# **Operational forecasting of ocean** *surface monthly and seasonal* **conditions** *from NOAA NCEP CFSv2*

Wanqiu Wang

Climate Prediction Center, NCEP/NWS/NOAA

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# Outline

- 1. NCEP Climate Forecast System version 2 (CFSv2)
- 2. CFSv2 retrospective and real-time forecast
- 3. Preliminary evaluation of the CFSv2 forecast
  - Monthly mean anomaly correlation skill
  - Seasonal mean anomaly correlation skill
  - ENSO composites

## 1. NCEP Climate Forecast System version 2 (CFSv2)

- Atmosphere NCEP GFS (T126/L64)
- Ocean

GFDL MOM4

• Initial conditions CFSR (Climate Forecast System Reanalysis)

## 2. CFSv2 retrospective and real-time forecast

- Retrospective forecasts (Hindcasts) 45-day forecasts: 4 runs/day (1999-2011) 9-monthly forecasts: 4 runs/5day (1982-2011)
- Forecasts (starting March 2011) 45-day forecasts: 16 runs/day 9-monthly forecasts: 4 runs/day
- Output

Temporal resolution: Atmospheric resolution: Oceanic resolution: 6 hours 1°X1° 0.5°X0.5°

## 3. Preliminary evaluation of the CFSv2 forecast

• Data

4 runs/day (1982-2015)

- Variables
  - Pmsl Mean sea-level pressure (-1000mb)
  - Tau Surface wind stress (0.01Nm<sup>-2</sup>)
  - SST Sea surface temperature (K)
- Observation

CFSR

Metrics

Anomaly correlation coefficient (monthly and seasonal mean) ENSO composites (seasonal mean)

# **Monthly-mean forecast**

• Target months

March to August

Lead time

0, 5, 10, 15 days

• Ensemble size 4 forecast runs

*Caveat*: Real-time forecast produces 16 forecast runs each day. Use of the ensemble of 4 runs from the hindcasts may give an underestimate of the skill.

# 0-day lead forecast

- Higher skill for Pmsl than Tau
- Highest skill in March
- Higher Tau skill near CA west coast



# 5-day lead forecast

- Higher skill for Pmsl than Tau
- Higher skill in March than other months
- Higher Tau skill near CA west coast
- Skill reduced from that of 0-day lead



# 10-day lead forecast

- Higher skill for Pmsl than Tau
- Higher skill in March than other months
- Higher Tau skill near CA west coast
- Skills much reduced than that at shorter leads



# 15-day lead forecast

- Higher skill for Pmsl than Tau
- Higher skill in March than other months
- Higher Tau skill near CA west coast
- Skills much reduced than that at shorter leads



Anomaly correlation of monthly mean **SST** 

# 0-day and 5-day lead forecast

- Skills > 0.7
- Higher skill in spring than summer

![](_page_10_Figure_5.jpeg)

Anomaly correlation of monthly mean **SST** 

# 10-day and 15-day lead forecast

- Higher skill in spring than summer
- Skills generally higher than
  0.5 near US coast in spring
- Skills lower than 0.5 in a large portion near US coast in summer

![](_page_11_Figure_6.jpeg)

## **Seasonal-mean forecast**

• Target months

DJF, MAM, JJA, SON

• Lead time

0, 1, 2 months

### • Ensemble size

20 forecast runs from 5 lagged initial dates

*Caveat*: Real-time forecast produces 4 forecast runs each day, allowing for larger ensemble size. Use of the ensemble of 20 runs from the hindcasts may give an underestimate of the skill.

### **Anomaly correlation of Pmsl**

![](_page_13_Figure_2.jpeg)

- Higher skills near CA west coast in DJF and MAM
- Lower skills in JJA and SON

### **Anomaly correlation of Pmsl**

![](_page_14_Figure_2.jpeg)

- Higher skills near CA west coast in DJF and MAM
- Lower skills in JJA and SON

### **Anomaly correlation of Pmsl**

![](_page_15_Figure_2.jpeg)

- Higher skills near CA west coast in DJF and MAM
- Lower skills in JJA and SON

### Anomaly correlation of Tau

![](_page_16_Figure_2.jpeg)

- Skills near CA lower than Pmsl
- Decrease from DJF to MAM and JJA
- Nearly no skill in SON

#### **Anomaly correlation of Tau**

![](_page_17_Figure_2.jpeg)

- Skills near CA decrease from DJF to MAM and JJA
- Nearly no skill in SON

#### Anomaly correlation of Tau

![](_page_18_Figure_2.jpeg)

- Skills near CA decrease from DJF to MAM
- Nearly bi skill in JJA and SON

### Anomaly correlation of SST

![](_page_19_Figure_2.jpeg)

- Skills near CA west coast highest in DJF and MAM
- Lower in SON
- Lowest in JJA

### Anomaly correlation of SST

![](_page_20_Figure_2.jpeg)

- Skills near CA west coast highest in DJF and MAM
- Lower in SON
- Lowest in JJA

### Anomaly correlation of SST

![](_page_21_Figure_2.jpeg)

- Skills near CA west coast highest in DJF
- Lower in MAM, SON
- Lowest in JJA

### **ENSO** composites

Strongest 5 El Nino years – Strongest 5 La Nina years

DJF

![](_page_23_Figure_2.jpeg)

- Strong signal near CA west coast in CFSR (observation)
- Reasonable anomalies in CFSv2 prediction

MAM

![](_page_24_Figure_2.jpeg)

Strong signal near CA west coast in CFSR (observation)

Reasonable anomalies in CFSv2 prediction

JJA

![](_page_25_Figure_2.jpeg)

• Weak signal near CA west coast in CFSR (observation)

Weak anomalies in CFSv2 prediction

SON

![](_page_26_Figure_2.jpeg)

Moderate SST anomalies and Weak Pmsl/Tau anomalies near CA west coast in CFSR

Weak SST anomalies in CFSv2 prediction

# Summary

- Monthly and seasonal (lagged) ensemble forecasts can be obtained from operational NCEP CFSv2
- The system has some skill for monthly forecast at the lead time of 10-15 days, depending on the target month, variables and locations
- Seasonal skills are higher in winter and spring than in summer and fall
- CFSv2 is capable of capturing the ENSO signals which are stronger in DJF and MAM, and weaker in JJA and SON

# **Additional notes**

• CFSv2 Forecast data

Hindcasts (1982-2011) from NCEI <u>http://nomads.ncdc.noaa.gov/data.php?name=access#cfs-refor</u> Forecasts (initialized from last 7 days) from NCEP <u>http://nomads.ncep.noaa.gov/pub/data/nccf/com/cfs/prod/cfs</u>

- Sub-surface ocean variables are also available from CFSv2 but no detailed analysis has been done
- Forecasts are also available from NMME (National Multi-Model Ensemble)