**GEO-KOMPSAT-2A Precipitation Retrieval Algorithm: Status and Ongoing Works**

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### Introduction
- Korea's second geostationary satellite, GEO-KOMPSAT-2A (GK-2A), is planned to be launched in Nov. 2018.
- The Advanced Meteorological Imager (AMI) onboard the GK-2A satellite has 16 channels.
- A precipitation retrieval algorithm has been developed for the Advanced Meteorological Imager (AMI) onboard the GK-2A, the second Korea's geostationary satellite.
- Channels used in the algorithm are shaded (3 IRs ± 2 WVs).
- Requirement accuracy: Bias 9 mm/h at rainfall rate 10 mm/h.

### Algorithm strategy

**Well-known assumption in IR-based precipitation algorithms:**

Cloud top temperatures are assumed to be associated with the surface rainfalls.

**Problem in rainfall retrievals:**
- Large variability of TB at the same rain rate from all types of precipitating clouds
- Using the brightness temperature differences (BTDs) between IR channels the algorithm discriminates five types of precipitating clouds:
  - one shallow and four non-shallow types.
- In addition to the separation of cloud types in the databases, the algorithm also uses databases classified by latitudinal bands.
- The separation of database based on latitudes may have an effect of distinguishing the cloud types that can occur regionally.
- The a-priori databases are thus classified with 20 different categories.

### Retrieval example
- An RGB image taken from AHI on 03 July 2017 and a map of AHI Rain rates for the same granule (Typhoon - NAMADOL).
- The GK-2A-RR algorithm can be calculated in real time for the global or restricted area.

### Validation
1) Cloud Types
- Validations for rainfall rates retrieved from five different cloud types are performed.
- The results show that rainfall rates retrieved from non-shallow-taller-colder cloud type have the best validation statistics while shallow cloud type shows the lowest validation statistics.

2) Accuracy of retrieved rainfall rate
- AHI vs TRMM
  - Comparison of similarity values in a certain space scale (10 km).
  - CDFs of the errors of the retrieved rainfall rate of 10 mm/h based on pixel-to-pixel matching (left) and the Fuzzy method (right). Black solid line indicates the point where CDF (%) is 68%.

### Summary and ongoing works
- **Operational Algorithms for precipitation products have been developed for the AMI onboard the GK-2A.**
  - The products include a primary rainfall product (RR) for 3-h forecast.
  - The rain rate algorithm is characterized by a-priori DBs classified five rain cloud types (Shallow, Non-shallow: tall/colder; cold/colder) and five latitude bands (total 20 DBs).
  - Comparisons with various validation dataset (DPR, GMI, GOES-R, etc) showed that the algorithm meets the designated accuracy for the AMI operation.
- **Ongoing works.**
  - Preparing for IOT operations.
    - Calibration to AMI including the adjustment of thresholds and LUT constants
    - Extension of a-priori DBs
  - Minor adjustments to improve the accuracy of the RR algorithms.
    - Including and/or referring to the other GK-2A cloud products to improve the false alarm and the probability of detection in the RR algorithm

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### Algorithm Flowchart and Data

#### A-priori DBs
- IR TBs/MW RRs observations
  - Construction of a-priori DBs: Static DBs
    - Four latitudinal bands
    - 1st classification of cloud type (thickness) Shallow and Non-Shallow
    - 2nd classification of not-shallow clouds (phases) Non-shallow-tall Non-shallow-cold
    - 3rd classification of not-shallow clouds (water vapor) Non-shallow-tall-cold/colder Non-shallow-taller-cold/colder

#### Inversion
- Selection of DBs (Thresholds of BTDs)
  - Selection of optimal cases in the DB (Comparisons of PDFs)
  - Assignment of channel weights
  - Bayesian inversion
  - CDF-based scaling
  - Surface rain rates (RR)

#### Proxy data for GK-2A AMI
- Himawari AMI
  - IR TBs at the selected channels: 6.2, 7.3, 8.6, 11.2, 12.4 μm
  - Spatial/temporal resolutions: 2 km/10 min.
  - Coverage: 60° E - 220° E, 80° N - 80° S

#### Ancillary data
- For-a-priori DBs and separation of clouds
  - GPM (GlobalPrecipitation Measurement) DPR level 2 data (Surface rain, shallow flag, storm height)
  - GMI level 2 surface rain (comparison)
  - Coverage: 180° W - 180° E, 65° S - 65° N