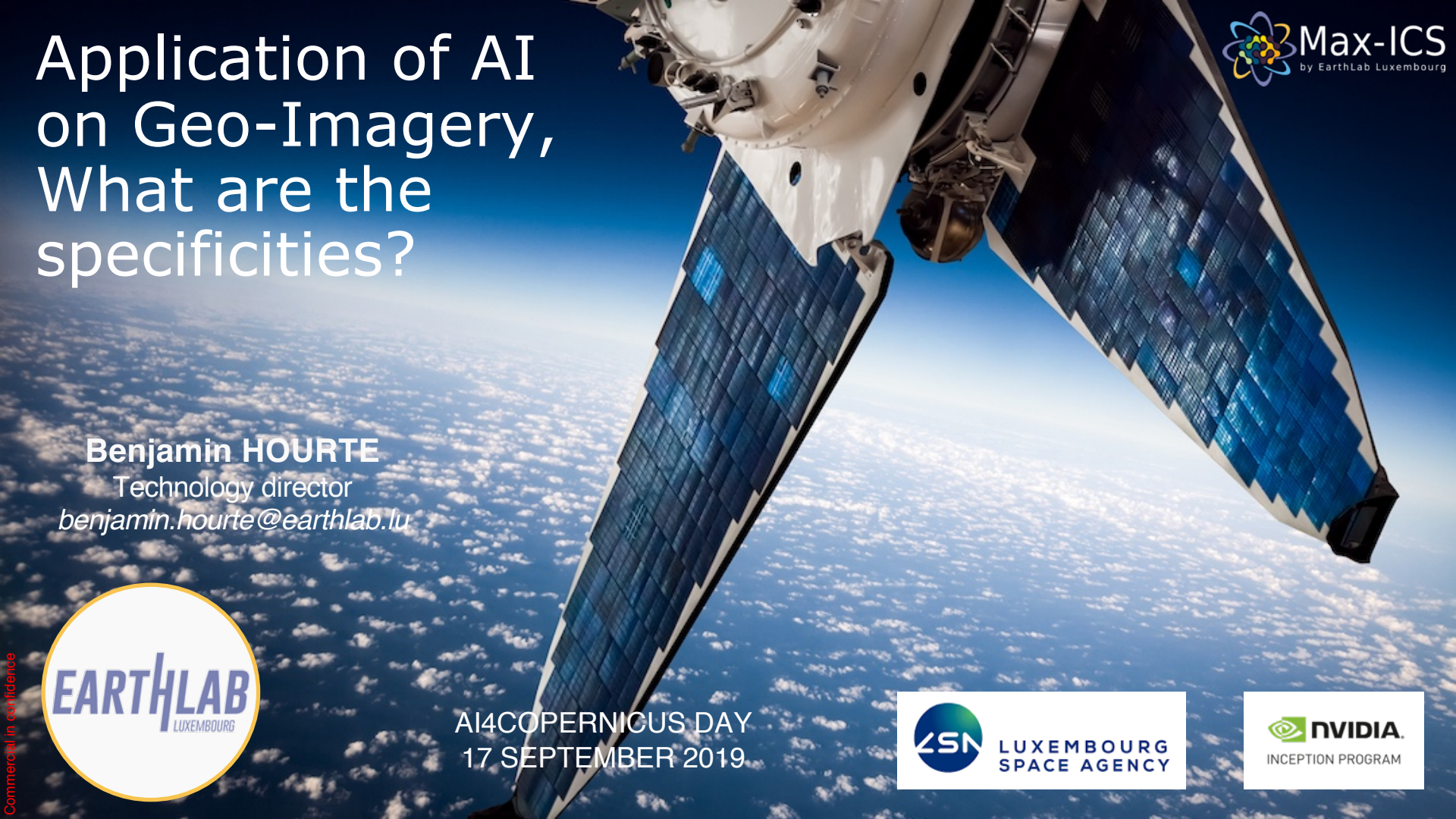
Application of AI on Geo-Imagery, What are the specificities?



