Four Years of Zonal CO_2 Trends from AIRS

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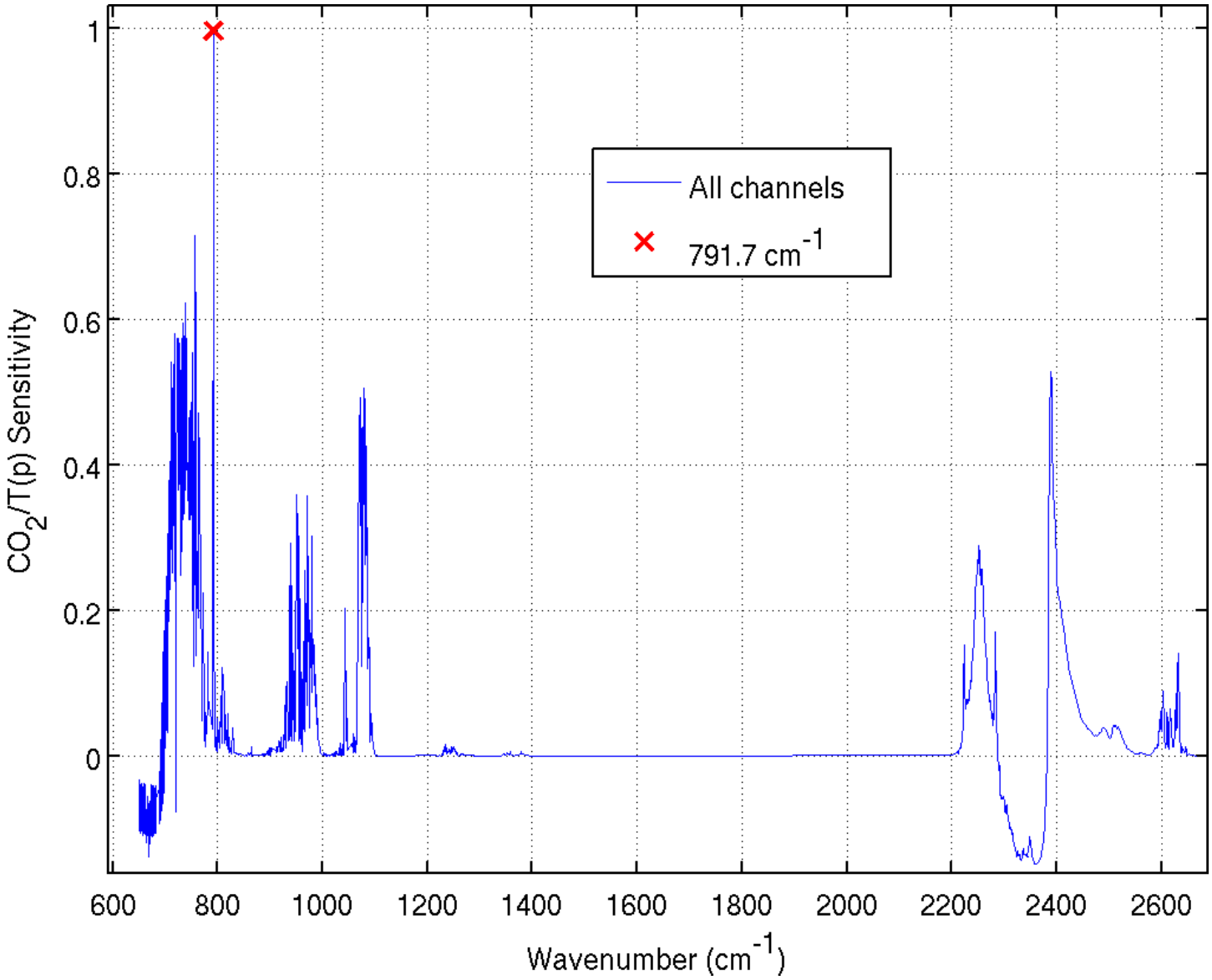
Overview

- During RTA validation found that CO_2 growth rate impacted results
- Variable CO_2 must be taken into account for climate-quality results from AIRS (and RTA validation);
- V5: Single fixed growth rate, no latitude dependence
- We use ECMWF (independent T(p)?) and NOAA/CMDL MLO CO_2 to examine AIRS sensitivity to CO_2 and implications for radiometric stability
- Calibrate AIRS CO_2 channels with MLO (altitude close peak of weighting functions for channels used here).
- Apply results to other latitudes. Use channels with different T(p) sensitivities to evaluate possible ECMWF T(p) errors (LW/SW).
- Use “uniform_clear” subuset of clear ocean FOVS generated at UMBC.

