The Joint ESA-NASA Multi-Mission Algorithm and Analysis Platform (MAAP): Enabling Open Science for the Global Aboveground Terrestrial Carbon Dynamics Research Community

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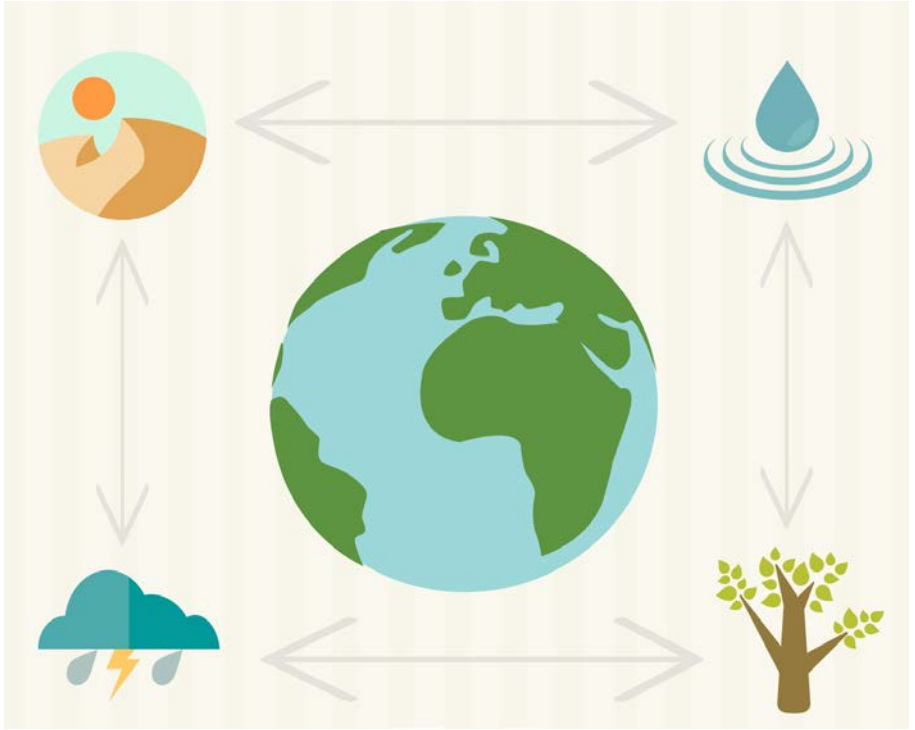
IMPACT
Interagency Implementation and Advanced Concepts Team

Importance of Open Science

- Open science allows collaboration that creates beneficial synergies
- Improves teamwork
- Encourages both higher quality work and community feedback on work
- Work has greater impact across the scientific community
- Open science creates new opportunities to leverage data, resources
- Encourages reuse of algorithms and computational workflows which lead to greater reproducibility



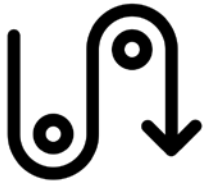
Challenges to Open Science

Data friction

- “costs in time, energy, and attention required simply to collect, check, store, move, receive, and access data”
- Every time data is moved or transformed there is a risk of data loss/corruption
- Questions of data trustworthiness, data quality

Computational friction

- “Every calculation requires time, energy, and human attention.”
- Physical and cost limits of data processing
- Human work of programming, debugging, etc…
- Effort involved in getting others to accept results



Science Limitations

- Lack of availability of data
- Need for transparency of methods and algorithms
- Need for data at correct temporal and spatial resolution

