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Interactive comment on "Influence of Estuarine Tidal Mixing on Structure and Spatial Scales of Large River Plumes" *by* Alexander Osadchiev et al.

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C: The paper presents very interesting observations of two major river plumes in the Arctic basin. There is a paucity of such information in the oceanographic literature, so the paper certainly merits publication in the Ocean Science. However, some details of the data analysis and interpretation need improvements. In my opinion, the authors pay too much attention to the fact that the outflows from the Yenisei Gulf and the Khatanga Gulf form plumes of roughly the same offshore extension, although the freshwater discharges of the two rivers differ by an order of magnitude (∼30,000 m3/s for the Yenisei River vs ∼3,000 m3/s for the Khatanga River). According to the authors, this happens

due to the different intensity of tidal mixing in the two gulfs. I think this observation is rather trivial and obvious. Besides, it's not entirely accurate. First, the Yenisei River plume indeed separates from the coast and extends offshore (northward) over 300 km from the estuarine mouth. The Khatanga River plume on the other hand remains attached to the Taymyr Peninsular coastline on its left flank (facing downstream) so its northward spreading cannot be characterized as the offshore extension (even more so in August 2000).

R: Thank you for this important comment. We agree that the data from individual transects is not enough convincing for analysis of areas of the Yenisei and Khatanga plumes. Therefore, we provided analysis of satellite observations of the Yenisei and Khatanga plumes in the revised version of the manuscript. Based on joint analysis of satellite and in situ data, we detected spreading areas of the Yenisei and Khatanga plumes and validated them against in situ measurements. We showed that, first, spatial extents of the Yenisei and Khatanga plumes were similar during the periods of field measurements, and, second, large spreading area of the Khatanga plume was regularly registered at cloud-free satellite imagery acquired in 2000-2019.

C: Second, the wind forcing, while weak, is upwelling-favorable for the Khatanga River plume (in 2017) and is downwelling-favorable for the Yenisei River plume. The authors do not describe the wind forcing conditions prior to shipboard surveys, and the plumes of such spatial scales can keep a "memory" of the wind forcing on time scales of a week or even more if the wind is not strong. So the wind field snapshots at the time of measurements are not entirely convincing.

R: According to your recommendation we added analysis of daily averaged wind speed and direction during 29 June – 26 July 2016 for the Yenisei plume and during 8 August – 18 September 2017 for the Khatanga plume. These wind time series cover ice-free periods at the study areas from decline of ice coverage to in situ measurements in the Yenisei and Khatanga plumes, i.e., the periods when wind forcing can influence river plumes. In Section 3.2 we provide analysis of these time series and showed that

speed of the considered wind forcing was mainly moderate and low. In particular, the longest observed periods of continuous moderate and strong wind (> 5 m/s) were only 4 days in the central part of the Kara Sea and 3 days in the western part of the Laptev Sea. Wind direction during the study periods was highly variable due to high variability of atmospheric pressure accompanied by multiple cyclones and anticyclones. As a result, the wind forcing averaged during 2-week time periods is characterized by even more low wind speed (< 4 m/s) for the considered periods. Therefore, we presume that the Yenisei and Khatanga plumes were only weakly affected by wind forcing during the periods preceding the in situ measurements. As a result, the registered spatial extents of the Yenisei and Khatanga plumes depend mainly on river discharge conditions and estuarine mixing. This issue was clarified in the text.

C: I also somewhat disagree with the authors' interpretation of the plume structure formed by large rivers (lines 187-190, page 11): In fact, both "medium-size" and "large" (author's terminology) river plumes have the anticyclonic bulge region near the mouth and the semi-geostrophic, narrower coastal current farther downstream, as long as the Coriolis force is important. In this regard, the Amazon River and the Congo River plumes are not quite relevant since they are near the equator, while other major river plumes do have both a bulge region and a coastal current (far field), including the Mississippi plume, The Yangtze plume, the La Plata plume, the Columbia River, the Danube River, the Siberian rivers, etc.

R: We totally agree that large river plumes have asymmetric shapes that result in their different cross-shore and alongshore extents. However, in this part of the manuscript we expressed the idea that cross-shore extents of large river plumes near their estuaries are more stable that those of small river plumes. Anyway, in the revised version of the manuscript we omitted this statement and the related discussion because we quantified the similarity of areas of the Yenisei and Khatanga plumes based on satellite observations described in Section 3.4.

C: Some minor issues with the manuscript: Line 46 and later: I think it's better to

use m3 /s units for the freshwater discharge throughout the text. Line 58: ": : :tidal amplitude and velocity: : :" Amplitude of what, perhaps the free surface? As for the velocity, is it also an amplitude or rms? Line 86: ": : :performed at 100 m spatial resolution: : :". How can it be? I thought the water was pumped continuously under way. Do the authors imply the averaging interval here? Line 92: ": : :and 200 km far from the river mouths: : :". "Far" is not needed here. Line 107:" : : :Kara Sea shelf (stations 5336-5350)." The statement is misleading; it should read "stations 5333-5336 and 5349-5350". Lines 123-124: "As a result, the majority of river runoff propagated off the estuary: : :". This is a somewhat strange proposition; the riverine discharge should "propagate off the estuary", otherwise there will a freshwater flux convergence in the estuary and the estuary will be continuously getting fresher. Line 126 and below: ": : :was located in two salinity layers: : :". "Layer" is not a good choice in this context; it is one buoyant layer, just comprising different salinity classes or ranges or whatever word the authors would prefer. Line 138: Is the salinity gradient in this context "stable" or constant?

R: Thank you for these minor comments, we made the related corrections in the text.

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