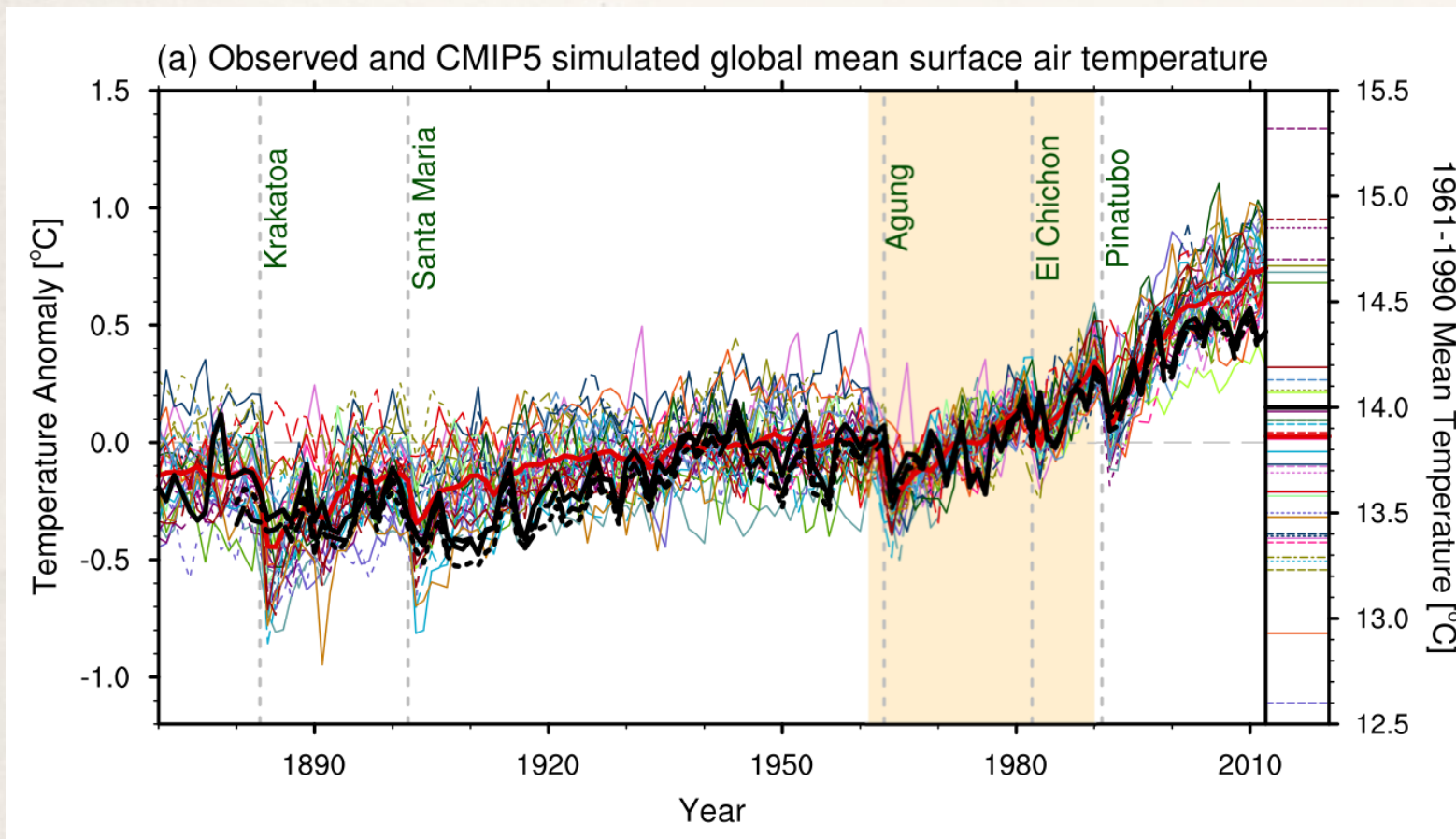


Local rainfall under climate change - Why uncertainty is your friend

Christian Jakob, ARC Centre of Excellence for Climate System Science, Monash University, Melbourne, Australia

Special thanks: My Friends and colleagues on IPCC Chapter 9 and at Monash

All climate predictions are based on models



$$\frac{du}{dt} - \left(f + u \frac{\tan \phi}{a} \right) v = -\frac{1}{a \cos \phi} \frac{1}{\rho} \frac{\partial p}{\partial \lambda} + F_{\lambda}$$

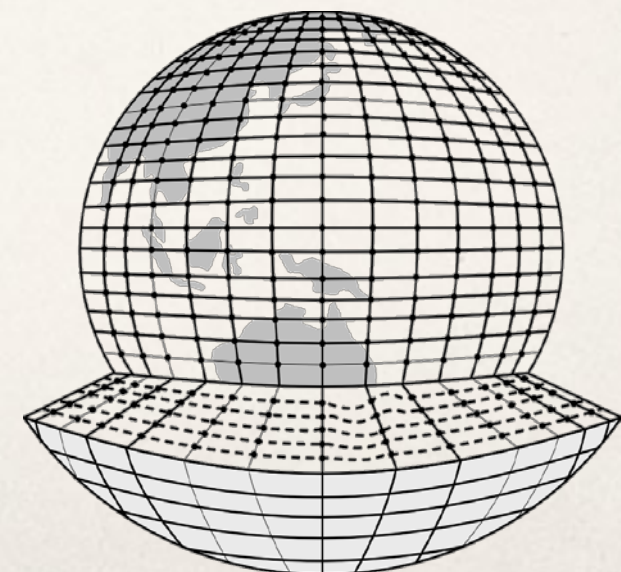
$$\frac{dv}{dt} + \left(f + u \frac{\tan \phi}{a} \right) u = -\frac{1}{\rho a} \frac{\partial p}{\partial \phi} + F_{\phi}$$

$$g = -\frac{1}{\rho} \frac{\partial p}{\partial z}$$

$$\frac{\partial \rho}{\partial t} = -\frac{1}{a \cos \phi} \left[\frac{\partial}{\partial \lambda} (\rho u) + \frac{\partial}{\partial \phi} (\rho v \cos \phi) \right] - \frac{\partial}{\partial z} (\rho w)$$

