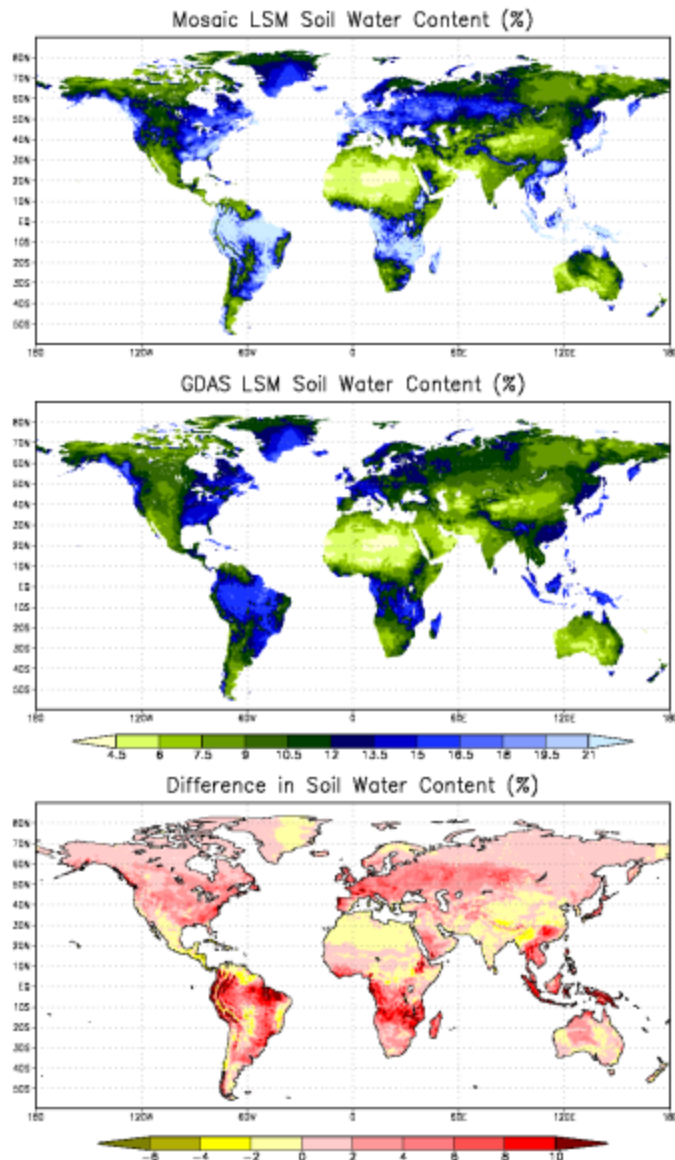


## GLOBAL LAND DATA ASSIMILATION SYSTEM

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*The panels compare volumetric water content (%) in the top meter of soil predicted by GLDAS, running Mosaic and forced with GDAS meteorology (top), to that predicted by the land model coupled to GDAS (middle), at 00Z on 31 March 2001. GLDAS was initialized with GDAS states, including soil moisture, on 1 March 2001. The predictions of soil moisture from the two systems display similar patterns, but the GLDAS field is more extreme, being wetter in locations such as Amazonia, south-central Africa, and western Europe, and dryer in regions such as south-central Asia and central America. The bottom panel shows the difference between the two predictions. The global average soil water content is 11.22% in the GLDAS field and 11.31% in the GDAS field, and so are very close, but clearly GLDAS allows for more variability.*

Accurate initialization of land surface moisture and energy stores is critical in weather and climate prediction because of their regulation of surface water and energy fluxes between the surface and atmosphere over a variety of time scales. Since these are integrated states, errors in land surface forcing and parameterization accumulate in land stores, leading to incorrect surface water and energy partitioning. However, many new land surface observations are becoming available that may provide additional information necessary to constrain the initialization of land surface states critical for weather and climate prediction. These constraints can be imposed in two ways. Firstly, by forcing the land surface primarily by observations (such as precipitation and radiation), the often severe atmospheric numerical weather prediction land surface forcing biases can be avoided. Secondly, by employing land surface data assimilation techniques, observations of land surface storages (soil temperature, soil moisture, and snow depth/cover) can be used to constrain unrealistic simulated storages.

