Second WMO RCC-Washington International Training Workshop

Demonstration
Extreme precipitation outlooks

8 – 10 November 2021

Outline

- Introduction
  - Extreme Precip Definition
  - Causes of Extreme Precip
- Forecasting Tools
- Week-1 Extreme Forecast Demonstration

Introduction

- How to define weekly extreme precipitation?
  - There is no standard definition
  - It is location and season dependent … different definitions for wet and dry areas
  - Purpose dependent (eg. different meaning for Agricultural and Hydrological sectors)
- In this training we present exceedance probability forecasts with respect to a wide range of thresholds:
  - Rainfall amount in excess of a given amount (eg. >50mm, >100mm, >200mm)
  - Rainfall amount in excess of a given percentile climatology (eg. 67^{th}, > 80^{th}, >90^{th}, > 95^{th} percentiles)

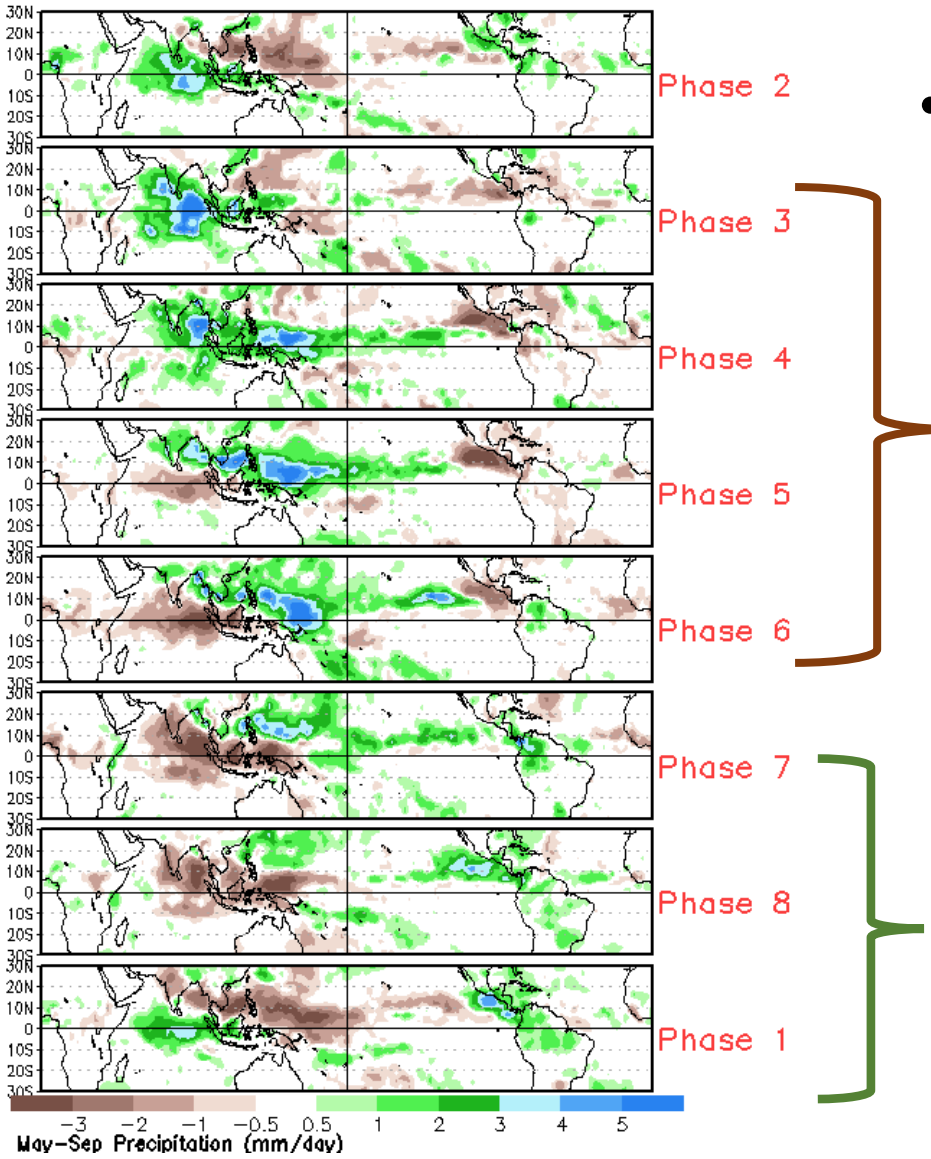
Introduction (Cont.)

- Users in the agriculture sector can be interested in the upper and lower tercile rainfall (Weekly rainfall amount >67th and <33rd percentiles)
- Hydrologists may be interested mainly on heavier rainfall amounts exceeding the 80th or 90th percentiles.
- Persistent extreme low rainfall can lead into drought conditions.
- Users can also be interested in the likelihood of persistent extreme low rainfall (eg. <10th, <20th percentiles).

Introduction (Cont.)

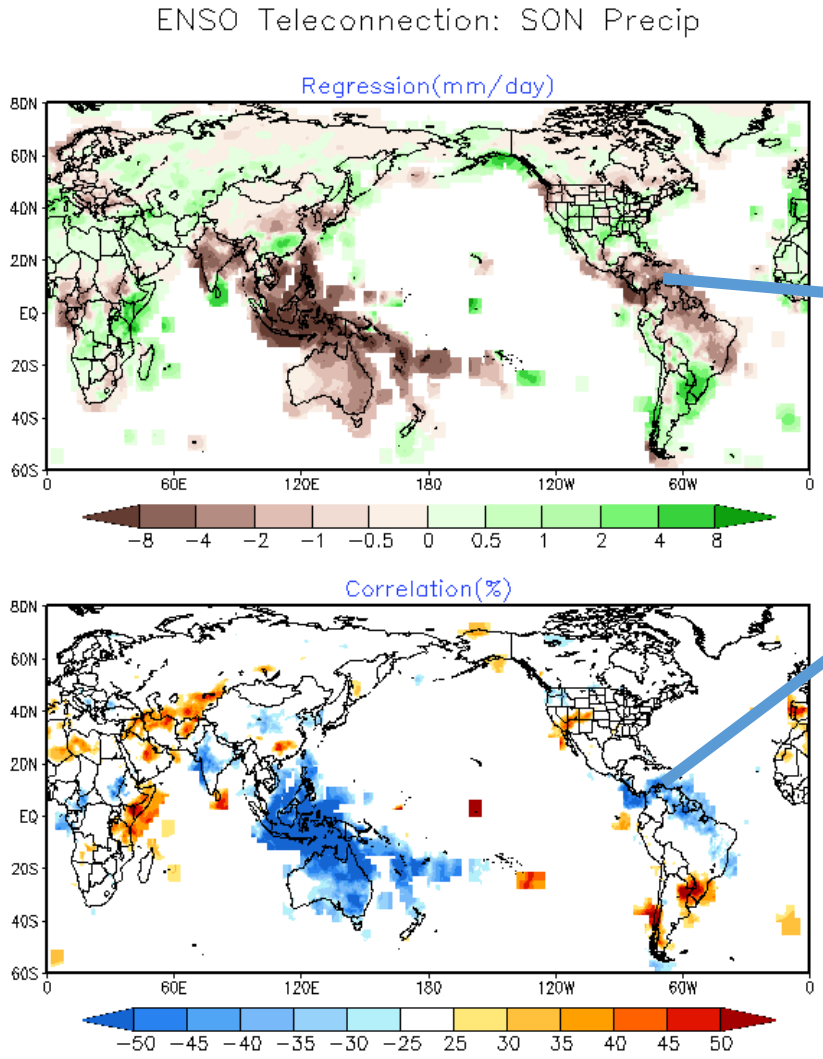
- Causes of extreme rainfall events depend on the location and season
  - Hurricanes
  - Large Scale atmospheric anomalies, including blocking events … stationary anticyclones may lead to extreme dryness, while stationary lows/trough may lead to extreme wetness.
  - Sub-seasonal scale modes of variabilities (eg. MJO)
  - Low frequency modes of variability (eg. ENSO)

Forecasting Tools



- MJO Tools
  - Drier conditions are likely in the central America and the Caribbean during MJO phases of 3, 4, 5 and 6.
  - Wetter conditions are likely during MJO phases of 7, 8 1 and 2.

Forecasting Tools (cont.)



- ENSO Tools
  - La Niña events may contribute to wetter than normal condition, while El Niño events may contribute to drier than normal conditions.

Forecasting Tools (cont.)

