



# RECONSTRUCTION OF MODEL TIME EXTENDED ERROR MODES TO PREDICT AND SUBTRACT ERROR IN REAL TIME

PAUL E. ROUNDY

WILLIAM STIKELEATHER

# SYSTEMATIC ERROR IN NUMERICAL WEATHER PREDICTION

- Model error emerges from many causes
- Some model error is at least partially systematic
- Systematic error can include
  - Seasonally evolving mean state bias
  - Systematically evolving patterns of error

# SYSTEMATIC PATTERNS OF ERROR

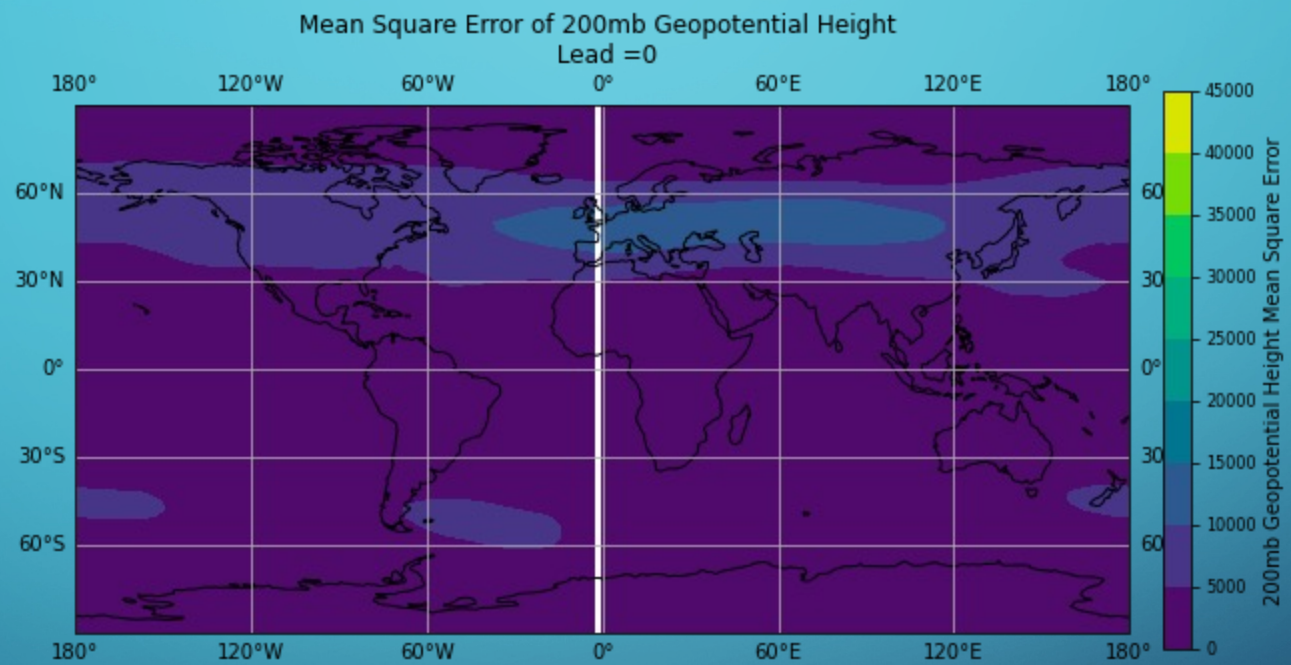
- These include
  - Erroneous evolution of the leading eigenmodes of the flow
  - Systematic changes in the eddies by the biased model mean states

# METHODS

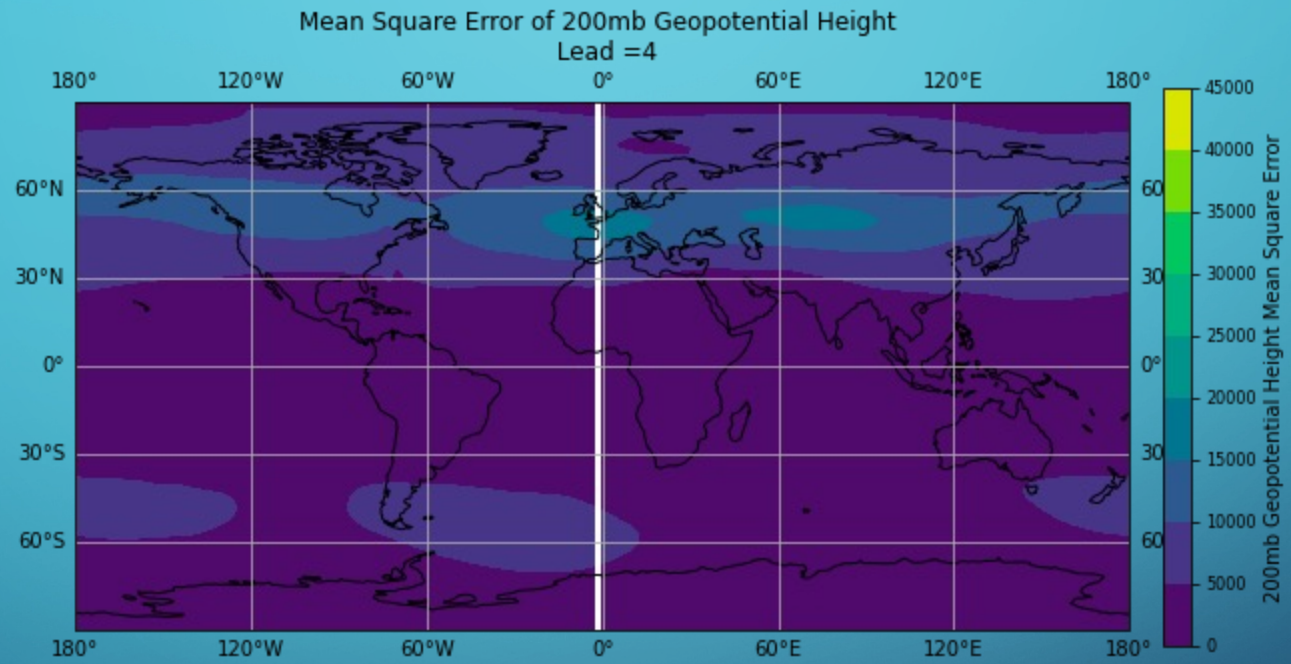
- Calculate and subtract seasonally evolving model bias
- Given the remaining model error, calculate its leading eigenvectors in space and time (Roundy 2012 QJRMS)
  - 1. Find leading spatial EOFs of error.
  - 2. Create the corresponding principle components
  - 3. Create a time extended matrix of those PCs
  - 4. Find their leading EOFs.

# METHODS

- Can be applied to any model variable. Herein we use 200 hPa geopotential height



