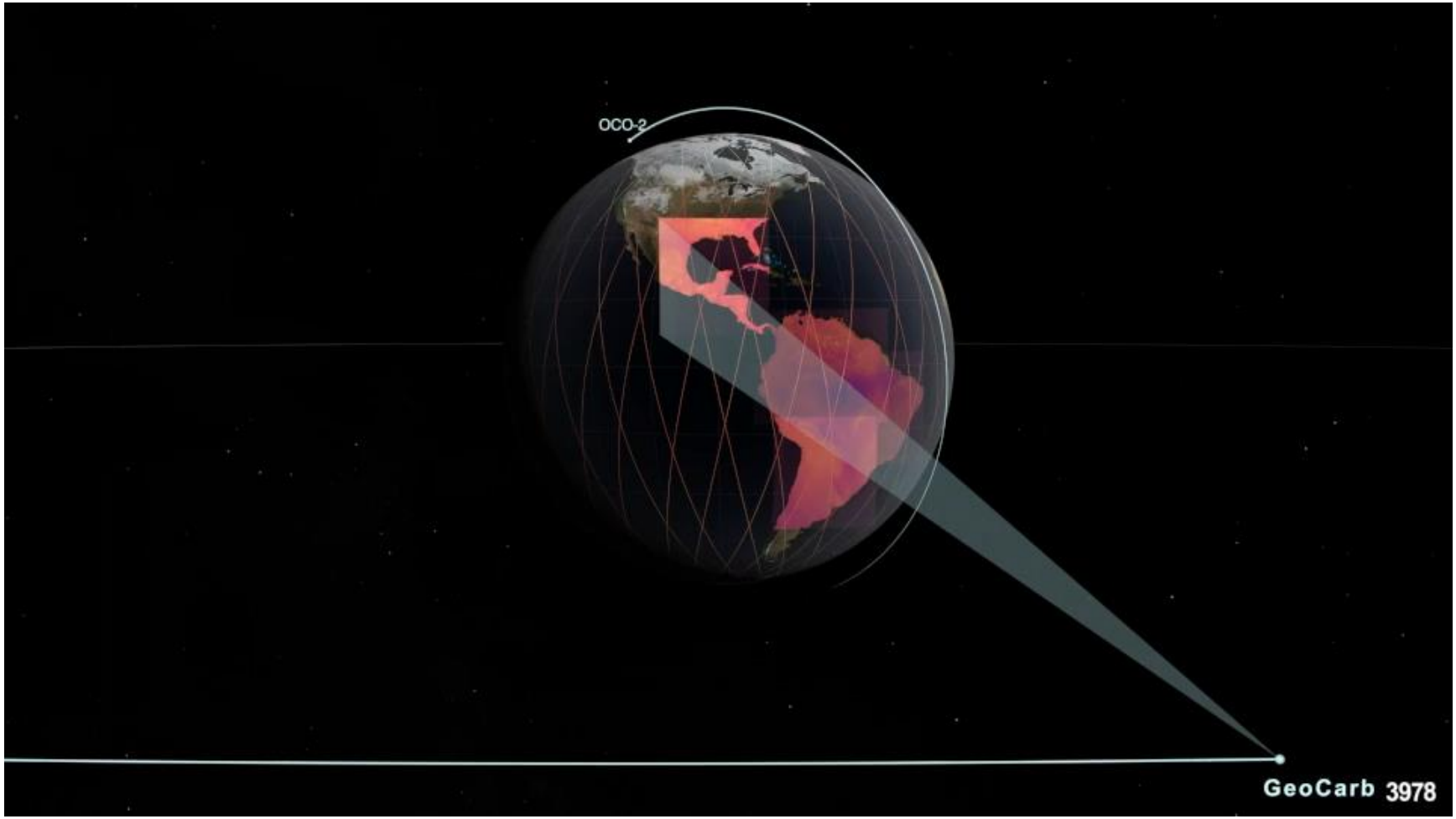
GeoCarb Mission Status

10/23/2023

Mapping from Geostationary orbit



Why GeoCarb?

