**Note: Filtering brightness temperature caused by solar reflection**

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(Technical note as supplementary information file)

As reported by Su et al. (2020), Sci. Data, there appear some spikes in $T_b^V$ (on 24/08/2016, 30/08/2016, and 03/09/2016 and 04/09/2016), which are consequences of surface reflected solar beams into the ELBARA-III antenna horn under certain surface conditions. For users who wish to filter out these signals, this technical note provides some technical guidance. Three methods are briefly described as follows: 1) Quantile filtering of brightness temperature, 2) Quantile filtering of polarization index, and 3) A time series filtering technique using the HANTS algorithm.

## 1. Data information

Date period: 22/03/2018 to 25/06/2018, time interval: 30 minutes.

## 2. Mask algorithm

### 2.1 Quantile filtering

$$If \quad T_B^p(i) > Quantile\left[T_B^p(\mathrm{i}-\mathrm{K}{:}\,\mathrm{i}+\mathrm{K}), q\right] \qquad (1)$$

$$Then \quad loc.append(i) \qquad \#\, record\ position$$

$$If \quad PI(i) > Quantile[PI(\mathrm{i}-\mathrm{K}{:}\,\mathrm{i}+\mathrm{K}), q] \qquad (2)$$

$$Then \quad loc.append(i) \qquad \#\, record\ position$$

Where $T_B^p$ is observed brightness temperature with $p$ (H, V) polarization. $q$ is quantile (ranged in [0,1]) to compute and K is half-time window. In this case, $q = 0.85$ for $T_B^H$, $q = 0.90$ for $T_B^V$ and K is taken of 100. $PI$ is polarization index $((T_B^V - T_B^H)/(T_B^V + T_B^H))$, in which $q = 0.90$ and K is taken of 100 for PI case.

### 2.2 Filtering using the HANTS algorithm

$$T_B^p(i) > Maxium[T_B^p\_HANTS(i-K{:}\,i+K), q] \qquad (3)$$

Where $T_B^p\_HANTS$ is estimated brightness temperature by using HANTS algorithm. Frequency of 50 is used in this case.

## 3. Results

Figure 1 shows results based on quantile filtering of $T_B^p$. Figure 2 shows results based on quantile filtering of $PI$. Figure 3 shows seasonal variations of the Maqu ELBARA-III radiometry dataset for pre-monsoon period (late March to late June), in which $T_B^p$ displayed in the figure are based on quantile filtering of $T_B^p$. Figure 4 shows results based on using HANTS algorithm. Figure 5 shows seasonal variations of the Maqu ELBARA-III radiometry dataset for pre-monsoon period (late March to late June), in which $T_B^p$ displayed in the figure are based on filtering using the HANTS algorithm.

