

**Title: [Open Science Techniques for Exploring Greenhouse Gas Data: An Interactive Workshop on the U.S. Greenhouse Gas Center and VEDA Tools for use in Earth Science Research](#)**

- **Workshop Pre-requisites:**  
<https://us-ghg-center.github.io/ams-2024-workshop/prerequisites.html>
- [Workshop registration page](#) at AMS

Description:

This workshop provides a hands-on learning experience for researchers, educators, and students who are eager to harness NASA's key greenhouse gas datasets, open-source tools, and accessible computing resources for visualizing, exploring, publishing, and communicating scientific results. Participants will learn about and utilize the new U.S. Greenhouse Gas Center (GHG Center) to examine curated, trusted data in a cloud computing environment. The activities will center around data and information aligned with three science use cases to ensure broad applicability. Participants will learn to access analysis workflows using cloud-optimized data, access data products via a standards-based catalog, configure data products for web-based visualizations, and communicate scientific discoveries through a web dashboard.

The workshop will provide an overview of the newly released U.S. Greenhouse Gas Center, a prototype system that aims to integrate federal and non-federal data, reflecting transparency in both data and methods, to address a variety of end user needs for greenhouse gas monitoring and to bring together actionable information from multiple sources. Examples of products that will be part of this training include methane concentration anomalies from space-based instruments (e.g., EMIT), data on natural emissions and fluxes available from the U.S. GHG Center, as well as gridding processes of anthropogenic methane emissions.

Learning Outcomes:

Upon completing this workshop, participants will be able to:

1. Understand the scientific basis of the GHG products from the newly formed U.S. Greenhouse Gas Center.
2. Employ Python and Jupyter Notebooks for effective data analysis and visualization of Earth science data in the cloud.
3. Disseminate and share scientific findings to achieve a wider impact.
4. Understand basic principles for contributing to open-sourced software projects.

Target Audience:

The target audience for this workshop includes **Earth Science researchers, educators, and students across all career stages and disciplines who are interested in utilizing GHG datasets and open-source tools for their research projects.** The workshop will be beneficial

for both experienced programmers seeking an overview of modern open tools and those just getting started with scientific programming.

**Short Course (January 28):** Advancing Open Science: An Interactive Workshop on Harnessing VEDA for Earth Science Research at the U.S. Greenhouse Gas Center. Learn how to effectively analyze and visualize Earth science data in the cloud using open-source tools and datasets.

### **Workshop Agenda:**

The full-day workshop will be divided into the following sections:

- Welcome (8:00 - 8:15)
  - Welcome message
  - Workshop Introduction
  - Team Introduction
  - Icebreaker
  
- Overview of the U.S. Greenhouse Gas Center and the Science (8:15 - 8:45)
  - What is the US GHG Center?
  - Role of Methane and Carbon Dioxide in Climate Change
  - What is included in the Center and why these datasets
  - Introduction to the science use cases / demonstration areas that will be explored during the workshop
  
- Introduction to GHG Center Data Catalog (8:45 - 10:00)
  - Intro to the VEDA project and its relevance to Earth Science research and the US GHG Center
  - What is a STAC catalog?
  - **Hands-on exercise:** searching and accessing cloud-optimized datasets using the STAC catalog
    - Intro to JupyterHub and Jupyter Notebooks
      - Access to the JupyterHub environment
      - Creating and running a Jupyter Notebook in the hub
    - Using the pystac client library to read the US GHG STAC catalog
      - List all available datasets
      - Spatial and temporal search
      - Access assets and visualize them
    - Accessing the US GHG STAC catalog using QGIS on the browser (stretch/if time permits)

- Establishing connection to the US GHG STAC catalog using the qgis-stac-plugin in QGIS in the GHG Center JupyterHub environment
  - Adding a dataset/asset from the catalog as layer in QGIS
- **BREAK (10:00 - 10:15)**
- Interactive Session 1: EPA Gridded Methane Emissions Inventory and ODIAC data (10:15 - 11:15)
  - Introduction and background of datasets & human anthropogenic emissions (15 mins)
  - **Hands-on exercise:**
    - (20 mins) Comparing emissions over time using EPA Gridded methane data
    - (20 mins) ODIAC: Compare ODIAC data to satellite data over time/on specific date (using OCO-2, OCO-3 DAAC data), introduce intersection with geospatial data
- Interactive Session 2: Complementing Anthropogenic GHG Emissions with Natural GHG Emissions and Fluxes (11:15 - 12:15)
  - Description of data sets and analysis available via the U.S. GHG Center (e.g., gridded wetland emissions and ecosystem exchange estimates)
  - **Hands-on exercise:** Exploring annual U.S. wetland methane emissions and their meteorological influences.
- **LUNCH BREAK (12:15 - 1:30)**
- Interactive Session 3: Identifying and quantifying emissions from large point source methane emission events leveraging aircraft and satellite data (1:30 - 2:45)
  - Description of data sets and analysis available via the U.S. GHG Center (e.g., EMIT methane enhancements; plans for emission rates, CO<sub>2</sub>, etc.)
  - **Hands-on exercise:** Locating enhancement, understanding temporal relevance, exploring sites with multiple observations.
- Open Science in Action: Intro to GitHub & Communicating Science Discoveries via Web Dashboard (2:45 - 3:15)
  - How do VEDA, GitHub, and JupyterHub interoperate and why is this important?
  - Introduction to web dashboards for science communication
    - **Hands-on exercise:** creating a web dashboard to communicate science discoveries using the platform
      - Short intro to GitHub
      - Creating a “data insight” based on datasets in the US GHG Center
- Closing Remarks (3:15 - 3:30)
  - Future Developments and Community Contributions
  - Engaging with the U.S. Greenhouse Gas Center

Throughout the workshop, facilitators will be available to provide support and guidance, ensuring participants are able to actively explore the workshop topics and apply their knowledge and skills to their own research projects.

## **Speakers:**

Shanna Combley<sup>1</sup>, Argie Kavvada<sup>1</sup>, Slesa Adhikari<sup>2</sup>, Sid Chaudhary<sup>2</sup>, Tom Oda<sup>3</sup>, Lesley Ott<sup>4</sup>, Rob Green<sup>5</sup>, Annmarie Elderling<sup>6</sup>

1. National Aeronautics and Space Administration (NASA) Headquarters
2. University of Alabama in Huntsville (UAH)
3. Universities Space Research Association (USRA)
4. NASA Goddard Space Flight Center (GSFC)
5. NASA Jet Propulsion Laboratory
6. National Institute of Standards and Technology

## **Support Team:**

- General Support:
  - Deborah Smith (UAH)
  - Sid Chaudhary (UAH)
  - Alix Kashdan (NASA HQ)
- Interactive Sessions:
  - Emily Bell (GSFC)
  - Colin Quinn (GSFC/UMD)
  - Thomas Coligan (GSFC)