CU Airborne Multi AXis DOAS

Detection of iodine oxide and glyoxal in the tropical free troposphere

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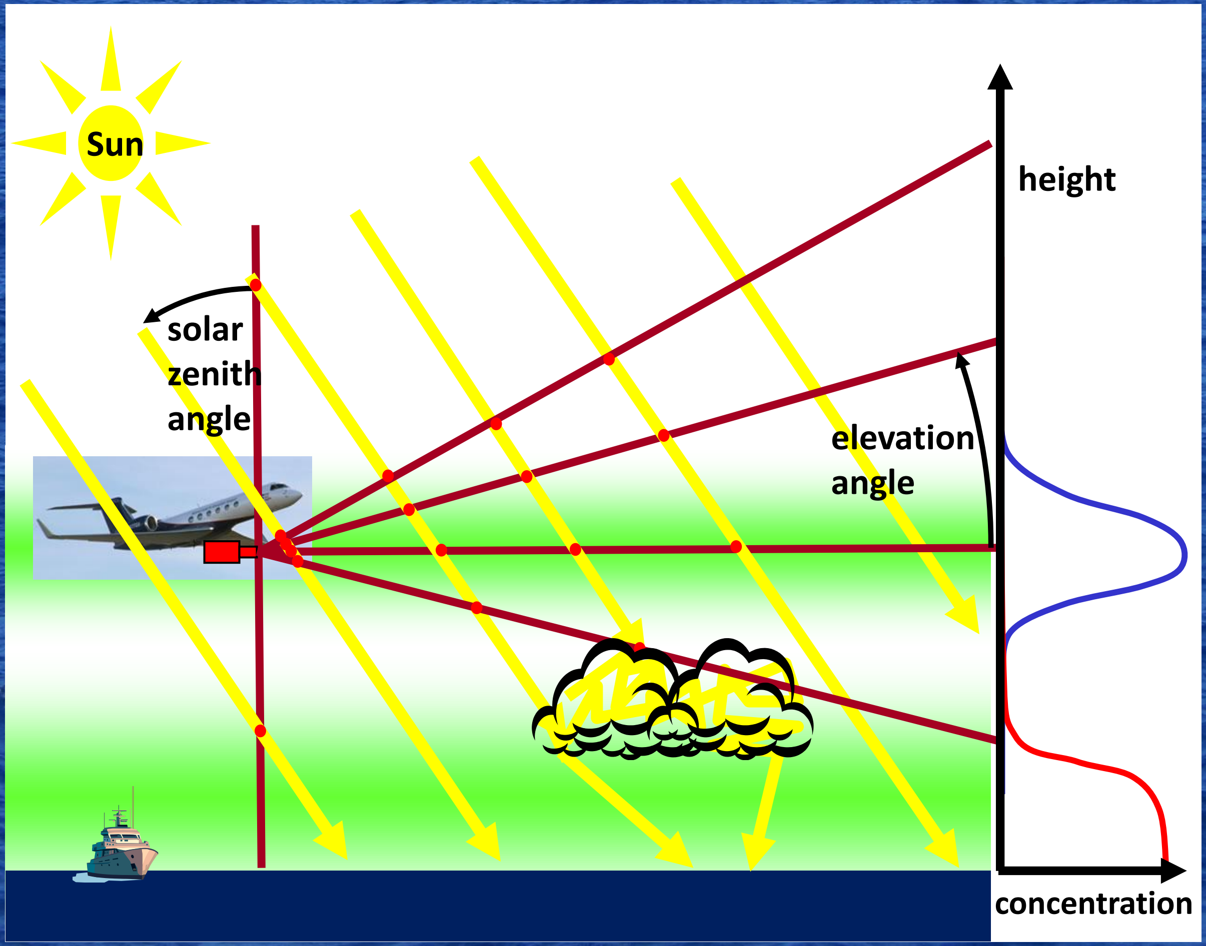
University of Colorado Boulder

