

F-TEP – Forestry Thematic Exploitation Platform

Forest monitoring platforms workshop

San Cristóbal de las Casas, Chiapas, Mexico
23 February 2016

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+ the F-TEP Team**

F-TEP: Serving foresters, administration, scientists, service providers and NGO's globally



Topics

- Objective
- Project
- Advantages
- Functionality
- Usage scenarios
- Services and tools
- Service example: AutoChange
- Collaboration and community features
- Costs and sustainability
- Data sources



forestry

tep

- Challenges
- Users
- Pilots
- Technical solution
- Evolution

Objective of TEP Forestry

- **One-stop shop for forestry remote sensing services for the academic, operational public and commercial sectors**

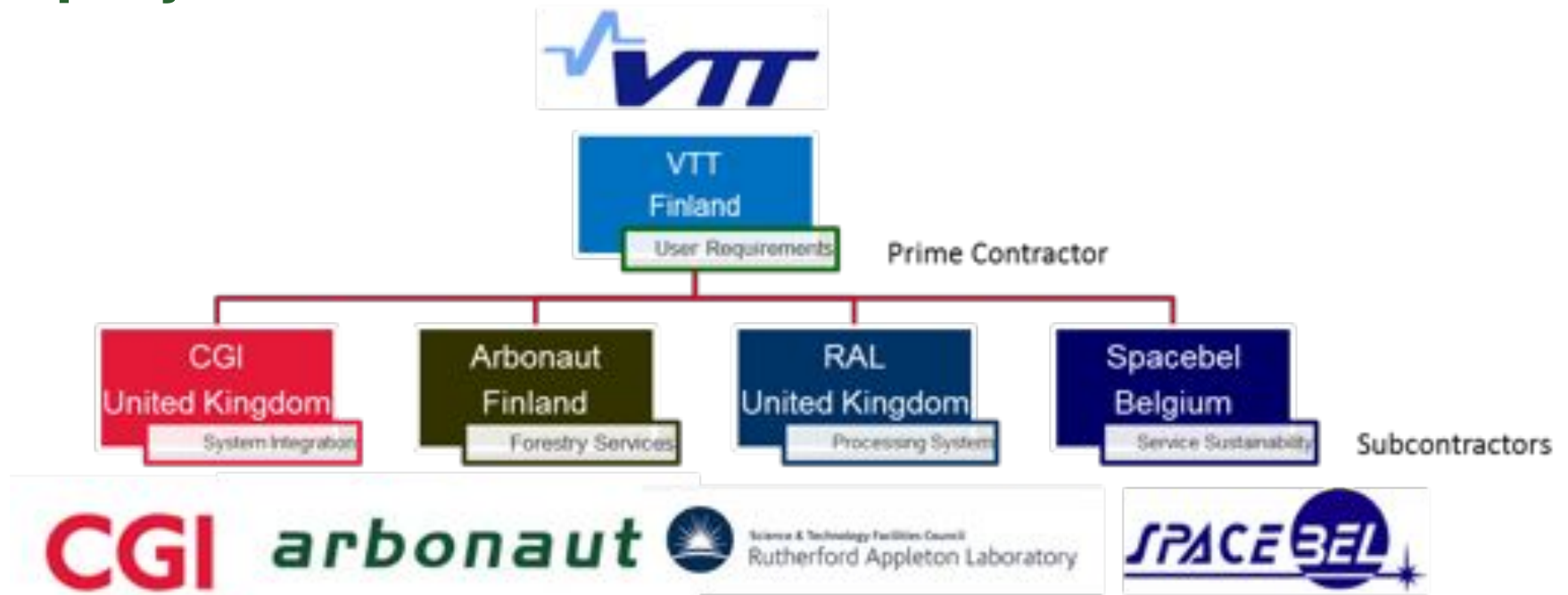


Project

- **TEP Forestry project** is funded by the European Space Agency
- 30 months from March 2015 until September 2017
- One of six Thematic Exploitation Platforms
 - Geohazards, Forestry, Coastal, Hydrology, Polar, Urban

- **Phase 1 completed:** user community survey, system design etc.
- **Current work:** detailed design, start of implementation, data and service agreements, demonstration pilot preparation, sustainability development
- **Pre-operational services** for the user community open in early 2017 (preview for selected users is planned for autumn 2016)
- Contingency being planned for after the ESA project
- In operational phase open to all users, product and service providers

F-TEP project team



- Tuomas Häme (VTT) – Project Manager & User Community Leader
- Renne Tergujeff (VTT) – Deputy Project Manager
- Clive Farquhar (CGI) – Systems Development Manager

Infrastructure services:



VTT Technical Research Centre of Finland Ltd

VTT Technical Research Centre of Finland Ltd is the leading research and technology company in the Nordic countries.

We use our research and knowledge to provide expert services for our domestic and international customers and partners, and for both private and public sectors.

We use 4,000,000 hours of brainpower a year to develop new technological solutions.

We have over 2,000 experts.
VTT Group turnover is approximately EUR 270 million yearly.

Our service offering:

- Technology and business foresight
- Strategic research
- Product and service development
- IPR and licensing
- Assessments, testing, inspection, certification
- Technology and innovation management



VTT – Centro de Investigación Técnica de Finlandia S.A.

Centro de Investigación Técnica de Finlandia VTT, sociedad anónima, es la primera sociedad en el ramo de la investigación y de tecnología en los Países Nórdicos.

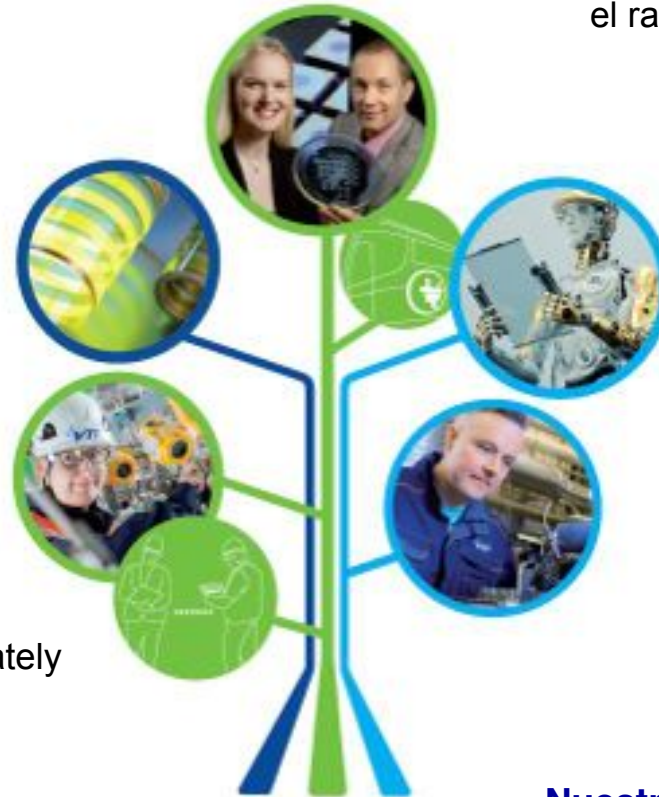
Por la investigación y conocimiento producimos servicios de pericia a nuestros clientes, socios de cooperación, ámbito de los negocios y sector público, en Finlandia y en el extranjero.

