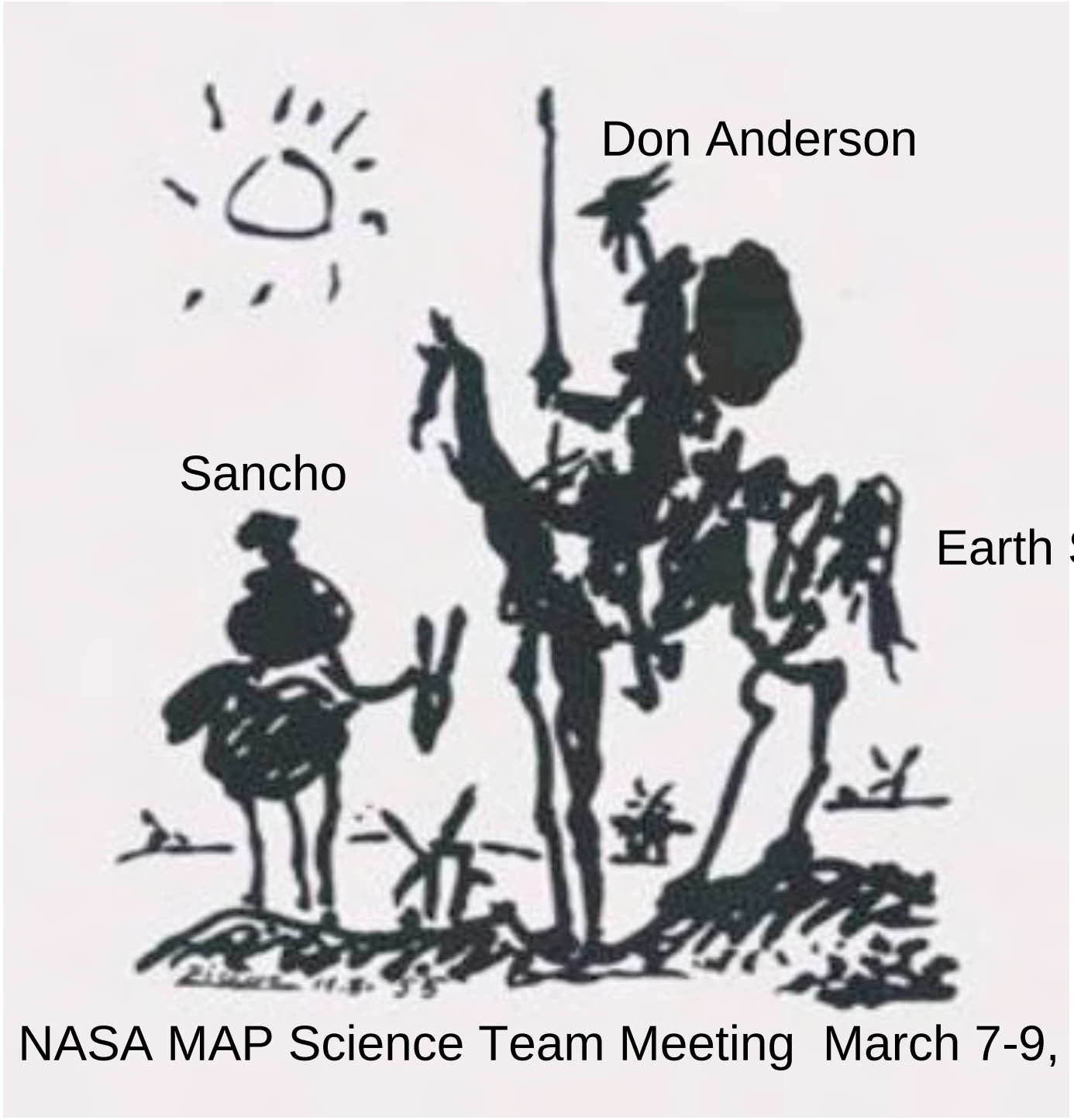
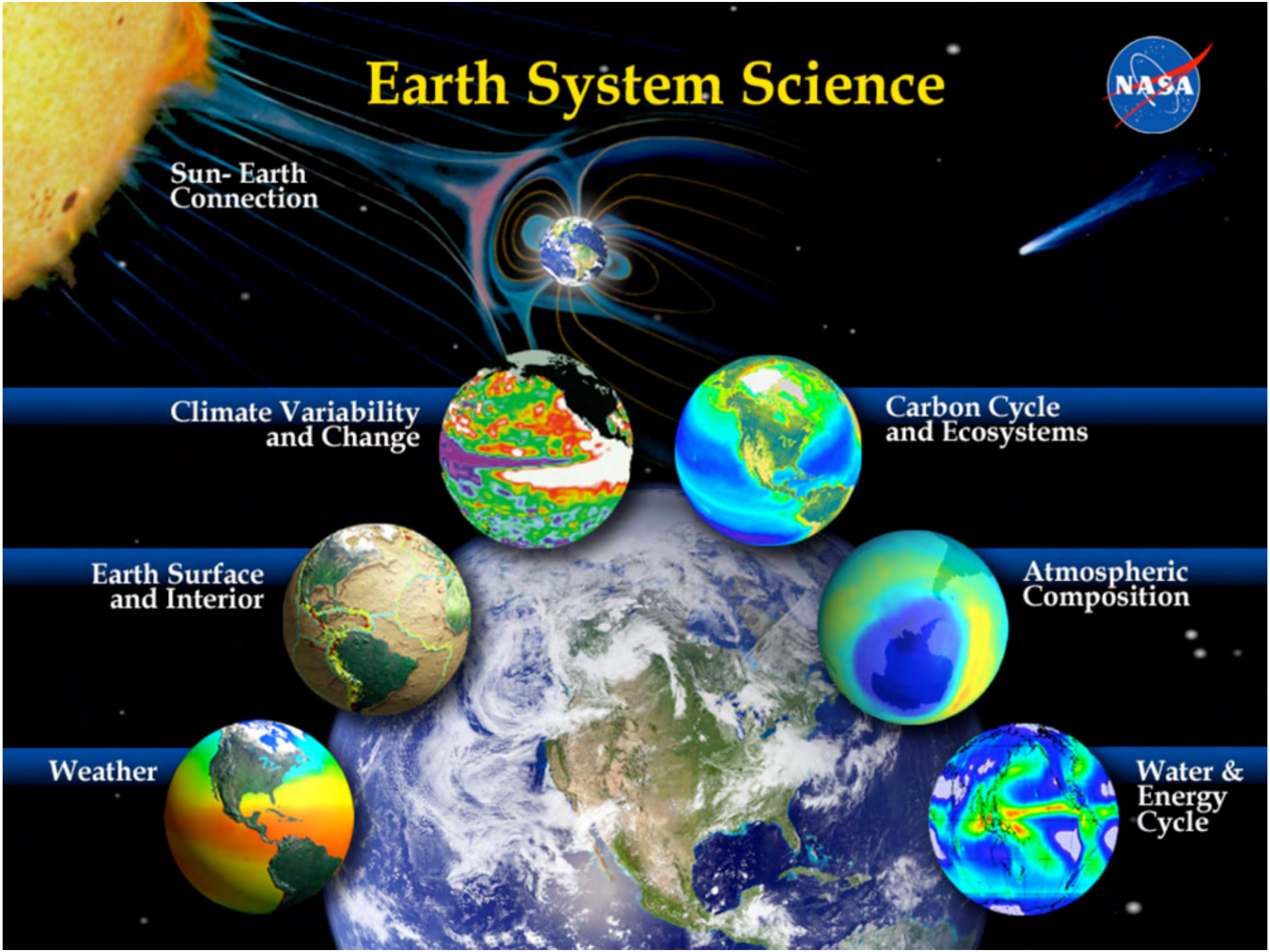