- NWP Tools
  - Large scale atmospheric patterns
    - Mean Sea Level Pressure anomalies
    - 850-hpa , 500-hpa, 700-hPa and 200h-pa wind and divergence anomalies.
  - Rainfall exceedance probability forecasts with respect to fixed thresholds (>25mm, >50mm …>150mm and 200mm).
  - Exceedance probability forecasts with respect to percentile climos (<20th & > 80th, <33rd & > 67th percentiles).
    - These exceedance probability forecasts need to be used along with the corresponding percentile climos.

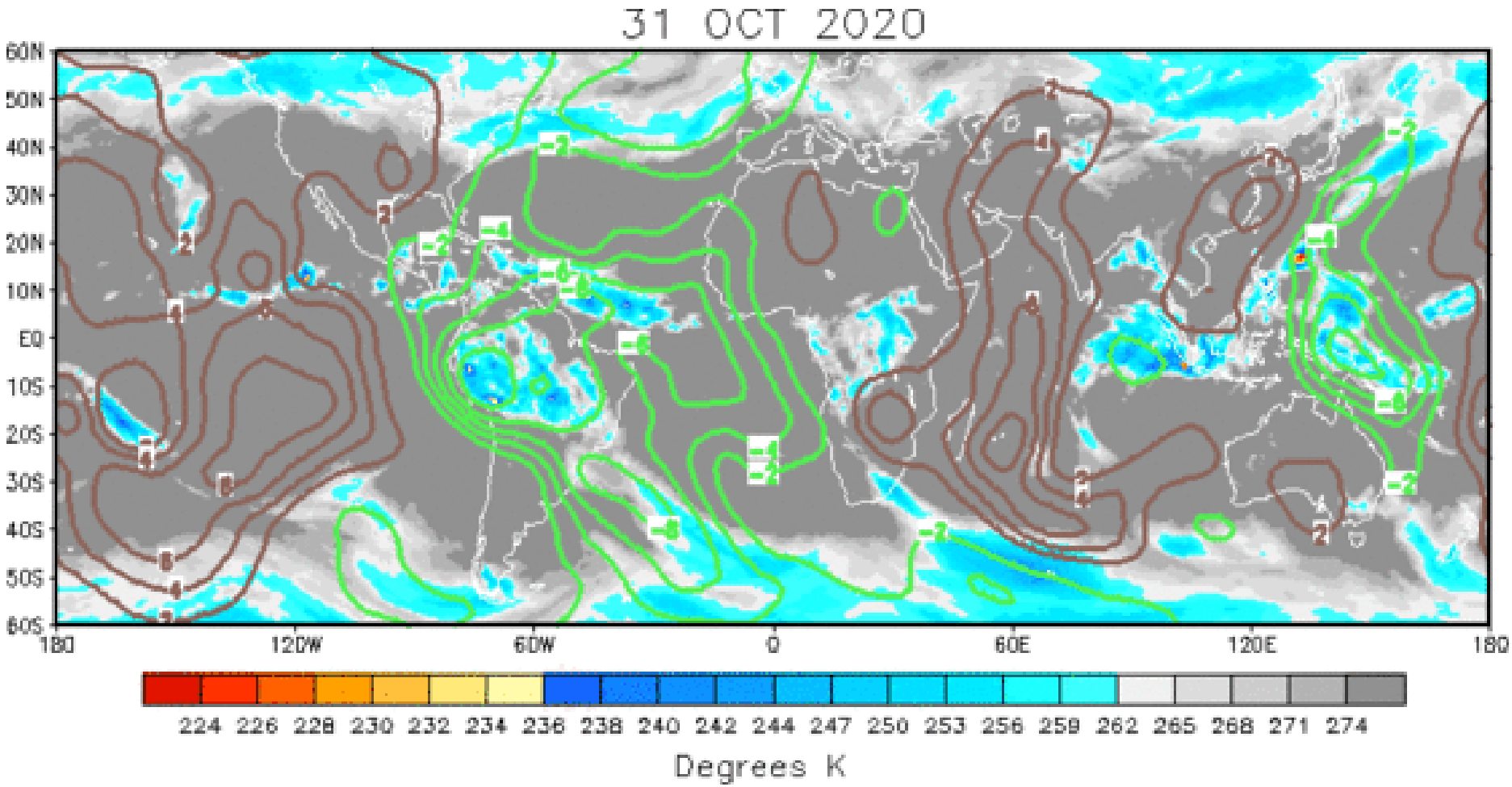
Forecast Demonstration, 1 – 7 November 2020

- Week-1 extreme precip outlooks
  - **Date of issue**: 31 October 2020
  - **Valid period**: 1 – 7 November 2020

- Produce the week-1 extreme precipitation outlook map for the Lesser RA IV region.

- Tools:
  - Hurricane : Hurricane Eta
  - MJO: Not active
  - ENSO: La Niña Advisory

200 hPa Velocity Potential Anomaly

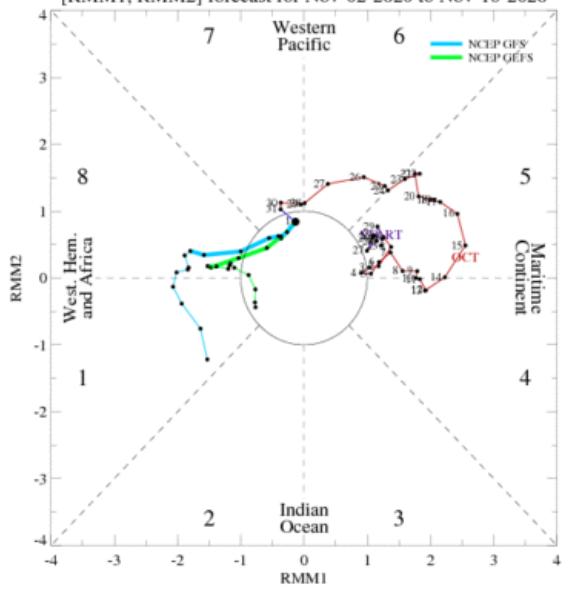


•Green contours indicates areas of upper level divergence and convection or precipitation at surface. Brown contours indicate areas of upper level convergence or subsidence and suppressed precipitation at surface.

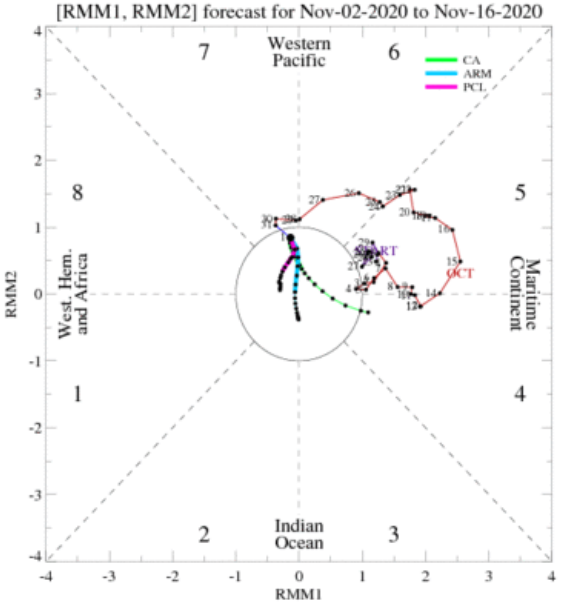
- A wave number-1 pattern is not evident in the velocity potential anomaly => Weak MJO.

