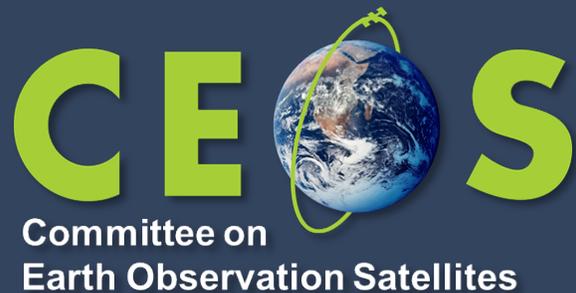


The CEOS AFOLU Roadmap:

*Update & recommendations for GHG
collaboration*



Ben Poulter, NASA

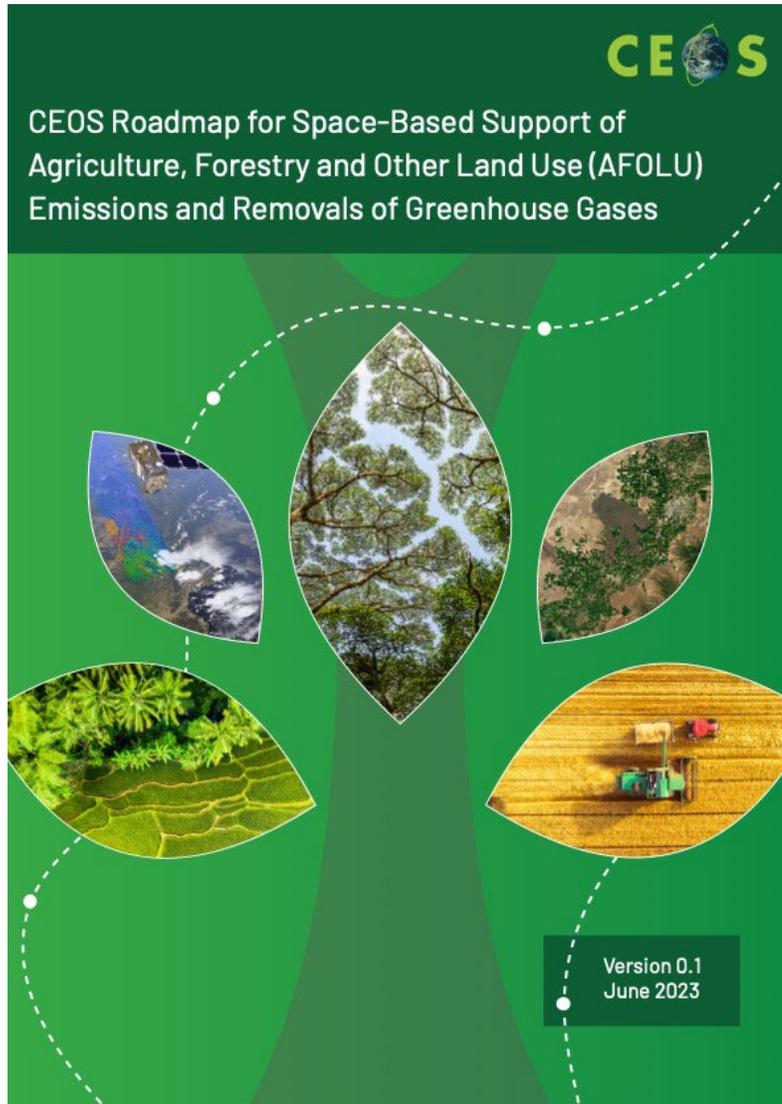
Osamu Ochiai , JAXA

