Lessons Learned from Constructing Merged Ozone Data Sets

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Lessons learned from construction of Merged Ozone Data sets

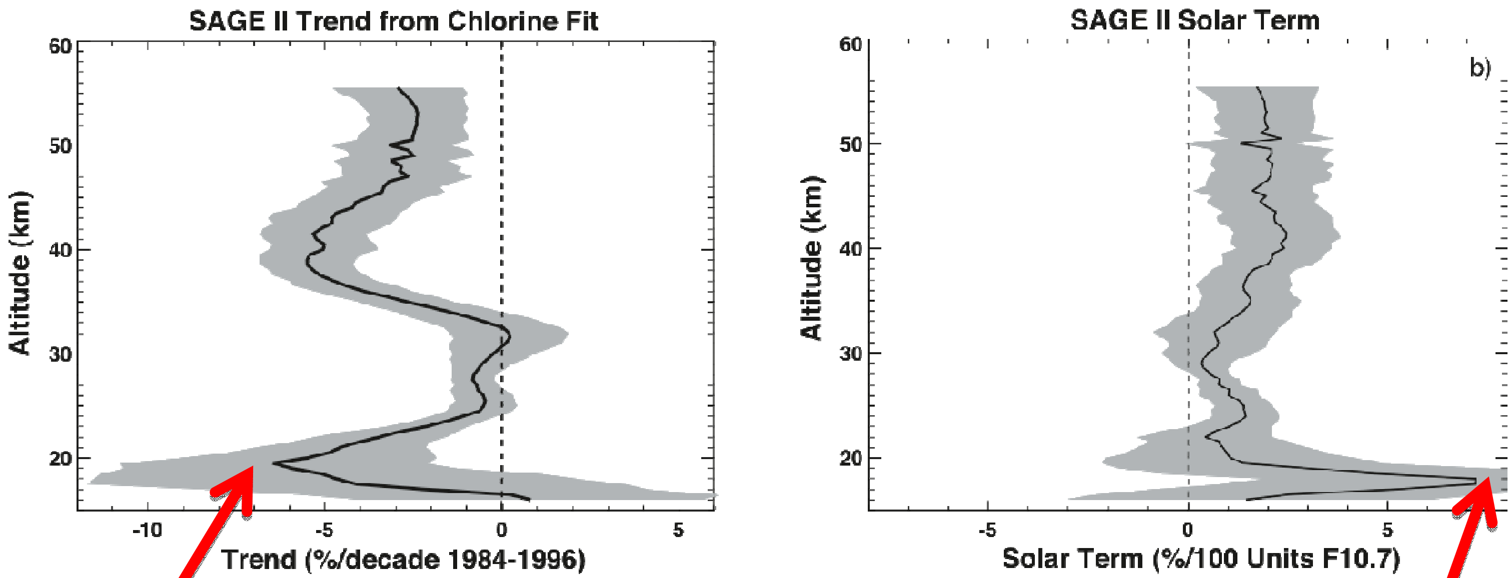
- **Must consider offsets between instruments and possible (uncorrected or miss-corrected) calibration drift of single instrument**
- **Offsets may have systematic problems that are not reduced to zero by long overlap (e.g. Nimbus 7 TOMS and SBUV)**
- **Uncertainty estimation for change over time is difficult, but necessary**

Lessons (2)

- **Prefer to have multiple, independently-calibrated data sets to understand atmospheric variability and change**
- **Must archive merged data sets: example is our MOD archive**
  - **Merged data**
  - **Links to original data providers**
  - **Description of adjustments made in merging (probably should include code)**
  - **History of previous versions with description of differences from each subsequent version**

