# An Assessment of Annual Load Estimation Methods in Small Watersheds for Cross Site Comparisons

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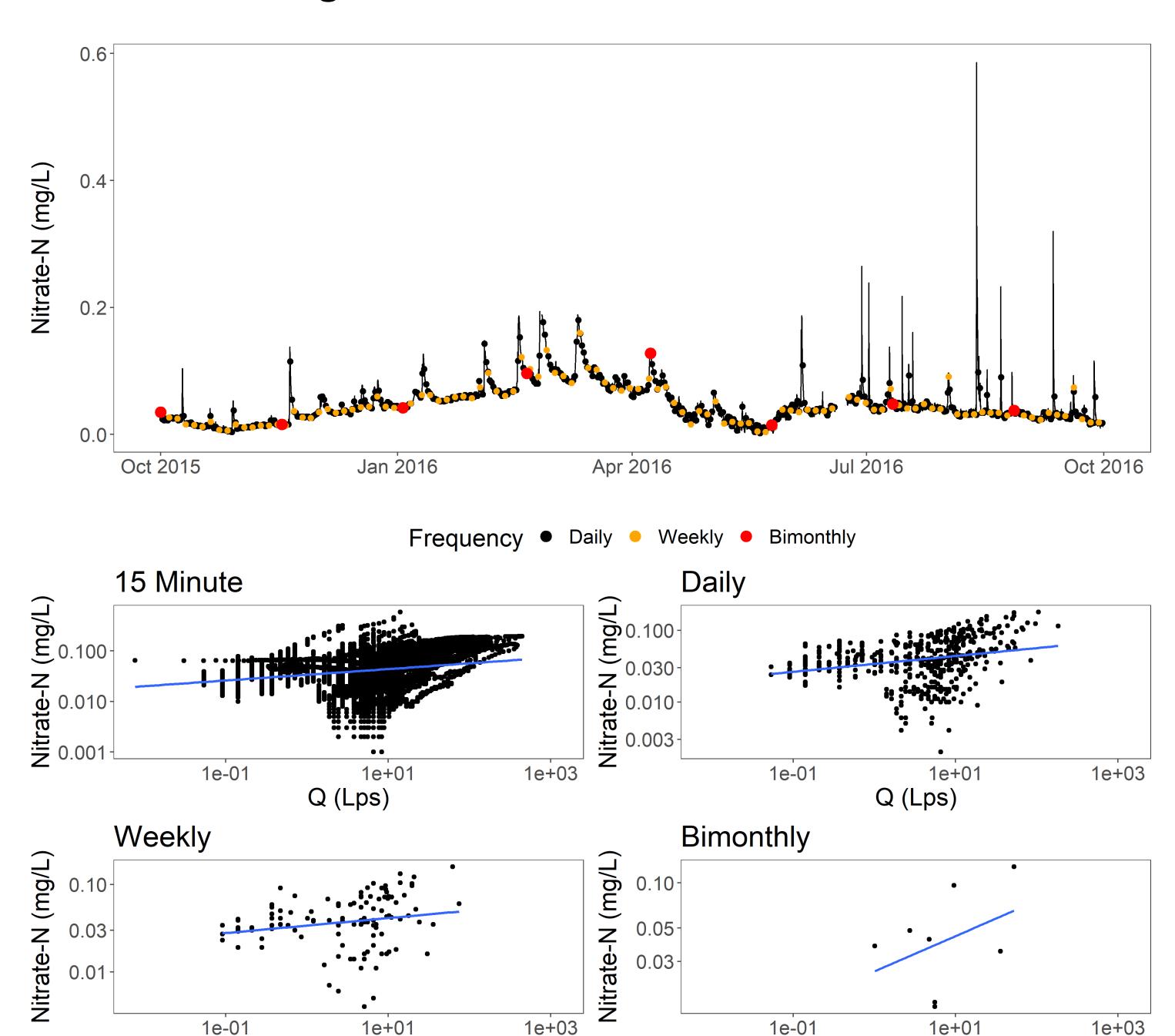[1]*Colorado State University, Fort Collins, CO;* [2]*Duke University, Durham, North Carolina*

