Modeling the West African Monsoon and the Formation of African Easterly Waves

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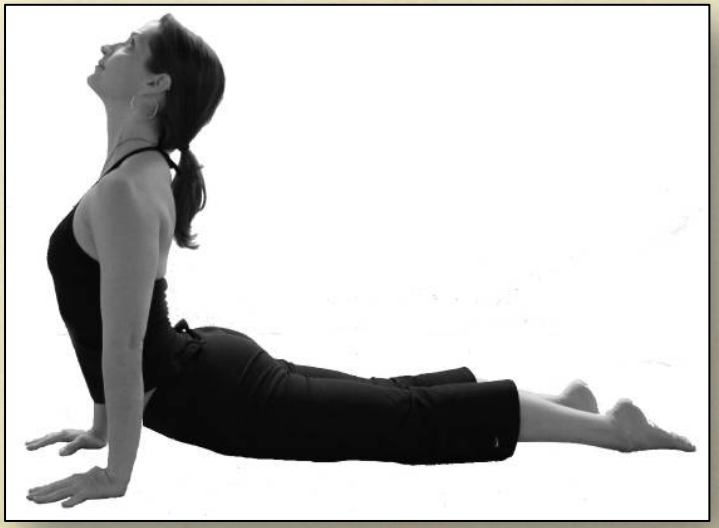
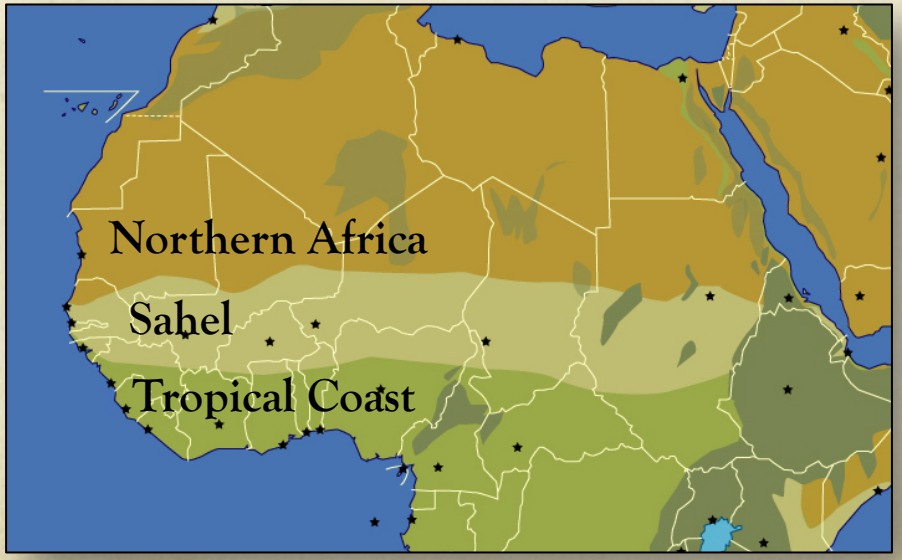
About Me

- Embry Riddle Aeronautical University - Senior



Introduction

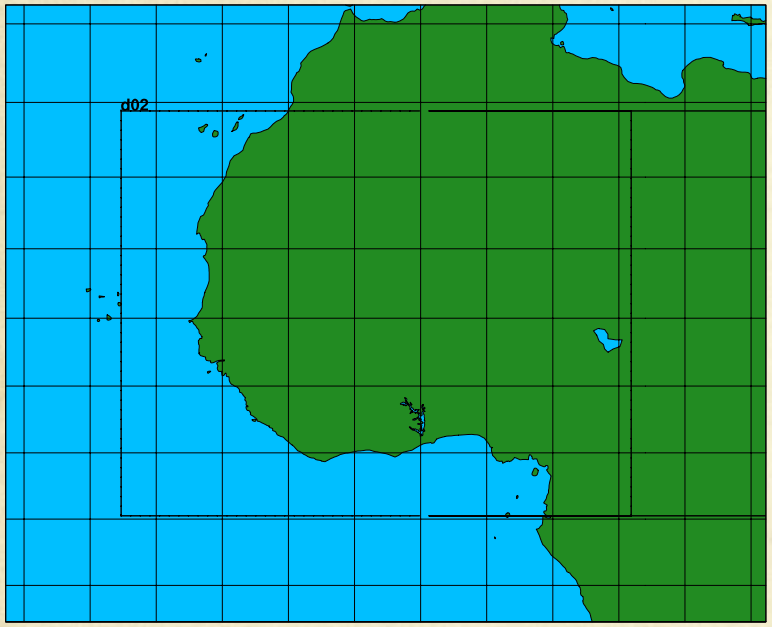
- The West African Monsoon brings seasonal rains to the Sahel region during the summer months of May to October



