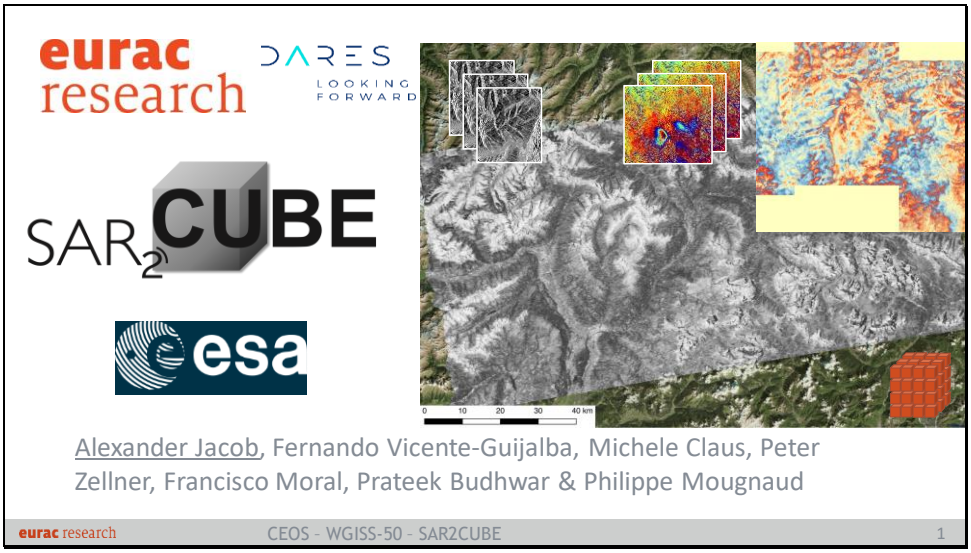
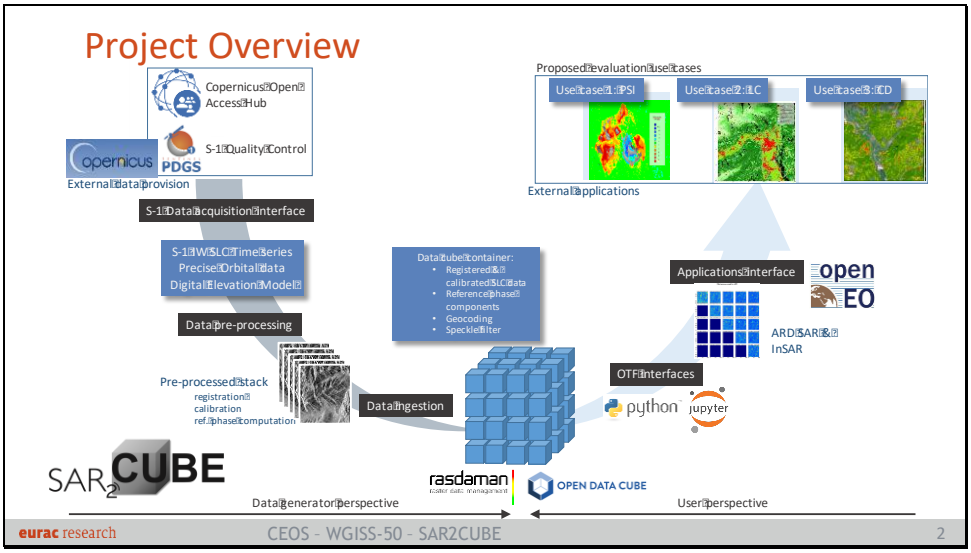
Slide 1



