Two Decades of Changes in Forest Aboveground Biomass in the Southwestern United States from MISR on Terra

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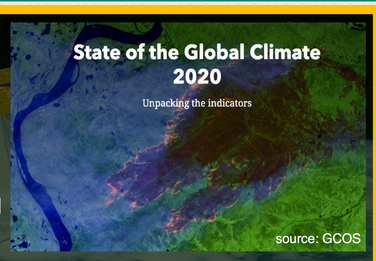
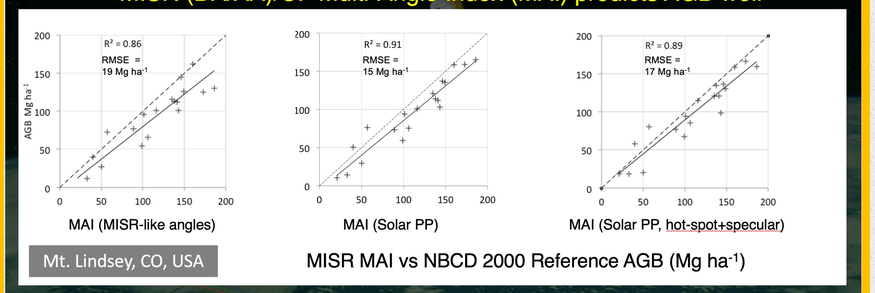
Why? Lidar and radar technologies are optimal for mapping forest aboveground biomass (AGB, Mg ha^{-1}) but the record is as yet short and sporadic. Near-nadir spectral metrics from the Landsat record do not afford reliable prediction of forest AGB.

How? MISR allows mapping forest AGB at broad scales on an interannual basis at ~250 m.

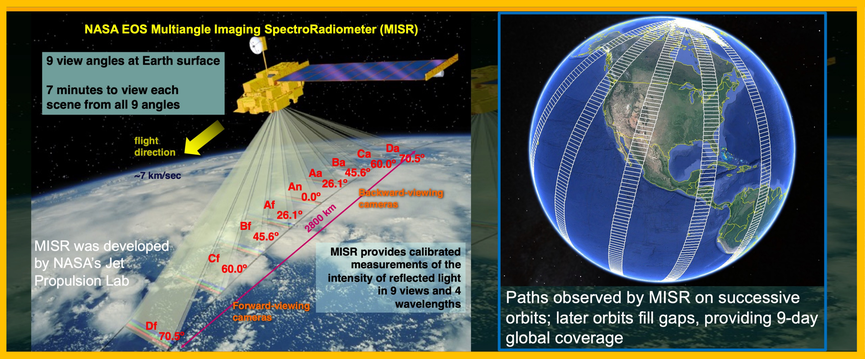
Status Mapping across the southwestern US has been achieved for 2000 – 2022, with calibration and validation performed using NBCD 2000 radar-based and NASA Carbon Monitoring System (CMS) lidar-based AGB datasets, respectively.

