

New data processing in the Czech weather radar network

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Abstract. The Czech weather radar network, consisting of two Doppler C-band weather radars (Gematronik Meteor 360 AC, EEC DWSR-2501C), is operated by Czech Hydrometeorological Institute (the national weather service of the Czech Republic). It serves to the national and military weather services, operational hydrology and recently also to the air traffic control.

To overcome the limitations of vendor software, an independent in-house software package for volume data processing and visualization has been developed. Wide range of products generated from volume data: reflectivity (incl. storm detection algorithms: VIL, Y-algorithm), precipitation (VPRs and VPR-corrected estimates) and Doppler wind (modified VAD algorithm) is available at a user's selectable resolution and geographical projection. The software package allows to use 1 km (or better) horizontal resolution of radar products (instead of previous 2 km), enabling to construct the fine resolution radar composite pictures. In a near future, interlaced scanning with 5 minute sub-scan interval for air traffic control purposes will be implemented using this new software.

JavaScript based viewer (JSMeteoView) has been developed for versatile visualization of radar and other meteorological data in the Internet/Intranet environments. The JSMeteoView is designed to enable combination of the following data sources:

- Czech weather radar network products
- Meteosat IR imagery
- Central European Lightning Detection Network data
- NWP LAM outputs
- Geographical navigation

The software package is recently under implementation in the Czech Hydrometeorological Institute. Examples of radar

products and their graphical presentations are given.

1 Introduction

The Czech weather radar network (CZRAD) consists of two Doppler C-band weather radars (Gematronik Meteor 360 AC with RAINBOW 3.1 software – in operation since 1996, and EEC DWSR-2501C with EDGE software 4.88 – operated since 2000), which cover the entire area of the Czech Republic by volume scans in 10-min. time intervals up to 256 km range. Volume radar data processing and visualization, initially done by the vendor software, has been upgraded by in-house software package RVD/RPD which satisfies the increased requirements on output radar products.

2 Volume radar data processing

To ensure vendor independence of radar data processing, the spherical volume data captured in vendor formats are converted into open-source format, which is used as the input for all consequent processing. RVD/RPD package offers generation of wide range of both reflectivity (PPI, CAPPI, MAX, MAX-3D, Echo top, VIL, Y-algorithm, vertical reflectivity profiles (VPR), radar precipitation estimates, VPR based corrections of precipitation estimates) and Doppler products (PPI, modified VAD), at user's selectable geographic projection, area and resolution. This software enables the 1 km horizontal resolution products to become a new operational standard. This finer spatial resolution offers the possibility for studying the storm structure much better than the 2 km resolution used previously. RVD/RPD software offers also compositing the radar data including radars from neighboring countries (exchanged in WMO FM-94 BUFR format).

