



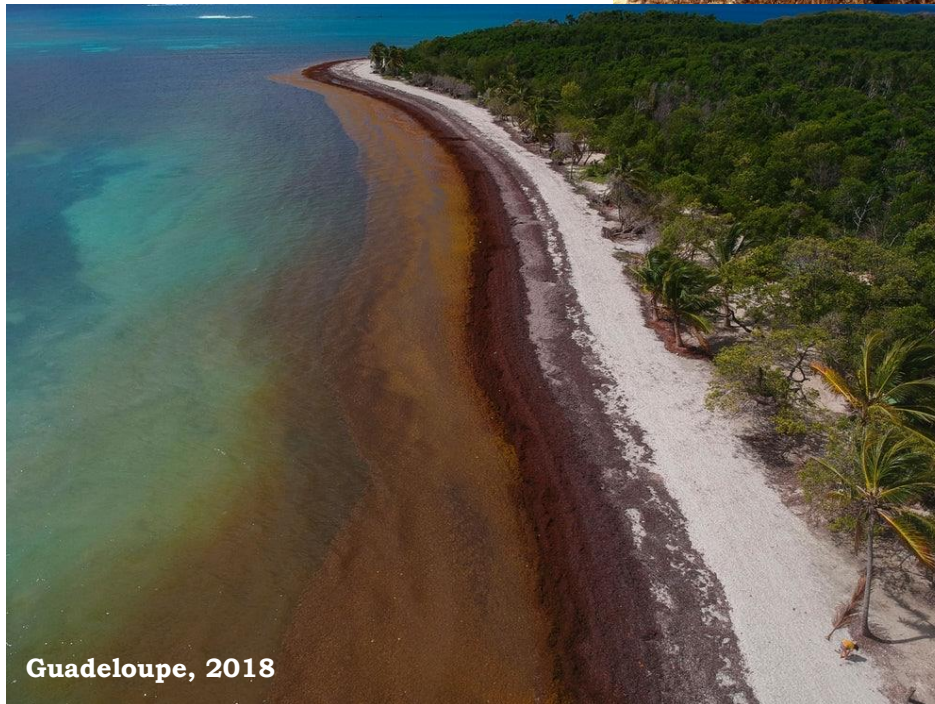
TRAITEMENT VIDÉO EN TEMPS RÉEL POUR LA CARACTÉRISATION DES ÉCHOUAGES DE SARGASSES SUR LES PLAGES CARIBÉENNES

NICO VALENTINI, BRGM

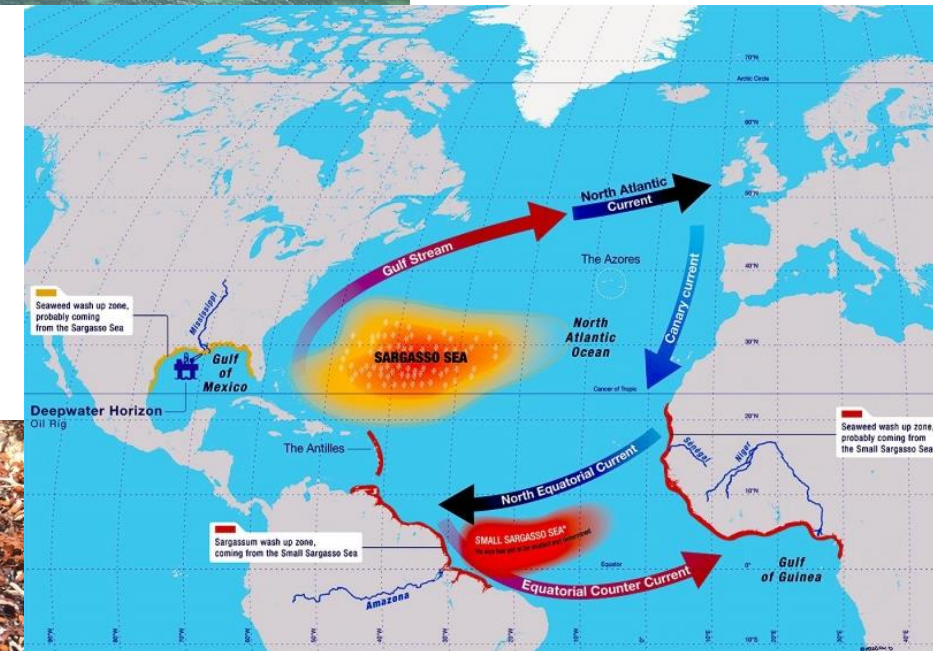


WHY?

- Telluric nutrients
- Overexploitation
- Seawater temperature

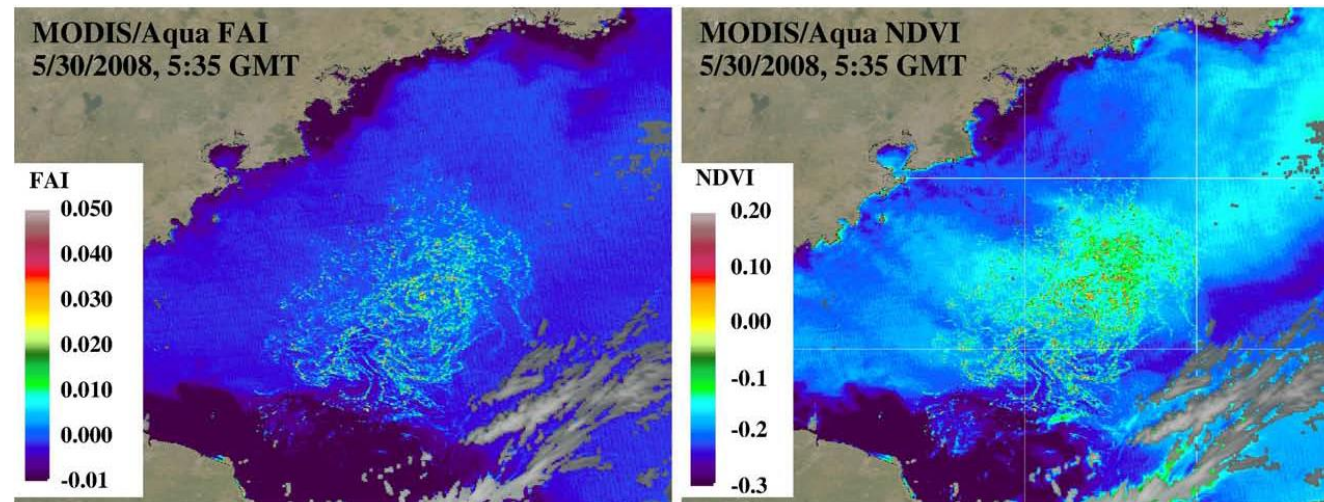


Sargassum in the Caribbean



Detection of Sargassum Strategies

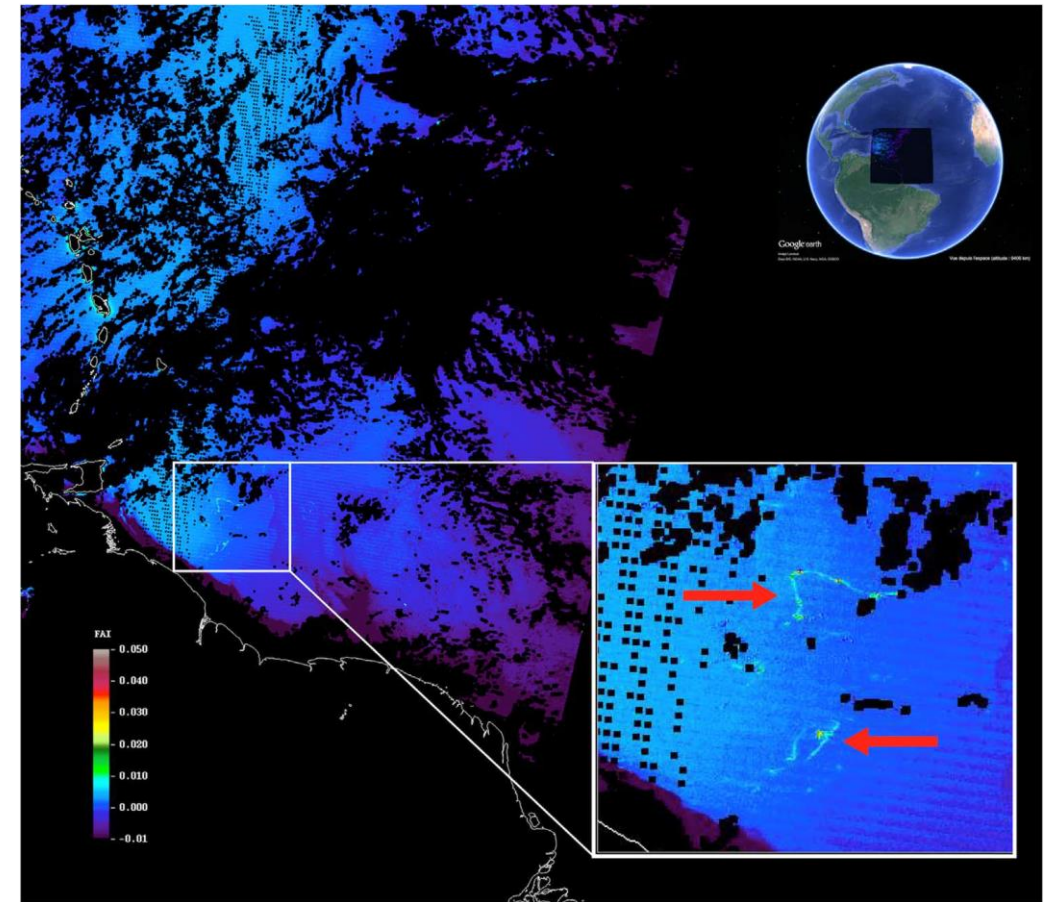
❖ Moderate Resolution Imaging Spectrometer (MODIS)



❖ Sargassum Watch System (SaWS)

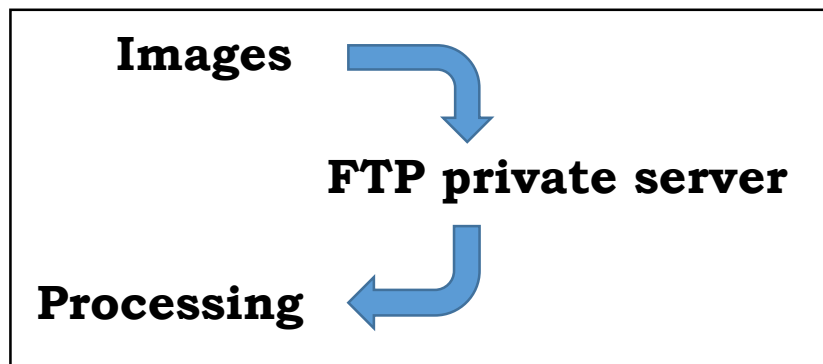
Numerical model (currents)

A/FAI: Alternate/Floating Algae Index



Early-warning alerts

Mini Autonomous Solar 3G Time Lapse Camera - **SolarCam**

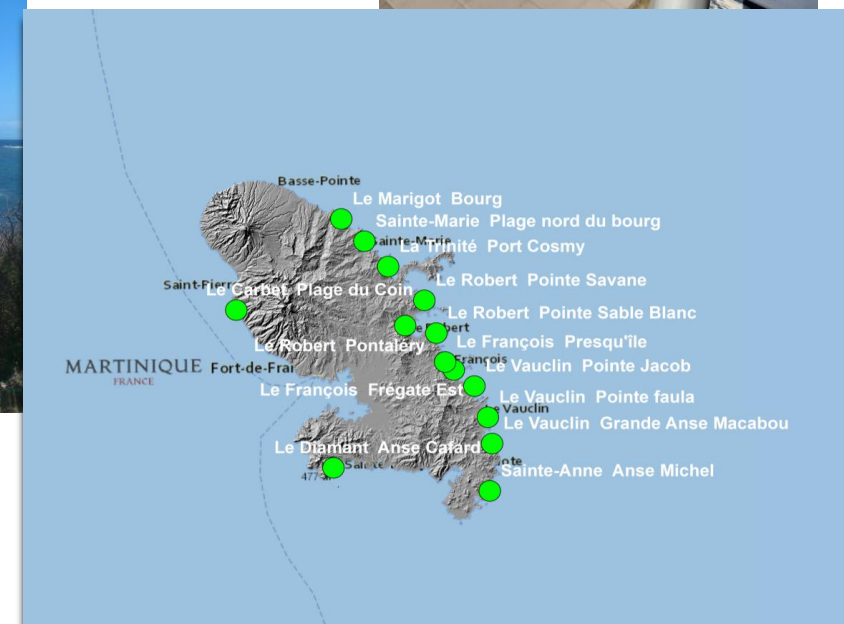
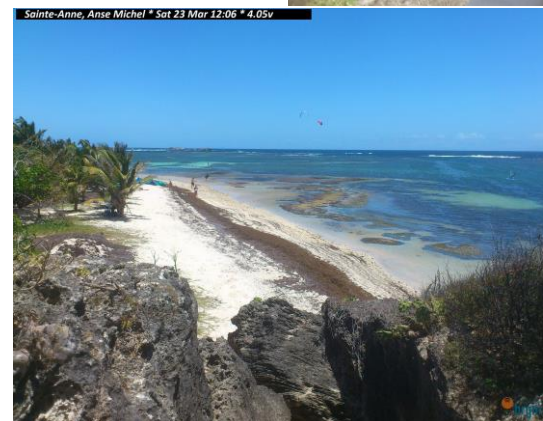


