Assessing terrestrial ecosystem responses to climate change from analysis of the shape and amplitude of the atmospheric CO_2 seasonal cycle

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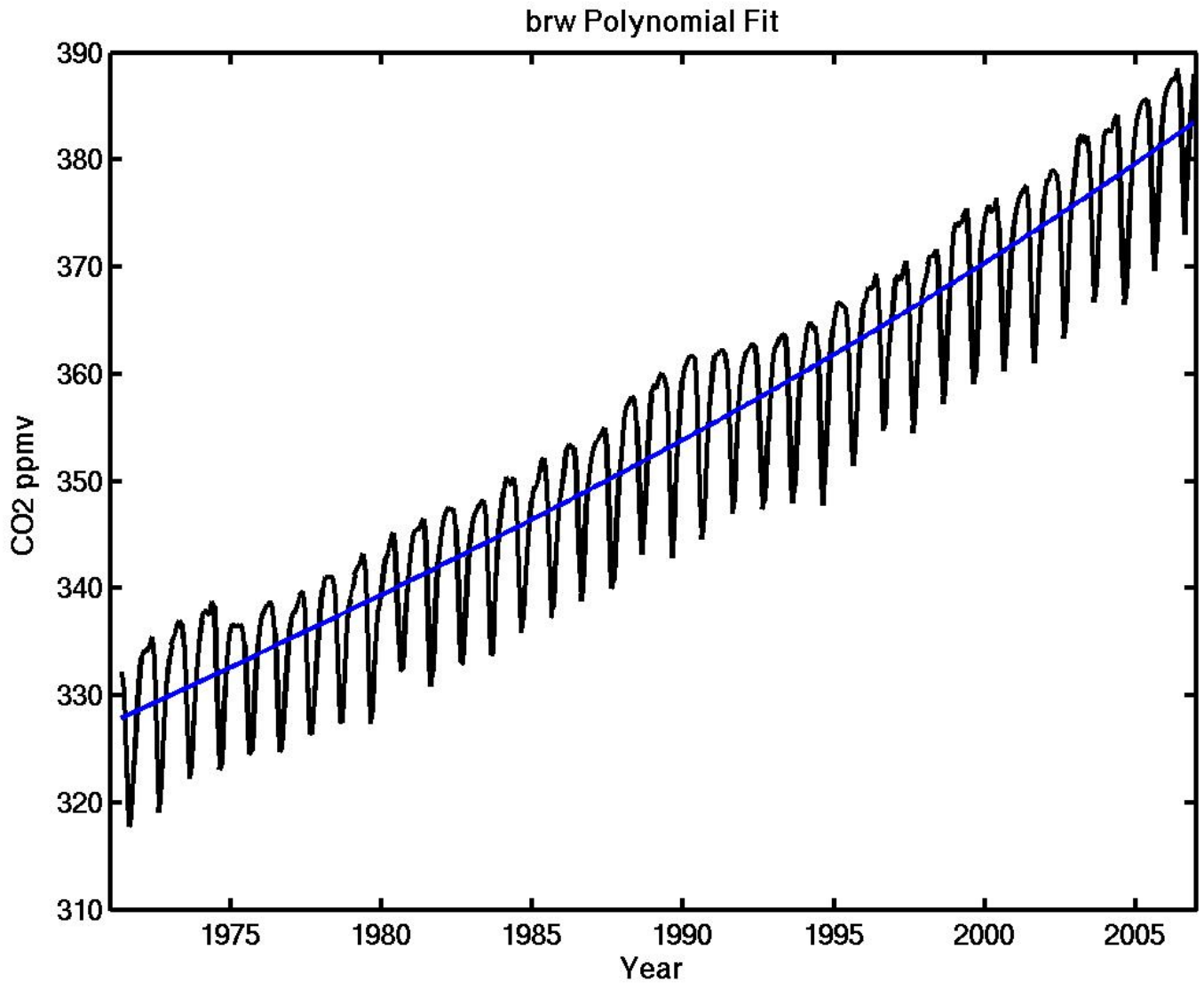
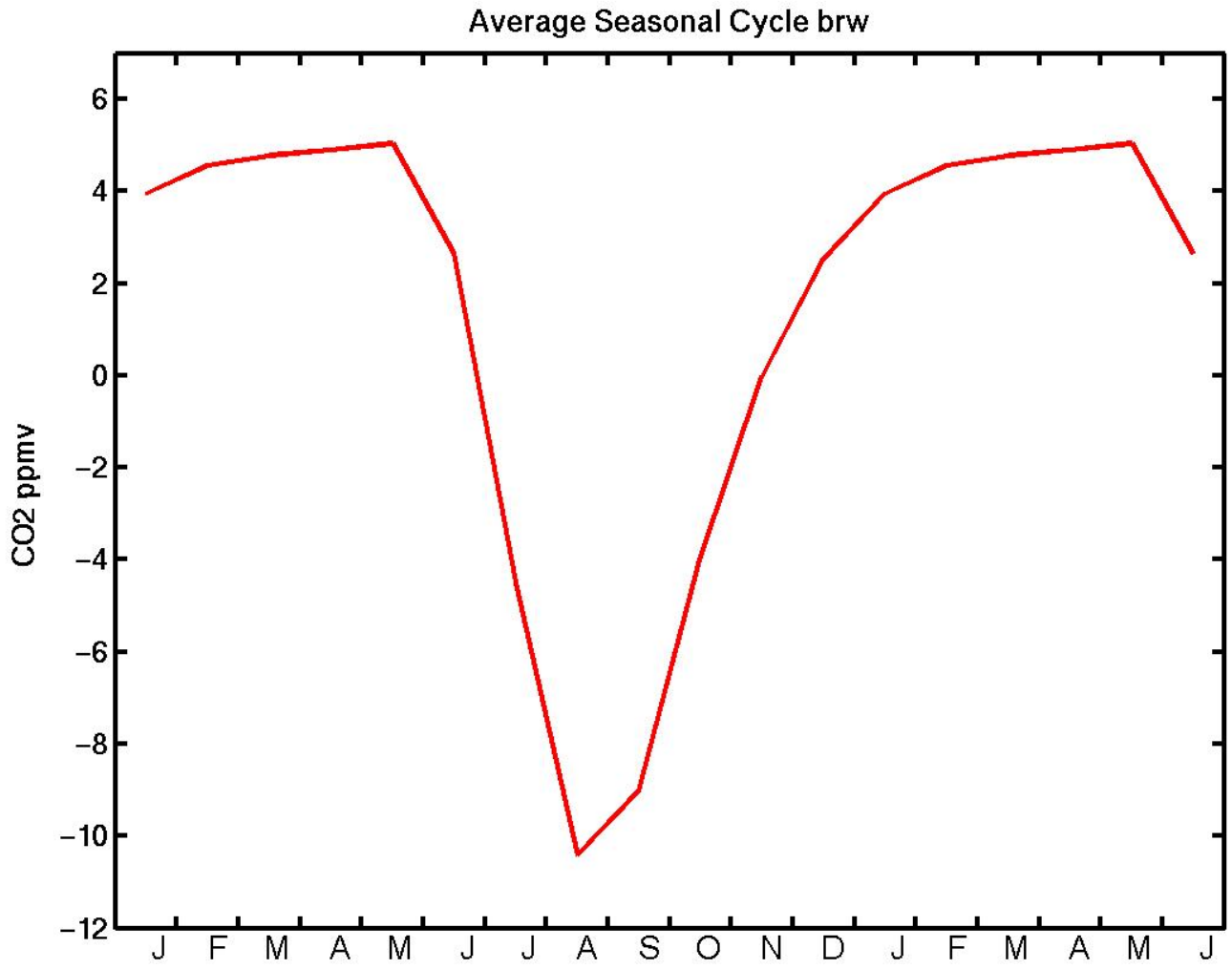
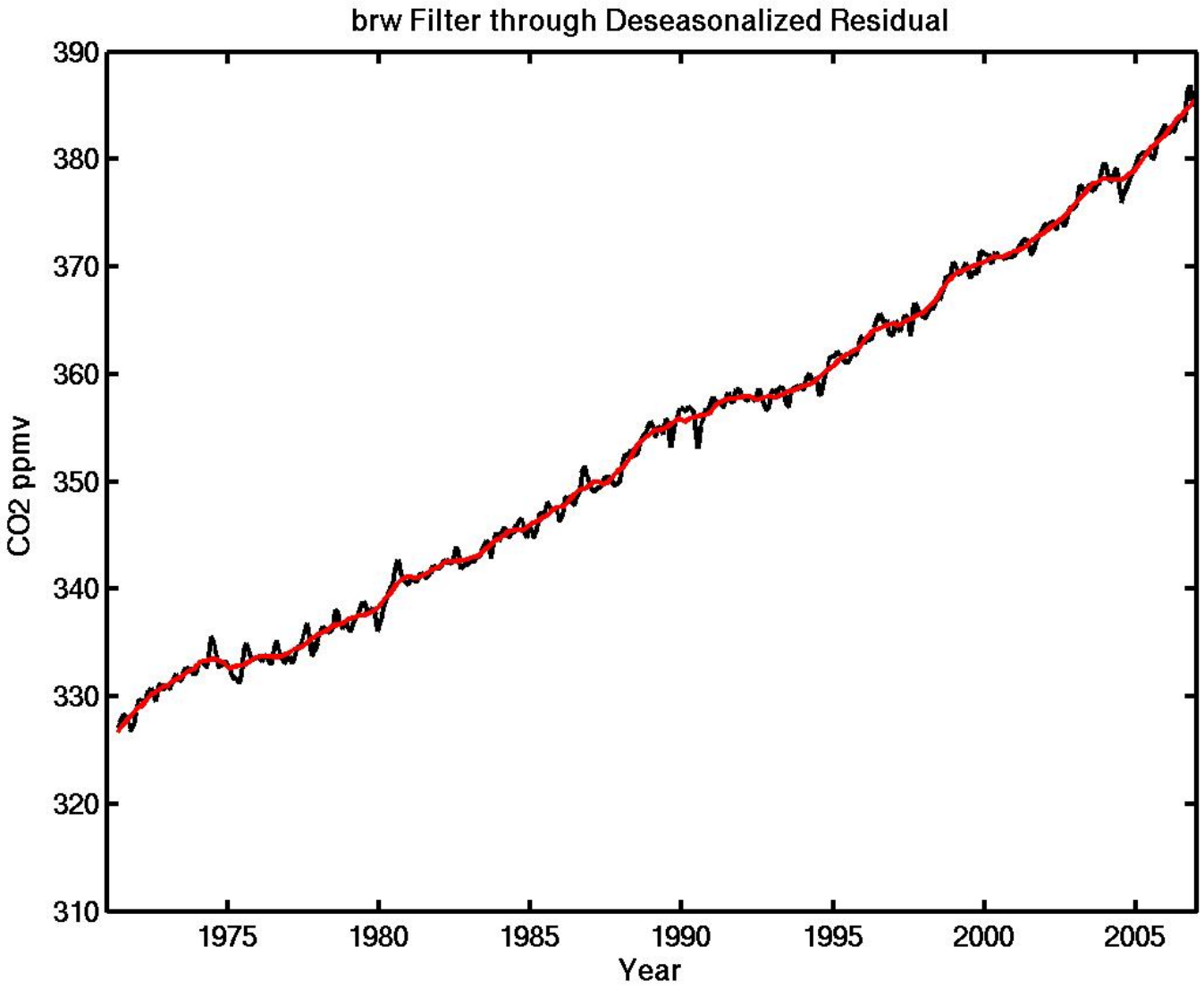
Barrow, Alaska CO_2: Detrend with polynomial