The SAR2CUBE project, launched in February 2020, has the objective to facilitate the use of SAR products in the scientific EO community and to promote them as relevant EO assets. The Sentinel mission within the Copernicus program defines a new playground where to exploit an extraordinary and unique amount of EO information. In particular, the radar pair defined by the twins Sentinel-1A and Sentinel-1B is offering a constant stream of SAR data since they were launched, late 2014 and early 2016 respectively. However, the interferometric capabilities provided by this source are underused. The particular nature of the complex interferometric data often presents a barrier to incorporate these data within the processing chains. The obvious nature of other kinds of sensors, such as optical or multi-spectral data, facilitates the incorporation of these products into different analysis frameworks. To reduce the entry-level barrier of the InSAR-derived products the SAR2CUBE project is designed to provide both SAR and InSAR analysis-ready data (ARD) specifically defined to achieve efficiency and flexibility in processing and analysing this valuable source of information.
The SAR2CUBE project is lead by the team of Eurac Research and carried out in collaboration with DARES Technologies, funded through the EOEP-5 open call of the European Space Agency.

Slide 2

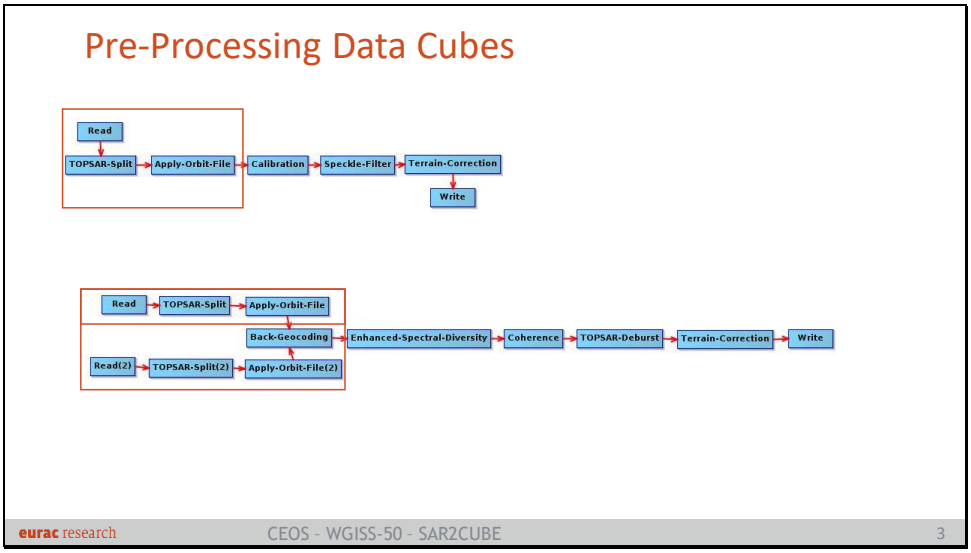


The first step on the scientific part of this project is the definition of all the required information that has to be stored in the data cubes, this includes both the original SLC data from Sentinel-1 as well as auxiliary data that is used during the workflow to be able to compute an analysis ready data product, including for example a digital terrain model (DEM) or precise orbit information. Then all pre-processing steps that can be employed without altering the nature of the original data are defined together with the way of storing those intermediate data points in the data cube. On the other end of the processing pipeline it is necessary to see how flexibility of the final analysis ready data cubes can be provided in an efficient manner. For different types of analysis different levels of filter might need to be applied, depending on robustness of dealing with noisy data. In some cases, a very strong speckle filter might be desired to provide a smooth image; in other cases, a certain level of noise might be tolerated in order to minimize the reduction of spatial detail. This requires the adaption of existing methods for a data cube ready implementation as opposed to working in the traditional file system, but also provides the opportunity for possible novel methods, fully utilizing the access to complete time series in the cube domain. See figure 1 for a general workflow of the idea.

With the digital poster we will provide an introduction to the project, the basic ideas behind it and showcase a first proof of concept implementation based on the open data cube and the openEO API for accessing and processing of the data.

The novelty of this work comes two-fold. One part is how the data is physically stored in order to facilitate flexible on the fly processing of all kinds of SAR derived products and the second part is on the access of the data through an open source api (openEO), which comes with a programming language agnostic interface, allowing for exploiting the SAR data from e.g. R, python or javascript.

