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STEREO IV

HERMES

Hybrid Estimation and Remote sensing Monitoring of Evaporation & Soil moisture

Diego Miralles | Oscar Baez Villanueva | Akash Koppa | Miguel Mahecha | Maximilian Soechting | Gustau Camps-Valls | Alvaro Moreno

Ghent University

Leipzig University
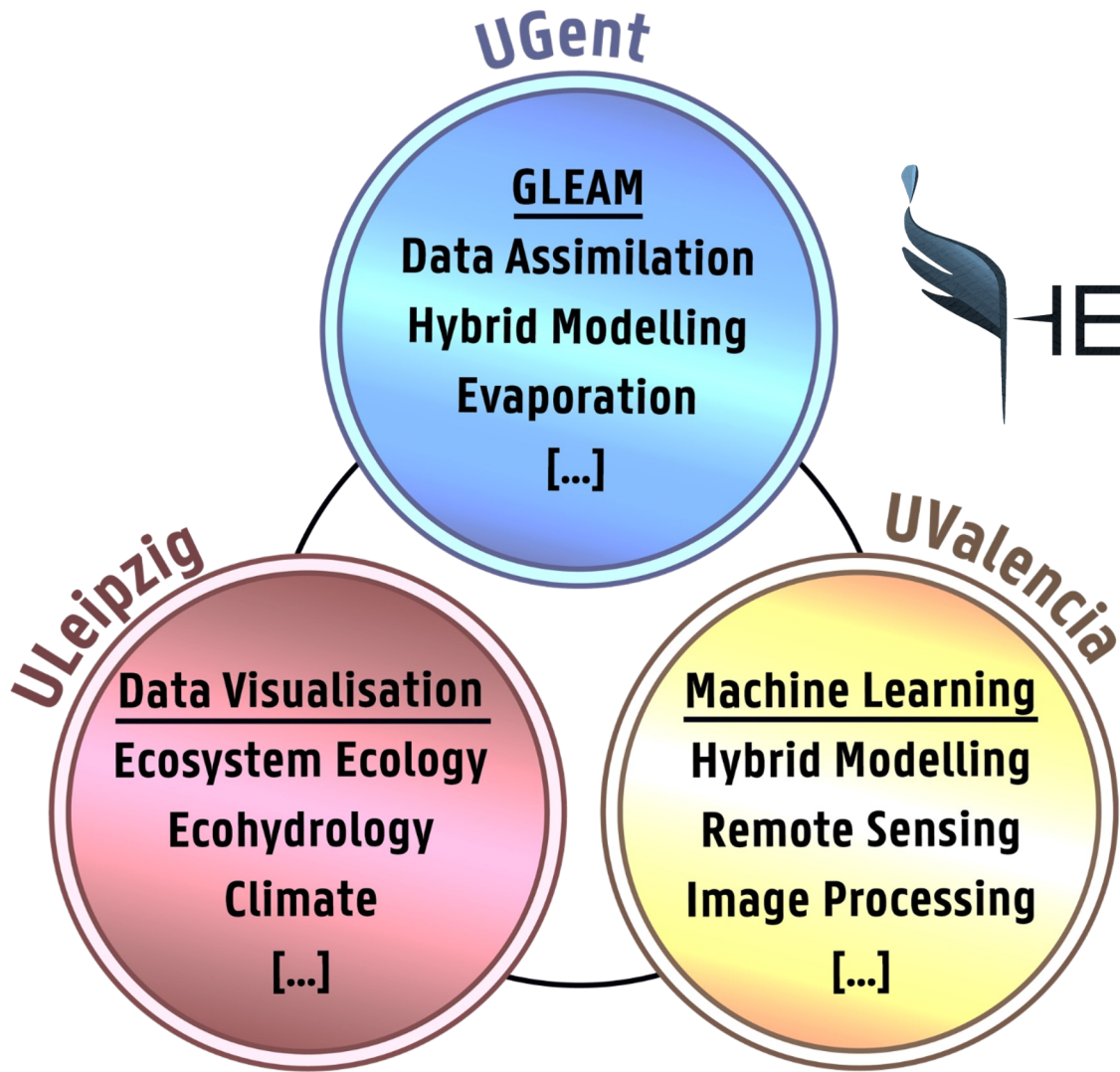
University of Valencia

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STEREO IV

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- ❖ <u>Goal</u>: Hybrid high-resolution dataset of E and SM for Africa and Europe

- ❖ <u>Framework</u>: 2.5 years | 3 partners | 1 post-doctoral scientist

- ❖ <u>Expertise</u>: Remote sensing | AI + hybrid modelling | visualization | ecohydrology

- ❖ <u>Impact</u>: Climate research | water management | agricultural science

Ghent
University

Leipzig
University

University
of Valencia

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UGent

GLEAM
Data Assimilation
Hybrid Modelling
Evaporation
[...]

ULeipzig

Data Visualisation
Ecosystem Ecology
Ecohydrology
Climate
[...]

UValencia

Machine Learning
Hybrid Modelling
Remote Sensing
Image Processing
[...]

