OPERATIONAL NOWCASTING OF THUNDERSTORMS IN THE ALPINE AREA

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I. INTRODUCTION

Operational nowcasting of convection in the Alpine area with its complex orography is a challenging task. In the mountains even relatively small but intense thunderstorms can produce local flash floods causing severe consequences and damages. The complex terrain requires thus the tracking of individual, even relatively small thunderstorms, while orography may also lead to the organization of convective cells at the meso-beta scale in the pre-Alpine and plateau region.

In this context, since 2003 MeteoSwiss runs operationally the real-time object-oriented nowcasting tool TRT (Thunderstorms Radar Tracking), as a part of its severe thunderstorms nowcasting, warning and information system (Ambrosetti et al., 2004). TRT is a multiple-radars nowcasting system that uses heuristic and centroid-based methods for the automatic detection, tracking and characterisation of intense convective cells.

The actual version of TRT fully exploits 3D-radar data and has been expanded to a multiple-sensors system including cloud-to-ground lightning data with both polarities (Hering et al., 2006). Cell characteristics describing the 3D storm structure and properties as well as the accompanying time series, are computed from the volumetric radar data. These parameters include 15/45 dBZ echo tops, VIL (Vertically Integrated Liquid), as well as the altitude of the maximum storm reflectivity. Such 3D cell-based radar derived severe weather attributes are rather sparsely used operationally in Europe.

II. THE TRT ALGORITHM

TRT is based on a dynamic thresholding scheme, derived from the RDT satellite algorithms, applied on the reflectivity data of multiple-radar composites (Hering et al., 2004, 2005). The dynamic scheme is able to identify each storm object at individual thresholds, depending on the stage of its life cycle. A detected storm cell is tracked in successive images using the method of the geographical overlapping of cells. It is then possible to create the time history of cell displacement, and tracks are created from a sequence of radar images. To estimate future storm position, the motion of individual cells is extrapolated up to 1 h, using their weighted displacement velocities. Complex cases with several cells, splits and merges are also taken into account. Since TRT is tuned to identify individual cells rather than storm systems, the evolution of cell-based characteristics is available to the forecasters (FIG. 1 right).

As input the TRT uses the reflectivity data of the Swiss composite image (mosaic) of 3 volumetric C-Band Doppler radars. Operationally a 20-elevation volume scan between -0.3° and 40° is performed with a time resolution of 5 minutes (Joss et al., 1998). For the cell detection algorithm we use the vertical maximum projection from 12 constant altitude surfaces (CAPPI) between 1 and 12 km with a spatial resolution of 2 km. To compute the multiple-radar severe storms detection products TRT uses the 3D Cartesian composite image of the Swiss radar network.

For a successful detection and tracking of even relatively small convective cells in complex orography it is necessary to have a qualitatively good radar network with effective clutter elimination algorithms, as well as a high temporal update rate and high vertical resolution. The reflectivity values used as input for the TRT have already passed a sophisticated 7-step clutter elimination algorithm and an extensive quality control program (Germann et al. 2006).

III. OPERATIONAL USE AND VISUALISATION

The forecaster receives automated cells activity information in real-time, which he can use as a decision-making aid for convection warning. During the summer season, based on the TRT and additional data, MeteoSwiss issues severe thunderstorms alerts in whole Switzerland, for the general public as well as to civil protection authorities. These warnings are simple flash-news broadcasted by local and national radio stations, with a lead time of 30-120 min (Hering et al., 2005).

The operational real-time visualisation of the TRT-products is done using a browser. FIG. 1 (left) gives an example of the cell tracking view with a superimposition of detected and extrapolated cells, their velocities and trajectories onto the composite radar image. A pop-up window (FIG. 1 centre) containing additional, cell-specific, up-to-date quantitative attributes, appears when moving the mouse inside a cell. Finally clicking inside a cell, the time series of different cell attributes like velocity and direction, VIL, 15/45 dBZ echo tops, altitude of the maximum storm reflectivity, CG lightning flashes, and others, are shown in a separate window (FIG. 1 right). As from spring 2008 the TRT output will be visualized operationally from the new *NinJo* workstation visualisation platform, as part of the SCIT (storm classification, identification and tracking) layer (Joe, 2005).

