1. NLDAS History and Development – NLDAS Phase 1

a. Selection of Land Surface Models: Noah (version 2.7.1), Mosaic, SAC, VIC (version 4.0.3)
b. Establishment of NLDAS Framework: domain, spatial (1/8th degree) and temporal (hourly resolution), soil and vegetation parameters, and land-sea mask
d. Experiment Design and Data Selection: 3 water-years (Oct 1996 - Sep 1999) – the first year was used for spin-up period and the latter two years were used for analysis. The first phase of NLDAS was initiated in 2000 and completed in 2005 (Mitchell et al., 2004).

e. Noah Model Improvement: Noah model was upgraded to version 2.8 by enhancing its snow model to improve snowpack simulation during the winter (Lienhe et al., 2010) and by tuning model parameters and adding reasonable physical processes to improve water budget simulation during warm season (Figure 1.1; Wei et al., 2013).

Figure 1.1: (a) Partitioning of mean annual average monthly precipitation (shaded area) into mean annual average monthly rainfall and snowfall by snowfall (rms). (b) 50th and 95th percentiles for the period from 1 October 1997 to 30 September 1999. Observations from a given basin is calculated from 110+ subbasins and observed basin-actual discharge provided by the US Geological Survey. The same as (a) except for the ETEX.


2. Current NLDAS Operational and Research NLDAS-2 Systems

2a. Operational NLDAS-2 System: (1) models - Noah2.8, Mosaic, SAC, and VIC4.0.3; (2) covering period – 2 Jan 1979 to present; (3) 1/8th degree spatial and hourly temporal resolution; (4) near-realtime with a 3.5-day time lag; (5) comprehensive evaluation/validation for water fluxes (ET, Q), energy fluxes (SH, LH, G, H), and state variables (soil moisture and temperature, skin temperature, snowpack etc.); and (6) over 70 million files and 144 TB NLDAS-2 data are downloaded by about 5,000 distinct users in 2015. For more details about NLDAS product validation, please see http://ldas.gsfc.nasa.gov/nldas/NLDAS2valid.php and http://ldas.gsfc.nasa.gov/nldas/NLDASSpecifications.php.

2b. Current Research NLDAS-2 System: (1) improved models including Noah-I, SAC-Clim, and VIC4.0.5 except for Mosaic and the covering period is 2 Jan 1979 to Dec 2010.

Figure 2.1: (a) Comparison of NSE calculated from reference ET and model-simulated ET from the four models (Noah - thin red line, Mosaic - thick green line, SAC - thick blue line, VIC - thin orange line) and their ensemble mean (MME – thick yellow line) in the operational NLDAS-2 and the three upgraded models (Noah-I thick red line, SAC-Clim - thick blue line, VIC4.0.5 – thick orange line) in the research NLDAS-2. (b) is the same as (a) but for USGS observed and model-simulated Q (Xia et al., 2015, JGR-Am.)

3. NASA LIS-based NLDAS-2 System – Near Future

- Land Information System (LIS) based framework with updated land surface models (Noah-3.6, CLSNN-3.2, SAC-Clim-4.1, VIC-4.2.1, VIC-3.5)
- NCEP reanalysis and research systems to comprehensively document system improvement through model parameter, physical processes, and forcing via a joint effort between the two NLDAS teams of the NASA Hydrological Sciences Laboratory and the NCEP Environmental Modeling Center.

4. Future Unified NLDAS System

- Unified NCEP Land Data Assimilation System including NLDAS and GLDAS.
- Use NCEP/NAWM (North American Model) nested concept (CONUS/LDAS – 1-4 km; North American LDAS – 4-12 km; Globe -12-25 km).
- Perform real-time run with actual data assimilation process.
- Implement unified NLDAS Science and Evaluation/Validation testbed including tools, observed/reference datasets, physical process update, model parameter rationality, and forcing data improvement.
- Improve both monitoring/analysis mode and prediction/forecast mode in next generation NLDAS system.