



Equatorial Wave Activity in the tropical atmosphere represented in the WCDA-GloSea6

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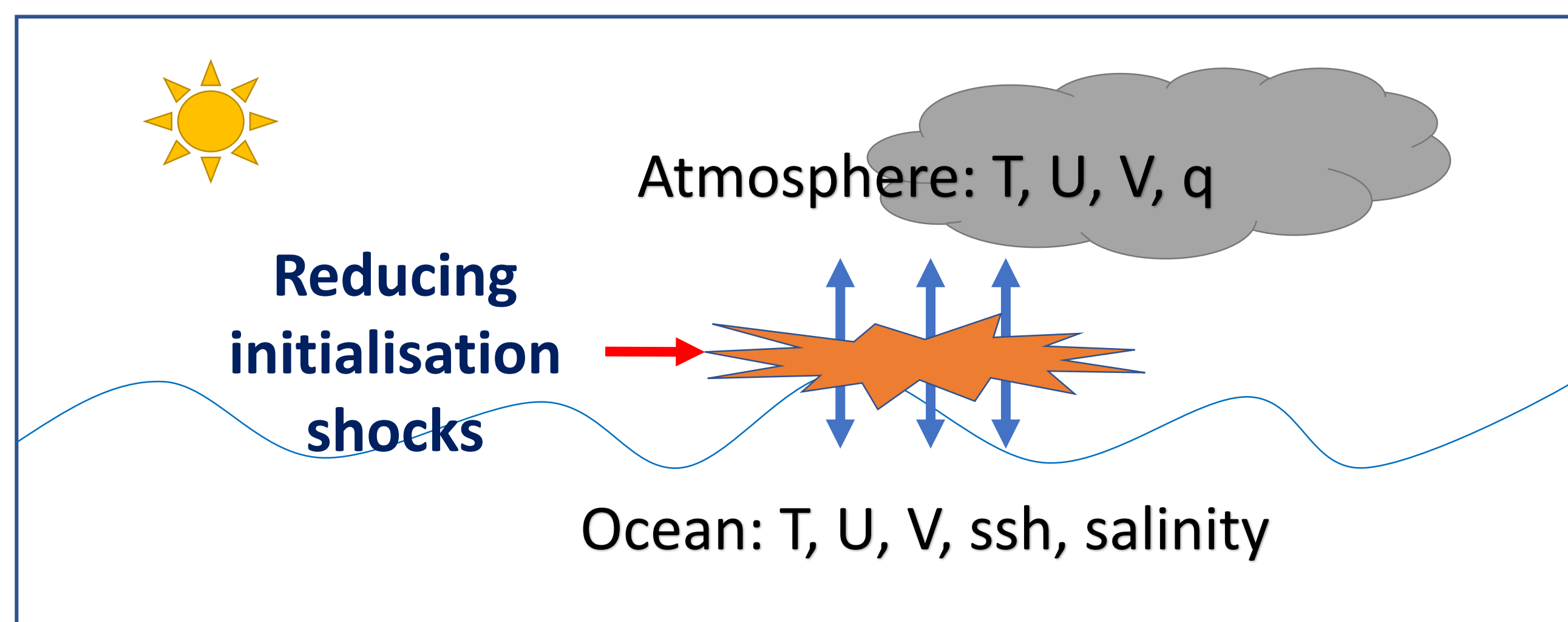


