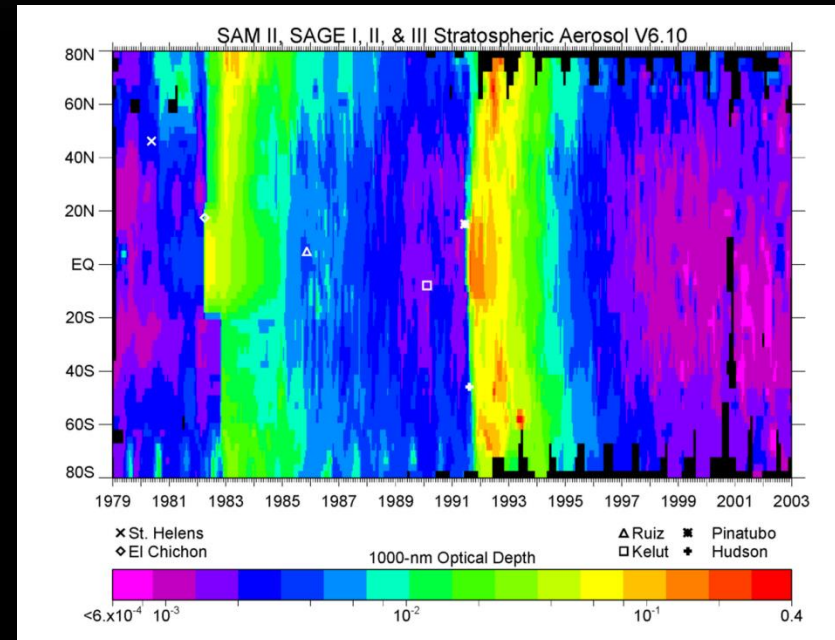


THE STRATOSPHERIC AEROSOL DATA SET: FILLED AND INTERPOLATED

- The CCMI stratospheric aerosol data set is an effort to produce a 'gap-free' stratospheric aerosol data set for 1960-present
- It is outgrowth of the ASAP 'gap-free' data developed in the early 2000s.
- ASAP's was primarily based on the SAGE series of measurements but has been extended into the future using CALIPSO and GOMOS and into the past using volcanic records and simple modeling and now spans 1960 to 2013.
- This presentation focuses on some 'tall pole' limitations associated with the SAGE period



FEATURES OF THE CURRENT STRATOSPHERIC AEROSOL DATA SET (SAGE II PART)

- The basic approach has not changed from that described in the ASAP approach
- Basic paradigm:
 - SAGE II (now v7.0 vs v6.2) is used exclusively used when it is available
 - The extinction-to-derived products methodology has also been change. Derived products are based on the ETH 4λ approach; LT's Luddite approach used to bracket low end of aerosol SAD.
 - Reported uncertainties are measurement noise/zonal inhomogeneity and not algorithmic.
 - Interpolation is used for gaps of up to 2 months except at higher latitudes and in the data gap period in 2000
 - When gap data is used, it is used stand-alone so discontinuities in the data set may occur when SAGE II and gap data are not *fully* consistent

