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Linking in situ measurements with remote sensing in Level I and II ICP Forests network in Romania: Prototyping a national forest monitoring system

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Context

EO-ROFORMON (http://eo-roformon.ro/)
prototype a national forest monitoring and forecasting system based on the integration of active (radar) and passive (optical) Earth-Observation (EO) sensors calibrated with *in situ* data

The project aimed to differentiate forest defoliation caused by natural vs. anthropic disturbances by taking advantage of the temporal dimension of changes in the remote sensing signal from optical and radar data.

Thus, spatially explicit information on forest condition, logging extent, intensity and their timeline could become available.

Partners

CESBIO, Gamma RS, OSU - College of Earth, Ocean, and Atmospheric Sciences

Advisory Board

Thuy Le Toan, Ludovic Villard (CESBIO), M. Santoro (Gamma RS), R. Kennedy (Oregon State Univ.)

Workflow

- In situ monitoring data and preliminary analysis
- Earth Observation data processing and algorithm development
- Modeling and forecasting forest in the context of environmental and socio-economic changes
- A case study for prototyping a national forest monitoring system

Data / Process Requirements

IN SITU

- Forest structure
- Species traits
- Leaf sampling
- Environmental conditions
- TLS
- Spectral measurements

EO

- Sentinel 1 / 2
- ALOS PALSAR 1 / 2
- Landsat 5 / 7 / 8

MODELING

- µwave Simulations
- Radiative Transfer Model
- Landscape Change Model

SCALING

- ICP Forests network (Level I & II)
- LTER network

Results [I]

Forest Structure

- species composition
- dbh
- height
- tree position
- crown height and projection
- canopy cover
- growth

Leaf sampling

- leaf water content
- leaf area and thickness
- C/N ratio

Environmental conditions

- soil moisture
- soil humidity
- soil temperature
- air temperature

TLS

- dbh
- height
- tree position
- crown height and projection
- LAI
- stand and canopy structural indices
- phenology

