IMPROVED MODELS FOR CHLA ESTIMATION BY CONSIDERING THE EFFECT OF PHYTOPLANKTON SPECIFIC ABSORPTION

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Abstract: In water color remote sensing, the importance of studying chlorophyll-a has been recognized for decades not only due to its indicative status for bio-production of water bodies but also for its importance to determine water trophic state. Different kinds of algorithms were developed to retrieve Chla information [1-4], from empirical models to semi-empirical ones. Recently, a conceptual three-band model $[R_{rs}^{-1}(\lambda_1)-R_{rs}^{-1}(\lambda_2)]\times R_{rs}(\lambda_3)$ and its revised version the four-band model $[R_{rs}^{-1}(\lambda_1)-R_{rs}^{-1}(\lambda_2)]\times[R_{rs}^{-1}(\lambda_3)-R_{rs}^{-1}(\lambda_4)]^{-1}$ were proposed for Chla estimation in Case-II waters [5,6]. Although a series of researches have confirmed their robust use in turbid, productive waters [7,8], they were all based on the assumption that the optical parameter of phytoplankton specific absorption coefficient a^*_{ph} remained constant. In practice, the parameter is variable from site to site owing to the changes in phytoplankton cell size, intracellular pigment concentration and the relative importance of auxiliary pigments [9,10]. Therefore, the assumption of a constant for a^*_{ph} would be a significant source of uncertainty in models for the remote estimation of Chla.

In this paper, we presented newly improved models, $[R_{rs}^{-1}(\lambda_1)-R_{rs}^{-1}(\lambda_2)]\times R_{rs}(\lambda_3)\times a^{*}_{ph}{}^{-1}(\lambda_1)$ and $[R_{rs}^{-1}(\lambda_1)-R_{rs}^{-1}(\lambda_2)]\times[R_{rs}^{-1}(\lambda_3)-R_{rs}^{-1}(\lambda_4)]^{-1}\times a^{*}_{ph}{}^{-1}(\lambda_1)$, to eliminate interferences from a^*_{ph} for a more accurate estimation of Chla. A case study in Shitoukoumen Reservoir, Jilin Province China, was carried out. Spectral properties and inherent optical properties (IOPs) of target water were analyzed first based on two filed campaigns in different seasons in 2008, as well as associated laboratory analyses. Results showed that as a typical example of inland Case-II

waters, Shitoukoumen Reservoir had two distinct diagnostic peaks in its specific absorption spectrum of phytoplankton pigments among which $a^*_{ph}(675)$ could vary up to three folds between different samples. Although the spectrally tuned results of conceptual three-band model and four-band model had pretty good relationship with Chla contents (Figure 1), when we retuned the two models under the consideration of a^*_{ph}, more accurate results were achieved (Figure 2). Comparison indicated that four-band models performed better than three-band models and the improved four-band model owned the best determination coefficient (R^2) and root mean square errors ($RMSE$), implying that consideration of a^*_{ph} could effectively enhance retrieving accuracy of Chla. Although the findings underline the rationale behind the improved models, an extensive database containing data in different water conditions and water types is required to generalize their application.