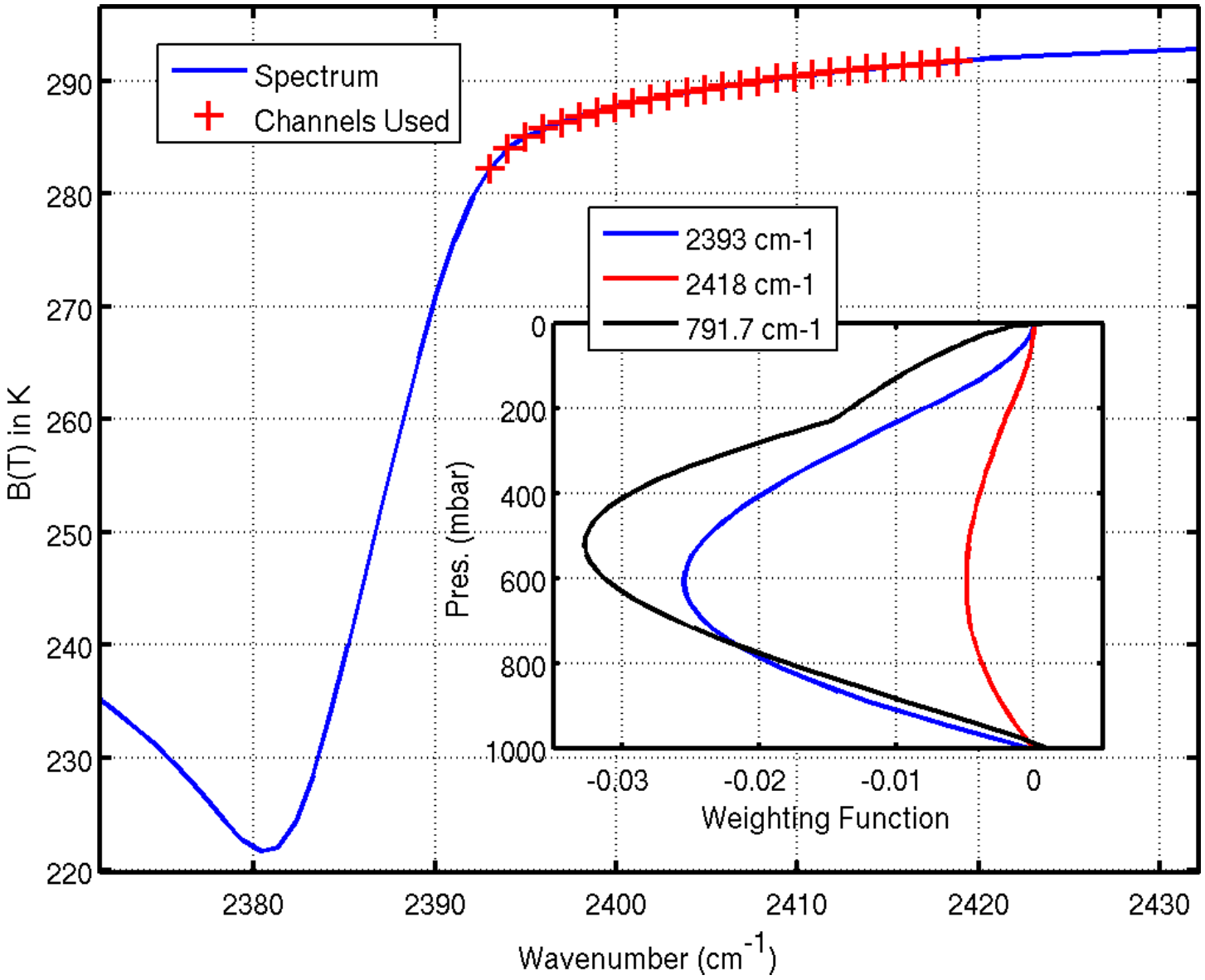
Approach

- $BT_{obs} - BT_{calc}(ECMWF) = \frac{dB}{dCO_2}\delta CO_2 + \frac{dB}{dT}\delta T_s$
- SW: 2392-2420 cm^{-1}, all channels used for both CO_2 and T
- LW: 791.7 cm^{-1} used for CO_2 and T_s; 790.3 cm^{-1} used for T_s only.
- CO_2 and T_s solved for each profile, Start with 2616 cm^{-1} T_s. Probably solving for emissivity at 2400 cm^{-1}, residual H_2O and emissivity at 791 cm^{-1}.
- Median CO_2 and T_s binned for 1 deg. latitude bins
- 36 months of data analyzed, almost ready for 48 months

