



# Land surface processes simulated in the NCEP global model: A comparative study using the CEOP reference site observations

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# Introduction

- Land surface processes simulated from the NCEP Global Forecast System (GFS) are compared against in situ observations from CEOP reference sites during EOP-1 and EOP-3
- Two versions of GFS are examined:
  - The operational GFS, which uses the legacy OSU Land Surface Model (LSM)
  - An experimental version, which uses the latest version of the NCEP Noah LSM (advanced descendant of OSU LSM)

# CEOP: Coordinated Enhanced Observing Period

- CEOP is a GEWEX/GHP coordinated international activity to establish an integrated **global observing database** for the global water cycle.
- It contains **satellite data, model and assimilation output, and in situ observations at reference sites**.
- The 40+ **CEOP reference sites** are globally distributed. Data sets sampled at these reference sites include: (1) surface meteorology and surface energy/water fluxes, and (2) soil moisture and temperature.
- Under GAPP sponsorship, UCAR/JOSS has collected the reference site data into a centralized database and transformed all observations into a common format.

# NCEP Global Forecast System (GFS)

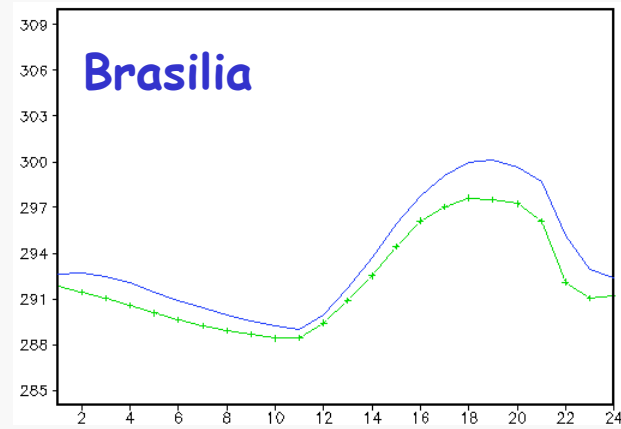
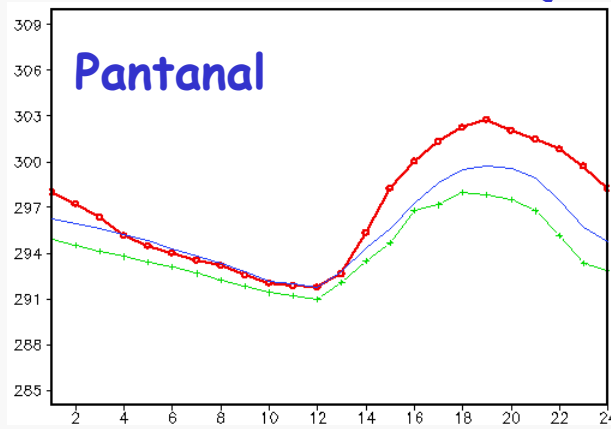
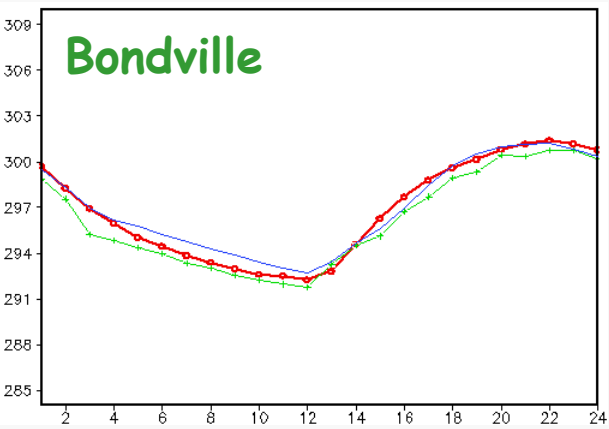
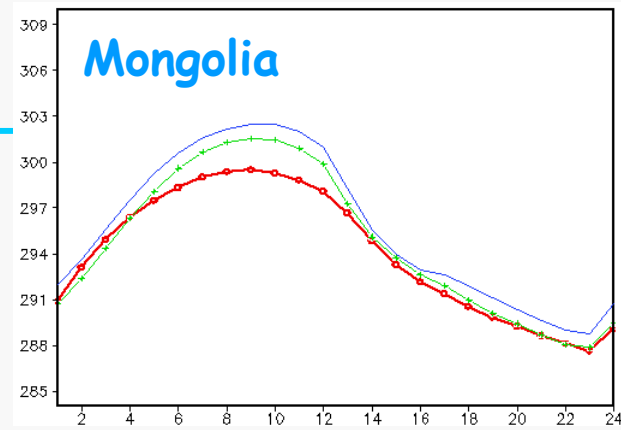
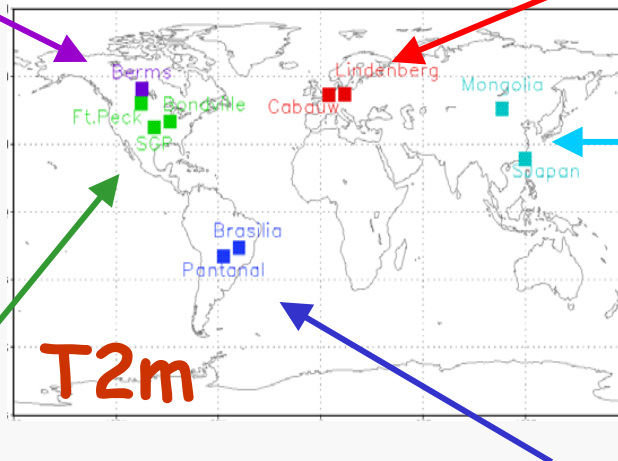
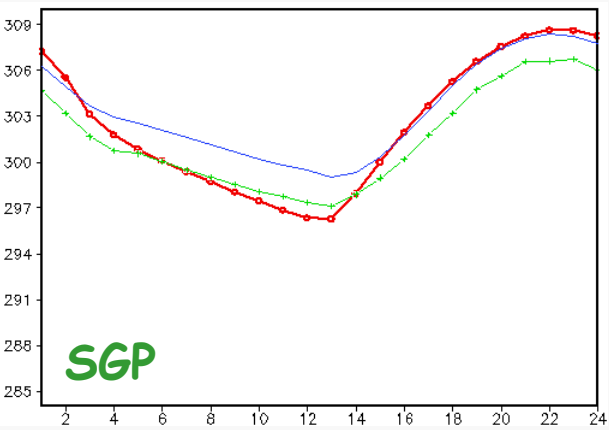
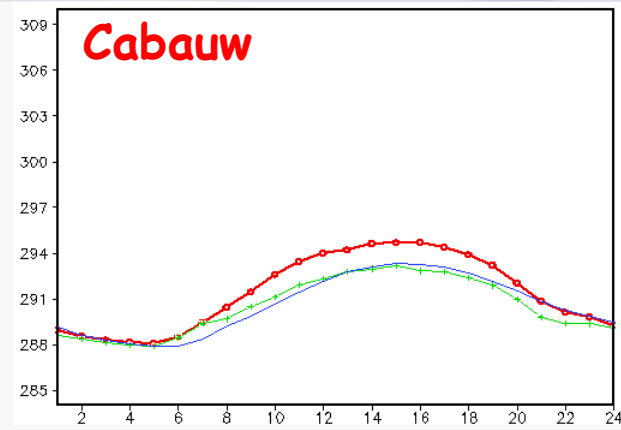
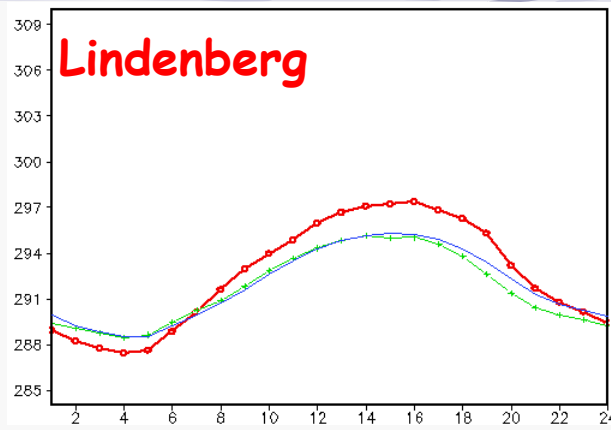
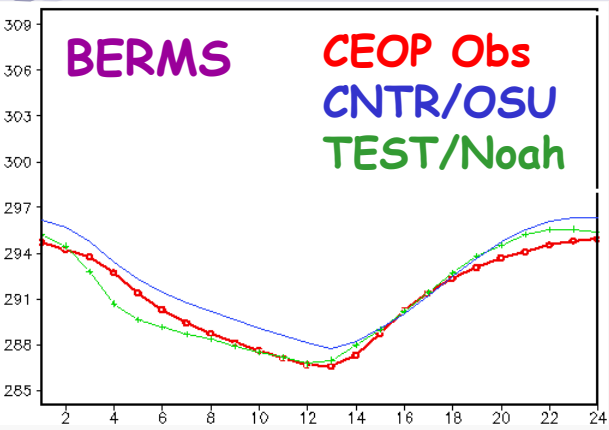
- ✓ Resolution (as in NCEP seasonal forecast system)
  - T62 horizontal resolution
  - 64 vertical levels
- ✓ Model physics
  - Non-local vertical diffusion
  - SAS convection
  - MD Chou radiation
  - Explicit cloud microphysics
- ✓ Land-surface models
  - OPER OSU LSM
    - 2 soil layers: 10 and 200 cm depth
  - TEST Noah LSM
    - 4 soil layers: 10, 40, 100, 200 cm depth

