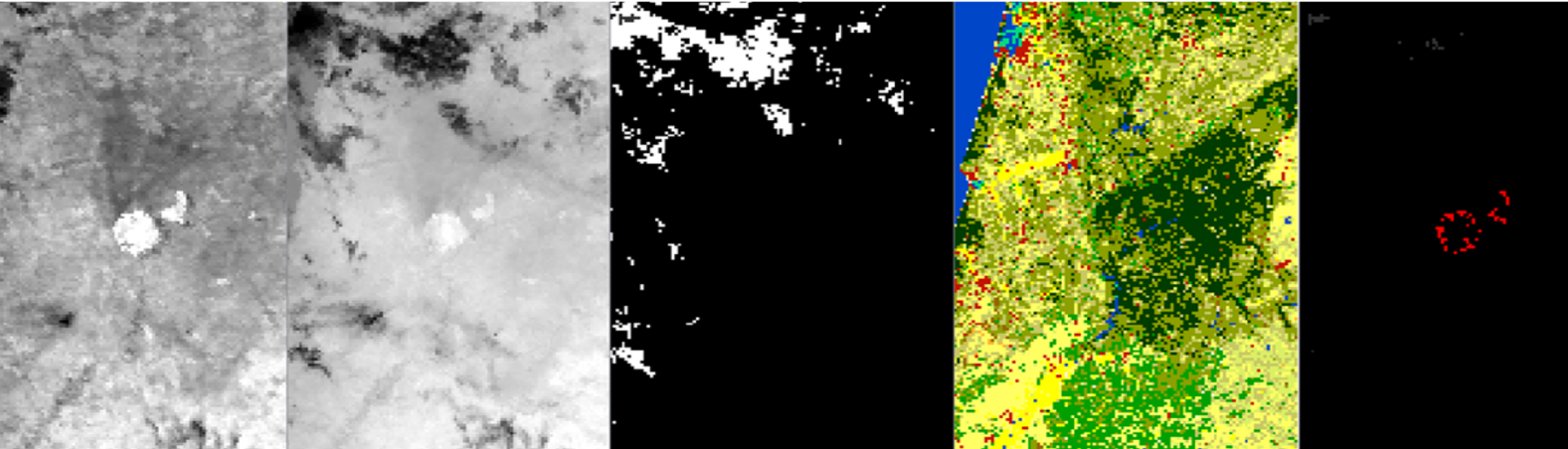


EO4GEO WEBINAR

Active fire detection with Sentinel-3 data

Tereza Roth, Remote Sensing Scientist
Thursday, 28 October 2021

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Key figures

- **Duration:** 4 years from January the 1st, 2018
- **Budget:** 3,87 million € (funded by ERASMUS+)
- **Partnership:** 25 Partners + 40+ Associated Partners (from 16 EU Countries) from Academia, Companies and networks
- **Coordinators:** GISIG (General), KU Leuven (Scientific & Technological), PLUS (Education & Training), Climate-KIC (Exploitation)



Defining the Vision and Mission

From Vision to Action

The **VISION of the Sector Skills Strategy** is to foster the growth of the European EO*GI sector ensuring a workforce with the **right skills, in the right place, at the right time.**

The **MISSION of the Sector Skills Strategy** is to ensure the strategic cooperation among stakeholders on skills development in the EO*GI sector (Sector Skills Alliance).



