TTL TRANSPORT RATES ACROSS THE EQUATORIAL PACIFIC DURING BOREAL WINTER

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CONTRAST, ATTREX, CAST Science Team Meeting
October 20, 2014

OUTLINE

Motivation

1- Origin of air
- NOAA surface network
- Convection: local (SPCZ) and non-local

2- Stratospheric aging during ATTREX

Summary

MOTIVATION

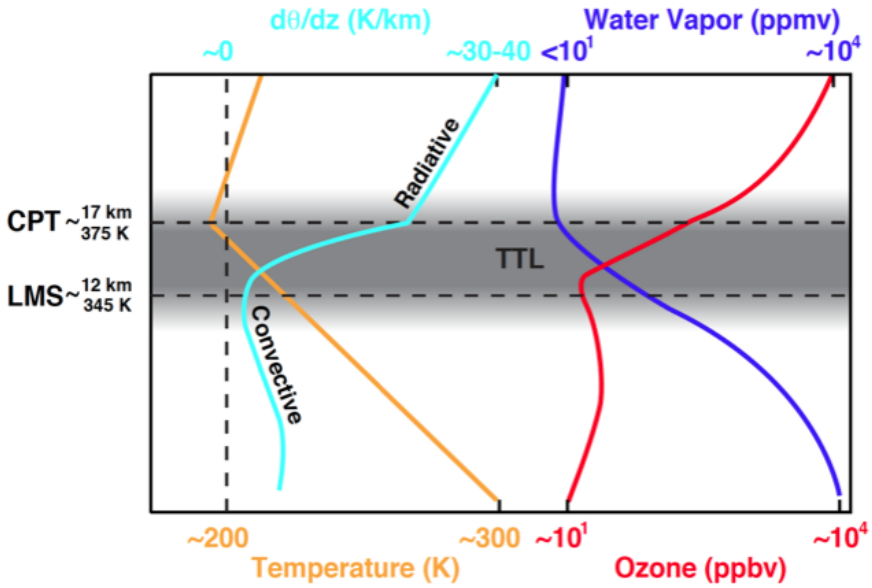
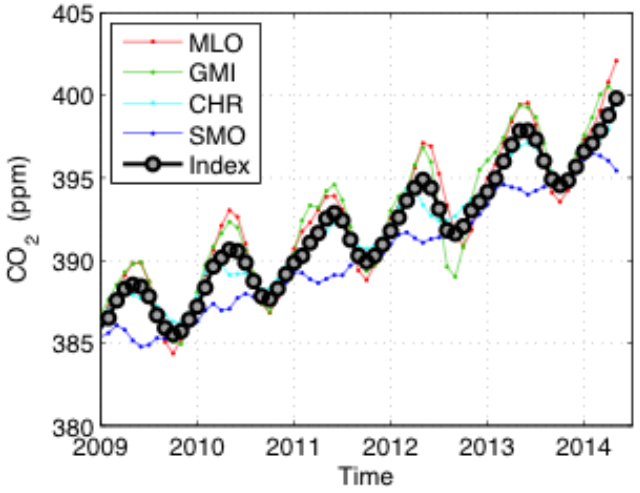


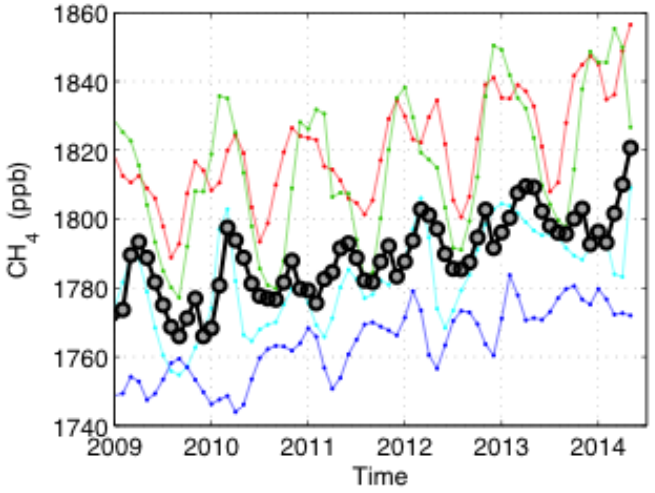
Figure 12. Schematic of TTL based on the thermal structure and chemical tracer relationships. The schematic highlights the change of O_3 and H_2O at the two critical levels in the thermodynamic structure – O_3 begins to depart from its tropospheric background value at the LMS, and H_2O reaches its stratospheric background value near the CPT. The transitional air masses, as identified by the tracer-relationship, are well correlated with the LMS and the CPT.

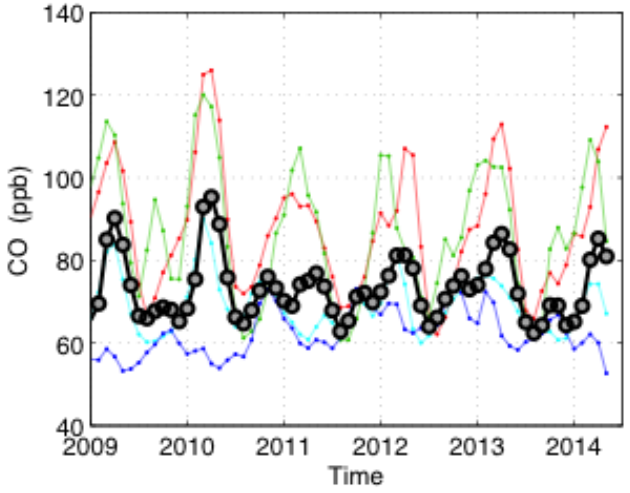
Pan et al., JGR, 2014

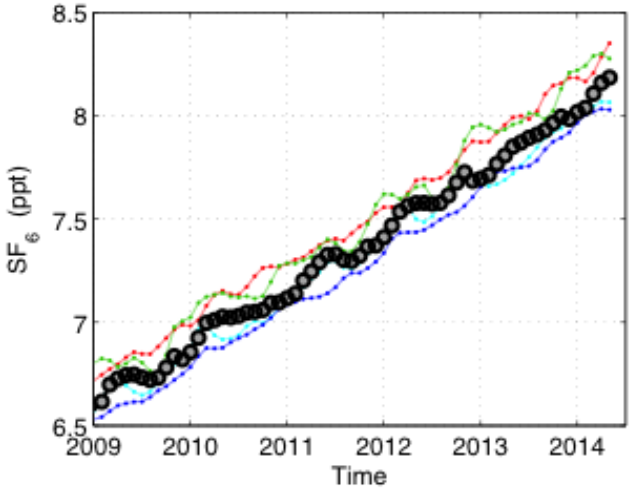
- ✧Chemical composition of the stratosphere is primarily controlled in the tropics
- ✧The composition is driven by transport processes and timescales in the TTL
- ✧Use of chemical tracers with seasonal dependence allows for determination of transport rates that are critical for understanding the fate of reactive ODS entering the stratosphere
- ✧Unique opportunity for intensive sampling of the TTL

