erc

GCOS Joint Panel Meeting

21 | 04 | 2021

Satellite-based Land Evaporation: Status and Perspectives

Diego G. Miralles

Diego.Miralles@UGent.be

GHENT UNIVERSITY

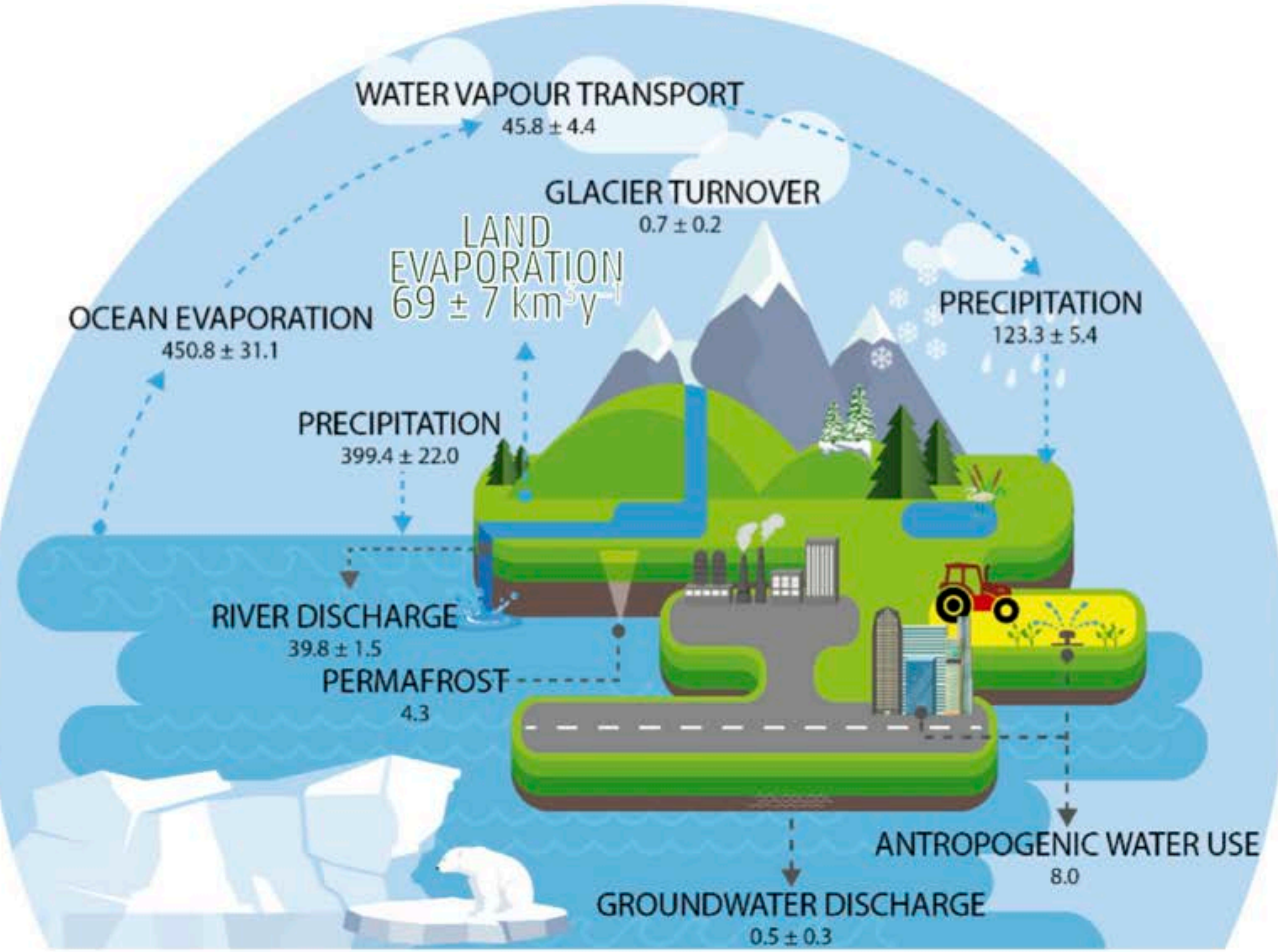
Land Evaporation ('*ET*')

Necessary

1. Climate change diagnosis
2. Hydrometeorology events
3. Water management
4. Agriculture & food security

Poorly understood

1. Scarcity of global measurements
2. Difficult to model
3. 'Invisible': not directly observed from space



Dorigo *et al.* (2021)

Available EO Datasets

Land Evaporation ('*ET*')

Not observable | Alternative:

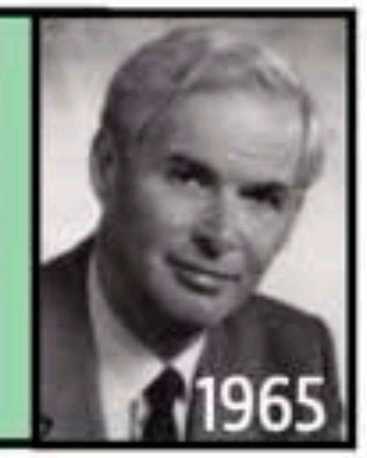
To combine observable drivers

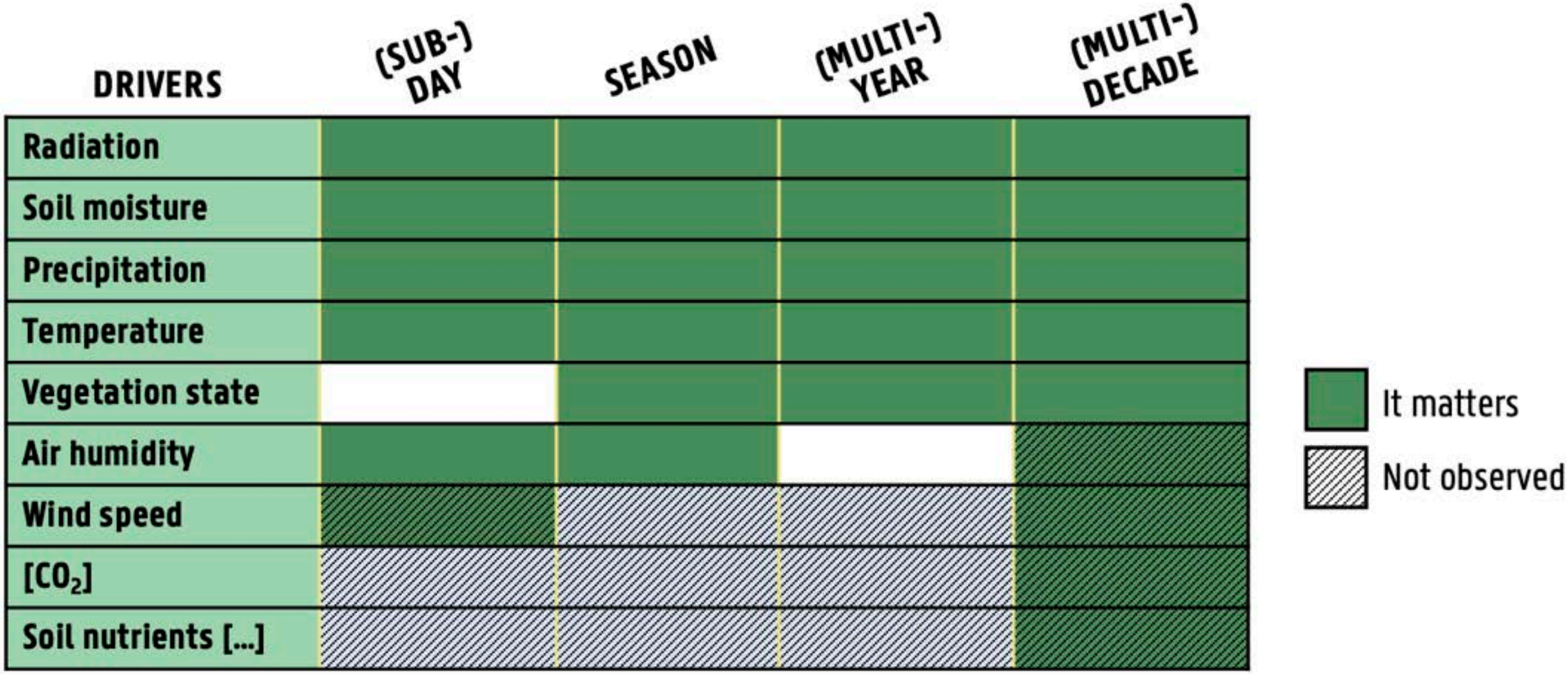
Diagnostic regional models

$\lambda E = f$ (LST, NDVI, etc.)

Prognostic global models

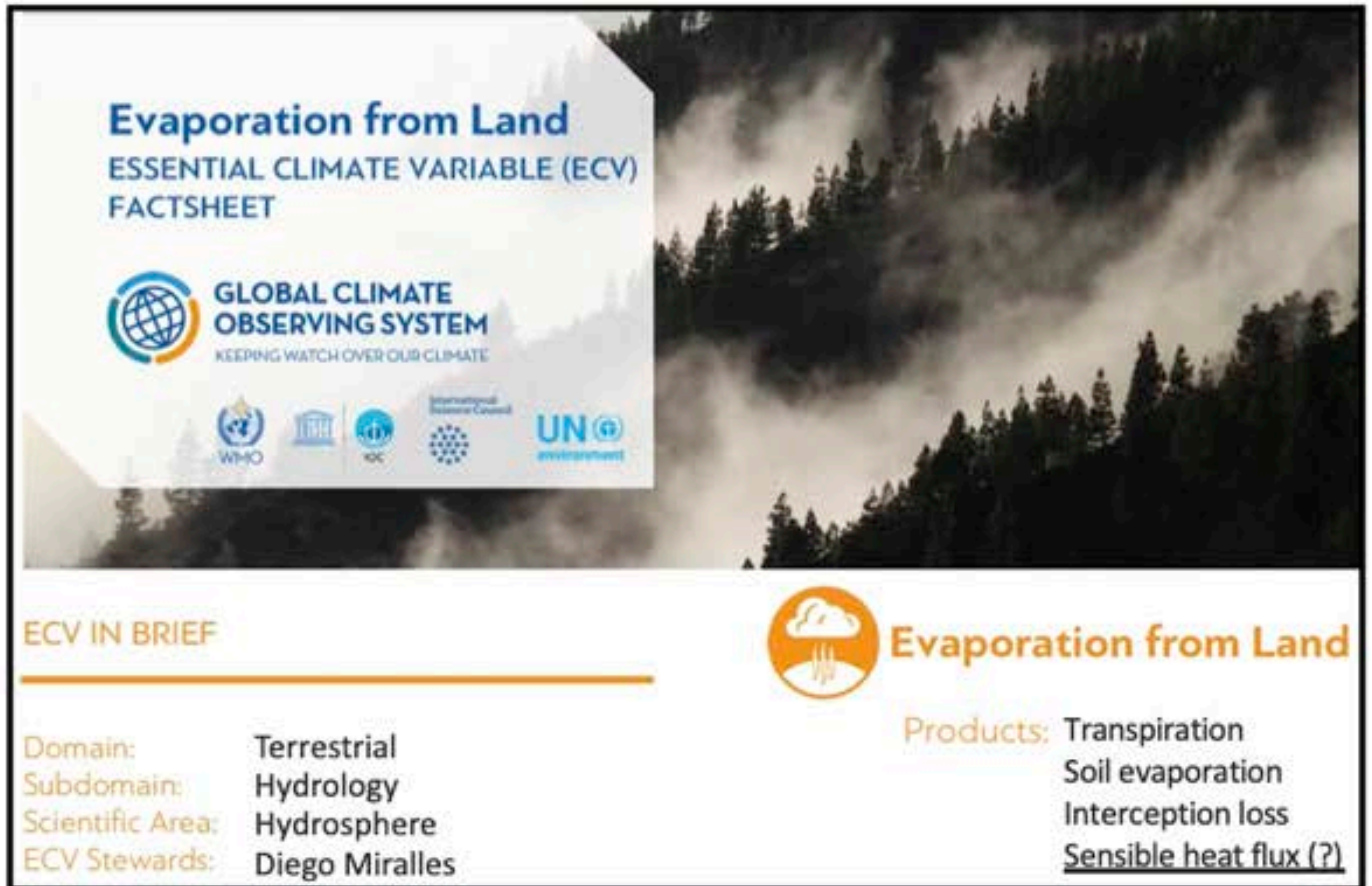
$$\lambda E = \frac{\Delta (R_n - G) + \frac{\rho \, c_p}{r_a} (e^* - e)}{\Delta + \gamma \left(1 + \frac{r_s}{r_a}\right)}$$