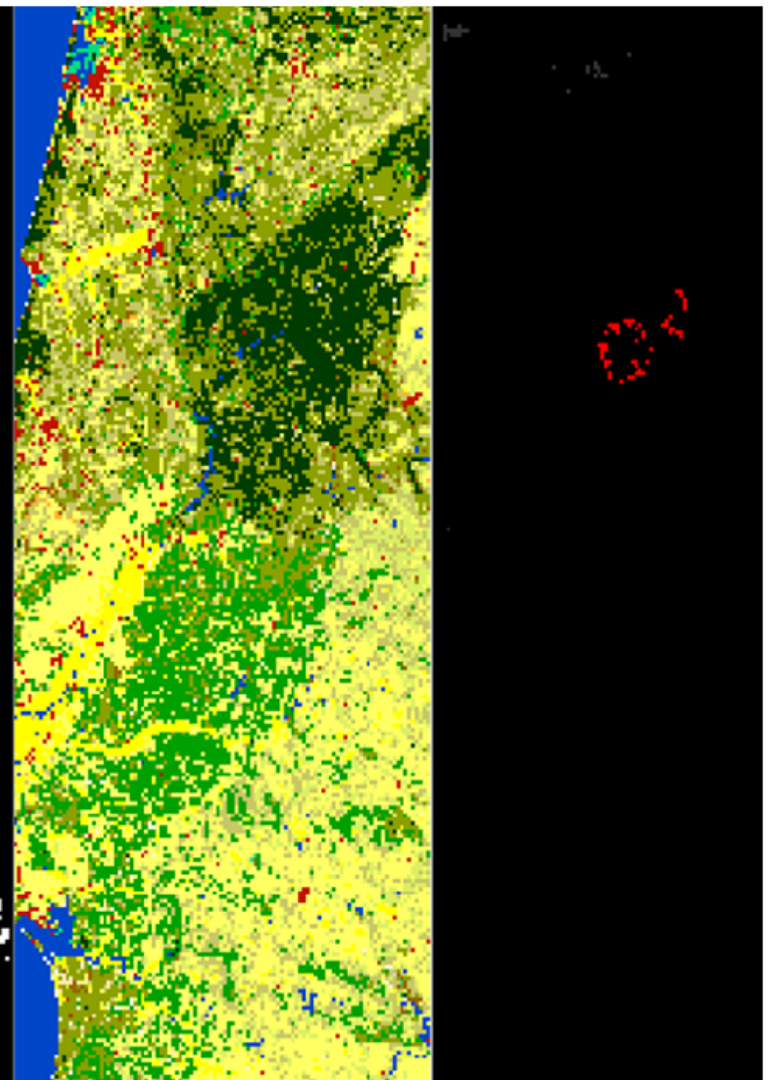


Webinar agenda

- Introduction to the topic of active fire detection
- Demonstration of the Sentinel-3 data processing for active fire detection
- Live Q&A session



