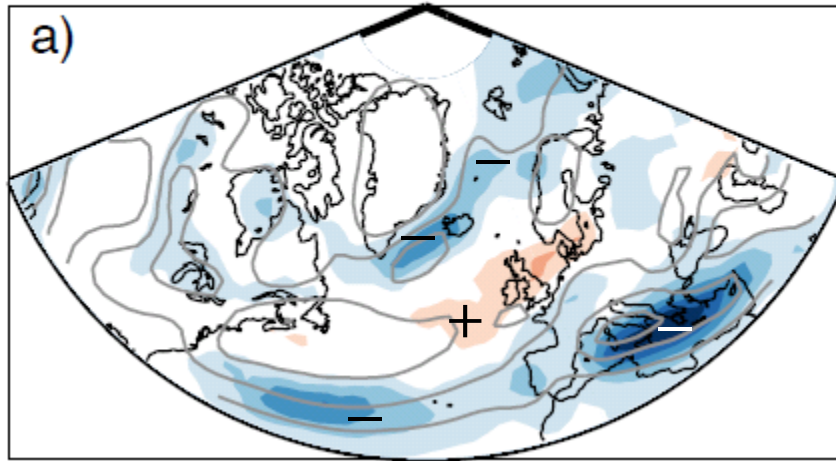


4. Changes in this temperature difference between equator and pole can alter the position, strength and characteristics of the **jet stream**. Both **natural** and **human-caused** effects influence our weather patterns

How will jet stream & winter storm characteristics alter in the future?

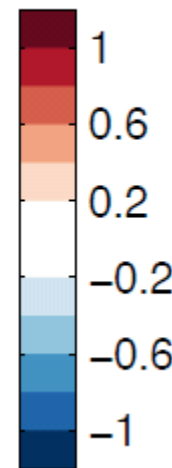
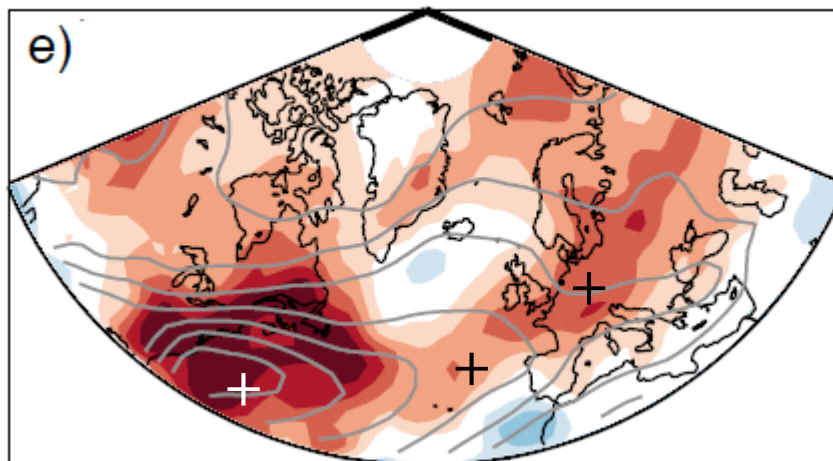


track density

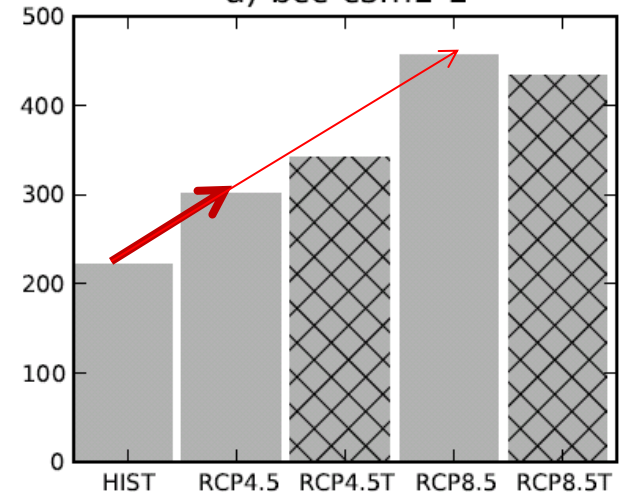


- Shifts in the **jet stream** unclear (left)
- **Precipitation intensity** (bottom left) & number of **Atmospheric River** events (below) likely to increase with warming

precip intensity



a) bcc-csm1-1



Zappa et al. (2013) J. Climate

Lavers et al. submitted

Weird weather – is this the new normal?

- Attributing every extreme weather event to climate change is not useful
- However, the environment, from which our weather takes shape, has changed significantly since the 1970s
- Storms, jet streams, tropical cyclones and other weather phenomena are slightly different than they would have been without global warming
- The “normal” is changing...