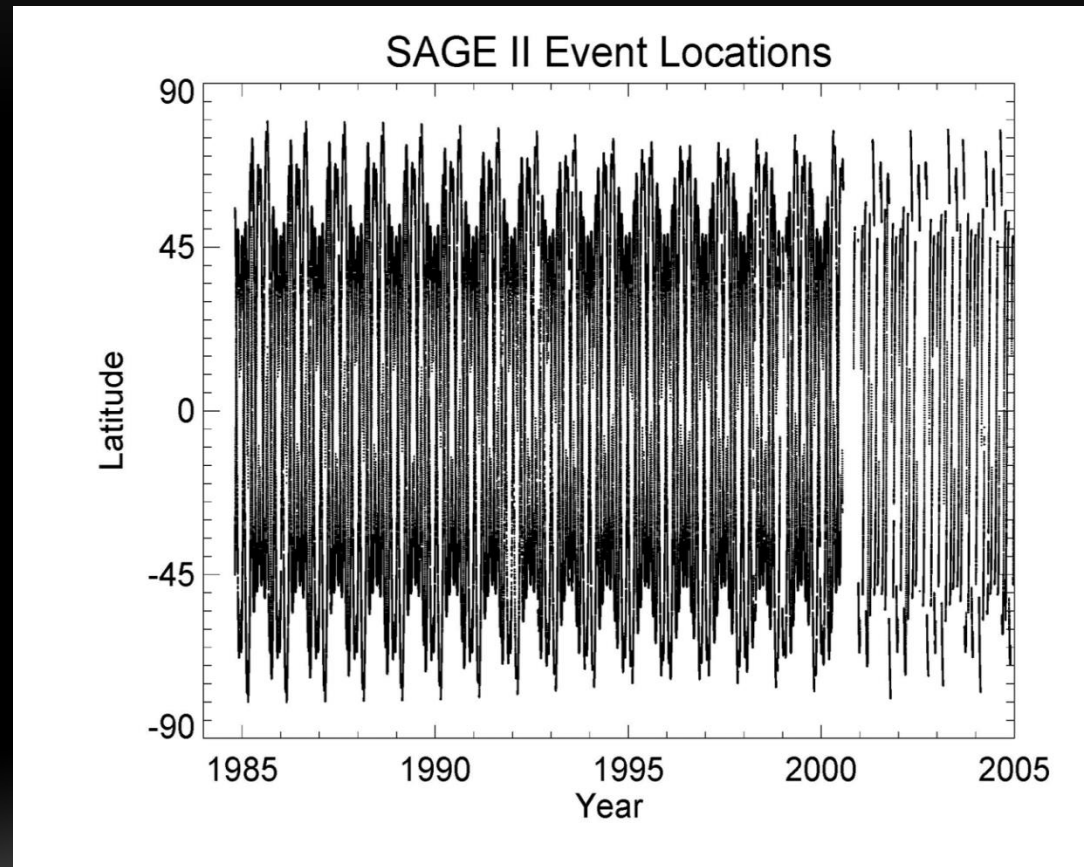
THINGS WE IGNORE

BECAUSE I DON'T HAVE ANY IDEA HOW TO ACCOMMODATE THEM

- Composition Issues
 - Many sulfate stratospheric aerosol have solid or dissolved inclusions (metal, salts, etc.) with probable impact on optical properties and things derived from them
 - Above the main aerosol layer, the partitioning of sulfur changes from primarily as sulfate aerosol to primarily gases; this change is currently ignored
 - Organic-sulfate aerosol certainly exist in the UTLS (see above)
 - Non-ice PSCs (should they be cleared?)
- While a single mode log-normal is convenient, it most likely not representative of the stratospheric aerosol size distribution in general; impact on bulk property retrieval
- It is difficult to quantify uncertainty in the derivation of inferred quantities (s.d., SAD, etc.)

