DLR contributions to R&D Support strategy (Element 3) – Status update

Michael Bock, Helmut Staudenrausch

SDCG-12 Session 4

TerraSAR/TanDEM-X Mission Status

Satellite lifetimes

The TerraSAR-X and TanDEM-X satellites were launched in 2007 and 2010, respectively. Both satellites show an excellent health status:

- the radar instrument is working nominal
- the battery status is much better than specified
- consumption of consumables (hydrazine) is well below initial predictions
- For both satellites a further lifetime beyond 2020-22 is expected
- This allows operations at least until the next-generation SAR mission is operational.
- In July 2017 Phase A of the next Generation – bi-static - X-Band SAR (“HRWS”) mission started

TerraSAR/TanDEM-X Mission Status

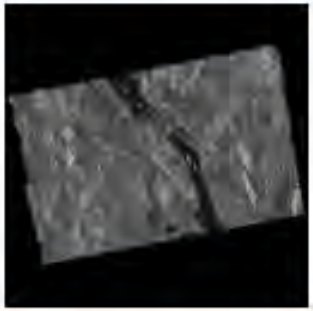
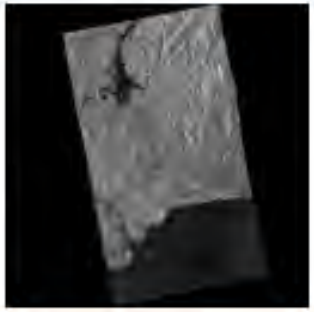
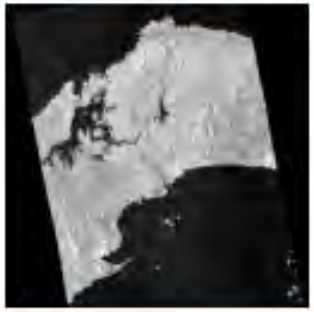
TerraSAR-X Mission

- The TerraSAR-X Mission is performed by TerraSAR-X and TanDEM-X spacecrafts, each contributing a part of their imaging resources.
- In the case of the unavailability of one of the two satellites, the second system will ensure continuity of the TerraSAR-X Mission.

TanDEM-X Mission

- The TanDEM-X Mission is performed by TerraSAR-X and TanDEM-X in close formation flight, each contributing a part of their resources.
- The close formation flight of both satellites is continued beyond 2017.
- The acquisition planning beyond Sept 2017 was setup by DLR (see next slides)

Data products TerraSAR-X

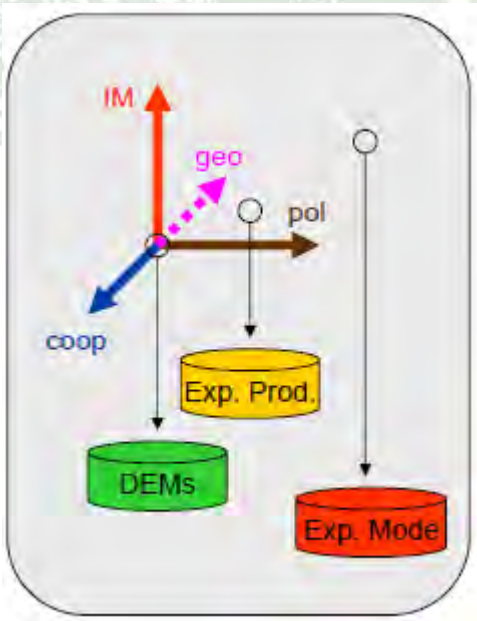
Staring SpotLight	High Resolution SpotLight	StripMap	ScanSAR	Wide ScanSAR
				
• Up to 25cm resolution • Scene size depending on incidence angle, for example ~ 4km (width) x 3.7km (length) at 60°	• Up to 1m resolution • Scene size 5 to 10km (width) x 5km (length)	• Up to 3m resolution • Scene size 30km (width) x 50km (length*)	• Up to 18.5m resolution • Scene size 100km (width) x 150km (length*)	• Up to 40m resolution • Scene size up to 270km (width) x 200km (length**)
Identification of objects	Recognition of objects (airplanes, hangars, vessels)	Detection & classification and monitoring of vessels and infrastructure Large scale mapping	Detailed maritime monitoring & detection Small scale mapping	Large area maritime monitoring of ship traffic, oil spills, sea ice

Data products TanDEM-X

- CoSSC
- DEM

DEM Product	Spatial Resolution	Absolute Horizontal Accuracy, CE90	Absolute Vertical Accuracy, LE90	Relative Vertical Accuracy (90% LE point-to-point within an area of 1°x1°)
TanDEM-X DEM				
TanDEM-X DEM	**~12 m (0.4 arcsec @ equator)**	**<10 m**	**<10 m**	**2 m (slope ≤ 20%) 4 m (slope > 20%)**
TanDEM-X DEM (1 arcsec)	~30 m (1 arcsec @ equator)	<10 m	<10 m	
TanDEM-X DEM (3 arcsec)	~90 m (3 arcsec @ equator)	<10 m	<10 m	

- Experimental modes
  Acquisitions in “4D mode space”:
  - Imaging Mode SM, SL, HS, SC, (DRA-ATI, …)
  - Polarization Mode Single, Dual, Twin, DRA-Quad
  - Cooperative Mode bistatic, alternating bistatic, pursuit monostatic, none (TS-X mission)
  - Formation Geometry:
    - small or large along & across track
    - separation / baseline



TerraSAR/TanDEM-X Mission

Data provision procedures

- TSX-Data **Archiv data**: TerraSAR **Archive AO** (no costs, open unlimited)
- TSX-Data **New acquisitions**: TerraSAR **General AO**
- TDX-DEM: **General AO (**TDX-**Final-DEM AO closed)**
- **General AO COFUR Costs for GFOI R&D group be waived** if DLR SDCG PoC is contacted before AO-proposal submission
- **New TanDEM-X acquisitions** ongoing, e.g. for forest monitoring.
- **Global 90m DEM:** Final discussions on open release conditions (German Data Security law) ongoing

TanDEM-X
Current and Future Obseravtion scenario

Sept 2016 – Sept. 2017: focus on areas with high dynamics and local height changes:

