Development of a global and dynamic map of wetland and inundated areas based on microwave remote sensing product (GIEMS-2) over 1992-2020

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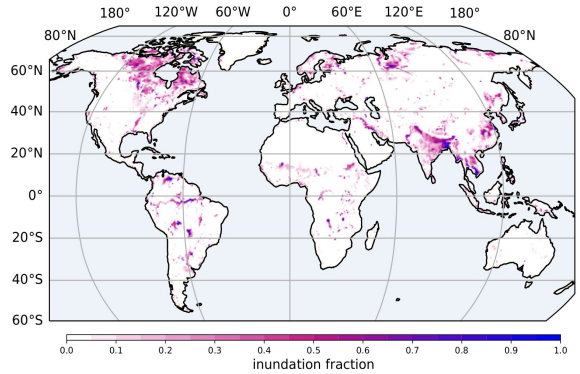
From surface waters to a methane-centric database

→ **GIEMS-2 : Global surface water extent** and **dynamics** estimated from satellite observations (passive microwaves) over 30 years

1. GIEMS-2 surface water evaluation

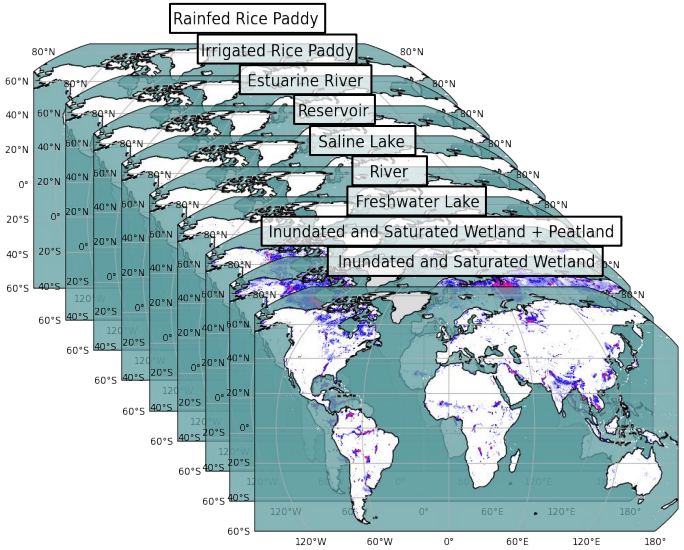


1992-2020 monthly **inundation fraction**
passive microwave remote sensing

Bernard et al., accepted

2. characterization of these water surfaces

development of a database for methane emission modeling



Bernard et al., in prep.

1. GIEMS-2 evaluation

Bernard et al., accepted

Assessing the time variability of GIEMS-2 satellite-derived surface water extent over 30 years

Juliette Bernard [1,2*], Catherine Prigent [1,3], Carlos Jimenez [3,1], Frederic Frappart [4], Cassandra Normandin [4], Pierre Zeiger [5], Yi Xi [2], and Shushi Peng [6]

→ compare **GIEMS-2** time series with **other satellite products** and **river gages**.
→ 10 basins studied

Table 1. Characteristics of the independent products used for comparison analysis.

