

SAR and SARscape updates

Dr Paolo Pasquali

Co-founder, President and Technical Director

New SAR missions! The «Golden Era» of SAR?

Institutional

Commercial

PALSAR-3

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....

....

Biomass

....

....

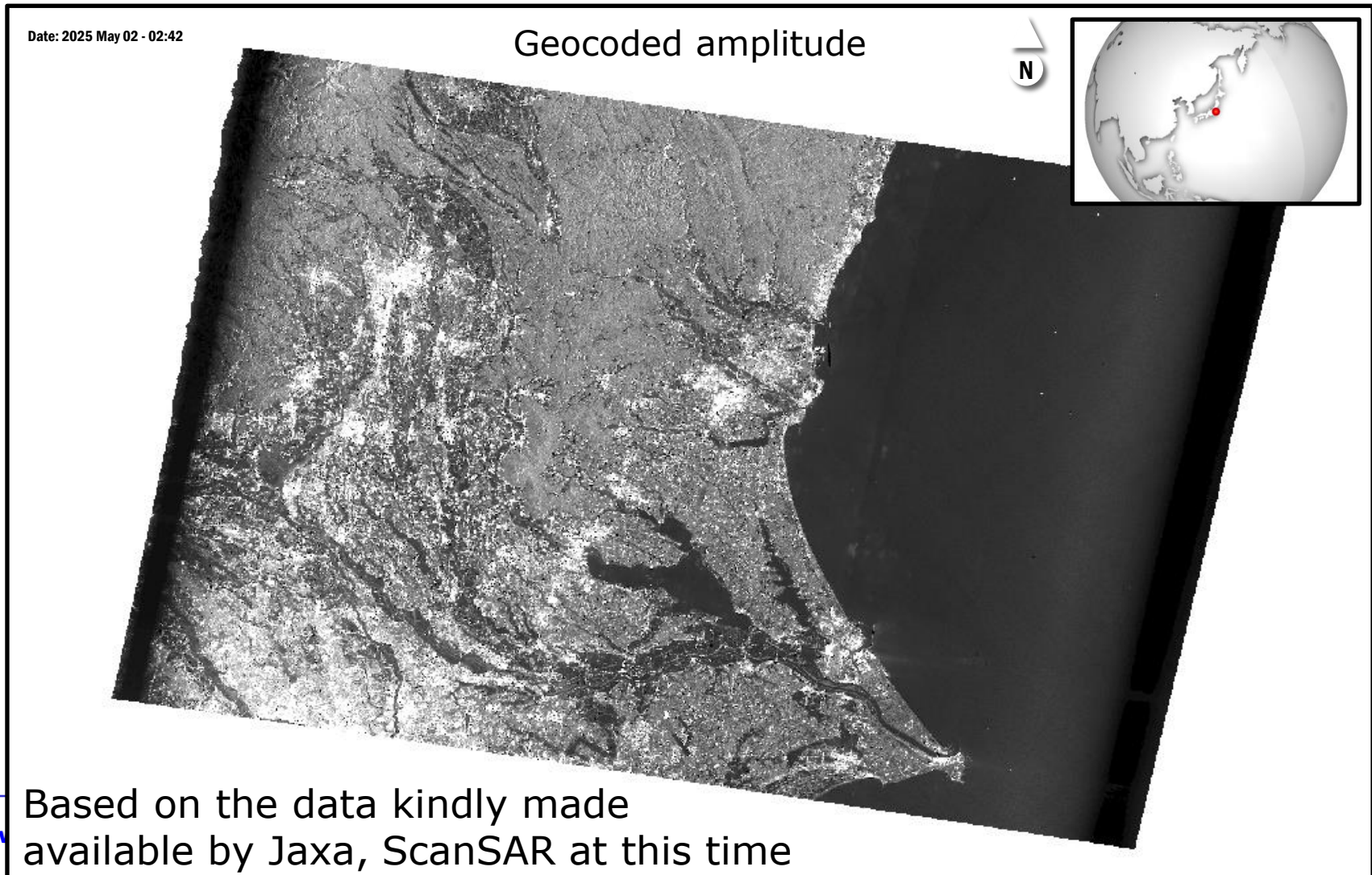
NISAR

....

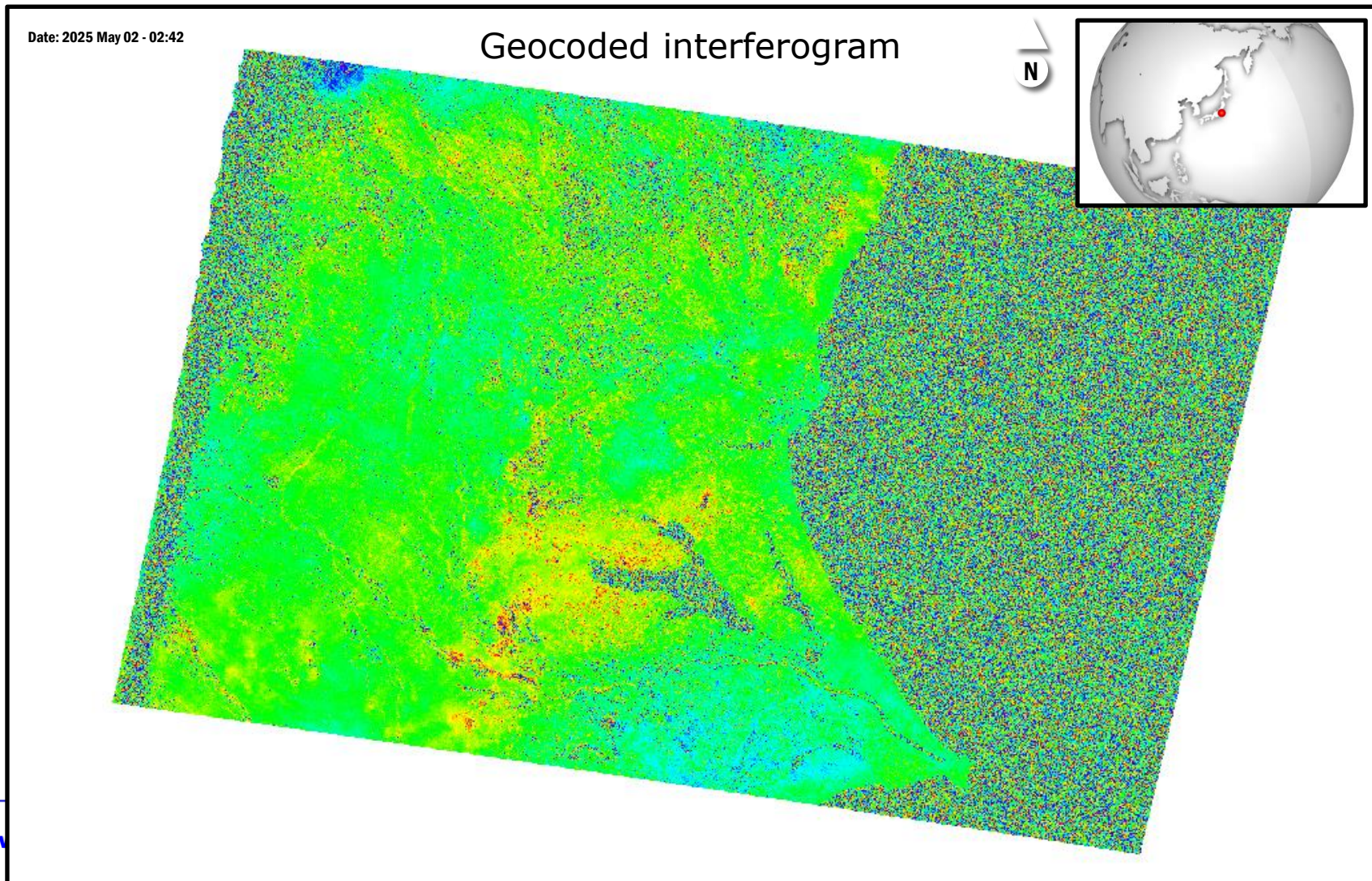
....

The responsibility for the success is also on us all, providing applications and tools based on these data...!

