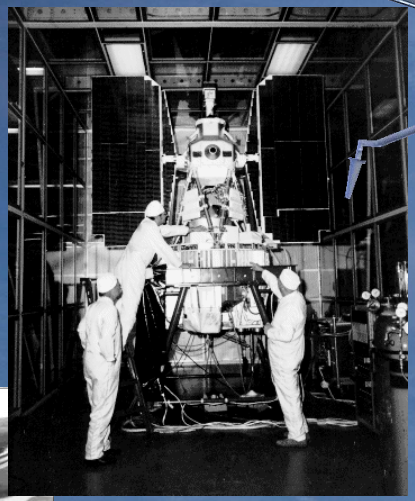
Earth Science with the Stratospheric Aerosol and Gas Experiment III (SAGE III) on the International Space Station



Joe Zawodny, Jean-Paul Vernier, Larry Thomason, Marilee Roell , Mike Pitts, Randy Moore, Charles Hill, David Flittner, Rob Damadeo, Mike Cisewski

Sept 17, 2015

SAGE III Science Objectives

NEED – enhance our understanding of ozone recovery and climate change processes in the upper atmosphere

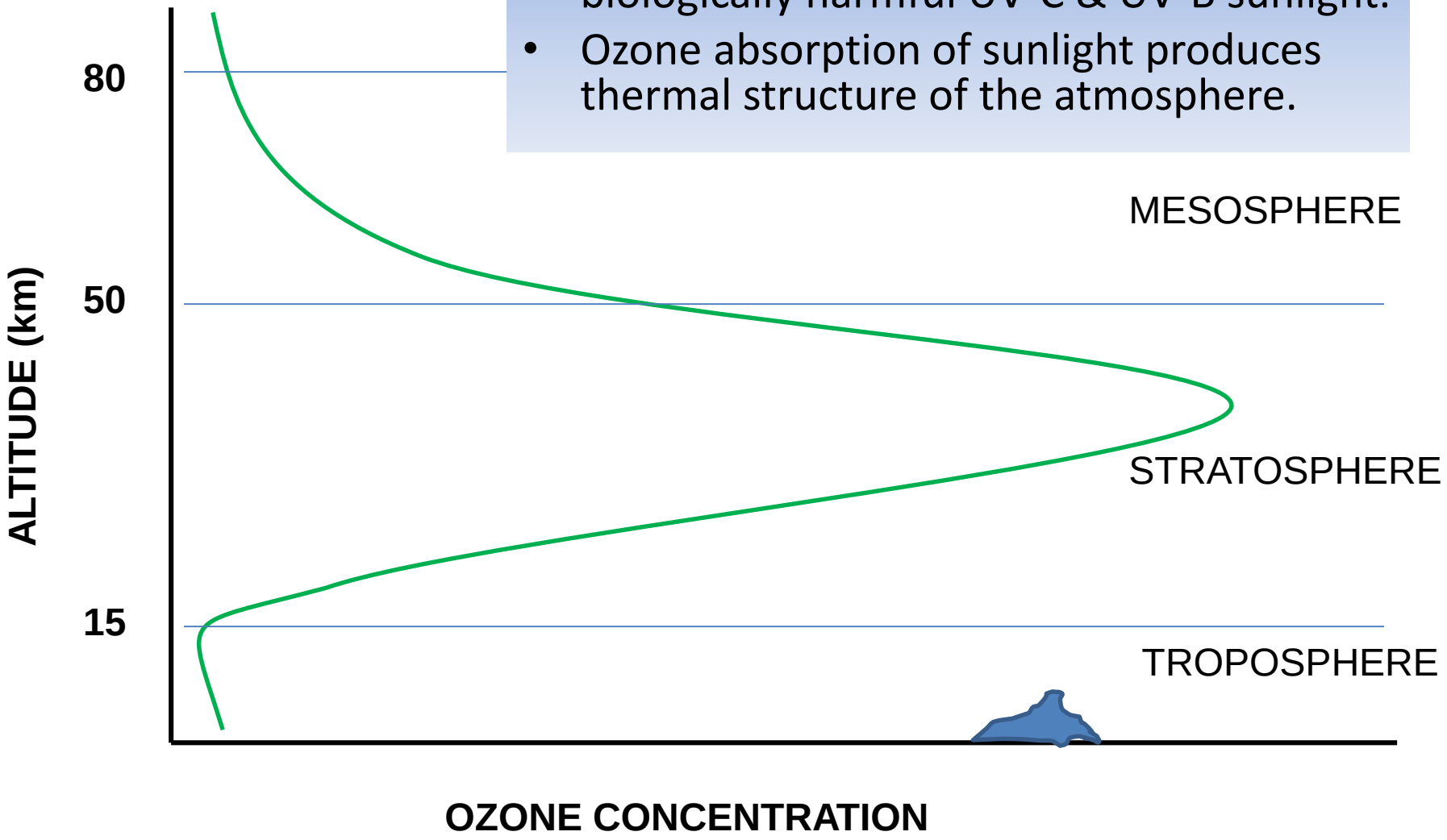
HOW – monitor the vertical distribution of aerosol, ozone, and other trace gases in the Earth's stratosphere and troposphere

SAGE III/ISS provides data to:

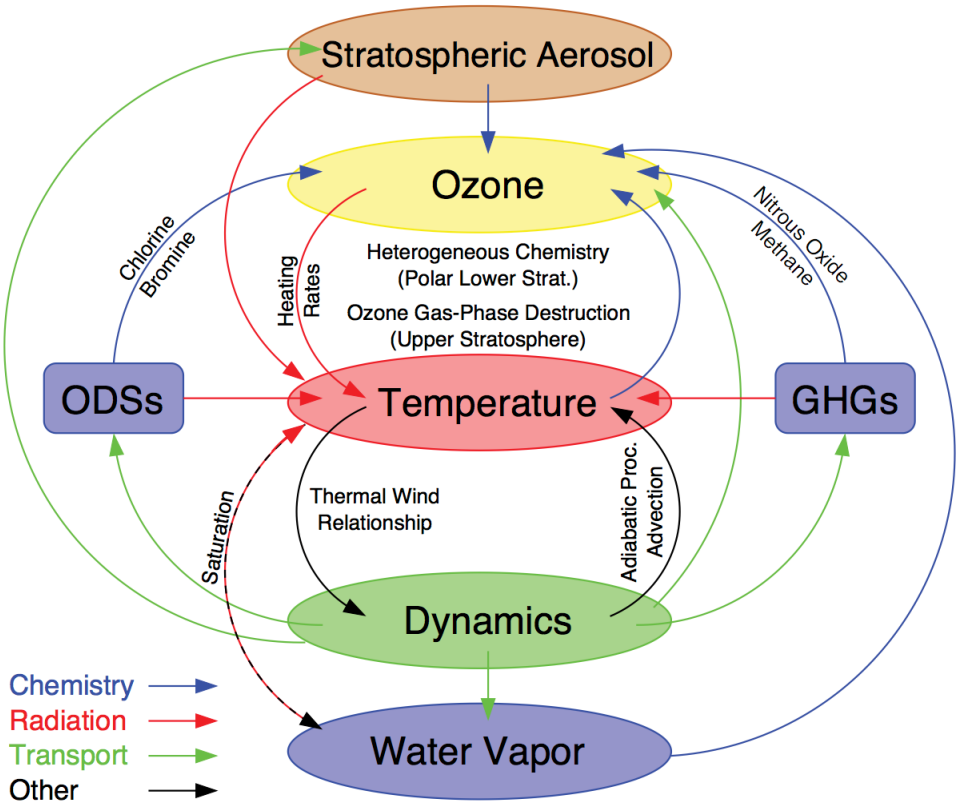
- Assess the recovery in the distribution of ozone
- Extend aerosol measurement records needed for climate and ozone models
- Gain further insight into key processes contributing to ozone and aerosol variability

