Assimilation of satellite-based geophysical variables to improve land evaporation estimates

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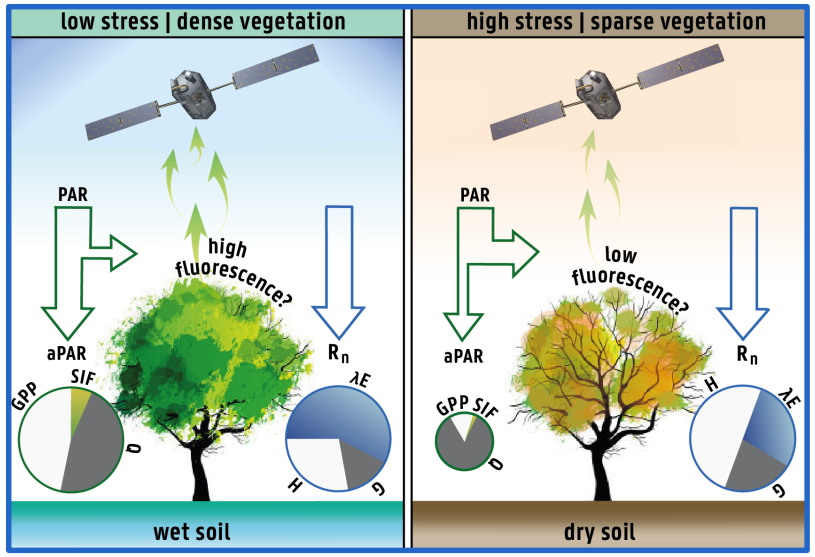
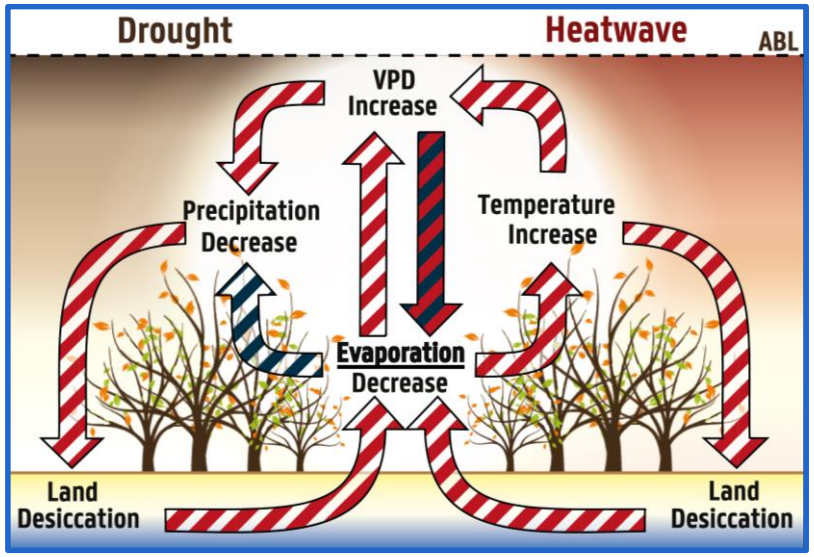
INTRODUCTION

Link in bio-geochemical cycles



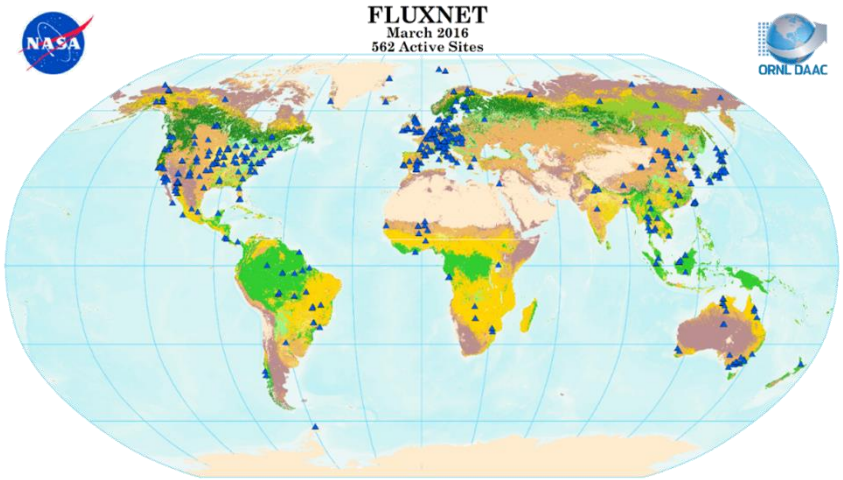
Pagán *et al.* (2019)
Remote Sensing

Crucial in land-atmosphere feedbacks



Miralles *et al.* (2018)
ANYAS

Poorly understood



GLEAM – BASELINE

radiation

temperature

soil moisture

vegetation state

precipitation

land cover

soil parameters

Potential Evaporation Module
Priestley and Taylor equation driven by observed surface meteorology

Rainfall Interception Model
Gash analytical model driven by observed precipitation

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

Soil Module
Multi-layer soil model driven by observed precipitation

Data assimilation of satellite surface soil moisture

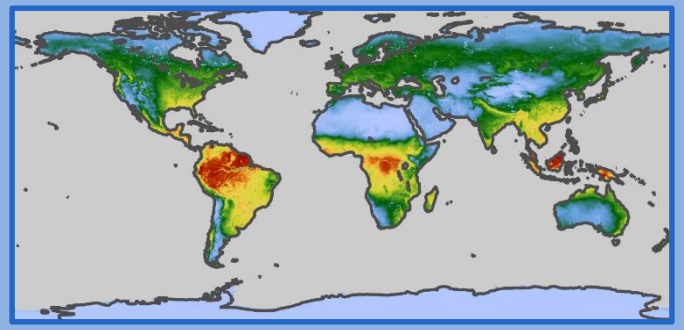
Stress Module
Semi-empirical relationship to root-zone soil moisture and vegetation optical depth