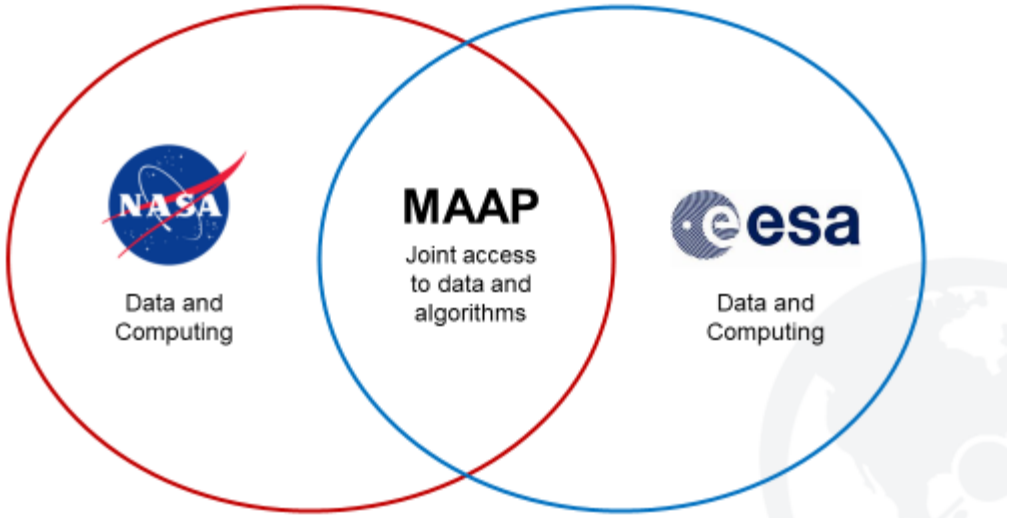
A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming. Paul Edwards. MIT Press 2010.

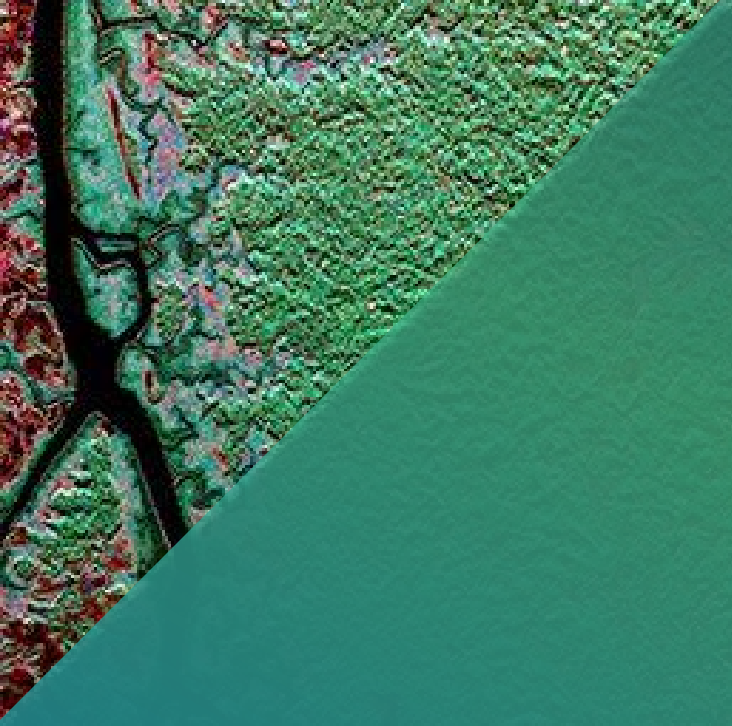
What is MAAP?

- The MAAP is a virtual environment dedicated to the unique needs of sharing and processing data from relevant field, airborne and satellite measurements related to ESA and NASA missions
  - Jointly managed by ESA and NASA and accessible to designated ESA and NASA scientists.
  - Initially populated with pre-launch and complimentary data from other projects.
- Science focus is to improve the understanding of global terrestrial carbon dynamics & to support algorithm development
- Addresses a need expressed by the science community to more easily share and process data collected by NASA and ESA activities

How is the MAAP Enabling Open Science?

- The MAAP's long term vision:
  - Clearly connect data, algorithms, software and results to support the global aboveground terrestrial carbon dynamics research community
  - Encourage community collaboration by
    - Providing collaborative work environments
    - Making it easy to share data, algorithms and software to collaborators and the MAAP
  - Reducing data and computational friction
  - Support ESA and NASA's commitments to open data, open software

