Review of „Testing ground based observations of wave activity in the (lower 1 and upper) atmosphere as possible (complementary) indicators of streamer events" By M. Kozubek et al.

In this paper, an attempt is made to relate streamer events during 15 months of analysis, particularly in the Northern Atlantic region, with signatures seen in infrasound and gravity wave recordings from ground-based microbarometer recordings in the Czech Republic, and in local ionospheric Doppler soundings. Comparison of these recordings during streamer events and during more calm conditions without obvious streamers did not reveal a significant streamer signature in the records. The paper is motivated by a possible use of local observations for a quick identification of streamers, in addition to analyse peculiarities of GW during streamer events. The selection of streamers, however, is subjective and incomprehensible, the analysis does not following rigid and clear schemes, and the description of observations and analysis is very much lacking in detail. The authors did not find clear signals of streamers in the local observations, but because the analyses are not based on objective criteria, they can neither rule out that there could be a signal. So the conclusions to be drawn are at least vague and there is hardly any insight to be gained from the paper. I cannot recommend publishing the paper without a complete revision of the data base construction and analysis methods. There are a number of minor grammar issues. Some of them are included below, but in addition the paper would need a careful language revision. Major comments Streamer events are identified by subjective criteria. However, it is not described, what "strong", "large spatial size", or "low ozone" means, e.g. by providing the order of magnitude, threshold values of meridional and zonal gradients, etc. Actually, objective criteria have been used in the literature to define streamers (e.g. Eyring et al., 2003, Krüger et al., 2005). It is also not described, how the authors analyse the irreversible mixing mentioned in line 127. In turn, it is also not clear how calm periods were identified. E.g., during the period 9.-15.11.2020, which is defined as "calm" in Table 1, considerable longitudinal variability can be found visually (see figure below taken from https://atmos.eoc.dlr.de/tropomi). So, given that the choice of calm and streamer periods is questionable or at least not convincing, any subsequent analysis based on a comparison of differences between them is inconclusive.

The term "streamer" lacks a precise definition, as noted by Krüger et al. (2005). They discuss various aspects of streamers, including their impact on mixing and the divergent definitions associated with them. Offermann et al. (1999) describe streamers as large-scale tongue-like structures formed by the meridional deflection of air masses. Streamers are characterized by irreversible mixing of air masses between equatorial and polar regions which is why the might be linked to planetary wave breaking (Waugh, 1993). Eyring et al. (2003) give a climatology of the seasonal and geographical distribution of streamer events. They show, that streamers often occur over the Northern Atlantic and can be identified by either high NO_2 or low ozone concentration, which is why we select streamers by total ozone column measurements. They show that streamer events occur most often during winter and least during July and August in the Northern Hemisphere. Therefore, we focus on the winter season from September until March.

The streamer events are selected by eye for this study (results see **Error! Reference source not found.**) considering the TO3 global maps from January 2020 and March 2021. As planetary waves are permanently disturbing the atmospheric dynamic of the higher troposphere / lower stratosphere, especially smaller scale streamers can be observed almost every day and the identification of streamer events becomes subjective.

We define a streamer as such when the ozone column concentration of the finger-like structure above the Northern Atlantic/Western Europe is lower than 300 DU and persists for at least 3 days. The longitudinal extension is of approx. 15 to 30 degrees in the mid-latitudes (between 30 to 70°N).

The northernmost point of a streamer exceeds 50°N. Fig. 1 shows a streamer event above the Northern Atlantic, indicated by the blue color which represent the low ozone concentrations. The streamer shown in fig. 1 reaches latitudes beyond 70°N, which indicates a large example. At the western and eastern flanks of the streamer, the ozone concentration exceeds 350 DU, defining distinct boundaries. This is also visible in fig. 1 represented by the green colors at the eastern coast of Northern America and western Europe. So, there is a gradient of the ozone concentration of about 50 DU / 5°. Furthermore, the streamer exhibits a discernible pattern of circulation, with air masses being meridionally deflected, contributing to its formation and maintenance. These air masses, characterized by their movement from south to north at the eastern flank and from north to south at the western flank, play a significant role in the streamer's dynamics. This is the reason why equatorial low ozone concentration is transported northward. In contrast, the calm periods, representing the opposite dynamic situation to the streamer events, are characterized by only very few meridionally deflected air masses. During these periods, the ozone concentration in the mid-latitudes above the Northern Atlantic is consistently higher than 350 DU, indicating stable atmospheric conditions and minimal perturbations in the ozone distribution. An example for a calm period is shown in Fig. 2.

On lines 189-195 it is written that configuration is set on individual basis, but how?

Relevant PMCC input parameters are given in Table 2.

It is unclear, what is meant with detection bulletins.

The arrival parameters of the detected signals are stored in the detection bulletins

It is unclear how single points in Fig.3 are obtained.

One circle or point in the plot represents one detection family.

What is meant by a detection pixel?

Elementary detection with the PMCC or the detection pixel is declared in the time-frequency window when signal correlation and consistency criteria are met (Brachet et al., 2010 in Infrasound Monitoring for Atmospheric Studies).