Wheeler-Hendon Index - Forecasts

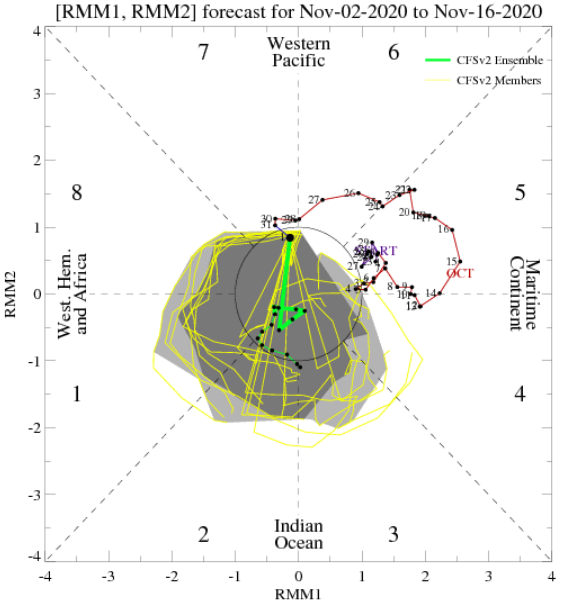
GEFS



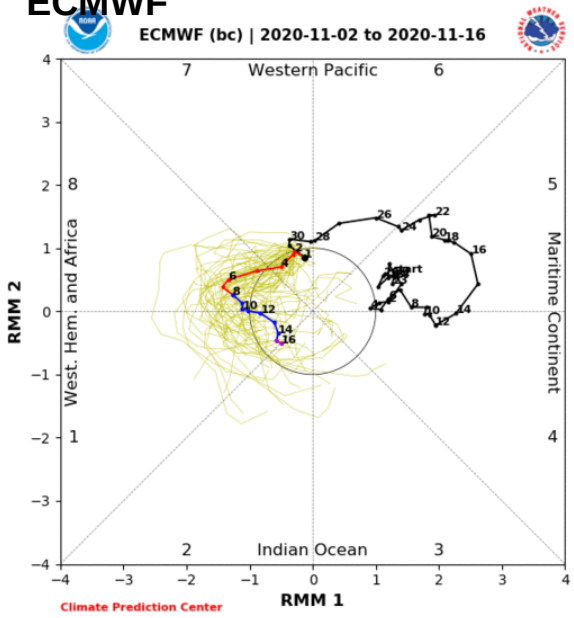
Statistical



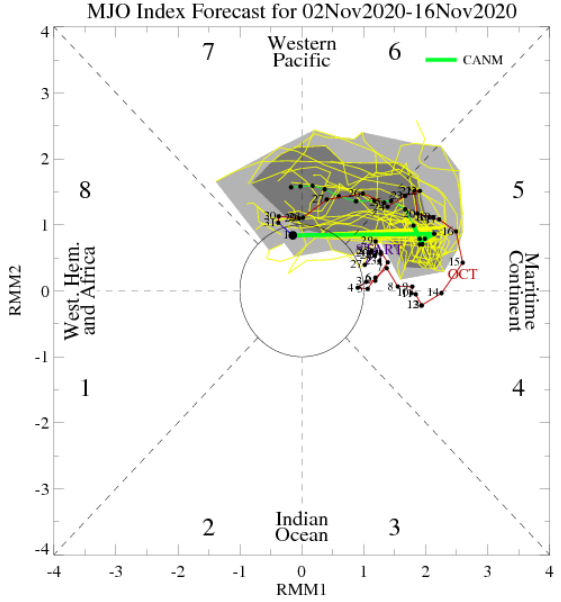
CFSv2



ECMWF



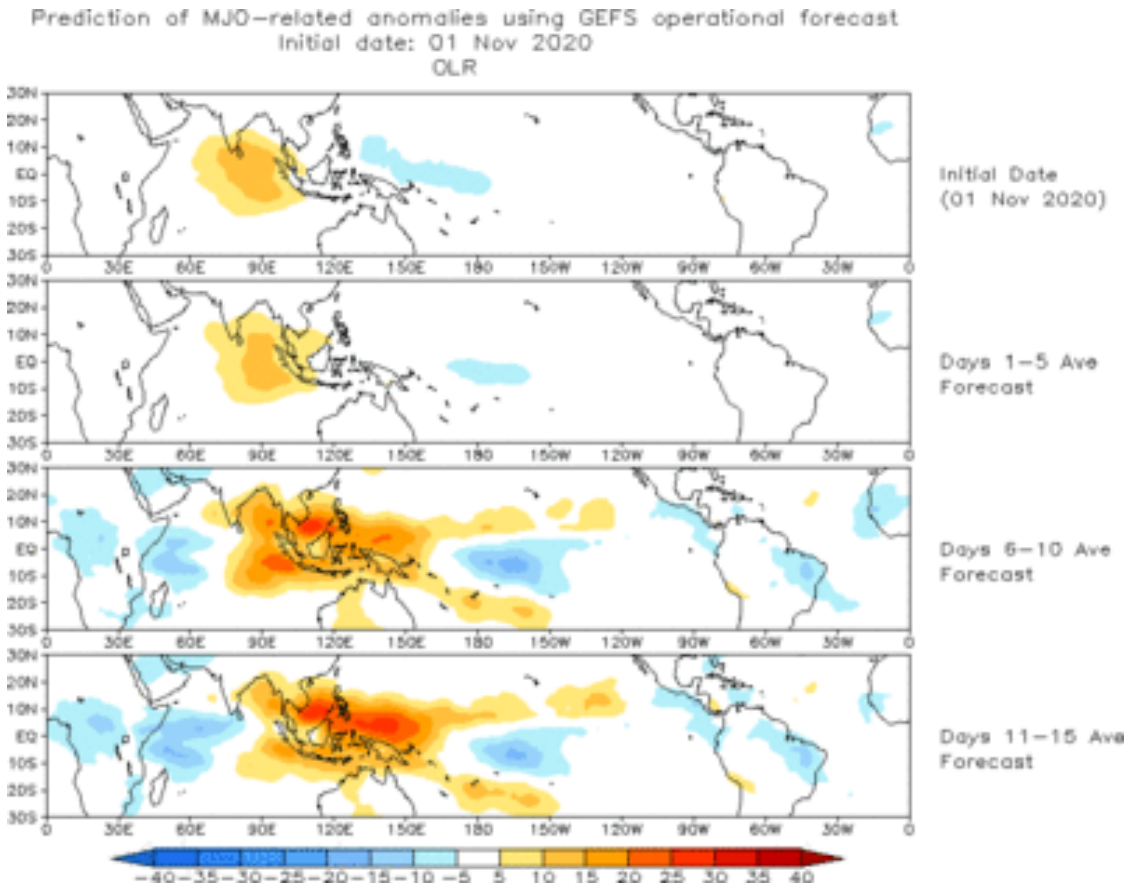
CMET



- Most models forecasts suggest eastward propagation, but lower amplitude => Weak MJO.

