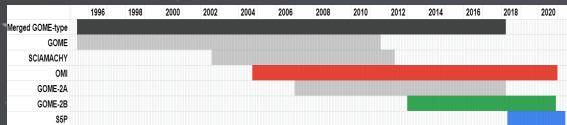


Characterisation of Sentinel-5p TROPOMI tropospheric ozone in preparation for inclusion in the GOME-type Climate Data Record

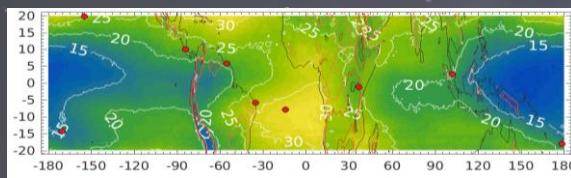
D. Hubert, K.-P. Heue, J.-C. Lambert, T. Verhoelst, M. Allaart, S. Compernolle, P. Cullis, A. Dehn, C. Félix, B. Johnson, D. Kollonige, C. Lerot, D. Loyola, M. Maata, S. Mitro, M. Mohamad, A. Piters, H. Selkirk, F. da Silva, R. Stauffer, A. Thompson, P. Veefkind, H. Vömel, J. Witte, C. Zehner



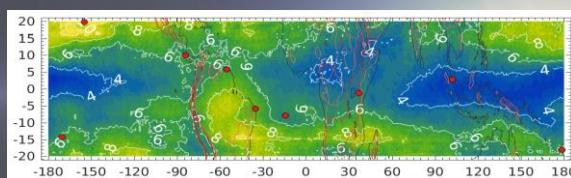
Goal: add TROPOMI to tropospheric O₃ CDR



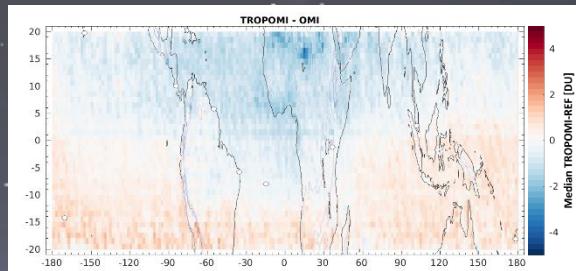
TROPOMI mean tropo O₃ (2018-2020)



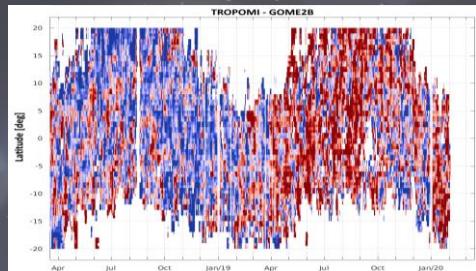
TROPOMI stddev tropo O₃ (2018-2020)