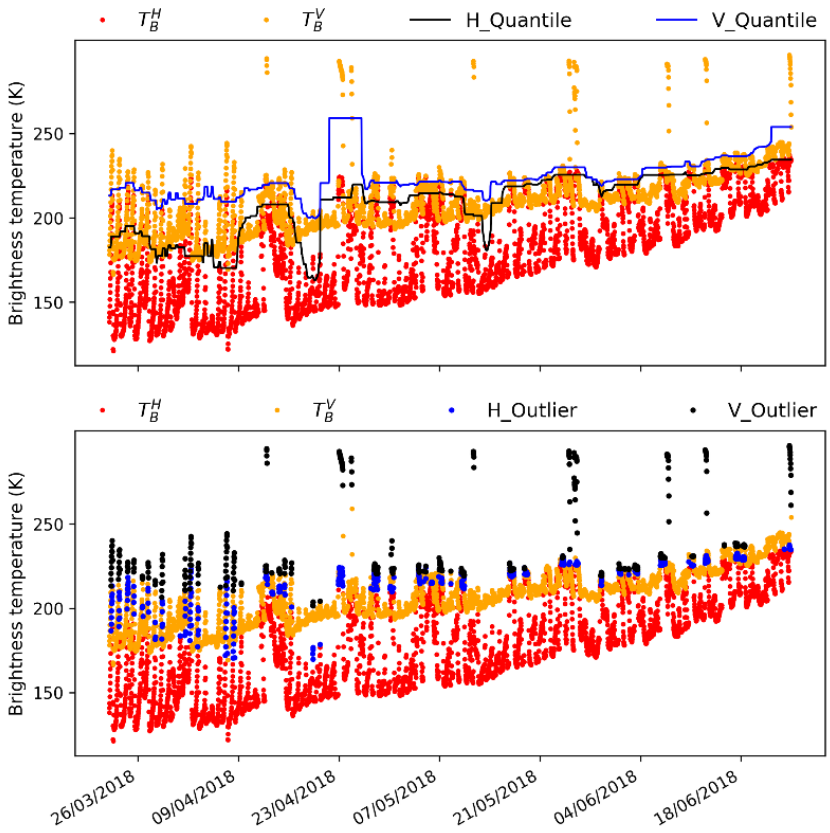



Fig1. Top panel shows original $T_B^p$ with calculated quantile $T_B^p$. Bottom panel shows original $T_B^p$ and identified outliers by procedures taken in terms of information in the top panel. The results seem ok, if black dots presented during 26/03/2018 and 09/04/2018 are not your objects, please maybe just keep it from masking. Fig. A1 in the Appendix shows the same as in Fig.1 but for the period of 09/04/2018 to 25/06/2018.

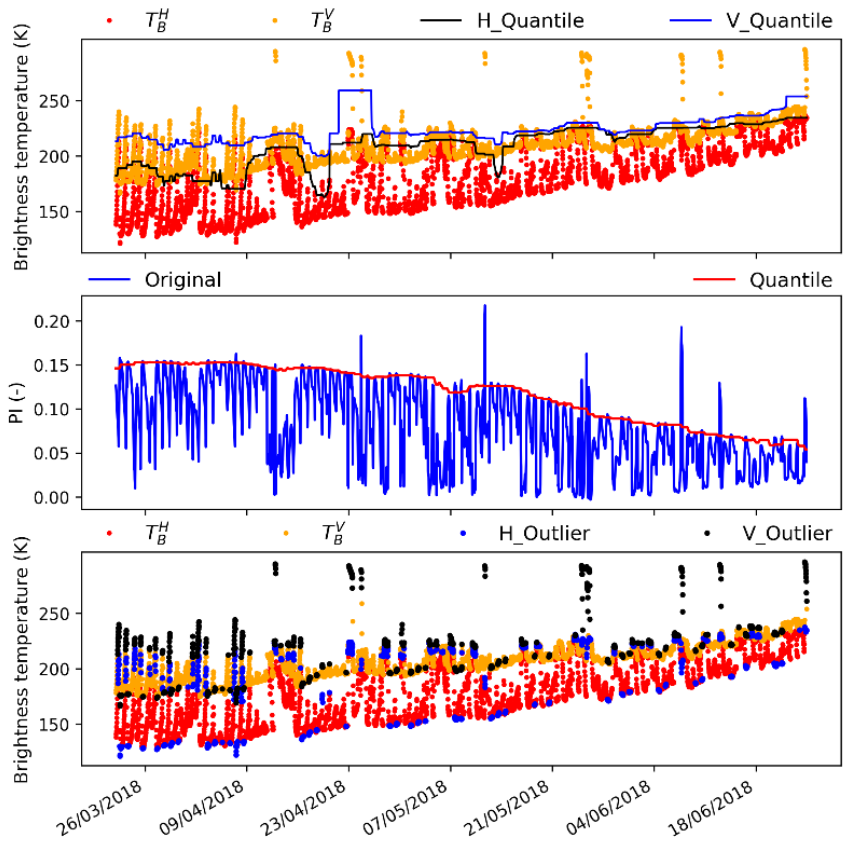



Fig2. Top panel shows original $T_B^p$ with calculated quantile $T_B^p$. Middle panel shows PI with its quantile ones. Bottom panel shows original $T_B^p$ and identified outliers by procedures taken in terms of information in the top and middle panels. Fig1. shows extra 'outliers' that have minimum values are identified. The identified 'outliers' that have maximum values are the same as in Fig.1. Therefore, (Eq.1) is sufficient for outliers mask.

