



CMS Applications: Engaging Stakeholders in CMS Flux Projects

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CMS Applications Team:

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- George Hurtt, University of Maryland
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CMS Flux Working Group Meeting
Wednesday, May 13, 2020



Presentation Overview

- CMS Applications Efforts Overview
 - CMS Applications Program Framework
 - Overview of CMS Data Products & ARLs
 - CMS Stakeholder Survey for Science Team
 - CMS Stakeholder Surveys Results
- Stakeholder Engagement Approach
- Resources & Opportunities
- Potential Stakeholders for CMS Flux Projects
- Upcoming Applications Events in 2020

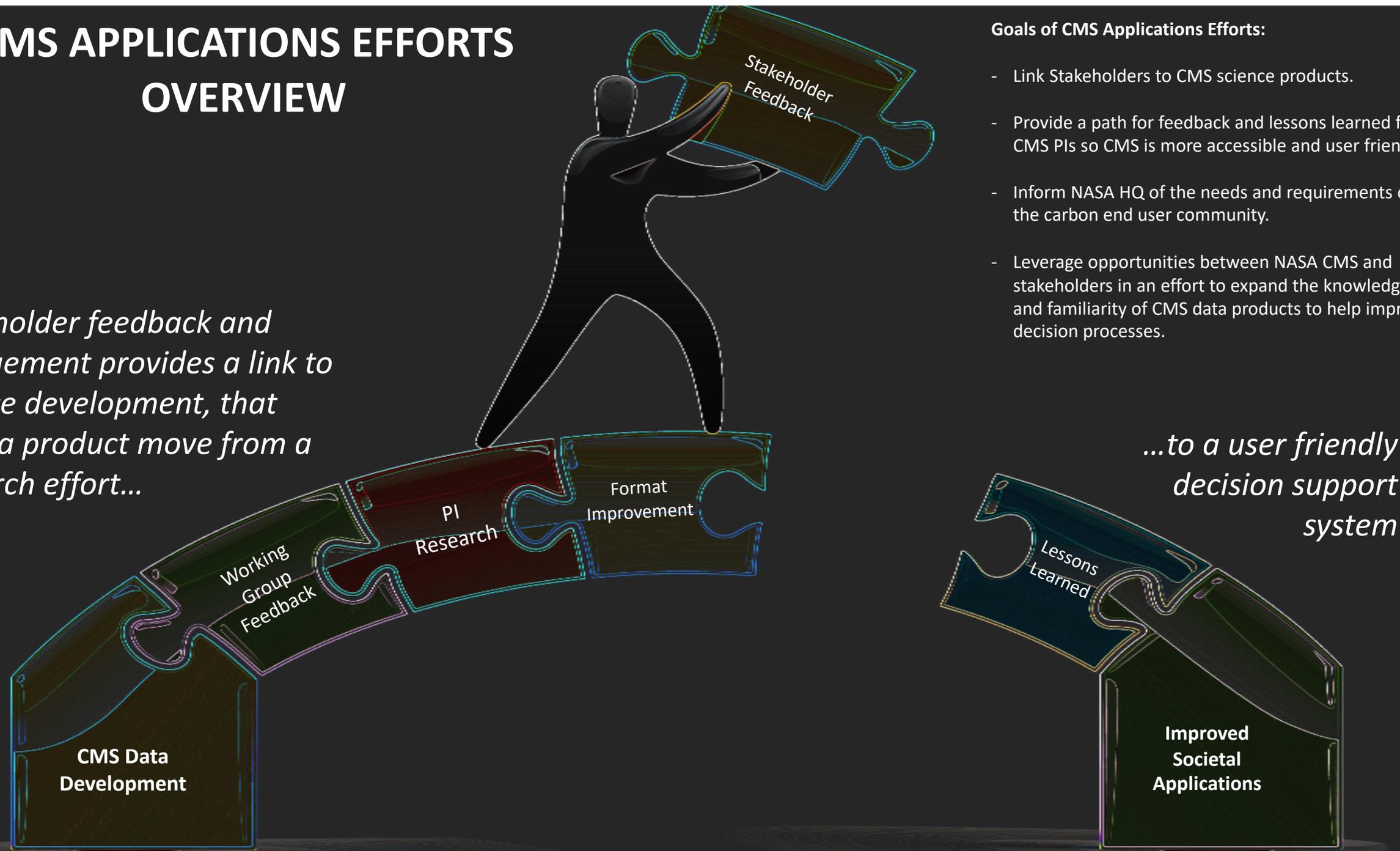


CMS APPLICATIONS EFFORTS OVERVIEW

Goals of CMS Applications Efforts:

- Link Stakeholders to CMS science products.
- Provide a path for feedback and lessons learned for CMS PIs so CMS is more accessible and user friendly.
- Inform NASA HQ of the needs and requirements of the carbon end user community.
- Leverage opportunities between NASA CMS and stakeholders in an effort to expand the knowledge and familiarity of CMS data products to help improve decision processes.

Stakeholder feedback and engagement provides a link to science development, that helps a product move from a research effort...



*...to a user friendly
decision support
system*

**CMS Data
Development**

**Working
Group
Feedback**

**PI
Research**

**Format
Improvement**

**Stakeholder
Feedback**

**Lessons
Learned**

**Improved
Societal
Applications**



CMS Applications Program Framework

Policy Speaker Series

Brings stakeholders to NASA to explain how carbon science data are applied to specific policies. Informs CMS science community of specific stakeholders data needs and collaboration opportunities.



Applications Workshops

Annual event with CMS Science Team and end users for a better understanding of stakeholder uses, needs and challenges for carbon monitoring and MRV as well as lessons learned.



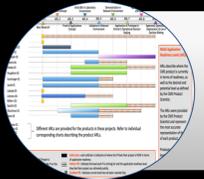
Data Products Fact Sheet

Collection of CMS metadata and policy data for each product (e.g. spatial extent, resolution, uncertainty, application areas, relevant policies), Integrated into CMS website database.

Product Name	Resolution	Spatial Extent	Uncertainty	Application Areas	Relevant Policies
Global Carbon Dioxide (GCD)	1.000000E+01	360.000000E+00	0.000000E+00	Global	Paris Agreement, UNFCCC
Global Carbon Monoxide (GCM)	1.000000E+01	360.000000E+00	0.000000E+00	Global	Paris Agreement, UNFCCC

Application Readiness Levels (ARLs)

Provide transparency to HQ and user community on the maturity of each CMS product. Used as a communication tool for stakeholders to assess product maturity.



Surveys & Community Assessments

Evaluate thematic user challenges within the CMS. Assess impact of CMS data products for end user organizations.



Socioeconomic Studies

Development of socioeconomic case study addressing the social value of CMS Lidar in MD DNR policy, and an ongoing assessment of the contribution of CMS flux products to the reduction of uncertainty in the carbon cycle.

Investment Type	Cost (\$/tCO ₂ e)	Abatement (tCO ₂ e/yr)
Forest Management	100	1000
Reforestation	150	1500
Conservation	200	2000



