MINUTES OF THE 12th MEETING OF THE CEOS SPACE DATA COORDINATION GROUP FOR GFOI (SDCG-12)
GFOI Early Warning Session

Monday 4th September 2017
ESA ESRIN, Frascati, Italy

*An SDCG-12 session to discuss the potential requirements of a GFOI Early Warning system was held on the Monday before the main SDCG-12 meeting. The morning session was a **GFOI Early Warning Task Force Meeting** (summary report below), and the afternoon session was a discussion of how space agencies might respond via CEOS and SDCG.*

Participants: Brian Killough (CEOS SEO/NASA), Stephen Ward (SDCG Sec), Rachael Petersen (WRI), Mikaela Weisse (WRI), Steven Hosford (CNES), Anna Rita Pisani (ASI), Yves Crevier (CSA), George Dyke (SDCG Sec), Johannes Reiche (Wageningen/GOFC-GOLD), Helmut Staudenrausch (DLR), Eugene (Gene) Fosnight (USGS), Frank Martin Seifert (ESA), Ake Rosenqvist (JAXA), Matthew Steventon (SDCG Sec), Masato Hayashi (JAXA, GoToMeeting)

Welcome and Introductions

Stephen Ward (SDCG Sec) welcomed everyone to the afternoon session and reviewed the agenda which looks at identifying opportunities for collaboration, common interests, and capacities around deforestation early warning. SDCG-Exec collaborated on a related paper earlier this year, and this meeting is an opportunity to follow up and refine away forward.

Summary of GFOI Early Warning Task Force – Monday Morning Session

Brian reviewed his notes from the GFOI Early Warning Task Force meeting which took place in the morning.

- It was noted that there are many stakeholders involved and there is a need to understand the number of options for EW. Effective use of EW systems by governments is often a bigger issue than technology. There is also a role for civil society groups (e.g. Amazon Conservation team, Jane Goodall Institute) as they tend to use EW products to put pressure on countries to make decisions.
- GFOI sees a role for CSO (Civil Society Organizations) and the need for their involvement, and this will be in part addressed via a "User Needs Assessment". This will require ensuring all relevant actors have been consulted.
- “Lessons Learned" from the GFW alerts efforts were shared, and parameters vary across resolutions (e.g. 30m, 250m), various frequencies (e.g. weekly, monthly) and locations (not global and mostly pantropical). Users have different needs, such as a desire for all land change (Uganda) and a desire to minimize commission errors (Peru).
- A summary of a Peru Case Study was given, noting that alerts are generally accurate - some individual pixels are wrong but clusters of pixels are usually correct. 68% said cloud cover was a "major limitation". Some users noted a desire for country "ownership" of the system rather than depending on global systems that depend on external funding.

- The "CEOS Concept Note" for an EW system was presented, and the outputs from the GFOI EW Workshop in Jan 2015 in Brazil were reviewed with the meeting report here: https://drive.google.com/open?id=0ByjVYQqIoebeS0NyajlSV1ZCcDA
- The team went through the agenda items under "User Needs Assessment" and expanded on each bullet. These addressed **objectives, scope, process, outcome, team and timeframe.**
- **Objectives**: what are we aiming to achieve from this assessment?
    - More defined set of requirements for EW system(s) that can inform future R&D directions
    - Driven by user needs rather than tech push – not only a focus on technical requirements
    - Stratify assessment based on country capacities (e.g. Peru/Colombia, DRC, Indonesia all have different needs and knowledge etc.)
    - Present unified voice to the global community (countries, donors, tech partners and R&D orgs)
    - Determination of end user groups (e.g. govts, CSOs, media)
- **Scope**: what's in and what's out?
    - Political and institutional conditions for uptake
    - All forest changes included. Consider all aspects of early warning and then stratify into systems
    - Bottom up (not top down)
    - Consideration for country ownership of products and product generation (incl cost-benefit analysis)
    - Interest to broaden user groups from govts to also CSOs
- **Process**: how will the study be undertaken?
    - Stratify assessment into different EW system categories which have different reqs on resolution, latency, temp frequency etc. (eg law enforcement, fires, reporting, etc.)
    - Will be determined by partner resources
    - Iterative approach. Start with WRI ongoing Lessons Learned study. Then Multi-stakeholder forum. Improved requirements. Etc.
    - Build on reqs expressed in GFOI/SilvaCarbon workshop in Brazil (Jan 2015)
    - GLAD system an entry point for everybody
    - How to collect the info for the MSF (calls, emails, surveys?)
- **Outcome**: what will be delivered and what purposes will it serve?
    - User requirements document
    - Guidelines and recommendations (stratified). Similar tool such as REDDcompass (decision tree structure)
    - Pilot studies
    - List of R&D topics
- **Team**: who will be involved?
    - GFOI Office (co-lead)
    - WRI (Lead coordinator of UNA) & UMD
    - CEOS

- GOFC-GOLD/WUR
- WRI collaborating countries (PER, DRC, IND, COL)
- GFOI collaborating organisations and countries
- SilvaCarbon
- FAO
- WB?