Introduction

- African Easterly Jet (AEJ) is most strongly developed
- African easterly waves (AEWs) form in association with this jet
- AEWs propagate westward over the Atlantic and can foster development of hurricanes, as well as provide beneficial rainfall to west Africa during the summertime

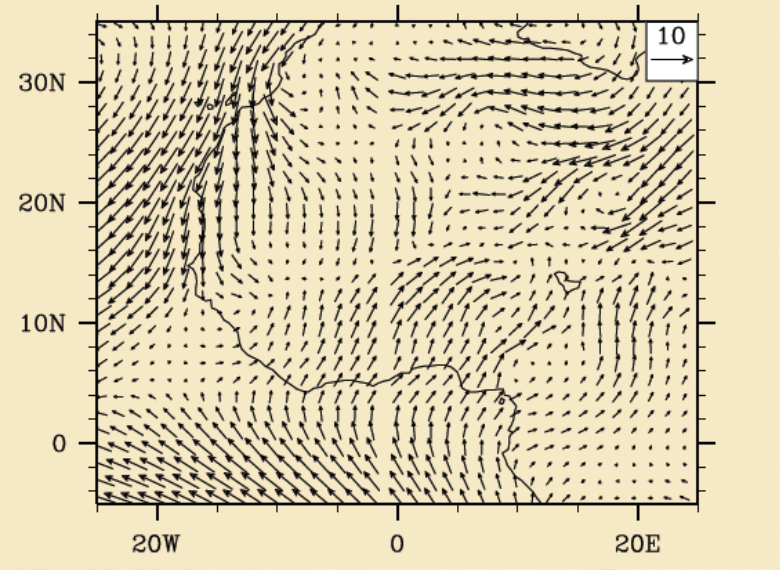
Model Details



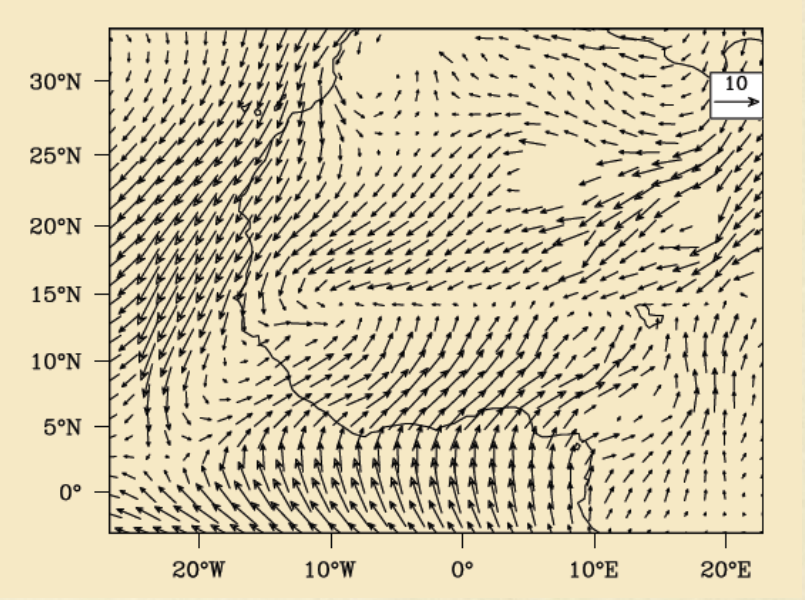
- Weather Research and Forecasting (WRF ARW) Model version 3.3
- Fully compressible, non-hydrostatic
- Time step of 240 seconds
- 2 Nested domains, each with 28 vertical levels:
  - Domain 1 - 78km resolution, 3.130°S-33.46°N 26.8°W to 22.8°E
  - Domain 2 - 26km resolution, 1.7°N-29.31751°N, 21.9°W to 17.2°E