Slide 3



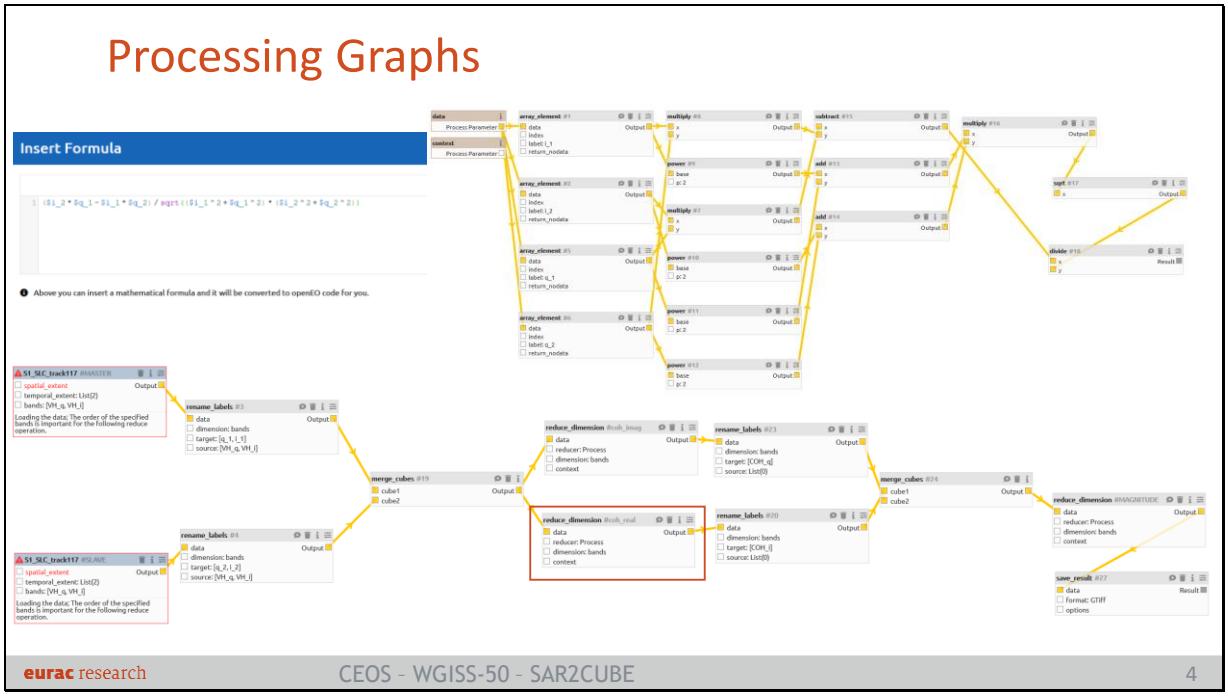
Datasets are pre-processed using both the ESA SNAP toolbox and the DARES in-house SAR processing software.
This slide shows two examples of simple processing graphs in SNAP for pre-processing of back scatter and interferometric coherence.

It can be noted that several steps in the chain are common, and that hence a partially common pre-processing procedure can be developed.
In our case the level-0 data would be the co-registered SLC stack in SAR-geometry.

Further levels of pre-processing can be achieved by adding further steps of refinement towards ARD data including different filters and normalization steps and finally geo-coding in a projected coordinate system for common use with other datasets like e.g. Sentinel-2 data.

