EARLY SPRING THUNDERSTORM DEVELOPMENT

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Summary

The paper is focused on early spring thunderstorm development and its impact on aviation in BULATSA region of responsibility.
The aim of the study is to reveal specific features of the convective developments as seen on the time synchronized radar and satellite pictures. Features associated with severity of storm are pointed, like zones with high maximum radar reflectivity
The pre convection environment is very important for issued nowcasting forecast. It is studied by NWP(ECMWF) fields, upper level sounding and synoptic observation at different altitudes.
Satellite imagery and advanced products are used for inferring atmospheric instability
The considered case shows that the behaviour of convective storms is linked to complex factors of land surface conditions and orography as well as upper level dynamics, in addition to the specific environmental wind shear characteristics.

About Sofia FIR

Sofia Air Traffic Control (ATC) Centre provides air navigation services in Sofia Flight Information Region (Sofia FIR) comprised of the sovereign airspace of the Republic of Bulgaria and that part of the airspace over the Black Sea wherein the Republic of Bulgaria has assumed responsibility for the provision of air navigation services.
Sofia ACC provides continuous ATS over a territory of approximately 145,000 sq. km. In 2015 about 695,000 en-route civil flights were controlled without any delays attributable to operational constraints.

SYNOPTIC SITUATION AND OROGRAPHIC INFLUENCE AT 06.04.2017

At 500 hPa (fig.1 Bulgaria is in red rectangle) on 06 April 2017 Bulgaria is located in eastern head part of deep upper level trough of low geopotential. Cold polar air mass approaching Balkan peninsular from northwest. At surface level (fig.2, fig.3 and fig.4) the region is in low pressure field ahead of approaching from northwest cold front. Orographic convergence line is forming in Eastern Bulgaria (fig.5).

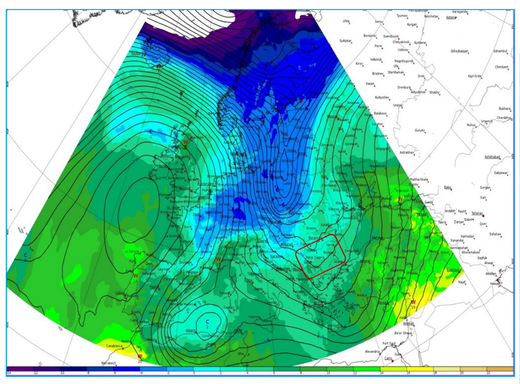


Fig.1 ECMWF HIRES 06.04.2017
Valid:12:00 UTC Model: 00:00UTC
Geopotential height (black contour) and Temperature (color) at 500 hPa

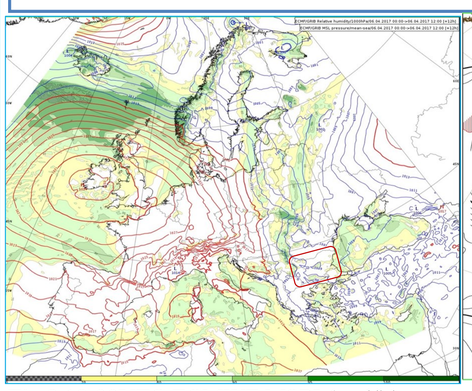


Fig.2 12:00UTC ECMWF MSPL(red/blue isobars, relative humidity in color), run from 00:00UTC

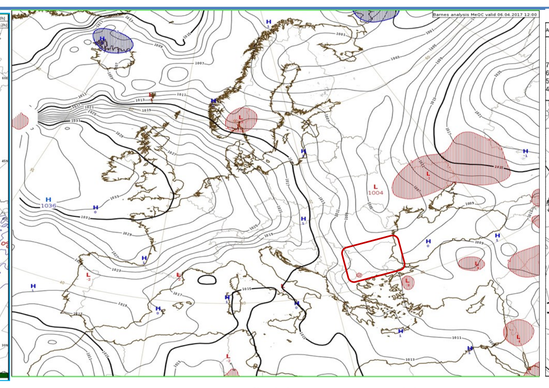


Fig.3 12:00UTC MSPL field constructed by SYNOP information shows good correlation with ECMWF HIRES MSLP forecast.