Monsoon Winds

ERA-Interim 925 mb average wind vector field



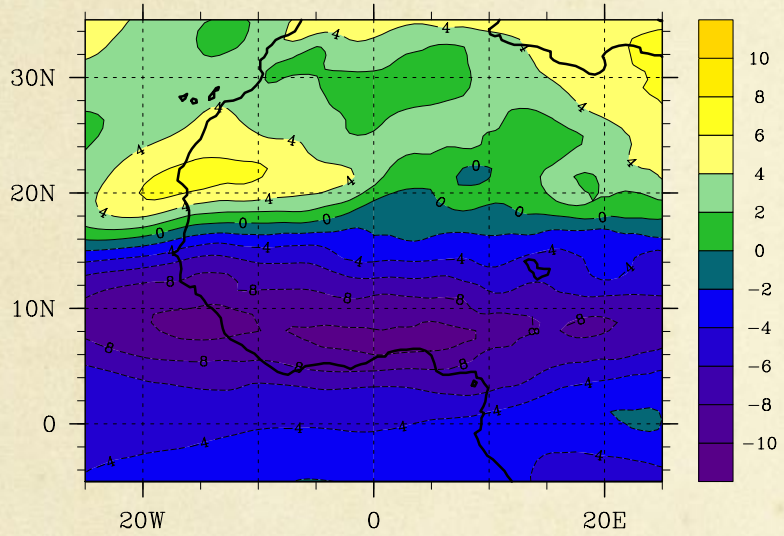
WRF 925 mb average wind vector field



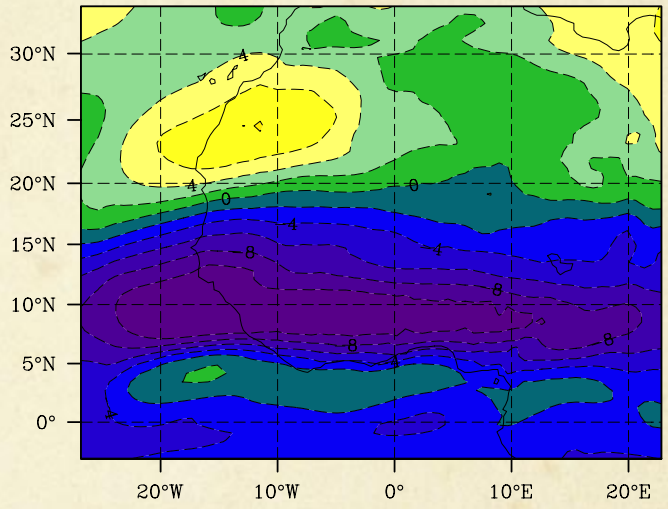
May 2006

African Easterly Jet

ERA-Interim average u-winds at 700 mb

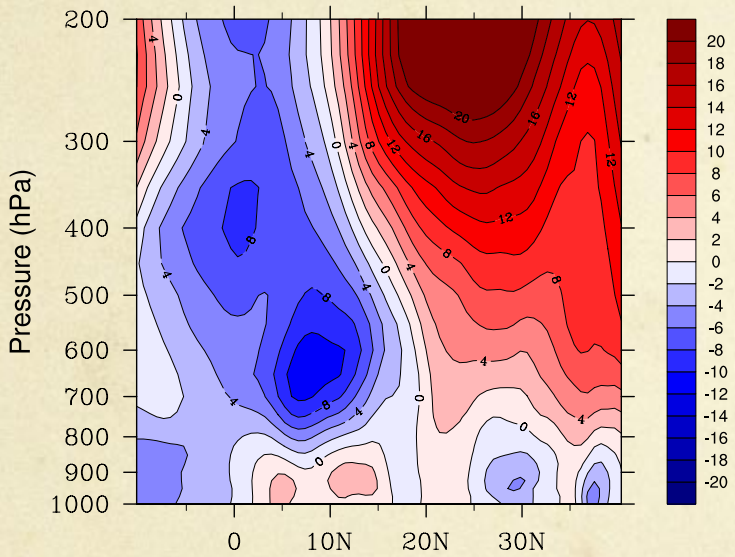


