European Conference on Severe Storms 2015
14–18 September 2015, Wiener Neustadt, Austria
ECSS2015-114-2

A severe bow echo in Western Germany on June 9, 2014: Forecasting and warning of a high impact weather event with the help of different tools and methods

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I. Introduction

Each year Germany is affected by numerous thunderstorm events. Their degree of organization varies from short-lived single cells that involve only a low potential for damage to multicells in form of lines and clusters up to perfectly organized and long-lived supercells. The latter often lead to considerable damage and can be life-threatening.

Using physically based ingredients like the content of humidity in the atmosphere, the degree of instability, as well as lifting processes and the intensity of vertical wind shear (directional and speed shear), the forecaster is able to determine the degree of organization and severity of thunderstorms, as well as their accompaniments (Johns and Doswell, 1992).

The use of this approach for assessing the convective situation of the day gives the forecaster an idea whether a direct model output may fail in predicting severe weather or not. When the convection is developing the forecaster is able to make use of several supporting tools that help him to assess the current degree of severeness.

The presentation will show the process of forecasting convection at DWD by making use of a prominent severe weather case where numerical models failed to forecast a large mesoscale convective system in advance.

II. The Pentecost severe weather event in Western Germany

Around Pentecost 2014 (June 8 to 11), Western Europe including Germany was affected by several severe weather events that caused widespread damage and resulted in multiple fatalities. A preliminary peak of this weather pattern occurred in the evening hours of June 9, 2014 (Pentecost Monday).

An extensive upper level trough was situated to the west of Ireland, whereas further east the axis of a ridge affected Eastern Germany. Downstream of the trough, a hot and humid air mass spread into France and reached West-Germany. The combination of lift and humidity led to predicted MLCAPE values of locally more than 3000 J/kg, which is significant with regard to Germany.

However, while humidity and instability showed a substantial overlap, a lack of large scale lift was noted. Enhanced lift was instead forecast to the west over France. As a consequence, models showed the development of convection over France but did not give a hint for initiation over Germany.

Since models did not indicate significant signals for lift as a necessary ingredient for convection, this raised the question for other triggering factors.
From the experience of the activity the days before, decaying mesoscale clusters were identified as a possibility to introduce lift. An eastward spreading cold pool, which was generated by a dying overnight mesoscale convective system (MCS) in combination with a southwesterly background flow led to enhanced convergence further upstream. Attendant lift led to the development of new convection that eventually organized to an MCS.

The described mesoscale lift was the triggering factor for convection that in turn could make use of the large CAPE values. Developing thunderstorms then benefited from high values of deep layer shear in the affected

region in Western Germany (0-6 km: 20 to 25 m/s).
Therefore, organized and long-lived convection was expected and a preliminary information about severe thunderstorms was issued during the morning hours.

III. Tools + methods of nowcasting severe weather at Deutscher Wetterdienst (DWD)

The forecaster at DWD has several tools that help him to evaluate ongoing convection concerning its severeness and accompaniments. First ranked are remote sensing methods like radar or satellite data and their interpretations. “Sandwich products”, which combine several satellite channels, allow to achieve multiple information by one single image, which is a helpful tool in nowcasting. Also radar can give valuable information not only from radar intensity but for instance by Doppler winds or vertical integrated liquid (VIL) which are a good supplement to reflectivity or accumulated rainfall amounts.

During the talk it will be shown how these information are visualized in one window that can be opened for each detected thunderstorm. This tool is called “CellView” and accelerates the gathering process of important information about ongoing thunderstorms. This is especially important since a warning meteorologist is responsible for large areas that can be affected by many storms during a high impact weather situation.

Another mechanism that supports the forecaster is the so called “NowCast-Mix”. This tool combines several input data as “radar reflectivity”, “cell detection”, “CellMOS” or ”VIL” and ground observations as well as parameters from local area models like “PPW” or “cell motion”. The combination is done by a fuzzy logic algorithm and the resulting output is a depiction of the current state of severeness of a storm, as well as its extrapolation into the future.
The talk will show how a forecaster works with those different tools during high impact convective weather situations by making use of the “Pentecost Monday MCS”.

IV. Results and Conclusions

June 9, 2014 was a prime example to show how important it is to have an experienced forecaster who makes use of a physical based approach to achieve the risk for convection and its severeness.
Although the direct output of almost all model forecasts did not show any hint of the severe weather situation that developed in the late evening in Western Germany, the forecaster was able to predict the event quite reliable and issued preliminary information about severe weather before noon.

After the process of raising awareness, the warning meteorologist issued severe weather warnings considerably in advance of the approaching convective system. For that effect he could benefit from several supporting methods and tools. The final decision to issue the highest possible warning category (extremely severe weather) resulted from a wind measurement from the airport of Düsseldorf as well as from an obvious bowing signature in reflectivity image.

Since the severe MCS affected among others a highly populated area (Ruhr area) with up to hurricane-force wind gusts, widespread damage led to a loss of 650 Mio. Euro. Unfortunately also six fatalities had to be complained and 37 people got hurt. It took several days to re-implement the public infrastructure with the help of the German Federal Armed Forces, among others.

Looking on the frequency of occurrence of such an event it could be determined that this case had a return period of more than 50 years.

V. Acknowledgements

The authors like to thank Deutscher Wetterdienst for offering remote sensing data, measurements and models. Special thanks go to all contributors that have supported us to make the data available and who gave helpful hints.

VI. References

Johns, R. H., and C. A. Doswell III, 1992: Severe local storms forecasting. Wea. Forecasting,7, 588–612.