Combining radar, satellite and NWP data for precipitation estimation

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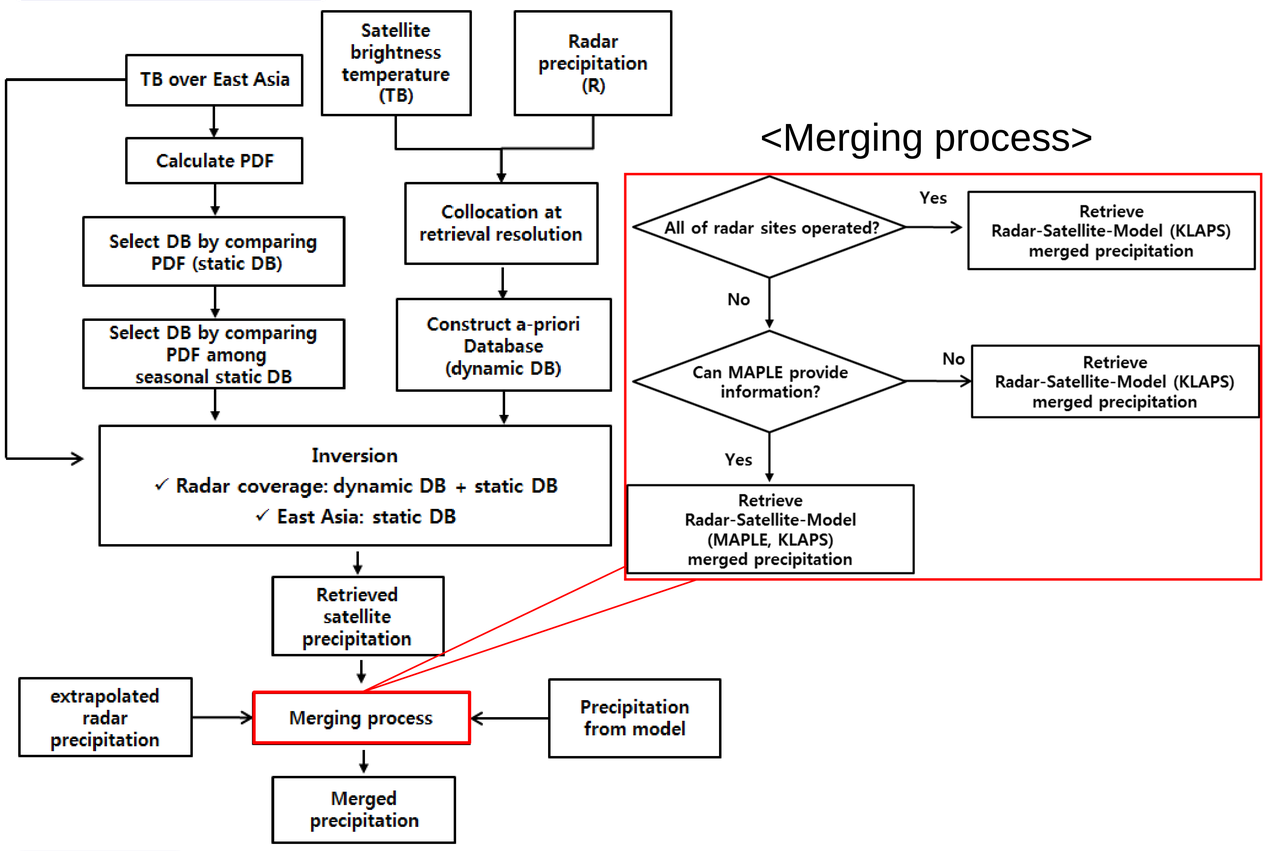
Introduction

Continuous monitoring and accurate measurements of precipitation are critical for diagnosing and forecasting severe weather and extreme rainfall events. Precipitation measurements can be obtained from a variety of sensors including ground-based radar as well as space-borne sensors. However, precipitation estimation from ground-based radars is limited over land and near coastal regions. This study develops a method merging precipitation estimates over East Asia region from various sensors and models with optimally determined weights.

