Noah land-surface model used in the NCEP operational North American Mesoscale (NAM/WRF-NMM) model

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Noah land-surface model at NCEP

· linearized (non-iterative) surface energy budget

· Jarvis-Steward “big-leaf” canopy conductance for different land-use classes

· intercepted canopy water

· bare soil evaporation

· vegetation-reduced soil thermal conductivity

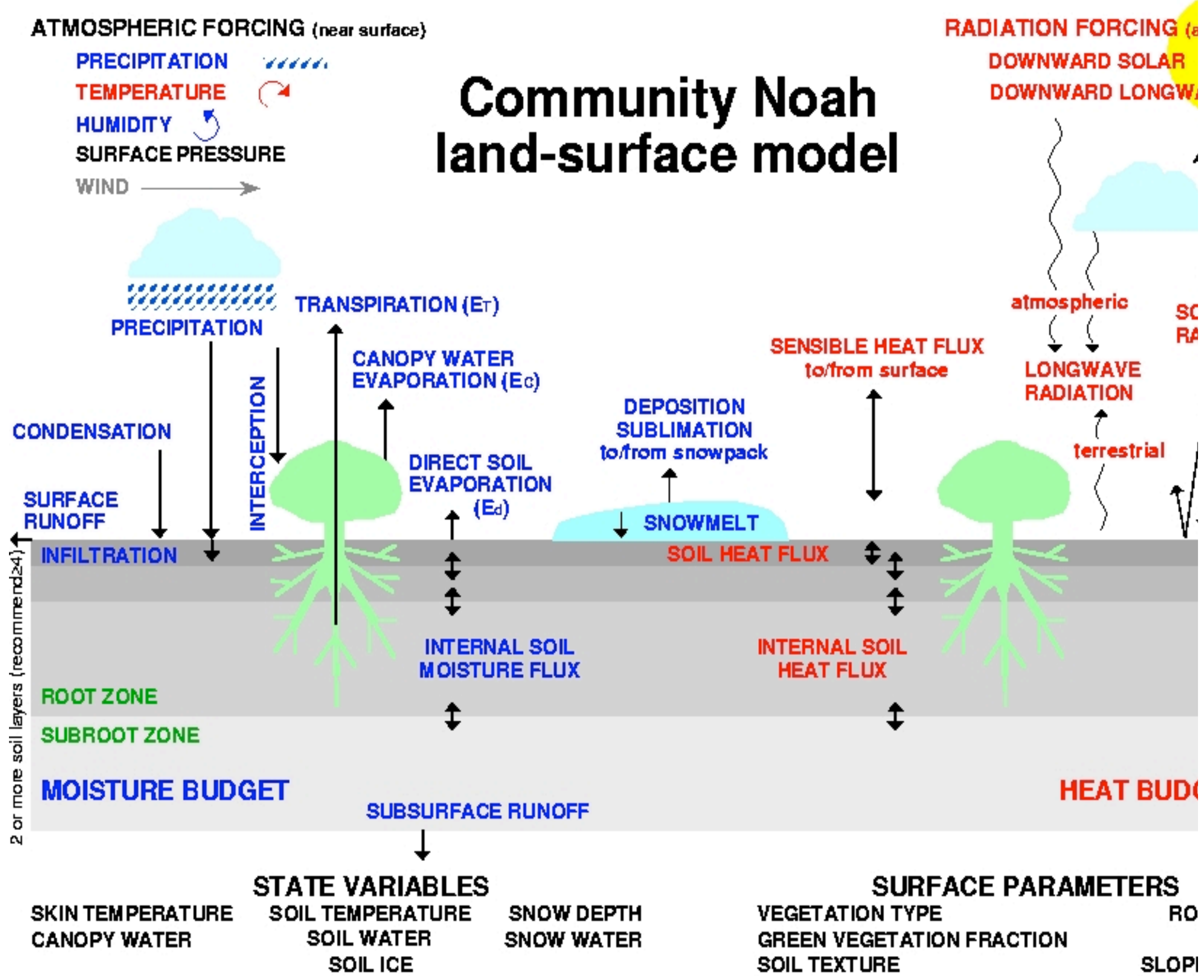
· multiple soil layers, with soil moisture diffusion and soil heat conduction eq'ns for different soil textures

· frozen soil processes

· single-layer snowpack, snow density, max snow albedo

· patchy snow cover affect on surface fluxes

(Chen et al 1996, Schaake et al 1996, Koren et al 1999, Ek et al 2003)



ftp://ftp.emc.ncep.noaa.gov/mmb/gcp/ldas/noahlsm

· Noah LSM tested in various land-surface mode intercomparison projects, e.g., PILPS 2a, 2c, 2d, GSWP 1 & 2, Rhone, DMIP, GLACE.

NAM/Eta to NAM/WRF-NMM transition: land-surface aspects

· *Imbed NAM/Eta Noah LSM v2.7.1 in "nmmlsm (WRF land opt 99) …"99% identical" with WRF land model opt 2, a.k.a."unified Noah LSM"*

· WRF-NMM dynamic core

· MYJ surface layer & PBL

· BMJ convection

· Ferrier microphysics

· GFDL radiation

WRF-NMM (NAMX) testing at NCEP/EMC

- Real-time cycled parallel (January-May 2006)
- Summer retrospective (May through August 200
  May, June “cycling/spinup”
  July, August free forecasts (84-hr)
- Special case study runs with EMC “WRF-launc
  Various warm & cold season runs, plus verificat
  and comparison with operational NAM/Eta

NAM/Eta to NAM/WRF-NMM transition: land-surface aspects

Surface flux differences in Eta vs WRF-NMM:

