

Groundwater-fed riparian wetlands delineation

CHALLENGES AND ADVANCES AT THE GLOBAL SCALE

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Outline

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- General project description

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- Wetland and their hydrology

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- Wetland and their hydrology
- Wetland delineation methods

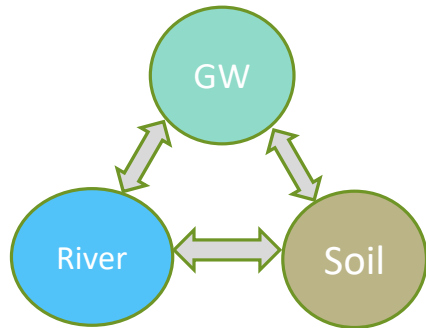
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- General project description
- Wetland and their hydrology
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- Tests in the global scale

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- Tests in the global scale
- Conclusion

General description of the project



Potentially
wet



La Bassée
<http://www.vnf.fr/>

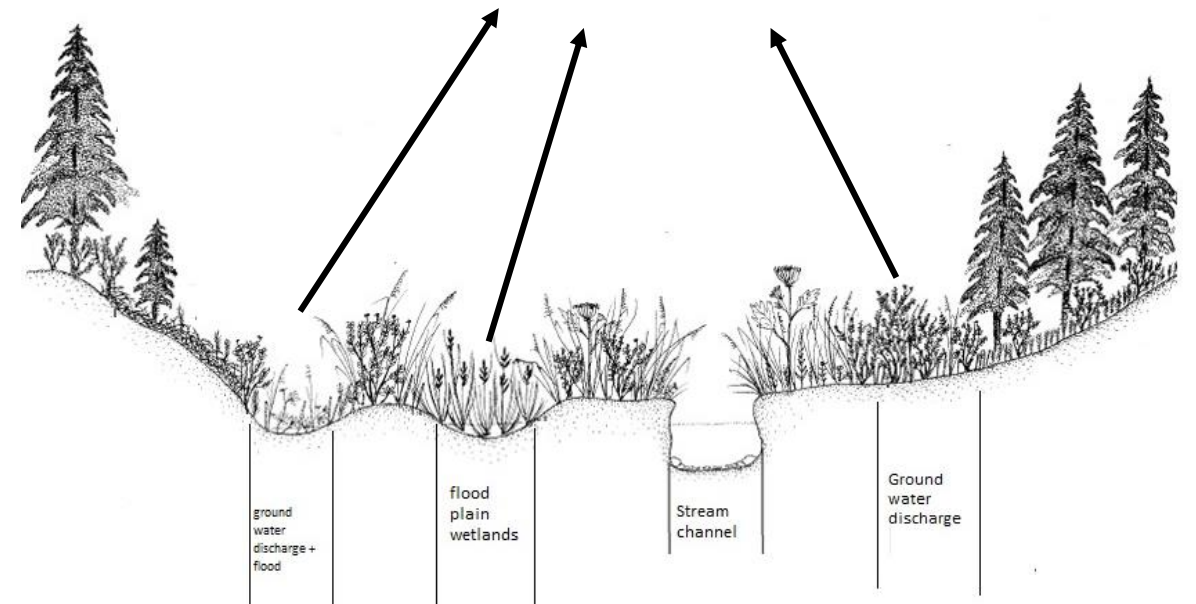
ORCHIDEE

Buffering
effect

Vulnerability

ORCHIDEE: IPSL's Land Surface Model

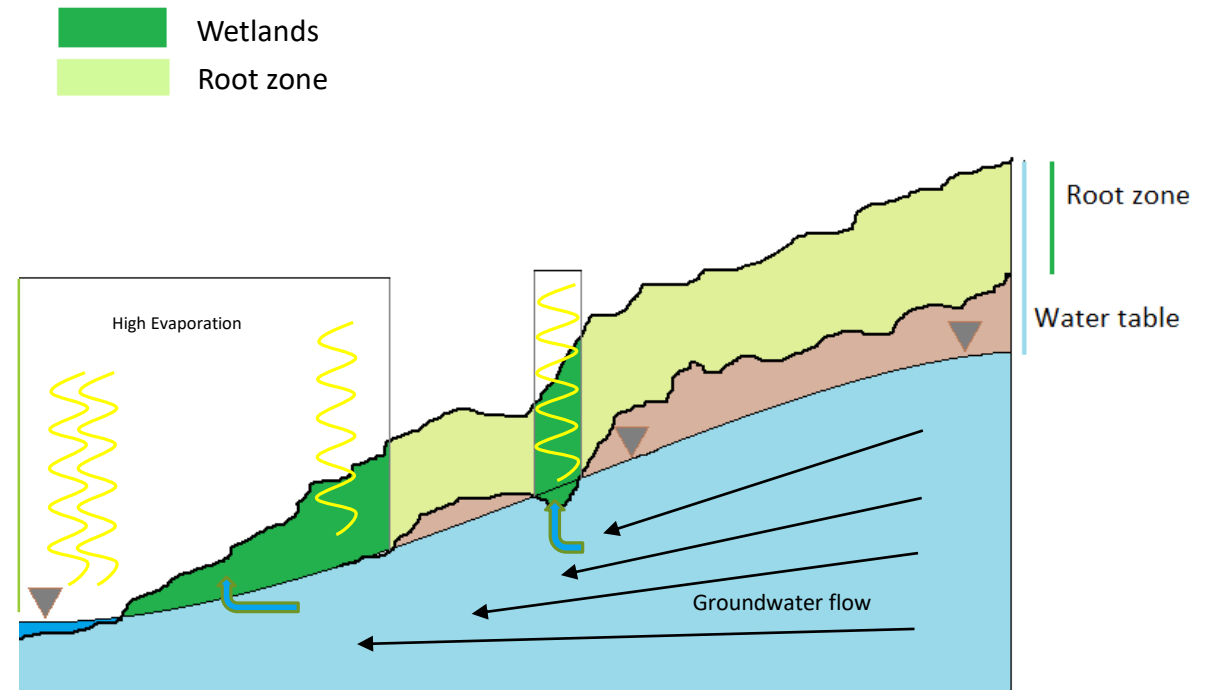
<http://labex.ipsl.fr/orchidee/>



Wetlands and their hydrology

What do we call a wetland?

Where ground water is at the surface or within the soil root zone during all or a part of the year.



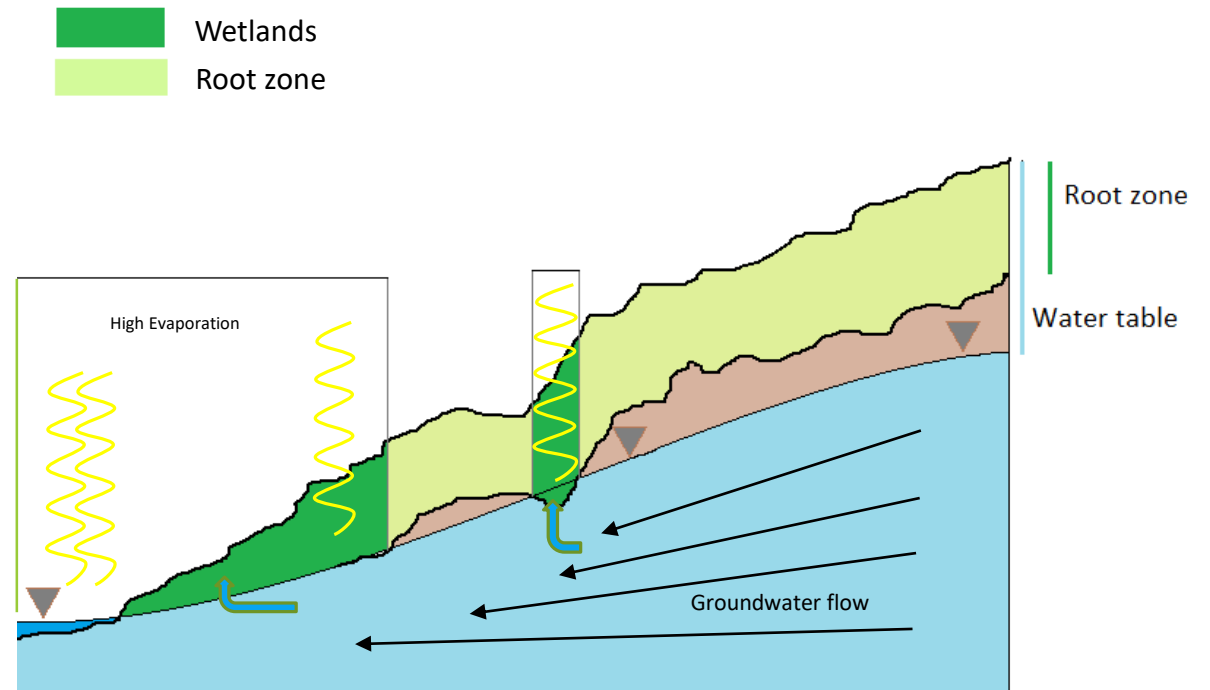
Wetlands and their hydrology

What do we call a wetland?

