140

Assimilation of GPM Retrieved Surface Meteorology Variables for ICE-POP case studies

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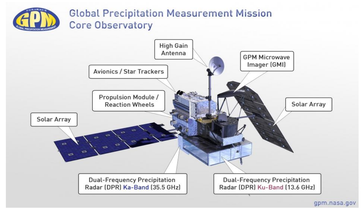
Introduction

Global Precipitation Measurement (GPM):

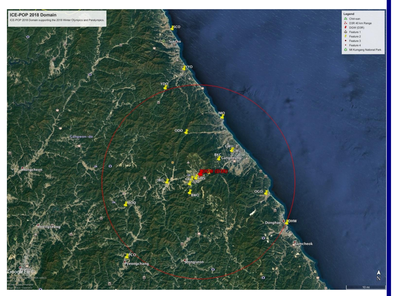
Built upon Tropical Rainfall Measuring Mission (TRMM) legacy for next-generation global observation of rain and snow. The GPM has a broad global coverage ~70°S – 70°N with a swath of 245/125-km for the Ka (35.5 GHz)/Ku (13.6 GHz) band radar, and 850-km for the 13-channel GMI. GPM also features better retrievals for heavy, moderate, and light rain and snowfall.



http://www.nasa.gov/mission_pages/GPM/main/

ICE-POP:

- International Collaborative Experiments for Pyeongchang 2018 Olympic and Paralympic Winter Games (ICE-POP 2018). ICE-POP is led by the KMA as a component of the WMO's World Weather Research Program (WWRP) Research and Development and Forecast Demonstration Projects (RDP/FDP).



ICE-POP Domain and Instruments

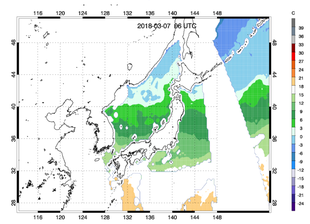
- ICE-POP is taken place during the Winter Olympics (February-March) of 2018 and focused on the measurement, physics, and improved prediction of heavy orographic snow in the PyeongChang region of South Korea.
- Goals of ICE-POP:
- Improvement of our understanding on severe weathers (snowfalls, visibility, rapid wind changes and gusts,) over complex terrain - Specially focus on the microphysical processes over complex terrain as well as the impact of the ocean on snow.
- Improvement of the predictability of nowcasting and very-short-range forecasting with a few kilometer horizontal resolution - Development of NWP-based nowcasting, multi-scale data assimilation and time- lagged ensemble for VSRF, and radar reflectivity and visibility data assimilation.
- Improvement of verification and evaluation methods for high resolution model considering complex terrain - Development of verification methods for high spatial and temporal variables with remote-sensing observation and non-traditional variables (visibility and precipitation type, etc) to consider benefit for social and economic effect.

Data and Methodology

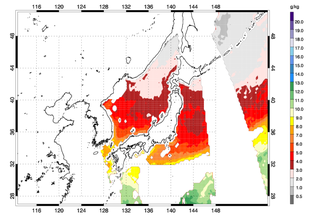
GPM Retrieved Product:

- As part of NASA Weather Focus Area and GPM support of the ICE-POP 2018 program, near-real-time ocean surface flux retrievals were produced using the GPM microwave imager constellation.
- Besides estimate of the surface turbulent fluxes, the GPM brightness temperatures are used to estimate the ocean surface meteorology — wind speed, sea surface temperature (SST), air humidity and temperature.

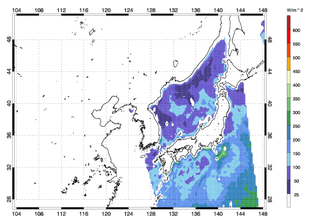
2-m Temperature



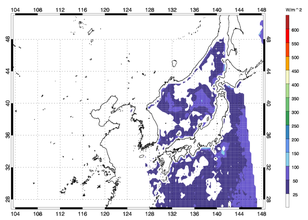
Specific Humidity



Latent Heat Flux



Sensible Heat Flux



Model and Data Assimilation System:

WRF ARW V3.7
Community GSI v3.6

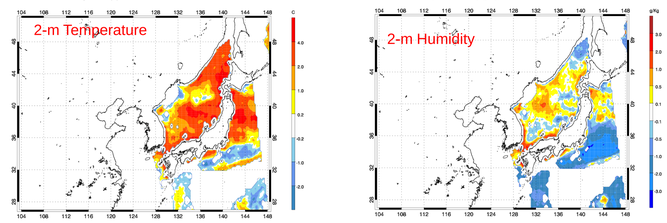
Experiments:

- 9, 3, and 1-km resolution
- Case studies:
  - Heavy snow storm 00 UTC 7 – 00 UTC 9 March 2018
  - Heavy snow storm 00 UTC 27 – 00 UTC 1 March 2018
- Observations: GPM retrieved 2-m temperature, 2-m specific humidity, and 10-m wind speed
- Observational errors: 2 °C in temperature, 1 g/kg in specific humidity, 2 m/s in wind speed
- DA cycles: 06, 09, 12, 18, and 21 UTC on 03/07/2018 and 03/08/2018; 06, 09, 12,15, 18, and 21 UTC on 02/27/2018 and 02/28/2018

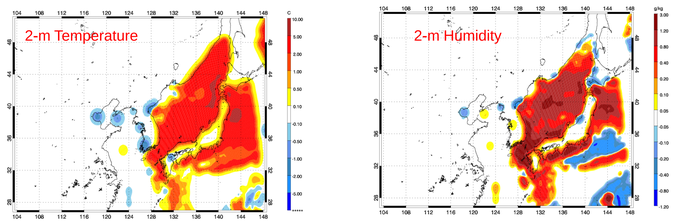
Experiments	Data Assimilation
WRF	No
CTRL	Prepbufr observations at 06, 12, 18 UTC 03/07/2017 and 03/08/2017
DA_tquv	GPM surface retrieval product and prepbufr observations at 06, 09, 12, 18, and 21 UTC 03/07/2017 and 03/08/2017

Result

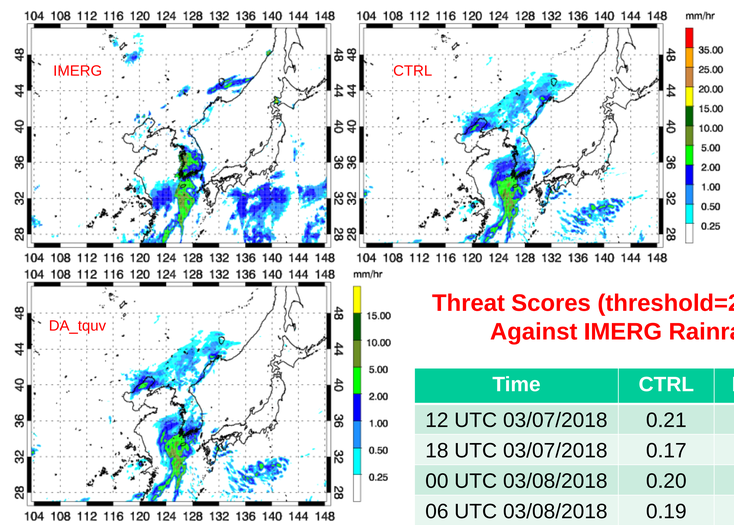
Observation Innovation (FLUX - WRF)



Increment from the 1st Data Assimilation Cycle at 06 UTC 03/07/2017



Data Impact on Precipitation at 15 UTC 03/07/2017



Threat Scores (threshold=2mm/hr) Against IMERG Rainrate

Time	CTRL	DA_tquv
12 UTC 03/07/2018	0.21	0.22
18 UTC 03/07/2018	0.17	0.20
00 UTC 03/08/2018	0.20	0.23
06 UTC 03/08/2018	0.19	0.22

Conclusion and Discussion

1. The GPM surface retrieved data has been successfully assimilated using the GSI surface data assimilation. Significant impacts of the retrieval product have been found in temperature and moisture fields of initial conditions.
2. Assimilation of GPM retrieval product also produces significant impact on precipitation amount and structure for heavy snow storms. More statistic analysis using ICE-POP field data as independent validation dataset is ongoing for a thorough understanding of the impact of the GPM surface retrieval product.

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