

# Lakes as Climate Sentinels WG

5-7 Nov 2013 meetings

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# G15 Deliverables

- Group name and participants
- Projects/products
  - Including potential *Inland Waters* special issue paper(s); feedback sought from WG
- Timeline for making progress

# Climate Sentinel Topics & Projects\*

- Lake transparency response to glacier melting (Balseiro, Velez, Perga)
- Changes in size, lake level, salinity (& biota), and DOC arid climates (potential leaders, De los Rios, Bohn, Hargreaves)
- Lake DOC concentration and qualities and transparency in response to land cover, e.g. changes in treeline and human land use, (potential leaders, Modenutti, Hargreaves)
- Lake anoxia increasing or more sensitive to climate with global warming and resultant changes in phosphorus and productivity (potential leaders, Perga, Velez)
- \*Small lake temperature metrics to serve as climate change signals (Pilla et al., ms in prep; Williamson plans to engage project members for larger set of lakes when ms is finished)
- \*Longterm trained analysis in lake ice seasons using the Simple Ice model (Samal et al, paper 1 to submit by Dec2013, #2 by Aug 2014)
- \*”Lakes as sensors in the landscape: Optical sentinels of climate change”, manuscript (Williamson et al, submitted to L&O Oct 2013).

# Lake transparency response to glacier melting (potential leaders, Balseiro, Velez)

- Other lakes? Austrian lakes (Sommaruga)
- Likely timeline a bell curve (increasing, then decreasing)
- Value in collecting new data and comparing with historic data and future data.
- Suggestion to use sediment cores to analyze seasonal varves for glacial flour loading; compare to holocene data. First phase is trial exam of Canadian lake (Mud Lake) where samples exist to be analyzed.
- Revisit Lakes as climate sentinels to consider better/new groupings
- Timetable:
  - Identify members and confirm leadership, Dec 2013
  - Ms. By Dec 2014

# Changes in size, lake level, salinity (& biota), and DOC of lakes in arid climates

(potential leaders, De los Rios, Bohn, Hargreaves)

- Changes in size, lake level, salinity (& biota), and DOC (esp. in closed basin lakes) in arid climates, including high latitudes and regions with mountain “rain shadows”. Remote sensing important because of difficult/dangerous access)
  - Colhue Huapi now gone (evaporation or perhaps withdrawal/diversion?)
  - Natron (E. Africa, saline lake that is shrinking)
  - Lakes in Arg. Pampas will be more variable over decades
  - Mar Chiquita (N. Cordova, AR)—closed basin lake with variable area
- Lake level change in paleo record vs Land use change & land cover in paleo record
- Revisit Lakes as climate sentinels to consider better/new groupings
- Timetable:
  - identify members and confirm leadership, Dec 2013
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## Lake DOC concentration and qualities and transparency in response to land cover (potential leaders, Modenutti, Hargreaves)

- Lake DOC concentration and qualities and transparency in response to land cover (e.g. changes in treeline and human land use, and shift from lake DOC to terrestrial DOC as tree line goes up)
  - Microbial community changing (functional response with shift from protein-like DOC to complex humics)
  - Clear lakes good?
  - Revisit Lakes as climate sentinels to consider better/new groupings
- Timetable:
  - identify members and confirm leadership, Dec 2013
  - Ms. By Dec 2014

# Lake anoxia as a climate change sentinel (potential leaders, Perga, Velez)

- Lake anoxia increasing or more sensitive to climate with global warming and resultant changes in phosphorus and productivity (e.g. Lake Geneva, using of sediment paleo record, driver=flood frequency and land use changes)
- Drivers?
  - Increased stability of meromictic Lake Tanganyika
  - Temperature and metabolism (P vs R response to T)
  - Light penetration depth changing?
  - Episodic event: flood frequency and drought f and summer or winter kills
- Consequences anoxia
  - P release
  - Metals (Hg?)
  - Eutrophication and more biomass loading
  - Aerobic habitat changing; benthic habitat aerobic area
  - Light penet. Changes benthic habitat for autotrophs.
  - Food web changes (+ or -; e.g. mixotrophic algae eating anearobic bacteria)
  - Effects hypoxia important?
  - Effects of anoxic sediments where water is not anoxic
- Revisit Lakes as climate sentinels to consider better/new groupings
- Timetable:
  - identify members and confirm leadership, Dec 2013
  - Ms. By Dec 2014

Longterm trained analysis in lake ice seasons using the Simple Ice model  
(Samal et al, paper 1 to submit by Dec2013, #2 by Aug 2014)  
(Nihar Samal)

- To do by Dec. 2013:
  - Load all remaining lake data for N=21 lakes
  - Run additional lakes through model (local calibration factor)
  - Run regressions for calibration factor versus lake traits to search for a parameter that can adjust calibration factors making model more generally useful
  - Submit ms #1, Dec 2013
- To do in Jan-Jul 2014:
  - Add adjustment for snow cover, estimated from available precipitation and temperature data
  - Rerun all lakes to adjust model calibration and adjustment factor for snow cover
  - Explore gridded climate data to assess errors relative to weather data distance from lake
  - Explore relative errors in ice-on date versus ice-off dates with each lake region.
  - Compare Simple Ice Model with other models (e.g. GLM)
- Aug 2014: Complete manuscript #2 and submit
- Future work:
  - explore remote sensing for more lakes to compare
  - Compare model results using local or gridded weather data with NSIDC database of ice on and ice off dates.



## Small lake temperature metrics to serve as climate change signals (Craig Williamson)

- How long is the data set? What sensor accuracy is needed.
  - Toolik lake
  - Two PA lakes
  - Lake Mendota (WI)
- Effects of lake size
- Effects wind, evaporation, turbulence or mixing stress
- Complication of vertical stratification and response to CDOM or algal blooms.
- Revisit Lakes as climate sentinels to consider better/new groupings
- Timetable (existing project):
  - Ms #1 in preparation by Pilla et al for two lakes in USA (Pilla et al), by Dec 2013?
  - Ms #2: Larger data set from project members will be sought after first ms is finished--By Dec 2014

# General advice for new topics

- Some topics (e.g. measuring “glacial flour” in sediment cores) are really research questions and need a different approach from projects that are primarily analysis of existing data.
- Several topics have been “done” in some form at other locations. All the new topics need rigorous literature review in order to become projects that make a new contribution to science. This should include thorough research in the older literature and research from other geographic areas.

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