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Impact of initial SST fields on Hurricane Edouard (2014) forecasts with the HWRF model

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1. Motivation

Tropical cyclone (TC) is like a heat engine; SST directly affects hurricane forecast by providing energy source through surface enthalpy heat flux. 26 ^oC SST is known as the threshold for TC formation and development. SST perturbations can increase spread for global ensemble forecast (McLay et al. 2012) or regional ensemble TC forecast (Kunii and Miyoshi 2012). Specific ocean feature, such as Atlantic warm pool, defined as warm water with SST over 28.5 ^oC, is known to affect Atlantic hurricane activity. This study will address how prescribed SST from different sources (GFS, NCODA, RTOFS) and different years will affect TC forecast (Hurricane Edouard 2014)

2. HWRF Model

- **Hurricane Weather and Research Forecast system (HWRF) v3.7**
- **Resolution: 18-6-2 km nesting grids with the two inner most domain moving with the TC; 61 vertical sigma levels extending to 2 hPa; surface flux parameterization with bulk aerodynamic formula; RRTMG long- and short-wave radiation parameterization; non-local EDMF GFS PBL scheme; Ferrier-Aligo microphysics scheme and scale-aware Simplified Arakawa-Schubert (SAS) cumulus scheme (for all three domains)**
- **HWRF vortex relocation and initialization; No GSI**
- **Cold start from 0000 UTC Sep. 12 2014**
- **SST sources:**
  - **GFS SST**
  - **HYCOM-NCODA (US GODAE): resolution 1/6 ^{o}; at the same date from 2010 to 2014**
  - **EMC global RTOFS: resolution 1/12 ^{o}**
  - **GDEM climatology at September**

