AIRS Derived CO_2 Zonal Anomalies over Ocean

AIRS Science Team Meeting

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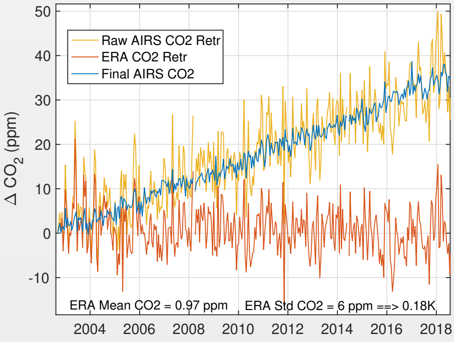
Introduction

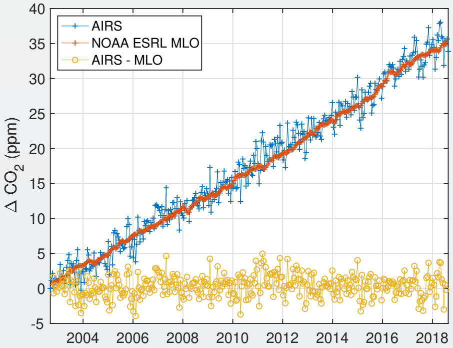
- How to AIRS growth rate anomalies compare to OCO
- OCO is column, AIRS is broad kernel around 400 mbar, little surface contribution
- OCO is quite heavily constrained over ocean in the S. Hemisphere
- Why: AIRS S. Hemisphere anomalies grew during 2015 ENSO before the N. Hemisphere anomalies. Doesn't seem right?
- Either very interesting, or, more likely, good way to investigate ultimate accuracy of AIRS CO_2 anomalies.

CO_2 Anomaly Fit for 20° N. (MLO)

Fitting Trick

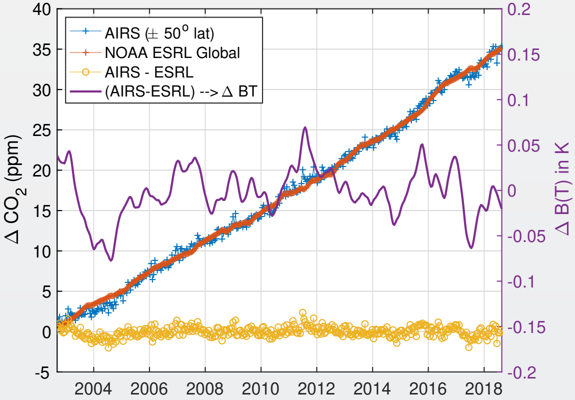


Fitted CO_2 Anomalies



- ERA simulations done per footprint
- Fit ERA simulation for CO_2
- Removes co-linearity? and lowers "noise"
- Possible approach for Level 2 CO_2 retrievals?

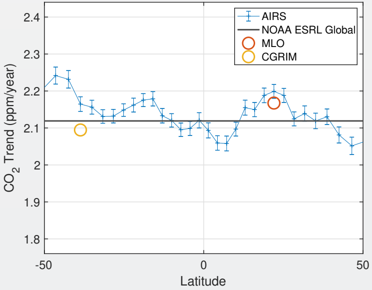
CO_2 Anomaly Converted to B(T) Trends



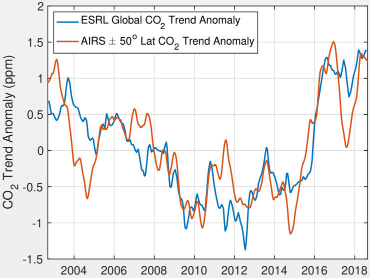
- Mean AIRS-ESRL CO_2 = 0.035 ± 0.032 pppm (1σ standard error)
- Mean AIRS-ESRL in BT Units = +0.0026K ± 0.0023K (1σ standard error)
- Sampling and ESRL errors hard to characterize

