Committee on Earth Observation Satellites

Carbon & Biomass Session

CEOS SIT Technical Workshop 2020

Session 4, Agenda Item # 4.1 & 4.2

Virtual Meeting

15 September 2020

Presenters

- In part 1, please keep talks to 5-10 minutes, we aim to maximise discussion time
  - 1 minute warning will be given. Please conclude on time.
- In part 1, SIT Chair team will advance the slides on your cue
- In part 2, presenters have more time and will be assigned presenter status in GTM to advance their own slides

5 mins

Committee on Earth Observation Satellites

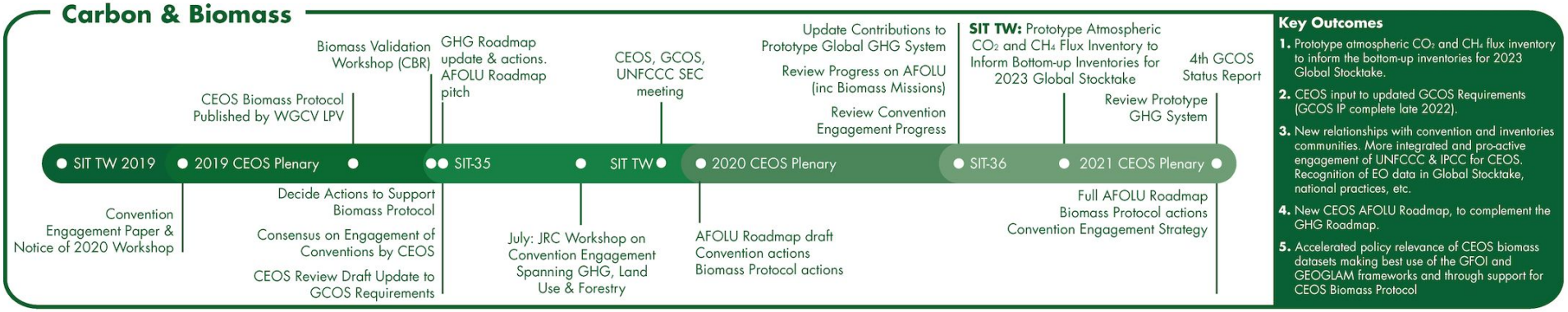
Carbon & Biomass Session - Part 1

Introduction & Objectives

Australian SIT Chair Team

CEOS SIT Technical Workshop 2020

A SIT term priority



- **Supporting the GHG Roadmap process** – escalating, elevating, and accelerating progress towards major milestones, including for the 2023 Global Stocktake. **2021 prototype flux products.**
- Encouraging **stronger and more systematic CEOS engagement with convention frameworks** – building on IPCC outreach
  - **And national inventory communities as our future users**
- Reflecting large investment (2018-2024) in Above-Ground Biomass missions and seeking to **accelerate the policy relevance of these new data (GFOI, GEOGLAM…)**
- **Promote uptake of biomass datasets beyond science community** – forest monitoring, inventories…

What do we hope to achieve?

- (Very) big picture… an optimally efficient and effective partnership between space data providers and the main UN and national stakeholders that use our data to make and manage policy.

- CEOS exploring more integrated and pro-active relationships with major stakeholders in conventions and national inventories - to accelerate the policy impact and application of our data

- Shine a light on the underlying technical work underway in the organisation and agencies and advocate for support from Principals for it to realise its full potential. *Elevate, escalate, accelerate.*

Specific objectives/agenda today

Session 1

- Convene with key partners in the major requirements and policy processes
  - → UNFCCC SEC (Joanna & Florin)
  - → GCOS (Anthony & Han)
  - → GFOI (Nikki & Maria)
  - → GEO (Sara)

- Brief updates from UNFCCC & GCOS and key CEOS activities — 5 - 10 mins each
  - → AFOLU & GHG Roadmaps status
  - → GHG-AFOLU synergies

- Moderated (by Mark & Jörg) discussion with the theme of…

Climate Data Requirements & Policy processes - optimising the space agency contribution

- **Global Stocktake process**
- **GCOS Requirements process**

90 mins

Add comments and questions via GTM chat at any time in the session

Specific objectives/agenda today

Session 2

- Preparation of our relevant agenda items for CEOS Plenary
  - → CEOS Biomass Protocol and implementation support (Laura) — 30 mins
  - → WGClimate: ECVI 3.0 and Use Case activity (Jörg) — 20 mins
  - → GHG Roadmap (Mark) — 15 mins
  - → White Paper to AFOLU Roadmap (Osamu) — 20 mins

- 15 mins wrap (SIT Chair Team)
  - → Plenary readiness actions
  - → 2021 outlook

- All Session 1 participants very welcome to stay - or feel free to leave @ break (15 mins)

Add comments and questions via GTM chat at any time in the session

Key Updates & Context

- **CEOS-CGMS WGClimate (Jörg Schulz, WGClimate)**
  - → Heritage and context

- **UNFCCC SEC (Joanna Post & Florin Vladu)**
  - → Latest on Global Stocktake processes
  - → Emphasis on SO and CEOS engagement

- **GCOS (Anthony Rea & Han Dolman)**
  - → Latest on key GCOS documents, processes and reorganisation

- **AFOLU Roadmap (Osamu Ochiai, JAXA)**
  - → Objectives, status and relevance for the GST SO Synthesis Report

- **GHG Roadmap (Mark Dowell, EC)**
  - → Objectives, status and relevance for the GST
  - → GHG-AFOLU synergies and suggested actions

10 mins

Committee on Earth Observation Satellites

Heritage and Context

CEOS-CGMS WGClimate

Jörg Schulz

CEOS SIT Technical Workshop 2020

Addressing Observational Needs of UNFCCC

United Nations
Climate Change

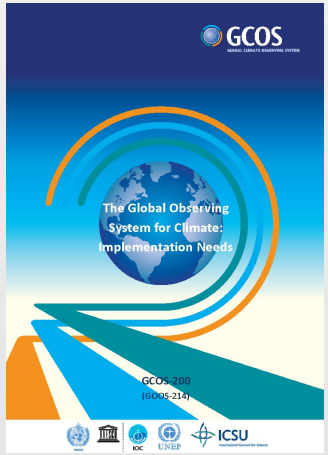
COP-21 Paris Agreement: Adaptation (Article 7(c)):
Strengthening scientific knowledge on climate, including research, **systematic observation of the climate system** and early warning systems, in a manner that informs climate services and supports decision-making.

Reports on Progress
@ SBSTA/COP
Earth Info Day

CEOS Committee on Earth Observation Satellites
WGClimate The Joint CEOS/CGMS Working Group on Climate
CGMS

Needs and Requirements

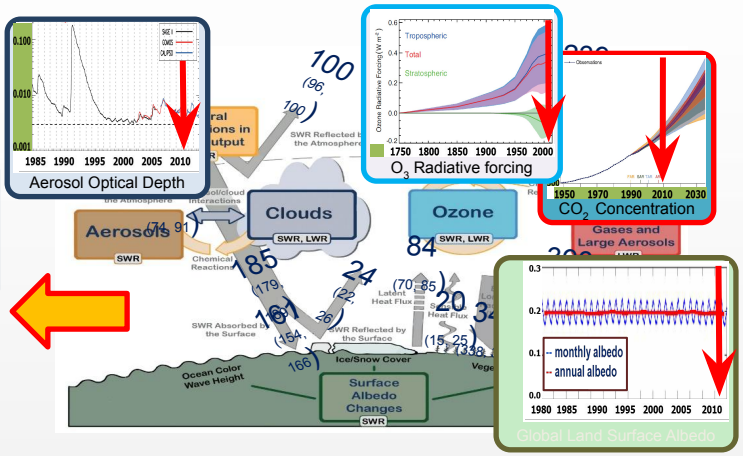
Coordinated Response



GLOBAL CLIMATE OBSERVING SYSTEM
KEEPING WATCH OVER OUR CLIMATE

The Paris Agreement
Contributions from Space

IPCC reports
SBSTA reports
Agency reports



Potential for satellite data
NDC: Global and regional constraints on GHG sources and sinks;
Adaptation, loss & damage: forestation, changes in disaster impacts (storms, floods, drought), sea level rise, evolution of urban areas, etc.

Synthesis Report for GST

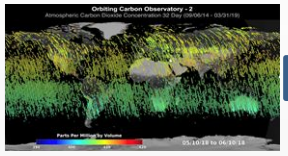
ASSESS PROGRESS
- Transparency Framework (Art. 13)
- Reporting
- Global Stocktake (Art. 14)
- Facilitate
- Committee to facilitate compliance (Art.15)

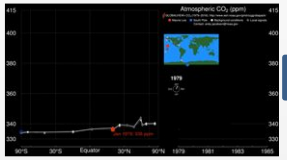
Increasing ambition

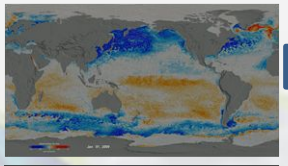
5-year reviews

ACTIONS
- Nationally Determined Contributions (Art. 4)
- Conservation of Sinks and REDD+ (Art. 5)
- Voluntary Cooperation & non-market mechanisms (Art. 6)
- Improvement of adaptive capacity (Art. 7)
- Loss and Damage (Art. 8)
- Provision of financial support (Art. 9)
- Technology transfer (Art. 10)
- Capacity Building (Art. 11)
- Education and public awareness (Art 12)

A System Approach is Adopted to Deliver Atmospheric CO_2 and CH_4 Inventories







Observations

- **Satellite Measurements of CO_2 and CH_4**
- **Ground and Airborne Measurements of CO_2 and CH_4**
- **Meteorology** Satellite & in-situ
- **Auxiliary Data** Satellite observations of CO, NO_2, clouds, aerosols ...

Prior Information

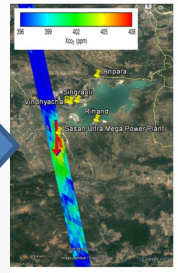
Fluxes, model parameters, emission reports, economic statistics.

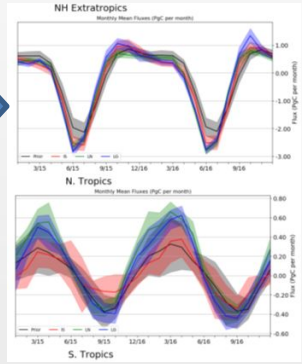
Integration & Attribution

- **Estimation system** Data assimilation and uncertainty estimation
- **Models** Transport, land & ocean carbon cycle, fossil fuel emissions.

Outputs

- **CO_2 and CH_4 emissions & removals from Hot-spots** with uncertainties
- **Country/region CO_2 and CH_4 emissions & removals** with uncertainties
- Other Carbon Cycle Products





Emission Source Detection?

Requirements are changing – need to reflect this in GCOS IP

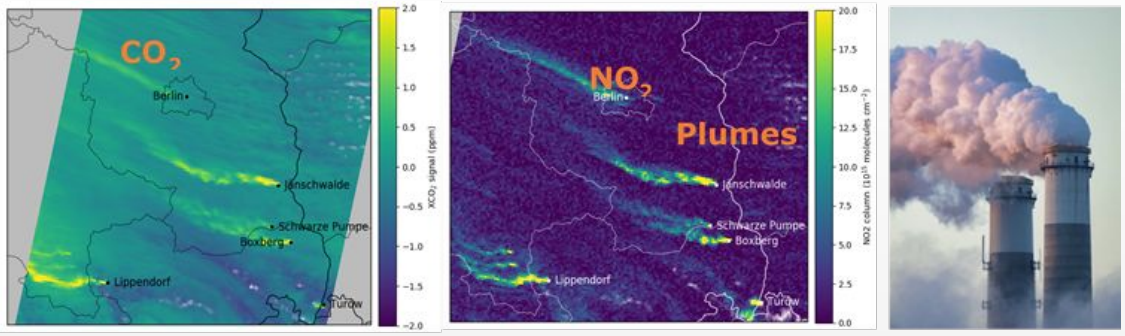


Figure: Simulated XCO_2 and NO_2 plumes originating from power plants and other emission sources in a larger area around Berlin. Simulated data come from the COSMO-GHG model as used in the SMARTCARB study simulating a swath width of 250 km. (credit: ESA SMARTCARB).

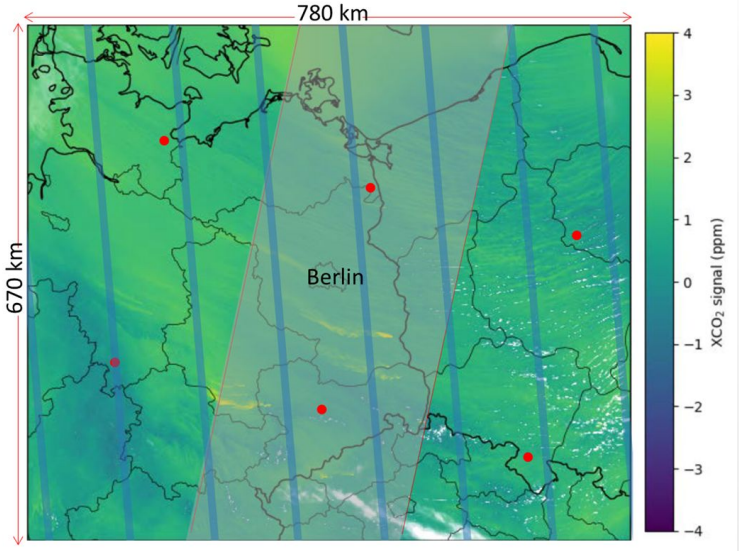
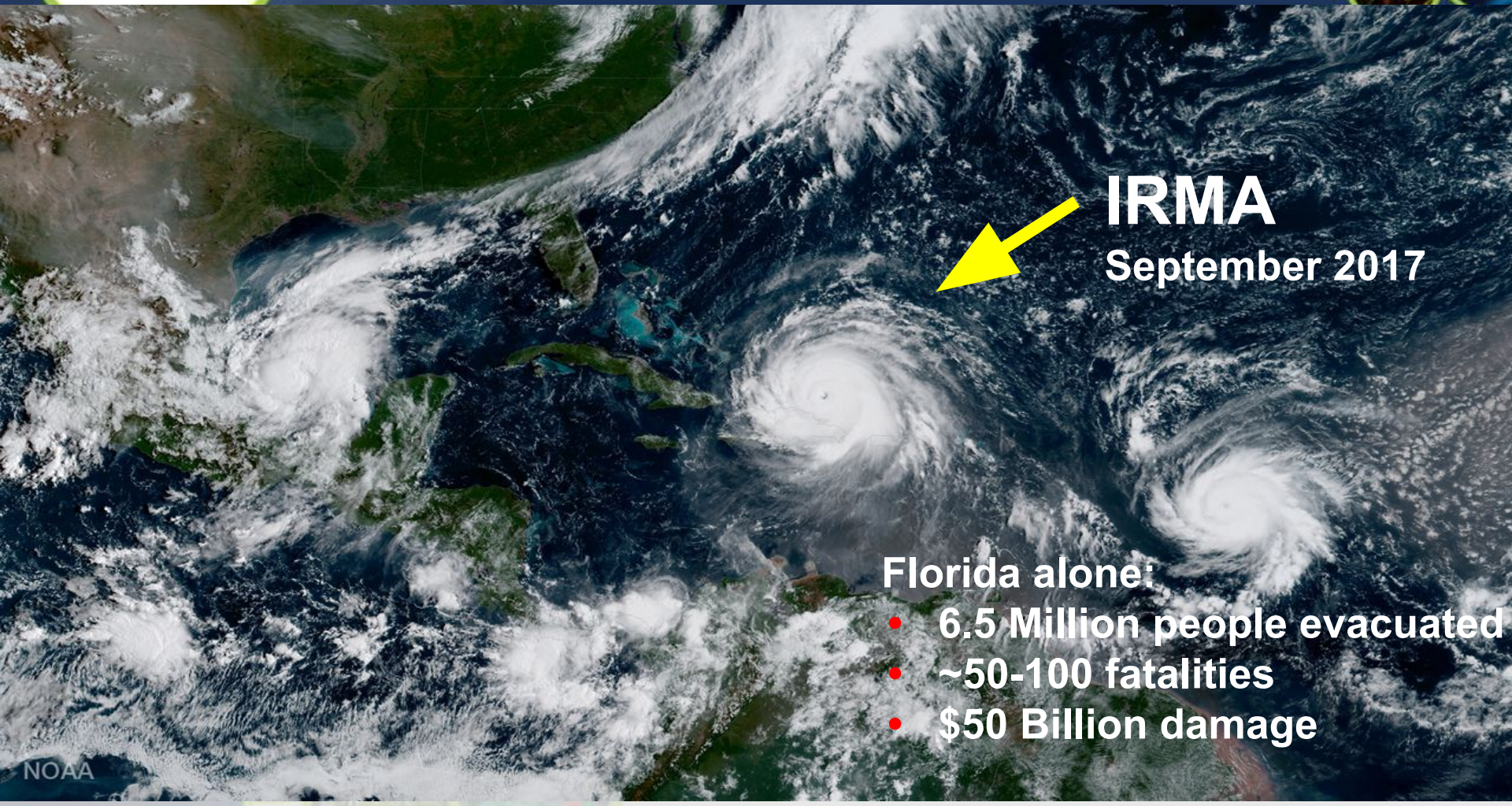


Figure: The XCO_2 distribution over 780 km by 670 km region centered over Berlin, Germany (adapted from Kuhlmann et al. 2018) is shown along with the spatial coverage and resolution for GOSAT (red dots), OCO-2 (blue tracks) and a proposed CO_2 Sentinel mission with a 250 km-wide swath (light grey region). Credit: ESA SMARTCARB.