INTRODUCTION

The GloSea6 at KMA/NIMS

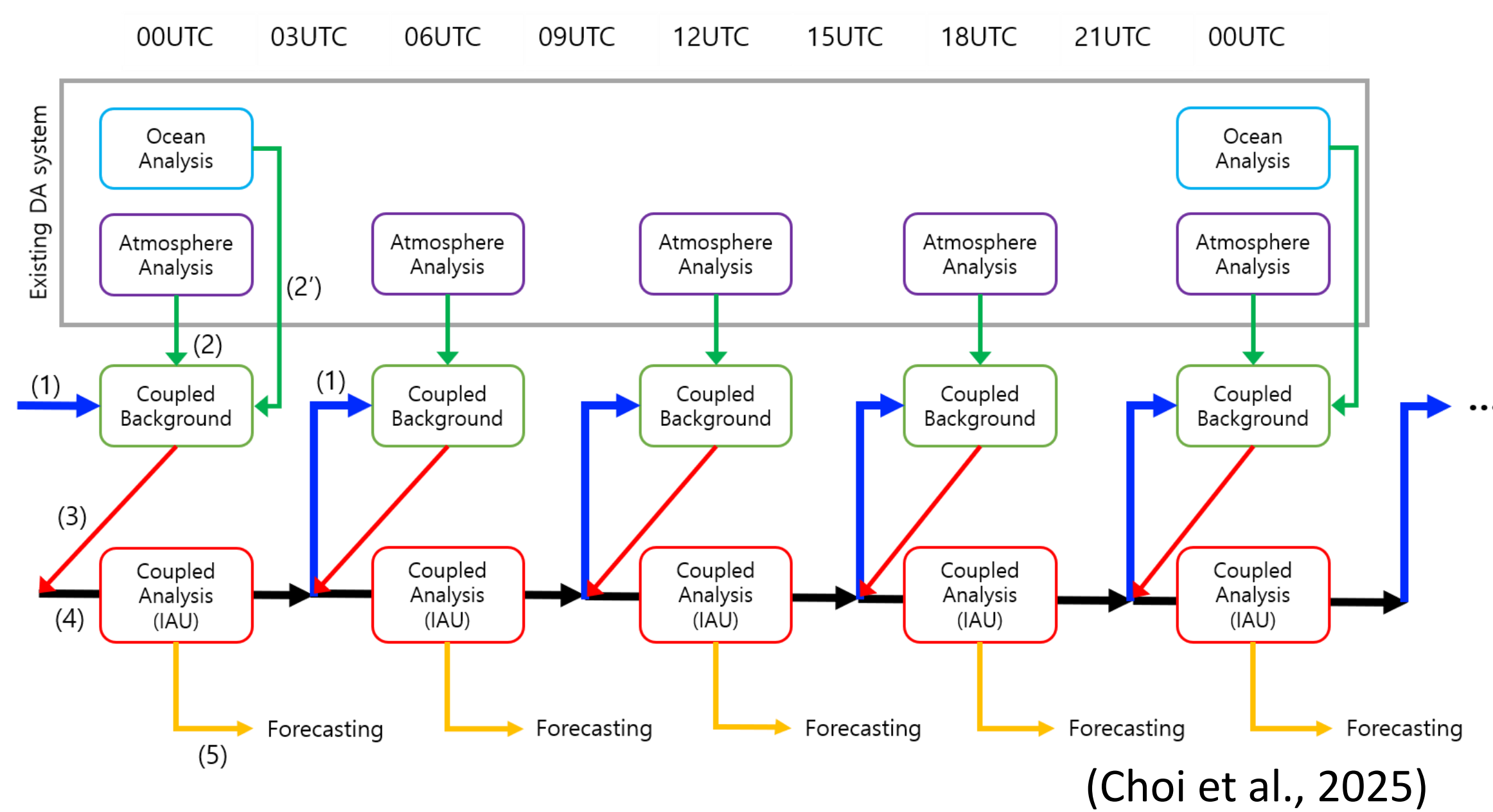
The National Institute of Meteorological Sciences (NIMS) has been operating the GC3.2-based GloSea6 since 2021. The GloSea6 is a coupled ensemble model in which atmosphere/ocean/sea-ice/land models are performed in different initial fields (Kim et al., 2021).

What is the topic of this study?



