FLEGT Watch

Support de formation

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    → Enregistrement des participants
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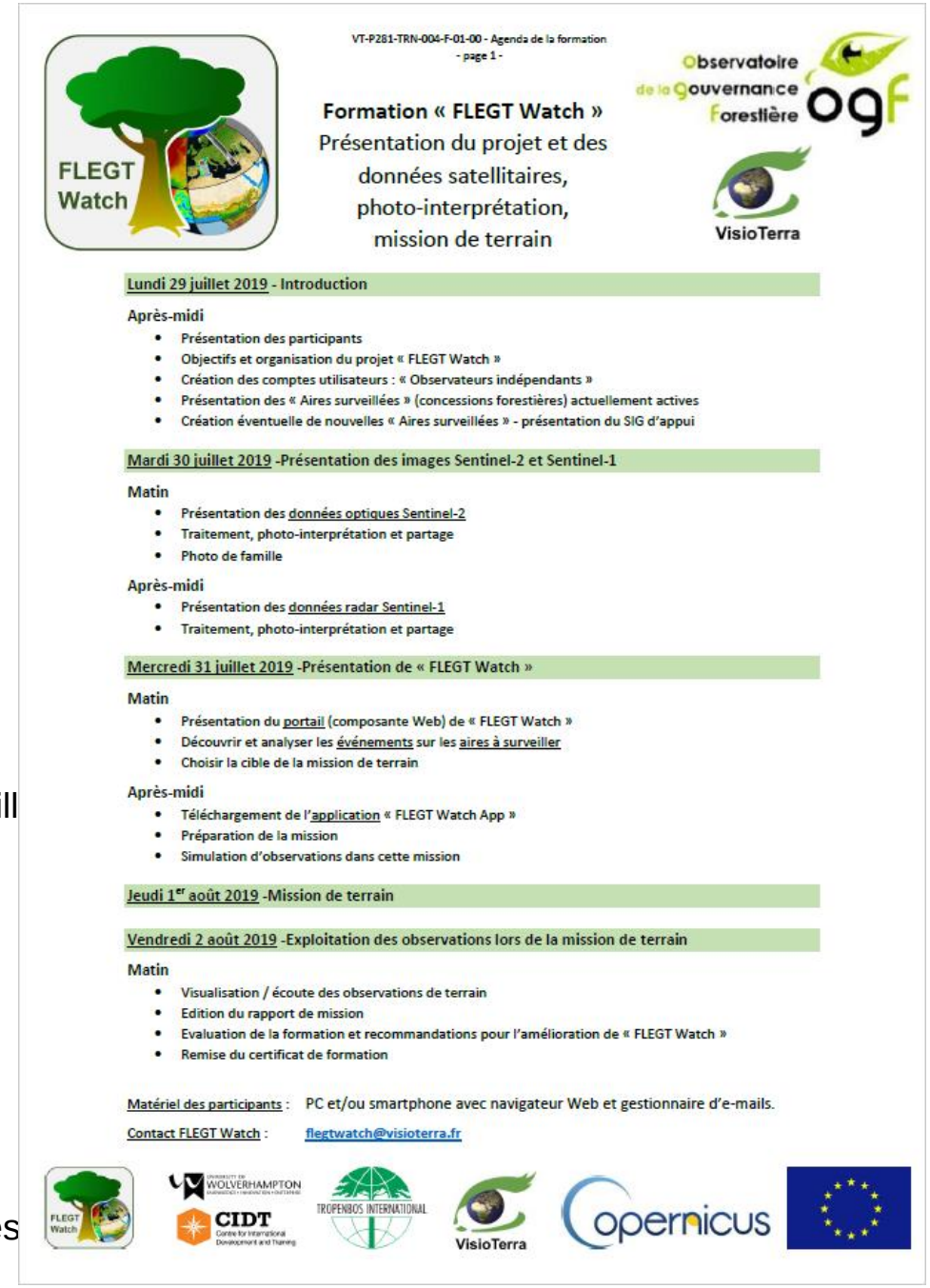
- L'observation par satellites
  - Plateformes, orbites et instruments
  - Sentinel-2 – Optique HR
  - Sentinel-1 – Radar HR
- Photo-interprétation
  - Examiner les évènements d'une Aire à surveill
  - Vérifier un événement avec:
    - les cartes de base
    - des images optiques
    - les précipitations l'ayant précédé
- Mission de terrain
  - Préparer la mission
  - Exécuter la mission
  - Retourner de mission, partager les ressources



VT-P281-TRN-004-F-01-00 - Agenda de la formation
- page 1 -

FLEGT Watch

Observatoire de la Gouvernance Forestière ogf

Formation « FLEGT Watch »
Présentation du projet et des données satellitaires, photo-interprétation, mission de terrain

VisioTerra

Lundi 29 juillet 2019 - Introduction

Après-midi
- Présentation des participants
- Objectifs et organisation du projet « FLEGT Watch »
- Création des comptes utilisateurs : « Observateurs indépendants »
- Présentation des « Aires surveillées » (concessions forestières) actuellement actives
- Création éventuelle de nouvelles « Aires surveillées » - présentation du SIG d'appui

Mardi 30 juillet 2019 -Présentation des images Sentinel-2 et Sentinel-1

Matin
- Présentation des données optiques Sentinel-2
- Traitement, photo-interprétation et partage
- Photo de famille

Après-midi
- Présentation des données radar Sentinel-1
- Traitement, photo-interprétation et partage

Mercredi 31 juillet 2019 -Présentation de « FLEGT Watch »

Matin
- Présentation du portail (composante Web) de « FLEGT Watch »
- Découvrir et analyser les événements sur les aires à surveiller
- Choisir la cible de la mission de terrain

Après-midi
- Téléchargement de l'application « FLEGT Watch App »
- Préparation de la mission
- Simulation d'observations dans cette mission

Jeudi 1er août 2019 -Mission de terrain

Vendredi 2 août 2019 -Exploitation des observations lors de la mission de terrain

Matin
- Visualisation / écoute des observations de terrain
- Edition du rapport de mission
- Evaluation de la formation et recommandations pour l'amélioration de « FLEGT Watch »
- Remise du certificat de formation

Matériel des participants : PC et/ou smartphone avec navigateur Web et gestionnaire d'e-mails.

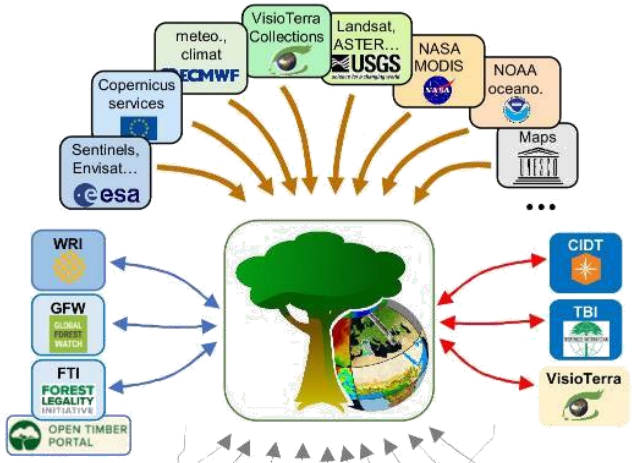
Contact FLEGT Watch : flegtwatch@visioterra.fr

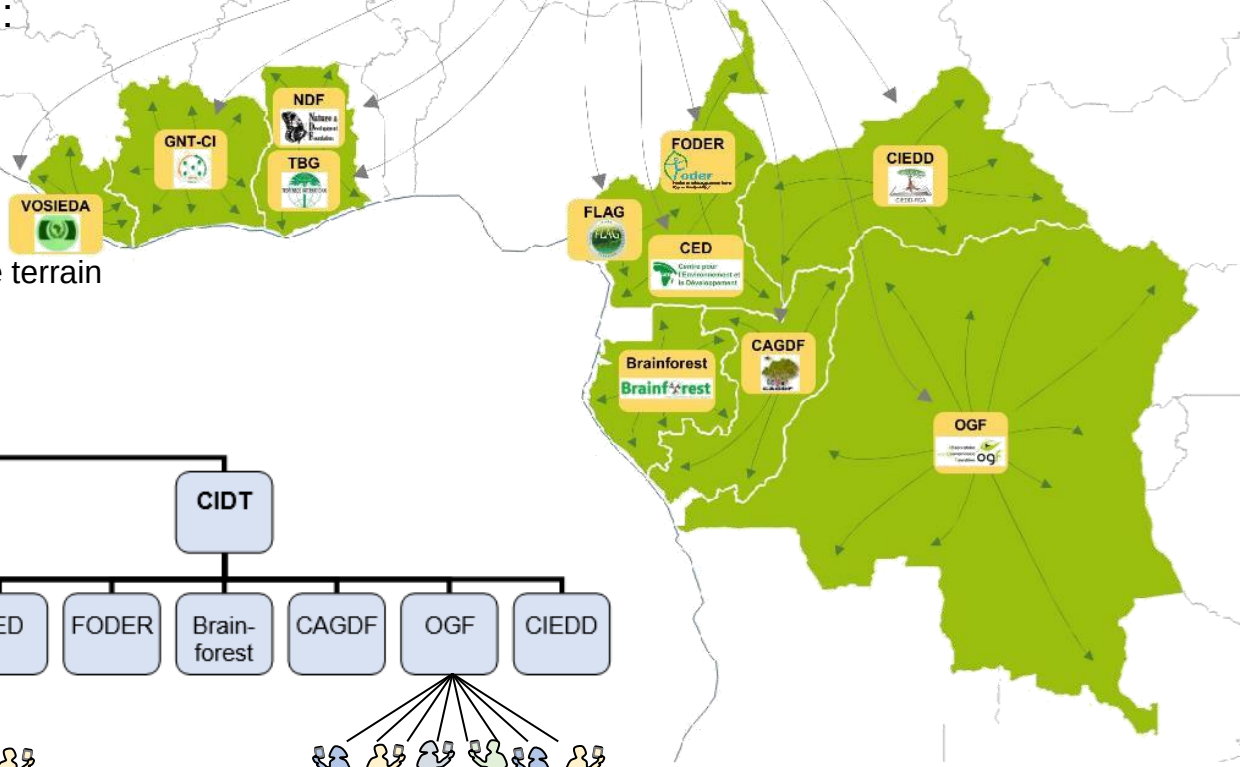
FLEGT Watch · University of Wolverhampton · CIDT Centre for International Development and Training · Tropenbos International · VisioTerra · Copernicus

Organisation du projet

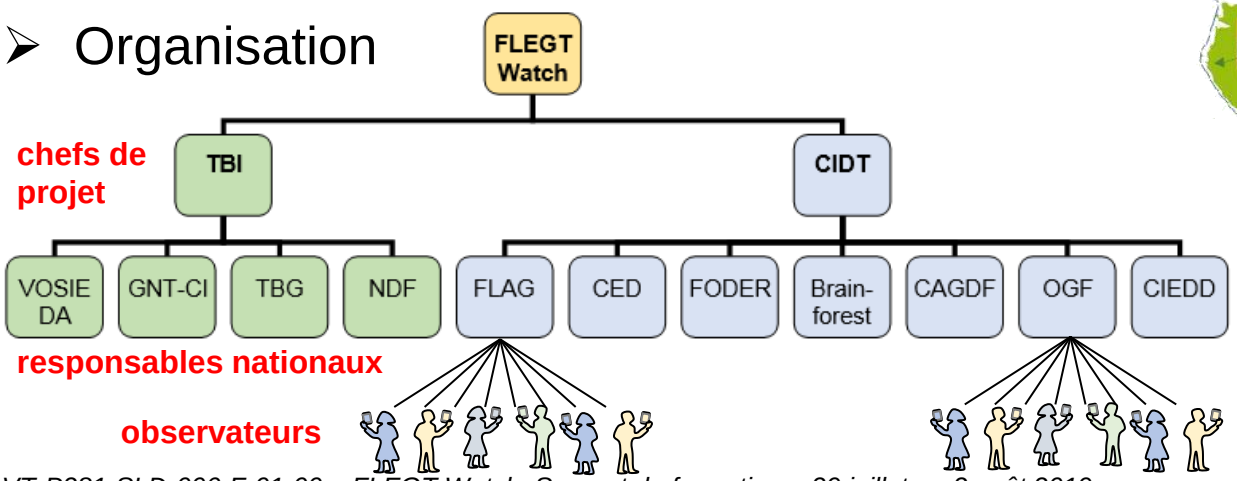
- "FLEGT Watch" offre les mêmes services aux deux sous-régions:
  - Afrique de l'Ouest – Liberia, Côte d'Ivoire, Ghana
  - Afrique Centrale – Cameroun, Gabon, République Centrafricaine, Congo, RDC

- Objectifs de "FLEGT Watch" :
  - performances – en utilisant les toutes nouvelles technologies
  - sécurité – en protégeant la communauté des observateurs
  - traçabilité – en enregistrant les observations des satellites et de terrain



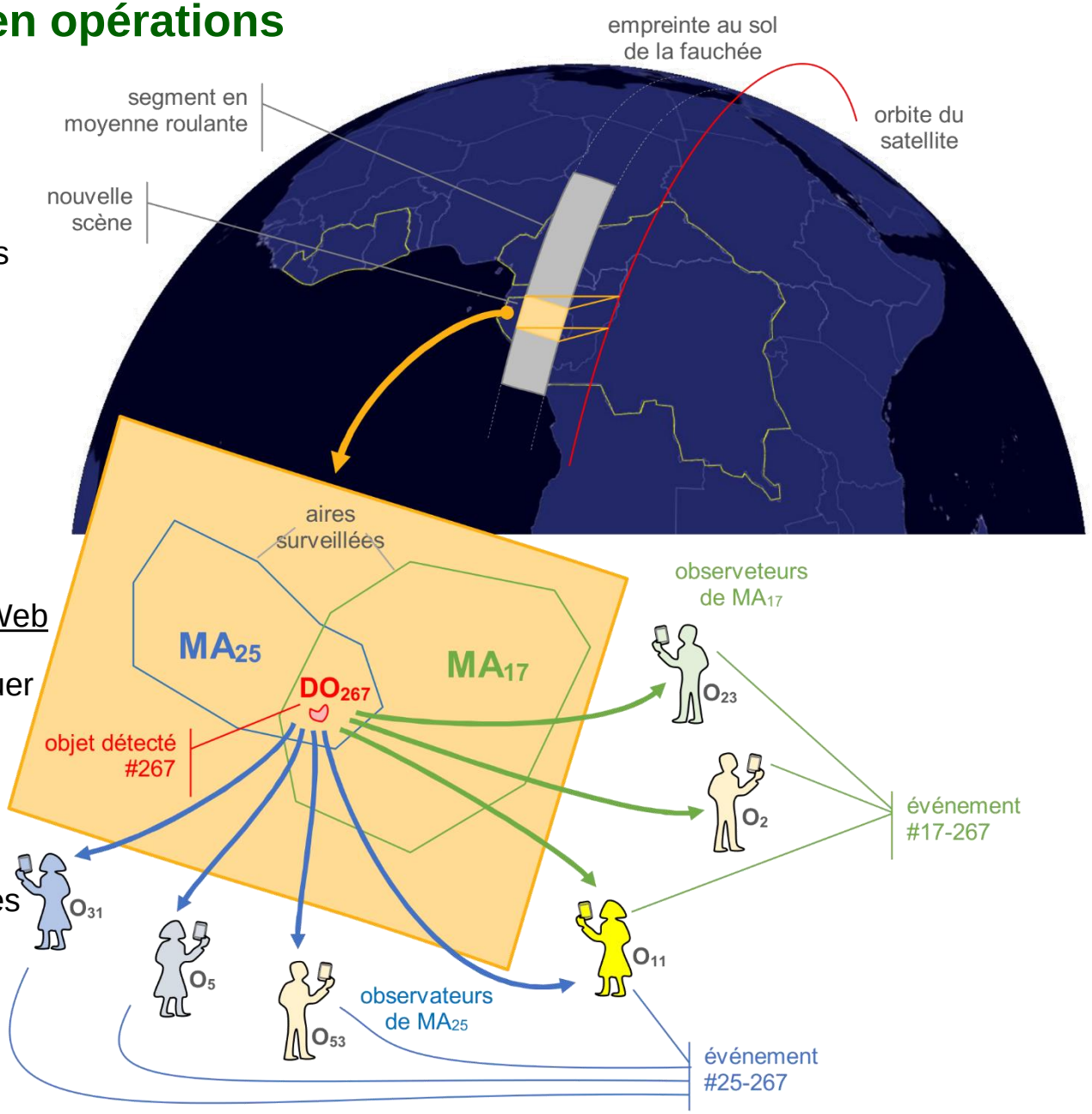


- Organisation



FLEGT Watch en opérations

- Observations satellite tous les 6 jours en utilisant S1A et S1B
- Détection automatique avec des algorithmes toujours optimisés
- Les objets détectés ont un indice de confiance
- Distribuer les événements dans les aires à surveiller
- Les observateurs évaluent un événement sur FLEGT Watch Web
- Les observateurs peuvent évaluer l'événement sur le terrain
- Des observations de terrain peuvent être collectées
- Ces observations sont partagées à travers la communauté
- On peut produire un rapport de mission de terrain

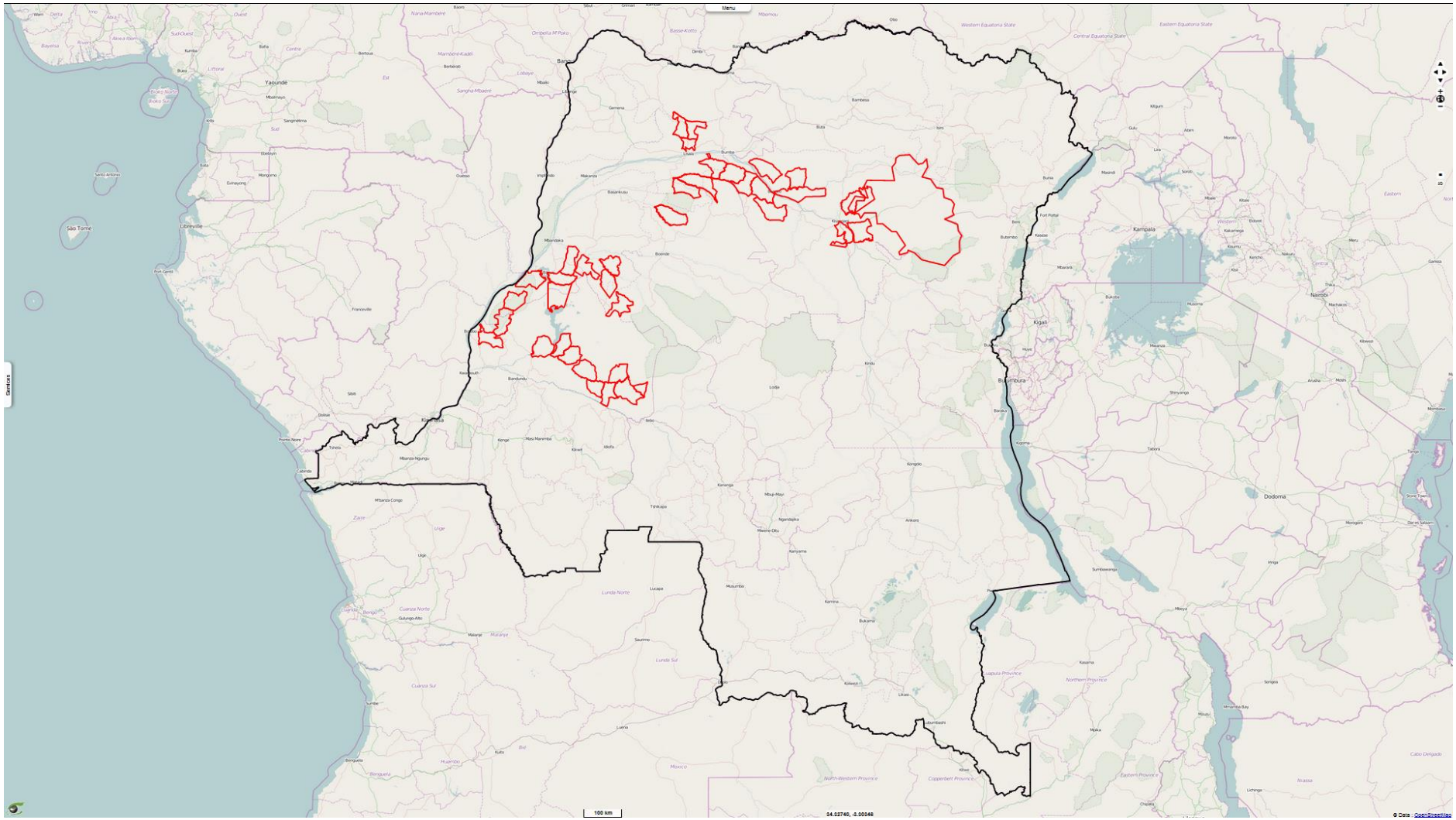


Observateurs en RDC (liste collectée le 29 juillet 2019)

Prénom(s)	NOM	Organisation	adresse e-mail
Chef de projet			
Aurelian	MBZIBAIN	CIDT	A.Mbzibain2@wlv.ac.uk
Responsable national			
Serge	BONDO	OGF	skayembeb@gmail.com
Observateurs			
Michel	WOTOKO	BERDA	mwotoko@gmail.com
Nicole	LWANZO	CFLEDD	nickylwanzo@gmail.com
Olga	MBULA	DYJEDD	olgaitumba@gmail.com
Prince	MABUSU	GTCRR	mabusuprince@yahoo.fr
Jean-Claude	LUKUSA	IFCO	jclukusa14@gmail.com
John	KATEMBO	LECAFOR	jmukirania1@yahoo.fr
Florent	KAY	OCEAN	florentkay@gmail.com
Papy	MOLIMA	OCEAN	papymolima@yahoo.fr
Daudet	TOKINDA	OCEAN	daudettokinda@gmail.com
Céline	EKAVU	OGF	cekavu@gmail.com
Childerick	KILOLO	OGF	papykilolos@gmail.com
Baudouin	LIFEE	OSAPY	baudlifee@gmail.com
Stanis	BITABOTO	PCN	bitabotostanis@gmail.com
Serge	BUBALA	RRN	sergebubala2013@gmail.com
Grâce	KOMBA	SOS NATURE	gracekomba28@gmail.com
Masimo	KABUANGA	Tropenbos RDC	mkabuang@hotmail.com
Justin	KYALE	Tropenbos RDC	koykyale@yahoo.fr