BRW Mean CO_2 Seasonal Cycle



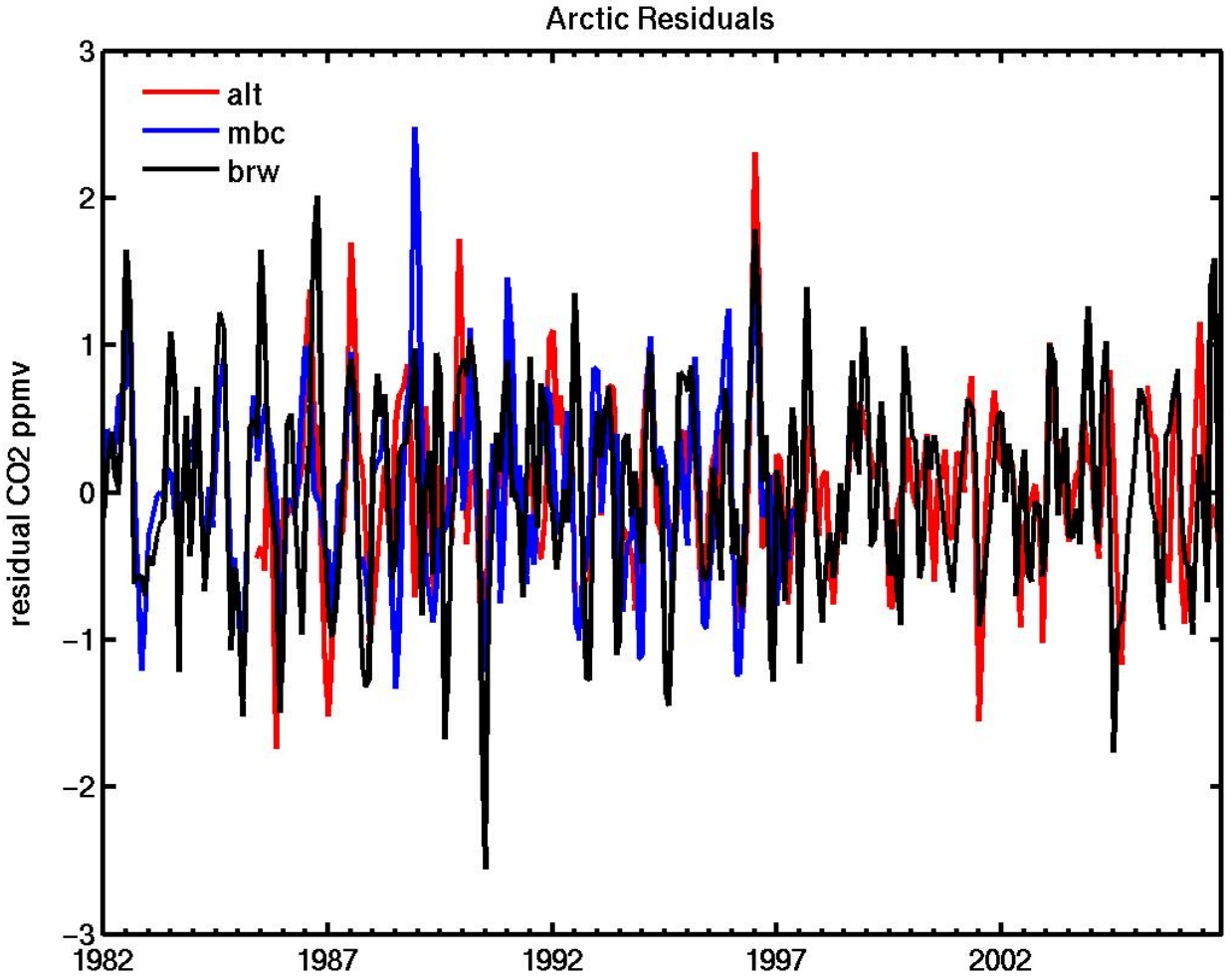
BRW: Apply Filter to Deseasonalized Residuals



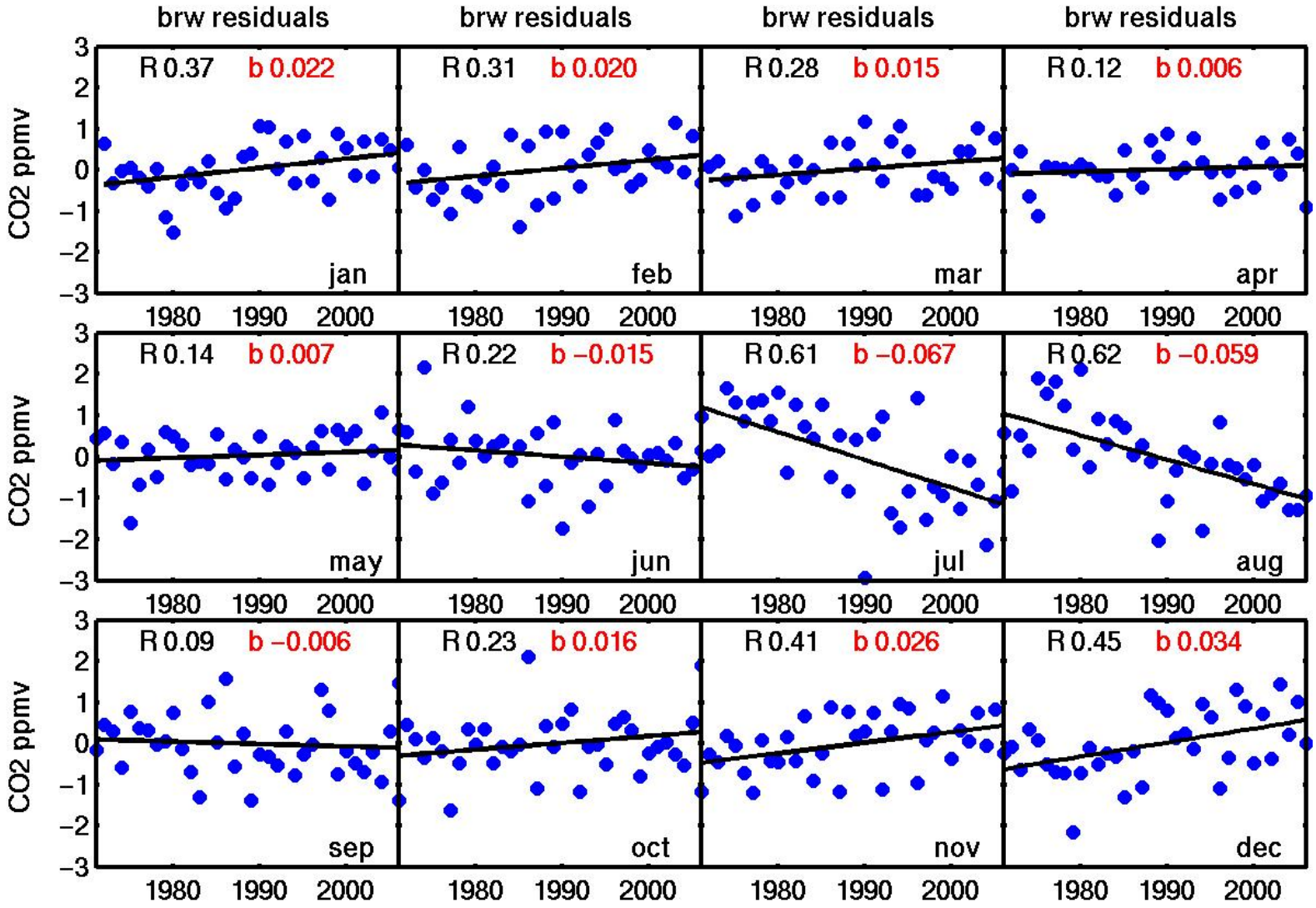
High Frequency Residuals

significantly correlated among Arctic stations

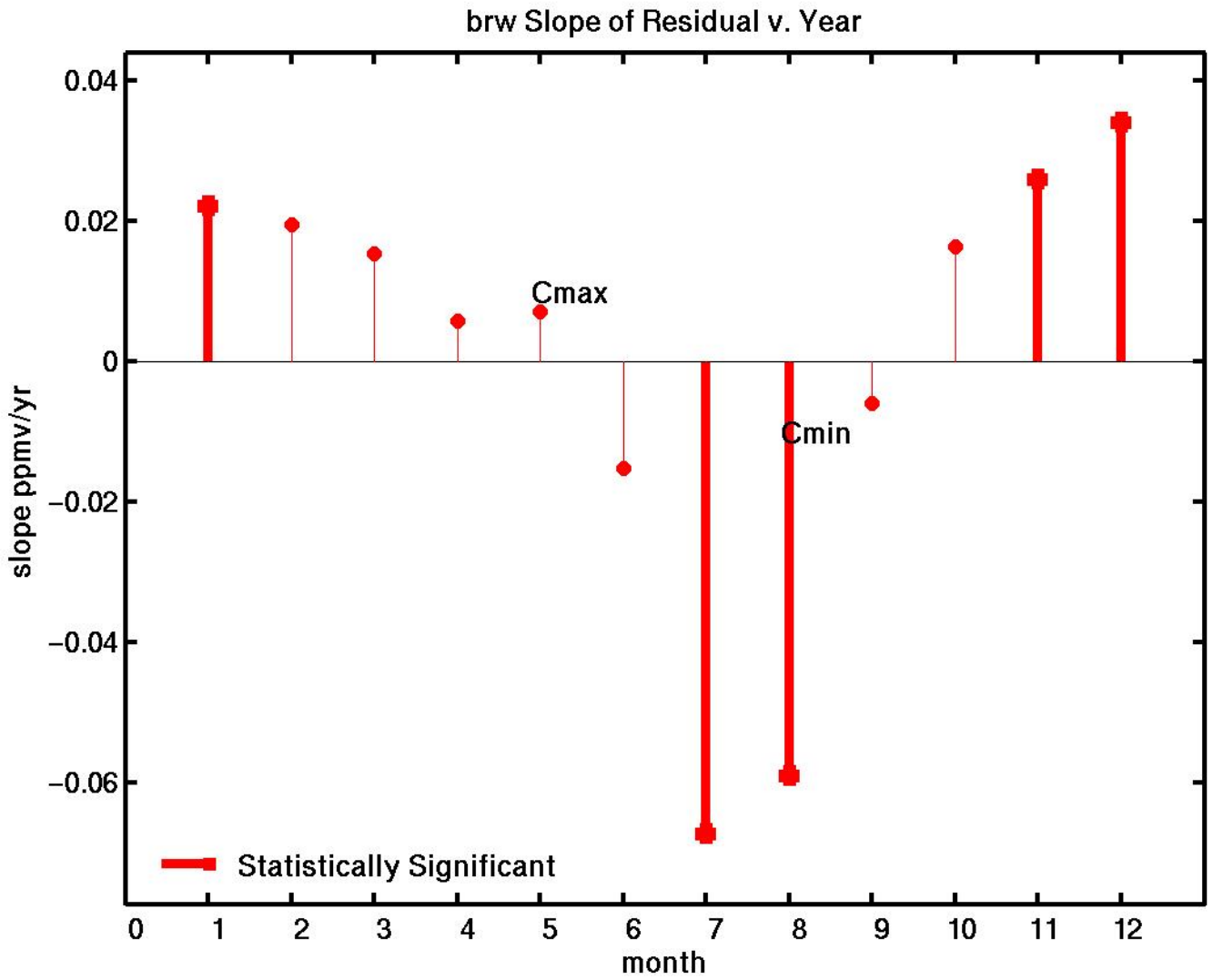
R=0.54 (brw v. mbc); R=0.44 (brw v. alt); R=0.49 (alt v. mbc)



