GLEON 10
Cool Things Oral Presentations

1. A Cross-GLEON Cyanobacterial Analysis: Network Synergy and Serendipity
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At GLEON 9, I proposed a cross-site analysis of the ecosystem effects of cyanobacterial blooms, soliciting plankton samples and historical data from GLEON lakes around the world that experience yearly blooms. The response from GLEON members was overwhelmingly positive, and 14 lakes in 9 countries are participating in my project. The focal lakes are on a trophic gradient from oligotrophic to hypertrophic, and I hypothesize that blooms stimulate phytoplankton and zooplankton in oligotrophic systems, and inhibit plankton food webs in more eutrophic systems. This project was recently funded by an NSF Doctoral Dissertation Improvement Grant, and sampling is already underway. In addition to the scientific contribution of this work, this project also incorporates a number of outreach activities, including the training of a Chinese masters student at Lake Taihu and teaching Lake Sunapee homeowners limnological sampling methods.

2. Web Service for Korean Lake Ecological Observatory Network
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Limnologists and ecologists need data acquisition to understand lake ecology, data management, and data analysis tools to estimate the ecological health assessment of lakes and reservoirs.

KISTI (Korea Institute of Science and Technology Information) and KNU (Kangwon National University) are constructing a web site to share the observations as KLEON (Korean Lake Ecological Observatory Network), which has a goal to support lake ecological research, ecosystem education, and environment preservation policy.

KISTI is supporting IT parts such as the ecological data retrieval module, the sensor management module, and Google earth based user interface.

1) Ecological data retrieval module

-Summarization of the observation and the content in the ecological research sites such as LTER, GLEON

2) Sensor management
-Status and history of sensors with the sensorML

3) Google earth based user interface
-Data presentation with statistical methods

KNU, which undertakes the ecological research, is constructing the sensor network in 7 lakes/reservoirs/swamp, designing the water quality modeling, and building the web site.

1) Construction of Sensor Network (ecological data collection)
from Lake (Soyang, Uiam), Swamp Upo, River (Han, Anyang, Soyang, Gapyeong)
-Measurement: water temperature, EC, DO, pH, Turbidity

2) Water quality modeling
-Utilization of CE-QUAL-W2

3) Building Web service
-The observation management and the membership management

With the international cooperation with the GLEON, KEON, this project will support the development of environment/ecology research with data accumulation & the improved modeling. Besides, the result will be useful for the environment preservation policy and teaching resource.

3. Distilling Free-Form Ecological Theory Using High Frequency Data

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Traditionally, ecology research has been conducted using spot sampling or small scale experiments. The advent of autonomous sensors coupled with advanced cyber infrastructure has facilitated a change in the nature of ecology where the field is rapidly becoming a data rich enterprise (Rundel et al. 2009). Simultaneously, recent advances in computer science have facilitated the automation of the discovery of natural laws (Schmidt and Lipson 2009). Coupling of these advances represents a rapid advancement for understanding our complex natural world. Using high frequency GLEON (Global Lake Ecological Observatory Network) data and automation software distributed across multiple servers, I show how these technologies can both test current theories as well as produce new theories from ecological data that were previously unidentified.

1. Rundel et al. 2009. Environmental sensor networks in ecological research. New Phytologist 182: 589-607
2. Schmidt and Lipson 2009. Distilling Free-Form Natural Laws from Experimental Data Science 324: 81-85

4. Hyperspectral Airbourne Survey and Spectrofluorometer field support in Lakes, Wetlands and Reservoirs, Chile

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Among environmental issues, eutrophication and algae blooms became a major problem for water bodies in the central and coastal regions in Chile. The understanding of aquatic ecosystems and their process has leaded us to evaluate the use of spectral analysis in lakes, wetlands and reservoirs. The spectral sensors provide the chance to measure and map the continuous distribution of algae and suspended solids in a highly spatial detail, and getting results in a very short time due to the few laboratory analysis required. The ability of getting information of water quality and algae almost in real-time also provides the opportunity of being more proactive with water management measures.

Not long ago our group has acquired the equipment necessary for taking the spectral analysis in Chile to a new level, using a Hyperspectral Airborne Sensor VNIR-range (AISA Eagle Specim Imaging) and a Submersible Spectrofluorometer (Fluoroprobe BBE Moldaenke) with automatic algae class and chlorophyll analysis able to identify functional groups as green algae, blue-green algae, diatoms and cryptophytes.

These spectral equipments have been used, among others, in three different aquatic systems: 1) Aculeo lake used for recreation purposes, 2) Rapel reservoir for hydropower generation and tourism, and 3) Conchalí wetland lagoon, it is a bird-watching protected RAMSAR site. All of them in Central Region of Chile, between the latitudes 31.8ºS and 34.4ºS.

Results have shown an adequate correlation between field and aerial spectral data, allowing outputs of detailed maps of chlorophyll and suspended solids. In some cases other parameters have also been measured in the field as CTD casts, conductivity, dissolved oxygen and nutrients. Thermistor chains and a meteorological station have been installed in Rapel reservoir in order to provide a temporal evolution and physical/hydrodynamic linking.

