

ACTIVITY REPORT:

LOTUS

(Long-term Ozone Trends and Uncertainties in the
Stratosphere)

Activity leads:

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27th SPARC SSG meeting

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Boulder, CO, USA

- WMO/SPARC LOTUS report published 2/2019, GAW Report No. 241, www.sparc-climate.org/publications/sparc-reports
- It summarized the most recent (up to 2018) status of long-term ozone profile records, uncertainties of measurements and analyses, and stratospheric ozone trend models.
- Results of the LOTUS report were used in Chapter 3 of the WMO/UNEP Ozone assessment (2018).

- Development of the LOTUS multiple linear regression (MLR) trend model for gridded records: additions of seasonal trends, accounting for sampling biases and applying measurement error weighting (covariance)
https://arg.usask.ca/docs/LOTUS_regression
- Open source Dynamical linear model (DLM; Laine et al., 2014; Alsing, 2019: github.com/justinalsing/dlmmc)



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Progress and achievements

Long-term records for climate understanding



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- LOTUS group held several telecons to discuss the new methods for treatment of anomalous data for trend analyses and reduction of uncertainties.
- Bernet et al. (2019) investigated instrumental biases in Microwave Ozone record at Bern and its impacts on trends. Comparison of multiple ozone records in the EU region were performed.
- The method was developed to account for varying uncertainties in the record.



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- LOTUS group continued to improve combined satellite records by addressing satellite stability and reprocessing records
- Homogenization of ozonesonde records has been expanded to EU and SHADOZ records
- Homogenization of Umkehr and SBUV NOAA combined records has began (per NOAA AC4 grant)
- ISSI grant to develop BASIC approach to reconcile differences in satellite and GB records

- Optimization of trend model for ground-based (GB) records: accounting for sampling biases, temporal changes in measurement errors, use of dynamical proxies, assessment of seasonal trends.
- Reconciling discrepancies in ground-based and satellite trends
- Investigating a coherence between stratospheric ozone, total column and tropospheric ozone
- Expanding trend analyses to Polar Regions
- Assessment of trends in gridded global datasets

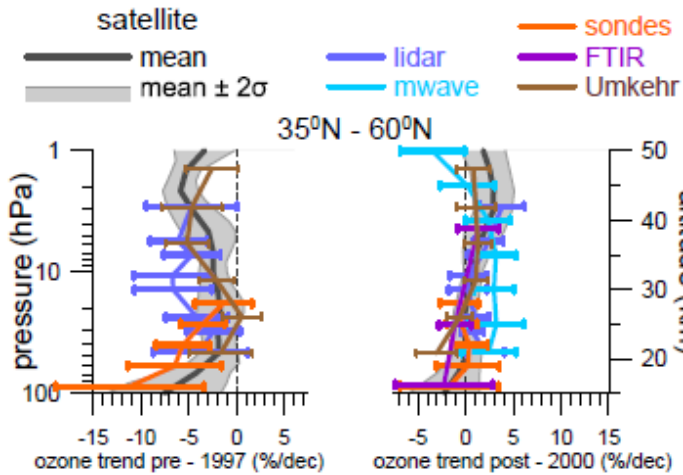
- LOTUS-2 workshop in Spring 2019
- Presentations at AGU2019, EGU2020, TRENDS 2020 (May, Helsinki), QOS2020
- Collection and archival of updated ozone records (extension to 2019; new NASA and NOAA SBUV combined; homogenized Umkehr, MW, Lidar and sonde)
- Gridded CCCi satellite record – studies of regional trends, station overpass
- Side meeting at QOS 2020, Seoul, S. Korea.

- Which direction would you like to see SPARC move forward to?
 - SPARC should continue to support and develop its current themes and activities.
- What are important research questions?
 - atmospheric composition changes under the climate change
 - geoengineering impacts on atmospheric composition
- What collaborations should be maintained or started?
 - collaborations between modelers and observationalists: mutual benefit from verification of models with observations and interpretation of observations with model scenarios

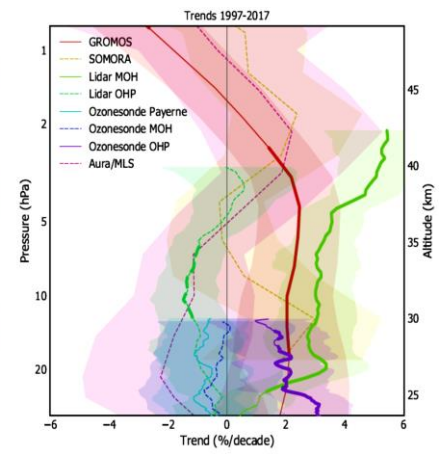
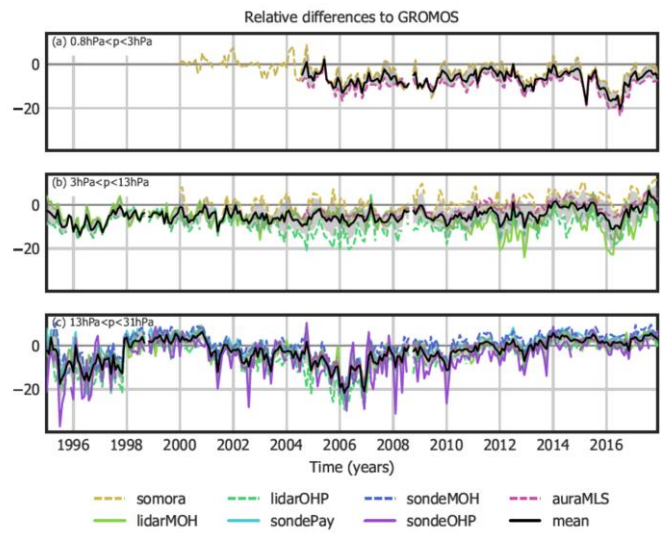
- Strategic Plan (SP; <https://www.wcrp-climate.org/wcrp-sp>)
 - ozone recovery is not addressed at all. No discussion of verification of models with observations.
- and Implementation Plan (IP; <https://www.wcrp-climate.org/wcrp-ip-overview>) (note: this is a work in progress!)
 - there is some attention to the observations, long-term record and uncertainties of observations, but there is no clear discussion how it should be supported or funded nationally
- how should SPARC's new strategy fit in with those plans?
 - Bottom-up strategy in developing new scientific ideas and activities
- What are important issues that need to be addressed in the WCRP IP?
 - support for continuing observations of atmospheric composition (i.e. WMO GAW, NDACC, SHADOZ and other ozone observing networks)

- Any issues requiring the immediate attention of the SPARC SSG
 - LOTUS Phase 2 workshop in 2019 will need financial support
 - The repository for LOTUS Phase-I data is needed (possible on the NDACC open-access data archive).
 - Obtaining DOI for the LOTUS products (ozone monthly averaged and de-seasonalized time series, zonal broadband averages and combined ground-based records)

- Aim: Thoroughly investigate drifts in satellite & GB data, implement corrections (i.e. O3S-DQA ozonesonde homogenization, MW as in Bernet et al., 2019, ongoing Umkehr, SBUV, lidar dataset homogenizations) and account for anomalous periods in trend model.
- Extended, revised and new datasets to be submitted to the LOTUS ftp site for the second phase of the data analyses by the beginning of 2020.



Trends from GB and satellite ozone records, SPARC/WMO/IO3C LOTUS Report, 2019



Bernet et al (2019) investigates anomalous periods in MW record in Bern, Switzerland and compared to other ozone records in Europe