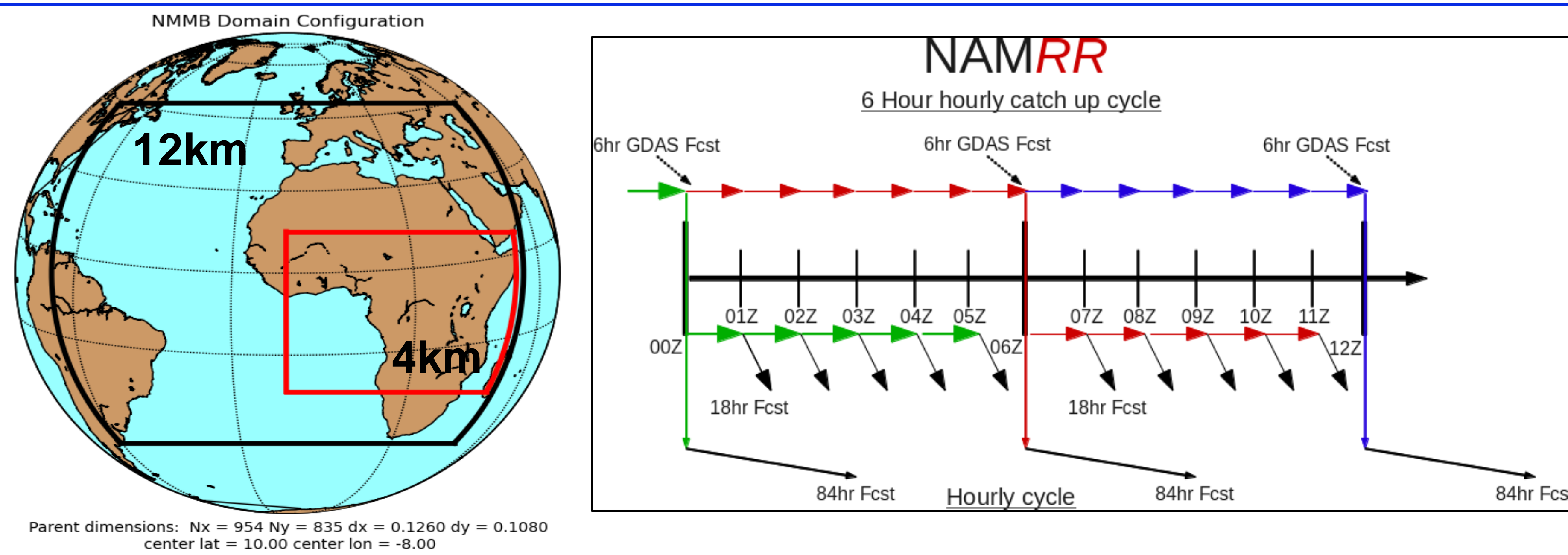


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## Motivation

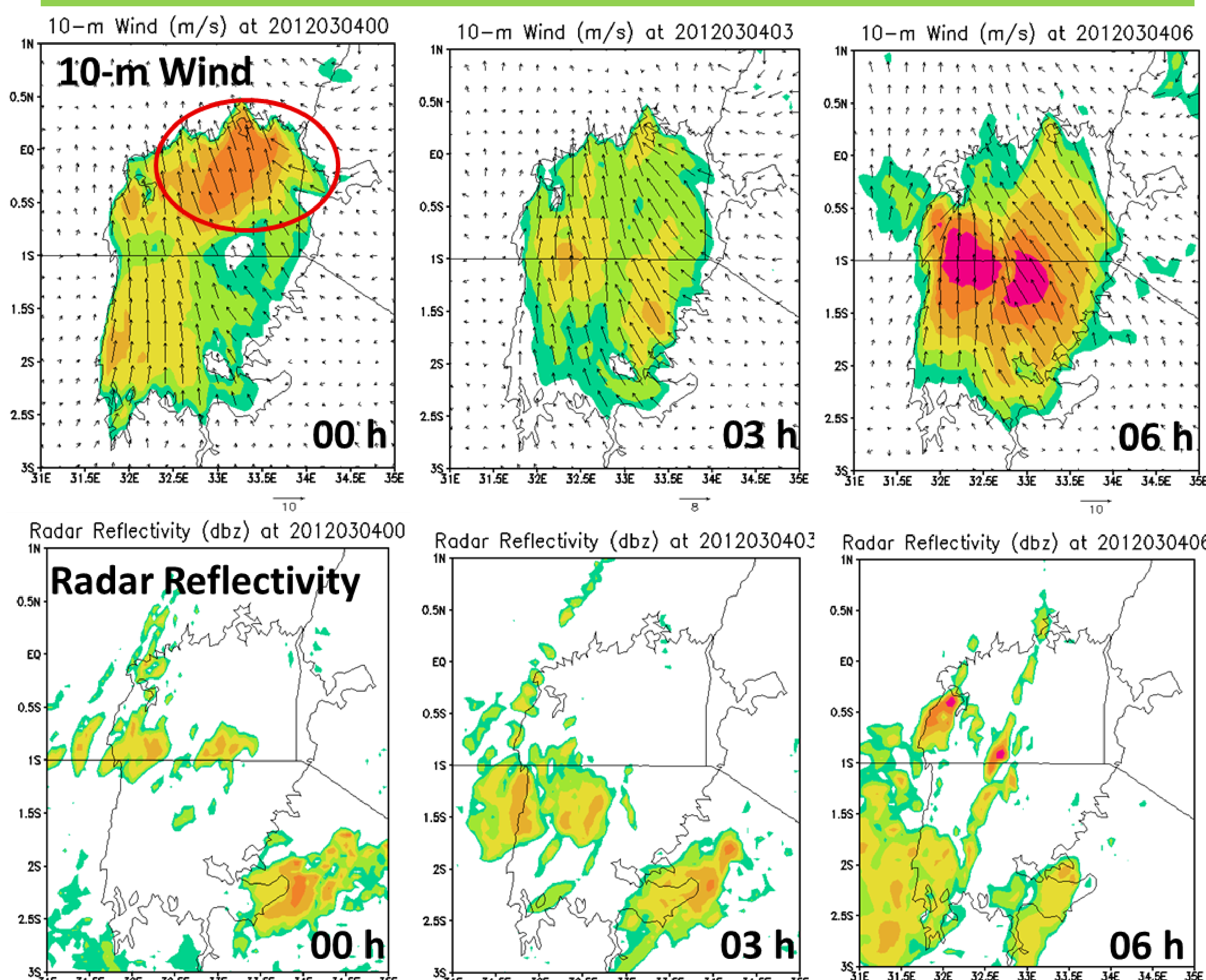
We are developing and testing the ability to assimilate Infrared radiances from geostationary satellites to improve the prediction of high impact weather with NCEP NDAS and NMMB model under the hourly update configuration. Geostationary satellite data has high horizontal resolution and scan frequency that contains valuable mesoscale information for quickly developing convective weather. We start to assimilate two water vapor channels from SEVIRI with NCEP NAM Rapid Refresh (NAMRR) system with the domain covering Europe, Africa, and Atlantic Ocean. Clear-sky and cloudy SEVIRI radiances were treated as two separate data sets in current tests with the 3D-Var method.



