VALIDATION OF AMMONIA SATELLITE RETRIEVALS WITH GROUND-BASED FTIR

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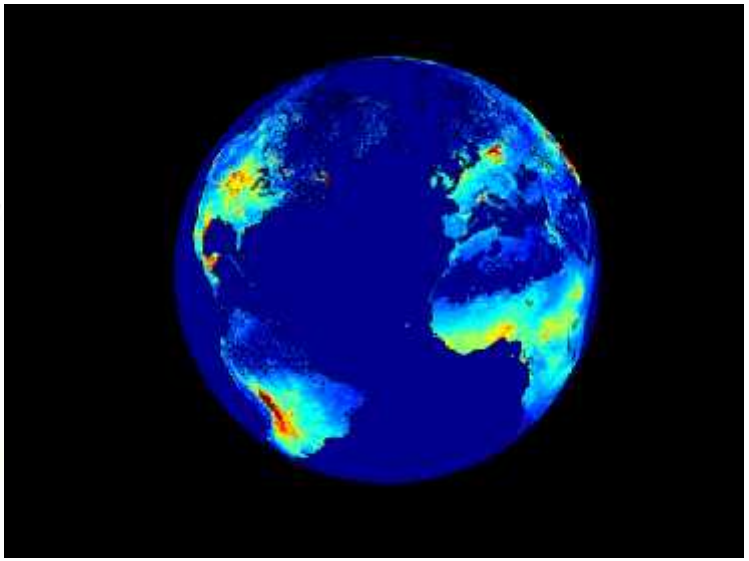

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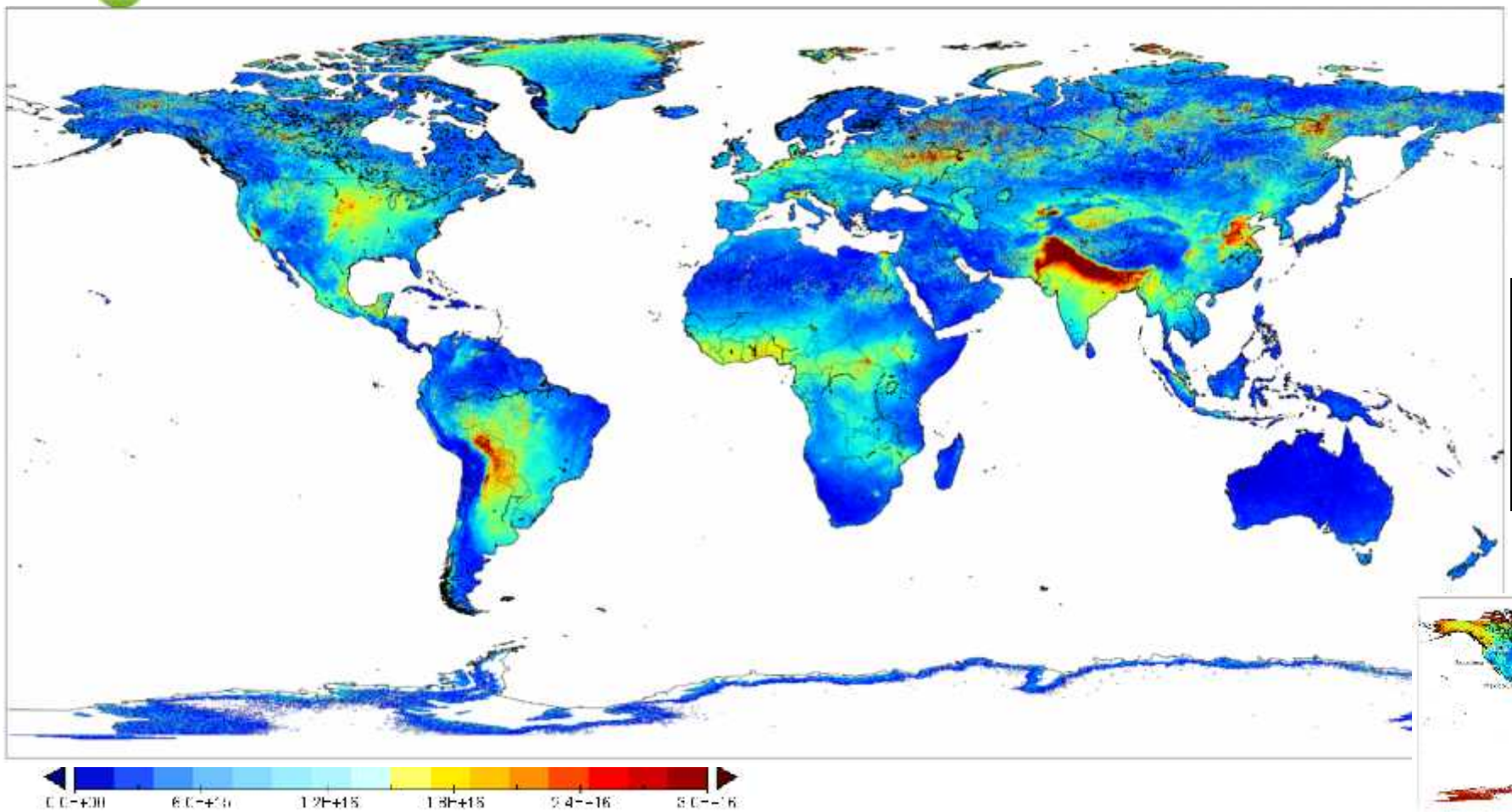
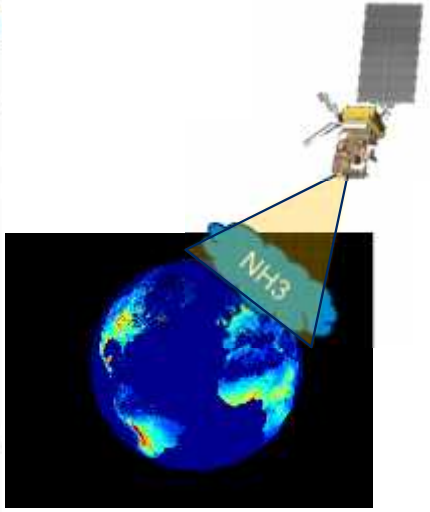
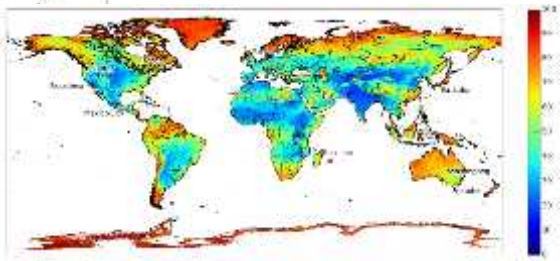
LOOKING FURTHER