Frank -Martin Seifert, ESA

CEOS AC-VC-19

24 - 27th October 2023, Brussels

A team effort across/beyond CEOS

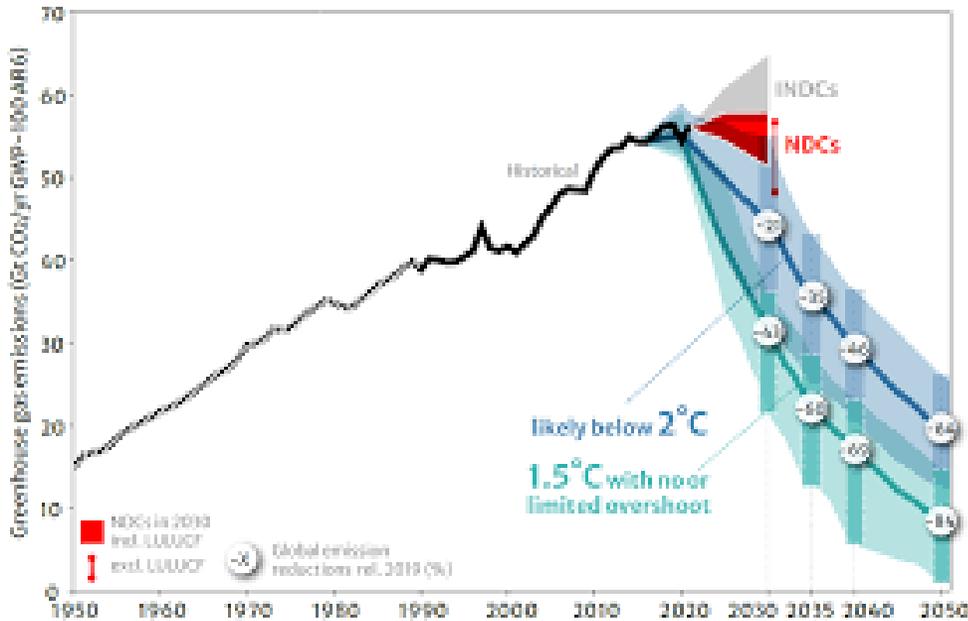
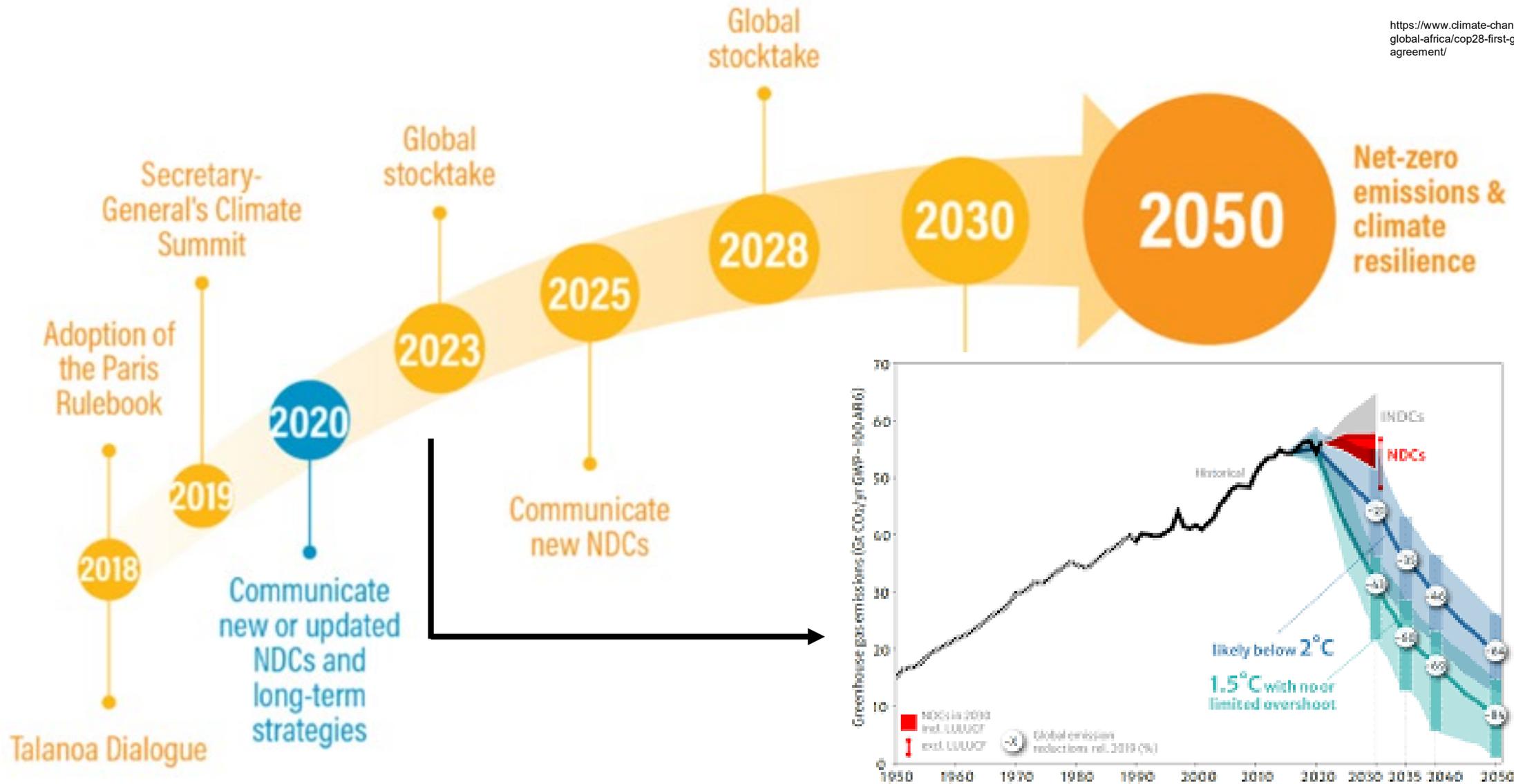