Spectral measurements

- chlorophyll a + b content
- discoloration

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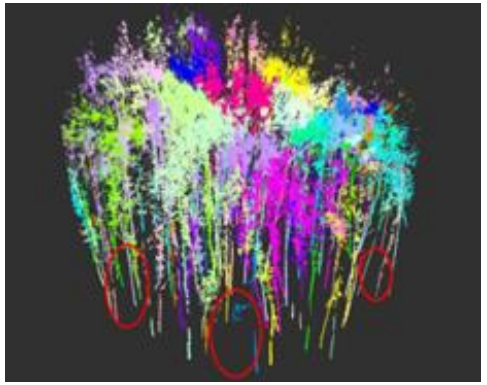
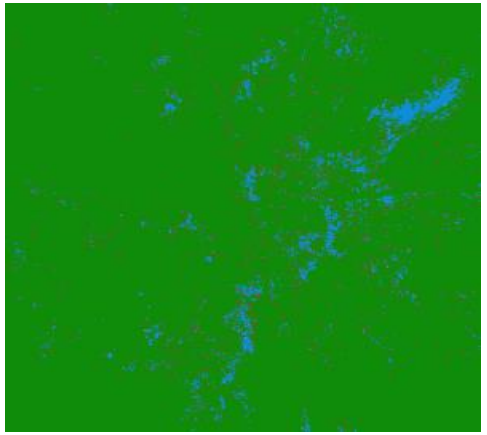
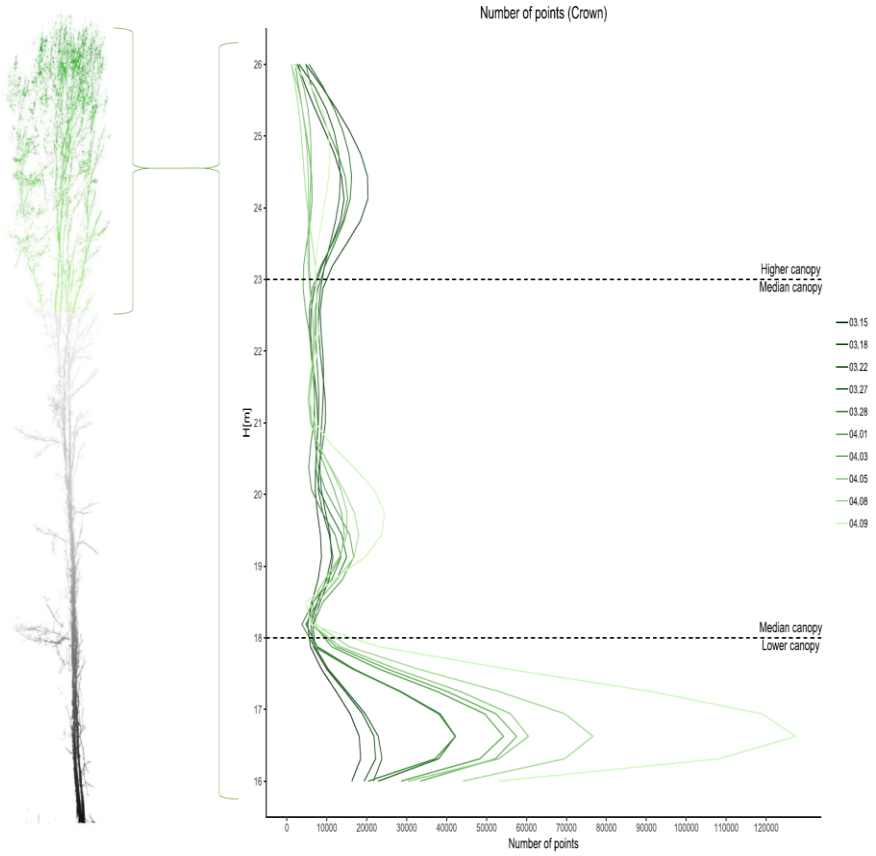
Results [I]







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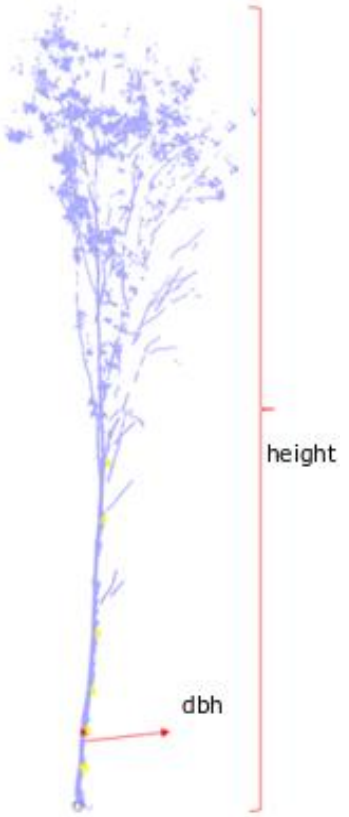


Results [II]