Oscar Baez Villanueva
Diego Miralles
Akash Koppa

Miguel Mahecha
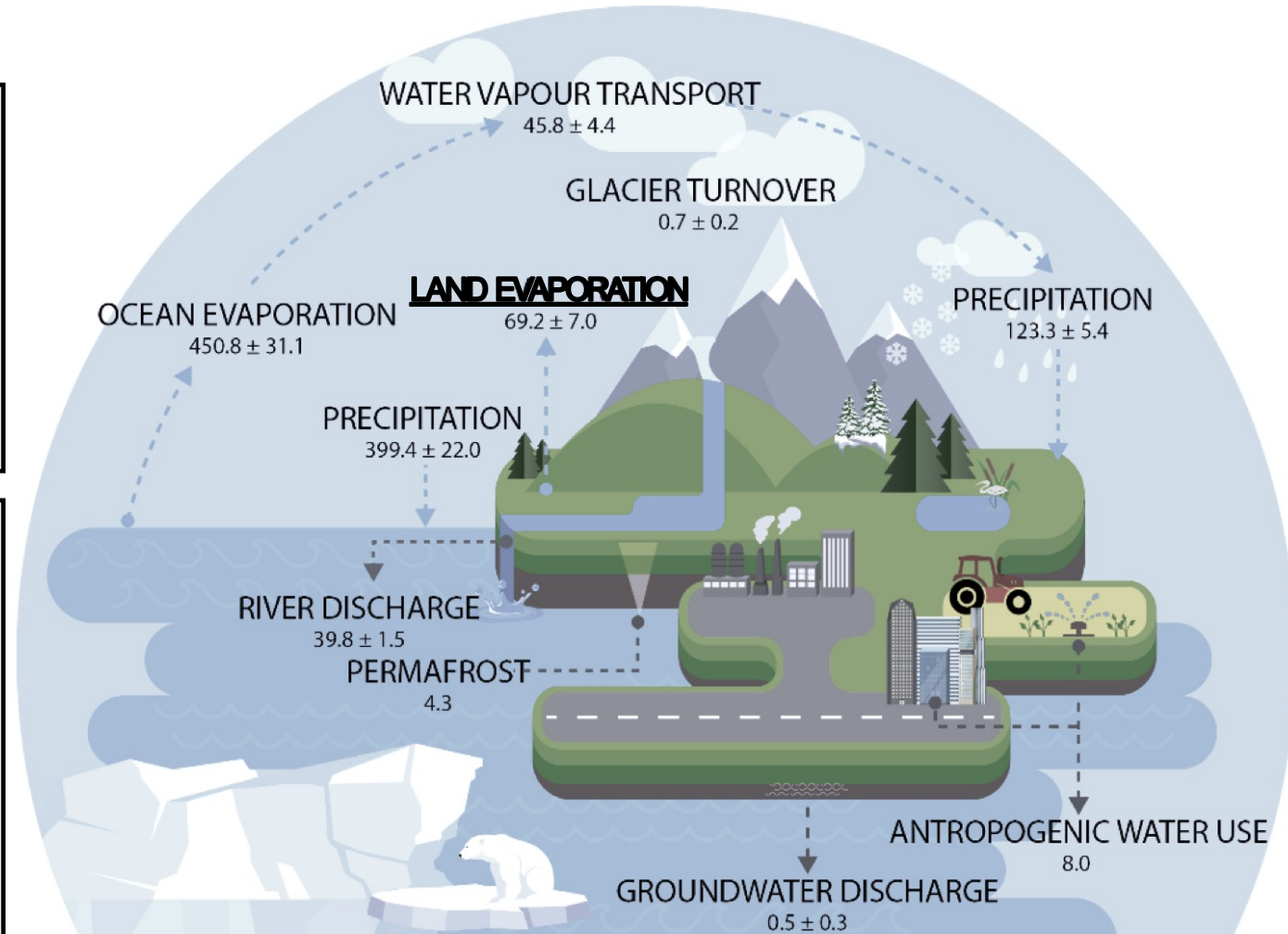**Maximilian Soechting**

Gustau Camp-Valls
Alvaro Moreno

Land Evaporation

Necessary

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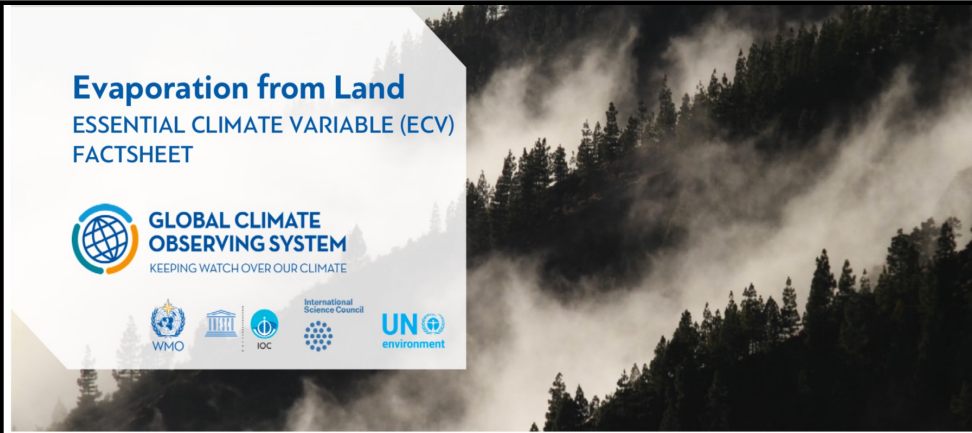2. **Hydrometeorology** events
3. **Water** management
4. **Agriculture** & food security

Poorly understood

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

WATER VAPOUR TRANSPORT
45.8 ± 4.4

GLACIER TURNOVER
0.7 ± 0.2

OCEAN EVAPORATION
450.8 ± 31.1

LAND EVAPORATION
69.2 ± 7.0

PRECIPITATION
123.3 ± 5.4

PRECIPITATION
399.4 ± 22.0

RIVER DISCHARGE
39.8 ± 1.5

PERMAFROST
4.3

ANTROPOGENIC WATER USE
8.0

GROUNDWATER DISCHARGE
0.5 ± 0.3

Dorigo *et al.* **(2022)**

Evaporation from Land — ESSENTIAL CLIMATE VARIABLE (ECV) FACTSHEET

ECV IN BRIEF

Domain:	Terrestrial
Subdomain:	Hydrology
Scientific Area:	Hydrosphere
ECV Stewards:	Diego Miralles

