

GOFC-GOLD

Global Observation of Forest Cover and Land Dynamics



Land Cover
Project Office



GFOI Plenary/SDCG 11

GFOI R&D Groups

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- Country needs and priorities
 - UN-REDD, FCPF
- GFOI Review of Priority R&D topics (2013)
 - RS forest map products that can be used by countries to implement NFMS
 - Operational status of methods
 - R&D gaps/needs
- Active research program
 - Facilitate access to satellite data
 - Future inclusion of methods in MGD
- Donor support & research calls
 - SilvaCarbon, DLR, EC, ESA...
- Expert workshops
 - Sensor interoperability, degradation, biomass, global datasets, stratification
- GFOI R&D Plan



Priority R&D Topics



Table 5. GFOI Priority R&D topics: Approaches and issues for consideration
(yellow highlights products that are high priority, and ✖ indicates topics that address priority issues and ✕ are other R&D topics)

GFOI Product	Time Series Consistency	Hyper-temporal Processing	Spatio-temporal data mining	Satellite Sensor Interoperability	Stratification	Proxy Methods	Software Development & Capacity Building	Uncertainty & Inference	Data-Model Integration	Socio-economic Analysis	Overall Inventory priority	Operational Readiness
1) Forest/Non-forest	✖			✖							Medium	Operational ⁴
2) Forest/Non-forest change	✖	✕	✕	✖			✕	✕	✕	✕	Medium	Operational ⁴
3) Forest stratification				✖					✕		High	Operational ⁵
4) All Land use categories	✖			✖							Medium	Operational ⁶
5) Land use change between forests and other land uses	✖	✕	✕	✖	✖		✕	✕	✕	✕	High	Operational ⁶
6) Change within Forest land	✖	✕	✕	✖	✖			✕	✕		High	Operational ⁵
7) Near-Real Time Forest Change Indicators	✖	✕	✕					✕		✕	Medium	Operational ⁷
8) Degradation type map	✖	✕	✕	✖		✖					Medium	R&D Topic
9) Degradation and/or Enhancement of C stocks	✖	✕	✕	✖	✖	✖	✕	✕	✕	✕	High	R&D Topic
10) Above-ground Biomass Estimates				✖	✖			✕	✕		Low	R&D Topic
11) Change in Above-ground Biomass				✖	✖			✕	✕		Low	R&D Topic
Tropic Forest Country request	✖	✕		✖		✖	✕	✕				

GFOI affiliated R&D Program



Group	Affiliation	Study Site(s) [country]	Sensor data requested								Publicly open & others					R&D topics under investigation								
			SPOTS(Take5)	SPOT 1-5 (archive)	VHR Optical	ALOS-2 PALSAR-2	ALOS-1 PALSAR-1	RAIDARSAT-2	TerraSAR-X	TanDEM-X	Cosmo-SkyMed	LandSat	Sentinel-1	Sentinel-2	RapidEye	ENVISAT ASAR	Others	Forest type	Forest cover	Deforestation	NRT detection	LC & LLC	Degradation	Biomass/carbon
1	INPE, Brazil	Brazil		■	■	■		■				■											X	X
2	SIRS, France	Malawi		■	■	■						■					X	X	X				X	X
		Gabon		■	■	■							■					X	X	X	X			X
3	WHRC/BU, USA	Colombia	■	■	■	■						■							X		X		X	X
4	U Wageningen, The Netherlands	Ethiopia			■	■						■							X	X			X	X
		Fiji			■	■						■							X	X			X	X
		Bolivia				■						■							X	X			X	X
5	Guyana Forest Com.	Guyana			■					■		■			■							X	X	
6	U Wageningen, NL	Indonesia	■			■		■		■							X		X	X	X	X	X	X
7	U Tromsø, Norway	Tanzania			■	■	■	■	■									X	X				X	X
8	HGC, Malaysia	PNG			■	■		■	■										X				X	X
9	VTT, Finland	Mexico			■	■												X			X		X	X
		Finland	■			■																	X	X
10	CSIRO, Australia	Australia	■			■				■							X					X	X	
11	UNSW, Australia	Australia				■		■		■									X		X		X	X
12	CFS, Canada	Canada				■	■		■								X	X					X	X
13	U Humboldt, Germany	Brazil			■	■		■	■			■							X		X		X	X
14	RSS, Germany	Indonesia				■		■	■										X				X	X
15	Airbus D&S, Germany	F. Guiana			■	■			■	■							X	X	X	X			X	X
		Indonesia				■			■	■							X	X	X	X			X	X
		Ghana			■	■			■	■							X	X	X	X			X	X
16	CSIR, South Africa	S. Africa	■		■	■		■	■							X	X					X	X	
17	NORUT, Norway	DRC			■	■							■					X	X					X
18	FSU Jena, Germany	Mexico			■	■		■	■														X	X
		S. Africa				■		■	■														X	X