Feedback to CMS Science Community and NASA HQ, ESD



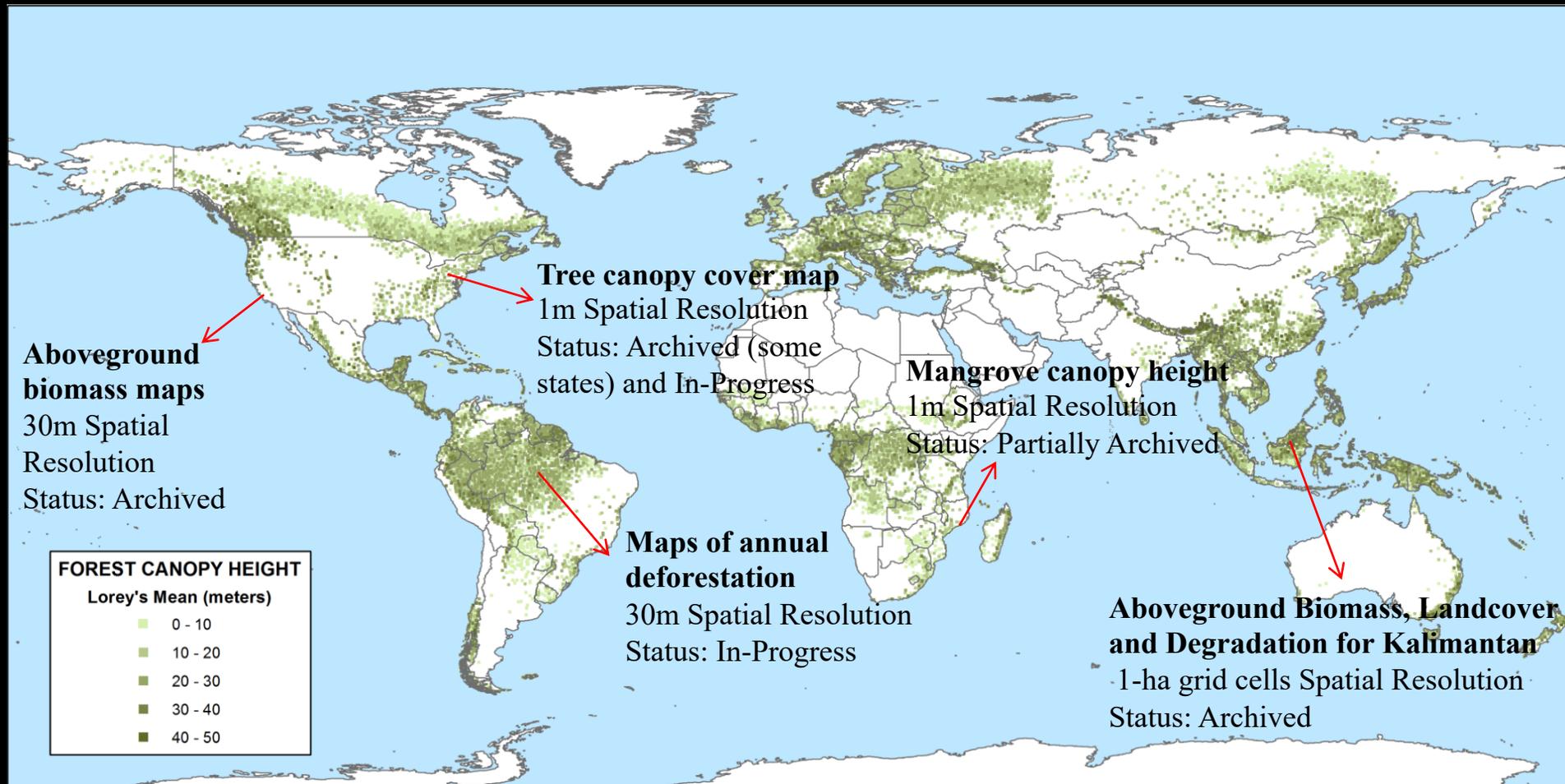
CMS Applications Efforts Examples. Tri-State Area Applications Workshop & Tutorial in Newtown Square, PA: CMS Application workshops and tutorials provide an opportunity for CMS Science Team members and stakeholders to engage on thematically detail objectives that help advance CMS science into appropriately scaled policy arenas.





CMS Data Products

96 Projects
312+ Data Products
Local to international scale



Global forest canopy height (Healey, 2015)
Archived at ORNL DAAC

Available at: <https://doi.org/10.3334/ORNLDAAC/1271>



Overview of CMS Data Products

- Where can CMS datasets be found?

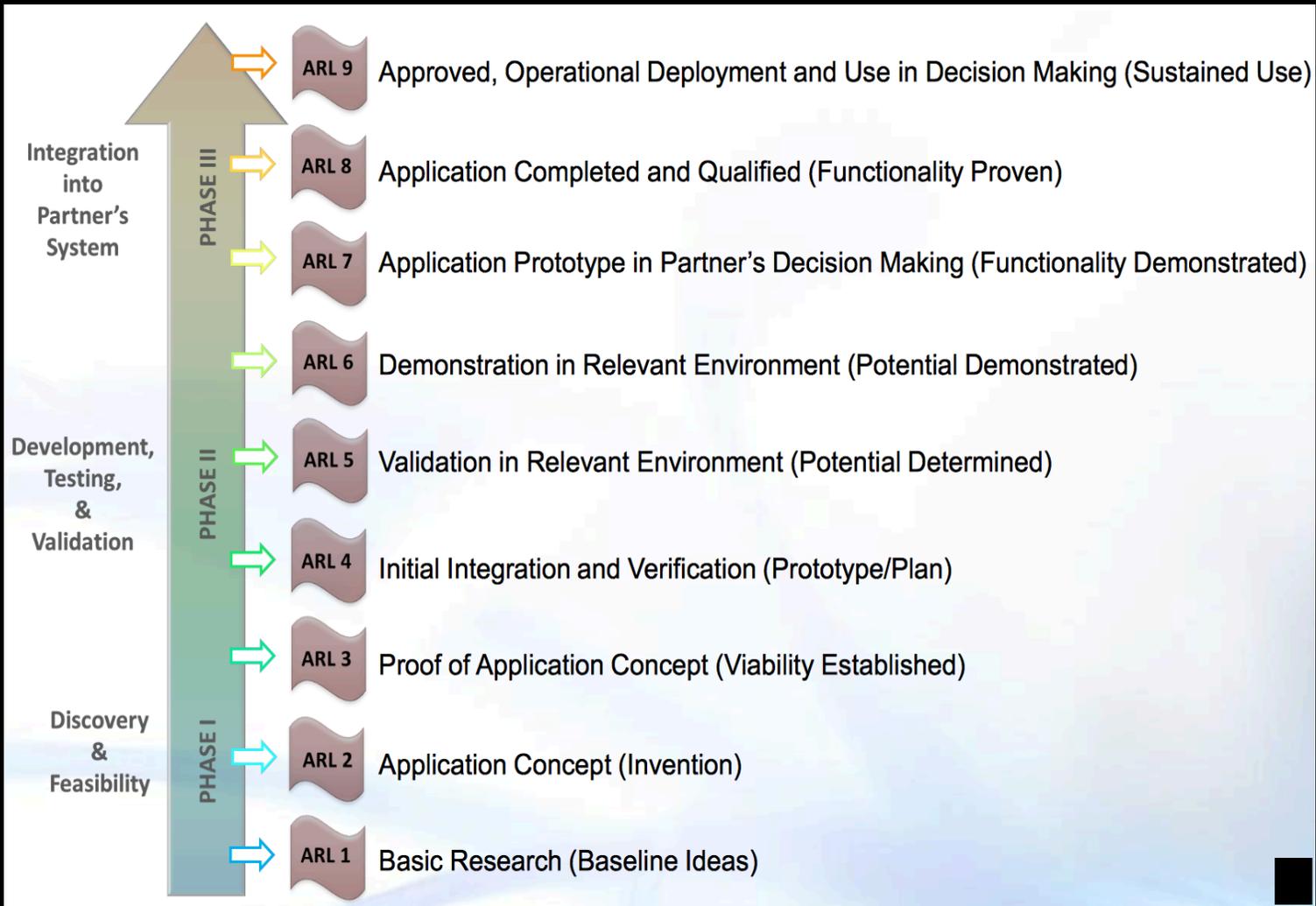
Metadata Fields	Explanation
Award Year	The year the funding was granted
Project ID	Principal Investigator's last name and project #
Objectives	Goals that the project seeks to attain by developing data and products
Science Theme	Type of data and products, according to components of carbon cycle research that are most relevant: Global Flux, Ocean-Atmosphere Flux, Land-Atmosphere Flux, Land-Ocean Flux, Land Biomass, Ocean Biomass, Lake Biomass, MRV, and Decision Support
Products Keywords	Keywords that will help stakeholders identify data and products appropriate to their needs. See below for a table that explains each product keyword.
Data Products	A description of output data and products that will be publicly available upon completion of the project
Spatial Extent	The geographical area that the data and products cover
Coordinates	Coordinates can be approximate. They can be the center of Spatial Extent or study sites. Shape files are welcome.
Time Period	The time period that the data and products cover
Spatial Resolution	Finest spatial resolution of data and products
Temporal Frequency	Time intervals of data products
Input Data Products	Any satellite, airborne, field, and modeled data products used. If airborne Lidar data was used, please indicate where, when, which instruments, and how much data (area, dimensions, or number and length of lines).
Algorithm/Models Used	Any algorithm or models used to develop data and products
Evaluation	Any efforts to evaluate the accuracy, robustness, and/or performance of data and products
Intercomparison Efforts/Gaps	Any key intercomparison effort(s) that have been undertaken or gaps where future intercomparison efforts are warranted
Uncertainty Estimates	Plans to quantify data uncertainty, if any
Uncertainty Categories	1. Ensemble (e.g. stochastic), 2. Deterministic, 3. Model-Data Comparison, 4. Model-Model Comparison, and/or 5. Data-Data Comparison
Application Areas	Areas with policy or societally relevant decision processes, which may benefit from the usage of data and products
Potential Users	Possible end users of data and products once fully developed
Stakeholders	End users engaged with CMS PIs who are using or plan to use data and products in the future
Application Readiness Level (ARL)	The NASA index that assesses applications potential of data and products in operational settings. Detailed explanation . Principal Investigators specified the ARLs of their own projects
Future Developments	Future plans to engage stakeholders, share data and products, and raise awareness of the product development efforts
Limitations	Any shortcoming of data and products that users must be aware of
Date When Data/Product Available	The date (MM/DD/YY - if possible) on which data and products will be made publicly available
Data Server URL	The URL address where a user may access data and products
Metadata URL	The URL address where a user may access metadata

