Comparison of Modeled vs. Measured Dry Deposition of Nitrogen and Phosphorus

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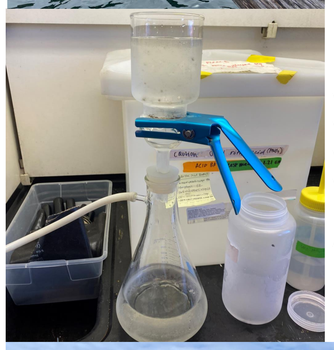
Introduction

- Dry deposition is not regularly measured, estimates of dry deposition using computer modeling have been done but studies comparing regional modeled estimates to collected dry deposition have found that modeled estimates had one-fourth of the actual dry deposition rates measured (Tipping et al. 2014).
- Dry Deposition is particulate matter from the atmosphere. This includes dust, dirt, soot, or simply dry solids.
  - Atmospheric inputs of phosphorus come from dust, ash, and biological sources and Nitrogen enters the lake predominantly through the atmosphere and deposition (Tipping et al. 2014).
- Excess nitrogen and phosphorus inputs from anthropogenic sources lead to harmful algae blooms and eutrophication (Russel et al. 2003).
- Spirit Lake was recreated following the 1980's eruption and there has been much preliminary research on this new lake due to the fascinating regrowth surrounding Mt. St. Helens (Gawel et al. 2018).
  - A nutrient budget was constructed for Spirit Lake in the last decade but the researchers found a significant imbalance between inputs and outputs, with outputs much greater than inputs. All fluxes were directly measured except for wet and dry deposition, which utilized published regional values instead.

Methods

← 5 gallon bucket inside a 10 gallon bucket embedded in a log on Spirit lake placed to collect dry deposition. The buckets were removed about every 20-30 days over a 3-month period and rinsed three times with filtered water to transfer contents to acid-washed sample bottle.



← In the lab, filters were pre-weighed, and the water samples were filtered, dried, and then weighed once more. The samples were sent to the School of Environmental and Forest Resources Analytical Services Center at the University of Washington Seattle

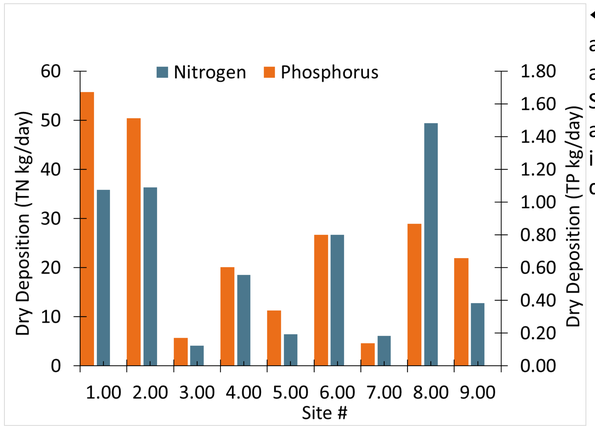
- CHN Analyzer used for total N
- ICP-MS used for total P

Spirit lake featuring the log mat→ The northeastern portion of the lake was unreachable due to the movement of the log mat.

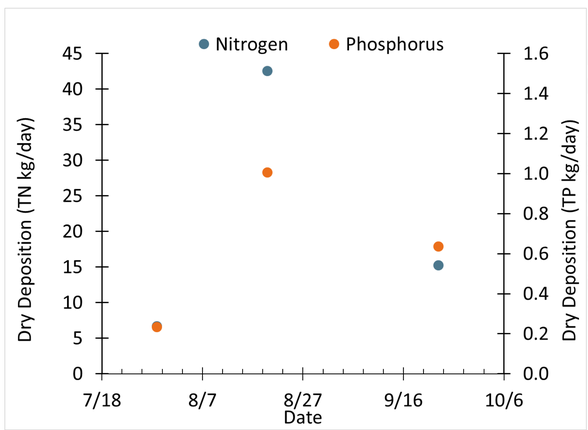
Results

	Average N (kg)	Average P (kg)
Estimated data	1,937	133
Quantified data	3,2623	115
Amount under-estimated	-1,326	+18

← Comparison of previous estimates of total nutrient deposition over 5 months to our measured values (Gawel et al. 2018).



← Average total nitrogen and phosphorus per day at each sampling location. Site 10 was removed as an outlier due to the impact of osprey droppings.

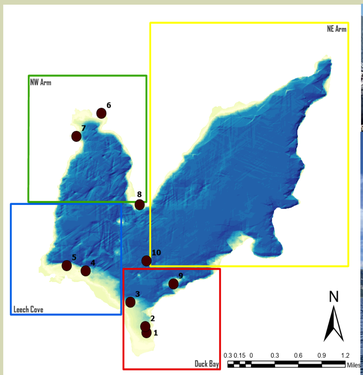


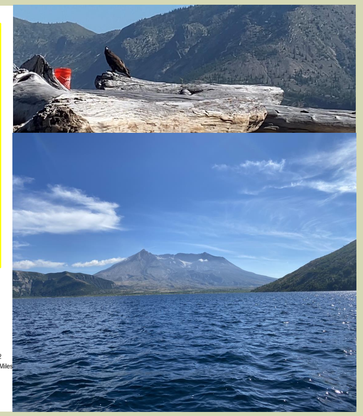
← Total nitrogen and phosphorus on the lake per day for each month from July to September. N and P deposition increase and decrease similar amounts, indicating that biological factors are impacting deposition inputs.

← Sample filled with osprey guano which caused this sample to be removed as an outlier.

← One sample with four spiders. The lake had a lot of spiders which can contribute a high amount of nitrogen.

Site





GIS map and images of Spirit Lake.

Discussion

- Nitrogen deposition is 68% more than what was previously estimated, it is a significant difference but the phosphorus difference of 13% is not a significant difference.
- Nitrogen and phosphorus seemingly follow similar trends, there are high nitrogen inputs and low phosphorus inputs which is to be expected. The large amount of insects, bird droppings, bat droppings, and organic debris collected within the dry deposition contributed to the high N concentrations but are relatively low in P.
  - Although abnormally high ratios of nitrogen may suggest another input of nitrogen such as from pollution.
- The highest temperatures occurred in August which created a dry climate allowing for an increase in dust movement.
- As global warming progresses dry deposition will increase as land gets drier and remains drier for longer periods of time (Al-Taani et al 2015).
- For the variable deposition over the three months, we encountered an increase in temperature and ash from nearby wildfires from August to September. Ash has the potential to leech phosphorus and nitrogen species into lake bodies (Bodi et al. 2014).
- Future studies could include doing a year-round study to look at seasonal differences in deposition and deposition rates over time. Analyzing specific nitrogen could also help track where the nitrogen deposition is coming from.

Acknowledgements

We recognize this land was stolen from the original people without a treaty. The Confederated Tribes of Siletz Indians, Qwû'lh-hwai-pûm (Klickitat) , Stl'pulmsh (Cowlitz) tribes are recognized original stewards of the Loowit/Louwala-Clough monument and continue to reside on nearby reservations to this day.

I would personally like to acknowledge Dr. Jim Gawel for letting me join this project and helping every step of the way. I would also like to thank Hailey Germeau and everyone who helped during our trips.

Overview:
The estimated values of TN deposited on the lake were underestimated and the TP estimates were overestimated. Overall TN from dry deposition does have a significant contribution to the N budget but the TP contribution is minimal.

QR code for poster, raw data, more pictures, and references!