Assessing Uncertainty in Regional Scale Climate Variability And Change: And Some Consequences

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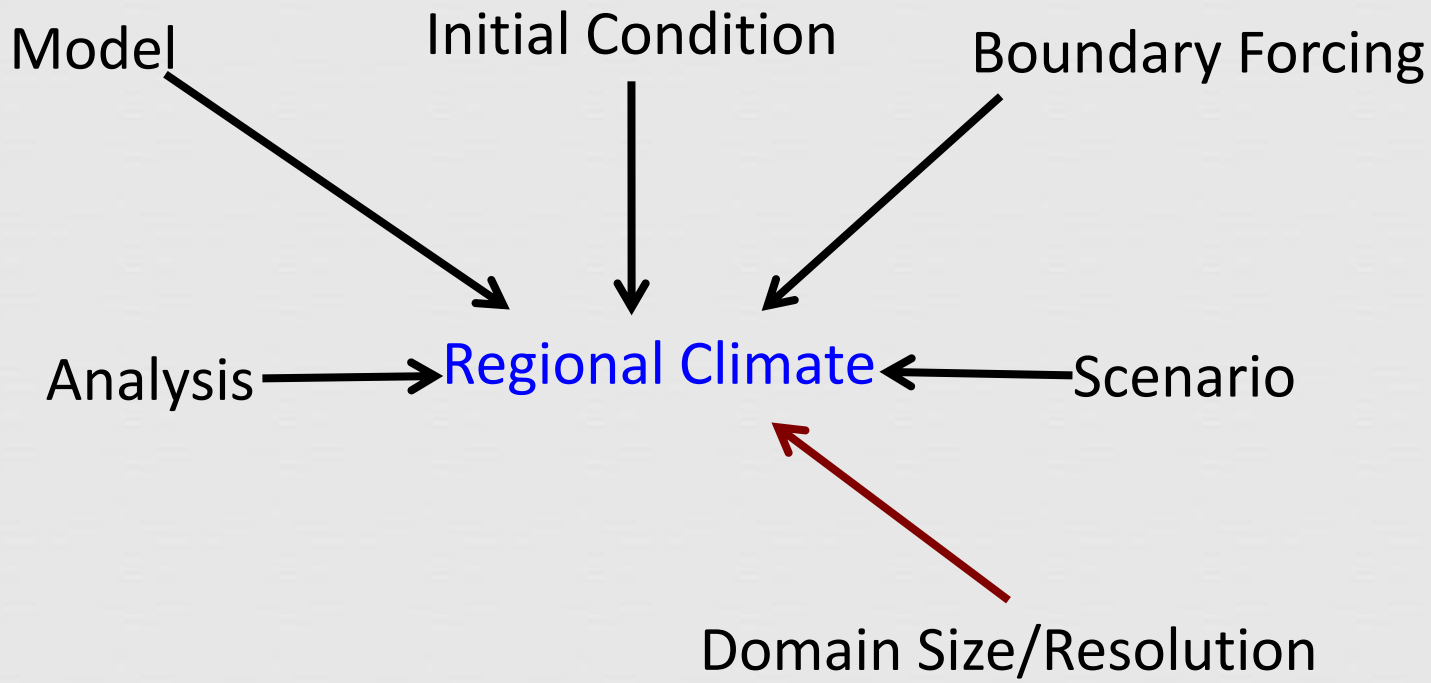
Summary

- Sources of Regional Climate Uncertainty
- Assessing Uncertainty and its Consequences

Sources of Uncertainty

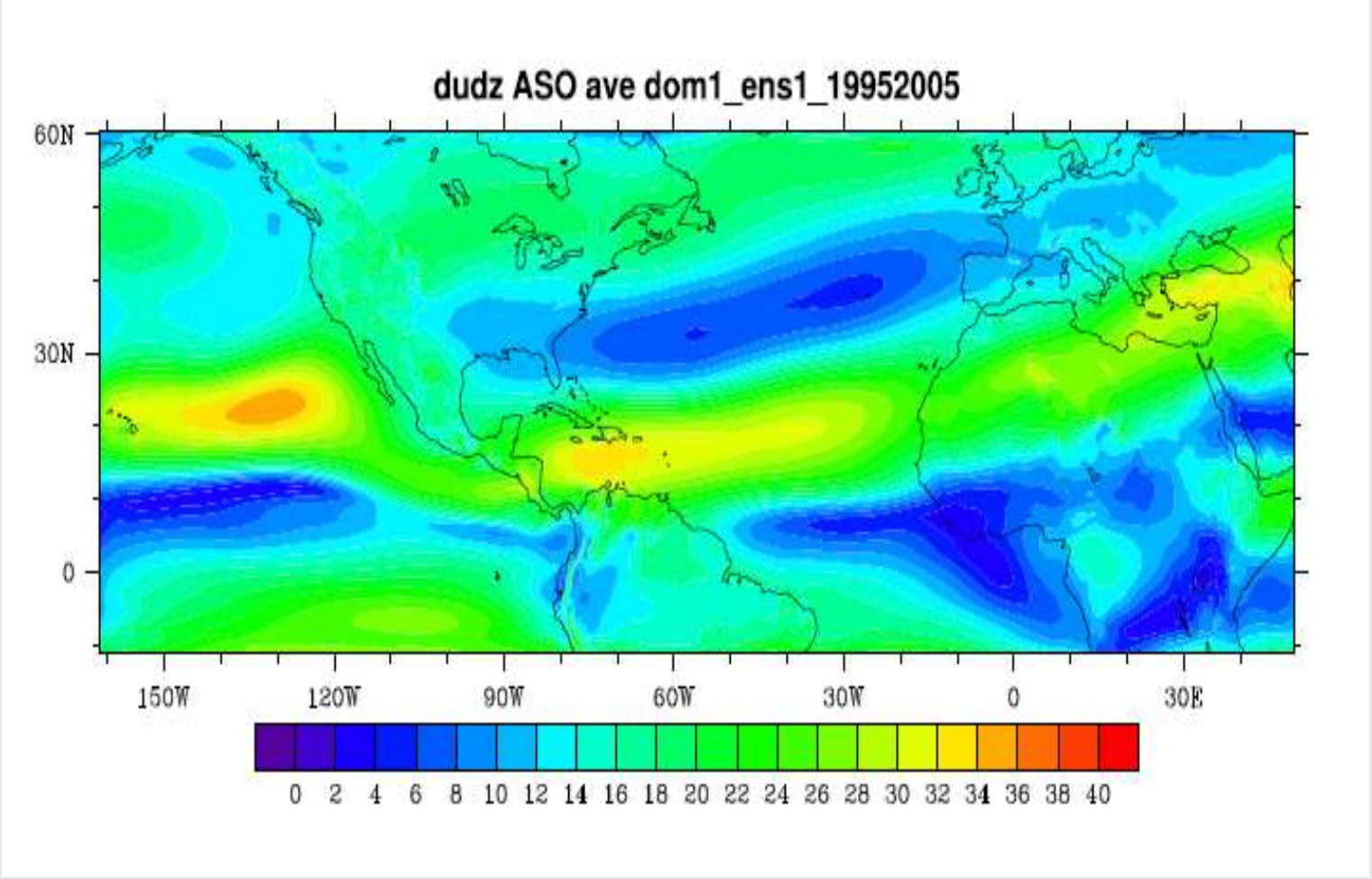


Boundary Forcing: Bias Correction

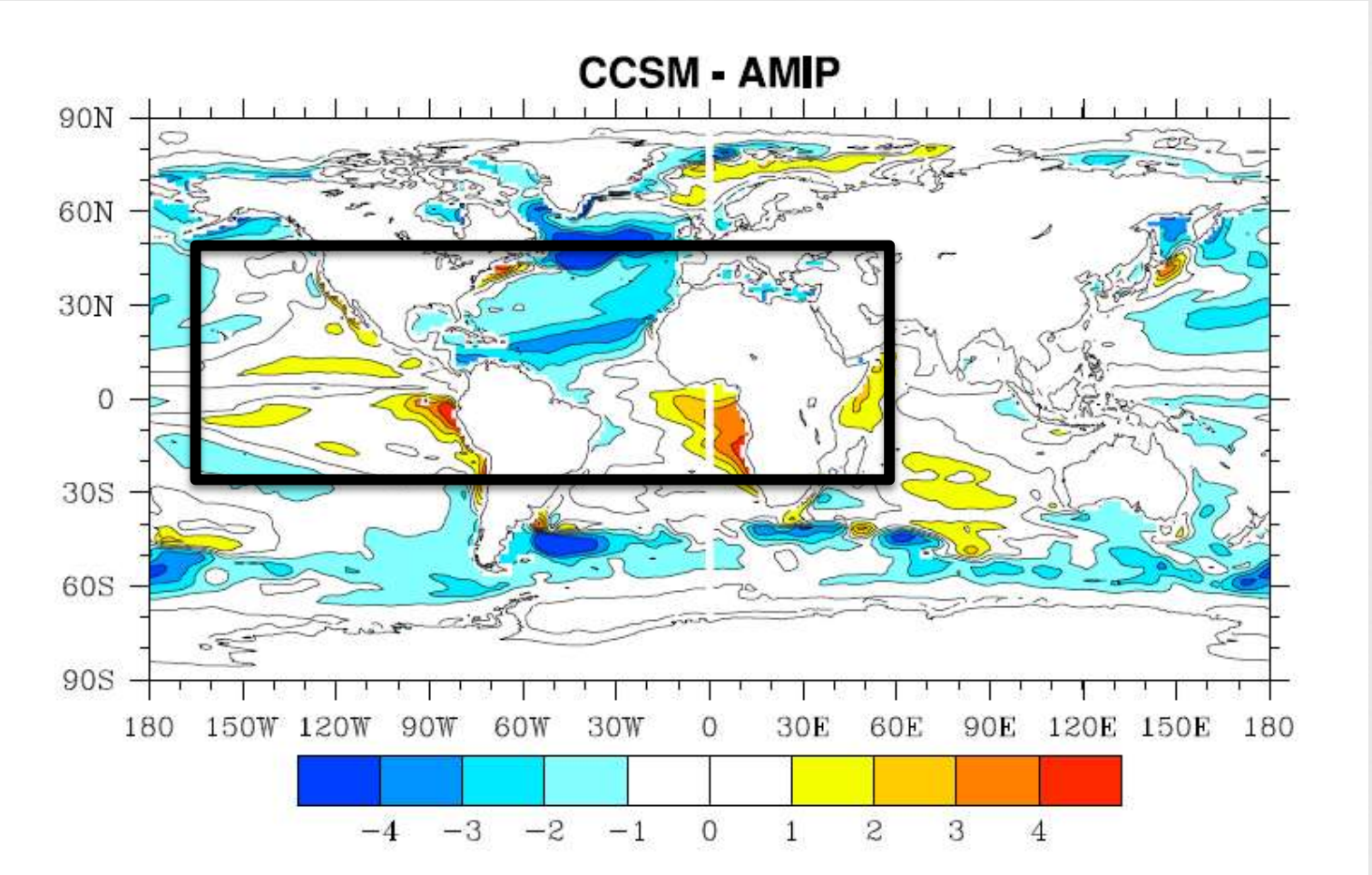
Approaches:

- *Adjust RCM data after simulation*
- *Correct bias in GCM boundary conditions driving the RCM*
- *Adjust the size of the RCM domain.*

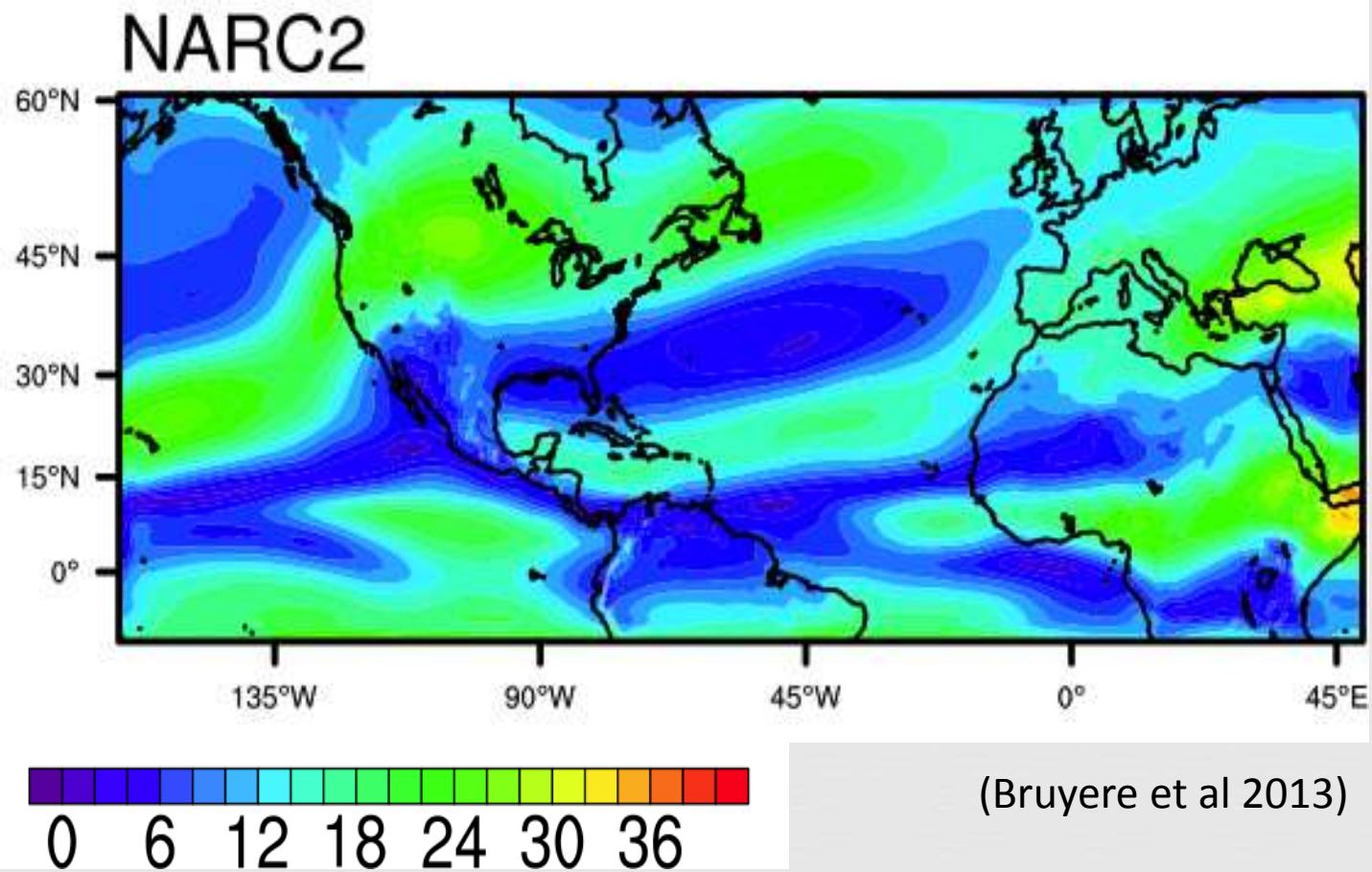
Example Impact of GCM Bias



Removing GCM Bias

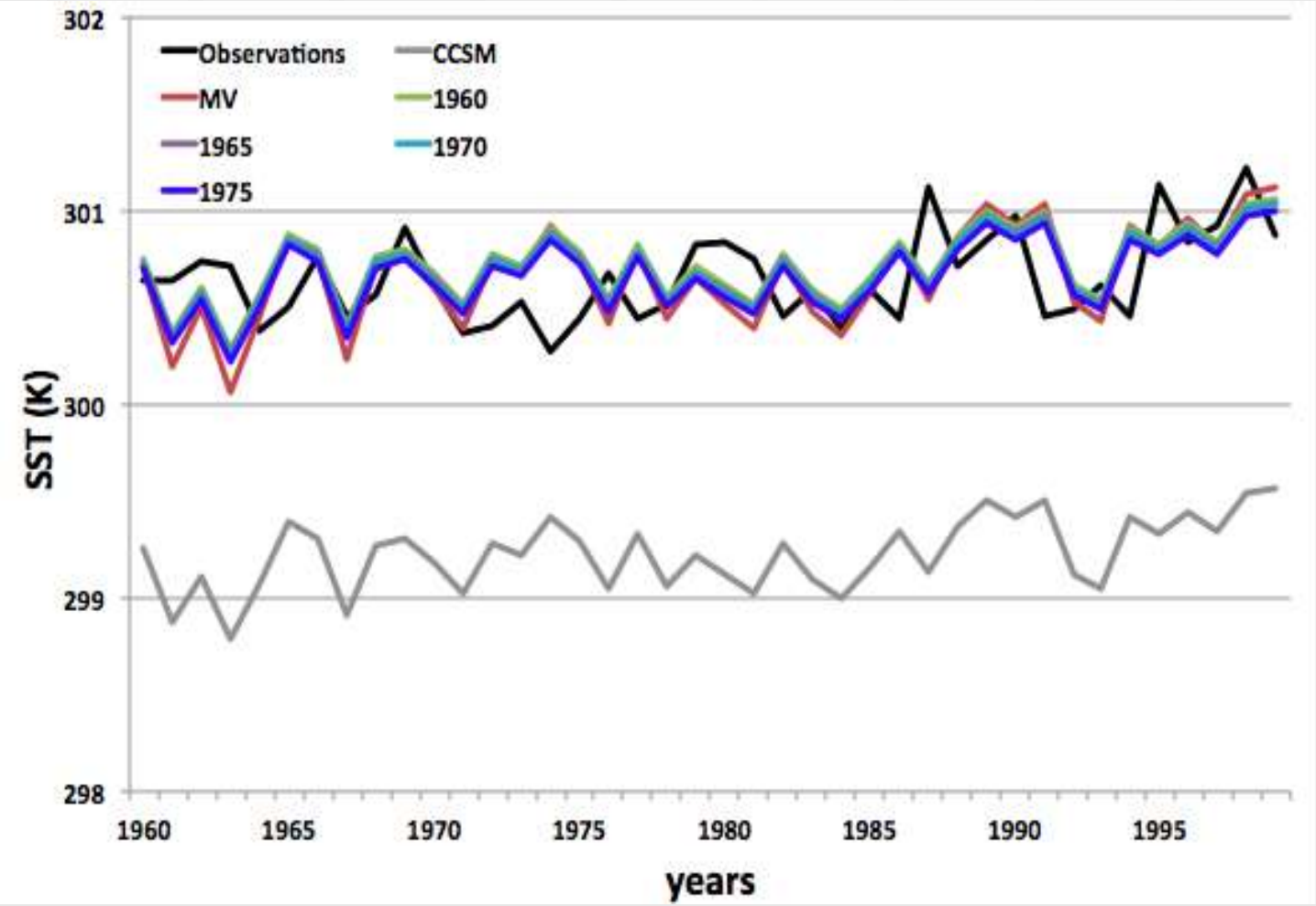


After GCM Bias Correction at RCM Boundaries



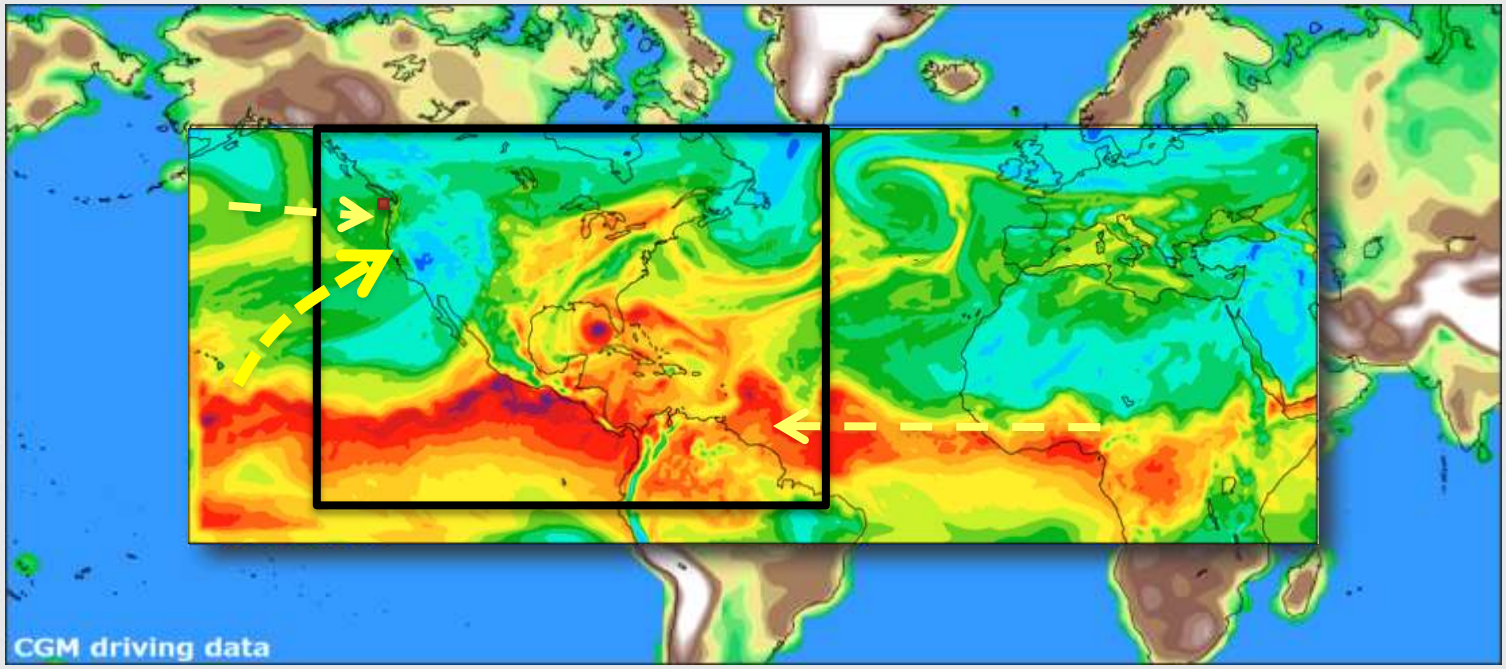
(Bruyere et al 2013)