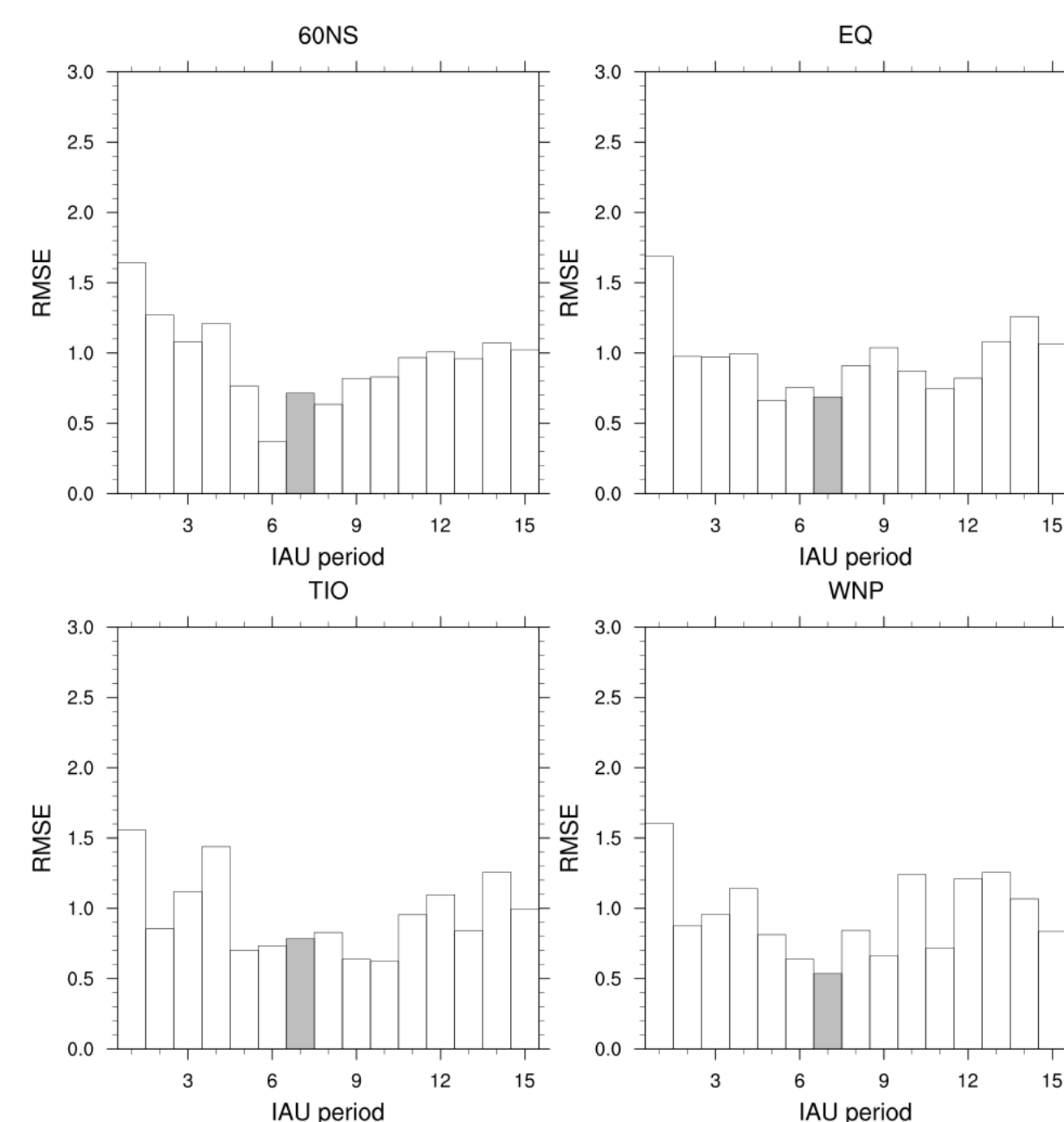
How to remove the shocks?

- Atmosphere : 6hourly Incremental Analysis Update (IAU) for T, U, V, q
- Ocean : 24hourly IAU for T, U, V, SSH, salinity



How long update?

