Total Carbon Column Observing Network: Variability in Total Column CO_2 and CO

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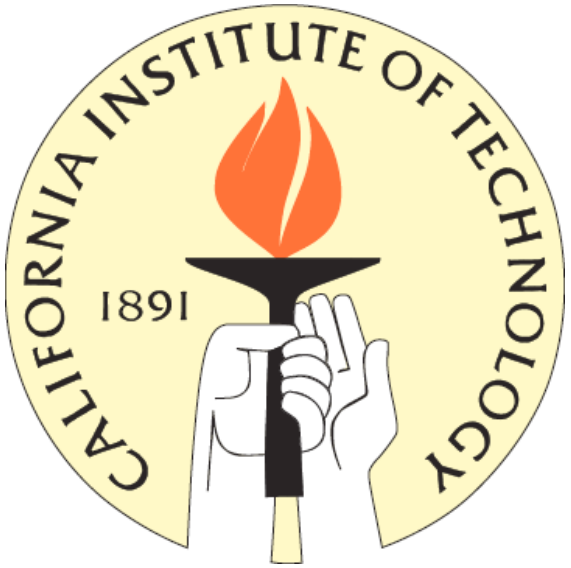

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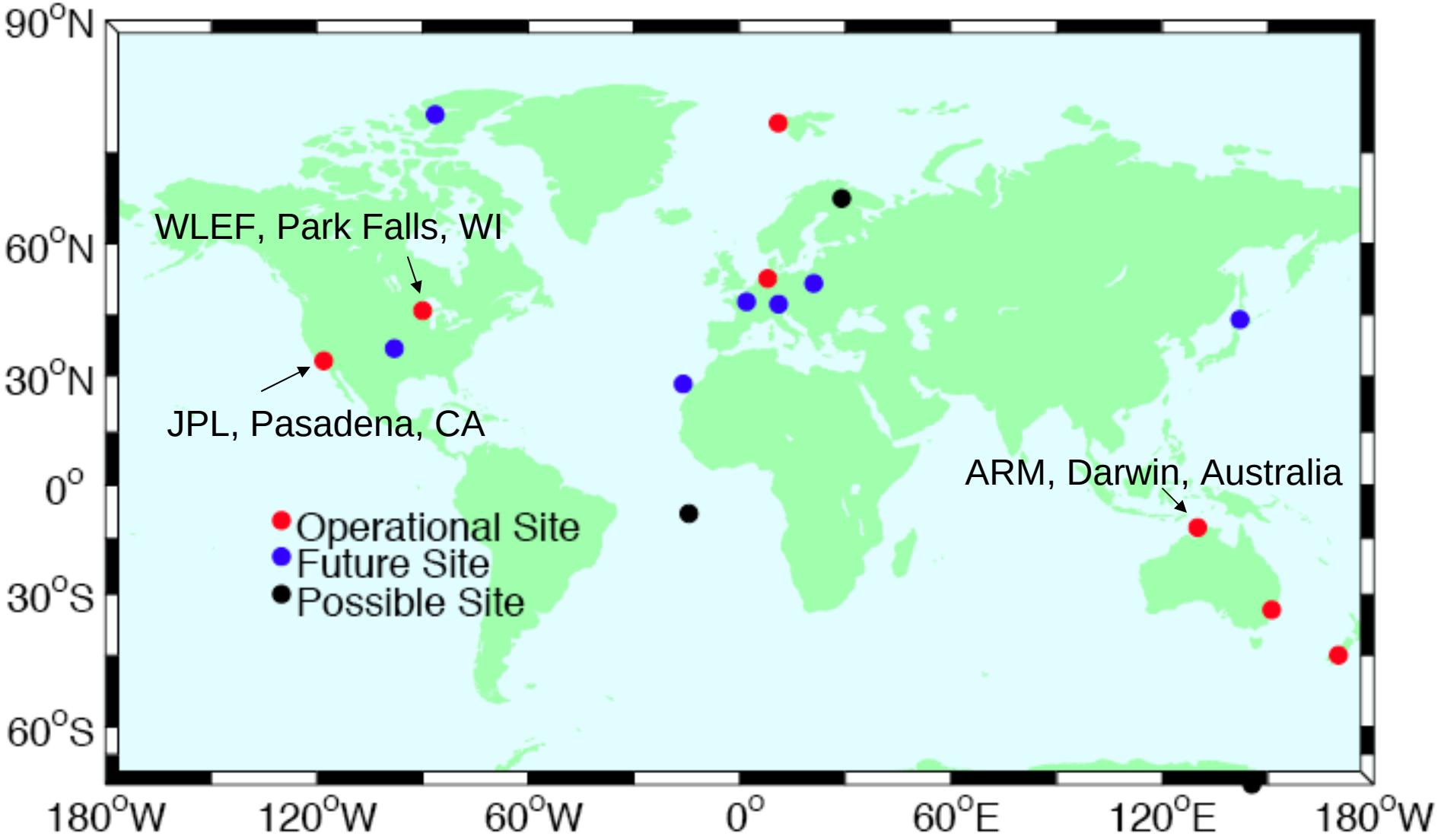
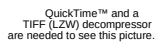
Total Carbon Column Observing Network



High Resolution Fourier Transform Spectrometry



Direct solar absorption spectrometry using Bruker IFS125 HR

Spectral coverage in NIR (3800-15700 cm^{-1}) using InGaAs and Si diode detectors