3. Experiment setup

Experiments	SST
EXP GFS	GFS SST
EXP NCODA (2010-2014)	HYCOM-NCODA 2010-2014
EXP GDEM	GDEM

4. Results

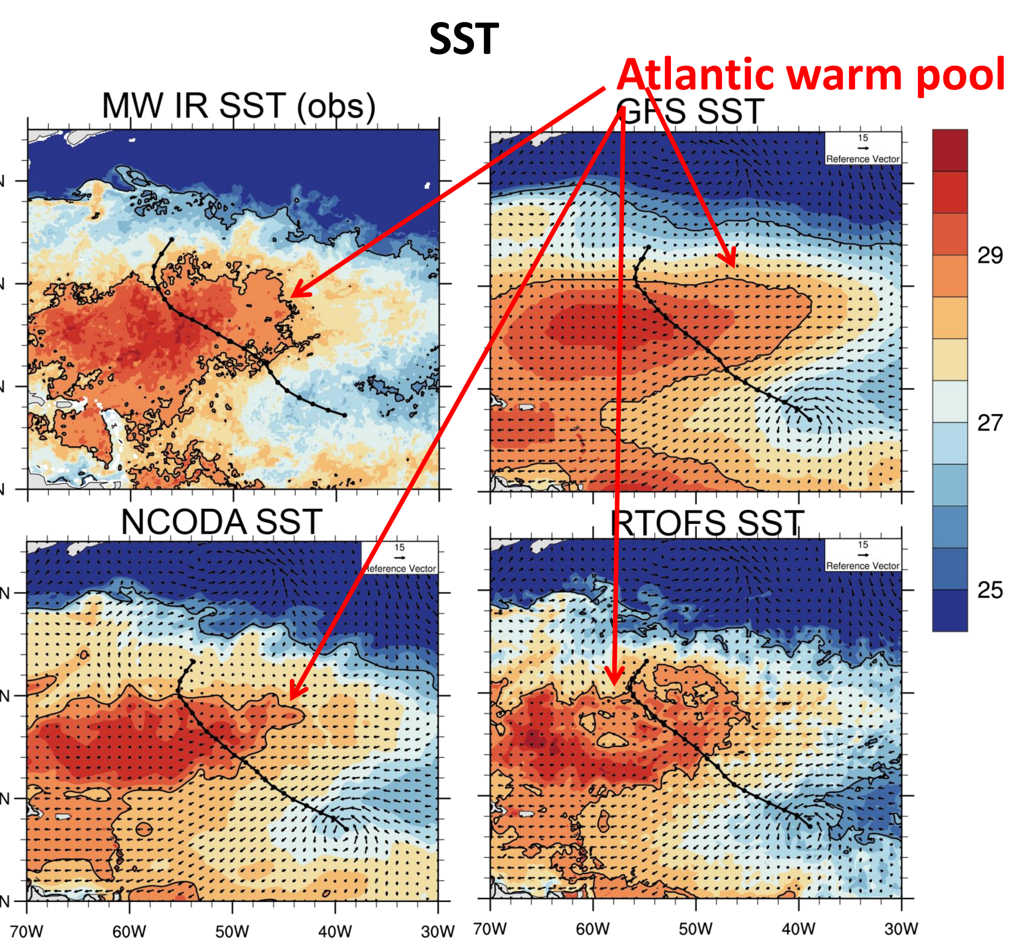

Fig. 1. The satellite composite SST (upper left) and prescribed SST of three experiments, superimposed on the best track (upper left), and individual predicted storm track.

