



Forest Carbon
Monitoring

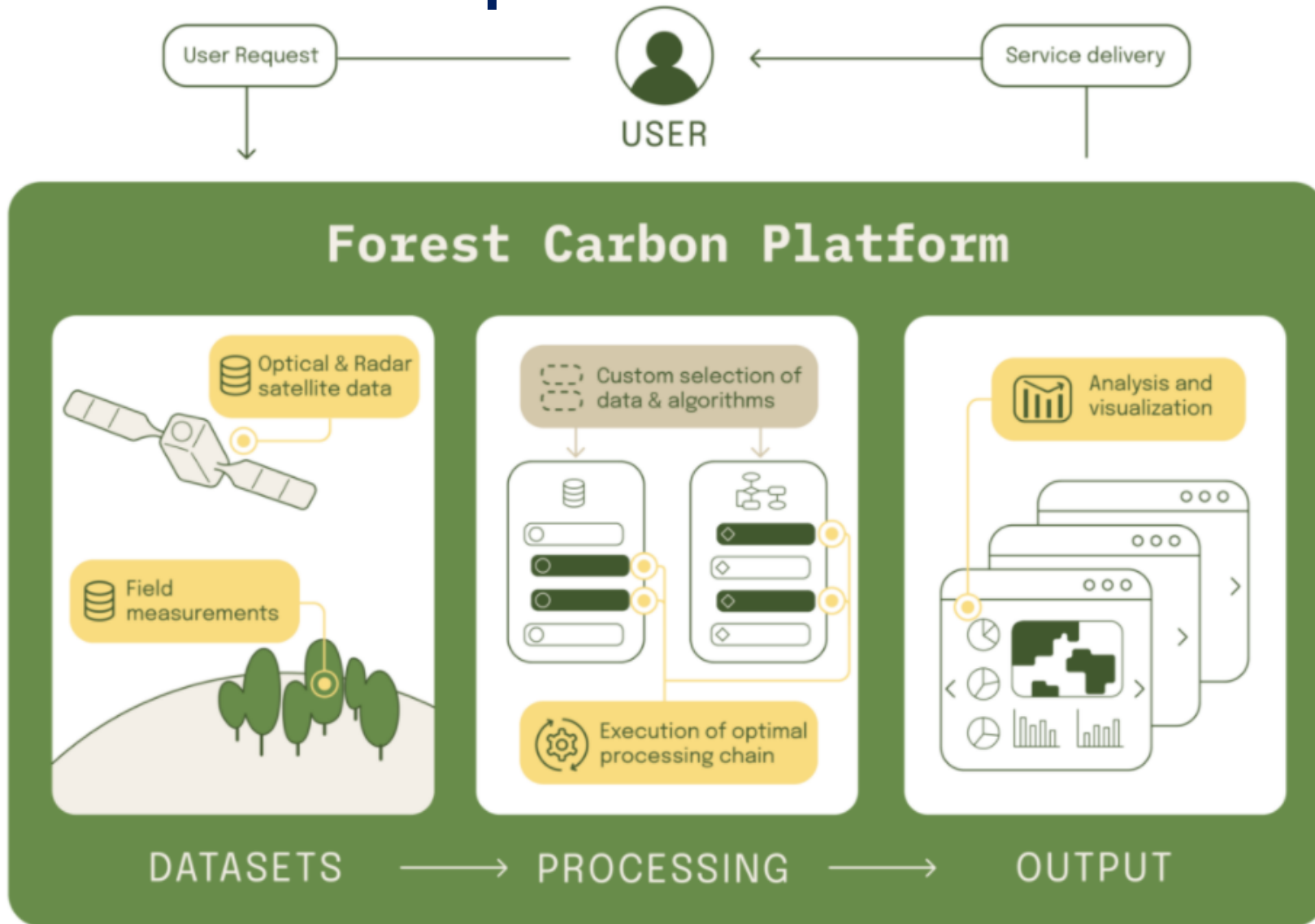
Key Technical Development

User Workshop 1-2 March 2023

Jukka Miettinen



Platform overall concept



Forestry TEP

- **Online platform for forest monitoring to maximize the benefits of EO data**

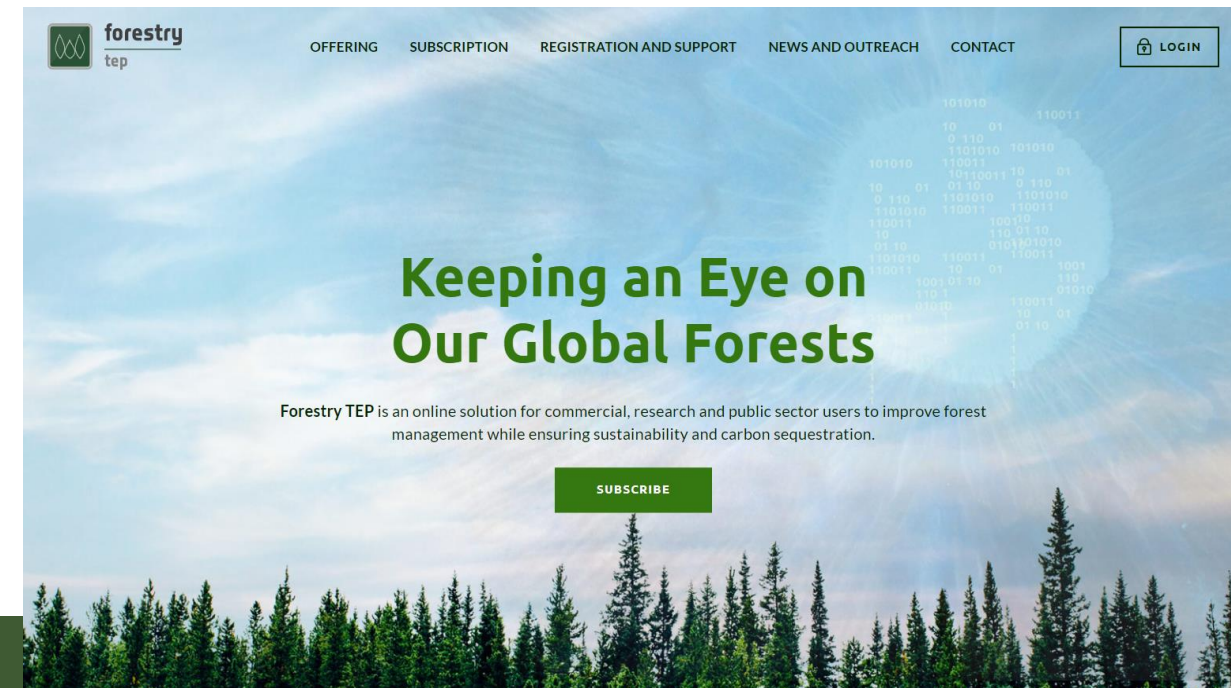
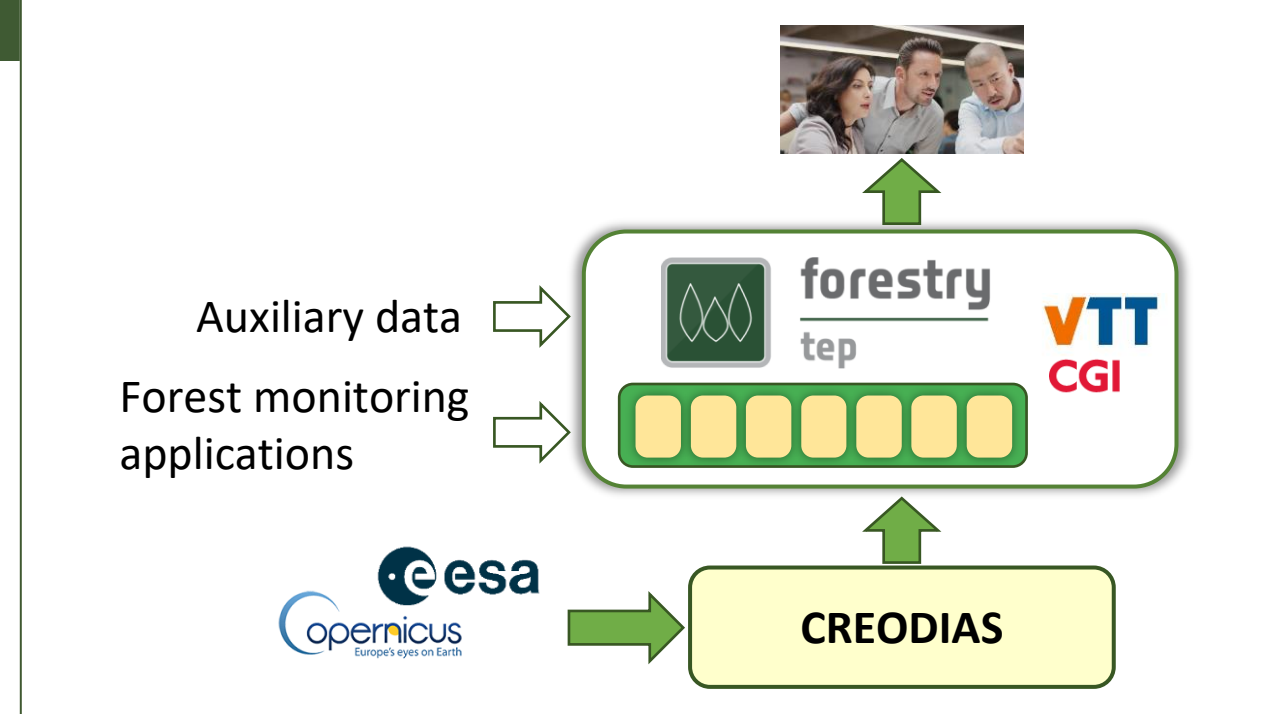
- **Ways to use the platform**

- Use available applications that combine EO data and your own input datasets
- Develop your own processing scripts
- Share or license applications
- Access or share output products

- **Two modes of usage**

- Online web user interface
- REST API for interconnecting between systems

- **All information available at: <https://f-tep.com>** →



FCM processing in Forestry TEP

High level orchestration

- Processing pipeline orchestration through the REST API access points, developed by *AFRY Smart Forestry* team, who ran the large demonstration output product processing.