IV. MAP D-PHASE 2007: FIRST RESULTS

MAP (Mesoscale Alpine Programme) D-PHASE is a Forecast Demonstration Project (FDP) of the WWRP of WMO. It aims at demonstrating some of the many achievements of MAP, in particular the ability of forecasting heavy precipitation and related flooding events in the Alpine region. The D-PHASE Operations Period (DOP) will be between 1 June and 30 November 2007. TRT will be used in

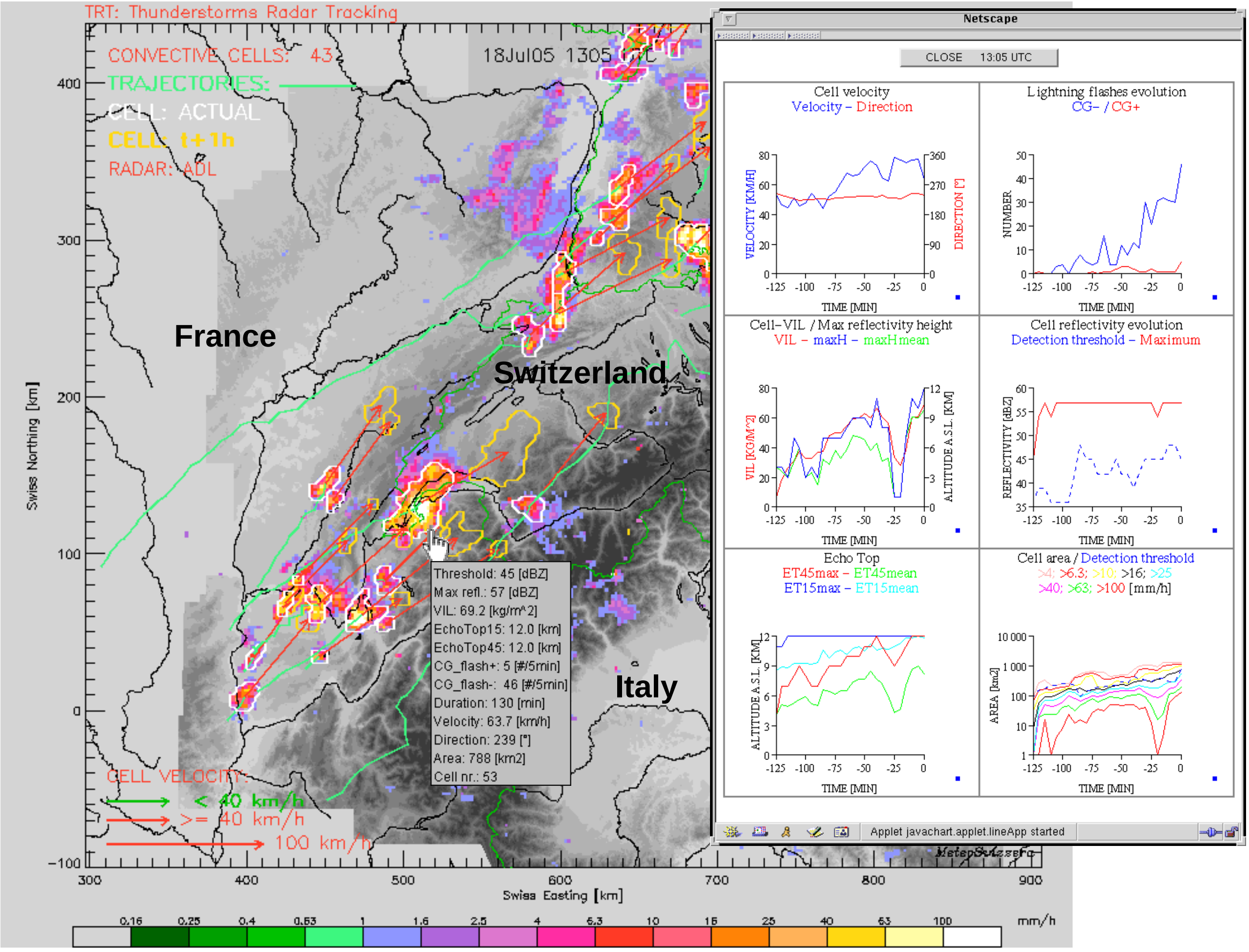

FIG. 1: Operational visualisation of the real-time TRT cell tracking product (18 July 2005, 13:05 UTC) over the Alpine region. Superimposition of the Swiss composite radar image, detected cells (white contours), trajectories (green lines), estimated velocities (≥40 km/h: red vectors; <40 km/h: green vectors), extrapolated cells positions (+ 1h; yellow contours), the pop-up window, and cell-based time series.

this project as one of the operational nowcasting systems in the Alpine area (Ambrosetti et al., 2007). We present preliminary results from D-PHASE on how the 3D cell-based radar derived storm properties of the improved TRT version will help to assess the severity of thunderstorms in rather complex orography like the pre-Alpine and Alpine region. The operational use of the 3D parameters during D-PHASE is expected to enhance the reliability of severe convection warnings, especially concerning heavy rain, hail, and wind gusts.

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