Reviewer #1

“Seasonal variations in flooding inferred from lake sediments in Western Norway”
General assessment

This manuscript presents a very solid and carefully conducted palaeoflood reconstruction from western Norway. The study follows a robust and now well-established methodological framework for the identification and interpretation of flood deposits in lacustrine sediments, and contributes an important new high-resolution record to the growing network of comparable palaeoflood archives in Norway.

A major strength of the paper is the combination of CT-based event detection, sedimentological criteria, and validation against both instrumental and historical discharge records from the Vosso river, which provides an exceptional framework for interpreting the sedimentary archive. The attempt to discriminate flood seasonality (snowmelt versus rainfall-driven floods) using sedimentological proxies is convincing and builds coherently on previous work (e.g. Hardeng et al., 2022).

Overall, the manuscript represents a valuable contribution within the scope of the journal. The scientific approach is sound, the results support the interpretations, and the authors are generally careful and transparent when discussing uncertainties and limitations. In my opinion, the manuscript requires only minor revisions.

Major strengths
The study provides a long (Holocene-scale), high-resolution flood record that is exceptionally well constrained by instrumental and historical data, which is rare and adds substantial confidence to the interpretations.

The methodology is robust and largely consistent with recent palaeoflood studies from Norway, improving the intercomparability between records while acknowledging that individual lakes have different sensitivities to extreme events.
The differentiation between flood seasonality based on sedimentological criteria is well reasoned and represents an important added value of the study, particularly given the complex hydroclimatic forcing of Norwegian catchments.

The authors are generally honest in discussing the limitations related to human impact, sediment availability, and the difficulty of disentangling climatic and anthropogenic signals, especially in the most recent part of the record.

We appreciate the reviewer’s very positive assessment and thoughtful suggestions.

Specific comments and suggestions (minor revisions)

1. References

   The reference list and in-text citations do not appear to follow a consistent ordering scheme (neither alphabetical nor chronological). This should be corrected throughout the manuscript.
   We have corrected the reference order to be consistent throughout.

2. Geomorphological context of the inlet and delta dynamics

   Given that the lake inlet is associated with a complex deltaic system and that the coring site is located relatively close to the delta, it would be useful for the authors to briefly discuss whether there is any geomorphological evidence for inlet or delta shifting during the Holocene. Even a short discussion acknowledging whether such changes are known, likely, or unknown would strengthen the interpretation, as inlet position can influence sediment focusing and the preservation of flood layers. It would be advisable to check previous works from Bruno Wilhelm
   This is a relevant and good question. We will expand the discussion by adding information on old river channels (also in Fig. 2) and include some interpretation on delta progradation. We will also include a sentence about bedrock at the confluence of Strandaelva and Raundalselva, steering the river southward along the main river channel.

3. Intercomparison between palaeoflood records

   The manuscript successfully places the lake record within the context of other Norwegian palaeoflood archives. It may be useful to further emphasize that intercomparisons are inherently complicated by differences in lake sensitivity, threshold behaviour, and sediment availability. Some lakes preferentially record only the most extreme floods, while others may also record more moderate events, and this should be clearly highlighted when discussing regional coherence.
   We will clarify the challenges of comparing archives with different sensitivities and thresholds. We have a section in the discussion (485-490) stating some of the challenges already but will provide more details and challenges.

4. Clarifications in figures and methods
   In Figure 3c, the reason why the October 2014 and November 2015 floods are marked with an asterisk should be explicitly explained in the caption or in the text.
   We will add information about the two large floods (2014 and 2022) in the caption.
   In the Methods section, the CT-based protocol referred to a reference under review should be briefly described (a few sentences), as this work is not yet accessible.
   We will add a short summary of the CT protocol or refer to the article if it is accepted or in preprint.

5. Alternative sedimentary processes and mass movements

   The authors document the presence of lateral collapses and mass movements along the lake margins based on CHIRP data. In this context, it would be useful to more explicitly discuss why the identified event layers—particularly the thicker mixed

(MO) layers—are not interpreted as the distal expression of mass movements, delta collapses, or slope failures.