Earth Science Division

NASA MAP Science Team Meeting March 7-9, 2007

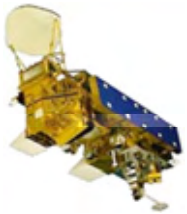

Earth System Science
NASA
Sun- Earth Connection
Climate Variability and Change
Carbon Cycle and Ecosystems
Earth Surface and Interior
Atmospheric Composition
Weather
Water & Energy Cycle

TRMM

GRACE

CloudSat

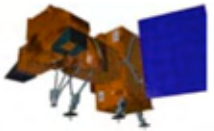
CALIPSO



Aqua

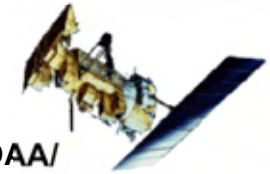
TOPEX

Meteor/
SAGE

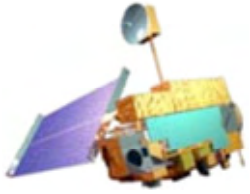


Landsat

SeaWiFS

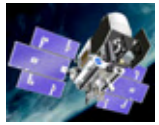


NOAA/
POESS



Terra

Jason



ICESat

SORCE

Aura

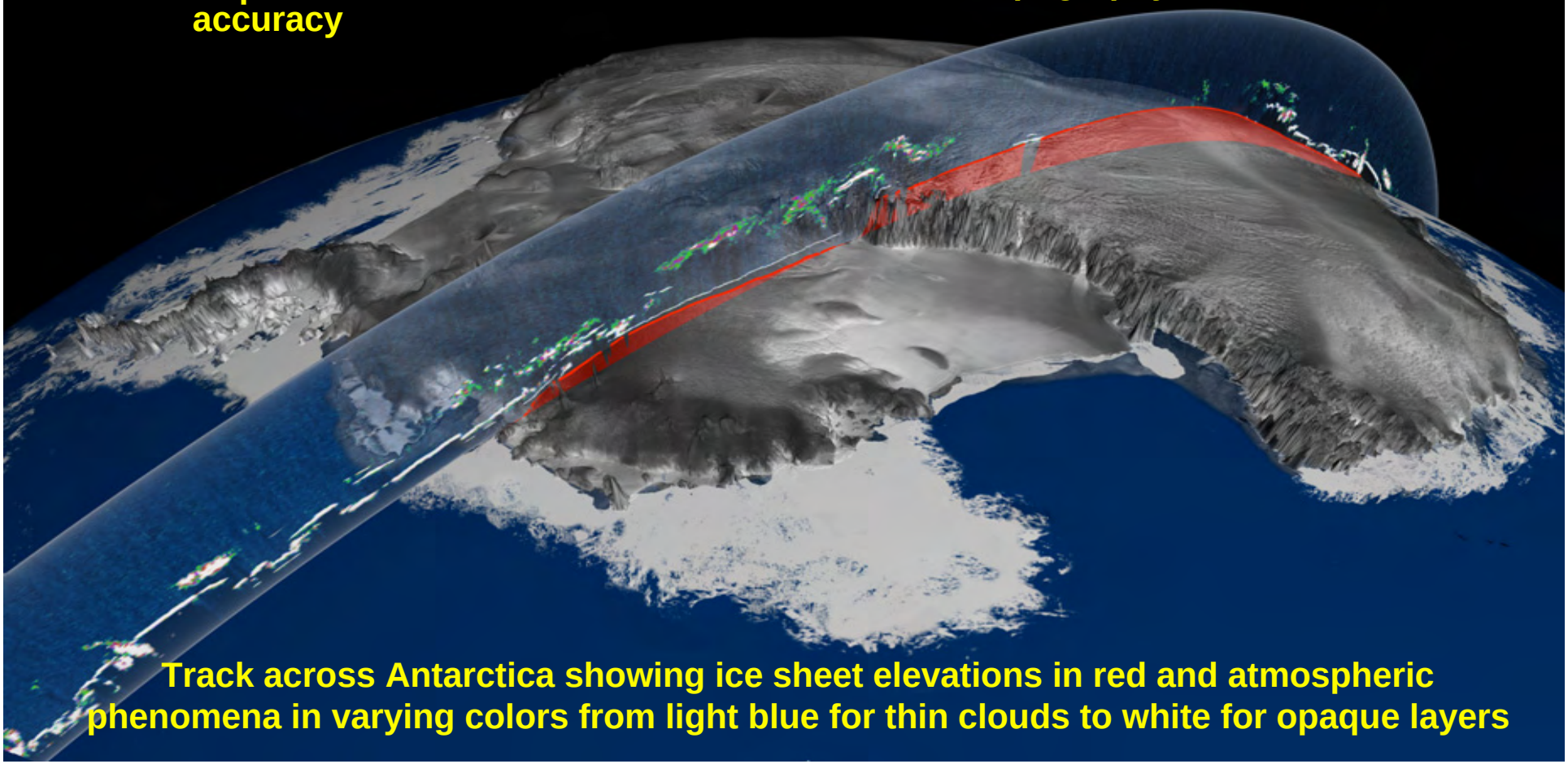
Ice Cloud and land Elevation Satellite (ICESat)

Precisely determines surface elevations

- 15 cm accuracy over ice
- Ground-breaking pointing capabilities
- Unprecedented orbit accuracy