As microbaroms are ubiquitous, how is an infrasound record defined?

Pressure is recorded by the respective microbarographs that form a microbarograph array. An infrasound detection is declared by an infrasound detector, e.g. the PMCC when coherent signal is found in the pressure recordings of the array elements. The length of infrasound records varies depending on the source. Microbaroms are infrasound signal of long or continuous duration. Contrary, signals generated by an explosion can last only several seconds.

How is similarity of arrival parameters defined to obtain families?

Detection pixels are grouped into the detection families based on similar time, frequency, azimuth of signal arrival, and signal trace velocity (Brachet et al., 2010 in Infrasound Monitoring for Atmospheric Studies).

Similarly, how is the data base to produce the histograms in Fig. 9 obtained? Did you simply used the complete time series, and calculated hourly rms values? Similarly, more information on then ionospheric GW analysis is necessary for the reader to understand the method without having to consult Chum and Podolska, 2018. E.g., how long is a registration needed for detection of events? Provide details of the 2 frequencies, and are they operated simultaneously? Without more information it is difficult to interpret Fig. 10.

We specified that that the values for the histograms were calculated with 1-hour time resolution.

We now provide additional information on continuous Doppler sounding and data analysis in Section 2. We have also expanded the text related to Figure 10 and discuss the usability/limitation of each sounding frequency.

Minor comments Abstract, first sentence: remove, there is no information in it.

L 22: explain acronyms when first used

PVCI and WBCI are not acronyms, but the names of the infrasound stations. The reference to the Czech microbarograph network was added in the reference list.

L 23/24: insert “tropospheric” before GW, remove “in the troposphere”

corrected

L 40: remove “upper troposphere”

Done

L 44: introduce and describe streamer events before discussing them

Done.

L 46: closely linked. To what?

This part has been redone.

L 52: strong → strongly

This part has been redone.

L 54: focus will be on GW periods. You mean the analysis of variation sin the GW period range?

This part has been redone.

L 59: tens km → tens of km

Done

L 63: mesosphere → stratosphere and mesosphere

Added.

L 65: wind field → wind speed

Changed

L 67: remove "us"

removed

L 72: wind → the wind

Meant as an adjective the wind field and the temperature field or in shorter version wind and temperature fields.

L 92: Dopper → the Doppler

L 94: follow → follows

L 111: add dot after "al"

L 114: dynamic → dynamics

L 114: capitalize "Especially"

L 129: criterions → criteria

L 130: effect → affect

All notes have been corrected or removed

L 132: do you mean "large-scale spatial structures"?

Corrected

Figs. 2 and 3: Labels should be enhanced

L 170: introduce WBCI and PVCI when first mentioned Paragraph starting with line 196: please add more details on the sounder, e.g. frequencies, here.

PVCI and WBCI are the names of the stations. Details about each station are described on lines 198-219.

L 196: using → using the

corected

L 209: from → from the

Corrected.

L 210: will be → was

corrected

L 219: streamers → streamer events

L 221: visual comparison. What is analysed and compared here?

L 228: This sentence is unclear. From one set of nx, ny data you obtain one value for u. So do you use different sets of x and y and calculate u for each of them?

Fig. 3: Please modify scaling to decrease azimuth range, and extend x-axis a bit so that data points don´t fall on the axis.

Fig.3 was modified

L 251: insert full stop after "family"

Inserted

L 263: same → the same

L 266: Notice → Note

L 266: what means "results for the overall dataset"?

L 355: what is the difference between "streamer" and "streamer-like" in your analysis?

It is deleted.

L 359: Visually I cannot detect differences between calm and streamer conditions in Fig. 9. The authors should consider plotting, for each parameter, both histograms in one panel after a normalisation by the overall counts.

We now display normalized histograms as suggested and modified/expanded the text. However, we keep the histogram, separated to display the quartiles and boundaries for large values.

Fig. 9: indicate that "0" means the beginning of Nov. 1 (in UT?). And the y-axis legend should read prms.

We do not understand this comments for former Figure 9 (current Figure 14)

Fig 9: the data seems to be hourly values. Is the rms calculated on one hour of data each? Please provide the information.

Yes, hourly values, now specified.

L 377: much → a much

Done

L 380: what is the frequency range of the observed GW?

5-60 min, now specified

L 389-390: Why do the recordings at the two frequencies depend differently on the time of day? Is there different signal damping, or reflection heights?

We added: The 4.65 MHz signal did not reflect from the ionosphere (escaped to the outer space) at night due to the low critical frequency of the ionosphere. On the other hand, the 3.59

MHz signal mostly reflected during the day from the ionospheric E layer and the Doppler shift was negligible, difficult to analyse

L 400-402: Is there a paragraph missing? What are the results of the statistical analysis (based on which data) mentioned in line 401?

Now specified

L 455: remove “which”

L 465: What is the DTK-GPMCC software? It is not mentioned in the text.

DTK-GPMCC is the version of the infrasound detection software the core of which is the PMCC algorithm described in Section 2) Data and Methods.

L219, L221, L 228, L263, L 266, L,266, L267, Fig 4.

The Section 3.1. was completely reworked and so these points disappeared.