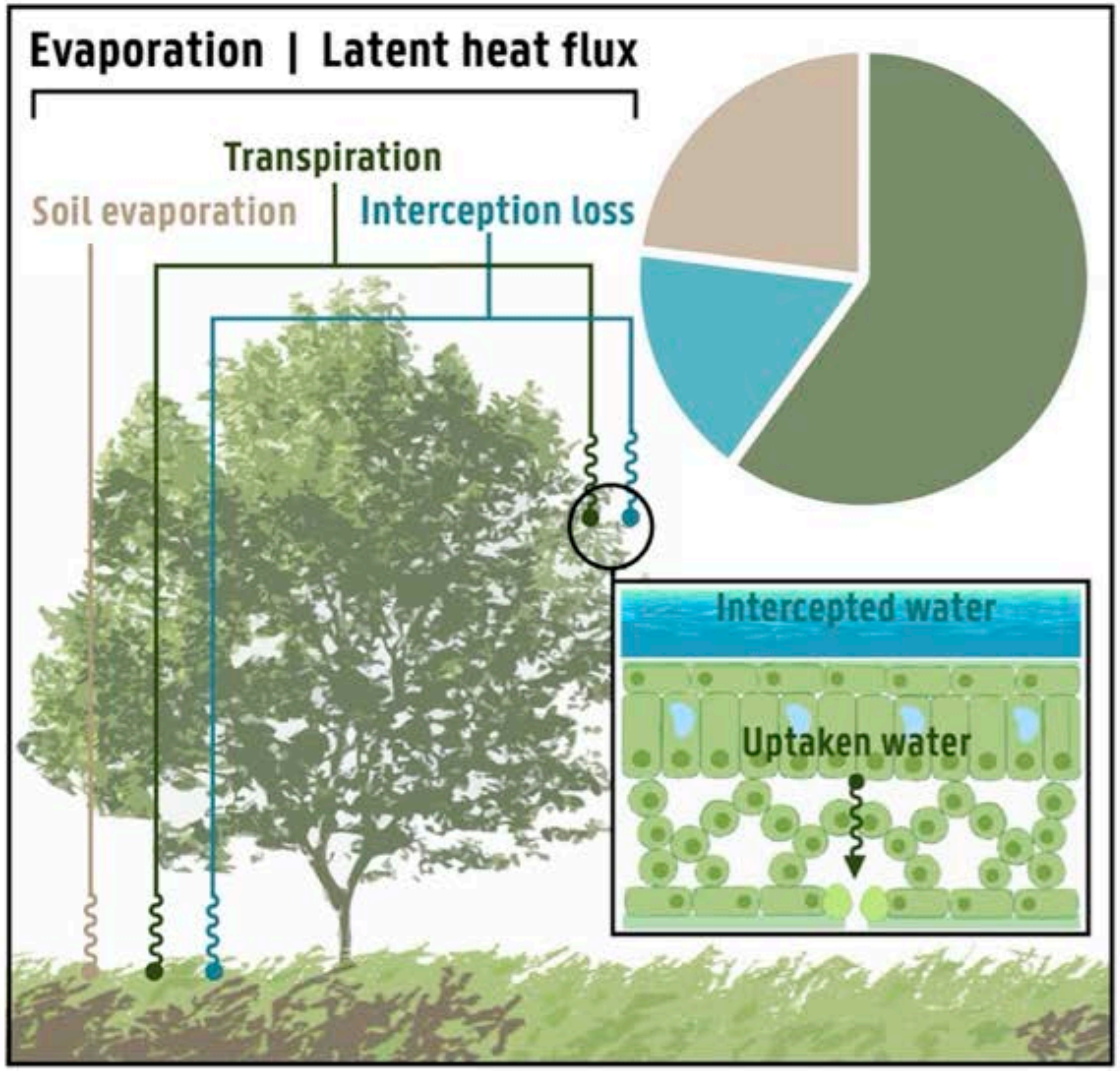
✉ Diego.Miralles@UGent.be

Land Evaporation ('*ET*')



ECV Criteria

1. Relevance: Critical for the climate system.
2. Cost effectiveness: Archiving data is affordable.
3. Feasibility: Deriving it <u>globally</u> is feasible. [?]