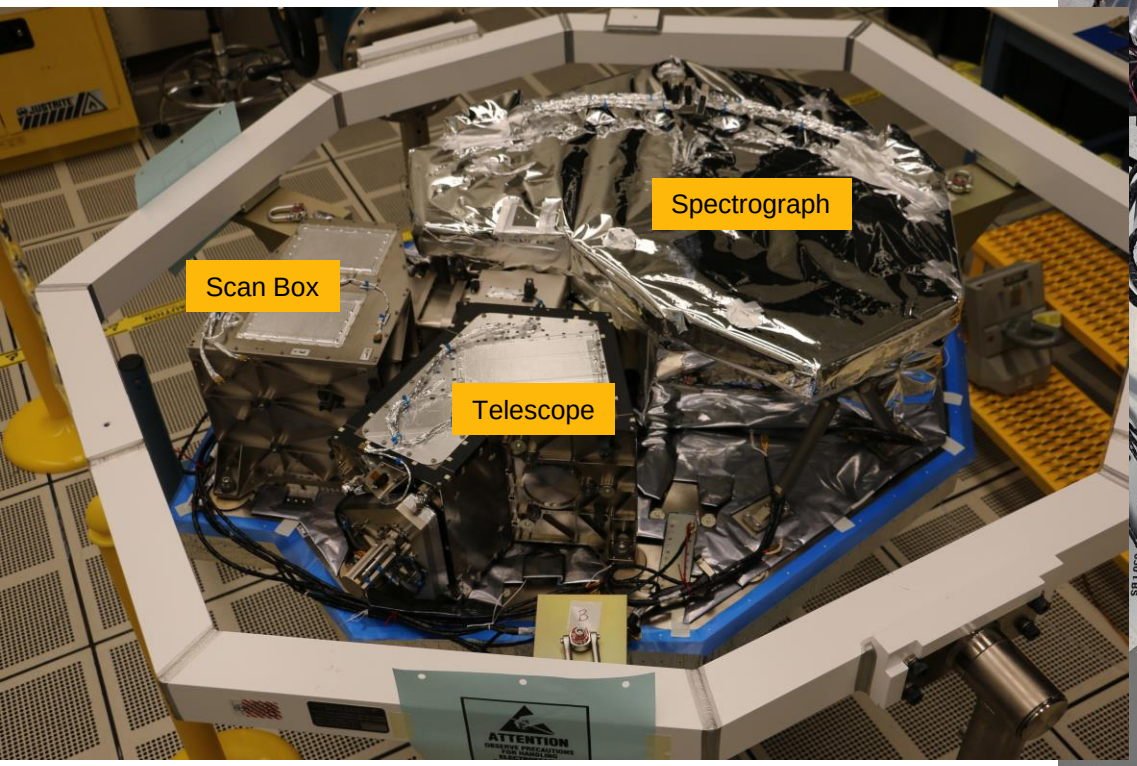
- **GEO adds a flexibility to observing that is not reproducible from a LEO orbit**
  - Amazon convection intensifies after 10am local time
- **Persistent, daily mapping of the Western Hemisphere land in the tropics, subtropics, and midlatitudes**
  - Opens up the possibility of estimating fluxes with different techniques (perhaps less dependence on transport?)
- **GeoCarb complements missions focused on monitoring anthropogenic emissions of CO_2 and methane by addressing climate-driven natural carbon flux variability**

