

ROSE-L (Radar Observation System for Europe in L-band)

11th Advances Training Course on Land Remote Sensing

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→ THE EUROPEAN SPACE AGENCY

Radar Observation System for Europe in L-band

Copernicus Expansion missions

- Respond directly and traceably to Copernicus user needs
- Provide new information not yet available through current Sentinel missions (**Gaps**)
- Provide enhanced information in combination with current Sentinels (**Enhanced continuity**)

Will in particular augment the current and future Copernicus C-band SAR missions (Sentinel-1) by means of a **synergistic acquisition plan**

HIGH-PRIORITY CANDIDATE MISSIONS

ROSE-L

L-Band Radar for Arctic and Cryosphere Monitoring, Land and Emergency Mapping, Ground Motion, Soil Moisture

CO2M

Carbon Dioxide Monitoring

CRISTAL

Polar Ice & Snow Topography Altimeter

CHIME

Hyperspectral Imaging

LSTM

Land Surface Temperature

CIMR

Imaging Microwave Radiometer

GENERAL

- ❖ Constellation of 2 satellites (PFM & FM2) + options under study
- ❖ Consortium led by Thales Alenia Space Italy (TAS-I), involving 29 companies from 15 countries
- ❖ Service continuity with Sentinel-1 FG and NG

COVERAGE

- ❖ Coverage of Global Land (excl. Antarctica) and Arctic
- ❖ Revisit with 2 satellites :
 - 6 days Global Land
 - 3 days Europe
 - 1 day Arctic
- ❖ Repeat cycle of 6 days over Global Land (2 satellites)

PROGRAMMATICS

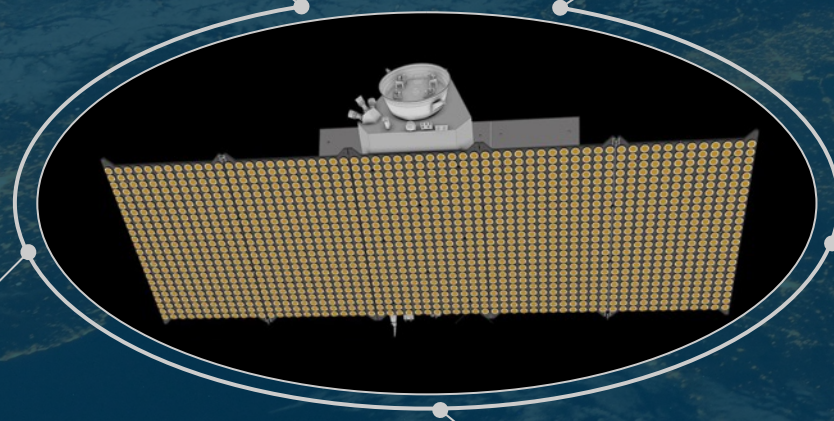
- ❖ Currently reaching end of Phase B2
- ❖ Science Plan activities start in 2022
- ❖ Launch of PFM expected in 2028
- ❖ FM2 delivery expected in 2030

IMAGING

- ❖ L-Band – 85 MHz ITU allocated band (1.215-1.300 GHz)
- ❖ Dual-Pol and Quad-Pol modes
- ❖ Wave mode capability
- ❖ Resolution < 50 m2 (Dual-Pol)
- ❖ NESZ < -28 dB
- ❖ DTAR < -23 dB
- ❖ Swath width > 250 km

SYSTEM

- ❖ Synergic acquisitions with Sentinel-1: co-located swaths and support to convoy configuration
- ❖ Low latency
 - 10 min Europe coastal waters
 - 200 min Global
- ❖ Enable companion for single-pass Interferometry



ROSE-L Objectives and Services



Geohazards Monitoring

- Deformation
- Landslides
- Urban subsidence
- Flooding



Land Use, Agriculture and Forestry

- Forest biomass and structure
- Land over and land cover change
- Agriculture



Soil Moisture

- High-resolution soil moisture



Cryosphere and Arctic

- Sea ice characterization
- Ice sheets and glacier velocity
- Grounding line
- Snow water equivalent
- Permafrost thawing and extent