· Same Noah LSM

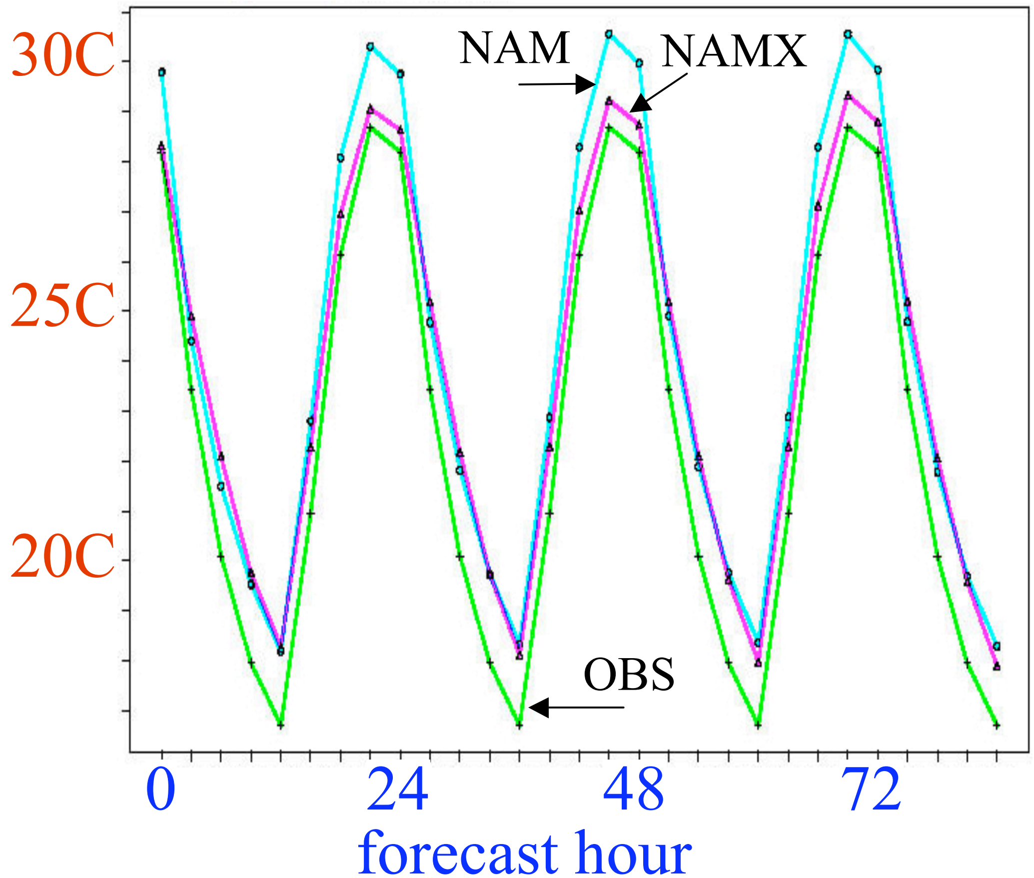
· Surface roughness, surface layer & PBL change and height of lowest model layer (affect surface exchange coefficients)

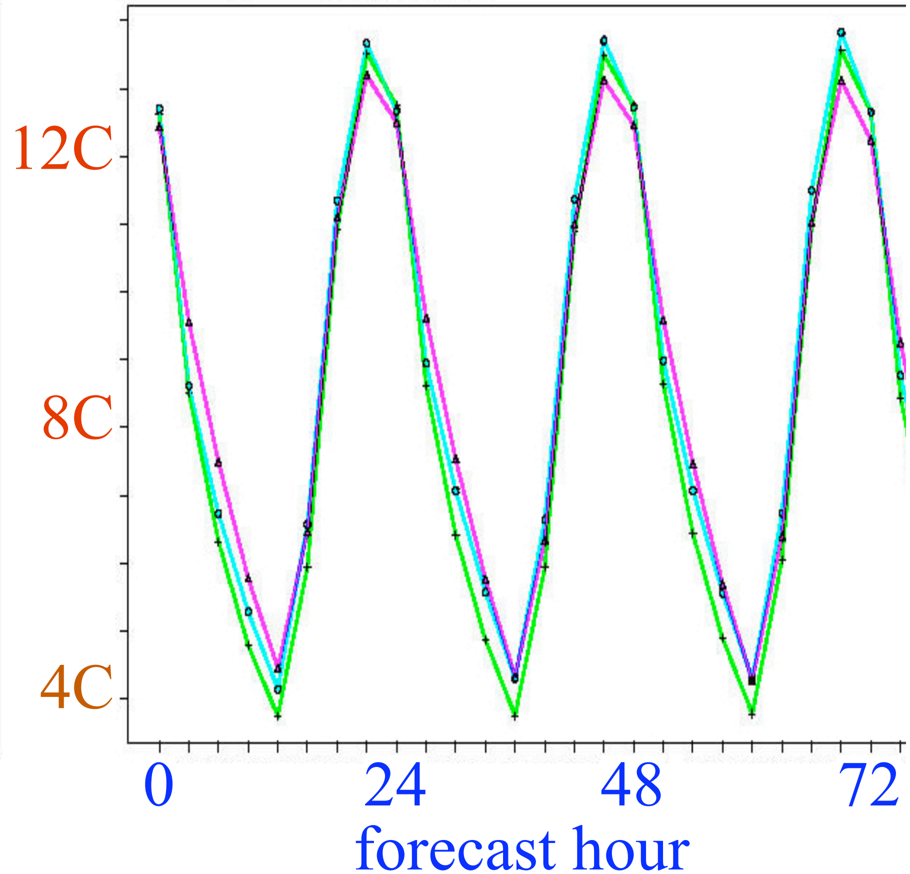
· Cloud & radiation changes (affects radiation)

· Tests found a “glitch” in Eta LSM ***driver*** (yield greater surface evaporation, higher dew points), but ***NOT*** in WRF-NMM