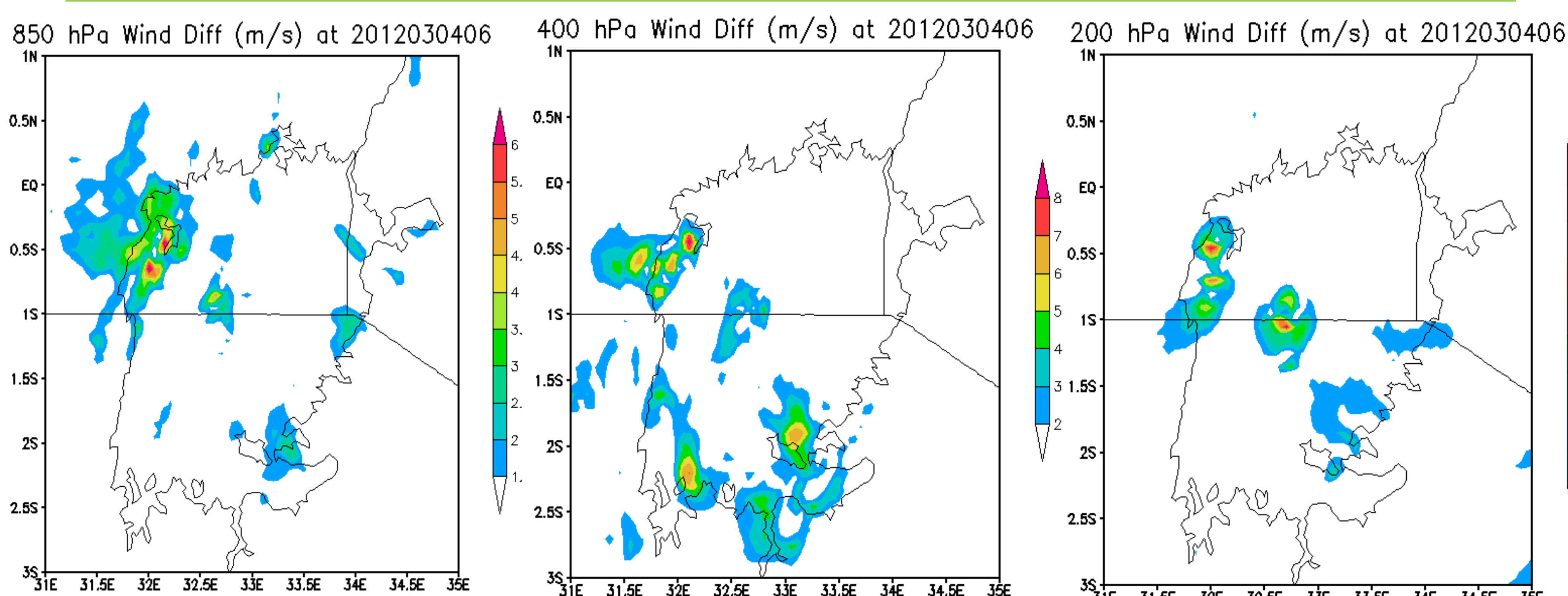
## Clear-sky SEVIRI

Experiment for Lake Victoria storm on March 4, 2012 assimilated clear-sky SEVIRI radiance data as well as other conventional and satellite radiance data that are operationally used in NCEP NDAS. This storm grew over north-west of the lake from approximately 0000 UTC (0300LT) and moved southwards towards the Bukoba region by 0300 UTC (0600LT).

### 4-km model forecast for Lake Victoria storm with SEVIRI clear-sky radiance



### 6-hr forecast wind-speed differences between with and without clear-sky SEVIRI



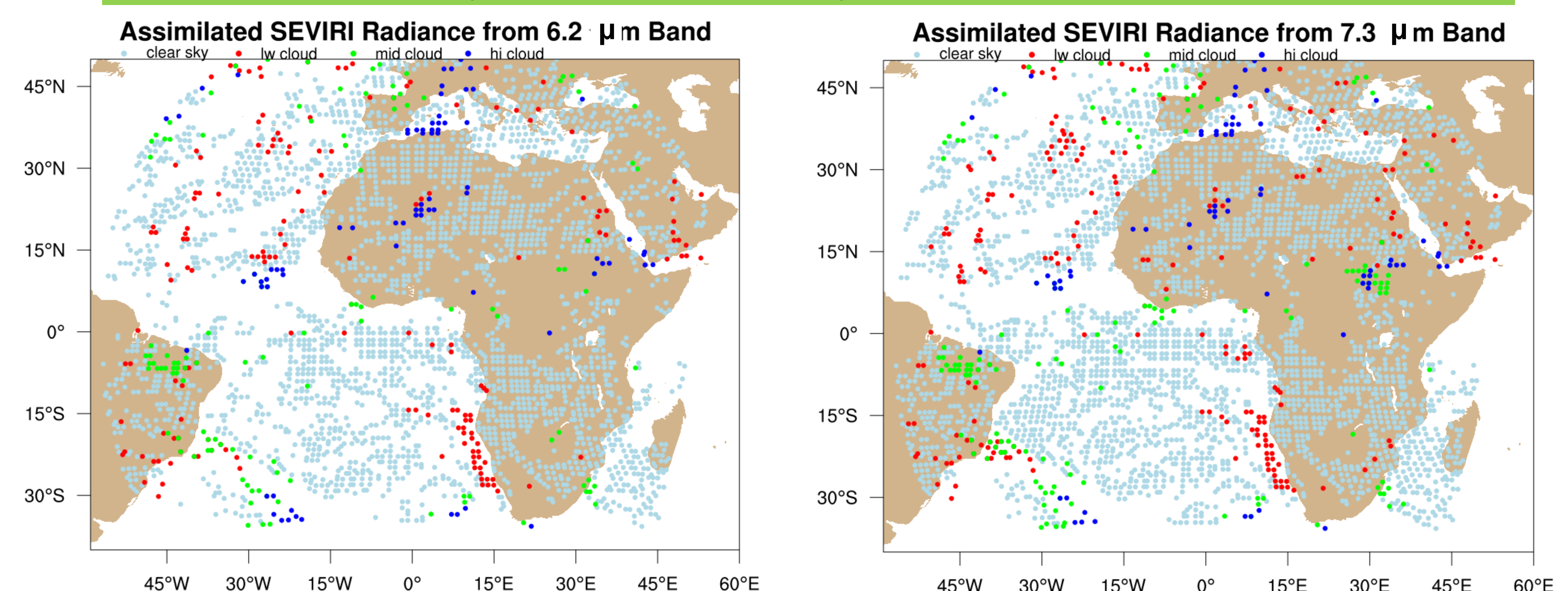
## Conclusion

NCEP NMMB Model 4-km forecast is able to capture the 6 hours' evolution of Lake Victoria storm on March 4, 2012. Assimilation of SEVIRI clear-sky water vapor channel radiance data leads to a stronger 6 hrs wind forecast on upper levels (850, 400 & 200 hPa) for this storm.