Al año utilizamos 4.000.000 de horas del trabajo cerebral para desarrollar los avances tecnológicos.

Contamos con más de 2000 expertos.
Los ingresos anuales del Grupo VTT rondan los 270 millones de euros.

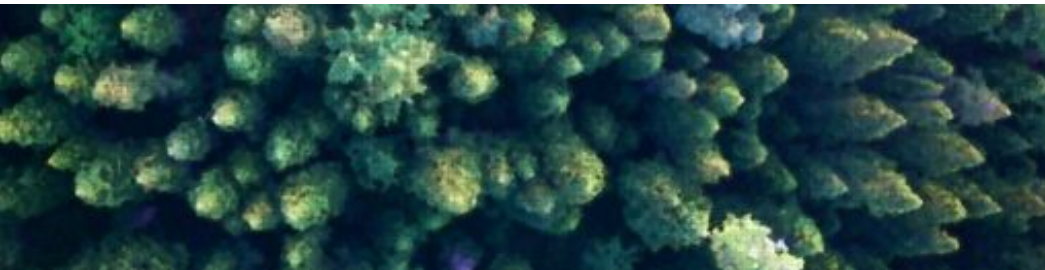
Nuestra cartera de servicios:

- Proyecciones tecnológicas y de negocio
- Investigación estratégica
- Desarrollo de productos y servicios
- DPI y licencias
- Evaluaciones, ensayos, inspección, certificación
- Gestión de tecnología e innovación



F-TEP Advantages

- Reducing the costs and effort of data acquisition and processing
- Efficient exploitation of “big forest data” for various user groups
- Moving away from the model where users work in their own ‘silos’
- Marketplace for forest community users and service providers
- Ability to benefit from self-developed services and products
- Both free and commercial services and data available



- **Full focus on the forest user community**

Functionality

- Access to relevant EO data
- Efficient remote exploitation
- Toolboxes, services
- Use of (own) in-situ data
- Very simple user interface and procedure for basic tasks
- Advanced features for more complex tasks
- Full virtual environment for expert users
- Accuracy assessment (RMS errors, confusion matrices)
- Visual analysis
- Data management
- Service development
- Sharing/licensing products & services
- Accounting
- Collaborative working
- Community features, forum
- Support helpdesk
- Usage scenarios
 - 1 - EO Data Exploitation
 - 2 - New EO Service Development
 - 3 - New EO Product Development

Usage scenario 1 - EO Data Exploitation

- **Produce products for the user himself**
- User searches and selects services and data/products
- Exploitation using the available processing and visualization tools
- e.g. forest cover map, change map, vegetation index

- Users: Non-experienced – e.g. state government, forest administration
- Needs: Data, products, services, push button functionality



User Interface Mock-up

Selection of data and processing

- *Explorer/Data*

The screenshot displays the 'forestry.tep' web application interface. The top navigation bar includes 'Home', 'Dashboard', 'Explorer', 'Workspace', 'Community', 'My Account', and 'Helpdesk'. The main content area is titled 'Data | Software' and features a search bar with 'Search' and 'Results' buttons. Below the search bar, there are filter options: 'Satellite' (unchecked), 'Products' (checked), and 'Reference' (unchecked). A table lists search results with columns for Start/End times and Metadata links. At the bottom of the table are buttons for 'Select All/None', 'Process / Analyse', 'Create Data Basket', 'Share Data Basket', 'Download Product', and 'Upload Ref. data'. On the right, a 'Metadata pop-up' window is open, showing a satellite image of a forest and a list of metadata details.

Start	End	Metadata
2015-11-19T08:43:08.000Z	2015-11-19T11:55:07.000Z	Metadata
2015-11-18T08:38:08.000Z	2015-11-19T08:43:07.000Z	Metadata
2015-11-18T08:37:08.000Z	2015-11-18T10:38:07.000Z	Metadata
2015-11-17T12:31:08.000Z	2015-11-18T08:27:25.000Z	Metadata
2015-11-17T09:21:08.000Z	2015-11-17T12:31:07.000Z	Metadata

