

An aerial photograph of a town, likely in the French Alps, is shown from a high angle. The town is surrounded by green hills and is partially obscured by a thick layer of white clouds. Overlaid on the bottom left of the image is a white weather map showing isobars and wind vectors. The background of the slide is a dark blue gradient with a stylized sun and cloud icon in the top left corner.

The French radar network Past, Present and Future

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Centre de Météorologie Radar
Meteo-France



Outline of the presentation

- Evolution of the French metropolitan radar network
- Radar QPE: are we really making progress ?
- Challenges, questions & perspectives

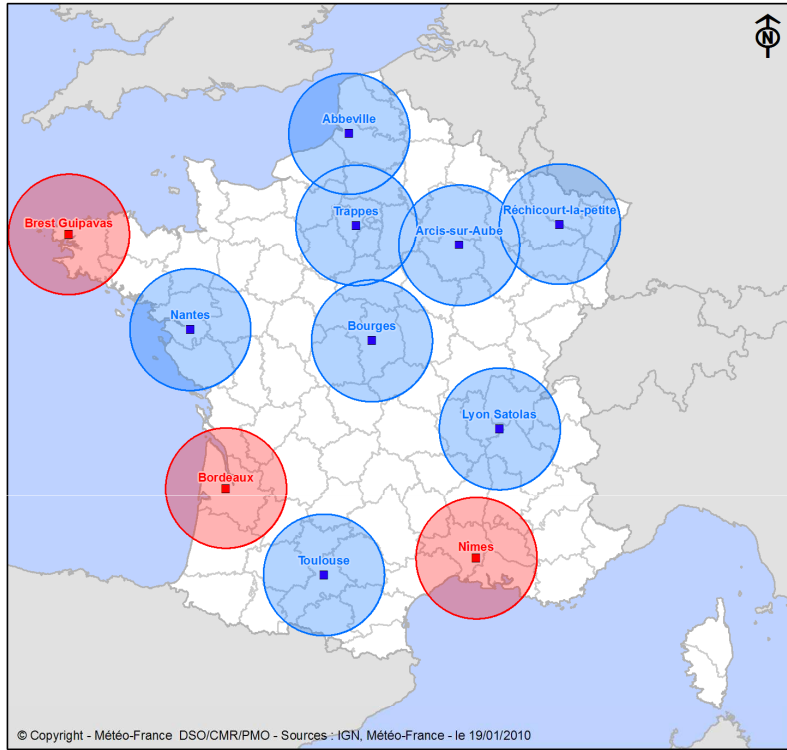
Evolution of the French metropolitan radar network

- ❑ **1991** : 11 radars – none Doppler – none polarimetric
- ❑ **2002** : 18 radars – none Doppler – none polarimetric
- ❑ **2002-2007** : **PANTHERE** Project
 - ✓ Addition of 6 new radar sites – 24 radars
 - ✓ 2 renewals
 - ✓ Introduction of « new » technologies: DPOL & DOPPLER (Triple-PRT)
- ❑ **2012**: 26 radars – all Doppler
 - ✓ 18 C band (13 DPOL)
 - ✓ 6 S band (2 DPOL)
 - ✓ 2 X band « gap fillers » (DPOL)

} 17 DPOL
- ❑ **2012-2017**: **RHYTMME, PUMA & LEOPARD** Projects → ~35 radars in 2017
 - ✓ 19 C band (19 DPOL)
 - ✓ 5 S band (2 DPOL)
 - ✓ 8 X band « gap fillers » (DPOL)
 - ✓ 2 - 5 dedicated X-band Airport DPOL radars

