Observations of Formaldehyde in the remote tropical western Pacific during CONTRAST

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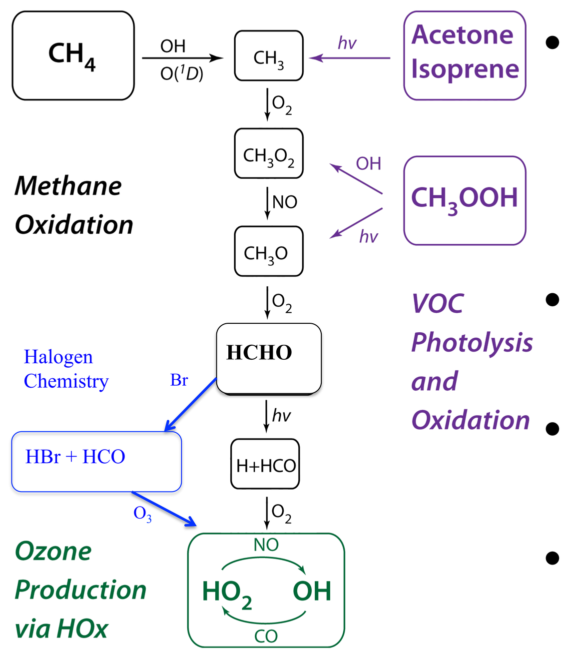
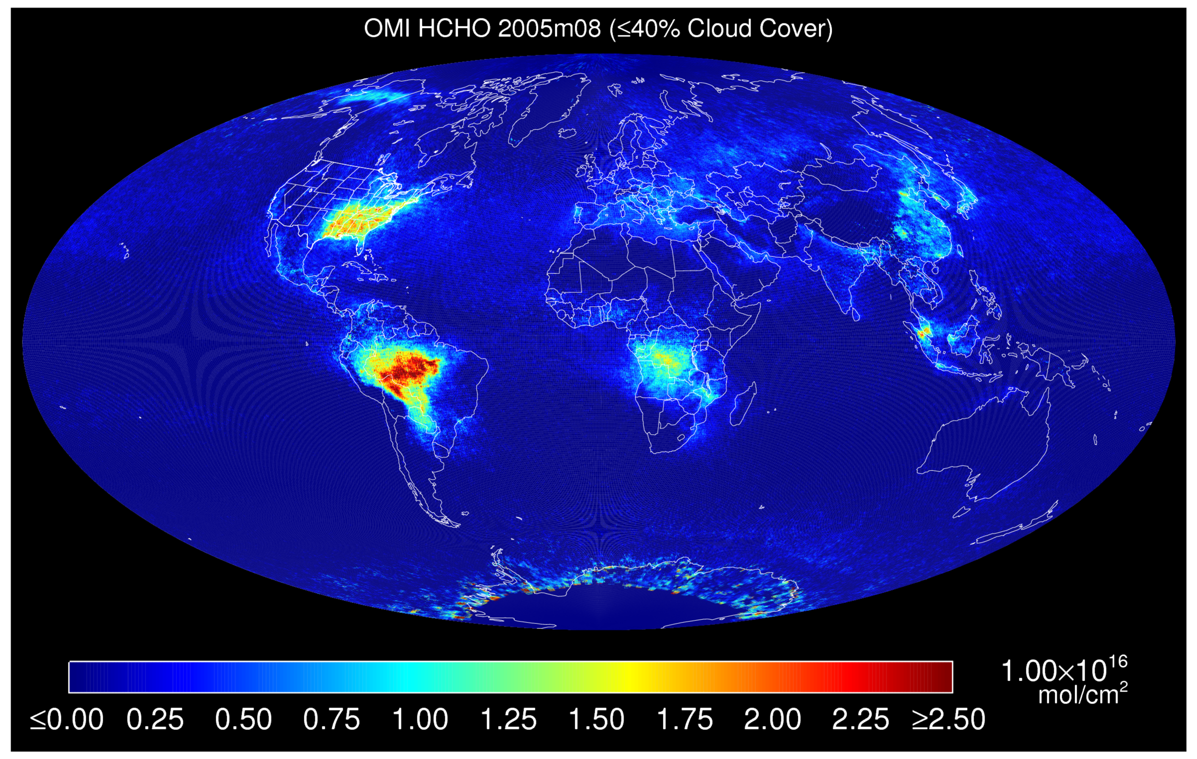
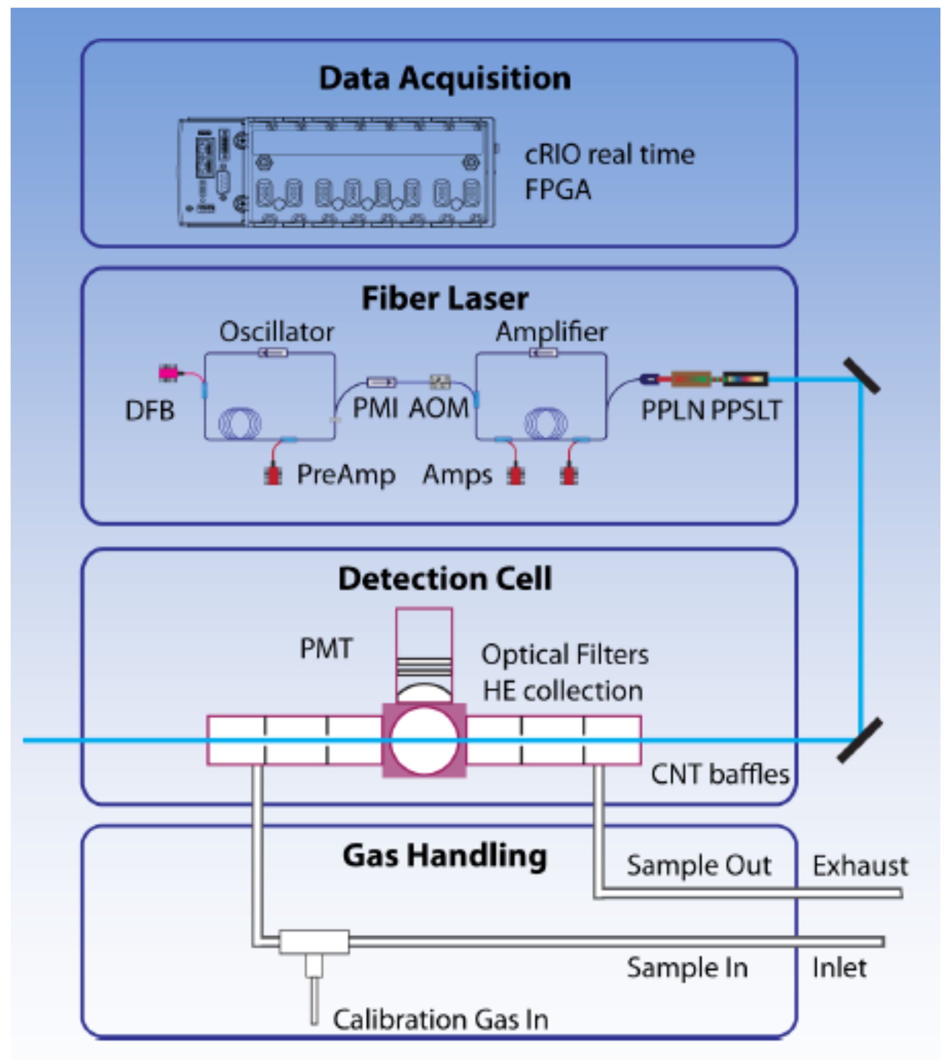
Formaldehyde Background