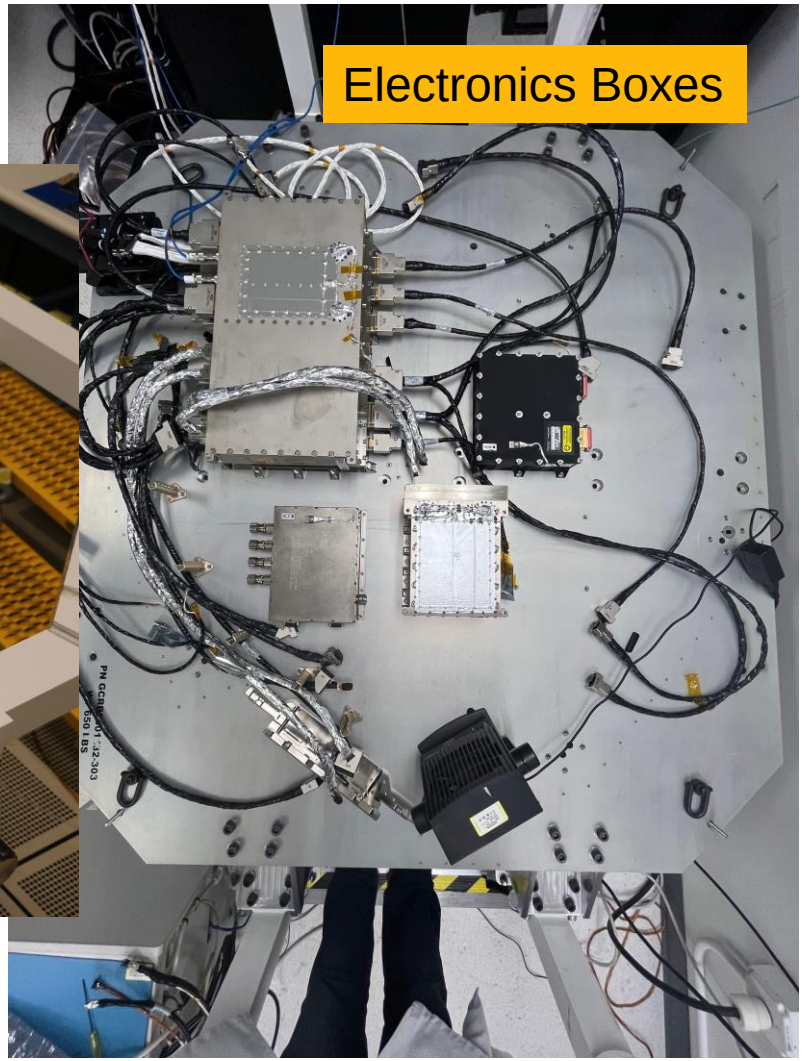
Then and Now

- **The last public GeoCarb update… (AGU 2022)**
  - GeoCarb was canceled due to cost and schedule overruns with no hope of completion
  - The spectrograph was integrated, but the first t-vac test showed that we were far out of focus
  - The electronics were still in assembly
  - Integration of the rest of the optics had not yet begun
- **In the last 10 months**
  - Spectrograph, telescope, scan box, and baffle/door successfully integrated onto the main bench and co-aligned - we have an integrated optics package! (June 2023)
  - Instrument optics package and electronics integrated and functionally tested - we have a functioning instrument! (Late August 2023)
  - Engineering Performance Test demonstrated that we have an instrument that has demonstrated the potential for game changing science (after a thorough calibration and some technical hurdles)

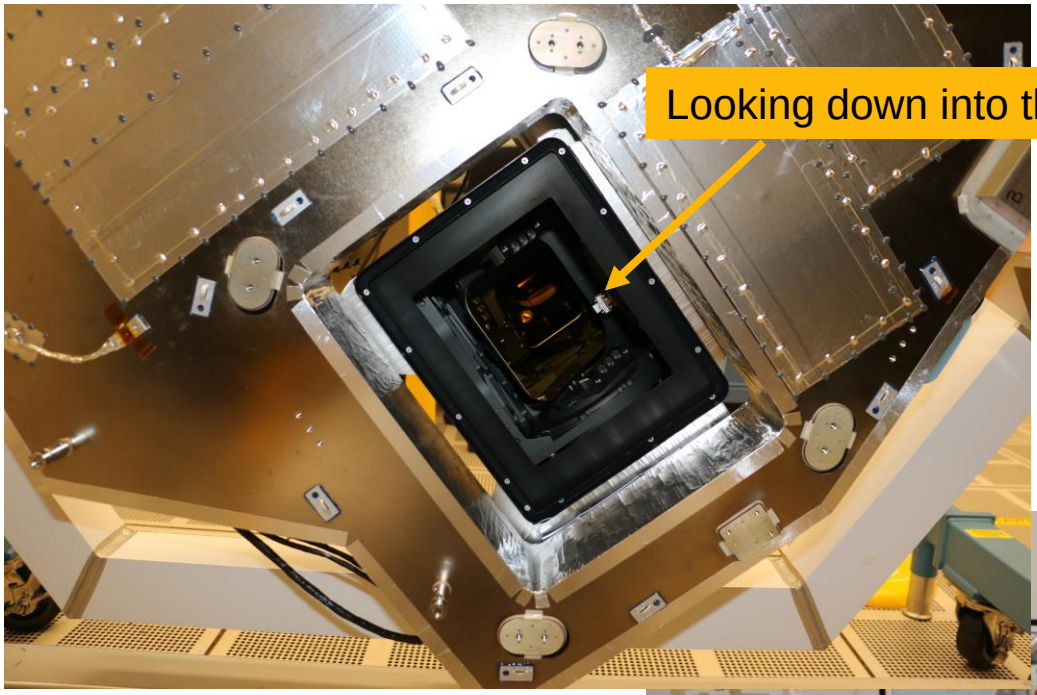
In less than a year, GeoCarb has gone from a functional spectrograph and immature subassemblies to an integrated instrument.