WRF average u-winds at 700 mb

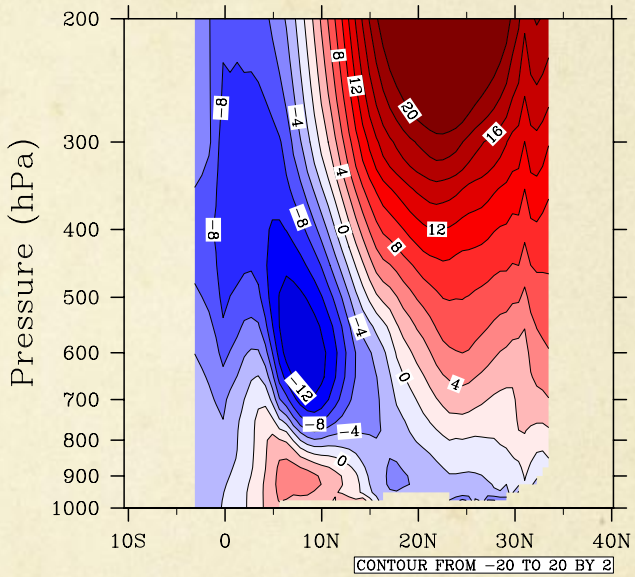


African Easterly Jet

ERA-Interim cross section of u-winds at 0-East

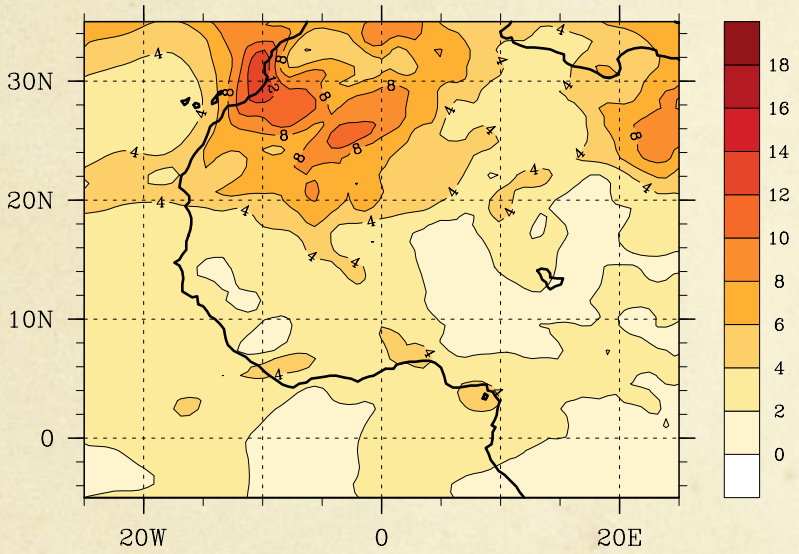


WRF cross section of u-winds at 0-East

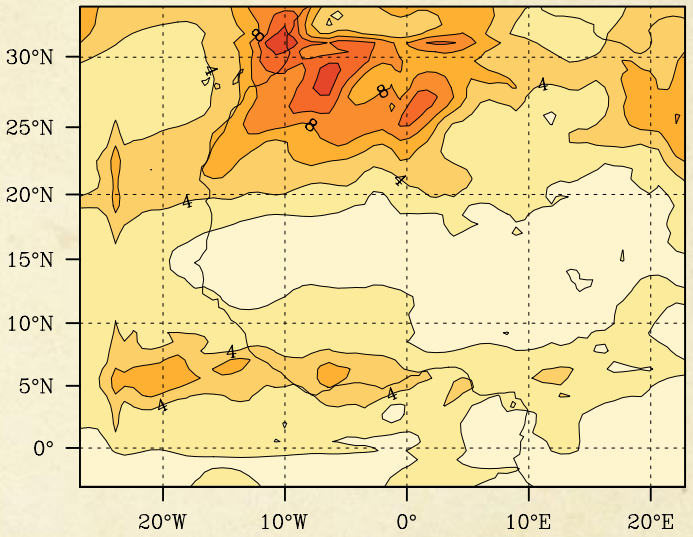