Where ground water is at the surface or within the soil root zone during all or a part of the year.

Wetland coverage in validation datasets

Dataset	% of the land	Description
GLWD	9.1%	12 classes
ESA-CCI	3.9%	3 flooded classes
GLC2000	3.6%	3 flooded classes



Wetland delineation Methods

■ Delineation using Topographic index

$$\text{Topographic index} = \ln\left(\frac{a}{\tan(\beta)}\right)$$

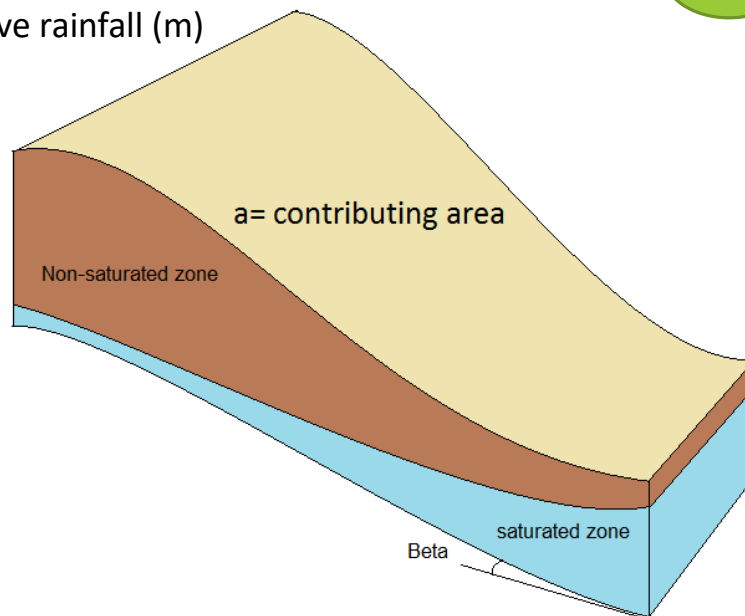
$$\ln\left(\frac{a}{T \cdot \tan(\beta)}\right) \longrightarrow \text{TI-Tr}$$

$$\ln\left(\frac{P_{eff} \cdot a}{\tan(\beta)}\right) \longrightarrow \text{TI-Climate}$$

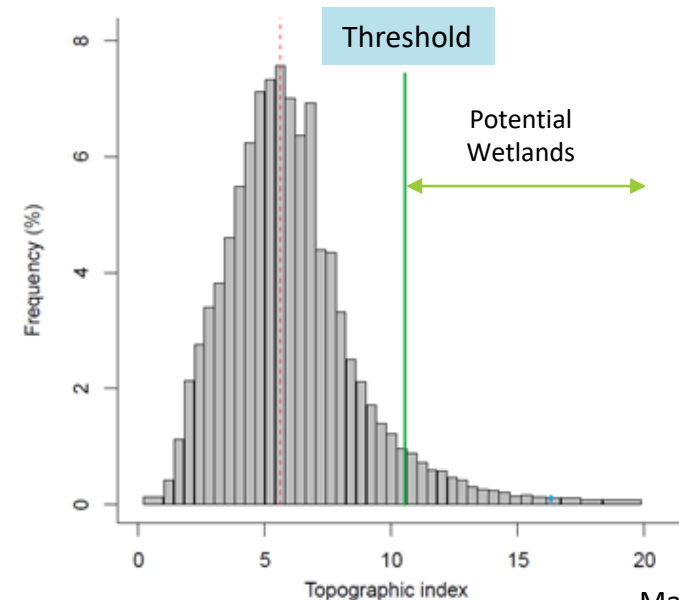
$$\ln\left(\frac{P_{eff} \cdot a}{T \cdot \tan(\beta)}\right) \longrightarrow \text{TI-Tr-Climate}$$

T : Transmissivity ($\text{m}^2 \cdot \text{s}^{-1}$)

P_{eff} : Effective rainfall (m)



Based on the TOPMODEL (Beven and Kirkby, 1979)

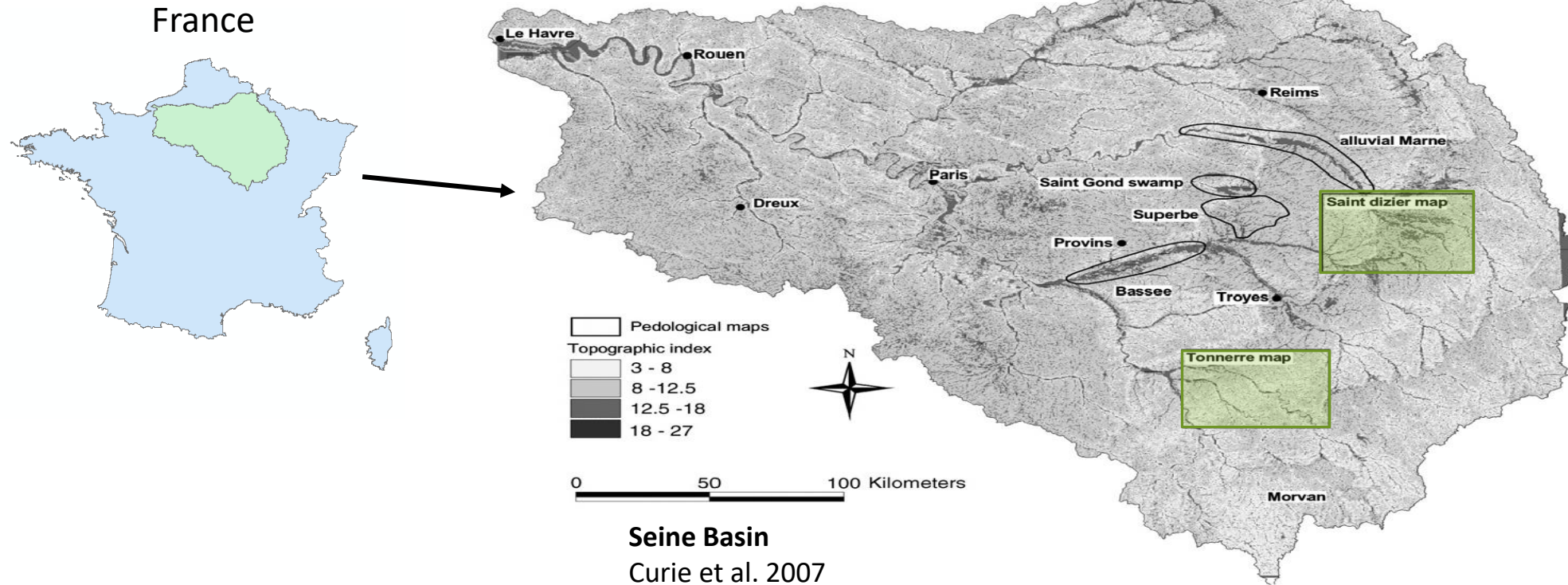


Marthews et al. 2015

Wetland delineation Methods

- Delineation using Topographic index

$$TI = \ln \left(\frac{a}{\tan(\beta)} \right)$$



Compare TI in the waterlogged areas



10.9 % of the basin is wetlands



Threshold



Going global

Tests in the global scale

- Delineation using Topographic index $TI = \ln\left(\frac{a}{\tan(\beta)}\right)$