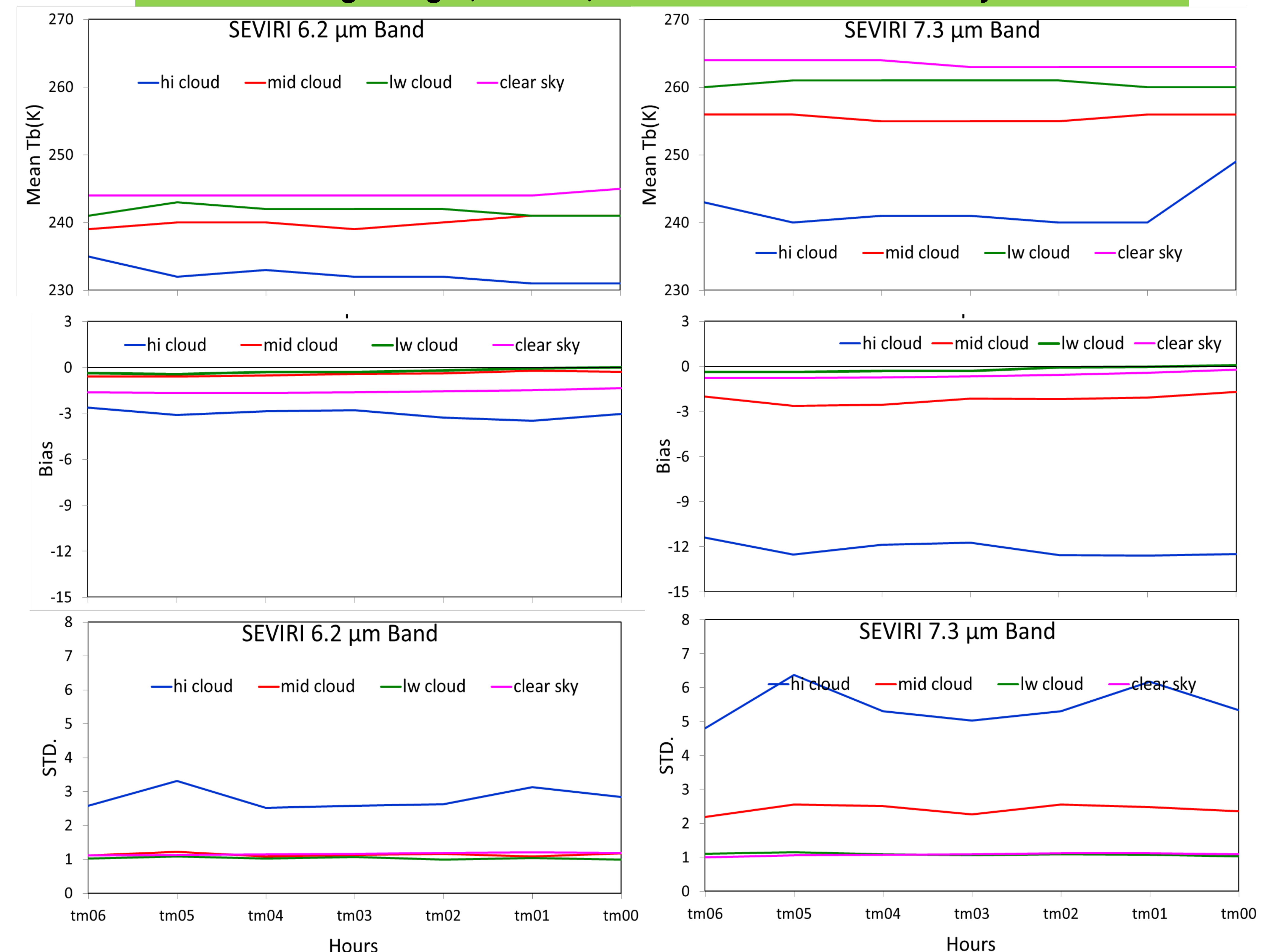
## Cloudy SEVIRI

- ❖ Add observation-centered cloud top height as the control variable at a footprint location over all channels measured at that point; So in addition to modified  $\partial T_B / \partial T(p)$ ,  $\partial T_B / \partial q_v(p)$ , etc., the minimization now incorporates the CTP Jacobian,  $\partial T_B / \partial p_{\text{cloud}}$ .
- ❖ Under the greybody assumption, the partially cloudy observation can then be considered for a single, fractional cloud as:  $I_{\text{cloud}} = N I_{\text{overcast}} + (1-N) I_{\text{clear}}$ ; GSI IR cloud detection solved the cloud top height and cloud fraction using 6 channels (6.2, 7.3, 8.7, 10.8, 12.0, and 13.4  $\mu\text{m}$ ), whereas only two water vapor channels (6.2 and 7.3  $\mu\text{m}$ ) were activate in the analysis as for the assimilation of clear-sky radiance.
- ❖ Only overcast cloud (cloud fraction > 90%) scenes are selected both over water and land.

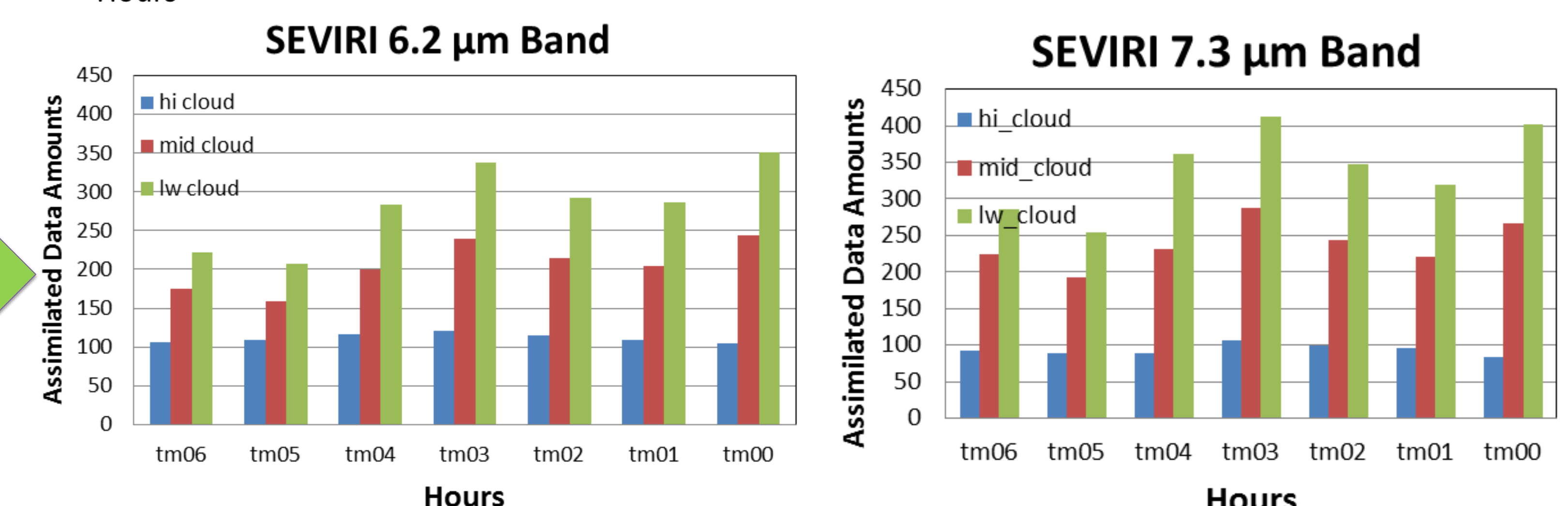
### Assimilated clear-sky and overcast cloudy SEVIRI data in 1-hour time window



### Bias monitoring of high-, middle-, low-level cloud and clear-sky observation



Hourly assimilated overcast cloudy data in catch-up cycle.



## Summary and Future Work

Cloud-affected SEVIRI radiance assimilation has been implemented in GSI. The bias of cloudy radiance varies along with the cloud height. High clouds have largest bias for both of the assimilated channels, while low level has smallest bias. Adding overcast cloud situations increases the number of used data by less than 10% data compared to clear-sky. Future work will include development of the bias correction and height dependent cloud top height background errors. We will explore if the cloud detection scheme based on radiance space is better than current scheme based on brightness temperature space. The impact of assimilating cloud-affected SEVIRI radiance will be investigated over the Africa domain and for the Lake Victoria storm.