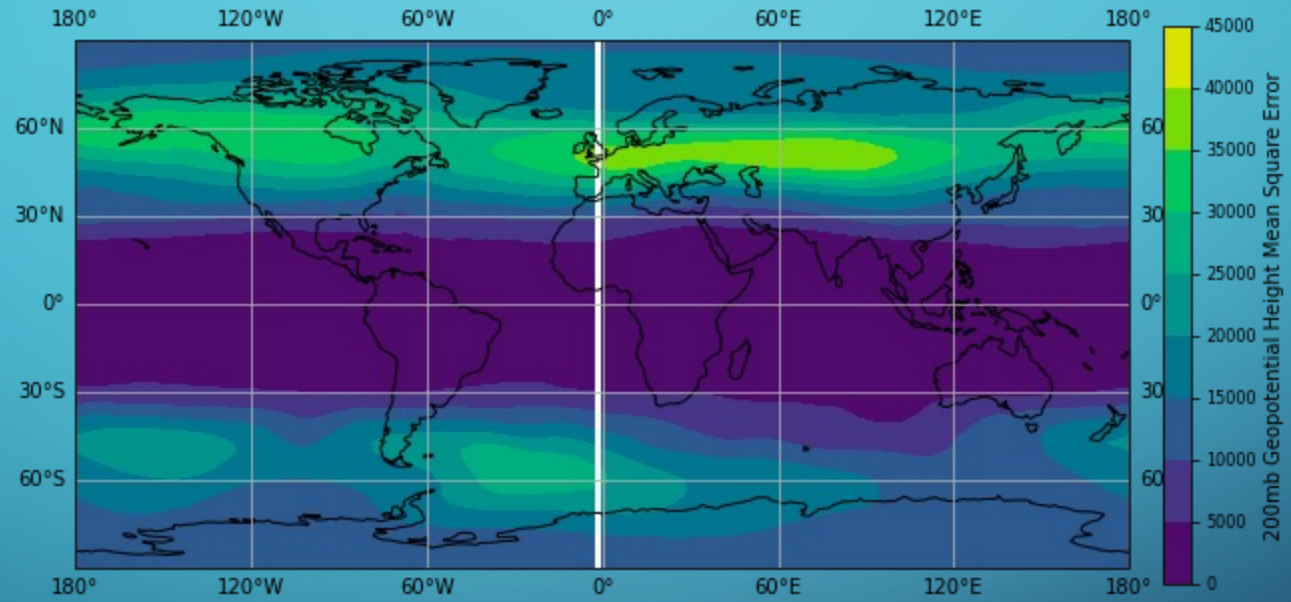






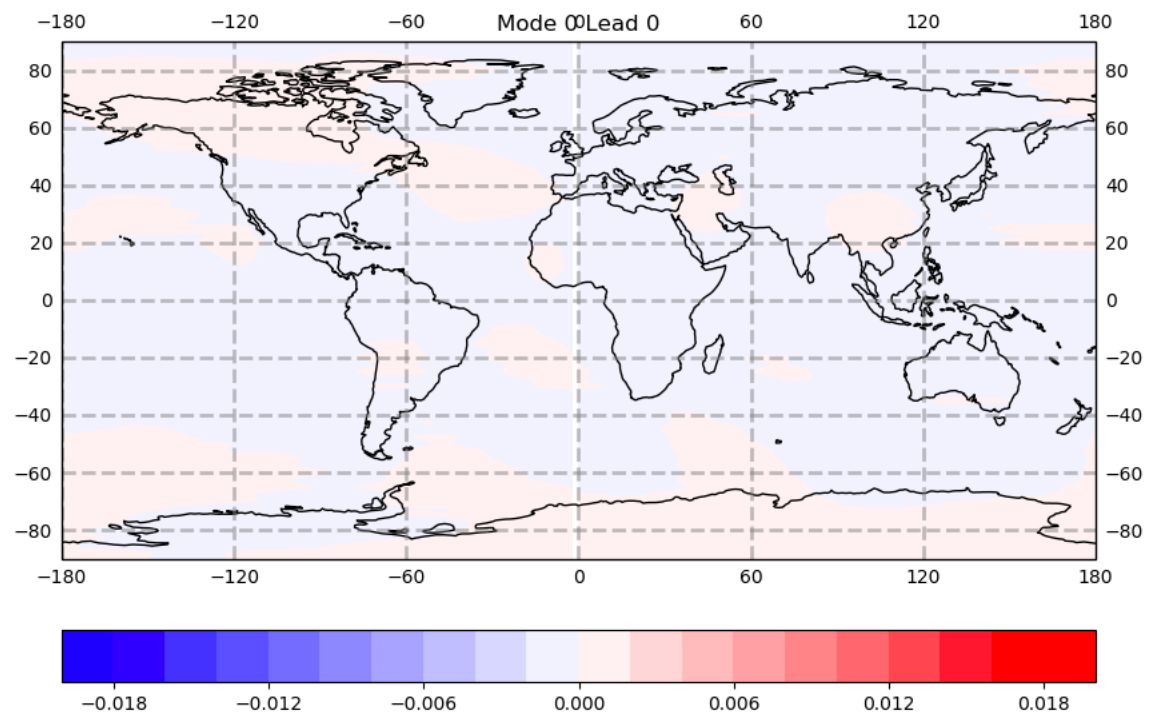


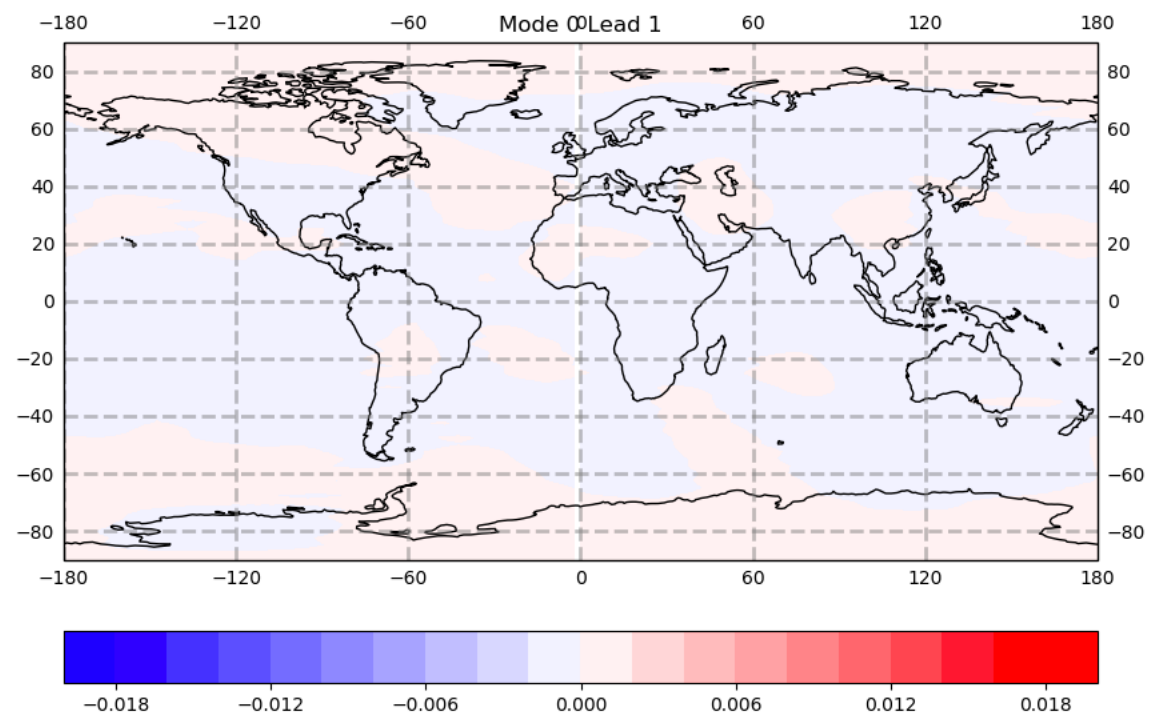
Mean Square Error of 200mb Geopotential Height  
Lead = 8

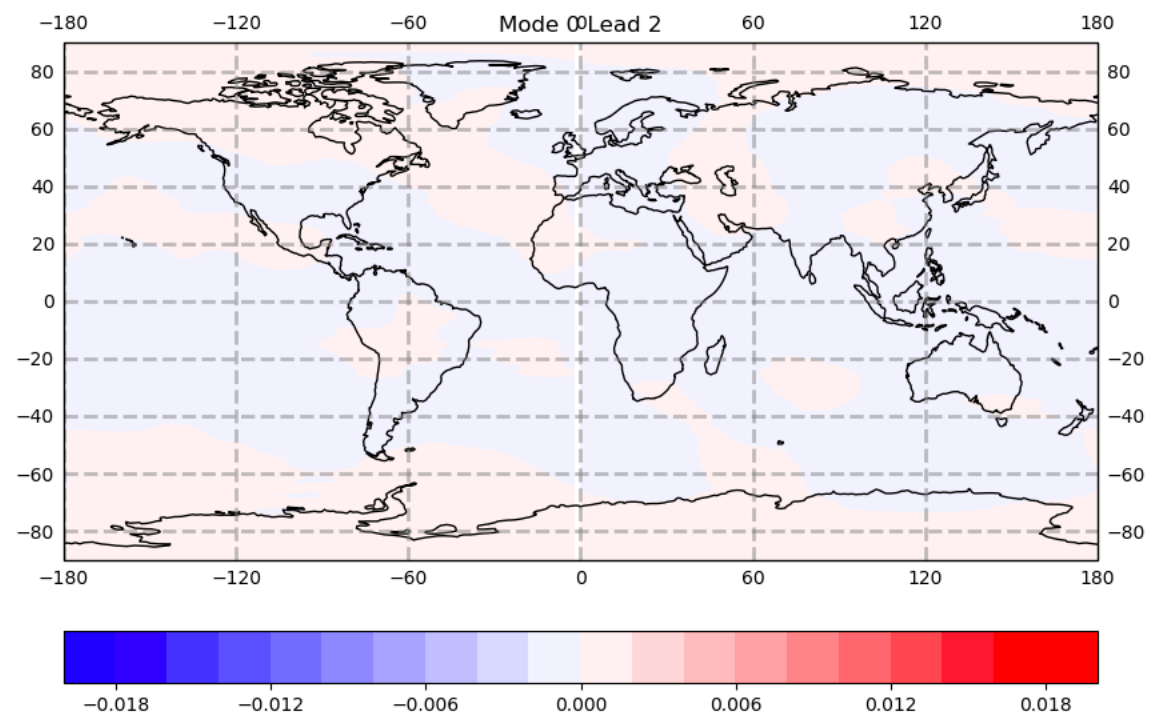


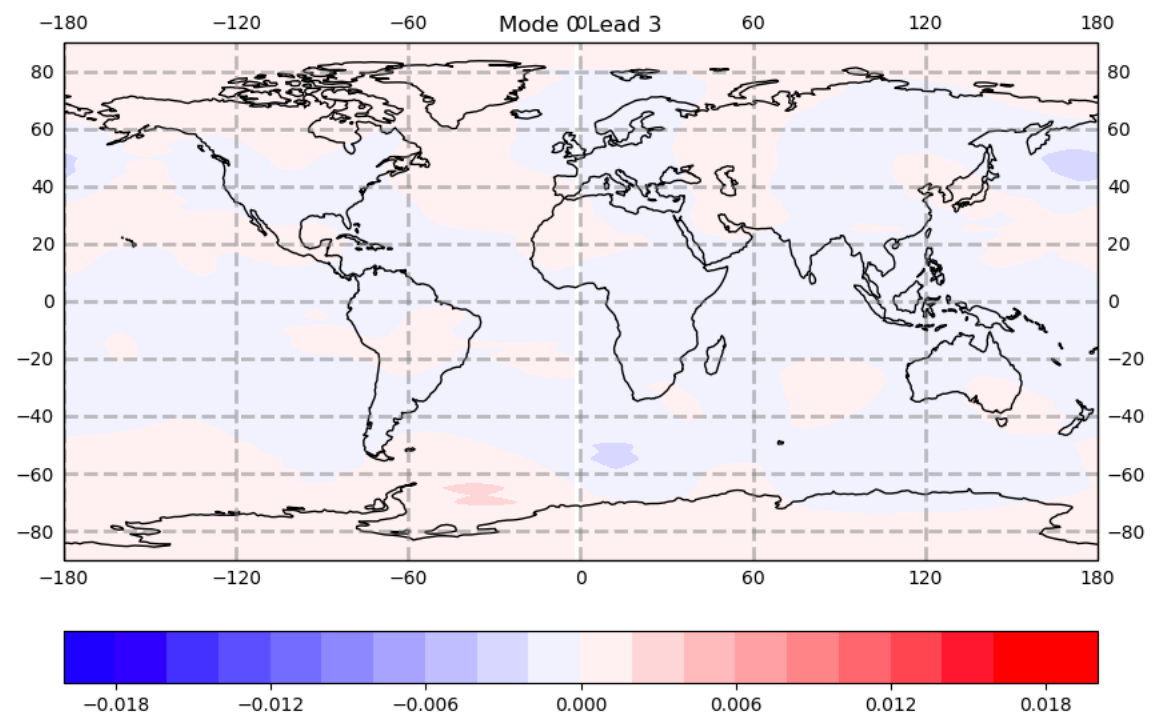
# METHODS

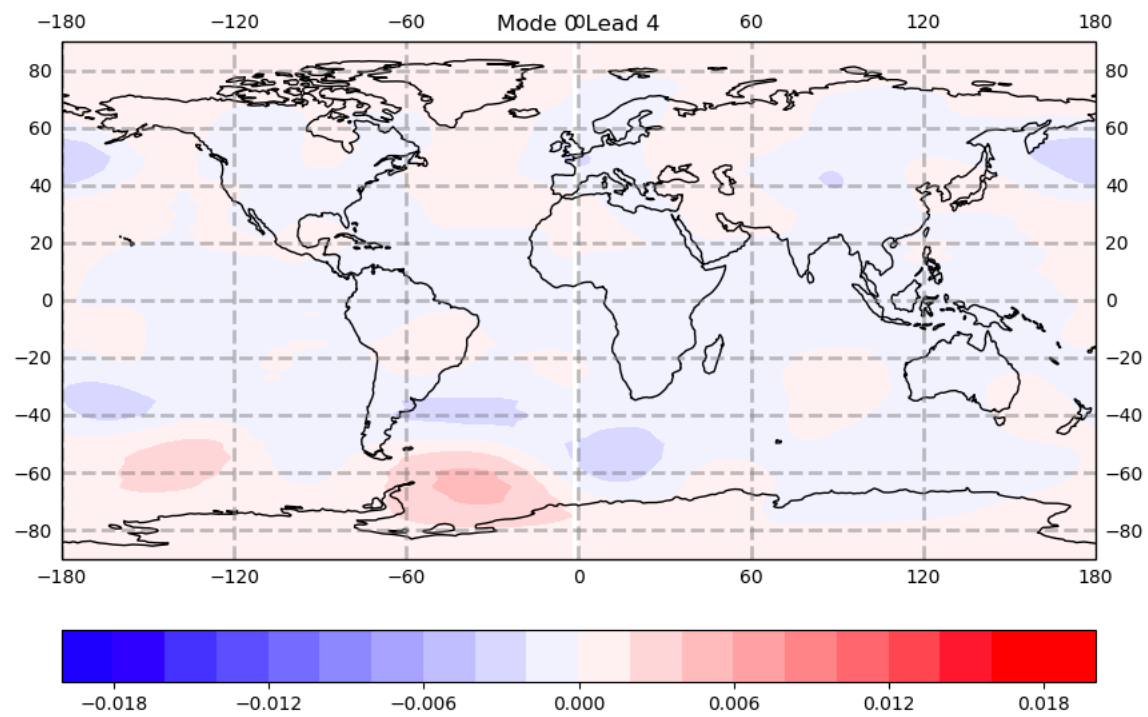
- The results constitute efficiently calculated space-time error eigenmodes.
- Project model forecast anomalies from the model's climatology onto the patterns.
- Compare the result for skill against the original model error.
- Subtract the predicted error where the algorithm is skillful.