5. Taking Calibration and Drift Characteristics from a Qualitative to a Quantitative Science

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What if sensor manufacturers published, along with accuracy, precision, and range, quantitative and comparable indices of drift characteristics? We present here a few simple quantitative metrics of sensor drift. These metrics, if adopted, could be used to easily compare and contrast different available sensors, to quantitatively predict sensor drift, to better select sensor types for certain deployment types, and to monitor for cleaning and calibration frequency across a range of environments. Having rigorously defined methods to classify and predict sensor drift would: one, add creditability and confidence in sensor-

derived data, two, simplify choosing sensors for specific scientific applications, and three, remove much of the ambiguity currently in sensor calibration methods.

6. Routine Use of GEO Science Infrastructure in PRAGMA

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Satellite data imagery is widely utilized to study the Earth's surface. The high-spatial resolution images are indispensable to study land surface, inland water, atmosphere and coastal areas in regional scales, but they cannot be freely accessible unlike low-resolution imagery. Our aim is to build a framework and infrastructure for sharing various data such as satellite data, in-situ observation data, geology maps, etc. with appropriate access control for sensitive data.

PRAGMA GEO Science Working Group has started routine-use of PRAGMA GEO Science Infrastructure which provides services for accessing satellite data including ASTER provided by AIST, Japan, and Formosat-2 provided by NSPO, Taiwan. Since these data sets are not freely accessible, appropriate security by authentication and authorization is required.

In this demonstration, we show how GEO Science Infrastructure in PRAGMA is used. In order to make appropriate access control for sensitive data, users must be registered in GEO Group in PRAGMA VO. The user registration process and background security framework will be demonstrated. Then, we will show that PRAGMA VO members can easily find and retrieve satellite imagery provided by AIST and NSPO. Sample application which utilizes in-situ data from GLEON and satellite data will also be demonstrated. We discuss possible collaboration with GLEON.

7. **A Tribute to Sir Hubert Wilkins (1888-1958)**

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It is cool to do modern science with fancy instruments, software and gadgets. However, it is also really cool to learn about our forefathers who were pioneers and made massive advances in discovery and exploration. Sir Hubert Wilkins is one such individual, however he is relatively unknown alongside other greats such as Mawson, Byrd, Shackleton, Scott and Amundsen.

Sir Hubert Wilkins was born in Mt Bryan, a dry town in the Mid-north of South Australia. The Wilkins farm was north of Goyder's line, a boundary marked by the

Surveyor general, Goyder, indicating the line above which rainfall was less than 250mm annually. The sharp rainfall gradient meant that the Wilkins farm received less than two-thirds of their neighbours annual rainfall just half an hour horse ride away. Wilkins' experiences of tragic drought and hardship in this climate prompted him to question *" why should it not be possible to learn of the laws which govern the movement of the atmosphere, the conditions that bring about the seasonal rains and drought? ... it occurred to me, as it must have to others that while it might not be possible for man, with his limitations, to control the weather, it might be possible to learn something of its movements."*

Wilkins became one of the pioneers of aviation and moving pictures but these were only tools for him to solve the mysteries of the weather. *"I was not inclined to devote my time to local meteorological work… there were many engaged in that, but few apparently who were looking at the subject from a global view."*

This motivation is not so different from the motivation of GLEON but it prompted Wilkins into a life of exploration, particularly of the Polar Regions, as he believed that by understanding the poles you could understand global weather patterns.

Wilkins' achievements are outstanding

1913-1916 Arctic exploration returning to Point Barrow Alaska to discover the world had been at war for two years

1917-1918 War photographer on the Western front with Frank Hurley just returned from the epic adventure with Shackleton on the *Endurance.* Wilkins was awarded the Military Cross for rescuing wounded soldiers. Australian General Monash described him as "the bravest man I have ever seen"

1919 England to Australia Air Race; their plane crashed in Crete

1921-1922 Wilkins joined Shackleton on an Antarctic expedition. Wilkins went onto South Georgia to photograph flora and fauna but unfortunately Shackleton died on the way to join him

1924-1925 Wilkins worked for the British Museum of Natural History collecting specimens from Outback Australia and the Torres Strait Islands

1926-1928 Wilkins flew a Fokker from Point Barrow Alaska across the Arctic Sea to Spitsbergen, Norway. This was the first such plane flight. Wilkins earnt the Patrons Medal of the Royal Geographical Society, the Morse Medal of the American Geographical Society and a knighthood from the King of England

1928-1929 Wilkins took a plane to Antarctica hoping to find a runway on Deception Island long enough to launch and fly over the South Pole. This was not possible but it was the first time unchartered land was mapped by plane

1929 Wilkins was invited onto the Graf Zeppellin as it attempted the first world flight. Wilkins joined the trip to make a photographic record of the historic circum-navigation

1931 Wilkins made an unsuccessful attempt to reach the North Pole in the Submarine *Nautilus*

1932-1939 Wilkins organised three expeditions to Antarctica to assist Lincoln Ellesworth become the first person to fly across the Antarctic continent. Wilkins also called on the lead search for missing Russian aviators

1939-1958 Wilkins retained by US Army to train soldiers in Arctic survival skills.

Wilkins died in Massachusetts on 30 November 1958. On 17 March 1959 the US nuclear submarine Skate became the first submarine to surface at the North Pole. A memorial service was held for Wilkins and his ashes scattered.

Wilkins was an amazing adventurer who opened up frontiers for science to continue exploration. His fascination for meteorology led to many polar expeditions and he was a pioneer in aviation. Global research such as we do in GLEON owes a gratitude to explorers such as Wilkins because they have paved a path for us to follow.