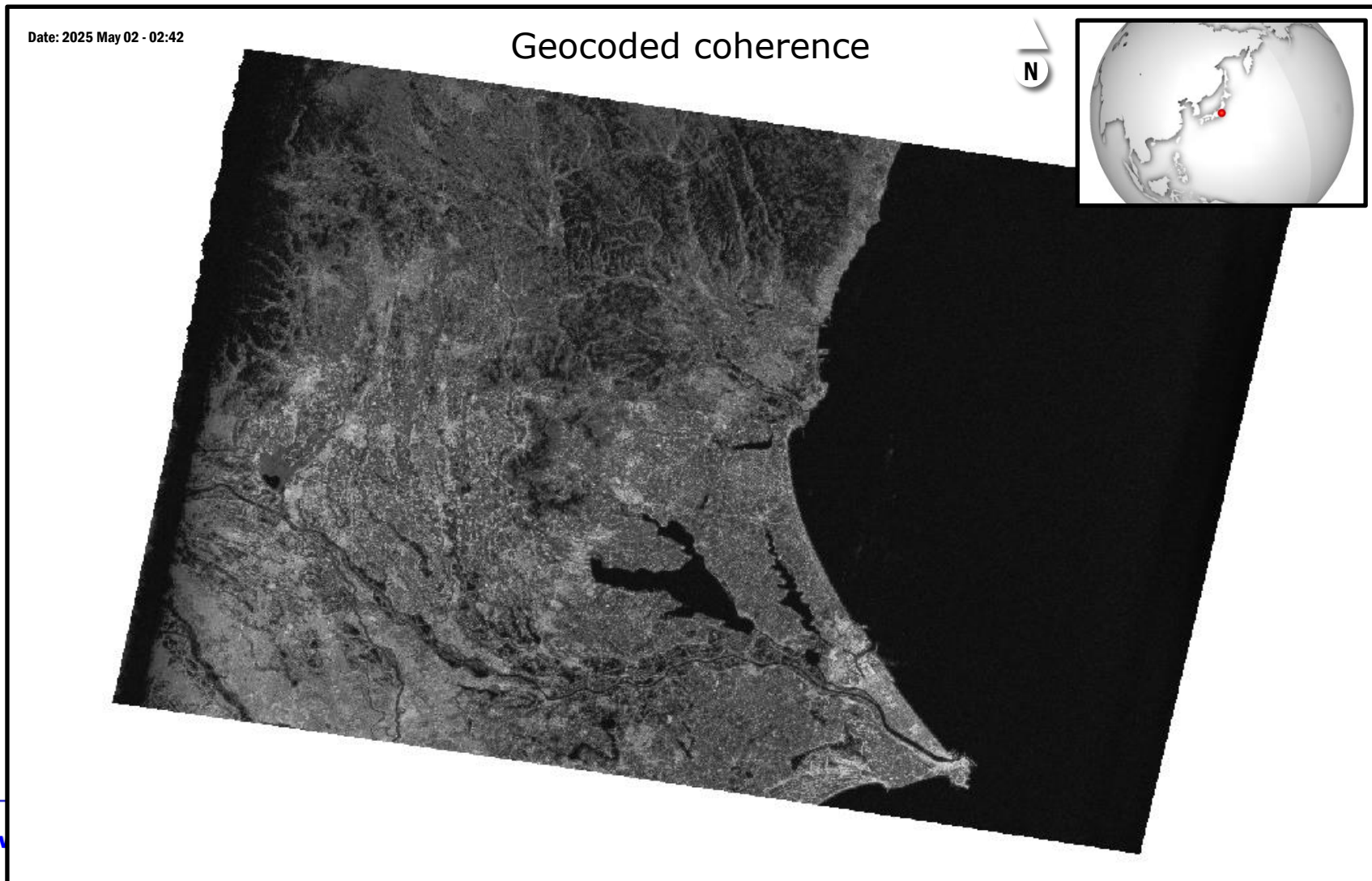
PALSAR-3 support in SARscape



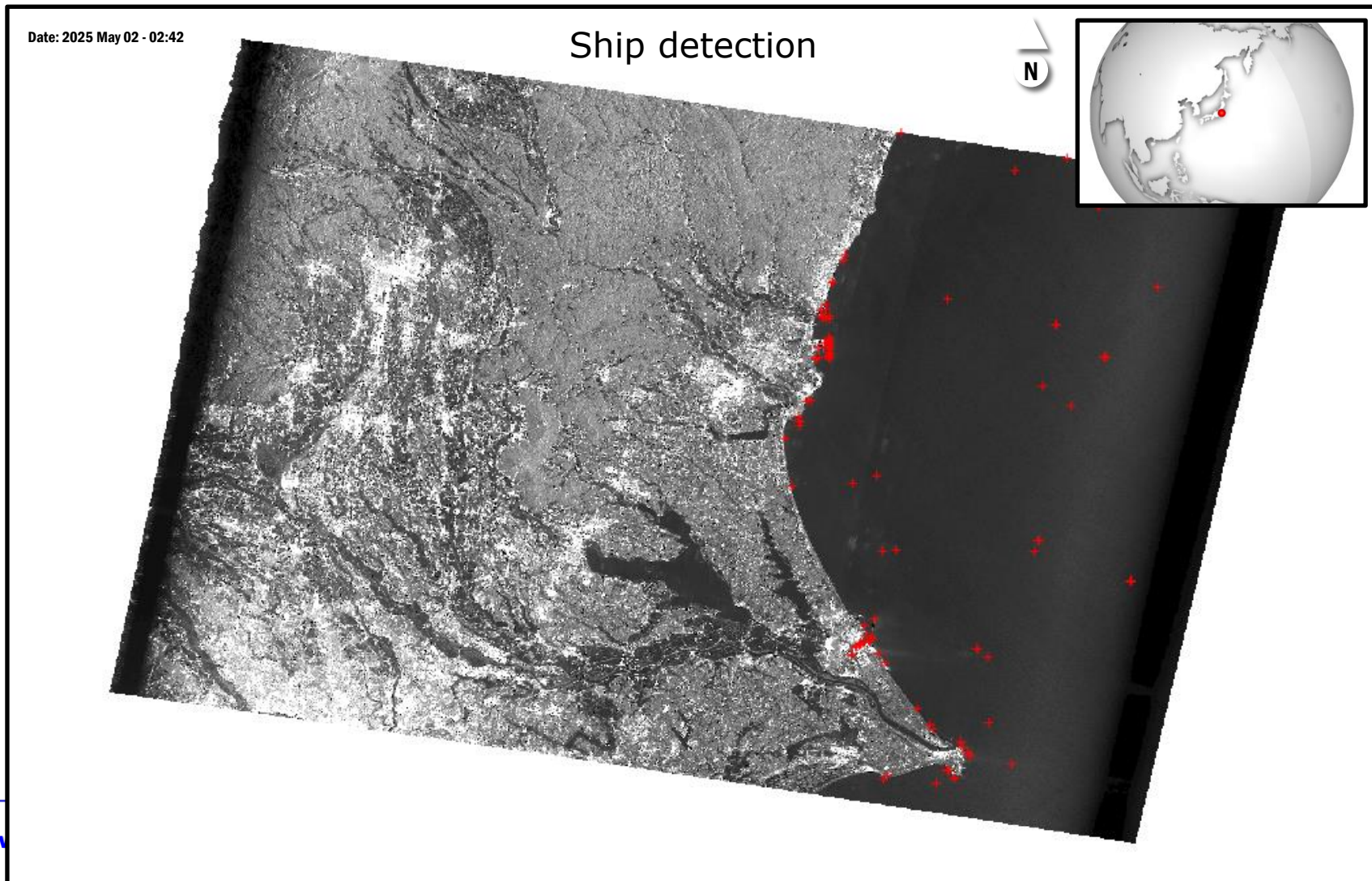
PALSAR-3 support in SARscape



PALSAR-3 support in SARscape



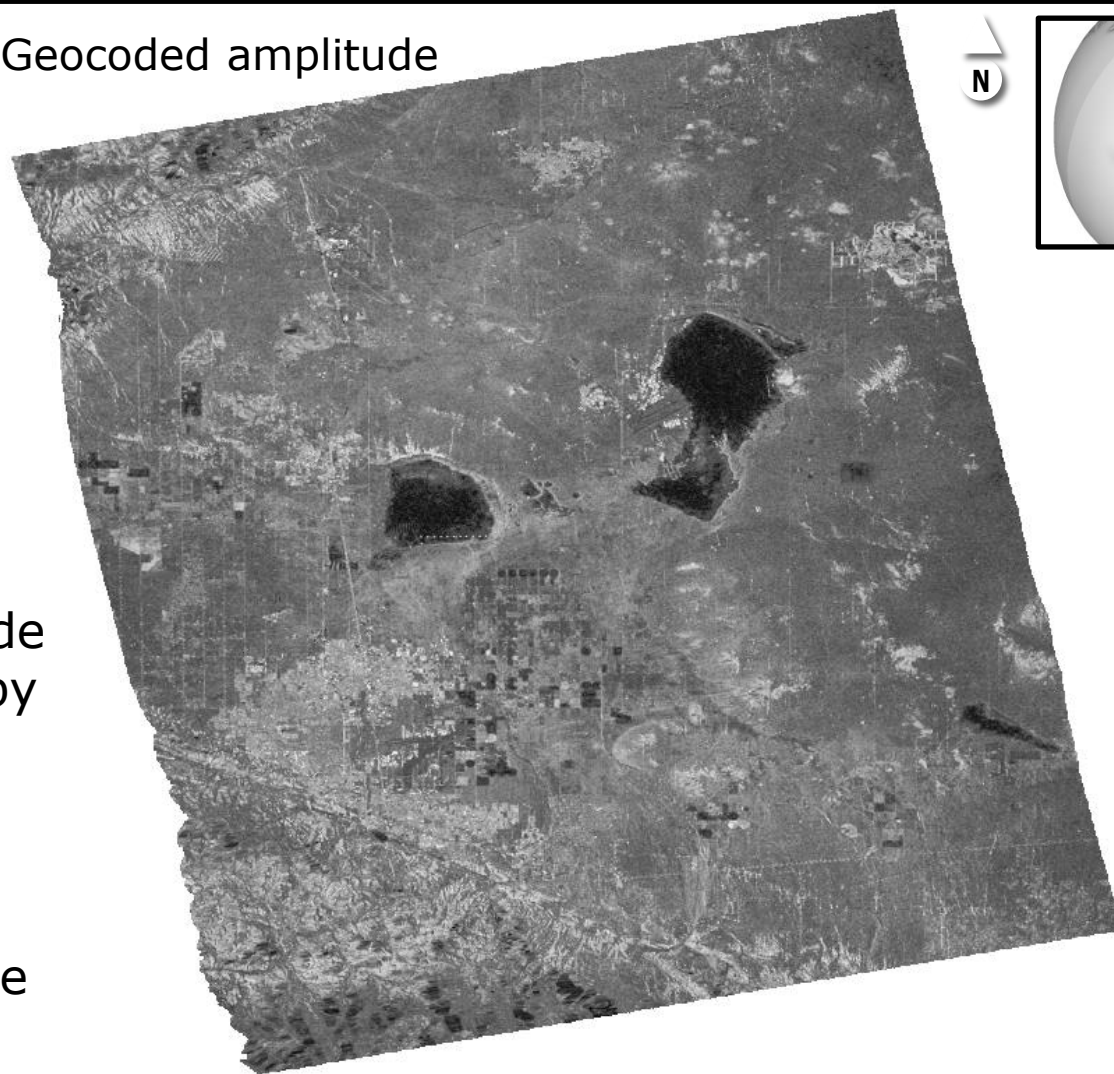
PALSAR-3 support in SARscape



NISAR RSLC support in SARscape

Date: 2008 Nov 27 - 06:10

Geocoded amplitude

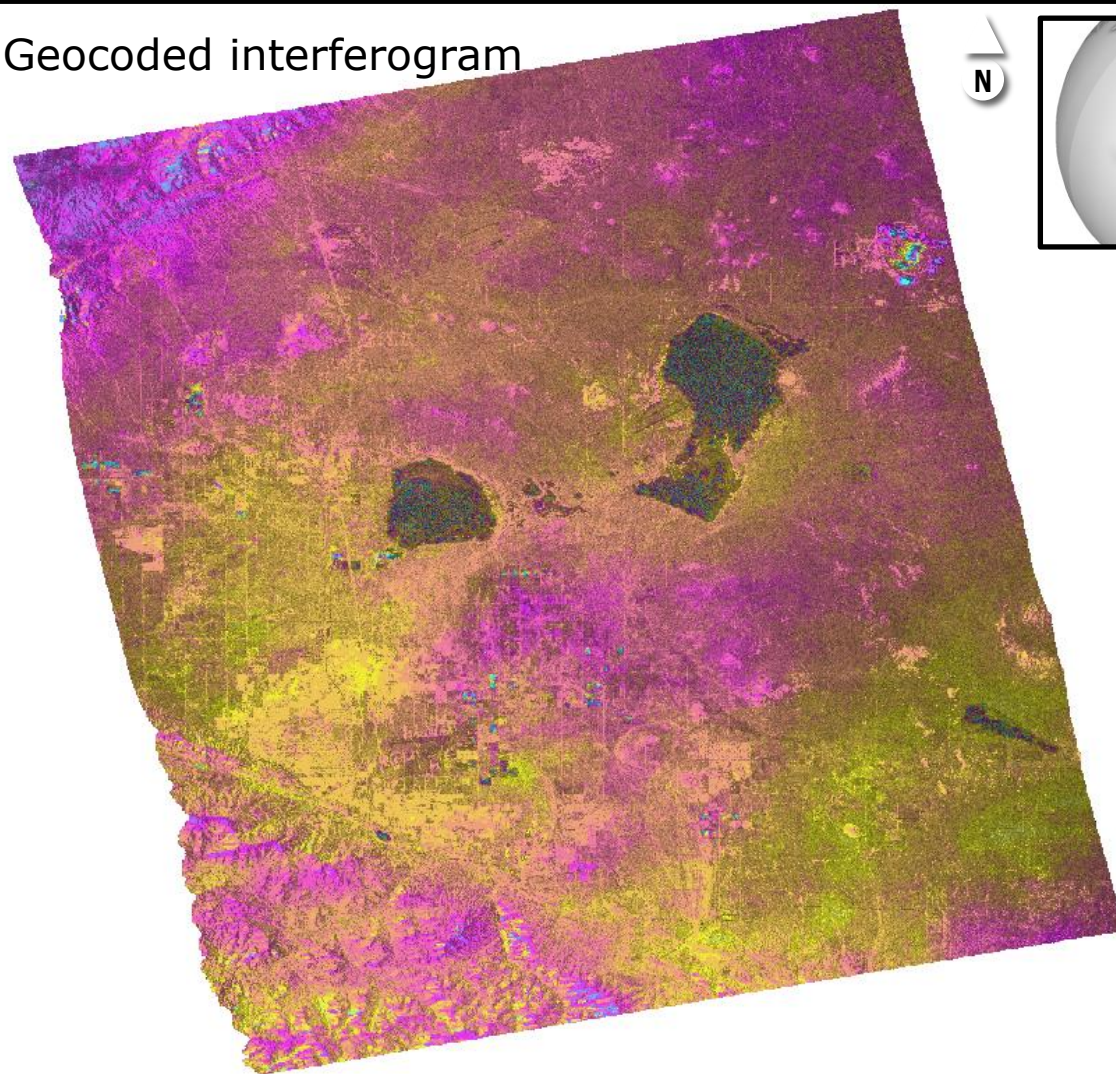


Based on
the data
kindly made
available by
JPL,
simulated
from
PALSAR-2
at this time