Eddy Kinetic Energy

ERA-Interim average kinetic energy at 700 mb



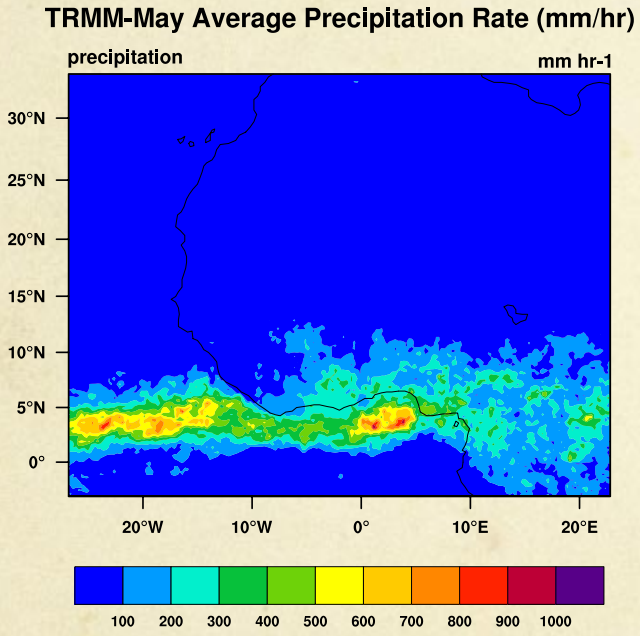
WRF average kinetic energy at 700 mb



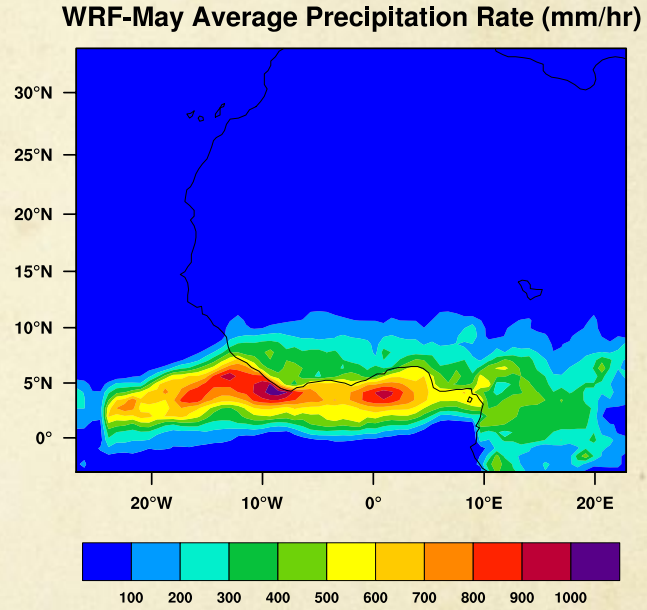
Calculation: $\frac{u^{1^2} + v^{1^2}}{2}$ Primes calculated as deviations from the 5-day mean