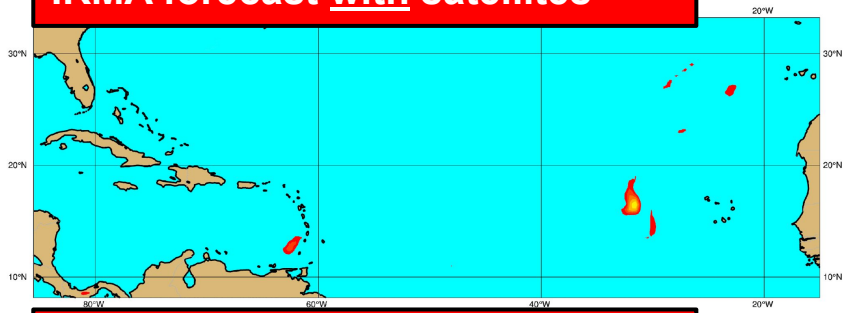
Loss & Damage - Intensity of Cyclones and Upper Ocean



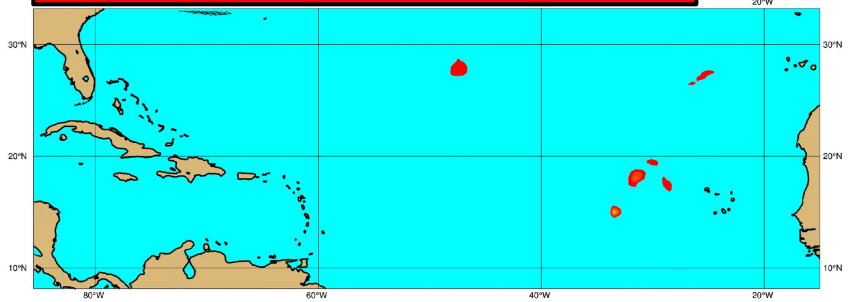
By NOAA National Environmental Satellite, Data, and Information Service (NESDIS) - https://www.nesdis.noaa.gov/content/goes-16-sees-three-hurricanes-atlantic, Public Domain, https://commons.wikimedia.org/w/index.php?curid=67039446

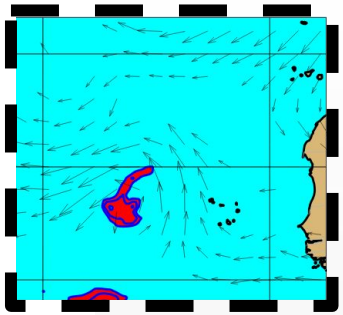
Loss & Damage: Weather Impacts and Preparedness

IRMA forecast with satellites



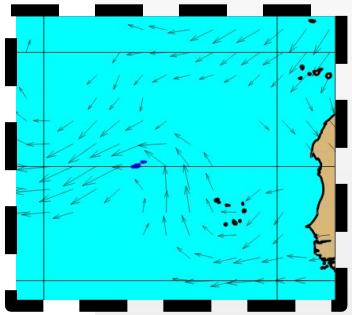
IRMA forecast without satellites





700hPa initial conditions with satellites

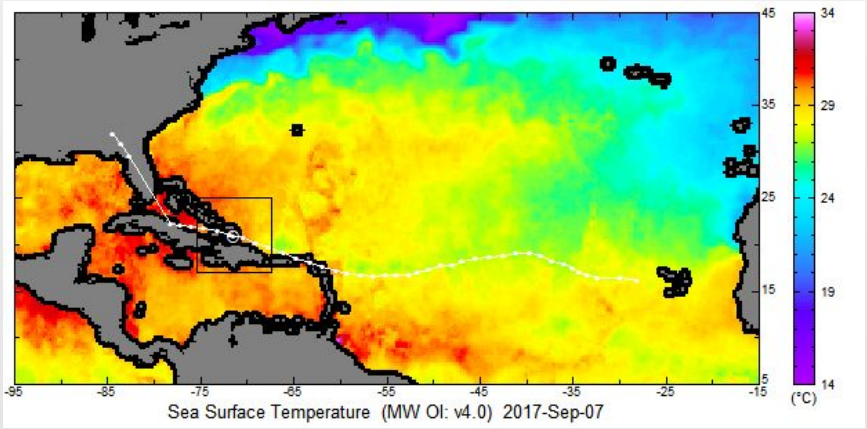
Red shading humidity > 95%



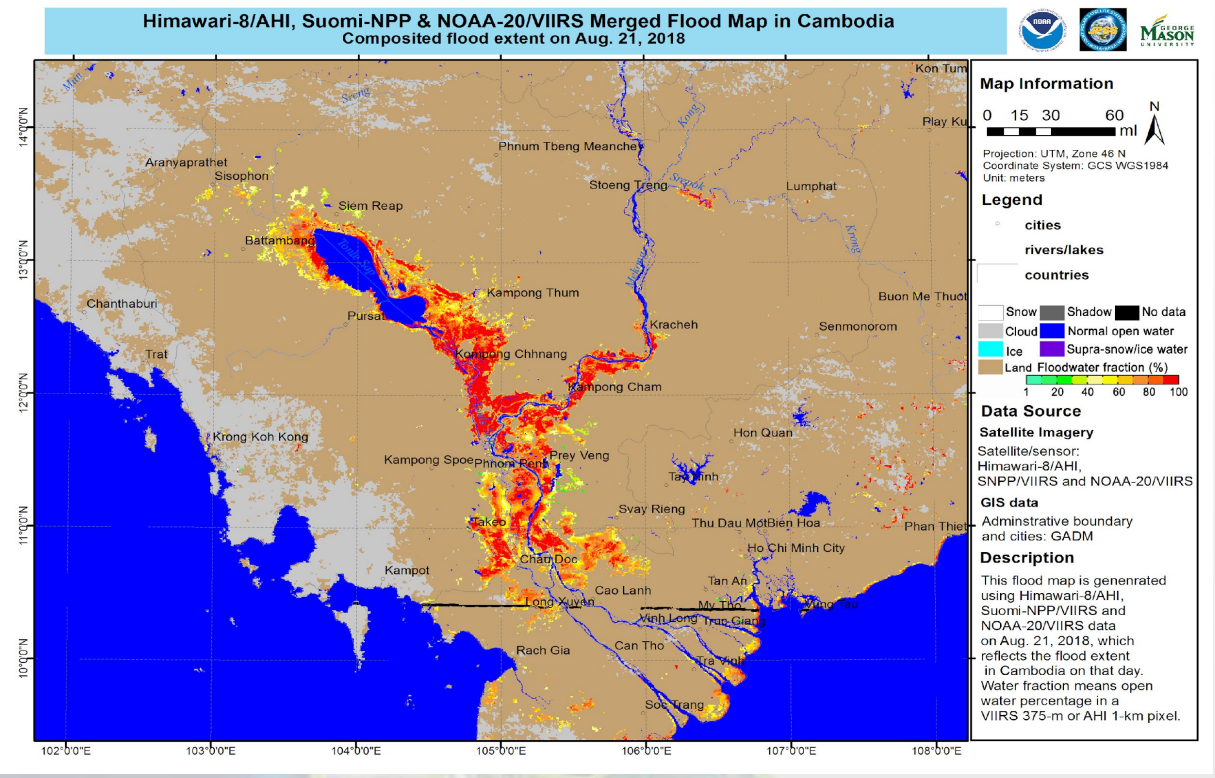
700hPa initial conditions without satellites

ECMWF

Good understanding of storms and good prediction links event causing loss and damage to climate variability and change. Operational attribution systems will become part of climate services in the future.



Loss & Damage: Floods



- Combined use of satellite data from geostationary and polar orbit;
- Enables disaster responders to act;
- Analysis of past events enables risk assessment as function of time as climate changes.

Courtesy, Mitch Goldberg, NOAA, USA

Broadening and Consolidating UNFCCC engagement (1/2)

- CEOS & CGMS has been very effective over last 8 years in establishing a **positive and proactive dialogue** with UNFCCC/SBSTA
- This is in large part due to the to the **symbiotic relationship we have established with the Global Climate Observing System** (GCOS) and the Climate Monitoring Architecture, which has been our guiding framework
- The creation of **the Joint WGClimate established an unambiguous entry point** for the discussion between SBSTA and the Space Agencies
- To date, this **engagement**, through the SBSTA Research and Systematic Observation (RSO) subgroup has largely **focused on our support on Climate Data Records for GCOS ECVs**
- **GHG Monitoring**
- In recent years, our **support has been visibly expanding**: CEOS Carbon Strategy, CEOS GFOI support and evolution to biomass, other AFOLU, Climate Services and support to Climate Adaptation etc. so…

Broadening and Consolidating UNFCCC engagement (2/2)

- CEOS needs a long-term strategy accounting for the multitude of contributions it and its member Agencies can make to the Convention
  - Maintaining the effective focal point established through WGClimate
  - Increasing communication on contributions from other parts of CEOS (in statements, SBSTA Briefings etc.)
- Use, and re-enforce, CEOS Carbon Strategy as framework for carbon relevant aspects.
- Give greater visibility to GFOI/Biomass aspects as well as Agriculture, not only through REDD+ but also RSO
- In the short/mid term:
  - Build on priorities of SIT Chair (AUS) on Carbon and Biomass, as well as current visibility on GHG Monitoring
  - Initiate dialogue between GHG and AFOLU communities – Workshop hosted by EC June 2021
  - Dedicated discussion at SIT TW with all CEOS entities, GCOS and UNFCCC Secretariat

10 mins

Committee on Earth Observation Satellites

Global Stocktake Update

UNFCCC SEC

Jo Post & Florin Vladu

CEOS SIT Technical Workshop 2020

United Nations Framework Convention on Climate Change

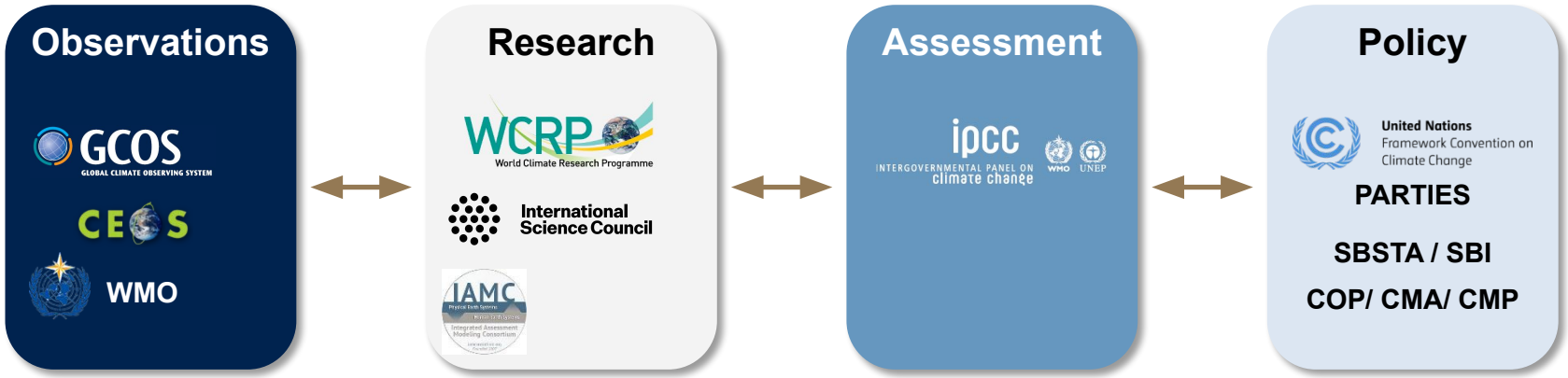
2020 CEOS Strategic Implementation Team Technical Workshop

4.1 and 4.2: Carbon and Biomass

Supporting the UNFCCC and the Global Stocktake

Joanna Post, Programme Officer
UNFCCC secretariat

Observations - the foundation for commitments and decision making on climate change

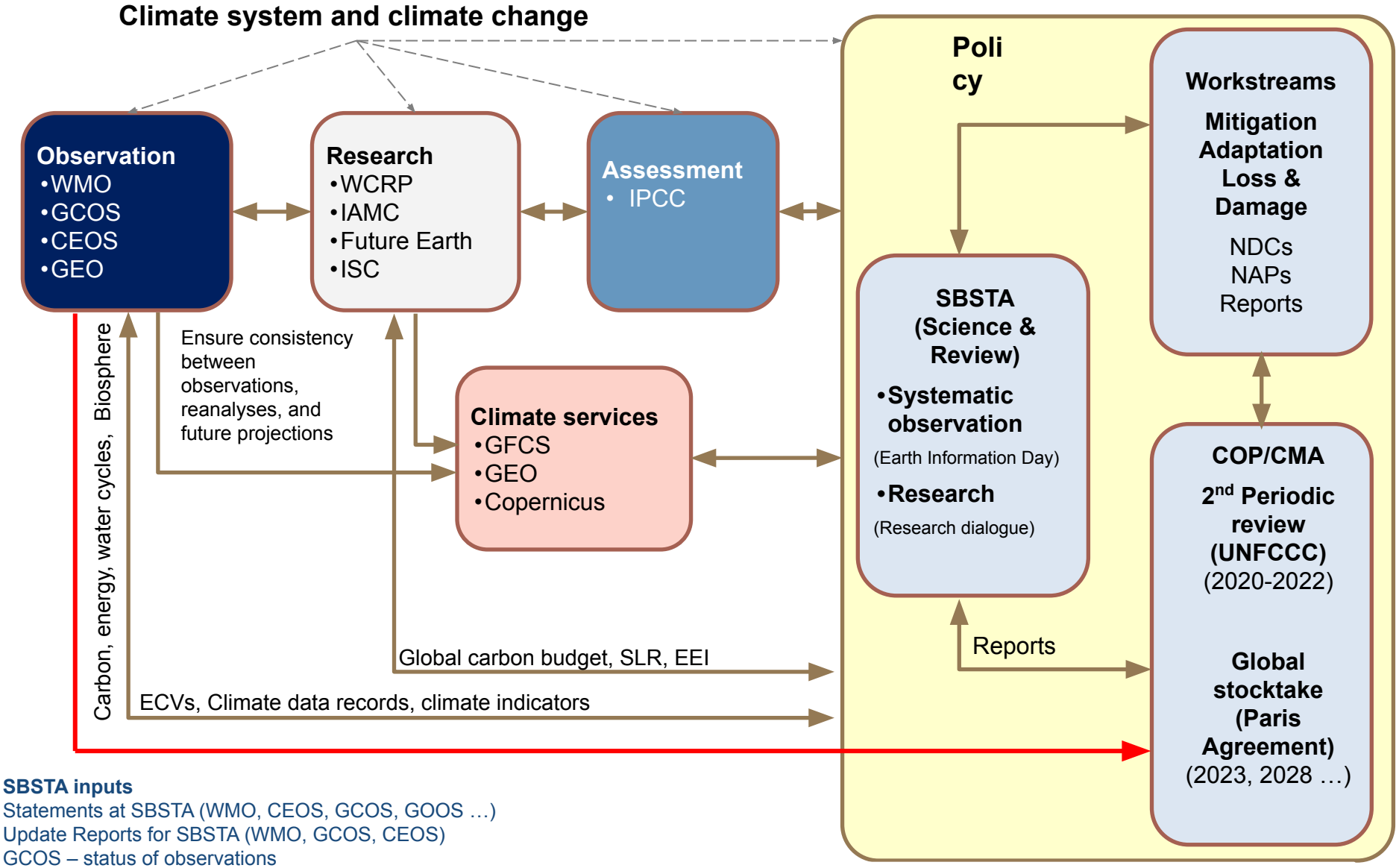


Article 4.1(g) Commitments

Article 5
Research and systematic observation

SBSTA Research and systematic observation agenda item

Paris Agreement | Science – Policy interface



SBSTA inputs

Statements at SBSTA (WMO, CEOS, GCOS, GOOS …)
Update Reports for SBSTA (WMO, GCOS, CEOS)
GCOS – status of observations
GCOS IP
WMO Statement on the state bulletin

GST synthesis report??

The systematic observation community will contribute to the GST – indirectly, through Parties, constituted bodies, IPCC, UN Agencies. Can it contribute directly?

The "ambition" cycle of the Paris Agreement

Take action to implement Paris Agreement

- **At national and international level**

- Limit global warming to < +2/1.5° C
- Enhance adaptive capacity, resilience, & low-emissions development
- Finance compatible with resilient development and low emissions

***Communicate* individual efforts (forward looking)**

- **NDCs:** 2020, 2025, 2030 …
- **Adaptation Communication:** …
- Long-term low GHG development strategies: 2020

***Report* individual efforts (backward looking)**

- **Biennial transparency reports (BTRs): 2024, every 2 years after**
- **Includes information necessary to track progress made in implementing and achieving NDCs**

5 years cycle

Take stock of implementation of the Paris Agreement and assess collective progress towards its purpose and long-term global goals

- **Global stocktake (GST) (2023, 2028, 2033)**
- Comprehensive: mitigation, adaptation and means of implementation and support

Informs Parties in:

- Updating NDCs in a nationally determined manner (progression clause)
- Enhancing international cooperation for climate action

Key to catalyze progress

- IPCC assessments
- Constituted Body reports
- Secretariat synthesis reports
- UN agencies
- …

The global stocktake – an anchor for the ambition cycle to bring it all together

Recent RSO conclusions

SBSTA 51 (2019) FCCC/SBSTA/2019/5 Earth Information Day 2019

35. The SBSTA welcomed the work of the scientific community, Parties, climate service providers, and space agencies in **collecting, managing and openly sharing data and processed data products** for addressing climate change and current and future climate risk.

The SBSTA **urged Parties and relevant organizations to continue to establish and support open data sharing, and the development of openly available, relevant and accessible data products**, particularly for supporting and monitoring adaptation and mitigation.

40. Recalling the conclusions of SBSTA 47, the SBSTA welcomed the continued work of the Joint CEOS/CGMS Working Group on Climate in response to the GCOS implementation plan.

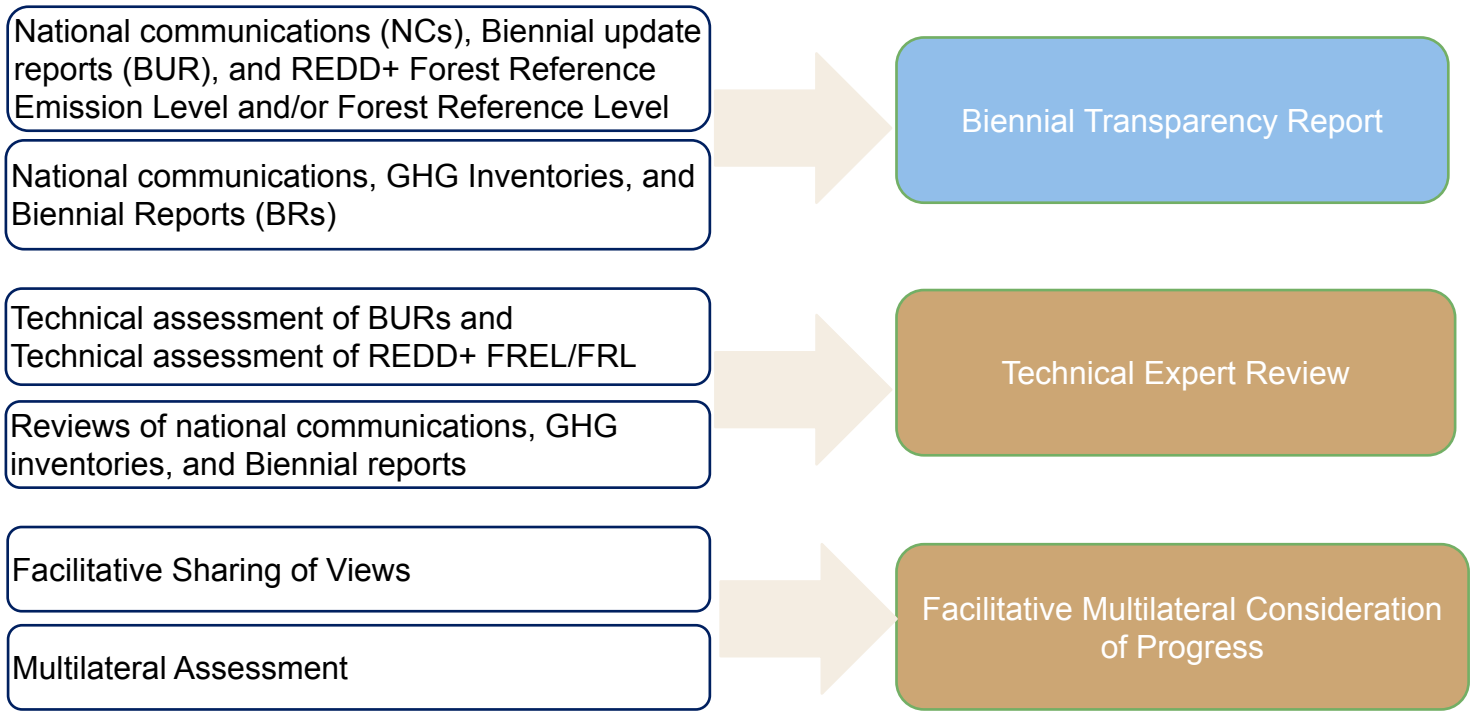
It **recognized the systems approach of the constellation architecture**, which combines satellite, in-situ and modelling components for emission estimates, for monitoring CO_2 and CH_4 from space.