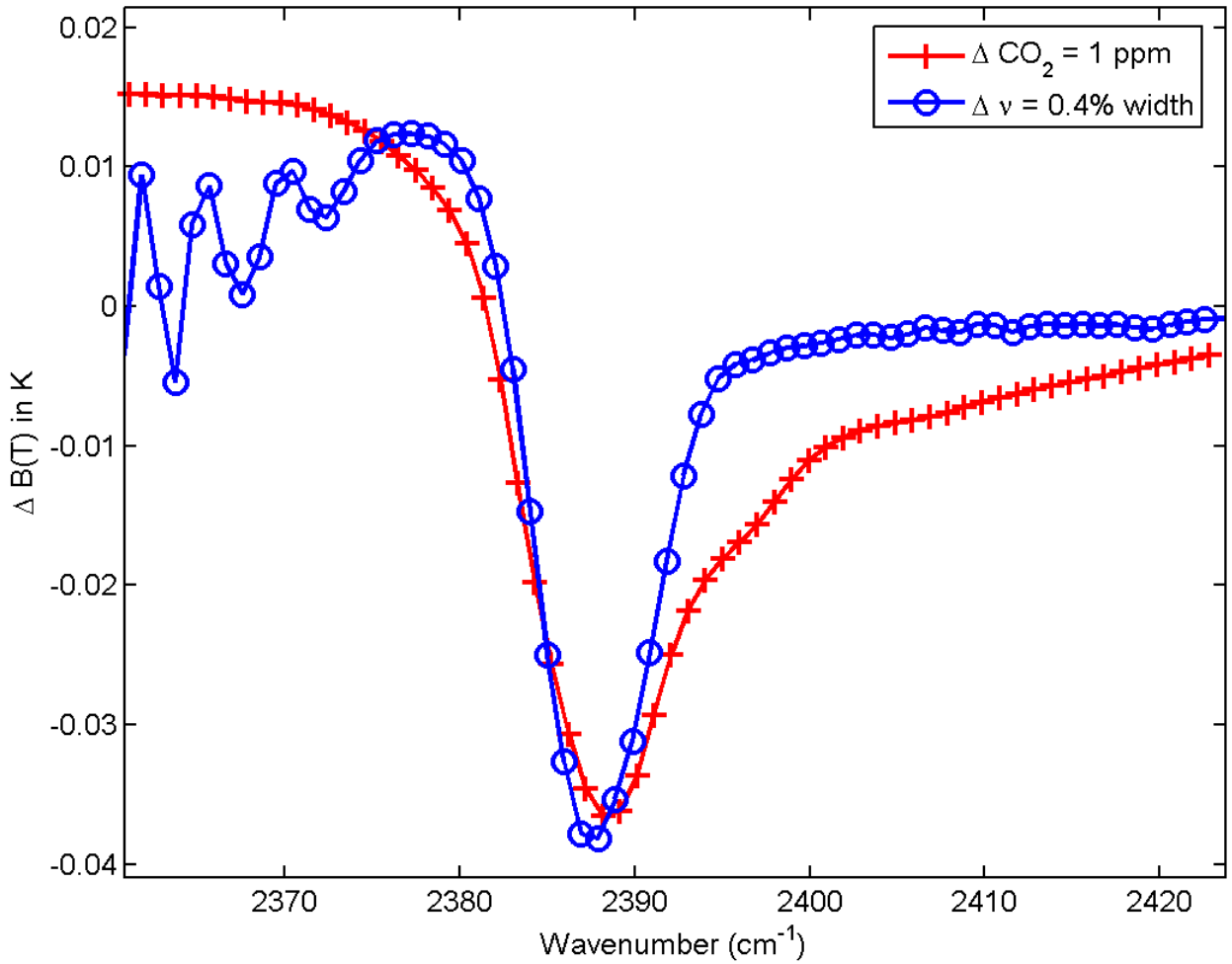
Ratio of CO_2 to T(p) Jacobians



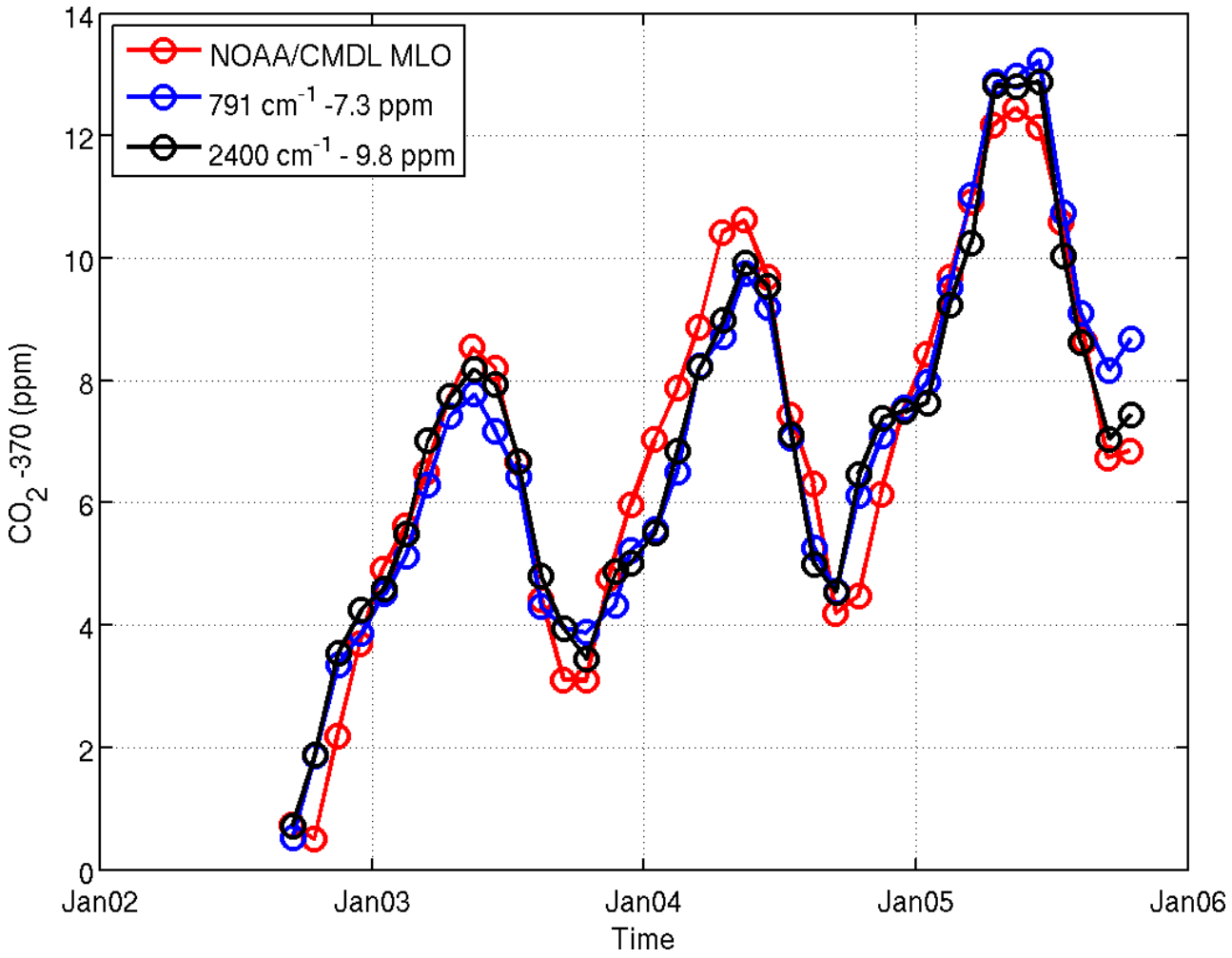
CO_2 Retrieval Using Shortwave Channels



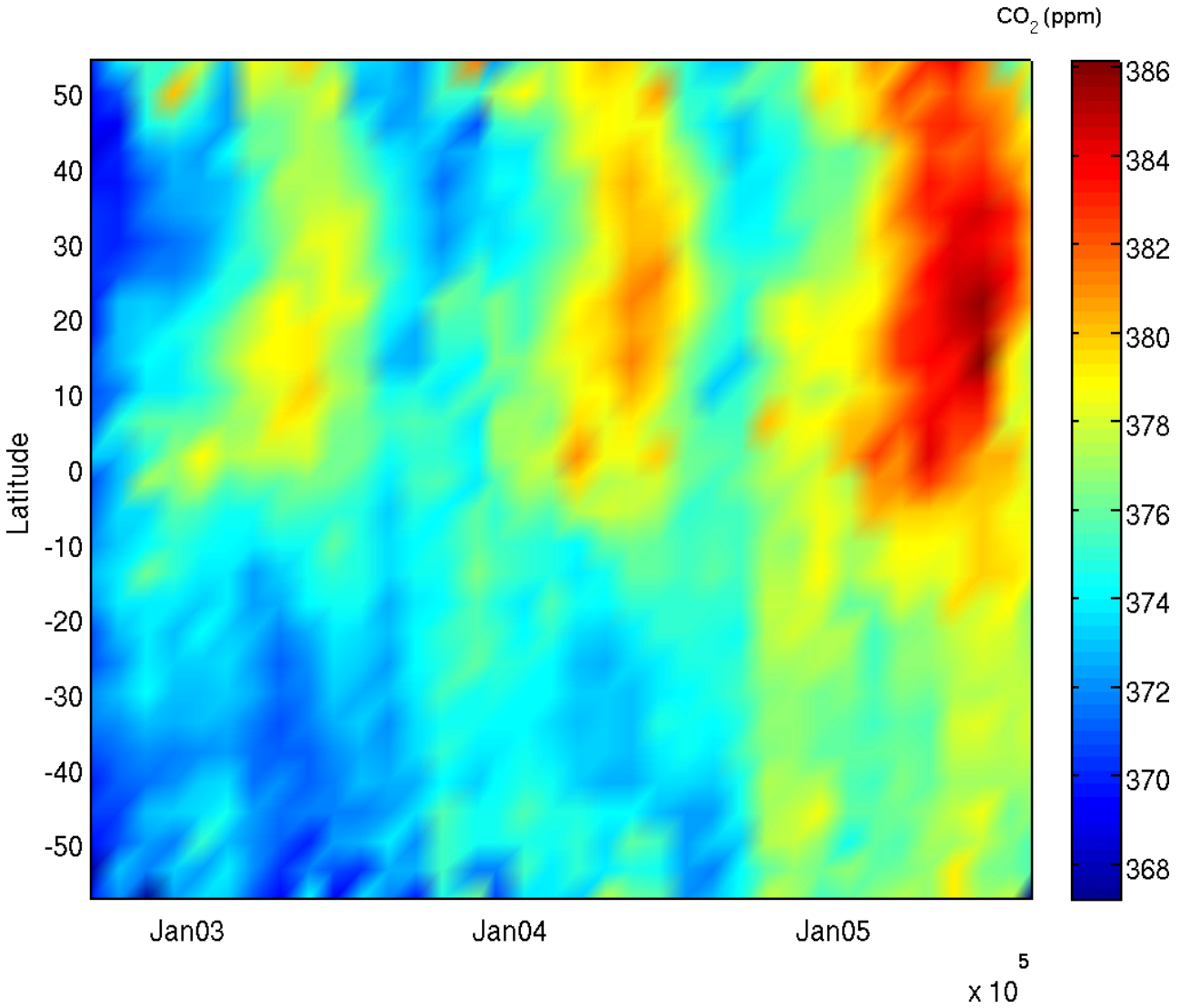
But: Need Better AIRS Frequency Calibration!