} ~32 DPOL

1991



0 100 200 300 400 500 Kilomètres

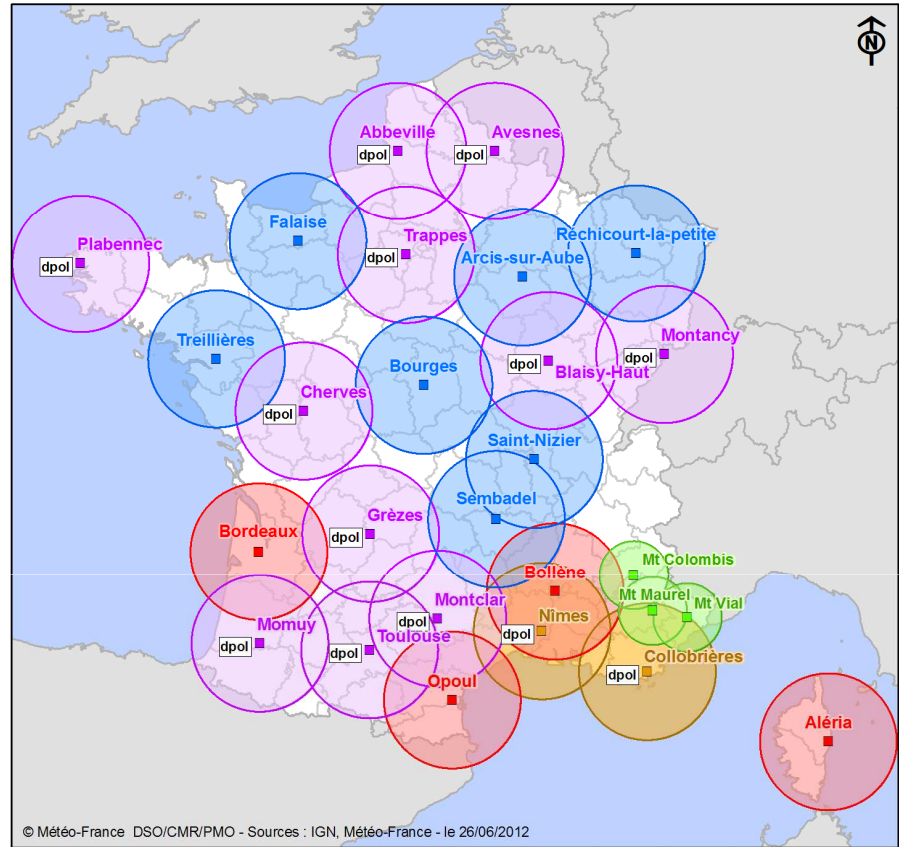
Légende

Type de radar

- bande S (10 cm)
- bande C (5 cm)