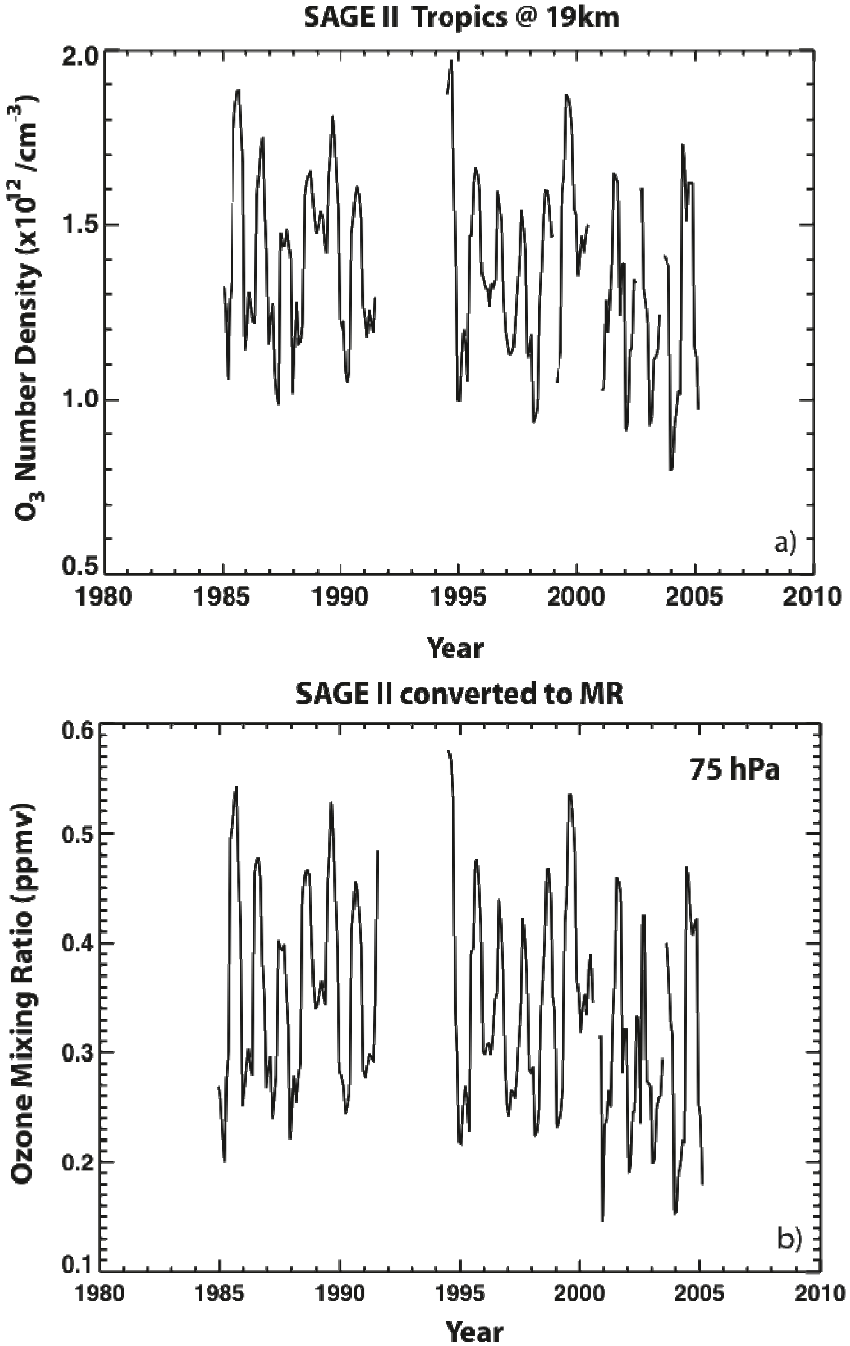
http://code613-3.gsfc.nasa.gov/Data_services/merged/index.html

Trend/Solar Cycle from SAGE Tropical Data (15S-15N; 1984-2005)



