Gap-filling, X-band radars as part of the RHYTMME program; retrieval of real-time, multiple-Doppler wind fields in southeast France

Jeff Beck and Olivier Bousquet
Météo-France, CNRM-GAME
Toulouse, France

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The French radar network and RHYTMME

- Together, 24 S- and C-band radars cover 90% of the country of France within the ARAMIS network
- Important mountainous regions prone to flash-flooding still exist where coverage is missing
- Project RHYTMME was created, in part, to address this particular problem in southeast France
- When completed, four new X-band radars will compliment the ARAMIS network to cover this region

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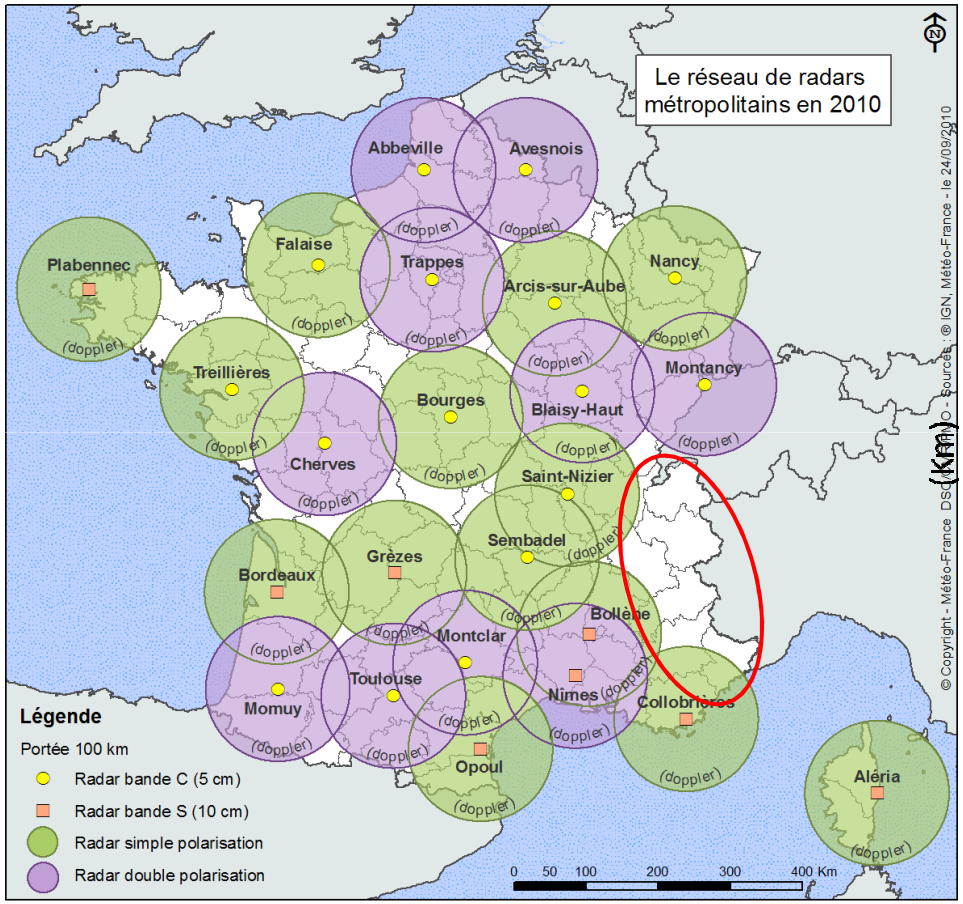
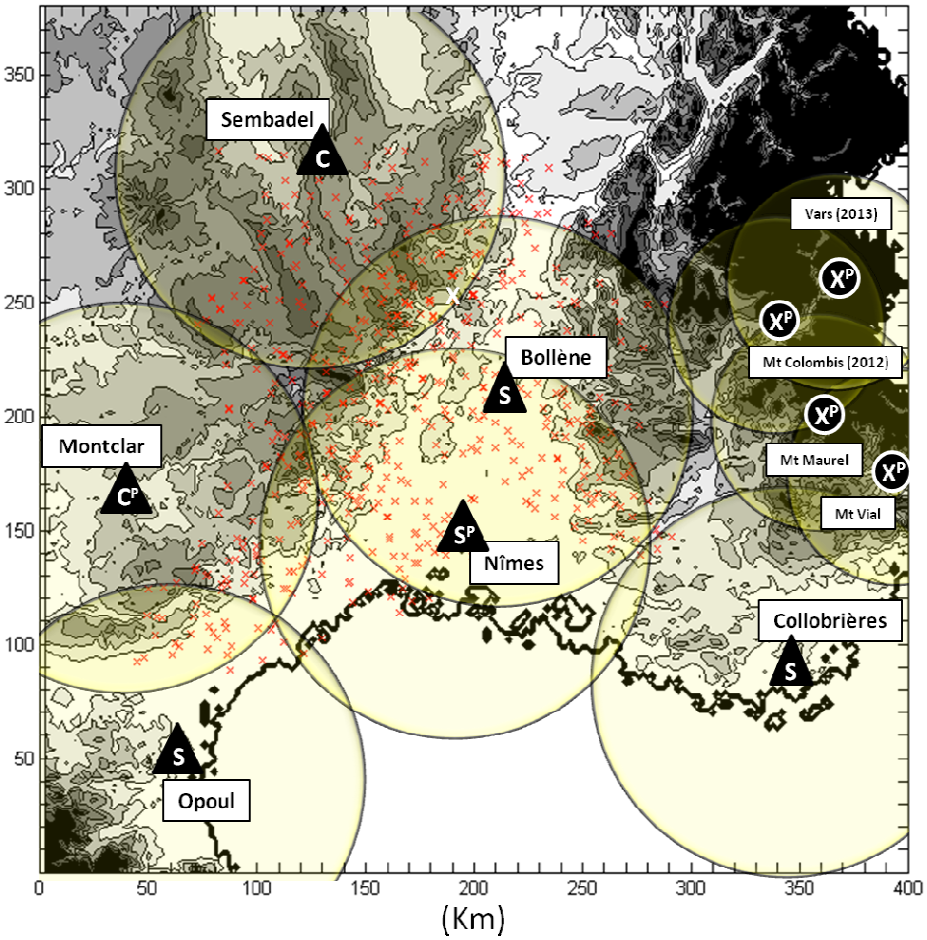
ARAMIS and RHYTMME Radar Networks