The screenshot displays the NASA Carbon Monitoring System (CMS) website. At the top, it features the NASA logo and the text 'National Aeronautics and Space Administration'. The main heading is 'NASA Carbon Monitoring System'. Below this, there are navigation links for 'Visit ccc.nasa.gov', 'Visit nasa.gov', and 'Contact Us'. The page is divided into several sections:

- Overview:** A brief description of the CMS program, stating it provides significant contributions in characterizing, quantifying, predicting the evolution of global carbon sources and monitoring of carbon stocks and fluxes. It mentions the use of observations and modeling/analysis capabilities to address quantitative uncertainties and the utility of products for international policy, regulatory, and management activities.
- Carbon Monitoring System Datasets List:** A list of datasets with a search bar and filters. The list includes:
 - Annual Burned Area from Landsat, Mawas, Central Kalimantan, Indonesia, 1997-2015
 - DARTE Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, V2, 1980-2017
 - Forest Carbon Stocks and Fluxes After Disturbance, Southeastern USA, 1990-2010
 - Ecosystem Functional Type Distribution Map for Mexico, 2001-2014
 - Ocean Surface pCO2 and Air-Sea CO2 Flux in the Northern Gulf of Mexico, 2006-2010
 - CMS: Mangrove Forest Cover Extent and Change across Major River Deltas, 2000-2016
- Refine By:** A section for filtering datasets by subject (Atmospheric Chemistry, Ocean Chemistry), measurement (Alkalinity, Biogeochemical Cycles, Carbon, Carbon Dioxide, Dissolved Gases), and source (GOSAT TANSO-FTS, Models/Analyses BLING, Models/Analyses CASA-GFED3-V2, Models/Analyses CMS-Flux-V1, Models/Analyses ECCO2 Darwin-V3).
- Fatoyinbo (CMS 2014) Project Profile:** A detailed profile for a specific project, including:
 - Project Title:** Total Carbon Estimation in African Mangroves and Coastal Wetlands in Preparation for REDD and Blue Carbon Credits
 - Science Team Members:** Temilola (Lola) Fatoyinbo, NASA GSFC (Project Lead); David Lagomasino, USRA-NASA
 - Project Duration:** 2014 - 2018
 - Solicitation:** NASA: Carbon Monitoring System (2014)
 - Abstract:** Coastal Blue Carbon ecosystems such as mangroves, salt marshes and seagrass beds have the highest total carbon densities of all ecosystems. Although they only represent 3% of the total forest area, carbon emissions from mangrove destruction at current rates could be equivalent to 10% of carbon emissions from deforestation. The high carbon sequestra ... [more]
 - Keywords:** CMS; Land Biomass; Land-Atmosphere Flux; Land-Ocean Flux; Decision Support; MRV
 - Participants:** Temilola (Lola) Fatoyinbo, NASA GSFC; Emanuele Feliciano, NASA GSFC / ORAU; David Lagomasino, USRA-NASA; Marc (Mac) Simard, Jet Propulsion Laboratory / Caltech
 - Contact Support:** to request an email list of project participants.
 - Project URL(s):** None provided.
 - Data Products:**
 - Product Title: Mangrove forest biomass estimates.
 - Time Period: 2013-2015
 - Spatial Extent: Gabon, Tanzania, and Mozambique
 - Spatial Resolution: 1m to 12 m
 - Temporal Frequency: Single Product 2013/2014
 - Status: In-Progress



