The Effect of Satellite Data on a Global Hydrological Simulation

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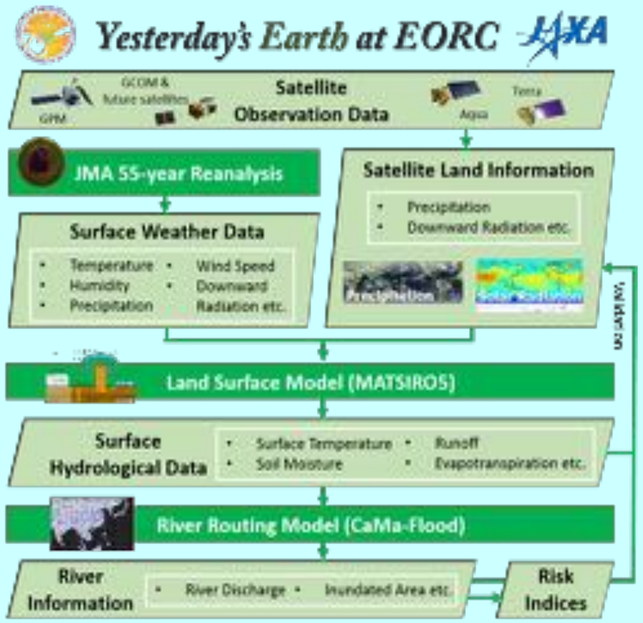
Introduction

For better understanding of hydrological cycle, Japan Aerospace Exploration Agency (JAXA) has developed the global simulation system called **"Yesterdays Earth at EORC (YEE)"** under the joint research with the University of Tokyo. The YEE system is able to :

- ✓ utilize both satellite and global analysis data as forcing of surface meteorological parameters
- ✓ produce over 50 hydrological parameters including return period

This study shows its preliminary validation results and the effect of the satellite observation data on a global hydrological simulation.

Methods



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1. **Forcing Data**
   Baseline experiment:
   JMA 55-year Reanalysis data (JRA55)
   Controlled experiment:
   uses satellite observation data

2. **Land Surface Model (MATSIRO5)**[1]
   MATSIRO5 describes water and heat transfer among atmosphere, vegetation and soil based on the input from 1.. The handling of runoff follows after flux calculation.

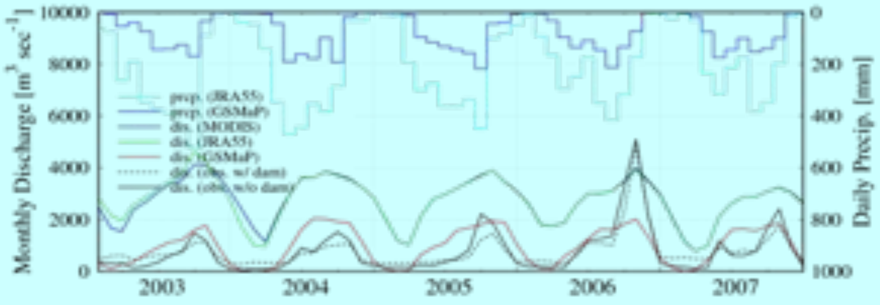
3. **River Routing Model (CaMa-Flood)**[2]
   This model converts runoff from 2. to river discharge at any point. It also enables us to see the value in other type of index (e.g. DPI[3], inundation area/depth).

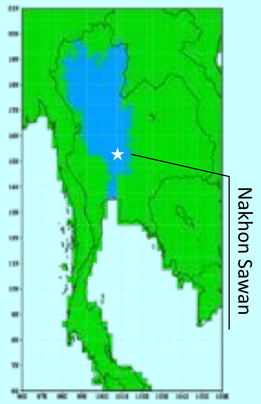
Experiment	Spatial Resol.	Temporal Resol.	Period	Latency	Forcing
JRA55 ver.	0.5-deg(Land) 0.25-deg(River)	3hourly, daily, monthly	1958-present	About 3.5days	Surface meteorological parameters by JRA55
MODIS ver.	〃	〃	2002-present	About 5days	Same as JRA55 ver. except solar radiation from MODIS
GSMaP ver.	〃	〃	2000-present	About 20days	Same as JRA55 ver. except rainfall from GSMaP

Results

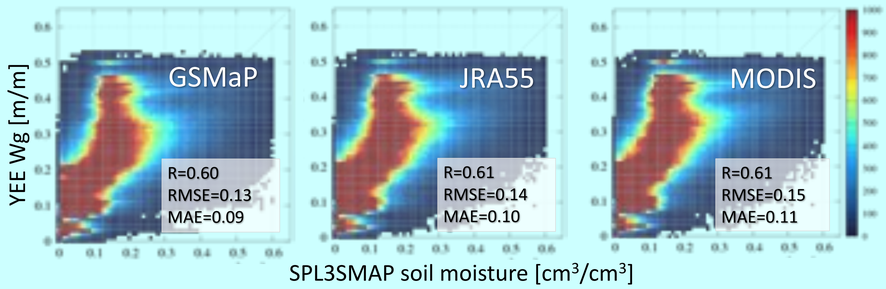
◆ **River Discharge** vs Chao Phraya (Thailand) obs. data

GSMaP improved result by about 10 % though others overestimate significantly due to inappropriate description of rainfall.





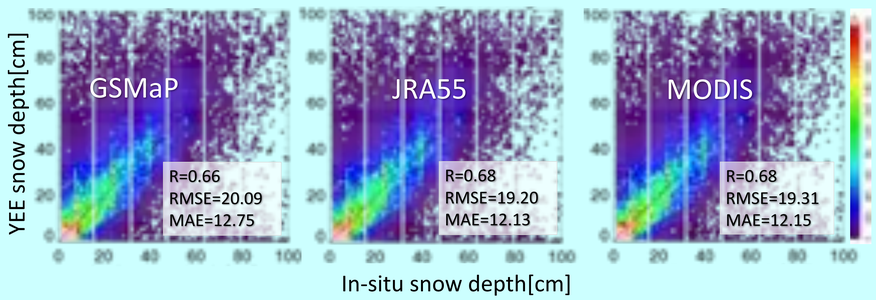
◆ **Soil Moisture** vs SMAP (Soil Moisture Active/Passive) L3 product



Duration:
2015/04/13-2015/07/07

Though correlation coefficient is a bit low, using GSMaP suppress variation compared to other experiments.

◆ **Snow Depth** vs WMO global summary of day (1007 points in total)



Duration:
2012/07/23-2016/10/31

All experiments show reasonable results. Inferiority of GSMaP ver. is due to its non-sunsynchronous orbit (65S-65N).

Summary & Conclusion

- Global hydrological simulation system so called "YEE" has been developed and its accuracy for several essential output variables is confirmed by using in-situ and satellite observation data.
- For some variables and area, authors found that the utilizing satellite data improves simulation dramatically although there still remain negative effect for other parameters.
- Further analysis on seasonality and regionality of accuracy is required for actual use of the system.

References
[1] Takata, K., S. Emori, and T. Watanabe, 2003: Development of the Minimal Advanced Treatments of Surface Interaction and RunOff (MATSIRO), Global and Planetary Change, vol.38, pp.209-222.
[2] Yamazaki, D., S. Kanae, H. Kim, and T. Oki, 2010: A physically-based description of floodplain inundation dynamics in a global river routing model, Water Resour. Res. 47, W04501, doi:10.1029/2010WR009726.
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