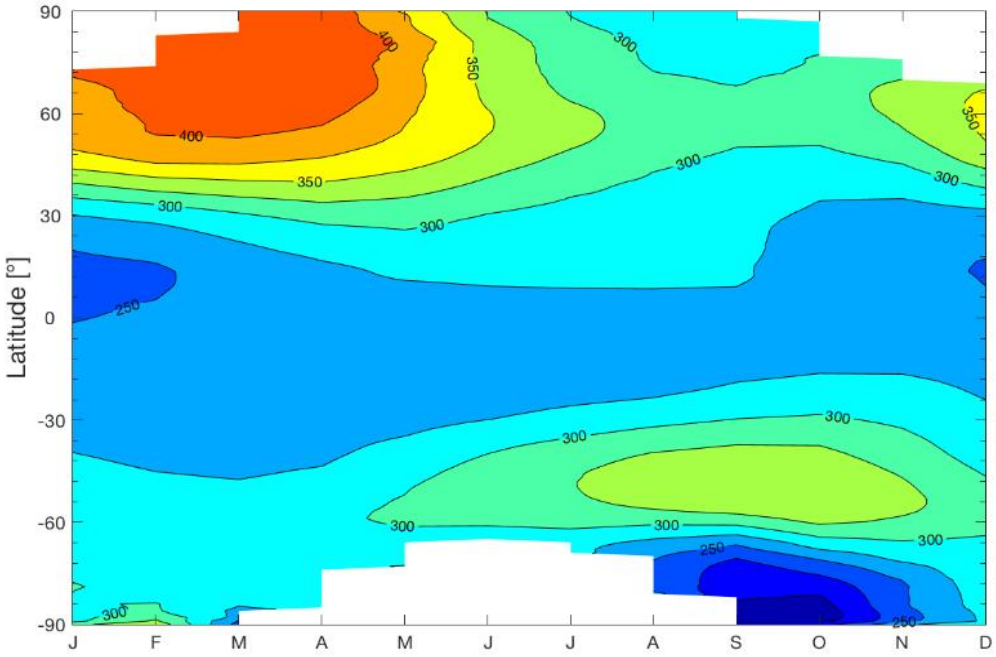
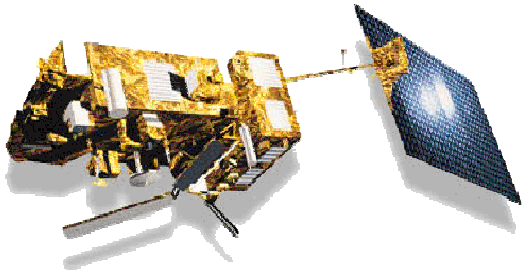
IASI ozone profiles

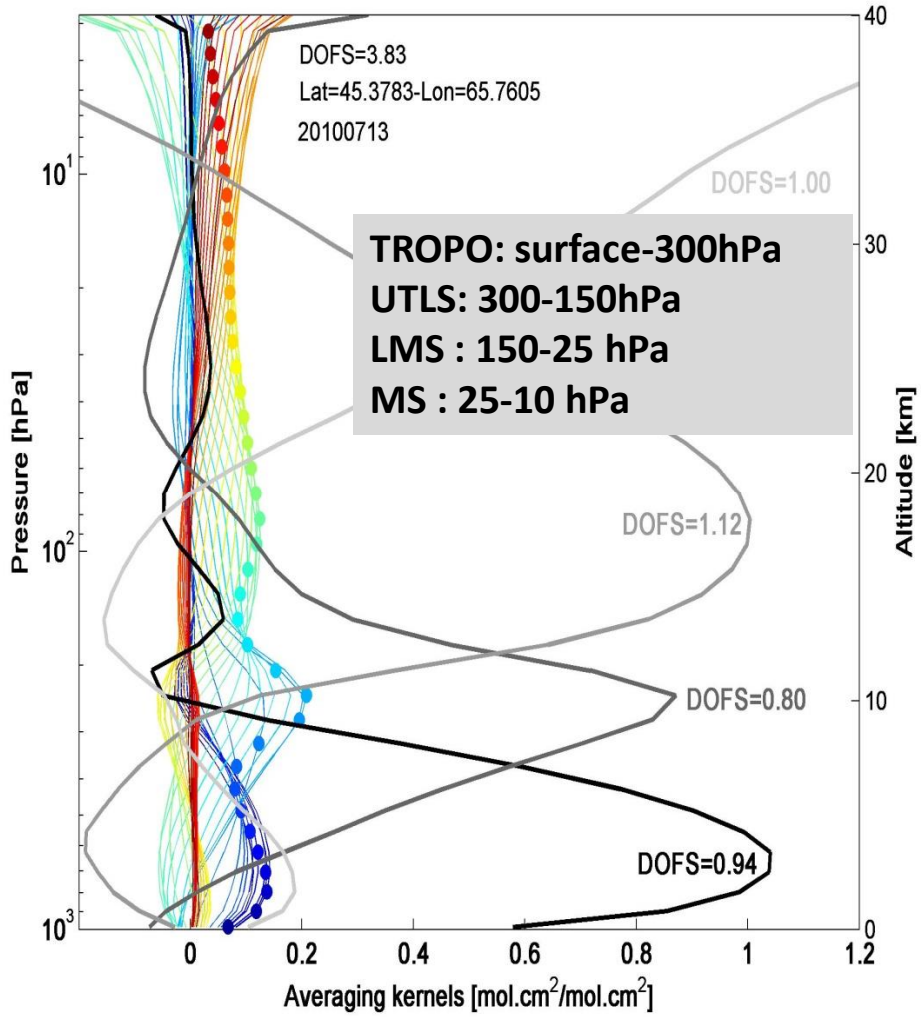
IASI Total Ozone Column - 2008-2017





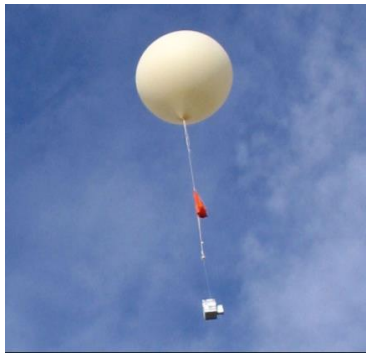
Cathy Clerbaux
Anne Boynard (LATMOS) and Catherine Wespes (ULB)

IASI – ozone [FORLI]



Ozone validation
total columns, partial columns and profiles

satellite (GOME-2)



Ground-based (lidar, NDACC/FTS, SAOZ, sondes)

Validation of IASI Ozone retrieved with FORLI

https://doi.org/10.5194/amt-2017-461

Discussion papers

Abstract | Discussion | Metrics

Research article

22 Jan 2018

Validation of the IASI FORLI/Eumetsat ozone products using satellite (GOME-2), ground-based (Brewer-Dobson, SAOZ) and ozonesonde measurements

Review status

This discussion paper is a preprint. It is a manuscript under review for the journal Atmospheric Measurement Techniques (AMT).