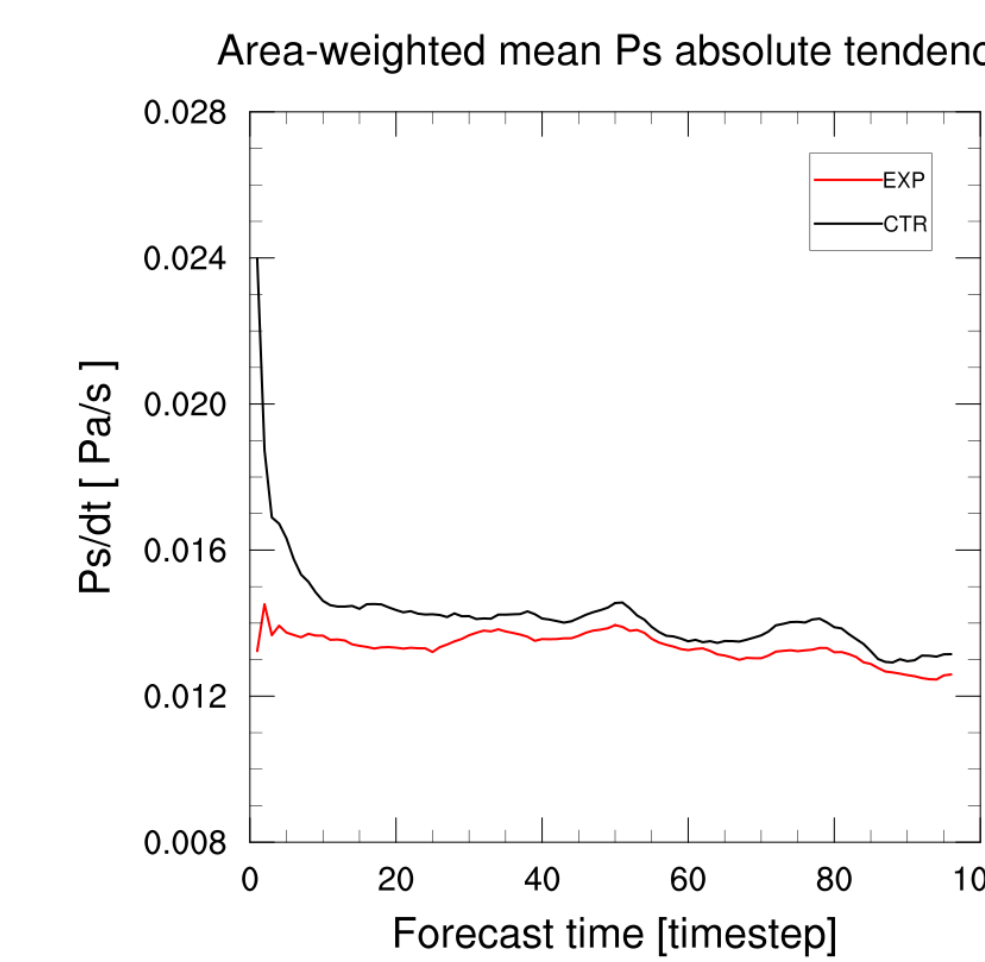
- Target time : 00 UTC 30th May 2022
- Observation : Merra2
- Variables : T1.5m, Tsfc, SLP, T850, T500, U850, U500, V850, V500, Q850, Q500
- IAU (relaxation time) : 1 ~ 15 days
- Areas
 - 60NS : [-60, 60, 0, 360], EQ : [-5, 5, 0, 360]
 - TIO : [-30, 30, 40, 120], WNP : [0, 60, 100, 180]
- Although the absolute magnitude of the bias between IAU periods is not large, it is characterized by decreasing and increasing around 7 days, so it is selected as **7 days**



