ACTIVITY REPORT:

OCTAV-UTLS

(Observed Composition Trends And Variability in the Upper Troposphere and Lower Stratosphere)

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Progress and achievements

Atmospheric dynamics and predictability

- Updated the JETPAC (JEt and Tropopause Products for Analyses and Characterization) algorithm to analyze multiple satellite, ground-based and airborne in-situ ozone records in several dynamical coordinates.

- Ozone datasets in UTLS were remapped using multiple combinations of Subtropical jet and tropopause related coordinates (i.e. WMO lapse rate, Potential Vorticity, Potential Temperature).

- Evaluated and ranked coordinate selection for reduction in UTLS ozone variability.

Progress and achievements

Chemistry and climate

- Ozone distributions in dynamical coordinates were compared for different time periods to look for signatures of long-term changes in the dynamical drivers.

- The changes in dynamical drivers can be influenced by climate changes, including broadening of the tropical belt and shift of the jets toward poles.

- OCTAV-UTLS assessment of change in UTLS ozone distribution (and other tracers) rely on re-analyses (i.e. MERRA-2 and ECMWF) that offer spatial and temporal distribution of temperature and winds that are analyzed in JETPAC for information on jet and tropopause changes (gridded or over observation station location).

Progress and achievements

Long-term records for climate understanding

- Long-term ground-based data sets were compared to satellite records in different decades (i.e during the SAGE II and Aura MLS time periods) and referenced to the JETPAC derived dynamical coordinates.

- Preliminary trend analyses were performed on Aura MLS record to assess reduction of uncertainties in dynamical coordinates. Reduced variability was found for some sets of dynamical coordinates.

- Long-term UTLS ozone records from commercial aircraft (IAGOS-CARIBIC) were analyzed to investigate the effect of coordinate transformation of ozone on the reduction of variability: The combination of a jet-based (STJ) horizontal and dynamical tropopause vertical coordinate led to the largest variability reduction of ozone.

Future plans

- We plan a paper aimed at explaining the updated JETPAC output products and showcasing some of the dynamical coordinates selected to reduce ozone variability in the UTLS. To be submitted to ESSD.

- 3rd OCTAV-UTLS Workshop is planned for 2-5 March, 2020:
  - Comparison of monthly averaged records resampled in selected dynamical coordinate systems
  - Assessment of the long-term changes and uncertainties in multiple ozone datasets
  - Explore new JETPAC dynamical coordinates (i.e. polar jet based coordinates)
  - Assessment of data mapping in dynamical coordinates and causes for discrepancies

Future plans

- Further activities relate to understanding mechanisms controlling the relationships of ozone to dynamical coordinate variables (i.e. effects of circulation and transport on ozone), including:
  - Transport barriers and Strat-trop Exchange (STE)
  - Mixing processes across dynamical barriers
  - Relationships of ozone to natural modes of variability (i.e. QBO, ENSO)
  - Climate impacts on long-term changes in UTLS composition

Vision

- Which direction would you like to see SPARC move forward to?
  - The current diverse portfolio of SPARC activities should be maintained. Cross-activity collaborations should be fostered to identify emerging stumbling blocks for development of the products and services.
  - SPARC-centric sessions at all major conferences should be organized and travel support for key-note speakers and early-career scientists involved in SPARC activities should be offered.
- What are important research questions?
  - What are the coupling mechanisms between different scales, linking composition, radiation and dynamics in the UTLS to the global scale dynamics and climate? e.g. (chemistry) vertical gradients of ozone, water vapor, aerosol composition, (microphysics) ice particle formation and (dynamics) turbulence and mixing?
  - What is the climate feedback to changes in the UTLS composition across scales?
- What collaborations should be maintained or started?
  - Identifying developing, national and international (including public, private and non-profit), programs/ institutions that may benefit from involvement in the SPARC activities.

Links to the WCRP SP and IP

- Your view on the WCRP SP and IP
  - The WCRP view includes top-level goals that are honourable and much needed, however the IP must clearly address how these goals will be implemented and funded.

- How should SPARC's new strategy fit in with those plans?
  - All SPARC activities already align with one or many of the goals listed in the 2019-2028 WCRP SP. SPARC needs to secure funding to continue successful structure of workshops and General Assemblies that foster productivity and cross pollination of new ideas.

- What are important issues that need to be addressed in the WCRP IP?
  - Funding avenues to address those goals should be properly discussed.

Emerging issues

- Travel of the coordinators and emerging young scientists, who play a central role for the activity, may need to be supported.
- Support of travel to collaborating activity workshops is also required.
- Support for remote access to SPARC-organized meetings and recording of presentations for later sharing between scientists and for training purposes would be appreciated.
- Remote access for participation in poster discussions should be discussed. Possibly by sharing posters ahead of the conference for viewing and online questioning.
- Remote access helps to reduce participant's carbon footprint, but also leaves out the face-to-face discussions.

Exploring different coordinate systems using JETPAC

- MLS data for DJF 2005–2016 in geophysical coordinates: Equivalent Latitude, Latitude from Subtropical jet (STJ), Potential temperature (PT) and difference from PT at the STJ.

- Overlaid wind speeds from MERRA-2 interpolated to the MLS measurement locations (black), 2PVU contour (white), and 345K and 380K potential temperature contours (dashed white).