Quantitative Precipitation Estimation in the French Alps with a dense network of polarimetric X-band radars

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The RHYTMME project

In mountainous regions, the performance of traditional weather radar networks is considerably reduced

- increased ground clutter,
- partial beam blocking,
- measurements made well above the ground,
- increased presence of the bright band in the measurements,
- higher frequency of solid state precipitation (snow, graupel ...).

RHYTMME
(Risques Hydro-météorologiques en Territoires de Montagnes et Méditerranéens)

Objective => to create a forecasting system for hydrometeorological hazards and improve risk management in mountain regions.

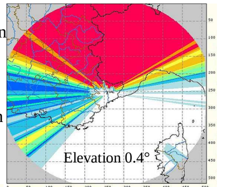
Means => deployment of 4 polarimetric X-band radars in the southern Alps, spaced apart by approximately 60 km, along the period 2010 – 2013.

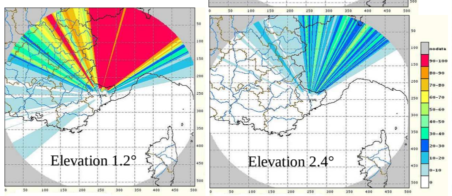
Data from a network of 4 polarimetric X band radars → Polarimetric processing chain → Real time QPE maps to transfer to the local operators

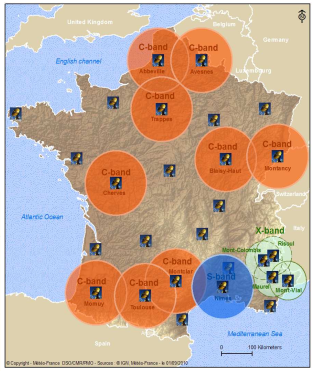
Both radars face challenges due to the orography: beam blockage by the Maritime Alps, north of the radars; sea clutter east of them, as well as the high altitude of their location.

- The effects of topography on the radar wave propagation of the Mont Vial Radar :

The simulations have been performed using the approach proposed by Delrieu et al. (1995).







The tested Pol-QPE algorithms

Z-R relation (with and without attenuation correction)

$Z = aR^b$ <=> $R = (Z/a)^{(1/b)}$

Marshall-Palmer (1948) : a=200 et b=1.6 <=> $R = 0.0365\ Z^{0.625}$

Fulton et al. (1998) : a=300 et b=1.4 <=> $R = 0.017\ Z^{0.714}$

R-K_{DP} relation

$R = c(K_{DP}/f)^d$ f=9.375 GHz (Bande X)

Beard et Chuang (1987) : c=129 et d=0.85 <=> $R = 19.25\ K_{DP}^{0.85}$

Brandes et al. (2002) : c=132 et d=0.791 <=> $R = 23\ K_{DP}^{0.79}$

Synthetic algorithm Z-K_{DP}

Based on threshold of Kdp (0.5º/km) (Approximately 10 mm/h).

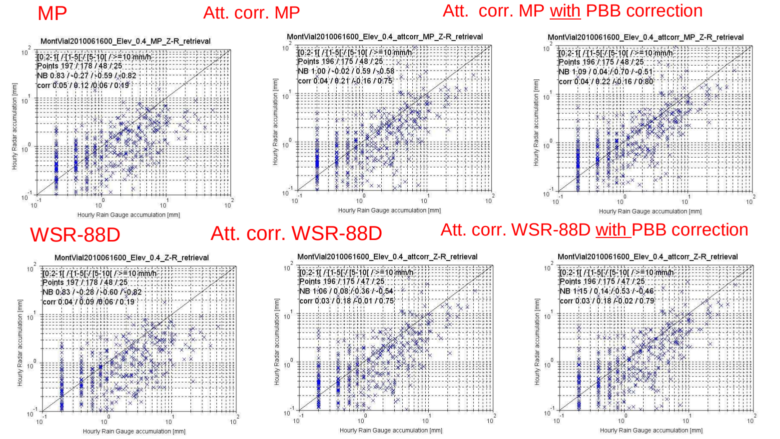
- Z-R relation (with attenuation correction) for K_{dp}<= 0.5 (º/km) (light rain)
- R-K_{dp} relation for K_{dp}> 0.5 (º/km) (moderate to heavy rain)