western CONUS, 2-meter air tem

JUL-AUG 2005 *JAN-MAY 200*

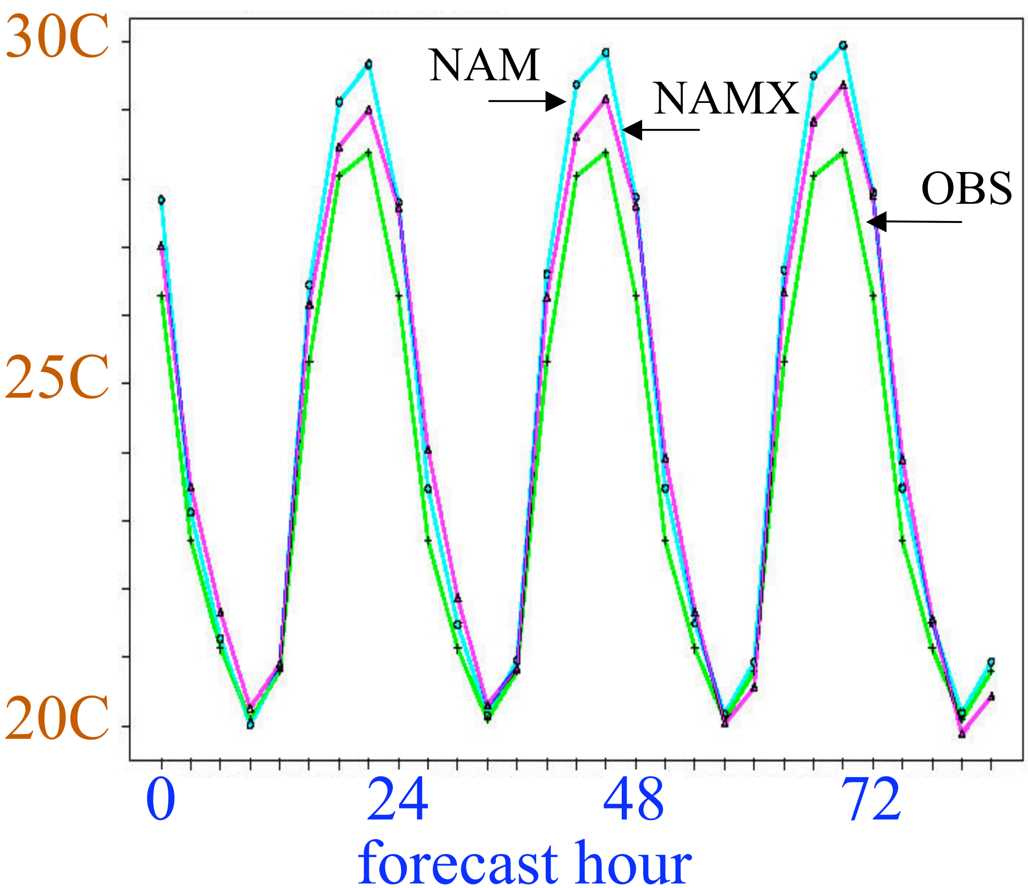




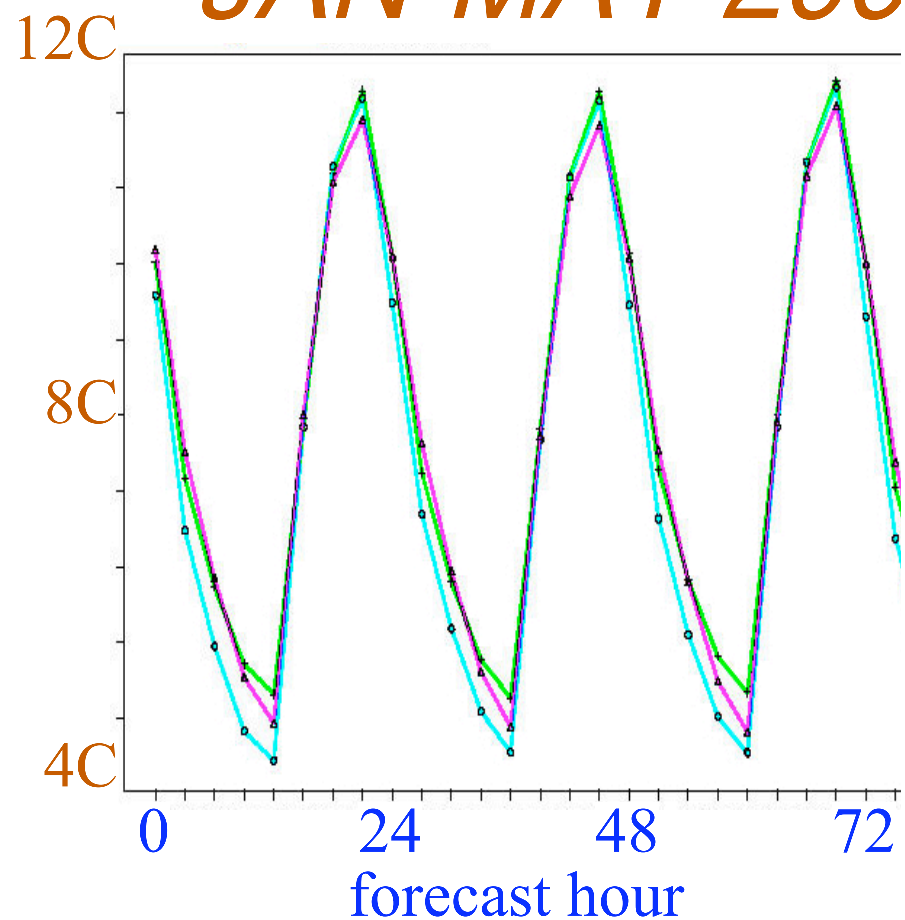
· NAMX: similar to NAM performance, with reduced daytime warm bias in summer.