Metadata pop-up

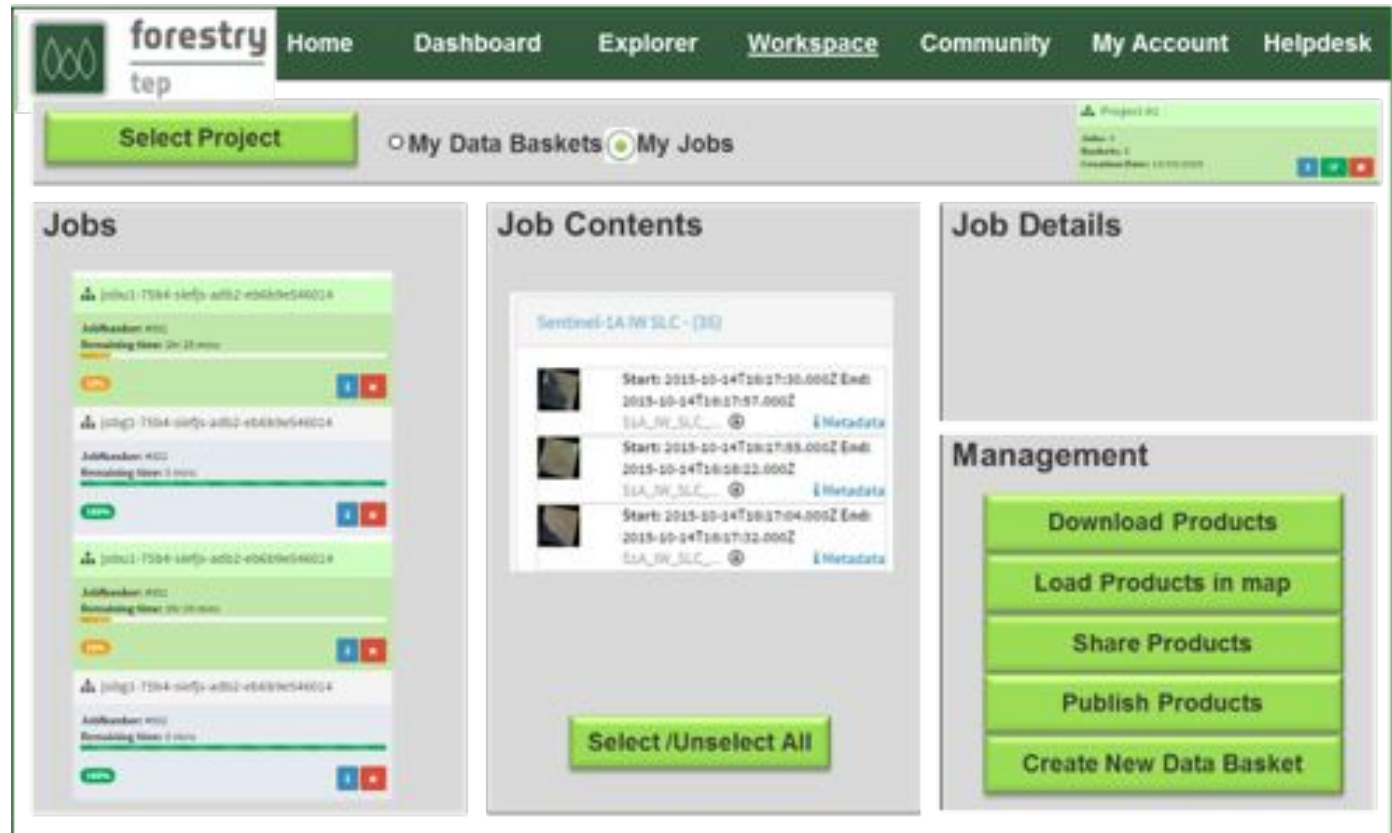
Metadata

- Collection : **S1**
- Acquisition date : **2015-04-26T06:22:20Z**
- Resolution : 30 m
- Satellite : **S1A**
- Product type : **GRD**
- Processing level : **LEVEL1**
- Sensor mode : **EW**
- Orbit number : 5651
- Publishing date : 2015-10-17T13:41:16Z

User Interface Mock-up

Monitoring and management of the processing tasks

- *Workspace/My Jobs*



Usage scenario 2 - New EO Service Development

- **Develop a new processing service**
- User develops his/her own processing algorithm into a new service
- Optionally can publish the service for others
- e.g. forest cover and biomass mapping service, change mapping service, degradation mapping service

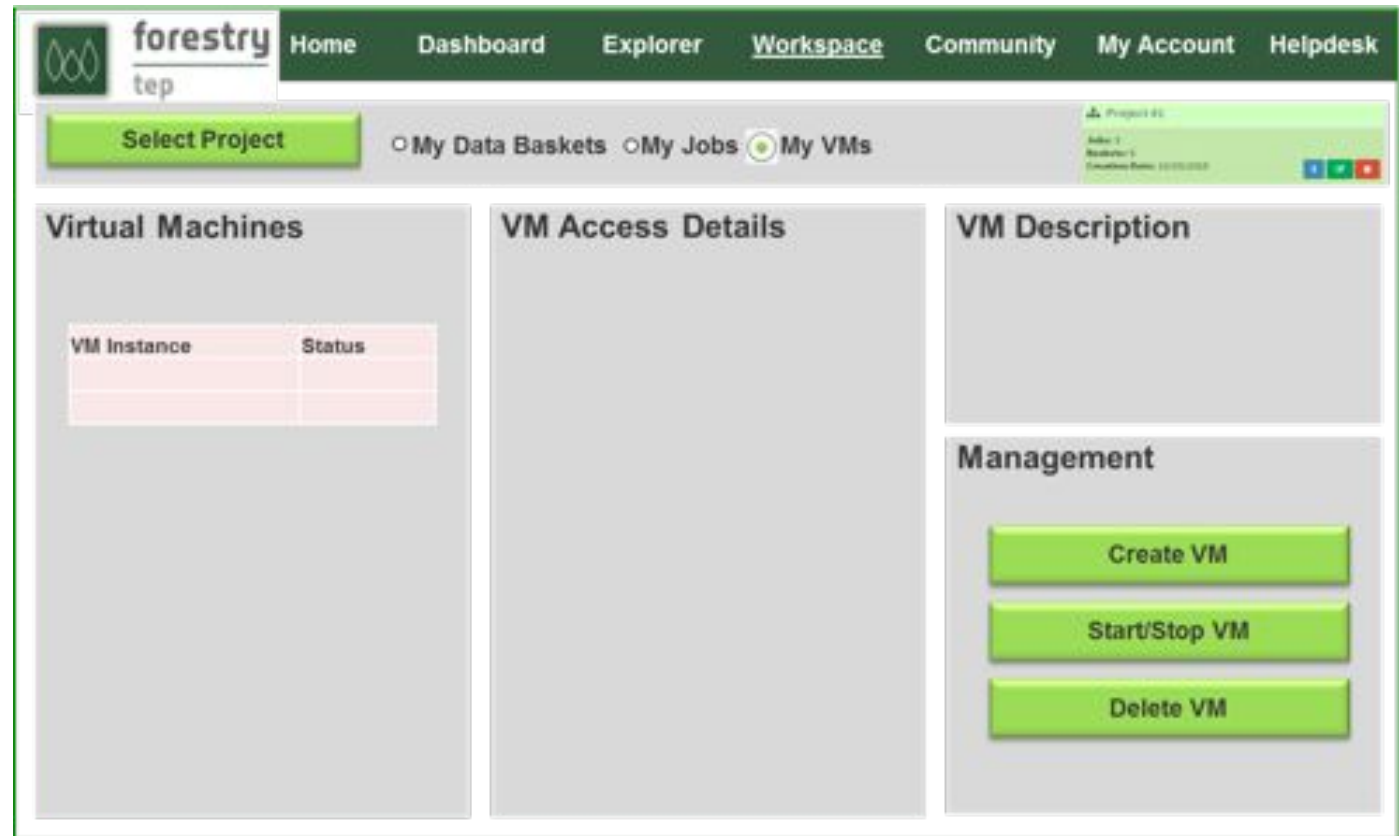
- Users: Experts – service companies, institutional users
- Needs: Versatile tools, computing power, simple charging model