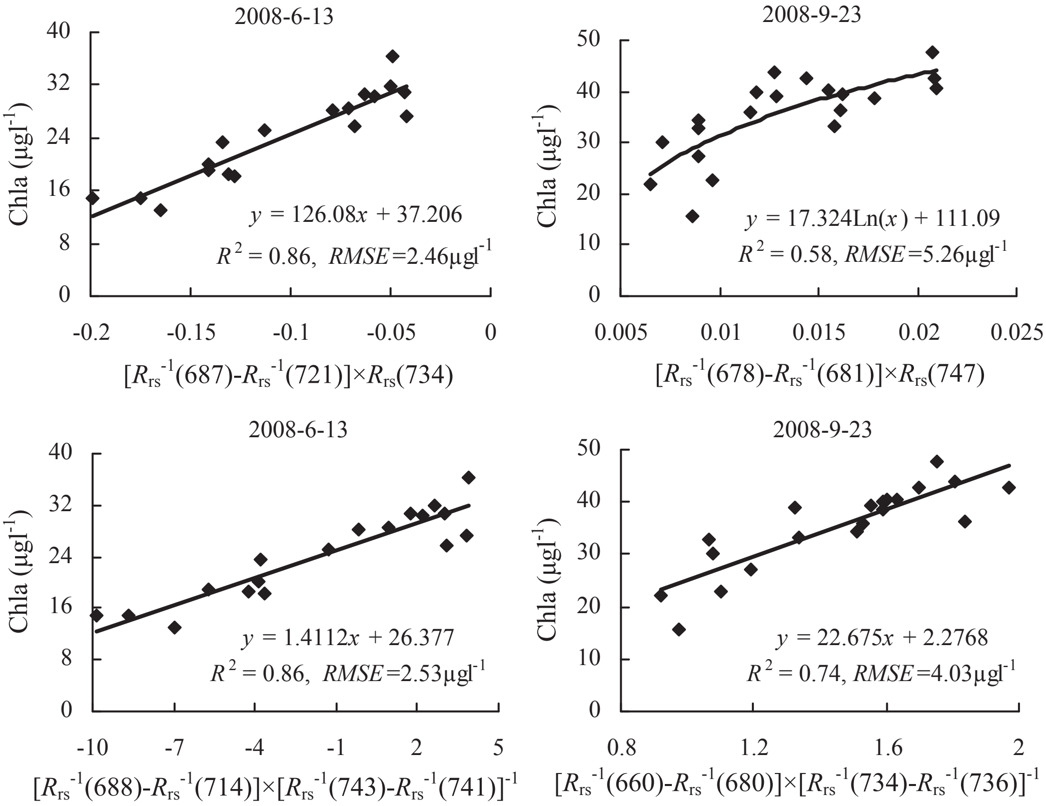

Figure1. Estimation of Chla based on conceptual three-band model and four-band model

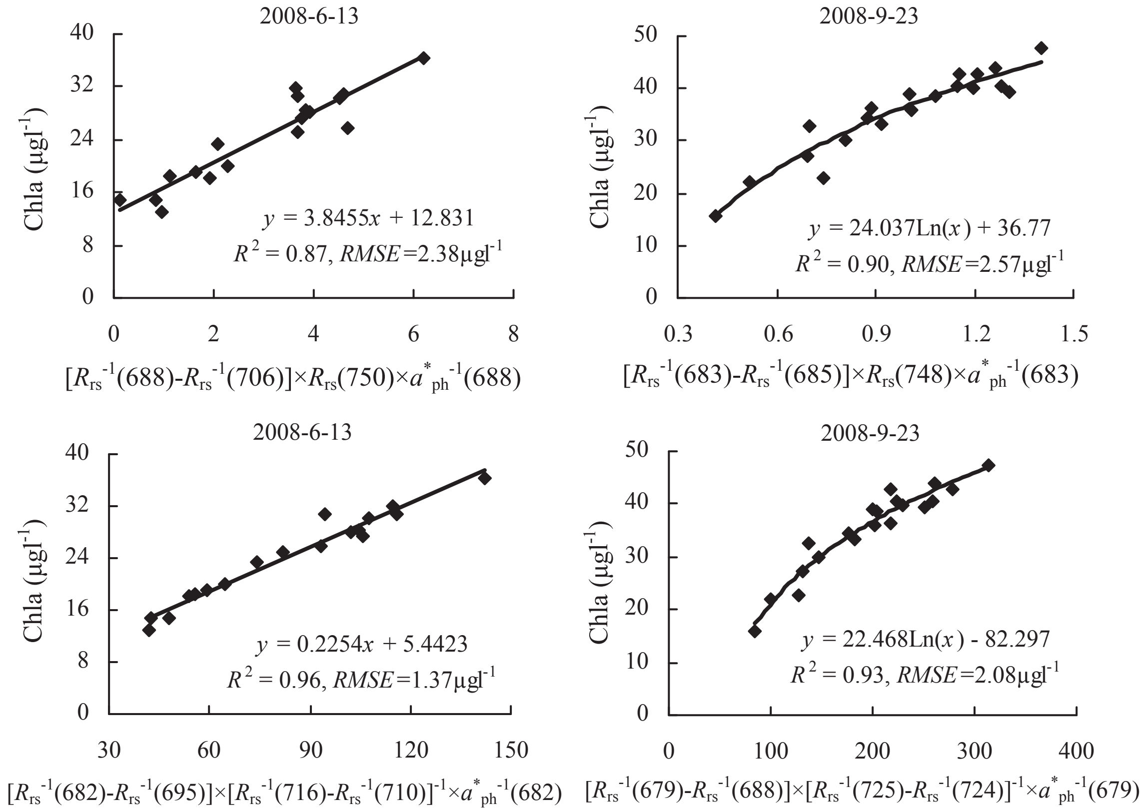

Figure2 Estimation of Chla based on the improved three-band model and four-band model

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