Ground Measurements Tracking Anthropogenic Activity

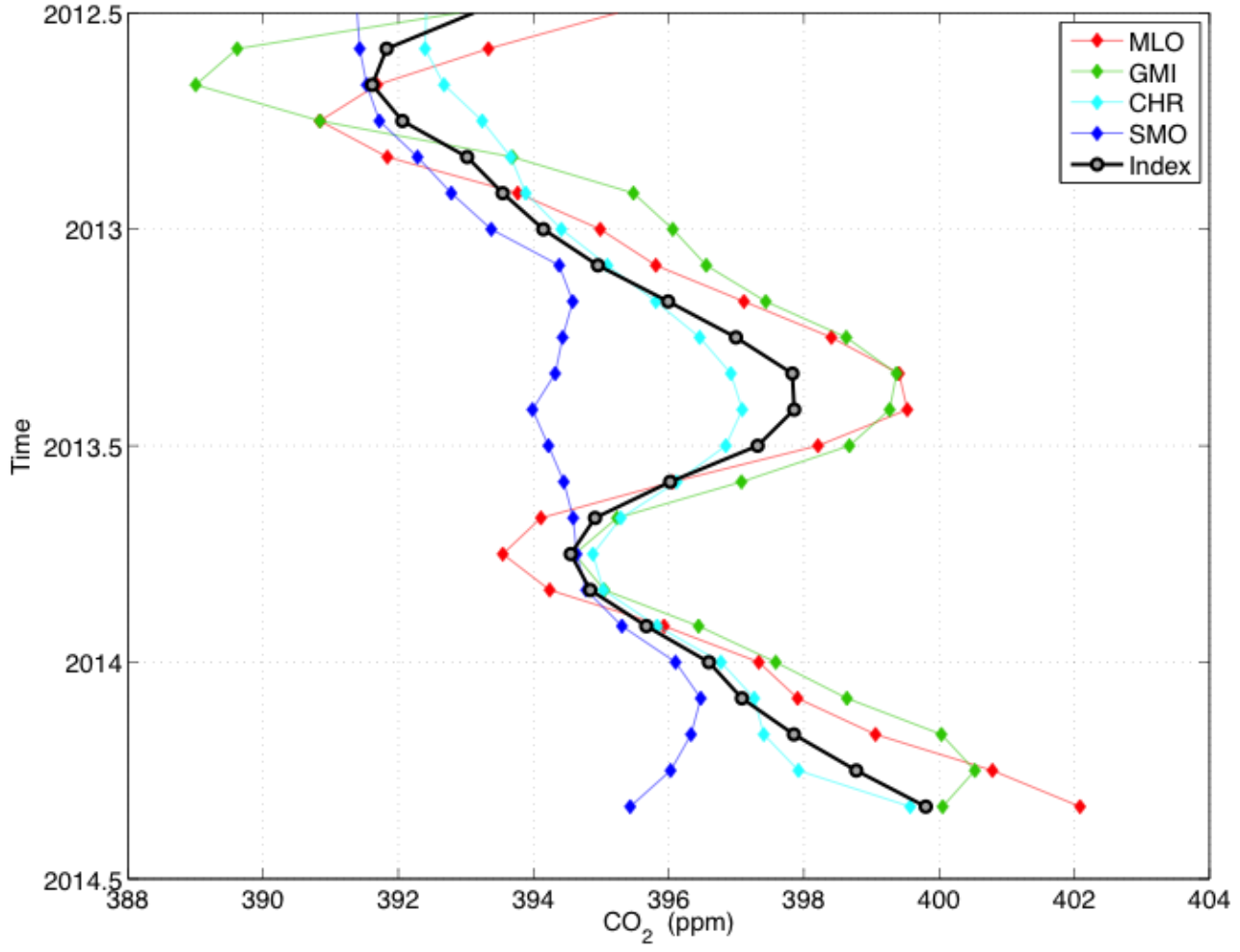








"CO_2 Clock": Propagation of Surface Signatures into the Stratosphere

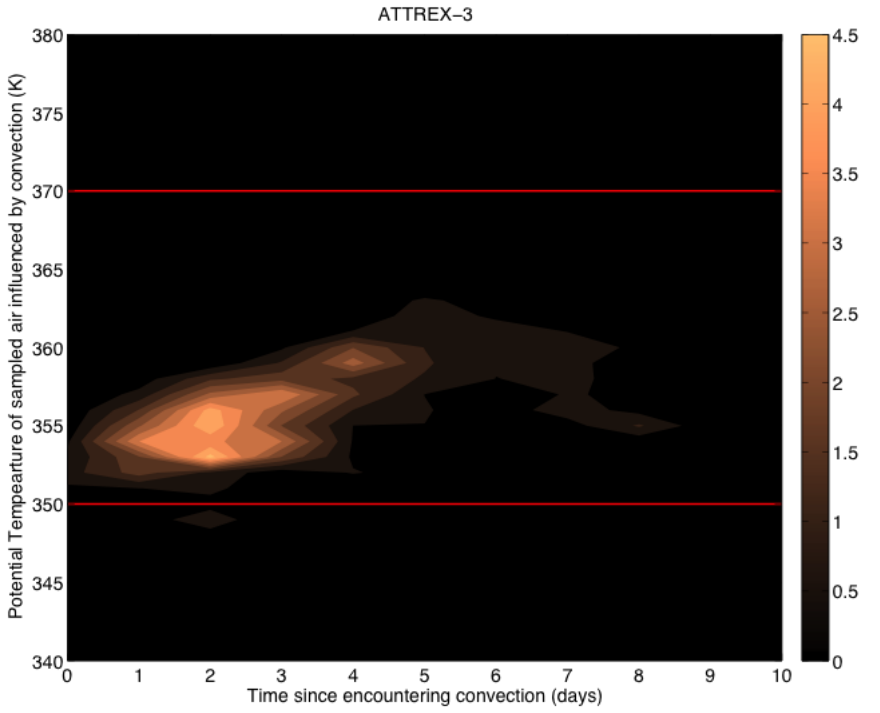


1- ORIGIN OF AIR

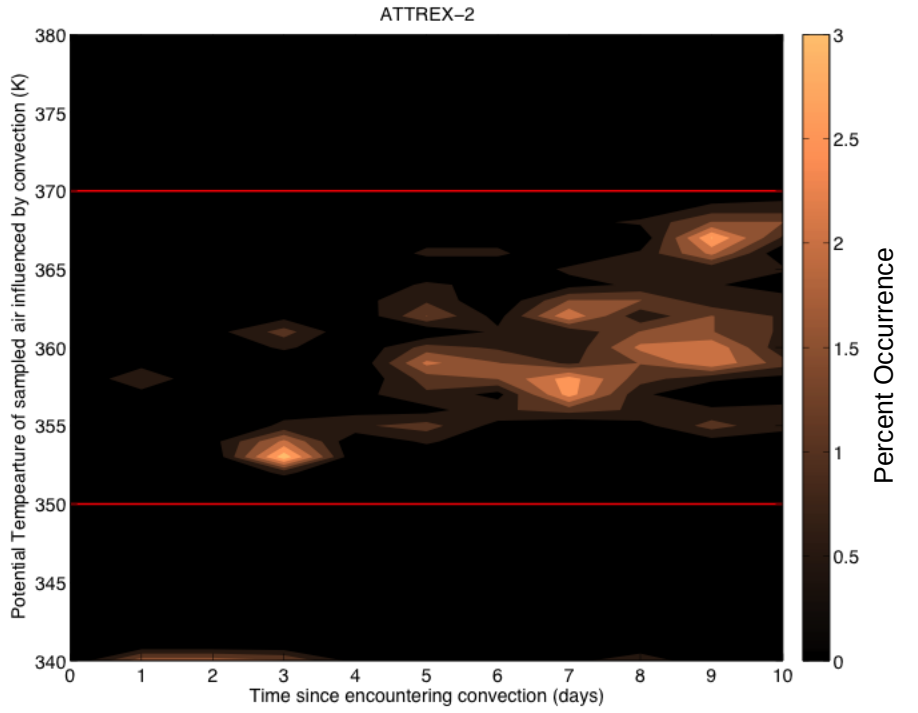
- Convective Influenced trajectories ran for 10 days
- Tracer-tracer correlations
  - Long-range transport
  - Typhoons
  - Interhemispheric transport over the Pacifc

