Water vapour data usage during powerful convection situations in Lithuania in summer 2012

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Some facts

Over the past ten years, the occurrence of severe storms cases in Lithuania is increasing. In total, there were 16 cases of intense convection recorded in Lithuania during the warm season in 2012. They included 5 cases of very heavy rain (≥50 mm/12 h), 6 squalls (≥28 m/s) and 4 severe thunderstorms (a complex of hazardous weather phenomena such as heavy rain, squalls, hail and lightning), and one tornado F0/1. Most of events occurred locally, but some of them brought dramatic damage and even injured people.

Main reasons

Objective – due to climate change, more frequent meridianic air flow brings tropical air mass from Northern Africa or Turkey to the northern countries, such as Baltic States and Scandinavia. Firstly, it means that very warm and moist air whith high instability produces intensive convection including heavy rain, thunderstorms, strong squalls, large hail and even tornadoes. Secondly, tropical air which is pushed out by cooler Atlantic cyclone trough with cold front inside. Then severe weather events could develop again;

Subjective – better situation at the Service (LHMS) and in all country: it includes the increase of meteorological stations network density (since 2012 there are 27 MSs and plus 30 AgroMSs instead of 20 MSs previously). Moreover, nowadays forecasters are better informed by active people who had perfect conditions to send immediately pictures or video from the event site.

The importance of Water Vapour information

Obviously, MSG WV 6.2 □m channel serves as the main tool in operational synoptic analysis and in large scale dynamic process assessment. Water vapour data (moisture field in the 700-300 hPa layer) along with ECMWF global model atmospheric physical parameters, especially potencial verticity, provide the insight into the situation at the middle and upper levels. Moist and dry regions in the WV image show the upper atmosphere features – troughs, jet streams, deformation zones. This information is usable as operational tool for nowcasting and issuing warnings;

Detailed information of WV imagery combined with different satellite products, lightning detection system and radar data (Doppler radar in Western Lithuania) play a leading role in detection and analysis of strong convection and development of severe weather phenomena. Finally, dark stripes in WV image can be used to detect discrepancies between numerical models and actual observations.

Additionally, atmospheric soundings, radar products and vertical profiles, different SAFs help to analyze the process more deeply and give an additional input for perceiving the main peculiarities of powerful convection and issue warnings well in advance. These data in association with WV information are very important before the event starts, during the peak and after it ends.

The main WV imagery features

During the strong and very strong convection over the Baltic region are such as:

- Intrusion of dry cold stratospheric air to lower layers;
- Convective cells in WV black area between WV humid layers;
- Enhanced convective activity in warm air;
- Development of cloudy area and frontal bulge;

The typical Conceptual Models in warm period are MCSs within unstable zones, Waves and Dark Stripes in Cold Front. Several hazardous weather cases in connection with Occlusion, RaCy, ULL have been detected as well.

Problems and Conclusion

Usually extreme weather events are local and poorly represented in synoptic-scale data and in NWP global models, so monitoring of process development over the southern and western part of Europe plays very important role. Due to objective reasons for increase of severe weather phenomena, WV imagery is a substantial component in satellite information. Deep analysis of WV information leads up to choice of the right conceptual model. Unfortunatelly, MetOP satellite data are sparse enough, thus necessary more precise information about further convection development over the northern latitudes often is missed.

Meanwhile additional satellite assimilated data along with radar, lightning and NWP model output help to better understand physical processes and are subservient to accurate prediction of severe weather events. Finaly, we should not foreget the human factor – from the first signs of deep convection, during the process analysis and untill the decition making.