





**Follow up Operations Workshop
South East Europe Flash Flood Guidance System (SEE FFGS)
9-13 May 2016, Zagreb, Croatia**

FLASH FLOOD IN MACEDONIA

A Case Study of 3rd August 2015



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FLASH FLOOD CASE STUDY

- Like every where in the world, Macedonian Flash Floods can be quite destructive
- Water mixture of sand, rock, and mud causes a lot of damage.
- The Flash Flood Wave causes huge damage particularly when the flash floods occurs in normally low water or dry ravines, where people not expect huge water quantity.



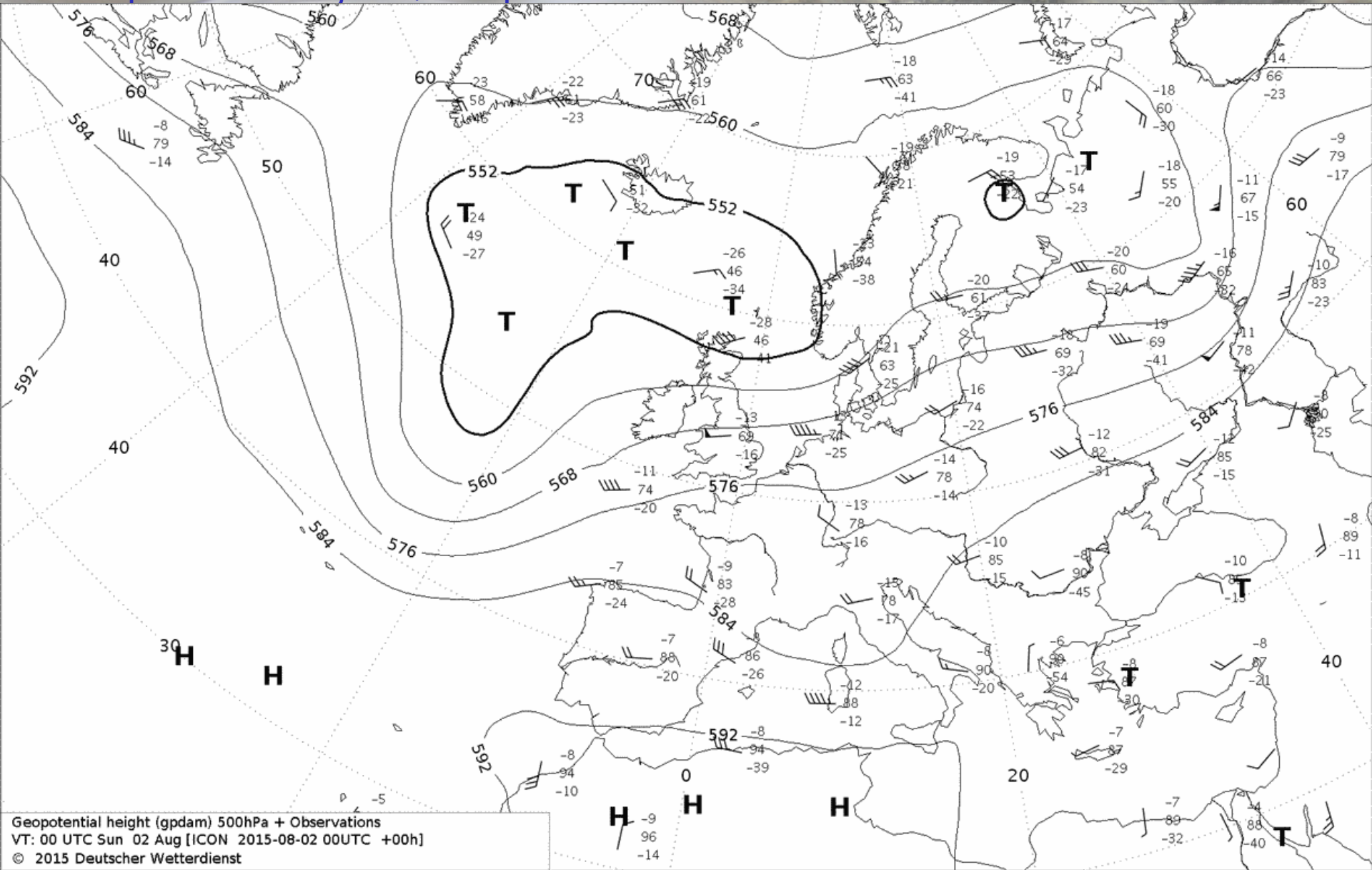
FLASH FLOOD CASE STUDY

- Following heavy rains, flash flooding occurred on the 3rd of August in the Tetovo region of Macedonia. Several villages and the city of Tetovo were impacted with severe losses. Six people lost their lives in the flash flood, with four of them being young children. Damage was also done to infrastructure and housing. The region of Shipkovica was hit hardest. The village of Shipkovica is located on the slope of the Sar Planina mountain in northern Macedonia.
- According to witnesses, the rain started around 15:00 local time (13:00 UTC), as a normal or common rainfall. However, it progressed into precipitation with strong intensity for approximately an hour. At 17:30 (15:30 UTC), water started to flow through the gully in the middle of the village. After only 10-15 minutes, large amount of dirt, sand and stones were being carried by the water, and were crashing between and through the houses. The flood wave passed through the village. The flow in the gully subsided at 18:00 (16:00 UTC), leaving much devastation as shown in the figures.



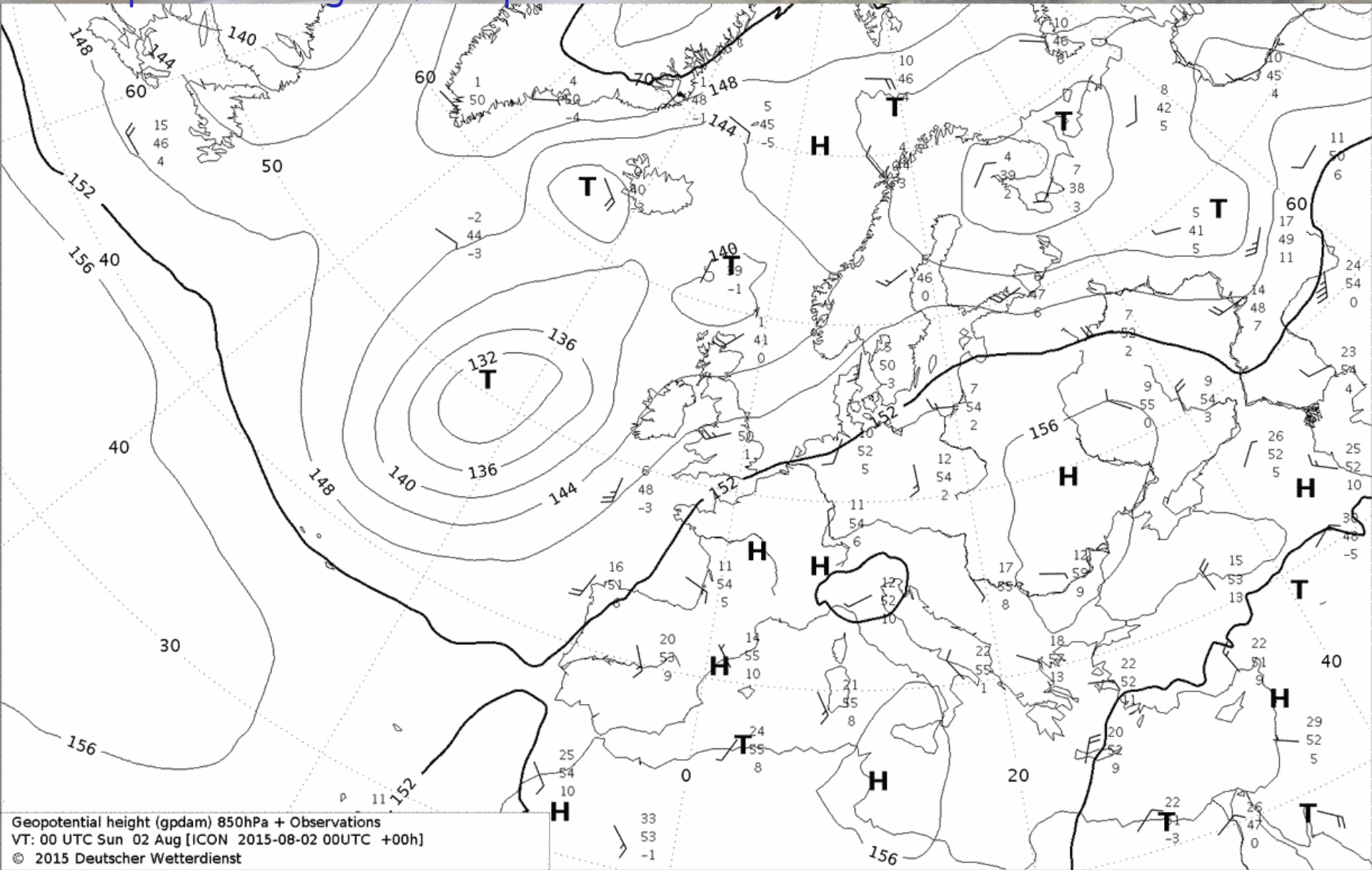
WEATHER SITUATION (-40:00-hr) 20150802 - 00:00

Geopotential height of the pressure level: 500hPa



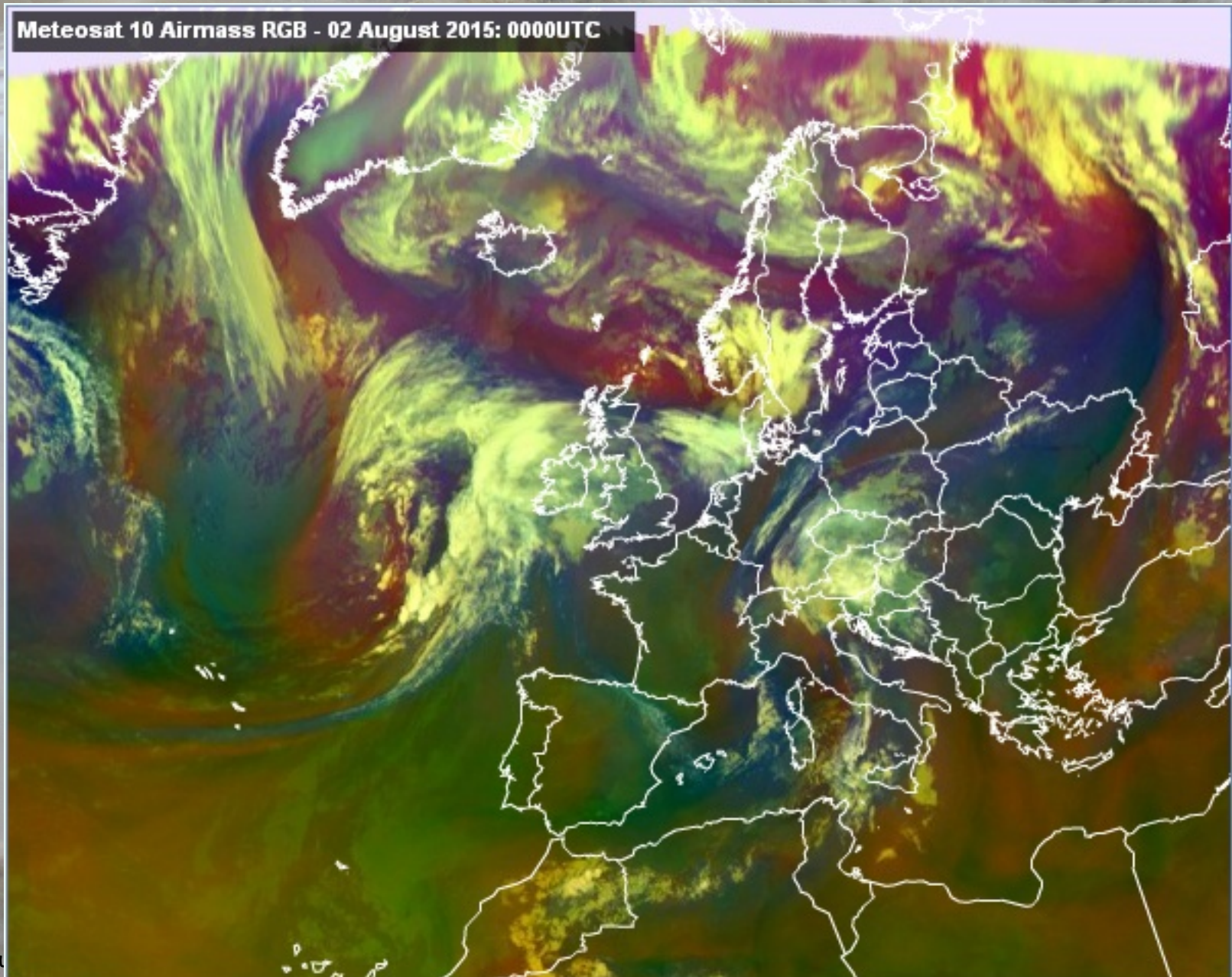
WEATHER SITUATION (-40:00-hr) 20150802 - 00:00

Geopotential height of the pressure level: 850hPa



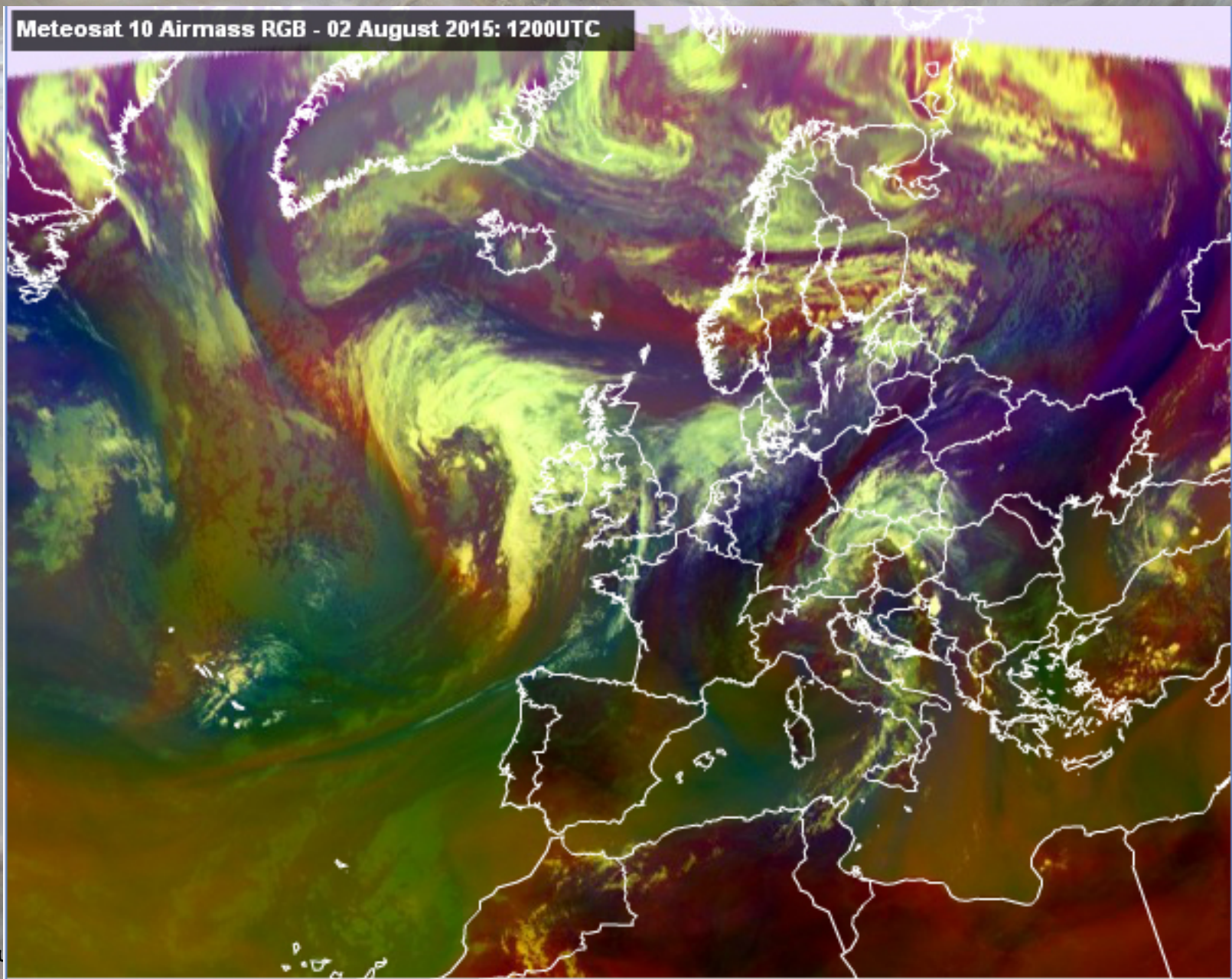
WEATHER SITUATION (-39:30-hr) 20150802 - 00:00

Air mass
RGB
Composite



WEATHER SITUATION (-27:30-hr) 20150802 - 12:00

Air mass
RGB
Composite



WEATHER FORECAST (-24:00-hr) 20150802 - 15:30



15:30 (17:30 local time)
Regular information to:

- CRISIS MANAGEMENT CENTER
- RELEVANT MINISTRIES
- PUBLIC AND MEDIA

WEATHER FORECAST

WEATHER TOMMOROW:

.....More expressive instability will be in the northern and southwestern parts of the country where locally processes are expected to be with heavy and intensive rain (over 30 mm/m²).....


РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЗЕМЈОДЕЛСТВО, ШУМАРСТВО И ВОДОСТОПАНСТВО
 УПРАВА ЗА ХИДРОМЕТЕОРОЛОШКИ РАБОТИ

02.08.2015

17:30ч.

ИНФОРМАЦИЈА

МАКСИМАЛНИ ТЕМПЕРАТУРИ:

29 Маврово, 30 Берово, 32 Охрид, 33 К.Паланка и Претор, 34 Прилеп, Битола и Струмица, 36 Скопје, Тетово, Штип, Д.Капија, Гевгелиј и Веница.

НАВРНАТ ВОДЕН ТАЛОГ до 17 часот (во л/м²): на мерните места не се регистрирани врнежи од дожд.

ВРЕМЕТО ДЕНЕС:

Сончево и топло со мала до умерена локална облачност. Попладне во западните и североисточните планинските подрачја имаше развој на нестабилна облачност проследена со локален пороен дожд и грмежи. Дуваше слаб до умерен ветер од променлив правец.

ВРЕМЕТО ДО КРАЈОТ НА ДЕНОТ:

На места сеуште ќе биде нестабилно со локален дожд и грмежи, но во вечерните часови атмосферата постепено ќе се стабилизира.

ВРЕМЕТО УТРЕ:

Променливо облачно и нестабилно со повремени дожд, кој во попладневните часови ќе биде пороен проследен со грмежи. Поизразена нестабилност ќе има во северните и југозападните делови на територијата, каде процесите да бидат поинтензивни со **обилен пороен дожд (над 30 mm/m²)**, засилен ветер и со услови за изолирана појава на град. **Најголема мјавна ќе биде во интервалот од 15 до 22, а дневната од 28 до 35** степени.

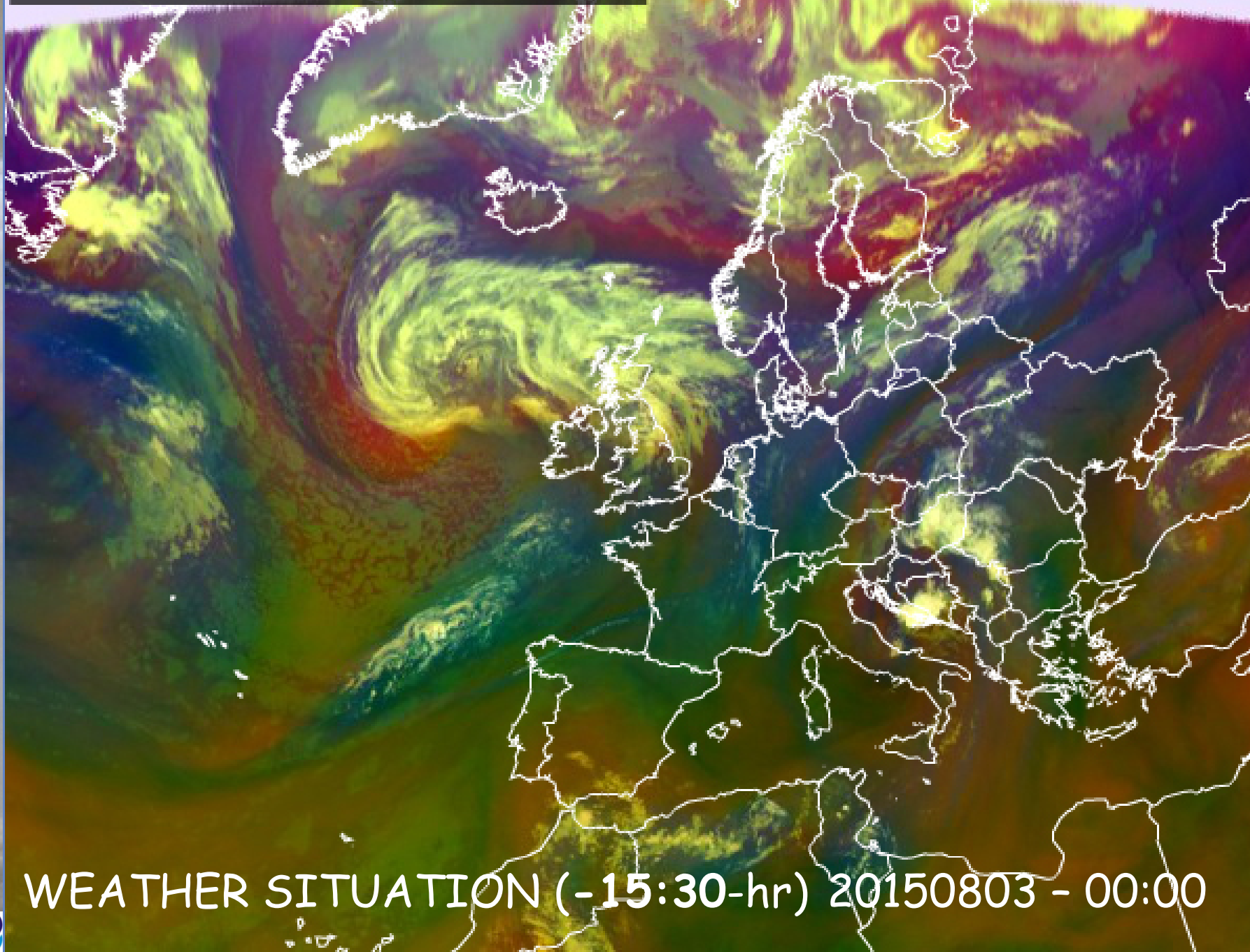
стабилно со повремени пороен дожд, грмежи и засилен ветер. Температурата ќе спушти до 21, а дневната ќе достигне до 33 степени.

ДЕНОВИ:

Во вторник променливо облачно и нестабилно време со повремени дожд, кој во северните и југозападните делови на територијата ќе биде пороен проследен со грмежи. Во среда ќе има локална нестабилност, а потоа во наредните денови ќе преовладува претежно стабилно и суво..



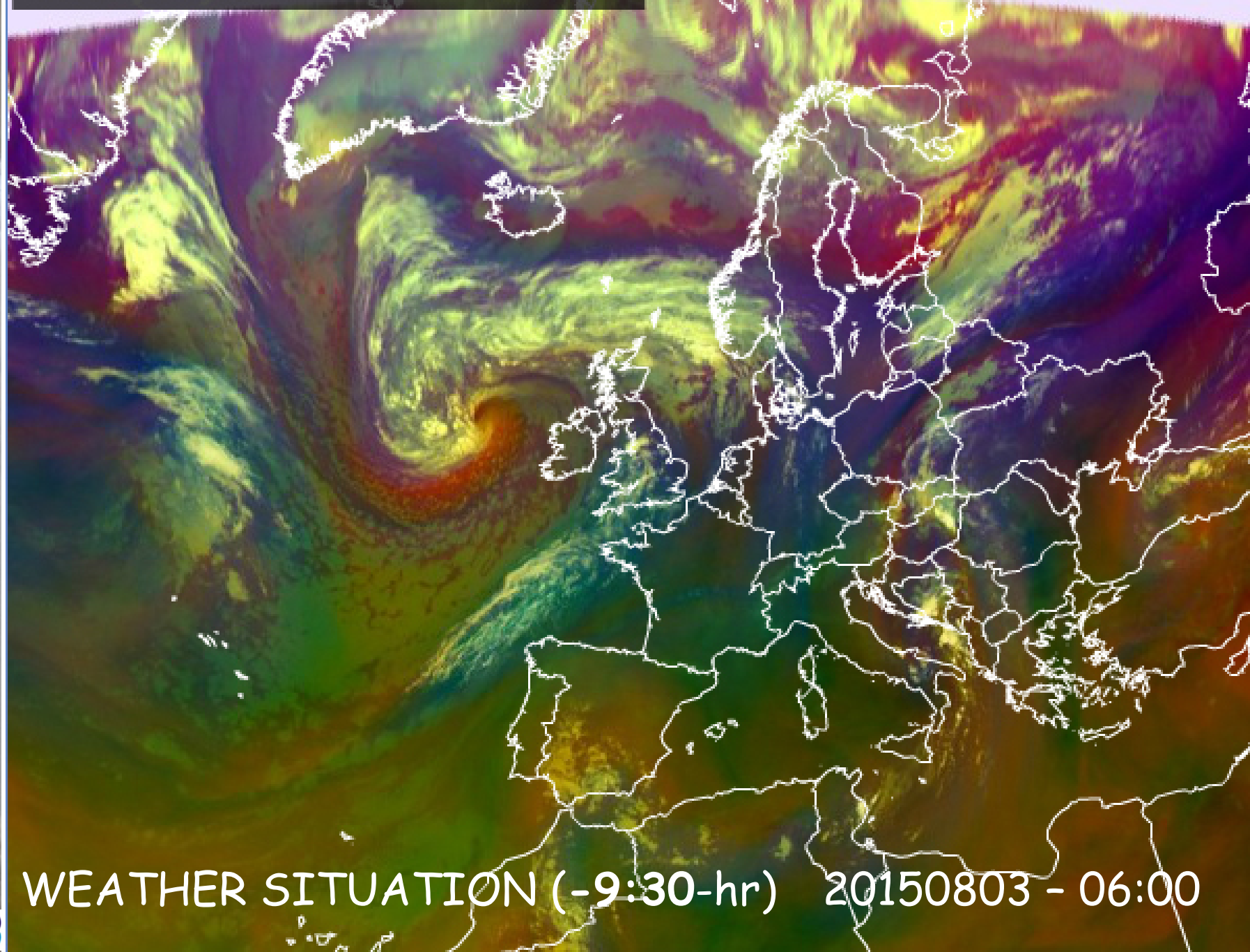
Meteosat 10 Airmass RGB - 03 August 2015: 0000UTC



WEATHER SITUATION (-15:30-hr) 20150803 - 00:00



Meteosat 10 Airmass RGB - 03 August 2015: 0600UTC

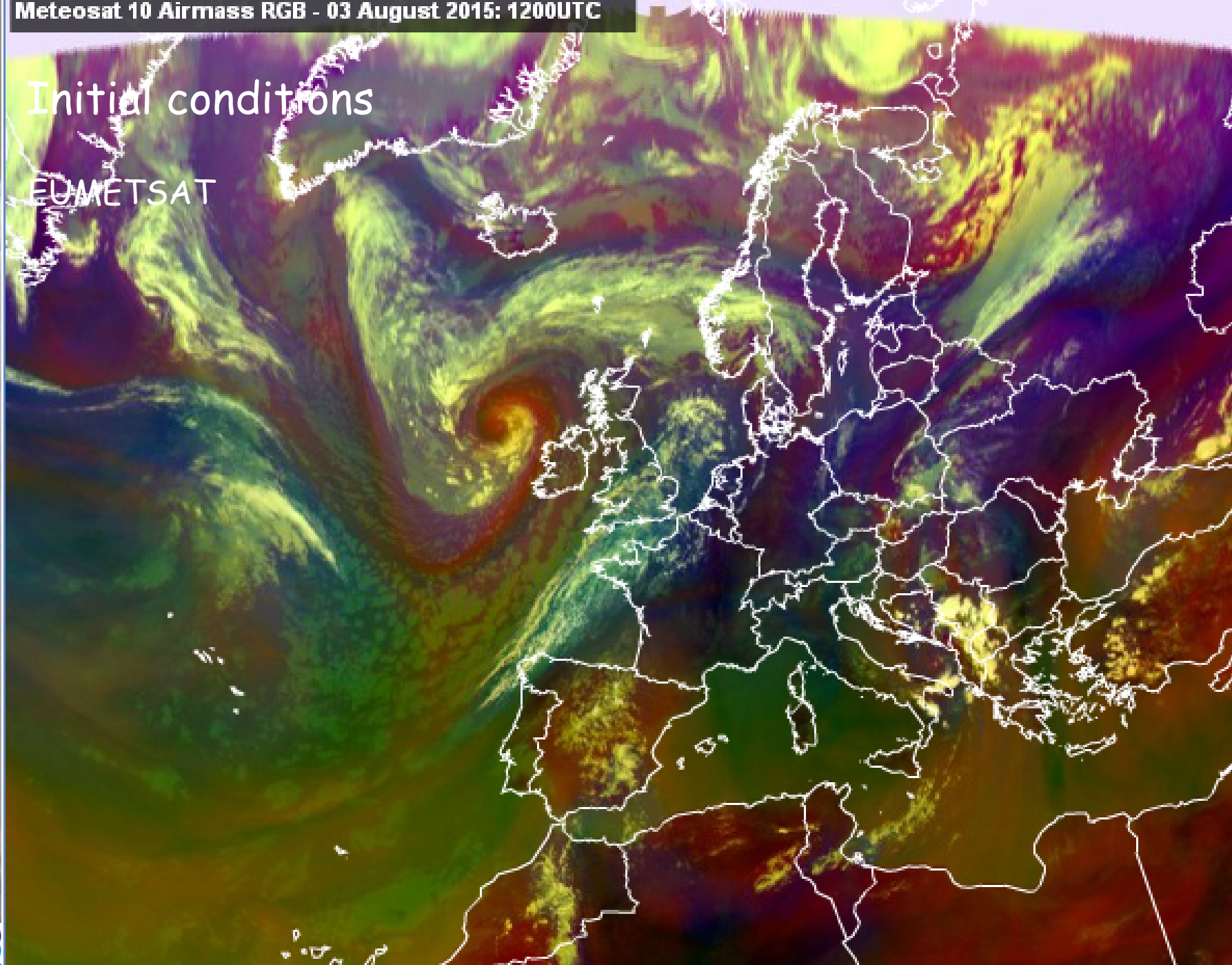


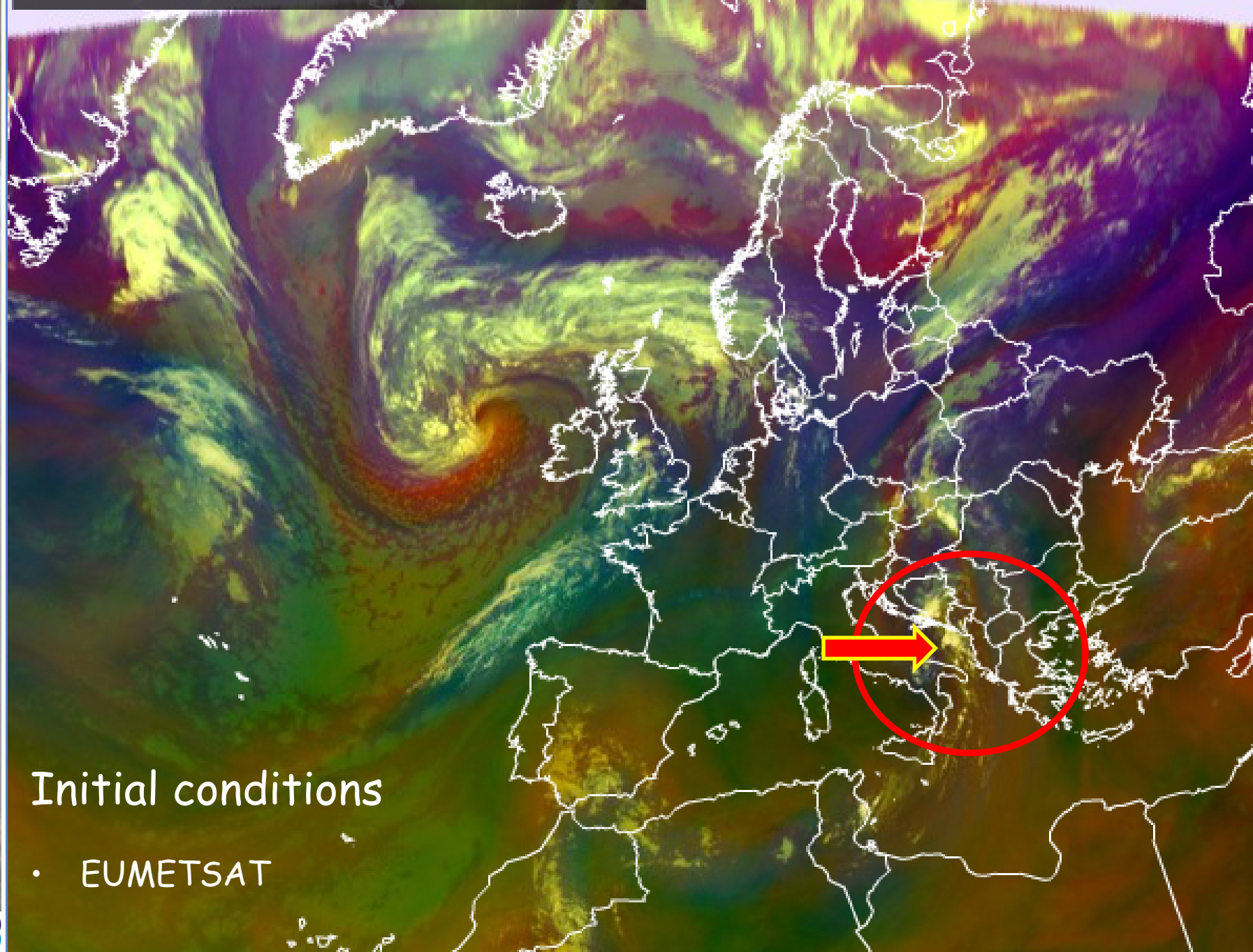
WEATHER SITUATION (-9:30-hr) 20150803 - 06:00