Advantages

- Price (±400€)
- Simple use
- Autonomies
 - Mobility
 - Resolution

Disadvantages

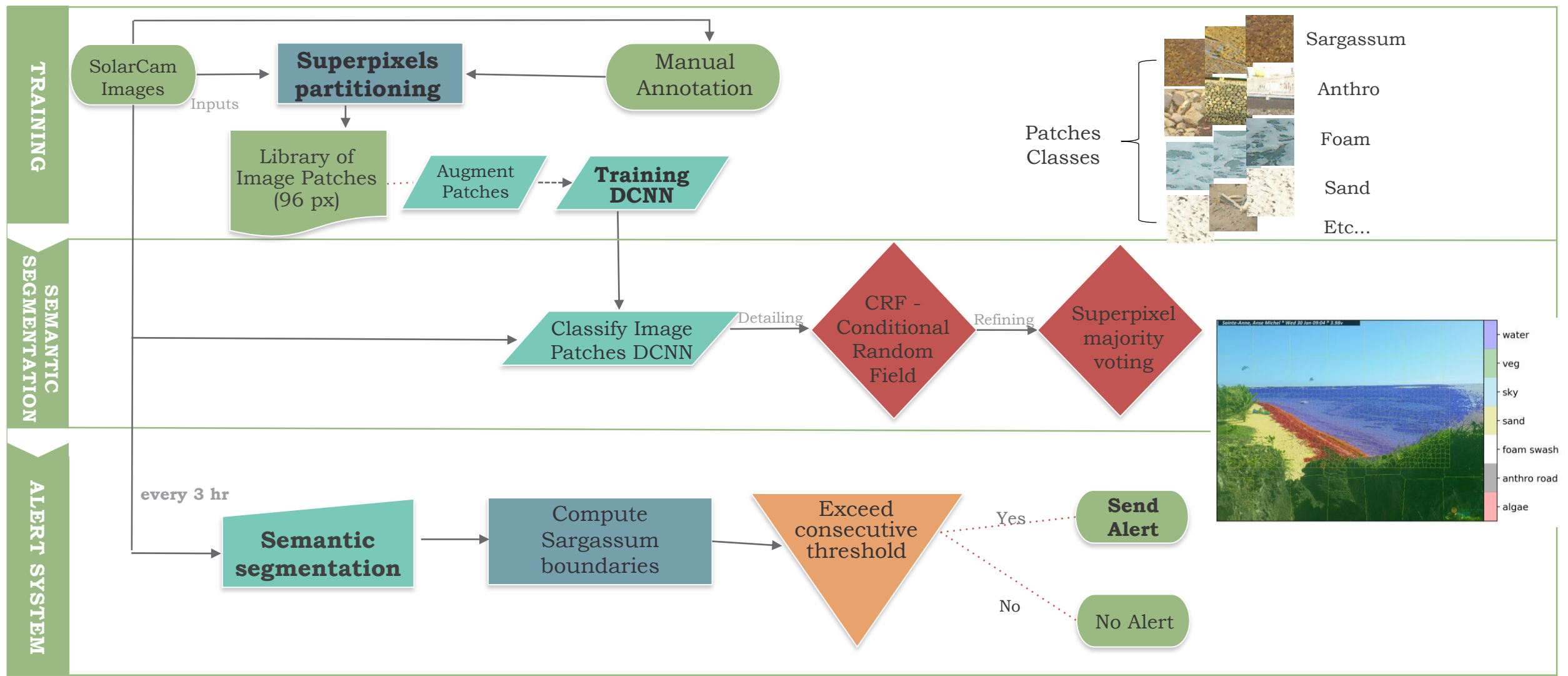
- Signal 3G fluctuations
 - Field of View (FoV)
 - Acquisition frequency
 - Quality signal

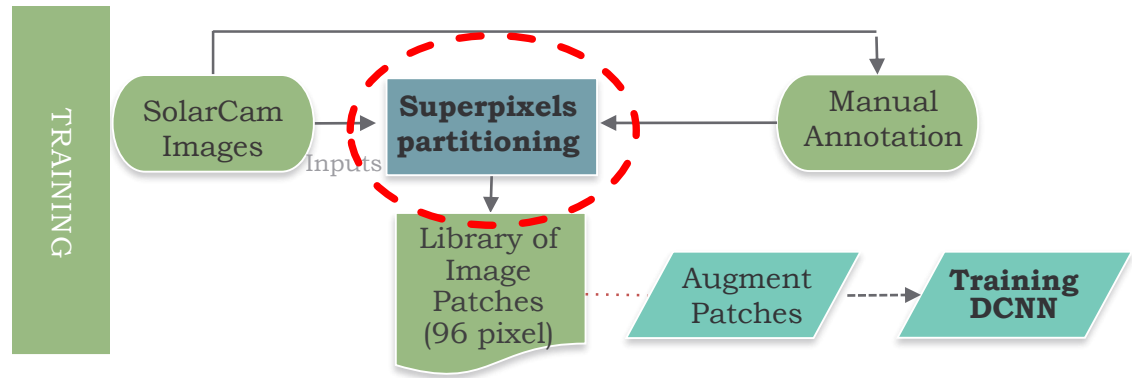


Scopes:

- ❖ Logistics support for the municipalities
- ❖ Validation of methodology Framework

Semantic segmentation – Workflow

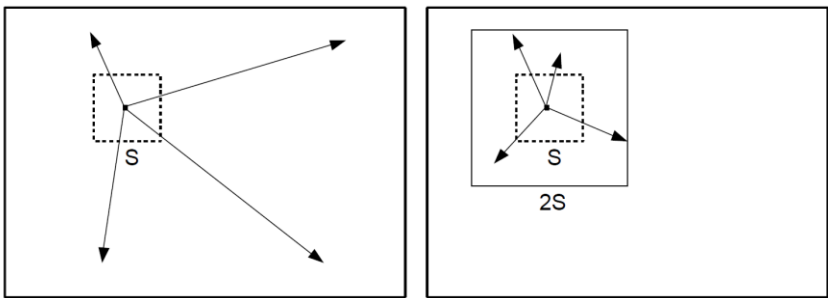
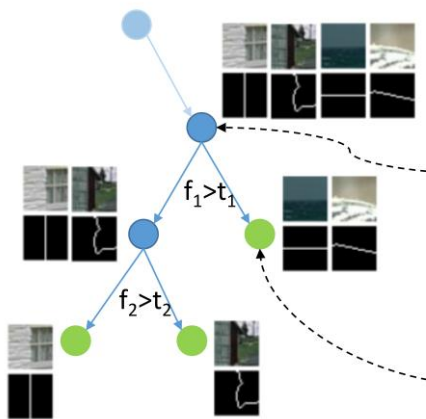




