Adaptive Observation Error Inflation (AOEI) & Adaptive Background Error Inflation (ABEI) for Convection-permitting Ensemble Assimilation of All-sky GOES-16 Radiances

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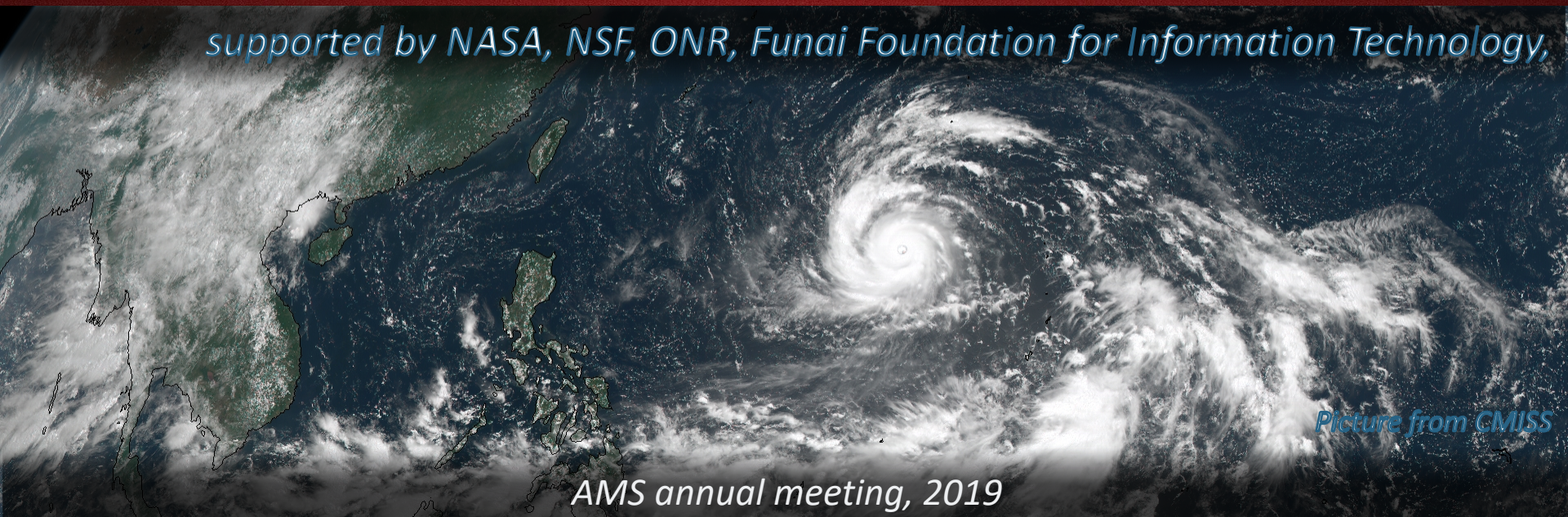
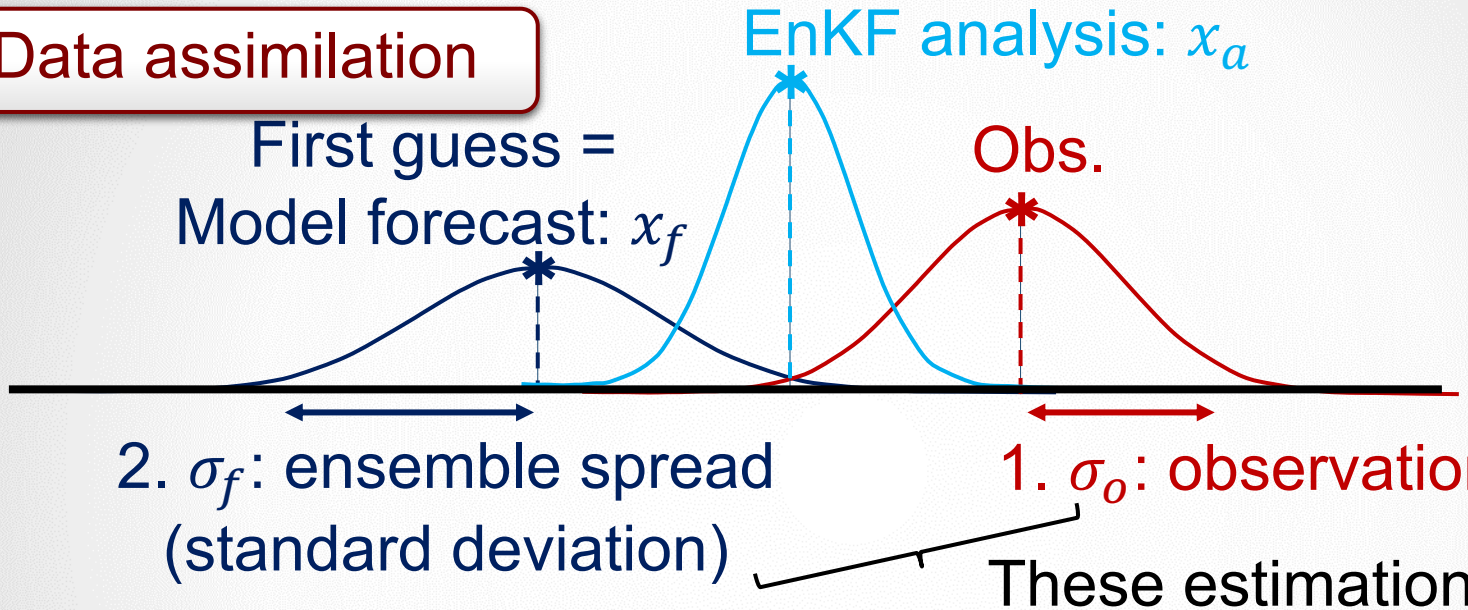
supported by NASA, NSF, ONR, Funai Foundation for Information Technology,