INTRODUCTION: IASI-NH3 PRODUCT



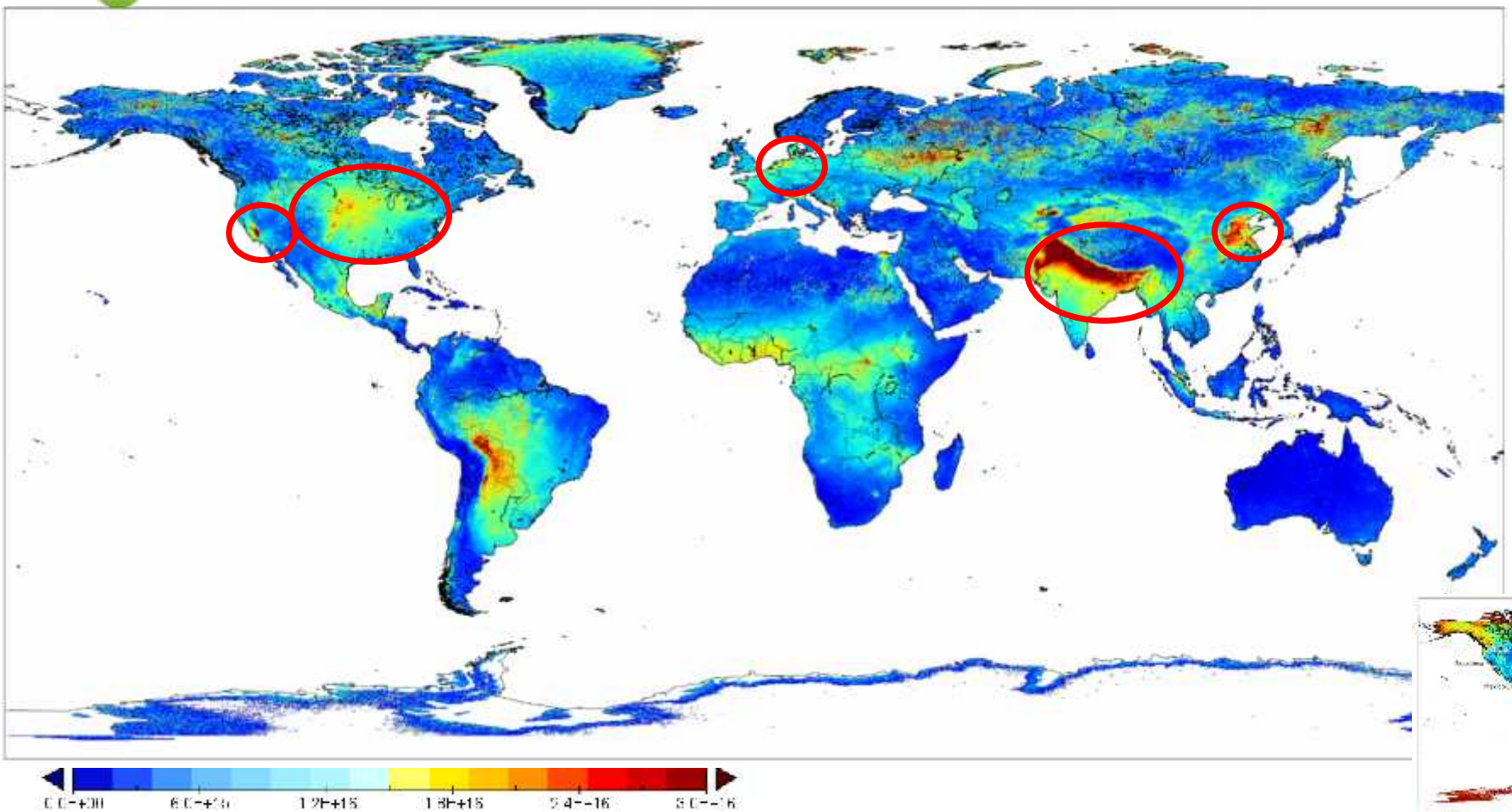


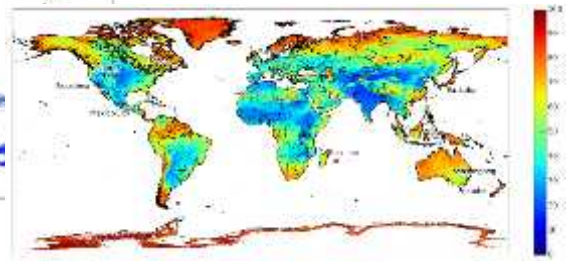


Molecules NH3 cm^{-2}

6 Year weighted mean Jan 1st 2008 – Jan 1st 2014

INTRODUCTION: IASI-NH3 PRODUCT





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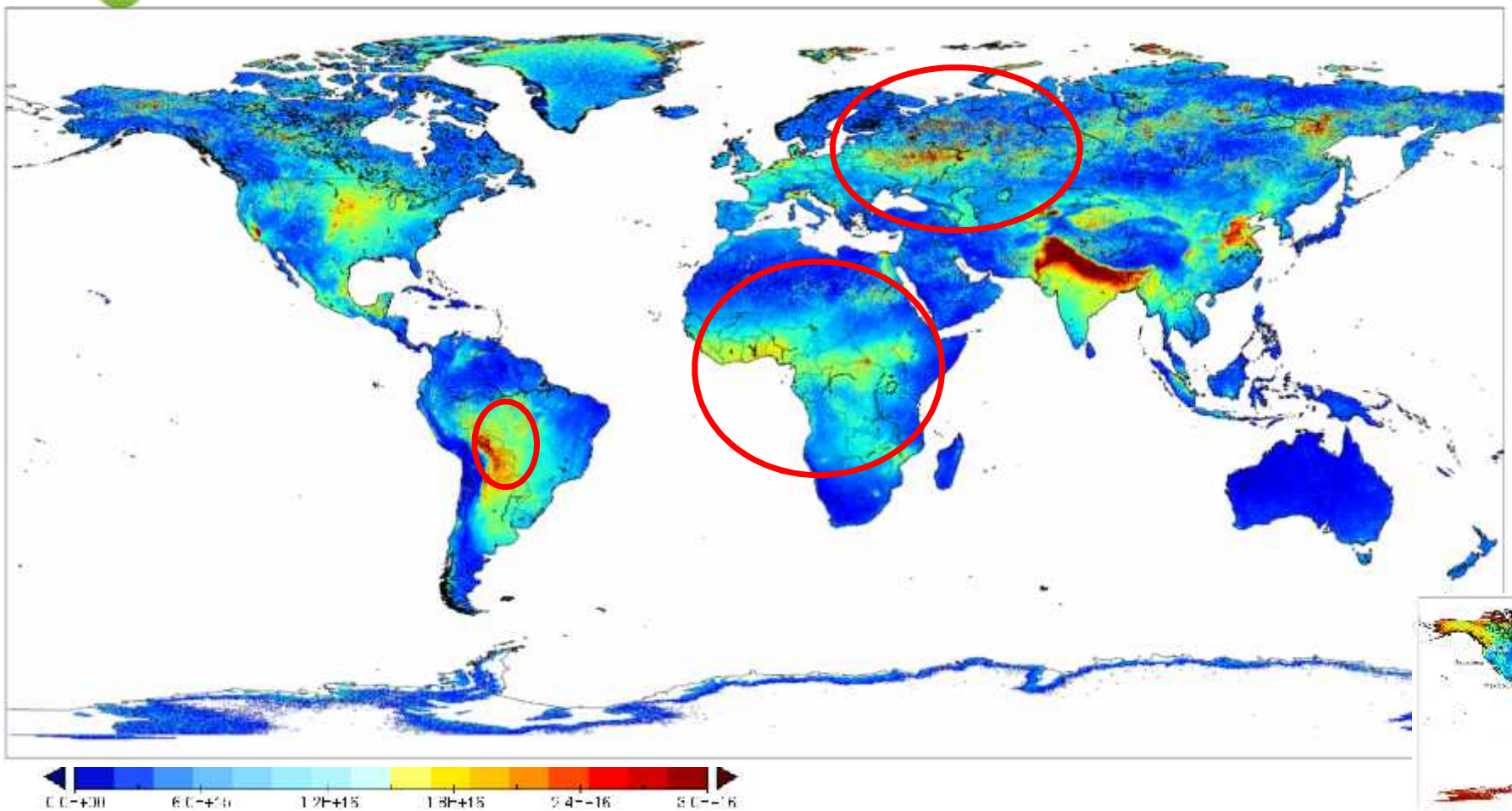
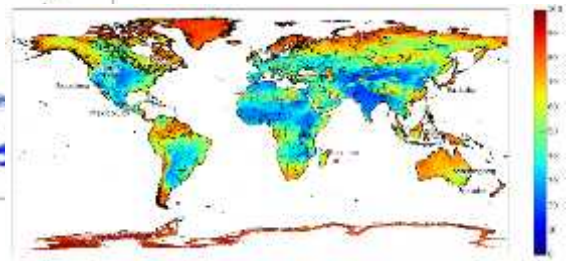