# Global Model Execution Scenario (EOP-1)

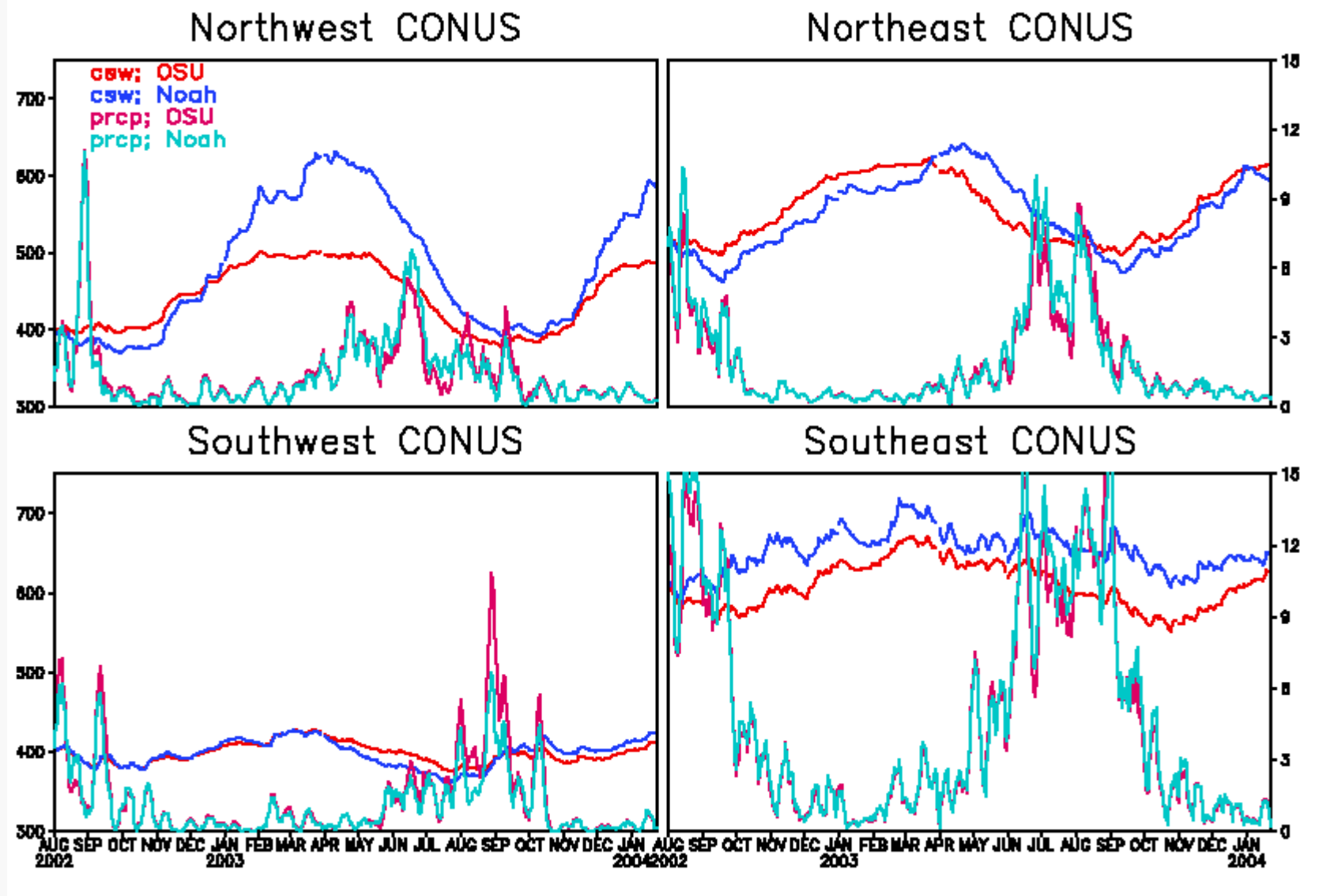
- Conduct 5-day forecast daily (Jul- Aug, 2001)
- Hourly output
- Day 1 forecast results are analyzed
- Initial conditions are taken from the NCEP Global Data Assimilation System (GDAS) analysis at 00Z

## Caveat:

- Land states are products of older OSU LSM
- Land states NOT optimal for newer Noah LSM



