

Estimation and Correction of Systematic Weather Model Error

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Sources of Numerical Forecast Error

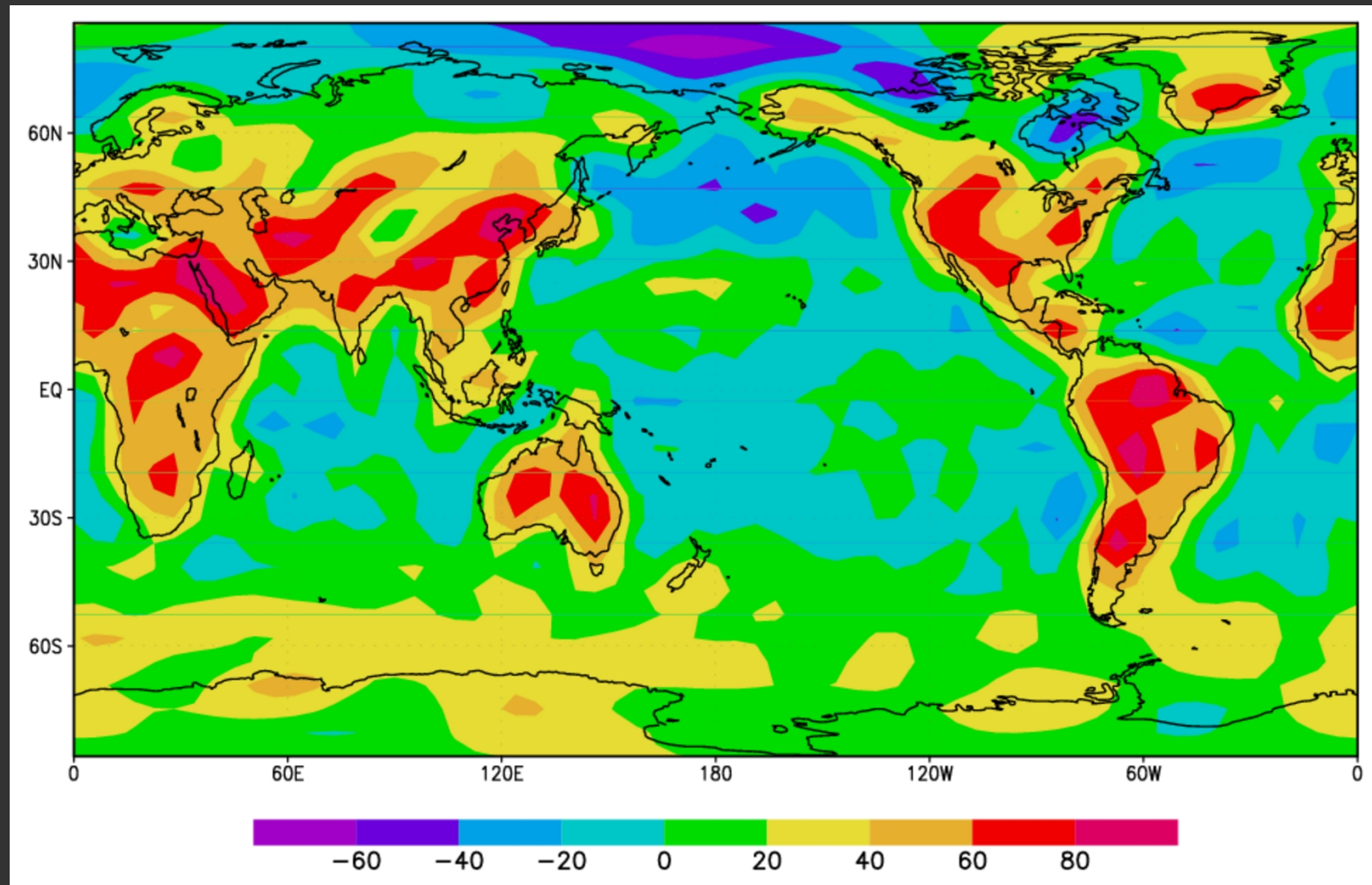
- *Displacement* error (standard chaos)
 - initial conditions are approximate
 - indistinguishable conditions of the atmosphere diverge
- *Model* error
 - inaccurate physical parameterizations and forcing
 - sub-grid scale phenomena

