


Diurnal cycle of precipitation over the Gulf Stream simulated by a regional atmospheric model

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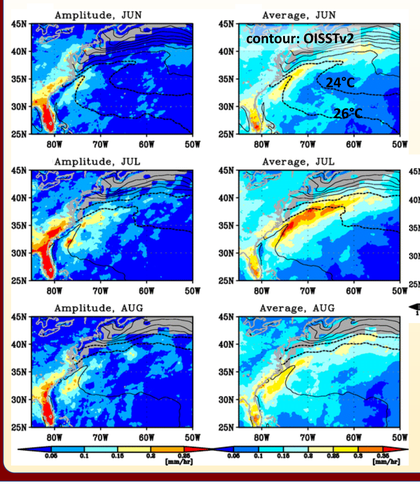
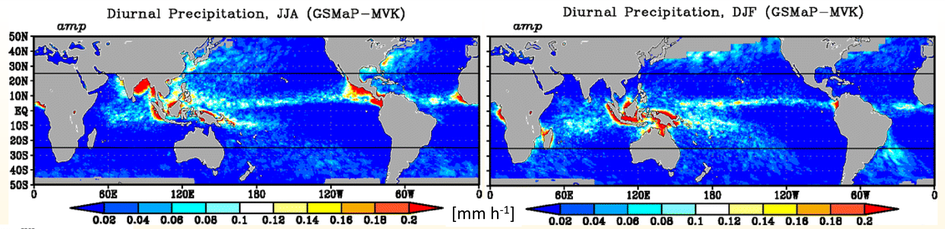
Key points

- Numerical simulation on the diurnal cycle over the Gulf Stream is conducted for the first time.
- The main features of diurnal precipitation are well simulated, including amplitude enhancement and oceanward phase propagation over the Gulf Stream.
- The structure of diurnal surface wind convergence is coherent with diurnal precipitation.

1. Introduction



Minobe and Takebayashi (2015; Clim. Dyn.)

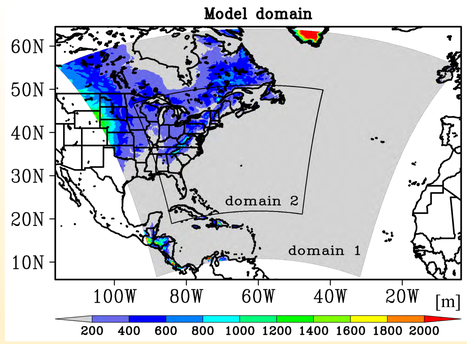


- An exceptionally strong diurnal precipitation amplitude is found over the Gulf Stream in boreal summer, with a maximum in July.
- A clear gap in small amplitudes between the Gulf Stream and the continent is prominent, and no such gap is found in the tropics.
- The oceanward phase propagation can be seen clearly.

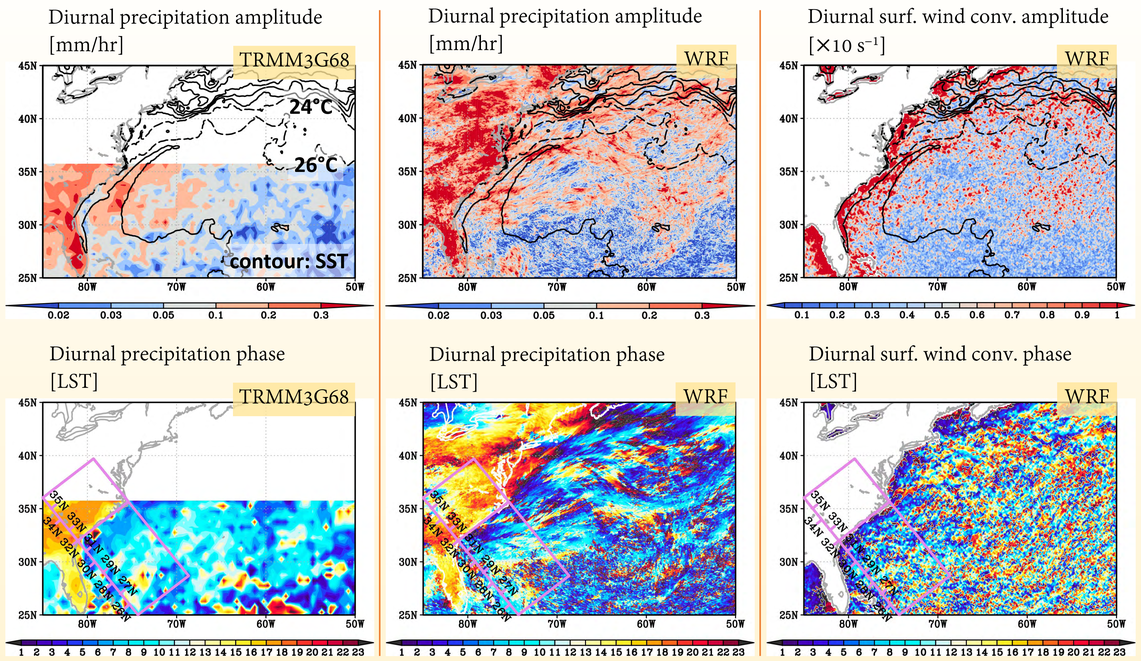
Q. What is the structure of the diurnal cycle, i.e., wind circulation?