Marine Monitoring

- Ocean surface wind vectors
- Swell properties



Maritime Monitoring

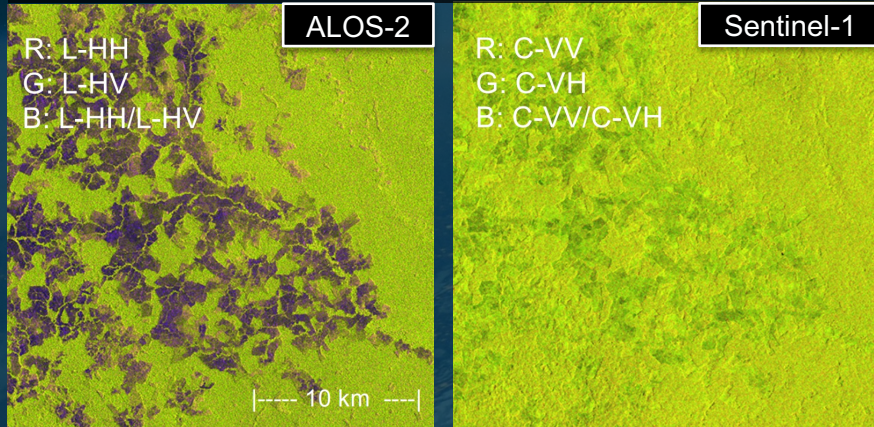
- Iceberg location, size and drift
- Vessel location, size and velocity
- Oil spill location and morphology



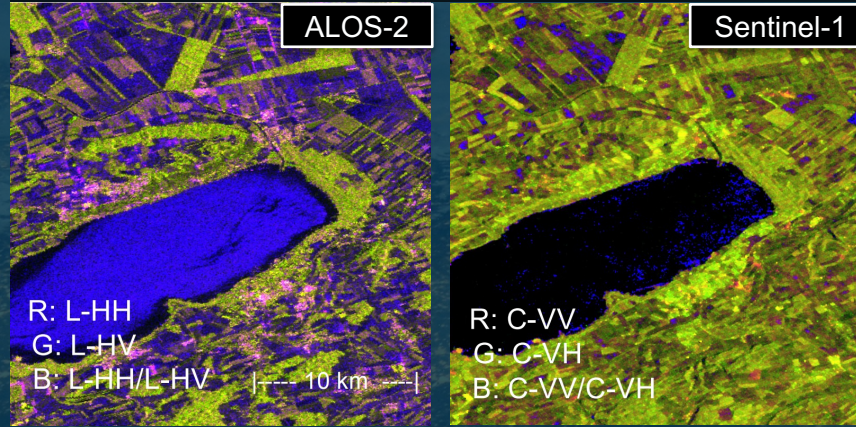
Meteorology and Hydrology Services

National and Local Authorities

Tropical forest conversion to mix of secondary growth and other land uses



Mixed agriculture area (Germany)

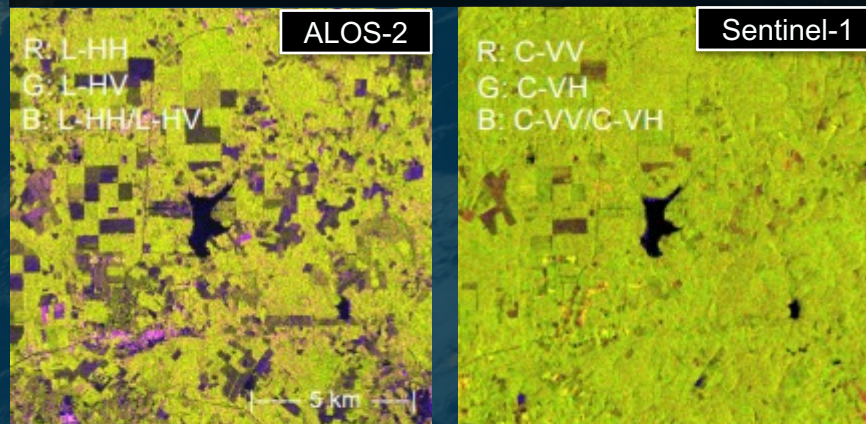


- **Improved Land Use / Land Cover mapping** in combination with Sentinel-1, exploiting the complementary sensitivity

REQUIREMENTS

- Revisit (6 days Global, 3 days Europe)
- High resolution
- Enable SP-InSAR capability for forest height