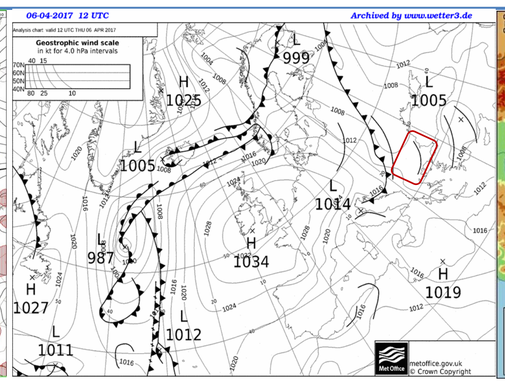


Fig.4 UK Met Office analyse 12:00 UTC

Fig.5 Orographically induced by Carpathian convergence line

ATMOSPHERIC INSTABILITY

Real upper air sounding in Sofia shows a rich low-level moisture up to 500hPA, and dry level above 500hPa. CAPE around 300 j/kg and NO CIN combined with diurnal heating lead to unstable air mass. ECMWF products valid for 12:00UTC, run from 06042017 00:00UTC (fig.7,fig.8,fig.9 and fig.10) describe quite well unstable situation. We can expect more intense convection in Eastern Bulgaria where there are: low level moisture, relatively height temperature and moderate CAPE.

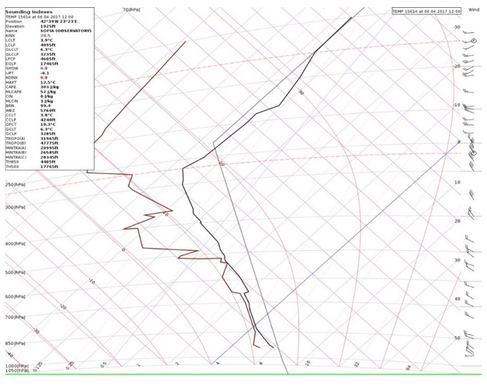


Fig.6 Aerological diagram for Sofia upper air station, 12:00 UTC

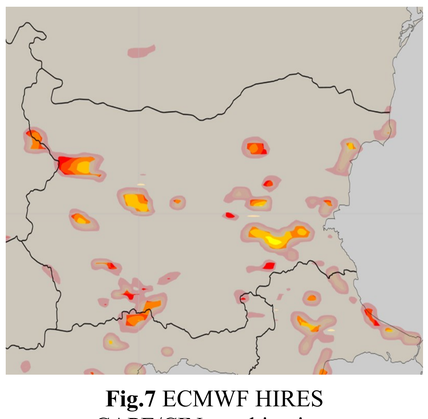


Fig.7 ECMWF HIRES
CAPE/CIN combination;