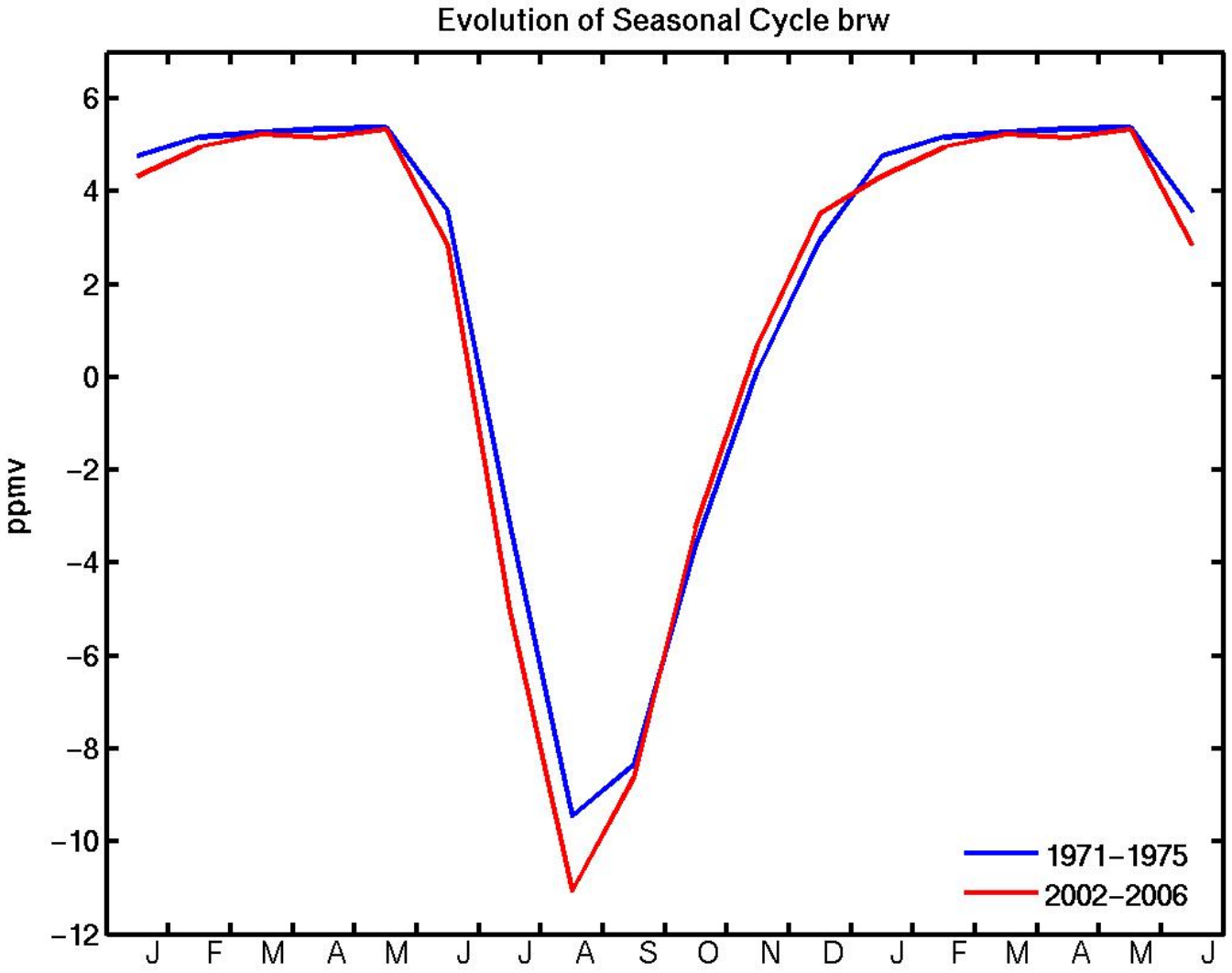
Sort High Frequency Residuals by Month



BRW: Summary of Monthly CO_2 Trends

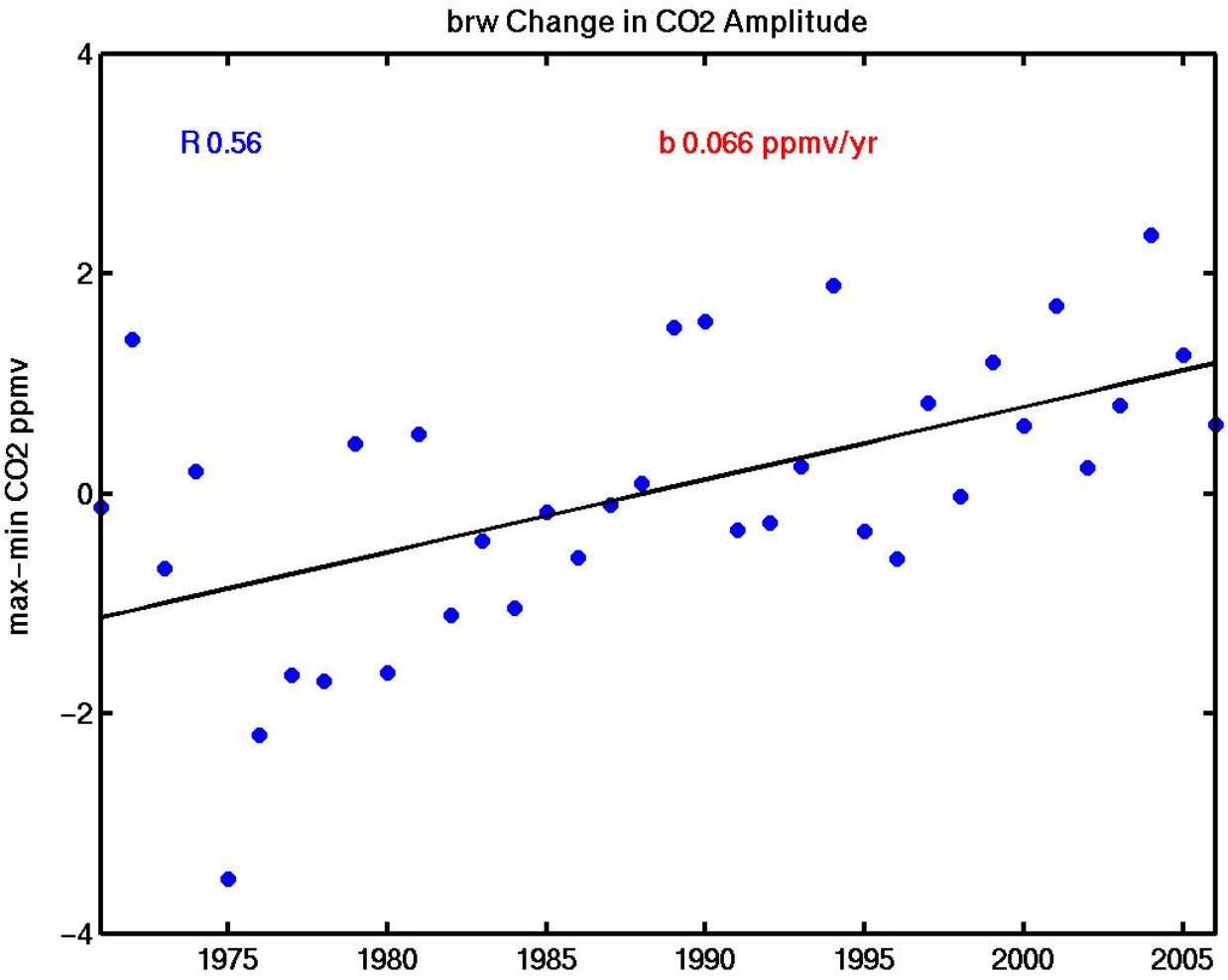


BRW Changing Shape of Seasonal Cycle

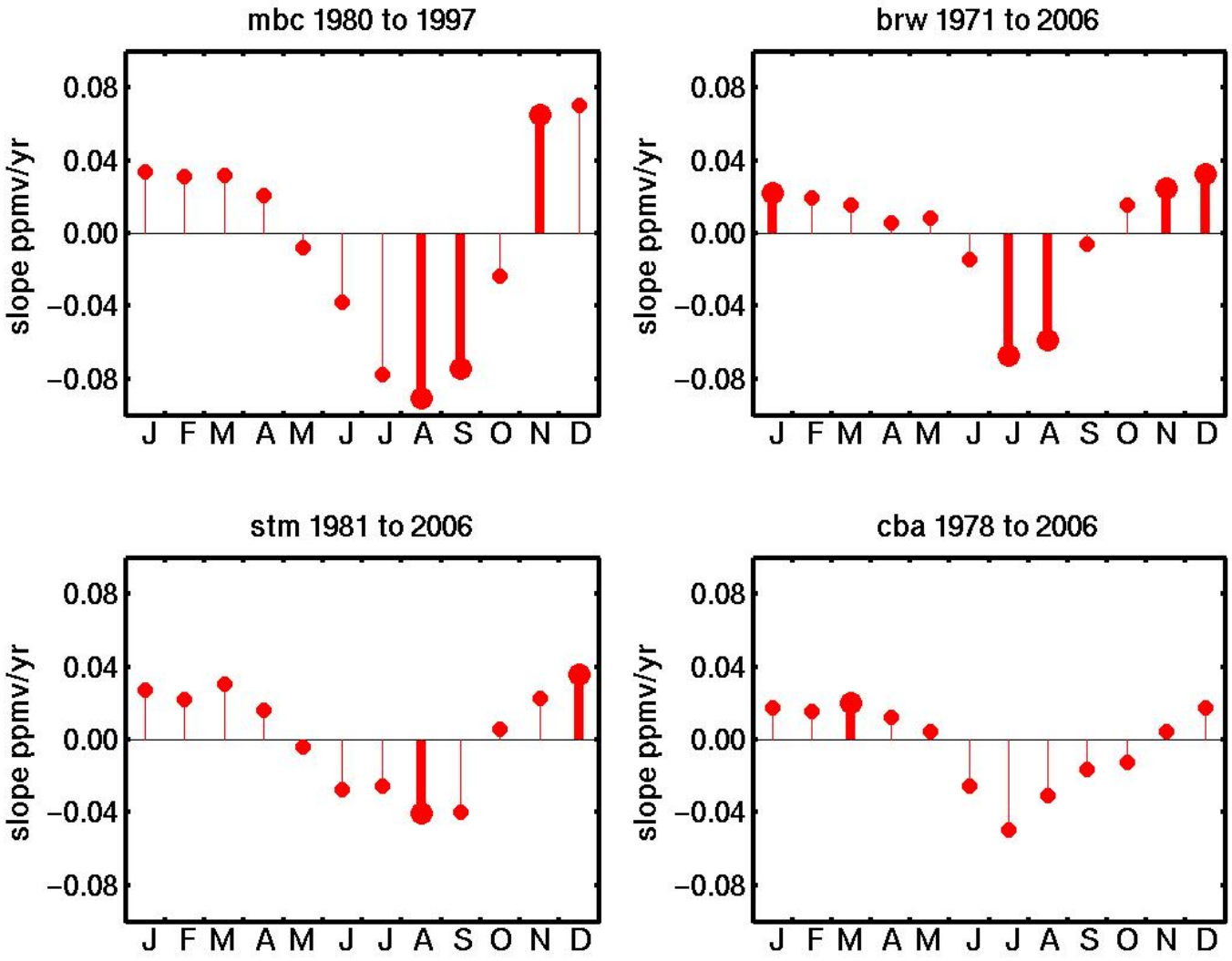


BRW Change in Amplitude

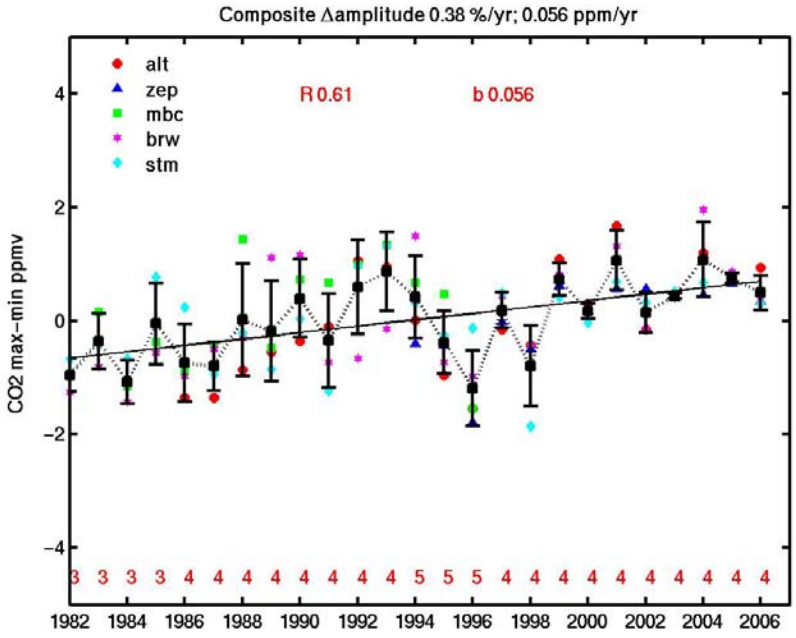
Slope of Cmax-Cmin Residuals v. Year