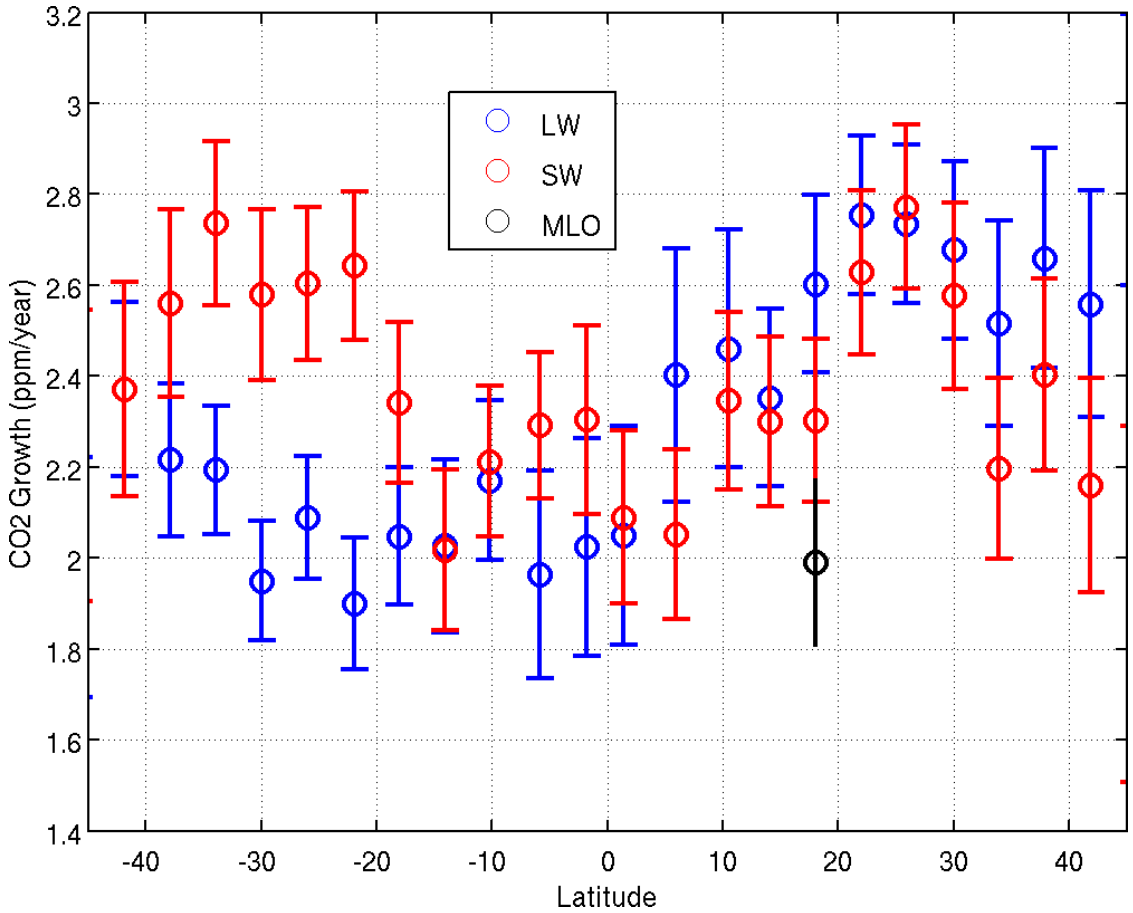
CO_2 Retrieval vs MLO (600 mbar)