- Reaction with Br radical is potentially important for HCHO removal in a marine environment:
  HCHO + Br ➔ HBr + HO_2 + CO
- Short lifetime (~2 hrs) makes HCHO an excellent tracer of recent convection.
- Necessary for modeling of OH and O_3 production.
- Concentrations in remote areas are too low for satellite observations to be useful.

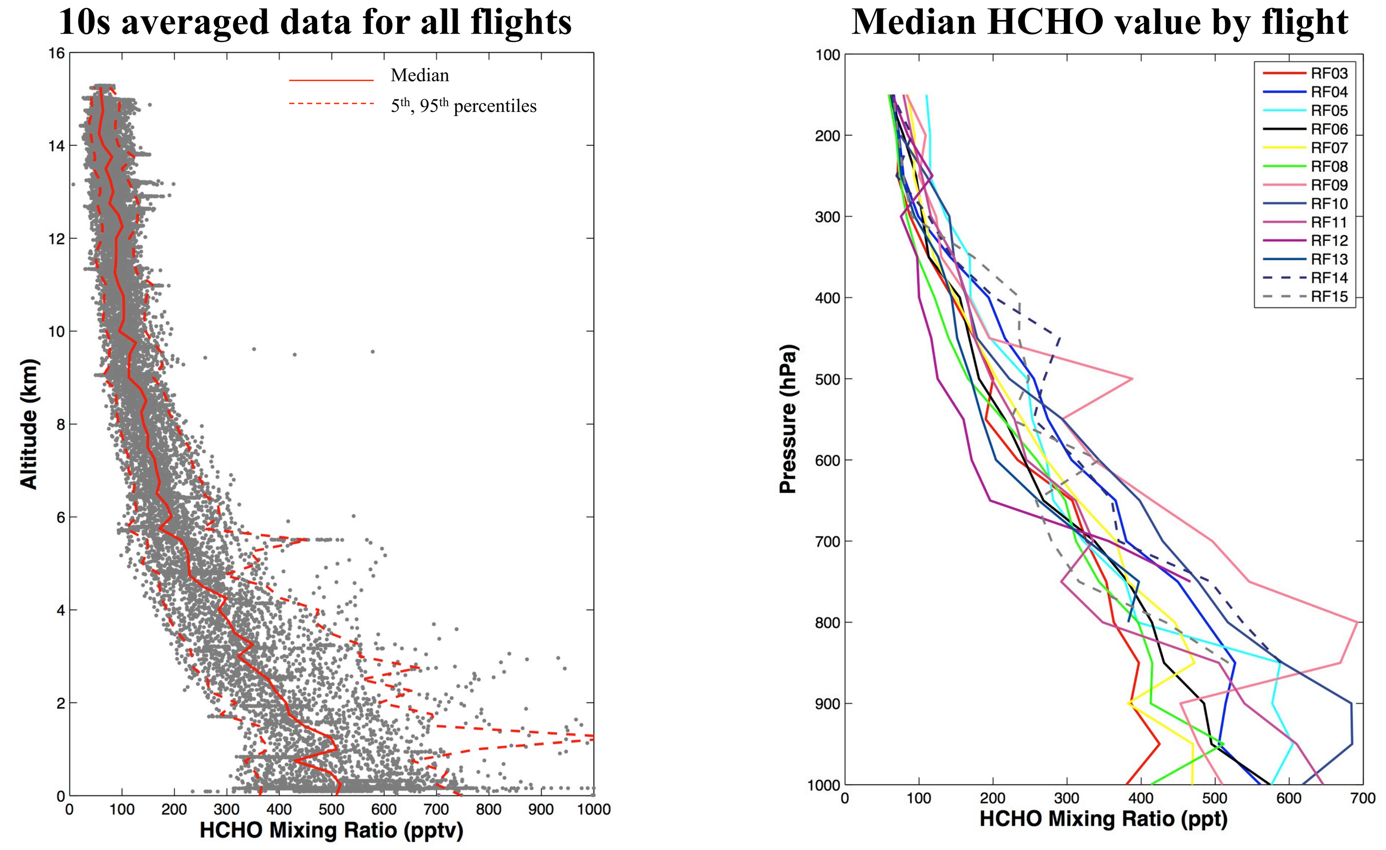


In Situ Airborne Formaldehyde (ISAF) Description

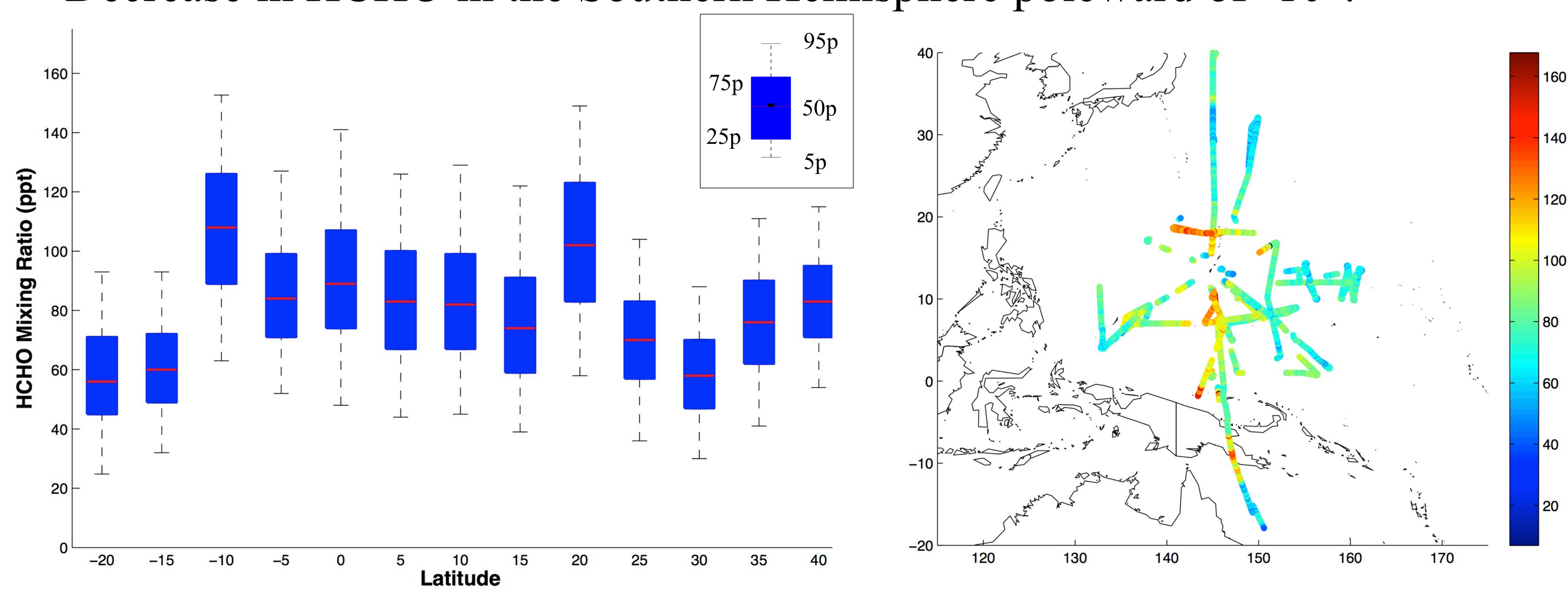


- Pulsed tunable diode laser induces a rotational transition at 353.16 nm.
- Laser tuned to on- and off- resonance features, allowing for subtraction of interferences.
- **Accuracy**: 10% **Precision**: 10 pptv/s **Detection Limit:** 10 pptv