Ben Poulter (NASA Goddard Space Flight Center), Osamu Ochiai (JAXA), Frank-Martin Siefert (ESA), Clement Albergel (ESA), Stephen Briggs (ESA), Mark Dowell (EC-JRC), Laura Duncanson (University of Maryland), Sven Gilliams (VITO), Nancy Harris (WRI), Martin Herold (GFZ), Neha Hunka (University of Maryland), Heather Friendship-Kay (Aberystwyth University), Ian Jarvis (GeoGlam), Richard Lucas (Aberystwyth University), Yasjka Meijer (ESA), Joana Melo (EC-JRC), Shaun Quegan (University of Sheffield), Ake Rosenquist (JAXA), Frank-Martin Seifert (ESA), Lindsey Sloat (WRI), Terry Sohl (USGS), Daniela Requena Suarez (GFZ/WUR/GFOI), Stephen Ward (JAXA), Alyssa Whitcraft (University of Maryland), Sylvia Wilson (USGS)

The Global Stocktake of the Paris Agreement



<https://www.climate-chance.org/en/comprehend/blog-observatory-global-africa/cop28-first-global-stocktake-what-to-expect-paris-agreement/>



The 2021 CEOS Strategy document to support the Global Stocktake was approved to:

Recommendation 5: The AFOLU Task Team should continue the work it has started for CEOS. The AFOLU and GHG Task Teams should work together to ensure consistency between data for emissions reported via AFOLU and for prior biogenic terrestrial emissions, and those due to changing land use, in implementing monitoring and verification systems. These need to be consistent on both temporal and spatial scales.

Recommendation 6: It is recommended that to help in ensuring the take-up of satellite-based methods for AFOLU (and indeed in the context of MVS) CEOS should work with a few selected demonstrator countries to assist them in their national reporting under AFOLU (the model of GFOI can be compared). USGS through its SilvaCarbon programme would be well placed to lead this.

Milestones and key accomplishments



Review

Towards a roadmap for space-based observations of the land sector for the UNFCCC global stocktake

Osamu Ochiai,^{1,*} Benjamin Poulter,² Frank Martin Seifert,³ Stephen Ward,⁴ I Ritvik Sahajpal,⁶ Sven Gilliams,⁷ Martin Herold,⁸ Sarah Carter,⁹ Laura Innice I Richard Lucas,¹⁰ Sylvia N. Wilson,¹¹ Joana Melo,¹² Joanna Post,¹³ Stephen E Mark Dowell,¹⁷ Alessandro Cescatti,¹⁷ David Crisp,¹⁸ Sassan Saatchi,¹⁹ Take and Ake Rosenqvist²⁰



- ❖ Distribution 1st draft, CEOS review, May 2023
- ❖ Presentation of AFOLU Roadmap WRI Land Carbon Lab. Summit & 24th Session of GCOS/WCRP/TOPC, summer 2023
- ❖ Contribution of AFOLU section to CEOS New Space report
- ❖ Contribution to GCOS IP updates on biomass
- ❖ Engagement with CEOS LSI-VC, WGClimate and GHG TT

Key papers

- Joana Melo *et al* 2023 Satellite-based global maps are rarely used in forest reference levels submitted to the UNFCCC. *Environ. Res. Lett.* [18 034021](#)
- Eric L Bullock *et al* 2023 Estimating aboveground biomass density using hybrid statistical inference with GEDI lidar data and Paraguay's national forest inventory. *Environ. Res. Lett.* [18 085001](#)
- Osamu Ochiai *et al* 2023 Towards a roadmap for space-based observations of the land sector for the UNFCCC global stocktake, *iScience* [26 106489](#)
- Neha Hunka *et al* On the NASA GEDI and ESA CCI biomass maps: Aligning for uptake in the UNFCCC Global Stocktake *Environ. Res. Lett.* (in review)
- Neha Hunka *et al* How the map-product estimates compare to the IPCC default tables for Tier 1 estimates (i.e. Tables 4.7 to 4.10 in Chapter 4, IPCC 2019 Refinement Guidelines)? (in prep)

