Iodine Oxide observations from CU AMAX-DOAS aboard the NSF NCAR GV

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1 Motivation

2 Instrumentation and Retrieval

3 CONTRAST

- Profile Comparison
- Stratospheric case study

4 TORERO

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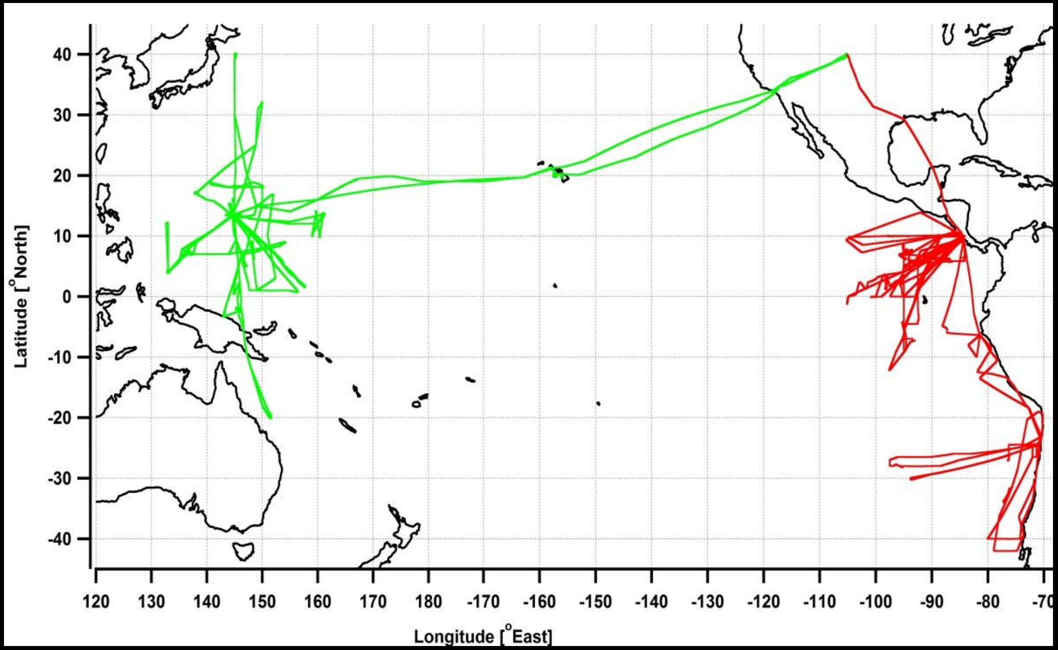
5 Summary and conclusions



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1 Motivation

- Why do we need to know about IO?
  - IO modifies the atmosphere's oxidative capacity
  - IO catalytically destroys ozone
  - IO may impact the creation and growth of aerosol particles

- What don't we know about IO?
  - Source chemistry and atmospheric lifetime
    - Organic biological/photochemical vs inorganic sources
    - Multiphase chemistry in aerosols
    - Aerosol loss vs Aerosol recycling
  - Vertical and global distribution
  - Only upper limits are known in the lower stratosphere
  - The magnitude of its importance for atmospheric chemistry and climate

1 Motivation – Uncertainty in stratospheric IO MR

Authors	Year	Method	Lower Stratospheric (12-15km) IO Mixing Ratio
Wennberg et al.	1997	Ground DOAS (Direct Sun)	0.2 ppt (0-0.3ppt)
Pundt et al.	1998	Balloon DOAS (Direct Sun)	<0.1 ppt
Butz et al.	2006	Balloon DOAS (Direct Sun)	<0.1 ppt