Formaldehyde Distribution



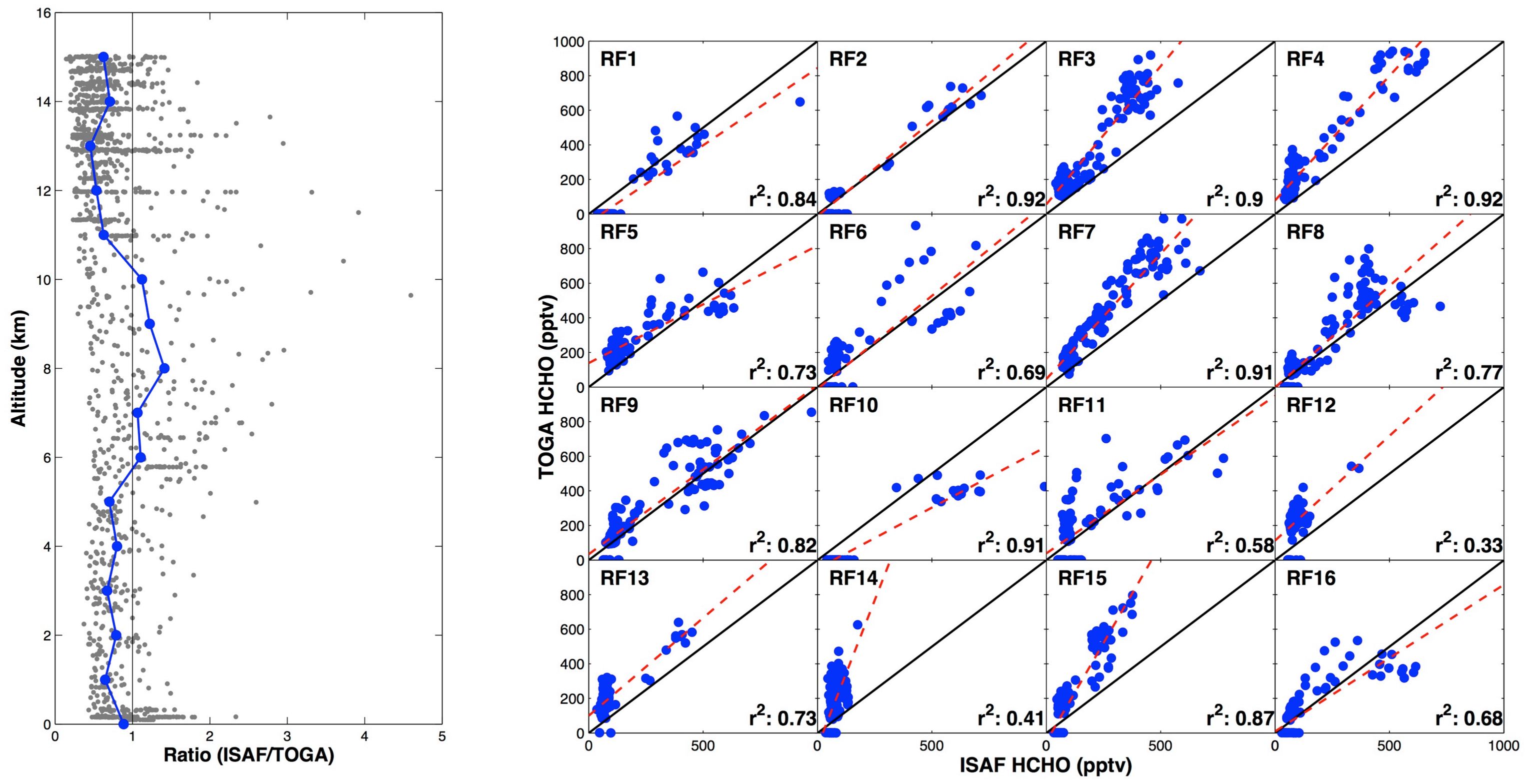
- Order of magnitude decrease from surface (500 pptv) to 15 km (50 pptv).
- Individual flights show significant enhancements in lower troposphere.
- Possible evidence of recent convection at 200 hPa over Papua New Guinea and north of Guam.
- Decrease in HCHO in the Southern Hemisphere poleward of -10°.