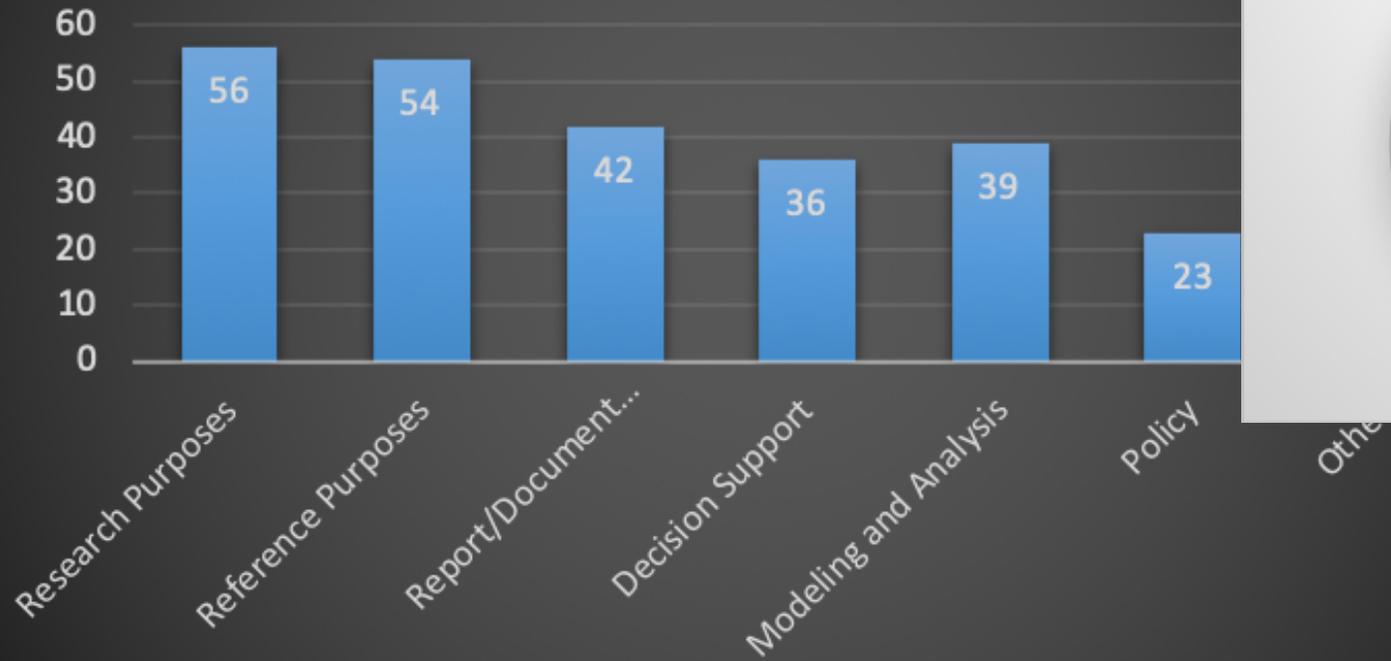
ARL Refresher



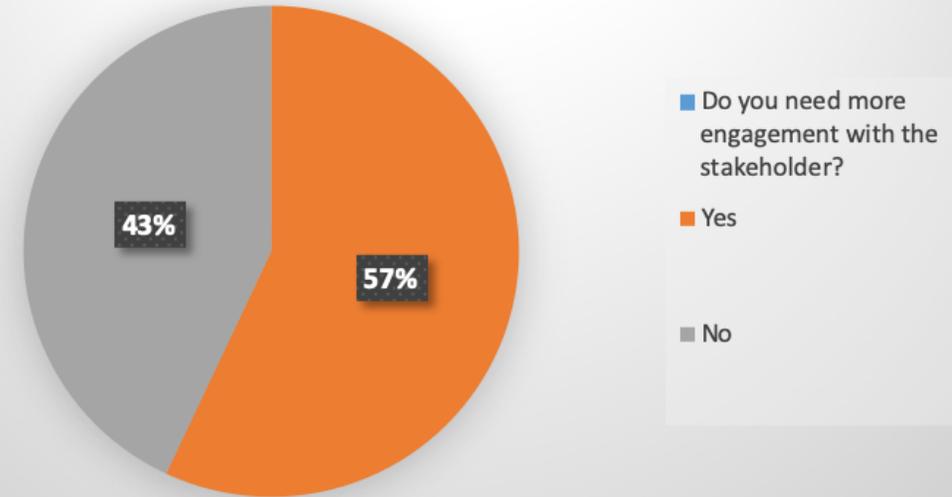
- Serve as a guide to user community
- Set expectations to user on how to use products and what feedback to provide
- ARL designated by the CMS PI
- Update as needed
- Intended to guide HQ and user community on the maturity of products



Current or Expected Use of CMS Products



Stakeholder Engagement Need



25 PIs responded
86 stakeholders identified

CMS Stakeholder Survey for Science Team

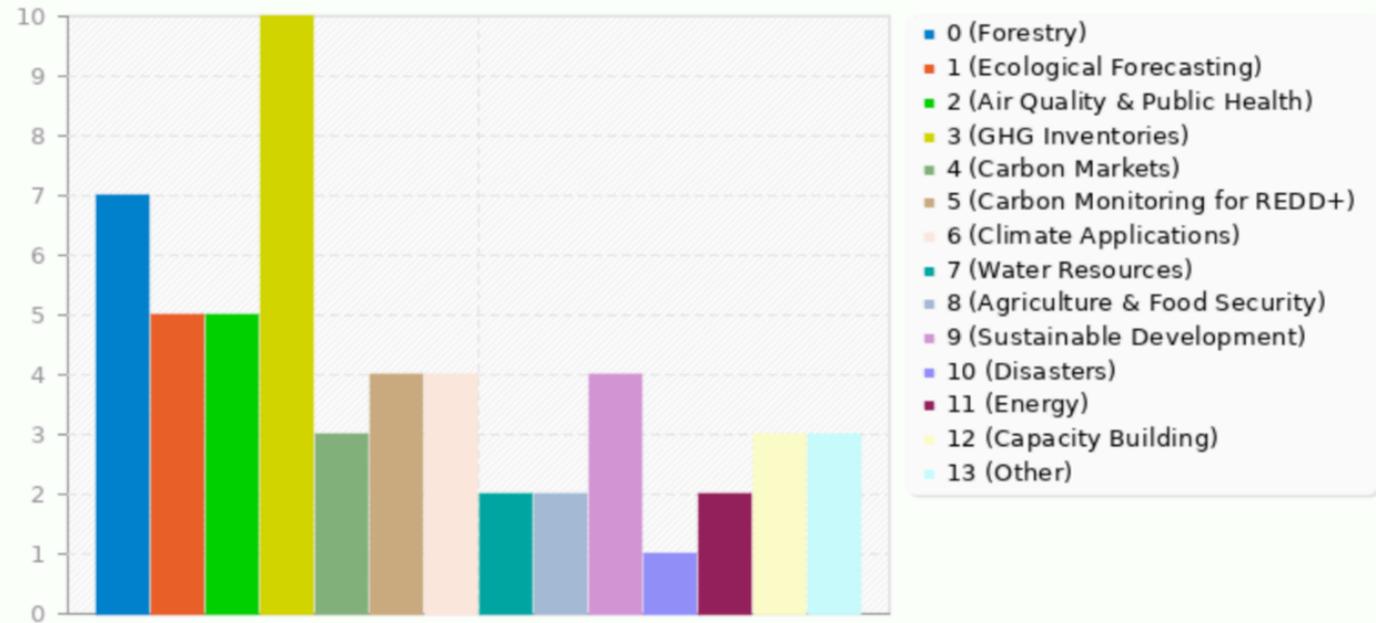
- Main stakeholders: USDA Forest Service, US EPA, NOAA, CA ARB
- Not all stakeholders are using CMS data products at this moment
- All products, be research or operational products, have feedback potential



Stakeholder Feedback

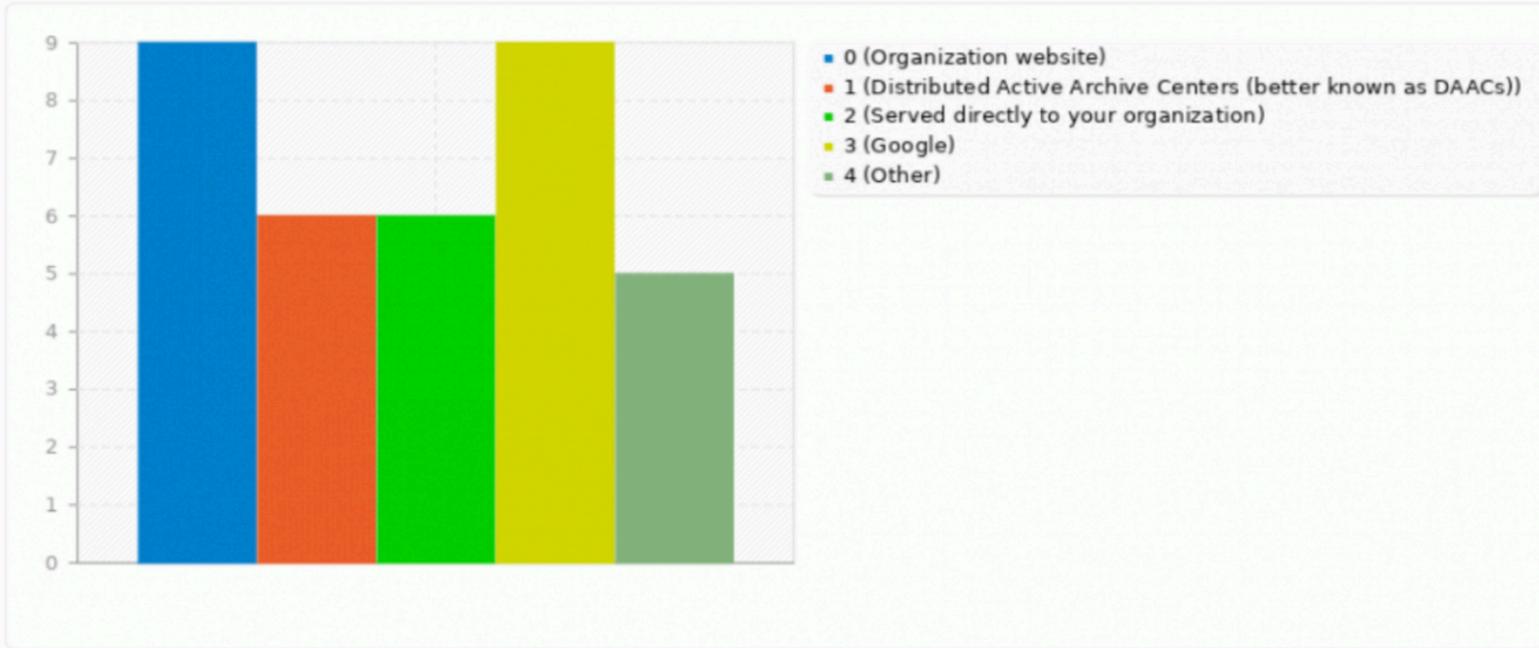
Principal Applications
GHG Inventories
Forestry
Ecological Forecasting
Air Quality & Public Health

What are some of the applications you address with the carbon products?

