

Meteorological and Hydrological Service
Croatia



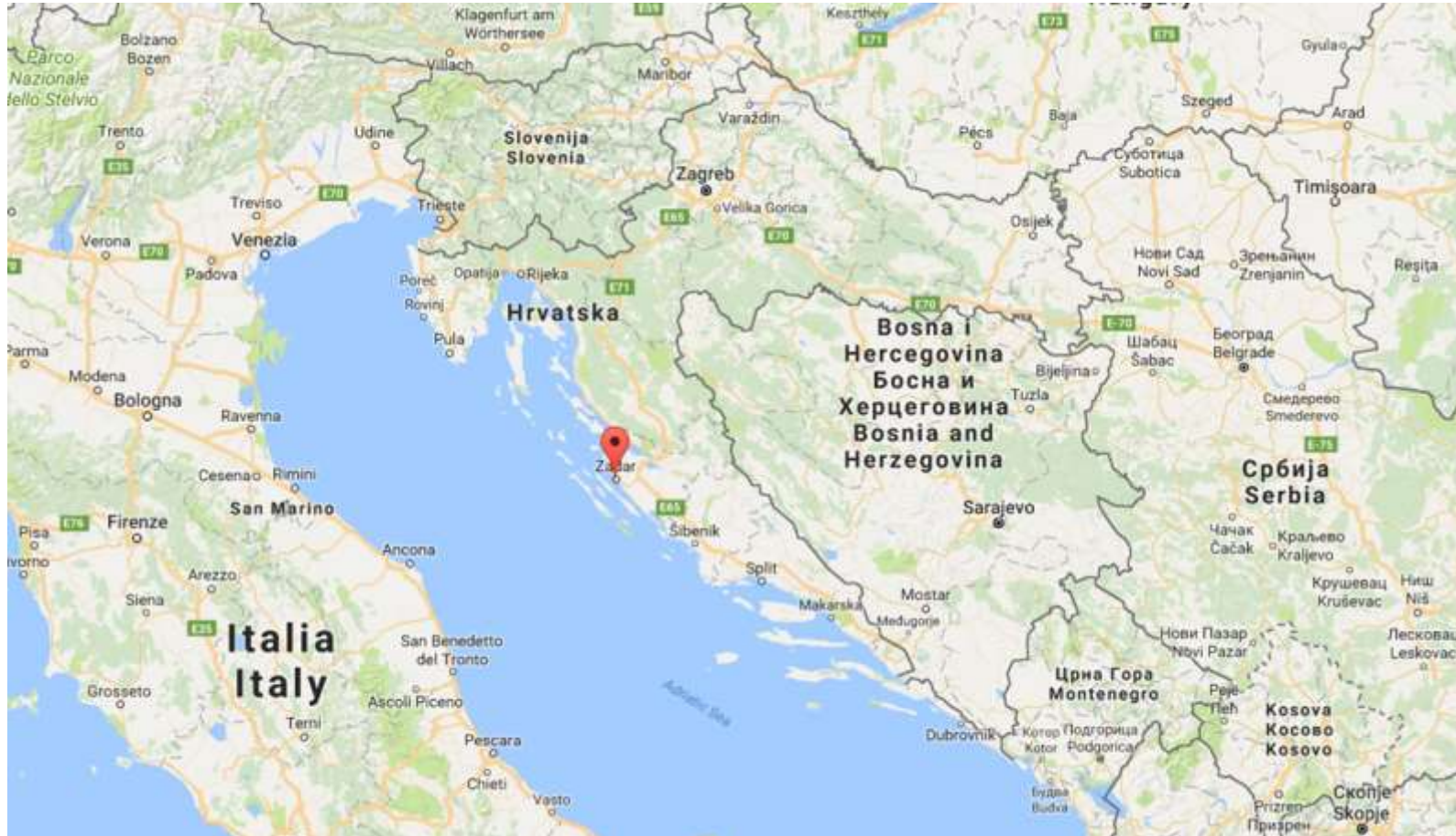
Flash Flood in West part of SEE Region, September 2017

Matea Martinkovic
Kornelija Macek

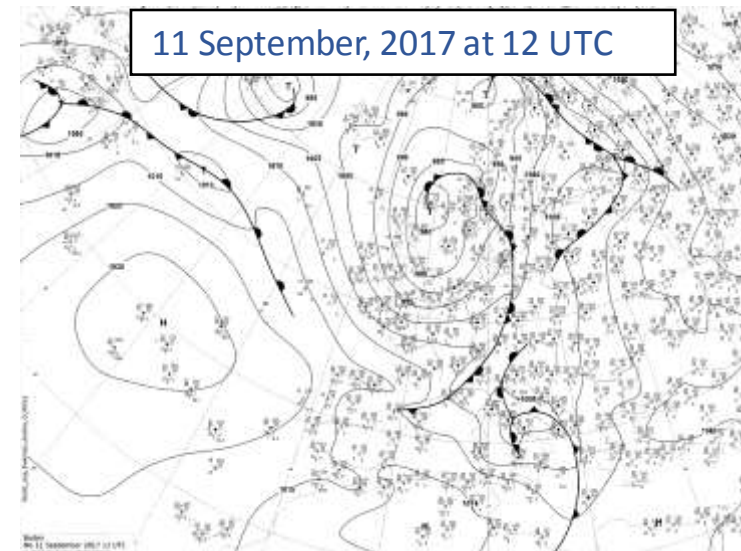
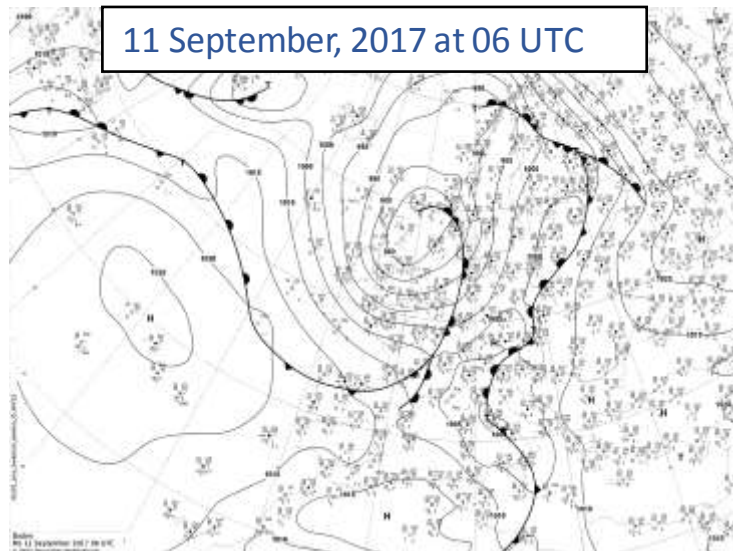
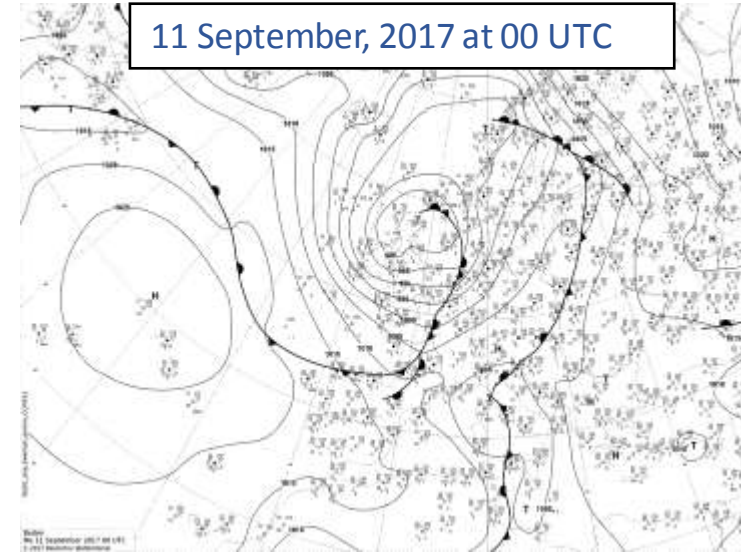
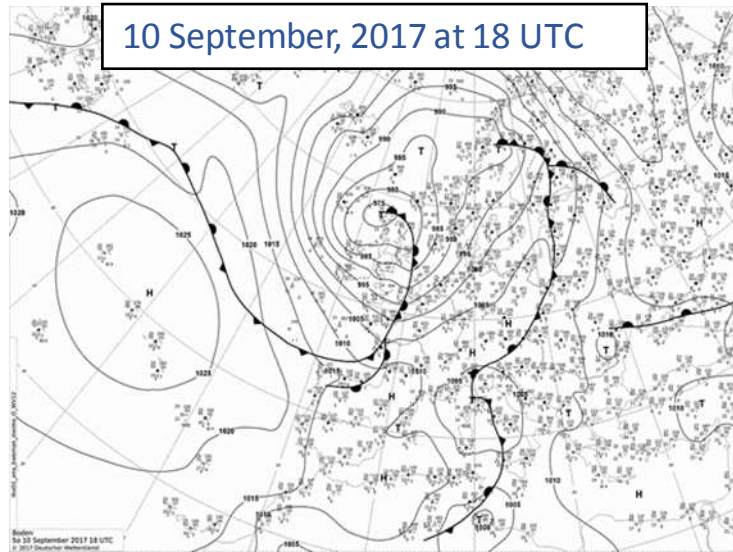
Flash Flood in Zadar, Croatia September 2017

- 11th September 2017
- Zadar, middle Dalmatia
- This case was an example of severe convection
- It was marked as mesoscale convective system (MCS)
- Extremely large amounts of precipitation
- Flash flood caused huge material damage in cities of Zadar and Nin

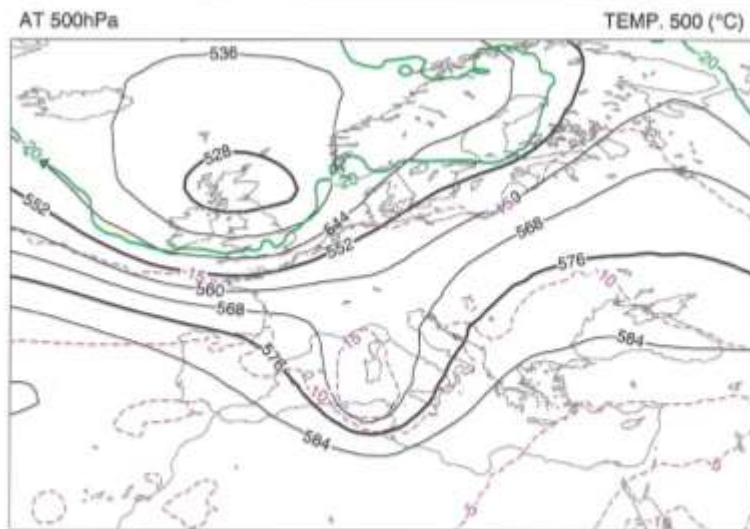
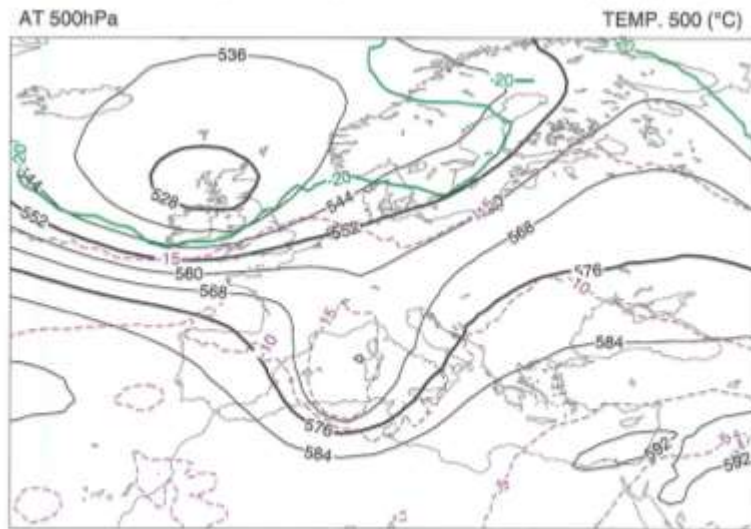
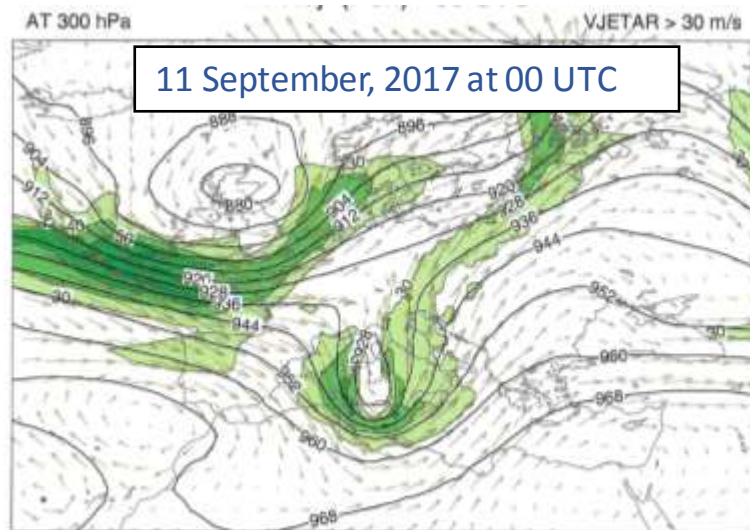
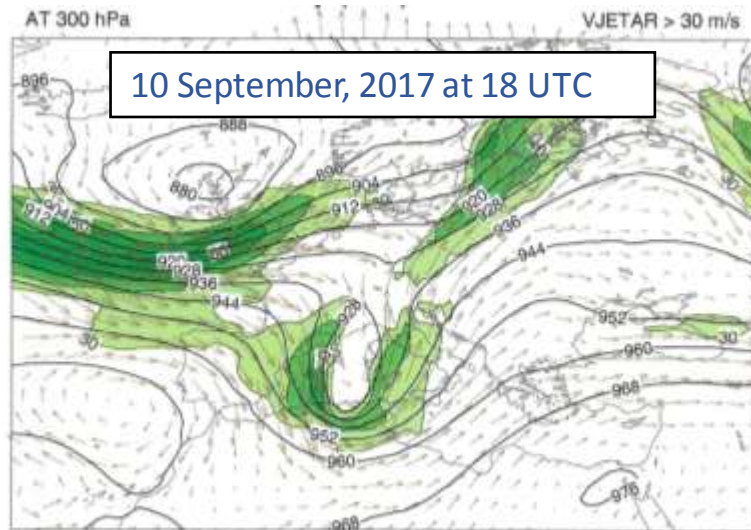
Location of Zadar on the map



Synoptic analysis: Surface air pressure (DWD)



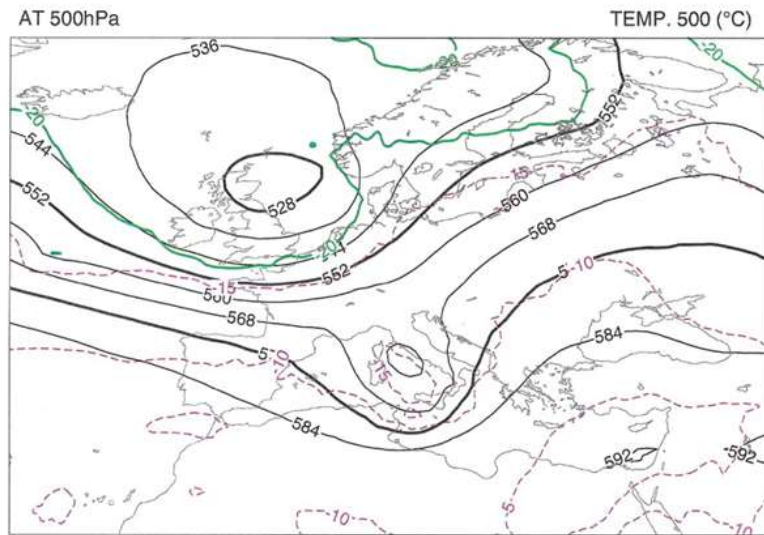
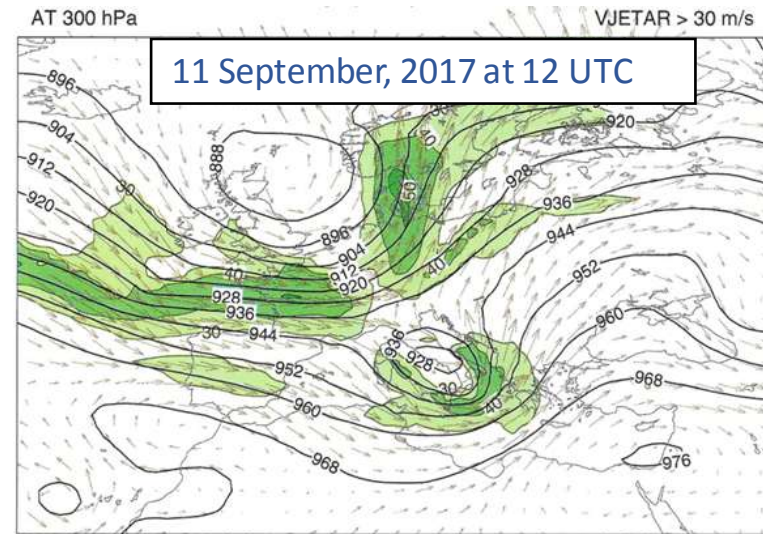
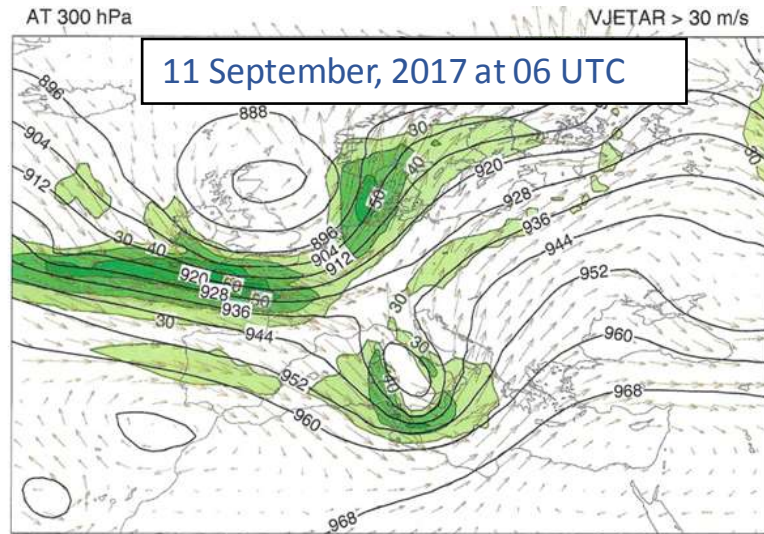
AT 300 hPa & wind speed > 30 m/s, AT 500 hPa & temperature (ECMWF)