Molecules NH_3 cm^{-2}

6 Year weighted mean Jan 1st 2008 – Jan 1st 2014

WHY SATELLITE OBSERVATIONS?

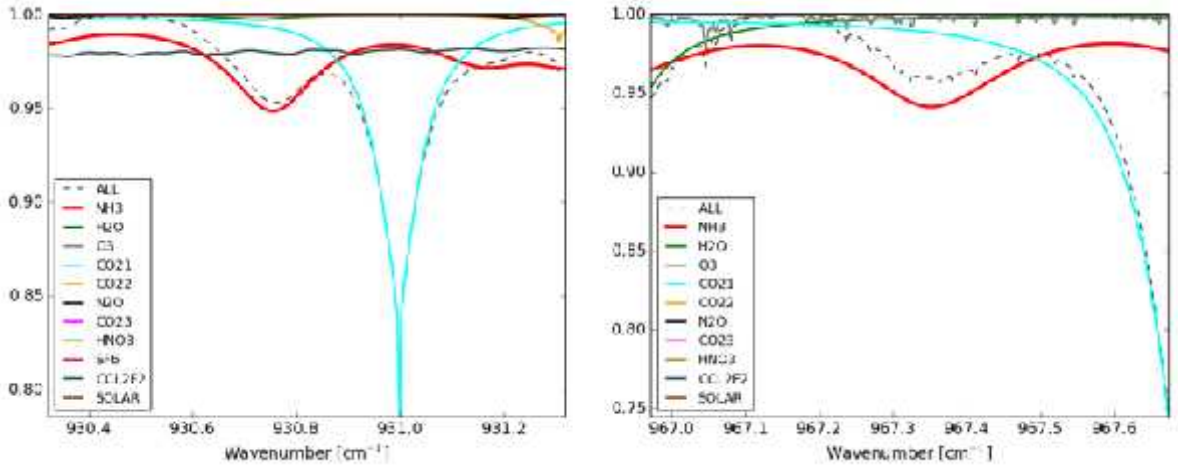
- NH3 total budget and distribution? Relatively uncertain…(Sutton et al., 2013)
- Sparse distribution of measurements (Van Damme et al., 2015)
- Hard to measure/ expensive measurements/ artefacts (Bobrutzki et al., 2010)