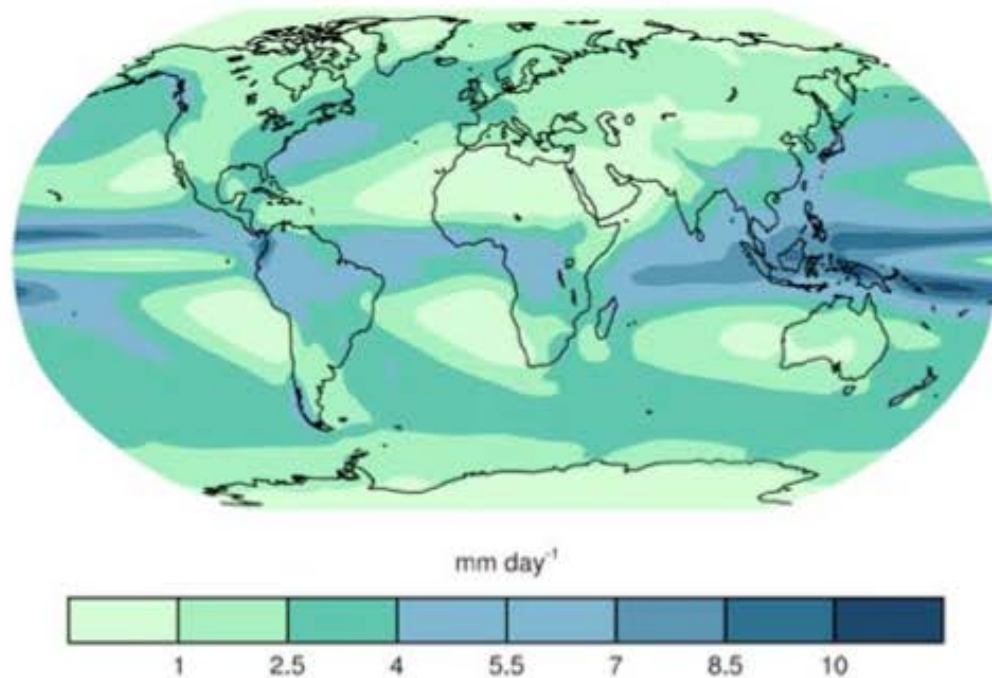
$$c_p \frac{dT}{dt} - \frac{1}{\rho} \frac{dp}{dt} = Q$$

