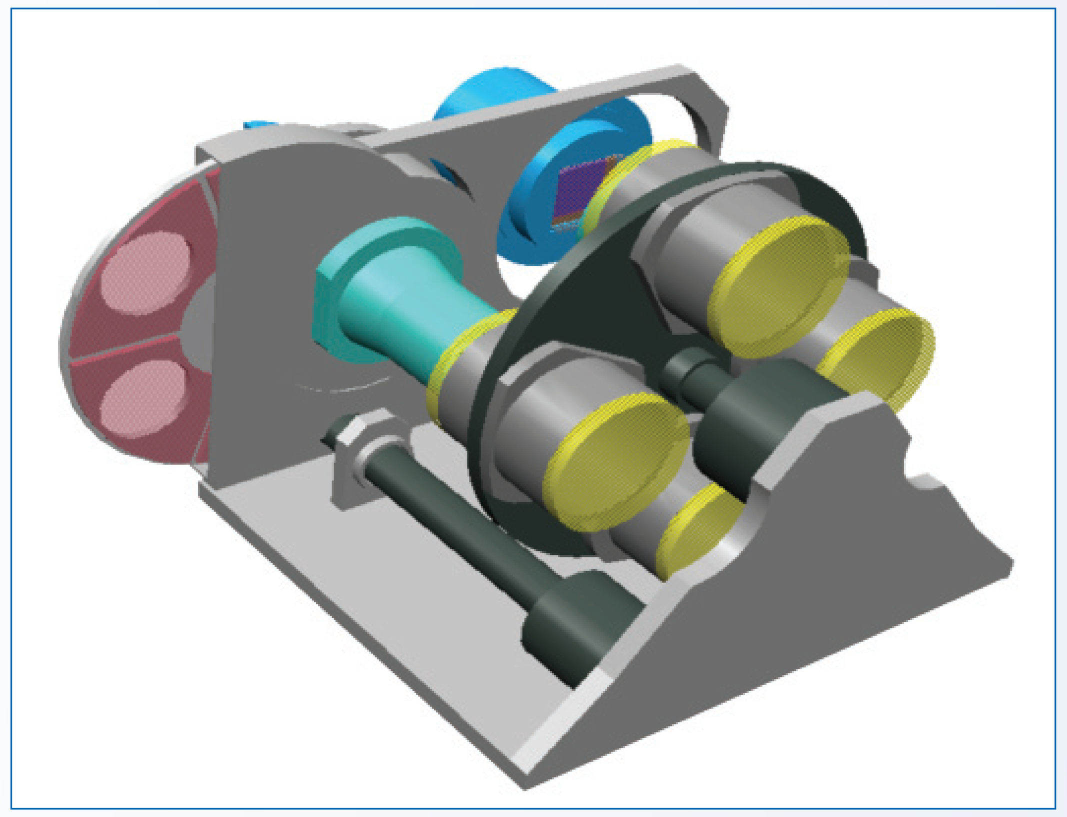
Earth Science Technology Office (ESTO) Investments in support of the

Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission

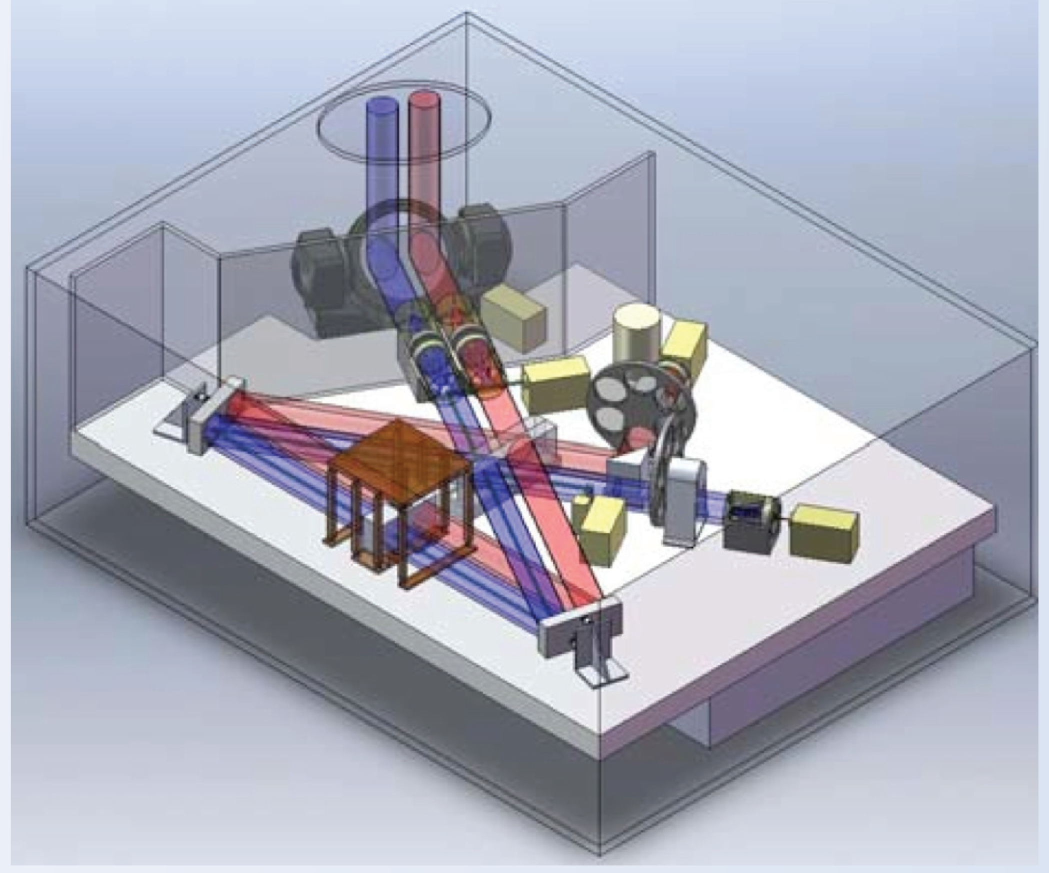
ESTO
Earth Science Technology Office

For over 10 years, the Earth Science Technology Office (ESTO) has been actively funding and developing a broad range of technologies that enable scientific measurements of Earth, mission operational requirements, and other related applications. A substantial subset of these technologies are directed broadly toward the study of air quality and ocean color and several relate directly to the goals and requirements for the Geostationary Coastal and Air Pollution Events (GEO-CAPE) Decadal Survey Mission. Below are a few examples of current and completed ESTO technology development efforts that may aid the formulation of the GEO-CAPE mission.

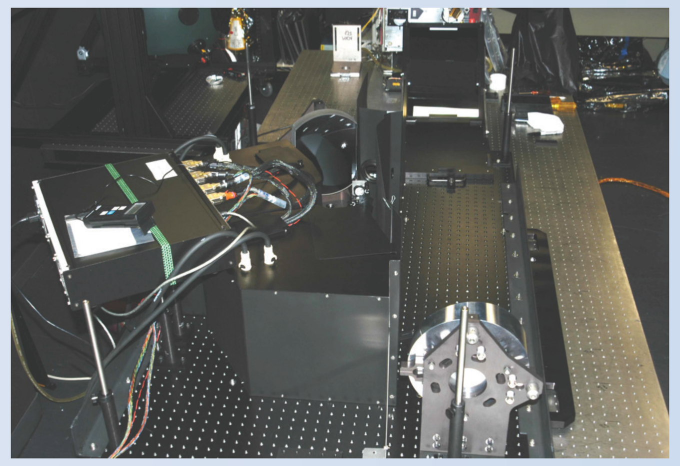
Instrument Technologies



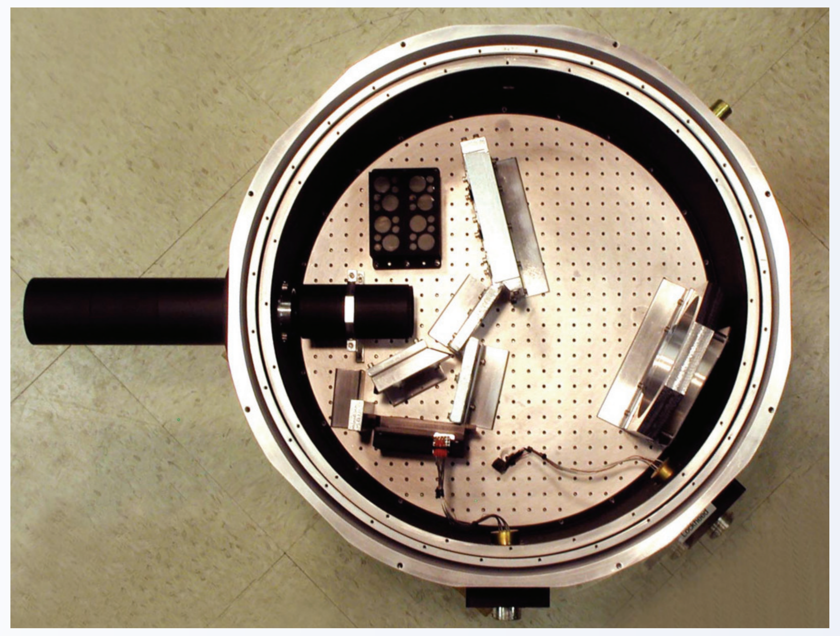
Above is a mechanical drawing of a Gas Filter Correlation Radiometer technology being developed for the GEO-CAPE mission. This project seeks to characterize the performance of a 2.3 µm infrared correlation radiometer (IRCR) prototype subsystem designed specifically to measure carbon monoxide from geostationary orbit. The focus is on characterizing the 2.3 µm IRCR subsystem, although both 2.3 µm and 4.6 µm subsystems will be required to obtain boundary layer CO.
[Doreen Neil, NASA Langley Research Center]