Miralles *et al.* (2011)
HESS
Martens *et al.* (2017)
GMD

transpiration

interception loss

soil evaporation



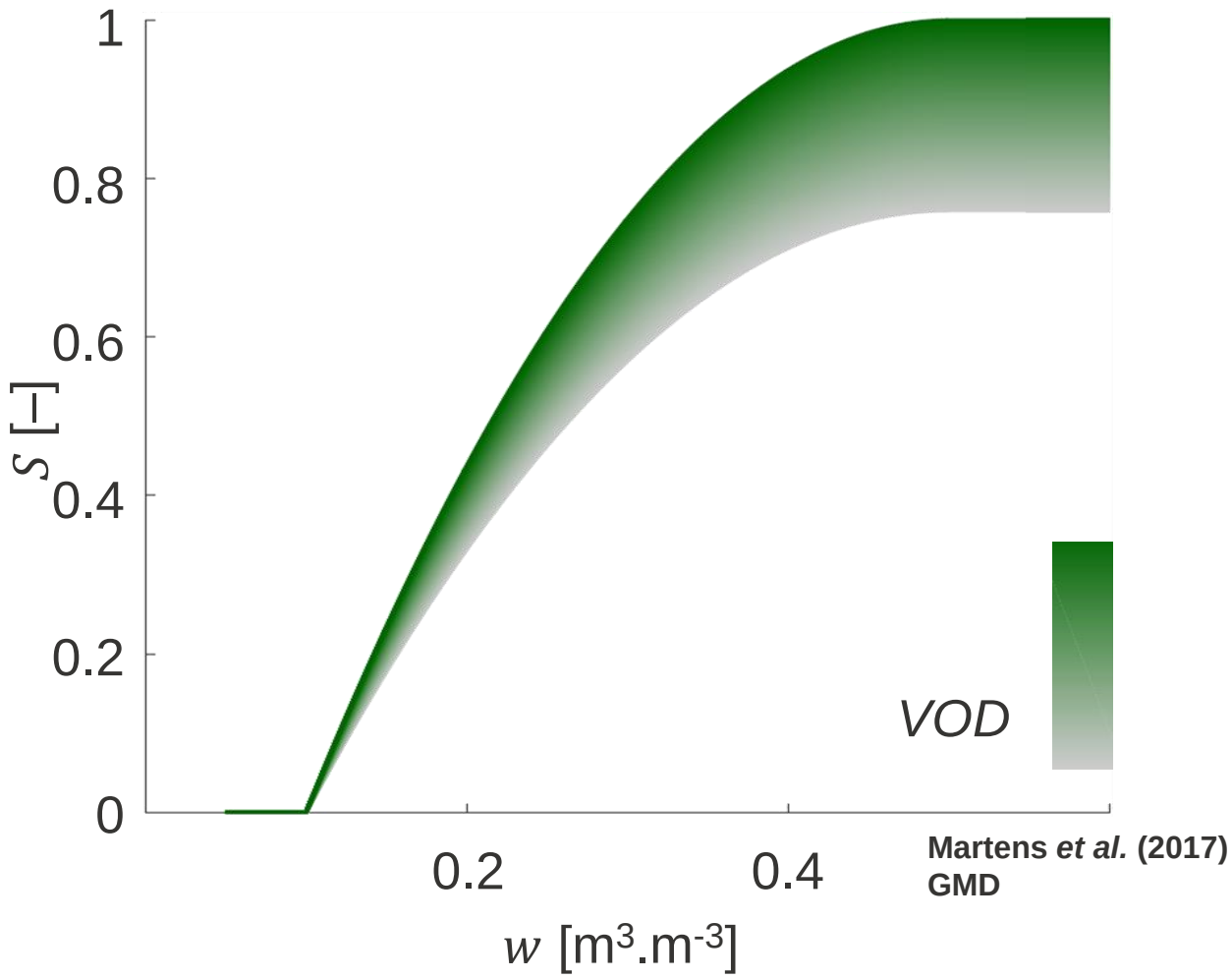
potential evaporation

soil moisture

evaporative stress

GLEAM – BASELINE

$$S = \sqrt{\frac{VOD}{VOD_{\max}}} * \left(1 - \left(\frac{w_c - w}{w_c - w_{wp}}\right)^2\right)$$