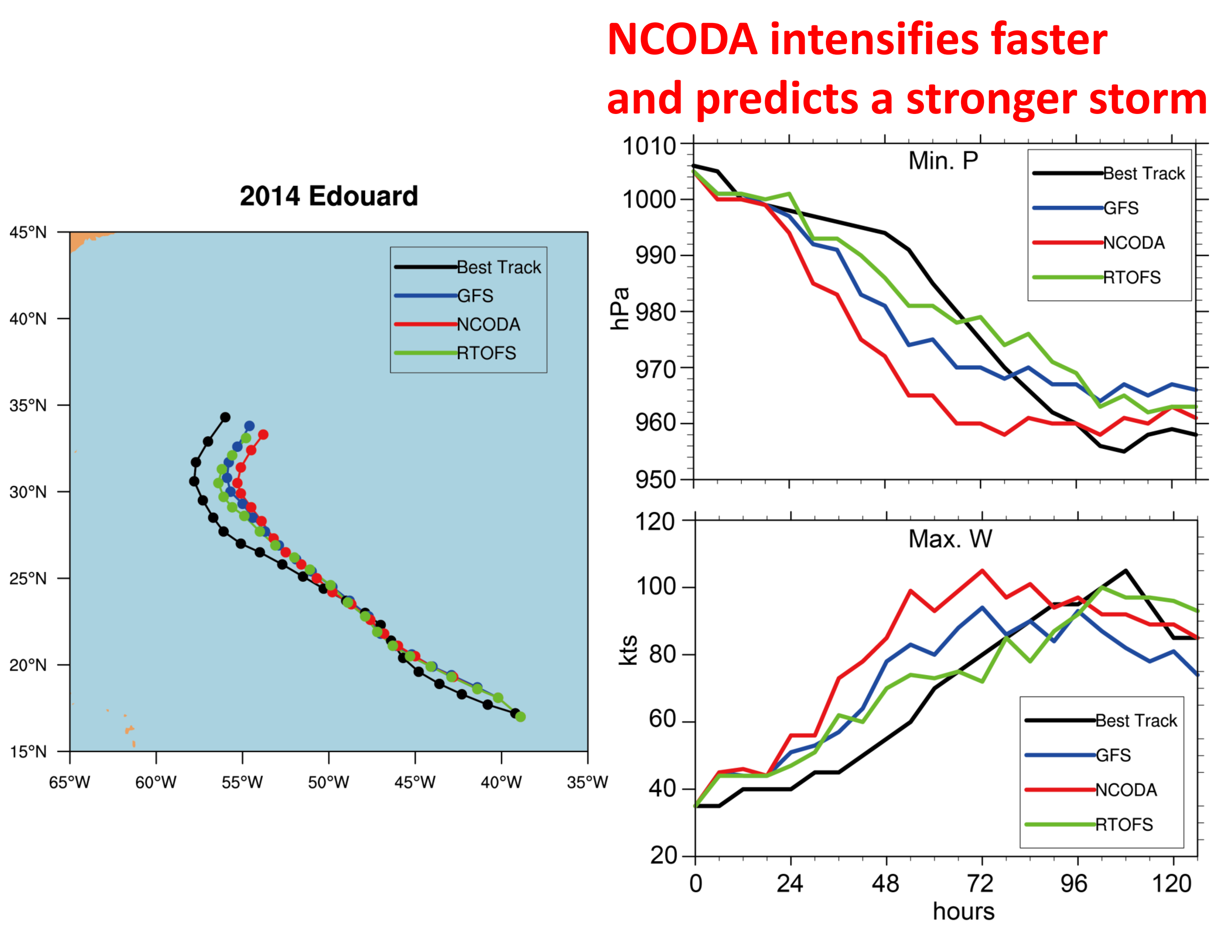

Fig. 2. Simulated tracks (left) and intensities (right) – the minimum sea level pressure (hPa; upper) and the maximum 10-m wind (kt; lower).

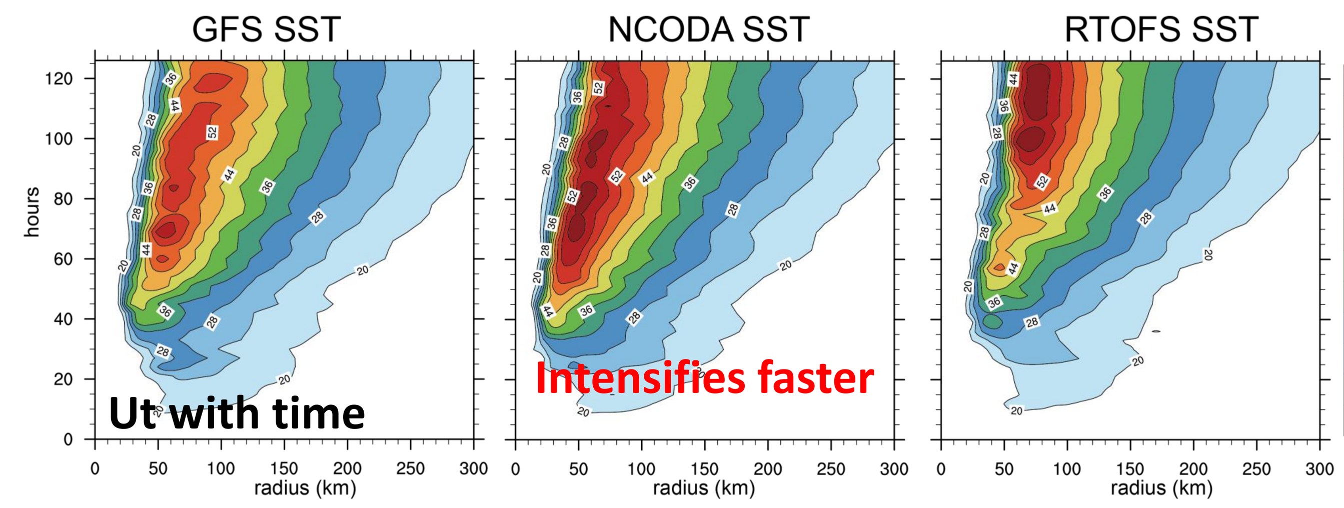

Fig. 3. Comparisons of azimuthal averaged tangential winds at 900 hPa.