10s Averaged HCHO at 200 hPa

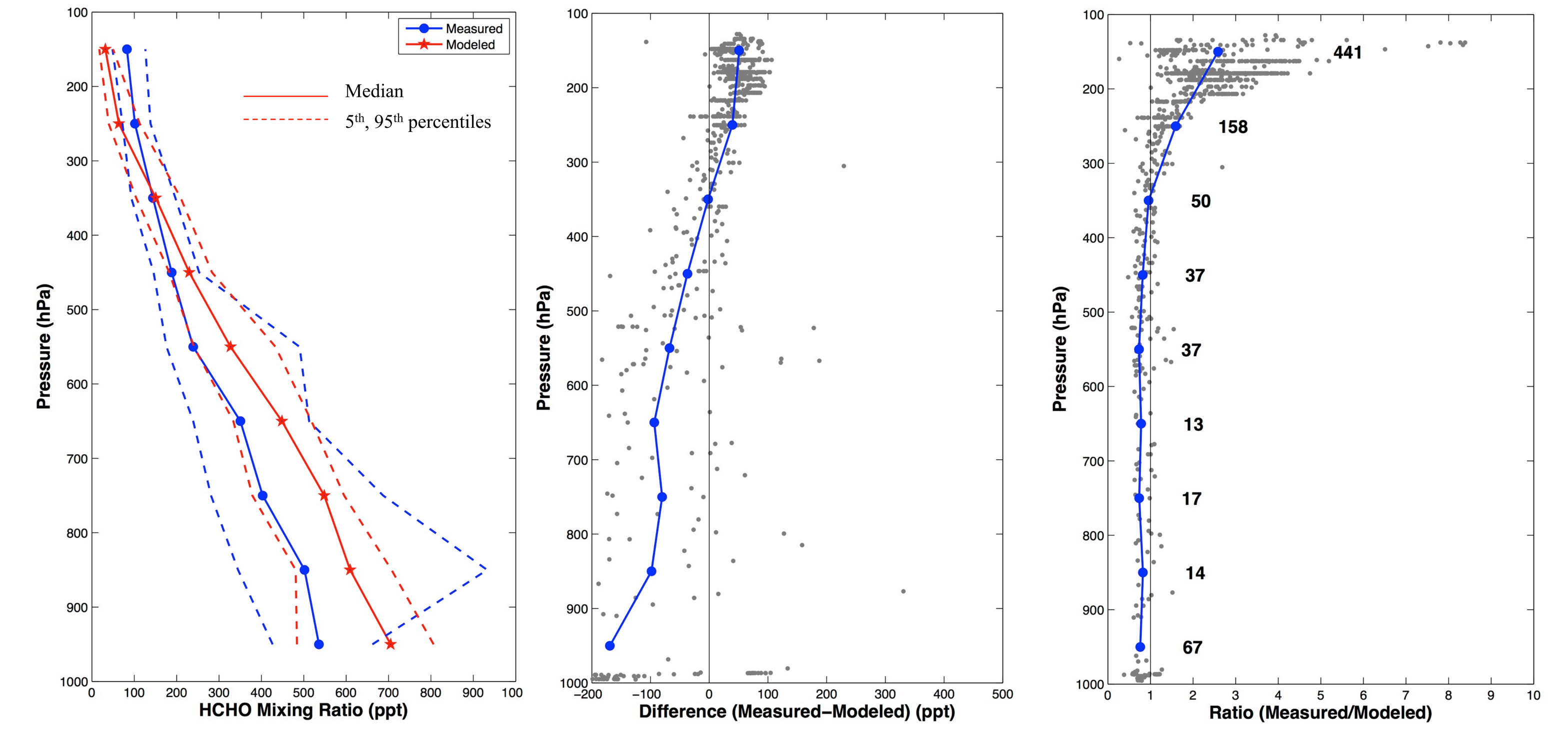
ISAF & in-flight GCMS (TOGA) Comparison

- Significant flight-by-flight variation in agreement between instruments.
- In general, TOGA observations are ~50% higher than ISAF.