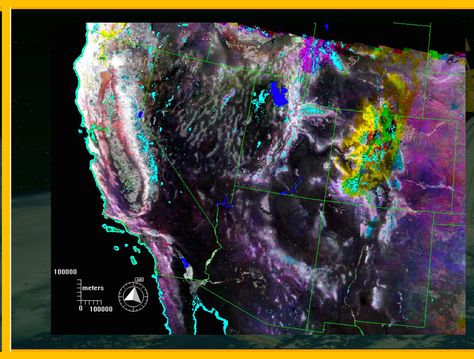


MISR (DA/AA)/CF Multi-Angle Index (MAI) predicts AGB well



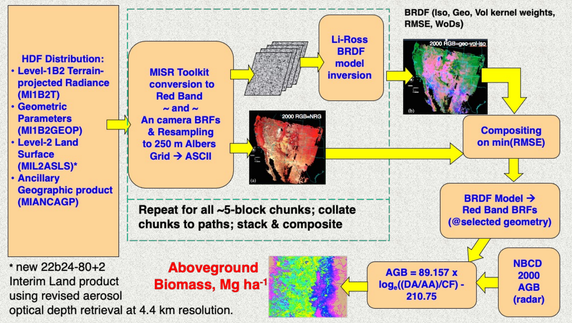
Surface reflectance estimates from the NASA, JPL Multi-angle Imaging Spectro-Radiometer (MISR) were used to map forest aboveground biomass (AGB) for the southwestern United States, annually, on a 250 m grid. The method and results for 2000 – 2015 are reported in Chopping et al. (2022), *Remote Sensing of Environment,* 275, 112964, doi.org/10.1016/j.rse.2022.112964. The dataset was extended to 2021 and published at the ORNL DAAC at https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1978.

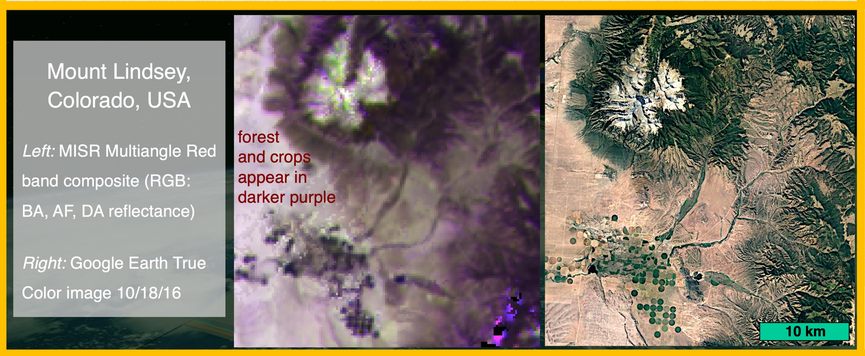


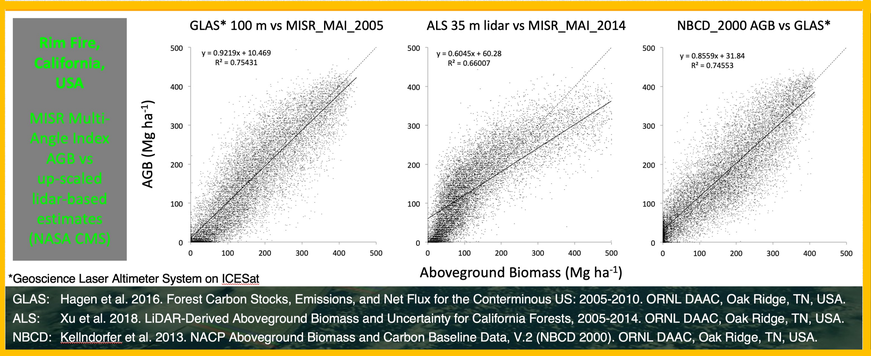


MISR Processing Chain

Example uses a fixed $\log_e$ function







GLAS: Hagen et al. 2016. Forest Carbon Stocks, Emissions, and Net Flux for the Conterminous US: 2005-2010. ORNL DAAC, Oak Ridge, TN, USA.
ALS: Xu et al. 2018. LiDAR-Derived Aboveground Biomass and Uncertainty for California Forests, 2005-2014. ORNL DAAC, Oak Ridge, TN, USA.
NBCD: Kellndorfer et al. 2013. NACP Aboveground Biomass and Carbon Baseline Data, V.2 (NBCD 2000). ORNL DAAC, Oak Ridge, TN, USA.