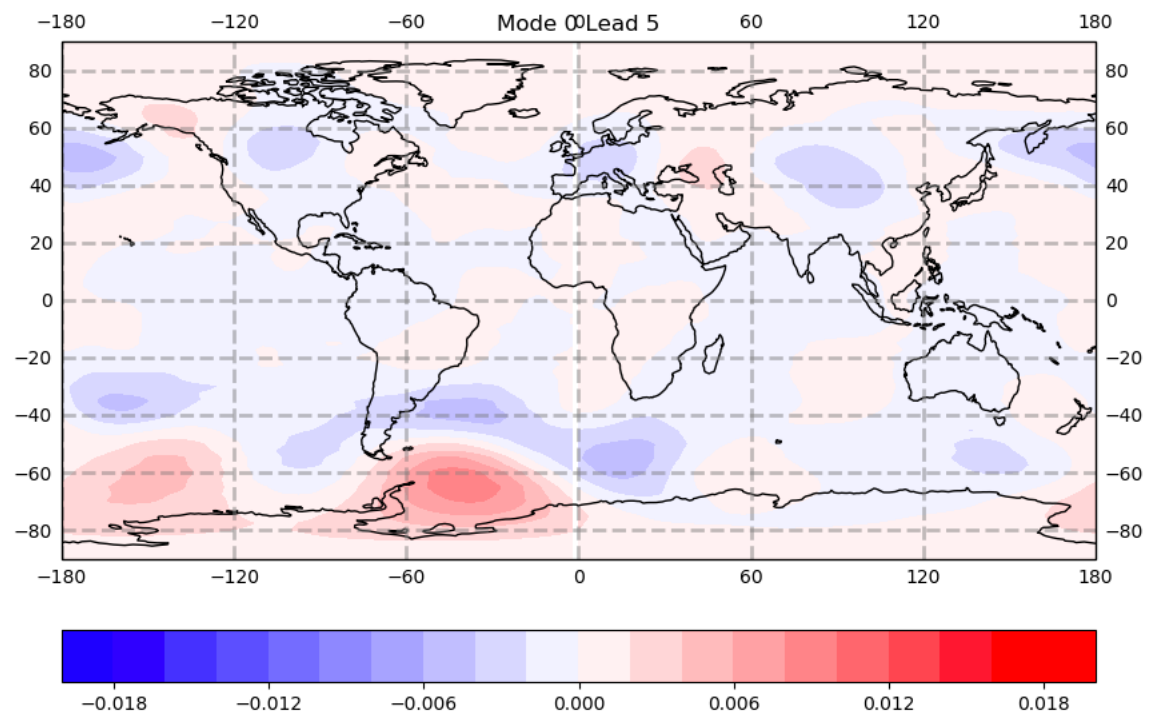


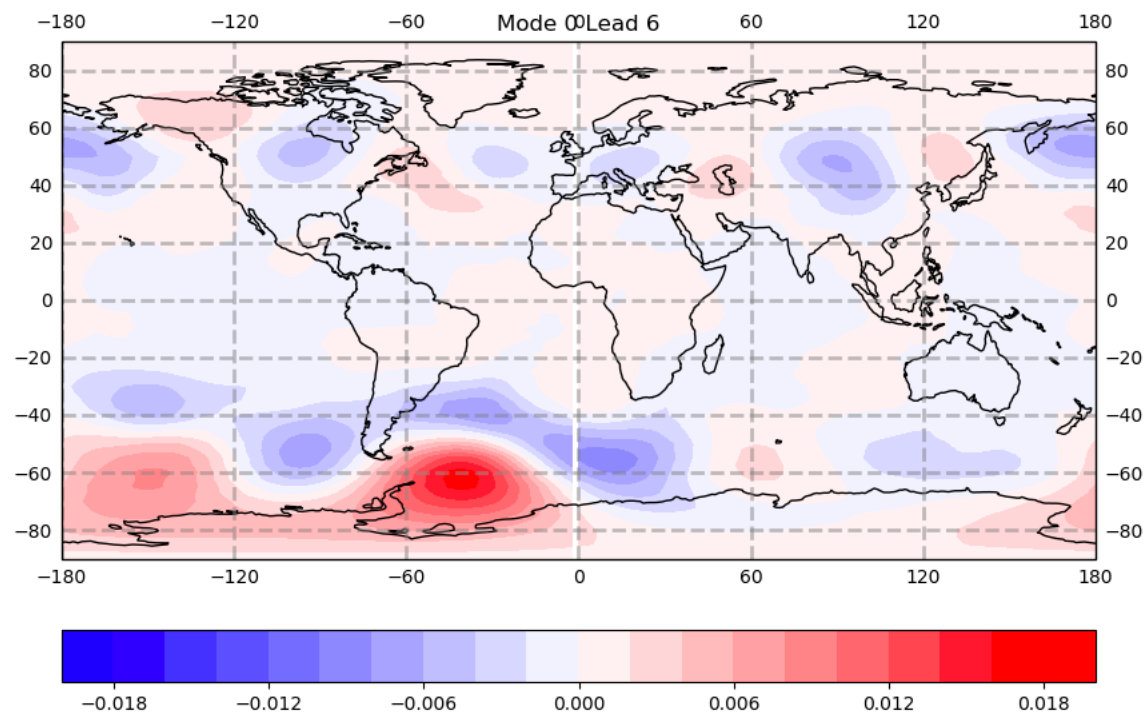


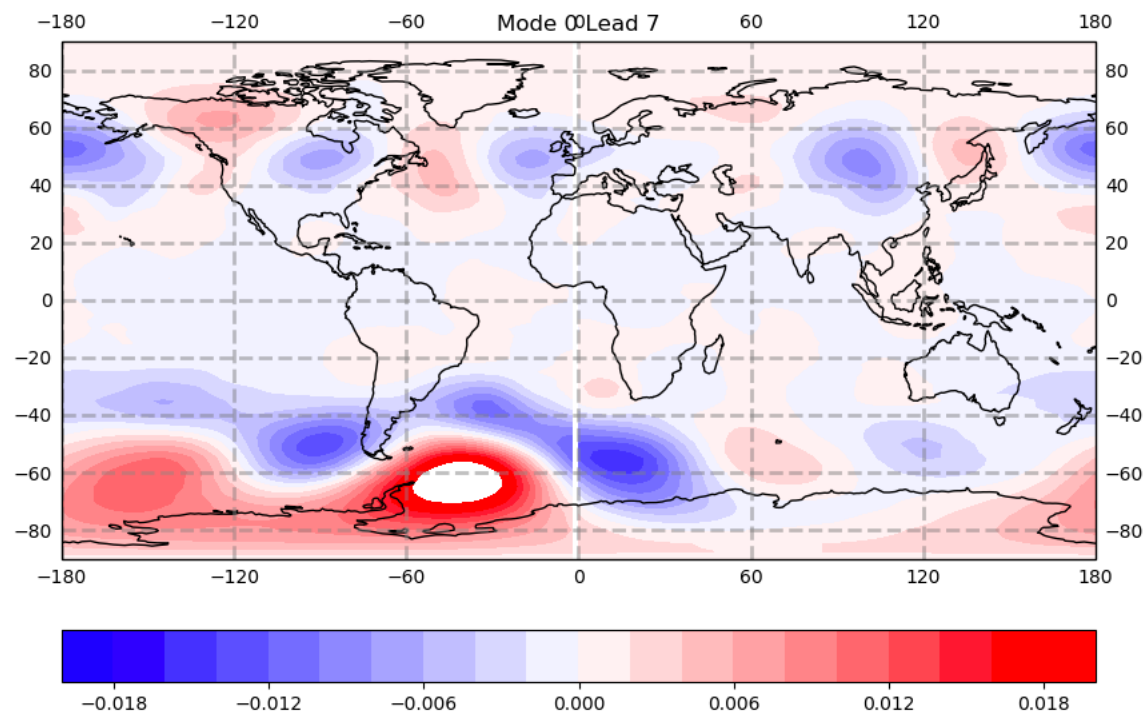


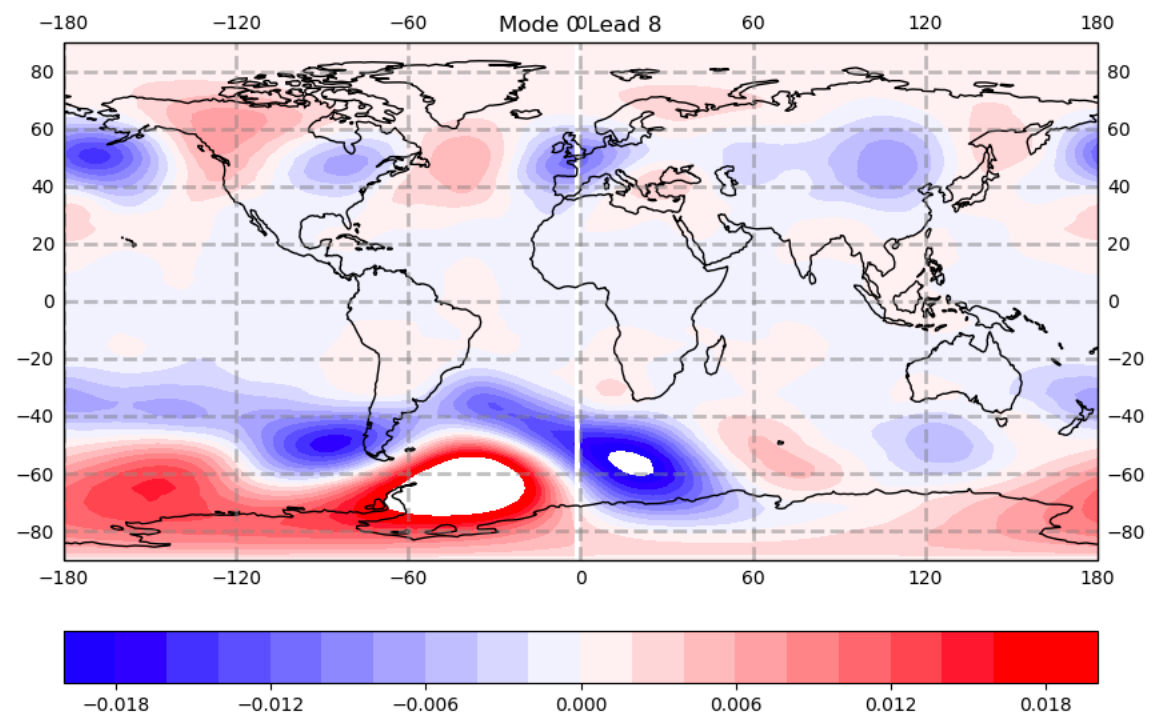


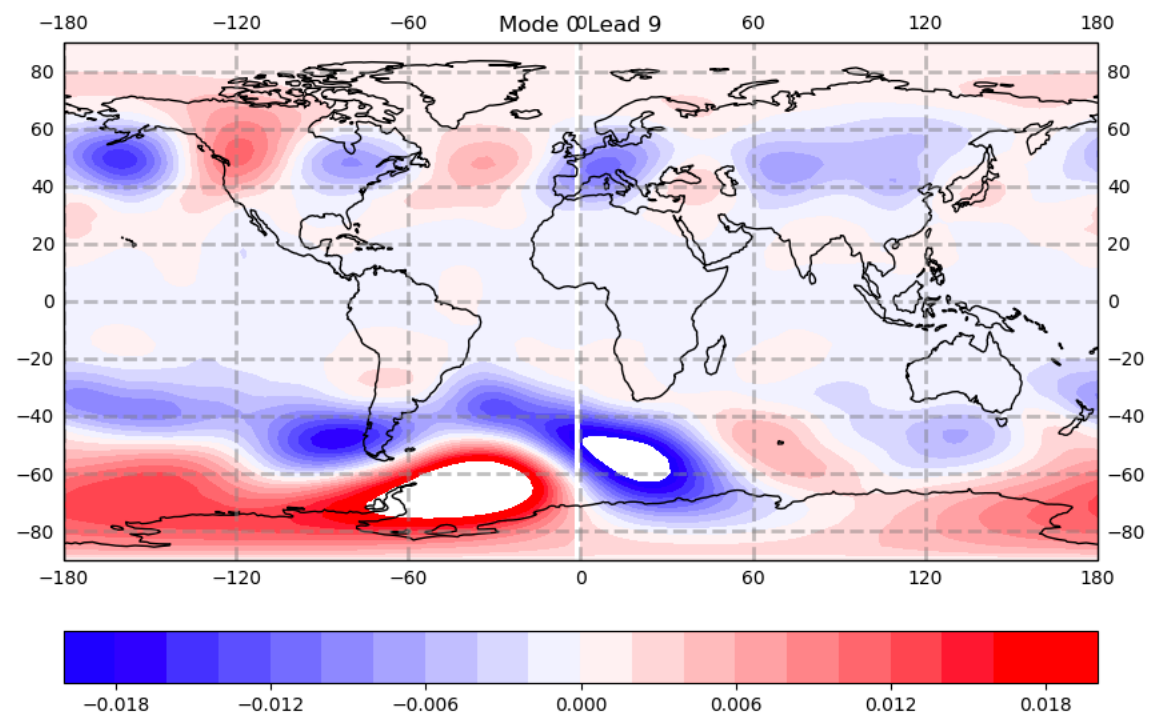