It encouraged meaningful engagement among the space agencies, modellers and Parties in the implementation and use of the system.

Constellation architecture recognized by the SBSTA

Reporting under the Enhanced Transparency Framework

A common framework with embedded flexibilities for developing countries that need it in the light of their capacities



Reporting requirements are changing and synergizing under the Paris Agreement

NB 2019 refinement to IPCC guidelines not (yet) acknowledged by Parties as the resource to use for inventories

Standing reporting requirements on top of the Enhanced Transparency Framework

Annual GHG inventory by developed countries (in BTR-years, may be stand-alone or part of BTR)

National communications

Parties may submit their national communication and BTR as a single report, in accordance with the ETF MPGs for information also covered by the national communication reporting guidelines.

In addition, Parties shall include in the report:

a) Supplemental chapters on **research and systematic observation** and on education, training and public awareness, in accordance with NC guidelines;

b) For those Parties that have not reported adaptation in BTRs, an additional chapter on adaptation, in accordance with the NC relevant guidelines.

REDD+ Forest Reference Emission Level and/or Forest Reference Level may be submitted; and the **technical annex on REDD+** for those Parties seeking results-based payments (as annex to the BTR)

Global stocktake - components

1. ***Information collection and preparation*** *2021/2022 - 2023*

   SBSTA/SBI joint contact group

   Sources of input (inc. synthesis reports)

2. ***Technical assessment*** *2022 - 2023*

   Technical dialogue guided by 2 co-facilitators

   Consider IPCC assessments

   Separate SBSTA-IPCC special events

3. ***Consideration of outputs*** *2023*

   identify opportunities for enhancing efforts, challenges, good practices, and political messages

   HL events to communicate messages

SB Chairs were invited to provide guiding questions for each of the 3 stages above

Decision for GST modalities: Decision 19/CMA.1 https://unfccc.int/documents/193408

In para 15 – After each GST – COP can refine logistical and procedural elements

Global stocktake – thematic areas

Mitigation

- Overall effect of NDCs
- State of GHG emissions and removals and mitigation efforts undertaken by Parties

Adaptation

- State of adaptation efforts, support, experiences and priorities

Finance flows and means of Implementation and support

- Finance flows and financial support
- Technology
- Capacity-Building

Efforts on:

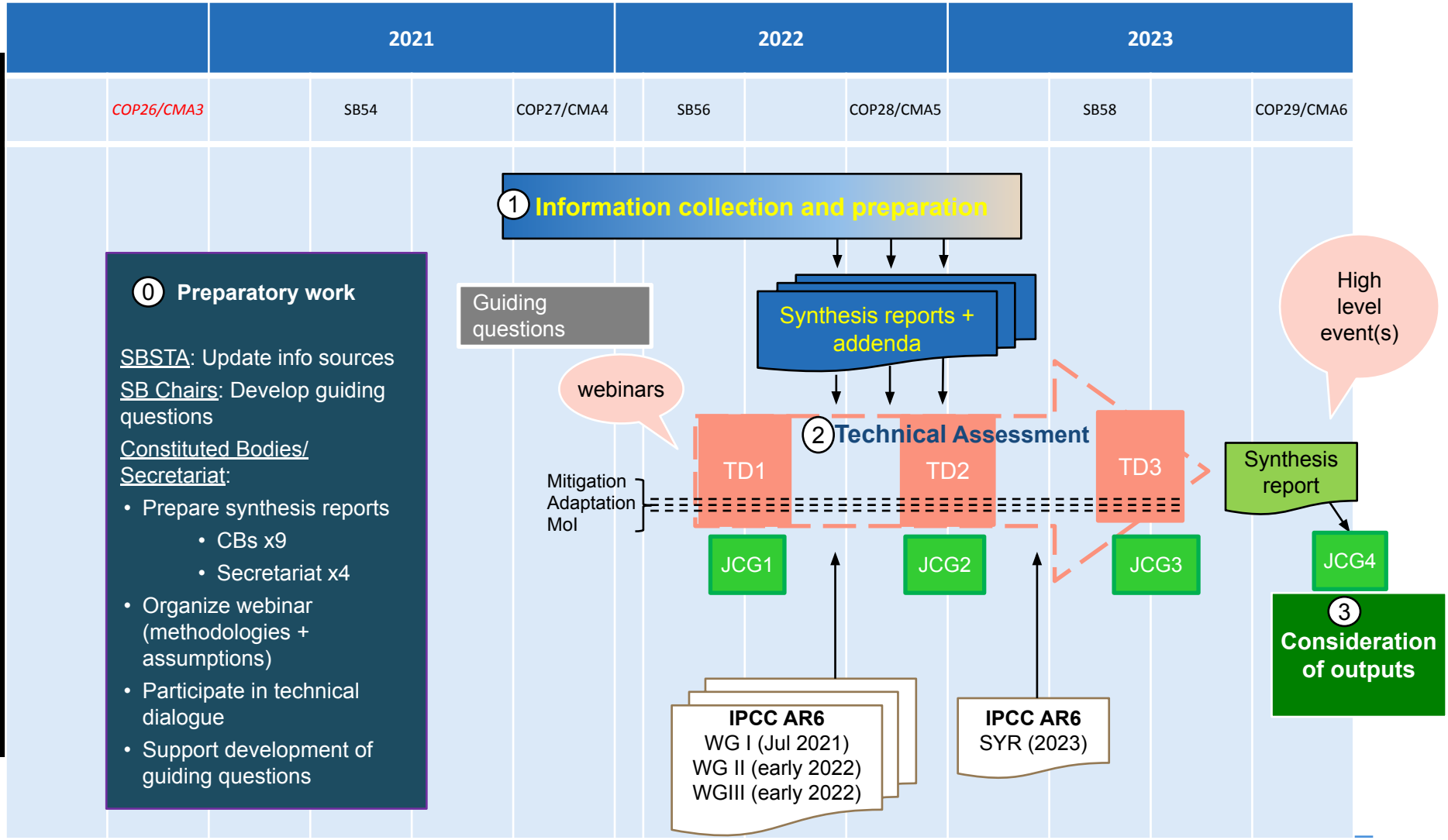
- Social and economic consequences of response measures (under mitigation)
- Adverting, minimizing and addressing loss and damage (under adaptation?)

Inputs on equity

- Fairness consideration including equity as communicated by Parties in their NDCs

GST has a thematic approach

What are the modalities of the GST and the timeline?



Contribution of EO community to assess collective progress under the first GST

Approach:

1. **Ad-hoc coordination group on systematic observation and collective progress**
   to better enable support by the EO community for Parties and the GST
   (supported by the UNFCCC secretariat) – *first meeting held Aug 2020*

2. **Possible activities**
   Support at global level to the GST AND at country-level

3. **Synthesis report** – EO community provide a consolidated contribution to the GST
   Can be produced in 3 parts corresponding to themes and guiding questions for the 3 technical dialogues

Preliminary scope of contribution:

1. Develop possible **guiding questions** (information collection, technical assessment, consideration of outputs; where are we? where we need to be? how to get there?)

2. **Aggregate information and identify indicators of progress and baselines**
   focus on the outcomes in terms of mitigation and adaptation
   (e.g. outcomes of supporting Parties to reduce uncertainties in GHG inventories, identify mitigation opportunities, and using climate services to adapt to climate change)

1. Identify **information gaps and good practices** and lessons learned

CEOS can contribute to the GST indirectly AND directly

Way forward – Pledge and review approach

CEOS can support Party reporting - including for

- Methodological support
  - GHG inventories – emissions estimates
  - IPCC methodology
- Review process / Refine data
  - Including as reviewers
- Support developing countries

CEOS can support the Global Stocktake

- On Party-level to improve accuracy / detail
- Provide advice to Constituted Bodies
- Collaborate on synthesis report at global level (GST 2023 …)

CEOS can support the needed integrated systems approach for MRV and GST

- CO_2 and CH_4
- Other atmospheric GHGs
- AFOLU/ Biomass
- …

Systems approach to support at national and international level

Thank you

jpost@unfccc.int

10 mins

Committee on Earth Observation Satellites

Update on key documents & processes

GCOS

Anthony Rea & Han Dolman

CEOS SIT Technical Workshop 2020

- Governance
  - Currently GCOS is led by a steering committee guided by its four sponsors (WMO, IOC of UNESCO, UNEP and ISC). This will continue.
  - A WMO study group including the four Co-sponsors and major partners will consider the future governance arrangements and make proposals in 2023
  - The GCOS secretariat will be based in the Infrastructure Department reporting to its director at WMO (previously it was in the Climate and Water Department)
- GCOS and WMO
  - WMO is strongly committed to GCOS and its continuing work, including
    - Reviewing and reporting on the needs for, and state of, climate observations
    - The GCOS Panels
    - The ongoing review of the ECVs, updates to the Status Report & Implementation Plan
    - The operation and integration of the GCOS networks
    - Regional activities and national support
  - WMO would also like to strengthen
    - The input of GCOS into WMO regulatory and guidance activities
    - Its consideration of ocean climate needs
  - WMO recognises the range of organisations GCOS cooperates with and the importance of this approach

GCOS Timeline

Input from other groups, e.g. **CEOS/CGMS WG Climate**, on ECV Requirements, contributions to the Status Report and Implementation Plan and review comments.

1. STATUS OF THE GCOS ESSENTIAL CLIMATE VARIABLES (Adequacy of the Observing System and Data Stewardship)
2. STATUS OF THE OBSERVING NETWORKS
   - 2.1 Satellite Observations
   - 2.2 GCOS Networks
   - 2.3 Ocean Networks
   - 2.4 Terrestrial Networks
3. STATUS OF THE IMPLEMENTATION OF ACTIONS FROM THE 2016 IMPLEMENTATION PLAN
4. OBSERVATIONS OF AND FOR ADAPTATION, AND EXTREMES
5. OBSERVATIONS OF THE EARTH SYSTEM CLIMATE CYCLES
6. CONCLUSIONS

Contribution from WGClimate to 1, 2.1 and 3 is critical

Status Report

Adequacy of the Observational System	Availability and Stewardship
(5) Very Good: Meets requirements.	(5) Very Good: Data available worldwide, with high standards of data stewardship
(4) Good: Generally, meets requirements, provides reliable global trends.	(4) Good: Data available but not meeting the highest standards of data stewardship
(3) Medium: Does not meet requirements: while observations are useful and reliable from a user's perspective, they have significant issues at a regional level.	(3) Medium: Most regions have available data but there may be stewardship issues, however the data are useful and reliable from a user's perspective
(2) Low: Can only produce datasets with limited reliability from a user's perspective at global and regional levels.	(2) Low: Some data is available but of limited utility
(1) Poor: Do not meet requirements and does not provide reliable trends.	(1) Poor: Useful data is not available at a global or regional level.

ECV	Adequacy of the Observational System Assessment	Availability and Stewardship Assessment
River Discharge	3 In-situ observations with gaps and highly variable Satellite data: measure water elevations, no direct measurement of discharge. Global monitoring but weak temporal resolution depending on the satellite orbit cycle (several days). The use of constellations (with 10 satellites or more) could improve the temporal resolution.	3 In-situ data quality and availability dependents on national hydrological service Satellite data: all freely available, long-term monitoring foreseen with the Copernicus program, QA/QC but dependant on in-situ data, and adequate metadata. Water elevation accuracy less precise than in situ (few decimetres accuracy).
Soil Moisture	3 Meeting requirements in semi-arid regions and crop lands, issues still in dense vegetation, organic soils, and regions of strong topography	**5 Most datasets are open access, including doi and validation reports and many are produced operationally**
Glaciers	3 Very limited glaciers have in-situ observations. Satellite data is globally covered but has too low spatial resolution to extract useful data with sufficient time resolution.	**5 In-situ data and remote sensing data is collected and published by prevailing networks with high quality and efficacy. Users can access and use most data easily.**
Ice Sheet and Ice Shelves	4 Great achievements cover vast and ca. inaccessible area.	4 Data product efforts were done, and information was compiled, and dissimilation have been progressing.

GCOS WMO IOC International Science Council UN environment

GCOS routinely maintains, reviews and revises ECV requirements

GCOS Implementation Plan (GCOS-200, Annex A) gives requirements for each ECV product.

Process for Updating Requirements

- Two public reviews
- Greater involvement of stakeholders
- More detailed information and definitions required
- More specific consideration of different users (e.g. adaptation and extremes)

Timeline for next update

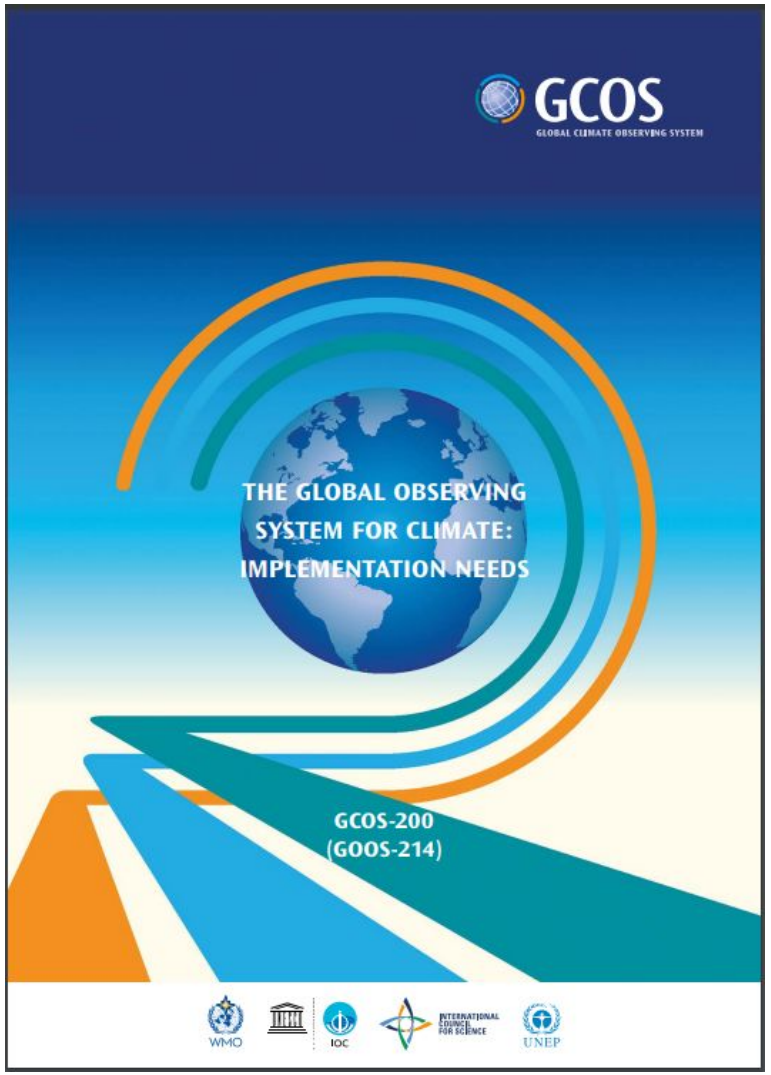
- 2018-2019: ECV stewards, in consultation with their community, updated the existing ECV requirements
  - **January-February 2020: 1st public review of ECV requirements**
- 2020 - Panels review comments and agree on ECV requirements. Identified issues taking into account into Status Report
- 2021: additional meetings for ECV requirements (if needed)
  - **January-February 2022: 2nd public review of requirements as part of the new IP**

Implementation Plan

Update of the GCOS IP: input from status report and climate observations conference

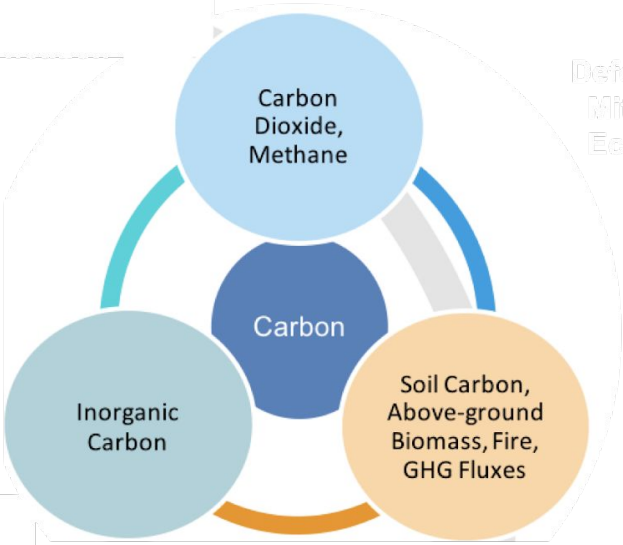
Timeline: ***Published by October 2022***

- shorter than earlier Implementation Plans
- Integrative actions
  - Consider benefits of synthesis and consideration of activities across ECVs
- Actionable actions
  - Things that are actionable by GCOS / GCOS sponsors
- Priority actions
  - Select what is critical
- ***Update of requirements***



GCOS IP

- Current GCOS ECVs are focused on mostly on the physical and biological aspects of the carbon cycle



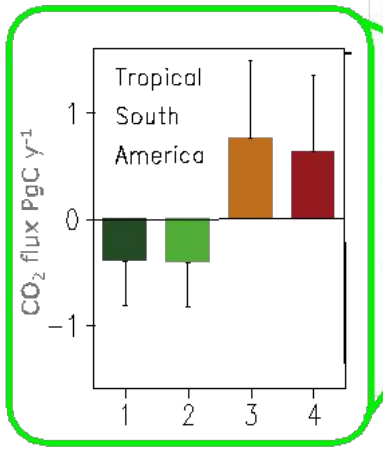
- We see after the Paris agreement, increased attention to anthropogenic emission monitoring

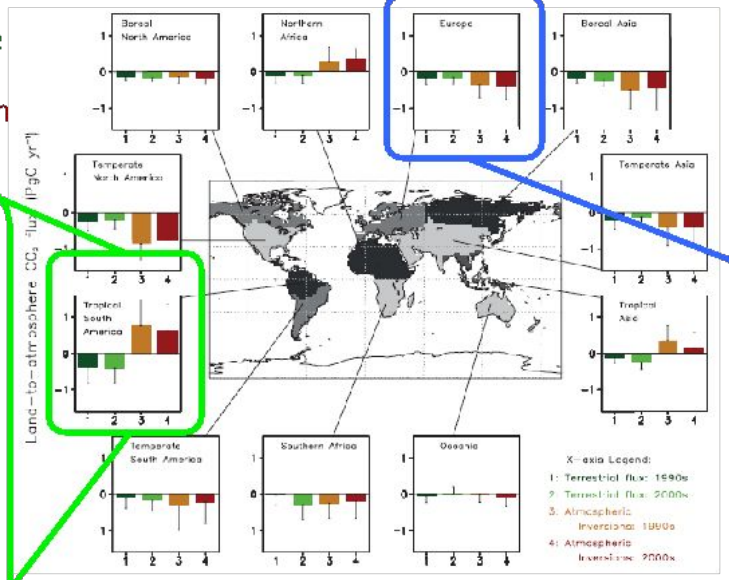
- This calls for a re-evaluation of the ECVs and possible enhanced requirements specification.

