Tandem-L: A Mission Proposal for Monitoring Dynamic Earth Processes

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German Aerospace Center (DLR)
The terrestrial carbon is the greatest unknown in the carbon cycle.
Forest and Carbon
Biomass and the spatial distribution of carbon
(50% of the biomass is Carbon)

Global biomass distribution and its dynamic are widely unknown!

Amazon basin
... the estimation ranges from 39 to 93 GtC
3-D Structure Mode

Polarimetric Backscattering

3-D Forest Structure

Forest height and Biomass

Tomography

Polarimetric SAR Interferometry (Pol-InSAR)
Forest Height Estimation (3D Structure Mode)
Traunstein Test Site

- Forest type: Temperate
- Topography: Moderate slopes
- Height: 25 ~ 35m
- Species: N. Spruce, E. Beech, White Fir
- Biomass: 40 ~ 450 t/ha
Biomass Estimation from Height + Structure

- Profile Decomposition (Series Expansion)

- Example (Testsite Bayerischer Wald)
Three Legendre polynomials explain the 92% of the total biomass !!!
Dynamic Processes on the Earth Surface

**Biosphere**
- Deforestation, Degradation, Fires* (REDD)
- Forest Biomass Change*
- Biodiversity

**Geosphere**
- Earthquakes
- Volcanic Activities
- Land Slides

**Cryosphere**
- Sea Ice Extent*
- Permafrost*
- Glacier & Ice Cap Dynamics*

**Hydrosphere**
- Soil Moisture*
- Flooding
- Ocean Currents*

*) Essential Climate Variables

**Observation Interval**
- Days
- Weeks
- Months
- Years
Deformation Mode

Earthquakes

\[ \frac{\lambda}{2} \approx 12 \text{ cm} \]

Volcanoes

\[ \Delta \phi \rightarrow \text{measurement of deformations of mm – cm} \]

Subsidence

Land & Sea Ice

systematic multi-temporal acquisitions (image stacks)
Cryosphere: Ice Motion and Topography of Glaciers

**ICESAT**
- 15 km track-distance at equator

**CryoSAT-2**
- 15 km x 250 m spatial resolution

**GRACE**
- > 200 km spatial resolution

**TanDEM-X**
- 1 year for global coverage

**Tandem-L**
- 3 – 10 m resolution
- weekly coverage

Tandem-L provides unique & complementary information:
- 3D Ice flow
- Ice Structure
- DEM
- weekly coverage, high resolution

Courtesy: Ian Joughin
Tandem-L provides unique & complementary information:

- soil moisture
- water level changes
- river & ocean currents
- weekly coverage & high resolution
Planar Array with Digital Beamforming

Reflector with Analog Beamforming

...at start of DLR/JPL collaboration
Digital Beamforming with Reflector Antennas

digital feed array with T/R modules
Digital Beamforming with Reflector Antennas

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Tandem-L: A proposal for a radar mission for environmental and climate change research

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Earthquakes
Volcanic Activities
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