Precipitation

TRMM average precip in mm/hr

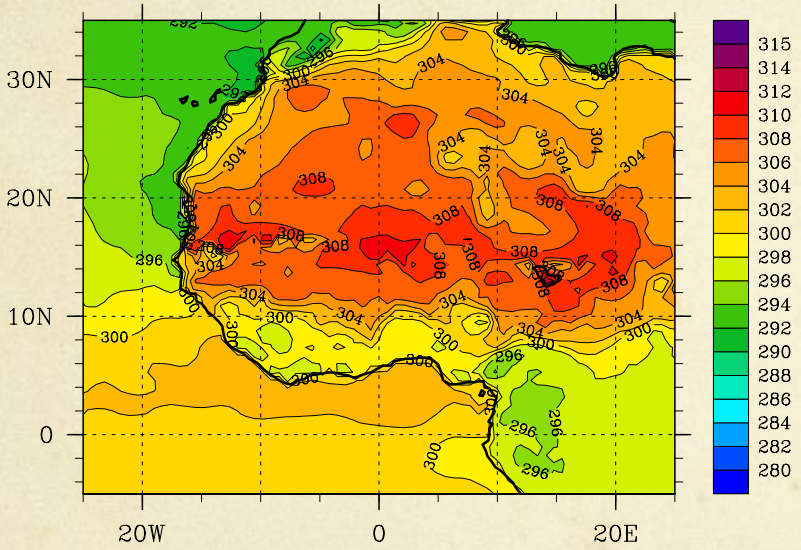


WRF average precip in mm/hr

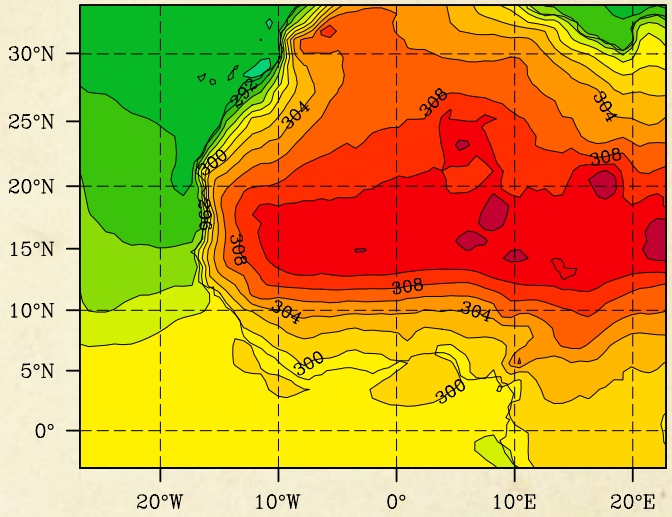


Surface Temperature

ERA-Interim average temperature in Kelvin

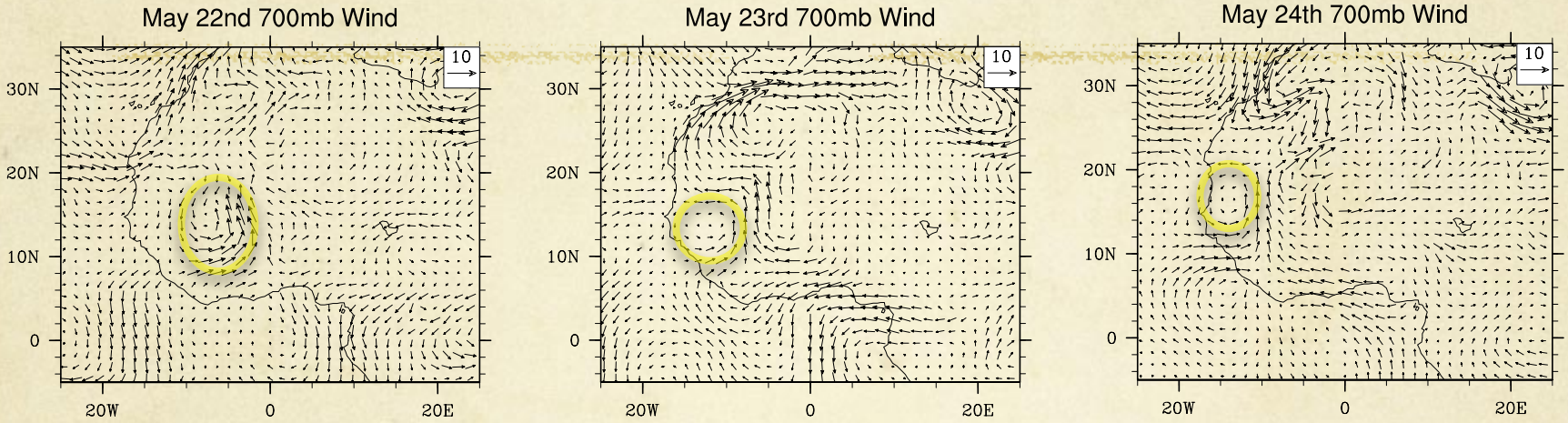


WRF average temperature in Kelvin

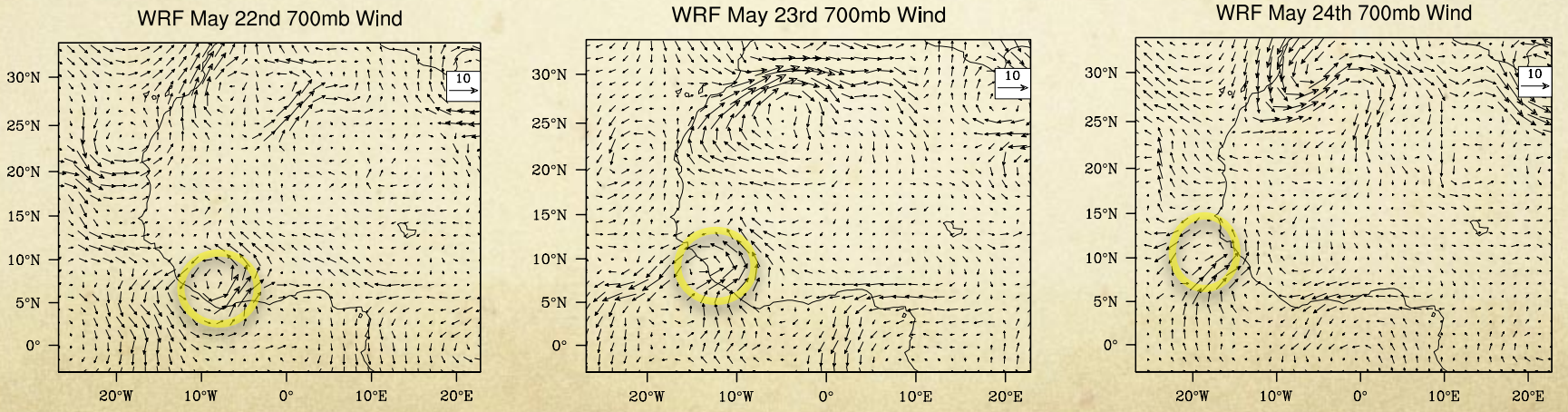


African Easterly Waves

U^1 & V^1 vector snapshots using ERA-Interim reanalysis data



