



USAID
FROM THE AMERICAN PEOPLE

 METEO.GOV.GE

Flash Flood Case Study NIMH-Bulgaria

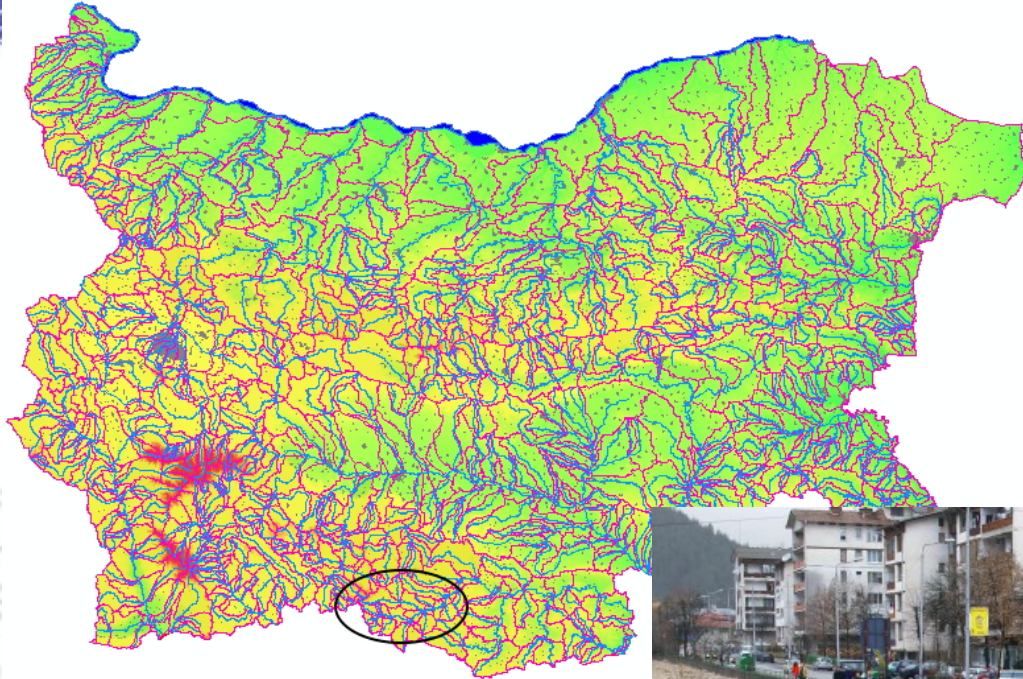
www.meteo.bg, www.weather.bg, www.hydro.bg

Meteorologists: A. Kirilova, K. Stoev, E. Egova
Hydrologists: G. Koshinchanov, V. Yordanova

BSMEFFG System - Amman, Jordan, 11-13 April 2017

Flood in the town of Smolyan and the region

16-17 January 2016

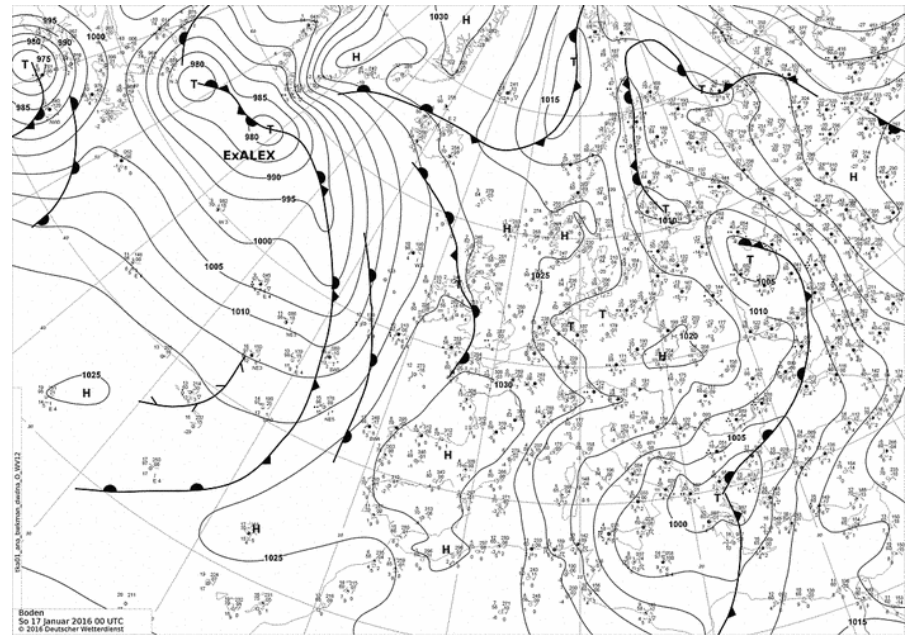
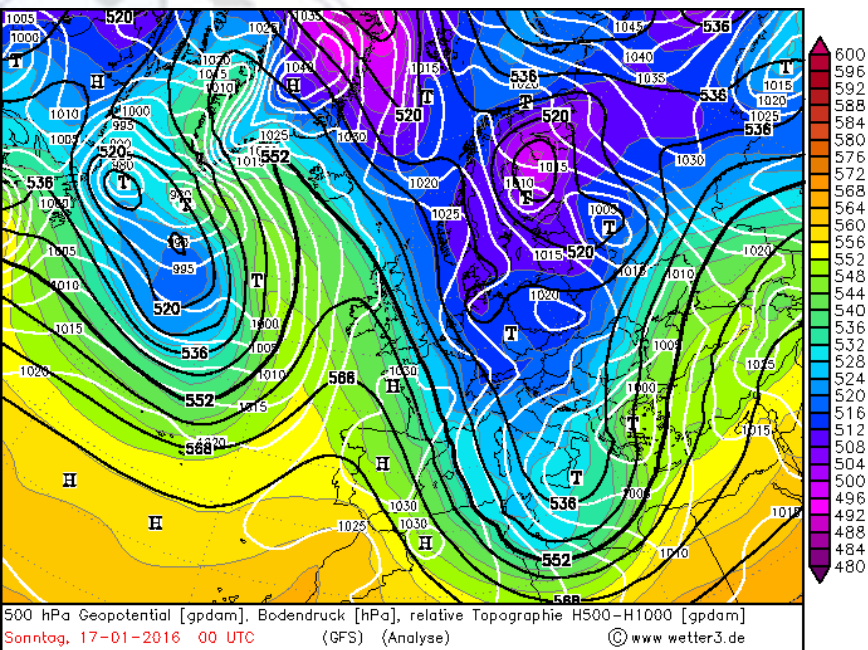
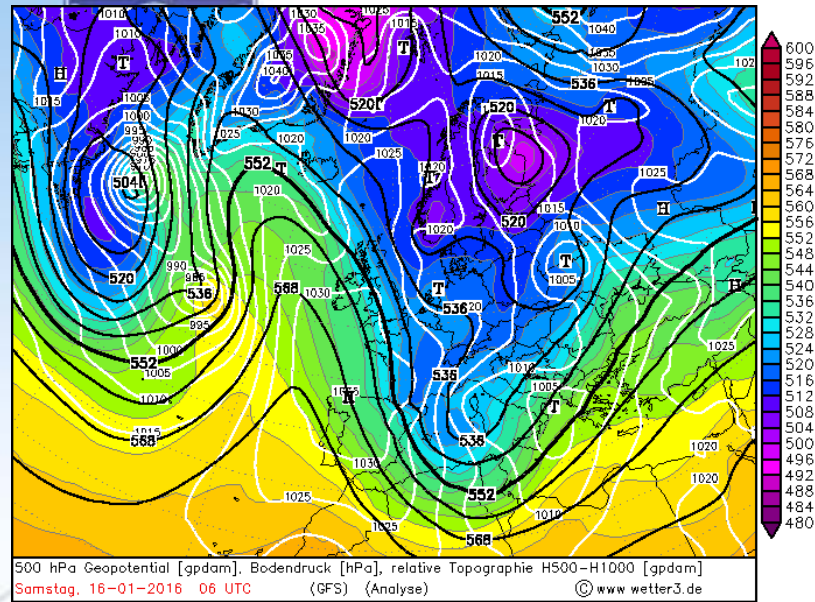