NISAR RSLC support in SARscape

Date: 2008 Nov 27 - 06:10

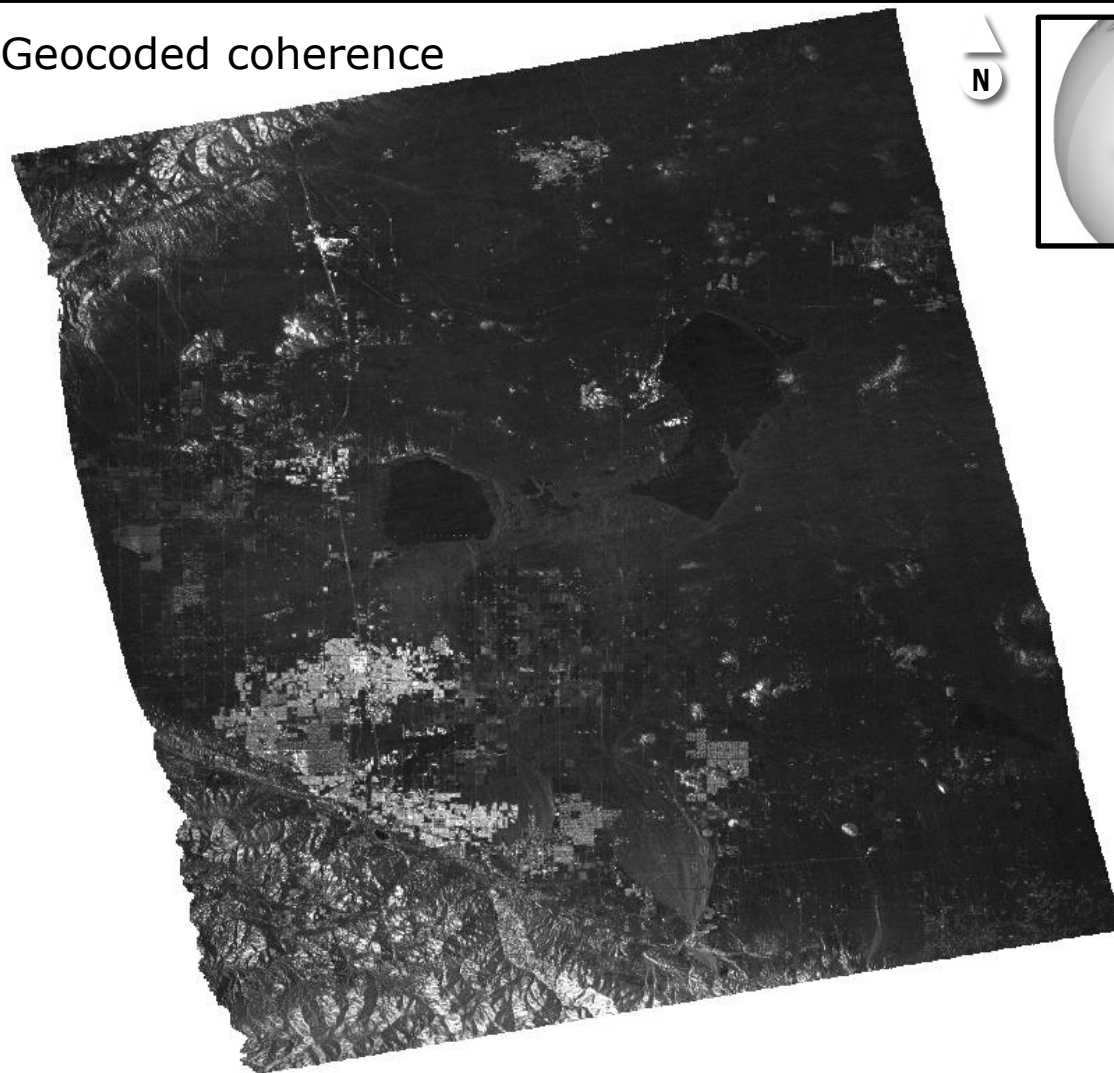
Geocoded interferogram



NISAR RSLC support in SARscape

Date: 2008 Nov 27 - 06:10

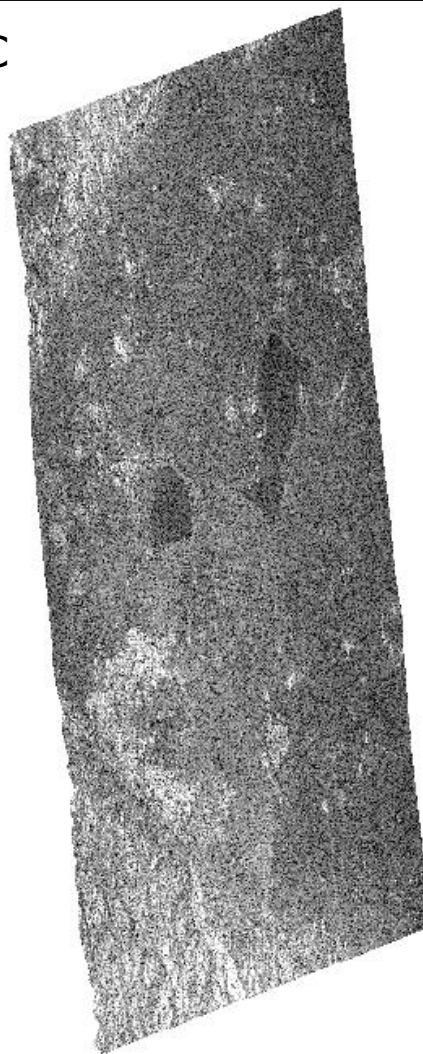
Geocoded coherence



NISAR GSLC support in SARscape

Date: 2008 Oct 12 - 06:09

Geocoded SLC



Based on
the data
kindly made
available by
JPL,
simulated
from
PALSAR-2
at this time



Starting
from
DInSAR

Biomass support in SARscape

Date:

Based on
the
simulated
data kindly
made
available by
ESA

sarmap part
of the Cal /
Val teams

AI & Deep Learning

- The current risk: if you don't know an answer, just use AI!
- When using AI / DL might be effective:
 - Phenomena not known in an analytic way
 - Too complex analytic processes
 - Plenty of well-constructed training data available
- Further risks: generative AI

Personal opinions!

AI & Deep Learning

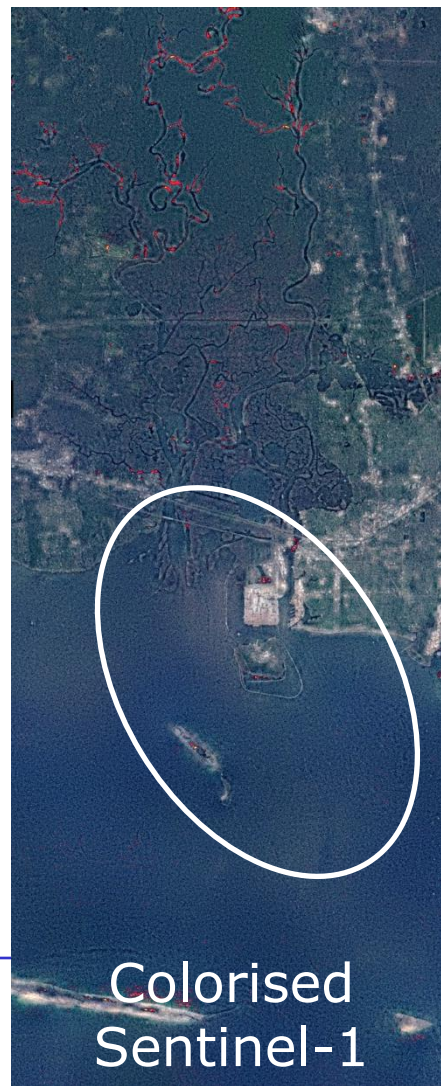
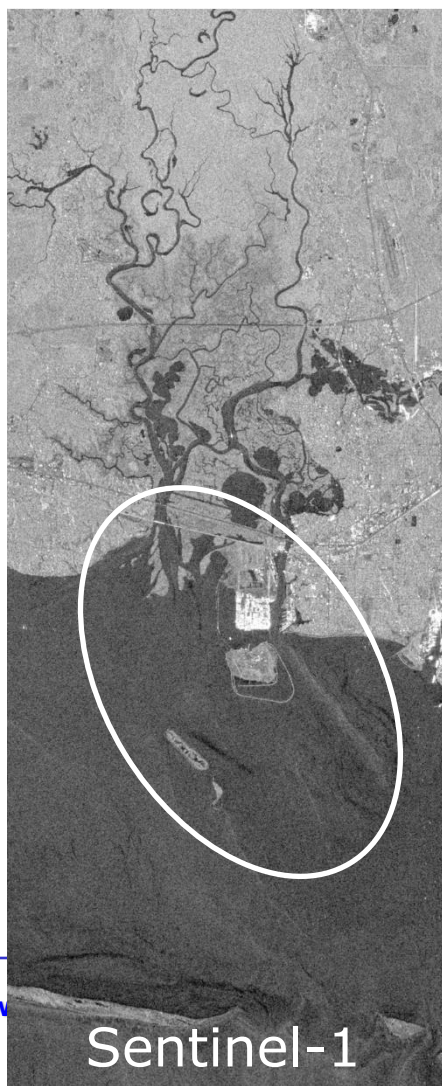
- Very effective in:
 - Finding hidden correlations among different input layers
 - Finding and recognizing objects

Personal opinions!