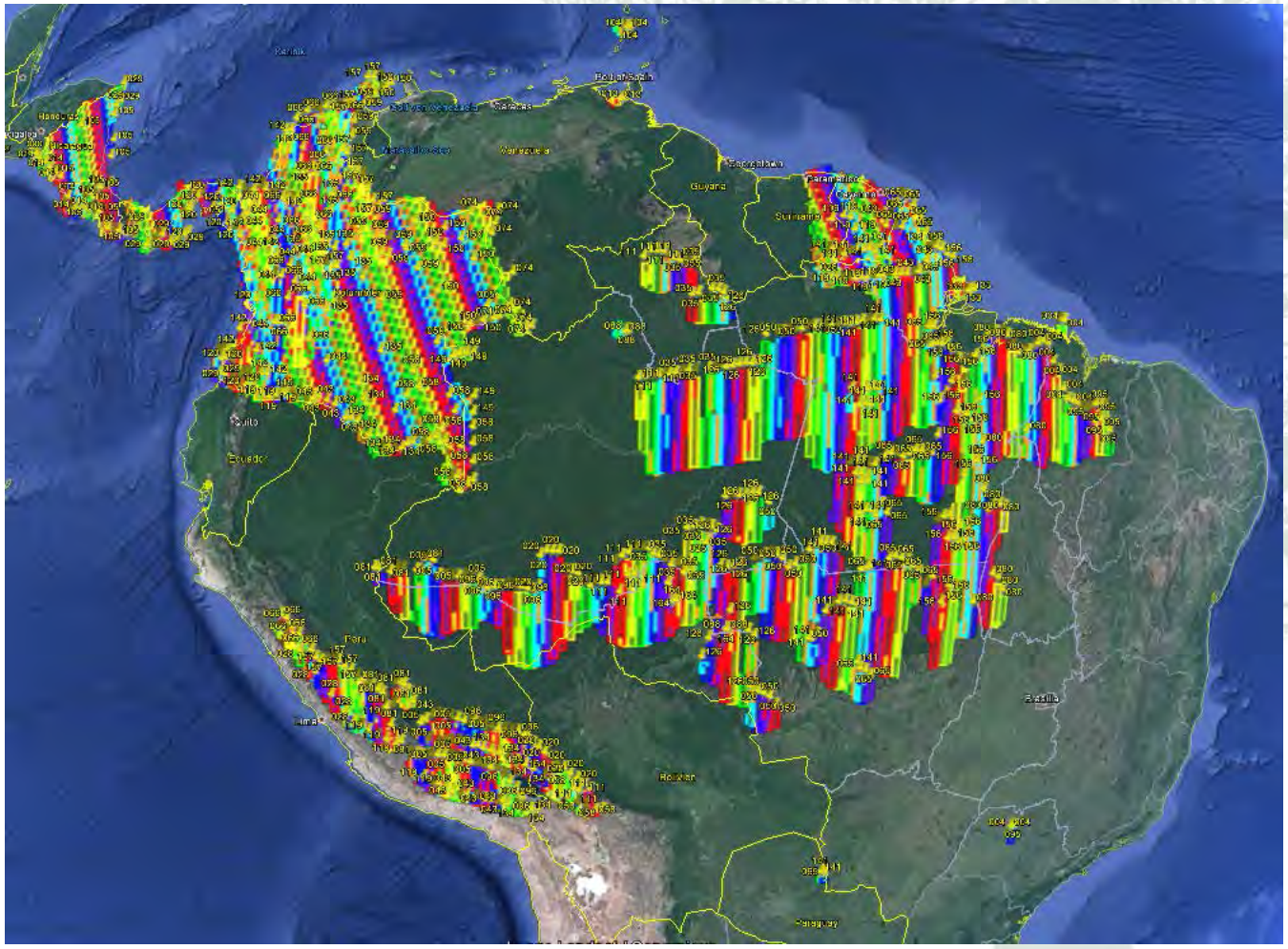
- Permafrost Boreal, Arctic & Antarctic
- Global Volcanos / Sahara
- (Sub-) Tropical Forests

Oct 2017 – Oct 2020

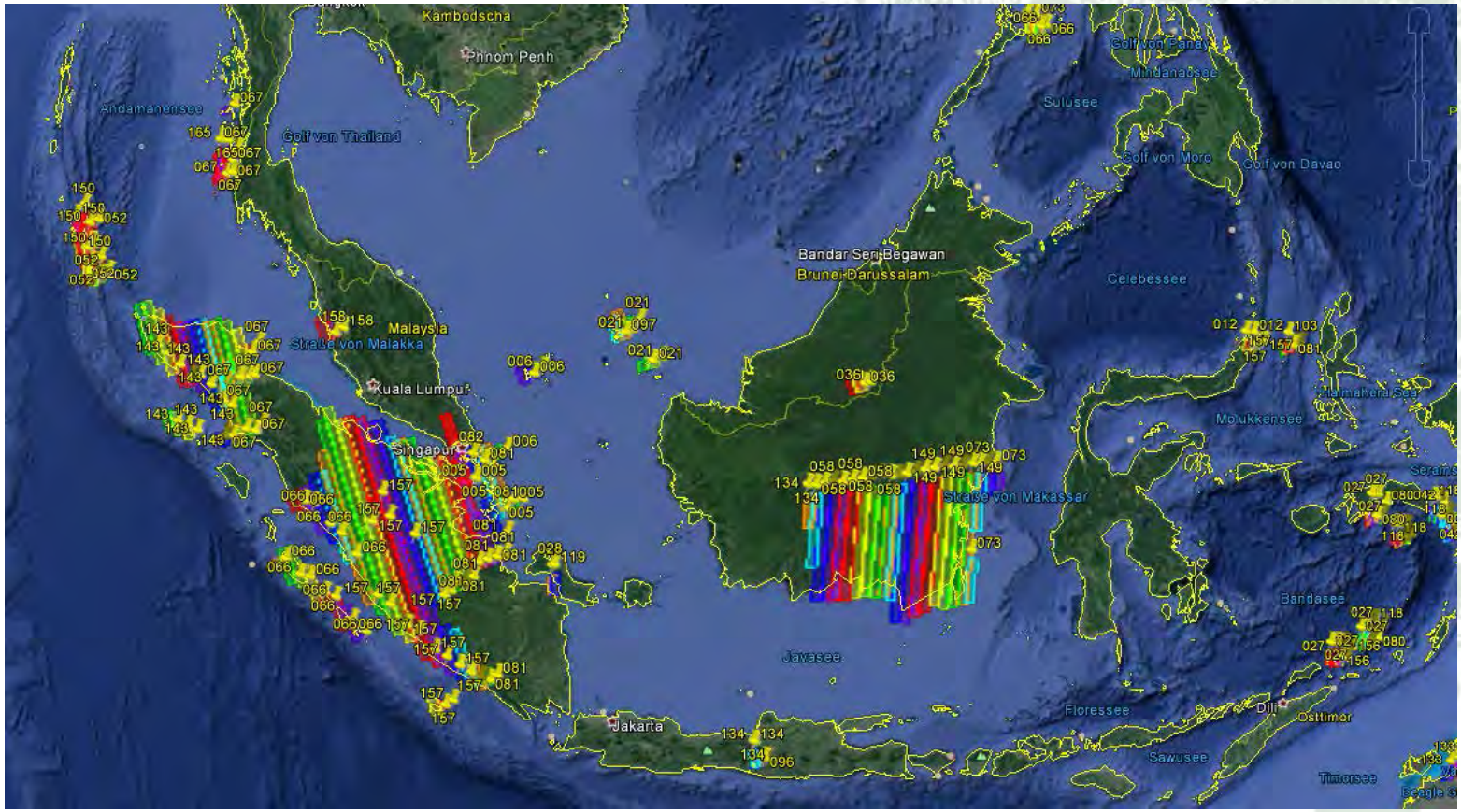
- Global DEM 2.0 (2010 – 2020)
- Change DEM 1.0 (2017-2019)
- Acquisition with a second baseline for tropical forest
- Tropical and moderate/boreal Forest aquisitions continue..