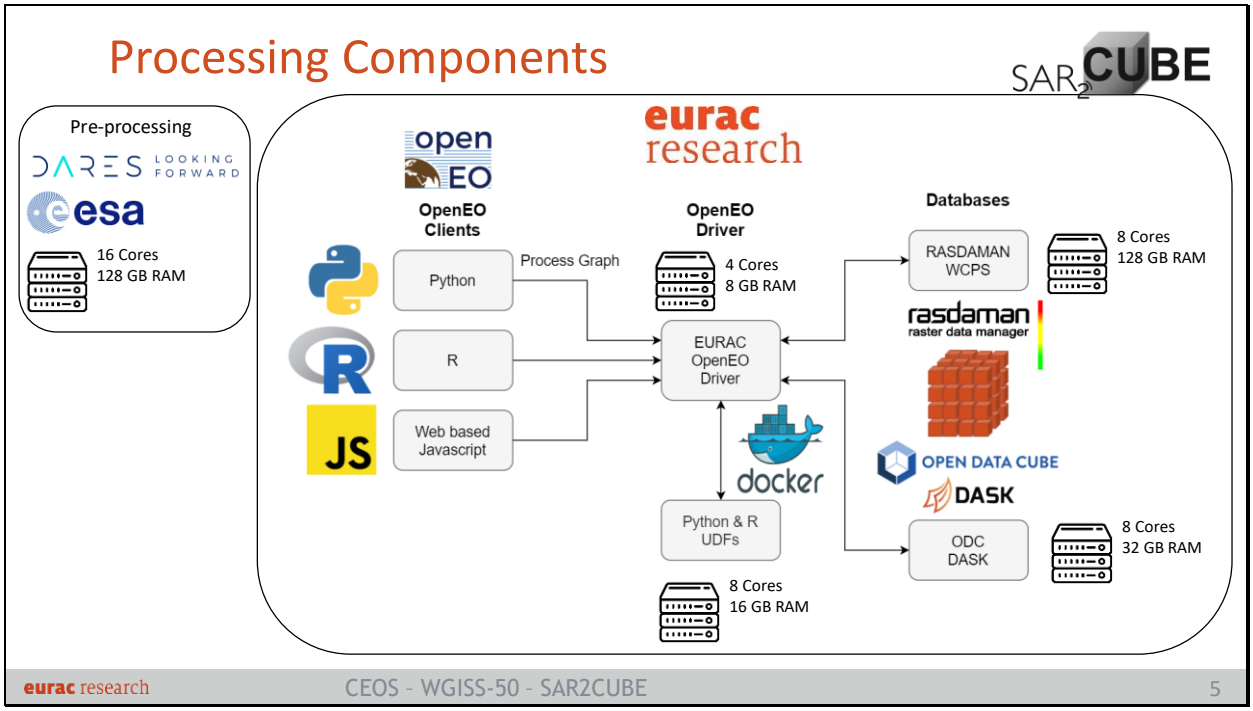
- Processing levels
    - Level-0 (L0): original SLC data in slant-range (radar) geometry
    - Level-1: (L1): filtered SLC data in slant-range (radar) geometry
    - Level-2 (L2): filtered SLC data in geographical geometry
    - http://saocompute.eurac.edu/sincohmap/rasdaman/ows
- Required extra data allocated in the cubes
    - Synthetic topographical phase: interferometric phase relative to a reference image
    - Georeference data: allows transformation from (L0 & L1) and to (L2) radar coordinates.
    - Geometrical distortion masks

Slide 4



Both the processing and SNAP and openEO is graph-based. On the previous slide we saw the processing graphs of SNAP and here we can see some examples of processing graphs in openEO. Luckily in openEO these graphs are only destined for machine to machine communication and are exchanged in form of JSON documents between client and back-end for submission of synchronous or batchjob processing.
Client software can be used to type a simple formula like the one on the top left corner for the calculation of coherence, which is then automatically translated into the graph representation for job submission.

Slide 5



In this slide we can see an overview of the processing environment composed of a number of different components.
A dedicated powerful virtual machine for generation of pre-processed data cubes of the previously described levels.
Two different data cube engines that are both tested as suitable candidates for the data provisioning and processing of jobs submitted via the openEO interface that is hosed on a lightweight VM as a web service and a dedicaed environment for running of so-called user defined functions (UDF), that are run in sandboxed docker containers with pre-defined code execution environment in R and python.
The client side can be operated as a simple software library in r or python run on a local machine or even a hosted jupyter or r-studio environment or as a web client hosted in a web-server in the case of java script.

Slide 6

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DARES LOOKING FORWARD

Thank you for your attention!

Questions & Answers?!

SAR2CUBE

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