Evaporation from Land

Products:
Transpiration
Soil evaporation
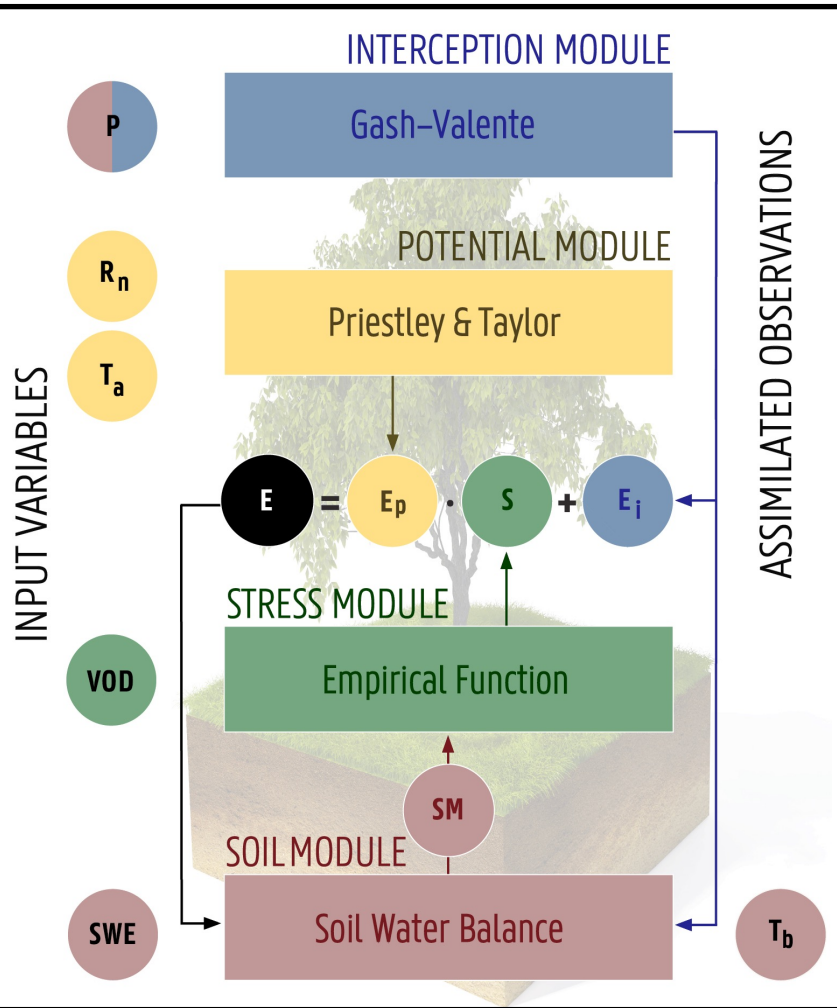Interception loss

ECV Criteria

1. <u>Relevance</u>: critical for the climate system

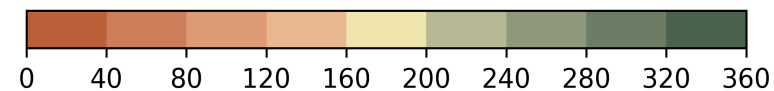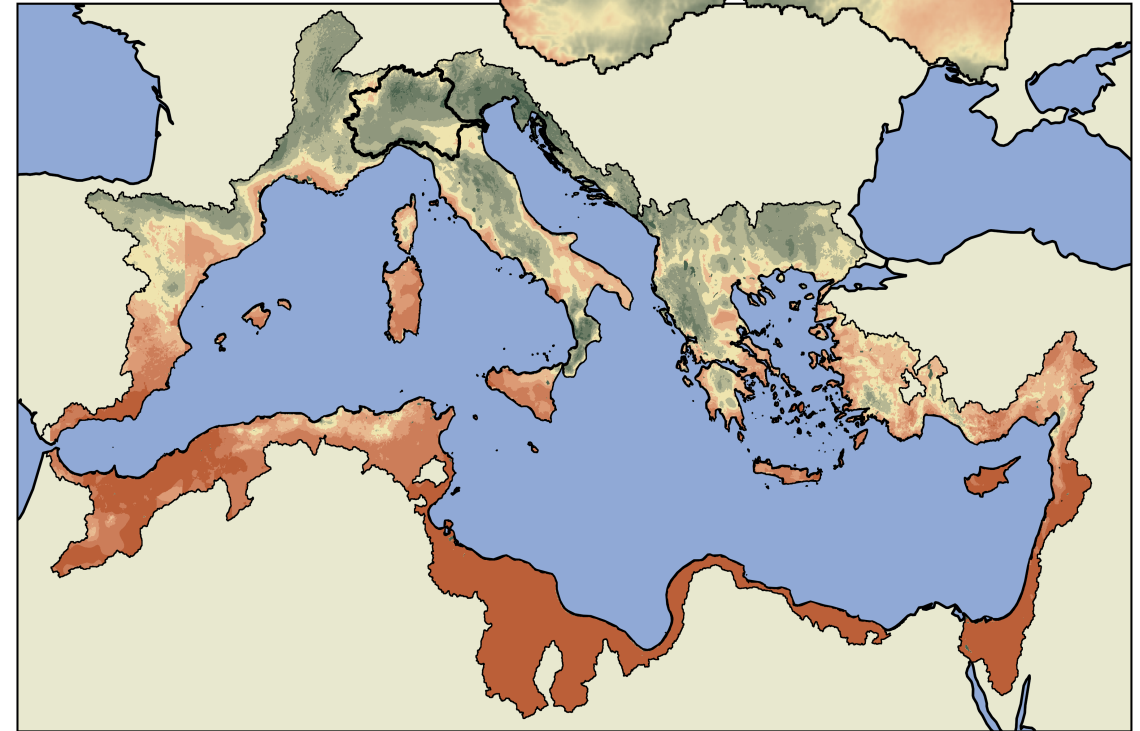2. <u>Feasibility</u>: accurately & globally is feasible (<u>?</u>)
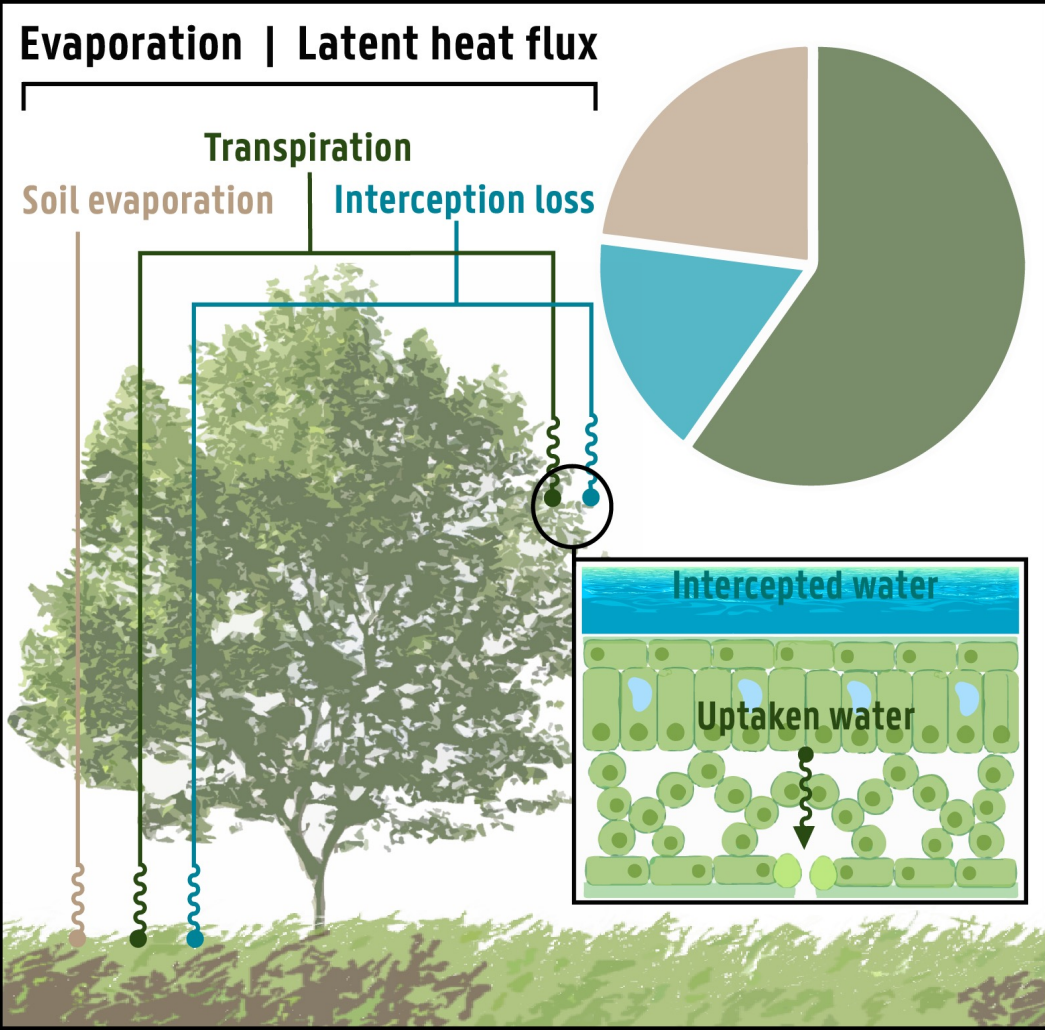
Miralles *et al.* (2020)