CO_2 vs Latitude and Time

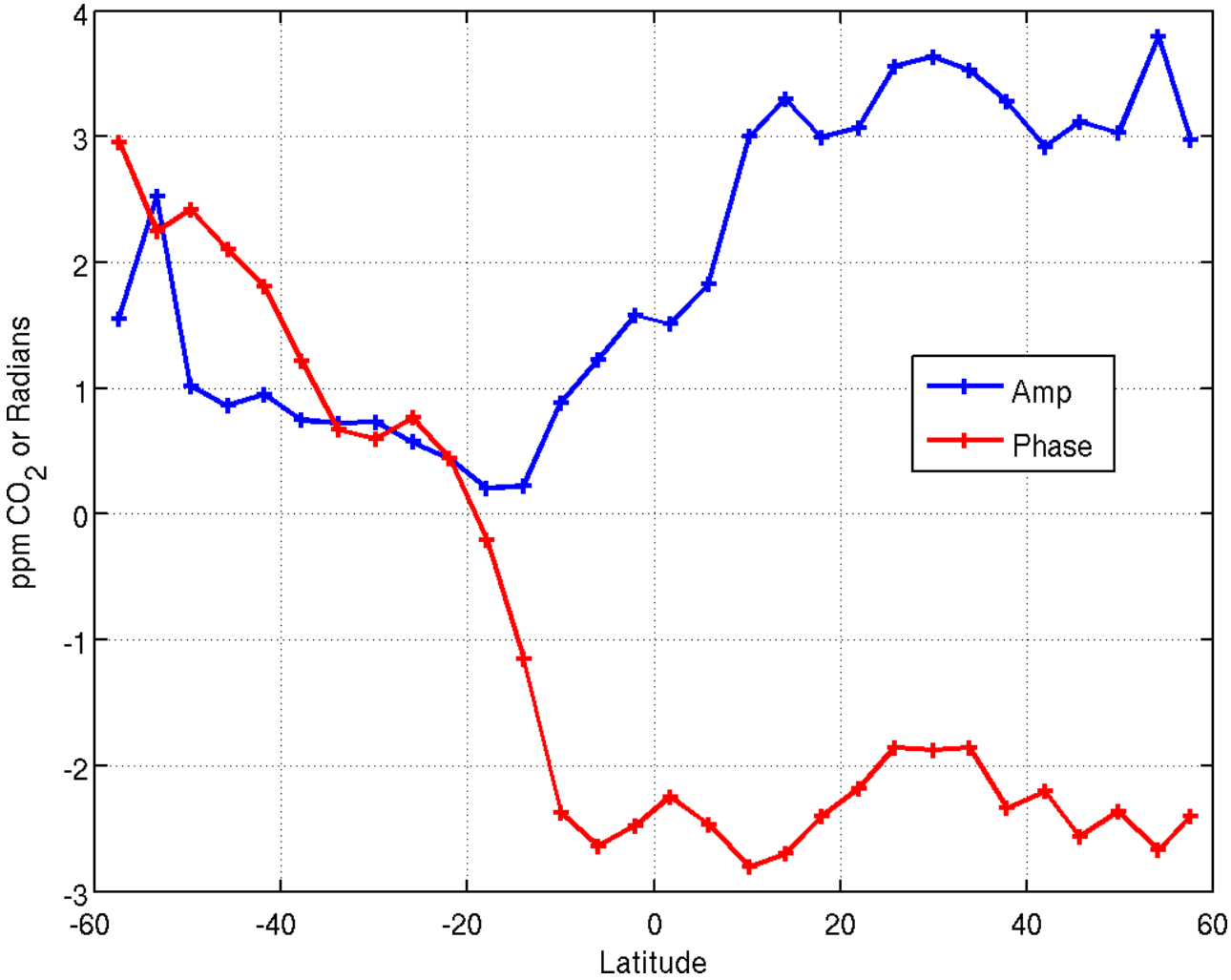


CO_2 Growth Rates: Sept 2002 to Aug. 2005 MLO is black circle

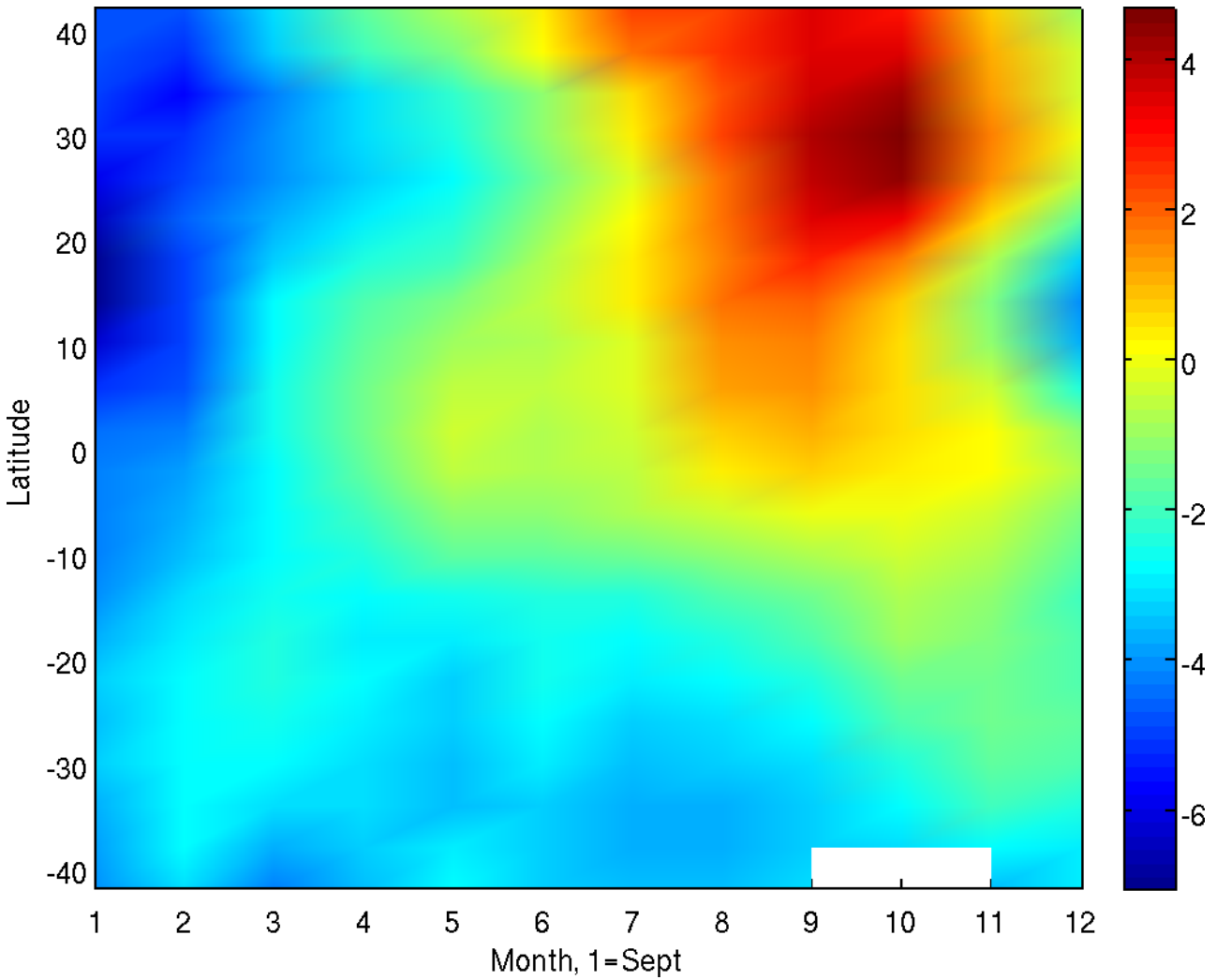


One problem: SW slightly mixes SST with CO2, modify by forcing no drift in SST for SW only

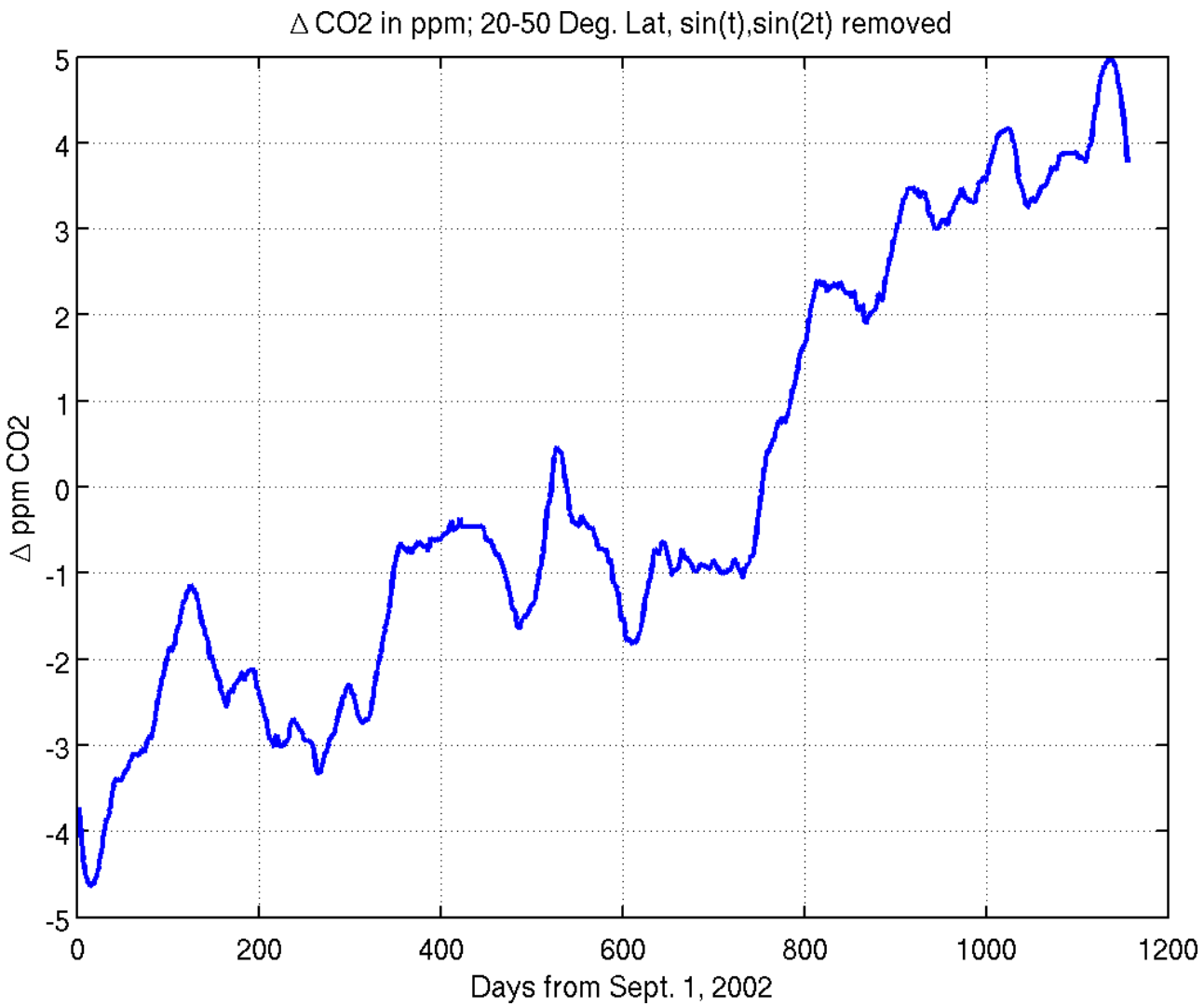
Amplitude and Phase of CO_2 Seasonal Cycle



Detrended (and averaged) CO_2 Cycle Amplitude



Sample Smoothed "Linear" Trend: 20-50 Deg. Lat.