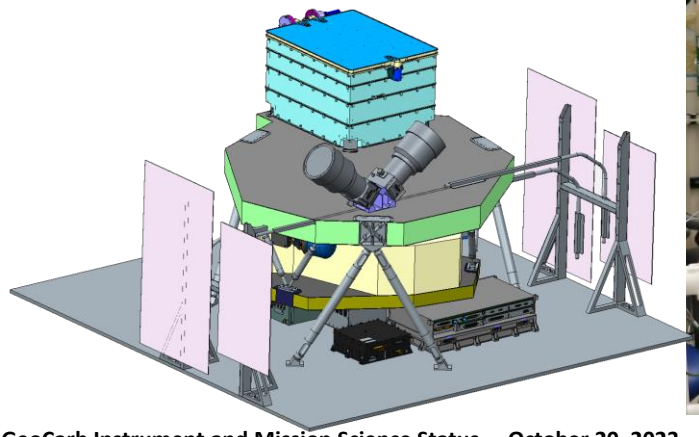
Completed Optics Package and Electronics

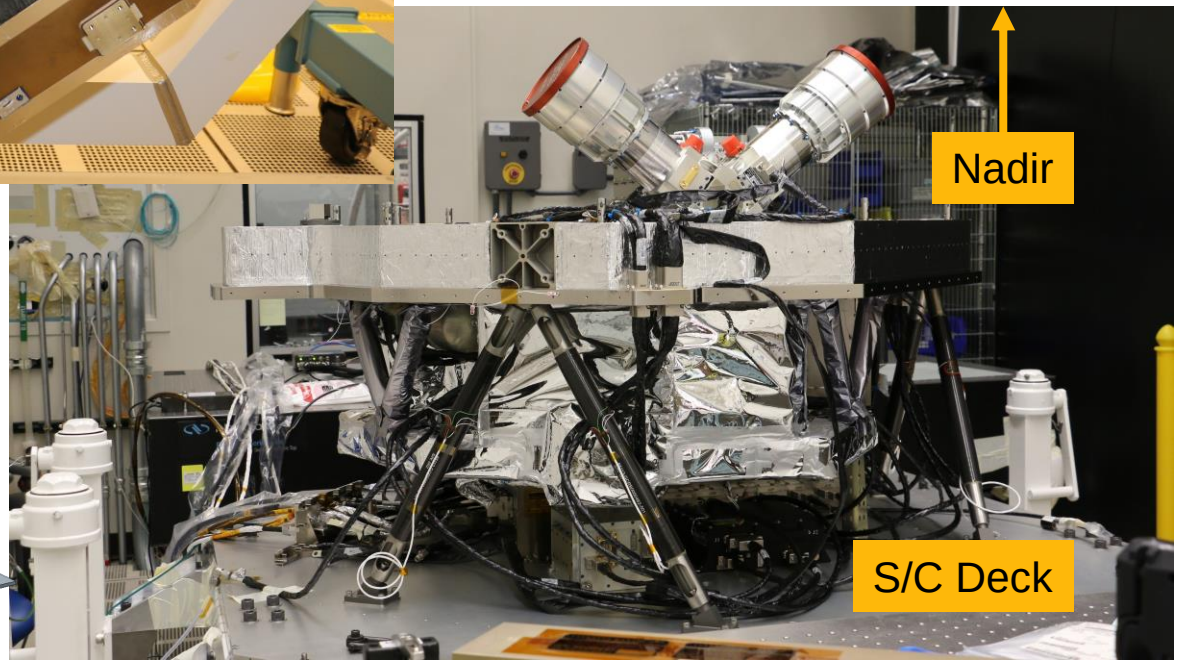




We have an integrated instrument!