Sentinel 1

- scattering center height
- radar backscatter
- coherence

Sentinel 2

- optical reflectance
- spectral indices

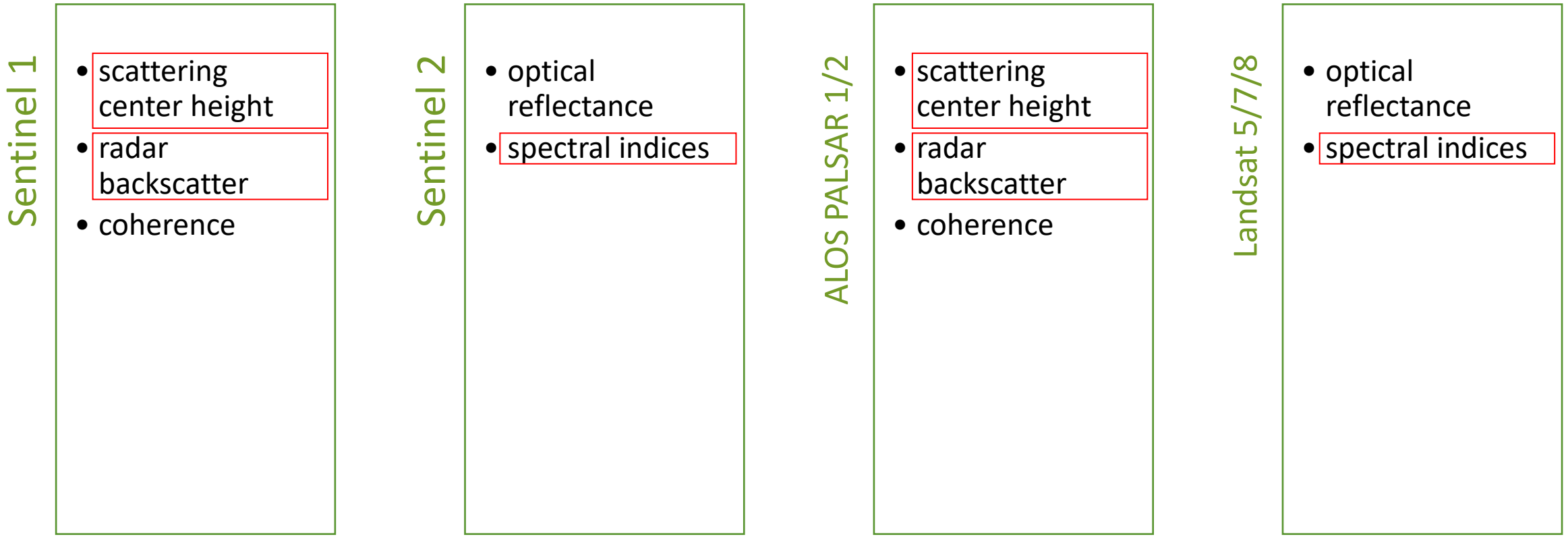
ALOS PALSAR 1/2

- scattering center height
- radar backscatter
