HIPPO Science Team Meeting
Boulder, Colorado
16-18 March 2011

O_3 Intercomparison: RAQMS vs Measurements

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Real-time Air Quality Modeling System (RAQMS)

• RAQMS is a valuable forecasting tool for intercontinental transport of pollutants that can affect US air quality—HIPPO data are very useful for validation of the model

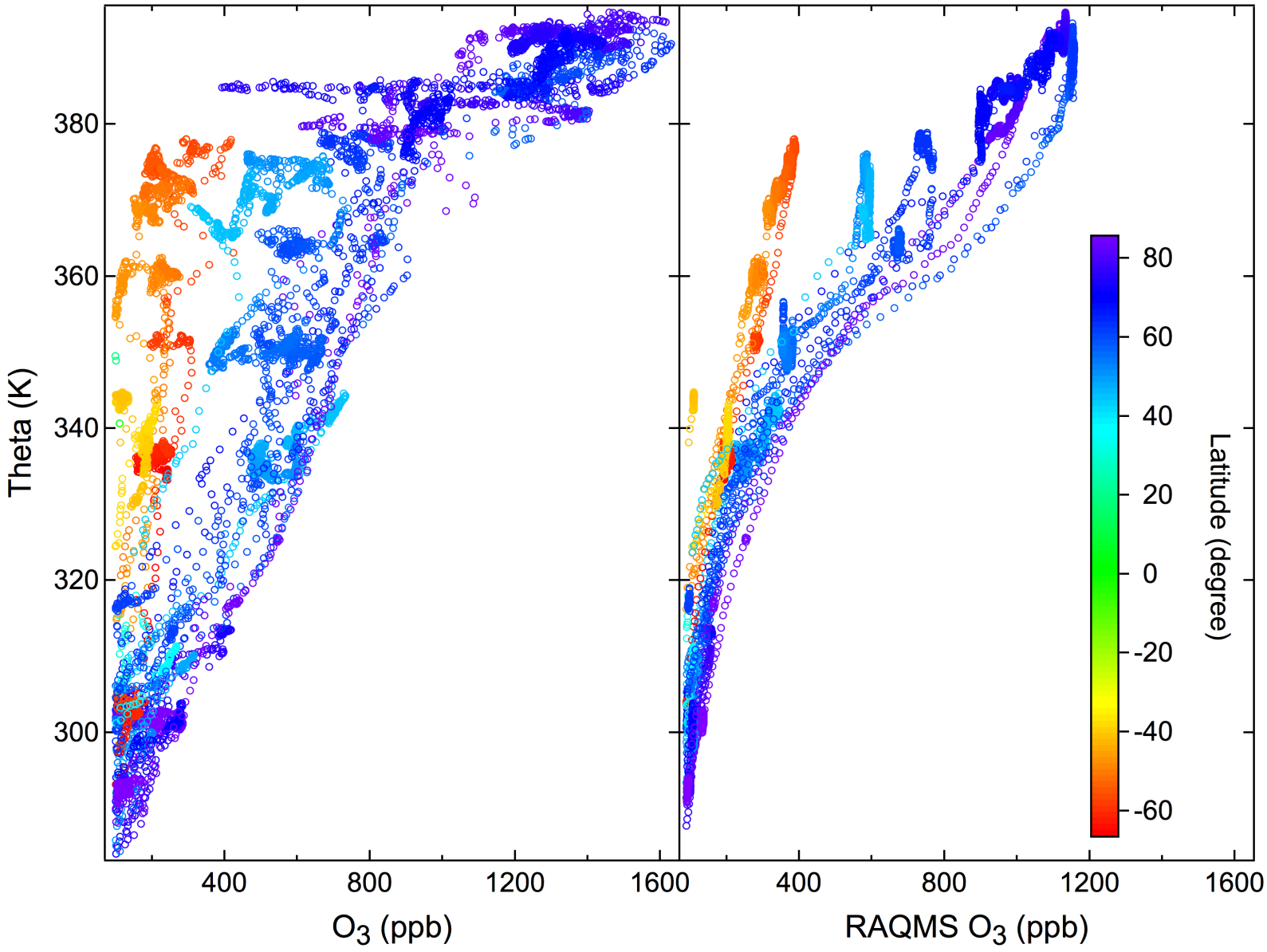
• Online global meteorological and chemical modeling system

• Real-time assimilation of MLS O_3 and OMI total column O_3 and MODIS aerosol optical depth for model initialization:

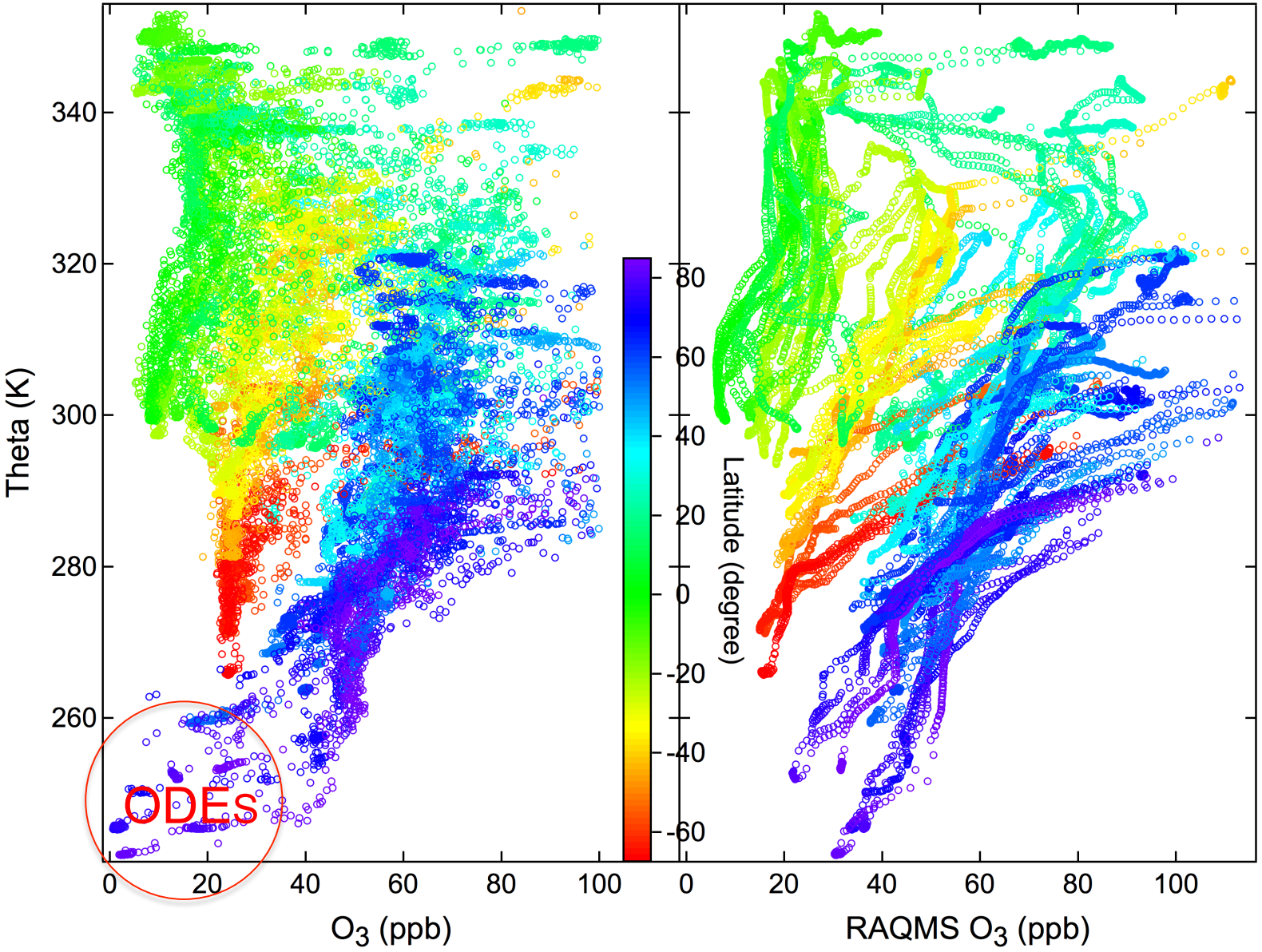
• MLS data provide constraint on stratospheric O_3
• OMI total column O_3 increments the profile (shape stays same)
• Model physics and chemistry (unified stratospheric and tropospheric chemistry) and assimilated meteorology then govern the structure in O_3
• All data shown are 2x2 degree 6 hour forecasts (00Z, 06Z, 12Z, 18Z) interpolated to HIPPO 10-s averages
• Details in *Pierce et al.* [2003; 2007; 2009], JGR