Martens *et al.* (2017) GMD

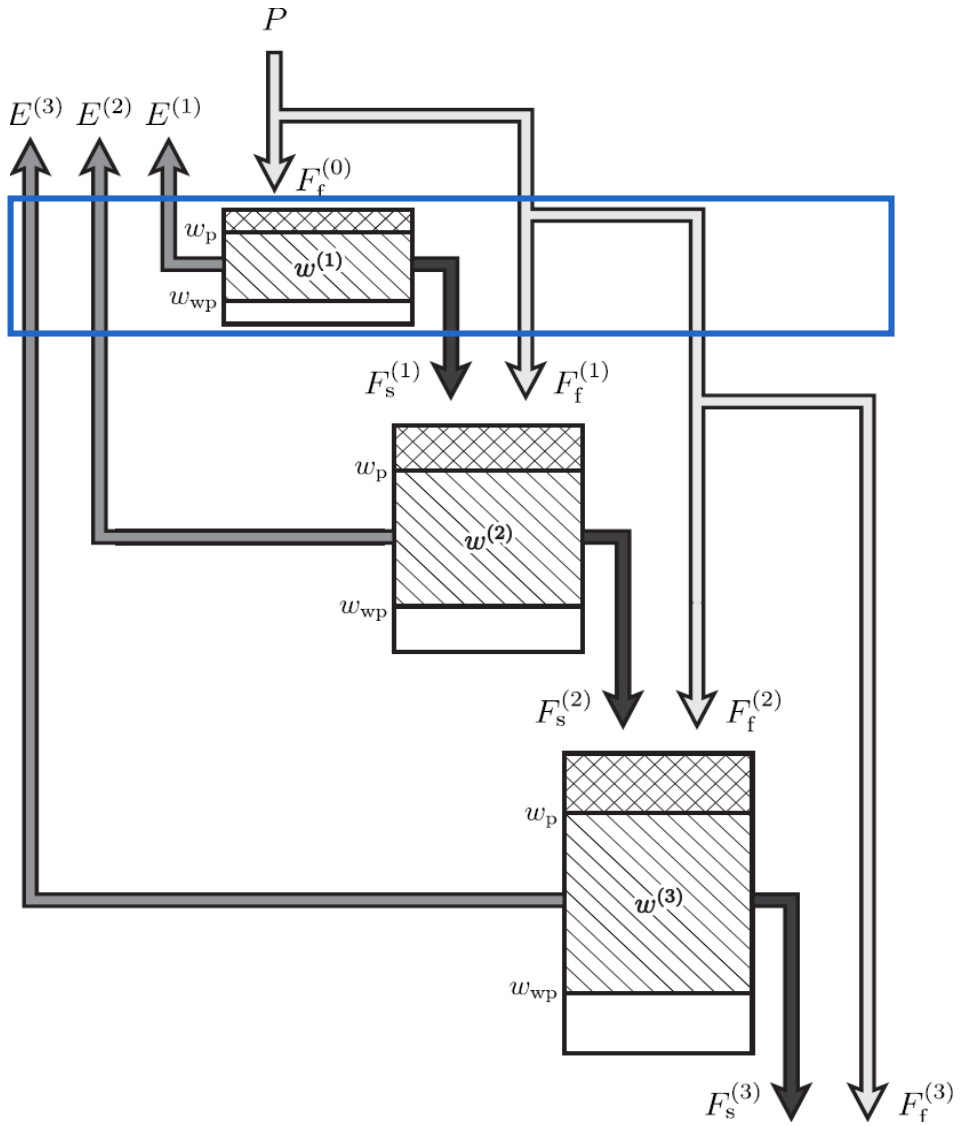
GLEAM – ASSIMILATION OF SOIL MOISTURE

Assimilation of level 2/3 data
ESA CCI soil moisture

$$w^{(1)+} = w^{(1)-} + G\gamma\left(\langle w^{(1),o}\rangle - \langle w^{(1)-}\rangle\right)$$

$$\gamma = \frac{\sigma_{\mathrm{mod}}}{\sigma_{\mathrm{mod}} + \sigma_{\mathrm{obs}}}$$