- coherence

Landsat 5/7/8

- optical reflectance
- spectral indices

Results [II]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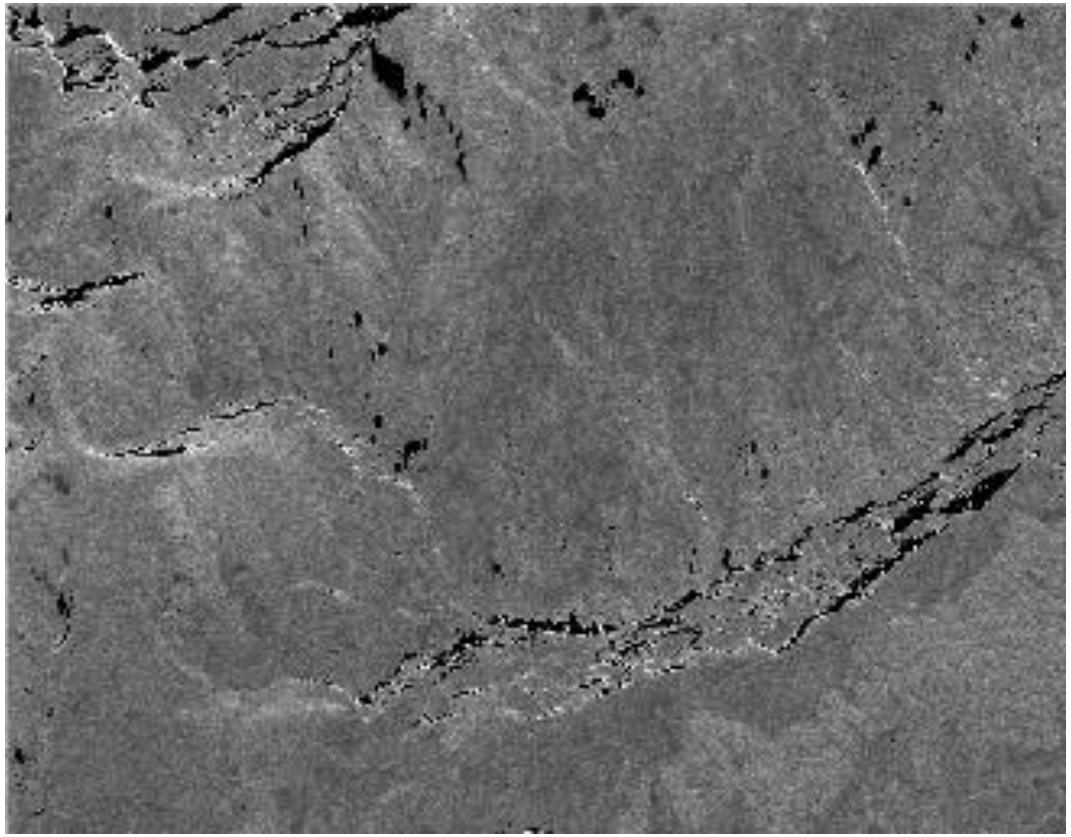
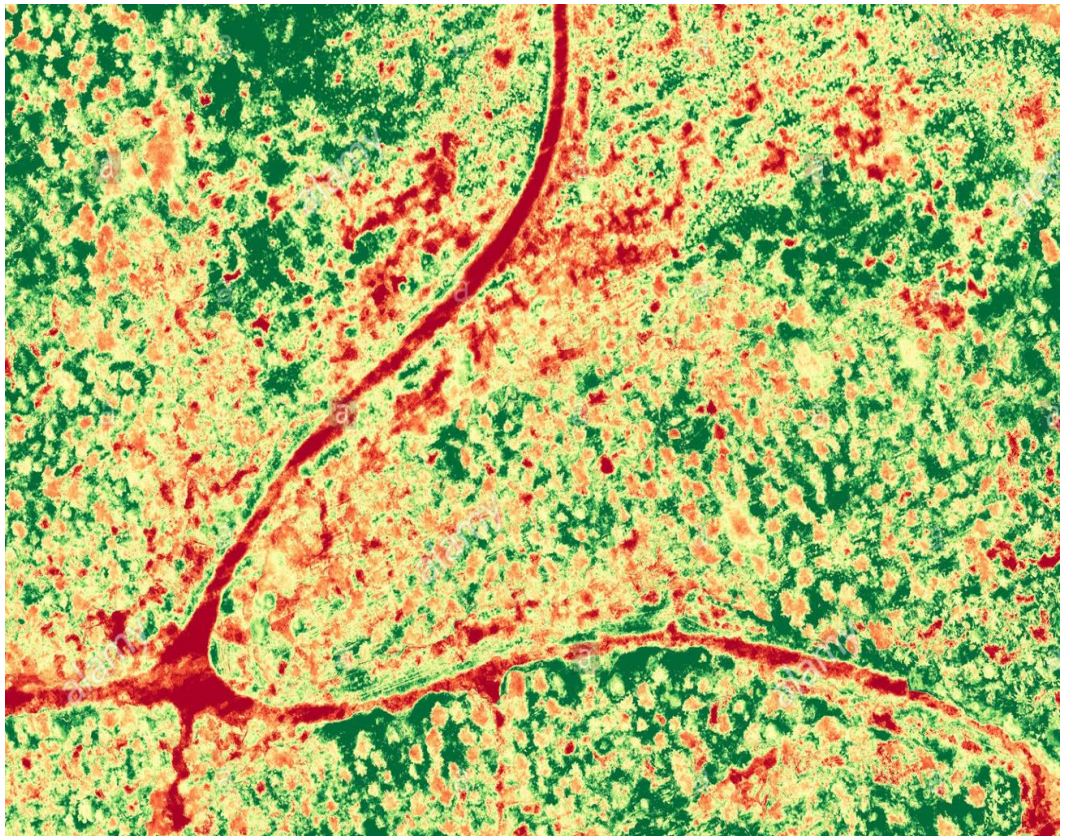
Results [II]

