

# Diagnostics of CrIS Preprocessing System in Korean Integrated Model (KIM)

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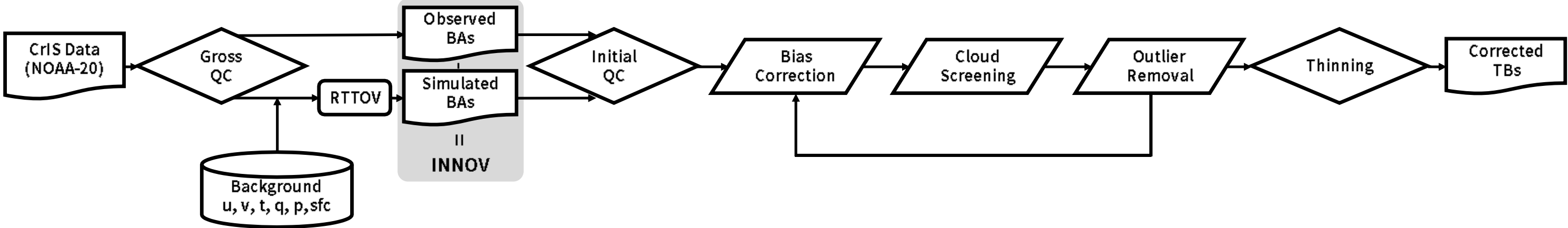


## KIM System and CrIS Data Preprocessing

NWP system at KMA: KIM (Korean Integrated Model) v4.0

Spatial resolution	ne576np3 ~8km, Cubed-sphere grid system
Vertical resolution	91 levels, up to 0.01 hPa
DA scheme	Hybrid-4DEnVar (3DVAR + LETKF, 50 members) Incremental analysis resolution: ne180np3, ~25km 4 analyses per day with 6-hour assimilation window KPOP (KIM Package for Observation Processing)

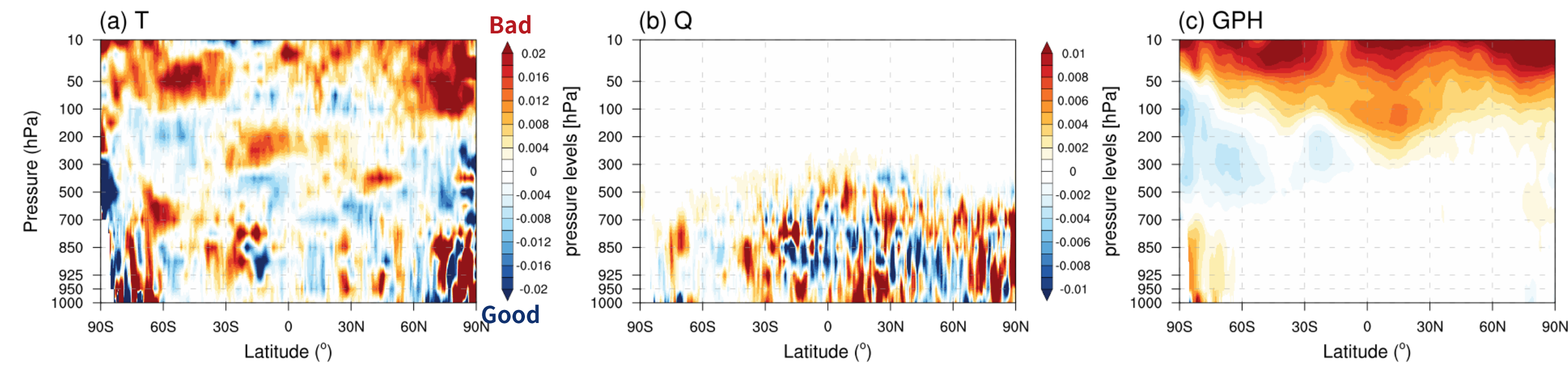
## CrIS Data Preprocessing in the KIM



- The operational setup utilizes 28 active channels on the NOAA-20 satellite.