Evolution of MJO-related anomalies

Initial date: 1 November 2020



Red shade indicate areas of suppressed convection

Blue shade indicate areas of enhanced convection

1 - 5 days ave. Forecast

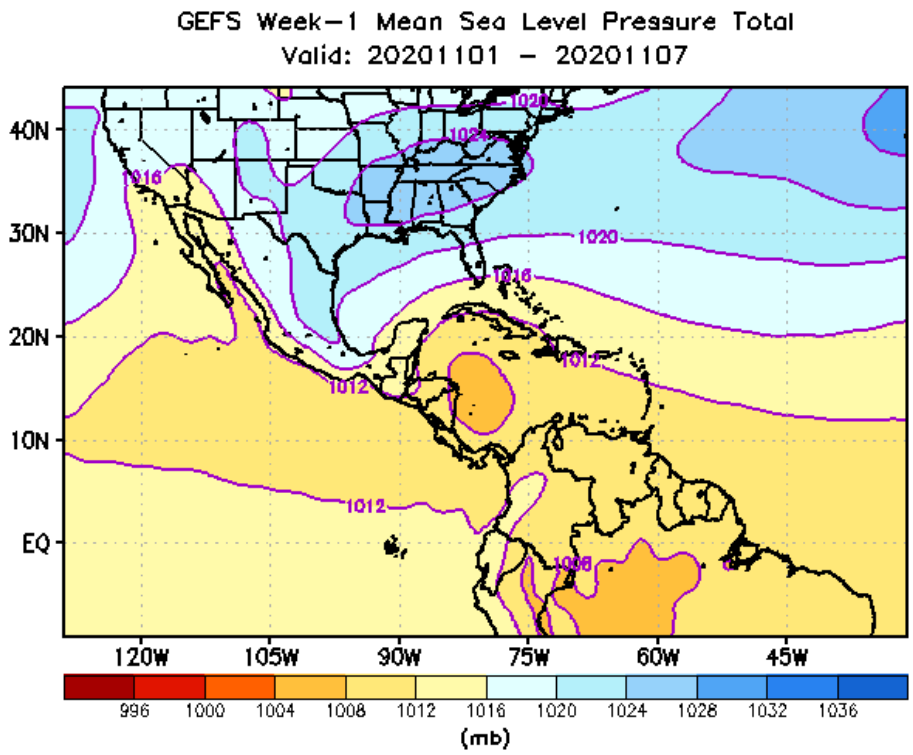
6-10 days ave. Forecast

11-15 days ave. Forecast

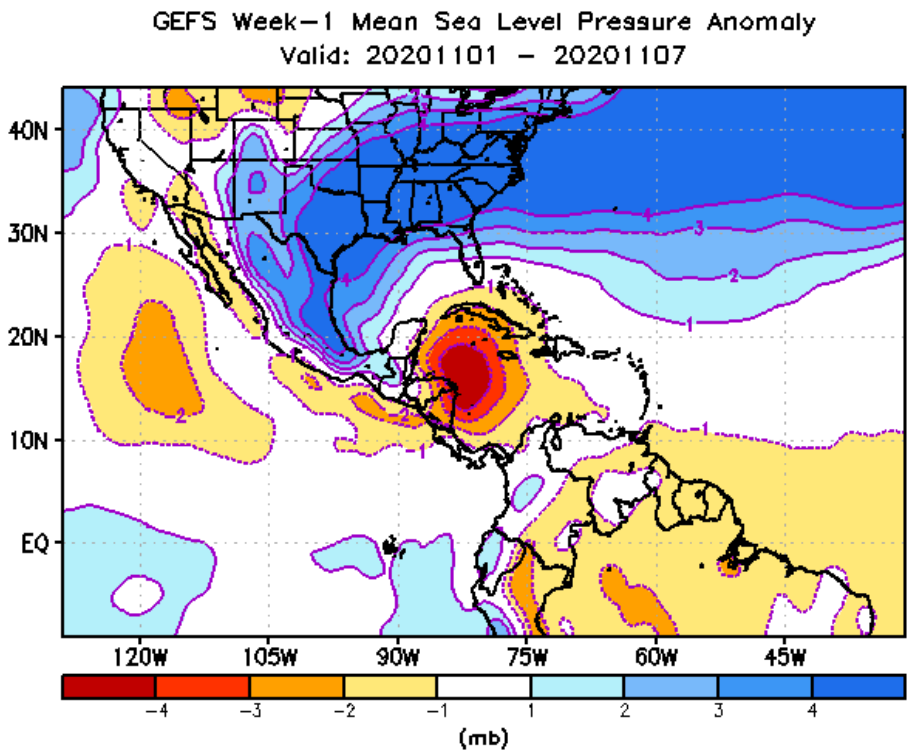
- Little or no MJO signal in the filtered OLR anomaly in Central America and the Caribbean region.

Mean Sea Level Pressure

Total



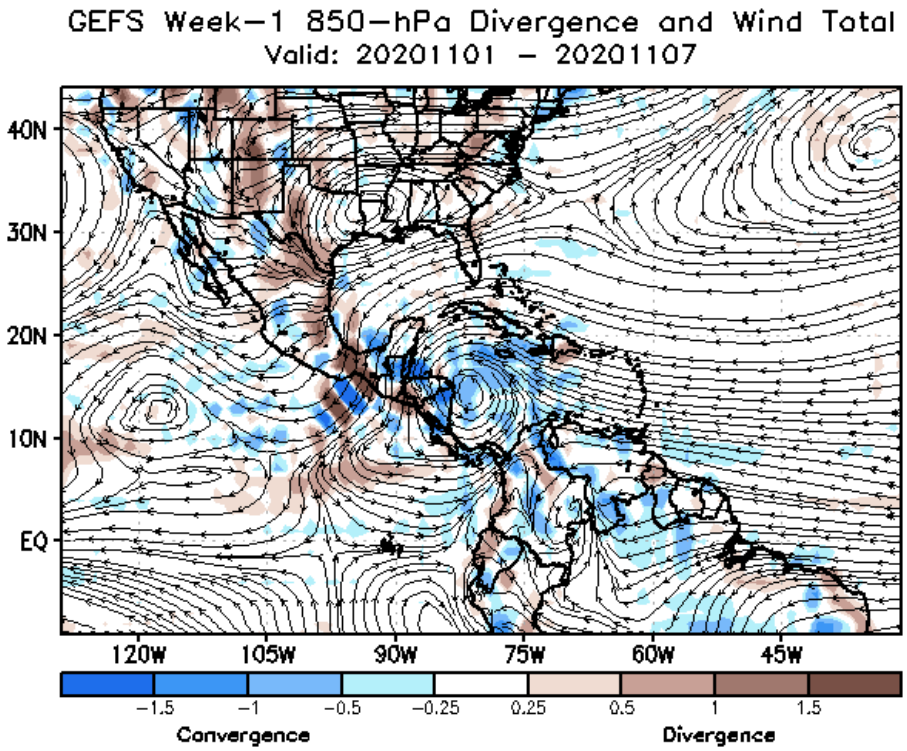
Anomaly



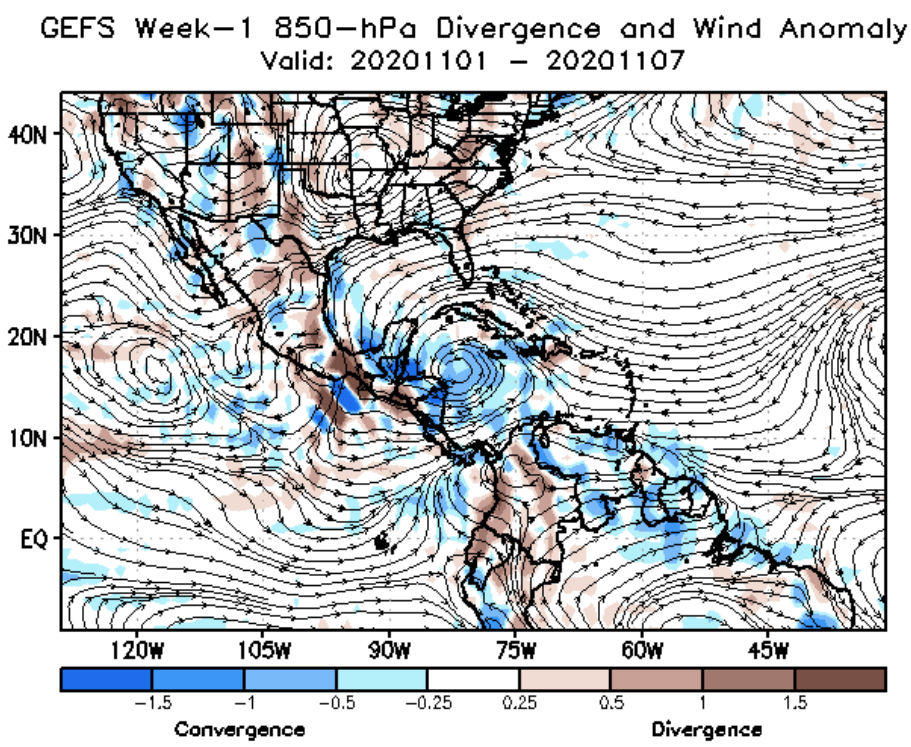
- A deep mean sea level pressure anomaly, associated with Hurricane Eta, in the Caribbean Sea and the neighboring areas.