eastern CONUS, 2-meter air tem

JUL-AUG 2005

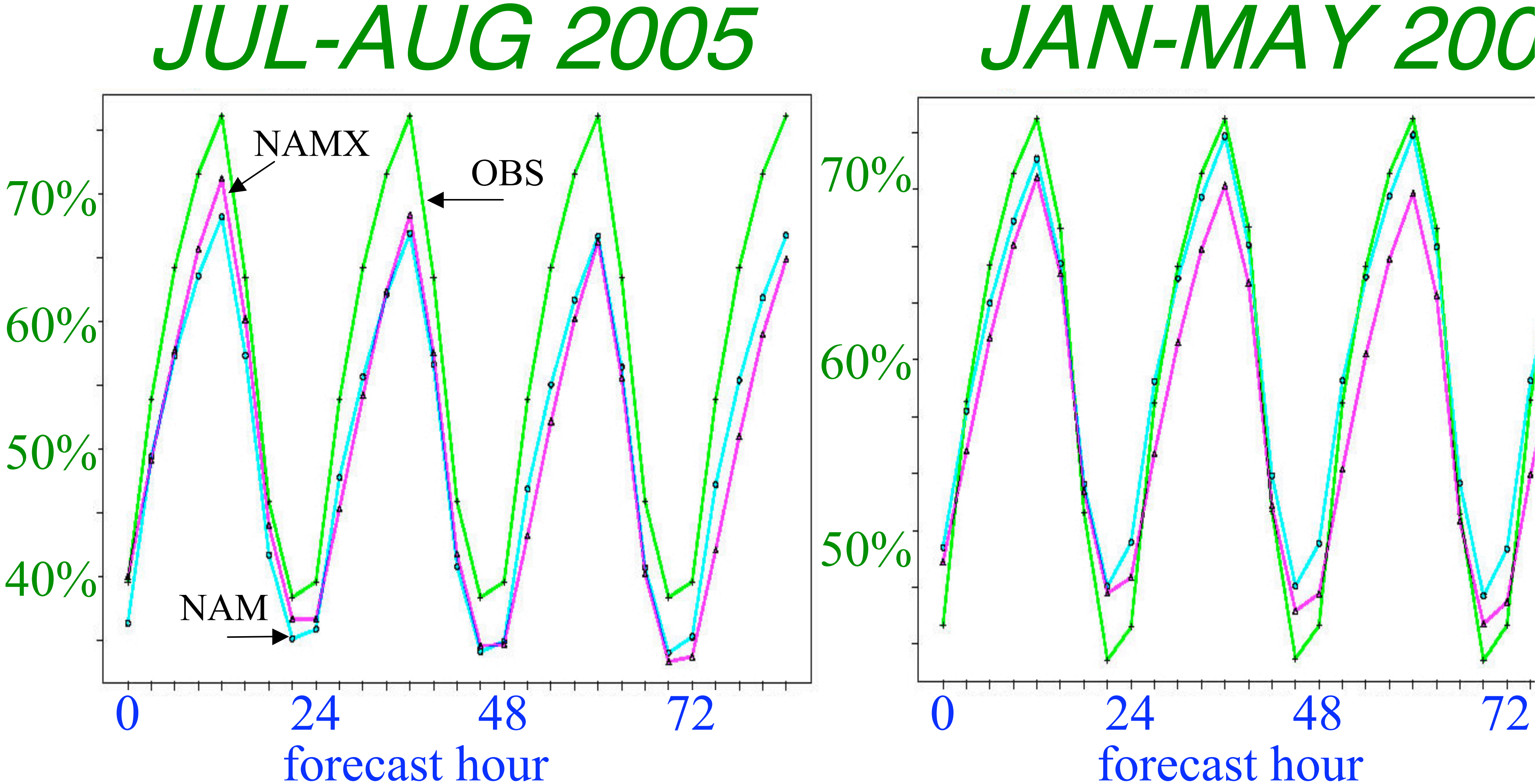


JAN-MAY 200



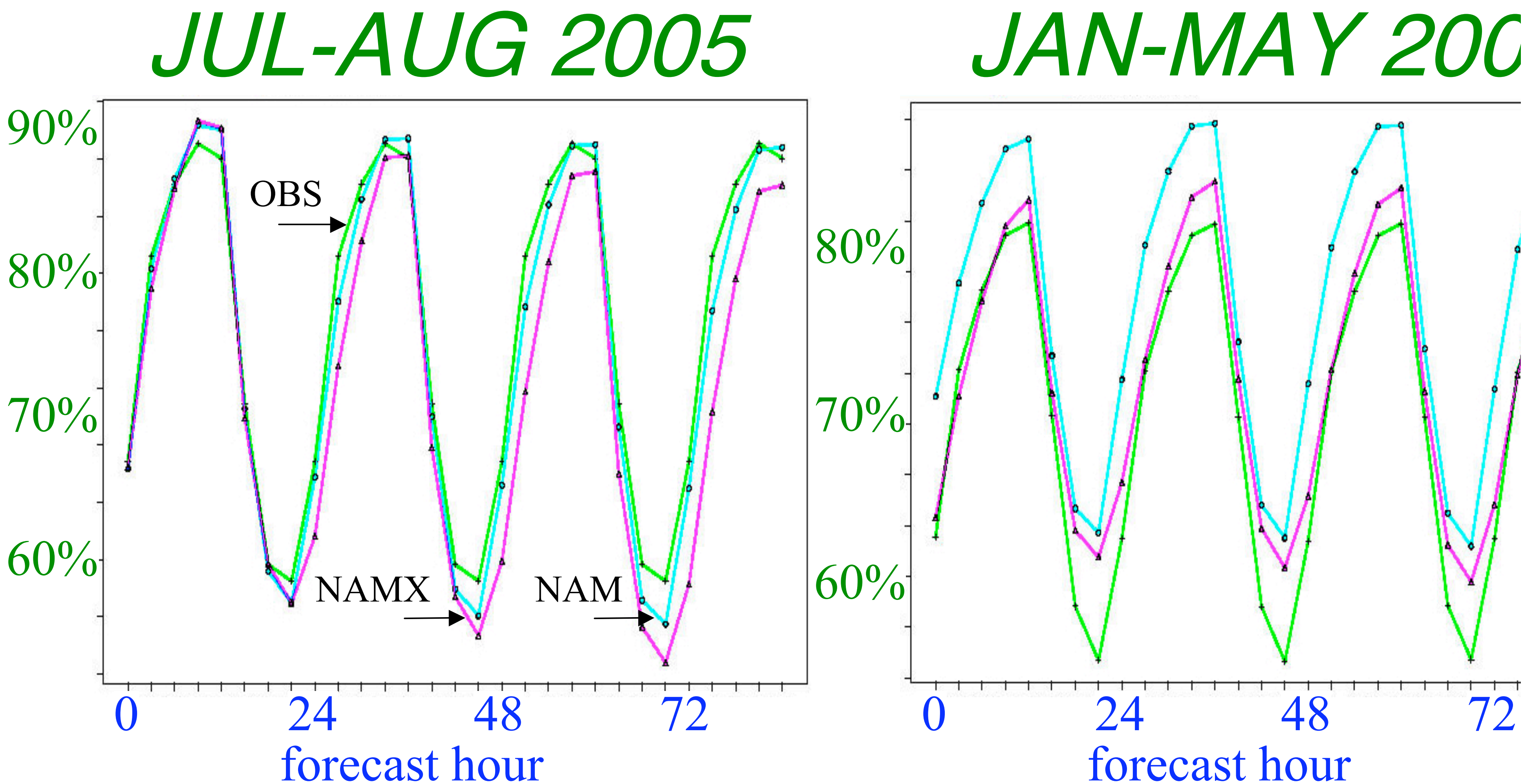
· NAMX: reduced daytime warm bias in summe
slightly reduced nighttime cool bias in cool seasc

western CONUS, 2-meter RH



· NAMX: similar to NAM, with nighttime dry bia
slightly reduced daytime moist bias in cool season

