A FIRST ANALYSIS OF THE VALLIRANA RADAR DATA QUALITY AND ITS CONTRIBUTION TO THE RADAR NETWORK OF THE METEOROLOGICAL SERVICE OF CATALONIA (XRAD)

Oriol Argemí*, Patricia Altube and Tomeu Rigo

***Corresponding address: oriol.argemi@gencat.cat**

(1) Meteorological Service of Catalonia, Barcelona, Catalonia

ABSTRACT: In 2012, the **Vallirana radar** (**PBE**) had a critical leveling pointing problem, among other issues, that arose because the antenna system was outdated and the tower was too old. From January 2013 to September 2016, the operation of this radar was interrupted, the unsuitable tower was replaced for a new, reinforced one and the antenna-pedestal system was upgraded to the 'standard' XRAD module, Orbit AL-1017-1E, in order to match the specifications of the rest of the XRAD radars.

With these changes and the corresponding reception chain configuration, the PBE data has been included in the XRAD composite, improving the reflectivity data field coverage over Catalonia, especially over the **Metropolitan Area of Barcelona** (**MAB**), which is one of the most populated areas of South Europe, also with high precipitation rates and frequently affected by floods and severe weather.

1 TECHNICAL INFORMATION

New tower (building)

Antenna Orbit AL-1017

XRAD Technologies: PBE old /new

ITEMS	PBE OLD	PBE NEW	XRAD MODEL
Radar Model	Kavouras TDR-3070	Mixed	MCV EXTOP-03
Emitter (Tx)	TWTA Kavouras / CPIVTC-5262B1K1061		Applied TWTA 177C / Teledyne MEC-3094ª
Receiver (Rx)	Vaisala–Sigmet IFD	Vaisala WRF 132 (Adapted) + RVP901 IFD	Vaisala–Sigmet IFD
Processor	Vaisala RVP8	Vaisala RVP902	Vaisala RVP8
Controller	Vaisala RCP8		Vaisala RCP8
Aantenna-Pedestal	Kavouras	Orbit AL-1017-1E	Orbit AL-1017-1E
Antenna Controller	Kavouras	Orbit AL-2613-3J	Orbit AL-2613-3J

Main improvements:

- **Tower and Pedestal: Antenna levelling.**
- **Antenna: Gain, beamwidth and pointing accuracy.**
- **Front-end and Receiver: Dynamic range, range resolution and data processing.**
- **Doppler filter: GMAP configuration.**
- **Tunning fixed filters thresholds: LOG, CSR and SQI.**

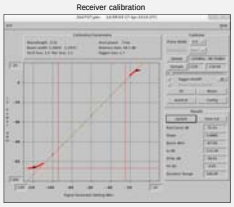
2 RADAR CONFIGURATION AND CALIBRATION

Receiver

RADAR SPECS.	VALUES
Pulse width	5 ms
Antenna Gain (dB)	44.1 dB
Antenna BW (H / V)	1.2º / 1.1º
Peak power	7.5 kW
Frequency	5.648 GHz
IF	60 MHz
Dynamic Range	106 dB
Zcal	-38.0 dBZ
Io	-113.4 dB
Noise	-87.09
IFD / bits	72MHz / 16

PBE configuration and calibration parameters

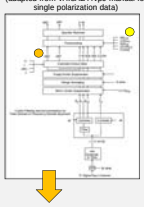
Receiver calibration

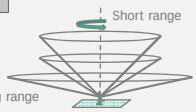


Filters: LOG, SQI and CSR

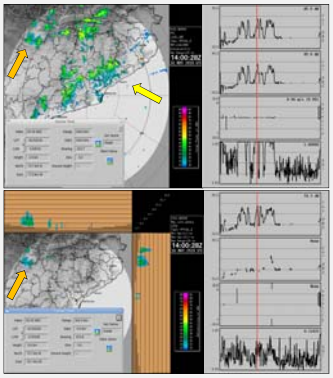
Filters Thresholds [LONG / SHORT (RANGE)]				
Radar Moments	LOG (dB)	SQI (dB)	CSR (dB)	TOTAL
T	1.50 / 0.75	-	-	LOG
Z	1.50 / 0.75	0.20 / 0.20	22 / 18	LOG & SQI & CSR
V	-	0.20 / 0.20	22 / 18	SQI & CSR

(adapted from VAISALA rvp9 manual for single polarization data)



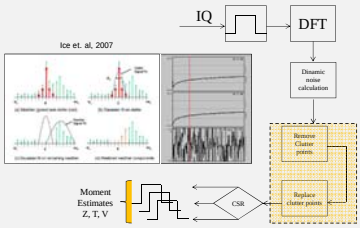


Tasks



Doppler filter: GMAP

(Siggia and Passarelli, 2004)

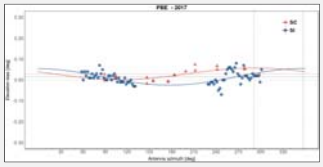


Gaussian Model Adaptive Processing in PBE			
Window	Antenna velocity (°/s)	Number of samples	Spectral width (m/s)
Hamming	24º/s	48	0.300m/s

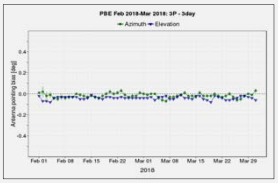
Validation with Sun Calibration
(Altube et al.)

