PREOPERATIONAL DOPPLER-RADAR MESOSCALE WIND STRUCTURE DETECTION ALGORITHM: APPLICATION TO SPANISH MEDITERRANEAN CASES

GOBIERNO DE ESPAÑA — MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO

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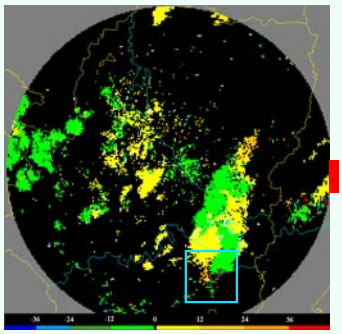
Introduction

Doppler radar information is used to identify features related to the radial wind field and signals such as mesovortex and other mesoscale wind structures. Automation of some processes can improve the forecasters' ability to issue early warnings for hazardous convective events.

Pre-processing

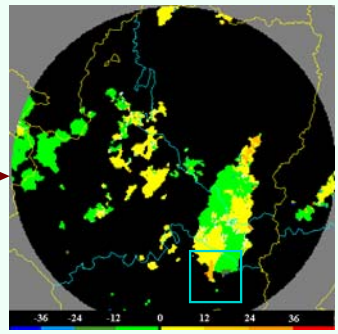
The radial velocity images could present spurious isolated echoes, which can adversely affect the algorithm performance. To avoid the negative influence of the noisy pixels, a filtering procedure is applied to eliminate these signals. An additional smoothing of the image is performed, filling in the holes with the mean value of the surrounding pixels.



Doppler radar velocity image
Zaragoza, 23 July 2003

FILTERING

SMOOTHING

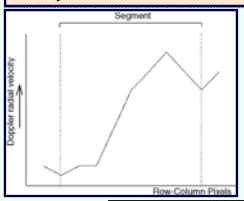


Final image resulting from the pre-processing

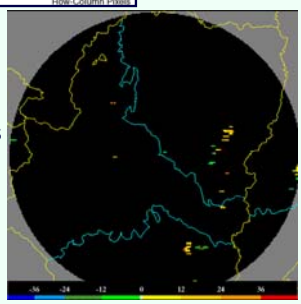
Mesovortex Detection: Procedure description

One-dimensional (1D) analysis

In Doppler velocity data, a rotation area appears as a pair of strong localized and opposing flows: a positive maximum value is located next to a negative minimum at approximately constant range. In this sense, the detection starts with the identification of positive and negative segments, searching for segments including a maximum (positive) or a minimum (negative) velocity value.



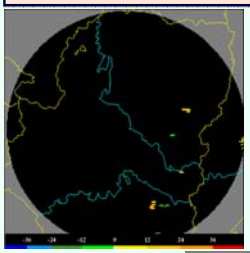
SCHEMA (1D)



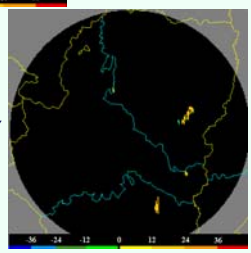
SEGMENTS (1D)

Two-dimensional (2D) analysis

In this step, individual segments are combined in 2D structures taking into account the spatial proximity between them. There must be at least another segment with the same characteristics (positive-positive or negative-negative) in an adjacent row for the segment to be included in the 2D structure. The same approach is applied for the columns analysis. The analysis result is shown here.