Synoptic situation on 16-17.01.2016



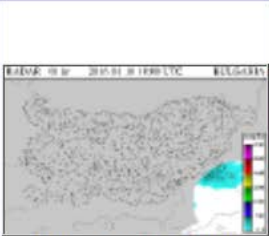
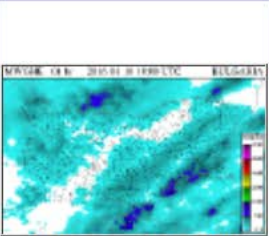
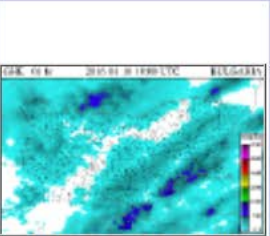
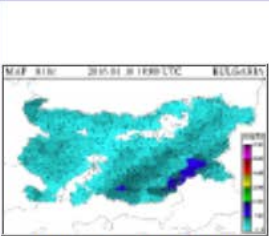
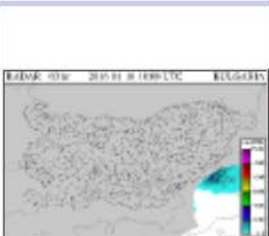
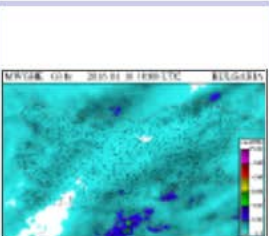
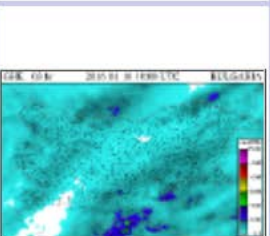
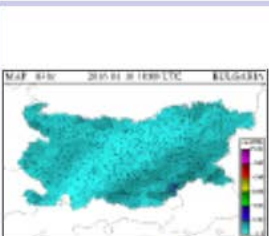
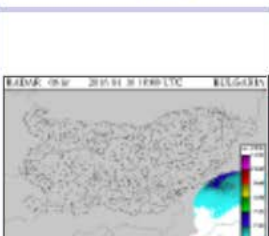
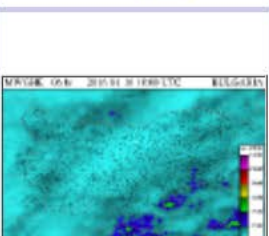
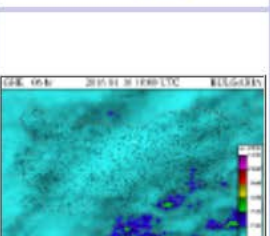
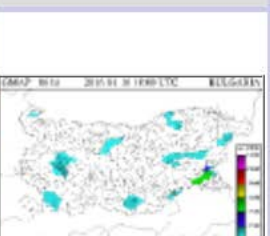
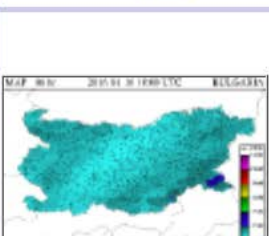
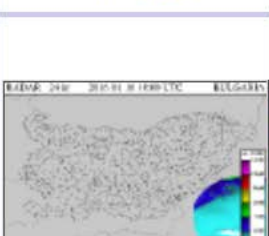
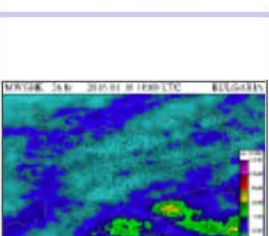
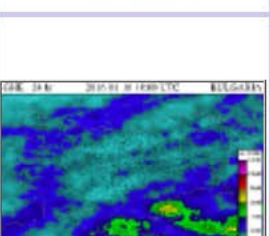
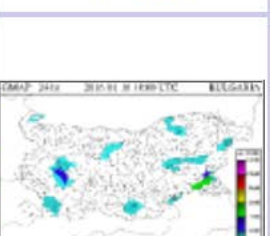
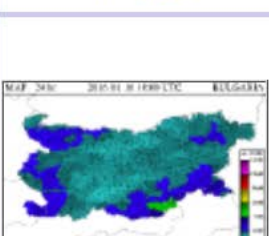
On January 16th 2016 at 06 UTC at 500 hPa, the Balkans are in the front part of a trough, that is related to a cyclone over Finland. The axis of the trough is coming to south-west through Central Europe and the Central Mediterranean. It moves to the east and a cyclone is formed over the West Balkans. (fig.1)

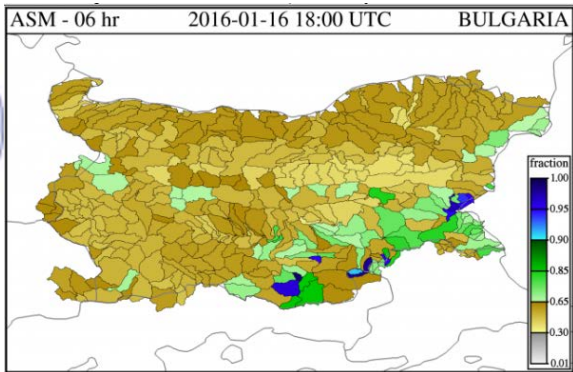
At the ground level of the atmosphere a Mediterranean cyclone is formed over the Ionian Sea, later it moves to the east over Greece and the Aegean sea to the Black sea region and deepens. (fig.2) The frontal system connected with it passes through Bulgaria. (fig.3) It's raining all over the country, in the north-western half – snow, in the south-eastern – in the beginning rain, that later turns to snow. The heaviest precipitation in South Bulgaria, especially in the Rila and Rhodope mountains