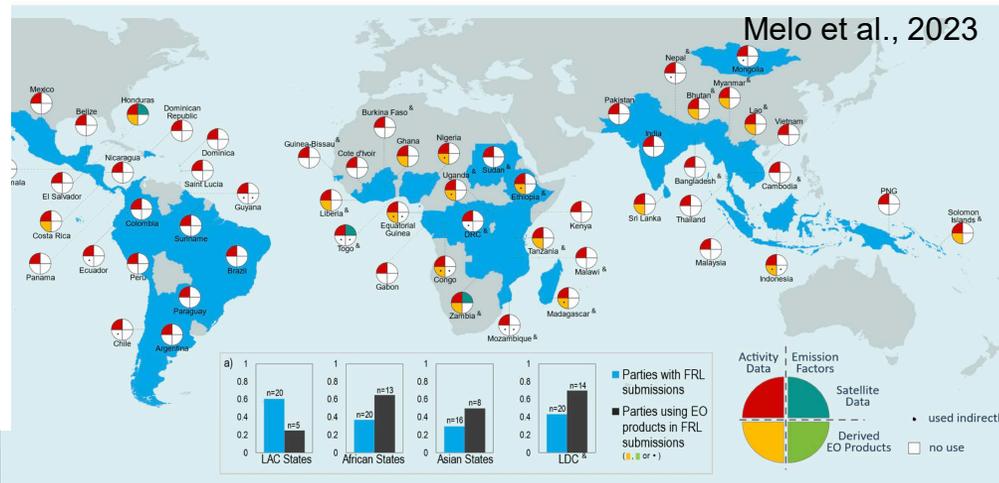
Milestones and key accomplishments



Land Cover Working Group

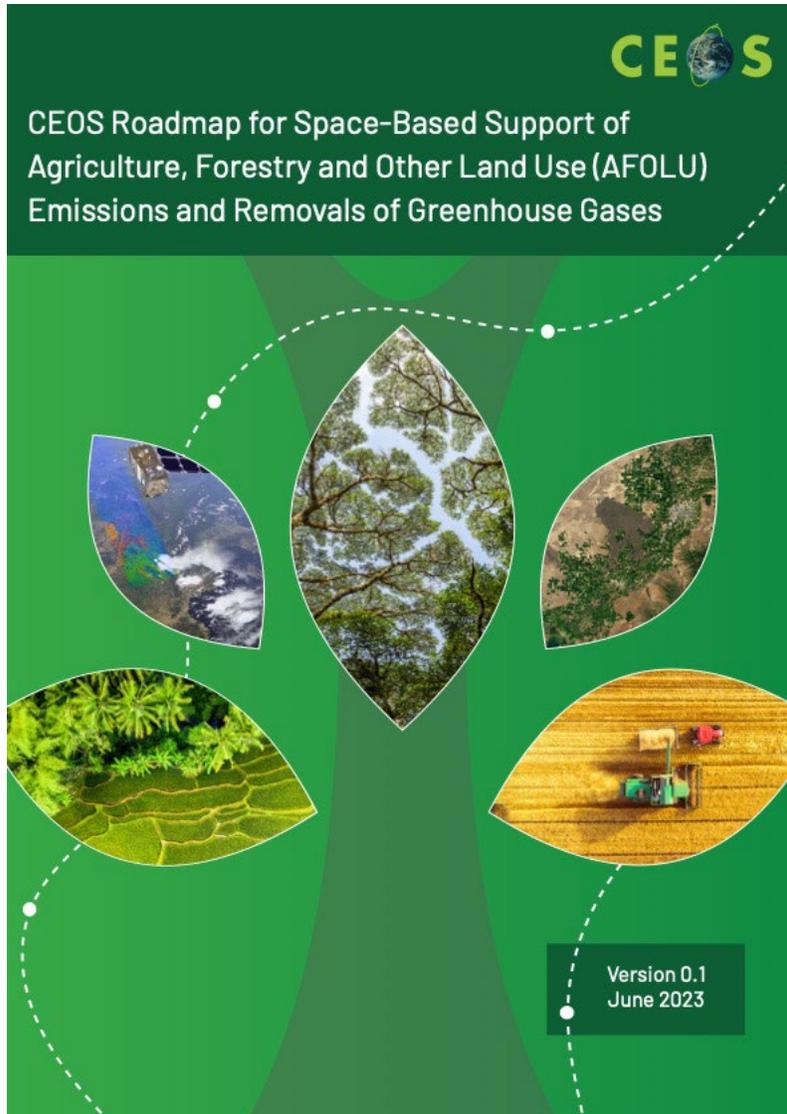
Top word/keyword mentions (N=74): **Biomass Harmonization WG**

- Free + free and open (10)
- Consistency (5)
- Collaboration + collaborative (5)
- Transparency (2)
- Accountability (2)
- Accurate (2)
- Interoperability (2)