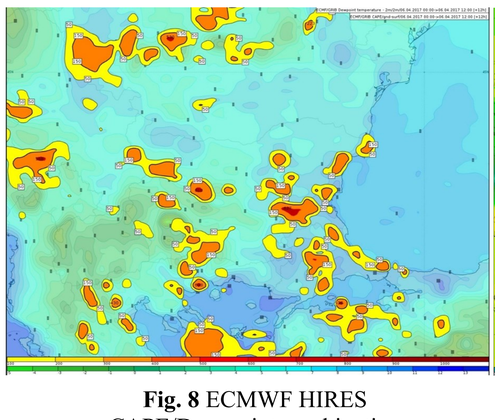


Fig. 8 ECMWF HIRES
CAPE/Dew point combination

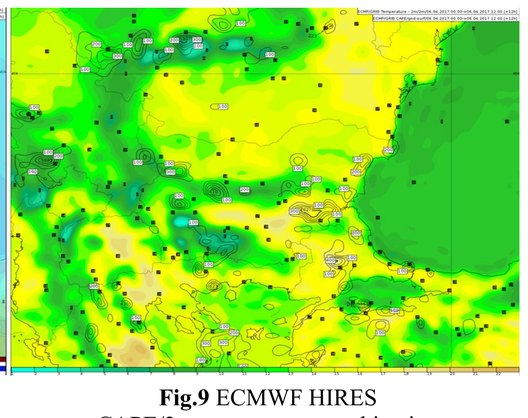


Fig.9 ECMWF HIRES
CAPE/2m temperature combination

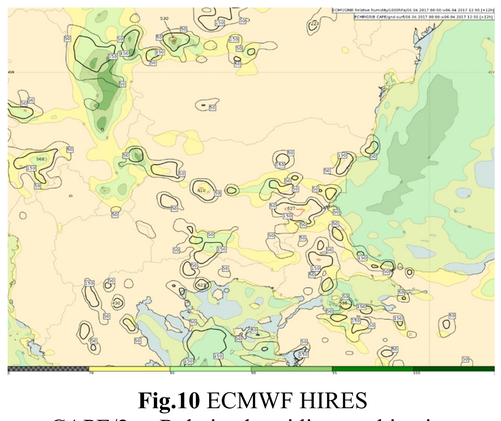


Fig.10 ECMWF HIRES
CAPE/2m. Relative humidity combination
Validity: 12:00UTC

DEVELOPMENT OF THE CONVECTIVE PROCESS

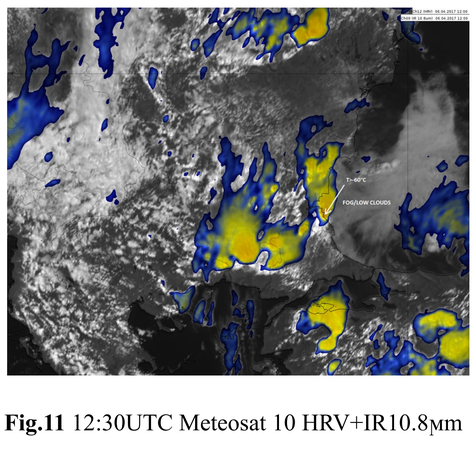


Fig.11 12:30UTC Meteosat 10 HRV+IR10.8μm

Convection initiation started around 10:00 UTC southwest from Burgas, maximum intensity was reached around 12:30UTC (fig.11 and fig.12) when reflectivity received by Doppler weather radar was above 55dBz. At the same time minimum brightness temperature at cloud top exceeded minus 60°C and produced hail (fig.12 right upper corner), at 14:30UTC a squall line (convergence line) was formed (fig.13), after 17:00UTC convective processes decay.

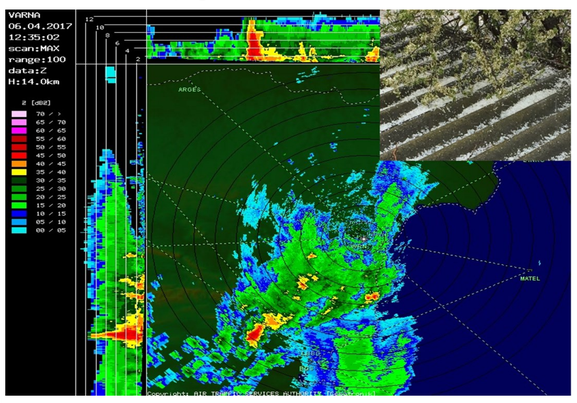


Fig.12 Maximum reflectivity received from Varna Doppler radar; Range: 100km;Validity: 12:35 UTC

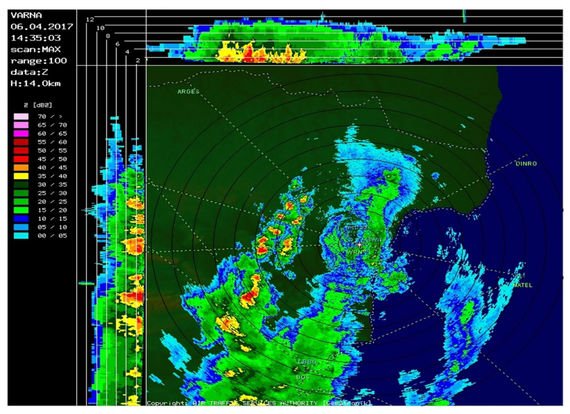


Fig.13 Maximum reflectivity received from Varna Doppler radar; Range: 100km;Validity: 14:35 UTC

On 06 April 2017 weather situation at Burgas airport was very complicated for forecasting. At the same time over the western part of Black sea fog was formed shown on the satellite image, which disappeared when cumulonimbus approached the airport. Fig.14 shows METAR and TAF reports issued from BULATSA MET Office for Burgas airport with validity between 10 and 15 UTC.

