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| **National Forest Inventories and Earth Observation: Can a geostatistical approach fulfill countries’ policy reporting needs?**  |
| **Abstract:** Aboveground dry woody Biomass Density (AGBD) maps produced with Earth Observation (EO) data have a large potential to periodically provide a transparent, consistent and replicable picture of the state of the world’s forests. Such map estimates may provide crucial support to nations and stakeholders reporting on forest carbon stocks, for example, to the United Nations Framework Convention on Climate Change (UNFCCC). Estimates can regularly contribute to complete and comparable aggregates for the Global Stocktake (GST) under the Paris Agreement. Yet, a recent synthesis of national-level reporting has concluded that only a handful of countries use EO-based AGBD maps in their (sub)national assessments of AGBD for policy reporting, highlighting a gap that is partially attributed to the lack of understanding on how to integrate forest plot-level data and the maps. Under the Committee of Earth Observing Satellites (CEOS), a Biomass Harmonization activity has been initiated (NASA 2021), with a core objective of developing methods to integrate National Forest Inventories (NFIs) with EO-based forest AGBD or height maps. We present a geostatistical model-based (GMB) approach for the countries of Mexico and Mozambique, whereby their NFI data is modelled using the ESA Climate Change Initiative (CCI) Biomass maps and NASA GEDI forest height estimates. We further present methods that permit computational efficiency, namely through the Finite Elements approach, that discretises the domain and uses a pre-defined neighbour-based spatial model to estimate model parameters. Finally, we demonstrate how the results of the GMB can be used to (1) gap-fill locations with missing NFI plots, (2) estimate baseline AGBD in any arbitrary location. Both these demonstrations serve to fulfil the purpose of complete biomass stock inventories or estimation of emission factors that countries may use in combination with activity data (i.e. tree cover or forest loss) in policy reporting. The approach is presented in an open-science framework on the ESA-NASA Joint Multi-Mission Algorithm and Analysis Platform (MAAP, <https://scimaap.net/>), which enables transparency, knowledge-transfer and flexibility to allow for the inclusion of new AGBD maps in the future. Finally, active support and liaising with the Global Forest Observations Initiative's Methods and Guidance Documentation component (GFOI 2020) will ensure that the approaches are communicated in manner aligned with country needs and policy requirements.  |

*References:*

NASA 2021 Biomass earthdata dashboard BETA: the biomass harmonization activity (available at: [www.earthdata.nasa.gov/maap-biomass/](https://www.earthdata.nasa.gov/maap-biomass/))

GFOI 2020 Integration of remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: methods and guidance from the global forest observations initiative, edition 3 0. section 4.3.1.2: use of biomass maps and remotely sensed data to support estimation of emissions and removals, Rome (available at: [*www.reddcompass.org/mgd/en-3/s08s05s02s04.html3309725*](https://www.reddcompass.org/mgd/en-3/s08s05s02s04.html3309725))