GLEON Storm-Blitz: An Update from the GEISHA Group on the Links Among Storms, Lake Physics, and Phytoplankton Community Dynamics

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General Objectives

- Lake physical, chemical and biological states can rapidly respond to pulses of storm energy and run-off (e.g., Fig 1)
- GEISHA formed within GLEON Project Storm-Blitz; works at multiple organizational levels (Fig 2) to:
  1. Link storm-induced changes in lake conditions to phyto-plankton traits via system attributes (Fig 3) across lakes (Fig 4)
  2. Identify mechanisms that lead to altered phytoplankton assemblages or community resilience
  3. Develop new frameworks to explore theoretical questions on species diversity and succession in lake ecosystems

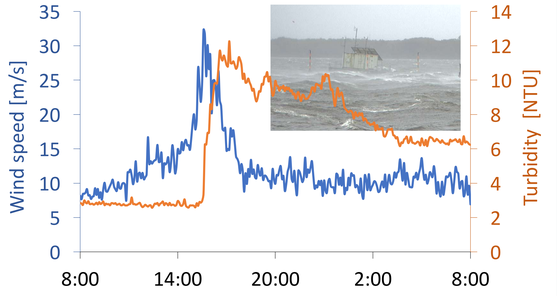
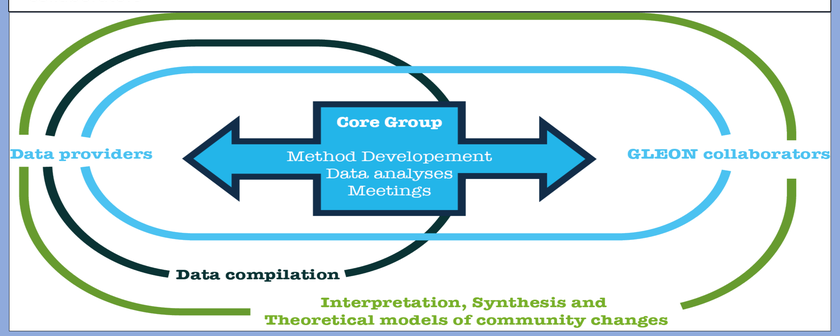


Fig 1 (right) Winds from Storm Xavier increased turbidity over several hours in Müggelsee, Germany, on 5 October 2017

Fig 2 (below) GEISHA consists of core group of 17 participants interacting with data providers and GLEON Storm-Blitz collaborators



Objectives within Core Group

- *Physics Group* – evaluate correlations between weather and water column stability using high- and low-frequency data to identify events with potential to alter phytoplankton habitat
- *Biology Group* – assess changes in phytoplankton at multiple levels of taxonomic and functional organization (e.g., genera, morpho-functional groups (MFG)) across various thresholds of "storm events"

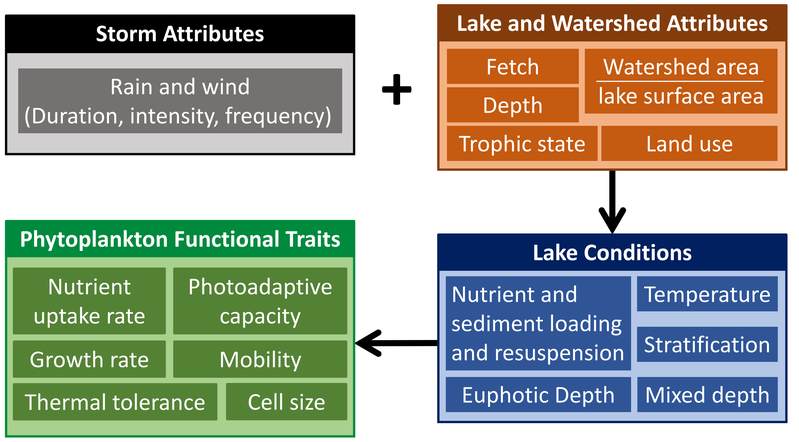


Fig 3 Conceptual model of how storm, lake, and watershed attributes combine to alter physical and chemical conditions of lakes, and the broad functional traits of phytoplankton likely to be important in phytoplankton responses to storm-induced disturbances