Ozone is Central to the Stratosphere

- Stratospheric ozone screens-out biologically harmful UV-C & UV-B sunlight.
- Ozone absorption of sunlight produces thermal structure of the atmosphere.



Stratospheric Science Needs

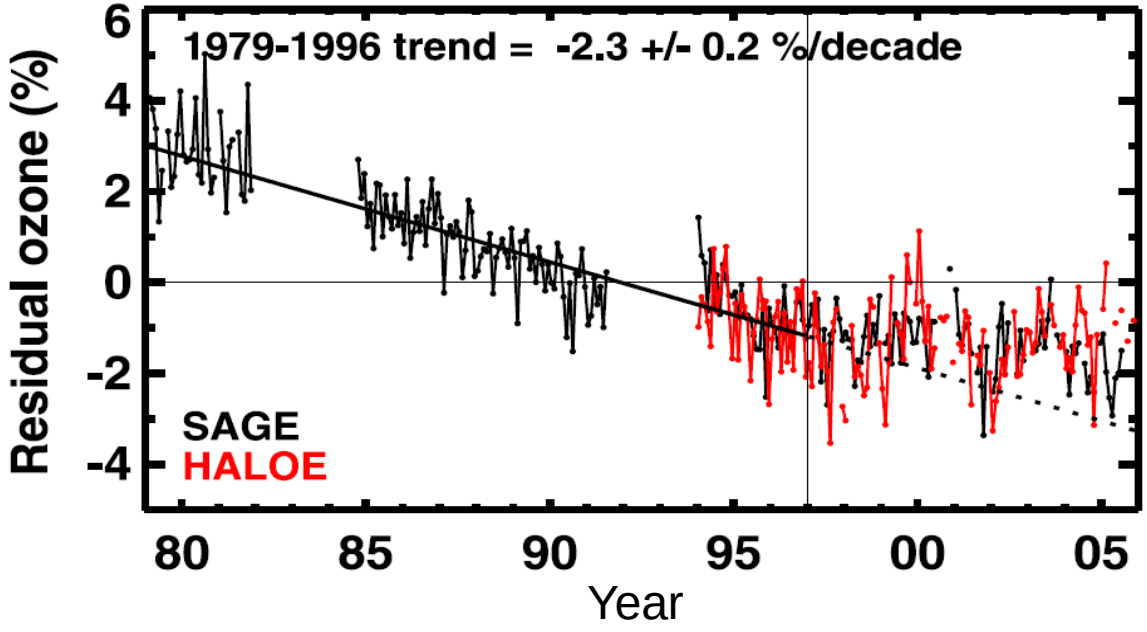


- This simplified schematic illustrates the parameters and process that control ozone
- Ozone Depleting Substances and Green House Gases can be measured from the ground as long as the dynamics can be modeled
- Ozone and Aerosol Profiles need to be measured
- Trends in Temperature and Water Vapor are inadequately measured