Spectral resolution of 0.02 cm^{-1}

Precision in CO_2 mixing ratio better than 0.1%

Variability in the total column

Substantial variability observed in the FTS total columns

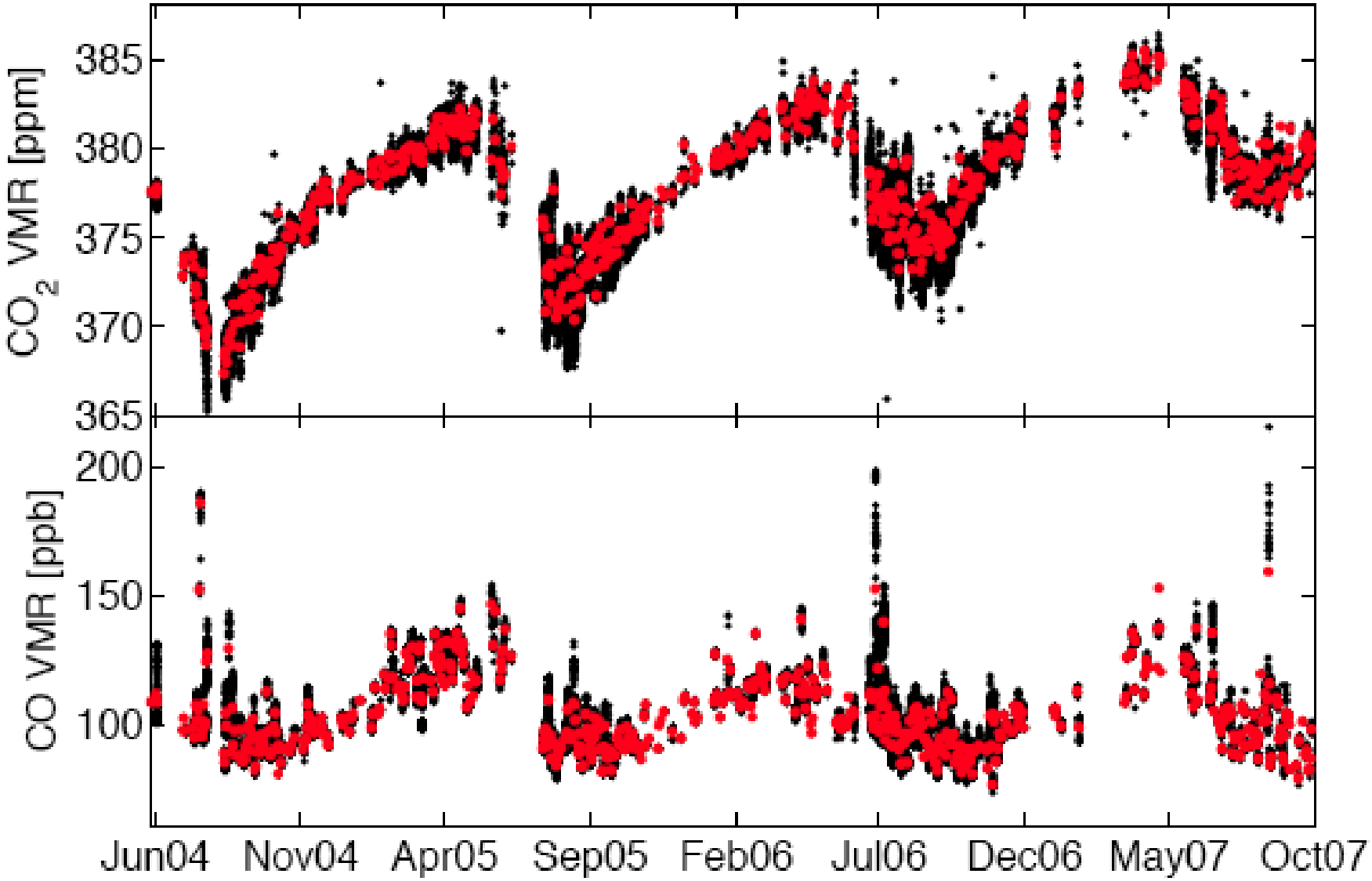
(1) At Park Falls, simultaneous observations of related gases do not help us prescribe causes for variability

Use dynamics to better understand our time series

(2) At JPL (urban site) and Darwin, simultaneous observations of CO allow us to understand systematic changes in CO_2

Demonstrate potential of observations to constrain emissions

Park Falls, Wisconsin (46 N, 90 W)