Initial conditions

• EUMETSAT

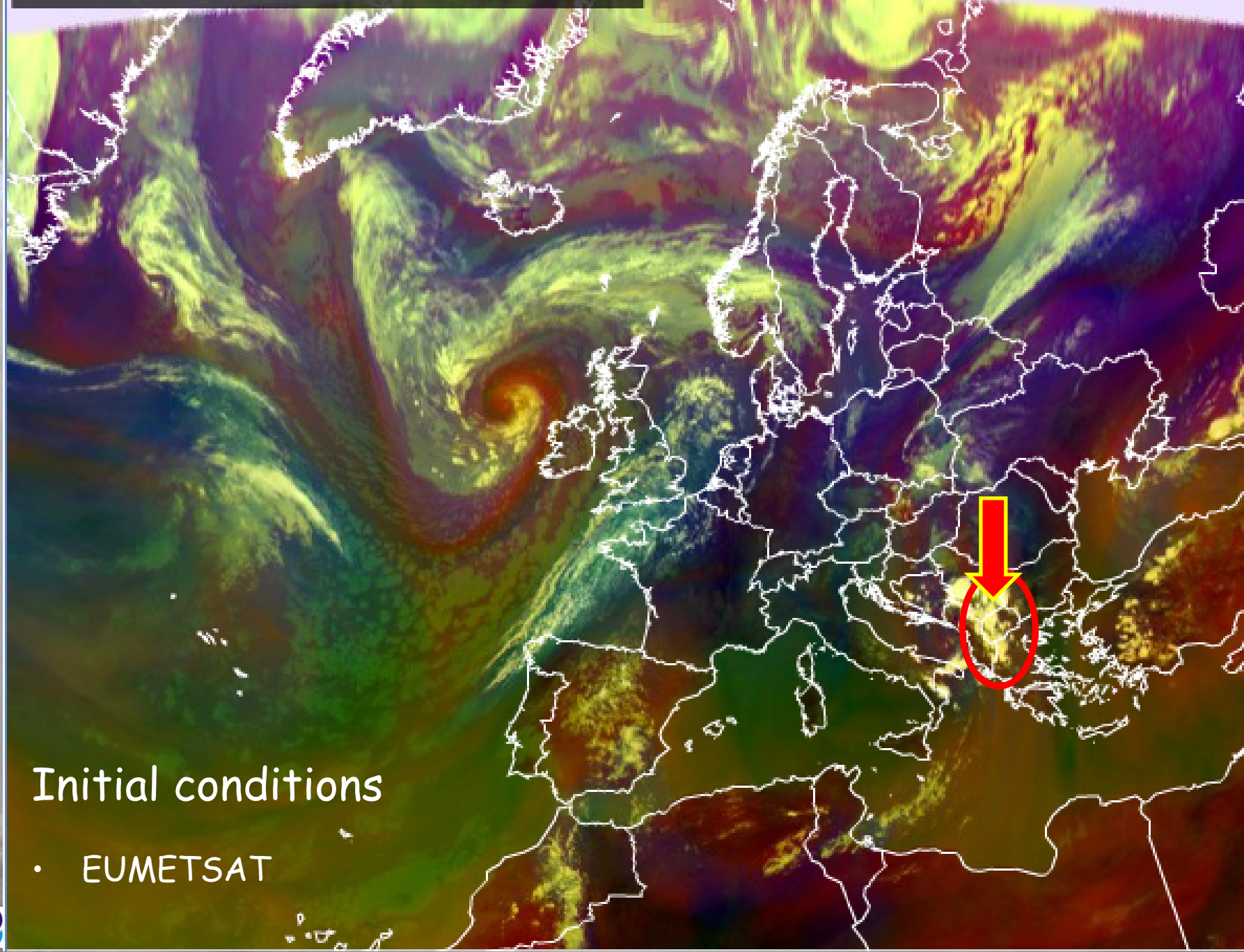




Initial conditions

- EUMETSAT

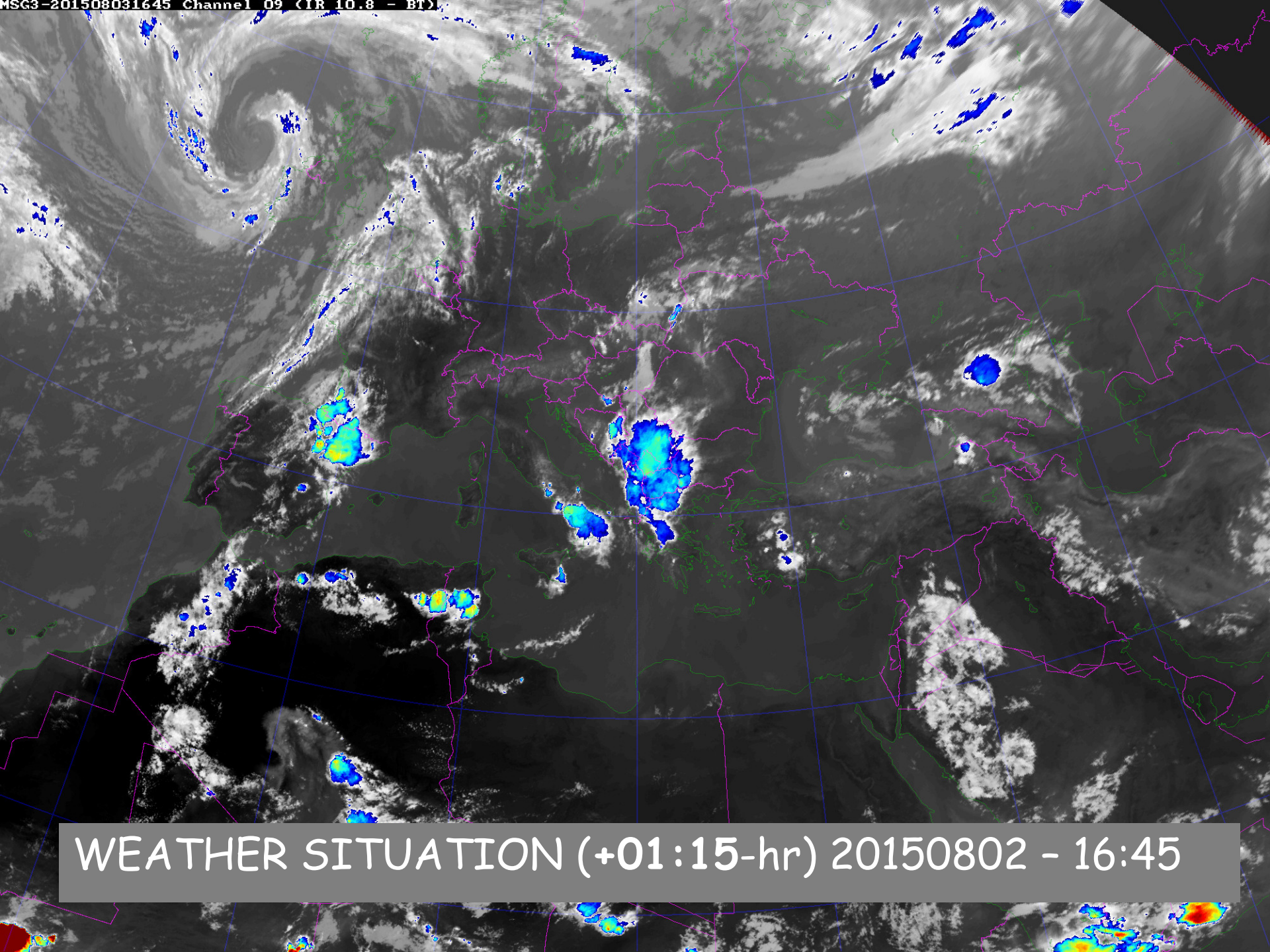




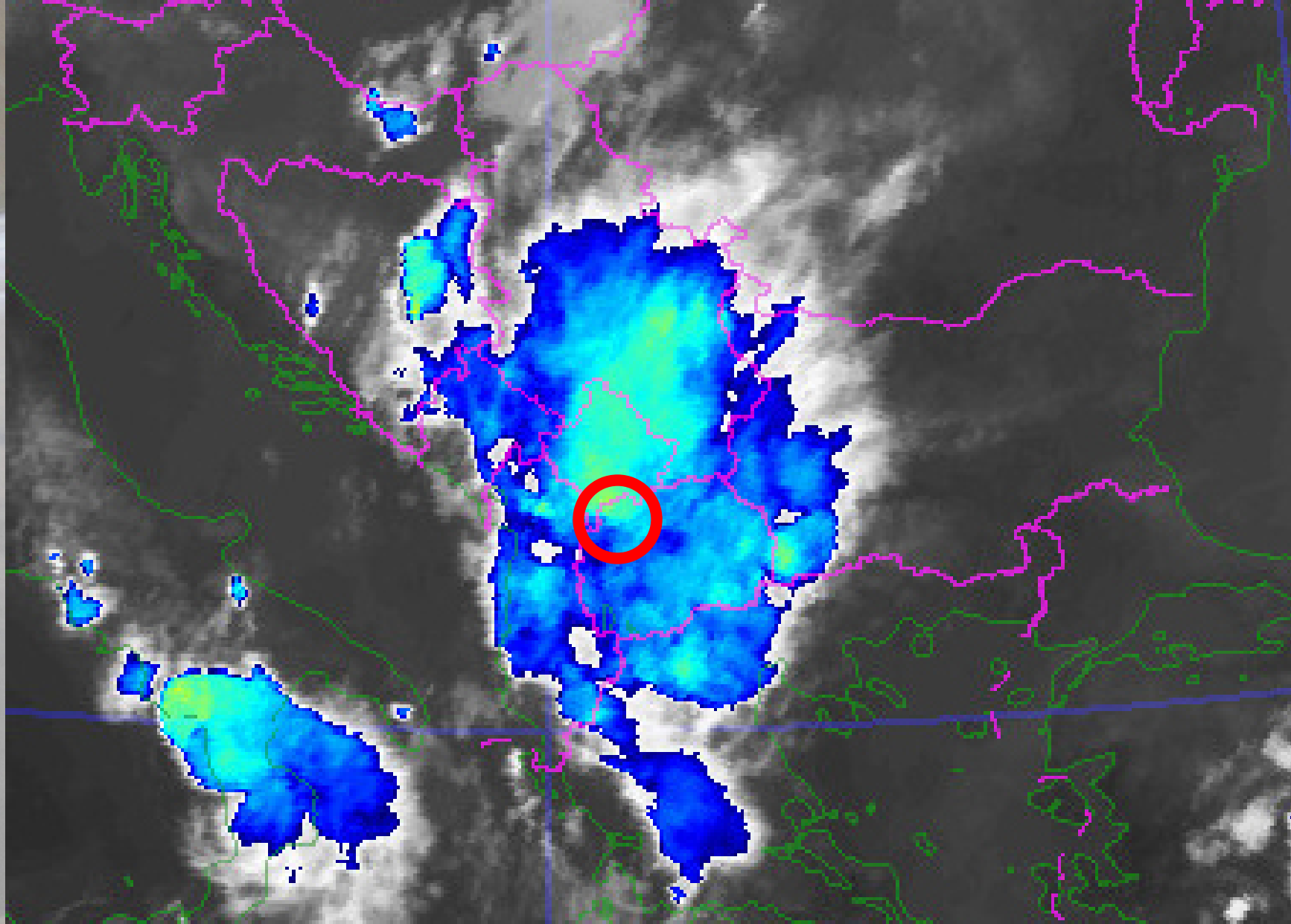
Initial conditions

- EUMETSAT





WEATHER SITUATION (+01:15-hr) 20150802 - 16:45



WEATHER SITUATION (+01:15-hr) 20150802 - 16:45



MACEDONIA (Shipkovica)

20150803 12:00

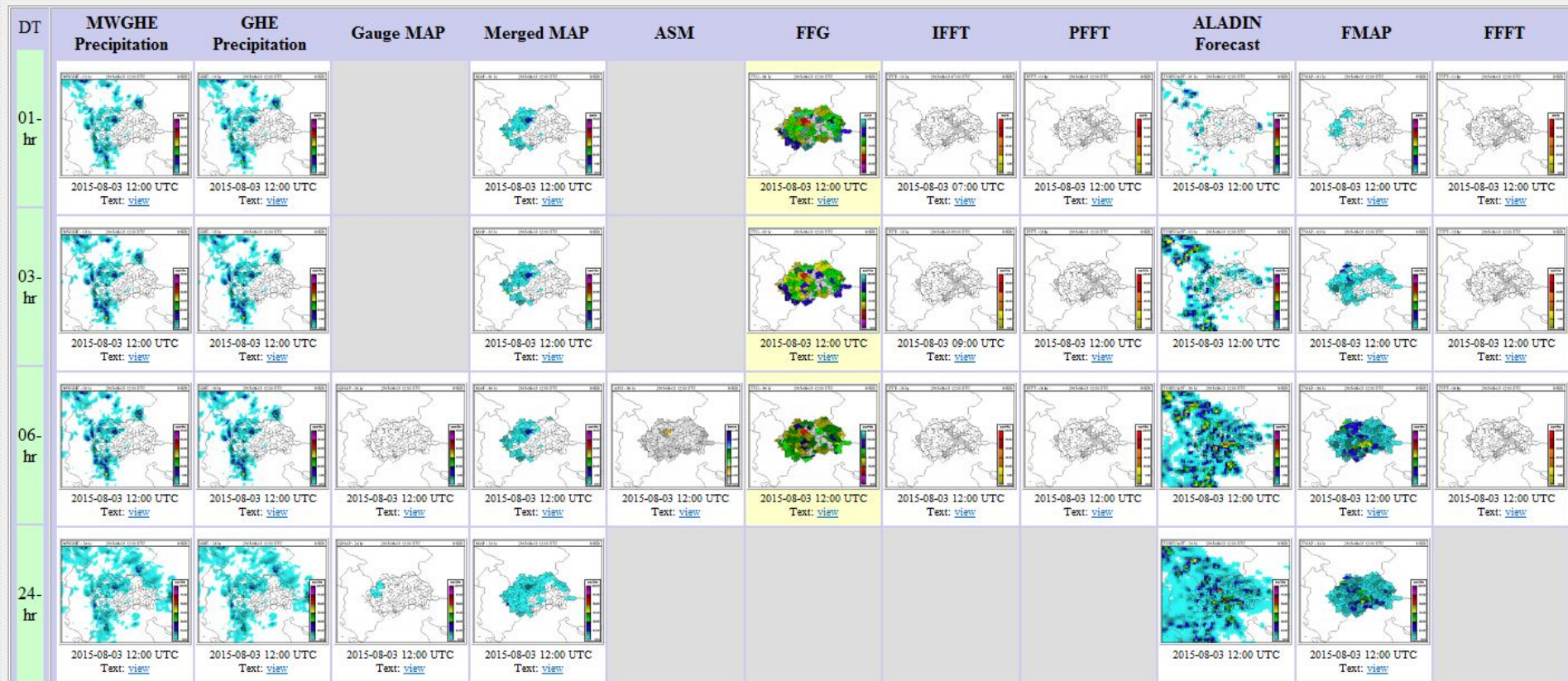
Console of SEE FFGS

SEEFFG - Southeast Europe Flash Flood Guidance System

Current Date: 2015-08-12 12:05 UTC

Nav Date: 2015-08-03 12:00 UTC

Year: 2015 Month: 08 Day: 03 Hour: 12 REGION: The former Yugoslav Republic of Macedonia



Composite Product: [text](#), [CSV](#), [CSVt](#)

