PRODUCTION: The Role of African Easterly Waves North of the African Easterly Jet on Tropical Cyclogenesis

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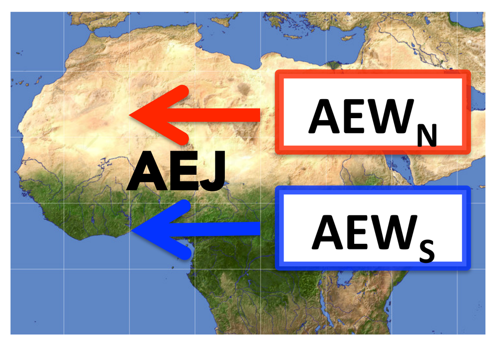
SCENE 1: Introduction

Previous studies (e.g., Carlson 1969; Burpee 1974) documented two propagation paths of African easterly waves (AEWs) north (AEW_N) and south (AEW_S) of the African easterly jet (AEJ):



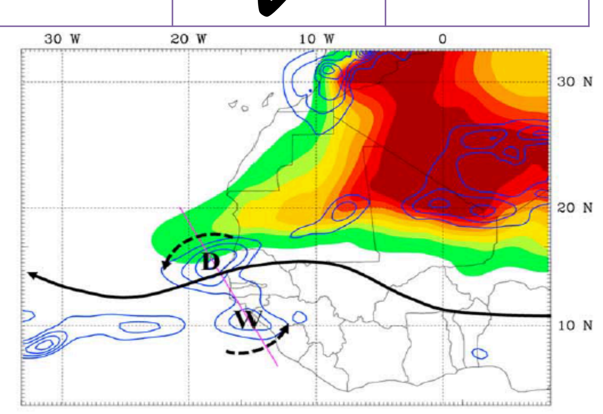
(1) AEW_N
- Forms associated with Saharan heat low
- Dry vortex maximized at low-levels (850 hPa)

(2) AEW_S
- Forms associated with moist convection/jet
- Moist circulation maximized at mid-levels (700 hPa)

Contribution to tropical cyclone (TC) genesis: ✔ (greater contribution)

Study	AEW_N	AEW_S
Thorncroft and Hodges (2001)		✔
Chen (2008)	✔	

Chen and Liu (2014): 70% of TCs that form in the main development region are associated with a merging AEW_N and AEW_S.



900 hPa relative vorticity (10^{-5} s^{-1}); Saharan air parameter (K)

Research Questions

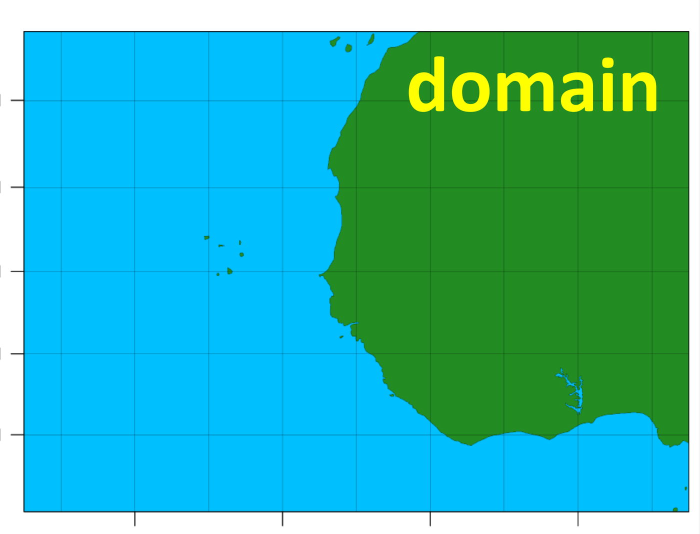
(1) Can an AEW_N contribute to tropical cyclogenesis?

(2) What is the relative or collective importance of AEW_Ns and AEW_Ss on tropical cyclogenesis?