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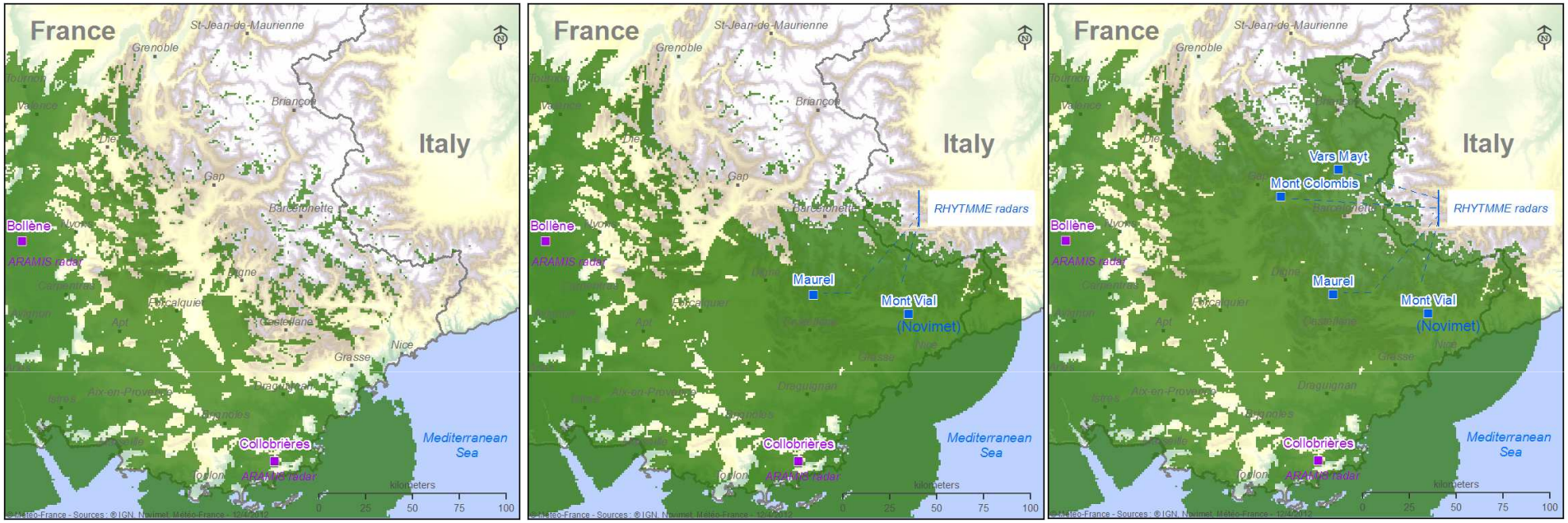
ARAMIS/RHYTMME Radar Coverage



- Mt Vial – 2010
- Mt. Maurel – 2011
- Mt. Colombis – 2012
- Vars Mayt – 2013

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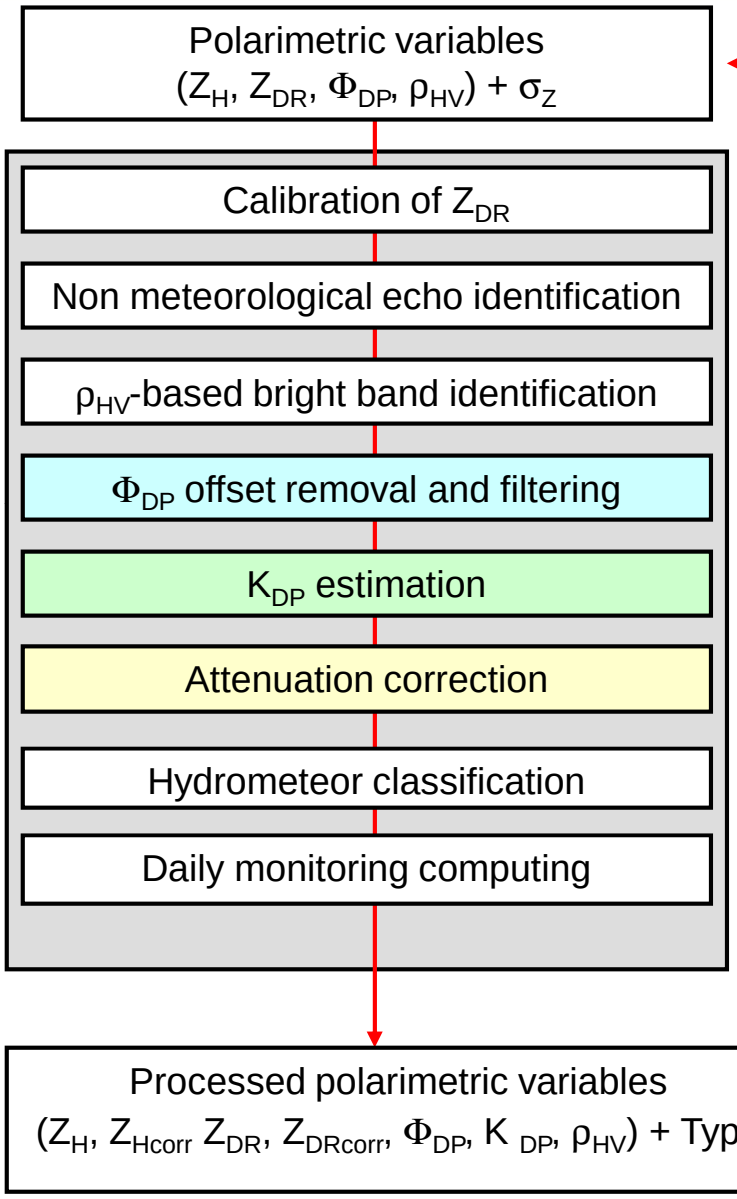
Processing Chain for RHYTMME Radars



Adaptation of chain from S-, C- band ARAMIS radars (Fadela Kabeche)

(Fadela Kabeche)

Attenuation correction

Using statistic empirical linear relation between (PIA) and PHIDP

$Z_H^{corr} = Z_H + \gamma_H \cdot \Phi_{DP}$ and $Z_{DR}^{corr} = Z_{DR} + \gamma_{DP} \cdot \Phi_{DP}$

$\gamma_H = 0.233$ and $\gamma_{DP} = 0.033$ (Bringi and Chandrasekar, 2001)

$\gamma_H = 0.313$ and $\gamma_{DP} = 0.0483$ (Snyder et al., 2010)

Fuzzy logic algorithms with specific probability density functions for precipitating and non-precipitating echoes (insects, birds, ground) used with polarimetric variables and knowledge of melting layer (Hassan Al-Sakka)

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Creation of Real-Time 2D Wind Syntheses

