CLARREO: Using OMPS and AIRS Data In Ozone Spectroscopy

Ester Nikolla, Robert Knuteson, Henry Revercomb
Space Science and Engineering Center
Atmospheric and Oceanic Sciences

Objective

The objective of this study is to correlate the infrared brightness temperature spectra from Earth orbiting satellites in ten degree latitude zones with time and space coincident vertical profiles of atmospheric temperature and ozone concentration. Mean and standard deviation vertical profiles will be computed from the north pole and south pole in ten degree and thirty degree latitude zones. Corresponding brightness temperature mean spectra will be correlated with the temperature and ozone vertical profiles.

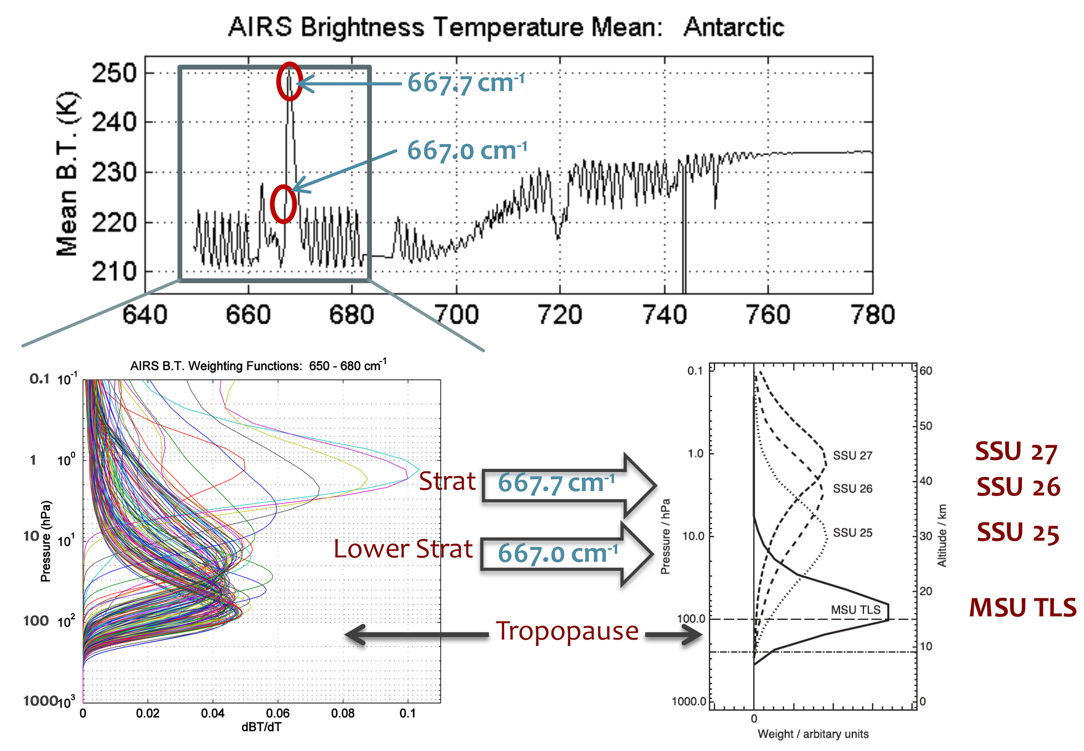
Background

The CLARREO mission has been established by NASA's Langley Research Center to establish benchmark measurements using traceable international standards (SI) through various independent paths. The University of Wisconsin Space Science and Engineering Center is developing the InfraRed spectrometer for the NASA CLARREO mission. **Time standard, temperature standard, and solar/lunar standard are used to ensure unbiased and simple processing methods, rendering the claims of atmospheric trends irrefutable.**