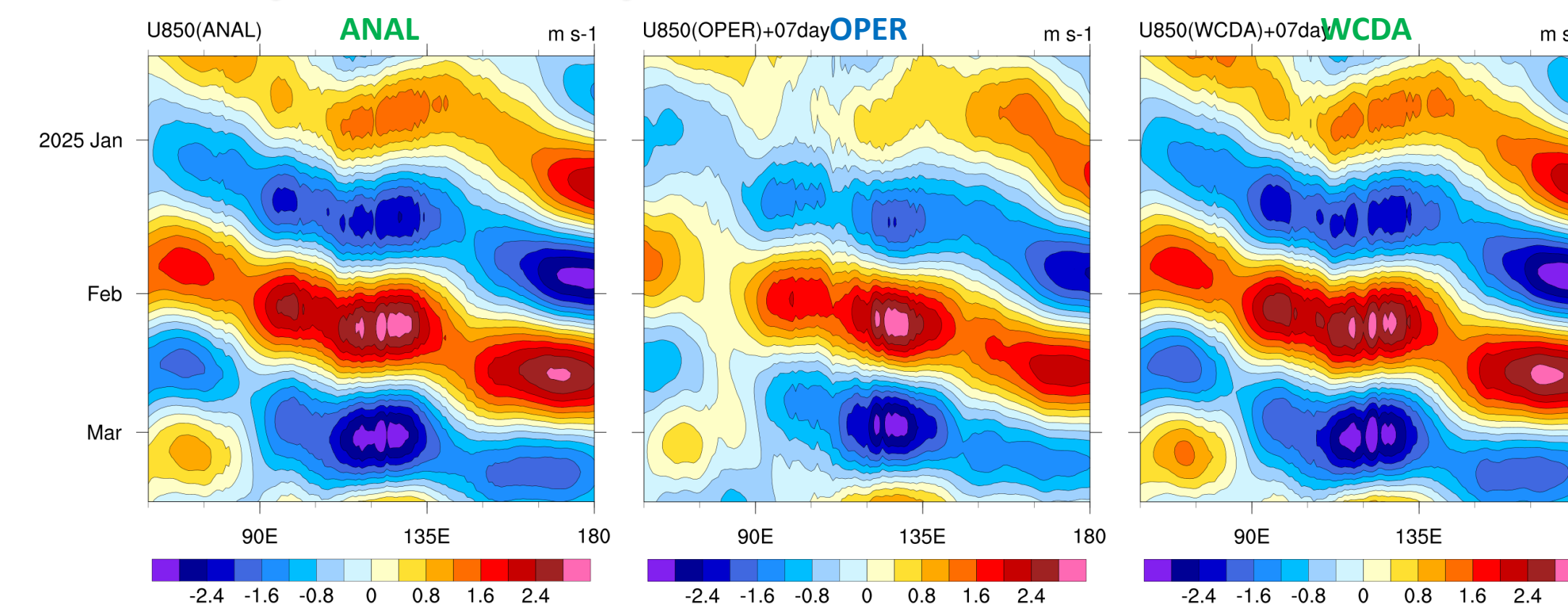
RESULTS

Surface Pressure Tendency

- Area-weighted mean Ps absolute tendency
- Target time : 00 UTC 30th May 2022
- 7days IAU
- In the 1day forecast, **EXP** (with IAU) had a Ps tendency of 0.13[Pa/s] at the 1st timestep, a 46% decrease compared to **CTR** (without IAU) of 0.24[Pa/s]