- Type classification key to generating reliable radial velocity data
- Automated algorithm created to edit/clean radar data
- Allows for a hands-off approach to producing real-time, multiple-Doppler syntheses
- Given the proximity of the ARAMIS and RHYTMME networks, syntheses are now possible over a much broader region than with only the ARAMIS radars

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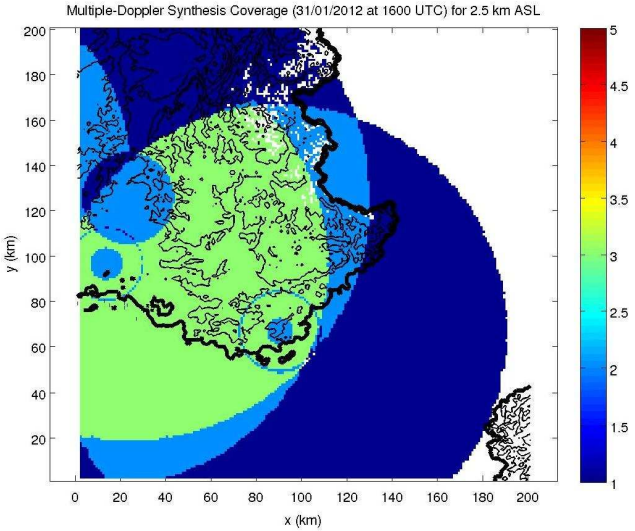
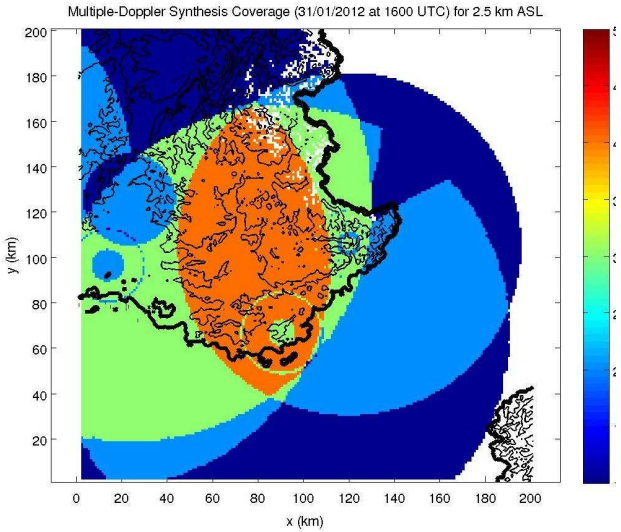
Theoretical Multiple-Doppler Radar Coverage at 2.5 km ASL