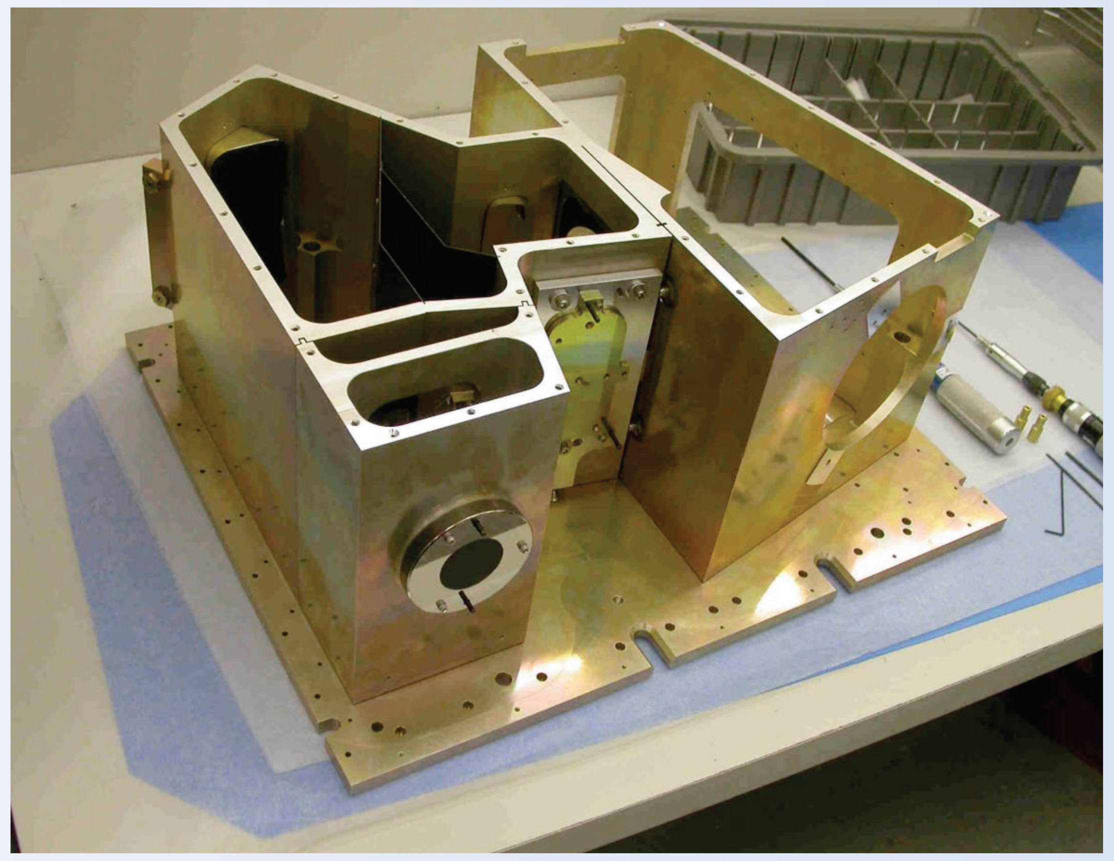
Above is an architecture drawing for the Panchromatic Fourier Transform Spectrometer (PanFTS), a revolutionary new instrument that may have a major impact on remote sensing of atmospheric trace gases, aerosols and ocean color. PanFTS is designed to measure all of the trace species called out in the decadal survey for GEO-CAPE and GACM. With continuous sensitivity from 0.26 to 15 micron and high spectral resolution, PanFTS combines the functionality of separate UV, visible and IR instruments in a single package at lower cost. The PanFTS IIP instrument will be a dynamically-aligned plane mirror system using an all-flexure scan mechanism. Two separate optical trains (0.26-1 micron and 1-15 micron) will share the scan and dynamic alignment systems. The output beams will drive separate two-dimensional focal plane arrays optimized for the spectral regions.
[Stanley P. Sander, Jet Propulsion Lab]