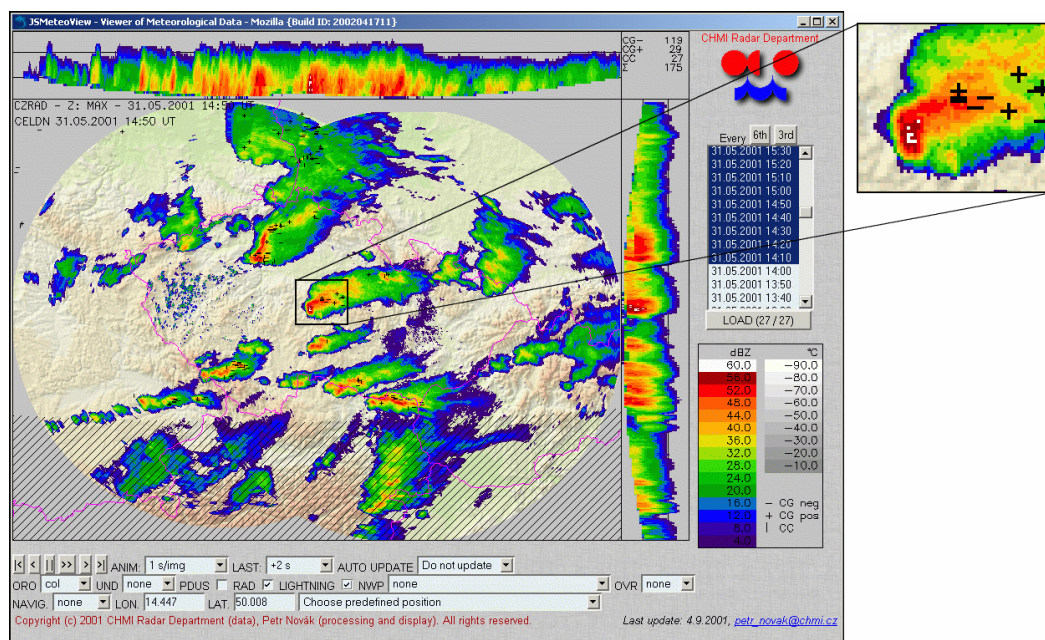


Fig. 1. Example of CZRAD composite of maximum reflectivity field and lightning data from CELDN network (+/-/I signs) combination using JSMeteoView. Tornadoic storm from 31 May 2001 is zoomed in the right top figure.

3 Radar products visualization

JavaScript based viewer (JSMeteoView) has been developed for versatile displaying radar and other meteorological data in the Internet/Intranet environment (Fig. 1). It is designed to combine the following data sources:

- Czech weather radar network (CZRAD) composite of Maximum reflectivity in pseudo 3D-view
- Meteosat (PDUS) IR-channel images
- data from the Central European Lightning Detection Network (CELDN)
- NWP LAM ALADIN outputs (mainly geopotential at 700 and 500 hPa)
- Geographical (under-)overlays and navigation

The JSMeteoView is written in HTML and JavaScript, uses also PHP code on the server side; it is optimized for Mozilla/Galeon/Netscape 6.x or Microsoft Internet Explorer 5.x/6.x web browsers.

All the data to be used by the viewer are pre-processed into a common geographical projection and graphical format by server applications (RVD/RPD software and shell scripts in LINUX environment). Image size of displayed products including side-views is 810×610 pixels and the JSMeteoView is optimized to be displayed at screen resolution of 1024×768 pixels or higher. The geographical projection used is the gnomonic one centered at Praha-Libus with horizontal resolution of 1 km.

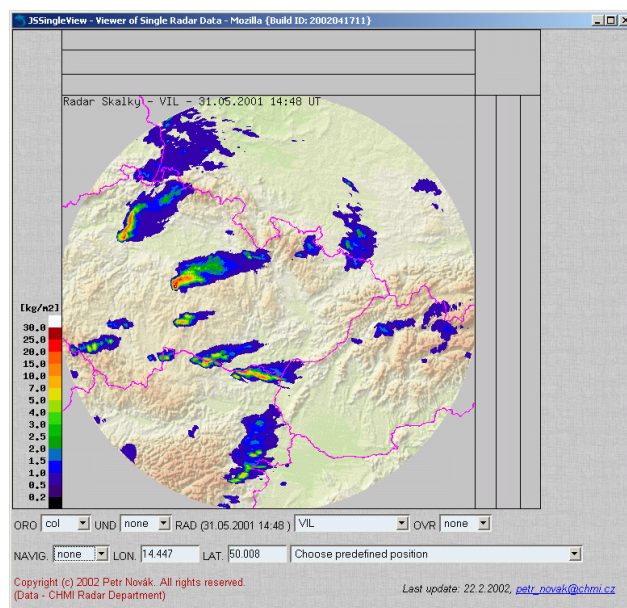


Fig. 2. Single radar product display by JSMeteoView – vertically integrated liquid (VIL) field from radar Skalky on 31 May 2001, 14:48 UTC.

Consequently, similar JavaScript viewers for single radar reflectivity products and for vertical wind field graphs have been developed (Fig. 2 and 3).