User Interface Mock-up

Virtual machines

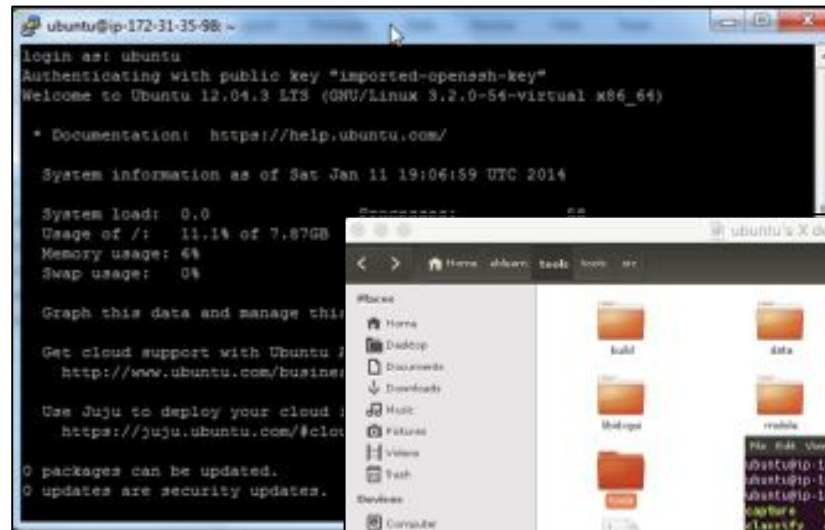
- Workspace/My VMs



User Interface Mock-up

Terminal clients and remote desktop

- Virtual machine (VM) access for service development
- Via terminal clients or Virtual Network Computing (VNC) viewer



```

ubuntu@ip-172-31-35-98: ~
login as: ubuntu
Authenticating with public key "imported-openssh-key"
Welcome to Ubuntu 12.04.3 LTS (GNU/Linux 3.2.0-54-virtual x86_64)

 * Documentation:  https://help.ubuntu.com/

System information as of Sat Jan 11 19:06:59 UTC 2014

System load:  0.0
Usage of /:   11.1% of 7.87GB
Memory usage: 4%
Swap usage:  0%

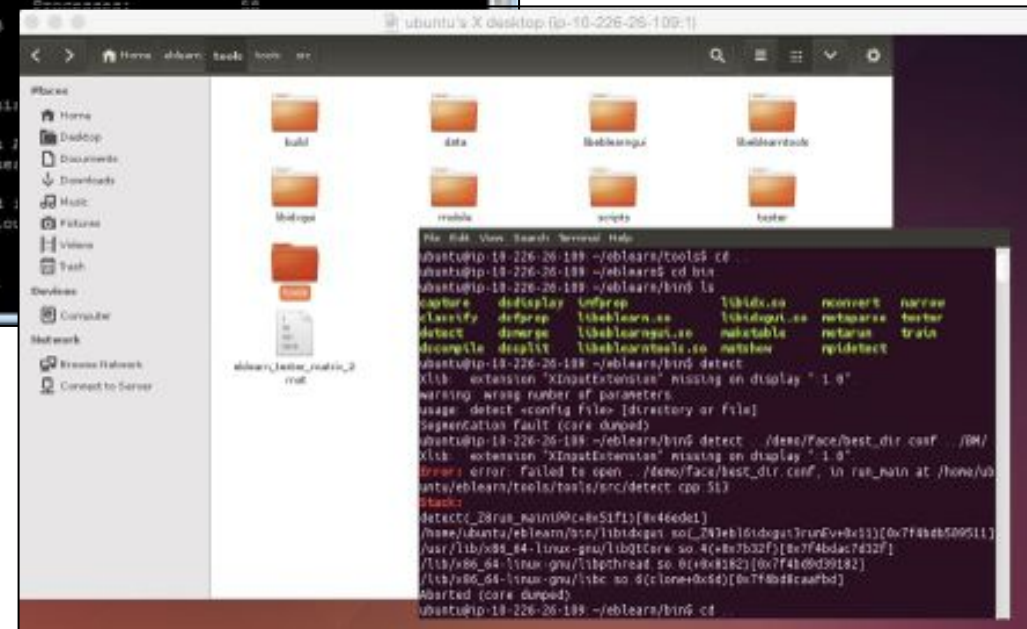
Graph this data and manage this storage space with 'glances'

Get cloud support with Ubuntu Cloudimg-utils: http://www.ubuntu.com/business/cloud

Use Juju to deploy your cloud: https://juju.ubuntu.com/#cloud

0 packages can be updated.
0 updates are security updates.

```



Usage scenario 3 - New EO Product Development

- **Generation of products for himself or for selling**
- Use of a service to create products by small-scale or bulk processing
- e.g. forest cover and biomass maps, change maps, degradation maps, primary productivity

- Users: Experts – academic & institutional, value adding ‘factory’ industry
- Needs: Versatile tools, computing power, simple charging model in case of commercial activity



User Interface Mock-up

Data management

- Workspace/ My Data Baskets

The screenshot displays the 'forestry tep' web interface. The top navigation bar includes links for Home, Dashboard, Explorer, **Workspace**, Community, My Account, and Helpdesk. Below the navigation, there are buttons for 'Select Project', 'My Data Baskets' (selected), and 'My Jobs'. A 'Project ID' section shows 'Julius 1', 'Basket ID: 1', and 'Created/Updated: 2015-01-01 10:00:00'. The main content area is divided into three panels:

- Data Baskets:** A table listing baskets with columns for Name, Size, and Add.

Name	Size	Add
SEA_WB_OUT __SSOV_20150831T084212_SBOC	40.55 Mb	
F1A_EW_OUT __SSOV_20150831T084212_SBOC	108.26 Mb	
F1A_EW_REF __SSOV_20150831T084212_SBOC	1108.28 Mb	
North Europe #2	6	
Amazon #11	4	
- Basket Contents:** Shows the contents of the selected 'Sentinel-1A W SLC - (30)' basket. It lists three items with their start and end times and a 'Metadata' link.

Item	Start	End	Metadata
	2015-09-24T10:17:30.000Z	2015-09-24T10:17:57.000Z	Metadata
	2015-09-24T10:17:58.000Z	2015-09-24T10:18:12.000Z	Metadata
	2015-09-24T10:17:04.000Z	2015-09-24T10:17:32.000Z	Metadata
- Basket Details:** Currently empty.
- Management:** A vertical stack of buttons: 'Download Products', 'Load Basket in map', 'Share Data Basket', 'Process/ Analyse', 'Save as', and 'Create New'.