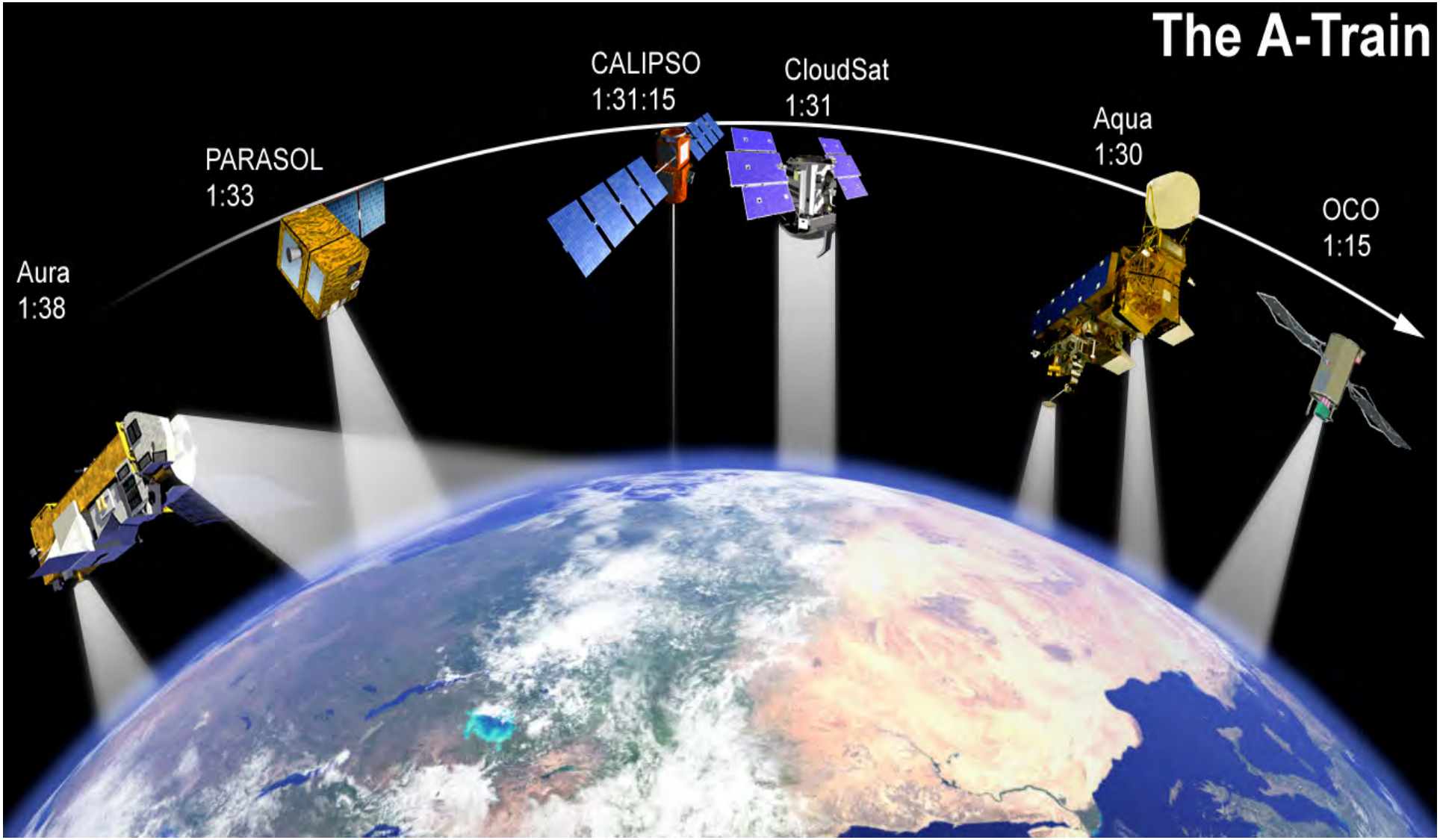
ICESat Science Objectives

- Polar ice-sheet elevation changes and mass balance
- Atmosphere-cloud heights and aerosol distribution
- Land topography



Track across Antarctica showing ice sheet elevations in red and atmospheric phenomena in varying colors from light blue for thin clouds to white for opaque layers

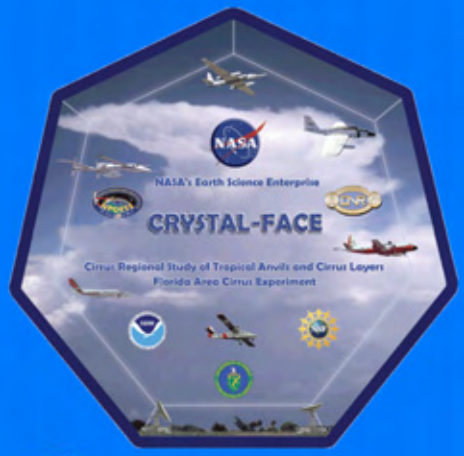
NASA-Coordinated Satellite Systems: The Past or The Future?

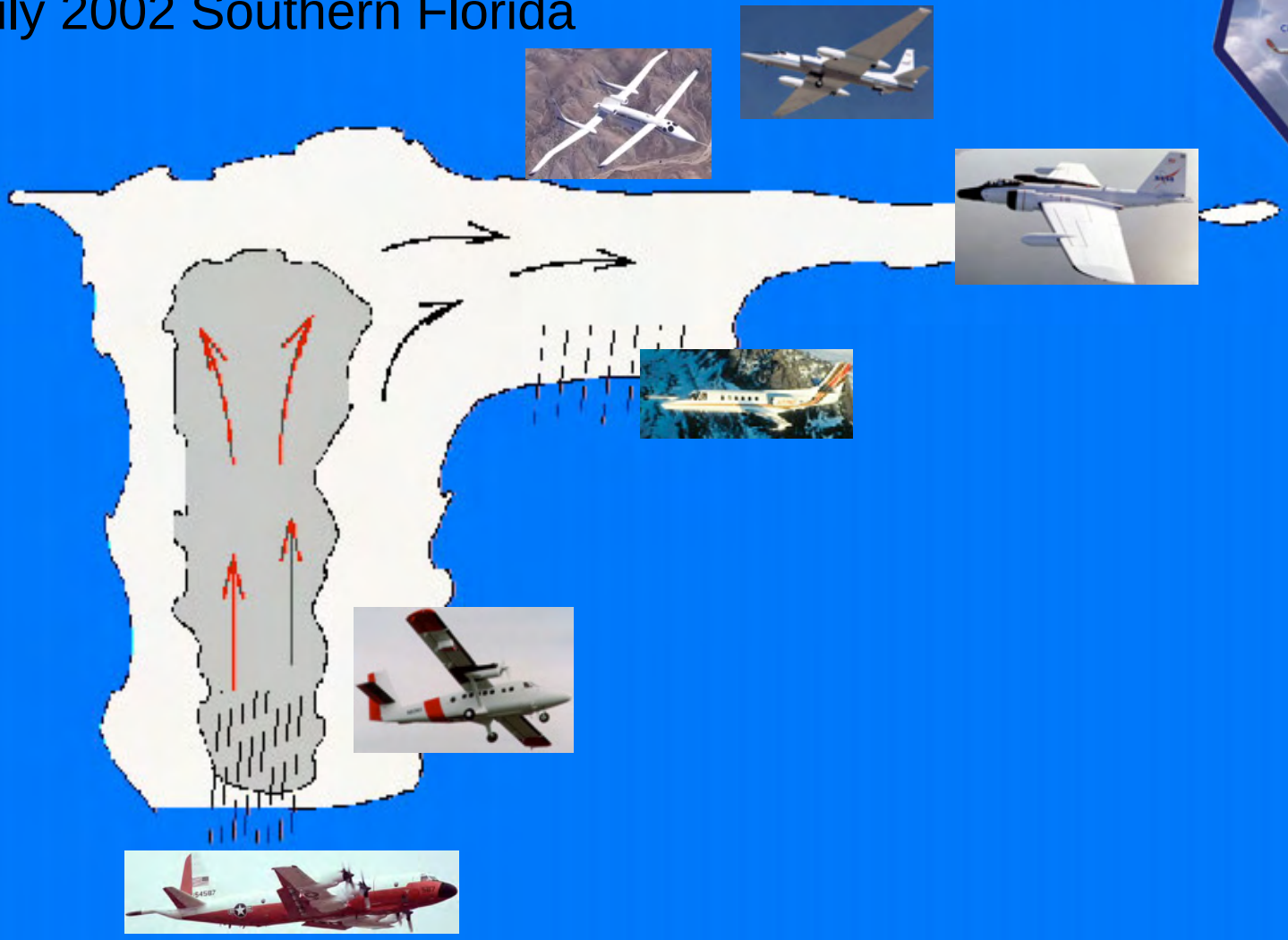


NASA Cirrus Regional Study of Tropical Anvils and Cirrus Layers - Florida Area Cirrus Experiment (CRYSTAL-FACE)