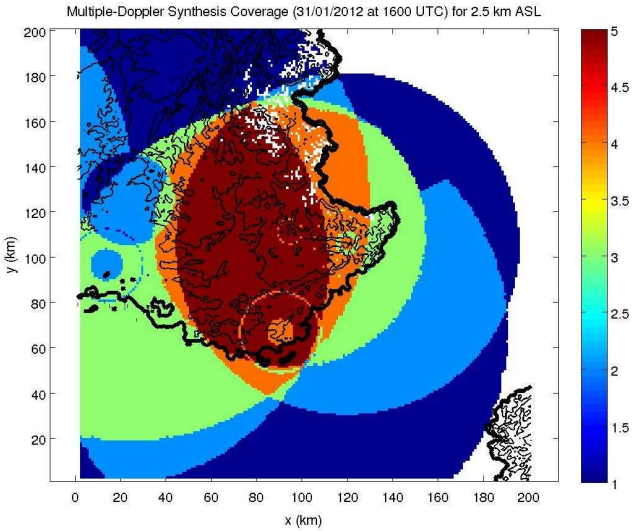
ARAMIS Radars



With Mt. Vial



With Mt. Vial and Mt. Maurel



- Dark blue – Single Doppler
- Light blue – Dual-Doppler
- Green – Multiple/Over-Determined Doppler (3 radars)
- Orange – Multiple-Doppler (4 radars)
- Red – Multiple-Doppler (5 radars)

*Ground clutter and partial-beam blockage are not considered

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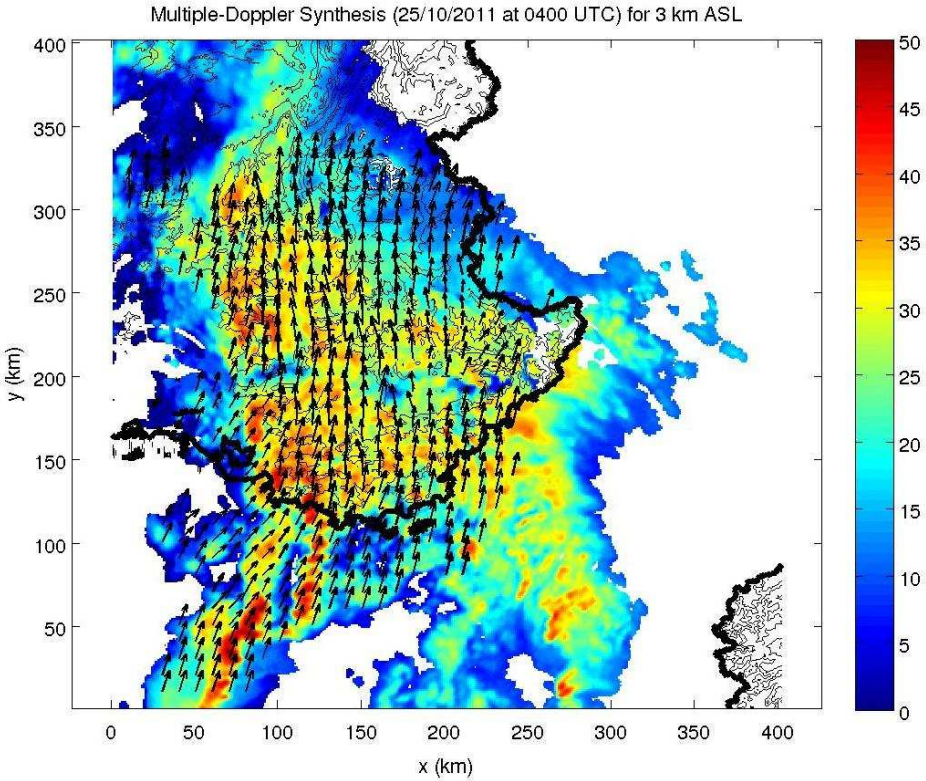
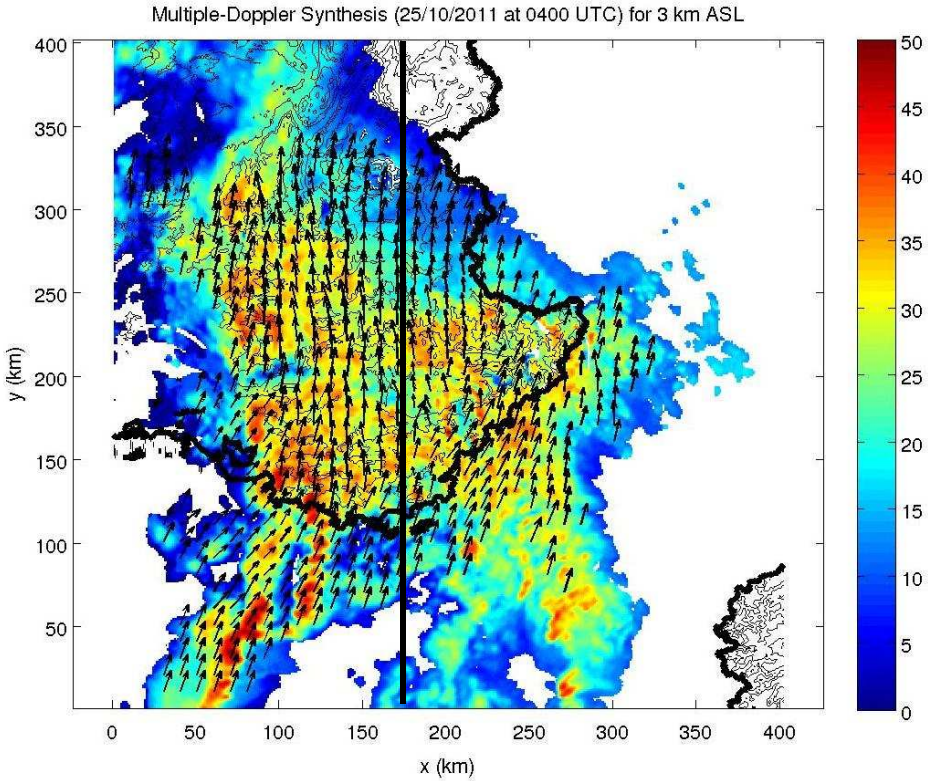
25 October 2011 at 0400 UTC for 3 km AGL