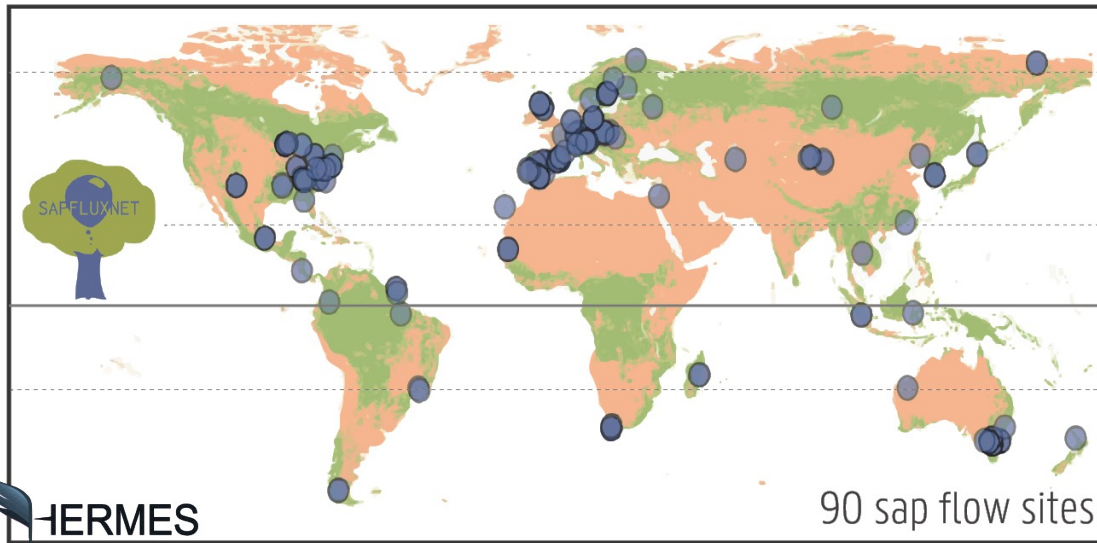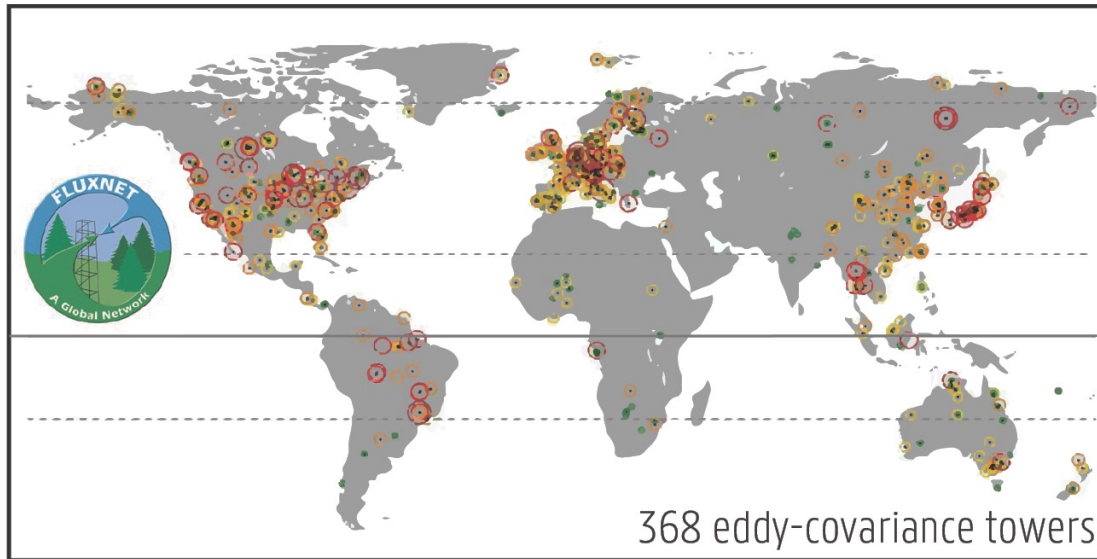GLEAM v3: satellite-based land evaporation

