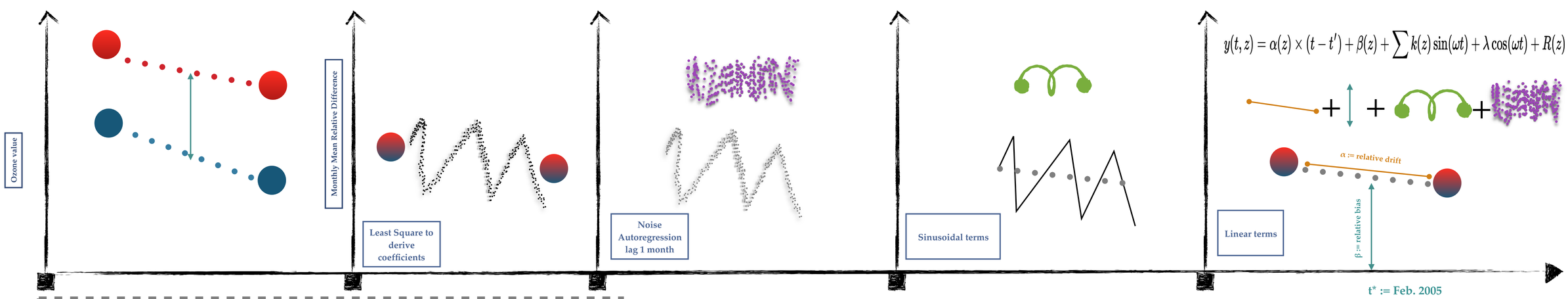
Tropospheric Ozone from Limb Nadir Matching method between MIPAS and SCIAMACHY

Nabiz Rahpoe[1] V. Sofieva[3], M. Weber[1], A. Rozanov[1], H. Bovensmann[1], J. P. Burrows[1], S. Lossow[2], Stiller[2] , A. Laeng[2], T. von Clarmann[2] , J. Tamminen[3], E.Kyrölä[3], J. Urban[5] , P. Bernath[6], R. Hargreaves[6], D. Degenstein [5], N. Lloyd [5]

C. Roth [5]

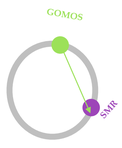
1-IUP Bremen, 2-KIT, 3-FMI, 4 - U. Saskatoon, 5 - Chalmers Univ., 6 The University of York

contact: *nabiz@iup.physik-uni-bremen.de*

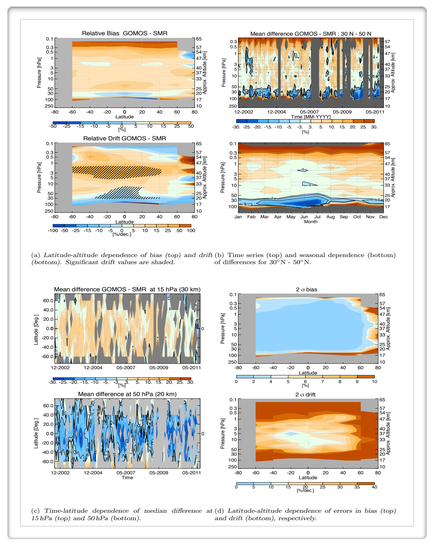


Schematic of the BIAZ procedure.

BIAZ: Bias and drift from pairwise relative multi regression Analysis of limb and occultation oZone satellite sensors.

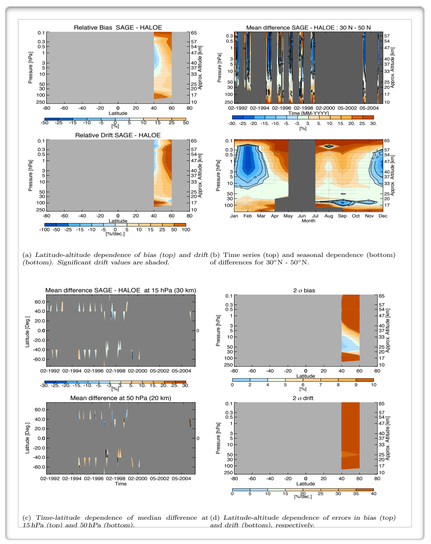


Overview of derived coefficients from the BIAZ (relative Bias and drift from pairwise multi-regression Analysis of limb oZone sensors).



(a) *Latitude-altitude dependence of bias (top) and drift (bottom).* Significant drift values are shaded. (b) Time series (top) and seasonal dependence (bottom) of differences for 30°N - 50°N.

