

Science Questions from CDI Key Collaborators
Additions to proposal submitted to U.S. NSF, May 2009
2009 May 20th

Distilled List

Transformative science questions that this proposal will enable

1. *Do climate cycles and other large-scale drivers produce synchronous variability in lake C processing across broad regions?*
2. *How does land use affect ecosystem processes in lakes, and the resilience of ecosystem processes to episodic disturbances?*
3. *Can we project abrupt changes in lake variables by using early warning indicators from sensor data?*
4. *What are the critical thresholds for lake ecosystems in providing ecological services in the context of climate change and other environmental stressors, and how can automatic sensors can provide us such an information?*

Full list

Human–lake and lake–human connections

1. *What are the critical thresholds for lake ecosystems in providing ecological services in the context of climate change and other environmental stressors, and how the automatic sensors can provide us such an information?* (Lauri Arvola, Finland)
2. *Is variance in emergent properties greater in lakes in developed watersheds? If so, (1) does this affect the ability to detect signals of drivers operating on large spatial scales, (2) are variance patterns consistent across temporal scales of resolution (can the magnitude of high-resolution variability be dependent on the magnitude of low-resolution variability)?* (Evelyn Gaiser, Florida)
3. *Is variance detected by buoys related to the frequency of unstructured data reporting?* (Evelyn Gaiser, Florida)
4. *Does the recognition of services lakes provide (measured by degree of use?) explain the degree of connection between buoy data and unstructured data?* (Evelyn Gaiser, Florida)
5. *Do differences in landuse (urban subcatchments vs forest) affect the resilience (ie. the time needed to recover from episodic disturbances) of the systems (measured as DO, water level ect)?* (Peter Staehr, Denmark)

Complex systems, regime shifts, ecosystem services

1. *What are the mechanisms behind high noise to signal ratios and can that ratio be used as an indicator for the inertia (resilience) of the system (can we learn from other disciplines, i.e. signal processing in computer science?* (Thorsten Blenckner, Sweden)
2. *Can we project abrupt changes in lake variables by using early warning indicators (senso Carpenter & Brock 2006, Guttal et al 2008), Biggs et al 2009), Kleinen et al 2003, Dakos et al 2008)?* (Thorsten Blenckner, Sweden)
3. *Ecosystem restoration can be considered large-scaled experiments, some are successful and others failed. Can we detect any early signals of and hence predict a successful restoration?* (Zhengwen Liu, China)

Watershed – lake connections and C processing

1. *Can we quantify metabolism at the catchment scale?* (Peter Staehr, Denmark)
2. *Can a network of lakes be used to detect change at the landscape scale?* (David Motta Marques, Brazil)
3. *To which extent is outgassing of CO₂ determined by episodic events?* (Peter Staehr, Denmark)

Physical-biological coupling

1. *How fast does lake metabolism respond to hydrodynamics driver?* (David Motta Marques, Brazil)
2. *How are external signals (e.g. extreme weather events) manifest in lake variables in terms of response patterns?* (Thorsten Blenckner, Sweden)
3. *How well does a single measurement in the middle of the lake characterize whole-ecosystem metabolism?* (Peter Staehr, Denmark)

Improvements in doing science

1. *Can we optimize investigations of episodic and developing events by adjusting sensor network sampling?* (Peter Staehr, Denmark)
2. *Can we learn more on the major physical, chemical and biological processes under ice in winter by using automatic sensors?* (Lauri Arvola, Finland)
3. *Can we automate ground-truthing of spatially resolved satellite data with GLEON buoy data, to provide real-time synoptic observations of temperature, chlorophyll and water clarity across a large number of lakes encompassed within the satellite path?* (David Hamilton, New Zealand)
4. *Can we use ground-truthed satellite data (e.g., from the previous question) to test for coherence through time in the spatial distributions of chlorophyll amongst the lakes within the satellite path?* (David Hamilton, New Zealand)

Modeling Mechanics (perhaps merge with previous)

1. *Can we adapt time scales of models to time scales of GLEON buoy measurements to greatly increase the capacity to adequately calibrate and validate these highly spatially and temporally resolved models?* (David Hamilton, New Zealand)
2. *Can we correct for solar quenching of chlorophyll fluorescence – the process by which phytoplankton adapt to excess irradiance by reducing their photosynthetic responsiveness (via photosystem 2) – which is commonly observed in daytime surface fluorescence readings from GLEON buoy data?* (David Hamilton, New Zealand)