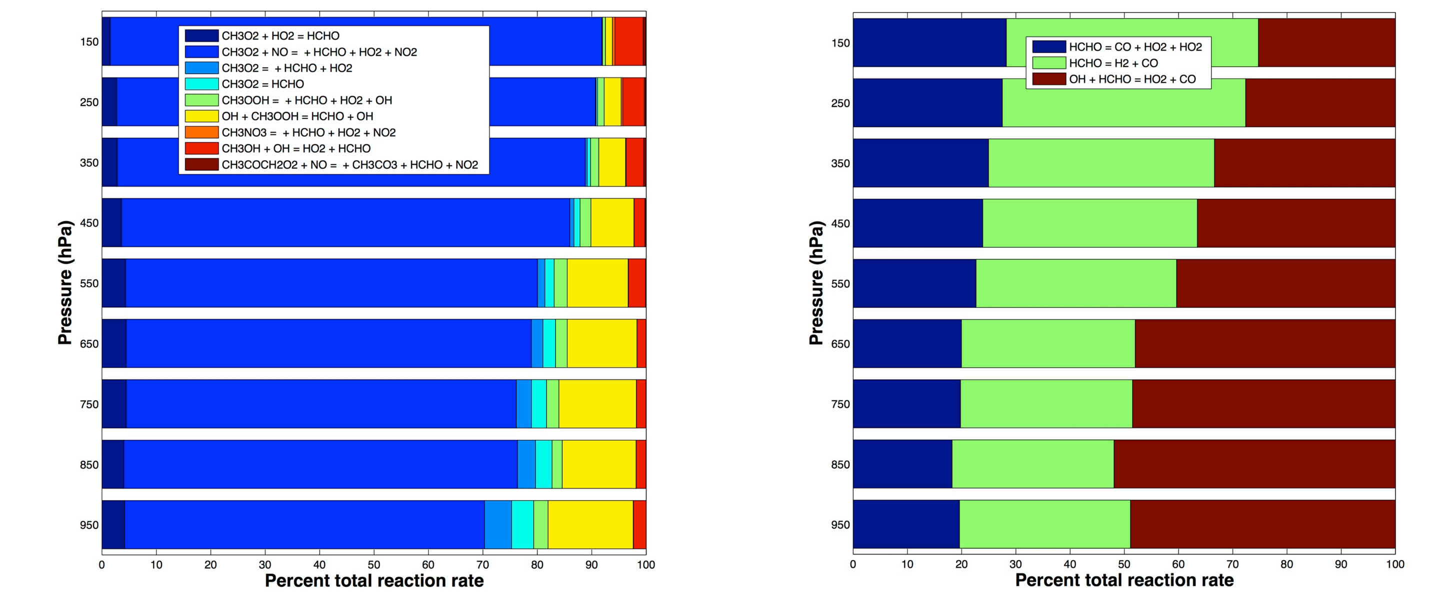
Initial Box Modeling Results

- UWCM box model run with the Master Chemical Mechanism v. 3.2.
- Constrained by observations of CH_4, CO, O_3, & NO. Initialized with MVK, methacrolein, isoprene, acetone, acetaldehyde, methanol, & NO_2.



- Model ~40% higher than observations near the surface and about 100% lower at 200 hPa.
- Disagreement aloft could be caused by convective transport.
- Addition of Br and heterogeneous chemistry to the model could lower modeled values.

Reactions contributing to HCHO Formation and Destruction



- Reactions involving CH_3O_2, produced almost exclusively by methane, responsible for at least 80% of HCHO production at all altitudes.
- Limited influence from other VOCs.
- Photolysis becomes more dominant at higher altitudes.

Future Work

- Determine impact of Br on HCHO concentration.
- Flight-by-flight analysis to find cause of elevated HCHO levels in the lower free troposphere.
- Analyze the effects of deep convection on upper tropospheric composition.