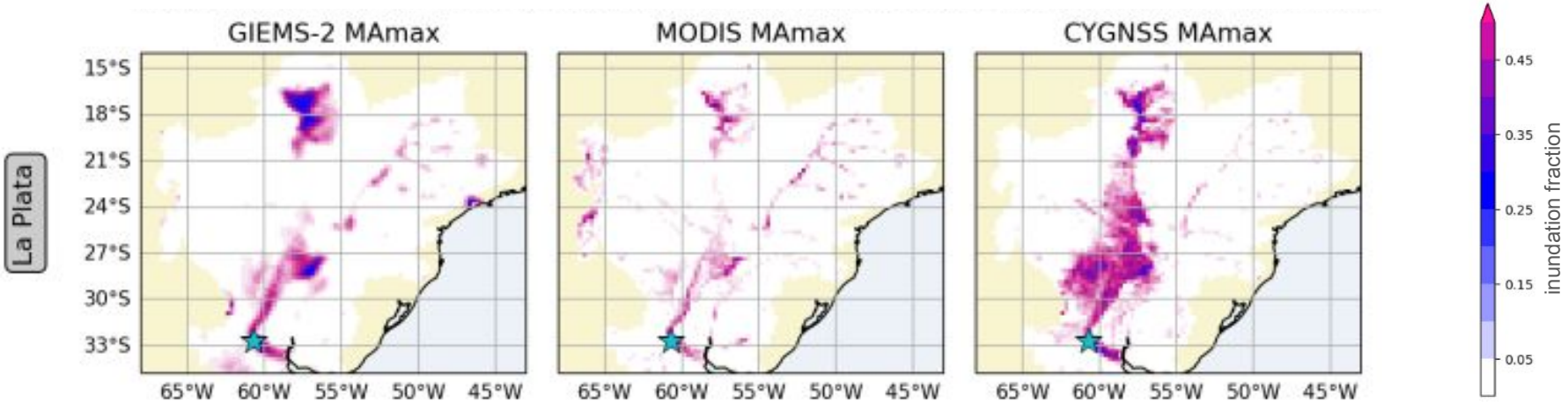
Data product	Wavelength	Spatial coverage	Spatial resolution	Temporal resolution	Available period
GIEMS-2	microwaves, visible, near IR	global	0.25°x0.25°	monthly	1992-2020
MODIS	visible	selected basins	~ 0.0045°x0.0045°	8 days	2000-2020
CYGNSS	L-band	37.5°S to 37.5°N	0.1°x0.1°	7 days	Aug 2018-Jul 2019
river gauges	-	point measurements	-	monthly/daily	station dependent

1. GIEMS-2 evaluation - spatial patterns

Bernard et al., accepted

Comparison with satellite products:

- MODIS : visible and near IR
- CYGNSS : active microwaves



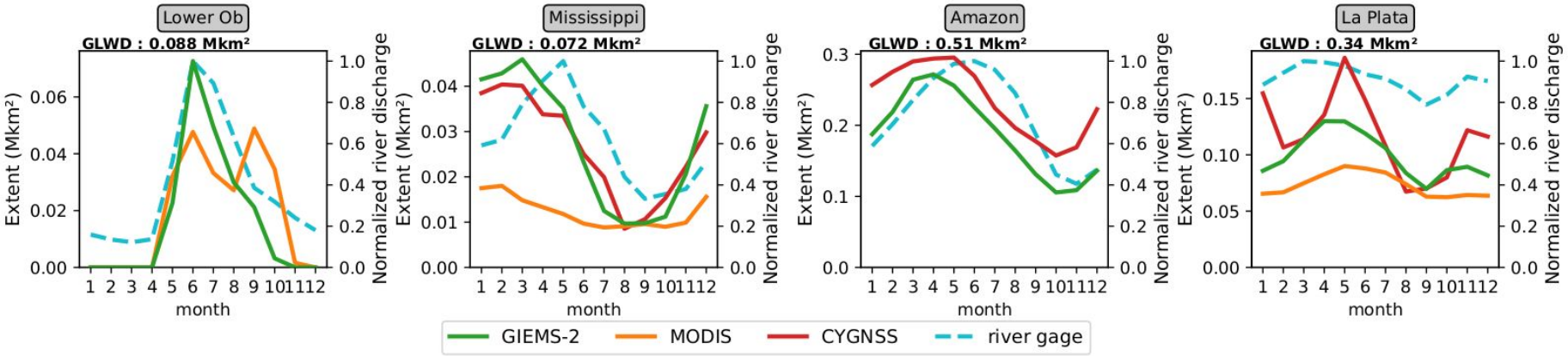
→ **spatial correlation** of Mean Annual maximum (MAmax) **> 0.7** for most of the basins between **GIEMS-2** and **MODIS & CYGNSS**.

