

VALIDATION OF MODIS EVAPOTRANSPIRATION DATA BY GROUND BASED MEASUREMENTS

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Abstract

Turbulent exchange of water vapour (latent heat flux, LHF) and carbon dioxide (Net Ecosystem Exchange, NEE) over a semi-arid grassland (46.69°N, 19.60°E near Bugacpuszta, Hungary) have been measured since 2002 by eddy covariance (EC) technique. Results concerning NEE of the grassland were published in Nagy et al, 2007 and Pintér et al, 2008 and 2010. The evaluation of the whole dataset is in the focus of my current research activity.

EC based LHF, which is equivalent to evapotranspiration (ET) if divided by the latent heat of evaporation, was compared to MODIS Evapotranspiration (MOD16, <http://www.nts.gov/umt.edu/project/mod16>). 8-day sum of EC based ET was calculated for the same days when MOD16 was also available. Goodness of fit for the regression (between paired daily values in that year) for the different years range between 0.6913 and 0.8879, while the slope ranges between 0.9271 and 1.2224. In terms of yearly sum of ET MODIS underestimated the EC based ET by 1% ($R^2=0.6236$, RMSE=43.03), however when considering only the summer period (DOY 121-216) the underestimation was 10% ($R^2=0.7700$, RMSE=22.74), showing that there is a bias on seasonal basis in the MODIS data.

1. Materials and Methods

a. Ground measurements



Location

The measuring site is located near Bugacpuszta (46.69N, 19.60E, 107m asl) at a pasture maintained by the Kiskunság National Park and grazed by gray cattle herd.

Measuring technique: Eddy Covariance (EC)

Exchange of energy and of scalars can be measured by the eddy covariance technique i.e. by measuring the wind speed, temperature and concentration of the scalar (e.g. H₂O, CO₂, CH₄) at high frequency (10-50Hz). The amount of energy or scalar passing through a surface unit (e.g. m²) at time unit (sec) is the turbulent flux of energy or scalar. The flux is calculated from the high-frequency dataset by calculating the covariance of the vertical wind speed and the concentration of energy or scalar. Turbulent fluxes are usually measured and computed on half-hourly basis, and are later summed up to daily, monthly or yearly sums. Gap-filled dataset of LHF was produced by Reichstein's on-line gap-filling and flux partitioning tool (Reichstein et al, 2005).

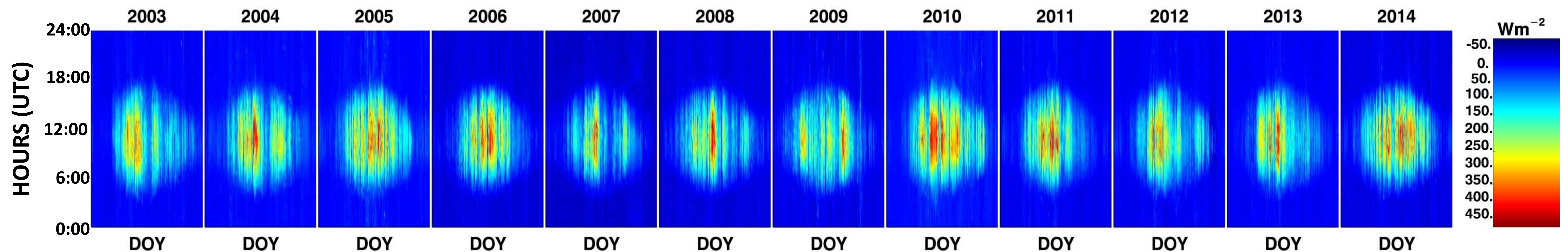
b. Spaceborne measurements

MOD 16 (land surface evapotranspiration product) was downloaded from: <http://www.nts.gov/umt.edu/project/mod16>.

Fig. 1. Half-hourly latent heat flux data in Wm⁻². I.e. each pixel on the graph represents one latent heat flux (evapotranspiration).