SCENE 2: Methodology

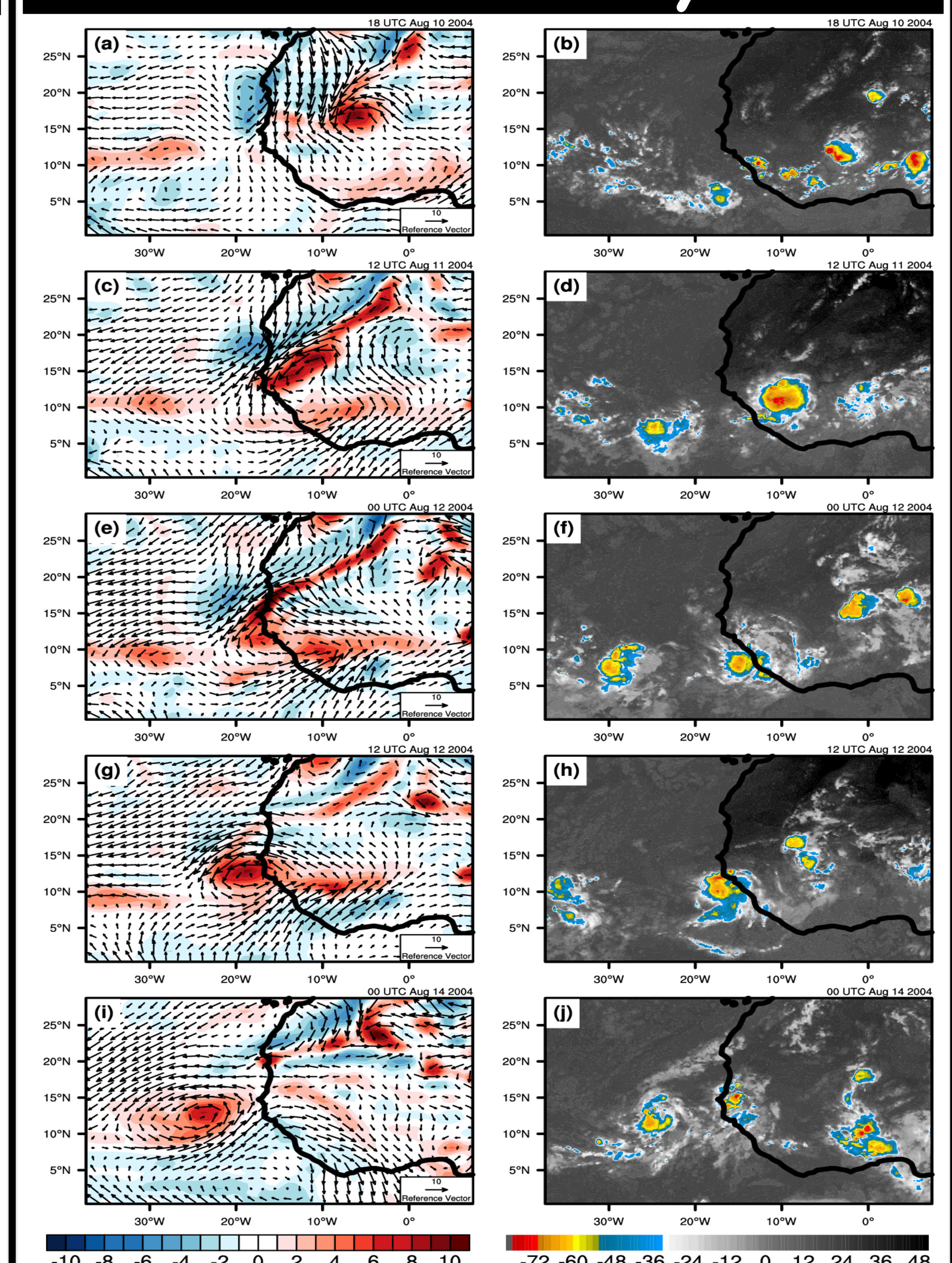
Model: Version 3.7.1 of the Advanced Research WRF (ARW)

- Single stagnant domain
- 27 km horizontal resolution
- 61 vertical levels
- ERA-Interim reanalysis for initialization
- NCEP real-time, global, sea surface temperature analysis for initialization
- Output every 30 minutes