1. GIEMS-2 evaluation - seasonality

Bernard et al., accepted

Comparison with satellite products:

- MODIS : visible and near IR
- CYGNSS : active microwaves



Mean annual seasonal cycle of the different datasets over selected basins

→ **high** 12-month **seasonality correlation** between **GIEMS-2** and **MODIS** & **CYGNSS** & **discharges**
(r>0.75 for most basins)

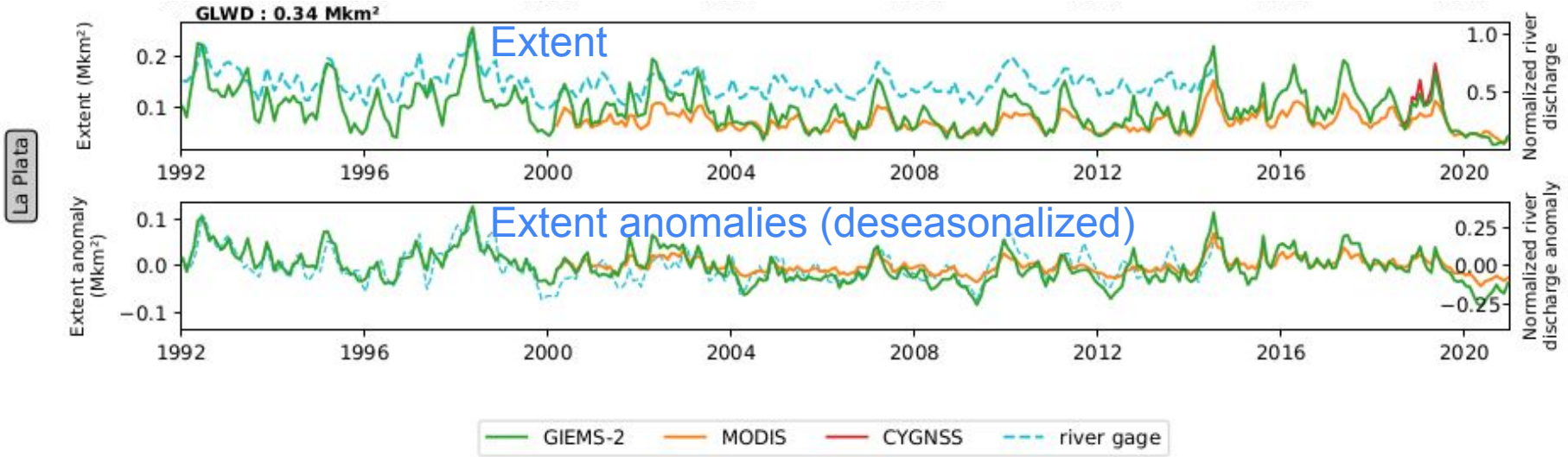
→ **uncertainties** in terms of extent

1. GIEMS-2 evaluation - interannuality

Bernard et al., accepted

Comparison with satellite products:

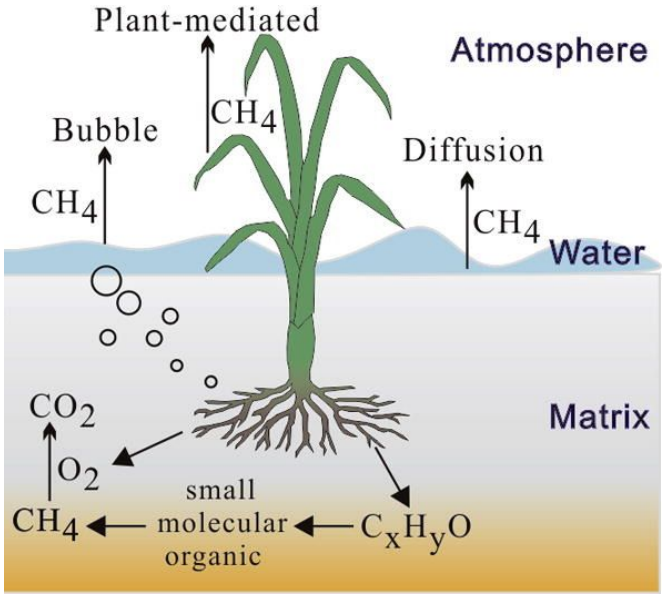
- MODIS : visible and near IR
- CYGNSS : active microwaves



Monthly time series and deseasonalized monthly anomalies

→ **correlation coefficient for anomalies > 0.6** for most of the basins between GIEMS-2, MODIS and discharges.
→ **reliable interannual variability** for both GIEMS-2 and MODIS datasets.