METEO FRANCE
Toujours un temps d'avance

End of 2012

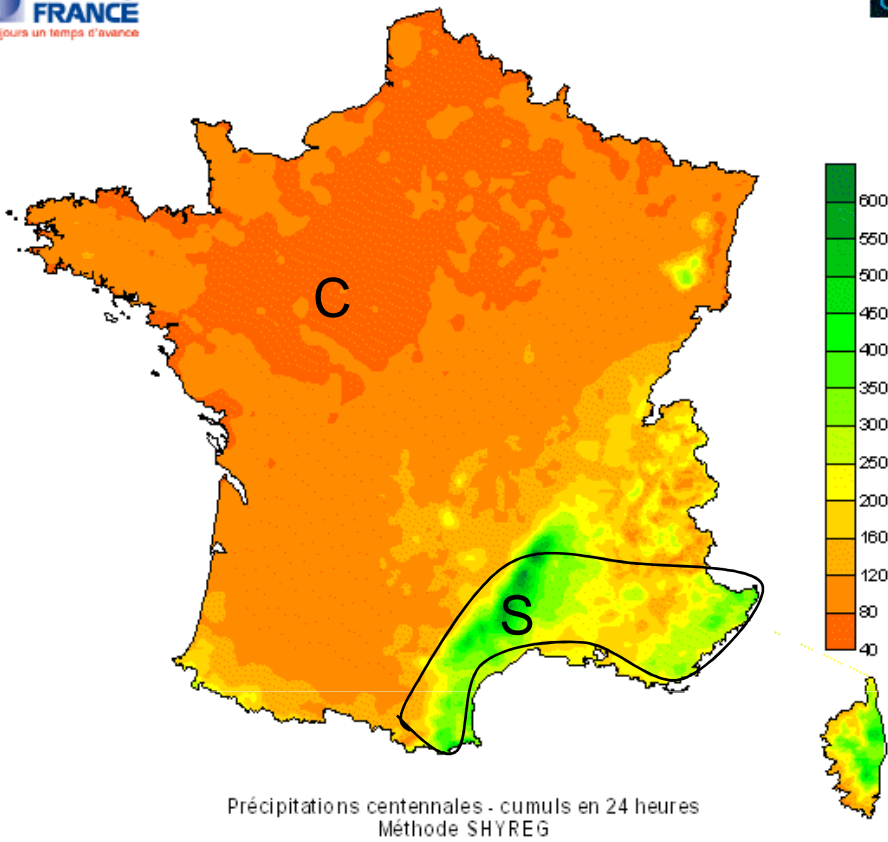


0 100 200 300 400 500 Kilomètres

Legend

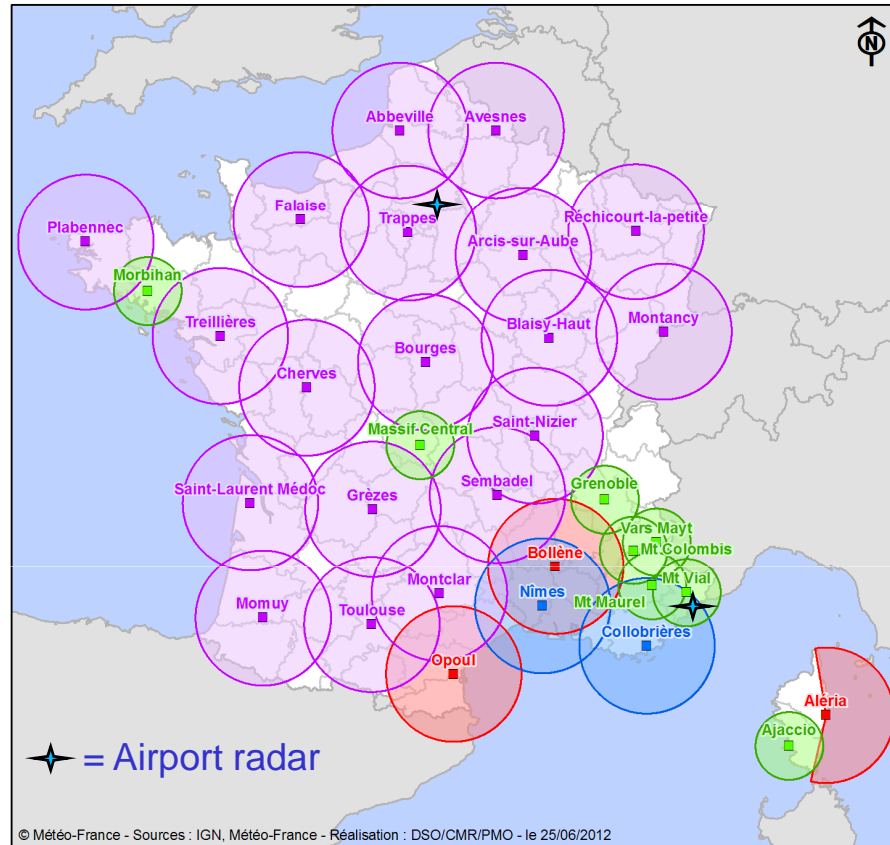
- S band
 - S band dpol
 - C band
 - C band dpol
 - X band, radar RYTHMME
- dpol : dual polarization

METEO FRANCE
Toujours un temps d'avance



24h rainfall accumulation associated with a 100 year return period

2017

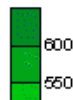
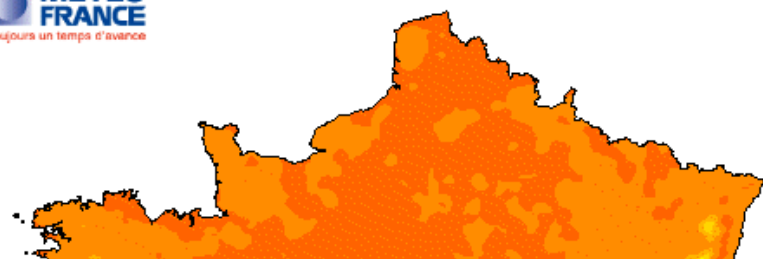


Legend

- C band dpol
- S band spol
- S band dpol
- X band dpol
- dpol : dual polarization
- spol : simple polarization



2017



The specification of the appropriate wavelength (S or C) for a new radar site is sometimes very difficult.

We lack tools (simulators ?) to make the decision more objective

associated with a 100 year return period

Legend

- C band dpol
 - S band spol
 - S band dpol
 - X band dpol
- dpol : dual polarization
spol : simple polarization

0 100 200 300 400 500 Km



Applications of Radar Data in France

- ❑ Surveillance / Nowcasting
Nation-wide 3D Reflectivity Fields / Wind Shear Mosaics
- ❑ QPE – Hydrology
Large investment in DPOL / X-Band / Radar – RG Calibration
- ❑ Numerical Weather Prediction
Reflectivity & Doppler data assimilated into AROME
Work on refractivity and DPOL Assimilation
- ❑ Aviation
Dedicated X-band Polarimetric Airport Radars
- ❑ Climate Studies – Reanalysis
10-year (1997 – 2006) hourly QPE reanalysis just delivered
- ❑ Research

A « multi-purpose, multi-user »
network

Trade-offs have to be found all the
time \Rightarrow (slightly) sub-optimal for all
applications

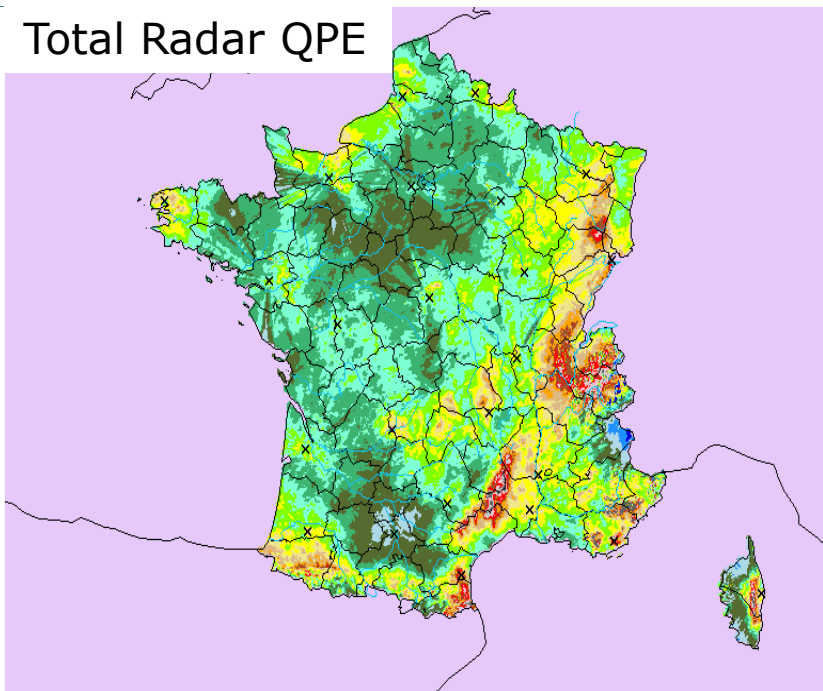
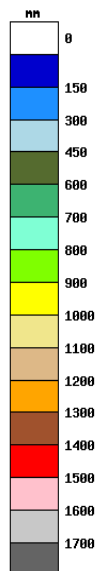
Are we reaching the limit of the
concept ?