AI-based SAR coloring

“statistical colors”
(never 100% reliable)

Finding correlations



Finding and recognizing objects



Floating-roof vs. fixed-roof oil tanks

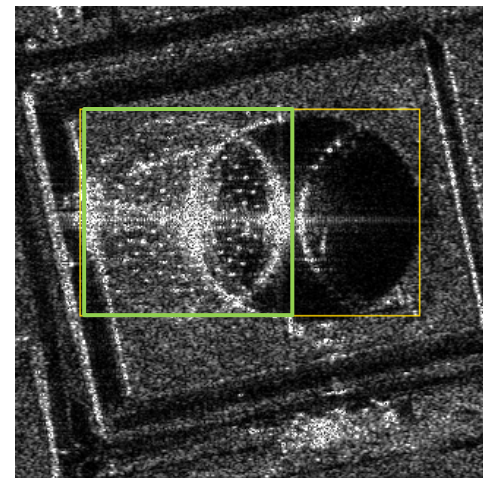
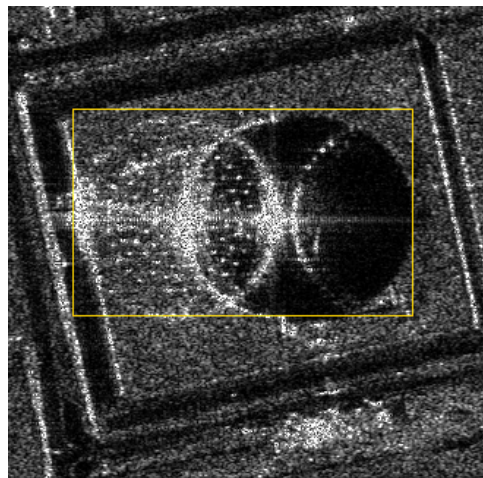
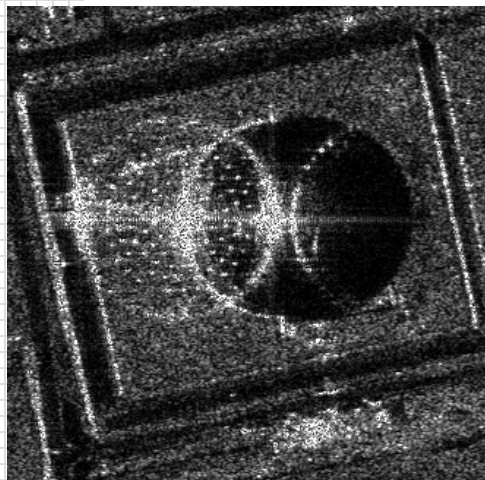


 Floating Roof Oil Tank

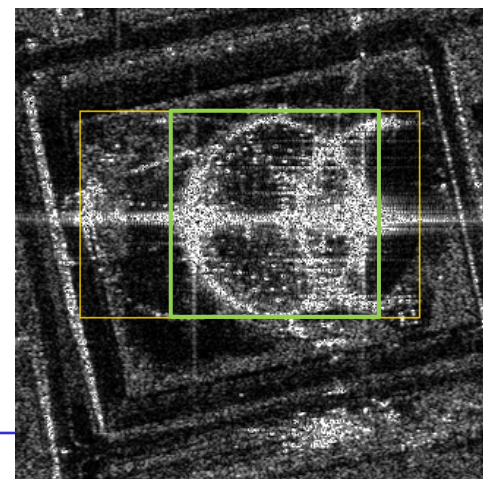
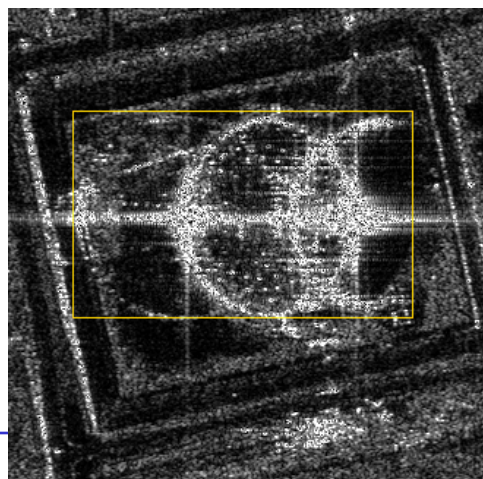
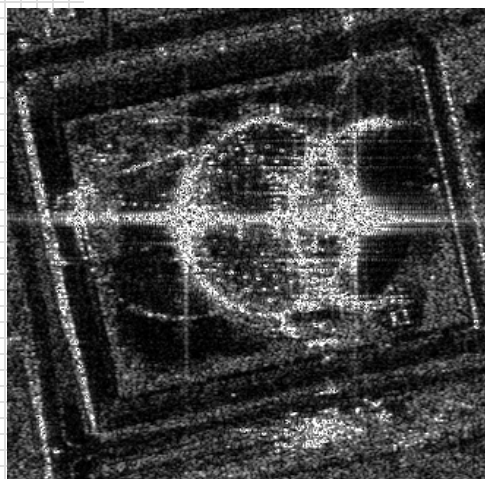
 Fixed Roof Oil Tank

Floating-roof oil tank monitoring

Date 1



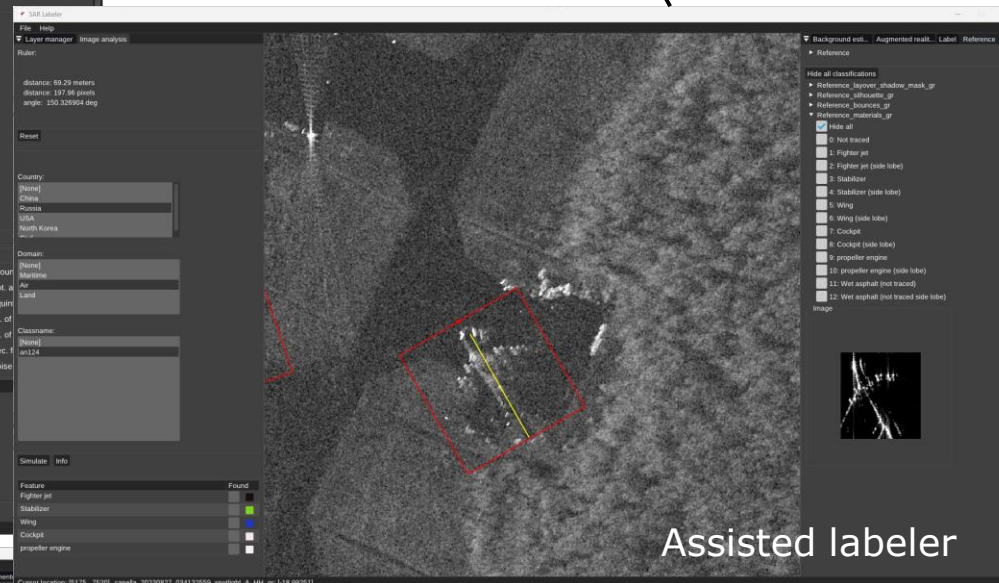
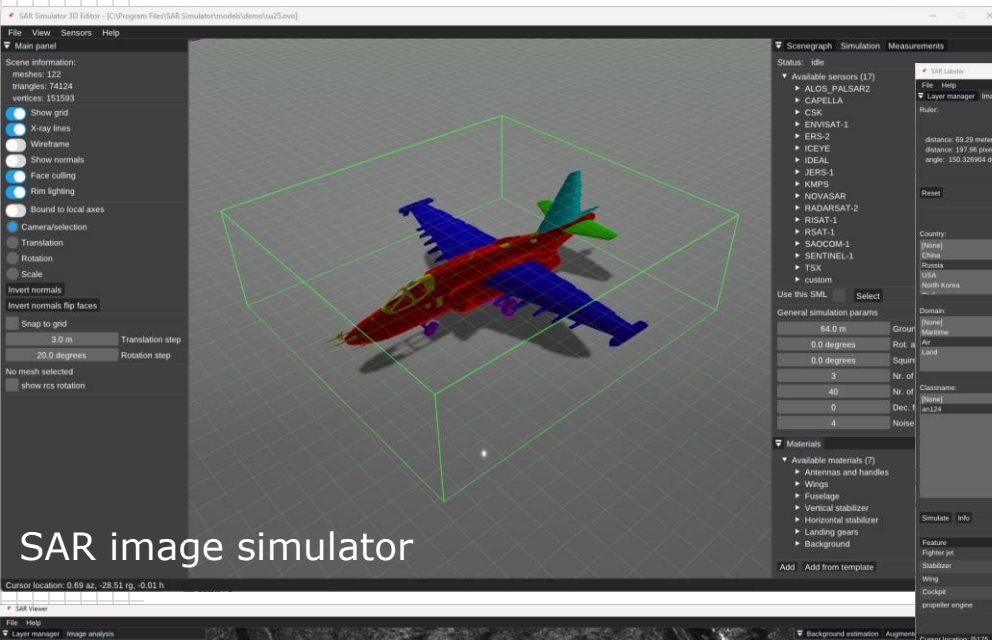
Total
Volume: Xm^3
Filling: Y%



Filling: Z%

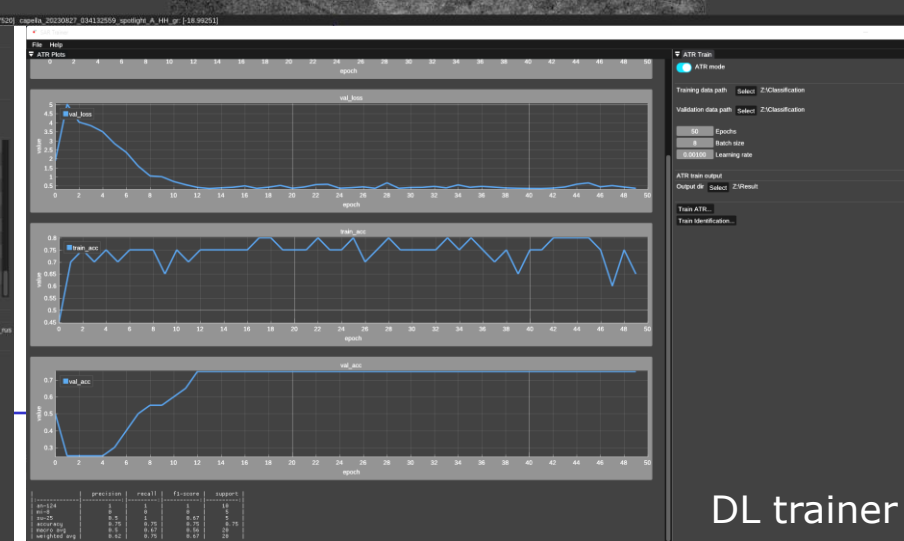
Automated Target Recognition full environment