Miralles *et al.* (2020)

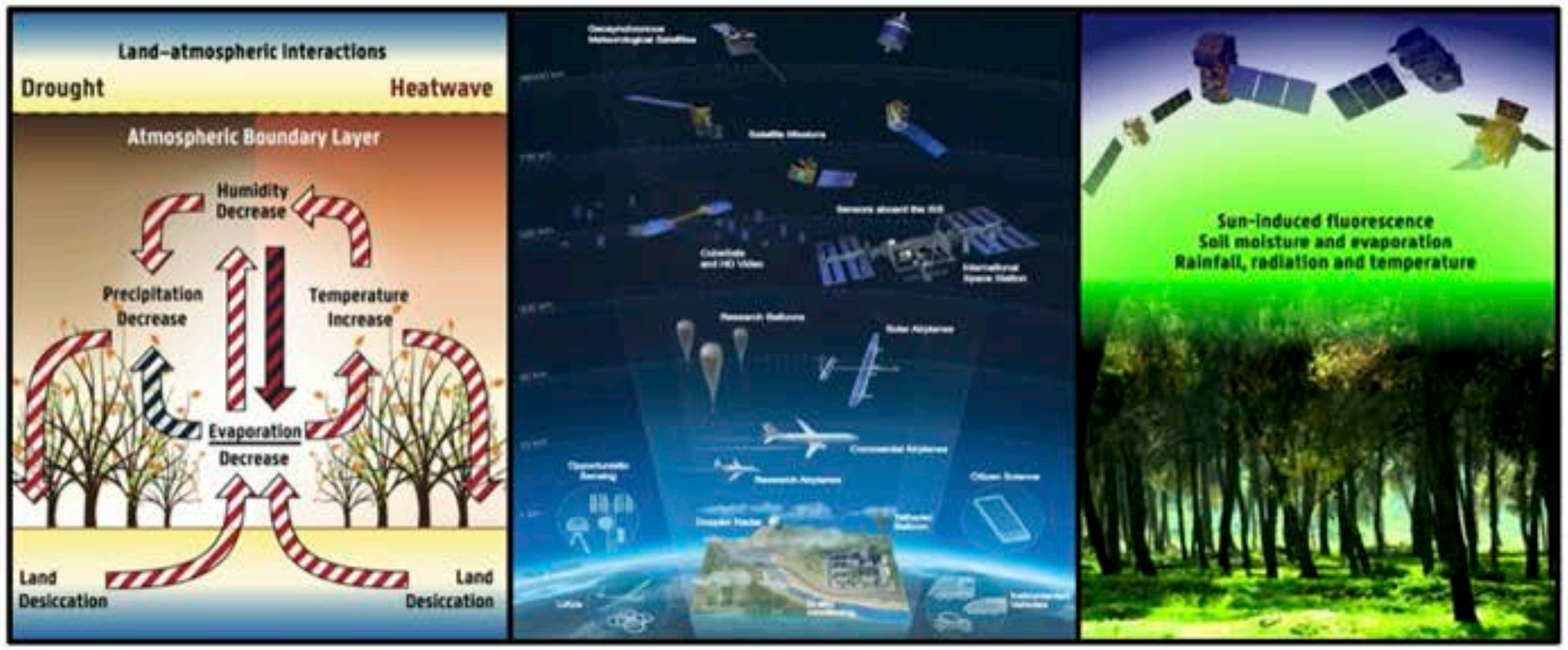
Available EO Datasets

Existing datasets (*non comprehensive*)

PT–JPL	Fisher *et al.* (2008)
PM–MOD16	Mu *et al.* (2011)
GLEAM	Miralles *et al.* (2011)
SEBS	Su *et al.* (2001)
BESS	Ryu *et al.* (2011)
FLUXCOM | MTE	Jung *et al.* (2009)
NTSG	Zhang Z. *et al.* (2010)
SSEBop	Senay *et al.* (2011)
(Dis)ALEXI	Anderson *et al.* (2011)
PML	Zhang Y. *et al.* (2016)
ETMonitor	Hu and Jia (2015)
HOLAPS	Loew *et al.* (2016)
LSA–SAF	Ghilain *et al.* (2011)
WECANN	Alemohammad *et al.* (2017)

Commonalities & Differences

1. From process-based to statistical models
2. Different degree of reliance on reanalysis data
3. From 1 degree to 1 km and monthly to sub-daily
4. Continental to global coverage
5. Longest records starting in the '80s



AGU PUBLICATIONS

Water Resources Research

The future of evapotranspiration: Global requirements for ecosystem functioning, carbon and climate feedbacks, agricultural management, and water resources

Joshua B. Fisher[1], Forrest Melton[2], Elizabeth Middleton[3], Christopher Hain[4,5], Martha Anderson[6], Richard Allen[7], Matthew F. McCabe[8], Simon Hook[1], Dennis Baldocchi[9], Philip A. Townsend[10], Ayse Kilic[11], Kevin Tu[12], Diego D. Miralles[13], Johan Perret[14], Jean-Pierre Lagouarde[15], Duane Waliser[1], Adam J. Purdy[1], Andrew French[16], David Schimel[1], James S. Famiglietti[1], Graeme Stephens[1], and Eric F. Wood[17]

Hydrol. Earth Syst. Sci., 21, 3879–3914, 2017
https://doi.org/10.5194/hess-21-3879-2017

Hydrology and Earth System Sciences
Open Access
EGU

The future of Earth observation in hydrology

Matthew F. McCabe[1], Matthew Rodell[2], Douglas E. Alsdorf[3], Diego G. Miralles[4], Remko Uijlenhoet[5], Wolfgang Wagner[6,7], Arko Lucieer[8], Rasmus Houborg[1], Niko E. C. Verhoest[4], Trenton E. Franz[9], Jiancheng Shi[10], Huilin Gao[11], and Eric F. Wood[12]

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Future Perspectives

McCabe *et al.* (2017)

Targets & Goals

1. Target <u>accuracy <10%</u> | now trends (.56±.3 mm y^{-2})
2. More accurate partitioning (<u>interception loss</u>)
3. Better representation of <u>water stress</u>
4. Resolve snow and ice <u>sublimation</u> explicitly
5. Improved <u>community practice</u> (open data, reported uncertainty, common database, latency, continuity)
6. More coordinated <u>inter-comparisons</u> (WACMOS-ET)
7. Novel means to <u>validate and calibrate</u> models
8. Utilize <u>novel satellite data</u> (SIF, backscatter, LST...)
9. Target <u>res. < 1 km</u>, for agriculture & management
10. Target temporal resolution: <u>sub-daily</u>