ANALYSIS BY ROWS



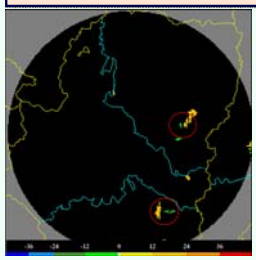
ANALYSIS BY COLUMNS

Combination of row and column analysis and final result

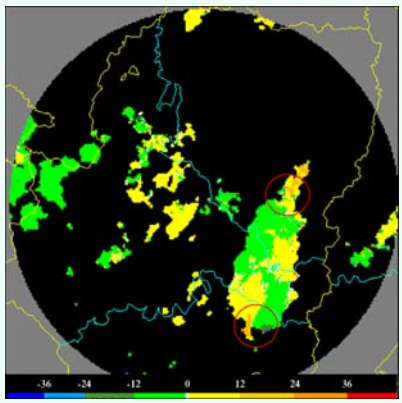
In this phase, all 2D structures previously identified are combined. Pairs of maximum and minimum, called *extremes,* must meet certain thresholds:

- A couplet maximum–minimum can be separate not more than 20 km and the difference between maximum and minimum velocities must be higher than 40 m/s.

- Finally, values of reflectivity greater than 20 dBZ must be found close to each *extreme*.

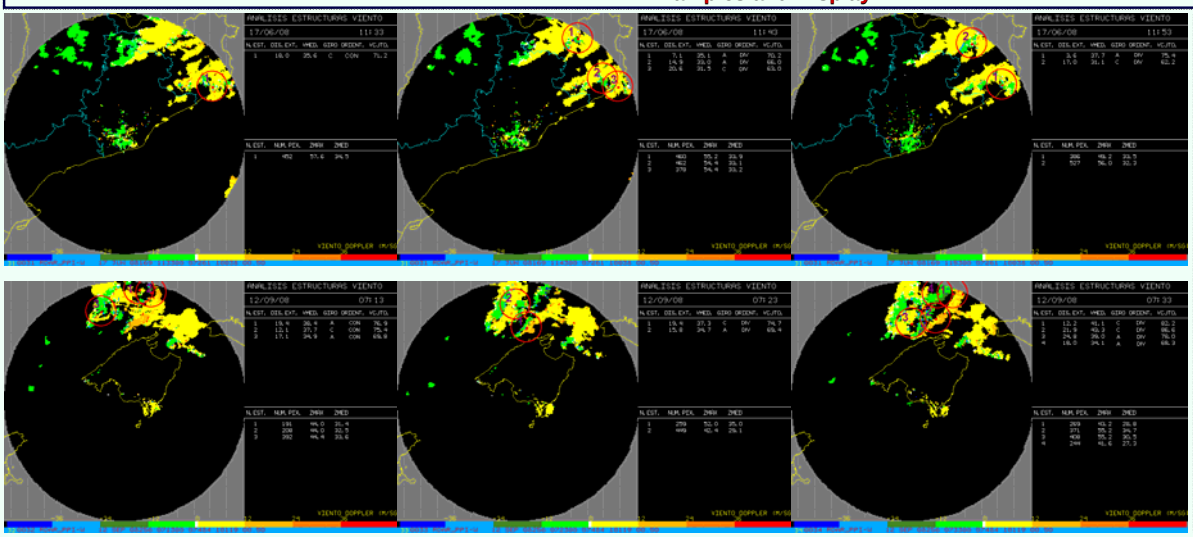


WIND STRUCTURES DETECTED ON THE EXTREMES IMAGE (RED CIRCLES)



WIND STRUCTURES DETECTED ON THE DOPPLER RADAR VELOCITY IMAGE (RED CIRCLES)

Examples and Display



In these examples, the current status of the application is shown.

In both cases, the radar of Barcelona (top) and the radar of Mallorca (bottom), different structures were detected with cyclonic (C) and anticyclonic (A) rotation, with divergent (DIV) and convergent component (CON).

Conclusions:

- Automation of analysis of Doppler data can help to the forecasters to provide precise and timely weather warnings of convective phenomena.

- Objective analysis of significant wind structures provides characteristics of them as well.

- There are false alarms in detection and other limitations due to low spatial and temporal resolution of radar data.

Future Works:

- Reduction of false alarms.

- The procedure has been adjusted using only a reduced number of situations. We plan to evaluate the algorithm and to introduce changes in some of the thresholds used.

- To check the results re-trying the archived cases.

- To improve the algorithm, methodology, displays, etc.

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