TI

Wet

Not wet

GLWD

Wetland

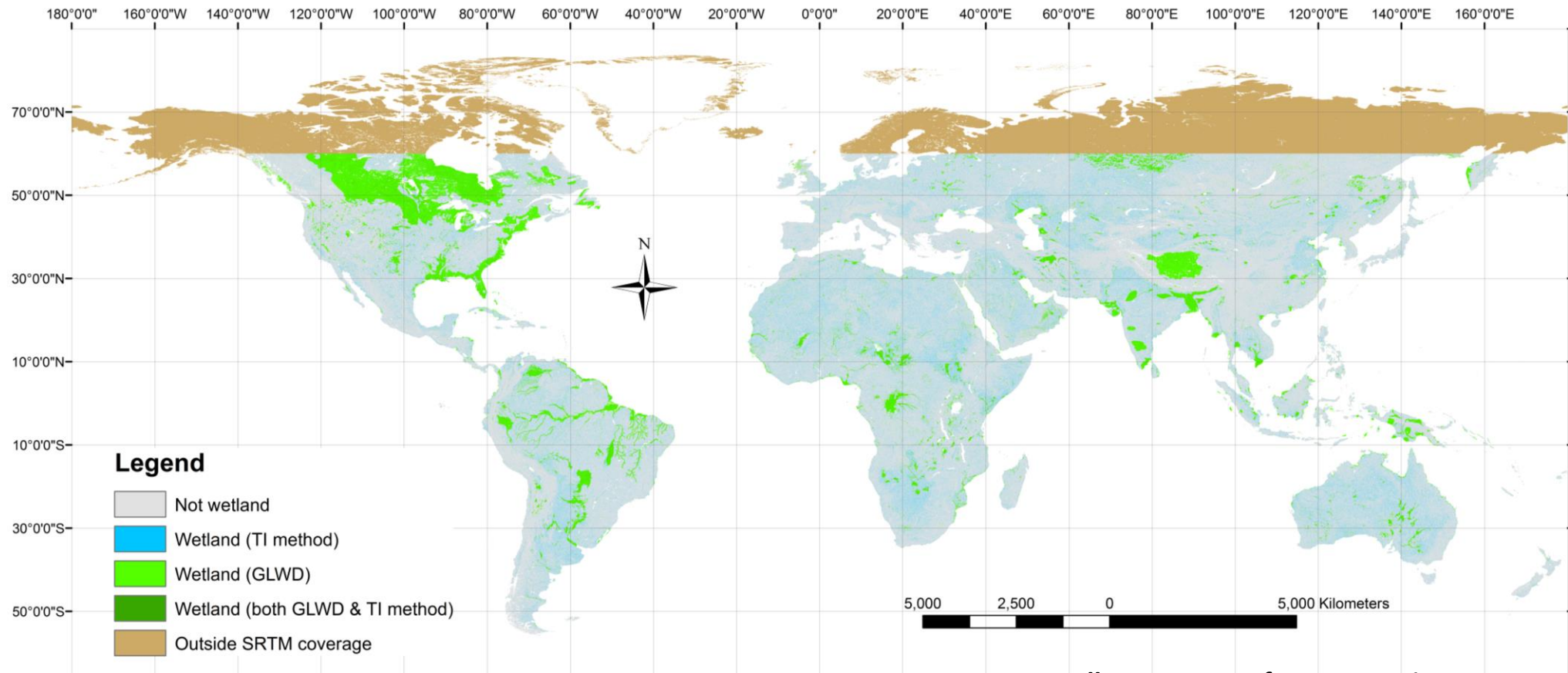
Not wetland

1.5 %

10.4 %

7.6 %

80.5 %



Overall percentage of PW: 11.9 %

Data: HydroSHEDS 15 arcseconds (460 m)

Tests in the global scale

- Delineation using Topographic index $TI = \ln\left(\frac{a}{\tan(\beta)}\right)$

TI

Wet

Not wet

GLWD

Wetland

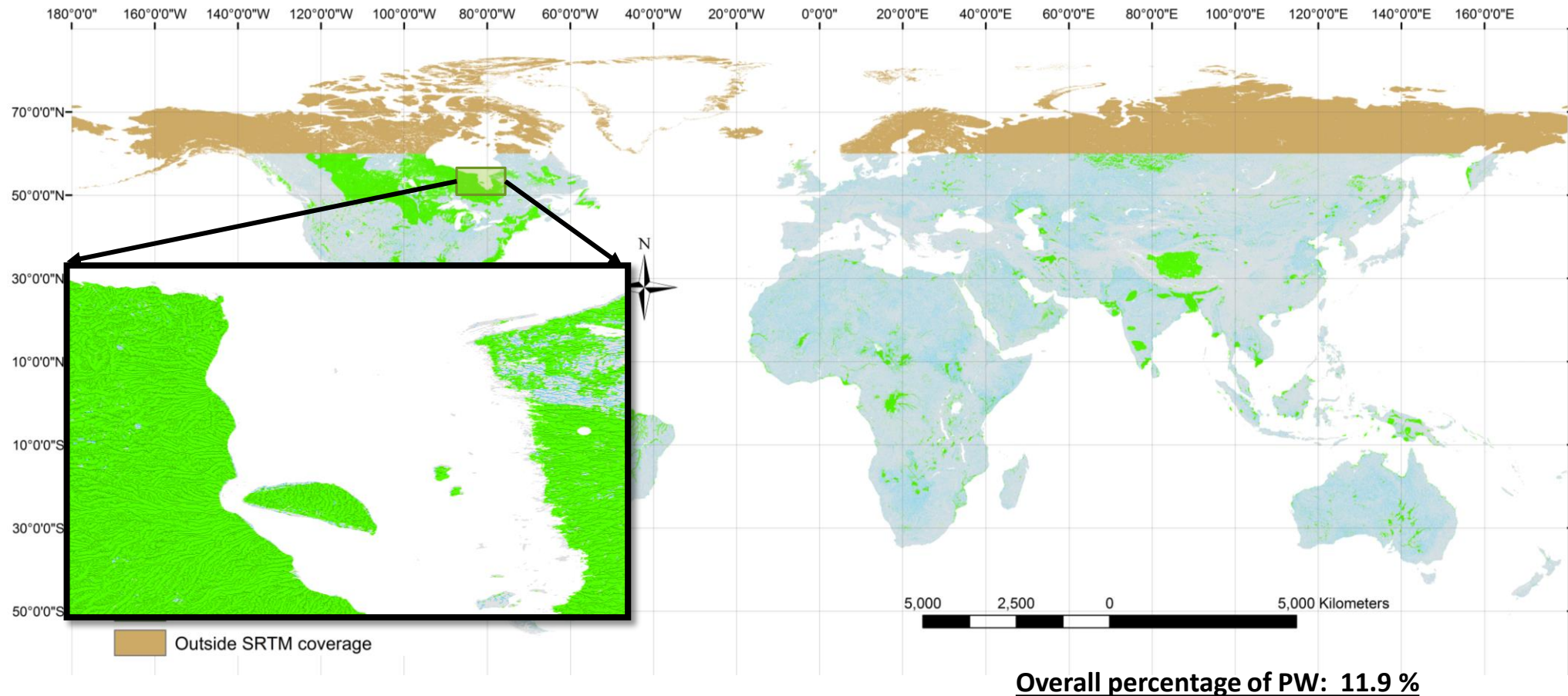
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Tests in the global scale

- Delineation using Topographic index $TI = \ln\left(\frac{a}{\tan(\beta)}\right)$