TanDEM-X: South America 9.2016 - 9.2017

Nicaragua
Costa Rica
Panama
Colombia
Peru
Brazil
French- Guayana



TanDEM-X: South-ASIA 9.2016 - 9.2017



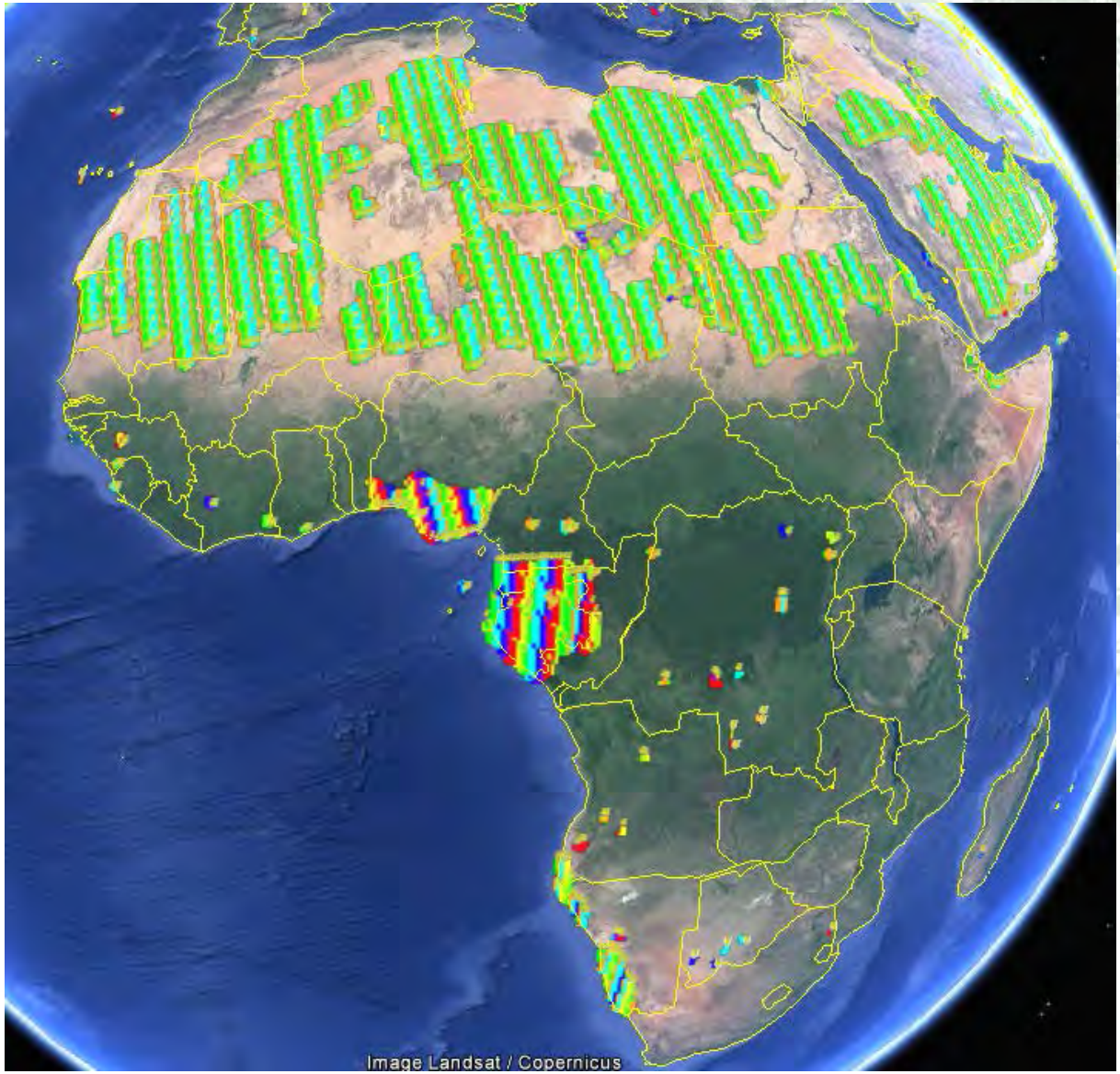
Sumatra

Borneo

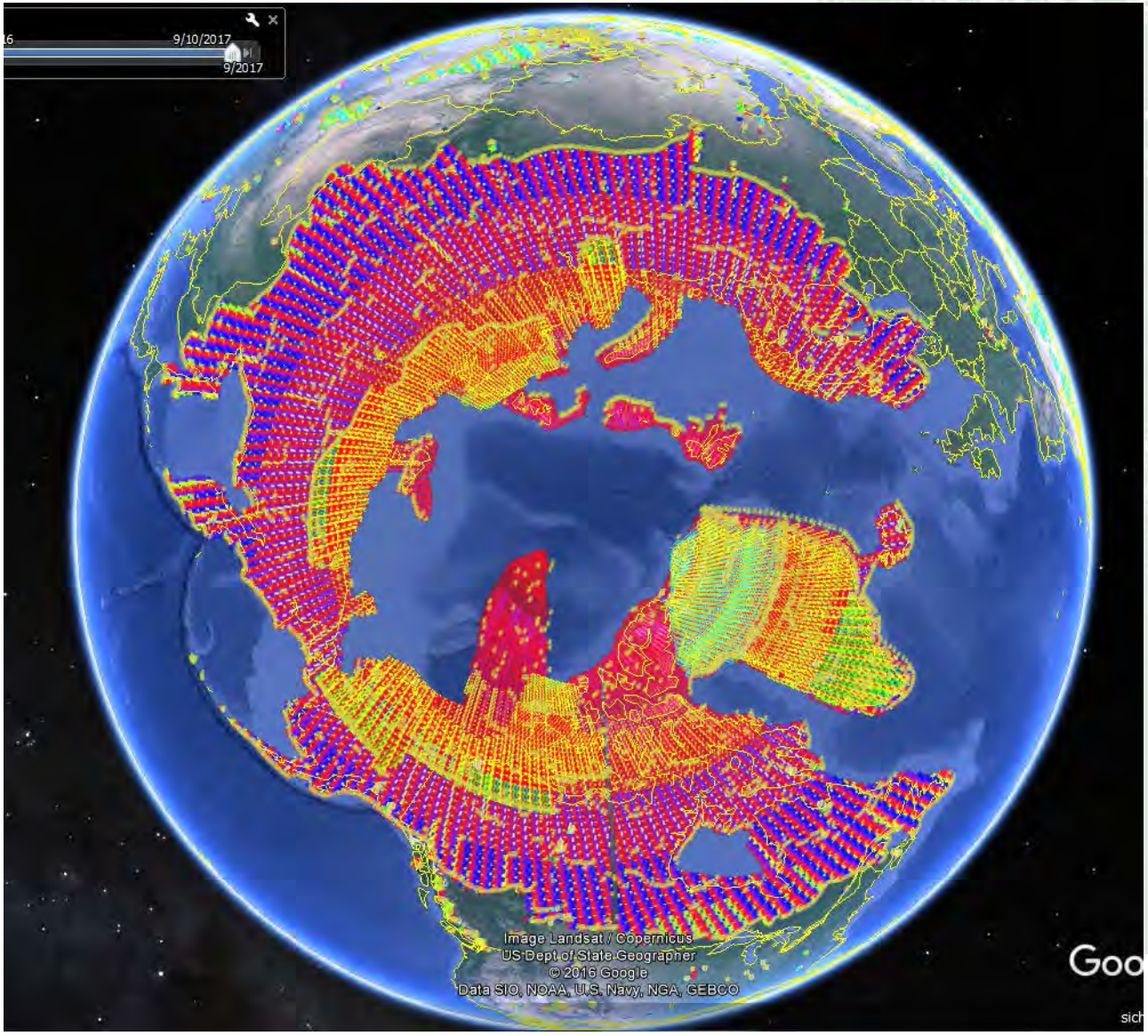
TanDEM-X: South-ASIA 9.2016 - 9.2017

TanDEM-X: Africa 9.2016 - 9.2017

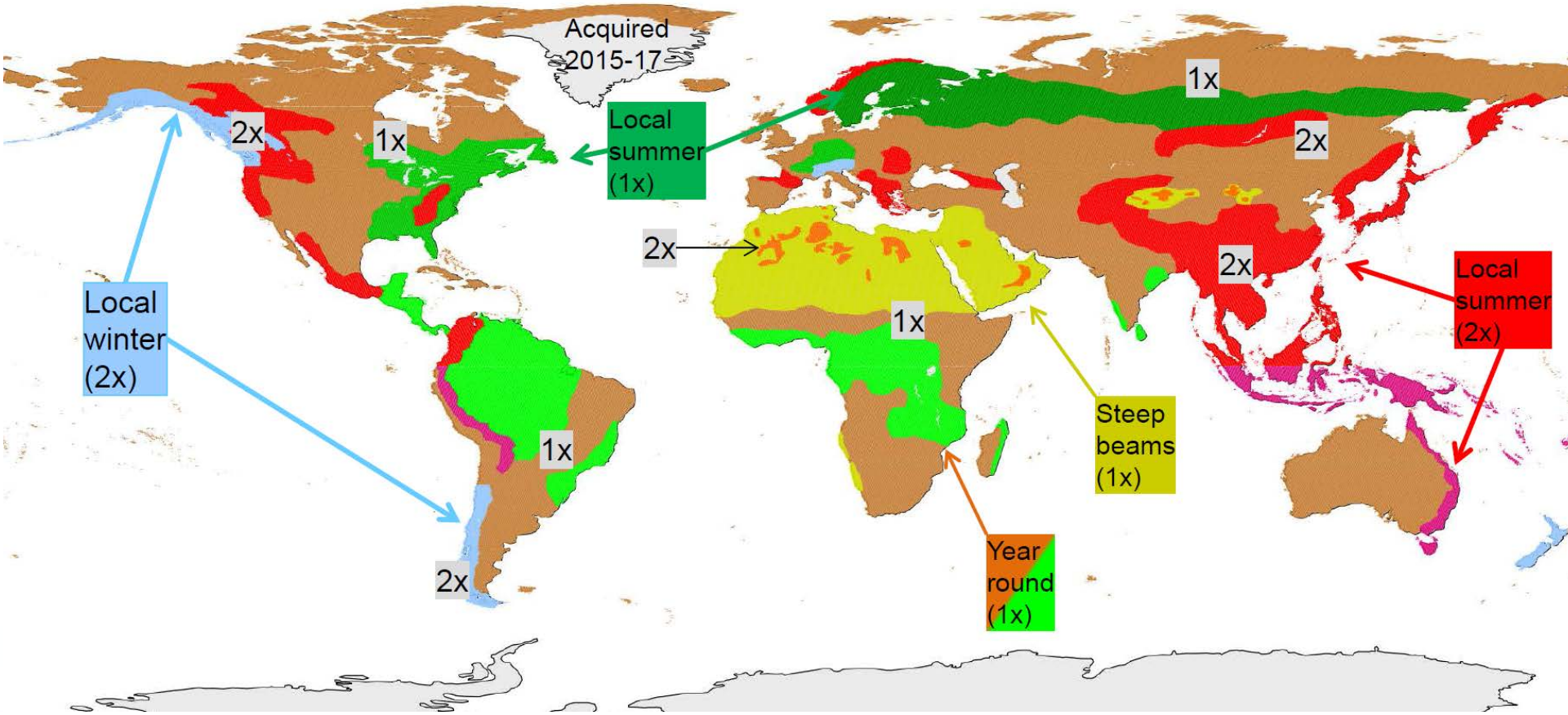
Gabun
Nigeria



TanDEM-X: Boreal & Arctic 2017



TanDEM-X
Observation scenario from Oct 2017 – Oct 2020



TerraSAR/TanDEM-X Mission

Approved support

- By E3 doc 11 R&D groups have requested data from TSX/TDX mission(s) as per Element-3 doc v2.1.

- DLR will continue to support **R&D groups** with TSX/TDX data (new acquisitions and/or from archive) **using Standard AO procedures**