CIRES
Cooperative Institute for Research in Environmental Sciences

Content

1 CU AMAX-DOAS on HIAPER

Airborne Multi-Axis Differential Optical Absorption Spectroscopy

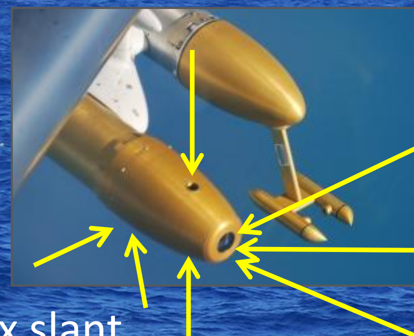


Volkamer et al., 2009

1 CU AMAX-DOAS on HIAPER

wing canister with telescopes

zenith

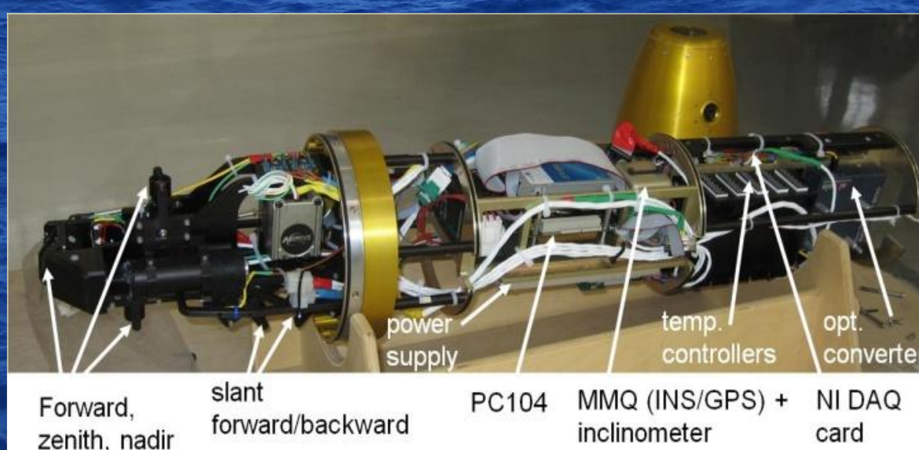


Forward:
RT motion stabilized
+23 to -23 degrees

2x slant down

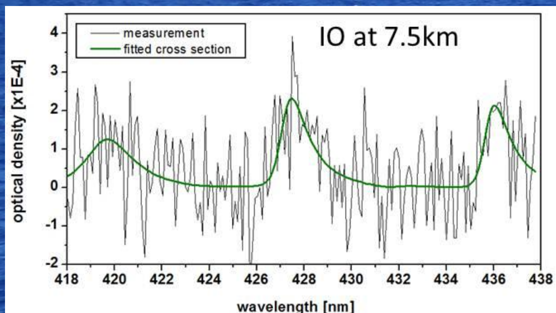
nadir

- 2 Acton/Pixis spectrograph/detector Trace gas/O_4
- Active temp. stab.
- Control electronics