Objective: Clouds and chemistry coupling

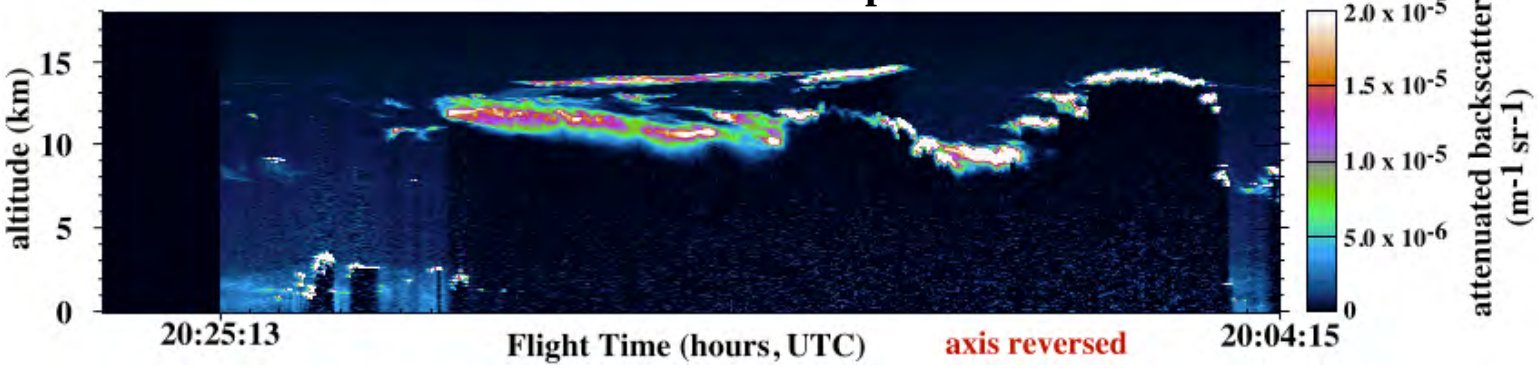
July 2002 Southern Florida



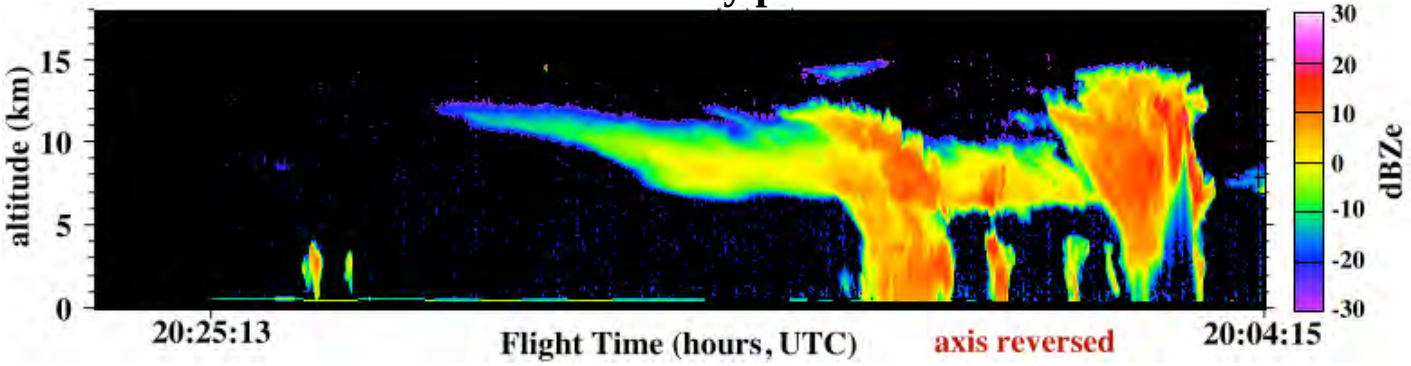


Combining the lidar and radar data shows the whole profile

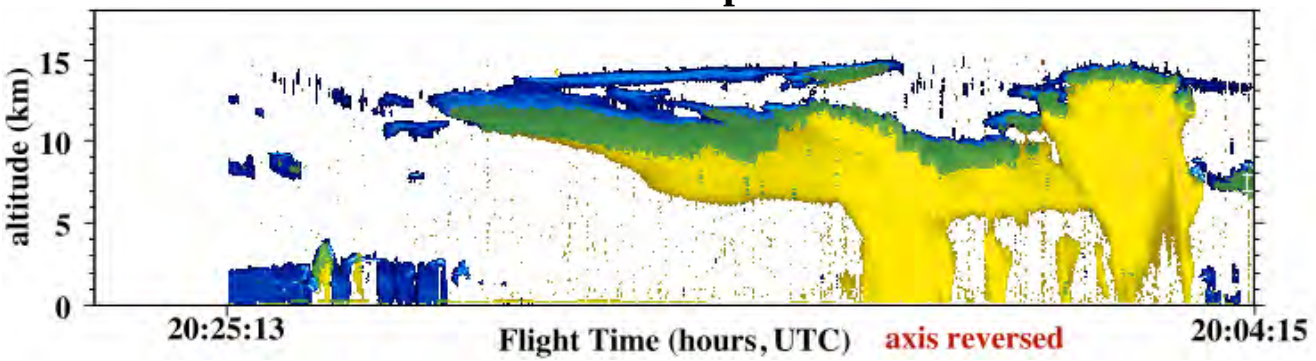
CPL attenuated backscatter profiles



CRS reflectivity profiles



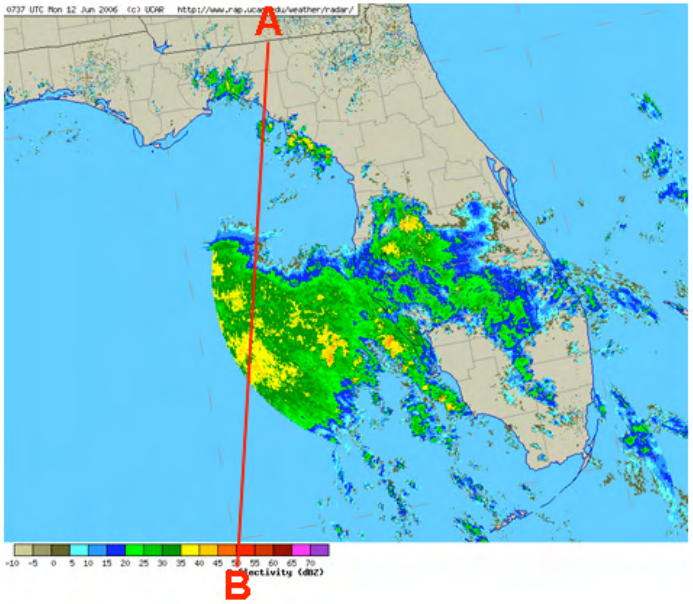
combined profiles



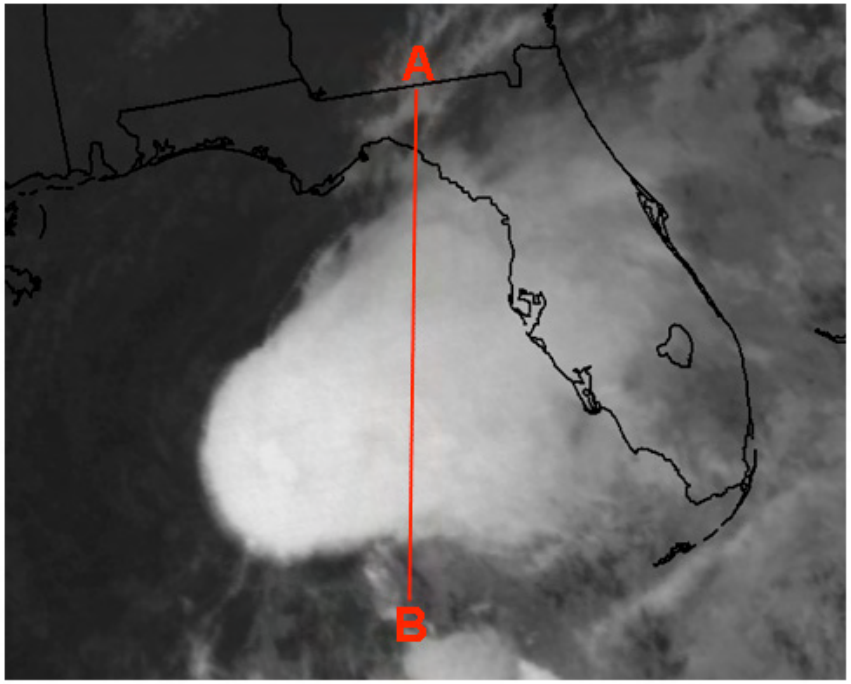
blue = lidar only; yellow = radar only; green = both

