Replies to reviewer 1

This paper reports in situ 14C data from Sweden and aims to assess the accuracy of this dating method by comparing it to a relative sea level (RSL) curve based on radiocarbon dating of organic material in isolated basins and a local deglaciation timing determined from a clay varve chronology. The authors collected samples of granitoid bedrock both below and above the highest postglacial shoreline and found that the in situ 14C measurements provided reliable age constraints, closely aligning with the RSL curve and local deglaciation chronology, demonstrating its utility for accurately dating ice sheet deglaciation and postglacial exposure in regions where other methods yield complex results.

It is a short and concise paper and I only have some comments to address:

1. Please include the statement "not affected by the marine reservoir effect" in line 92.

   We disagree. The comment makes no sense.

2. In lines 133-137, I kindly request a more in-depth discussion of the studies that this paper references, as the discussion and conclusion rely heavily on these two papers, focusing on the reliability of the quoted ages.

   We have expanded the review of these studies to (l. 135-143): "*The Hughes et al. (2016) reconstruction relies primarily upon chronological constraints supplied from radiocarbon, thermal luminescence, optically stimulated luminescence (OSL), infrared stimulated luminescence, electron spin resonance, terrestrial cosmogenic nuclide (TCN), and U series dating. Published landform data, mostly with respect to end moraines and generally accepted correlations of ice-margin positions between individual moraines, provide complementary evidence. In contrast, the Stroeven et al. (2016) reconstruction combines geomorphological constraints for ice sheet margin outlines, including ice-marginal depositional landforms and meltwater channels, ice-dammed lakes, eskers, lineations, and striae, with chronological constraints supplied by radiocarbon, varve, OSL, and TCN dating*."

3. The blue sign on the Figure map, indicating 'below the highest shoreline,' is confusing, considering that the Dalarna region pertains to the area above the highest shoreline. I recommend its removal, as it does not contribute to a better understanding of the research.

   Most of this area is below the highest postglacial shoreline. We sampled sites located on what were islands upon deglaciation, as we have illustrated in the figure panel, which we think should remain as is. To provide further clarity we have amended the caption of Figure 1 to: "*The five Dalarna-Gävleborg sample sites are located on what were islands above the highest postglacial shoreline*".

4. Given that two of the authors have contributed to the in-situ C-14 calculation paper published in Radiocarbon 2014, it would be beneficial to incorporate the VTS value into the analysis. Additionally, please specify whether OX-I or Ox-II was used for data reduction. If any dilution correction was applied, ensure that it is included in the table. Furthermore, I kindly request comprehensive data for the blank value, including gas

yield. It would also be greatly appreciated if you could include relevant information on Cronus A or another intercomparison sample closely aligned with the samples presented in Table 1. Based on the given data, I calculate for BG21-001 1.28-1.32*105 atoms/g but I'm unsure why the AMS split is less than the sample+dilution. Is this due to stable isotope fractionation or transfer loss?

We thank the reviewer for this comment, which has led to several improvements (see below). However, we are not sure what a VTS value is (not listed in Hippe and Lifton, 2014, as implied) so we cannot respond more usefully here. If it refers to the CO_2 volume, that can be converted quite straightforwardly to the equivalent mass of C (which we present), and would be redundant in our view. OX-2 is the measurement standard used (but that standard is referenced to OX-1). We are including a note in the tables. The interested reader can find representative CRONUS-A values in Lifton et al. (2023). Diluted sample mass is the correct mass to use for concentration determination (total of C yield + added ^{14}C-free CO_2), as that is reflected in the measured $^{14}C/^{13}C$ ratio. AMS split mass is diluted sample mass less a small aliquot (typically ca. 9 µg C) for offline stable carbon isotopic measurement. The AMS split mass is used for the mass-dependent graphitization blank correction (see Lifton et al., 2023, for example). Notes clarifying this have been added to the table below (Table 1 in the manuscript). Relevant procedural blank data has now been tabulated and included at the same level of detail as the samples, as suggested.