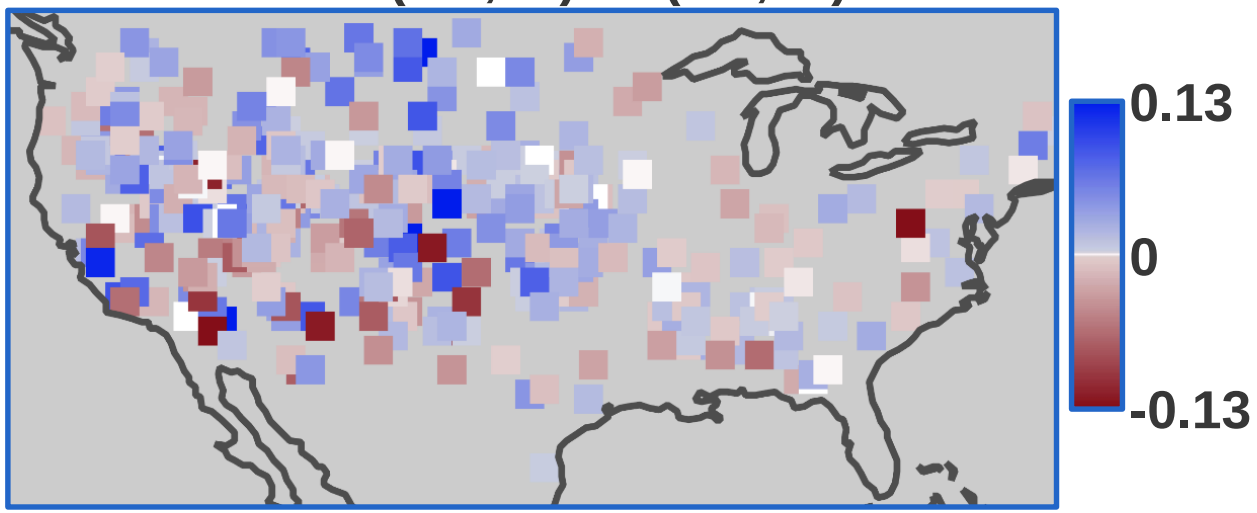
Triple Collocation Analysis



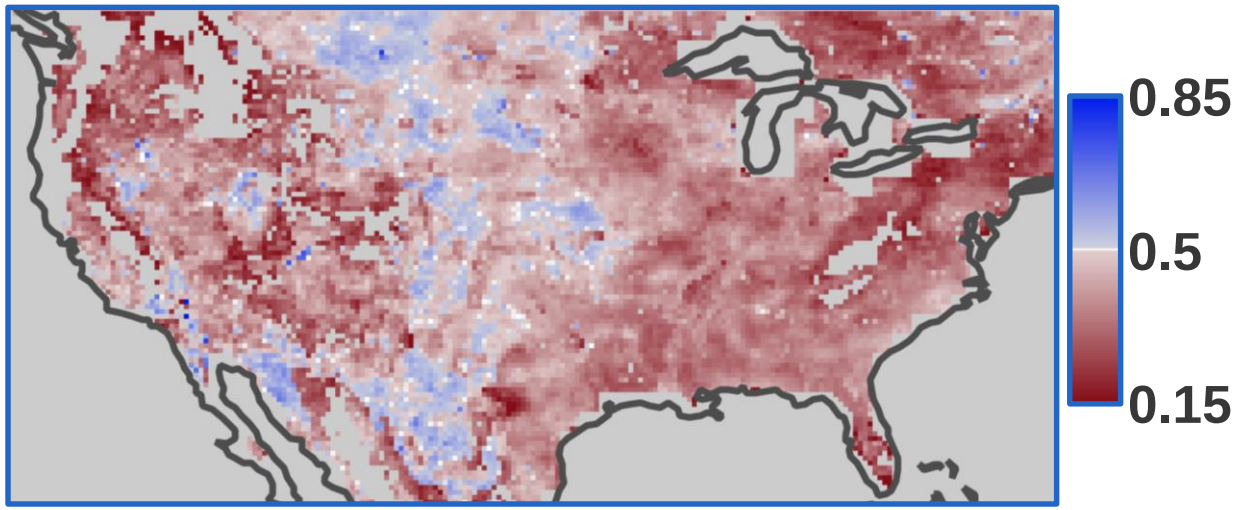
Martens *et al.* (2017)
GMD

GLEAM – ASSIMILATION OF SOIL MOISTURE

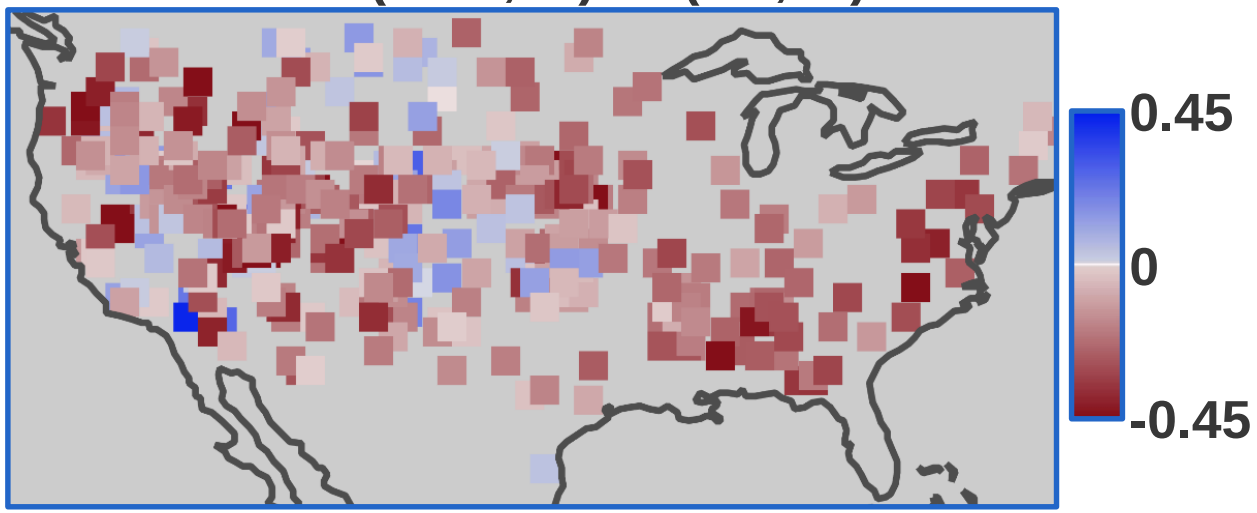
$w^{(1)}$: *R*(DA, *in*) - *R*(OL, *in*)



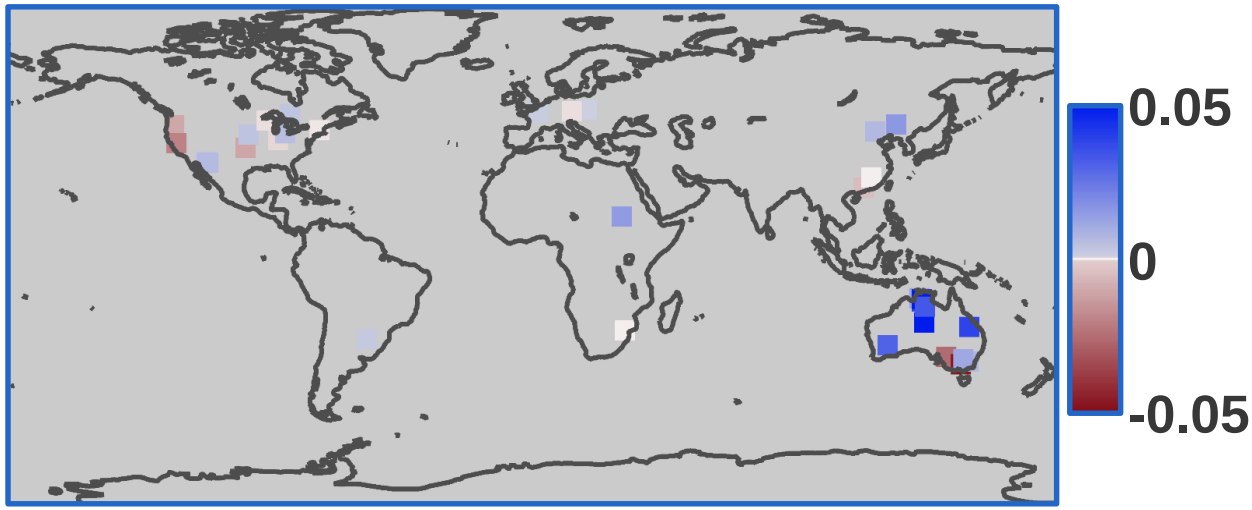
γ



$w^{(1)}$: *R*(OBS, *in*) - *R*(OL, *in*)



E: *R*(DA, *in*) - *R*(OL, *in*)