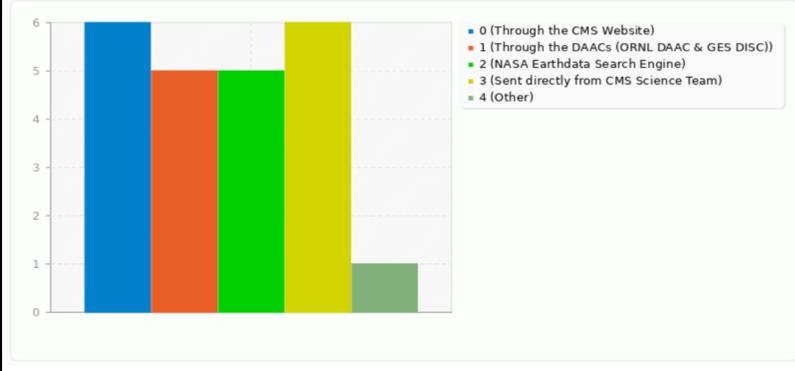




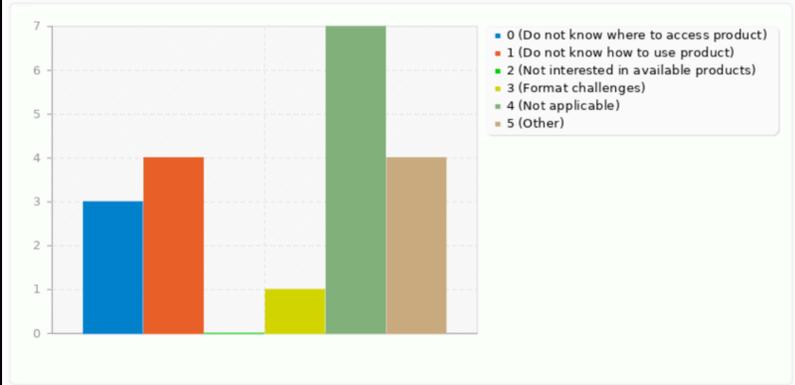
Where do you search for carbon data products?



How do you access the products?



What prevents you from accessing CMS data products?

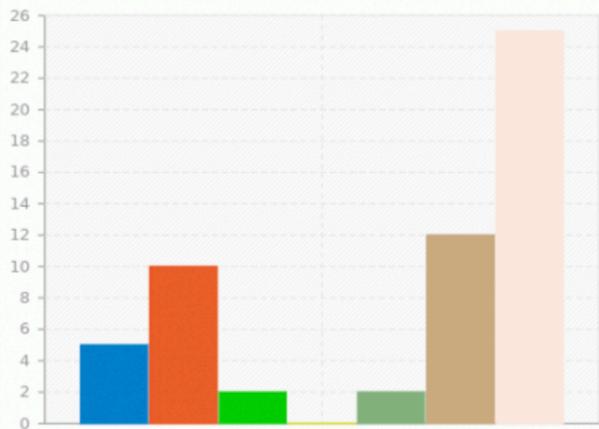


Stakeholder Feedback



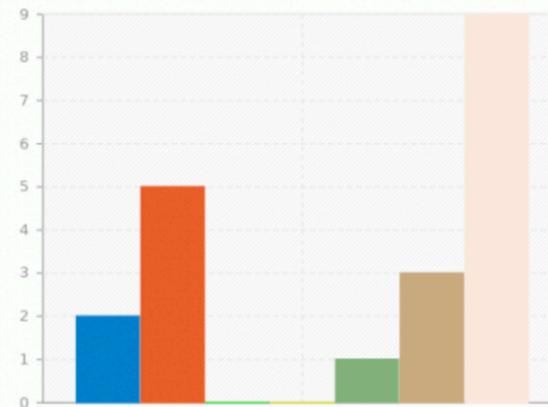
CMS Science Theme

Which CMS science theme is most relevant to your work? (Check all that apply)



- 0 (Global Surface-Atmosphere Flux)
- 1 (Land-Atmosphere Flux)
- 2 (Ocean-Atmosphere Flux)
- 3 (Ocean Biomass)
- 4 (Land-Ocean Flux)
- 5 (Land Biomass)
- 6 (Measurement, Reporting, and Verification (MRV) | Decision Support)

Which CMS science theme is most relevant to your work? (Check all that apply)

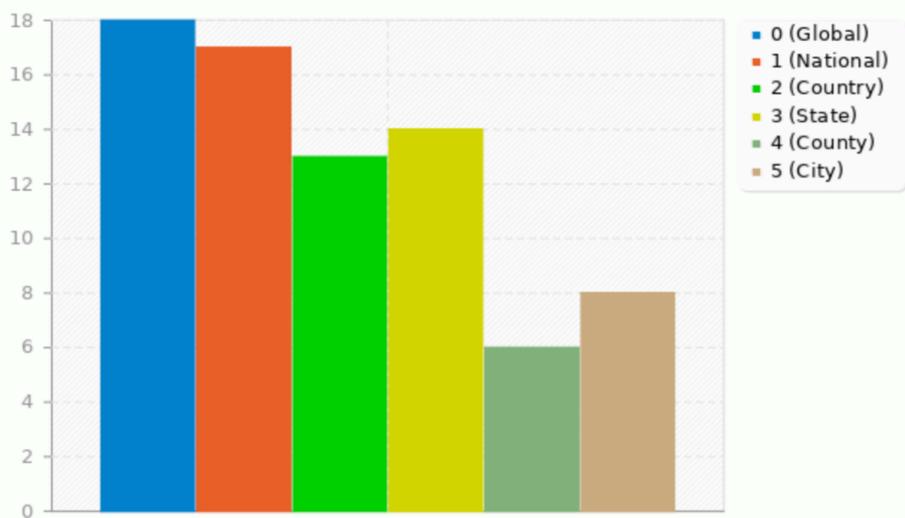


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- 1 (Land-Atmosphere Flux)
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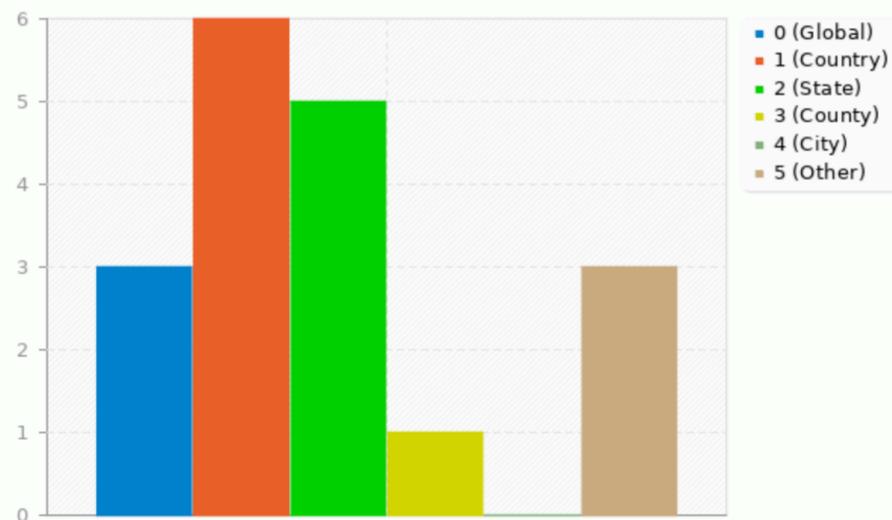


Spatial Extent

What is your geographical area of interest? (Check all that apply)