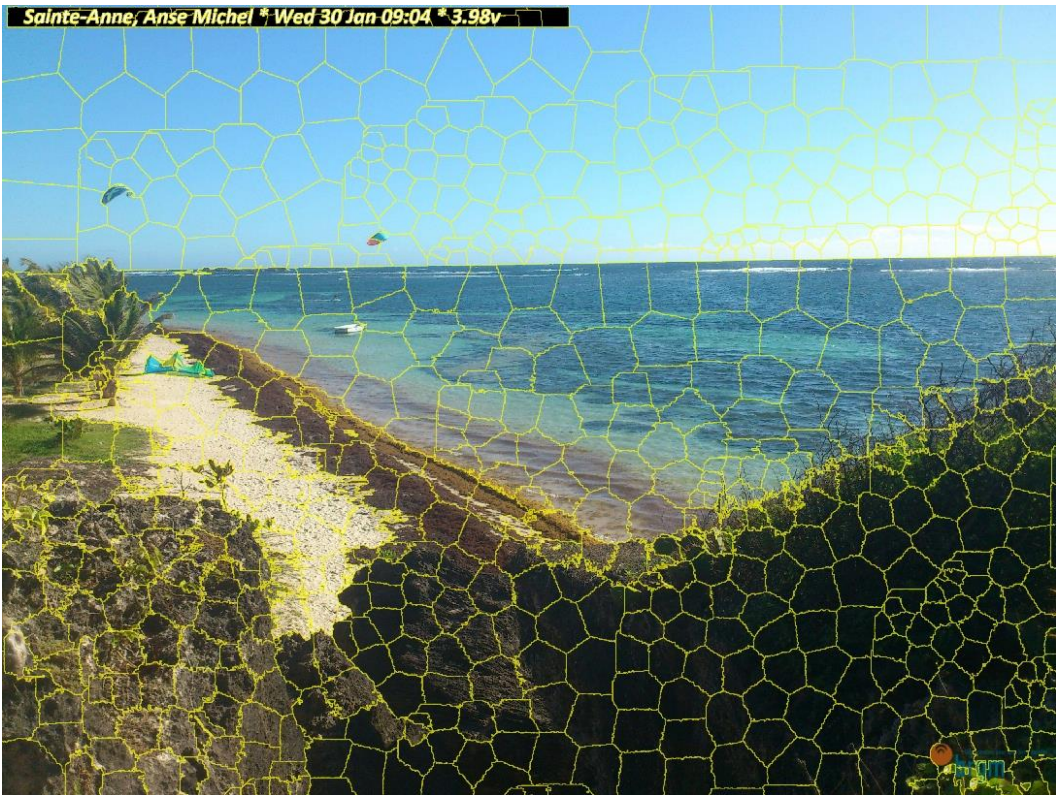
Sticky edge-adhesive Superpixels¹

Structured edge prediction¹

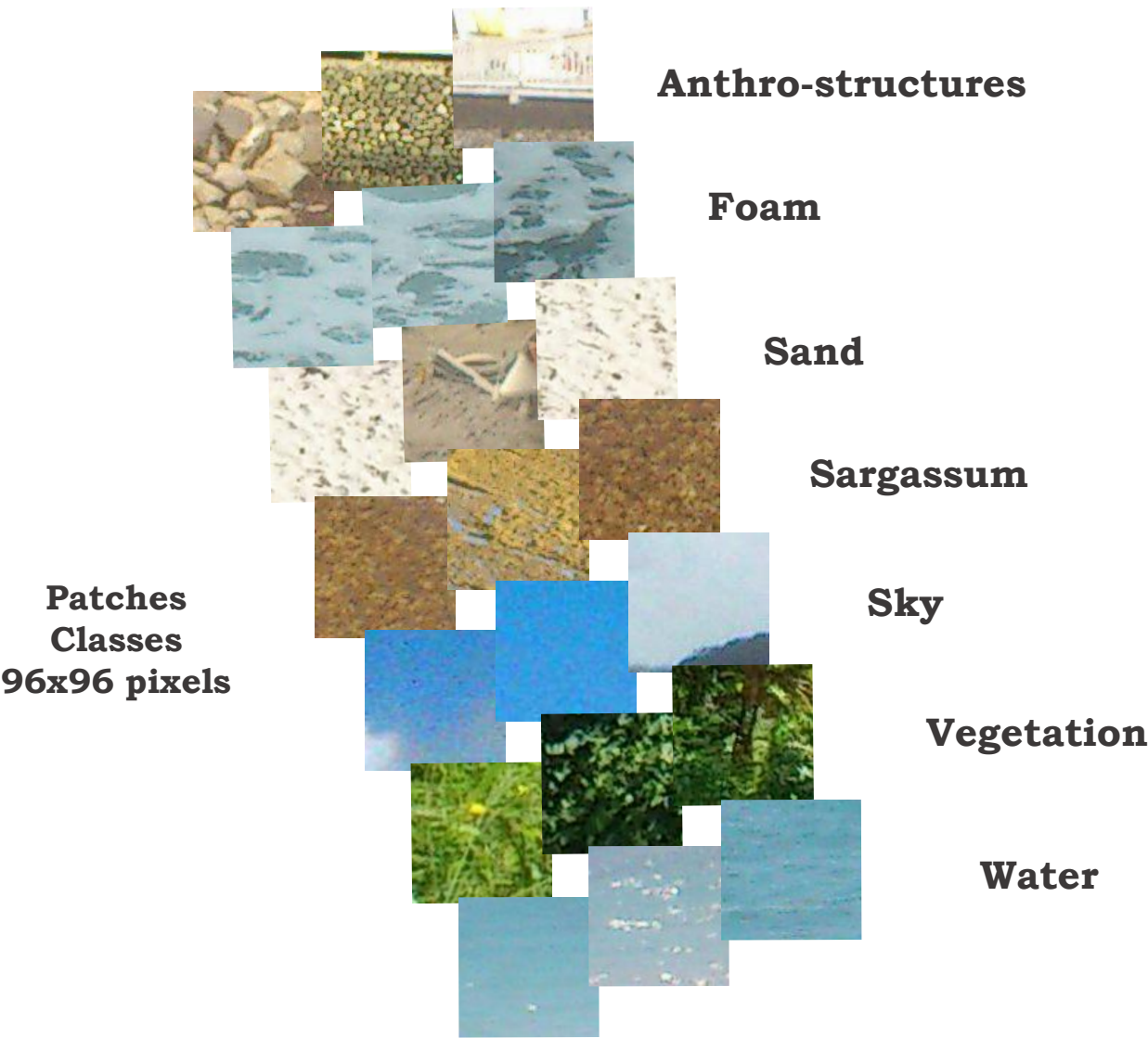
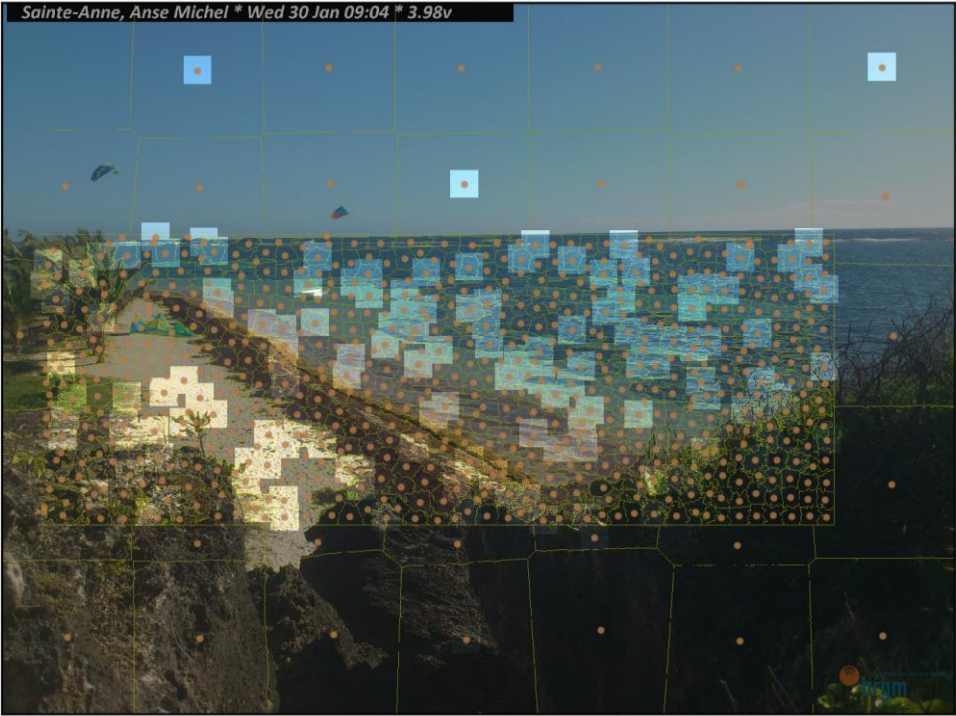
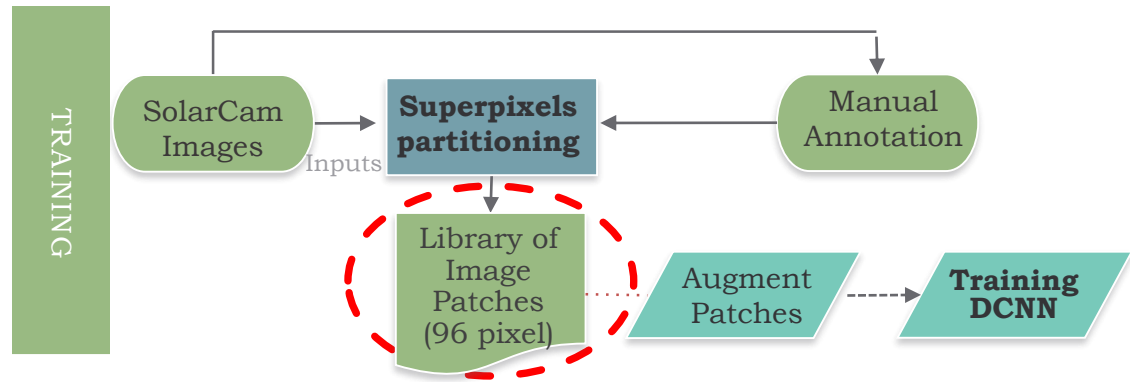
+ SLIC superpixels²

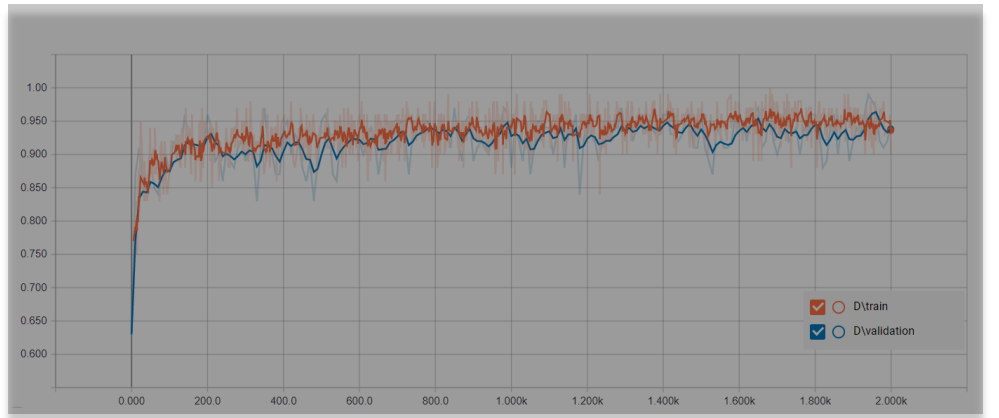
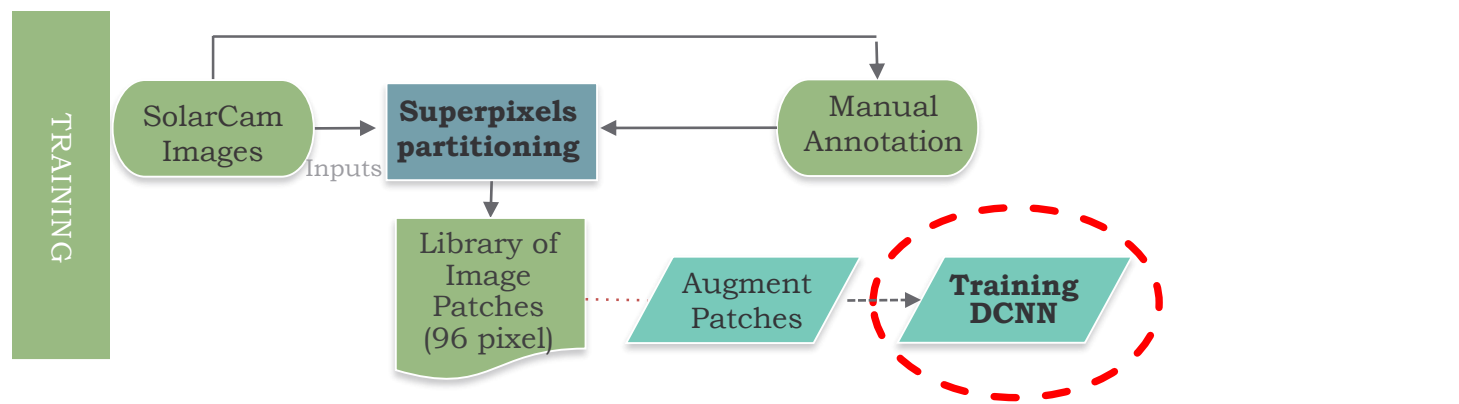