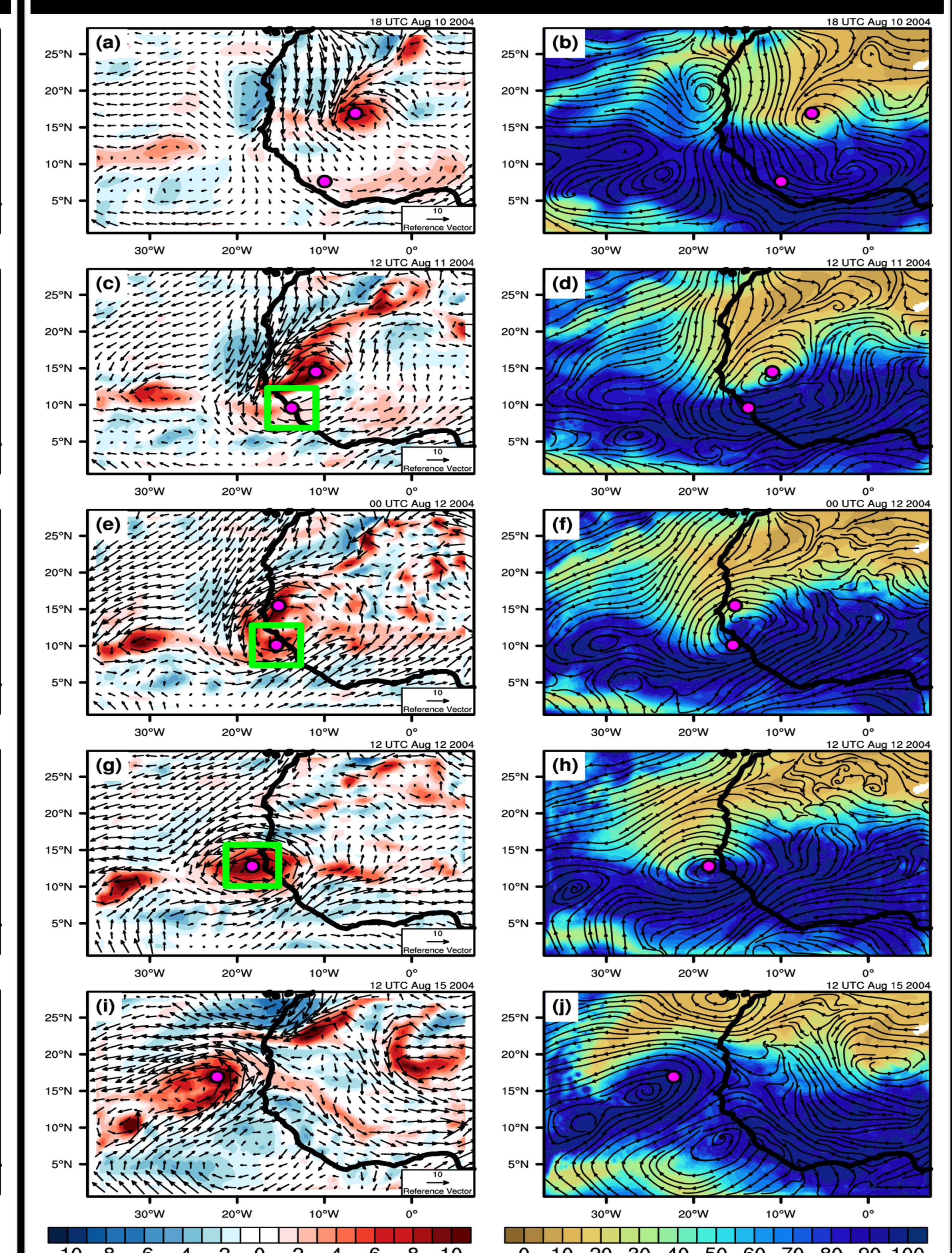
Parameterizations
WRF Single-Moment 6-class
Grell 3D cumulus
RRTMG shortwave
RRTMG longwave
Yonsei University PBL
Noah land surface model