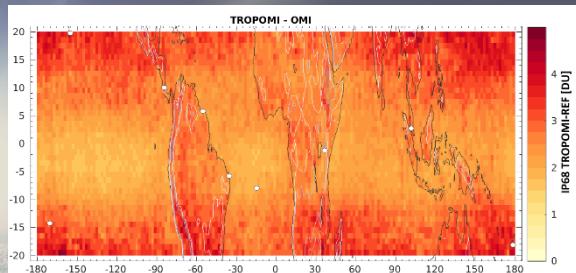
1. Spatial structure of bias



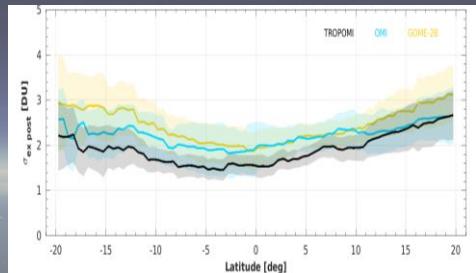
2. Temporal structure of bias



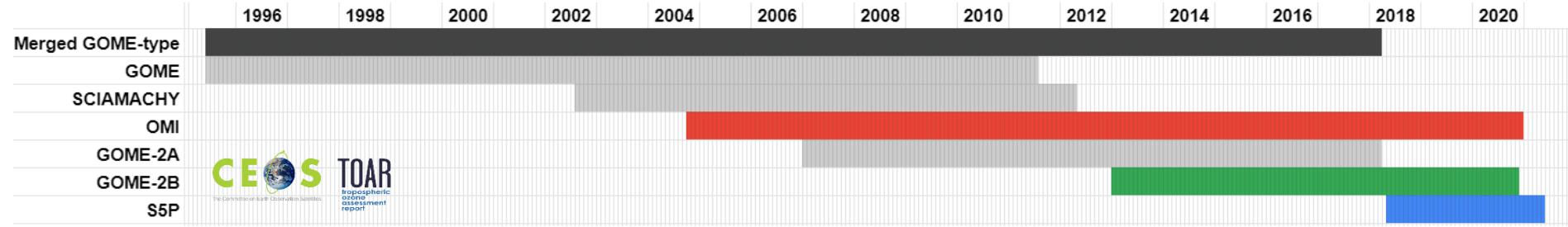
3. Spatial structure dispersion of pairs



4. Precision from analysis of triplets



GOME-type tropospheric O₃ data : Convective Cloud Differential technique

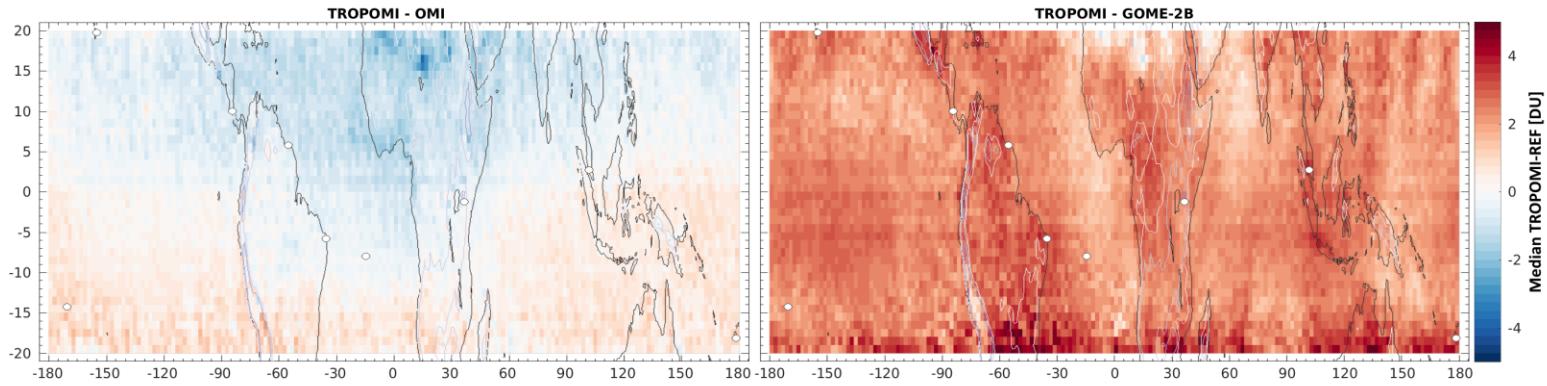


- Principle Convective Cloud Differential : total O₃ column – stratospheric O₃ column (Fishman et al., 1990)
 - Total column = total O₃ retrieval over cloud-free pixels
 - Strato column = total O₃ retrieval over pixels covered by thick convective clouds
 - Tropo column = 3-day mean O₃ column between surface and 270 hPa.
- Heue *et al.* (2016) : a merged tropospheric O₃ data record from series of GOME-type CCD data records.
- Preparatory work to add Sentinel-5p / TROPOMI to the time series
 - Spatial & temporal structure of bias
 - Structure of random uncertainty
- Presented here : validation using SHADOZ ozonesonde and intercomparisons to OMI and GOME-2B