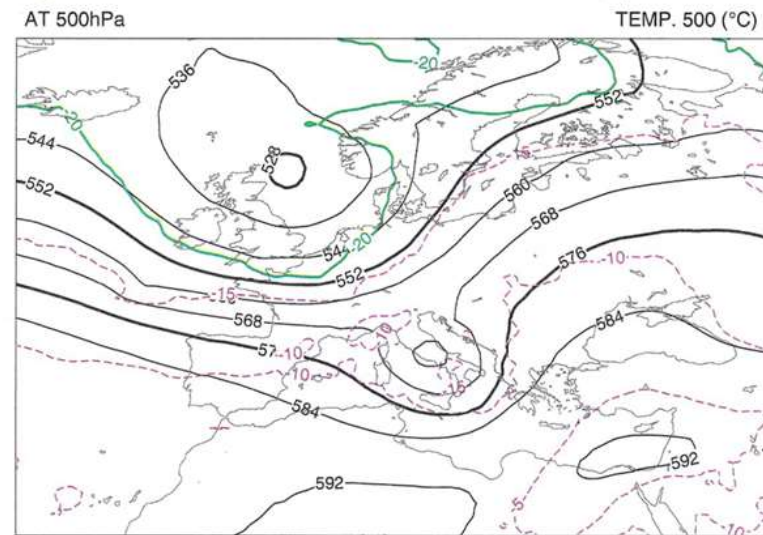
ECMWF RUN_12

start modela: Sub 09.09.2017 12UTC

AT 300 hPa & wind speed > 30 m/s, AT 500 hPa & temperature (ECMWF)

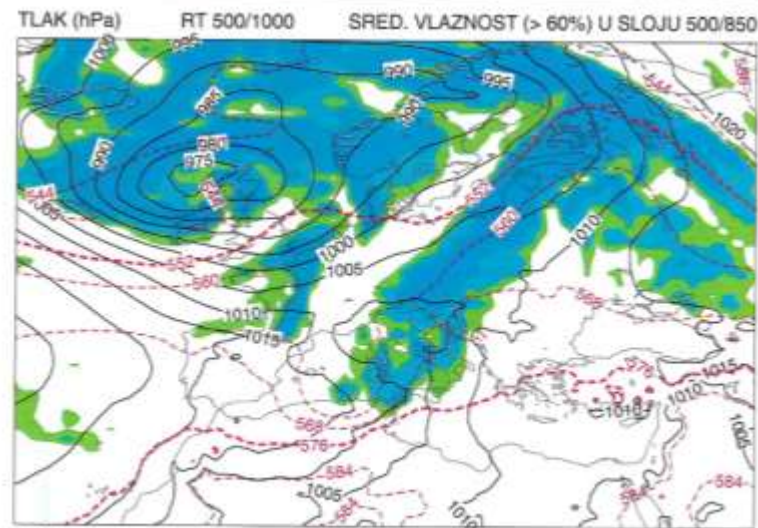
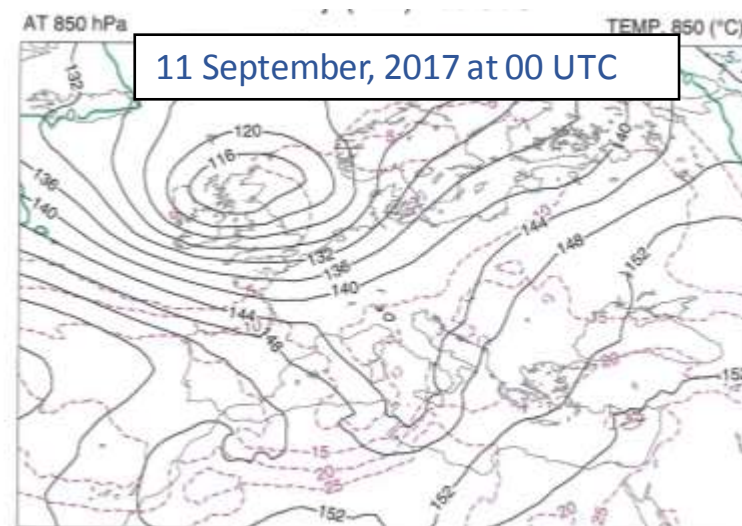
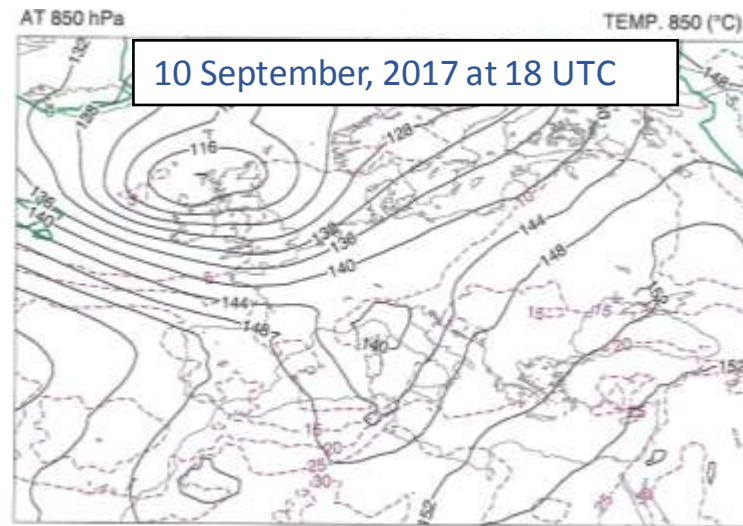


ECMWF RUN_12

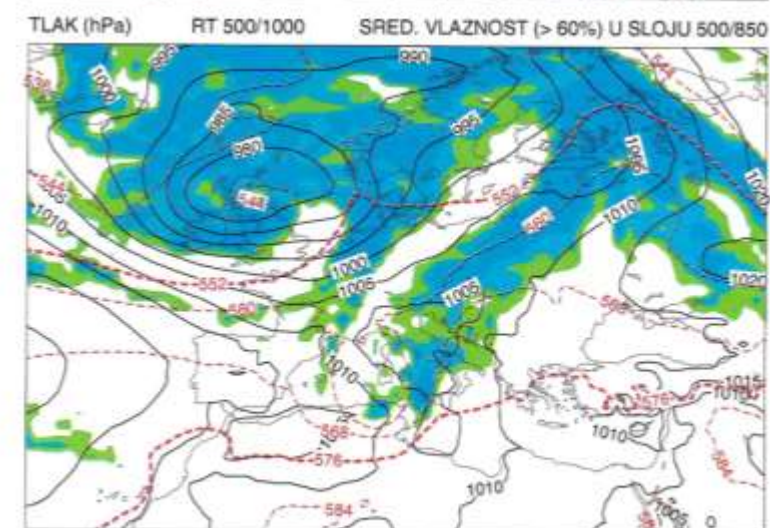


start modela: Ned 10.09.2017 12UTC

AT 850 hPa & temperature, MSLP & RT 500/1000 & RH 500/850 (ECMWF)

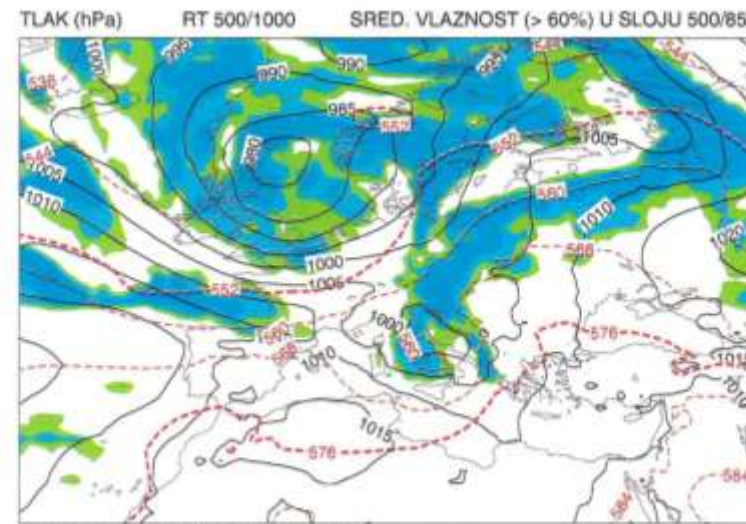
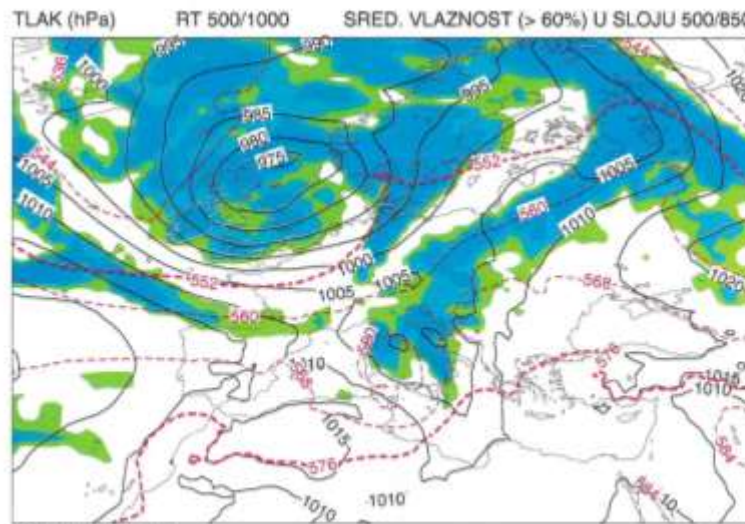
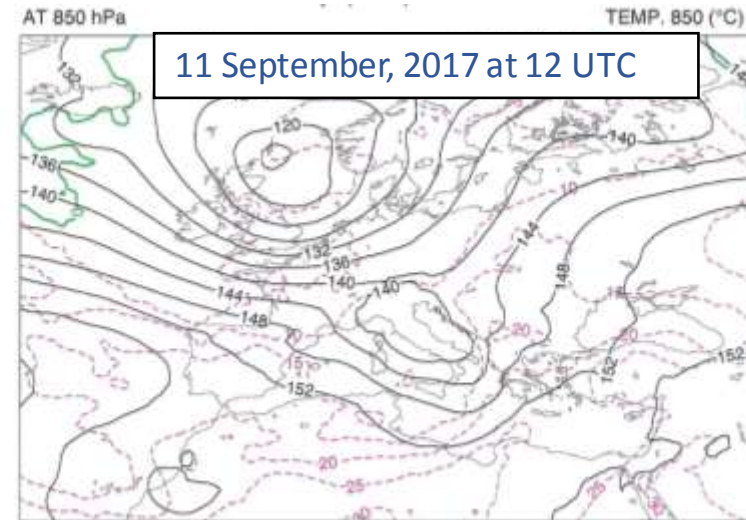
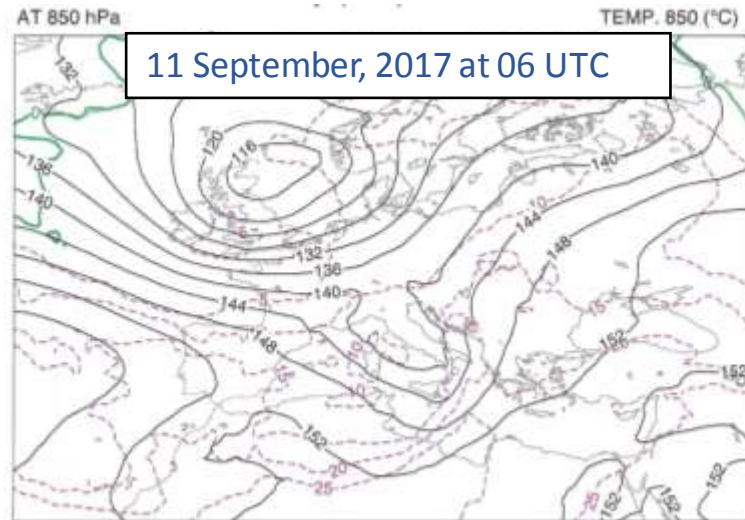


ECMWF RUN_12



start modela: Sub 09.09.2017 12UTC

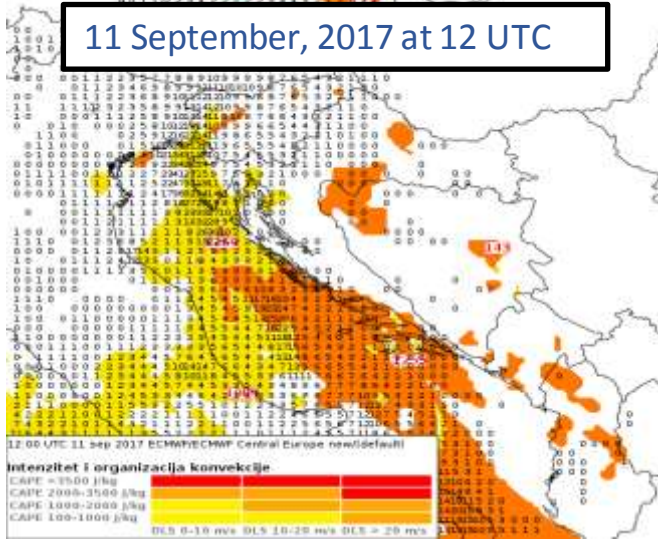
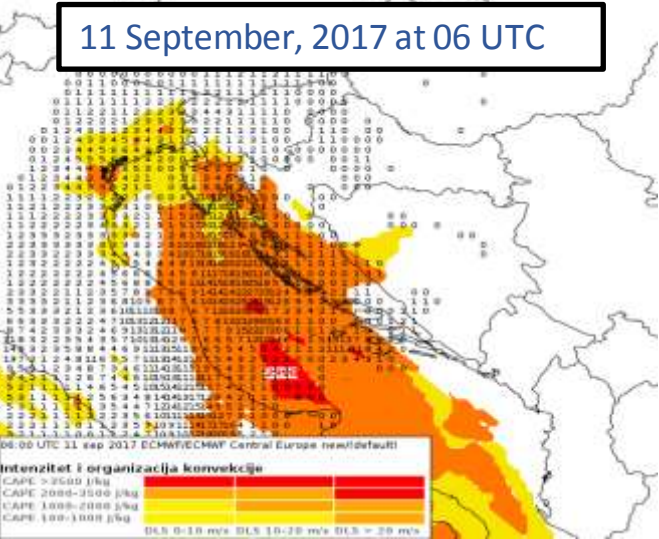
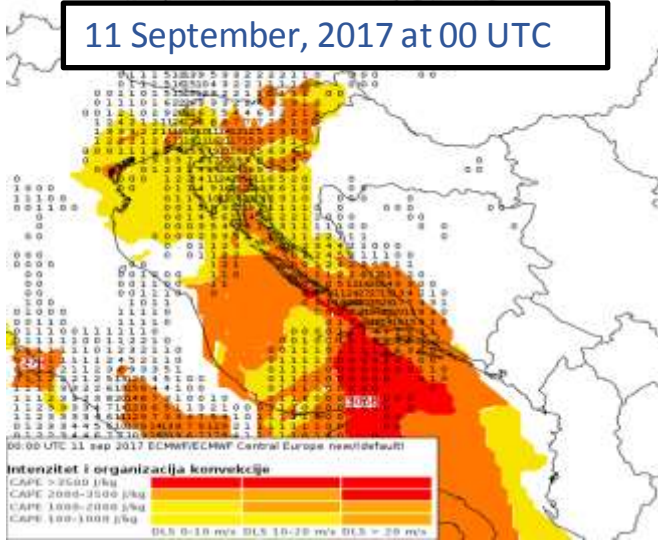
AT 850 hPa & temperature, MSLP & RT 500/1000 & RH 500/850 (ECMWF)



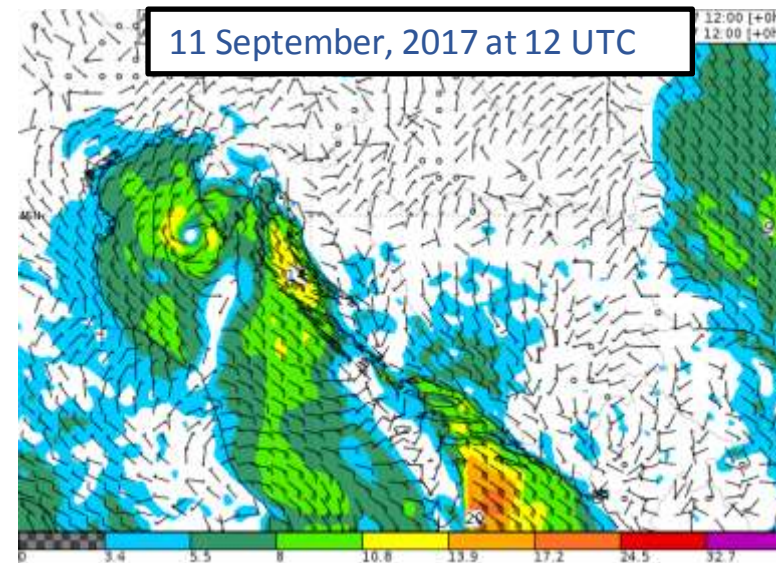
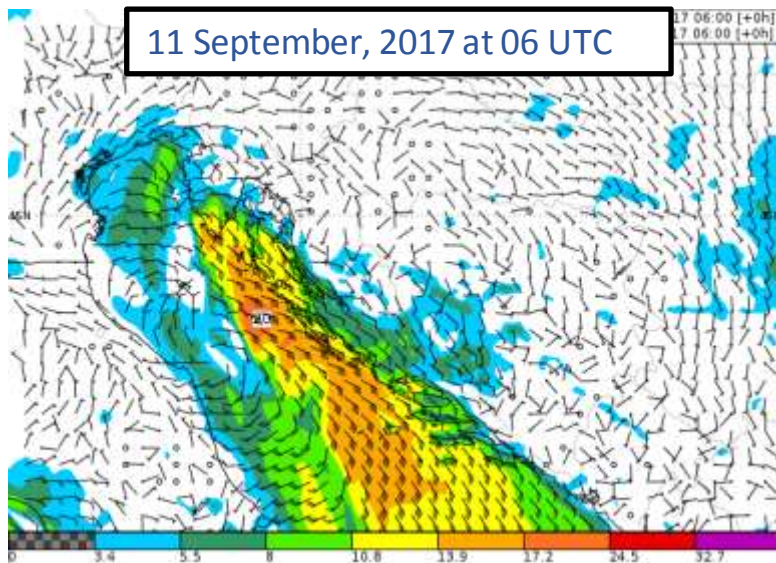
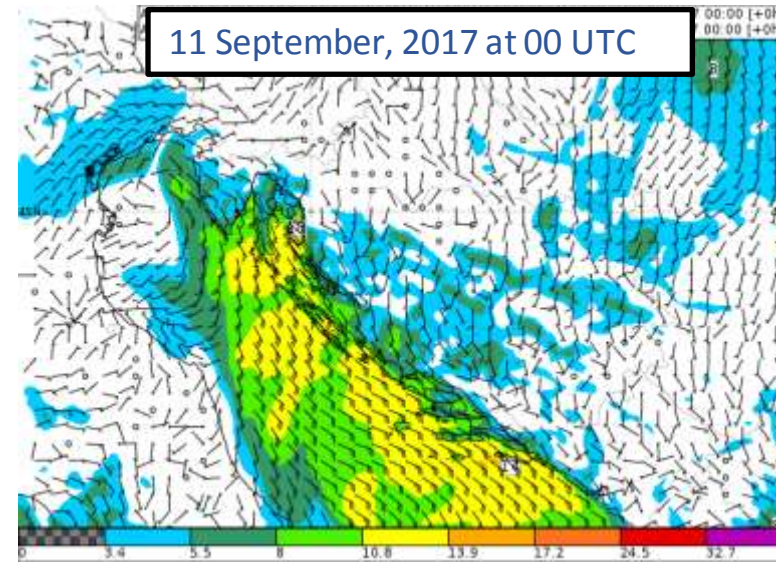
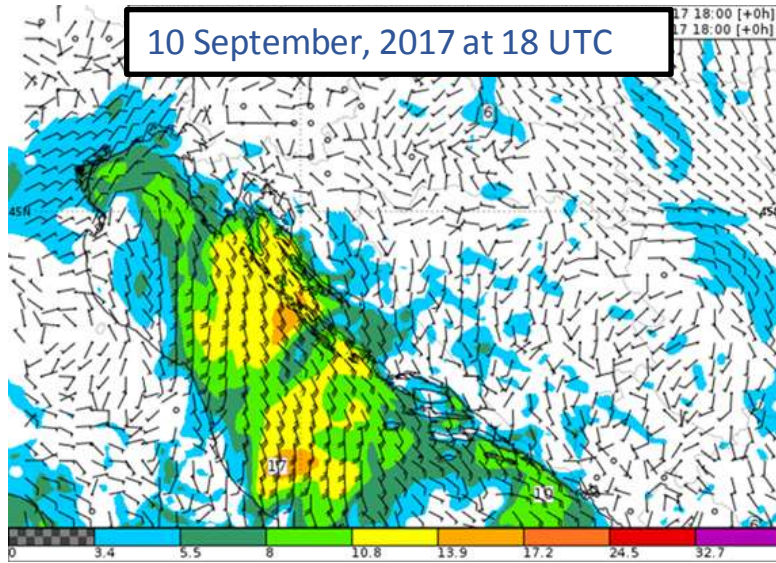
ECMWF RUN_12

start modela: Ned 10.09.2017 12UTC

Precipitation amount, CAPE and SHEAR (ECMWF)