Bias Removal Signal Constancy



(Bruyere et al 2013)

Domain Size/Resolution

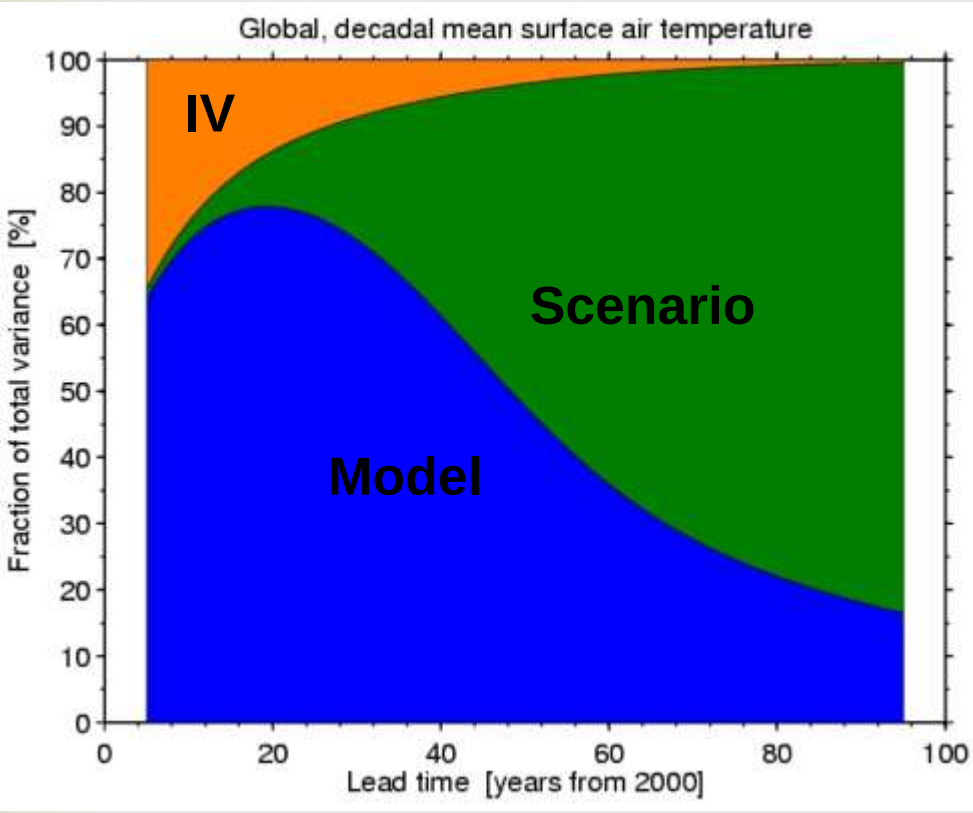


For Hurricanes

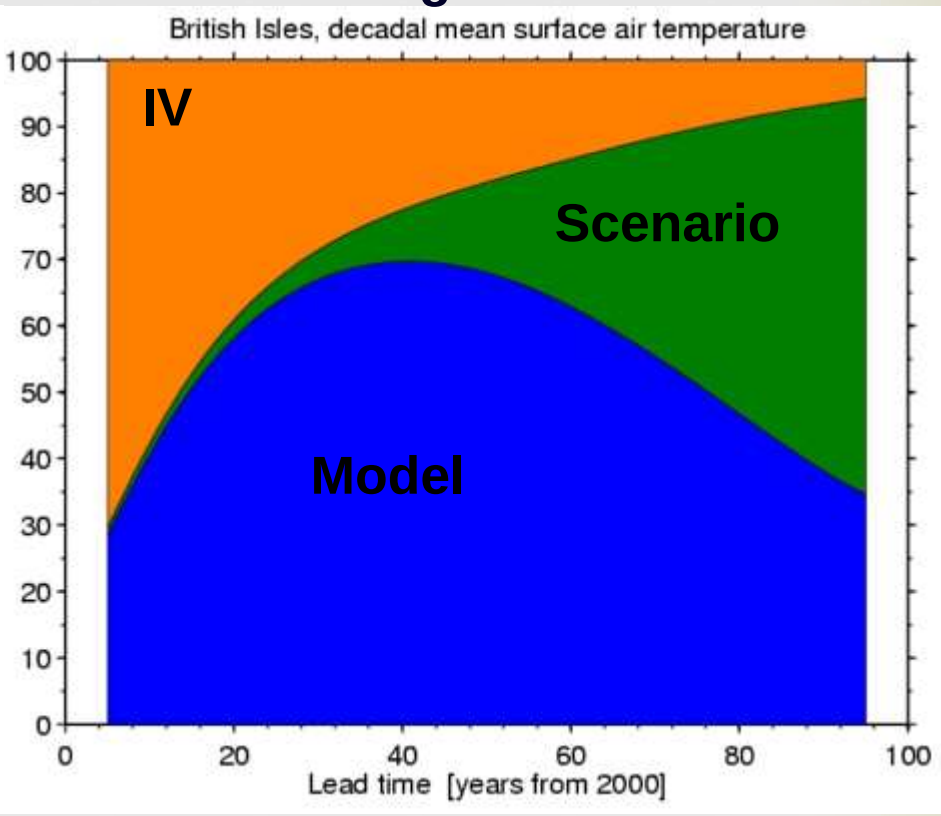
- 36km resolution is sufficient to capture main features
- 12 km resolution provides better results, 4km better again
- 15-20 km with hybrid statistical component may be optimal.