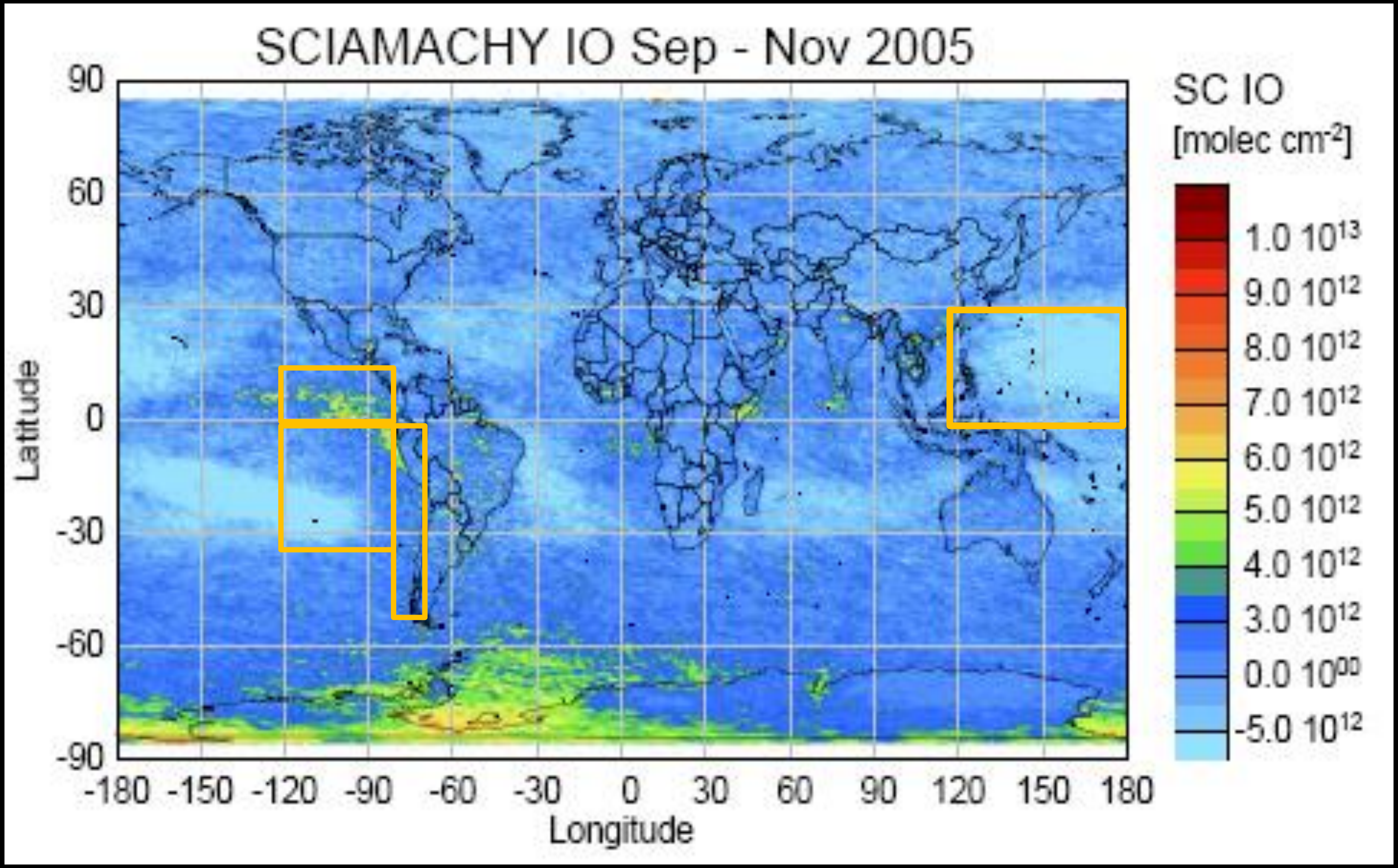
IO mixing ratios in the lower stratosphere are low.

Current knowledge of IO in the stratosphere is limited mostly to upper limits.

Previous measurements are limited to Direct Sun DOAS gathering most or all information at high Solar Zenith Angle (sunrise and sunset)

1 Motivation – IO over the Pacific

Schönhardt et al., ACP 2008

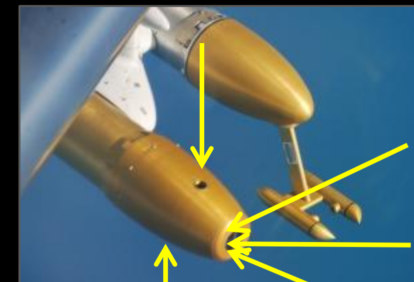


→ CONTRAST study area is expected to be an IO minimum

2 Instrumentation - CU AMAX-DOAS

Colorado University-Airborne Multi-AXis Differential Optical Absorption Spectroscopy