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Max-ICS
by EarthLab Luxembourg

EARTHLAB LUXEMBOURG

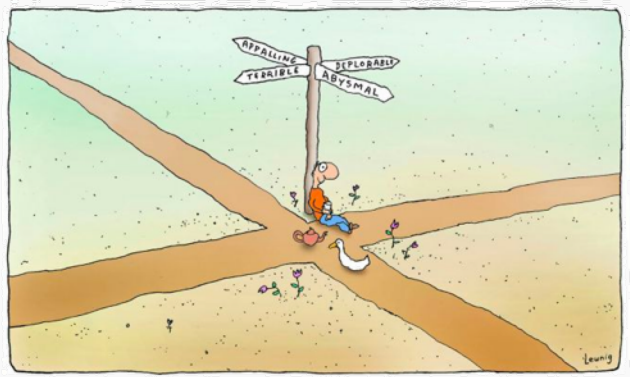
AI4COPERNICUS DAY
17 SEPTEMBER 2019

LUXEMBOURG SPACE AGENCY

NVIDIA
INCEPTION PROGRAM

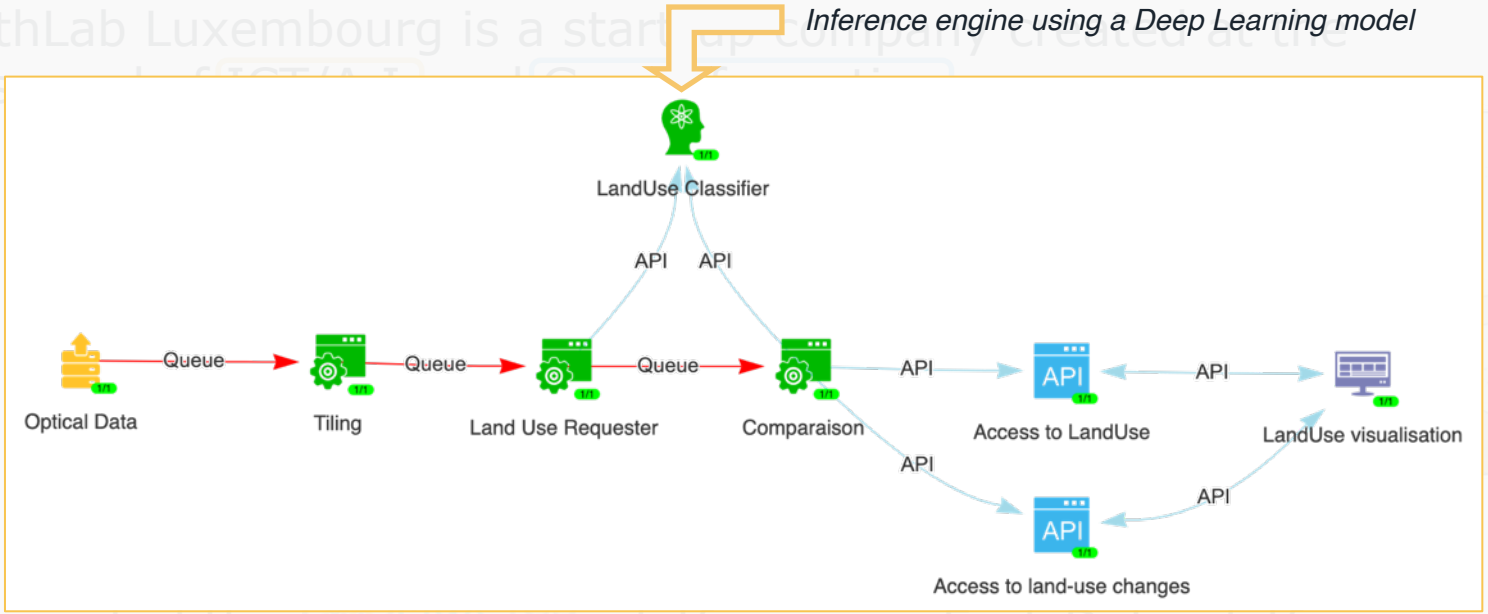
Short context introduction…

- EarthLab Luxembourg is a start-up company created at the crossroad of ICT/A.I. and Geo-Information