Impact of Scale

Global

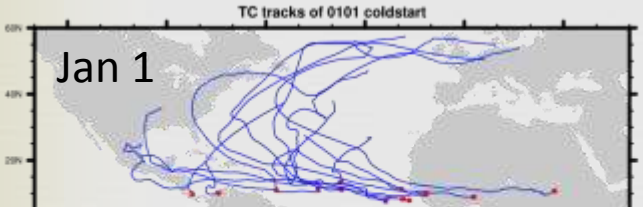


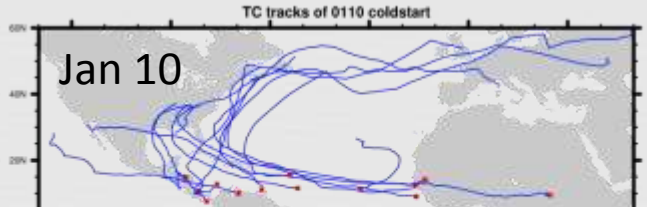
Regional

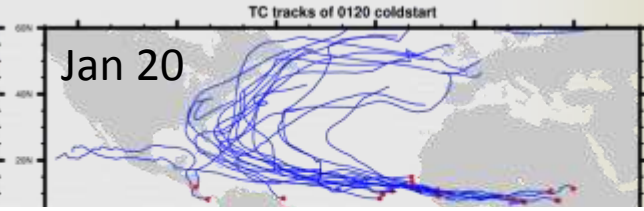


(Hawkins and Sutton 2009)

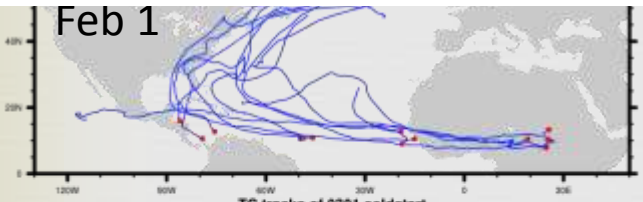
Initial Condition Impact on Simulated Tropical Cyclones

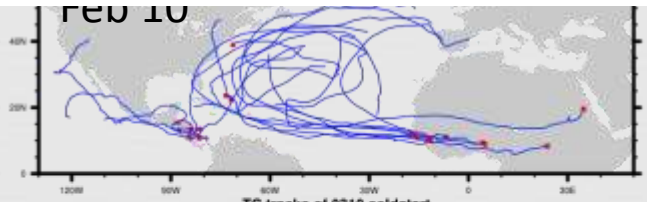


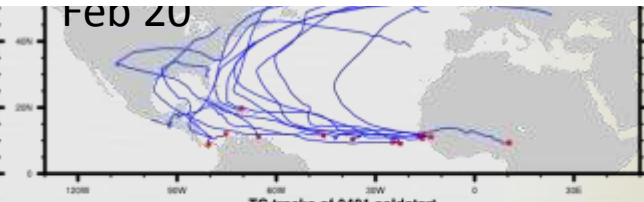


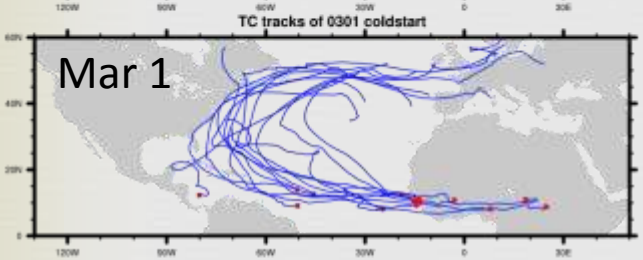


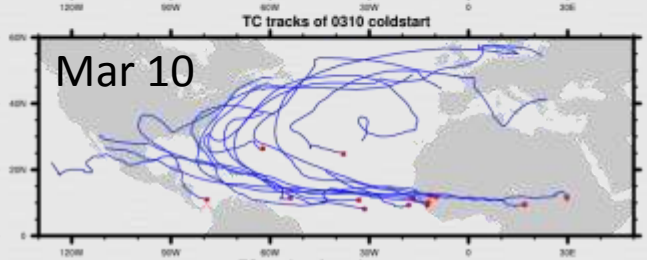
Range in number of tropical cyclones: 13 – 20

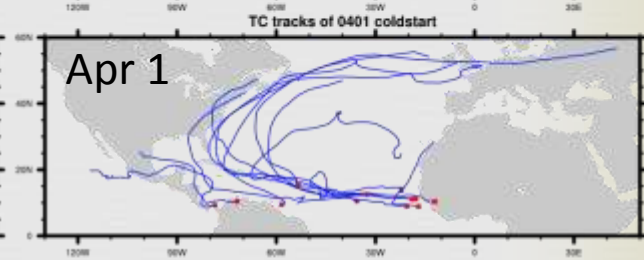


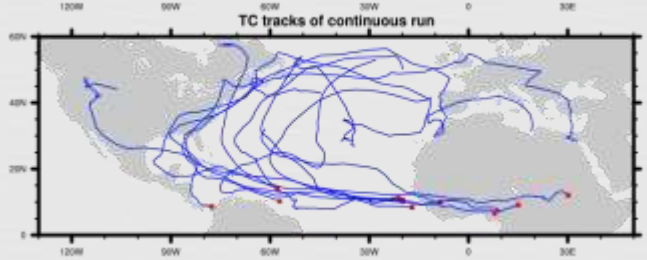








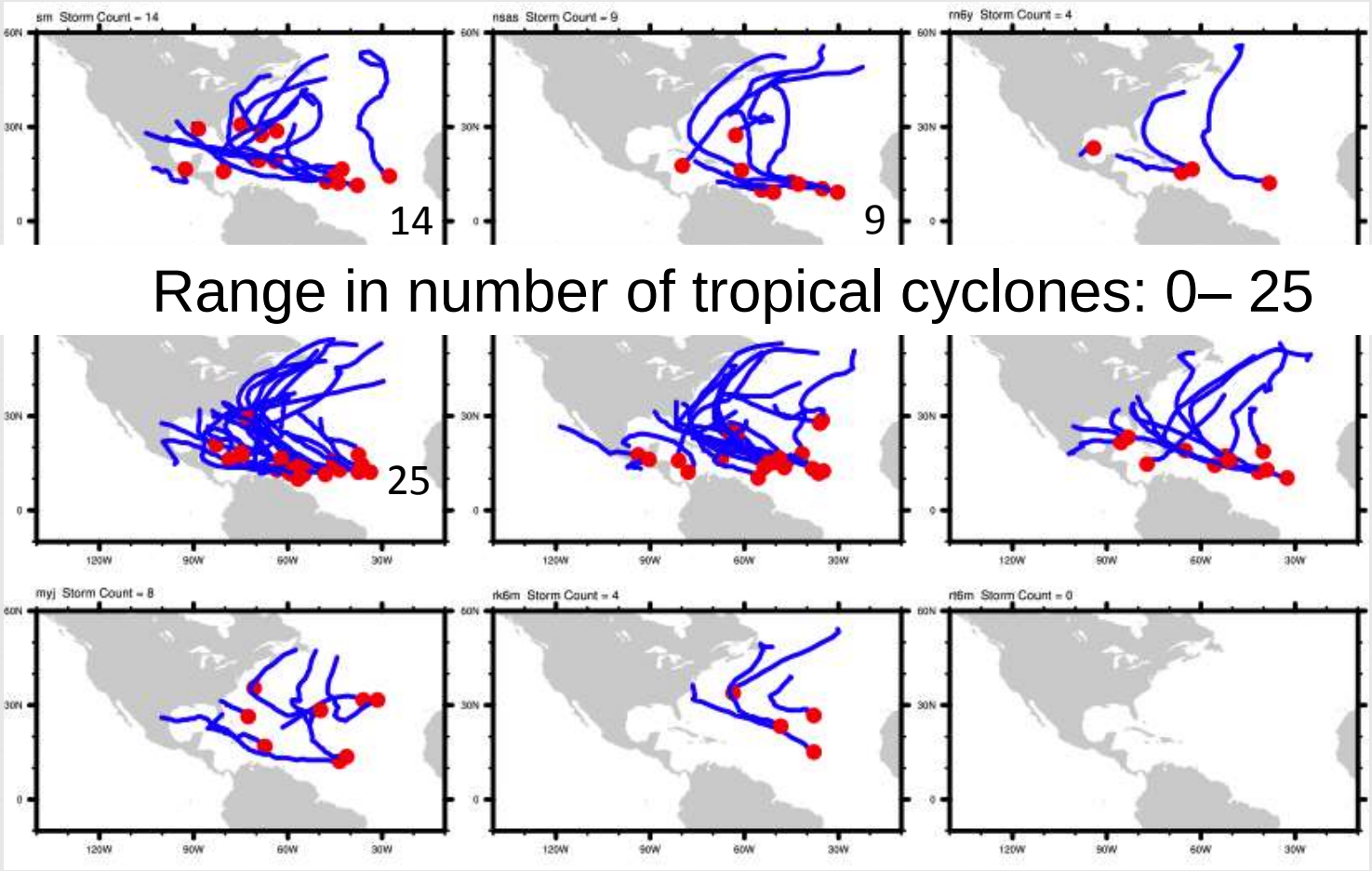




Continuous Climate Run

(Done et al 2013)