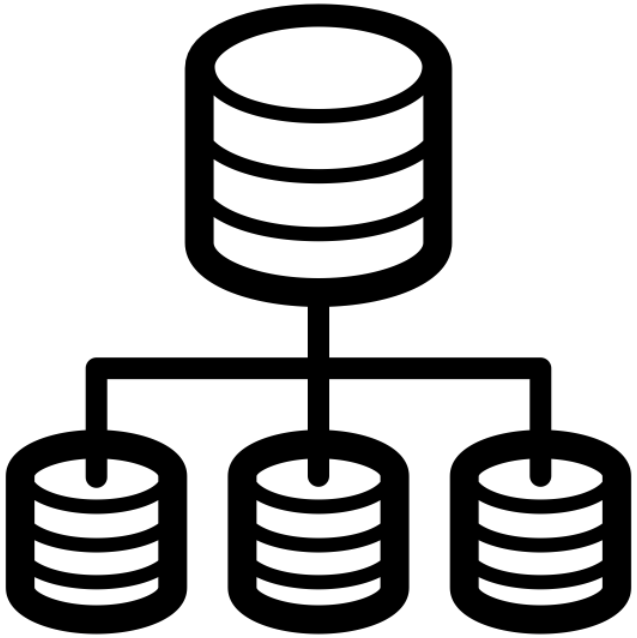




Data

Easing Data Friction: Data

- Facilitating discovery of biomass relevant data via a centralized location
  - Allows data from various organizations to be quickly discovered
  - Data includes primary mission data and supporting ancillary data
  - Highly curated data holdings encouraging data reuse
- ESA and NASA are contributing metadata to a single repository
  - Common Metadata Repository (CMR)
  - Meta(data) may be discovered via an API or the Earthdata Search client
  - Additional metadata information provided to support biomass search needs



Created by H Alberto Gongora from Noun Project

COMMON METADATA REPOSITORY

Easing Data Friction: Data Format

- Identified data formats relevant to biomass user community
- ESA and NASA are providing primary data in agreed upon data formats to lower data use barriers
  - GeoTIFF
  - HDF5
- Exploring analysis ready data options to make data use even easier
  - Exploring efficient formats for data with high volume and high spatial/temporal resolutions
  - Exploit cloud infrastructure

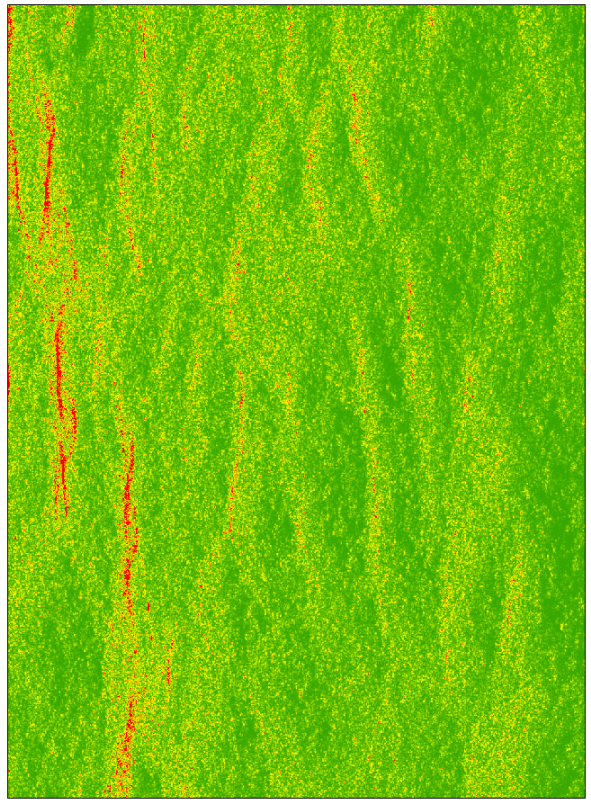


Image: AfriSAR ONERA SLC VV GeoTIFF

Easing Data Friction: Open Data Access Policy

- MAAP encourages free flowing data by promoting full and open sharing of all data
  - Standard MAAP data products will abide by NASA and ESA's open data policies
  - User uploaded and generated data will also be required to adhere to the MAAP open data policy
- Data is exchanged between NASA and ESA without restriction
- Data access for users is likewise non-discriminatory
  - All users treated equally

