



ANALYSIS OF RADIO FREQUENCY INTERFERENCE IN ASCAT-A NORMALISED RADAR CROSS SECTION DATA

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Goal

- ▶ Understand the ASCAT noise behaviour and its temporal long-term variation
- ▶ Detect and characterise any RFI contribution from sources on the Earth
- ▶ Evaluate effects on the ASCAT performances

Data

ASCAT-A Level 1A re-processed data 2007-2013 (v9.1 processor).

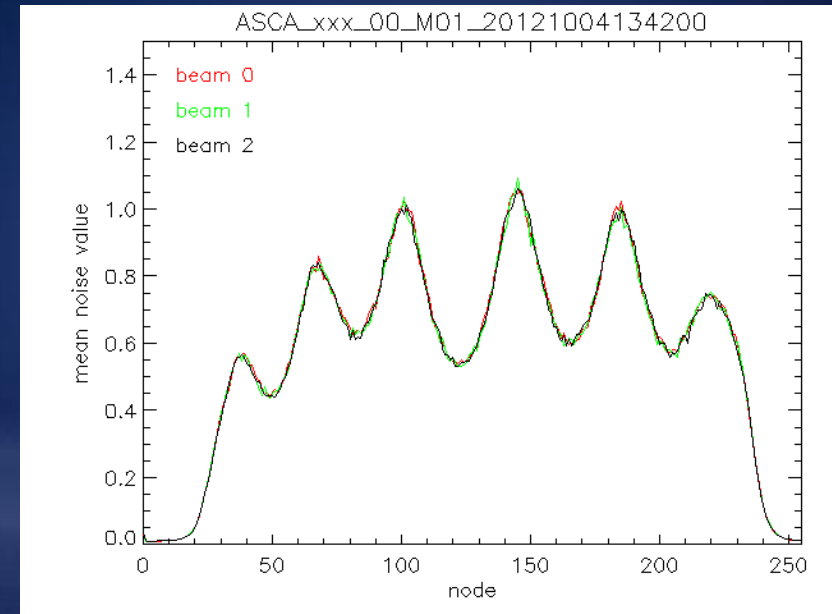
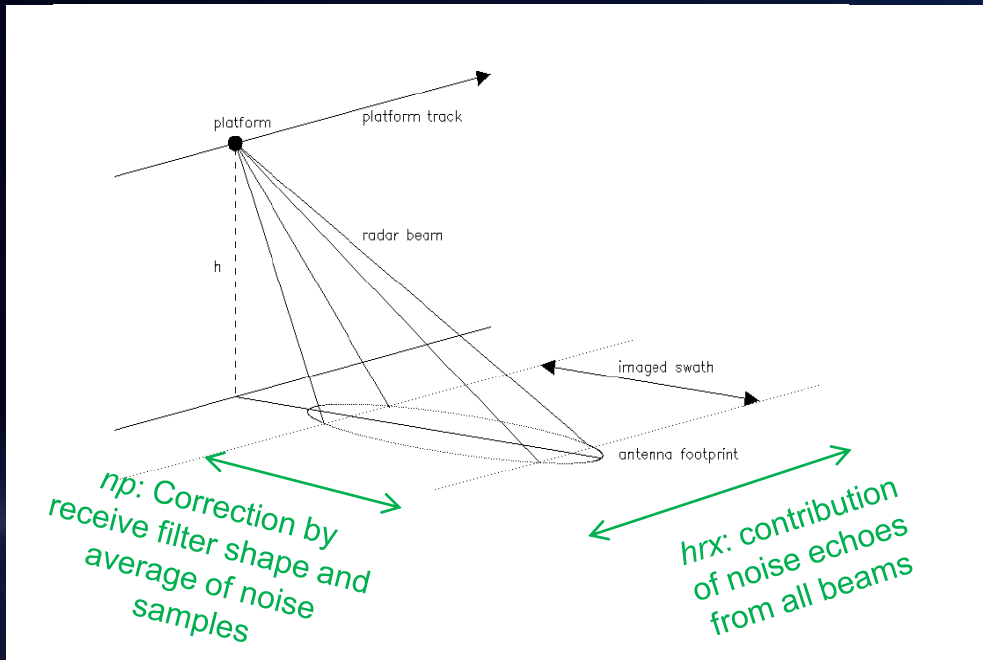
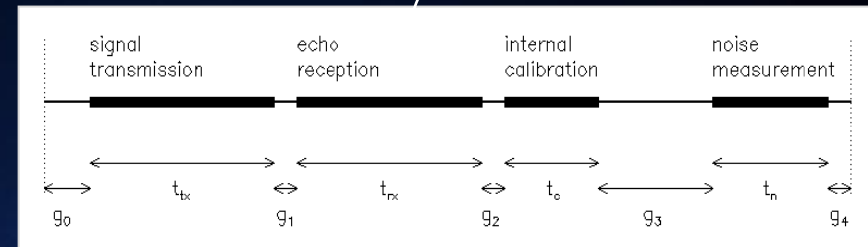
Periods used in the analysis:

- Jan-Dec 2007
- Jan-Dec 2013

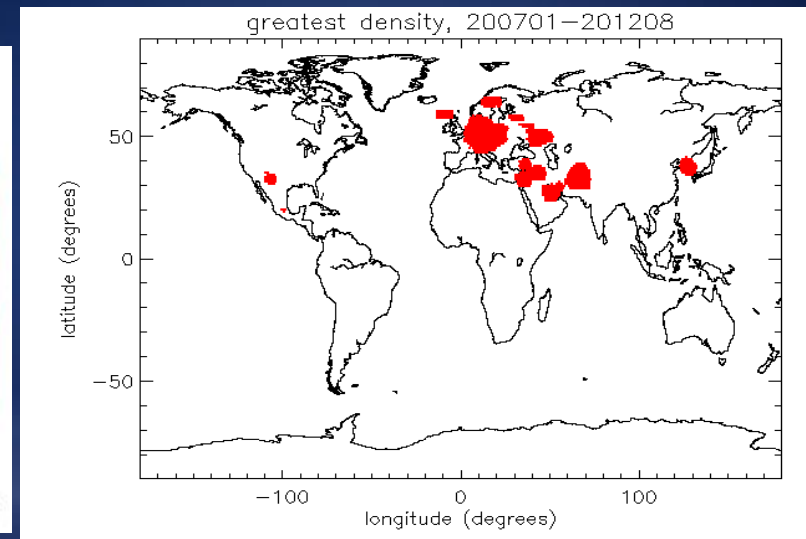
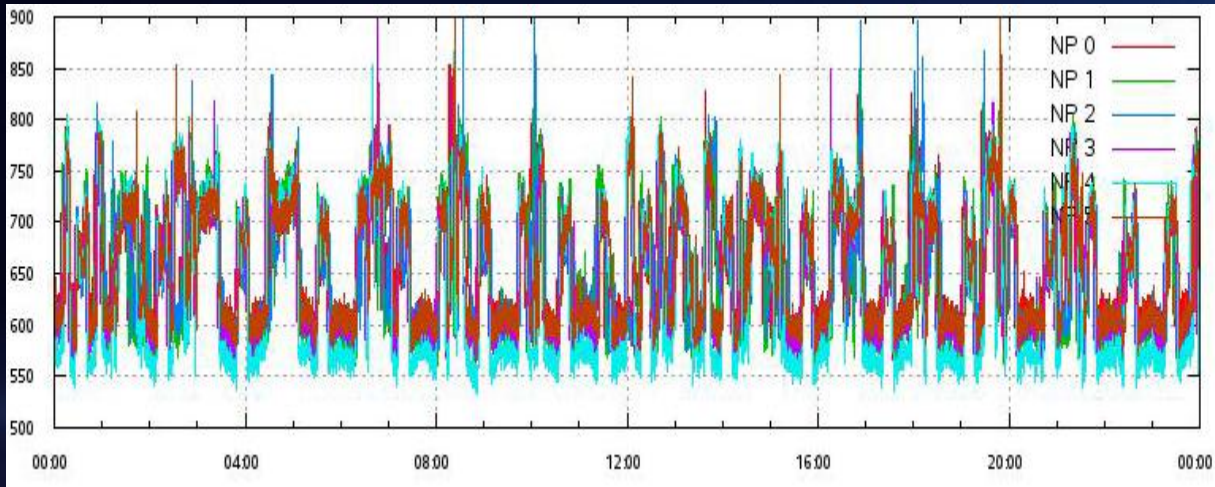
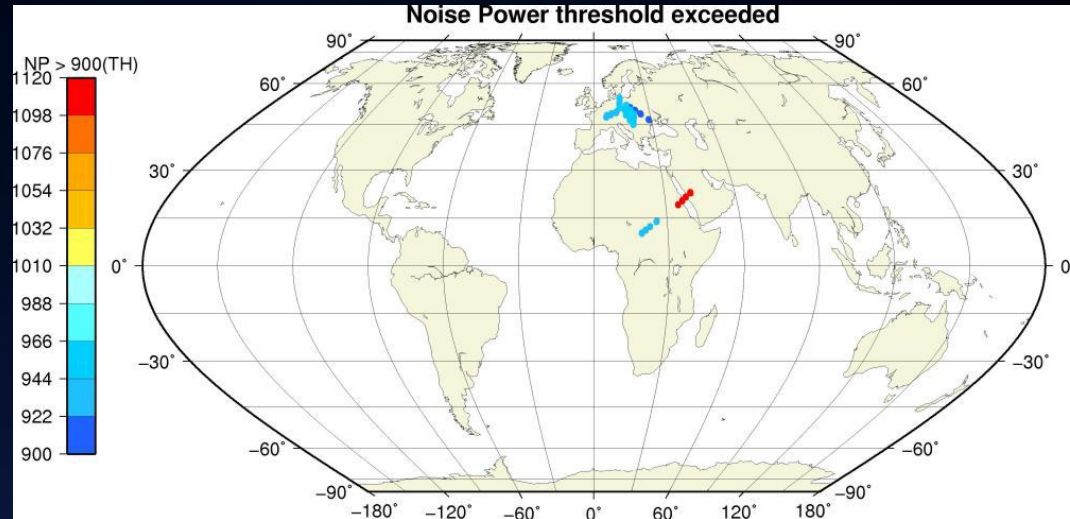
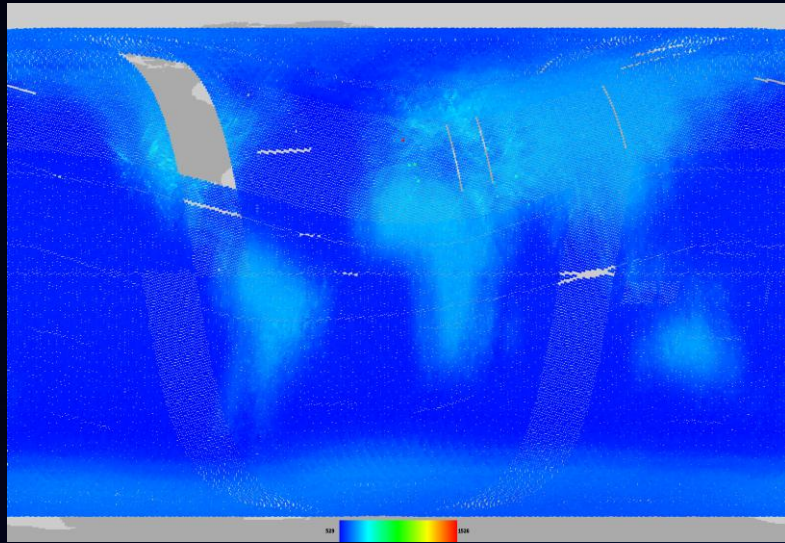
$$np = \frac{1}{j} \sum_j \frac{N}{h_{RX}}$$