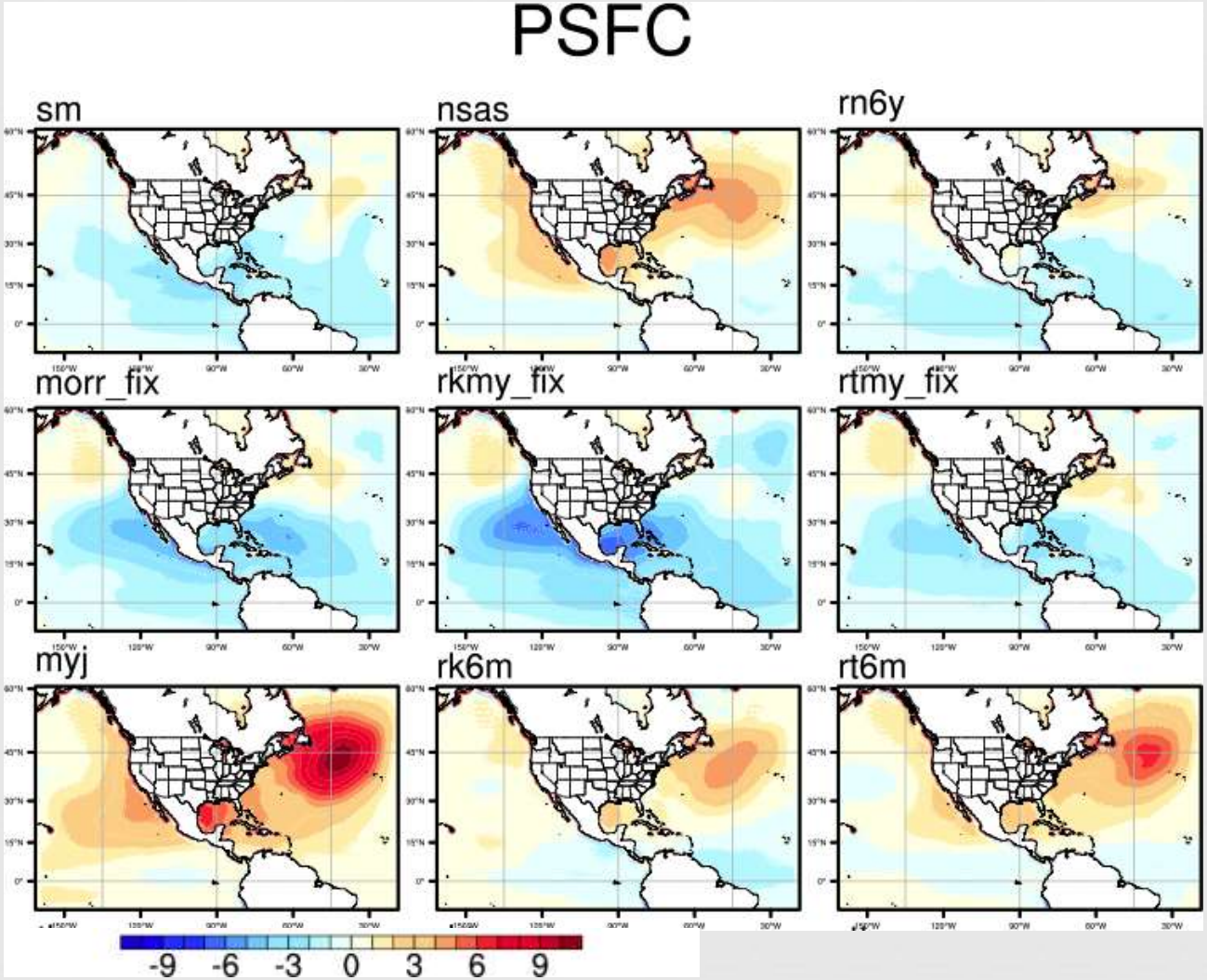
Uncertainty from Model Physics



Range in number of tropical cyclones: 0– 25

(Bruyere et al 2013)

Uncertainty from Model Physics



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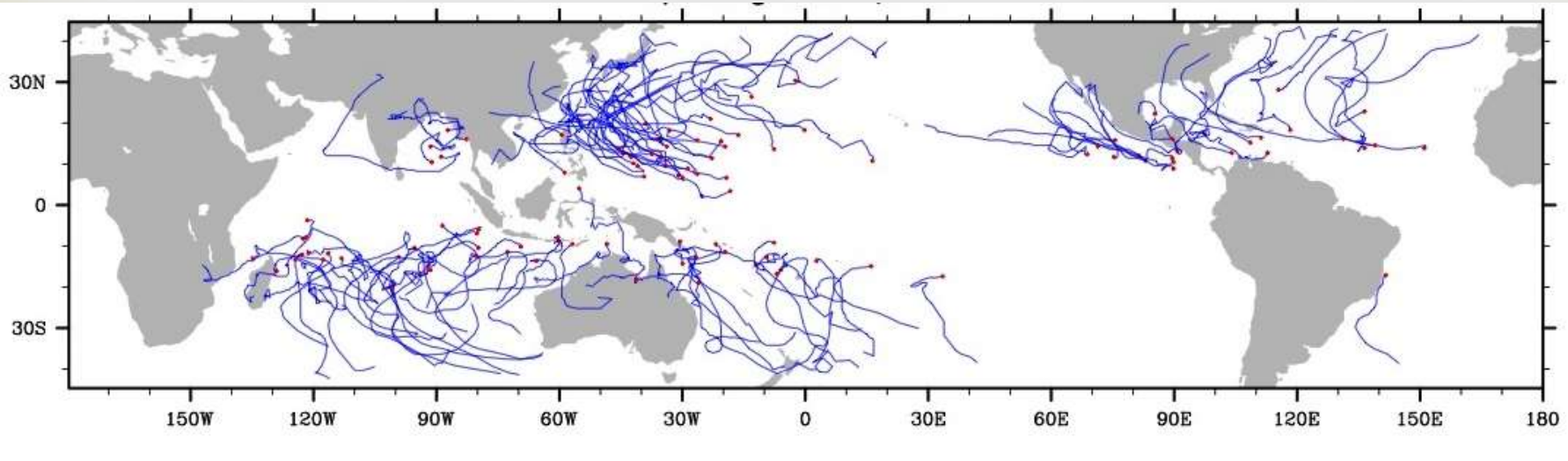
(Bruyere and Jaye 2013)

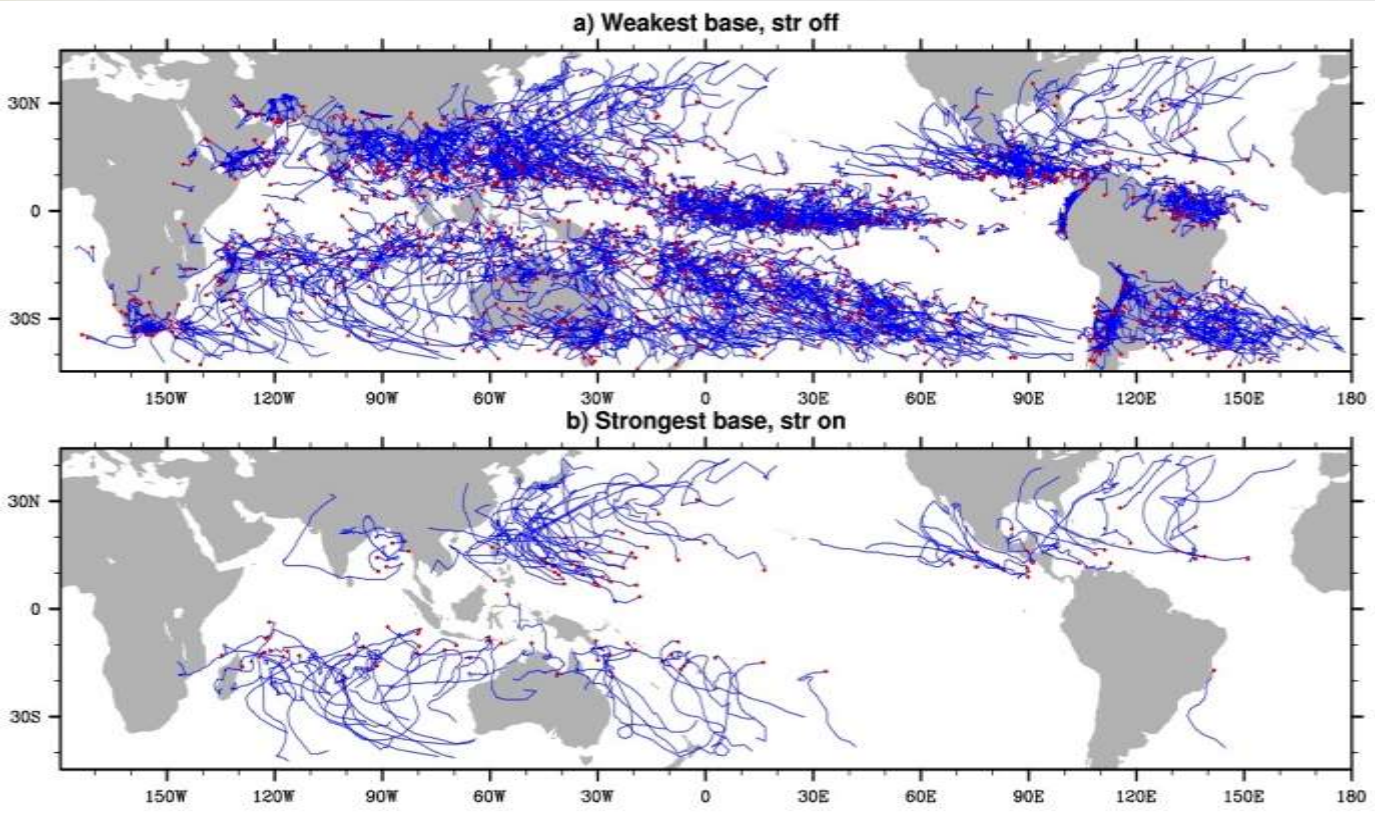
Analysis Uncertainty

One year of simulated tropical cyclones with NRCM at 36 km resolution, Analysis Boundaries



(Suzuki-Parker 2012)