A 'Select /Unselect All' button is located at the bottom of the Basket Contents panel.

Services and tools

- Sentinel toolboxes
- Monteverdi / Orfeo toolbox
- QGIS
- Open Foris
- Preprocessing, ortho-rectification, and radiometric and geometric correction tools
- VTT software AutoChange, Probability, Envimon
- AccuCarbon method (ESA Innovators III project)
- Possibly output from other projects, such as ESA DUE GlobBiomass and ESA Innovators III SAR for REDD
- More

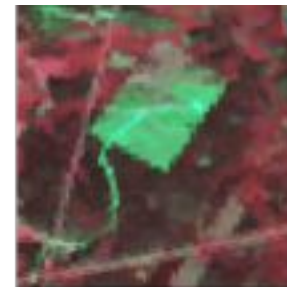


Service example: AutoChange

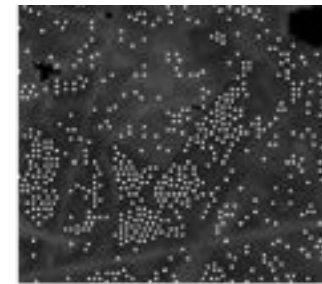
- Change detection method developed by VTT
- Analyses the magnitude and the type of change
- Based on hierarchical clustering
- Can detect rapid changes in small proportions of area



1.9* 1.9 km² Jul 13, 2013



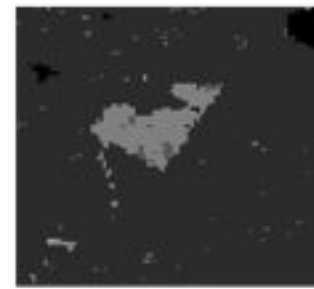
Jul 23, 2014



Intelligent selection of objects for clustering



Primary clusters 2013



Change type



Change magnitude



Map of cuttings

AutoChange example (1)

- Landsat-8 image from 7 July 2015 (~5x5 km)



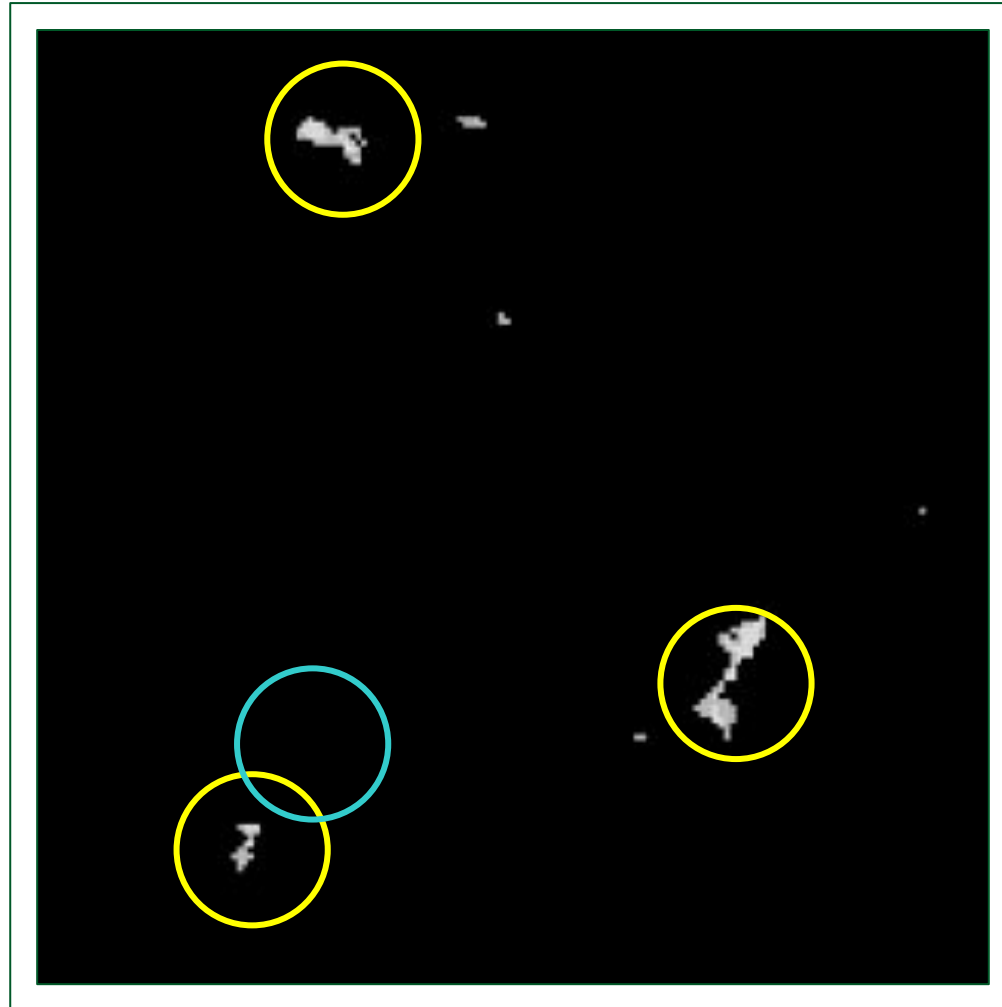
AutoChange example (2)

- Landsat-8 image from 20 August 2015 (one month later)



AutoChange example (3)

- Clear cuts identified
- Method validation not yet completed



Collaboration and community features

- Can work together in generating products and developing services, share them with other users, review products and services shared by others, and discuss them with the authors
- Can form groups of users with similar interests
- Can ask questions at the user forum
- Can share processing code and workflows
- Can manage own data sets and projects and optionally publish the results to other users
- Linking with external forestry communities through themed news and Twitter feeds



Costs and sustainability

- The development phase is paid in full by ESA
- Aiming for sustainable operation after the pre-operations phase
- Costs accounting is supported to enable pay-per-use model
- Complementing possible funding sources
 - fees from service, data and product providers
 - fees from users for some services
 - donor fund
- Freemium model now the primary approach
 - Free entry-level services
 - Multiple service levels



Web Access & Visualisation Tools

EO Toolboxes

- Earth Science Tools
- nest
- BEAM
- JIRA
- GDAL
- POLARPRO

Free SAR & Optical Data

Free of Charge Component

Commercial SAR data

Turn-Key Products

VHR data

COTS Software

Commercial Component

Data sources (free and commercial)