CO_2 Trends and Growth Anomalies

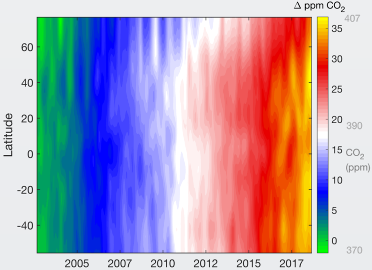
Growth Rates



Growth Rate Anomaly

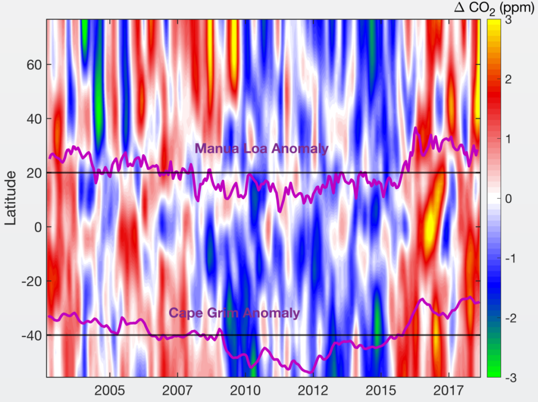


Zonal Anomalies



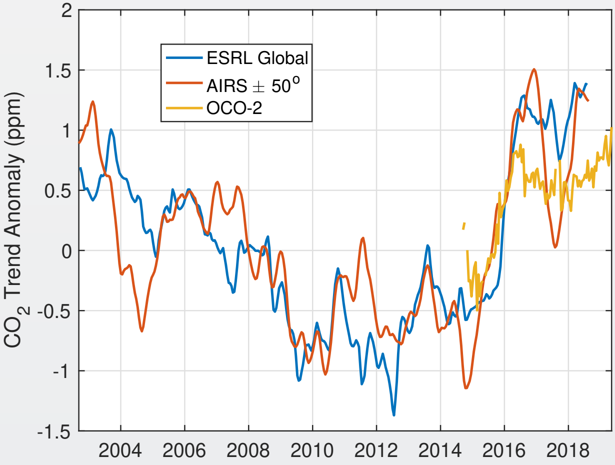
- Growth rate anomaly accuracy very encouraging.
- AIRS - Avg(MLO + CGRIM) growth rate difference: -0.0056K/year in BT units
- MLO, CGRIM growth rate uncertainty from ESRL ~0.0051K/year

Zonal CO_2 Growth Anomalies



- Growth rate anomaly = (CO_2 anomaly - CO_2 average growth rate)
- Magenta are ESRL MLO and Cape Grim CO_2 growth rate anomalies
- CO_2 color scale is equivalent to max ± 0.09K in BT units
- What is real? Smoothing may be an issue.
- 2015 ENSO effects very clear

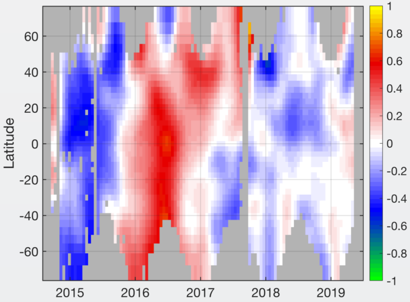
Global Trend Anomalies: ESRL, AIRS, OCO-2 (ocean)



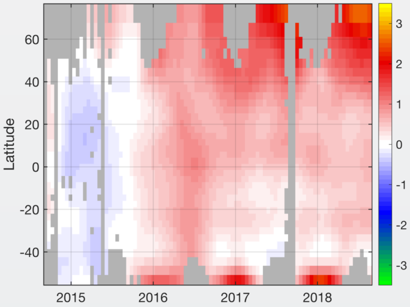
- At this level AIRS and OCO agree better than ESRL for 2015 ENSO
- OCO smaller ENSO shift than ESRL
- Still very clear AIRS has a Nov. 2003 shutdown problem

OCO Zonal Growth Anomaies

OCO Anomalies



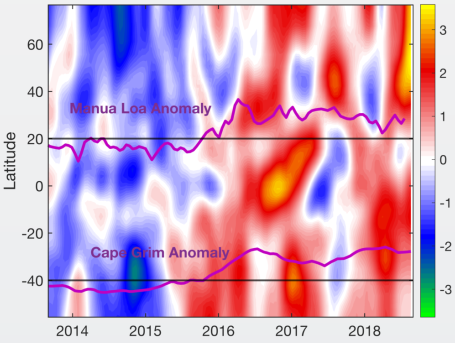
Adjust OCO to AIRS Anomaly Start



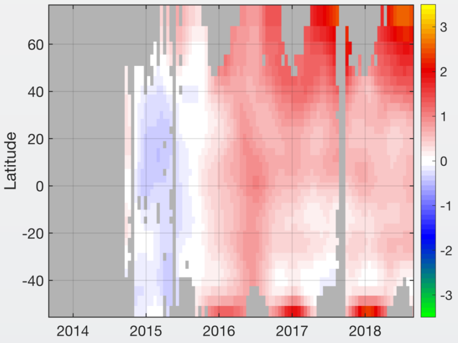
- Need to convert OCO anomalies to zero in Sept. 2002 for comparison to AIRS

Intercompare AIRS and OCO Anomalies

AIRS Growth Anomalies, OCO Time Frame



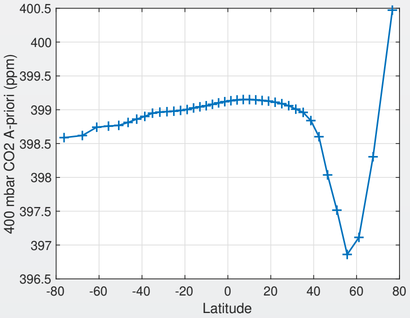
OCO Growth Anomalies



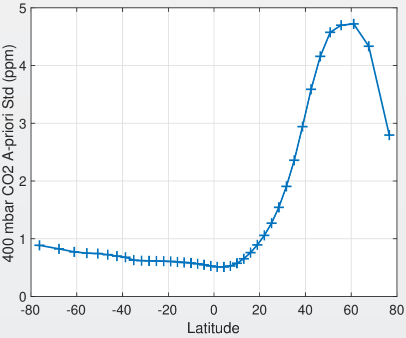
- Notice high OCO at lowest latitudes
- Why is AIRS ENSO higher in tropics? Transport from N.H.?
- More work needed to understand -40 deg. lat timing of CO_2 anomaly
- Compare to OCO Anomaly on previous slide

OCO A-Priori for Ocean, 400 mbar

OCO CO_2 A-Priori 400 mbar



OCO CO_2 A-Priori Std



OCO 400 mbar (and much of ocean profile) a-priori uncertainty is ~1 ppm

Conclusions

- Need to develop a gridded clear AIRS L1c subset
- Present subset is highly non-uniform spatially
  - However, fairly uniform near Cape-Grim at -40 deg
- Use these results to further understand ultimate accuracy of AIRS CO_2 retrievals