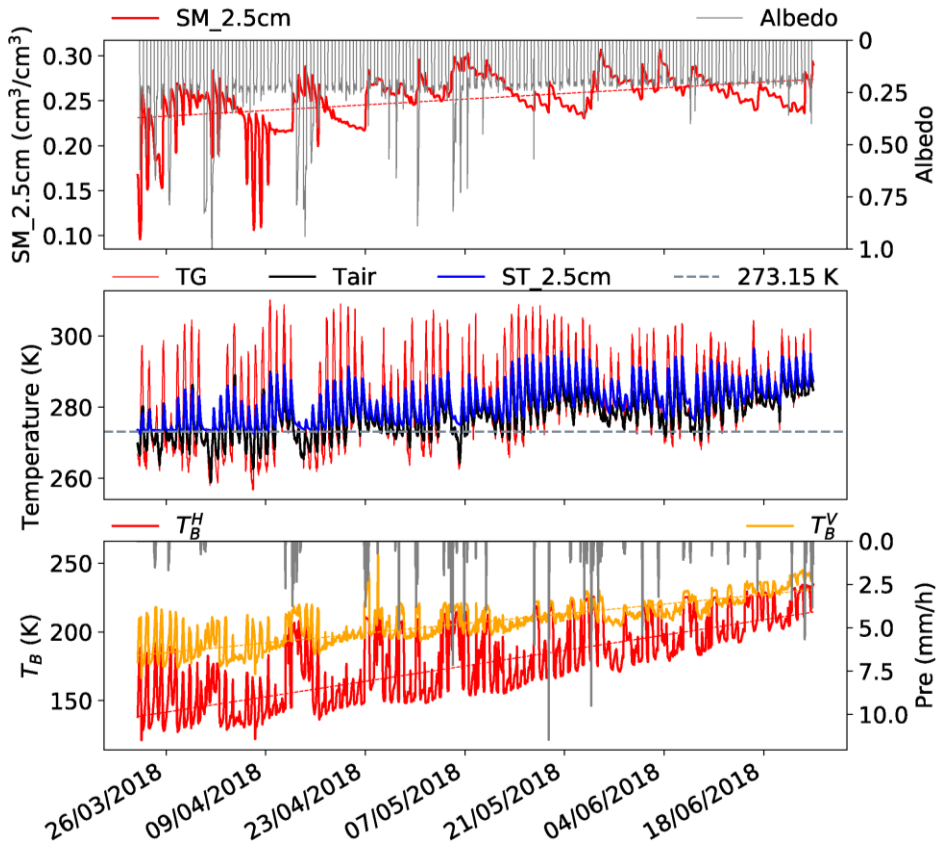
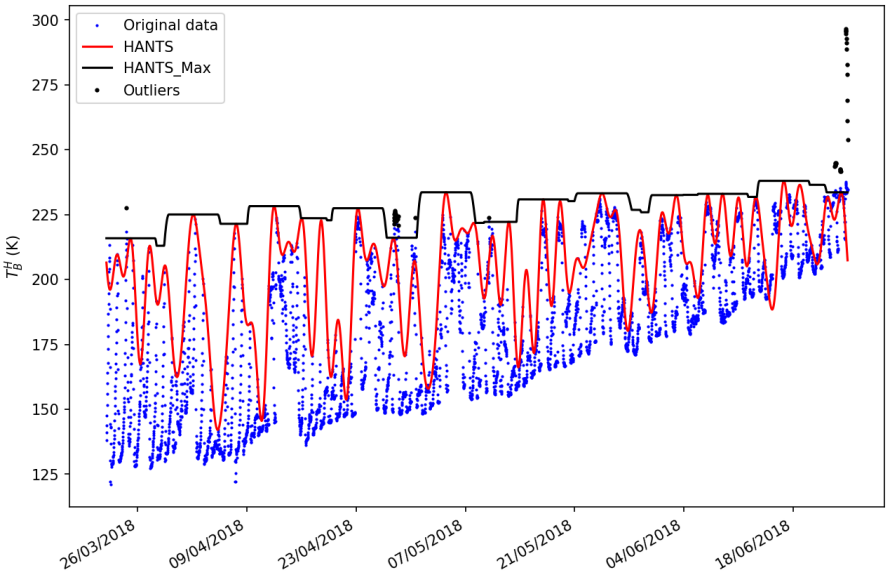



Fig. 3 Seasonal variations of the Maqu ELBARA-III radiometry dataset for pre-monsoon period (late March to late June), in which $T_B^p$ displayed in the figure are based on quantile filtering in terms of Fig. 1. Please to note the plotted Fig.3 based on raw data is Fig. 5 in Su et al. (2020), Sci. Data.