Not in SARscape



SAR image simulator

Assisted labeler

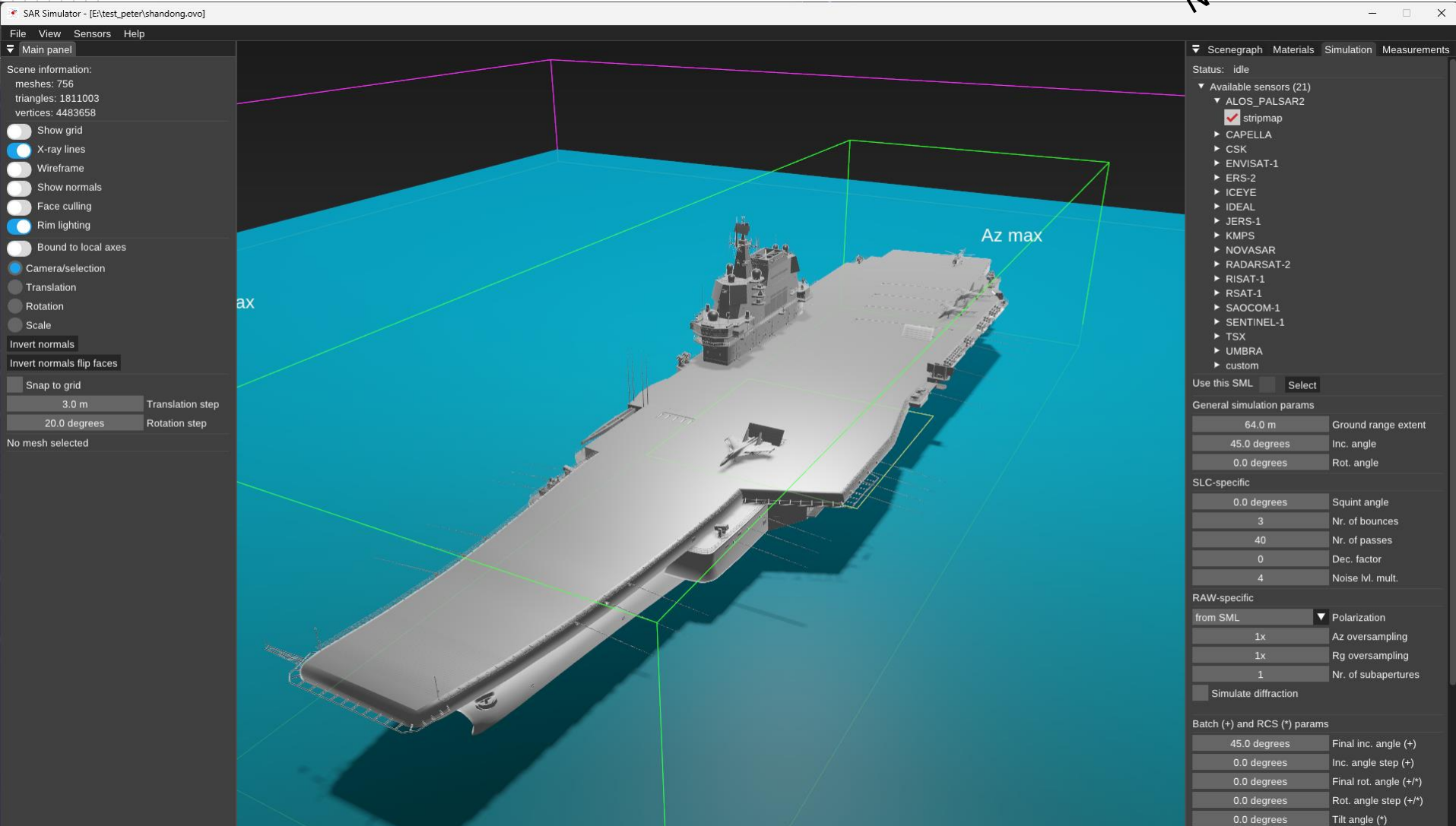


DL ATR

DL trainer

SAR image simulator

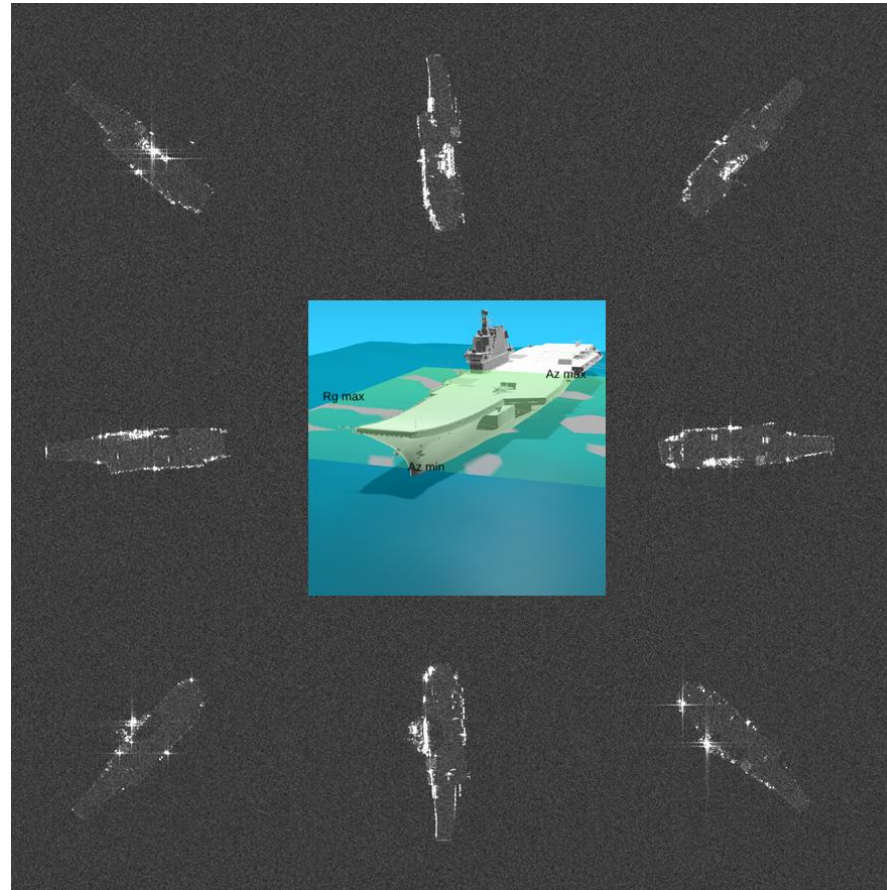
Not in SARscape



Simulation of different orientations / incidence angles

The ATR training shall be carried out with examples of targets of interest as seen by the SAR sensors from all possible relative orientations. A SAR image simulator can significantly help in obtaining a complete training dataset.

A physically reasonable sampling is to obtain one image e.g., every 3 degrees of relative orientation / incidence angle.

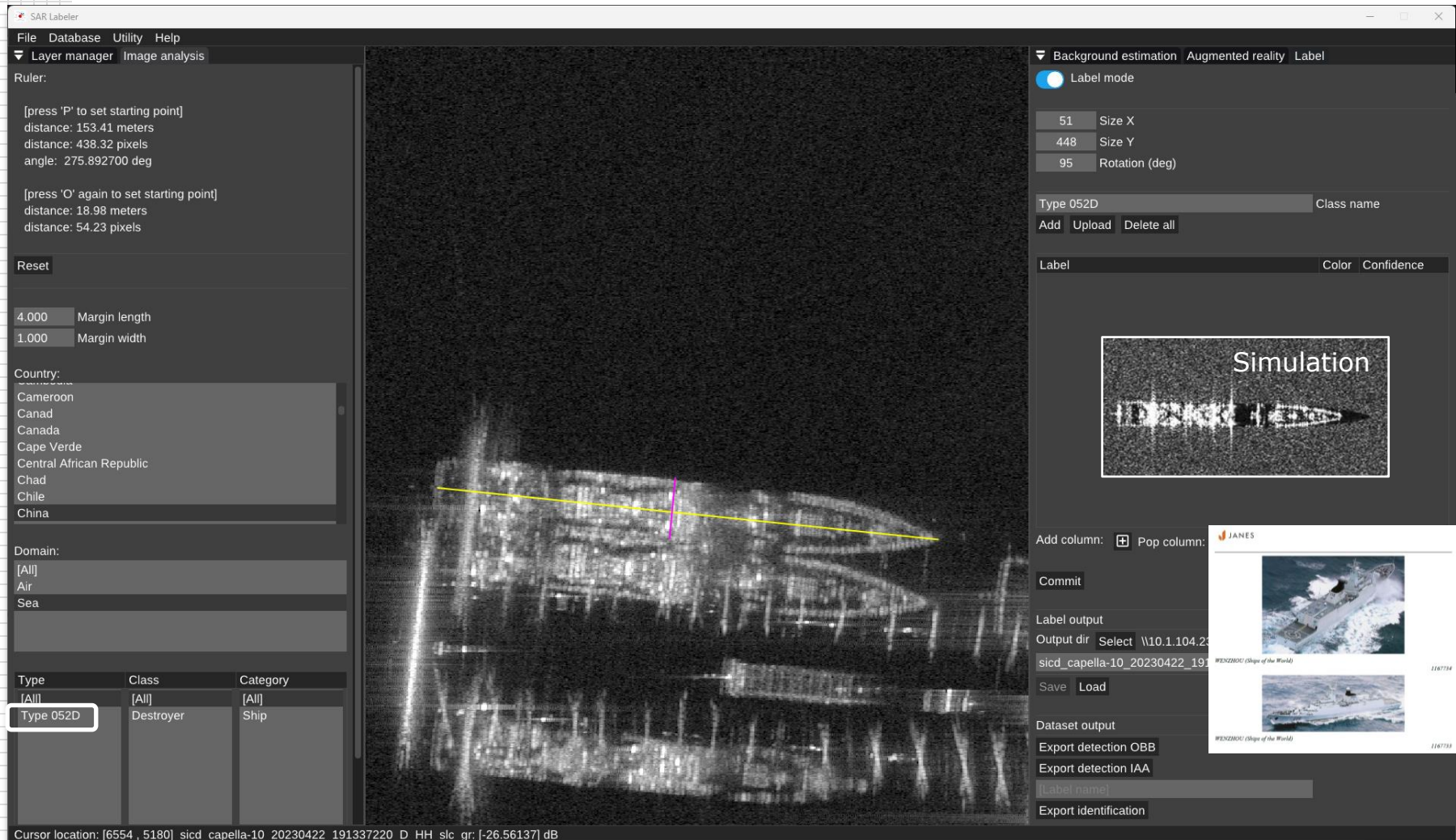


Not in SARscape

Example obtained every 45 degrees. A SAR simulator can immediately allow to extend the generation of simulated images for e.g., every 3 degrees of relative orientation.

Shandong Chinese airplane carrier
SAR system parameters of Capella Space images

SAR assisted image recognition and labeling tool



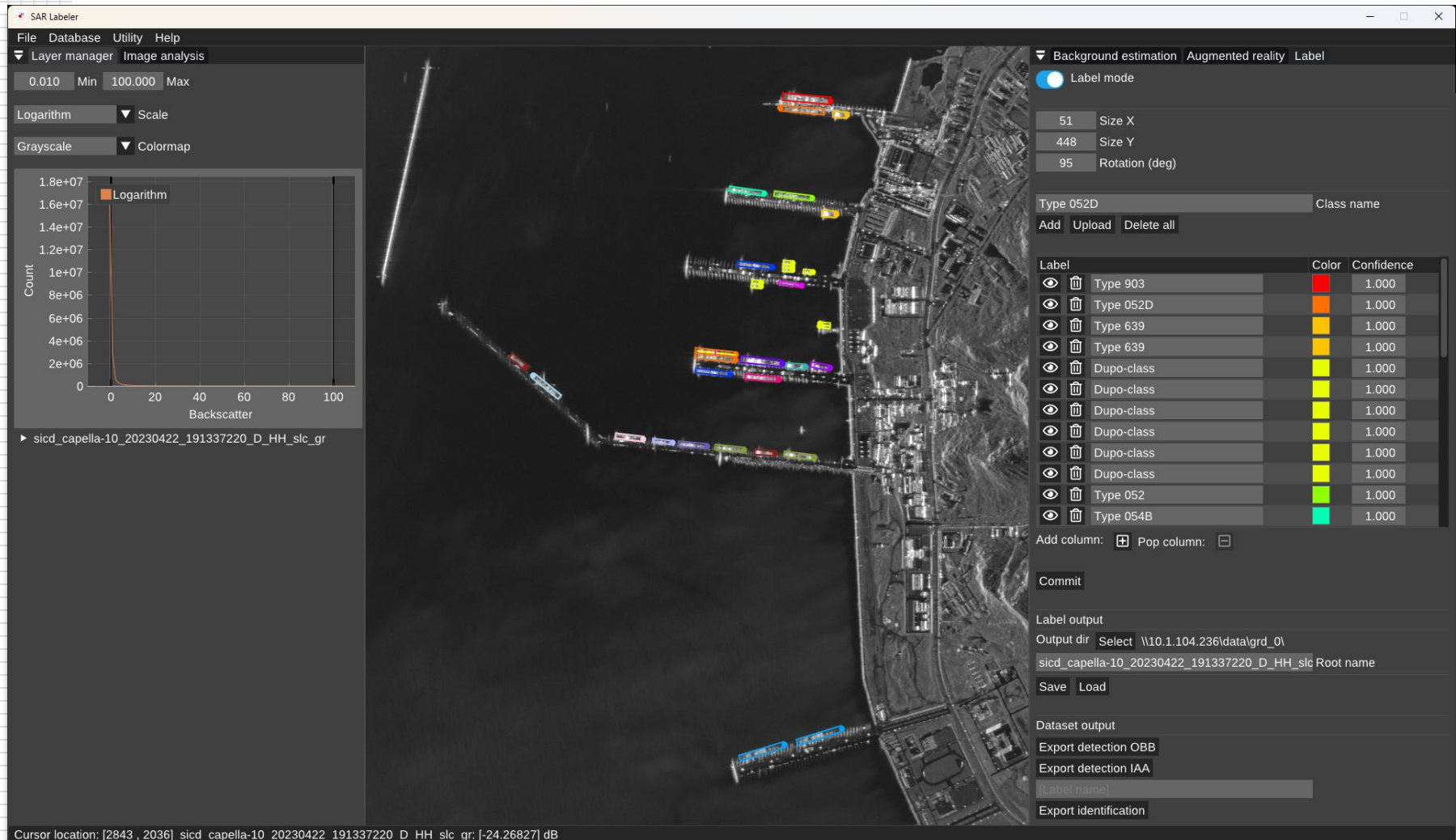
The screenshot displays the SAR Labeler application window. The interface is divided into several sections:

- Left Panel:** Contains a ruler section with distance and angle measurements, a 'Reset' button, margin length and width settings, a country selection list (including Cameroon, Canada, Cape Verde, etc.), a domain selection list (Air, Sea), and a table for labeling objects.
- Center Panel:** Shows a SAR image of a ship with a yellow line and a pink vertical line indicating a measurement.
- Right Panel:** Includes a 'Background estimation' section with 'Label mode' selected, size and rotation settings, a 'Type 052D' dropdown, and a 'Class name' field. Below this is a 'Simulation' window showing a ship's silhouette.
- Bottom Panel:** Contains a 'Cursor location' field showing coordinates and a 'db' value.

Type	Class	Category
[All]	[All]	[All]
Type 052D	Destroyer	Ship

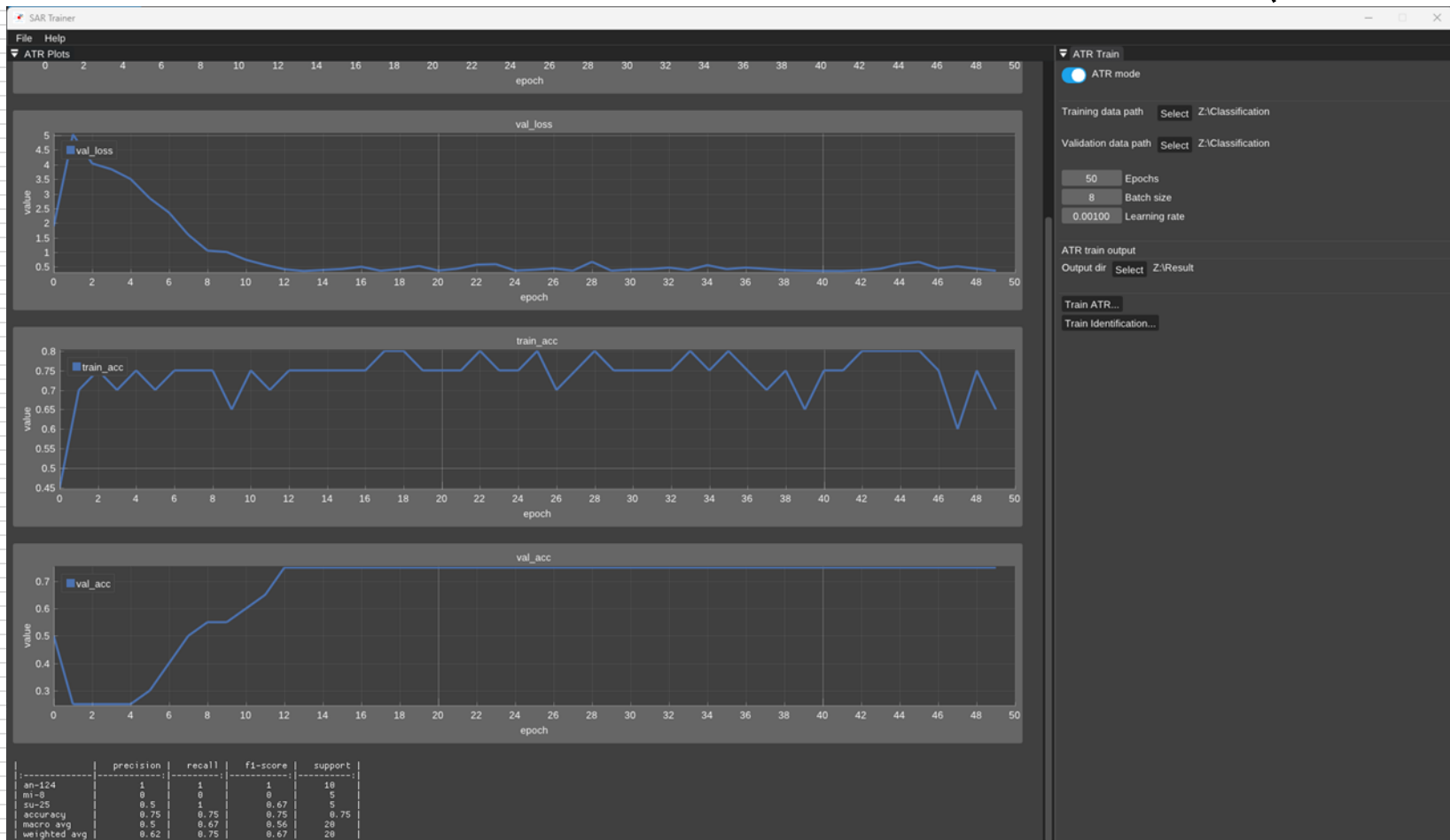
Cursor location: [6554 , 5180] sidc_capella-10_20230422_191337220_D_HH_slc_gr: [-26.56137] dB