$$p = \rho R T$$

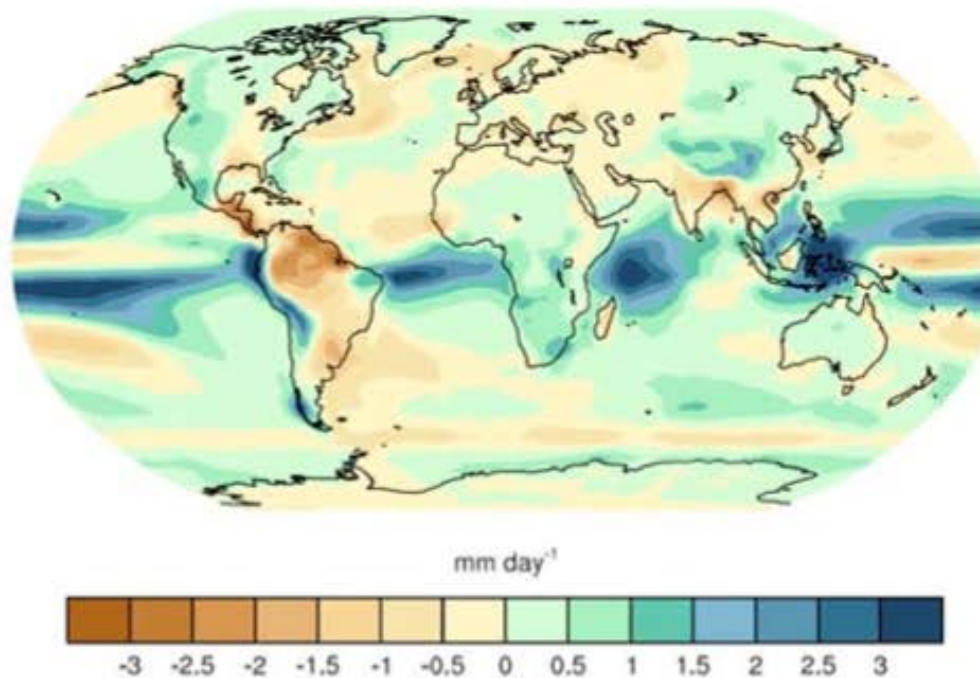


Simulating precipitation remains a challenge

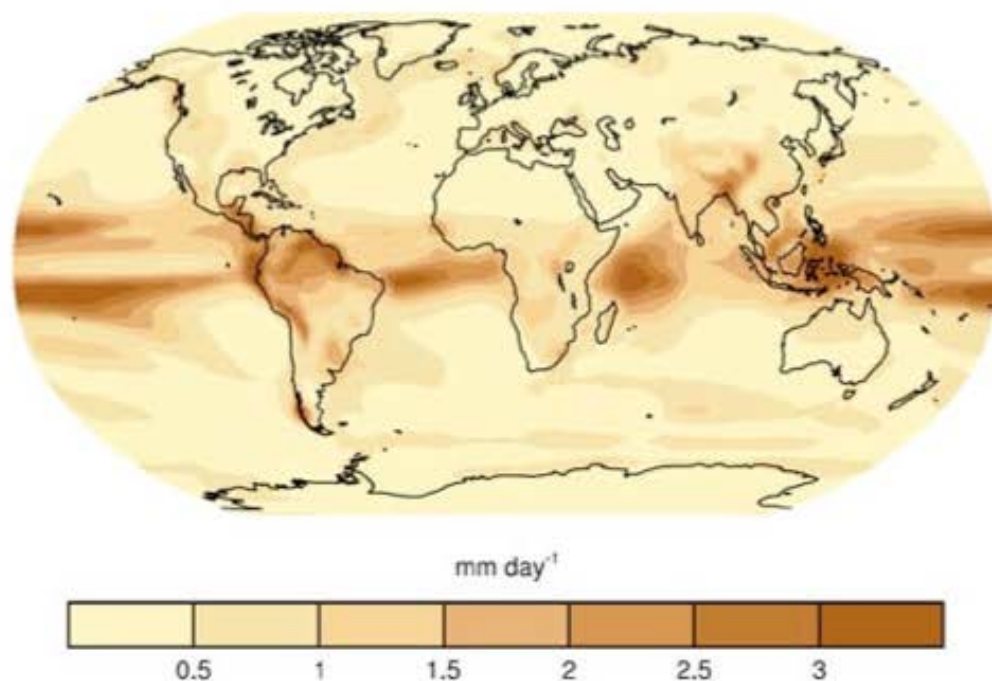
(a) Multi Model Mean Precipitation



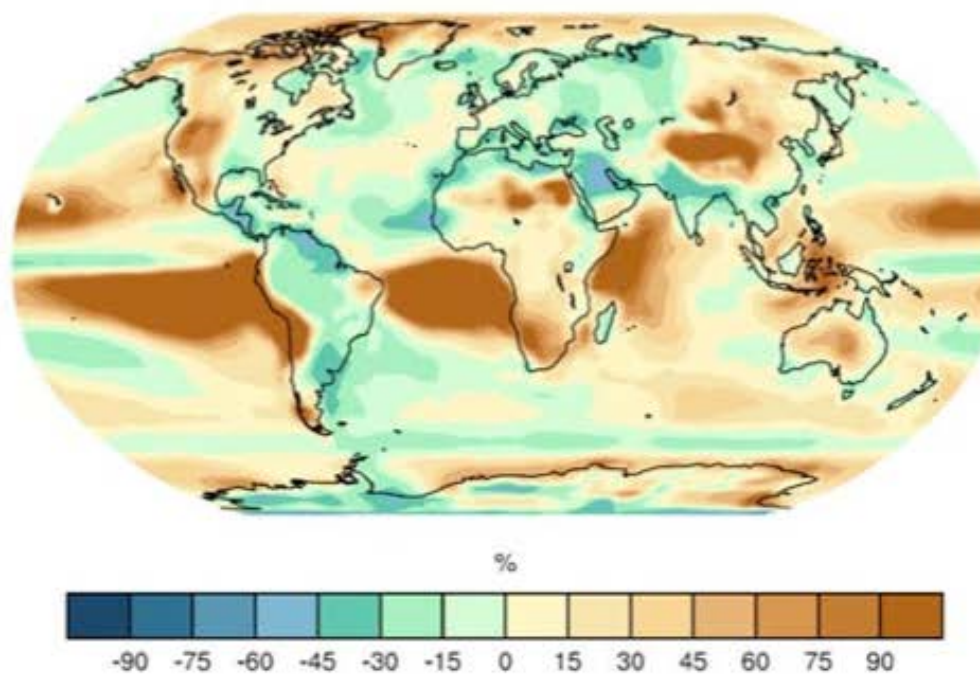
(b) Multi Model Mean Bias



(c) Multi Model Mean of Absolute Error

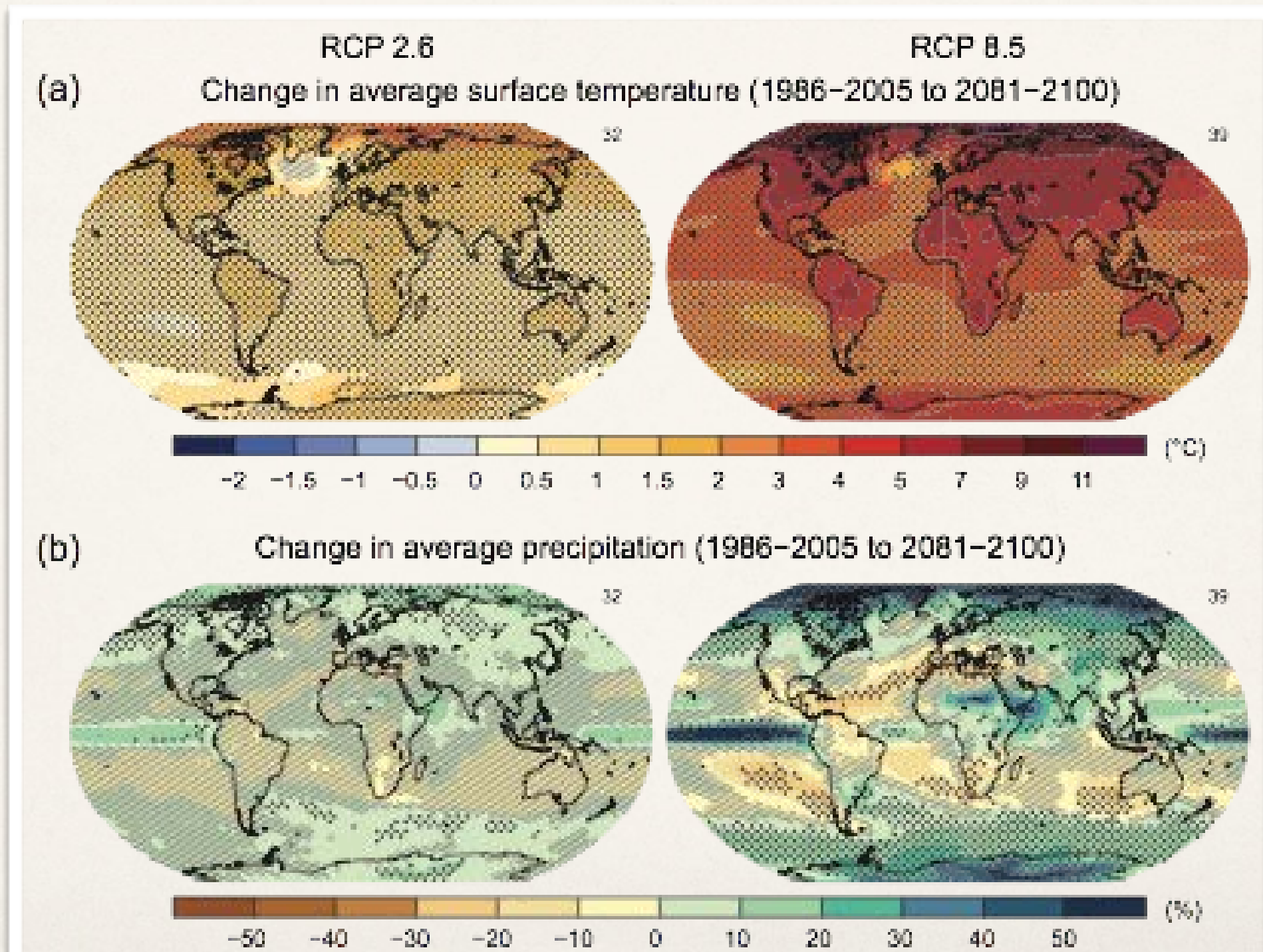