850-hPa Wind

Total



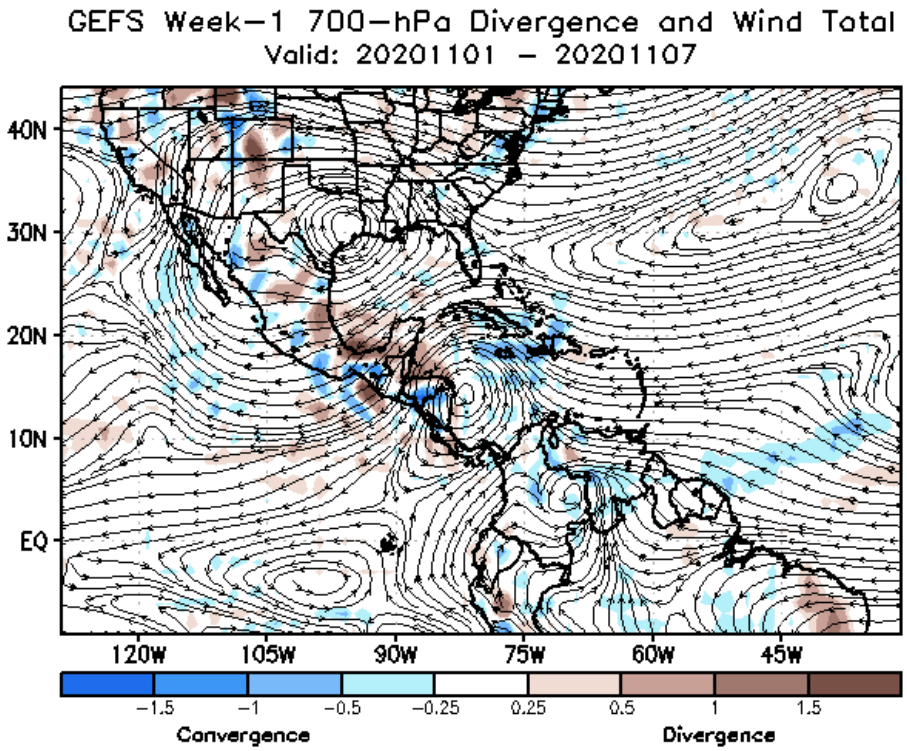
Anomaly



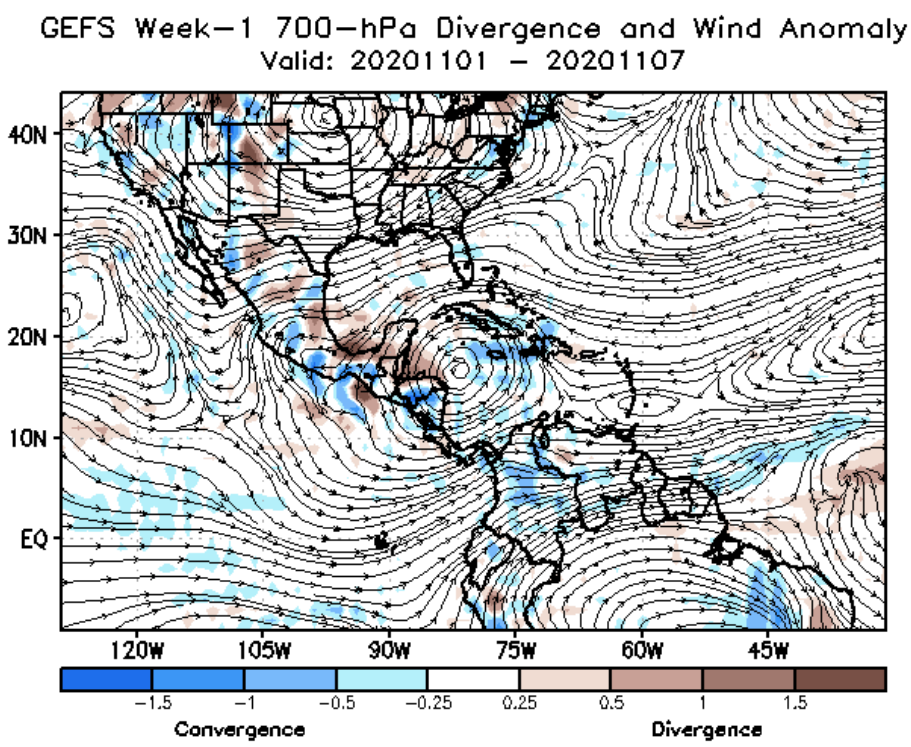
- A deep cyclonic circulation anomaly, associated with Hurricane Eta, in the Caribbean Sea and the neighboring areas.

700-hPa Wind

Total



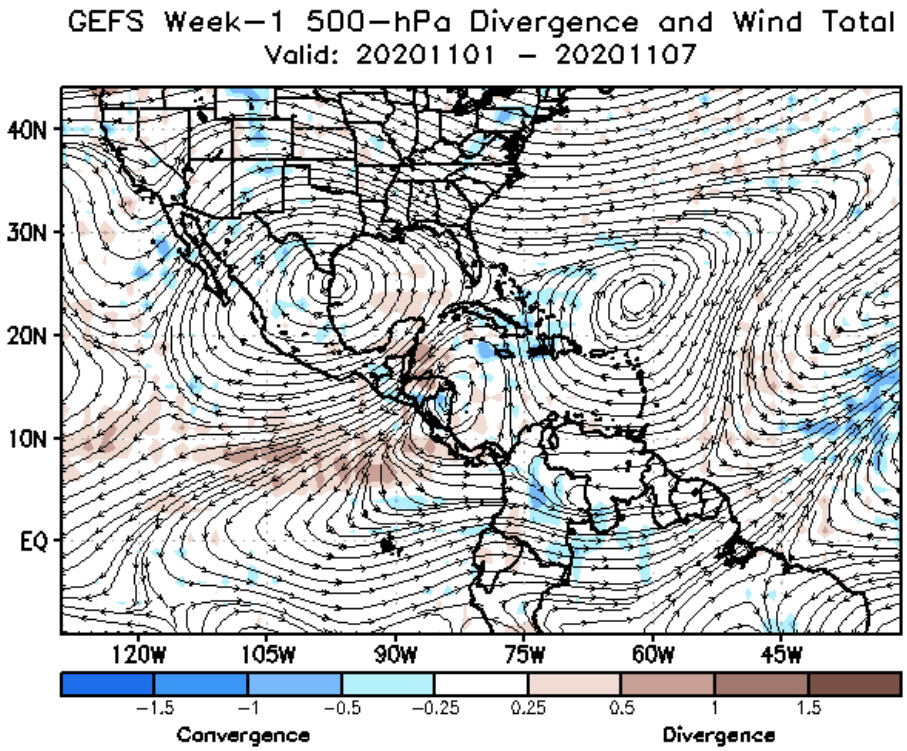
Anomaly



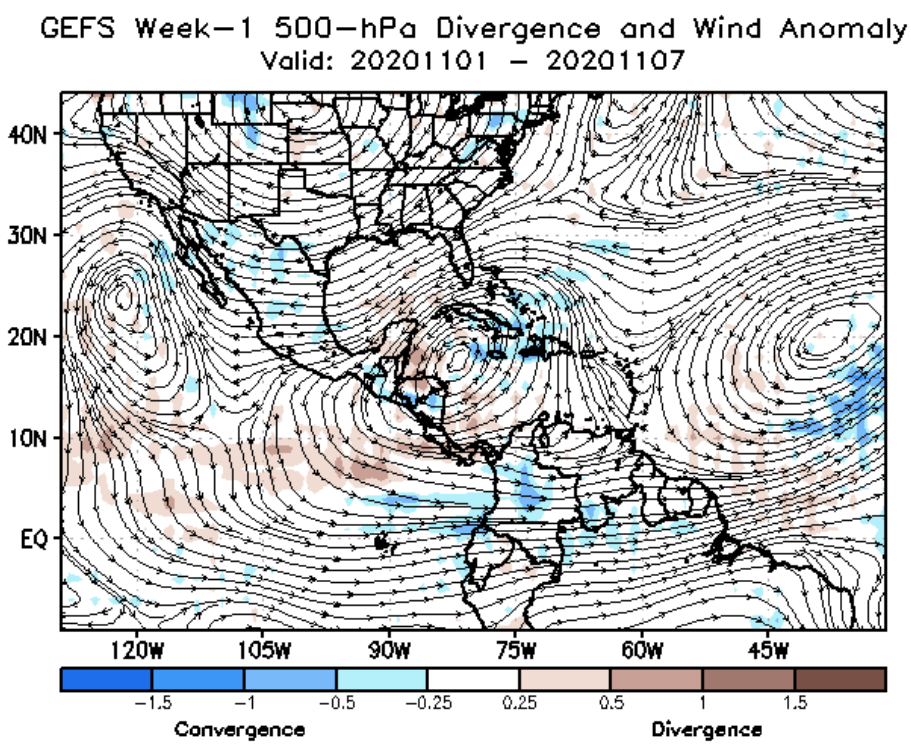
- The cyclonic circulation anomaly is evident at 700-hPa.