WMO: Ozone Assessment 2010

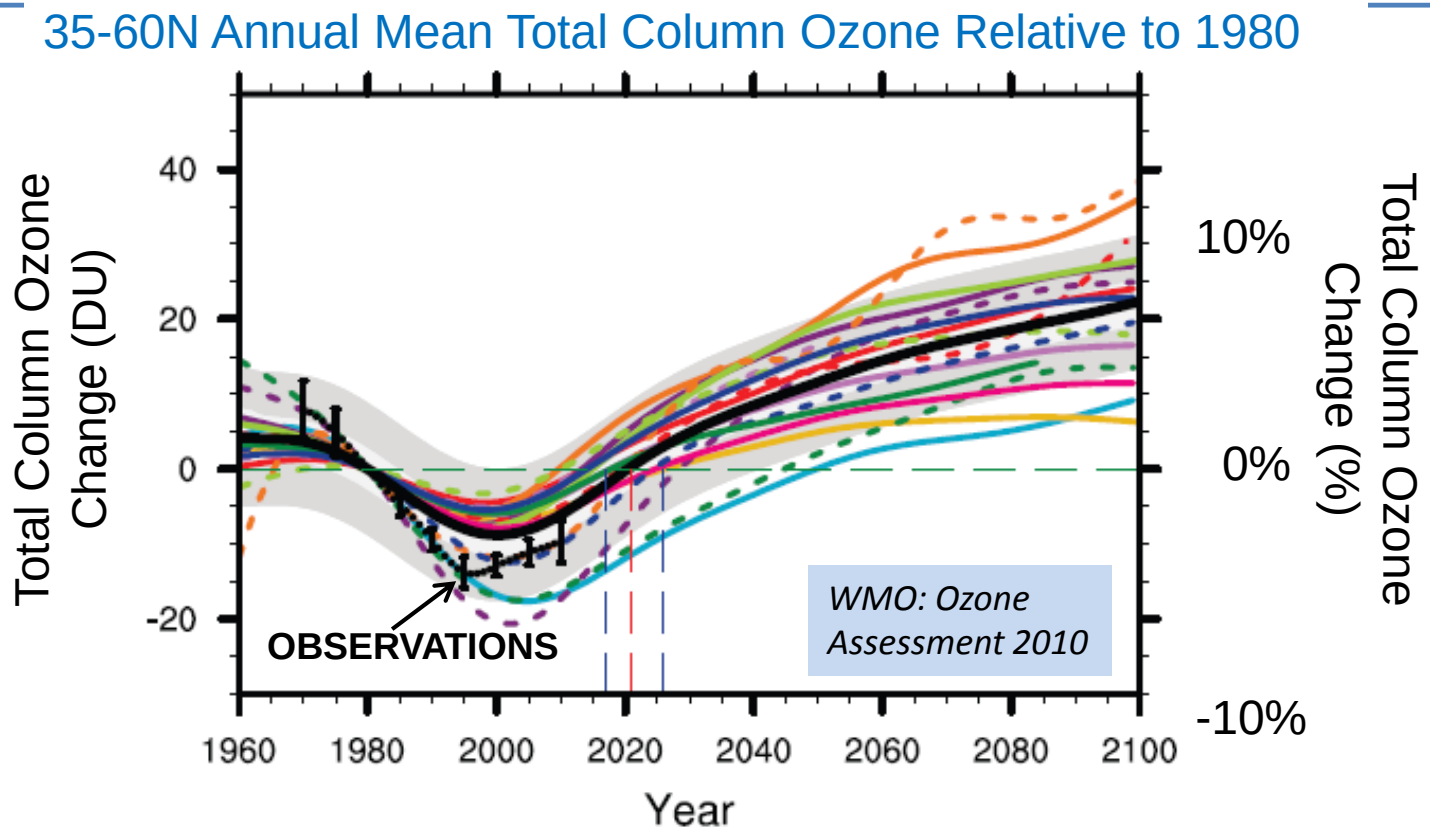
Stratospheric Science Results

- The multi-decadal SAGE data are the international standard for ozone and aerosol.
- SAGE III predecessors have documented the effectiveness of the Montreal Protocol ban on Ozone Depleting Substances.
- Stratospheric aerosol time series is a vital component to understanding ozone changes.



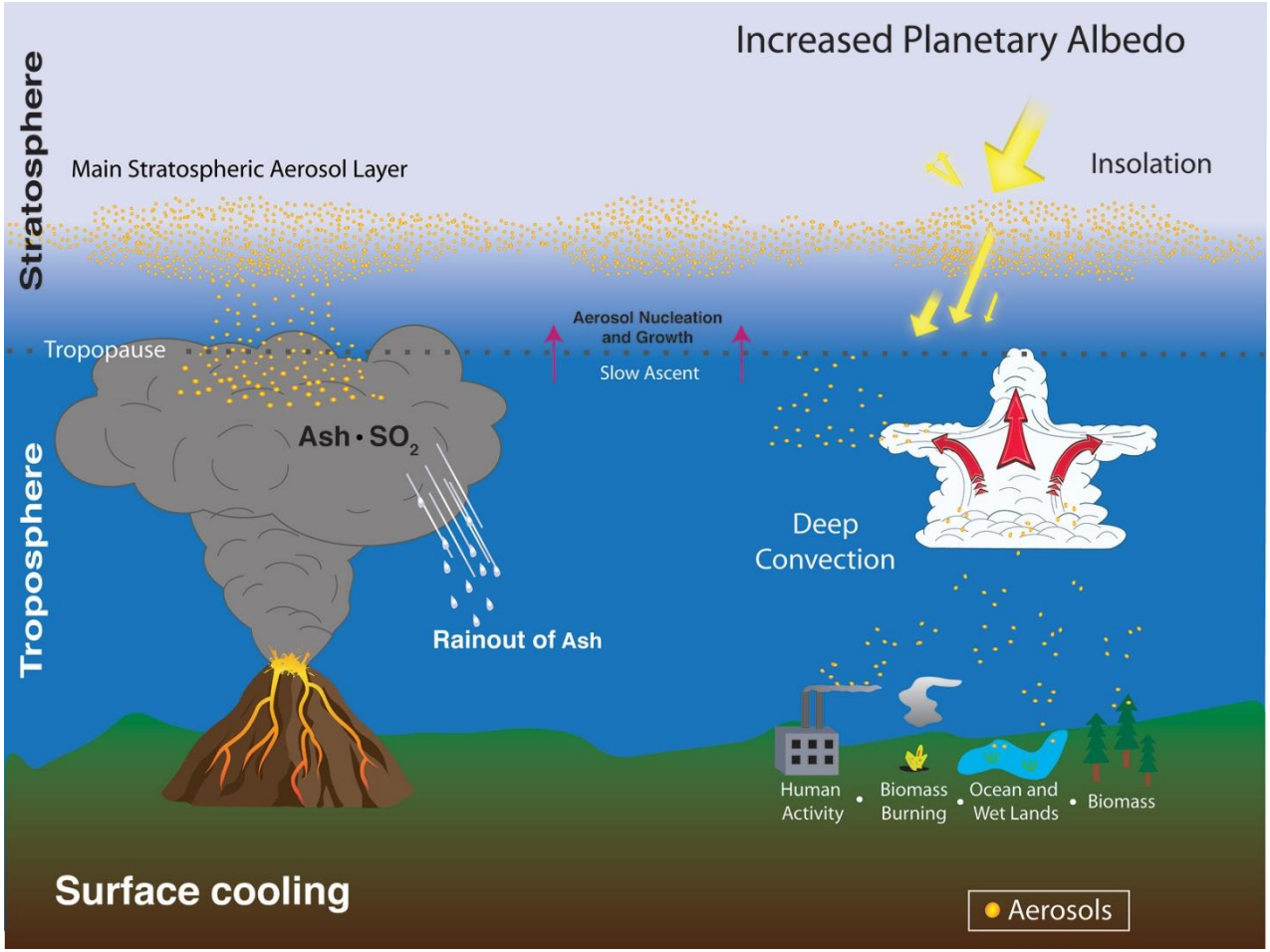
Yang et al., 2006

Model Ozone Uncertainties



- Ozone loss varies greatly with altitude and latitude
- Model estimates of the loss and eventual recovery differ
- Aggregate uncertainty due to modeling processes, and future ODS & GHG changes
- 2015-2020 measurements of ozone will improve understanding

