VALIDATION OF REMOTELY SENSED EVAPOTRANSPIRATION: A CASE STUDY

Zhenzhen Jia, Shaomin Liu, Ziwei Xu

State Key Laboratory of Remote Sensing Science, School of Geography, Beijing Normal University, Beijing 100875, China

1. INTRODUCTION

The application of remote sensing data has facilitated the estimation of regional evapotranspiration (ET). As a novel technology involving various physical processes, many uncertainties exist in ET estimation from remote sensing. Due to the understanding of some mechanisms and the parameterization of key factors have not been fully developed nowadays, and the complexity of land surface, validation of remotely sensed ET based on ground measurements is indispensable. Without validation, any methods, models, algorithms, or results derived from remotely sensed data can not be used in confident for agricultural, hydrological experts and common users. Nevertheless, validation method of estimated ET is one of the most troublesome problems currently, mainly because of both the scaling effects and advection effects [2].

2. MATERIALS AND METHODS

In this study, an elaborate validation method of ET estimated by remote sensing was proposed including: (a) ET observation system and a network at different satellite pixel scales, (b) observational data processing procedures and (c) validation procedure.

ET observations at different satellite pixel scales contained an observation system and a network of observations. The observation system with eddy covariance (EC), large aperture scintillometer (LAS) and automatic weather station (AWS) was constituted to gain continuous ET measurements at different satellite pixel scales and correlative parameters. Accordingly, a network of ET observations at satellite pixel scale was established over heterogeneous landscapes in Hai River Basin, Heihe River Basin and Tibetan Plateau located in different climatic zones of China (Figure 1). From 2004 to 2009, a series of long term ET observations in Miyun, Guantao, Daxing, Arou, and Naqu BJ as well as short term ET observations in Xiaotangshan and Haidian Park were carried out.

On this basis, data processing procedures including observational data screening and quality control were built for EC and LAS respectively [3, 6, 7]. And then different gap filling methods of EC and LAS measurements was discussed to acquire the serial ground data.

Based on ground measurements, a detailed validation procedure of remotely sensed ET was proposed, in which the estimated results can be assessed comprehensively from the quantitative accuracy analysis of estimated ET, verification of the spatio-temporal distribution characteristics etc. On the one hand, monthly and daily estimated ET at high and moderate/low resolutions were validated using observational data combined with footprint model of EC and LAS respectively. The footprint model [1, 4] was used to determine what area is contributing the observational fluxes to the sensors as well as the relative weight of each pixel inside. The weight images can be multiplied to the ET images to obtain the weighted pixel values, and then compared with measurements. On the other hand, remotely sensed annual ET was assessed by ET estimated from water balance method. Furthermore, the root mean square difference (RMSD), mean absolute percent difference (MAPD) and correlation coefficient (R) were considered as error check index. In a word, the whole validation procedure involved three aspects: analysis for the accuracy of retrieved ET, possible reasons of the difference between the ET estimated by remote sensing and measurements, and error analysis of the validation process (Figure 2).

3. RESULTS AND DISCUSSIONS

Validation of remotely sensed ET in Beijing area was performed. This work was supported by GEF Project - Hai Basin Integrated Water and Environment Management. ET products in diverse temporal scales (annual, monthly, and daily) and key parameters derived from ETWatch system [5] at both 30m and 1km resolutions in Beijing during 2004 to 2007 were validated, integrated with the ground-based measurements from EC, LAS and AWS in Xiaotangshan, Haidian Park, Miyun and Daxing sites and the annual ET data estimated by the water balance method. The results showed that: the estimated annual ET was about 9.1% and 11.09% larger than ET calculated from water balance method at 30m and 1km resolutions respectively; the 30m monthly ET was about 26.68% smaller than EC measurements and the 1km monthly ET was 21.32% larger than LAS observations. Consequently, the application in Beijing area demonstrated the proposed validation method was feasible.