- Sentinel-1
- Sentinel-2
- Landsat-5/7/8
- ERS-1/2 SAR
- Envisat ASAR
- DEM (various)
- ALOS PALSAR
- JERS
- Pleiades
- Spot
- SAOCOM
- RapidEye



Challenges

- Enlighten and encourage the forest user community to use F-TEP
- Ensure sustainability
- Communication network is an issue outside Europe
- Uncertainties in data, models and products
 - Products to be accompanied with metadata annotating the uncertainty



Target communities and their needs

- Primary user communities identified
 - ESA will define additional users during the project
- Similar requirements
 - Easy access to a range of specific products
 - Timely access to data
 - Access to wide set of data types
- Diversity in user requirements
 - e.g. spatial resolution, processing levels, source data, geographic area
 - Scale: from small study areas to sites to province and to country level

User Type	What they do	Key user needs
Forest and climate research community	Varies from developing own products to using existing products	Multi temporal & multi-sensor data, ability to tweak algorithms
Forest owners and managers	Monitor forest state and plans	Accurate and timely products (resource pool, damage, accessibility, etc.)
Forest certification organisations	Granting certificates of sustainable forestry	Information on good and sustainable forest management
Regional/national forest administration	Collect information on national forest resources to support forest planning and management	Timely information on forest status of forest (clear cuts, shrub abundance, etc.)
International Initiatives, research programmes and panels	Coordination of satellite image acquisition, pre-processing and delivery	Support to coordination activities
International development banks	Evaluation of forest state and resources; establishing markets for forest ecosystem services	Timely and accurate information forest resources and their dynamics including deforestation and forest degradation
Sustainable development NGOs	Economic and policy decisions affecting forests	Reliable and easy-to use products on forest cover, degradation, fragmentation, etc. (requiring also historical data)
UN organisations	Capacity building for the UN member countries on national forest inventories and REDD	Easy-to-use and freely distributable image analysis tools; access to pre-processed low-level products
Value adding (SME) industries	Collect and refine satellite and ancillary data for value added products to satisfy customer needs	Information on the amount and location of forest resources, monitoring of change

Core users of F-TEP

- Forestry Development of Ministry of Environment and Natural History, State Government Chiapas, Mexico
- Juarez University of Durango State, Mexico
- National Forestry Commission CONAFOR, Mexico
- Food and Agriculture Organization of the United Nations (FAO)
– Forestry Assessment, Management And Conservation
- Joint Research Centre / EC - Forest Resources and Climate Unit
- Global Forestry Observations Initiative (GFOI)
- UN-REDD
- more

Pilots in Mexico and Finland



Monitoring of forest carbon in Mexico



**Mapping of harmful broadleaved shrubs
in regeneration areas**

Approach to pilot projects

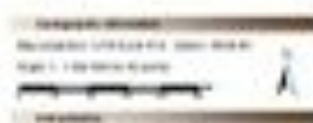
- Demonstrate the key functionalities of the TEP
 1. Showcase for the usefulness of the TEP
 2. Provide means for close engagement with key users
 3. Validate the TEP functions through actual usage
 4. Provide a template for later services to follow
 5. Deliver a service of value in itself to many users
- Involve users from research community, operational users (e.g. decision-makers in forest management)

Pilot projects

	Pilot 1 (Mexico)	Pilot 2 (Finland)
Region	Mexico: Chiapas and Durango states	Finland
Area covered	73,311 km ² (Chiapas) and 123,317 km ² (Durango)	338,424 km ² (TBD according to user preferences)
Theme	Monitoring of above ground biomass and quantifying associated carbon stocks for climate change reporting	Operational forest management; mapping undesired broadleaved tree shrubs on forest regeneration areas
Key outputs	Forest cover mapping and change detection	Map on degree of shrub damage on regeneration areas
Key data used	Sentinel-1 SAR, Sentinel-2 optical (one state)	Sentinel-2 Optical
In-situ data	1: Durango university ground sample network 2: From ESA pilot project EducEO 3: Optionally NFI plots from Chiapas	Forestry Centre's stand database Collected by Forestry Centre during standard field work
Key users involved	Ministry of Environment and Natural History of the state government of Chiapas University of Durango Mexican NGO's (several) ESA nominated users	Finnish Forest Centre (part of Ministry of Agriculture and Forestry) ESA nominated users



- Legend**
- Forest loss
 - Forest gain
 - Deforestation
 - Change
 - Forest loss



Disclaimer

The data used in this map were derived from satellite imagery and processed using the Global Forest Change v1.0 algorithm. The data are provided as a general overview and should not be used for legal or policy purposes. The data are subject to change and may be updated in the future.

