Thanks for the constructive comments to our MS and helping us making this a better paper. We have tried to accommodate nearly all. A few of them would require significant redoing of the processing (e.g. the ice chart uncertainty estimation and the geo-location correction of all data) and so it is not possible now. However, we are working on new updates of the dataset and in next versions of the dataset we will try to implement your suggestions.
See specific answers in the text below.

Interactive comment on “The EUMETSAT sea ice climate record” by R. T. Tonboe et al.

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The manuscript presents a harmonized Arctic and Antarctic sea ice concentration data set based on passive microwave SMMR, SSM/I and SSMIS satellite observations from 1978 to 2014, spanning observations from 11 different instruments. The new things of this data set are the atmospheric correction and uncertainties given for each pixel individually, based on a careful error estimation. The various error components are considered separately and an overall error model is forwarded in Fig.Âa3. ˇ

General comments: It is an elegant approach to use dynamic tie points to compensate for sensor drift and inter-sensor calibration. Were time series of the tie points also investigated?
We have made detailed investigations of the tie-point window (7, 14 or 30 days) and we have also looked at the short overlap period between SMMR and SSMI. Looking at the tie-point time series has several difficulties because it is unclear if the variability that you see is due to geophysical changes, instrument drift or due to NWP model biases (if the atmospheric corrections has been applied). The link between the different noise sources and the sea ice concentration is indeed an active research topic.

Could a seasonal cycle, drift or jumps with sensor change be observed?
What causes the tiepoint variability is difficult to assess (see above).

P(age)4L(ine)4 SSMIS data: While the SSM/I data from RSS comprise corrections for geo-location, C1 sensor calibration and inter-sensor calibration, this is not the case for the SSMIS data. Were similar corrections applied to the SSMIS data?
No, we use the data as is.

Is the dynamic tie points method considered to compensate automatically these errors?
The idea with the dynamical tie-points is to compensate the (unknown and) systematic errors in the retrieval process. Further, they make it possible to use NWP data for regional error reduction without introducing biases from the model. The random component of the tie-point is one of the two components in the sea ice concentration uncertainty estimate.

The large number of 14 subsections of Section 2 could be more structured for easy understanding. I would consider Secs. 2.6 to 2.10 as subsections of 2.5 Uncertainties. According to the short Sec. 2.5 and Eq. (1) I would expect two subsections, one on the tie point uncertainty and one on the representativeness error, with perhaps more subsections.

From the sentence in Sec 2.5 ‘The tie point uncertainty ε_tie-point , including residual atmospheric noise, sensor noise and ice surface emissivity variability, is derived from measurements as the first component of uncertainty’ I would expect the section on the first component to treat exactly these errors in exactly this order. However, the heading of 2.6 is ‘First component: instrument noise, algorithm and tie point uncertainties’, which is different. If the error components are not treated in the mentioned order, then the relation between the different error contributions should be made clear. I do not find algorithm noise treated in Sec. 2.6 which is promised in the heading. Rather, is seems to be treated in Sec. 2.10. Moreover, Secs. 2.12 to 2.14 deal with the correction of known errors which could be a common heading for these three.
We agree. We have followed your suggestions in the restructuring of section 2.

Sec. 1.5 Ice charts: It is very good to use ice chart as independent source. The data source should be indicated. Are those data freely available? Reference? Are they provided in the same polar stereographic grid as the SSM/I data? Is there any conversion required, e.g. from region shapes to pixel data?
We have reprocessed the ESICR - ice chart comparison using publicly available and documented datasets. The data are from three data sources: 1) The northern hemisphere from 1972-2007 described in “National Ice Center. 2006. Updated 2009. National Ice Center Arctic sea ice charts and climatology. F. Fetterer and C. Fowler. Boulder. Colorado, USA. National Snow and Ice Data Center”. 2) The Southern hemisphere from 1972-1994 described in F. Fetterer. A selection of documentation related to national ice center sea ice charts in digital format. NSIDC Special Report # 13, 2006. Boulder, Colorado, USA. 3) both the northern and southern hemisphere from 2006-2015 as shape files. The conversion to grid files is described in www.natice.noaa.gov/products/sigrid.html

These references and description of the data are included in the MS.

Some of the ice chart errors can be quantified: If the charts give ice concentrations in 10% steps, this corresponds to adding quantization noise equally distributed in the IC interval [0,10]. It has a standard deviation of 10*sqrt(1/12) = 2.9% IC. Moreover, weekly ice charts will contain as error the development of the ice within one week. This can be estimated considering ice chart differences of successive weeks.
This is a very good idea and we will try that in future comparisons. However, it has not been done here and the ice chart polygons do not have a standard interval of sea ice concentration, often it is given as 1-3 tens meaning that there are sections within the polygon where the sea ice concentration is between 10 and 30% (we interpret this as 20%). Some convention for translating the uncertainties needs to be developed. The sea ice services (Norwegian, Finnish and Greenlandic) are at the moment working on assessing the uncertainties in their ice charts. As far as I know there is no convention yet but I have forwarded your suggestion to them.