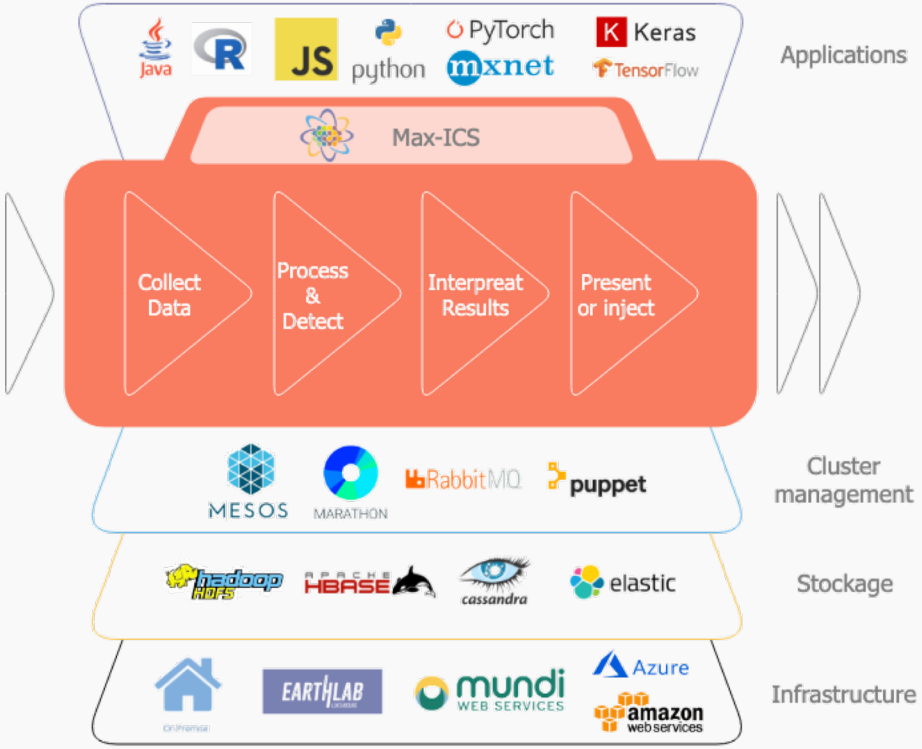
- We created the Max-ICS by EarthLab Luxembourg platform as a Fast-Data platform designed to process streams of data (EO and non-EO) using classical treatments or Machine/Deep Learning models.

Short context introduction…



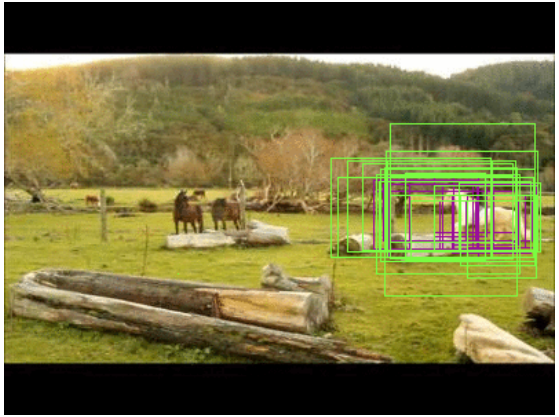
Example of treatment chain as modeled using Max-ICS