Timing and Altitude of Airmasses that Encountered Recent Convection

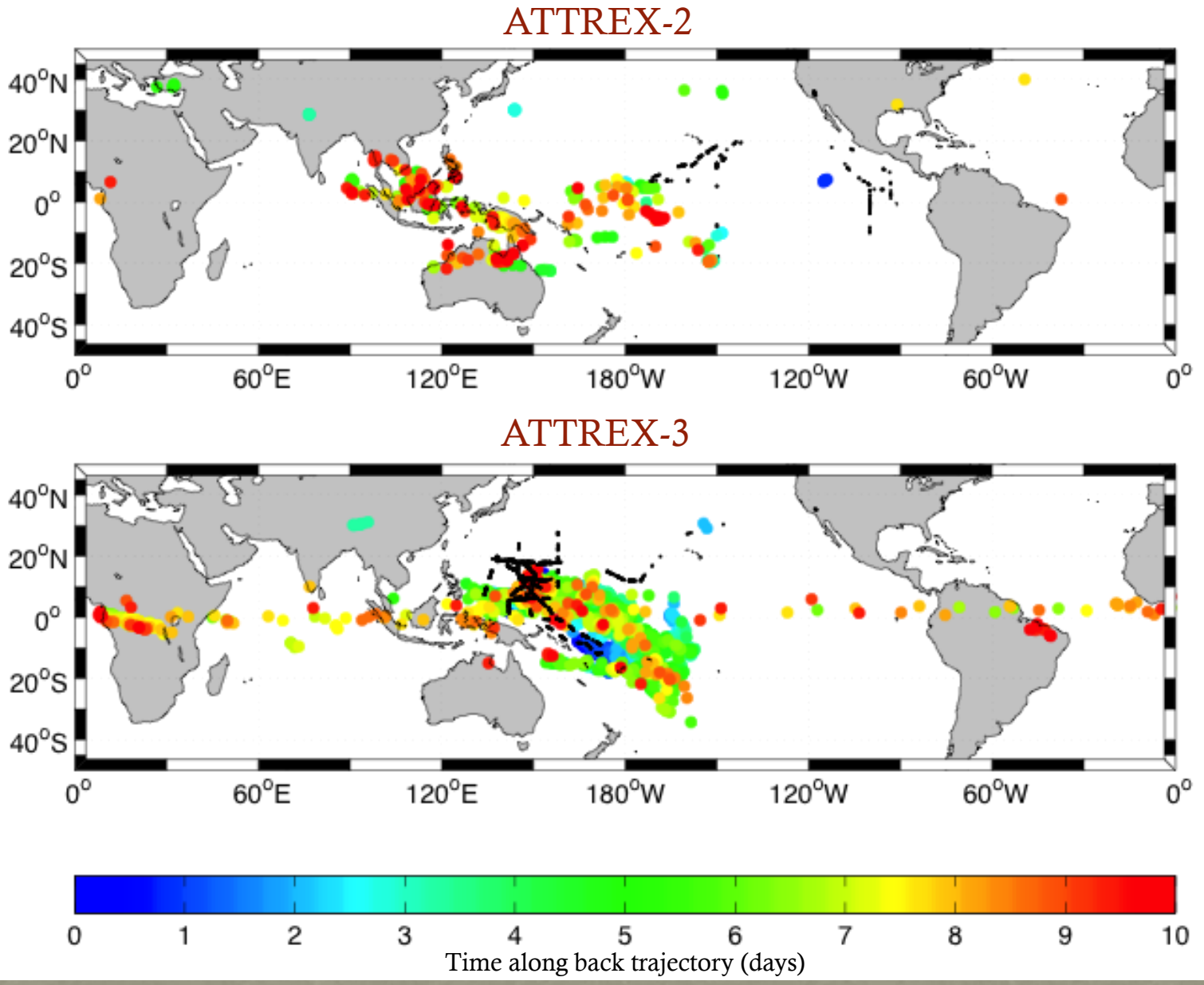
Western Pacific



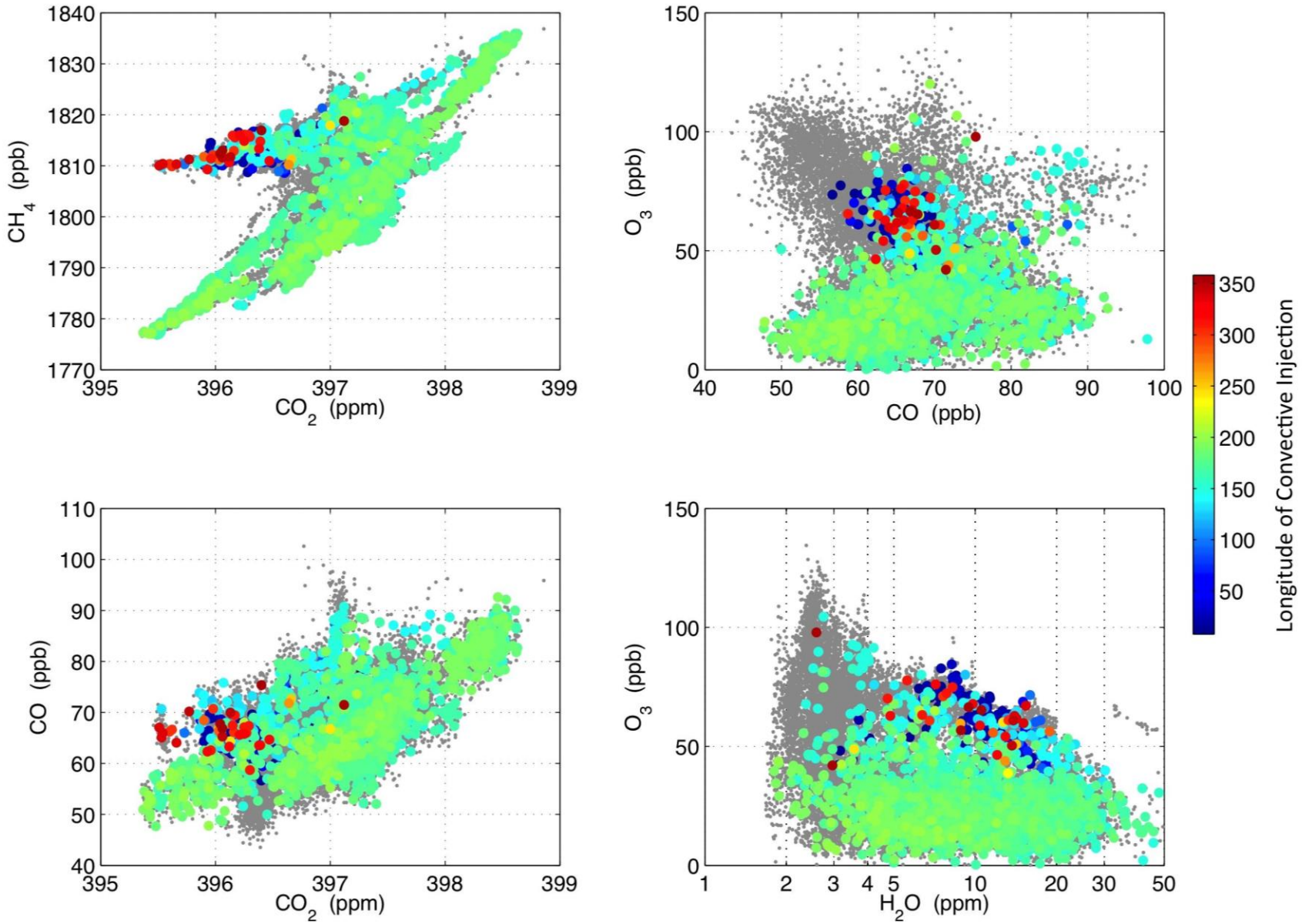
Eastern Pacific

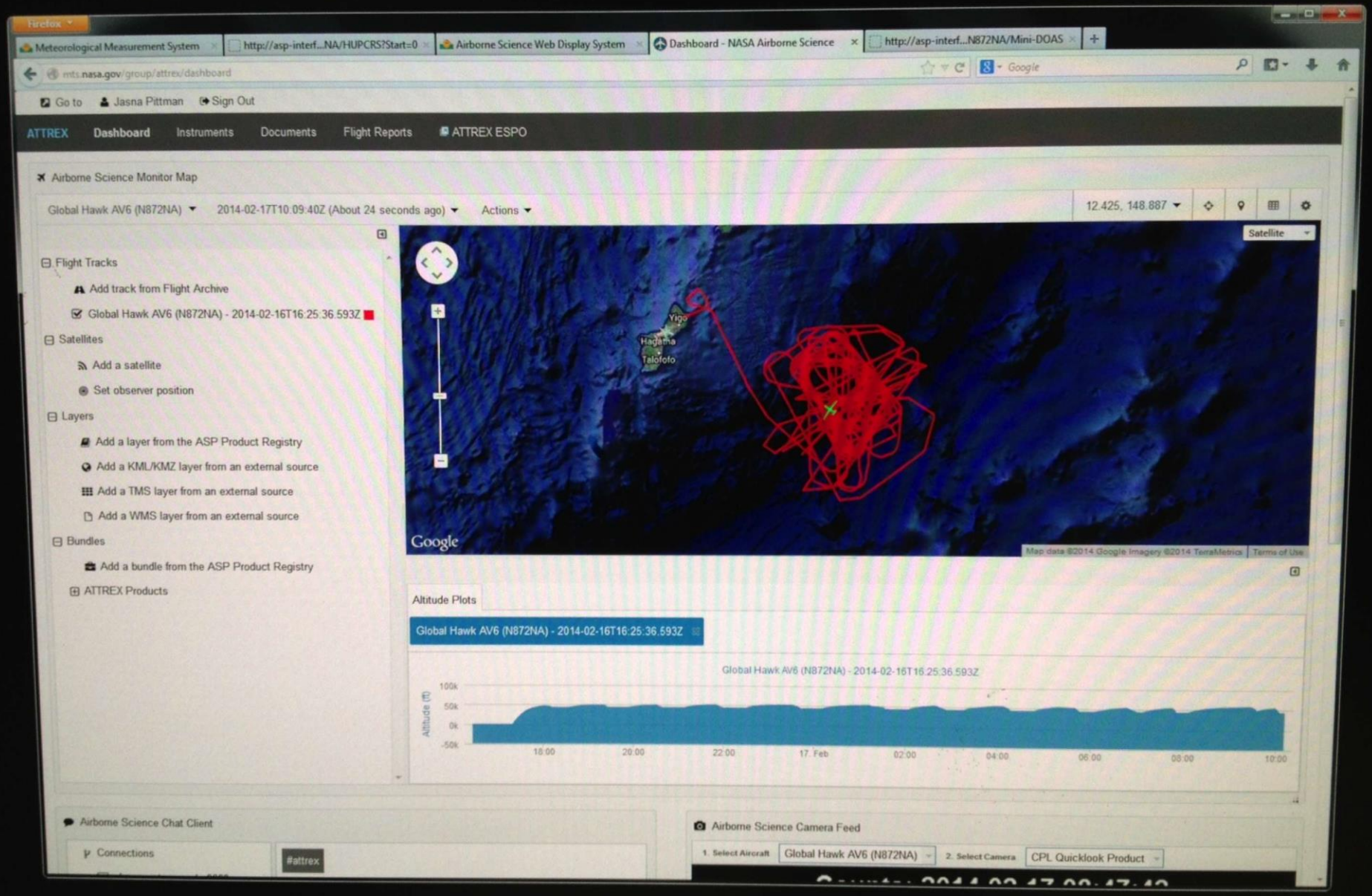


Timing and Geographical Location of Convective Encounter



Long-Range Transport from Africa to Guam

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Airborne Science Web Display System
Dashboard - NASA Airborne Science
http://asp-interf...N872NA/Mini-DOAS
mts.nasa.gov/group/attrex/dashboard
Google
Go to
Jasna Pittman
Sign Out
ATTREX
Dashboard
Instruments
Documents
Flight Reports