(d) Multi Model Mean of Relative Error

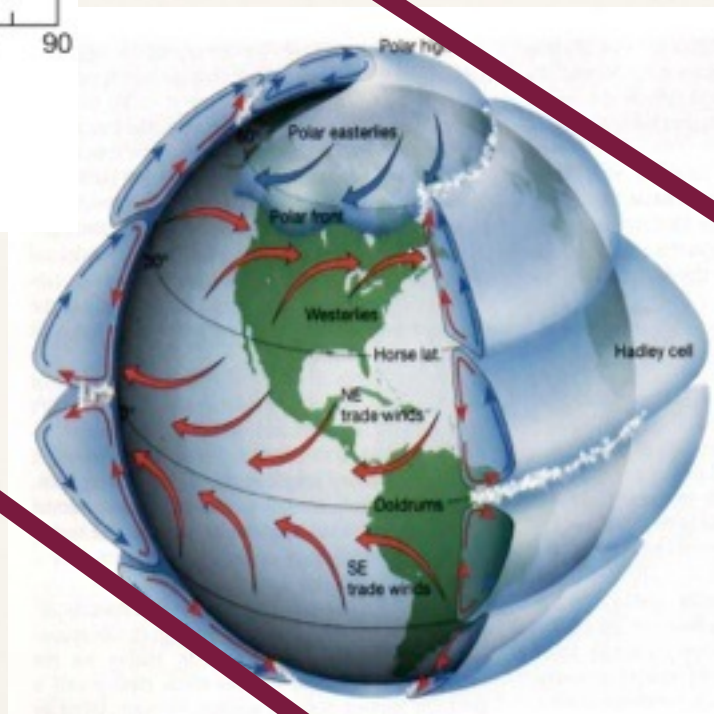
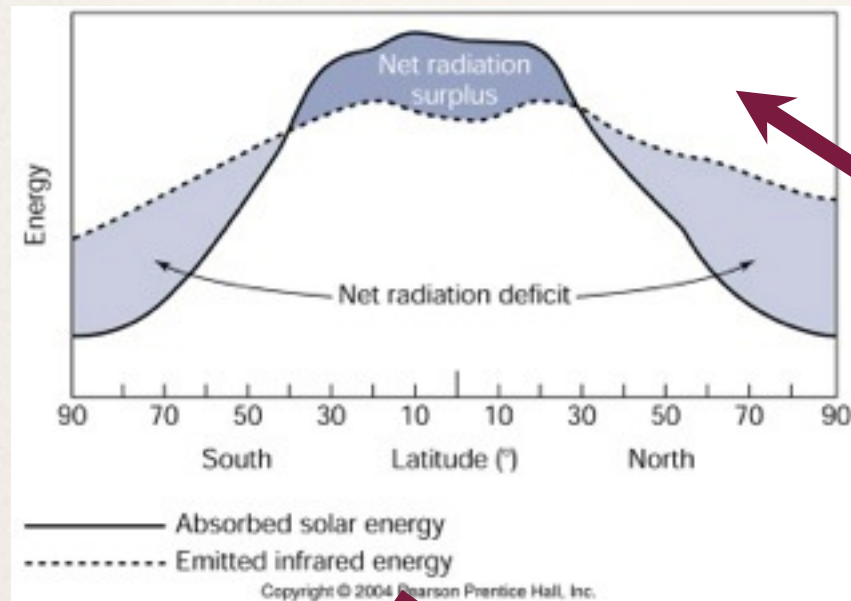


Precipitation CMIP5
multi-model mean

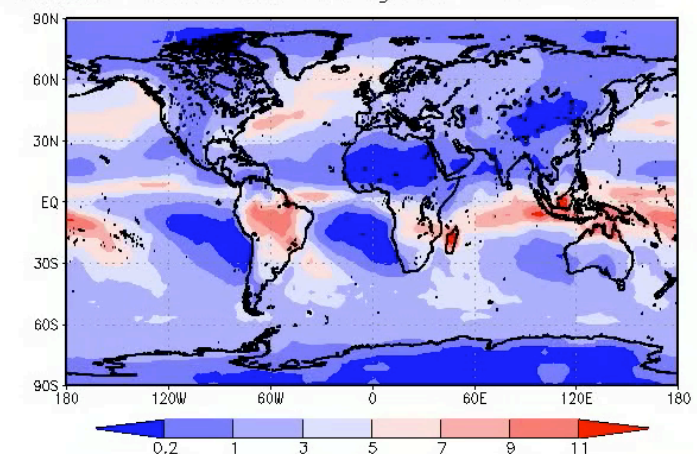
The difficulties in simulating precipitation at the local and regional level have profound influences for climate projections