Rubber plantation, Vietnam
Patchwork forest stands at different ages



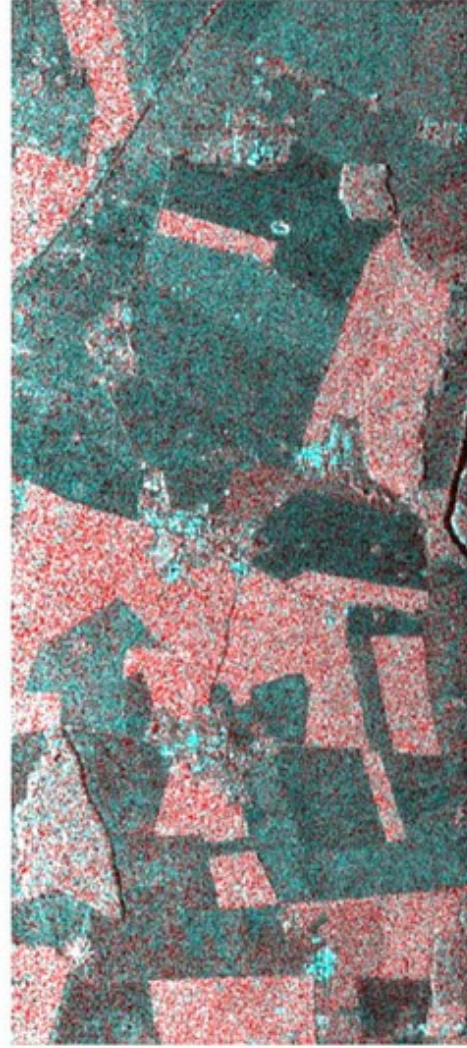
Source:
https://ceos.org/document_management/SEO/Data/Cube/Laymans_SAR_Interpretation_Guide_2.0.pdf



E-SAR standard (8 looks)



S1 SM [~S1-NG] (4 looks)



S1 IWS (4 looks)

Lower NESZ (-26 dB)

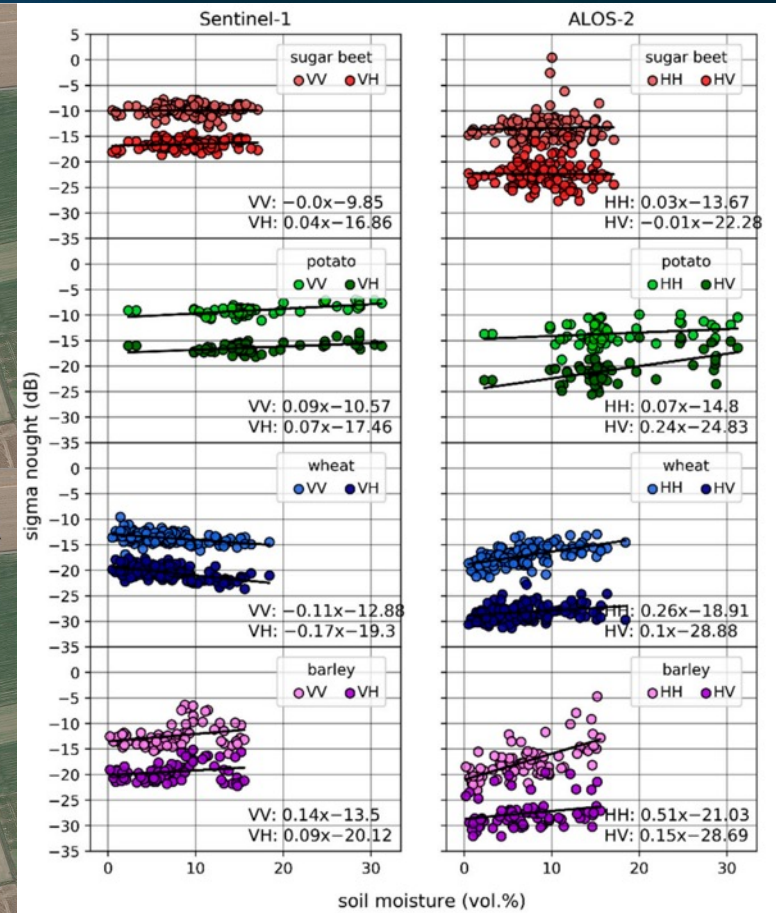
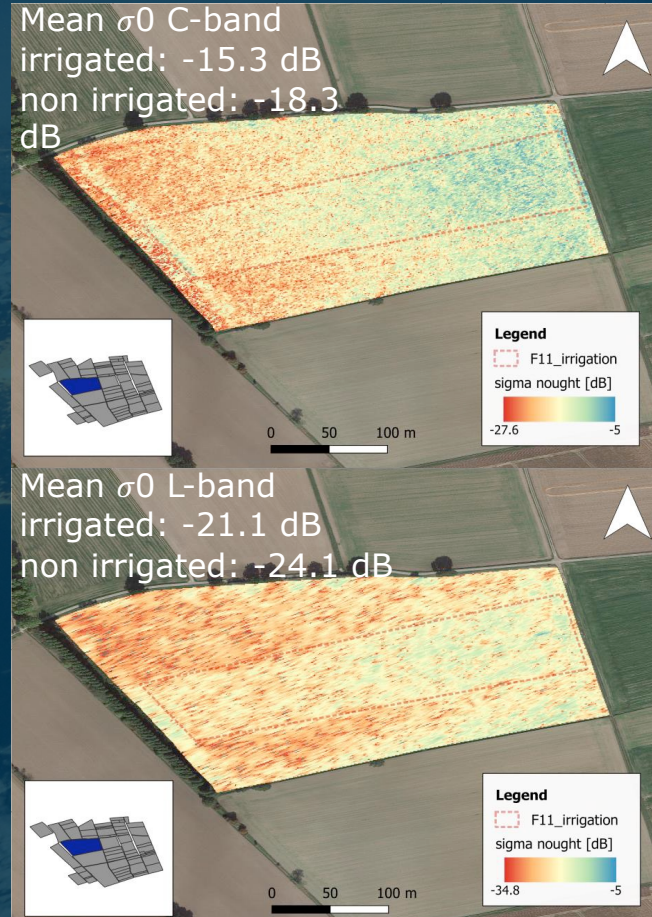
will further enhance mapping and characterization of weak scatterers (benefits in soil moisture, oil spills, sea ice mapping, etc...)