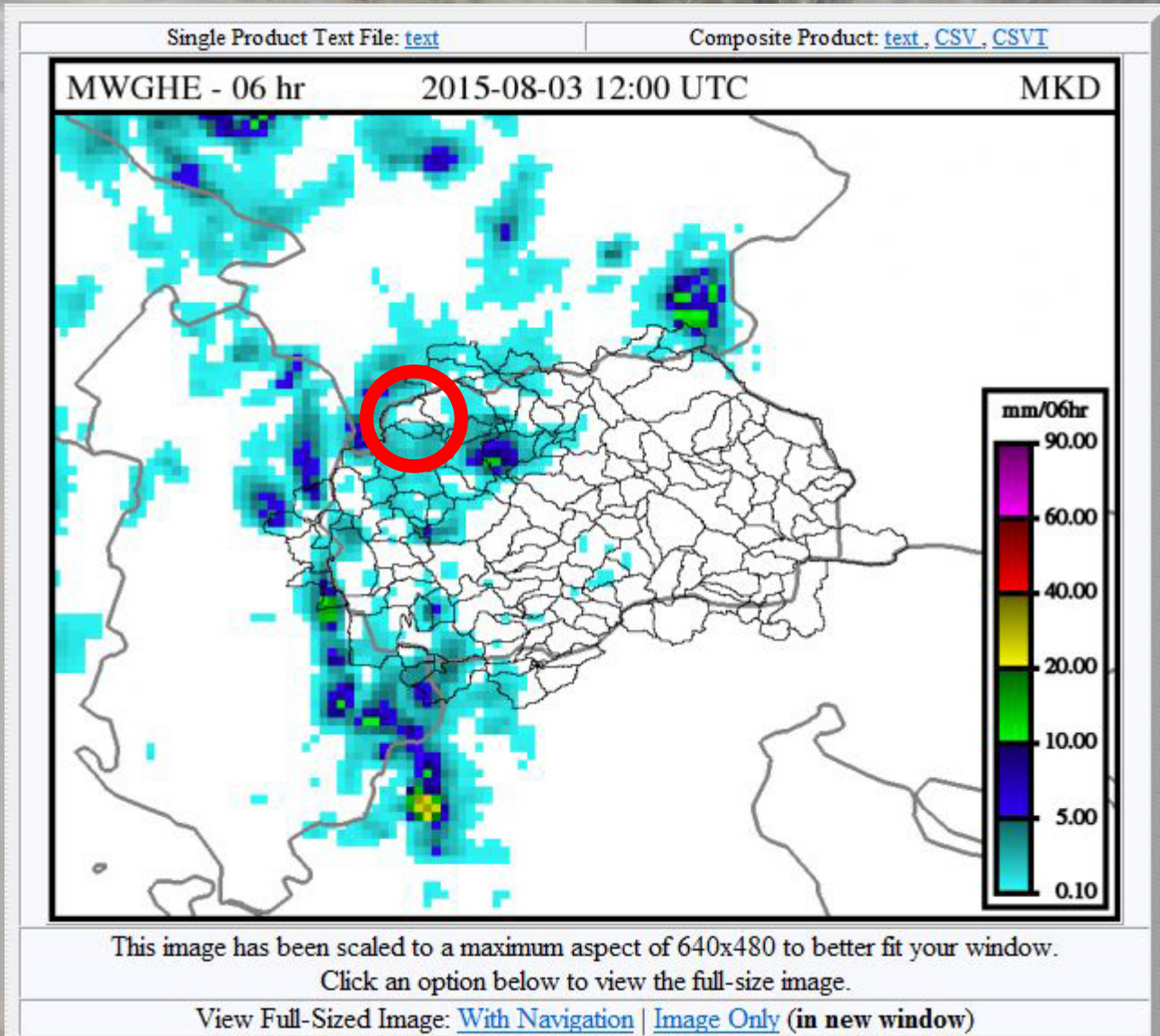
SFTP data transfer (requires SFTP Client): [EXPORTS/MKD/2015/08/03](#)



MACEDONIA (Shipkovic)

20150803 12:00

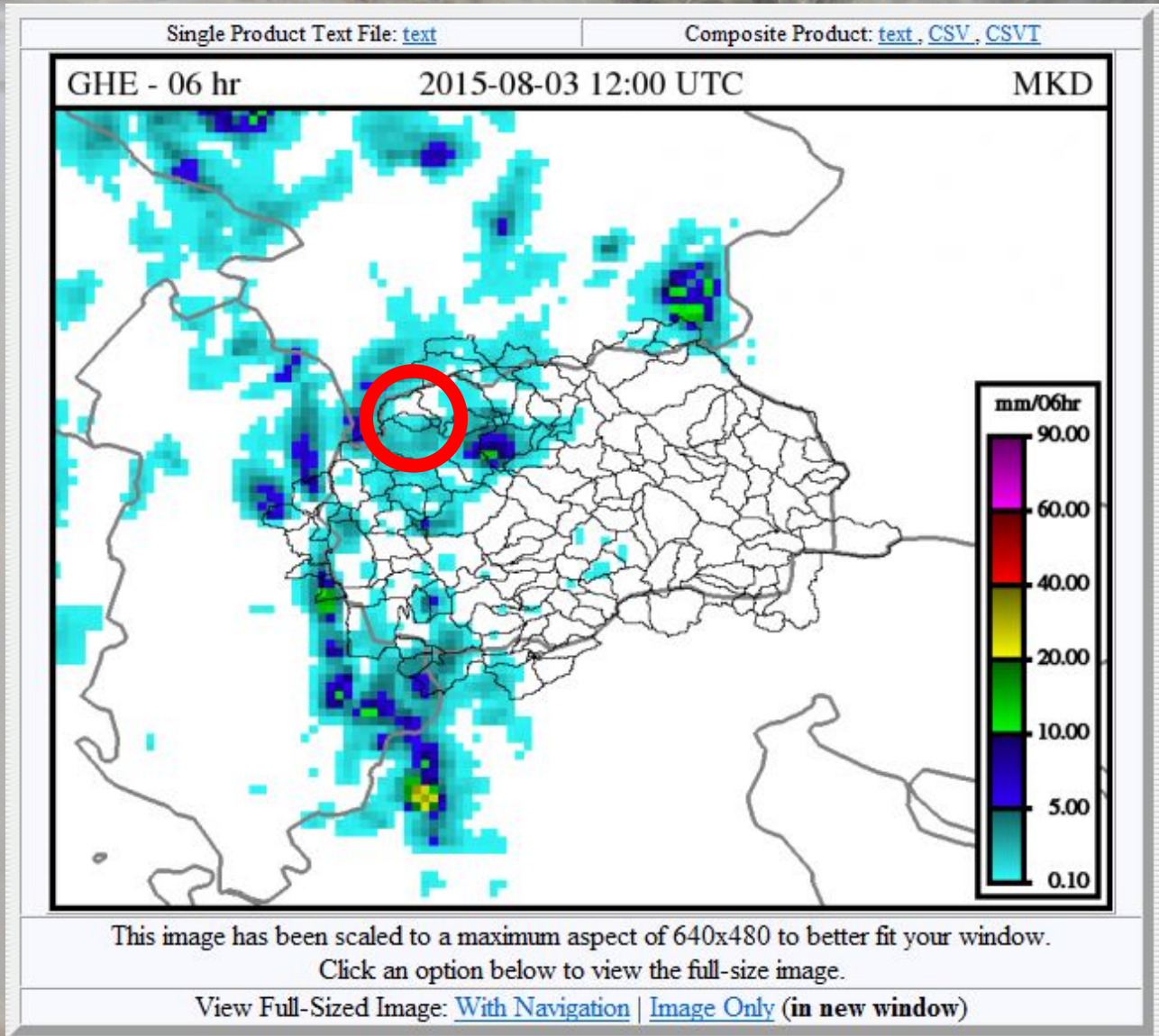
- MWGHE 06hr
12:00



MACEDONIA (Shipkovic)

20150803 12:00

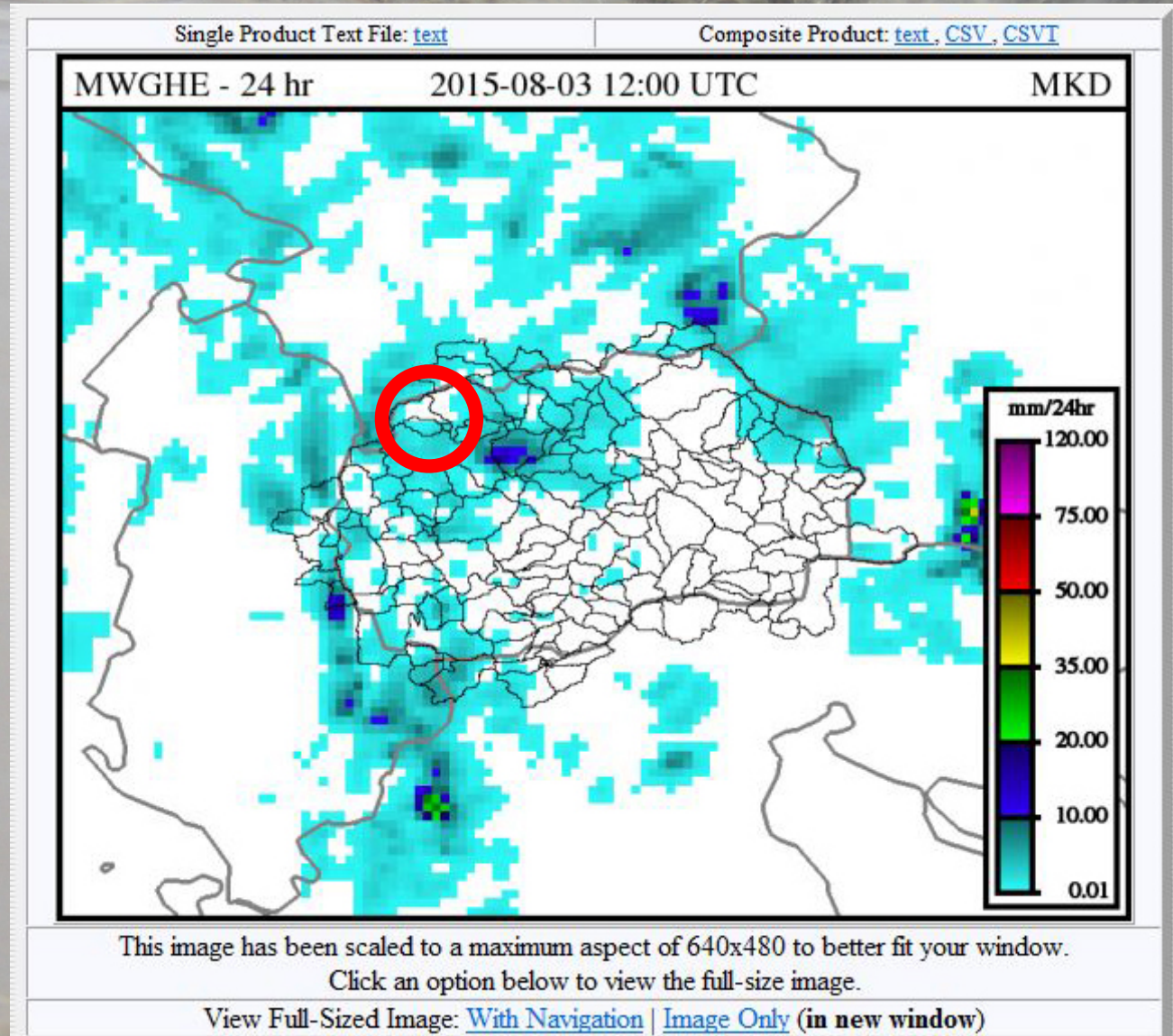
- GHE 06hr
12:00



MACEDONIA (Shipkovic)

20150803 12:00

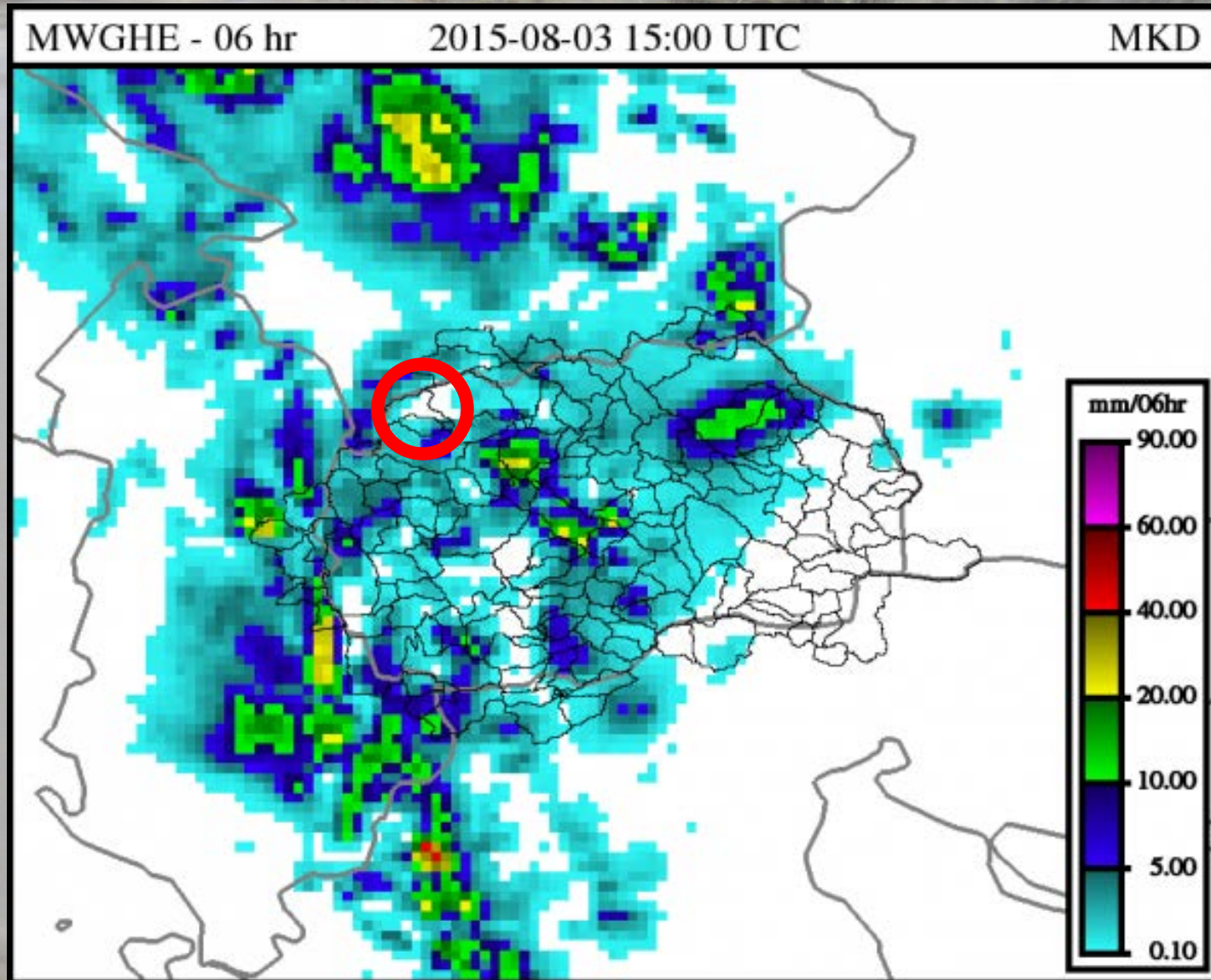
- MWGHE 24hr
12:00



MACEDONIA (Shipkovic)