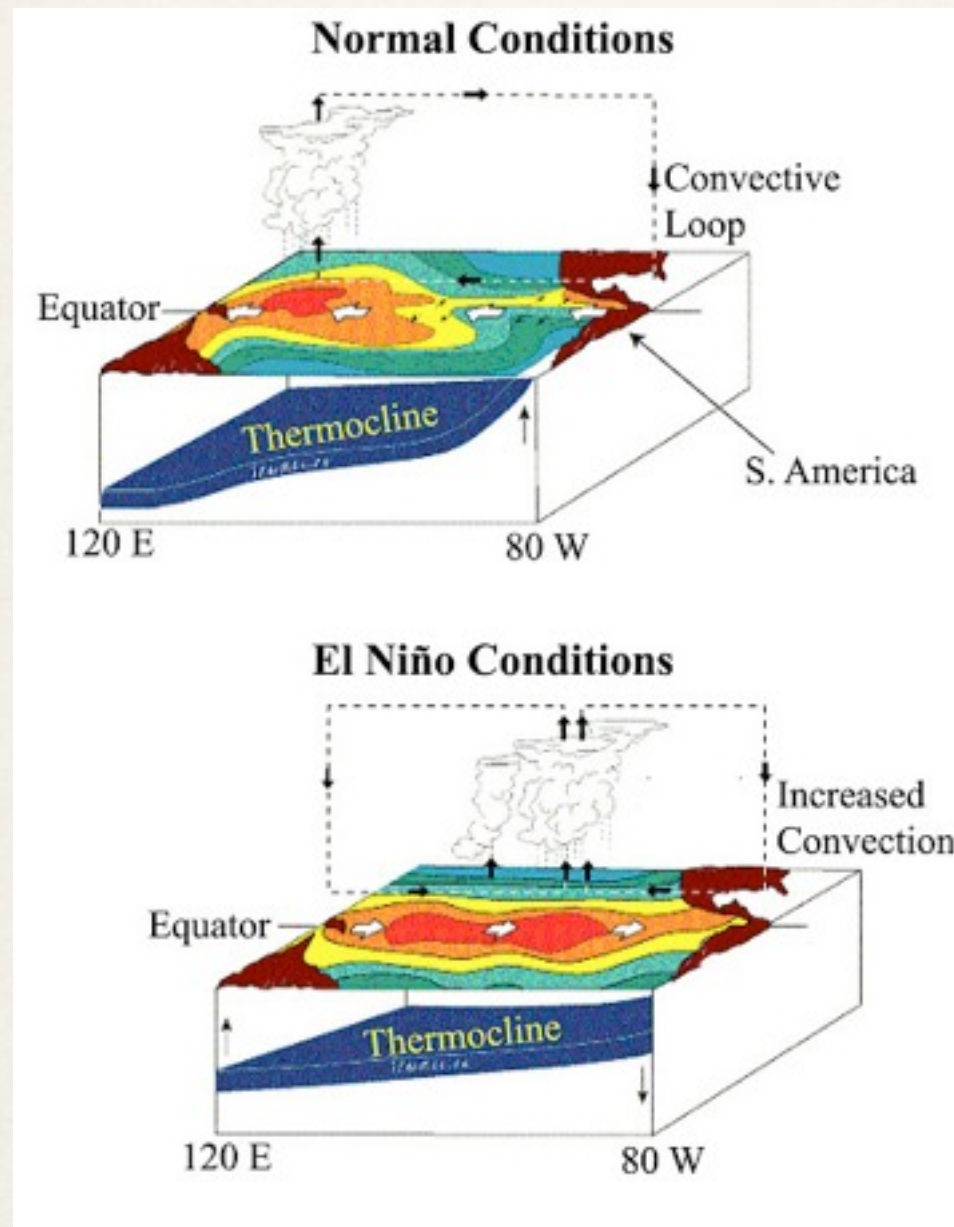
Precipitation is so difficult to model because it strongly couples to the circulation