2. Results

2.1 Half-hourly evapotranspiration



2.2 Comparison of EC based and MODIS ET

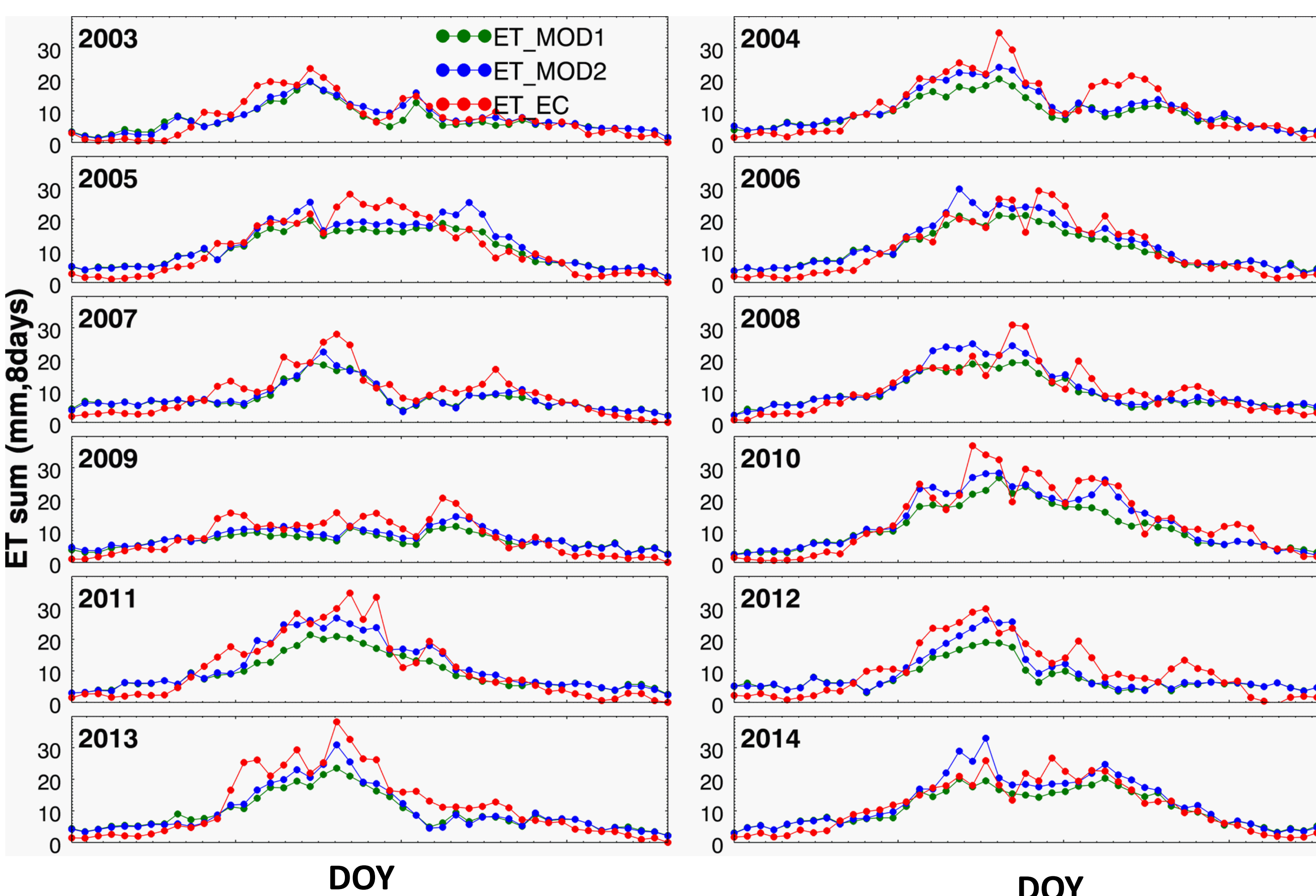


Fig. 2. 8-days sums of EC and MODIS based ET in mm.

The main footprint of the EC tower at Bugac can be covered by two pixels of MOD16. Data noted by ET_MOD1 corresponds to the pixel partly covered by woods. Data noted by ET_MOD2 corresponds to a pixel covered only by grass. Considerable differences in the estimates are mostly corresponding to wet periods.