Z-K_{DP}	Z-R relation (with attenuation correction)	R-K_{dp} relation
Z-$K_{DP\,1}$	Marshall-Palmer (Att. corr. MP)	Beard et Chuang
Z-$K_{DP\,2}$	Marshall-Palmer (Att. corr. MP)	Brandes et al
Z-$K_{DP\,3}$	Fulton et al. (Att. corr WSR-88D)	Beard et Chuang
Z-$K_{DP\,4}$	Fulton et al. (Att. corr. WSR-88D)	Brandes et al

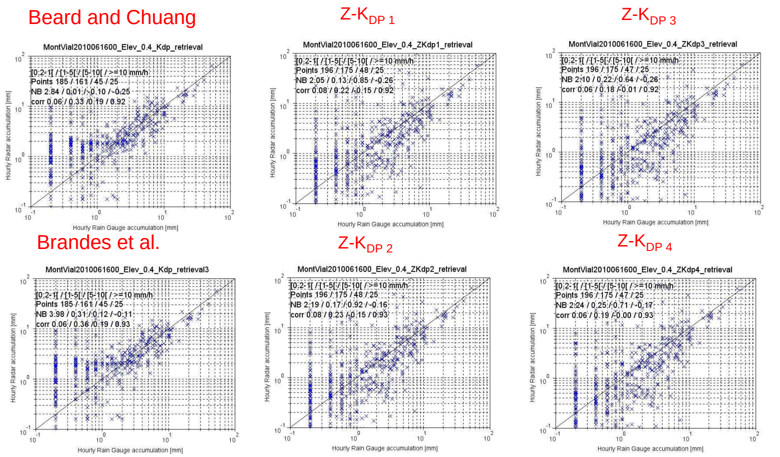
Results of single tilt QPE

Hourly rainfall accumulation : event of 06/15/2010 - elevation 0.4°- distance<60 km -

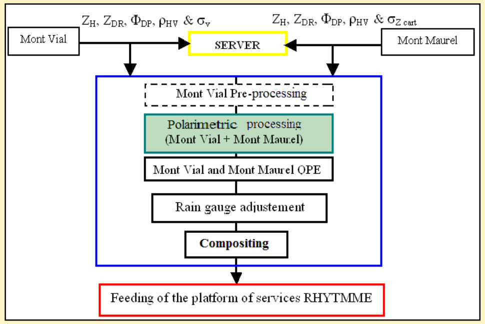
Z-R relation : Attenuation Correction and Partial beam blocking (PBB)Correction



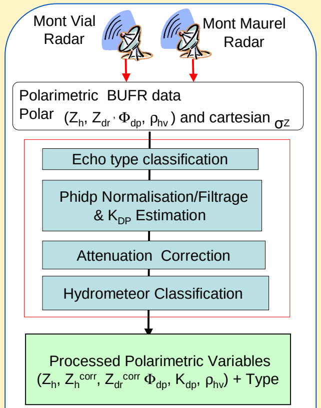
R-K_{dp} relation and Synthetic algorithm Z-K_{DP}



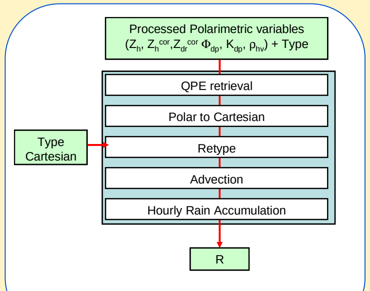
The RHYTMME radar data Processing chain



•The polarimetric processing chain has been adapted from an in-house developed S and C-band processing chain. **Echo type classification** and the **attenuation correction** are heavly dependent on the frequency. Therefore, these modules have been adapted to X-Band.



Flow diagram of the Dual polar chain



Flow diagram of the QPE processing

Acknowledgements

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