Model Error Experiment

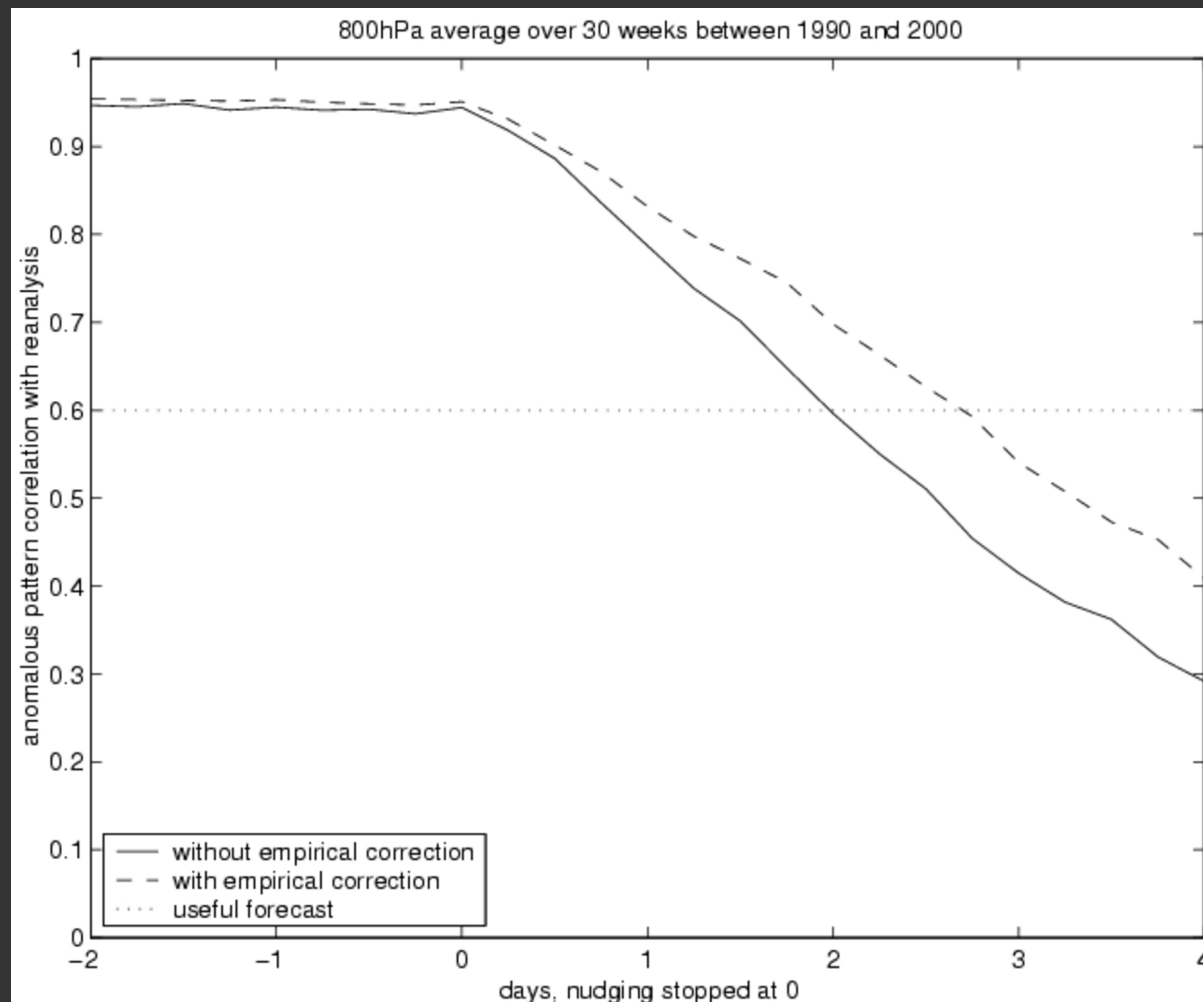
- Initialize model with observed global wind field on Jan 1, 2000
 - Integrate model for 6 hours
 - Compare forecast with reanalysis (observed 'truth')
 - Generate nudging term (synchronization)
 - Repeat
- Find time average model error correction
- Make zeroth order correction to forcing
- Does the forecast improve?

Nudging Movie

**Average vorticity ($\frac{10^{-6}}{s}$) correction term,
model error when relaxing towards 1980-1990 reanalysis**



Time series average PC of 30 model integrations (1990-2000) Model error correction extends forecast by 18 hours or 38%!



Conclusion

- Relaxation experiments provide an estimate of the systematic model error during the 1980s
- Correcting the model bias for the subsequent decade extends forecast accuracy substantially
- Next step: state-dependent correction