MiSRaR Project

GABROVO's Experience on Risk Analysis

Aveiro, June 2010,

GABROVO'S BEST PRACTICE

Bulgarian hail suppression system

Issues tackled in the best practice: Analysis of real time meteorological radar information for suppression of hail-storms

OBJECTIVES OF THE PRACTICE

- **To analyse real time meteorological radar information in order to predict hail storms and combat them**
- **To reduce the damage on agricultural crops**
- **To secure fast reaction against hails by delivering reagent - artificial ice-forming nucleus (AgI) in clouds by means of rockets**

TERRITORY COVERED

17 000 sq.m from the territory of Bulgaria and especially 8 regions with heavy hail-storm damages (Vidin, Montana, Vratsa, Pleven, Pazardjik, Plovdiv, Stara Zagora and Sliven)

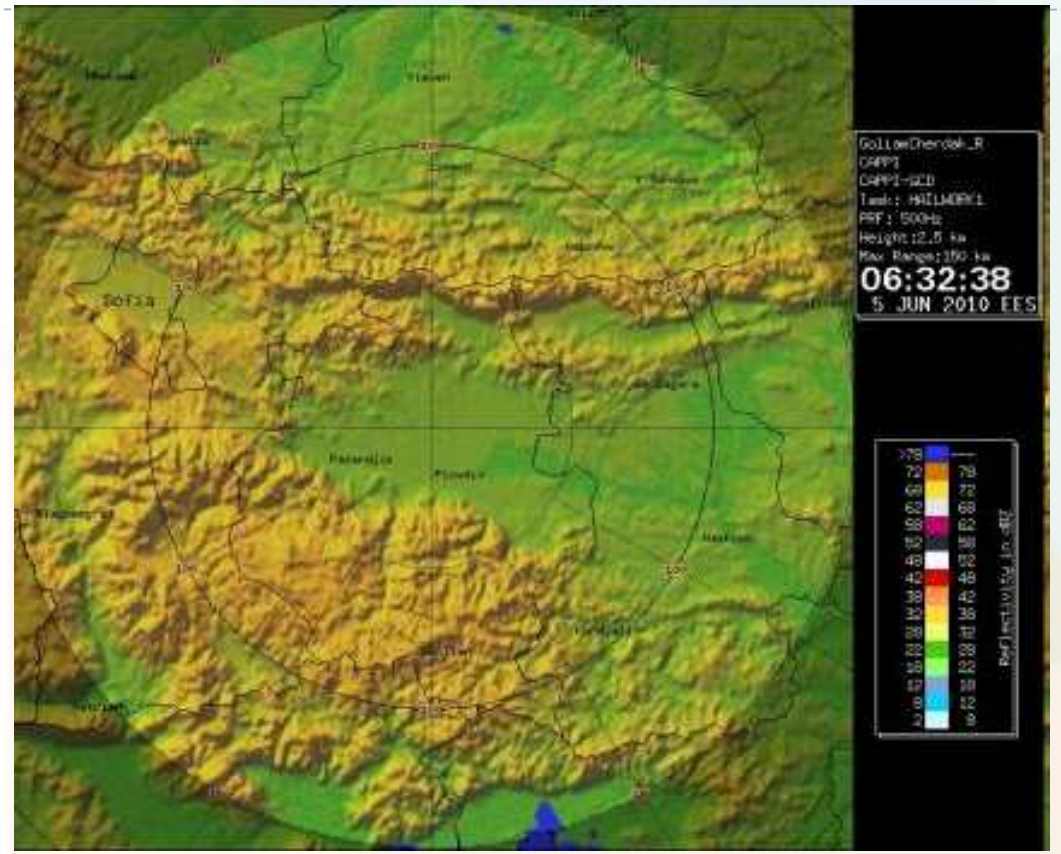
HOW WE DEAL WITH HAILSTORMS

1. **The Bulgarian hail suppression system** was set up in 1968 as a structure of the Ministry of Agriculture.
2. **Analysis and monitoring of the weather conditions** using MRL5-IRIS Doppler radars
3. **The method of cloud seeding** – delivering of reagent - artificial ice-forming nucleus (AgI) in clouds by rockets has been adopted. It enables the direct and continuous dispersion of reagent in seeding cloud areas at regular intervals during the whole period of hail danger.

RADAR SYSTEM

The overall hail suppression activity is carried out by the RAPIRA system. The system is designed to **process and display the weather radar information**, to process the aerological sounding data, to **command and control the cloud seeding** with seeding reagent and to **command the anti-hail rockets launching.**