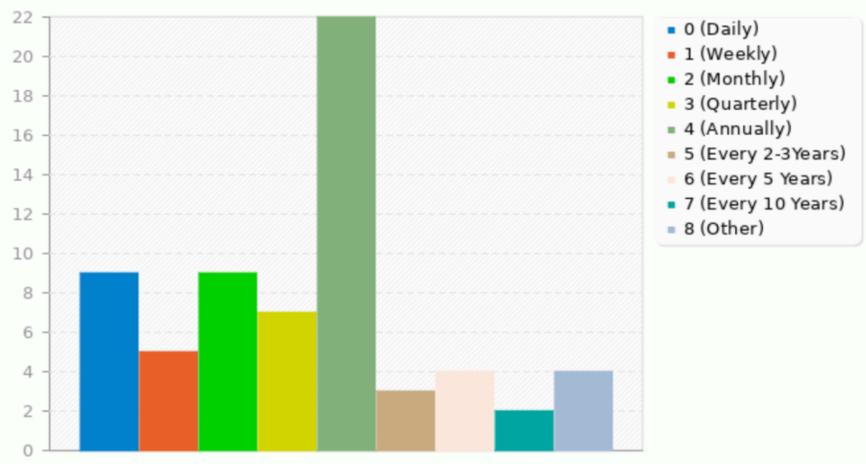
What is your geographical area of interest? (Check all that apply)



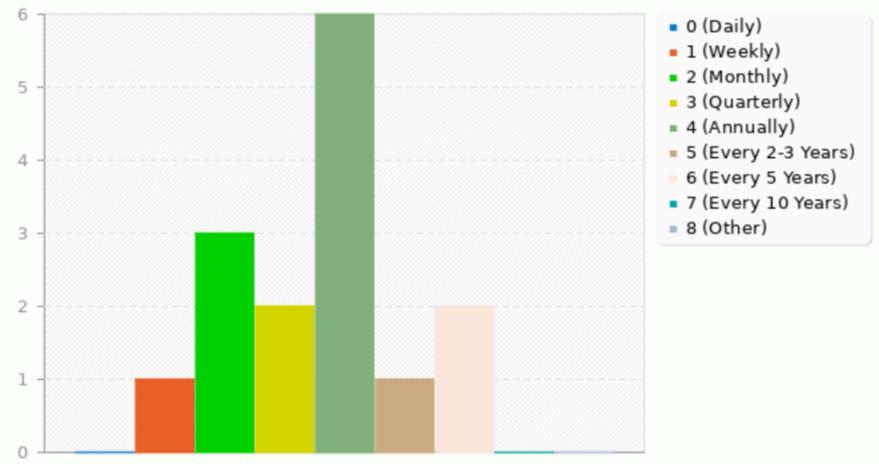


Temporal Frequency

What is the ideal frequency of carbon information updates that you need in your work? (Check all that apply)



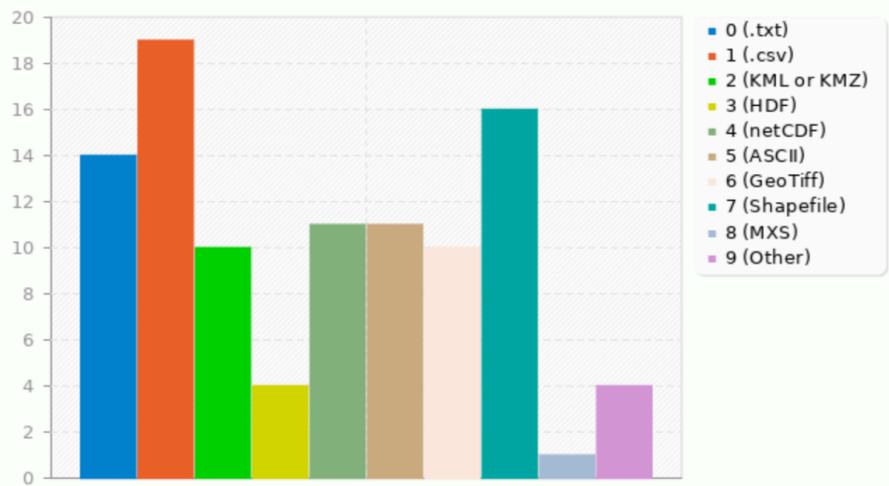
What is the ideal frequency of carbon information updates that you need in your work? (Check all that apply)



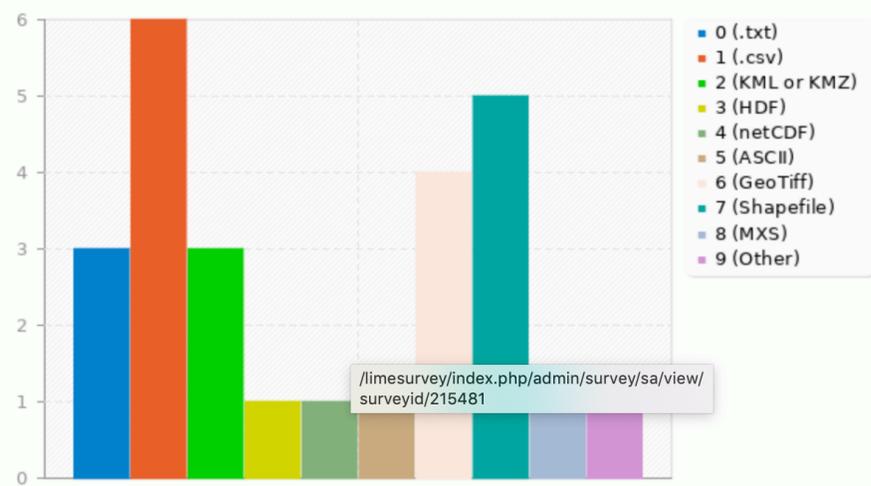


Data Format

With regards on data modeling and processing for your organization, what is the ideal data format for your work? (Check all that apply)



With regards on data modeling and processing for your organization, what is the ideal data format for your work? (Check all that apply)



[/limesurvey/index.php/admin/survey/sa/view/surveyid/215481](https://limesurvey/index.php/admin/survey/sa/view/surveyid/215481)



Engaging Stakeholders in CMS Flux Projects

- Stakeholder Engagement Approach
- Resources & Opportunities
- Potential Stakeholders for CMS Flux Projects
- Upcoming CMS Applications Events in 2020