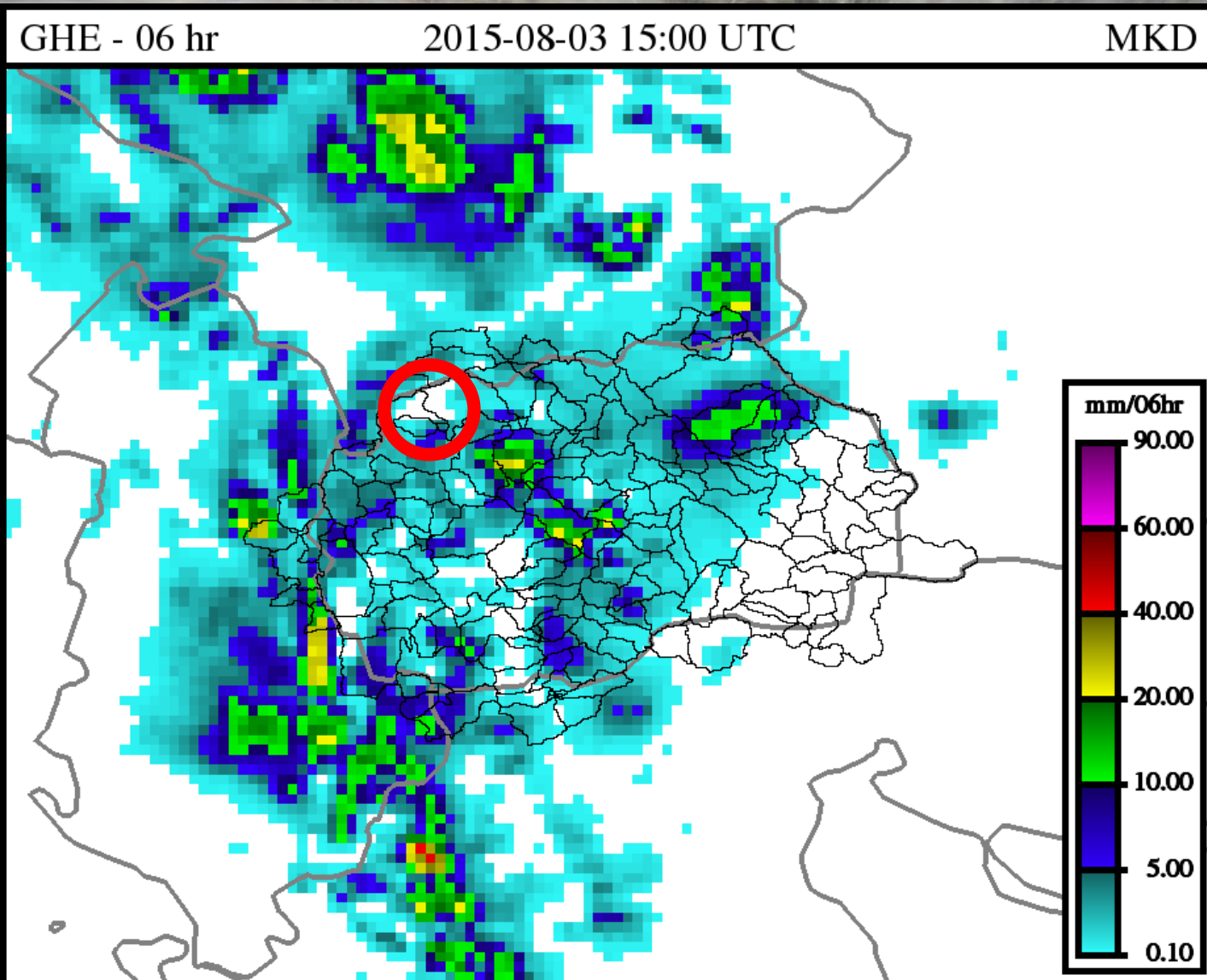
20150803 15:00

- MWGHE 06hr
15:00



MACEDONIA (Shipkovic)

20150803 15:00



- GHE 06hr
15:00



MACEDONIA (Shipkovic)

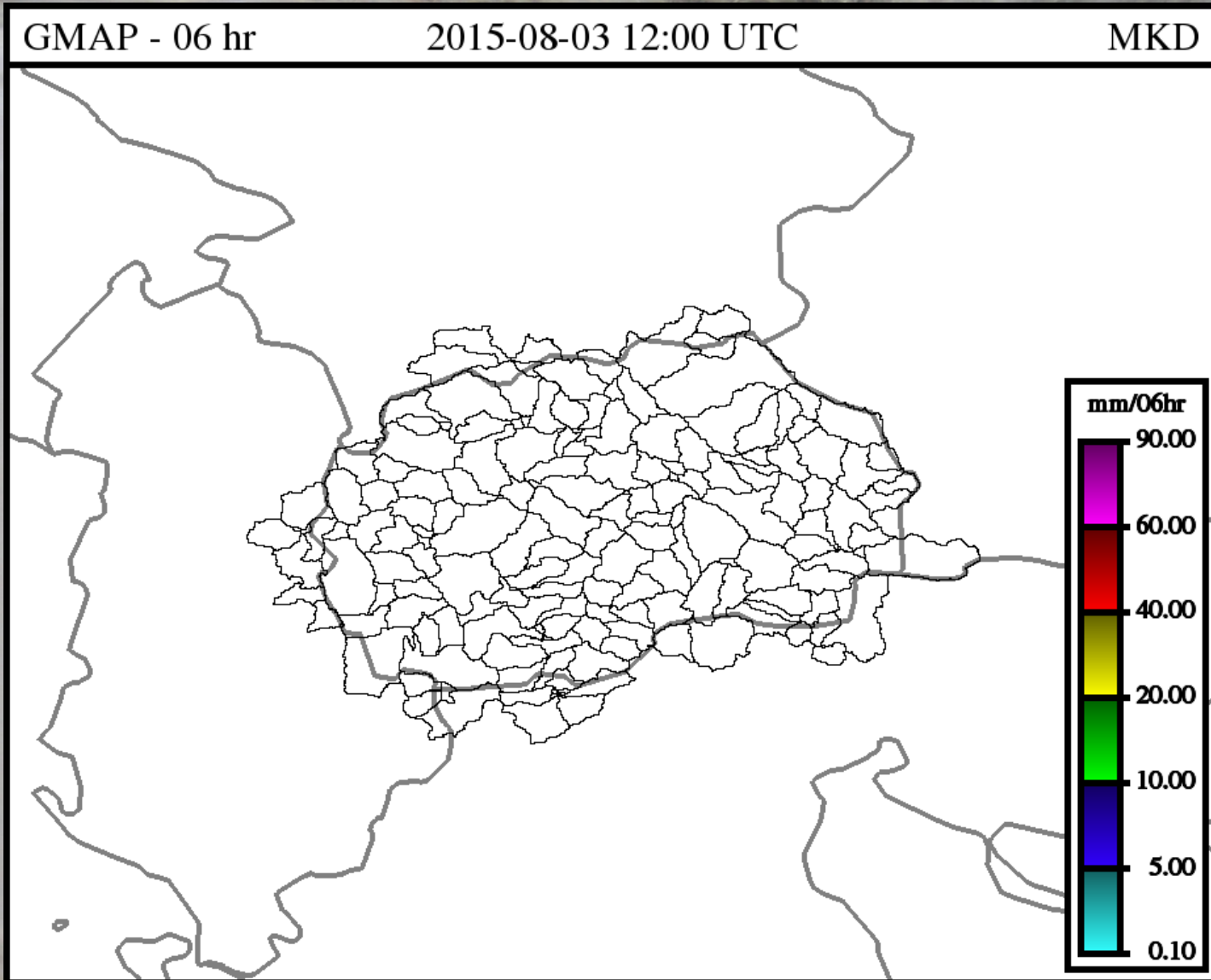
20150803 12:00

GMAP - 06 hr

2015-08-03 12:00 UTC

MKD

- GMAP 06hr
12:00



MACEDONIA (Shipkovic)

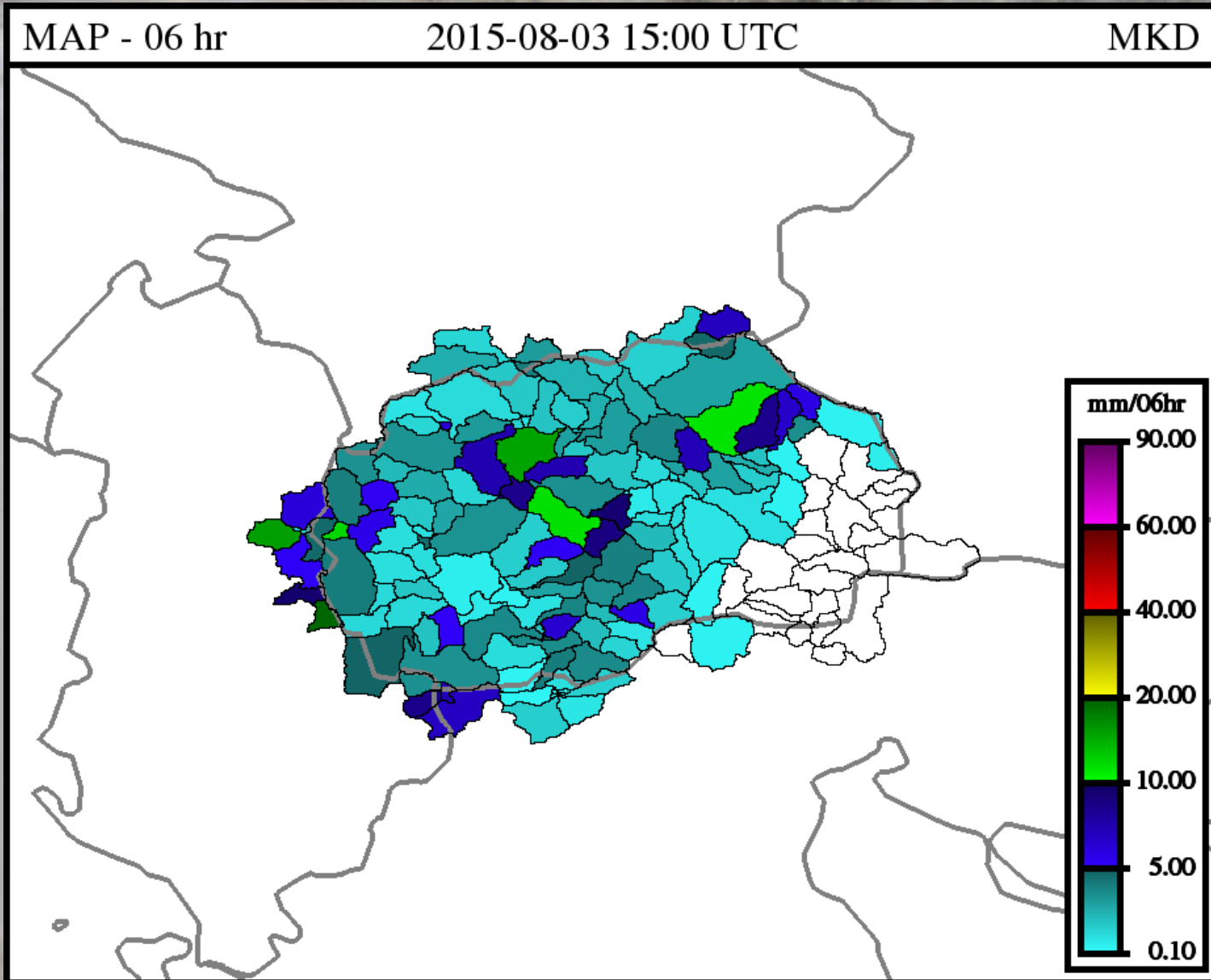
20150803 15:00

MAP - 06 hr

2015-08-03 15:00 UTC

MKD

- Merged MAP 06hr
15:00



MACEDONIA (Shipkovic)

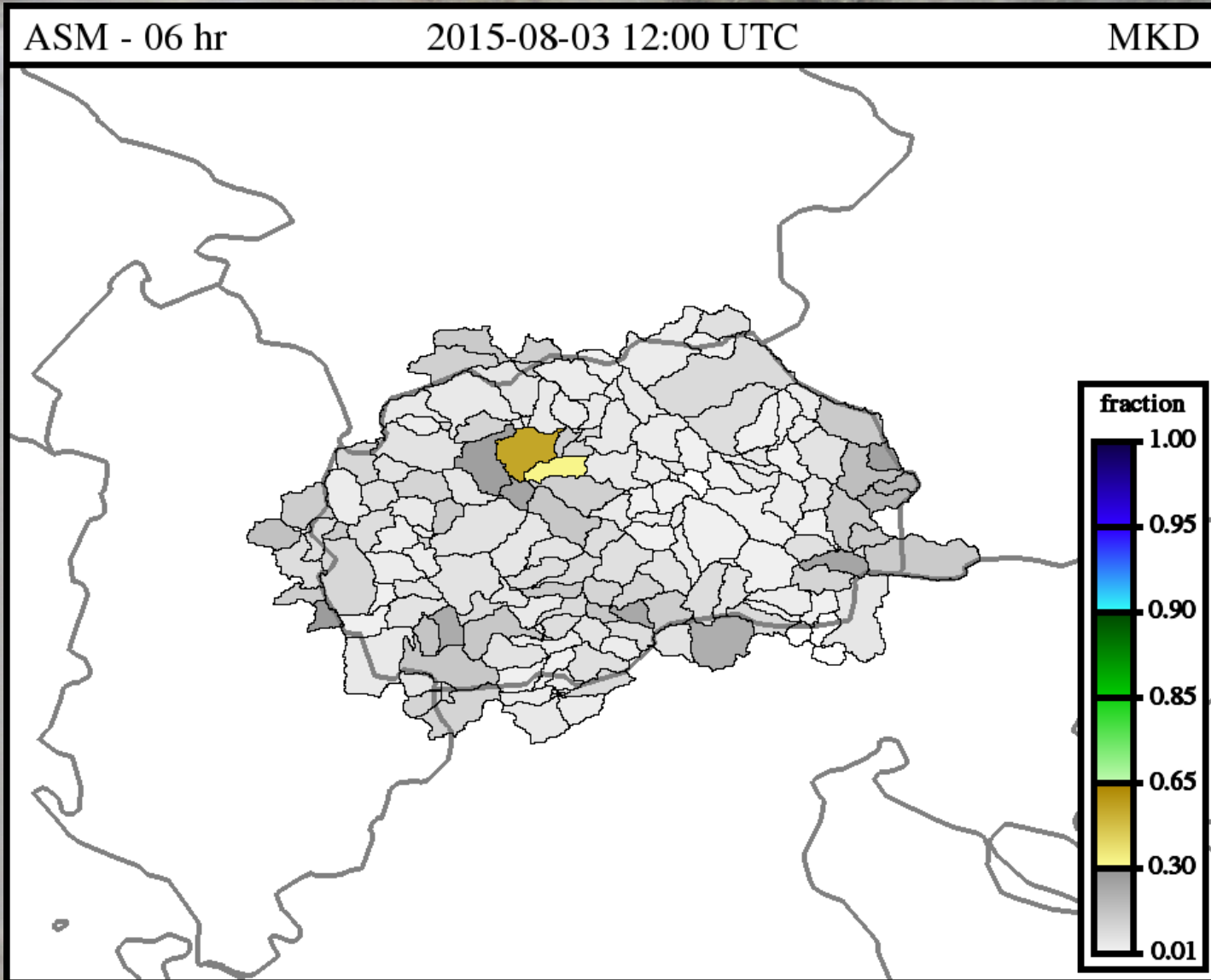
20150803 12:00

ASM - 06 hr

2015-08-03 12:00 UTC

MKD

- ASM 06hr
12:00



MACEDONIA (Shipkovic)

