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Surface energy fluxes estimation using a two source energy balance model, flux tower and remote sensing data in a Juniper woodlands of Doñana Biological Reserve

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Monitoring of evapotranspiration (ET) has important implications for global and regional climate modeling, enhancing the knowledge of the hydrological cycle and assessing water stress affecting agricultural and natural ecosystems. Nowadays, remote sensing is the only technology capable of providing the necessary radiometric measurements for the calculation of the actual evapotranspiration at global scales and in a feasible economic way. Currently, most of the algorithms developed for evapotranspiration modeling have been developed and validated in homogeneous agricultural areas, and its implementation over natural vegetation is still a major challenge, especially for Mediterranean plant communities. Doñana Biological Reserve (DBR) is Singular Scientific and Technological Infrastructure (ICTS) with a long-term ecological monitoring program based on permanent plots to carry out the validation and monitoring of evapotranspiration and other energy fluxes in an area dominated by Juniper woodlands (Juniperus turbinata ssp phoenicea). This plant community presents both high spatial heterogeneity and cover.
In this work we present the first results of energy flux modeling and validation, including actual evapotranspiration, net radiation, sensible heat flux and soil heat flux, using flux tower data and at satellite pass data from the experimental plot of “el Ojillo” in 2010. The methodology used in evapotranspiration modeling is based on a two-source surface energy balance model (TSEB) developed by Kustas and Norman (1999). To carry out this research a total of 5 Landsat-5 TM images for the following dates: 06/02/2010, 16/07/2010, 01/08/2010, 25/08/2010 and 10/09/2010 were used. The validation was performed using data from a flux tower located on the juniper tree plot. TSEB method showed acceptable results for the different energy flux modeled taking into account the high heterogeneity of this type of cover. RMSE obtained in the case of the evapotranspiration, net radiation, sensible heat flux and soil heat flux were 60, 42, 60 and 53 W•m-2, respectively. Currently, TSEB is also being applied locally using flux tower data from 2014 to 2016 for model refinements. This work has been the first of a larger project to map evapotranspiration, not only over the Juniper tree area but throughout the whole protected area using the currently available Landsat archive and other flux towers. Future research will be focused on estimation on daily energy fluxes by means of ALEXI methodology (Anderson et al., 2007) and Suomi-NPP VIIRS data.