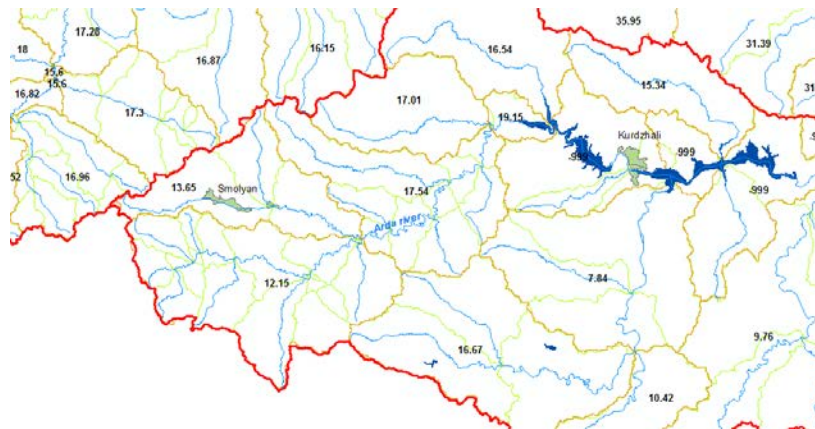
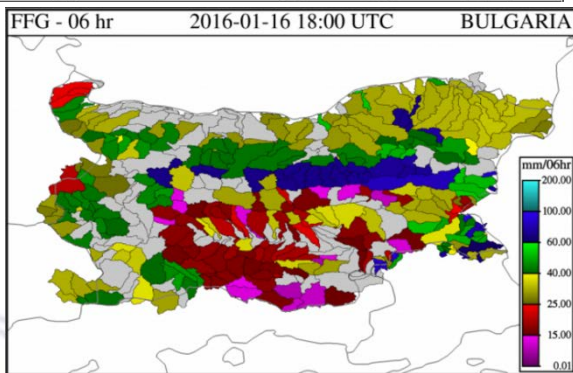


Measured & Estimated Precipitation at 18:00 UTC from BSMEFFG

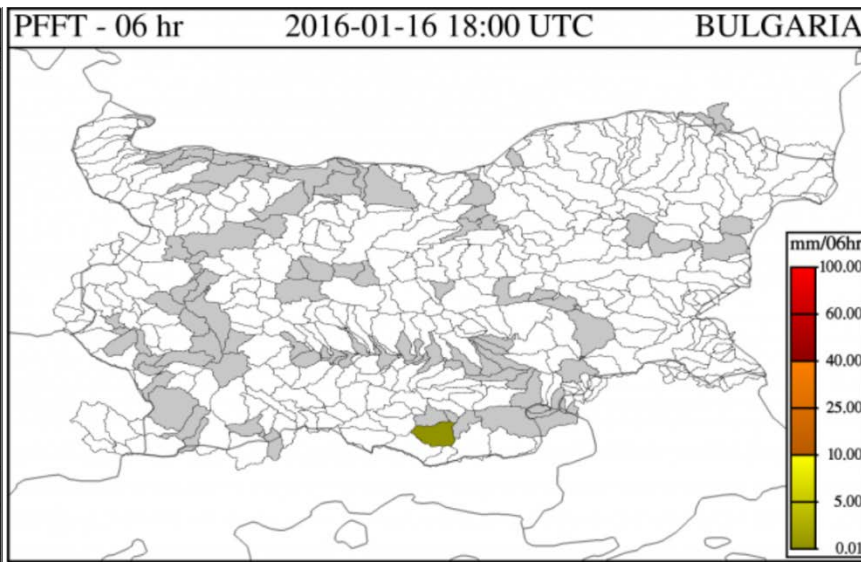
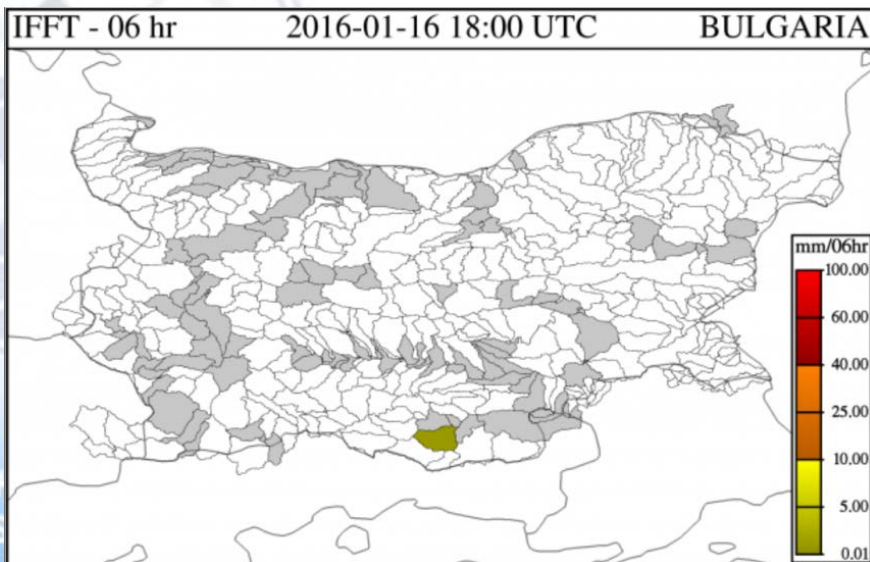
DT	RADAR Precipitation	MWGHE Precipitation	GHE Precipitation	Gauge MAP	Merged MAP
01-hr	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>		 <p>2016-01-16 18:00 UTC Text: view</p>
03-hr	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>		 <p>2016-01-16 18:00 UTC Text: view</p>
06-hr	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>	 <p>2016-01-16 18:00 UTC Text: view</p>
24-hr	 <p>2016-01-16 18:00 UTC</p>	 <p>2016-01-16 18:00 UTC</p>	 <p>2016-01-16 18:00 UTC</p>	 <p>2016-01-16 18:00 UTC</p>	 <p>2016-01-16 18:00 UTC</p>



Average Soil Moisture - soil water saturation (0.67 - 0.7)

