# Sentinel 1 and 2 timeseries for hydrodynamics and habitat mapping in the Amazon

Thibault Catry, Loic Marie-Louise, Rogerio Flores Junior, Aurea Pottier, Marie-Paule Bonnet

thibault.catry@ird.fr

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Amazon floodplain = major Earth biodiversity reservoir / biodiversity and productivity driven by inundation dynamics

Knowledge of distribution of floodplains and monitoring of floodplain dynamics



EO-based global products are available but coarse resolution and/or gaps in data due to the presence of clouds (GIEMS, Yamazaki, GSW...)

#### Context of the study

#### Global Surface Water (Pekel et al 2016)



https://global-surface-water.appspot.com/download

#### Context of the study

The Maximum Water Extent provides information on all the locations ever detected as water over the 37-year period.

#### MAXIMUM EXTENT



The Water Occurrence shows where surface water occurred between 1984 and 2020 and provides information concerning overall water dynamics.

### Global Surface Water (Pekel et al 2016)

RECURRENCE



#### https://global-surface-water.appspot.com/download

The Recurrence map provides information concerning the inter-annual behavior of water surfaces and captures the frequency with which water returns from year to year.

#### Objective of the study

Take advantage of Sentinel 1 and Sentinel 2 timeseries to:

- Map the maximum extent of open water
- Assess the flood duration in a specific area over a year
- Map wetland habitats

#### Earth observation data

With S1 and S2 data available every **6 and 5 days**, it is possible to build dense **timeseries** of Sentinel images, with high spatial resolution and very high revisit rates



**S1 RADAR timeseries** 



S2 optical timeseries



Sentinel timeseries cover a wide range of applications including **landcover mapping**, **hydrology** with strong capacities for the **monitoring of space and time dynamics** of environmental variables

#### Area of interest



# Sentinel 1 timeseries for hydrodynamics monitoring

#### Methodology







Maximum water extent from S1 timeseries





# *Hydroperiods (recurrence of water) from S1 timeseries*



#### Results



#### S1 vs GSW Maximum water extent

S1 vs GSW hydroperiods



Parana River, Argentina





#### Building a Sentinel 1 datacube

Collaboration with INPE, Brazil for the implementation of the algorithm in a S1 datacube



# **Sentinel 1+2 timeseries for habitat mapping**

#### Methodology

**Iota2** - Infrastructure for Landcover by Automatic processing Incorporating Orfeo Toolbox Applications is a processing chain dedicated to the productio of landcover maps developed at CESBIO (France)



#### Methodology

lota 2 is an opensource algorithm than can be implemented anywhere.

https://www.cesbio.cnrs.fr/open-source-software-developer-position-for-large-scale-continentalsurface-monitoring/

It is available at **https://framagit.org/iota2-project/iota2** with a complete documentation.

Thanks to a powerful gapfilling algorithm, iota 2 is able to overcome the limitations in optical images such as Sentinel 2 due to cloud cover resulting in missing pixels.

It allows frequent (monthly, seasonal, yearly...) updates of landcover maps and can be used to monitor the dynamics of environmental variables.

The main limitation is due to the download and storage of sentinel timeseries.



#### An example on Lago Grande do Curuai



Landsat map (2016) used as training dataset (30 m resolution)

Sentinel landcover map of 2020

#### Conclusions

Strong capability of Sentinel 1 timeseries to monitor hydrodynamics (water extent and reccurence) due to dense timeseries compared to reference products based on optical images disturbed by clouds.

Method tested in various sites, to assess its reproducibility.

Ongoing implementation of the method in a datacube in collaboration with INPE

One of the remaining questions: characterization of flooded vegetation using SAR? Capabilities of Cband Sentinel 1?

Regarding habitat mapping, S1+S2 timeseires have a strong potential thanks to the availability of powerful methods to process large volumes of data (IOTA2), provided that the relevance and quality of reference data is good enough.



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Thank you for your attention

thibault.catry@ird.fr