5. It is important to include a sentence discussing the blank effect, especially for samples BG21-006, 007, and 008. Please elaborate on the implications for ages if the blank were 5000-10000 atoms higher or lower.

   We are unsure of the 'blank effect' to which the reviewer is referring. The values in the total ^{14}C inventory column already reflect the subtracted procedural blank. We have clarified this in the table notes - any shifts in the blank would have only a small effect on the total remaining inventory. Yes, the subtraction is ca. 15-30% of the total measured values of the samples listed, but as one can see from the now-tabulated blank data (appended to Table 1, below), the blank is well constrained during this period, as represented by the mean and standard deviation that are used. In our opinion, it is uninformative to speculate about whether the mean is higher or lower than what has been demonstrably stable during the period spanning the sample analyses, when the variability is well-quantified by the mean and standard deviation. If we restrict the blanks to those immediately bracketing the Forsmark samples (PCEGS-145 and PCEGS-163), the resulting change in the mean is less than 3000 atoms (out of $>10^5$) between the full mean and the mean of just the bracketing values, and well within 1σ standard deviation of the broader mean blank. So, not much implication to ages at all – only 600 atoms/g change in concentration. We have therefore added text clarifying this to the discussion section (lines 272-274). "Analytical results for *in situ* ^{14}C samples and procedural blanks are presented in Table 1. The mean and standard deviation are used to correct measured ^{14}C sample inventories (Table 1) because procedural blanks are well-constrained during the analytical time frame."

6. My knowledge of MATLAB does not allow me from checking the script attached to the paper, but the currently published years appear significantly smaller when recalculated

with the online exposure age calculator v3. Please address this discrepancy in line 235 and provide reasons for it.

The reason for the online exposure age calculator v3 yielding clearly older exposure ages is that the v3 calculator uses a lower default in situ ^{14}C production rate. This text about the ^{14}C production rate is from the v3 calculator documentation:

“^{14}C is calibrated from some measurements of the CRONUS-A sample (saturated) by Brent Goehring in the now-defunct Tulane lab. This needs work. It is also not integrated with the ICE-D database. At present, I recommend supplying your own calibration for ^{14}C calculations.”

When we use the same production rate calibration dataset as used for the expage-202403 calculator production rate, we get similar ages from the v3 calculator.

7. I do not understand the reason for excluding the first sample if it passed the Chi-square test. Please provide a stronger explanation for this decision.

   We now include all data in a single panel figure to remove speculation.