Approx. 1 hour + Q&A



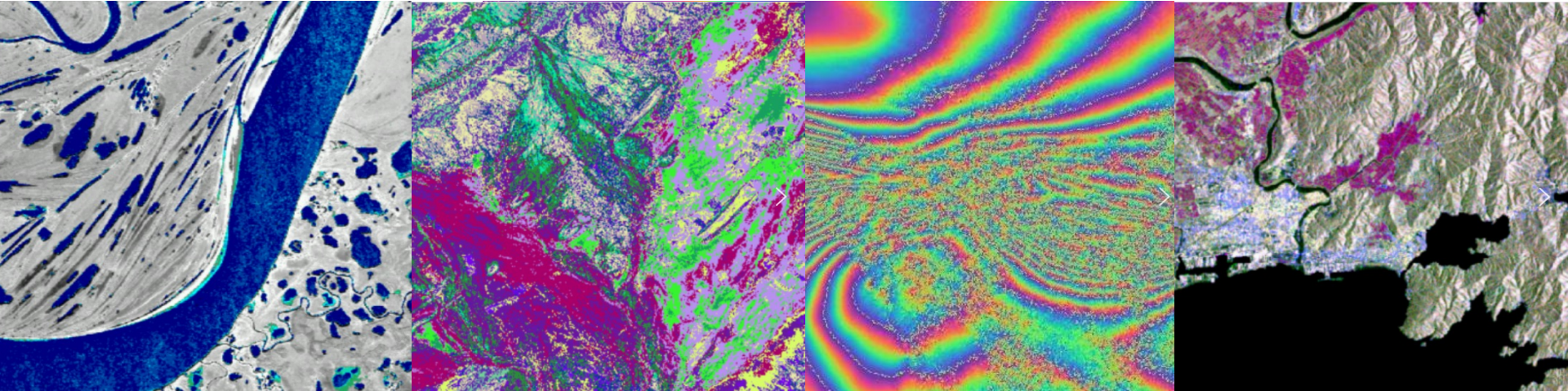
Serco EO Training



- Face 2 Face Workshop
- Webinar / Virtual Classroom
- Face 2 Face Training

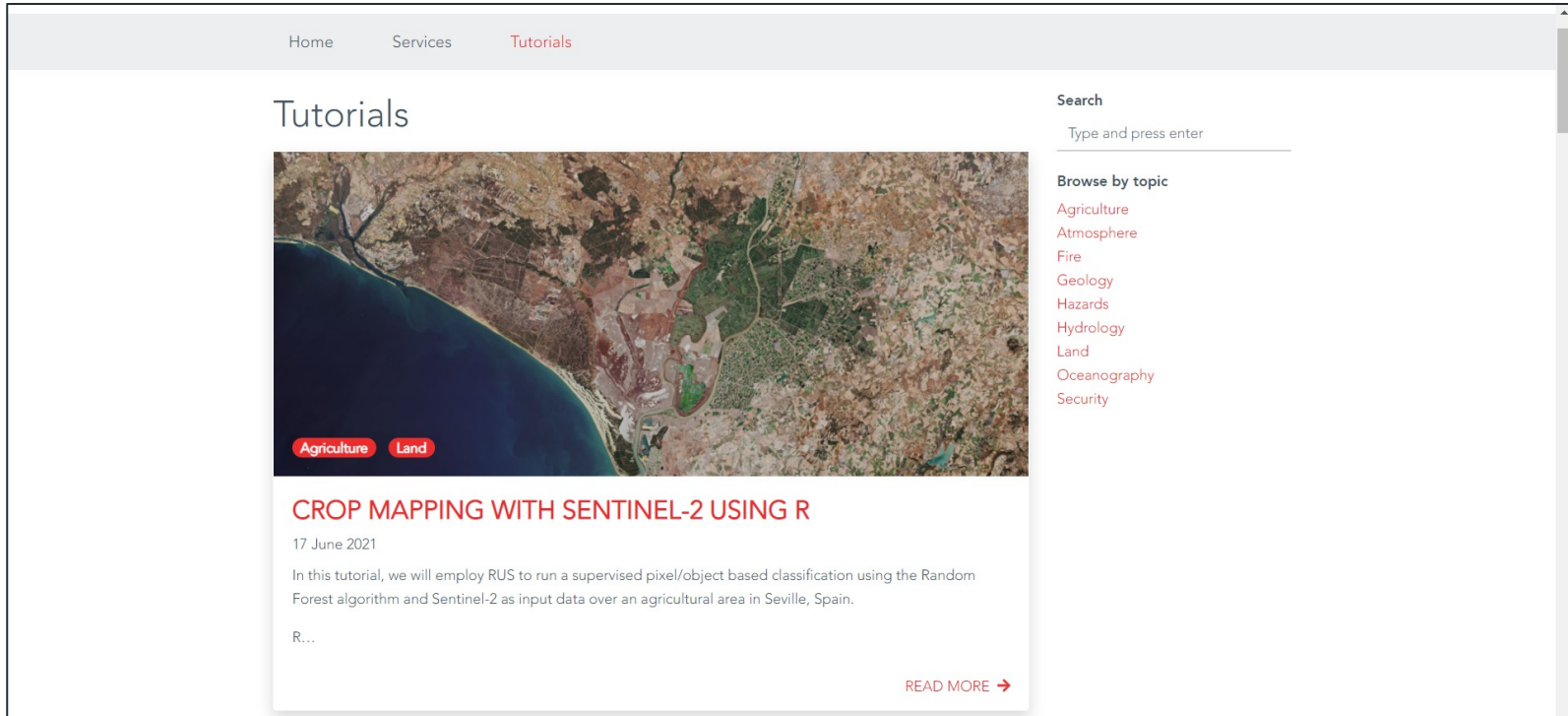
 eotraining-serco.com

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Serco website

Serco Training webpage



The screenshot shows the 'Tutorials' page on the Serco website. The navigation bar includes 'Home', 'Services', and 'Tutorials'. The main heading is 'Tutorials'. A featured tutorial card displays a satellite image of a coastal area with agricultural fields. Below the image are two red tags: 'Agriculture' and 'Land'. The title of the tutorial is 'CROP MAPPING WITH SENTINEL-2 USING R', dated '17 June 2021'. The description states: 'In this tutorial, we will employ RUS to run a supervised pixel/object based classification using the Random Forest algorithm and Sentinel-2 as input data over an agricultural area in Seville, Spain.' The text is truncated with 'R...'. A 'READ MORE' link with a right-pointing arrow is located at the bottom right of the card. On the right side of the page, there is a search bar with the placeholder text 'Type and press enter' and a 'Browse by topic' section with a list of categories: Agriculture, Atmosphere, Fire, Geology, Hazards, Hydrology, Land, Oceanography, and Security.