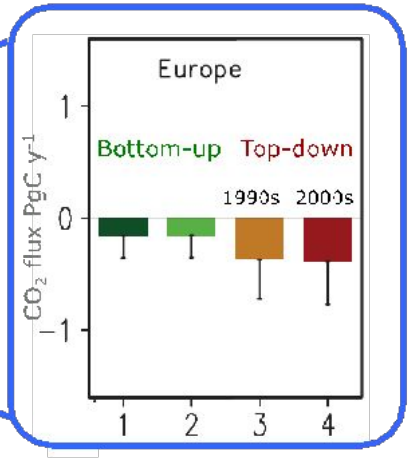
How good are we in closing the continental scale budgets?

understood by measuring regional fluxes

- Ecosystem models poorly represent mortality and land-use change
- No atmospheric station in this region







- Ecosystem models did not include land management and nitrogen deposition
- Even over Europe, too few atmospheric stations result in large errors

Source – IPCC AR5

- Large discrepancies between bottom-up models and atmospheric inversions
- Tropics and high latitudes regions have almost no observation
- Large uncertainties ~100% on regional budgets !

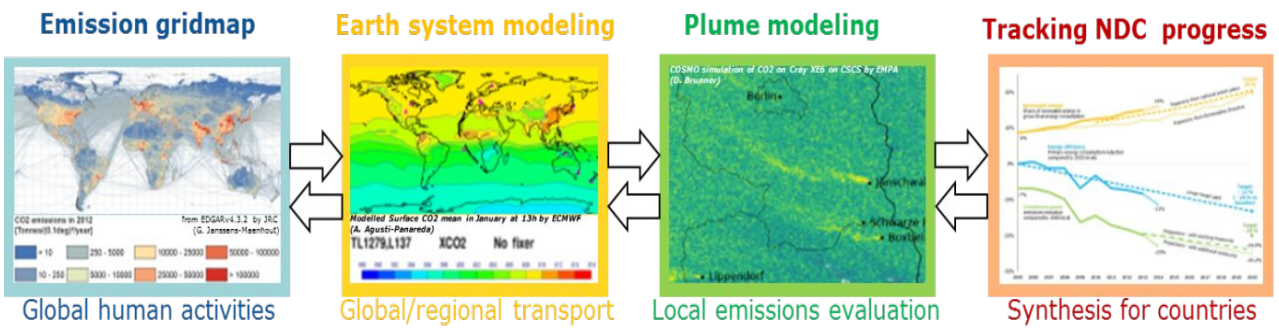
Ciais et al., 2020

VU VRIJE UNIVERSITEIT AMSTERDAM

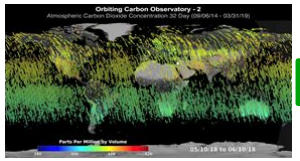
GCOS WMO IOC International Science Council UN environment

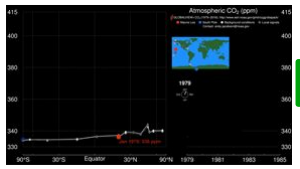
From ad hoc to systematic observations…

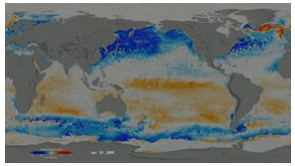
- The current closing of top down and bottom up budgets is unsatisfactory, particularly at country reporting level
- CO_2 from space is possible, and has detected peculiarities in the natural C-cycle, CH_4 hot spot monitoring works well
- To make CO_2 monitoring from space useful for Paris agreement reporting, stocktake etc., attention is required to the full system of in situ, space based and analysis capabilities

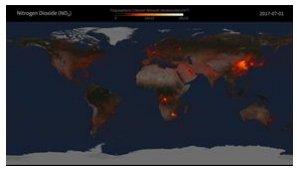


A Systematic Approach for Atmospheric Inventories









Observations

- **Satellite Measurements of CO_2 and CH_4**
- **Ground and Airborne Measurements of CO_2 and CH_4**
- **Meteorology** Satellite & in-situ
- **Auxiliary Data** Satellite observations of CO, NO_2, clouds, aerosols …

Prior Information

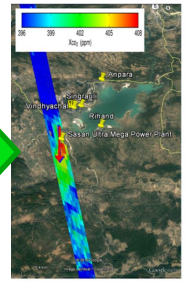
Fluxes, model parameters, emission reports, economic statistics.

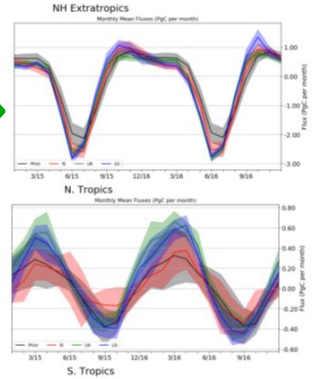
Integration & Attribution

- **Estimation system** Data assimilation and uncertainty estimation
- **Models** Transport, land & ocean carbon cycle, fossil fuel emissions.

Outputs

- **CO_2 and CH_4 emissions & removals from Hot-spots** with uncertainties
- **Country/region CO_2 and CH_4 emissions & removals** with uncertainties
- Other Carbon Cycle Products





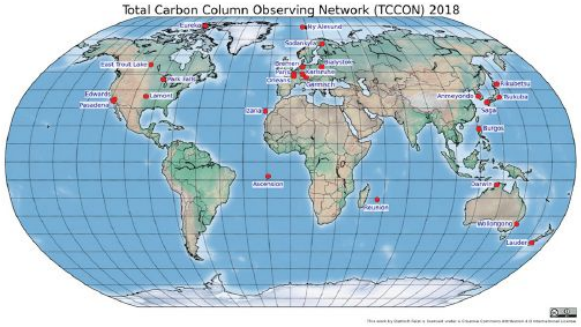
VU VRIJE UNIVERSITEIT AMSTERDAM

GCOS WMO IOC International Science Council UN environment

jpl.nasa.gov

Role of GCOS

- Review current ECVs related to carbon cycle (in progress)
- Define new requirements for satellite and in situ data from the user (UNFCCC) perspective at a range of spatial scales, taking their temporal variability into account.
- Distinguish between fluxes and stocks, making the link explicit
- What do we need to do?
  - Engage in discussion with space agencies (through CEOS
  - task force)
  - Engage with in situ community (through GAW, ICOS etc)
  - Include ocean, land and atmosphere expert in one group
- Arrive at a new, relevant set of GHG requirements in the new IP (2022)



Climate Observation Conference

Sponsored by EUMETSAT
2nd Climate Observation Conference
12–14 October 2021, Darmstadt, Germany

This conference follows on from the first climate observations conference, Global Climate Observation: The Road to The Future held on 2–4 March 2016 in Amsterdam.

AIM: assess how well the current global climate observing system supports current and near-term user needs for climate information. In particular the meeting will examine how well observations of the global Earth cycles (the global energy balance, global water and carbon cycles, and explaining changing conditions of the biosphere) support users' needs for climate data.

The outputs will provide inputs into the **next GCOS implementation plan** which will make recommendations to meteorological networks, major observing systems and satellite agencies and will be presented to the UNFCCC in 2022 as a contribution towards the UNFCCC's Global Stocktake.

Opportunity for experts dealing with climate observations and other key stakeholders to review and give input to and feedback on the production of the Implementation Plan.

Invitation for papers and posters in the autumn 2020.

10 mins

Committee on Earth Observation Satellites

CEOS AFOLU Roadmap

Task Team

Osamu Ochiai (JAXA) &
Frank Martin Seifert (ESA)

CEOS SIT Technical Workshop 2020

Overview

The importance of NDCs to Paris Agreement, and specifically the Global StockTake (GST), raises new challenges around country needs and implications for using EO data with greater emphasis on mitigation and adaptation, and national-level datasets.

- *"...if Land Use, Land Use Change and Forestry targets involved in the initial NDCs were implemented in full, this would represent approximately **a quarter** of pledged mitigation efforts up to 2030 "*

JAXA and ESA explore the development of a CEOS AFOLU Roadmap. The aim of the Roadmap is to assess the will, direction and capability of the relevant CEOS Agencies, with the SIT Chair team supporting communications with Principals and identifying team nominees.

AFOLU Team (so far)

Osamu Ochiai, JAXA & GFOI (Co-Lead)

Frank-Martin Seifert, ESA & GFOI (Co-Lead)

Stephen Ward, JAXA

Ake Rosenqvist, JAXA

Takeo Tadono, JAXA

Richard Lucas, ESA/CCI

Shaun Quegan, UK

Heather Kay, UK

Ian Jarvis, GEO-GLAM

Alyssa Whitcraft, GEO-GLAM

Steven Labahn, USGS

Michael Falkowski, NASA

Laura Duncanson, UMD

Brad Doorn, NASA

Christine Mcmahon-Bognor, NASA

Brian Killough, NASA

Team building up and monthly call meeting since SIT-35

Context

Title: A CEOS Roadmap for AFOLU Inputs to the UNFCCC Global Stocktake Process
(A Discussion Paper for CEOS Plenary)

Context:

1. **Introduction**
2. **Opportunity of the Global Stocktake**
3. **EO Capabilities in support of AFOLU**
4. **Deployment of Capabilities**
5. **Potential Roadmap Actions**
6. **Summary and Next Steps**
7. **References**
8. **Appendices**

Objectives

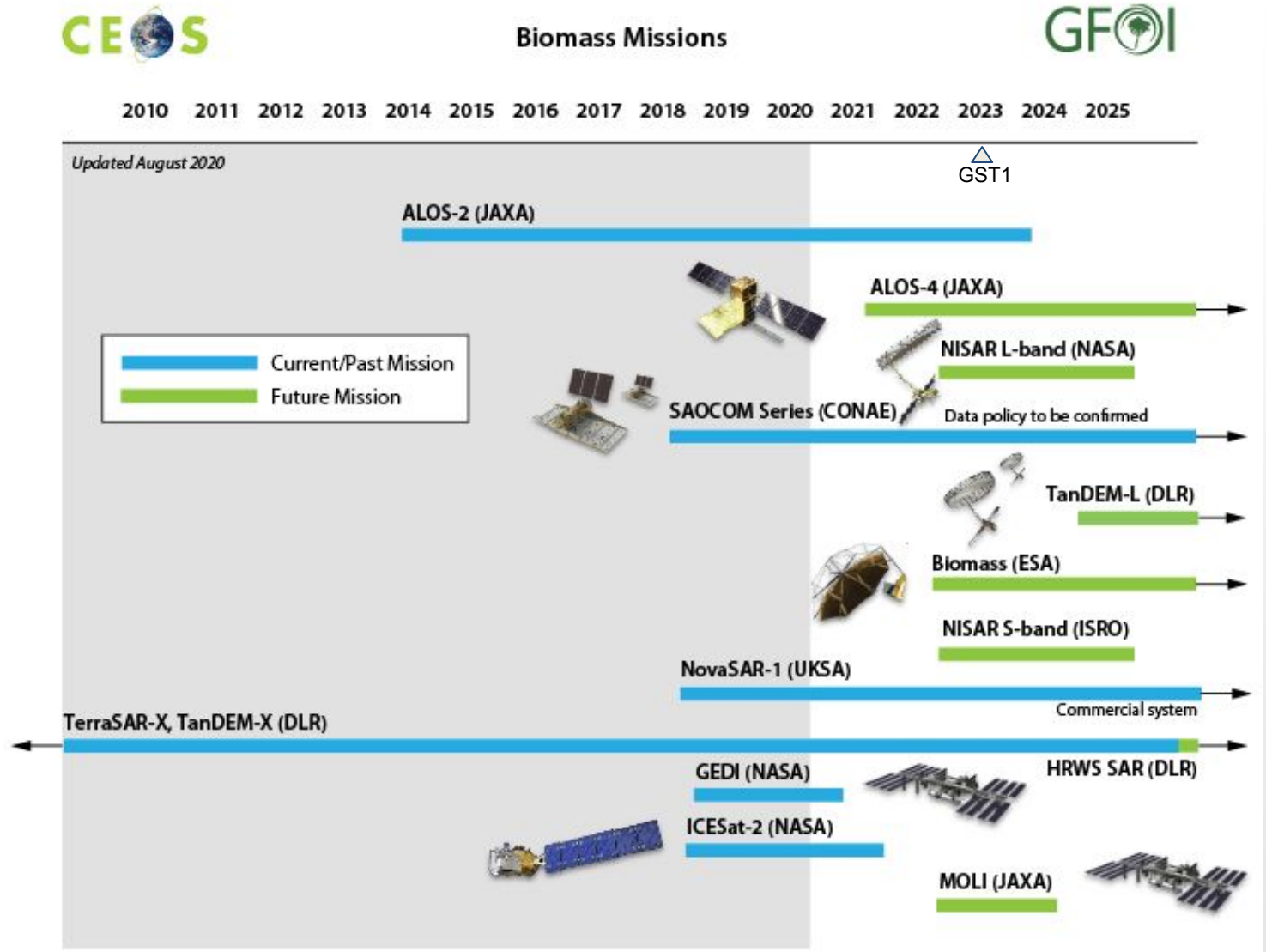
1. Provide the case to CEOS and its agencies for investing in development of such a Roadmap

1. Ensure a coordinated and comprehensive response from CEOS and space agencies to policy process

1. Provide a clear statement of the technical capabilities of CEOS agency EO satellite data and their characteristics

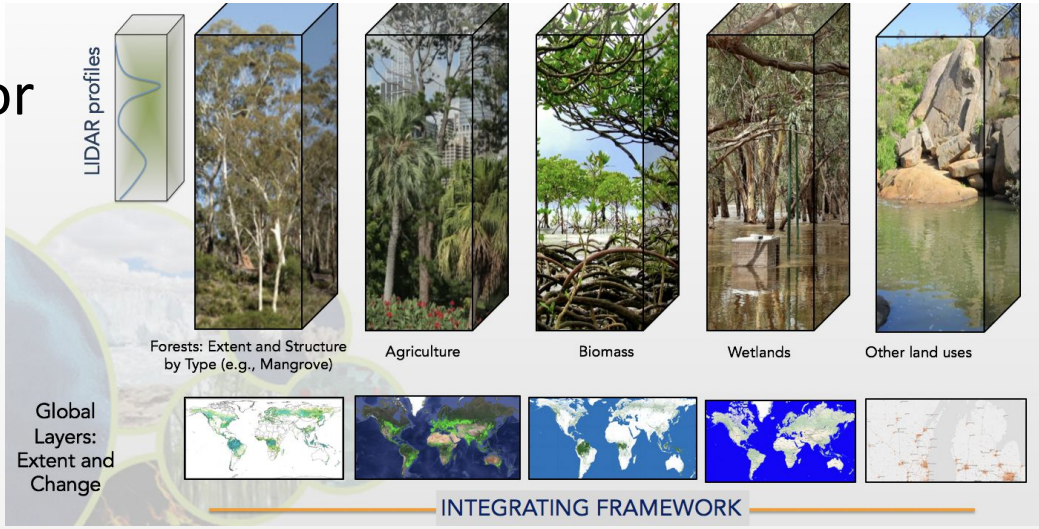
1. Provide a mechanism for further engagement and iteration between CEOS and the GST processes, including in support of the synthesis reports, and with UNFCCC SEC

CEOS Agencies' Capabilities
Biomass

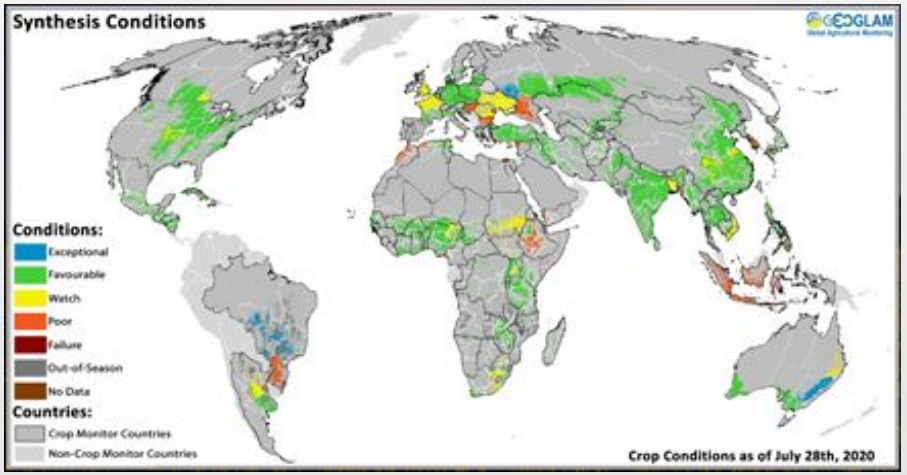


CEOS Agencies' Capabilities AFOLU

- Lays out the range of capabilities of EO satellites for
  - Agriculture
  - Forest (extend and structure)
  - Biomass (AGB)
  - Other Land Use



- Identifies the main deployment of these capabilities as datasets available to support both convention and national level
  - Agriculture, Forest, Biomass, OLU also



Potential Roadmap Actions

- **Improving EO capabilities to better meet the needs of the Convention or Parties,** globally and on national level
- **Providing new measurements** that do not currently form part of CEOS
- **Engaging with countries and stakeholders** (such as GFOI and GEOGLAM) in case studies to improve understanding and uptake of EO data by countries
- Taking actions to **assure the policy relevance of new capabilities** (e.g., through measures such as the CEOS Biomass Protocol)
- **Increasing efficiencies and effectiveness in the process by which climate data requirements are set** (e.g., by GCOS) and to which CEOS and CGMS space agencies respond.
- **Pragmatic focus for delivery to GST1 and GST2** like GHGs