AMS annual meeting, 2019

Why all-sky assimilation is difficult?

→ Strong nonlinearity  (violation of EnKF assumption)



- **Adaptive observation error inflation (AOEI)**

  Minamide, M., and F. Zhang, 2017: Adaptive Observation Error Inflation for Assimilating All-sky Satellite Radiance, *MWR*, 145,1063-1081

- **Adaptive background error inflation (ABEI)**

  Minamide, M., F. Zhang, 2018: An Adaptive Background Error Inflation Method for Assimilating All-sky Radiances, in press for *QJRMS*

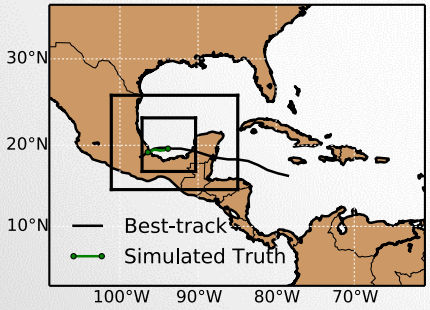
Experimental settings for ABEI

Model: **WRF** ver.3.6.1(Skamarock 2008), **CRTM** (Han et al. 2006)
Advanced PSU WRF-EnKF (APSU) DA system
(Weng and Zhang, 2016; Zhang, Minamide and Clothiaux, 2016)

Ensemble-based data assimilation system (60 members)
Regional convective-permitting model
- Resolution: 27, 9 & 3 km (D1-D3)

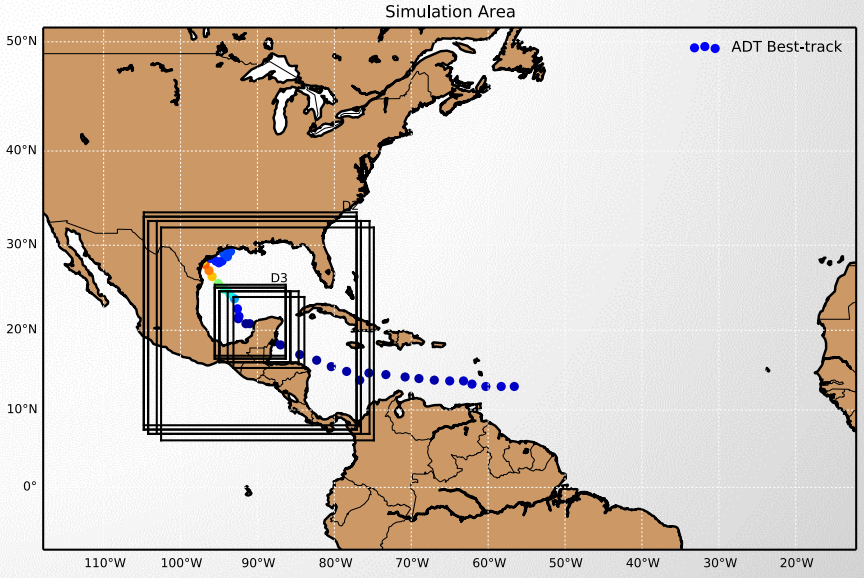
OSSE
(Hurricane Karl, 2010)

