Sensor Webs in Digital Earth

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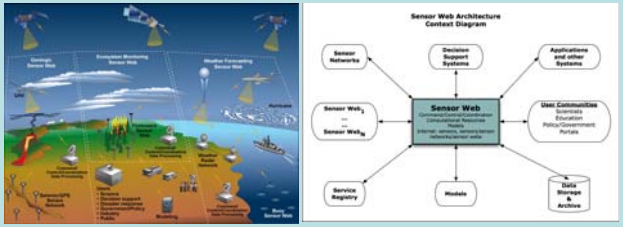
Sensor Web



"A sensor web is a coherent set of heterogeneous, loosely-coupled, distributed nodes, interconnected by a communications fabric that can collectively behave as a single dynamically adaptive and reconfigurable observing system. The Nodes in a sensor web interoperate with common standards and services. Sensor webs can be layered or linked together." (NASA AIST, 2007)

The critical difference between a sensor web and a sensor network is the communication between nodes and autonomous reconfiguration of the heterogeneous nodes.

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Digital Earth

NOAA Science on a Sphere

NOAA Second Life

Digital Earth is a virtual representation of the planet, encompassing all its systems and forms, including human societies, manifested as a multi-dimensional, multi-scale, multi-temporal, and multi-layer information facility. The Digital Earth vision incorporates a digital-formatted Earth, as a functional interfacing metaphor, whereby a corresponding virtual body of knowledge of the real Earth and its digital representation for understanding the oneness of the Earth and its relevant phenomena. (http://www.isde5.org/ISocDE.htm)

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Conclusions

Sensor webs represent the next technological step in environmental monitoring of both long-term climate trends and transient events.

Incorporating sensor web and digital earth technologies improves scientific studies, educational efforts, and public outreach all associated with climate change.

Integrating Sensor Webs and Digital Earth improve the capabilities and potential of both technologies.

Sensor Web management, analysis, and data dissemination is enhanced by using a Digital Earth platform.

The Digital Earth is enhanced by a sensor web through the robust, dynamic data representative of real-time state of the environment.

Science Motivation

1

Long term monitoring of the Juneau Icefield to observe watershed and ocean ecological impacts of glacial recession

50 km

2

Lake pre-drainage

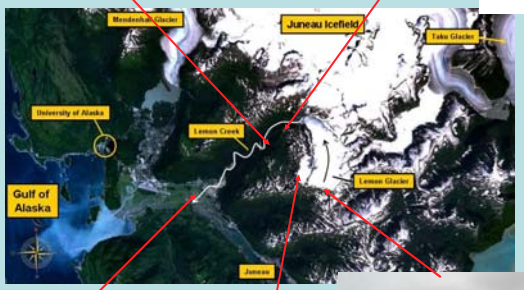
Lake post-drainage

Detection of transient glacial lake outburst floods and observation for watershed impacts

http://seamonsterak.com/

Southeast Alaska

Lemon Creek Watershed

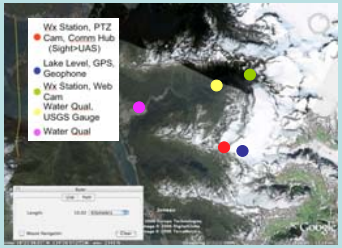


SEAMONSTER

SEAMONSTER is the SouthEast Alaska MOnitoring Network for Science Telecommunications Education and Research. It is a project to implement a Sensor Web in Southeast Alaska. After the first year of the project, the instrumentation is primarily meteorological or hydrological. Long-term monitoring coupled with detailed analysis of transient events motivates the use of sensor web technology.

Sensor Web

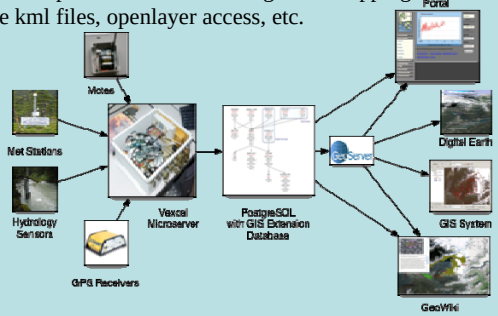
The SEAMONSTER sensor web uses software agents (an ongoing collaboration with Lockheed-Martin and Vanderbilt University) to provide resource brokering among science defined tasks. Resource scarcity includes power, bandwidth, storage, and processing.



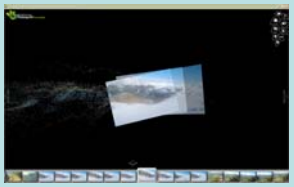
Communication between the sensor nodes enables the Sensor Web.
Ex: A pressure transducer detects lake drainage, passes message reconfiguring other sensor behavior.

Digital Earth

Using Open Geospatial Consortium (OGC) standards we currently implement several components of the digital earth concept.
Using a PostGIS database driving GeoServer software, many OGC protocols are provided. We are using Web Mapping Services to generate kml files, openlayer access, etc.



Additionally, we are making use of Photosynth collections in our georeferenced Digital Earth environment.



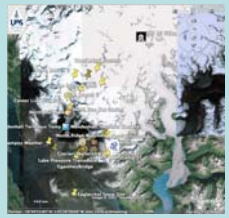
SEAMONSTER:

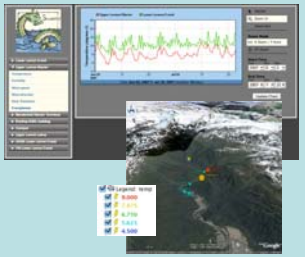
Sensor Web in Digital Earth

Three main uses of Digital Earth concepts integration with Sensor Web technologies have been identified and used to date.

Sensor Web Management

With a large number of heterogeneous sensors, identifying missing or invalid sensors or communication links underperforming is best done graphically in a digital earth environment. At right, we can easily see the Mendenhall Terminus Camera is not reporting.





Data Access

For science users, both those knowledgeable of the sensors and external investigators with little *a priori* knowledge, a spatially navigable data portal is invaluable. The screen shots at left show data portal and data analysis views.

Education/Public Outreach

Described in poster ED11A, we make use of a postGIS engine for mediawiki to enable a geowiki integrated with the SEAMONSTER data access to provide educational descriptions of the watershed

Future Work

Increase use of OGC standards such as SensorML
Expand spatial coverage of sensor web.
Incorporate “discovered” and external data sources.

Acknowledgments

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