Dear Reviewer,

Thanks for the great comments on the paper. Please find the answers we provided for your comments and questions, below.

Your Sincerely,

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Referee# 3:

The overall methodology is probably good but the description of the DMS measurements is confusing and would benefit from rewriting and reordering some sentences. Why did the sample collection times vary so much? Is there a reason for this? It seems like different collection times will result in different amounts of sample collected resulting in different limits of detection. Please comment on this and clarify. The paragraph beginning on page 5 line 23 is particularly confusing. It seems that this paragraph was intended to describe the calibration methodology but this is not obvious. It is stated that "Three Tenax tubes were injected with standard DMS along with one blank Tenax tube for each test period: : :", Why? What is the meaning of this? This is followed by a statement about calibrating the GC-SCD with 1 and 50 ppmv gas DMS standards.

Where did the laboratory get these standards. Were they certified standards etc. Collection and analysis were referenced to Sharma and Rempillo after the collection was already briefly described prior to this statement. It is stated that the uncertainty is 12% with this method but is that somehow independent of the amount of sample collected AND the mixing ratio of the sample that was collected? Please clarify and add a brief description of the Sharma and Rempillo methods and how the 12% uncertainty is determined.

The Tenax storage test shown in Figure 3 needs further discussion. The authors prepared a 1 pptv sample which is impressive. Would like details on how they did that. It is not clear what the standard deviation for each test represents. How many times were the samples analyzed etc.? And does the test have meaning given the uncertainty in the measurements? What is the LOD of the measurements?

Thank you- we tried to address these comments:

1000 mL of samples were collected in 5 mins with a flow rate of approximately 200 mL/min. For few samples the sampling time was shorter or longer than 5 mins, leading to different volume of samples. The uncertainties of DMS mixing ratio were 2 and 3 pptv for the minimum (400 mL) and maximum (2200 mL) of volumes, respectively.

(Page 6, line 1) Sampling collection time was 300 ± 5 seconds with a flow rate of 200 ± 20 mL/min (for few samples the sampling time was shorter or longer than 300 seconds, leading to different volume of samples).

A glass gas chromatograph (GC) inlet liner was used to pack 170±2 mg of Tenax. The Tenax packed in glass tubes was cleaned by heating to 200˚C in an oven with a constant He flow of around 15 mL/min for 5 hours. The DMS samples were analyzed with using a Hewlett Packard 5890 gas chromatograph (GC) fitted with a Sievers Model 355 sulfur chemiluminescence detector (SCD). Two DMS(g) certified standards (1 and 50 ppmv) were used to calibrate the GC-SCD and to determine accuracy of the measurements by checking the standards against each other (for example, 1 microliter of 50 ppmv vs 50 microliters of 1 ppmv). Collection and analysis of samples were based on methods described by Sharma (1997), Sharma et al. (1999) and Rempillo et al. (2011). Uncertainty in the measurements was determined based on the standard deviation (σ) of DMS(g) standards and was ±12 pptv. The detection limit for this method is approximately 7 pptv.

DMS measurements and discussion – the decline in DMS mixing ratios with height in July is essentially what is expected and the pattern been seen in a number of previous studies. As stated, it results from primarily from fast photochemical destruction in the absence of deep convection as the lifetime of DMS is fairly short in July (_ _ 1 day). The data points above the surface (1 and 3 km) could be interesting but it would be instructive to know/understand the confidence that the authors have in these measurements with respect to LODs etc.

The detection limit is ~ 7 pptv (Page 6, line 10). The measurement at 3000 m was below detection limit during July (we mentioned in the Table 1). For July 17, again the measurement was below 7 pptv at ~1000 m. However, for July 12th, simulation suggested a local (Lancaster Sound) influence:

(Page 9, line 21) However, relatively high DMS mixing ratios (> 15 pptv) were observed for July 12th at high altitudes (> 800 m), and FLEXPART results shows influence of local source, Lancaster Sound for that day (mentioned in Section 4.2). On this day, NETCARE results do not follow the usual DMS vertical pattern of high DMS at the surface declining with altitude to near zero above

the MBL. Instead, high concentrations aloft on July 12 imply convective transport into the free troposphere and potentially an extended photochemical lifetime due to reduced water vapor or limited sunlight.