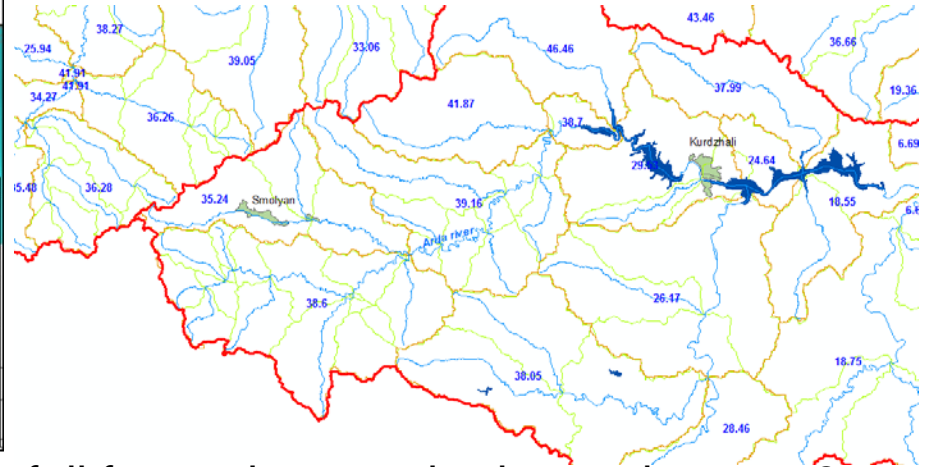
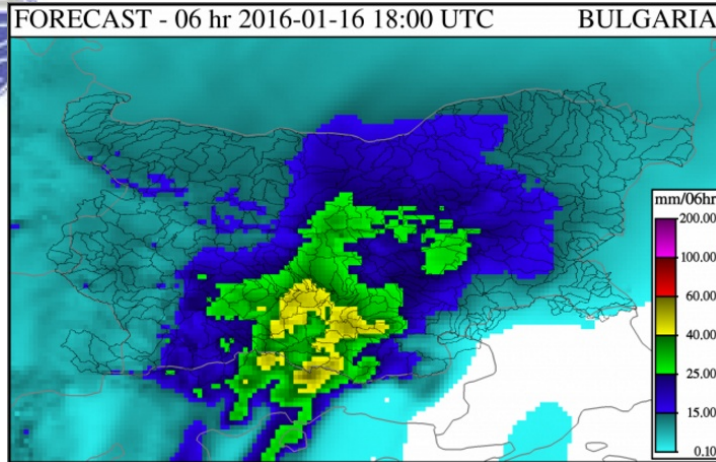


Required rainfall to cause bankfull flow over the next 6hrs (13 mm - 17 mm)

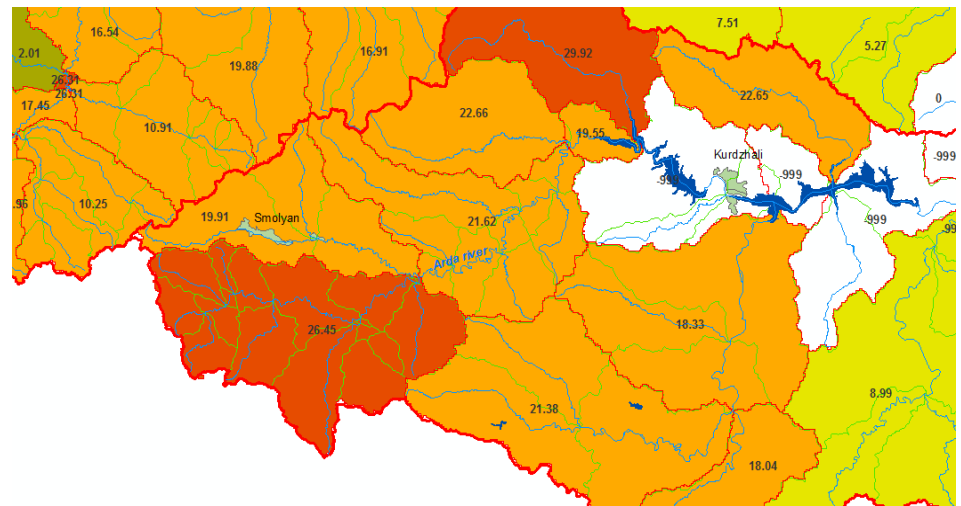
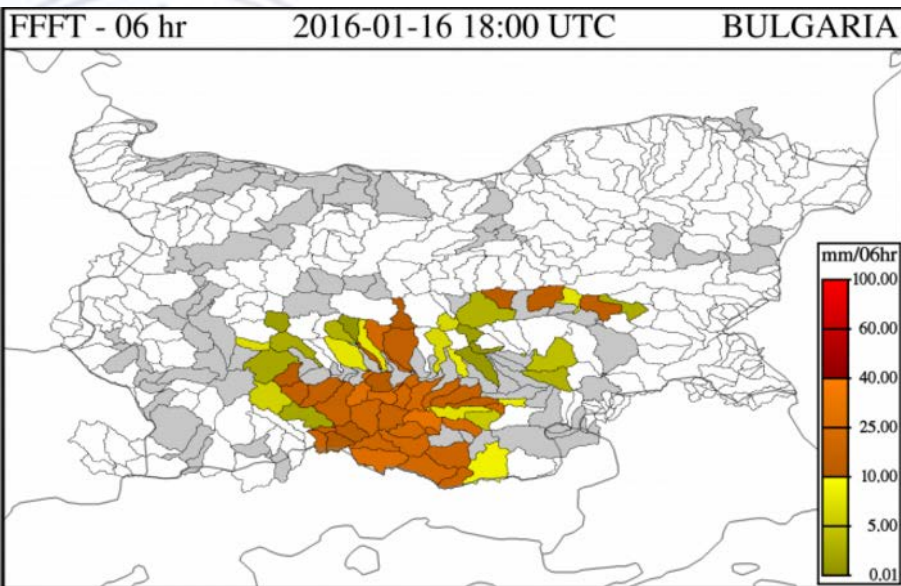