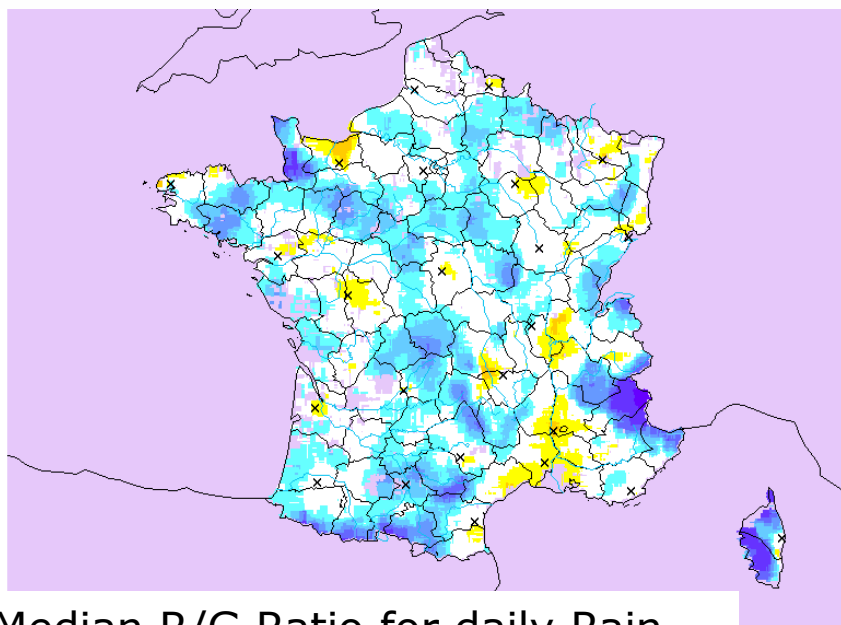
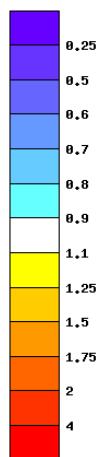
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Total Radar QPE