E-SAR data for ESA AgriSAR campaign with Sentinel-1 simulation in stripmap and IWS mode. Color coding is RGB: HV-HH-HH. Stripmap resolution is the same as S1-NG, although with higher NESZ (DLR)

- **High-resolution Soil Moisture tracking in a broad range of crops and vegetated land**, complementing Sentinel-1 SSM products that are mainly suitable for bare soils and low vegetation areas.
- Information of **Soil Moisture up to ~5 cm depth** that shall be combined with upper 1 cm layer SSM from Sentinel-1

REQUIREMENTS

- Revisit (6 days Global, 3 days Europe)
- High resolution
- Low noise level (NESZ, ambiguities)
- Integration (downscaling) with Scatterometers and L-band Radiometers for temporal revisit and accuracy



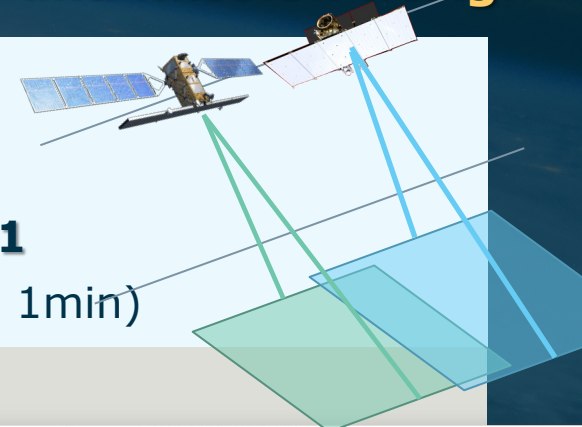
Results from ESA Sarsense air- and space- borne campaign. Acquisitions over Selhausen (DE).
(left) Change in backscatter observed in C- and L-band for irrigated and non-irrigated area (F11), but also range dependent.
(Right) Scatter plots between soil moisture and backscattering signal from co- and cross-polarized channels of C- and L-band satellite data. From Menges et al., 2021, Remote Sensing

ROSE-L Mission Design Highlights

ROSE-L will augment Sentinel-1 by means of a **synergetic acquisition plan and mission design**

Collocation with Sentinel-1

- Same orbit configuration of Sentinel-1.
- Phasing of the orbital plane adjusted to follow the **same ground track of Sentinel-1**
- Mission design supports option for optimized revisit or convoy with Sentinel-1 (within 1min)



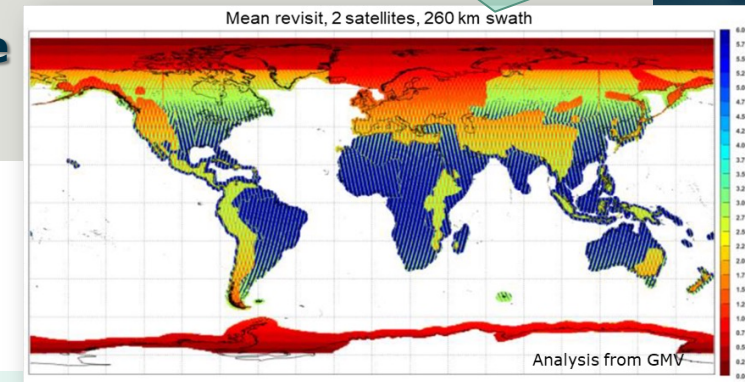
Extensive Global coverage and consistent long-term archive

- Coverage of Global land (except for South pole). **~ 38 min/orbit duty cycle**
- Consistent acquisitions through years for **long-term coherent data stacks**

Performant Imaging

- Low NESZ (-28 dB)
- Dual-pol and Quad-pol capabilities

Free, full and open data policy



Moving towards a **System of Systems concept** and enhanced information products