*User requirement: ■ Minimum required dataset; ■ Complementary dataset; ■ Available through other sources (not requested through SDCG)

R&D study sites

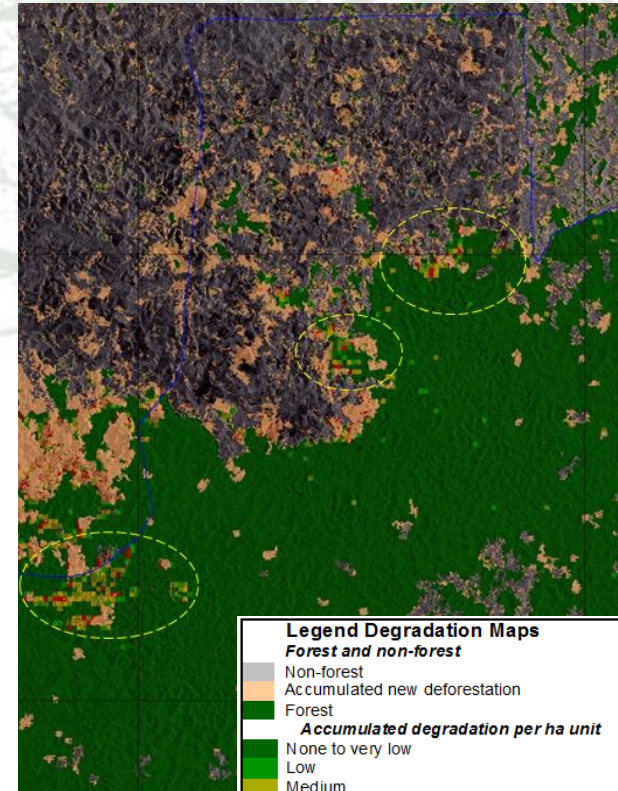


<http://www.gfoi.org/rd/study-sites/>

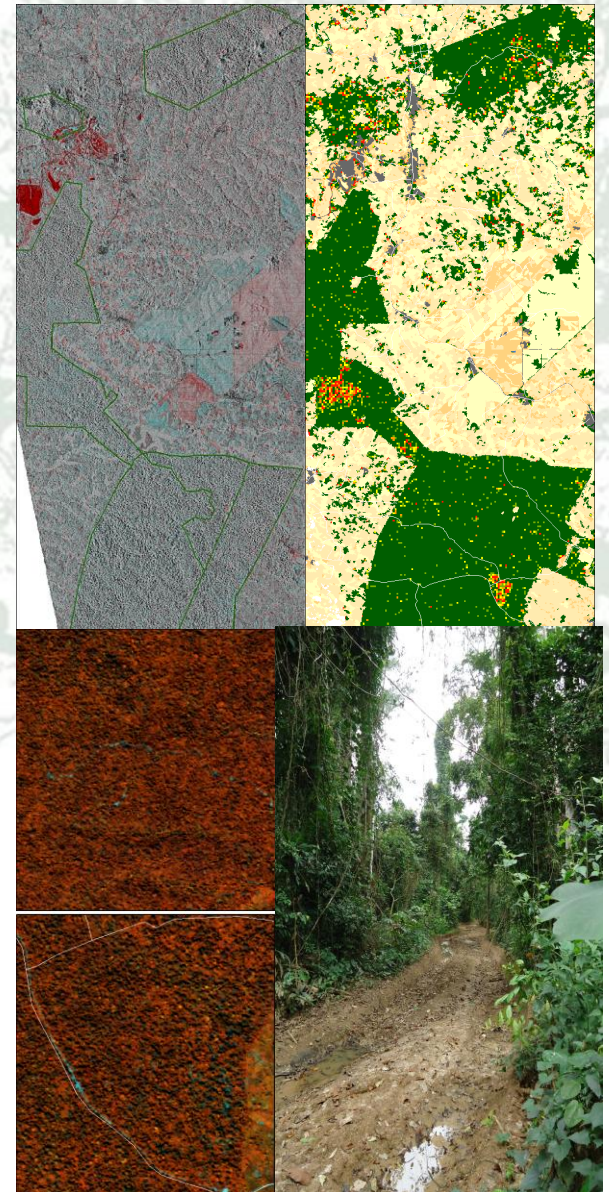
An aerial photograph of a dense, lush green forest. A winding, light-colored path or stream cuts through the forest, starting from the bottom left and moving towards the top right. The forest canopy is thick and vibrant green, with some brownish patches visible where the path or stream flows.

