Complementary-Relationship Method aids to develop a Long-term, 0.1° Terrestrial **Evapotranspiration Product for China**

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1. Introduction

- \triangleright Quantifying large-scale land surface evapotranspiration (ET_a) remains a challenging task, though plot-scale measurements by eddy-covariance (EC) are widely used.
- \succ A high uncertainty up to the order of ~30% still exists in current large-scale ET_a products (see e.g., Mueller et al., 2011; Jiménez et al., 2011).
- \succ The complementary-relationship (CR) estimates ET_a without the need of any surface soil and vegetation data, the latter two are indispensable for most LSMs and RS ET_a models.
- The calibration-free non-linear CR model establishes the value of the Priestley-Taylor coefficient by spatially integrating temperature and humidity data over wet areas, avoiding to use of any measured/water-balance-based ET_{a} for model calibration.

2. Materials and Methods



3. Validations against EC-measurements of 13 flux towers



✓ Read Full Paper: Ma, N., Szilagyi, J., Zhang, Y., Liu, W., 2019. Complementary-relationship-based modeling of terrestrial evapotranspiration across China during 1982-2012: Validations and spatiotemporal analyses. Journal of Geophysical Research: Atmospheres, 124(8), 4326-4351. doi: 10.1029/2018JD029580 V Download this CR-based ET_a product: <u>http://en.tpedatabase.cn/portal/MetaDataInfo.jsp?MetaDataId=249494</u> [Now it covers 1982-2015, monthly; 0.1-degree]

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Model: Calibration-free nonlinear CR model (Szilagyi et al., 2017): $y = (2-X)X^2$ $X = \frac{ET_{\text{pmax}} - ET_{\text{p}}}{ET_{\text{pmax}} - ET_{\text{w}}} \frac{ET_{\text{w}}}{ET_{\text{p}}}$ $y = \frac{ET_a}{ET_p}$

Forcing: CMFD T_a, q, downward short- and long-wave radiation; GLASS emissivity, black- and white-sky albedos; NCEP diffuse sky-light ratio; MODIS LST.

Validation: 13 EC towers and Water-Balance (ET_{wb}) results of Chinese 10 major river basins







3. Validations against water-balance of 10 river basins



4. Does this new CR product improve ET_a estimation?





 \succ A new ET_a product was developed by the latest non-linear CR method, which improves the accuracy (higher NSE value) and spatial resolution when compared with previous ET_{a} products. \geq ET_a increased significantly over most part of the western and northeastern China, but decreased in the eastern and southern China during 1982-2012.

For 90 basin-year (10 basins, 2004-2012 annual data) CR produces: NSE = 0.8, RMSE = 77 mm/yr> Perform well in most basins except for overestimation in Southwest River Basin (400 vs 580) as well as Yangtze River Basin (13%) and underestimation in Hai River

> Water-balance-based assessment of other 8 ET_a products (1 EC upscaling, 2 reanalysis, 3 LSM, 2 RS models):

> Accuracy: The NSE of CR product is higher than 7 of 8 products except for CLM

Resolution: CR's 0.1° is the highest