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USE OF DISAGGREGATED RAINFALL DATA FOR DISTRIBUTED HYDROLOGICAL MODELING IN YODO RIVER BASIN

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1. Introduction

Disaggregation of rainfall field from a coarse space-time resolution to a fine space-time resolution is emerging as an essential tool to relate the weather variability in multiple scales. The disaggregation studies enable us both to transform the structure of rainfall field at multiple scales of space-time representation and to supply the rainfall of finer space-time resolution for practical applications, e.g. for the distributed hydrological modeling. Having a large significance of the distributed input field in distributed hydrological modeling, the disaggregated rainfall fields can show extensive details of impacts in hydrological simulation caused by various rainfall scenarios and the effectiveness of a chosen disaggregation method as well. But the disaggregated rainfall fields are not investigated enough in hydrological simulation using a distributed hydrological model.

2. Methodology

In this study, we attempted to use the disaggregated rainfall field in hydrological simulation of various sub-catchments of the Yodo River. This study used the Yodo River model, an OHyMoS assisted distributed hydrological model with saturated-unsaturated surface-subsurface flow mechanism. This model was calibrated using the radar observed rainfall data. The rainfall dataset is having 3-km spatial resolution and 10-minute temporal resolution.

The rainfall dataset was then aggregated into a coarser space-time resolution having 48-km spatial resolution and 100-minute temporal resolution. This coarse resolution rainfall was used as the input data to obtain the disaggregated rainfall field. The multiplicative random cascade (RC) method (based on the beta lognormal model) disaggregated the rainfall into 3-km spatial resolution. The multiplicative random cascade HSA (RCHSA) method, which considers the spatial correlation of rainfall structure, also disaggregated the rainfall into 3-km spatial resolution. Both these methods did not have temporal disaggregation. The space-time rainfall modeling (STRaM) method disaggregated the rainfall into 3-km spatial resolution and 10-minute temporal resolution. This method uses multiplicative cascade model and rainfall translation model for space-time disaggregation.

The ensemble of rainfall field obtained from the disaggregation methods mentioned above were used to simulate the runoff at Ootori, Ieno, Kamo and Inooka having catchments areas of 156 km^2, 476 km^2, 1469 km^2 and 1589 km^2 respectively

3. Results

The simulation results have shown that the results depend on accuracy of disaggregated rainfall field both in terms of spatial and temporal variability generated by different disaggregation methods even for a well calibrated hydrological model. The discrepancy in the ensemble of results is relatively smaller for larger basins. The RC method and RCHSA method are not successful to yield runoff within acceptable uncertainty bound. The STRaM method is found promisingly successful for the catchment as small as of 156 km^2 at Ootori, which is about 15 times smaller in area than a single rain pixel of the coarse resolution representation before disaggregation.