Tracking water use efficiency (WUE) of terrestrial ecosystems using MODIS-EVI images

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1 Background and objectives

Water-use efficiency(WUE),which reflects trade-off between water loss and carbon gain in the process of plant photosynthetic,is an important parameter to describe terrestrial ecosystems.It indicates water-use strategy among different species or at different life stages of plants.The spatio-temporal dynamics of WUE exhibit rhythm and response of ecosystems to environmental variation and stresses including climate change.Accurate tracking and estimation of WUE continuously at regional or global scales will help to predict the change in stucture,function and distribution of terrestrial ecosystems under enviromental stresses.

Satellite remote sensing provides routine observations,such as vegetation and land surface temperature,and offers possibilities for extending point measurements or empirical relationships to much larger areas.Spatial related estimats of WUE can be done through defination of WUE with spatial estimates of ET and GPP by remote sesing models or models coupled with remsote sensing data. However, this is complex and results may be contaminated by uncertainties.

Zhang et al.(2009)found a significant linear relationship between MODIS-EVI and WUE over a mixed forest ecosystem. They constructed a simple one-parameter model (Eq1) to estimate WUE by linear transformations of MODIS-EVI data. The strong relationship between EVI and WUE is supported by recent reports on regulstion on WUE by LAI. These provides a possibility to constructe a simple direct model to describe WUE spatially.

$$WUE = \frac{WUE_{max}}{EVI_{max}} EVI \tag{1}$$

In this research, I propos**(1) to check if the linear relationship between WUE,defined as $WUE = \frac{GPP}{ET}$ estimated with eddy-covariance fluxes, and MODIS-EVI holds on over diverse**

ecosystems;(2)to relate the parameter WUE_{max} with geographic coordinates and climate factors and to develop a parameter vector corresponding to plant function types if (1) work; else (3)to recognize the relationships between WUE and MODIS-EVI and to develop direct empircal models to map the geographics variation.

It will provide a convinent direct way to track the response in water-use strategy of ecosystems to environmental stresses including climate change at high temporal and spatial resolution.It also outputs easy-obtained inputs and parameters for spatially resolved modelling.

2 Data input

Fluxes variables by eddy-covariance technique and supporting data at daily scales: WUE or GPP and ET; air temperature,TA; VPD. **Variables at annual scales:** annual air temperature; annual precipitation; geographic location(Longitude,latitude and elevation); IGBP vegetation classes; LAI_{max}.

3 Expected Output

(1) A direct model to relate WUE to MODIS-EVI; Geographics distribution of WUE_{max}

(2) A Paper aimed at ***Global Ecology and Biogeography***

4 Initial coordinator

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Junhui Zhang's CV

2005 – present, Associate professor, Institute of Applied Ecology, CAS

2002 – 2005, Assistant professor, Institute of Applied Ecology, CAS

2009.6 – present, Visisting Associate Professor, Yale Universlty, USA

2005.9 – 2006.3, START Fellowship, Australian National University, Australia

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5 Sites

All FLUXNET sites with measurements of NEE/ET and estimated GPP

6 Co-authorship

Colleagues who contribute data and ideas can be co-authored