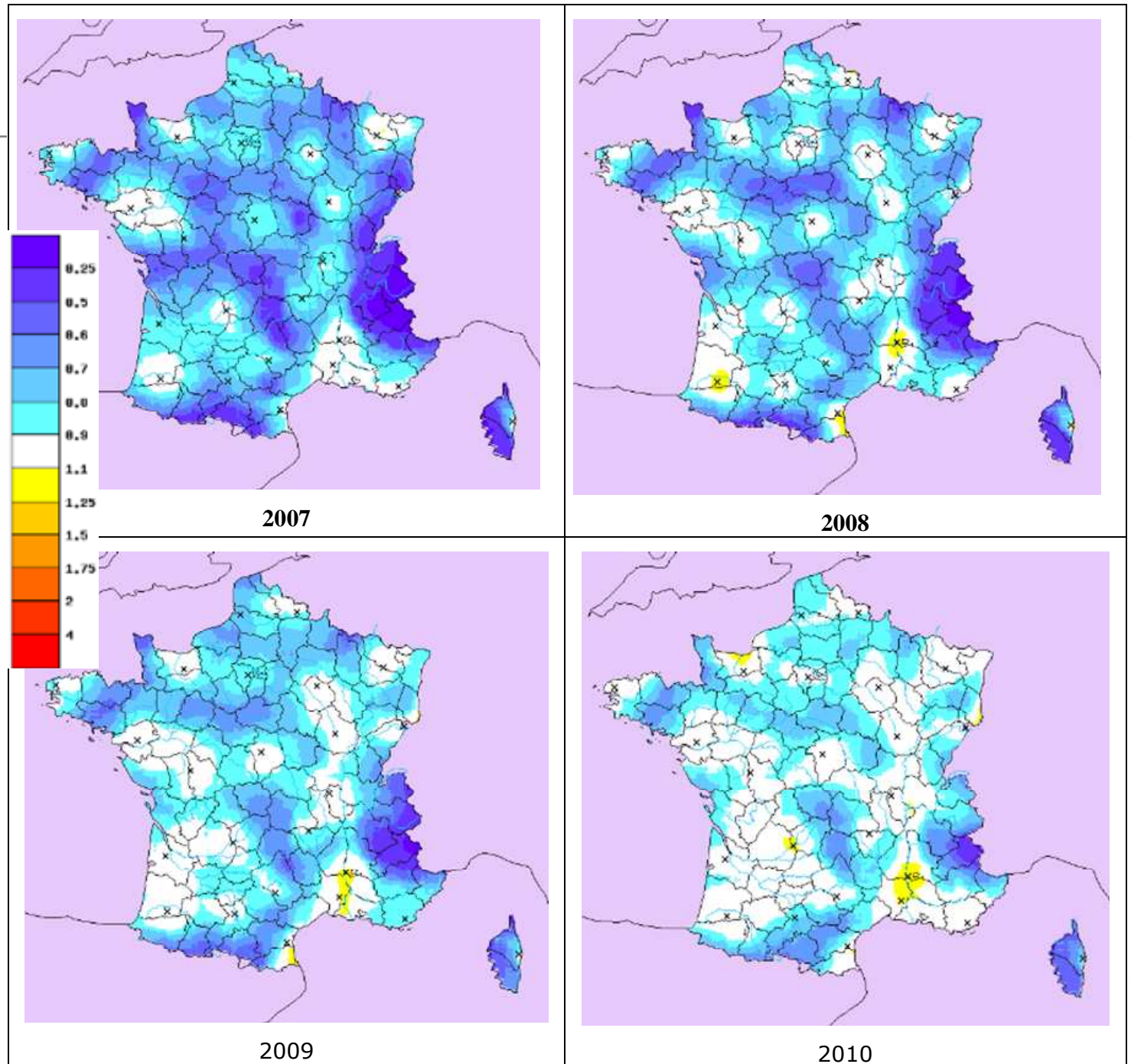
2011



Median R/G Ratio for daily Rain
Gauge Accumulation > 10 mm



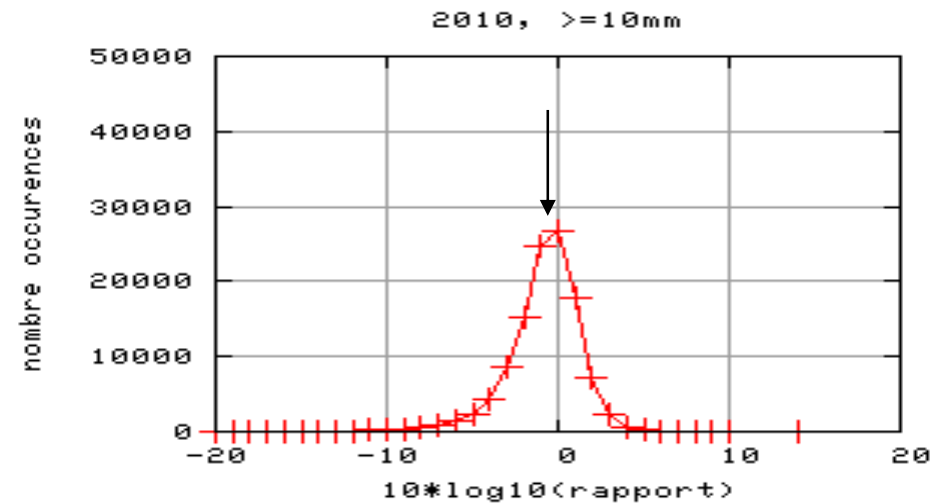
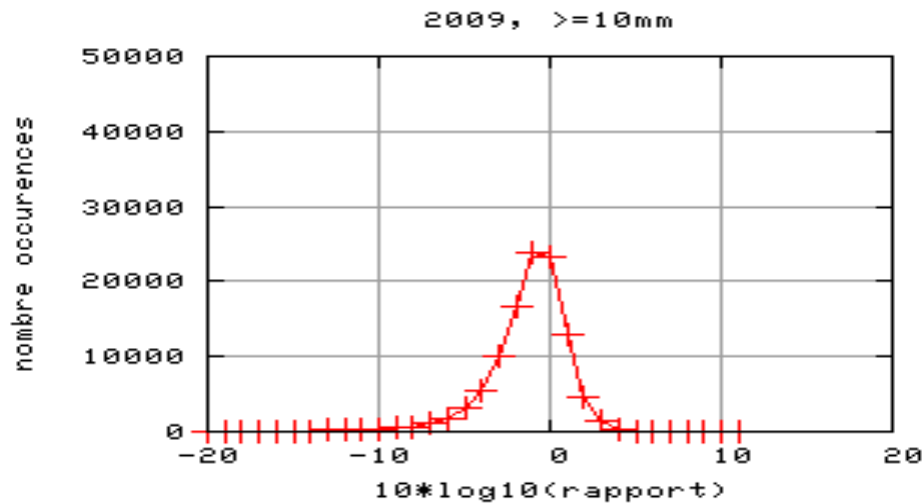
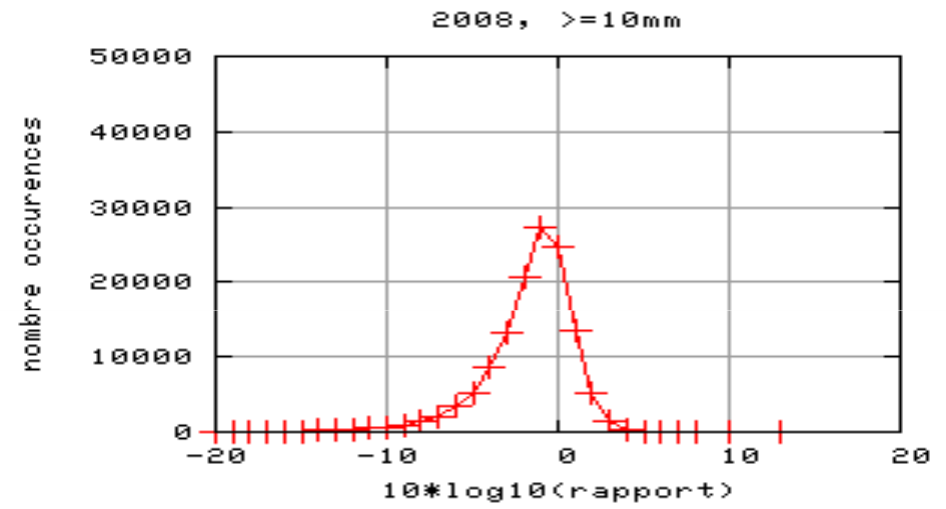