U^1 & V^1 vector snapshots using WRF model data



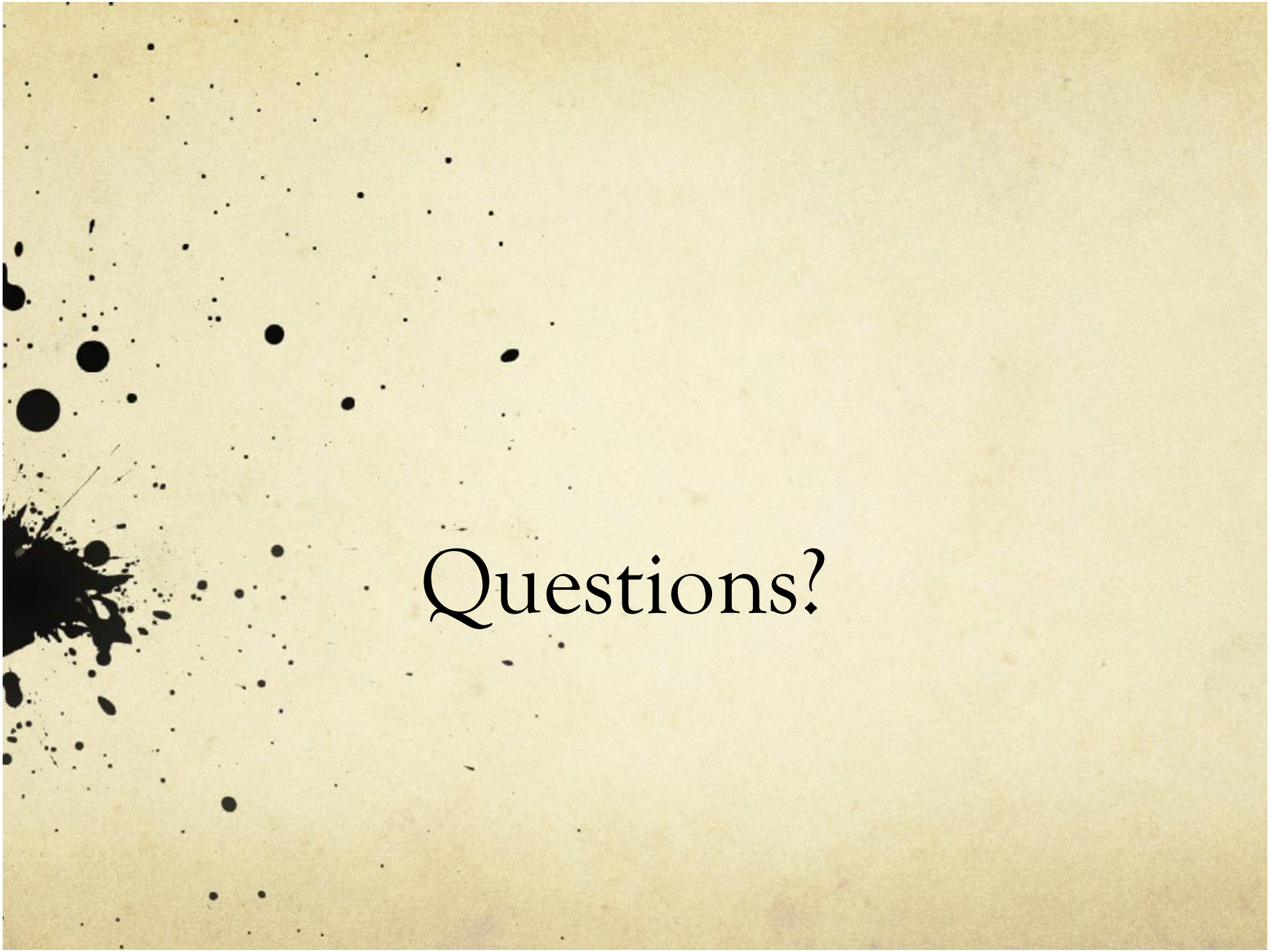
Primes calculated as deviations from the 5-day mean

Conclusions

- WRF model has evident flaws when compared to observed data, but not bad
- Higher vertical resolution model approximately 8x more expensive in terms of computing time
- WRF model will be used for future research

Future Work

- Extend WRF model run through September
- Determine the conditions that cause variations in the strength of easterly waves
- Understand the influence these waves have on convection over the region
- Complete a series of runs filtering out AEW information from the ERA-I input data to see how this may change the characteristics of convection over the region
- Extend model domain west over the Atlantic
- Assess the implication of AEWs and their variability for tropical cyclone formation


Questions?