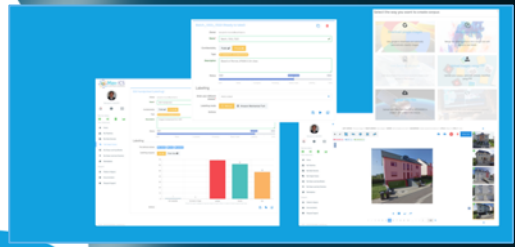
Short context introduction…



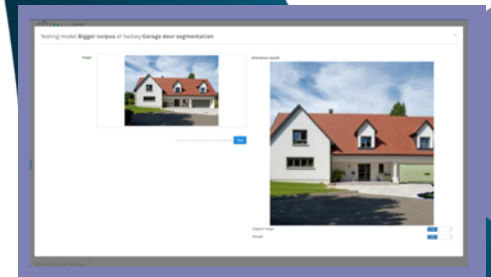
CREATE, MANAGE AND OPERATE YOUR ARTIFICIAL INTELLIGENCE

USE YOUR MODEL IN YOUR TREATMENTS





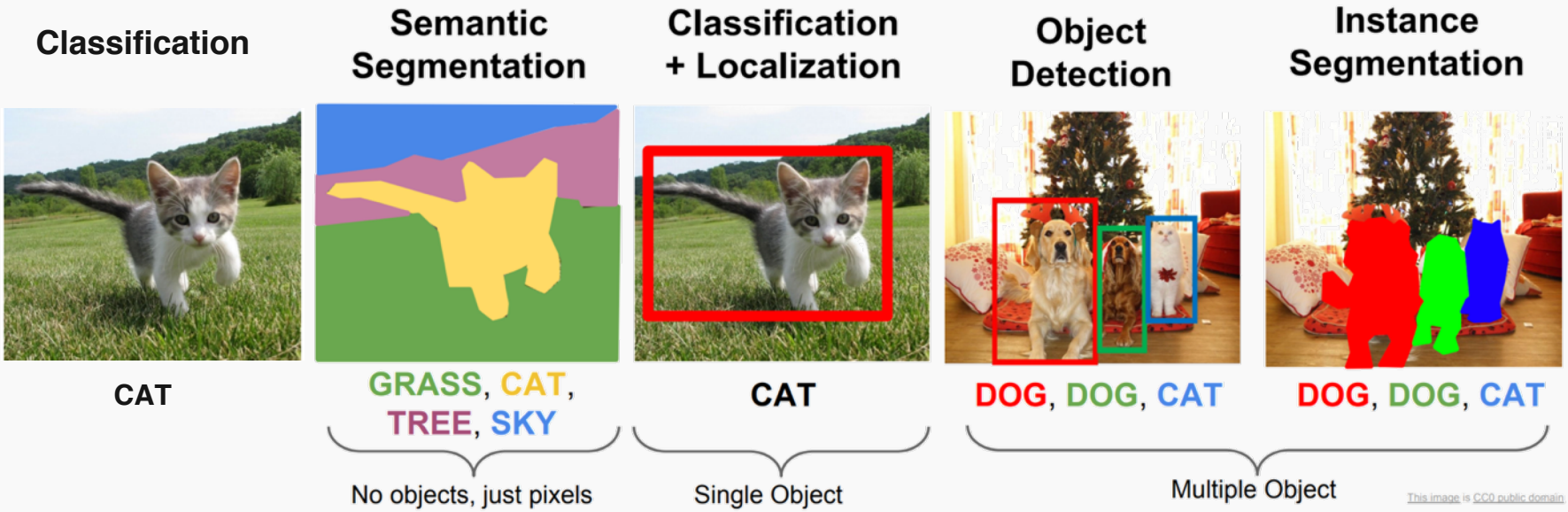
MANAGE YOUR DATASET



TEST YOUR MODEL

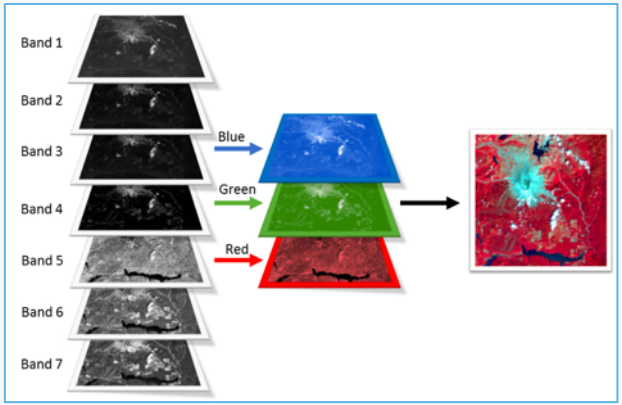
TRAIN YOUR MODEL

Use of EO and non-EO images in Machine and Deep Learning models



The same concepts, imagined and defined for classical images can be functionally applied to Earth Observation data.

The multi-bands source (hyperspectral/radar polarization)