The Geostationary Spectorgraph (GeoSpec) project sought to demonstrate the feasibility of future GEO missions using hyperspectral UV/VIS/NIR instrumentation. By 2007, the project team had completed testing of a fully aligned breadboard system (shown above) as well as studies for a flight instrument concept. Below are final hybrid detector packages.
[Scott Janz, Goddard Space Flight Center]

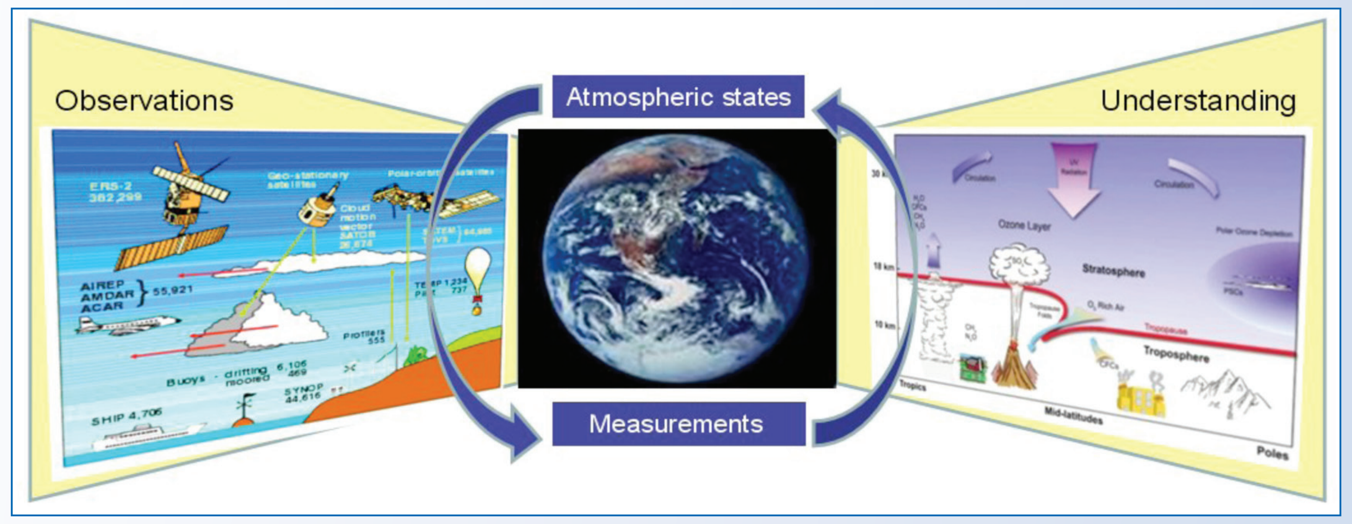


Above are optics hardware for the Tropospheric Infrared Mapping Spectrometer (TIMS), an instrument that may provide considerably improved CO measurements. Nadir radiance acquired at high spectral resolution in the regions of the CO bands near 2.3 microns (solar reflective) and 4.7 microns (thermal emissive), together with the low noise design, provide for CO retrieval with improved vertical information, including the lowest several km (boundary) layer. While the primary measurement goal is CO, the spectra contain information that could be used to measure column CH_4 and H_2O partial columns. The TIMS technology uses low noise 2D arrays fed by a grating spectrometer. There are no moving parts. The compact design was intended for LEO but many technologies could be useful for GEO missions.
[John Kumer, Lockheed Martin]