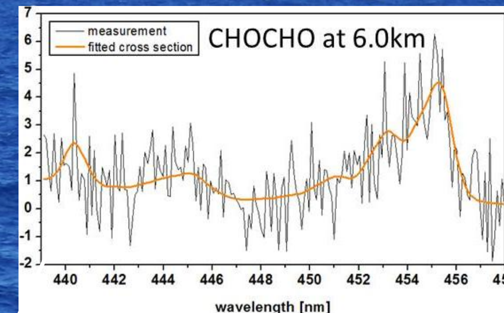


2 HEFT-10-RF1 Results: 1 Slant Column Densities

spectral signature

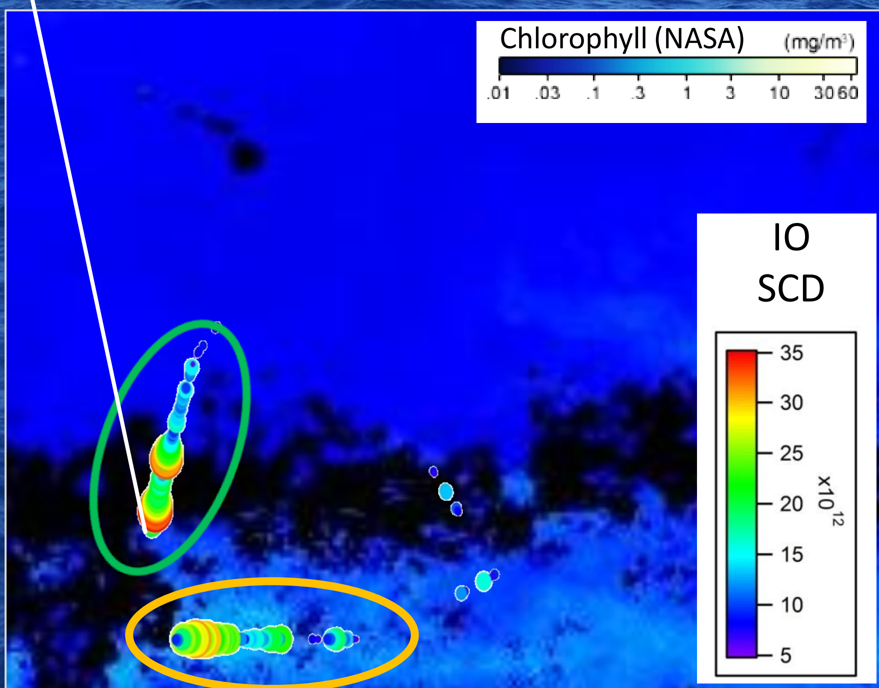


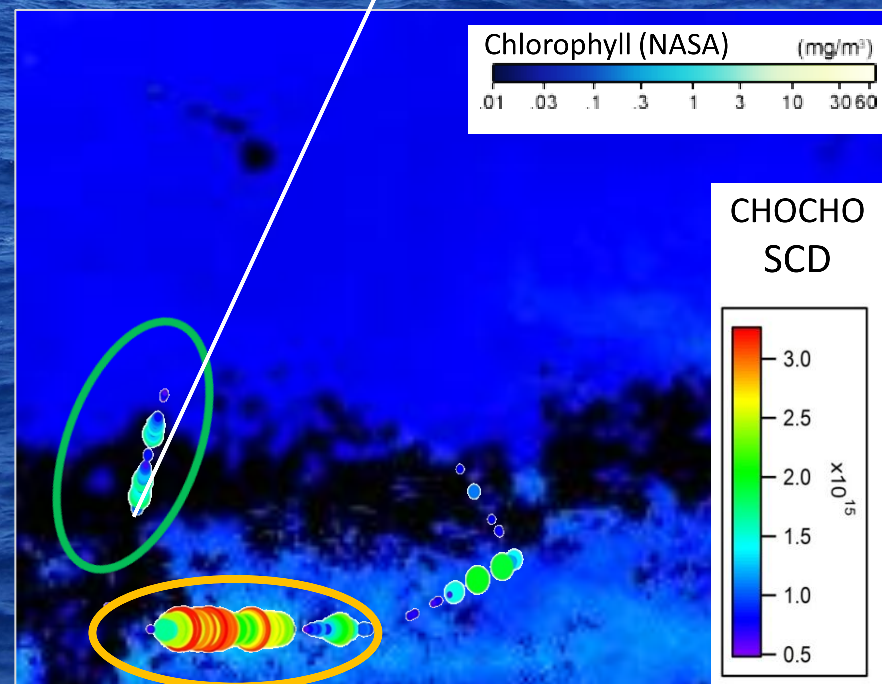
spectral signature



