We thank Review#2 for their comments that helped improving the study. In red italic are our responses to each of the comments

The manuscript attempts at developing a novel algorithm to derive skin temperature from the IASI sounder via a neural network techniques. Two trainings are chosen to this scope and the results are compared against each other and a third independent in situ source.

1- **My major comment on this manuscript is abouot the conclusion remarks where it is stated that this technique provides a simple method to derive skin temperature from the full IASI constellation. This is true as long as the radiance measurement series is calibrated uniformly and consistently with the training radiance data set. At this stage this uniformly reprocessed radiance data set is missing. Perhaps the authors should aim at developing a set of coefficients for each intermediate time series, especially considering that instrument dis-homogeneities will always be present. More emphasis should be put to actually explain what is the advantage of this method over the existing EUMETSAT L2 Tskin method.**

The radiance dataset used in this study is uniformly reprocessed. This is mentioned in the introduction here:

*“*The Metop-A L1C record has been reprocessed back in time at EUMETSAT for the period 2007-2017, and is used in this work, and will be publically available in summer 2019. L1C data after 2017 are not reprocessed because they are assumed to be up to date and consistent with reprocessed data. The Level 2 series has not yet been reprocessed back in time, which complicates the construction of a homogeneous T_{skin} data record from IASI.”

As such we were the first ones to use this homogeneous radiances dataset to produce a consistent Tskin data record. It is worth mentioning that the Eumetsat L2 products (clouds, Tskin and T profiles, trace gas contents) are evolving with time and algorithm improvements. No backward processing was done so far, so there is no Tskin record available for climate studies. That’s the advantage of this work: providing the only homogeneous Tskin data record from IASI.

We address the Reviewer comment, by reminding the reader in the conclusion that the L1C data record is homogenous as follows:

“[…] Consequently, no homogenous consistent IASI T_{skin} record exists to date. ***However, in this study we take advantage of the fact that the Metop-A L1C radiances, recently reprocessed at EUMETSAT and used in this work, are homogeneous.****”*

2- **A concern is the fact that the NN technique seems to strongly depend on the training ensemble. What’s the author’s take on the impact that this aspect might have on future applications of their data record?**

Indeed, the NN will depend on the training ensemble. However, the aim of this work is to have a Tskin a homogeneous product from IASI to analyze the regional and global temperature distributions. Our algorithm is not as sophisticated as the EUMETSAT L2 algorithm or the ECMWF reanalysis, and depends on them. However, it also depends on the IASI radiances, and those are changing independently.

are put in coincidence with direct observations (radiosondes, buoys, etc…). The authors of this paper have proposed long time ago a calibration dataset based on reanalysis outputs such as in the work done by Aires et al. 2005; Kolassa et al., 2013; and Rodriguez-Fernandez et al., 2015. They have shown that when doing this, it is possible to obtain a satellite retrieval that has no global bias with the reanalysis, but can have strong regional biases with it. The retrieval, even if trained with the reanalysis, does not reproduce the reanalysis, the time and spatial variations are driven by the satellite observations.

We addressed the Reviewer's comment, by adding the following sentence when discussing ANN in section 2.3 as follows:

*"*The feasibility of using ANN to T_{skin} retrieval has been shown for instance by Aires et al. (2002) for IASI, and has also been performed to tackle various problems in atmospheric remote sensing (Blackwell and Chen, 2009; Hadji-Lazaro et al., 1999; Whitburn et al., 2016; Van Damme et al., 2017). ***The retrieval, even if trained with the reanalysis, does not reproduce the reanalysis; the time and spatial variations are driven by the satellite observations (Aires et al. 2005; Kolassa et al., 2013; Rodriguez-Fernandez et al., 2015****)."*

3- **Finally, the author should provide more information about the in situ measurement station. Is this part of an operational network? What type of skin temperature measurement does it exactly perform?**