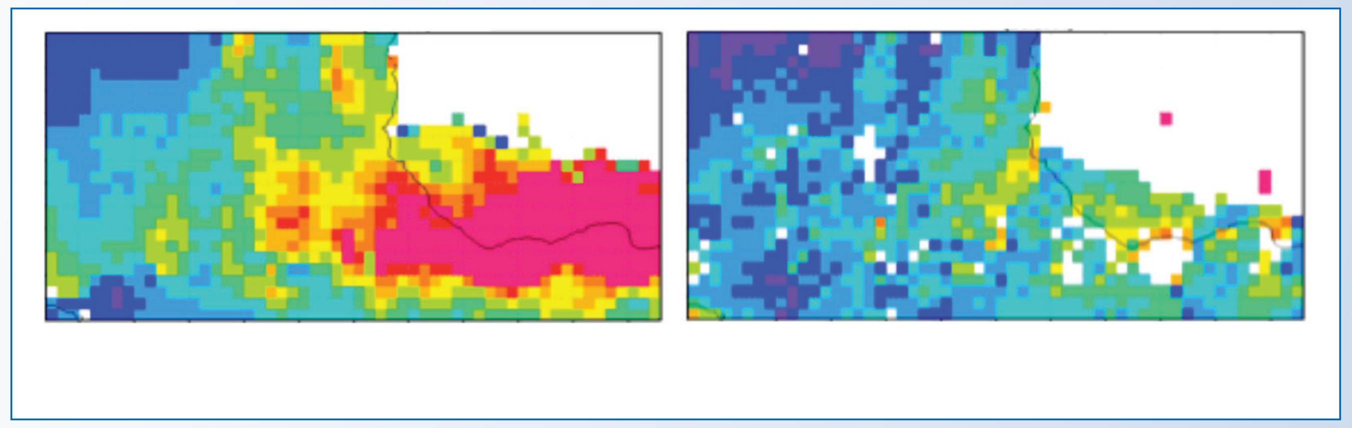


At left is the optical bench assembly for SIRAS-G, the Space-borne Infrared Atmospheric Sounder for GEO. The SIRAS-G project, which graduated from ESTO funding in 2006, had two major components: 1) to develop and demonstrate an infrared imaging spectrometer at cryogenic temperatures in a lab environment, and 2) to develop infrared spectrometer concepts suitable for future Earth science missions.
[Thomas Kampe, Ball Aerospace]

Information Systems Technologies



Understanding the atmospheric state and its impact on air quality requires observations of trace gases, aerosols, clouds, and physical parameters across temporal and spatial scales that range from minutes to days and from meters to more than 10,000 kilometers. The Sensor-Web Operations Explorer (SOX) project seeks to enable adaptive measurement strategies for an air quality sensor web; provide a comprehensive sensor-web system simulation with multiple sensors and multiple platforms; provide a quantitative science return metric that can identify where and when specific measurements have the greatest impact; and enable collaborative campaign planning processes among distributed users.
[MeeMong Lee, Jet Propulsion Lab]



Above is a simple comparison of aerosol optical depth data sets derived from the MODIS (left) and MERIS (right) satellite instruments from the March 2004 high aerosol event west of the Sahara. MODIS and MERIS instruments are very similar – the MERIS aerosol product has the same spatial and temporal resolution as MODIS –but MERIS misses high aerosol events because MERIS aerosols are reported only where ocean color retrievals are made. The discrepancy between the two data sets illustrates how the lack of data provenance can produce very different results. The Multi-Sensor Data Synergy Advisor (MDSA) project seeks to help data users better understand the provenance and utility of data sets by augmenting data analysis tools with semantic web technologies and ontologies that support data inter-comparisons from different sensors or models. *[Gregory Leptoukh, NASA Goddard Space Flight Center]*

Additional Information Systems Projects:

- Technology Infusion for the Real Time Mission Monitor, Michael Goodman, NASA Marshall Space Flight Center
- Real-Time and Store-and-Forward Delivery of Unmanned Airborne Vehicle Sensor Data, Will Ivancic, NASA Glenn Research Center
- Telesupervised Adaptive Ocean Sensor Fleet, John Dolan, Carnegie Mellon University
- A Smart Sensor Web for Ocean Observation: System Design, Modeling, and Optimization, Payman Arabshahi, University of Washington
- Autonomous In-situ Control and Resource Management in Distributed Heterogeneous Sensor Webs, Ashit Talukder, Jet Propulsion Lab
- Adaptive Sky, Michael Burl, Jet Propulsion Lab
- Spatiotemporal Data Mining System for Tracking and Modeling Ocean Object Movement, Yang Cai, Carnegie Mellon University
- A Reconfigurable Computing Environment for On-Board Data Reduction and Cloud Detection, Jacqueline Le Moigne, NASA Goddard Space Flight Center