Parameter: **Noise Power (np)**

Noise echo: N



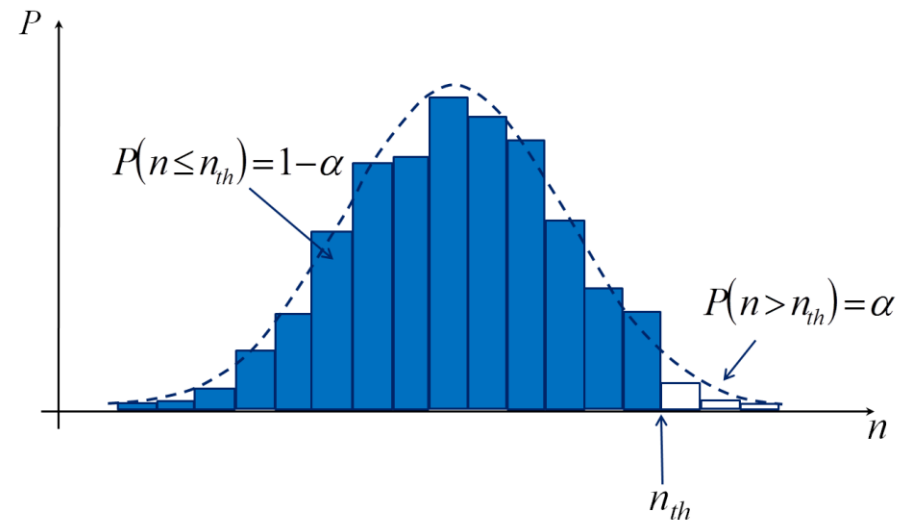
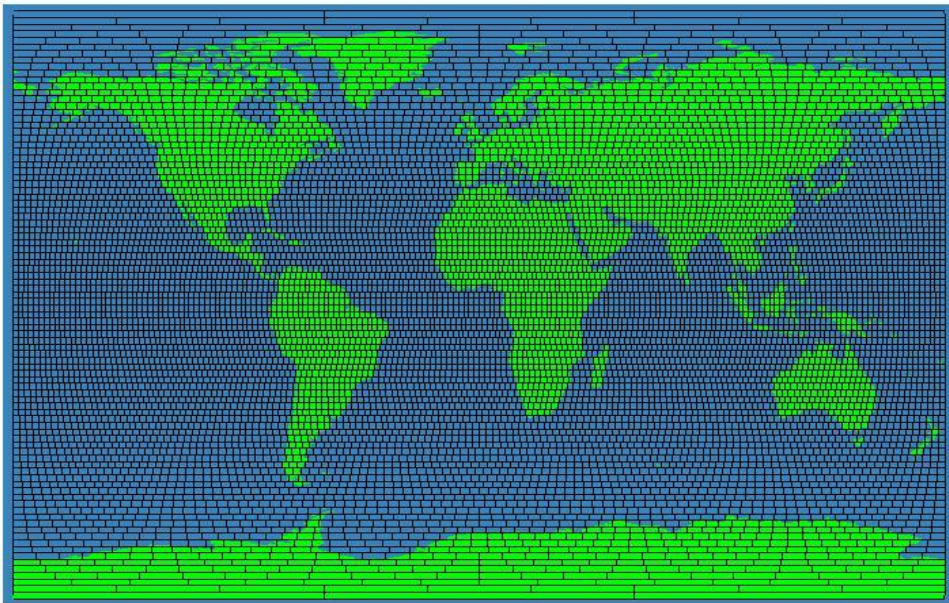
Behaviour