Next steps

- Reflect on SIT TW discussions
- Engage with UNFCCC SEC offline re the SO Synthesis Report
- Solicit support from CEOS Principals on the case for an AFOLU Roadmap
- Prepare CEOS Plenary decision
  - seeking approval (& resources) to proceed
  - will need large AFOLU investor agencies on board to be viable

15 mins

Committee on Earth Observation Satellites

GHG Roadmap & AFOLU synergies

WGClimate Task Team

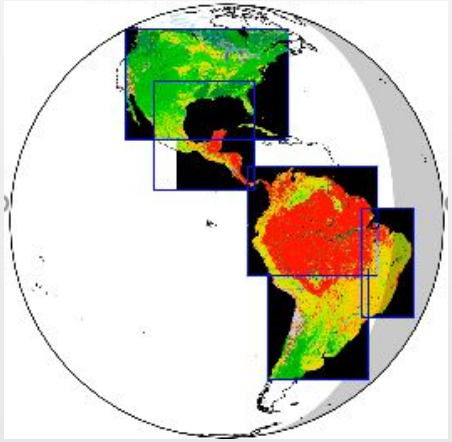
4.1.6 & 4.1.7

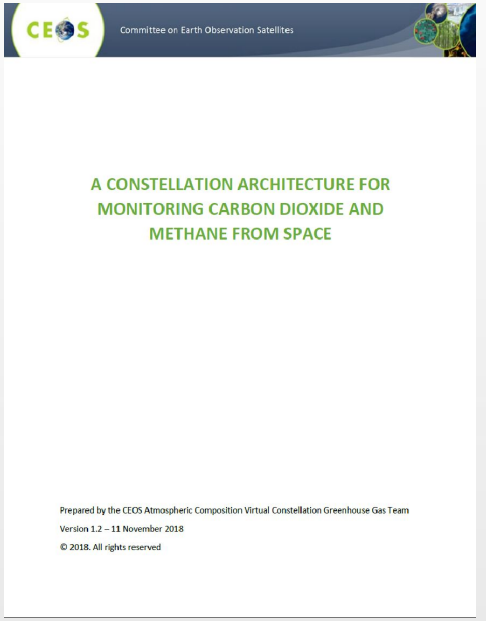
Mark Dowell

CEOS SIT Technical Workshop 2020

The CEOS Architecture for Monitoring Atmospheric CO_2 and CH_4 Concentrations

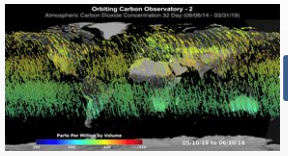
- **The CEOS Atmospheric Composition Virtual Constellation (AC-VC) white paper defines a global architecture for monitoring atmospheric CO_2 and CH_4 concentrations from instruments on space-based platforms**
- **166-page document, 88 authors from 47 organizations**
- **Executive Summary (2 pages)**
- **Body of report (75 pages)**
- **Technical Appendices (42 pages)**

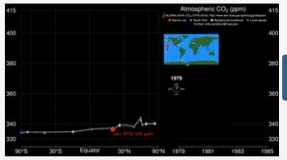


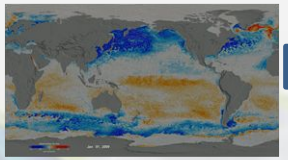


http://ceos.org/document_management/Virtual_Constellations/ACC/Documents/CEOS_AC-VC_GHG_White_Paper_Publication_Draft2_20181111.pdf

A System Approach is Adopted to Deliver Atmospheric CO_2 and CH_4 Inventories







Observations

- **Satellite Measurements of CO_2 and CH_4**
- **Ground and Airborne Measurements of CO_2 and CH_4**
- **Meteorology** Satellite & in-situ
- **Auxiliary Data** Satellite observations of CO, NO_2, clouds, aerosols ...

Prior Information

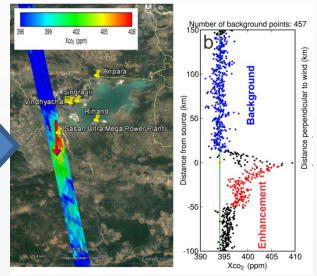
Fluxes, model parameters, emission reports, economic statistics.

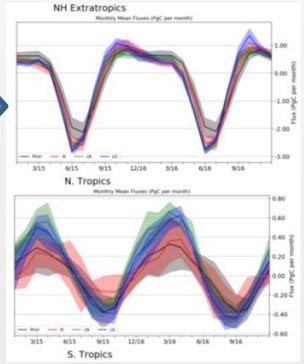
Integration & Attribution

- **Estimation system** Data assimilation and uncertainty estimation
- **Models** Transport, land & ocean carbon cycle, fossil fuel emissions.

Outputs

- **CO_2 and CH_4 emissions & removals from Hot-spots** with uncertainties
- **Country/region CO_2 and CH_4 emissions & removals** with uncertainties
- Other Carbon Cycle Products





GHG Roadmap Objectives

- **The GHG Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stake holders and users.**

- **The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs**
  - Maintained by the WGClimate GHG Task Team
  - Considered to be a living document whose Actions (Annex C) provide a snapshot of the work plan, which will be updated over time

Expected Outcomes of the Roadmap Activities

- The delivery of pilot datasets of CO_2 and CH_4 fluxes to enhance the uptake of Earth Observation satellite data sets in support of the Global Stocktake 2023;
- The delivery of an operational system for producing future atmospheric CO_2 and CH_4 flux products to support the Global Stocktake 2028; and
- The refinement of user requirements in preparation of the implementation of the operational system.

The delivery of each system version is accompanied by a requirements refinement process leading to the additional objective:

- Establishing the end-to-end requirements for a system that delivers atmospheric CO_2 and CH_4 flux products for use in stocktakes (with requirements apportioned to each system version).

High Level GHG Roadmap Timeline

Global Stock Take 1
using inventories through 2021

Global Stock Take 2
using inventories through 2026

2015 2017 2019 2021 2023 2026 2028

CEOS GHG Whitepaper

Pilot atmospheric CO_2/CH_4 Data sets

Consultation of Inventory requirements

Refined atmospheric GHG requirements

Initial Operational GHG Constellation Deployment

Atmospheric GHG data sets from operational system

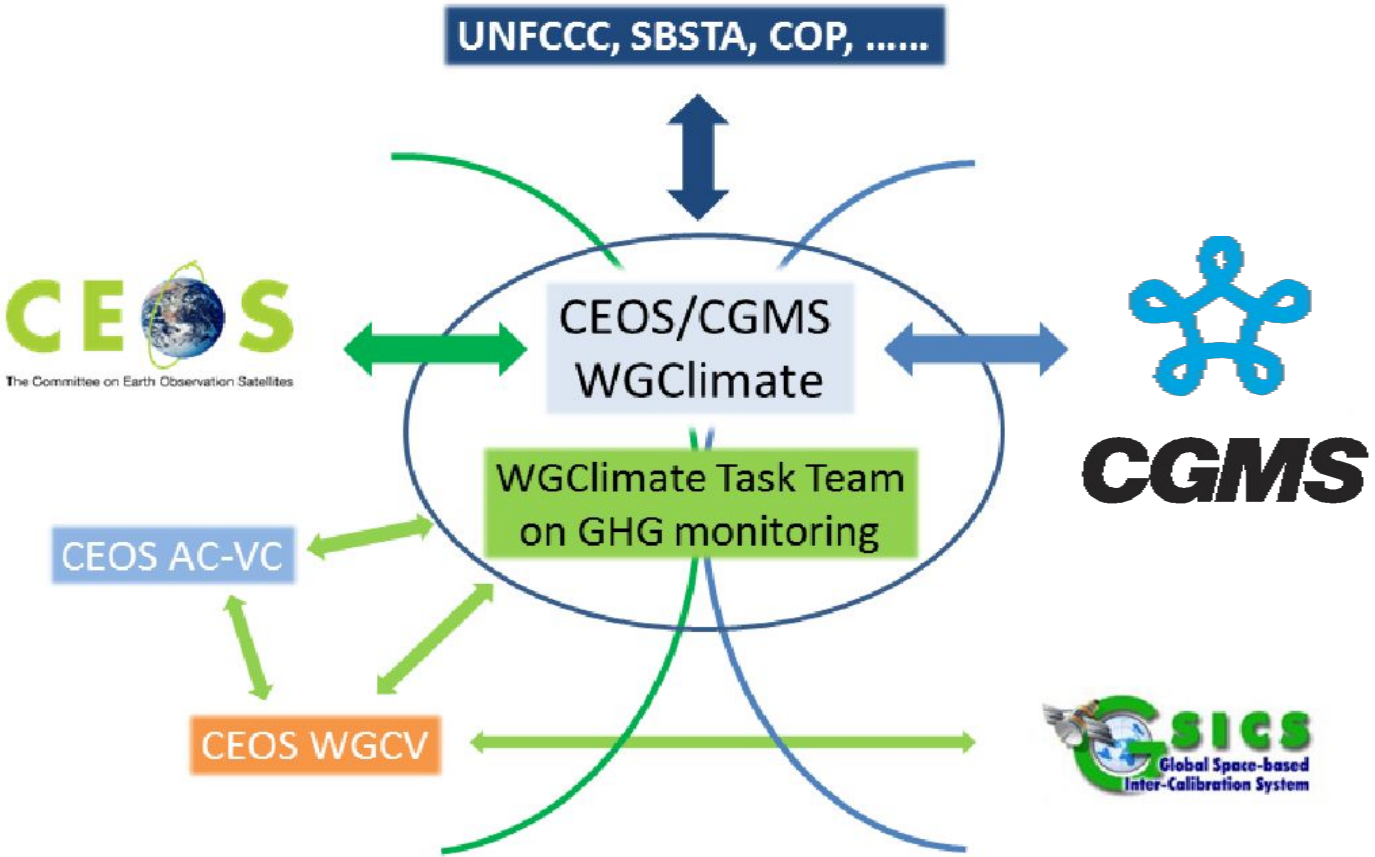
PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

Interface to and Feedback from External Communities

Engagement with external stakeholders and end users is fundamental to the success of the implementation of the system approach:

- **Engagement with the emission inventory community is critical to the iterative feedback approach, both:**
  - Through existing international coordination mechanisms (e.g. Global Emissions InitiAtive - https://www.geiacenter.org)
  - Through working with champion users on real applications – «beta testers»
- **Continued engagement with international policy frameworks, i.e. UNFCCC/SBSTA, IPCC TFI**
- **Engagement with technical implementing entities at international level, i.e. WMO IG^{3}IS and Joint Programmes supporting the Convention, i.e., GCOS, as well as the broader modelling community.**

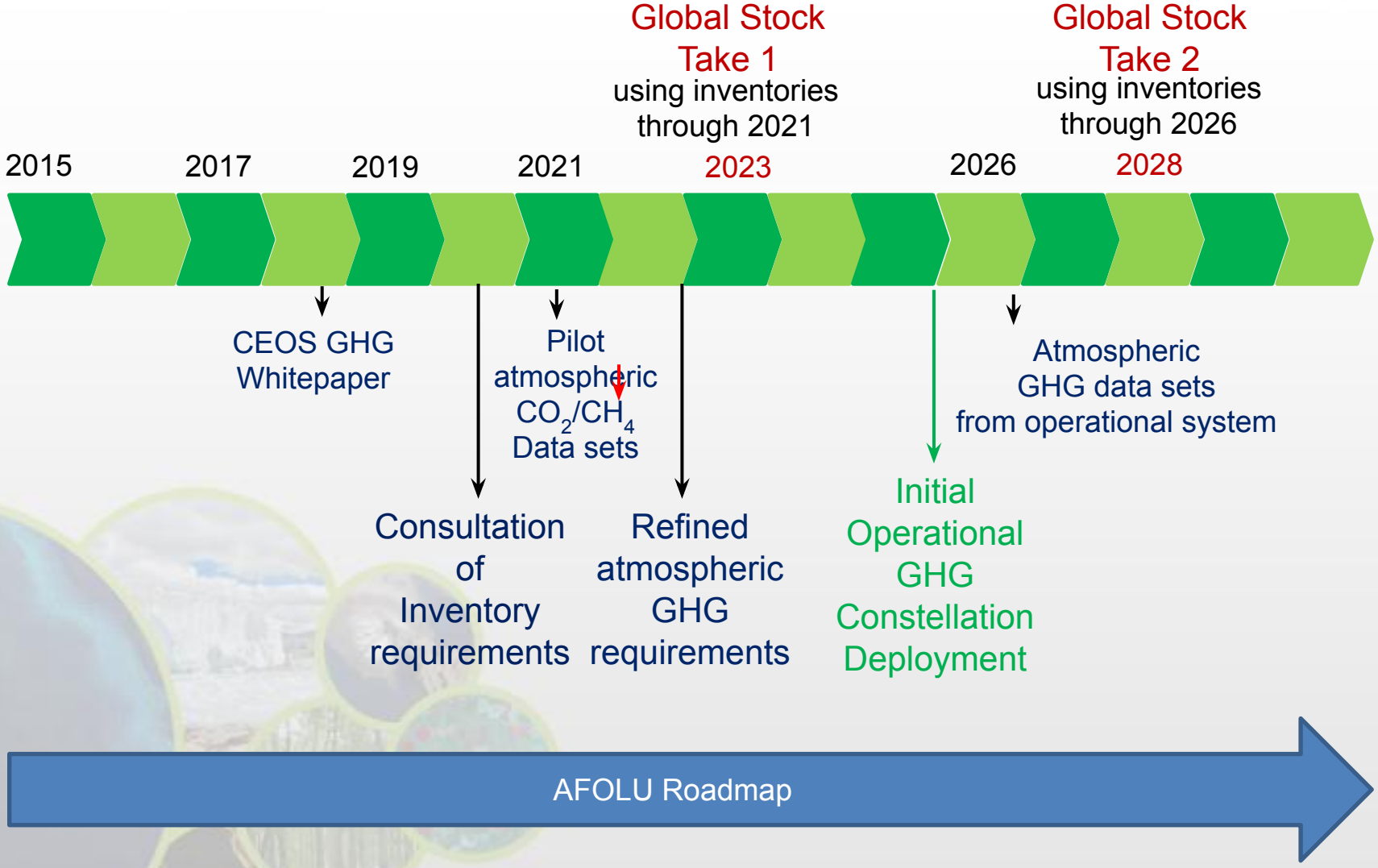
Multiple Contributors and Roles



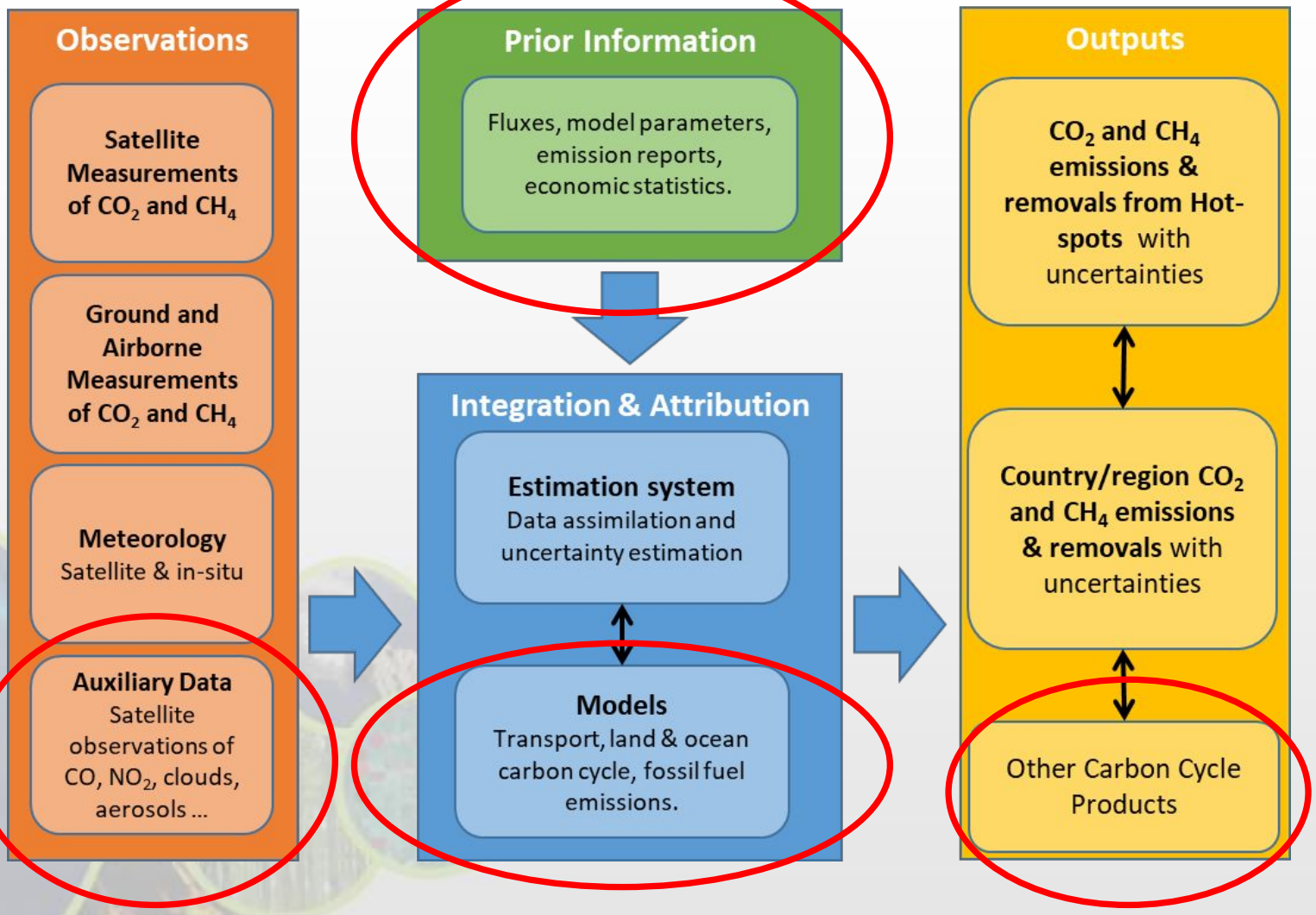
Status of GHG Task Team Activities and next Steps

- **Maturing GHG Roadmap and Project Plan specifying deliverables, responsible organizations, schedules and resources**
- **Establishing interfaces with National Inventory community**
  - Worked with the Copernicus H2020 VERIFY Project to organize an atmospheric inventory workshop @ Global Emissions IniAtive (GEIA) (still delayed due to COVID-19)
- **Establishing interfaces with stakeholders (UNFCCC/SBSTA & GCOS)**
  - Supported UNFCCC/SBSTA & GCOS at COP-25 & Earth Information Day
  - Support to the UNFCCC Secretariat and the Parties in the Synthesis and Assessment phase of the first Global Stocktake process
  - Engaged in the newly established adhoc group on Systematic Observations to support of the Global Stocktake.
  - Planning workshop on synergies and opportunities between GHG and AFOLU Earth Observation communities working in support of UNFCCC
- **Engaging the Atmospheric GHG Community**
  - Presented Roadmap to workshop@AGU, 12/2019; AC-VC, 06/2020; CGMS 08/2020
- **Progressing in Atmospheric Inventory Development and identification of GHG validation capabilities**

GHG-AFOLU Synergies Parallel Roadmaps



AFOLU in the System



Starting Discussion
GHG-AFOLU Workshop

Workshop on <u>synergies and opportunities between GHG and Agriculture Forestry and Other Land Use (AFOLU) Earth Observation communities</u> working in support of UNFCCC

- [**Postponed**] Originally planned July 9-10th 2020 Varese-Italy
- Start dialogue between the different Earth Observation communities addressing the needs of UNFCCC.
- In particular, atmospheric GHG monitoring and those addressing aspects of the AFOLU sector (incl. REDD+).
- Co-organised, based on an identified gap, both at the European level through discussions in Copernicus as well as at the international level CEOS, GEO

GHG-AFOLU Workshop

- **The workshop plans to address:**
  - both the "soft" coordination and stakeholder engagement aspects of the interface with the Convention, the UNFCCC Secretariat and,
  - Parties (including through their inventory agencies/compilers) but also more technical aspects of reporting, outputs datasets, formats, avoiding "double-accounting" and the longer-term ambition of using diverse earth observation datasets in the modelling and data integration systems being developed.
- **<u>Now postponed till ~Q2 2021</u>, but plan:**
  - initial discussion at CEOS SIT Technical Workshop [TODAY]
  - European discussion in context of CHE-VERIFY Q4 2020 (organised by ECMWF).
  - International meeting in 2021 should include CEOS/CGMS, GFOI, GEO, UNFCCC Sec, GCOS, GOFC-GOLD etc.