ATTREX ESPO
Airborne Science Monitor Map
Global Hawk AV6 (N872NA)
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Actions
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Satellite
Flight Tracks
Add track from Flight Archive
Global Hawk AV6 (N872NA) - 2014-02-16T16:25:36.593Z
Satellites
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Set observer position
Layers
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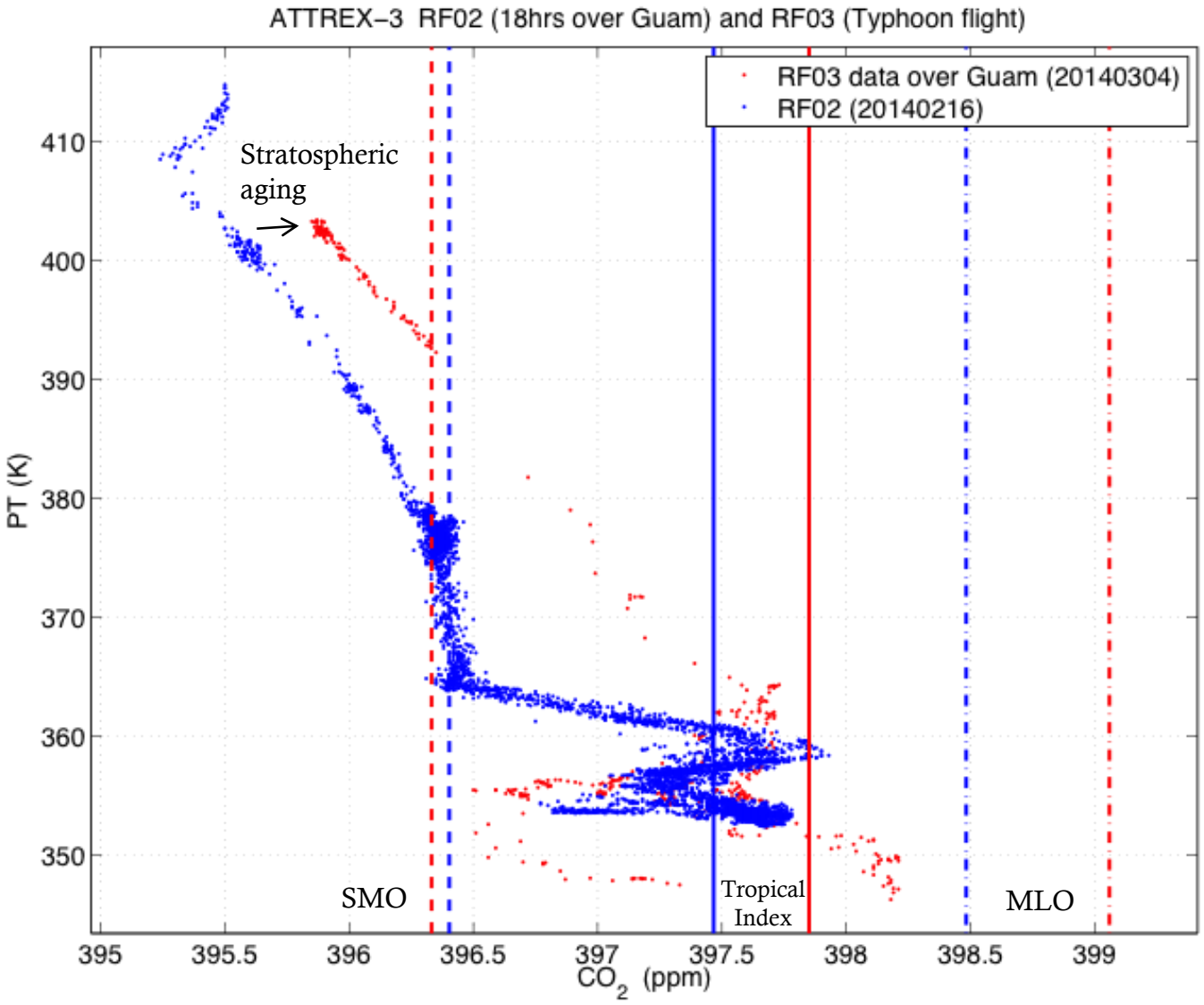
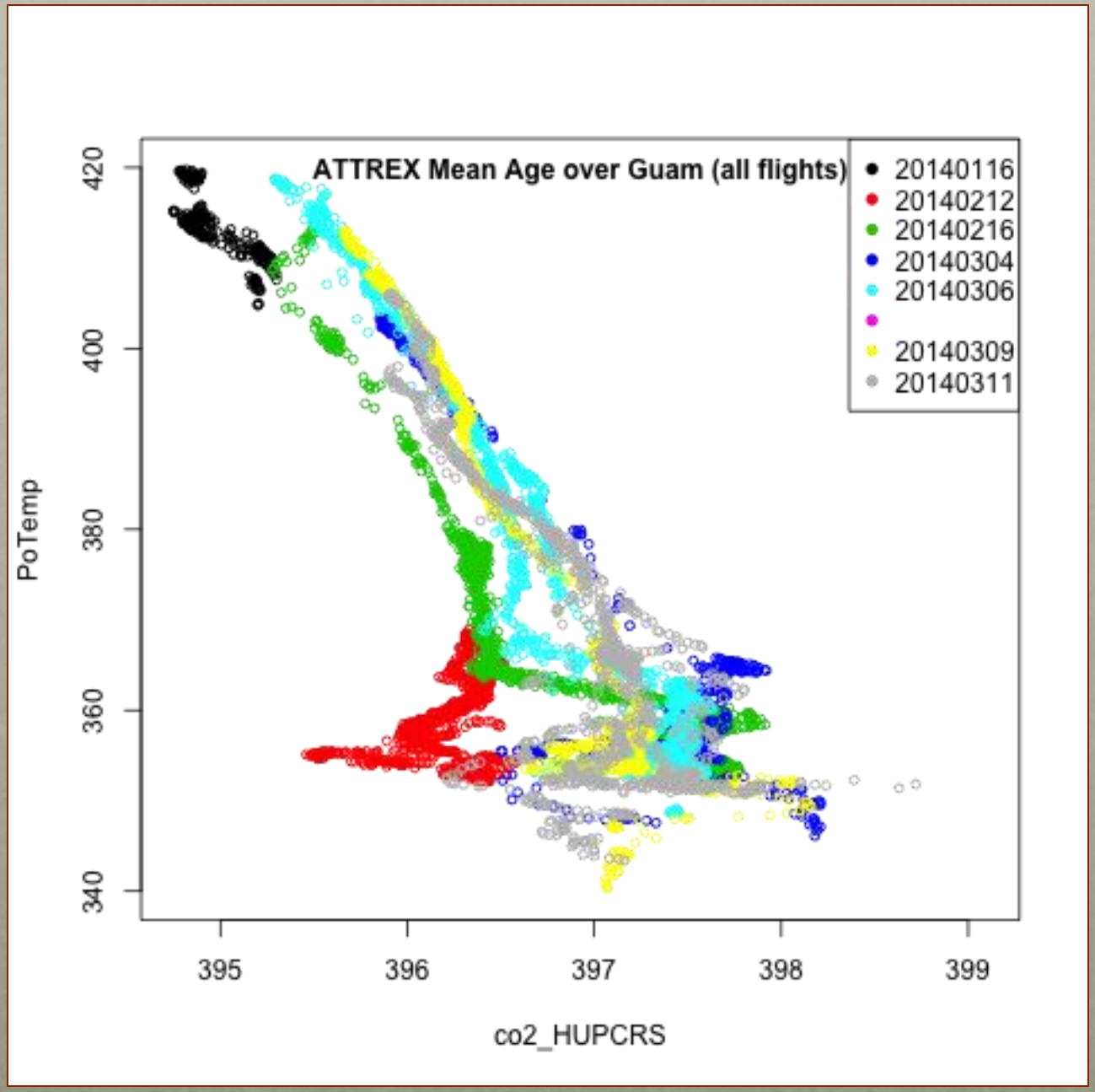
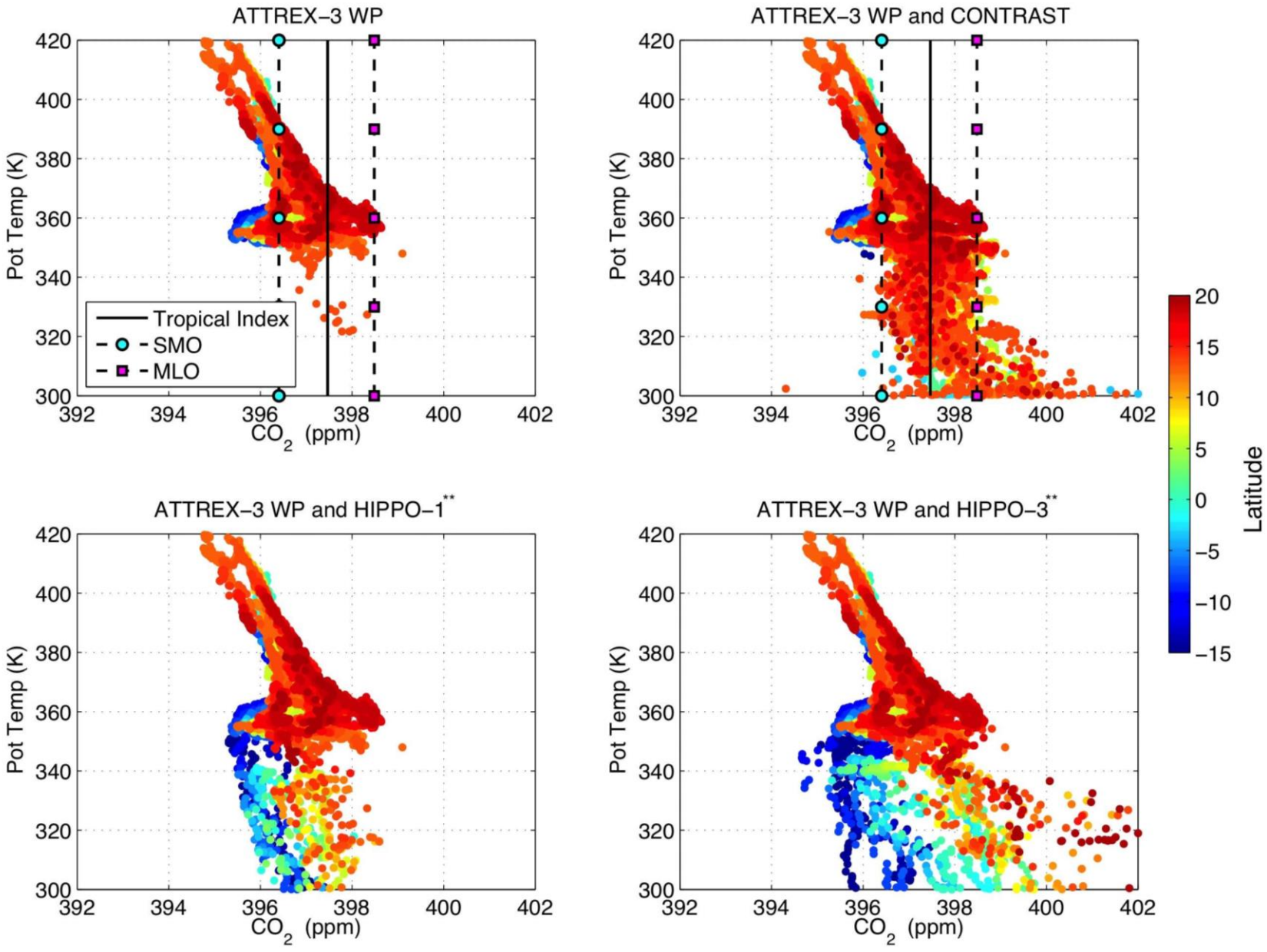
Add a KML/KMZ layer from an external source
Add a TMS layer from an external source
Add a WMS layer from an external source
Bundles
Add a bundle from the ASP Product Registry
ATTREX Products
Yigo
Hagatna
Talofofo
Google
Map data ©2014 Google Imagery ©2014 TerraMetrics
Terms of Use
Altitude Plots
Global Hawk AV6 (N872NA) - 2014-02-16T16:25:36.593Z
Global Hawk AV6 (N872NA) - 2014-02-16T16:25:36.593Z
Altitude (ft)
100k
50k
0k
-50k
18:00
20:00
22:00
17. Feb
02:00
04:00
06:00
08:00
10:00
Airborne Science Chat Client
Connections
#attrex
Airborne Science Camera Feed
1. Select Aircraft
Global Hawk AV6 (N872NA)
2. Select Camera
CPL Quicklook Product
Address