- Using OSSE result to calculate ABEI parameters

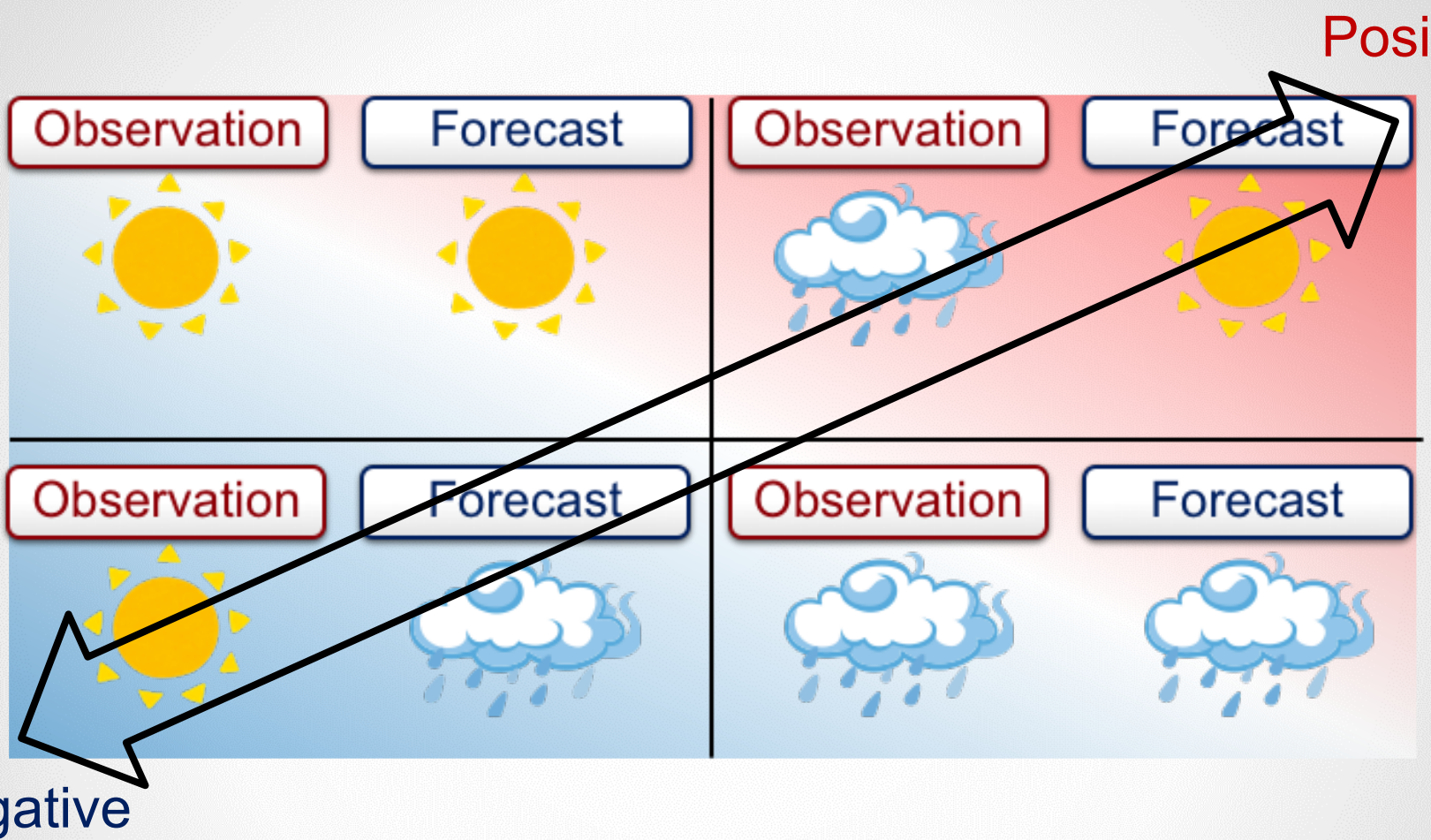


(Zhang, Minamide & Clothiaux, *GRL*, 2016)

Real-data
(Hurricane Harvey, 2017)



