General Comments

This paper compares two Baltic Sea estuaries that receive differing levels of riverine nitrate inputs. Using a variety of oceanographic measurements in the water column, the benthic boundary layer, and sediments, along with 15-N isotope labeling experiments, the authors compare differences in N cycling pathways between the two sites. In particular the authors examined the efficiency of each estuary as "filters" of land-derived N loading. The authors found that both estuaries had similar nitrification and assimilation rates but that denitrification rates were higher in the estuary that received higher N loading. Based on C:N and POC:Chl a ratios the authors conclude that the quality of organic matter plays an important role in controlling these N-cycling processes. They state that phytoplankton derived POM is an important link between riverine N loads benthic N-cycling by functioning as a temporary reservoir that increases the residence time of nitrogen in the estuary and allows more time for removal through denitrification. Generally I thought this was a well conducted study that sheds important light on the role of estuaries in removing land derived N, an important issue especially for the Baltic that suffers from N-loading induced eutrophication. I do however have a few comments that should be addressed in the final version of the manuscript.

Specific Comments

The authors should explicitly state how they define the BBL, since the BBL figures heavily in the analysis. They do mention it is based on density stratification and provide some references, but they should say exactly what criteria they used.

I find the presentation of the sediment characteristics in Table 3 a bit confusing. Why are the LOI values not provided as a mean and standard deviation like the OPD and NH4+. Also it seems that the range of LOI values is quite wide in some cases, (ie. Ore Spring 1.9-12.8 dw%) this implies to me there are many different sediment environments grouped together. Likewise the variability in the ammonium pools within sites is also quite large. It seems there might be more information here that could prove useful if the authors looked at this variability in greater detail. Presumably the high LOI values and high ammonium values come from the same sediment cores. Also I find the per area inventories of NH4+ a little bit of a strange way to present this, I think pore water ammonium profiles would useful to see as well. Why go through the effort of section cores and extracting porewater profiles with Rhizons if you are not going to show the changes with depth.

The authors mention that the NO3-+NO2-, PON, POC concentrations in the BBL were significant higher in Ore than in the Vistula estuary (again no statistics) they mention this is due to the long particle retention time of the Ore estuary compared to the more open unrestricted bottom topography of Vistula. However one of the most striking features of the BBL chemistry in Figure 3 and Table S1 is the

accumulation of NH4+ in the BBL of Vistula. I am wondering how the authors reconcile these two points.

The authors make a big deal about the difference in bottom topography and the role it plays in differences in N-cycling, however the estimated bottom topography in Figures 2 and 3 does not look that different to me. The authors should explain these differences in bottom topography in more detail to make a more convincing argument. In section 2.1 the authors state that the "deep waters of the [Ore] estuary are confined by a small elevation (~30 m water depth) at its southern border." This to me implies there is some sort of sill that restricts the exchange of bottom water. But I do not see any such feature in the map in Figure 1 or the bottom topography of Figures 2 or 3 that would restrict flow, 30m seems to be the deepest water depth and it appears to occur right at the estuary mouth. The authors need to explain this a bit better, and provide stronger evidence for the restricted circulation.

In Section 2.2.1 the authors mention the high CDOM content of the Ores estuary and that they needed to do a correction to account for this in their nutrient analysis. If this is the case I think it is likely that this CDOM would interfere with the in-situ Chl-a measurements using the optical sensor. If the optical properties of the water in the both estuaries are different (due to CDOM levels) how accurate/comparable are the chlorophyll a cross-sections in Figures 2 and 3?

On line 385 the authors mention temperature as the factor determining higher ammonium assimilation rates in the summer, which could very likely be a contributing factor, but couldn't this also just be a concentration effect since NH4+ concentrations are so much higher in the summer (Figure 3).

Line 401 states: " *In summary, the magnitude of nitrification and ammonium assimilation in the BBL was not influenced by the different trophic state or by seasonal differences. However, the regulation of those two processes differed depending on the trophic state, i.e. the availability of organic N from POM."* I do not understand this statement. How is the magnitude of nitrification and ammonium assimilation not influenced by differences in trophic state, when figure 6 shows a clear correlation between these rates and the concentration of PON.

Line 429, The authors state the dominance of the NO3- source is controversial what is controversial about it? The authors should elaborate on this a bit more.

I think Figure 7 would be more effective if numbers were put to the various arrows, it seems the authors have constrained at least some of these flows, and would be valuable to indicate which ones were known.

Technical corrections

Individual panels and figures 2 and 3 should be labeled.

Also is the horizontal axis for the right side of Figure 2 labeled correctly or should it be from 0-20km.

Line 259 "…In the BBL, particulate C:N ratios were significantly higher in the Öre (10.2 ± 0.9, n=9) than in the Vistula (8.6 ± 0.6, n=12) estuary in summer, but covered similar ranges in spring (ÖE: 7.1–10.8, n=7 and VE: 6.6–13.5, n=18)." – be consistent in how variability is reported 10.2+/- 0.9 vs 7.1-10.8.