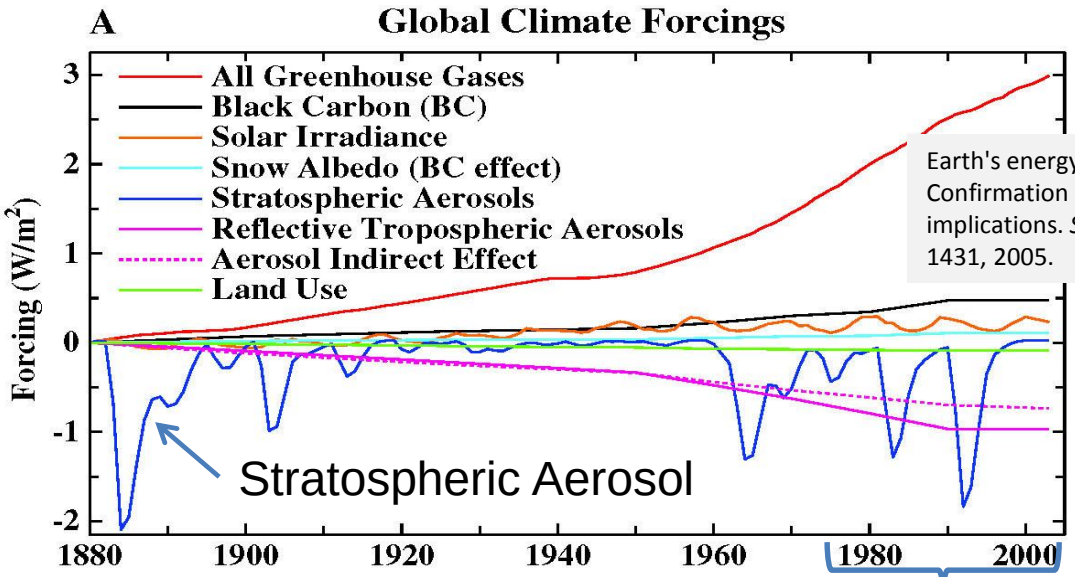
Stratospheric Aerosol Layer



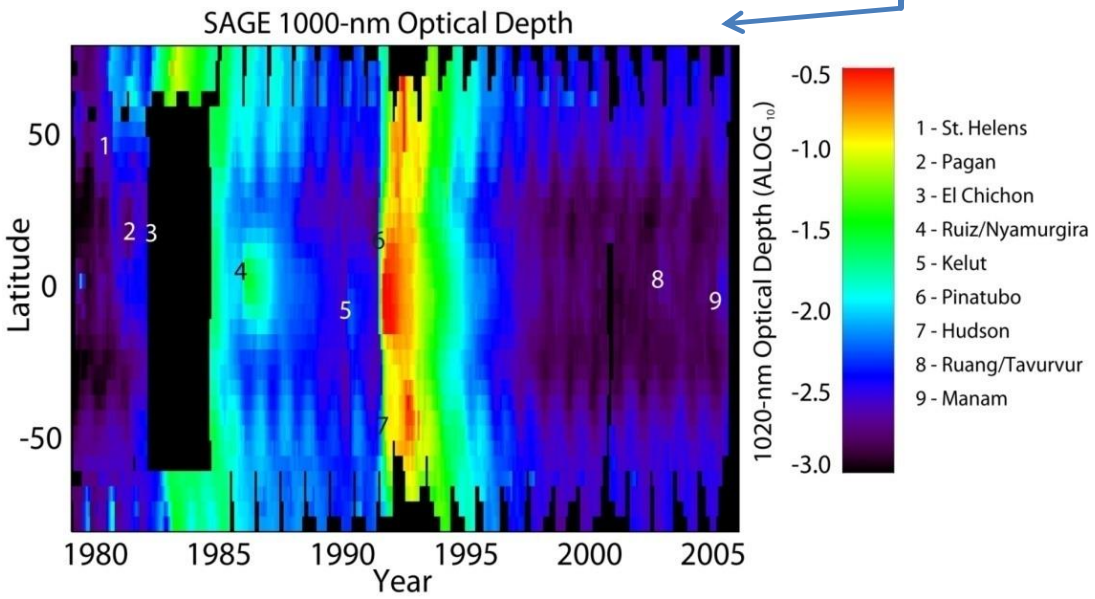
Stratospheric Aerosol Forcing Must be Included to Understand and Predict Climate Change

- Isolated colossal volcanic eruptions have significant cooling for a limited time.

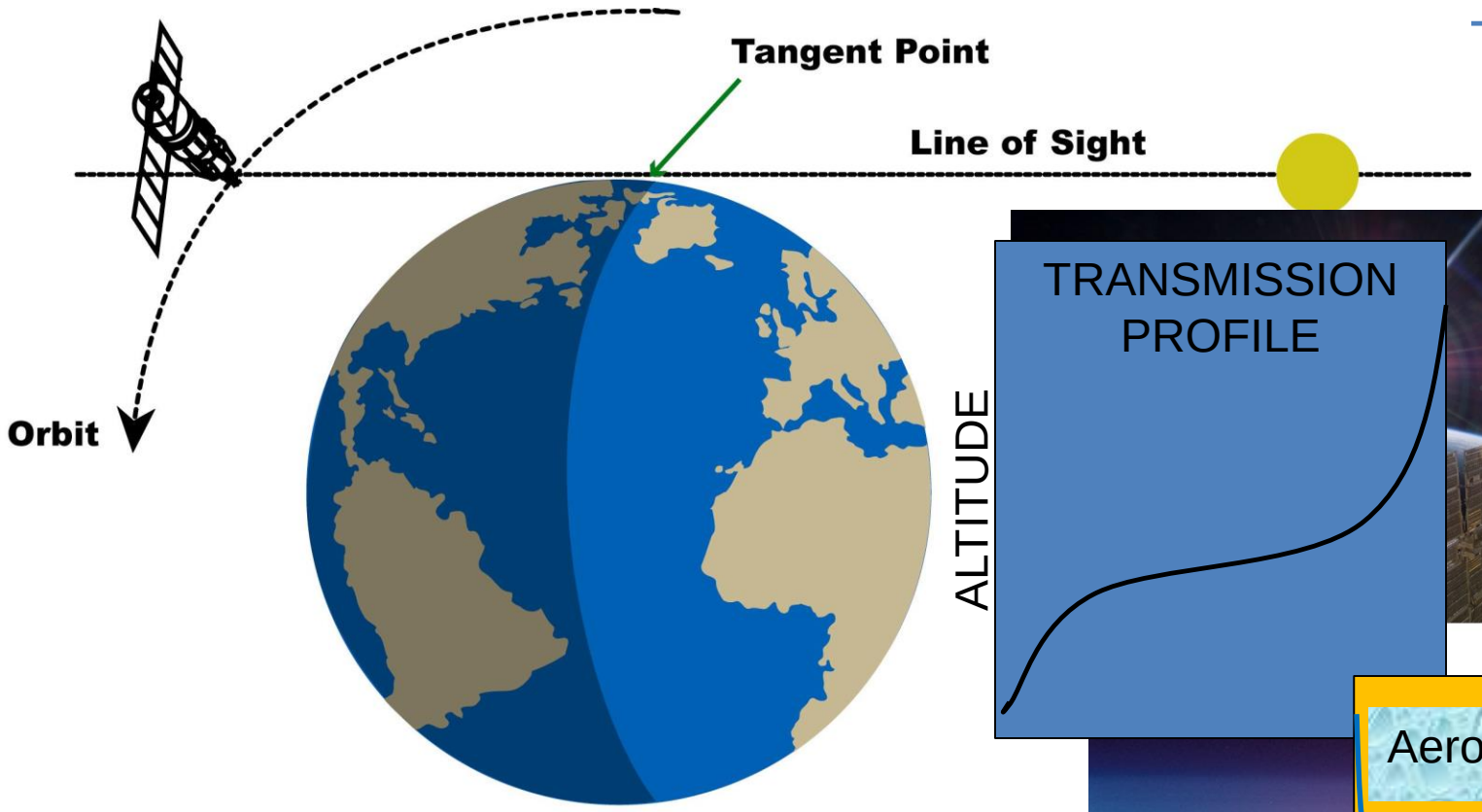
- Increased background loading during 2000-2010 likely cause of global warming slow-down (*Solomon, 2011*).



