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→ 4th ADVANCED TRAINING COURSE IN LAND REMOTE SENSING

ESA & Third Party Toolboxes

NEST

M. Engdahl (ESA-ESRIN), **A. Minchella (RSAC c/o ESA)**, P. Marinkovic (Ppo.Labs), L. Veci (Array Systems Computing)

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Contents

- **NEST Project Overview**
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- **Graph Builder**
- **NEST Features**

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What is NEST

- NEST = **N**ext **E**SA **S**AR **T**oolbox
- A **free** and **fully open source** toolbox under the GNU GPL license
- Supports the scientific exploitation (reading, processing, analysing and visualising) of ESA and 3rd party *spaceborne* SAR data
- Development started in 2008
- Current stable version is 4C-1.1
- 5.0.9 beta (used in the LTC Course) by July 2013

NEST is being developed under ESA Contract number 20698/07/I-LG

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NEST Development Team

NEST is being developed under ESA Contract number 20698/07/I-LG

NEST TEAM

1. **ESA**
   Marcus Engdahl (ESA Technical Officer), Andrea Minchella (RSAC c/o ESA)
2. **Array Systems Computing** (prime)
   Rajesh Jha, Luis Veci, Jun Lu, Shengli Dai
3. **Brockmann Consult**
   Norman Fomferra, Marco Peters
4. **PPO.labs (InSAR)**
   Petar Marinkovic
5. **TU Delft (InSAR)**
   Prof. Ramon Hanssen

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NEST Architecture

- NEST is built re-using the **proven** BEAM Earth Observation Toolbox and Development Platform (http://www.brockmann-consult.de/cms/web/beam/welcome)
  - Reduced development cost
  - Development synergy – thanks to the **shared NEST-BEAM Core** plug-in **modules** for both toolboxes are largely interchangeable.
  - Easy expandability (*BEAM processors*, etc.)
- **Java** implementation: guarantees **platform independence** and **easy portability** (Windows, Linux, Mac)
- Advanced features include:
  - A "**Tiled**" memory model
  - **Multi-core** processor support
  - Modular design (plugins)

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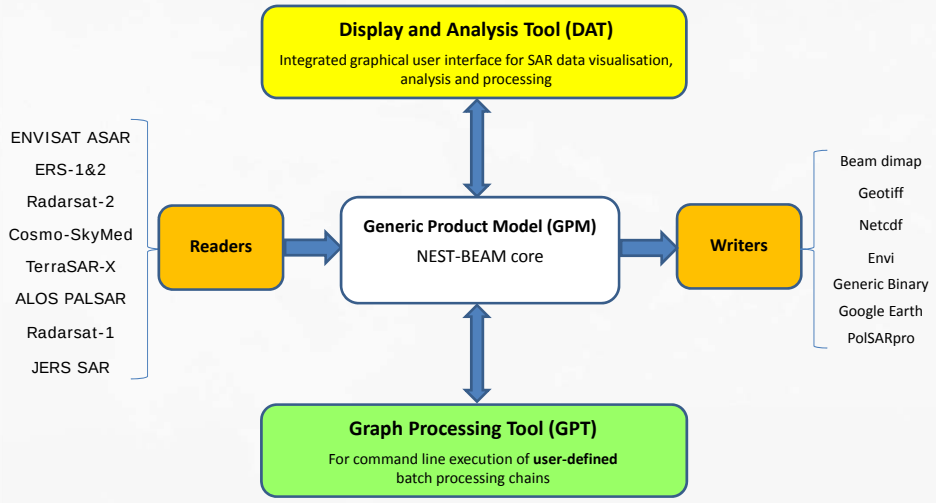
NEST Architecture: data flow



