(Joint) Submission to the first Global Stocktake
Satellite-based map of global mangrove extent and changes:
Global Mangrove Watch (GMW)

The Japan Aerospace Exploration Agency (JAXA), the Institute for the Global Environmental Strategies (IGES), Aberystwyth University, solo Earth Observation (soloEO), Wetlands International and The Nature Conservancy, are pleased to submit an input to the Global Stocktake of the Paris Agreement in response to the mandate of Decision 19/CMA.1, paragraph 19, 36 and 37. This submission provides inputs to a cross-cutting guiding question 21[1]:

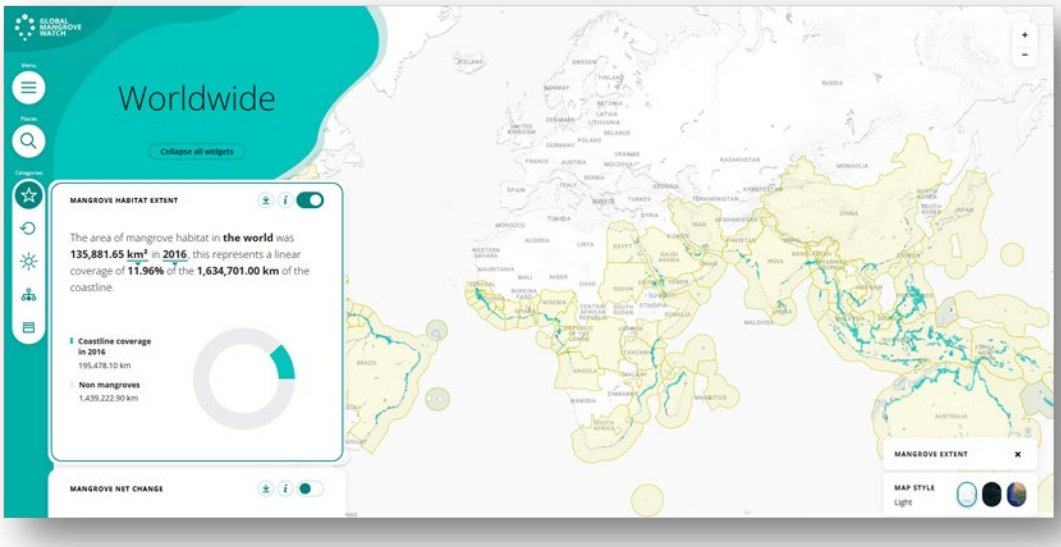
Summary

- Nature-based Solutions (NbS), including coastal and marine NbS, such as mangroves, are a critical element of meeting the goals of the Paris Agreement for their capacity to sequester and store vast amounts of carbon, commonly known as Blue Carbon, and prevent and minimize coastal erosion and flooding[1].
- The Global Mangrove Watch (GMW)[2] map of global mangrove extent and changes is an open-access geospatial dataset and online tool, derived from a combination of optical and radar satellite data, for tracking changes in mangrove spatial extent, including the progress of mangrove conservation and restoration between the 1990's and the present.
- As such, the GMW can be used as a tool for countries that do not yet have their mangrove monitoring systems to design, implement and track the progress of their national climate commitments and identify opportunities to include mangroves in the next round of nationally determined contributions (NDCs), in support of the Paris Agreement's long-term goals for mitigation and adaptation.
- The GMW dataset is furthermore used by UNEP to support reporting on Sustainable Development Goals, Indicator 6.6.1 (Change in the extent of water-related ecosystems over time)[3]
- The GMW dataset is provided by the Global Mangrove Watch and JAXA.

[1] What evidence and methodologies exist for taking stock of the implementation of the Paris Agreement to assess the collective progress towards achieving its purpose and long-term goals, including under Article 2.1(a–c), in the thematic areas of mitigation, adaptation and means of implementation and support, including on efforts to address the social and economic consequences and impacts of response measures and efforts to enhance understanding, action and support, on a cooperative and facilitative basis, related to averting, minimizing and addressing loss and damage associated with the adverse effects of climate change (para 6(b))?
[1] https://unfccc.int/sites/default/files/resource/Scopingpaper_Finalest%20version.pdf

[2] The Global Mangrove Watch (GMW) is a partnership between Aberystwyth University, solo Earth Observation, Wetlands International and The Nature Conservancy, established in 2011 as part of JAXA's Kyoto & Carbon Initiative

[3] https://www.sdg661.app



The Global Mangrove Watch interactive website platform (globalmangrovewatch.org)
(Yellow: countries/territories with mangroves; Green: mangrove extent)

1. The importance of mangroves within the first Global Stocktake

Coastal and marine ecosystems such as mangroves have been historically overlooked within UNFCCC processes, despite their importance and the recognition of their potential in the Paris Agreement. Mangroves and other coastal "Blue Carbon" ecosystems, which also include e.g. saltmarshes and seagrass beds, have exceptional capacity to sequester and store carbon, and provide protection for coastal communities to mitigate the impacts of climate change.