Significant trend derived from time-series analysis at ~ 20 km

Significant solar cycle derived at ~ 18 km



Time series of SAGE data in tropics

Variance explained by step function greater than by linear trend or EESC

Fitting Terms	Variance Explained (%)	Additional Variance Explained (%)
Annual Only	68.2	
Annual + Step Function	72.3	4.1
Annual + Linear Trend	70.8	2.6
Annual + EESC	69.9	1.7
Annual + QBO	71.6	3.4
Annual + Solar Cycle	69.2	1.0
Annual + Semi-Annual	70.2	2.0
Annual + ENSO Lag 0	70.5	2.3
Annual + ENSO Lag 1	72.6	4.4
Annual + ENSO Lag 2	70.6	2.4
Annual + Step Function + QBO + Solar + ENSO Lag 1 + Semi-annual	81.9	13.7

Table 1: Time series analysis of SAGE II data averaged over the tropics (15^{o}S-15^{o}N) at 75 hPa. Terms included in analysis are indicated in column 1. Variance explained by that combination is in column 2. Additional variance explained over simple annual cycle fit is indicated in column 3.

Annual + ENSO Lag 1 + step 76.1 7.9

Clearly, it would be advantageous to extend this record to get a clearer picture of the important terms

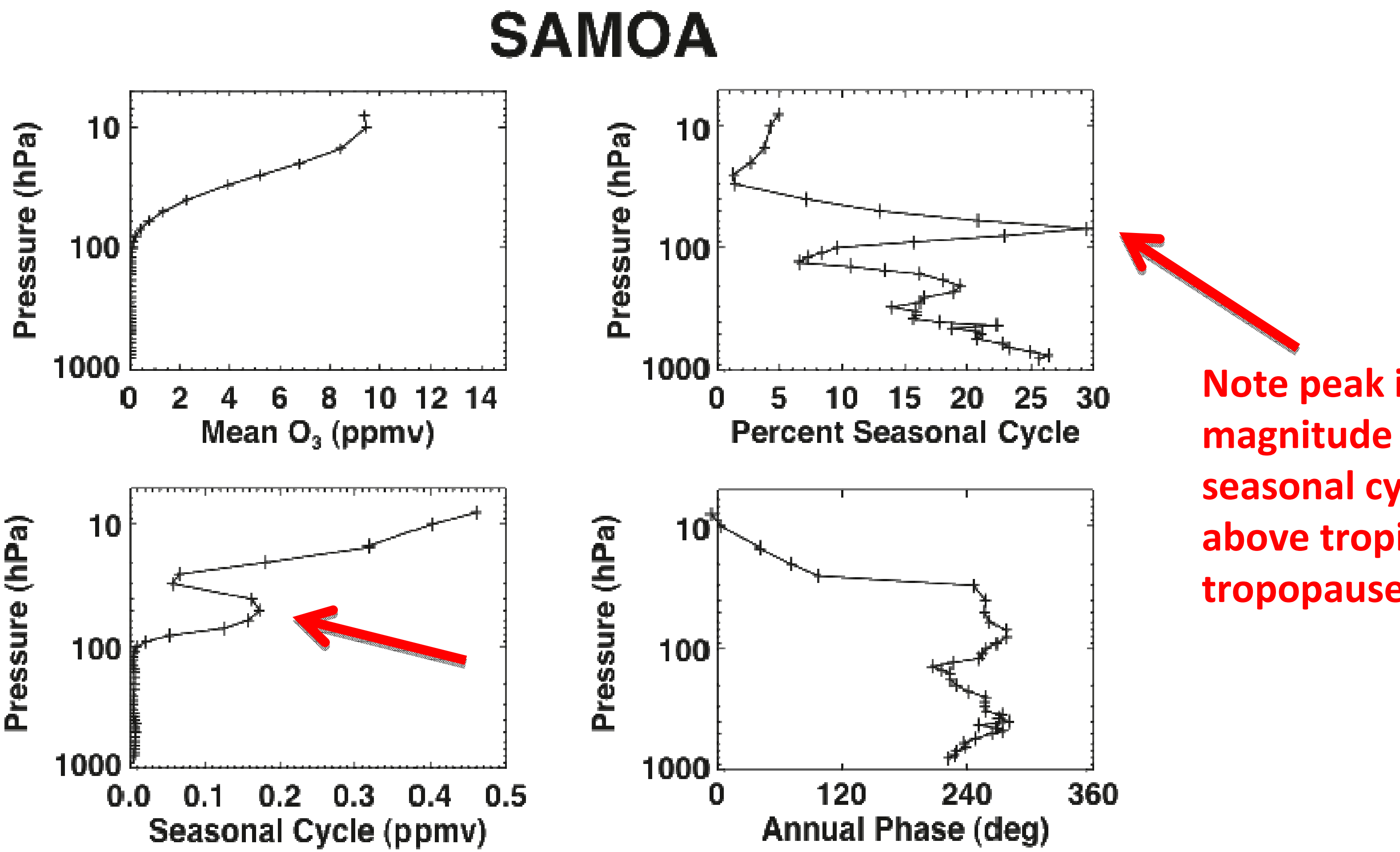
Extending data set

- First thought is to use Aura MLS
- SHADOZ ozone sondes provide overlap to both data sets
- Want to first examine basic properties of data sets, specifically annual cycle magnitude

Solution is a longer time series

- **MLS on aura has information with almost no overlap with SAGE**
- **SHADOZ ozone sondes span period of both**
- **Are these data consistent with one another?**
- **Start with examination of magnitude of seasonal cycles**

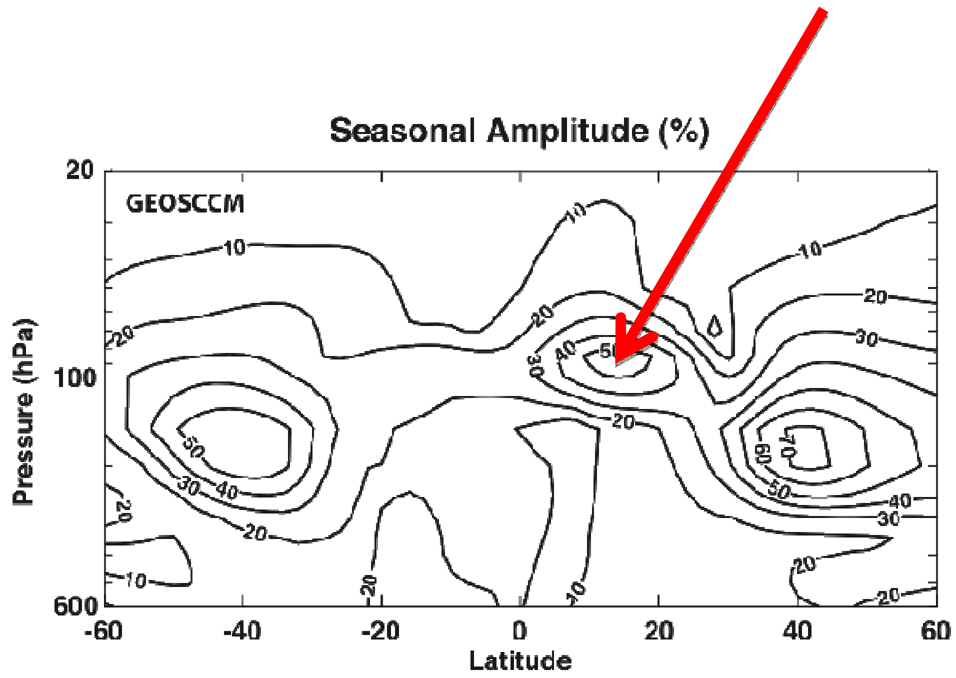
Mean Ozone and Seasonal Cycle from a SHADOZ Station