Les aires à surveiller (*monitored areas*) en RDC

Hyperlook



Hyperlooks à examiner

- Hyperlook document
  - HYP-072-Sentinels – FLEGT Watch in Ghana, Ivory Coast and Cameroon

- Layer stacks – A photo-interpretation work of Elisée TCHANA
  1. https://visioterra.org/FlegtWatch/hyperlook/9dad2acef95b4bbb909fd13477b99df9
  2. https://visioterra.org/FlegtWatch/hyperlook/f1bad3e30a604305ae2da851641f1363
  3. https://visioterra.org/FlegtWatch/hyperlook/d99be89aa3d746bc99c942162d8fcad2
  4. https://visioterra.org/FlegtWatch/hyperlook/e3ccf94a1ffb4ee59cd750547e43ab22
  5. https://visioterra.org/FlegtWatch/hyperlook/8280812c35444739a8d957dc304f09ae
  6. https://visioterra.org/FlegtWatch/hyperlook/c024ff96e4bd4bfba096970f47840662
  7. https://visioterra.org/FlegtWatch/hyperlook/2593e91bd22e4d5d8fb6ccb86d65b28e
  8. https://visioterra.org/FlegtWatch/hyperlook/66cc918cdd6d41d98d2bd961e6990c2e
     "*From my observation this image surely shows an old forest unit or an old wood processing area*"

- Layer stacks – A photo-interpretation work of Zhour NAJOUI (09.04.2019)
  1. https://visioterra.org/FlegtWatch/hyperlook/21b4b3b52c064dcda5d5c3c438676362
  2. https://visioterra.org/FlegtWatch/hyperlook/16f1291133c848329a14da4d4d9638de
  3. **https://visioterra.org/FlegtWatch/hyperlook/fa9e7fab242b4469b76551b8581dd5d1**
  4. https://visioterra.org/FlegtWatch/hyperlook/f6c838678ef14092af7012d08f3a6207

Documentation de FLEGT Watch

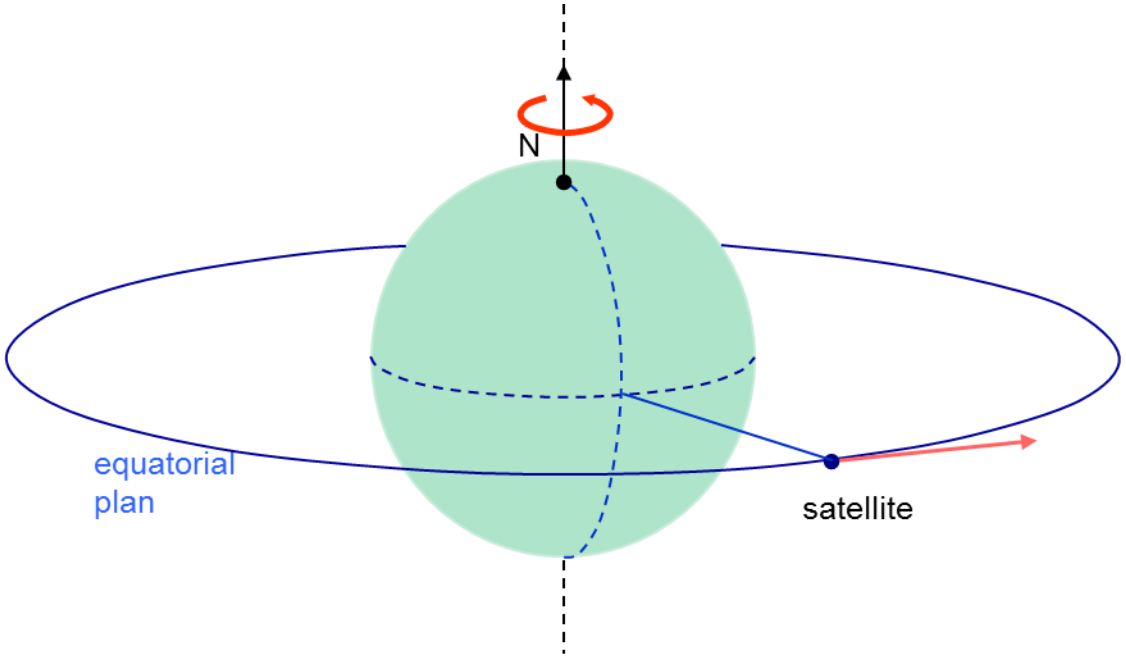
- Brochures
  - VT-P281-BKL-001-E-01-06 – Introduction to FLEGT Watch
    VT-P281-BKL-001-F-01-06 – Introduction à FLEGT Watch (français)
  - VT-P281-BKL-002-E-01-00 – FLEGT Watch in operation
    VT-P281-BKL-002-F-01-00 – FLEGT Watch en opération (français)
- Manuels utilisateur
  - VT-P281-SUM-005-E-01-01 – FLEGT Watch user's manual
  - VT-P281-SUM-005-F-01-01 – Manuel utilisateur de FLEGT Watch (français)
- Vidéos
  - VT-A003-VID-010-E-01-01 – Application for field observations
  - VT-A003-VID-010-F-01-01 – Application d'observations de terrain (français)
- FLEGT Watch App
  - visioterra.fr/flegtwatch/app.apk
- Support
  - flegtwatch@visioterra.fr

Les satellites

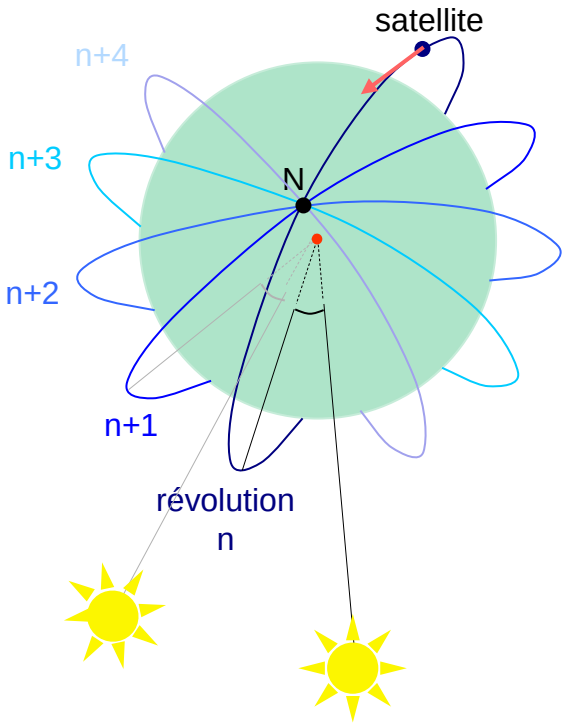
Plateformes, orbites et instruments

Types d'orbites, révolutions et temps de cycle

satellite géostationaire

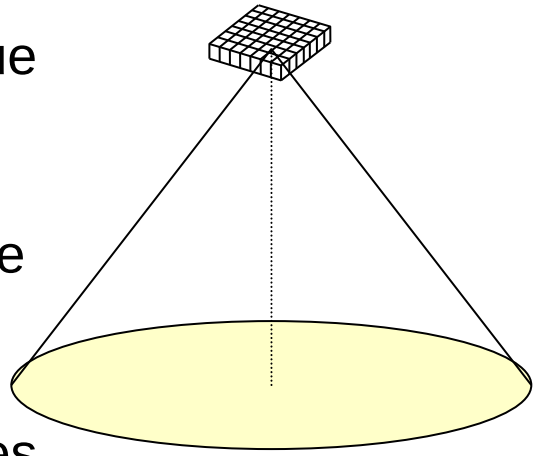


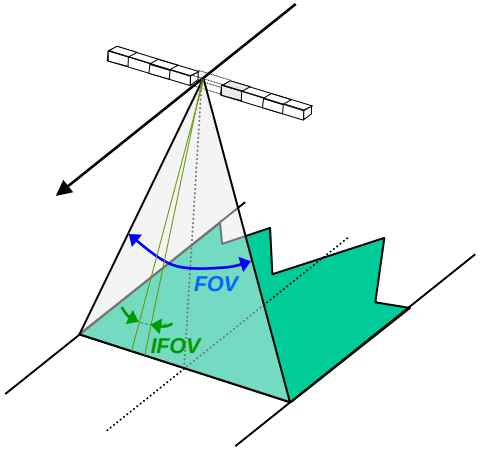
satellite héliosynchrone

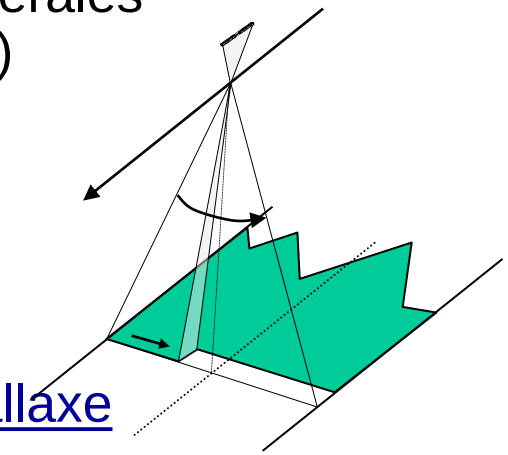


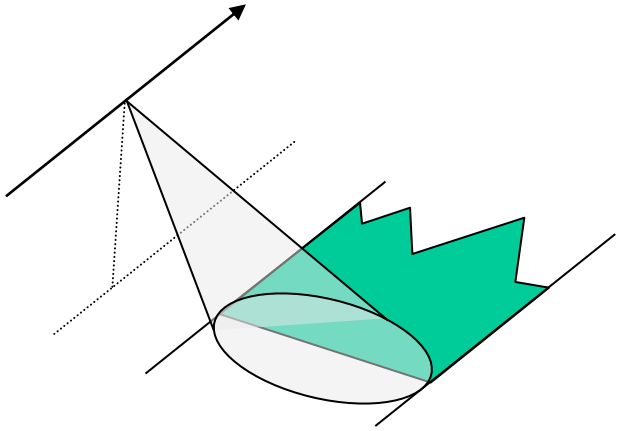
➢ Satellites et instruments – Géométrie de prise de vue

- ❑ Capteur matriciel
  Géométrie conique
  (*frame camera*)
- ❑ Capteur en peigne
  (*pushbroom*)
- ❑ Fauchées latérales
  (*whiskbroom*)
- ❑ Radar



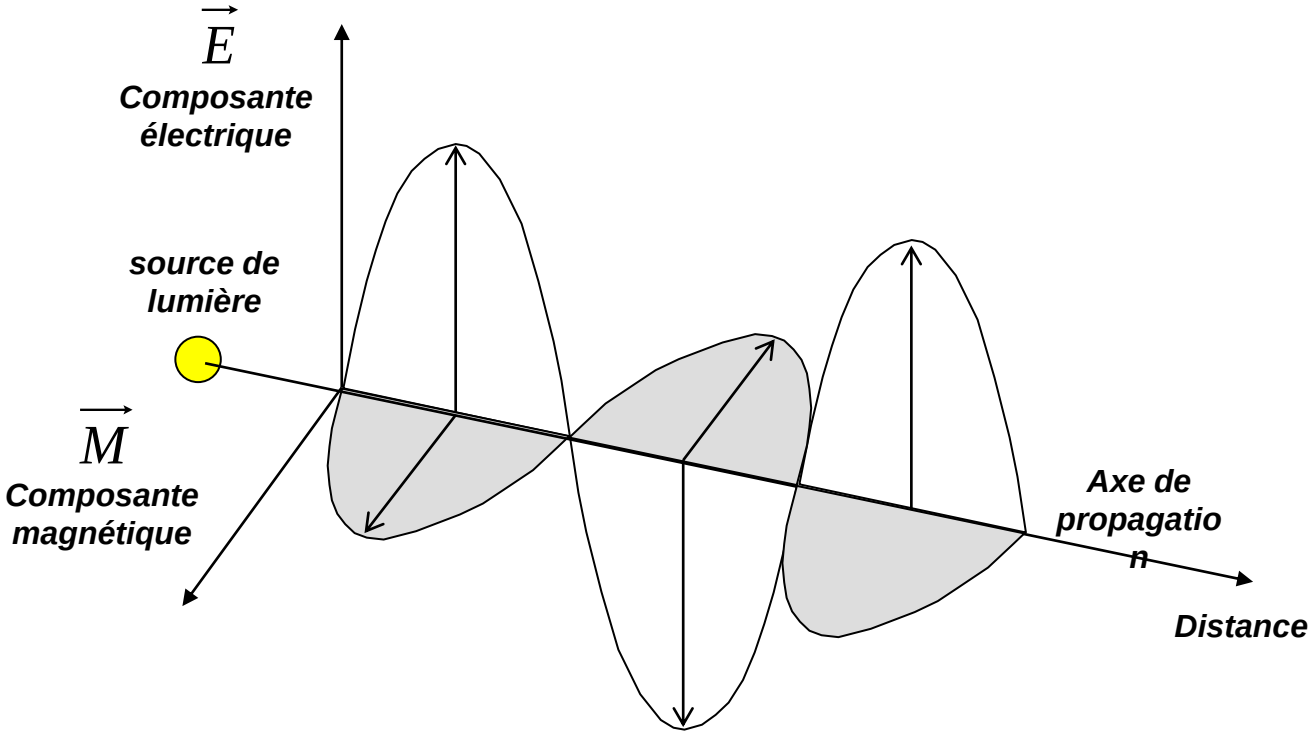




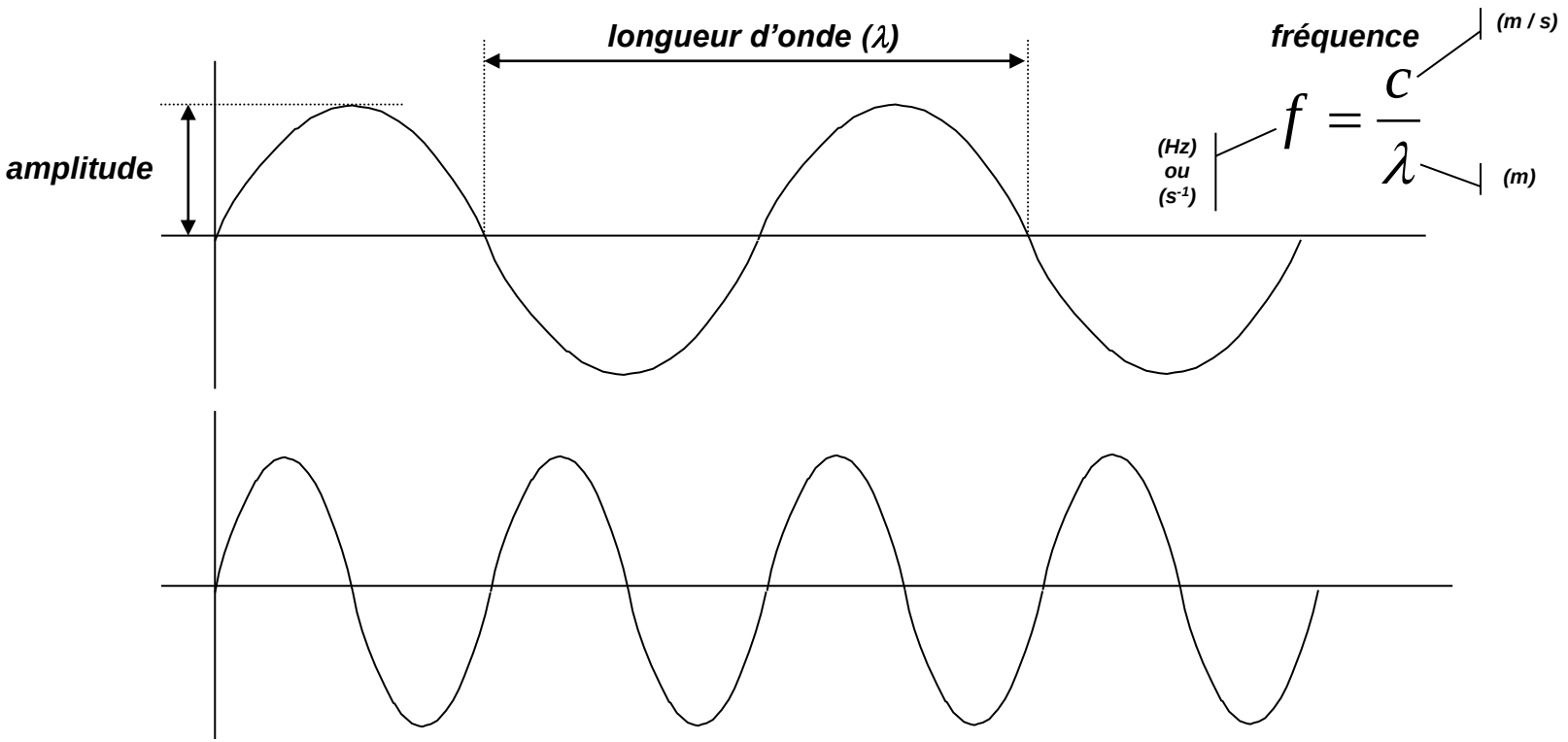


Erreurs de parallaxe

La radiation électromagnétique



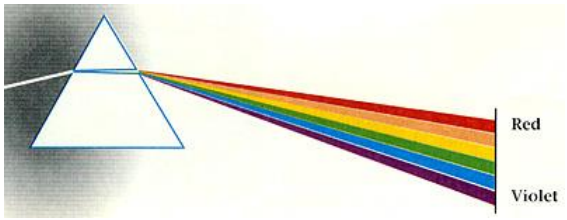
➢ L'onde électromagnétique

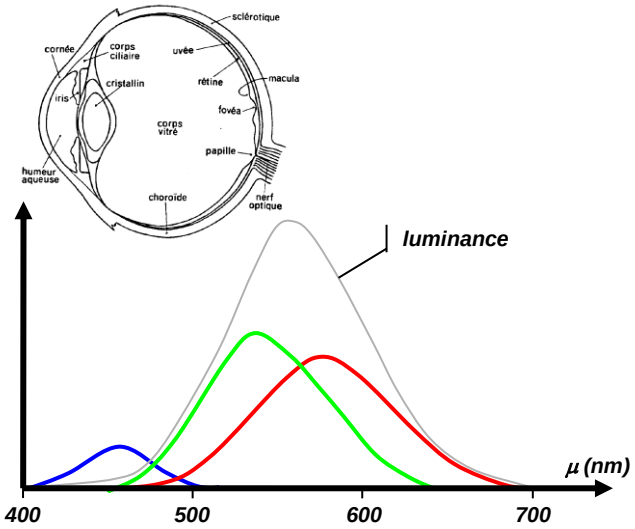


➢ Le spectre électromagnétique

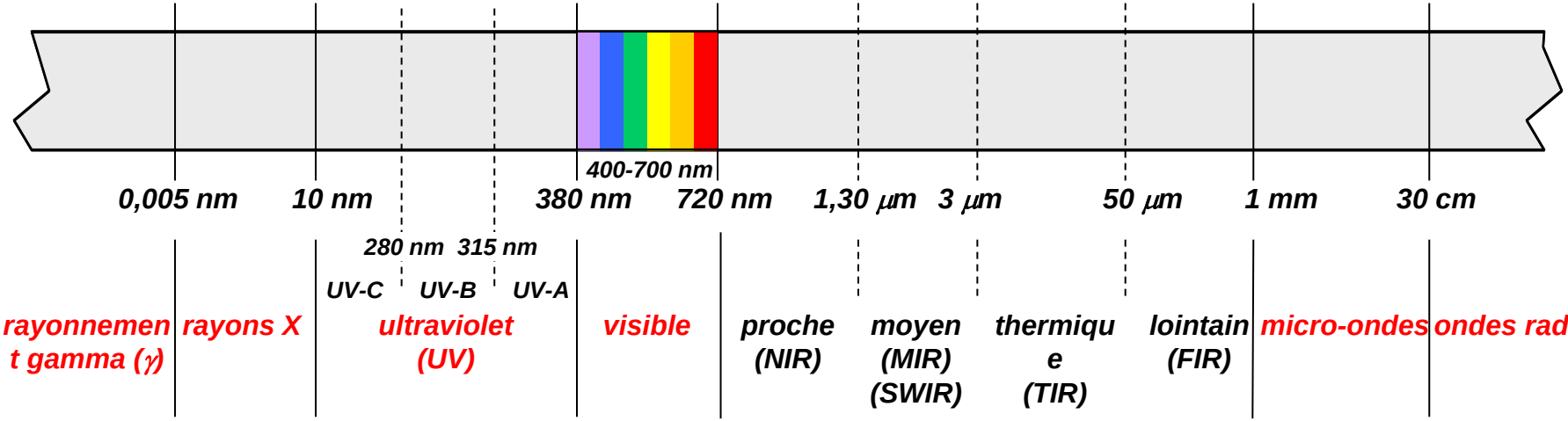
violet	380–450 nm
blue	450–495 nm
green	495–570 nm
yellow	570–590 nm
orange	590–620 nm
red	620–750 nm

http://en.wikipedia.org/wiki/Visible_spectrum





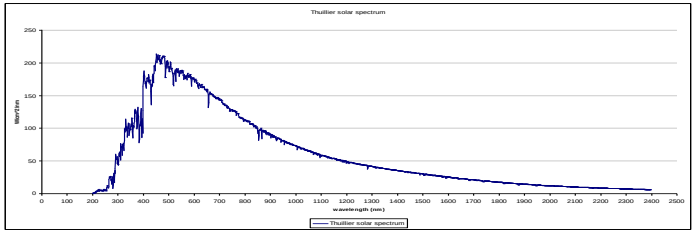
Sensibilité spectrale des cônes de l'œil
http://www.rennes.supelec.fr/ren/perso/jweiss/tv/perception/percept4.html