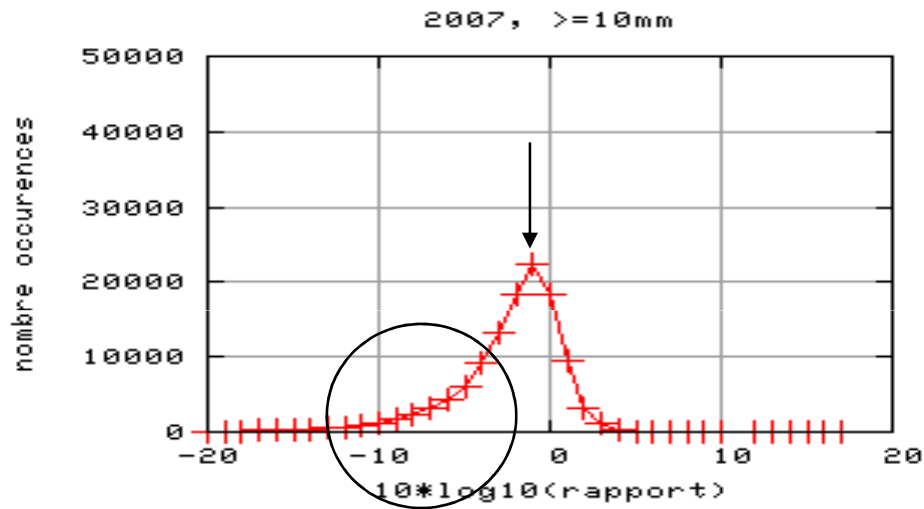
Radar overestimates
↑
Radar underestimates



Median R/G
Ratio for 24h
Rain Gauge
Accumulation
> **10** mm



Distribution of $10\log_{10}(24h_accumulation_radar / 24h_accumulation_RG)$
24h Rain Gauge Accumulation > 10 mm