• Model results currently only available for HIPPO 3

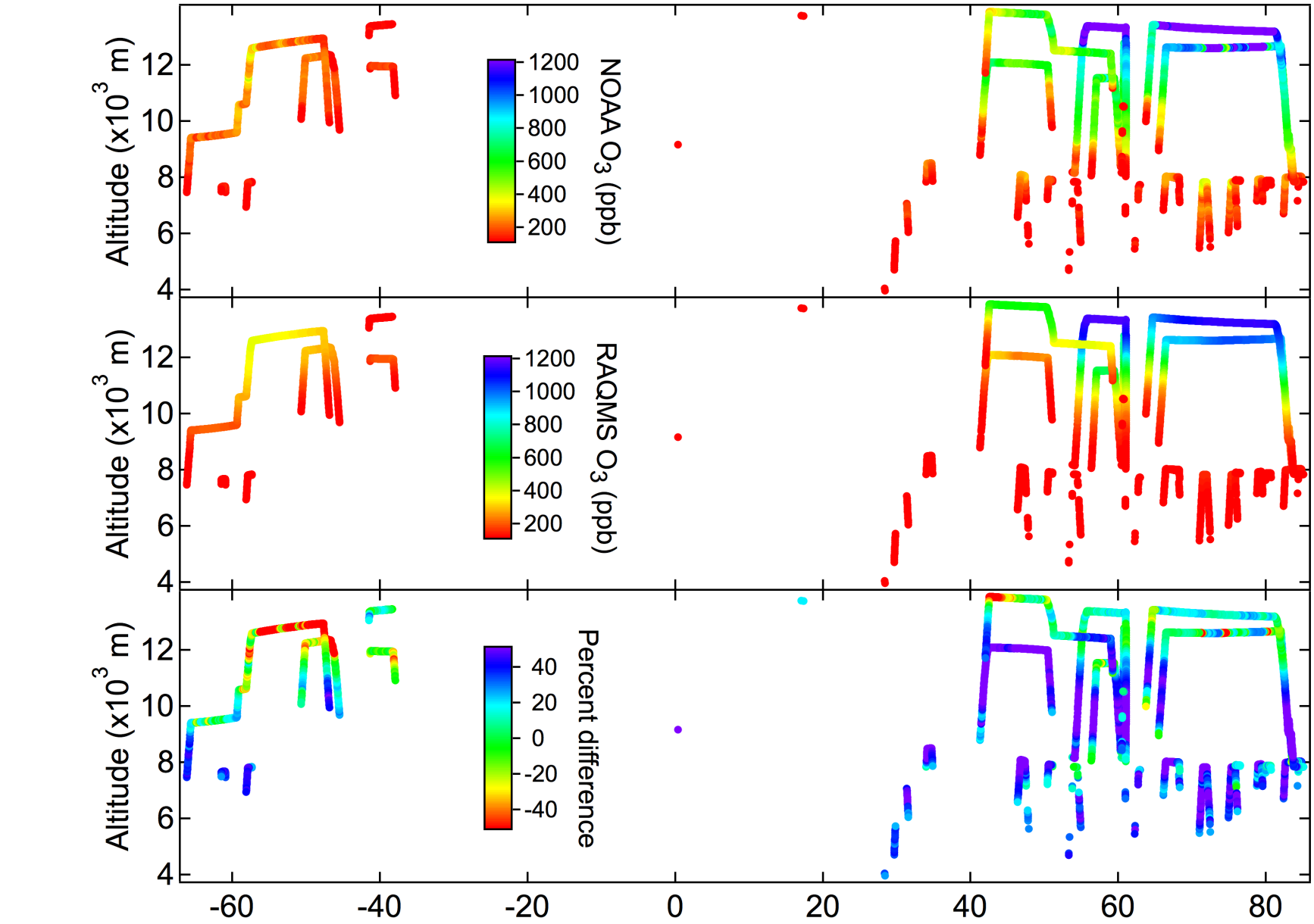
Stratospheric O_3 (> 100 ppb) as functions of θ