Energie du photon: $E = h \nu$

Constante de Planck: $h = 6{,}626\,068\,96 \times 10^{-34}$ J.s

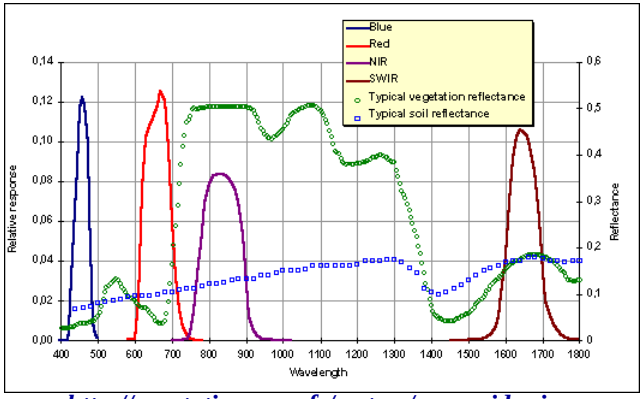
Instrument passif



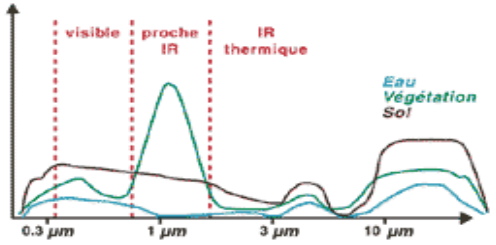
Thuillier (2003) solar spectrum - wavelength range 200 - 2397nm

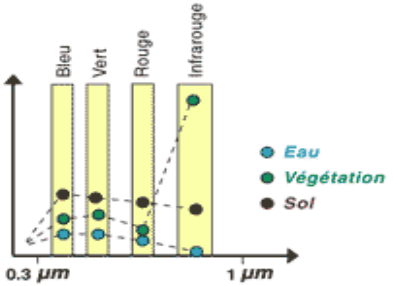
Thuillier, G., M. Hersé, P. C. Simon, D. Labs, H. Mandel, D. Gillotay, and T. Foujols, 2003, "The solar spectral irradiance from 200 to 2400 nm as measured by the SOLSPEC spectrometer from the ATLAS 1-2-3 and EURECA missions, Solar Physics, 214(1): 1-22

http://oceancolor.gsfc.nasa.gov/DOCS/RSR_tables.html

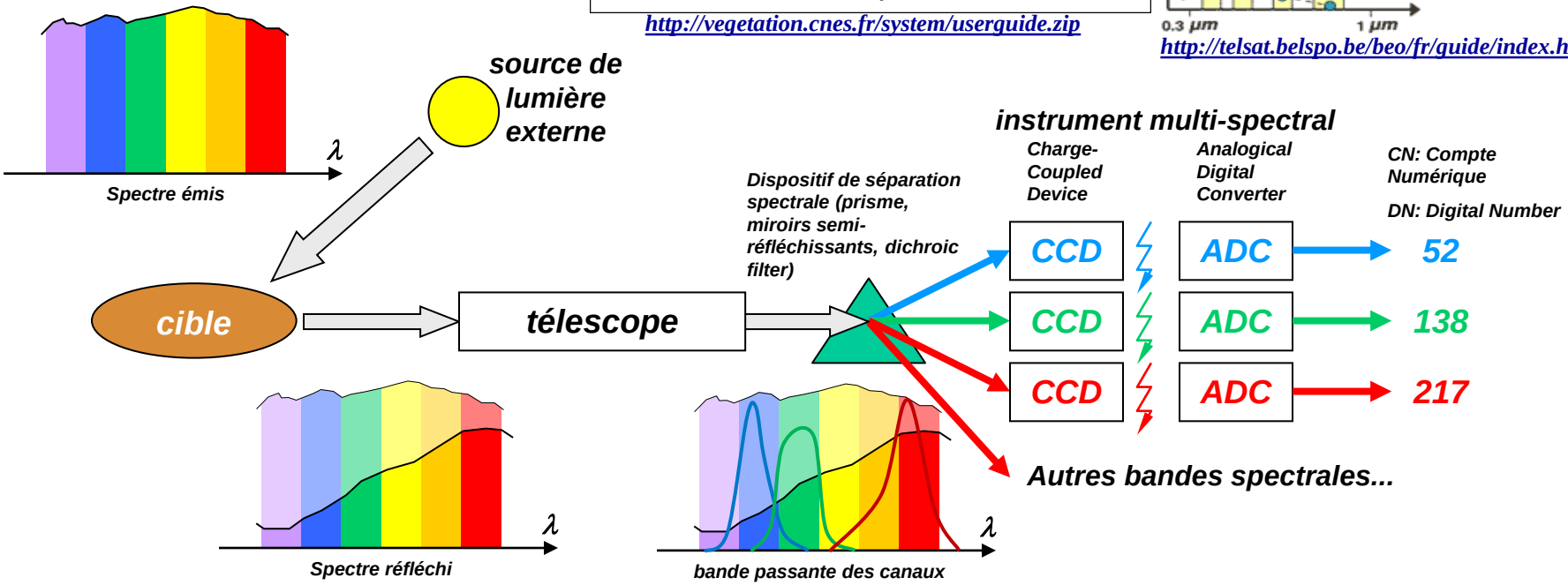


http://vegetation.cnes.fr/system/userguide.zip





http://telsat.belspo.be/beo/fr/guide/index.htm



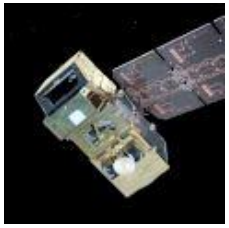
Sentinel-2

optique Haute résolution (HR)

Sentinel-2 – HR optical

https://sentinel.esa.int/web/sentinel/missions/sentinel-2

Sentinel-2



10 days cycle

	launch	*1st data*
S2A	23.06.2015	27.06.2015
S2B	07.03.2017	??.??.????

+5 days phase

Instrument

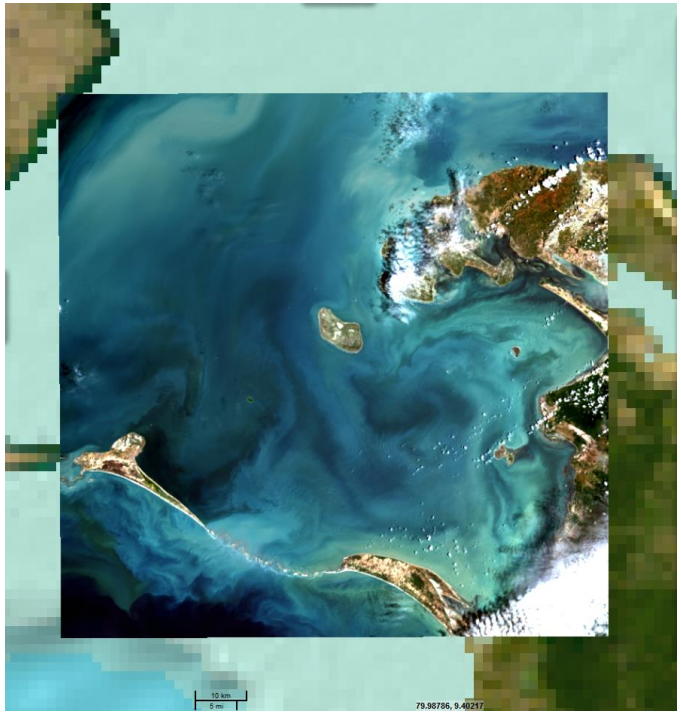
- MSI (Multi-Spectral Instrument) – optical – 290km swath

13 Bands

- VIS (visible): 2,3,4 (10m)
- Red edge: 5,6,7 (20m)
- NIR (Near Infrared): 8 (10m) 8A (20m)
- SWIR (Shortwave infrared): 11,12 (20m)
- Absorption (used for atmospheric corrections): 1,9,10 (60m)

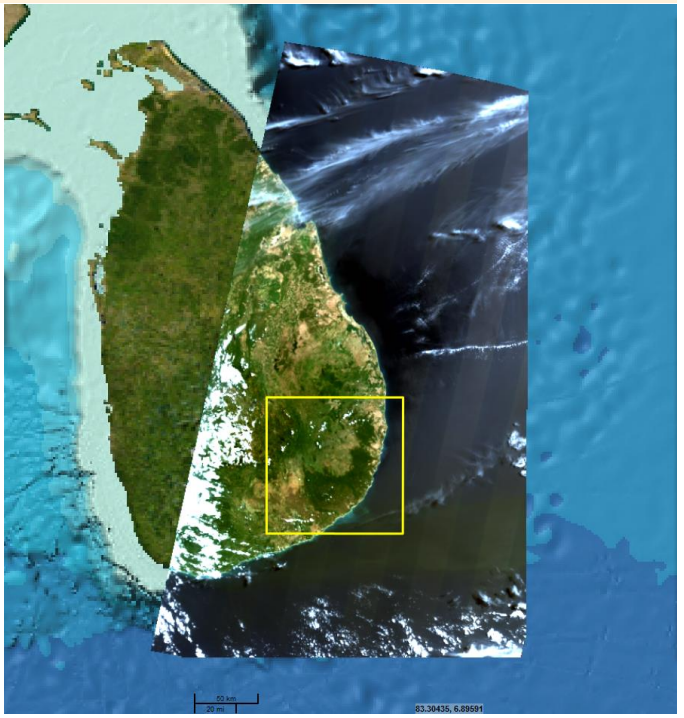
Bay of Kachchativu (North) on 18.09.2017 04:56:51 GMT
One tile (100km x 100km).

2D-view-left



East coast of Sri-Lanka on 27.07.2017 05:06:01 GMT
5x3 tiles (tile D1 highlighted).

2D-view-right

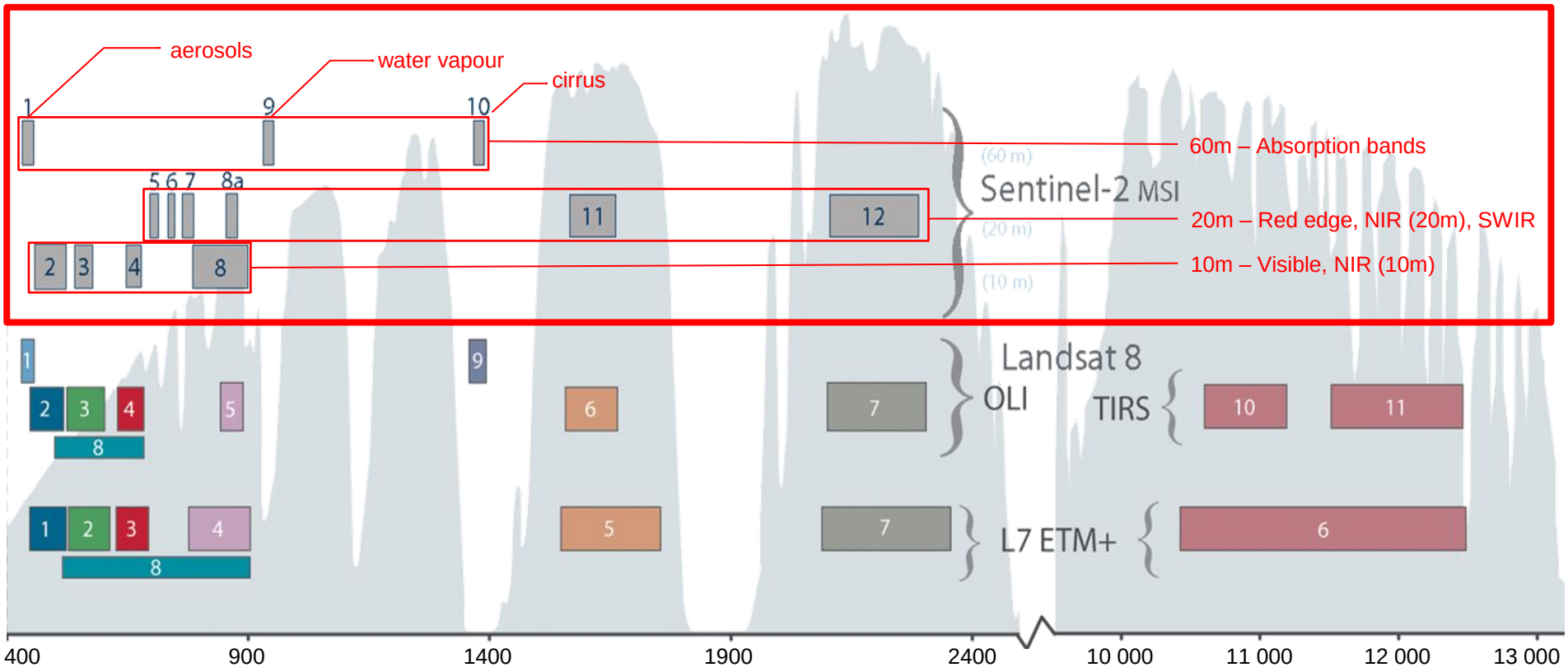


Sentinel-2 MSI – Spectral bands

MSI radiometry values: https://earth.esa.int/web/sentinel/technical-guides/sentinel-2-msi/msi-instrument

MSI 10m, 20m, 60m groups: https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/resolutions/spatial

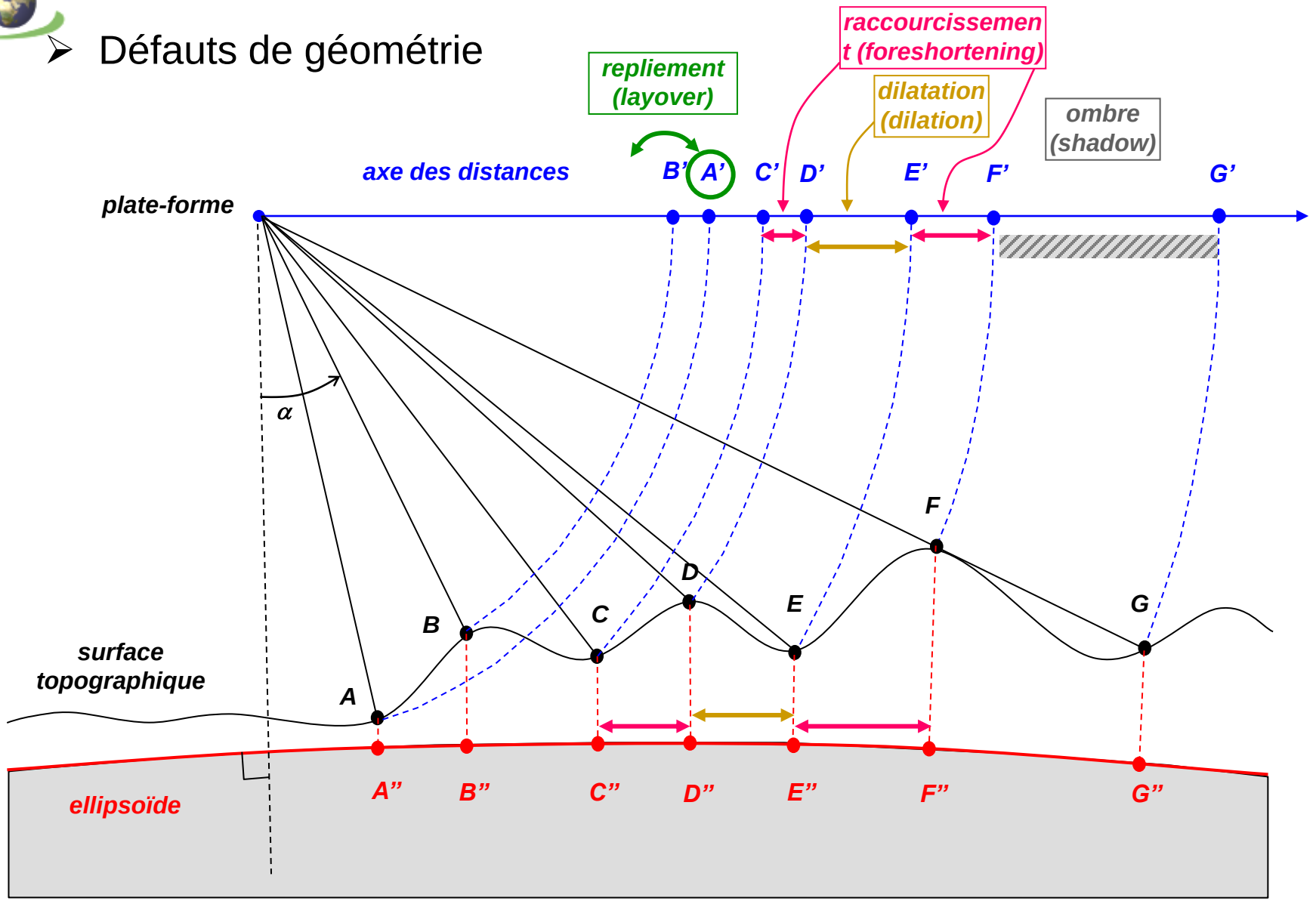
Landsat heritage: https://landsat.gsfc.nasa.gov/wp-content/uploads/2015/06/Landsat.v.Sentinel-2.png



Sentinel-1

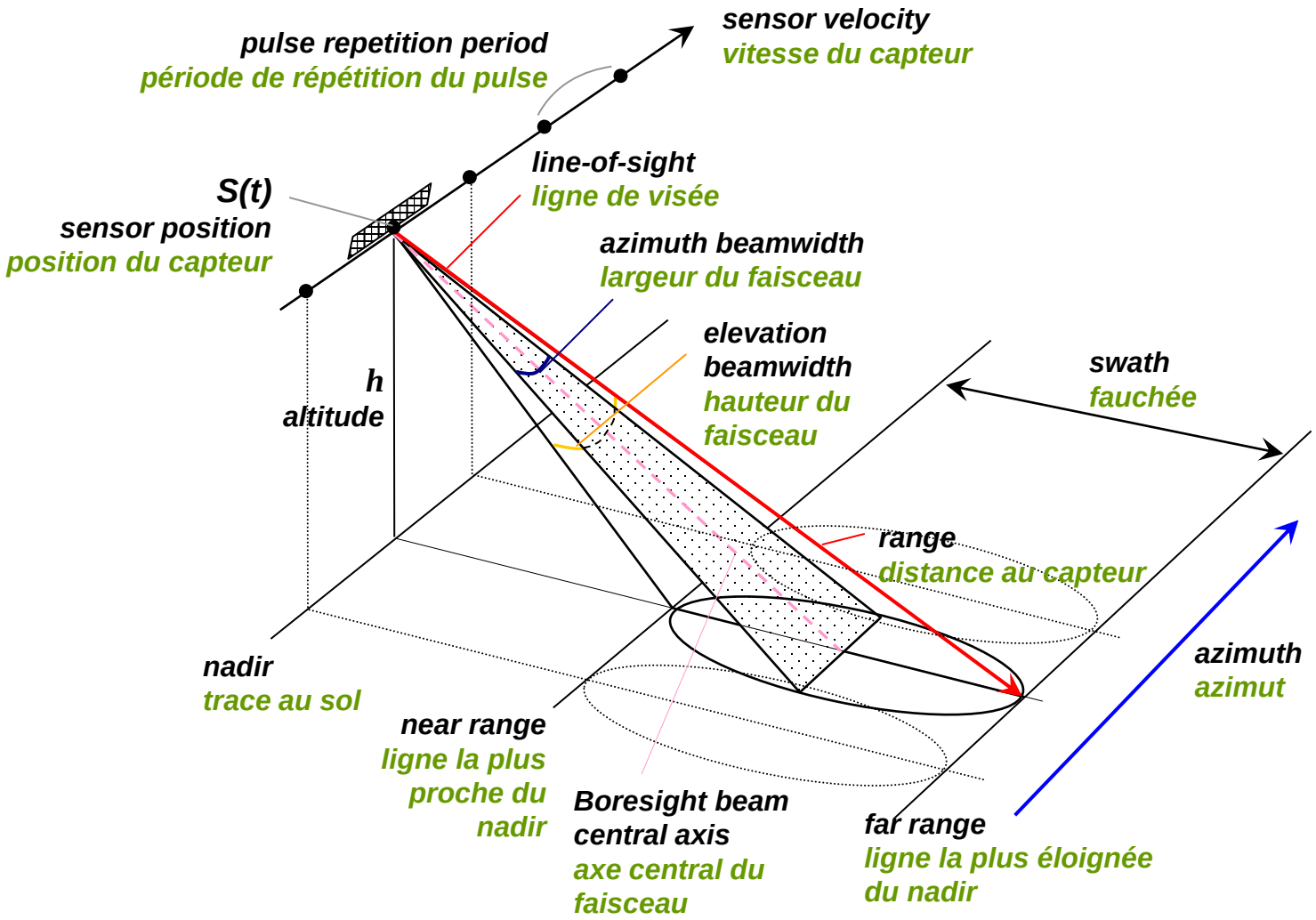
radar Haute résolution (HR)