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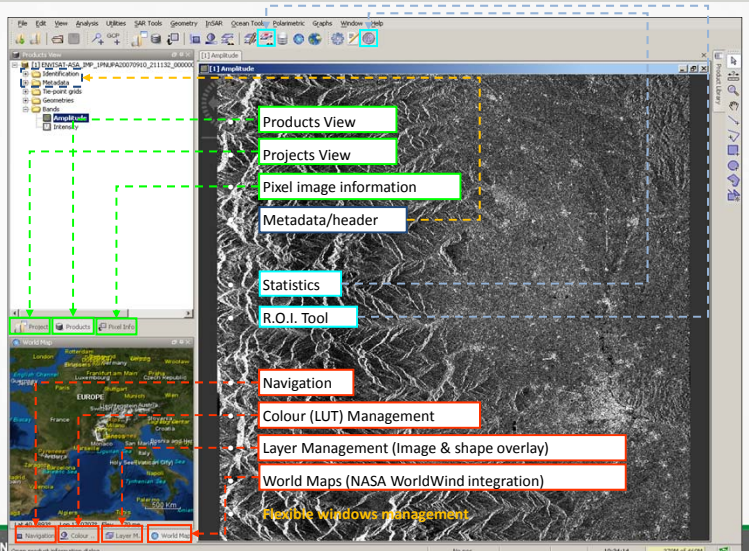
Display and Analysis Tool (DAT)



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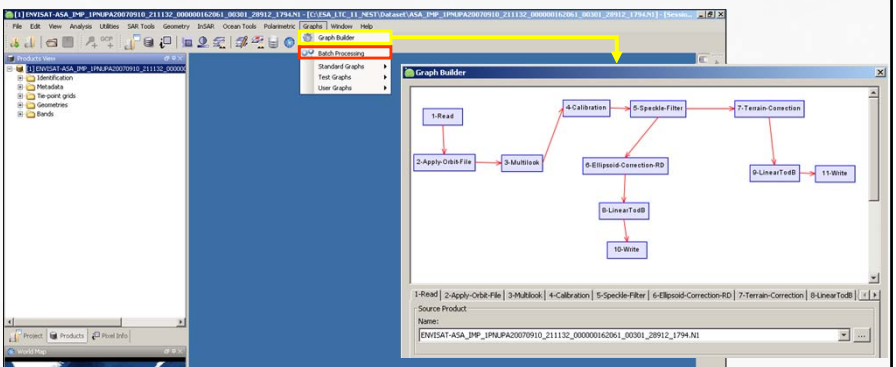
Graph Processing Tools



- Create your own processing chains & save in XML
- Visual Graph Processing Framework interface
- Executed from command line or from GUI
- Allows for ***batch processing*** on stack of images
- Very useful for large-scale processing

NEST Features

- Readers and Product library
- Utilities
- (Basic) SAR Tools
- (Advanced) SAR Tools: Geometry, InSAR, Ocean

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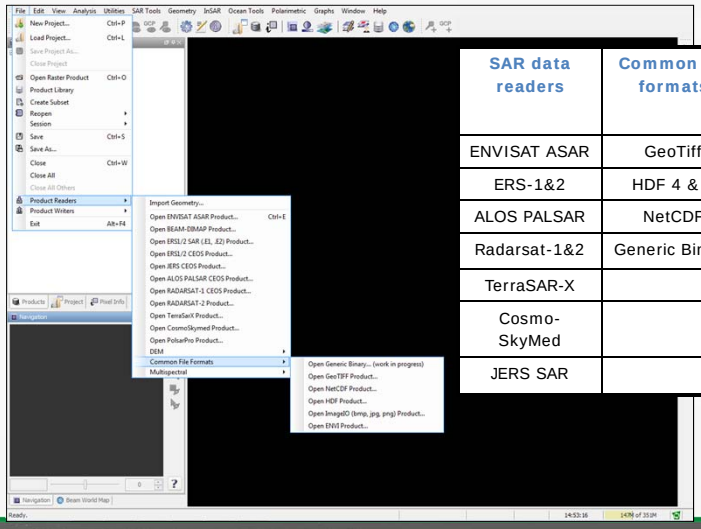
Readers



SAR data readers	Common EO formats	Compatibility with other software
ENVISAT ASAR	GeoTiff	Envi
ERS-1&2	HDF 4 & 5	PolSARpro
ALOS PALSAR	NetCDF	BEAM
Radarsat-1&2	Generic Binary	
TerraSAR-X		
Cosmo-SkyMed		
JERS SAR		

