

ASSIMILATION FIELD MEASURED LAI INTO CROP GROWTH MODEL BASED ON SCE-UA OPTIMIZATION ALGORITHM

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Abstract: Crop growth model had been widely used to simulate the crop yield and the better results had been gotten when applying the crop growth model at field level. But when crop growth model was used at the regional scale, the gotten results were not so good. The main reason was that the necessary input data such as agricultural management information (including fertilizer application and crop planting date, etc) and crop variety information couldn't be gotten at a large scale. But this information was very critical to the crop growth model. So these situations have hindered the effective application of crop growth model at regional scale.

With the development of technology of computer and remote sensing, how to use external data to get the spatial valuable information through assimilating remote sensing data into crop growth model has been becoming a research hotspot which makes it possible to do better job in crop yield prediction and crop growth monitoring. In this paper, we emphasized particularly on the basic research about the feasibility and suitability of coupling the Shuffled Complex Evolution (SCE-UA) algorithm with crop growth model. Finally, we assimilated the measured summer maize leaves area index (LAI) into crop growth model to simulate yield, sowing date and nitrogen fertilizer application rate of summer maize in Huanghuaihai Plain in China.

The crop growth model used in this paper was EPIC (Environmental Policy Integrated Climate) model which was developed in America in 1984 and is suitable to most of all crop simulation. The global optimization algorithm of this paper was shuffled complex evolution (SCE-UA) method which was

developed by Q. Y. Duan in 1992.

The results showed that root mean squared error (RMSE) between simulated yield and ground measured yield of summer maize was 0.84 t/ha and the correlation coefficient (R^2) between them was only 0.033 without external data assimilation. While the performance of EPIC model of simulating yield, sowing date and nitrogen fertilizer application rate of summer maize was better through assimilating field measured LAI into the EPIC model. The RMSE of between simulated yield and ground measured yield of summer maize was 0.60 t/ha and the correlation coefficient (R^2) was 0.5301. The relative error between simulated sowing date and real sowing date of summer maize was 2.28%. On the simulation of nitrogen fertilizer application rate, the relative error was -6.00% compared with statistic data. These above errors could meet the need of crop growth monitoring and yield estimation at regional scale. It proved that assimilating field measured LAI into crop growth model based on SCE-UA optimization algorithm to monitor crop growth and estimate crop yield was feasible.

Key words: Crop growth model; EPIC; Data assimilation; Optimization algorithm; Yield estimation; LAI