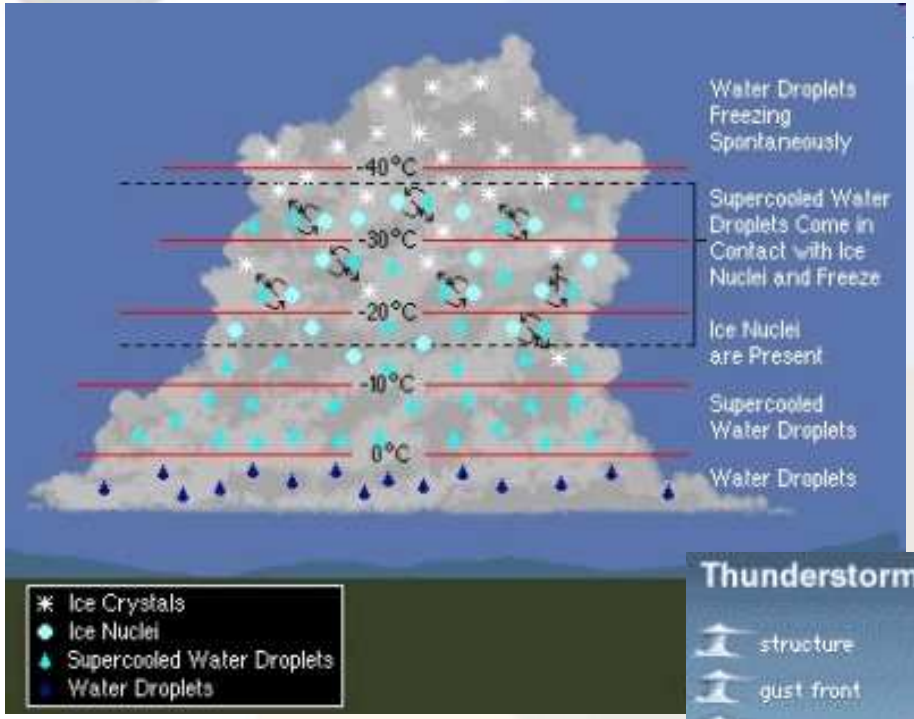
MRL5-IRIS is a modern Doppler radar system for automatic volumetric scanning of the atmosphere and data archiving. The system includes **three radar stations and an information centre** in Sofia, fitted up with IRIS Analysis and **6 remote posts with IRIS Display**. Real time volumetric radar information is transmitted to other command posts and the information centre in Sofia.

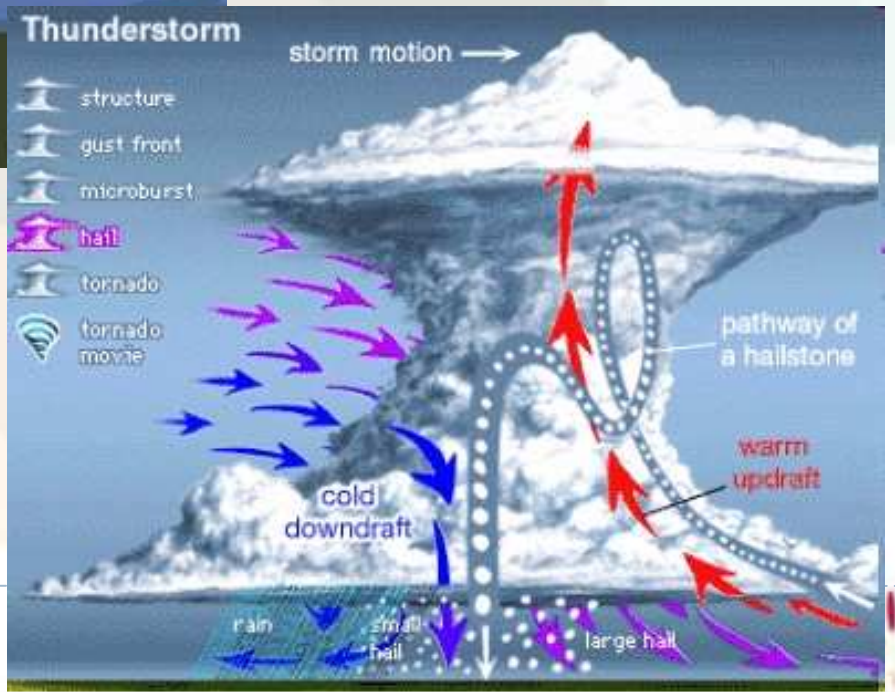


Real time on-line monitoring of the weather conditions, accessible for citizens as well from the web-site of the Agency

SEEDING

In order to prevent hail damages, it is necessary to transform the dangerous convective clouds so as not to allow the formation of large hailstones.
Seeding increases significantly the ice embryos concentration so that the artificial and natural ice particles compete with each other for available liquid water. The supercooled water redistributes between all ice embryos and thus resulting hailstones are small. Falling to the ground, they melt to rain or sleet – this is called **beneficial competition**


Water Droplets Freezing Spontaneously
-40°C
Supercooled Water Droplets Come in Contact with Ice Nuclei and Freeze
-30°C
-20°C
Ice Nuclei are Present
-10°C
Supercooled Water Droplets
0°C
Water Droplets
Ice Crystals
Ice Nuclei
Supercooled Water Droplets
Water Droplets

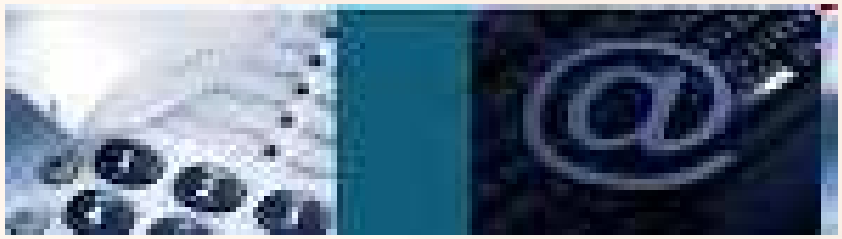

Thunderstorm
storm motion
structure
gust front
microburst
hail
tornado
tornado movie
pathway of a hailstone
warm updraft
cold downdraft
rain
small hail
large hail

EVALUATION AND CONCLUSION

- The geographical location and diverse terrain of Bulgaria characterise it as one of the most hail-stormy countries in Europe.
- The method proved its effectiveness for more than 40 years.
- Preliminary research and analysis where to place the radar stations and the anti-hail rocket launches in order to have best results for protection of the agricultural crops.
- Expensive method in terms of administration involved

CONTACTS

Hail Suppression Agency
Address: 17, “Hristo Botev” blvd., 1606 Sofia, Bulgaria
Tel. - +359 2 9152952
Fax - +359 2 9516597
e-mail: agencyweathermod-bg.eu



THANK YOU
FOR THE ATTENTION

Questions???

Phone: 00 359 2 952 32 59
fax: 00 359 2 953 27 15
http://www.europerspectives.org/