Approach

NP measurements considered random variables, n
Computation of the noise value n_{th} that is likely to identify the interval $[0, n_{th}]$ which contains the radar noise measurements with a probability equal to $1-\alpha$, α being 0.05.

Gaussian Grid



$$Nth_{\max} = \max_{lat_i, lon_i, b, y} \{n_{th}\}$$

$$i = 1 \dots N_{gc}$$

$$b = 0 \dots 5$$

$$y = \{2007, 2013\}$$

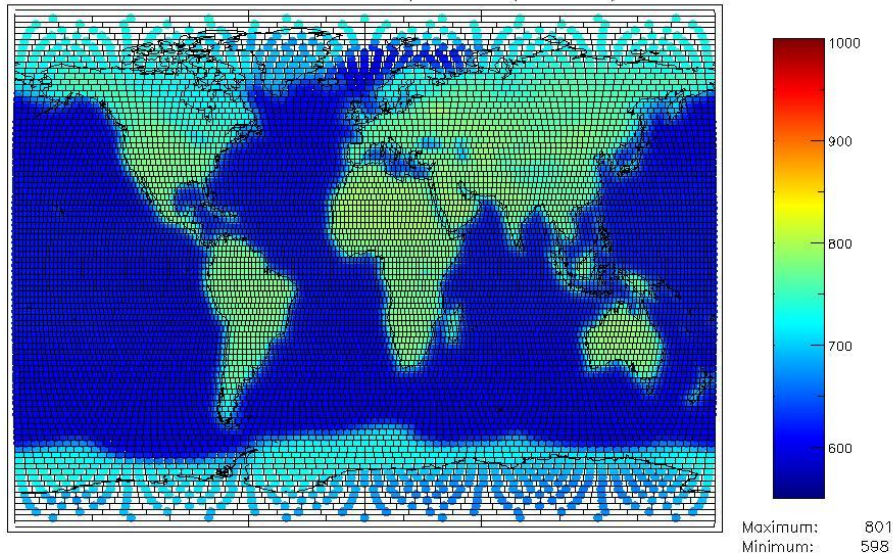
Absolute reference to define outliers

Methodology applied

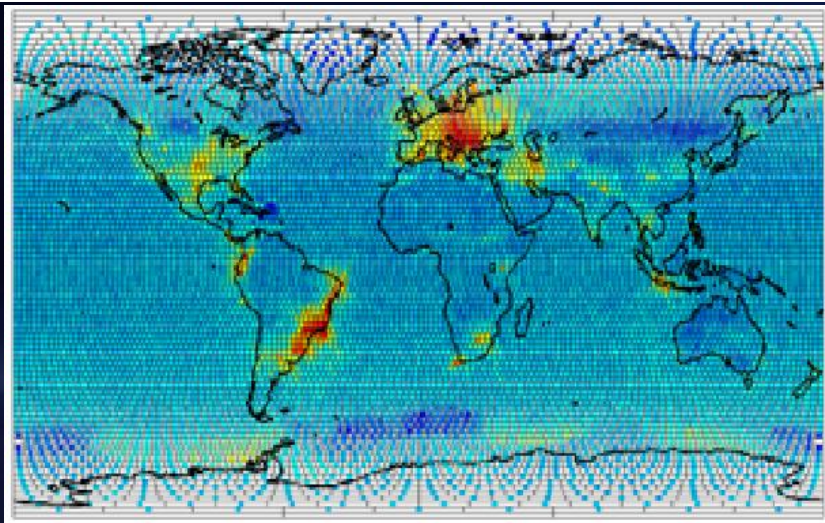
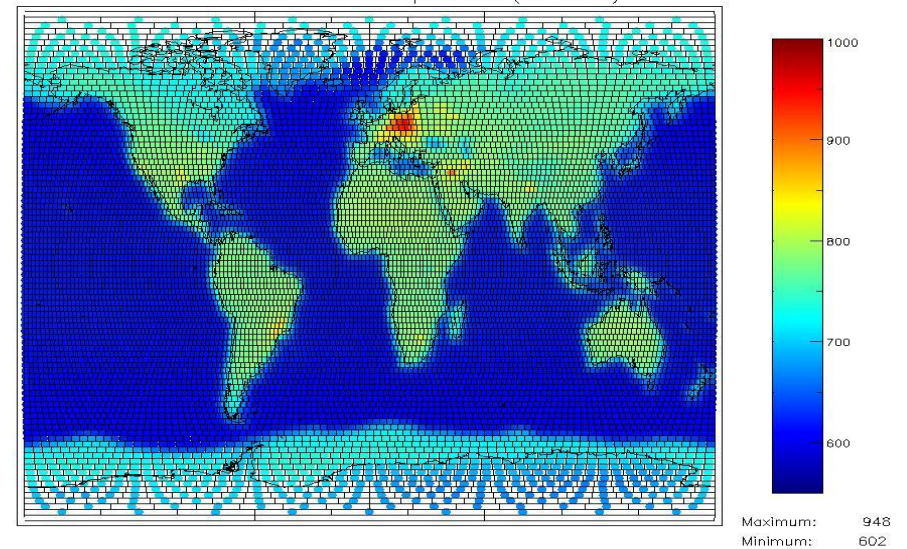
- ▶ Gaussian grid used to localise the noise power measurements.