Flowchart

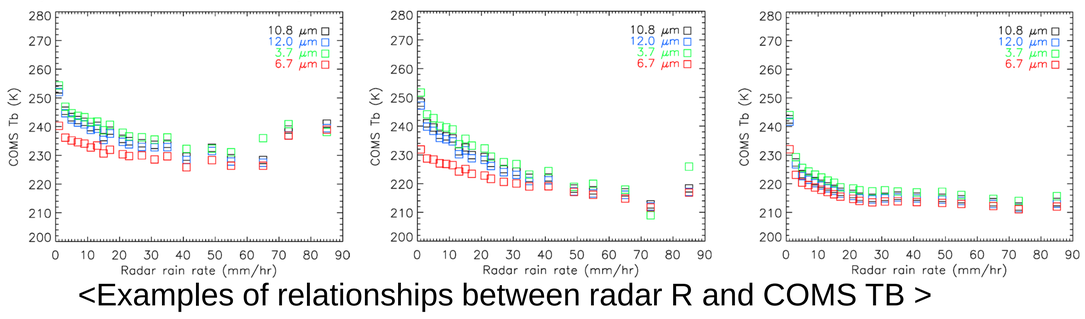


Data

- Radar: CAPPI 1.5km over Korean peninsula
- Satellite: retrieved precipitation from COMS (Communication, Ocean, and Meteorological Satellite).
- Model
  - ➢ KLAPS (Korea Local Analysis and Prediction System)
    - ✓ Based on numerical model
    - ✓ Forecast near Korean peninsula
  - ➢ MAPLE (McGill Algorithm for Precipitation nowcasting and Lagrangian Extrapolation)
    - ✓ Extrapolation-based model
    - ✓ Forecast over radar observing area

Satellite precipitation estimation

- The satellite precipitation estimation greatly relies on the diverse relationships between rain rates (R) and brightness temperatures (TB) included in a-priori databases.



<Examples of relationships between radar R and COMS TB >

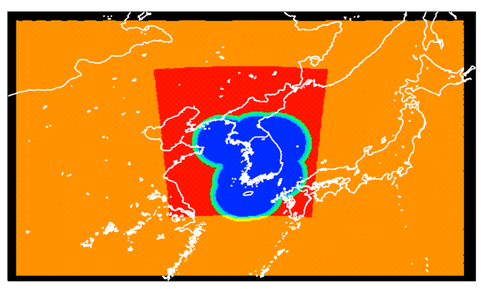
- The databases were built with the temporally and spatially collocated brightness temperatures at three channels (6.7, 10.8, and 12 μm) of the COMS and ground-based radar rain rate estimates.
- The database showing the most similar probability density function (PDF) of TB to that of the observed TB is first selected.
- Through the Bayesian inversion (Rodgers, 2000), satellite estimated precipitation is retrieved.

Merging method

Determine weight coefficients (C_j) of each datasets (radar, satellite and model precipitation) from optimal weight merging method.