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International Journal of Applied Earth Observations and Geoinformation 95 (2021) 102240

Contents lists available at ScienceDirect

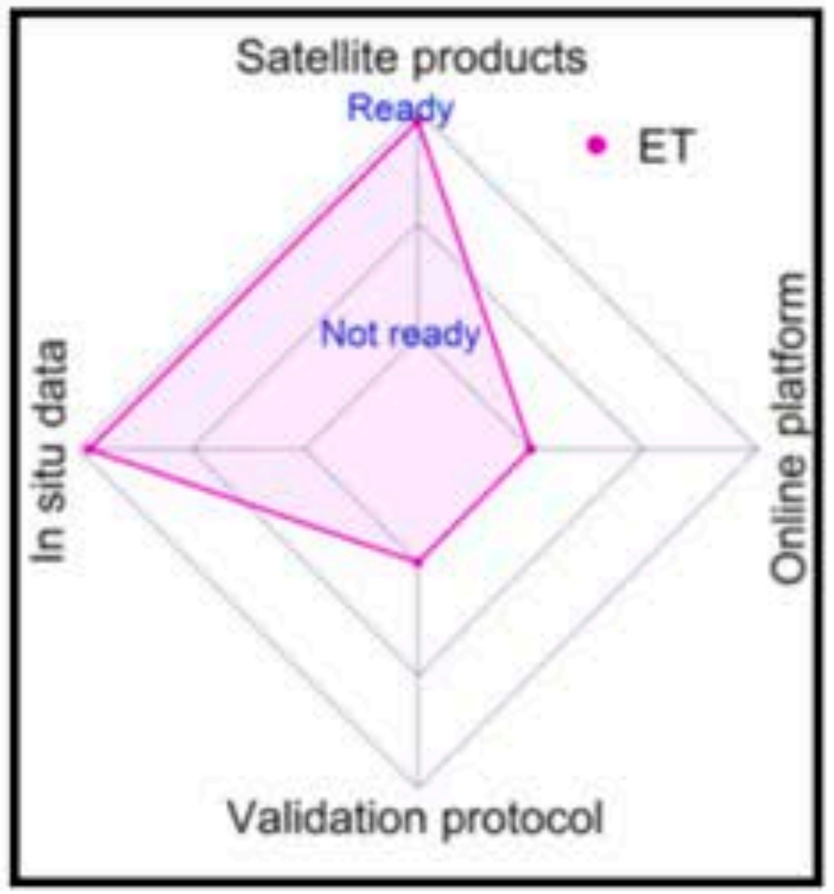
International Journal of Applied Earth Observations and Geoinformation

ELSEVIER

journal homepage: www.elsevier.com/locate/jag

Toward operational validation systems for global satellite-based terrestrial essential climate variables

'ET is at the lowest level of readiness, due to the lack of validation good practice protocol and of pilot online platform'



Bayat *et al.* (2021)

1. No quality/validation protocol
2. No common data platform
3. Few datasets regularly updated
4. Not always openly accessible
5. No reported uncertainty

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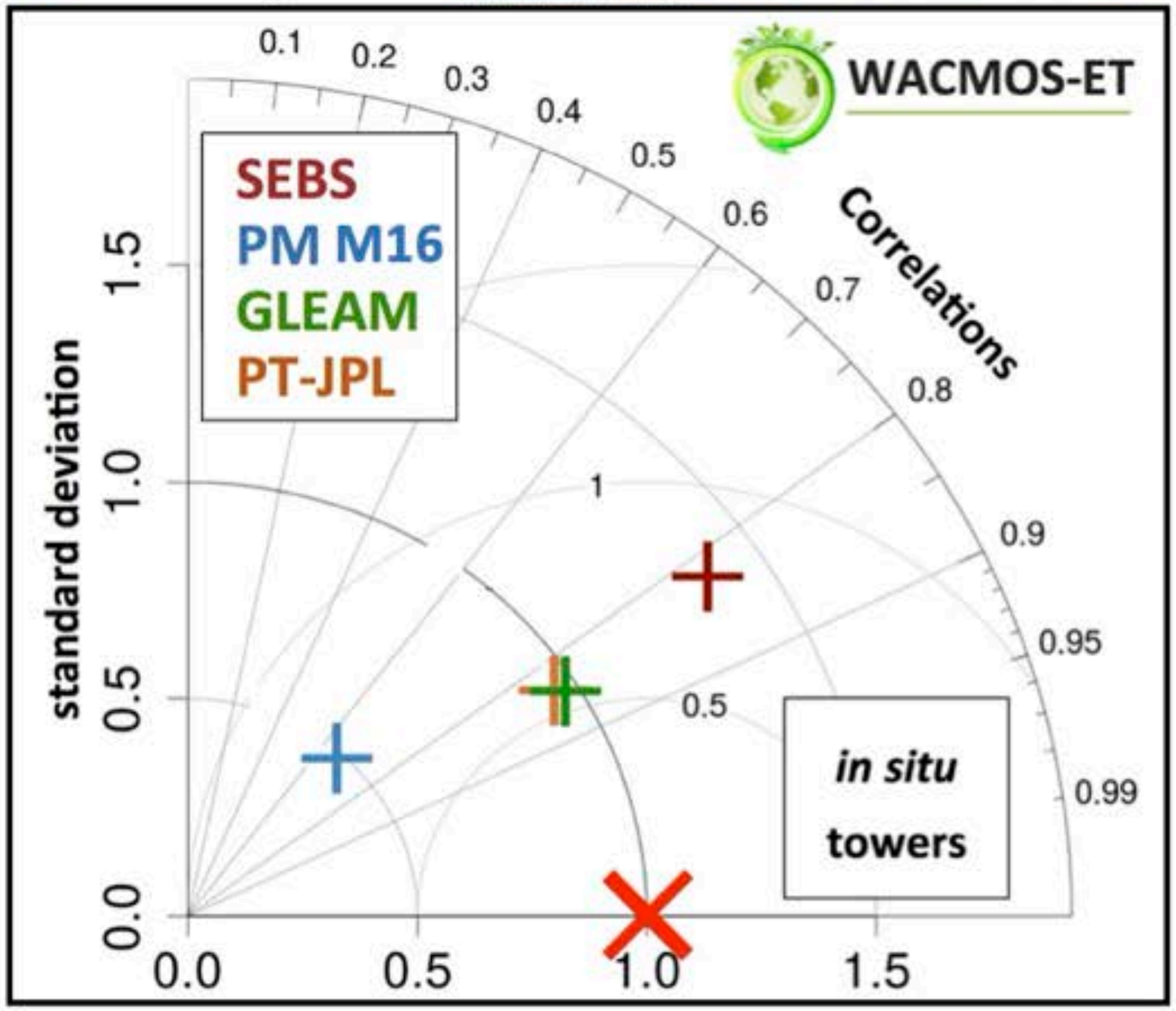
Inter-comparison initiatives