Slant Column Density

SCD = $\int c * l dL$

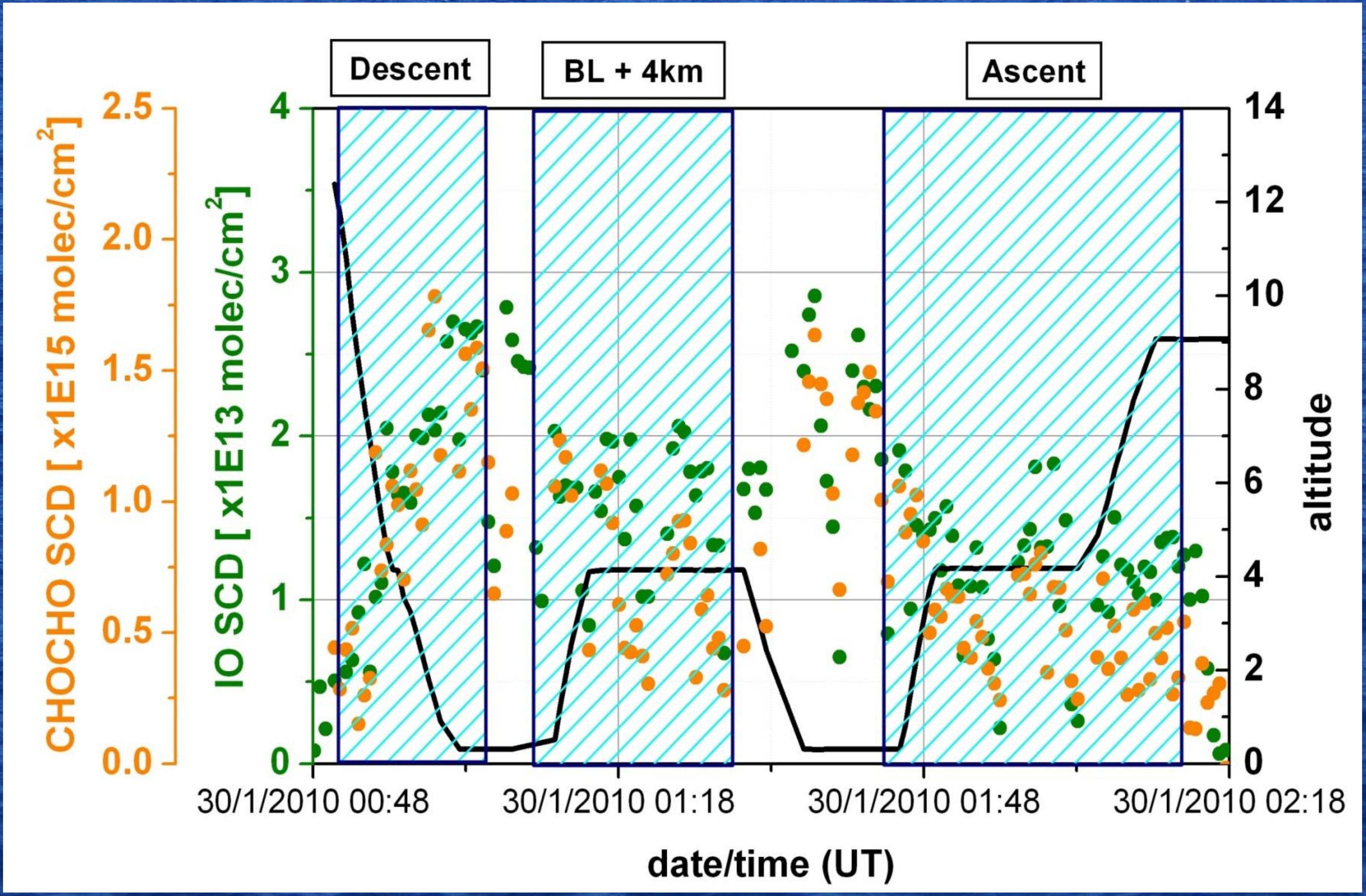




profile retrieval (Hypothesis #1)

Hypothesis #2

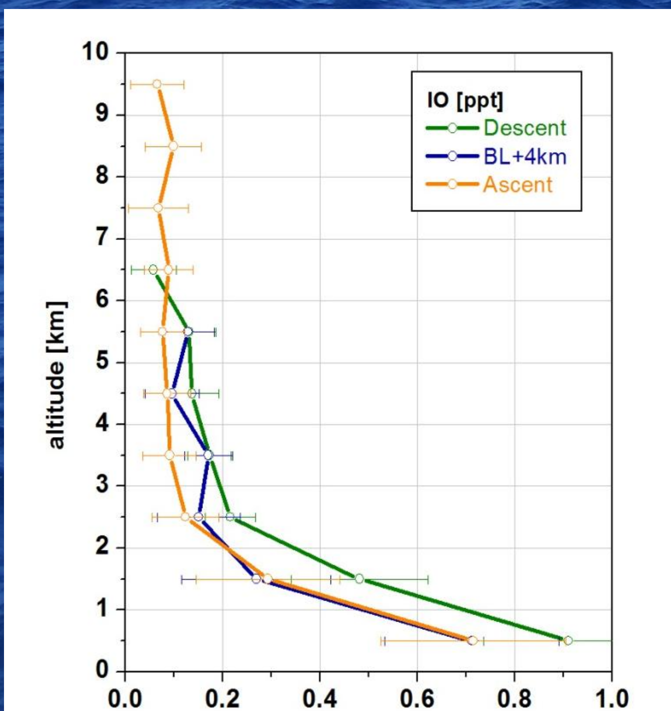
2 HEFT-10-RF1 Results: 1 Slant Column Densities

