**tc-2016-115-SC1 by A. Royer (alain.royer@usherbrooke.ca)**

**Dear Dr. Alain Royer,**

**Hereafter the responses to your comments.**

General Comment:

Interesting paper, including the practical inter calibration between AMSR-E and AMSR2.

**Response:**

**Thank you for this positive comment.**

Comment (1):

The authors should better refer to previous works, including those made with SMOS: Rautiainen et al., 2016, RSE and Roy et al., 2015, IEEE JSTARS.

**Response:**

**Previous works focused on L-band by Rautiainen et al., 2012 and Rautiainen et al., 2014 were already referred in our manuscript. We also want to stress out that the herein paper is focused on higher frequency radiometers and it is based on works from Zhao et al. 2011 as clearly mentioned in the objectives.**

**Changes:**

**Thanks for your kind remind that we added the new references you mentioned. In addition, a more recent work from Xu et al., 2016 that is related to Aquarius and SMAP mission is added.**

Comment (2):

I would have been interested to see a comparison between algorithm used by the authors and used by SMOS and SMAP.

**Response:**

**We agree this would have been interesting but a comparison of SMOS and SMAP algorithms and the current algorithm was not feasible and out of the scope of this paper. Since there is not either in Roy et al. 2015 the detection algorithm based on the AMSR-E, and SMOS/SMAP approaches are using only L-band, we think that a future work of algorithms development to combine several spectral bands and their comparison would be of great interest.**

Comment (3):

I am not really convinced by the global application, nor by the global evaluation not really relevant. However, the focus on the Tibetan Plateau is interesting. It would have been more relevant to focus on northern high latitudes and specific mountain regions for the validation!

**Response:**

**We agree that the interest in freezing and thawing is for areas where this process is dominated in northern high latitudes. However, we believe that a successful algorithm**

should be able to directly distinguish both of frozen soil and thawed soil, including thawed soil which may never freeze from a priori knowledge. If we only detect the freeze/thaw status over frozen ground, then how to accurately define the frozen ground domain and non-frozen ground domain would be another issue. This work is in the continuity of our previous study but done at global scale and the motivation is to develop a continuous data record by using two microwave sensors. Therefore, we conducted the global evaluation by using air temperature is to verify the consistency of algorithm accuracy after inter-calibration. And thank you for your positive comment and interests on the Qinghai-Tibetan Plateau, as we mentioned in the paper that it has been called the 'third pole' of the Earth.

Changes:

According to your advice, we have reduced the scope of our evaluation to the area of (26°N-90°N, 180°W-180°E), since previous statistics show permafrost occurs as far north as 84°N in northern Greenland, and as far south as 26°N in the Himalayas (https://nsidc.org/cryosphere/sotc/permafrost.html). The new results found that the satellite derived F/T map has an agreement 82.25% (Spatial agreement) and 85.43% with WMO air temperature in 2010 and 2013 respectively. In addition to this, we have added external data including modeled (GLDAS) and in situ measured soil temperature (ISMN, Table 2) to evaluate our freeze/thaw dataset. The comparison of F/T map with the GLDAS modelled soil temperature at 0-10cm depth shows an agreement of 87.6% and 89.74% at ascending and descending time respectively (Figure 1). As comparison with the in situ 0-5cm soil temperature from ISMN, we selected 220 stations located in the north of 26°N and the overall agreement is 86.62% (Table 1). The validation over northern high latitudes and specific mountain regions is included in part of our comparison by using multiple source data we could obtained at the current stage. Please refer to Section 2.2 (Materials and Methods) and Section 3.2 (Results).

Figure 1 Comparison of F/T map with soil temperature modelled by GLDAS

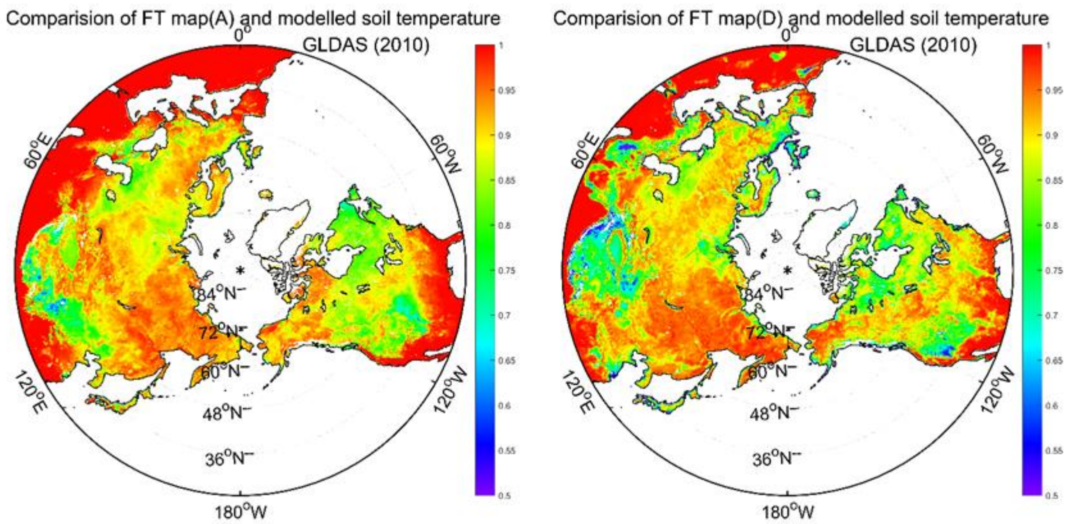

**Table 1 The main soil moisture networks distribution and the agreement with F/T map**

| **Main Soil Moisture Networks** | *location* | *Total stations* | *Overall agreement* |
|---|---|---|---|
| ARM | USA | 88 | 91.17% |
| SCAN | USA | | |
| HOBE | Europe | 75 | 87.65% |
| REMEDHUS | Europe | | |
| SMOSMANIA | Europe | | |
| MAQU | QTP | 48 | 77.20% |
| CTP_SMTMN | QTP | | |