FOREST DEGRADATION & REGROWTH

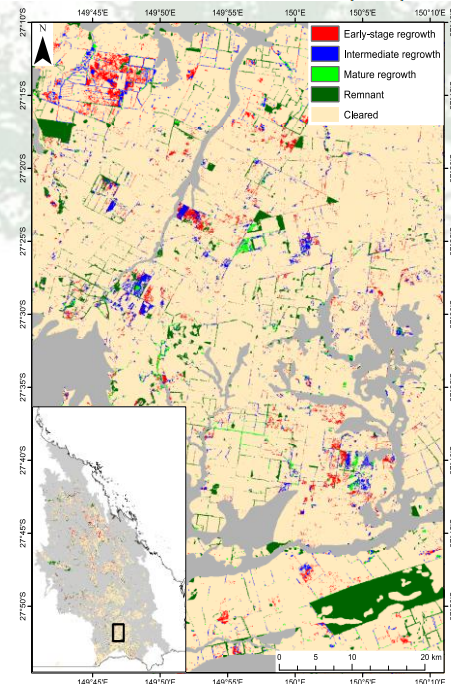
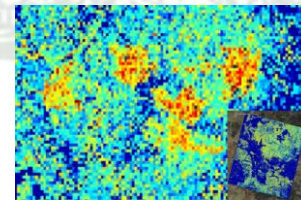
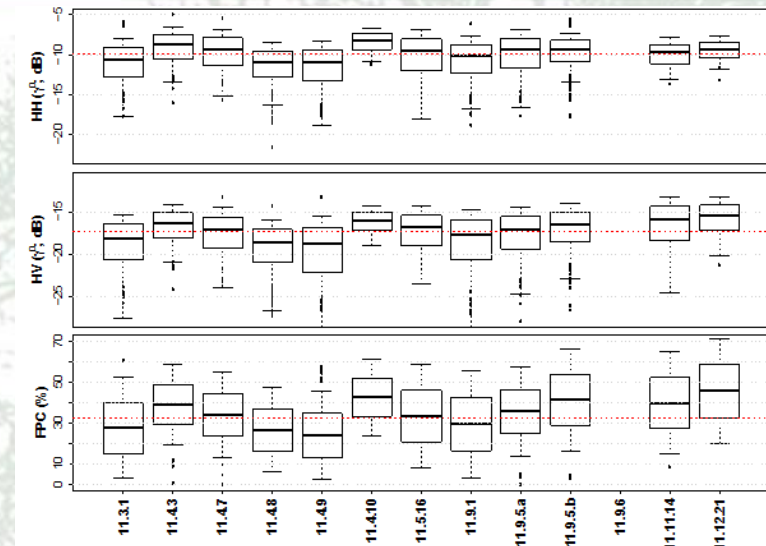
- Degradation and vigilance monitoring (TSX)
 - Vigilance (tree level change) & accum. degrad/ha
 - TS approaches applied to Spotlight and Stripmap
 - Loss of individual trees mapped by detecting disappearing tree crowns and radar shadows
 - Spatio-temp. tuning (speckle/precipitation effects)
- NRT degradation and logging detection using dense time-series ENVISAT ASAR and TSX
 - Overall acc. 93.4%, FAR 2.3% (@95% CI)
- Nested approach using Sentinel-1 w2w (DP) and TSX (SP) hot spots
 - Satellite monitoring for early alert of illegal logging & expansion of oil palm/rubber plantation
- Test site: Harapan rainforest, Indonesia
- Local radar capacity building