Martens *et al.* (2015) JAG

Martens *et al.* (2017) GMD

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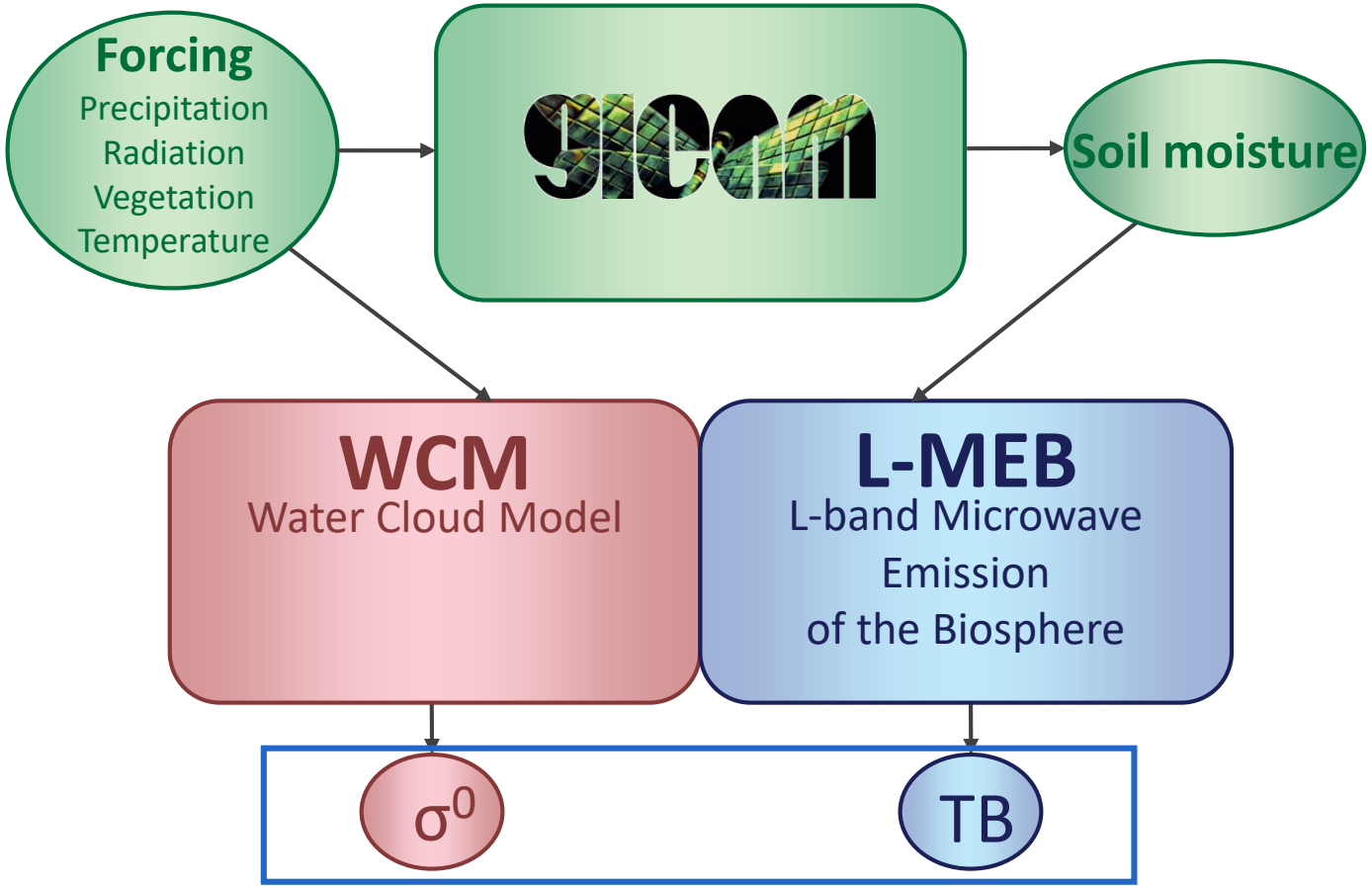
GLEAM – ASSIMILATION OF TB AND σ^0

Assimilation of level 1 data
SMOS TB and ASCAT σ^0

$$\hat{\mathbf{x}}_k^{i+} = \hat{\mathbf{x}}_k^{i-} + \mathbf{K}_k\left[(\mathbf{y}_k - \langle\mathbf{y}\rangle_k) - (\hat{\mathbf{y}}_k^i - \langle\hat{\mathbf{y}}\rangle_k)\right]$$