Sensors

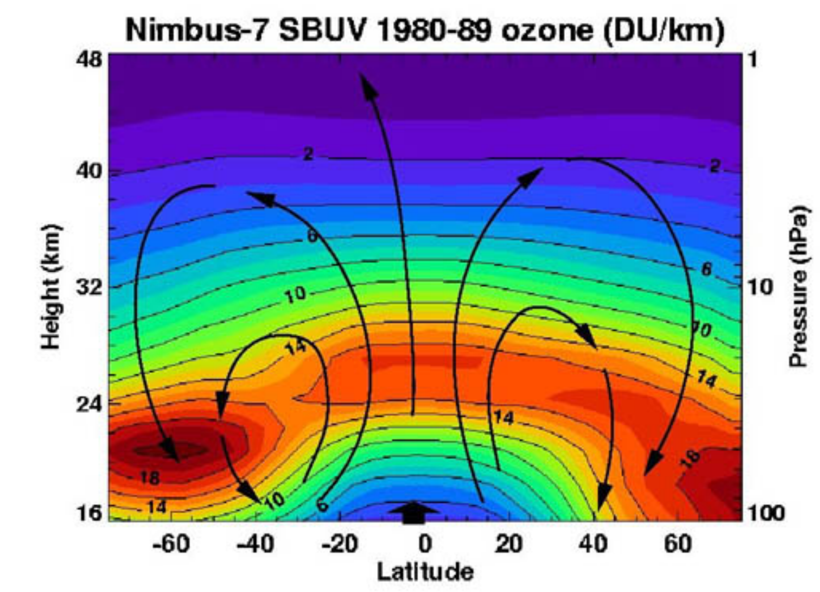
The satellite observations used in this study are from a series of hyperspectral infrared sounders developed for the operational assimilation into numerical weather prediction models (NWP).

The NASA AQUA satellite with the AIRS sensor with data record beginning in September 2002. The EUMETSAT METOP satellite series with the IASI sensor with data record beginning in January 2007. The NASA/NOAA Suomi-NPP satellite with the CrIS and OMPS sensors with data record beginning in April 2012. The ozone profile observations were obtained from the OMPS data portal with data product named OMPS Limb Profiler-Suomi NPP- LP-L2-O3-DAILY.



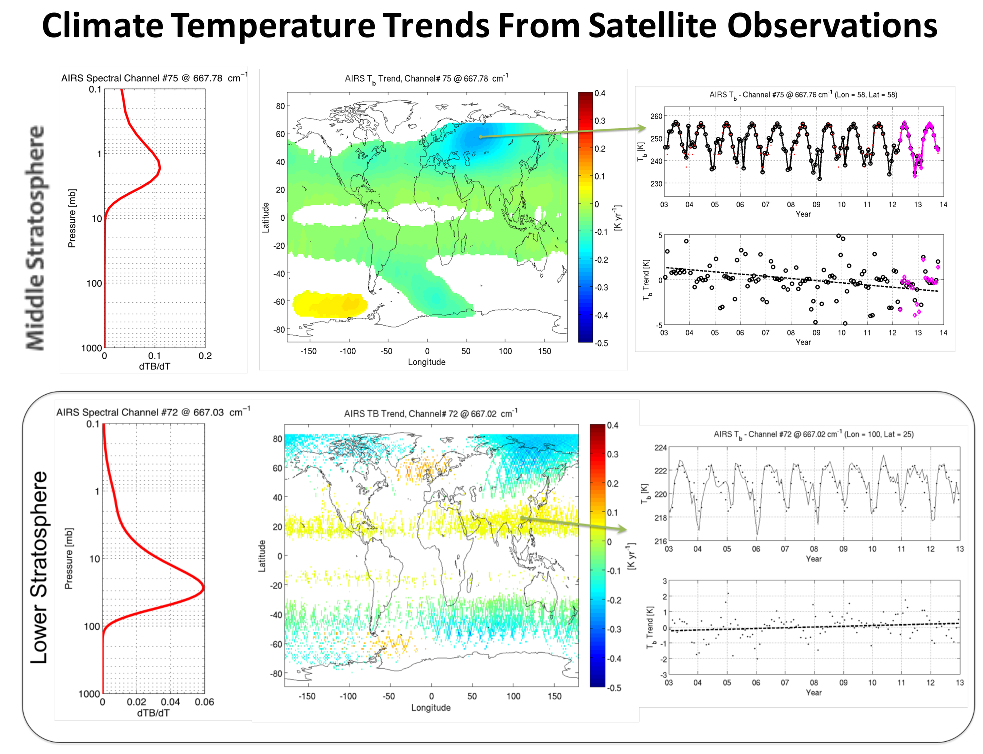
Satellite observed infrared brightness temperature spectra (upper panel). Channel's peak sensitivity are in the stratosphere. AIRS has 100 times the number of infrared channels as the older Stratospheric Sounding Unit (SSU).

