Development of nationwide 150m high-resolution Rainfall-Runoff-Inundation model for flood forecasting: Integration of 26,000 cross-section data to improve flood predictions

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Background and Objective

- Sayama et al.[1)] had developed **150m high-resolusion RRI model**, and applied it for ensemble flood forecasting.
- Despite the high accuracy of discharge prediction, **accuracy of waterlevel prediction is still limited**.
- In this study,
  - we try **to improve waterlevel prediction accuracy**,
  - by **introducing 26000 observed sections** in JRRI.

Idea and Method

- Data: Database of measured Cross-Sections by MLIT.
- Previous : CS introduction required **manual efforts**.
- Yamada et al.[2)] developed **semi-automated algorithms** for introducing mass database of CS into distributed hydrological models, like RRI model.
- Procedure (detail in ref.)
  - Projection -> Allocation
  - Extension on River
- Introduced **26000 observed CSs** for whole-Japan RRI model (**> 6000km** !)
- By w/ vs w/o CS experiment, check the effect of CS on waterlevel precition accuracy.
- Target Event : 2018 West-Japan Heavy Rain.

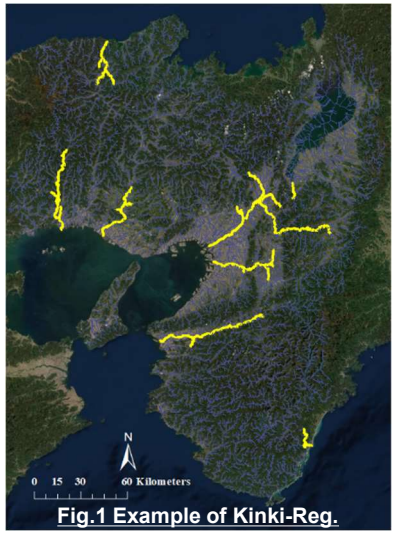

Fig.1 Example of Kinki-Reg.

Summary of Result

- Introduced **26000 observed CSs** (i.e. **> 6000km**) for whole-Japan RRI model.
- Waterlevel prediction : Both of **overall accuracy and peak accuracy IMPROVED**.
  - Overall Accuracy : **RMSE** improved from 1.80 ± 1.57 [m] to **0.74 ± 0.41 [m]**.
  - Peak Accuracy : **Peak Error** improved from -2.04 ± 1.70 [m] to **0.14 ± 0.88 [m]**.
- **Wide-area CS introduction in the model is desirable** for waterlevel predictions.
- To Do : Further introduction of CSs into model is now undergoing…

Detail of Result and Discussion

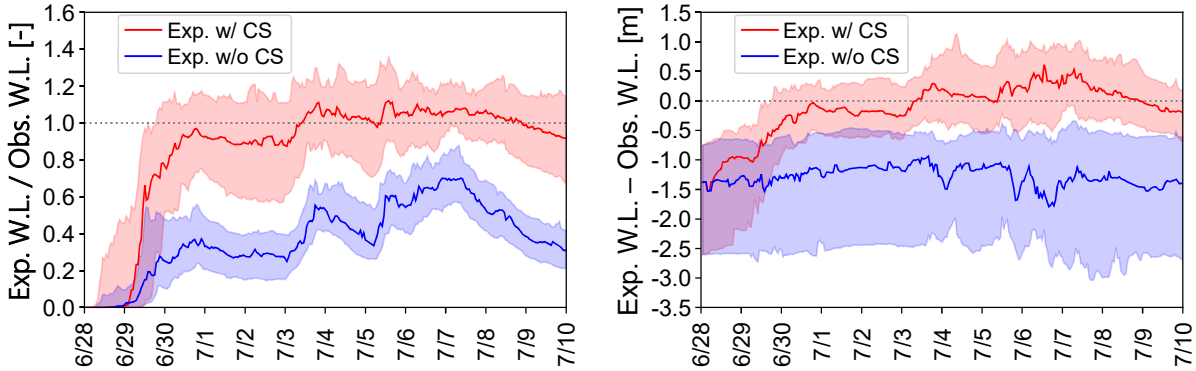

Fig. 2 Comparison of Exp w/ CS vs Exp. w/o CS (line: median of each hour, shade : 25%~75%)

- Targets : 51 WL observation sites with complete WL record and corresponding CS.
- For whole period of the event, experiment WITH CS simulates observed waterlevel change more accurately than experiment without CS does.
- Persistent negative bias in experiment without CS is alomst cleared in exp. w/ CS.
  - Fluctuation of ratio/difference has also decreased in exp. w/ CS. : more stable.
- Direct comparison of observed WL vs. simulated WL over wide-area become possible.
- Accuracy Metrices have been also improved by CS introduction(vals in summary abv.)

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Refs: 1) Sayama, T. et al. Ensemble flash flood predictions using a high-resolution nationwide distributed rainfall-runoff model: case study of the heavy rain event of July 2018 and Typhoon Hagibis in 2019. Prog Earth Planet Sci 7, 75 (2020). https://doi.org/10.1186/s40645-020-00391-7
2) Yamada. M. et al. Submitted in JSCE Journal of Civil Engineering. Acknowledgement : This research is supported/funded by SIP(Section:Super-Typhoon, PI: Dr. TACHIKAWA), and JSPS KAKENHI-B(19H02248).