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Received: 22 Dec 2017 – Accepted for review: 14 Jan 2018 – Discussion started: 22 Jan 2018

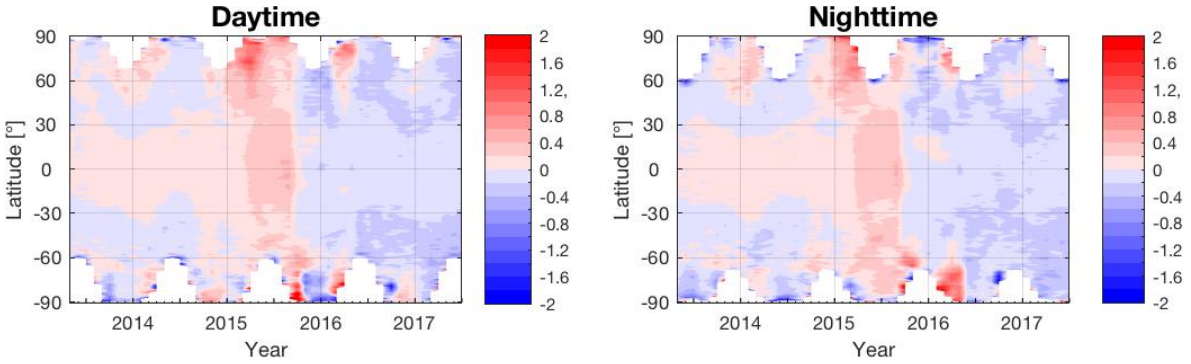
Abstract. This paper assesses the quality of IASI/Metop-A (IASI-A) and IASI/Metop-B (IASI-B) ozone (O_3) products (total and partial O_3 columns) retrieved with the Fast Optimal Retrievals on Layers for IASI Ozone (FORLI-O_3) v20151001 software for nine years (2008–2017) through an extensive inter-comparison and validation exercise using independent observations (satellite, ground-based and ozonesonde). IASI-A and IASI-B Total O_3 Columns (TOCs) are generally consistent, with a global mean difference less than 0.3 % for both day- and nighttime measurements, IASI-A being slightly higher than IASI-B. A global difference less than 2.4 % is found for the tropospheric (TROPO) O_3 column product (IASI-A being lower than IASI-B), which is partly due to a temporary issue related to IASI-A viewing angle in 2015. Our validation shows that IASI-A and IASI-B TOCs are consistent with GOME-2, Dobson, Brewer and SAOZ retrieved ones, with global mean differences in the range 0.1–2 % depending on the instruments. The IASI-A and ground-based TOC comparison for the period 2008–July 2017 shows good long-term stability (negative trends within 3 % decade^{-1}). The comparison results between IASI-A and IASI-B against smoothed ozonesonde partial O_3 columns vary in altitude and latitude, with maximum standard deviation for the 300–150 hPa column (20–40 %) due to strong ozone variability and *a priori* uncertainty. The worst agreement with the ozonesondes and with UV-vis retrieved TOC [satellite and ground] is found at the southern high latitudes. Compared to ozonesonde data, IASI-A and IASI-B O_3 products overestimate the O_3 abundance in the stratosphere (up to 20 % for the 150–25 hPa column) and underestimates the O_3 abundance in the troposphere (within 10 % for the mid-latitudes and ~ 18 % for the tropics). Based on the period 2011–2016, non-significant drift is found for the northern hemispheric tropospheric columns while a small drift prevails for the period before 2011.

Citation: Boynard, A., Hurtmans, D., Garane, K., Goutail, F., Hadji-Lazaro, J., Koukouli, M. E., Wespes, C., Keppens, A., Pommereau, J.-P., Pazmino, A., Balis, D., Loyola, D., Valks, P., Coheur, P.-F., and Clerbaux, C.: Validation of the IASI FORLI/Eumetsat ozone products using satellite (GOME-2), ground-based (Brewer-Dobson, SAOZ) and ozonesonde measurements, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2017-461, in review, 2018.

- IASI-A/IASI-B Ozone intercomparison (total and tropospheric column)
- IASI Total Ozone validation (GOME-2, Brewer/Dobson)
- IASI ozone partial column validation (ozonesonde)

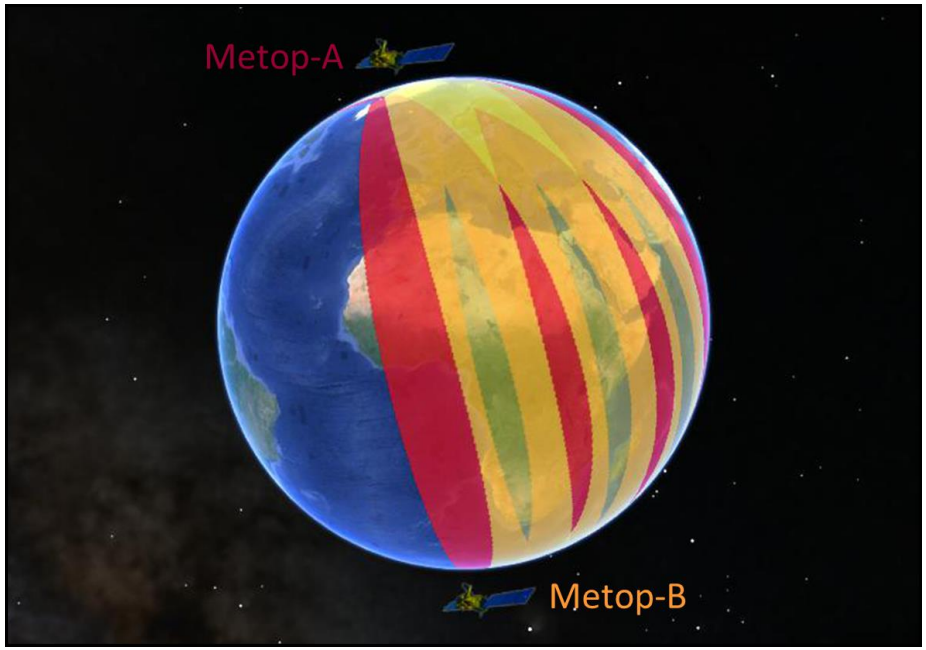
Intercomparison between IASI-A and IASI-B
May 2013 – July 2017