Multi-bands source composition

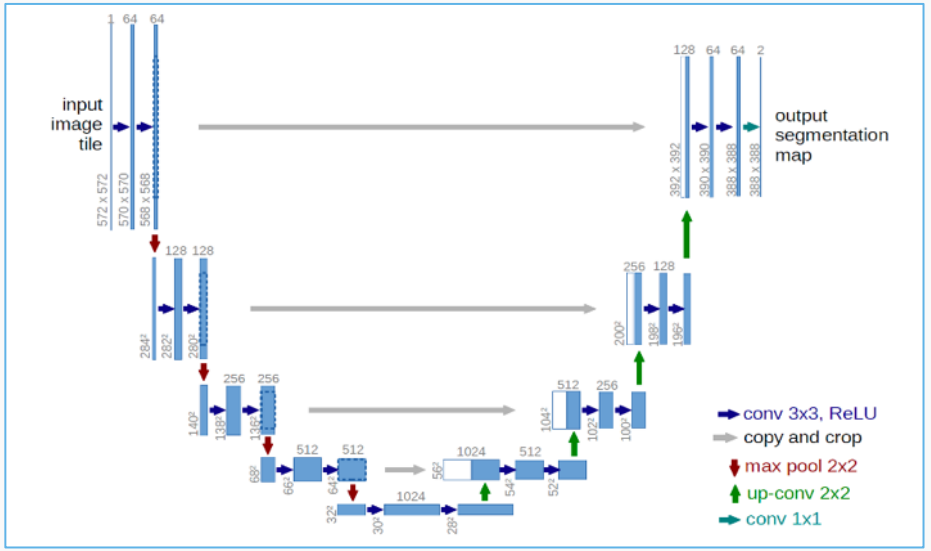
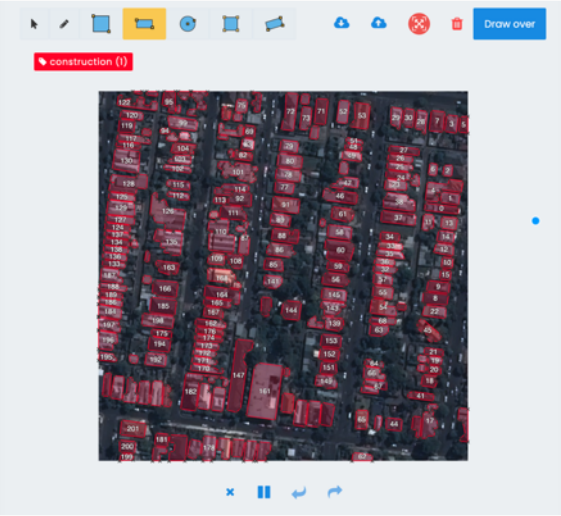


Illustration of U-NET network

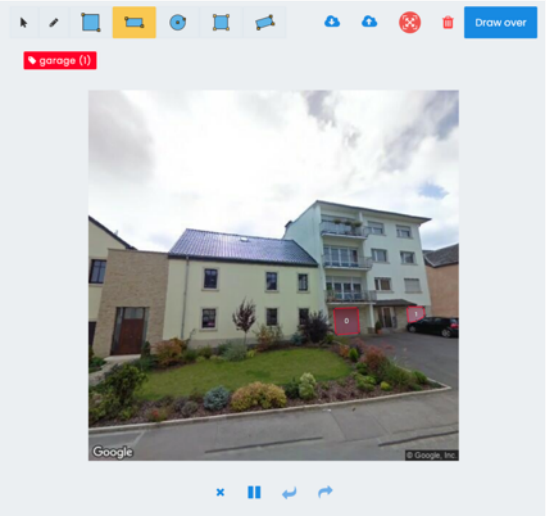
Most of the Deep Learning models are based on a three bands (RGB) input shape forcing a composition of a false colour image.

Some models (like UNET) can integrate adapted to accept multi-band input shapes but nearly all pre-trained networks are provided as 3 bands input.