GHG-AFOLU Synergies
Open questions (examples)

- Should we foresee points of intersection (milestone checkpoints) and maybe a future merging of the GHG and AFOLU Roadmaps?
- Are the respective communication lines on EO support on GHG and AFOLU to UNFCCC and SBSTA adequate and consistent?
- Is there coherence in terminology and definitions used for EO data (GHG, AFOLU etc.) so as to not confuse “users”?
- Are the EO Guidance (reports etc.) for both GHG and AFOLU, e.g. though IPCC TFI, compatible ?
- Should our long term view include dedicated efforts to include AFOLU EOs explicitly in the “system” approach being implemented?
- Are there dedicated investments on products, modelling data assimilation which could be made to enable greater consistency/integration?
- Could we conceive a “closure” experiment (maybe in a specific region e.g. tropics) bringing together the different EO datasets (an IMBIE for carbon)?

Committee on Earth Observation Satellites

Workshop Discussion Time

Moderators:
Mark Dowell & Jörg Schulz

CEOS SIT Technical Workshop 2020

Broadening and Consolidating UNFCCC engagement (1/2)

- CEOS & CGMS has been very effective over last 8 years in establishing a **positive and proactive dialogue** with UNFCCC/SBSTA
  - This is in large part due to the to the symbiotic relationship we have established with the Global Climate Observing System (GCOS) and the Climate Monitoring Architecture, which has been our guiding framework
- The creation of **the Joint WGClimate established an unambiguous entry point** for the discussion between SBSTA and the Space Agencies
  - To date, this engagement, through the SBSTA Research and Systematic Observation (RSO) subgroup has largely focused on our support on Climate Data Records for GCOS ECVs
  - GHG Monitoring
- In recent years, our **support has been visibly expanding**: CEOS Carbon Strategy, CEOS GFOI support and evolution to biomass, other AFOLU, Climate Services and support to Climate Adaptation etc. so…

Broadening and Consolidating UNFCCC engagement (2/2)

- CEOS needs a **long-term strategy accounting for the multitude of contributions** it and its member Agencies can make to the Convention
  - Maintaining the effective focal point established through WGClimate
  - Increasing communication on contributions from other parts of CEOS (in statements, SBSTA Briefings etc.)
- Use, and **re-enforce, CEOS Carbon Strategy as framework for carbon relevant aspects**.
- Give **greater visibility to GFOI/Biomass aspects** as well as Agriculture, not only through REDD+ but also RSO
- In the short/mid term:
  - Build on priorities of incoming SIT Chair (AUS) on Carbon and Biomass, as well as current visibility on GHG Monitoring
  - Initiate dialogue between GHG and AFOLU communities – Workshop hosted by EC June 2021
  - Dedicated discussion at SIT TW with all CEOS entities, GCOS and UNFCCC Secretariat

Topics

1. **CEOS/CGMS contributions to the Global Stocktake process**
2. **Efficiencies in GCOS Requirements process**

Discussion 1: CEOS-CGMS contributions to the Global Stocktake

- Contribution to UNFCCC Sec *adhoc* group on Systematic Observation support to Global Stocktake
- Contributions to first GST: products (also beyond GHG), user engagement (GHG Roadmap)?
- Realistically what contributions on AFOLU can we expect for first GST?
- What are our contributions to synthesis and technical assessment phases?
- What links should we establish to other “contributors” e.g. WMO, GEO Climate Change WG?
- Should we plan for Guidance documents, case studies, interpretation/analysis tool development?

Discussion 2: Efficiencies in GCOS Requirements process

- GCOS has been an effective partner, and the GCOS IP and requirements are the primary framework against which agencies make substantial investments in the space segment for climate and climate data record production
- There is increasing need for application specific requirements (e.g. for GHGs)
- Would make the space agency coordination, as well as individual agency investment more efficient. Our preference is to maintain GCOS as primary "source" of EO requirements.
- Can we define a typology of requirements for ECV products in all domains, i.e., linking the requirements with the GCOS objectives?
- Can we use the WGClimate Case Study Exercise to emerge some additional and refined requirements?
- What are opportunities for gathering requirements, e.g., for adaptation through other initiatives e.g. WMO GFCS, GEO Climate Change WG?
- Can the envisaged GCOS study team help in this process? What could be realistically achieved for next GCOS IP?
- What are the implications for ECV Inventory, Gap Analysis, and Action Plan process?

Committee on Earth Observation Satellites

Carbon & Biomass Session - 15 minutes break (UTC 1300 restart)

2nd half is prep for CEOS plenary

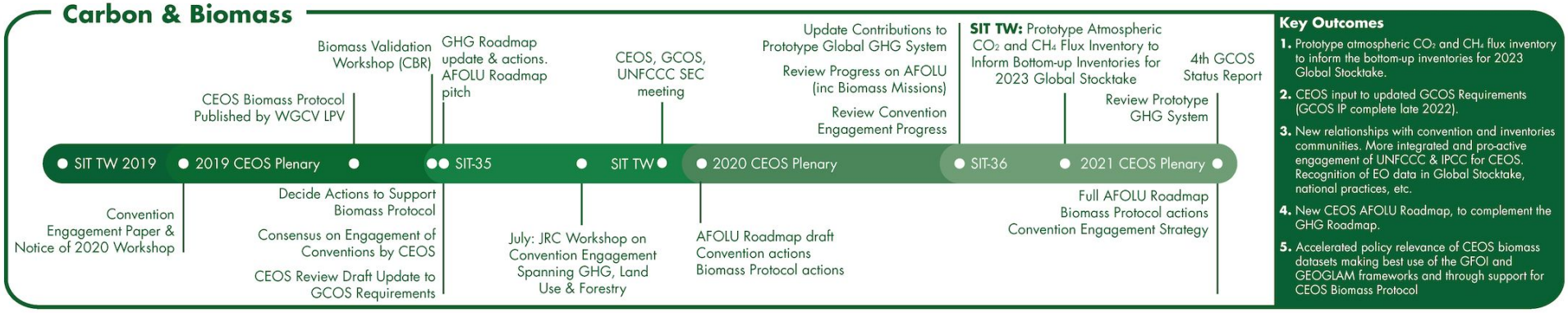
CEOS SIT Technical Workshop 2020

Committee on Earth Observation Satellites

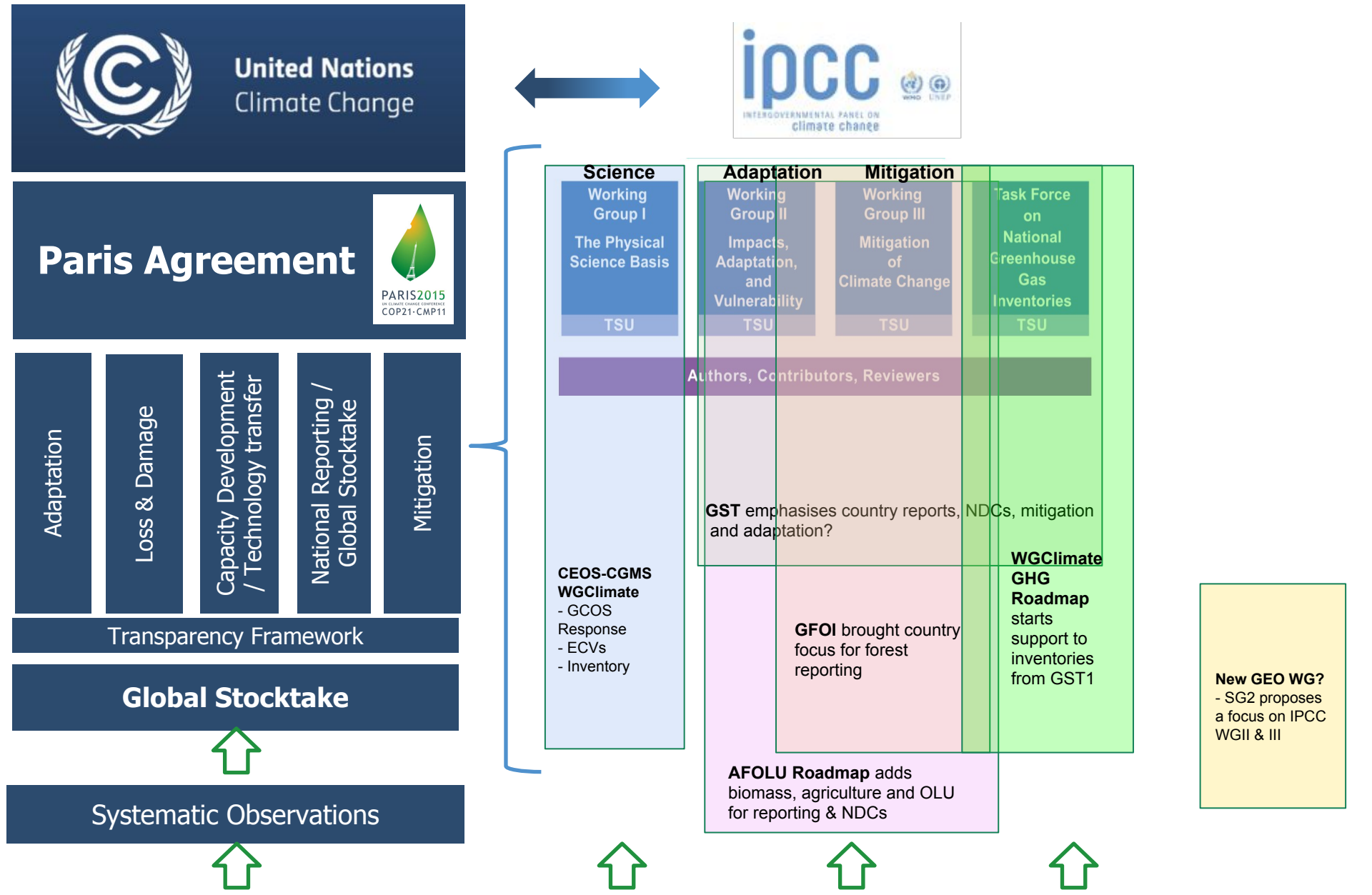
Carbon & Biomass Session - Part 2

CEOS SIT Technical Workshop 2020

A SIT term priority



- **Supporting the GHG Roadmap process** – escalating, elevating, and accelerating progress towards major milestones, including for the 2023 Global Stocktake. **2021 prototype flux products.**
- Encouraging **stronger and more systematic CEOS engagement with convention frameworks** – building on IPCC outreach
  - **And national inventory communities as our future users**
- Reflecting large investment (2018-2024) in Above-Ground Biomass missions and seeking to **accelerate the policy relevance of these new data (GFOI, GEOGLAM…)**
- **Promote uptake of biomass datasets beyond science community** – forest monitoring, inventories…


United Nations
Climate Change
Paris Agreement
PARIS2015
COP21·CMP11
Adaptation
Loss & Damage
Capacity Development / Technology transfer
National Reporting / Global Stocktake
Mitigation
Transparency Framework
Global Stocktake
Systematic Observations
ipcc
INTERGOVERNMENTAL PANEL ON climate change
Science
Working Group I
The Physical Science Basis
TSU
Adaptation
Working Group II
Impacts, Adaptation, and Vulnerability
TSU
Mitigation
Working Group III
Mitigation of Climate Change
TSU
Task Force on National Greenhouse Gas Inventories
TSU
Authors, Contributors, Reviewers
GST emphasises country reports, NDCs, mitigation and adaptation?
CEOS-CGMS WGClimate
- GCOS Response
- ECVs
- Inventory
GFOI brought country focus for forest reporting
WGClimate GHG Roadmap starts support to inventories from GST1
AFOLU Roadmap adds biomass, agriculture and OLU for reporting & NDCs
New GEO WG?
- SG2 proposes a focus on IPCC WGII & III
Earth Observation

Specific objectives/agenda today

Session 2

- Preparation of our relevant agenda items for CEOS Plenary
  - → CEOS Biomass Protocol and implementation support (Laura) — 30 mins
  - → WGClimate: ECVI 3.0 and Use Case activity (Jörg) — 20 mins
  - → GHG Roadmap (Mark) — 15 mins
  - → AFOLU Roadmap (Osamu) — 20 mins

- 15 mins wrap (SIT Chair Team)
  - → Plenary readiness actions
  - → 2021 outlook

Add comments and questions via GTM chat at any time in the session

30 mins

Committee on Earth Observation Satellites

CEOS Biomass Protocol

and Implementation Support

WGCV LPV Team

Laura Duncanson

CEOS SIT Technical Workshop 2020

CEOS Biomass Protocol

- Refer to separate slide deck - Laura will present

CEOS Biomass Protocol
Points to address - SIT team list

- Availability of Protocol document
- Desired outcome from CEOS Plenary
  - Endorsement?
- Ground Reference Network
  - Space agencies
  - User groups, inc GFOI
  - GST relevance

CEOS Biomass Protocol
Revisit Laura's slide...

1. The **large number of new biomass data** and products **could reduce product uptake** by user community unless validation activities are user-friendly, transparent, and well-coordinated.

2. **Significant funding for new and updated reference datasets is required**. **We propose establishment of a CEOS Forest Biomass Reference System** of new and ongoing field, terrestrial and airborne lidar acquisitions

3. **Particular support is needed in the tropics** because this is where most biomass, tree growth, and diversity is located, and this is where long-term security for measurements is lacking.

4. The proposed system **enables all CEOS member agencies to contribute** to a global and lasting effort for forest carbon monitoring

5. Biomass reference **data should be free and open** to enable transparency in product validation.

20 mins

Committee on Earth Observation Satellites

ECVI 3.0 & Use Case Development

WGClimate

Jörg Schulz

CEOS SIT Technical Workshop 2020

JWG Climate Leadership

- Until October 2020 (CEOS Plenary)
- Chair: Jörg Schulz (EUMETSAT)
- Vice Chair: Albrecht von Bargen (DLR)
- October 2020 – October 2022
- Chair: Albrecht von Bargen
- Vice Chair: Nomination Proposal at WGCL#12

- WGClimate received nomination letter from NOAA for Jeff Privette;
- WGClimate #12 in May 2020 has unanimously recommended Jeff Privette as next WGClimate Vice Chair becoming Chair in November 2022;
- CGMS-48 Plenary has endorsed this proposal;
- CEOS Plenary is asked to endorse the proposal as well.

CEOS Plenary is invited to endorse:

- Leadership proposal as on slide 1
- Gap Analysis report v 3.0 on ECV Inventory #3 and updated coordinated action plan. CGMS Plenary is asked for virtual endorsement in parallel
- The GHG Roadmap document (v2.4)
  - describing an approach and resource needs for the implementation of the GHG Constellation Strategy.
  - This is to be considered a living document and the Actions in Annex C provide a current snapshot of the work plan definition which will be updated over time.
  - CEOS Agencies will provide the identified resources for the specific activities and entities (i.e. CEOS WGs and VCs as well as the GHG Task Team).
  - The GHG roadmap (v2.4) has been endorsed by CGMS-48 Plenary.

Plenary is invited to take note:

- CEOS agencies are requested to continue and strengthen their contribution to the WG Climate, in particular by participation in WGClimate regular meetings, planned ECV Inventory gap analysis workshops, the GHG Task Team, and other specific activities of their interest.
- The ECV Inventory V3 has been published in August 2020.
- Work on the ECV Inventory gap analysis needs further be rationalised to ensure long term affordability. The 12th session of WGClimate in April 2020 made the proposal to host specific workshops starting in 2021.
- WGClimate sees an improved approach for GCOS ECV requirements as essential for GCOS. The pathway to a new approach is under discussion with GCOS but should be effective for the next GCOS Implementation Plan. CEOS entities (WGs, VCs, SHTs) should support this discussion when requested.
- WGClimate has published a call for use cases for climate data records https://climatemonitoring.info/use-cases. CEOS agencies are requested to organise submission of use cases for climate data records within your area.

ECV Inventory, gap analysis, coordinated action plan

- ECV Inventory v3 published July 30, 2020 on https://climatemonitoring.info/ecv_inventory. Big THANKS to all agencies and involved people!
- The delivery of the Gap Analysis and Coordinated Action Plan has moved to autumn 2020 (due to COVID-19 impact), but should be ready for Plenary approval
- Dialogue and action with CMA and JAXA on providing input has intensified, raising hopes to have more completeness in V4
- Gap analysis process will be further rationalised to ensure affordability. It will involve an annual workshop to which agencies are requested to send experts on ECVs

Gap Analysis Topics

Related to the objectives of the WG Climate the gap analysis addresses three topics:

1. Existence of Climate Data Records
2. Analysis of Inventory Entries against GCOS Criteria
3. Analysis for specific ECVs
   - An analysis as to whether the ECV inventory misses a known existing or planned climate data record;
   - An analysis of missing measurements in the future that would be required to continue existing and planned data records or to establish new ones with enhanced quality;
   - An analysis of the missed opportunities for creating a climate data record from existing past and planned future measurements from space.