Filter performance and cloud-scene

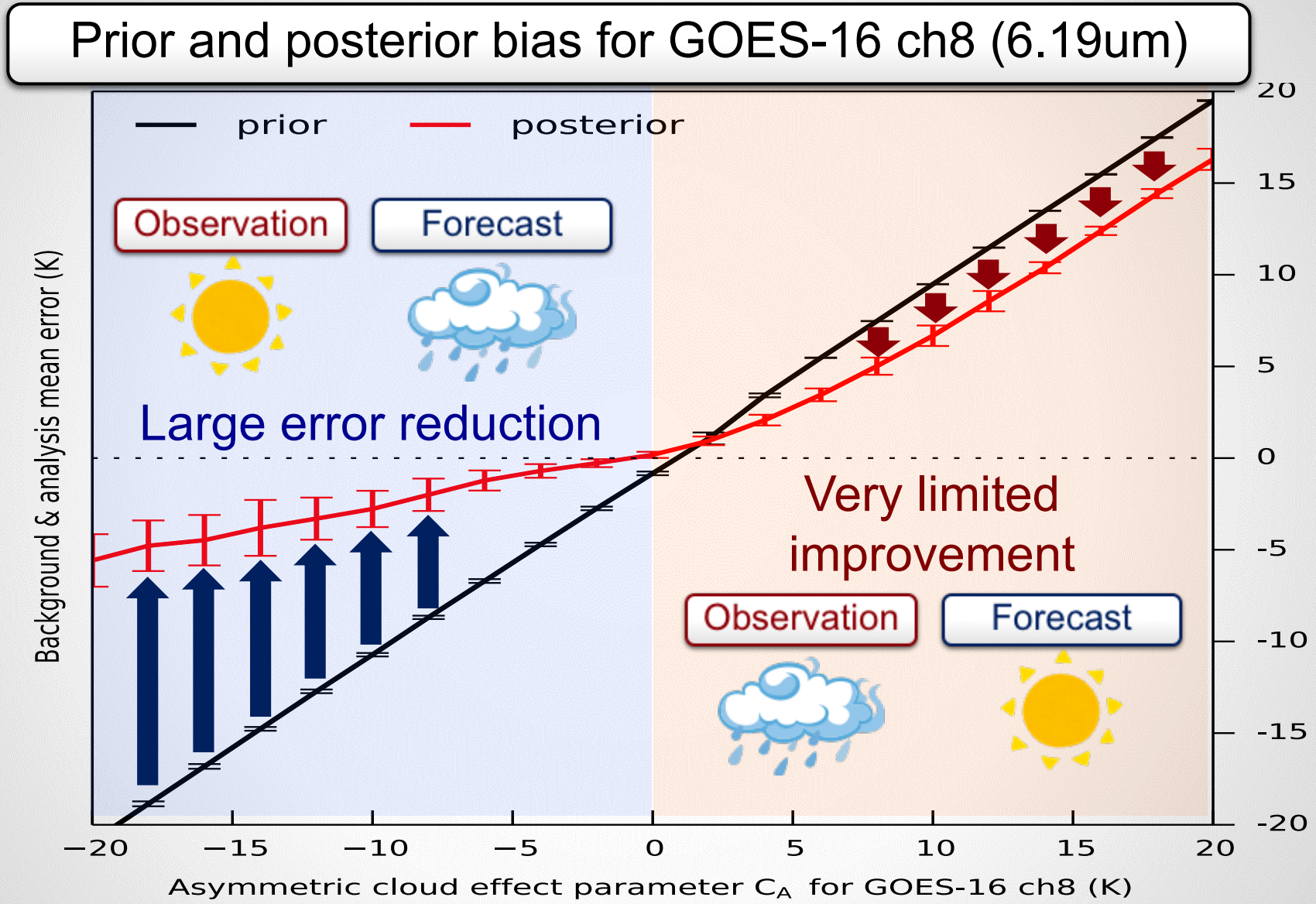


Asymmetric Cloud parameter - Modified from Okamoto et al. (2014), QJRMS

$$C_A = |O - F_{clr}| - |F - F_{clr}|$$

(Minamide & Zhang, accepted for *QJRMS*)

How much do we currently improve?