ALADIN forecast at 18 UTC is for significant rainfall in the next 6 hours



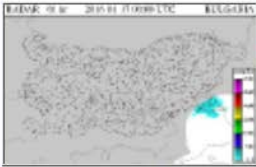
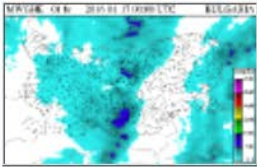
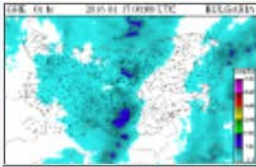
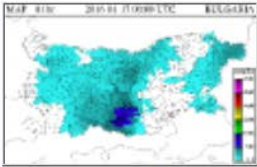
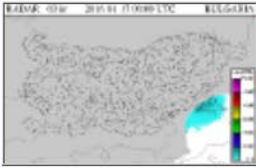
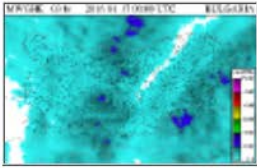
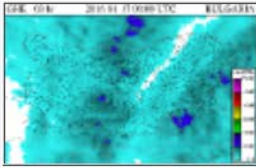
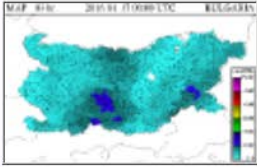
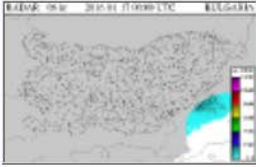
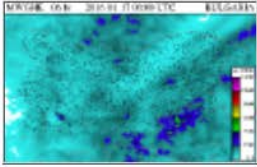
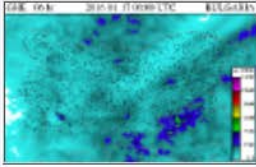
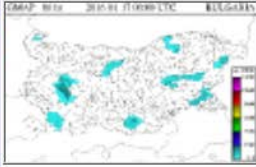
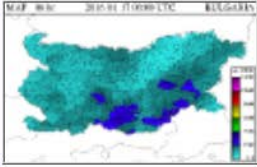
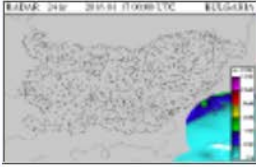
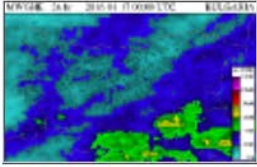
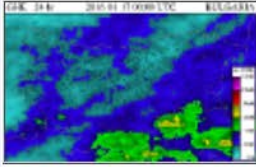
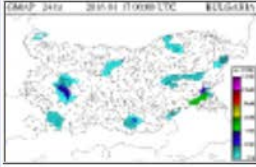
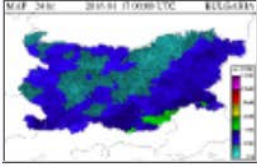
The forecasted average accumulated rainfall for each watershed over the next 6 hours is between 30 mm and 47 mm

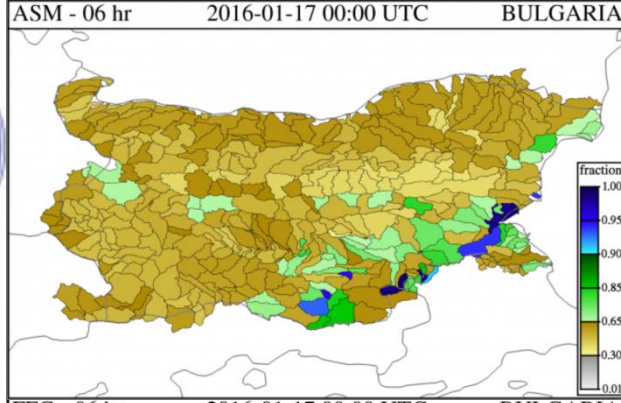


FFFT shows values between 5 mm and 30 mm over next 6 hours

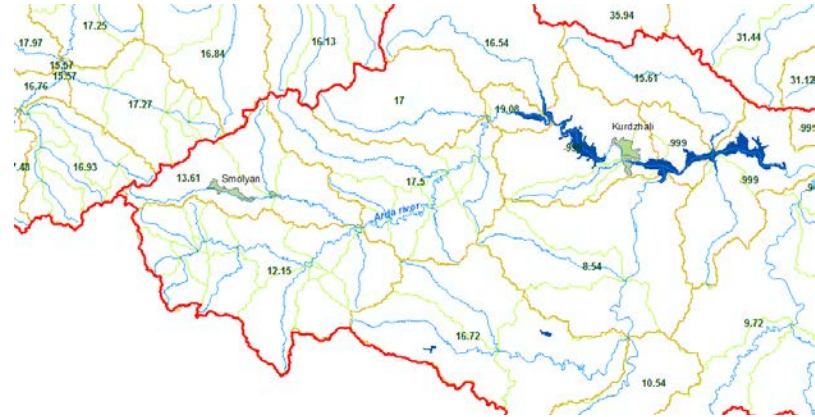
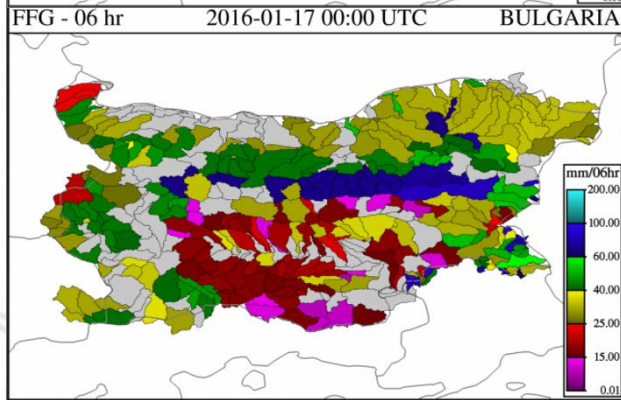


Measured & Estimated Precipitation Forecast 00:00 UTC 17 January from BSMEFFG

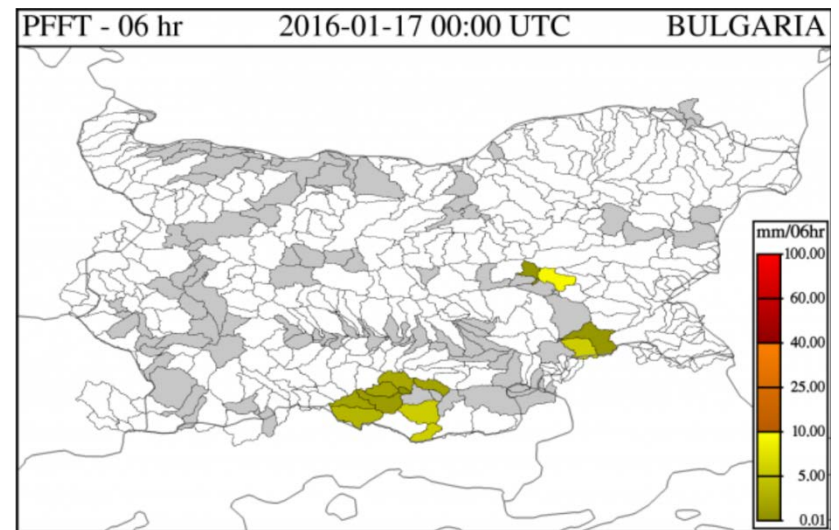
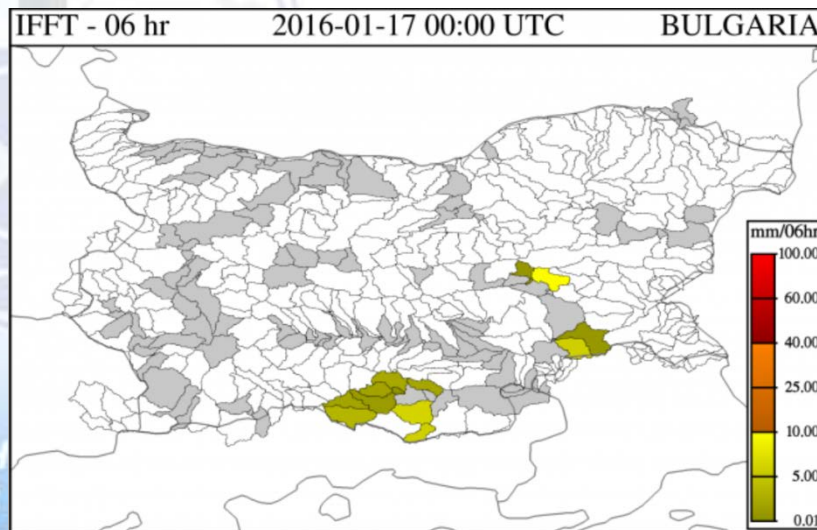
DT	RADAR Precipitation	MWGHE Precipitation	GHE Precipitation	Gauge MAP	Merged MAP
01-hr	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view		 2016-01-17 00:00 UTC Text: view
03-hr	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view		 2016-01-17 00:00 UTC Text: view
06-hr	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view	 2016-01-17 00:00 UTC Text: view
24-hr	 2016-01-17 00:00 UTC	 2016-01-17 00:00 UTC	 2016-01-17 00:00 UTC	 2016-01-17 00:00 UTC	 2016-01-17 00:00 UTC