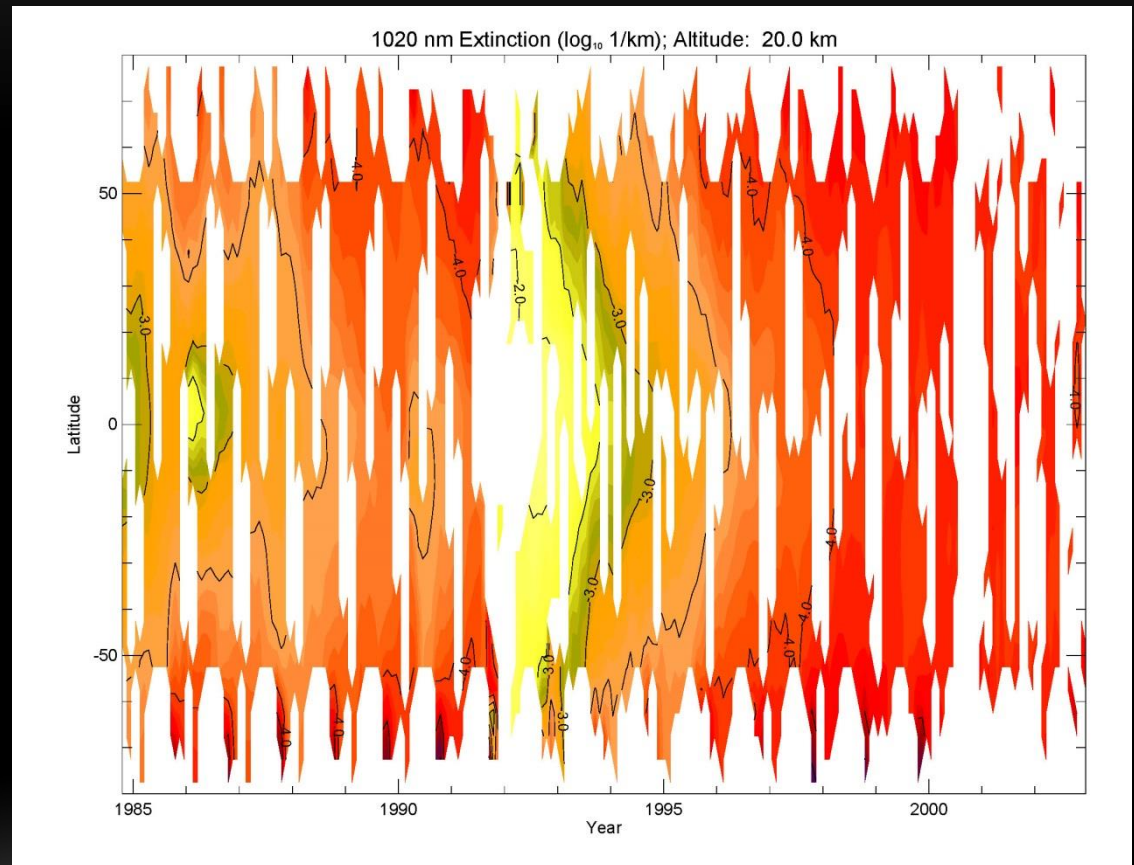
FEATURES OF THE SAGE II SAMPLING

- SAGE II occultation is seasonally dependent and there are few measurements at high latitudes in the winter hemisphere
- Low latitude observations are relatively sparse but adequate under most conditions
- There is a 3 month gap in data in late 2000 and from late 2000 to the end of mission the data rate is reduced to 50%



A NO INTERPOLATION, NO FILL ANALYSIS, MONTHLY ANALYSIS

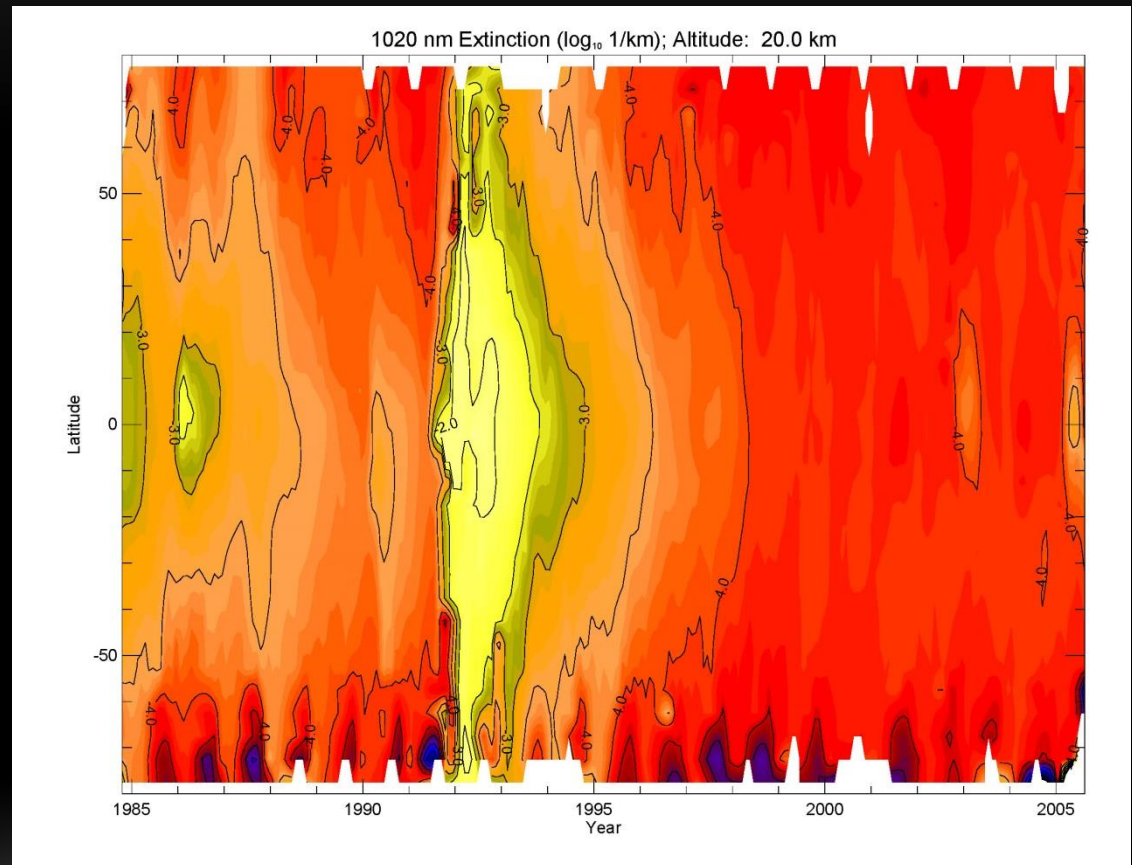
While the graphics on this figure exaggerates the sparse nature of the data, even under ideal SAGE conditions the density of the observations is low and has long gaps in observations at high latitudes in winter where aerosol is likely to be much lower than Summer and lower latitudes.