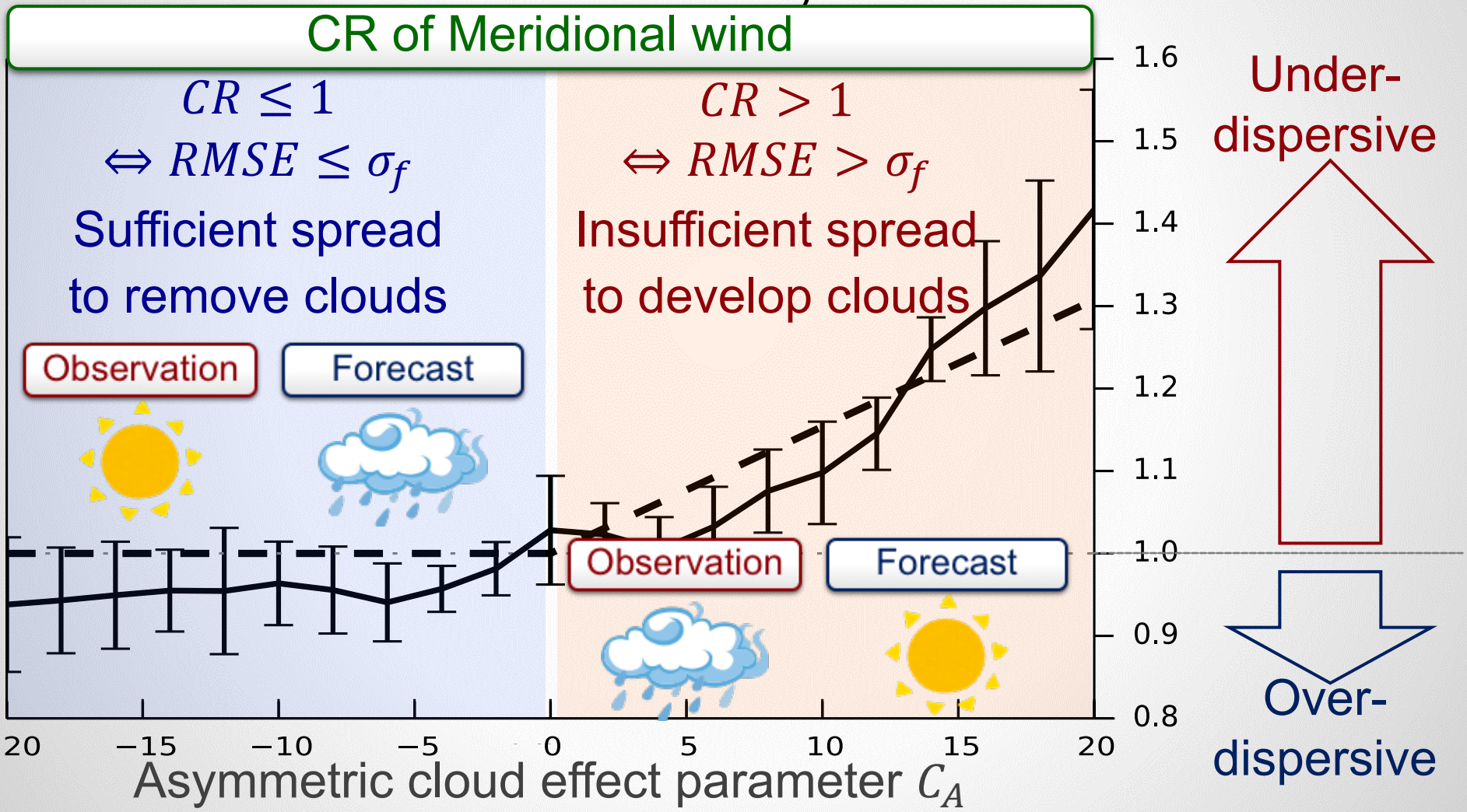


(Minamide & Zhang, accepted for *QJRMS*)

Why does performance depend on cloud-scene?

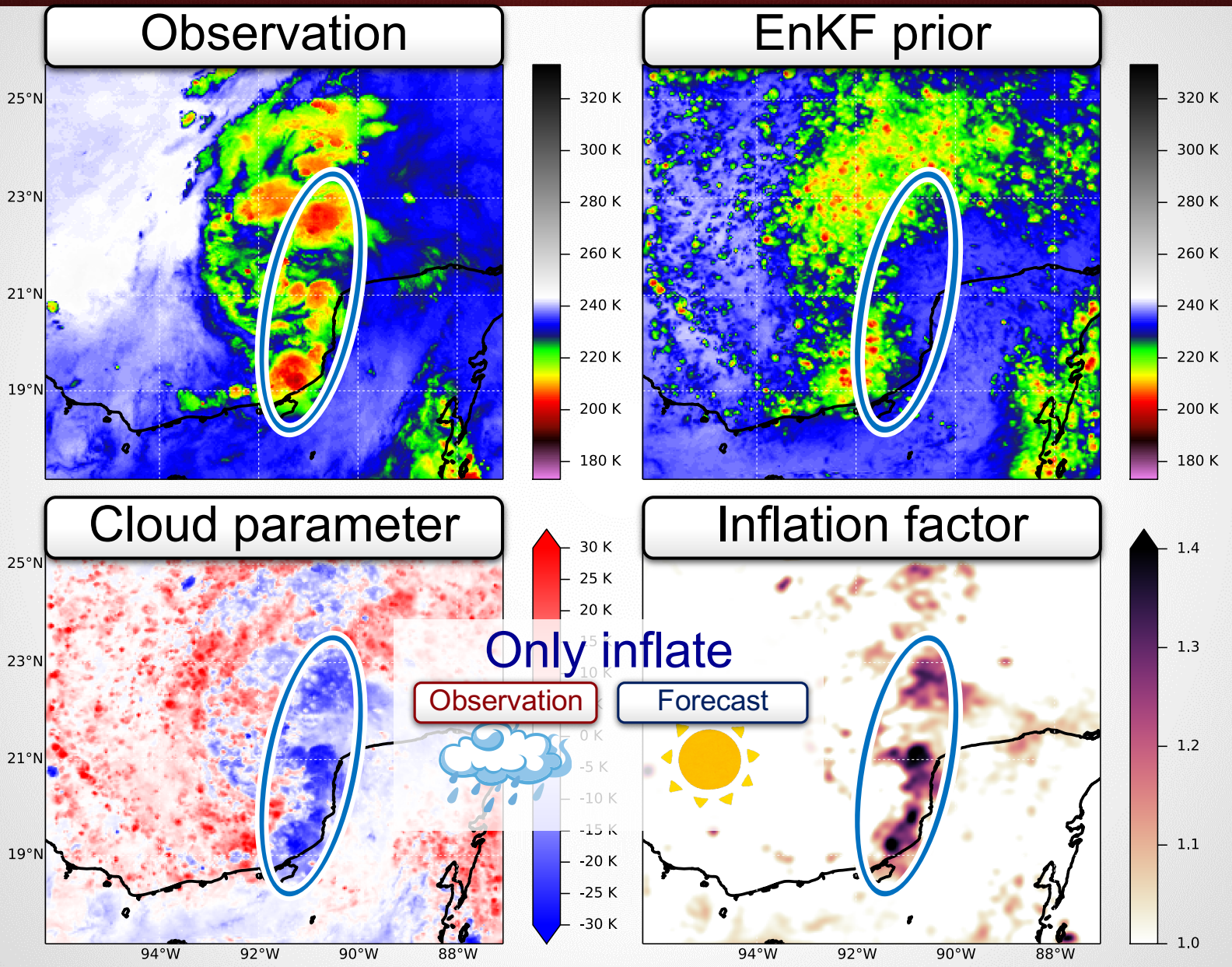
$$Consistency\ Ratio:\ CR = \frac{RMSE}{\sigma_f}$$