Average Soil Moisture - soil water saturation (0.67 - 0.7)

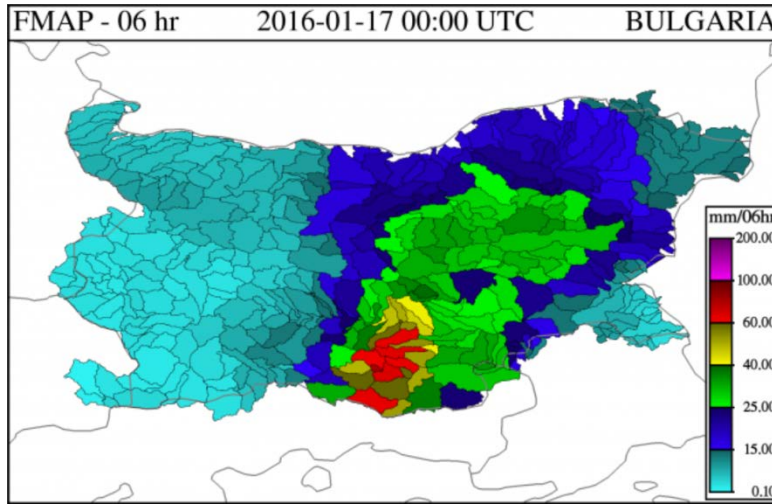


Required rainfall to cause bankfull flow over the next 6hrs (13 mm - 17 mm)



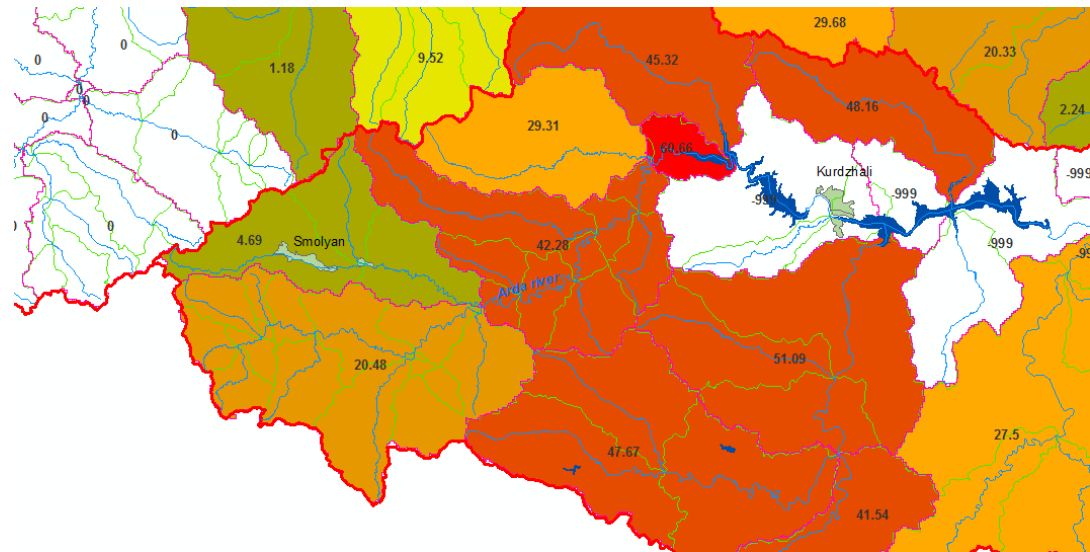
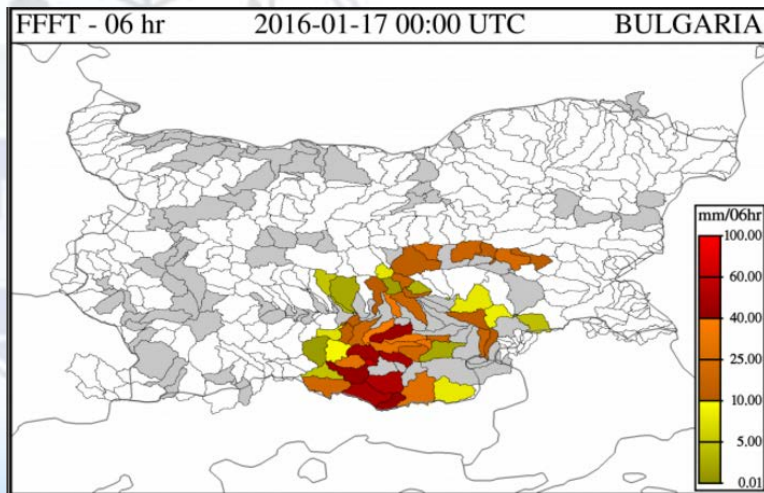