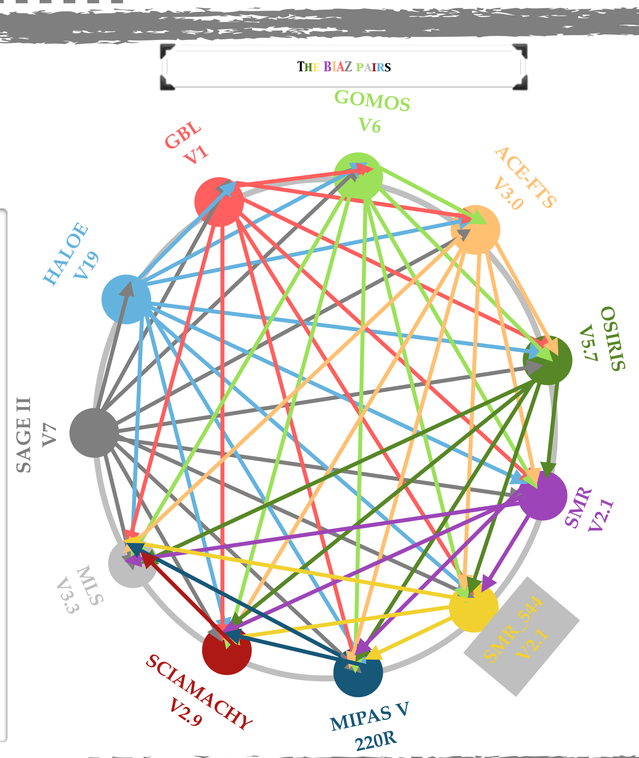
(c) *Time-latitude dependence of median difference at 15 hPa (top) and 50 hPa (bottom).* (d) *Latitude-altitude dependence of errors in bias (top) and drift (bottom), respectively.*



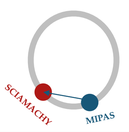
(a) *Latitude-altitude dependence of bias (top) and drift (bottom).* Significant drift values are shaded. (b) Time series (top) and seasonal dependence (bottom) of differences for 30°N - 50°N.

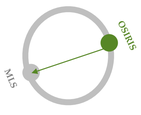
(c) *Time-latitude dependence of median difference at 15 hPa (top) and 50 hPa (bottom).* (d) *Latitude-altitude dependence of errors in bias (top) and drift (bottom), respectively.*

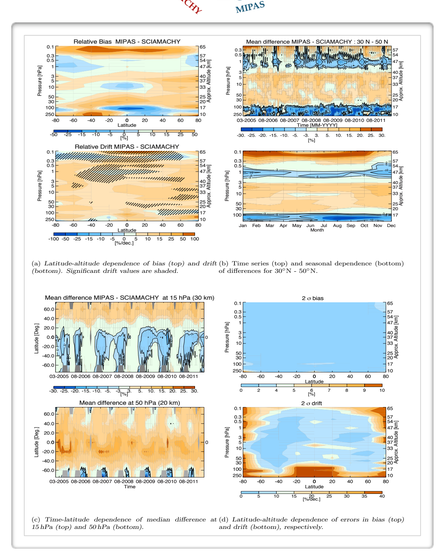
THE BIAZ PAIRS



Overview of the derived coefficients from BIAZ (relative Bias and drift from pairwise multi-regression Analysis of limb oZone sensors).