Stakeholder WG



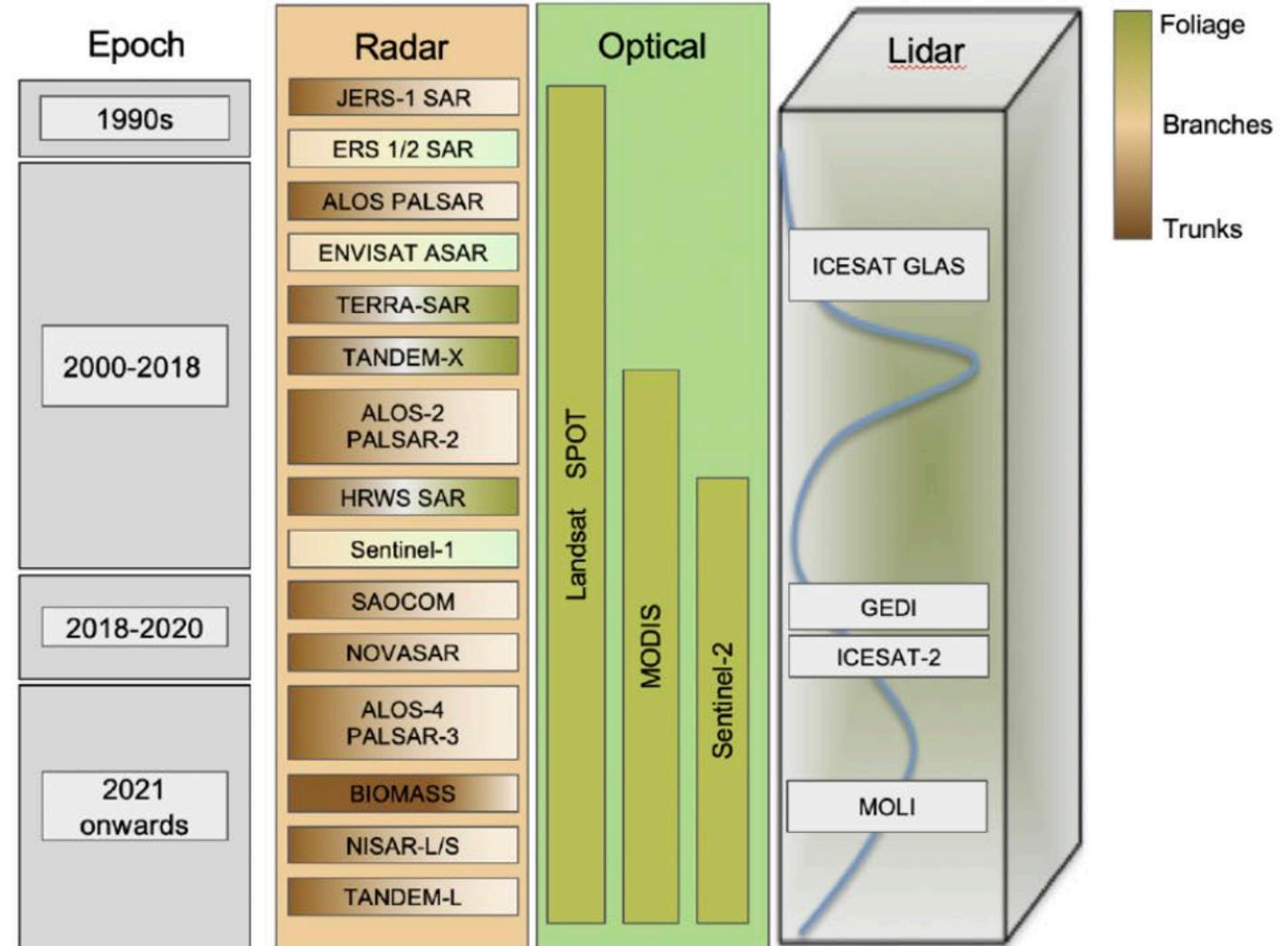


- ❖ Overview of IPCC methodologies
 - Stock change
 - Gain loss
- ❖ EO for Activity Data
 - Land cover change working group
- ❖ EO for Emissions Factors
 - Biomass harmonization working group
- ❖ Capacity Building and Stakeholder Engagement
- ❖ Integrated Monitoring and Verification System
- ❖ Recommendations (& actions)