# Low-resolution T62L28 GDAS (starting from Aug 2002)



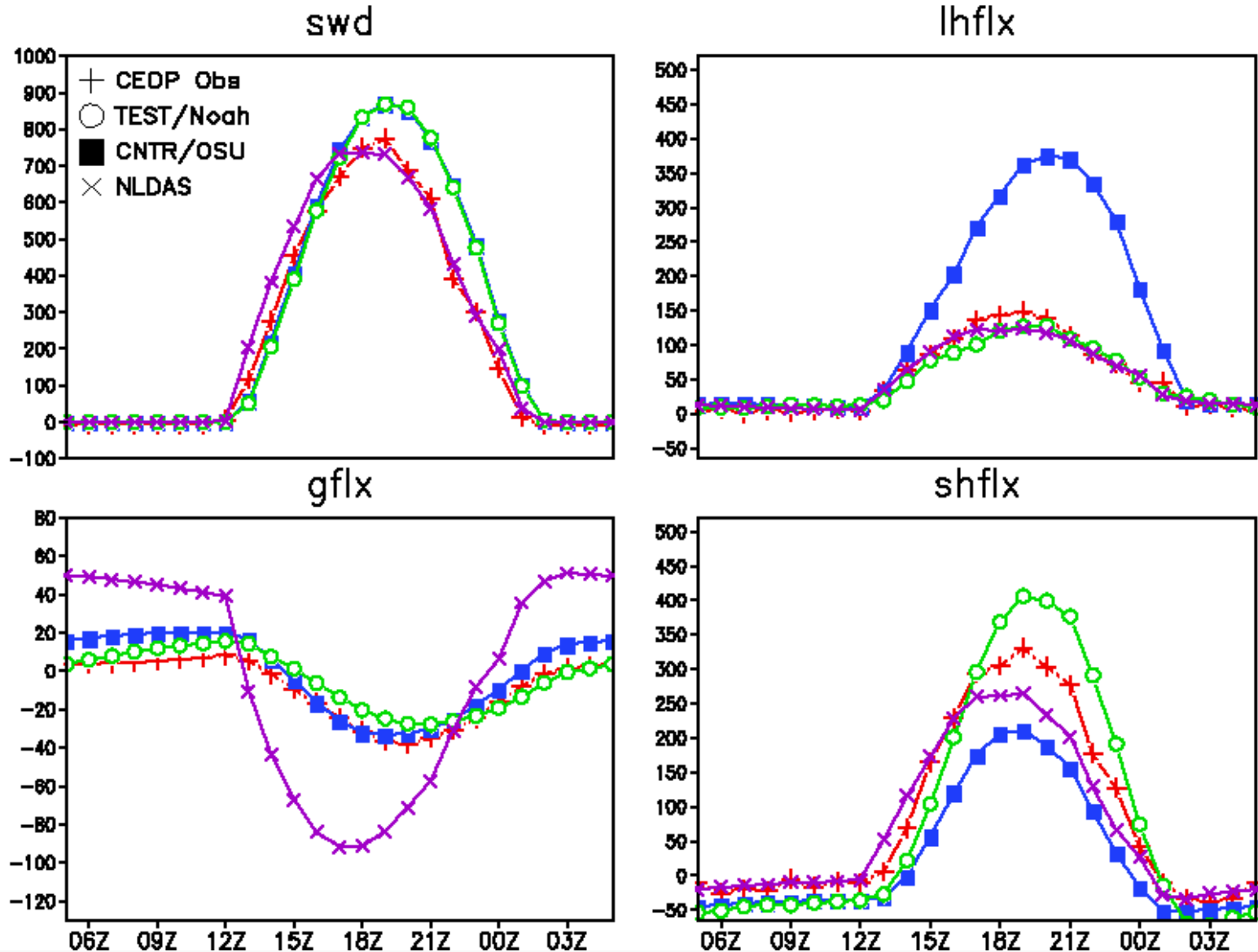
# Global Model Execution Scenario (EOP-3)

- Conduct 5-day forecast daily (Jul-Aug, 2003)
- Hourly output
- Day 1 forecast results are analyzed
- Initial conditions for CNTR/OSU are taken from low-resolution OSU cycled GDAS at 00Z
- Initial conditions for TEST/Noah are taken from low-resolution Noah cycled GDAS at 00Z