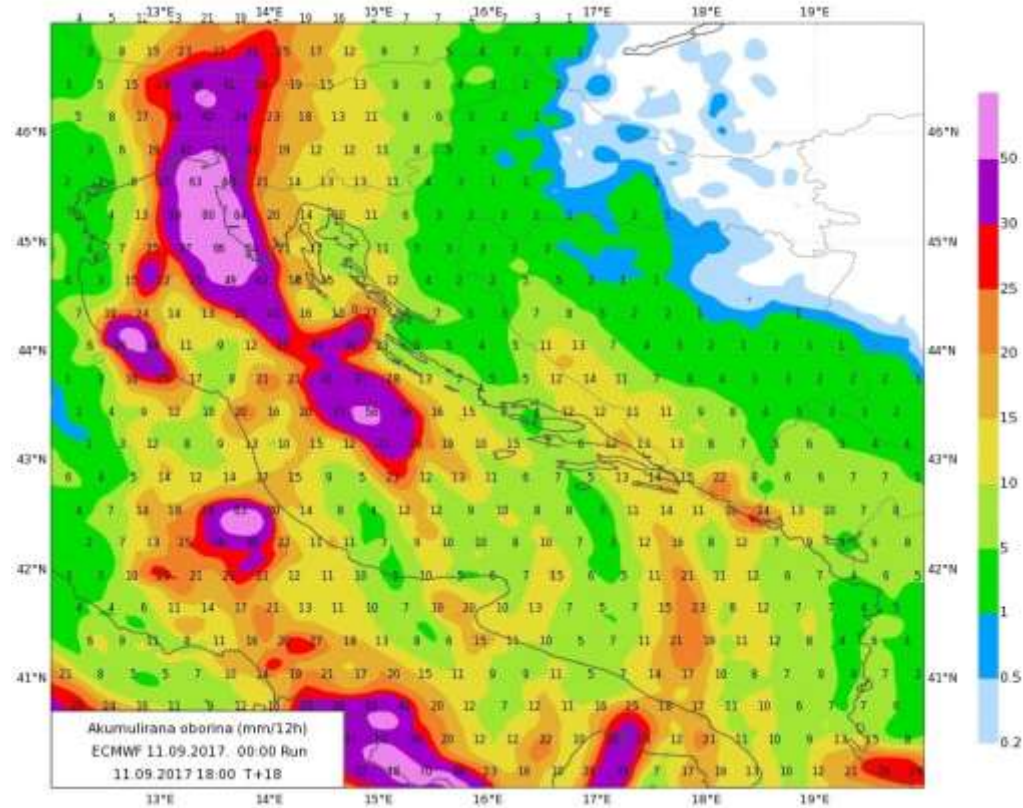


Wind (ALADIN)

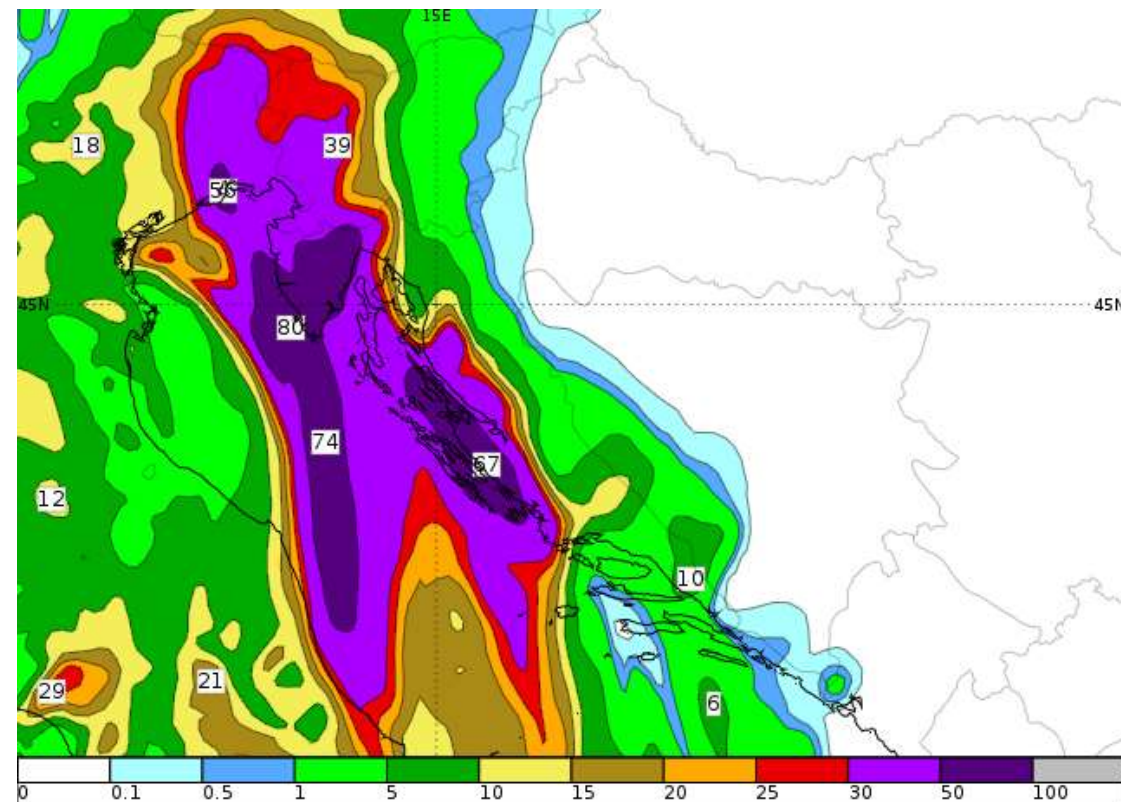


12-hours PRECIPITATION FORECAST

11 September, 2017 at 18 UTC (ECMWF)



11 September, 2017 at 12 UTC (ALADIN)

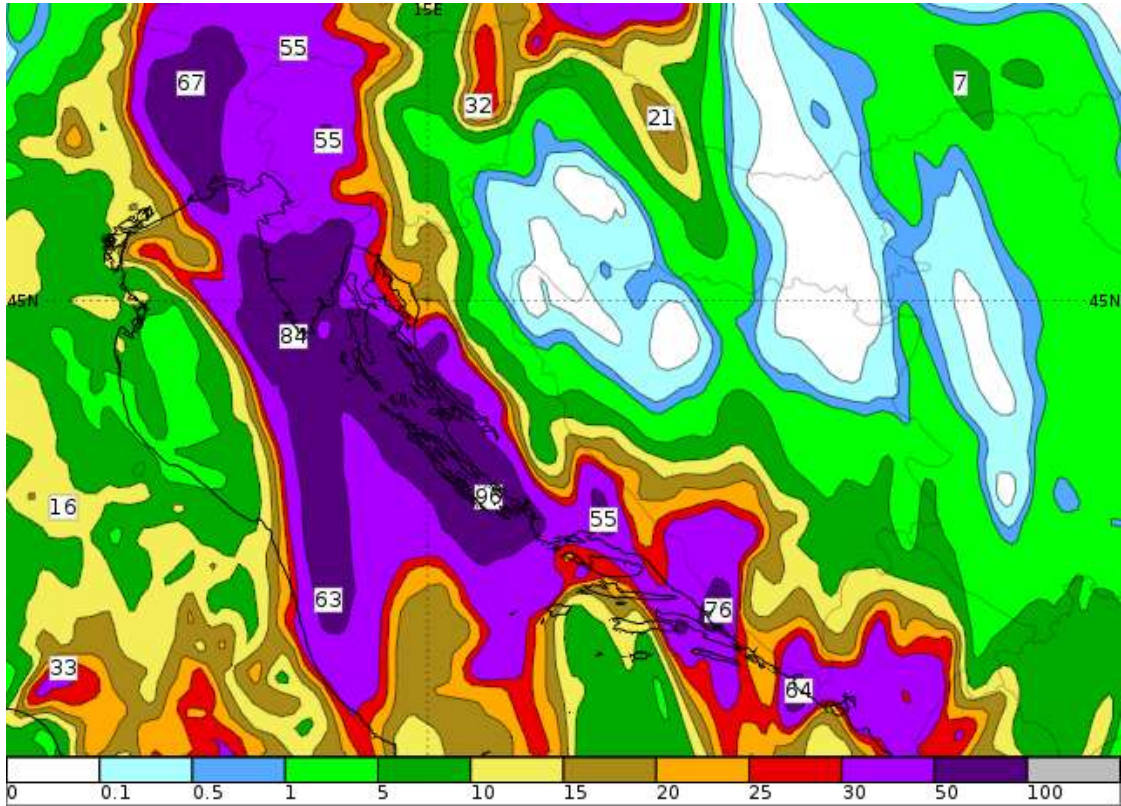
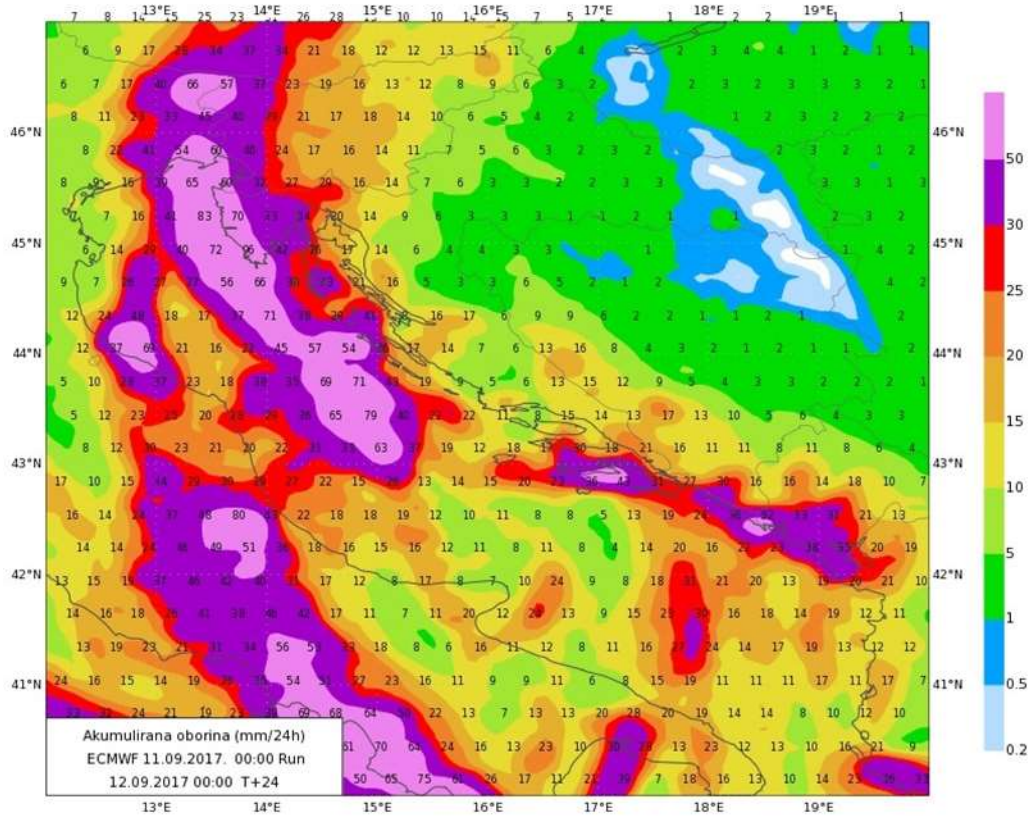