K-means clustering in 5D space with limited region

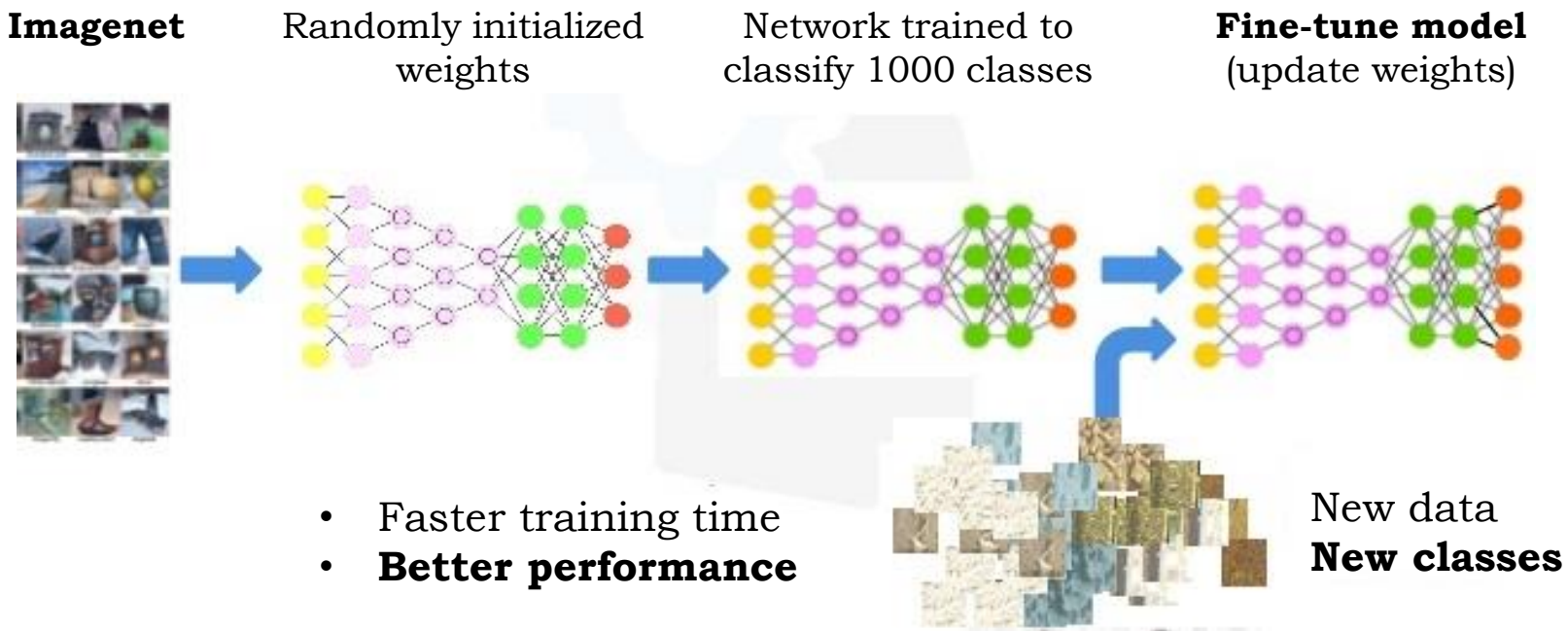


¹Dollár, 2013; ²Achant, 2012

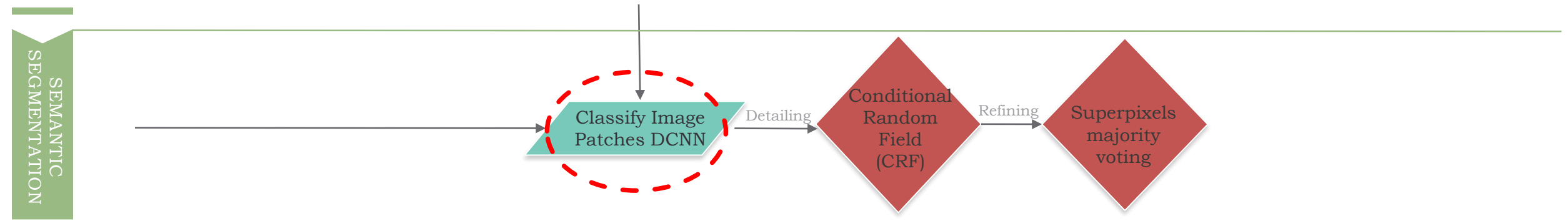




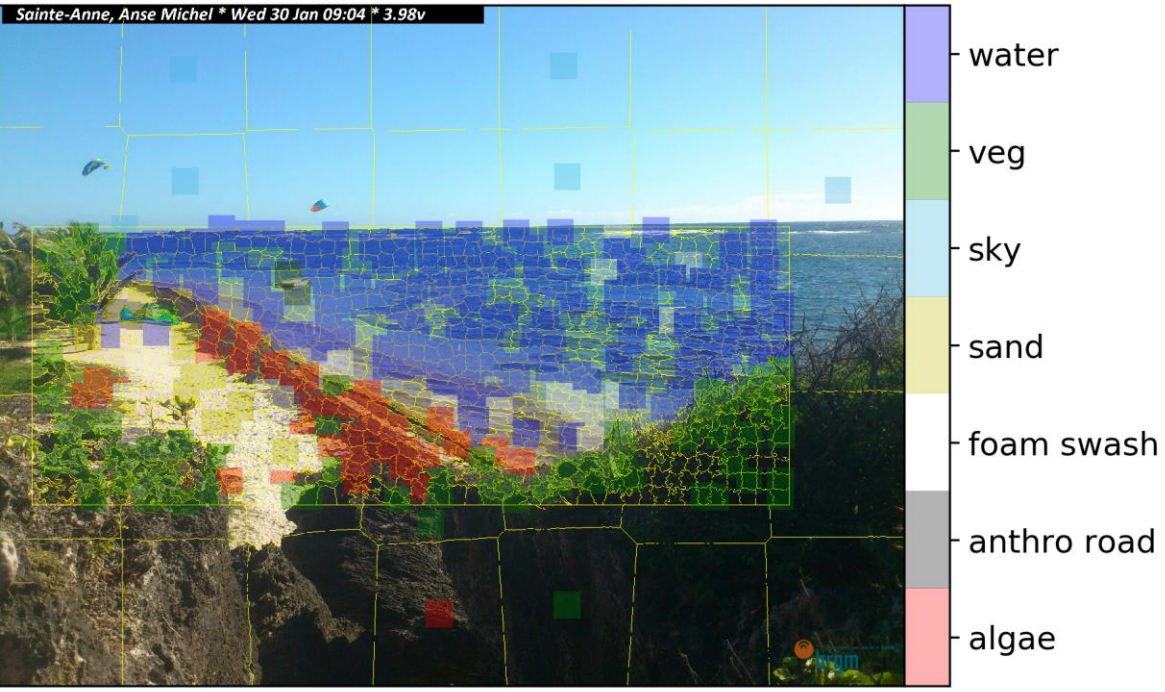
Transfer learning - DCNN - Mobilenet¹



¹Howard, 2017; Buscombe, 2018

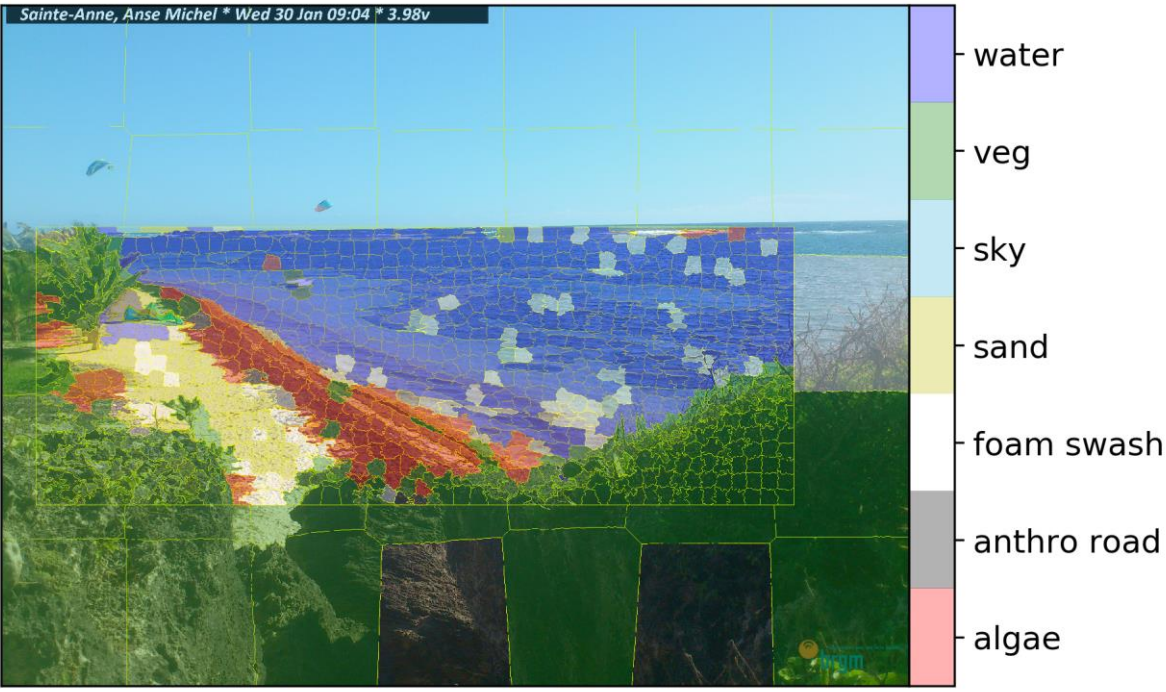


b) DCNN prediction

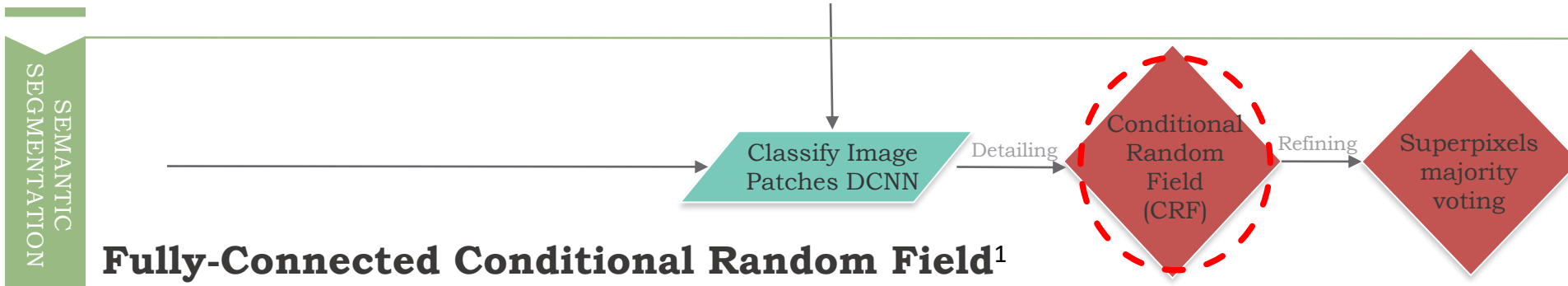


Patches Classification

b) DCNN prediction



Superpixel labelling



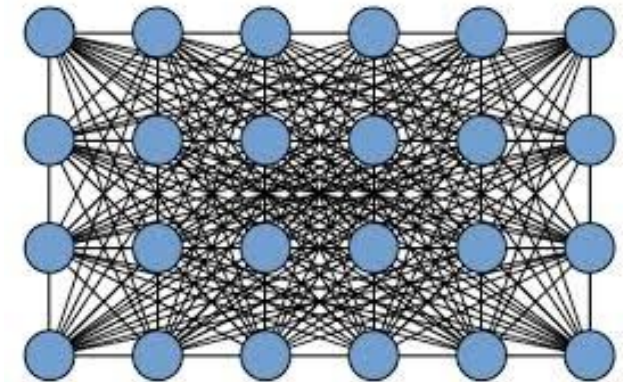
$$P(y|x, \theta) = \frac{1}{Z(x, \theta)} \exp(-E(y|x, \theta))$$

Energy function to minimize

$$E(y|x, \theta) = \sum_i \psi_i(y_i, x_i, |\theta) + \sum_{i < j} \psi_{ji}(y_i, y_j, f_i, f_j | \theta)$$

Unary & Pairwise Potentials

$$\psi_{ji} = f\left(k^l(f_i^l, f_j^l)\right) = f\left(\exp\left(-\frac{|p_i - p_j|^2}{2\theta_\alpha^2} - \frac{|x_i - x_j|^2}{2\theta_\beta^2}\right) + \exp\left(-\frac{|p_i - p_j|^2}{2\theta_\gamma^2}\right)\right)$$



¹Krähenbühl & Koltun, 2011

Fully-Connected Conditional Random Field¹

$$P(y|x, \theta) = \frac{1}{Z(x, \theta)} \exp(-E(y|x, \theta))$$

Energy function to minimize

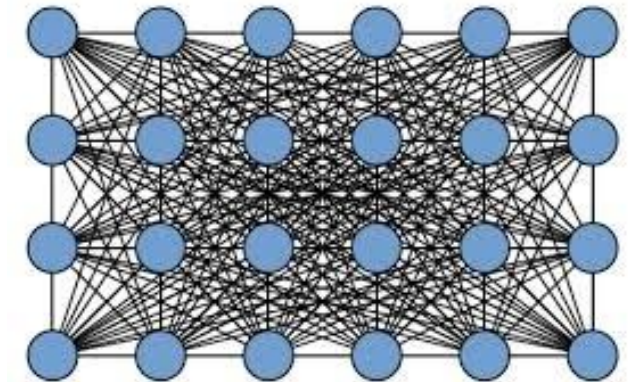
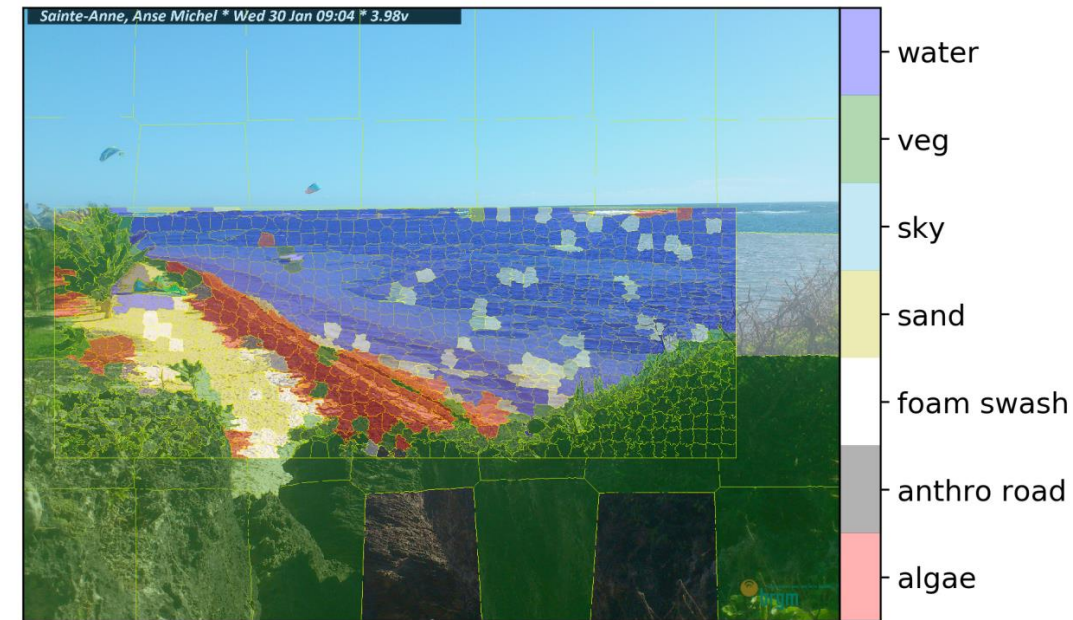
$$E(y|x, \theta) = \sum_i \psi_i(y_i, x_i, |\theta) + \sum_{i < j} \psi_{ji}(y_i, y_j, f_i, f_j | \theta)$$

Unary & Pairwise Potentials

$$\psi_{ji} = f(k^l(f_i^l, f_j^l)) = f\left(\exp\left(-\frac{|p_i - p_j|^2}{2\theta_\alpha^2} - \frac{|x_i - x_j|^2}{2\theta_\beta^2}\right) + \exp\left(-\frac{|p_i - p_j|^2}{2\theta_\gamma^2}\right)\right)$$