Dashed-line: ABEI model



(Minamide & Zhang, accepted for *QJRMS*)

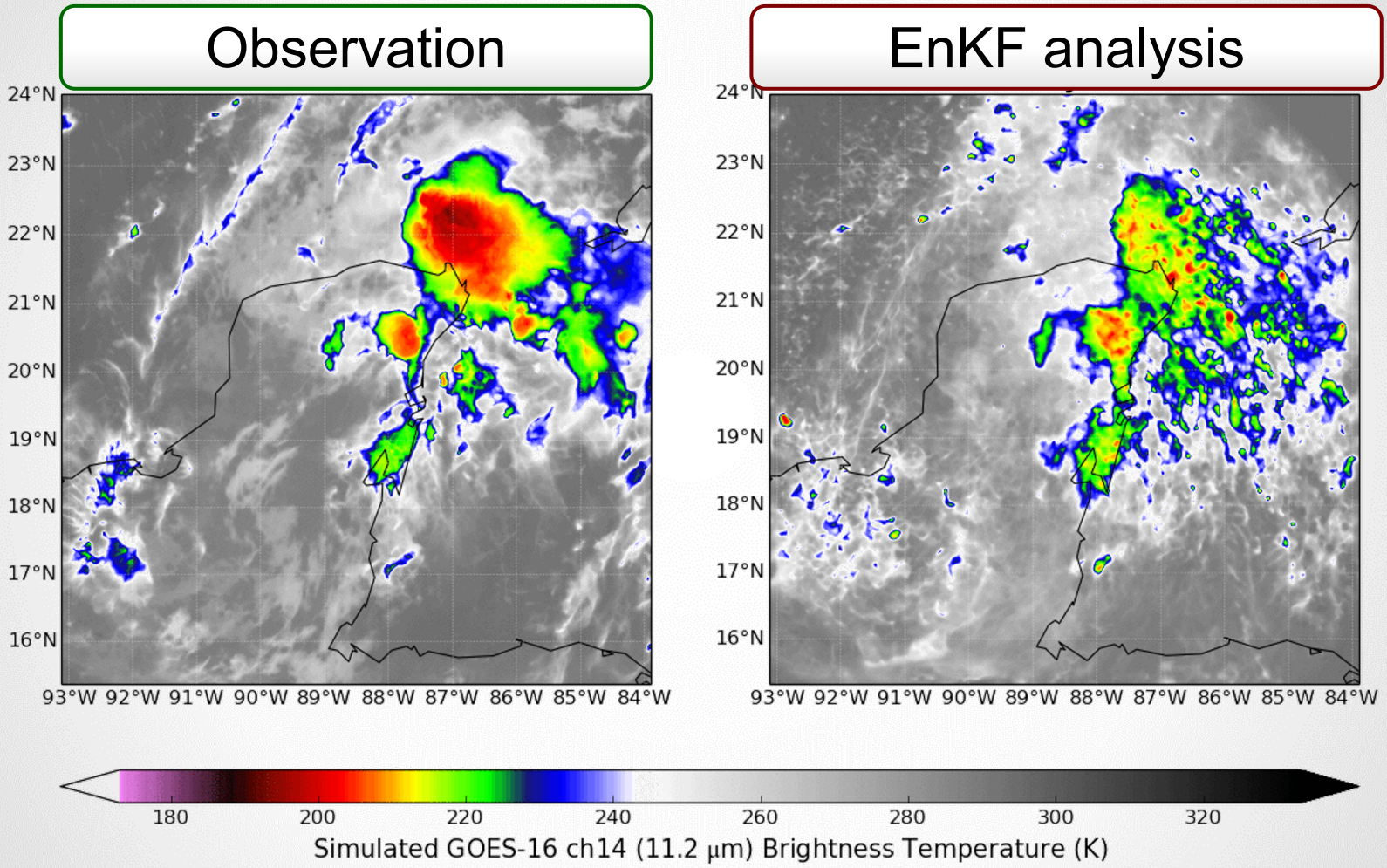
Adaptive Background Error Inflation (ABEI)