SAR assisted image recognition and labeling tool

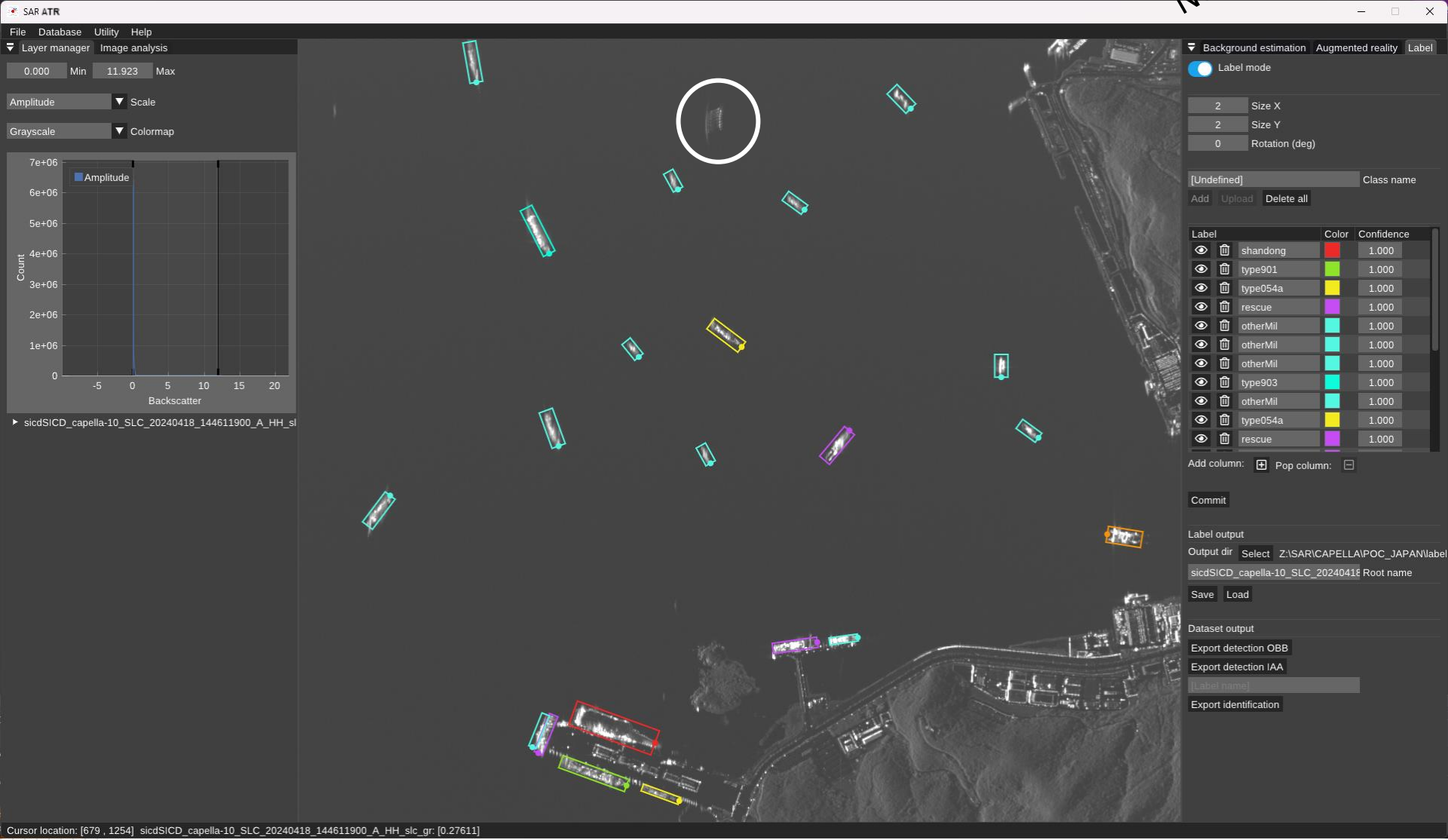


SAR ATR training

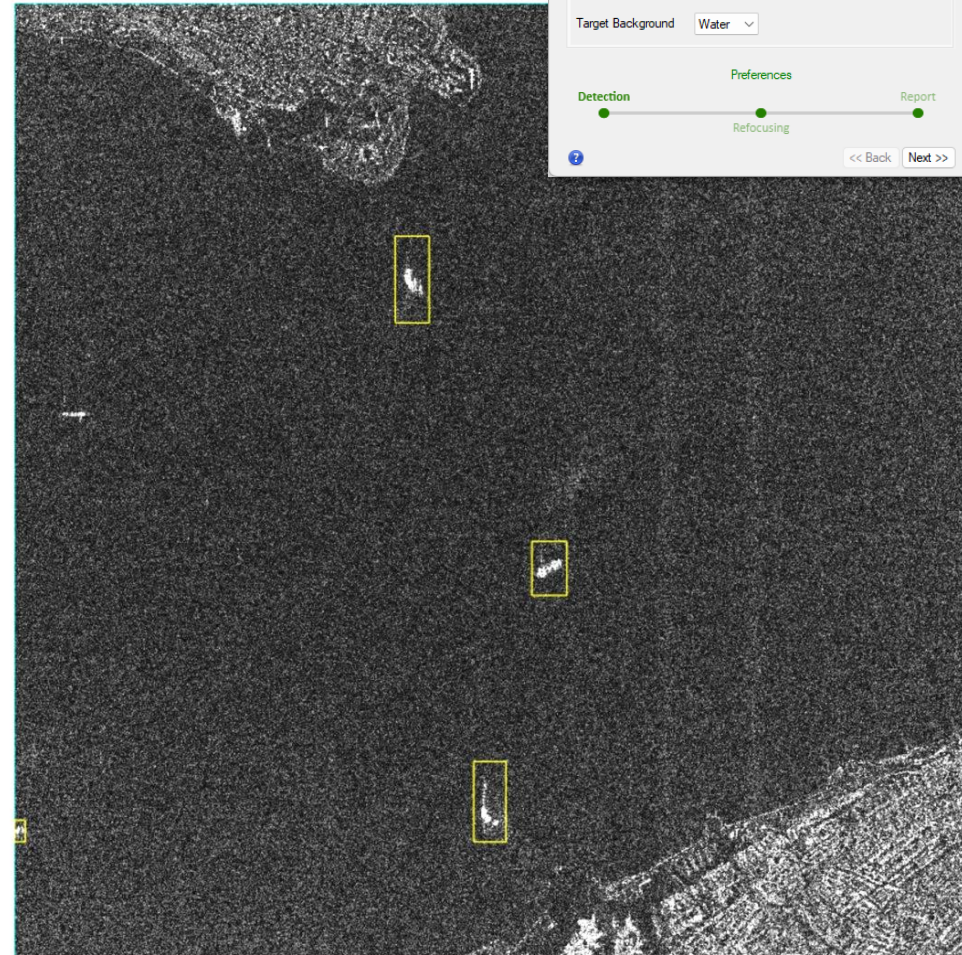
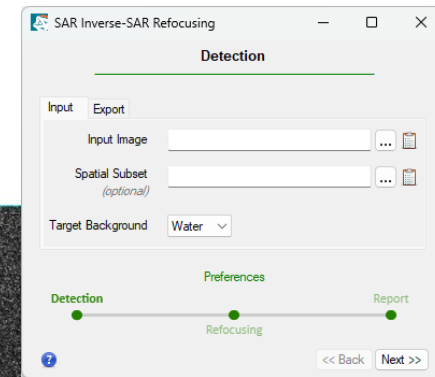
Not in SARscape



SAR Automatic Target Recognition

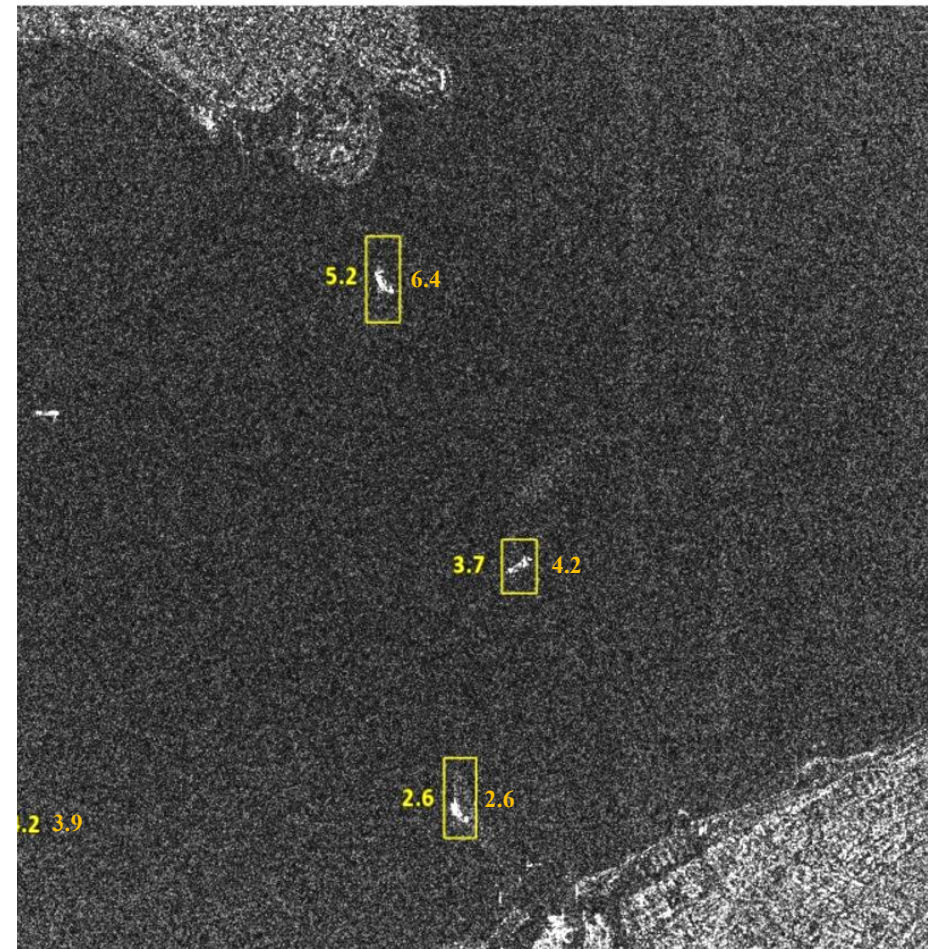


Moving Target Detection & ISAR workflow



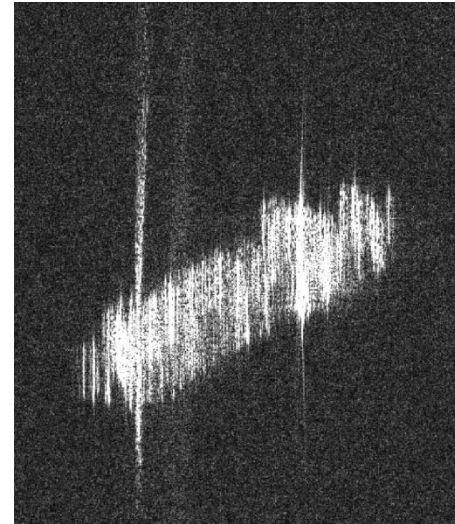
Moving Target velocity estimation

Comparison with **AIS**

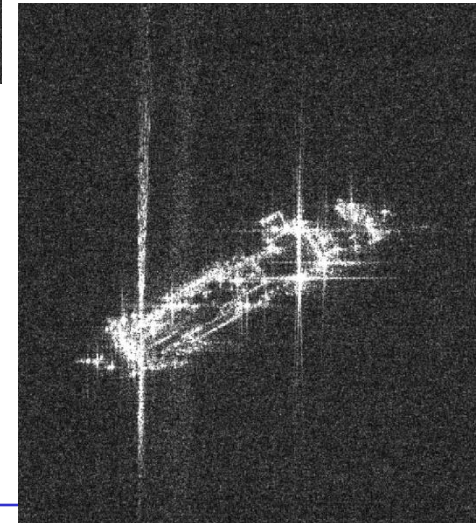


Moving Target refocusing / InverseSAR

Before



After



NIIRS (National Imagery Interpretability Rating Scale) and (RGIQE) Radar Generalized Image Quality Equation

«How good is a certain image / mode for D, R & I»

NIIRS Rating	Description
0	Interpretability of the imagery is precluded by obscuration, degradation, or low resolution.
1	Detect lines of transportation, either road or rail, but do not distinguish between.
2	Distinguish between forested areas and agricultural fields.
3	Detect multiple wings of large buildings.
4	Detect smokestacks in industrial facilities.
5	Distinguish between a large vertical mast antenna and a large power-transmission tower.
6	Detect cargo on a railroad flatcar.
7	Detect the break between cab and trailer on a tractor-trailer truck.
8	Detect individual rail ties.
9	Distinguish between models of fighter aircraft (e.g., FLANKER B-C, F-15 A-E).

$$RNIIRS_{predicted} = 3.7555 + 0.3960 \cdot \log_2(C_{SAR})$$

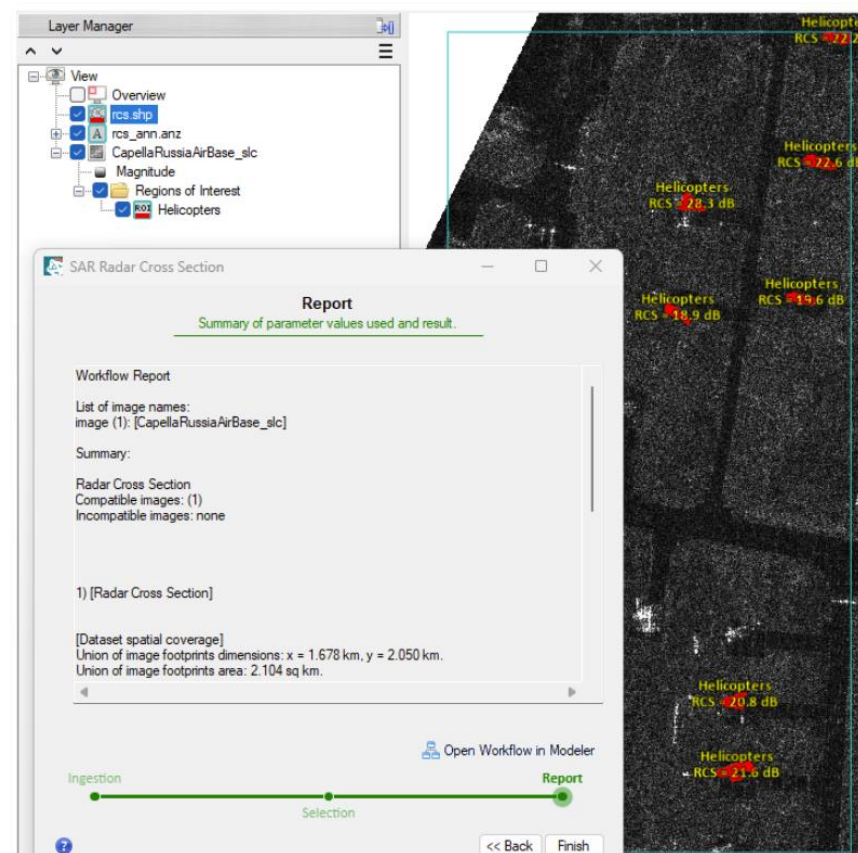
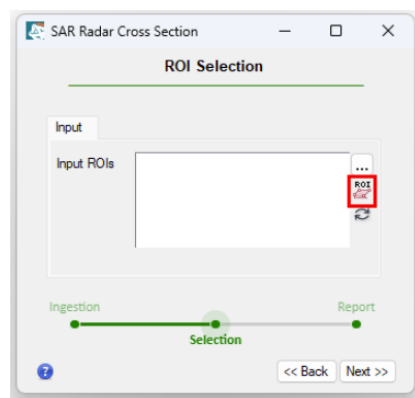
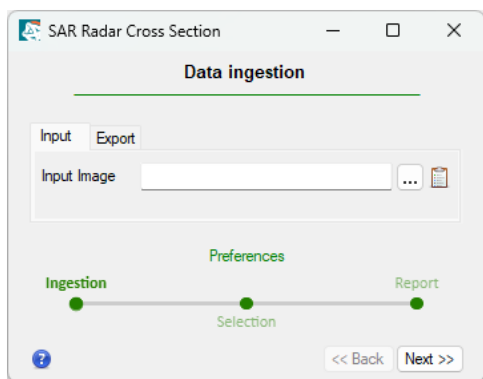
Evaluation starting from image / mode parameters

Original definition assessed through visual analysis

W. Schwartzkopf, J. Brown, G. Farquharson, C. Stringham, M. Duersch and J. Heemskerk, "Radar Generalized Image Quality Equation Applied to Capella Open Dataset," *2022 IEEE Radar Conference (RadarConf22)*, 2022, pp. 1-5.