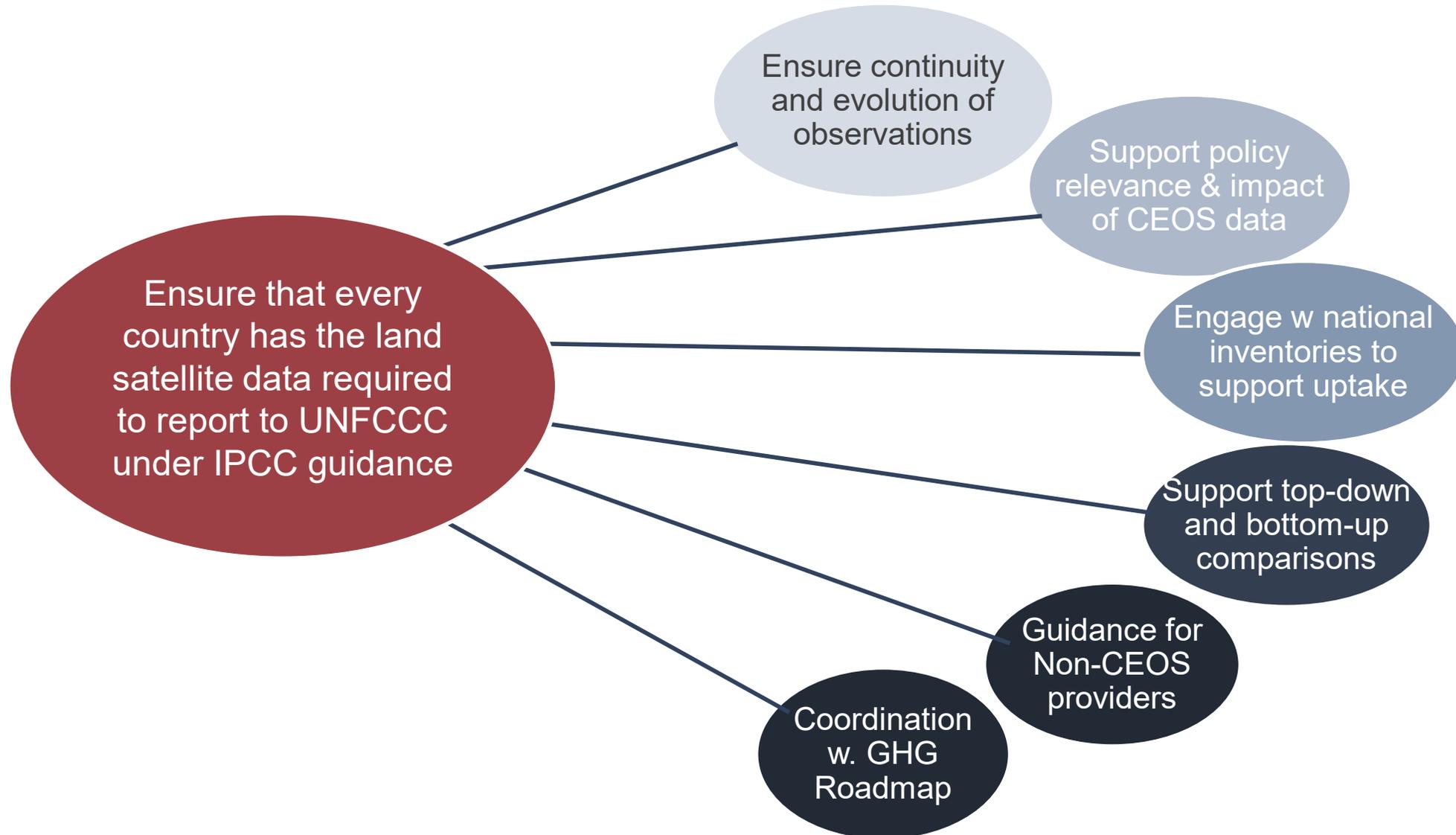
Assessed contributions of radar, optical and lidar missions