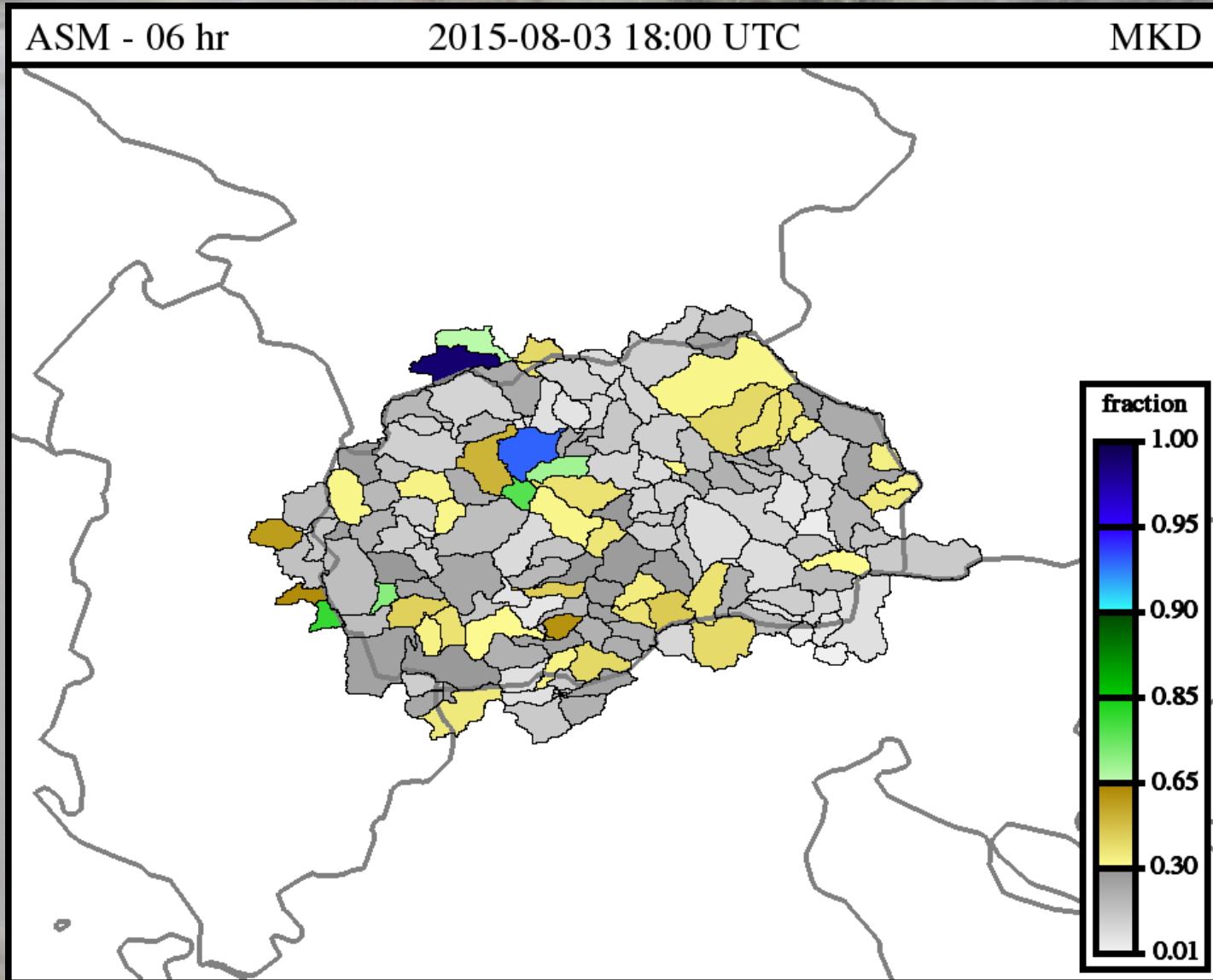
20150803 18:00

ASM - 06 hr

2015-08-03 18:00 UTC

MKD

- ASM 06hr
18:00



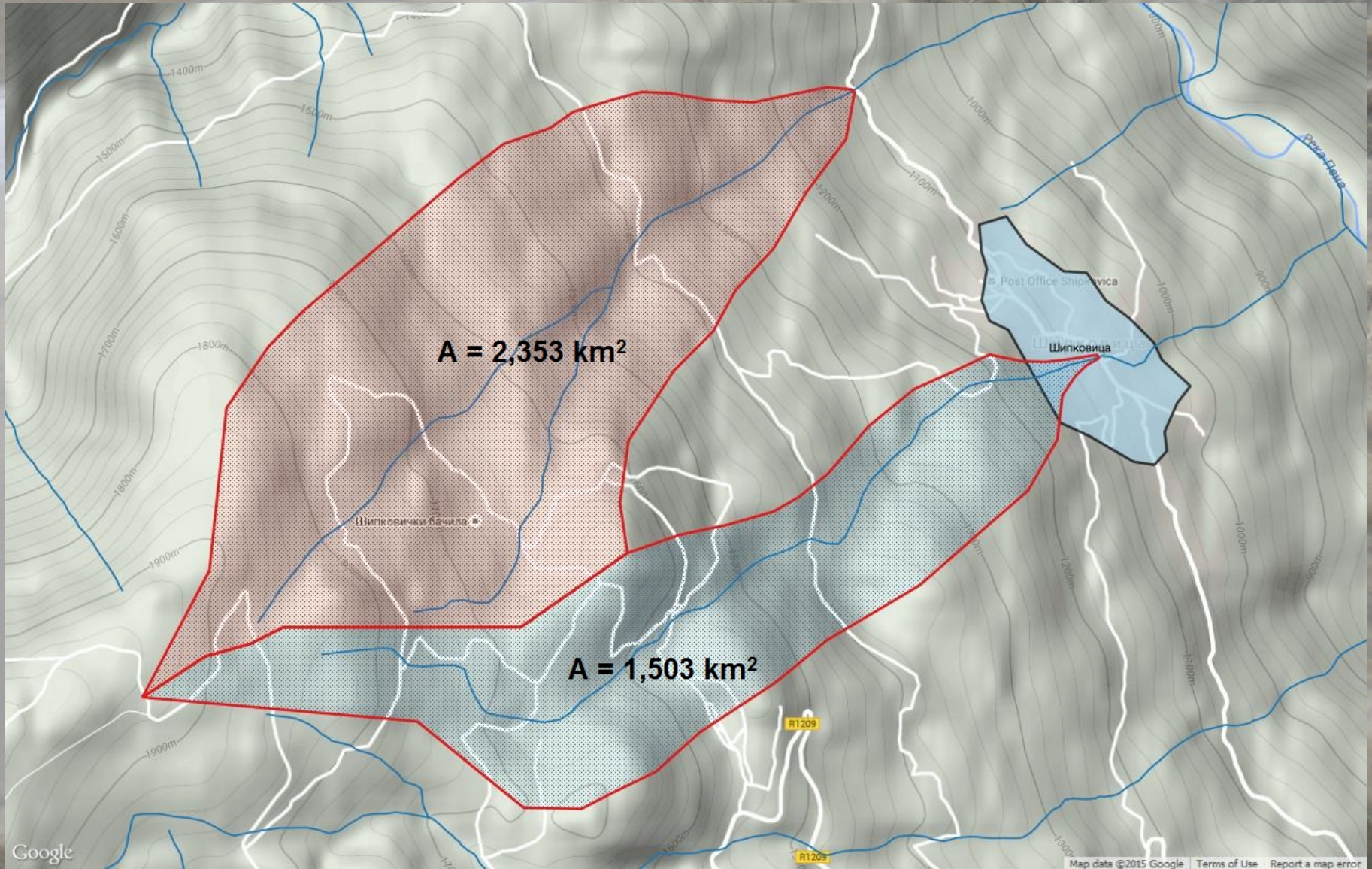
GOOGLE MAP OF THE FLASH FLOOD AREA

- Google Earth - Type of the terrain above Shipkovica



MAP OF THE FLASH FLOOD AREA

- QGIS - Map of the catchments above Shipkovica



MACEDONIA (Shipkovic)

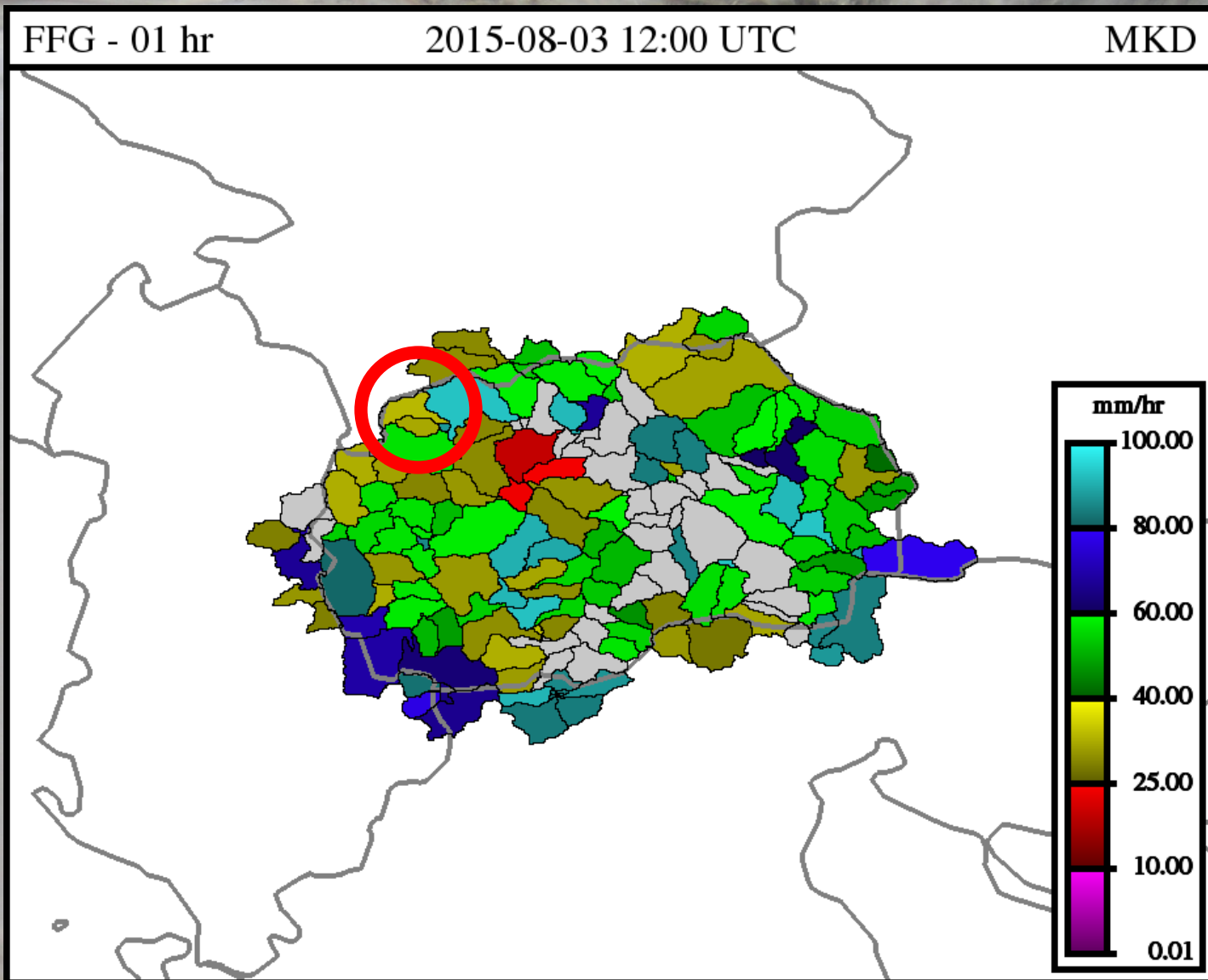
20150803 12:00

FFG - 01 hr

2015-08-03 12:00 UTC

MKD

- FFG 01hr
12:00



MACEDONIA (Shipkovicica)

20150803 12:00

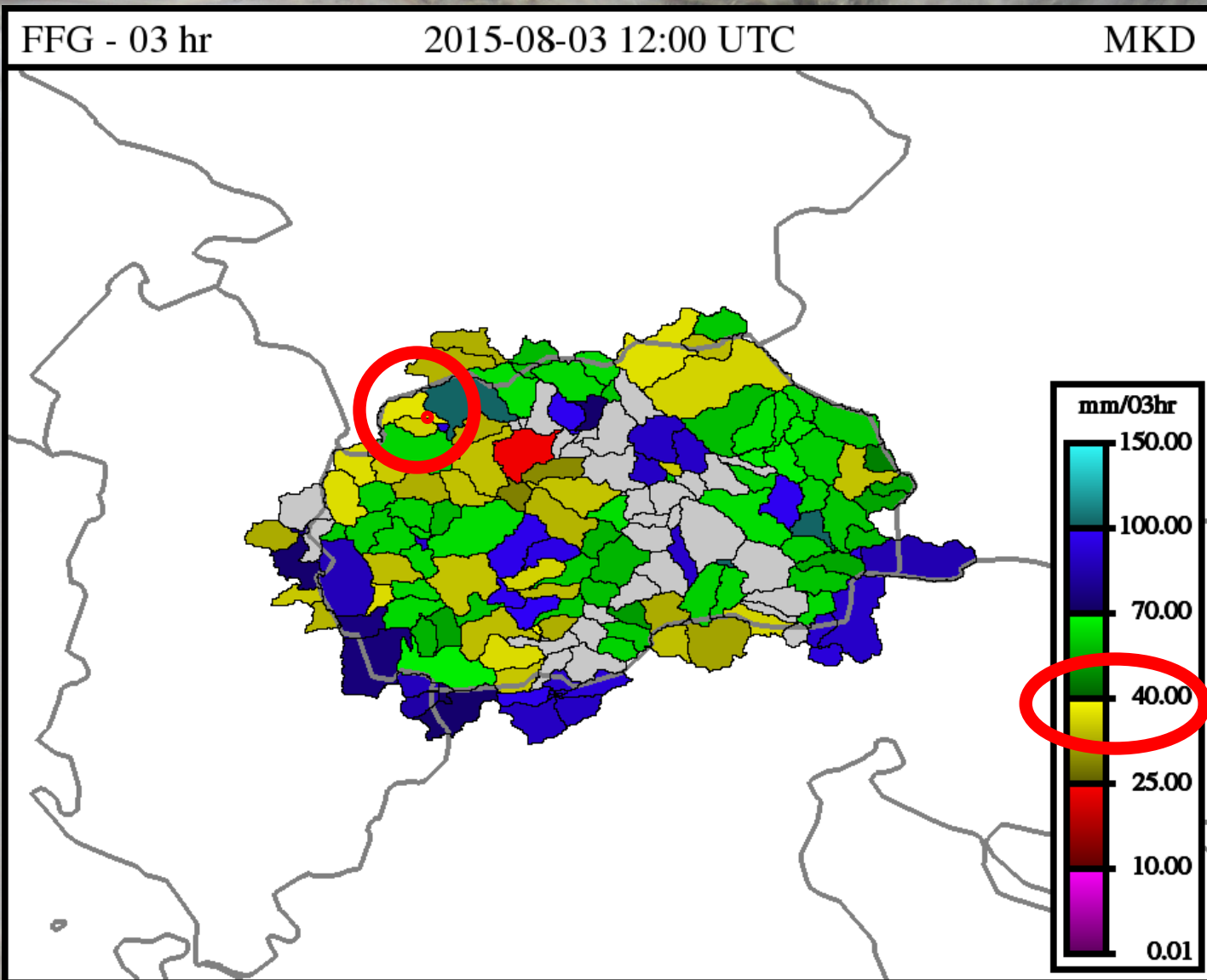
FFG - 03 hr

2015-08-03 12:00 UTC

MKD

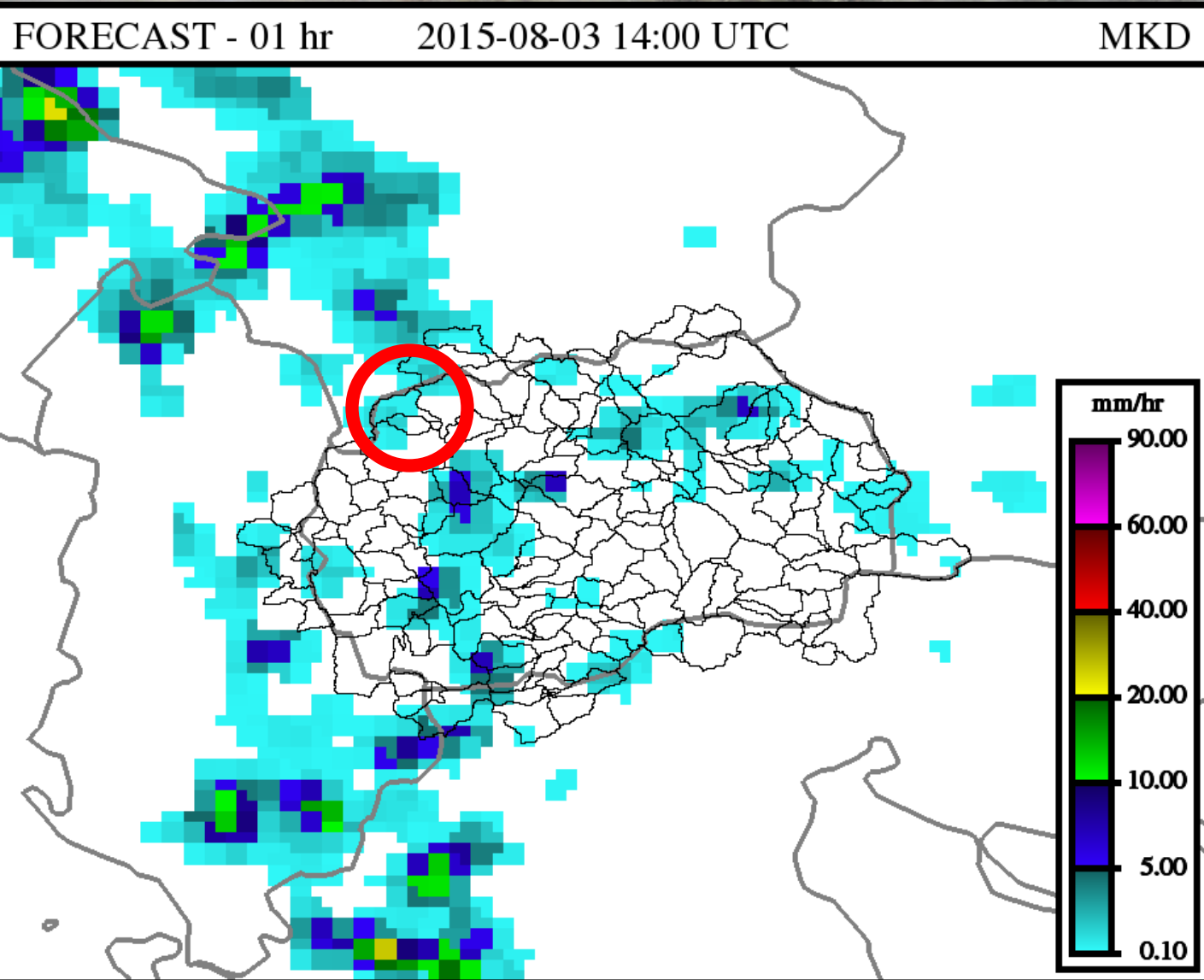
- FFG 03hr
12:00

In the next 3hr if fall
 $P > 40\text{mm}$ it is possible
Flash Flood
at the outlet
of the catchment