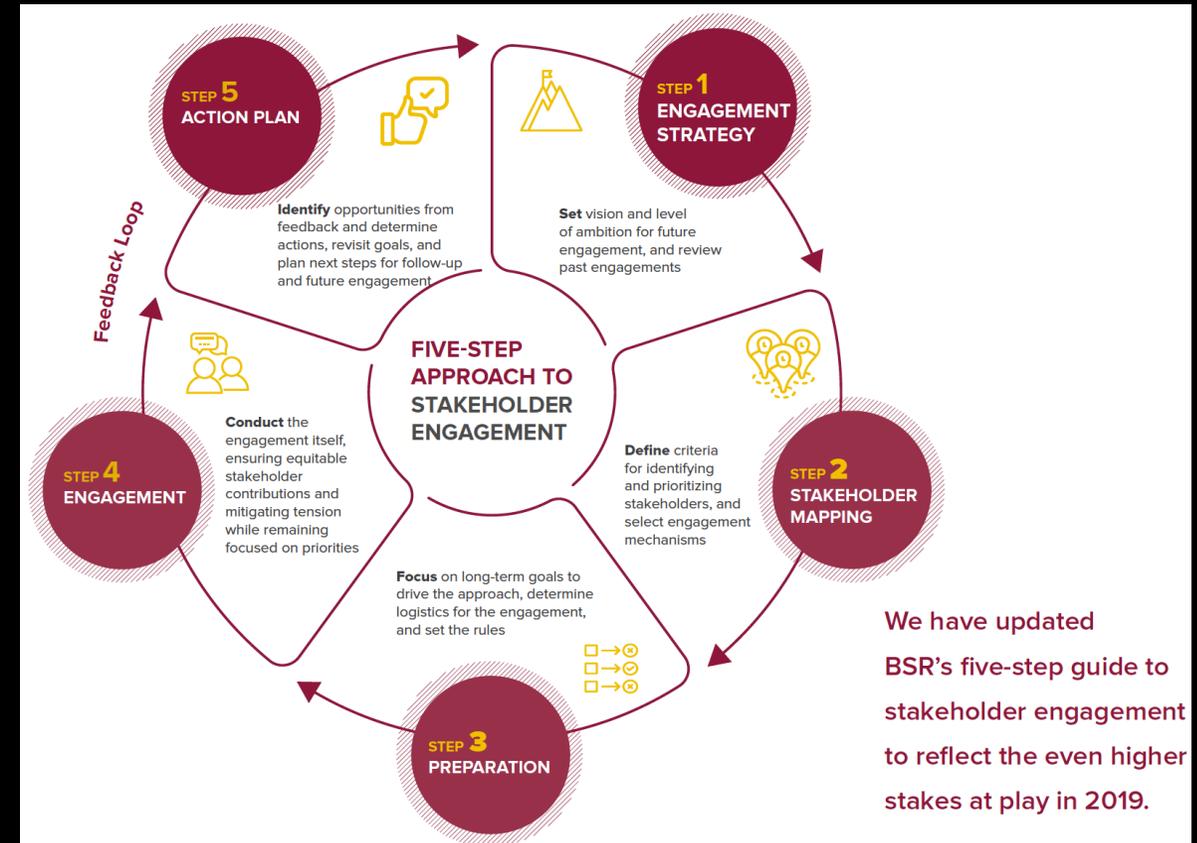
Stakeholder Engagement Approach

1. Develop an Engagement Strategy

- Lessons learned from past efforts will inform the current strategy
- Overall vision and level of ambition

2. Do a Stakeholder Mapping

- Identify stakeholders
- Analyze and rank stakeholders
- Map to identify key stakeholders
- Select engagement approaches





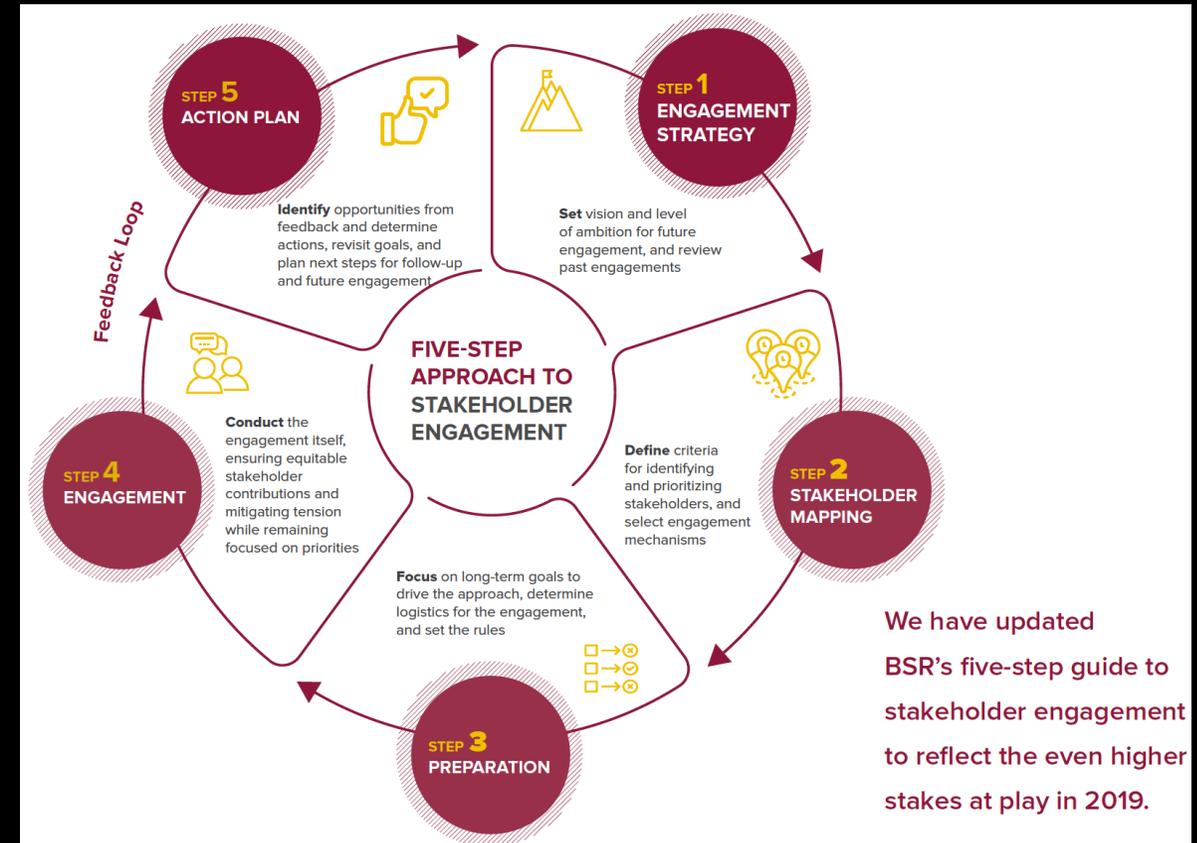
Stakeholder Engagement Approach

3/4. Preparation & Engagement

- Develop an Internal Stakeholder Engagement Team, if possible
- Develop short-term and long-term goals for the engagement
- Engagement should be focused, timely, and respectful
- Engagement Options: Joint research, workshop, survey, virtual conferences
- Document the Engagement

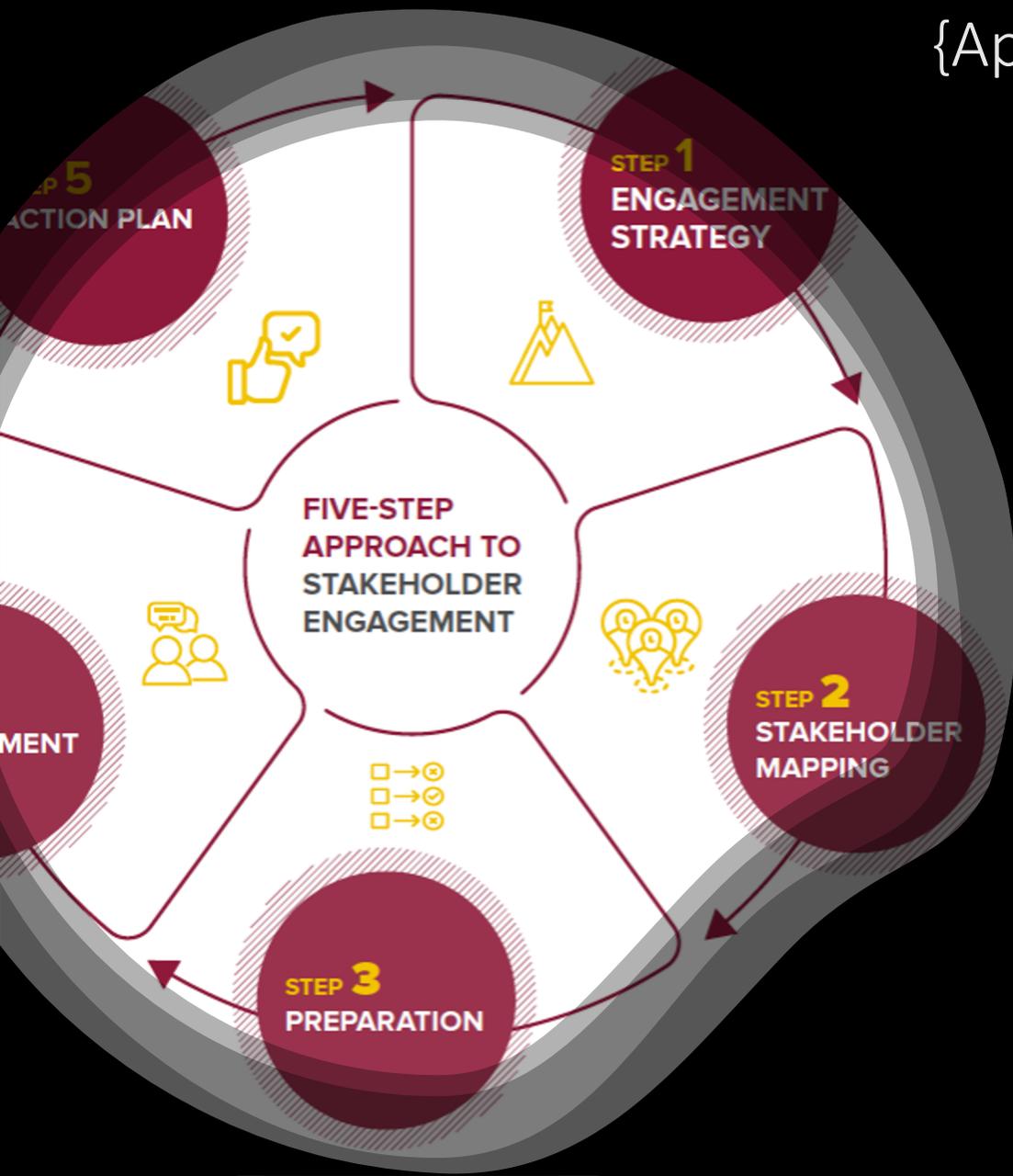
5. Action Plan = Research Paper

- Develop an action plan (publication) whose key aim is to translate the findings, insights, and agreements from the engagement, and then communicate these to the general public.