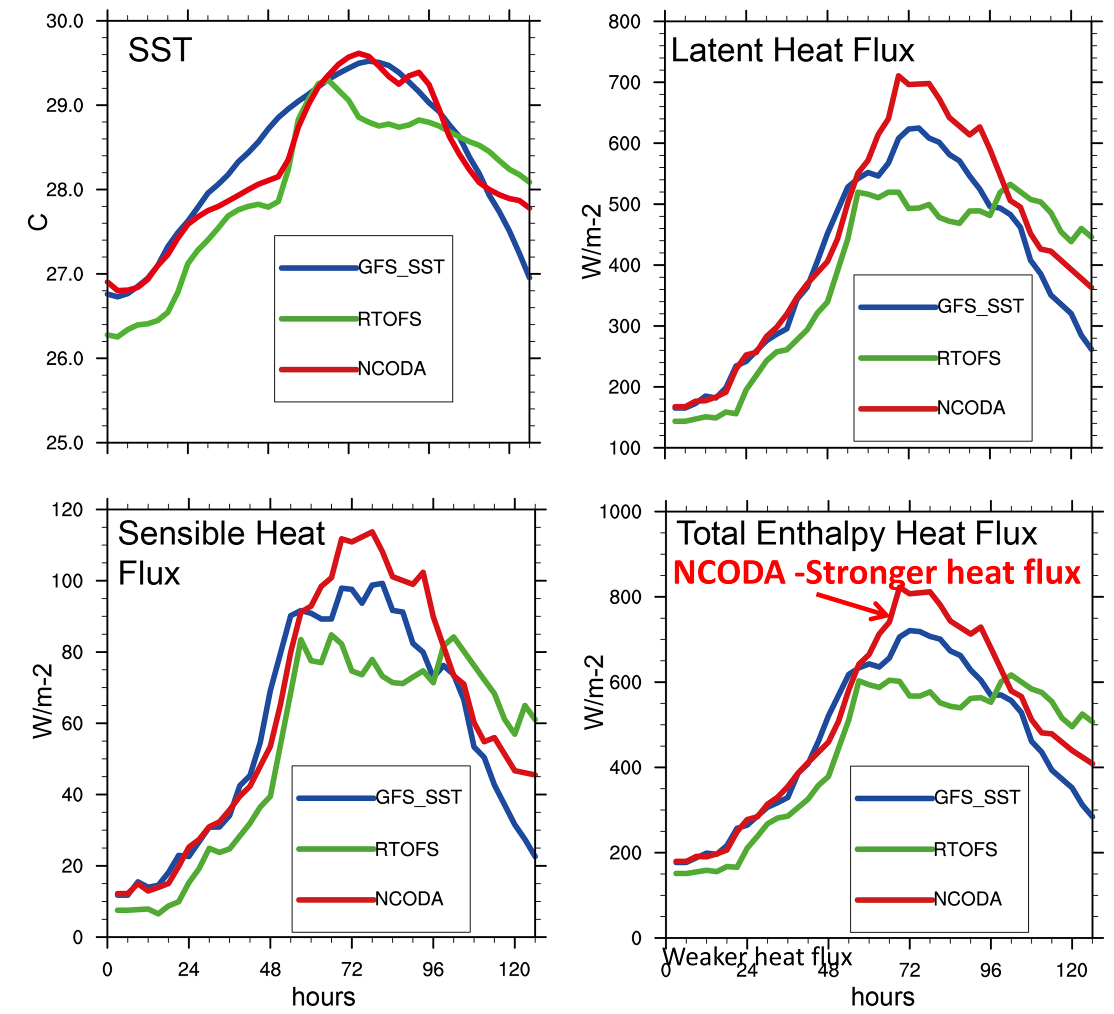

Fig. 4. Footprint SST and heat flux averaged within 100 km radius.