# GAPP South Great Plains, USA (36.6°N, 97.5°W)

GAPP/SGP (Aug 01–31, 2003); EOP-3

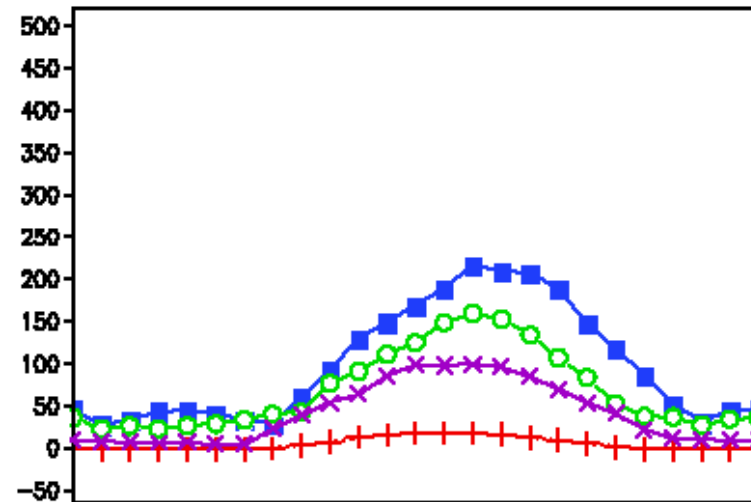
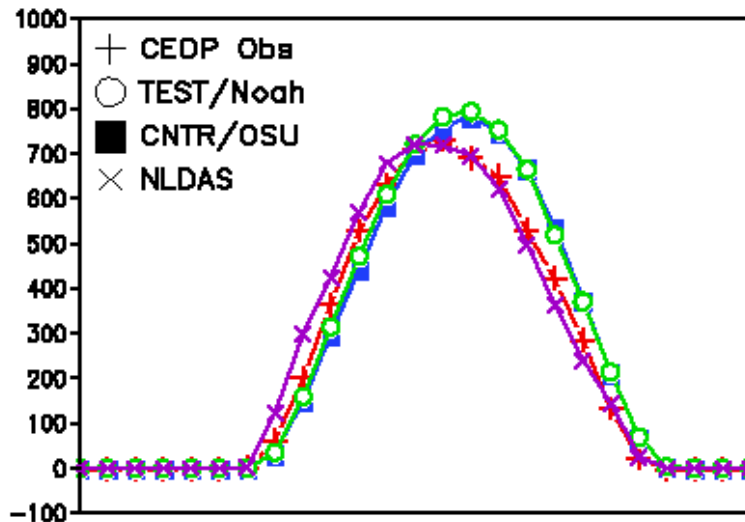


# GAPP Ft. Peck, MT, USA (48.3°N, 105.1°W)

GAPP/FtPeck (Aug 01–31, 2003); EOP-3

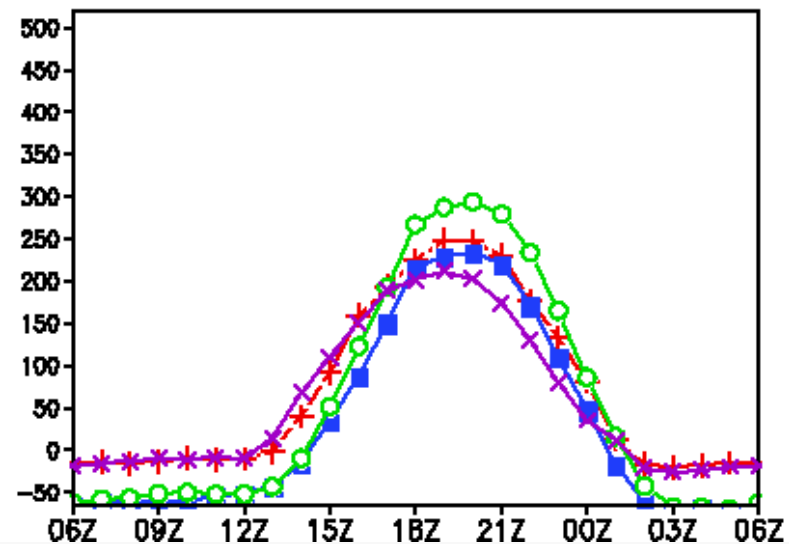
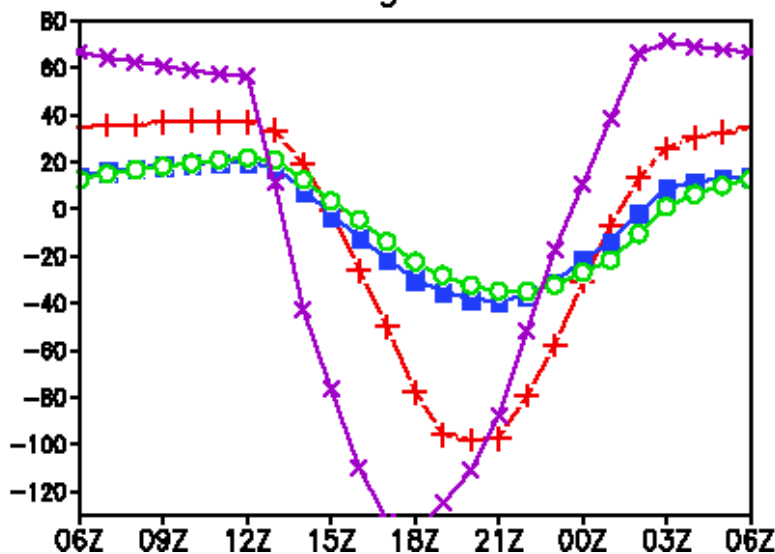
swd