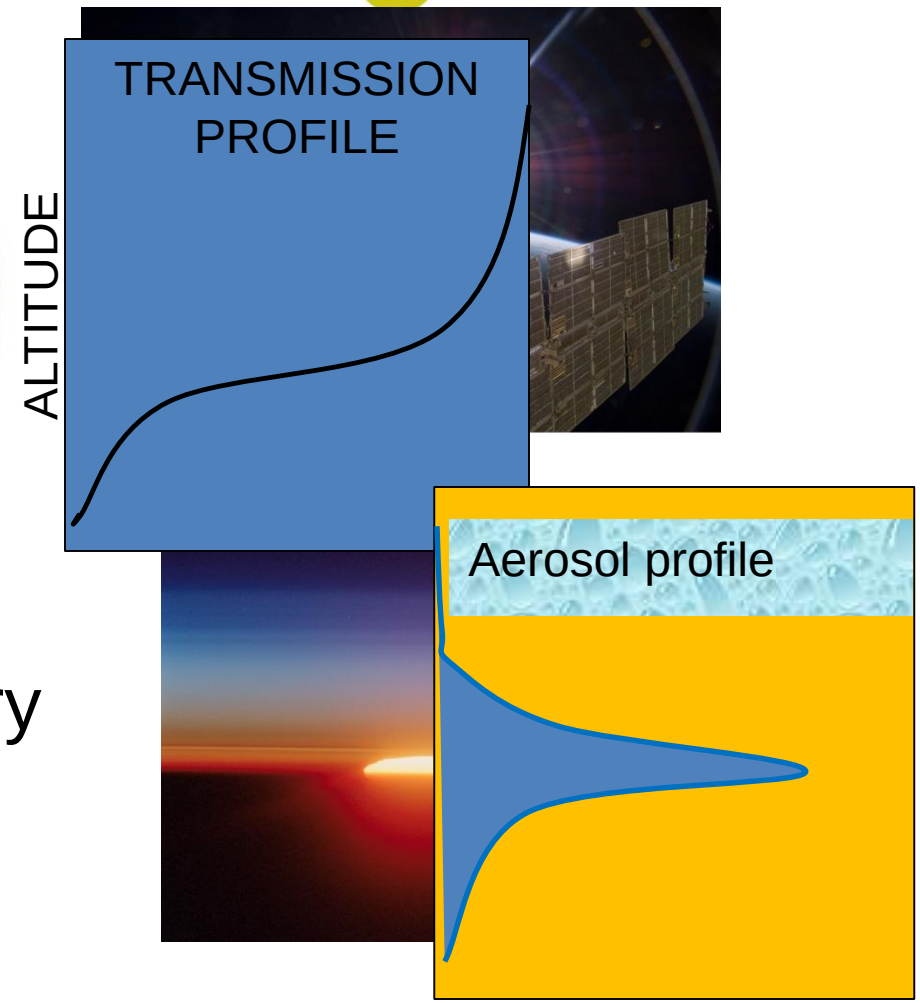
Earth's energy imbalance: Confirmation and implications. *Science* **308**, 1431, 2005.