CMS Stakeholder Engagement In Practice

{Applications Effort for Hurtt (CMS 2016) Project}



- We developed an Internal Stakeholder Engagement Team, comprise of PI, grad student with knowledge on policy and economics, colleague with experience on decision-making, and CMS Applications Coordinator – Step 3 First!
- We reviewed lessons learned from previous engagement efforts and leveraged past relationships (Stakeholder Working Group), we determined that this would be an ongoing iterative process, and we developed short-term and long-term goals – Steps 1 & 3
- We researched and identified key stakeholders, and selected engagement mechanisms (Multi-State Working Group Quarterly Meetings & Regional Workshop) – Step 2
- We held quarterly meetings and presentations, and document the engagement through meeting reports – Step 4
- We are writing a paper on the findings to be published in the near-future – Step 5



Resources & Opportunities

- Leverage the work of the CMS Applications Team!
- CMS Policy Speaker Series Talks
 - We can invite any policy stakeholder you would like to learn more of, or engage with
- Applications Workshops & Data Tutorials
 - CMS Applications Workshop, Thematic Workshops, Stakeholder Workshops, Stakeholder Working Groups, DAACs Data Tutorials, ARSET Trainings
- Surveys & Community Assessments
 - To better understand the data needs, interests, and challenges of your potential stakeholders
- Other Resources/Opportunities
 - NASA Goddard Applied Sciences Efforts & Working Groups (Interagency Chesapeake Bay Group, Disasters, Food Security, Air Quality & Health, Climate, Mission Applications)
 - <https://sciences.gsfc.nasa.gov/610/applied-sciences/index.html>
 - Contact Stephanie Uz – stephanie.uz@nasa.gov
 - NASA Applied Remote Sensing Training (ARSET) Program



Potential Stakeholders of CMS Flux Projects

Deborah Gordon

Senior Fellow at Watson Institute for International & Public Affairs, *Brown University*

Former Director of the Energy and Climate Program at the *Carnegie Endowment for International Peace*

Data Needs

- Timely satellite reports and updates, including TROPOMI methane
- Finer-tuned methane estimates beyond North America
- Methane measurements **over water** (where a lot of oil and gas activity takes place)
- Better understanding of plumes, wind, and background methane concentrations for guidance on attribution to equipment
- CMS products for black carbon (from the oil & gas lifecycle)

Our Research: The Oil Climate Index (OCI)

A first-of-its-kind, open-source analytic tool that offers a fully transparent method to analyze greenhouse gas (GHG) emissions differences between oil and gas resources over time. By assessing the life-cycle carbon footprints of (soon to be over 100) global oil and gas resources, stakeholders can identify where in the value chain the largest emissions occur and advance innovations that make the deepest cuts in emissions.



A brief history of the OCI

2013:

- Gordon initiates the OCI with partners from Stanford University and the University of Calgary

2015:

- OCI Version 1.0 is launched, modeling 30 global oils (5% of global oil production)
- Gordon and her team find nearly an order of magnitude difference in per-barrel GHGs among oil producers and a similar range among oil refiners

Collaboration with NASA Carbon Monitoring System Science Program

Gordon is a stakeholder of NASA's Carbon Monitoring Science Program. Watch Gordon's talk on how NASA is incorporated into current and future versions of the Oil Climate Index.

[WATCH HERE](#)



Deborah Gordon, Principal Investigator of the Oil Climate Index, with GSE Sepkoski, Applications Coordinator for NASA Carbon Monitoring System.



Potential Stakeholders of CMS Flux Projects

Ritesh Gautam

Senior Physical Scientist at Office of Chief Scientist, Environmental Defense Fund (EDF)

Data Needs

- Within the US, Permian Basin is a priority area of methane science and policy efforts
- One of the questions they are presently trying to address globally relates to characterizing methane emissions linked to gas flaring
- Also highly interested in building an oil & gas infrastructure database, in support of MethaneSAT



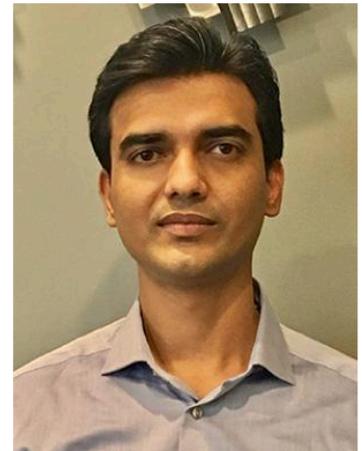
[Donate now](#)

Ritesh Gautam

Senior Physical Scientist

Areas of expertise: Satellite remote sensing, atmospheric aerosols, climatology, radiative forcing

Ritesh Gautam, PhD works in the Office of Chief Scientist where his current research focuses on remote sensing of methane and other pollutant emissions from oil and gas sector. Ritesh is based in EDF's Washington DC office, and provides scientific guidance for EDF's emerging studies on international methane emissions from global oil and gas sector, primarily using satellite observations.





Potential Stakeholders of CMS Flux Projects?



Sylvia Wilson

Physical Scientist, *USGS Land Resource Mission Area*

SilvaCarbon Steering Committee Co-Chair

Data Needs

- Wall to wall products that integrate radar and optical data – applicable in the tropics.
 - Latin America Pacific coast (Colombia, Ecuador, Peru)
- Emission Factors derived from Earth Observation
- Models that integrate Activity Data and Emission Factors
- Monitoring of other Land covers besides Forest
 - Regeneration, differentiate palm from forest



Other Potential Stakeholders of CMS Flux Projects

- Alden Meyer, Director of Strategy & Policy at Union of Concerned Scientists
 - Principal advocate for UCS on national and international policy responses to the threat of global climate change.
- Sue Biniatz, Senior Fellow for Climate Change at United Nations Foundation
 - For more than 25 years, Sue Biniatz served as the lead climate lawyer for the U.S. State Department.
- Laurence Tubiana, CEO of European Climate Foundation
 - France's Climate Change Ambassador and Special Representative at the Paris Accord
- Global Carbon Project
- International Ocean Carbon Coordination Project
- Intergovernmental Oceanographic Commission
- International Carbon Action Partnership (ICAP)
- U.S. Department of State Office of Global Change
- Secretariat of United Nations Framework Convention on Climate Change (UNFCCC)



Upcoming CMS Applications Events in 2020

- CMS Policy Speaker Series in 2020 at NASA GSFC
 - Special Panel on Covid-19 & Impact on Global Carbon Emissions – May 2020
 - CMS PIs are welcome to provide speaker recommendations
- USFS-NASA Virtual Pitch Fest – June 2, 2020
- USFS-NASA Joint Applications Workshop – September 1-3, 2020
- 2020 CMS Applications Workshop & Data Tutorial – November 17, 2020
 - Data Tutorials for CMS Stakeholders
 - How to use CMS datasets and scenario-based exercises (DAACs & ARSET)
- CMS Thematic Workshops: Carbon Removal Workshop – Fall/Winter 2020

CONTACT INFORMATION

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