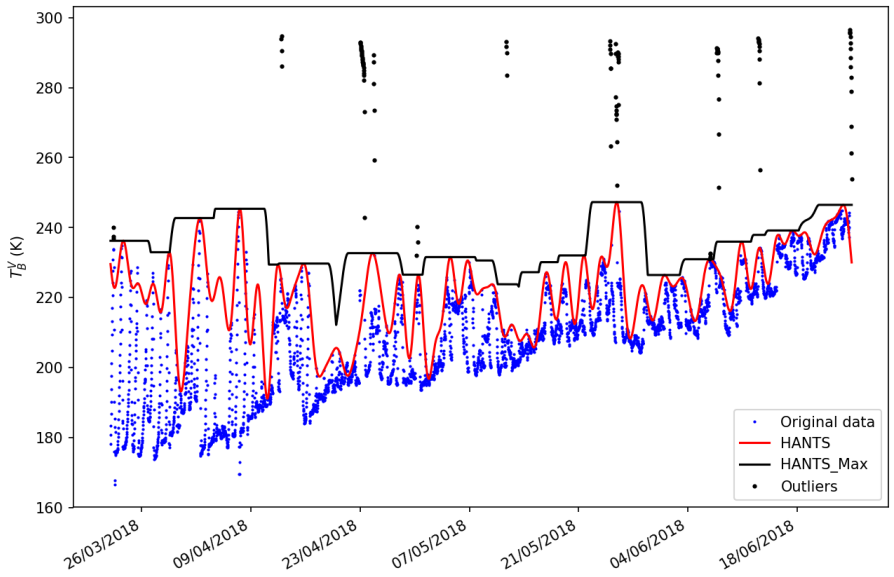



Fig. 4 *In situ* $T_B^p$ and filtered ones based on using HANTS algorithm. It shows that $T_B^p$ outliers can be effectively detected by using HANTS algorithm, and the results is better than those show in Fig. 1 by quantile filtering of $T_B^p$.