Also related to that, I agree with other reviewers that the authors should include more discussion of the vertical structure of the atmosphere in section 3.1 It is important to know if there evidence of atmospheric stability or of convection and mixing into the free troposphere.

More information is added:

(Page 11, line 4) DMS (g) vertical profiles are sensitive to the boundary layer height. For the summertime, Arctic the boundary layer height on various days (275±164 m), for the July 2014 campaign, is reported in Aliabadi et al. (2016). They showed that the profiles of the potential temperature exhibited a positive vertical gradient throughout the aircraft campaign (their Fig. 4). In addition, using vertical profiles of wind speed, they derived a positive gradient Richardson number (Ri) with a median of 2.5 (Their Fig. 7) throughout the aircraft campaign. The magnitude of the positive gradient Richardson number is an indicator of the strength of thermal stability in the atmospheric boundary layer. Due to the strong thermally stable conditions during the field campaign, mixing was weaker compared to well-mixed boundary layers at mid latitudes. As a result the summertime measurements show a strong decrease in DMS(g) above the boundary layer. Although there is no reference for the April 2015 campaign boundary layer, we expect similar boundary layer characteristics in the stable Arctic boundary layer at high latitudes due to the even more reduced thermal forcing with large sun angles in the month of April compared to the month of July. The springtime measurements show a more uniform vertical profile suggesting transport in the free troposphere from open water sources that were relatively farther distance from the observation point in springtime than in summer.

The April results are definitely quite interesting. I am surprised at both the surface measurement and aloft mixing ratios since this time of year is early for substantial biological productivity I would think. The authors didn't mention previous ob servations from the NASA DC-8 during ARCTAS (https://www-air.larc.nasa.gov/cgibin/ ArcView/arctas). The results in paper contrast

with the ARCTAS data in spring where lower DMS mixing ratios were observed (below detection limit to a few pptv and a max of 1 pptv in the free troposphere). It would be interesting to describe leads observed etc. in the region of sampling.

During NETCARE campaign, there were not leads in the sampling locations. We added more information about ARCTAS study:

(Page 4, line 12) Observations of the NASA DC-8 during ARCTAS (https://www-air.larc.nasa.gov/cgibin/ArcView/arctas) showed low DMS mixing ratios in spring (below detection limit to a few pptv in the boundary layer and a maximum of 1 pptv in the free troposphere) (Simpson et al., 2010; Lathem et al., 2013).

I am curious about the DMS emission source inventories used in the model and where these came from during springtime.

The DMS emissions inventory used in the model are from Lana et al. (2011) monthly mean DMS climatology, which includes both the springtime and summer.

Minor things:

P3 line 8 – describe CLAW hypothesis

(Page 3, line 9) Charlson et al. (1987) hypothesized that DMS could provide a negative feedback to stabilize the global warming (CLAW hypothesis). Although no evidence in support of the hypothesis has been found (Quinn and Bates, 2011), DMS(g) emissions may play an important role in the climate of remote areas with low aerosol concentrations, such as in the Arctic (Carslaw et al., 2013, Leaitch et al., 2013, Levasseur 2013, Croft et al., 2016a).

P4 line 13 add s to altitudes to make it plural

Thank you, We made the change.

P4 line 20 – suggest replacing “act” with “appear”

Thank you, We made the change.

P5: As suggested above rewrite paragraph beginning on line 17

Thank you, We made the change.

P8 line 25 replace “higher present” with “a higher presence”

Section 3.1 is removed.

P8 line 26 – make Cloud plural – “Clouds”

Thank you, We made the change.

P10 line 5 eliminate comma after mixing ratios

Thank you, We made the change.