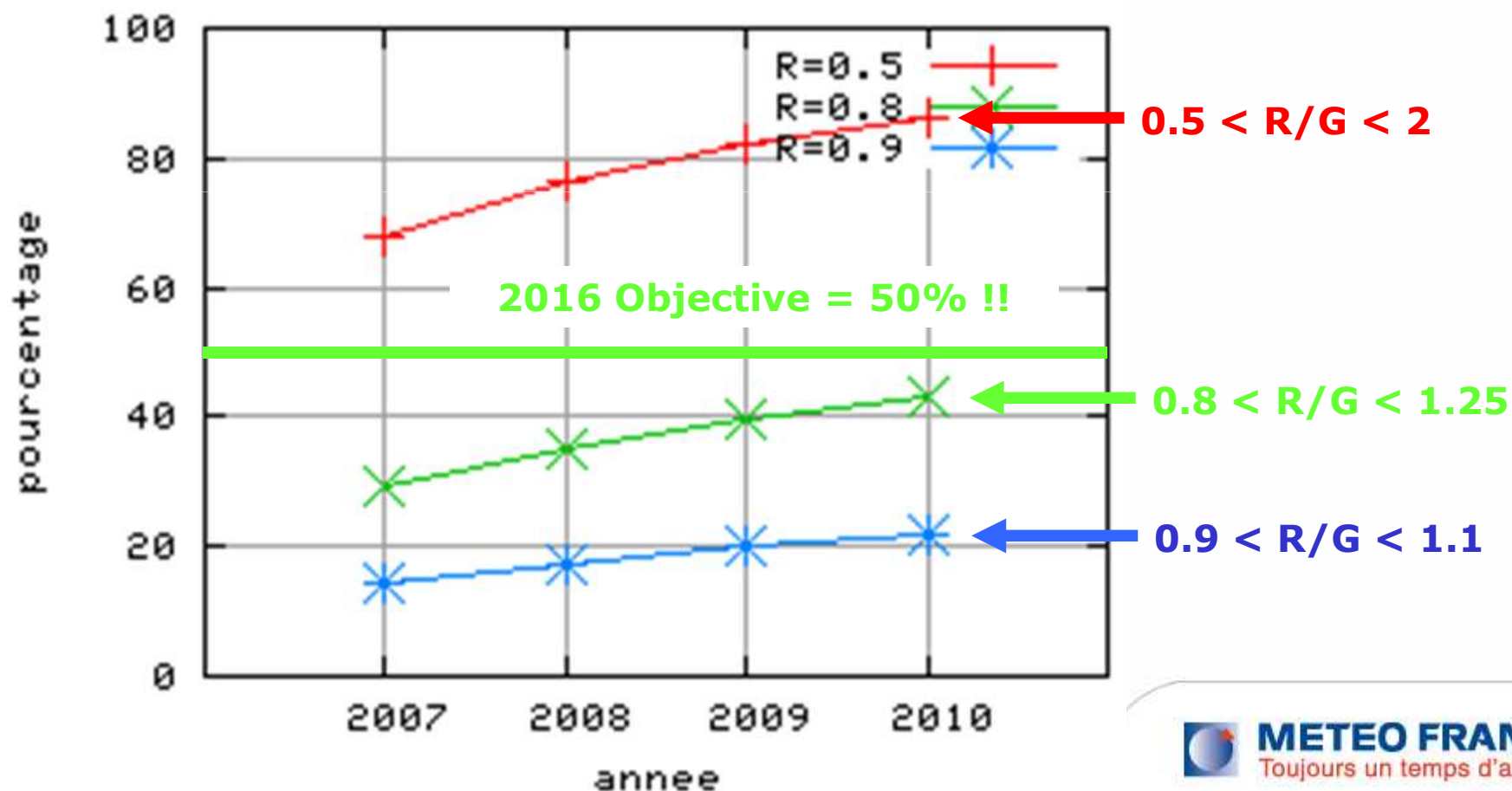
A scary picture ...

Percentage of R/G Ratios between r & $1/r$

Daily Gauge Accumulation > 10 mm

French Operational QPE mosaick – All pixels taken into account

≥ 10 mm





Practical issues to be solved in the near future at French and European level ...


- ✓ A composite network with SPOL and DPOL radars: how do we combine them ? Should be always favor DPOL ?