MACEDONIA (Shipkovic)

20150803 14:00

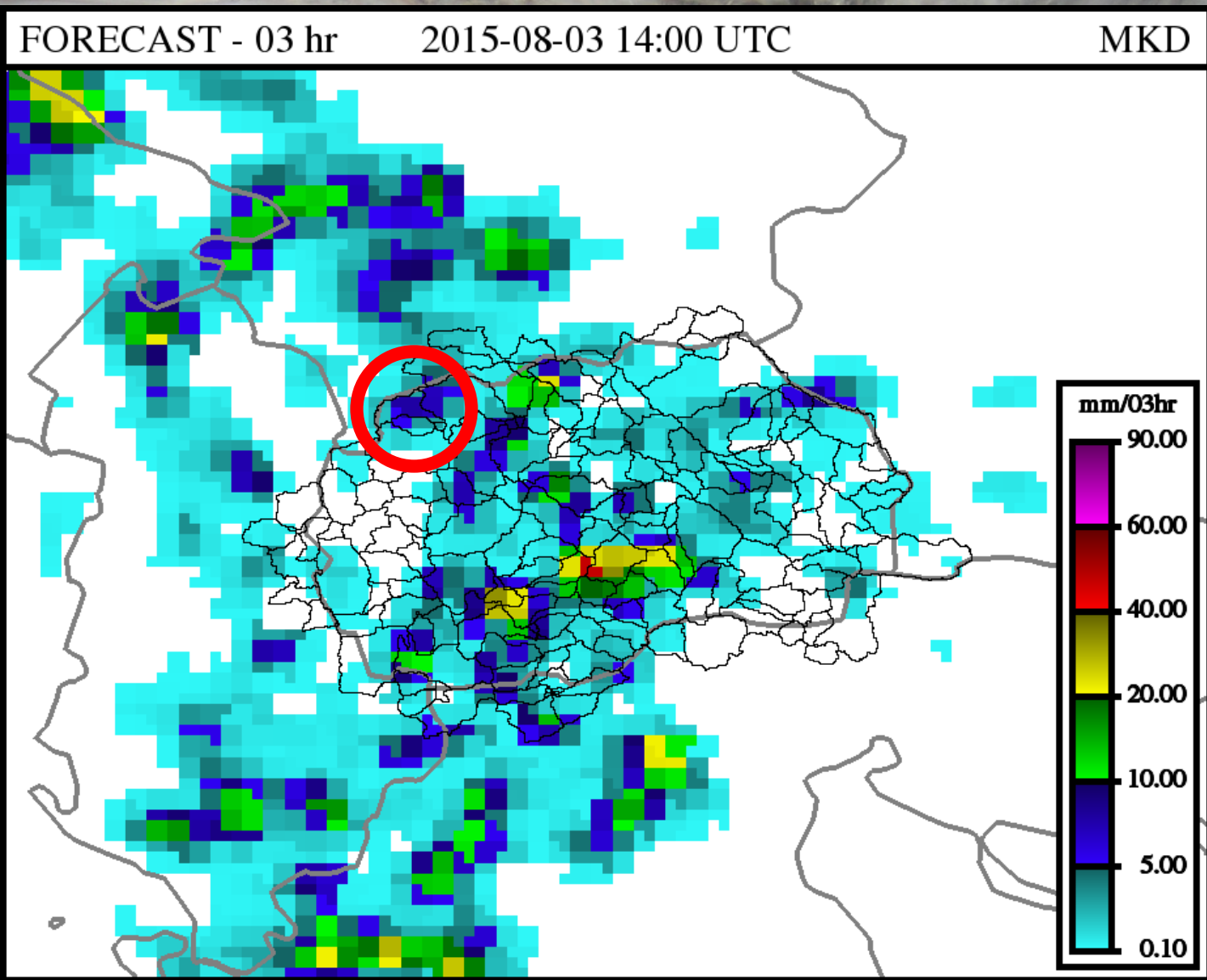


-Aladin Forecast 01hr
14:00

5mm/01hr

MACEDONIA (Shipkovic)

20150803 14:00



-Aladin Forecast 03hr
14:00

10 mm/03hr

MACEDONIA (Shipkovic)

20150803 12:00

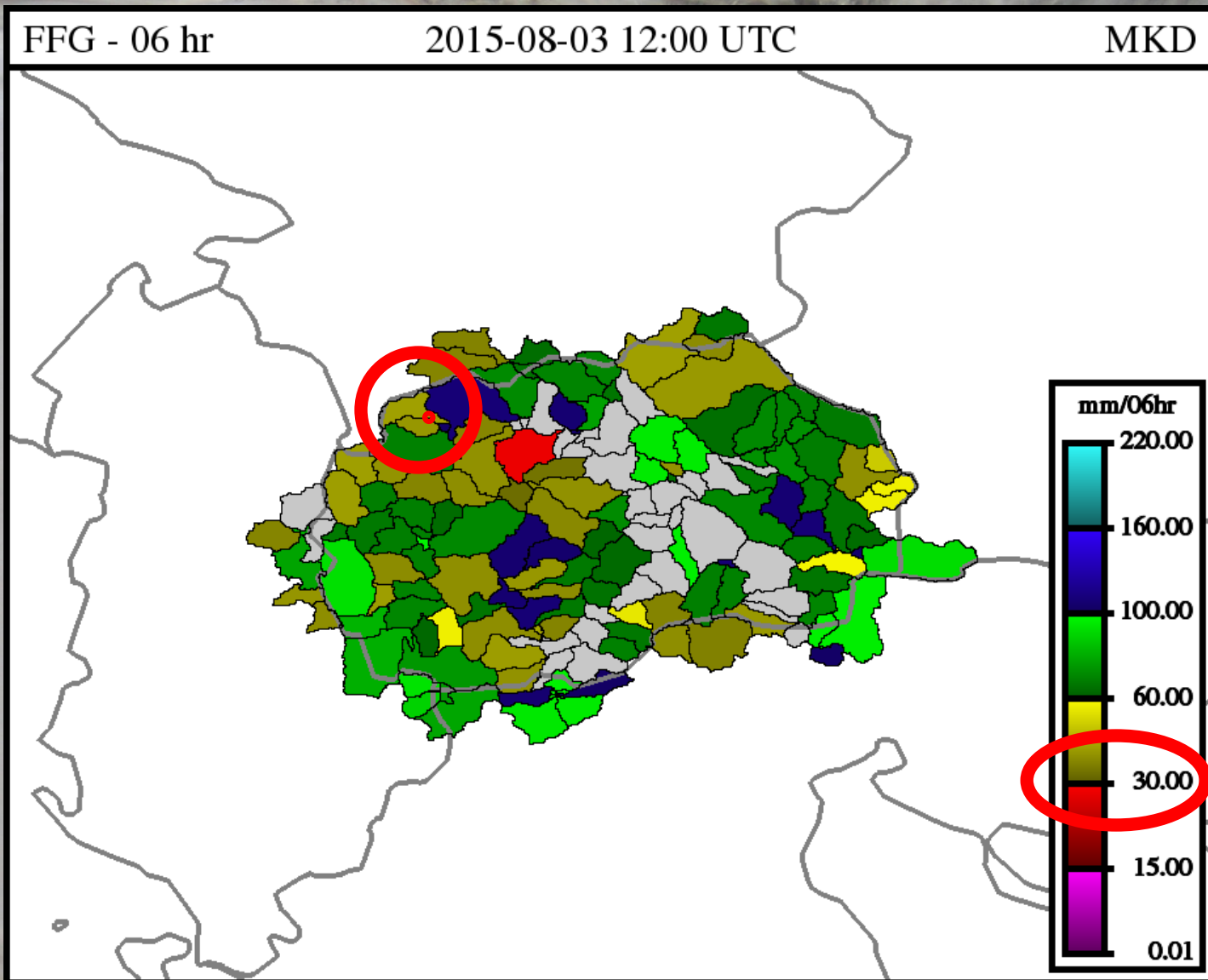
FFG - 06 hr

2015-08-03 12:00 UTC

MKD

- FFG 06hr
12:00

In the next 6hr if fall
 $P > 30\text{mm}$ it is possible
Flash Flood
at the outlet
of the catchment



MACEDONIA (Shipkovica)

20150803 14:00

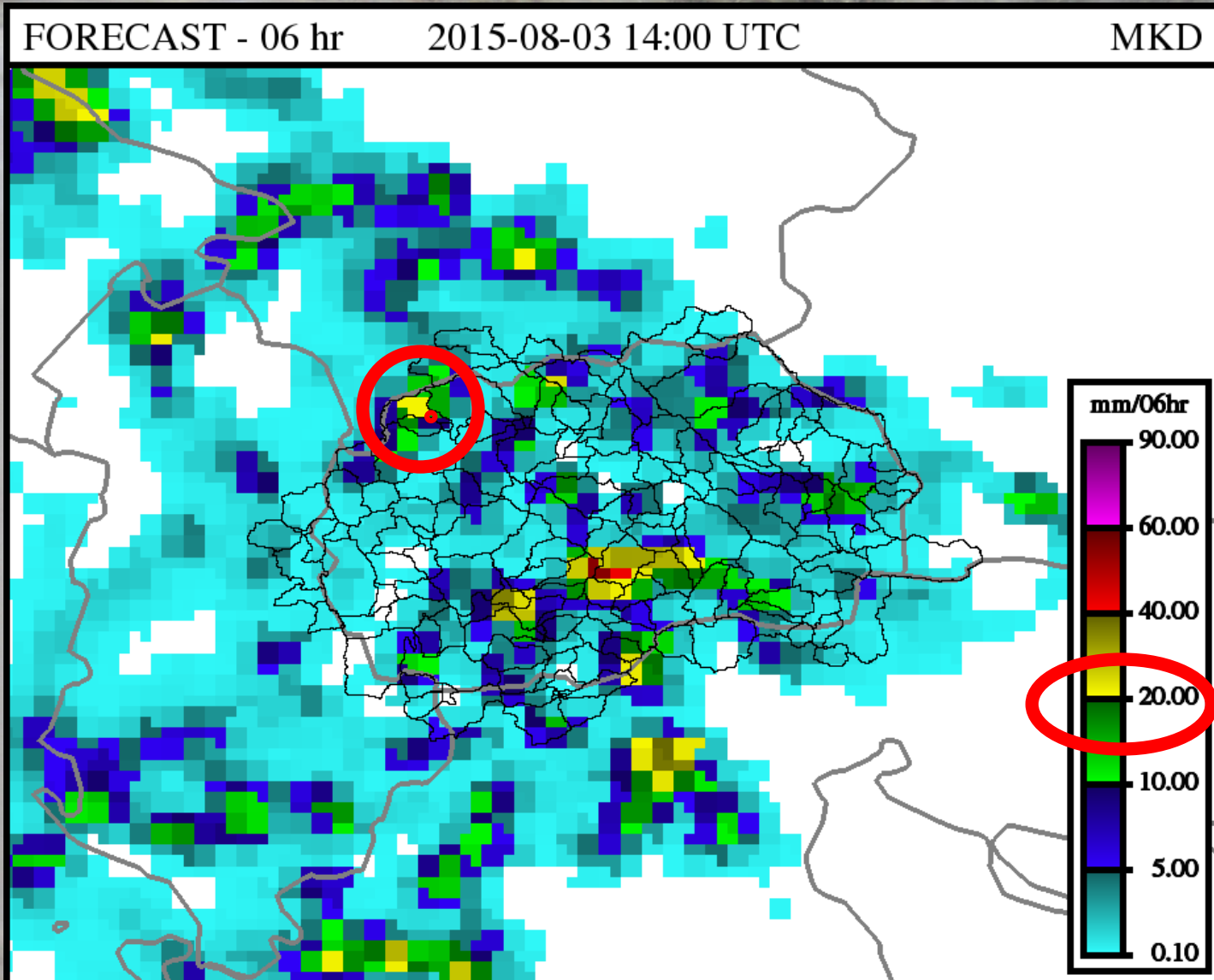
FORECAST - 06 hr

2015-08-03 14:00 UTC

MKD

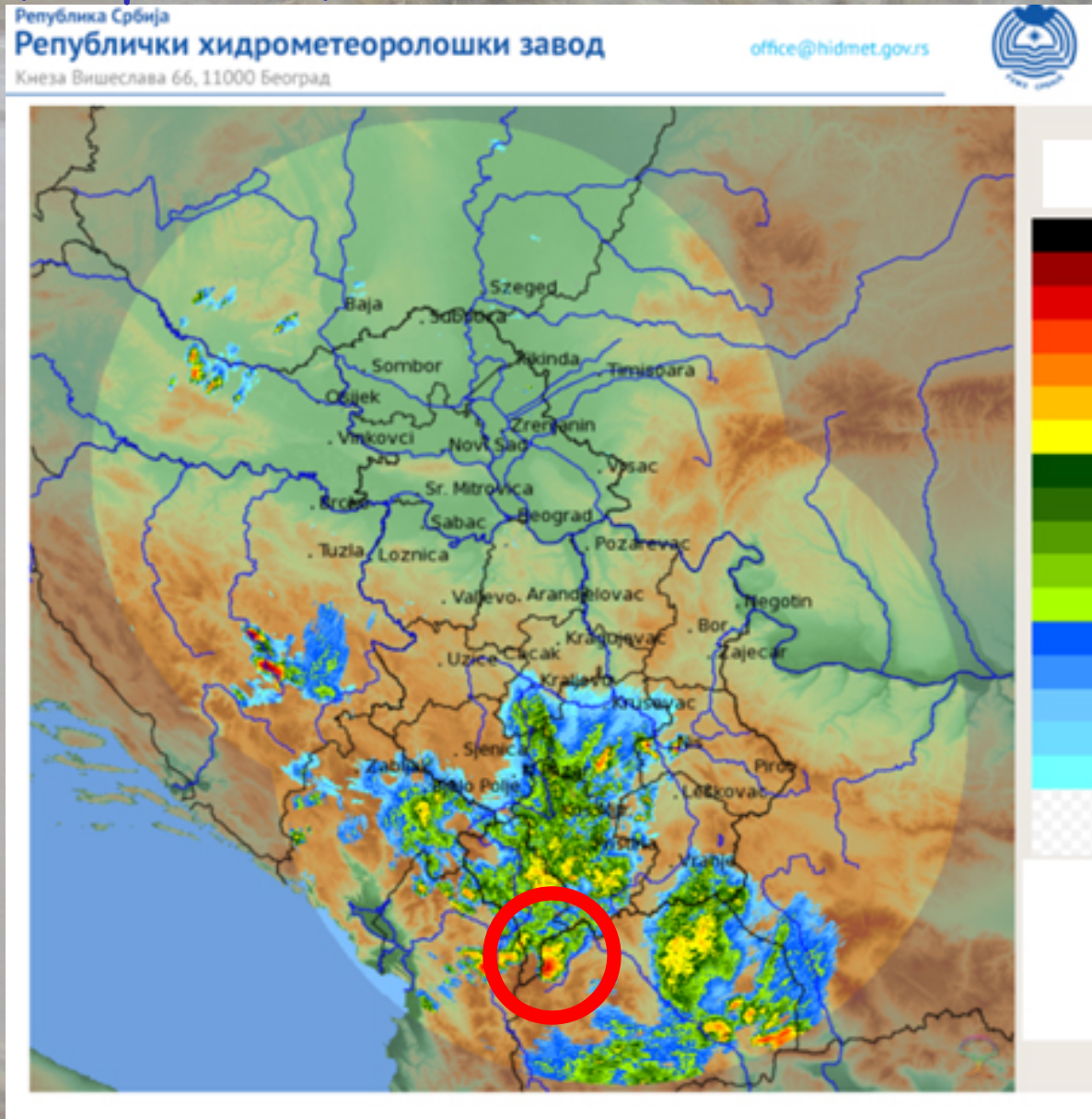
-Aladin Forecast 06hr
14:00

20 mm/06hr



MACEDONIA (Shipkovica)

20150803 16:30



-RADAR
16:30



MACEDONIA (Shipkovic)

