Opportunity Title: Arctic Carbon Cycle Dynamics and the Permafrost Carbon Feedback: CARVE, ABoVE, and Arctic CO2 and CH4 Syntheses
Opportunity Reference Code: 0090-NPP-NOV23-JPL-EarthSci

Organization National Aeronautics and Space Administration (NASA)

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Application Deadline 11/1/2023 6:00:59 PM Eastern Time Zone

Description The Arctic is warming dramatically, yet we lack the sustained observational time series and accurate physical models to know with confidence how the Arctic ecosystems and carbon cycle will respond to direct forcings from climate change or to poorly understood climate feedbacks such as fire and permafrost thaw. Fundamental elements of the Arctic hydrologic-carbon-climate system are poorly quantified and the sensitivity of the Arctic carbon cycle to climate change during the remainder of the 21st century is highly uncertain.

Permafrost soils are warming even faster than Arctic air temperatures. The efficient penetration of heat from the surface to these depths threatens to mobilize massive reservoirs of organic C that have been sequestered for tens of millenia. There are an estimated 1400 – 1850 PgC (1 PgC = 1×10^{15} gC) stored in permafrost across the Arctic, with ~500 PgC stored in the most vulnerable top 100 cm (for comparison, there have been ~350 PgC released from all fossil fuel combustion since 1850).

The importance of Arctic-boreal C dynamics is underscored by the potential for a large permafrost carbon feedback (PCF) where rapidly changing climate conditions accelerate the microbial decomposition of the large quantities of old organic C stored in the region‘s frozen soils (permafrost) and the release of the greenhouse gases CO_2 and methane (CH_4). A critical carbon cycle science challenge is to detect and quantify the PCF. Despite intense research, the timing, magnitude, location and form of the PCF remain highly uncertain due to the many poorly understood or unconstrained mechanisms and parameters that control permafrost thaw and subsequent organic matter decomposition.

We apply the full suite of JPL‘s measurement and modeling capabilities to understand and quantify carbon cycling in northern high latitude ecosystems. This research uses data acquired by satellites (SCIAMCHY, GOSAT, OCO-2, OCO-3, TropOMI), airborne measurements from NASA‘s CARVE and ABoVE investigations, and numerous ground-based atmospheric CO_2, CH_4 and CO measurements. NPP researchers will have the opportunity to participate in

- 2017 and 2019 ABoVE Airborne Campaigns in Alaska and Canada‘s Northwest Territories
- International activities to synthesize Arctic CH_4 and CO_2 data in conjunction with the SEARCH Permafrost Action Team and the Permafrost Carbon Research Network
- The Pan-Arctic Carbon Budget Closure Experiment
- Developing methods to detect the permafrost carbon feedback

- Data assimilation and analysis studies designed to characterize scale-dependence and spatiotemporal variability in the processes that control Arctic CO_2 and CH_4 fluxes

Successful candidates will have expertise in atmospheric physics and chemistry, carbon cycle science, airborne instruments, atmospheric remote sensing, or the equivalent. They will join JPL's Carbon Cycle Science group and the ABoVE Science Team, with the opportunity to engage in related activates at JPL. The final research plan will tailored to the expertise and future goals of each candidate.

References

CARVE: The Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE) was one of NASA's first Earth Ventures Suborbital (EV-S1) investigations. CARVE was a 5-year, ~$30 million mission designed to quantify correlations between atmospheric concentrations of CO2 and CH4 with surface-atmosphere carbon fluxes and surface state control variables (soil moisture, freeze-thaw state, inundation state, surface soil temperature) and elucidate the sensitivities of Arctic carbon cycle processes to climate change. CARVE conducted nearly 200 sorties and flew ~1100 science flight hours from 2012-2015. Flight lines covered most of Alaska and extended into the Mackenzie Delta region of Canada's Northwest Territories. Dr. Miller was the CARVE PI. See http://science.nasa.gov/missions/carve/ for additional details.

ABoVE: NASA's Arctic Boreal Vulnerability Experiment is a ~10-year, ~$100 million community field experiment conducted by the Terrestrial Ecology Program. ABoVE fieldwork began in 2016 and will feature intensive airborne campaigns in 2017 and 2019. Dr Miller is the ABoVE Deputy Science Lead and lead for the ABoVE airborne campaigns. See http://above.nasa.gov/index.html for additional details

Permafrost Carbon Network: http://www.permafrostcarbon.org/

Location:
Jet Propulsion Laboratory
Pasadena, California

Field of Science: Earth Science

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Applications with citizens from Designated Countries will not be

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accepted at this time, unless they are Legal Permanent Residents of the United States. A complete list of Designated Countries can be found at: https://www.nasa.gov/oiir/export-control.

Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Eligibility Requirements

- **Degree:** Doctoral Degree.