Apperance Kernel – Color sensitive Smoothness Kernel

b) DCNN prediction



¹Krähenbühl & Koltun, 2011

DCNN + CRF

Fully-Connected Con

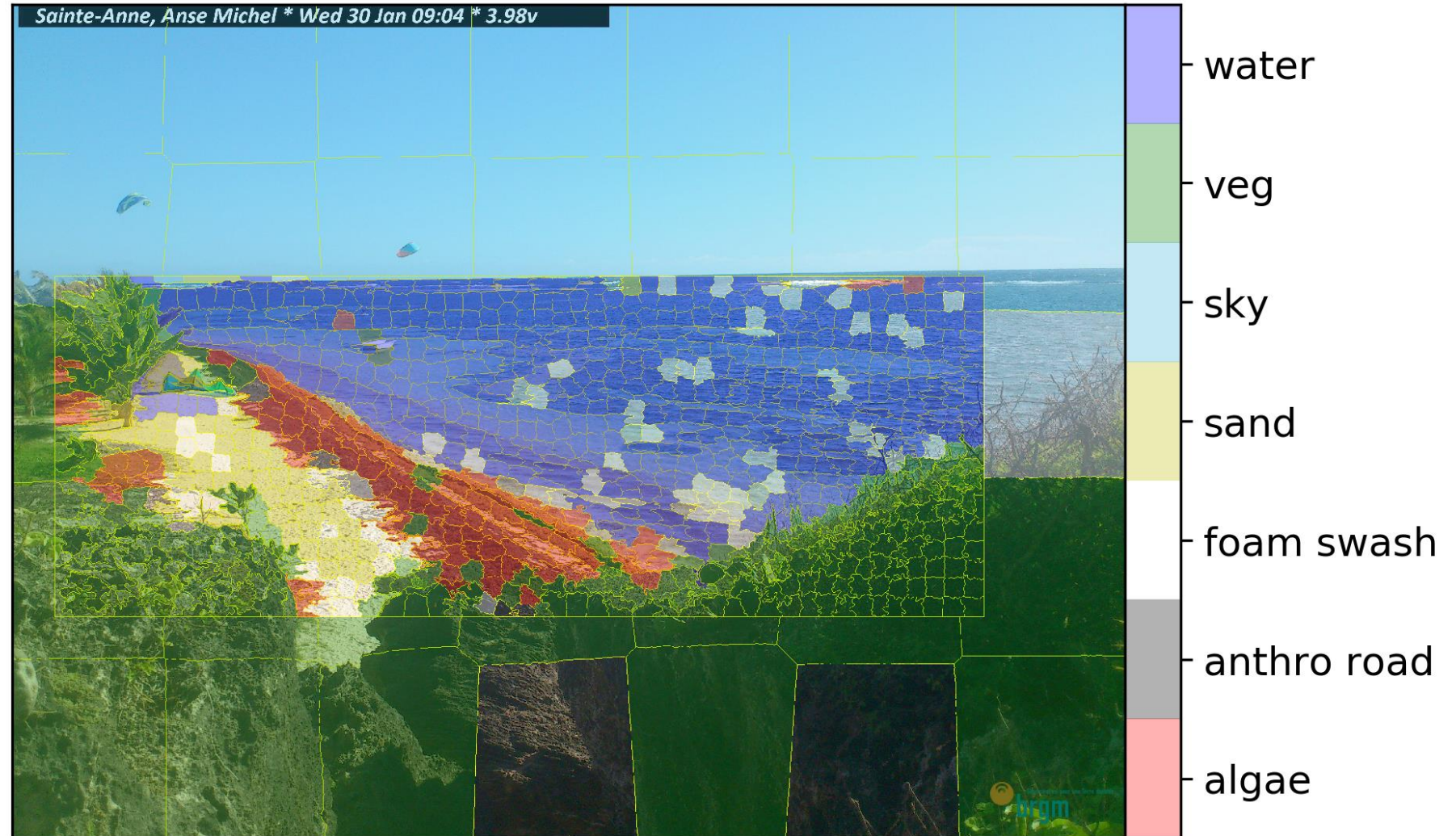
$$P(y|x, \theta) = \frac{1}{Z(x, \theta)}$$

Energy function to r

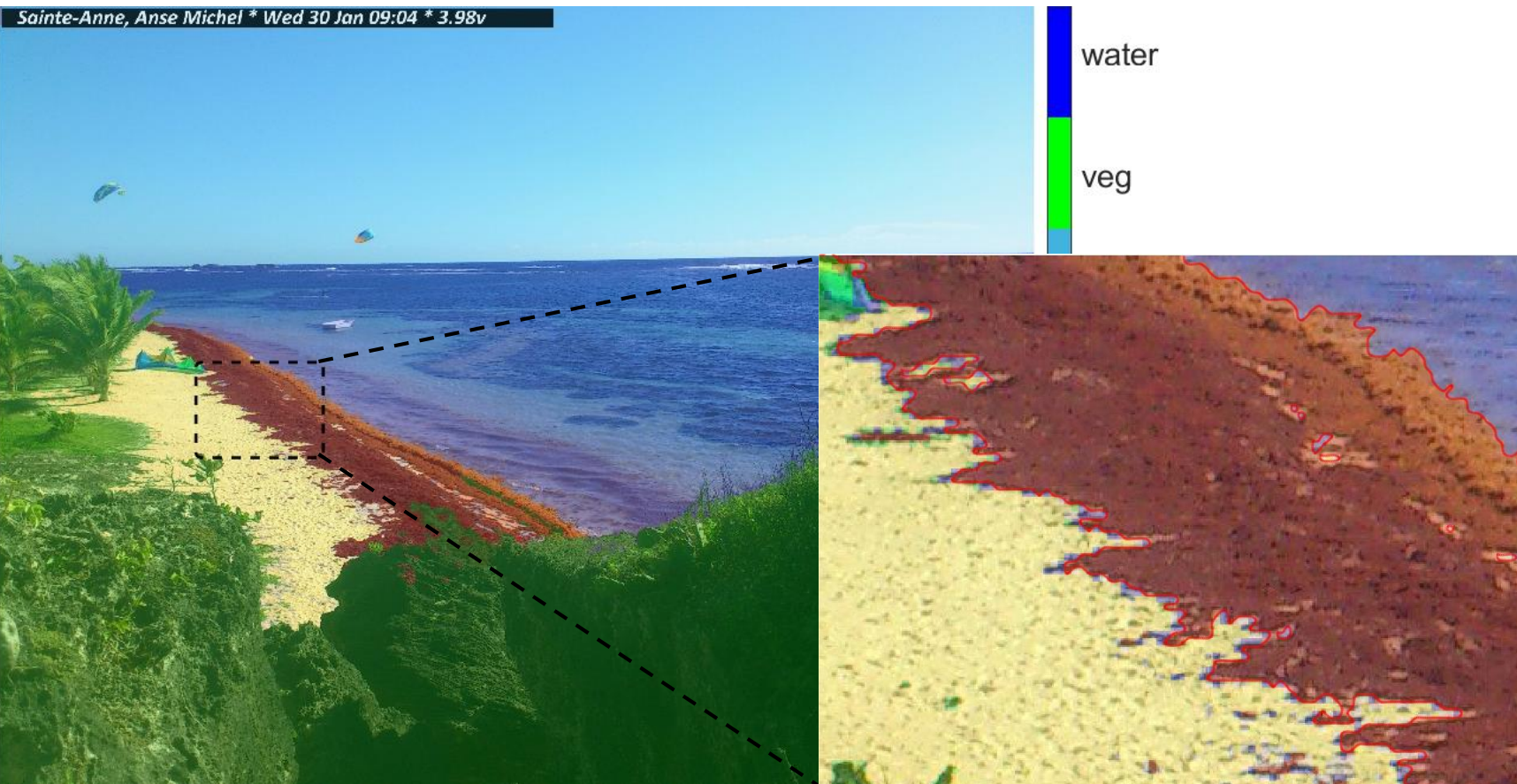
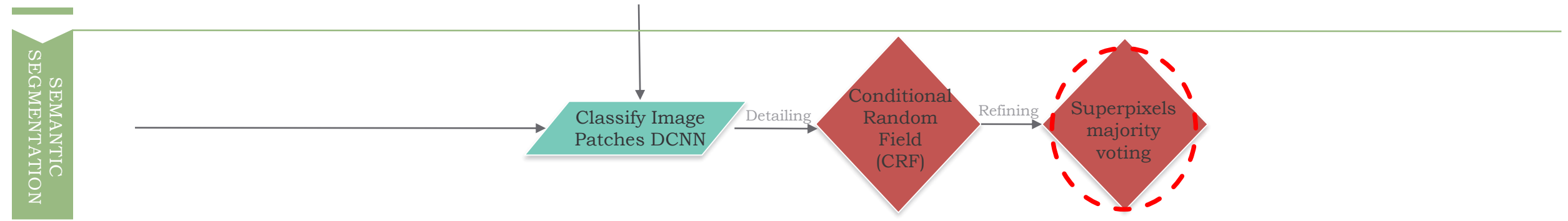
$$E(y|x, \theta) = \sum_i \psi_i$$

Unary & Pair

$$\psi_{ji} = f\left(k^l(f_i^l, f_j^l)\right) = f(\exp\left(\right.$$



¹Krähenbühl & Koltun, 2011

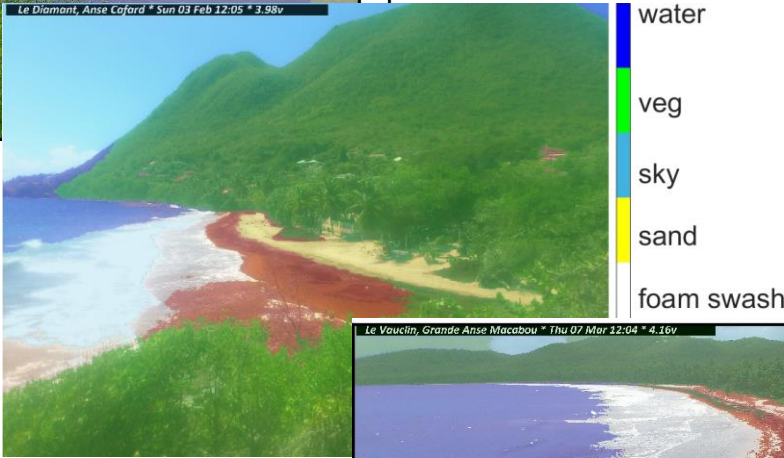
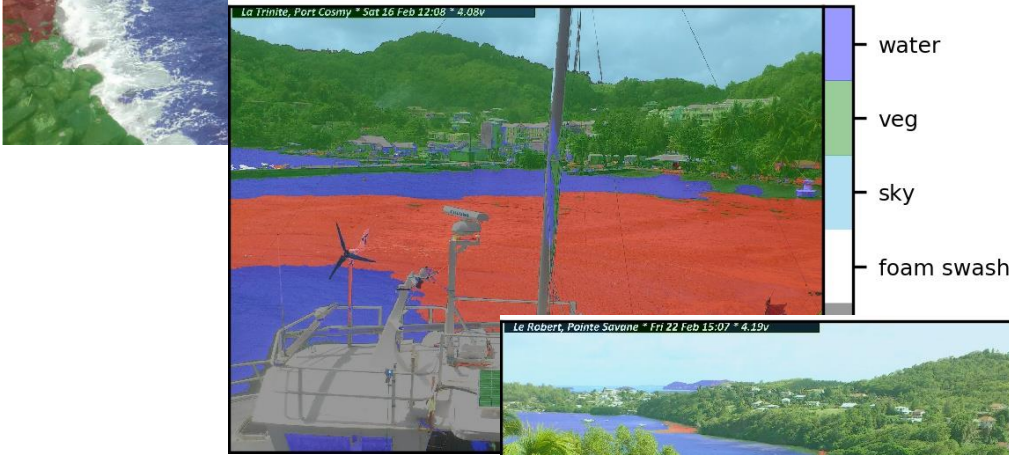


Snapping the segmentation by **majority voting** of the regions

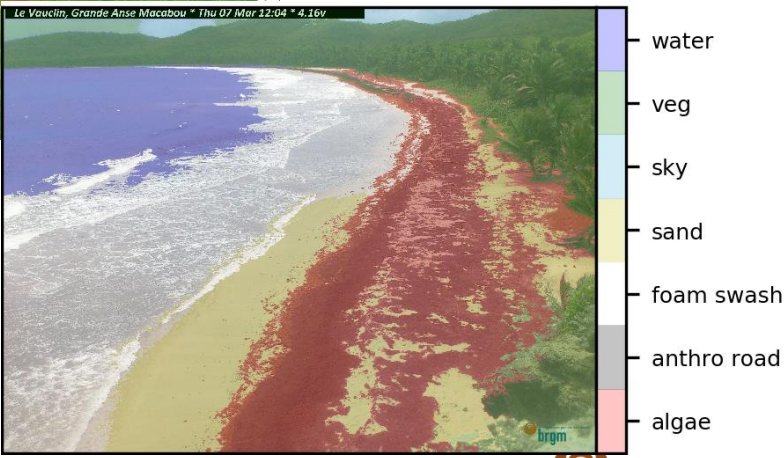
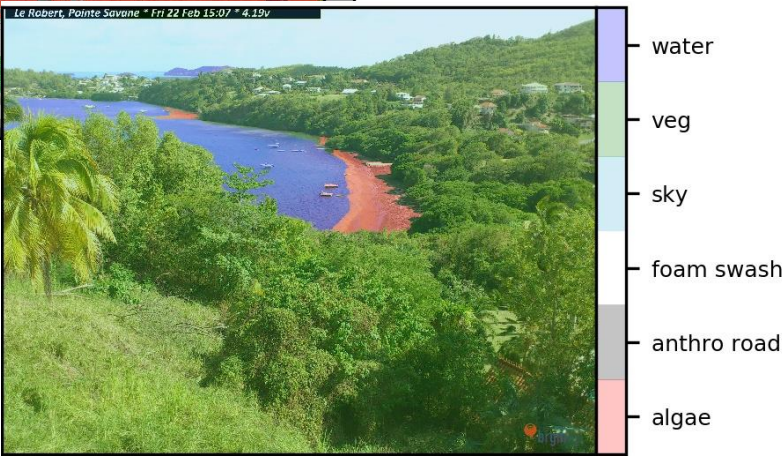
2 Main groups of Images - 9 SolarCams - 5 DCNN models