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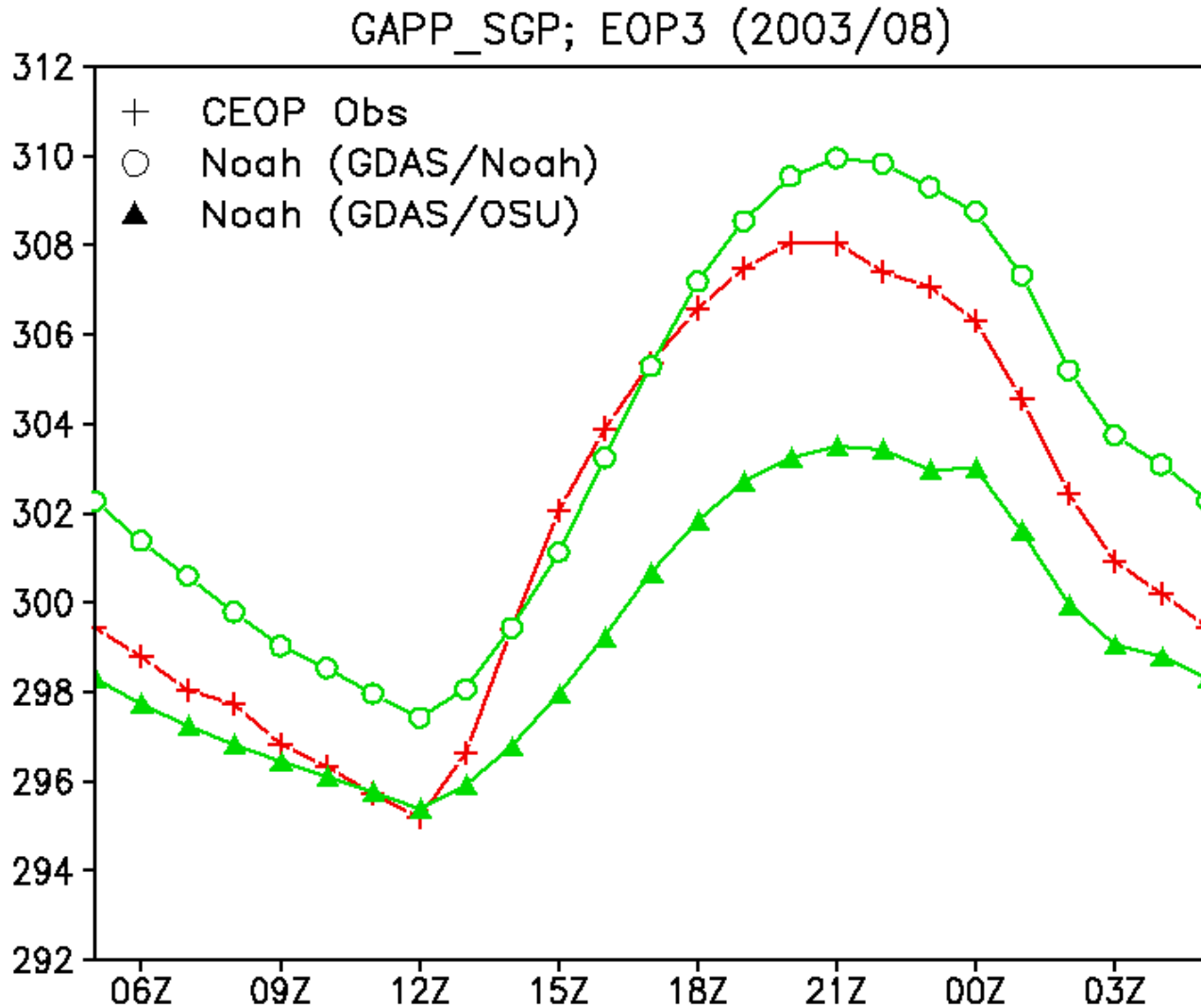