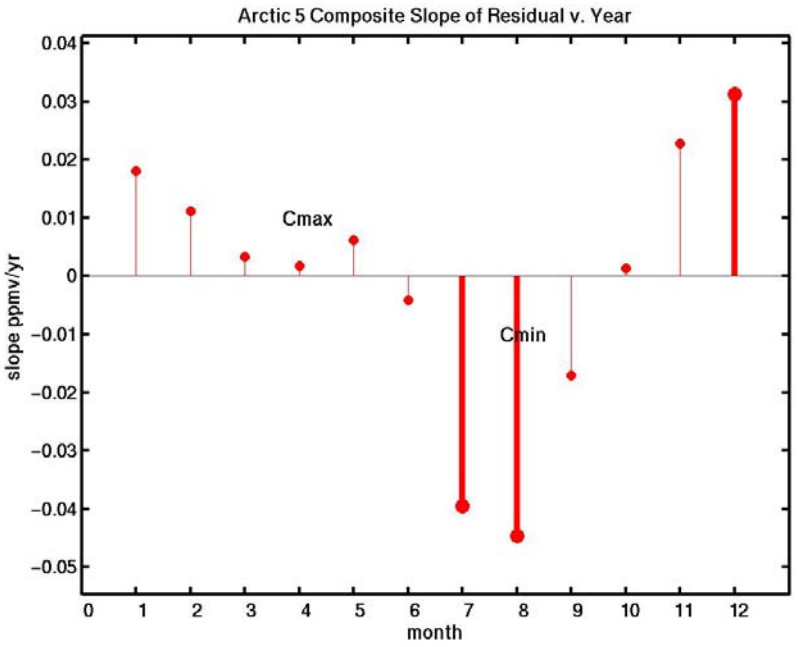


Monthly CO_2 Trends at 4 Arctic Stations

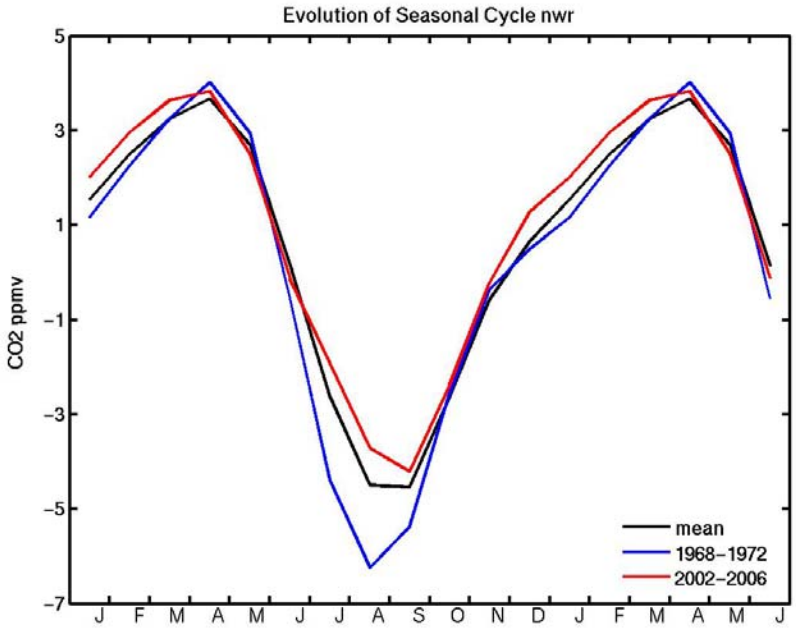


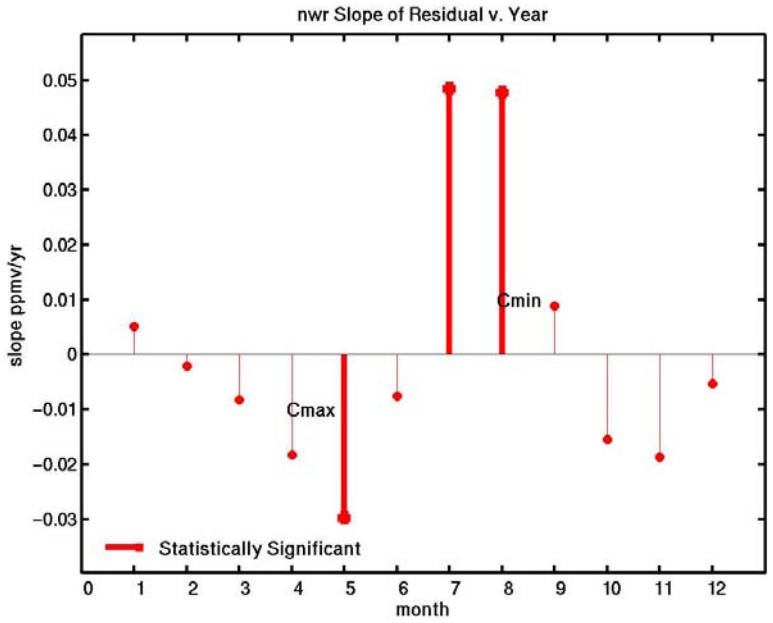
Arctic 5-Station Composite



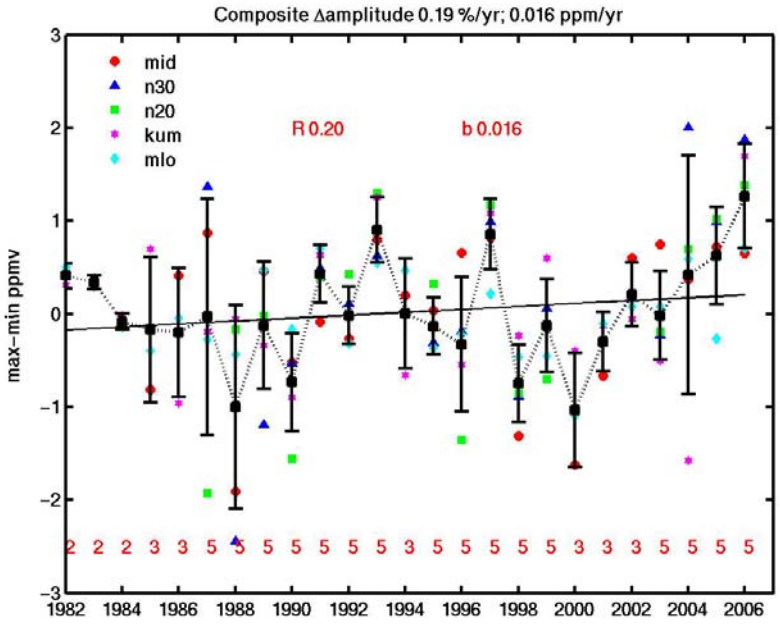


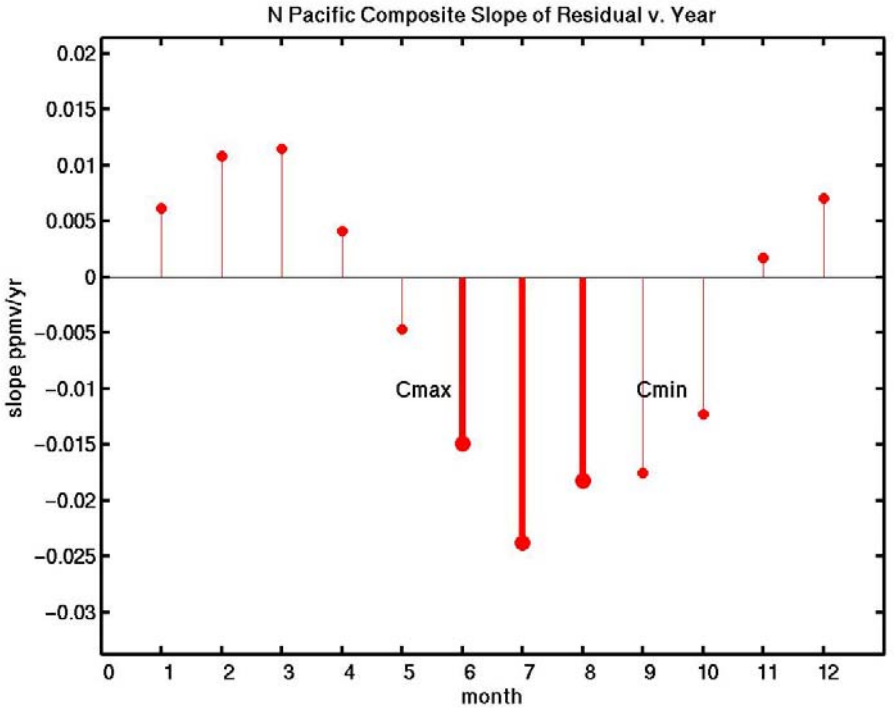
Niwot Ridge: Trends in CO_2 Seasonal Cycle