500-hPa Wind

Total



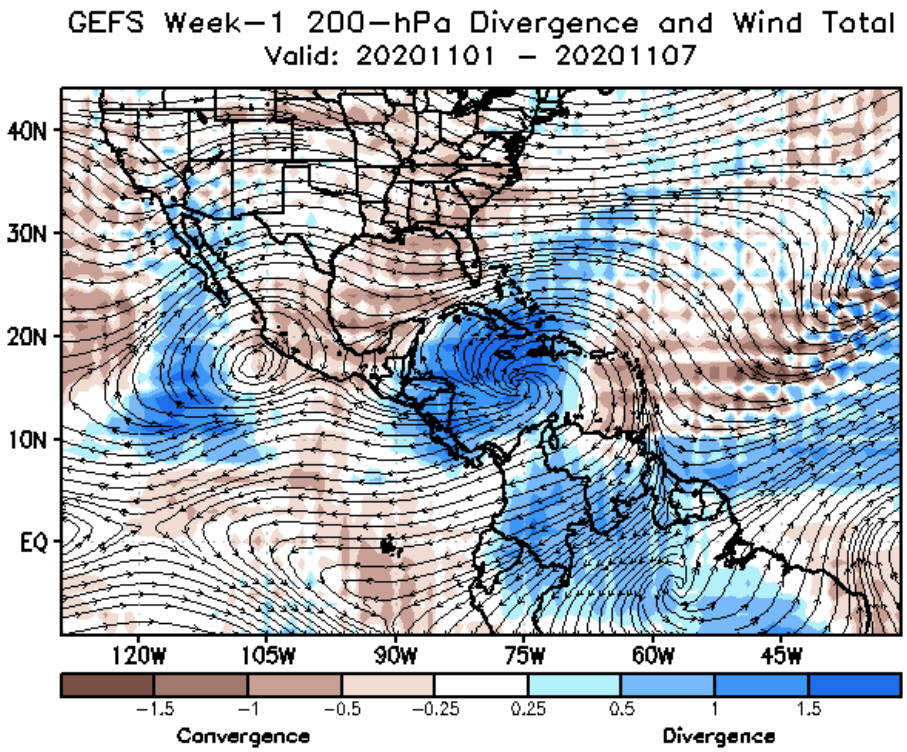
Anomaly



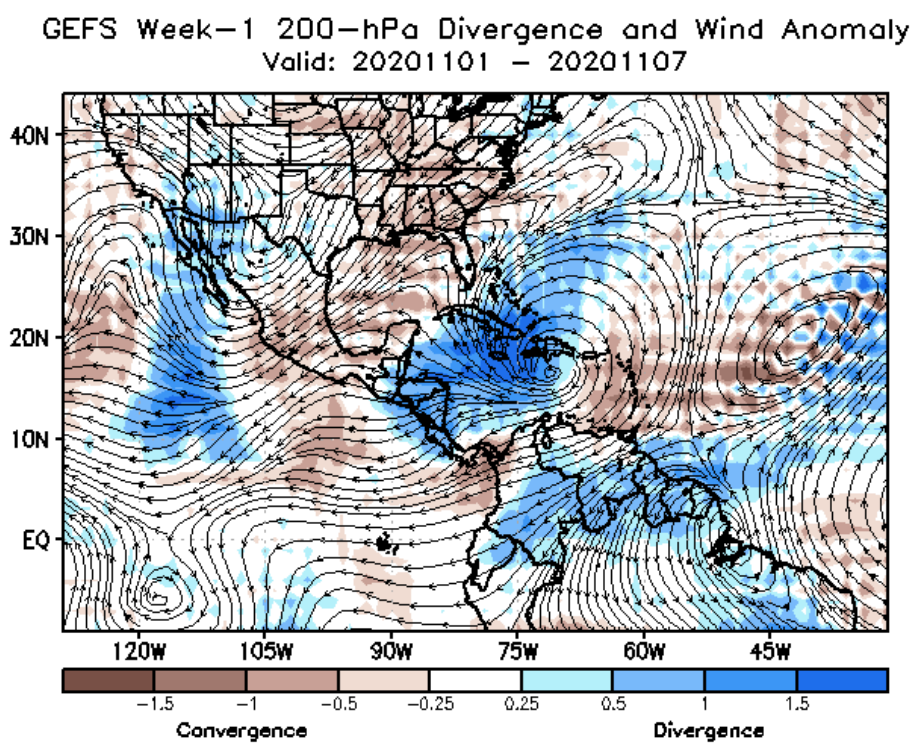
- The cyclonic circulation anomaly is evident at 500-hPa level as well.

200-hPa Wind

Total



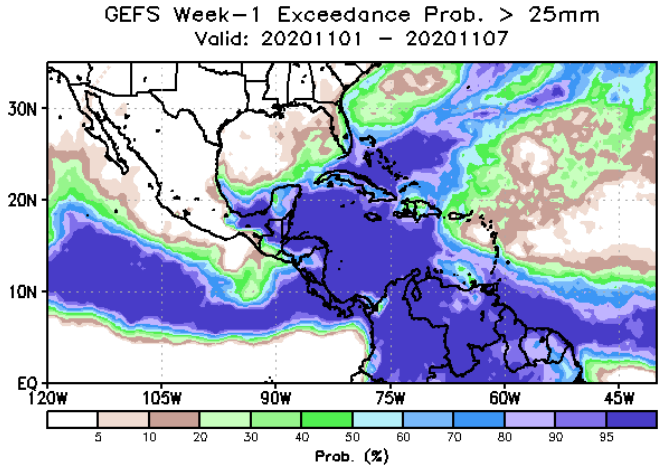
Anomaly



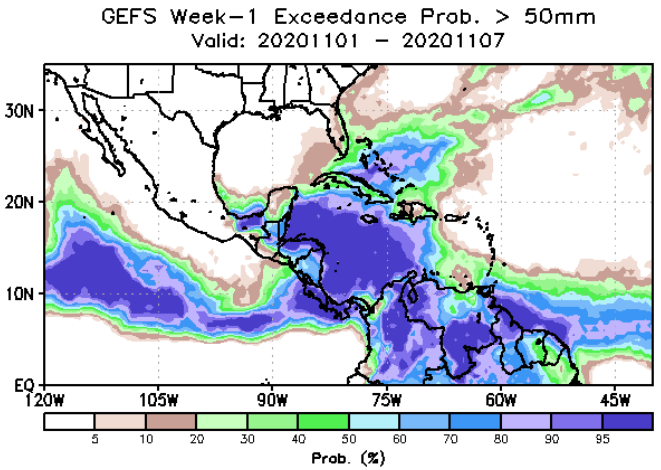
- A strong upper-level divergence and anti-cyclonic anomaly is evident in the Caribbean Sea region and the neighboring areas.