Analysis Uncertainty

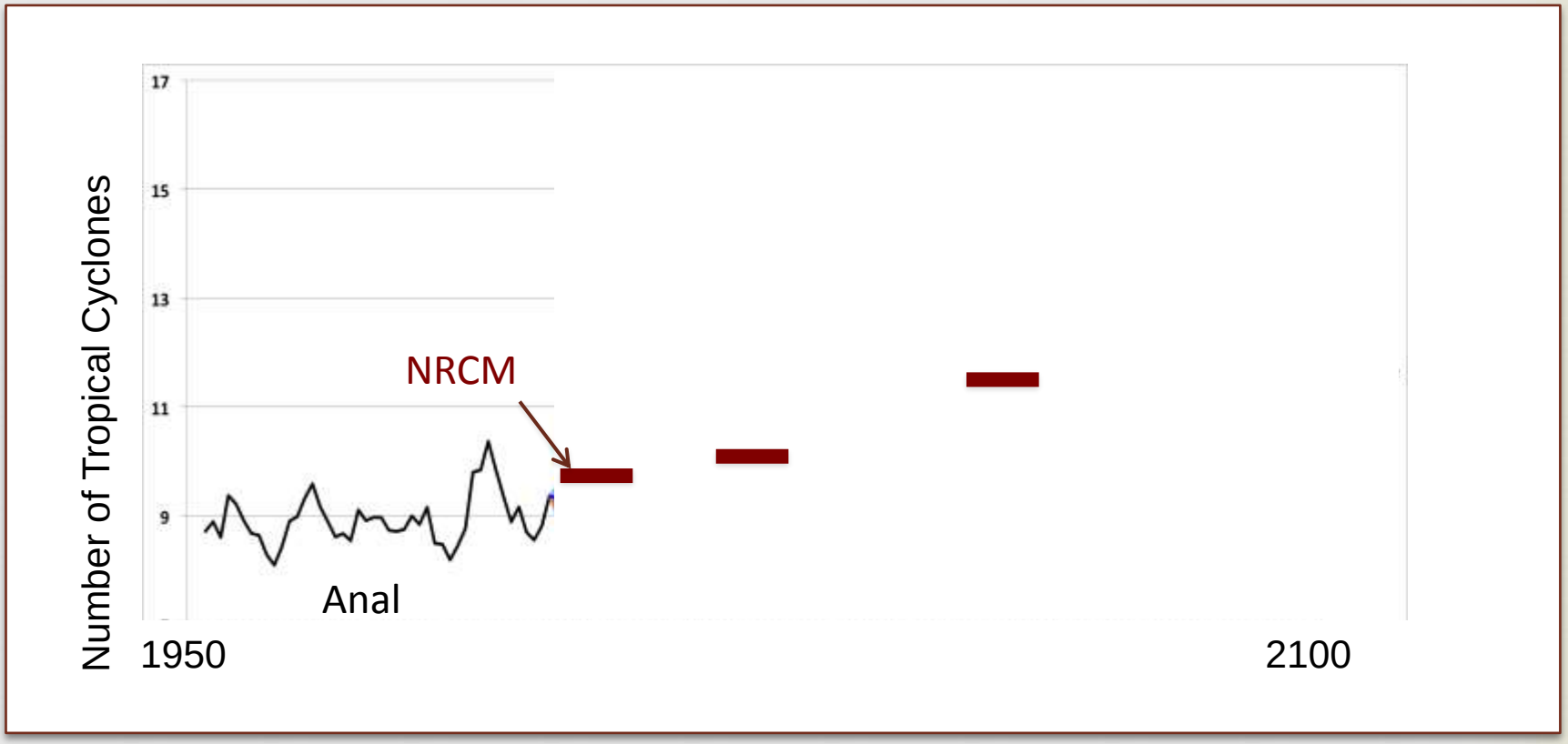


Relaxed Tracking Criteria
1468 tracks/yr

Strict Tracking Criteria
106 tracks/yr

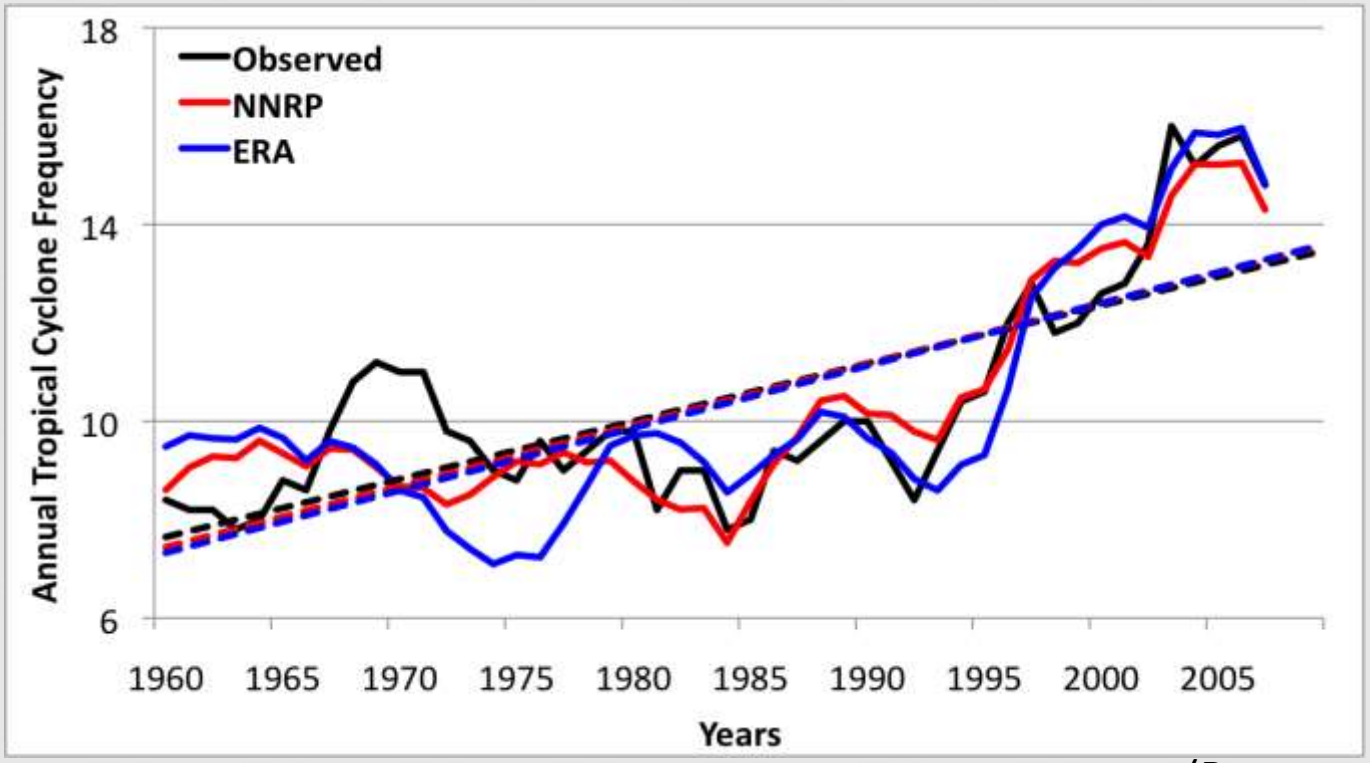
(Suzuki-Parker 2012)

Assessing Uncertainty Statistically



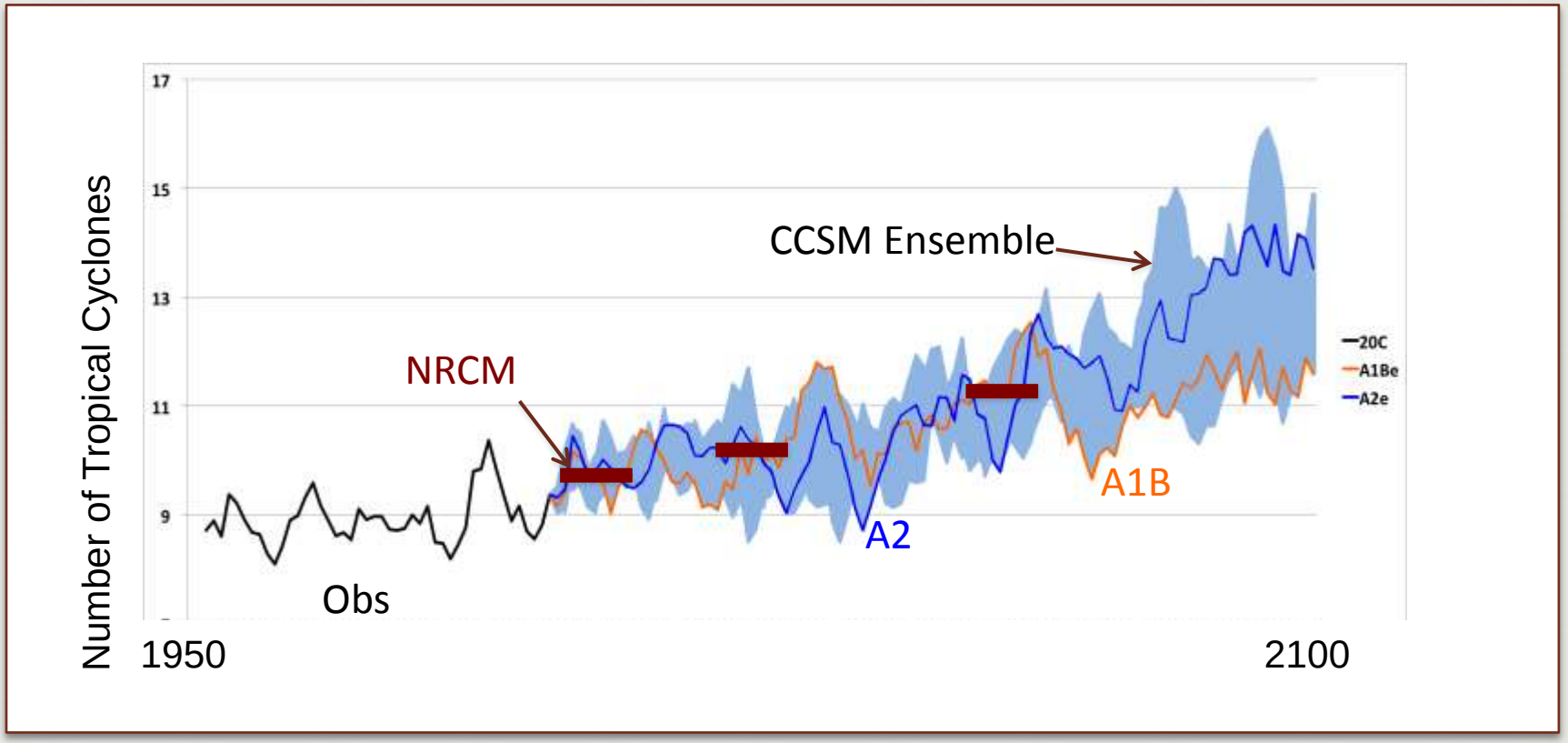
Use the Cyclone Genesis Index

$$CGI = \left(\frac{PI}{70}\right)^3 \left(1 + 0.1(V_{shear} + a)\right)^{-2}$$



(Bruyere et al 2012)