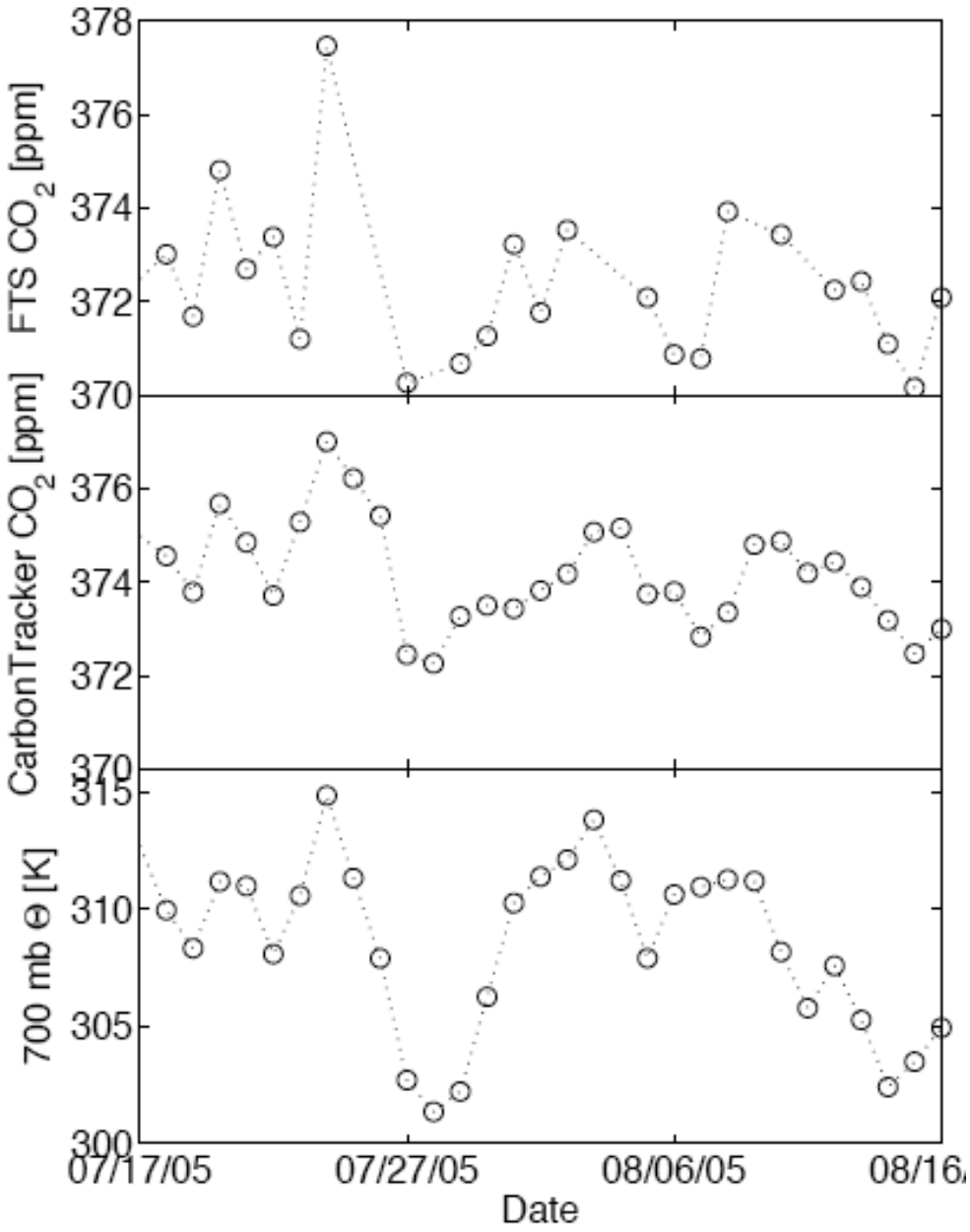
Translating time series to spatial information

FTS provides stationary observations at few locations

Use temporal variability to infer information on several spatial scales

Interannual increase 1.7 ppm per year	<-->	Global trend
Seasonal cycle integrated NEE 11 ppm (peak to trough)	<-->	Northern Hemisphere
Subseasonal variability <5 ppm day-to-day	<-->	No clear spatial correlary
Diurnal cycle ~1 ppm	<-->	Local fluxes

