DEPLOYMENT OF THE ASCAT CALIBRATION TRANSPONDERS

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ABSTRACT

During the development programme, it was determined that the Advanced Scatterometer Radar, now embarked on METOP-A could not meet its stringent radiometric requirements without regular, accurate, calibration. It was not believed that the stability requirements of 0.2dB or better could be met by natural sources such as rain forest or simple corner reflectors, so three highly stable return signal sources were required, precisely sited to give accurate measures of the beam patterns over the satellite repeat cycle, and situated in an area where the calibration function would interfere as little as possible with the nominal operation of the Scatterometer; this Scatterometer was to be an operational instrument, not an experiment, and thus required to provide full coverage over all the oceans. Accordingly it was determined that Turkey would be the best site as the Black Sea and Eastern Mediterranean are not used in the Scatterometer data acquisition programme.

As a result, three calibration transponders have been installed in Turkey to provide through life support to the Advanced Scatterometer radar on board METOP-A. They have now completed two month-long calibration campaigns with the satellite, and produced excellent results. Monthly four day routine campaigns are also implemented to support operational use of ASCAT data. The means to deliver radiometrically characterised responses at a configurable delay and record the received pulse offer demonstrable advantages over vicarious techniques which make assumptions upon the physical properties of calibration sites.

The transponders track the satellite as it passes over, each using a single Potter Horn for reception and transmission. The on-mount transmitter – receiver assembly provides gain-stabilised down-conversion and up-conversion over a wide range of operating temperatures, giving a very precise target return to the

radar, simulating an exactly specified target echoing area of 98.10dBsm (equivalent to > 2300m^2 trihedral reflector). The transponder characteristics are as in Table 1.

Azimuth Range	±256º
Elevation Range	-20to70º
Pointing/datation	±0.27º/ 1ms
Wind (operate/survive)	90/160kph
Op Temperature Range	-15 to50ºC
Radar Cross-section	98.1±0.05dBm^2
Sampling rate	30Msam/s
Pulse delay	22.3-47.7ms
Pulse delay accuracy	153nS (RSS)
Repetition frequency	5-30Hz
Height/Diameter	1.25/1.5m
Mass (local/rack)	245/122kg

Table 1: Transponder Characteristics

The transponder not only receives and retransmits the radar pulses, but also stores data about the received signals and captures pulse for separate analysis. This allows the performance of the radar to be separately assessed in both downlink and uplink, a powerful tool for diagnosis of performance issues. Figure 1 shows beam patterns of METOP-A captured during system commissioning.

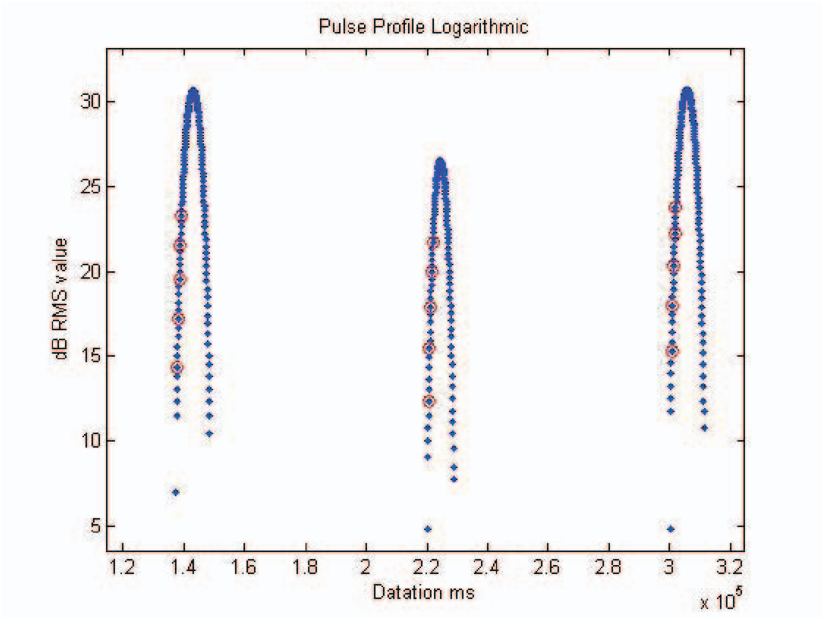

Figure 1: METOP-A ASCAT Beam Patterns Recreated from Data Captured in the Satellite In Orbit Verification Phase

Installation at three remote sites on the Anatolian Plateau brought its own particular challenges and lessons were learnt particularly in terms of logistics and support aspects, and the importance of local knowledge.

The lessons learnt from ASCAT will be invaluable in improving the availability of future transponders. In particular it is necessary to introduce appropriate maintainability and reliability into the requirements and design of calibration transponders. Novel approaches to reducing the complexity of transponder implementation whilst maintaining performance for future missions need to be considered.

The ability to properly record & characterise the received signal and transmit a response with the necessary stability of radar cross section, amplitude, phase and delay precision can greatly improve calibration and improve the quality of all multi-temporal SAR products. The challenge will be to use the most appropriate technologies to do this affordably over the entire operational lifetime.

11. REFERENCES

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