STUDY OF REMOTE SENSING BASED PARAMETER UNCERTAINTY IN PRODUCTION EFFICIENCY MODELS

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1. INTRODUCTION

Terrestrial net primary productivity (NPP) is the central-related variable summarizing the interface between plant and other processes[1] and is sensitive to the environmental factors and is highly variable in space and time. Thus, estimating NPP more precisely is a key component to understand the terrestrial carbon cycle.

Along with the increasing availability of remote sensing measurement, the remote sensing based production efficiency models (PEMs) which uses the "Light Use Efficiency (ε)" concept[2] has been applied more and more for estimating terrestrial NPP (i.e. CASA, GLO-PEM, SDBM, VPM, and TURC). However, Researches[3, 4] shows that global NPP estimate vary greatly (48.9 - 80.5 Pg C) between different models under the same data source, it is difficult to evaluate the accuracy of the results. Since no field data is available to validate the results on global scale, we have no way to determine which result is closer to the "true value".

In this study, we focus on the uncertainty of remote sensing based parameters' acquisition and analysis in PEMs, by using different data sources as input for each parameter and combining with ground measurement in Hulunbeier, to seek methods to improve model accuracy.

2. REMOTE SENSING BASED PARAMETERS IN PEMS

PEMs are based on the concept of light use efficiency: under the ideal environment, NPP has a strong linear relationship with light use efficiency (ε) and absorbed photosynthetically active radiation ($APAR$): NPP=$\varepsilon \cdot APAR$. Remote sensing data was used to acquire the land surface condition, especially vegetation type and $fPAR$. Parameters obtained from remote sensing data (Tab.1) can be divided into three categories: (1) Vegetation Distribution Information; (2) Vegetation Index and (3) Vegetation growth environment information.

Model	Remote sensing based parameters
CASA	Vegetation Distribution, *fPAR*
GLO-PEM	*fPAR,* Solar radiation,Temperature, Vapour Pressure Deficit, Soil water
TURC	Vegetation Distribution, *fPAR*
SDBM	*fPAR*
VPM	Vegetation Distribution, *fPAR*

Table 1. Remote sensing based parameters in PEMs

3. UNCERTAINTY ANALYSIS OF REMOTE SENSING PARAMETERS

3.1. Remote sensing based *fPAR*

fPAR reflects the status of vegetation canopy's absorption of photosynthetically active radiation, has a direct impact on the uncertainty of PEMs. Remote sensing provides a means to estimating *fPAR* globally. Most models (CASA, GLO-PEM, SDBM and TURC) utilizes Normalized Difference Vegetation Index (*NDVI*) to obtain *fPAR* (apply different algorithms), while VPM uses Enhanced Vegetation Index (*EVI*). Our research uses MODIS *NDVI* and *EVI* data with 1*km*, 500*m* and 250*m* spatial resolution, and ground measured spatial data from Hulunbeier grassland. The relative error (Fig.1) shows that the better spatial resolution brings the higher precision. In some extra point, relative error from the 1*km* resolution can reach up to 51.3%.

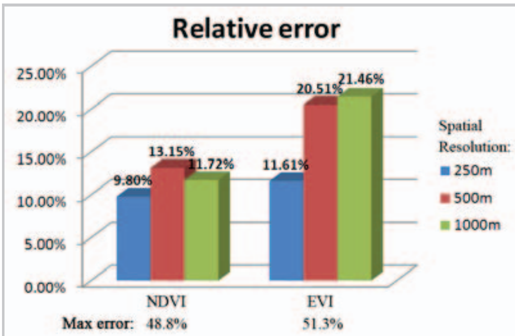

Figure 1. Relative error of *NDVI* and *EVI*

3.2. Vegetation distribution

Vegetation Distribution affect the model accuracy mainly can be described in two types:

- Applying Vegetation Distribution: All remote sensing based PEMs assumes the world is covered by vegetation. A comparison between actual vegetation data set and potential vegetation data set shows that the human land use and agriculture affect up to 40% of NPP estimate in temperate mixed forests and deciduous forest on a global scale[3]. Regionally the simulated NPP with land use constraint in the south portion of NSTEC was about 65% of that without land use constraint[5]. On the other hand, a better classification accuracy has testified its improvement for NPP estimate[6].

- Determination of other parameters: Vegetation distribution is applied directly or as an intermediate variable to determine the precision of other parameters such as ε^*, R_A, P_L and *EET*. In most models, these parameters are assumed constant or determined by the vegetation maps. However, these plant physiological-related parameters apparently depend on the vegetation type with the classification accuracy taken into account.

It is not possible for us to know the exactly number how much vegetation distribution affected, but it is surely that a real-time, more accurate vegetation distribution can significantly affect the accuracy of the models.

4. CONCLUSION

In this study, the remote sensing based parameters in PEMs and uncertainty analysis have been performed. Our results consider vegetation distribution as the most important parameter because of its application and influence to other parameters. Uncertainty of vegetation index derived *fPAR* is mainly determined by the precision of vegetation index, and our research combining with Hulunbeier ground measurement shows that a better resolution (250*m* versus 1*km*) may reduce up to 51.3% uncertainty of *fPAR*. Spatial resolution in *fPAR* and a more accurate vegetation distribution obtained from remote sensing can significantly increase the precision of NPP estimation.

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