Défauts de géométrie

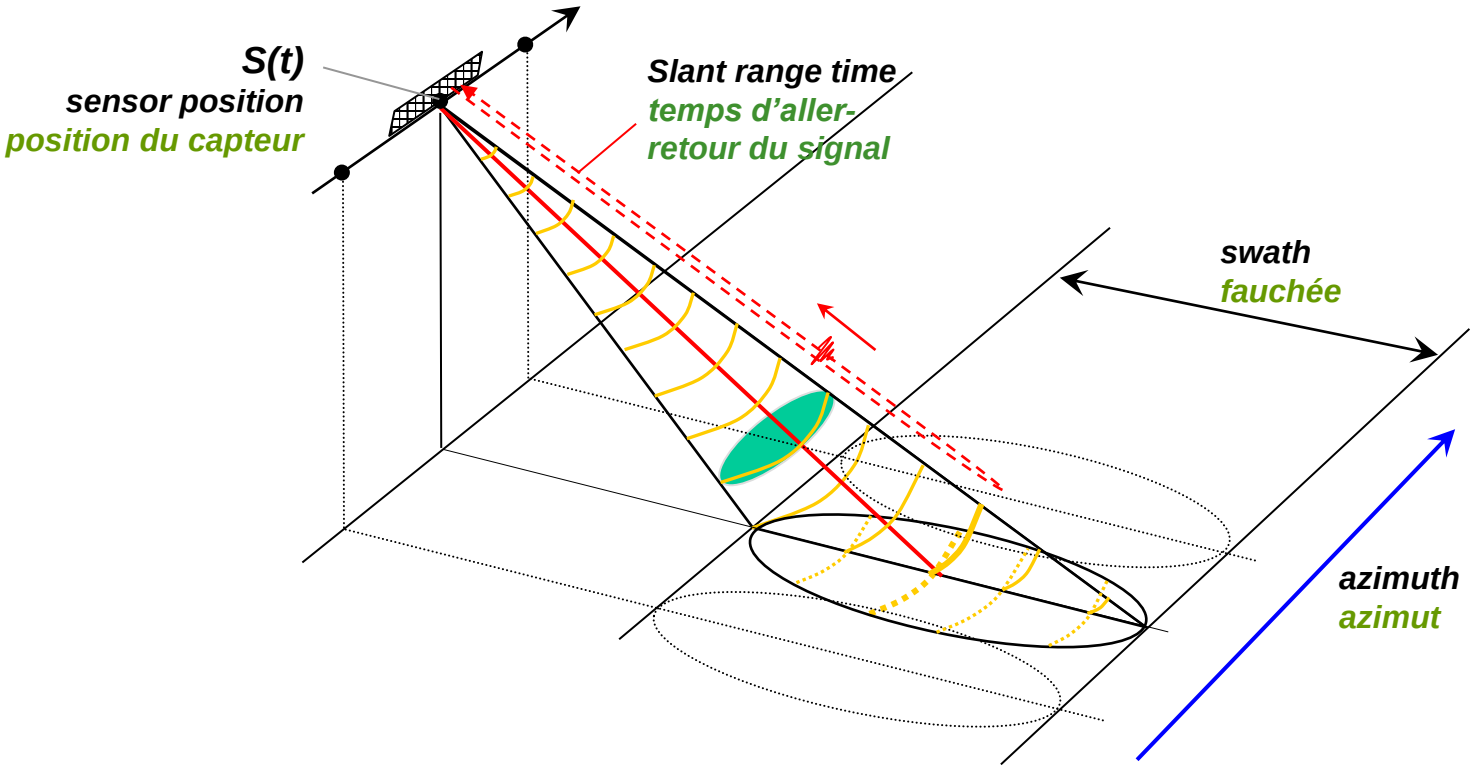


Physique de l'acquisition

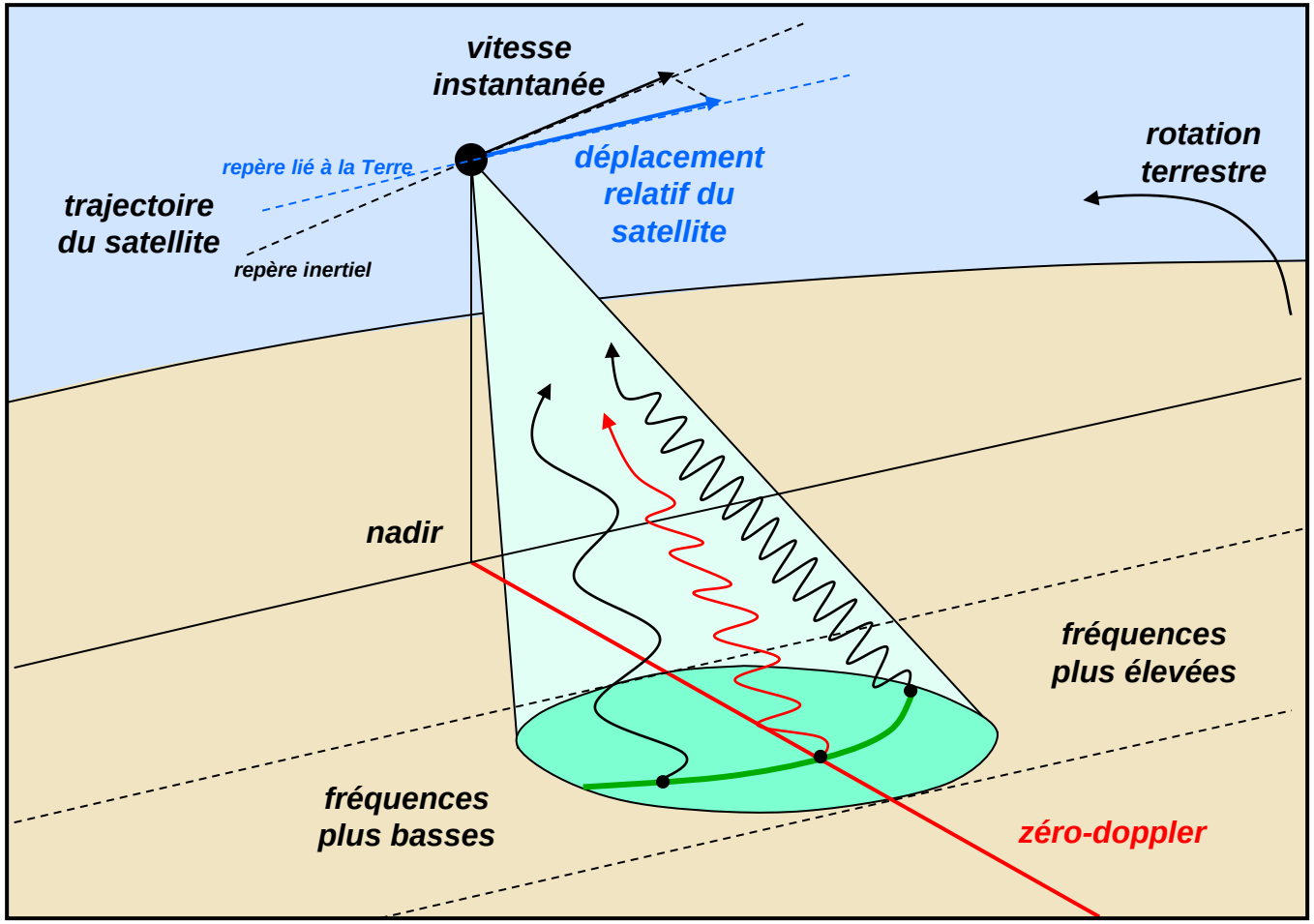
RADAR ↔ ***RAdio Detection And Ranging***



Positionnement en distance (range)



Positionnement en azimut (azimuth)



Fréquence du signal radar

$$f = \frac{c}{\lambda}$$

(Hz) ; (m / s) ; (m)

JERS-1/SAR – 1.2 GHz

Seasat – 1.3 GHz

Radarsat – 5.3 GHz

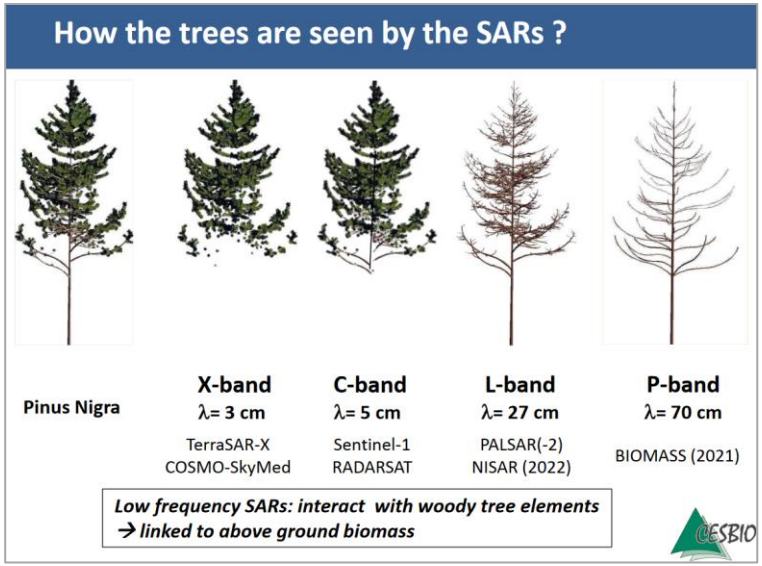
ERS/SAR – 5.3 GHz

TerraSAR-X – 9.65 GHz

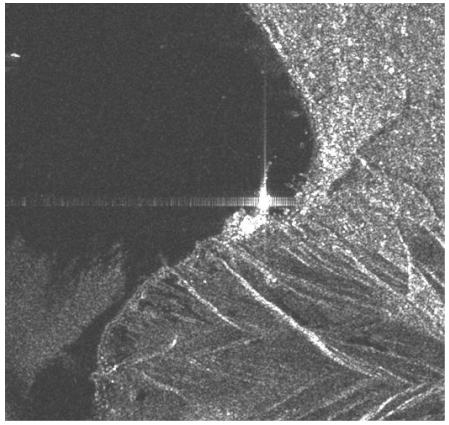
Bande	Fréquence (GHz)	Longueur d'onde (cm)
P	0.255 – 0.390	133 – 76.9
L	0.390 – 1.550	76.9 – 19.3
S	1.550 – 4.20	19.3 – 7.1
C	4.20 – 5.75	7.1 – 5.2
X	5.75 – 10.90	5.2 – 2.7
K Ku Ka	10.90 – 36.0 10.90 – 22.0 22.0 – 36.0	2.7 – 0.83 2.7 – 1.36 1.36 – 0.83
Q	36.0 – 46.0	0.83 – 0.65
V	46.0 – 56.0	0.65 – 0.53
W	56.0 – 100.0	0.53 – 0.30

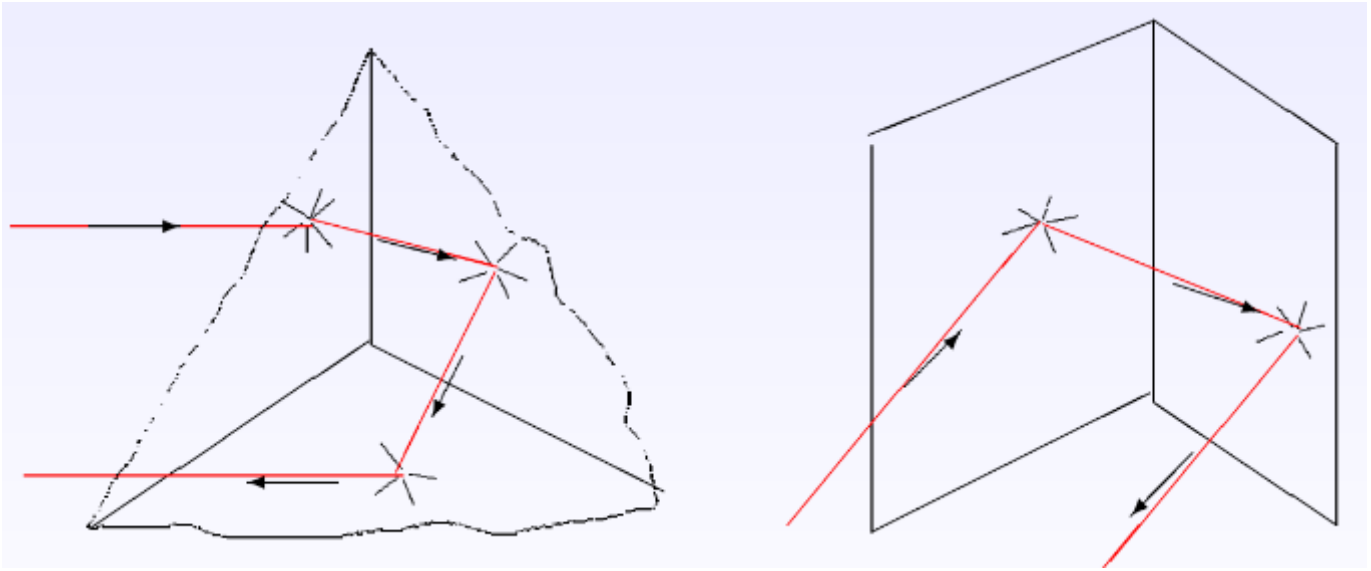
λ > 2 cm - Pénétration des nuages

λ > 4 cm - Pénétration de la pluie
Meilleure pénétration des sols secs



Mécanisme de rétrodiffusion (*back-scattering*)





trièdre (corn-reflector)

bièdre

http://smsc.cnes.fr/PLEIADES/Fr/PDF/methodo/presPolar_inglada.pdf

La polarisation de la lumière

filtre vertical (V)

filtre horizontal (H)

Sentinel-1 – HR Radar

https://sentinel.esa.int/web/sentinel/missions/sentinel-1

Sentinel-1

12 days cycle

	launch	*1st data*
S1A	03.04.2014	03.10.2014
S1B	22.04.2016	26.09.2016

+6 days phase

Instrument

- C-SAR (Synthetic Aperture Radar), 5.405 GHz,

Modes

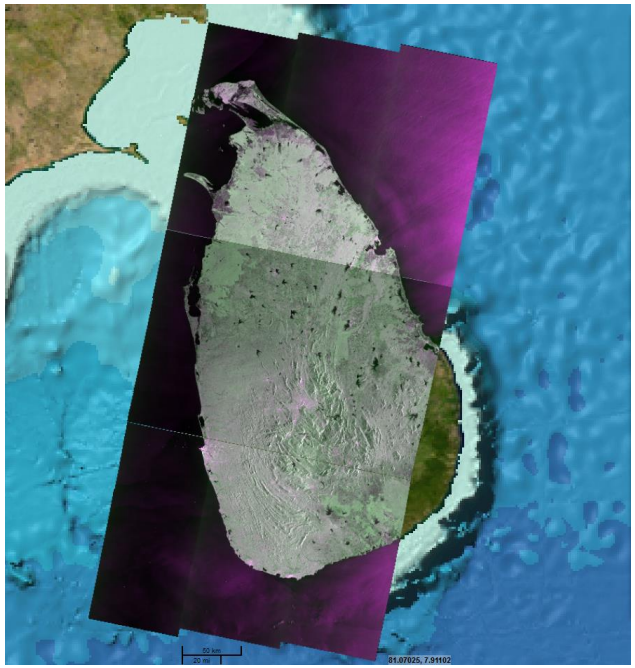
- IW (Interferometry Wide Swath) – swath=240km – GSD=10m
- EW (Extended Wide Swath) – swath=400km – GSD=40m
- SM (Stripmap) – swath=80-100km – GSD=6-10m

Polarization

- Single: Vertical (V) or horizontal (H)
- Dual: VV,VH (V emission, V or H reception) or HH, HV (H emission, V or H reception)

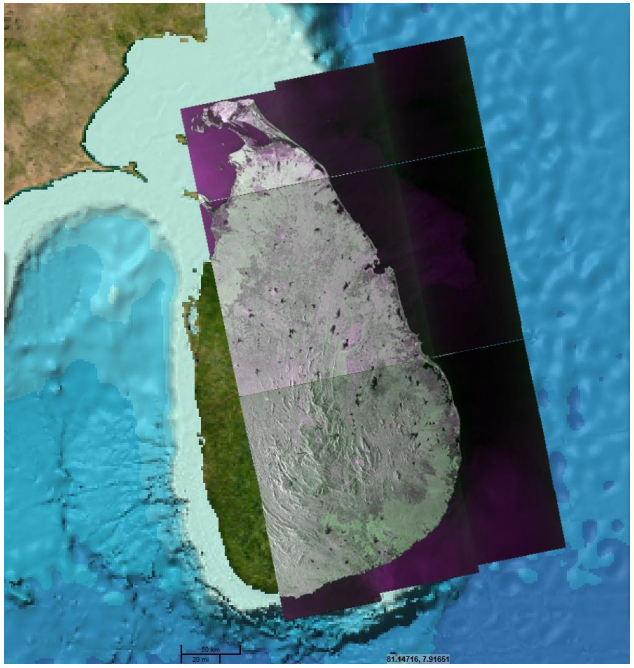
Series of 3 scenes
acquired on 21.09.2017
00:24:24 GMT
in descending orbit (left)

2D-view-left



Series of 3 scenes
acquired on 21.09.2017
12:49:54 GMT
in ascending orbit (right)

2D-view-right



Sentinel satellites (S3)

https://sentinel.esa.int/web/sentinel/missions/sentinel-3

Sentinel-3

27 days cycle

	launch	*1st data*
S3A	16.02.2016	18.10.2016
S3B	??.??.2018	

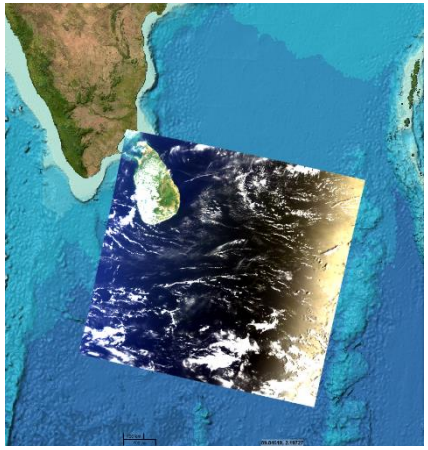
+?? days phase

Instruments

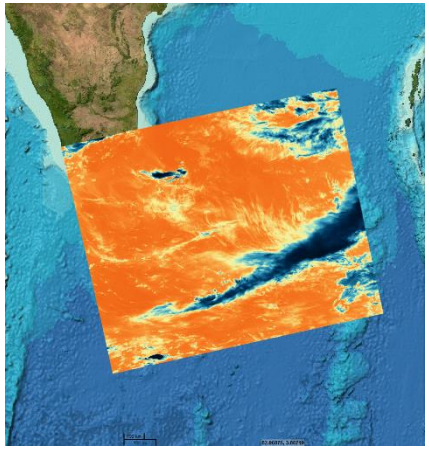
- OLCI (Ocean Land Colour Instrument) – optical
  - 21 bands [0.4-1.02] µm
  - GSD = 300m
  - swath width = 1270 km
- SLSTR (Sea and Land Surface Temperature Radiometer)
  - 9 bands [0.55-12] µm, NADIR + backward
  - GSD = 500m (VIS, SWIR), 1 km (MWIR, TIR)
  - swath width = 1420 km (NADIR), 750 km (backward)
- SRAL (SAR Radar Altimeter)
  - Range measurement: Ku-band (13.575 GHz) and C-band (5.41 GHz)
  - Sampling rate: 1 Hz (≈850m) and 10 Hz (≈85m)

Sri-Lanka seen by:

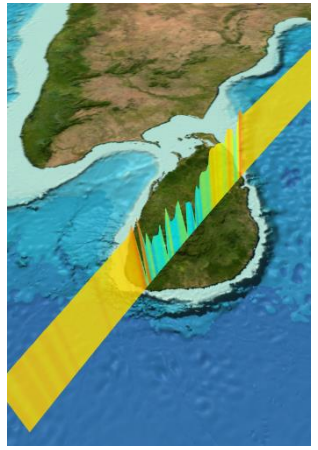
OLCI on
30.09.2017 09:30:04 GMT.
2D-view-left



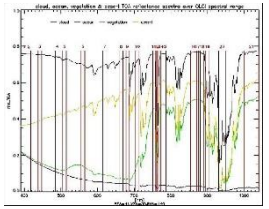
SLSTR on
01.10.2017 16:28:18 GMT.
2D-view-middle



SRAL on
29.09.2017 04:35:48 GMT.
2D-view-right



Sentinel-3 OLCI – Spectral bands



See fig.48 of
eoPortal Directory

OLCI bands function: https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-olci/resolutions/radiometric
Envisat MERIS heritage (https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-olci/overview/heritage)

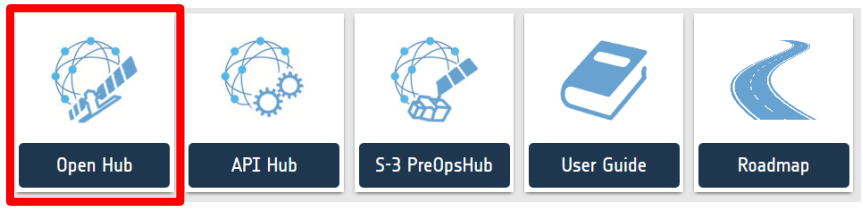
Band	λ centre (nm)	Width (nm)	Function
Oa1	400	15	Aerosol correction, improved water constituent retrieval
Oa2	412.5	10	Yellow substance and detrital pigments (turbidity)
Oa3	442.5	10	Chlorophyll absorption max., biogeochemistry, vegetation
Oa4	490	10	High Chlorophyll , other pigments
Oa5	510	10	Chlorophyll , sediment, turbidity, red tide
Oa6	560	10	Chlorophyll reference (Chlorophyll minimum)
Oa7	620	10	Sediment loading
Oa8	665	10	Chlorophyll (2nd Chlorophyll absolute max.), sediment, yellow substance / vegetation
Oa9	673.75	7.5	For improved fluorescence retrieval and to better account for smile together with the bands 665 and 680 nm
Oa10	681.25	7.5	Chlorophyll fluorescence peak, red edge
Oa11	708.75	10	Chlorophyll fluorescence baseline, red edge transition
Oa12	753.75	7.5	O2 absorption / clouds, vegetation
Oa13	761.25	2.5	O2 absorption band / aerosol correction
Oa14	764.375	3.75	Atmospheric correction
Oa15	767.5	2.5	O2A used for cloud top pressure, fluorescence over land
Oa16	778.75	15	Atmos. corr./aerosol corr.
Oa17	865	20	Atmos. corr./aerosol corr., clouds, pixel co-registration
Oa18	885	10	Water vapour absorption reference band. Common reference band with SLSTR instrument. Vegetation monitoring
Oa19	900	10	Water vapour absorption/vegetation monitoring (maximum reflectance)
Oa20	940	20	Water vapour absorption, atmosphere / aerosol correction
Oa21	1 020	40	Atmosphere / aerosol correction

bands absent in the previous Envisat / MERIS instrument

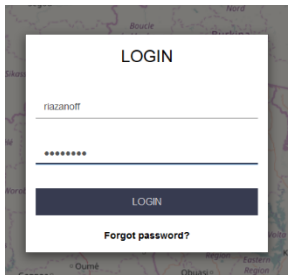
Sentinel infrastructures

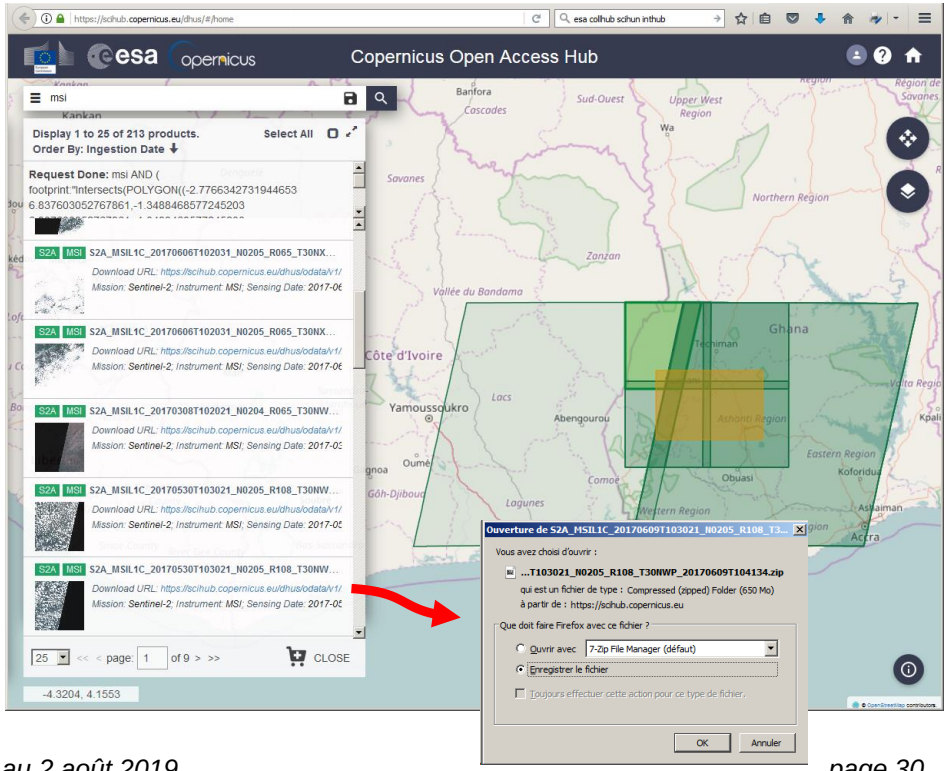
https://sentinel.esa.int/web/sentinel/sentinel-data-access