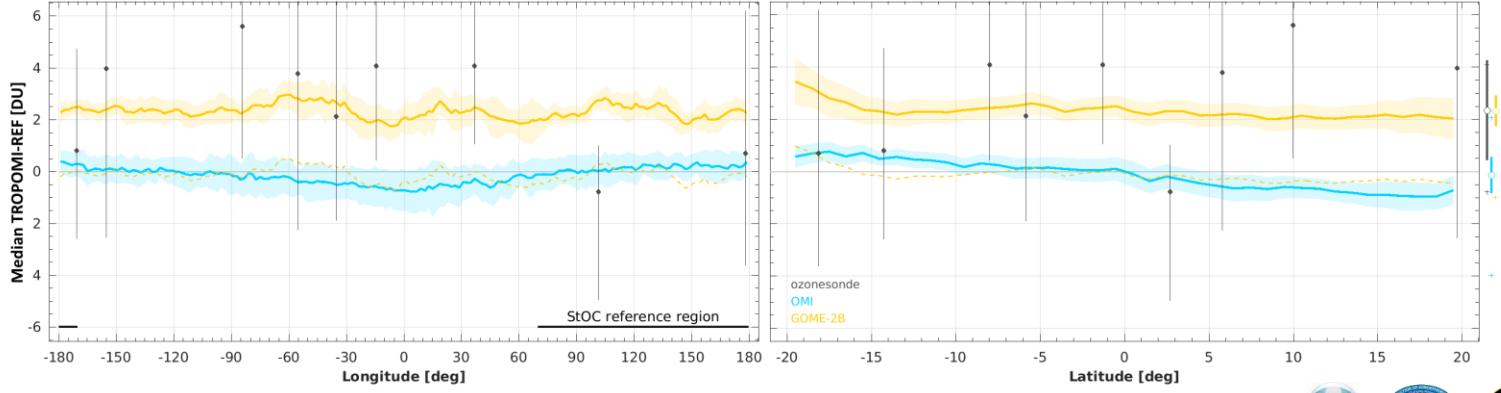


Bias estimates : spatial structure

TROPOMI and OMI agree < 0.1 DU, though with some spatial structure in bias.



GOME-2B and ozonesonde have ~2.3 DU lower O3 columns than TROPOMI/OMI.