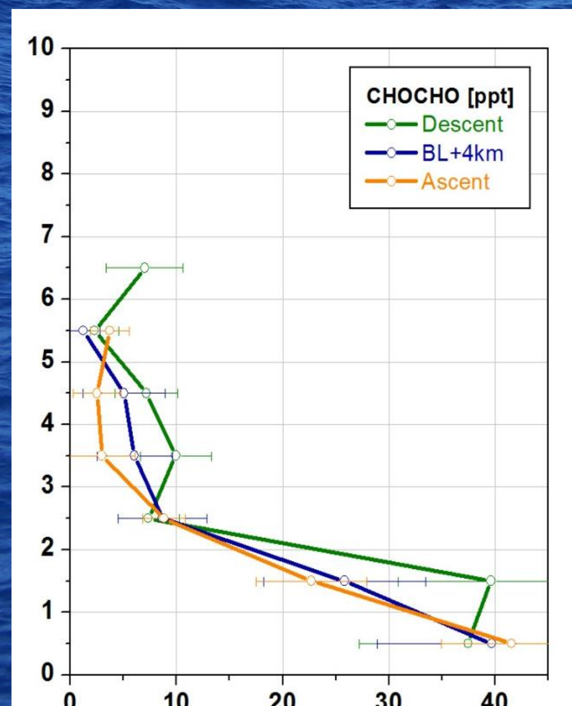


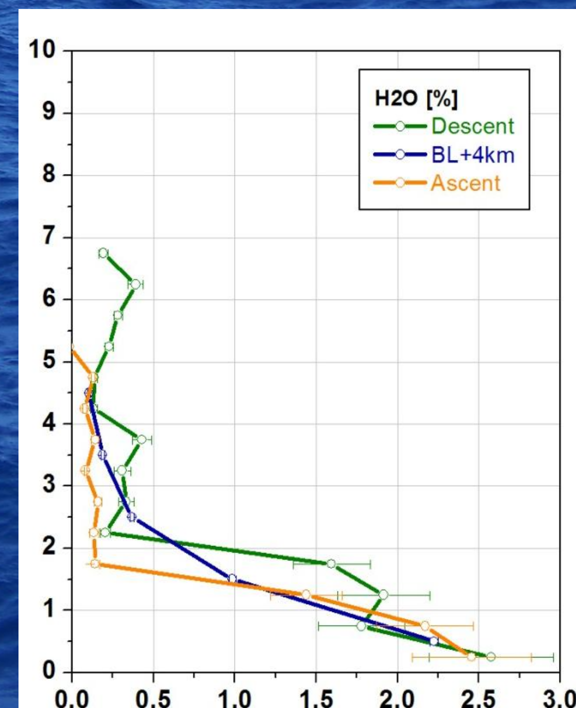
2 HEFT-10-RF1 Results: 2 Profile Retrieval

SCD O_4 ⇨ Radiative Transfer Modeling (RTM) ⇨ Aerosol Profile ⇨ RTM + trace gas SCD + Optimal Estimation ⇨ Trace Gas Profiles