2. GIEMS-MethaneCentric - water surfaces emit methane



Liu et al. 2017

Methane-emitting surfaces

→ **inundated and saturated wetlands**
→ **peatlands**
→ **open freshwater** (lakes, ponds, rivers…)
→ **rice paddies**

→ **waterlogged conditions** lead to methane production (a powerful greenhouse gas)
→ need to **differentiate these different surfaces**

2. GIEMS-MethaneCentric - methodology

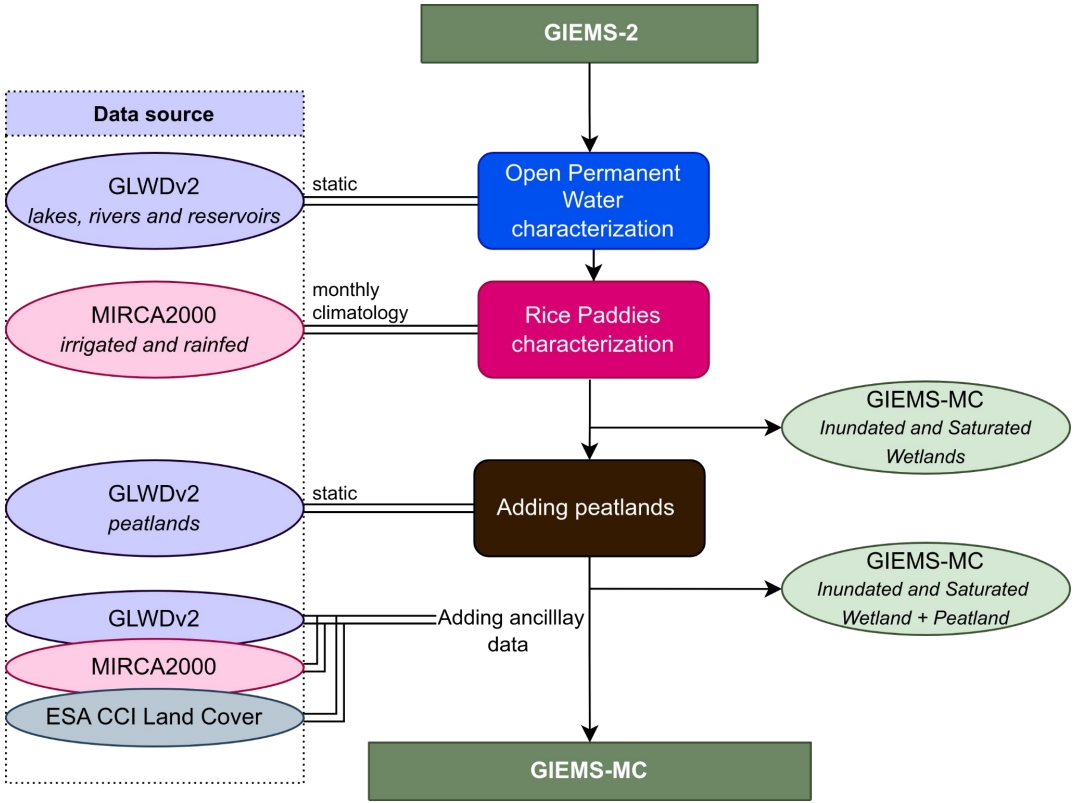
Bernard et al., in prep.

