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

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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: 6 hours
  Atmospheric resolution: 1°X1°
  Oceanic resolution: 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$^{-2}$)
  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.
Anomaly correlation of monthly mean Pmsl and Tau

0-day lead forecast

US West Coast:

- Higher skill for Pmsl than Tau
- Highest skill in March
- Higher Tau skill near CA west coast
Anomaly correlation of monthly mean Pmsl and Tau

5-day lead forecast

US West Coast:

- 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
Anomaly correlation of monthly mean Pmsl and Tau

10-day lead forecast

US West Coast:
- 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 Pmsl and Tau

15-day lead forecast

US West Coast:

- 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

US West Coast:

- Skills > 0.7
- Higher skill in spring than summer
Anomaly correlation of monthly mean SST

10-day and 15-day lead forecast

US West Coast:

- 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
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

- Higher skills near CA west coast in DJF and MAM
- Lower skills in JJA and SON
Anomaly correlation of Pmsl

• Higher skills near CA west coast in DJF and MAM
• Lower skills in JJA and SON
Anomaly correlation of Pmsl

- Higher skills near CA west coast in DJF and MAM
- Lower skills in JJA and SON
Anomaly correlation of Tau

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

1-month lead

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

2-month lead

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

0-month lead

- Skills near CA west coast highest in DJF and MAM
- Lower in SON
- Lowest in JJA
Anomaly correlation of SST

Skills near CA west coast highest in DJF and MAM
Lower in SON
Lowest in JJA
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
• Strong signal near CA west coast in CFSR (observation)
• Reasonable anomalies in CFSv2 prediction
- Strong signal near CA west coast in CFSR (observation)
- Reasonable anomalies in CFSv2 prediction
- Weak signal near CA west coast in CFSR (observation)
- Weak anomalies in CFSv2 prediction
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
    - [http://nomads.ncdc.noaa.gov/data.php?name=access#cfs-refor](http://nomads.ncdc.noaa.gov/data.php?name=access#cfs-refor)
  - Forecasts (initialized from last 7 days) from NCEP

- 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)