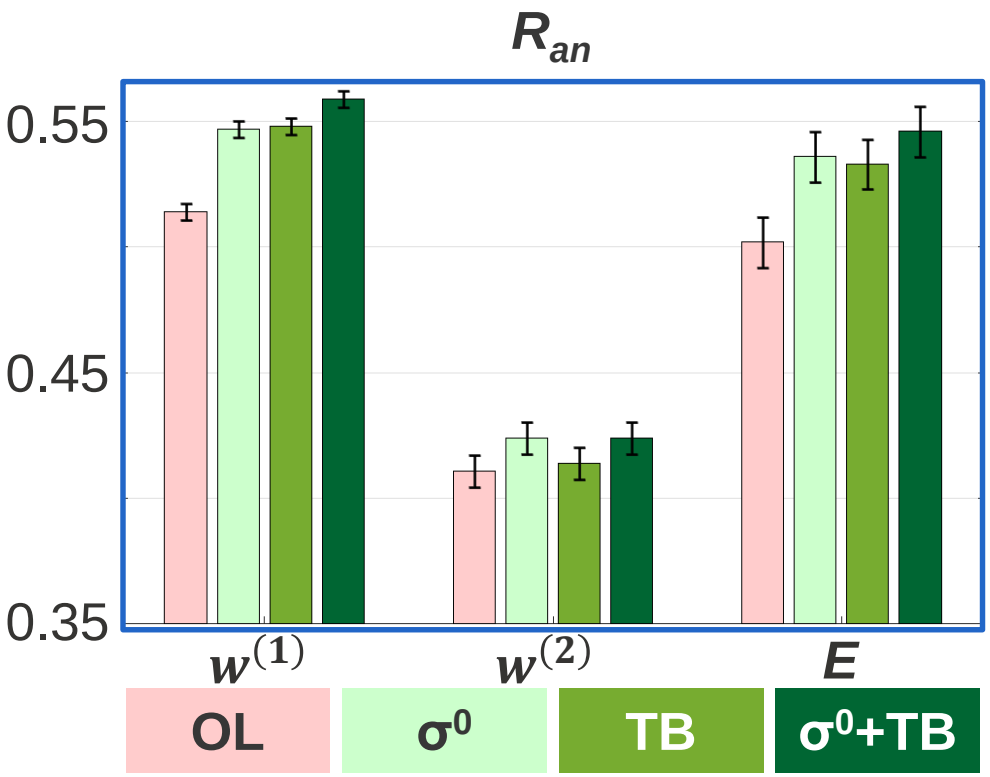
$$\mathbf{K}_k = \mathrm{Cov}(\hat{\mathbf{x}}_k^f, \hat{\mathbf{y}}_k)[\mathrm{Cov}(\hat{\mathbf{y}}_k, \hat{\mathbf{y}}_k) + \mathbf{R}_k]^{-1}$$