LandFLUX WACMOS-ET ileaps WATCH Water and Global Change NASA ENERGY AND WATER CYCLE STUDY NEWS



Michel *et al.* (2016)

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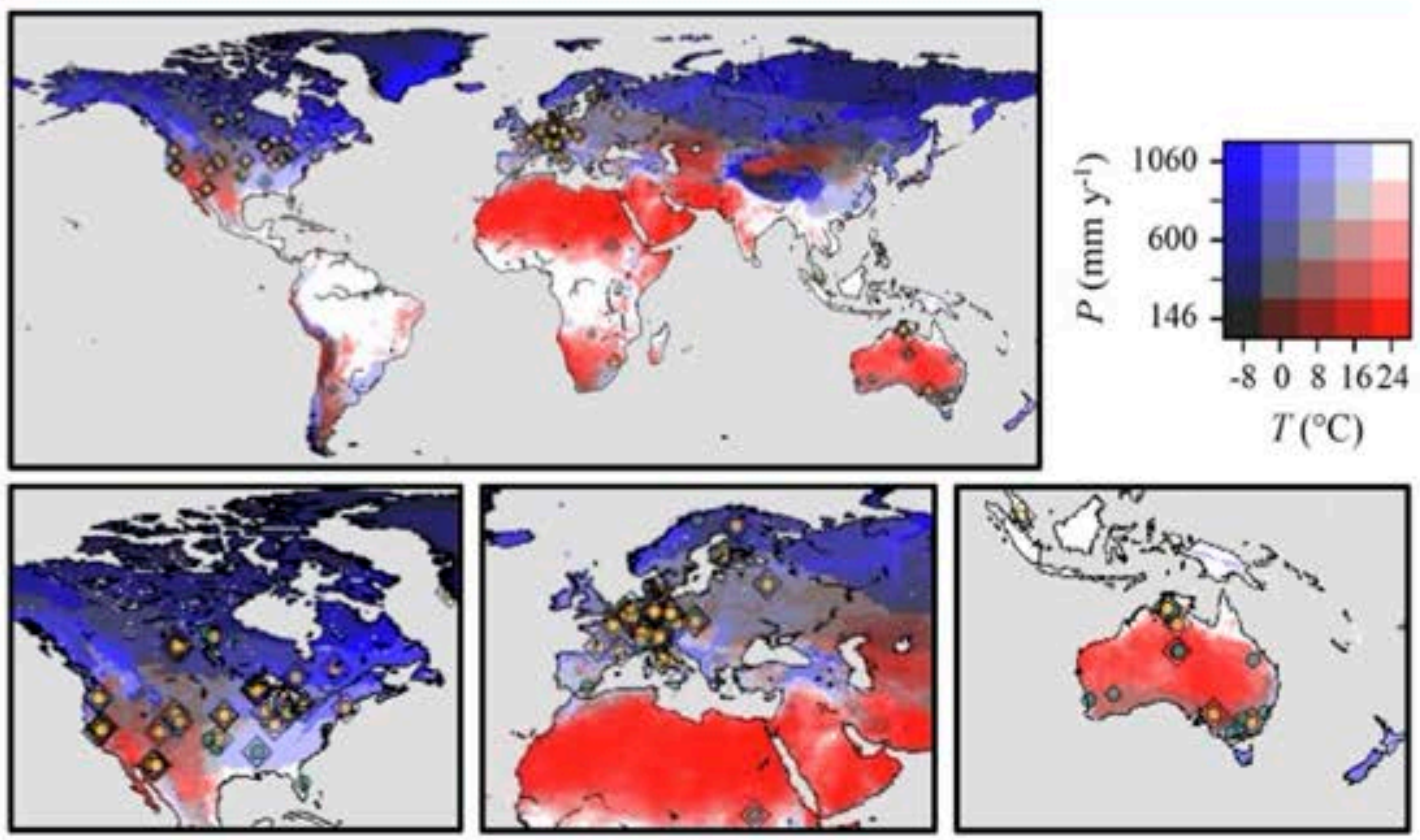
Future Perspectives

New validation data

FLUXNET A Global Network · SAPFLUXNET · TERENO · CLASS4GL · GRDC […]

1. Validation (sapflow, lysimeters, scintillometers)
2. Calibration (e.g., machine learning hybrid models)



Martens *et al.* (2020)