Relative Difference for the Total Ozone Column



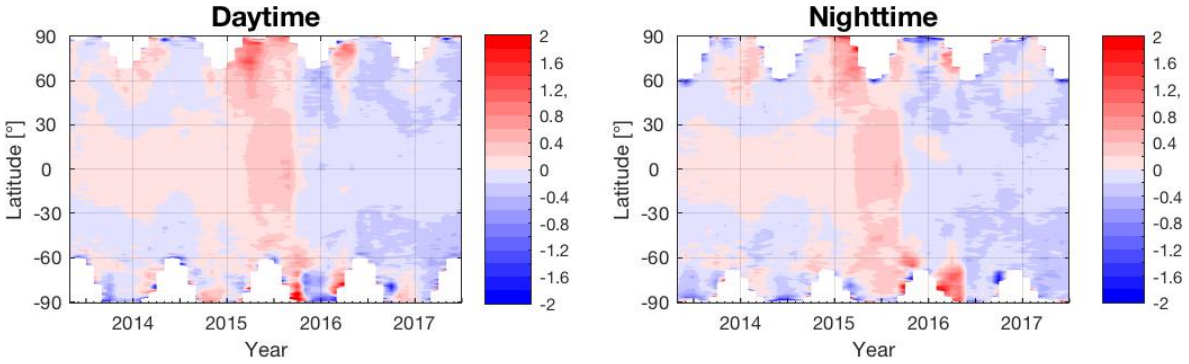
Relative difference=(IASIA-IASIB)/IASIA

Differences within 0.4%



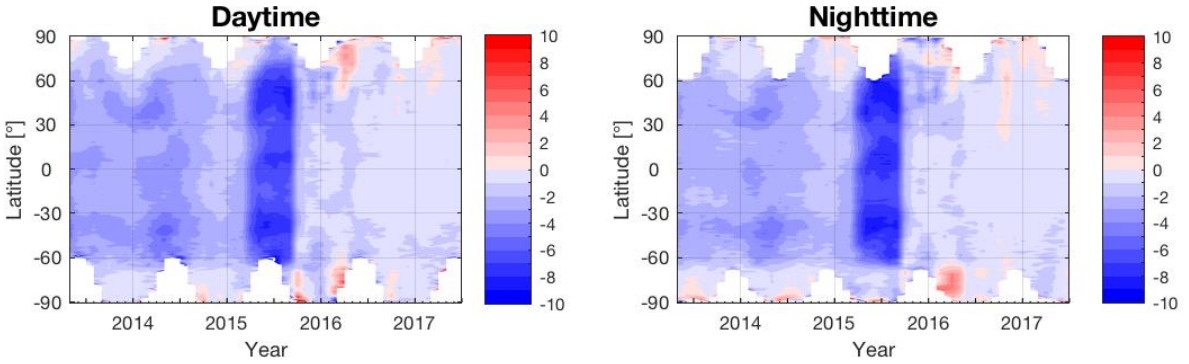
Intercomparison between IASI-A and IASI-B
May 2013 – July 2017

Relative Difference for the Total Ozone Column



Differences within 0.4%

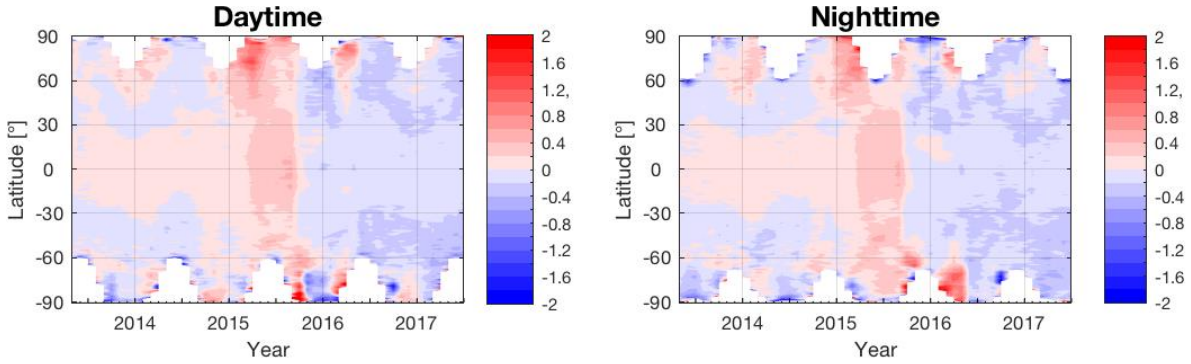
Relative Difference for the surface-300hPa column



Differences within 2%

Intercomparison between IASI-A and IASI-B
May 2013 – July 2017

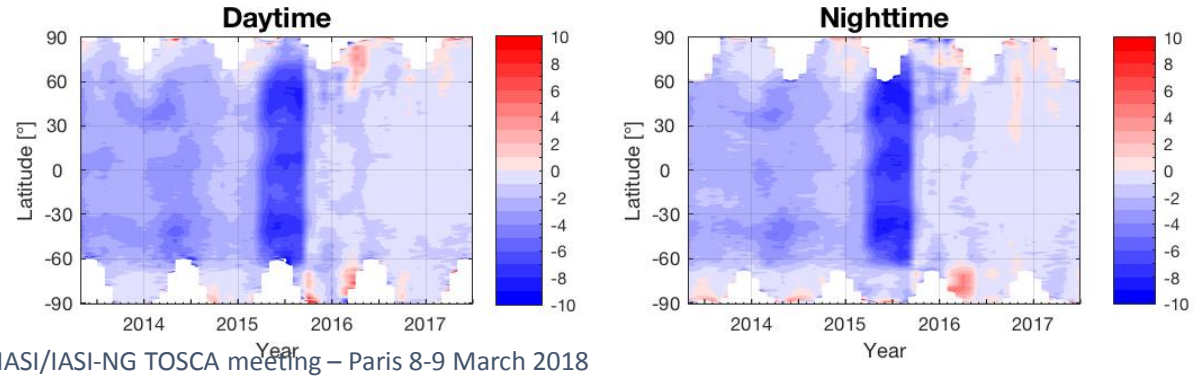
Relative Difference for the Total Ozone Column