ATTREX–3 RF02 (18hrs over Guam) and RF03 (Typhoon flight)
RF03 data over Guam (20140304)
RF02 (20140216)
Stratospheric aging
SMO
Tropical Index
MLO
PT (K)
410
400
390
380
370
360
350
395
395.5
396
396.5
397
397.5
398
398.5
399
CO2 (ppm)

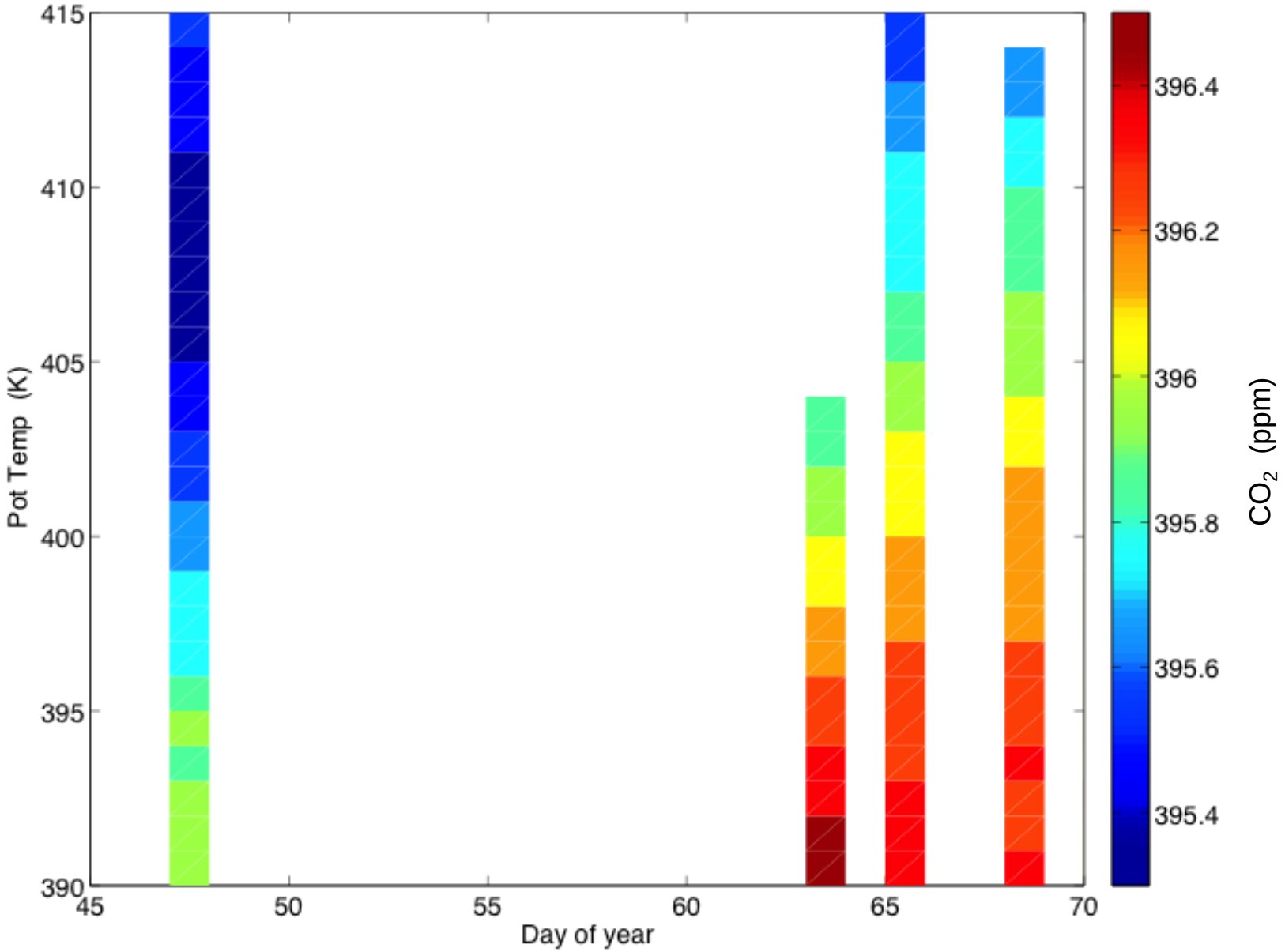

ATTREX Mean Age over Guam (all flights)
20140116
20140212
20140216
20140304
20140306
20140309
20140311
PoTemp
420
400
380
360
340
395
396
397
398
399
co2_HUPCRS