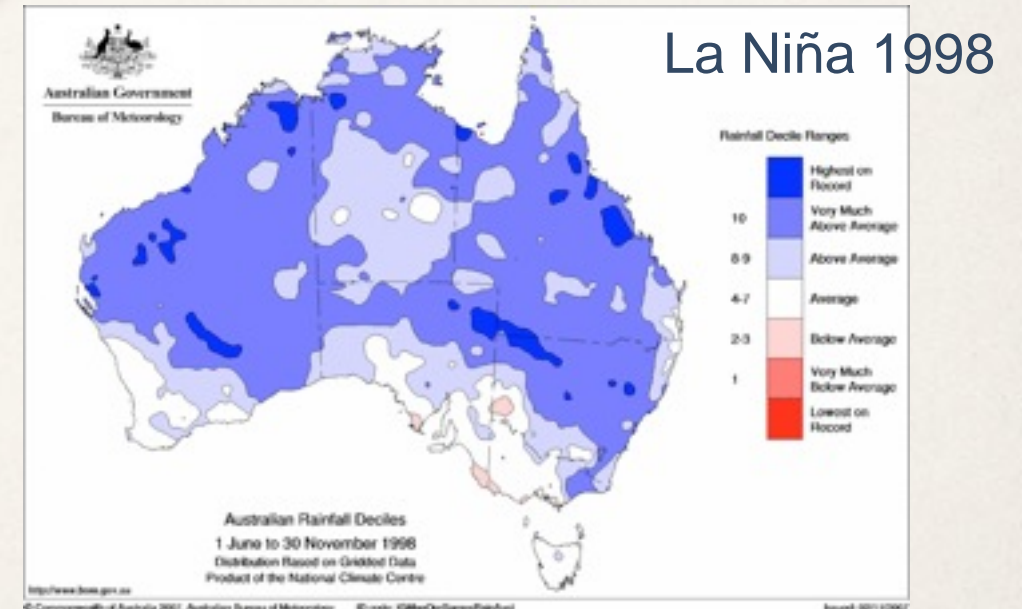
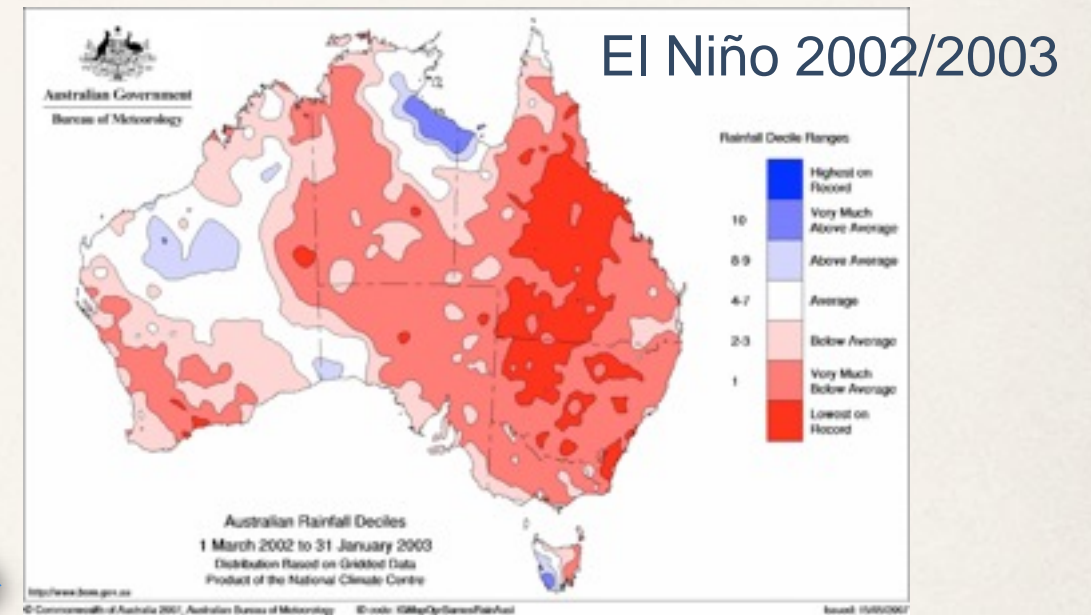
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month JAN Average of 1979--2008



We know this well in Australia:

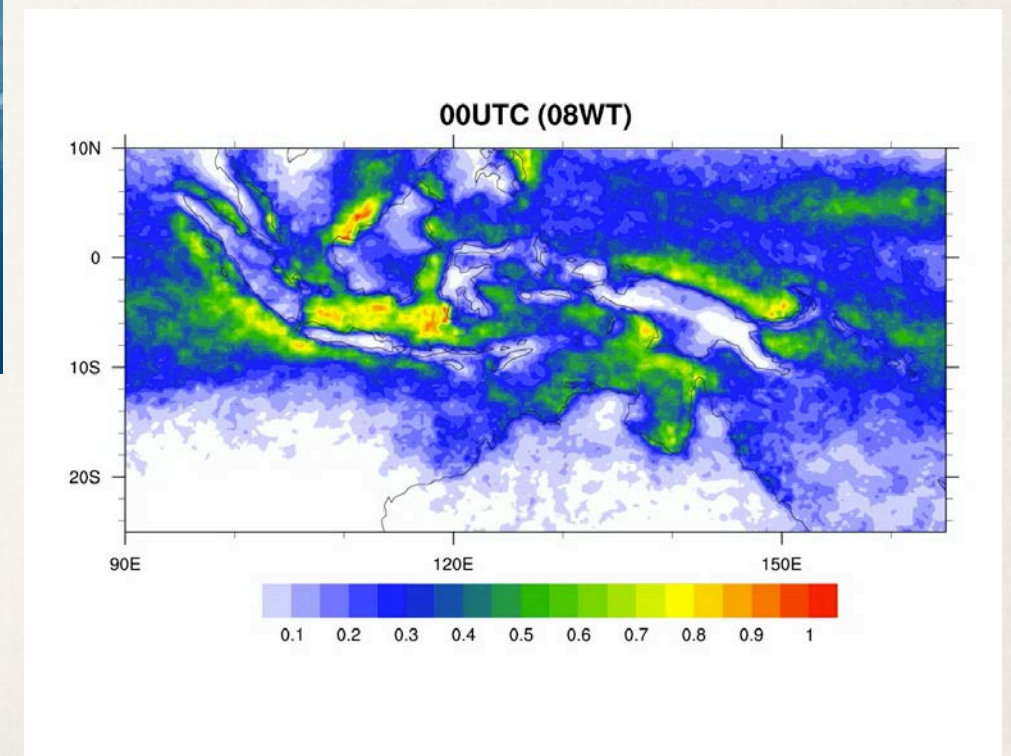
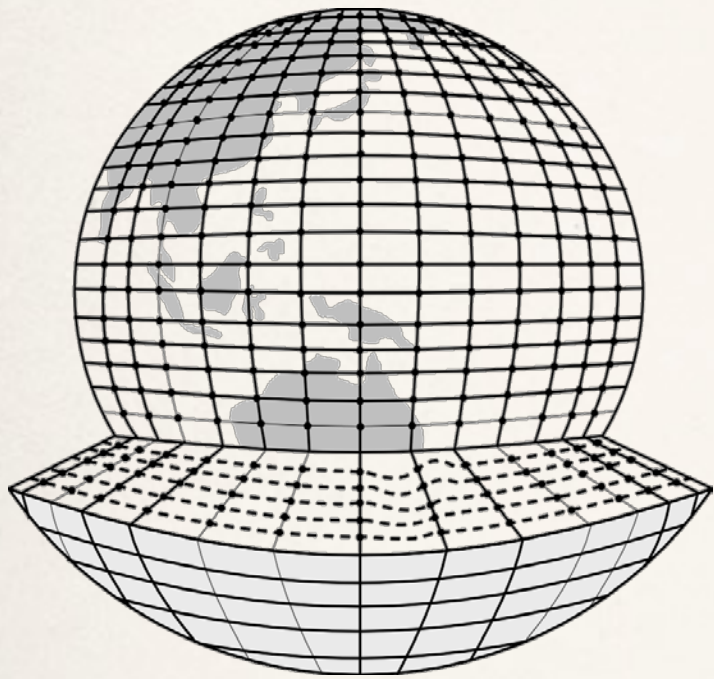