SCENE 3: Reanalysis



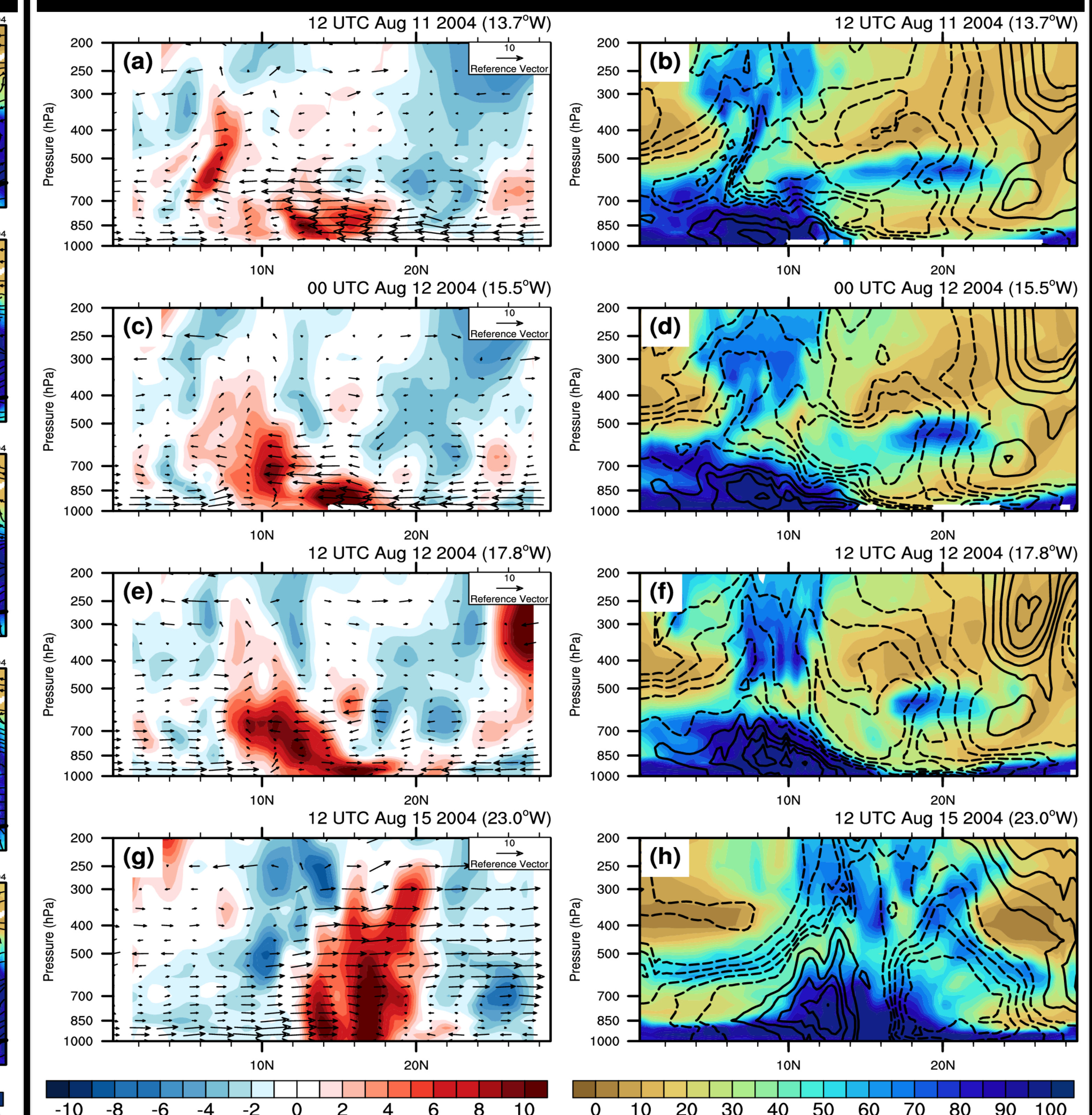
850 hPa relative vorticity (10^{-5} s^{-1}); wind vector (ms^{-1}) — brightness temperature (°C)

SCENE 4: Model Simulation



850 hPa relative vorticity (10^{-5} s^{-1}); wind vector (ms^{-1}) — 850 hPa relative humidity (%); streamlines