gflx

shflx

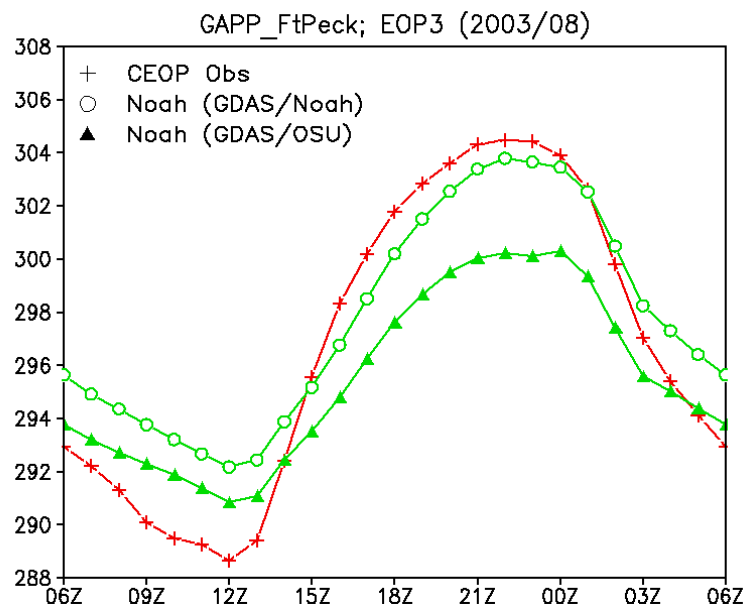


# Near-surface temperature ( $^{\circ}$ in K)

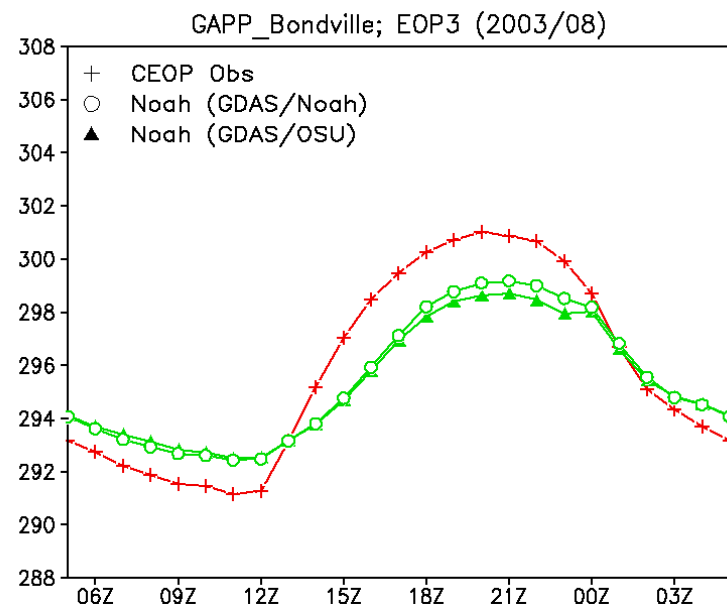


Same GCM  
Same LSM  
Different IC

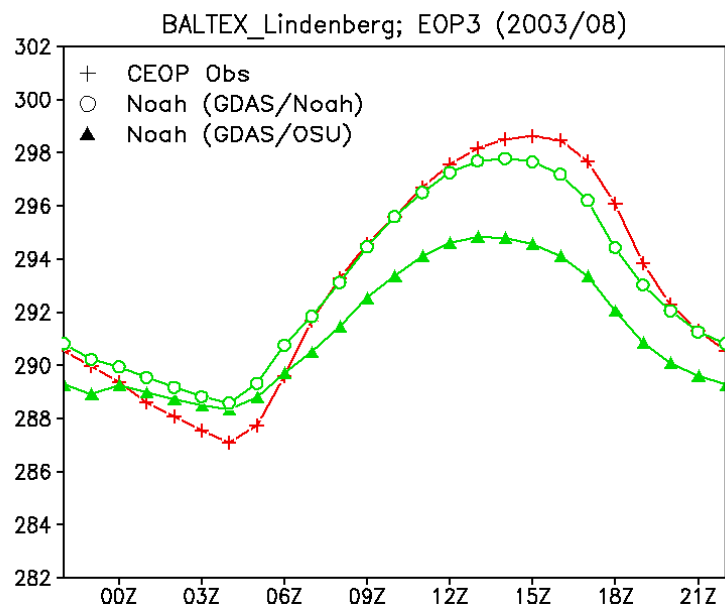
# Ft. Peck, MT (48.3°N, 105.1°W)



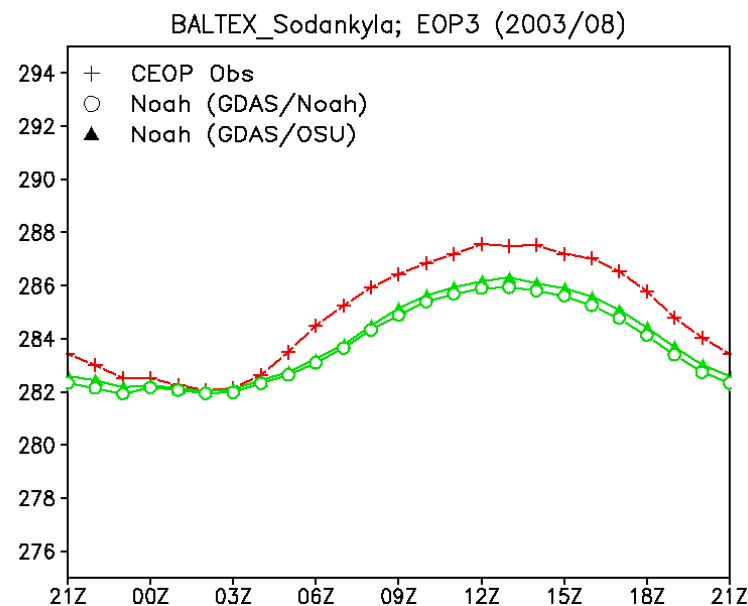
# Bondville, IL (40.0°N, 88.3°W)