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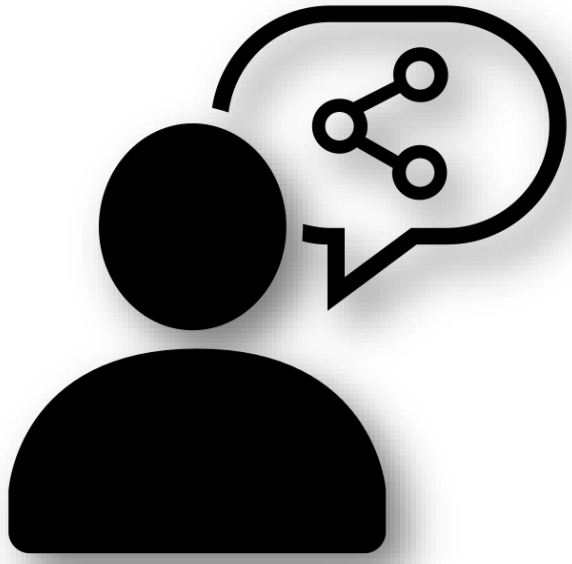
Easing Data Friction: User Data

- Enabling quick and easy data sharing with MAAP users
  - Users can share data with select collaborators
  - Can share data more broadly to MAAP CMR so users can discover it
  - Supports MAAP open data policy

- To make data sharing easier, MAAP will leverage creative ways to capture metadata info
  - Capturing information from the data itself
  - Streamlining metadata needs to lower burden on user



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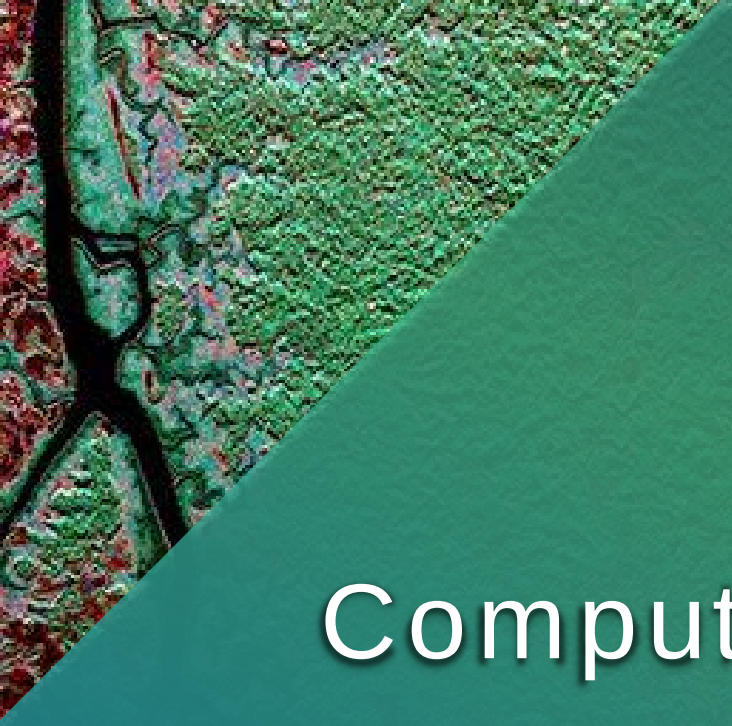