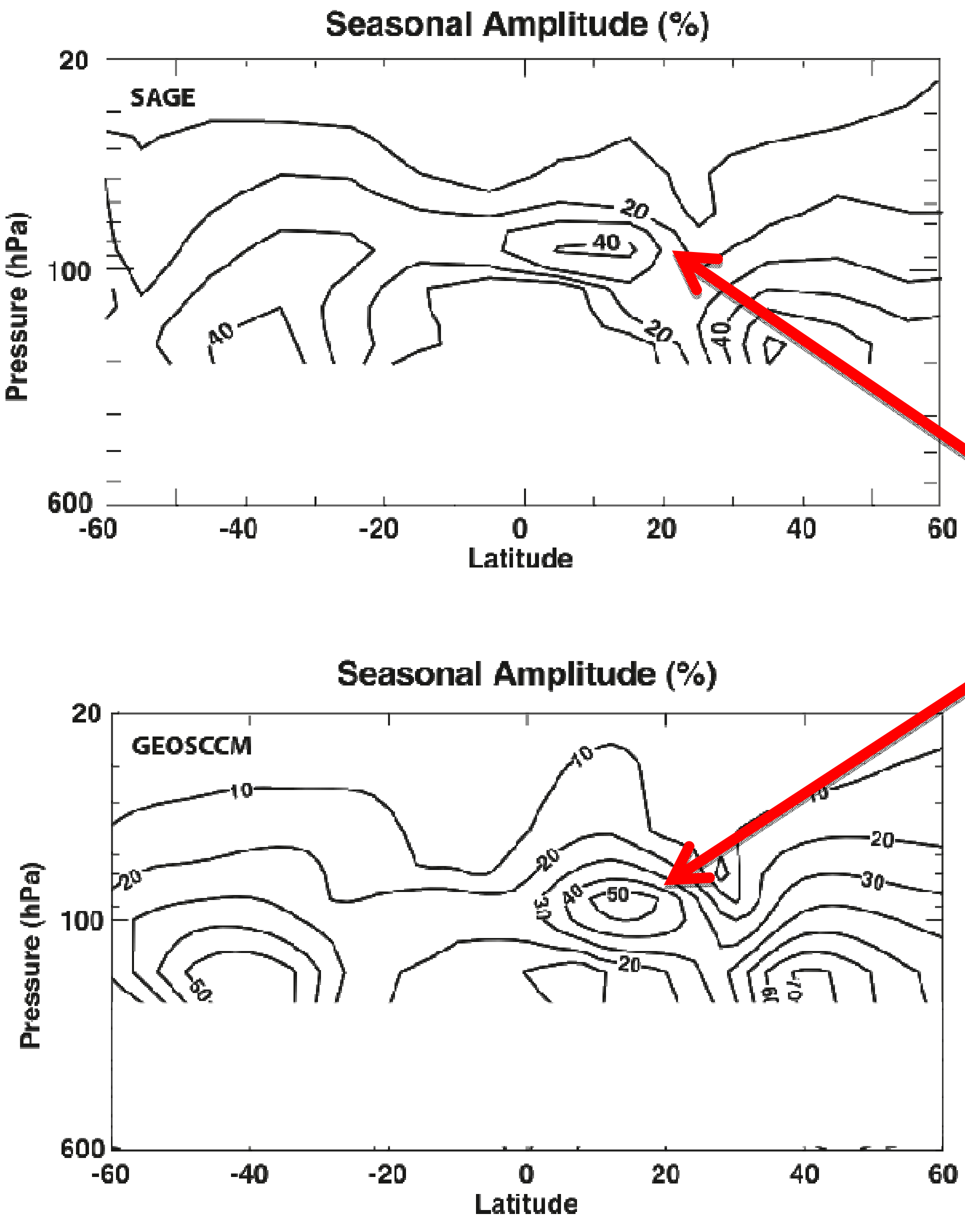
Note peak in magnitude of seasonal cycle above tropical tropopause

What does a CCM obtain for seasonal cycle magnitude?