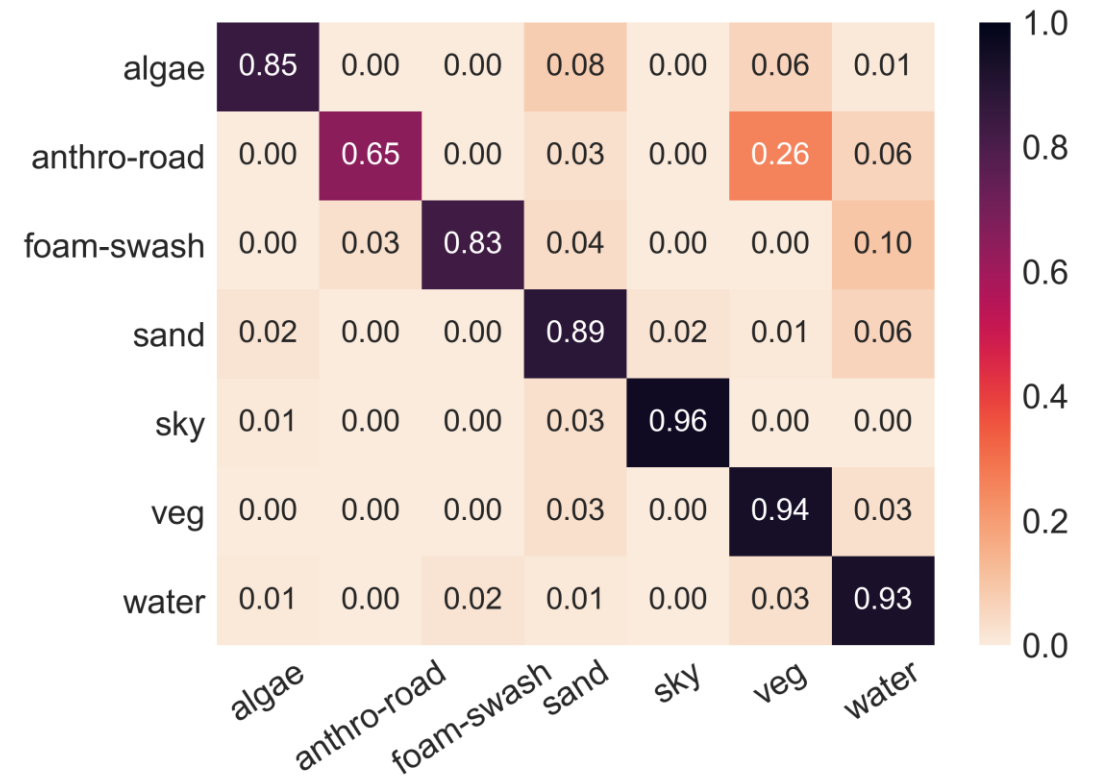
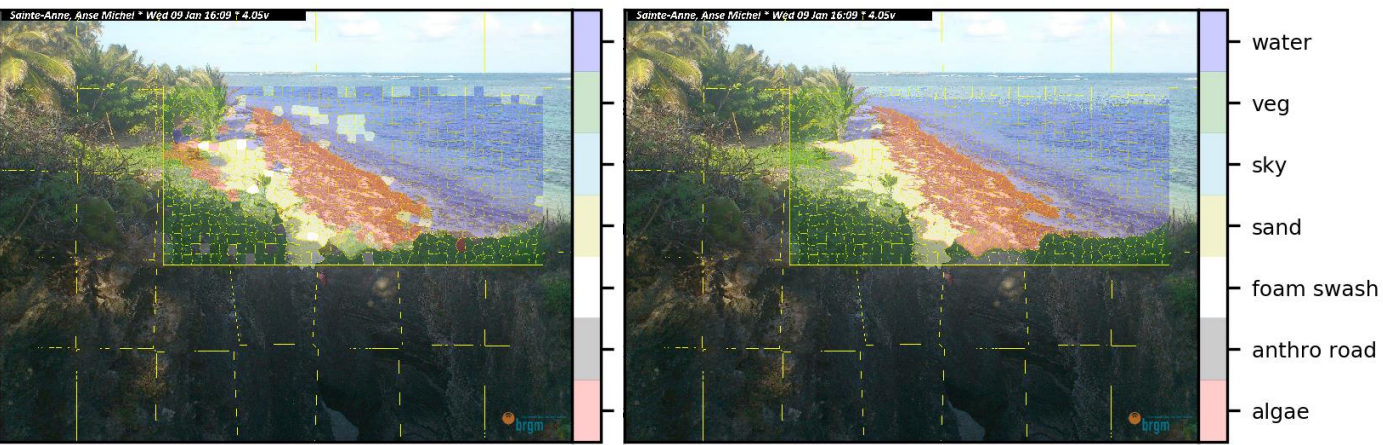
Sandy beach



Structures/Ports



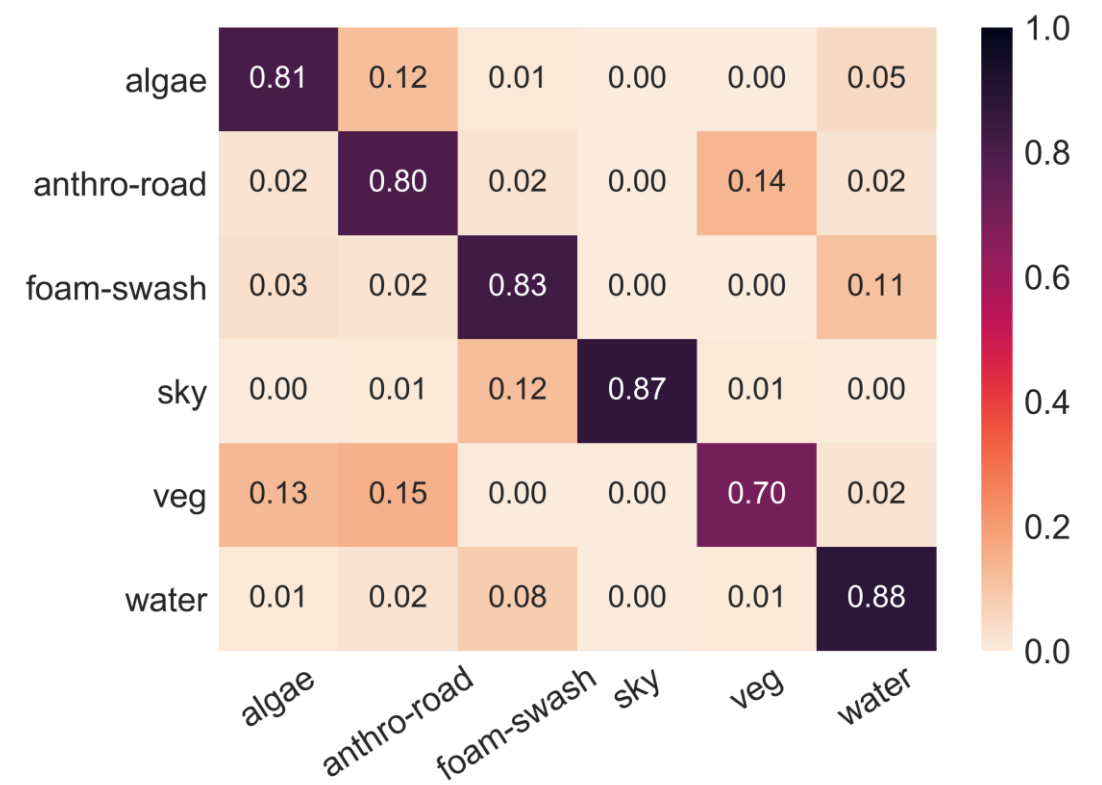
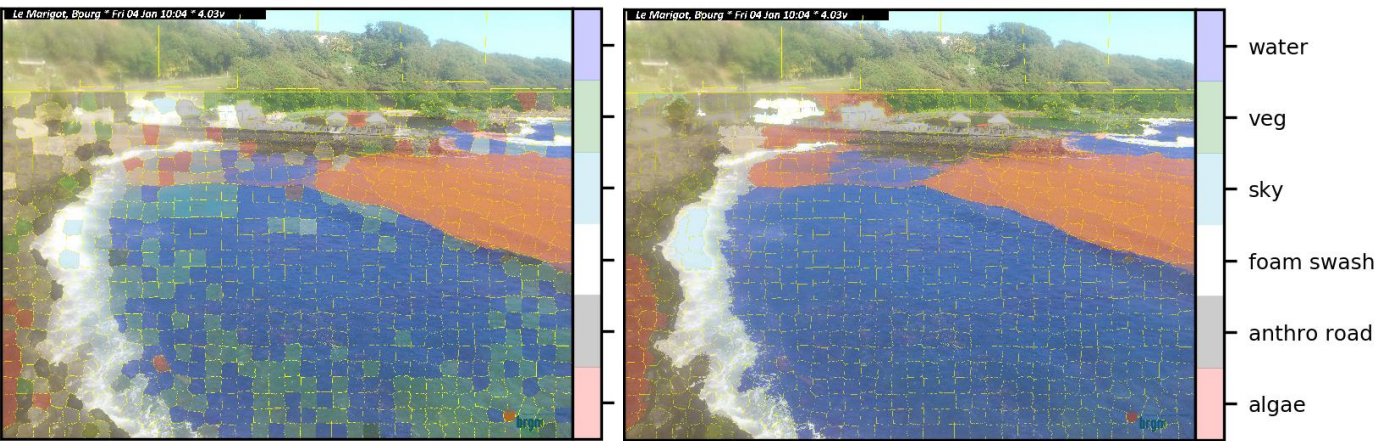
Training database: 45 images Testing database: 38
3 Solarcam



Score:

$$F1 = 2 \times \frac{P \times R}{P + R}$$

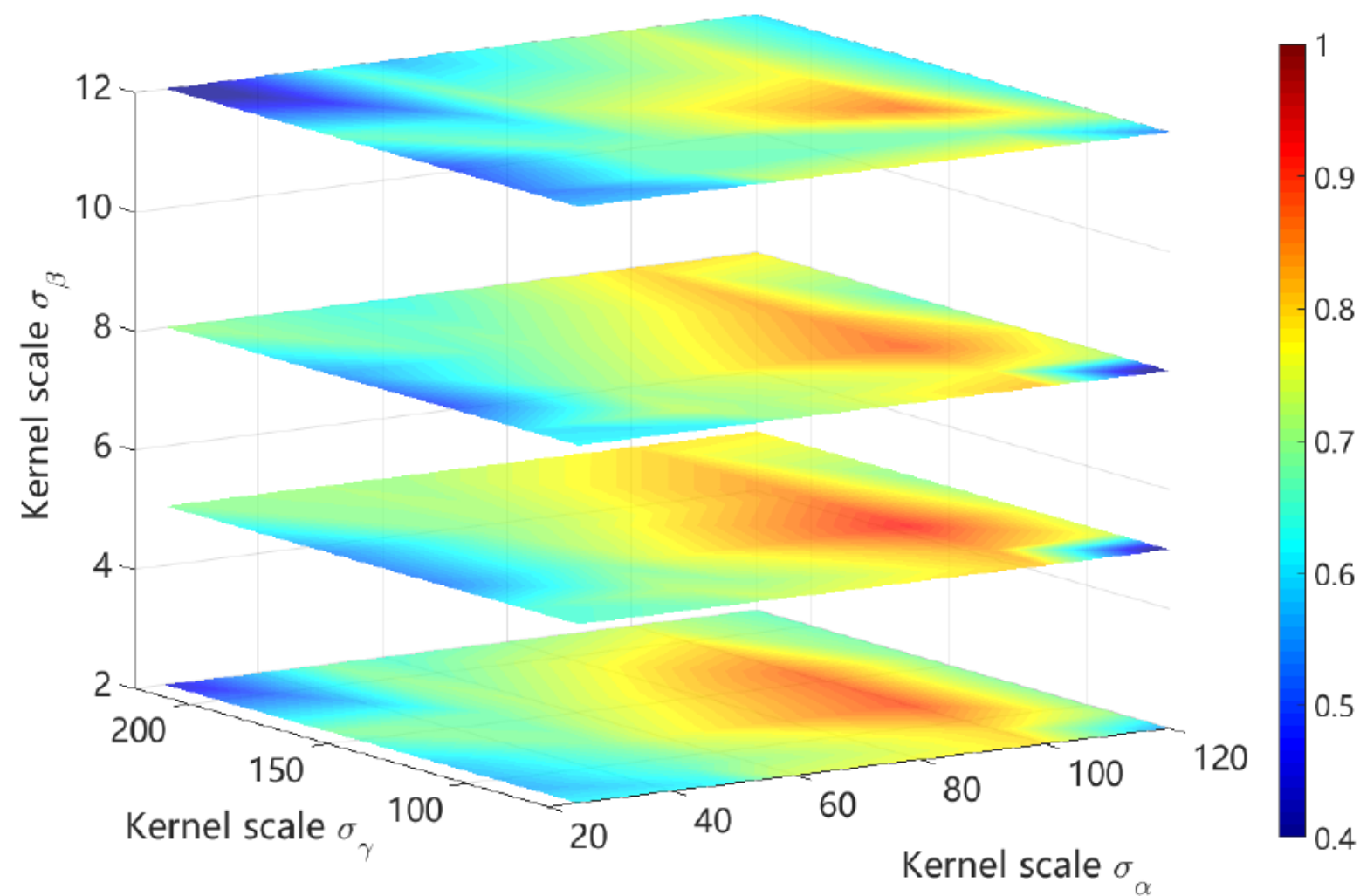
Training database: 43 images Testing database: 34
3 Solarcam