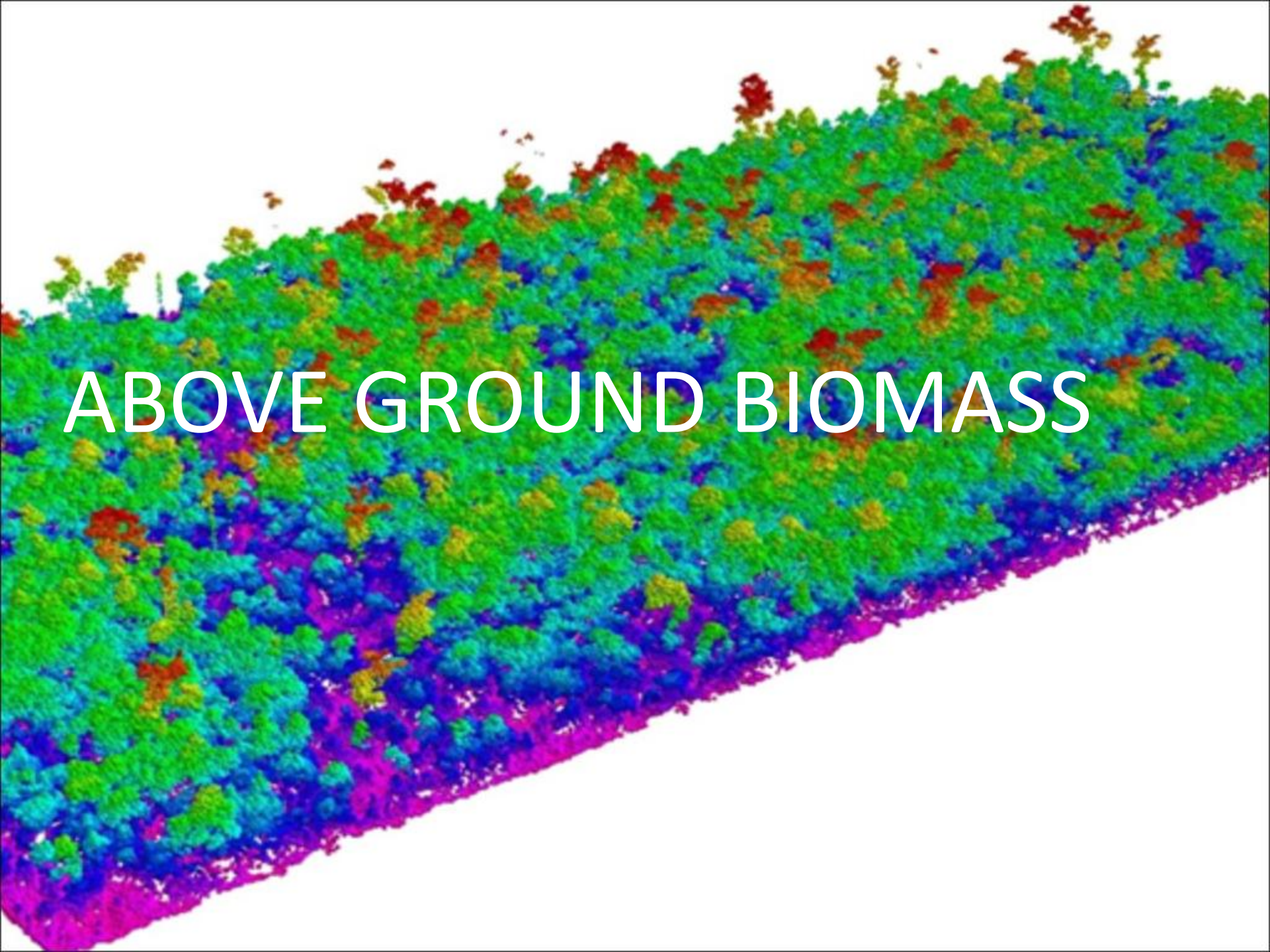


- Forest disturbance mapping using dense TS TSX (SM, VV)
 - Persistent change in forest canopy over 6 years
 - Amplitude change detection
 - High degree of automation
 - Overall acc. 94% ($\pm 3\%$)
- Test site: Ghana
- SAR/Optical synergy
 - Sentinel-2, SPOT-6/7, TSX/TDX
- Applications
 - Early alert on forest disturbances
 - C stock change
 - Compliance monitoring