Tropospheric O_3 (< 100 ppb) as functions of θ



Stratospheric O_3 (> 100 ppb) curtain plots

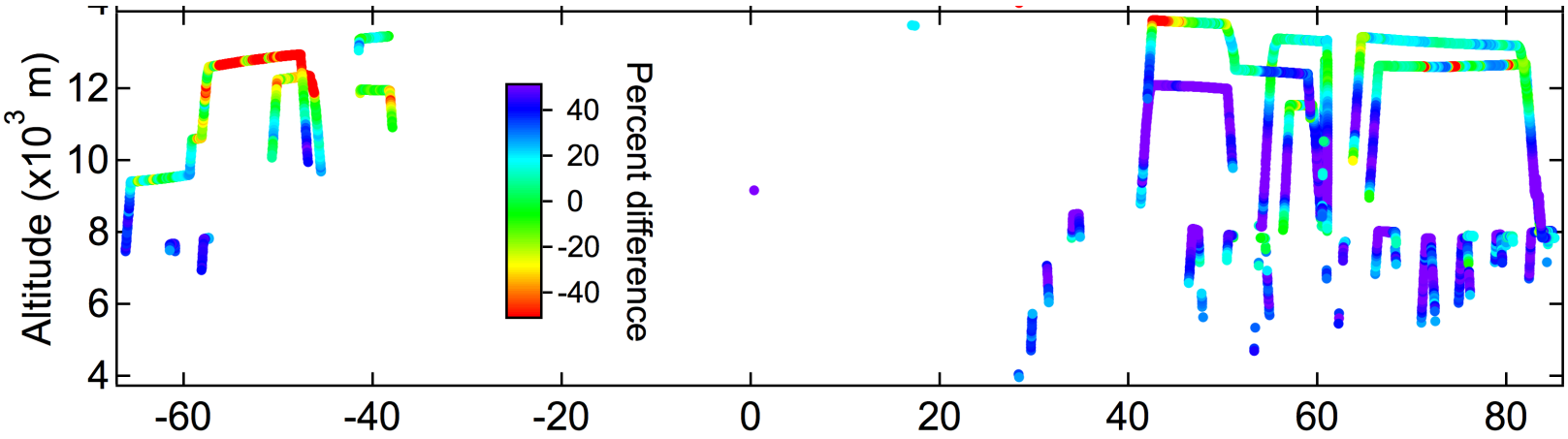


Red: Model values too high

Blue: Model values too low

Stratospheric O_3 (> 100 ppb) curtain plots

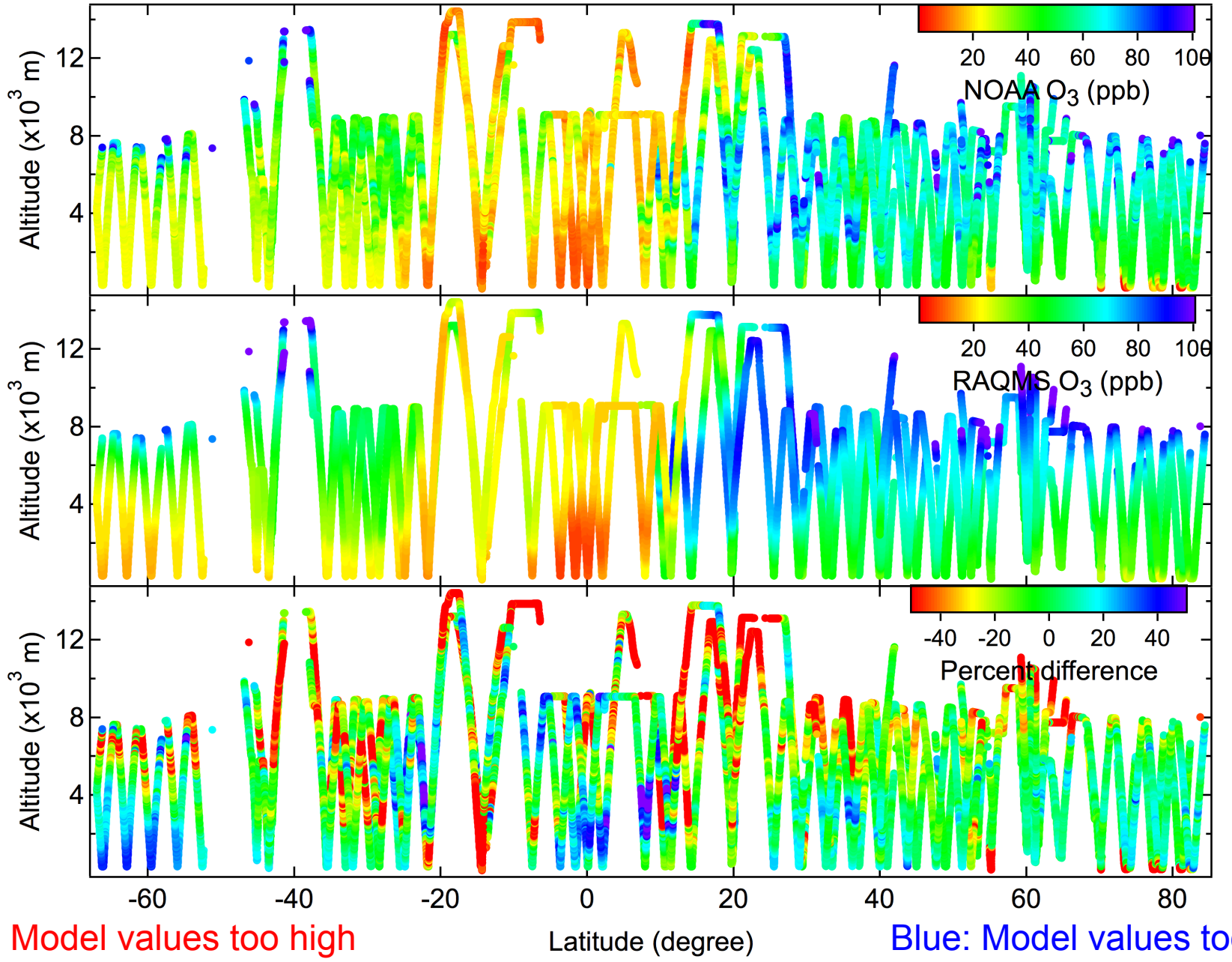
Points with difference greater than |±40%|: 29%