Martens *et al.* (2017)

Geoscientific Model Development — Open Access — EGU

INTERCEPTION MODULE
Gash–Valente

POTENTIAL MODULE
Priestley & Taylor

$$E = E_p \cdot S + E_i$$

STRESS MODULE
Empirical Function

SOIL MODULE
Soil Water Balance

INPUT VARIABLES: P, R_n, T_a, VOD, SWE, SM, T_b

ASSIMILATED OBSERVATIONS

Po Valley

2017–2021 JJA E [mm]

0 40 80 120 160 200 240 280 320 360
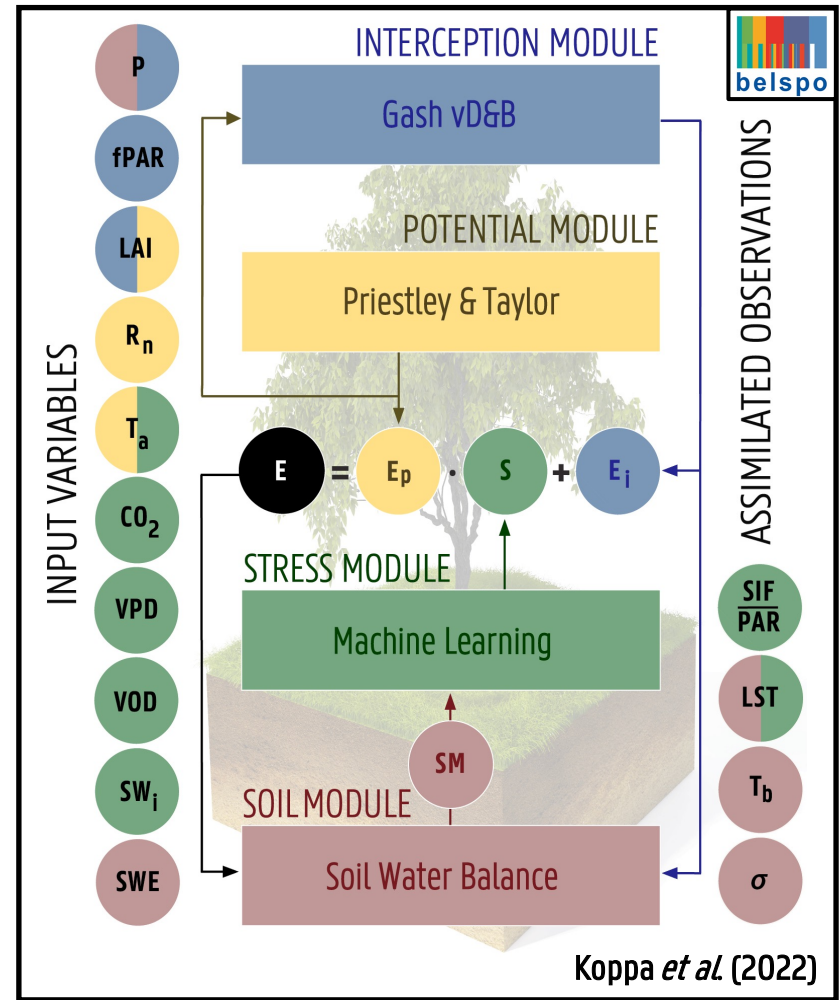
368 eddy-covariance towers

90 sap flow sites

A deep learning-based hybrid model of global terrestrial evaporation

nature COMMUNICATIONS

INPUT VARIABLES

- P
- fPAR
- LAI
- R_n
- T_a
- CO_2
- VPD
- VOD
- SW_i
- SWE

INTERCEPTION MODULE
Gash vD&B

POTENTIAL MODULE
Priestley & Taylor

$E = E_p \cdot S + E_i$

STRESS MODULE
Machine Learning

SM

SOIL MODULE
Soil Water Balance

ASSIMILATED OBSERVATIONS

- $\frac{SIF}{PAR}$
- LST
- T_b
- σ

Koppa *et al.* (2022)

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WP1 | To generate a **high-resolution forcing** dataset covering the entire Meteosat disk

