Global Above Ground Biomass changes in the last 30 years

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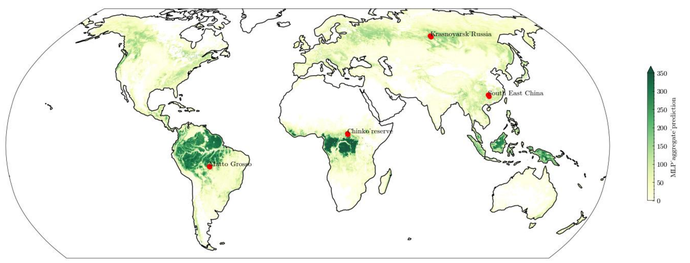
Retrieval of AGB from satellite microwave observations at **12.5 km²** from **1992** to **2022:**

Data sources

- Passive Microwave Radiometers:
  Special Sensor Microwave Imager, (SSMI/SSMIS) at 18 and 36 GHz monthly values,
- Active Microwave Scatterometers:
  CScat [1] using ERS, ASCAT and Qscat (5.3 and 13.4 GHz) monthly values,
- Reference AGB: CCI v5 [2], (2019/2020 during training)

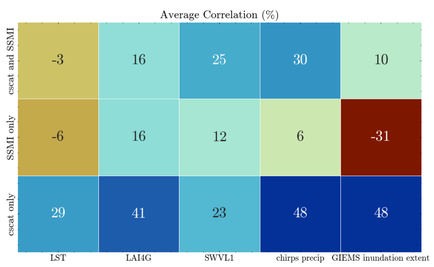
Using a neural network we estimate the global monthly AGB values per grid cell from observations. Performance depends on the input variable combination:

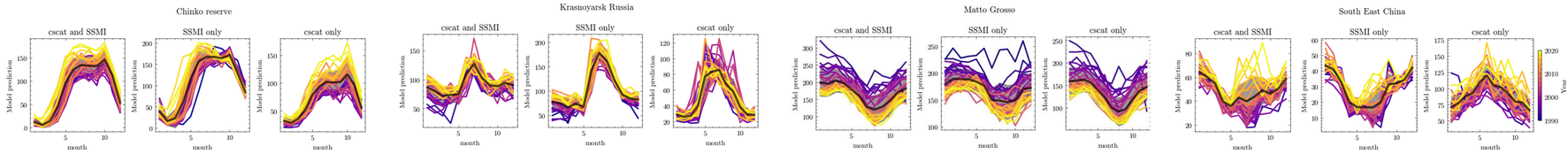
Input	R^2	RMSE (Mg/ha)
CScat	0.51	56.8
SSMI 18&36	0.64	48.3
All	0.75	40.6



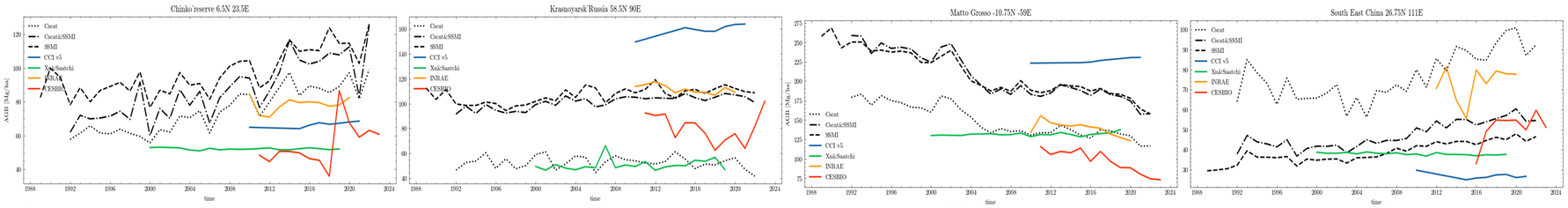
Strong seasonality in predicted values at monthly timescales, with spatial variations in the correlation to other environmental variables:

- Land Surface Temperature,
- Leaf Area Index,
- Soil Moisture,
- Precipitations,
- Inundation extents.