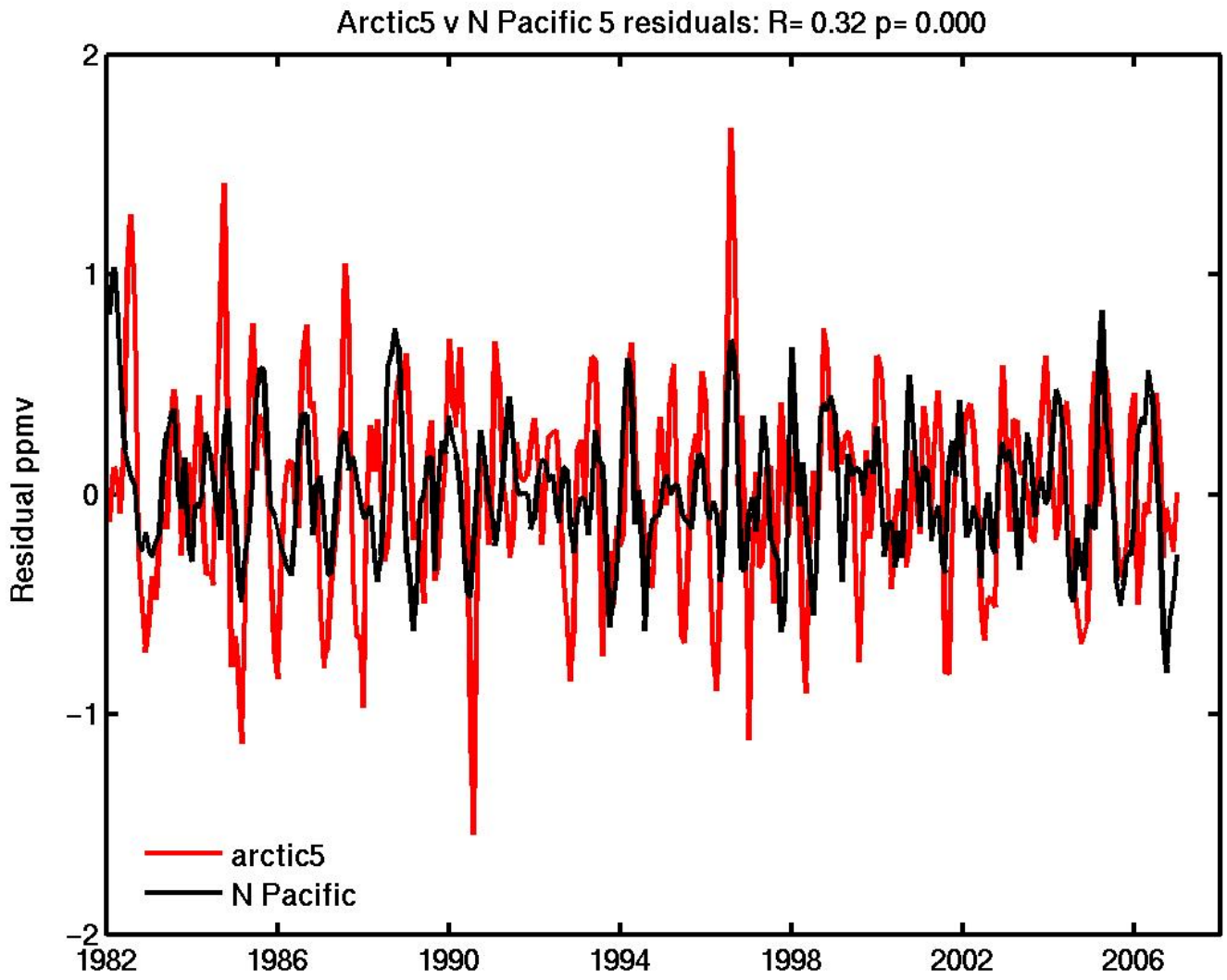


North Pacific Islands 5-Station Composite



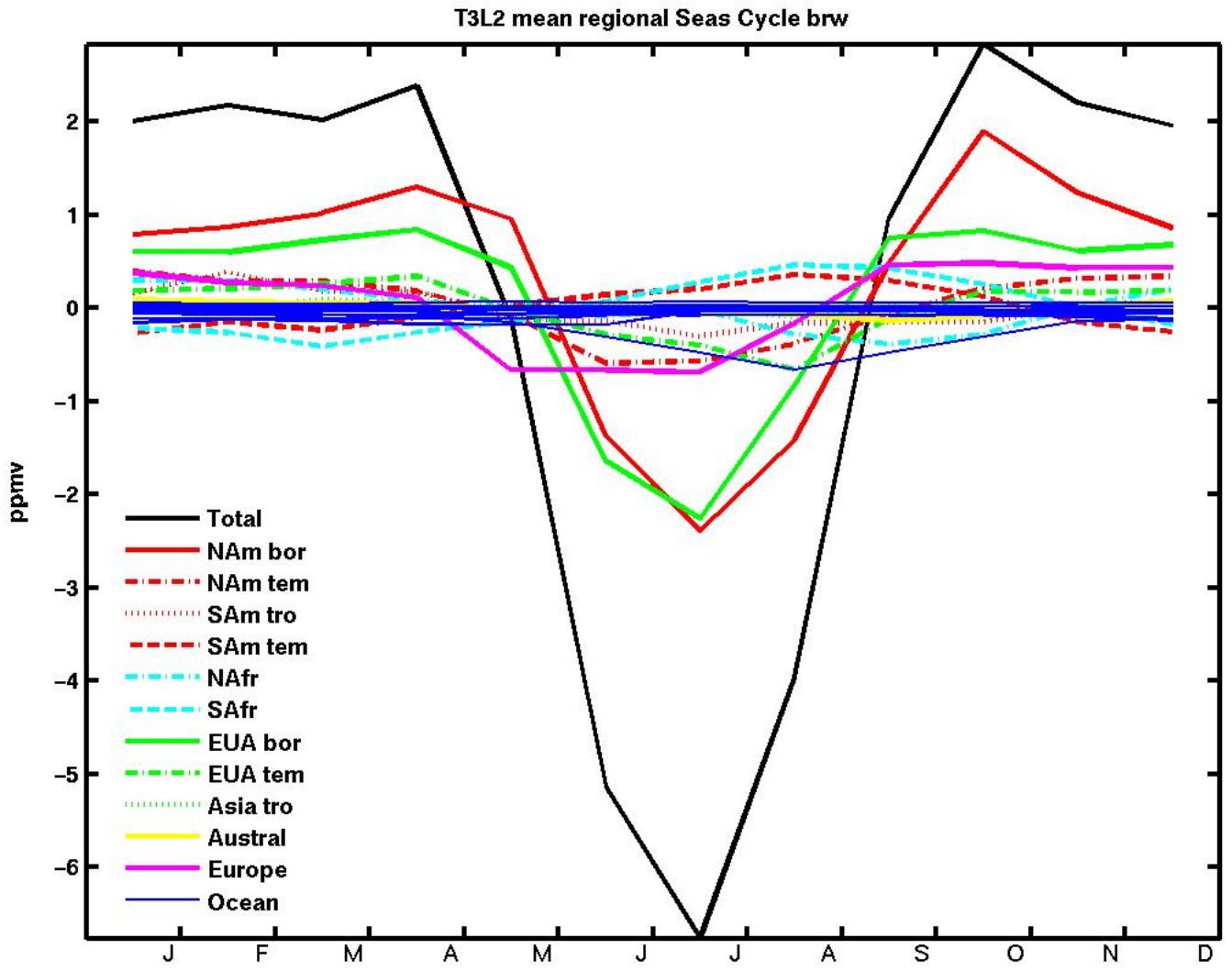


Correlation between composite N Pacific and Arctic high frequency residuals



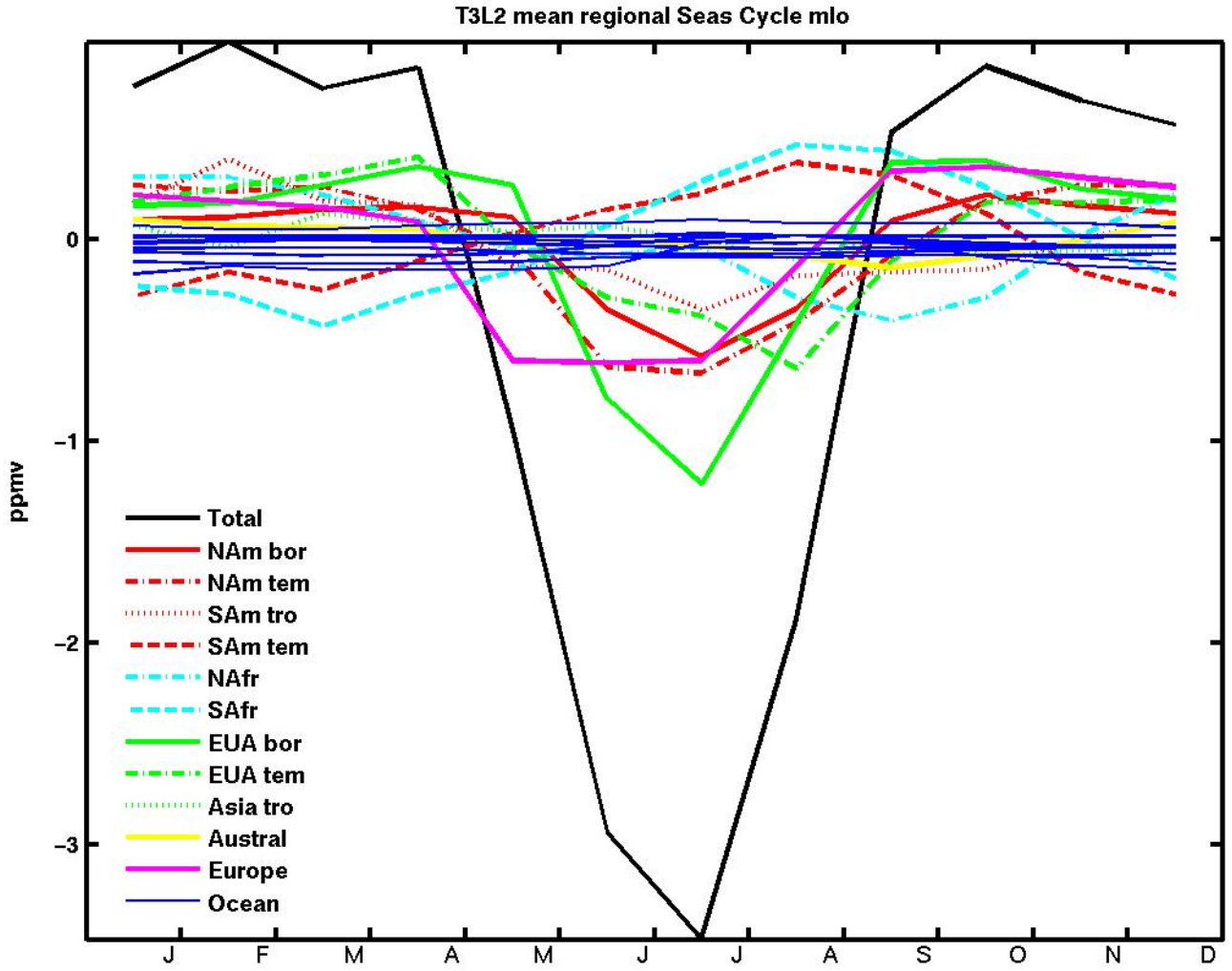
Source regions from Transcom basis functions

Barrow, Alaska (BRW): 71.3N, -156.6W, 11m

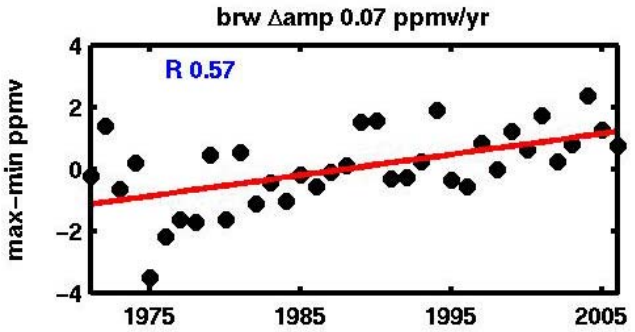


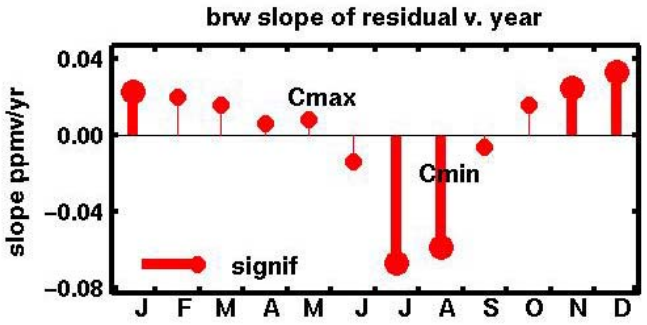
Source regions fromTranscom basis functions

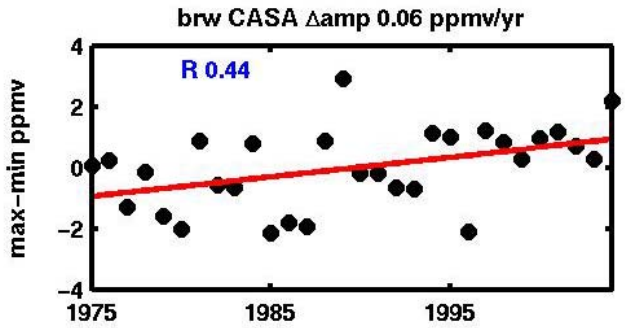
Mauna Loa (MLO): 19.53N, -155.58W, 3397m

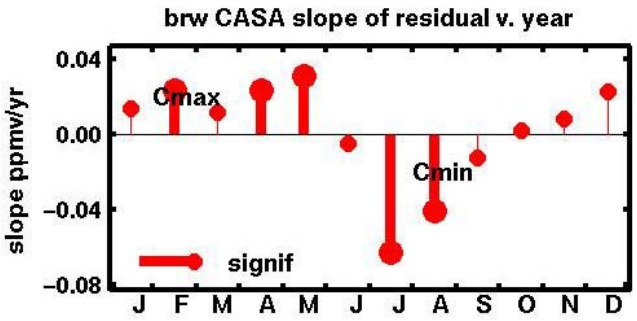


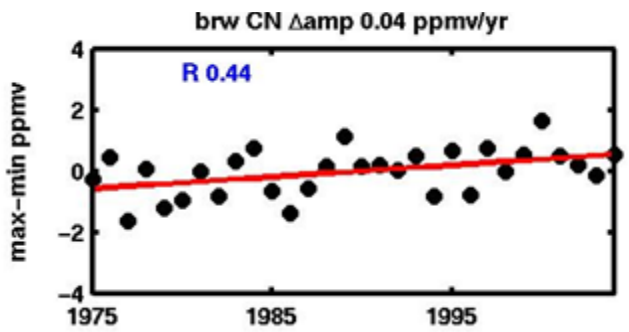
MATCH Transport Runs with NEE from Two Terrestrial Ecosystem Models

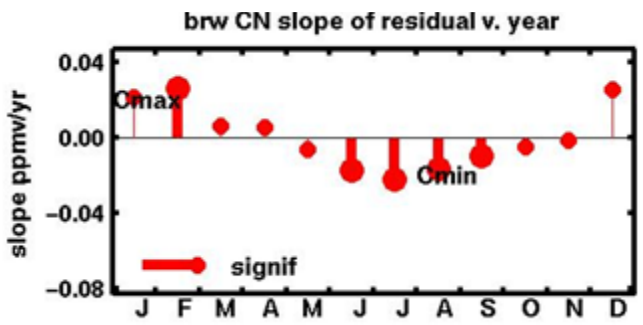








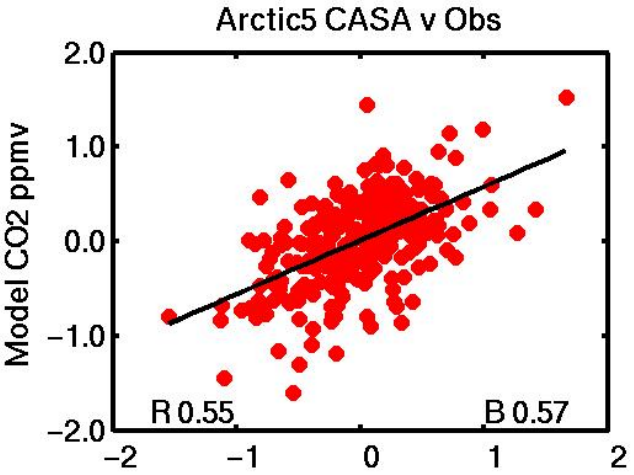


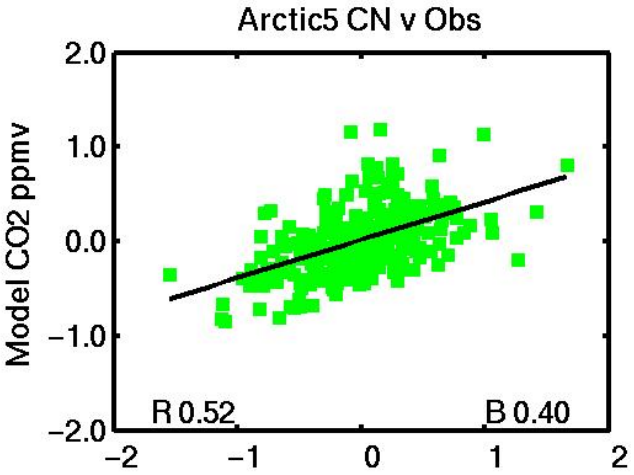


MATCH:CLM-CN and CASA' Transport Runs

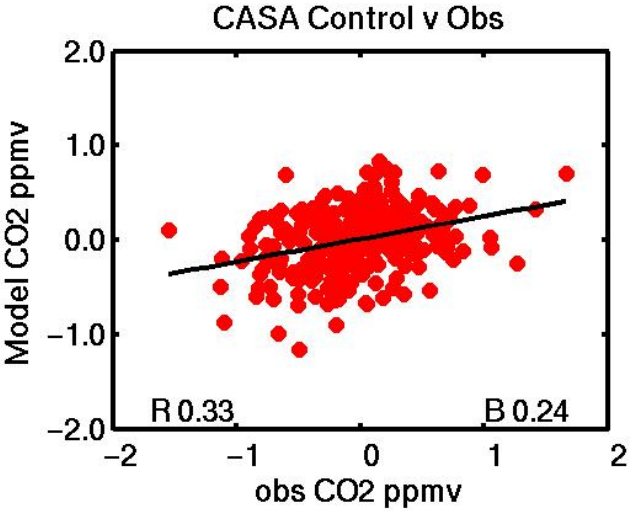
high frequency residuals from both ecosystem models correlated to obs