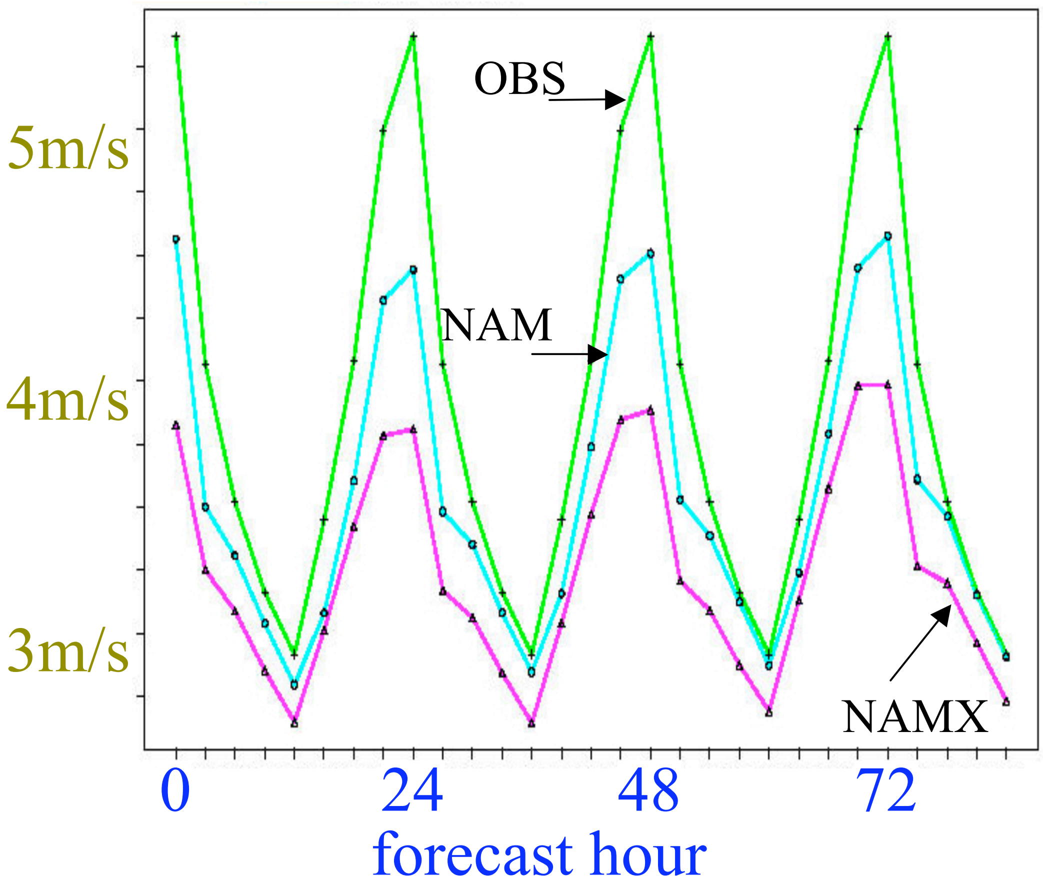
eastern CONUS, 2-meter RH



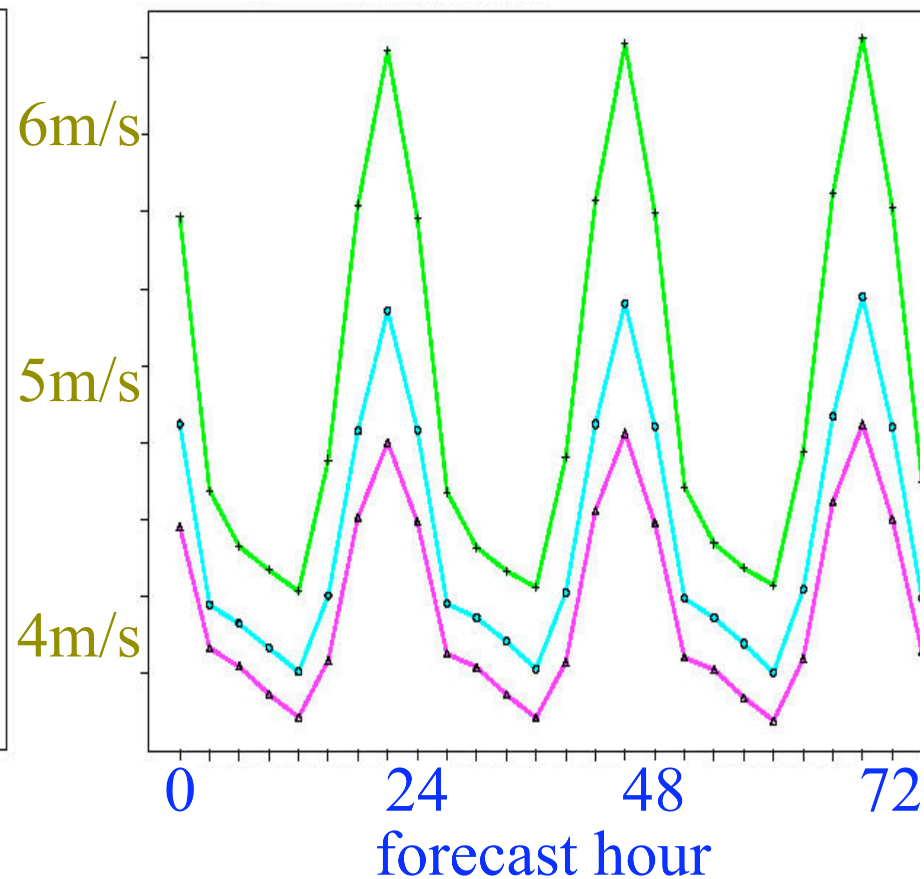
· NAMX: similar to NAM in warm season, with reduced day/night moist bias in cool season.