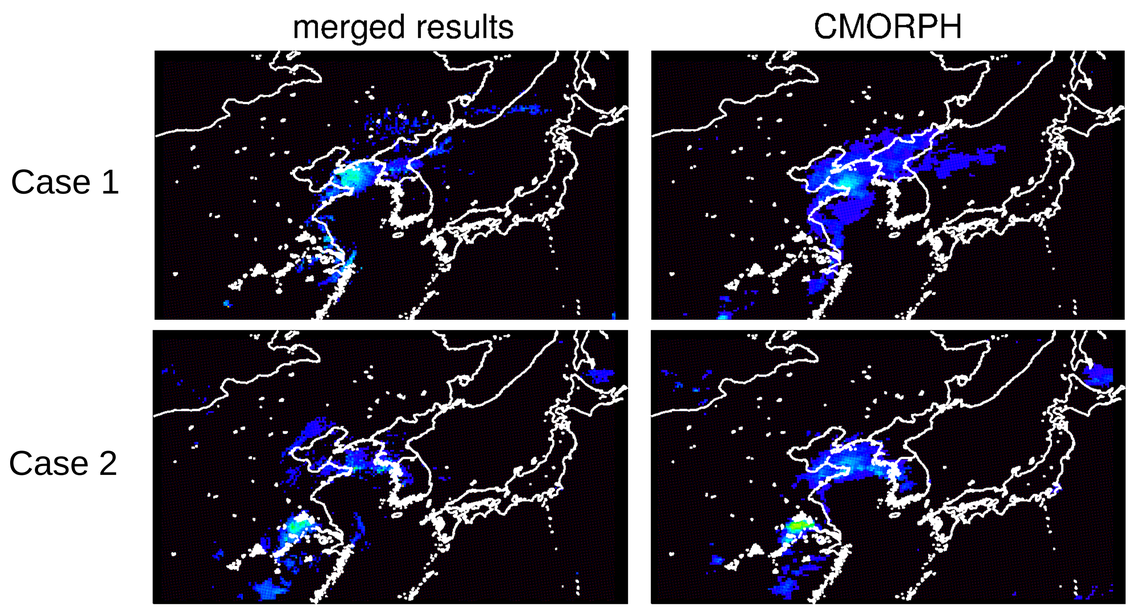
- The edge of radar observation area is used for reference data.
- Determine weight coefficients from root mean square error with reference radar data.

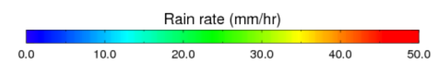
<Merging mask >



- ➢ Blue: radar observing area.
- ➢ Green: radar data uses as reference data.
- ➢ Red: KLAPS forecasting area. radar-satellite-model combined precipitation can be produced at inside the red box.
- ➢ Yellow: radar-satellite combined precipitation
- ➢ Orange: only satellite precipitation

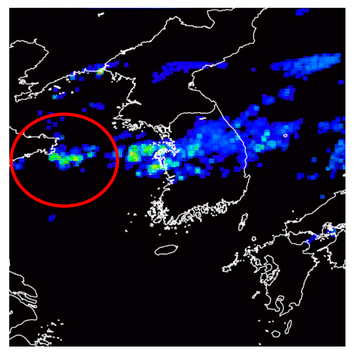
Results (radar + satellite + model (KLAPS))





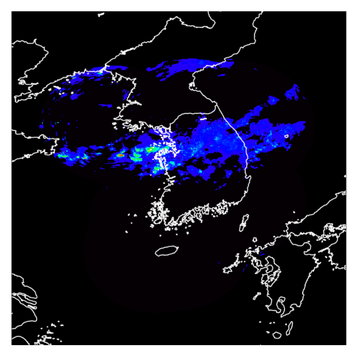
- Merged precipitation is generated over East Asia region, and compared to independent satellite precipitation product (CMORPH).

Results (radar + satellite + model (KLAPS, MAPLE))



Case 3

<Merged result when Baengyeong-radar (west part of Korean peninsula) did not operate>



<Radar estimated precipitation at 10 minute after the case 3. (Baengyeong-radar operates)>

- Merged precipitation shows rain rate where radar did not operate but MAPLE predicted precipitation exists.

Summary and ongoing work

- A method is developed to merge precipitation estimates from various sensors and models with optimally determined weights.
- As an elements of the merging, satellite precipitation is estimated based on radar R - satellite TB relationships of a-priori databases.
- The merging methodology can include additional precipitation estimates such as microwave based product.
- Since the model (KLAPS) simulated rain has a problem of incorrect location and intensity, the optimal estimation based precipitation data is produced to replace KLAPS.

Acknowledgement

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