ARAMIS Radars



With Mt. Vial

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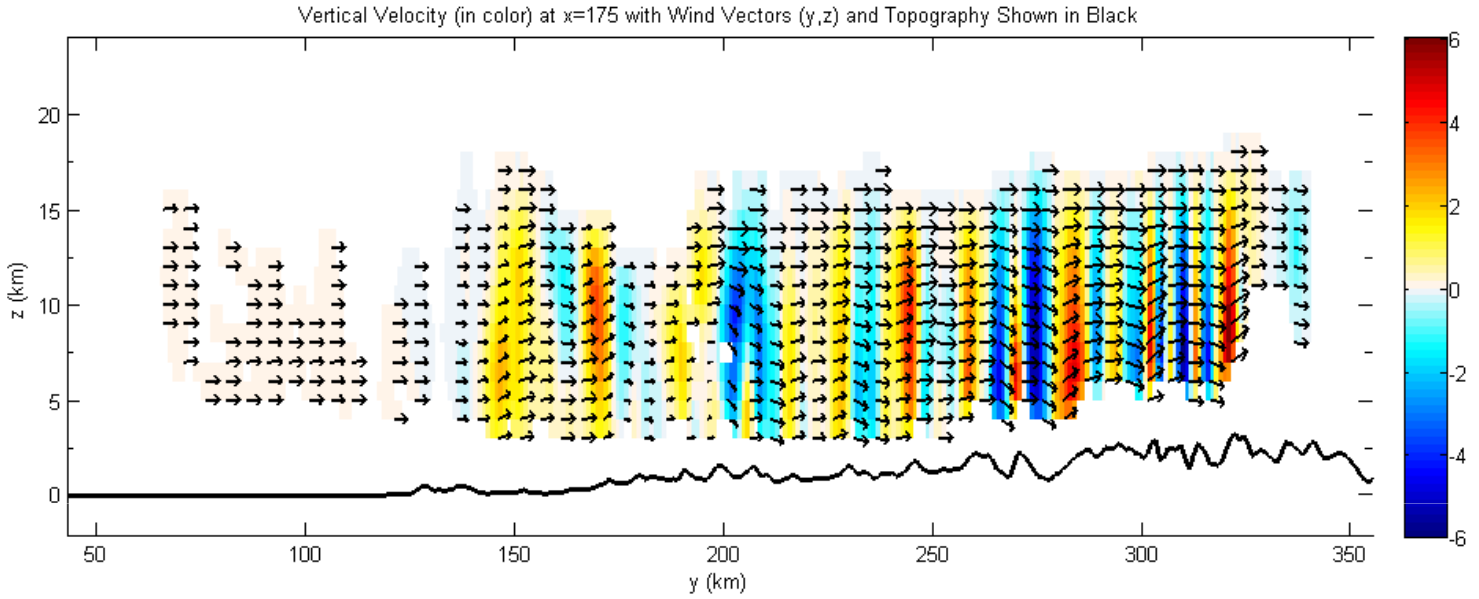
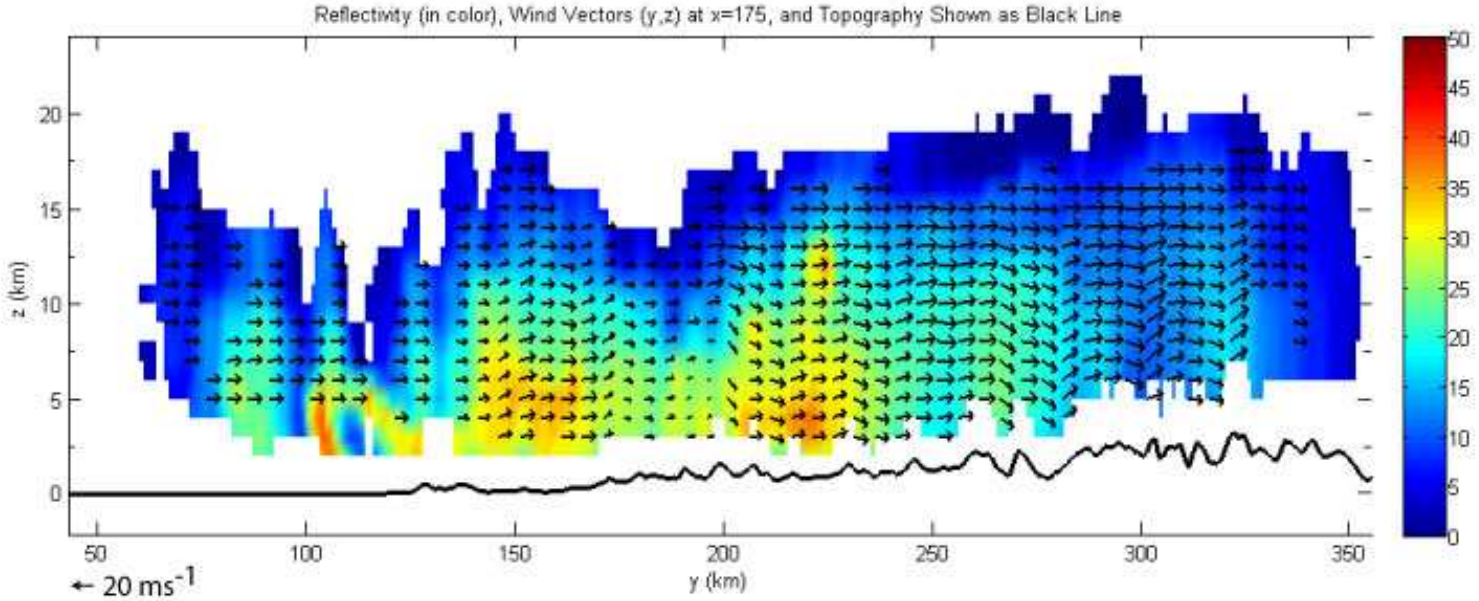
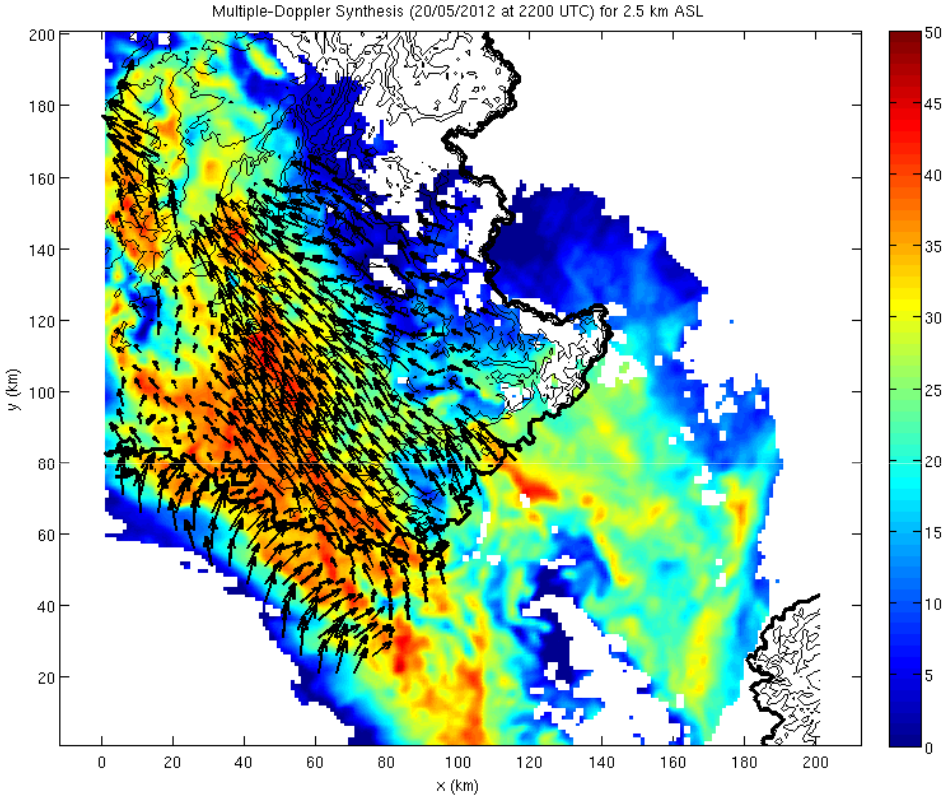
25 October 2011 Cross Section