Mixing Ratio Profiles: IO, CHOCHO, water vapor

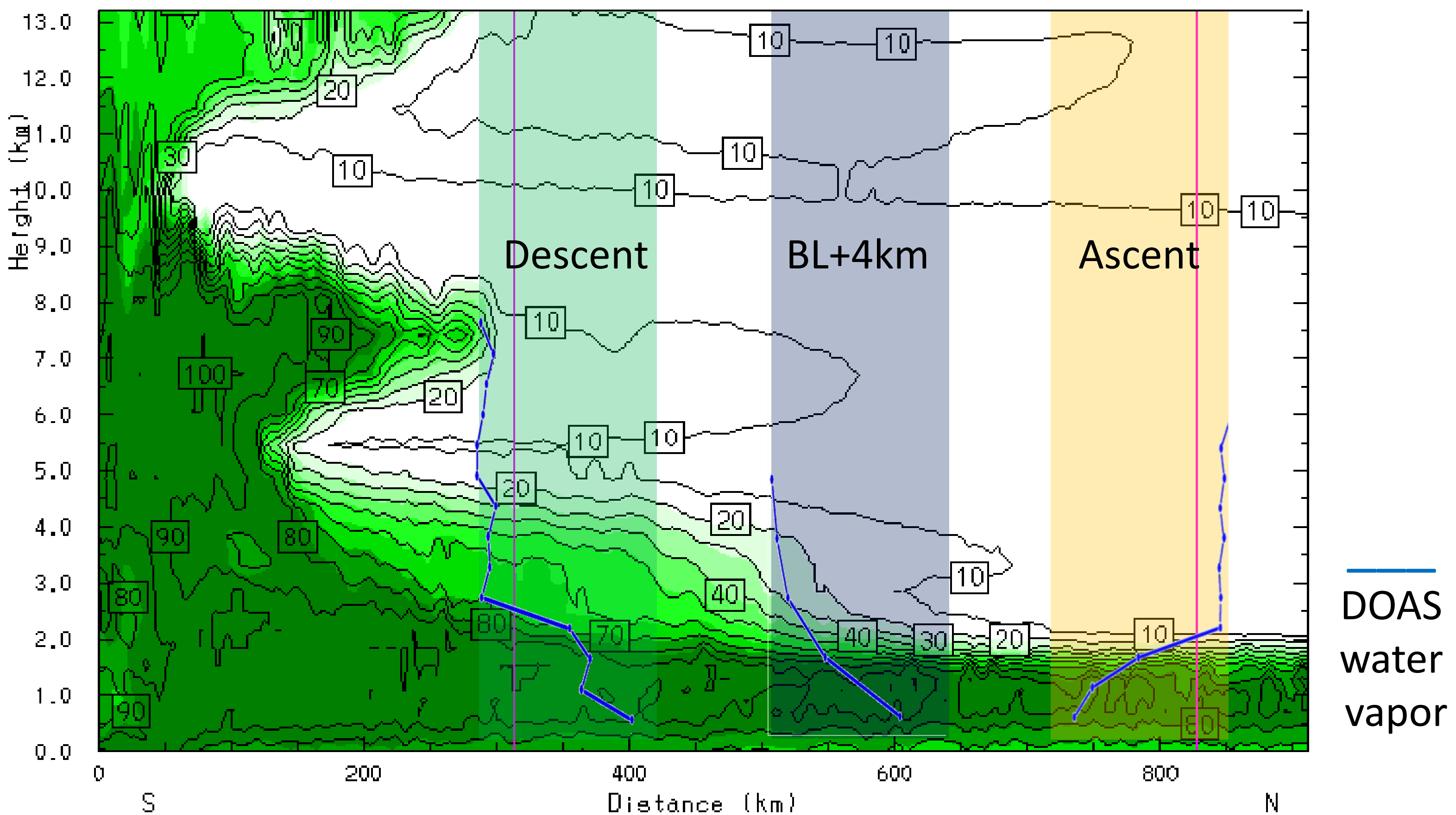






2 HEFT-10-RF1 Results: Meteorological Modeling

RH cross section along flight track (24h high resolution WRF analysis)



→ Role of deep convection/detrainment?

WRF = Weather Research and Forecast Model

3 Summary and Conclusions

- First observation of IO from research aircraft, first evidence for IO and CHOCHO in the tropical free troposphere and first full profile retrieval.
- Between 45% and 61% of the retrieved columns are located *above* the Marine Boundary Layer corroborating the presence of reactive halogen species and OVOCs in the FT on global relevant scales.

	IO		CHOCHO	
	VCD [molec/cm^2] (error) fraction of total VCD [%]		VCD [molec/cm^2] (error) fraction of total VCD [%]	
	Descent	Ascent	Descent	Ascent
total	4.3E12 (0.5)	3.3E12 (0.6)	2.2E14 (0.3)	1.8E14 (0.2)
MBL (0-1km)	2.1E12 (0.4) 49%	1.7E12 (0.4) 51%	0.9E14 (0.2) 39%	1.0E14 (0.2) 55%
strat.cum. layer (1-2km)	1.0E12 (0.3) 24%	0.6E12 (0.3) 19%	0.8E14 (0.2) 37%	0.5E14 (0.1) 28%
FT	1.2E12 (0.2) 27%	1.0E12(0.2) 30%	0.5E14 (0.1) 24%	0.3E14 (0.1) 17%

- Short life times of IO (~ few minutes) and CHOCHO (~1-2h) render MBL to Free Troposphere transport unlikely. The observed amounts of IO and CHOCHO in the FT call for additional airborne sources.