2. Model and configuration

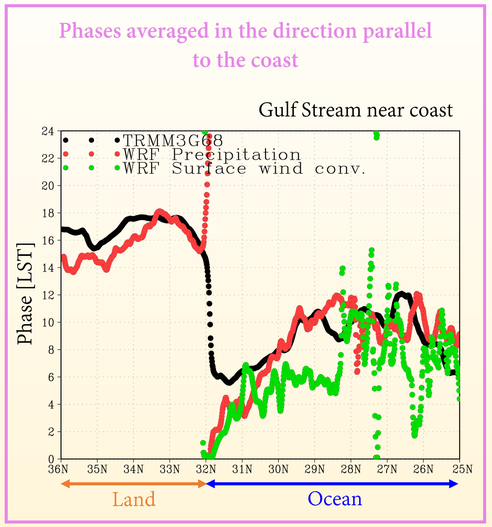
- The WRF-ARW model version 4.3 (Skamarock et al. 2008) is used.
- Two domains, i.e., domain 1 (12 km) and domain 2 (4 km), with two-way nesting are adopted.
- Lateral boundary is 6-hourly NCEP-Final product with a 1-degree spatial resolution (NCEP 2000).
- Boundary condition of SST is a daily OSTIA product on 1/20° × 1/20° grid (Stark et al. 2007).
- The model is integrated for one month in July 2021 with hourly output.
- Hourly climatology for July over the period from 1987 to 2014 is obtained from TRMM3G68 dataset as a comparison.



3. Simulation results: Diurnal cycle of precipitation and surface wind convergence



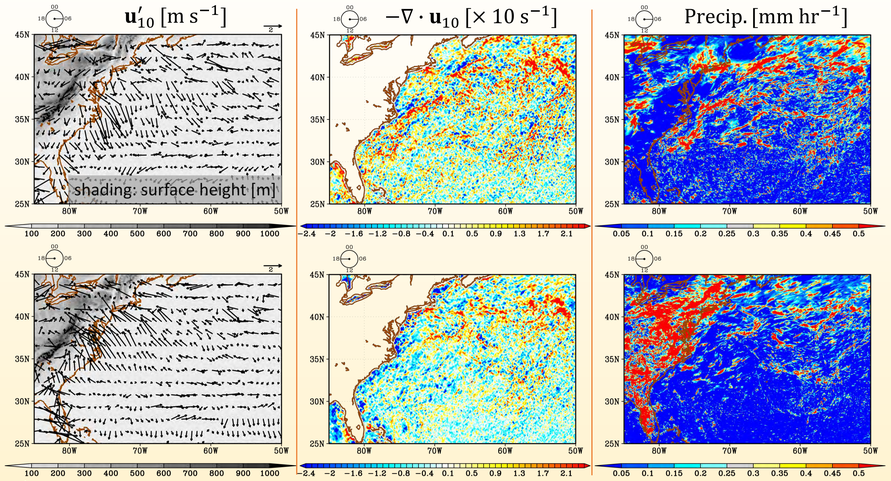
Phases averaged in the direction parallel to the coast



- The main features of diurnal precipitation are well simulated, including oceanward and landward phase propagations as well as strong diurnal amplitudes along the Gulf Stream with a clear gap in small amplitudes between the Gulf Stream and the continent.
- Diurnal surface wind convergence also depicts strong amplitudes over the Gulf Stream and its phase leads precipitation by ~1–3 h.

4. Evolution of diurnal cycle

Clock in top left corner is in LST @ 75W.



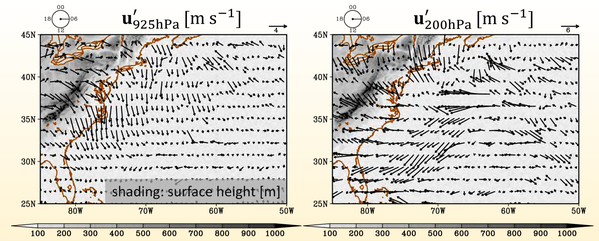
$\mathbf{u}'_{10}$ is defined as the deviation of hourly surface wind from the mean flow in July 2021.

Please kindly click https://docs.google.com/presentation/d/1tYykYs1GLlmuiCBbB6-TXNdT9HiuhRCa/edit?usp=sharing&ouid=109914235310717649440&rtpof=true&sd=true for the animated diurnal cycle.

OR scan

5. Discussion

- Does diurnal cycle relate to a deep diurnal circulation?
- What mechanism responsible for diurnal cycle over the Gulf Stream needs to be investigated.



Please kindly click the link or scan QR code in Section 4 for the animated diurnal cycle.