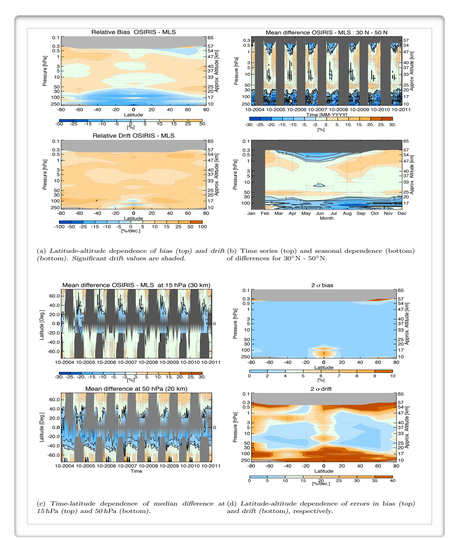






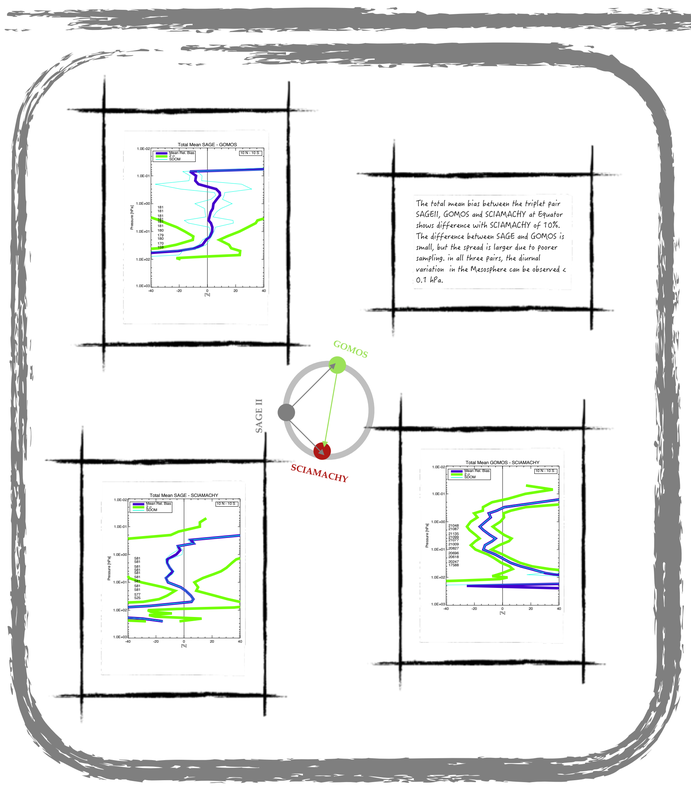
(a) *Latitude-altitude dependence of bias (top) and drift (bottom).* Significant drift values are shaded. (b) Time series (top) and seasonal dependence (bottom) of differences for 30°N - 50°N.

(c) *Time-latitude dependence of median difference at 15 hPa (top) and 50 hPa (bottom).* (d) *Latitude-altitude dependence of errors in bias (top) and drift (bottom), respectively.*

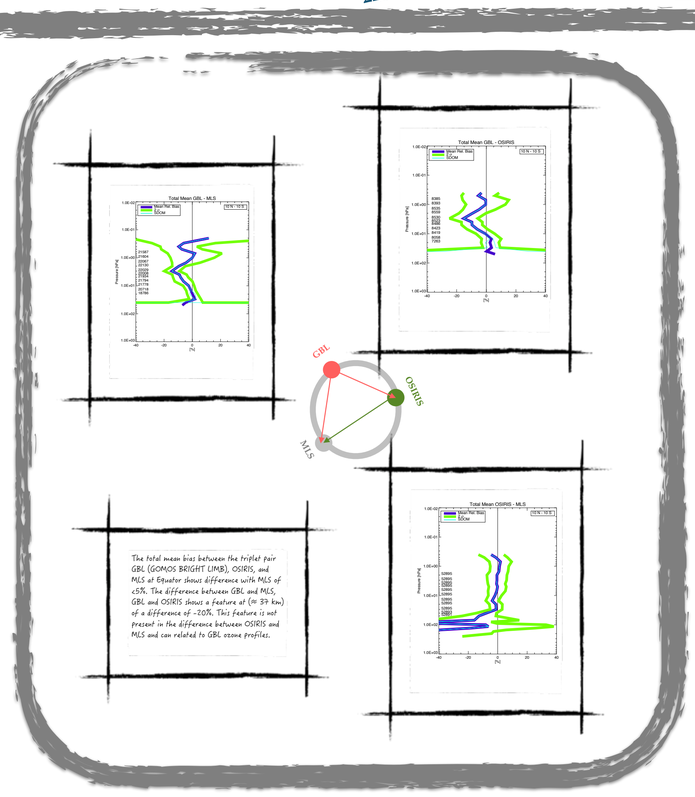


(a) *Latitude-altitude dependence of bias (top) and drift (bottom).* Significant drift values are shaded. (b) Time series (top) and seasonal dependence (bottom) of differences for 30°N - 50°N.