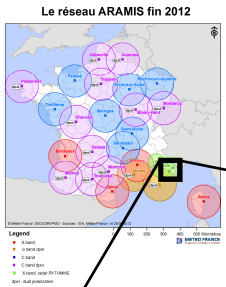


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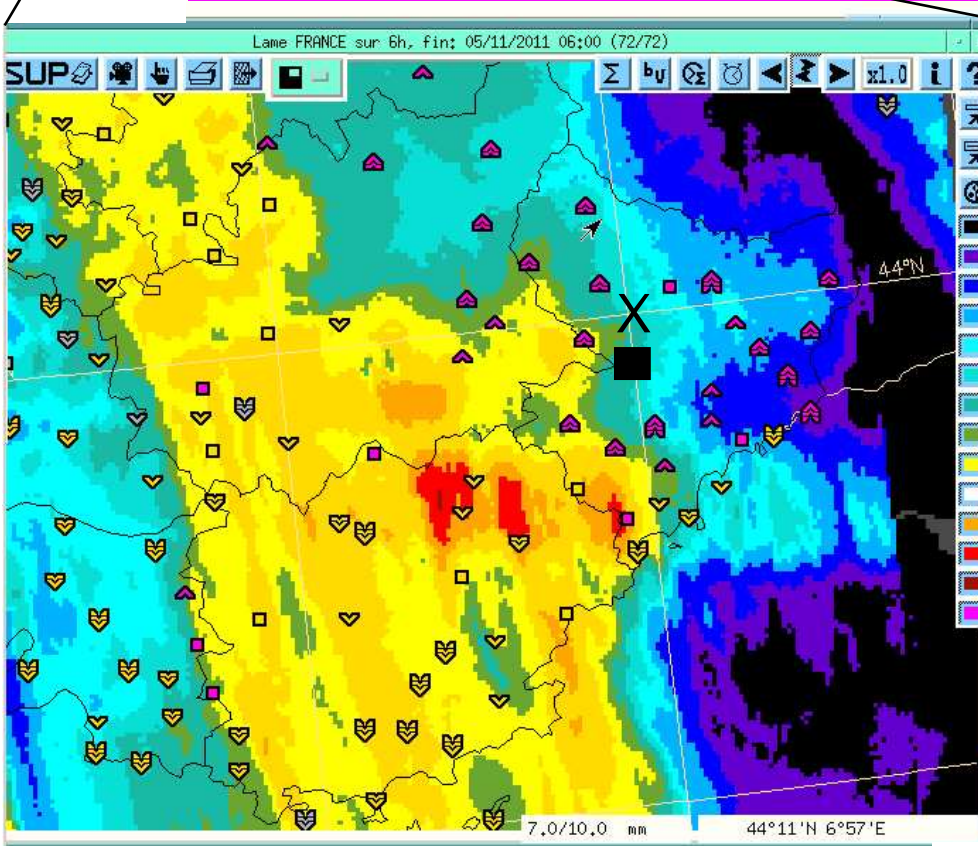
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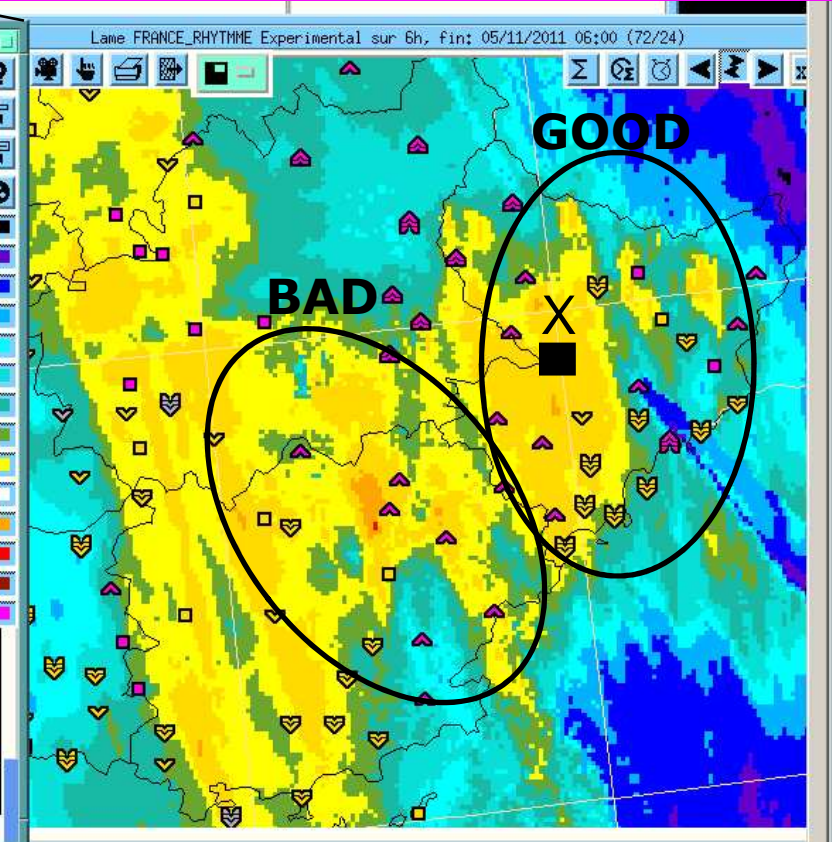
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 - ✓ Is Mean Field Bias Adjustment by gauges still needed in the context of DPOL radars ? Can we lower the density of gauge networks ? How much ?
 - ✓ X-band radars: how to optimally integrate them with neighboring S-band or C-band radars (DPOL or SPOL)
 - ⇒ Include attenuation (Φ_{DP}) & type of estimator (e.g. $R(K_{DP})$ or $R(Z)$) in the mosaicking rules
 - ⇒ Identify "extinction areas"
 - ⇒ Compute Minimum Detectable Reflectivity
-  A pixel at noise level should be interpreted as a valid, 0 mmh⁻¹ pixel



6-hour accumulation
 5 November 2011 - 00.00 → 06.00
Note: closest Radar is Nîmes (S) – 150 km



French operational national QPE
No X-band



French operational national QPE
X-band integrated WITH BASIC
COMPOSITING RULES (~lowest height)

An aerial photograph of a town, likely in a mountainous region, is shown. The town is partially obscured by thick, white clouds. Overlaid on the bottom left of the image is a white weather map showing isobars (lines of equal atmospheric pressure) and wind vectors (arrows). The isobars are labeled with values such as 1010, 1015, 1020, 1025, 1030, 1035, and 1040. The wind vectors indicate a flow pattern around a low-pressure system. The background of the entire slide is a dark blue gradient with a stylized sun and cloud icon in the top left corner.

Thank you for
attention