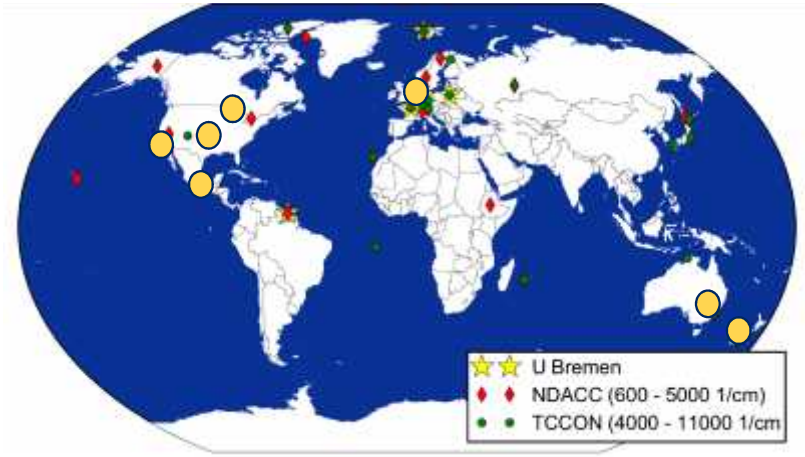
- Satellite products(TES, IASI, CrIS):
  - Global coverage
  - Bi-daily measurements
  - Real time monitoring
  - But lack of validation…

Study aim:
Validate the IASI & CrIS NH3 satellite products with FTIR observations

FTIR – NH3 PRODUCT

- FTIR – NH3 dataset (Dammers et al., 2015, ACP)
- Two spectral windows (931 & 967 cm^{-1})
- Interfering species: H_2O, O_3, CO_2, N_2O, HNO_3, SF_6, CFC-12, solar lines
- Spectra from NDACC FTIR sites
- This study: spectra from seven measurement sites

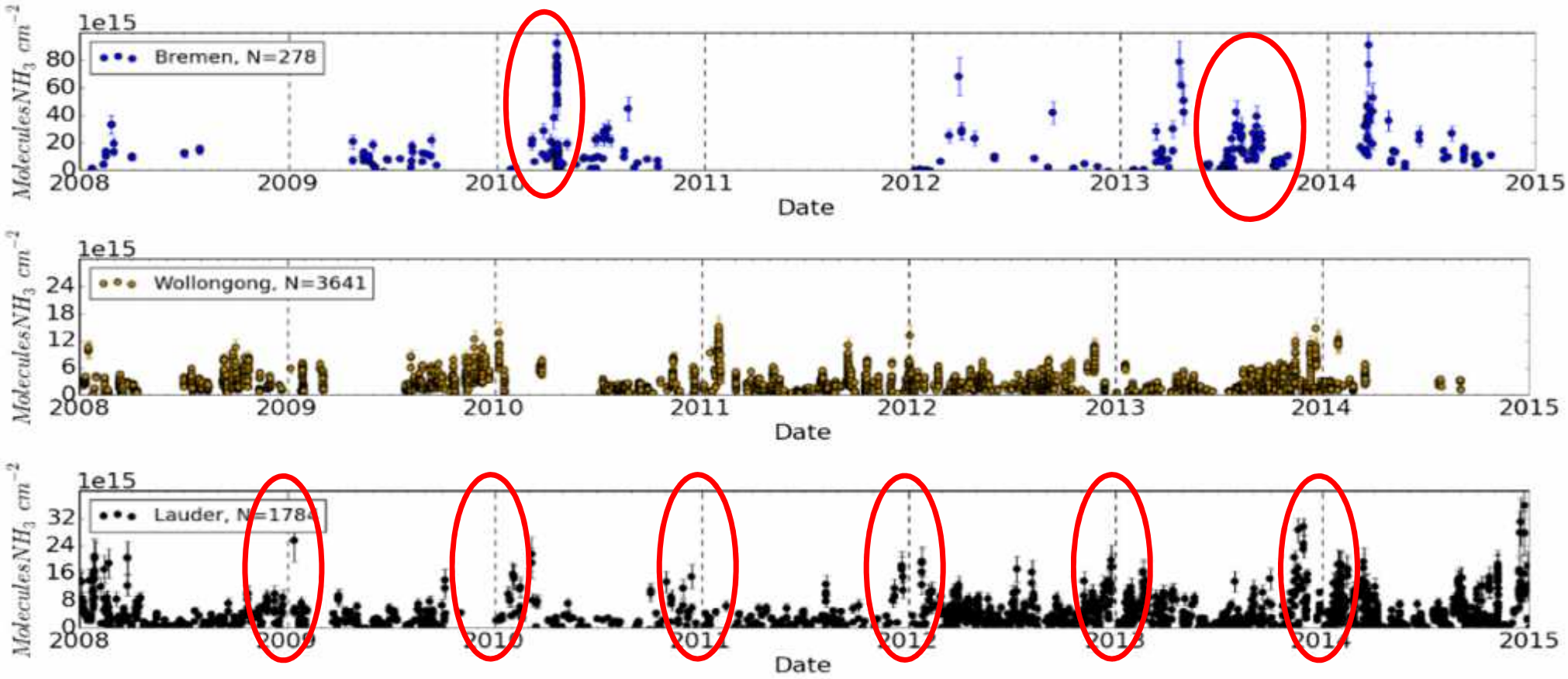




Dammers et al., 2015 ACP

FTIR – NH3 PRODUCT

Retrieved total columns for Bremen, Germany; Wollongong, Australia; Lauder, New Zealand



Dammers et al., 2015 ACP

E3

E4

SATELLITE PRODUCTS

- Satellite instrument: IASI-A
- Product: IASI-LUT (Van Damme et al., 2014, ACP)
- Retrieval-type: HRI & Look-up-tables

- Product: IASI-NN (Whitburn et al.,. 2016, GRL)
- Retrieval-type: HRI & neural network (NN)
- Availability: IASI-A: Oct 2007- …; IASI-B: March 2013 -…

- Satellite instrument: CrIS
- Product: CrIS FPR (Shephard and Cady-Pereira., 2015, AMT)
- Retrieval-type: Optimal estimation
- Product: Availability: 2012 - …

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E3 Footprint size?
EnricoDammers, 29-Nov-16

E4 Overpass time?
EnricoDammers, 29-Nov-16

FTIR NH3 – VALIDATION OF IASI & CRIS NH3

IASI

Surface Temperature > 275.15 K

Cloud cover < 10%

CrIS

DOF ≥ 0.1

Retrieved profile: ≤ 200ppb

Cloud cover: Implicit by DOF filter

Both instruments:

Sampling time difference

T_{diff} ≤ 90 min

Distance between centre points

X_{diff} ≤ 50 km

Both instruments:

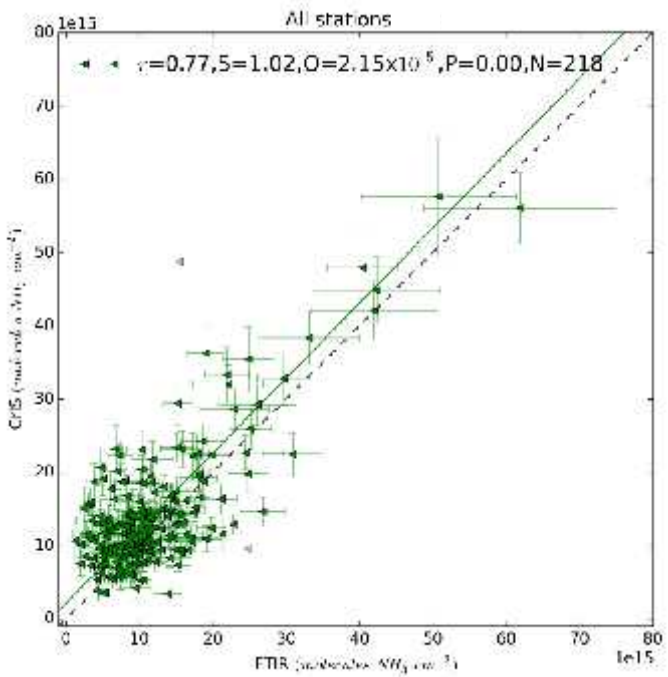
Elevation

Satellite observation and FTIR site:

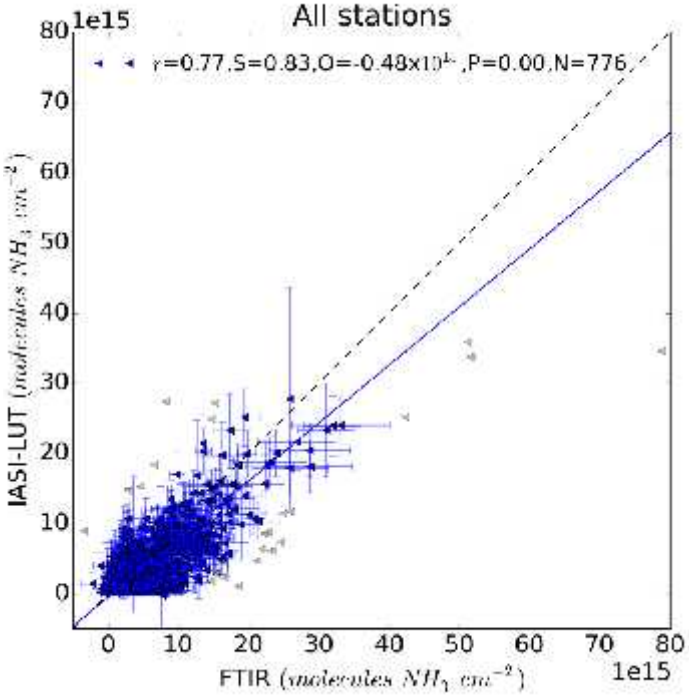
H_{diff} ≤ 300 m

FTIR NH3 – VALIDATION OF IASI & CRIS NH3 – TOTAL COLUMNS

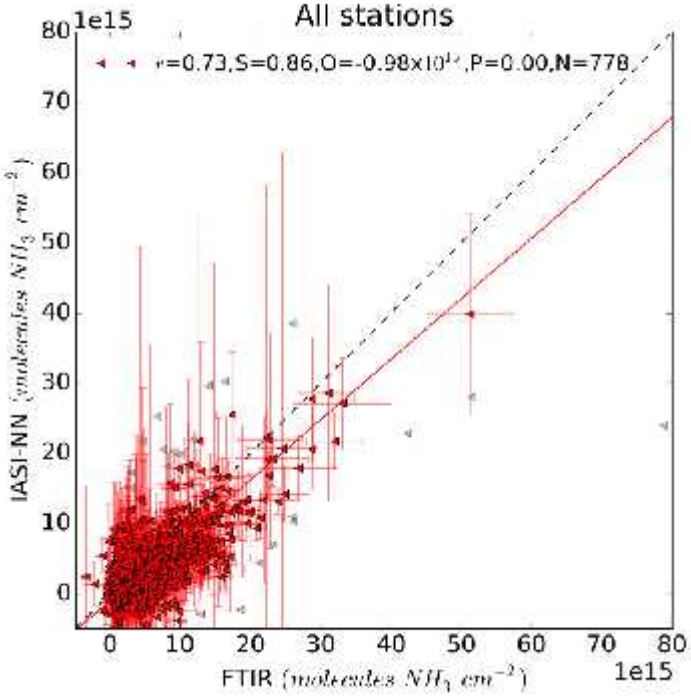
CrIS



IASI-LUT

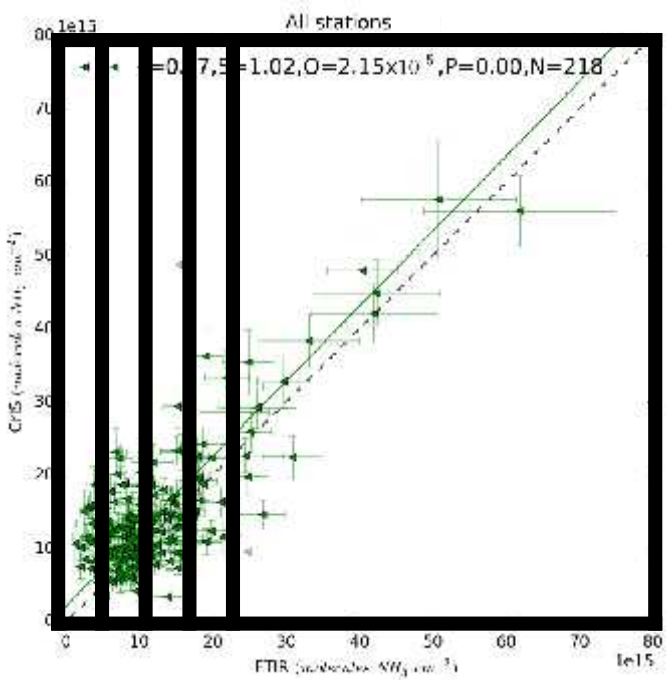


IASI-NN

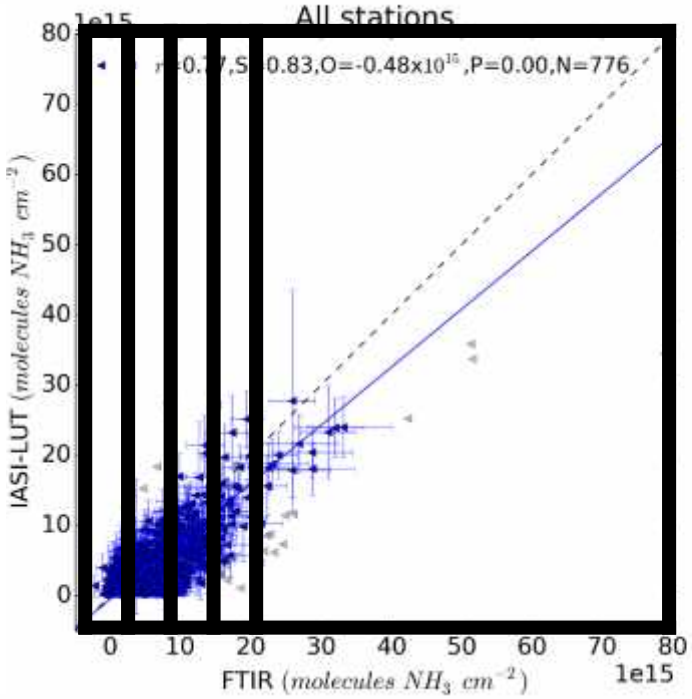


FTIR NH3 – VALIDATION OF IASI & CRIS NH3 – TOTAL COLUMNS