Copernicus Open Access Hub (COA)
https://scihub.copernicus.eu/



https://scihub.copernicus.eu/dhus





Traitement d’images

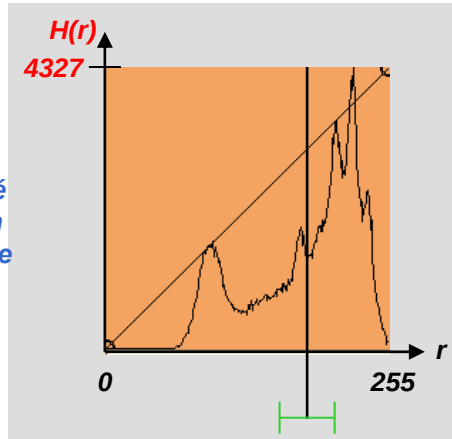
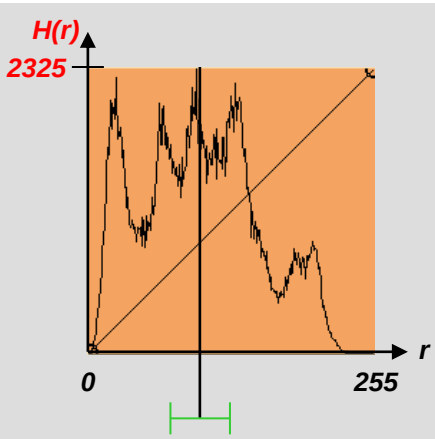
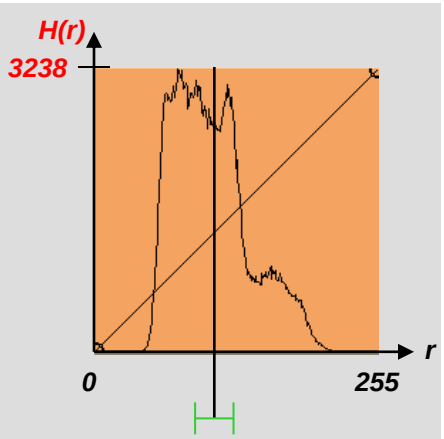
Histogramme, stretching linéaire

➢ Histogramme

$$\forall r = 0 .. 2^d-1,\ H(r) = Card\ (\ \{\ R(i,j)=r,\ i=0..(M-1)\ ,\ j=0..(N-1)\ \}\ )$$ avec d: nombre de bits par pixels

H(r) Occurrences de la radiométrie r dans l'image entière

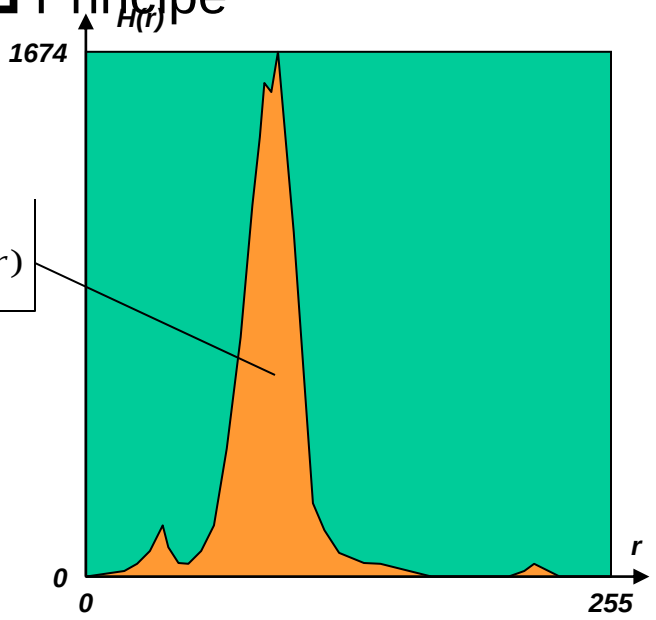
affichage calibré sur le maximum de l'histogramme (max(H(k))

girl.r	girl.g	girl.b	
			
			
m = 180,22 σ = 49,05	m = 99,05 σ = 52,88	m = 105,41 σ = 34,06	

➢ Stretching linéaire automatique

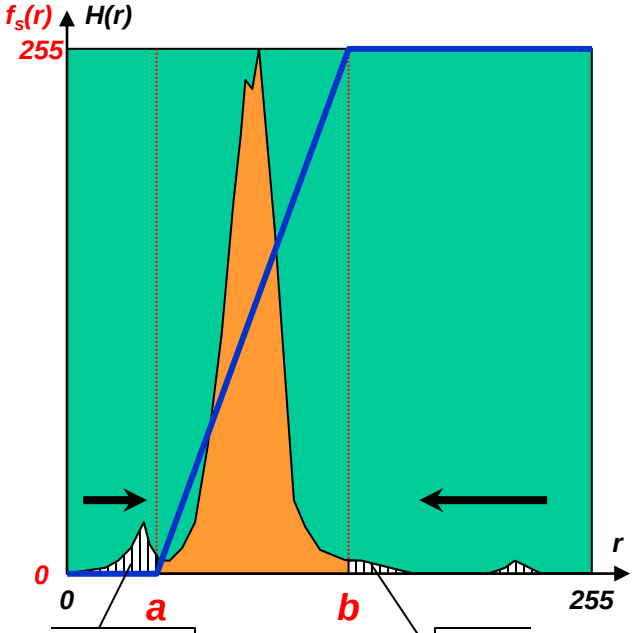
Déterminer automatiquement les bornes a et b du stretching linéaire

❑ Principe



Nombre de pixels image :

$$N = \sum_{r=0}^{255} H(r)$$



Pixels saturés à gauche

$$N_g = \sum_{r=0}^{a} H(r)$$

Pixels saturés à droite

$$N_d = \sum_{r=b}^{255} H(r)$$

α_s : Pourcentage de saturation

$N_s = N \times \alpha_s$: Nombre de pixels image saturés

$N_s = N_g + N_d$

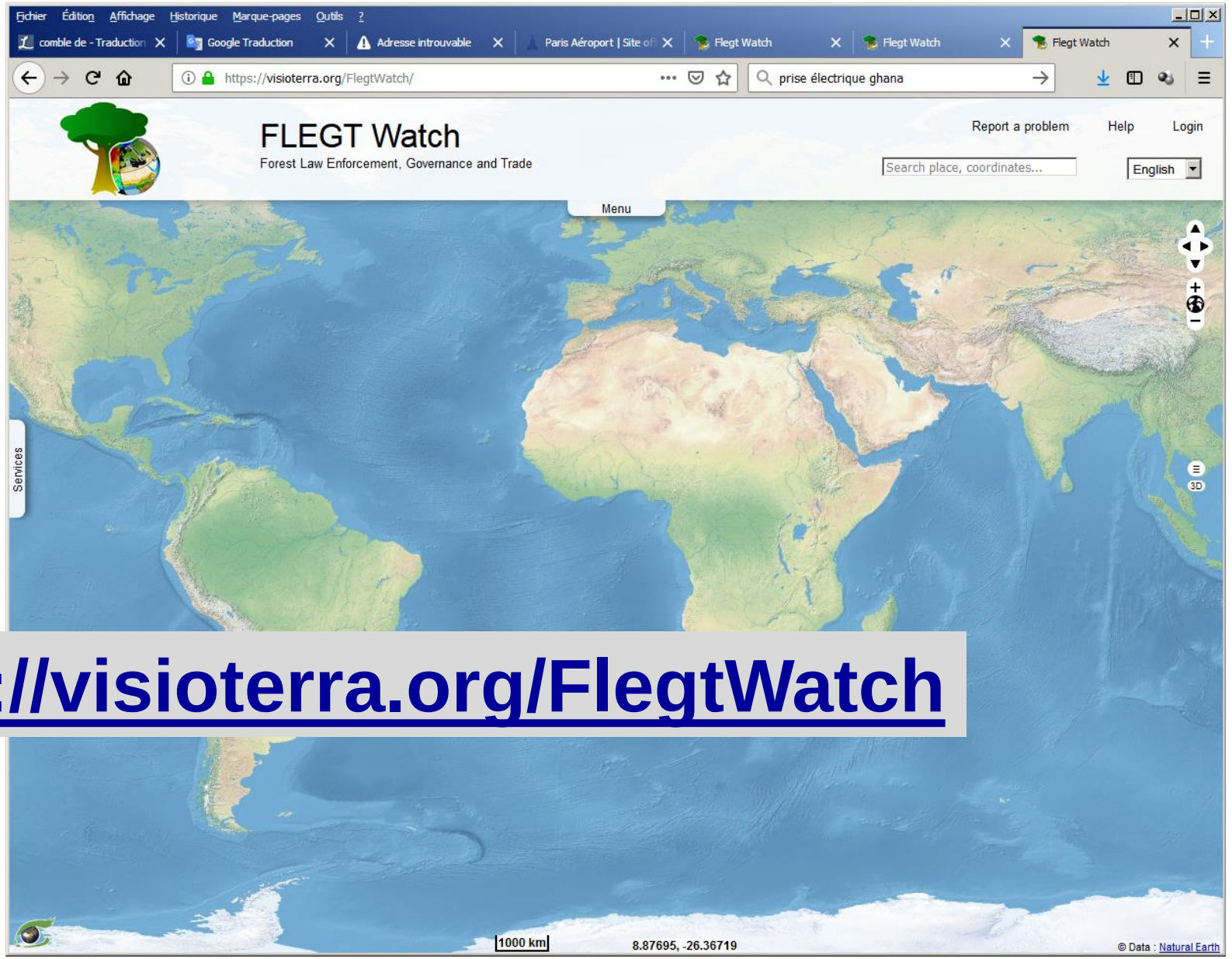
2 méthodes:

- *saturer $N_S/2$ pixels à gauche puis $N_S/2$ pixels à droite*
- *saturer du côté où l'histogramme est minimal*

FLEGT Watch Web

Utilisation pas-à-pas

Launch FLEGT Watch (Web)

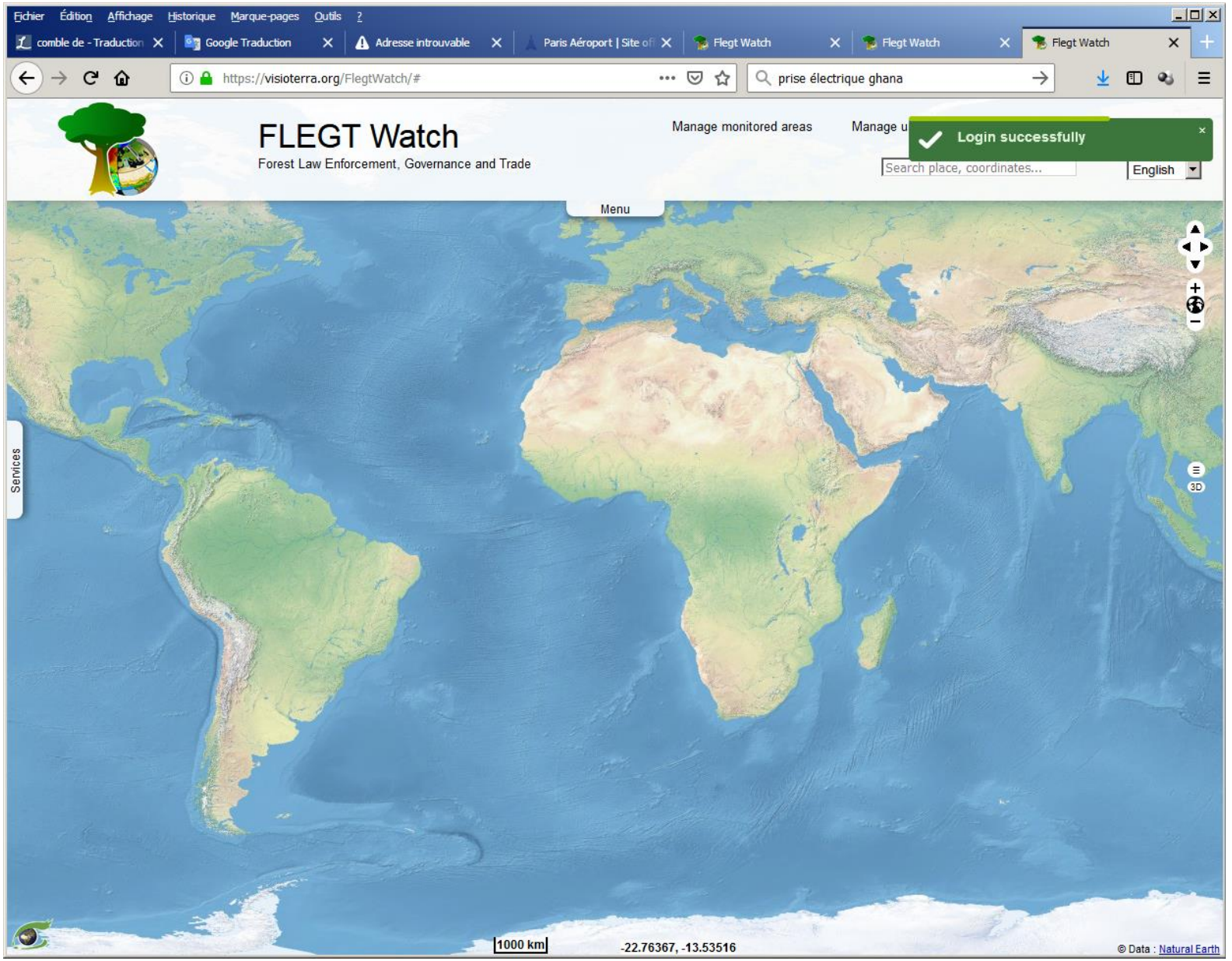


https://visioterra.org/FlegtWatch

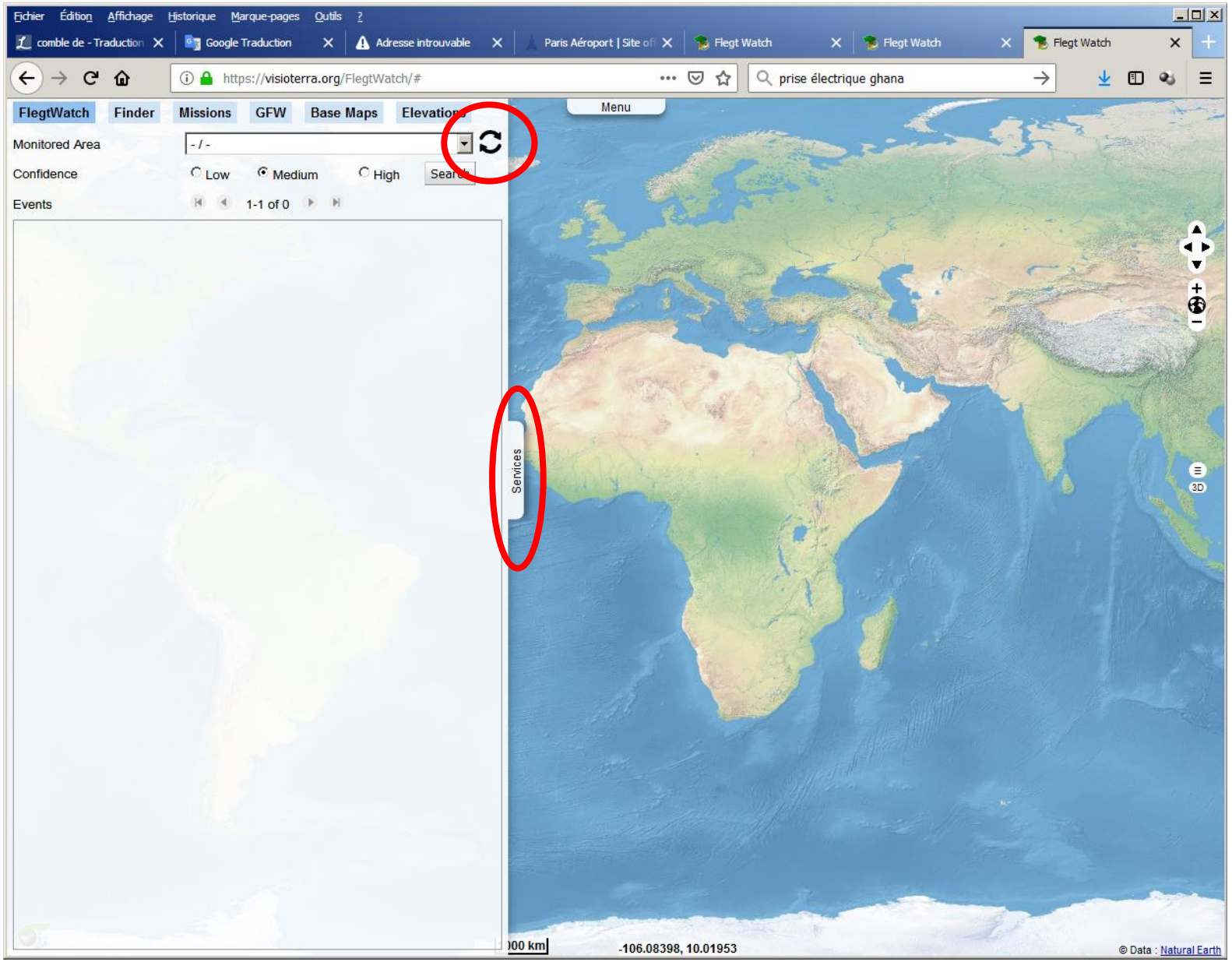
Enter your e-mail and password

default value of password for observers is “**fw**”

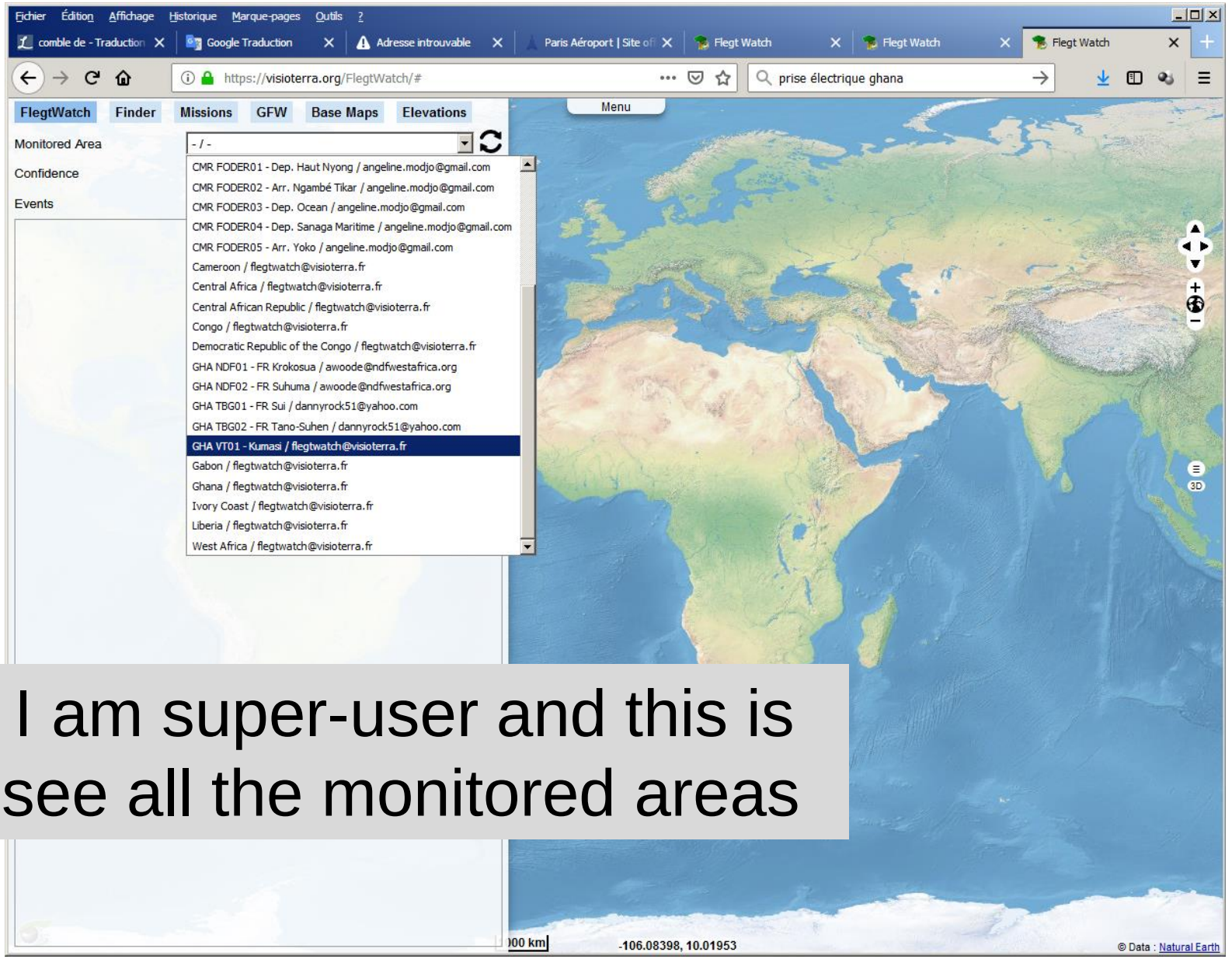
Check that you login has been accepted



Open the “Services” panel and actualise the “Monitored areas”