24-hours PRECIPITATION FORECAST

12 September, 2017 at 00 UTC

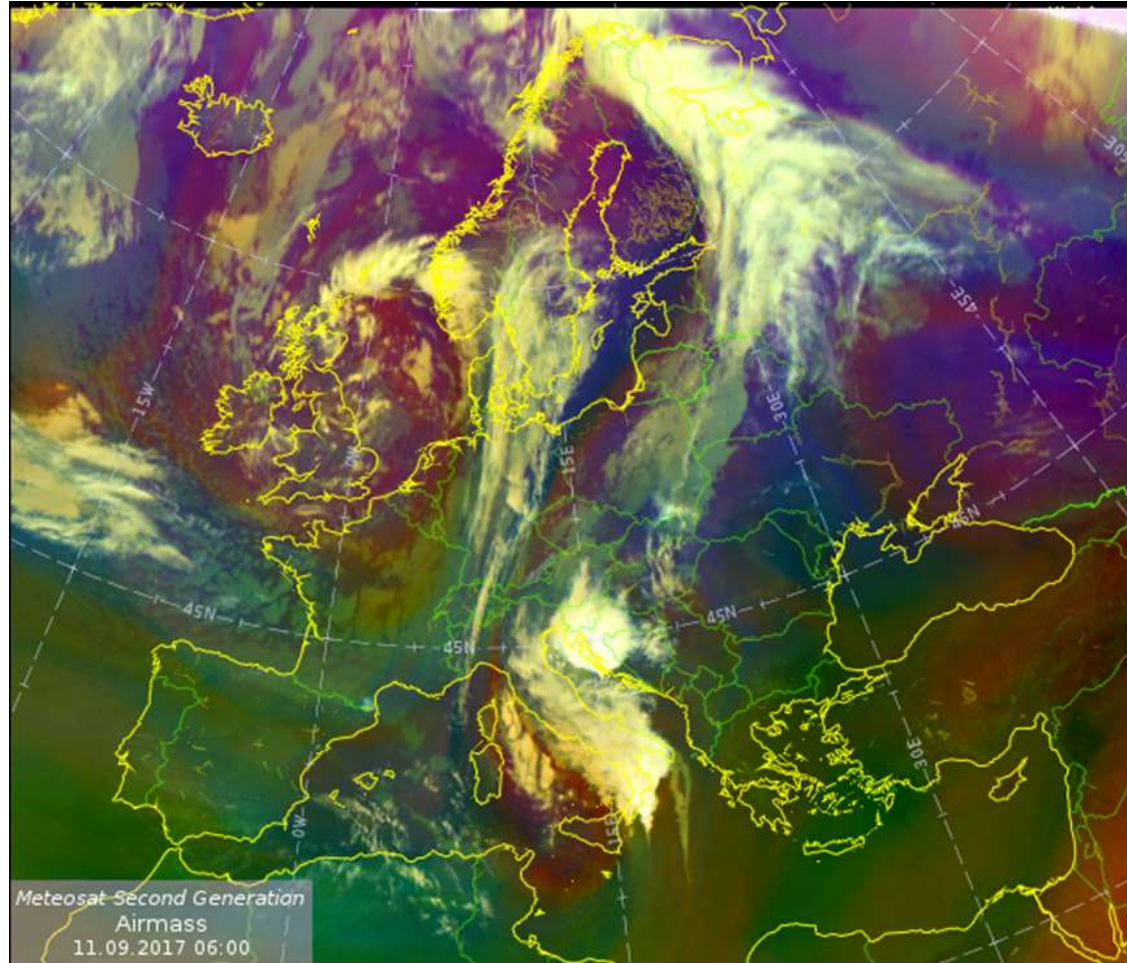
ECMWF

ALADIN



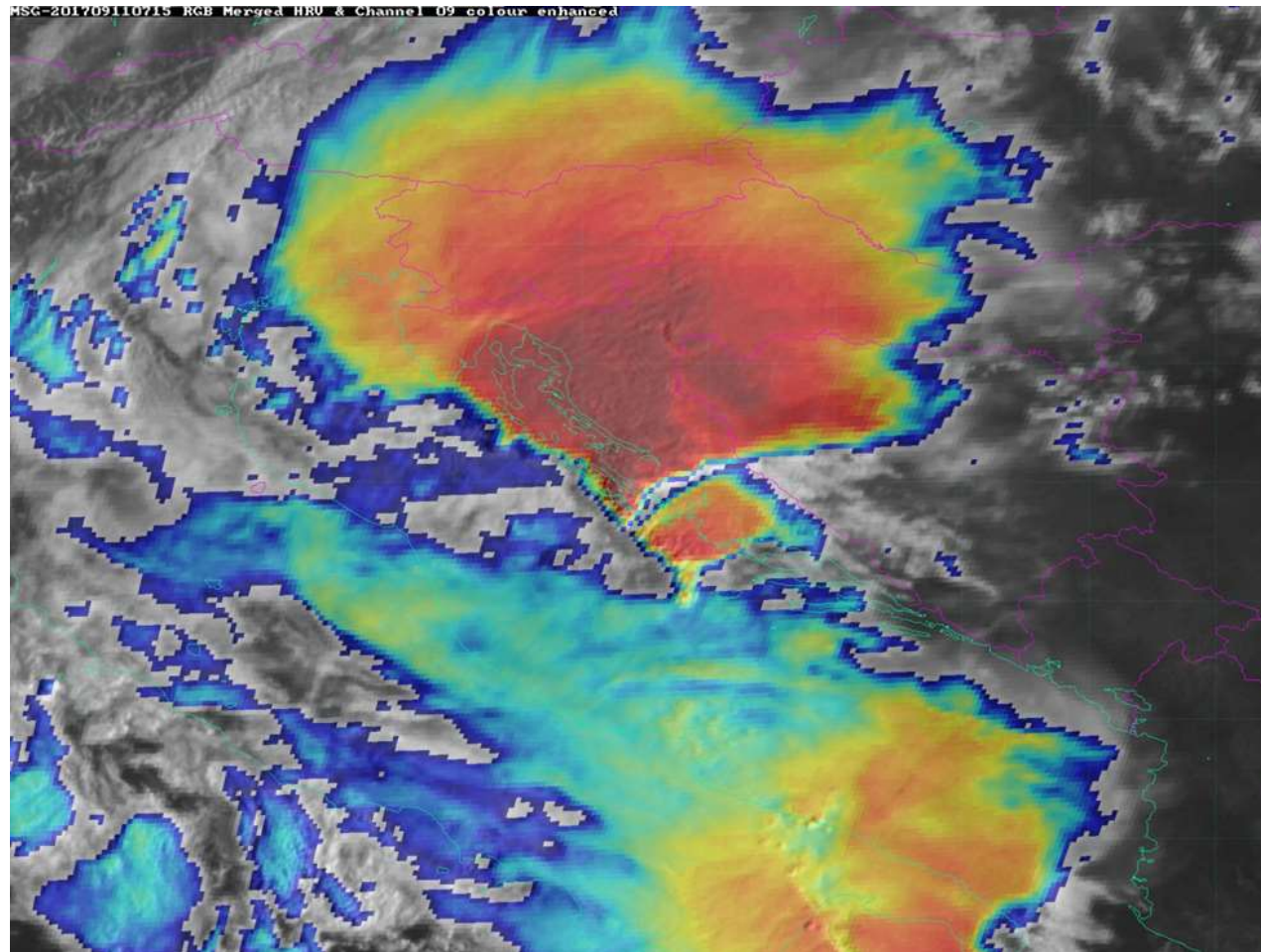
Satellite image: AIRMASS RGB

11 September, 2017 at 06 UTC

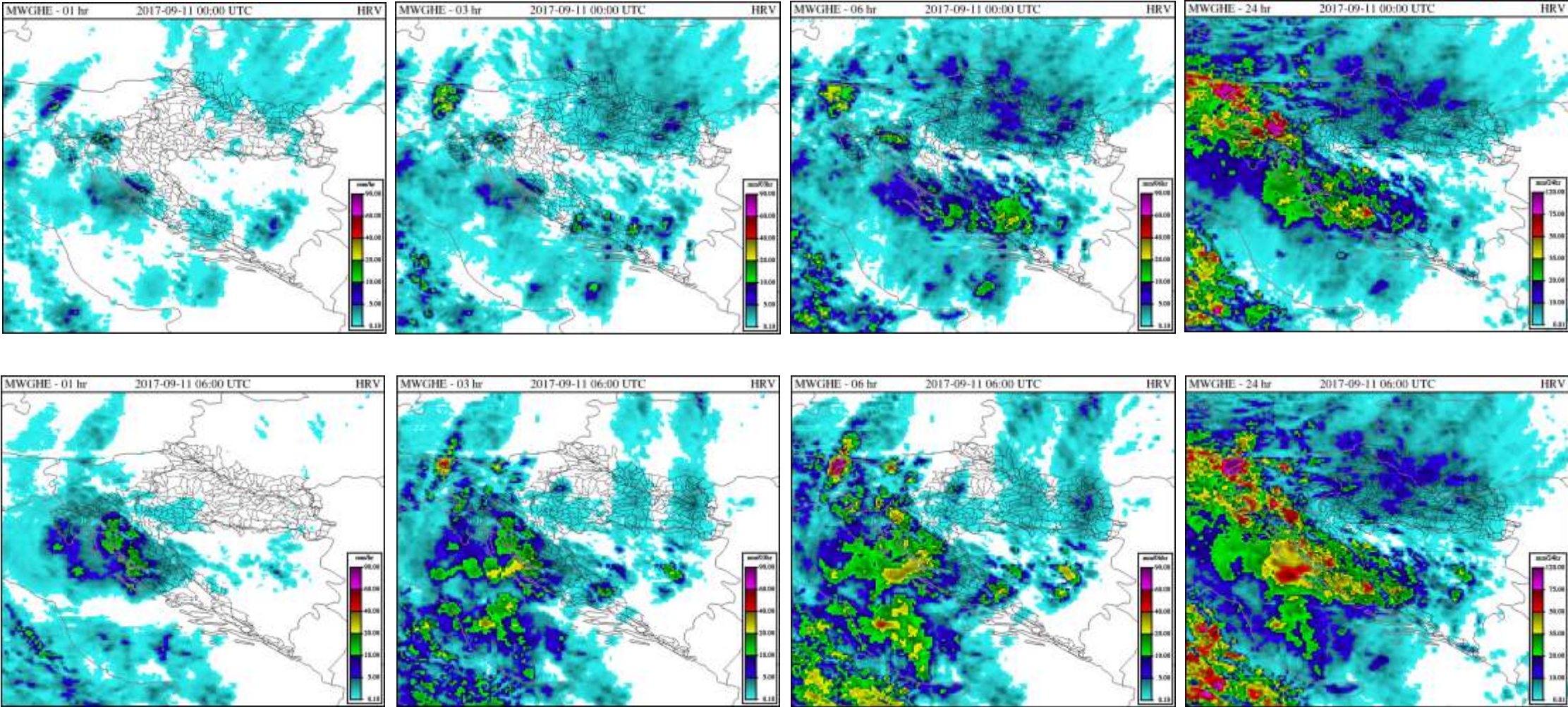


Satellite image: HRV and IR10.8 Color enhanced

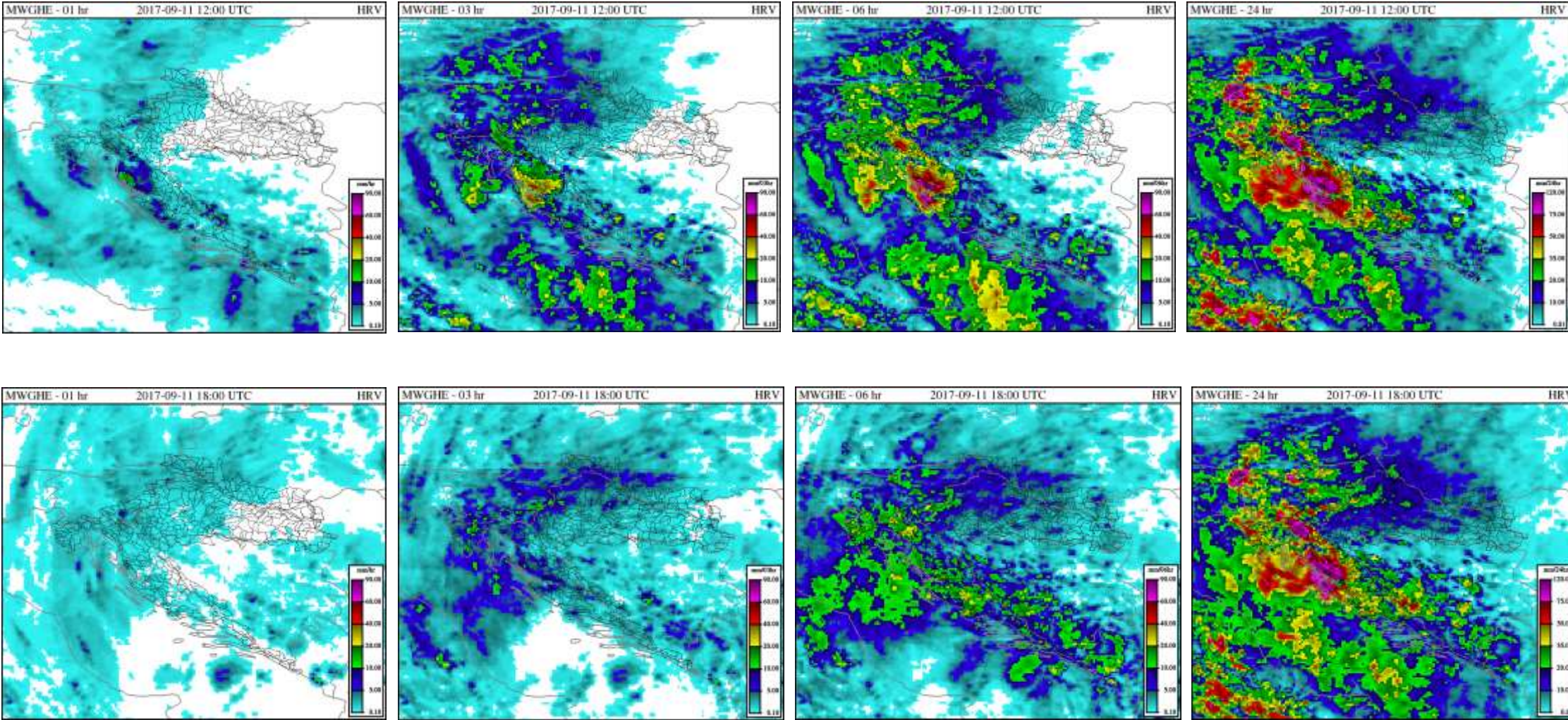
11 September, 2017 at 0715 UTC



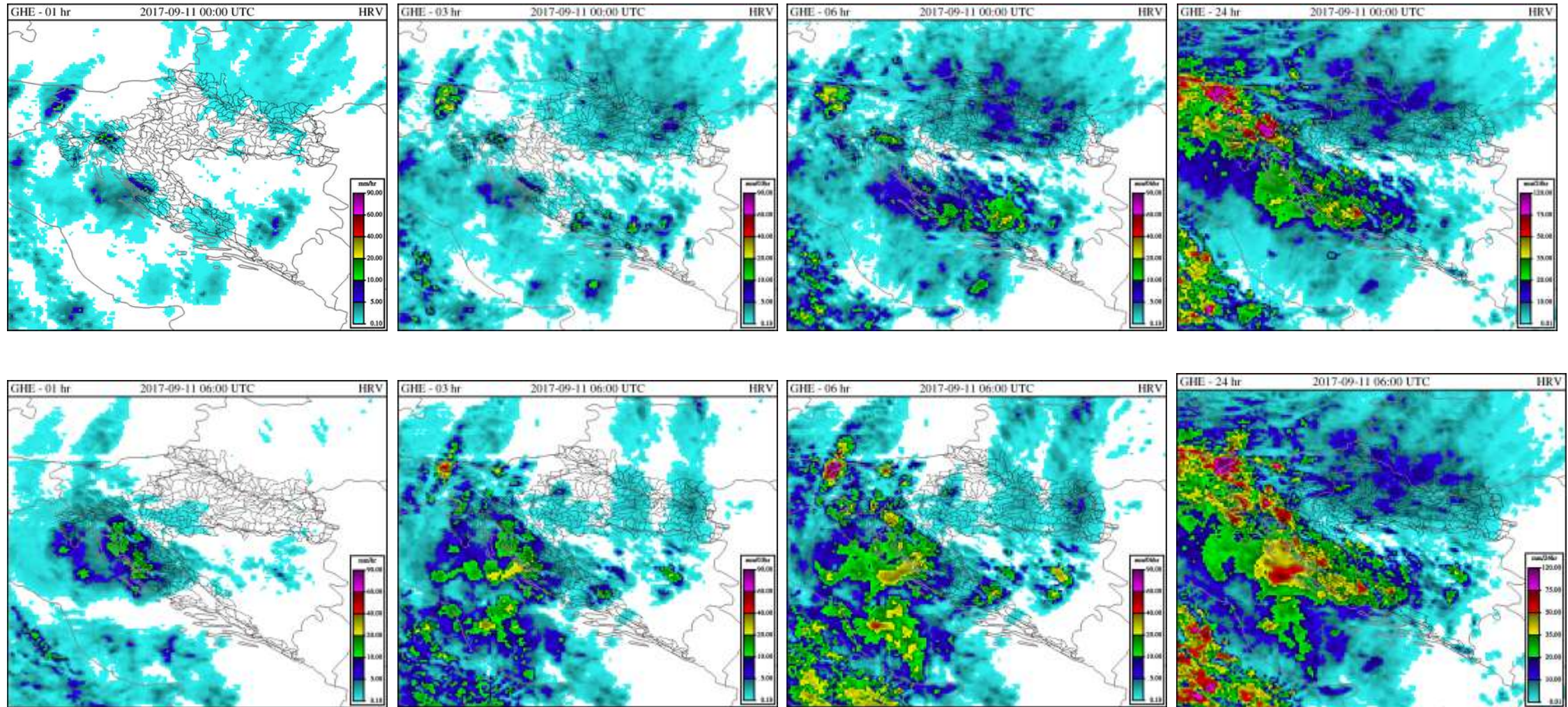
MWGHE Precipitation



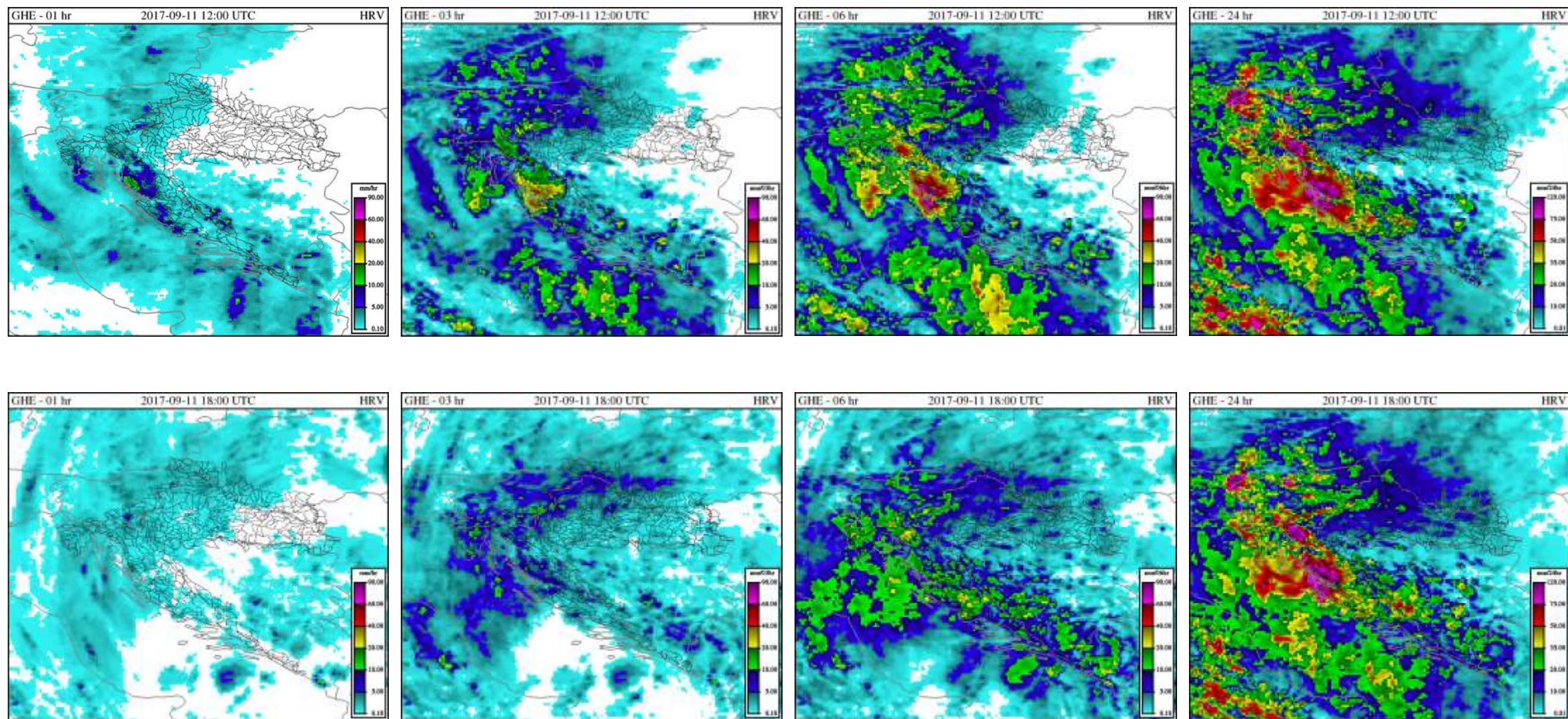
MWGHE Precipitation



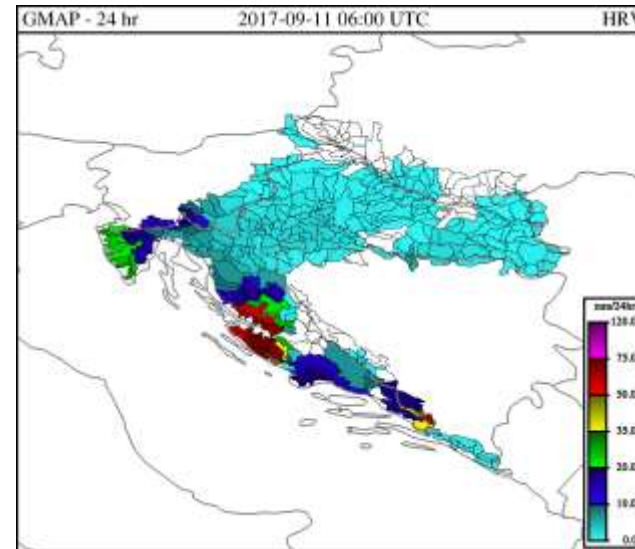
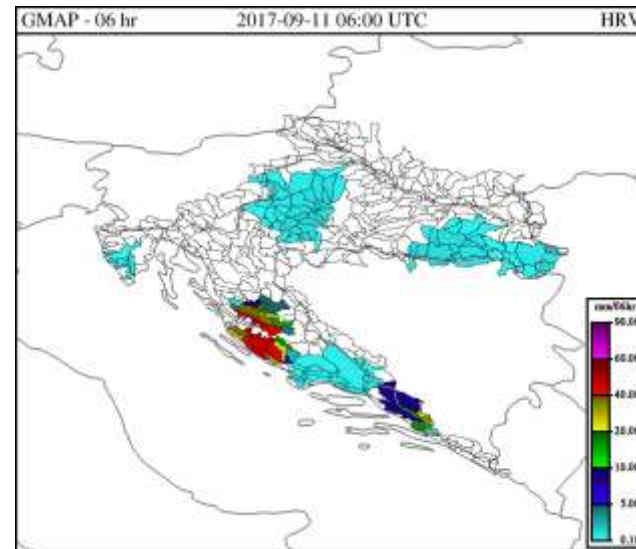
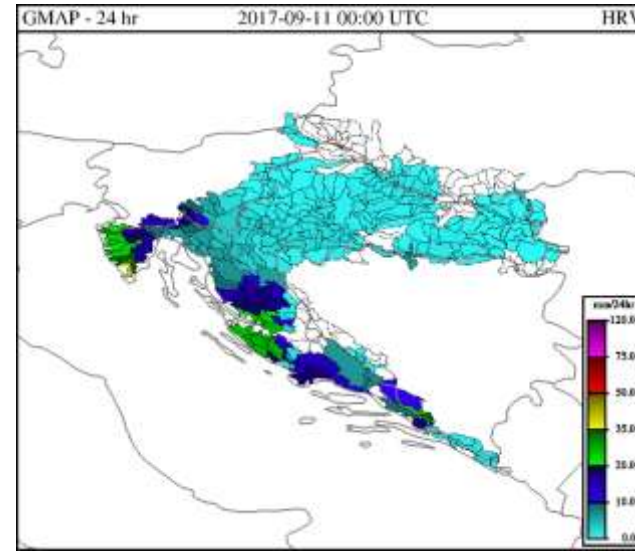
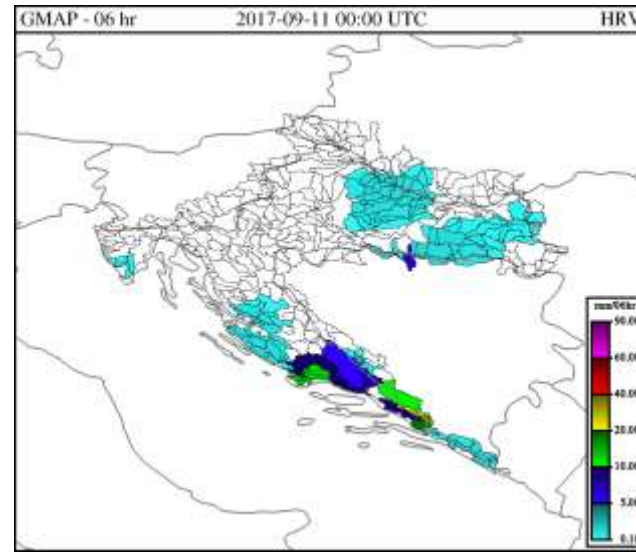
GHE Precipitation