- **Feedback from R&D groups remains of great interest for DLR.**

DLR R&D grants to GFOI R&D teams

Support to research GFOI R&D groups

R&D Team	Nr.	Scientific Focus	Sensors used	Region
HU & FU Berlin (P. Hostert, B. Waske)		*SENSE CARBON: Improved mapping of REDD+ using deep and dense time-series and large area compositing approaches*	*Landsat, Rapid Eye, ASAR, TSX, Sentinel-1 /-2*	*Brazil Mato Grosso*
FSU Jena, (C. Thiel)		SEN4REDD: Development of integrated multi-temporal Processing chain for Sentinel-1 und 2 data to REDD support	Sentinel-1 Sentinel-2	Mexiko, South Africa

Support to SME & industry GFOI R&D groups:

R&D Team	Nr.	Scientific Focus	Sensors used	Regions
Airbus DS / Univ. Hamburg		*Development of a cost efficient REDD+ Monitoring -concept by use of TSX/TDX and Sentinel-2*	*TSX/TDX Sentinel-2*	*Suriname Indonesia Ghana*
RSS (Florian Siegert)		Estimation of forest height and biomass using multipass X-and C-Band POL-INSAR data (CSA parallel support to AUG Signals)	TSX/TDX Radarsat-2 Sentinel-1	Indonesia

Project Factsheets: ***http://www.dlr.de/rd/desktopdefault.aspx/tabid-4285/6899_read-45464/***

CEOS WG CAPD SAR Capacity Building

DLR & SAREDU support CEOS WG CAP-D Regional Africa Workshops including forest and biomass topics

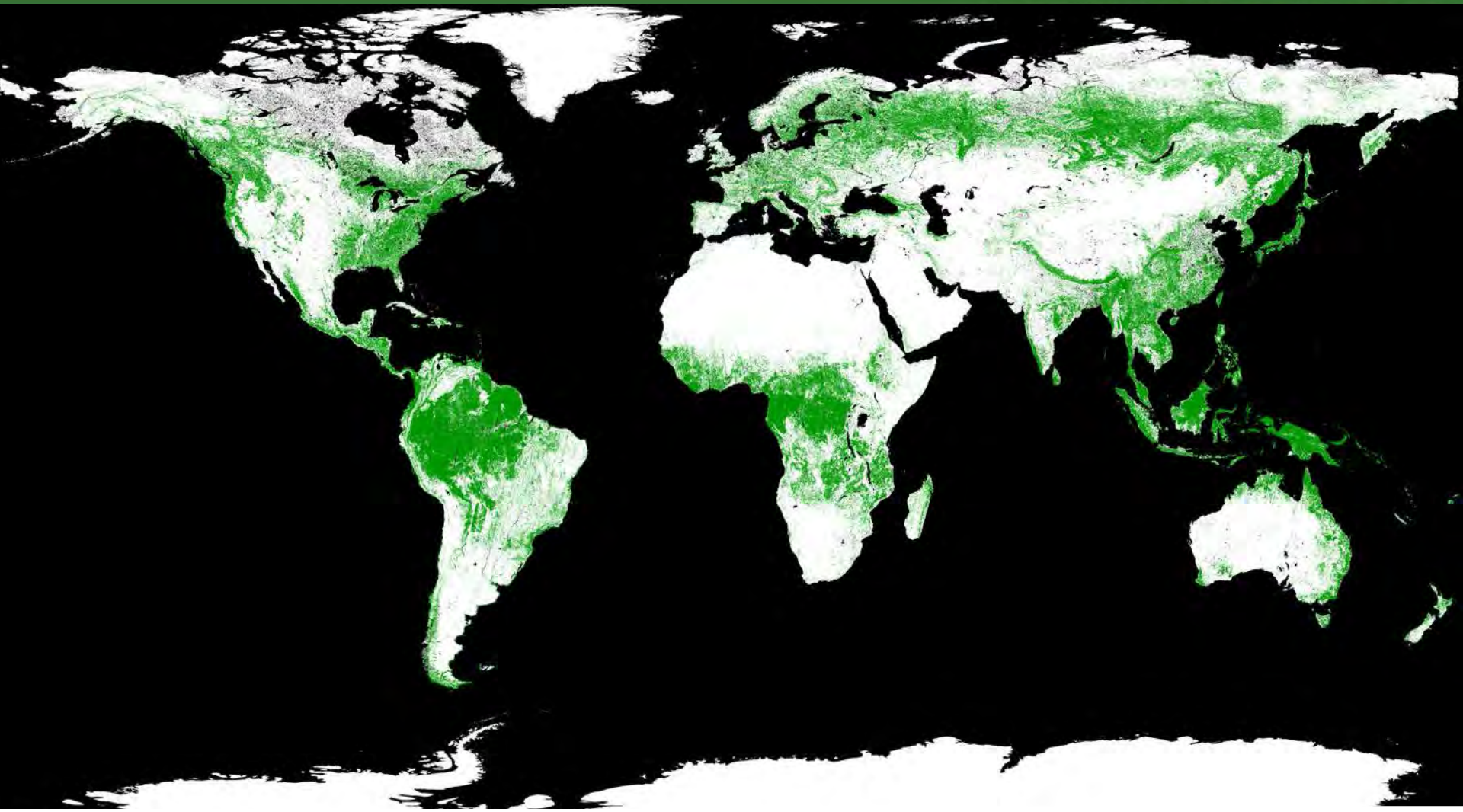
- ***Zambia, Lusaka Oct. 2016***
- ***Gabon, Libreville Feb. 2017.***