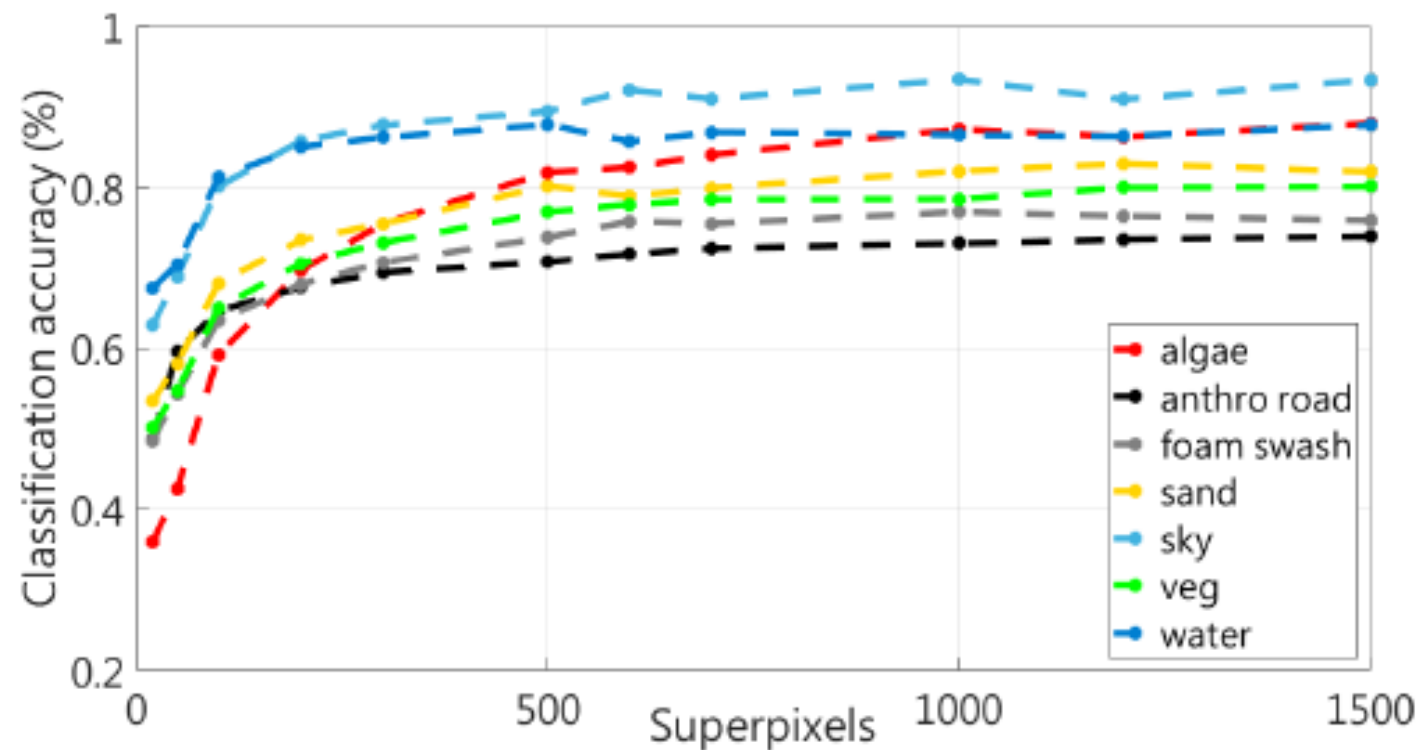
Score:

$$F1 = 2 \times \frac{P \times R}{P + R}$$

Sensitivity CRF F1 score



Sensitivity Number Superpixels
F1 score

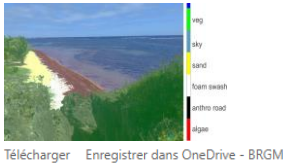


Alert system



Alert SARGASSES

S sargasses.martinique@brgm.fr
lun. 03/06, 22:44
Valentini Nico; De Cathelineau Thibaut; Nachbaur Aude; Balouin Yann



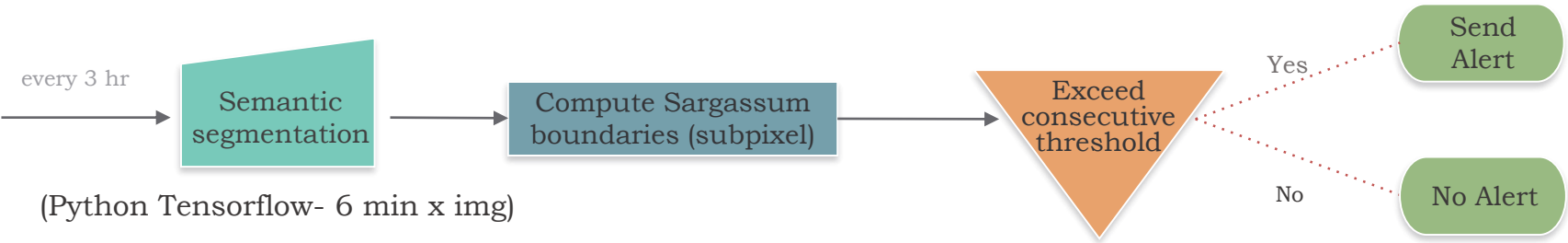
***** MESSAGES D'INFORMATION de SARGASSES *****

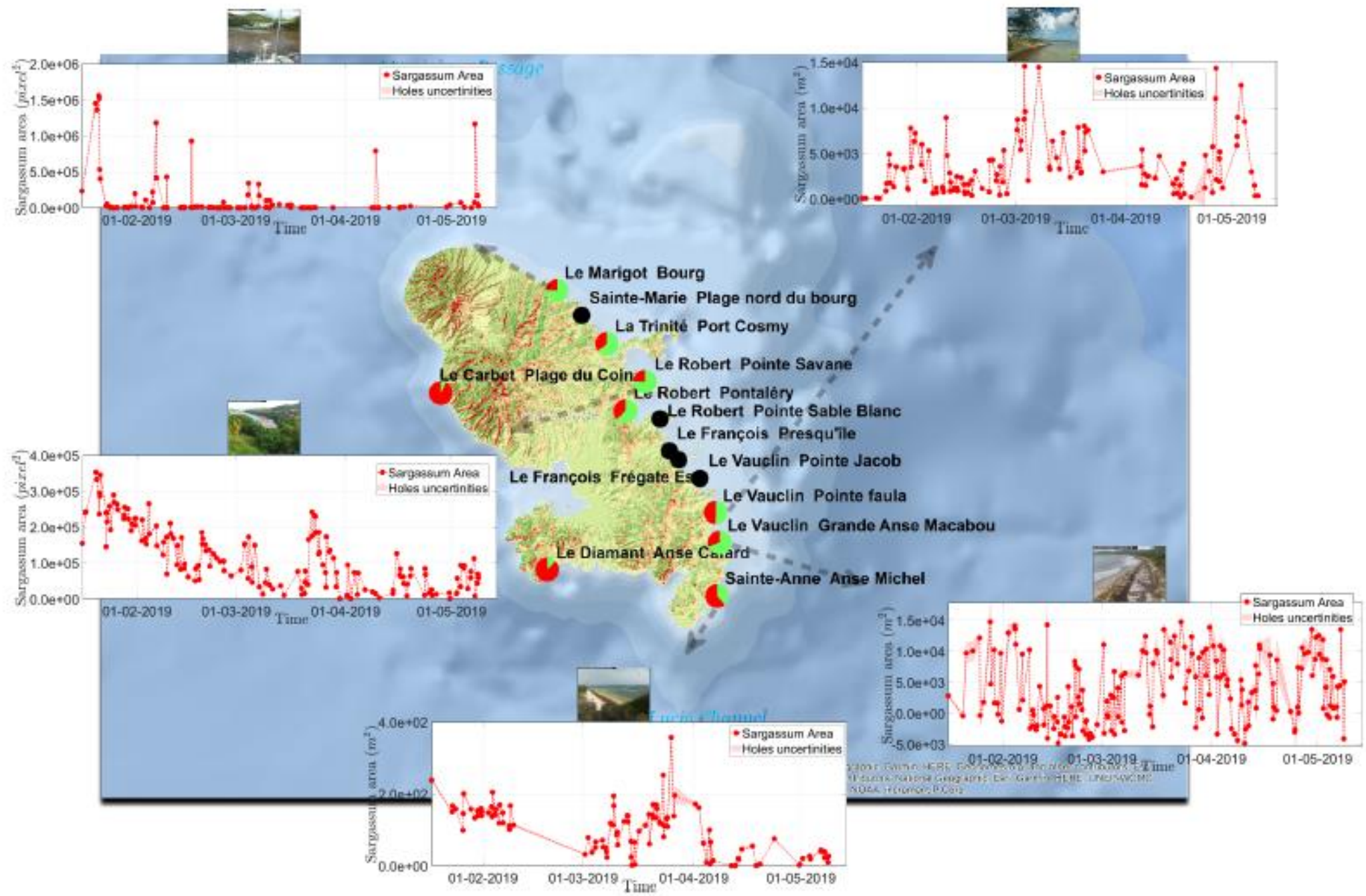
Ce message concerne la Martinique Littoral. Il est envoye directement comme information d'alerte pour les adresses mail liees au Groupe ALERT SYSTEM des Caraibes.

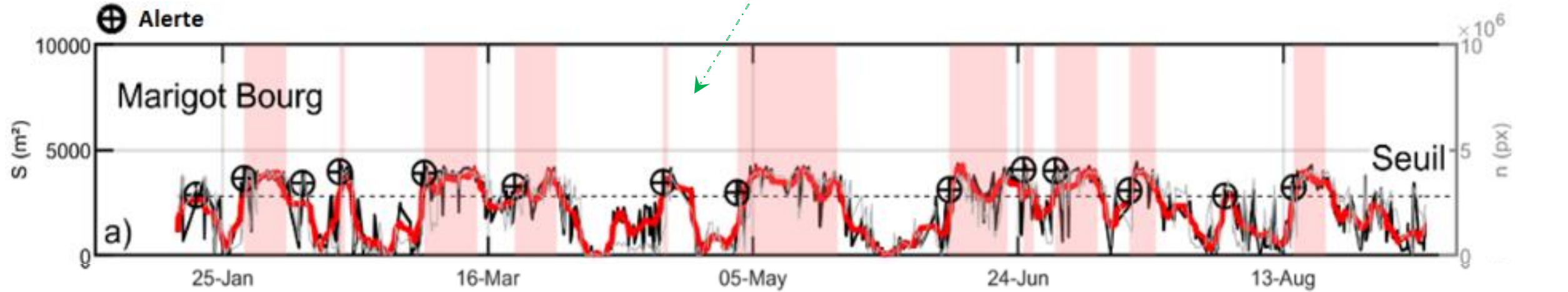
La superficie reelle des sargasses calculees a la Le Vauclin, Grande Ansa Macabou plage est de 10991.5972 m^2.