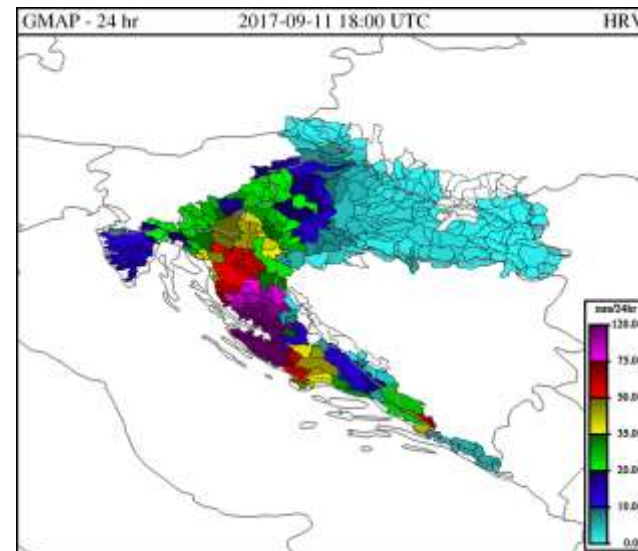
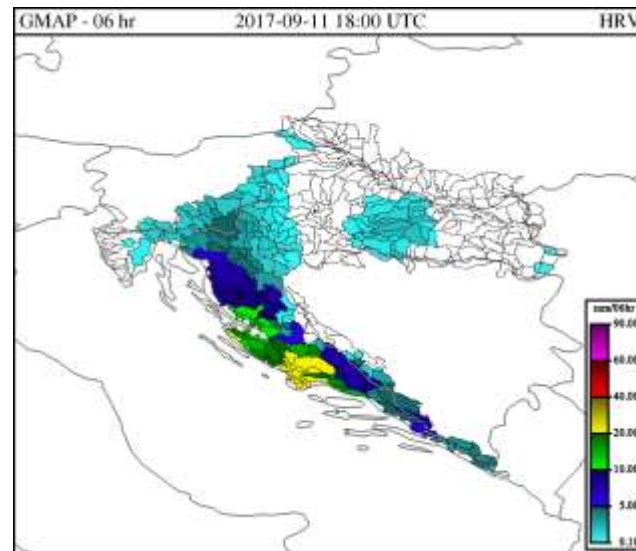
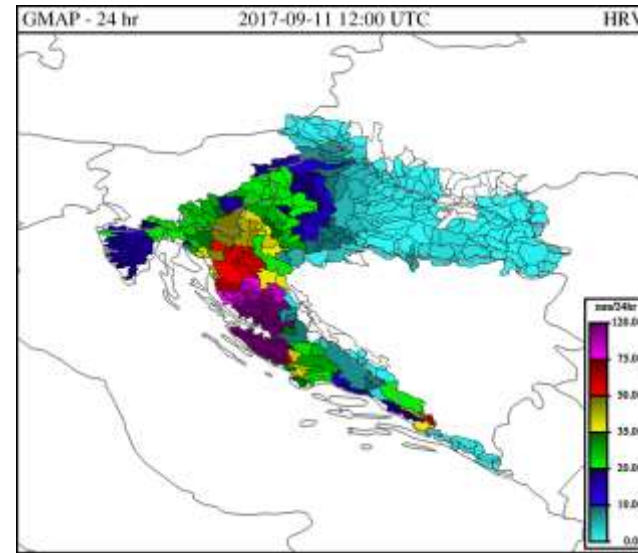
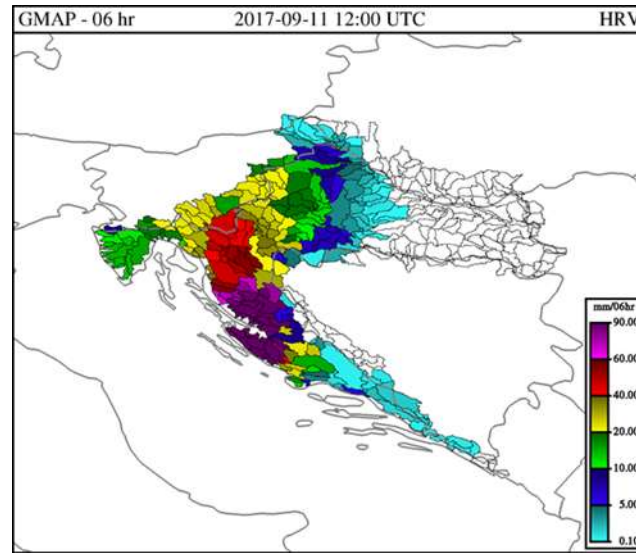
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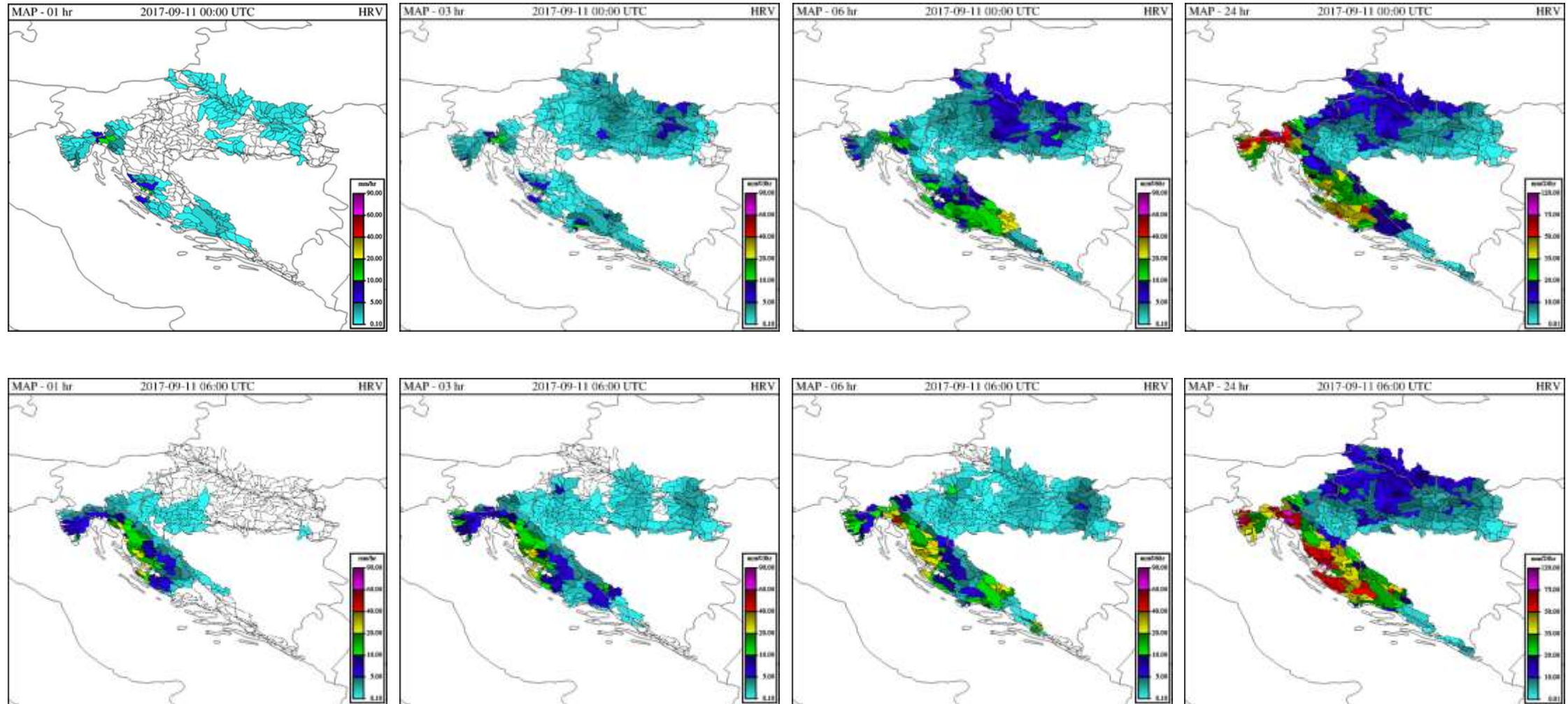
Gauge MAP



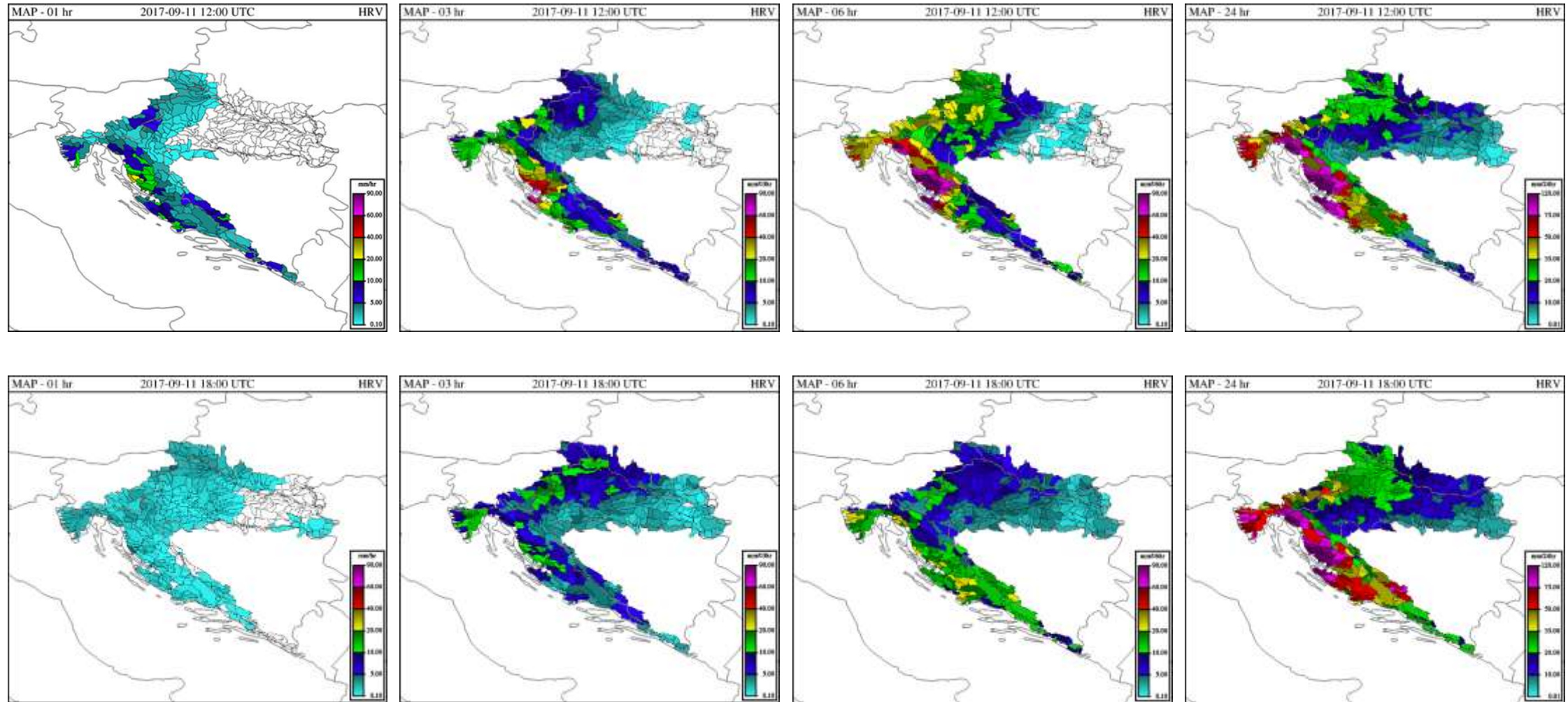
Gauge MAP



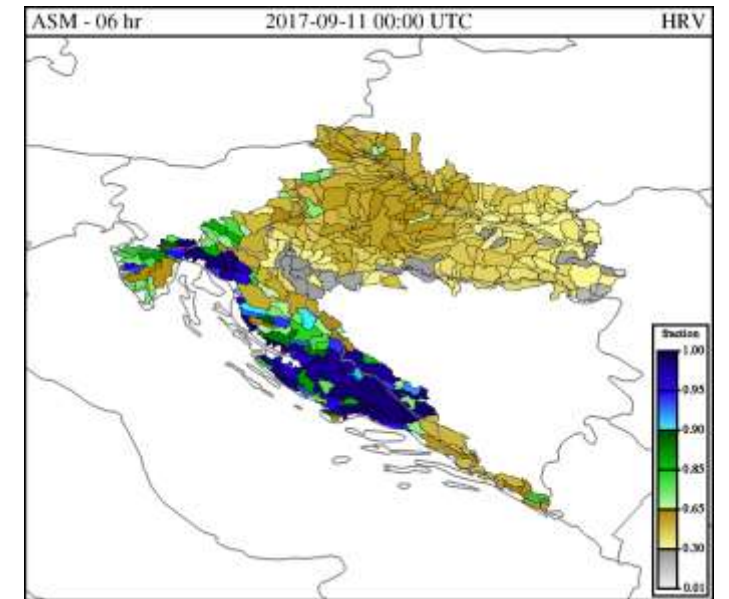
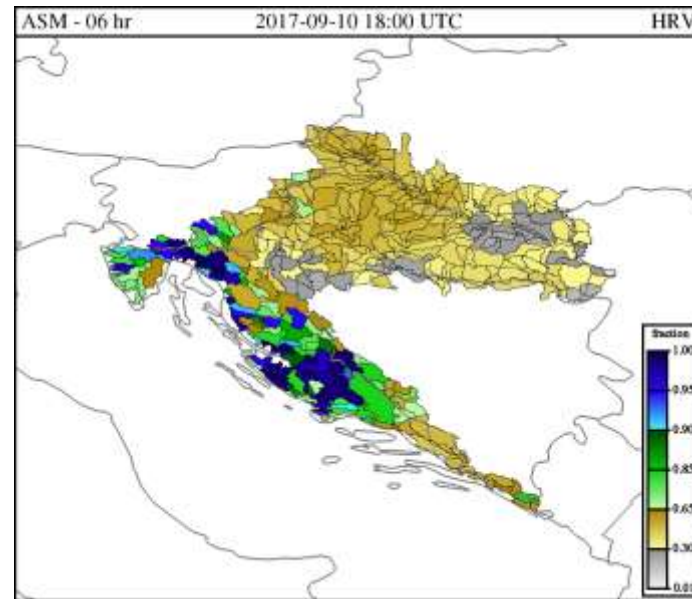
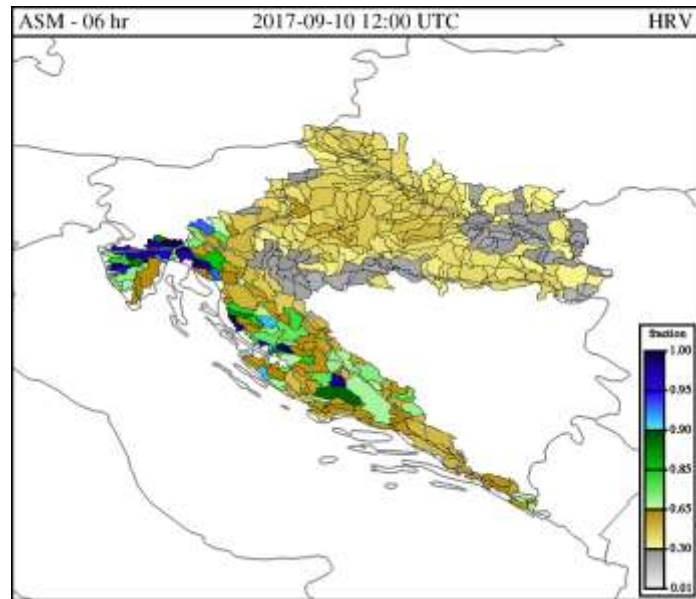
Merged MAP