Red: Model values too high

Blue: Model values too low

Tropospheric O_3 (< 100 ppb) curtain plots

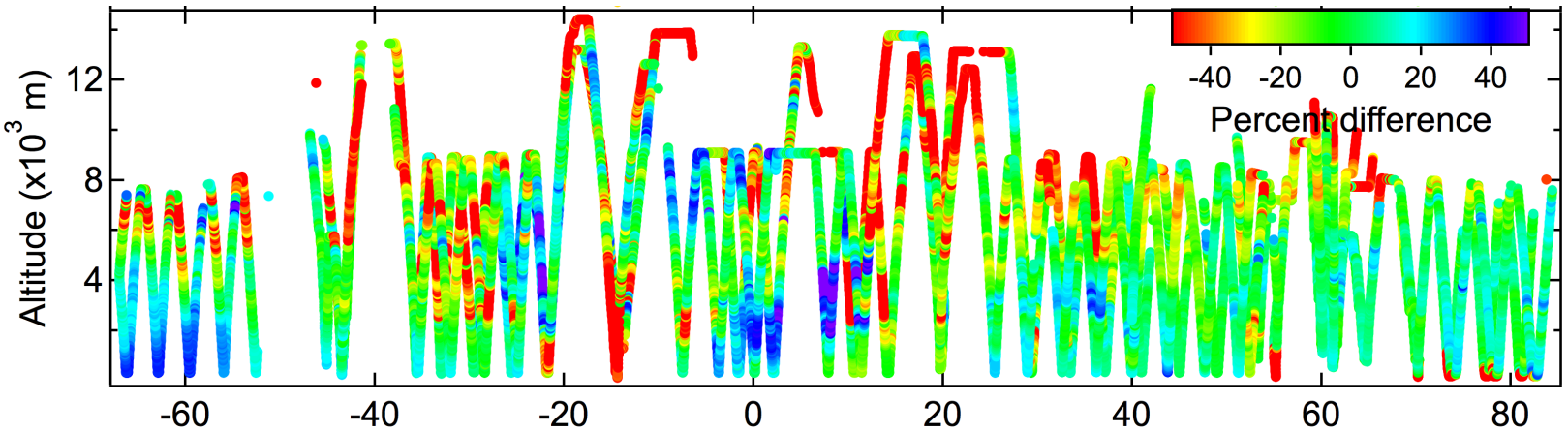


Red: Model values too high

Blue: Model values too low

Tropospheric O_3 (< 100 ppb) curtain plots

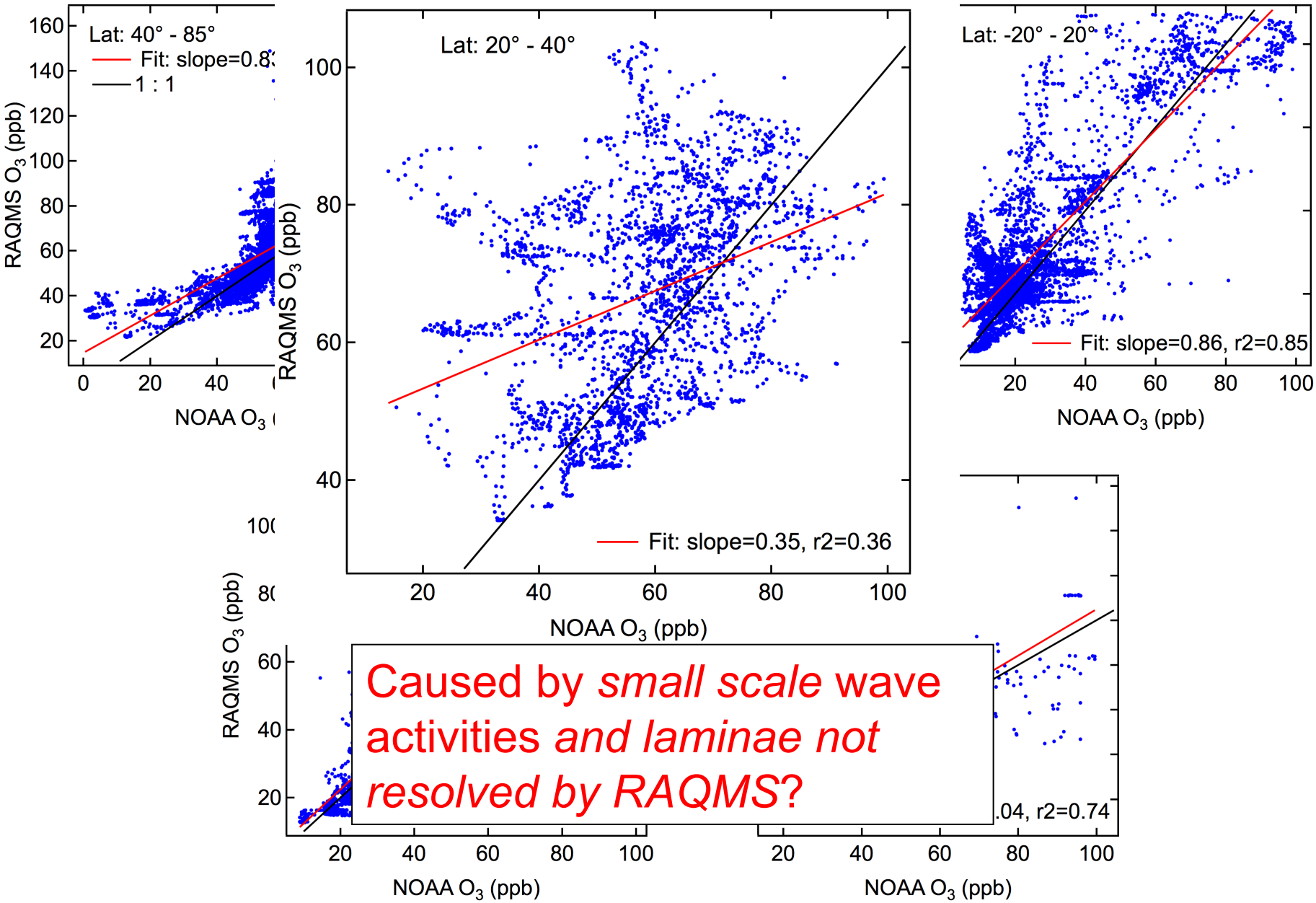
Points with difference greater than |±40%|: 18%