CloudSat Sees Alberto …

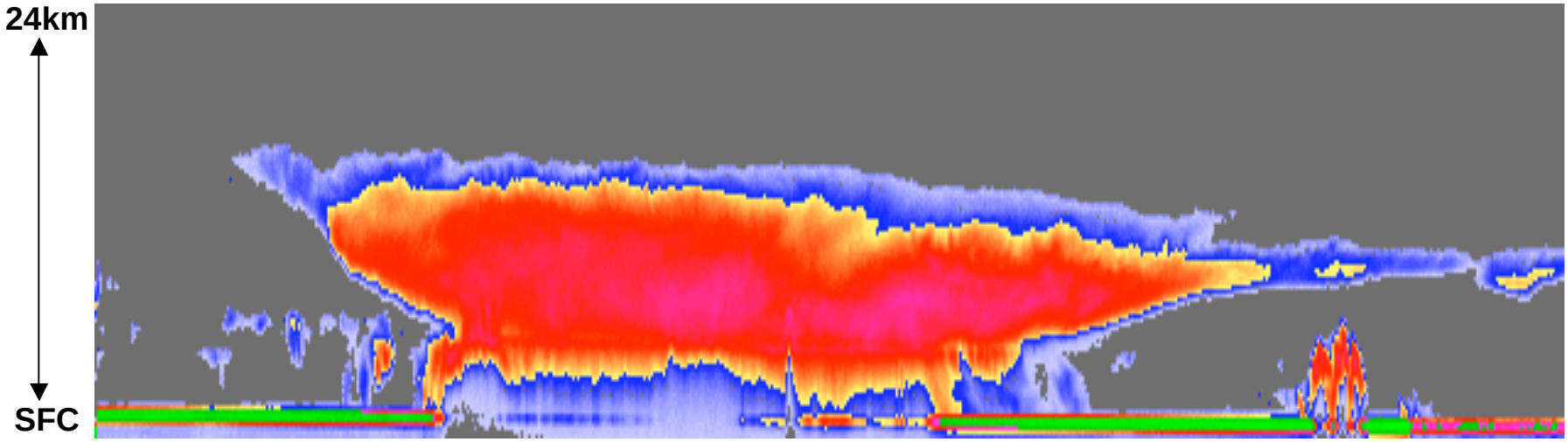
NEXRAD Radar (12 June, 2006 07:37 UTC)



GOES-12 Geostationary Satellite – Infrared Image (12 June, 2006 07:32 UTC)

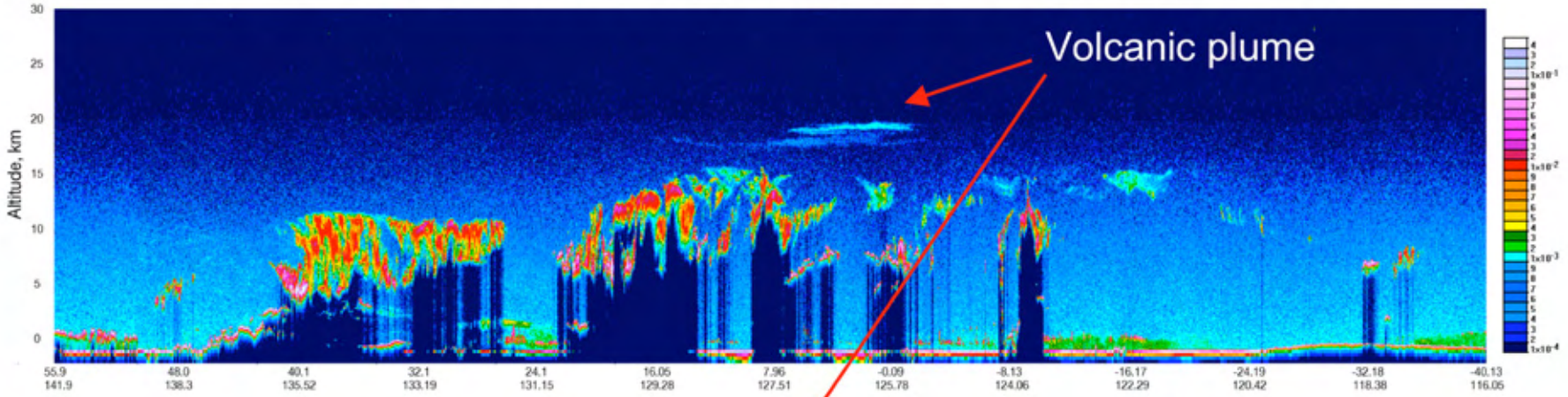


B **CloudSat Radar (12 June, 2006 07:35:56 – 07:37:33 UTC)** **A**

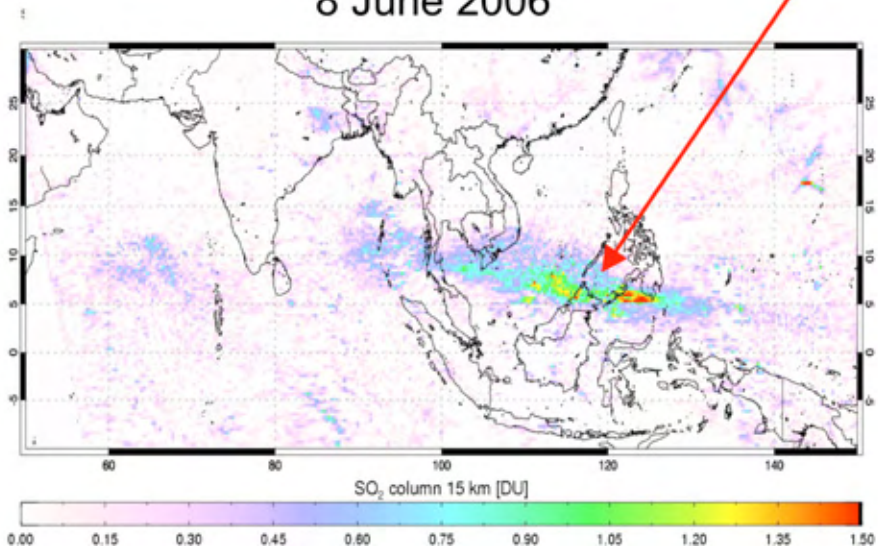


Observations of a Volcanic Plume from the Eruption of Soufriere Hills, Montserrat, on May 20