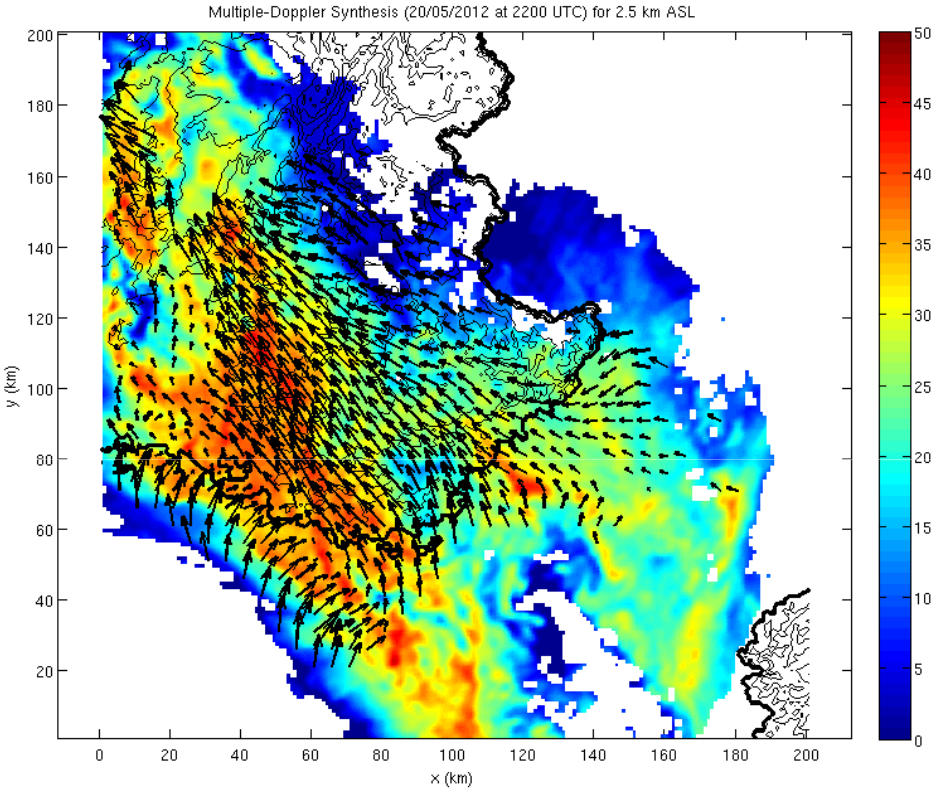




20 May 2012 at 2200 UTC for 2.5 km ASL



ARAMIS Radars



With Mt. Vial and Mt. Maurel

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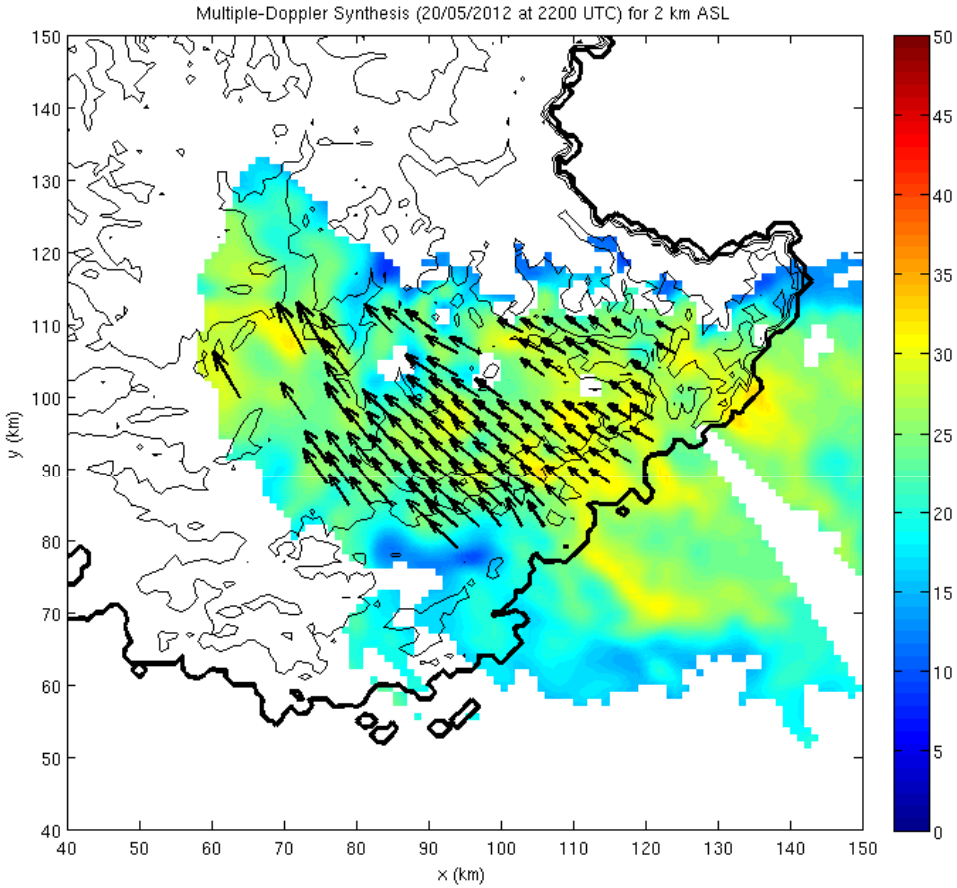
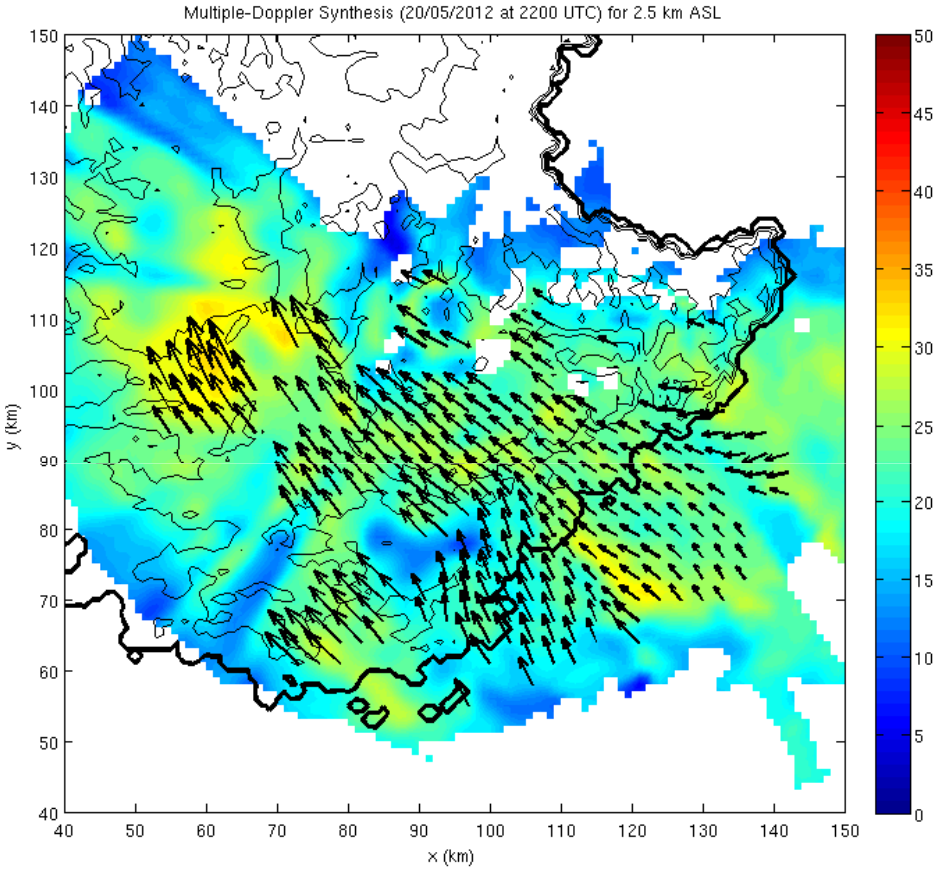
Mt. Vial - Mt. Maurel Dual-Doppler Analyses*