western CONUS, 10-meter win

JUL-AUG 2005

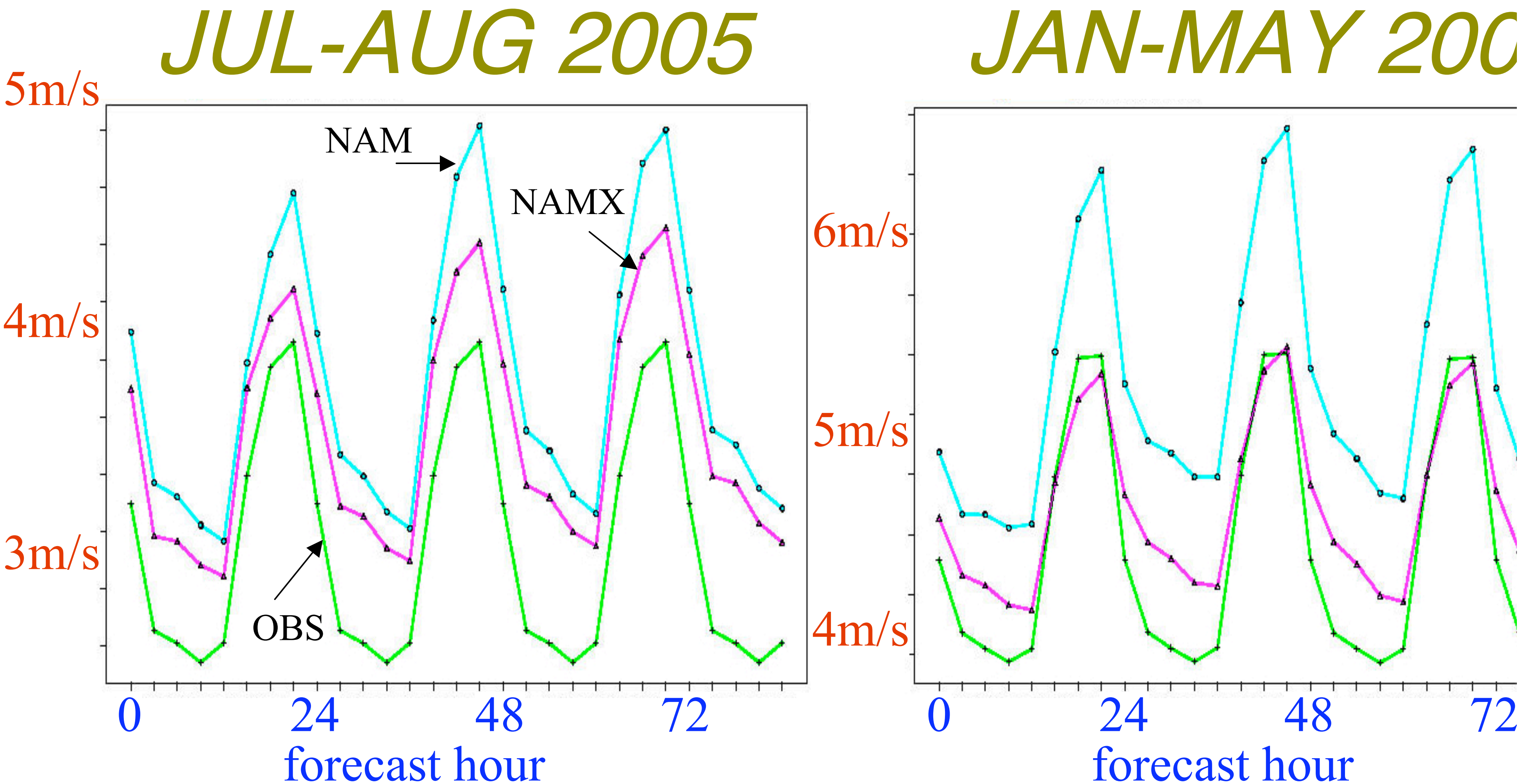


JAN-MAY 200



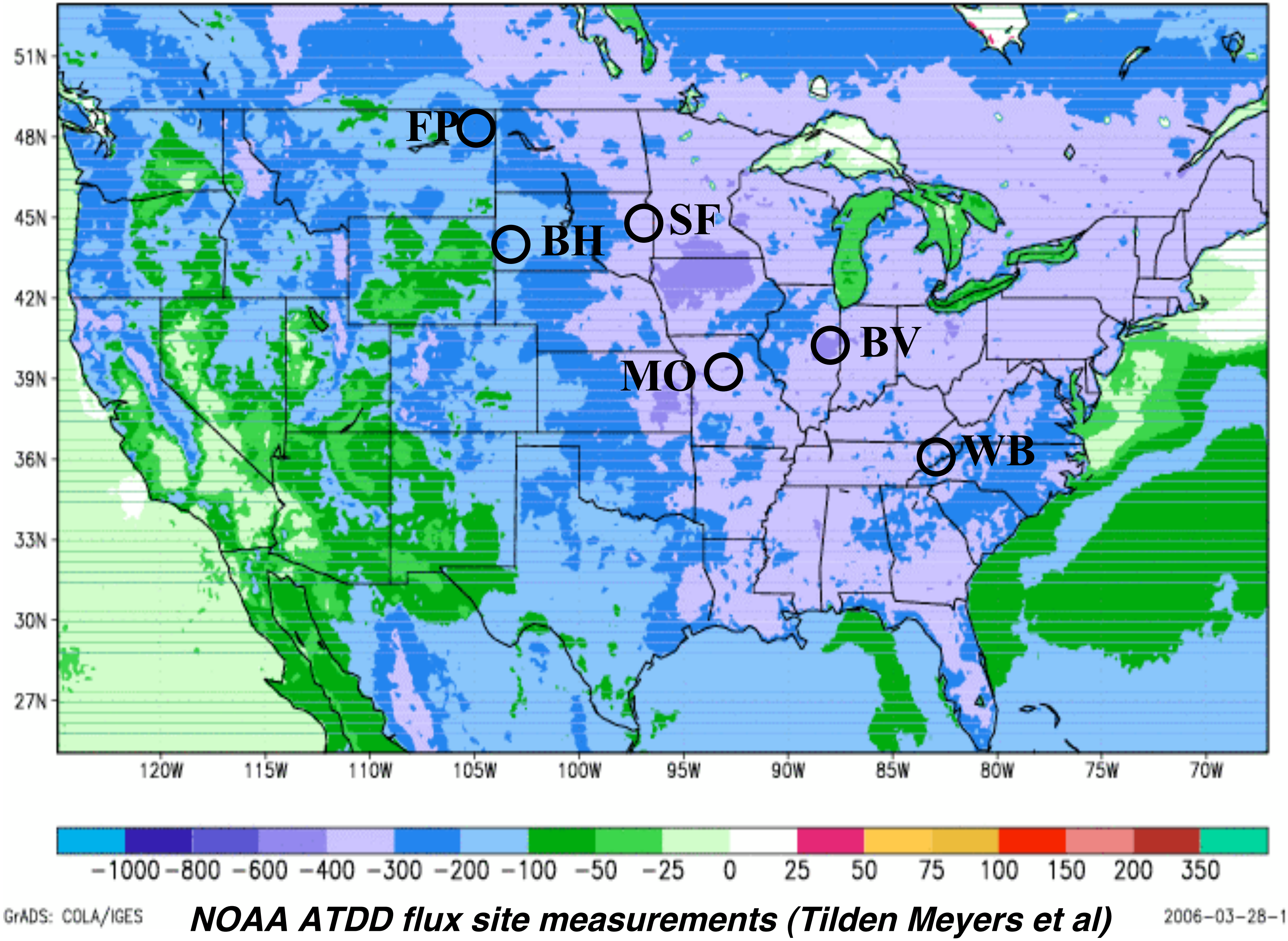
- NAMX: slightly more low bias than NAM

eastern CONUS, 10-meter winc



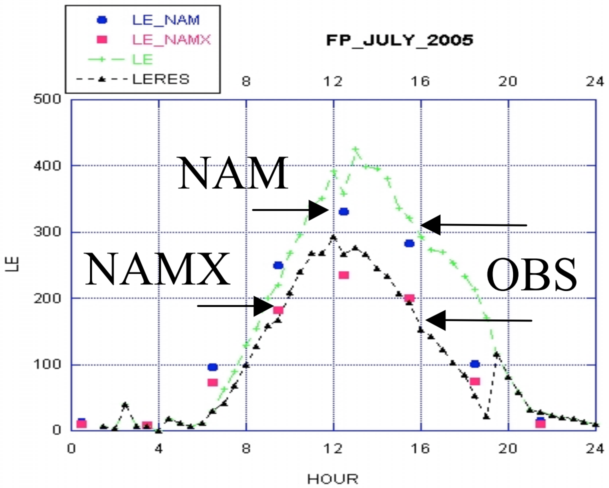
· NAMX: reduced high wind bias, especially co season daytime.