SAGE II VERSION 7.0 ASAP-LIKE INTERPOLATION

A typical altitude cross section from the latest gap-filled and interpolated stratospheric aerosol data set. It has minimal gaps and does not appear fundamentally flawed.

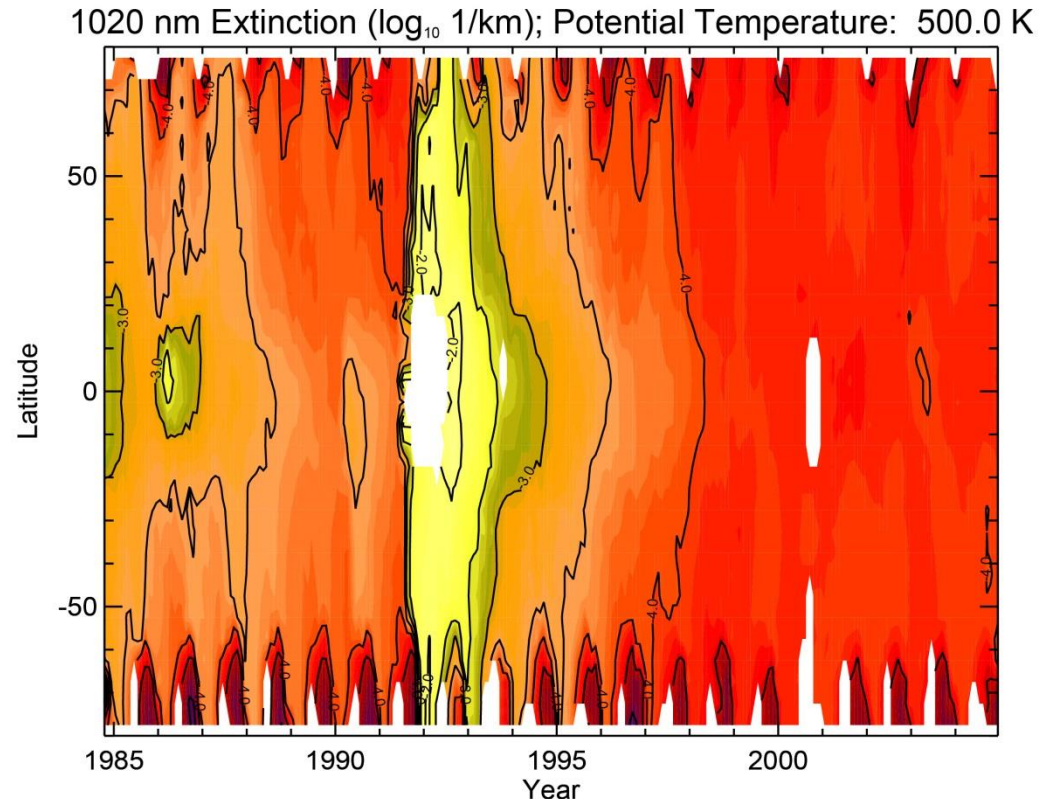
Of course, the Arctic vortex is missing...



SIMILAR ANALYSIS ON THETA SURFACES AND TIME VS. EQUIVALENT LATITUDE

In theta/equivalent latitude space, the need to interpolate for high latitudes is considerably mitigated and the vortex is depicted much more realistically. Of course, its not really latitude any more...