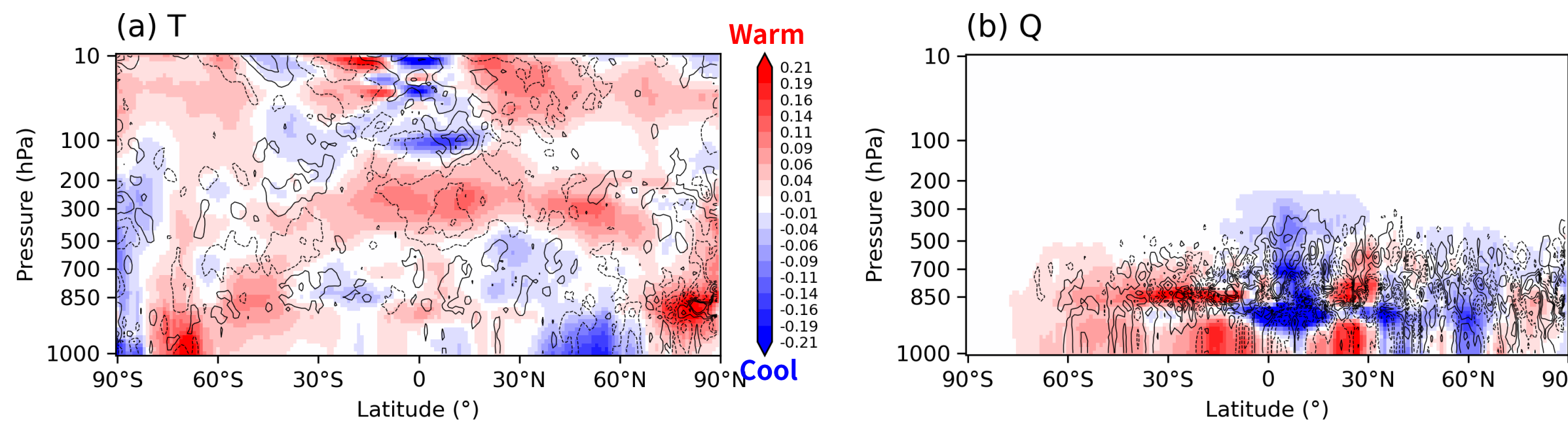
## Short-range Forecast Impact

### Difference in RMSE between EXP and CTL analysis relative to IFS analysis



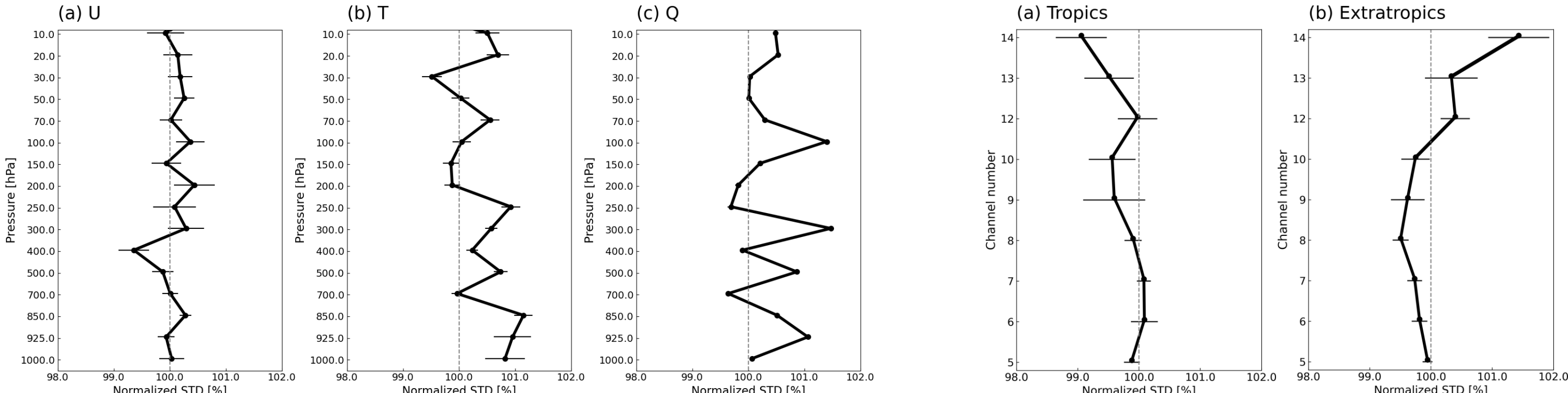
- (T) Performance degrades in the equatorial upper troposphere (150-300 hPa), global lower- to mid-stratosphere (10-100 hPa), and polar regions.
- (Q) Performance degrades in the boundary layer in both high and low latitudes of the Northern Hemisphere (NH).
- (GPH) Performance degrades in the stratosphere at all latitudes and in the Antarctic lower troposphere (700-1000 hPa).

### Analysis increment in the CTL (shading) and the EXP-CTL (contours)



- (T) Warm increments in the equatorial upper troposphere (150-400 hPa), Antarctic coast, and Arctic boundary layer; cool increments in the equatorial stratosphere (10-150 hPa) and NH mid-latitude boundary layer.
- (Q) Dry increments in the NH mid-latitude boundary layer; moist increments in the Southern Hemisphere (SH) boundary layer.
- (T, Q) CrIS assimilation produces opposite signals in the equatorial upper troposphere (150-400 hPa, reduced warming), equatorial stratosphere (10-150 hPa, reduced cooling), and NH mid-latitude boundary layer (reduced drying).