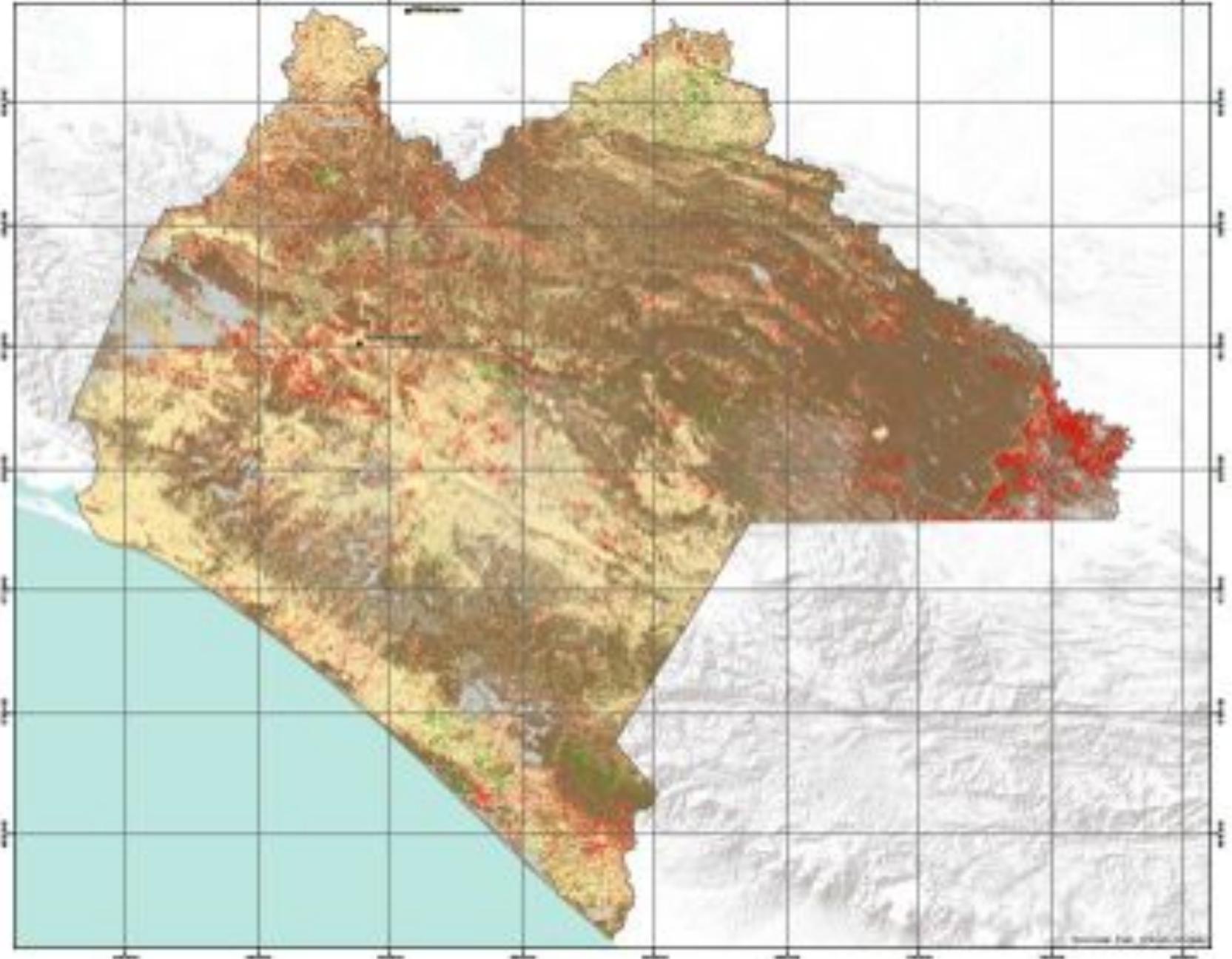
References

FAO. 2010. *World Forest Resource Assessment 2010*. Rome, Italy: FAO.