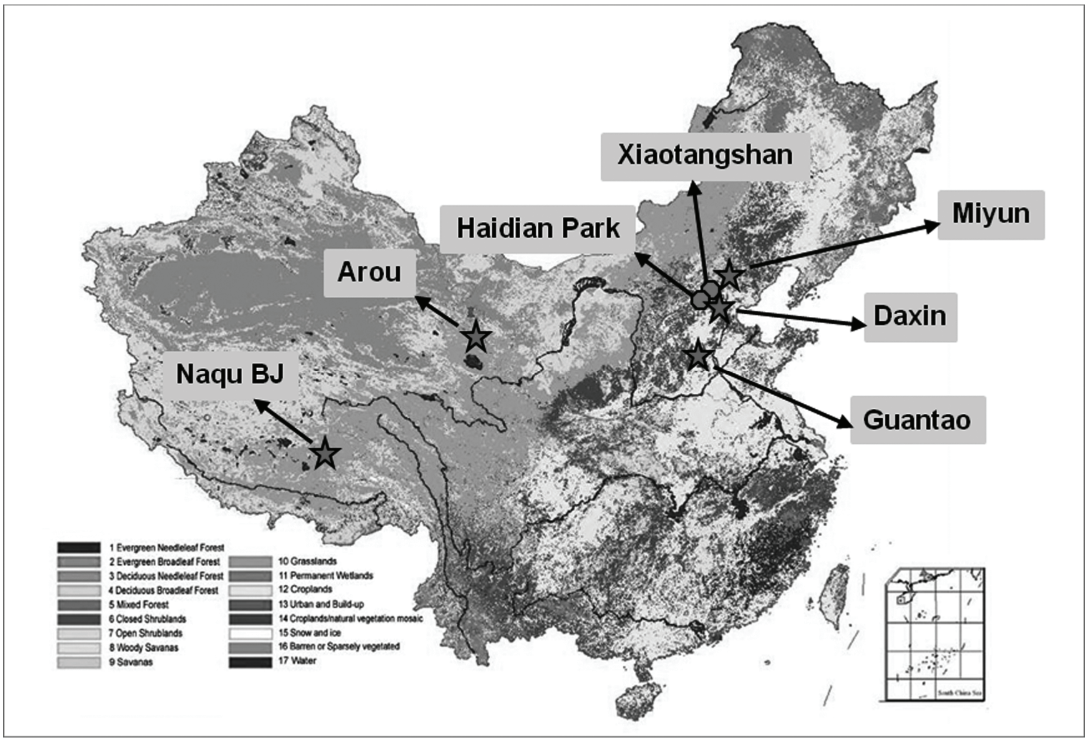

Figure 1. A network of ET observations at satellite pixel scale

★ :long term observations; ● :short term observations

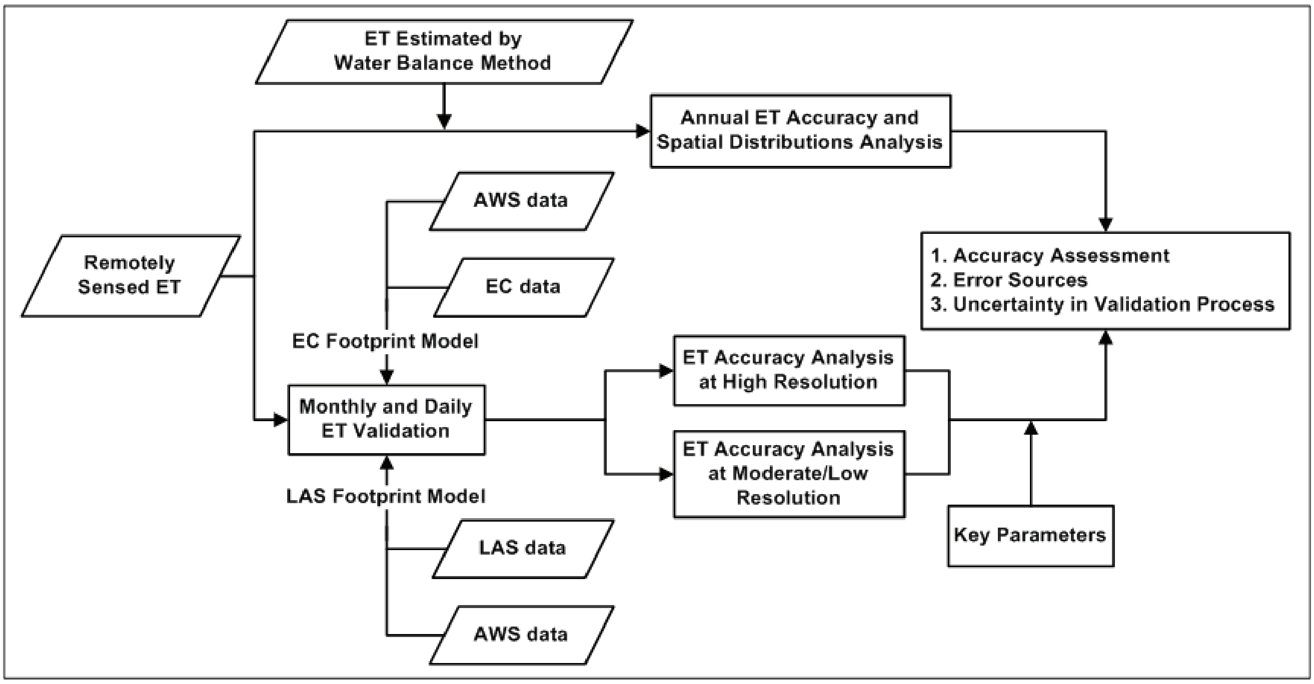

Figure 2. The flow chart of validation procedure

5. REFERENCES

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