(Minamide & Zhang, accepted for *QJRMS*)

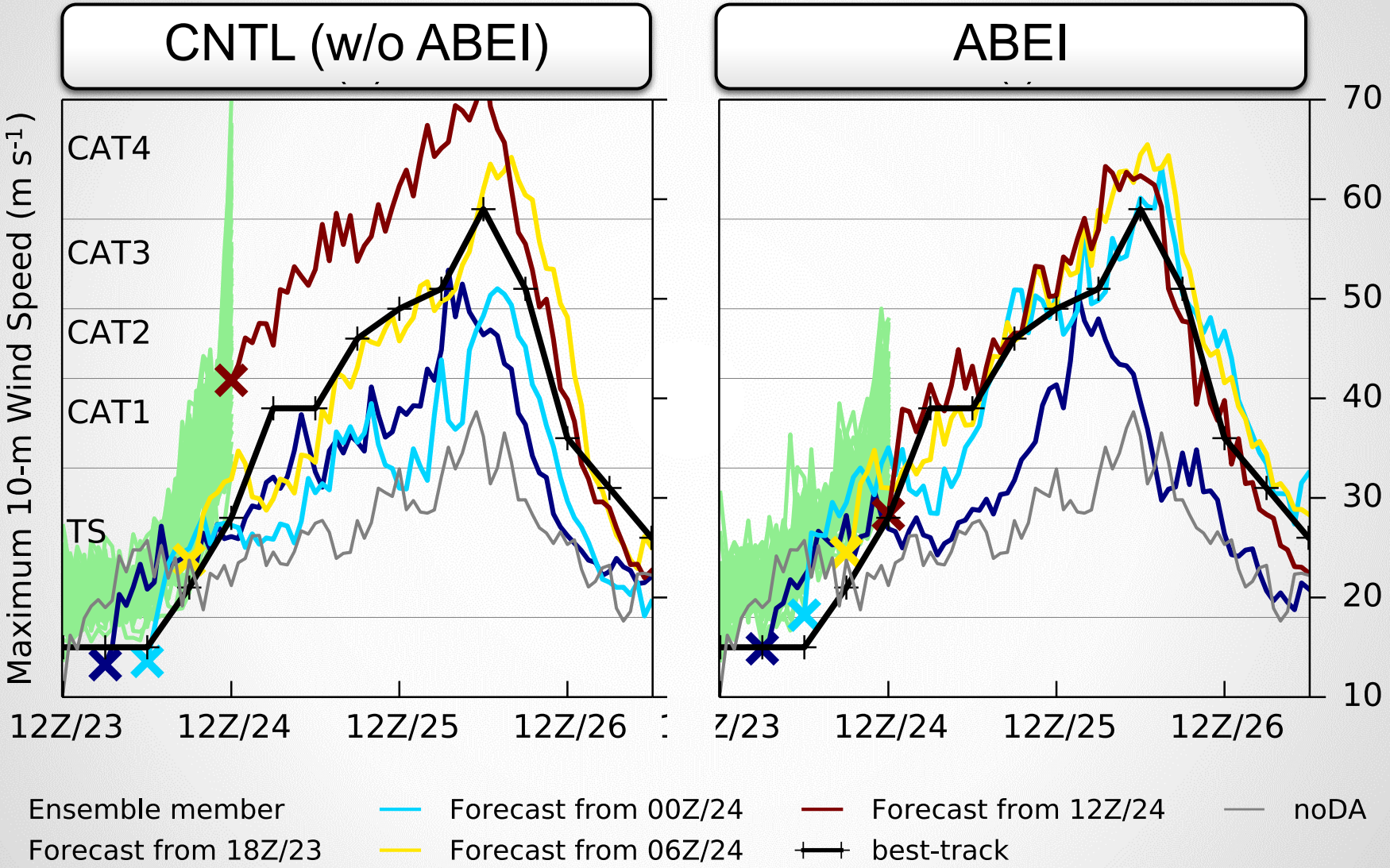
EnKF Performance Assimilating GOES-16 all-sky BT[8]

GOES-16 **Window** Channel (ch14: 11.2 μm)