– **Timeframe**: start, interim and delivery dates?

Ake added some comments on user needs assessment, noting that he performed a very broad user needs assessment, which was requested by the GFOI Office.

Rachael noted that the multi-stakeholder forum is planned as an opportunity to start gathering initial user requirements, and WRI has started to draft a paper on the topic.

Stephen noted the Vietnam Data Cube work supported by CSIRO, with FIPI planning deforestation applications, and a variety of datasets available.

The need for user requirement was agreed, as well as guidance documentation, and how this might interact with the GFOI R&D component. It was suggested that WRI paper be used as the basis for the stakeholder meeting, use the meeting to refine the paper, and this could be done in parallel with a GFOI effort to develop some guidance materials.

SDCG-12-1	Tom Harvey to add the link to the 2015 GFOI EW Workshop report to the GFOI website.	**September 2017**

JJ-FAST Overview

Masato Hayashi (JAXA, GoToMeeting) presented a summary on JJ-FAST, a collaboration between JICA and JAXA for detecting illegal deforestation. JJ-FAST detects deforestation greater than 5 hectares by comparing two ALOS-2 PALSAR-2 images, and is currently targeting 80 countries providing updates every 1.5 months. JJ-FAST covers almost all tropical forests, and the SAR dataset is able to observe through cloud cover. The JJ-FAST web interface presents warnings, and allows users to uncover extra information, including estimated deforestation areas. 83.3% accuracy has been shown by field validation, and a number of enhancements are planned, particularly around issues related to steep slopes, small areas, and seasonal changes, using more multi-temporal images. Johannes asked who interprets the polygons for inclusion/exclusion, and Hayashi confirmed this is done by JAXA staff. Rachael noted this will be a challenge to maintain quality control when scaling up to the planned 77 countries.

INPE DETER

Ake Rosenqvist (on behalf of INPE) presented on Brazil's DETER system. He noted that PRODES is being expanded to cover greater region, and that DETER is the detection system, whereas PRODES measures the final result (forest/non-forest). The system is driven by MODIS data, visual interpretation, and the results are then presented to IBAMA (law enforcement). DETER results also available online to the public. Recently they have integrated AWiFS and CBERS-4 data, and trying to integrate the various systems (DETER, DETEX, DEGRAD, etc.) Ake stressed that this is a truly operational system, and provides a lot of great lessons. He noted that in the past a JAXA-

IBAMA INDICAR system had been developed which used ALOS ScanSAR data to fill gaps in rainy season due to clouds.

GFW and WRI Early Warning Activities

Rachael presented an overview of WRI's early warning activities, noting that WRI has found that governance issues, i.e. unclear land tenure, lack of funding, etc., are one of the biggest hurdles to uptake of early warning systems. She noted that expanding GLAD alerts (currently covering 16 countries in the Amazon, Central Africa, and SE Asia) to more countries is restricted by computational resources, though UMD are working to expand their system to cover more areas leveraging Google Earth Engine.

Rachel confirmed that that Fred Stolle and WRI remain still very interested in support integrating SAR data to fill cloud gaps. Potential data streams SDCG-GFOI could help support with include ALOS-2 (9 times a year) and NovaSAR (once it is available), though Sentinel 1 likely remains the best option for large-scale monitoring since it is free and open.

Mikaela noted that there have been reports in Brazil that illegal loggers are now starting adapt their behaviours to deforest during cloudy periods to avoid detection by DETER. Radar data's ability to overcome cloud cover limitations may help greatly in this case.

GLAD doesn't have any image filtering yet to eliminate single pixels, and the accuracy tuned toward false negatives. In future, they plan to allow users to adjust their accuracy, as users may have diverse preferences for sensitivity depending on how they deploy the information.

Funding for GLAD coming through bilateral donations, and they are hoping to reach a lower future operating cost by migration to GEE. Yves asked how countries can be assured the system will exist in the future, if funding is not secure. This is a common question from users, who want to know the system will be sustained before building their own workflows on top of it. They would consider running GLAD on a Data Cube in future, but the questions of operational costs as well as source code / algorithms would have to be addressed.