- ▶ Each noise measurement is associated with a particular grid cell if its location (which is taken as the centre of the beam footprint) is within the grid cell considered.
- ▶ The changes in the yearly 95% percentile threshold indicate the changes in the background noise level
- ▶ The maximum threshold for the whole period defines the noise outliers. For each grid cell the following two parameters have been computed:
 - the mean value of the noise powers $> Nth_{max}$
 - the number of occurrences of the noise powers $> Nth_{max}$

Results – 2007/2013: values of n_{th}

2007: Noise value at the 95% percentile (all beams)



2013: Noise value at the 95% percentile (all beams)

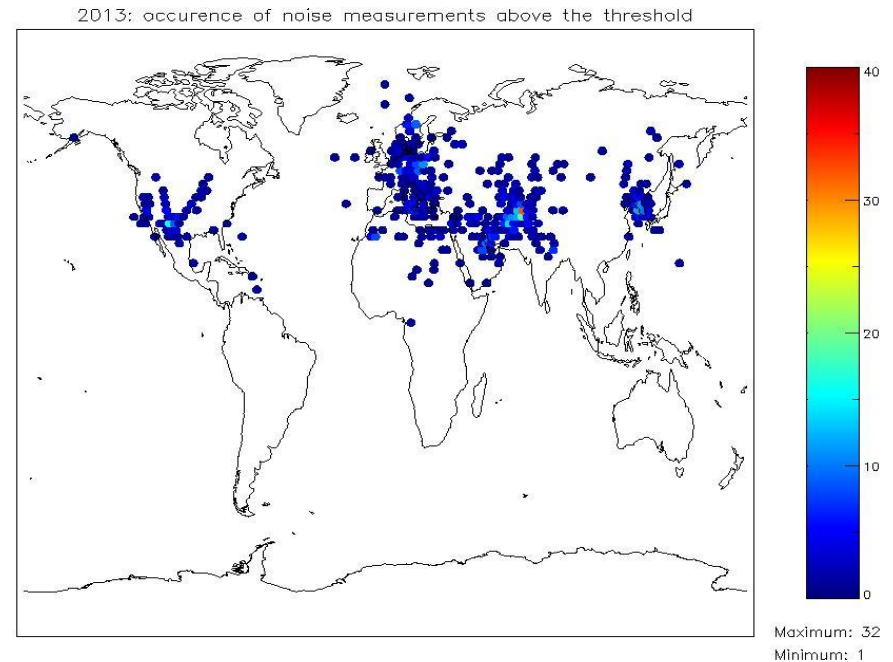
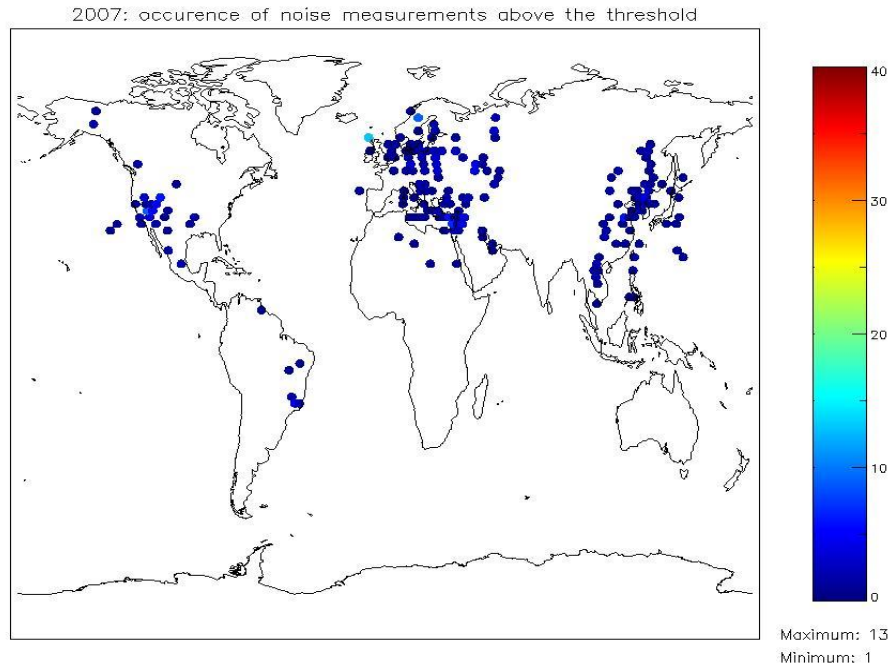