telescope pylon

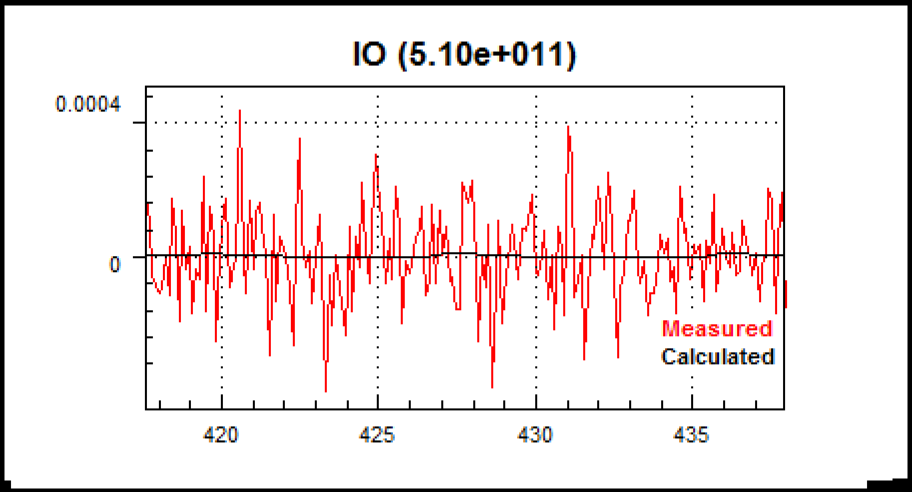


motion stabilized

spectrographs/detectors

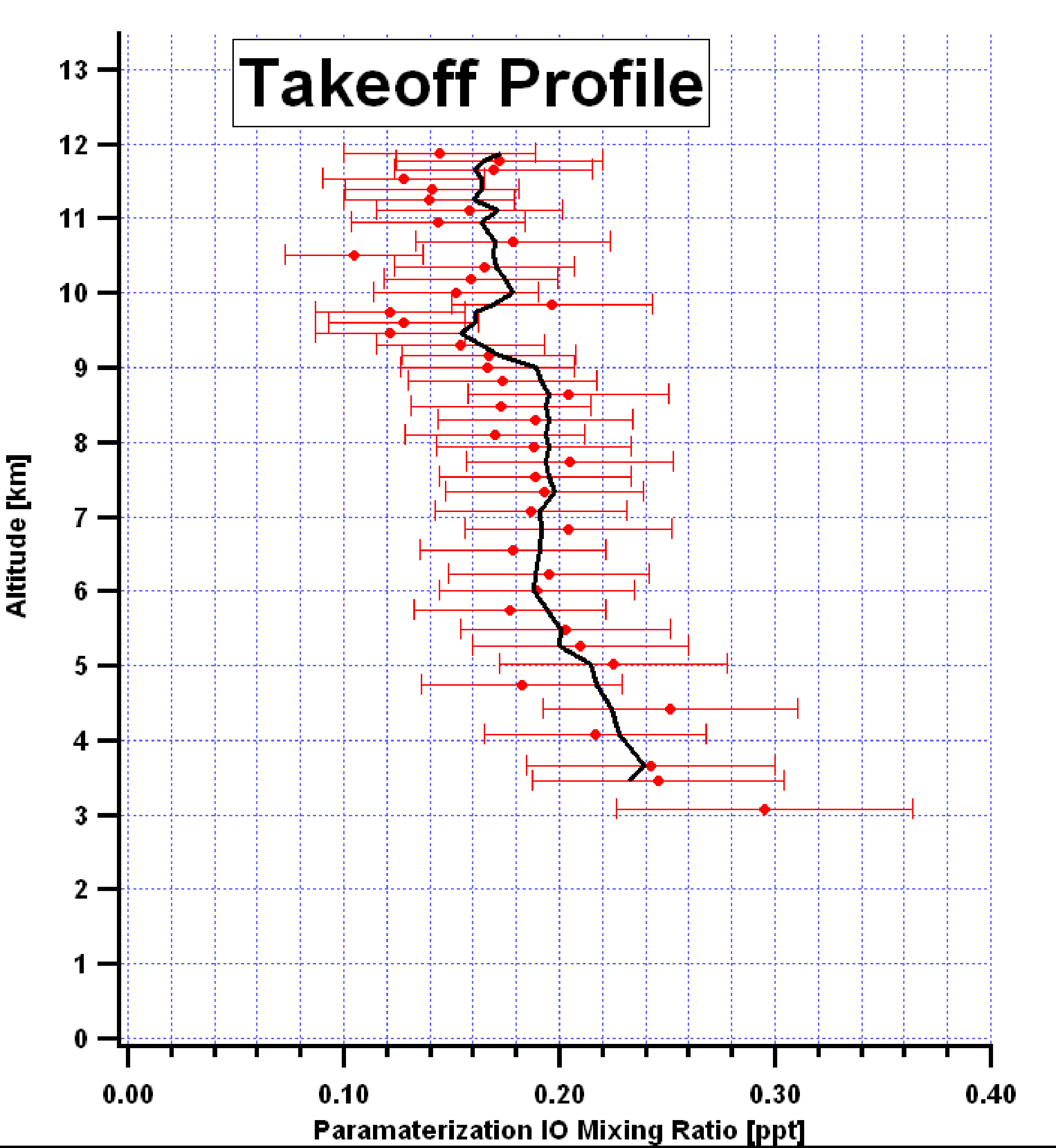
Volkamer et al., 2009, SPIE
Coburn et al., 2011, AMT
Baidar et al., 2013, AMT
Dix et al., 2013, PNAS