Ensemble forward simulation

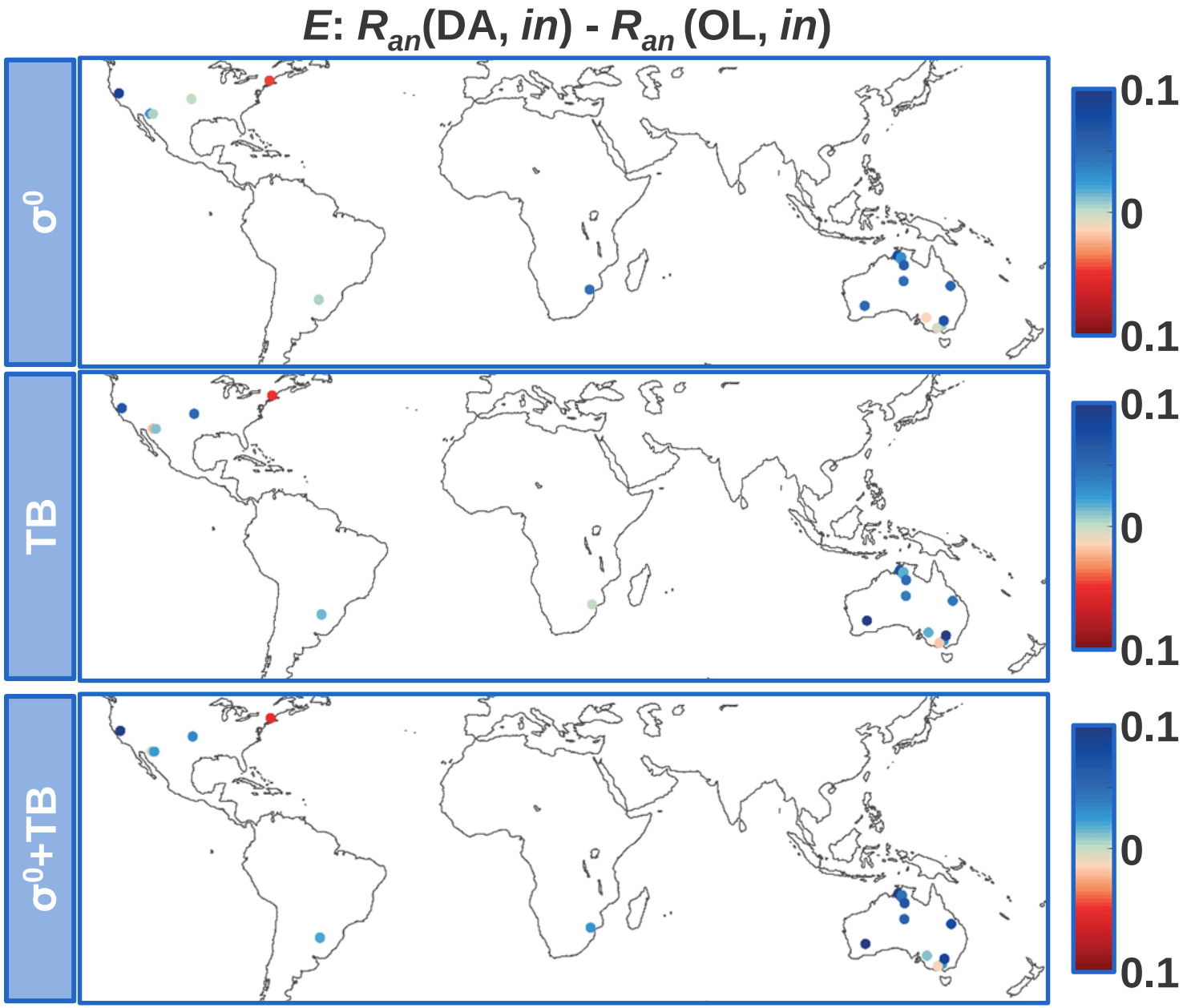


Lievens *et al.* (2017) RSE

GLEAM – ASSIMILATION OF TB AND σ⁰

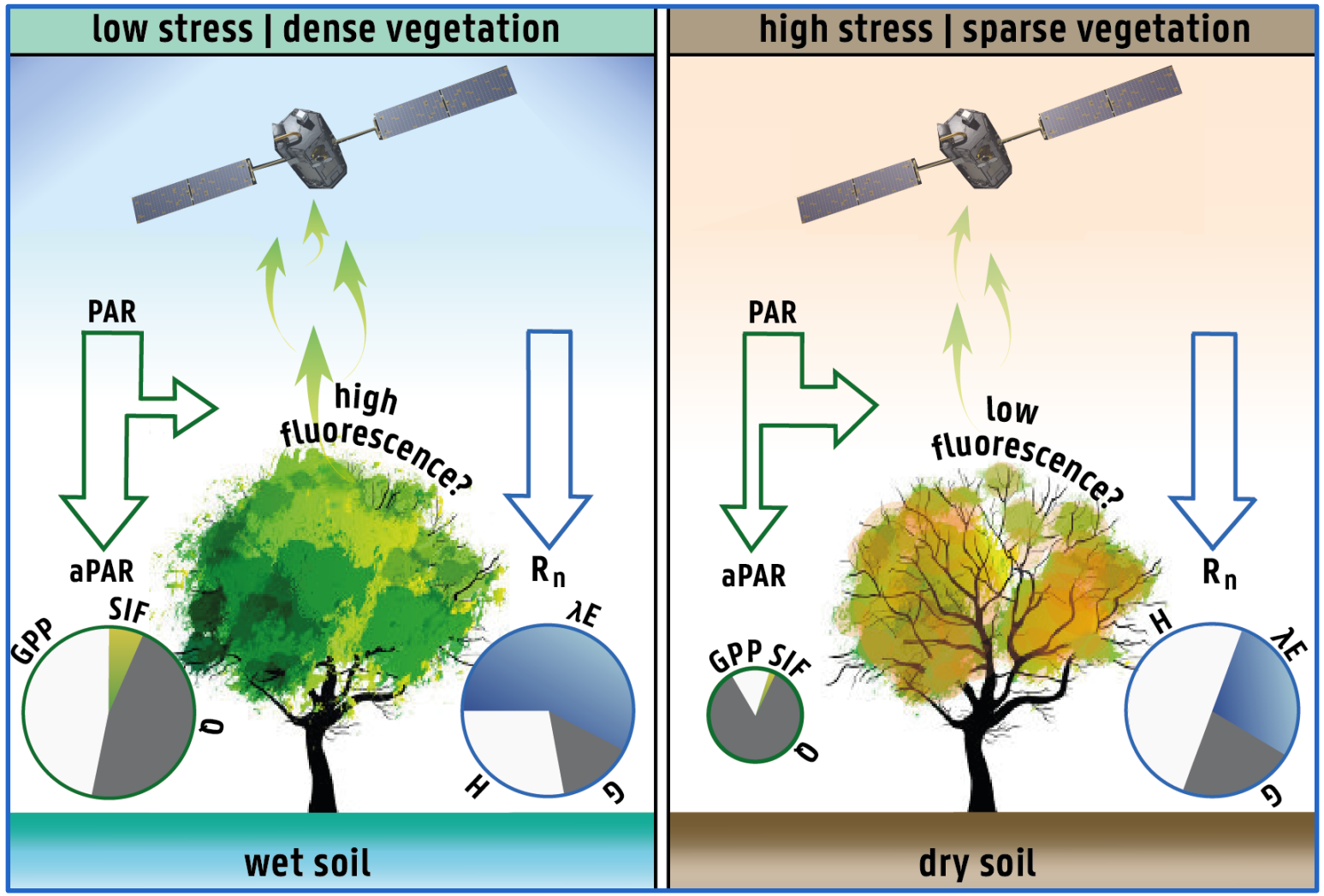


Lievens *et al.* (2017)
RSE



GLEAM – ASSIMILATION OF SIF

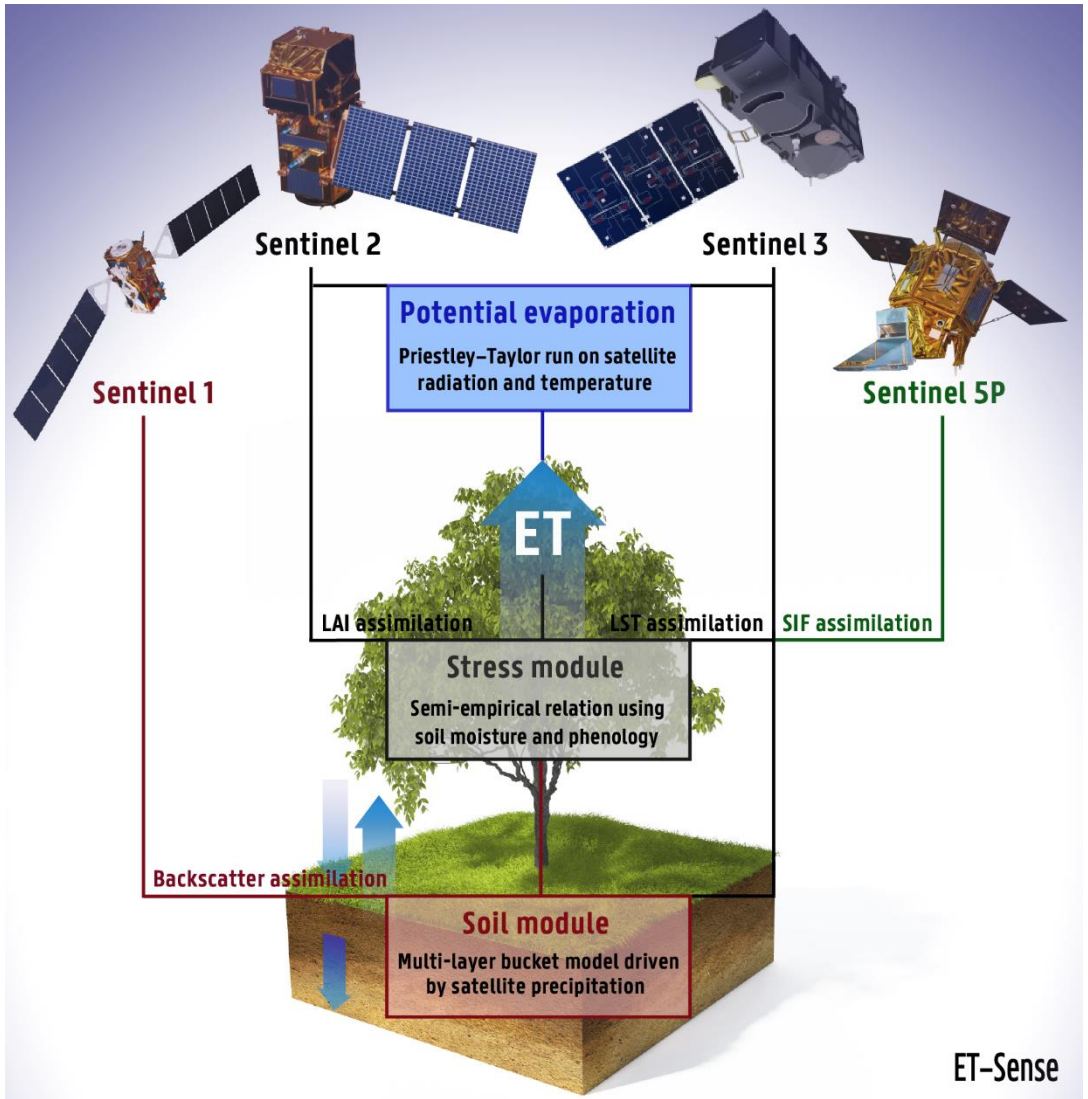
Direct update of *S*?



