RESPONSES TO REFEREE 1

Lines 10-12: In abstract, the authors concluded 'this suggests that replenishment of bromide in the snowpack occurs faster than bromine activation in mid-strength wind condition'. However, in the discussion section (page 11994, lines 15-17), they texted 'the lack of recorded bromine depletion in the surface snow may indicate that either surface snow bromide concentration is quickly replenished or that blowing snow represents only a small portion of the surface snowpack.' I do not understand why the authors throw the second possibility away? Which I think it could be very possible if that area is lack of strong winds.

We thank Referee #1 for catching this omission. The sentence has been edited to now read:

This suggests that replenishment of bromide in the snowpack occurs faster than bromine activation in mid-strength wind conditions (approximately $10\,m\,s^{-1}$) or that blowing snow represents only a small portion of the surface snowpack.

It would be very helpful if more meteorological information could be supplied for the 24-25 October case from nearby McMurdo station. They include wind speed, relative humidity (RH), temperature, and/or radiation. They may help us estimate the magnitude of the blowing snow event, and sublimation flux related.

In addition to the given wind speeds, we have now added temperature and relative humidity recorded from nearby McMurdo Station. The third paragraph of Section 2 now reads:

Winds during the field campaign were generally mild, only surpassing $10\,m\,s^{-1}$ on a few occasions. Site visits were not feasible during stormy weather, and much of the blowing snow captured during those periods sublimated in the baskets prior to collection as observed by a webcam. Thus, only on 25 October were blowing snow samples collected at both sites and all four heights. The collected snow was the result of approximately $10\,m\,s^{-1}$ southerly winds on 24 October. Visibility at McMurdo station during this blowing snow event dropped below 0.5 miles for about 4 hours. Temperatures ranged from $-20.5\,°C$ to $-11.5\,°C$ with an average relative humidity of 69%

on 24 October and $-17.5\ ^{\circ}C$ *to* $-13.5\ ^{\circ}C$ *with an average relative humidity of* 61% *on 25 October. These temperatures were a couple of degrees warmer than the average for the rest of the field campaign.*

Any further information, such as visibilities, that can be derived from webcam image during the BS event? What interested me is that the observation in fig3 shows a significant bromide depletion when height ¿ 2m. Then why is that? Is 2m roughly the top of the blowing snow under a moderate wind speed? Can webcam image give us more information?

The webcam at Butter Point Site recorded a still image approximately every 15 minutes with a field of view limited from the ice surface to about 2 m. Unfortunately, both the reduced visibility of the blowing snow event and the resolution of the still images does not allow direct observation of blowing snow. Reference to the reduced visibility has been added to the manuscript (see above). The webcam images do show that the three lower baskets are blowing in the wind and have collected snow. However, the top basket is not visible in the image.

Have you checked satellite BrO images around 24 October? Any elevated BrO spot occurring around the Ross Sea?

Satellite BrO images collected by the Global Ozone Monitoring Experiment-2 (GOME-2) were analyzed over the duration of the field campaign. There was no discernible BrO concentration spike over the Ross Sea around 24 October. This suggests that the recorded bromine release was a small-scale event that did not directly leaded to a greatly enhanced BrO spot. Since the lack of a dramatic BrO spike does not nullify the occurrence of bromine release, this analysis was not included in the revised manuscript.

Could you get snow samples (lofted and on surface) salinities? As salinity is another key factor that determine sea salt production.

Although we agree that it would be helpful to have both lofted and surface snow salinities, measured values for many of the samples would be less than the 0.1 g/m^3 detection limit of our YSI Pro30 conductivity/salinity instrument. The bulk of each sample was diluted further for ion chromatography. At this point, even with a different instrument that had a lower detection limit, there would be concern of lost of ions to the walls of the container over the last 2.5 years. We feel that anion concentrations provide more detail than a bulk salinity. We have provided the raw data of anion concentrations as a supplement to the manuscript.

Regarding to the bromine depletion profiles in fig.3, I suggest you thinking about plotting out profiles of depletion factors (DFs). DFs, rather than Cl-/Br- mass ratios, are very useful in modelling. You can use the formula shown below for DF calculation.

$$\mathrm{DF} = \frac{\frac{Br}{Cl}(\text{in sea water})\frac{Br}{Cl}(\text{in sample})}{\frac{Br}{Cl}(\text{in sea water})}$$

At DF=0, it means no bromine depletion in particles, while DF=1.0 indicates a complete bromide depletion.

We thank Referee #1 for this recommendation. Since the readership of ACP includes both field scientists and modelers, we have decided to include both mass ratios and depletion factors in the revised manuscript. The suggested figure would show the same trend as existing Fig. 3 and it would be repetitive to have both plots. In the revised manuscript we have kept Fig. 3 with mass ratios on the x-axis as it is a more familiar metric. Depletion factor calculations have been added to a new second paragraph of Section 4, which now reads:

A depletion factor (DF) was defined such that DF= 1 *signifies no bromine depletion in particles and DF=* 0 *signifies complete depletion. Averaging the* Br^-/Cl^- *mass ratios at each height for Butter Point yields DF=* $0.04, 0.11, 0.41,$ *and* 0.68 *for heights of* $0.3, 2.0, 3.0,$ *and* 5.5 *m, respectively. At Iceberg Site, DF=* $-0.08, 0.20, 0.33,$ *and* 0.64 *for the four heights, respectively. These values are consistent with previously reported values and currently used in some models (Sander et al., 2003). An increased depletion factor can either signify bromide depletion due to bromine release or chloride enrichment from, for example, gaseous HCL uptake. If the later hypothesis were true, one would expect to observe increased chloride concentrations in higher baskets. The lack of an observed chloride trend with height leads to our interpretation that the decreased mass ratio is a clear indicator of bromine activation. Interestingly, lower* Br^-/Cl^- *ratios also correspond to a decrease in chlorine release. It has been shown that BrCl plays a critical role in chlorine production, and BrCl* *release is reliant upon the existence of HOBr from prior bromine activation (Wren et al., 2013).*