It was noted that integration of Sentinel-2 imagery is also a future goal to increase revisit frequency and resolution.

GLAD is being used widely in Peru (e.g. government, civil society), and they are finding good timeliness and coverage. There are technical limitations around cloud cover, and separating natural and anthropogenic changes. However overall, they have found the governance and legal limitations are greater than technical limitations, e.g. lack of resources to follow up and prosecute those responsible.

Overselling the utility of EO is a concern, particularly when it comes to legal cases.

GOFC-GOLD heritage in EW activities

Johannes provided an update on the work GOFC-GOLD is doing in deforestation assessment, noting there is a tradeoff between system complexity and capability, where generally speaking the more complex, the less implementation is likely.

GOFC-GOLD has been developing and implementing probabilistic methods for Early Warning detection using Sentinel-1 dual-pol. Preliminary results in Sumatra detect forest changes as many as 54 days earlier than GLAD alerts.

There was a discussion around BFAST, and it was noted that it was never designed for early warning.

Overall, the ambition for the GFOI Alert activity is to move targeted R&D into operational practice via the synthesis of various data and approaches. The process should use case driven analysis of uncertainties toward specific solutions.

Johannes noted the importance of listening to the user on the tradeoff between timeliness and accuracy, and that in their experience there is a broad range of user requirements. For example, some users prefer very unreliably estimates (10% accuracy) provided quickly (within days), while others require high reliability and attribution.

SDCG-12-2	SDCG EXEC to follow up the idea of a JJ-FAST and GLAD comparison as part of GFOI ALERT	**SDCG-13**

Agency Heritage & Interest in a GFOI Early Warning Collaboration

Helmut noted that DLR is ready to contribute data (e.g. TSX, TDX), either through the AO system or some shortcut. Links to Planet in Berlin may also be possible. DLR is ready to support, but would like to see joint action from all SDCG agencies. Ake noted that RapidEye/fine resolution optical data would be very useful, in particular if targeted acquisitions could be planned in a similar way to disaster activities.

Gene suggested a follow up with Jeff Masek to get an update on NASA activities.

Yves noted that CSA demonstrated canopy change detection with time series of RADARSAT-2 in 2009, and this may be of interest. He noted that since2010, coherent RS-2 acquisitions have been ongoing over certain locations. This comprises thousands of images that could be contributed for deforestation monitoring. He noted CSA would like to contribute, in particular to initiatives where validation activities will be done. He is willing to do the necessary negotiations to get data to initiatives that can prove the utility of C-band for deforestation monitoring.

Anna-Rita notated that COSMO-SkyMED data can be provided for research projects, and she is gathering information now, to take back to ASI and see what contributions are possible.

Steven noted he is unable to commit on behalf of CNES, but that his colleagues there would likely be willing to put resources into any effort (e.g. Pleiades).

Overall, there was strong support from the agencies, while all agreed that most details are needed before concrete contributions can be determined.

Data Cube Support to GFOI Early Warning Objectives

Brian provided a summary of Data Cube support to Early Warning objectives, noting that they are seeking to work with Vietnam to demonstrate a deforestation alert tool that utilizes diverse moderate resolution datasets and a Data Cube infrastructure. He also suggested looking at a specific area flagged over Colombia, to bring together data from JAXA, CSA, DLR, and others. The

objective could be to take some of the work that GOFC-GOLD is doing (e.g. what Johannes presented) on the Data Cube to demonstrate progress while waiting for GFOI user needs assessment to be done.

Closing Discussion and Next Steps

There was a discussion around the main points agreed, a basic schedule, potential roles, geography, and data supply.

Broad points of agreement on the elements that might comprise a GFOI ALERT activity:

- a User Needs Assessment based on lessons learned (WRI Peru pilot), GFOI / SilvaCarbon EW workshop in Jan. 2015, dialogue with countries, phone interviews, questionnaire, …)
- a multi-stakeholder forum event (likely in DC - related to GFW Partnership meeting in Feb 2018) to solicit input on assessment
- subsequent GFOI guidance on Early Warning for countries (including maybe a decision-tree effort like REDDcompass)
- parallel R&D work to address some of the technical challenges around EW
- related pilot activities

Schedule

The User Needs Assessment (UNA) comes first. And should run to about June next year, with possible "launch" at Oslo REDD Exchange. It can have the existing WRI work as the nucleus (with Peru, DRC and Indonesia). Suggested we add from GFOI Vietnam and Colombia to that. WRI is motivated to progress this and willing to adapt their existing efforts to suit the GFOI geometry. Co-locating the proposed event with the GFW conference in Feb in Washington DC was discussed, but following the meeting this was found to be unsuitable due to scope and planning changes on the GFW side. They have flexibility to include maybe up to 2 days on the User Needs assessment around the core agenda. User needs assessment will include use cases for early warning, technical requirements for EW, but also political and institutional considerations for uptake of EW. We should establish early desired attendance for the UNA event.