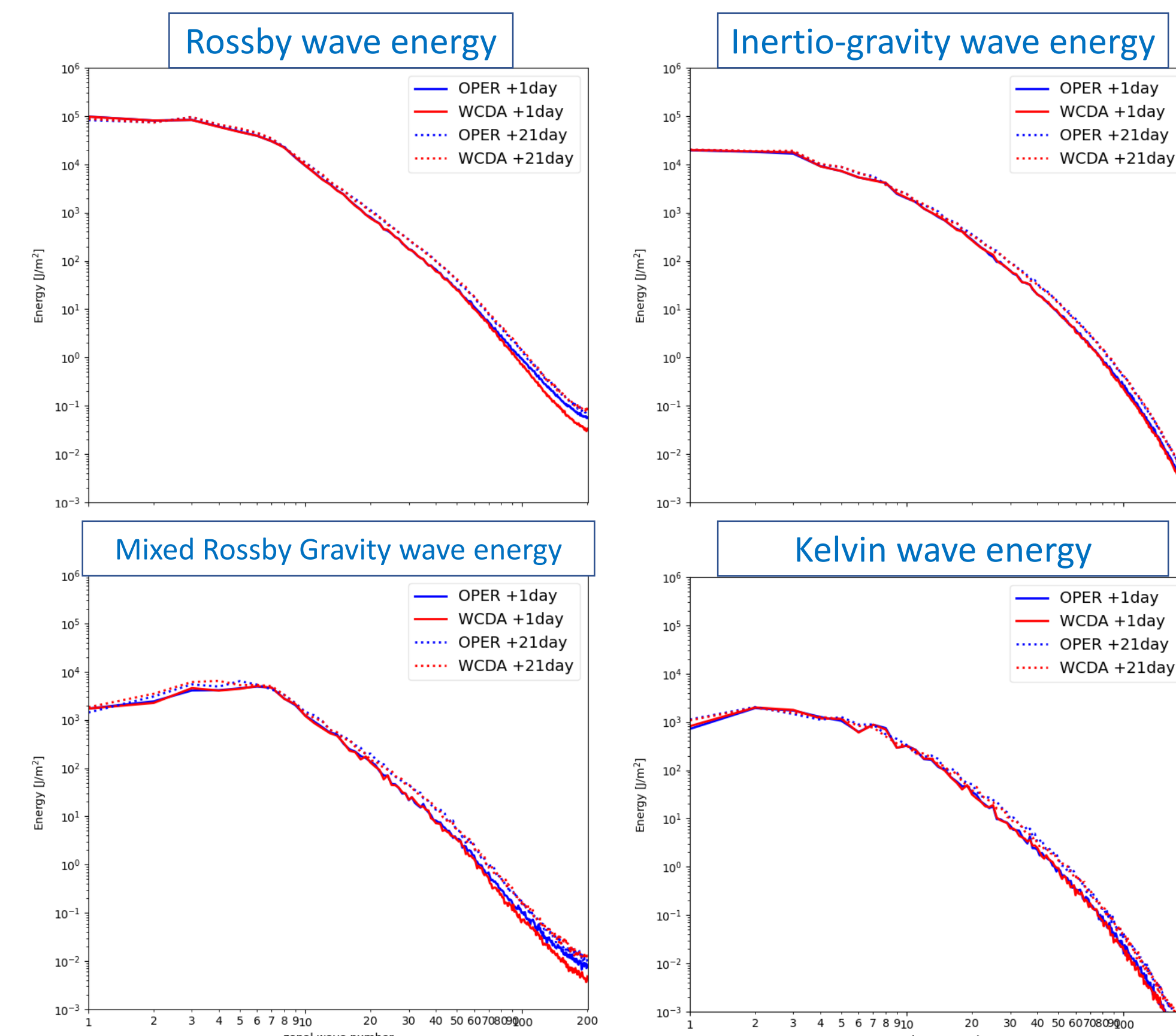
30-60 days band-pass filtered hovmoller



- (ANAL) U850 analysis of atmosphere model shows two MJO signals from DEC 2024 to FEB 2025
- (OPER-without IAU) +7 day forecast field, the signal gets week near the Indian Ocean
- (WCDA-with IAU) initial field after 7days IAU, the signal still remains

Spectral Analysis

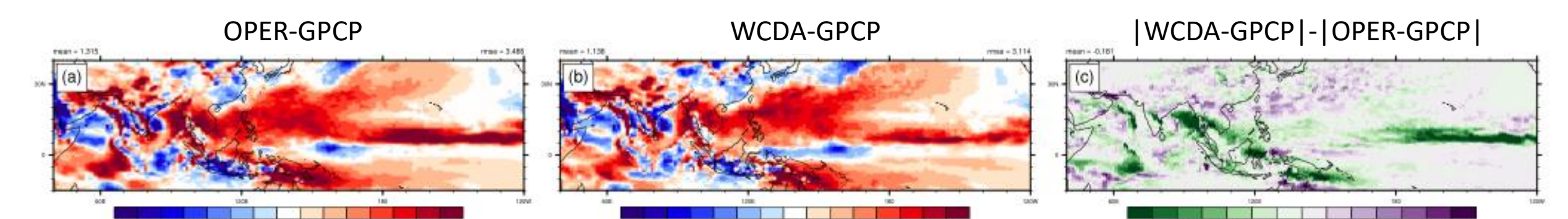
- Method : Analysis with Normal Mode Functions (Marques et al., 2020)
- zonal wave number=200, equivalent height: 9.8, 6.1, 2.7, 1.28, 0.66km
- Period : DEC 2024 to FEB 2025
- WCDA shows a decrease in high frequency Rossby wave energy, particularly a decrease in MRG components, however, zonal wave number and equivalent height levels must be increased to show the sensitivity of the gravity wave energy