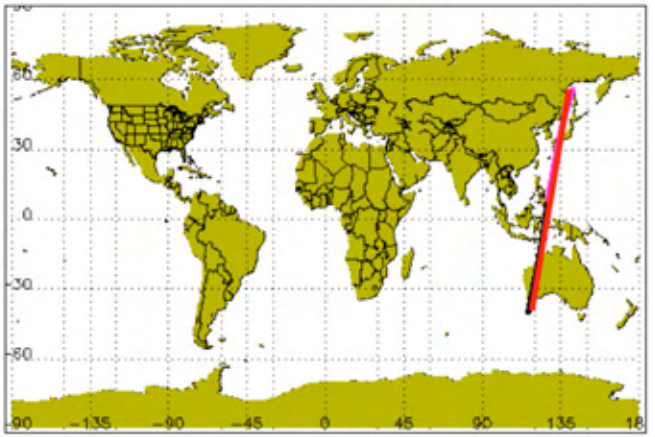
CALIPSO Total Attenuated Backscatter 532 nm 7 June 2006



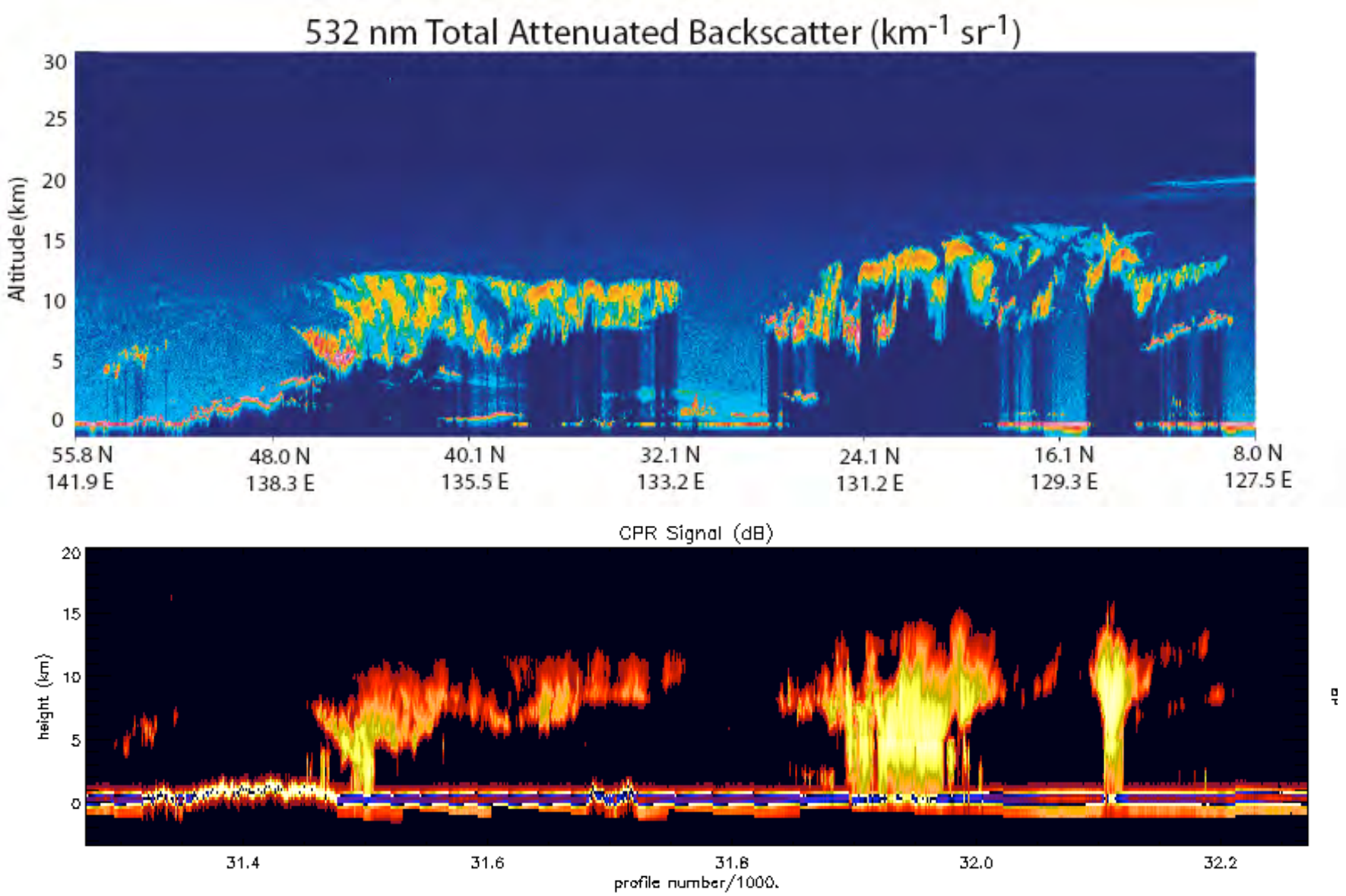
Aura/OMI Column SO_2 8 June 2006



CALIPSO Orbit Track 7 June 2006



CloudSat and CALIPSO data!