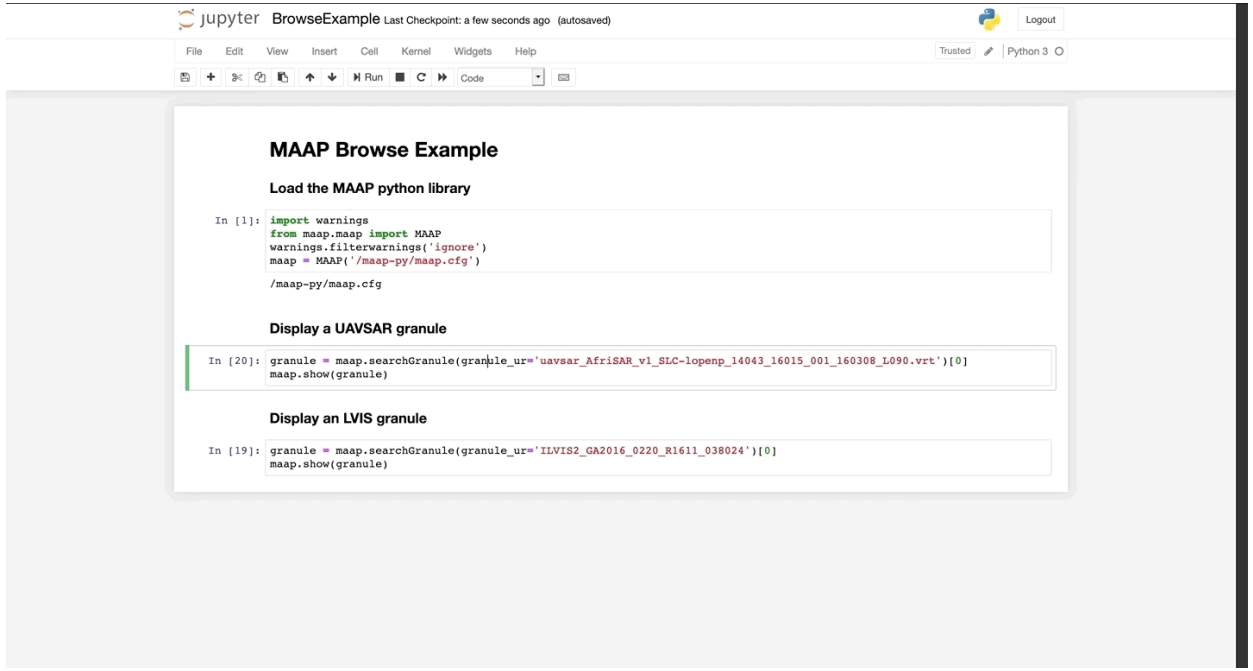
Computation & Open Source Policies

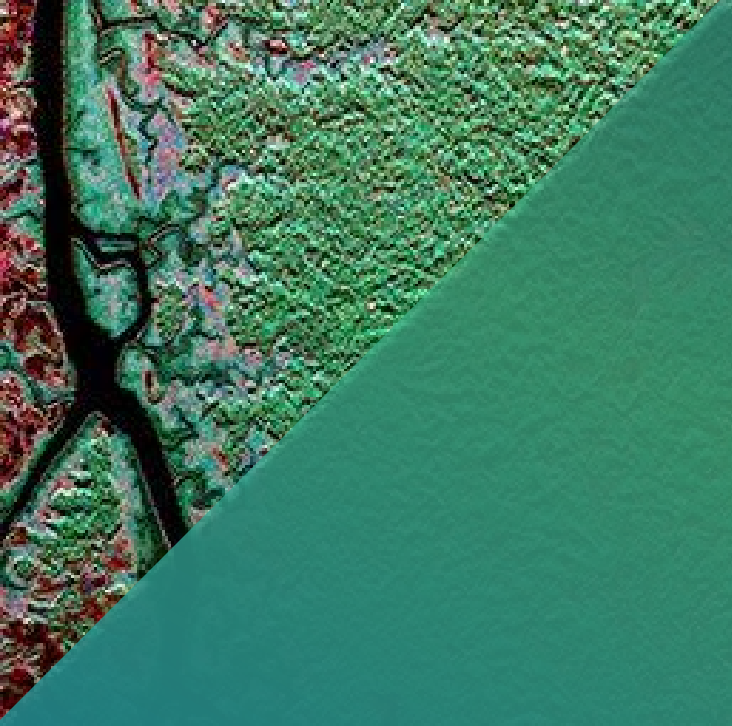
Easing Computational Friction: Software Sharing

- Encourage collaboration on algorithms by providing collaborative workspaces
- Encourage sharing of algorithms and the supporting implementations of those algorithms to the broader MAAP community
  - Create metadata to support sharing
  - Document inputs, outputs, processing steps, computation needed
  - Scientific rationale and algorithm behind the implementation

Easing Computational Friction: Open Source Policy

- User developed implementations of algorithms will be subject to MAAP's open source policy
  - Permissive licenses to support use, modification and redistribution will be strongly encouraged
- Software developed for the MAAP itself is open source
  - Both NASA and ESA have completed open source process
  - Source code will be available on GitHub once pilot MAAP is complete