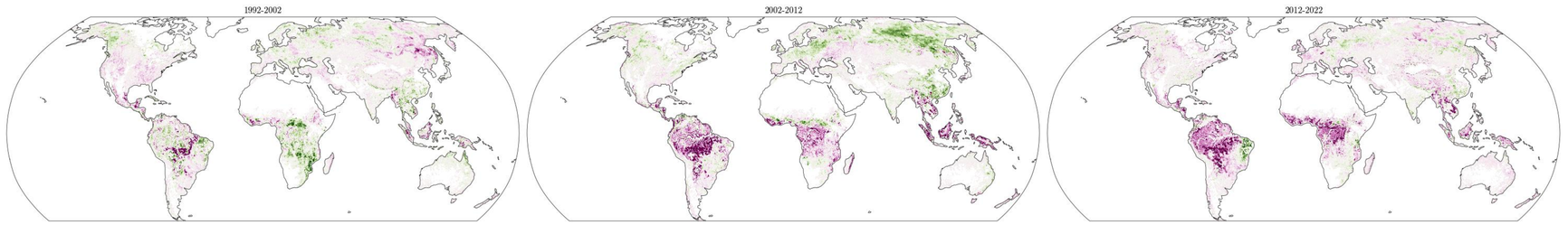




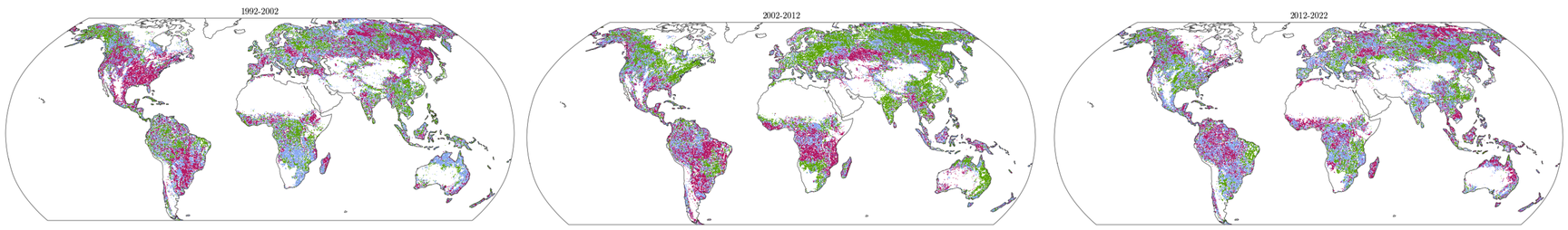
Yearly annual cycles of the predicted values for selected locations, using a combination of active and passive, only passive or only active observations.



Aggregate of monthly estimates from multiple platforms and sensors to create yearly values of AGB. Time series of remote sensing derived AGB from different input observations (L-band radiometers, radar data, optical and radar).



Decadal linear slopes from the combined CScat & SSMI time series. Known large scale patterns: Amazon arc of deforestation, Borneo coastline, large scales fires (Eastern Siberia), woody encroachment in northern Congo Basin clearly apparent. Low linear trends in most regions. Few long term consistent dynamic.



Agreement between Measures Forest Vegetation cover fraction [3] slopes and CScat & SSMI derived AGB slopes over the same time periods.

- ✓ Combining active and passive sensors improves robustness of the long term variations
- ✓ Longest monitoring (>30 years) achieved with the passive microwave time series
- ✓ Yearly variations diverge with some other time series, but show some similar patterns to the L-band microwave variations
- ✓ Challenges in absolute AGB levels (Pacific North West, dense tropical forests)
- ✓ Sensitivity to cofounding factors (Soil moisture) could lead to non AGB related variations
- ✓ Time series continuity and instrument changes can be handled for the long term monitoring

References:
1. Shengli Tao, et al. A global long-term, high-resolution satellite radar backscatter data record (1992–2022+): merging c-band ers/ascat and ku-band qscat. Earth System Science Data, 2023.
2. Santoro, M.; Cartus, O. (2024): ESA Biomass Climate Change Initiative (Biomass_cci): Global datasets of forest above-ground biomass for the years 2010, 2015, 2016, 2017, 2018, 2019, 2020 and 2021, v5.01
3. Hansen, M., X. Song. *Vegetation Continuous Fields (VCF) Yearly Global 0.05 Deg*. 2018, distributed by NASA EOSDIS Land Processes Distributed Active Archive Center, https://doi.org/10.5067/MEaSUREs/VCF/VCF5KYR.001. Accessed 2025-04-24

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