**Annual load is the amount of some solute of interest that moves past a point in a stream.** It is calculated from discharge (*Q*) and solute concentration (*C*) data.
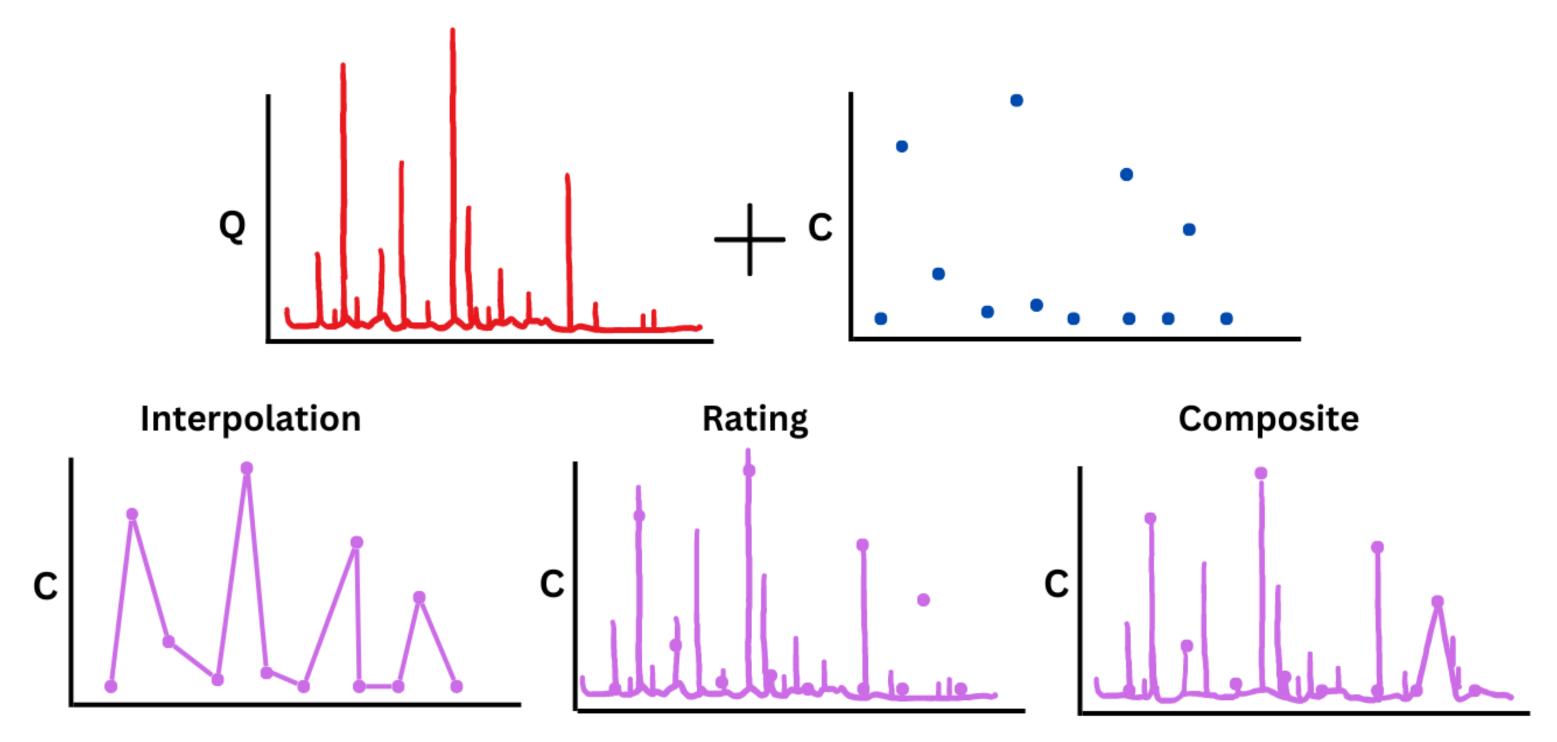
$$L = \int C(t)Q(t)dt$$

**Solutes are sampled at varying intervals,** both within sites as technology advances and between sites as research questions and funding differ. How frequently we sample informs our C:Q knowledge for the solute at the site.



Frequency ● Daily ● Weekly ● Bimonthly

**To estimate annual load, researchers must fill in gaps using one of a variety of methods.** All methods introduce error to load estimation. Selecting the most appropriate method is mostly dependent on the sampling frequency, C:Q relationship of the solute and the autocorrelation of samples through time.



Interpolation · Rating · Composite

## Works Cited

Appling et al, 2015, "Reducing bias and quantifying uncertainty in watershed flux estimates: The R package loadflex"
Aulenbach et al, 2016, "Approaches to stream solute load estimation for solutes with varying dynamics from five diverse small watersheds".
Nava et al, 2019, "An R package for estimating river compound load using different methods"

**Load estimates are greatly improved with high frequency sampling, complete C:Q knowledge, and proper method selection.** Solutes with low variability can estimated accurately with sparse data, but dynamic solutes require more frequent monitoring or effective modeling to accurately estimate.



**To assess a load estimate's quality, we need to assess:**
- Sampling frequency of underlying data
- Appropriateness of estimation method
- Hydrologic regime
- C:Q relationship
- Completeness and stability of C:Q relationship



| Excellent | Near-sensor estimate (~<2% expected error) |
| --- | --- |
| Good | Well imformed estimate (~2-5% expected error) |
| Fair | Estimate may be imcomplete (~5-20% expected error) |
| Caution | Estimate should be carefully considered (~>20% expected error) |