

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

### **Anonymous Referee #1**

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#### General comments

The manuscript describes using in-situ salinity observations to study the spatial scales and contrasting structures of two river plumes in the Arctic Ocean. The concept of freshwater volume is used to get new information from observational data and different vertical salinity structures in the two river plumes are demonstrated clearly. Even though one river has an order of magnitude greater discharge than the other, the limits of salinity concentrations consistent with spreading of riverine water are detected ~500km from both river mouths. Determining the processes that control riverine flow into the ocean is important for understanding the impacts of rivers on coastal and shelf

C1

regions. The manuscript is generally well written.

The title and abstract both mention tidal mixing as the primary process responsible for the observed differences in two river plumes. However, there is no analysis to demonstrate this in the manuscript. For the focus of the paper to be tidal mixing there needs to be some investigation of the processes involved. Another issue is that volumes and areas of the river plumes are inferred using data from one linear transect per river, but the justification for the calculations related to the width of the river plumes is not well argued (see specific comments).

#### Specific comments

Line 20: The assertion that “rivers with similar discharge rates can form plumes with significantly different areas” is not supported by the data presented in the manuscript.

Line 97: mean wind speed over 14 days of ~7m/s is quite high and could include periods of strong wind speeds from different directions; plotting appropriate time series would give more information and show if wind forcing might impact on the river plume development.

Line 117 and figures 3b and 4b: the plotted freshwater fractions are not consistent with the definition given: eg  $S = 15 \Rightarrow F = (32 - 15) / 32 = 0.53$  not  $1 - 1.5\%$  (which is plotted).

Figures 3c and 4c: How was the “total share of FV among SL” derived?

Line 128: the freshwater in different salinity layers is not a percentage volume since the changing width of the gulf is not accounted for.

Lines 168-172: This section needs clarifying. In “This result is in good agreement with” etc: what result is being referred to? The data in the manuscript is for rivers with very different discharge rates not rivers with the same discharge rate. Is figure 6 and its description based on Fischer (1972) and Nash (2009)?

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Lines 186-194: The authors suggest that data from transects are representative of total surface areas of the river plumes because the Yenisei and Khatanga are 'large rivers' and so the plumes have similar zonal and meridional extents. However, the cited references [Pavlov et al., 1996; Zatsepin et al., 2010; Zavialov et al., 2015] show high variability in size and shape of the Yenisei and Khatanga river plumes. Also, it is possible in figure 5a) that some of the freshwater in the "Yenisei plume" comes from the nearby Ob River (Zavialov et al 2015; Osadchiev et al 2017).

Lines 220-230: the calculation of the freshwater volume. Is this just for the limits of the two gulfs, or does it include the river plumes? Do the changing widths of the gulfs and plumes impact this calculation? What about flow to the ocean through other channels (both gulfs split in two at the seaward end)? In line 228, the agreement between the ratios of freshwater volume and river discharges isn't exactly "proof" that the transects can be used to infer freshwater volume.

Web links to access the river discharge and atmospheric data used in the analysis are included but there is no information about access to the salinity observations.

Technical corrections

Line 13: exhibits -> experiences.

Line 17: delete "obtained"

Line 47: accounts to -> accounts for.

Line 58: Kowalik and Proshutinsky, 1994 is missing from the references list.

Line 100: the date "24-18 September" is wrong in the caption. The colour palette is not very effective – could omit the range 1000-1010 hPa.

Lines 110 and 139: "several meters" lacks precision.

Line 121: insert "." after 2015]

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Line 125: omit "far".

Figure 5: need to label that the discharge rates are shown, and check their units. Also specify which part of the water column.

Figure 6: freshwater fraction values should be less than 1.

Line 217 was spreading -> spread

Line 235: omit "getting".

Line 313: Kulikov et al. doi reference is incomplete.

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