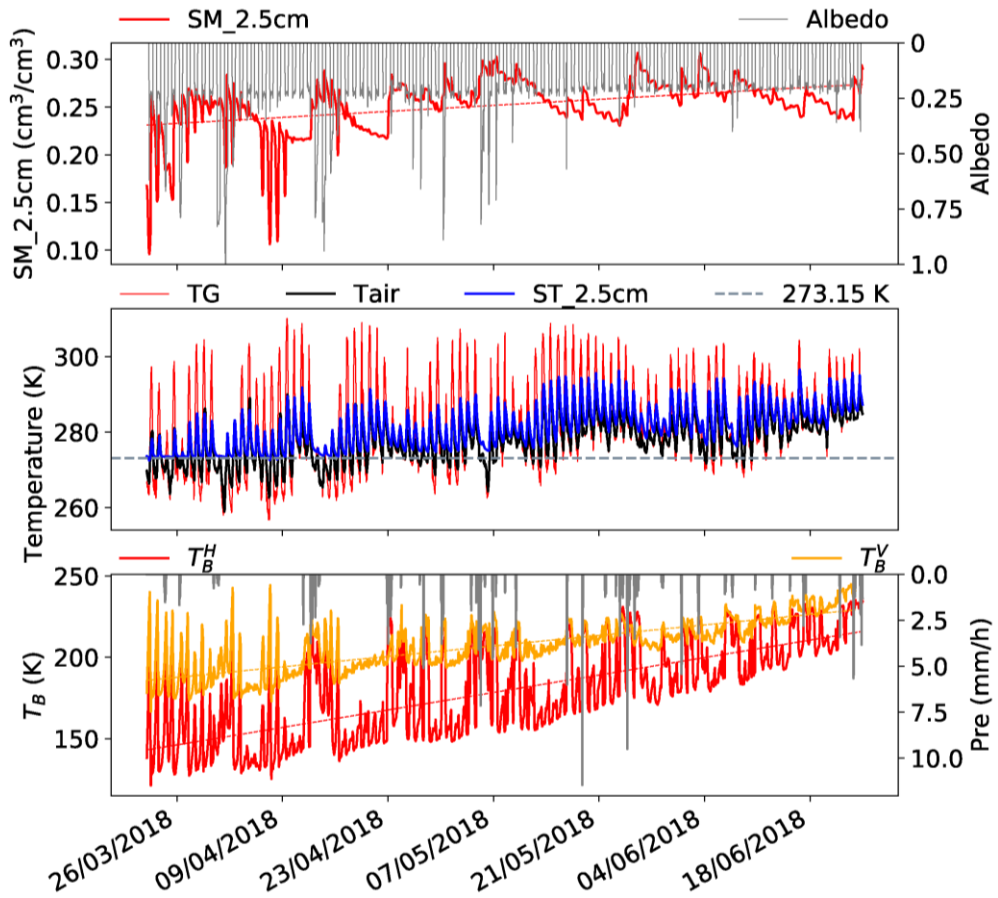


Fig. 5 Seasonal variations of the Maqu ELBARA-III radiometry dataset for pre-monsoon period (late March to late June), in which $T_B^p$ displayed in the figure are based on filtering using the HANTS algorithm. Please to note the plotted Fig.5 based on raw data is Fig. 5 in Su et al. (2020), Sci. Data.

## Appendix

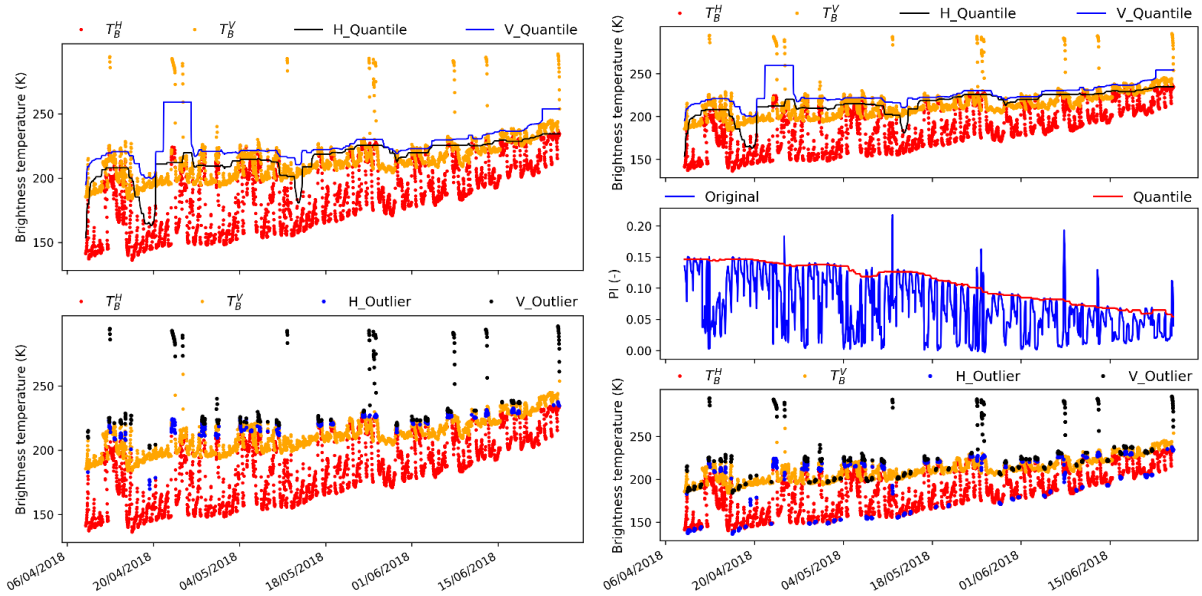



Fig. A1 The same as in Fig.1 and Fig.2 but for the period of 09/04/2018 to 25/06/2018.