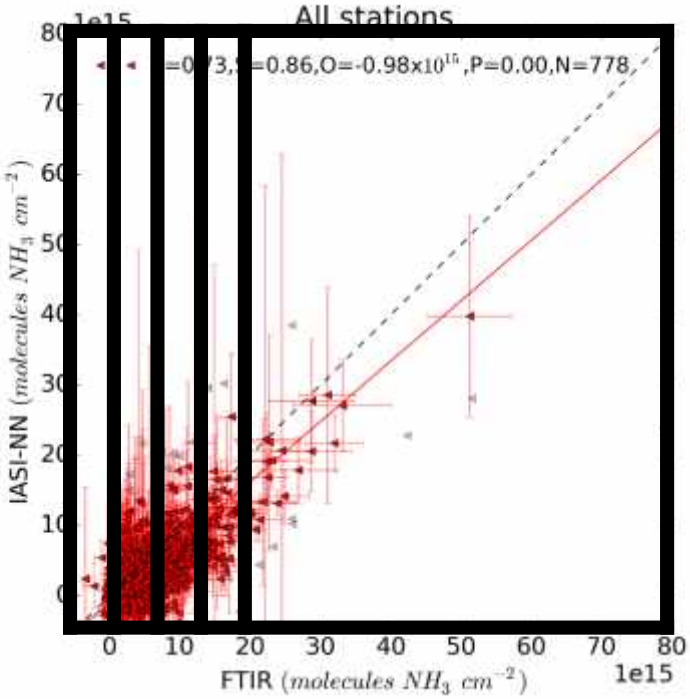
CrIS



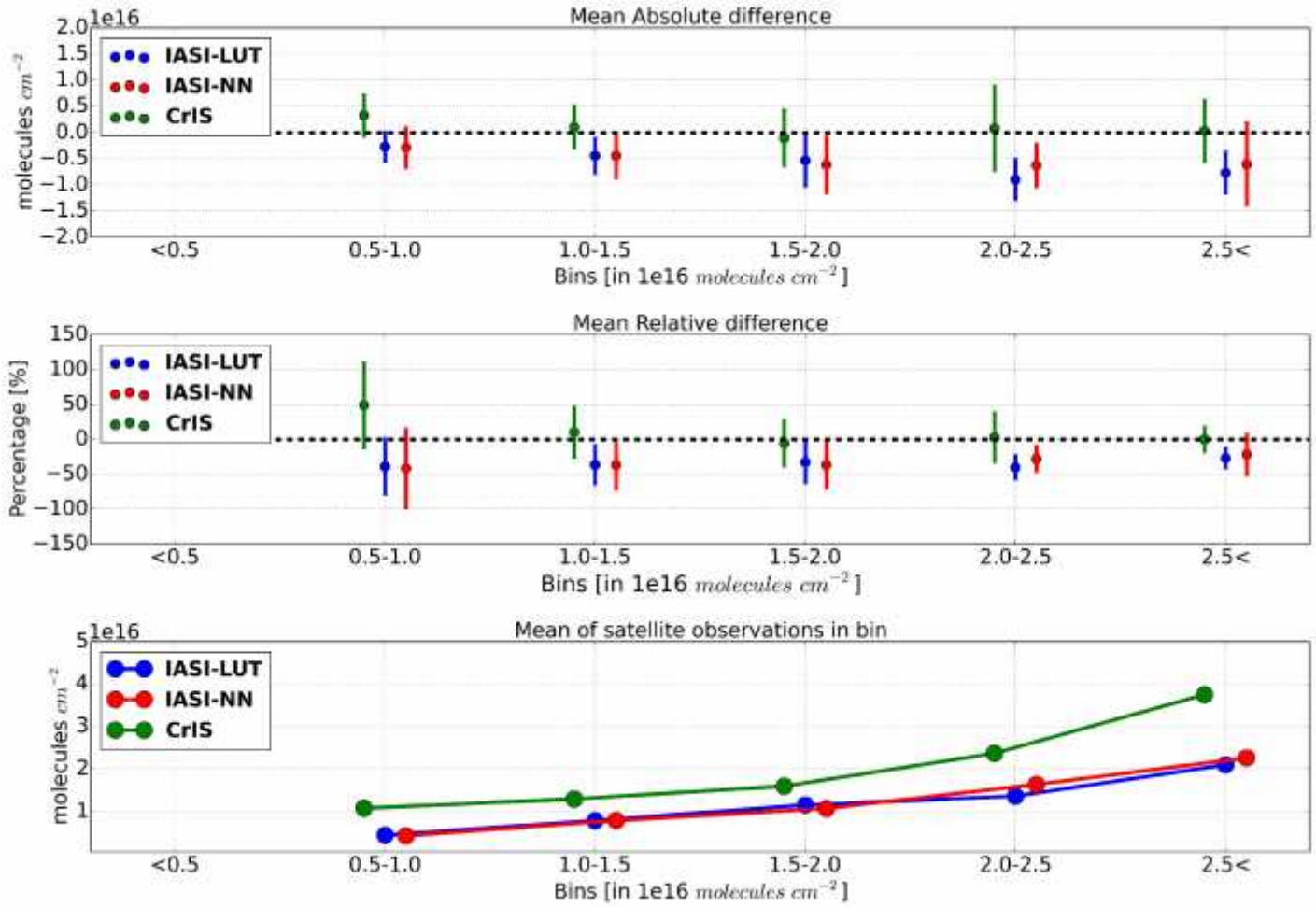
IASI-LUT



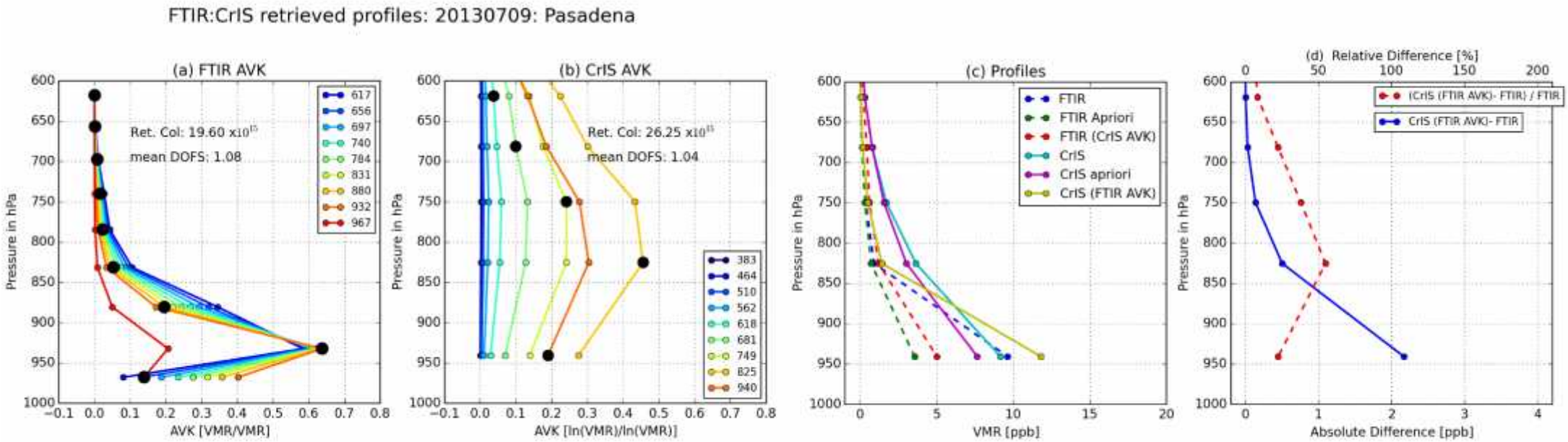
IASI-NN



FTIR NH3 – VALIDATION OF IASI & CRIS NH3 – TOTAL COLUMNS

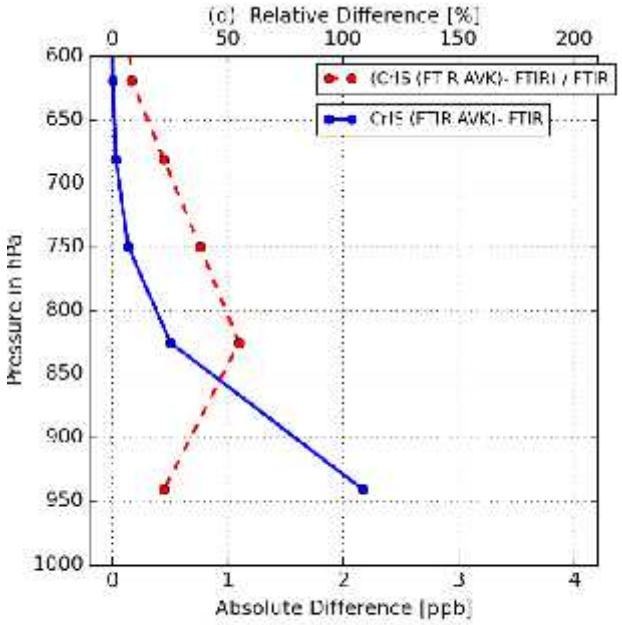


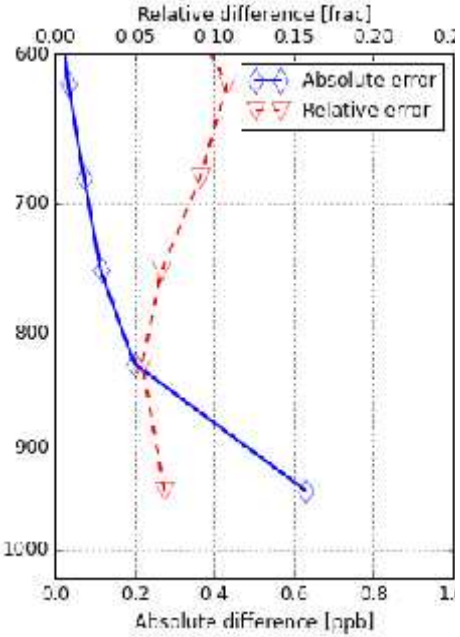
FTIR NH3 – VALIDATION OF CRIS NH3 – PROFILES