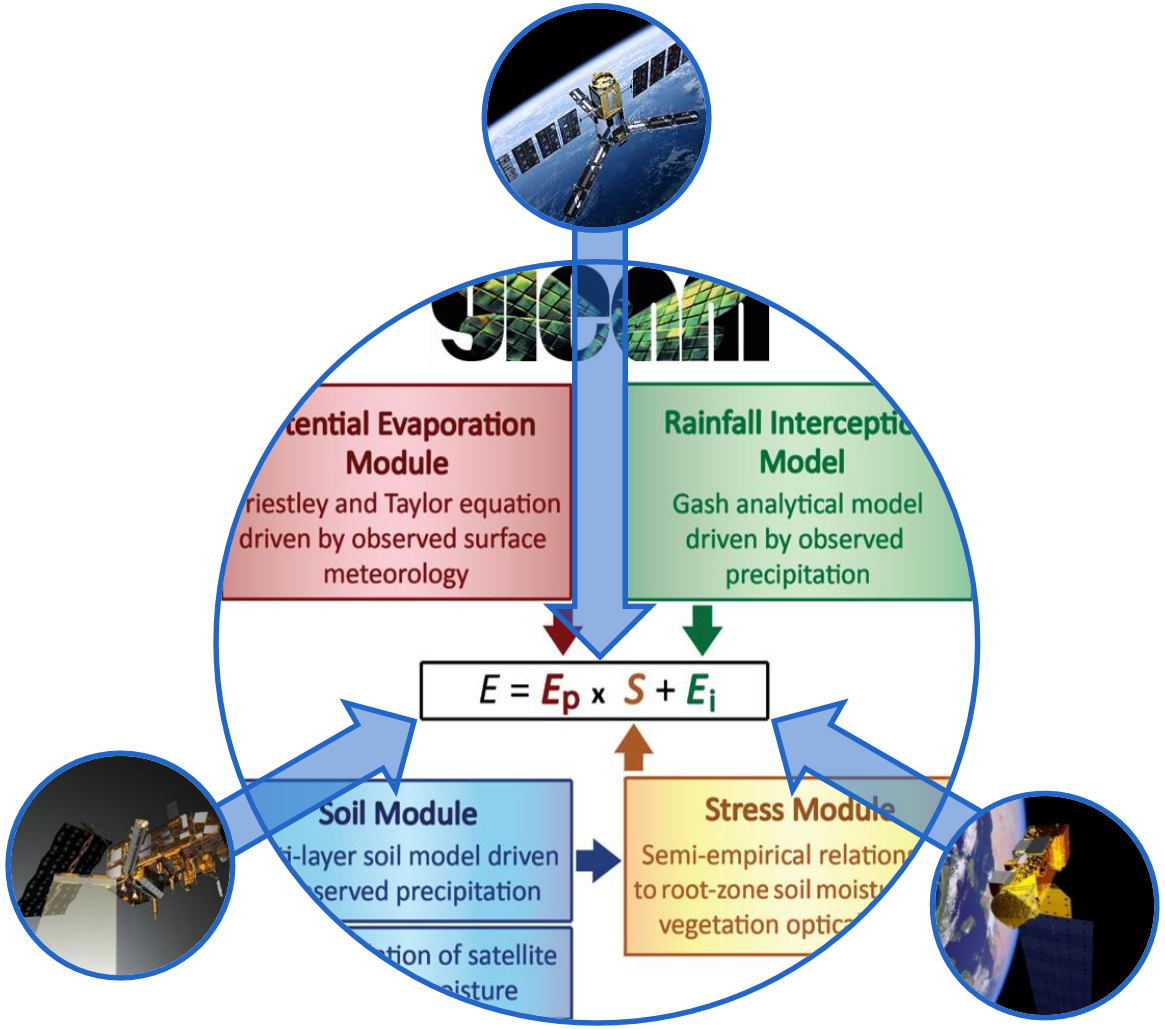
Pagán *et al.* (*in prep.*)

TOWARDS LAND EVAPORATION REANALYSIS?

Joint assimilation of LSVs?



CONCLUSION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