WORKSHOP 05

Simulation of Rice Growth at a High Spatial Resolution Using RCP Scenarios

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I. Introduction

Gridded climate data have been used as an input data to crop growth models for prediction of crop yields (Sheehy *et al.*, 2006; Lee *et al.*, 2011; Lee *et al.*, 2012b; Kim *et al.*, 2013). Depending on spatial resolution of gridded data, reliability of crop yield prediction could be affected by uncertainty in these data. For example, it would be challenging to simulate spatial variation of crop production using climate data at low resolution, *e.g.*, 100–200 km, which is common for the outputs of general circulation models (GCM). Although downscaled climate data become available for spatial prediction of crop production , biases of those data may cause errors in simulation of crop growth (Glotter *et al.*, 2014). Such an errors could affect identification of adaptation planning in crop management, *e.g.*, shift of planting date. The objectives of this study was to examine suitability of downscaled climate data at high spatial resolution as weather inputs to a crop growth model to determine planting dates in a region.

II. Materials and Methods

The optimal seeding date was determined at each grid point using regional climate model data under RCP 8.5 scenarios as inputs to the ORYZA2000 model. Gridded climate data were obtained from the web-based climate data base operated by Korea Meteorological Administration. It was assumed that the seeding date during the 1990s would be one of the dates from April 10th to June 9th. For each grid point, a set of crop yield simulations was performed from those seeding dates selected at 10 days interval. The optimal seeding date was chosen to be the date on which simulated crop yield was at maximum. In addition, low temperature conditions during grain filling periods were also considered to identify the optimal seeding date (Kim *et al.*, 2014). Simulation settings, *e.g.*, fertilizer application rate, and parameters for the ORYZA2000 model were configured to meet current recommendation for rice growth by Rural Development Administration (Lee *et al.*, 2012b) except for cultivars. In the present study, the late maturity cultivar was only subjected to a simulation of seeding date.

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III. Results and Discussion

Overall, the optimum seeding dates identified using the gridded climate data at 12.5km resolution as inputs to the crop model were between mid-April and late May, which was similar to actual seeding date (Fig. 1).

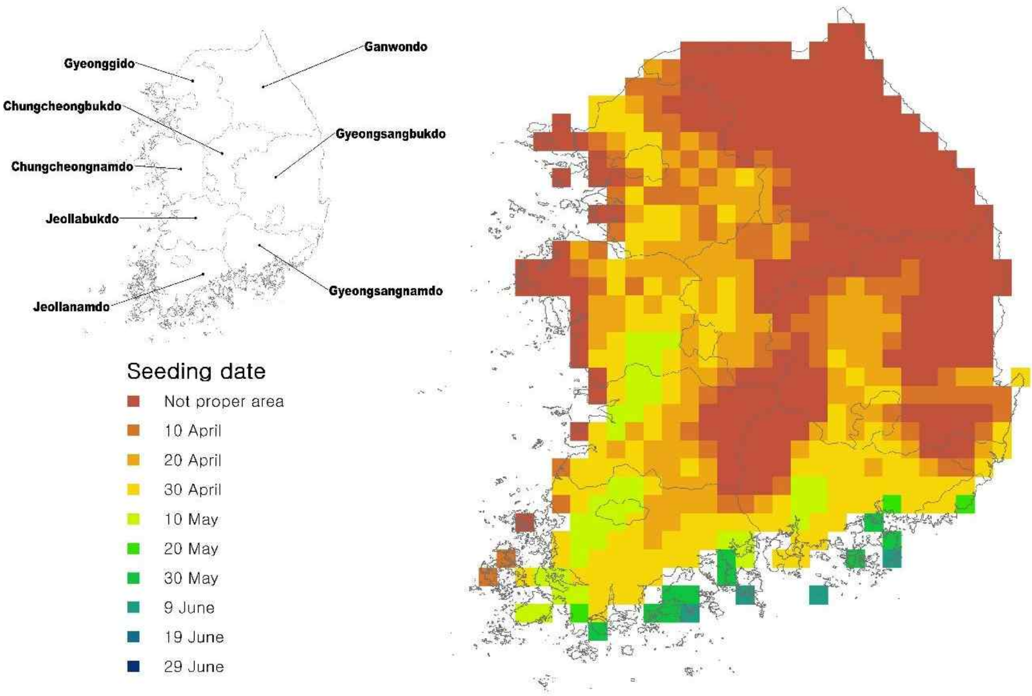

Fig. 1. The optimal seeding dates in the 1990s, which were determined using regional climate model data as inputs to the ORYZA2000 model. The regional climate data at a spatial resolution of 12.5 km were obtained using the HadGEM3-RA model through dynamic downscaling of global climate scenario data.

For example, areas with simple terrain conditions, e.g., plain areas, tended to have the optimum seeding dates consistent with seeding dates recommended by Rural Development Administration. Spatial variation in optimal seeding date predicted using the model was also similar to current range of seeding dates. For example, the optimum seeding date was determined to be earlier at higher latitude areas than at lower latitude area. In south coastal areas and islands, the optimal seeding date was determined to be early June. Mountainous areas in the north-eastern region were classified as non-favorable areas.

Nonetheless, there were a number of sites where the optimum seeding date determined using gridded climate data had considerably large errors. For example, non-favorable areas for rice cultivation located mostly near the large water body such as ocean, river, and lake, or in mountainous areas, *e.g.*, > 200m of elevation even though rice has been cultivated in those area.

For example, Seo-san area in mid-western region of Korea was identified as non-favorable area for rice cultivation although rice production in this area was considerably large.

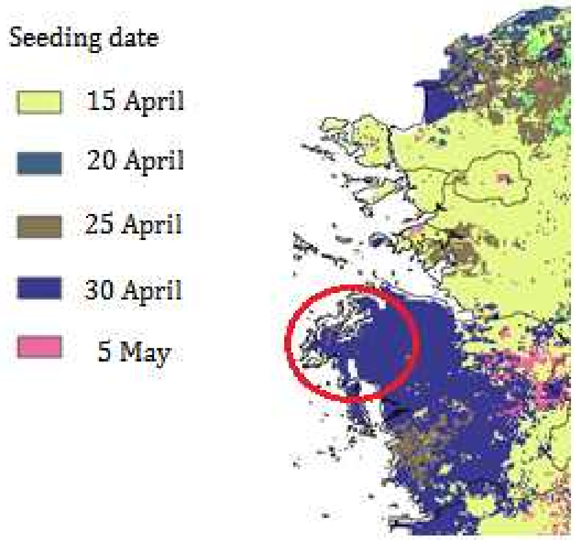

Fig. 2. Seeding date in mid-west Korea area determined by CERES-RICE based on downscaled climate scenario data under RCP 8.5. Area of a circle is Seosan.

When another gridded data set at spatial resolution of 1km were used as inputs to another crop model, CERES-Rice model, the optimum seeding date for the regions with complex terrain was identified to be similar to actual dates. For example, the optimum seeding date identified using the CERES-Rice model was about 30nd April in Seosan area (Fig. 2). Actual seeding dates range are between 21st to 30nd April in Seonsan area. These results suggested that the value at a grid cell that represent areas in a complex terrain could have relatively large uncertainty, which would result in large errors in simulation of rice growth. Therefore, it would be preferable to perform crop growth simulation using gridded data at higher resolution, *e.g.*, 1km, for areas with complex terrain conditions.

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