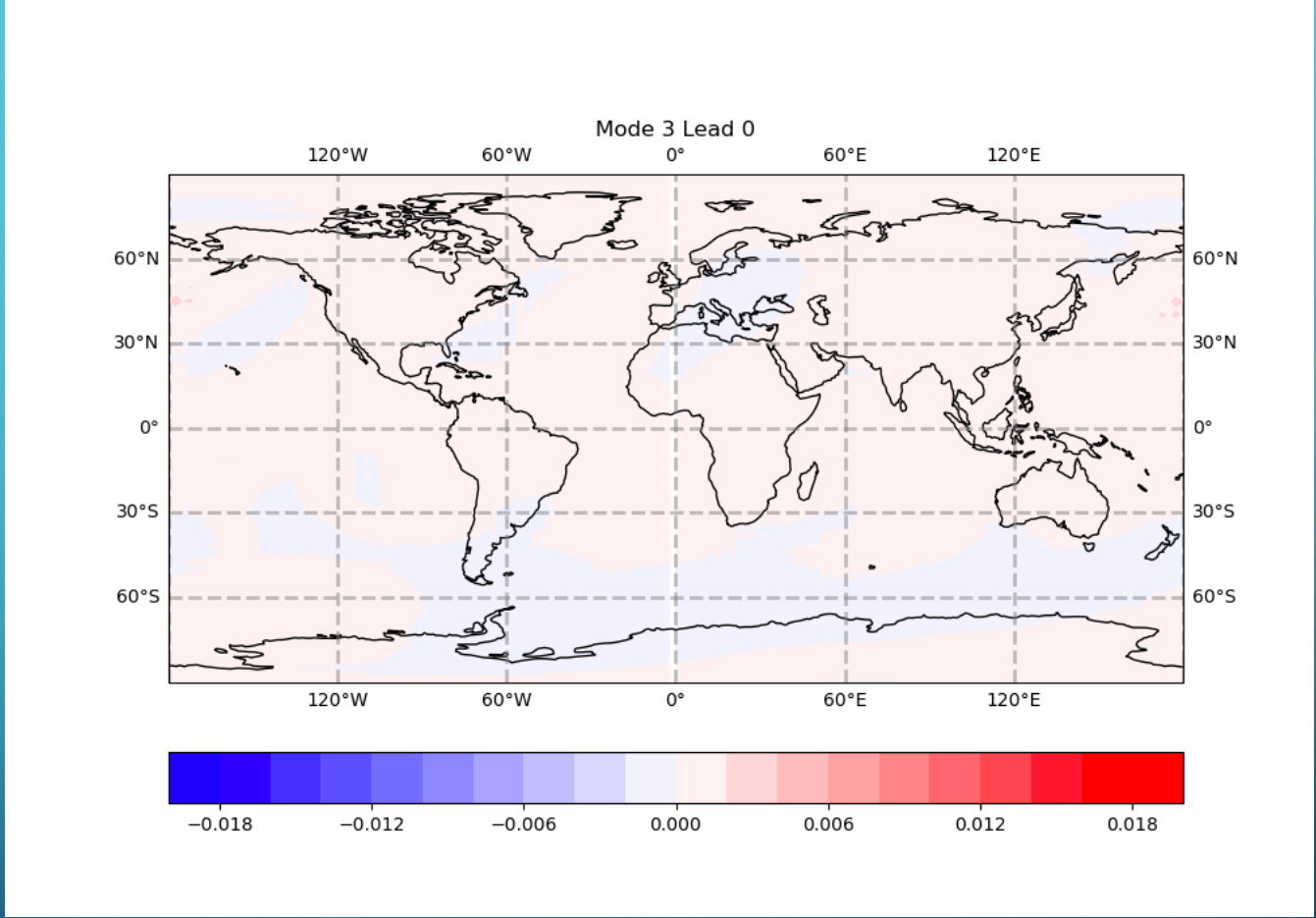


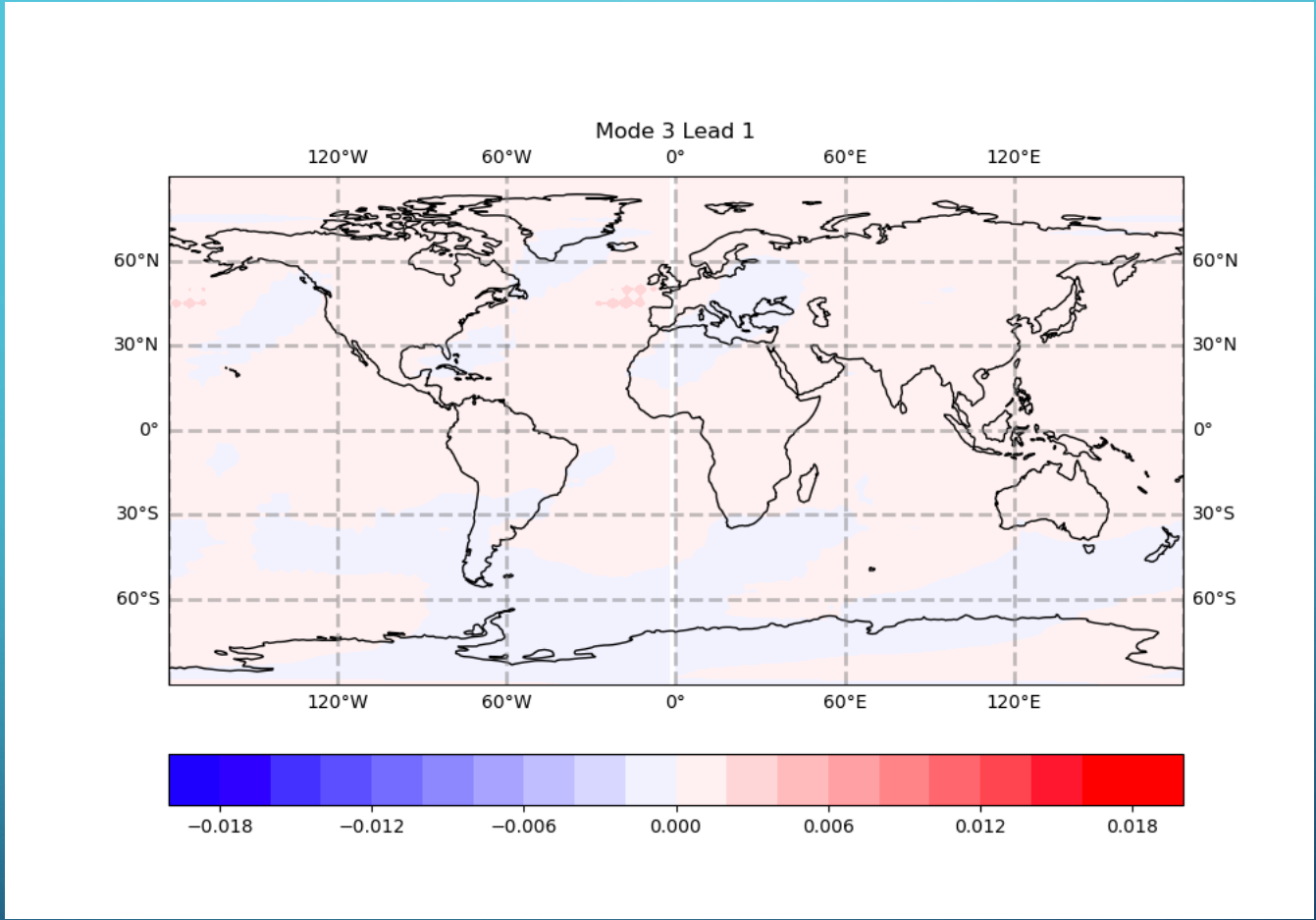




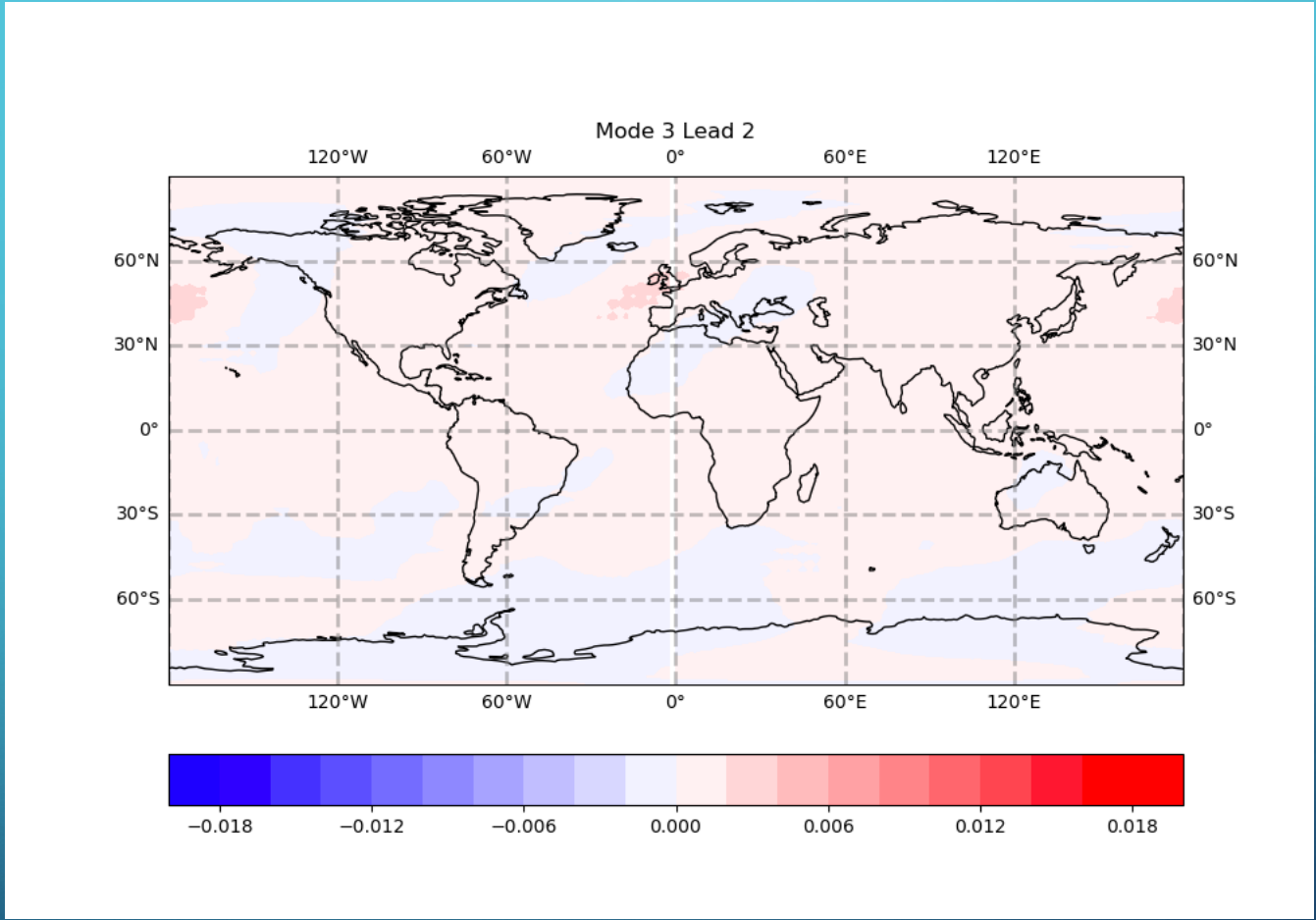


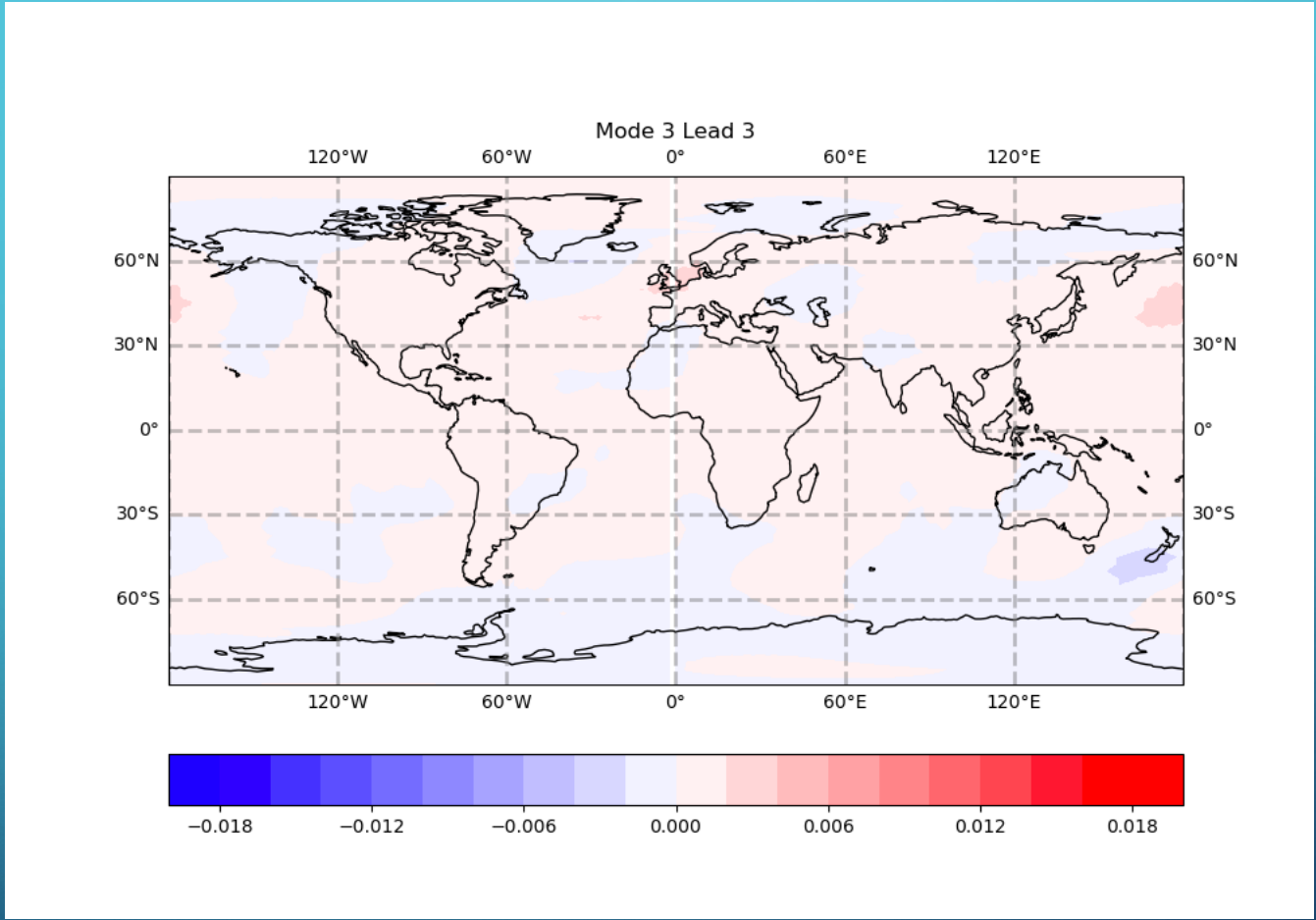


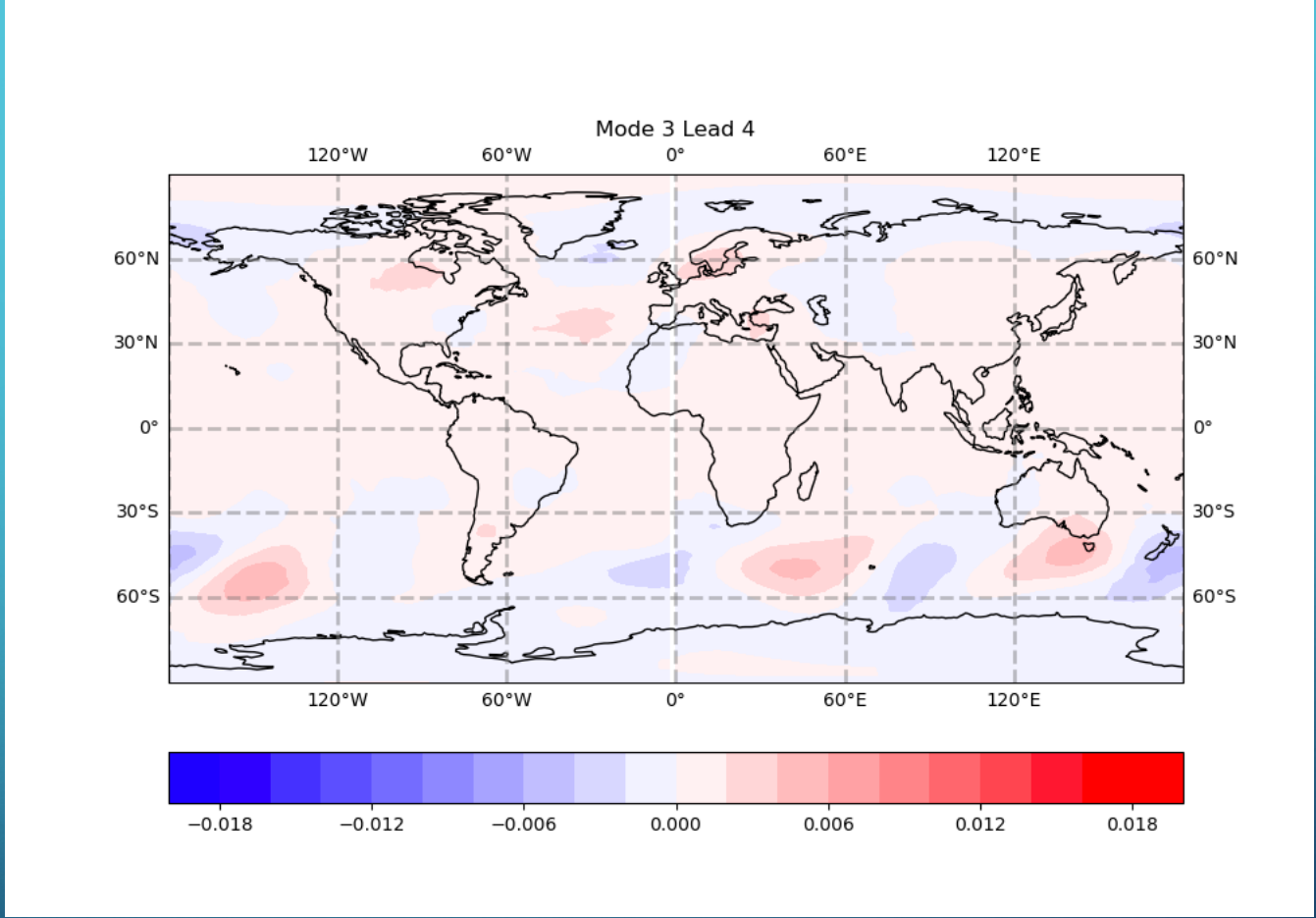


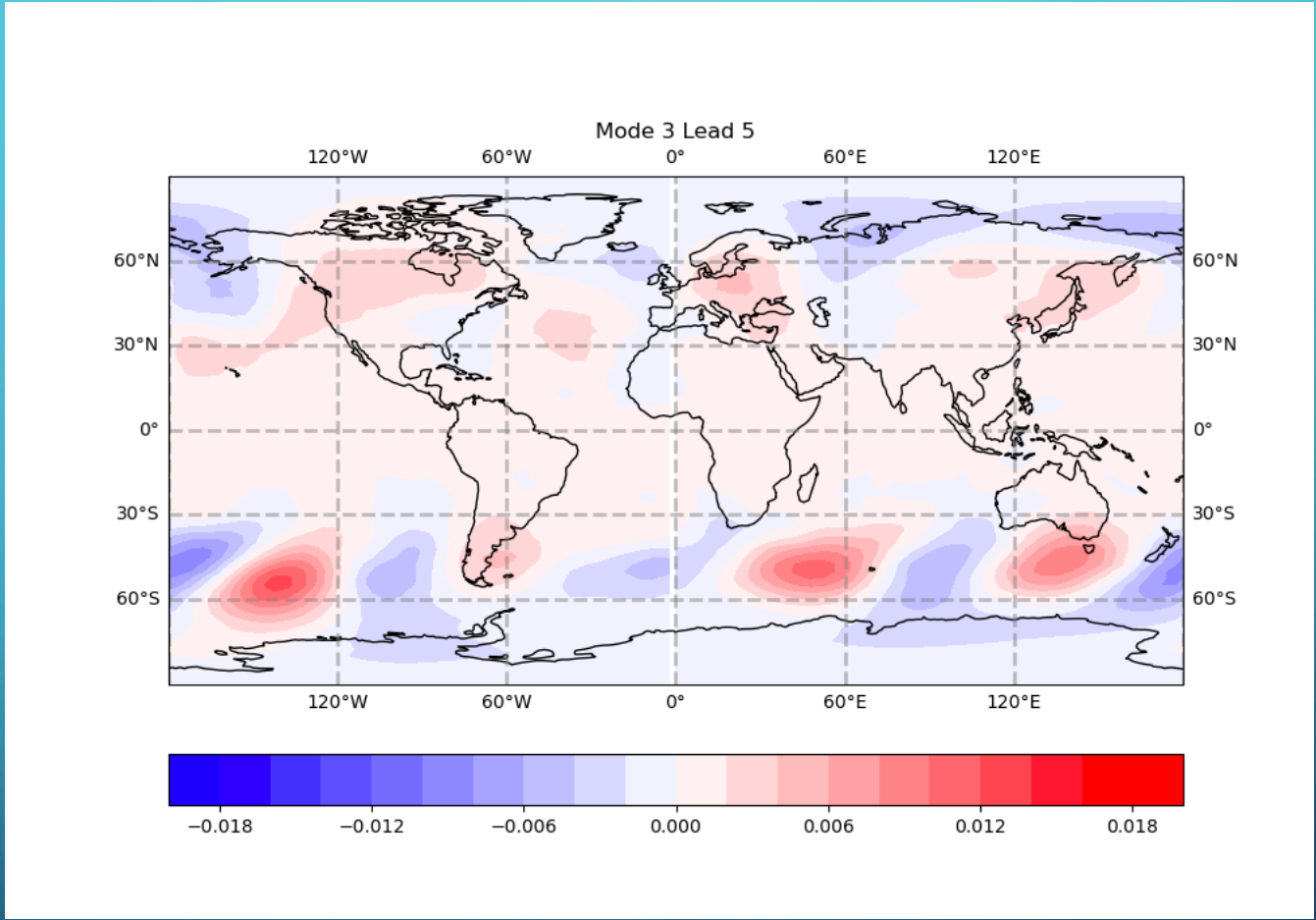