Value of n_{th} for 2007 and 2013

Average
yearly
increase
rate of n_{th}

Increase of the noise
background level of
~1 dB in Eastern Europe

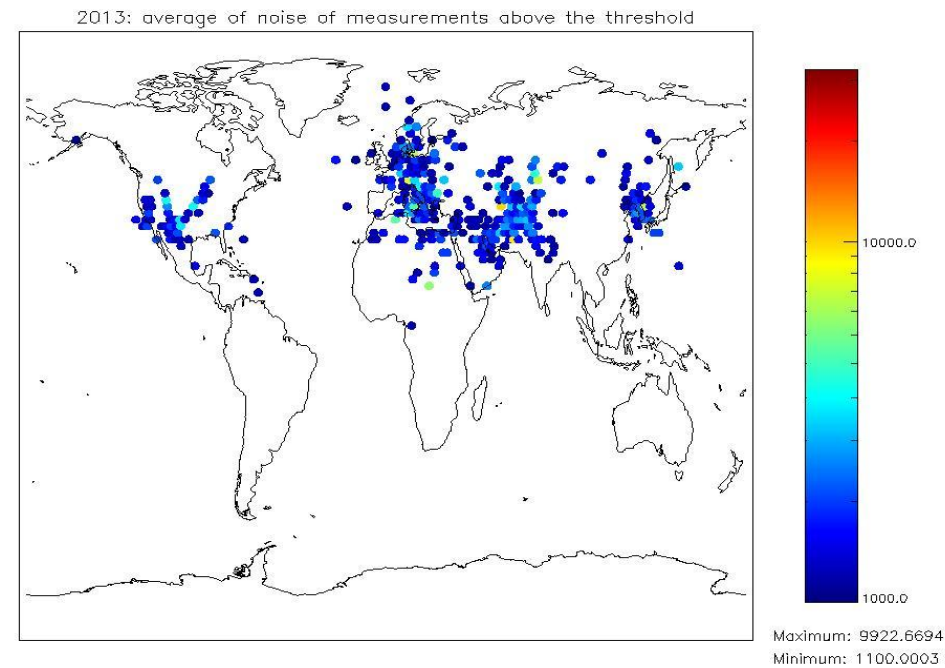
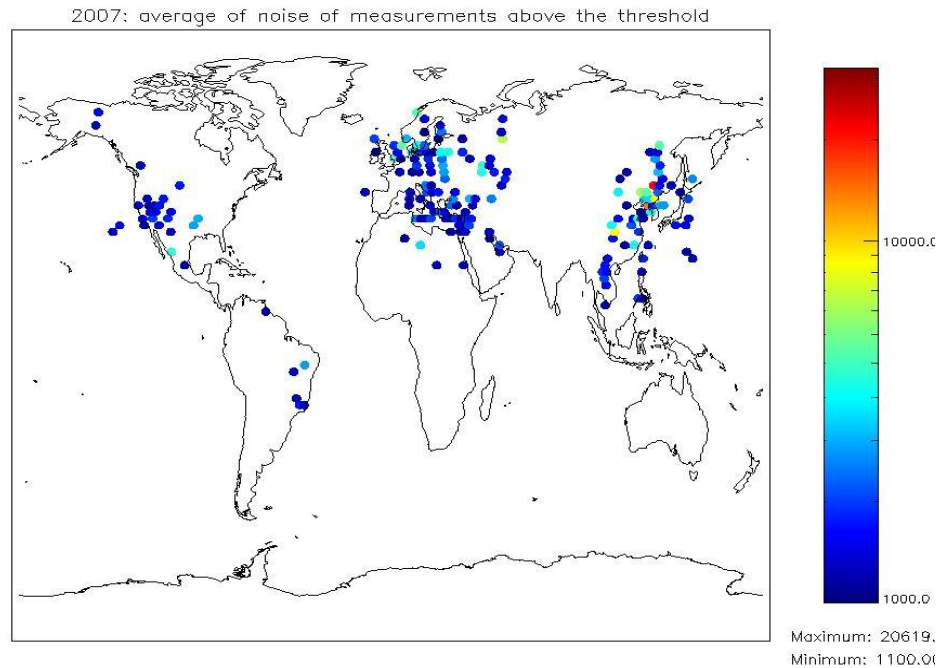
Results – 2007/2013: occurrences of $NP > n_{thmax}$



