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Assimilation of GPM-Retrieved Marine Surface Meteorology Data for Winter Storms during 2018 Olympic and Paralympic Winter Games

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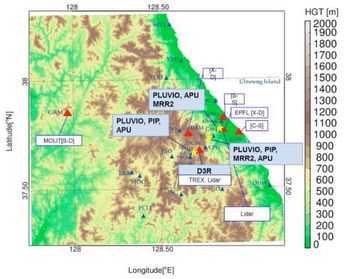
Introduction

International Collaborative Experiments for Pyeongchang 2018 Olympic and Paralympic Winter Games (ICE-POP 2018)

- 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)
- Taken place during the Winter Olympics (February-March) of 2018
- Focused on the measurement, physics, and improved prediction of heavy orographic snow in the PyeongChang region of South Korea

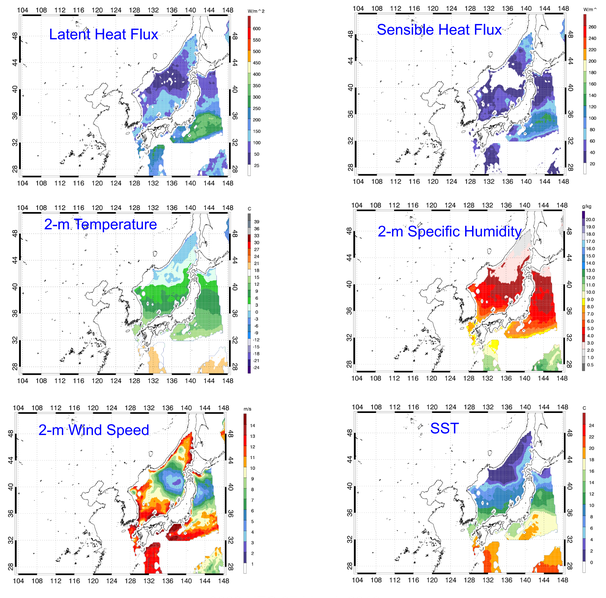


NASA Instruments during ICE-POP. Background: topography over PyeongChang region

- Goals of ICE-POP: To improve our understanding on severe weathers (snowfalls, visibility, rapid wind changes and gusts,) over complex terrain; To improve 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; To improve verification for high resolution model considering complex terrain.

GPM Retrieved Ocean Surface Product

- As part of NASA Weather Focus Area and GPM support of the ICE-POP 2018 program, near-real-time ocean surface turbulence flux retrievals were produced based on Roberts et al. (2010) taking advantage of the GPM constellation passive microwave radiometers SSMIS, AMSR-2, MADRAS, SAPHIR, MHS, ATMS, etc.
- Besides surface turbulent fluxes, the GPM brightness temperatures were used to estimate the ocean surface meteorology — wind speed, sea surface temperature (SST), air humidity and temperature.



0600 UTC 07 March 2018

Objectives and Methodology

- To assimilate the GPM-retrieved ocean surface 2-m temperature, 2-m specific humidity, 10-m wind speed into WRF simulation of snow storm events during ICE-POP campaign.
- To assess the impact of the retrieved meteorology product on short-term high resolution forecast and better understand the influence of ocean fluxes to winter storms.

Model and Data Assimilation System:

WRF ARW V3.7
Community GSI v3.6

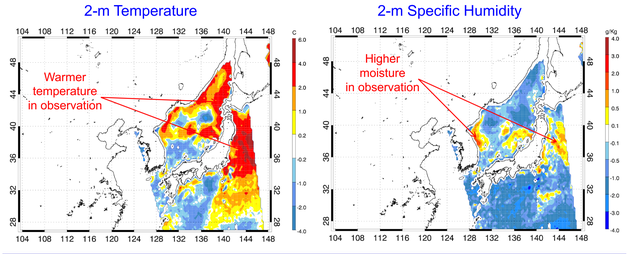
Experiments:

- Nested domains with 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
- Observation data: 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

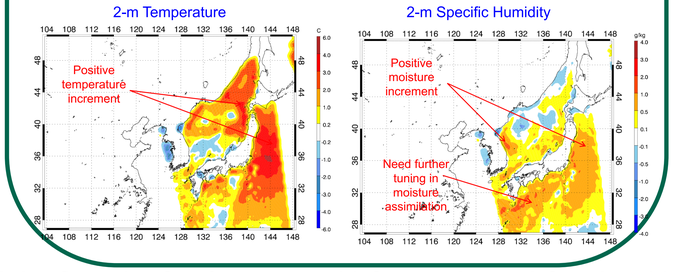
Experiments	Data Assimilation
WRF	No
CTRL	prepbufr conventional observations at 06, 12, 18 UTC 07-08 March 2018 and 27-28 February 2018
DA_tquv	GPM surface retrieval product and prepbufr observations at available times 07-08 March 2018 and 27-28 February 2018