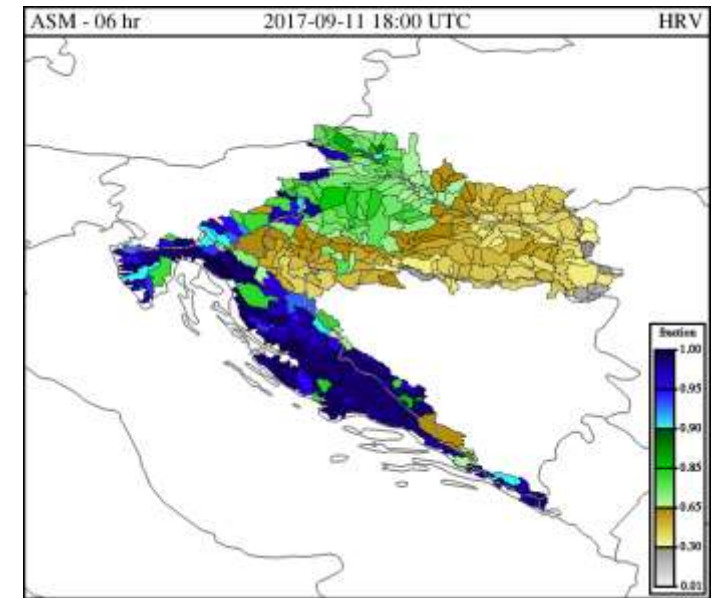
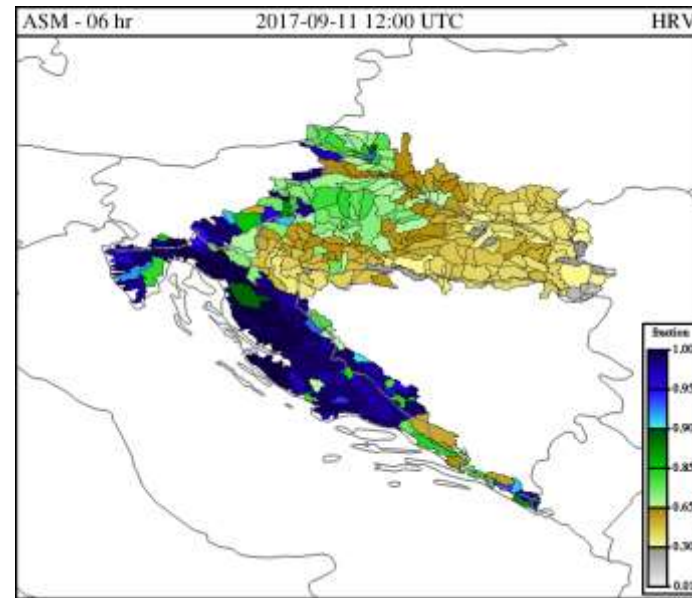
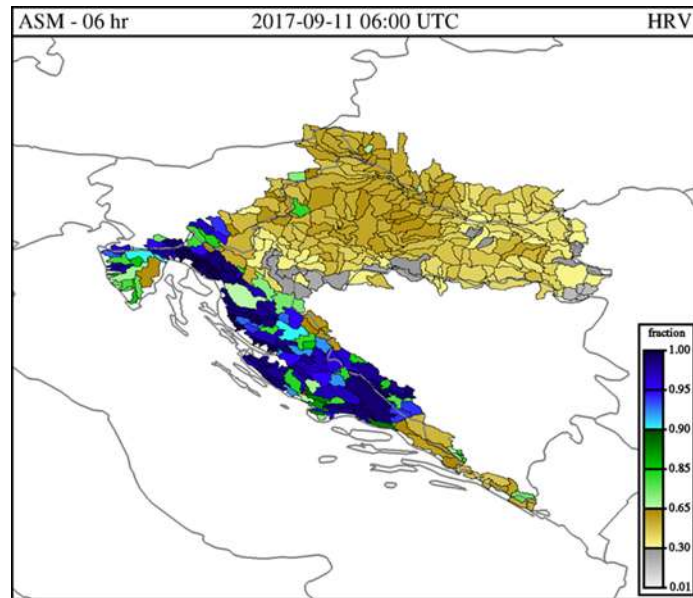
Merged MAP



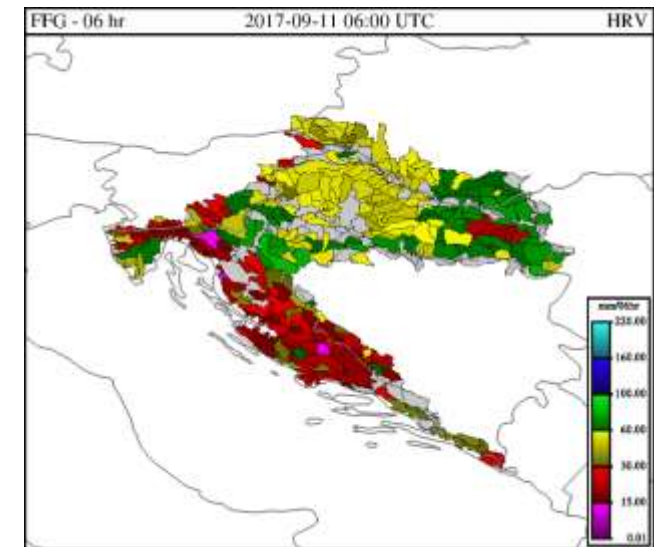
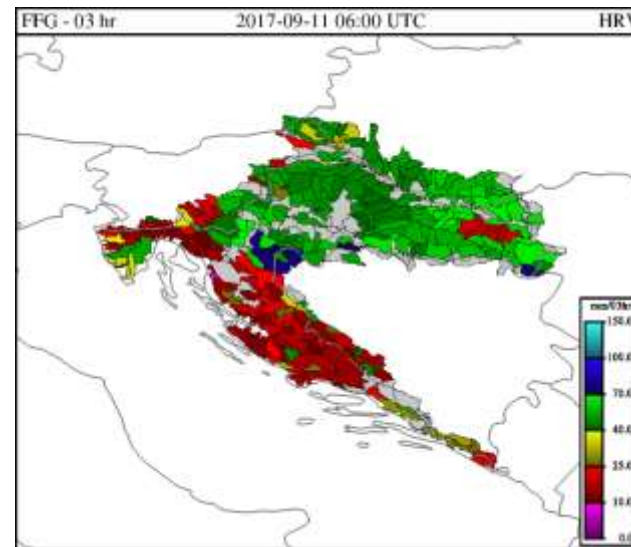
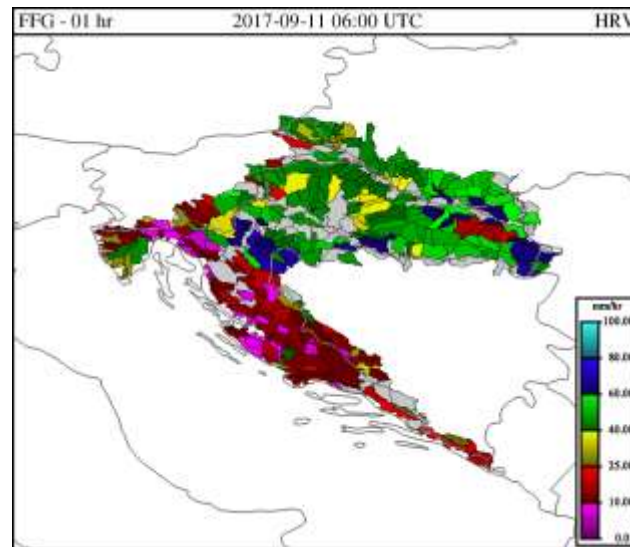
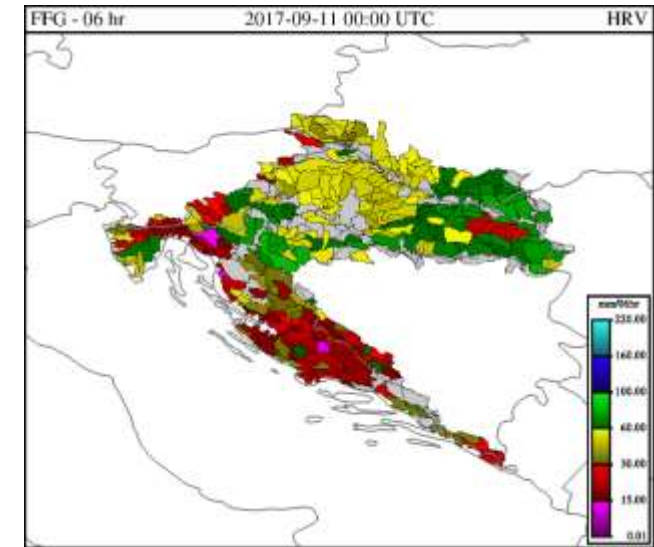
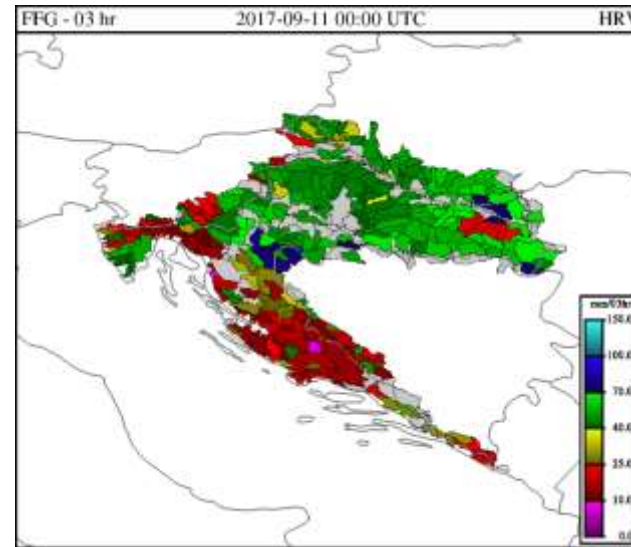
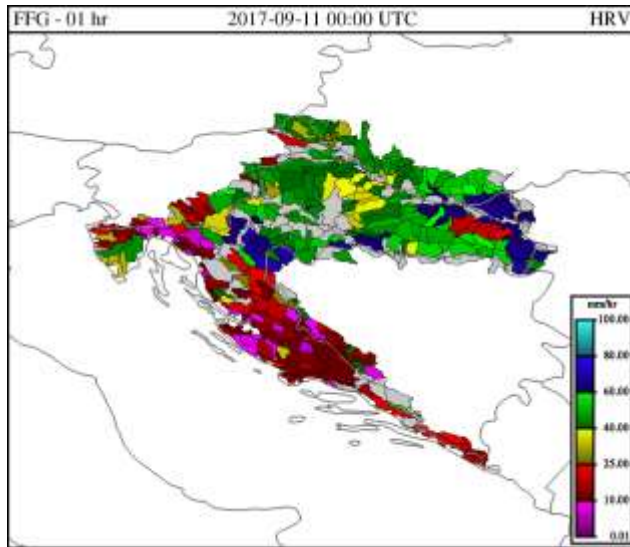
Average Soil Moisture (ASM)



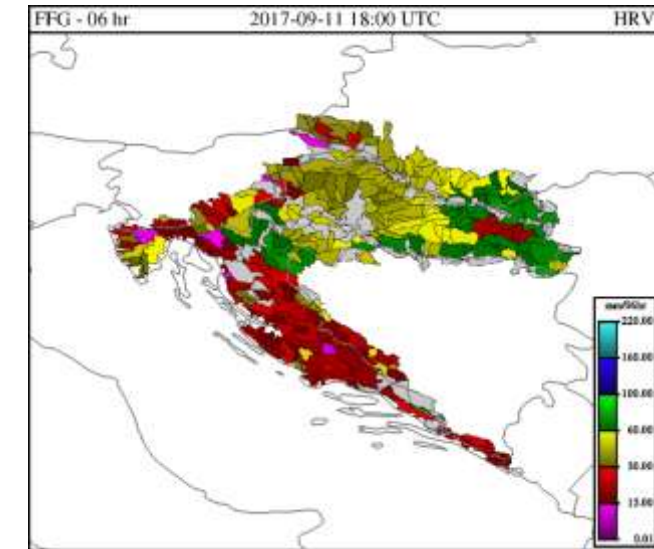
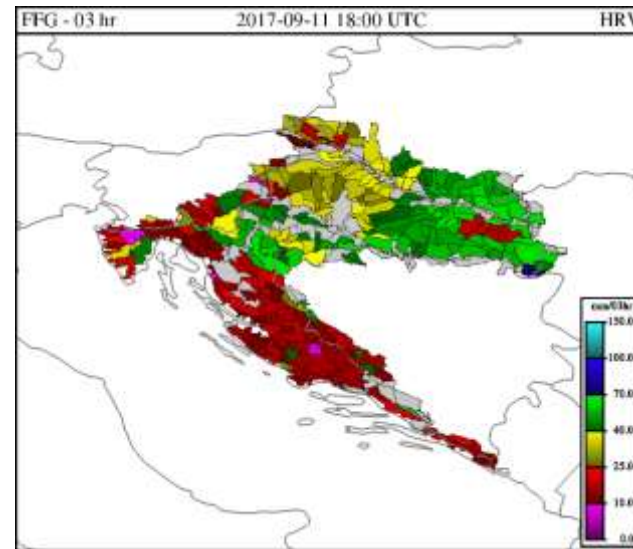
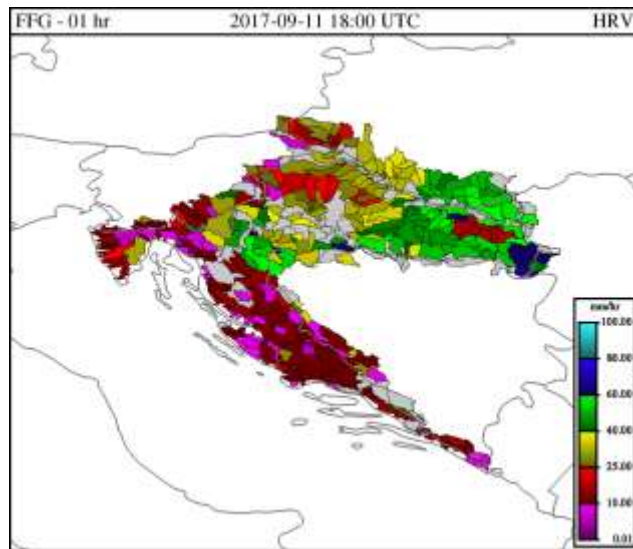
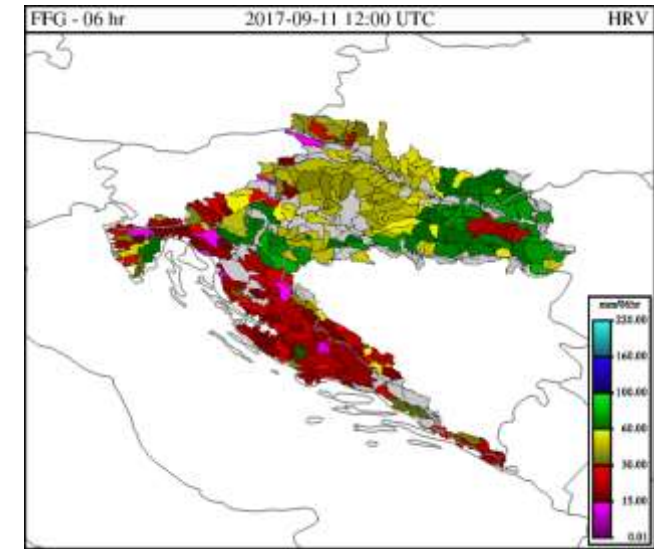
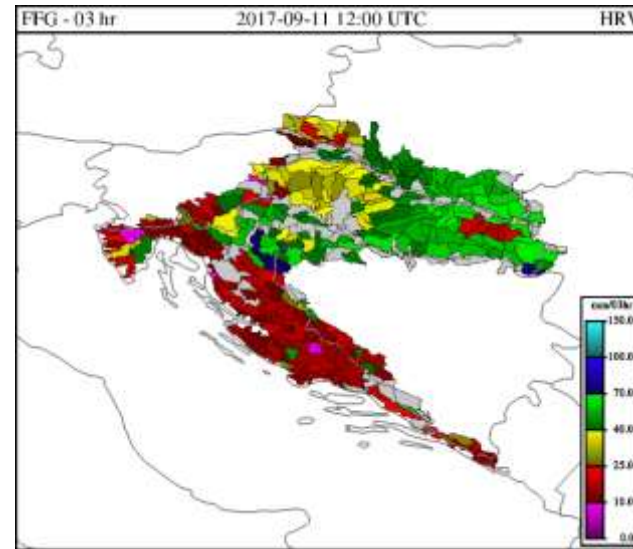
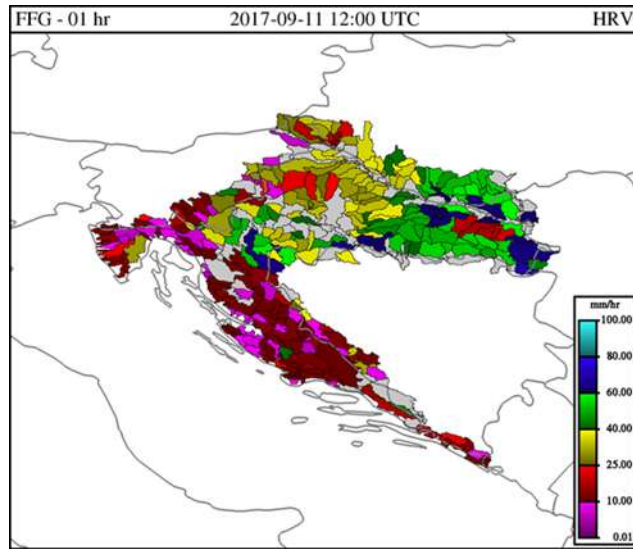
Average Soil Moisture (ASM)



