This manuscript uses the IASI retrievals of XCH4 over North Sea to estimate the methane emissions due to the leakage from Nord Stream pipelines in September 2022. The authors use two ways, the Integrated Mass Enhancement (IME) and a Bayesian inversion based on a 3-D transport model TOCAT, to calculate the emissions during 26^{th} to 28^{th}, September 2022. This is the first study to use the satellite methane retrievals to estimate the emissions from this event. The scope of the paper fits ACP well. However, there are many aspects need to be fully addressed before it can be published on ACP.

General comments:

1, IASI retrievals are the only satellite observations that recorded coherent XCH4 enhancement during the leakage from Nord Stream pipeline. As mentioned by authors, the plume initially transported eastwards then westwards, but only IASI observations over the North Sea from $26\text{-}28^{th}$ were shown in the paper. Does IASI also document the similar plume enhancements over Baltic Sea? If not, it is kindly suggested to adjust the relevant statement that IASI is the only satellite retrieval that documents the entire event.

2, The role or motivation of using HYSPLIT model is not clear. If I understand correctly, HYSPLIT model is used to figure out trajectories of the leakages then determine the regional background. However, the regional background will not change too much during a short period as in this case. Using a temporal average over a certain region to be the background does not affect the result of IME method too much. Then HYSPLIT model is not needed.

Another option is to use the simulation of HYSPLIT model to complete the "plume shape" that are partly covered by cloud. The incomplete IASI observations can inevitably cause a large uncertainty when using the IME method. If the trajectory of HYSPLIT can be better used, it firstly can help to validate the evolution of the plume on 28^{th} (i.e., separate into southern and norther parts). Secondly, the emission estimates of IME can be more comparable with the results from TOMCAT.

3, When using TOMCAT to do a reversion, the simulations at four sites with a priori emission rates show large discrepancies to in-situ observations (Figure 3). To me, it is not clear that why a priori emission rate is a fixed constant as 4.17 Gg hr^{-1}? Did the authors test other numbers that can derive more reasonable results for the comparisons between the simulation and in-situ observations?

Apart from site HTM, variations of simulations with a priori emission rate at other three sites look reasonable considering the coarse resolution of TOMCAT. It also implies that the metrological data and dynamics used in TOMCAT simulations are not main reasons cause large discrepancies. The coarse resolution, as mentioned in the paper, can be one of the important reasons. However, Fig. 6 indicates the negative biases are also very large over land comparing to IASI. Thus, the coarse resolution is not the key reason for such big discrepancies between TOMCAT and IASI.

4. The results including the IASI observations even became much worse. Followed by the above comment, it would be helpful if the authors can compare simulations with satellite observations at some background sites before the analysis. On one hand, this comparison can be used to check if the system bias exists between model and IASI. On another hand, the satellite observations can be quite noisy at high latitudes. It also helps to assess the quality of the observations over North Sea.

To a regional revision by using a transport model like TOMCAT, the boundary condition and initial condition can be quite important. There is little discussion about them, even the spatial distribution of the emission inventory used in this study is not presented and discussed. It is quite difficult to understand why the difference between model simulations with a priori and a posterior inventory only occurs in the dashed black box (plume region) showing in Fig. 6d.

Specific comments:

1, Line 54: It would be better to refer two gas leak points marked with longitude and latitude to red asterisks (i.e., Gas leak 1, 2, 3) in Figure 1.

2, Line 124: It would be better to add longitude and latitude along figures. The names of countries are also suggested to be added in Figure 2. The readability can be improved in this way.

3, Line 132-134: If I understand correctly, the authors mainly show temporal variations of methane concentrations over North Sea. Are there any observations of IASI over Baltic Sea, where the leakage occurred? If not, the authors should clarify the lack of satellite observations, although IASI retrievals are the only satellite observations that captured a coherent XCH4 enhancement in the days immediately after the leaks began.

4, Line 193-196: The areas of background in Figure 2 are decided by HYSPLIT model and the uncertainty is estimated by perturbate the area of a black box. However, the number of available observations in each black box is different. How significant is the impact of sampling bias?

5, Some XCH_4 enhancements are quite strong near the western coast of Norway and northern coast of the UK even before 28^{th}. What can be the possible reasons for this?

6, Line 236: Why is this emission rate selected? Any background information or explanation?