### Control-normalized STD of O-B departure for Radiosonde (Global) and AMSU-A



- Positive impacts at 400 hPa zonal winds, 150-200 hPa temperature, and 200-250 hPa specific humidity; neutral or negative elsewhere.
- Positive impacts at 50-100 hPa in the tropics and at level below 50 hPa in the extratropics; neutral or negative elsewhere.

## Experimental Design and Assessment

Model: KIM v4.0 low resolution (ne180np3, ~25 km)

### Experiment Configuration

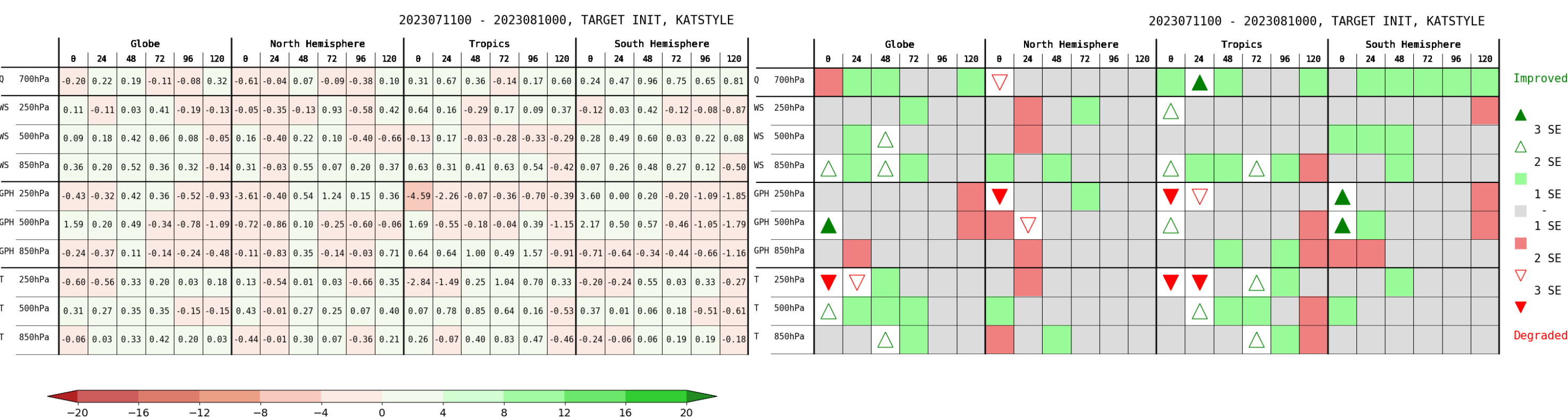
CTL	CrIS data denied
EXP	Uses the same observations as the operational system

Period: 2023.06.25-08.10 (Verification: 2023.07.11-08.10, 1 month)

Diagnostics Method: Observing System Experiment (Compared to ECMWF IFS analysis)