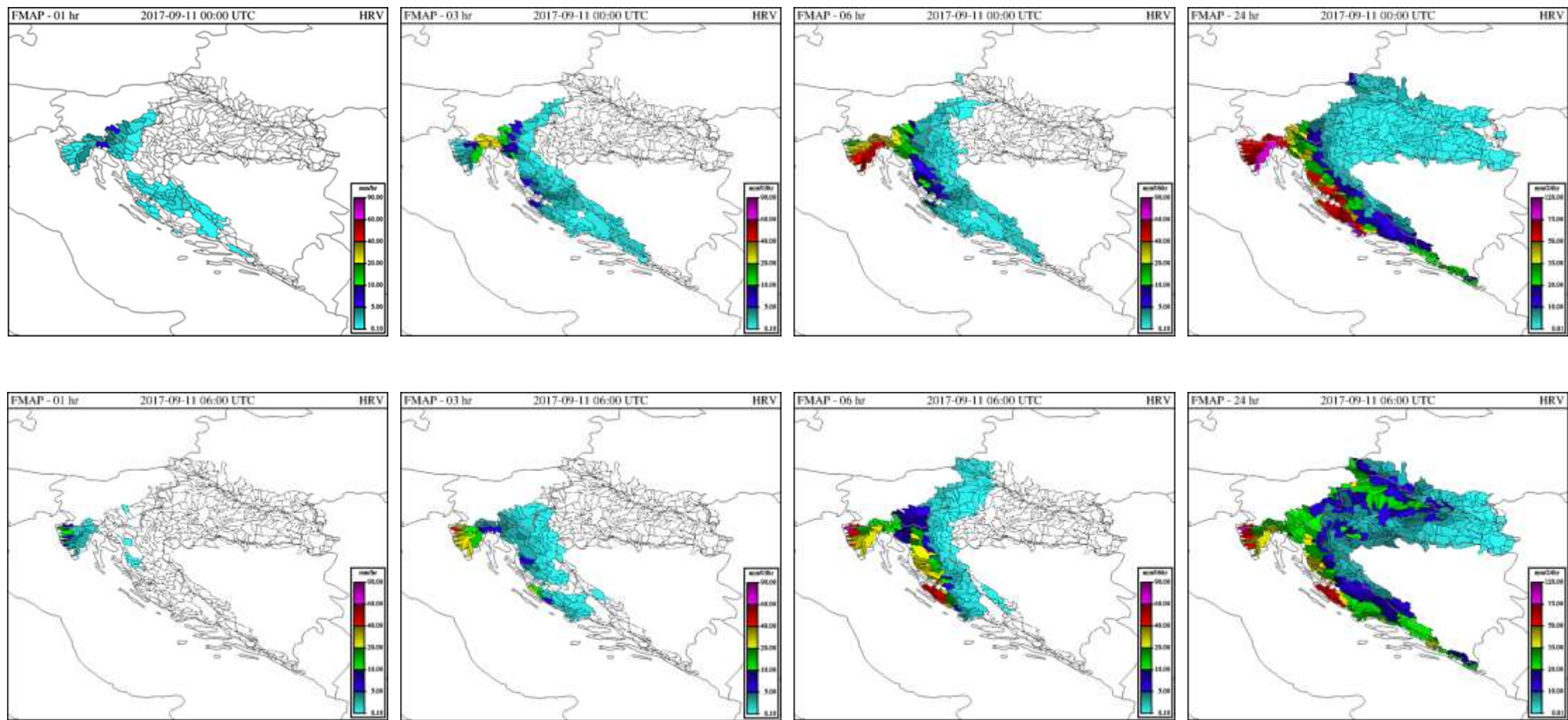
Flash Flood Guidance (FFG)



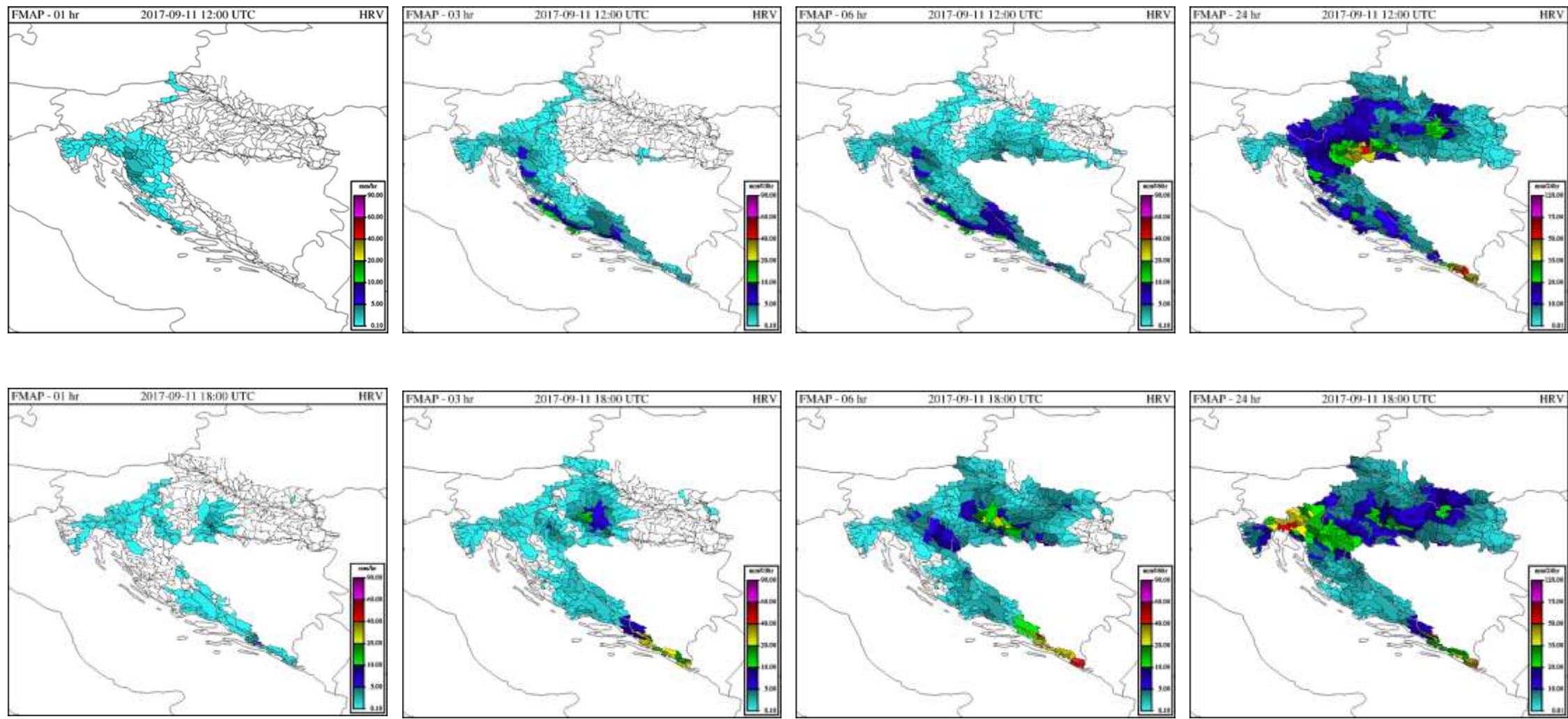
Flash Flood Guidance (FFG)



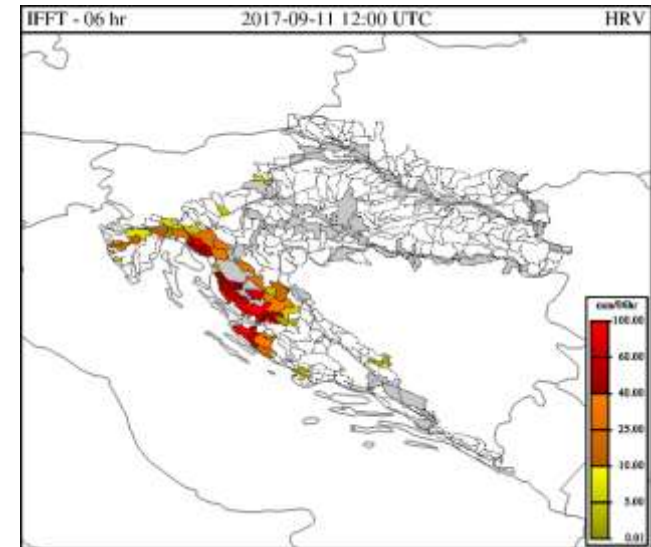
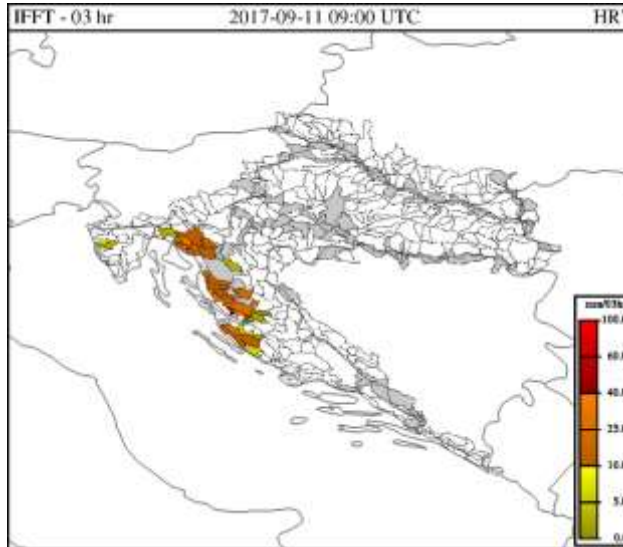
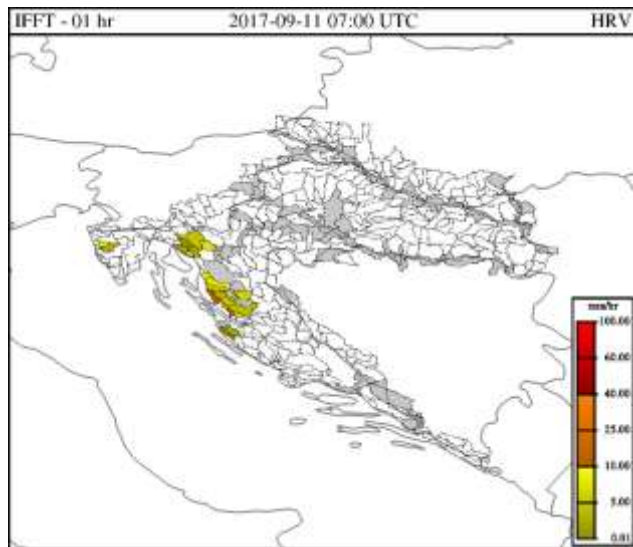
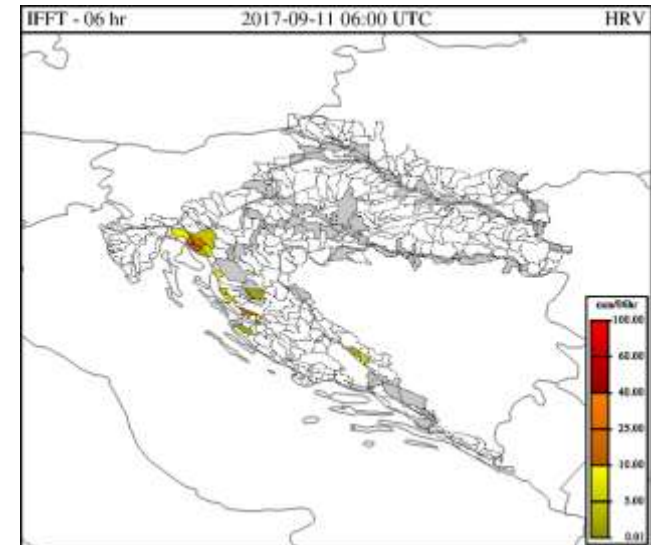
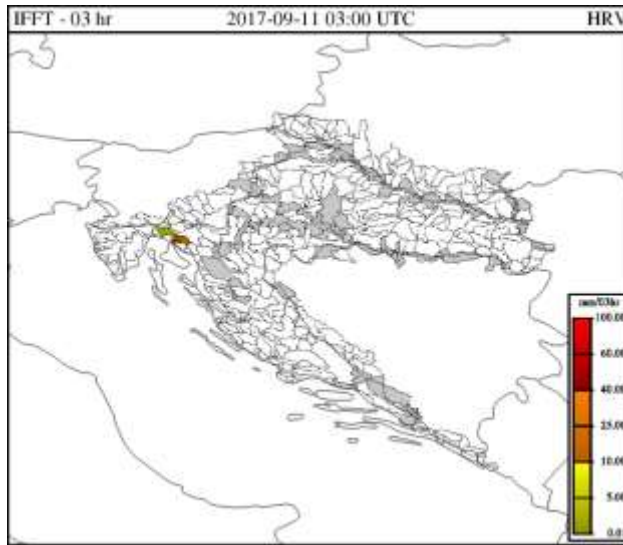
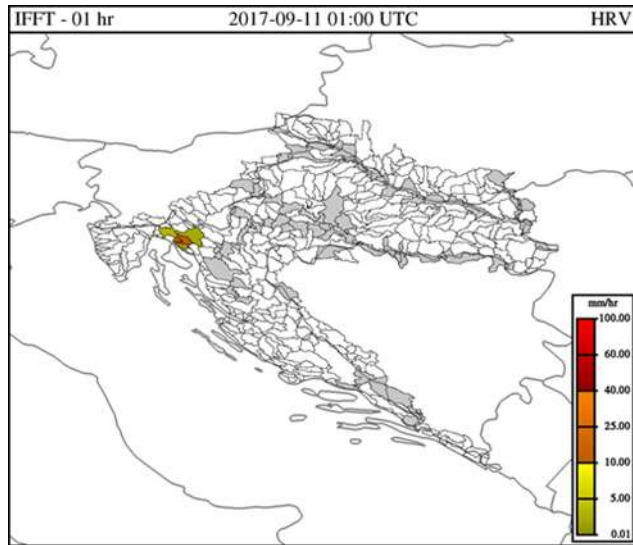
Forecast MAP (FMAP)



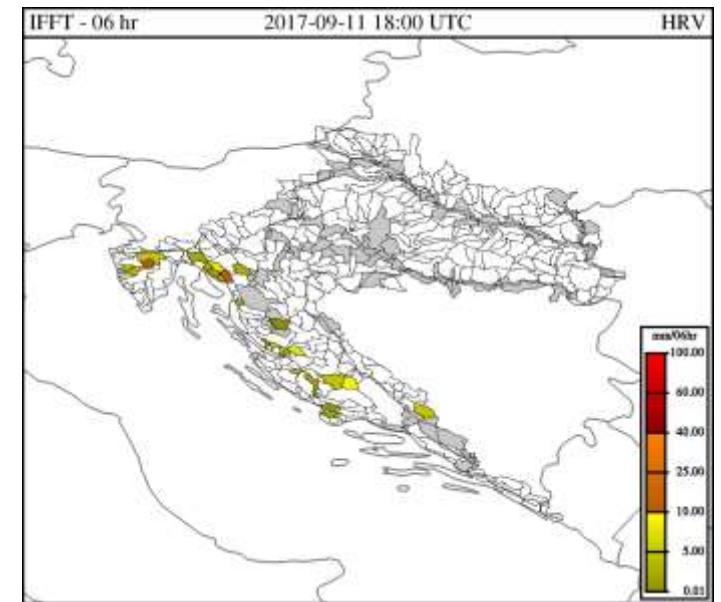
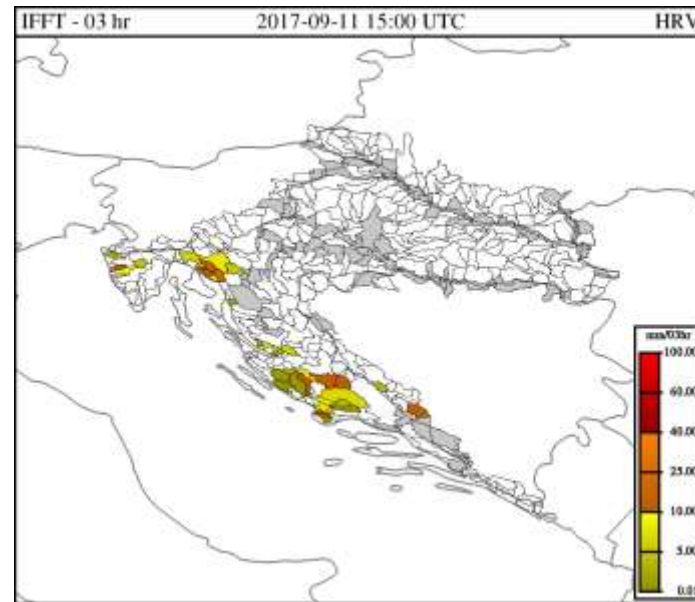
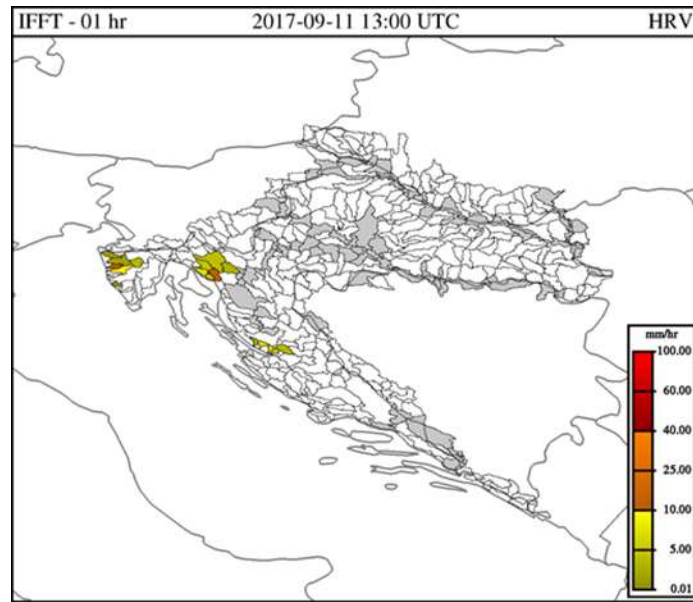
Forecast MAP (FMAP)



