

NCEP/EMC NLDAS Support for Drought Monitoring and Seasonal Prediction

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The North American Land Data Assimilation System (NLDAS)-phase 2 is an extension of the multi-institution NLDAS-phase 1 pilot project (Mitchell et al 2004), and is a cooperative project with NASA/Goddard/HSB, Princeton University, University of Washington, NOAA/NWS Office of Hydrologic Development (OHD), and other researchers and NOAA CPO/CPA partners.

NLDAS consists of four land models executed in an uncoupled mode using atmospheric forcing to yield surface fluxes and evolving land states. The land models are run at 1/8th-degree resolution over the continental US, and include Noah (from NCEP), VIC (Princeton), Mosaic (NASA), and SAC (NWS OHD). The atmospheric forcing data comes from the real-time extension of the North American Regional Reanalysis based on the mesoscale NAM/Eta model from c. 2003 (Mesinger et al 2006), with GOES-based bias-corrected incoming solar radiation, and observed daily gauge precipitation disaggregated to hourly using radar-based estimates. NLDAS has been run from 1979 to present in a retrospective mode, including a 15-year spin-up, with a 30-year climatology available for each model; output includes surface fluxes and hydrological land-state variables such as soil moisture, snowpack, and runoff. Figure 1 shows variation of the correlation between observed and simulated monthly soil moisture anomaly with month and soil depth. Soil moisture is averaged over the 17 sites of Illinois State to calculate its anomaly and correlation. All models show high simulation skills for all seasons except for winter, particularly for late spring and early fall although Mosaic model has lower skills than the other models. Low simulation skills for four models are closely associated with inability of models in simulating frozen soil and snowmelt processes. High simulation skills are because there is strong relationship between monthly mean precipitation and soil moisture anomaly.

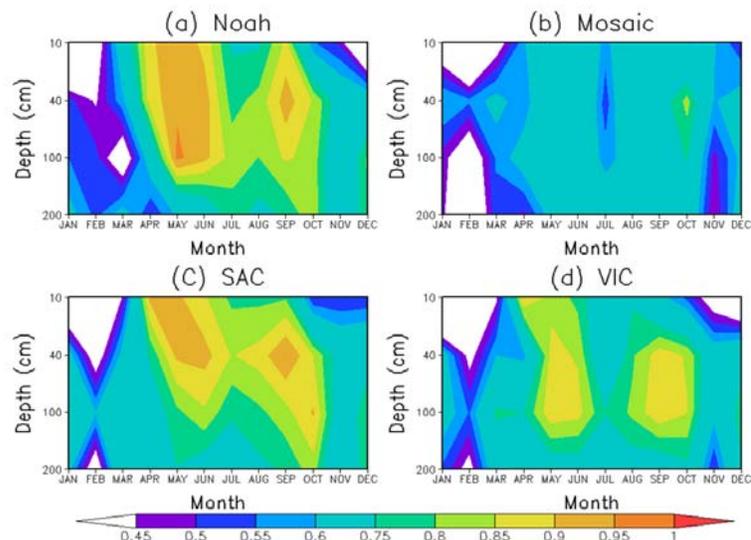


Fig. 1 Seasonal variation of the correlation between observed and simulated monthly soil moisture anomaly averaged over 17 Illinois sites using the four land surface models including (a) Noah, (b) Mosaic, (c) SAC, and (d) VIC for the period during 1985 and 2004 and four soil layers.

A companion uncoupled seasonal hydrological prediction system uses the VIC land model driven by seasonal forecasts from three sources for the required surface forcing: Ensemble Streamflow Prediction (ESP), NCEP Climate Prediction Center (CPC) Official Seasonal Outlook, and NCEP CFS ensemble dynamical model prediction. Twenty ensemble members (via a Bayesian-merging algorithm) are used to generate 1-6 month ensemble seasonal prediction products, e.g. soil moisture, runoff, streamflow, etc. Figure 2 shows ensemble-mean baseflow (part of streamflow) anomaly forecast for January-June 2010. The first two-month forecast shows very similar spatial patterns for all three approaches. From the third

month, three predictions display obvious differences. For example, CFS shows a negative anomaly, the CPC shows a positive anomaly, and the ESP shows an in-between result. In spite of the distinct differences among three predictions, similar variation tendencies can be found. Certainly, the quality of the products needs to be further evaluated by using USGS gauge streamflow measurement.