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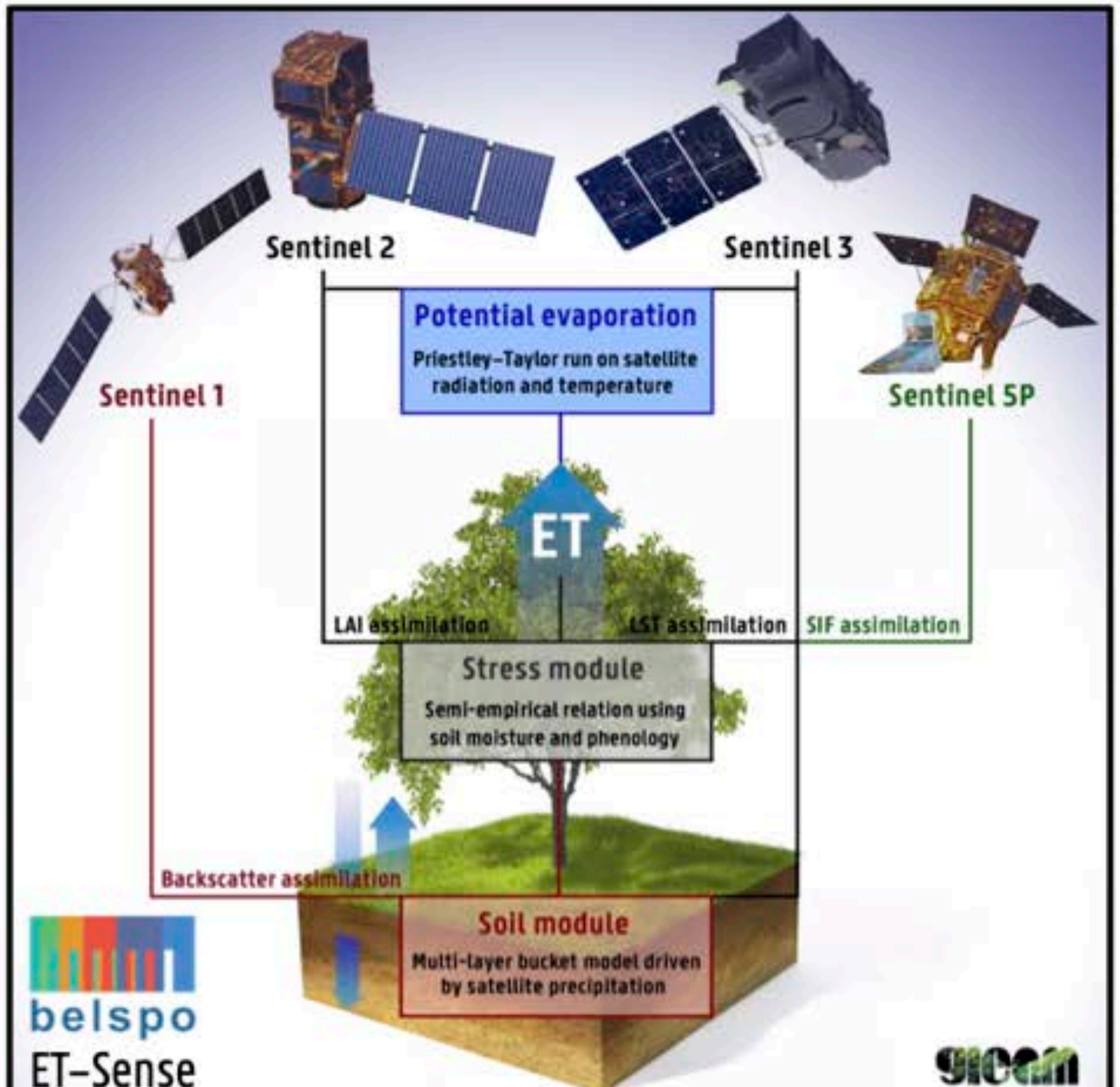
Innovative EO data

TRISHNA
LSTM
ECOSTRESS

1. New missions (e.g., ECOSTRESS, TRISHNA)
2. New use of current missions (e.g., Sentinels)



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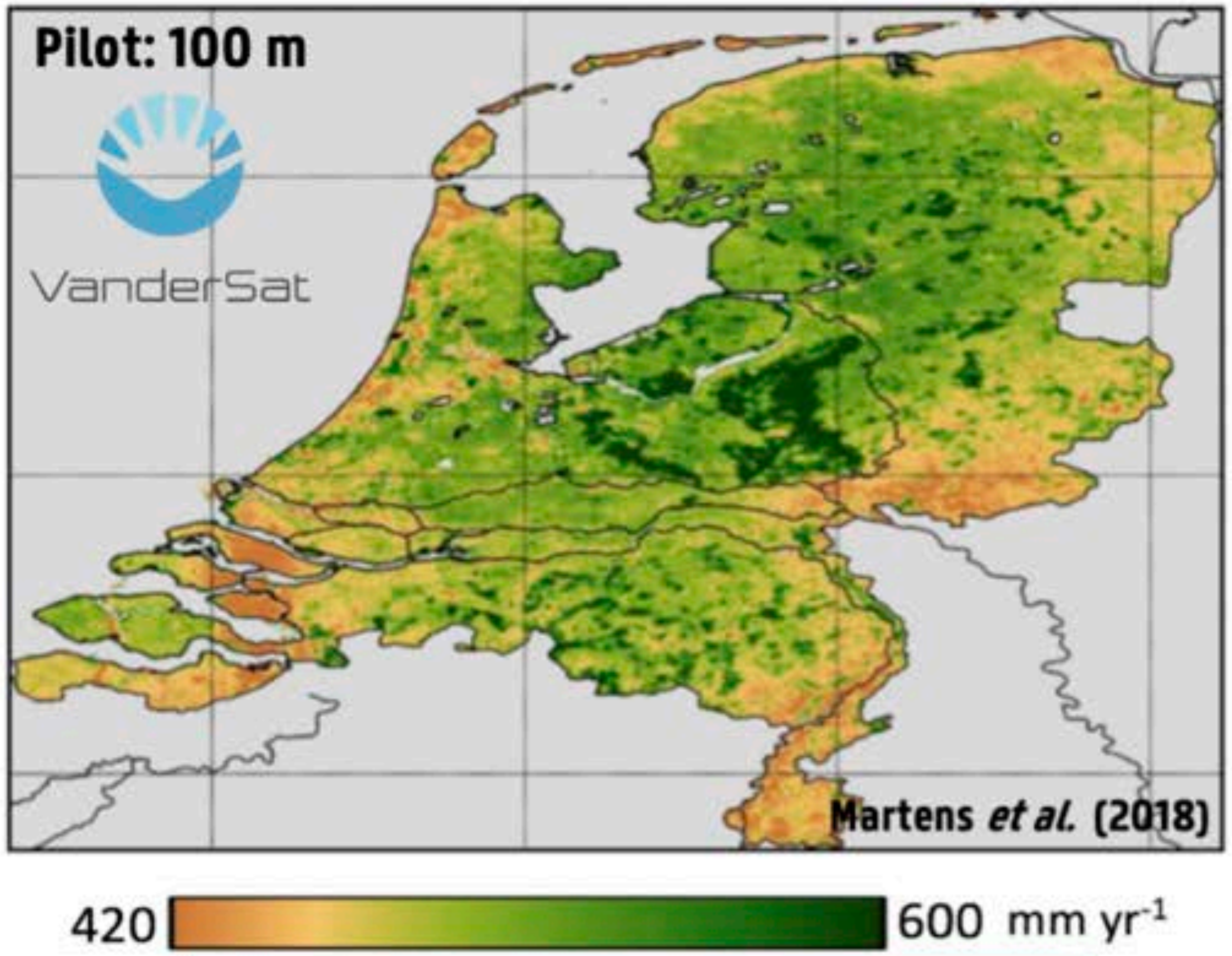
Future Perspectives