TI

Wet

Not wet

GLWD

Wetland

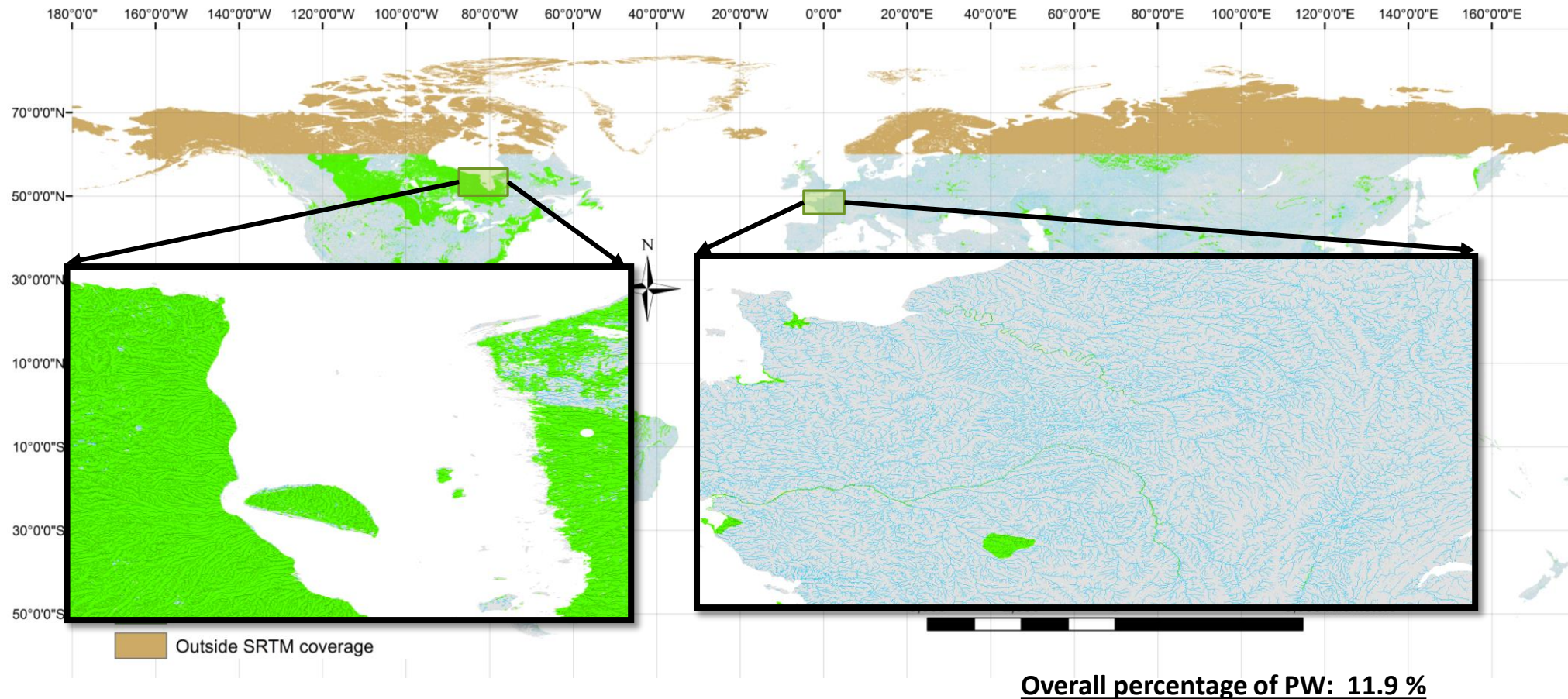
Not wetland

1.5 %

10.4 %

7.6 %

80.5 %



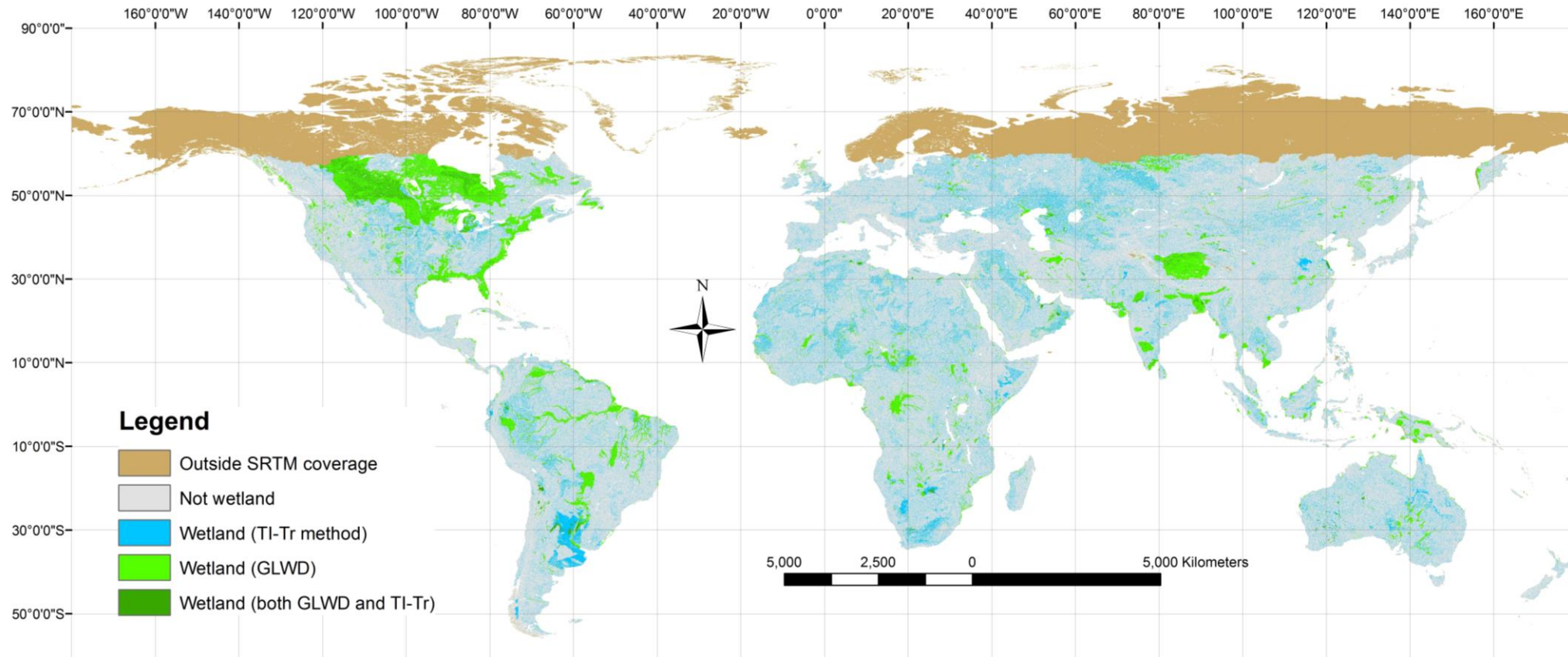
Data: HydroSHEDS 15 arcseconds (460 m)

Tests in the global scale

■ Delineation using TI-Tr

$$TI_{tr} = \ln \left(\frac{a}{T \cdot \tan(\beta)} \right)$$

GLWD	
Wetland	Not wetland
2.1 %	15.7 %
7 %	75.2 %



Data: HydroSHEDS 15 arcseconds (460 m)
Transmissivity (Gleeson et al. 2014)

