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A Prototype Land Information Sensor Web

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Project Abstract

This project will develop a prototype Land Information Sensor Web (**LISW**) by integrating the Land Information System (**LIS**) in a sensor web framework. It will allow for optimal 2-way information flow that enhances land surface modeling using sensor web observations, and in turn allows sensor web reconfiguration to minimize overall system uncertainty. Through continuous automatic calibration techniques and data assimilation methods, LIS will enable on-the-fly sensor web reconfiguration to optimize the changing needs of science and solutions. This prototype will be based on a simulated interactive sensor web, which is then used to exercise and optimize the sensor web - modeling interfaces. These synthetic experiments provide a controlled environment in which to examine the end-to-end performance of the prototype, the impact of various design sensor web design trade-offs and the eventual value of sensor webs for particular prediction or decision support. In addition to providing critical information for sensor web design considerations, this prototype would establish legacy for operational sensor web integration with modeling systems. Though the stand-alone LIS has achieved a TRL of 8, we determine our entry TRL to be 4 as other components are to be implemented and tested. This project will deliver an interoperable TRL 6 plug-and-play components based on LIS that enable data ingest and scientific analysis, the generation of new sensor web data products, connections to major spacecraft schedulers and task managers, metadata transformation and exchange, and data fusion techniques.

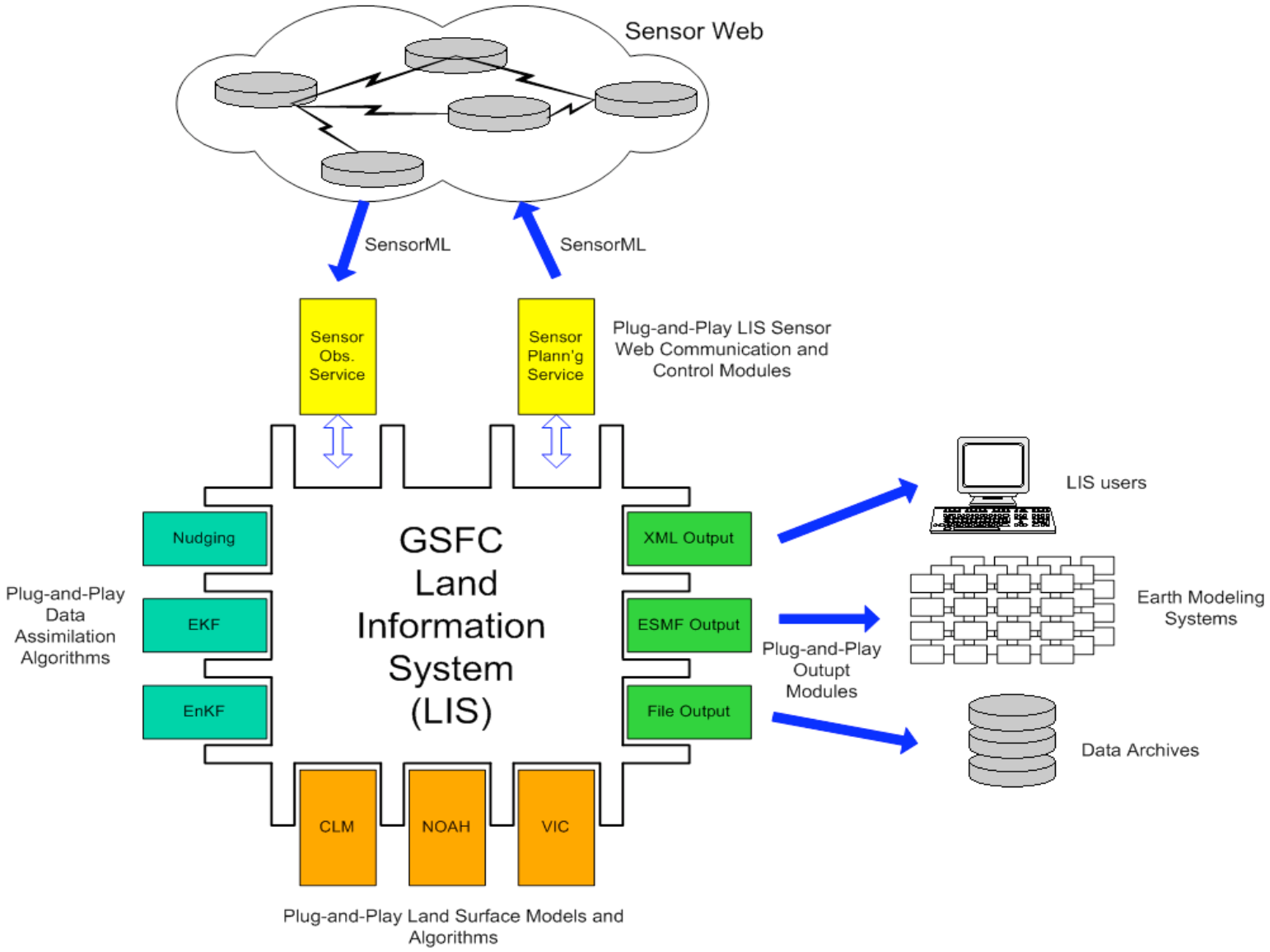

Figure 1. Enabling LIS to interact with sensor webs with open protocols and web services

Project goals and objectives

The overarching objective of this project is to develop a ***prototype Land Information Sensor Web (LISW) that will enable land model interactions in sensor webs by prototyping two-way interaction between the LIS land modeling and assimilation system and a reconfigurable sensor web framework that can minimize overall system uncertainty***. This work will be performed in three steps:

1. *Scenario development:* a synthetic global land "truth" will be established to approximate the real world, and will serve as the LISW development, evaluation and optimization environment.
2. Sensor simulation: a model of future land sensors will be established, which will include models of hypothetical in-situ, airborne and satellite sensors and realistic reconfiguration parameters.
3. *Sensor web framework:* a model of sensor web communication, reconfiguration and optimization will be developed.
4. Evaluation and optimization metrics: various land surface uncertainty, prediction and decision support metrics will be established as objectives to be optimized by the LISW.
5. LISW experiments: a number of experiments with this framework will be conducted to exercise and

evaluate the system.

6. Sensor web design implications: examine the impact of various sensor web design trade-offs and considerations to establish a legacy for operational sensor web integration with modeling systems.

Ultimately this LISW framework should establish the capacity to:

On-the-fly sensor web reconfiguration enabling optimal response to science and application needs.

Produce value-added sensor-web enabled products for distribution to the research community,

Integrate new kinds of data into Earth system modeling,

Evaluate various sensor web design and performance considerations,

Guide future sensor web development by establishing a legacy for sensor web-model integration.

The proposed LISW prototype will be based on an OSSE framework in which a simulated interactive sensor web is developed based on a LIS "nature run" and the projected characteristics of sensor web technology (emission models, orbital and sensor models, and reconfiguration options), which is then used to exercise and optimize the sensor web modeling interfaces. These synthetic experiments provide a controlled environment in which to examine the end-to-end performance of the prototype, and examine the impact of various design sensor web design trade-offs (e.g. orbital considerations, resolution, and accuracy requirements) and the eventual value of sensor webs for particular prediction or decision support application. This framework will result in an integrated land modeling sensor web tool with the following qualities:

Quantification of sensor web and model uncertainties and errors.

Reduced response time (over uncoupled sensors) for rapidly changing events.

Increased scientific value, quantity or quality of the observation and simulation results.

A planning and scheduling function to optimize sensor web deployment.

Ability to use sensor web observations in decision support systems.

Interactively linking groups of sensors to data assimilation and prediction models for improved science research and analysis.

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