(a) Antenna levelling
(b) Antenna pointing
(c) Receiver calibration

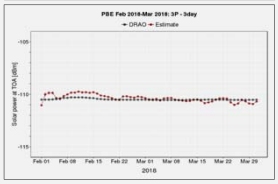
(a)



(b)

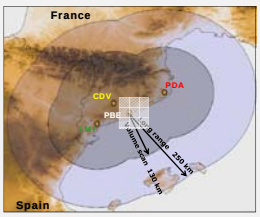


(c)

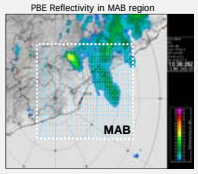


Pedestal levelling: Suncal "IRIS" calibration (SC) vs Sun Interferences (SI) measurements			
	Amplitud (°)	Phase (°)	Offset (°)
SI	0.114±0,005	53,1±2,8	-0,123±0,003
SC	0,094±0,006	58,8±5,5	0,005±0,006

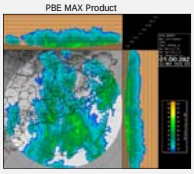
3 COVERAGE AND PRODUCTS



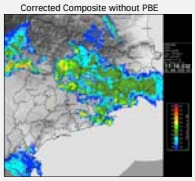
PBE Reflectivity in MAB region



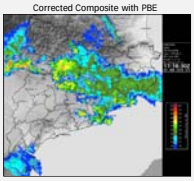
PBE MAX Product



Corrected Composite without PBE



Corrected Composite with PBE

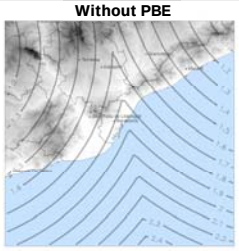


PBE helps to enhance the reflectivity composite field and it is the radar that better covers the Metropolitan Area of Barcelona (MAB)

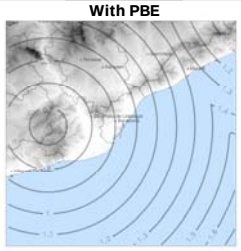
MAB Coverage:
Beam height comparison [km]

Minimum beam heights range [km]		
	without PBE	with PBE
Min	1.002	0.633
Max	2.473	1.750

Without PBE



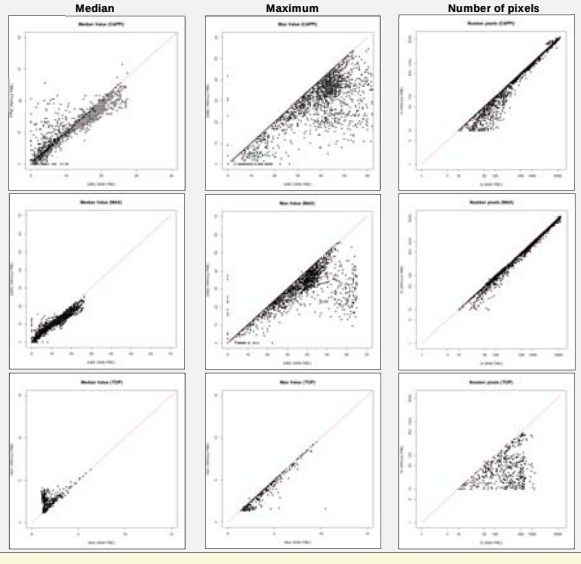
With PBE



Data Quality

Product comparison in MAB with and without PBE:

- **Each composite (6min - time resolution) has been generated with and without the PBE radar.**
- **Time Period: 2018/01/06 00:00:22 UT – 2018/02/08 23:54:23 UT.**
  34 days with rain episodes
  3527 files
- **MAB Area: Lon 1.715173 E – 2.642373 E; Lat 41.0 N – 41.7 N.**
  5852 total pixels (CAPPI 1km)
  5775 total pixels (TOP 12dBZ and MAX)



Results:

- **CAPPI and MAX fields with PBE identify better the maximum values in lower elevations.**
- **The same pattern is observed with the median values despite in this parameter the weight without PBE is higher than the maximum values.**
- **A similar behaviour is observed in the number of pixels, but only on those cases covering the whole region of study.**
- **In the TOP case, the median values are clearly higher as a consequence of the height of the lower beam contribution from the rest of the radars (CDV, LMI and PDA).**
- **The TOP product considering PBE presents results more agree with the reality as it can be deduced from the maximum and the number of pixels.**

References:

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