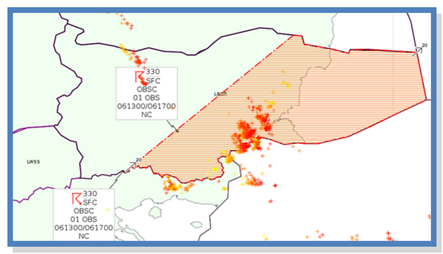
METAR report

LBBG	2017-04-06 10:30	2017-04-06 10:30		SA	METAR LBBG 061030Z 16006KT 4800 BR FEW007 FEW028CB SCT046 13/11 Q1009 TEMPO 3000 BR=
LBBG	2017-04-06 11:00	2017-04-06 11:00		SA	METAR LBBG 061100Z 13010KT 7000 2300SW BR FEW001 FEW028CB SCT046 12/11 Q1009 TEMPO 1500 BR=
LBBG	2017-04-06 11:30	2017-04-06 11:30		SA	METAR LBBG 061130Z 13012KT 4800 1400SW BR SCT001 BKN004 FEW028CB 10/09 Q1009 TEMPO 0500 BCFG=
LBBG	2017-04-06 12:00	2017-04-06 12:00		SA	METAR LBBG 061200Z 13009KT 0900 R22/0900VP2000U BCFG SCT001 BKN004 FEW028CB 10/09 Q1009 TEMPO 0800 BCFG=
LBBG	2017-04-06 12:30	2017-04-06 12:30		SA	METAR LBBG 061230Z 10009KT 3900 1600NE R22/1000V1900D BR SCT001 BKN004 FEW028CB 10/09 Q1009 TEMPO 1500 BR=
LBBG	2017-04-06 13:00	2017-04-06 13:00		SA	METAR LBBG 061300Z 10011KT 8000 SCT002 SCT004 FEW030CB 11/10 Q1009 NOSIG=
LBBG	2017-04-06 13:30	2017-04-06 13:30		SA	METAR LBBG 061330Z 05008KT 9000 SCT004 FEW028CB 11/10 Q1008 TEMPO 5000 TSRA=
LBBG	2017-04-06 14:00	2017-04-06 14:00		SA	METAR LBBG 061400Z 06009KT 030V090 6000 FEW004 SCT028CB BKN039 11/10 Q1008 TEMPO 3000 TSRA=
LBBG	2017-04-06 14:30	2017-04-06 14:30		SA	METAR LBBG 061430Z 10007KT 8000 -TSRA FEW004 SCT028CB BKN039 11/10 Q1008 TEMPO 3000 TSRA=
LBBG	2017-04-06 15:00	2017-04-06 15:00		SA	METAR LBBG 061500Z 14011KT 1800 0800SW R04/1300D TSRA BCFG FEW001 SCT028CB BKN042 10/09 Q1008 NOSIG=

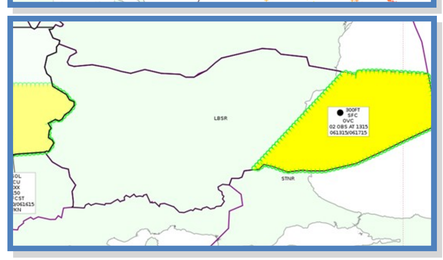
TAF report

LBBG	2017-04-06 11:00	2017-04-06 12:00	2017-04-07 12:00	FT	TAF LBBG 061100Z 0612/0712 13010KT 6000 SCT030 BKN050 TEMPO 0612/0613 0500 BCFG SCT002 TEMPO 0613/0620 5000 SHRA SCT030CB PROB40 0613/0618 3000 TSRA SCT030CB BECMG 0620/0622 28016G26 9999 SCT020 BKN030=

Fig.14



Information SIGMET
Issued by BULATSA MWO
at 13:49,
combined with SFLOC data
for last hour



Information AIRMET
Issued by BULATSA MWO at
13:49UTC for observed low
clouds and visibility in west-
ern part of Black sea

CONCLUSIONS

- **Early spring thunderstorms with hail are rare event in Bulgaria. Combination with low visibility and clouds close to Burgas airport could potentially lead to dangerous situations;**
- **This case shows that ECMWF HIRES is useful tool for short range forecast of convection;**
- **Fog and low cloud forecasts still are a challenge for weather forecasters, despite the advance of NWP.**