Red: Model values too high

Blue: Model values too low

Tropospheric O_3 correlation plots



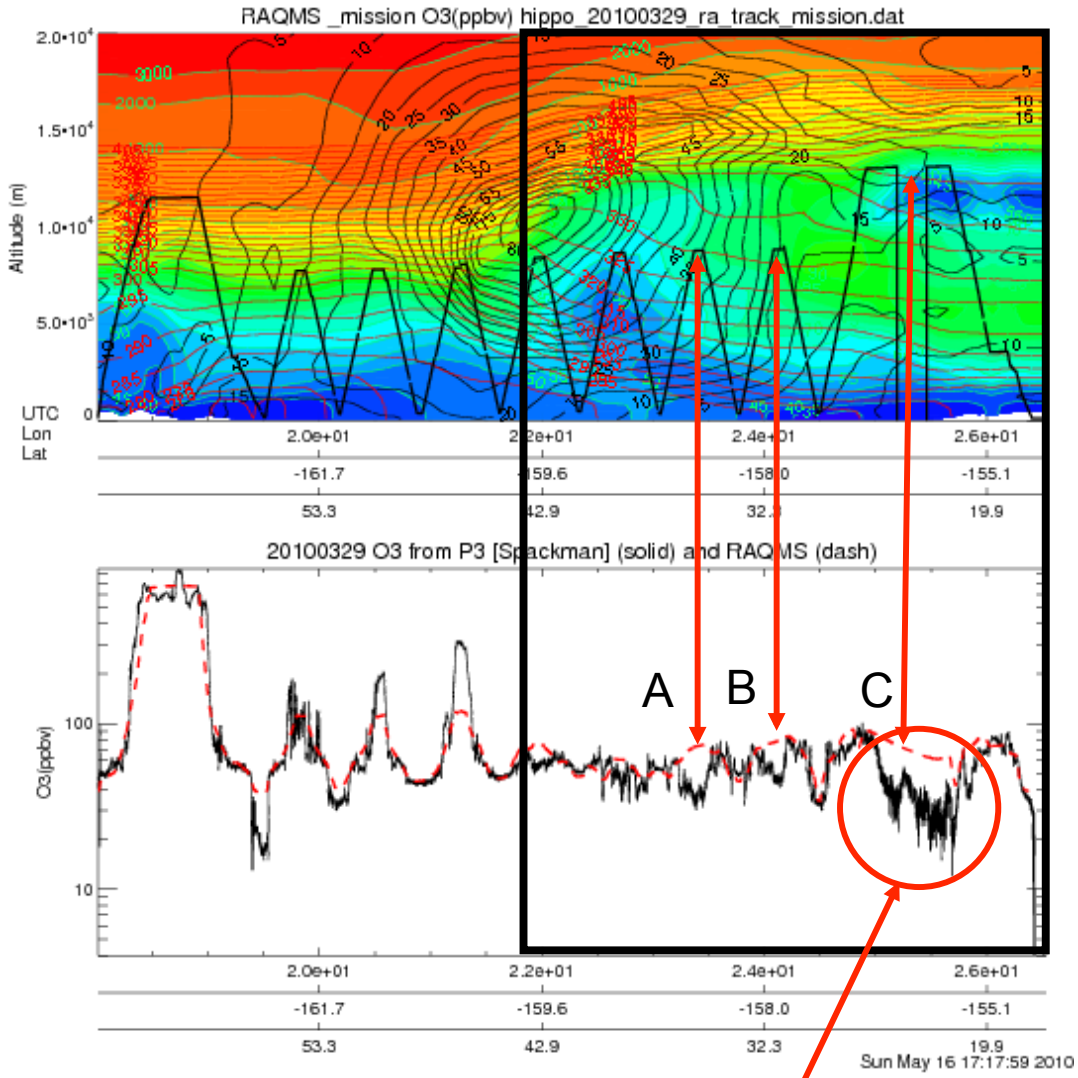
HIPPO-3 Southbound: Anchorage to Kona

- 20-40N: Model misses low O_3 features on equatorward flank of polar jet (A, B)

- Model also underestimates low O_3 features associated with convective outflow (C) from tropics