EUMETSAT

1km LST

Rains *et al.* (2022)
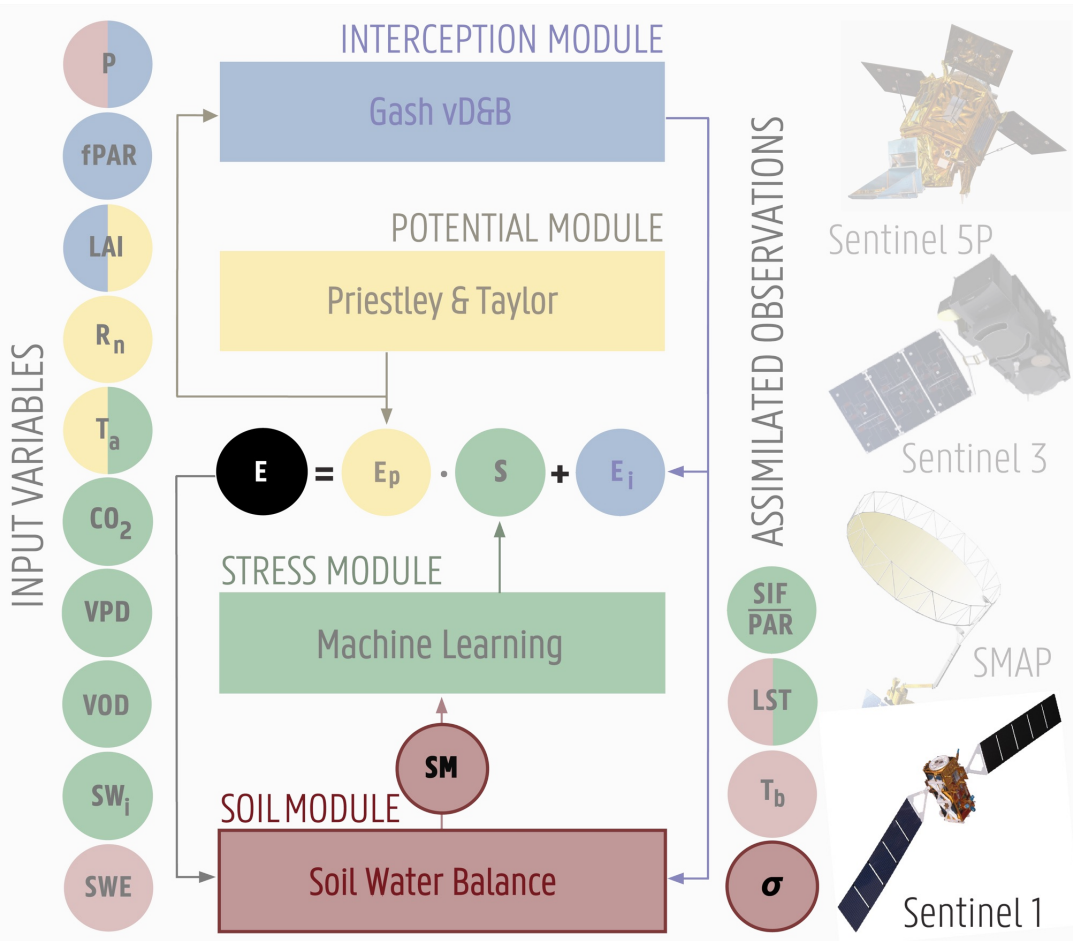
LST [C]

1km ∝

Albedo [−]

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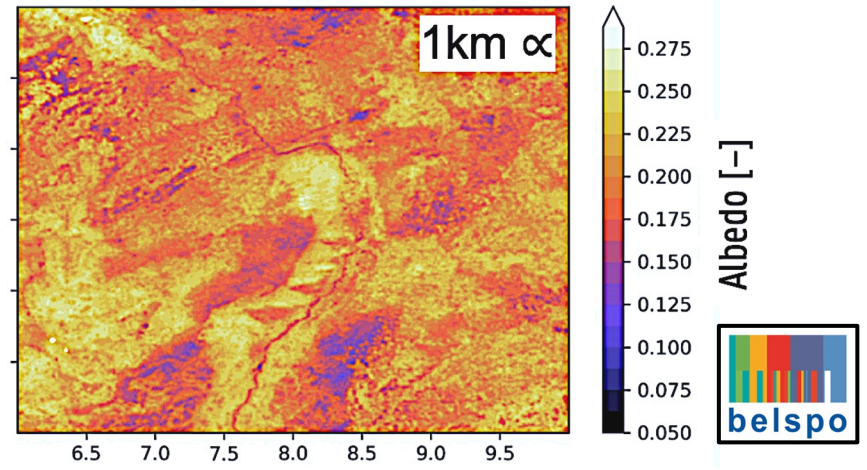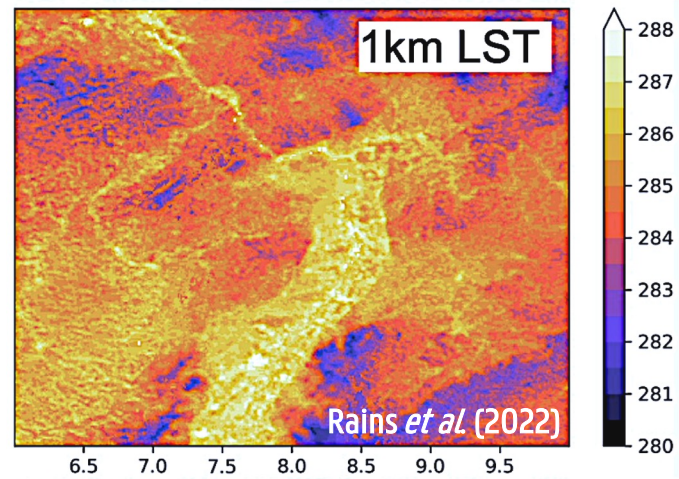
WP2 | To explore the full potential of current **AI algorithms** in the hybrid framework