Therefore, a high-resolution, near-real-time Global Land Data Assimilation Scheme (GLDAS) that uses relevant remotely-sensed and in-situ observations within a land data assimilation framework is being developed at NASA's Goddard Space Flight Center and NOAA's National Centers for Environmental Prediction (NCEP). This development will greatly increase our skill in land surface, weather, and climate prediction, as well as provide high-quality, global land surface *assimilated data fields* that are useful for subsequent research and applications. Analysis of the constant confrontation of model predictions with observations at various time and space scales provides an opportunity to improve our understanding and assessment of the space-time structure of land-atmosphere interaction, the relationship between model estimates and observations of land surface conditions, and the role of the land surface in regulating hydrologic and climatic variability.

GLDAS includes four components: (1) *Land Modeling*: The GLDAS driver is being developed in a modular fashion to facilitate the inclusion of multiple land surface models (LSMs), including Mosaic, the Common Land Model (CLM), and the National Oceanic and Atmospheric Administration's NOAH model. A runoff routing scheme will be implemented in the driver to permit runoff validation and the possible assimilation of lake/wetland/large river heights. (2) *Land Surface Observation*: NCEP operational global meteorological predictions will be the backbone of GLDAS forcing; however, to avoid known biases, these fields will be replaced (or corrected) by observations as available. Satellite remote sensing missions that will be used include Landsat TM, AVHRR, MODIS, ASTER, SSM/I, TRMM-TMI, AMSR, GRACE, and TOPEX/Poseidon. (3) *Land Surface Data Assimilation*: Data assimilation techniques merge a range of diverse data fields with a model prediction, to provide that model with the best estimate of the state of the natural environment, so that it can then produce more accurate predictions. A Kalman filter-based land assimilation strategy is being implemented for GLDAS. (4) *Calibration and Validation*: Because a number of land model states will be assimilated from observational data sets, the structure of the initialization scheme ensures their accurate reproduction. However, output will also be compared to independently-derived observations. Through the validation process, the quality of the land initialization will be evaluated, and, if necessary, appropriate changes to the model structure, forcing, or parameters will be instituted to increase the reliability of the initialization.

Currently, GLDAS is able to run at 1/4 degree resolution globally using atmospheric forcing fields from either of two general circulation models (GCMs): NASA's GEOS 3.24 GCM and NOAA's GDAS GCM. Drivers for two LSMs (Mosaic and CLM) have been developed, and at least three others are planned. Subgrid spatial variability is simulated using a tiling approach based on the quantitative distribution of vegetation types within each 1/4 degree land surface pixel. Users can designate the maximum number of tiles within a pixel and/or the minimum vegetative coverage required to define a tile. Globally varying soil properties are also being implemented.

Several potential sources of observation-derived forcing fields, such as precipitation based on remotely sensed infrared and microwave emissions and solar radiation based on cloud cover and/or visible and infrared satellite imagery, have been identified. We will replace modeled input fields with these observations, as available, in the near future.

After the development phase is complete, several studies will be performed, including an assessment of the impact of GLDAS reinitialization on the predictive capabilities of coupled land-atmosphere models, a comparison of offline versus coupled predictions, scaling and sensitivity investigations, and calibration/validation studies. GLDAS products will be made available in near-real time over the internet.

GLDAS is relevant to many international research programs. The land surface data produced by GLDAS will be valuable to Global Energy and Water Cycle Experiment (GEWEX) projects including the GEWEX Americas Prediction Project (GAPP), Climate Variability and Predictability (CLIVAR) projects such as the Global Ocean-Atmosphere-Land System (GOALS), and projects associated with the Coordinated Enhanced Observing Period (CEOP). GLDAS data will be used for regional climate analysis, model initialization, and comparison with results from field campaigns and modeling experiments.

For more information, please visit <http://ldas.gsfc.nasa.gov>.