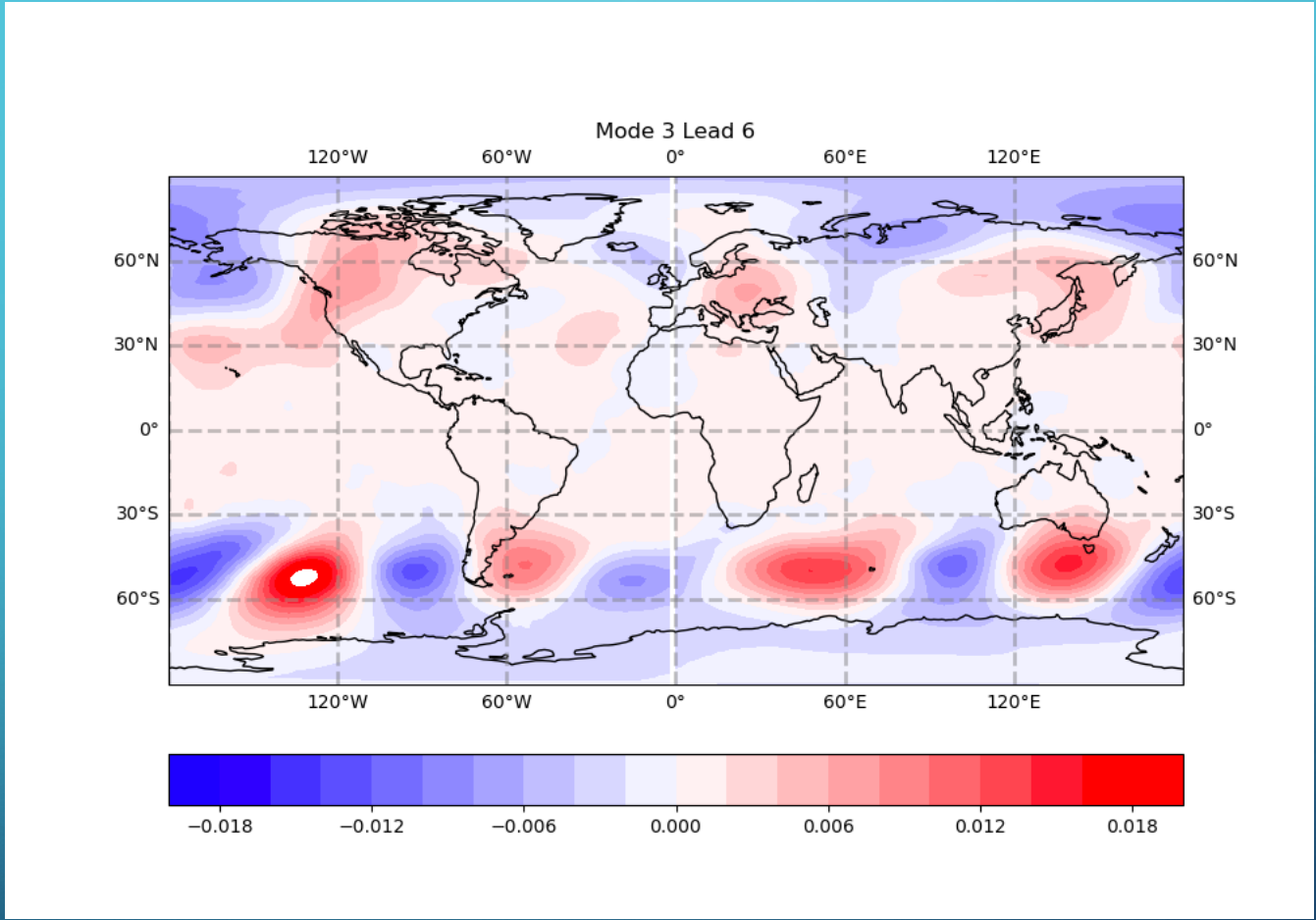


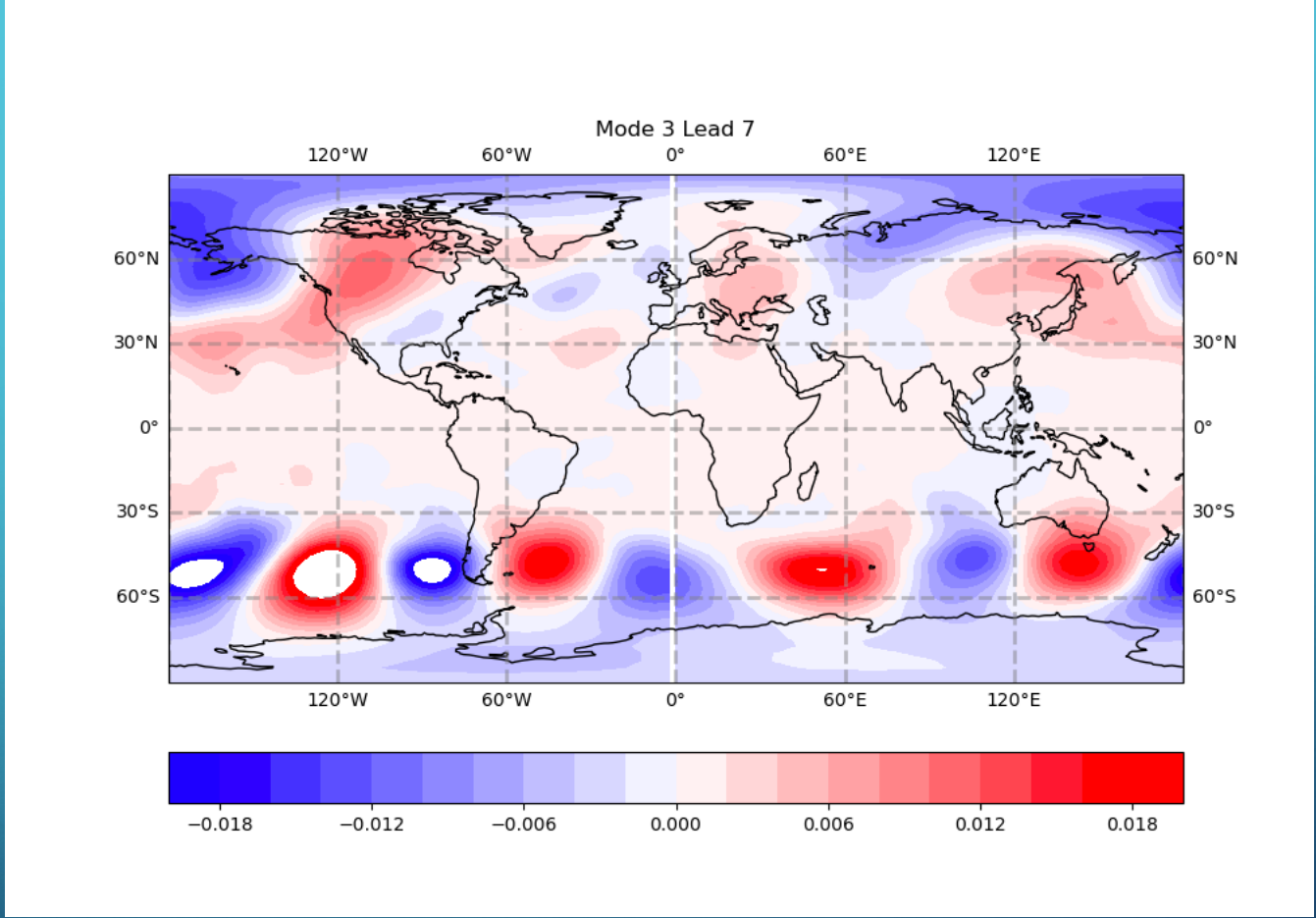


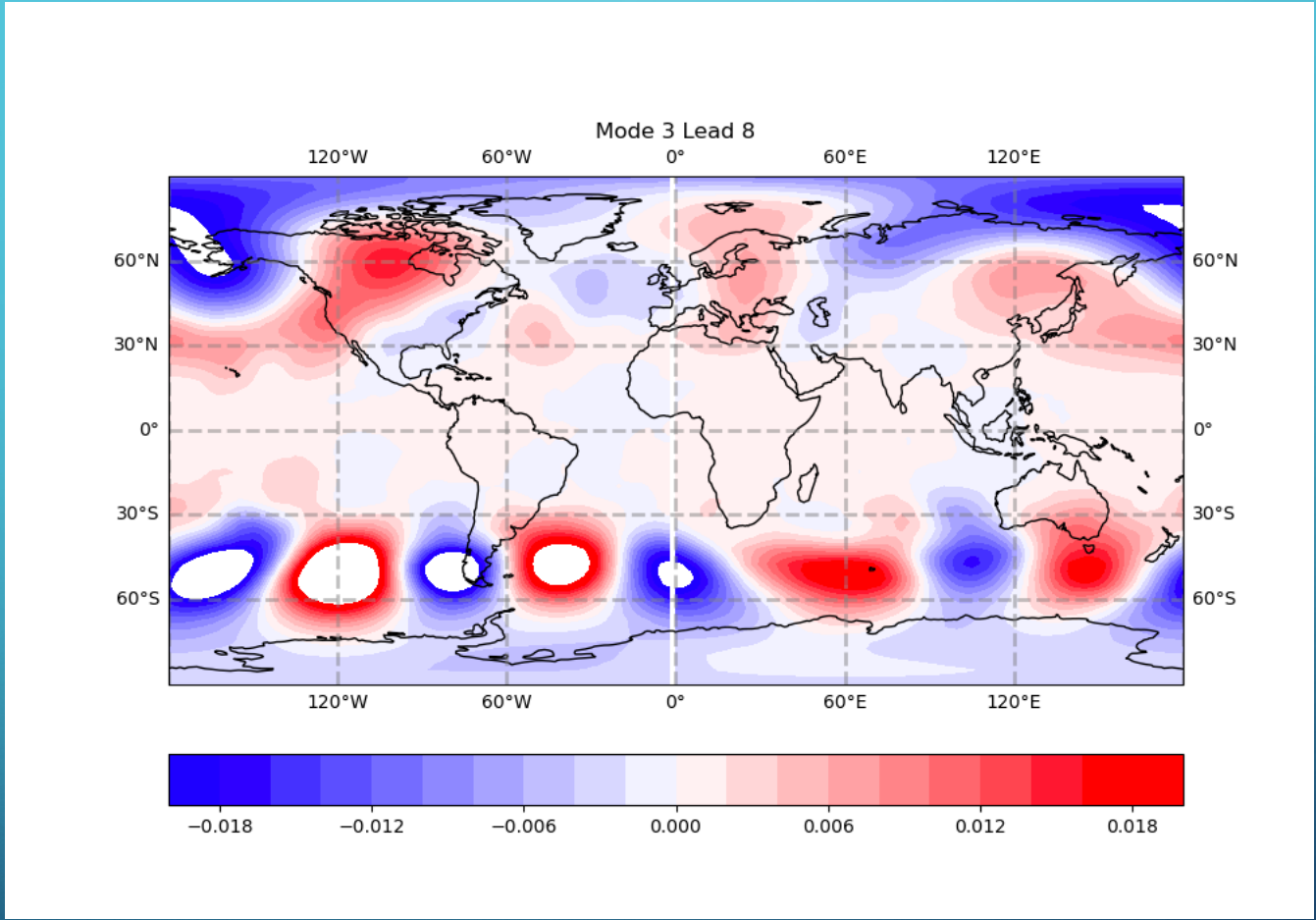


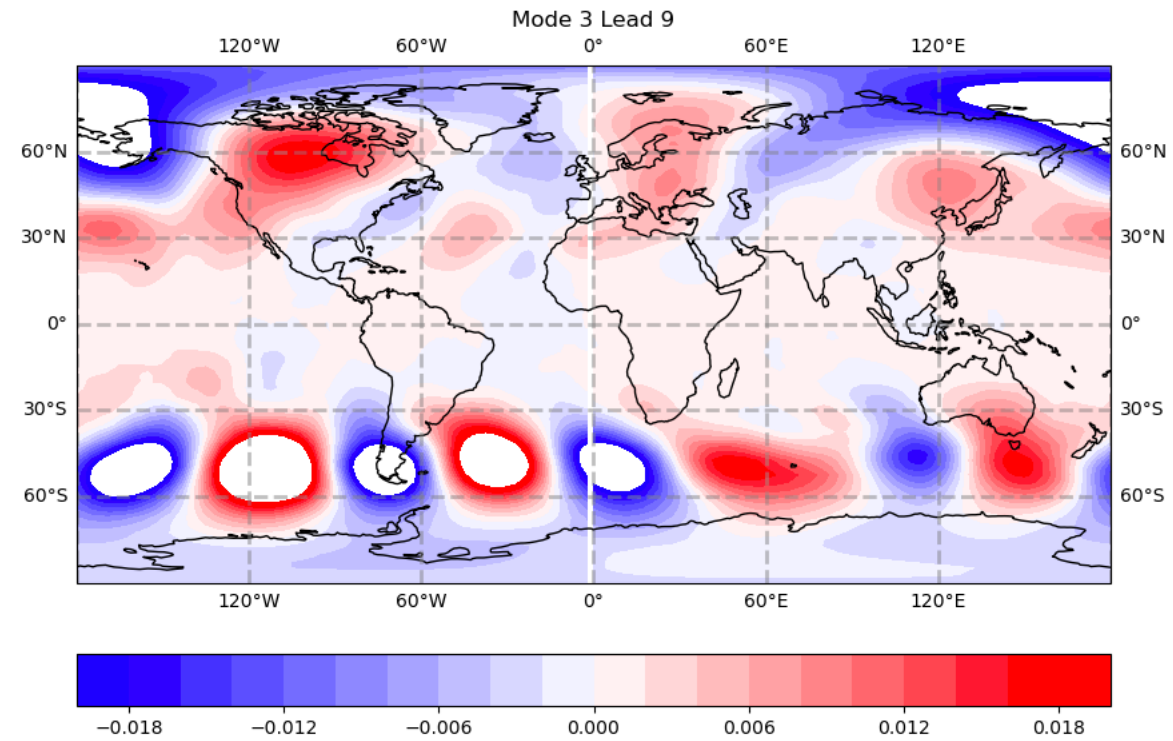








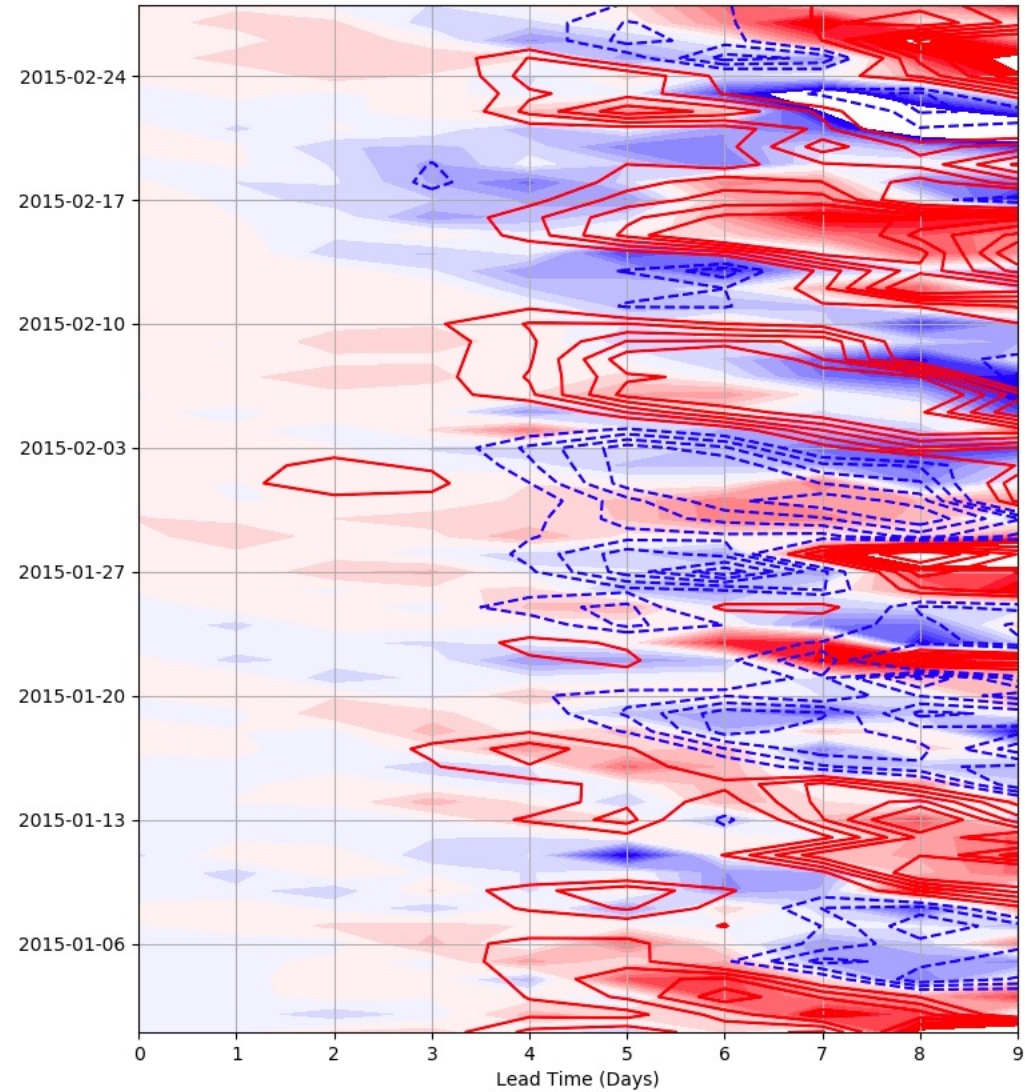