FTIR NH3 – VALIDATION OF CRIS NH3 – PROFILES

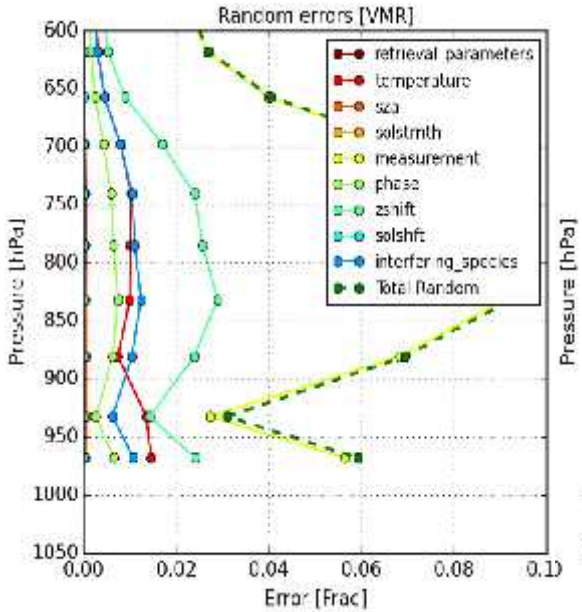
Difference CrIS-FTIR



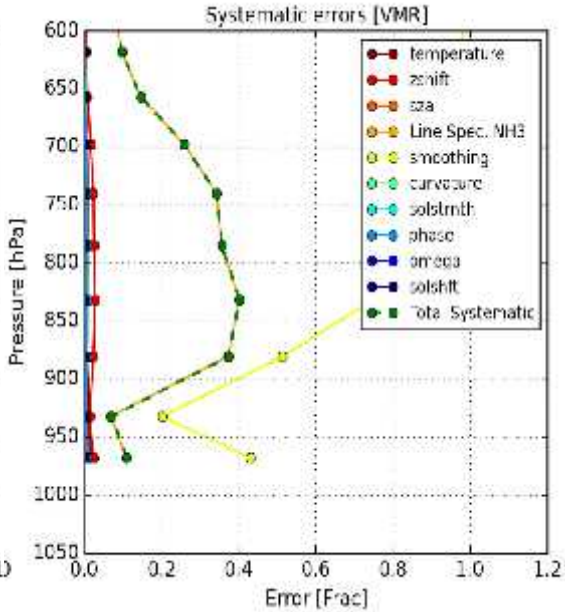


CrIS: Measurement error

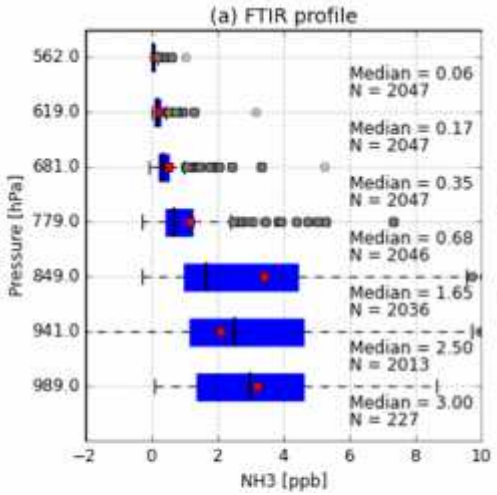
FTIR – random errors



FTIR – systematic errors



FTIR NH3 – VALIDATION OF CRIS NH3



CONCLUSIONS & OUTLOOK

Total column comparison:

- Good agreement
- IASI Underestimates compared to FTIR
- CrIS mostly agrees well, at low total columns small overestimation

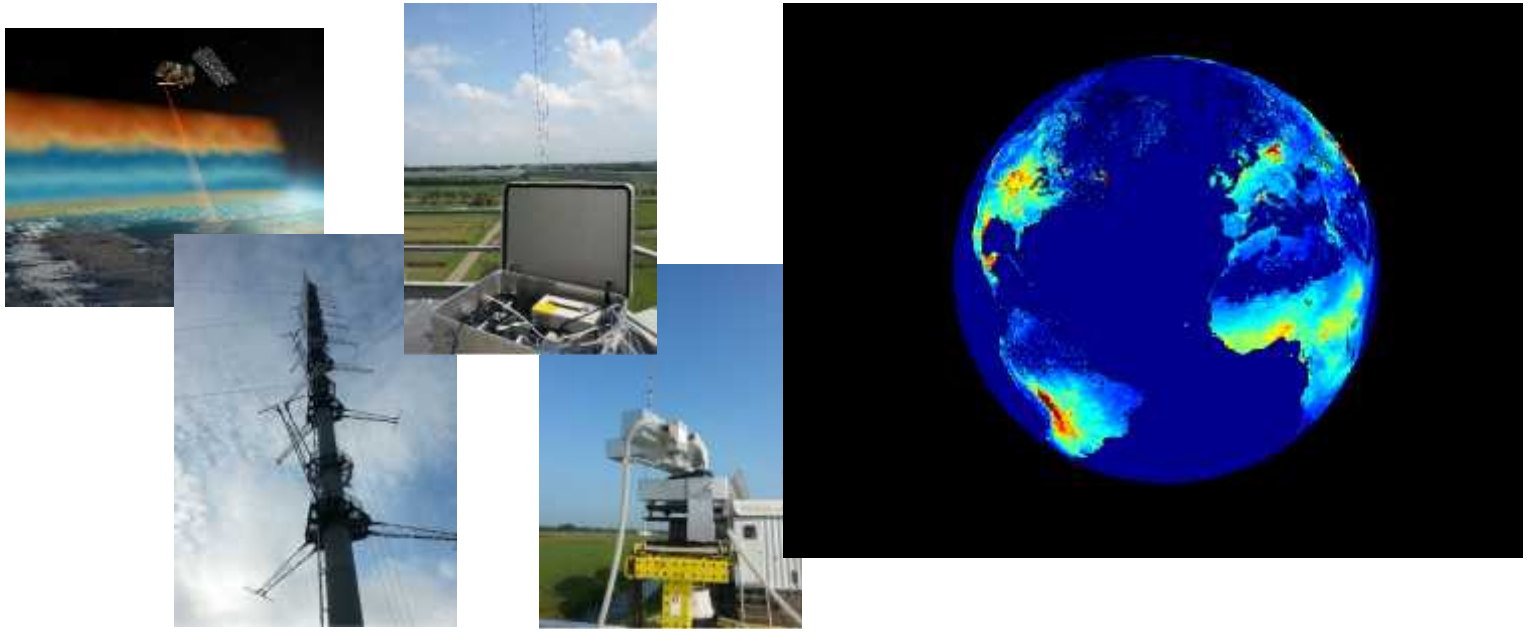
Profile comparison

- Overall good agreement
- Differences mostly follow from
  - Spectroscopy uncertainties
  - Instrument SNR

Outlook

- Need for flight campaigns to measure profiles for evaluation of retrievals

THANK YOU FOR YOUR ATTENTION



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