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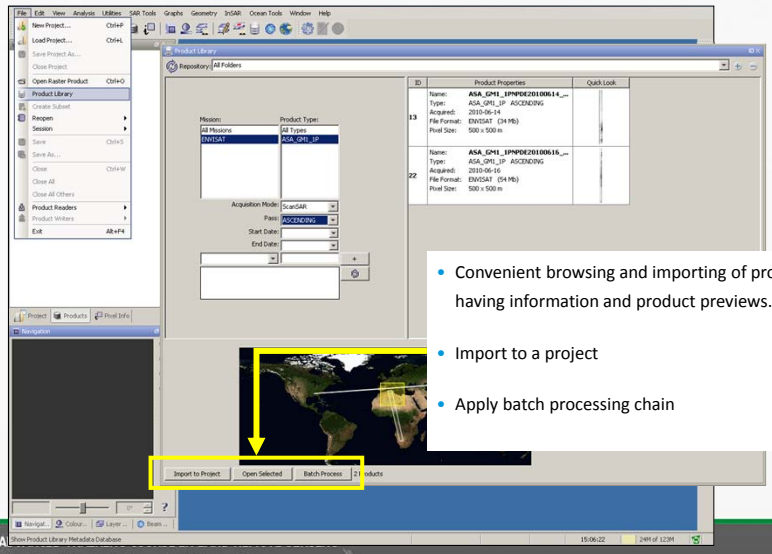
The Product Library



- Convenient browsing and importing of products having information and product previews.
- Import to a project
- Apply batch processing chain

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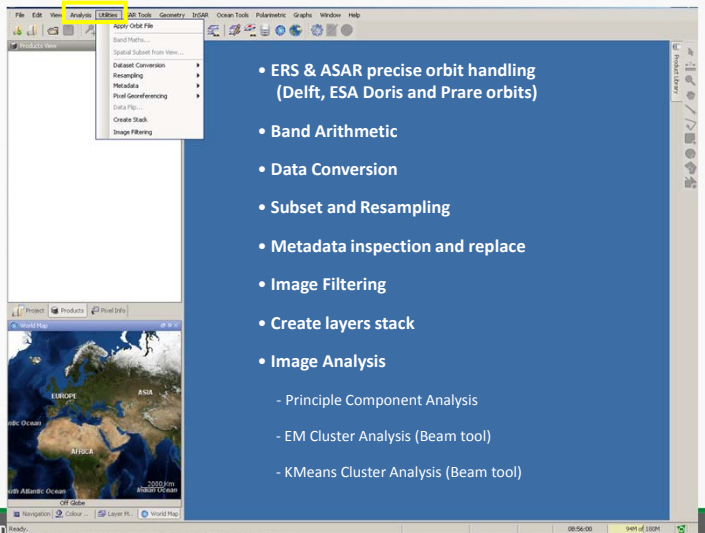
Utilities



- **ERS & ASAR precise orbit handling (Delft, ESA Doris and Prare orbits)**
- **Band Arithmetic**
- **Data Conversion**
- **Subset and Resampling**
- **Metadata inspection and replace**
- **Image Filtering**
- **Create layers stack**
- **Image Analysis**
  - Principle Component Analysis
  - EM Cluster Analysis (Beam tool)
  - KMeans Cluster Analysis (Beam tool)

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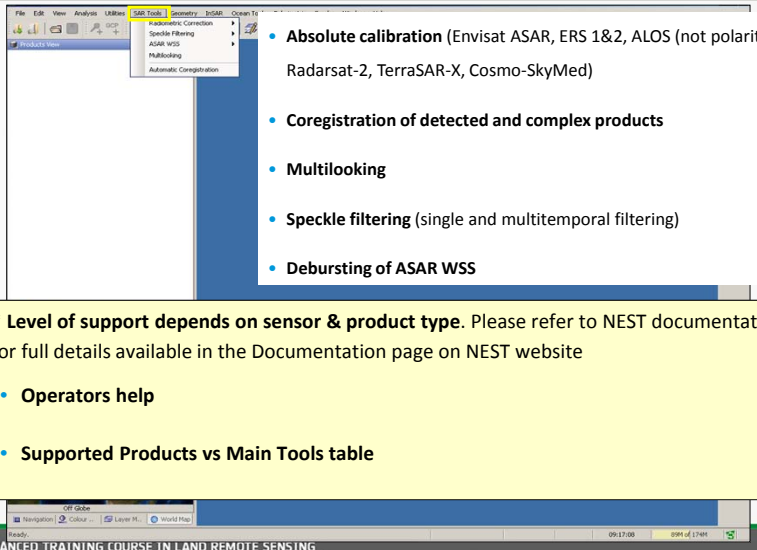
(Basic) SAR Tools