Global Data Set

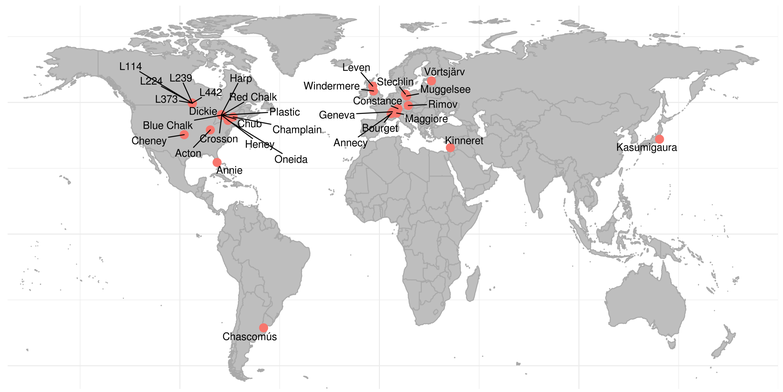


Fig 4 A total of 32 lakes with weather, water column, and phytoplankton data have been or are expected to be provided for GEISHA; we continue to look for data from South America, Africa, Asia, and Oceania

Preliminary Example Results (Rimov Reservoir, 2007)

- Drop in colonist group (C-strategists) with increased stratification, then an increase in stress-tolerant groups (S-strategists) during the summer (Fig 5C-D)
- Large rain event, with little wind, completely mixed water column on 5-6 September (Fig 5A-C)
- Initial drop in S group and increase in C-R group coincident with this large rain and de-stratification event was followed by a decline in all functional groups after the passage of the storm (Fig 5D-E)

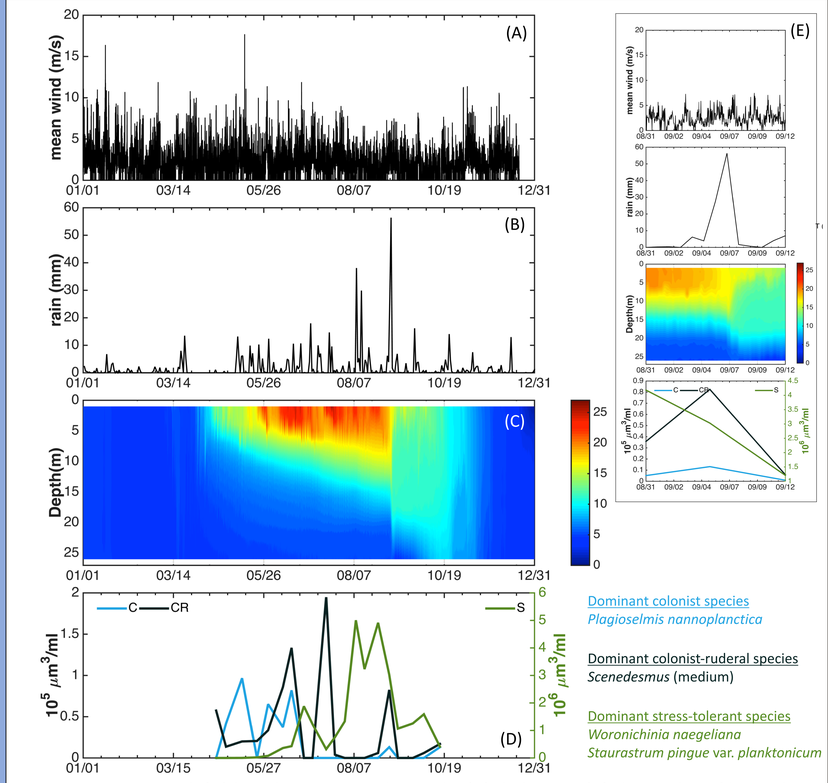


Fig 5 Time series of: (A) hourly mean wind speeds; (B) daily rain; (C) thermal profile; and (D) C-S-R (colonist, stress-tolerant, and ruderal) phytoplankton group biovolumes at Rimov Reservoir, Czechia, in 2007. (E) Zoom on the rain event of 5-6 September 2007.

Next Steps

- Develop R package tools to (1) assign MFG and C-S-R groups to species lists, and (2) explore storm thresholds based on weather, water column stability, and their rates of change
- Evaluate weather-water column stability relationships at different scales (hourly, daily, bi-weekly) and lake typologies
- Summarize seasonal trend in phytoplankton community structure across gradient of lake typologies, and identify dates of potential phytoplankton "storm" (abrupt departure from seasonal trend)
- Evaluate short-term mixing dynamics on diversity and functionality

Acknowledgements

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