Pre-processing pipelines:

- European demonstration Sentinel-1
- Sentinel-2 composite image mosaic

Output product processing pipelines:

- BIOMASAR
- Autochange
- Probability – PREBAS
- Finnish MS-NFI – PREBAS
- K-NN – PREBAS

Earth Observation Microservice Platform

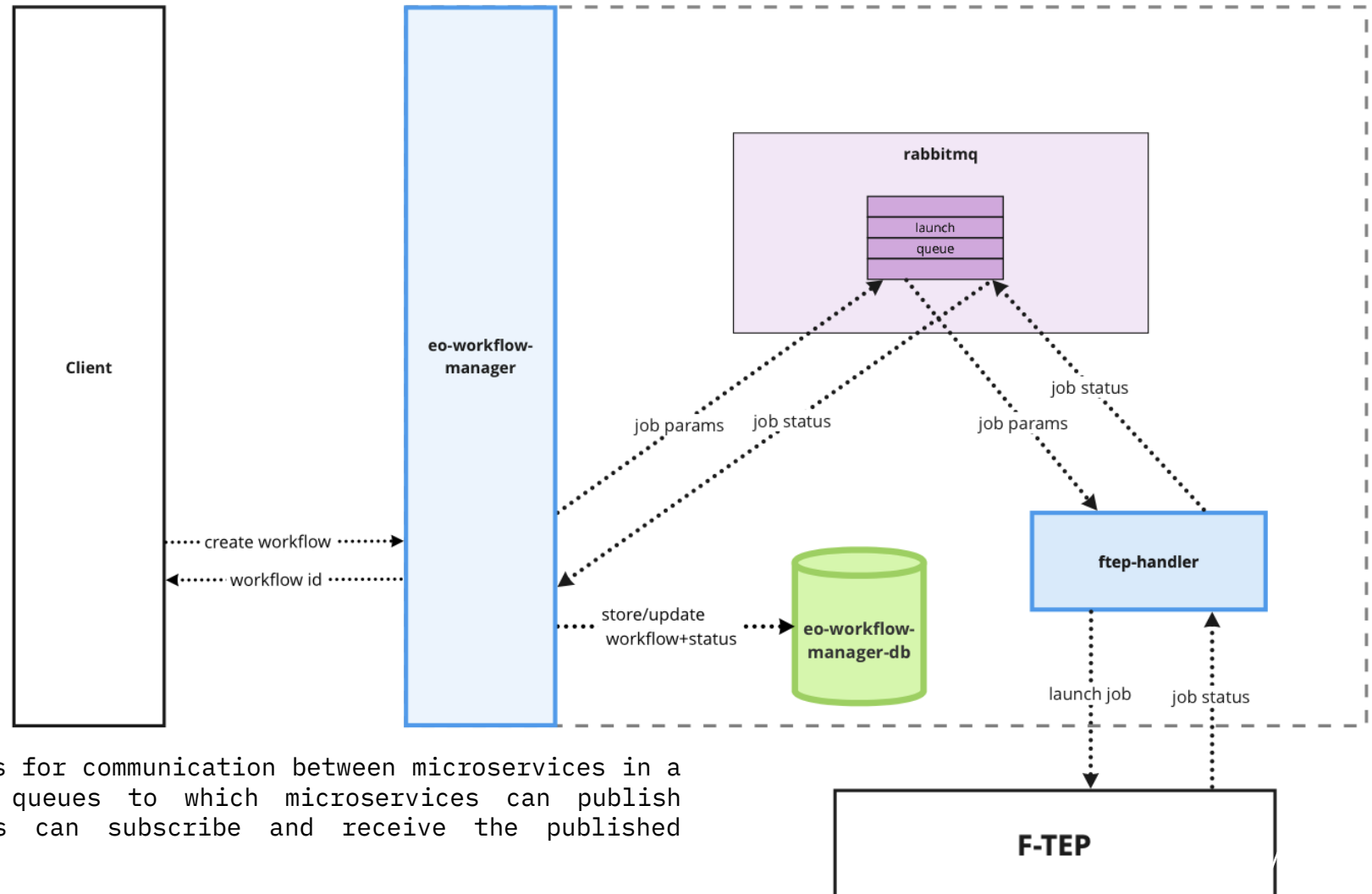
Client: The user interface to communicate with eo-workflow-manager REST API.

eo-workflow-manager: REST API to launch workflows and check status of tasks from the microservice platform.

eo-workflow-manager-db: Database which stores information about workflows, such as their configuration, and the status of the tasks contained in the workflow.