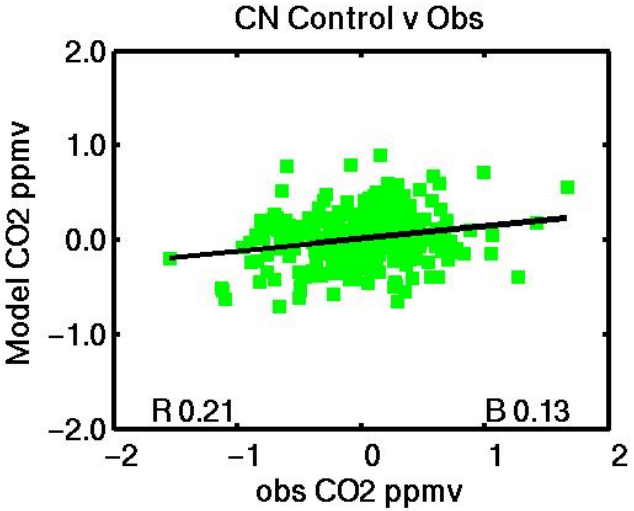
IAV in transport & biology





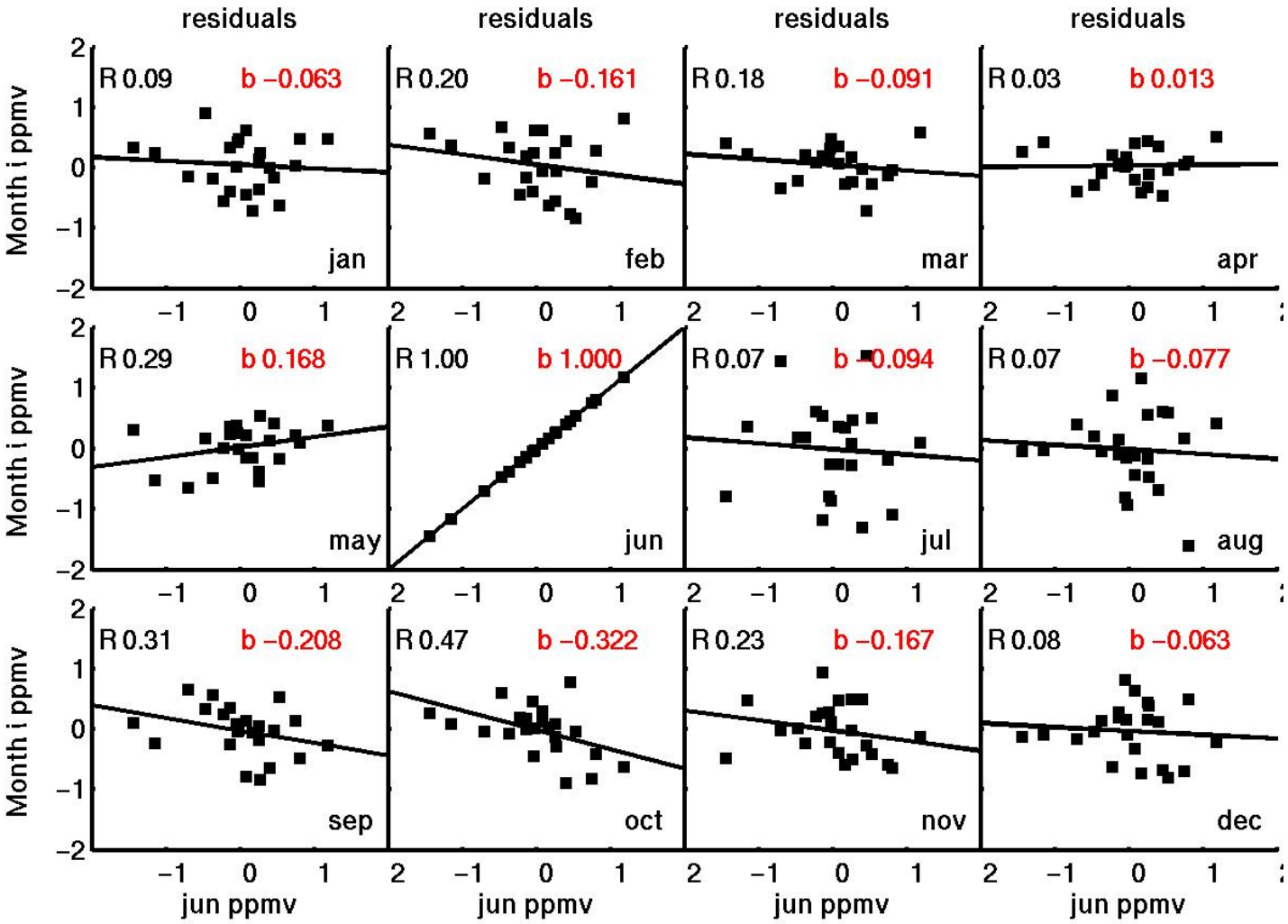
IAV in transport only



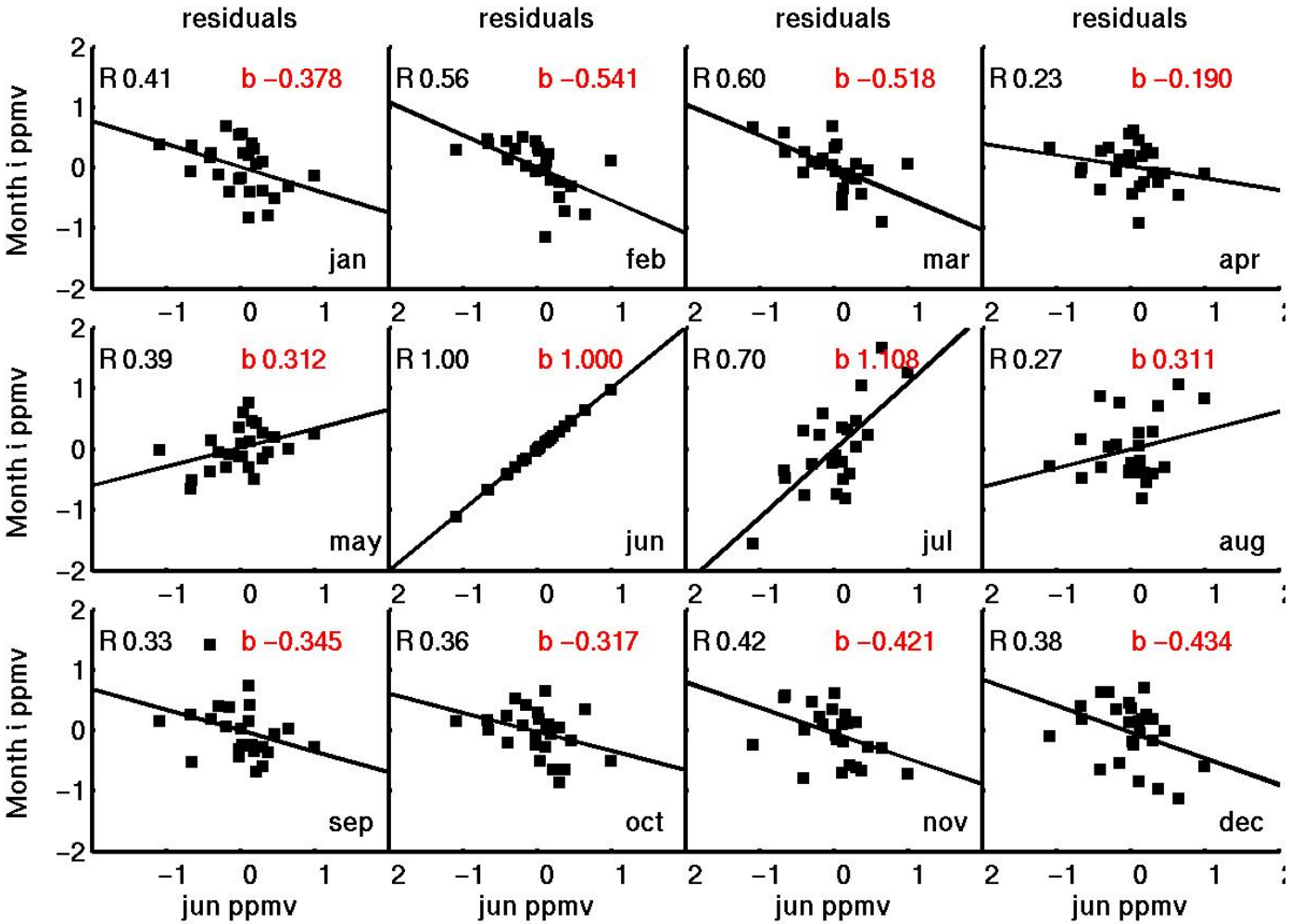


CASA'-MATCH Arctic Composite

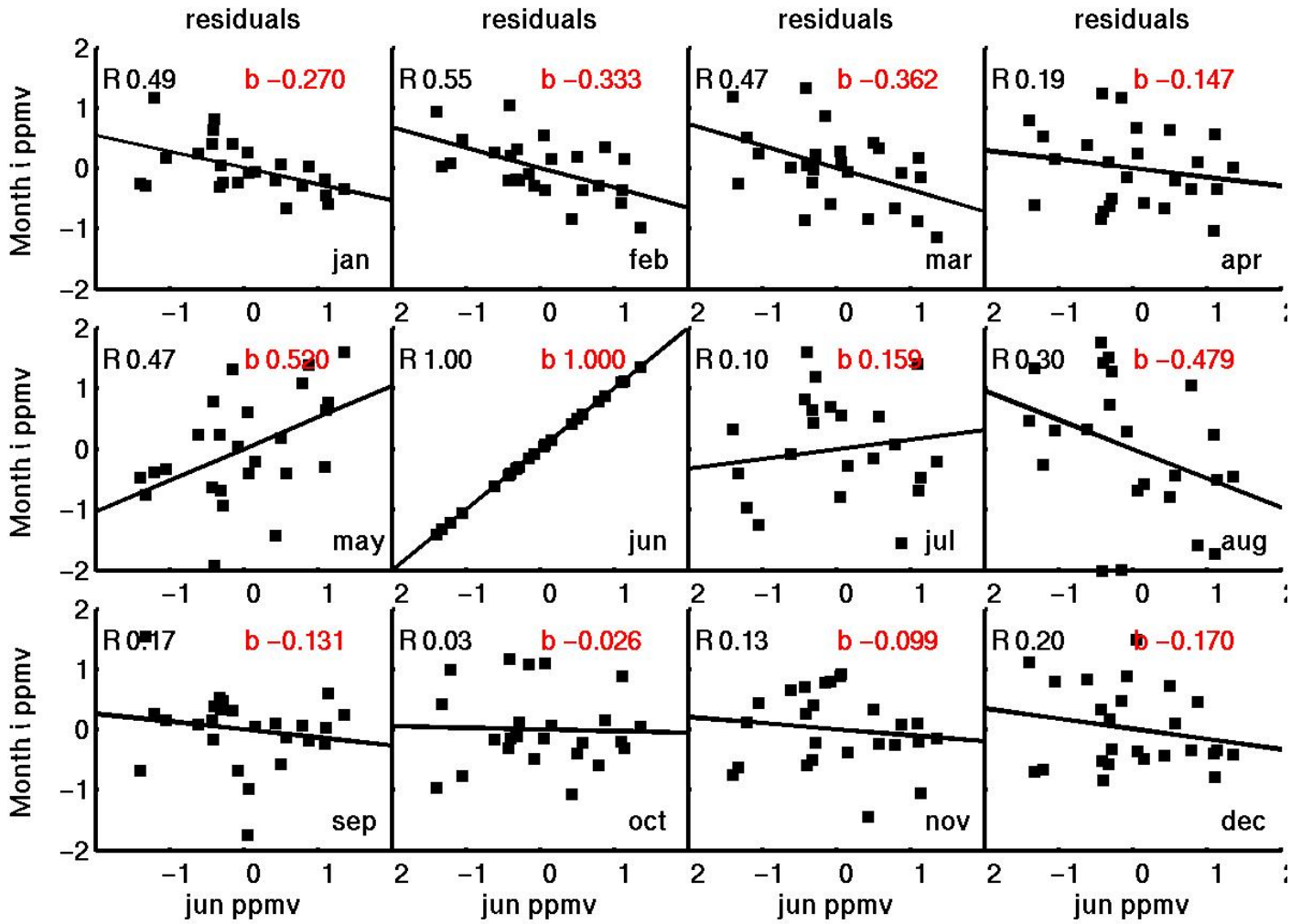
High Frequency Residuals: Intra-annual correlations of June v. other months
(each square represents one year from 1982-2004)