Enabling Science

Science

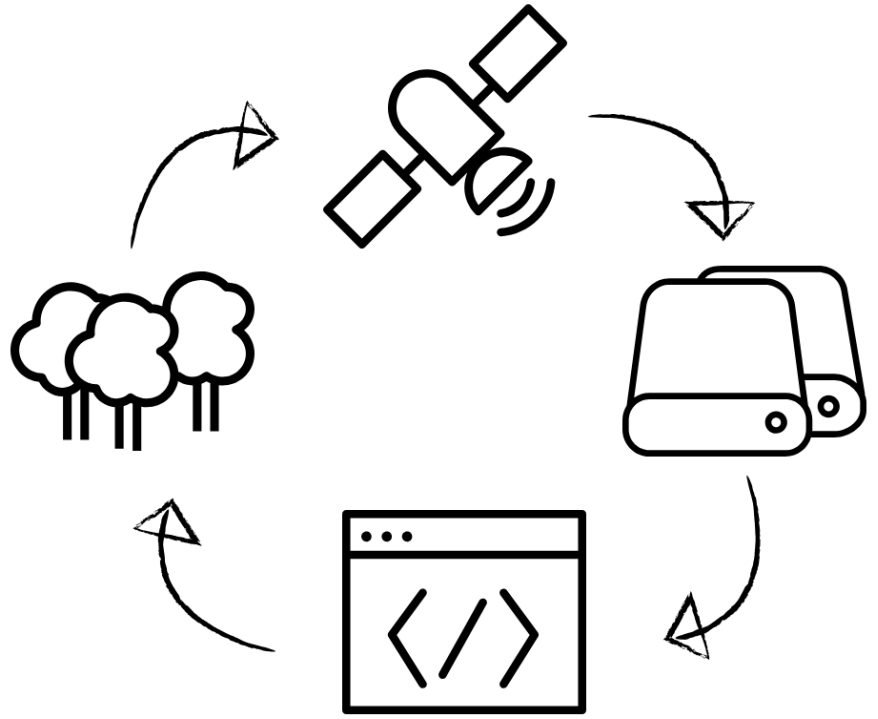
- MAAP will make more in situ data available needed for reference, calibration, validation
  - GEDI Cal/Val Database
- MAAP will act as a centralized location of several biomass-focused spaceborne observations
  - Encourage the development of fusion biomass estimation products
  - Promote collaboration across organizations
  - Increased geographic coverage, detail from combined data

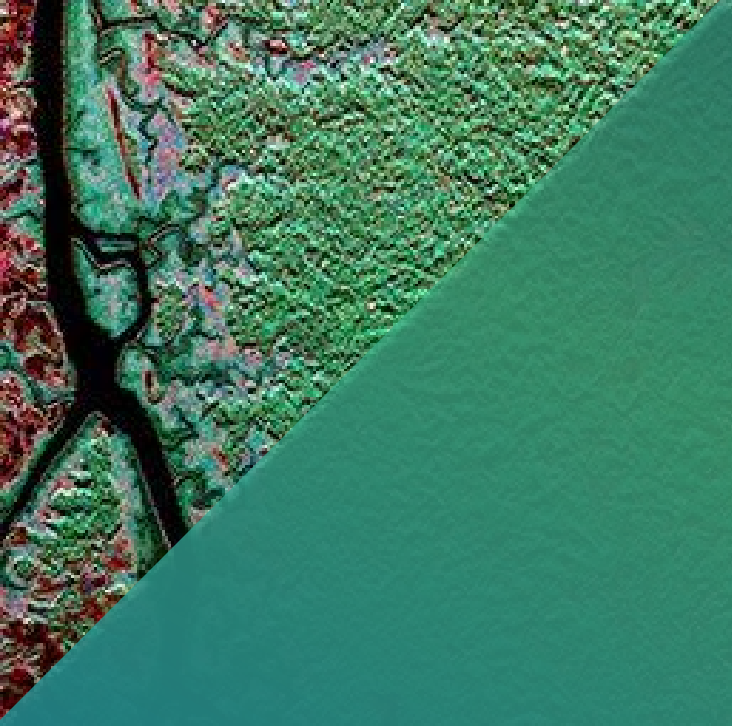
https://www.jpl.nasa.gov/images/earth/africa/20160225/earth20160225d.jpg

https://www.jpl.nasa.gov/images/earth/africa/20160225/earth20160225c.jpg

Conclusions

- The MAAP will make connections between data, algorithms, software and results
- Should make it easier to reproduce results and build from existing work
- Encourage collaboration between scientists and data scientists
- Help users match the tool to the question
- Bring together data from various spaceborne missions from various organizations to support development of biomass maps





Questions?

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