<https://eotraining-serco.com/tutorials/>

Study Area



- In 2017 the forest fires in Portugal burned 520,000 hectares of forest.
- Nearly 60% of all burned area in the EU in 2017
- Highest in the recorded history
- Sensors used for operational active fire detection - SLSTR (Sentinel-3), MODIS (Terra and Aqua), VIIRS (NASA/NOAA SNPP), etc.

Sentinel-3 SLSTR RBT



- SLSTR - Sea and Land Surface Temperature Radiometer
- Nadir and Oblique view
- 9 spectral bands:
 - **S1 to S6** - radiances on 0.5 km grid. Three stripes are distinguished: A ("*-an*", "*_ao*"), B ("*_bn*", "*_bo*"), and TDI ("*_cn*", "*_co*").
 - **S7 to S9 and F1 and F2 (fire bands)** – brightness temperatures on 1 km grid (notation "*_in*" or "*_io*")

Source: ESA

Band	λ centre (μm)	Width (μm)	Function	Comments		Res. (m)
S1	0.555	0.02	Cloud screening, vegetation monitoring, aerosol	Visible Near IR	Solar reflectance bands	500
S2	0.659	0.02	NDVI, vegetation monitoring, aerosol			
S3	0.865	0.02	NDVI, cloud flagging, Pixel co-registration			
S4	1.375	0.015	Cirrus detection over land	Short-Wave IR		
S5	1.61	0.06	Cloud clearing, ice, snow, vegetation monitoring			
S6	2.25	0.05	Vegetation state and cloud clearing			
S7	3.74	0.38	SST, LST, Active fire	Thermal infra-red Ambient bands (200 K - 320 K)		1000
S8	10.85	0.9	SST, LST, Active fire			
S9	12	1	SST, LST			
F1	3.74	0.38	Active fire	Thermal infra-red fire emission bands		
F2	10.85	0.9	Active fire			

