TRISHNA Level-2 products : Daily evapotranspiration and water stress

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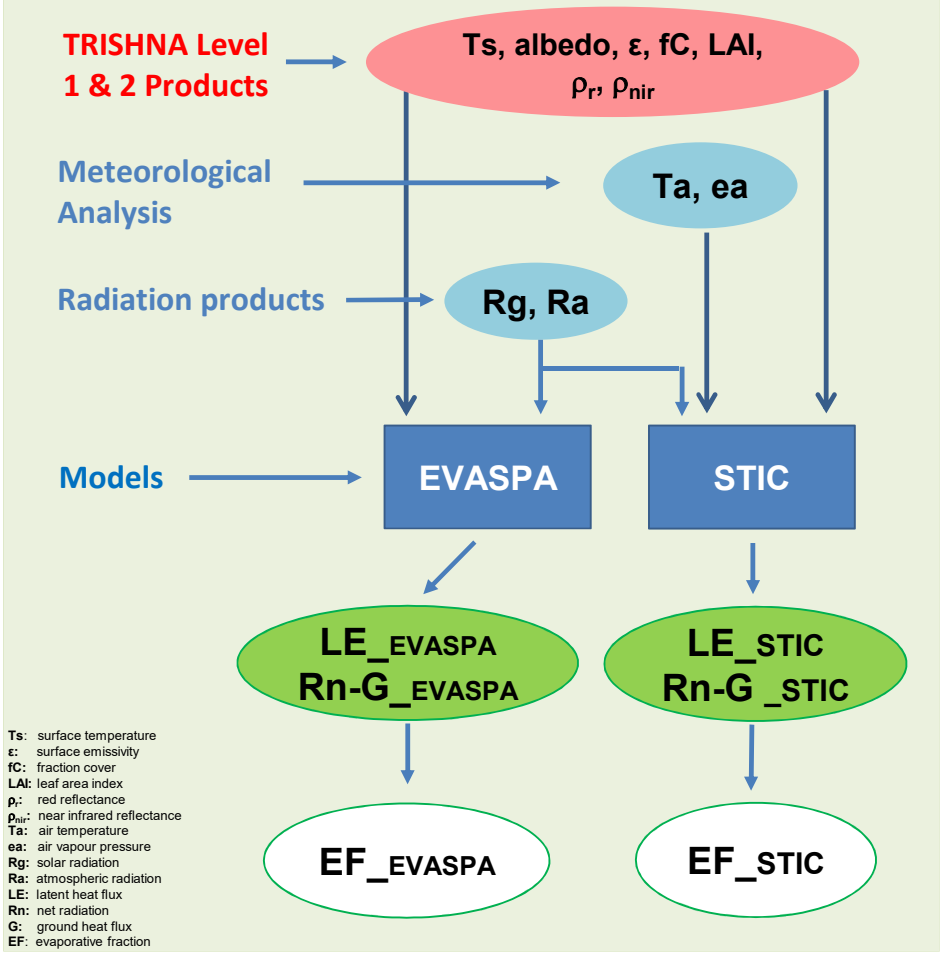
Trishna Products

TRISHNA products will include evaptranspiration and water stress index products to be delivered within 12 hours after acquisition:

At level 2:
- Latent heat flux (**LE**) at the time of satellite clear-sky acquisition
- Evaporative fraction (**EF**) as a water stress index

At higher levels:
- daily evapotranspiration (**ETd**) for days with acquisition
- reconstructed daily evapotranspiration for days with no acquisition (revisit, clouds…)

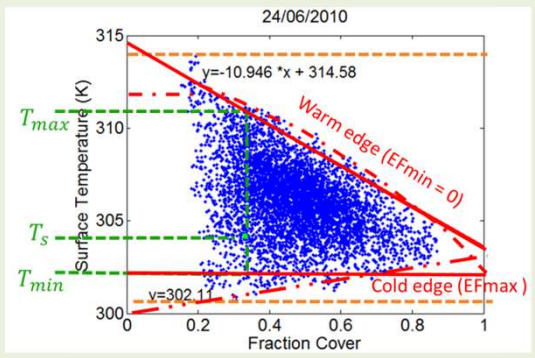
General scheme



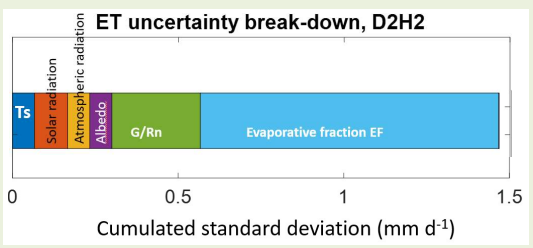
Models

EVASPA
(EVApotranspiration from SPAce)
Gallego-Elvira et al. 2013 ; Allies et al. 2020

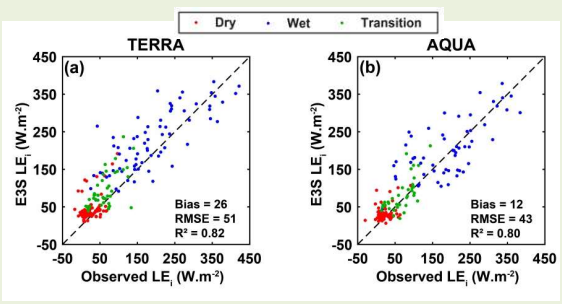
Contextual models:
triangle (fraction cover-Ts) and S-SEBI (albedo-Ts) methods;
LE derived from the Evaporative Fraction: **EF**=(Ts-Tmax)/(Tmin-Tmax)



Multi-data multi-model framework
=> **uncertainty assessment**:



Example of results over Niger using MODIS data (Allies et al. 2020):