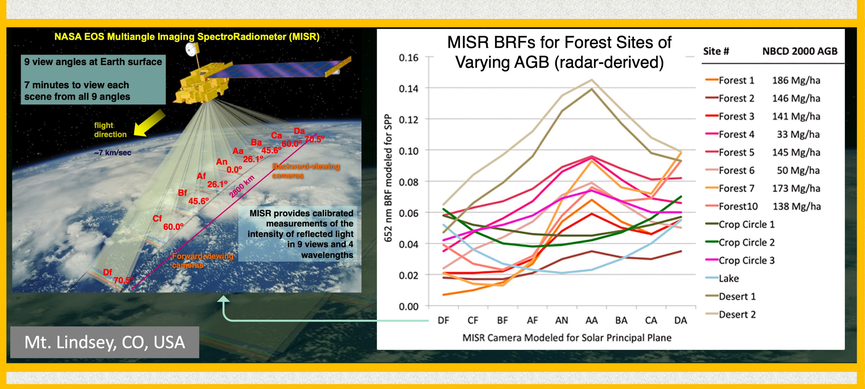
Goal: More complete surface records, tracking impacts of climate disruption on the terrestrial biosphere, including forest carbon stocks, for 2000-.

Bottlenecks in today's observation system

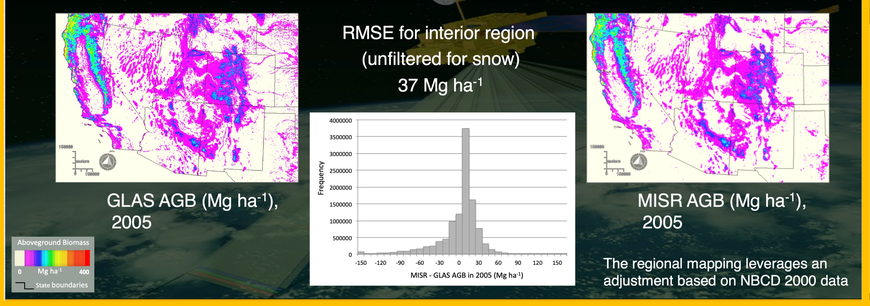
- Near-nadir spectral metrics from long series multispectral instruments do not predict AGB reliably, while active observing technologies optimal for forest AGB mapping have short records and/or limited geographic coverage.
- Multiangle remote sensing has the potential to fill this gap by providing compatible interannual AGB estimates from 2000-, with good reliability to ~500 Mg ha^{-1} and at a ground resolution that is appropriate for global mapping.

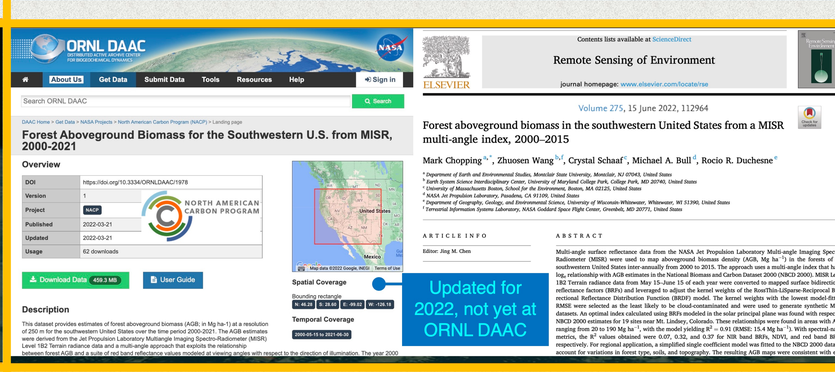
Which are the most urgent yet feasible actions for improving the situation?

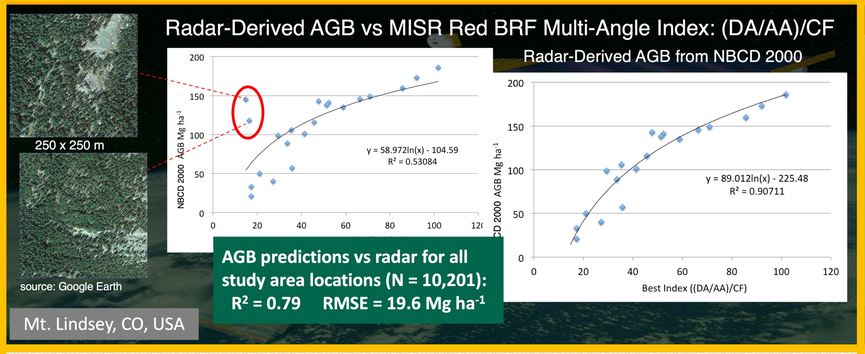
- Validation; extending mapping to all forests up to ~500 Mg ha^{-1}, using GEDI data.
- Deploying multiangle imagers to orbit for observing land, as well as atmosphere.