General Status

- Existence of Climate Data Records – **done**
- GCOS criteria analysis – **significant amount of data sets not assessed but statistics very stable**
- Progress on already assessed ECVs – **40%**
- Individual ECVs – **New ECVs assessed with various degree of information**

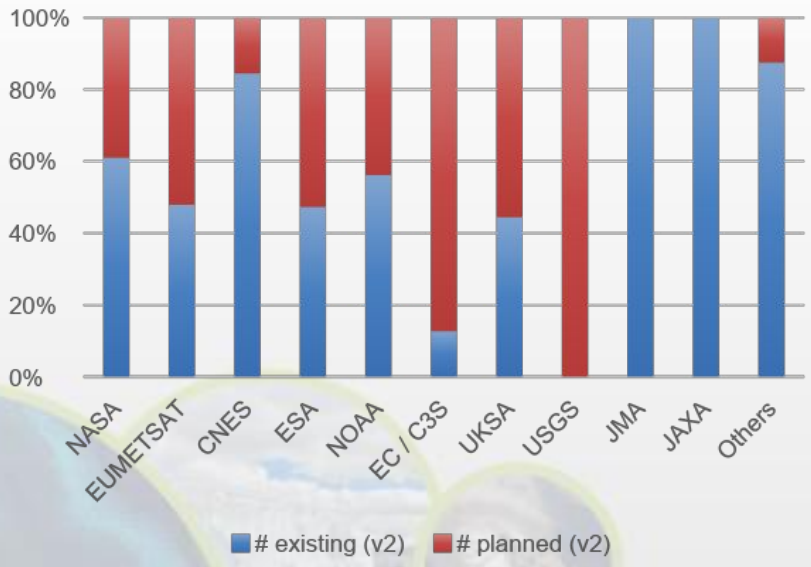
ECV Inventory Content

Domain	Existing	Planned	Total
Atmosphere	535	266	801
Ocean	90	43	133
Land	141	62	203
Total	766	371	1037

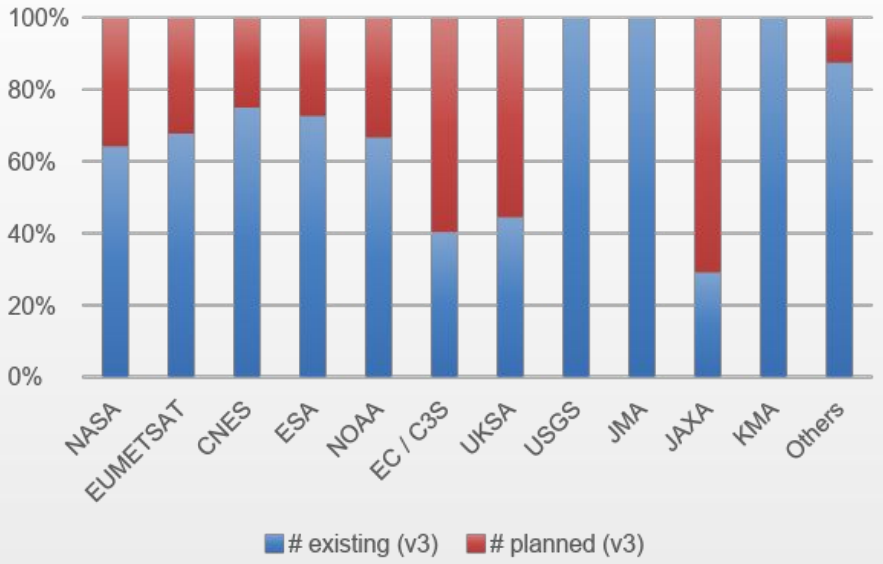
- GCOS IP space-observables: 37 ECVs (13 Atmosphere, 15 Land, and 9 Ocean) – 35 ECVs covered with some contribution in Inventory V3
- ECVs Lightning, Permafrost, and Above-ground Biomass represented for the first time
- From current ECVs only Ocean Surface Currents and Anthropogenic GHG fluxes appear as gaps

Relative number of existing and planned data records per agency

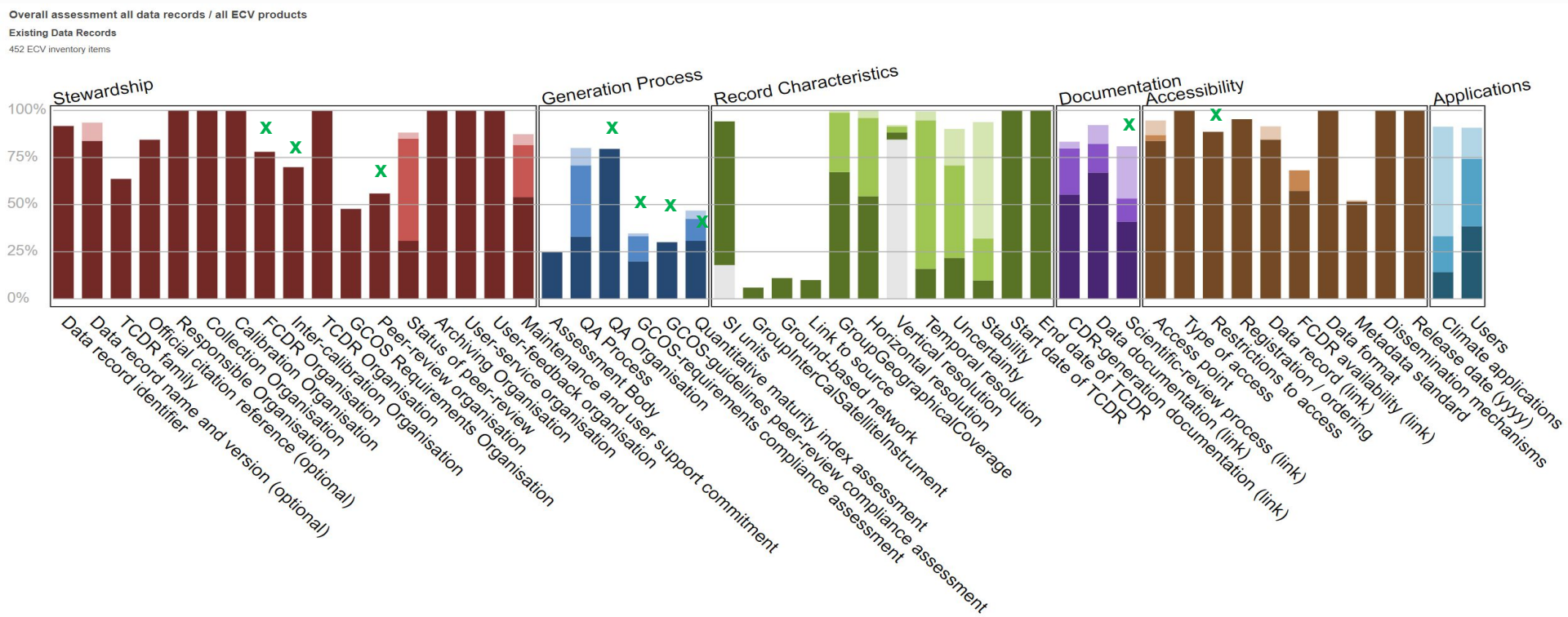
ECV Inventory #2



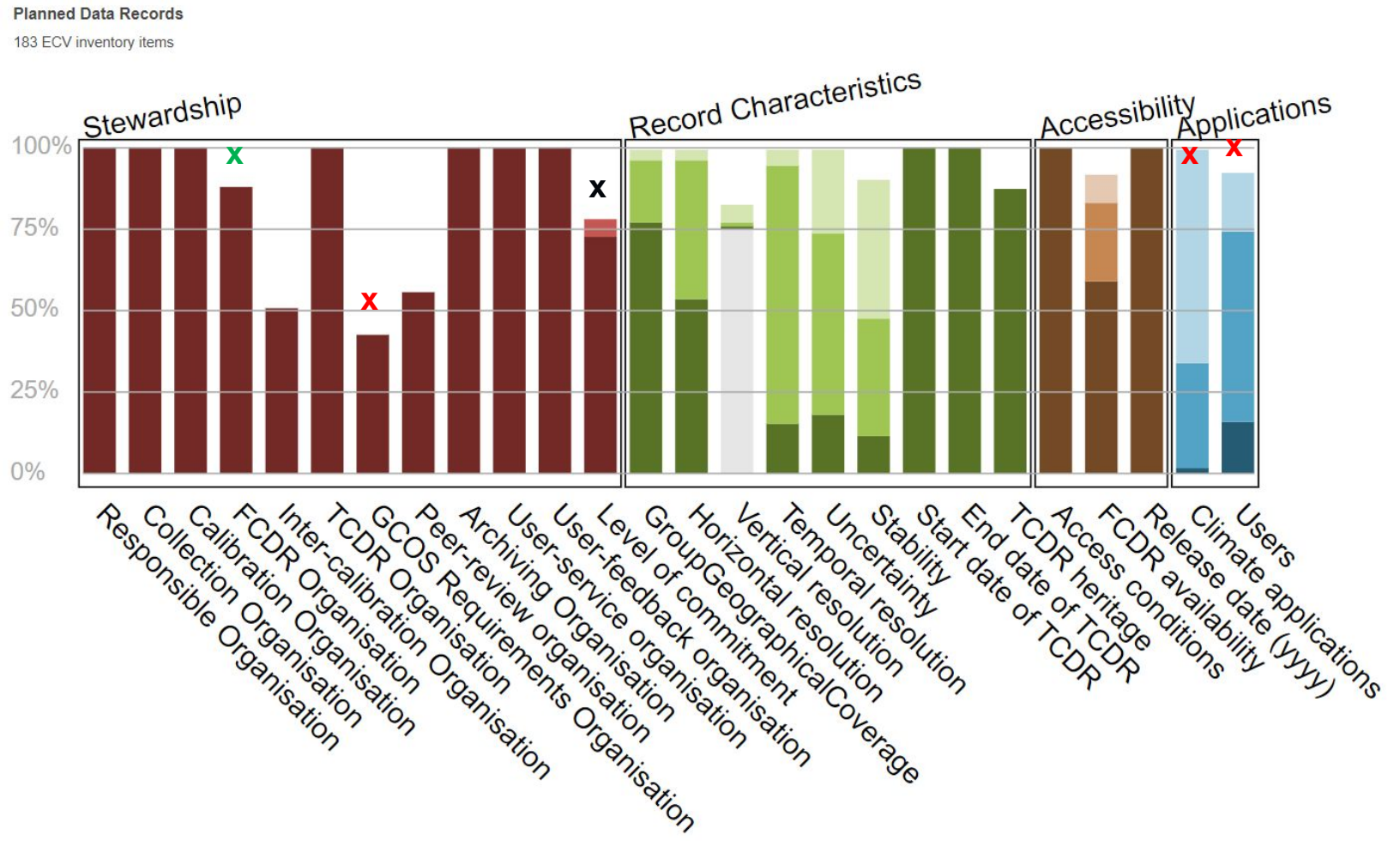
ECV Inventory #3



Assessment of GCOS Criteria for existing data



Assessment of GCOS Criteria for planned data



Issues observed in the process

- Observed decline in support to population, verification and gap analysis for ECV Inventory #3 within CEOS/CGMS agencies and bodies
- Gap analysis Topic 2 on GCOS criteria was hardly to finish, committed contributions were not realised in some cases;
- Gap analysis Topic 3:
  - Quality of expert contributions varies strongly
  - WMO and CEOS relevance estimates of missions seems not useful in many cases
  - Some experts seem not to understand the gap analysis procedure, others do very well
  - There is a danger of biased assessment by experts, seemingly trying to generate funding for specific activities

Gap Analysis Rationalisation

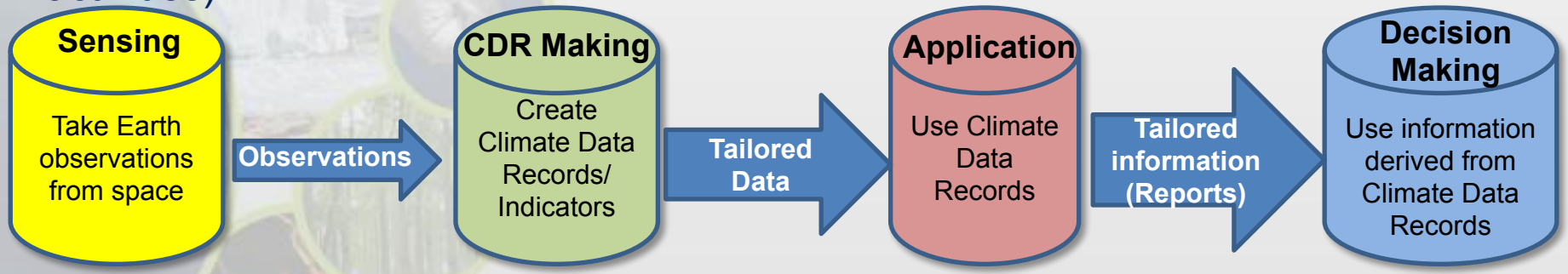
- Reduce number of data records for analysis in the ECV Inventory, .e.g., if they differ only by time and space sampling
- Decouple in time ECV Inventory update from gap analysis, i.e., ECV Inventory #4 published in 2021 – gap analysis report published in 2022
- Reformat gap analysis work into one workshop event per year collating experts on ECVs to perform the gap analysis. (First was planned for 31/08-04/09/2020@EUMETSAT but was cancelled due to COVID-19)
- Schedule 2021:
  - Concentrate on chasing identified missing data records and add contributions from CMA and JAXA for ECV Inventory #4
  - Start analysis of ECV Inventory #4 in Q3/4 2021 with a gap analysis workshop
  - Publish gap analysis report on Inventory #4 in 2022

Use Cases for Climate Data Records

- WGClimate#12 in May 2020 decided to start a new routine activity on collecting use cases for climate data records.
- Use Case gathering tool has been integrated into climate “Use Cases” web page (https://climatemonitoring.info/use-cases), which was opened on July 27, 2020 for submission with widespread distribution on social media.
- Use cases will be published on the web and selected use cases will become part of a special report issued by WMO in 2021/22.

Use Cases for Climate Data Records: Major Objectives

- Demonstrate the value of climate data records for decision/policy making, e.g., usage of satellite data in a use case with UNFCCC Parties to support the Global Stocktakes
- Optimize the use of climate data records in applications relevant for climate services and science
- Understand the application needs to provide feedbacks towards quality improvements for the ECV requirements defined by GCOS
- Validate the top-down architecture for climate monitoring from space with a down-top approach ensuring traceability from usage to space-based observing system
- Support capacity building by providing/receiving use cases for/from training activities, e.g., for developing countries (link to CGMS and CEOS capacity building activities)

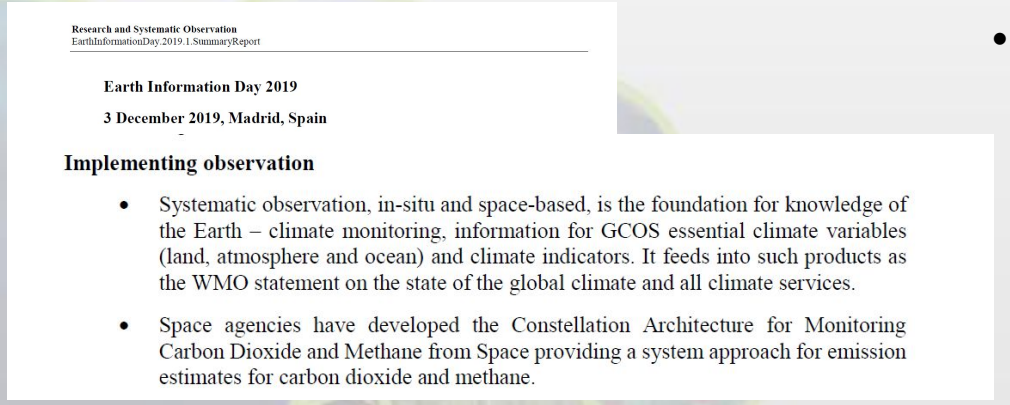


Two Use Cases Received

- **Coastal Risk Information Service (C_RISe)**
  https://www.des.nh.gov/organization/divisions/water/wmb/coastal/c-rise.htm
  - Satellite-derived sea-level record, ocean surface wind speed/direction, currents and wave height are used to provide coastal risk information service for countries on the east coast of Africa.
  - Information on sea level rise and storm surge can help reducing the social and economic impact of coastal inundation and extreme weather through coastal zone management, infrastructure protection and development, operational planning, fishery support, etc.
- **Parametric insurance for agricultural communities using weather and climate information**
  - Satellite-derived precipitation, temperature, land cover, soil moisture, and leaf area index are used to provide real-time risk assessment profiles to deliver insurance policies that are designed to protect individual farmers and agribusinesses against drought, flood, excess rainfall, heatwave, hail, cyclone, etc.

WGClimate and UNFCCC

- Provided full reporting including a CEOS/CGMS statement to SBSTA-50 in Bonn, Germany in June 2019 and SBSTA-51 in Madrid, Spain in December 2019.
- Participated in Earth Info Day and received good recognition for space agency contributions, full report: https://unfccc.int/sites/default/files/resource/EarthInformationDay2019.SummaryReport.pdf
- SBSTA-52/COP-26 has been postponed to 2021 due to the COVID-19 pandemic. No formal statements will be made in 2020, but plan to participate in Earth Info Day in November 2020.



Research and Systematic Observation
EarthInformationDay.2019.1.SummaryReport

Earth Information Day 2019

3 December 2019, Madrid, Spain

Implementing observation

- Systematic observation, in-situ and space-based, is the foundation for knowledge of the Earth – climate monitoring, information for GCOS essential climate variables (land, atmosphere and ocean) and climate indicators. It feeds into such products as the WMO statement on the state of the global climate and all climate services.
- Space agencies have developed the Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space providing a system approach for emission estimates for carbon dioxide and methane.

- The CEOS/CGMS WGClimate will further provide support to the UNFCCC Secretariat and the Parties in the Synthesis and Assessment phase of the first Global Stocktake process and will actively engage in the newly established *adhoc* group on Systematic Observations on support of the Global Stocktake.