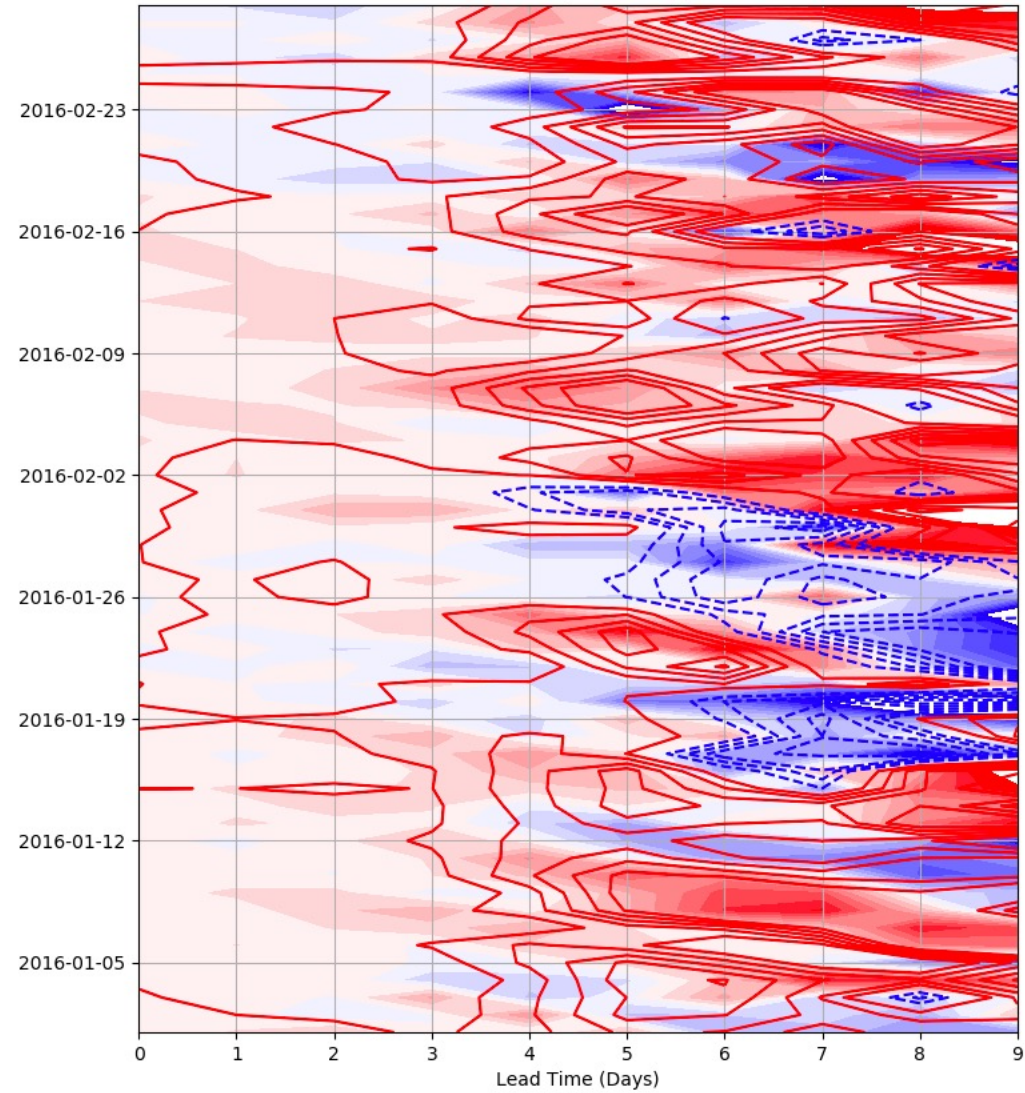




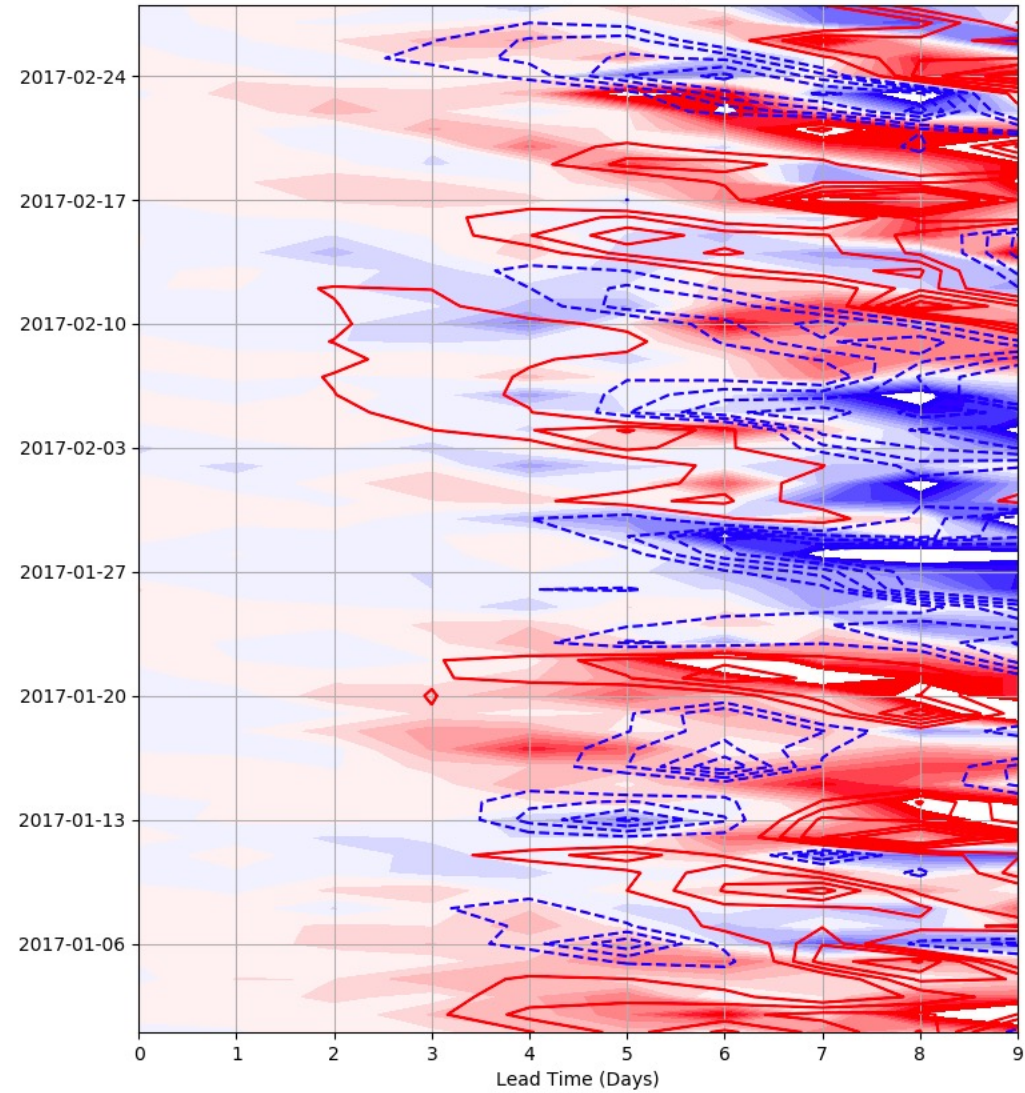
GEFS Error (Shading),  
Reconstruction (contours), London



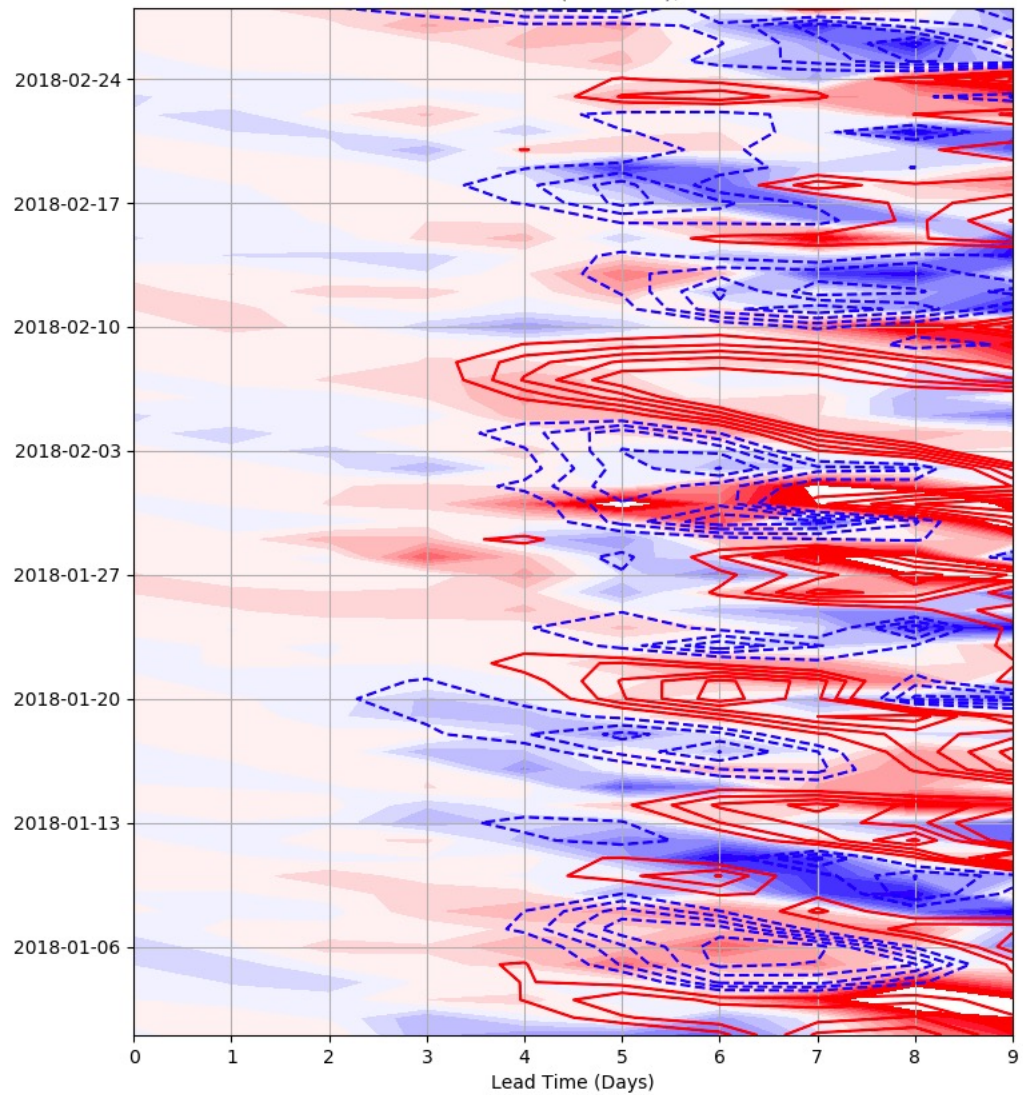
GEFS Error (Shading),  
Reconstruction (contours), London