Measurement Strategy

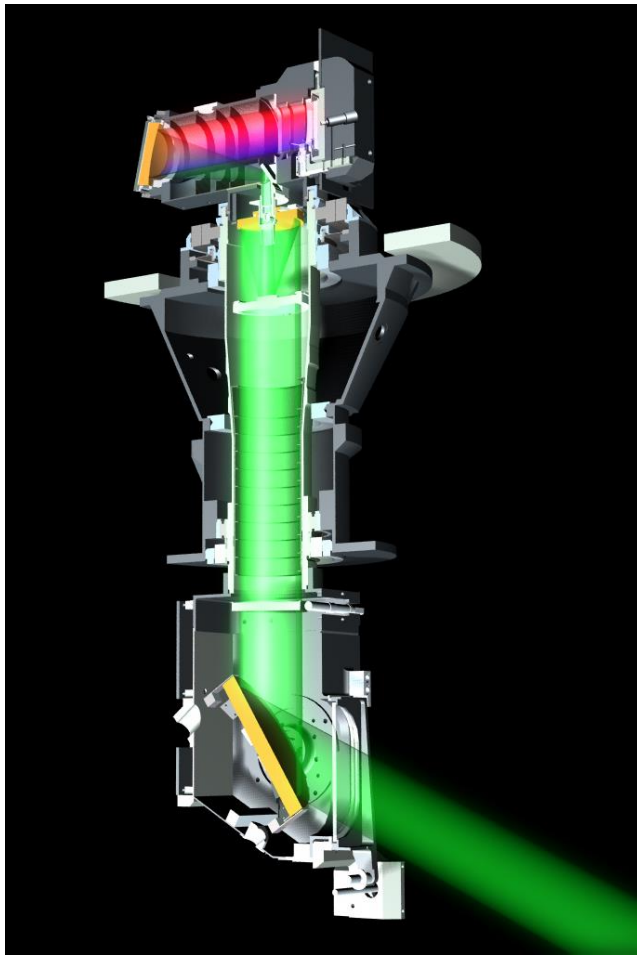


Solar Occultation Geometry

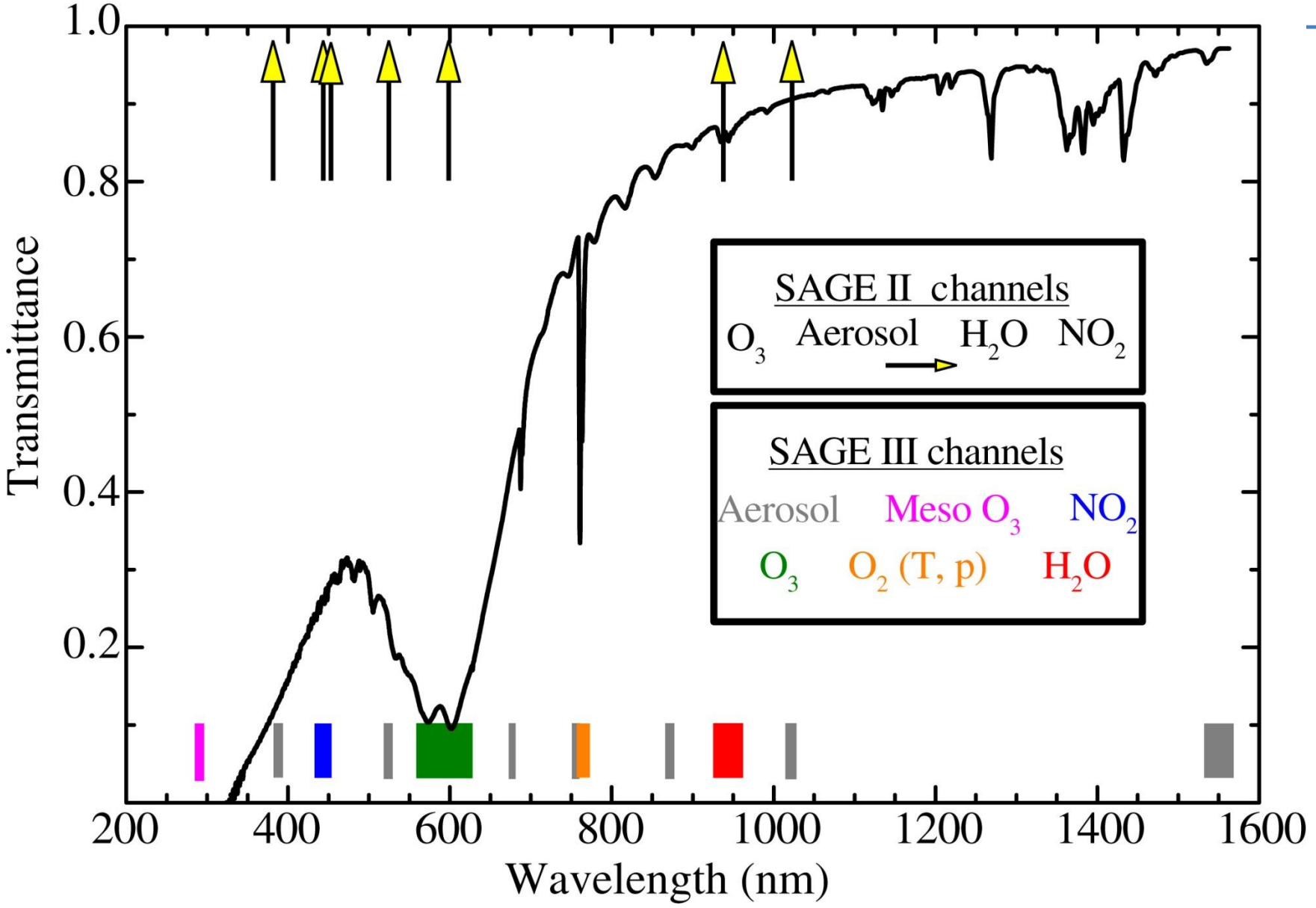


SAGE III Instrument Features

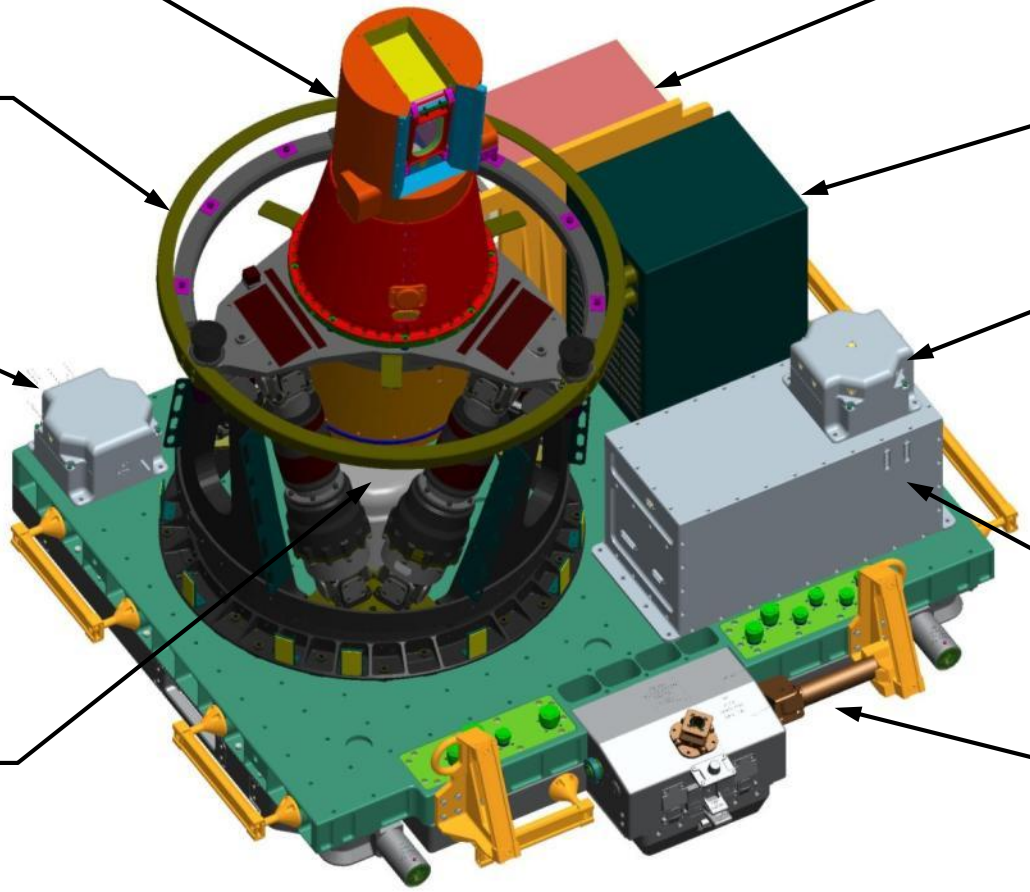
- A UV-Vis-NIR spectrometer
- Multiple modes of operation
  - Solar, lunar, limb scatter
- Surface/cloud top to 50 km, <1 km vertical resolution
- 87 channels (~1-3-nm resolution) between 280 and 1040 nm in solar occultation mode
- 64 kg, 102 watts, 0.12 Mbps