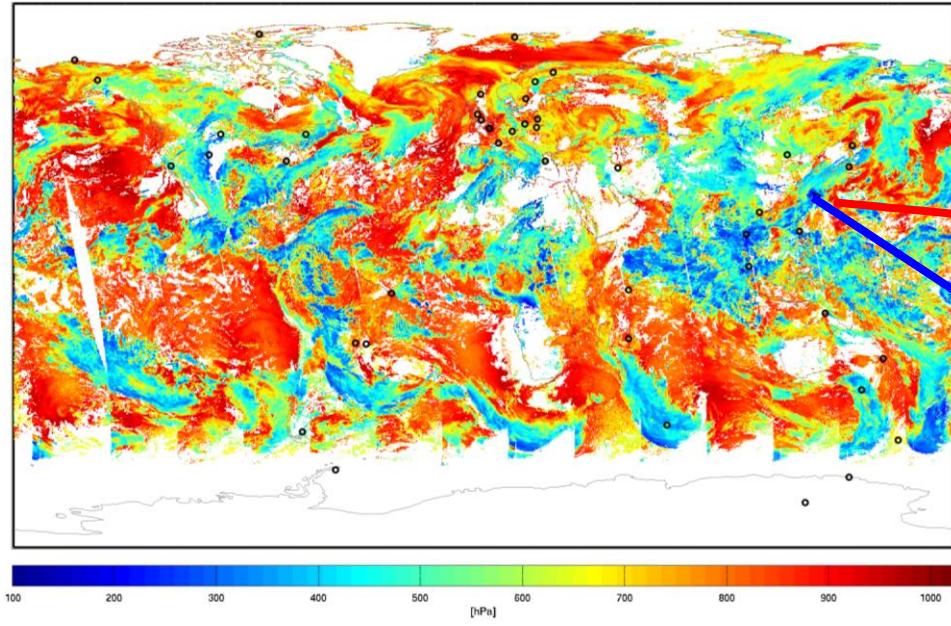


Challenge : providing AK and AP for residual technique data

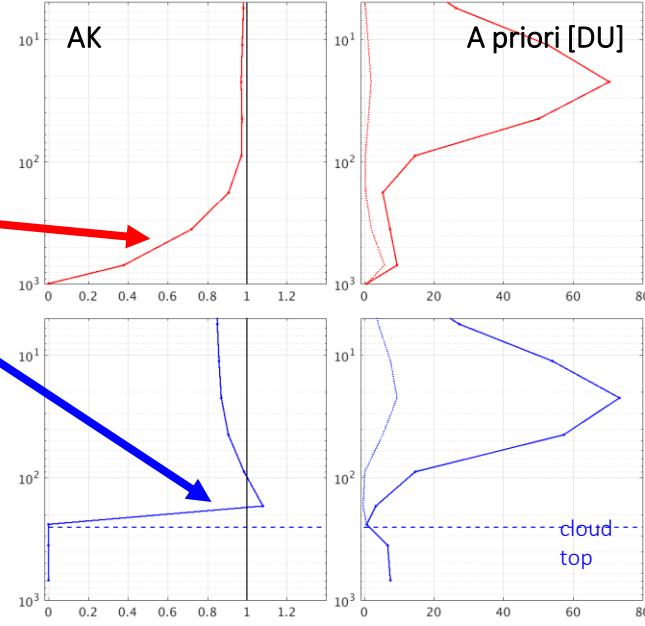
- How much does the difference in smoothing contribute to observed biases S5P - ozonesonde?
- This could be estimated if S5P vertical smoothing diagnostics were provided → challenge!

S5P cloud top pressure (CRB)