Ensemble Mean Fields : week 3

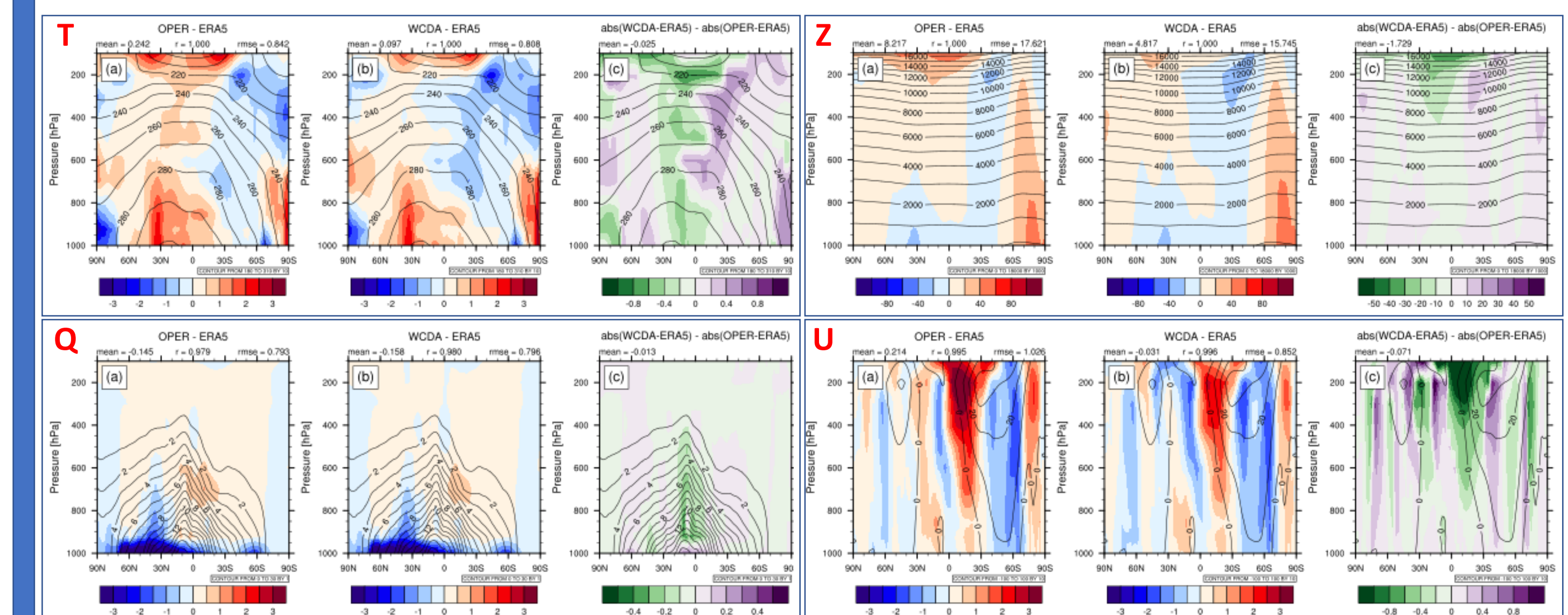
Precipitation

- (Left) Operational precipitation is overestimated compared to GPCP over the equatorial area
- (Middle) WCDA precipitation is still greater than observed one, but improves (green colour on the right panel)