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2.3 Regression of MODIS and EC based ET

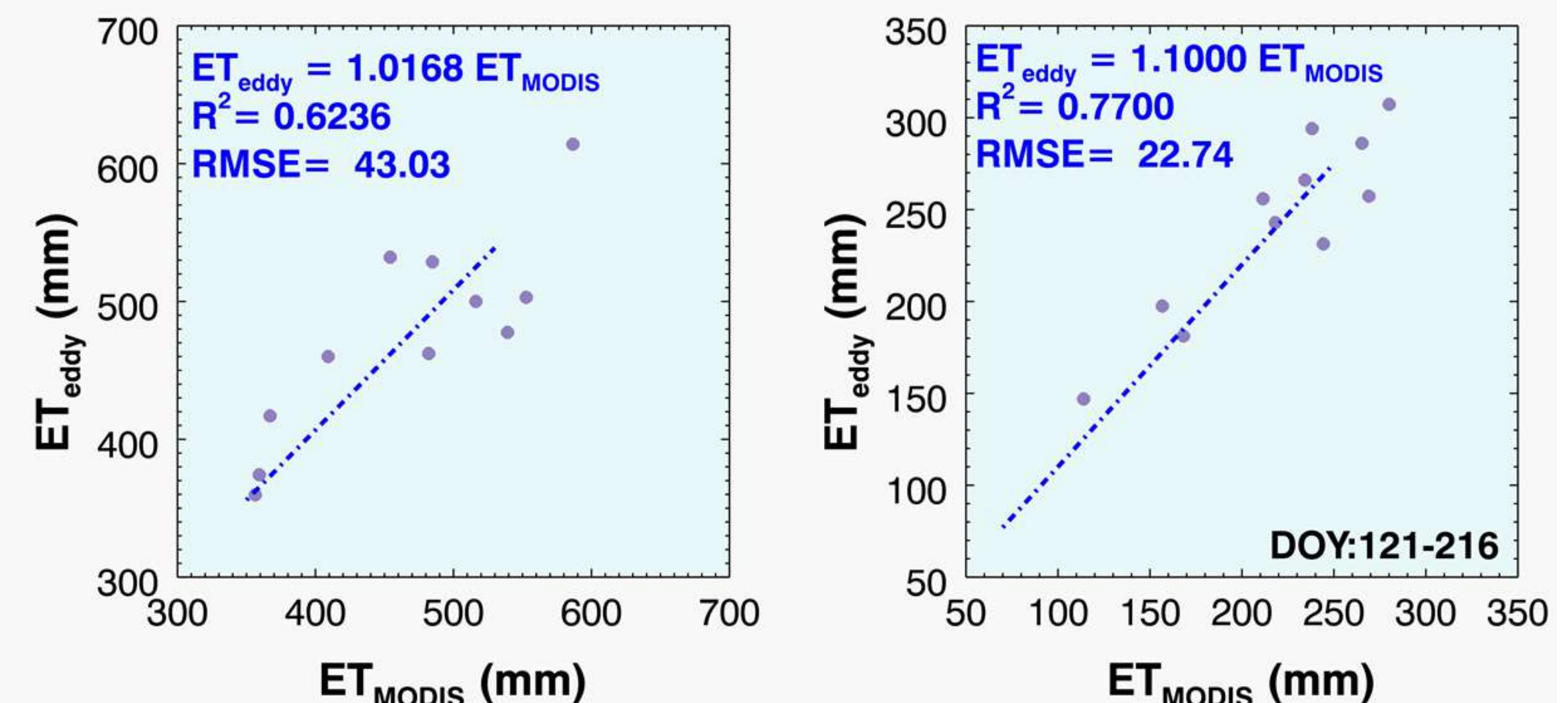


Fig. 3. Regression of MODIS and EC based sum of ET. Right: ET annual sum, left: ET sum for vegetation period.

Underestimation of ET by MODIS is more significant in the vegetation period, however R^2 was increasing and RMSE decreasing.

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