Table 1 - *In situ* ^{14}C sample measurement details

SAMPLE	PCEGS[1] #	PLID[2]	Mass Quartz (g)	C yield (ug)	Diluted Mass C (ug)	AMS Split Mass C[3] (ug)	$\delta^{13}C$ (‰ $_{VPDB}$)	$^{14}C/^{13}C$[4] (10^{-12})	$^{14}C/C_{total}$[5] (10^{-14})	^{14}C[6] (10^5 at)	[^{14}C] (10^5 at g^{-1})
BG21-001	PCEGS-146	202101960	5.02378	5.0 ± 0.1	393.8 ± 4.8	382.3 ± 4.6	-45.9 ± 0.2	3.3992 ± 0.0745	3.4118 ± 0.0785	6.1771 ± 0.1793	1.2296 ± 0.0357
BG21-002	PCEGS-147	202101961	5.02383	7.8 ± 0.1	303.3 ± 3.7	294.4 ± 3.6	-44.8 ± 0.2	4.5548 ± 0.0964	4.6226 ± 0.1016	6.4703 ± 0.1806	1.2879 ± 0.0360
BG21-003	PCEGS-148	202101962	5.01070	17.6 ± 0.3	303.4 ± 3.7	294.5 ± 3.6	-43.9 ± 0.2	4.6325 ± 0.1075	4.7091 ± 0.1134	6.6042 ± 0.1969	1.3180 ± 0.0393
BG21-002R	PCEGS-150	202201473	5.04116	7.7 ± 0.1	305.3 ± 3.7	296.4 ± 3.6	-45.2 ± 0.2	4.5575 ± 0.1350	4.6239 ± 0.1422	6.5186 ± 0.2368	1.2931 ± 0.0470
BG21-004	PCEGS-152	202101963	5.05927	11.9 ± 0.2	305.7 ± 3.7	296.8 ± 3.6	-44.6 ± 0.2	4.6181 ± 0.0789	4.6905 ± 0.0832	6.6300 ± 0.1588	1.3105 ± 0.0314
BG21-005	PCEGS-153	202101964	5.07578	4.6 ± 0.1	304.5 ± 3.7	295.6 ± 3.6	-45.4 ± 0.2	4.5997 ± 0.1272	4.6668 ± 0.1339	6.5656 ± 0.2251	1.2935 ± 0.0444
BG21-006	PCEGS-155	202101965	5.06572	5.5 ± 0.1	306.8 ± 3.7	297.8 ± 3.6	-45.2 ± 0.2	1.2766 ± 0.0562	1.1715 ± 0.0594	1.2426 ± 0.1010	0.2453 ± 0.0199
BG21-007	PCEGS-157	202101966	5.03589	6.9 ± 0.1	309.2 ± 3.8	300.1 ± 3.7	-45.0 ± 0.2	1.6838 ± 0.0507	1.6007 ± 0.0536	1.9221 ± 0.0960	0.3817 ± 0.0191
BG21-008	PCEGS-158	202101967	5.07653	4.0 ± 0.1	308.9 ± 3.8	299.9 ± 3.6	-45.4 ± 0.2	2.3565 ± 0.0634	2.3076 ± 0.0669	3.0145 ± 0.1185	0.5938 ± 0.0234
BG21-009	PCEGS-160	202101968	5.01906	55.3 ± 0.7	305.6 ± 3.7	296.6 ± 3.6	-38.0 ± 0.2	3.3393 ± 0.0946	3.3681 ± 0.1005	4.6013 ± 0.1703	0.9168 ± 0.0339
BG21-010	PCEGS-161	202101969	4.99961	42.2 ± 0.6	306.0 ± 3.7	297.0 ± 3.6	-40.1 ± 0.2	3.3197 ± 0.0680	3.3399 ± 0.0721	4.5648 ± 0.1321	0.9130 ± 0.0264
Procedural Blanks											
PB2-03222022	PCEGS-135	202201450	--	1.4 ± 0.1	305.2 ± 3.7	296.2 ± 3.6	-40.2 ± 0.2	0.4853 ± 0.0298	0.3413 ± 0.0320	0.5222 ± 0.0493	--
PB2-04212022	PCEGS-145	202201452	--	1.8 ± 0.1	307.0 ± 3.7	298.0 ± 3.6	-46.0 ± 0.2	0.5182 ± 0.0273	0.3731 ± 0.0292	0.5742 ± 0.0455	--
PB2-05212022	PCEGS-163	202201454	--	2.3 ± 0.1	307.4 ± 3.7	298.4 ± 3.6	-46.0 ± 0.2	0.5364 ± 0.0315	0.3922 ± 0.0335	0.6045 ± 0.0521	--
PB2-06022022	PCEGS-169	202201459	--	2.3 ± 0.1	307.3 ± 3.7	298.3 ± 3.6	-40.3 ± 0.2	0.4920 ± 0.0291	0.3486 ± 0.0312	0.5371 ± 0.0486	--
									Mean ± 1σ (All blanks)	*0.5595 ± 0.0371*	
									Mean ± 1σ (145,163 only)	*0.5894 ± 0.0214*	

Notes

1 Purdue Carbon Extraction and Graphitization System
2 Prime Lab ID
3 Mass graphitized for AMS analysis after small aliquot (ca. 9 ug C) taken for stable C isotopic analysis offline
4 Measured relative to OX-2 standard
5 Corrected for mass-dependent graphitization blank (based on AMS Split Mass C) and stable C composition
6 Sample values calculated using Diluted Mass C and corrected for mean procedural blank (All blanks)