Overall percentage of PW: 17.8 %

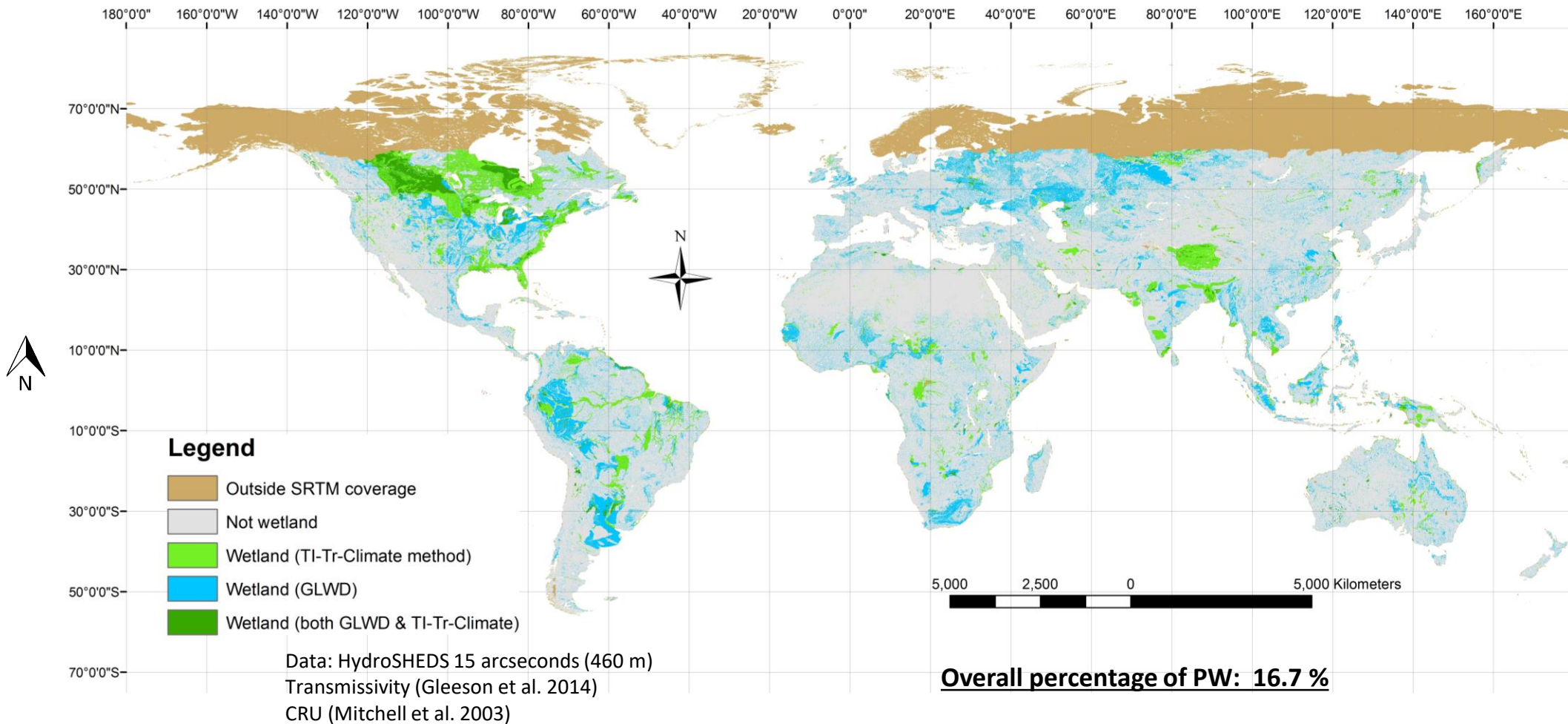
Tests in the global scale

■ Delineation using TI-Tr-Climate

V_r is the accumulated effective rainfall upstream

$$TI_{Tr-Climate} = \ln \left(\frac{V_r}{T \cdot \tan(\beta)} \right)$$

GLWD	
Wetland	Not wetland
Wet	2.5 %
Not wet	6.6 %
	14.2 %
	76.7 %

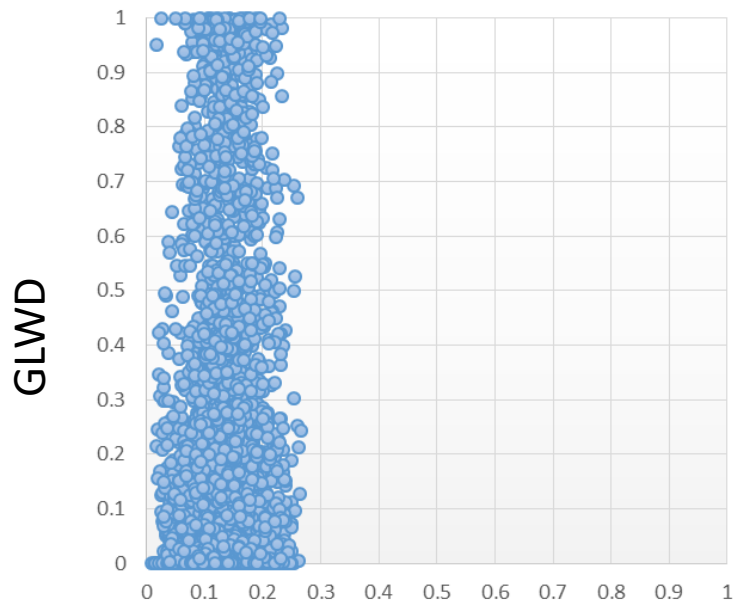


Tests in the global scale

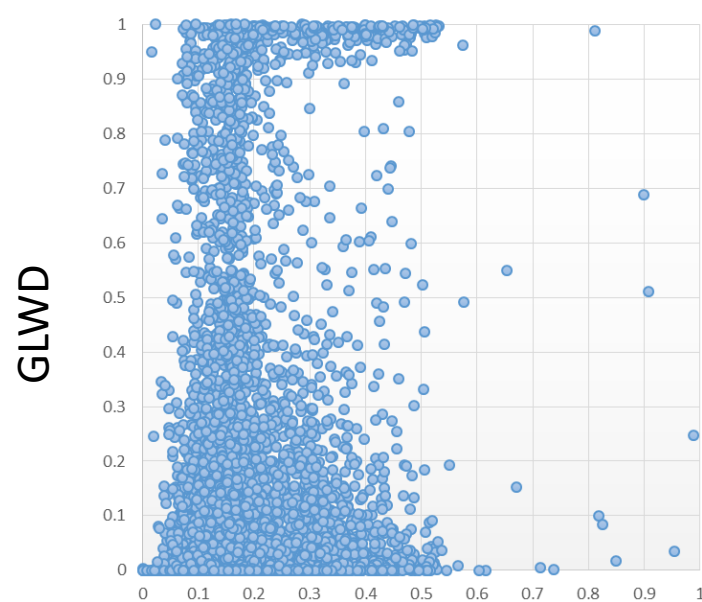
- Delineation using Topographic index

