Proposal for UTLS aerosol analysis

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Objectives and background

- **Objective:**
  - To assess the anthropogenic, volcanic, and biomass burning contributions to UTLS aerosol composition and decadal variations

- **Background:**
  - The UTLS is a crucial region for Earth's climate
  - Recently studies have found the increase of LS aerosols in the past decade, but the studies do not agree on if the increase is by the increase of Asian anthropogenic emissions or by the increase of volcanic activities
  - Can we use the models to help sort out the origin of UTLS aerosols?

- **Coordination with the SSiRC’s “model intercomparisons of transient aerosol records (MITAR)” activity**
Available data for model evaluation

- **Satellite:**
  - Aerosol extinction from SAGE II, OSIRIS, SCIAMACHY, GOMOS, CALIOP

- **Aircraft:**
  - CARIBIC, HIPPO, INTEX-A and -B, ARCTAS, ICATT, POLARCAT
Zonal mean aerosol extinction at 550 nm (Mm$^{-1}$), 0-20N

Model simulations
- g5e522m0c zonal mean aerosol extinction (550 nm) (Mm$^{-1}$) 0-20N
- G41c180ACMAPhSB zonal mean aerosol extinction (550 nm) (Mm$^{-1}$) 0-20N
- G41prcR2000v2 zonal mean aerosol extinction (550 nm) (Mm$^{-1}$) 0-20N

Satellite data
- SAGE-II_OSIRIS merged zonal mean aerosol extinction 525 nm (Mm$^{-1}$) 0-20N
- SCIAMACHY zonal mean aerosol extinction 550 nm (Mm$^{-1}$) 0-20N

Stratospheric (15-40km) AOD (525 or 550 nm) 0-20N

(Note: SCIA data not included for possible cirrus cloud contamination near tropopause.)

Total aerosol extinction at 550 nm (Mm$^{-1}$), 0-20N and anthropogenic and volcanic contributions

SO$_2$ and sulfate vertical profiles during ARCTAS (2008)
Free Tropospheric aerosol S and C measurements from CARIBIC

Majority of the data are taken at 200-300 hPa altitude

Comparisons between observed and simulated aerosol concentrations at different latitudes in 2008-2009

Model shows simulated aerosols S agree with the data with \( R = 0.75 \), but over estimate by 70%. On the other hand, model cannot reproduce the aerosol C at all.
Model simulation

- **Period:**
  - 2000 (or 2005)-2012

- **Emissions:**
  - Anthropogenic emission: from ACCMIP or EDGAR
  - Biomass burning emission: PyroCb based on parameterized Al-height (Guan et al., 2010) or MISR plume height
  - Volcanic emission: Diehl database (needs update) or Cam database

- **Model simulation:**
  - Base, natural only, volcano only; base simulation including sulfate from OCS oxidation

- **Output:**
  - Daily 3-D output of aerosol extinction and mass concentrations for all species