Differences within 0.4%

- Apr.-Sep. 2015: Error in the IASI-A pixel registration, (IASI-A viewing angle modified) => corrected in September
- October 2015: stop of the compensation of the cube corner movements

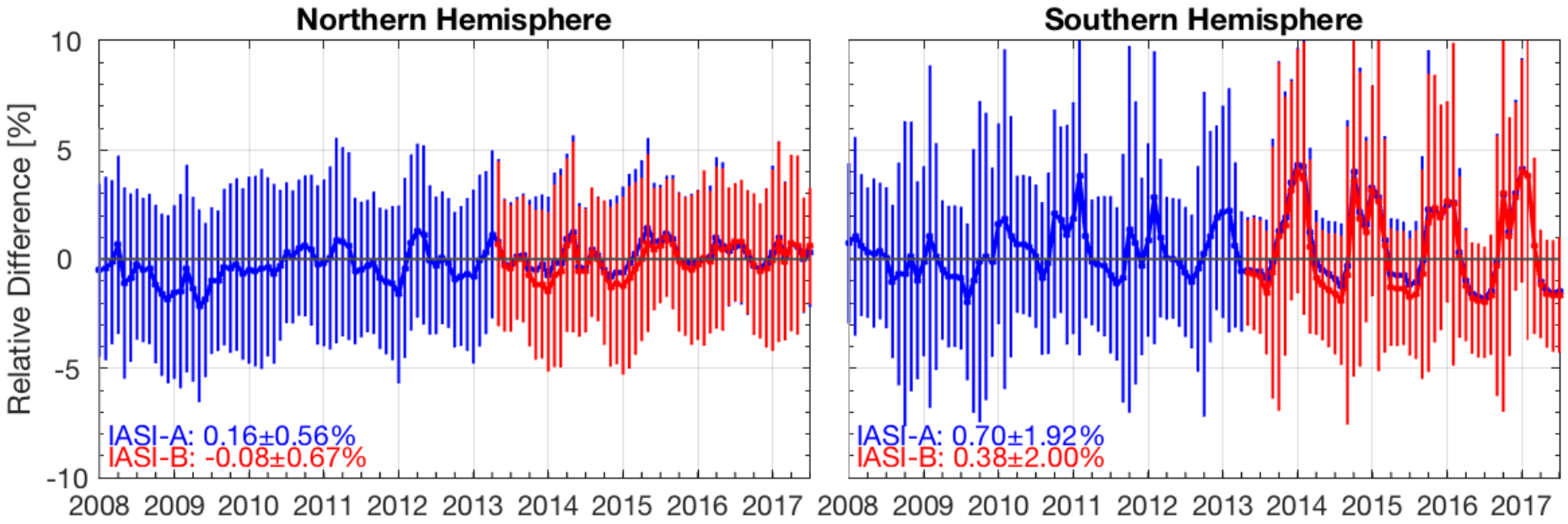
Relative Difference for the surface-300hPa column



Differences within 2%

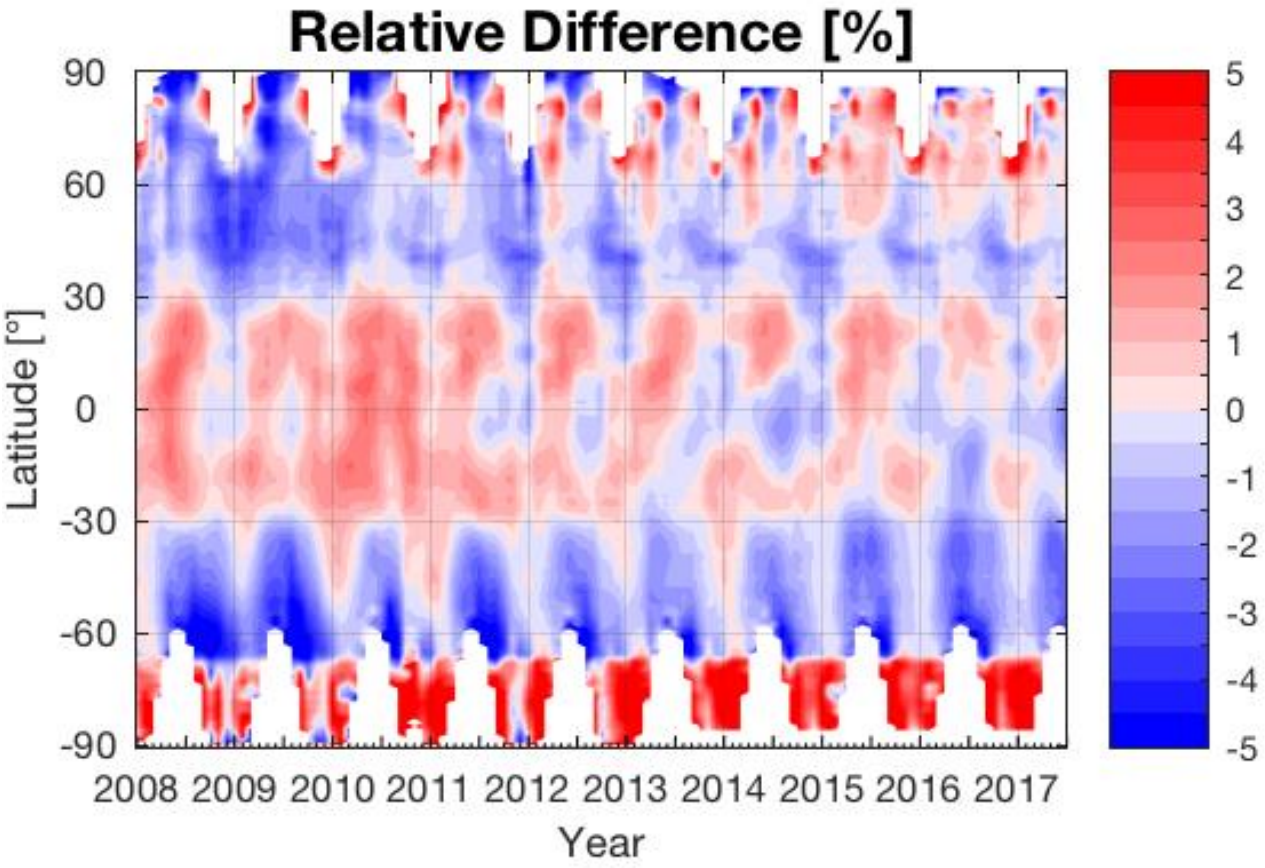
Validation of IASI TOC with DLR GOME-2A data (1/2)

relative difference=(IASI-GOME-2A)/GOME-2A



- Pronounced seasonality in the difference in the SH
- Largest differences being found during austral summer (> 4%)
- Lowest differences during the austral winter