Precip Exceedance Probability

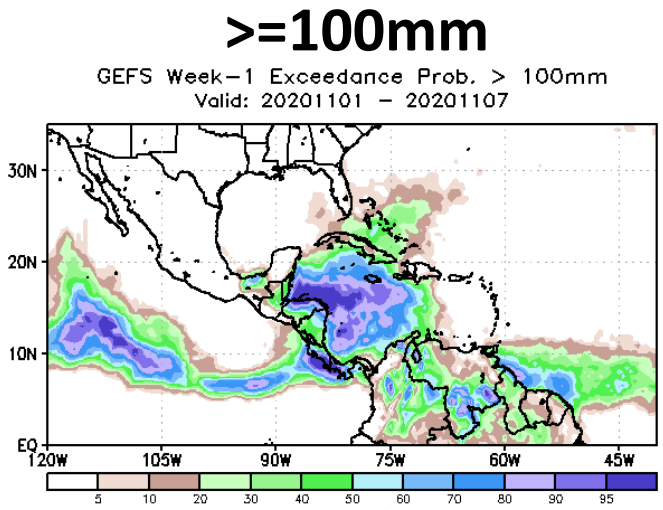
>=25mm



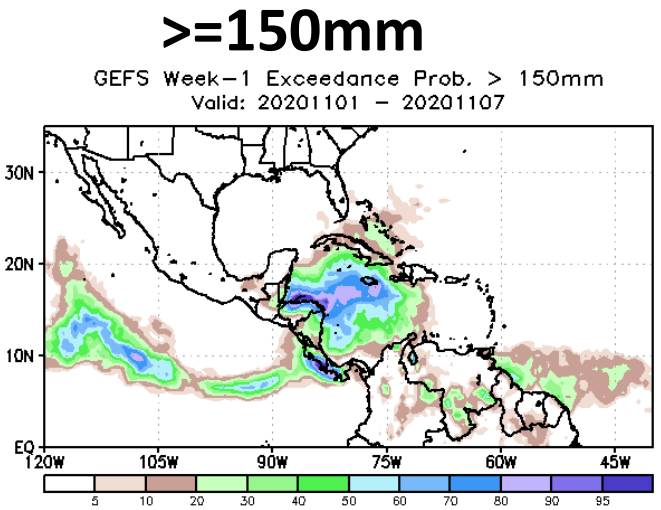
>=50mm



>=100mm



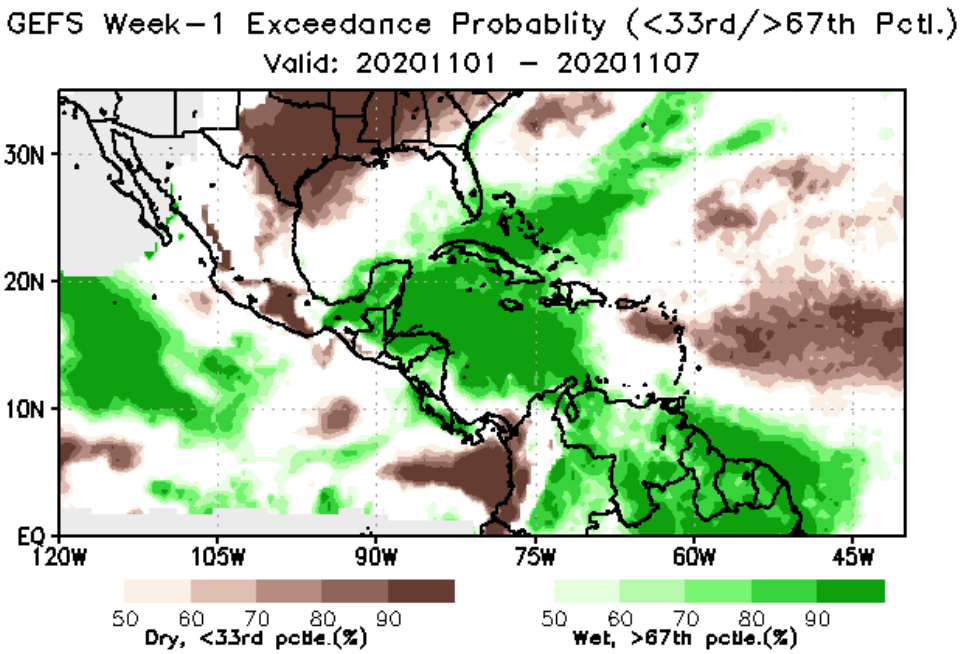
>=150mm



- High exceedance probability (>=50mm) over many places in Central America, the Caribbean, and the far northern South America.

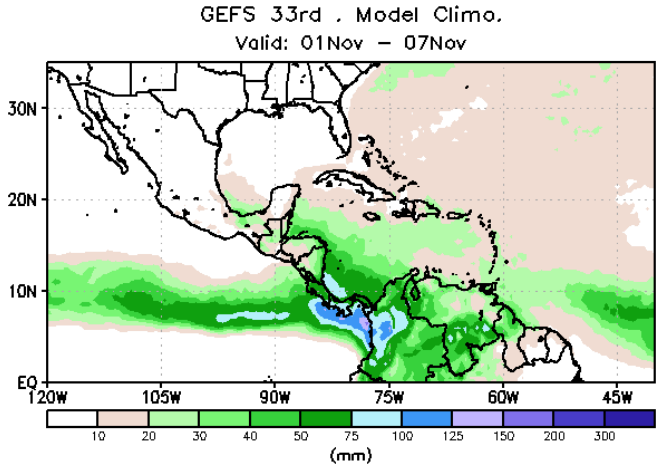
Precip Exceedance Probability (<=33rd & >=67th Percentile)

<=33rd & >= 67th Percentiles

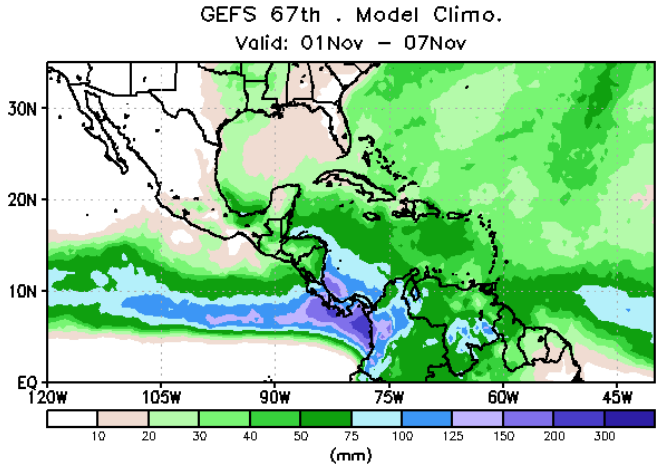


- High exceedance probability (>=67th percentile) over many places in Central America, the Caribbean, and the far northern South America.
- Drier condition (<=33rd percentile) is likely over portions of Mexico, coastal Columbia and the southern portions of the Caribbean islands.

33rd Percentile climo

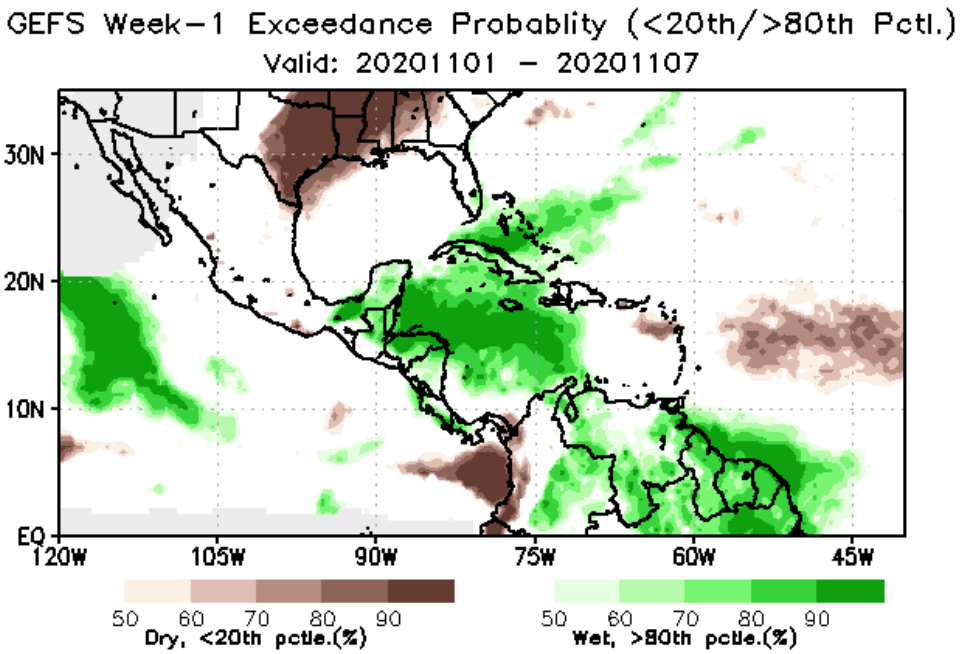


67th Percentile climo



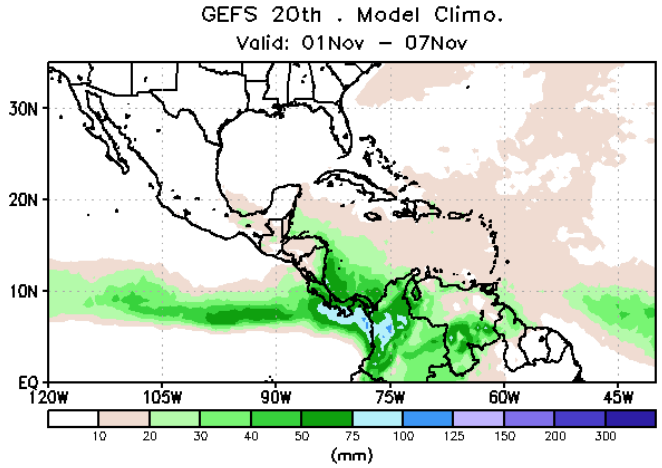
Precip Exceedance Probability (<=20th & >=80th Percentile)

<=20th & >= 80th Percentiles

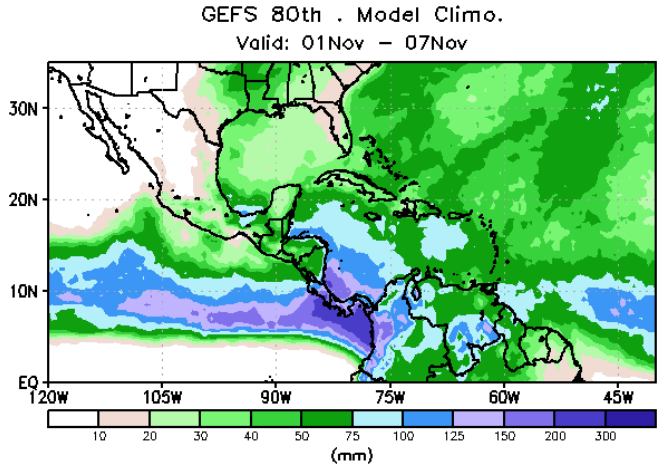


- High exceedance probability (>=80th percentile) over many places in Central America, the Caribbean, and the far northern South America.
- Drier condition (<=20th percentile) is likely over pockets of portions of the southern portions of the Caribbean islands.