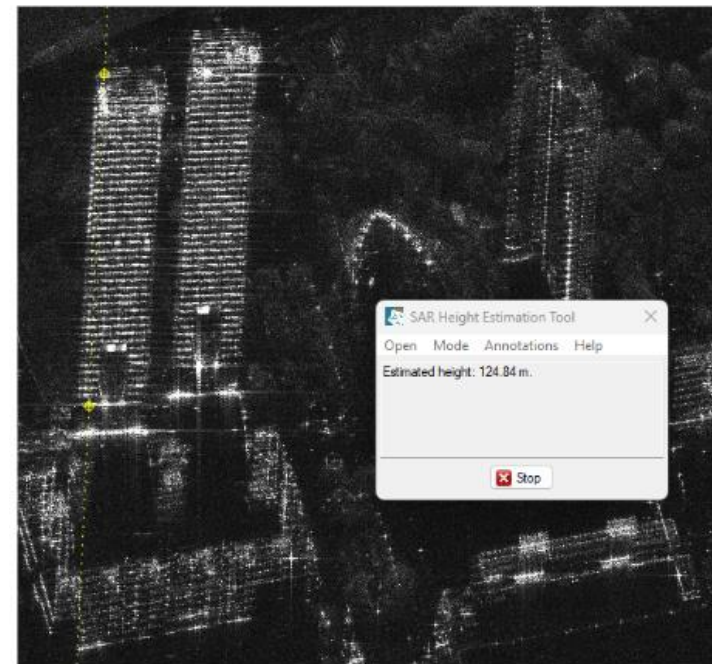
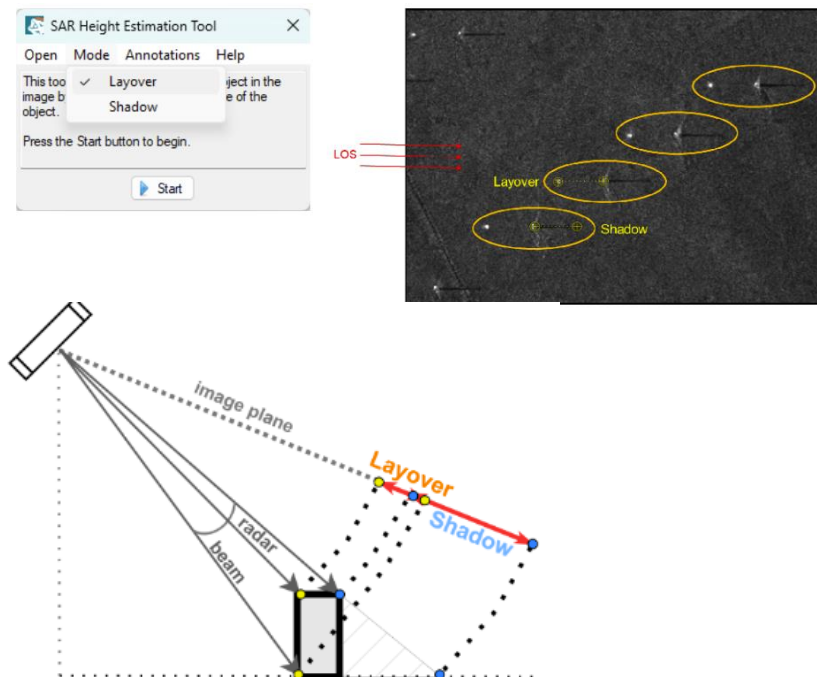
RCS measurement

This interactive tool can be used to estimate the RCS of targets.



Interactive tool for Height Estimation of vertical objects

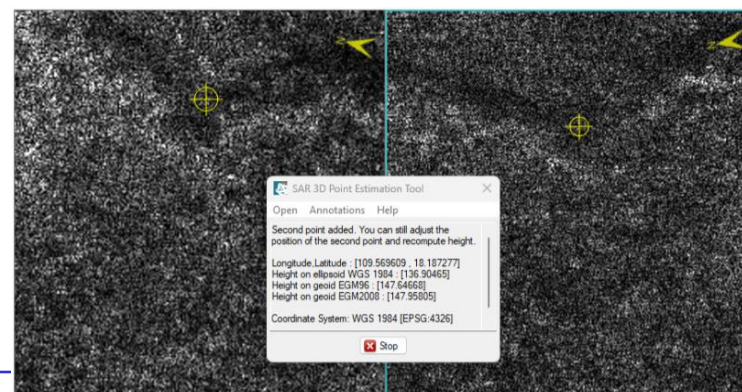
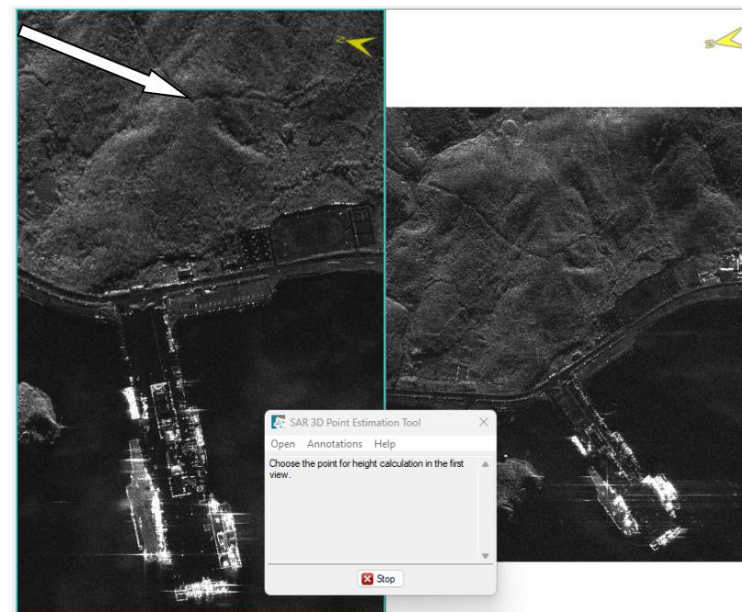
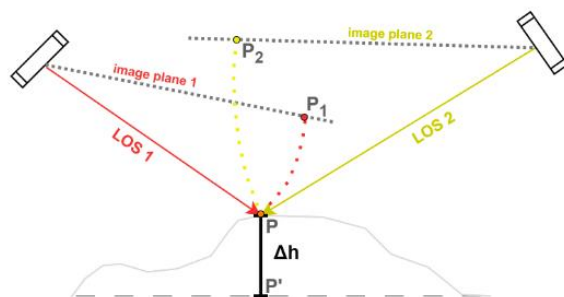
This tool estimates the height of a vertical object in a single image by interactively locating the top and the base of the object of interest.



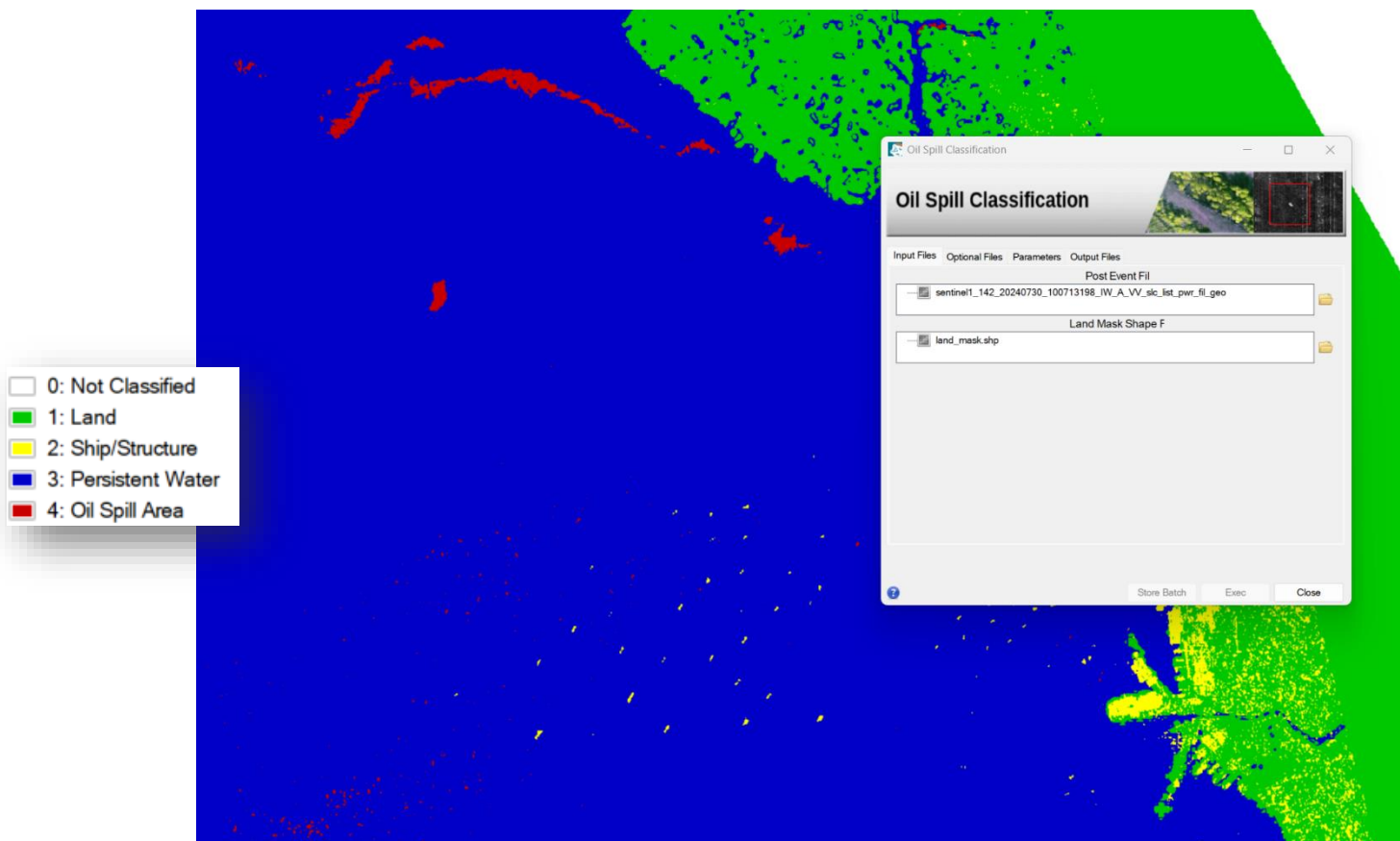
Skyscraper height estimation using an Umbra acquisition over Buenos Aires.

Interactive tool for Point 3D Location Estimation from SAR stereo pairs

This tool calculates the height and horizontal position of a point using two radar images of the same location.



Oil spill monitoring



どうもありがとうございます!