WGClimate
Points to address - SIT team list

- ECVI 3.0 desired outcome from Plenary
- Use Case Development…
- Plenary inputs on SBSTA/COP statements?
- Actions in relation to GCOS or GST processes?
  - Plenary discussion on space agency scope & emphasis

15 mins

Committee on Earth Observation Satellites

GHG Roadmap

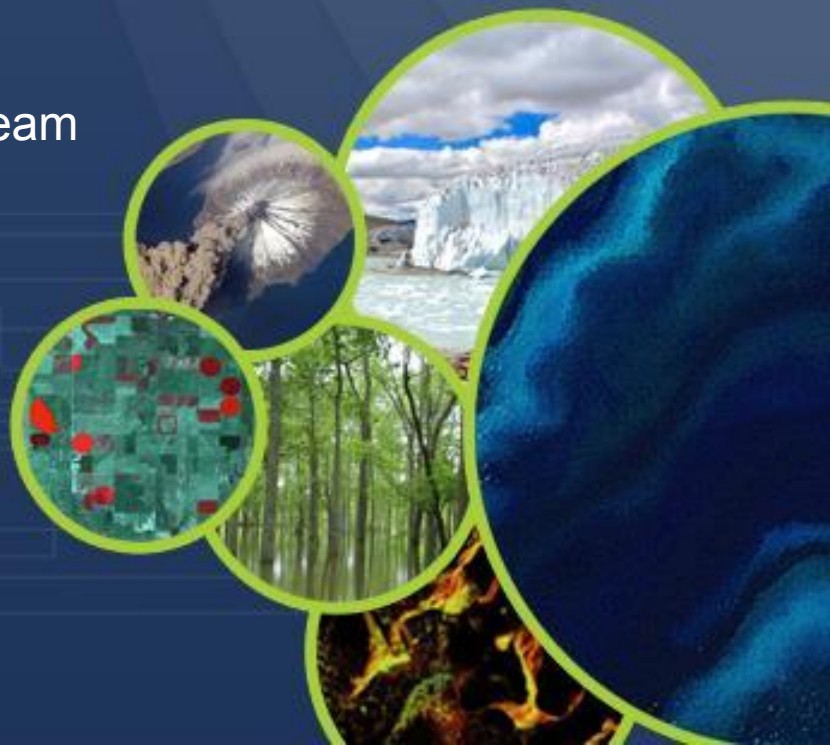
Mark Dowell, COM, WGClimate GHG Task Team

CEOS SIT Technical Workshop 2020

Session 4.1 Agenda Item #4.1.11

Virtual Meeting

7-11 and 14-18 September 2020



GHG Roadmap Objectives and Status

- The GHG Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stake holders and users.
- The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs
- This version of the Roadmap was submitted to the 2020 CGMS Plenary for endorsement.
- At this meeting, we seek feedback in preparation for endorsement of the GHG Roadmap at the CEOS Plenary and the provision of the resources identified for the specific activities and entities

Roadmap Table of Contents

Interface to and Feedback from External Communities

Engagement with external stakeholders and end users is fundamental to the success of the implementation of the system approach:

- **Engagement with the emission inventory community is critical to the iterative feedback approach, both:**
  - Through existing international coordination mechanisms (e.g. Global Emissions InitiAtive - https://www.geiacenter.org)
  - Through working with champion users on real applications – «beta testers»
- **Continued engagement with international policy frameworks, i.e. UNFCCC/SBSTA, IPCC TFI**
- **Engagement with technical implementing entities at international level, i.e. WMO IG^{3}IS and Joint Programmes supporting the Convention, i.e., GCOS, as well as the broader modelling community.**

Making inroads in GEIA

1. GEIA Meeting (154 participants) on 24 June 2020. The polls have identified the following research priorities:

- a. How do we best facilitate the information flow between global and local scale?
- b. How can we best use satellite observations to constrain emissions in regions with less available/reliable information bottom-up?
- c. How tackling energy sources in local/urban pollution (not only from transport, but also small scale industry, fugitive dust, waste, agriculture)?
- d. How do we facilitate and guide the use of uncertainty information in models and inventories?
- e. How to better deal with source apportionment for emissions of natural sources, dust, fires, agriculture?

2. More specific on the GEIA working group monitoring GHGs:

Call for collaborating in Working Group for Monitoring GHGs & Co-emitted Species Across Scales with:

- a. Global scale information is feeding into local scale, but how can we go back from the local scale and using the detailed information for a revision of global scale databases in a systematic way?

i. GHG emission gridmaps near real time
ii. Co-emitted species
iii. Use of atmospheric measurements in situ and space-borne
iv. Focus: 2019-2020, to prepare for 2021 = base year for Paris' Global Stocktake

- b. We call for BRIDGING COMMUNITIES AND EXCHANGING PRACTICES to demonstrate GHG monitoring and verification in- and outside EU.
- c. A follow-up meeting will be organized in Autumn 2020. In case of interest, please

Expected Outcomes of the Roadmap Activities

Roadmap Products

- The delivery of pilot datasets of CO_2 and CH_4 fluxes to enhance the uptake of Earth Observation satellite data sets in support of the Global Stocktake 2023;
- The delivery of an operational system for producing future atmospheric CO_2 and CH_4 flux products to support the Global Stocktake 2028; and
- The refinement of user requirements in preparation of the implementation of the operational system.

Progress

- Established critical interfaces with the UNFCCC SBSTA and GCOS.
- Made progress pilot atmospheric CO_2 and CH_4 inventory
  - Delivery of the OCO-2 version 10 XCO_2 and SIF data products
  - Advances in GHG flux inversion models by the NASA OCO-2 and CMS and Copernicus CAMS

High Level GHG Roadmap Timeline

Global Stock Take 1
using inventories through 2021

Global Stock Take 2
using inventories through 2026

2015 2017 2019 2021 2023 2026 2028

CEOS GHG Whitepaper

Pilot atmospheric CO_2/CH_4 Data sets

Consultation of Inventory requirements

Refined atmospheric GHG requirements

Initial Operational GHG Constellation Deployment

Atmospheric GHG data sets from operational system

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

Resource Implications and Needs from CEOS/CGMS

Three broad categories of resources are envisaged and requested for consideration by Agencies (introduced at CEOS Plenary 2019):

1. **Dedicated human resources** supported through Agency programmes & grants :

– Agencies are asked to provide support to the WGClimate Task Team (~17 PM/yr) Assumption: 15 members with 1PM/yr effort per member & 2 PM/yr effort for the two leads

– Agencies are asked to continue, and in some cases increase support to the GHG relevant staff (time & travel) contributing to the technical implementation tasks in CEOS and CGMS

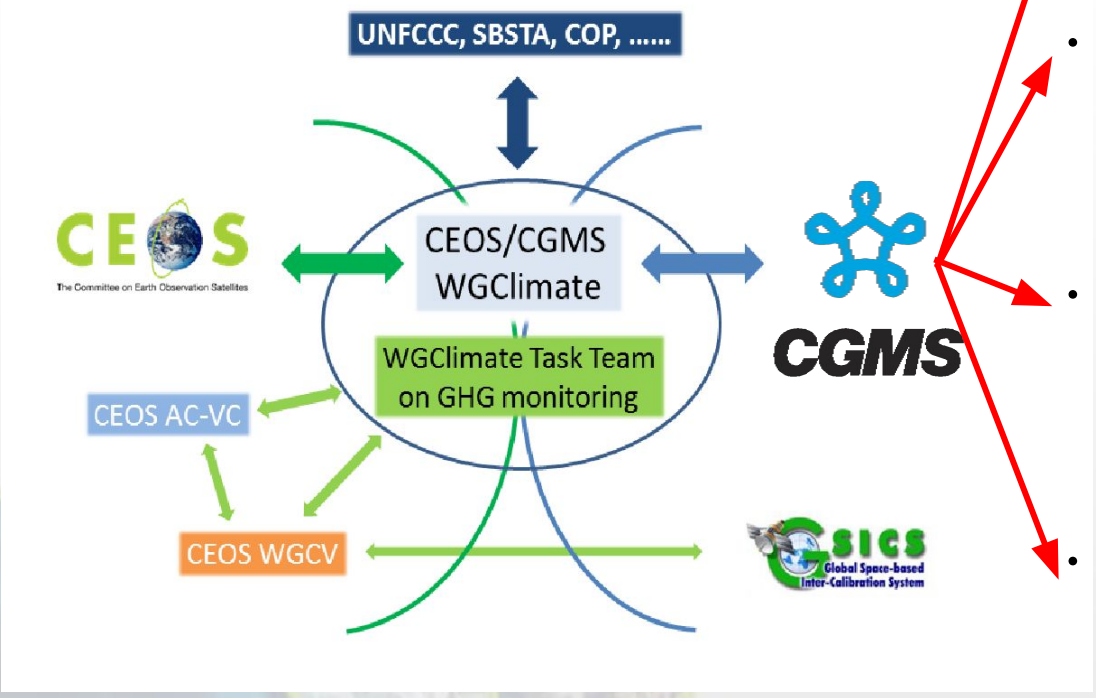
2. **Support for travel and hosting of workshops** and networking with:
    - National inventory community
    - Atmospheric GHG measurement and modelling communities
    - Stakeholders (GCOS, UNFCCC/SBSTA)
3. [On longer-term] Through internal funding mechanisms support research, development and infrastructure for priorities identified by GHG Task Team and Roadmap Implementation (annual updates will be provided to Agencies)

GHG TT Skill Request

For WGClimate GHG Task Team, the following “profiles” are **need**ed:

- Core team ensuring linkages to internal CEOS/CGMS entities (i.e., WGClimate – Dowell/von Bargen, AC-VC – Crisp, WGCV – Kuze)
- CEOS and CGMS Agency staff representing GHG missions/programmes
- Agency staff from “operational” agencies to ensure operational transition
- Agency Staff/Experts with links to Inventory Community
- Agency Staff/Experts involved in modelling aspects

CGMS involvement in the GHG Task Team



- **Working Group I:** Ensuring that the implementation of the GHG roadmap addresses the objectives of the WIGOS vision
- **Working Group II:** Facilitating the definition and application of standards for operational GHG constellation products and operational aspects of the satellite data production systems at international level
- **Working Group III:** Mapping the CGMS agency plans for CO_2 and CH_4 relevant measurements onto the CGMS baseline, identifying continuity issues and proposing contingency planning
- **Working Group IV:** Addressing operational access and end user support as well as training for GHG constellation products in cooperation with CEOS WGISS and WGCapD

As reported by Jörg Schulz: [The CGMS] Plenary endorsed the GHG roadmap version 2.4 and welcomed the proposal to have dedicated Points of Contacts (PoCs) for the JWG Climate GHG Task Team identified in all CGMS Working Groups (I - IV). The lead of the GHG Task Team is requested to define priorities for CGMS WG contributions

Agencies who have offered resources

- Mark Dowell (EC, WGClimate, Task Team lead)
- Albrecht von Bargen (DLR, WGClimate Vice-chair, deputy Task Team lead ex officio)
- Frederic Chevallier (LSCE/IPSL)
- David Crisp (NASA, CEOS AC-VC)
- Carole Deniel (CNES)
- Richard Engelen (ECMWF)
- Hiroshi Suto (JAXA)
- Akihiko Kuze (JAXA, CEOS WGCV)
- Rüdiger Lang (EUMETSAT)
- Yaska Meijer (ESA)
- Paul Palmer (UKSA)
- Hiroshi Tanimoto (NIES)
- Alisa Young (NOAA)
- N.N. (agency representative)
- N.N. (CGMS WG representative)

CEOS Plenary will be invited to endorse:

The GHG Roadmap document (v2.4), describing an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the Actions in Annex C provide a current snapshot of the work plan definition which will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities.

20 mins

Committee on Earth Observation Satellites

AFOLU Roadmap

Task Team

Osamu Ochiai & Frank Martin Seifert

CEOS SIT Technical Workshop 2020

Items for discussion and Plenary

1. The opportunity for space agencies - and the resources needed

2. Pragmatic deliverables for GST1 and beyond

3. AFOLU (Land) focal point to UNFCCC Secretariat

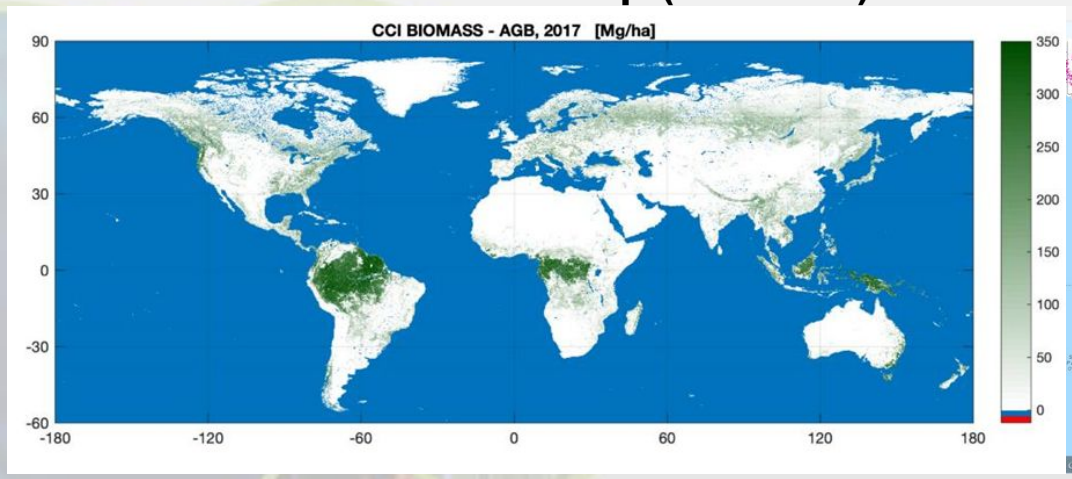
1. Opportunity & Resources

- The GST is a major new dimension to the UNFCCC and both an opportunity and challenge for space agencies and CEOS
- Land sector issues are a major part and proposed AFOLU Roadmap offers a structured response and approach
- CEOS agencies have many relevant assets and programmes - not necessarily all within current CEOS coordination scope
- Long term and complex process (GST every 5yrs) and wide variety of areas (AFOLU) - supporting national-scale reports is a major task but one we are uniquely capable of supporting
- Current AFOLU document is a "White Paper" - highlighting our capabilities and the opportunity in front of us. It aims to support Plenary discussion among Principals to launch a strategic initiative, starting with Roadmap
- Roadmap team would need the big AFOLU investor agencies to be viable and relevant (NASA, ESA, JAXA, USGS, amongst others)
  - current team of volunteer experts, many non-agency

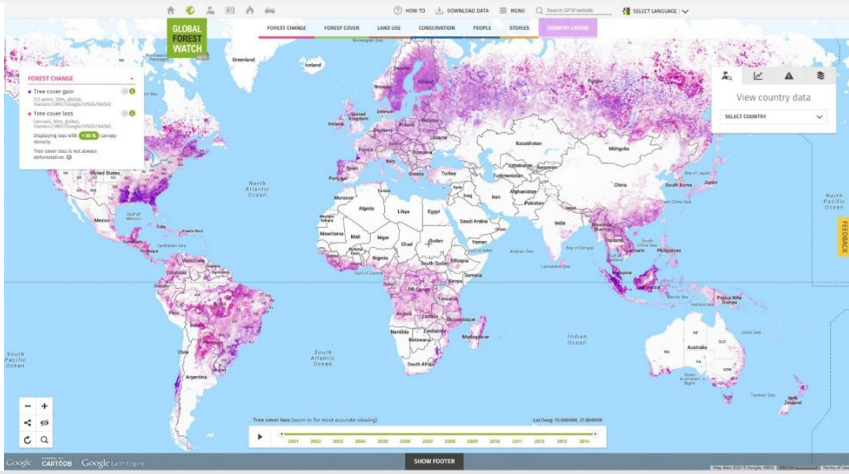
2. Pragmatic deliverables for GST1

- Aggregate potential inputs (Datasets at Global and Country levels) from Space Agency (Agriculture, Forest, Biomass, OLU)
- Discuss how to input to the UNFCCC synthesis report
- Synergy and alignment with GHG Roadmap for GST1 and GST2
- Further discussion needed for consolidation - hopefully at the GHG and AFOLU workshop in 2021

Global Biomass Map (ESA CCI)



Global Forest Watch



3. Land sector focal point for the UNFCCC Sec process

- **Given its significance to NDCs, we think we should confer to identify a focal point for EO land sector issues to the Ad-hoc WG**
- **Potential list of representatives for Land**
  - GEO (GFOI, GEO-GLAM, GEO-BON, GEO-Wetland, GEO-LDN,,,)
  - GCOS (Land ECVs)
  - CEOS (AFOLU, LSI-VC)
  - GOFC-GOLD
  - FAO
  - ,,,
- **CEOS is well placed given broad scope of member programmes**

Next steps

- Reflect on x xxxxççç ∫∫∫ ∫∫∫∫~~~~≈≈≈≈
- Engage with UNFCCC SEC offline re the SO Synthesis Report (through focal point of Ad-hoc WG)
- Solicit support from CEOS Principals on the case for an AFOLU Roadmap
- Prepare CEOS Plenary decision seeking approval (& resources) to proceed
  - will need large AFOLU investor agencies to be viable

20 mins

Committee on Earth Observation Satellites

Wrap up

SIT Chair

Alex Held

CEOS SIT Technical Workshop 2020

Wrap up
Points to address

- Do we have clarity on each agenda item for Plenary?
  - desired outcome
  - preparation
  - actions from today
- **SIT Chair Team will follow up with each Topic Lead to craft a single slide that will feature in a summary reel during Thursday's SIT TW session**

  - Biomass protocol & implementation
  - WGClimate ECVI & Use Cases
  - GHG Roadmap
  - AFOLU Roadmap
  - GHG-AFOLU integration
  - GCOS & UNFCCC GST engagement

Wrap up
WGClimate

- **CEOS Plenary desired outcomes**
  - Endorse leadership continuity
  - Endorse ECVI 3 gapa analysis report and action plan
  - Endorse GHG Roadmap v2.4

- **Issues raised**
  -
  -

- **Actions and Decisions recorded**
  - Plan to discuss requirements with GCOS
  -

- **Recap of key points for Plenary**
  - ?

Wrap up
CEOS Biomass Protocol & Ground Network

- **CEOS Plenary desired outcomes**
  - Endorse the CEOS Biomass Protocol
  - Discuss the CEOS (GEO/GFOI?) Forest Biomass Reference System
- **Issues raised**
  - Framework/partners for the Biomass Reference Systems
  - GEO & GFOI collaboration
- **Actions and Decisions recorded**
  - Follow up with GEO and GFOI
  - Side chat confirmed presentation to GFOI Leads Team in 2 weeks
- **Recap of key points for Plenary**
  - Framing the business case (staged, prioritised….)
  - Progress the support and collaboration discussions prior
  -

Wrap up
GHG Roadmap

- **CEOS Plenary desired outcomes**
  - Endorse the GHG Roadmap
  - Confirm actions towards GST1
- **Issues raised**
  - GHG Roadmap resources and skills
  -
- **Actions and Decisions recorded**
  -
  -
- **Recap of key points for Plenary**
  - Principal engagement on...

Wrap up
AFOLU Roadmap

- **CEOS Plenary desired outcomes**
  - Determine support for strategic engagement by CEOS in GST Process
  - Determine support & resources to launch (begin work toward?) AFOLU Roadmap
- **Issues raised**
  - Land sector EO representation (focal point) in GST process
  - Institutional home in CEOS to be addressed
  - GST1 deliverables need to be considered
- **Actions and Decisions recorded**
  -
  -
- **Recap of key points for Plenary**
  - Principals prepared for support for full roadmap effort