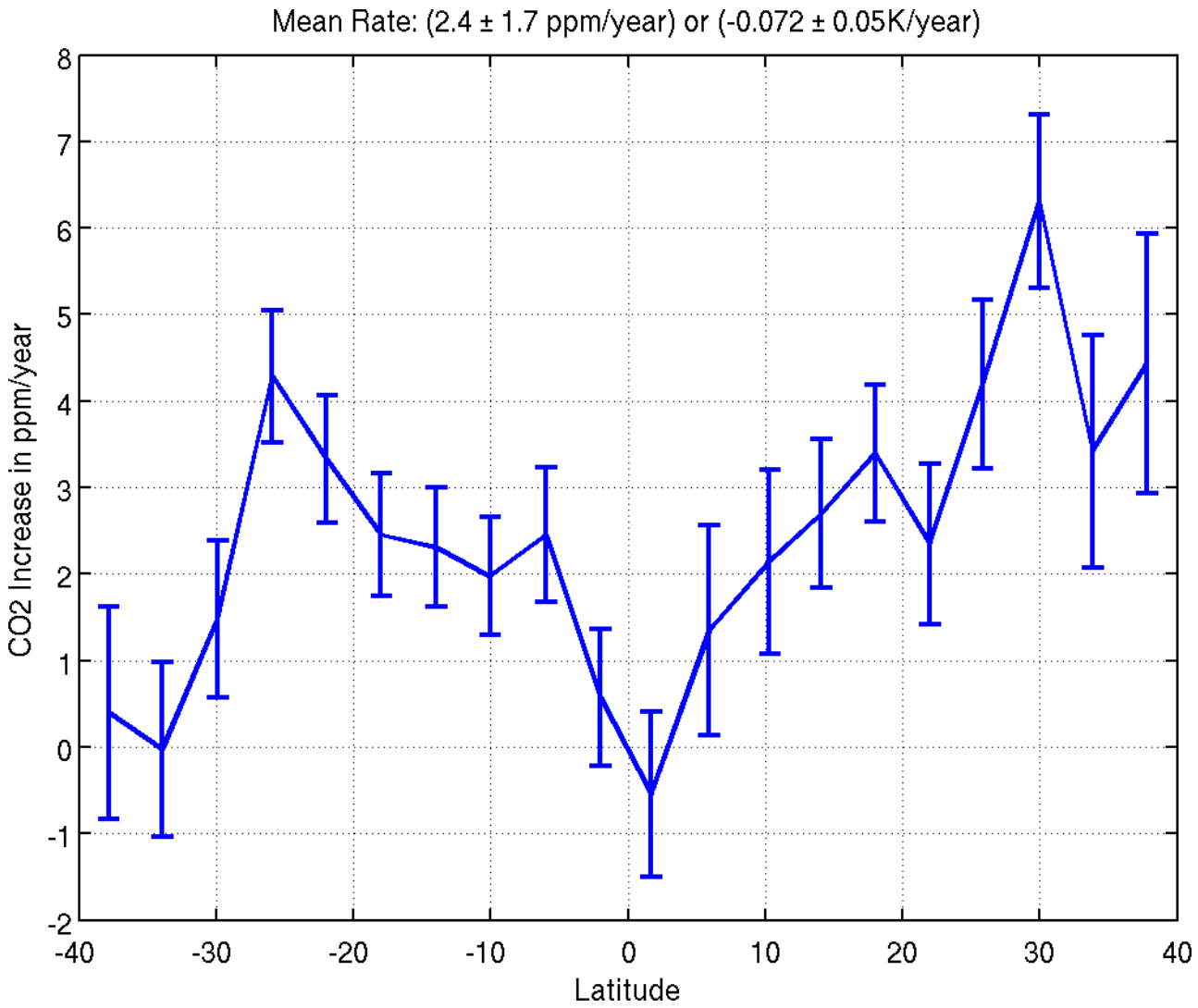


Summary: 3-year Averaged Rates

- Mean LW rate (-40 to +40 Lat): 2.31 $\pm$0.30 ppm/year
- SW rate: 2.39 $\pm$0.22 ppm/year
- MLO rate: 1.99 $\pm$0.09 ppm/year (my calculation)
- Global NOAA CMDL: 2.09 ppm/year
- 0.3 ppm rate error implies 0.009 K/year uncertainty in AIRS radiometric drift.