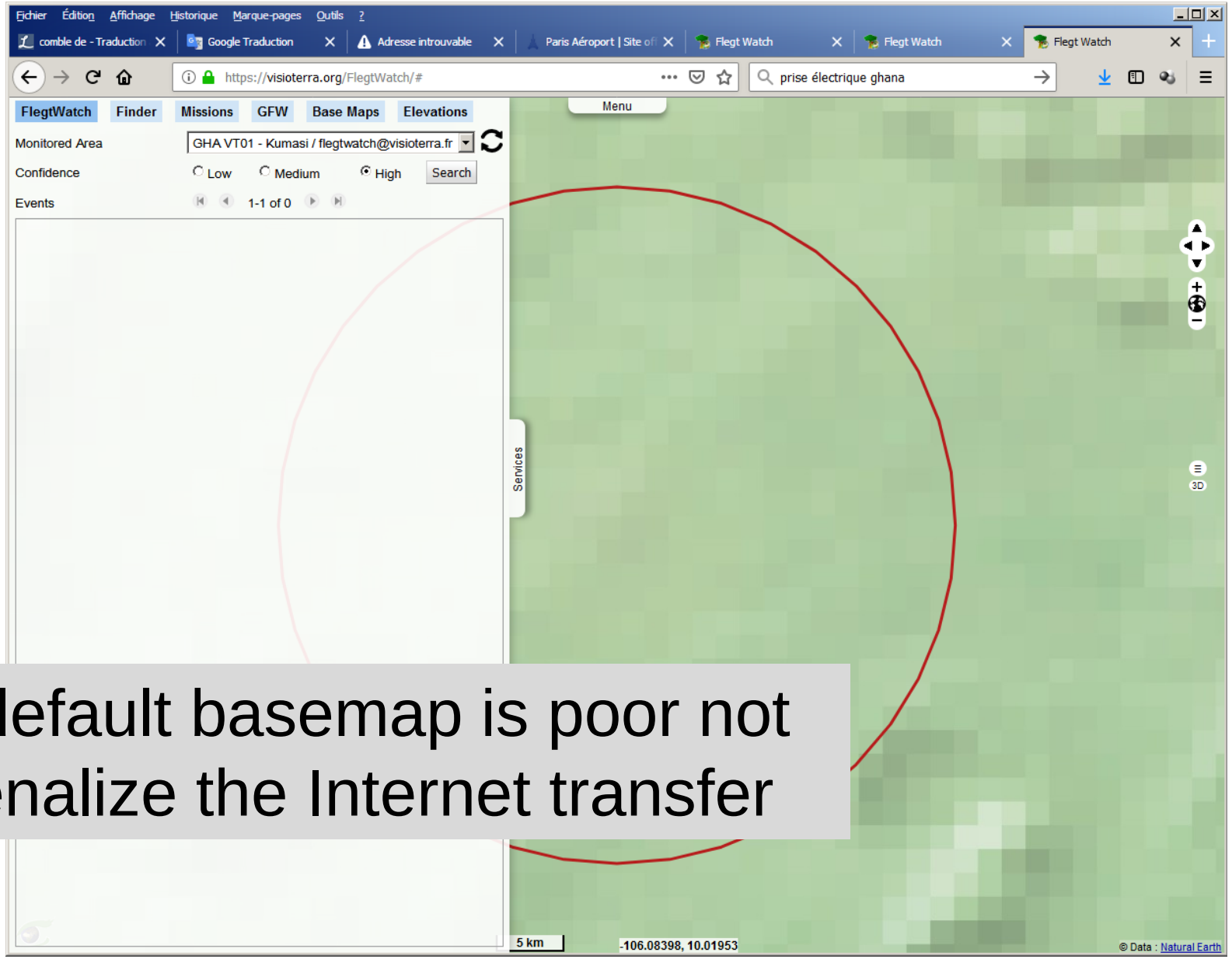


Select one of you monitored areas



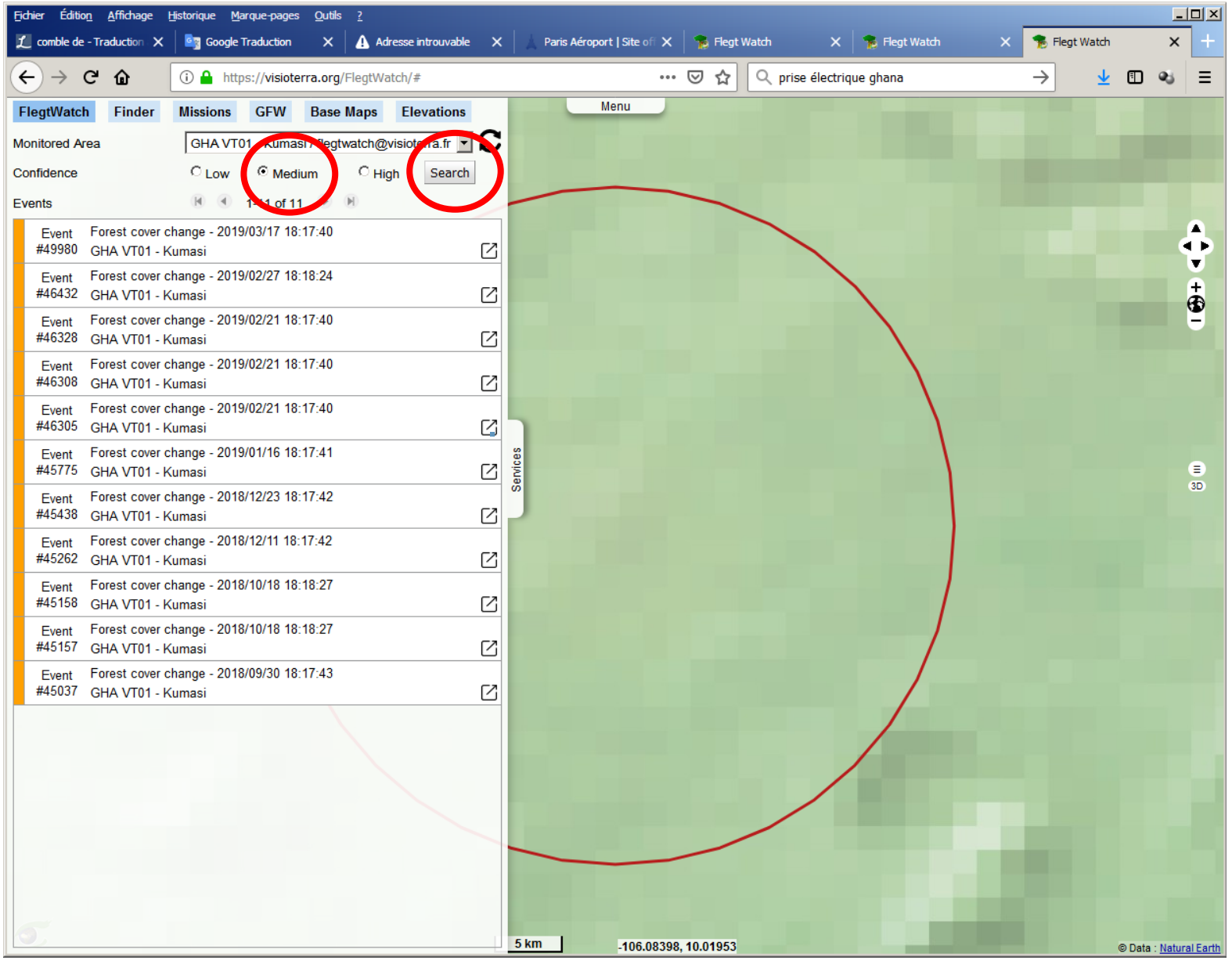
Here, I am super-user and this is why I see all the monitored areas

You see the polygon of your monitored area

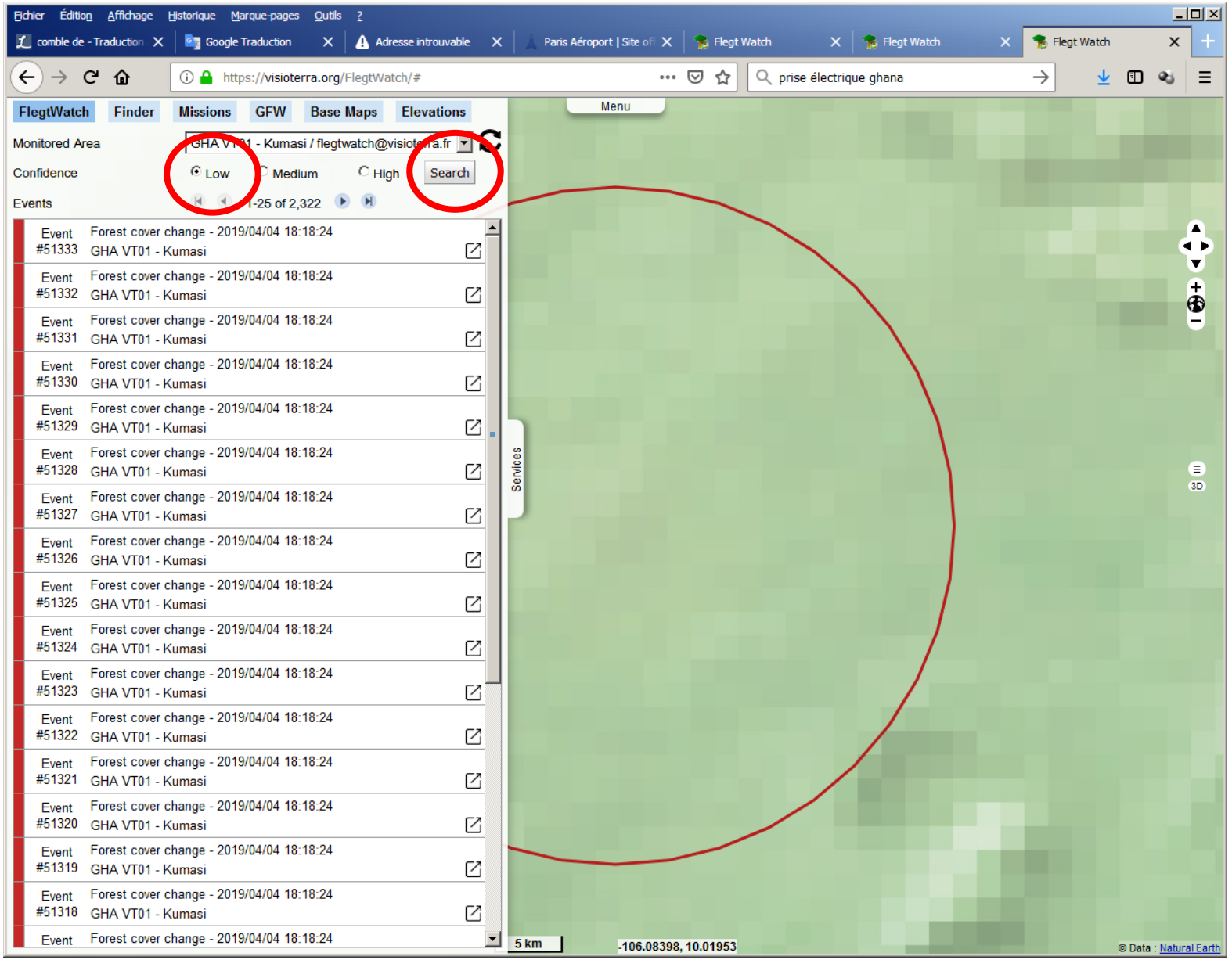


The default basemap is poor not to penalize the Internet transfer

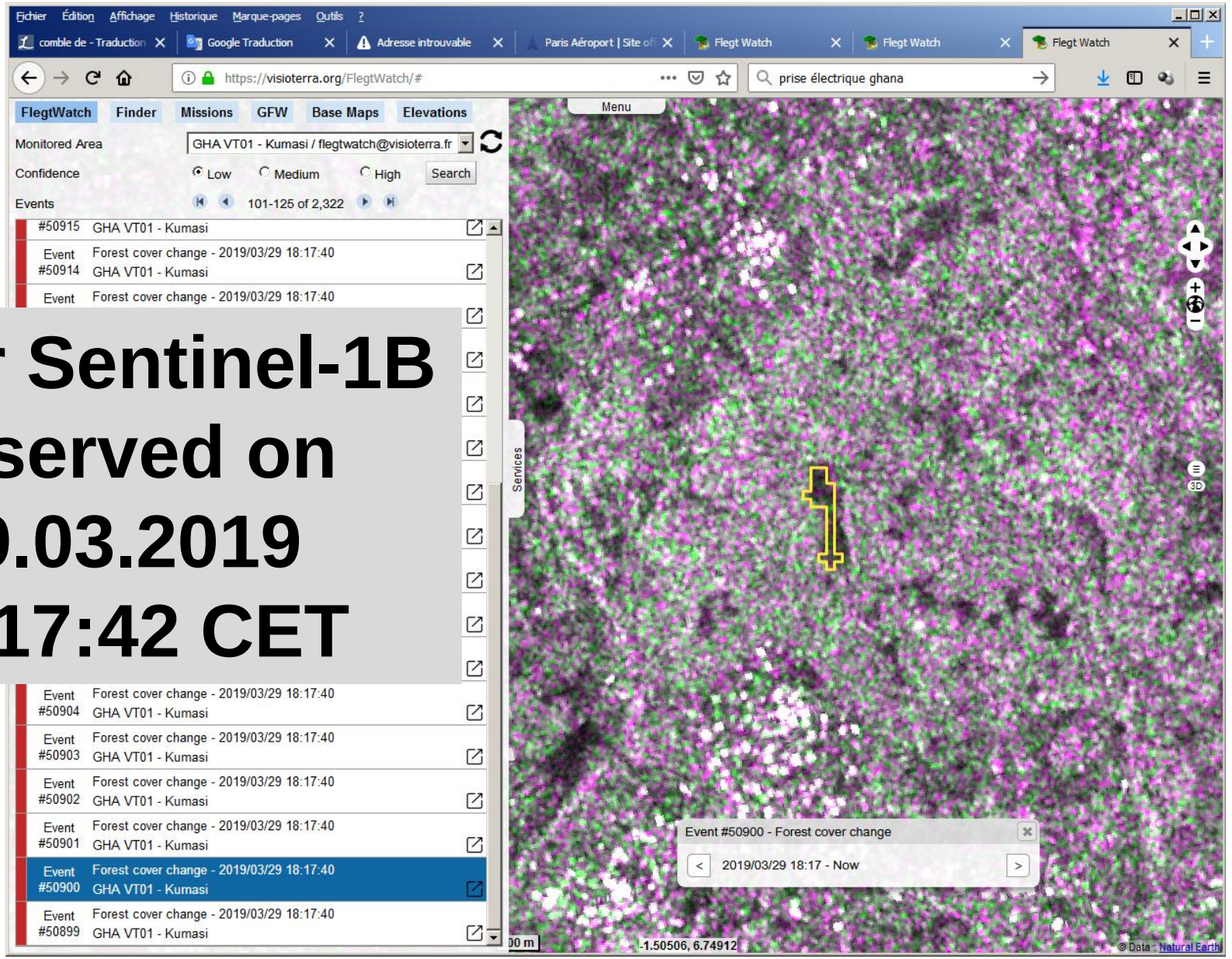
Get the list of events – Medium confidence index