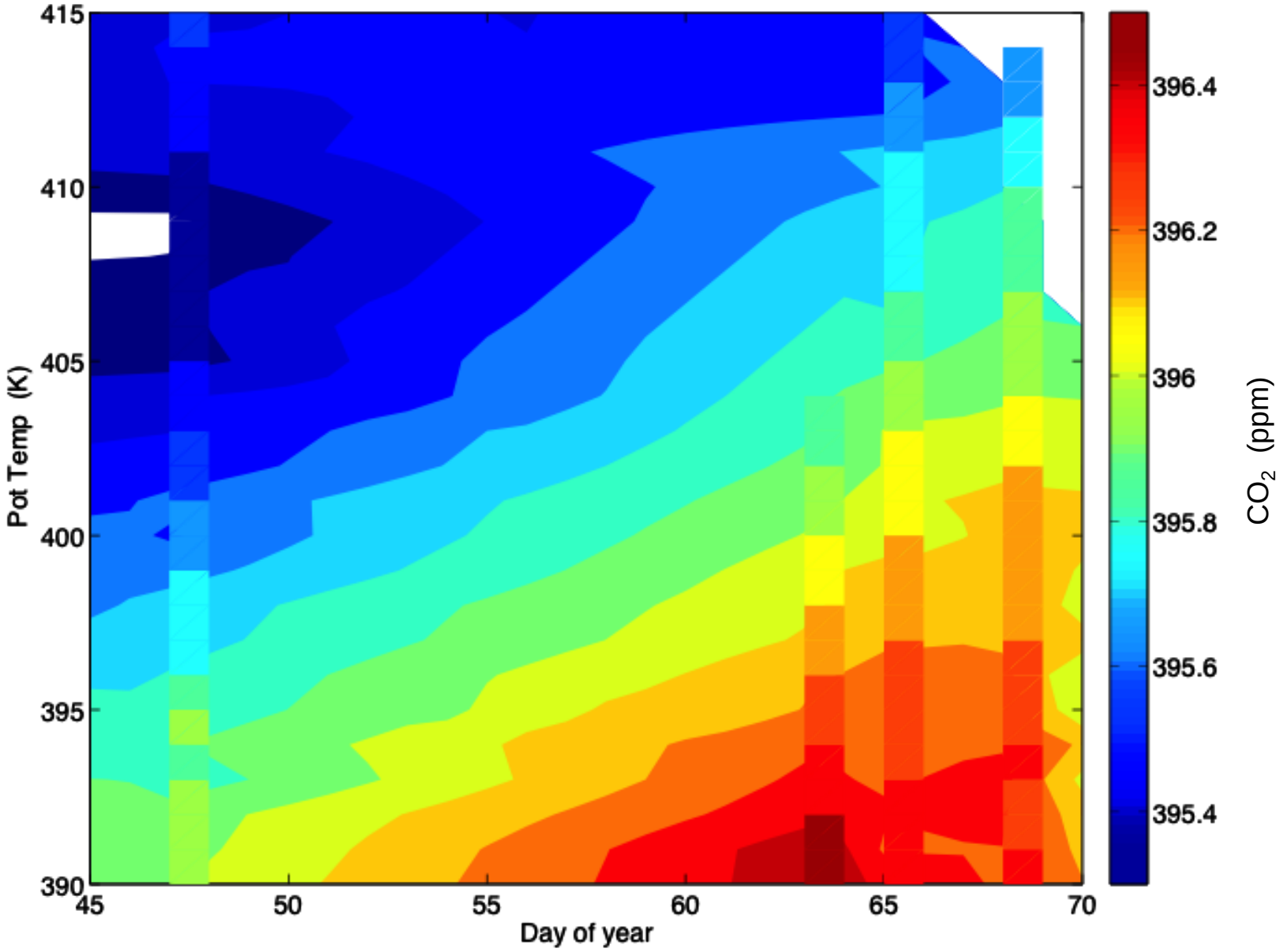
** = adjusted to current values

2- STRATOSPHERIC AGING

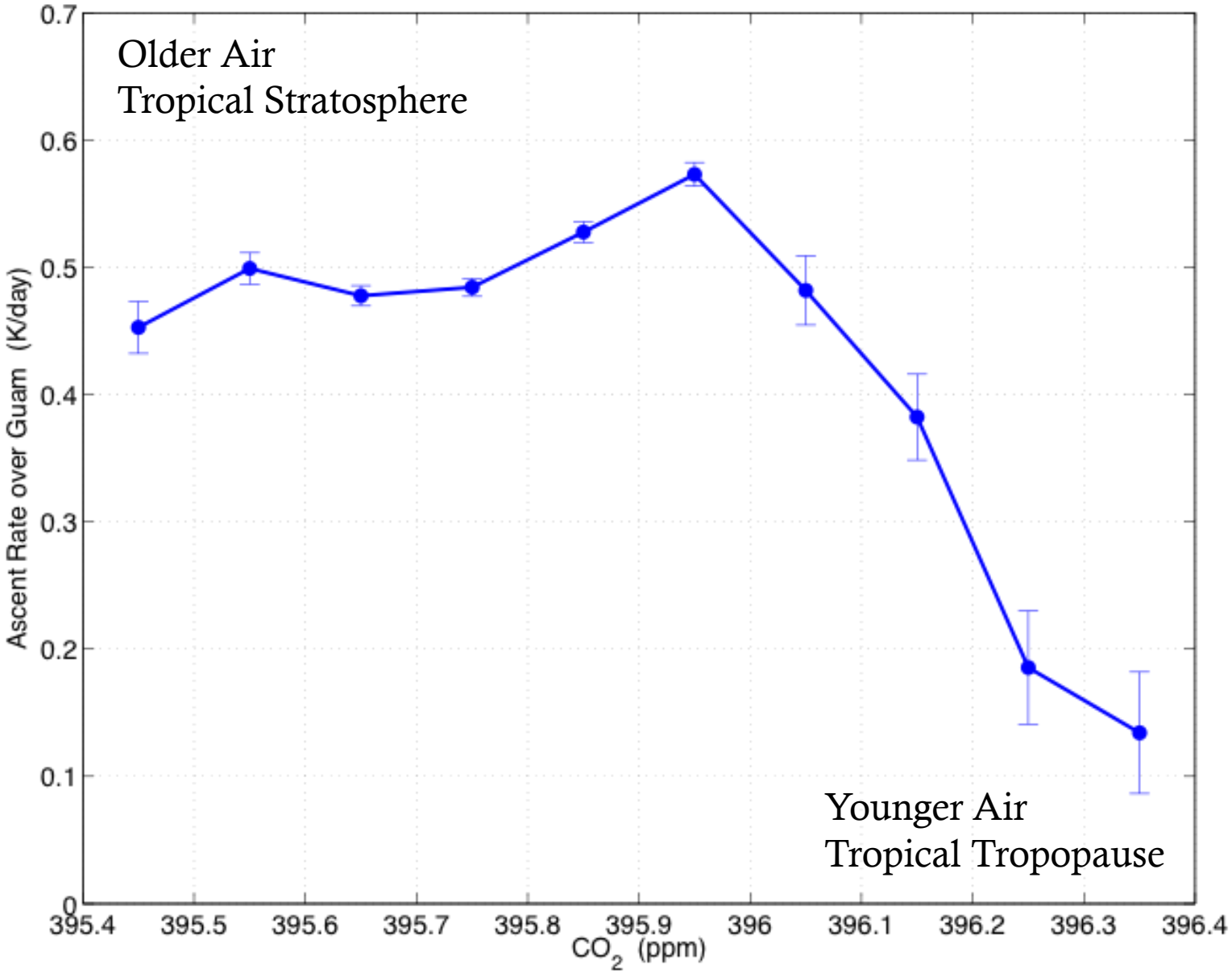
CO_2 Evolution in the Lower Stratosphere over Guam