MAP Direction

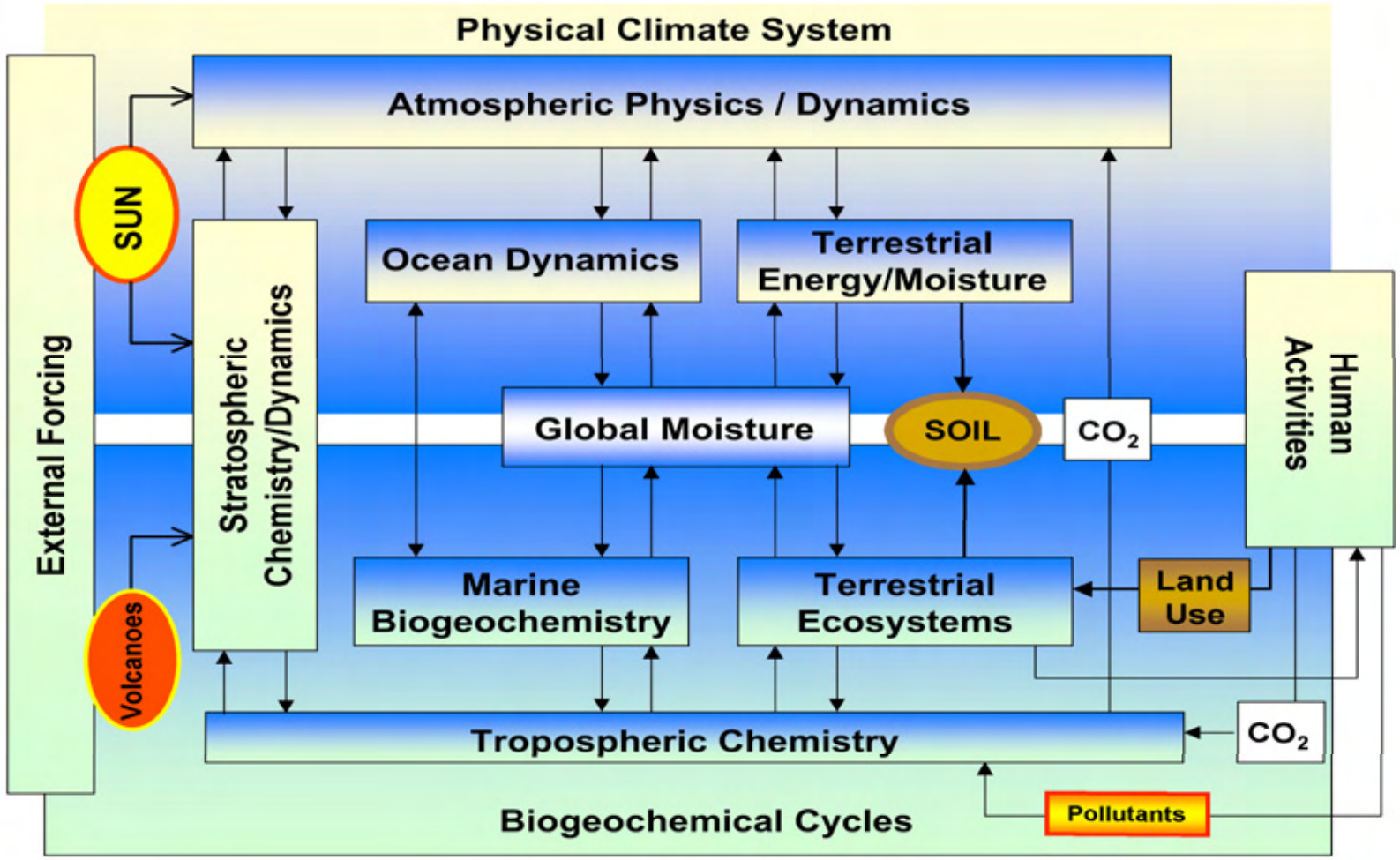
WCRP

CCSP/IESA

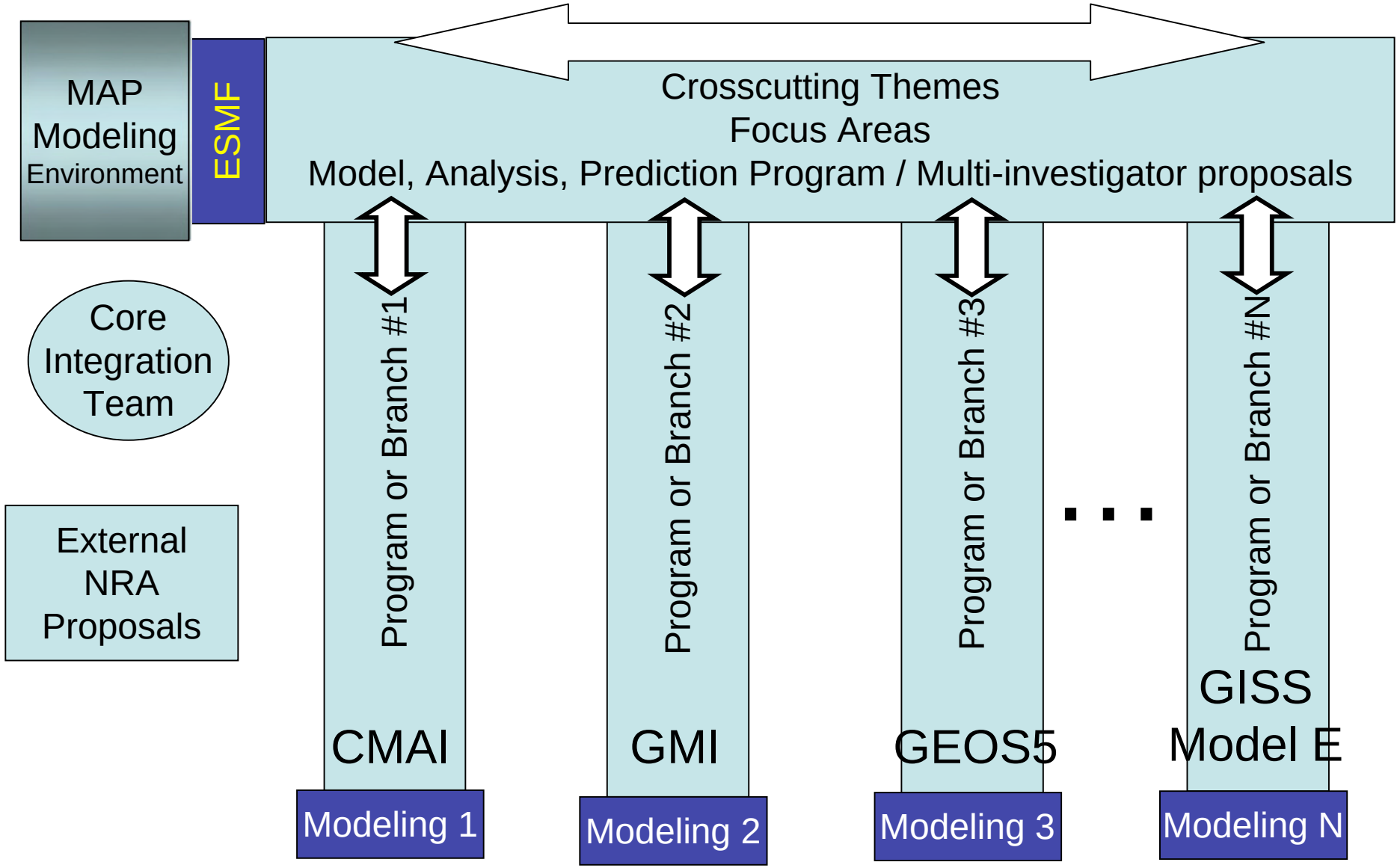
NRC/Decadal Survey

GEOSS

NASA's Mission, circa 1980's



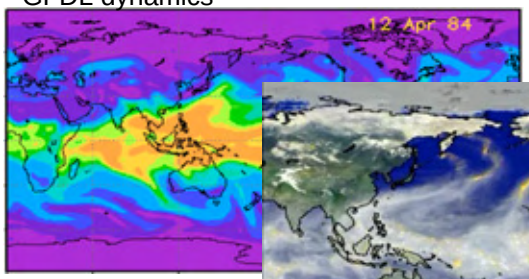
The NASA MAP Modeling Environment Components Added as Program Evolves



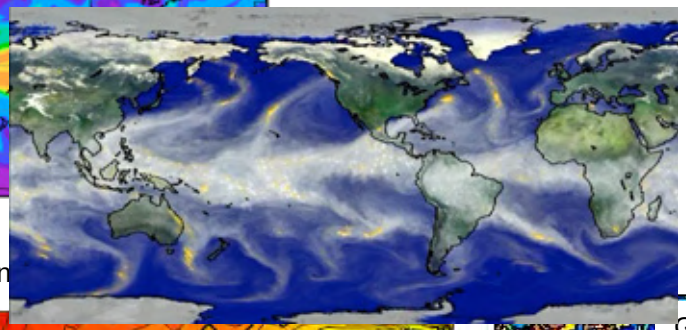
Where we are going: Modern models integrate components from different sources
ESMF accelerates development cycle