Brewer-Dobson Ozone Model



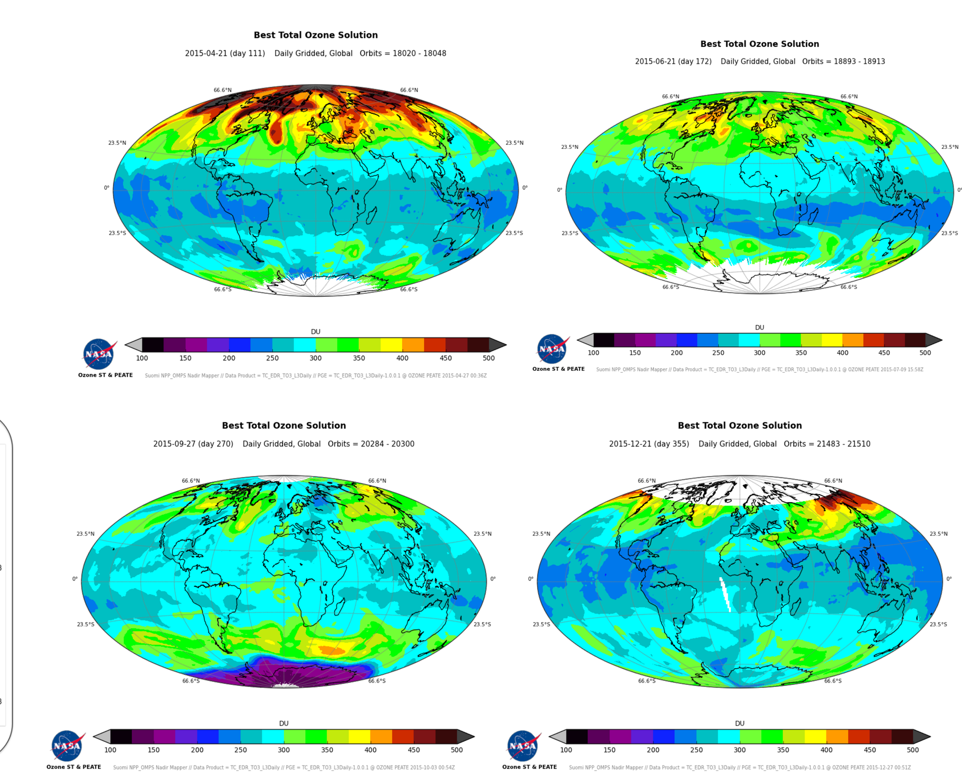
Absorption of UV radiation from the sun by the ozone layer in the tropics provides a source of heating which elevates stratospheric temperatures and creates a tropopause largely separating the tropospheric and stratospheric dynamics.

Climate Temperature Trends From Satellite Observations



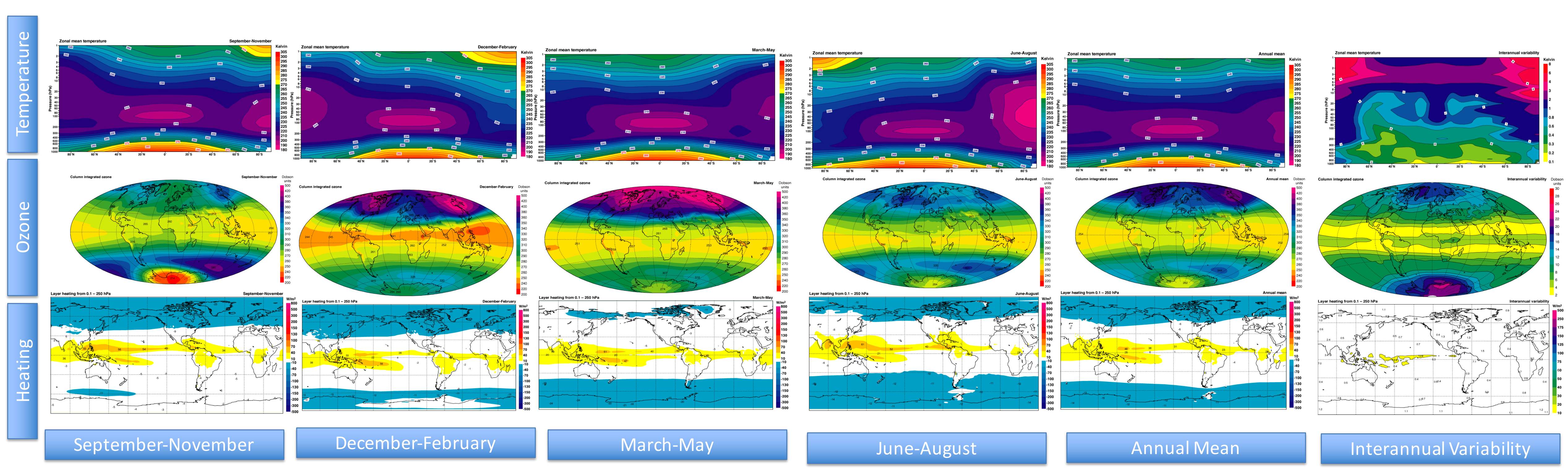
Cooling is observed in the upper stratosphere by NASA AIRS sensor. No trend is observed in the lower stratospheric temperature.