3 Summary and Conclusions

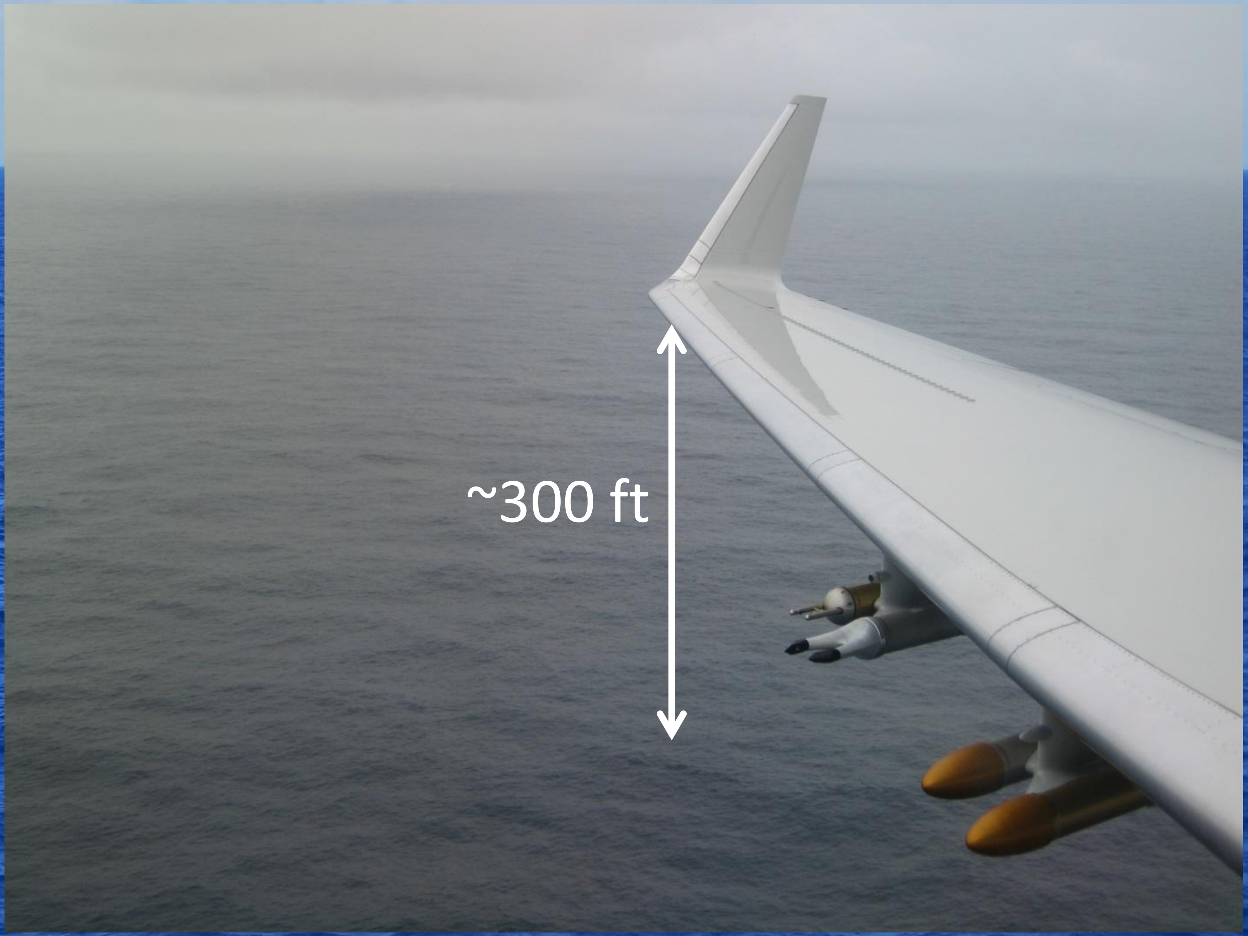
- Deep convective transport could play a role in transporting IO and CHOCHO precursors (e.g. methyliodide (CH_3I) and organic aerosol) into the FT.

- OVOC processing is a globally relevant source for secondary organic aerosol. Particle formation by IO could be relevant for missing sources of cloud condensation nuclei in the upper troposphere.