eesa



Data

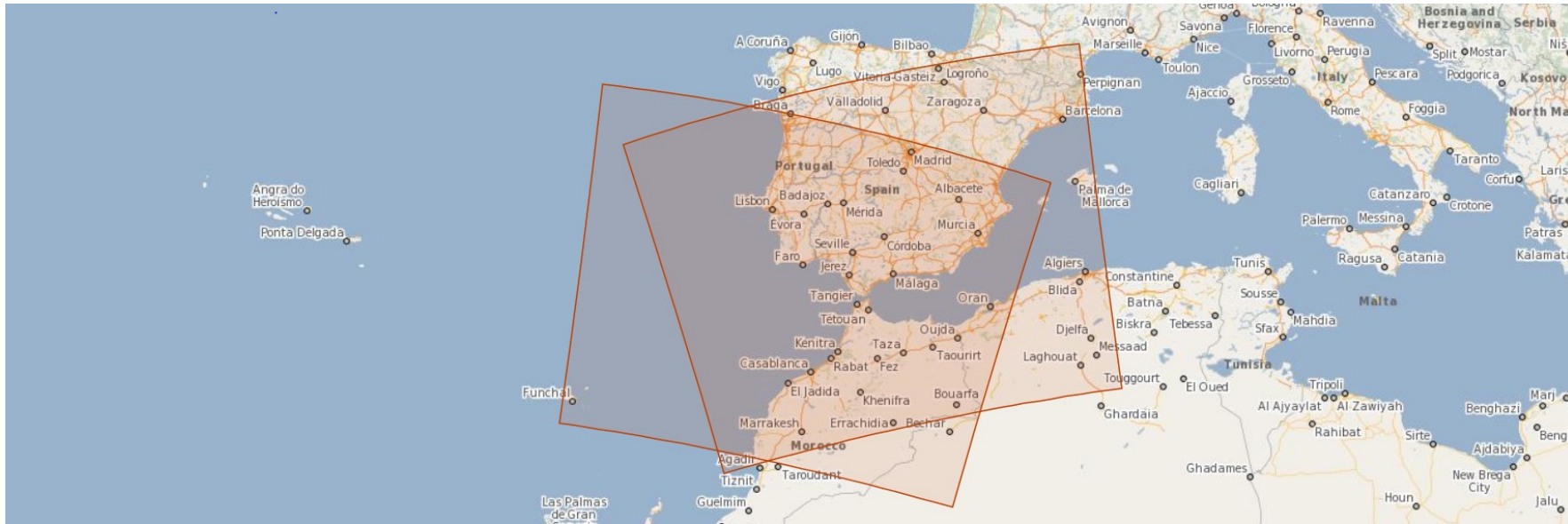


Day

S3A_SL_1_RBT___20170618T104548_20170618T104848_20170619T154448_0179_019_051_2340_LN2_O_NT_002

Night

S3A_SL_1_RBT___20170618T220242_20170618T220542_20170620T020303_0179_019_058_6599_LN2_O_NT_002



The Exercise



We will use the following open-source SW:

- SNAP – freely available from the [ESA STEP website](#)
- QGIS – freely available from the [QGIS project website](#)

Let's start!

Radiance vs. Reflectance

- The conversion from TOA radiance (L_{TOA}) to TOA reflectance (R_{TOA}) is defined by the following equation:

$$R_{TOA}(\lambda) = \frac{\pi L_{TOA}(\lambda)}{E_0(\lambda) \cos(\theta)}$$

solar spectral irradiance

sun zenith angle

- Radiance** - directly measured by remote sensing instruments. It is the amount of light seen by instrument from an object [$\text{mW} \cdot \text{m}^{-2} \cdot \text{sr}^{-1} \cdot \text{nm}^{-1}$].
- Reflectance** - is the ratio (percentage) of the amount of light leaving a target to the amount of light arriving to the target. It is the property of the observed object/material.

Cloud Mask - DAY

- We will use simple cloud test developed for daytime fire detection by Giglio et al. (2003b).

$$\{(\rho_{0.65} + \rho_{0.86} > 0.9) \text{ OR } (T_{12} < 265 \text{ K})\}$$

OR

$$\{(\rho_{0.65} + \rho_{0.86} > 0.7) \text{ AND } (T_{12} < 285 \text{ K})\}$$

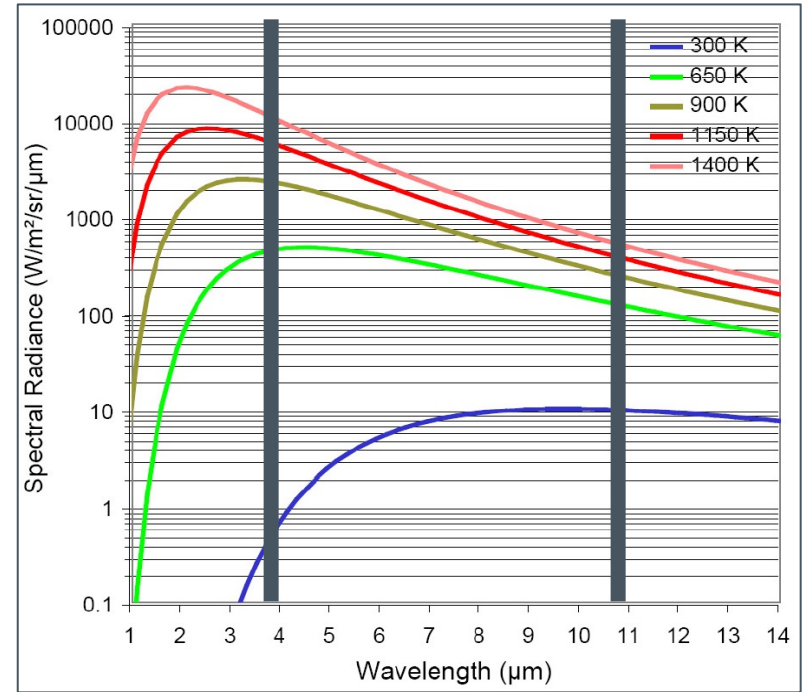
- Where, ρ_{λ} and T_{λ} correspond to reflectance and thermal bands (brightness temp.) at certain wavelength (λ [μm]).
- **Brightness temperature** – the temperature (K) of a black body “emitting” the same amount of radiance as the target pixel