Synoptic-scale variability at Park Falls

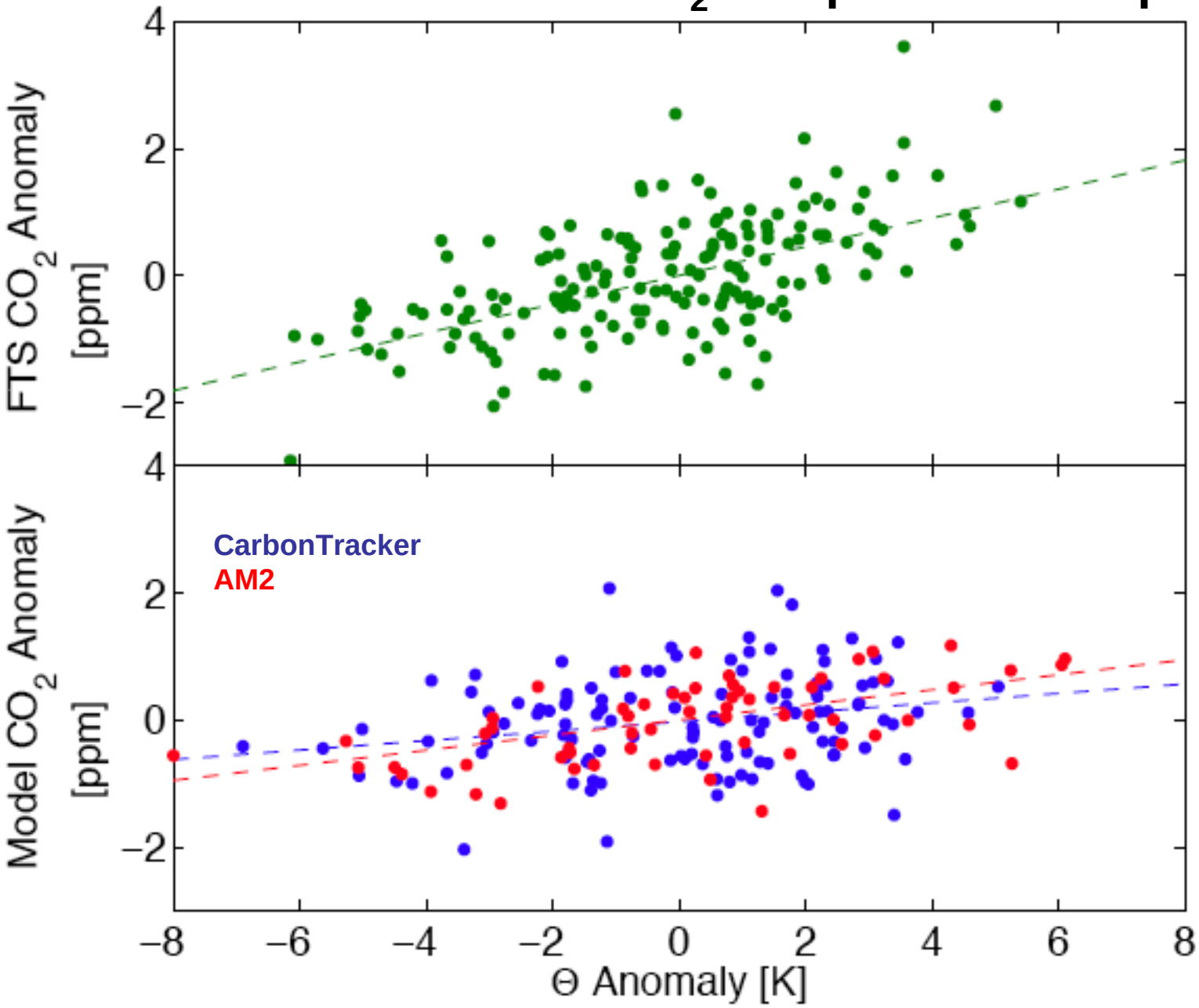


Day-to-day variability in the total column up to 5 ppm

Amplitude greater than that in CarbonTracker, although good qualitative agreement

Both observations and model track potential temperature variability

Summer correlation between CO_2 and potential temperature



Conclusions - Part 1

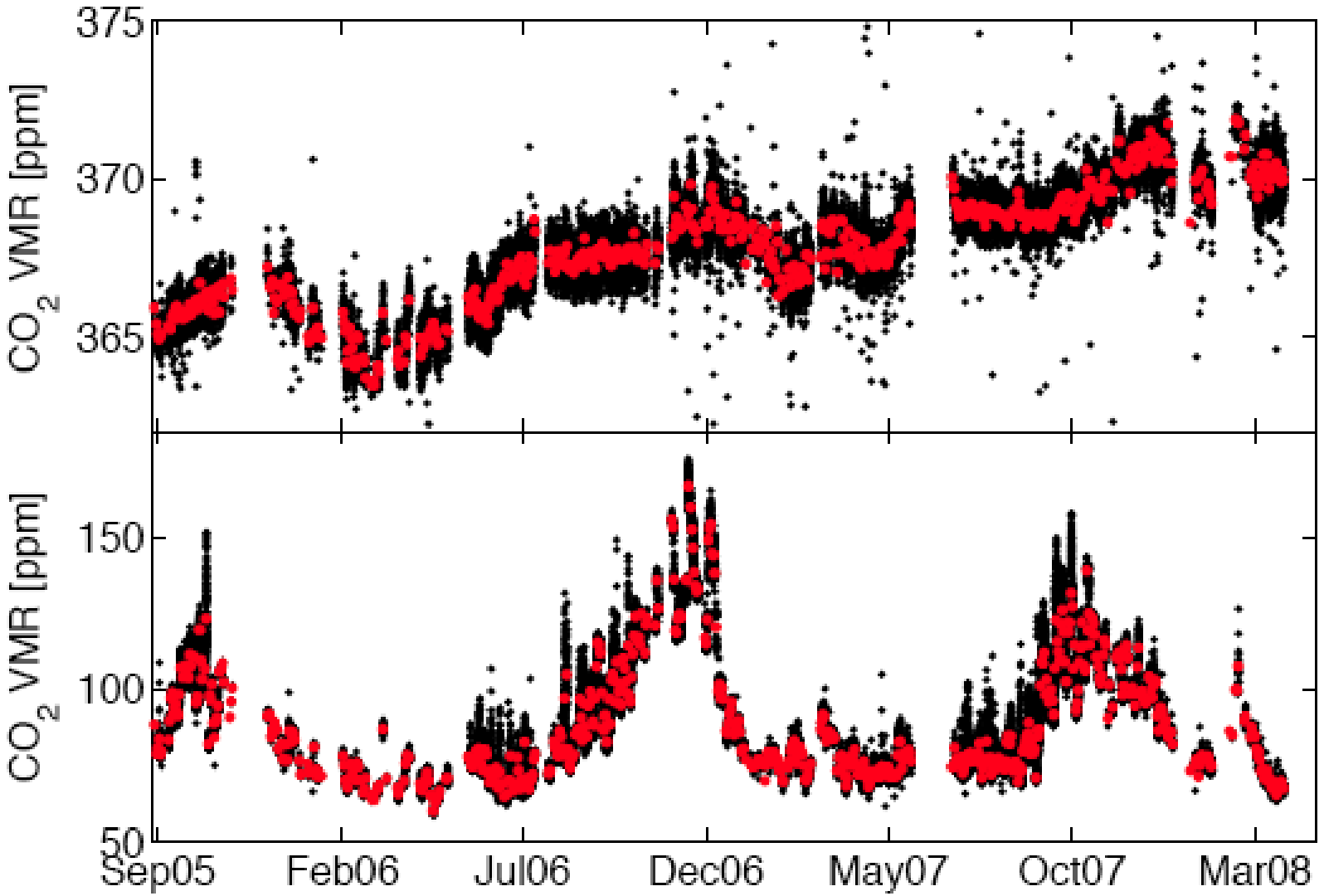
Synoptic scale variability is the largest source of variability in the summer mid-latitude total column CO_2 .

These results have substantial implications on the ability of the current modeling framework to use column CO_2 satellite data effectively.