20 May 2012 at 2200 UTC for 2 km ASL



20 May 2012 at 2200 UTC for 2.5 km ASL

* Proof of Concept for RHYTMME Radars

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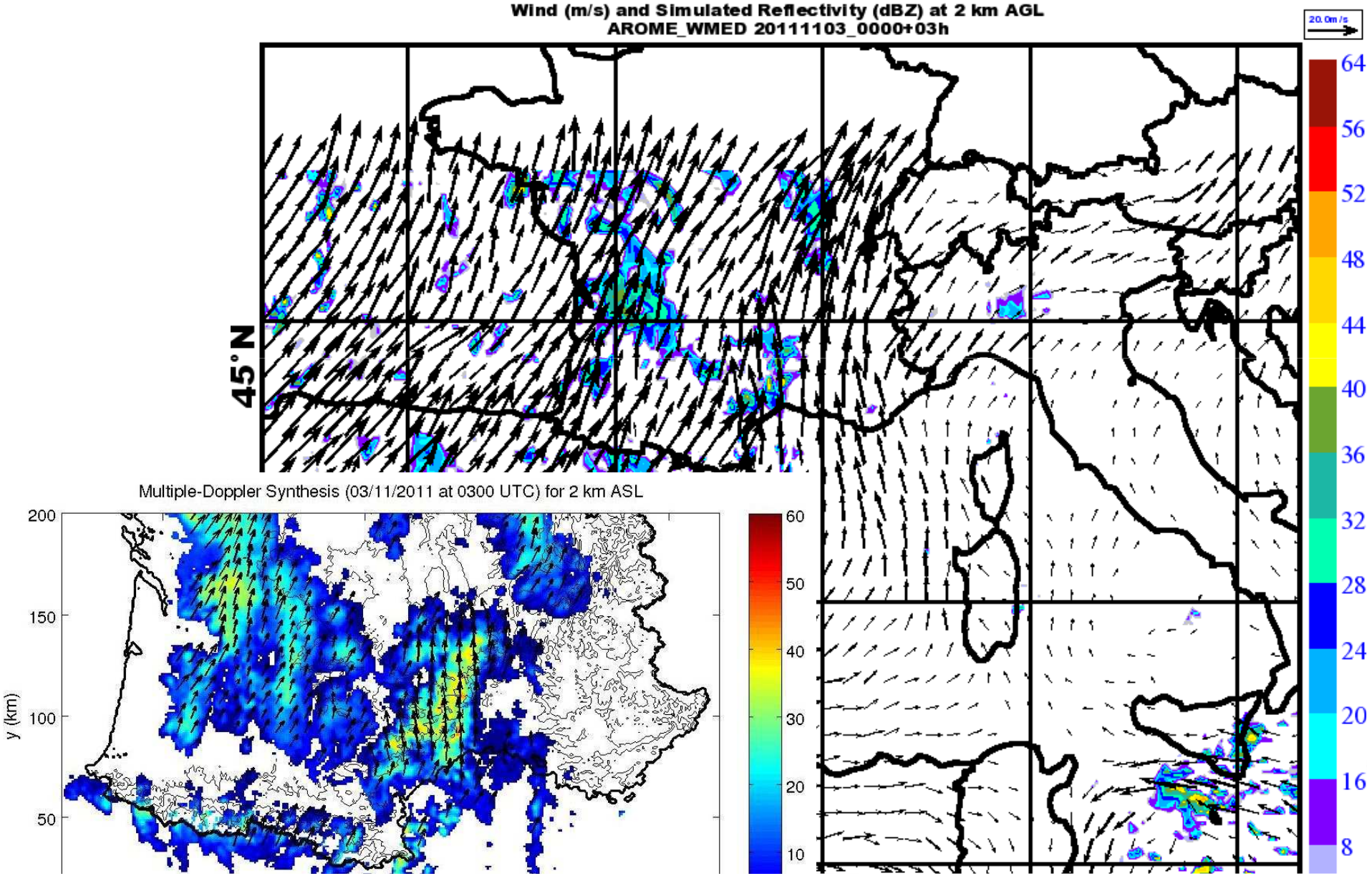
Application of broad multiple-Doppler coverage

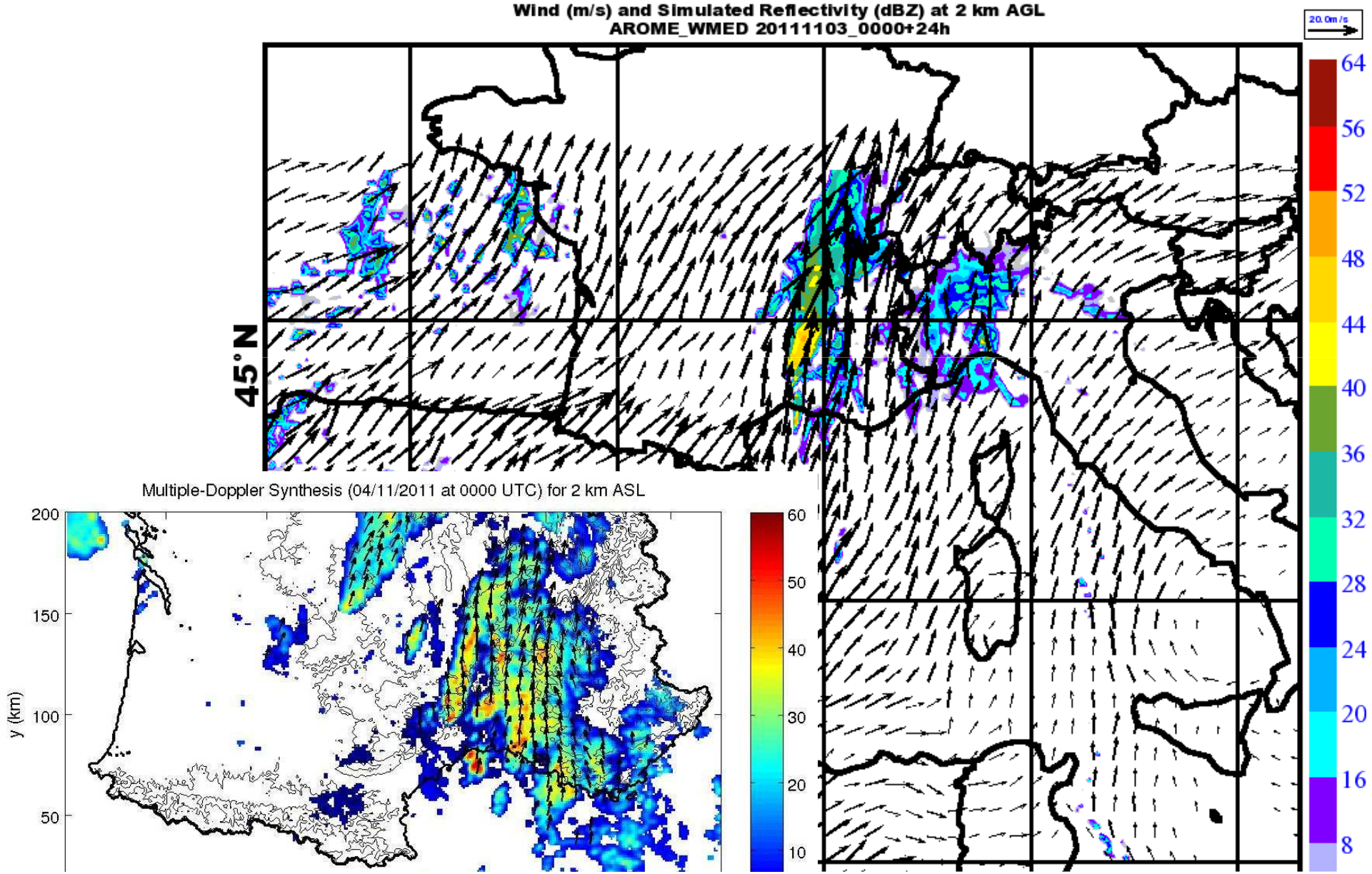
- An example: 1 November 2011 to 9 November 2011
- Two short waves and a Medicane affected south-eastern France over nine days and produced up to 800 mm of rain
- Multiple-Doppler analyses were produced for the entire period, every 15 minutes
- Comparison with AROME-WMED model output in progress