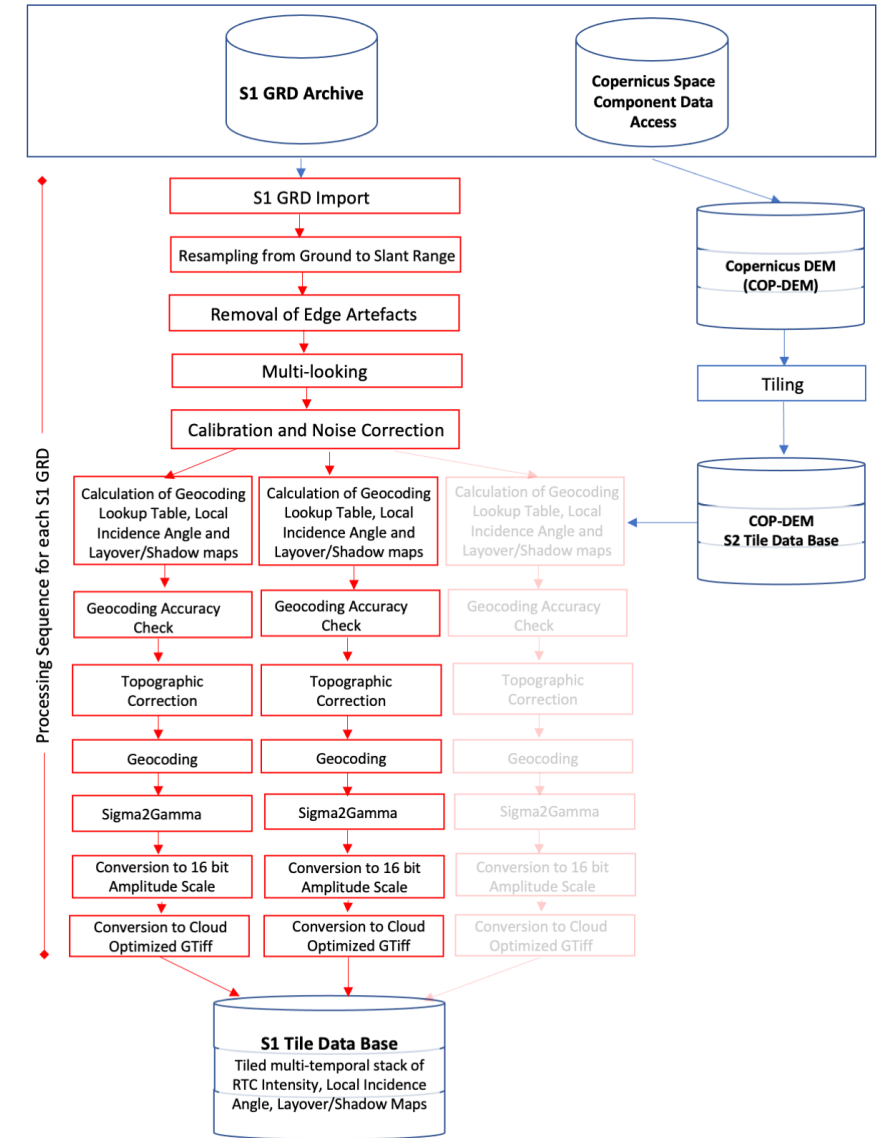
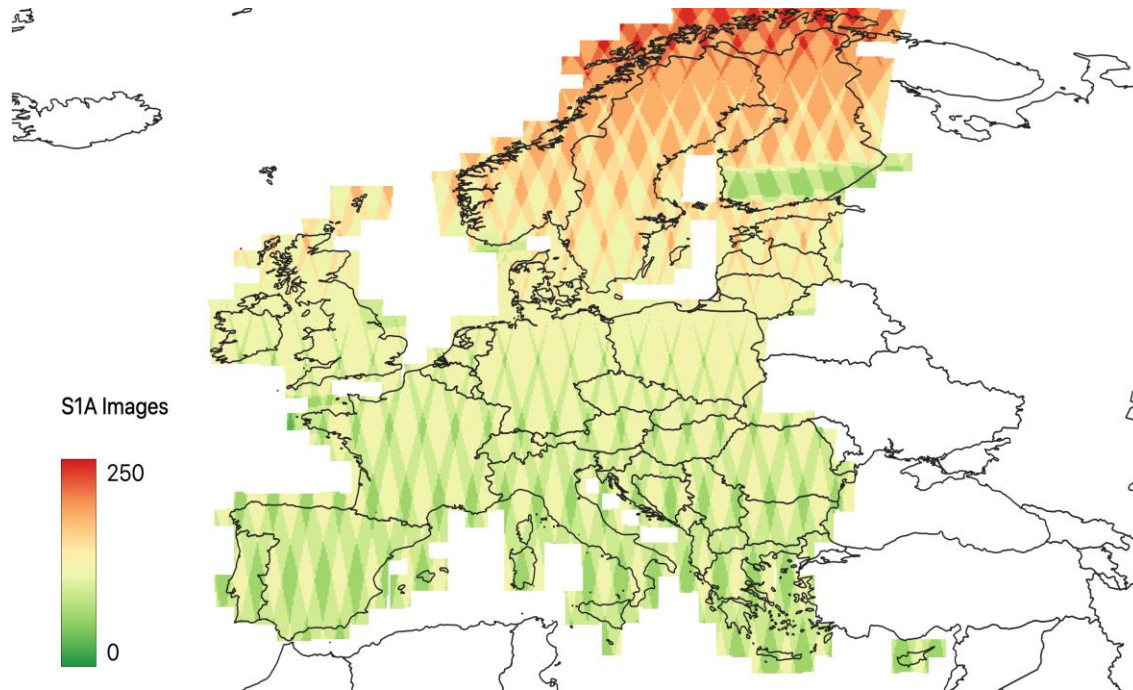
ftep-handler: Microservice which handles interactions with the F-TEP service. It launches jobs on F-TEP when requested by eo-workflow-manager, and then periodically checks the status of launched jobs and updates the eo-workflow-manager database with any status updates.

rabbitmq: Message broker service which allows for communication between microservices in a scalable manner. It consists of messages queues to which microservices can publish messages and to which other microservices can subscribe and receive the published messages.