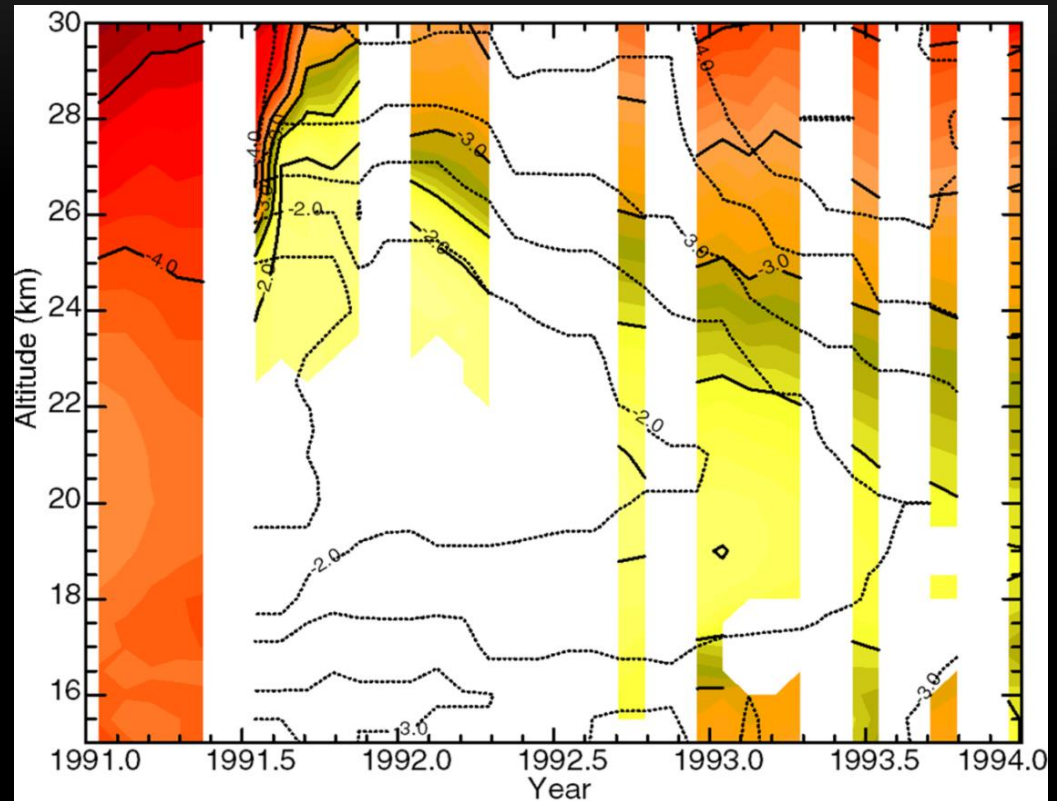
Perhaps using a PV-altitude reconstruction of 3-D aerosol fields would make more sense?



THE PINATUBO TROPICAL GAP-FILLING DATA SET

The Pinatubo tropical filling data set is constructed from a combination of lidar stations at Camaguey, Cuba and Mauna Loa USA. Neither site is particularly close to the Equator.

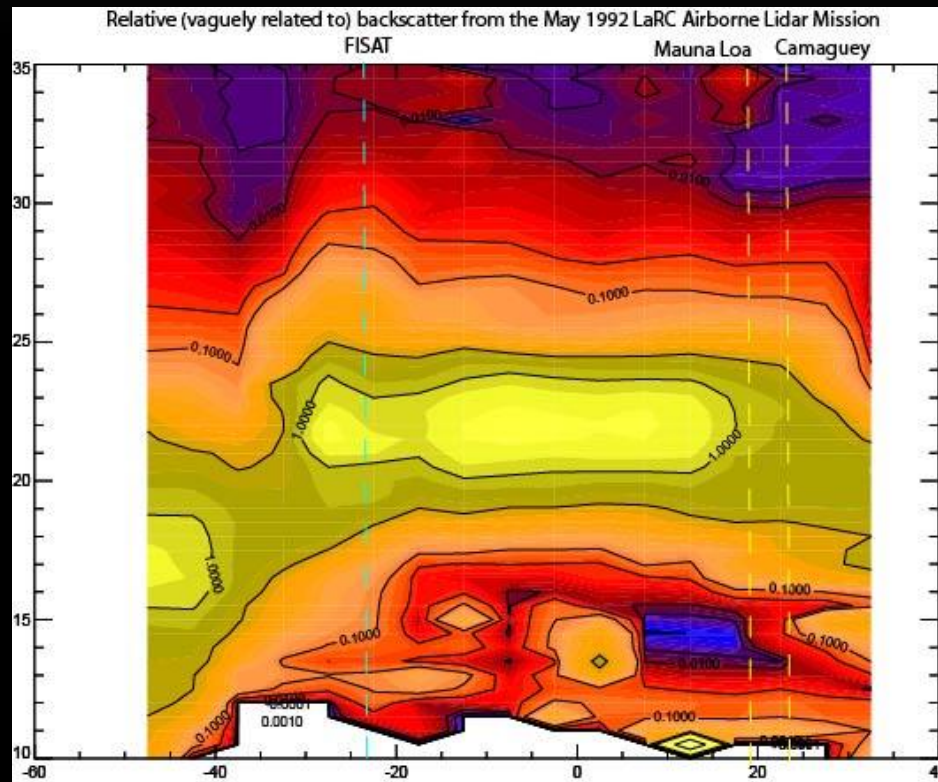
The general rule is that if SAGE data is available it is used alone. If it is not available the fill product is used with no smoothing between them. This leads to some discontinuities in the data sets.