- **Absolute calibration** (Envisat ASAR, ERS 1&2, ALOS (not polaritric), Radarsat-2, TerraSAR-X, Cosmo-SkyMed)
- **Coregistration of detected and complex products**
- **Multilooking**
- **Speckle filtering** (single and multitemporal filtering)
- **Debursting of ASAR WSS**

*** Level of support depends on sensor & product type**. Please refer to NEST documentation for full details available in the Documentation page on NEST website

- **Operators help**
- **Supported Products vs Main Tools table**

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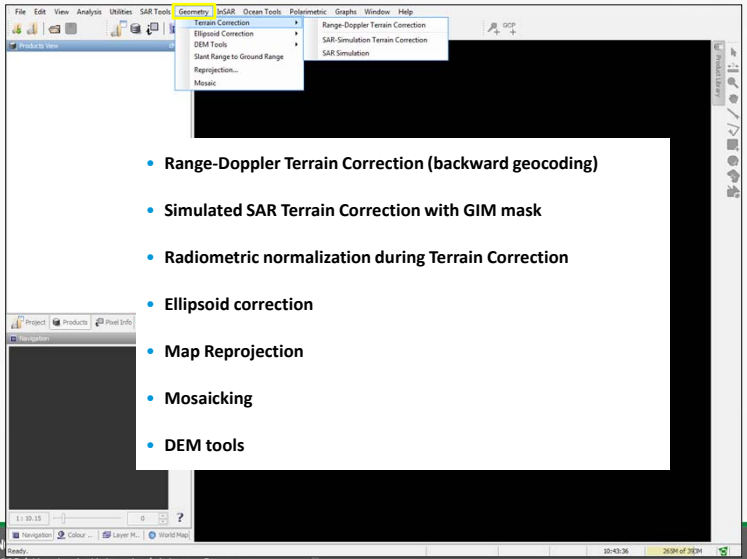
(Advanced) SAR Tools: Geometry



- **Range-Doppler Terrain Correction (backward geocoding)**
- **Simulated SAR Terrain Correction with GIM mask**
- **Radiometric normalization during Terrain Correction**
- **Ellipsoid correction**
- **Map Reprojection**
- **Mosaicking**
- **DEM tools**

(Advanced) SAR Tools: Geometry

$$\sigma^0_{NORLIM} = \sigma^0_E \cdot \frac{\sin\theta}{\sin\theta_m}$$

Mission	Range Doppler TC/SAR Simulation TC	Radiometric Normalization (Approach:Kellndorfer et al., TGRS, Sept. 1998)
ASAR	Both **complex** and **detected** products supported	Both **complex** and **detected** products supported
ERS	Both **complex** and **detected** products supported	Both **complex** and **detected** products supported
RADARSAT-2	Both **complex** and **detected** products supported	Both **complex** and **detected** products supported
Cosmo-SkyMed	Both **complex** and **detected** products supported	Both **complex** and **detected** products supported
TerraSAR-X	Both **complex** and **detected** products supported	Both **complex** and **detected** products supported

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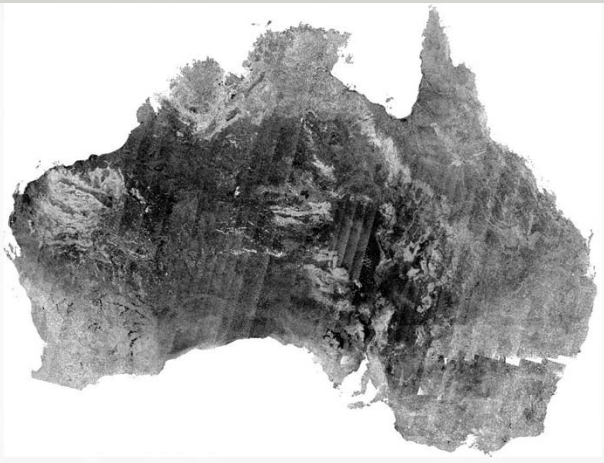
Mosaic