Climate Application



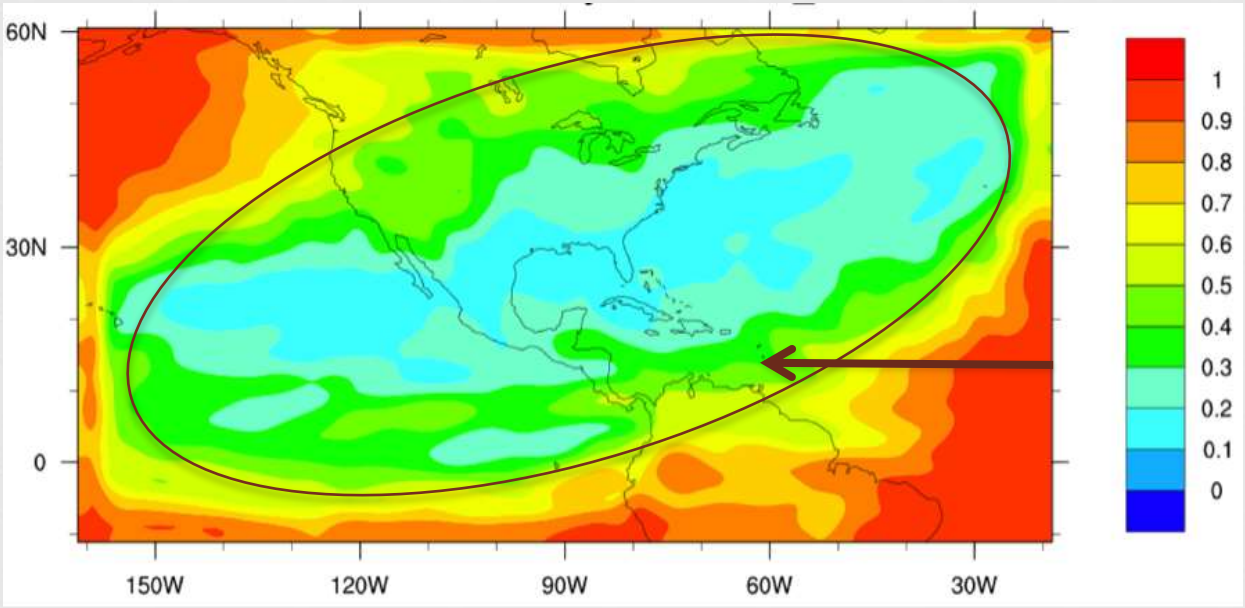
Understanding Uncertainty Variations: Simulated vs Real

- African Easterly Waves provide the seed for many Atlantic tropical cyclones.
- Vertical windshear is an important daily modulator
- Their phasing may be important.

- How well does the NRCM ensembles reproduce the statistics of these? And is there a relationship to errors?

Easterly Wave Uncertainty

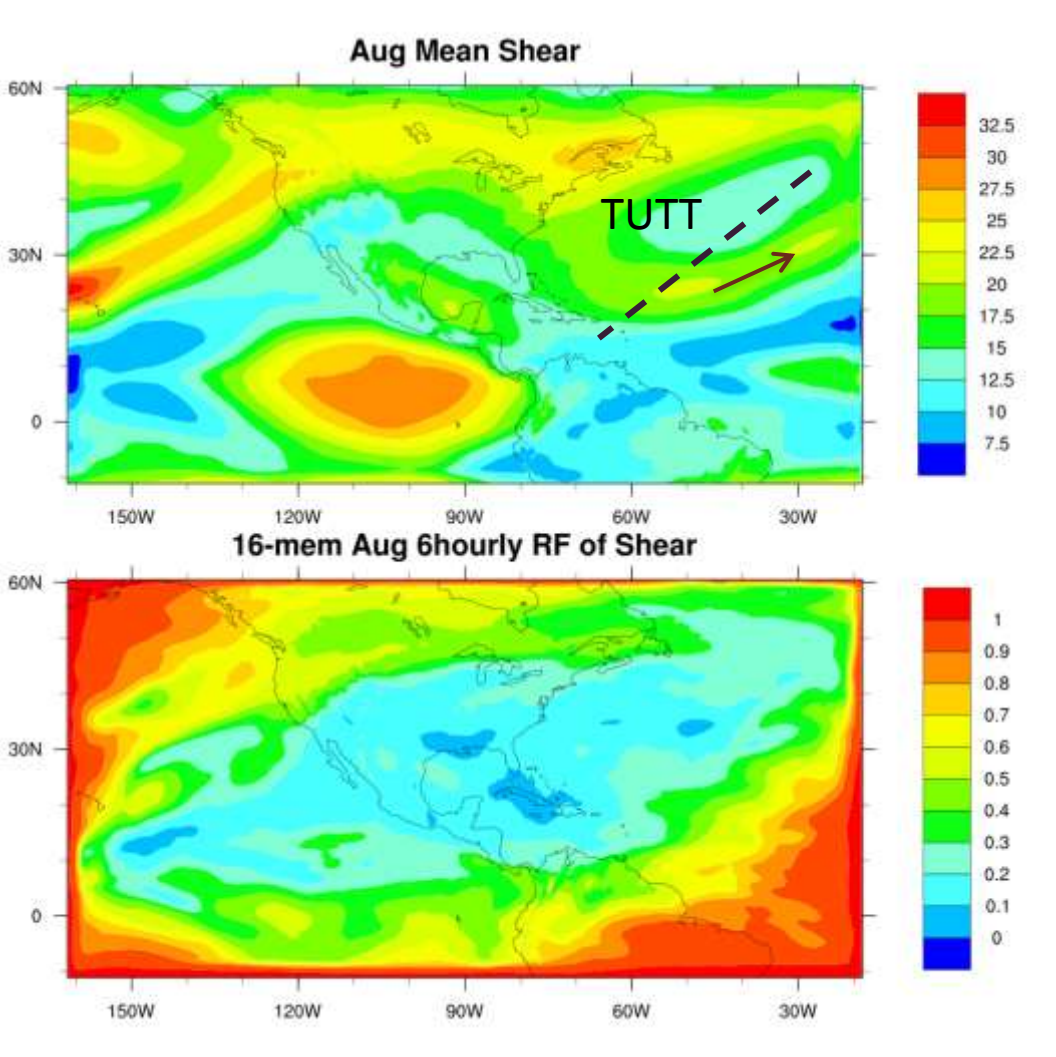
Fraction of day-to-day variability of 700hPa vorticity in phase between the 18 ensemble members.



Easterly wave uncertainty increases east to west

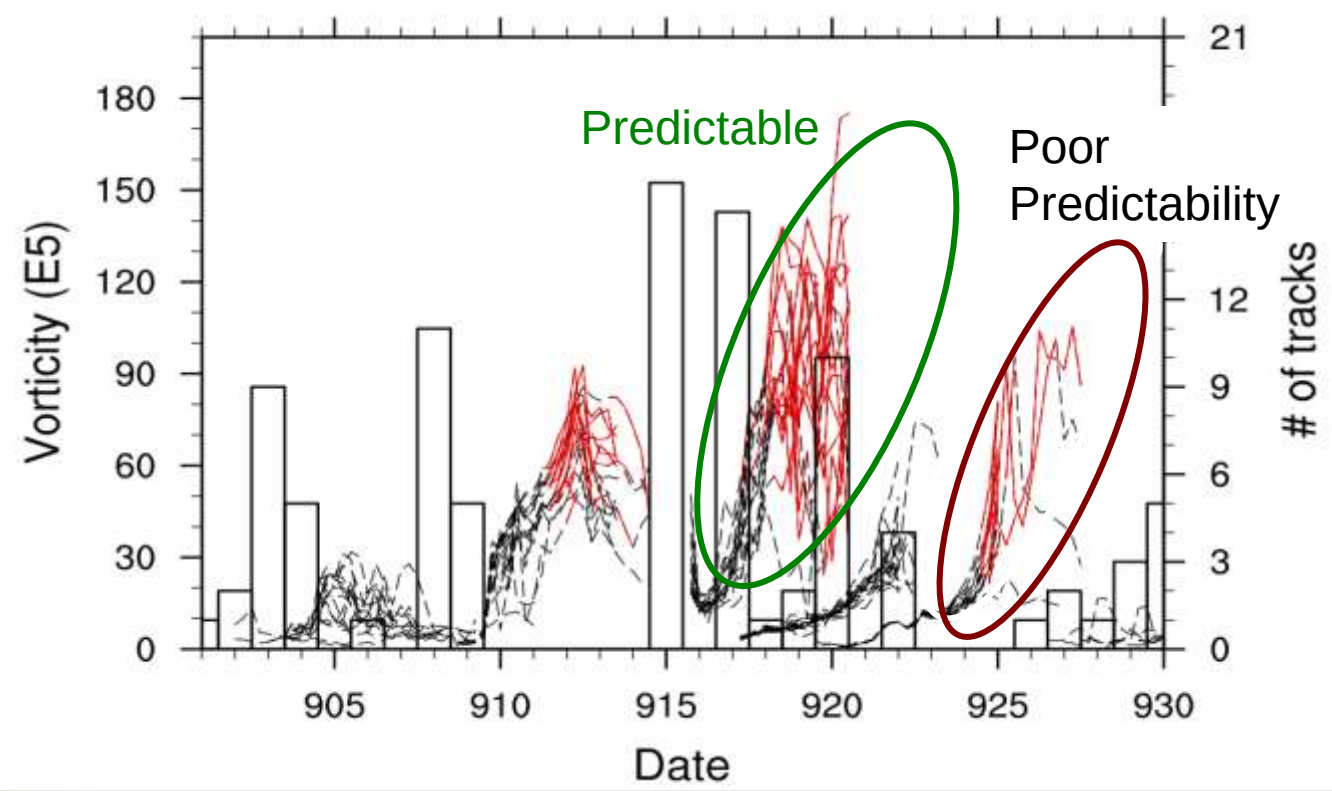
Likely source: stochastic convective systems coupled to the waves (Holland 1995)