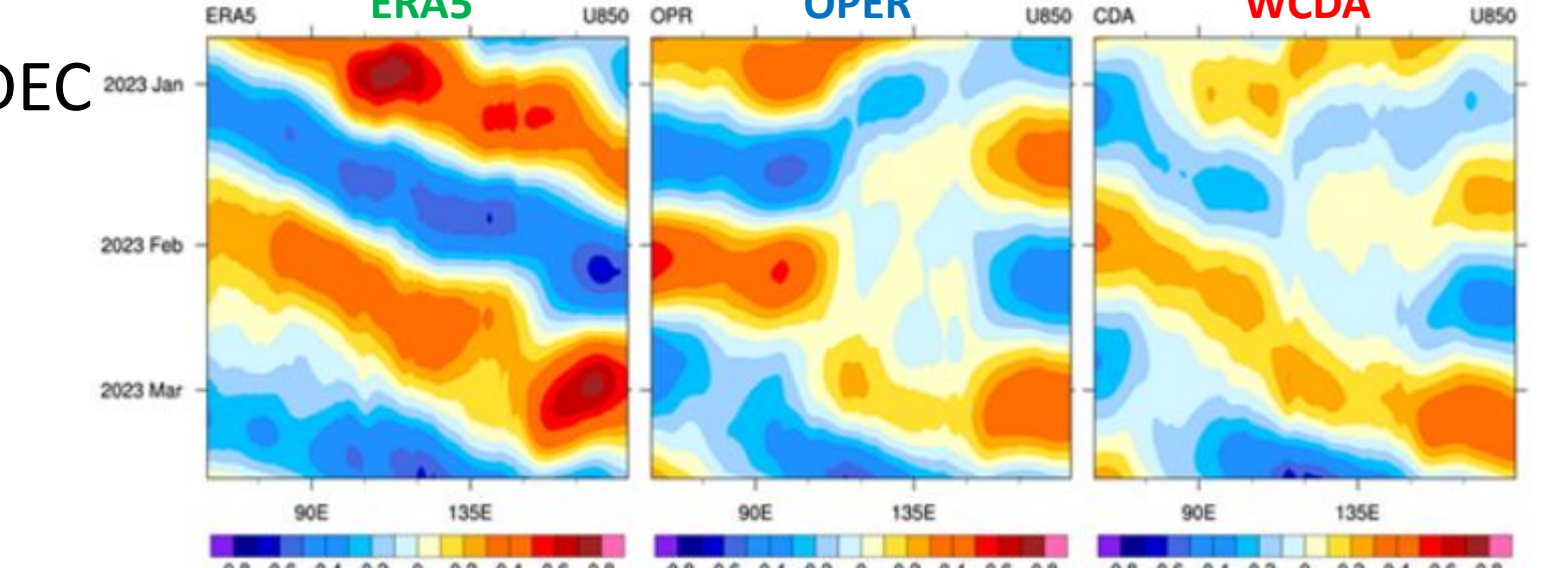
Zonal-mean latitude-pressure cross sections

- Temperature(left-top), specific humidity(left-bottom), geopotential height(right-top), zonal-wind(right-bottom) are overestimated compared to ERA5 both OPER and WCDA in the equatorial area
- WCDA shows a slight improvement in that area (green colour on the RHS panels)



30-60 days band-pass filtered hovmoller

- ERA5 shows two MJO signals from DEC 2022 to FEB 2023
- OPER breaks the MJO signals in the maritime continent area
- WCDA has a slight improvement in signal breaking



CONCLUSIONS

Summary

- Development of atmosphere-ocean weakly coupled data assimilation system completed
- WCDA is particularly effective in the equatorial area
- Future work
 - Reduce IAU execution time, it takes 4hours and 30mins and more evaluation
 - Under development of Sea-Ice weakly coupled data assimilation, Soil moisture strong coupled data assimilation

References

- Choi, N., M.-I. Lee, Y.-G. Ham, Y.-K. Hyun, J. Lee, and K.-O. Boo, 2025: Reducing initialization shock by Atmosphere-Ocean coupled data assimilation and its impacts on the sub-seasonal prediction skill. *J. Climate*, **38**, 1389-1401.
- Kim, H., J. Lee, Y.-K. Hyun, and S.-O., Hwang, 2021: The KMA global seasonal forecasting system (GloSea6)-Part1: Operational system and improvements. *Atmos. Korean Meteo. Soc.*, **31**, 341-359.
- Marques, C., M.-A. Martinho, and J. M. Castanheira, 2020: Three-dimensional normal mode functions: open-access tools for their computation in isobaric coordinates (p-3DNMF.v1). *Geosci. Model Dev.*, **13**, 2763-2781.