New adjustments to the 3D convective cells identification applied to severe weather study cases.

A. del Moral
t. Rigo
M.C. Llasat

(1) Dept. of Applied Physics, University of Barcelona, Spain (2) Meteorological Service of Catalonia, Barcelona, Spain

The newcast tools using radar data result essential in the study of severe weather phenomena. The identification of thunderstorms and their properties is probably the main step to follow for making a good short-time forecast. Probably, this point is even more important than the tracking and prediction modules. The importance of this type of tools is reflected in the fact that most of these analyses are used to feed early warning systems in many countries, helping to reduce the severe weather impacts. In the last decades, the research on this meteorological field has increased noticeably, defining different newcast methodologies which have result very efficient in many events. Nevertheless, sometimes these methodologies are fitted to the severe weather climatology of the region of interest of the country/region where the technique is developed. For instance, a methodology created in the USA for identify thunderstorms, could not be as efficient in Catalonia (N of Spain). Most of these methodologies are based in a previous 3D identification of the thunderstorms, from intensity and extension thresholds, the obtaining of their characteristics and the following tracking of the centroid (Don and Wainer, 1993; Johnson et al., 1998). In some cases, the thresholds are restrictive or are not well fitted to the thunderstorm itself which can derive in an incorrect definition of the convective cores and their subsequent tracking. This is the case, for instance, of some precipitating systems which present not more a convective core, close one to other and in different evolving phases. Other situations that need an improvement are those cases with isolated thunderstorms that present any kind of anomalous inter process, specially splitting or merging. This work presents a variant of the 3D-identification of convective cells proposed by Rigo and Llasat (2005) that consists on a centroid tracking based newcasting methodology. In the new version, it has been adjusted the reflectivity and extension thresholds to redefine the convective cells. It has been modified the way the 3D cells are constructed, helping to possible changing processes within the same thunderstorm, such splitting or merging. Two different cases of study are presented, showing the most common severe and adverse weather phenomena in the region of study (Catalonia, NE of Spain).

**WHY A NEW ADJUSTMENT?**

- **CURRENT SYSTEM (Rigo and Llasat, 2005):** adaptation from SCCT (Johnson et al., 1998): very effective in most of cases. Only saved the area with max. reflectivity.
- **New System:**
  - **Possibility to identify a 1-storm will split/merge within the 3DIdent. process (before tracking)?**
  - **Extract valuable information for forecasters to prevent possible associated severe weather?**

**THE 3D IDENTIFICATION ALGORITHM**

- **PRE-PROCESSING:**
  1. Application of a 3km-radius, centred in the locations of all the XRAD radars, filtering echoes > 75 dBZ (false echoes).
  2. Filtration of echoes < 30 minimum reflectivity to consider a structure.
  3. Connection of pixels with the Pixels are connected creating the "neighbouring pixels labelling" (NPA) technique following the Queen’s adjacency rule (Lloyd, 2004) rule and filtration of groups under 10 pixels.

- **HORIZONTAL IDENTIFICATION:**
  1. Application of 7 reflectivity thresholds (RTh) (30, 35, 40, 45, 50, 55 and 60 dBZ) starting from the upper value. Threshold must be represented for a minimum of 6 adjacent pixels.
  2. Application of the 7 RTh from the lower threshold and application of an erosion process (percolation) when it is found more than one possible core in the same structure.
  3. Repeated every CAPPI level available.

- **VERITCAL IDENTIFICATION:**
  1. Structures at level, are overlapped one by one with all the structures at level k (≥k).
  2. Existent multiple overlapped areas: ID=1, ID=2, ID=3
  3. No existing overlapped area: Look at level k
  4. Existing overlapped areas: Same association than a and b
  2. Multiple association are grouped in a single new ID, and it is saved a flag alert.

**ROI AND DATA**

**CASE 1: 2013/07/10**

- The splitting process can be intuited at 16:12 UTC: appearance of breaking signature of the cell at CAPPI 9 km.
- At 16:24 UTC: breaks at levels 4 to 10.
- At 16:48 UTC: two main cells differentiated at CAPPI 3km.

**CASE 2: 2016/10/14**

- The splitting process can be intuited at 16:36 UTC: appearance of breaking signature of the cell at CAPPI 4 to 6 km. It also can be seen that Southern cell is more vertically evolved (until 8 km) than the northern one (until 6 km).
- At 16:42 UTC: two main cells differentiated at CAPPI 3km.

**CONCLUSIONS:**

The previous horizontal (2D) identification, not only takes into account the most intense part of the cell. This allows more continuity of the characteristics of the cell, since the centroid, the area and the intensity wouldn't present steep changes, and therefore the final tracking would be easy. The new algorithm allows to obtain prior information to the tracking process, of a possible anomalous process within the thunderstorm. This is done thanks to the overlapping 3D-identification process, which connect all possible related cores at different heights, without the need of applying distance thresholds between 2D structure centroids. This also makes the algorithm faster. Days with higher convective activity (several cells close to each other and evolving really quick) may produce false DCAP warnings, but the pattern is easily distinguishable from the presented above and can be easily turned down in a tracking process, or a decision making process of a forecaster.

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