Tropical aerosol from SAGE II (color/solid contours; no filling) and the lidar 'gap' filling data set (dashed contours).

WHY DO WE NEED MORE FILLING DATA?

The July 1992 LaRC Airborne Lidar Mission



An effort to acquire additional filling data is required to produce a more representative analysis during gap periods.

For instance, the July 1992 LaRC Airborne Lidar Mission data suggests that the current filling underestimates the tropical aerosol loading at least in mid-1992.

WHY DO WE NEED MORE FILLING DATA?

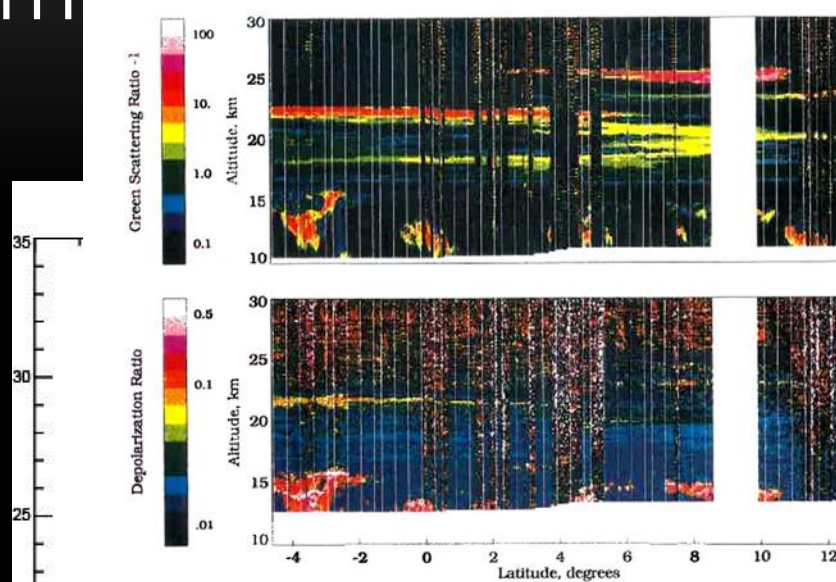


Fig. 2. Lidar observations of R-I and depolarization from 4.5°S to 12.5°N on July 12-13, 1991.

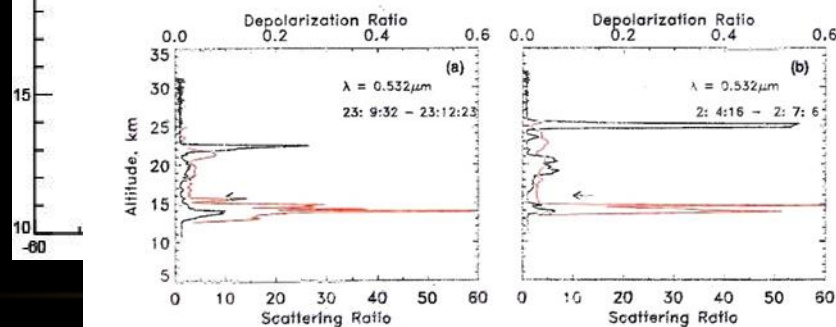


Fig. 3. Profiles of scattering ratio (black) and depolarization (red) from July 12-13 at (a) 4.2°S, 53.6°W; (b) 8.5°N, 55.6°W.