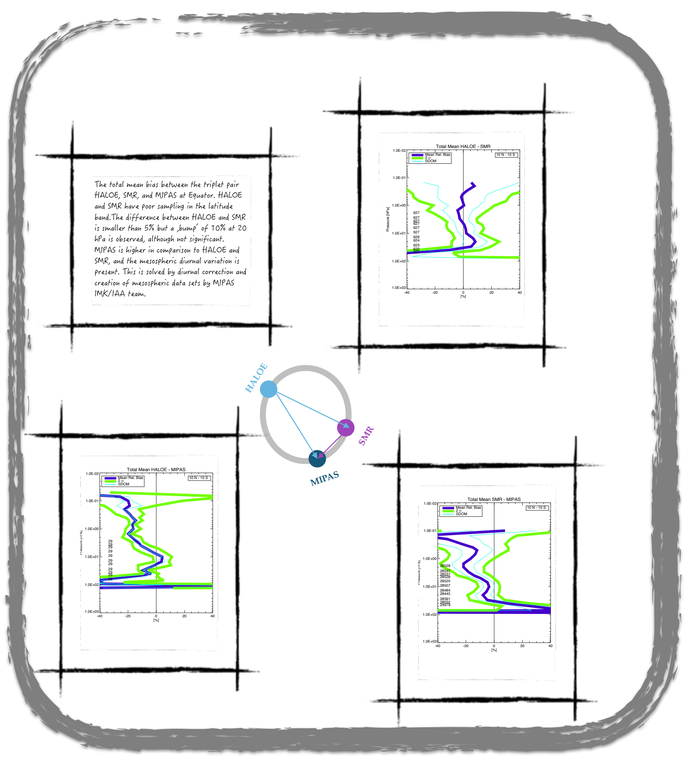
(c) *Time-latitude dependence of median difference at 15 hPa (top) and 50 hPa (bottom).* (d) *Latitude-altitude dependence of errors in bias (top) and drift (bottom), respectively.*



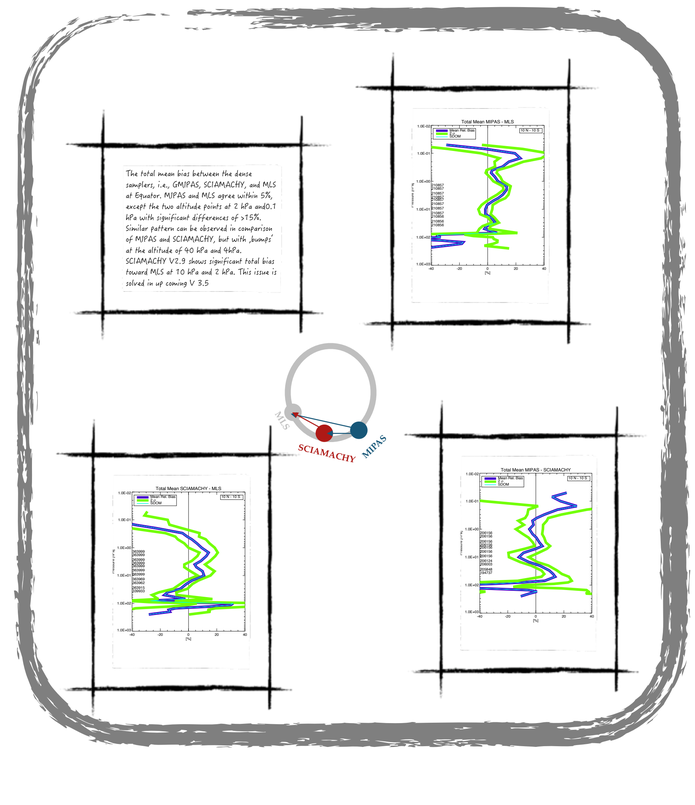
The total mean bias between the triplet pair SAGEII, GOMOS and SCIAMACHY at Equator shows difference with SCIAMACHY of 10%. The difference between SAGE and GOMOS is small, but the spread is larger due to poorer sampling, in all three pairs, the diurnal variation in the Mesosphere can be observed < 0.1 hPa.