HERMES
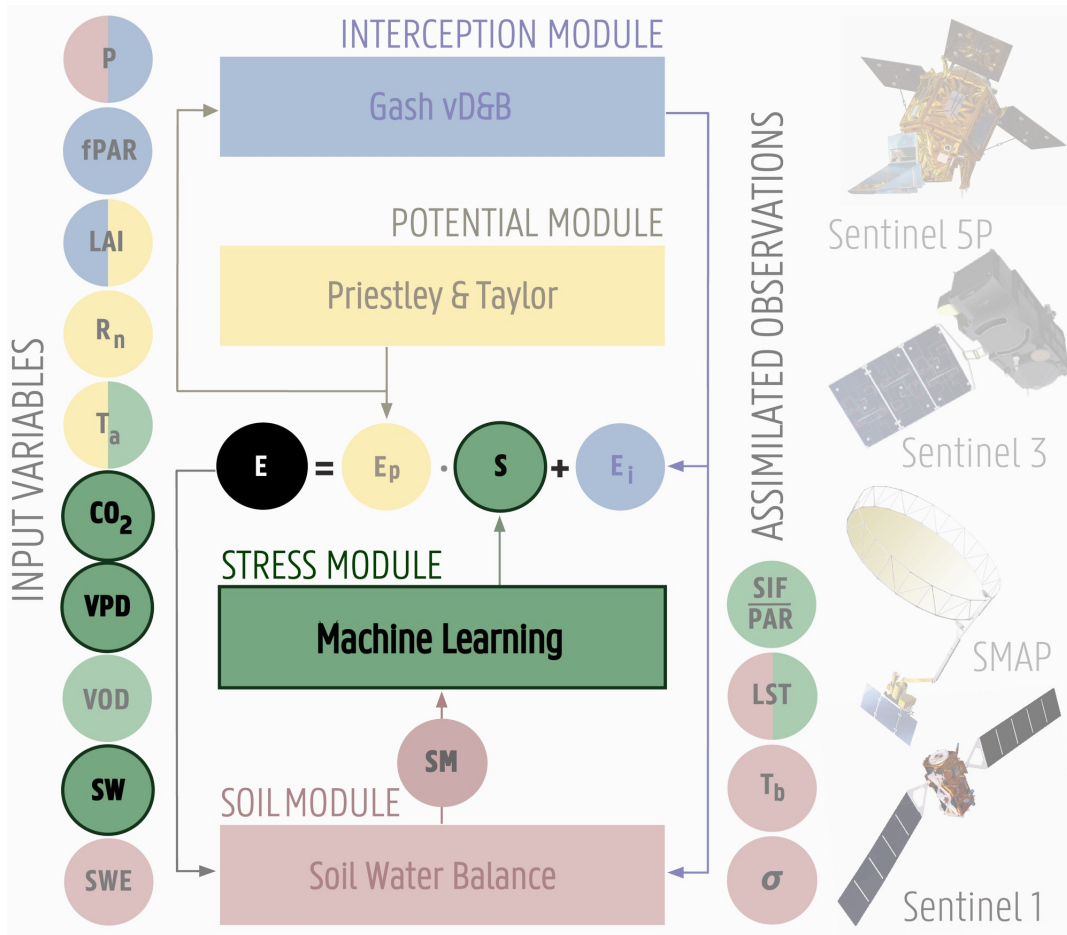
WP3 | To generate a high-resolution dataset of E and SM including the **influence of irrigation**
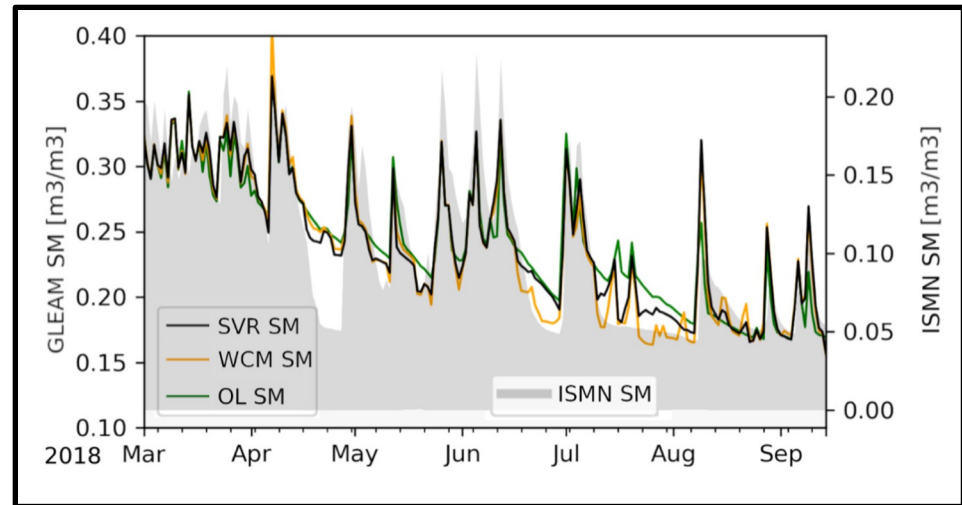
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WP4 | To explore the <u>drivers of vegetation stress</u> during agricultural droughts and heatwaves
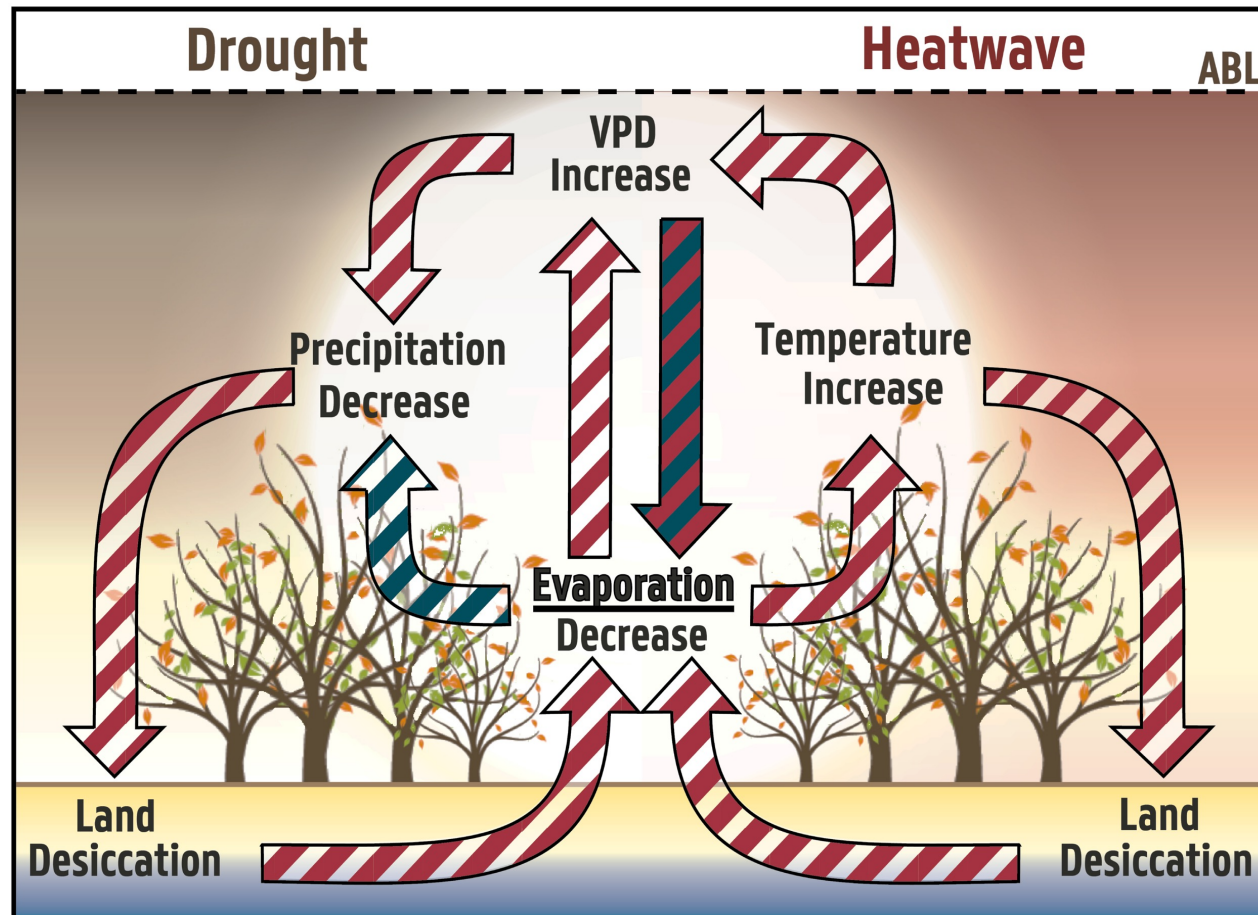
Miralles *et al.* (2019)