The number of occurrences has increased from 2007 to 2013

Possible sources: communication systems, air-traffic surveillance radars and other mainly (military-based?) radiation sources

Results – 2007/2013: average NP for NP > n_{thmax}



The highest value of the averaged noise power observed is about 14.4 dB above the typical noise floor over land.

Results

► Understand the ASCAT noise behaviour and its temporal long-term variation

- From 2007 to 2013 an increase of the noise background level of ~ 1 dB has been observed in Eastern Europe, but in most places the general background noise has hardly changed
- From 2007 to 2013 the number of outliers has increased
- The highest outlier value observed over the year 2007 and 2013 is about 14.4 dB above the typical noise floor over land

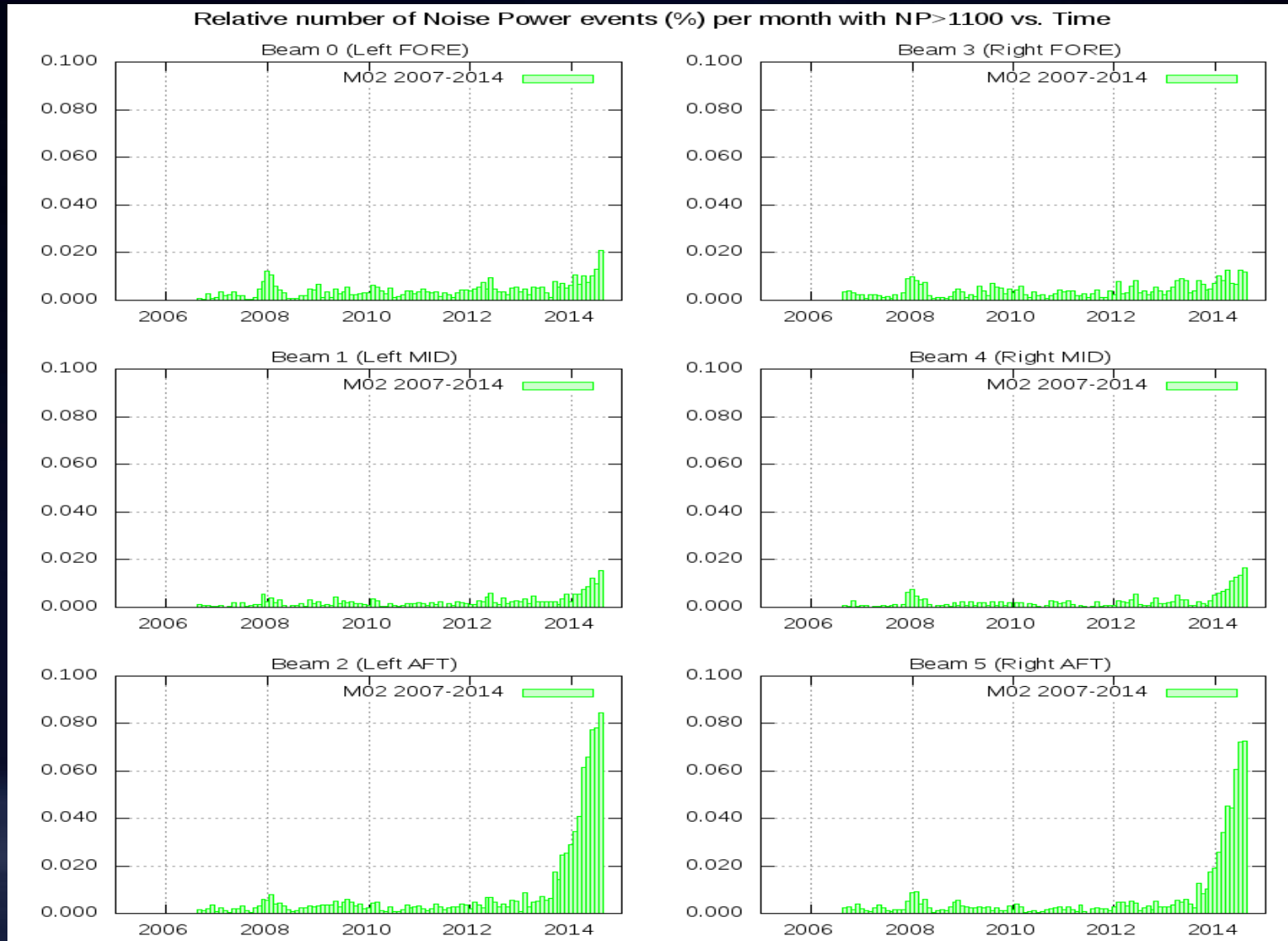
► Detect and characterise any contribution of RFI from other sources on the Earth