Correlation between predicted wetland ratio and GLWD for 1°x1° cells

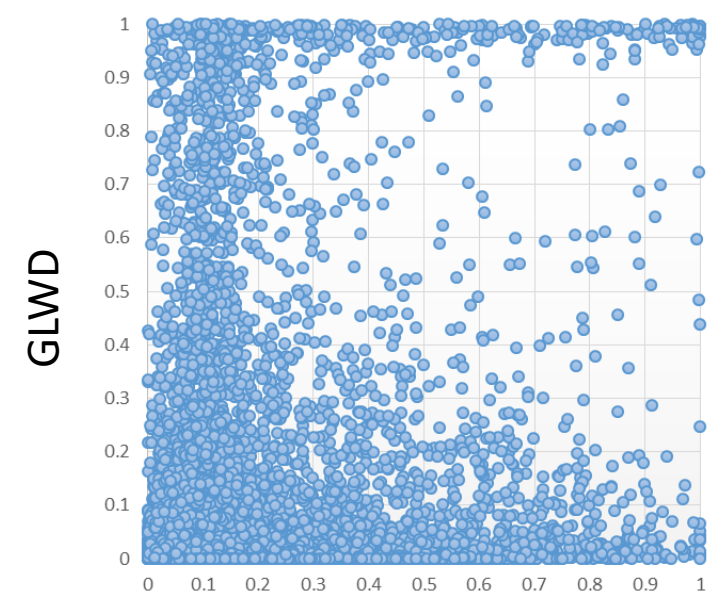
TI



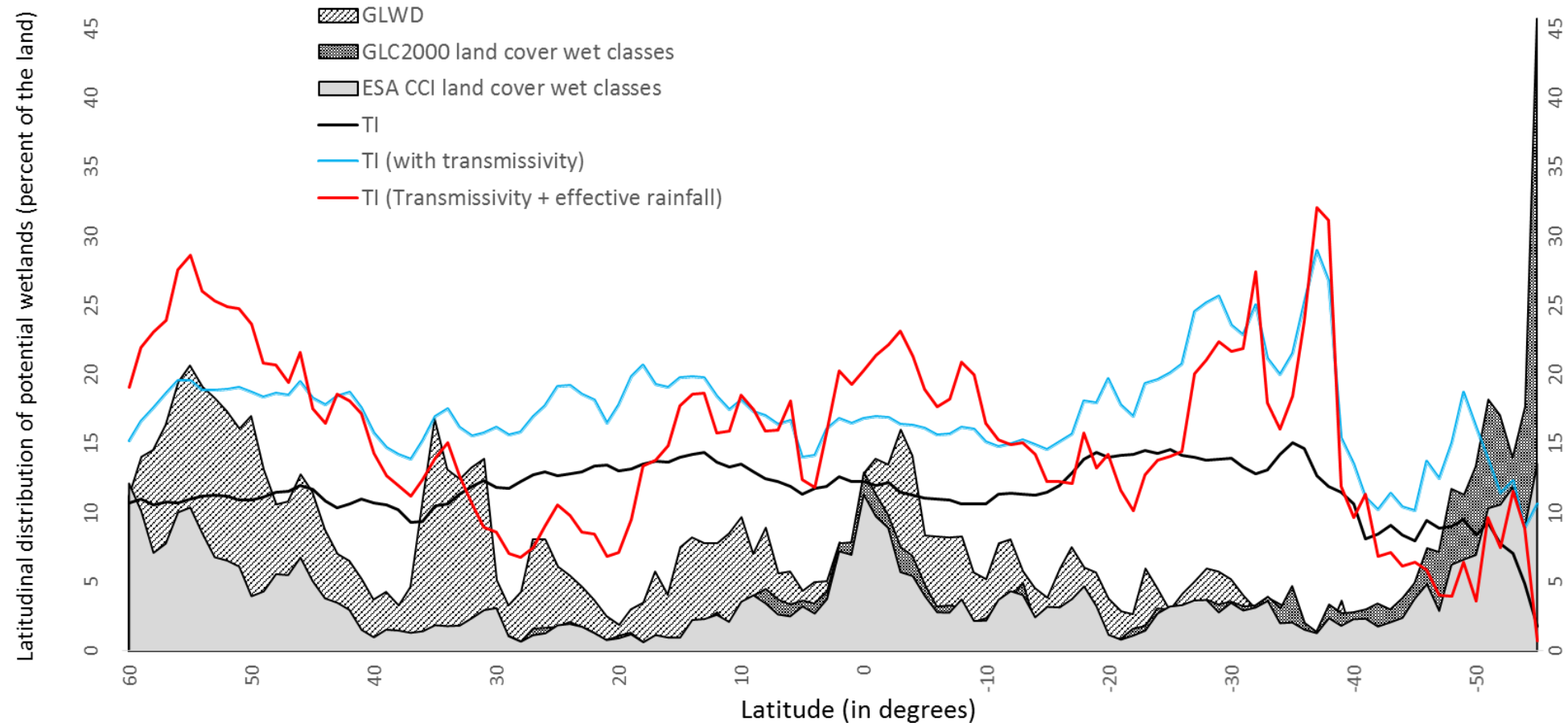
TI-Tr



TI-Tr-Climate



Discussion



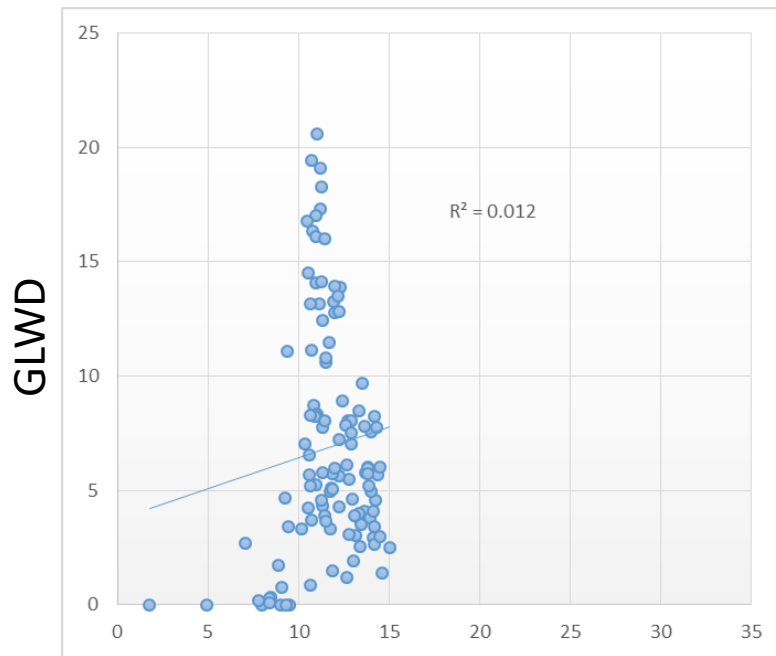
Percent of world's land between latitudes

Tests in the global scale

- Delineation using Topographic index

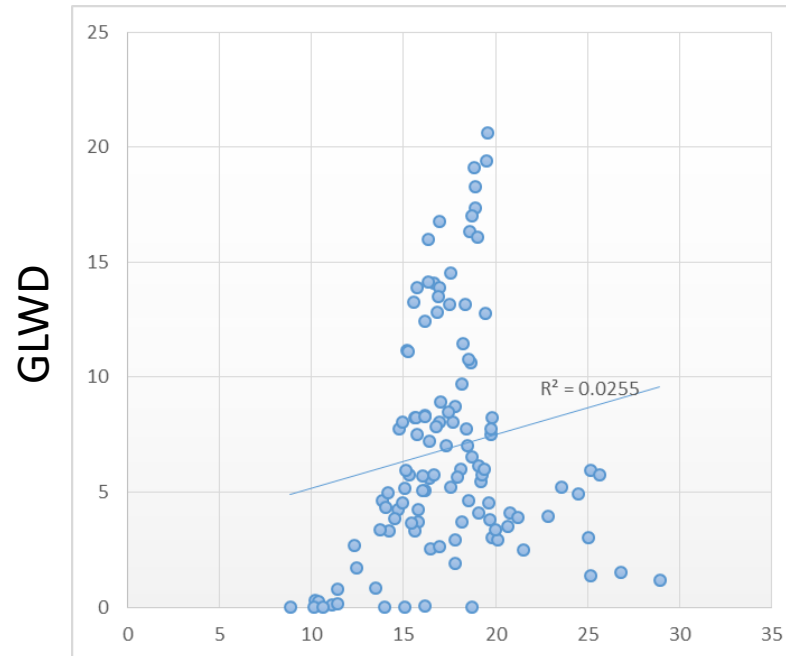
Correlation between predicted wetland percentage and GLWD in latitudinal average