Get the list of events – Low confidence index

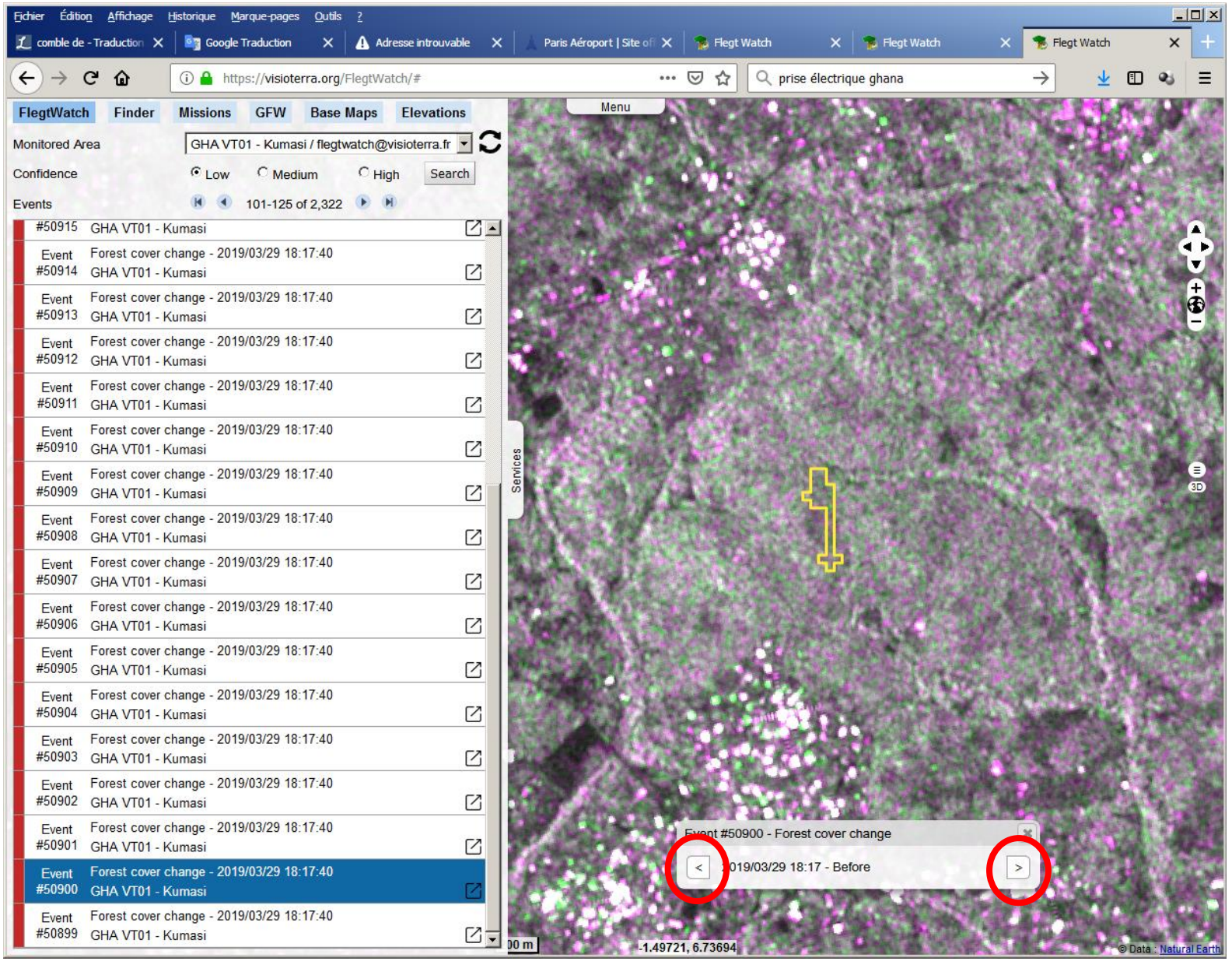


Select one event → GHA VT01 / #50900

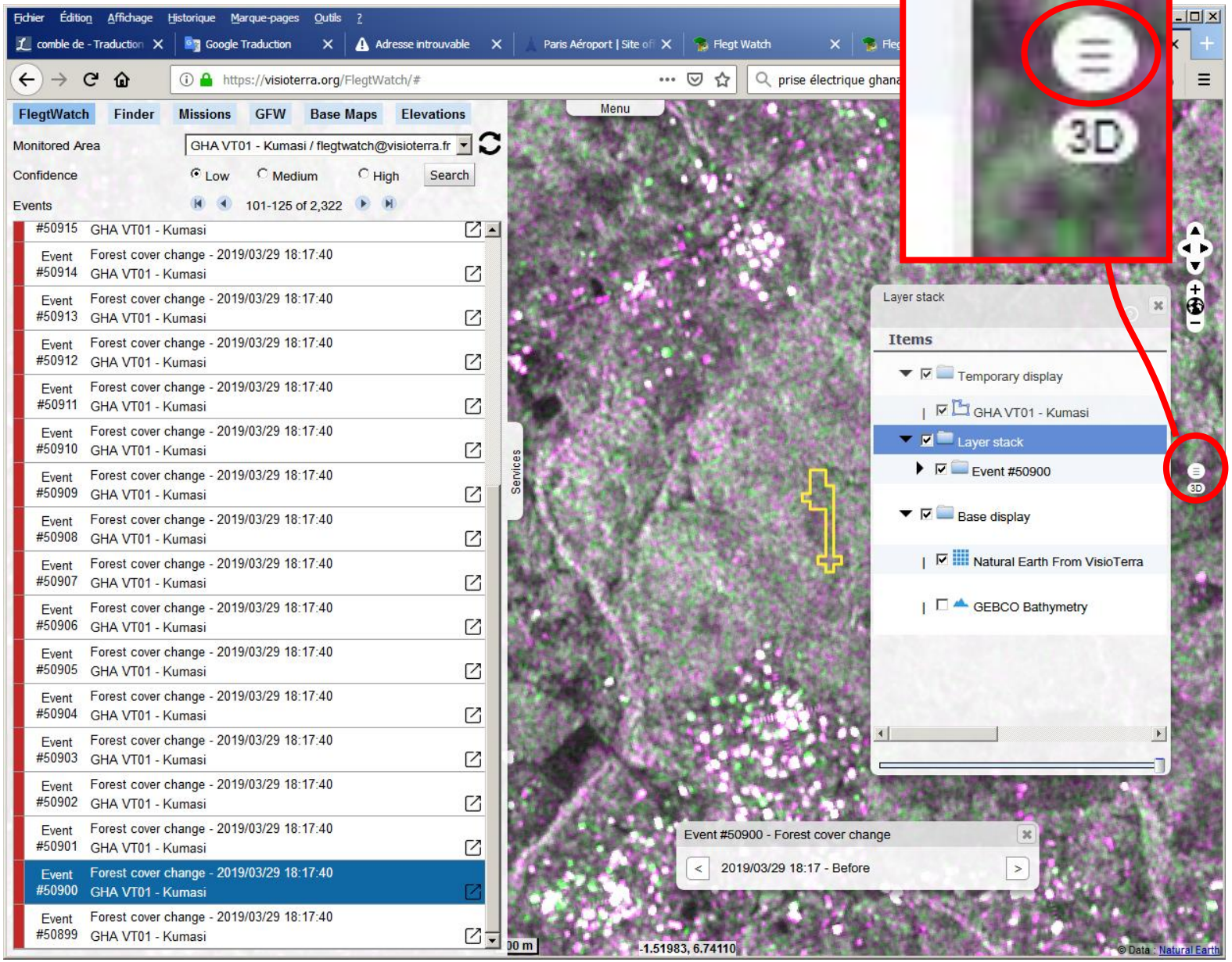


Radar Sentinel-1B observed on 29.03.2019 18:17:42 CET

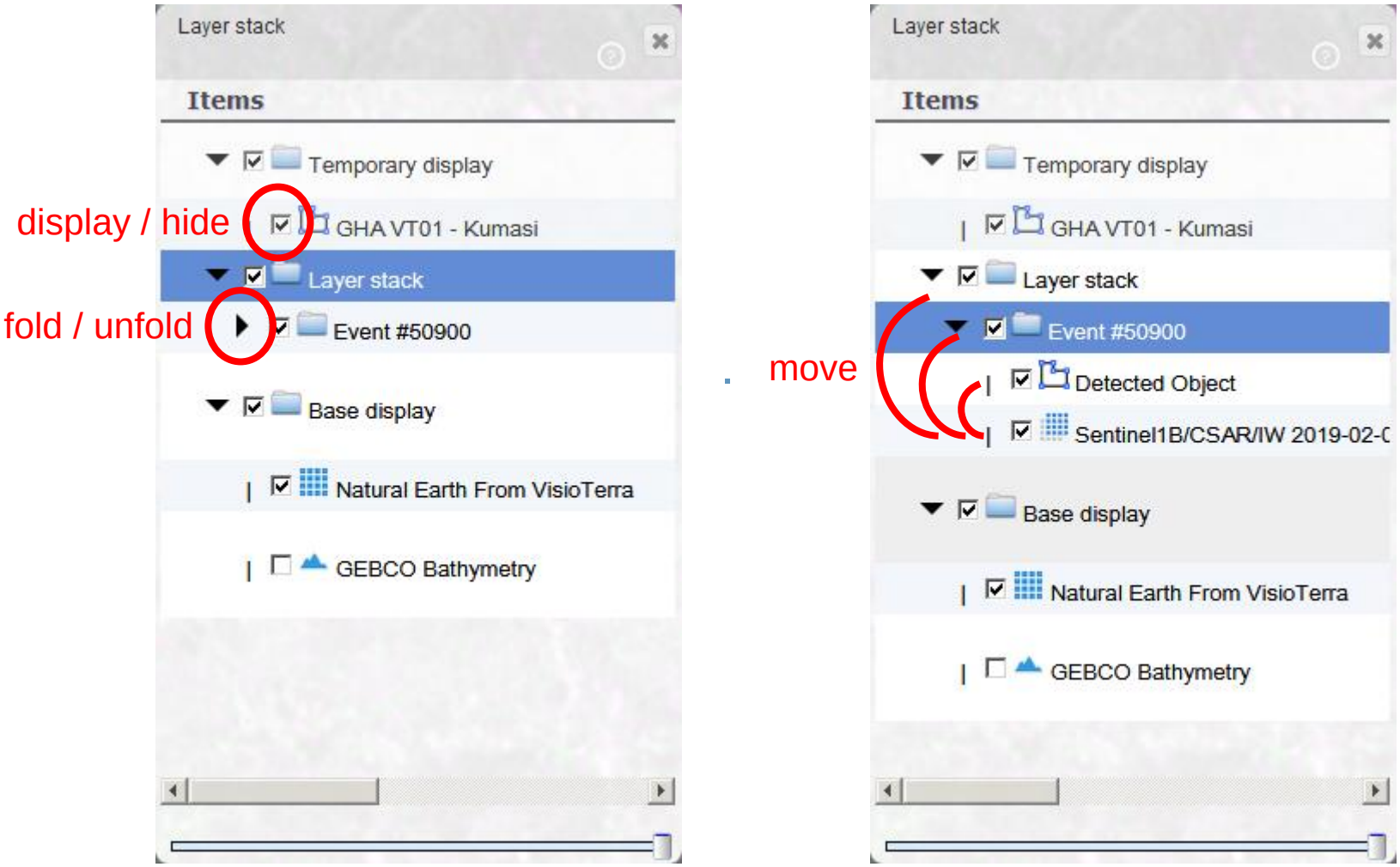
Check the difference with the previous acquisitions (mean of 4)



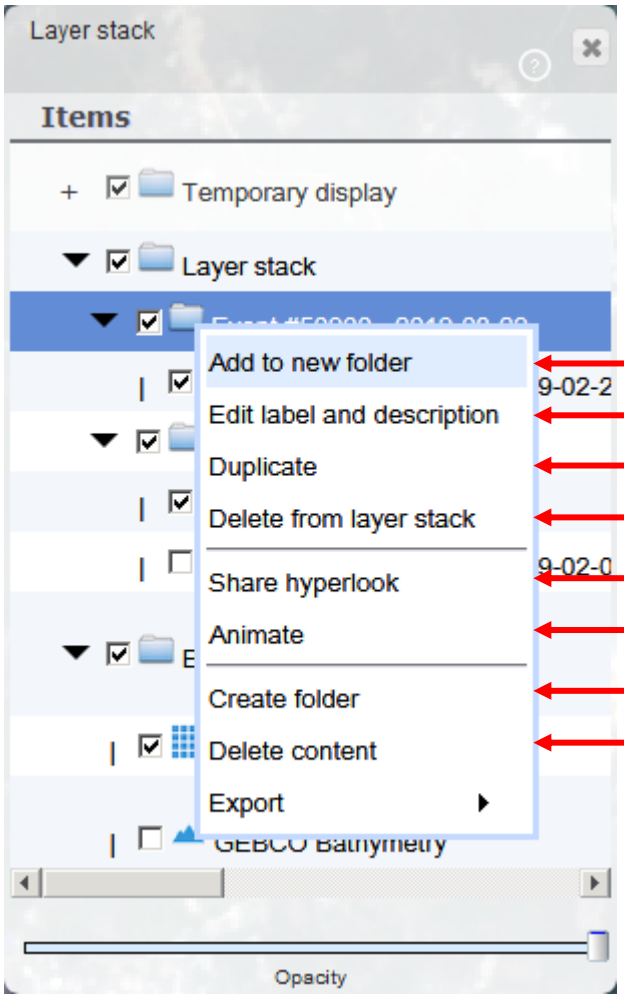
You may use the layer stack



Handle items in a layer stack



Handle items in a layer stack (2)



Add to new folder

Edit label and description

Duplicate

Delete from layer stack

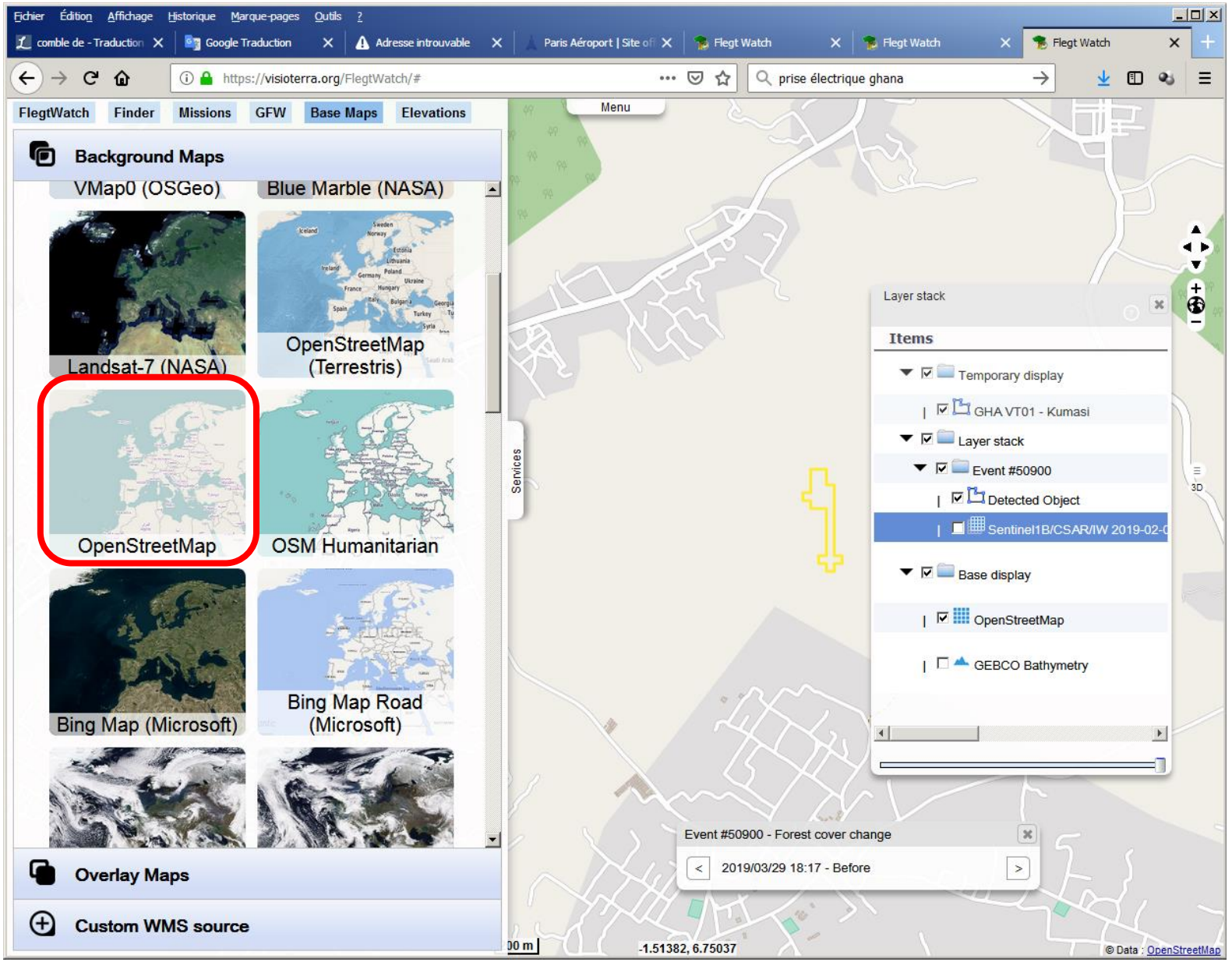
Share hyperlook

Animate

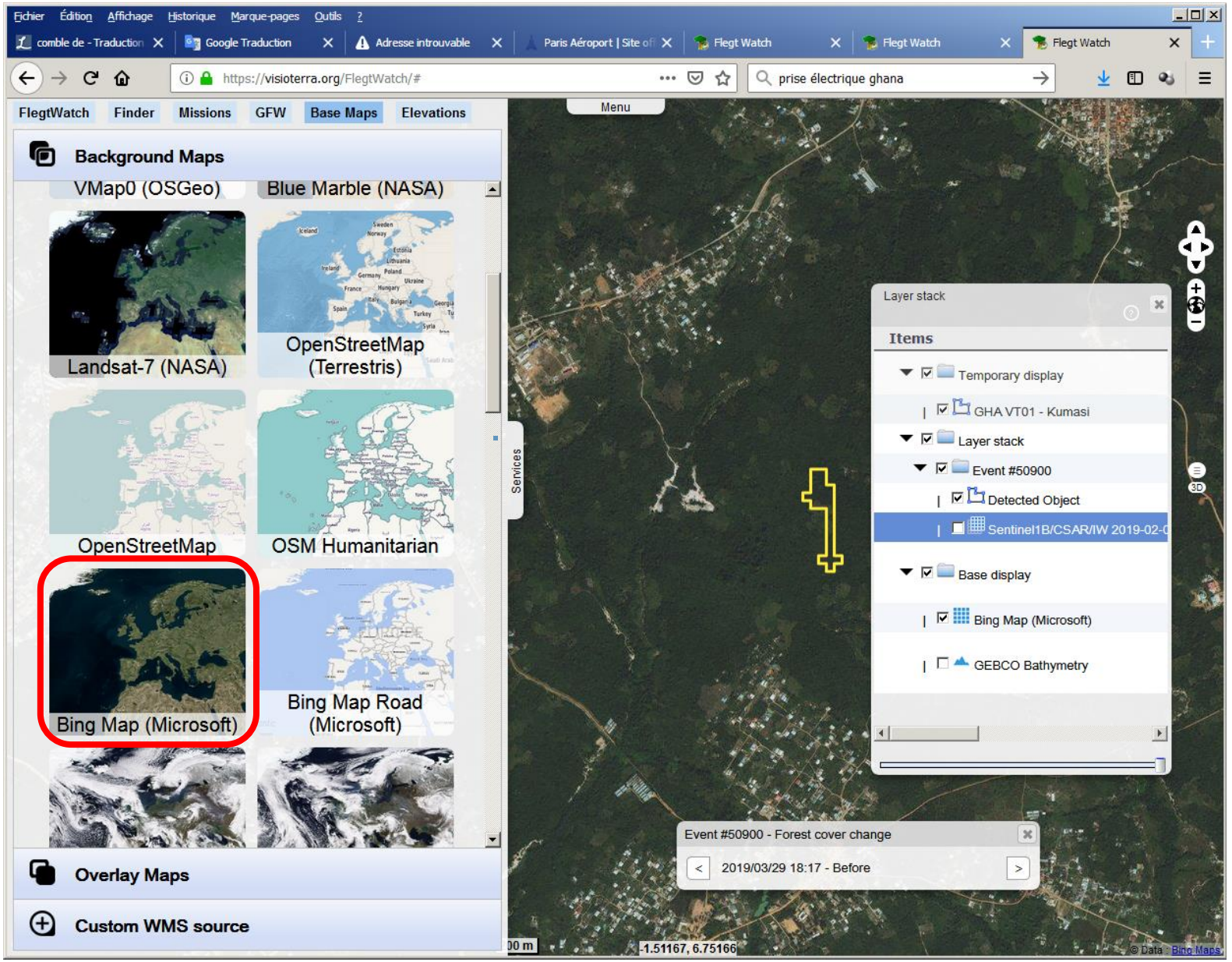
Create folder

Delete content

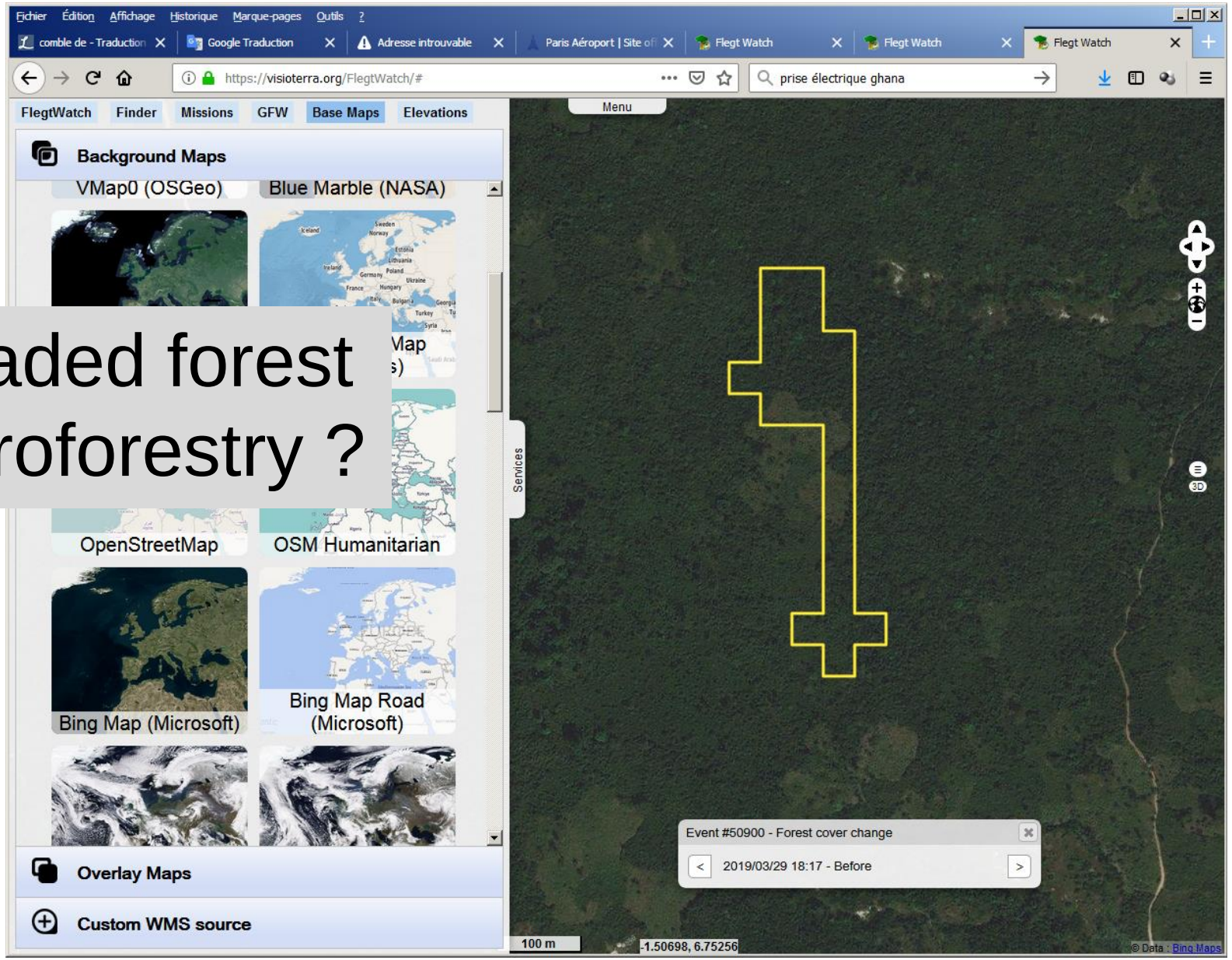
Change basemap - OpenStreetMap



Change basemap (2) – Bing map

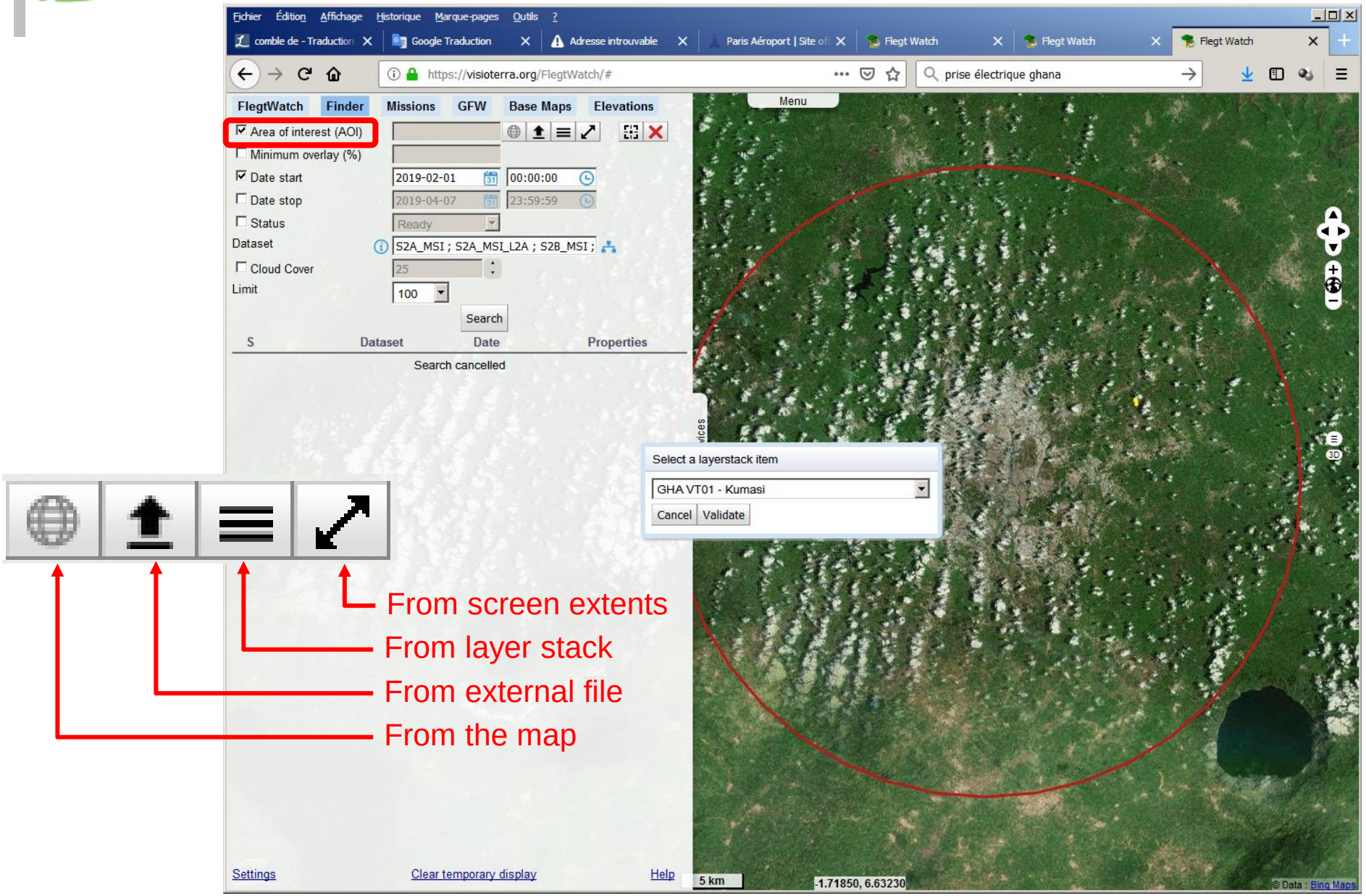


Characterise the land cover

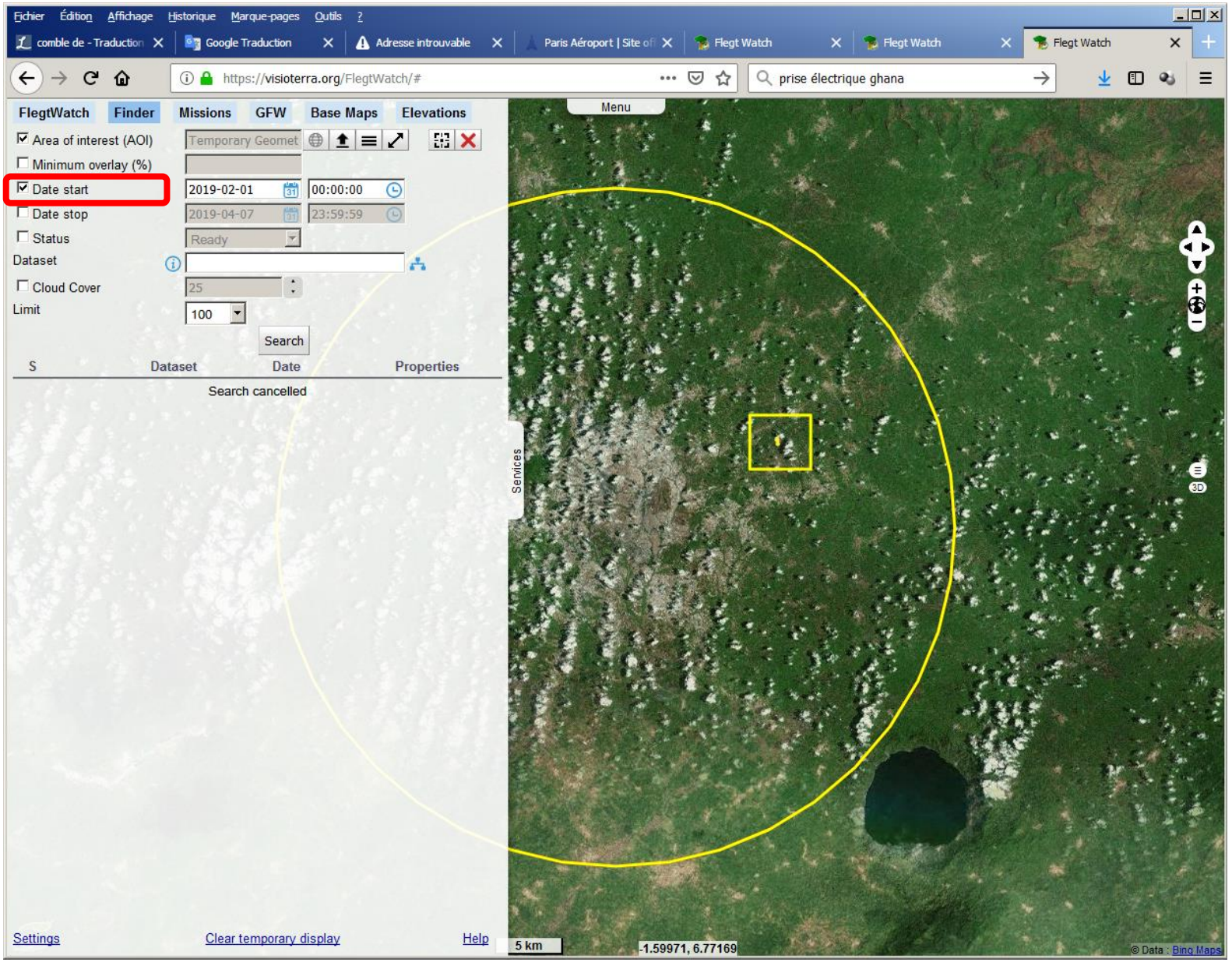


degraded forest
or agroforestry ?