4 Interlaced scan

The commonly used radar data update rate of 10 min. is not suitable for aeronautical users who require the data as

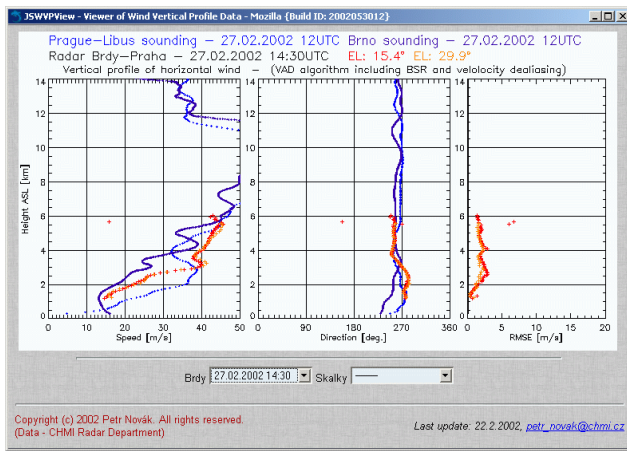


Fig. 3. Vertical wind profile display by JSMeteoView – vertical wind profile from radar Brdy on 27 February 2002, 14:30 UTC calculated using modified VAD algorithm.

close to the real-time as possible. In order to get faster update rate without losing the volume coverage, needed for other users of radar data (hydrology, synoptic meteorology), the implementation of interlaced scan is under preparation in the CZRAD network.

The original idea of interlaced volume scan (e.g. Vasiloff et al. (1987)) has been operationally implemented during 90's in Switzerland (see Joss and Lee (1995), Joss et al. (1998)). One important disadvantage is unequal volume coverage of partial scans: when animating the consequent images, a "flickering" effect can be observed between odd and even subscans caused mainly by the difference of radar coverages at lowest elevations. Based on climatology of radar images (yearly precipitation accumulations for individual PPI's shown in Novak and Kracmar (2001)), repetition of lowest 4 PPI's in both odd and even sub-scans has been proposed as a possible improvement of the scan-to-scan image continuity. The proposed volume scan for CZRAD is displayed in Fig. 4. During the scan, radar range (and PRF) and antenna rotation speed (RPM) will be changed. Duration of subscans for the aeronautical use is 5 min., the data from 10 min. complete volume scan will be used for other users. The interlaced scan will be implemented on both EEC and Gematronik radars, for the data processing, the in-house package RVD/RPD will be exploited.

5 CONCLUSIONS

RVD/RPD and JSMeteoView software packages have proved to be a very useful tools for both operational forecast meteorologists at the CHMI, as well as for research purposes. After the initial phase of testing and tuning (2001-2002), the JSMeteoView will become the main tool for the operational visualization of the radar and lightning detection network data in the Czech weather service (CHMI) as well as in other external locations (contractual users of these data) taking the advantage of platform independence. Presently (spring 2002), the RVD/RPD package and JSMeteoView are

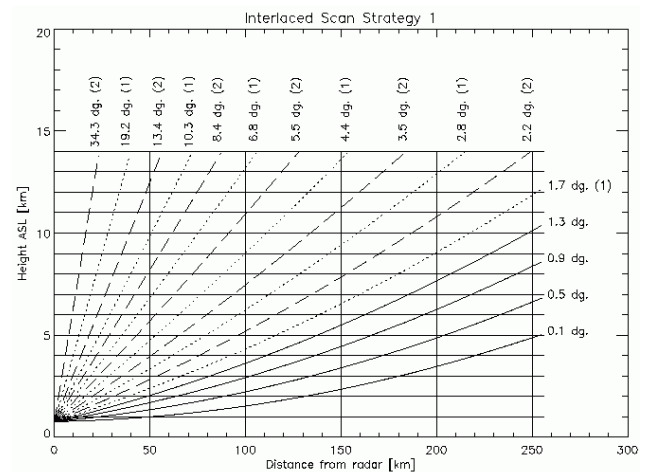


Fig. 4. Proposed interlaced scan for CZRAD network with repetition of 4 lowest PPIs. Repeated elevations are denoted by solid line, other elevations are dashed and labeled by the number of subscan (1 or 2).

used as the main tool by researchers involved in studies of severe convective storms. Improved interlaced scan will be implemented in CZRAD during 2002-03, using the RVD/RPD software tools.

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