TI



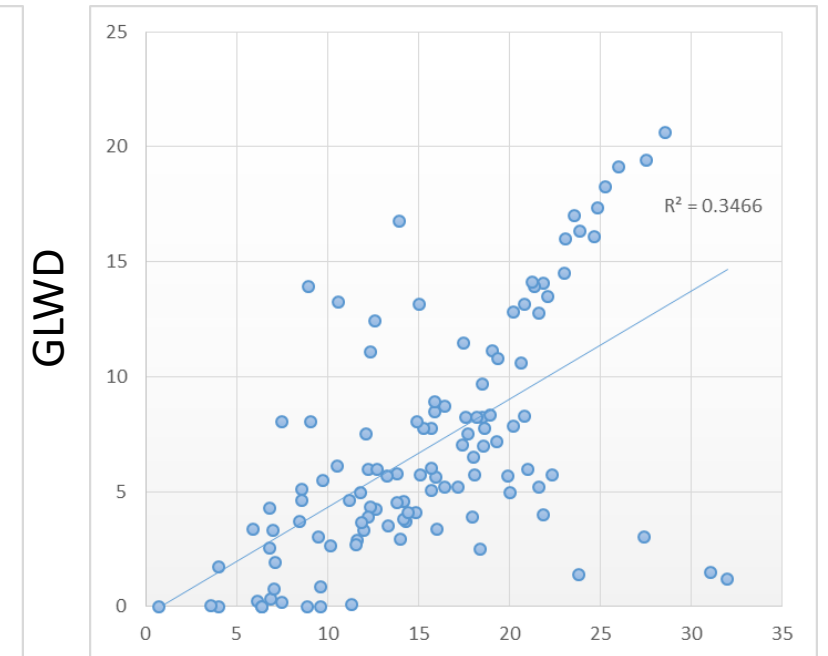
$R^2=0.012$

TI-Tr



$R^2=0.025$

TI-Tr-Climate



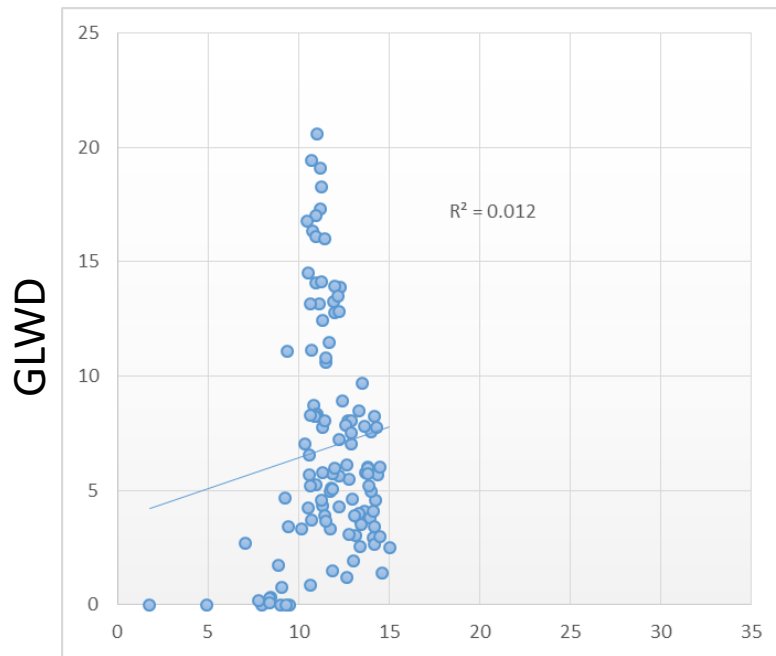
$R^2=0.35$

Tests in the global scale

- Delineation using Topographic index

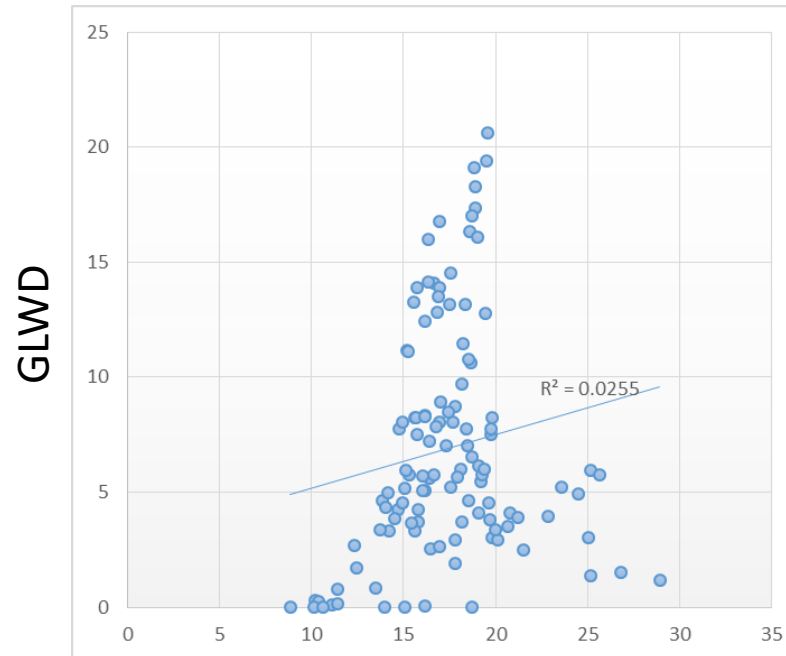
Correlation between predicted wetland percentage and GLWD in latitudinal average

TI



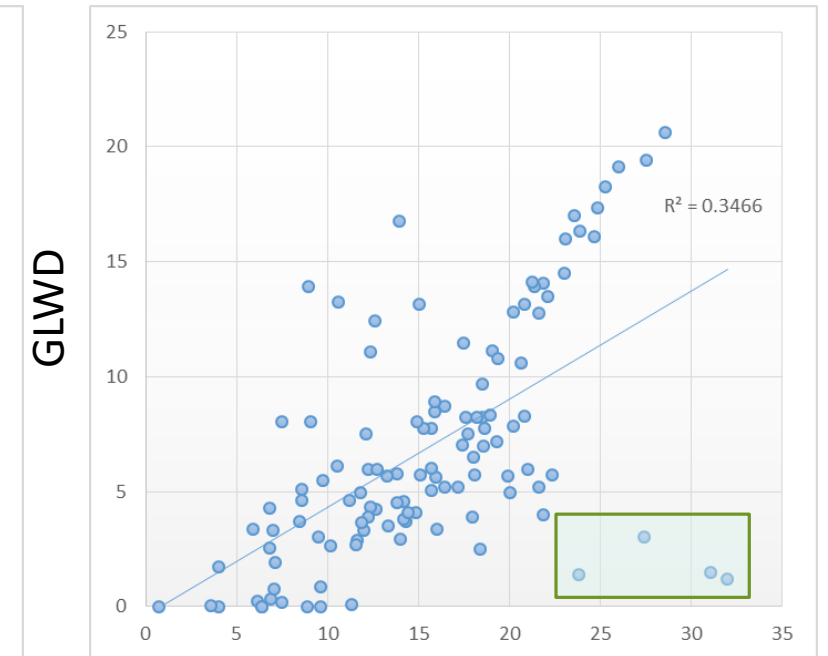
$R^2=0.012$

TI-Tr



$R^2=0.025$

TI-Tr-Climate



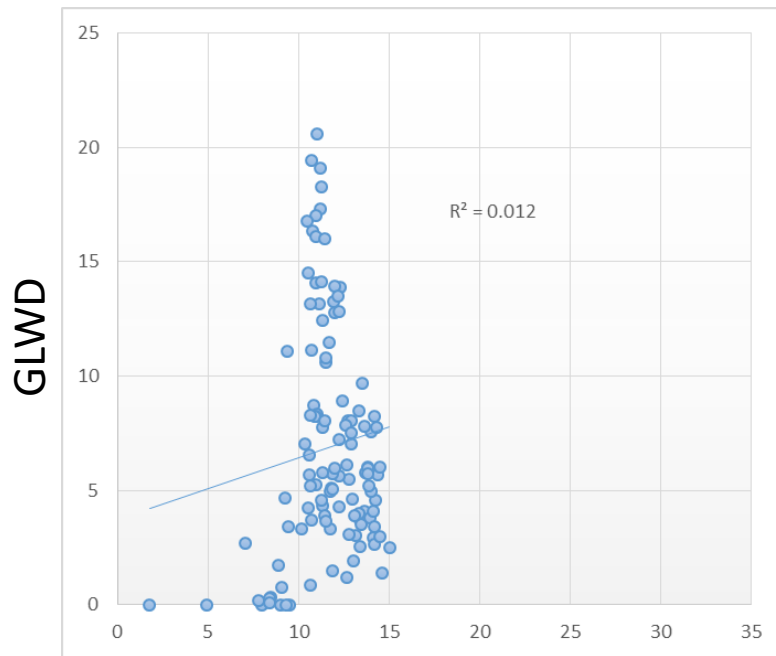
$R^2=0.35$

Tests in the global scale

- Delineation using Topographic index

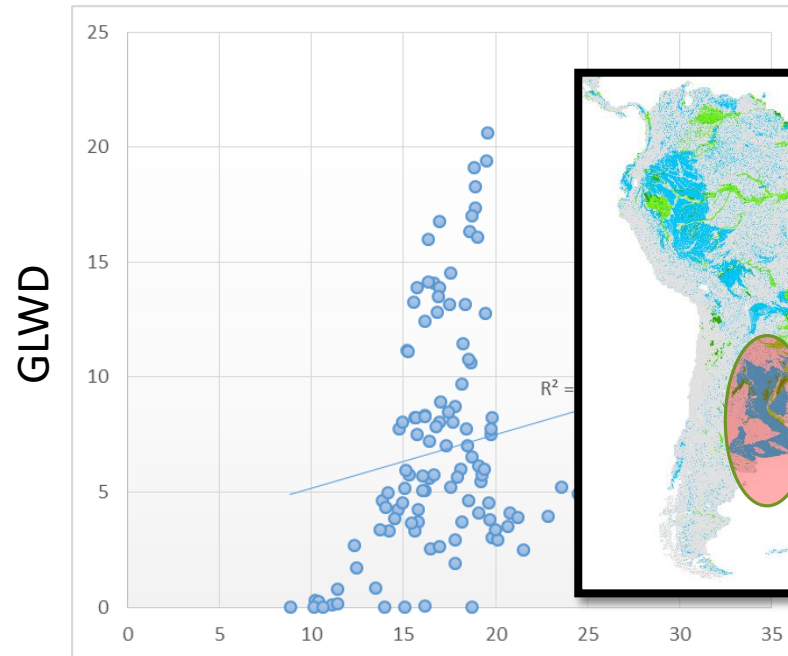
Correlation between predicted wetland percentage and GLWD in latitudinal average

