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Interactive comment on "Spatiotemporal patterns of N_2 fixation in coastal waters derived from rate measurements and remote sensing" *by* Mindaugas Zilius et al.

Anonymous Referee #2

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1. General comments (an initial paragraph or section evaluating the overall quality of the preprint) Overall, this is a very nicely written paper that integrates remote sensing data with empirical biogeochemical and biological data to estimate ecosystem-scale N-fixation in an oligohaline coastal lagoon. Using remote sensing data to study processes such as N-fixation, given the good empirical relationship between N-fixation and chl-a in the late summer, is a very nice application of these data in coastal systems. As the authors point out, blooms of N-fixing cyanobacteria can significantly alter the N-budgets of enclosed coastal water bodies. Importantly, this can lead to these systems serving as 'sources' of N to the coastal ocean rather than serving as reactors for removing DIN via denitrification.

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Discussion paper

One concern I have is the spatial distribution of the water sampling locations. I agree that using the remote sensing approach appears to provide much more resolved estimates of N-fixation (this ms) than simply scaling up from the two sample locations (Line 310-312). Still, the entire southern half of the lagoon was not sampled. For example, it is noted at Line 78 in this ms that, “Longer water residence time in the southern lagoon provides favorable conditions for cyanobacteria bloom development (Bartoli et al., 2018).” Without actually measuring N-fixation rates vs chl-a concentrations at those southern areas (which could differ if the phyto community composition differs), there is still uncertainty about whether or not the remote-sensing based approach is yielding biased results in those southern reaches. This is particularly true because most of the high N-fixation rate hotspots in Figure 8 are further south than the ‘southern’ sampling location. It seems unlikely that this particular concern can be addressed using the same dataset but it is an important caveat that should be acknowledged. If the authors have evidence that the phytoplankton community in the southern part of the lagoon is the same as the community in the middle of the lagoon (i.e., the ‘southern’ sampling location) either from previous literature or their own unpublished work, then this would be an important pattern to note for readers.

The methods are very sparse for the TN riverine data collection. While not a central part of the analysis, these data are used to place the remote sensing results in an ecosystem context and are therefore important to the manuscript. In the text, reference is made to a previous paper rather than providing methods, but in the referenced paper (Zilius et al. 2018), the methods reported in that paper are limited to the following: “For the mass balance analysis, water samples were collected at the inflow (Nemunas River) and outflow (Klaipeda Strait) of the lagoon, and from an off-shore site in the Baltic Sea (55°55âĂš13.1"N and 21°02âĂš39.4"E), to estimate riverine inputs, lagoon export, and marine inputs, respectively (Fig. 1). Samples were collected monthly at each of the sites from December 2014 to November 2015, except at the inflow site (Nemunas) where additional samples were obtained (at 1–2 week intervals) during the period of highest discharge (January–April).” (Zillius et al. 2018) It is important to see

some additional details, even if they are only provided in the Supplemental file. Were samples collected monthly or at higher resolution at certain times of the year (as in Zilius et al. 2018)? Was there any effort to collect during average flow conditions? Where were the samples collected – mid-stream in the river, or from the shore? Is the collection location the same location referenced in the Zilius et al. 2018 paper?

2. Specific comments Figure 1. Please provide definitions for abbreviations (RUS, LT) and increase font size on some of the smaller figure elements such as the scale bar. There is a gray rectangle just above the Nemunas River. . .is that meant to be there and if so, what is it? Please show the river sampling location on the map.

Line 114 – please provide a long-term estimate of d15N analytical precision for the UC Davis facility. They should have these numbers readily available. Otherwise, you could also report summary statistics on sample duplicates that were (presumably) interspersed with the submitted samples.

Figure 3 – it is confusing to list Anabaena in the figure while referring to it as Dolichospermum in the text. There is a note in the figure legend that the two are the same but why not simply use Dolichspermum in the figure (or at least an abbreviation)?

Figure 4 – are the southern site values averaged between surface and bottom or are these only surface (or bottom) values? Can you please clarify in the figure legend? Line 346-360 – also see papers by Karlson et al. (2015), Woodland, Cook and others (2013, 2014) for evidence of diazotrophic N from cyanobacteria contributing to brackish food webs

3. Technical corrections Line 182 – what do you mean by 'process' here? Is that word out of place or does it reference to a specific type of measurement taken in the surface and bottom waters? Can you please rephrase to make this more interpretable?

Line 248 – add a comma after '0.88'

Line 249 – add a space between '=' and '0.07'

Line 356-357 – replace ‘their’ with ‘these blooms to have a’ or something similar. The current phrasing is awkward

References: Karlson, A.M.L., Duberg, J., Motwani, N.H. et al. Nitrogen fixation by cyanobacteria stimulates production in Baltic food webs. AMBIO 44, 413–426 (2015). https://doi.org/10.1007/s13280-015-0660-x

Woodland RJ, Holland DP, Beardall J, Smith J, Scicluna T, Cook PLM (2013) Assimilation of Diazotrophic Nitrogen into Pelagic Food Webs. PLoS ONE 8(6): e67588. https://doi.org/10.1371/journal.pone.0067588

Woodland, R.J. and Cook, P.L.M. (2014), Using stable isotope ratios to estimate atmospheric nitrogen fixed by cyanobacteria at the ecosystem scale. Ecological Applications, 24: 539-547. https://doi.org/10.1890/13-0947.1

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