Vertical Windshear Uncertainty



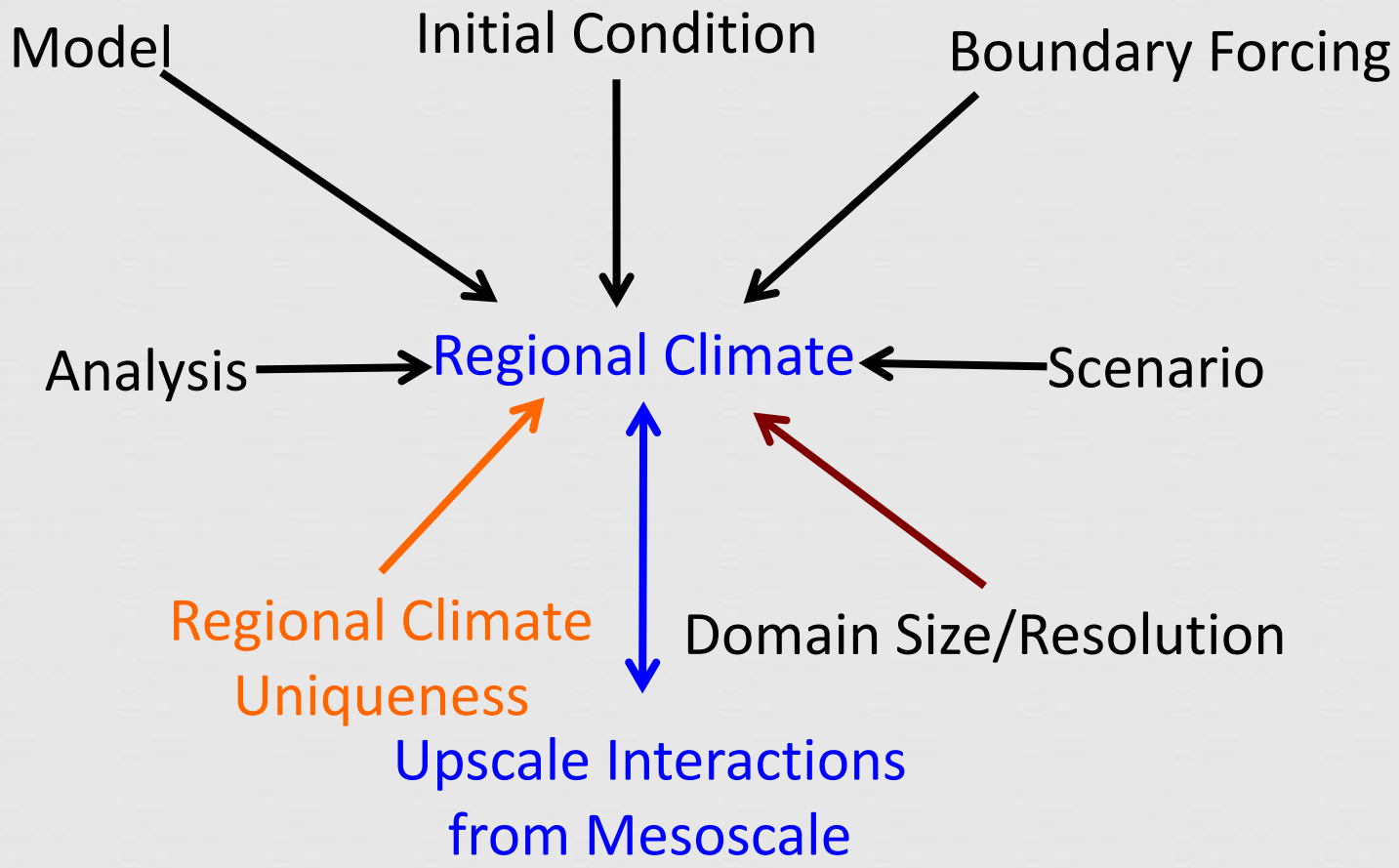
Influence of Environmental Uncertainty

Ensemble total number of tracks forming each day east of 30° W and vorticity-time trajectories over 5 days for September (red=TC).



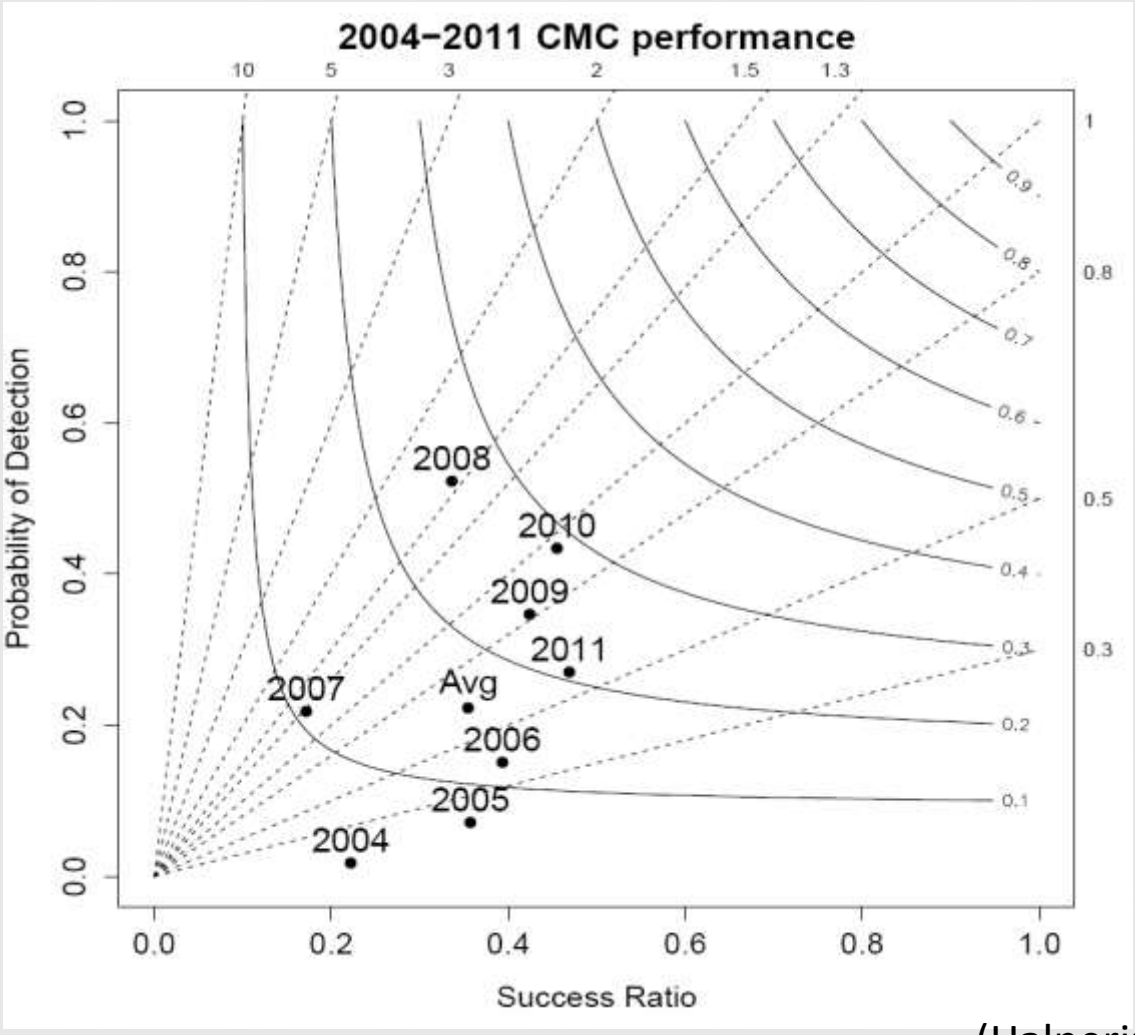
Possible influence of large-scale drivers?

Sources of Uncertainty



All RCM Data are freely available for community use

Cyclone Genesis in Global Weather Models



(Halperin et al 2013)