2 DOAS detection of IO



[illegible]
[illegible]
detection

3 CONTRAST – RF15 Parameterization derived Profile

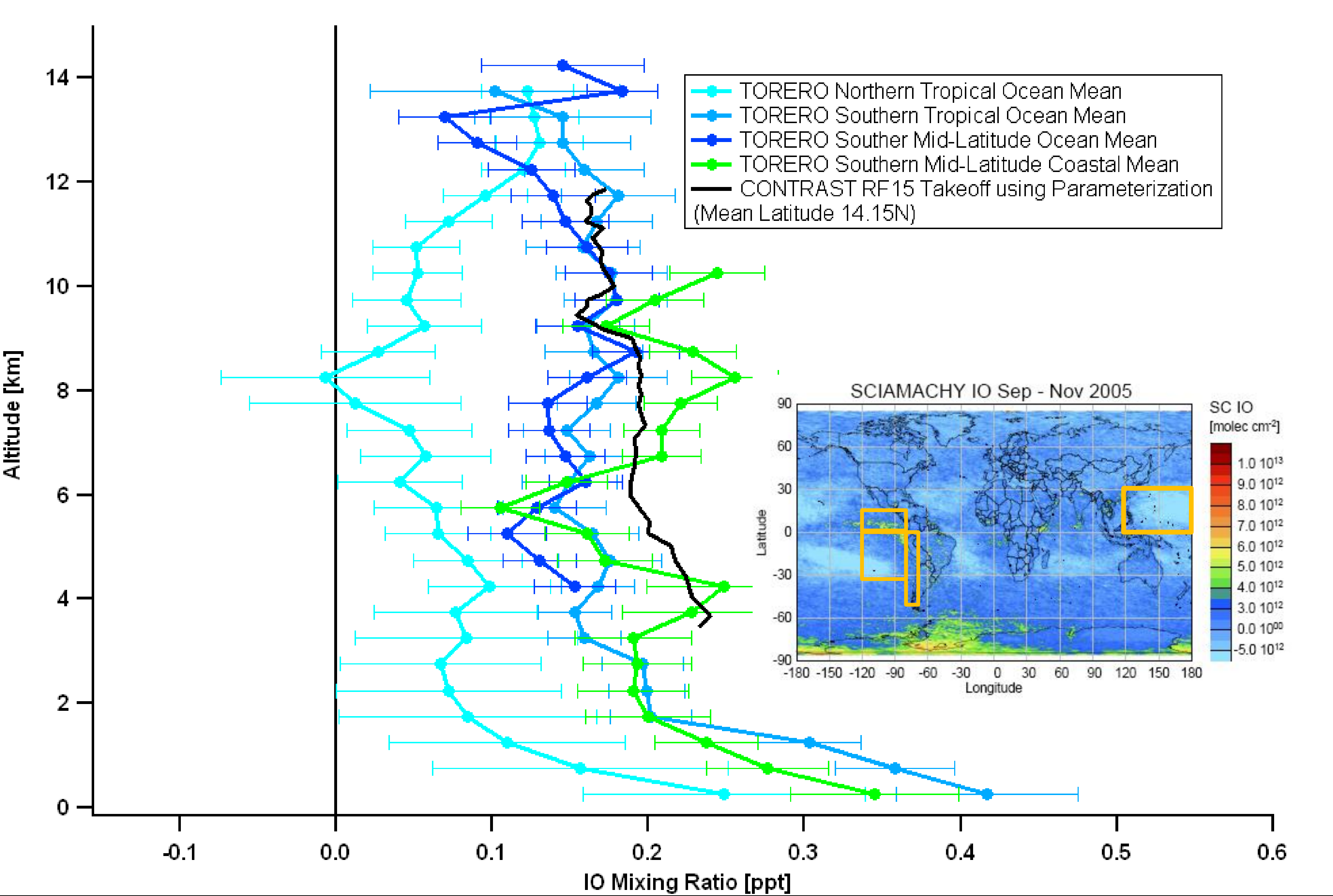