Black: Obs

Red: Model



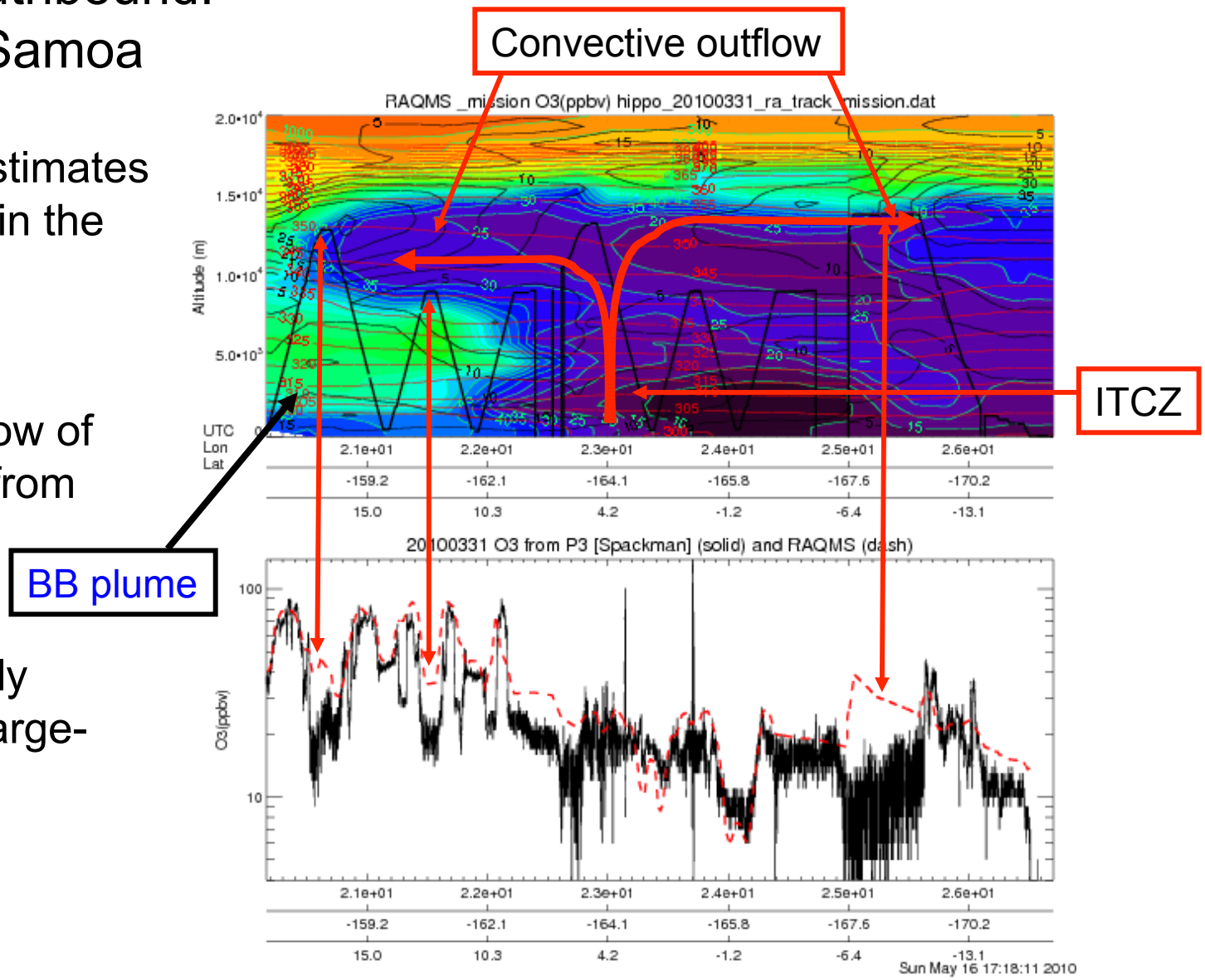
HIPPO-3 Southbound: Kona to Am Samoa

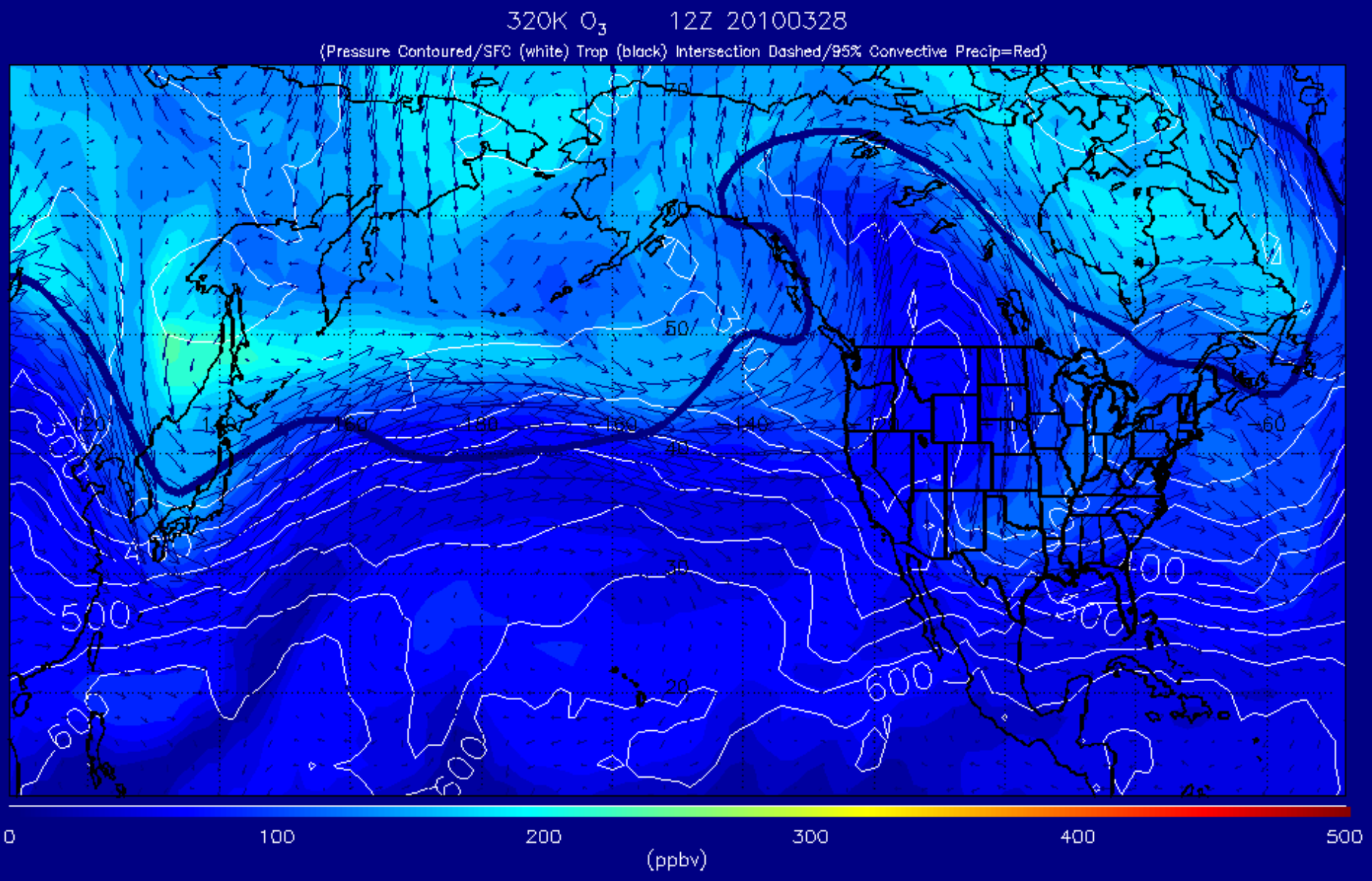
- Model underestimates low O_3 features in the upper tropical troposphere associated with convective outflow of low O_3 MBL air from ITCZ