Multiple-Doppler Animation

Model Comparison (03h Forecast from 00Z at 2 km ASL for 3/11/2011)

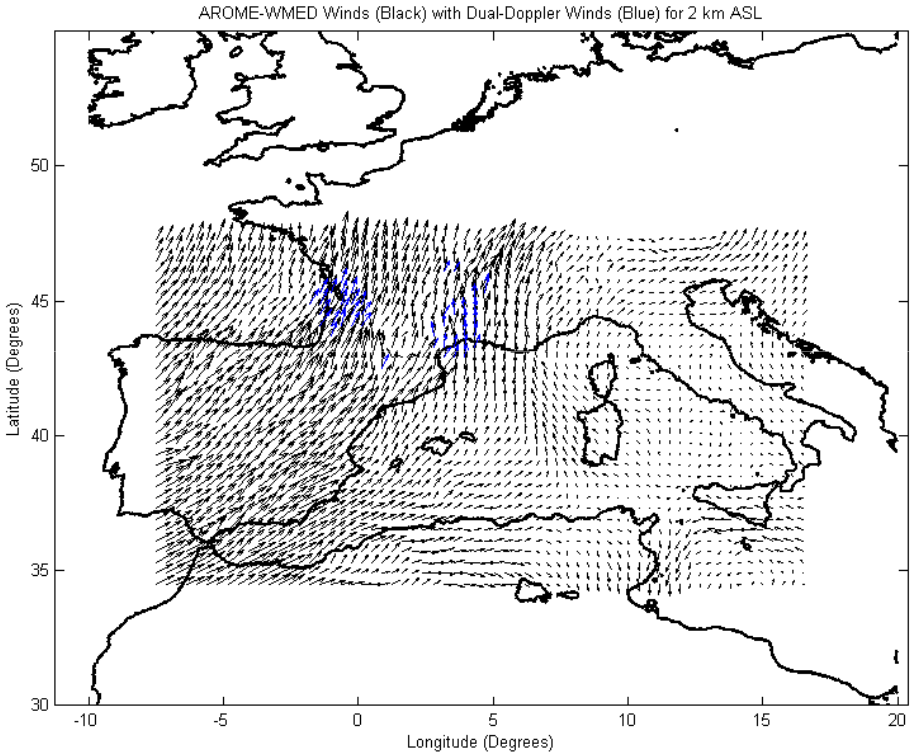


Model Comparison (24h Forecast from 00Z at 2 km ASL for 3/11/2011)

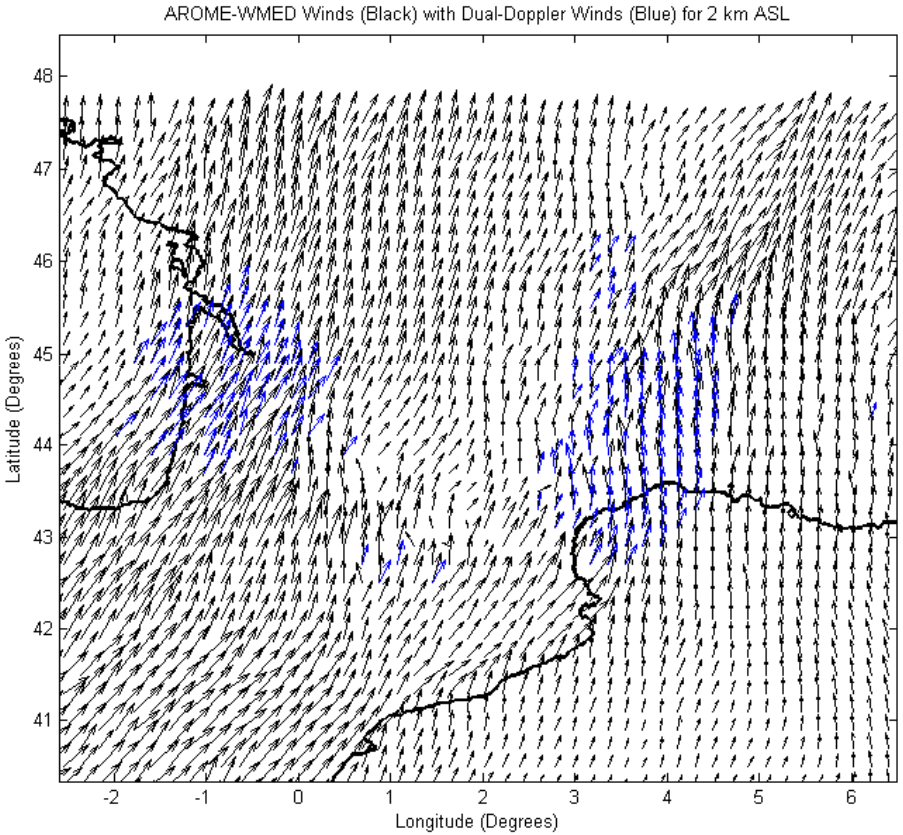


AROME-WMED Model Domain (2 km ASL, Multiple-Doppler Winds in Blue)

- 00Z 3 Nov 2011 Initialization – 3h forecast



Every fourth vector shown



Every other vector shown

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Model Assessment

- Work has started on quantitative analysis of AROME-WMED forecasts within France for this event, others may follow

- Statistical comparison of wind speed and wind direction between model and multiple-Doppler retrieved winds:
  - As a function of forecast time for specific multiple-Doppler analyses
  - For observed winds within threshold ranges (e.g.. 5 to 10 ms^{-1}, 10 to 20 ms^{-1})
  - As a function of altitude (mountainous versus low-lying areas)

- Future possibility: Data assimilation of multiple-Doppler winds

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Thank You!

- Jeff Beck: jeff.beck@meteo.fr
- Olivier Bousquet: olivier.bousquet@meteo.fr

- RHYTMME Project: http://rhytmme.cemagref.fr
- HyMEx Project: http://www.hymex.org