GIEMS-2 : **all surface waters**

\+ **GLWDv2**

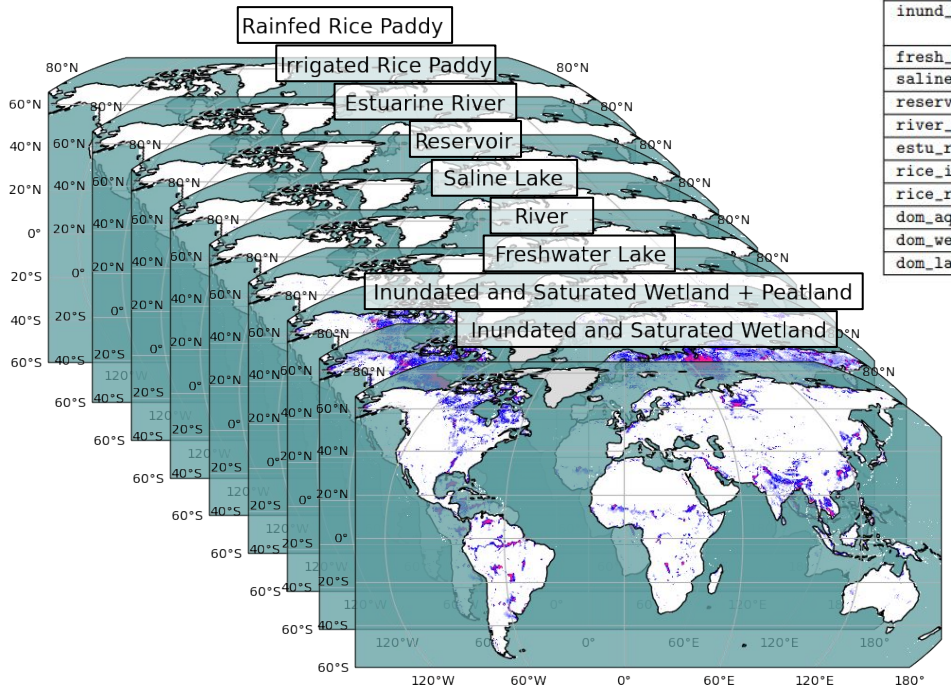
delta version available on HydroSHEDS website (Lehner et al., in prep)

GIEMS-MethaneCentric : characterization of **methane emitting surfaces**



2. GIEMS-MethaneCentric - description

Bernard et al., in prep.



GIEMS2-MC variable	Long name	Primary data source	Time resolution
inund_sat_wetland_frac	Inundated and Saturated Wetland	GIEMS-2	monthly
inund_sat_peat_wetland_frac	Inundated and Saturated Wetland + Peatland	GIEMS-2 + GLWDv2	monthly
fresh_lake_frac	Freshwater Lake	GLWDv2	static
saline_lake_frac	Saline Lake	GLWDv2	static
reservoir_frac	Reservoir	GLWDv2	static
river_frac	Large River	GLWDv2	static
estu_river_frac	Large Estuarine River	GLWDv2	static
rice_irri_frac	Irrigated Rice Paddy	MIRCA	12-month seasonality
rice_rainfed_frac	Rainfed Rice Paddy	MIRCA	12-month seasonality
dom_aqua_class	Dominant Aquatic Class	GLWDv2	static
dom_wet_peat_class	Dominant Wetland or Peatland Class	GLWDv2	static
dom_land_cover_class	Dominant Land Cover Class	ESA CCI Land Cover	static

Table 1. *Summary of GIEMS-MC variables with corresponding data source and temporal resolution.*

→ **GIEMS-MC** contains **dynamic wetland maps** (1992-2020) along with other **methane emitting surface maps** and ecosystem information at 0.25°x0.25°

→ First dynamic harmonized maps for methane emission modeling, can avoid double/mis-counting

Conclusion

→ GIEMS-2 is a **global inundation** dataset with **a realistic interannual variation** over 30 years *(Prigent et al. 2020, Bernard et al., accepted)*

→ from GIEMS-2 and GLWDv2 we derived the first dynamic harmonized dataset for methane modeling
GIEMS-MethaneCentric contains **dynamic wetland maps** (1992-2020) along with other **methane emitting surface maps** and ecosystem information at 0.25°x0.25° *(Bernard et al., in prep)*

→ **GIEMS-MethaneCentric** will be available soon for the community

Thank you for your attention

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