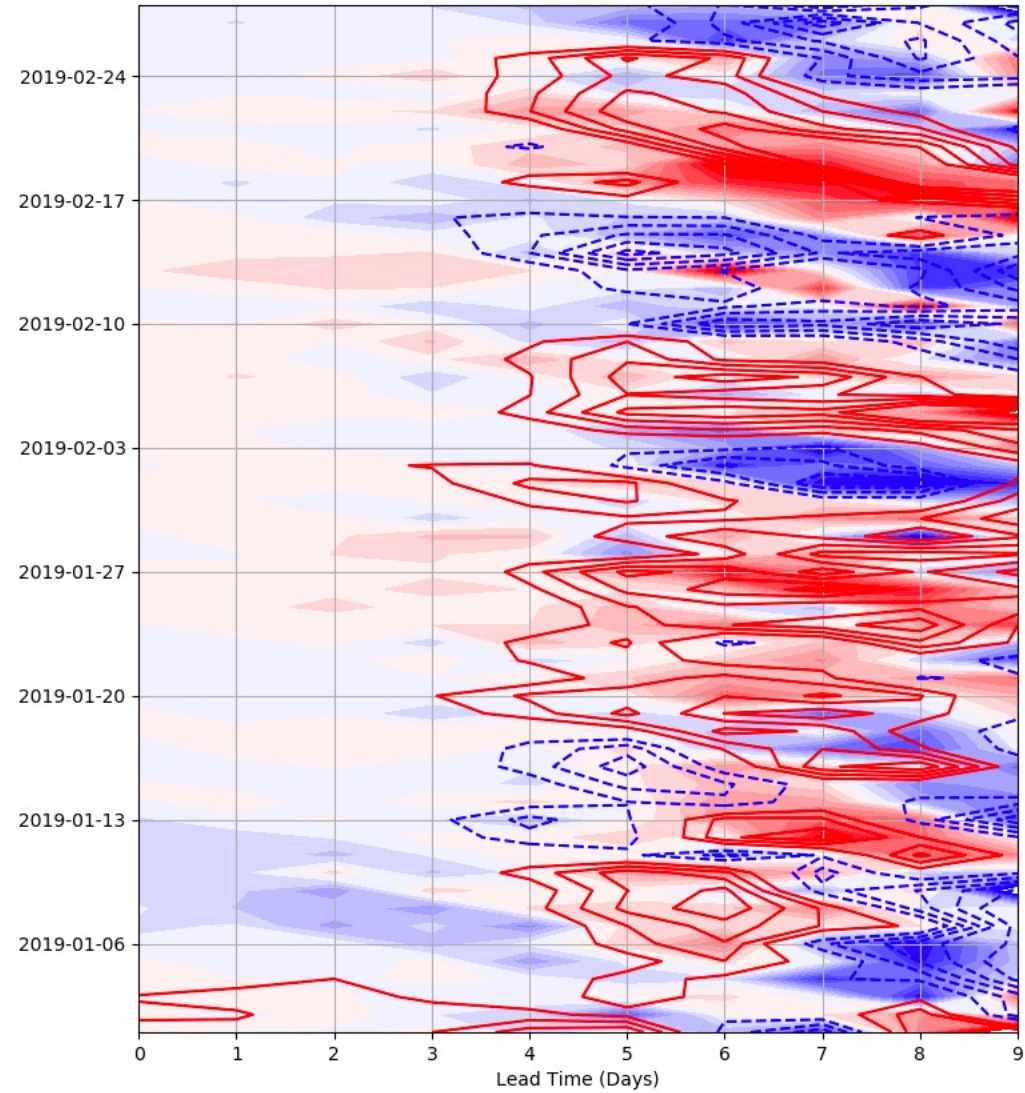
GEFS Error (Shading),  
Reconstruction (contours), London



GEFS Error (Shading),  
Reconstruction (contours), London



GEFS Error (Shading),  
Reconstruction (contours), London



# CONCLUSIONS

- After subtracting predicted error in 200 hPa height anomalies, mean square error is improved by 20-30% in most middle latitude regions at 10-day lead times in GEFS V12 data relative to the unmodified forecast