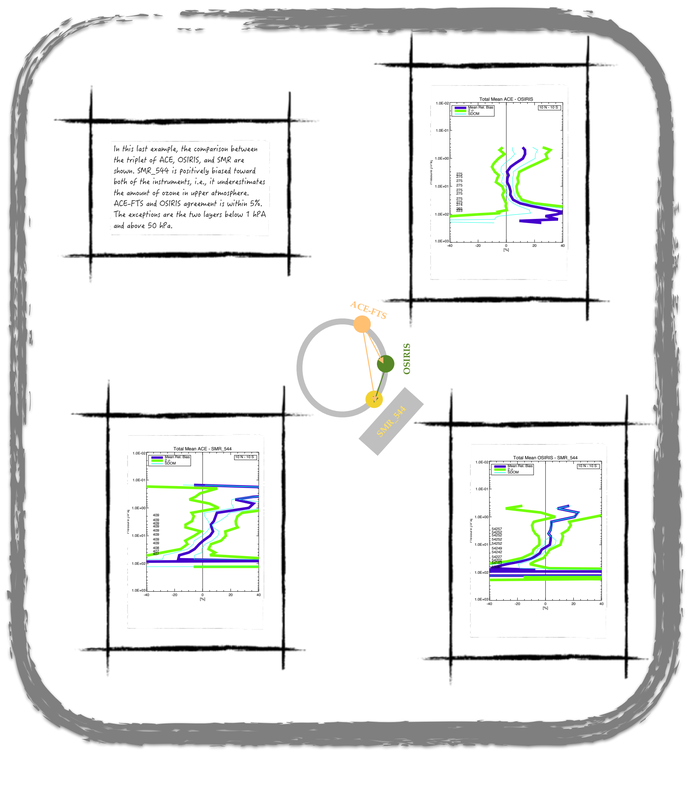
The total mean bias between the triplet pair GBL (GOMOS BRIGHT LIMB), OSIRIS, and MLS at Equator shows difference with MLS of <5%. The difference between GBL and MLS, GBL and OSIRIS shows a feature at (= 37 km) of a difference of ~20%. This feature is not present in the difference between OSIRIS and MLS and can related to GBL ozone profiles.



The total mean bias between the triplet pair HALOE, SMR, and MIPAS at Equator. HALOE and SMR have poor sampling in the latitude band. The difference between HALOE and SMR is smaller than 5% but a 'bump' of 10% at 20 hPa is observed, although not significant. MIPAS is higher in comparison to HALOE and SMR, and the mesospheric diurnal variation is present. This is solved by diurnal correction and creation of mesospheric data sets by MIPAS IMK/IAA team.



The total mean bias between the denze samplers, i.e., GMIPAS, SCIAMACHY, and MLS at Equator. MIPAS and MLS agree within 5%, except the two altitude points at 2 hPa and0.1 hPa with significant differences of >15%. Similar pattern can be observed in comparison of MIPAS and SCIAMACHY, but with 'bumps' at the altitude of 40 hPa and 4hPa. SCIAMACHY V2.9 shows significant total bias toward MLS at 10 hPa and 2 hPa. This issue is solved in up coming V 3.5



In this last example, the comparison between the triplet of ACE, OSIRIS, and SMR are shown. SMR_544 is positively biased toward both of the instruments, i.e., it underestimates the amount of ozone in upper atmosphere. ACE-FTS and OSIRIS agreement is within 5%. The exceptions are the two layers below 1 hPA and above 50 hPa.

As part of ESA's climate change initiative high vertical resolution ozone profiles from three instruments aboard ESA's Envisage (GOMOS, MIPAS, SCIAMACHY) in combination with ESA's third party missions (OSIRIS, SMR, ACE-FTS) and U.S. Sensors (MLS, HALOE, SAGE II, SABER) are to be combined in order to create an essential climate variable data record (ECV). In this paper, we present a detailed analysis of ozone profile differences based on pairwise collocated measurements, including the evolution of the differences with time. Such diagnosis is helpful to identify strengths and weaknesses of each data set that may vary in time and introduce uncertainties in long-term trend estimates. The analysis for the first six sensors (without the U.S.) revealed (Rahpoe et al. 2015) that the relative drift between the sensors was not statistically significant for most pairs of instruments. The relative drift values was used to estimate the added uncertainty in physical ozone trends. The added drift uncertainty was estimated at about 3% per decade (1 sigma). Larger differences and variability in the differences were found in the lowermost stratosphere (below 20 km) and in the mesosphere.

In this poster the evaluation of all combinations of 10 sensors have been performed by applying the similar BIAZ (Bias and drIft from pairwise relative multi regression Analysis of oZone measurements) method, where the two main parameters of relative drift and relative bias are derived, and can be viewed in this poster for couple of example pairs (contour plots) . Moreover the combination can also assess the differences of different combined pairs by comparison of the triplets (see the total bias profiles).

These results are available at the ozone cci web site, in addition to the harmonized ozone profile data sets (HARMOZ) (Sofieva et al. 2014).

Acknowledgement

This work has been performed and supported by the ESA O3CCI project. We would like to thank the MLS, SAGE II, HALOE, and SABER scientific teams for providing their data sets for this project.

References

Rahpoe et al. 2015: Relative drifts and biases between six ozone limb satellite measurements from the last decade, Atmos. Meas. Tech., 8, 4369-4381,2015.

Sofieva et al. 2013: Harmonized dataset of ozone profiles from satellite limb and occultation measurements, Earth Syst. Sci. Data, 5, 349-363, 2013.