Community Comment - CC4 - Hartmut Hein

The text is a very comprehensive and certainly almost complete review on the topic of sea level rise in Europe. I enjoyed reading the text.

We thank you for your feedback and for providing comments on our manuscript.

However, I note that the chapter "3.3 Vertical land motion including human induced subsidence." the "human induced subsidence" is only mentioned in the title and in the introductory sentence without further references. However, since the time scale of "human induced subsidence" is considerably shorter than that of natural subsidence, the combination can result in non-linear subsidence behavior over time. This topic is crucial for interpreting observed sea level data. Numerous publications address human-induced subsidence. For instance, Candela and Koster (2022) argue that the complexity arises from the overlaying of different sources of human-induced subsidence. Smith et al. (2019) demonstrate the time-dependent changes in subsidence caused by deep gas production at the Groningen field.

We have removed "human induced subsidence" from the subtitle, since VLM can have a number of causes.

In the text we have added the following for background:
"As discussed, subsidence can be natural or human induced. Gas production at the Groningen field, for example, situated in the northeast Netherlands, has caused measurable subsidence since the 1960s (Smith et al., 2019). Understanding the processes causing subsidence and their respective timescales is crucial for sea-level studies. This can be particularly challenging in areas where subsidence has multiple causes and requires to disentangle the individual contributions to VLM (Candela and Koster, 2022)."

It is not within the scope of this paper to look in detail at the local causes of VLM, but rather we give a regional picture of what's going on across Europe.

Candela, T., & Koster, K. (2022). The many faces of anthropogenic subsidence. Science, 376(6600), 1381-1382.

Smith, J. D., Avouac, J. P., White, R. S., Copley, A., Gualandi, A., & Bourne, S. (2019). Reconciling the long-term relationship between reservoir pore pressure depletion and compaction in the Groningen region. Journal of Geophysical Research: Solid Earth, 124(6), 6165-6178.

Row 318 states that the average sea level rise in Europe is slightly higher than the global average. This may contradict the study by Frederikse et al, 2020b cited two lines earlier. Due to the proximity of Greenland, lower rates of rise are expected, especially in northern Europe. In their interpretation, Frederikse et al, 2020b point out the effects of gravity, rotation and deformation on the trends in the North Atlantic subpolar region. Your statement that sea level rise in Europe is slightly above the global average refers to a period that includes only the satellite domain. It should be noted that a period of 30 years on a high-resolution scale is not suitable for making meaningful trend statements. Instead, it mainly reflects multi-decadal variability.

Sea level rise is due to both density changes of the ocean (steric sea level) and the mass addition from ice sheet and glaciers melt. In the future, when ice sheet melt will dominate sea level rise, indeed we expect sea level to rise slower than the global mean rate in Europe because of the gravity field adjustment around Greenland. But for the time being, the steric contribution is still the dominant contribution to regional sea level rise and this contribution is particularly high around Europe which makes current sea level to rise faster in Europe than on average. This steric contribution is due both to the internal variability and the forced signal (due to anthropogenic forcings). As we discuss geocentric sea level based on altimetry in this section, the statement here on European sea level refers indeed only to the period 1993-2021.
To clarify this point, we changed the statement to *"In Europe, geocentric SL trends since 1993 have been contrasted with high SLR in the Baltic Sea (see section 6.5 and Fig 7 for RSLR in the Baltic), low sea level rise in the Mediterranean Sea and a SLR close to the global mean rate in the Atlantic sector on average (Figure 6)"*