ALADIN forecast at 00 UTC is for significant rainfall in the next 6 hours



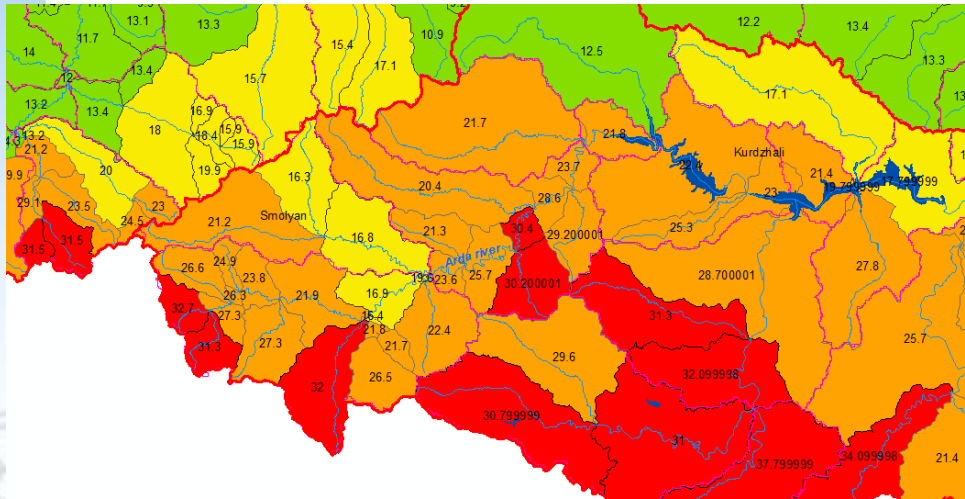
The forecasted average for each watershed accumulated rainfall over the next 6 hours is between 30 mm and 70 mm

FFFT shows values between 5 mm and 50 mm over next 6 hours





In GIS is presented the forecasted over 3 and 6 hour maximum average rainfall in each watershed (1088 watershed) for the next 72 hours.
ALADIN-Bulgaria issued at 06:00h UTC 16.01.2016

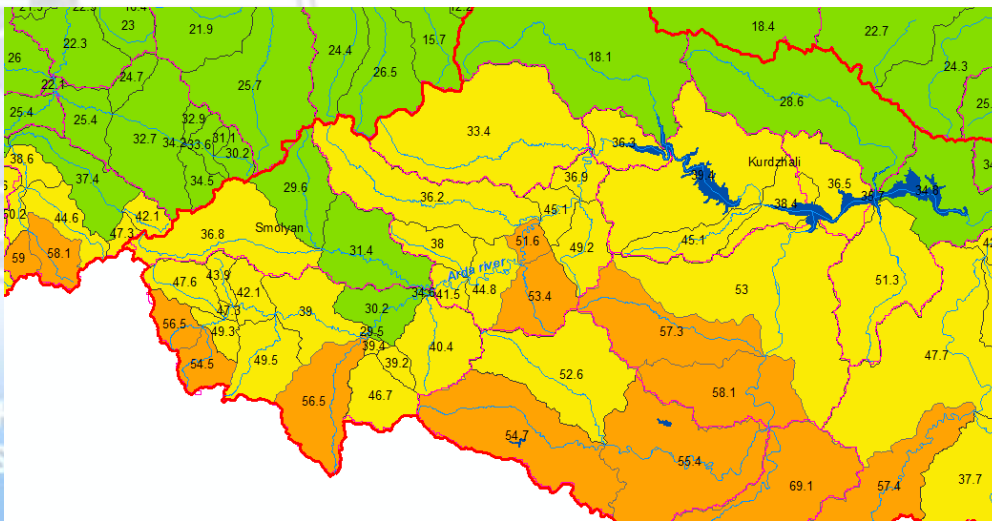


The maximum precipitation is forecasted to occur 18-21 UTC on 16.01.2016

for 3 hours accumulated precipitation

- No intensive precipitation;
- Precipitation from 15 mm/3h to 20 mm/3h; (attention)
- Precipitation from 20 mm/3h to 30 mm/3h; (warning)
- Precipitation over 30 mm/3h; (alert)

According to the accepted categories for intensive rainfall, forecasted hour rainfall is below the thresholds for warning