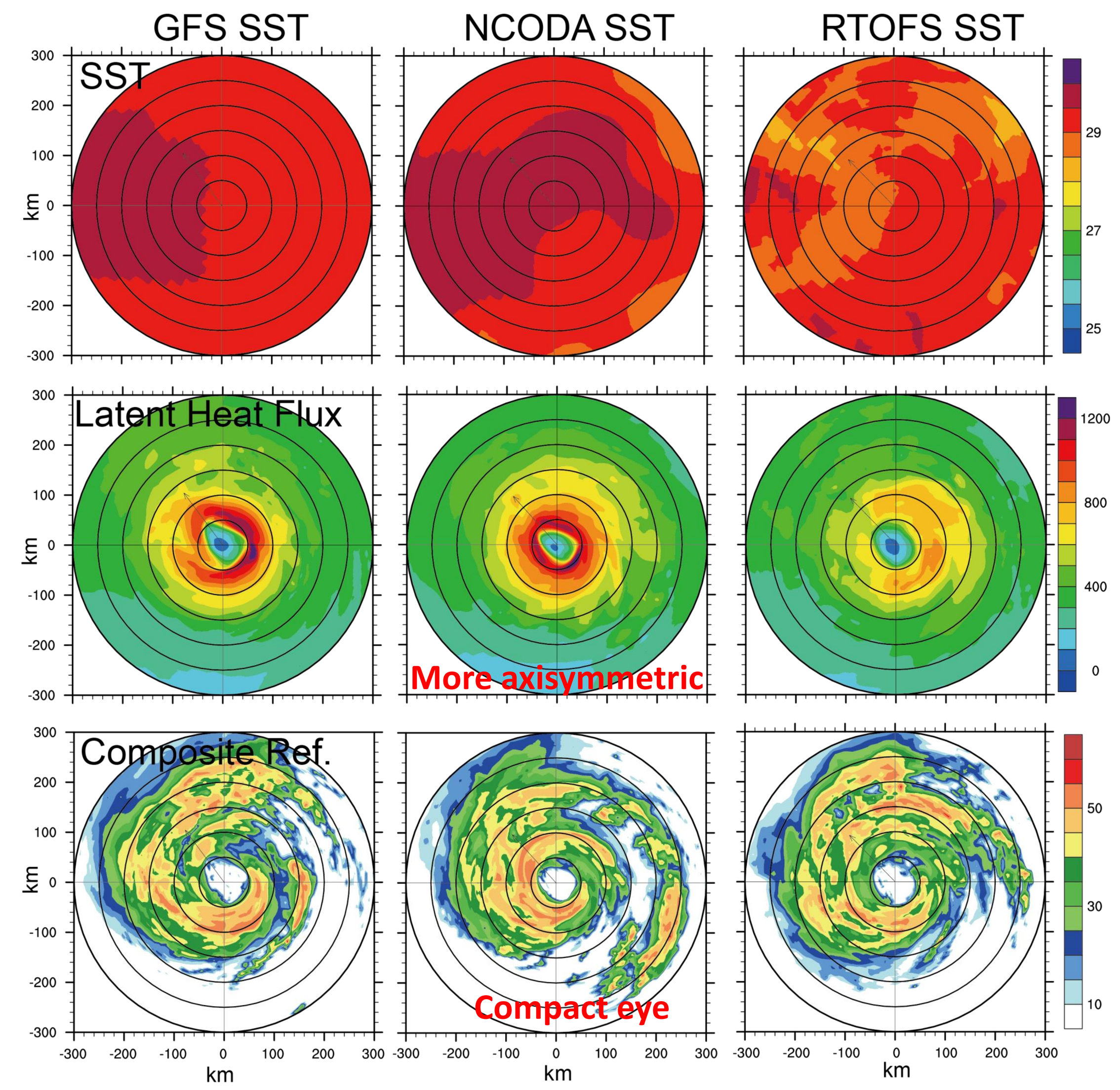

Fig. 5. Comparisons of SST (top), latent heat flux (middle) and composite reflectivity (bottom) at 72 hours forecasts.