An effort to acquire additional filling data is required to produce a more representative analysis during

Also recoverable:

The July 1991

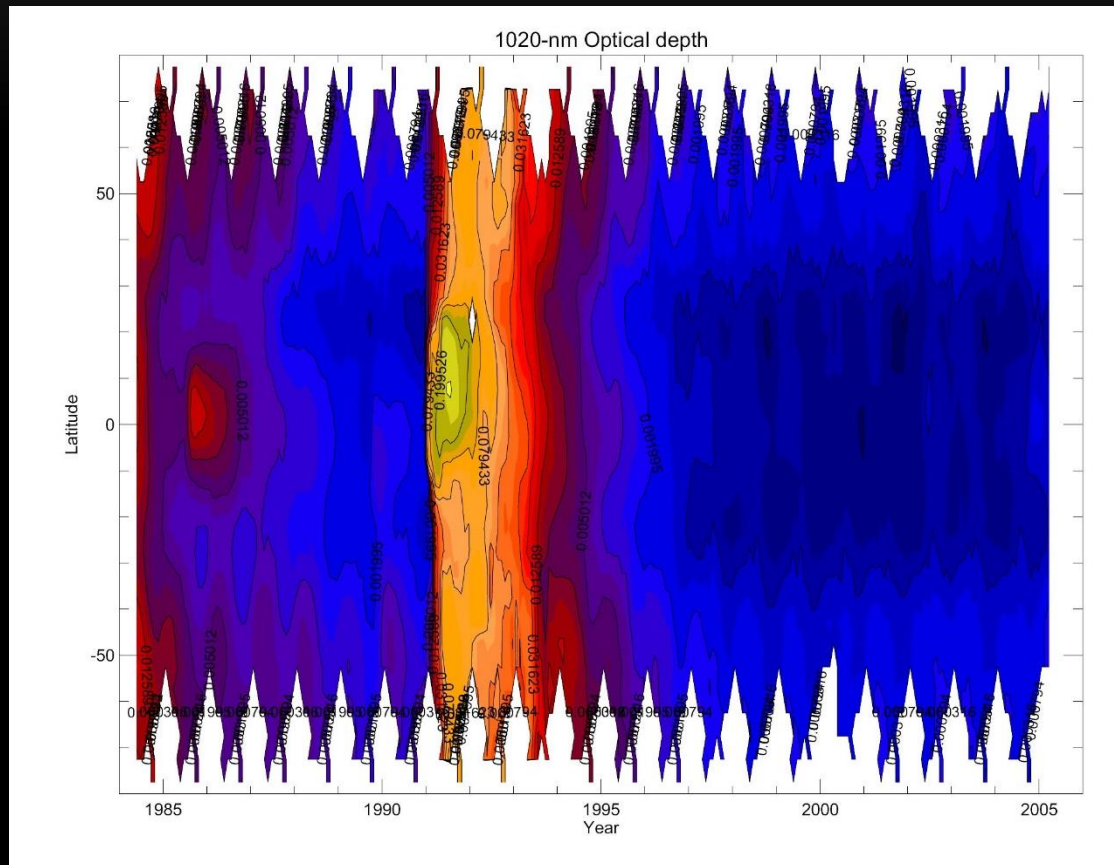
For LaRC Airborne

LaRC Lidar Mission

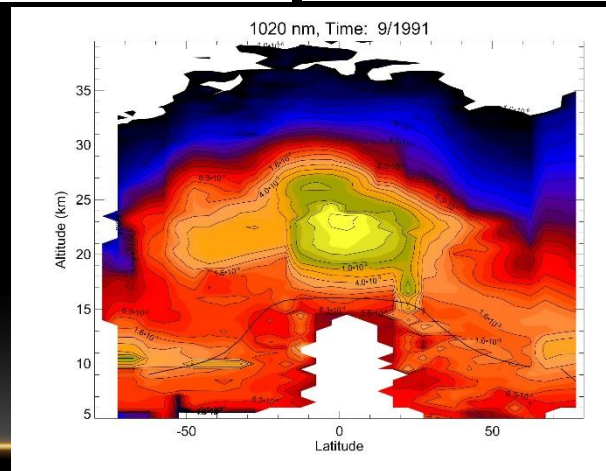
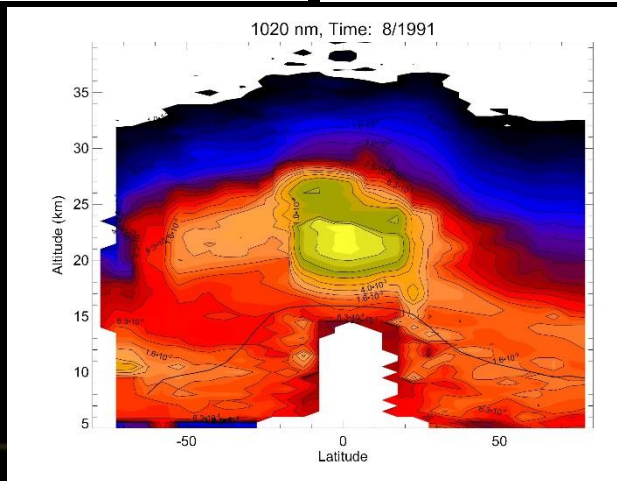
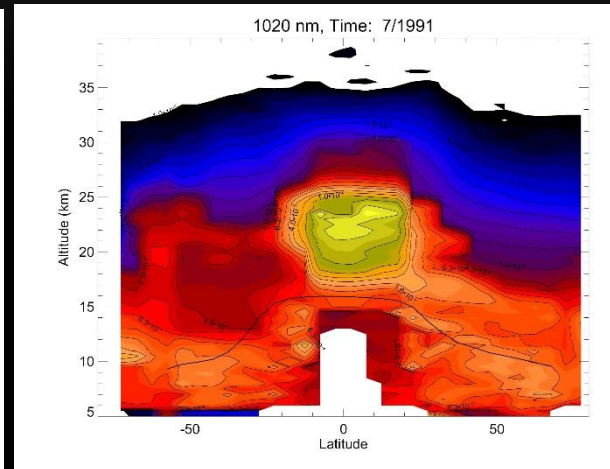
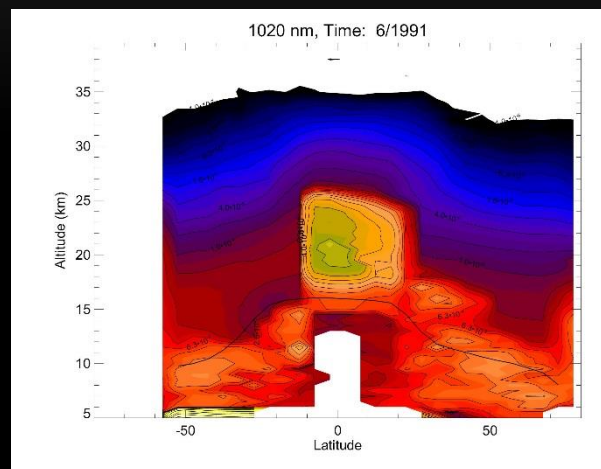
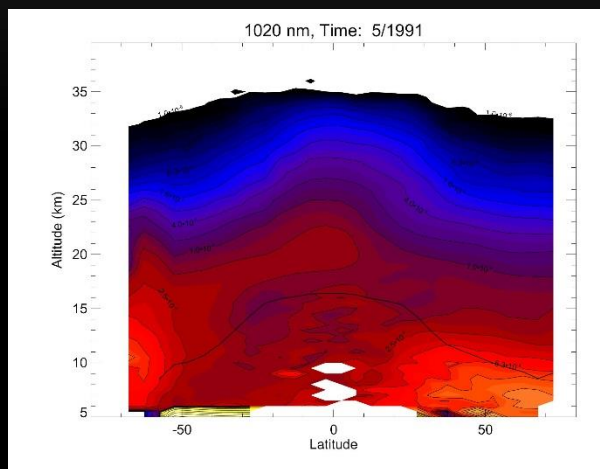
data

filling underestimates the tropical aerosol loading at least in mid-1992.

LARRY THOMASON



THE PINATUBO ERUPTION (NEW)



A TO-DO LIST FOR CMIP6

- Obtain more data for gap filling particularly at low latitudes during Pinatubo and, if possible, El Chichon and the SAGE I to SAGE II gap
 - much of this data is not readily accessible in electronic form and may require a data 'archaeological' expedition.
 - Adding new sources of data is not trivial and may involve substantial interpretive effort.
 - A role for SSiRC
- Improved missing data filling at high latitudes; can equivalent latitude or PV mapping help?
- Improve transitions from SAGE II-derived data to gap-filling data (e.g., data inferred extinction-to-backscatter values); better flagging as to the origin of the data; explore a role for combined SAGE II/HALOE retrievals
- Reconsider how the extended data set (forward and backward from the SAGE period) is constructed
 - Roles for OSIRIS, OMPS, SCIAMACHY
 - Consider maintainability issues
- Formal publication(s) on how the data set is constructed
- Support \$, £, €, ¥
- Improved collaboration with the end users