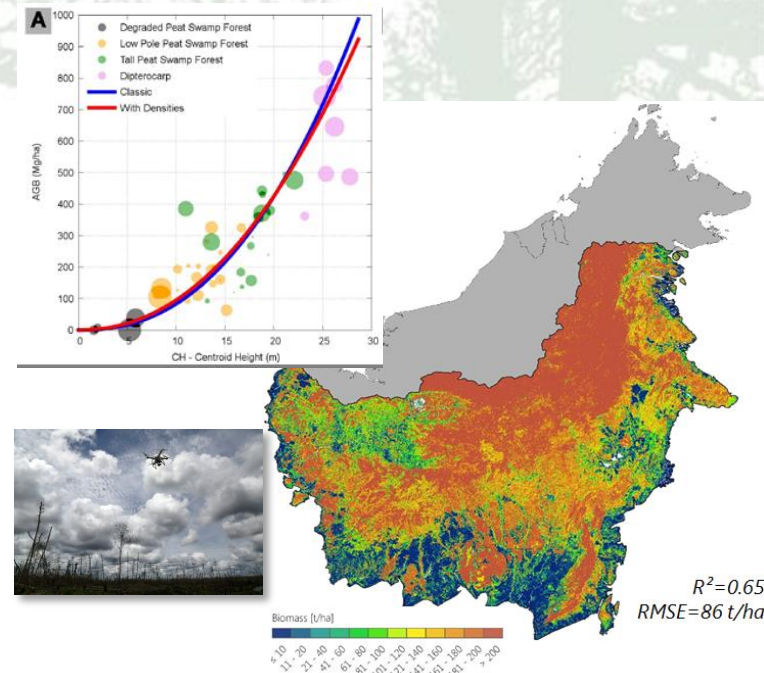
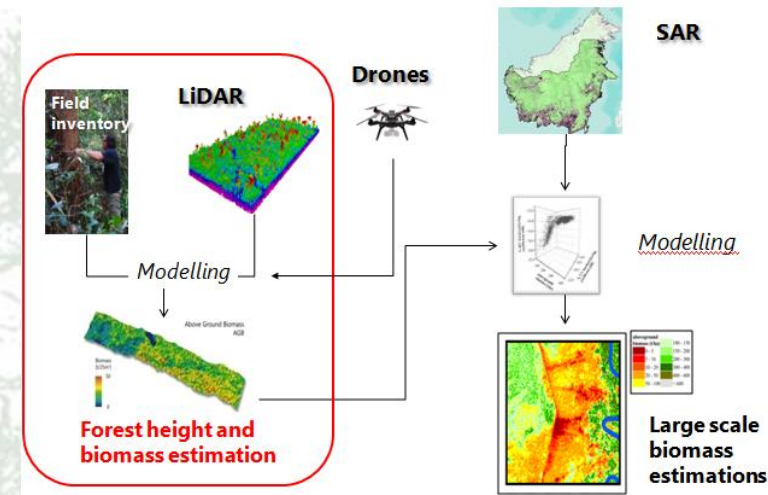
- Forest growth stage mapping using Landsat FPC and ALOS PALSAR (DP)
 - Differentiation of early regrowth & remnant forest
- Tree level change using repeat LiDAR
- Observation of vegetation vertical structure and disturbance using L-band InSAR
 - ALOS PALSAR correlation (Aug-Oct 2007)
- Test site: Brigalow belt bioregion, QLD Australia
- Methods applicable at national scale
 - Testing required in tropical countries