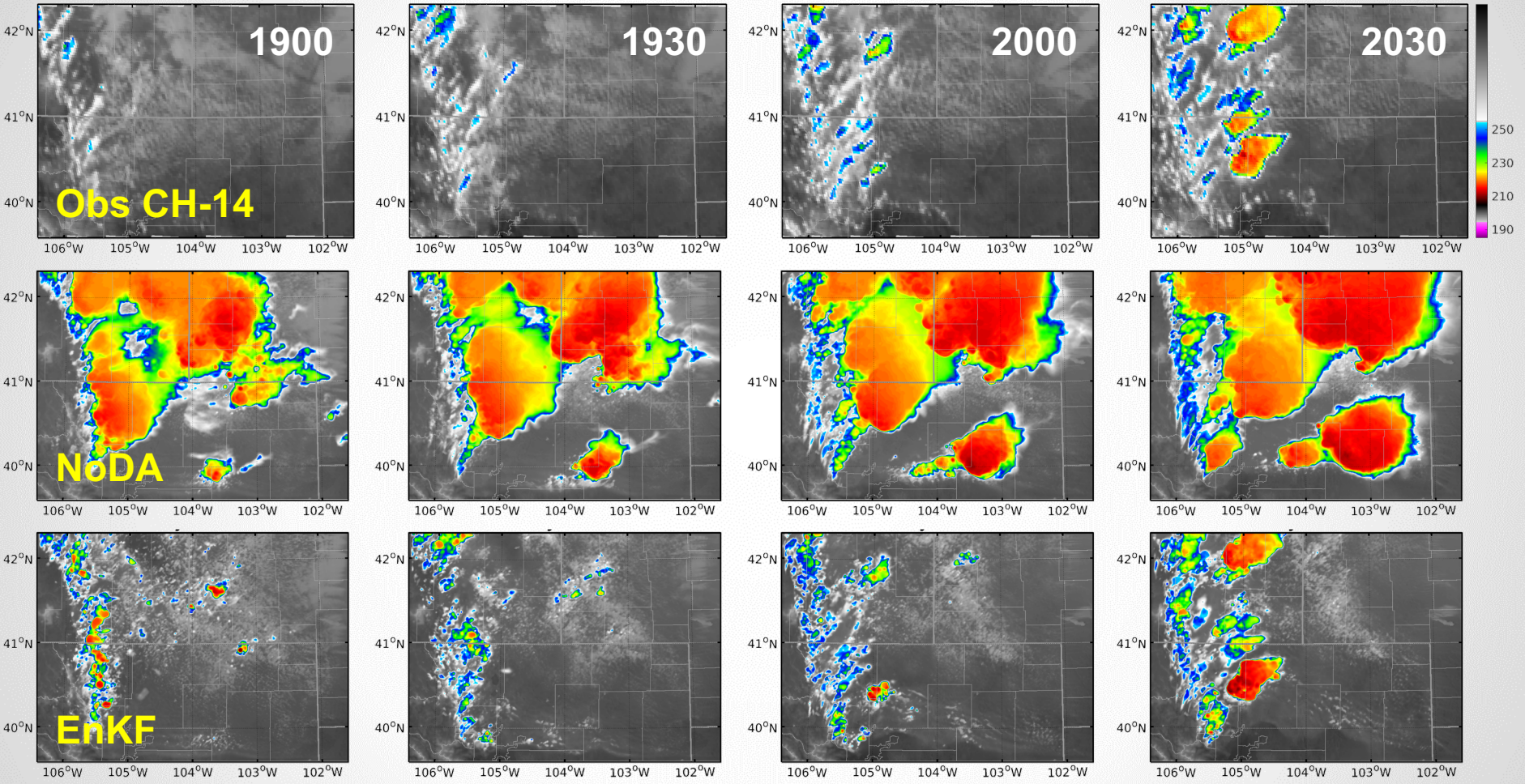
- All-sky DA helps to capture convection through entire TC life.

EnKF Performance on TC intensity



(Minamide & Zhang, accepted for *QJRMS*)

Application on severe thunder-storm in 2017



Concluding Remarks

- It is very hard to develop convections where cloudy-sky is observed but clear-sky is forecasted, because of the lack of sufficient ensemble spread.
- Cloud-scene-dependent Adaptive Background Error Inflation (ABEI) method is newly proposed.
- Assimilation of all-sky brightness temperatures from GOES-16 with ABEI contributed to
  - avoiding filter-divergence
  - keeping appropriate amount of ensemble spread

  that helped to improve the forecast of hurricane Harvey (2017).

Minamide, M., F. Zhang, 2018: An Adaptive Background Error Inflation Method for Assimilating All-sky Radiances, accepted for *Quarterly Journal of Royal Meteorological Society*

Thank you for your attention. (Masashi.Minamide@jpl.nasa.gov)