Obs Arctic June High Frequency Residuals plotted vs. all other months



Niwot Ridge June High Frequency Residuals plotted vs. all other months



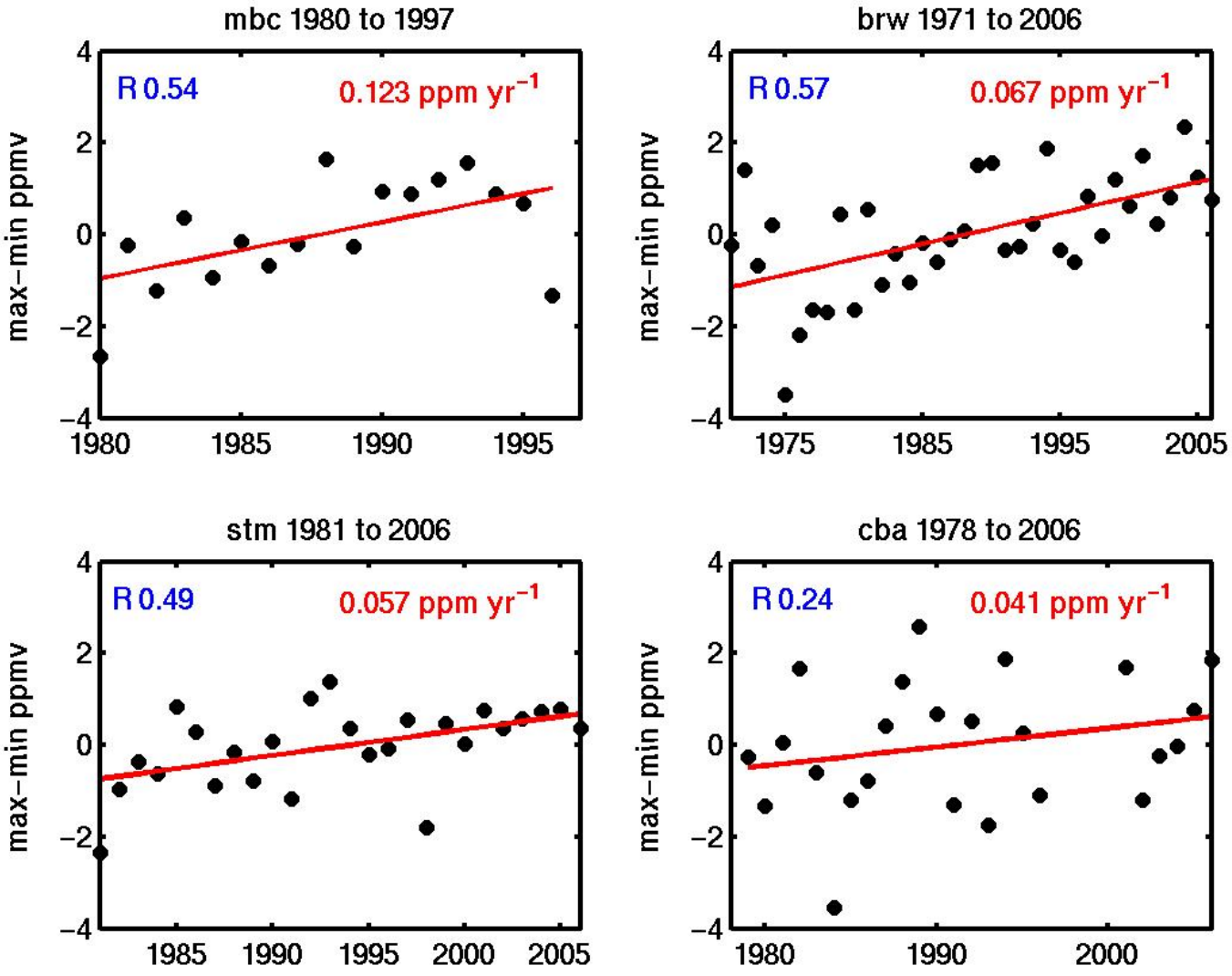
Conclusions

1. **Significant increases in amplitude at 5 Arctic stations ~ 10% over 25 years**

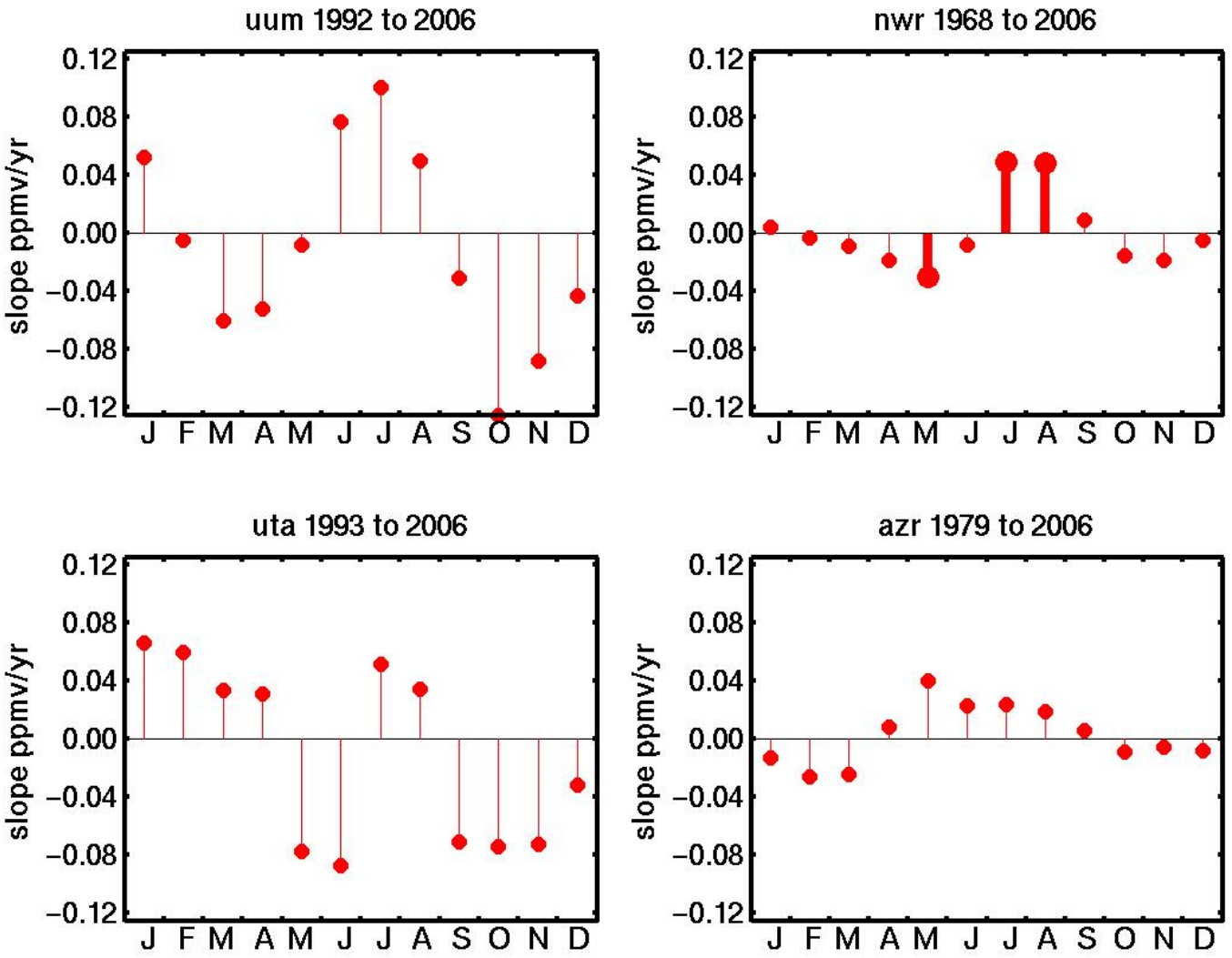
2. **Most likely reflects a terrestrial ecosystem response, although transport may also contribute**

3. **CASA' and CLM-CN Ecosystem models in part reproduce these trends, although not necessarily for the right reasons.**

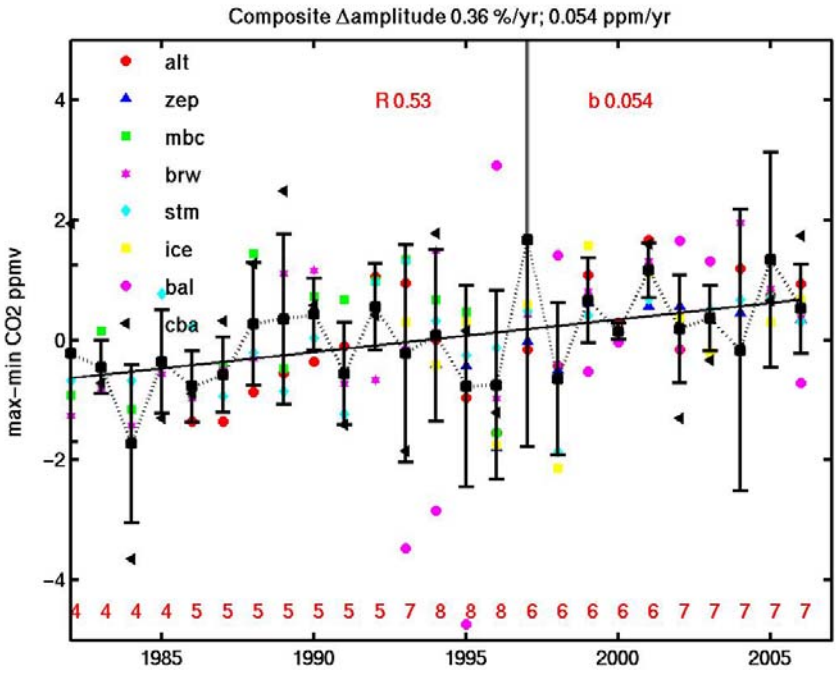
CO_2 Seasonal Amplitude Trends at 4 Arctic Stations

