NASA Participation in the International Collaborative Experiment for the PyeongChang Olympics and Paralympic Winter 2018 Games (ICE-POP)

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11x439
NASA Contributions:
- GPM GV Instruments - D3R, MRRs, PIPS, Pluvios, Parsivels
- SPoRT GPM products (including NRT surface SH/LH fluxes)
- NU-WRF model forecasts/research

NASA Objective(s): Collaborate with interagency/international partners to:
- Evaluate and improve GPM estimates of orographic snow
- Test and improve NWP, cloud model orographic snow physics
- Serve/test new satellite products in a decision support environment

- KMA-led, WMO WWRP-sponsored winter precipitation project (Jan-Mar. 2018)
- Objective: Improve understanding and prediction of orographic falling snow

Network, aircraft images courtesy Korean Meteorological Administration
Ocean to Summit Instrument Transects

Courtesy: G. Lee
Ground Instrument Supersites

West ↔ Mountain ranges → East

<table>
<thead>
<tr>
<th>Location</th>
<th>Instrument</th>
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</thead>
<tbody>
<tr>
<td>YPO</td>
<td>MRR-2, Parsivel², POSS, Pluvio² 200 (Belfort Double Alter shield)</td>
</tr>
<tr>
<td>MHS</td>
<td>MRR-2, Parsivel² (DFIR), POSS, Pluvio² 400 (DFIR + Tretyakov + Alter shield)</td>
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<tr>
<td>CPO</td>
<td>MRR-2, Parsivel², POSS, Pluvio² 200 (No shield)</td>
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<tr>
<td>BKC</td>
<td>MRR-2, Parsivel², POSS, Pluvio² 400 (Tretyakov + Alter shield)</td>
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<tr>
<td>GWU</td>
<td>MRR-2, Parsivel², POSS, Pluvio² 400 (Tretyakov + Alter shield)</td>
</tr>
</tbody>
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Images Courtesy G. Lee, KNU, Korea
Multi-frequency, Polarimetric Radar Coverage

S--band (S), X-band (X), Ka-Ku, C-band (C), D= Dual-Pol, S=Single pol

Courtesy G. Lee, KNU, Korea
ICE-POP Campaign examining agreement between forecast and remote/in situ snowfall observations over complex terrain

Precipitation Type
(Rain or Snow)

Forecast is Snow

Precipitation Amount (24-hr estimate)

Forecast is for 2-5 mm

IMERG Estimates 1-2 mm

Light

Heavy

NASA and KMA ground-based observations measure ~1.5 mm

Forecast, GPM IMERG, and ICE-POP observations agree on precipitation type and amount for an early ICE-POP snow event near PyeongChang.

These comparisons will continue as ICE-POP progresses
NU-WRF Real-time Model Configuration for ICE-POP

NASA Unified-WRF (NU-WRF) Model Features:

- 4x daily 24-hour forecasts
- Initialized 00/06/12/18z
- Half-hourly output on nests
- 62 vertical levels
- PBL: MYJ; LSM: Noah
- SW/LW Radiation: NASA/GSFC schemes within NU-WRF
- Microphysics: NASA/GSFC 4-ice graupel+hail
- Cumulus: Grell-Freitas (9km only)
- ICs/BCs: NCEP/EMC GFS
- SSTs: 2-km NASA SPoRT MODIS+VIIRS product
Observations and Simulations from High-Impact Events: 11 February High Winds Delayed Mens’ Downhill

(above) Animation of 30-min interval maximum 10m wind speeds from NU-WRF 1km nested grid.

(right) Comparison between NU-WRF 9-km grid [left column] 10m winds, sensible, & latent heat flux to passive microwave oceanic retrievals [right column]
Observations and Simulations from High-Impact Events: 14 Feb Shallow Snow & High Winds Disrupted Skiing on Jeongseon Hill

(above) Animation of 3-hourly 500-mb isotachs from NU-WRF 9km grid

(right) Animation of visible satellite imagery from JMA Himawari

(bottom-right) Disdrometer measurements, showing high concentration of primarily small hydrometeors between 01-04z
Observations and Simulations from High-Impact Events:
14 Feb Shallow Snow & High Winds Disrupted Skiing on Jeongseon Hill

(above) Animation of 30-min Comp. reflectivity from 1-km grid
(right) Animation of 30-min interval maximum 10m wind speed
(bottom) Time-height cross section in lowest 2km AGL of precipitation microphysical mixing ratios
Observations and Simulations from High-Impact Events:
Three Significant Snowstorms between Olympics (Feb) and Paralympics (Mar)

Twenty four-hour simulated snow accumulation [in cm] from the NU-WRF 1-km grid for snowstorm events on (a) 28 February, (b) 4 March, and (c) 7-8 March 2018.
Observations and Simulations from High-Impact Events:
Three Significant Snowstorms between Olympics (Feb) and Paralympics (Mar)

NASA Precipitation Imaging Package (PIP; left) and PIP observations of 2.5+ cm diameter snowflakes, associated with 28 February snowstorm (courtesy: Kwonil Kim, KNU)
Observations and Simulations from High-Impact Events: Three Significant Snowstorms between Olympics (Feb) and Paralympics (Mar)

(left) Animation of NU-WRF 1-km grid simulated composite reflectivity, and
(right) Time-height cross section in lowest 2km AGL of precipitation microphysical mixing ratios

Notice transition from deep synoptic snow to shallow banded snow in NE flow after 06z!
Future Research: ICE-POP Flux Product Data Assimilation

**Objective:** Conduct data assimilation of retrieved surface temperature, moisture, and wind speed product from L1C GPM data; to assess the data impact on snowstorm forecast through case studies observed by ICE-POP.

**Approach:** NU-WRF 9 km + 3 km resolution with 62 vertical levels; Community GSI v3.6

**Cases:** Sea of Japan-effect snow in Japan 15-17 February 2018; Snowstorm in Korea 27-28 February 2018

**DA Experiments:** Cycled assimilation of the retrieved products every 6 hours; 3D-VAR vs. Ensemble Kalman Filter; Sensitivity studies and data denial experiments

36-h forecast of precip rate (mm/hr), SLP (hPa) and 10-m wind valid at 1200 UTC 28 Feb 2018

Sample data: retrieved 2-m specific humidity at 0600 UTC 28 Feb 2018
Thank you!!

Questions and Comments Welcome

NASA/SPoRT web: https://weather.msfc.nasa.gov/sport/

Twitter: @NASA_SPoRT

Facebook: NASA.SPoRT

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