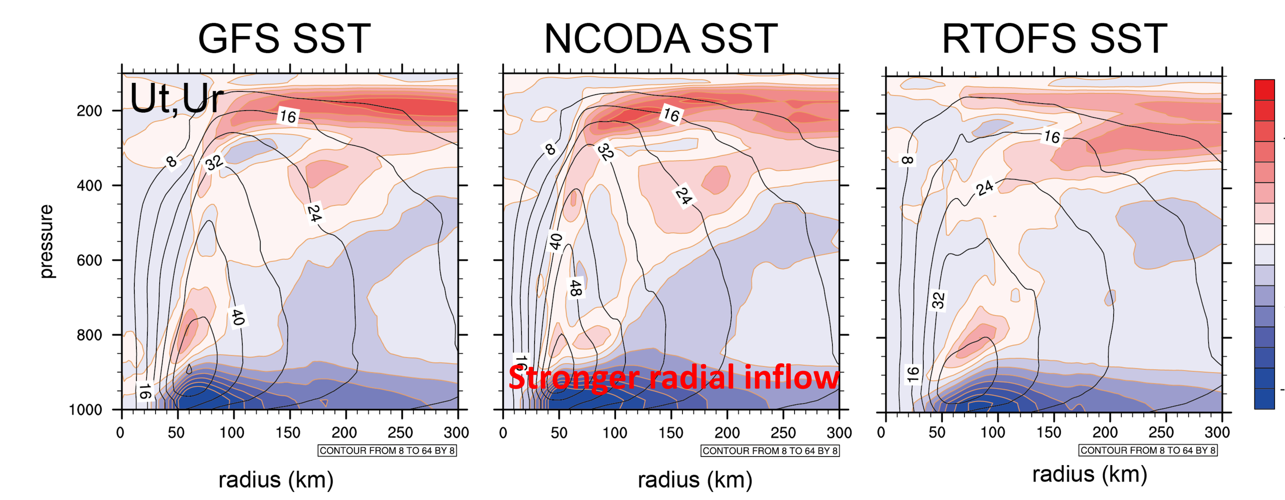

Fig. 6. Azimuthal averaged tangential (curves) and radial winds (shades) at 72 hours.

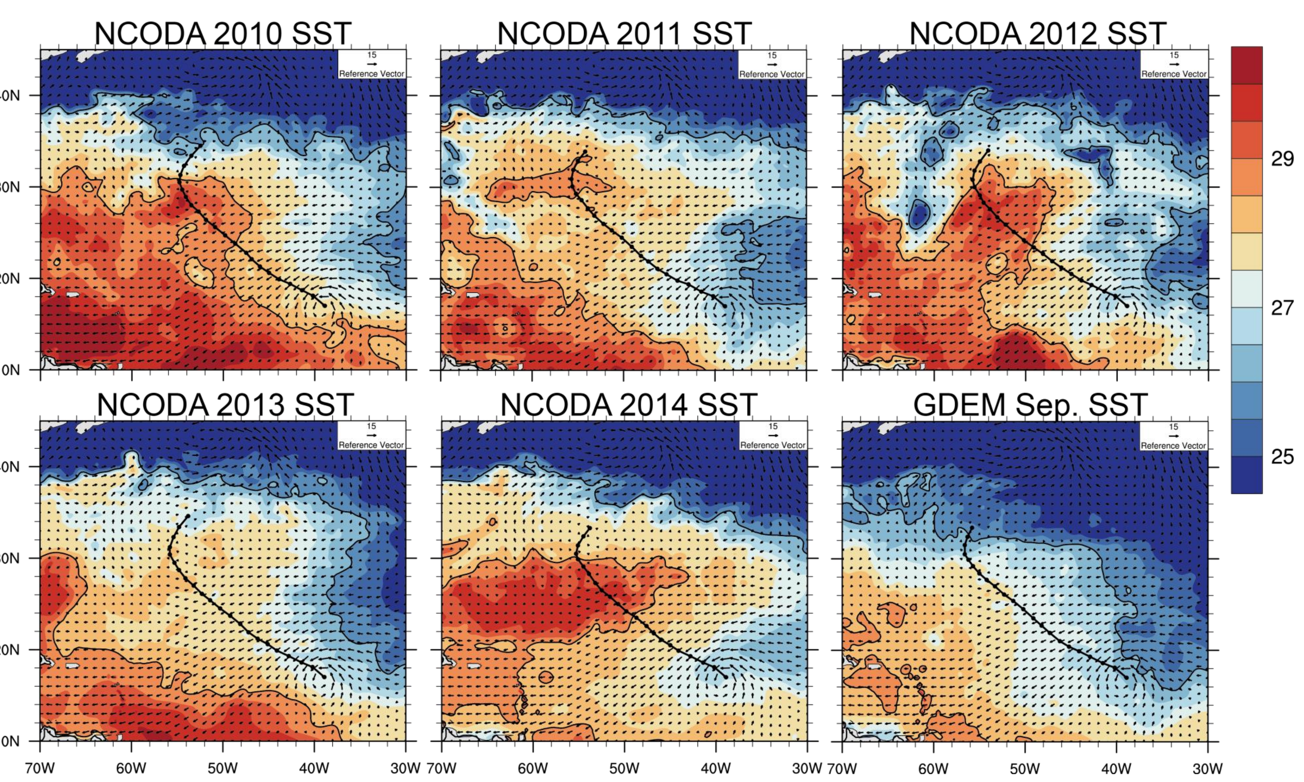

Fig. 7. Prescribed SST of multi-year NCODA experiments, overlapped with individual storm tracks of 126 hours forecasts.