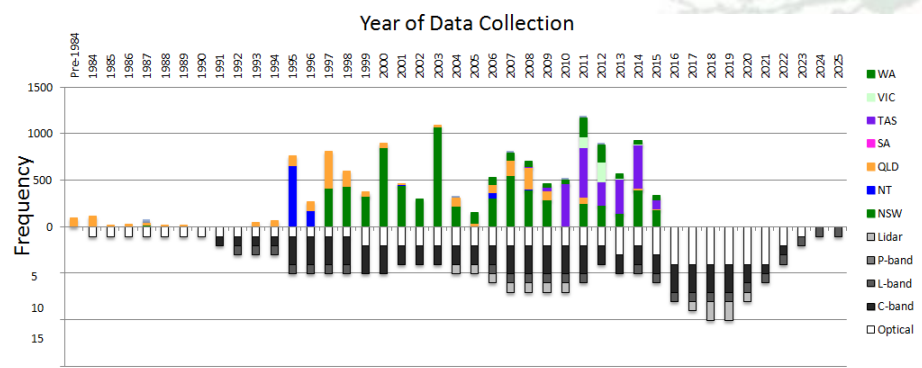
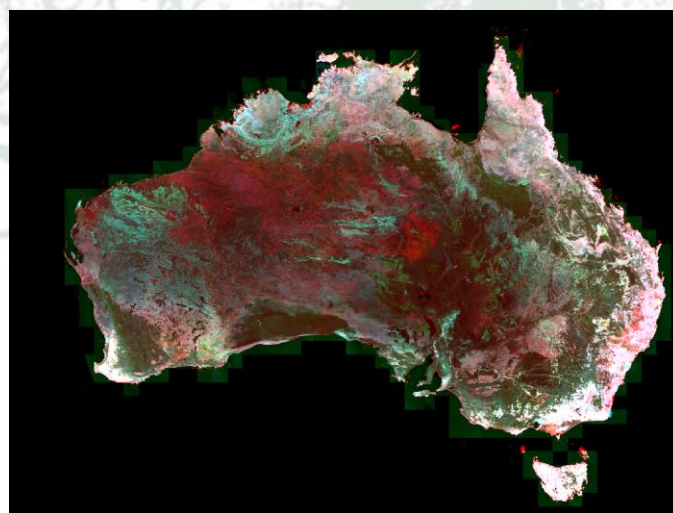
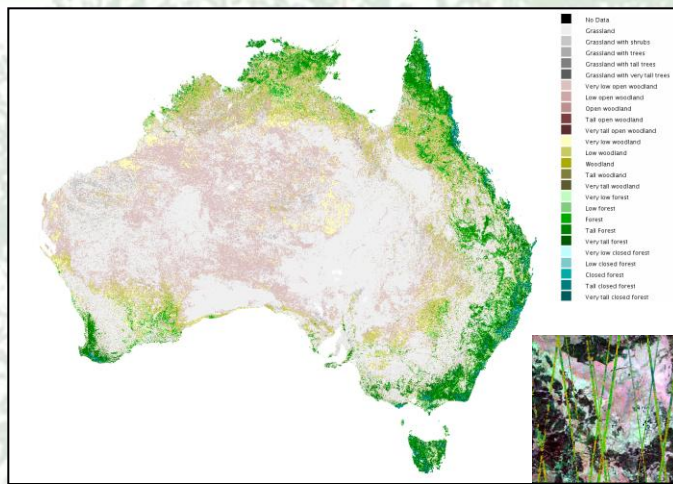
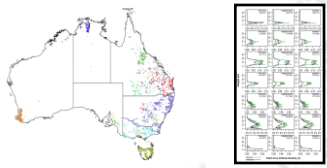


ABOVE GROUND BIOMASS

- LiDAR-based AGB model
 - Forest inventories and allometric modelling
 - LiDAR height metrics: centroid height and quadratic mean canopy height
 - LiDAR transects show high AGB variability of different forest classes
- Monitoring AGB change (decrease) using repeat LiDAR
 - Forest degradation due to logging and fire
- Canopy height models from drones
- InSAR height/AGB estimation
 - TSX/TDX, RADARSAT-2, Sentinel-1
- Regional AGB using ALOS (25m), SRTM-30 and LiDAR
- Test site: Peat swamp forest, Indonesia