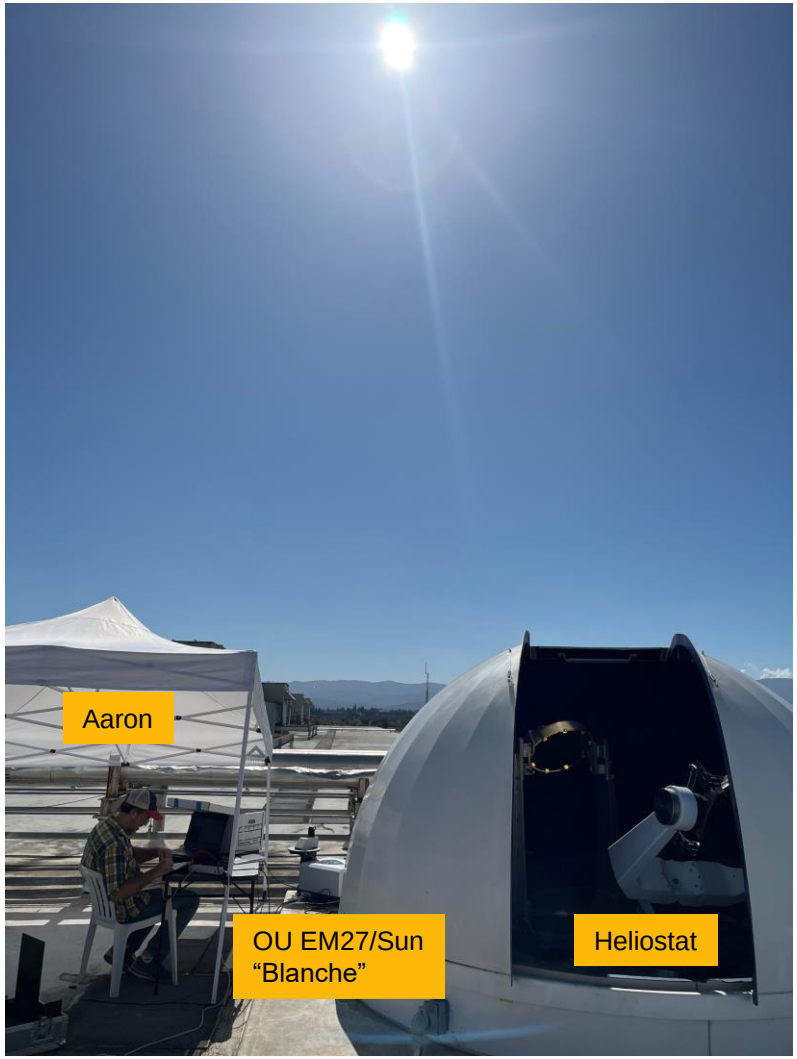




GeoCarb Heading into Test

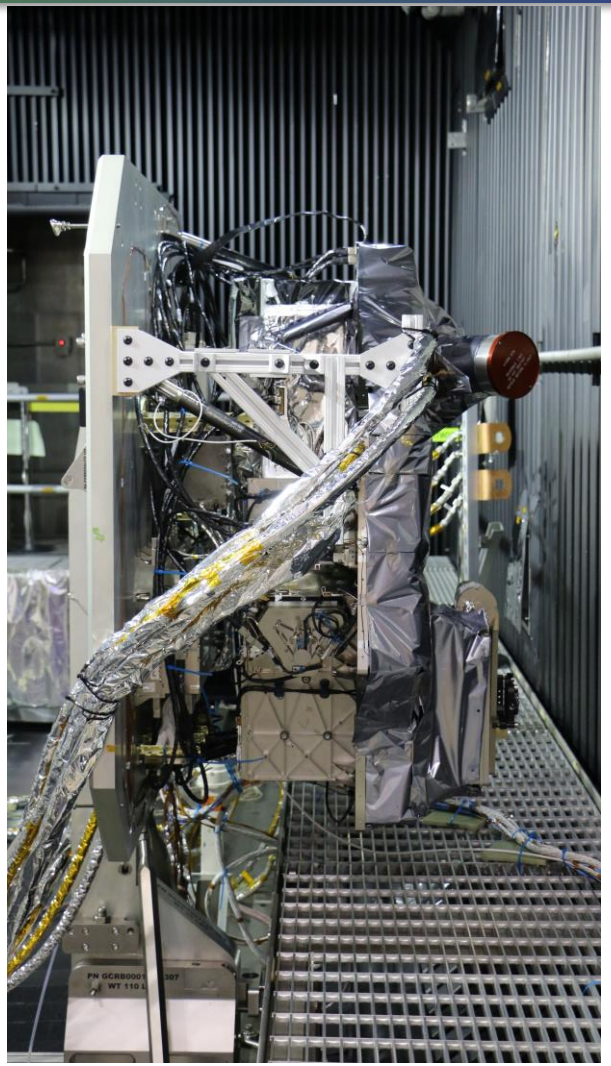
GeoCarb and EM27/Sun Solar Measurements

To assess spectral resolution and ILS shape, we take independent FTS measurements with higher resolution as a benchmark for comparison with GeoCarb sun looking measurements. Data were taken from solar noon through sunset.



Test Suite

- **Focus**
- **Alignment**
- **Darks and read noise**
- **Geometric Distortion**
- **Stray Light**
- **PSF**
- **ILSF**
- **Persistence**
- **Responsivity and linearity**
- **Polarization**
- **Heliostat**
  - Mid-day, sunset, and bar targets



Over 10,000 4-band images taken!

Summary of Instrument Performance

- **Signal-to-Noise Ratio:**
  - SNR will meet or exceed requirement for >95% of pixels
- **Spectral Resolution:**
  - Consistent with expectations
  - R = 14000 – 16000 (varies within slit)
- **Spatial Resolution:**
  - 1.5-2 pixels FWHM
  - Variation to be analyzed
- **Instrumental Polarization:**
  - <10% at all wavelengths, dominated by grating
- **Challenges:**
  - Geometric distortion (keystone)
    - Control points were measured
    - Data taken with heliostat and bar target for use in algorithm development
  - Stray light
    - Grating scatter in the dispersion direction contributes to high ZLO (1-5%)
    - Spatial scatter along slit
  - Persistence
    - Temperature dependent residual image
    - Forward bias of FPAs as mitigation (still under test)

What is next?

- **Closeout review and ship to NASA (November 2023)**
  - GeoCarb will be stored at NASA LaRC in a cleanroom with a nitrogen purge to keep contaminants out
- **Science and instrument team analyze EPT data and deliver report to NASA (November 2023 - July 2024)**
  - EPT results vs. science requirements
  - Prototype correction algorithms - background subtraction, bad pixels, stray light, geometric distortion, etc
- **NASA ESSP assessment (November 2023 - September 2024) - advise NASA HQ of expected cost and time to get GeoCarb calibrated and into space**
- **After assessment, NASA will determine next steps**

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  - Opens up the possibility of estimating fluxes with different techniques (perhaps less dependence on transport?)
- **GeoCarb complements missions focused on monitoring anthropogenic emissions of CO_2 and methane by addressing climate-driven natural carbon flux variability**
- **GeoCarb could be space-ready in 2025 with continued development after completed assessment**
- **NASA's ESE-GHG mission will not fly before 2029 at the earliest - more likely after 2031**

Thanks!