Spectral Sampling



Instrument Payload: NASA SMD, HEOMD & ESA contributions

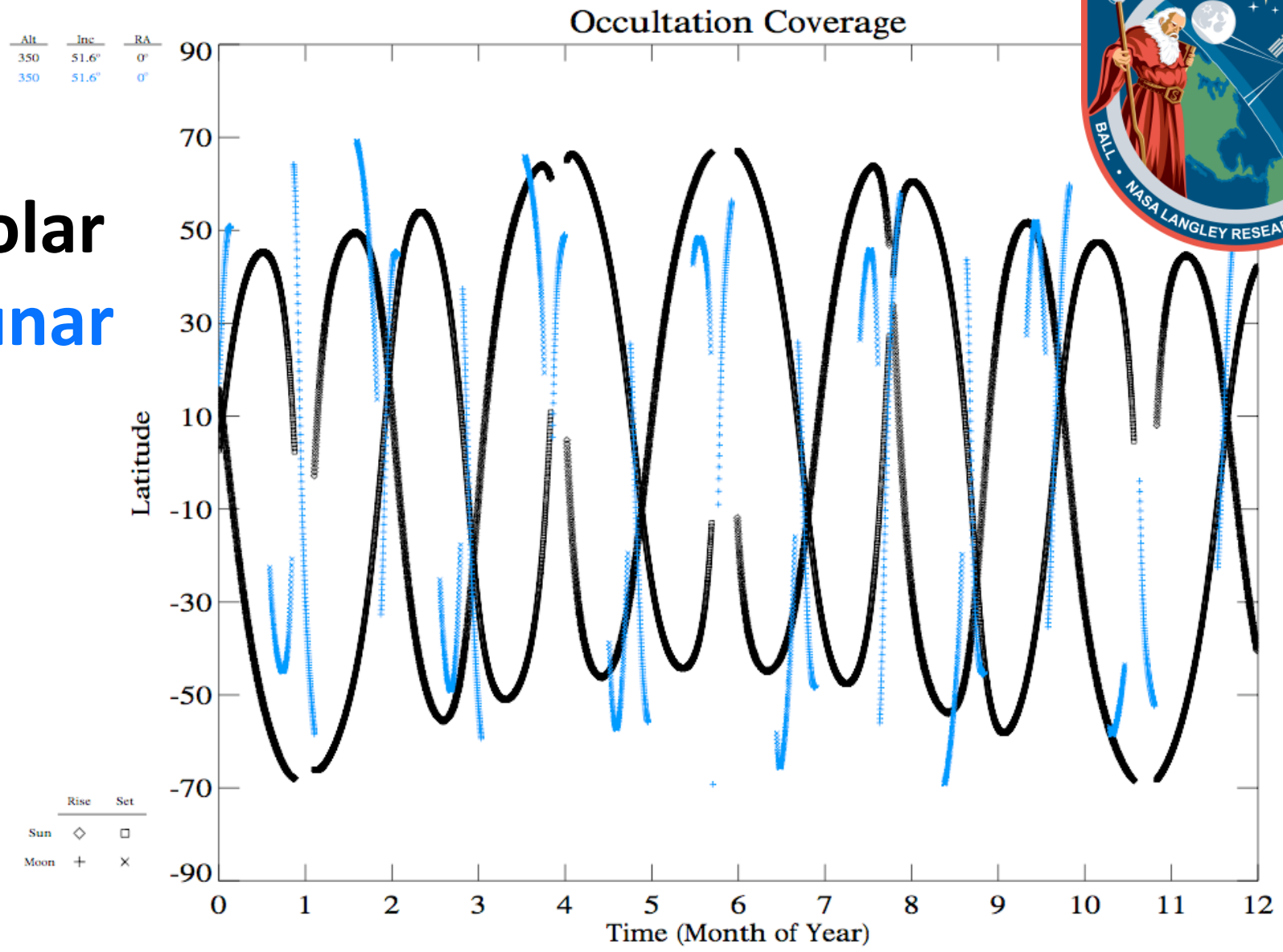


NOTE: New hardware in **blue**

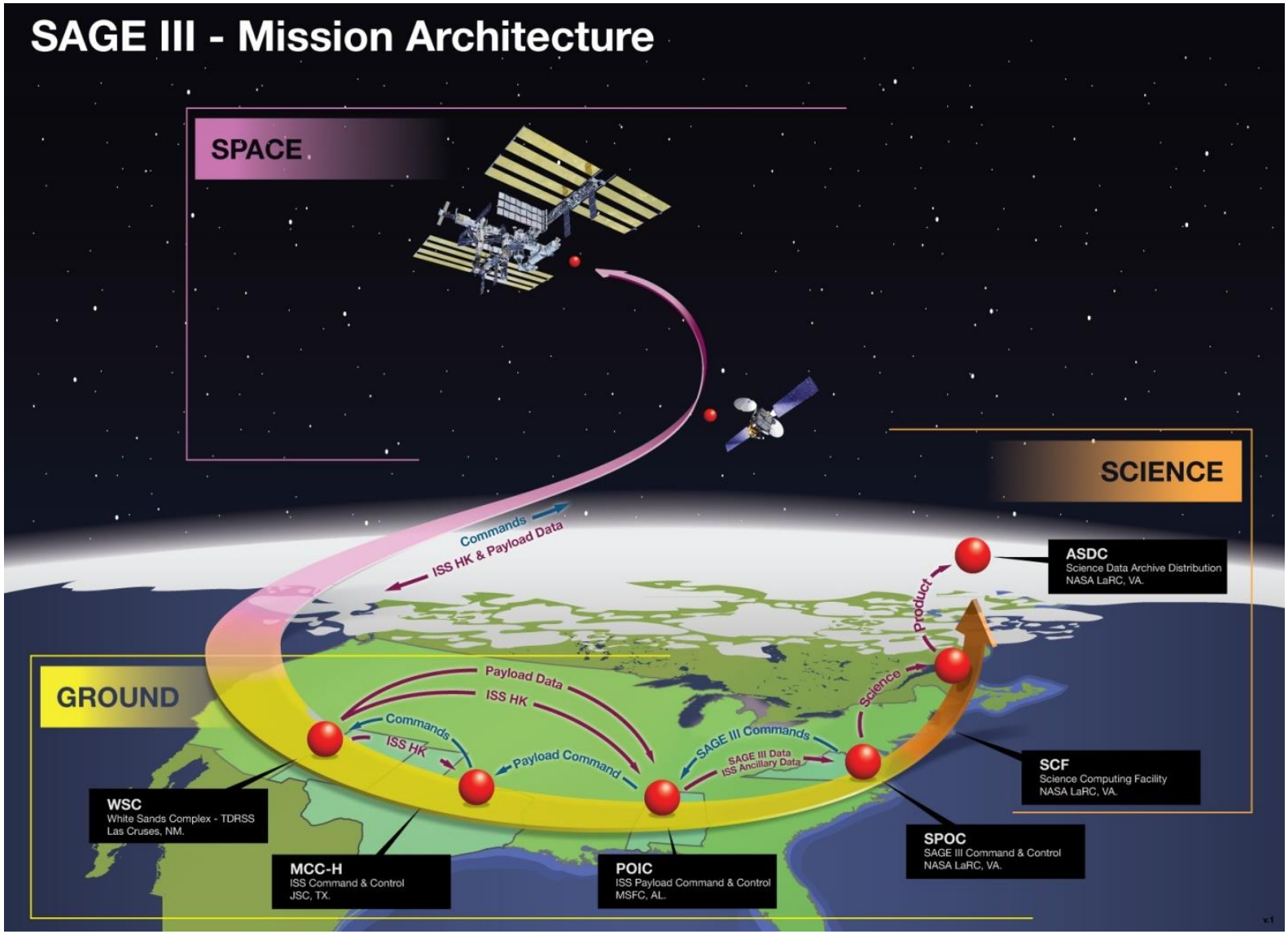
ISS Orbit is Ideal!