NAMX July 2005 monthly avg. mid-day latent heat f

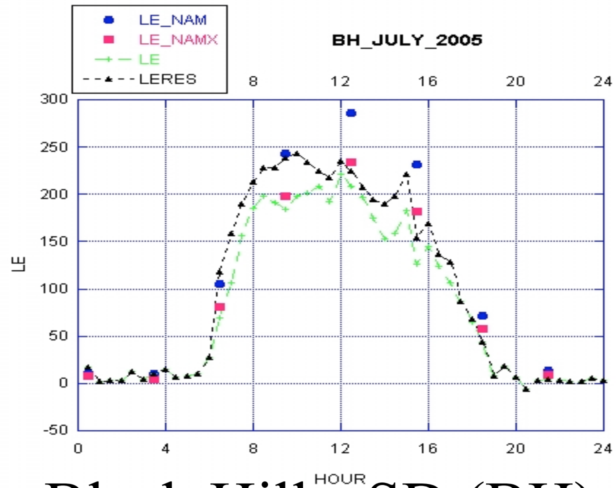


NOAA ATDD flux site measurements (Tilden Meyers et al)

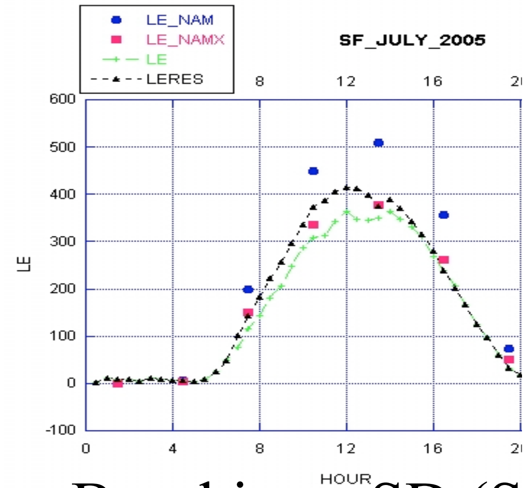
July 2005 mean diurnal avg. latent heat flux



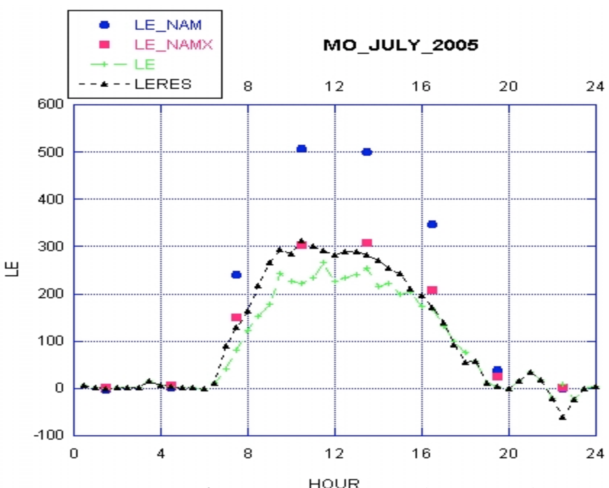
Ft. Peck, MT (FP)
grassland



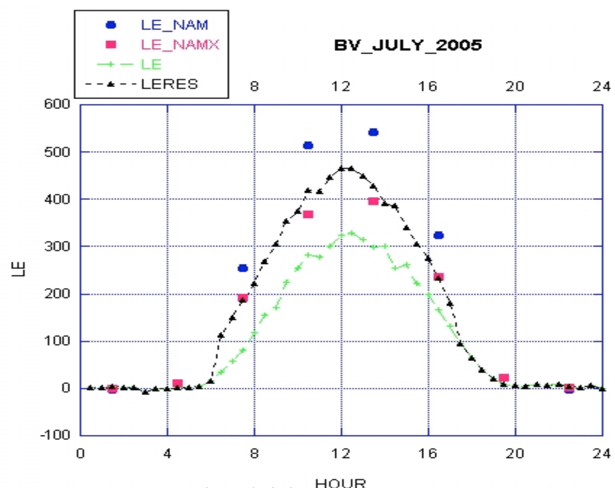
Black Hills, SD (BH)
ponderosa pine



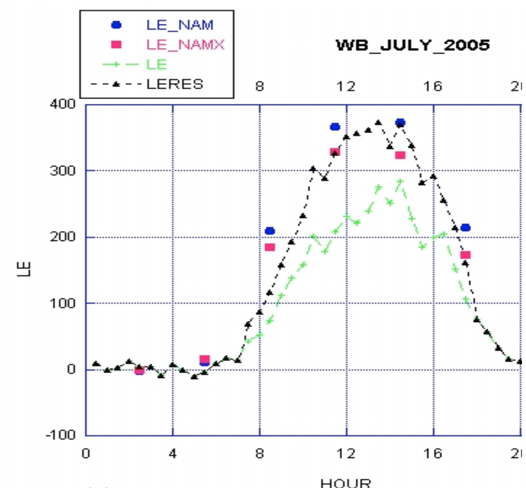
Brookings, SD (S
grassland



Ozarks, MO (MO)
deciduous forest



Bondville, IL (BV)
alernating crops



Walker Branch, NC (
deciduous fores

SUMMARY

· Realtime & retrospective parallel, and case study testing shows ***NAMX/WRF-NMM*** *performance generally similar/some cases better than* ***NAM/Et***

· WRF-NMM: *reduced summertime warm bias* (2-m temps), *similar/drier humidity* (2-m RH) (no Eta "glitch"), *lower 10-m winds* (better in east, bu slightly worse in west).

Alaska (not shown):
cool season: reduced cool, moist, low wind bias,
warm season: slightly degraded cool, moist, low wind bias.

· *Model fluxes compare favorably with flux site o*

FUTURE

Re-examine:

· Surface roughness (momentum flux/10-m wind
"digging" troughs).