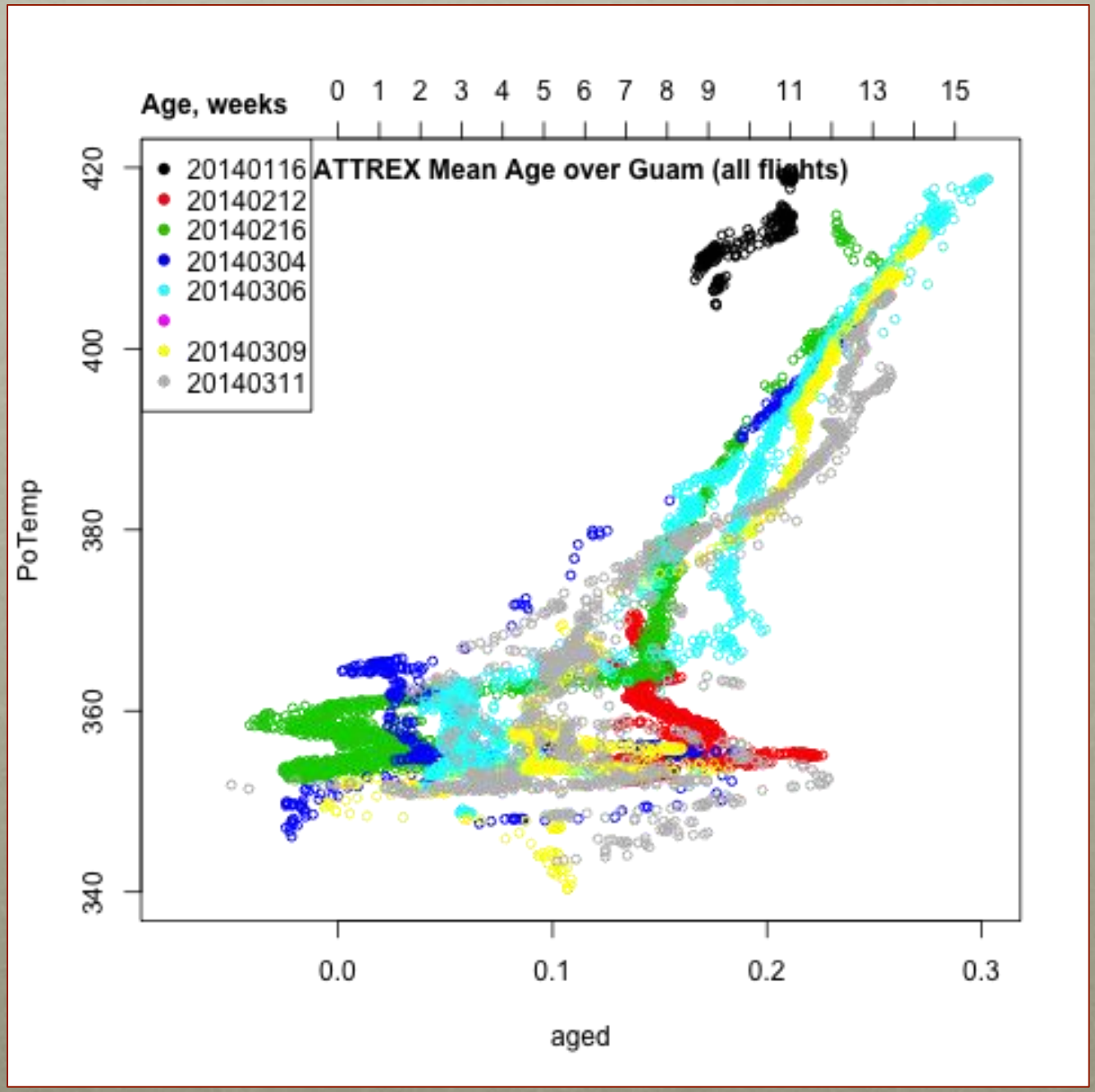


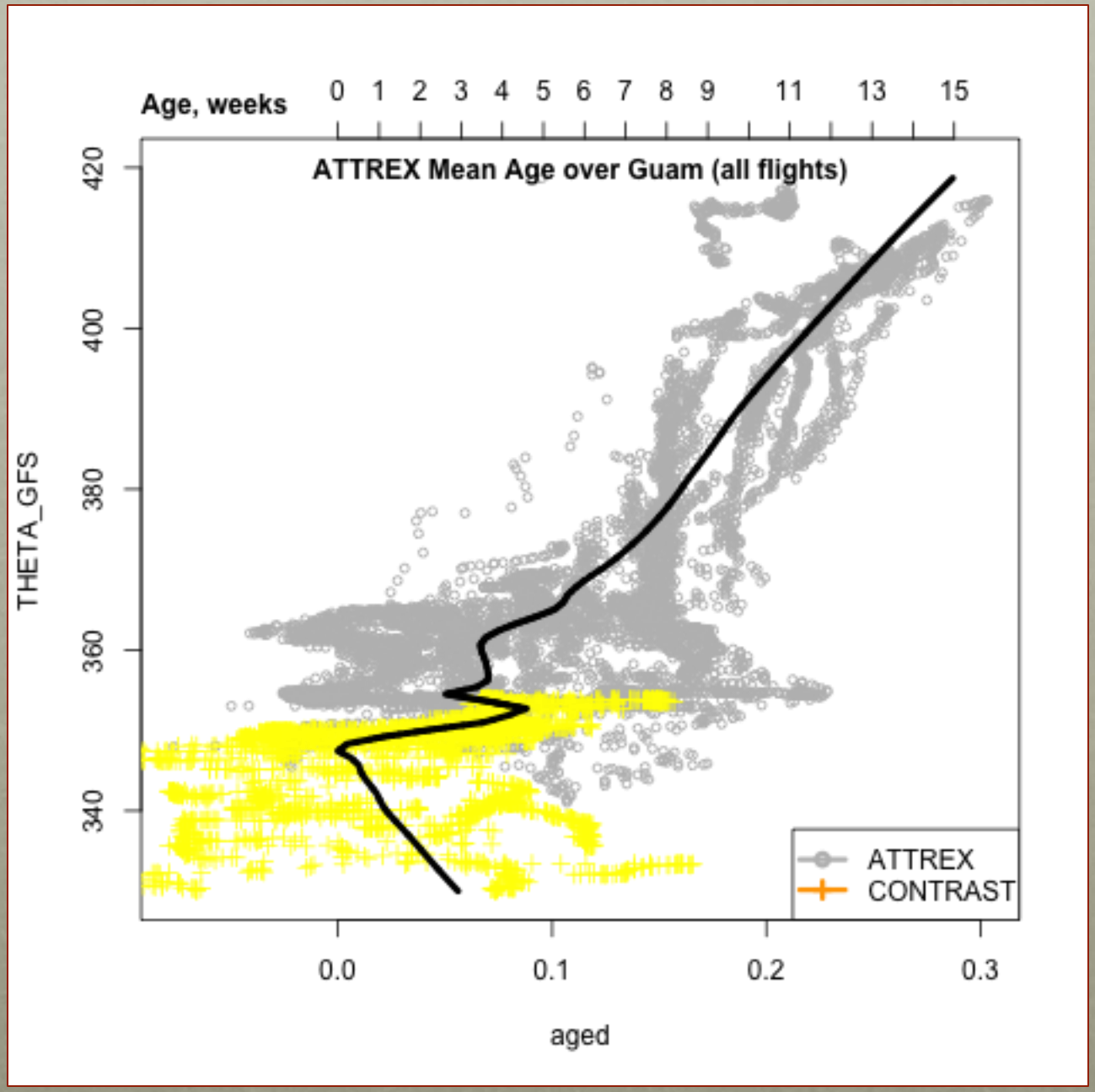
CO_2 Evolution in the Lower Stratosphere over Guam



CO_2 Evolution in the Lower Stratosphere over Guam




Age, weeks
0 1 2 3 4 5 6 7 8 9 11 13 15
ATTREX Mean Age over Guam (all flights)
20140116
20140212
20140216
20140304
20140306
20140309
20140311
PoTemp
420
400
380
360
340
0.0
0.1
0.2
0.3
aged


Age, weeks
0 1 2 3 4 5 6 7 8 9 11 13 15
ATTREX Mean Age over Guam (all flights)
THETA_GFS
420
400
380
360
340
0.0
0.1
0.2
0.3
aged
ATTREX
CONTRAST

SUMMARY

- Chemical composition of the TTL was affected by not just local (i.e., Maritime Continent) but also non-local convection.
- Based on CO_2 measurements, we find that air in the TTL over Guam on average reflects 0 age (input from the tropical boundary layer) at Θ~348K and ~12 weeks of residence time (age at Θ~400K).
- CO_2 data define the ascent rates for air over Guam, from single profiles and from change over the mission duration. Both imply 0.5 K/day ascent above 360K, slower in the lower TTL. From 370-390K (tropopause) there is evidence that ascent and mixing may be sporadic rather than uniform.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THANK YOU!