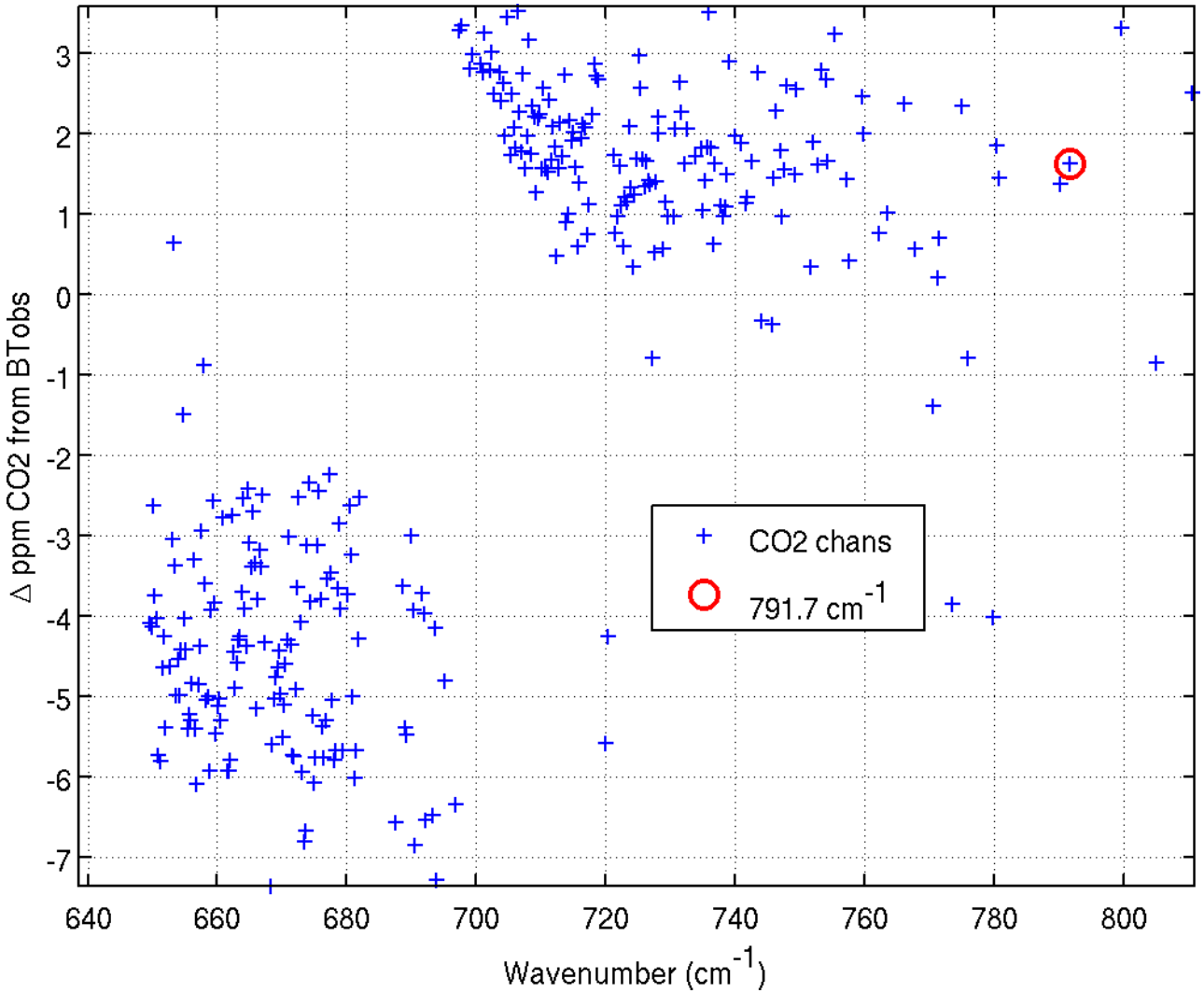
LW CO_2 Growth Rate from B(T) Obs (4 years)

NO ECMWF



Linear Rate of CO_2 from B(T) Obs: 4 years

"Good" CO_2 channels, scatter from bad weighting functions.



