Error Analysis of SAIL Model and Application

Hua YANG [1], Zheng LU [1], Xiang MA [2], Haoran WU [1] and Hengjian CUI [2]
[1]School of Geography and Remote Sensing Science, Beijing Key Laboratory of Environmental Remote Sensing and Digital City, State Key Laboratory of Remote Sensing Science Jointly Sponsored by Beijing Normal University and the Institute of Remote Sensing Applications of CAS, Beijing, 100875, China
[2] Department of Statistical and Financial Mathematics, School of Mathematical Science, Statistical Data Analysis Laboratory, Beijing Normal University, Beijing, 100875, China

BRDF (Bidirectional Reflection Distribution Function) models are based on the physical process of the light propagation in the medium. Different model has its own emphasis on describing the process but all established on some assumptions and approximation of the real world. In other words, the model simulations are the approximation of the real and the difference between them is called model error. At present, models are usually assumed perfect in quantitative remote sensing inversion without considering of the model error, in another hand, the analysis of model error in data assimilation is also a big problem. In this paper, SAIL（Scattering from Arbitrarily Inclined Leaves）model is taken as an example, acquiring and expression method of the model error are investigated at first, and then, how to use it in inversion as the prior knowledge is studied. The aim of these researches is improving the accuracy of inversion results, declining the uncertainty of the unknowns and giving a base for model error analysis in data assimilation.

Normal distribution is often used to describe the difference between models and observations basing on perfect model assumption. When model error is considered, normal distribution is not suitable. So, the distribution of the model error and its expression are studied firstly in this paper. Forward simulations of Radiosity model are assumed the real. Differences between them and the SAIL model are taken as SAIL model error. Statistical test results show that the error is not obey the normal distribution. Analyzing and fitting found two possible distribution type, mix normal distribution and exponential distribution. For parameters inversion, expression function of some model parameters for model error is fitted. All these are taken as prior knowledge to modify the cost function in inversion. Multi-stage strategy for inversion and adaptive genetic algorithm are used in the inversion method.

Finally, forward simulation of Radiosity model, the field observations and MODIS data are used to validate the method. Results of simulation and observation data illustrate that the accuracy of inversion results is improved, and the uncertainty of the unknowns is declined than that of not considering model error. Results of MODIS data have same trend to the LAI products. The results are encouraged. The further validation and model error analysis has been going on.

Corresponding author: Hua YANG

Hua YANG
Associate Professor

School of Geography and Remote Sensing Science, Beijing Normal University, No.19, Xinjiekouwai Street, Haidian District, Beijing, 100875, China
Email: yh_crs@bnu.edu.cn

Zheng LU
Master
School of Geography and Remote Sensing Science, Beijing Normal University, No.19, Xinjiekouwai Street, Haidian District, Beijing, 100875, China
Email: luzh1984@tom.com

Xiang MA
Master
Department of Statistical and Financial Mathematics, Beijing Normal University, No.19, Xinjiekouwai Street, Haidian District, Beijing, 100875, China
Email: mxbnu@126.com

Haoran WU
Bachelor
School of Geography and Remote Sensing Science, Beijing Normal University, No.19, Xinjiekouwai Street, Haidian District, Beijing, 100875, China
Email: whr1987@yahoo.com.cn

Hengjian CUI
Professor
Department of Statistical and Financial Mathematics, Beijing Normal University, No.19, Xinjiekouwai Street, Haidian District, Beijing, 100875, China
Email: hjcui@bnu.edu.cn