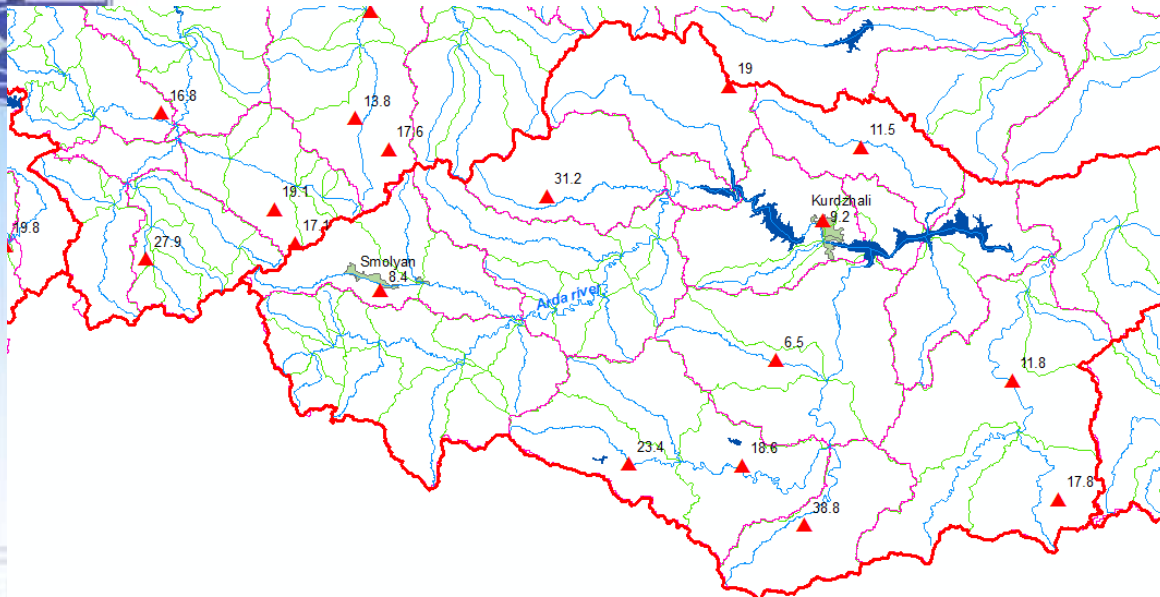


The maximum precipitation is forecasted to occur 16-22 UTC on 16.01.2016

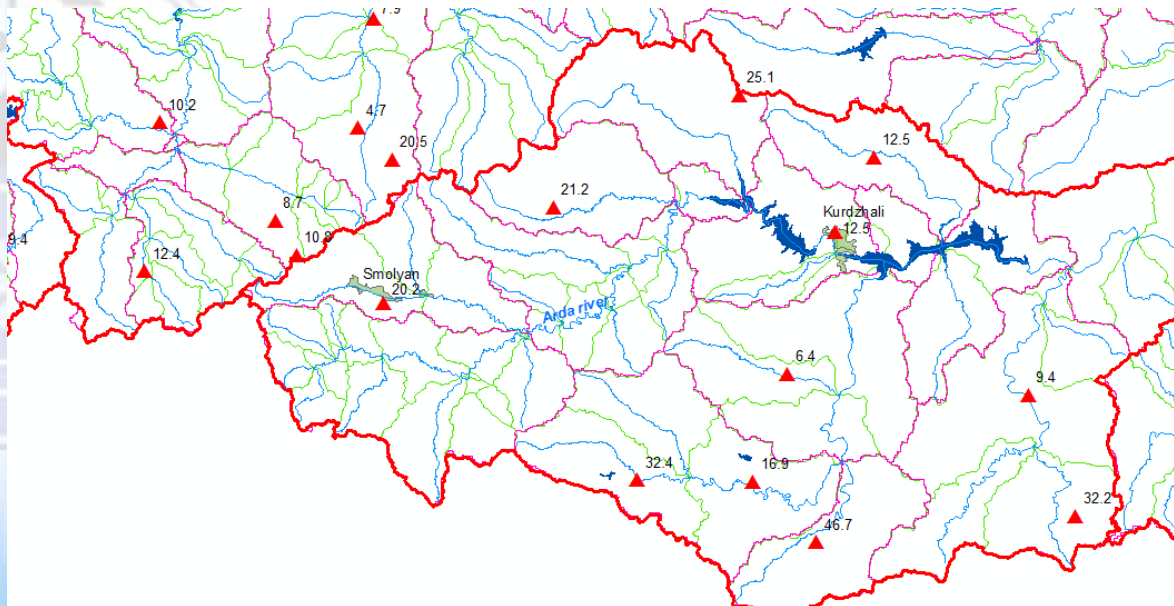
- No intensive precipitation;
- Precipitation from 20 mm/6h to 30 mm/6h; (attention)
- Precipitation from 30 mm/6h to 40 mm/6h; (warning)
- Precipitation over 40 mm/6h; (alert)



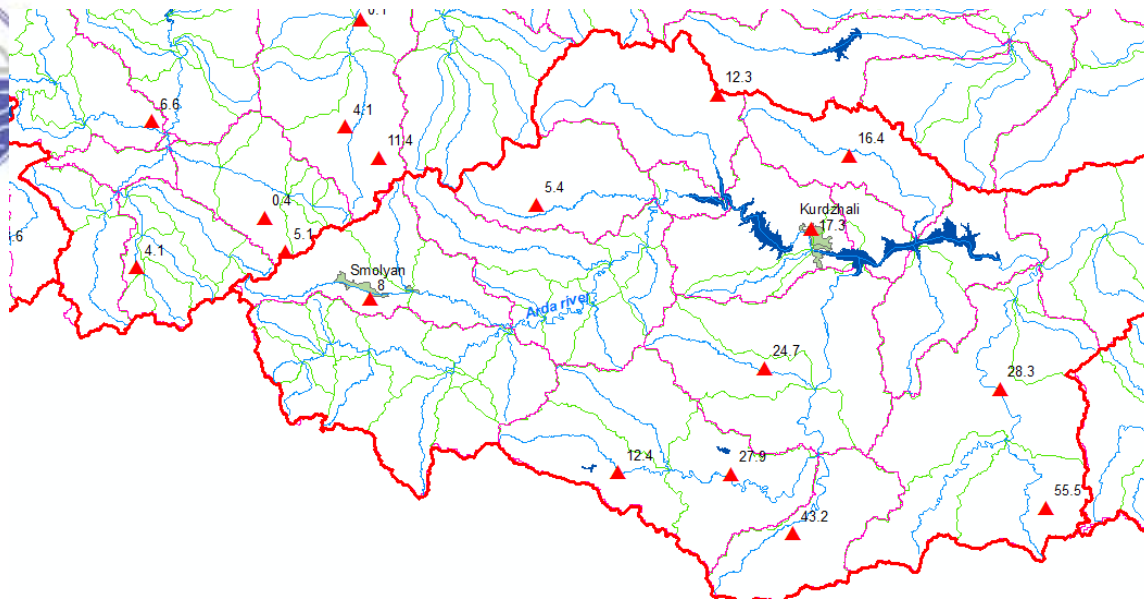
Validation of the event



Real precipitation 18-21 UTC 16.01.2016 from Auto stations

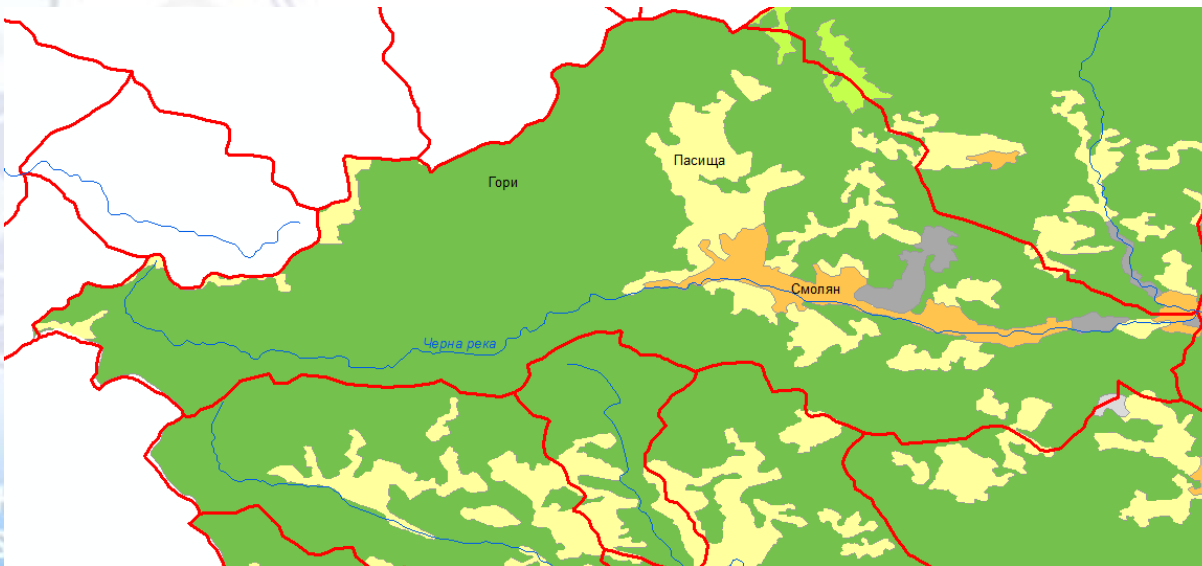


Real precipitation 21-00 UTC 16/17.01.2016 from auto stations



Real precipitation 00-03 UTC 17.01.2016 from auto stations

Rational method to assess the water discharge in the small basins



Land cover



Rational Equation

$$Q = C \times I \times A$$

Where:

Q - Peak discharge [m³/s]

C - Runoff coefficient

I - Rainfall intensity mm/h

A - Watershed area [km²]

Runoff coefficient *C* depends on soil type, land cover and slope of the basin

k	c	i	a	Q
0.28	0.30	6.733	117.196	66.286

$$Q_{\text{bankfull}} = 47,068 \text{ m}^3/\text{s}$$

Thank you for your attention

<http://www.meteo.bg>

<http://hydro.bg>