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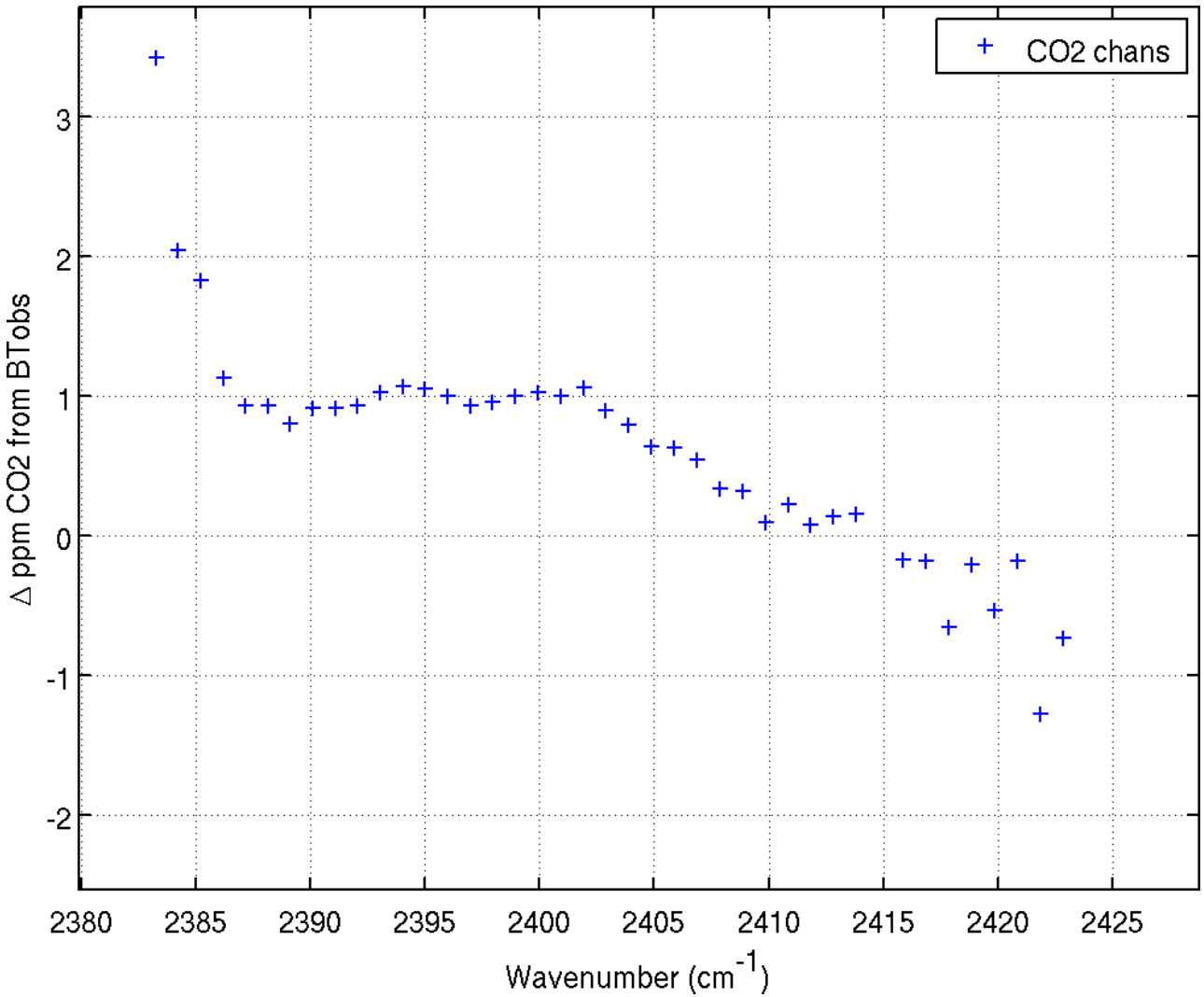
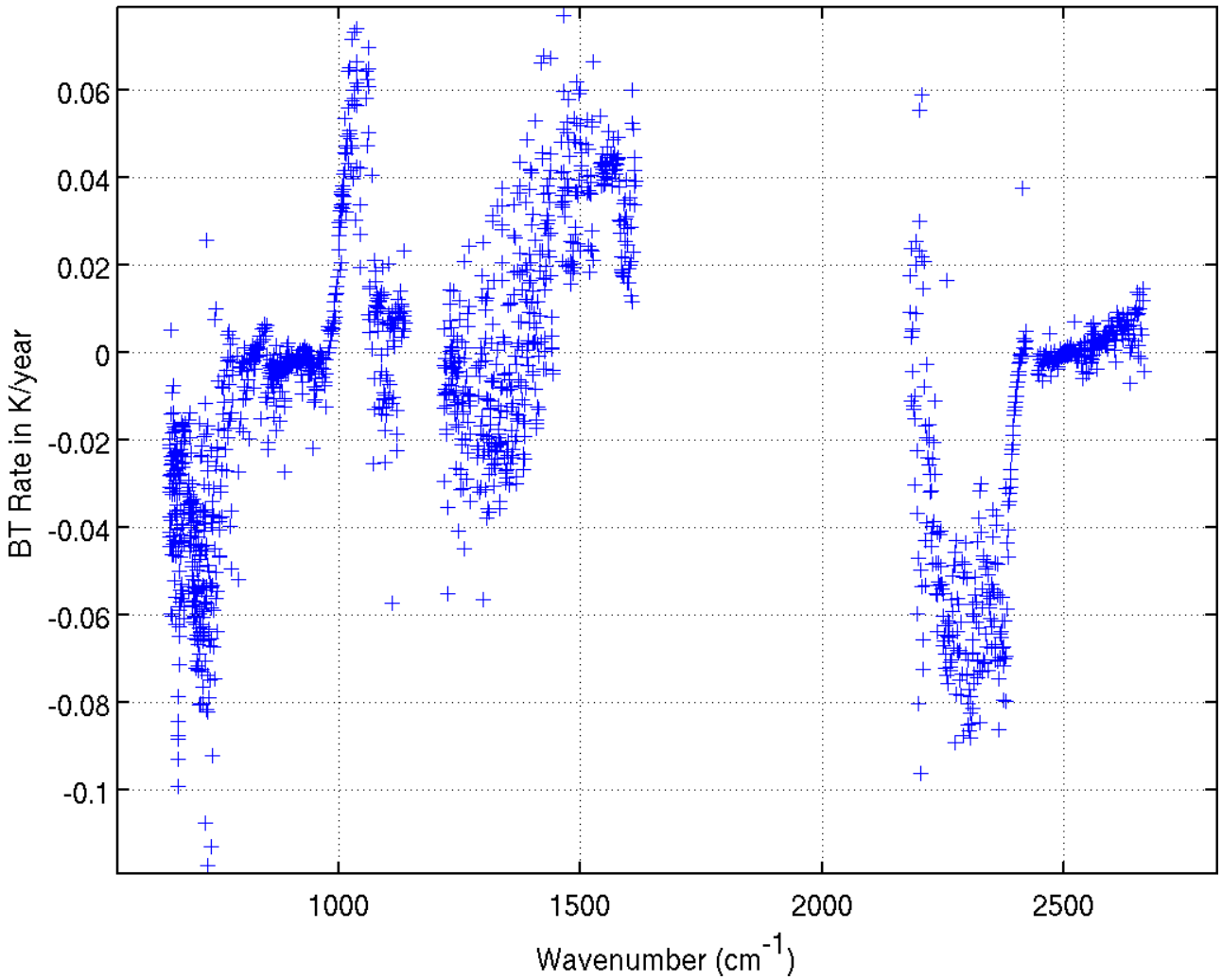
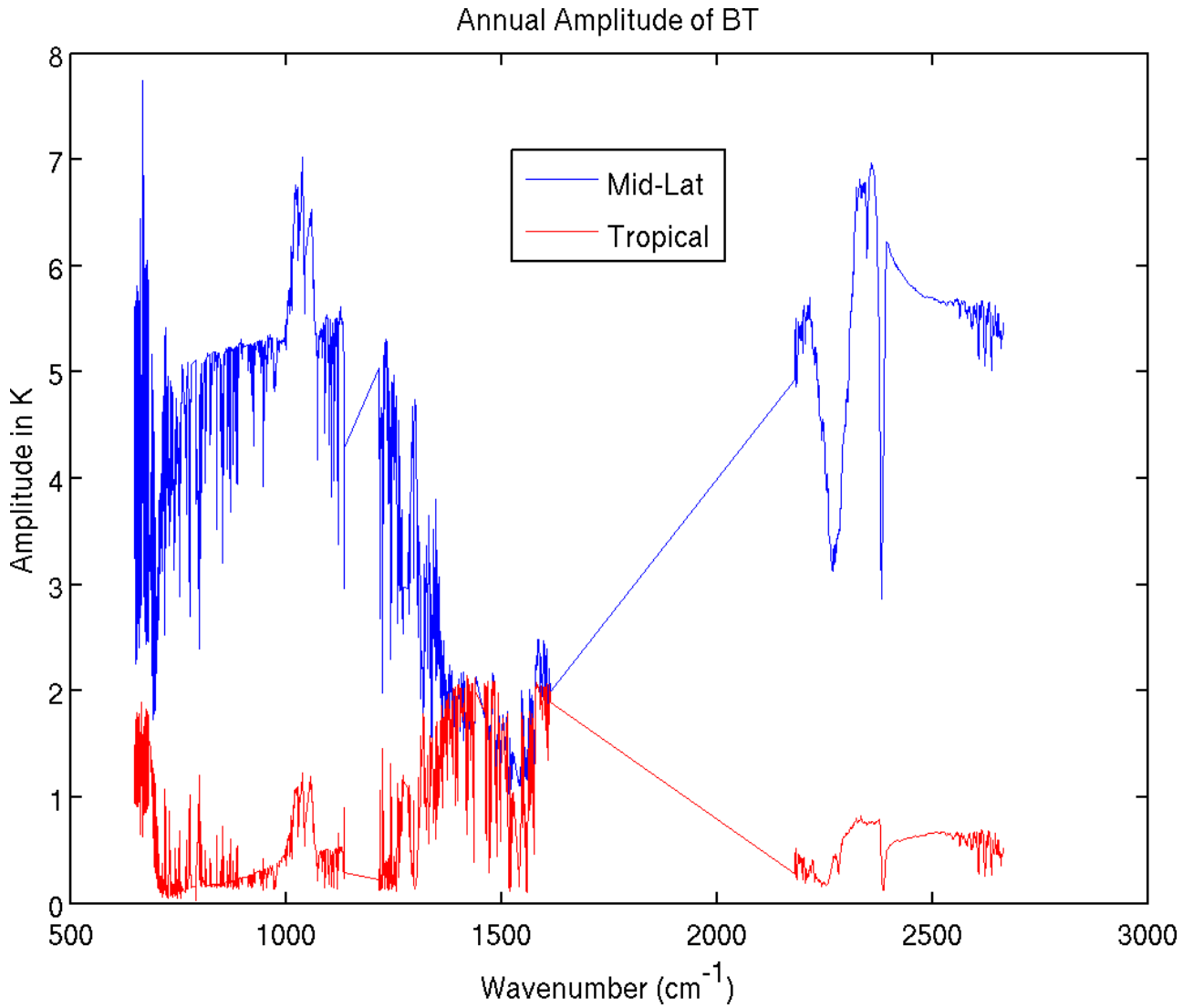


Linear Rate of B(T) in *K/year*: 4 years



Amplitude of B(T) Seasonal Cycle



Phase of B(T) Seasonal Cycle
$\pi/2$ subtracted from Tropical