For the GST to comprehensively assess progress on meeting the goals of the Paris Agreement, each of its three components, including submissions of inputs from countries and other stakeholders, must reflect the key role of Nature-based Solutions (NbS) and coastal and marine ecosystems for climate action. The GST can help assess progress and provide an understanding of what is needed for NbS to fully harness the potential of nature-based solutions in the next round of national climate commitments and near-term international support.

2. Global Mangrove Watch dataset usage

The GMW dataset, described in further detail below, can be used as a tool for countries that do not yet have their own mangrove monitoring systems for taking stock and assessing their progress towards achieving international commitments regarding mangroves and identifying opportunities of including mangroves in their NDCs.

National or regional data on changes (gains and losses) in mangrove extent can be estimated and used as evidence to assess the collective progress in efforts towards adaptation and mitigation. In

particular, increase in mangrove areas can help prevent and minimize coastal erosion and flood damage, and thus contribute to progress in efforts towards adaptation. The GMW change maps can furthermore be used to estimate CO_2 removals following the methods provided in Chapter 4 of the "*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*" (IPCC, 2014) in combination with e.g., IPCC default data or available local or global maps of mangrove above-ground biomass (such as e.g. the global dataset by Simard et al., 2019), and thus demonstrate progress in efforts towards mitigation.

3. Methodology

The mangrove maps (GMW v3.0) were derived in two steps: (1) Generation of a baseline map of global mangrove extent for the year 2010, and, (2) Detection of changes between the 2010 baseline and each of the other years, respectively. A combination of optical and radar satellite data was used. Optical sensors are useful to distinguish mangroves from other types of vegetation, while radar sensors, which are unaffected by cloud cover and sensitive to changes in structure, were used to map changes throughout the time-series.

The 2010 baseline map was derived through a Random Forest classification of optical (primarily Landsat) satellite data. The classification was confined within a mangrove habitat mask, which defines the biogeographical range where mangrove ecosystems can be expected to exist (notwithstanding human influence). The mangrove habitat definition was based on geographical parameters such as latitude, elevation, distance from ocean water, as well as historical open surface water occurrence. Training for the mangrove classification was based on random sampling from historical maps of mangroves.

The classification accuracy of the 2010 baseline dataset was assessed with more than 50,000 randomly sampled points across 60 randomly selected regions globally. The overall accuracy was estimated to be 95.0% (Kappa coefficient 0.901).

The mangrove maps for the non-baseline years were subsequently derived by detection of changes (both gains and losses) relative to the 2010 baseline map using radar (JERS-1 SAR, ALOS PALSAR and ALOS-2 PALSAR-2) satellite data. The change pixels for each year were then added or removed from the baseline map. The classification accuracy for the change maps is currently under assessment (February 2022).

Detailed descriptions of the Global Mangrove Watch baseline and change maps development and accuracy assessments are available in Bunting *et al.* (2018; 2022)

NOTE. While the GMW dataset constitutes the most comprehensive dataset of mangrove geospatial extent and changes currently available, users are advised to keep in mind that it a global-scale dataset, generated with a single methodology applied over all regions, and as such, the accuracy of the map may vary between locations and with scale.

4. Technical Characteristics

Spatial resolution	25 m
Recommended minimum mapping unit (MMU)	1 ha
Geographical coverage	Global (all countries with mangroves)
Temporal coverage	1996, 2007, 2008, 2009, 2010 (baseline year), annual data 2015-2020
Update frequency	Annual (subsequently from 2021)
Format	GIS shapefile (.shp), geocoded raster (Geotiff), numerical statistics (.csv)
Data Policy	Public open (Creative Commons CC BY 4.0)

5. Contacts and data access

Contact:
Osamu Ochiai, Japan Aerospace Exploration Agency: ochiai.osamu@jaxa.jp

Technical contact:
Ake Rosenqvist, Global Mangrove Watch: ake.rosenqvist@soloEO.com

Associated Guidance and User Manual:
Global Mangrove Watch Platform: www.globalmangrovewatch.org

Web address for dataset download:
UNEP-WCMC (vector data): https://data.unep-wcmc.org/datasets/45
JAXA (raster data): https://www.eorc.jaxa.jp/ALOS/en/dataset/gmw_e.htm

6. References

Bunting P., Rosenqvist A., Lucas, Hilarides L., Thomas N. (2022). "Global Mangrove Watch: Updated 2010 Mangrove Forest Extent (v2.5)". *Remote Sensing* (under review, Jan. 2022).

Bunting P., Rosenqvist A., Lucas R., Rebelo L-M., Hilarides L., Thomas N., Hardy A., Itoh T., Shimada M., Finlayson C.M. (2018). "The Global Mangrove Watch – a New 2010 Global Baseline of Mangrove Extent". *Remote Sensing, 2018, 10, 1669,* doi.org/10.3390/rs10101669.

IPCC (2014). 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.