Training on Synthetic Aperture Radar (SAR) satellite imagery use in Gabon

The 3rd Synthetic aperture radar (SAR) workshop - coordinated by the CEOS Working Group on Capacity Development and Data Democracy (WGCapD), supported by UNOOSA through its UN-SPIDER Programme, the European Commission (Copernicus Programme) and ESA, and hosted by Gabonese Space Agency (AGEOS) - took place in Libreville, Gabon, between 20 and 24 February. The aim of this and two previous such workshops is to build specific capacity and a good understanding of how to process and analyze SAR imagery for participants in West Africa, East Africa and SADC countries.

South Africa, Pretoria May 2017 ISRSE SAR Summer school included a specific REDD session .

Global TanDEM-X Forest/Non-Forest Map



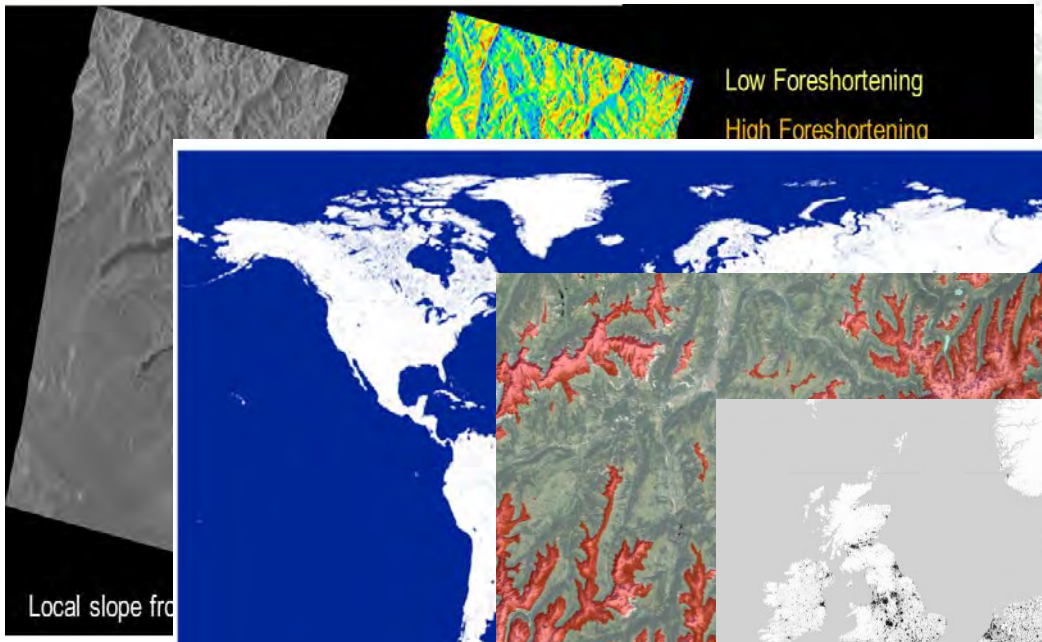
Paola Rizzoli, Michele Martone, Christopher Wecklich, Carolina Gonzalez, José-Luis Bueso-Bello, Gerhard Krieger, and Manfred Zink
Microwaves and Radar Institute, German Aerospace Center (DLR)

Final product resolution of 50 m x 50 m

Binary (forest/non-forest) information

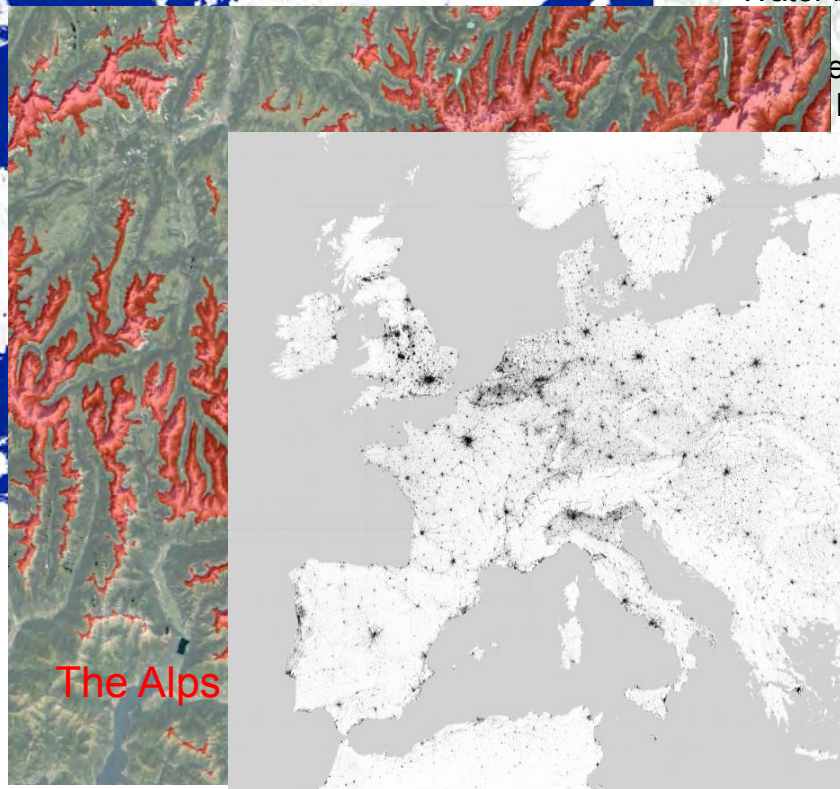
Will be available for free for scientific purposes