TI



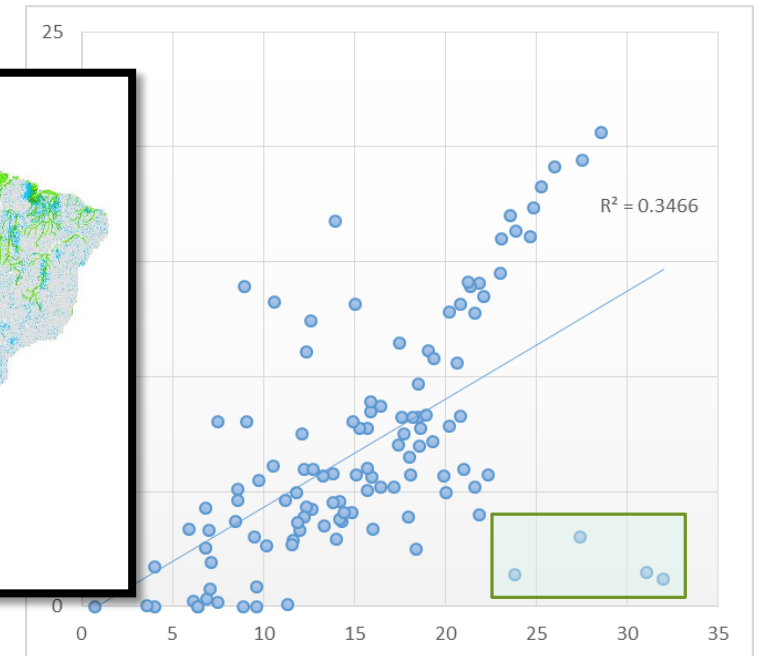
$R^2=0.012$

TI-Tr



$R^2=0.025$

TI-Tr-Climate

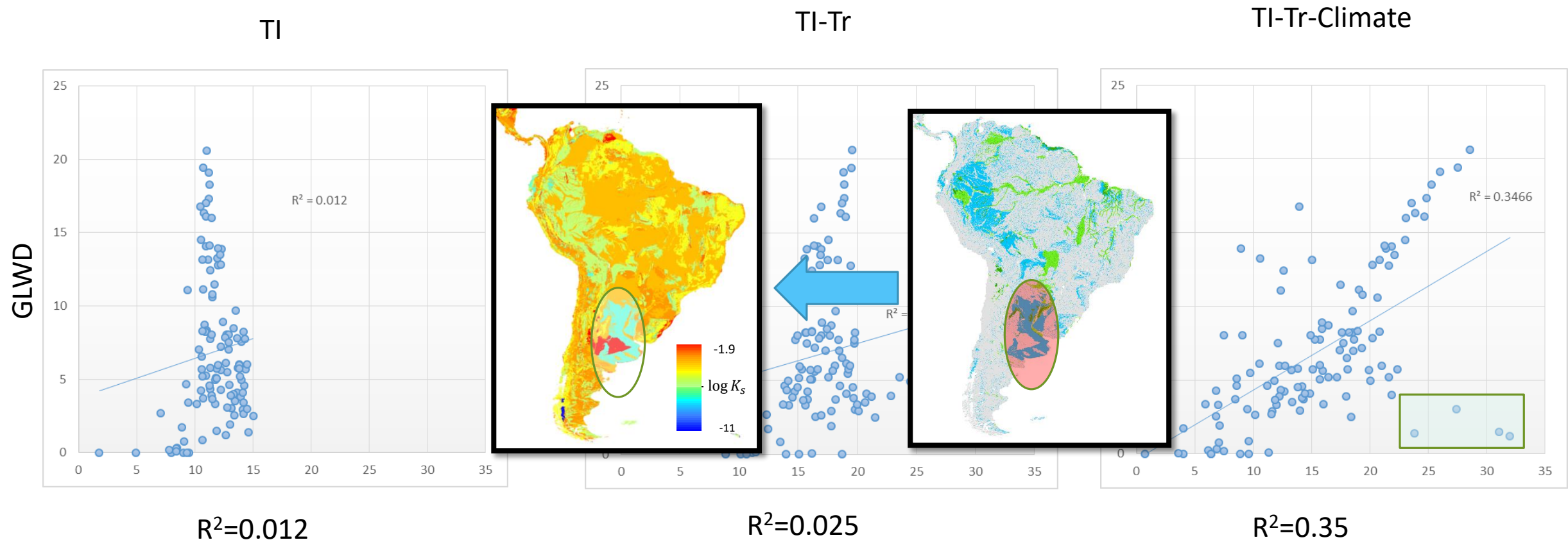


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Tests in the global scale

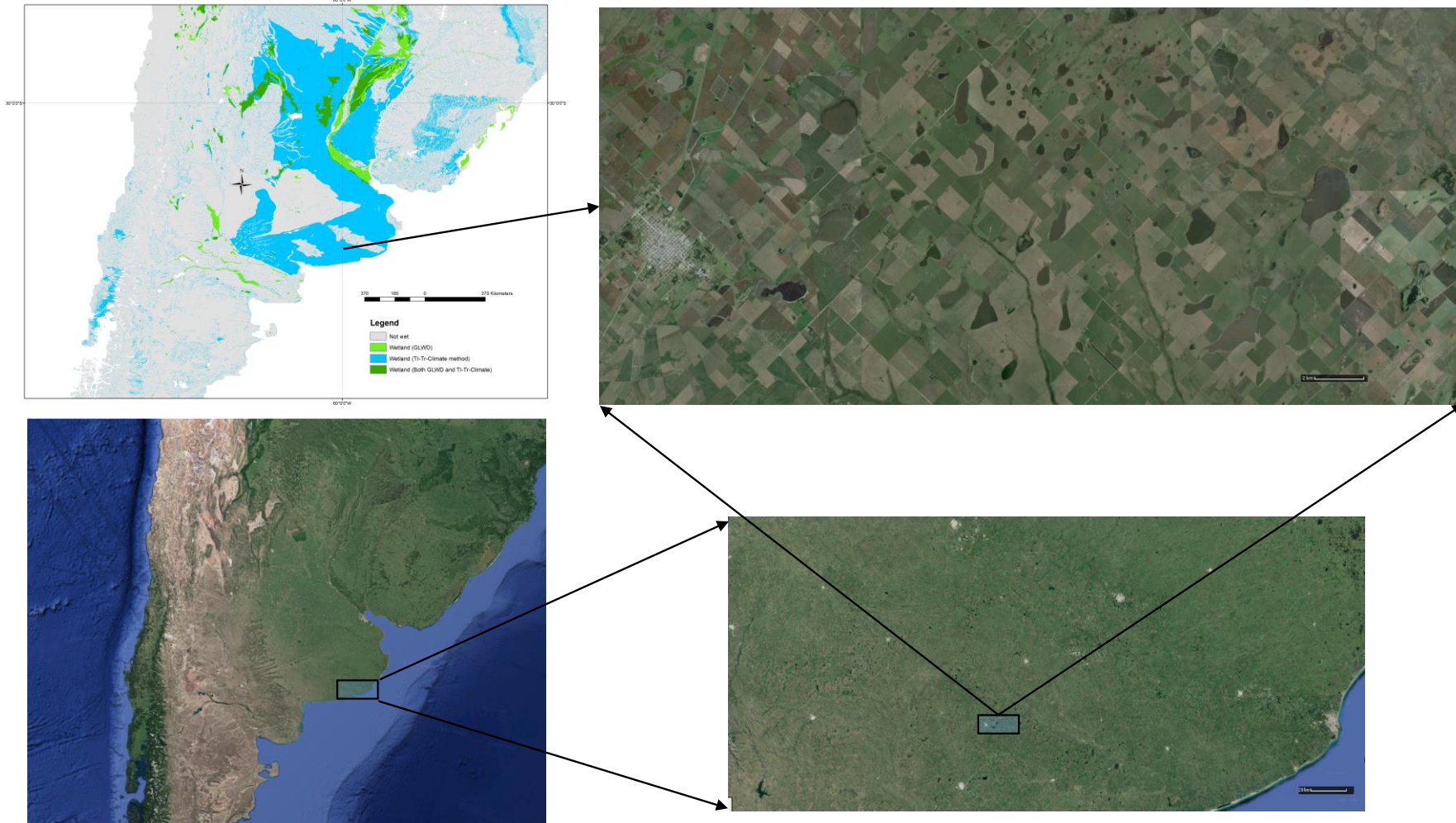
- Delineation using Topographic index

Correlation between predicted wetland percentage and GLWD in latitudinal average



Tests in the global scale

- Delineation using Topographic index



Tests in the global scale

- Delineation using Topographic index
 - In addition we tested the USDA soil texture for transmissivity calculation

		GLWD		
		Wetland	Not wetland	
TI + Transmissivity USDA: Carsel & Parrish (1988)	Wet	1.5 %	13.1 %	GT
	Not wet	7.3 %	78.1 %	
TI + Transmissivity Gleeson et al. 2014	Wet	2.1 %	14.7 %	
	Not wet	6.7 %	76.5 %	

Conclusion

- TI-Tr-Climate: better correlation with observed wetlands
- One definition of wetlands globally
- Ability to detect small wetlands
- Terrain analysis as a support to observation
- Transmissivity can be a dominant factor in wetlands

Thank you for your attention!

