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The STRIVE Earth System Explorer Mission Concept

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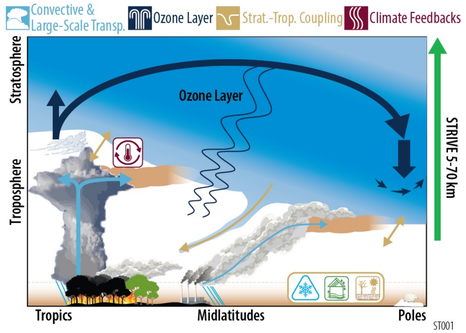
Earth System Explorers Mission Concept

Stratosphere Troposphere Response using Infrared Vertically-resolved light Explorer (STRIVE)

- One of 4 mission concepts (STRIVE, EDGE, ODYSEA, Carbon-I) selected for a competitive Phase A Concept Study within NASA's 2023 Earth System Explorers Program
- NASA will select up to 2 missions by November 2025: first launch no later than September 2030, second launch April 2032
- STRIVE fills a critical need for high vertical resolution profiles of temperature, ozone, trace gases, and aerosols in the upper troposphere and stratosphere with near-global horizontal sampling

Science Goal and Objectives

Goal: Understand processes controlling the composition and dynamics of the upper troposphere and stratosphere to constrain their influence on climate, the ozone layer, air quality, and weather



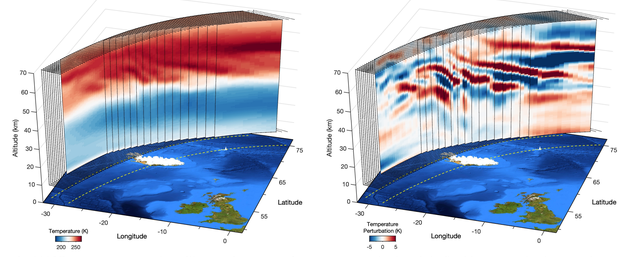
Objectives

1. **Convective & Large-scale Transport**: Determine how surface emissions and tropospheric processes influence the composition of the upper troposphere and global stratosphere
2. **Ozone Layer**: Quantify how changes in circulation, greenhouse gases, ODSs, as well as episodic aerosol and trace gas injections, affect the recovery of the ozone layer
3. **Stratosphere-Troposphere Coupling**: Constrain the influence of the stratosphere on global tropospheric composition, surface air quality, and weather
4. **Climate Feedbacks**: Reduce uncertainties in the feedbacks due to ozone, water vapor, and thin cirrus in the UTS

STRIVE has the novel ability to resolve small-scale vertical structures of atmospheric composition and temperature, enabling new insights into processes of troposphere-stratosphere interactions

Example 1: 3D sampling of gravity waves

STRIVE would capture gravity waves in 3D with fine-scale vertical and horizontal resolution



Synthetic ALICE temperature plots illustrating a gravity wave over Iceland. Left: Along-track planes, shown every other cross-track profile. Right: Removing planetary-scale waves reveals gravity wave temperature perturbations.

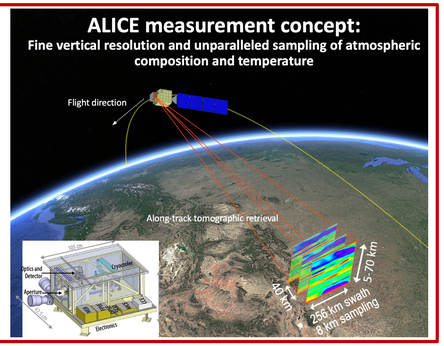
STRIVE Instruments

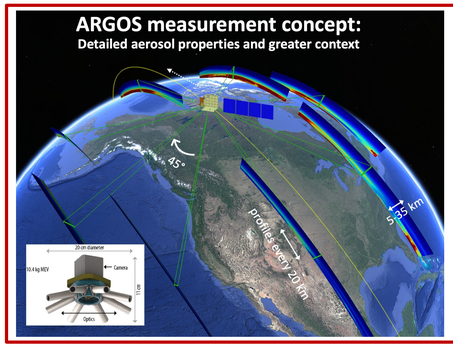
Two limb viewing instruments on Sun-synchronous orbit at 801 km altitude, 1:30/13:30 LT

ALICE

Advanced Limb Infrared Chemistry Experiment

- Dyson imaging spectrometer measuring emitted IR radiation (4.5-14.1 µm) day & night
- Vertically scans Earth's limb, viewing 256 km cross-track by 1 km vertically in 200 m increments; 40 km spacing along track
- 410,000 profiles per day at 1 km vertical resolution
- Temperature, O_3, H_2O, CH_4, N_2O, CFC-11, CFC-12, CO, HCN, NO_2, HNO_3, $ClONO_2$, N_2O_5; Cloud/Aerosol height, type, extinction