High spatial resolution global



- Climate change diagnosis
- Benchmarking climate models
- Hydroclimatic extremes
- Water management
- Agriculture & food security

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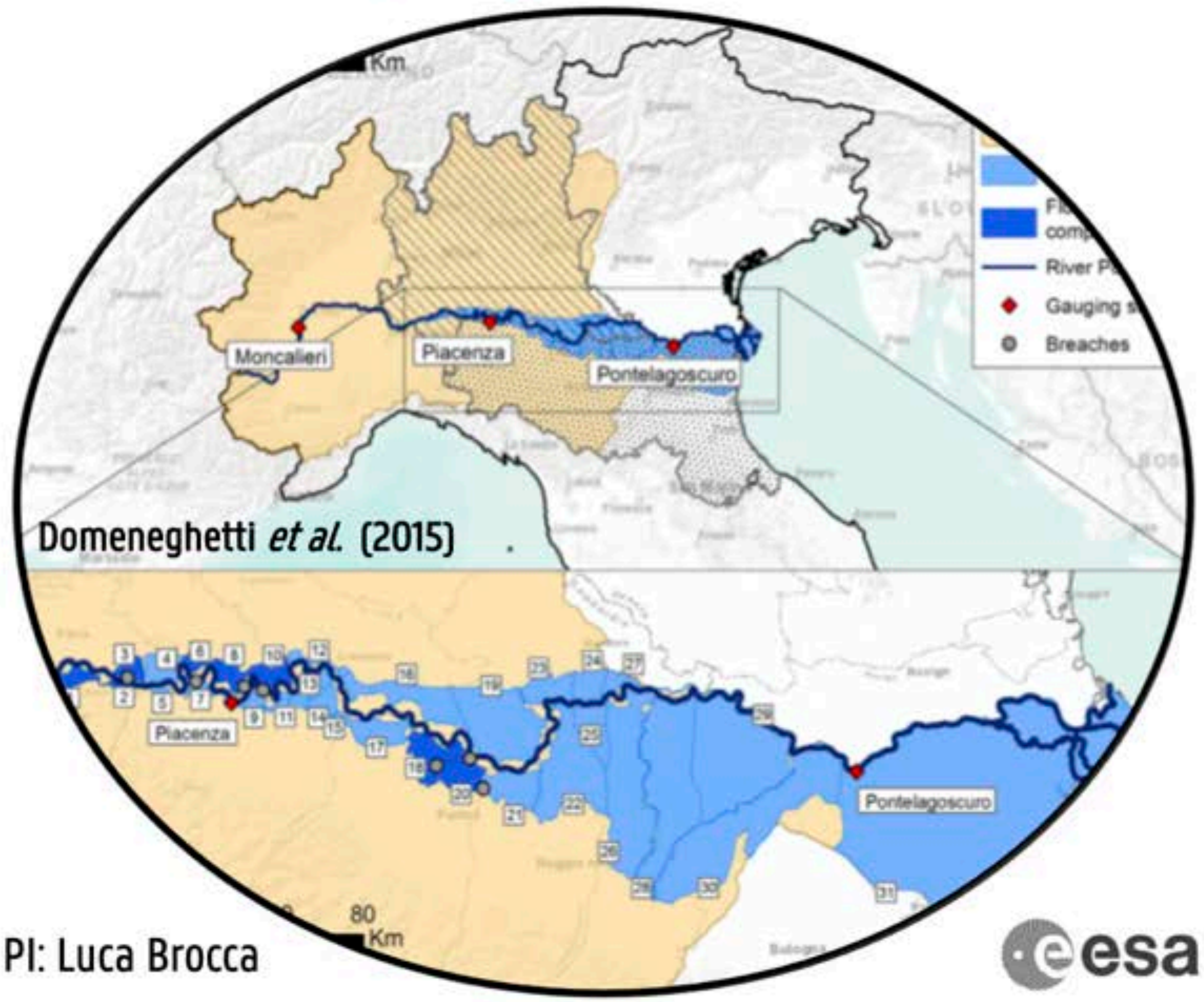
Future Perspectives

High temporal resolution global

DTE Hydrology

Prototype of Digital Twin Earth with focus on water cycle, hydrological processes and their impacts



Domeneghetti *et al.* (2015)

PI: Luca Brocca

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