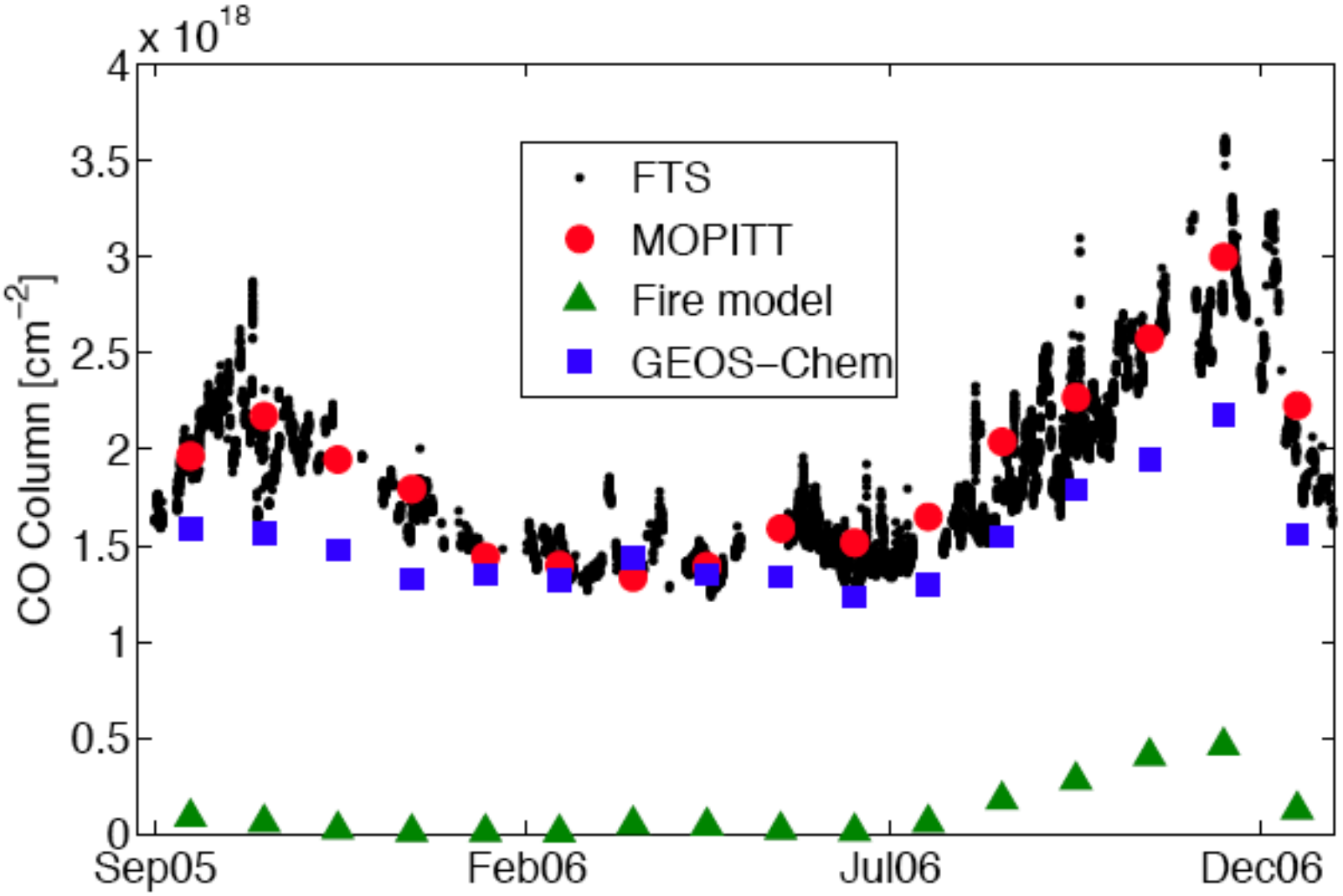
Given that the variability in total column CO_2 is significantly influenced by long-range transport, it will be difficult to infer regional-scale fluxes from gradients in the observations.

- tune CTMs to correctly model carbon weather

Darwin, Australia (12 S, 131 E)