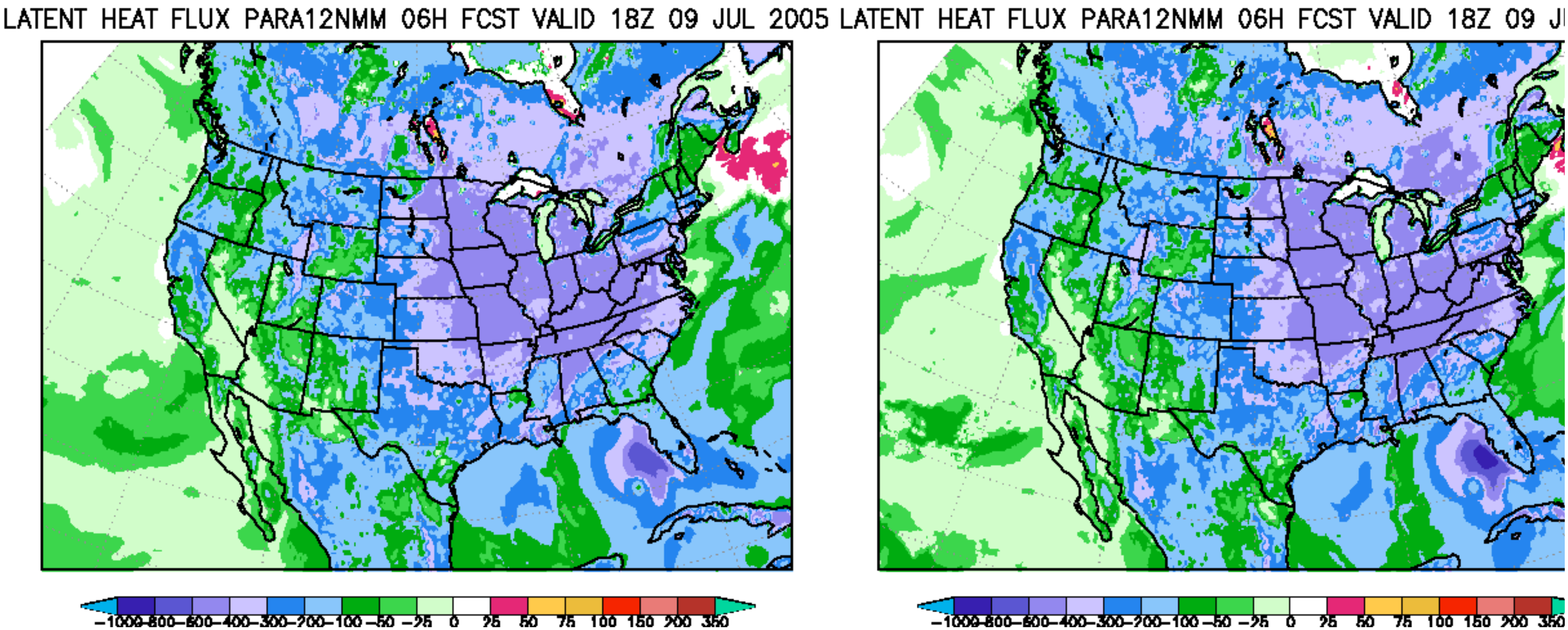
· Surface layer parameterization, radiation/surfac
emissivity (esp. cold season over snow, nighttim
surface fluxes in stable boundary layer).

· Shallow, cool, moist ABLs, e.g. Gulf Coast

· Transpiration processes/parameters

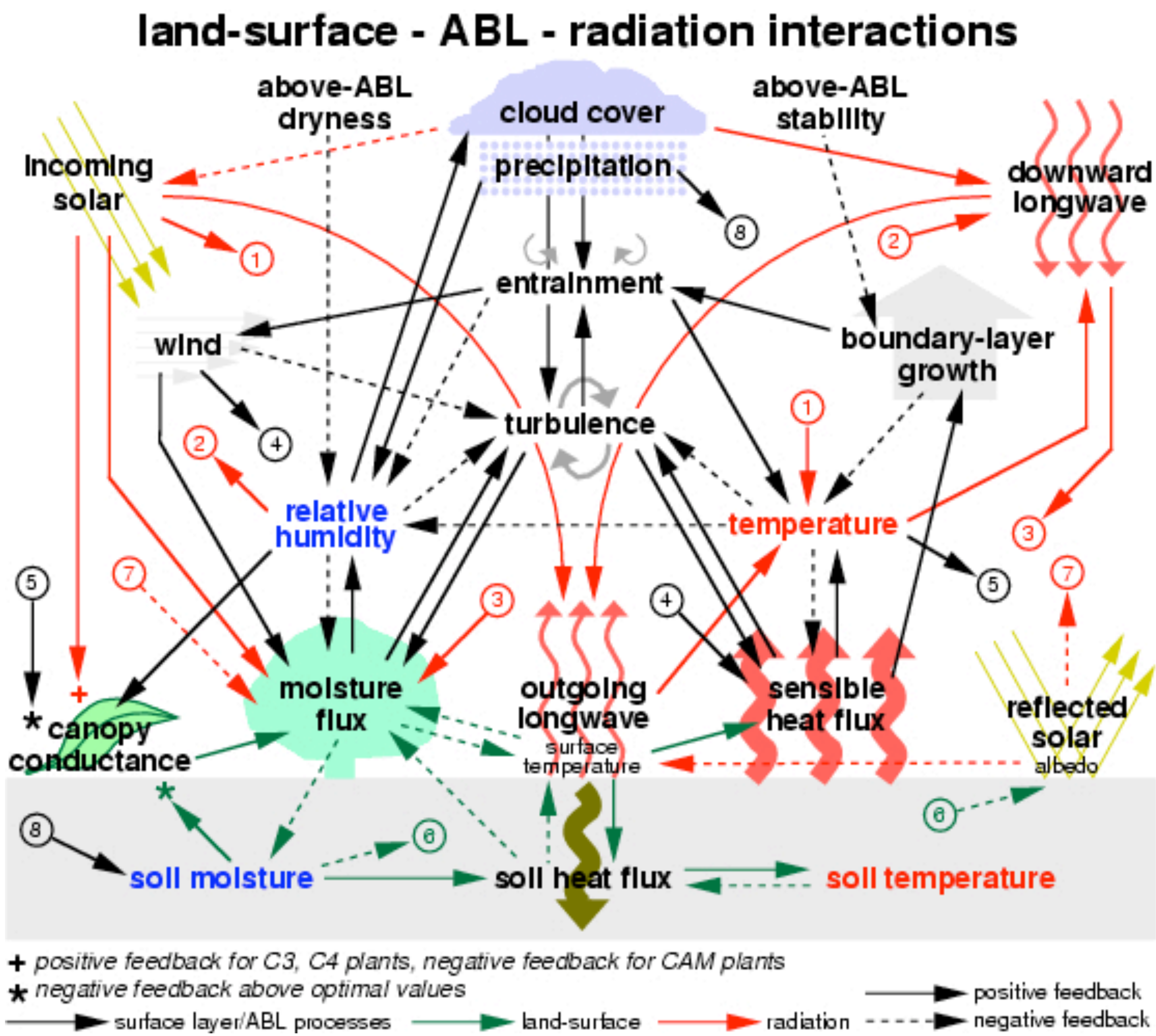
· Finish Noah LSM unification with NCAR, i.e.
WRF land opt 2, "unified" Noah LSM (next slid

Noah LSM unification



Noah LSM v2.7.1 *"unified" Noah LSM*

· Latent heat fluxes ***very*** similar using Noah LSM v2.7.1 vs WRF "unified" Noah LSM *in WRF-NM*
("WRF launcher" run valid mid-day 09-July-2005)



Model Physics "Web of Pain"