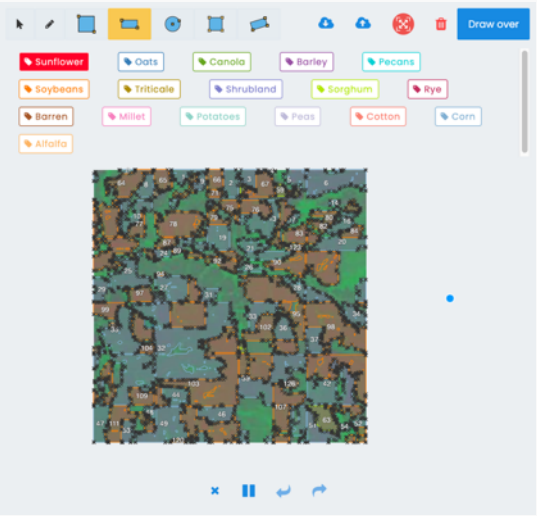
The “edges” and geometry (re effects



Land-use annotations



Garage doors detection

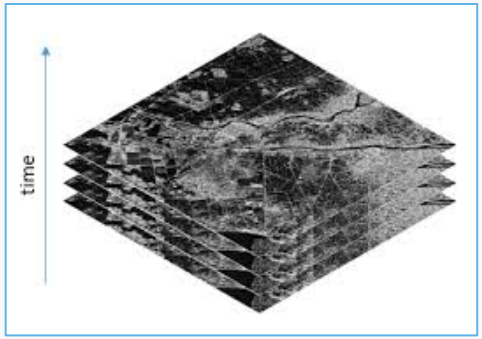


Crop classification annotations

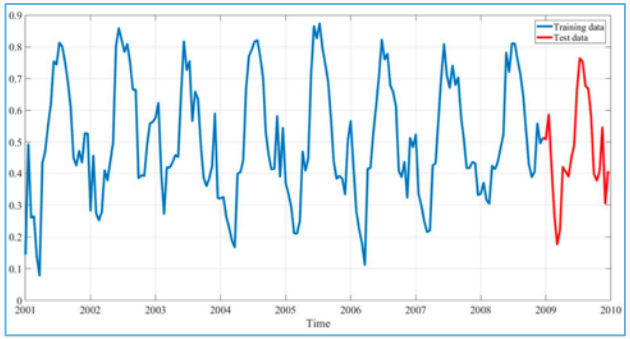
Deep Learning models are using the geometry representation (convolutions, atrous convolution…) giving the satellite and even aerial representation more difficult to apply.

Even more, the edges do not have the same signification in EO and non-EO.

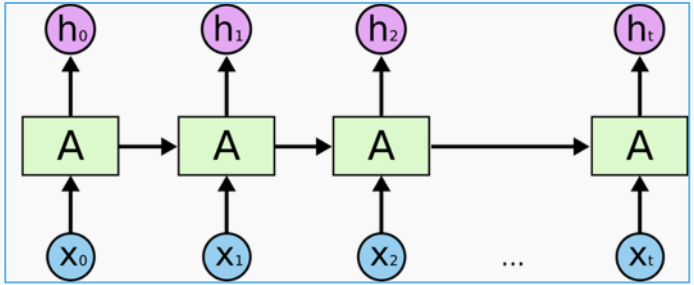
The evidence of timeseries



Time dimension illustrated on Sentinel-1



Visualisation of timeseries of GEMI (Global Environment Monitoring Index)



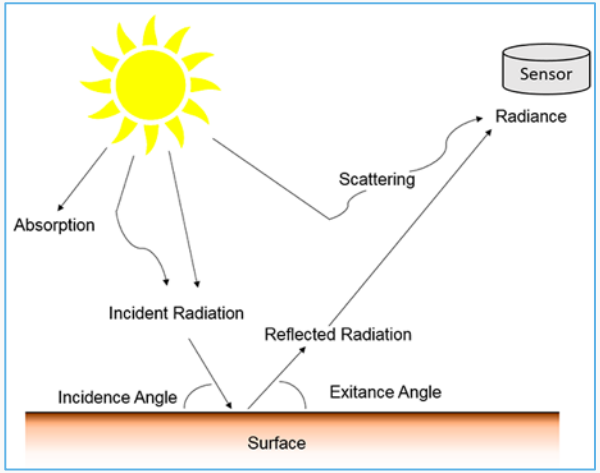
RNN model illustration

The time dimension (thanks to revisit and calibration) is an important asset of EO.

Difficult to maintain within a single model the spatial dimensions, multi-bands and timeseries. Possibility to include hybrid networks like applied in image captioning (mixed convolution/RNN).

In that context pre-processing is key!

The requirement of pre-processing



Courtesy of Humboldt State University

Sentinel-2 reflectance input image - atmospherically corrected image

Pre-processing includes sensor radiance to surface reflectance correction (radiometric calibration) and orthorectifying

Pre-processing includes overlaying and georeferencing several geo-spatial layers (of different sources).

Especially for timeseries analysis pre-processing is essential.