C2 Sec. 2.7 Geo-location error: A reference to Hollinger et al. (1990) is not suitable for SSMIS geolocation which was not launched at the time of publication. More suitable would e.g. be Poe et al., Geolocation Error Analysis of the Special Sensor Microwave

Imager/Sounder, IEEE TGRS, VOL. 46, NO. 4, APRIL 2008. They find a geolocation error 'in excess of 20–30 km' which cannot be considered small compared to the footprint size. Was the SSMIS L2B NRT data version you are using (P4L4) ever corrected for such errors?
Thanks for the reference it will be included together with Hollinger. Poe et al. describes a relatively simple method where the geolocation error can be reduced from "in excess of 20-30 km" in the cal/val phase to near 5 km. When the SSMIS L2B NRT dataset is used for sea ice drift analysis the standard deviation compared to drift-buoys is less than 4 km (http://osisaf.met.no/docs/osisaf_cdop2_ss2_valrep_sea-ice-drift-lr_v4p0.pdf). This is comparable to other sensors with comparable resolution (ASCAT, AMSR) and it shows that the SSMIS data geo-location accuracy is not in excess of 20-30 km it may rather be close to 5 km as indicated in the text. The 5 km is the value we used in the simulations to assess the impact of geo-location accuracy on the sea ice concentration estimate.

Anyway, the geolocation errors should be corrected beforehand. We are working together with the EUMETSAT climate SAF who are compiling different microwave radiometer data sets and geo-location correction is on top of our wish list. Geo-location is a prerequisite for doing proper land-spill-over correction.

It would be helpful for comparison with other publications (e.g. with Spreen et al. 2008: . J. Geophys. Res 113, C02S03, doi:10.1029/2005JC003384) to give, in addition to the time series of bias and stddev in Figs. 4-7, the average values for these quantities.
We have recomputed the comparison to ice charts extending it to cover 1978-2015, but we did not find a way to include the absolute concentrations in the figure. In the ice charts the open water concentration is 0% and over ice the ice chart concentration is higher than the ESICR concentration.

It could be interesting to show in Figs. 8 and 9 also the open water bias for the overlap period.
On average the open water bias is smaller for SMMR than for SSM/I because the SMMR 18.0 GHz channels is further away from the water vapour absorption line than the 19.3 GHz channel on the SSM/I. The overlap bias is shown geographically in fig. 15 and 16 in the validation report (http://osisaf.met.no/docs/osisaf_cdop2_ss2_valrep_ice-conc-reproc_v2p0.pdf) and will not be reproduced here.

Data Levels 3 and 4 at the beginning of Sec. 2.11 should be briefly explained.
An explanation is included in the MS. Level 3 is left out because it is not needed here.

As TCD does no more any typesetting, it would be nice if the manuscript would obey simple rules of typesetting: numbered quantities are denoted with capital words like Figure 1, Table 3, etc., and numbers up to ten are written as words.
The MS has been corrected with attention to typesetting.

Minor points: Use for the same quantity always the same symbol. Wind is sometime u*, sometimes U* . Ice concentration sometime ic, sometimes IC. Does the * symbol in Eq. (1) at u* have a meaning?

We have been through the text carefully and corrected this. u is the friction velocity, which is the slope of the logarithmic wind profile (under certain conditions). The friction velocity is called u* in the literature and we will also use that term here.*

P3L14 ‘There is SMMR data only every second day’: No, each day. Only, because of the narrow swath, full coverage requires data accumulation over two days. Similar P15 L11.
Actually the radiometer was only operated every second day to save power on the spacecraft working shifts with another instrument. This is now stated in the text.

P6L13 ’ The representation of atmospheric liquid water column in the NWP data is not suitable to use for brightness temperature correction.’: Give reason: because of the spatial and temporal variability of cloud, which is higher than the model grid cell size and model time step size.
OK the reason has been included.

P7L1 ‘. The fluctuations due to atmospheric and surface emission are systematic.‘: Meaning unclear.
It has been clarified.

P8 L7: explain OSI SAF
It is spelled out in the abstract.

P9L23 ‘spatial ice concentration standard deviation’: meaning of ‘spatial’ unclear. Omit?
“spatial” has been omitted since it is clear from the rest of the sentence that it is the standard deviation of larger regions.

P11L14: meaning of ‘logically’ unclear. Omit?
“logically” has been omitted.

P11L30 to P12L3: Necesscity of Eq.(6), Boxcar and Heaviside function unclear. For the subsequent text, it is sufficient to define the truncated ice concentration alpha by P12L4-6.
This sections has been simplified omitting equations 6 and 7.

P13 L15 weighting function Eq. (12): In principle, the function should reflect the antenna pattern. Then it would have to be a Gaussian. Linear weights taken here as simple approximation.
You are right and in coming versions of the dataset we will be using a Gaussian weighting function. However, for this dataset we use Eq. 12.

P14L22 and P15L2: equation 6 -> Eq. (13)
OK

P15L18 Latter -> later
OK, the validation has been extended and therefore the sentence omitted.

P19L22 ‘(Q3)’ not needed, never used.

OK, it has been deleted.

P20L1-5: There is an extended literature on detecting onset and end of melt season with sophisticated methods. It is ok to use a simple method here, but it should be mentioned that more exist, e.g. by citing the recent article by Close et al.: Regional dependence in the timing of onset of rapid decline in Arctic sea ice DOI: 10.1002/2015JC011187. See also literature cited there.
The reference has been included for comparison.

P21L5: trend in number of open water days shown in figure 13 → Figure 12.
OK.

P21 L13 . As for the Arctic the open water days is calculated.. → As for the Arctic, the open water days are calculated.
OK.

P21 L 29 the pole → Antarctica or the South Pole
We have changed it to Antarctica as suggested.

P23 L16 'The next update': insert 'of the ESICR data set'
OK.

P23 L9 'minor differences': why should there be any differences between the two algorithms? Specify.
The expected differences stem from the tie-point selection period which is either the last 30 days or 15 days before and after. This has been specified in the text.

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-34, 2016.