Solar

Lunar



SAGE III Climate Continuity Mission is empowered by NASA SMD & HEOMD, and ESA

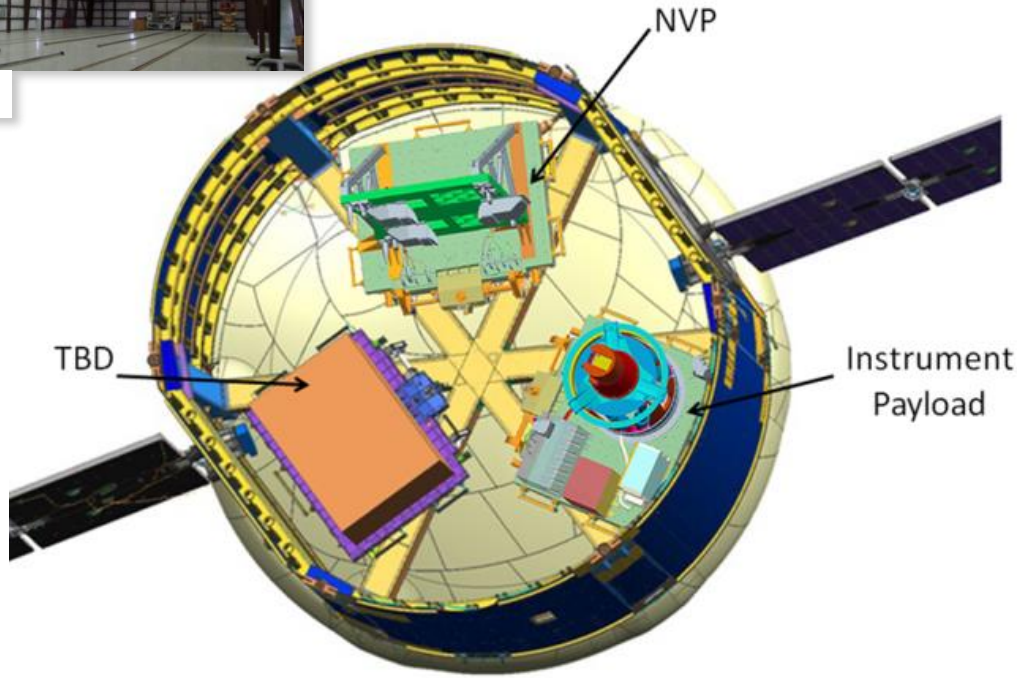


Launch Configuration

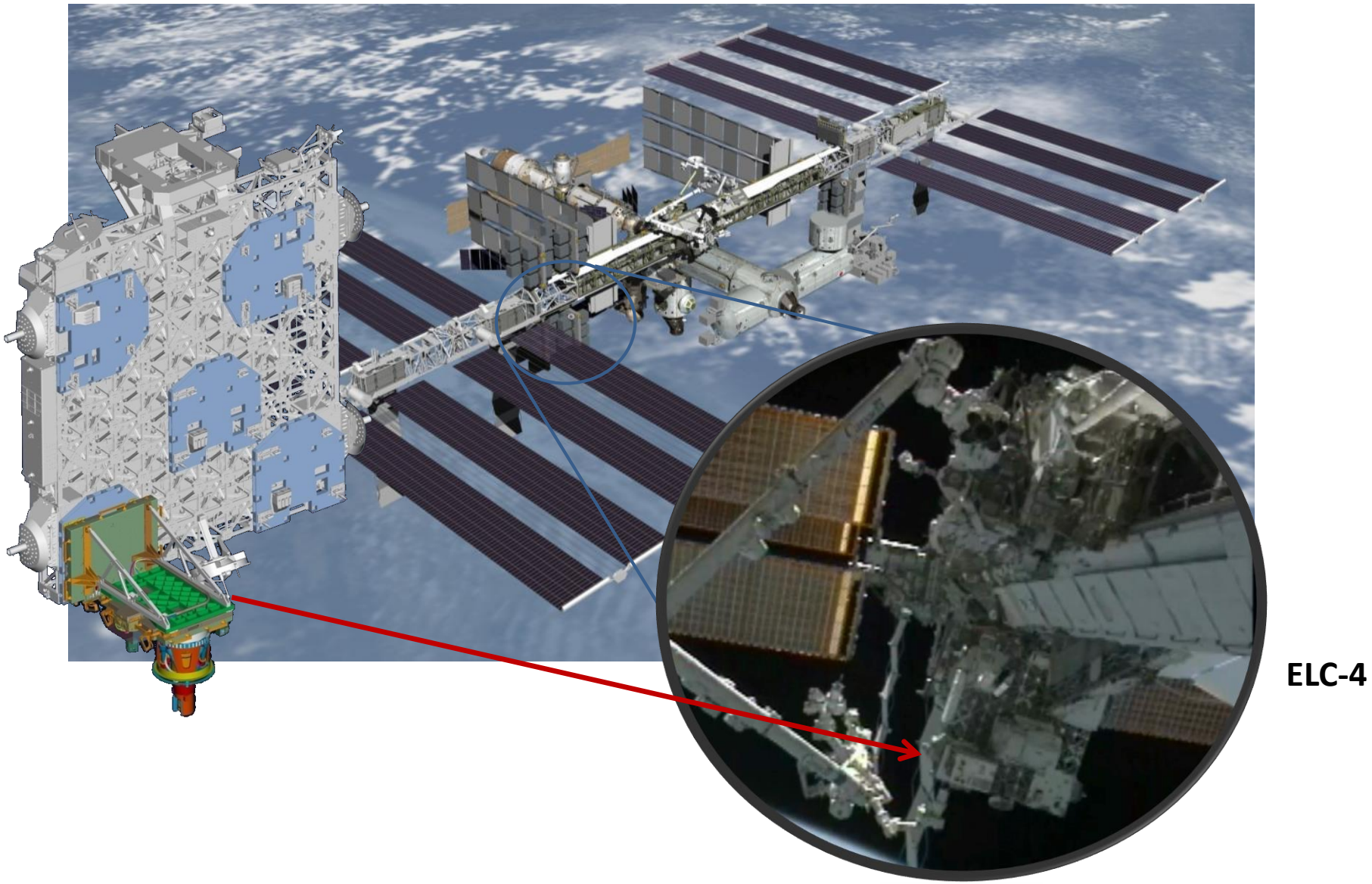
Manifest: February, 2016

Integration Hangar

Dragon Trunk
(Unpressurized Cargo Area)



SAGE III on ISS, an Earth Science Mission on the International Space Station



ELC-4

Summary

- The SAGE series has a long heritage and history of delivering outstanding and unique science products.
- SAGE III/ISS is a climate continuity mission addressing critical science needs.
- The ISS is an exceptional national asset in an ideal orbit for SAGE III to contribute internationally.
- SAGE III/ISS is designed to meet the core science objectives, while capturing data for additional science discoveries.