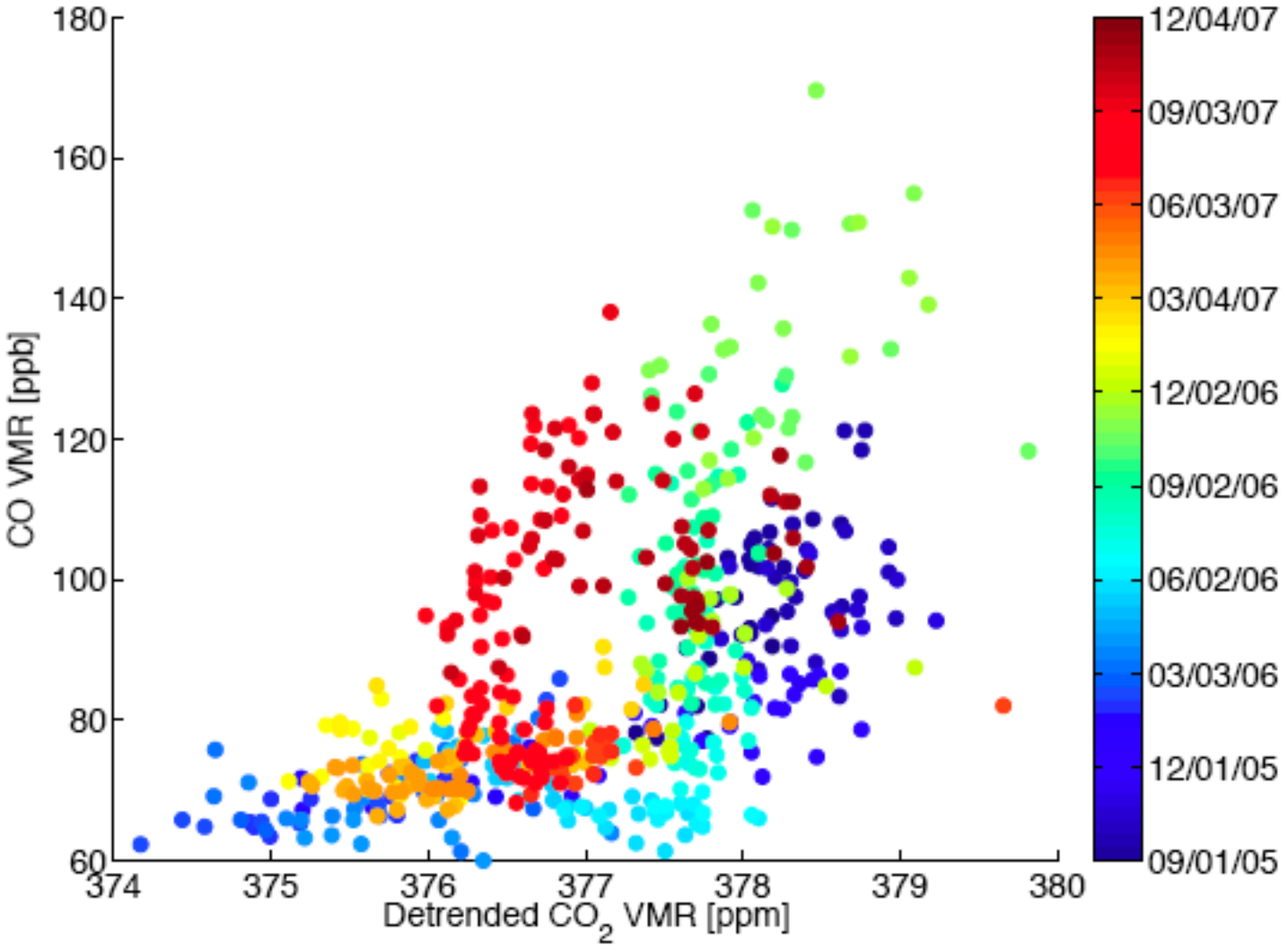


Darwin CO Comparison with satellite and models

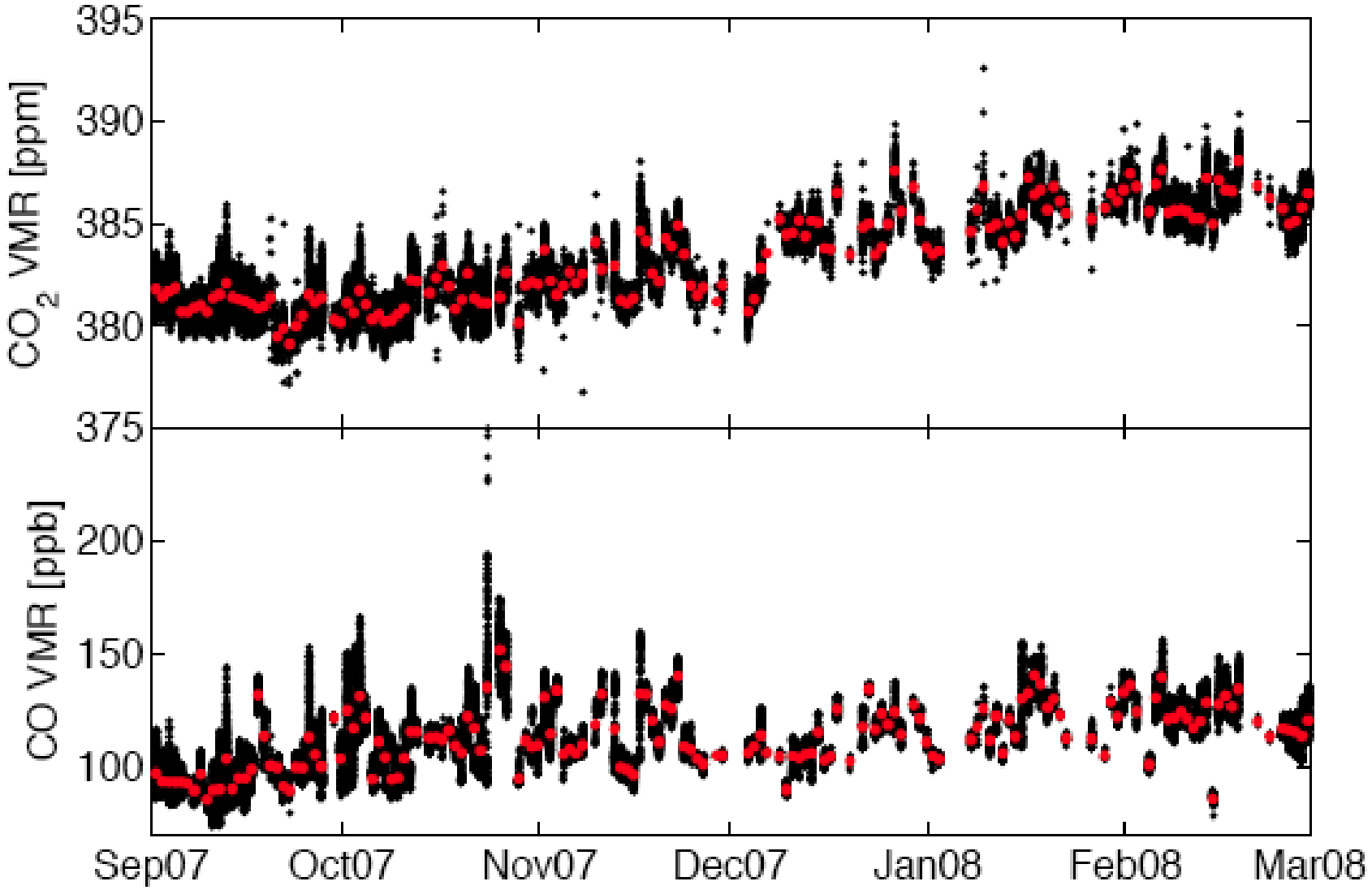


Can use FTS data to provide better emission inventories

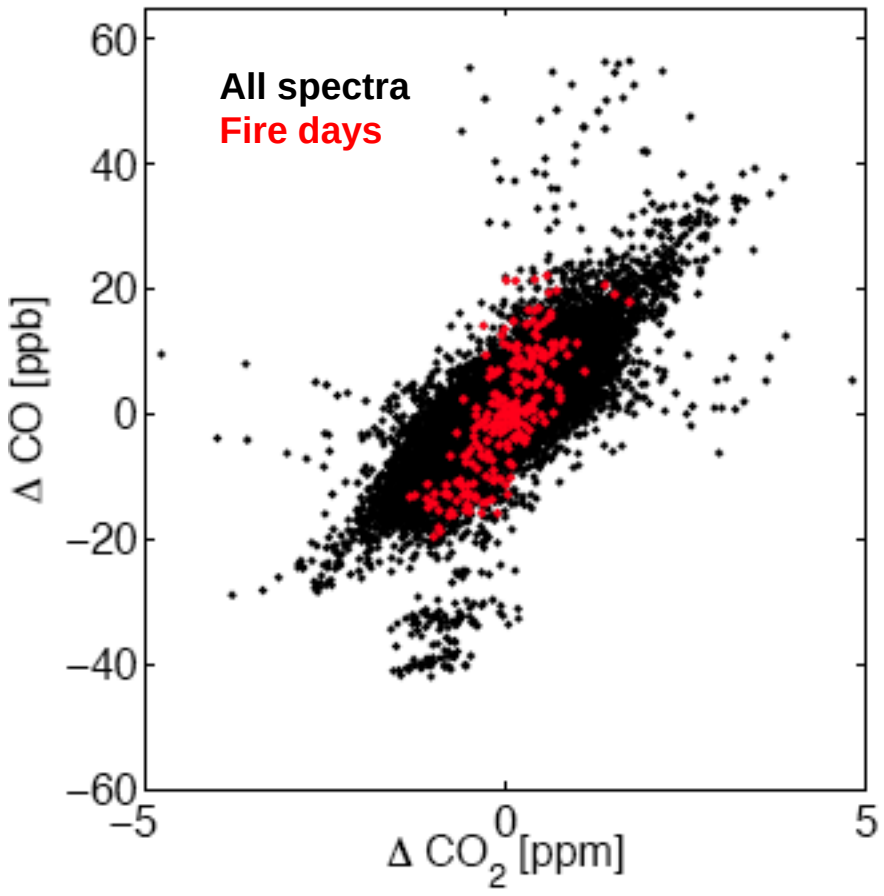
Emissions ratios during burning seasons



Pasadena, California (34 N, 118 W)



Urban signal dominated by traffic patterns



Tight correlation between CO and CO_2

Combustion efficiency of ~1.5% for all spectra

Fire days have emission ratios of CO/CO_2 twice those of traffic signal

Next step… aerosol optical depth retrievals

Conclusions - Part 2

TCCON provides a rich data set for carbon cycle science

Simultaneous observations of CO allow more information to be gained from total column observations

- Using CO as a marker for burning and advective influence gives insight to the variability in the Darwin CO_2 timeseries

We can use the observations to improve inventory for local emissions

Observations provide a tool for monitoring burning regimes in western Pacific, urban emissions in Los Angeles