Parameterization is faster than inversion but has larger errors

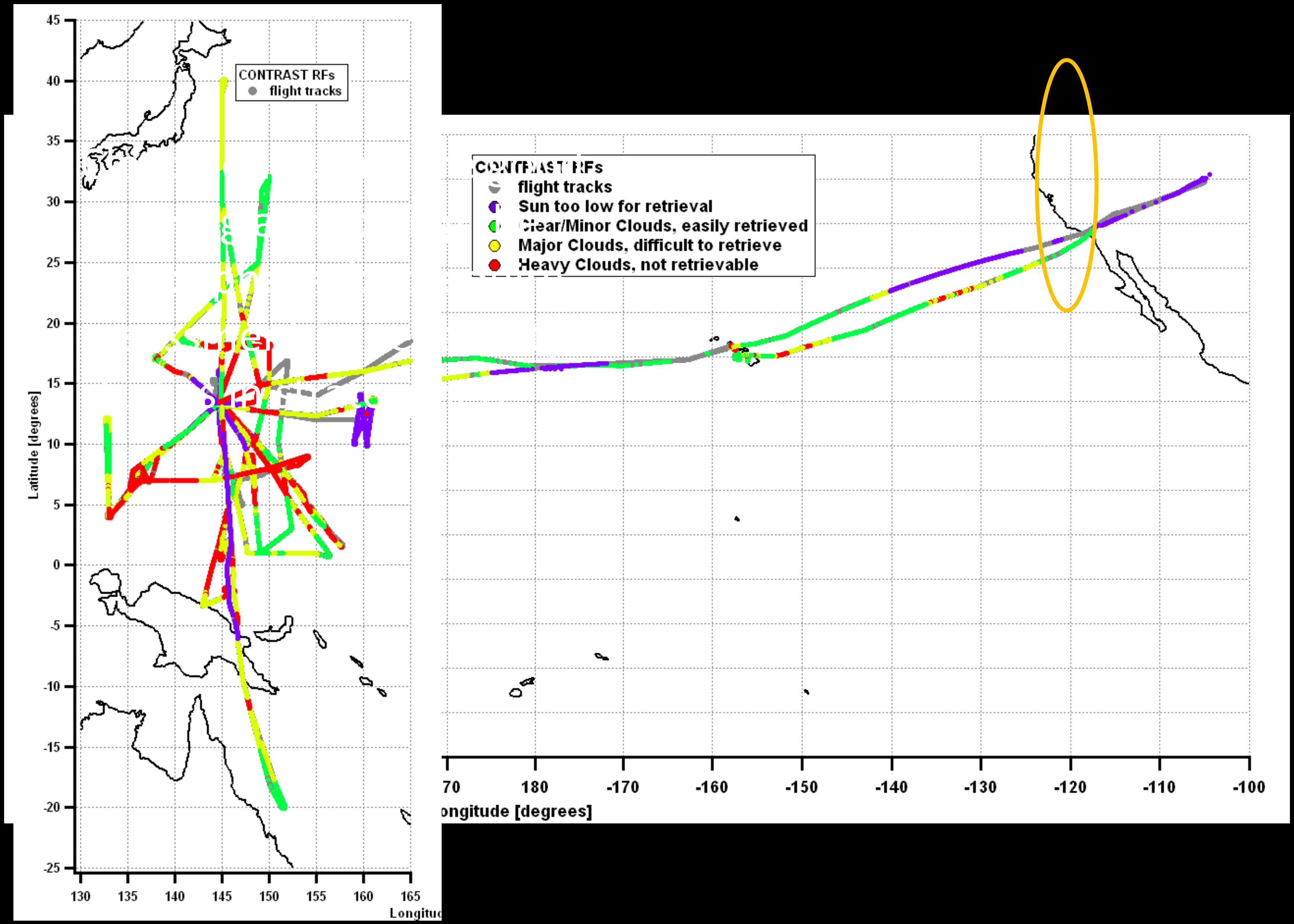
Higher and lower altitudes are irretrievable due to cloud effects