We will expand the discussion explaining why a mass movement origin is unlikely and provide additional sedimentological reasoning (also see comment from the Editor). The lateral collapses are not seen in CHIRP data, but in the multi-beam data. The collapses are located along the new road construction near Vandrarheimen (400 meter north of the coring site), and most of the sliding occurred during the construction which happened between 2010-2013. No collapses are located at the delta front. We will provide additional data about the collapses north of the core location.

While the interpretation of MO layers as large or prolonged flood events is plausible, a slightly expanded discussion of their texture, structure, and grain-size characteristics would help to further exclude gravitational processes and strengthen the sedimentological interpretation. Similar processes have been documented in Lake Geneva (Kremer et al., 2015) and other swiss lakes.

We agree that we need a slightly expanded discussion on the MO-layers. The MO layers show sedimentological characteristics that support interpretation as deposits derived from large or prolonged flood events rather than gravitational remobilisation. CT imagery reveals sharp, planar basal contacts and internally homogeneous mixtures of organic and minerogenic material without soft-sediment deformation, or shear structures typically associated with subaqueous mass-movement deposits. Grain-size distributions are mostly unimodal and poorly sorted but lack the multi-modal, extremely poorly sorted tails that characterise debris-flow or slump deposits. Although one MO layer displays inverse grading, this is consistent with waxing flood energy rather than gravitational collapse. The flat basin-floor setting and absence of mass-wasting features in CHIRP profiles further argue against gravitational processes. These characteristics closely resemble flood-derived mixed-density flow deposits described from Lake Geneva and other Swiss peri-Alpine systems (e.g., Kremer et al., 2015), where large floods mobilise both coarse minerogenic particles and terrestrial organic debris and deliver them through combined over-, inter-, and underflow processes. We will add references to the work in the revised manuscript and an expanded discussion on the MO-layers to strengthen the sedimentological interpretation.

6. Sedimentation rates in the uppermost section

In Section 4.4, the authors state that the highest sedimentation rates occur in the upper 0–30 cm and are "< 5 mm yr^{-1}". Given the otherwise very robust chronological framework (numerous ^{14}C dates and short-lived radionuclide dating), it would be preferable to provide a more precise estimate or a narrower range for these sedimentation rates.

Yes, we will add some more details in section 4.4: "The final age-depth model indicates a relatively stable sedimentation rate of 1 mm yr^{-1} from 8200–3500 cal yr BP, increasing to an average of 2.1 mm yr^{-1} from 1000–0 cal yr BP. The uppermost unconsolidated sediments (0–30 cm) indicate the highest sedimentation rates of 4.7 – 2.6 mm yr^{-1} respectively".

7. Interpretation of the last 500 years

The authors identify the last ~500 years as the period with the highest flood frequency in the record. Although this is already discussed, it may be worth emphasizing even more strongly that this increase could partly reflect enhanced sediment availability and human impact rather than a purely hydrological signal. The climatic and anthropogenic influences are likely strongly intertwined during this interval, which limits a straightforward climatic interpretation. The authors' honesty in acknowledging that the human impact cannot be quantified is appreciated. As a possible way forward, the comparison with independent indicators of land-use change (e.g. regional pollen records, arboreal vs. non-arboreal pollen ratios) could be briefly mentioned.

We thank the reviewer for this important comment. We agree that the marked increase in flood-frequency over the last ~500 years likely reflects a combination of climatic change and enhanced sediment availability stemming from increased human activity in the catchment. We will rephrase a paragraph in section 5.4 to: "The last 500 years represent the interval with the highest flood frequency in the record, exceeding that of the second-highest period by more than a factor of 2. This period also coincides with increased human activity in the Vosso catchment including deforestation, agricultural expansion, lowering of lake level, and the establishment of water-powered sawmills which would have increased sediment availability. Climatic cooling during the LIA, with increased winter snow accumulation, likely acted in parallel with enhanced anthropogenic disturbance, making the two drivers difficult to disentangle. Thus, the flood frequency increase during this interval should be interpreted as a combined climatic–anthropogenic signal rather than a purely climatic trend. Nevertheless, comparison with regional climate archives and independent indicators of land-use change could help clarify the extent to which human landscape modification contributed to the observed changes in flood activity."