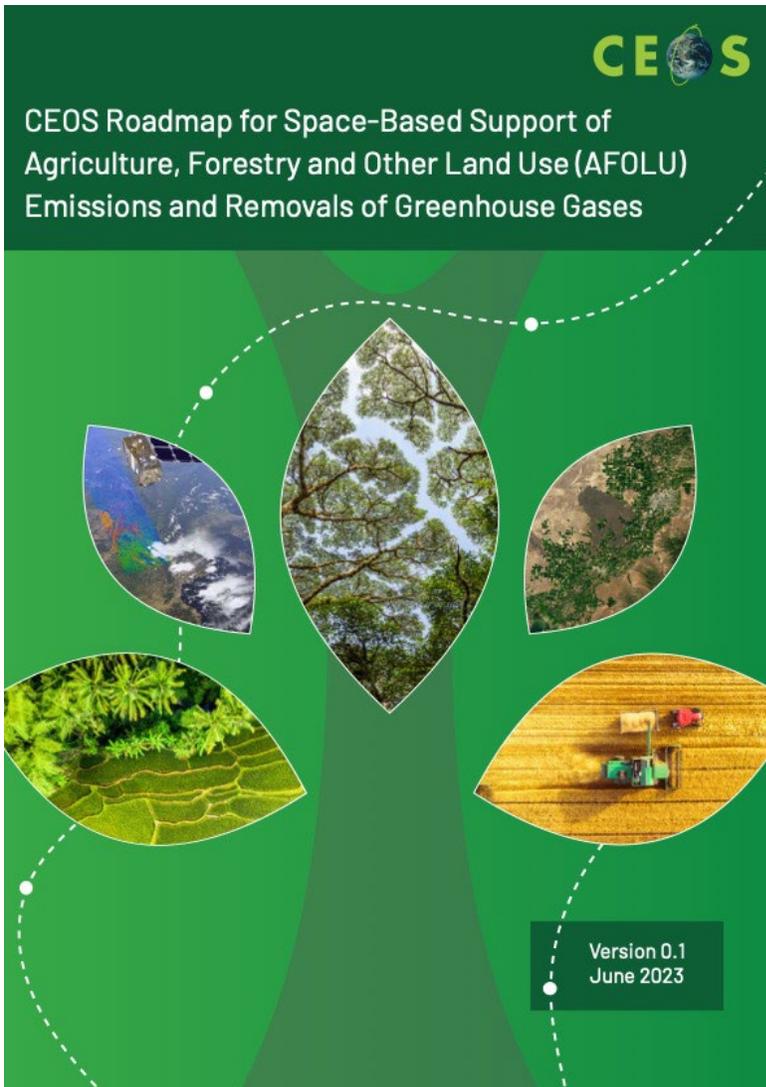


- Reviewed the use of Earth observations in national GHG inventories
- Identified thematic areas where EO data are successfully used, i.e., forests, agriculture, wetlands, or biomass
- Identified challenges and opportunities in using EO data in national GHG inventories as basis for Recommendations and actions



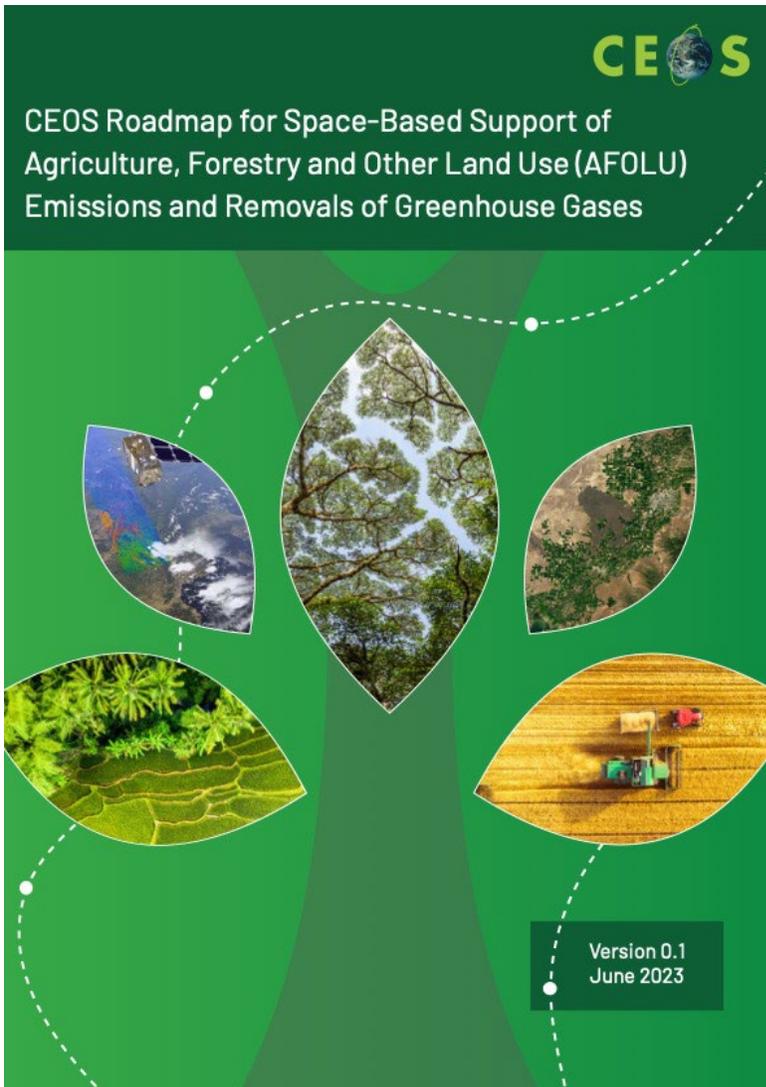
Recommendation principles





Propose several different combinations of coordination between AFOLU & GHG Roadmaps