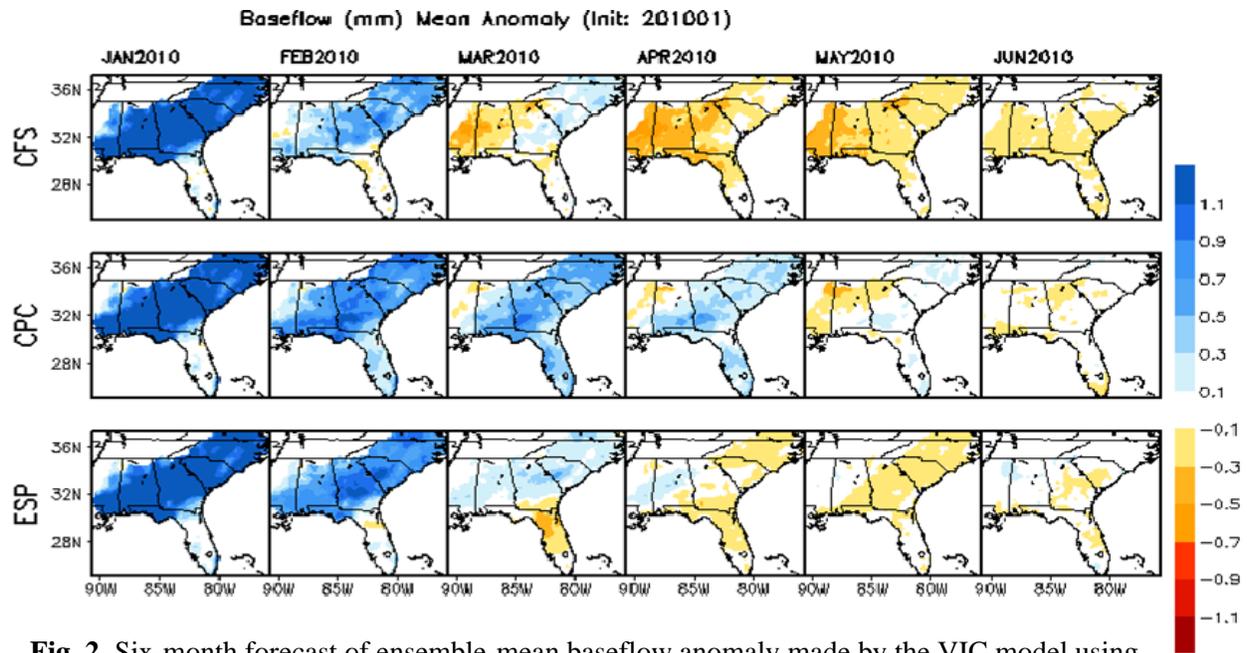


Fig. 2 Six-month forecast of ensemble-mean baseflow anomaly made by the VIC model using three surface forcing seasonal forecasts of the NCEP CFS ensemble dynamic model prediction (top), NCEP CPC Official Seasonal Outlook (middle), and Ensemble Streamflow Prediction (bottom).

The motivation for NLDAS-2 is to support drought monitoring and seasonal drought prediction at CPC, and for the National Integrated Drought Information System (NIDIS, drought.gov) by providing NLDAS multi-model analysis, monitoring, and seasonal prediction products. (See www.emc.ncep.noaa.gov/mmb/nldas.) NLDAS datasets include the forcing data, and output from the four models, staged on NCEP public servers: nomad6 for real-time runs, and ldas3 for retrospective (see: www.emc.ncep.noaa.gov/mmb/nldas/Download_Public_users.txt), and at the NASA Earth Science Data and Information Service Center (disc.sci.gsfc.nasa.gov/hydrology/data-holdings).

References

- Mesinger, F. and co-authors, 2006: North American Regional Reanalysis. *Bull. Amer. Meteorol. Soc.*, **87**(3), 343–360, DOI: 10.1175/BAMS-87-3-343.
- Mitchell K. E., and co-authors, 2004: The multi-institution North American Land Data Assimilation System (NLDAS): Utilizing multiple GCIP products and partners in a continental distributed hydrological modeling system. *J. Geophys. Res.*, **109**, D07S90, doi:10.1029/2003JD003823.