Validation of IASI TOC with DLR GOME-2A data (2/2)

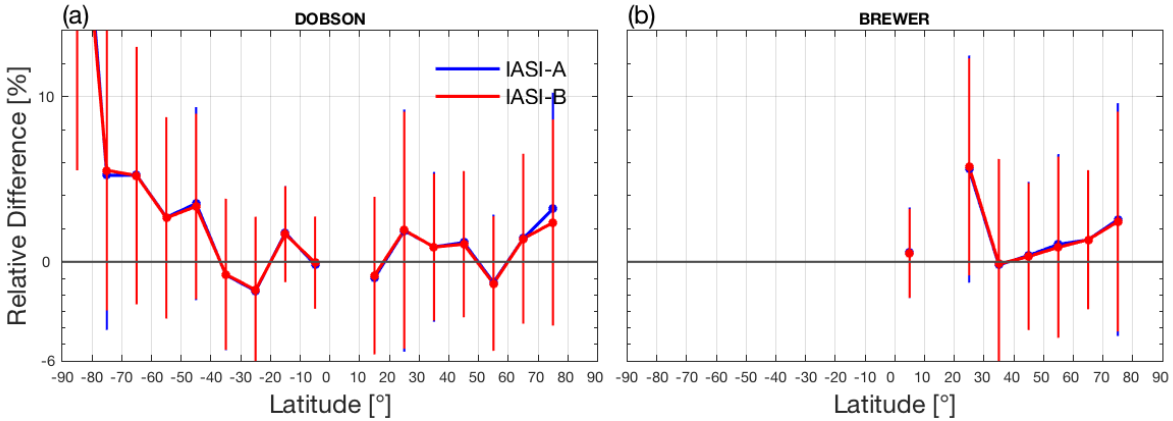


relative difference=(IASI-GOME-2A)/GOME-2A

- Lowest differences in the mid-latitudes and tropics
- Largest differences in the polar regions (>>5% over Antarctica)

Validation of IASI TOC with Brewer/Dobson data (1/2)

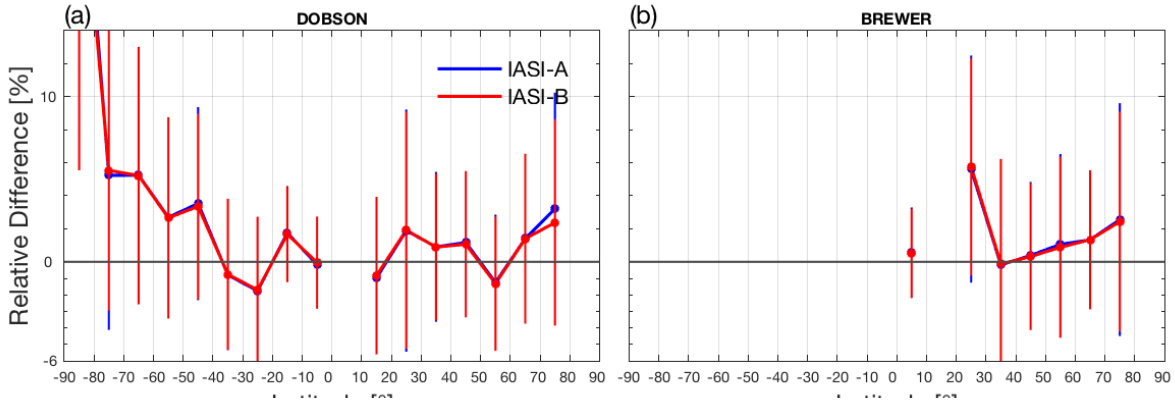
Coincidence criterium: 50km around the station

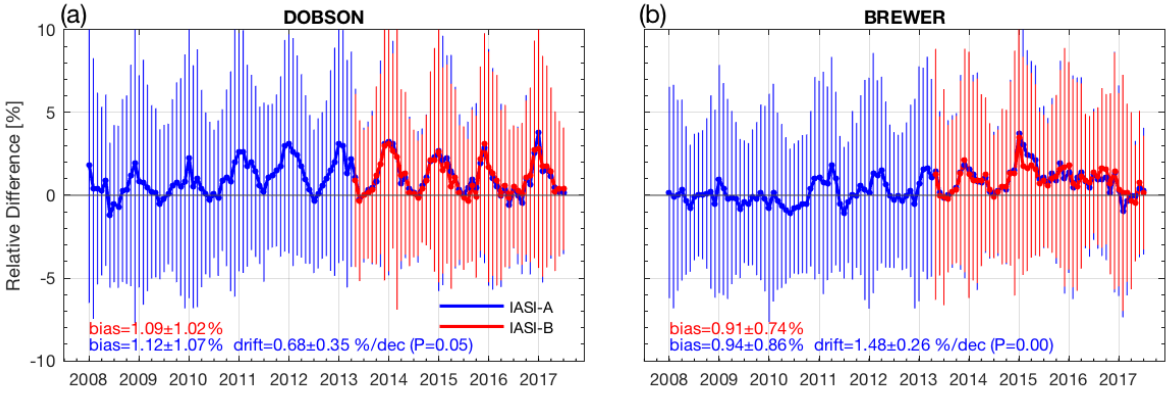


- Lowest differences found in the Northern hemisphere (NH) (generally within 1%)
- Largest differences are found in Antarctic (beyond 20%).

Validation of IASI TOC with Brewer/Dobson data (2/2)

Coincidence criterium: 50km around the station





- Lowest differences found in the Northern hemisphere (NH) (generally within 1%)
- Largest differences are found in Antarctic (beyond 20%).