Additional Layers



Climate Change Initiative (CCI) by the ESA

- Water bodies at 150 m x 150 m resolution based on data ed by Envisat ASAR

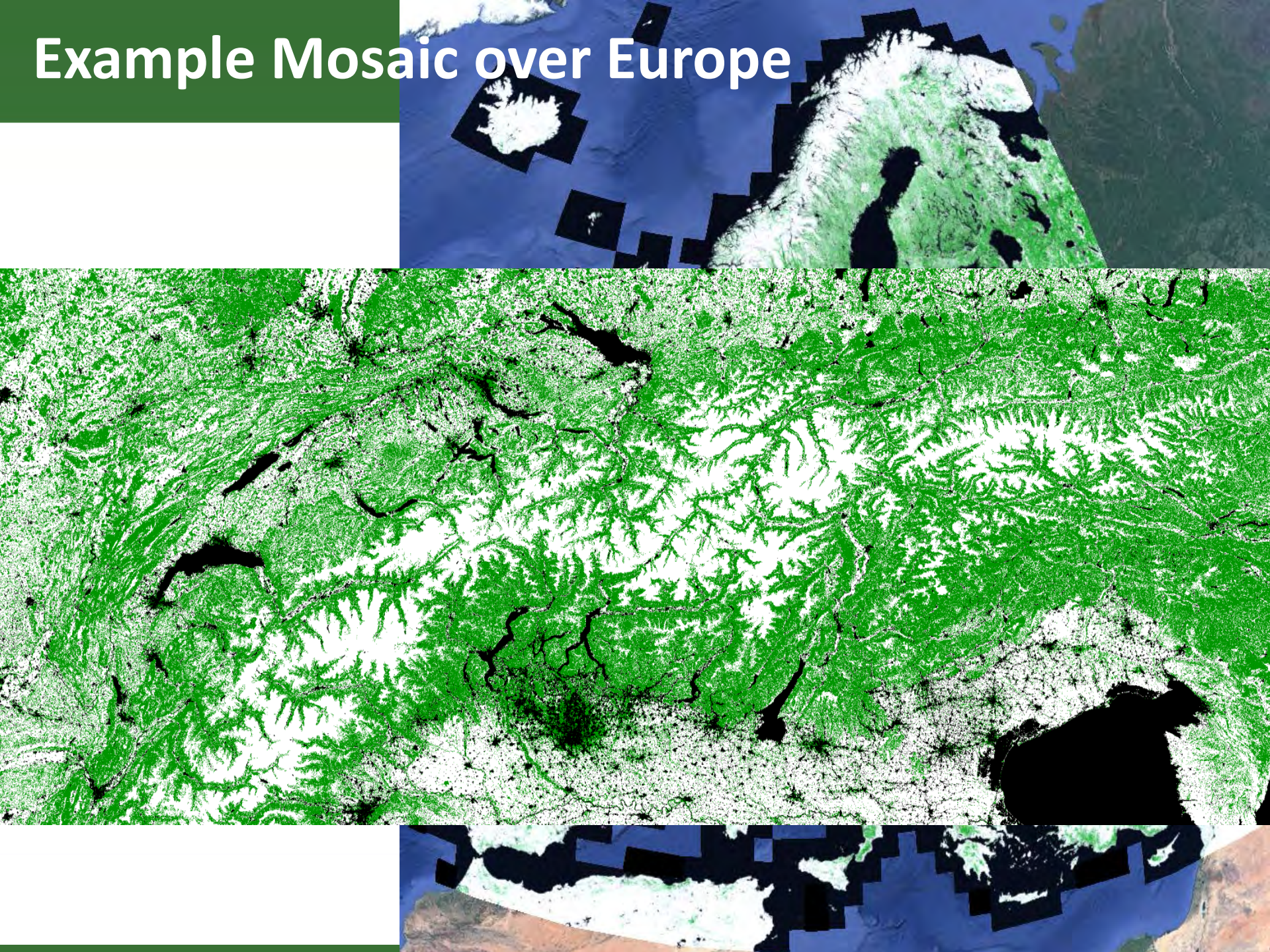


Tree-line Mask:

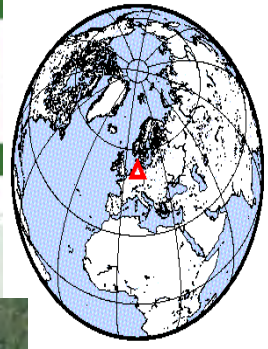
- Derived by combining TDX DEM and GLOBCOVER classification map (ESA)

TanDEM-X GUF (Copyright DLR-DFD)