The Guidance effort would start after conclusion of the UNA. Say mid-2018. The R&D studies and pilots can tentatively start on some fundamental issues now (like combining radar and optical and impact on False Alarm Rates based on initial user feedback) but would be directed when possible by the needs assessment and have the demos focus on specific issues highlighted by the UNA.

Potential Roles

WRI willing and able to lead the assessment and forum event pending resource availability. WRI is the natural lead for this work and willing to do so. They may seek some additional resources to achieve this. Agreed that the Capacity Building component should perhaps co-lead the user assessment. The Guidance task requires leadership from the MGD component ideally.

CEOS (and agencies) and GOFC-GOLD willing to progress the R&D studies and pilots. WRI is keen to be the user pull and to explore addition of radar data streams to their EW capabilities. Early

work could focus on comparing GLAD results with the JAXA/JICA JJ-FAST results as an obvious first step.

Geography

As noted WRI early alert work is with DRC, Indonesia and (especially) Peru. SDCG is keen to use its existing pilots as platforms for the technical studies and demos. Vietnam and Colombia were discussed and agreed as possibilities.

Data Supply

There were strong statements of support from a range of space agencies for supply of data in support of the technical studies. Including ESA, USGS, DLR, CSA, CNES, and ASI. This included the Sentinels, Landsat, Radarsat, TerraSAR, Planet, COSMO Skymed and Pleiades. Also ScanSAR data from ALOS for Vietnam. And hopeful of S-Band data from UK's NovaSAR, which needs still to be launched. Agreed that a coordinated data supply and R&D effort should be orchestrated across CEOS agencies for maximum focus and benefit.

Discussion and Actions

A brief discussion followed, and actions were agreed.

- The UNA should be carried out by WRI, in coordination with the GFOI capacity building component. WRI should also push GFOI Office for resources.
- WRI noted they may be able to include GFOI Early Warning topics for their next user forum (February 2018), though after further discussion following the meeting this was found to not be possible due to scope and planning changes in their user forum. This meeting is a chance to identify opportunities for collaboration that will make the most of limited resources available, and to come together under a few key user pull projects.
- There is a need to engage the GFOI MGD group to sign up for the guidance on early warning, ideally with a similar approach as what was take for REDDCompass.
- It was agreed that there are several tasks that CEOS can carry out in parallel with UNA (e.g. Brian's Data Cube exploratory activities). The CEOS niche is really focused on country-level support.
- Frank Martin noted he can follow-up on further contributions to GFOI R&D, e.g. around early warning, inter-comparison, inclusion of SAR in operational systems.
- Johannes is confident that his GOFC-GOLD methods are mature enough to consider scaling up, and Ake noted this sounds like a good pilot.
- The first two best possibilities are likely a JJ-FAST - GLAD comparison, and working on the GOFC-GOLD approaches.
- There is good enthusiasm from data providers to support these development activities.

SDCG-12-3	WRI to confirm the broadened scope of the Early Warning User Needs Assessment (EW-UNA) based on discussions with CEOS agencies at SDCG-12	**Revisit at GFOI Plenary / SDCG-13** After further discussion with GFOI leads, a

		consultant coordinated by GFOI will lead the User Needs Assessment. Tom is currently working on the TOR with support from Rachael
SDCG-12-4	WRI to confirm the details of their February 2018 user forum (i.e. location, dates), as well as possible agenda time for the EW-UNA	**COMPLETE** After further discussion, the GFW meeting in February will not be a good fit, both due to timing and to a restructuring of the GFW meeting. The timing of the forum is still TBD. The forum committee will develop a more detailed scope for the forum by the end of the year
SDCG-12-5	Frank Martin to work with the GFOI Leads to ensure appropriate GFOI representation at WRI's user forum, and any sessions around Early Warning	**October 2017**
SDCG-12-6	Frank Martin to raise the possibility of GFOI R&D component support (e.g. GOFC-GOLD) to the operationalisation of Early Warning approaches being studied, e.g. around early warning, inter-comparison	**SDCG-13**
SDCG-12-7	Ake to advise the MGD User Advisory Group of the on-going discussions around Early Warning, and report back on any reactions, interest, and potential next steps	**SDCG-13**