Preprocessing: Sentinel-1 pre-processing

- Conducts independent processing of each individual S1 GRD, i.e., the service is initiated for each S1 GRD image.
- Processing results in radiometric terrain corrected backscatter images with 20 m resolution that are geocoded to the S2 tiling grid.

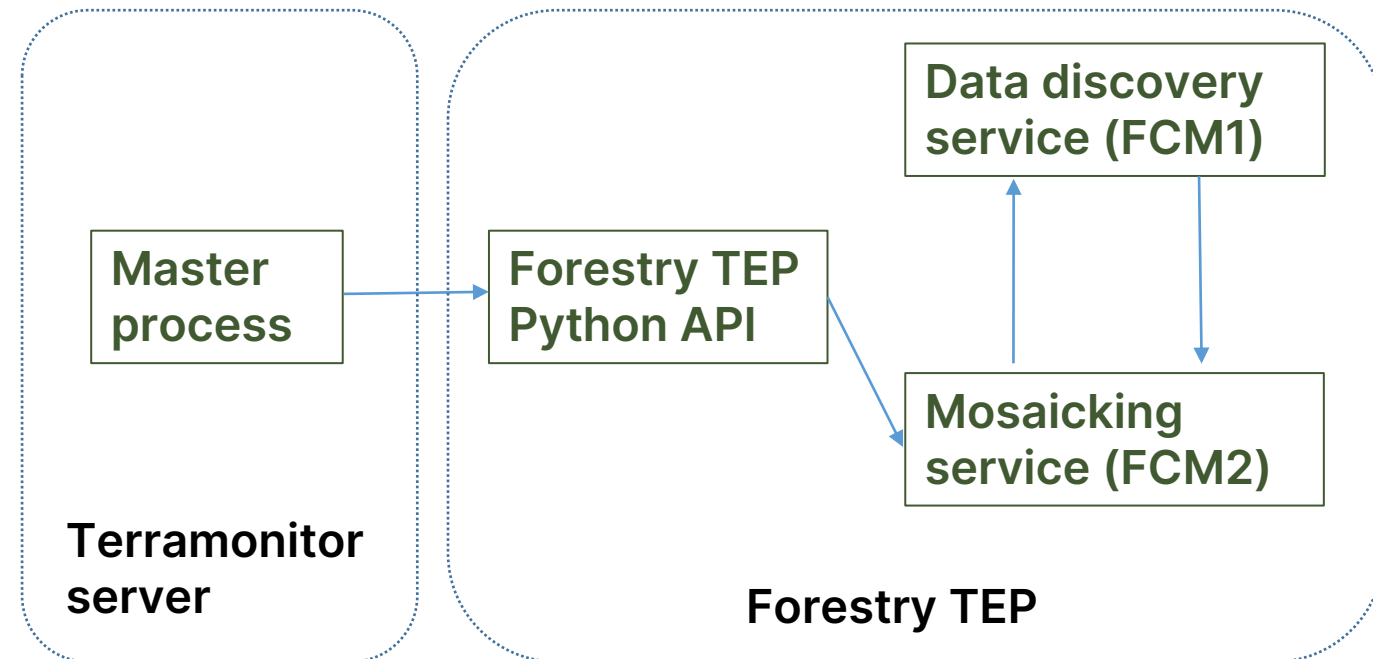
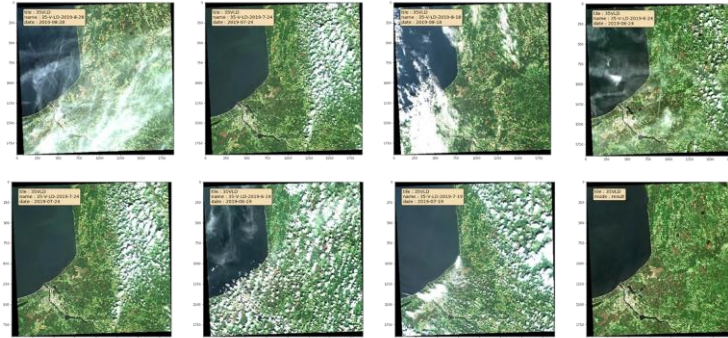