Sentinel 1 / ALOS PALSAR



Sentinel 2 / Landsat



Results [III]

µwave Simulations

- parametric models relating changes in forest properties to changes in remote sensing data
- simulate SAR data for different forest growth stages
- identification of the scattering components affecting SAR backscatter at different wavelengths (C-, L- and P-band)
- quantitative evaluation of biomass removal (canopy and trunk levels) on the SAR signal for different disturbance types and intensities
- evaluation of the influence of changed vegetation water content, foliage density, and forest structure (i.e., tree count), as well as their interactions, on the SAR signal

RTM

- simulate the optical spectrum for wavelengths relevant to Sentinel-2 and Landsat sensors
- Spectral libraries for classifications
- Forest status LUT

LCM

- Analysis of the shifts in forest species composition and abundance under Climate change RCP scenarios in Romanian temperate forests (including the effect of harvest and insect attacks) using Landis-II
- Assessment of stands resistance and resilience to insects attacks under different climate change scenarios using Landis-II
- Proposal for the Integration of Landis-II in forest management in Romania

ICAS
Pentru o gestionare durabilă a pădurilor

Results [III]

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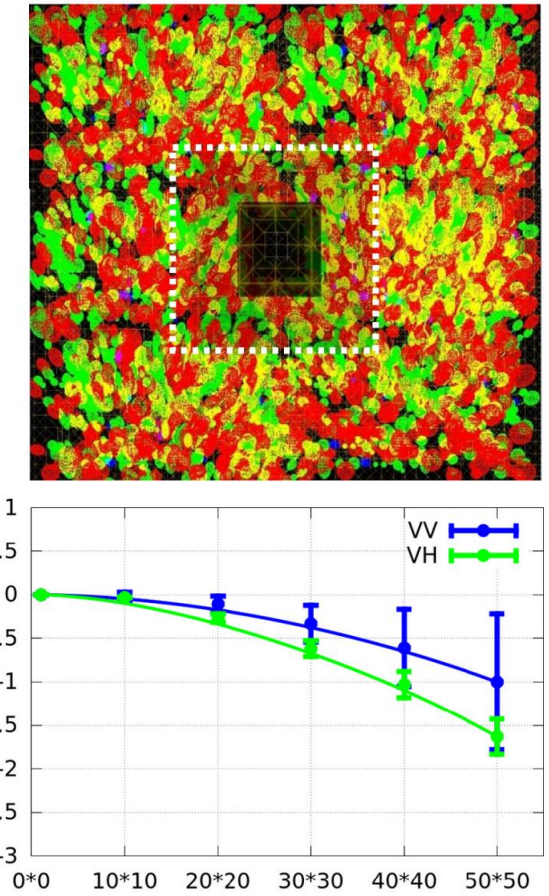