El Niño schematic



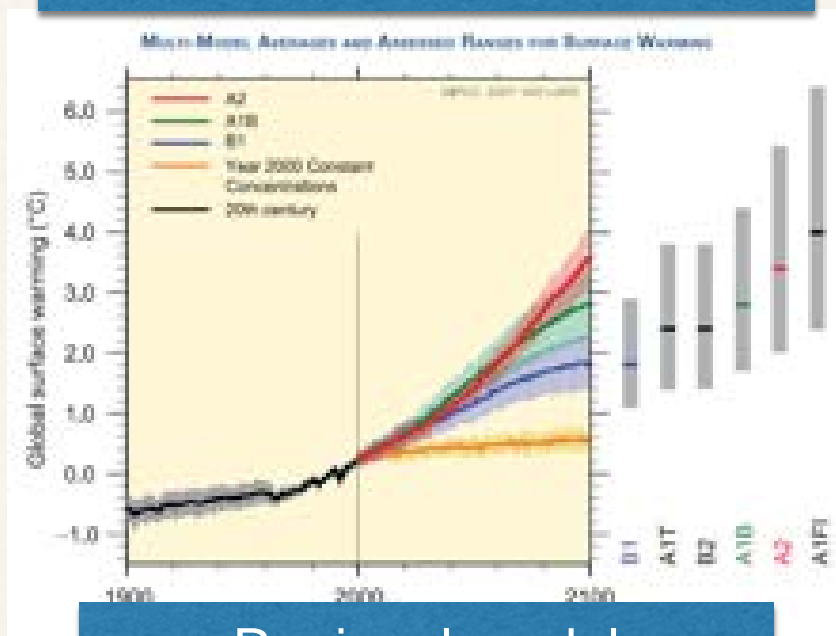
Rainfall in Australia

Precipitation is so difficult to model because it involves small-scale processes



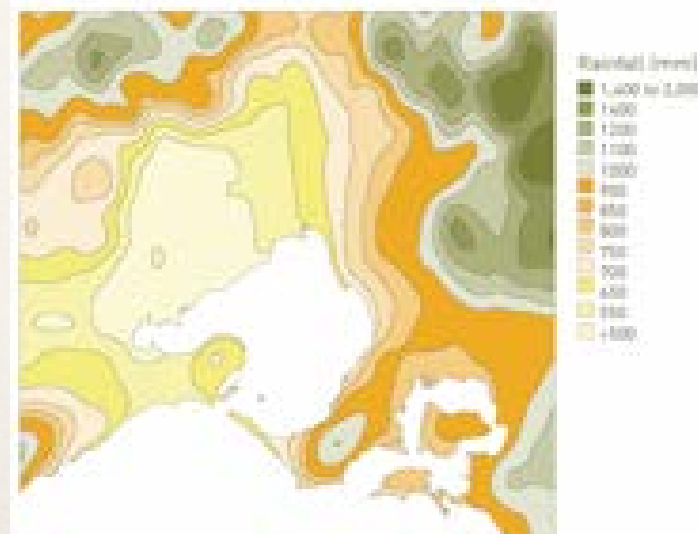
As a result we need to deal with at least 4 sources of uncertainty:

Climate scenario
uncertainty

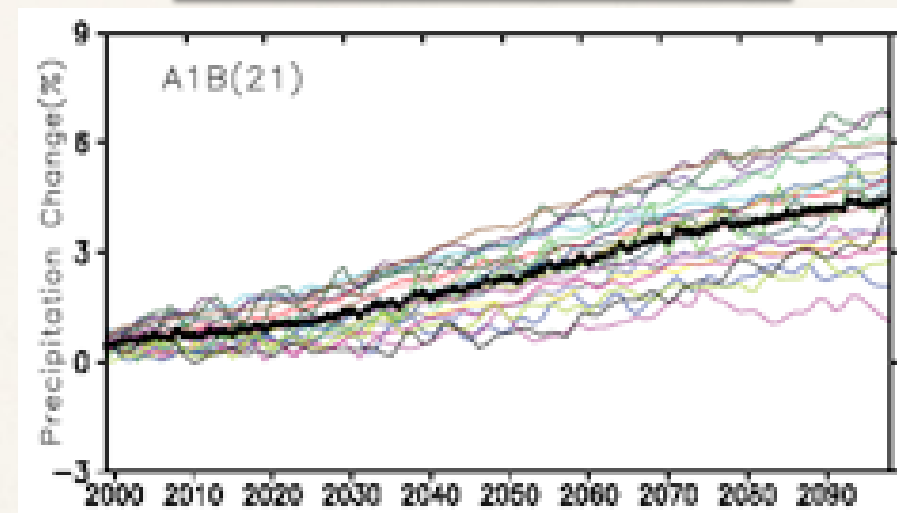


Regional model
uncertainty

Average annual rainfall
Melbourne, 2004



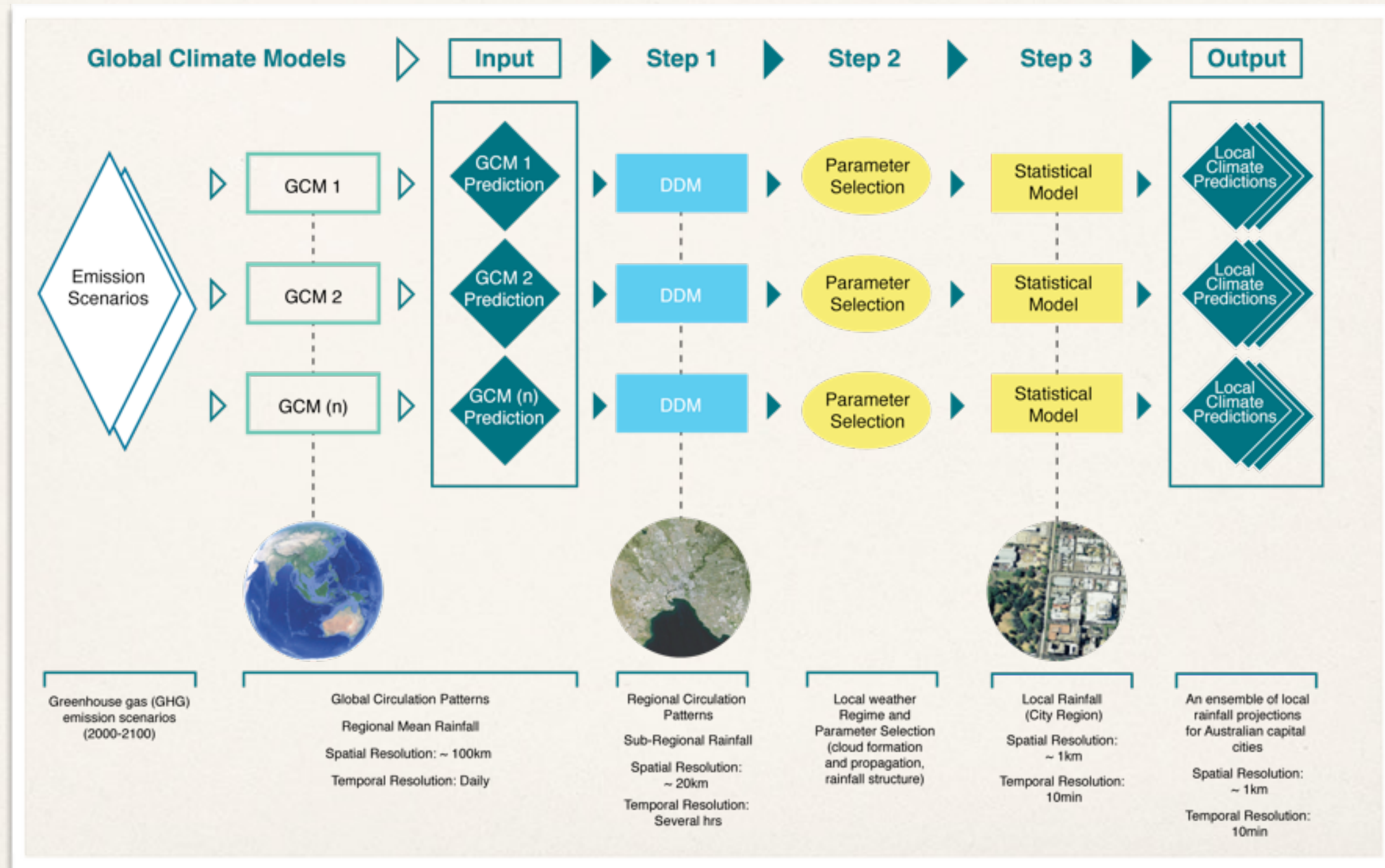
Global model
uncertainty



Unpredictable
scales

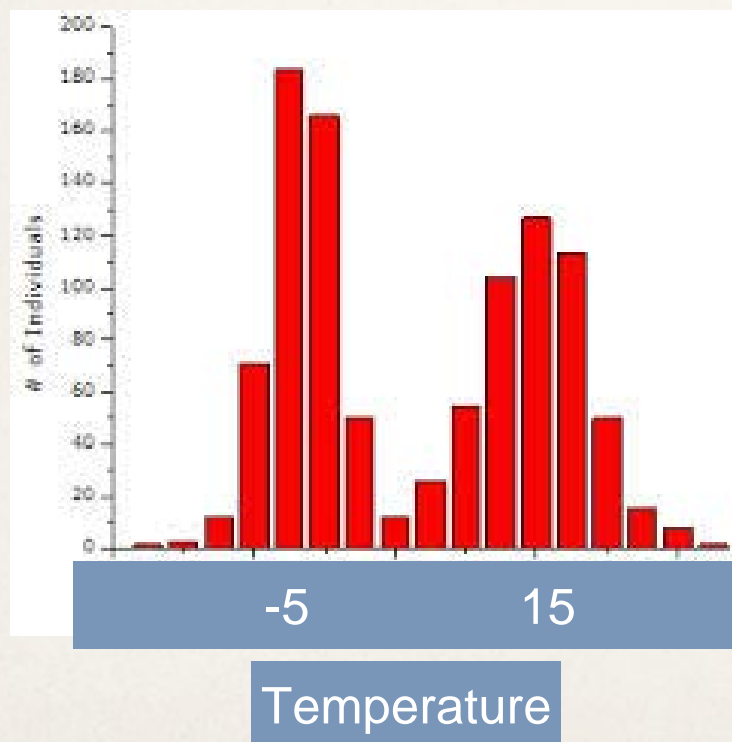


In the absence of “perfect” information, each prediction must come with a prediction of its uncertainty



The CRC for Water Sensitive Cities rainfall scenario model

Why is uncertainty your friend? - Resilience vs. decisions based on poor information



Summary

- ❖ Uncertainty information is good for you. Demand it and embrace it.
- ❖ Locally, climate change will manifest itself as a change in the weather.
- ❖ Rainfall changes at local and regional scale are amongst the most difficult changes to predict and we do understand why. Don't let climate scientists get away with giving you easy answers, because those don't exist.