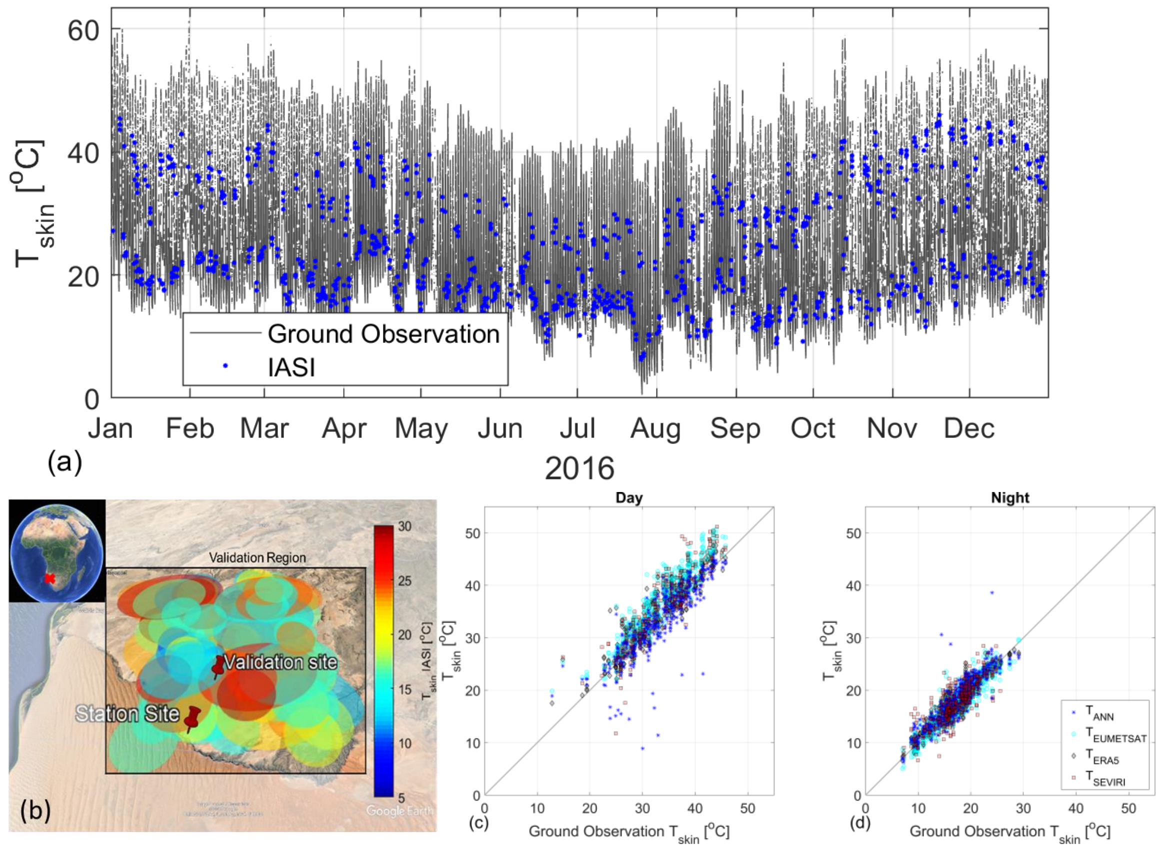
We provide more information on the in situ measurement station, by expanding section 2.4.4 as follows:

"The ground observations are from Gobabeb wind tower, Namibia (23.551° S 15.051° E, location shown in Figure 7, Göttsche et al., 2016). Gobabeb station is located on the large and homogenous Namib gravel plains (Göttsche and Hulley, 2012). ***It is part of the Karlsruhe Institute of Technology (KIT) stations, designed for continuous validation of LST products over several years. The core instruments of KIT's validation stations are Heitronics KT15.85 IIP infrared radiometers that measure radiances between 9.6 and 11.5 µm. The temperature resolution is 0.03 K with an uncertainty of ±0.3 K over the relevant range, and high stability with a drift of less than 0.01 % per month (Goettsche et al., 2013). Based on in-situ measurements, the surface emissivity of the gravel plains is estimated as 0.944 +-0.015 for MSG/SEVIRI 10.8 µm channel (Göttsche and Hulley, 2012). During an international inter-comparison campaign in-situ emissivity spectra were obtained at 49 sample***