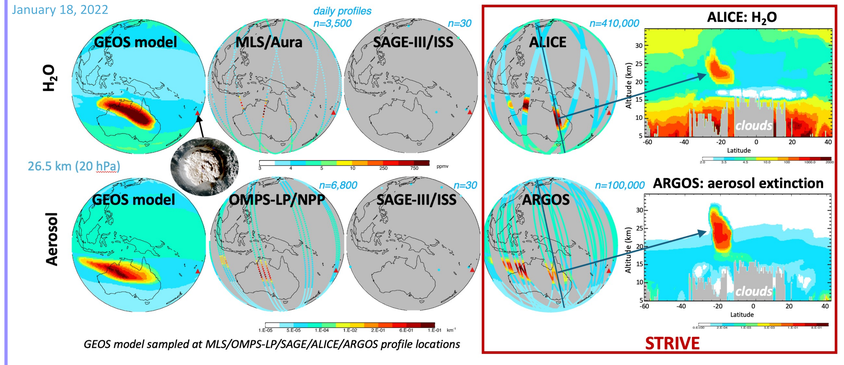


ARGOS

Aerosol Radiometer for Global Observations of the Stratosphere

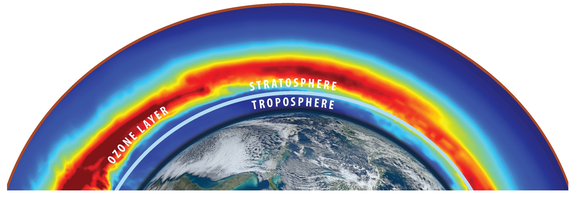
- Dual-spectral (870 nm and 1550 nm) and multi-direction (8 angles) radiometer measuring vertical limb profiles using scattered solar light
- 100,000 profiles per day at 1 km vertical res.; 20 km spacing along track
- Technology demonstration flight in March 2025
- Aerosol extinction, Ångström exponent, radius, number density, PSCs

Example 2: Hunga 3 days after eruption



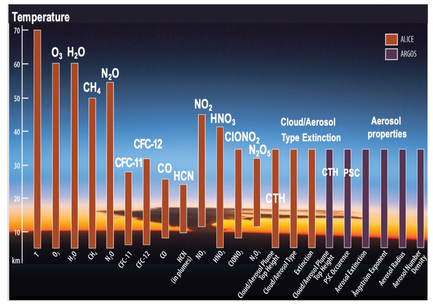
GEOS model sampled at MLS/OMPS-LP/SAGE/ALICE/ARGOS profile locations

STRIVE would generate more 2-4 orders of magnitude more profiles and greater coverage than current instruments

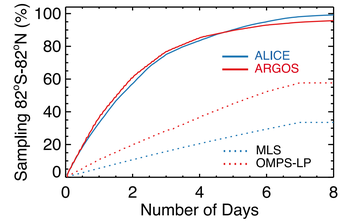


STRIVE Products & Coverage

STRIVE Products and their Altitude Ranges



Global Coverage: 75% in 3 days, 90% in 5 days



Applications & Synergies

Enhancing Predictive Models (weather, S2S, climate, air quality) and Forecasts

- STRIVE will deliver unique observations of stratospheric temperature and composition, revealing key mechanisms that link the stratosphere to extreme surface weather events
- STRIVE profiles of temperature, O_3, H_2O, and aerosols enable initialization, evaluation, and improvements of next-generation models used in forecasts, analyses, and reanalyses

Enhancing Air Quality Management

- Observations of wildfire plume height and stratospheric ozone intrusions

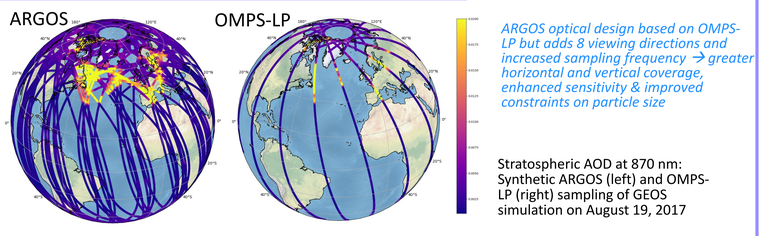
Improving Aviation Safety

- Vertical profiles of aerosols (>5 km altitude) from volcanoes and wildfires. Potential to retrieve SO_2 concentrations and volcanic ash
- Vertical gradients in temperature provide information on turbulence in stratosphere

Synergies with Nadir-Viewing Observations

- STRIVE's profiles (O_3, NO_2, CH_4, CO, aerosols) above 5 km would enhance instruments measuring column concentrations → improve tropospheric composition and surface emissions estimates

Example 3: 2017 British Columbia pyroCb events



ARGOS optical design based on OMPS-LP but adds 8 viewing directions and increased sampling frequency → greater horizontal and vertical coverage, enhanced sensitivity & improved constraints on particle size

Stratospheric AOD at 870 nm: Synthetic ARGOS (left) and OMPS-LP (right) sampling of GEOS simulation on August 19, 2017

STRIVE would provide a more complete picture of pyroCb outflow evolution

Interested in STRIVE science/applications/synergies?
We'd love to hear from you! Please reach out to us:
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