OMPS Satellite Ozone Observations



The seasonal dependence of total ozone is measured by OMPS. Spring (upper left), summer (upper right), autumn (lower left), and winter (lower right).

ERA Ozone, Temperature and Heating Profiles



Methods

The stratospheric temperature, ozone and water vapor model data were obtained from the European Centre for Medium-Range Weather Forecasts, ECMWF. ERA-Interim is a global atmospheric reanalysis with special resolution of approximately 80 km on 60 vertical levels from the surface up to 0.1 hpa. ERA-Interim allows monitoring of the variability and change of global climate, thereby contributing to the understanding and attribution of climate change.

Latitudinal Ozone and Carbon Dioxide Variability of Earth Emitted Infrared Radiance.

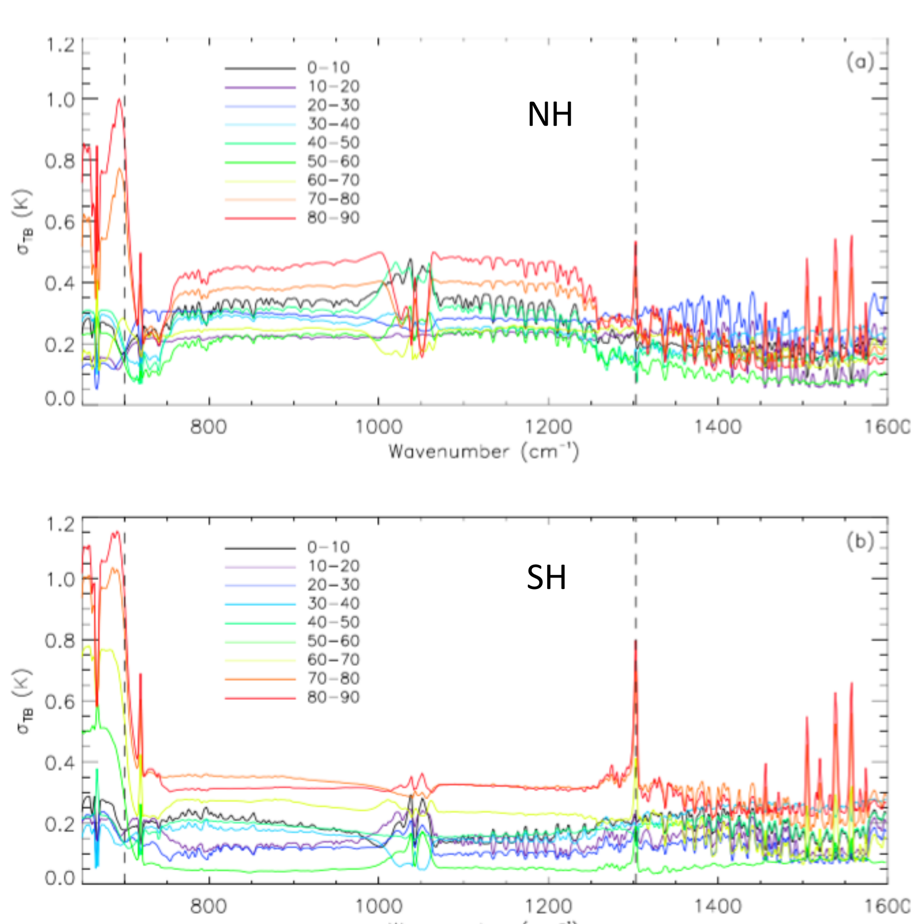


Figure 2 from Brindley et al. 2015

Conclusion

Previous findings (Brindley et al. 2015) imply that at the largest spatial scales, fluctuations in the mid to upper tropospheric temperatures and water vapor, and not cloud or surface temperature, play the dominant role in determining the level of inter-annual variability in all sky outgoing longwave infrared radiation.

Enhanced variability was seen in the 9.6 micron ozone band. In this study, we quantify the contribution of ozone fluctuations to the variability of the observed atmospheric infrared radiation to space.

An increase in carbon dioxide causes a cooling effect in the stratosphere whereas ozone recovery should lead to a warming of the stratosphere. Possible implications of this work could lead to disentangling a possible correlation between carbon dioxide and ozone. The trends in ozone may mask the effects of carbon dioxide.

References

Brindley, H., Bantges, R., Russell, J., Murray, J., Dancel, C., Belotti, C., & Harries, J. (2015). Spectral signatures of Earth's climate variability over 5 years from IASI. *Journal of Climate*, *28*(4), 1649-1660.

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