- Model generally captures O_3 in large-scale BB plume

Black: Obs

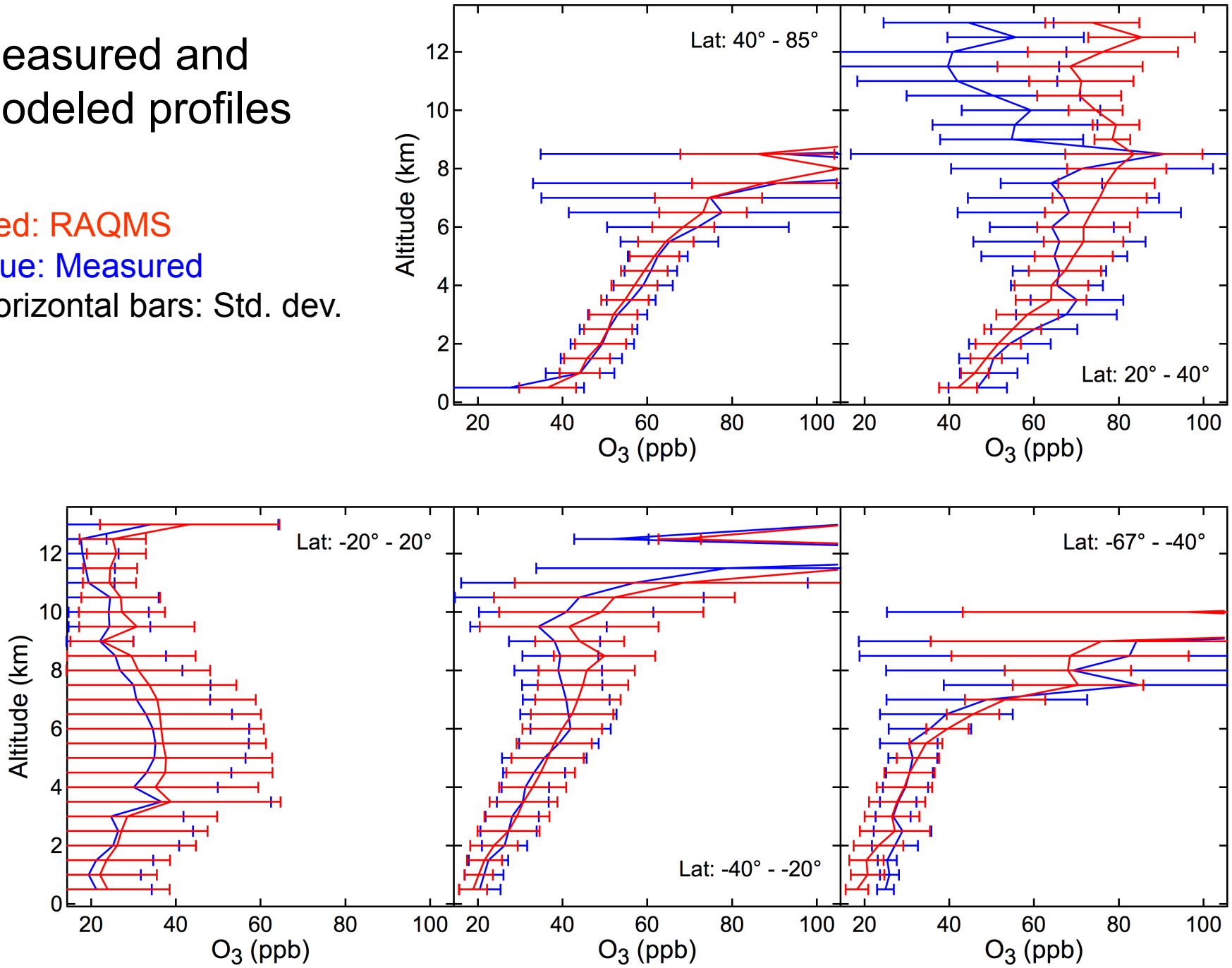
Red: Model




320K O_3 12Z 20100328
(Pressure Contoured/SFC (white) Trop (black) Intersection Dashed/95% Convective Precip=Red)
0
100
200
300
400
500
(ppbv)
$RAQMS_G$ −24hr OMI/MLS ASSIM Initialized 12Z 20100328

Measured and modeled profiles

Red: RAQMS
Blue: Measured
Horizontal bars: Std. dev.



Conclusions

• HIPPO measurements provide an excellent dataset for model validations and large latitudinal coverage over a short time period constrains model dynamics

• Comparisons demonstrate that real-time assimilation of MLS O_3 and OMI total column O_3 provides good constraints on modeled O_3 distributions over the Pacific over a wide range of photochemical and dynamical environments

• RAQMS model does not capture O_3 minima associated with poleward meridional transport of low O_3 marine boundary layer air that was convectively lofted in the tropics—this contributes to the model high bias at northern midlatitudes