Overview

The focus of this crosscutting integrated systems solutions project is to develop, demonstrate, and enable the use of land surface research tools to address multiple national application solutions. Knowledge of terrestrial water, energy, and carbon conditions are of critical importance to real-world applications such as agricultural production, water resource management, food, weather and climate prediction, hazard mitigation and mobility assessment. A huge volume of land surface states and fluxes are being observed on the ground or from space, including surface temperatures, vegetation conditions, snow states, albedo, longwave and solar radiation, precipitation, surface moisture, freeze/thaw state, runoff, total water storage, and elevation, among others. The need to interpret and transition these NASA land surface research results into decision support solutions has motivated the development of the Land Information System (LIS). LIS incorporates the following functionality to enable this transition: a high-resolution capable land data assimilation system, involving several independent community land models, land surface data assimilation technologies, and integrated database operations for observation and prediction data management; a web-based user interface that accesses data mining, numerical modeling, and visualization tools. LIS has been recognized by many partner agencies as a valuable tool for translating and interpreting NASA’s vast Earth observation resources into information useful for decision support. Therefore, this work is being conducted in response to requests by these partner agencies to prototype LIS solutions, demonstrate them in the partner’s operational environment, and characterize LIS performance. In addition, the data assimilation capability provided within LIS enables the optimization of NASA Earth science research results in partner decision support tools using Observing System Simulation Experiments (OSSEs).

Users and Tools

First, we identify the current and future observational systems (Table 1) that may guide the development of improved parameters, forcing, validation, and data assimilation constants for end-use solutions (Table 2). A huge volume of land surface observations may be operationally sensed from space, including surface temperatures, vegetation conditions, snow, albedo, longwave and solar radiation, precipitation, surface moisture, freeze/thaw state, runoff, total water storage, and elevation, among others.

Table 1. List of the primary data products generated from NASA’s terrestrial satellite observations

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Upper Air Meteorology</th>
<th>Forcings</th>
<th>Land Parameters</th>
<th>Land States</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODIS, NPOESS optical/IR</td>
<td>1–10 km weekly</td>
<td>MODIS, NPOESS optical/IR</td>
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Table 2. Example LIS relevance to crosscutting national priority applications.

- **Agricultural Efficiency**
  - Assessment and forecasting of water availability; irrigation requirements.
  - Prediction of weather/climate; estimation of crop yield and crop growth.
  - Prediction of weather/climate; mitigation of drought.
  - Rapid production of timely forecasts and warnings on flood inundation modeling, insurance coverage.

- **Disaster Management**
  - Assessment and forecasting of water availability; irrigation requirements.
  - Prediction of weather/climate; estimation of crop yield and crop growth.
  - Prediction of weather/climate; mitigation of drought.
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- **Water Management**
  - Assessment and forecasting of water availability; irrigation requirements.
  - Prediction of weather/climate; estimation of crop yield and crop growth.
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- **Ecological Forecasting**
  - Assessment and forecasting of water availability; irrigation requirements.
  - Prediction of weather/climate; estimation of crop yield and crop growth.
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- **Homeland Security**
  - Assessment and forecasting of water availability; irrigation requirements.
  - Prediction of weather/climate; estimation of crop yield and crop growth.
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- **Public Health**
  - Assessment and forecasting of water availability; irrigation requirements.
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- **Energy Management**
  - Assessment and forecasting of water availability; irrigation requirements.
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Progress

**NCEP Forecast Initialization**: LIS was used to generate land surface states to initialize NCEP’s eta model, which should lead to improved meteorological forecasts (Cosgrove and Alonje, 2005). Forecasts of surface and upper air meteorological fields, as well as precipitation, were validated against observations using NCEP’s Forecast Verification System (FVS), with the following conclusions:

- **Surface Forecasts**: Improved relative humidity and temperature. Mixed impact on wind speed forecasts.
- **MOIS snow cover data improved forecasts**
- **Upper Air Meteorology**: Mixed results
- **300mb temperature consistently improved**
- **Daily Precipitation**: Impact generally mixed & slight improvements in placement.

**Columbia River basin in Washington state**: Initial in situ observation and land surface model gridbox comparison for different soil and atmospheric variables.

**Snow Water Equivalent**

**US Bureau of Reclamation**: Integration of LIS land products into USBR river forecasting systems (such as land cover, snow, evapotranspiration, streamflow, soil moisture, etc.) is being used to improve water resource and Hydro-energy management.

Literature Cited


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More information

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