When differences are too high… 1/3

Reference image

Rush capture (source: plane NOAA)

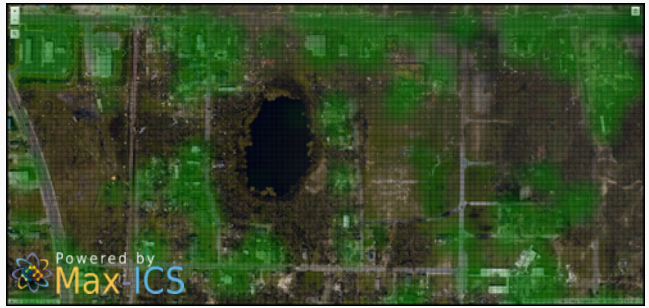
When differences are too high… 2/3

Reference image

Rush capture (source: plane NOAA)

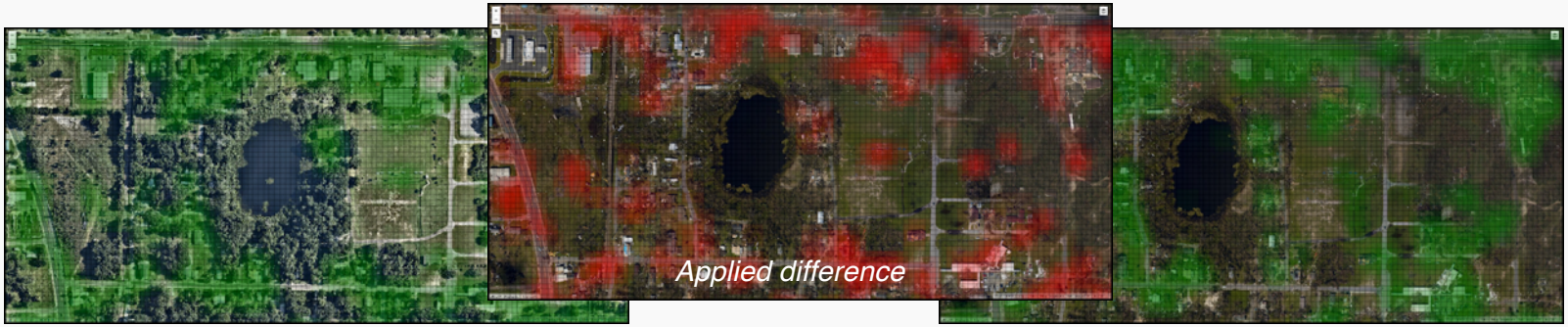
Detection of “non-damaged” houses

Application of the same model



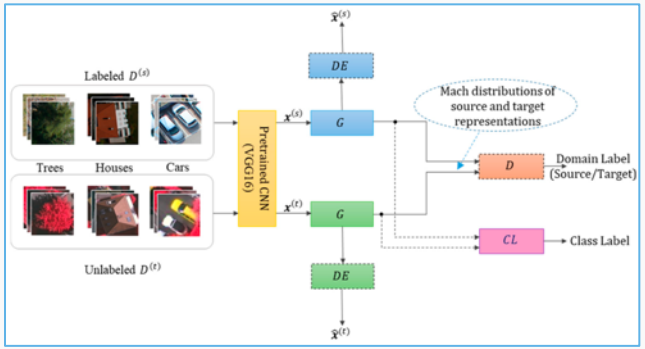
Detection of “non-damaged” houses

When differences are too high… 3/3



Detection of “non-damaged” houses

Detection of “non-damaged” houses



Courtesy of Laila Bashmal & all

Application of (Siamese) GAN (Generative Adversary Networks) can be very useful to handle some scale, geometric and calibration problem.

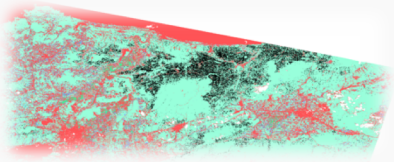
Conclusions

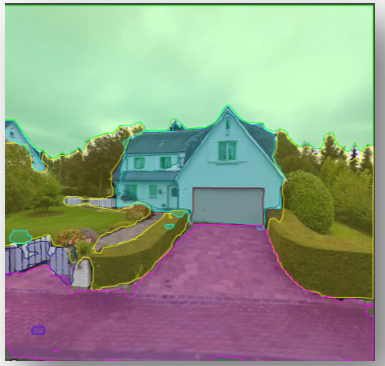
Application of Deep Learning is not as “simple” as for non-EO data.

Machine Learning (SVM, Random Forrest...) are still largely applied at the pixel level.

Specialised sub-field in Deep Learning that requires specific efforts and specific tools.

Strong impact on the Explainability.





Thanks for your attention

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