Active Fire detection

- Active fire signature is the result of the large difference in blackbody radiation at $4\mu\text{m}$ and $11\mu\text{m}$ emitted at vegetation combustion temperatures

Image:

- Earth ambient temperature (300 K) and a range of possible vegetation fire temperatures (650 – 1400 K).
- The approximate central wavelengths of the Sentinel-3 SLSTR MIR ($3.74\mu\text{m}$) and TIR ($10.85\mu\text{m}$) channel are also indicated.



Credits: Sentinel-3 Active Fire: Fire Detection and Fire Radiative Power Assessment (ESA)

CCI Land Cover 2015

Label	Colour	Value	Freque...
0 No data		0	0.000%
10 Cropland, rainfed		10	0.000%
11 Herbaceous cover		11	0.000%
12 Tree or shrub cover		12	0.000%
20 Cropland, irrigated or post?...		20	0.000%
30 Mosaic cropland (>50%) / n...		30	0.000%
40 Mosaic natural vegetation (...)		40	0.000%
50 Tree cover, broadleaved, e...		50	0.000%
60 Tree cover, broadleaved, d...		60	0.000%
61 Tree cover, broadleaved, d...		61	0.000%
62 Tree cover, broadleaved, d...		62	5.705%
70 Tree cover, needleleaved, ...		70	10.054%
71 Tree cover, needleleaved, ...		71	2.492%
72 Tree cover, needleleaved, ...		72	0.000%
80 Tree cover, needleleaved, ...		80	0.000%
81 Tree cover, needleleaved, ...		81	0.000%
82 Tree cover, needleleaved, ...		82	0.000%
90 Tree cover, mixed leaf type...		90	0.000%

100 Mosaic T and shrub (>50...		100	0.000%
110 Mosaic herbaceous cover (...)		110	0.000%
120 Shrubland		120	2.692%
121 Shrubland evergreen		121	0.000%
122 Shrubland deciduous		122	0.000%
130 Grassland		130	0.000%
140 Lichens and mosses		140	0.000%
150 Sparse vegetation (tree, s...		150	0.000%
151 Sparse tree (<15%)		151	0.000%
152 Sparse shrub (<15%)		152	0.000%
153 Sparse herbaceous cover ...		153	0.000%
160 Tree cover, flooded, fresh...		160	0.000%
170 Tree cover, flooded, salin...		170	5.668%
180 Shrub or herbaceous cove...		180	0.000%
190 Urban areas		190	0.000%
200 Bare areas		200	0.000%
201 Consolidated bare areas		201	0.000%
202 Unconsolidated bare areas		202	0.000%
210 Water bodies		210	0.000%
220 Permanent snow and ice		220	0.000%

Active fire detection

	DAY	NIGHT
Initial test	$T_4 > 325 \text{ K}$	$T_4 > 315 \text{ K}$
Eliminate warm background	$(T_4 - T_{11}) > 18 \text{ K}$	$(T_4 - T_{11}) > 15 \text{ K}$
Eliminate clouds	$cloud_mask == 0$	$cloud_mask == 0$
Eliminate non-forest pixels	$'land_cover_CCI\text{LandCover-2015}' \geq 50$ and $'land_cover_CCI\text{LandCover-2015}' \leq 130$	$'land_cover_CCI\text{LandCover-2015}' \geq 50$ and $'land_cover_CCI\text{LandCover-2015}' \leq 130$

Contact

Trainer:

- Tereza Roth: eotraining@serco.com
- Training Webpage:
 - <http://www.eo4geo.eu/training-actions/active-fire-detection-with-sentinel-3-data/>
- Serco EO Training website:
 - <https://eotraining-serco.com/>
 - Step-by-step tutorial - <https://eotraining-serco.com/tutorials/active-fire-detection-with-sentinel-3/>

Q&A

Please type your questions to the GoToWebinar Questions tab.

Thank you for joining!

