F-TEP – Forestry Thematic Exploitation Platform

Forest monitoring platforms workshop
San Cristóbal de las Casas, Chiapas, Mexico
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VTT Technical Research of Finland Ltd
+ 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

- 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

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

<table>
<thead>
<tr>
<th>Region</th>
<th>Pilot 1 (Mexico)</th>
<th>Pilot 2 (Finland)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region</strong></td>
<td>Mexico: Chiapas and Durango states</td>
<td>Finland</td>
</tr>
<tr>
<td><strong>Area covered</strong></td>
<td>73,311 km² (Chiapas) and 123,317 km² (Durango)</td>
<td>338,424 km² (TBD according to user preferences)</td>
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<tr>
<td><strong>Theme</strong></td>
<td>Monitoring of above ground biomass and quantifying associated carbon stocks for climate change reporting</td>
<td>Operational forest management; mapping undesired broadleaved tree shrubs on forest regeneration areas</td>
</tr>
<tr>
<td><strong>Key outputs</strong></td>
<td>Forest cover mapping and change detection</td>
<td>Map on degree of shrub damage on regeneration areas</td>
</tr>
<tr>
<td><strong>Key data used</strong></td>
<td>Sentinel-1 SAR, Sentinel-2 optical (one state)</td>
<td>Sentinel-2 Optical</td>
</tr>
<tr>
<td><strong>In-situ data</strong></td>
<td>1: Durango university ground sample network</td>
<td>Forestry Centre’s stand database</td>
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<td></td>
<td>2: From ESA pilot project EducEO</td>
<td>Collected by Forestry Centre during standard field work</td>
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<td></td>
<td>3: Optionally NFI plots from Chiapas</td>
<td></td>
</tr>
<tr>
<td><strong>Key users involved</strong></td>
<td>Ministry of Environment and Natural History of the state government of Chiapas</td>
<td>Finnish Forest Centre (part of Ministry of Agriculture and Forestry)</td>
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<td></td>
<td>University of Durango</td>
<td>ESA nominated users</td>
</tr>
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<td></td>
<td>Mexican NGO’s (several)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESA nominated users</td>
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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

- **Software as a Service (SaaS)**
  - End-users rely on this layer to deliver EO applications over the web
  - End-users focus on data exploitation and collaboration activities

- **Platform as a Service (PaaS)**
  - Expert users rely on this layer to develop and test their applications and to deploy it for the benefit of forestry community
  - Service providers access this layer to integrate their data, software etc.

- **Infrastructure as a Service (IaaS)**
  - This layer provides the complete platform infrastructure including the underlying hardware and software
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**
Contact

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