- Forest structural classification using height and cover
 - Landsat, ALOS PALSAR and ICESat
- TERN Biomass library
 - Plot and LiDAR data
- Sensor synergy for retrieving estimates of AGB
- National scale methods



Number of satellites supporting regional to global biomass mapping

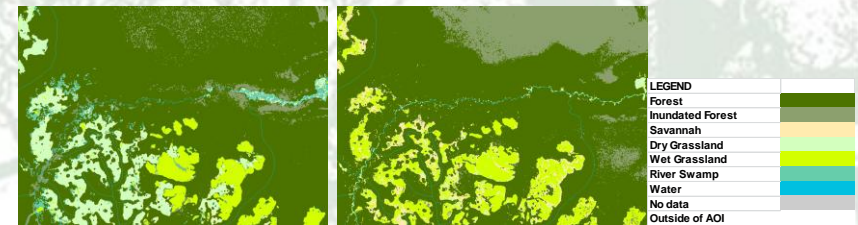
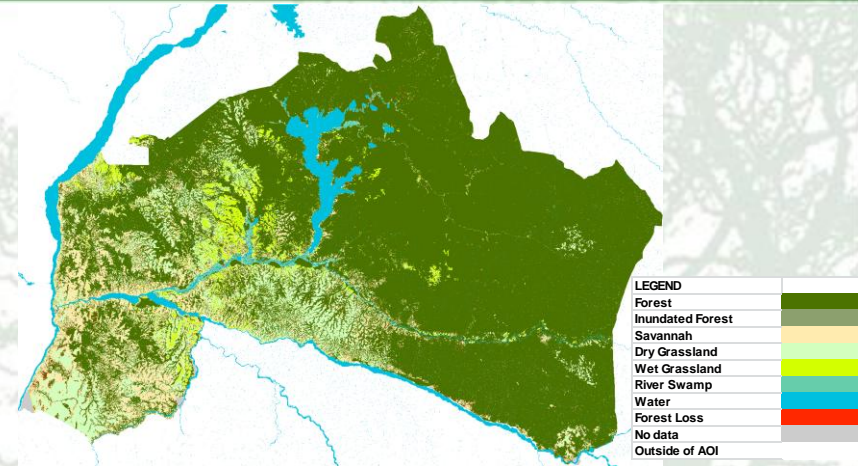
Optical	C-band	L-band	P-band	Spaceborne lidar
Landsat-7	ERS-1 SAR	JERS-1 SAR	BIOMASS	ICESAT GLAS
Landsat-8	ERS-2 SAR	ALOS PALSAR		ICESAT-2
Sentinel-2	RADARSAT-1	ALOS-2 PALSAR-2		GEDI ON ISS
	RADARSAT-2	SAOCOM CONAE		
	Sentinel-1	NISAR		

Landsat persistent green, ALOS HH and HV in RGB

An aerial photograph of a forested area, overlaid with a map showing forest cover change. The map uses a color scale where green represents forest cover and purple/pink represents areas where forest cover has changed or been lost. A prominent river network is visible, with the main river and its tributaries highlighted in a darker blue/purple color. The text "FOREST COVER CHANGE" is overlaid in white, bold, sans-serif font across the center of the image.