- ❖ Scenario 1: Use combined AFOLU inventory and DGVM datasets as priors to inform GHG inversions
- ❖ Scenario 2: Compare GHG posterior fluxes with AFOLU inventory and DGVM datasets
- ❖ Scenario 3: Use country-level AFOLU inventory data to support partitioning of posterior fluxes
- ❖ Scenario 4: Work toward integrated GHG and AFOLU monitoring, reporting and verification framework



- ❖ JAXA/ESA/RESTEC/GOFC-GOLD side event on Satellite Observation at COP28
- ❖ Set of 'actions' to implement the Roadmap recommendations defined by SIT-39 (2024)
- ❖ ESA-led Amazonia field campaign w INPE and NASA contributions (2024+)
- ❖ AFOLU Roadmap for endorsement by the 37th CEOS Plenary (2023)

Recommendation 1



	Audience	Recommendation
Ensure long-term continuity and backward compatibility for missions providing activity data and emission factors	CEOS Agencies	<p>1a: Support continuation of remote sensing missions and derived products that provide activity data and biomass change information so that countries can safely embed these data streams into their inventory workflows and guidance documents.</p> <p>1b: Explore harmonization and integration activities that generate temporal continuity and provide complete and consistent spatial coverage of activity data and biomass estimates.</p> <p>1c: Evaluate the planned program of record to identify mission gaps and to define future missions, including backward compatibility of next-generation missions, to support activity data and biomass estimates.</p>

Recommendation 2



Thematic Area	Audience	Recommendation
Improve use of Earth observation data in UNFCCC reporting and IPCC Guidelines.	UNFCCC/ IPCC	<p>2a: Formalize a dialog between CEOS GST activities and the UNFCCC regarding the systematic use of Earth observations to inventory guidelines and reporting.</p> <p>2b: Develop a protocol or best-practice guidance to use EO-based estimates of AGB in support of national estimation, reporting and climate policy support, including guidance on the use of spatially disaggregated land cover change and biomass estimates in inventories.</p> <p>2c: Enable international activities such as the establishment of Forest Biomass Reference Measurement in-situ long-term monitoring plots (e.g. Geo-Trees) to ensure space-derived data are of the highest quality, uncertainties are well characterized.</p> <p>2d: Align terminology and analytical frameworks of uncertainty assessments and the release of AGB estimates consistent with IPCC Guidelines.</p> <p>2e: Develop traceability and flexibility for different land activity definitions to be consistent with national definitions used in GHG inventories.</p>

Recommendation 3



Thematic Area	Audience	Recommendation
Recognizing that different countries have various requirements to support their system for reporting, enable dialog between inventory practitioners and CEOS community	National Inventories / CEOS Agencies	<p>3a: Work with national measurement and reporting teams to define, develop and evaluate Earth observation datasets that serve common needs of countries.</p> <p>3b: Build capacity for national GHG inventory teams to integrate Earth observations data with existing and new inventory guidelines through demonstration projects.</p>

Recommendation 4



Thematic Area	Audience	Recommendation
Support efforts to reconcile bottom-up, top-down, and inventory estimates of GHG emissions and removals	Research community	4a: Develop guidance and datasets to support the consistent comparison and assessment of bottom-up and top-down methodologies with national GHG inventories.

Recommendation 5



Thematic Area	Audience	Recommendation
Integration of New Space and commercial partnerships in supporting national GHG inventories	CEOS	<p>5a: Provide guidance for how new forms of activity and biomass data from non-government supported space agencies can be integrated within public-space Earth observation workflows.</p> <p>5b: Establish protocols for open-source science sharing tools and cloud computing to facilitate data and code development.</p>

Recommendation 6



Thematic Area	Audience	Recommendation
Ensure consistency of CEOS AFOLU and GHG Roadmaps to support an integrated national GHG inventory system, GHG+.	CEOS	<p>6a: Coordination with GHG Task Team to integrate bottom-up and top-down measurements in support of national GHG reporting.</p> <p>6b: Expand the purview of CEOS AFOLU Roadmap to include methane and nitrous-oxide emissions from agriculture.</p> <p>6c: Work with WMO to facilitate and support the development of a Global Greenhouse Gas Watch (G3W).</p>

Recommendation 7



Thematic Area	Audience	Recommendation
Development of actions to support the CEOS AFOLU recommendations	CEOS AFOLU	Develop series of actions for implementing the CEOS AFOLU Roadmap for CEOS SIT 2024