NASA GEOS5 AGCM for climate and weather

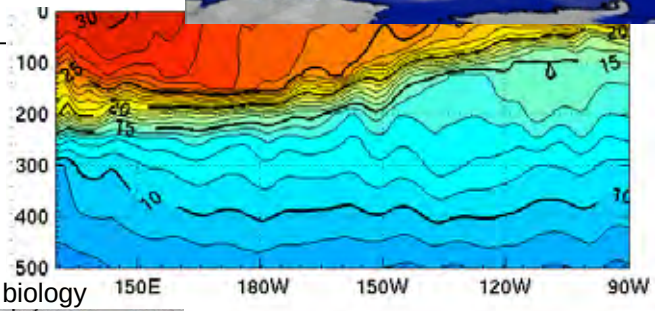
GFDL dynamics



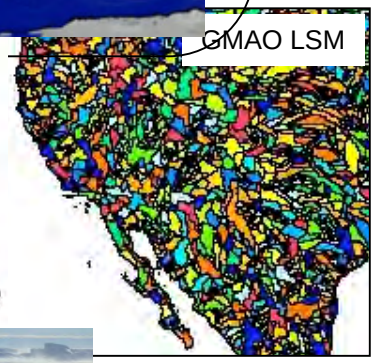
GMAO physics



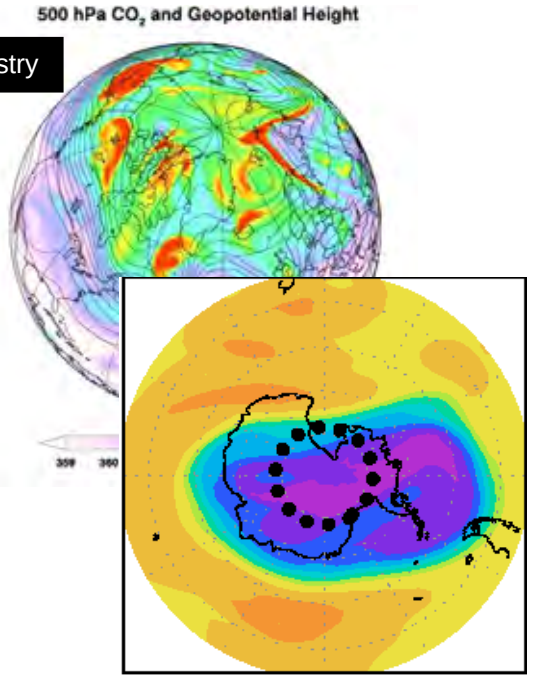
GMU ocean



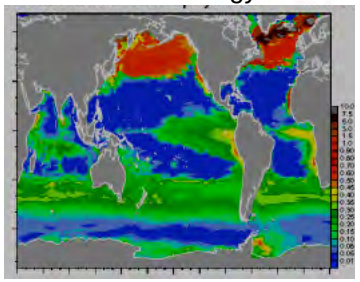
GMAO LSM



GMI chemistry



GMAO ocean biology



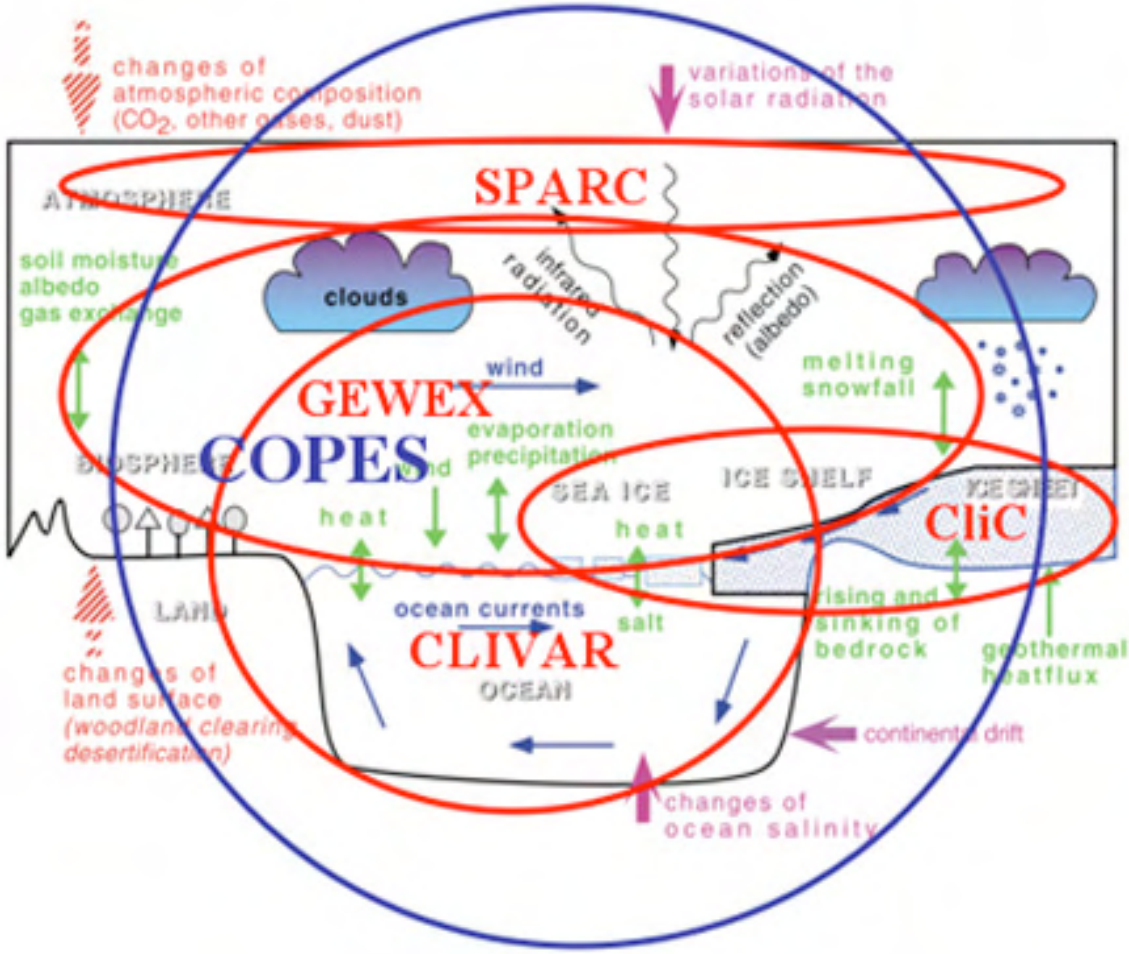
LANL sea ice model

Add in the assimilation components and the satellite data ⇒ science + future mission design
OSSE, DAS, Reanalysis

NASA and WCRP

While fundamental knowledge of each model element will continue to increase, and for some disciplines the gains will be dramatic, NASA's raison d'etre for the next 10-20 years is understanding the linkages, i.e. understanding the global integrated Earth system. NASA's focus is on the arrows or lines among the boxes, especially in the context of planning and executing observations missions in support of constraining/improving Earth System Models. This concept was expressed in the description of NASA in the "Our Changing Planet: 2007".

NASA has investments in most WCRP activities and is willing to help WCRP focus their future work on linkages among core WCRP components like SPARC, GEWEX, CLIVAR, etc. in order to improve global integrated Earth system science.



WCRP Coordinated Observation and Prediction of the Earth System (COPES)

To facilitate analysis and prediction of the Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

What is the purpose of the CCSP Integrated Earth System Analysis (IESA) effort?

To develop an *earth system analysis capability* that will:

- **Improve descriptions of the earth system and understanding how that system works.**
- **Support evaluations of the fidelity of earth system models and help identify areas where improvements in models and observations will have the greatest benefits.**
- **Aid in evaluating potential predictability and improving climate forecasts on seasonal-to-decadal time scales.**
- **Provide state-of-the-art descriptions of the past and present state of the earth system that support the needs of both scientists and end users.**

The Bottom Line:

Earth system analyses produced by assimilating diverse observations into state-of-the art models are an essential integrating component in an end-to-end *Earth Observing System.*

Building a capability for an integrated earth system analysis cross-cuts most, if not all, science elements within the CCSP. This effort is therefore a fundamental integrating activity within the overall Program.