Distributed Computing on
Creodias

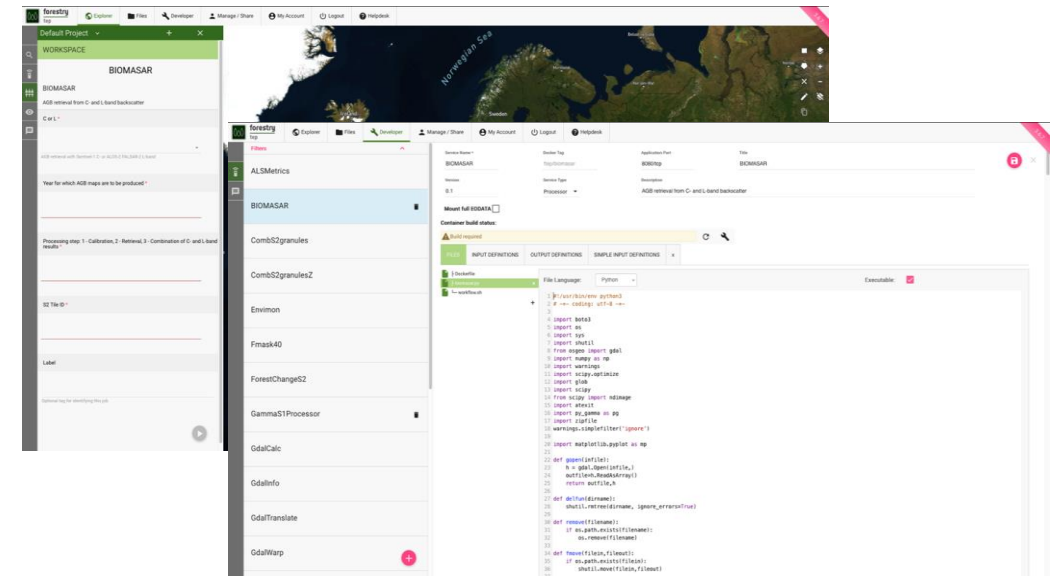
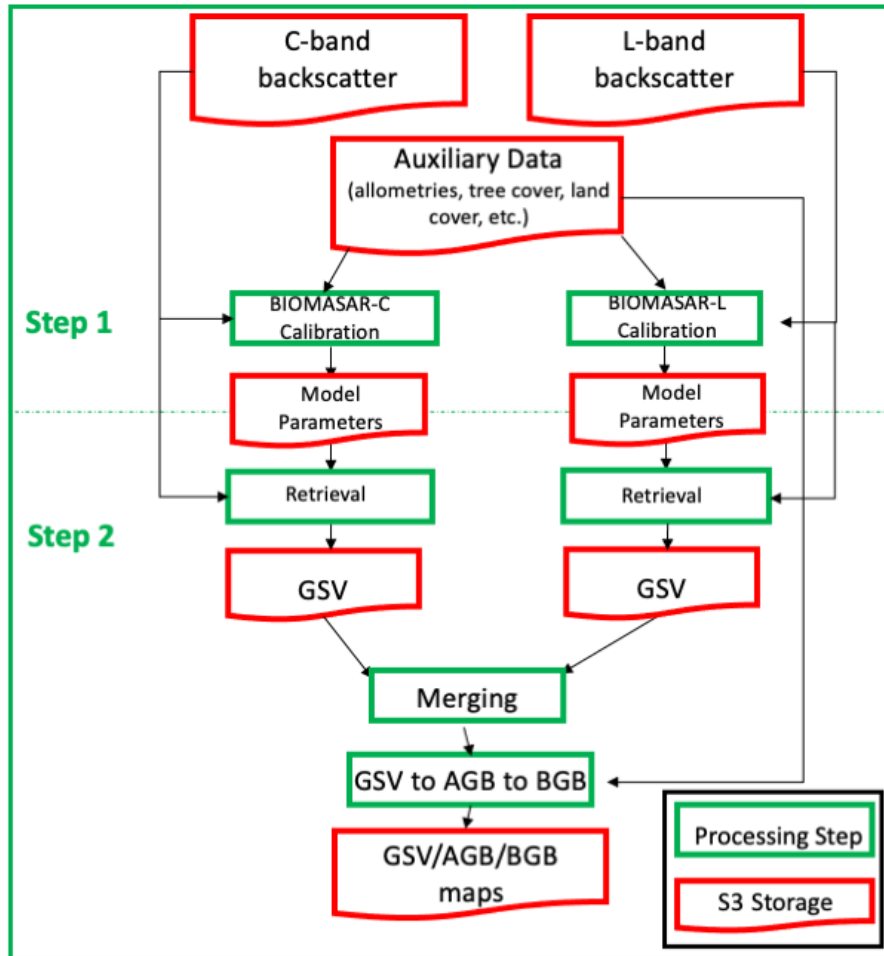
Flow chart illustrating the sequence of
processing steps for S1 TOPS GRD data.

Preprocessing: Sentinel-2 composite mosaic creation

- The *data discovery service* (FCM1) to discover available Sentinel-2 products in CREODIAS
- The *mosaicking service* (FCM2) compute the actual image mosaic using the output of service FCM1 as input.
- Both services operate on Sentinel-2 tile level.
- External master process used for batch processing by calling the FCM2 service for each tile in the area of interest for 2020 and 2021.