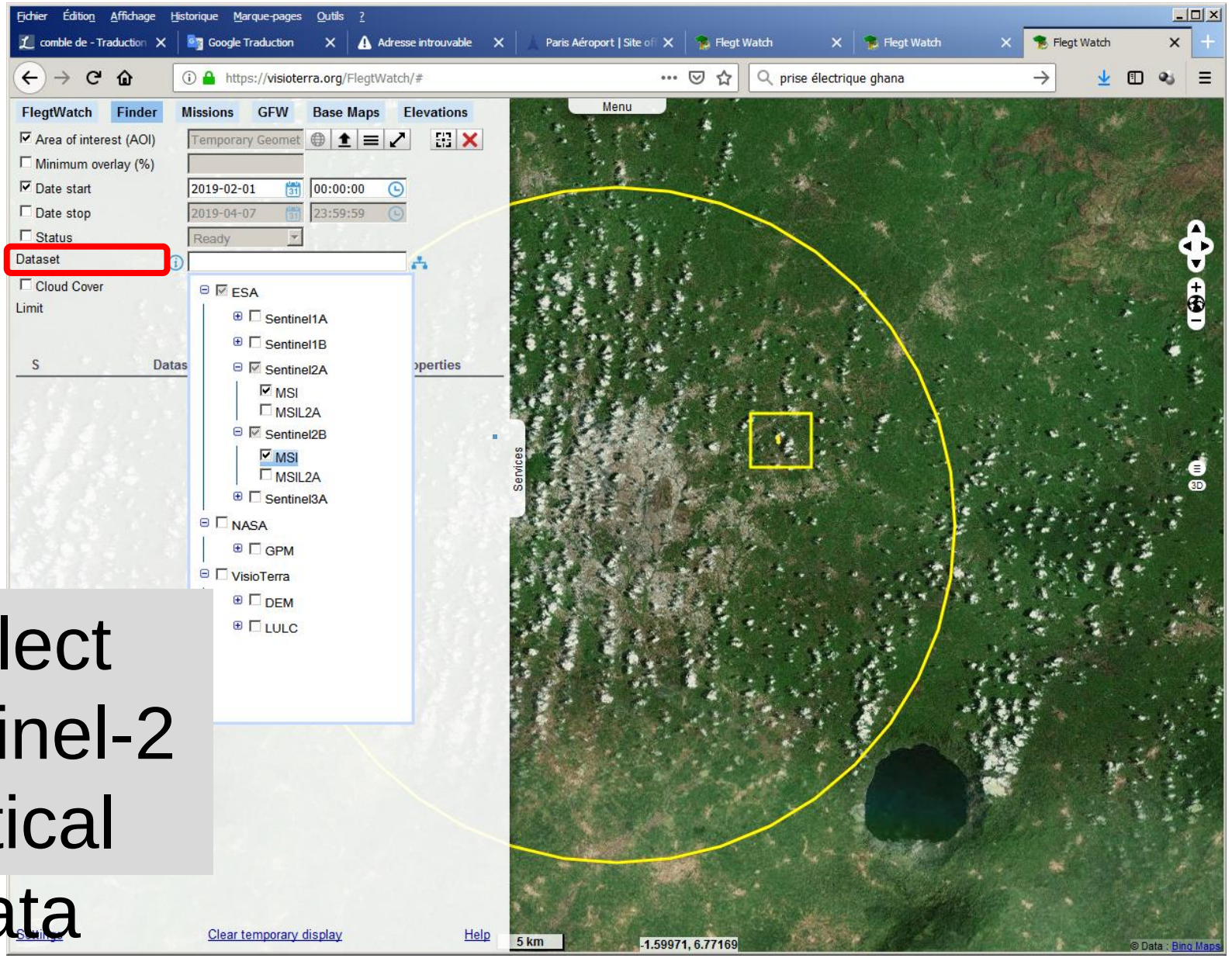
Getting other data – 1. Define your area of interest



Getting other data – 2. Define (possibly) a date or a date interval



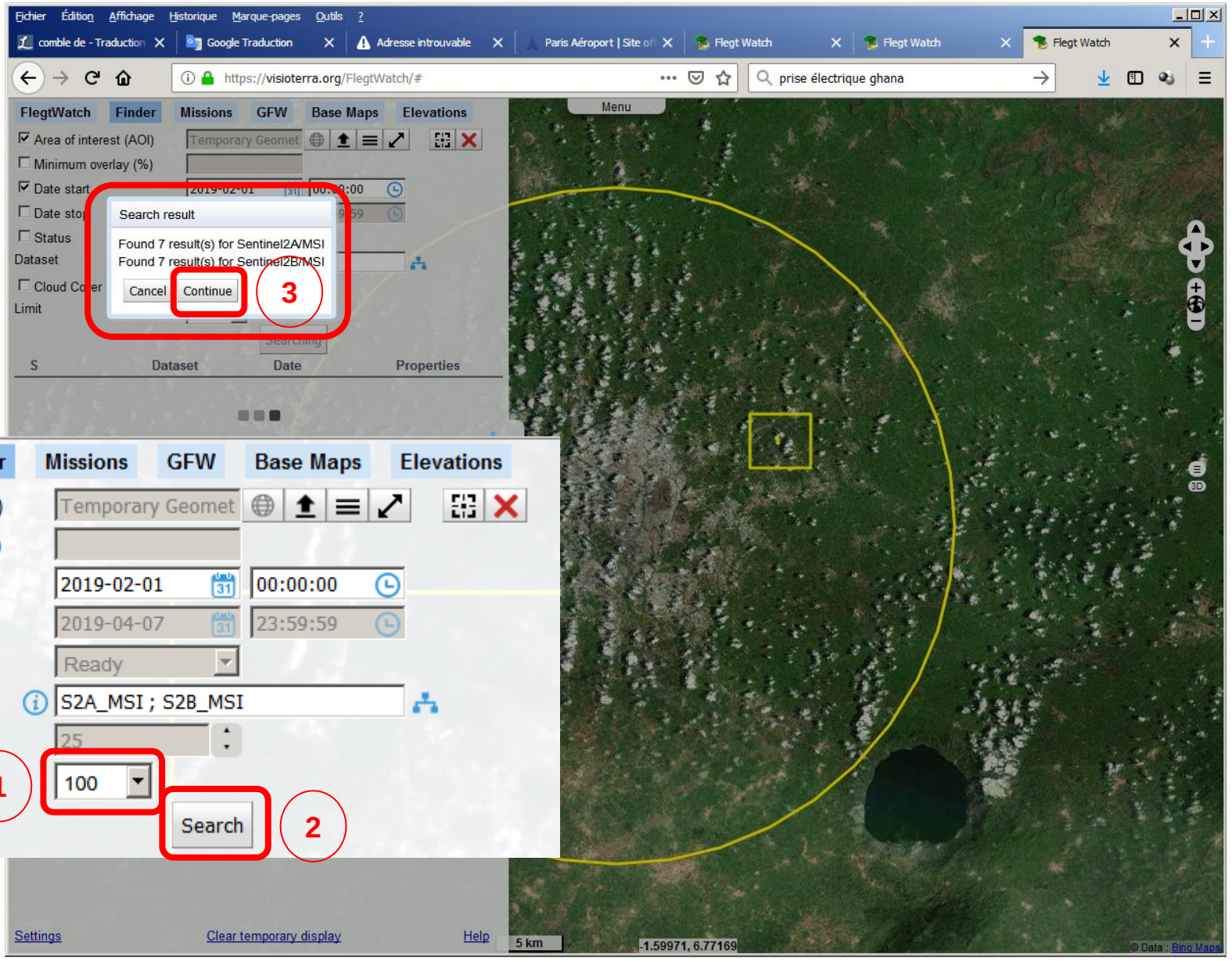
Getting other data – 3. Define dataset(s)



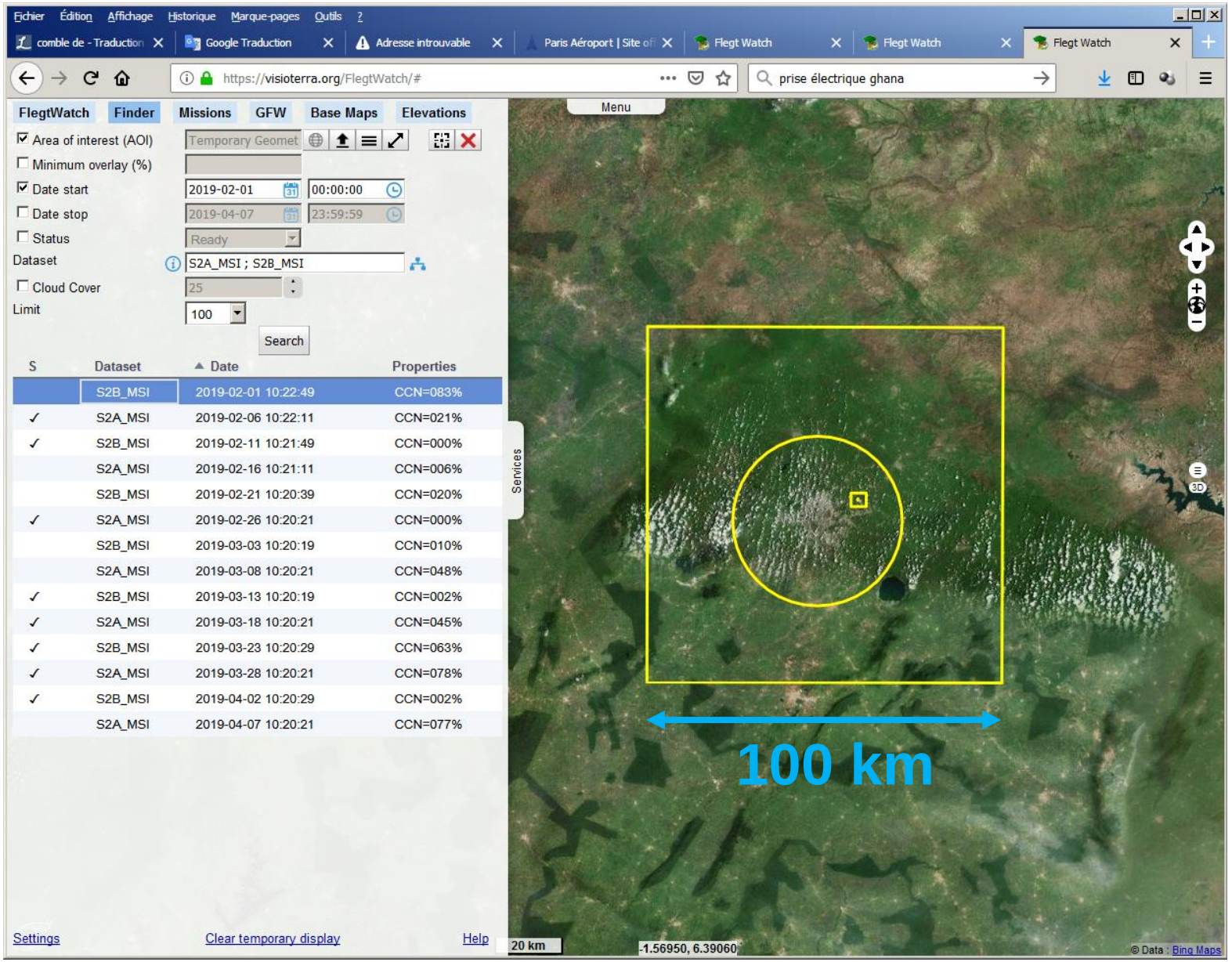
Select Sentinel-2 optical data

Getting other data – 4. Launch “Search” and get result number

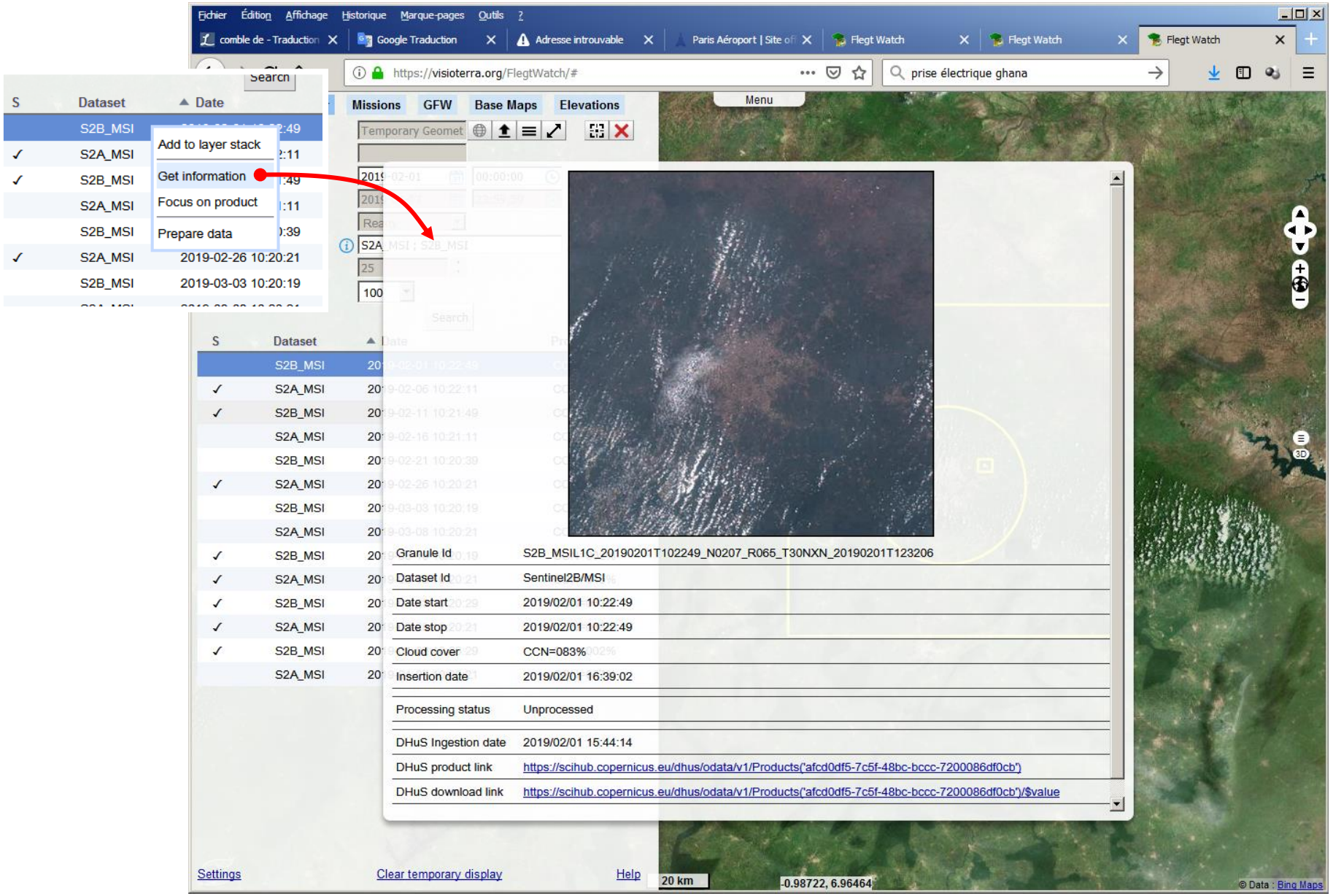
1. Adjust the max results
2. Launch “Search”
3. Press “Continue” or “Cancel”



Getting other data – 5. Watch results (product footprint)

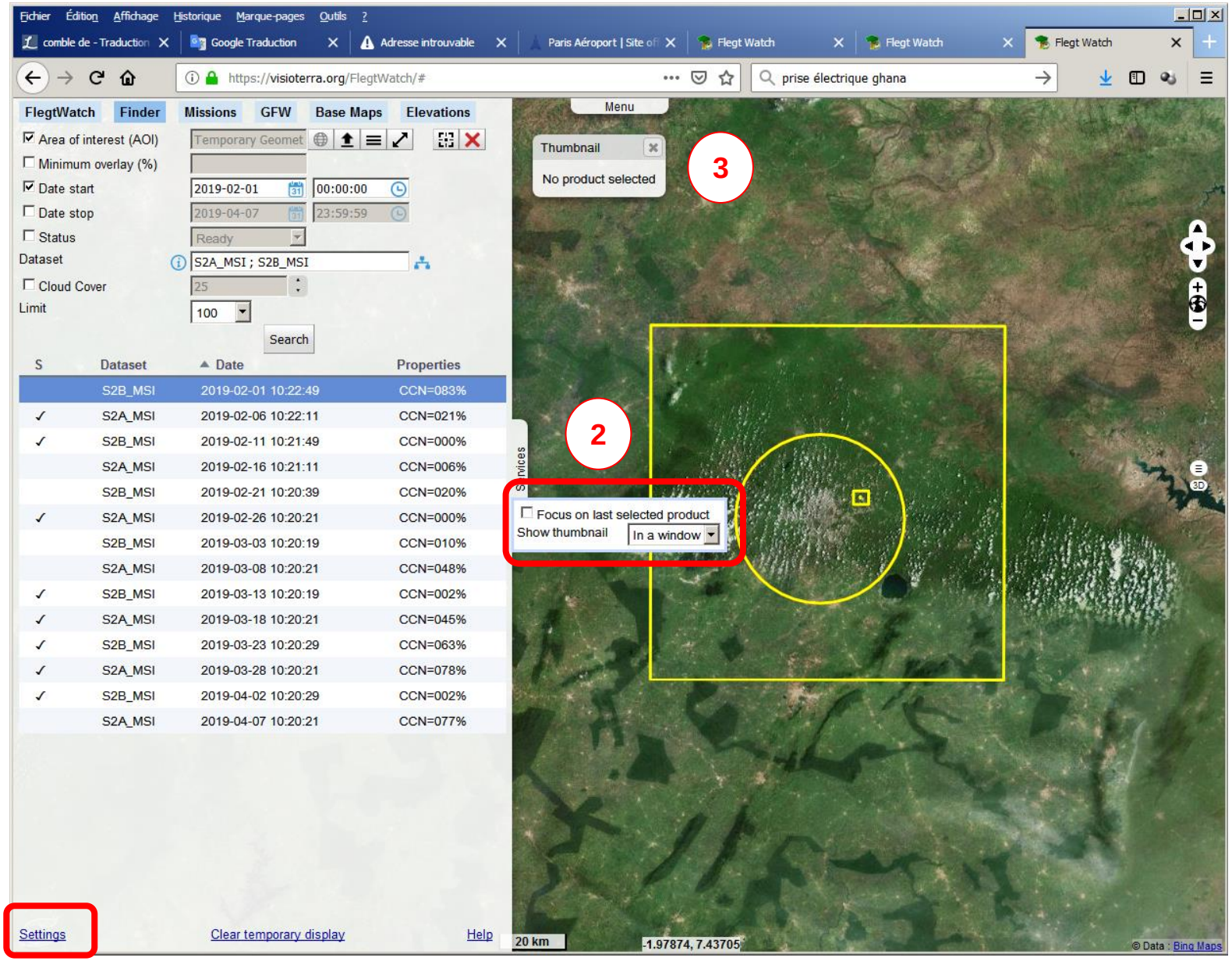


Getting other data – 5. Watch results (product information)



Getting other data – 5. Watch results (quick-look)

1. Activate “Settings”
2. In “Show thumbnail” select “In a window”
3. Select a product to display its thumbnail (quick-look) in the window



Merci de votre attention.

Thank you for your attention.

Questions ?

VisioTerra

Serge RIAZANOFF Director serge.riazanoff@visioterra.fr

www.visioterra.fr