- The wireless land networks can be discarded as possible sources because they would have caused an increase of the noise background level almost homogeneous over all land regions
- The geographical location of noise outliers suggests an association with communication systems, air-traffic surveillance radars and other mainly (military-based?) radiation sources

Conclusions

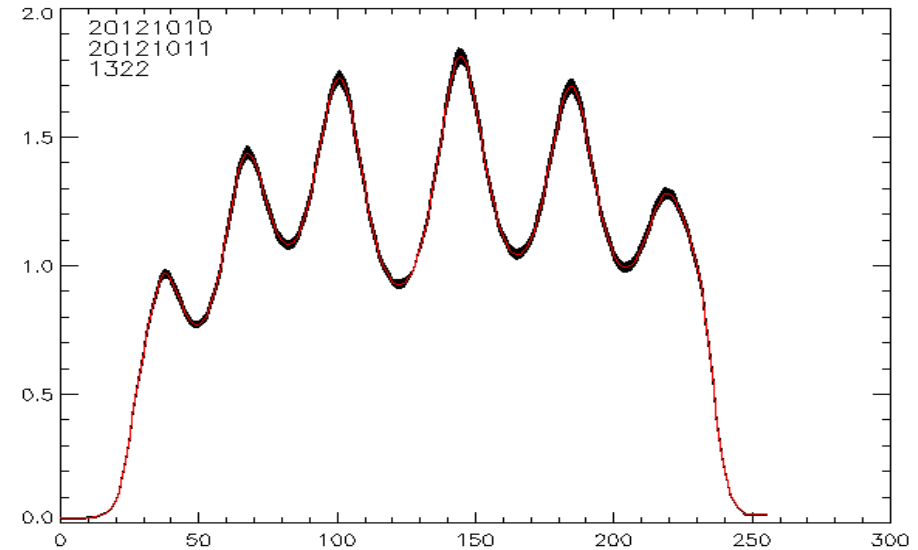
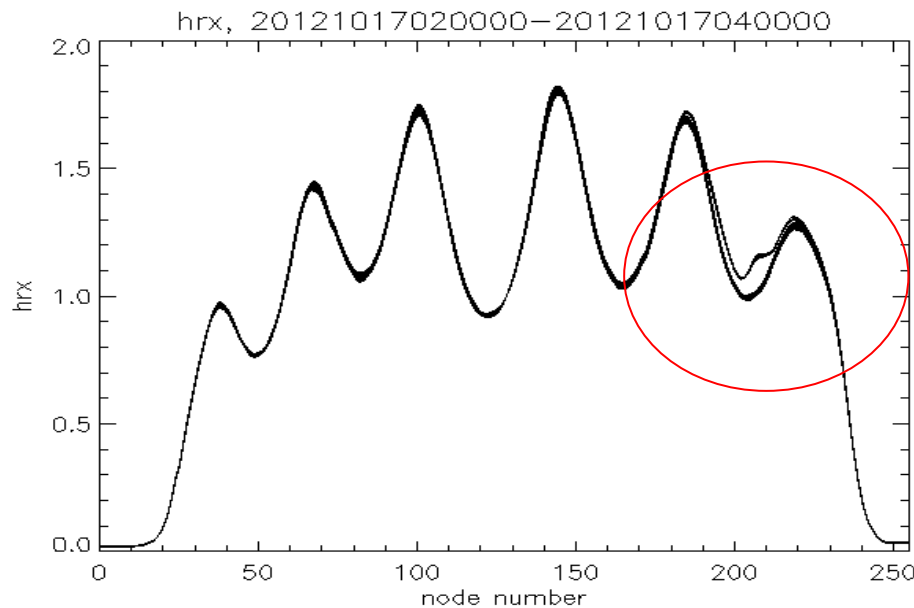
- ▶ Evaluate effects of on the ASCAT performances
 - A 1dB increase in noise floor in a specific place over land has almost no impact on performance, in particular on soil moisture performance, due to the ASCAT dynamic range of 30 dB and to the typical backscattering dynamic range of vegetated land surfaces which varies between $[-15, 0]$ dB.
 - With respect to the outliers, there are two effects
 - On the accuracy of the receive filter shape estimation: Starting with the ASCAT Level 1 v 9.2 processor version, noise outliers are being removed from the calculation of the receive filter shape
 - On the NP correction for the full echo: in this case, the only option is to flag the data.

Evolution in the last year- Different AFT beam behaviour?



Thanks

Mitigation of impact on products



Removal of high noise values before the estimation of the receive filter shape