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Nutrient deposition in the headwaters of streams may impact nitrogen loading in Southern Californian estuaries

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Abstract

As has been shown for other estuarine ecosystems, roughly a quarter of the total N and P load in Southern California coastal waters cannot be accounted for by known anthropogenic sources. Although the contribution of deposition to estuarine nutrient loads has been demonstrated in other regions, it is has not been well characterized in California. In particular, little data are available on the dry N and P deposition. Studies were conducted to address the following research objectives:

1. Identify methods for measuring dry deposition controlled fumigation systems. These included water surface samplers and acid impregnated filters and Nylasorb filters.

2. Estimate the spatial and temporal variability in N and P deposition to five, undisturbed feeder catchments.

3. Evaluate the utility of dual isotopes: (δ18O and δ15N) to assess the contribution of atmospheric NO3- to streams.

Of the surrogate surfaces tested in fumigation chambers, the water surface samplers produce the most reliable results for both NO3- and NH4+. They demonstrated a strong linear relationship with air concentrations. For the Nylasorb filters the linear relationship was weaker, and the flux of HNO3 was significantly less than to water samplers. Citric acid impregnated filters were poor passive samplers for NH4+, but oxalic acid impregnated filters were satisfactory under controlled fumigations. Under field conditions, the water samplers had limited usefulness due to as evaporation and freezing, Nylasorb prove more robust under field conditions.

The average N dry deposition was ~70% of, and the average P dry deposition is ~30% of the total load. An important finding was that at several sites NH3+ was a more dominant N component of both wet and dry deposition that expected. Water surface sampler deposition data show that in general, NH4+ dry deposition is nearly twice as high as NO3- and at some sites NH4+ wet deposition also dominated the N deposition pool. The prevalence of NH4+ is likely due to the proximity of agriculture even in an area of moderately high traffic.

The high δ18O value for atmospheric NO3- across all sites suggests that the dual isotopic composition of NO3- could be a useful tracer for atmospheric N deposition. However, dissolved NO3- in streams did not reflect the isotopic composition of atmospheric NO3. This was not surprising given the relatively small surface area of headwater streams. Atmospheric deposition of nutrients is more likely indirectly accumulated in streams, following deposition to other surface before entering the streams through surface and subsurface runoff.