5 June 2021



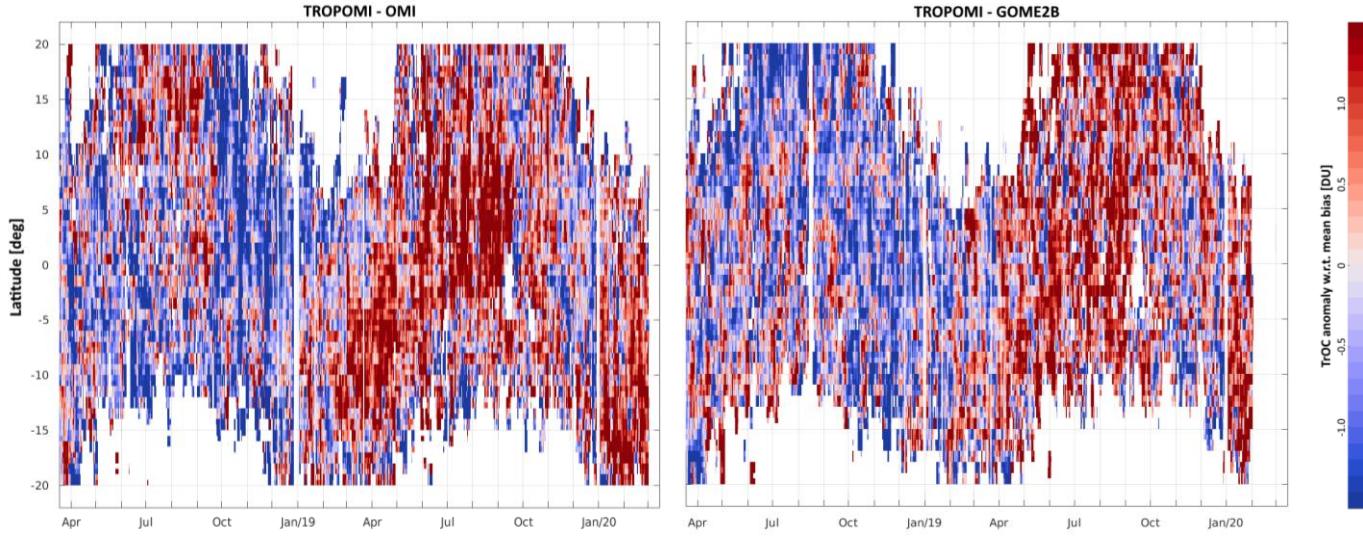
S5P total O₃



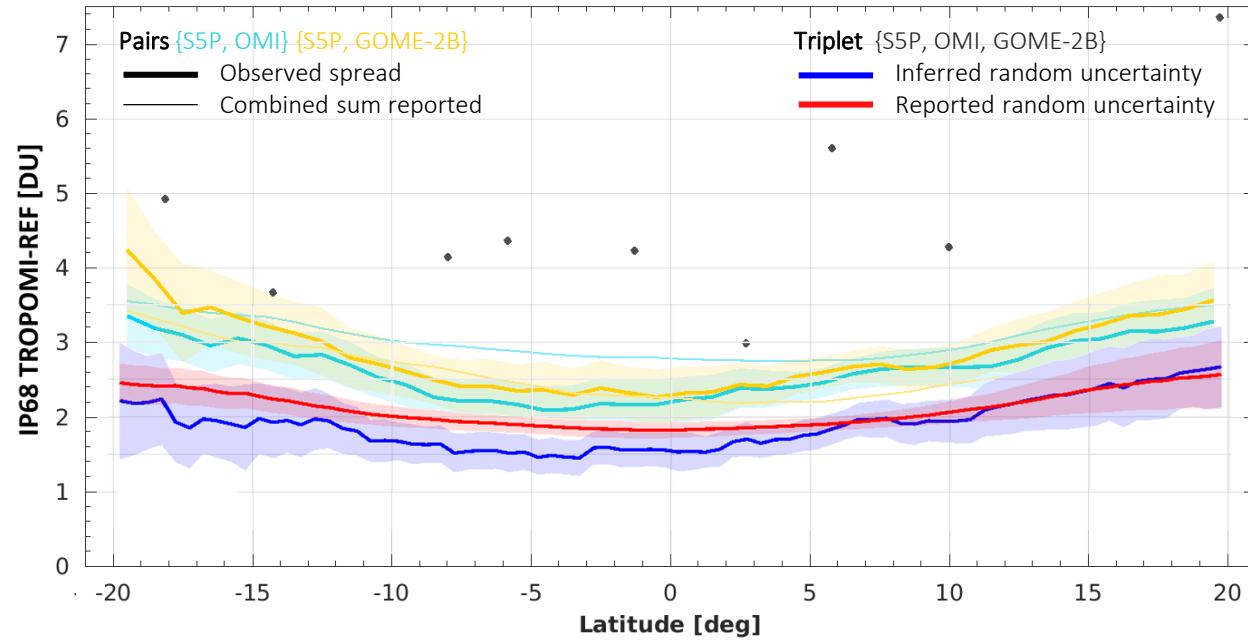
Bias estimates : temporal structure?

Preliminary results

- Satellite intercomparisons show a similar temporal modulation of 1.4-2.4 DU peak to peak.
- This hints at an issue with TROPOMI.
- Time series are too short to verify whether this is an episodic event or seasonally reoccurring.
- Additional analysis on longer time series is ongoing.



Improving estimates of random uncertainty : co-located pairs and triplets



Observable from pairs {A,B}

$$\text{var}\{A\} + \text{var}\{B\} + \text{var}\{\text{co-location}\}$$

→ validation **combined sum** random uncertainties

Observable from triplets {A,B,C}

$$\text{var}\{A\}, \text{var}\{B\}, \text{var}\{C\}, \text{var}\{\text{co-location}\}$$

→ validation of random uncertainty **individual sensors**

(Stoffelen *et al.*, 1998)