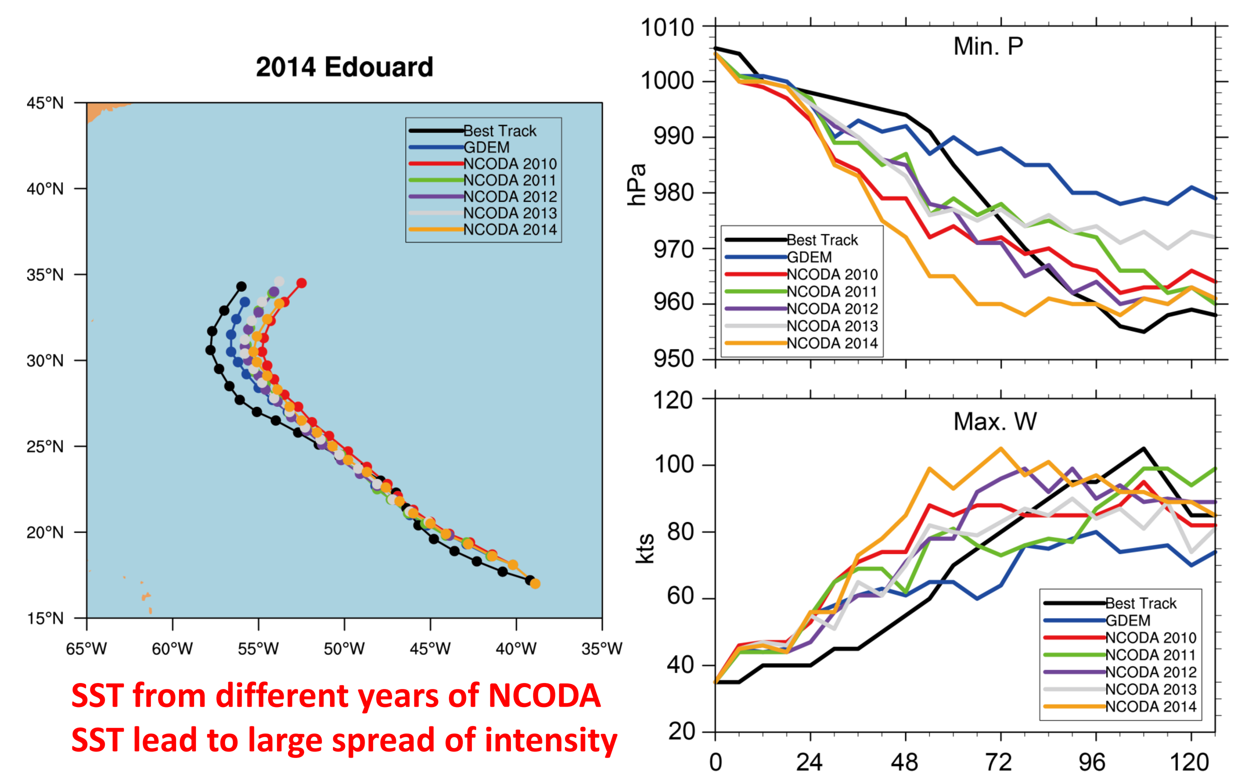

Fig. 8. Simulated tracks (left) and intensities (right) – the minimum sea level pressures (hPa; upper right)) and maximum surface winds (kt; lower right), compared with the best track.

5. Conclusions

- **The intensity forecast of Hurricane Edouard (2014) using HWRF is sensitive to different SST sources (GFS, HYCOM-NCODA, RTOFS)**
- **The forecast using HYCOM-NCODA SST predicts a stronger hurricane with a more compact TC eye than GFS and RTOFS SST**
- **SST pattern could affect storm intensification and structure; how SST impacts the development of the storm and the organization of convection is under further investigation**
- **Intensity forecasts of Edouard is also sensitive to warm pool location and structure: larger warm pool generally helps Hurricane Edouard intensifies more**
- **More TC cases need to be systematically evaluated to establish the correlation between SST and TC intensity**
- **Initialization of SST is important to convective-scale TC forecasts**