Example Mosaic over Europe



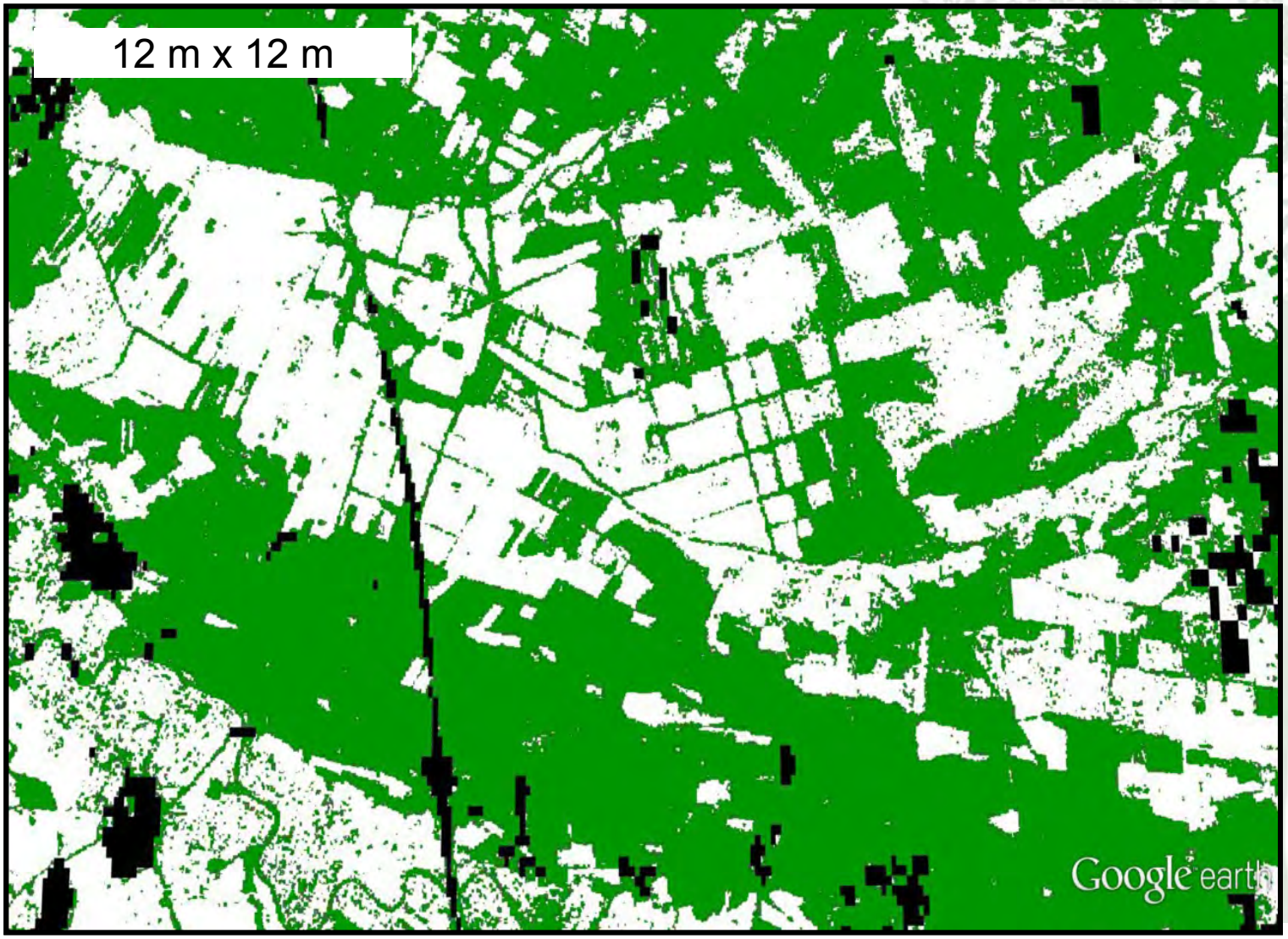
Forest/Non-Forest Classification – Quicklook Image



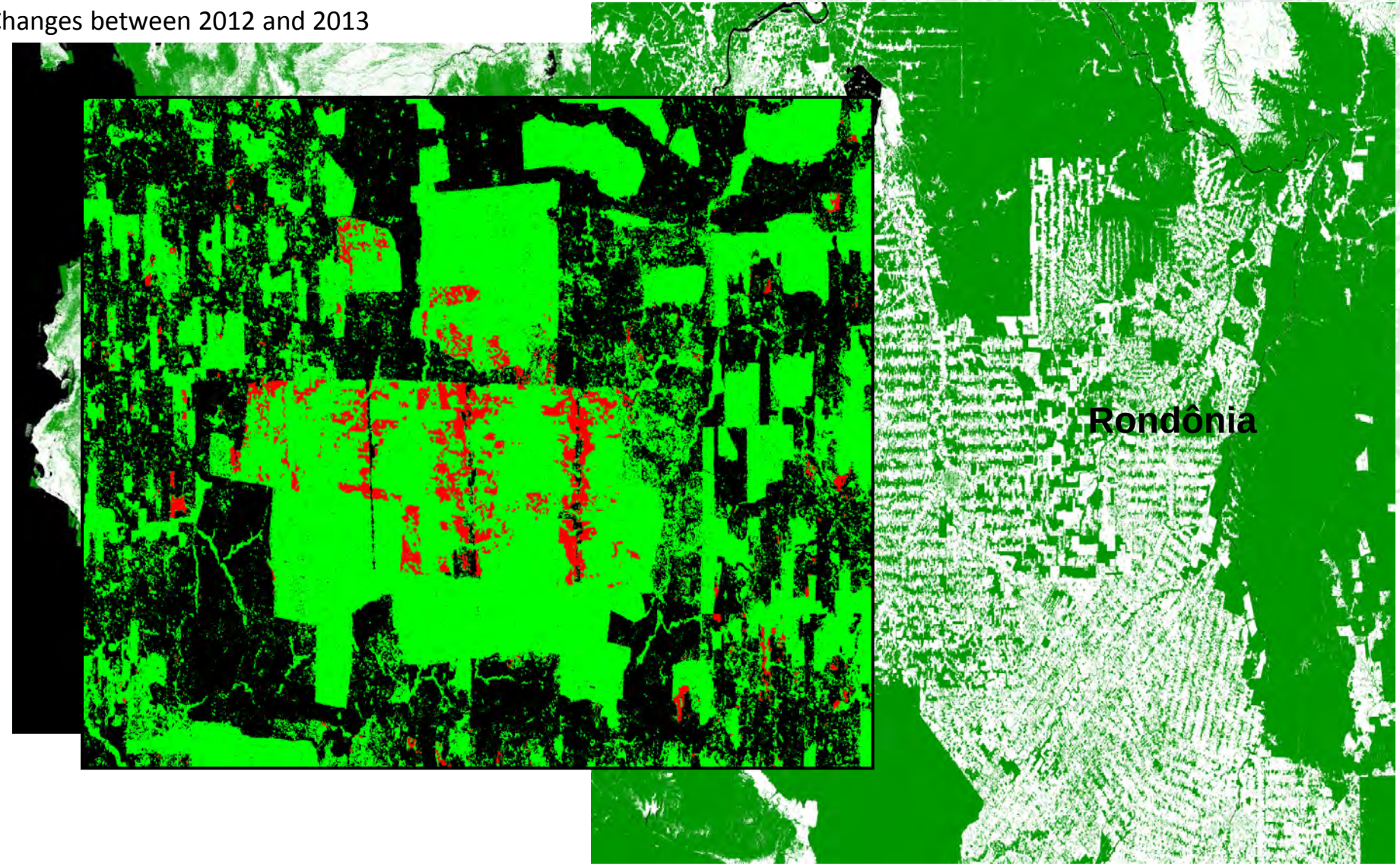
Temperate Forest, Germany, (50 m resolution)

Optical Image

High-Resolution Maps at Regional Scale



Potential for Change Detection

Deforestation in the Amazon Rain Forest – Rondonia State

Changes between 2012 and 2013