PREFERENCE FOR PRESENTATION

POSTER (A0) no (yes/no) **ORAL (10 min) yes (yes/no)**

Advances in the three-source energy balance model to improve flux partitioning in heterogeneous agro-ecosystems

Vicente Burchard-Levine[1], Héctor Nieto[1], William P. Kustas[2], Radoslaw Guzinski[3], Andrew Gal[4], Nicolas Bambach[4], M.Dolores Raya-Sereno[1], Karem Meza[4], Andrew McElrone[5], Kyle Knipper[6], Bayu Hanggara[7], Arnaud Carrara[8] , Sung-Ching Lee[7] , M.Pilar Martin[1]*

[1]Institute of Agricultural Sciences (ICA), Spanish National Research Council (CSIC), Madrid, Spain; [2]USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD, United States; [3]DHI, 2970 Hørsholm, Denmark; [4] University of California–Davis, Department of Viticulture and Enology, Davis, CA, United States; [5] USDA-ARS, Crops Pathology and Genetics Research Unit, Davis, CA, United States; [6] USDA-ARS, Sustainable Agricultural Water Systems Research Unit, Davis, CA, United States; [7] Max Planck Institute for Biogeochemistry, Department Biogeochemical Integration, Jena, Germany: [8] Fundación Centro de Estudios Ambientales del Mediterráneo (CEAM), Valencia, Spain [*]To whom all correspondence should be addressed (*vicente.burchard@csic.es*).

a. **KEYWORDS:** Evapotranspiration; 3SEB; savannas; perrenial crops; Copenicus; UAVs

MAIN BODY OF TEXT (MAX 3000 CHARACTERS) -

Energy and water fluxes, such as actual evapotranspiration (ET), are key variables to better understand ecosystem function, manage water resources and detect drought events and impacts. Thermal infrared surface energy balance models, such as the two-source energy balance model (TSEB), have shown great utility in estimating ET at various spatio-temporal scales, showing good performance using data from in-situ, drone-based or spaceborne sensors and across different landscapes, including various types of croplands and natural ecosystems. However, there still remains greater model uncertainty in some heterogeneous agro-ecosystems, such as savannas or perennial crop systems, which may have additional sources of plant water use and energy exchange stemming from having both an understory and overstory vegetation layer. Due to this, a three-source energy balance model (3SEB) was developed based on TSEB to improve flux partitioning in these complex agro-ecosystems by inherently incorporating two distinct vegetation sources within its modeling framework. 3SEB was previously evaluated using tower-based inputs across a range of flux sites in savannas and vineyards along with inputs from geostationary satellites. This contribution will showcase the latest advances in the 3SEB model development and applications, including its implementation with high resolution drone imagery (<1 m), and medium resolution satellite-based inputs from the Copernicus Sentinel constellation (20-1000 m) along with improving vegetation physiological constraints in the model structure. For the latter, the original Priestley-Taylor potential transpiration initialization in 3SEB may not adequately characterize stomatal regulation, especially for semi-arid agro-ecosystems. As such, Penman-Monteith and Shuttleworth-Wallace-like transpiration formulations are being incorporated to integrate vapour pressure deficit as a limiting factor and evaluate its effect on ET and its partitioning into evaporation (E) and transpiration (T). Model versions and implementations were benchmarked against eddy-covariance (EC) observations from FLUXNET sites located in savanna ecosystems and over different perennial crop sites in California, USA from the GRAPEX (https://www.ars.usda.gov/northeast-area/beltsville-md-barc/beltsville-agricultural-research-center/hydrology-and-remote-sensing-laboratory/docs/grapex/grapex-home/) and T-REX (https://www.t-rexproject.com/) projects. Preliminary results indicate 3SEB's ability to improve flux partitioning for these complex agro-ecosystems, highlighting the potential for more accurate T/ET estimates to improve plant water stress detection, support irrigation management and understand ecosystem function.