62 ASAR GM Products Mosaic of Australia

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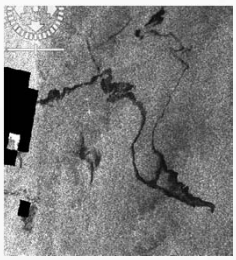
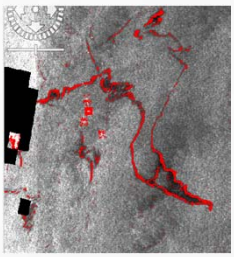
Ocean Tools

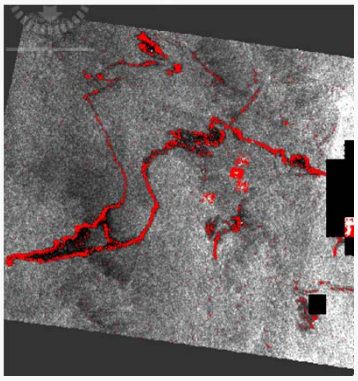
- **Object (ship) Detection**
- **Oil Spill Detection**
- **Wind Field Estimation**
- **Create Land Mask**



Land Masked



Detection



Map Projected

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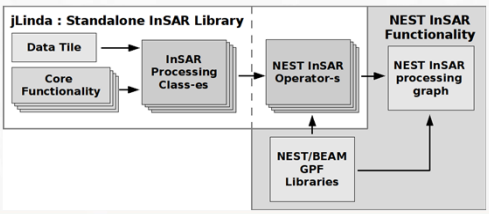
InSAR functionality of NEST

The InSAR functionality of NEST is structured in two layers:

- The core layer is formed by **JLinda** (Java Library for interferometric data analysis) which is a standalone API/InSAR library, independent from the NEST/BEAM core, encapsulating the classes, functionalities and algorithms for the interferometric processing.
- The NEST InSAR operators are built on top of core classes from JLinda package by using the NEST/BEAM Graph Processing Framework (GPF) and libraries.



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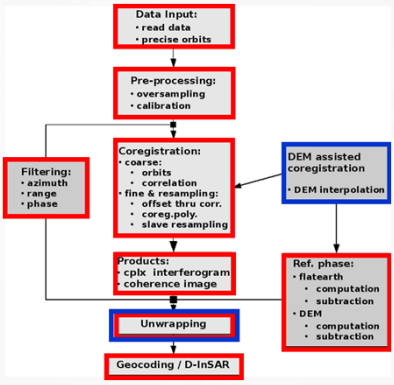
InSAR functionality of NEST



Available in 509 beta

Unwrapping via 3rd party sw (SNAPHU)

Available in 5A

Fully integrated and featured InSAR processor within NEST

- Coregistration and resampling
- **DEM assisted coregistration**
- Products: interferogram and coherence
- Filtering: both spectral and phase
- Geo-coding
- **Unwrapping**
- DEM product
- Differential InSAR
- **Cross InSAR (ERS-ENVISAT)**

Only zero doppler and strip map data are fully supported

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What's new in NEST 509 respect to 4C-1.1

- Autoupdate installation
- **New abstraction for left/right facing missions**
- **Rigorous TerraSAR-X calibration**
- **TC of TerraSAR-X detected products**
- Copy, move, delete from product library
- Graphical subset selection
- Mapping tools layers
- Mosaic several bands at once to create RGB mosaics
- Import vector operator
- Flip operator
- **Update to ENVISAT reader for ASAR 4/C specification**
- Fix for GeoTIFF projection issue
- **Code refactoring for performance improving**
- Bugs fixes

Further information

For software upgrades, documentation and more information regarding the NEST project, please visit the website at

http://earth.esa.int/nest

THANK YOU

Andrea Minchella

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EO Science, Applications and New Technologies Department

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