BIOMASAR retrieval algorithm on Forestry TEP

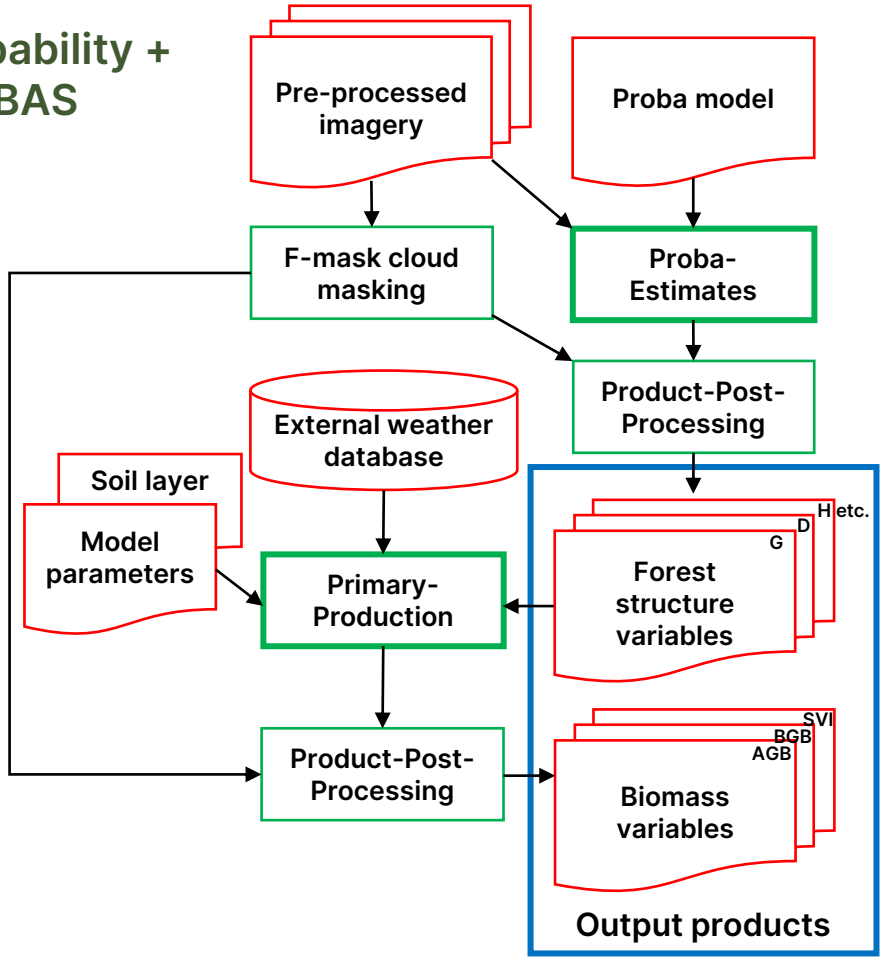


- In step 1, models relating backscatter to GSV are calibrated for each backscatter observation in the multi-temporal stack of images.
- Step 1 has to be run twice (for 2020 and 2021) for each of the S2 tiles covering the European demonstration area.
- In step 2, the C- and L-band derived GSV maps are combined to obtain improved GSV maps. Conversion factors are then obtained from the auxiliary data storage to convert GSV to AGB and finally AGB to BGB.
- In total, the service must be run 2984 times (Step 1: 746 tiles * 2 years, Step 2: 746 tiles * 2 years).

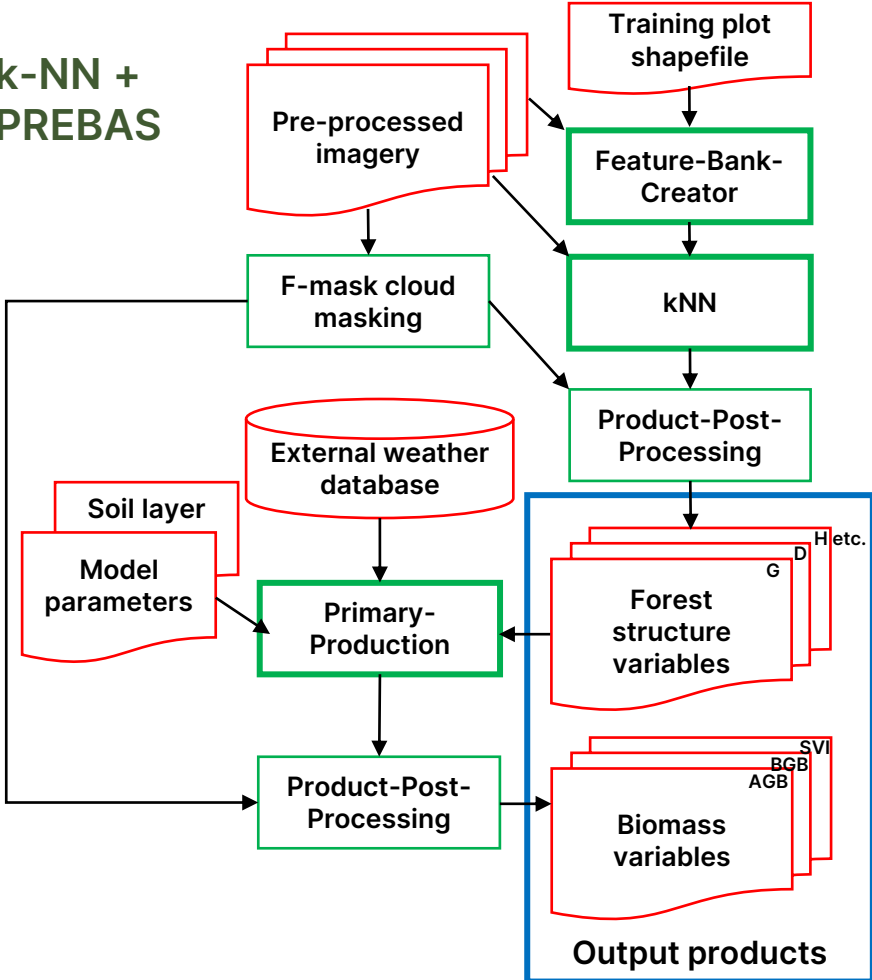
Flow chart illustrating the sequence of steps to derive GSV, AGB, and BGB maps from S1 and ALOS-2 C- and L-band backscatter data.