Free Troposphere shows background of ~0.2 ppt IO

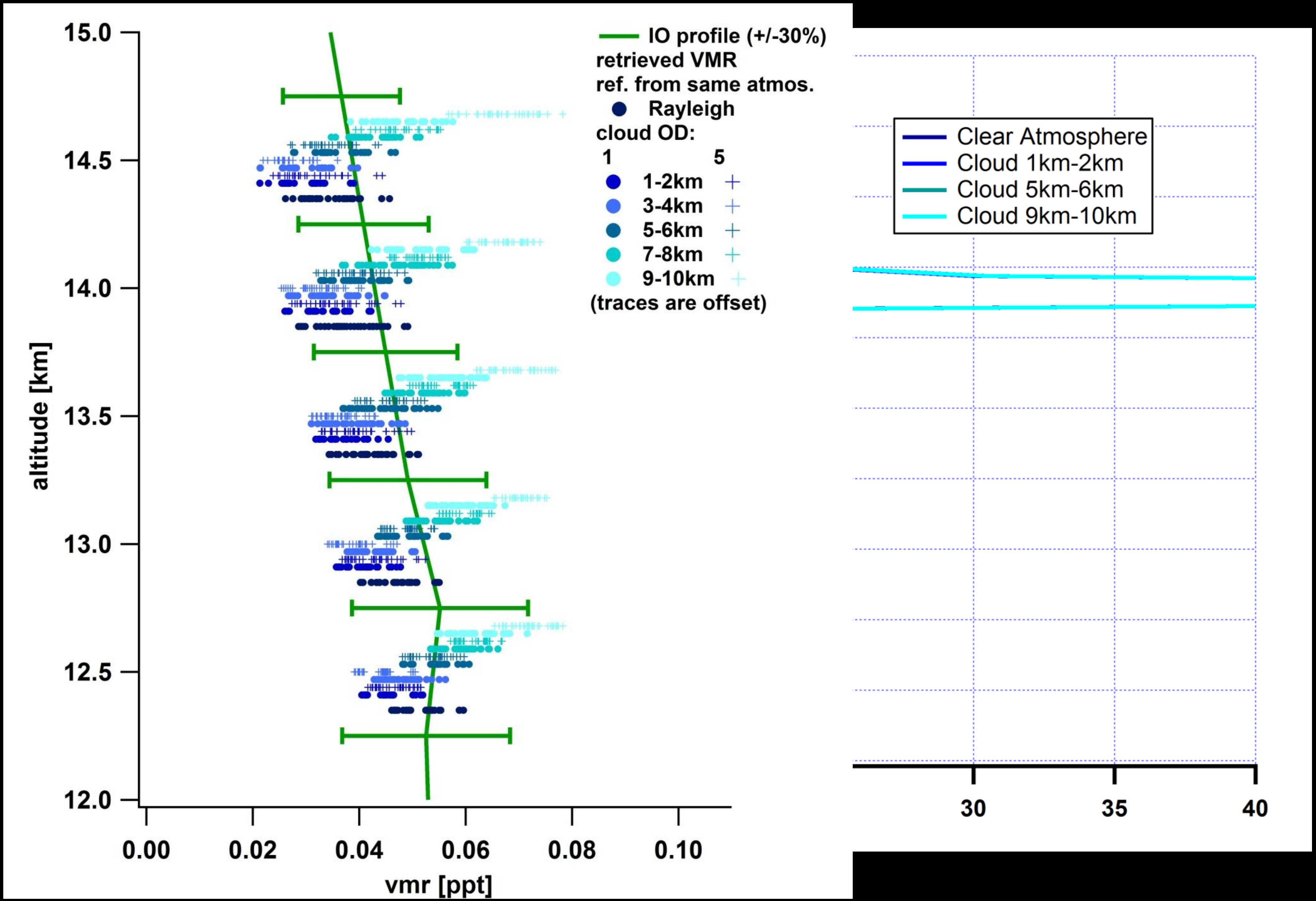
3 CONTRAST – Comparison with TORERO



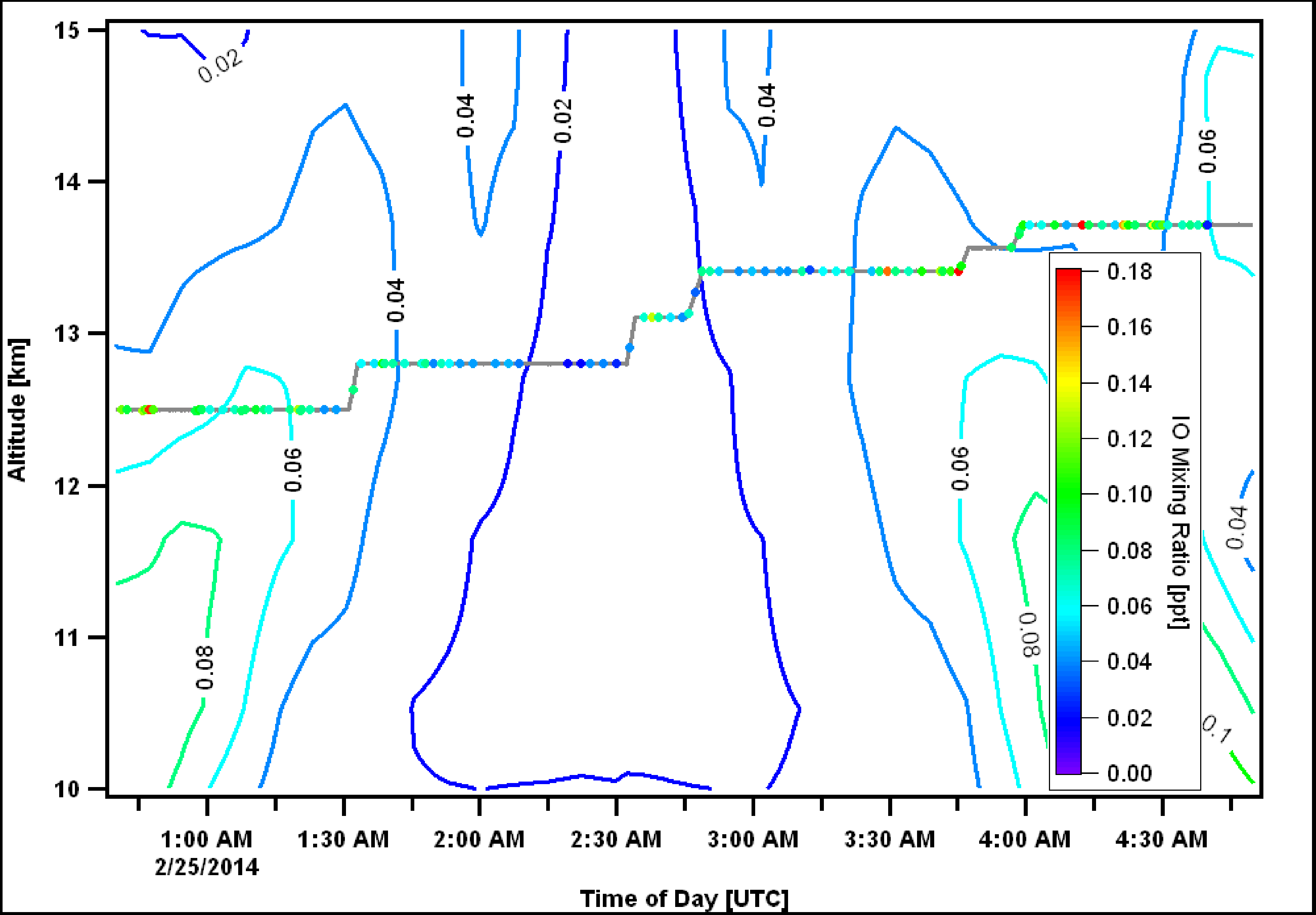
3 CONTRAST – Overview of Data Retrieval



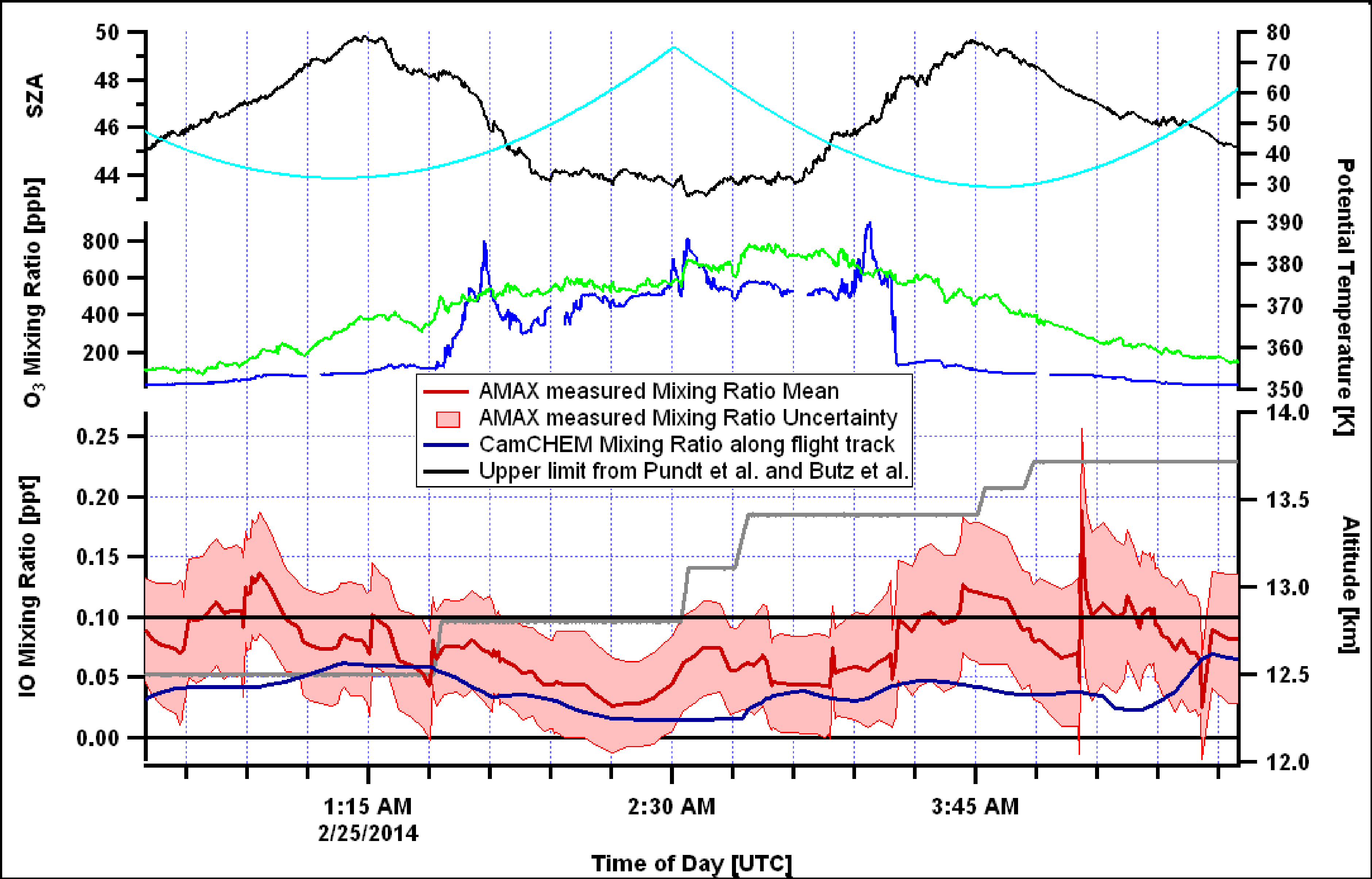
3 CONTRAST – Cloud Sensitivity



3 CONTRAST – Comparison with CamCHEM



3 CONTRAST – RF15 Jet Crossing



Conclusions & Outlook

- IO is detected and quantified in the LS
  - First detection of IO in the stratosphere by limb measurements
  - AMAX measurements qualitatively match models but show more IO overall in the LS (up to a factor 2)
  - A more direct comparison with model requires design of an instrument mask
- FT-IO in the NH over the Western Pacific is similar to the levels that had been observed in the SH over the Eastern Pacific (TORERO)

- Understanding Stratospheric IO:
  - Further collaboration with CamCHEM team
- Process Level Understanding:
  - Use TORERO and CONTRAST observations of IO, organoiodine, and aerosols to better constrain iodine chemistry (WRF-Chem, GEOS-Chem)

Thank You!

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Thank you for your attention

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