Result

Observation Innovation (GPM Retrieval - CTRL) at 06 UTC 02/27/2018

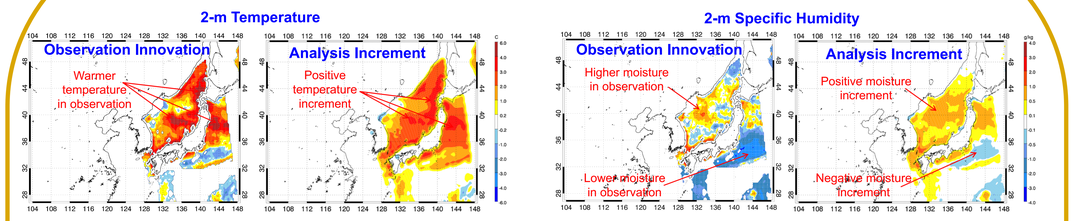


Analysis Increment (DA_tquv - CTRL) from the 1st DA Cycle at 06 UTC 02/27/2018

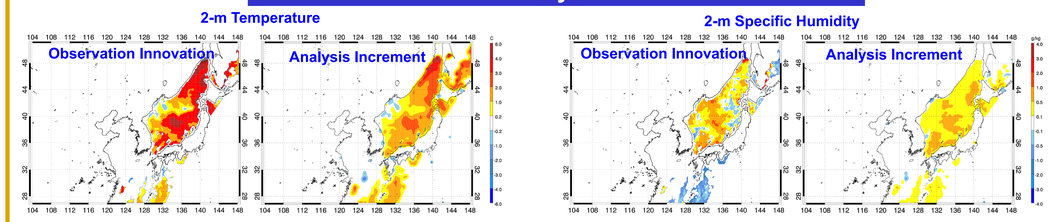


Result

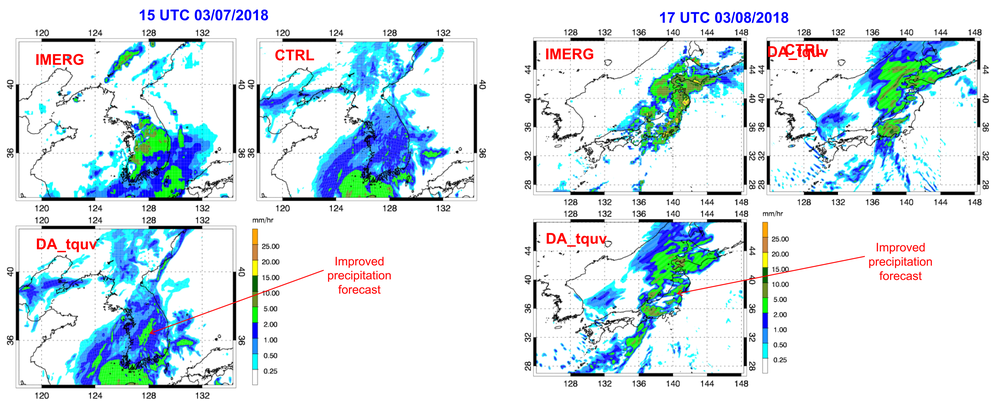
1st Data Assimilation Cycle 06 UTC 03/07/2018



2nd Data Assimilation Cycle 12 UTC 03/07/2018



Data Impact – Precipitation Forecast



Data Impact on Precipitation Forecast – Forecast Threatscore

Time	CTRL	DA_tquv
00 UTC 3/08/2018	0.18	0.22
06 UTC 3/08/2018	0.23	0.25
12 UTC 3/08/2018	0.10	0.15
18 UTC 3/08/2018	0.13	0.24

Conclusion and Discussion

1. The GPM-retrieved marine surface meteorology data has been successfully assimilated using the GSI data assimilation system. Significant impact of the retrieval product has been found in temperature and moisture initial condition and forecast.
2. Assimilation of GPM surface retrieval product shows positive impact on precipitation amount and location for the heavy snow events 7-8 March and 27-28 February 2018. Validation of model result with ICE-POP field data as independent dataset will be conducted for a thorough understanding of the impact of the GPM retrieved product.

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