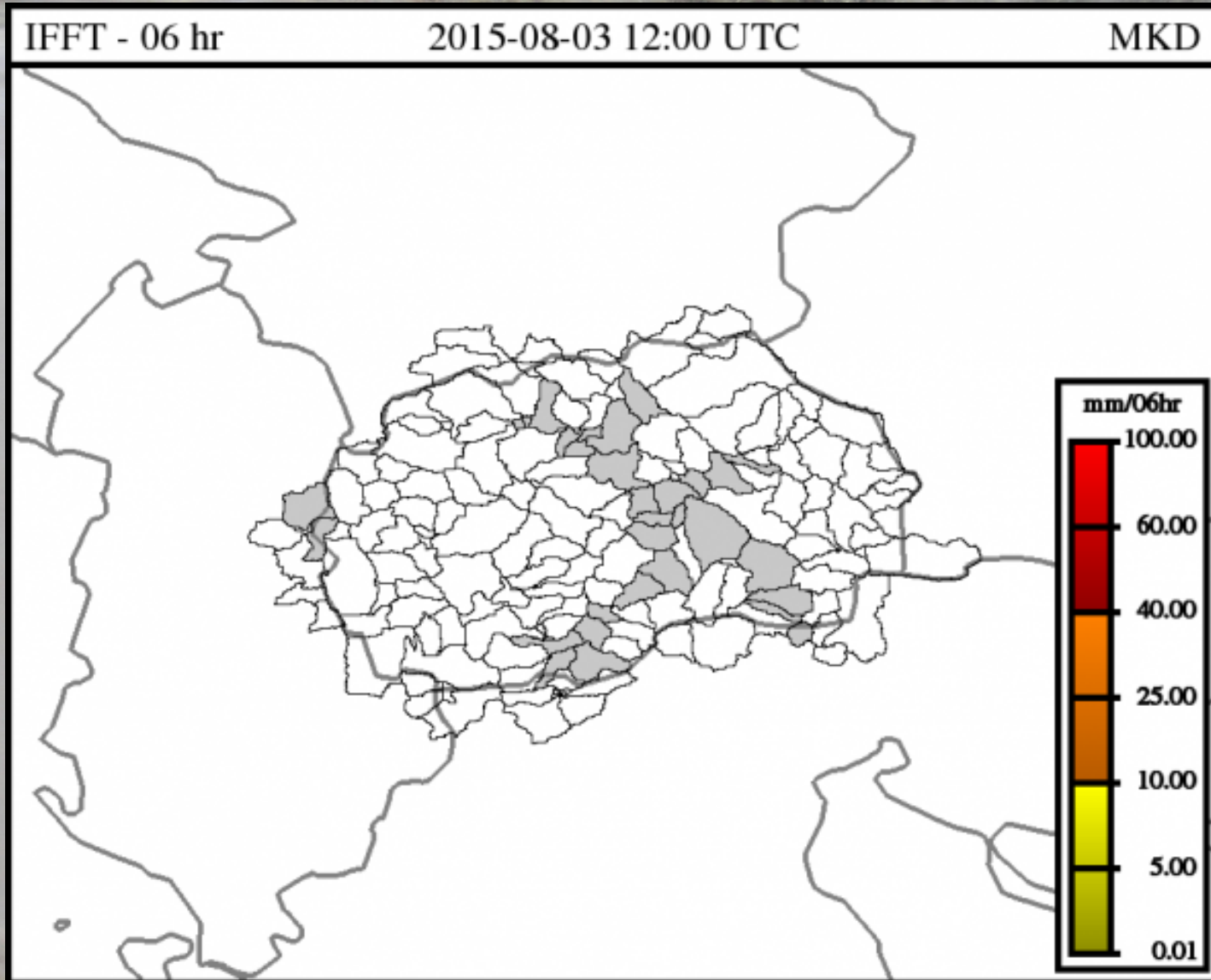
20150803 12:00

IFFT - 06 hr

2015-08-03 12:00 UTC

MKD

-IFFT



MACEDONIA (Shipkovic)

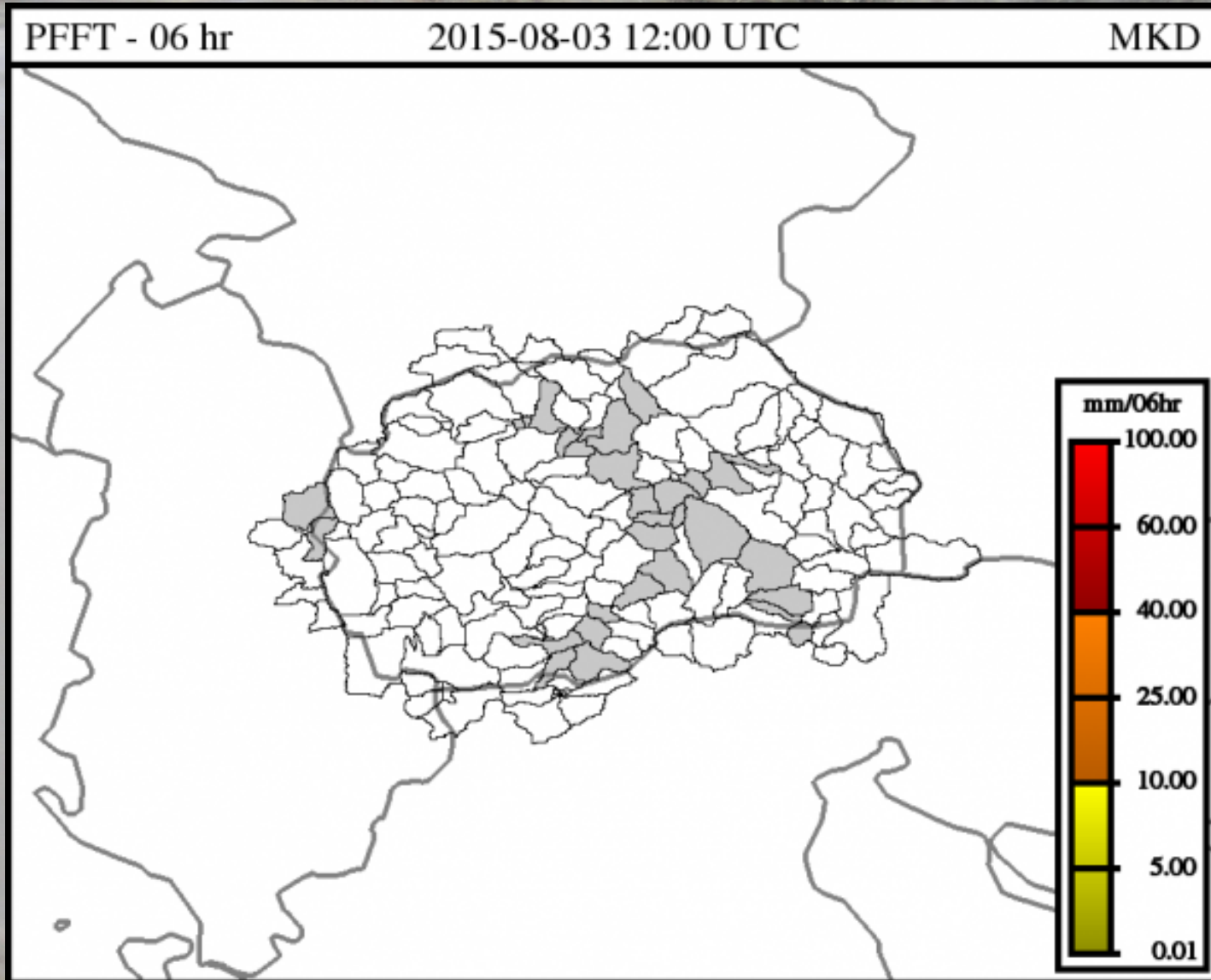
20150803 12:00

PFFT - 06 hr

2015-08-03 12:00 UTC

MKD

-PFFT



MACEDONIA (Shipkovic)

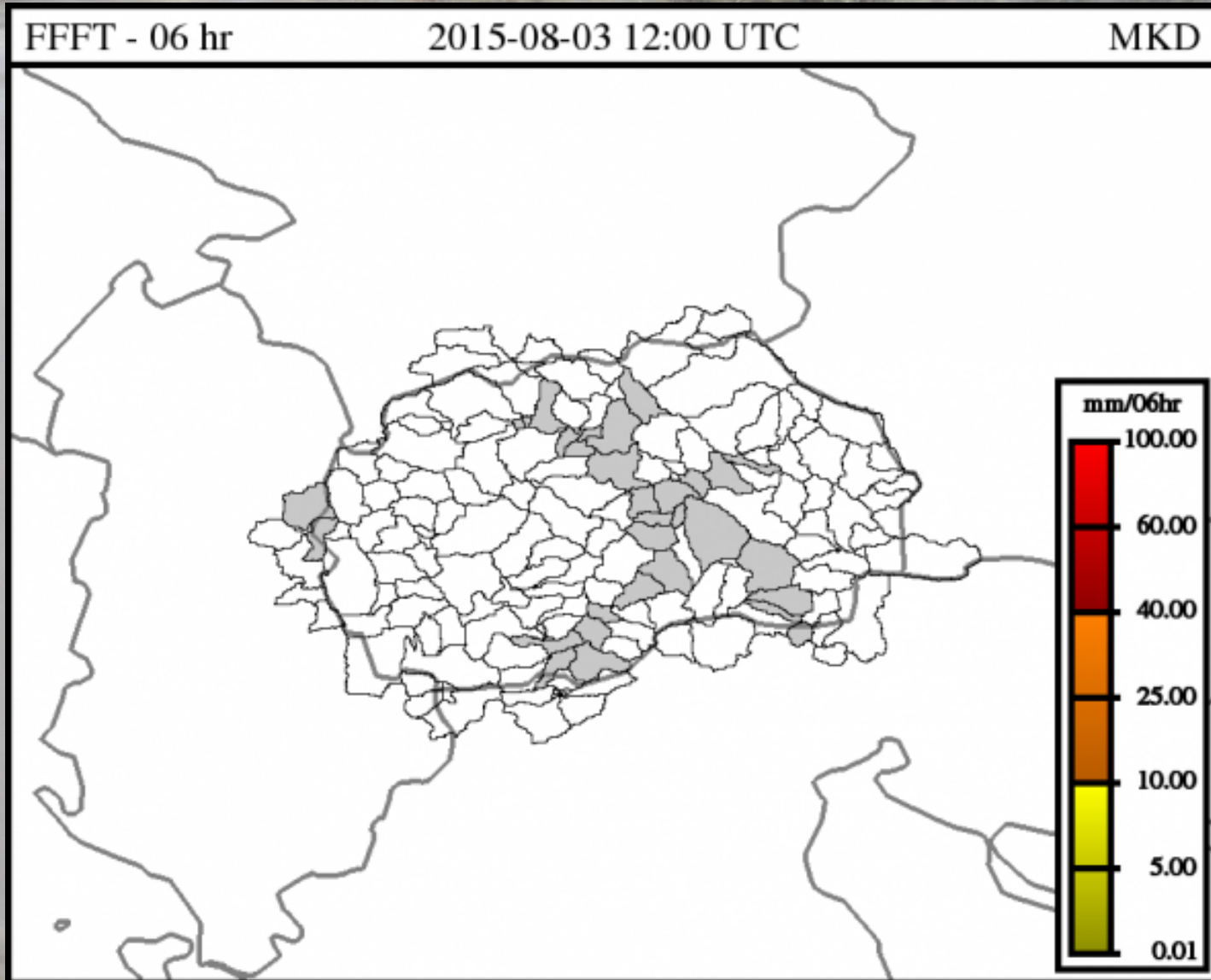
20150803 12:00

FFFT - 06 hr

2015-08-03 12:00 UTC

MKD

-FFFT



CONCLUSION FLASH FLOOD

20150803

Prediction for heavy rain in the northern part of Macedonia was done in advance, but it was difficult to predict exact location of the flash flood. For the region of Tetovo, there is currently only one meteorological station situated in the town. The next morning after the flooding, only 9 mm of rainfall was measured over the previous 24 hours at this station. This highlights the fact that existing gauge measurements are not enough to observe areal precipitation amounts in the case of flash floods. Satellite and Radar information is necessary. After visiting flooded sites and observing the flood damage, preliminary calculations suggest that the rainfall intensity was around 60-90 mm for a period of 3 hours, and the maximum flood wave size which passed through Shipkovica was around 10 m³/s.



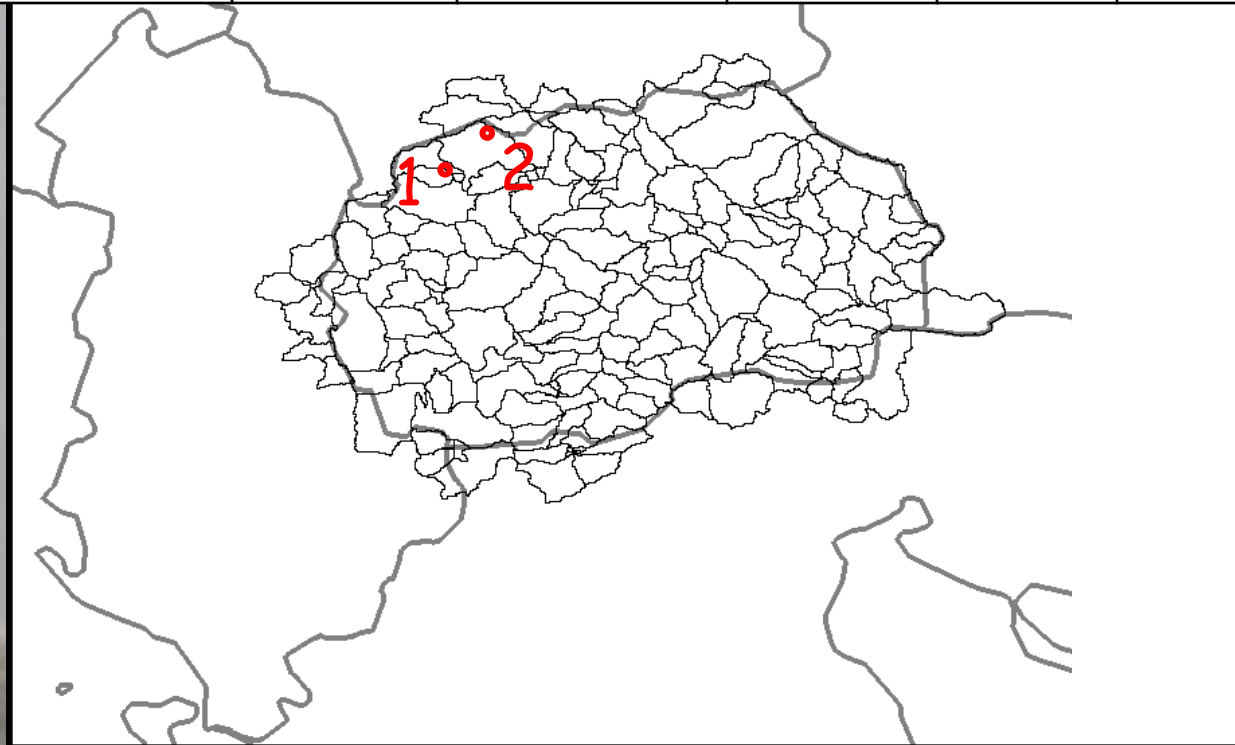
MONITORING STATIONS

20150803

(24hr precipitation measured on 20150804 - 06:00)

Measured parameters:

Station	Parameter	Year	Month	Date			
				1	2	3	4
1.Tetovo	tavg(°C)	2015	08	25.3	28.9	22.6	24.5
1.Tetovo	tmax (°C)	2015	08	33.4	35.6	31.5	32.0
1.Tetovo	tmin (°C)	2015	08	17.9	18.6	20.4	17.4
1.Tetovo	f (m/s)	2015	08	2.4	0.0	2.4	2.4
1.Tetovo	r24 (mm)	2015	08	0.5	0.0	0.0	9.4
2.Jazince	r24 (mm)	2015	08	0.0	0.0	0.0	50.0



CONCLUSION FLASH FLOOD

20150803

The satellite observations of precipitation (gridded GHE) indicated heavier precipitation of up to 40 mm/6-hr in the central to north-central part of Macedonia at 15:00 UTC. The heavier precipitation was to the south of the Sar Planina mountain. Soil moisture conditions as indicated by the FFG system were fairly low throughout Macedonia prior to the event (12:00 UTC). The FFG values were low for several basins to the south of the Sar Planina mountain (for example, on the order of 25-40 mm/3-hr for the region of Shipkovica).

The forecast of precipitation within the System indicated numerous heavier rainfall throughout Macedonia, with highest rates of 40-50 mm/3-hr, but located further south of the Shipkovica region, and 20 mm/3-hr in the region. The flash flood basins in the north of Macedonia showed very low FFG values (order of 10-15 mm/3-hr) at the end of the event at 18:00 UTC. Knowledge of local conditions and the location of heavy precipitation (both observed and forecast) were critical in assessing the situation for this event.



MACEDONIA (Shipkovica)

Photos (6.08.2015)



MACEDONIA (Shipkovica)

Photos (6.08.2015)



MACEDONIA (Shipkovica)

Photos (6.08.2015)



MACEDONIA (Shipkovica)

Photos (6.08.2015)



MACEDONIA (Shipkovicica)

Photos (6.08.2015)



MACEDONIA (Shipkovica)
Photos (6.08.2015)

Thank you for attention!