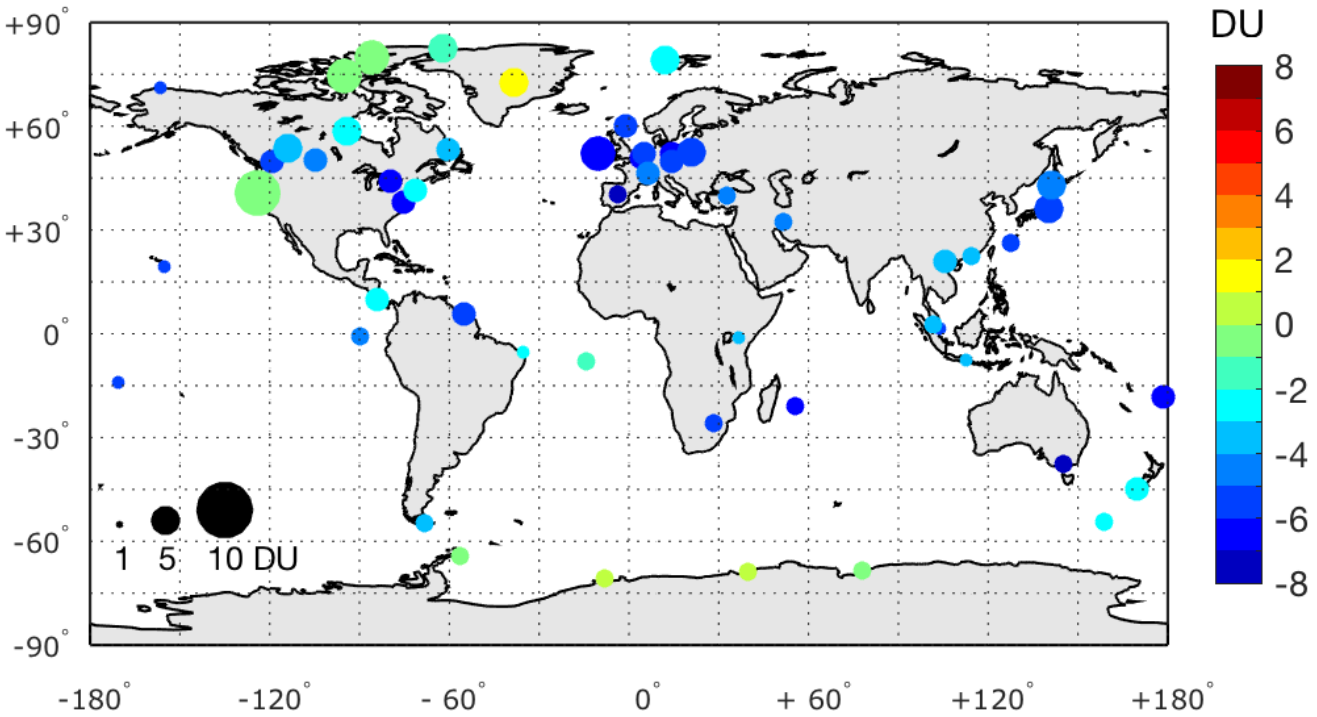
Overall bias (NH):

- Dobson: ~1±1% / Brewer: ~0.5±1%.
- Seasonal variability visible (Dobson spectrometer depends on stratospheric effective temperature (Koukouli et al., 2015))
- No significant trend in the difference for the total ozone column

Validation of IASI O3 partial columns with ozonesonde data

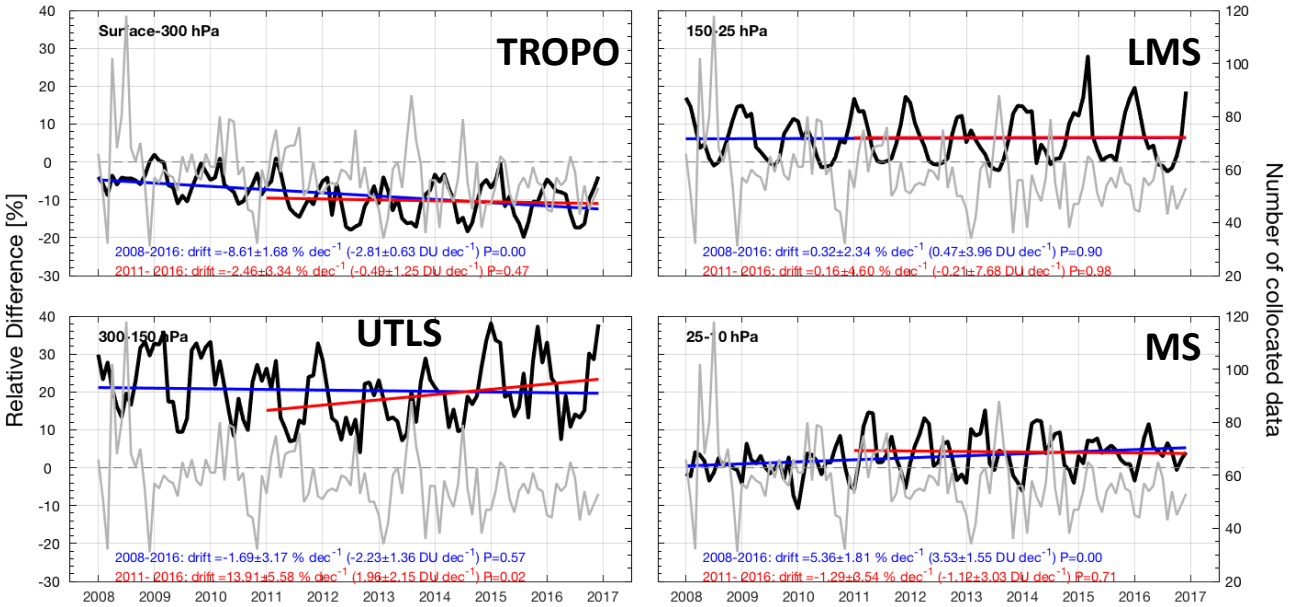
Coincidence criteria:
- 100km search radius
- ±6 h

TROPO: surface-300hPa
UTLS: 300-150hPa
LMS : 150-25 hPa
MS : 25-10 hPa



Tropospheric ozone:
- Negative bias in the middle latitudes and the tropics (around -10%)
- Positive bias in polar regions (around 4%)