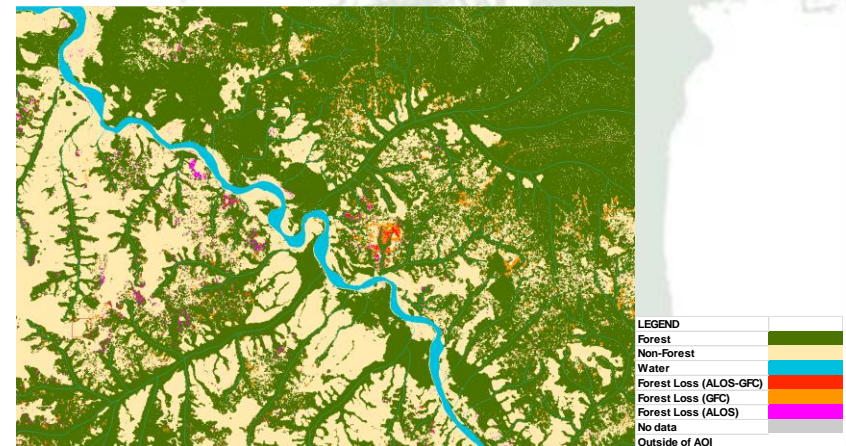
FOREST COVER CHANGE

- Forest, LC and change mapping using Landsat GFC, ENVISAT, Sentinel-1 and ALOS-2
 - Validation using VHR and ground data
 - Comparison of ALOS and Global Forest Change products
 - 7x more forest loss (GFC) over 5 years
 - Dense TS Sentinel-1 gives similar results to ALOS PALSAR (FNF)
 - Additional info for separating other forest types (inundated forest)
- Capacity building with OSFAC
 - SAR processing tools and workshops
- Test site: Mai Ndombe, DRC

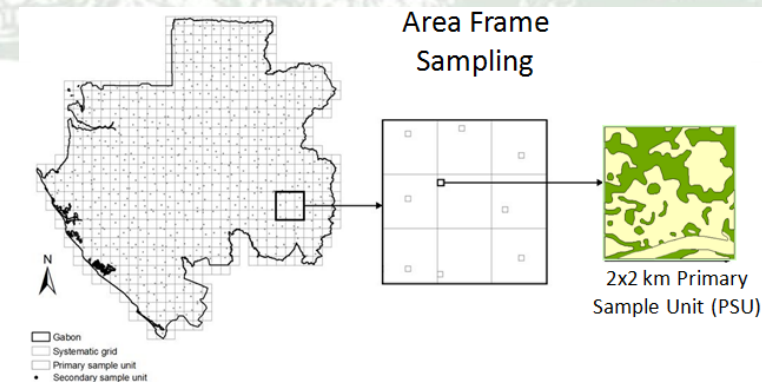
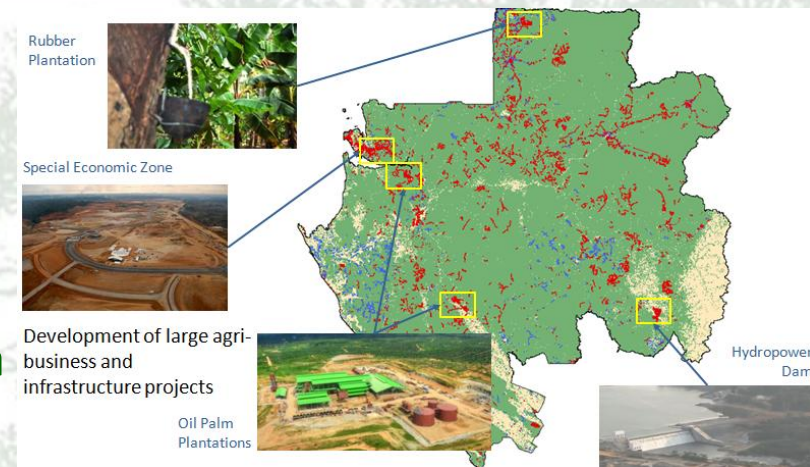


ALOS -2 PALSAR-2

Sentinel-1



- Forest cover & change mapping
 - Baseline F cover maps for 1990/2000/2010
 - Processing and classification of cloud-free Landsat-8 composites
 - Validation: Sampling design using VHR data
 - Overall acc. 98.05 % (FNF 2015)
- NRT forest disturbance monitoring using Landsat
 - Cloud and NF masking > NDVI > Threshold difference
 - Improvements: cloud/shadow masking, identifying clear pixels
- Knowledge transfer (AGEOS) to produce 2015 update and NRT monitoring to detect illegal logging activities



- Prototype monitoring system compliant with IPCC Approach 3 for securing activity data
 - Continuous Change Detection and Classification (CCDC)
 - Open source BEEODA
 - Improvements: constructing annual estimators using single sample is time-saving but imprecise – other approaches?
- Implementation with IDEAM
- Pixel level C modelling framework
 - Land conversions trigger carbon response that is modelled by bookkeeping approach
 - NASA CMS 2016 funding
- Test site: Colombian Amazon

