Land-Hydrology Modeling at NCEP

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Uncoupled Hydrology

North American Land Data Assimilation System (NLDAS)

Uncoupled land model simulations: Noah, VIC, Mosaic, SAC.

1/8-deg domain over continental US.

Common surface forcing from hourly North American Regional Reanalysis & disaggregated daily Gauge precipitation.

Output: surface flows & hydrological output such as soil moisture, snowpack, & runoff (1979-2008 retrospective mode, 15-year spinup, and 28-year model climatology for each model).

Uncoupled seasonal hydrological prediction mode uses VIC model driven by 3 sources for seasonal forecast of surface forcing; 20 ensemble members (Bayesian merging) used to generate 1-6 month ensemble seasonal prediction products.


NLDAS output used by NCEP/CPC for drought monitoring and seasonal prediction with NLDAS output provided to the National Integrated Drought Info. System (NIDIS, drought.gov).

NLDAS website: www.emc.ncep.noaa.gov/mmb/nldas

Current real-time monitoring
Seasonal forecasting

High-resolution hydrologic modeling

Hydrolimic Rainfall Analysis Project (HRAP) 5-km grid using upgraded SAC-HT/SNOW17.

Downscaled 20-30-60 km HRAP grid used in 30-year retrospective run over continental US (1979 to 2008), 2-step multi-year spin up.

Hydrological applications, including real-time river forecasts and flood monitoring.

Cooperative project with OHD; CPPA support.

Global Medium-Range

Global Forecast System (GFS): global forecast model T382L64 (~35 km resolution with 64 levels) runs to 16 days, with surface-layer/Noah LSM providing surface fluxes.

GFS assumes equal momentum & thermal roughness, resulting in large surface heat exchange coefficients & excess upward (downward) sensible heat flux for unstable (stable) conditions, leading to warm (cold) atmospheric (surface) temperature biases for unstable conditions (e.g. daytime) and the opposite case for stable conditions (e.g. night).

New momentum & thermal roughness (fct of GVF, via Univ. Arizona) addresses these biases with positive effect in GVF tests, e.g. reduced daytime atmospheric temperature warm bias.

Climate Model & Reanalysis

NCEP Climate Forecast System (CFS): seasonal forecasts using coupled land-atmos-ocean model (based on GFS/ocean models).

Land model physics upgraded from OSU to Noah in CFS.

Noah LSM runs offline using Global Land Data Assimilation System (GLDAS) under NASA Land Information System (LIS).

Combined use of Noah LSM with GLDAS initial conditions improves seasonal season CFS/Noah precipitation prediction over continental US, especially for ENSO-neutral years.

GLDAS/Noah/LIS infrastructure and coupled CFS/Noah implemented in CFS Reanalysis & Reforecast (CFSRR), with obs. forcings; 31-year CFSRR data set to be released 2011.

Land component research of CFS/CFSRR via CPPA support.

Data Assimilation

Gridpoint Statistical Interpolation (GSI) used in NCEP Global & Regional data assim.

Due to large daytime cold bias in land skin temperature (LST), most satellite data related surface sensitive channels rejected in the GSI.

New momentum & thermal roughness (fct of GVF) tests in GFS show greatly reduced arid region LST biasrier & substantially improved LST forecast.

New microwave emissivity model (NESDIS) tested to better SST results in reduced calculated brightness temperature cold bias (infrared & microwave satellite sensors), so more GSI satellite data use.

GEWEX Projects

GWEX/Glass/LoCo Determine "local" land-atmos. coupling metrics, e.g. role of soil moisture.