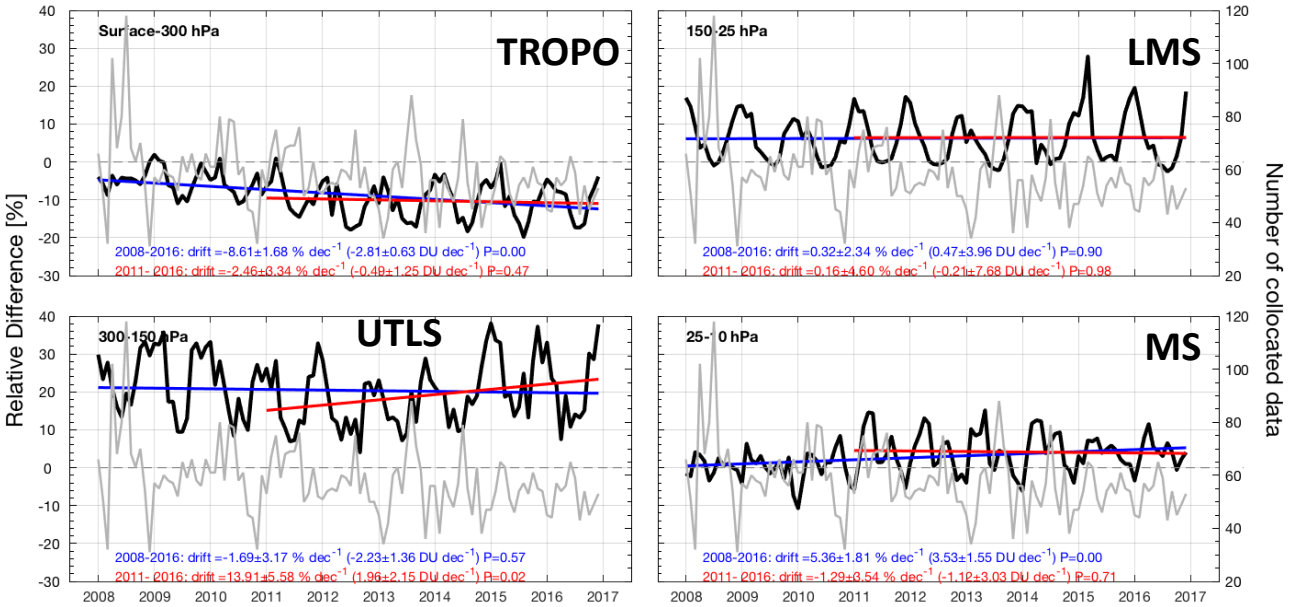
Validation of IASI O3 partial columns with ozonesonde data



- Pronounced seasonality for UTLS and LMS (less visible for the TROPO column)

- Largest differences for the UTLS column (up to 30% during winter)

Validation of IASI O3 partial columns with ozonesonde data

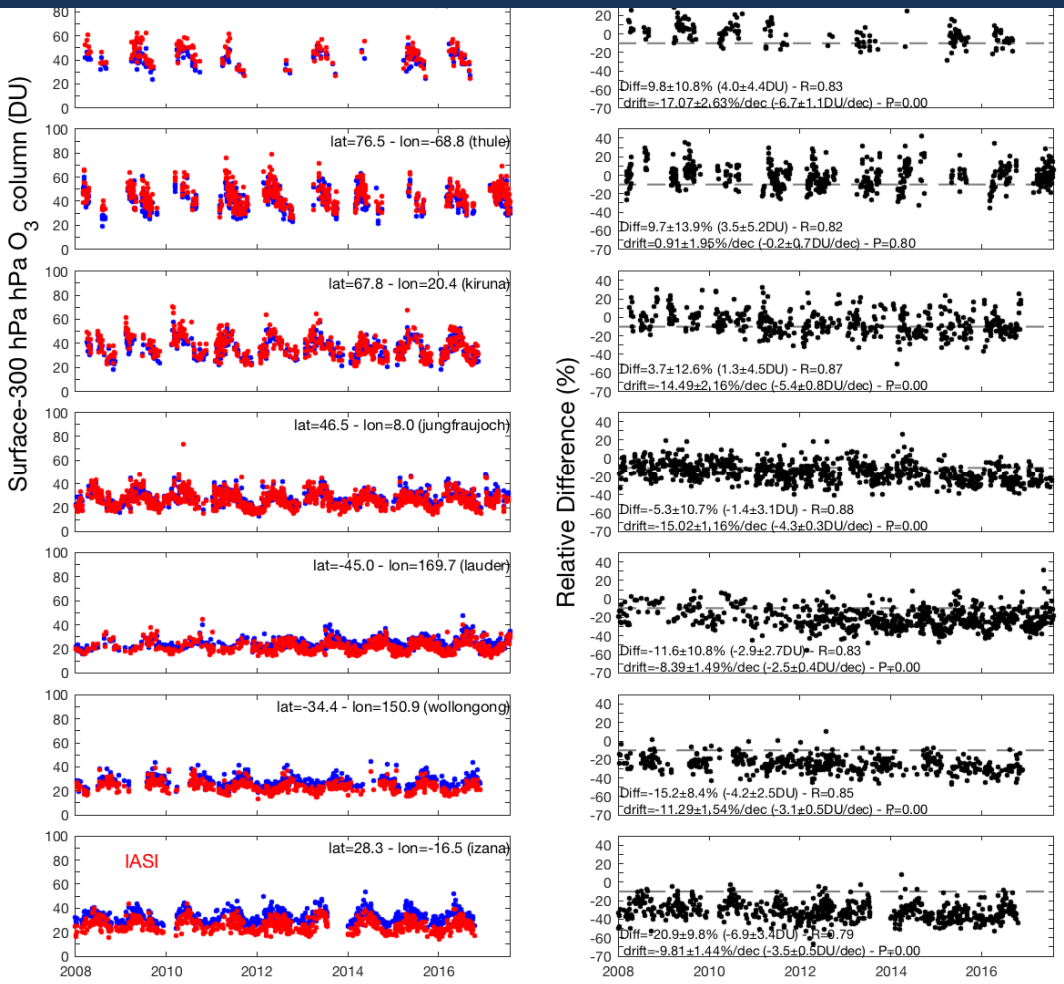


- Pronounced seasonality for UTLS and LMS (less visible for the TROPO column)
- Largest differences for the UTLS column (up to 30% during winter)