WP5 | To develop a new **datacube visualization** tool and data dissemination platform

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Close

Cube:
Earth System

Parameter:
Evaporation

Sensible H
Terrestrial Ecosystem Respiration

GFED4
Carbon dioxide emissions due to natural fires expressed as carbon flux
Monthly Burnt Area

GLEAM
Bare Soil Evaporation
Evaporation
Evaporative Stress Factor
Interception Loss
Open-water Evaporation
Potential Evaporation
Root-Zone Soil Moisture
Snow Sublimation
Surface Soil Moisture
Transpiration

GPCP
Precipitation

GlobAlbedo

06.02.2015

26.03.2018

19°2'31"S

79°2'26"E

0°42'27"E

-0.35   6.21   12.76
mm/day
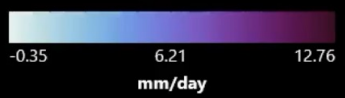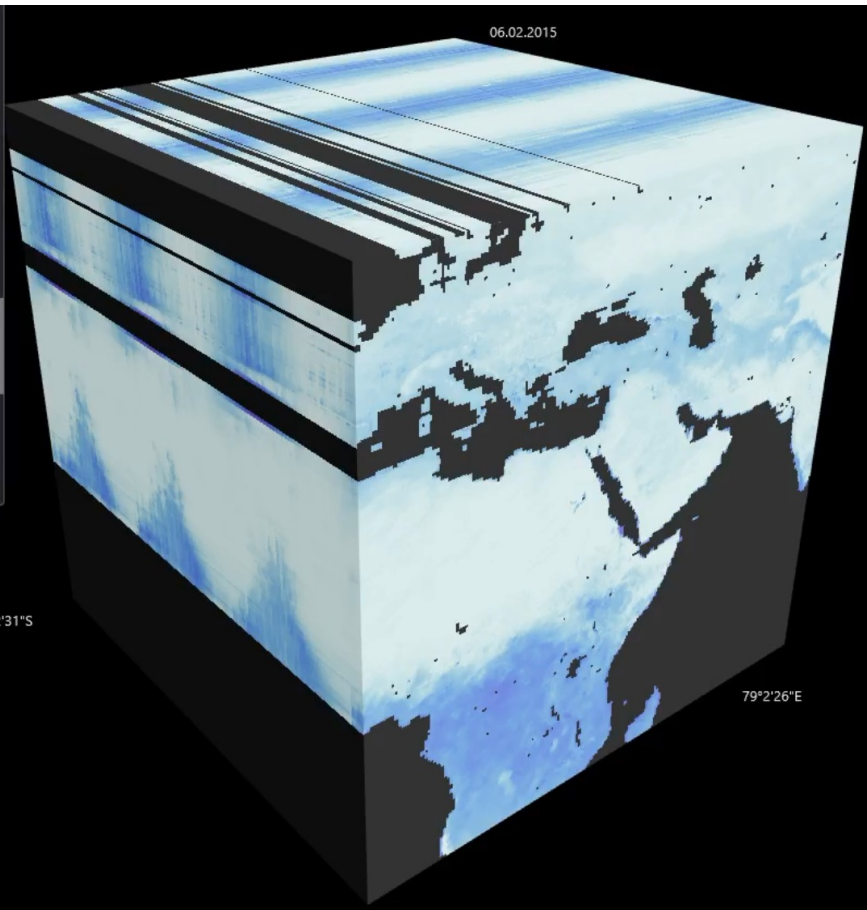
Evaporation
Data Source: GLEAM
Data attribution and license
Images generated by LexCube - Leipzig Explorer of Earth Data Cubes by Maximilian Söchting are licensed under CC BY 4.0

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