Global Forest Change v1.0. 2015. <http://www.forestchange.org/>

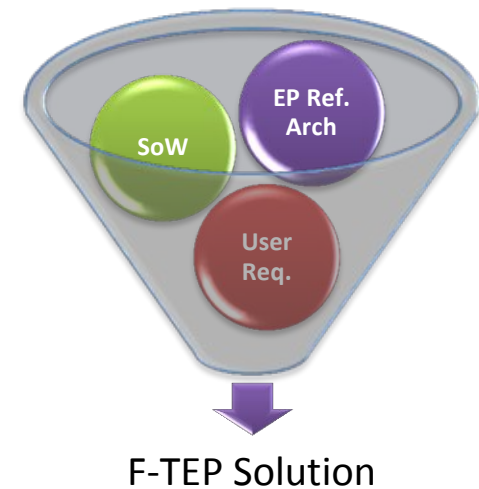
Supporting Information

Supporting Information for this map is available at www.forestchange.org/

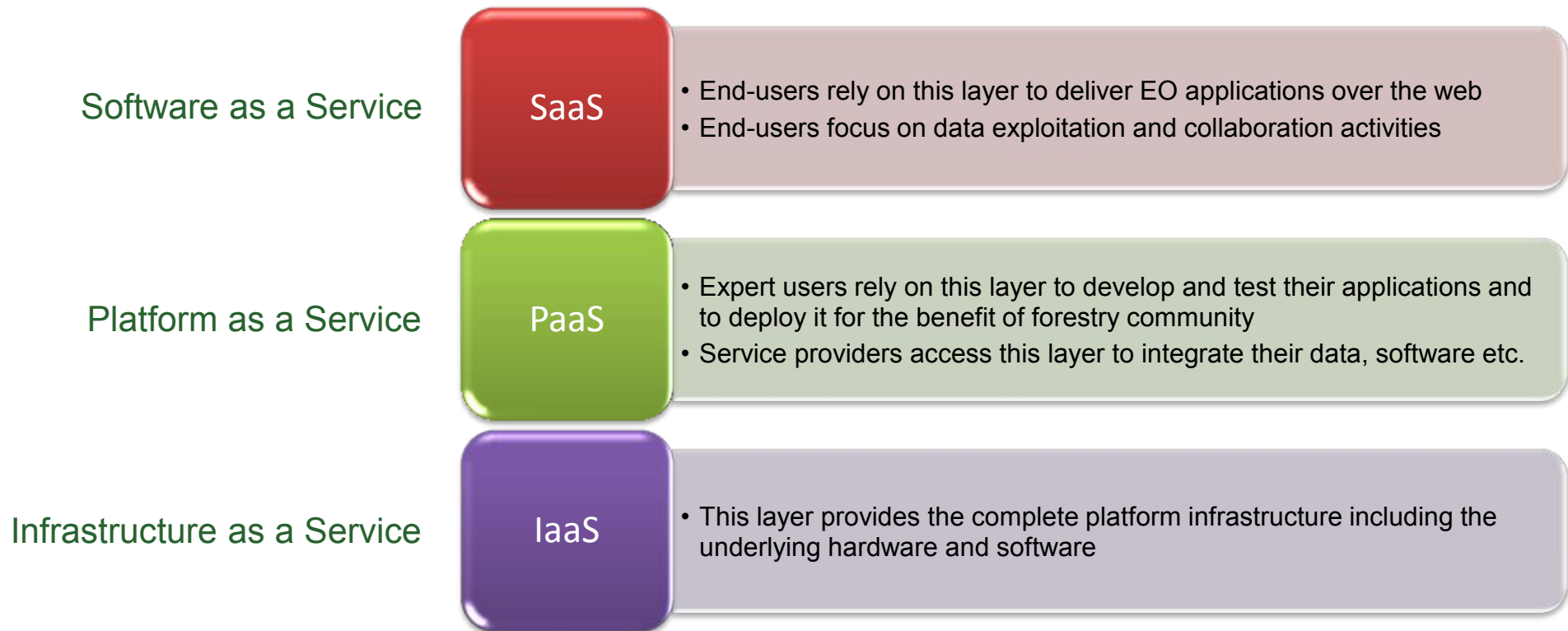


Technical Solution - Design Drivers

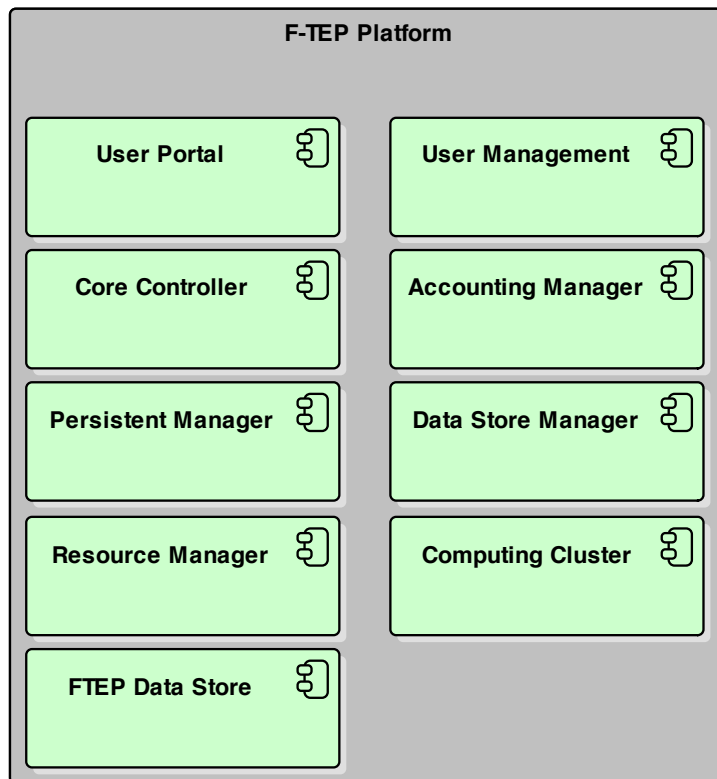
- Community & impact driven
- Deliver a smart ICT-based solution in a user-friendly environment
- Enable infrastructure independence
- Scalable as per usage, cost effective solution
- Open Source Software driven
- Standards based (e.g. OGC Web Services)
- EO-SSO integration
- Integrated accounting & quota management
- Implements data access policies



F-TEP Architecture – Service Layers



F-TEP Functional Architecture

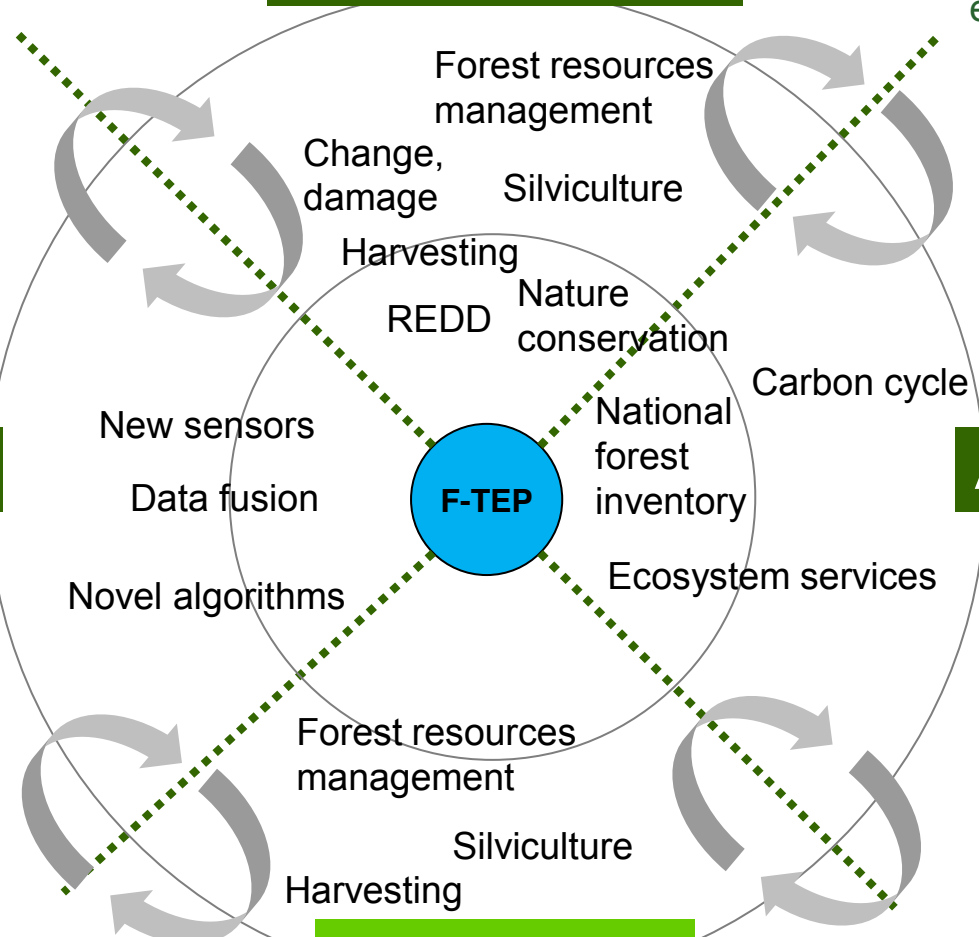


- **User Portal** acts as an entry point for users of F-TEP and provides the functionality described earlier.
- **User Management** function authenticates and authorizes platform users for their activities. Functionality to foster user collaboration is included.
- **Core Controller** is the heart of the platform as it serves the user requests by delegating the tasks to other functions. It has the complete view of the platform and is responsible for coordinating other functions within the platform. For instance, it interacts with the Data Store Manager to locate the data requested by the user.
- **Accounting Manager** is responsible for tracking the resource usage and providing capabilities for pay-per-use model for sustainability, covering EO data, storage, processing power and software usage.
- **Persistence Manager** hosts a working area for the platform. This working area can be considered as a rolling cache for input data and processed output data.
- **Data Store Manager** ingests and retrieves data by interacting with the internal and external data archive.
- **Resource Manager** allocates virtual machines, applications and other resources. It optimizes the resource usage to keep the cost of operation to a minimum level.
- **Computing Cluster** constitutes all the computing nodes responsible for executing the user requests. It represents the actual resource that completes the requested processing tasks.
- **F-TEP Data Store** indexes and archives all the products generated within the platform.

Evolution of F-TEP

Routine end users

- Acquire required products easily through F-TEP



Research users

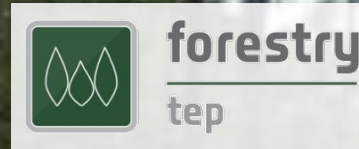
- Develop and share new algorithms or EO products for the research community through F-TEP
- Share ideas & enable collaboration

Advanced expert users

- Develop new services or products to increase offering

Administrator users make it all happen

Non-EO users



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