Acknowledgements

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QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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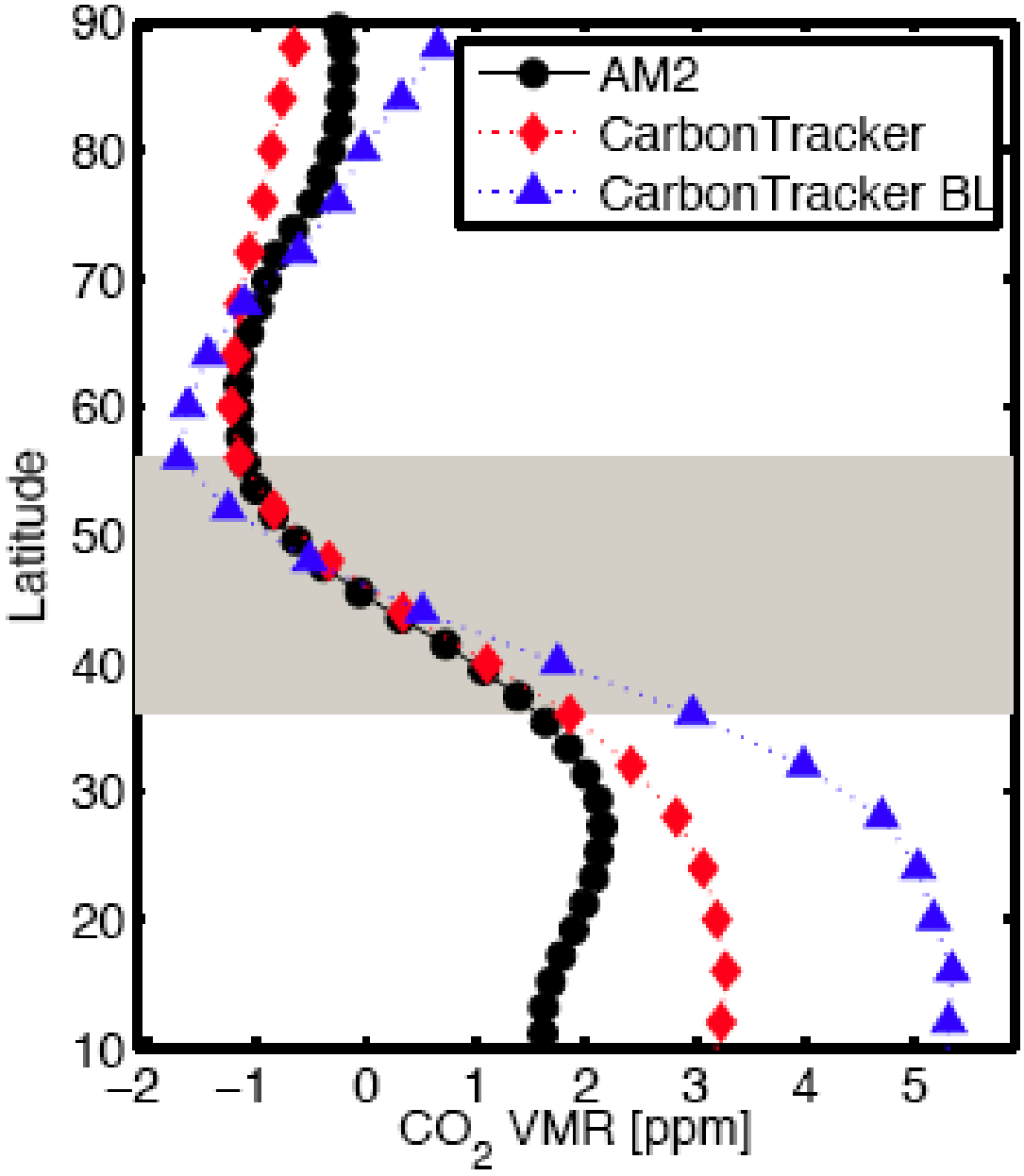
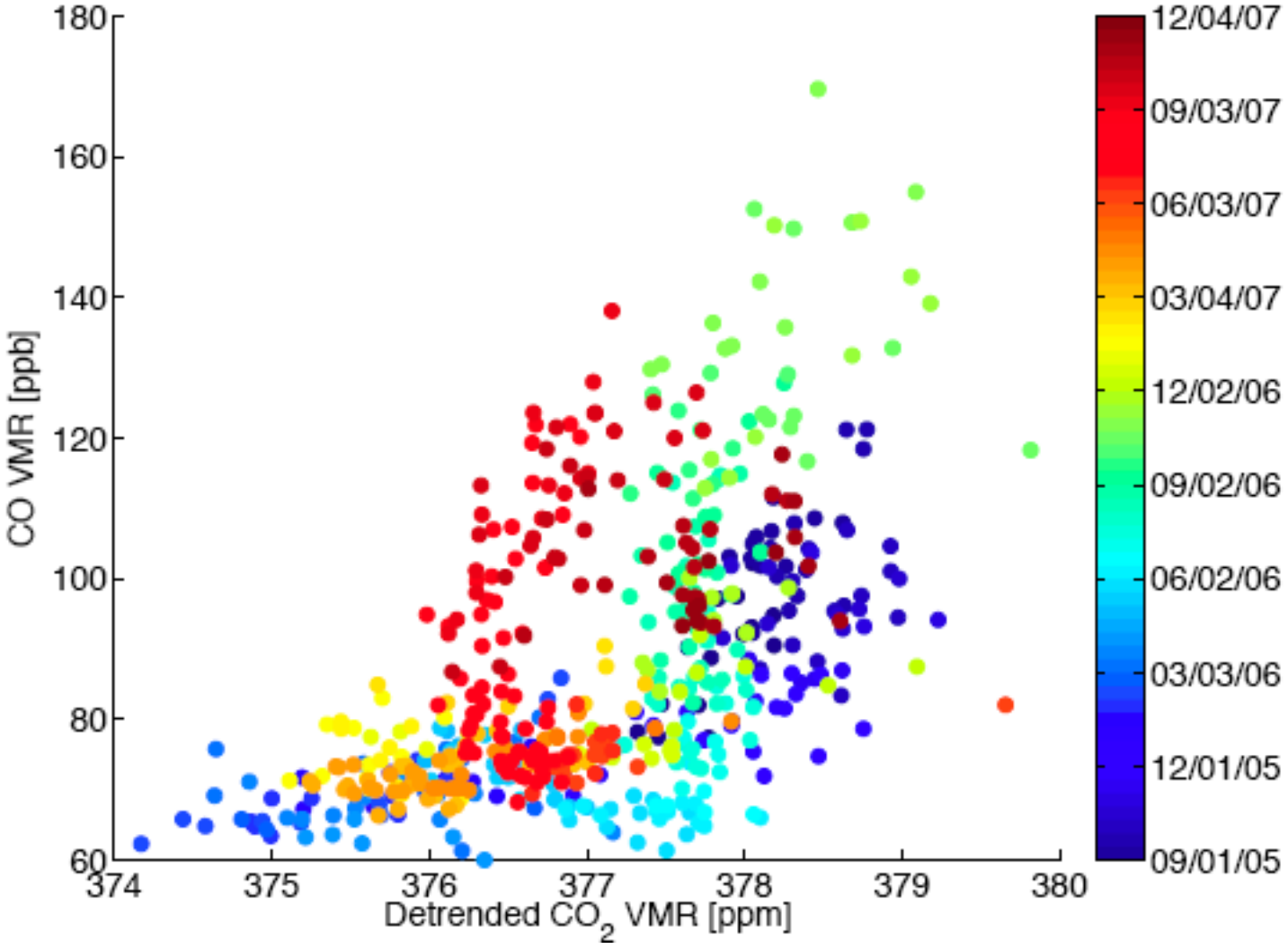

AM2
CarbonTracker
CarbonTracker BL
Latitude
90
80
70
60
50
40
30
20
10
−2
−1
0
1
2
3
4
5
CO2 VMR [ppm]


180
160
140
120
100
80
60
CO VMR [ppb]
374
375
376
377
378
379
380
Detrended CO2 VMR [ppm]
12/04/07
09/03/07
06/03/07
03/04/07
12/02/06
09/02/06
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