

# Impact of assimilation of the Advanced Technology Microwave Sounder data over sea-ice in the Korean Integrated Model

Jisoo Kim<sup>1</sup>, Myoung-Hwan Ahn<sup>1</sup>, Juntae Choi<sup>2</sup>, Jae-Gwan Kim<sup>2</sup>

<sup>1</sup>Ewha Womans University, Seoul, Republic of Korea (kjsu231@gmail.com)

<sup>2</sup>National Meteorological Satellite Center, Jincheon-gun, Republic of Korea



## Introduction

- ❖ In KIM system, the assimilation of microwave observations over sea-ice regions is limited due to the difficulties in estimating the surface radiation.
- ❖ **In this study**, for better utilization of sea-ice observations, the dynamically estimated emissivities is applied to the pre-processing of KIM model.

## Data and method

- ❖ Korean Integrated Model (KIM) (Hong et al., 2018)
  - The operational NWP model at the KMA
  - Resolution: horizontal 12 km, vertical 91 layers
  - Data Assimilation (DA): Hybrid 4D-EnVar
- ❖ Suomi-NPP/ATMS
  - 22 channels: 5 window CHs, 12 temperature sounding CHs and 5 humidity sounding CHs
- ❖ Experimental design

Experiment	Channels assimilated over sea-ice	Sea-ice emissivity
CTRL	ATMS 9~15	FASTEM
Sealce_rEM	ATMS 6~8, 9~15	Real-time emissivity

- Calculation of the real-time emissivity

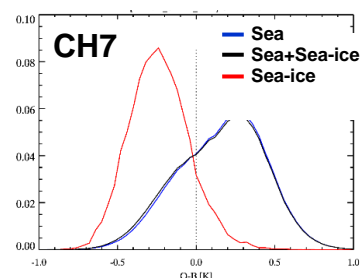
$$\varepsilon = \frac{R_{obs} - R^{\uparrow} - R^{\downarrow}\tau}{(R_{sfc} - R^{\downarrow})\tau}$$

$R_{obs}$ : Observed radiance  
 $R^{\uparrow}$ : Upwelling radiance  
 $R^{\downarrow}$ : Downwelling radiance  
 $\tau$ : Transmittance

- DA type: 4D-Var (w/o Ensemble)
- Observations
  - ✓ Sonde, Surface, aircraft, AMV, SCATWIND, AMSU-A, GPSRO, IASI, CrIS, ATMS, MHS, CSR-gk2A, AMSR2, MWHS2
- Static bias correction (Harris and Kelly 2002)
- Cycle run: 2019121500~2020011418 including spin-up

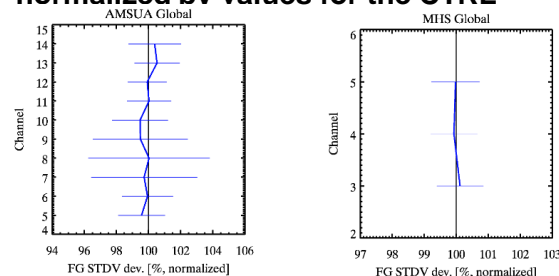
## Results

- ❖ On average, 1.07% of ATMS observations is additionally assimilated per window time.
- ❖ Distribution of First Guess (FG) departure



- ✓ Although the sea-ice observations shows negative FG departures, it does not change the overall distribution of assimilated observations as the coverage of sea-ice is much smaller than that of ocean surface.

- ❖ Impact on background compared to ECMWF IFS
  - STDV of FG departures of AMSU-A, MHS, normalized by values for the CTRL

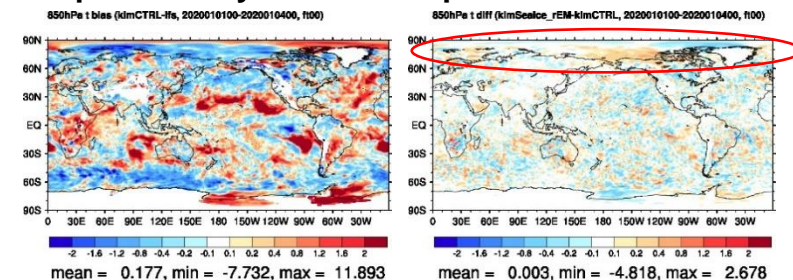


- ✓ Values below 100 indicate a reduction when sea-ice observation is added.
- ✓ Overall, it shows neutral impact for both microwave temperature and humidity sounders.

## Summary

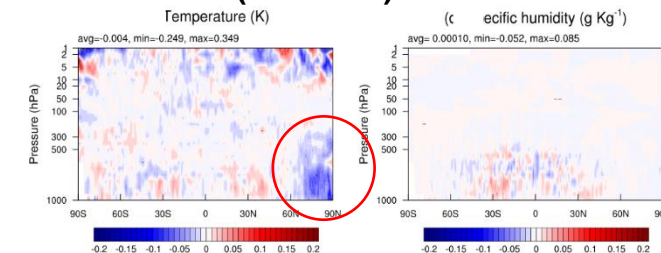
- Assimilation of sea-ice data improved the analysis and forecast by warming the T fields at high-latitude of NH.
- This suggest that assimilation of sea-ice data is possible with dynamic emissivity.

- ❖ Impact on analyses fields compared to ECMWF IFS



- ✓ A reduction of cold bias in temperature (T) analysis over high-latitude region of the NH (red circle).

- ❖ Horizontal distribution of temporally averaged zonal mean RMSD difference (EXP-CTRL)



- ✓ Reduced the analysis RMSD below 850 hPa.

- ✓ In humidity fields, it shows combined results.

- ❖ Impact on forecasts compared to ECMWF IFS

- ✓ Reduced forecast error in temperature fields especially in the high-latitude of the NH, although there was a little degradation in the SH.

- This work was funded by the Korea Meteorological Administration's Research and Development Program, "Technical Development on Weather Forecast Support and Convergence Service using Meteorological Satellites".
- This work is supported by Numerical Modeling Center of Korea Meteorological Administration.