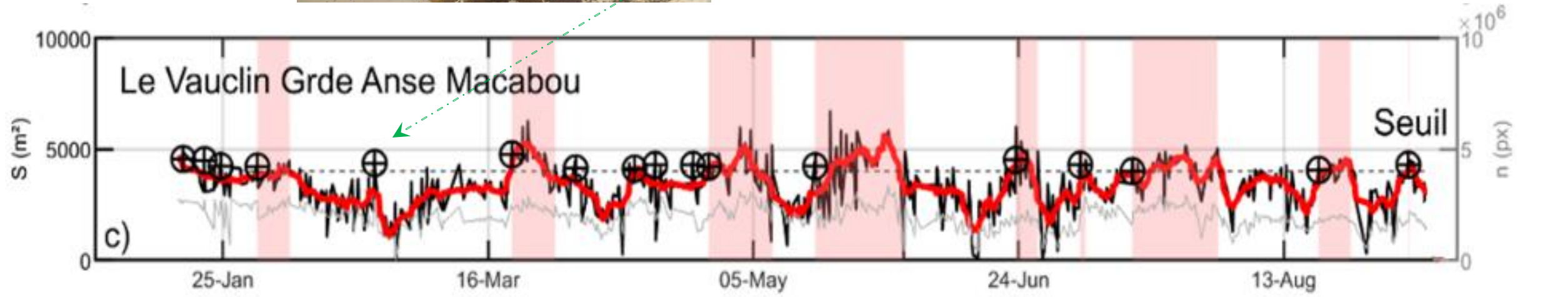
S'il n'est pas possible de se rendre sur place pour une investigation, veuillez contacter les personnes charge' de la recherche sur les sargasses des Caraibes: t.decathelineau@brgm.fr, a.nachbaur@brgm.fr, y.balouin@brgm.fr, b.vittecoq@brgm.fr.

***** FIN DU MESSAGE *****



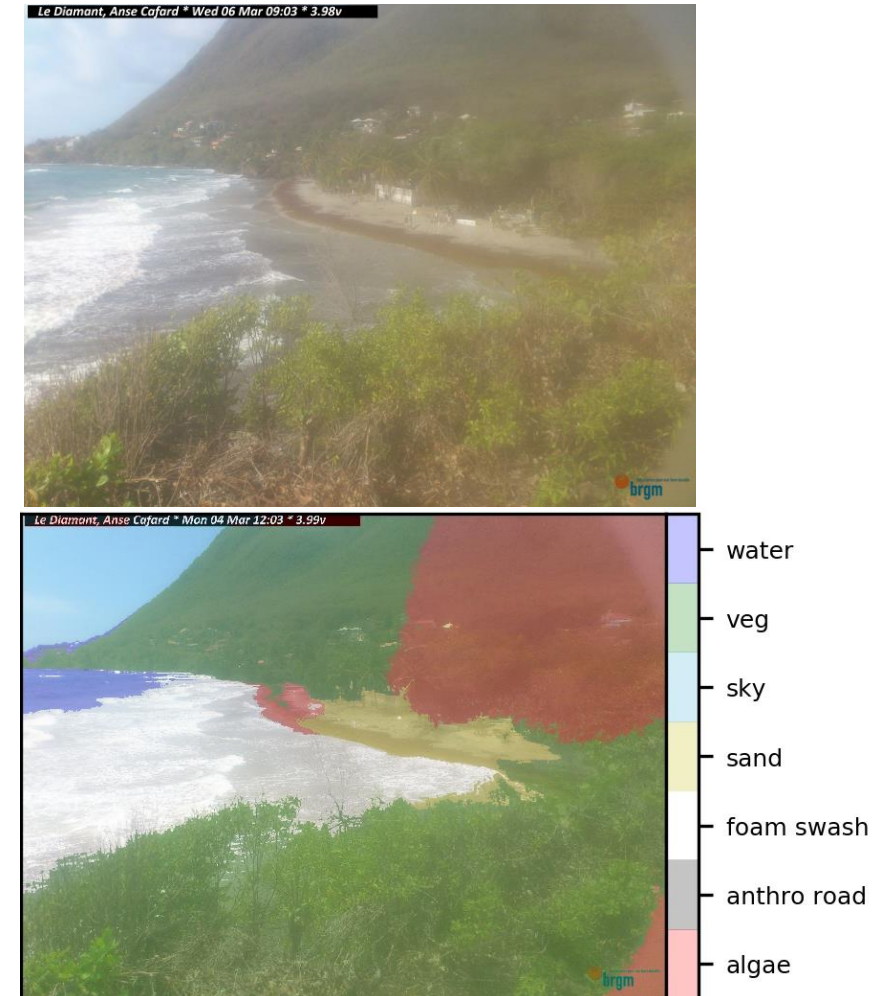






Main issues:

1. Camera displacements
2. Smallest spots areas (<100px, no alert)
3. Quality of the images
4. Dirtiness on the lenses & illuminations



Thank you for listening

Martinique, 2019

DCNN + CRF

Fully-Connected Conditional Random Field¹

$$P(y|x, \theta) = \frac{1}{Z(x, \theta)} \exp(-E(y|x, \theta))$$

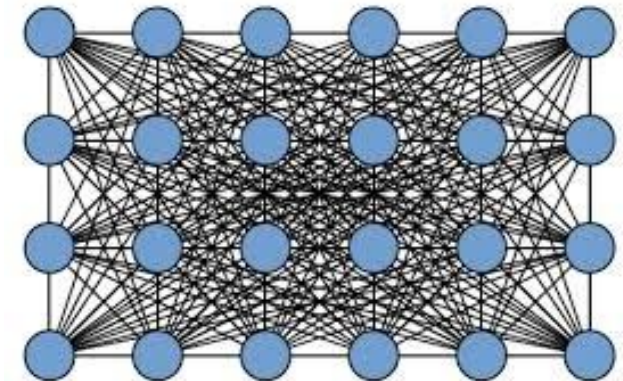
Energy function to minimize

$$E(y|x, \theta) = \sum_i \psi_i(y_i, x_i, |\theta) + \sum_{i < j} \psi_{ji}(y_i, y_j, f_i, f_j | \theta)$$

Unary & Pairwise Potentials

$$\psi_{ji} = f\left(k^l(f_i^l, f_j^l)\right) = f\left(\exp\left(-\frac{|p_i - p_j|^2}{2\theta_\alpha^2} - \frac{|x_i - x_j|^2}{2\theta_\beta^2}\right) + \exp\left(-\frac{|p_i - p_j|^2}{2\theta_\gamma^2}\right)\right)$$

Smoothness Kernel



¹Krähenbühl & Koltun, 2011

Fur

1. At

2. Co

in

3. Va

rtToolsDesktopWindowHelp

Mean displacement computed is high according to the precision (threshold set 5 pixel) of the mesurement: 10.13 pixel. A correction is needed:
Please pusck the button: "Apply Geometry changes" in order to create a new georeference file

OK

Gui_redressement

Prerequisites

Reference file GCP

Géoref OK

Image OK

Geometry seems changed

Apply geometry changes

Main Menu

1329107

35

19

23/01/19 12:00

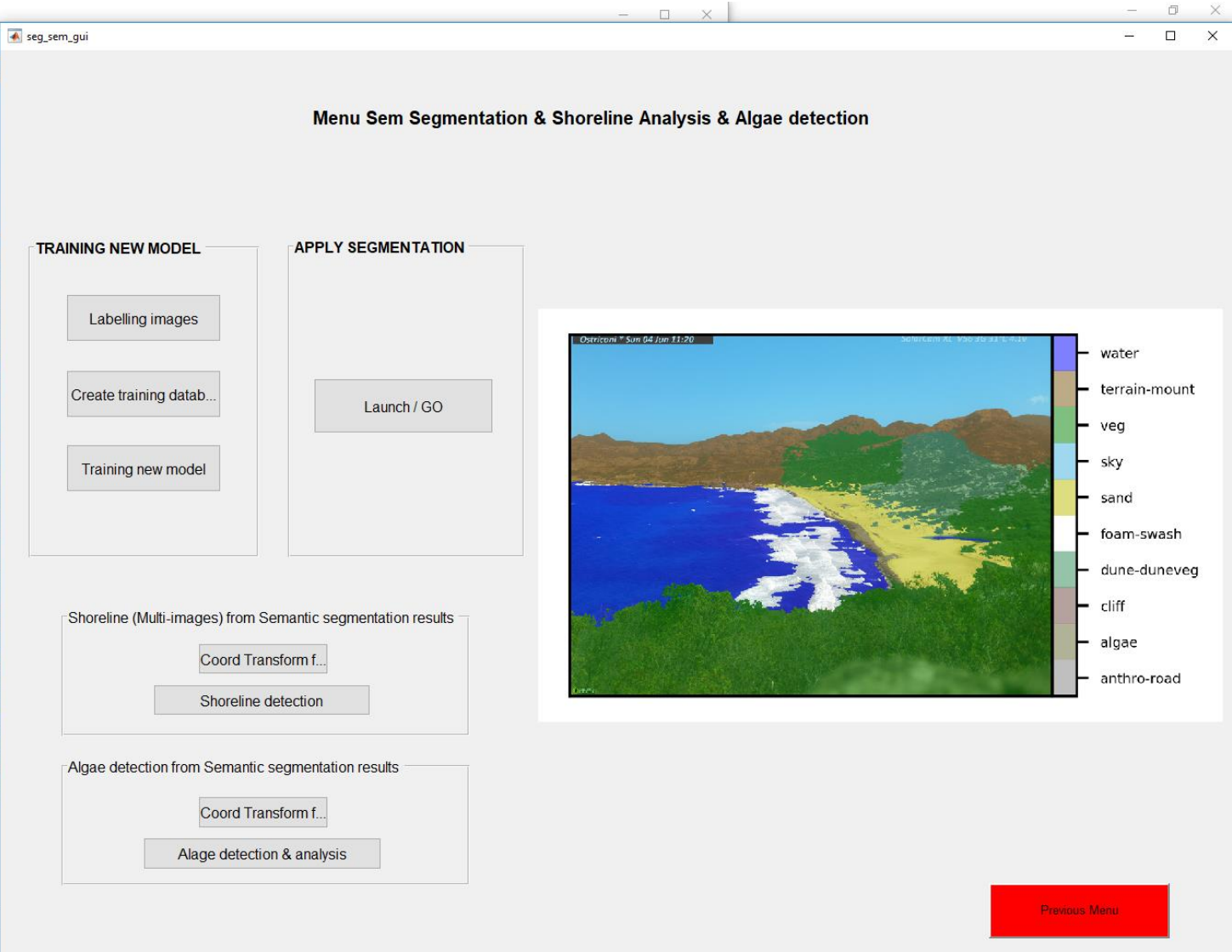
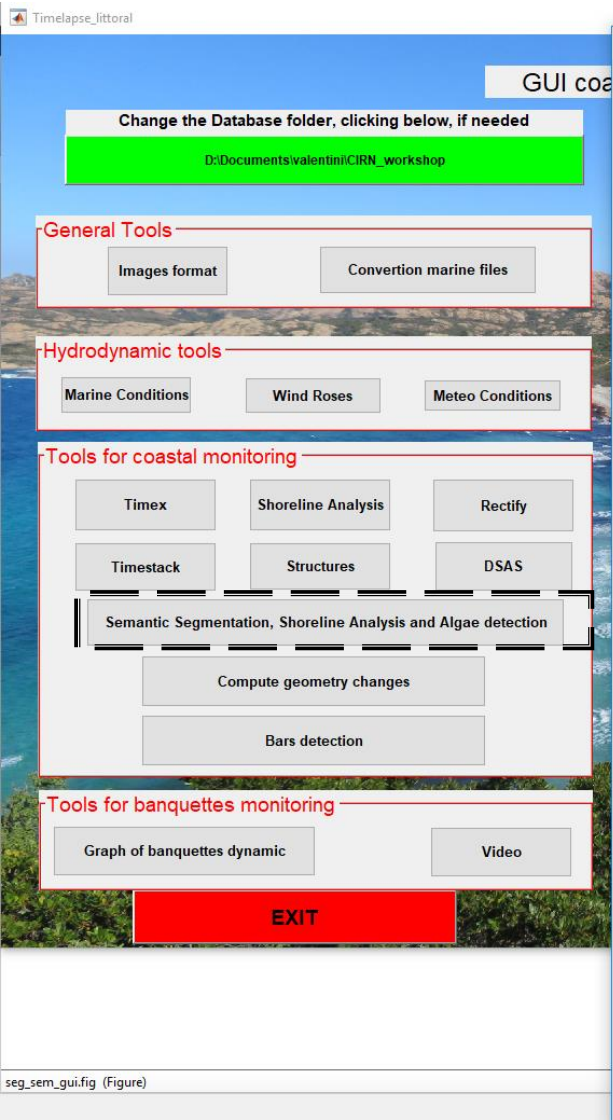
91002315

19

09/04/19 09:00

MATLAB GUI

19-21/06/2019



SURF AREA CLASSIFICATION – SHORELINE DETECTION



BEACH AREA (WIDTH) CALCULATION