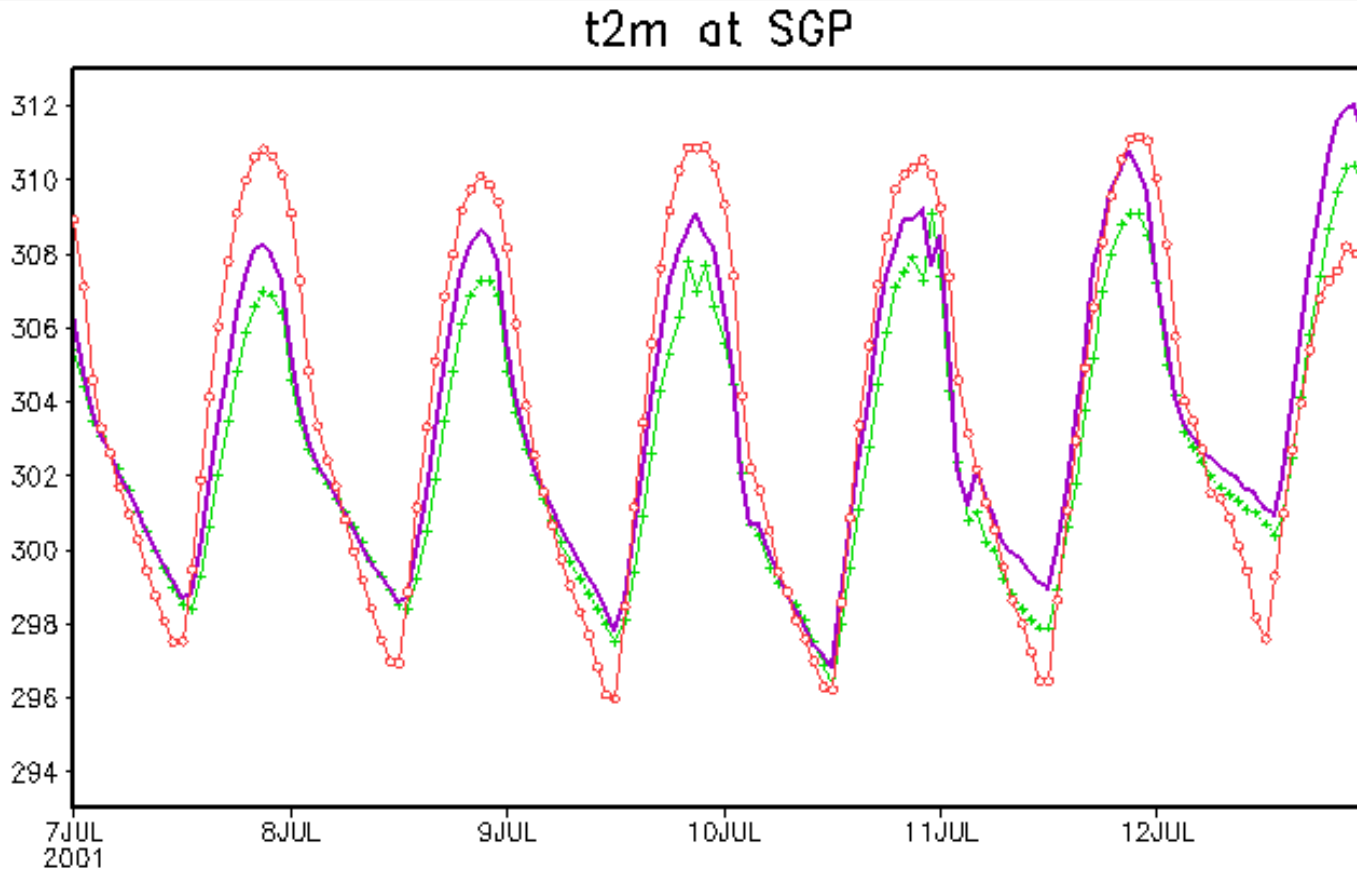
# Lindenberg, Germany (52.2°N, 14.1°E)



# Sodankyla, Finland (67.4°N, 26.7°E)



# GFS Sensitivity Study



Observations

TEST/NOAH

TEST/NOAH (CH reduced by 50%)

# Caveats to fair LSM assessment in GFS

## Surface forcing biases in parent atmospheric model

- Positive solar insolation bias shown here
- Precipitation bias will be examined

## Initial land states

- Lack of compatible initial land states reflecting many months of cycling of the experimental land model

# Summary

- ☞ This study illustrates the utility of the CEOP reference site observations for assessing land-surface processes simulated in the NCEP GFS.
- ☞ Two sets of GFS runs are conducted, one is based on the operational version employing the legacy **OSU LSM** and the other is an experimental version coupled with the newer **Noah LSM**.
- ☞ The use of the **uncoupled NLDAS** offers an appealing and useful alternative assessment of land model candidates because:
  - Provides **surface forcing** with much less bias
  - Easier to execute long periods of self cycling to provide properly **spun-up land states** using candidate land surface model

**Thank You**