- The presence of IO in the FT establishes a link between ocean surface emissions and air masses above the MBL.

- A.o. TORERO will further investigate precursors and their origin from either land or ocean sources.

Thank You!



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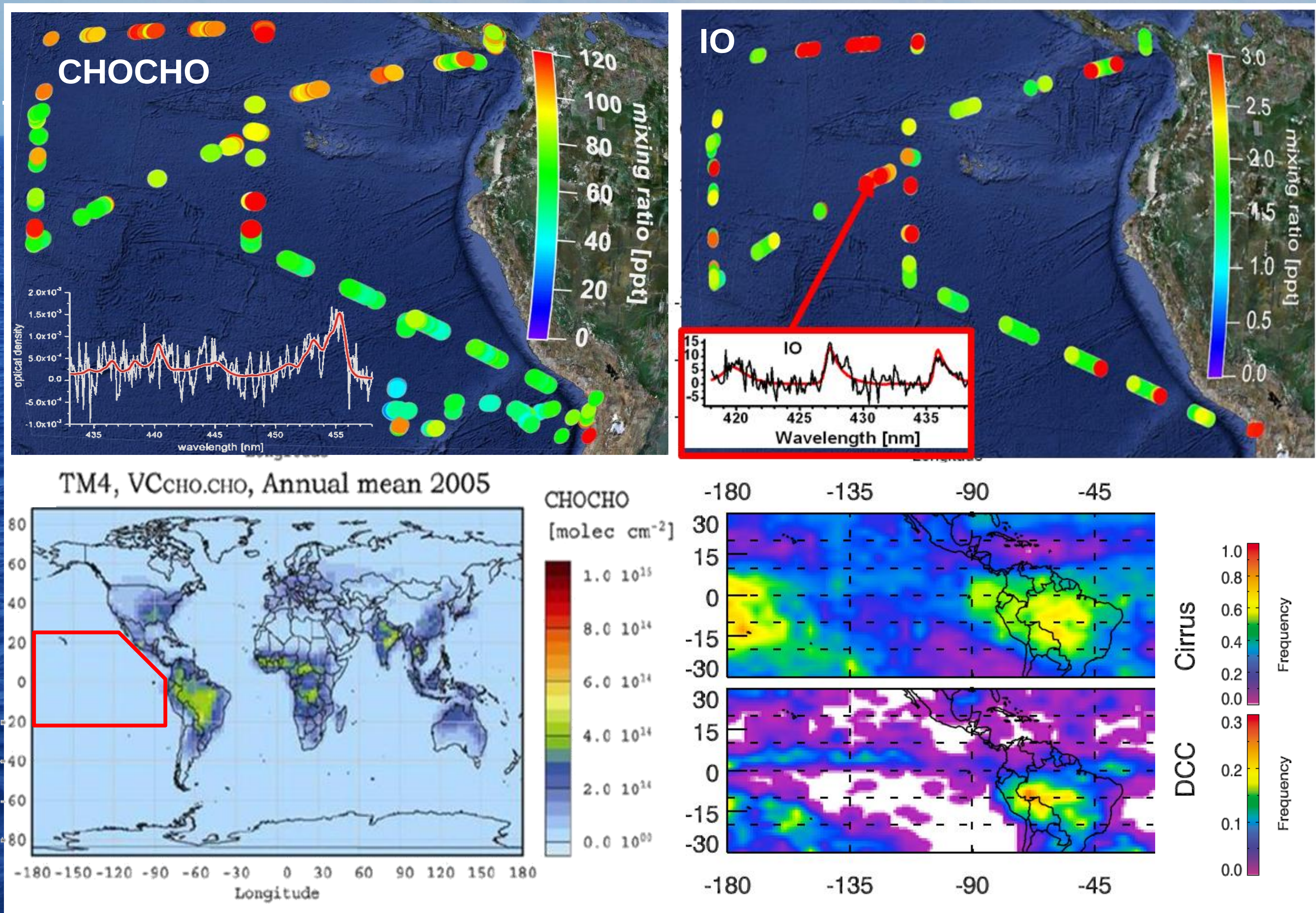

Myriokefalitakis et al., 2008, Schoenhardt et al., 2008, Sassen et al., 2009
Sinreich et al., 2010, Volkamer et al., 2010