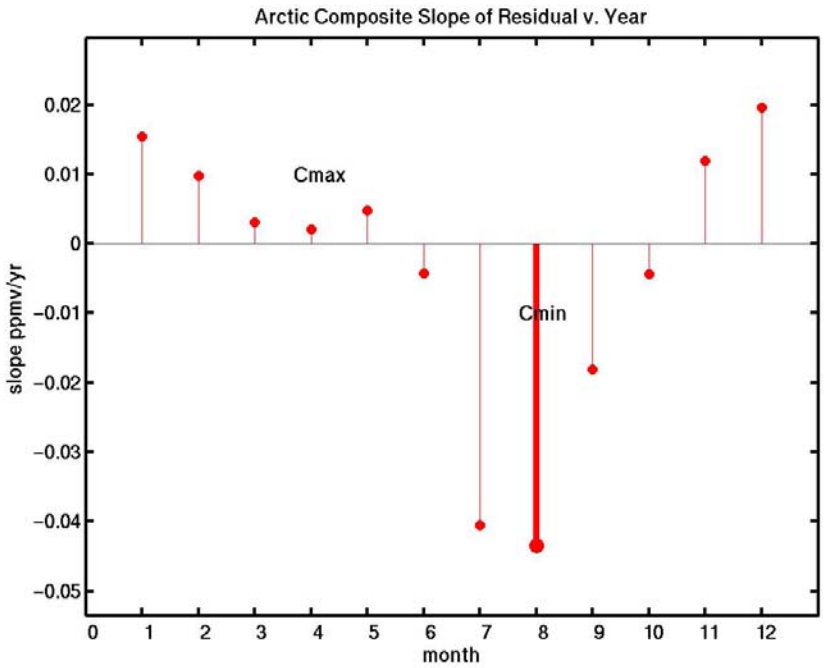


Monthly Trends at 4 NH Midlatitude Stations

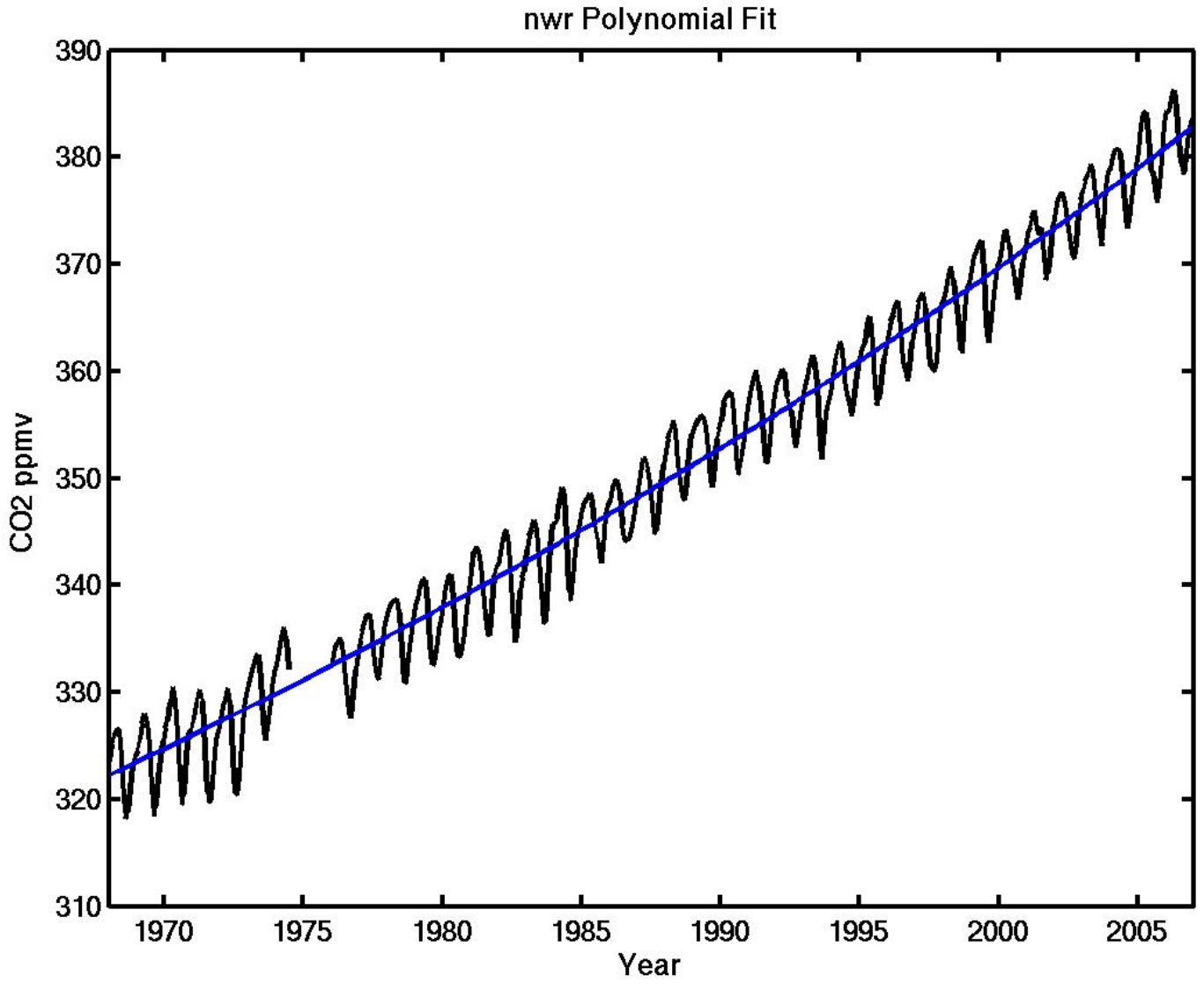


Arctic 8-Station Composite

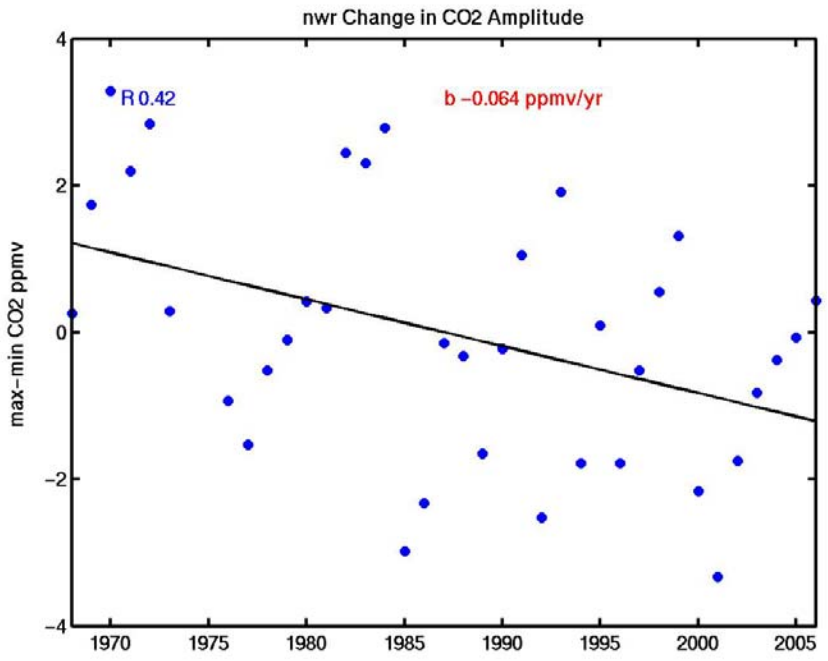


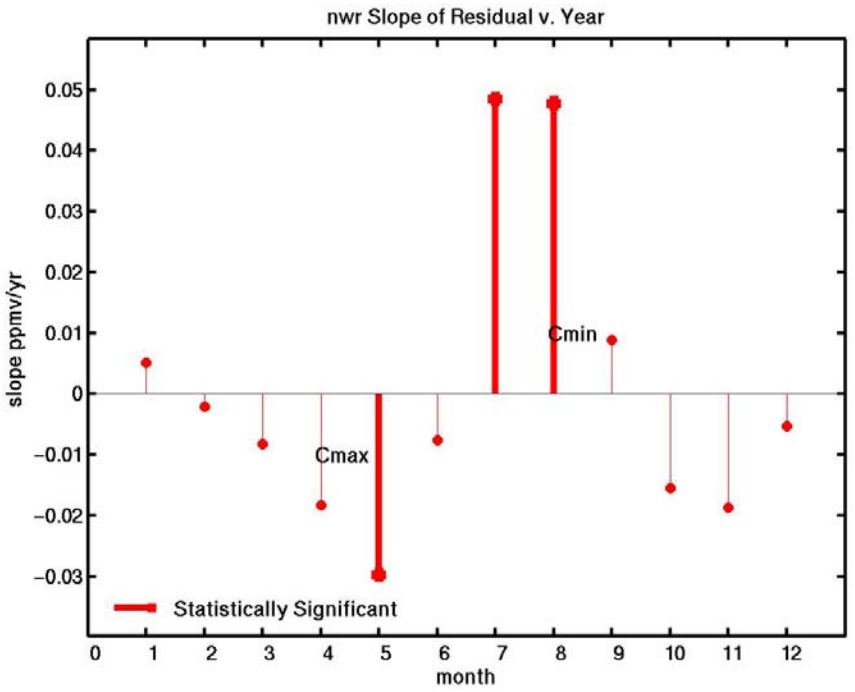


Niwot Ridge CO_2: 40.0N, -105.6W, 3523m



Niwot Ridge: Trends in CO_2 Seasonal Cycle

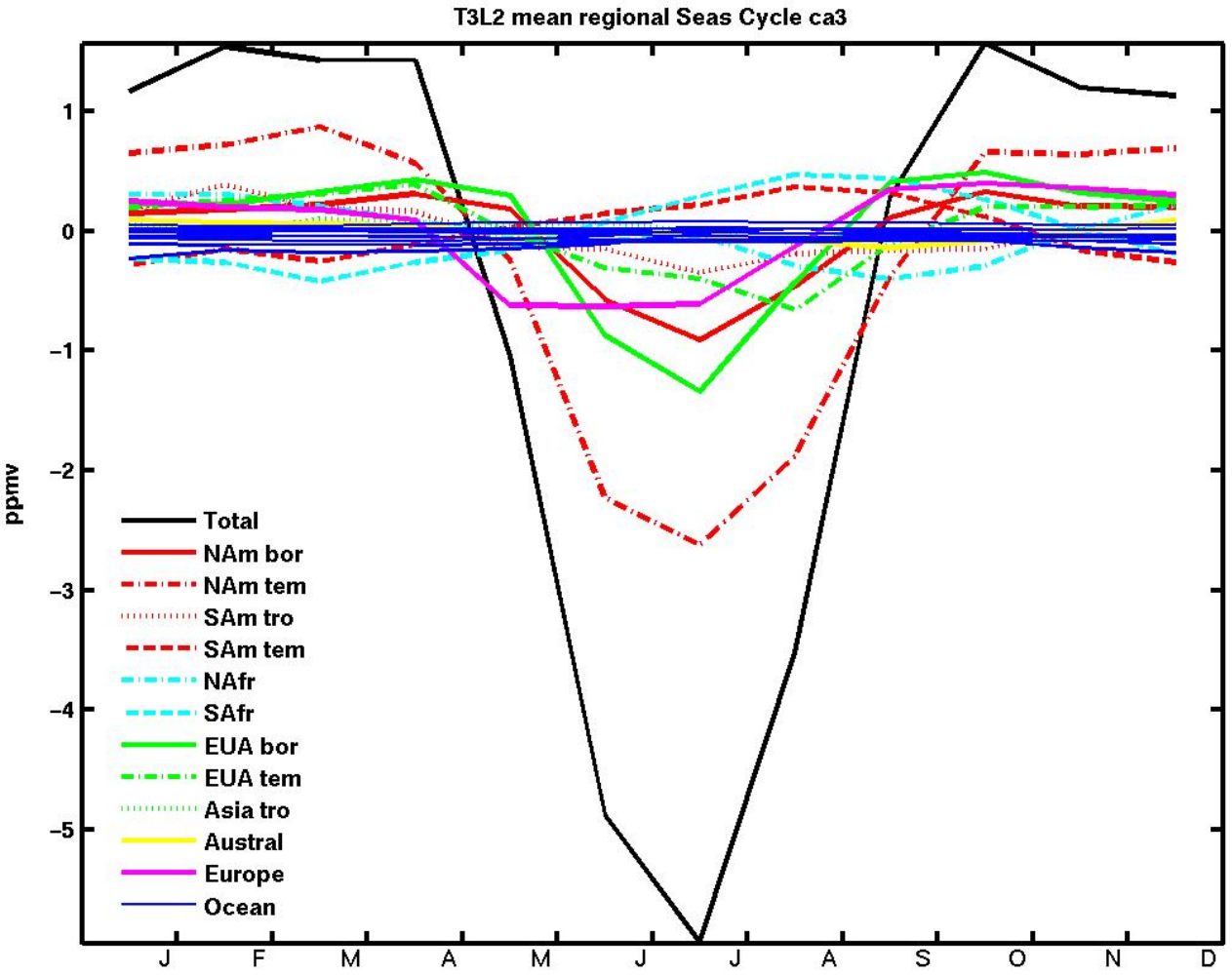




Source regions fromTranscom basis functions

Carr (CO): 40.90N, -104.8W, 3000m

(using as analog for Niwot Ridge (CO): 40.0N, -105.6W, 3523m)



MATCH Fossil Fuel Simulation

high frequency residuals not correlated to observations