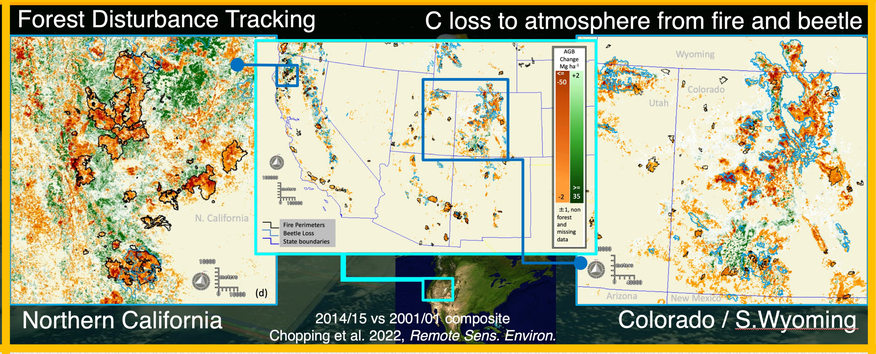


Regional Aboveground Biomass Density Mapping









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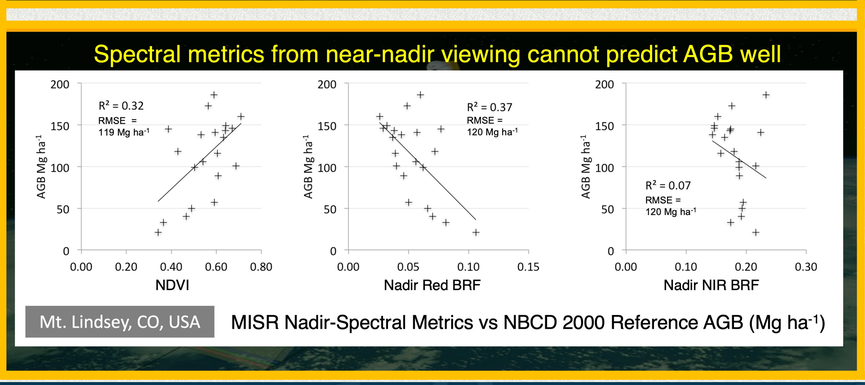
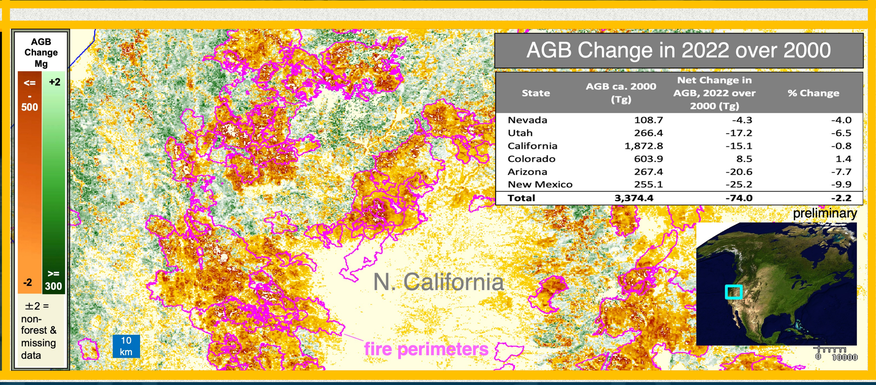
MISR NASA Carbon Monitoring System ORNL DAAC DISTRIBUTED ACTIVE ARCHIVE CENTER FOR BIOGEOCHEMICAL DYNAMICS NBCD 2000 National Biomass & Carbon Dataset for the Year 2000

Spectral metrics from near-nadir viewing cannot predict AGB well





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