locations distributed across the gravel plains: the results confirm the previously obtained results (Göttsche et al., 2018).
The IR radiance measurements from KIT stations have been successfully used to validate several satellite LST products derived from MODIS (Freitas et al., 2010; Guillevic et al., 2013; Ermida et al., 2014), SEVIRI (Freitas et al., 2010; Goettsche et al., 2013; Ermida et al., 2014) and a range of sensors (Martin et al., 2019). The monitoring capability of KIT's validation stations was demonstrated by Göttsche et al. (2016) for LST derived from MSG/SEVIRI[..]*"*

4- Comparing against one single station is reductive in terms of a final assessment of the proposed algorithm. Could more stations be added to the assessment?

Generally speaking, it is hard to validate satellite measurements with ground LST given that the footprint of the satellite instrument will have various land surface types and the LST will therefore be an effective measure of this surface inhomogeneity. Gobabab is the only of KIT's site that is suitable for validating IASI LST: the homogenous areas around the other sites are just too small. To extend our analysis and to address Reviewer#1 concerns, we perform a validation over the whole year (instead of just one month). The results and discussion show similar results to the one-month validation, as the figure hereafter shows:



New ***Figure 7. Comparison of IASI T_{ANN} with ground observations at Gobabeb: (a) Diurnal and seasonal variation of T_{skin}; (b) station and validation site location with a one-month example of IASI-coincident observations; (c) T_{ANN} versus in-situ T_{skin} during the day; and (d) during the night for all coincident observations in 2016.***

The discussion of this figure is updated in the manuscript when necessary. Since it doesn't change much from the conclusions of the comparison with the one-month data, we don't include it here and we ask the Reviewer to refer to the corrected version of the paper if needed.

5- On a final note, few additional comments. 1. Few references are missing. The AIRS v6 algorithm employs a NN algorithm to regress skin temperature, along with temperature and water vapor profiles for the AIRS sounder.

Two references related to AIRS NN v6 were added when discussing ANN and Tskin retrievals in the introduction as follows:

"The feasibility of using ANN to T_{skin} retrieval has been shown for instance by Aires et al. (2002) for IASI, and has also been performed to tackle various problems in atmospheric remote sensing (Blackwell and Chen, 2009; Hadji-Lazaro et al., 1999; Whitburn et al., 2016; Van Damme et al., 2017). [..] ***For AIRS and AMSU, projected principal***

components for coefficient compression and a neural network trained using global training set derived from European Center for Medium-Range Weather Forecasting (ECMWF) fields are used in the version 6 retrievals of atmospheric temperatures and water vapor (Milstein and Blackwell, 2016; Tao et a., 2013).*"*

6- **Besides Ventress and Dudhia, Gambacorta and Barnet 2013, Methodology and information content of the NOAA/NESDIS operational channel selection for infrared hyper spectral sounders, IEEE Geoscience and Remote Sensing Letters, also address the the cross-interference of unwanted species using an initial climatology and updating this with actual retrieval error estimates in a sequential retrieval method.**

The reference was included along with Ventress and Dudhia.

7- **What cloud filtering technique was used to select IASI clear sky radiances in the training?**

Cloud filtering from AVHRR on Metop was used. This was added when discussing cloud free radiances in section 2.3 as follows:

"The training dataset is constructed out of clear-sky scenes (cloud cover <10%) *selected* ***using AVHRR measurements, collocated with those of IASI on Metop (Maddy et al., 2011).*** Level 1C (L1C) clear-sky IASI radiances are used over the 100 channels selected in section 2.2."

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