GK-2A Quantitative Precipitation Nowcast

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1. INTRODUCTION

The quantitative precipitation nowcast (QPN) is one of the major products of GEO-KOMPSAT-2A (GK-2A), the Korea's second geostationary satellite. An extrapolation-based algorithm to **predict the accumulated rainfall (or rainfall potential) and probability of rainfall from short lead times of 0-3 hours** has been developed with the Spinning Enhanced Visible and Infrared Imager (SEVIRI) observations as a proxy for the Advanced Meteorological Imager (AMI) flown on the GK-2A. The rainfall potential algorithm consists of two major steps: the identification of rainfall feature on the outputs from the GK-2A rainfall rate algorithm and the tracking of rainfall feature between two consecutive images. Then, the probability of rainfall algorithm uses the outputs from the GK-2A rainfall potential algorithm in order to estimate the probability of precipitation. The preliminary results of the algorithm and ongoing works are discussed.

2. DATASETS

Description	Value
Name	Rainfall Potential / Probability of Rainfall
Satellite	Meteosat9 SEVIRI
Spatial Resolution	3 km
Geographic Coverage	Africa+ (~ 8000 x 10000 km^2)
RR algorithm	GK-2A 2015v.1
Data Period	2012. 07. 19. 14:30 - 2012. 07. 19. 18:00

3. METHODOLOGY

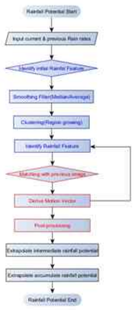


Fig. 1. Flowchart of the Rainfall Potential Algorithm

- Extrapolation techniques using current and previous rainfall rate outputs
- **Two Steps of Rainfall Potential Algorithm**
  - ✓ Feature Identification
    - ✓ Threshold = 1mm/hr
    - ✓ Smoothing filters = 11 x 11 Median & Average
    - ✓ Rainfall Feature Size = 15 to 50 pix
  - ✓ Feature Tracking
    - ✓ Cross-correlation = $\frac{\sum_{i=1}^{n}[(r_{past,i}-\bar{r}_{past})(r_{current,i}-\bar{r}_{current})]}{\sqrt{\sum_{i=1}^{n}[(r_{past,i}-\bar{r}_{past})^2]}\sqrt{\sum_{i=1}^{n}[(r_{current,i}-\bar{r}_{current})^2]}}$
    - ✓ Weighted motion vectors
    - ✓ Post-processing (Kalman filter)

- Statistical error analysis
- **Three Equations of Probability of Rainfall Algorithm**
  - ✓ Eq.1: $PoR = \frac{\sum_{i=1}^{12}\alpha_i n_i}{12} \times 100\%$, where $\alpha_i = \frac{1}{\sigma_i^2 \sum_{i=1}^{12}\frac{1}{\sigma_i^2}}$ & $\sigma = \sqrt{\frac{1}{N}\sum(rr_{obs} - rp_{for})^2}$
  - ✓ Eq.2: $PoR = (\langle n \rangle_{15} + \sigma_{15}) \times 100\%$, where $\langle n \rangle_{15}$ is the mean value of n within a 15 by 15 pixels box grid and σ_{15} is the standard deviation of the same box grid
  - ✓ Eq.3: $PoR = 0\%$

Requirement values for measurement range, accuracy, and time			
	Measurement Range	Measurement Precision	Computing Time
Rainfall Potential	0 - 100 mm	5 mm	180 s
Probability of Rainfall	0 - 100 %	25 %	180 s

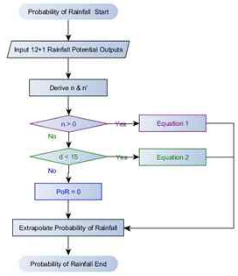


Fig. 2 Flowchart of the Probability of Rainfall Algorithm

4. PRELIMINARY RESULTS

Fig. 3. 3hr Accumulated Rain rates

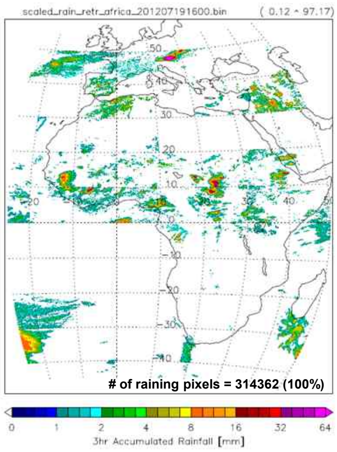


Fig. 4. Rainfall Potential

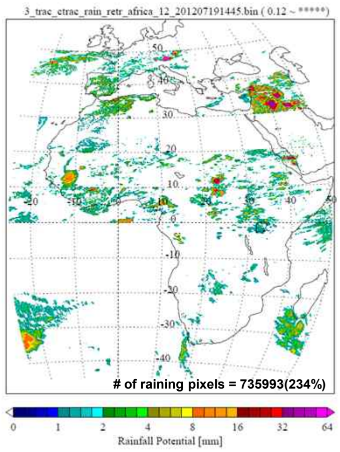
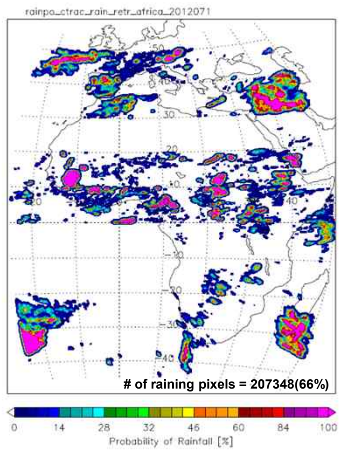


Fig 5. Probability of Rainfall



Scalar Accuracy Measures			
	C.C.	Bias	RMSE
3hr accumulated Rainfall Rates vs. Rainfall Potential	0.46	-0.04	1.35
3hr accumulated Rainfall Rates vs. Probability of Rainfall	0.55	0.01	0.13

Categorical Accuracy Measures			
	POD	FAR	HSS
3hr accumulated Rainfall Rates vs. Rainfall Potential	0.72	0.69	0.41
3hr accumulated Rainfall Rates vs. Probability of Rainfall	0.45	0.31	0.54

5. CONCULSION AND FUTURE WORK

- **The prototype algorithms of Rainfall Potential and Probability of Rainfall** have been developed for the AMI on the GK-2A.
- The results of prototype algorithms indicate **overestimation of Rainfall Potential and underestimation of Probability of Rainfall**.
- We plan to improve the final version of algorithms by including:
  - ✓making adjustments for **growth and decay** of rainfall features.
  - ✓adding **two different tracking** strategies between shallow and not-shallow rainfall types.
  - ✓using **Himawari-8 AHI** (Advanced Himawari Imager) data as a proxy data.

6. REFERENCES

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7. ACKNOWLEDGEMENTS

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