Probability/kNN + PREBAS processing chains

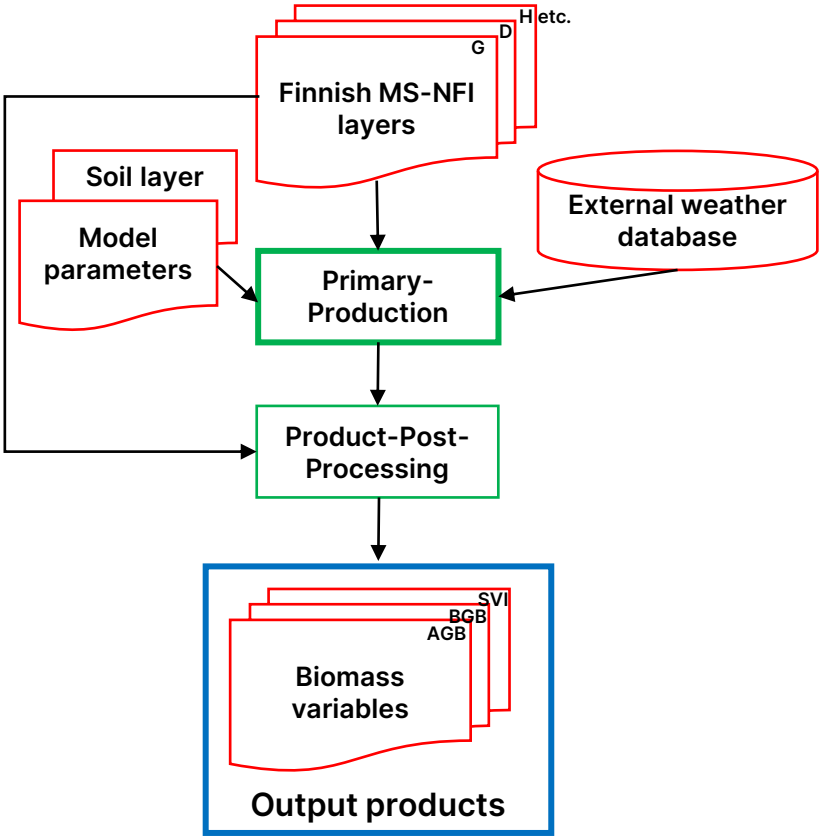
Probability + PREBAS



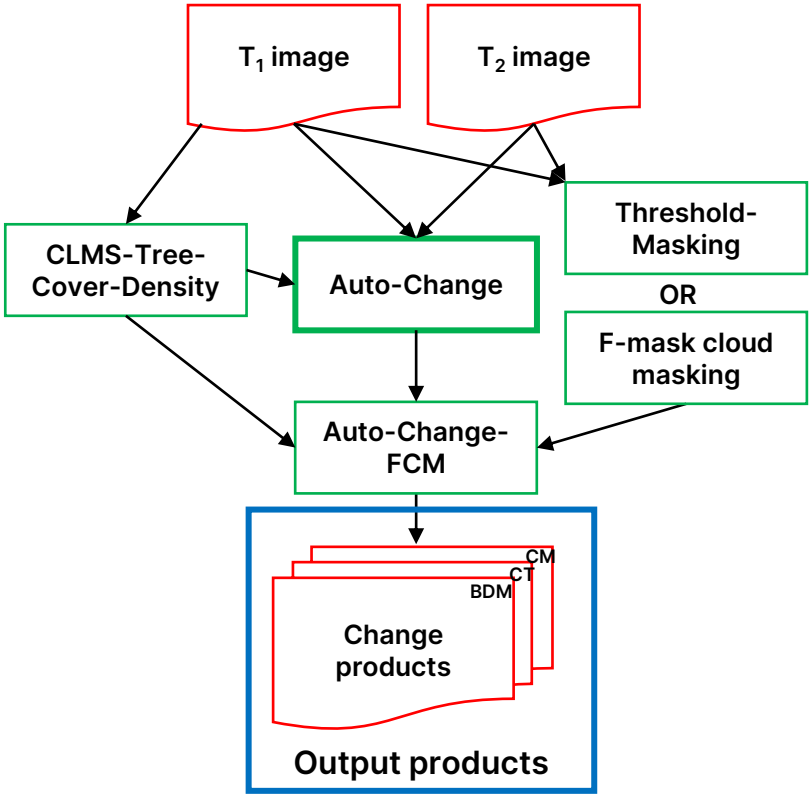
k-NN + PREBAS



Finnish MS-NFI - PREBAS processing chain



Autochange processing chain



Summary of technical development status

Status:

- Individual services can be run smoothly
- Chaining the services for mass production implemented via REST API procedures
- Data pre-processing and manipulation (e.g. calibrations and stacking of optical and radar data) was conducted outside the platform

Further development ideas:

- Adaptive data pre-processing tools, allowing smooth creation of fusion datasets
- New interpretation methods
- Output data visualization and analysis

To be defined:

- Optimal user interfaces and level of automatization for services
- Dedicated platform or generic tools available on platforms and/or offline



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Thank you!

More information at:

<https://www.forestcarbonplatform.org>