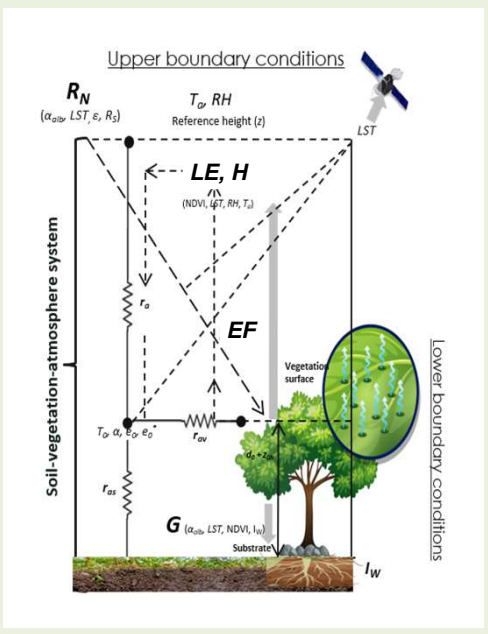


Allies A., J. Demarty, A. Olioso, I. Bouzou Moussa, H. B.-A. Issoufou, C. Velluet, M. Bahir, I. Mainassara, M. Oï, J.-P. Chazarin, B. Cappelaere. (**2020**). **Evapotranspiration Estimation in the Sahel Using a New Ensemble-Contextual Method**. *Remote Sensing*, 12, 380. doi:10.3390/rs12030380

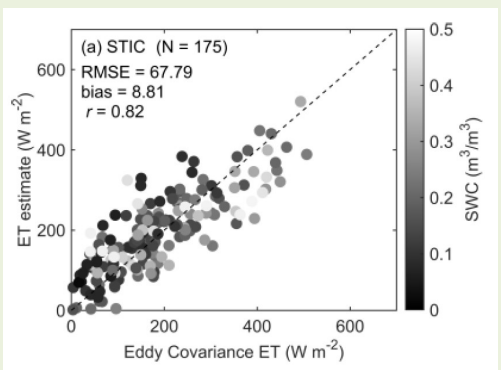
Gallego-Elvira, B., Olioso, A., Mira, M., Reyes Castillo, S., Boulet, G., Marloie, O., Garrigues, S., Courault, D., Weiss, M., Chauvelon, P., Boutron, O., (**2013**). **EVASPA (EVapotranspiration Assessment from SPAce) tool: an overview**. *Procedia Environmental Sciences*, 19, 303-310

STIC
(Surface Temperature Initiated Closure)
Mallick et al., 2014, 2016

Single pixel model:
Penman-Monteith equation for the vegetation layer, Shuttleworth-Walace resistance network



Example of results over various sites using ECOSTRESS data (Hu et al. 2023):



Mallick, K., Jarvis, A.J., Boegh, E., Fisher, J.B., Drewry, D.T., Tu, K.P., Hook, S.J., Hulley, G., Ardö, J., & Beringer, J. (**2014**). **A Surface Temperature Initiated Closure (STIC) for surface energy balance fluxes**. *Remote sensing of Environment, 141*, 243-261

Mallick, K., Trebs, I., Boegh, E., Giustarini, L., Schlerf, M., Drewry, D.T., Hoffmann, L., Randow, C.v., Kruijt, B., & Araùjo, A. (**2016**). **Canopy-scale biophysical controls of transpiration and evaporation in the Amazon Basin**. *Hydrology and Earth System Sciences, 20*, 4237-4264

Hu T., K. Mallick, P. Hitzelberger, Y. Didry, G. Boulet, Z. Szantoi, B. Koetz, I. Alonso, M. Pascolini-Campbell, G. Halverson, K. Cawse-Nicholson, G.C. Hulley, S. Hook, N. Bhattarai, A. Olioso, J.-L. Roujean, P. Gamet, Z. Su. (**2023**). **Evaluating European ECOSTRESS Hub Evapotranspiration Products Retrieved from Three Structurally Contrasting SEB Models over Europe.** To be published in *Water Resources Research*. (preprint: doi: 10.1002/essoar.10512884.1)

Daily ET

The instantaneous latent heat flux **LE** is scaled to **ETd**, the **daily evapotranspiration,** by assuming a constant ratio LE / Rg along the day (following Delogu et al. 2021, Guillevic et al. 2019).

Instantaneous solar radiation at the time of TRISHNA acquisition is obtained from TRISHNA data (Champion et al. 2022). Daily value of solar radiation can be computed as a theorethical value or obtained from geostationnary satellite products.

Champion, J., J.-L. Roujean, J. Auclair, O. Hagolle, J. Michel, X. Ceamanos (**2022**). **Estimate of short- and long-wave downwelling surface radiation fluxes at high resolution**. *TRISHNA Days*, Toulouse, March 2022.

Delogu, E., Olioso, A., Alliès, A., Demarty, J., Boulet, G., (**2021**). **Evaluation of Multiple Methods for the Production of Continuous Evapotranspiration Estimates from TIR Remote Sensing.** *Remote Sensing*, 13, no. 6, 1086. DOI: 10.3390/rs13061086

Guillevic, P.C.; Olioso, A.; Hook, S.J.; Fisher, J.B.; Lagouarde, J.-P.; Vermote, E.F., (**2019**). **Impact of the Revisit of Thermal Infrared Remote Sensing Observations on Evapotranspiration Uncertainty—A Sensitivity Study Using AmeriFlux Data**. *Remote Sensing*, 2019, 11, 573.

Tiling

TRISHNA data will be projected on to a UTM grid and made available on **100x100 km² tiles** following the system used for Sentinel 2. Some tiles, in particular on coast, will be grouped to increase the number of available pixels to run EVASPA.