SCENE 5: Cross Sections

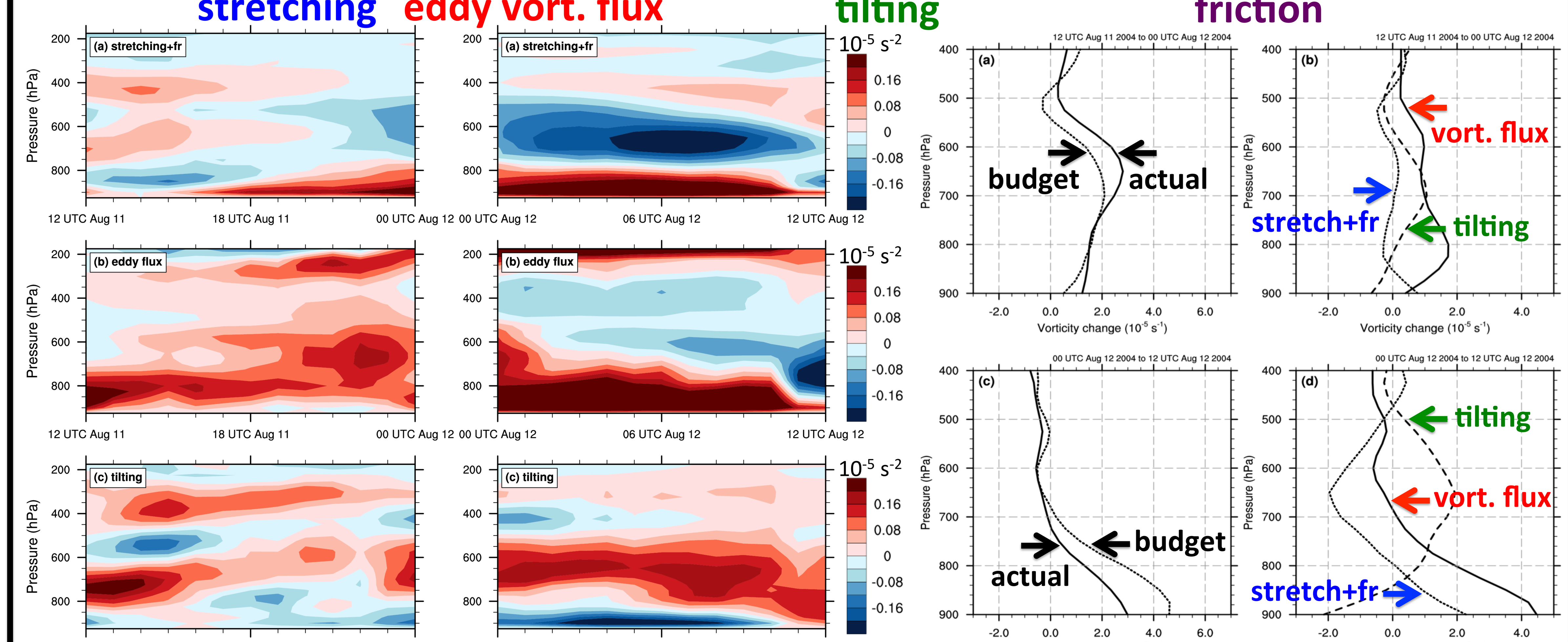


relative vorticity (10^{-5} s^{-1}); meridional circulation (ms^{-1}) — relative humidity (%); zonal wind (ms^{-1})

SCENE 6: Vorticity Budget

$$\frac{\partial \zeta}{\partial t} = -\bar{\eta}\bar{\delta} - \frac{1}{A}\oint \eta' \mathbf{V}'_h \cdot \hat{\mathbf{n}}\, dl + \frac{1}{A}\oint \omega \left(\hat{\mathbf{k}} \times \frac{\partial \mathbf{V_h}}{\partial p}\right) \cdot \hat{\mathbf{n}}\, dl - \frac{1}{A}\oint \left(\hat{\mathbf{k}} \times \mathbf{F}\right) \cdot \hat{\mathbf{n}}\, dl$$

stretching — eddy vort. flux — tilting — friction



SCENE 7: Conclusions

(1) Can an AEW_N contribute to tropical cyclogenesis?
Yes. The evolution of merging was very similar between the reanalysis and model. After merging, the merged vortex developed into a TC.

(2) What is the relative or collective importance of AEW_Ns and AEW_Ss on tropical cyclogenesis?
Merging is at least as important as diabatic processes at increasing the low-level vorticity of the merged vortex.

SCENE 8: Observational Needs

Observational data across Africa and the West African coast is temporally and spatially limited. A better observation network is needed to capture the 3D evolution of AEW_N, AEW_S, and the merging process.

SCENE 9: Acknowledgements

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