- Significant trends in the differences for the period 2008-2016:
  - TROPO: 8.6%/dec
  - MS: 5.4%/dec
- Trends become unsignificant for the period 2011-2016

⇒ Reasons for this « artificial » trends still not clear and further investigations are needed

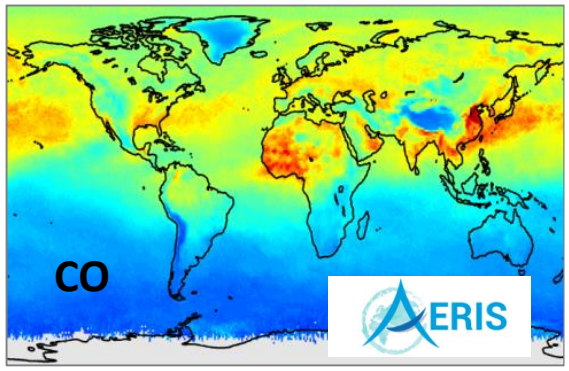
Validation of IASI O3 partial columns with NDACC data



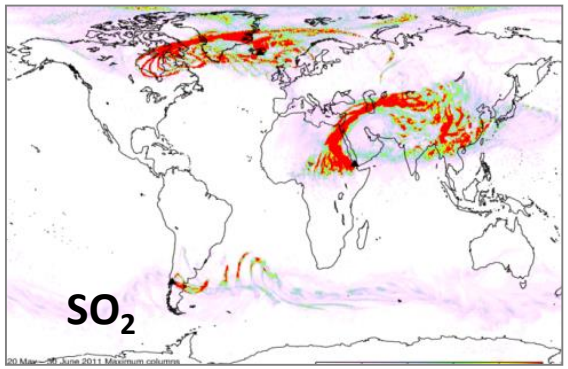
IASI-A versus FTIR Ozone surface-300 hPa partial Column

- Good agreement between FTIR and IASI tropospheric ozone (correlation coefficient>0.82 except for Izana)
- Compared to FTIR, IASI tropospheric ozone is positively biased in the high latitudes by 3.7% (Kiruna) to 9.8% (Ny-Alesund/Thule) and negatively biased in the middle latitudes (-11.6 to -5.3%) and tropics (-20.9% to -15.2%)
- Worst agreement is for Izana

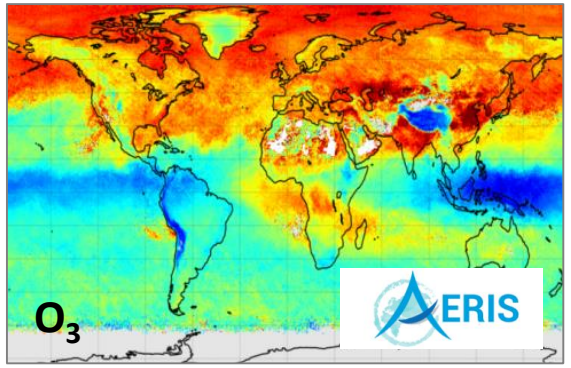
Operational distribution of IASI products



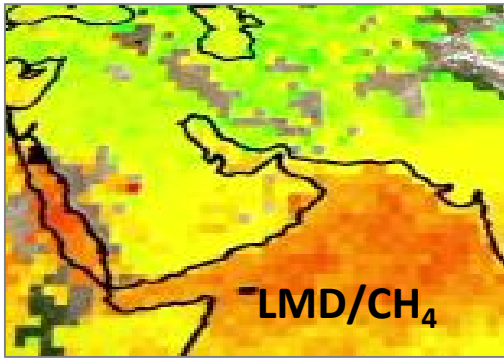
> 2016



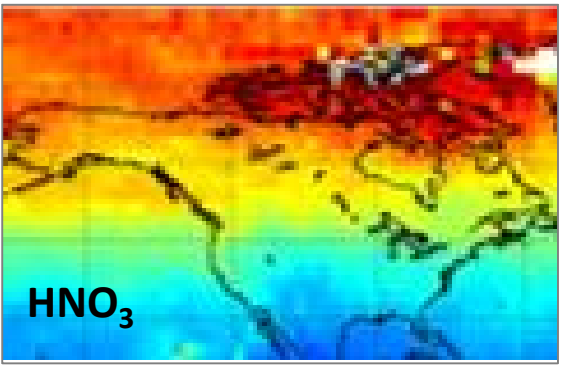
> 2017



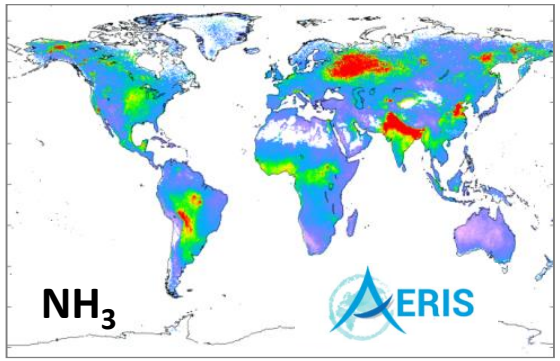
> 2018



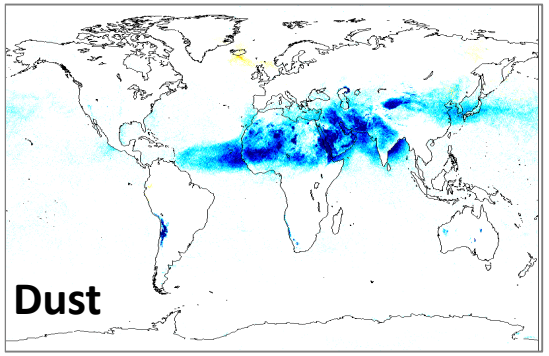
2019



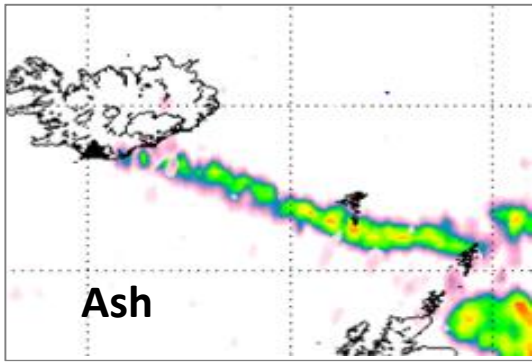
> 2018



2019



2020



2021