Introduction

Since the advent of FLUXNET, land surface models are often evaluated on a handful of EC sites. Previous studies characterized the model-data errors on different time scales and pointed out that the large relative model-data errors occurred in low frequencies. However, the share of model-data error which is not random at and across different time scales is still not well understood. In this study, taking a land surface model (ORCHIDEE) as an example, we resort to time series decomposition method (SSA) and artificial neural network (ANN) for quantifying time-scale transitivity and space transitivity of model systematic errors on different time scales (diurnal, annual and interannual) based on 500 site-years of eddy covariance data from 123 sites across the global in FLUXNET database. The scientific issues we would like to answer in this study are as follows: (1) The share of model systematic errors on diurnal, annual and interannual time scales; (2) Whether model study errors can be transferable or not across different time scales; (3) Whether their is model systematic error transitivity within and across different vegetation types on different time scales.

Data and Methods

Lathuile Fluxnet dataset

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Table 1. The number of sites belonging to each PFT x climate zone

ORCHIDEE model

Identification of model systematic errors

Time series decomposition (Singualr system analysis)

To overcome great computer burden of decomposing half-hourly time series, we use local SSA (Yiou et al., 2000) to reconstruct diurnal cycle from the whole half-hourly time series. Daily time series are used for the reconstruction of the time series on annual and low frequencies parts.

Main Results

Model error transitivity

Within and across time scales

Error transitivity in spatial domain

Space transitivity of model Error is only obvious within Climate zone and PFT!!

Conclusions

Inter-annual time scale (low frequency) has the largest share of model error in the frequencies we considered; model systematic errors are poorly transferable across different time scales, which can be expected due to climate-driven processes regulating ecosystem fluxes across time scales in ORCHIDEE are different; model systematic errors is more shared within PFT and within climate zone at all frequencies, implying that model improvement based on specific sites can enhance the model behavior for the sites covered by the same PFT within the same climate zone. Our study also enables LSM community to have an idea of the theoretical bound for the space of model improvement and model uncertainties reduction, and provides the clues on how much of the benefits can be obtained for the overall model performance from site-based model calibration.

Bibliography

3. Krinner, G., N. Voviy, N. de Noblet, J. Ogée, J. Polcher, P. Friedlingstein, P. Ciais, S. Sitch, et I.C. Prentice, 2005. A dynamic global vegetation model for climate zone. Our study also enables LSM community to have an idea of the theoretical bound for the space of model improvement and model uncertainties reduction, and provides the clues on how much of the benefits can be obtained for the overall model performance from site-based model calibration.

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