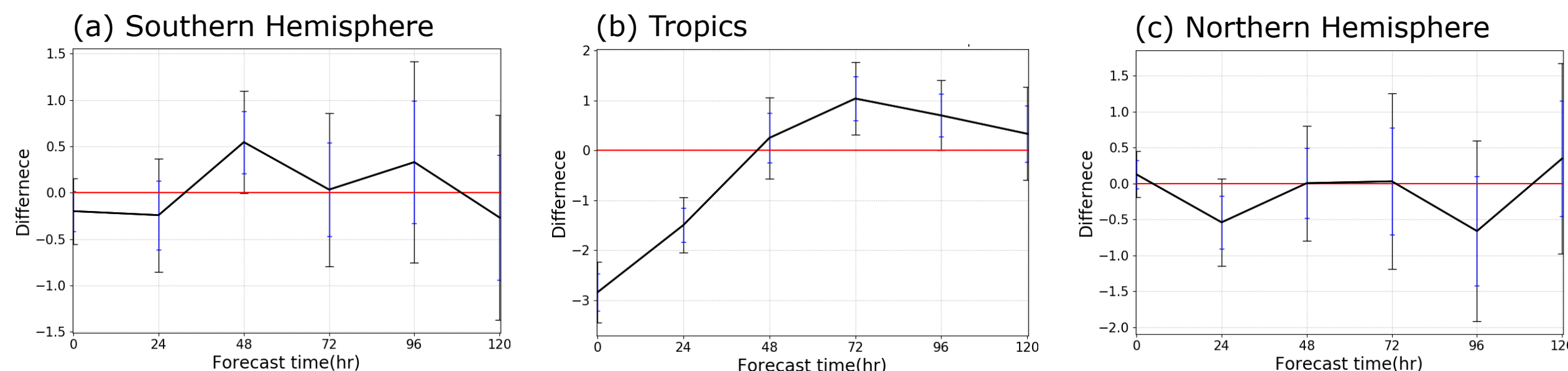
## Medium-range Forecast Impact

### Improvement rate of RMSE relative to IFS analysis (%)



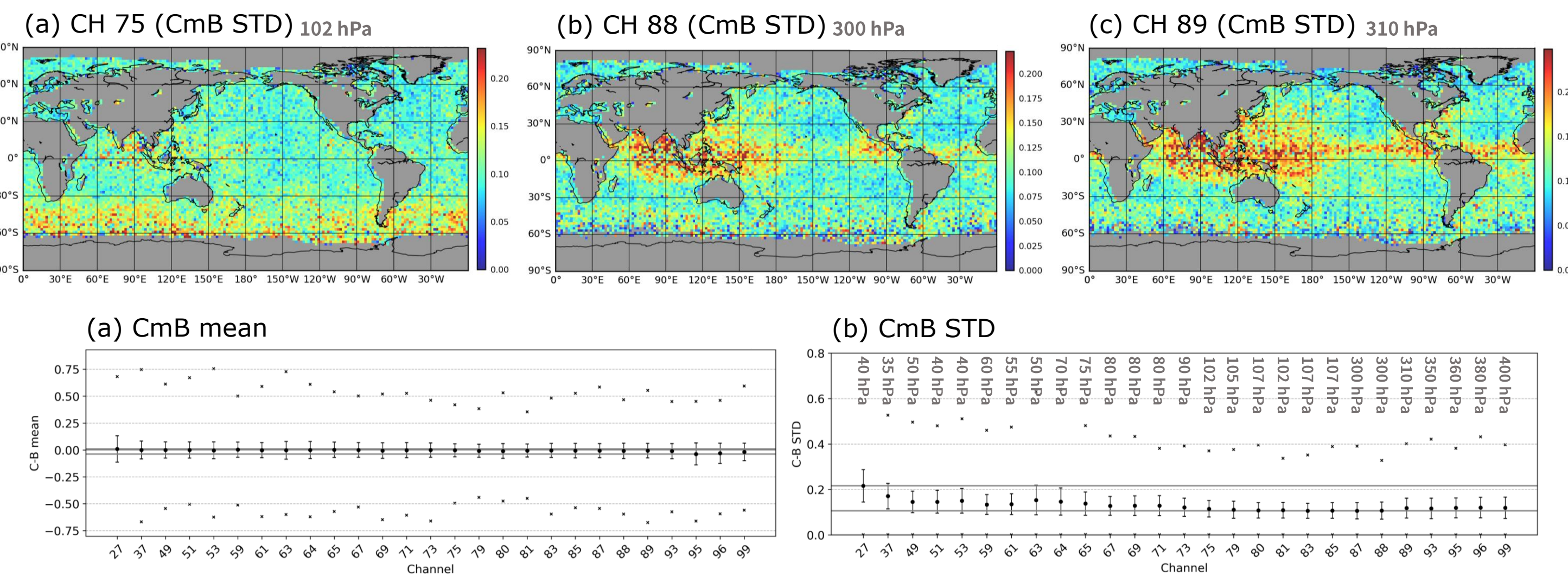
- Geopotential height performance improves in the SH mid- to upper troposphere (250, 500 hPa).
- Temperature and geopotential height performance degrade in the NH and in the equatorial upper troposphere (250 hPa).

### Difference in RMSE between EXP and CTL for 250hPa Temperature



- (Tropics) Neutral or improving impacts prevail except for ~1-day lead time.
- (SH, NH) Neutral impacts are dominant across both hemispheres.

## Evaluation of C-B Mean and Standard Deviation



- CH 87-93 (300-350 hPa) exhibit high C-B STD in the equatorial region, indicating a need for improved cloud screening.
- The mean C-B for these channels is close to zero, but the relatively small STD suggests a need for better bias correction.

## Summary

- Performance degraded in the equatorial upper troposphere (150-300 hPa) in analysis.
- Tropical 250 hPa temperature forecasts showed especially notable degradation.
- Improvements to cloud screening and bias correction are planned, with additional analysis to optimize and resolve identified issues.

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