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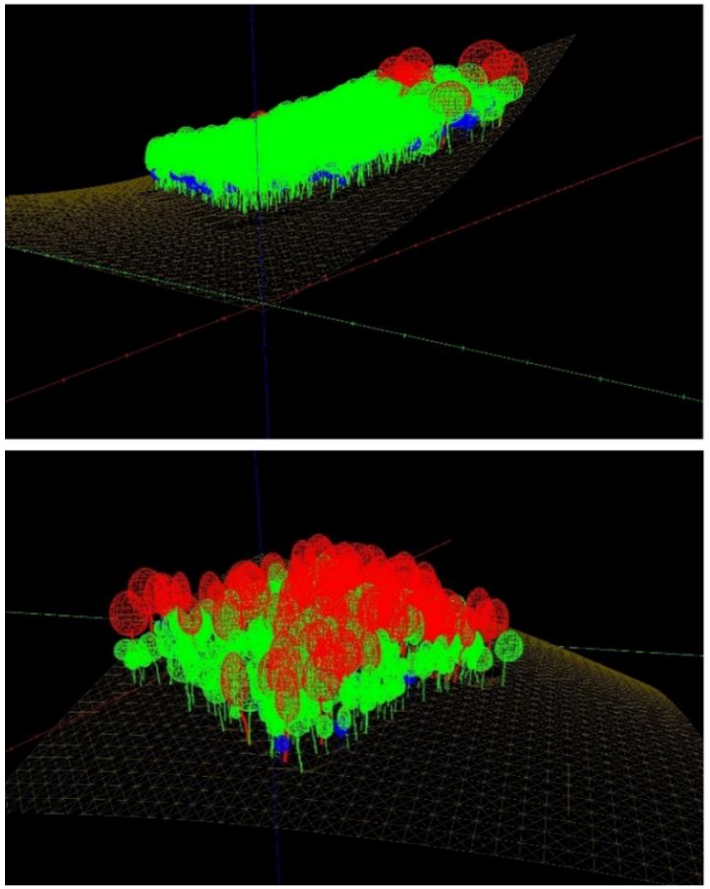
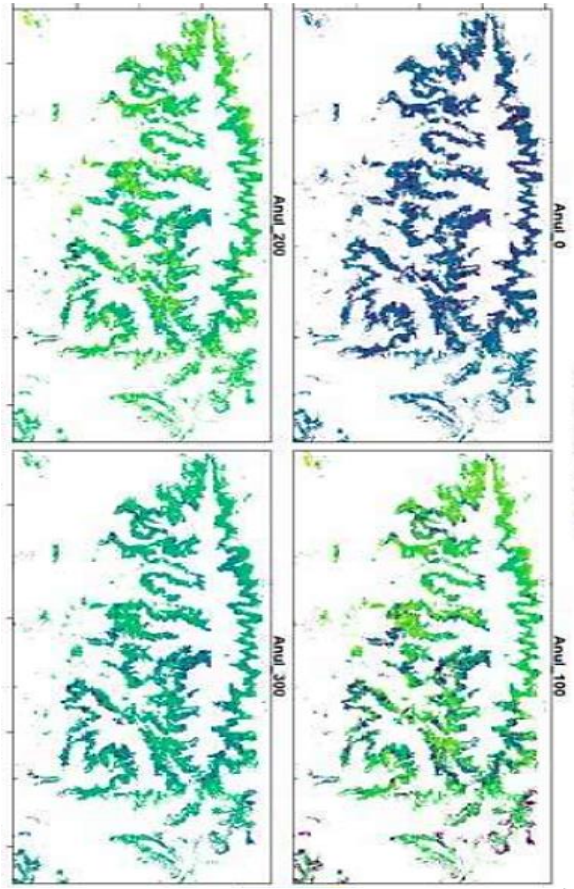


LCM



Strong Points

- Capability of covering by means of RS of over 50% of ICP Forests Level I and Level II surveys
- Extension of ICP Forests survey data by means of LUT referenced to optical and radar satellite data
- Increased temporal resolution
- Variable spatial resolution
- Endless revisiting capabilities
- Objective analysis
- Broad perspective over the studied area
- Ongoing development towards new, both close range and satellite RS sensors

Limitations & Overcoming Drawbacks

- SAR C band sub optimal
- Single wavelength TLS

- Air quality

- Litterfall
- ICP individual base analysis

- Focus on X band
- Combine with already on orbit LiDAR satellite data
- Extend out of the main stream satellite constellation
- Calibrated TLS scans
- Individual base modelling

Achievements

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Achievements

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B Nguyen Tran, M. A. Tanase, L.T. Bennett, C. Aponte, 2020, Are High Severity Fires Increasing In Southern Australia?, IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Sept. 26 – Oct. 2, Virtual Symposium.

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