Peak seasonal cycle on northern side of tropics

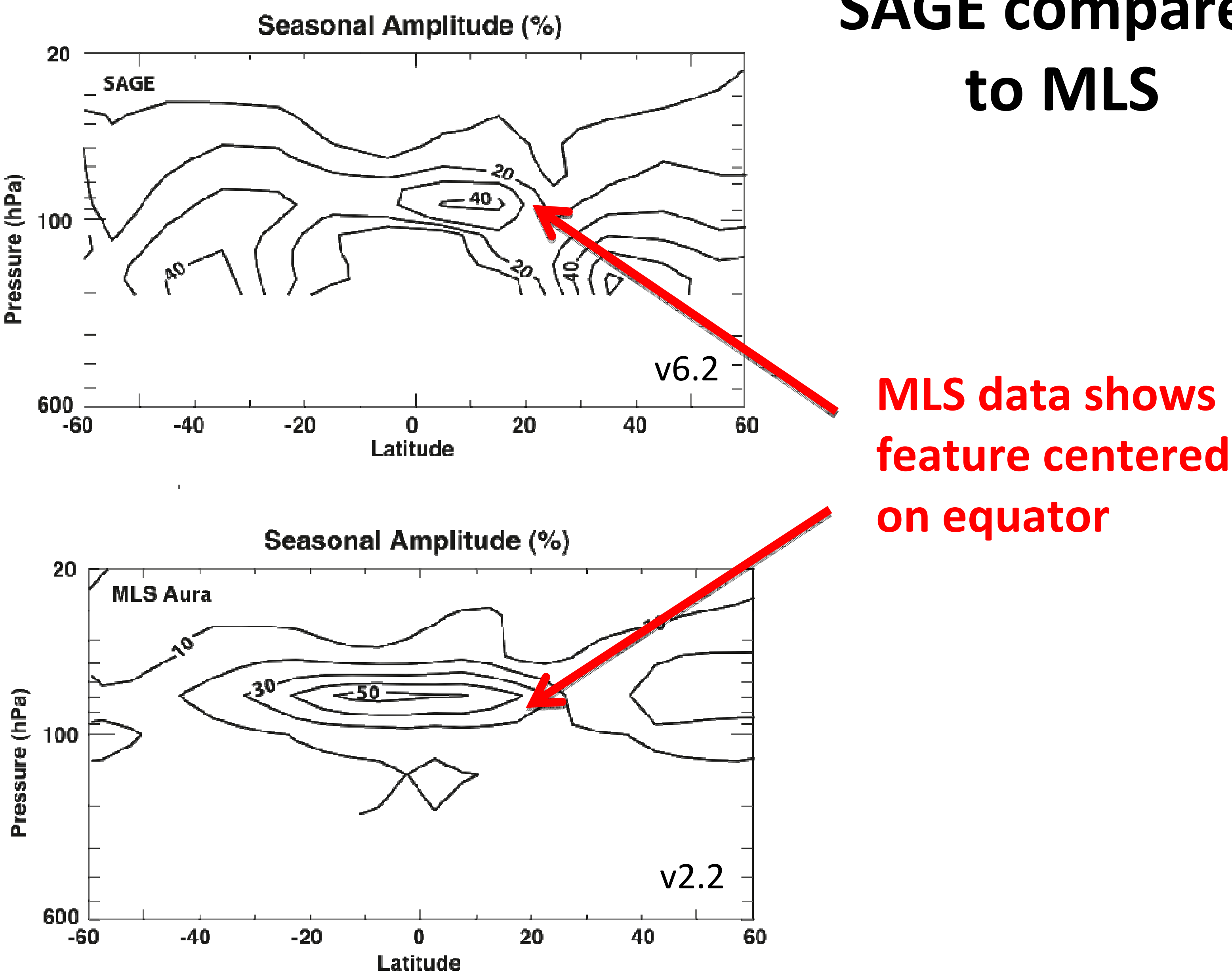


SAGE compared to GEOS CCM



SAGE data shows same feature of lesser magnitude

SAGE compared to MLS



Summary

- **Multiple independently calibrated data sets are desirable**
  - **How many?**
  - **What are the natural combinations?**
- **Four (at least) important scientific issues**
  - **How much ozone depletion occurred due to CFCs?**
  - **Early detection of recovery trend**
  - **Tropical lower stratospheric trend: an indication of BD circulation change?**
  - **Ozone response to atmospheric fluctuations and short-term perturbations**
    - **QBO**
    - **ENSO**
    - **Volcanoes**
    - **Solar Cycle**
    - **Other?**