20th Percentile climo

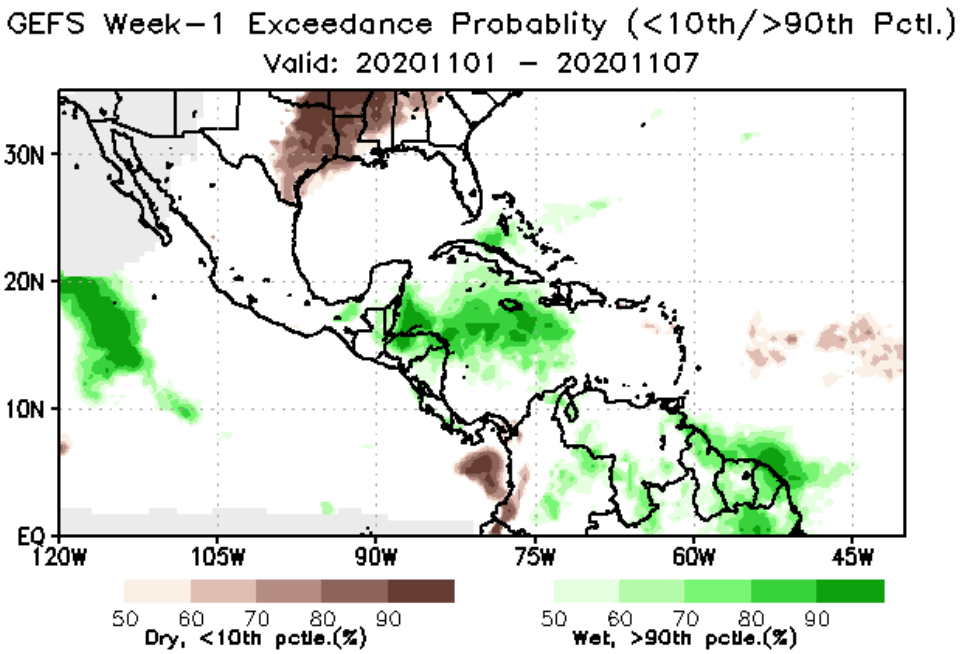


80th Percentile climo



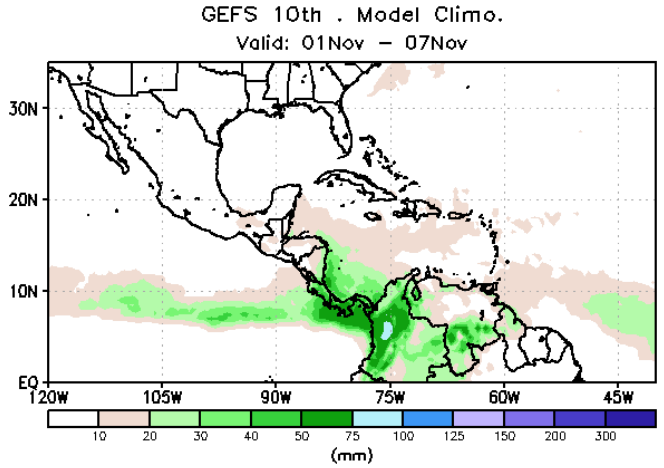
Precip Exceedance Probability (<=10th & >=90th Percentile)

<=10th & >= 90th Percentiles

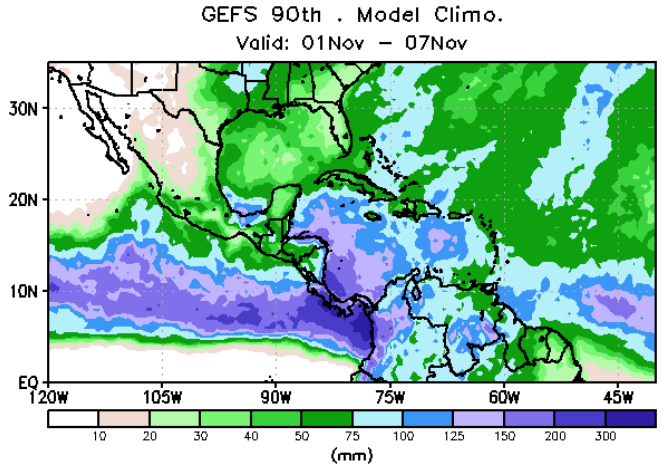


- High exceedance probability (>=90th percentile) over much of Guatemala and the far northern portions of South America.

10th Percentile climo



90th Percentile climo

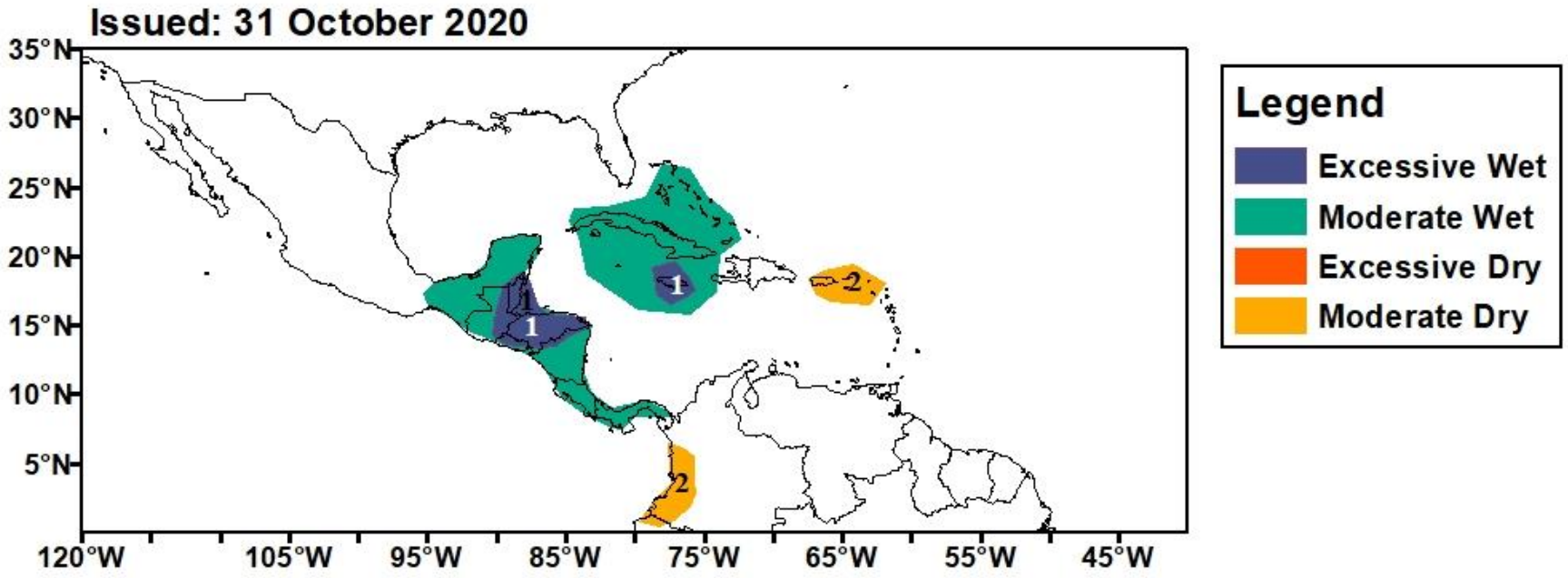


Summary

- **Convergence of evidences**
  - **MJO => Not active**
  - **Hurricane Eta => Likely to enhance precip in the Caribbean Sea and the neighboring areas.**
  - **Large Scale Circulation patterns => Strong lower and mid-level cyclonic circulation and convergence, combined with strong upper-level divergence in the region.**
  - **Exceedance probability forecasts = > higher probability of exceedance for >=67th, 80th and 90th percentiles.**
- **Models suggest higher probabilities for precip to be below the 33rd percentile over parts of Mexico, the southern portions of the Caribbean and coastal Colombia.**

Extreme Precip Outlooks

Experimental Week-1 Extreme Precip Hazards Outlook
Valid: 1 - 7 November, 2020



1. **An area of anomalous lower level cyclonic circulation, and strong upper-level divergence is expected to enhance rainfall over portions of Central America and the Caribbean. Model precip forecasts also suggest an increased chance for the precip to exceed the 67th percentile over many places, with pocket areas of high exceedance probabilities in excess of the 90th percentile.**
2. **Model forecast suggest an increased chance for moderate dryness over coastal Colombia and the east-central portions of the Caribbean.**