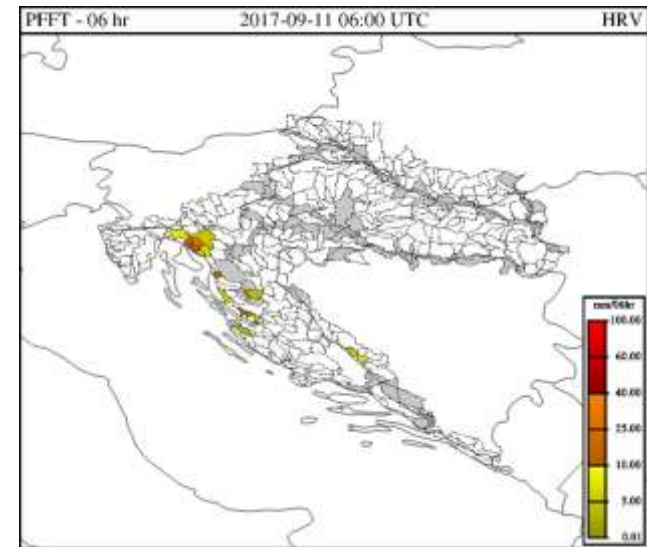
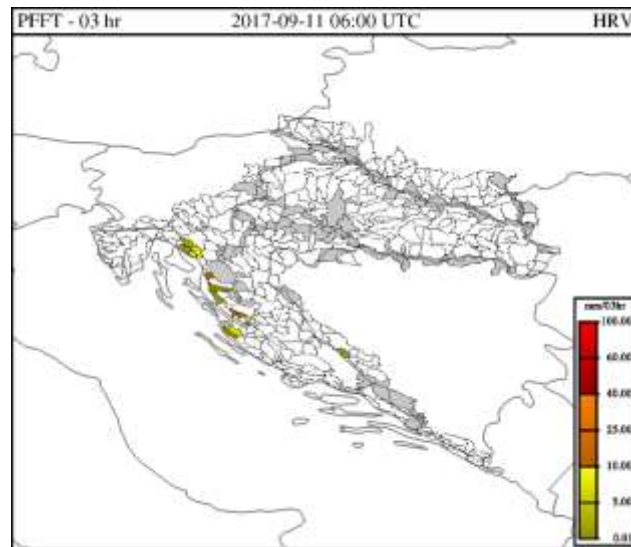
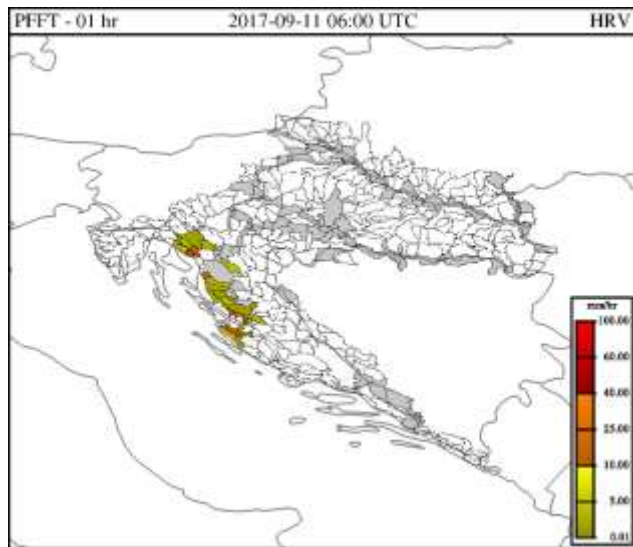
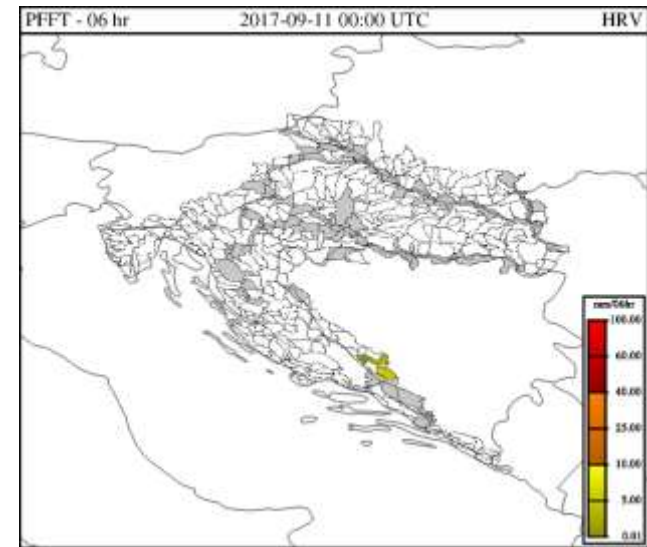
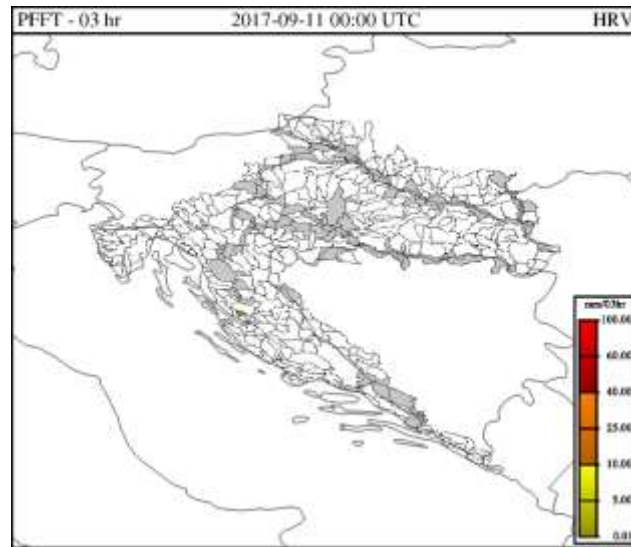
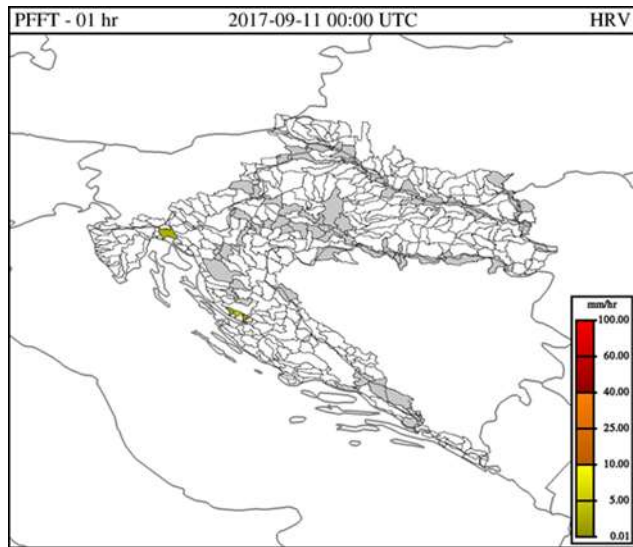
Imminent Flash Flood Threat (IFFT)



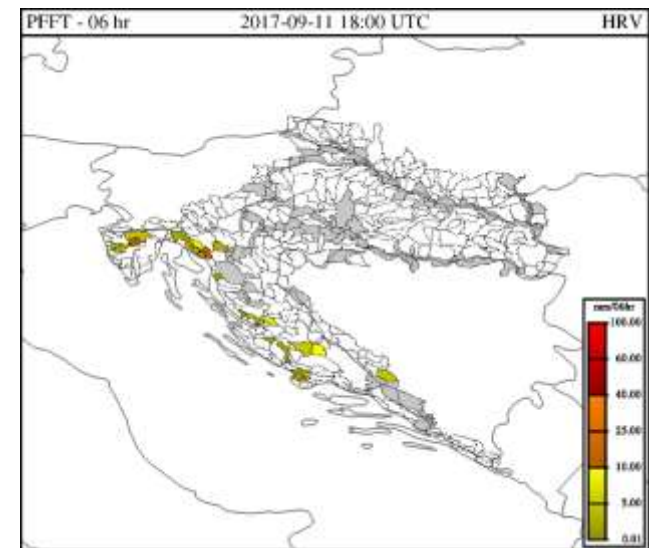
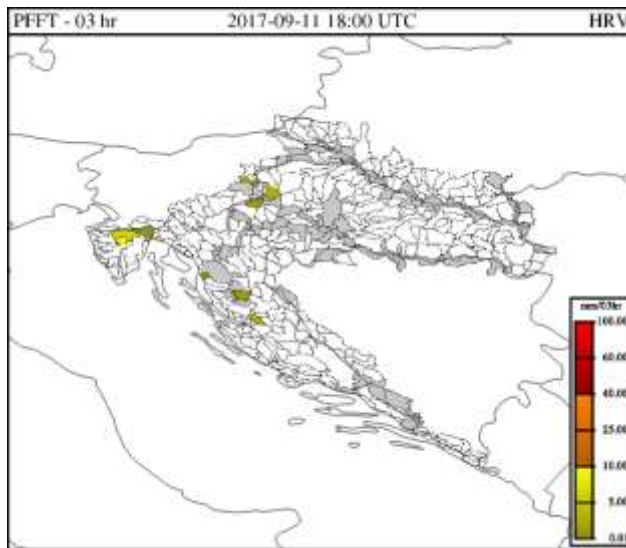
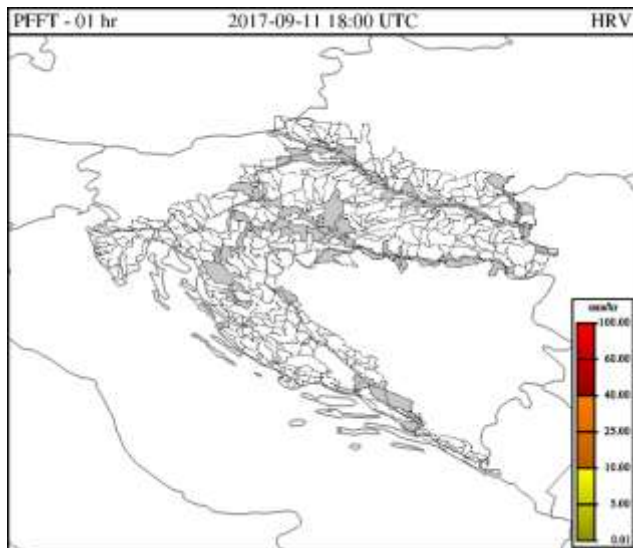
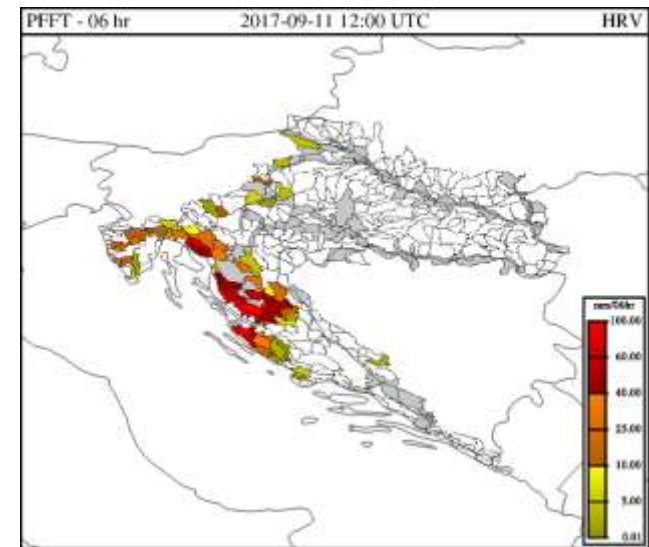
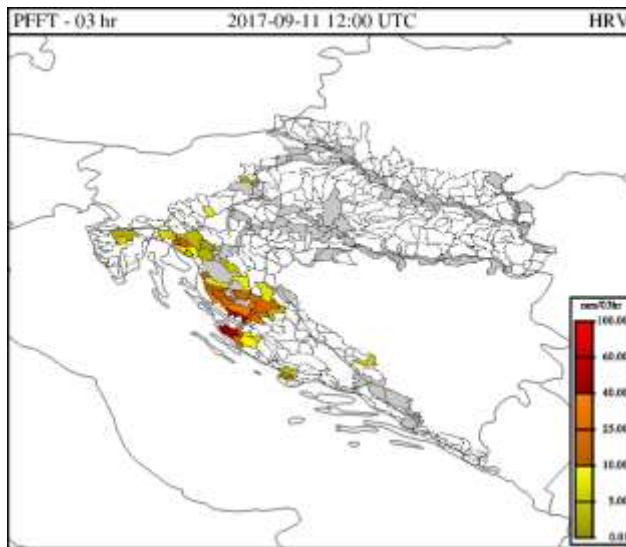
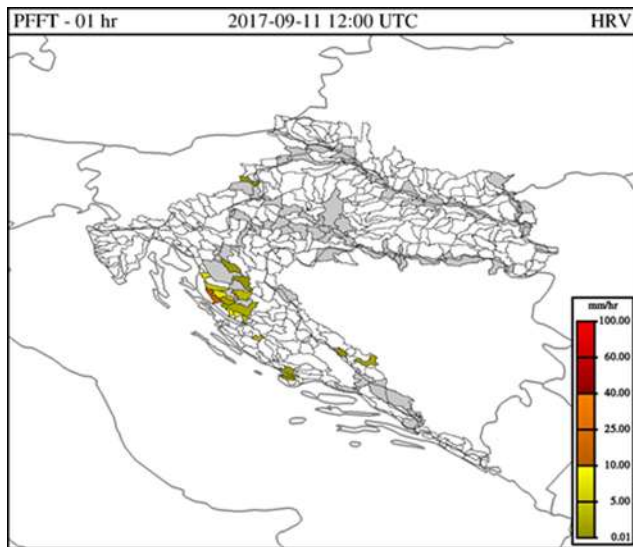
Imminent Flash Flood Threat (IFFT)



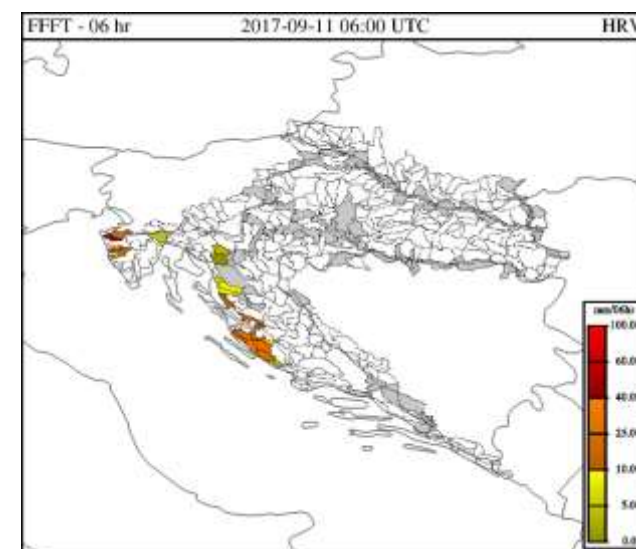
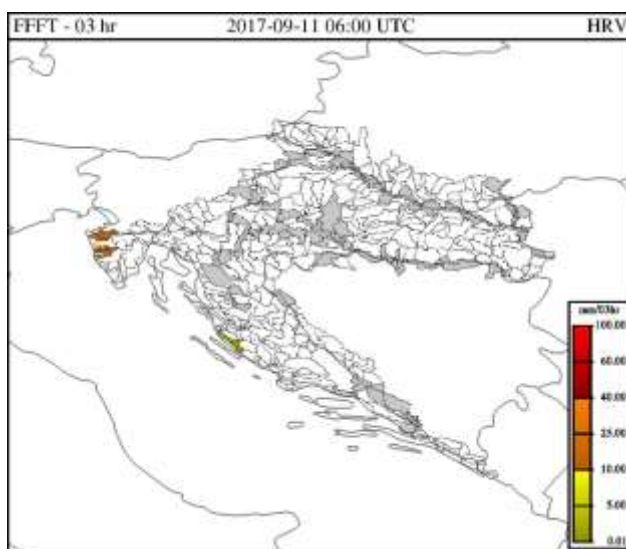
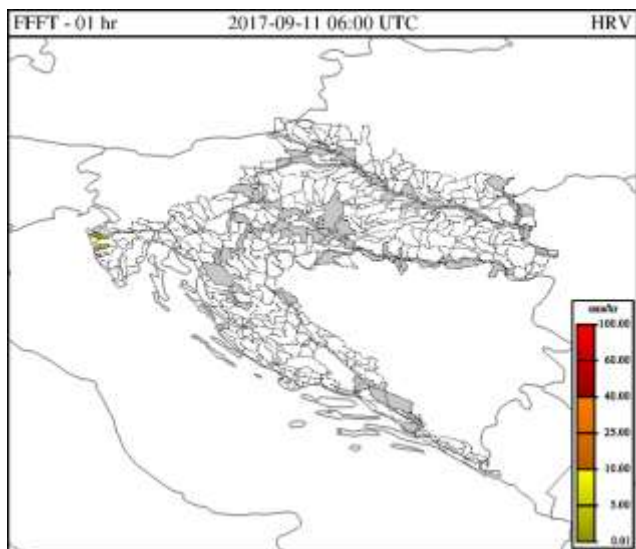
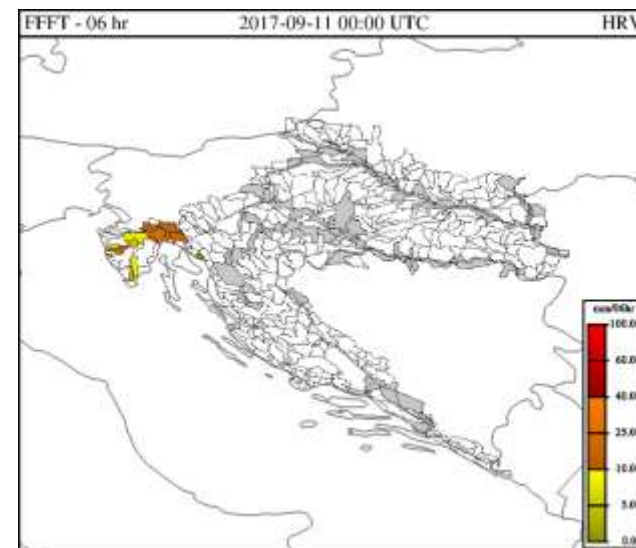
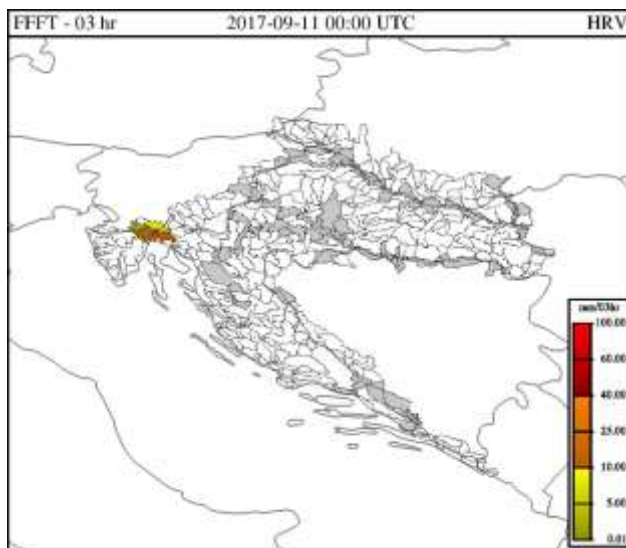
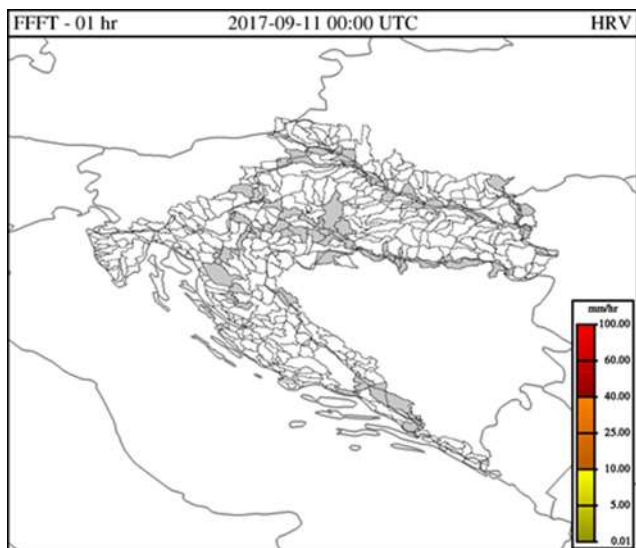
Persistent Flash Flood Threat (PFFT)



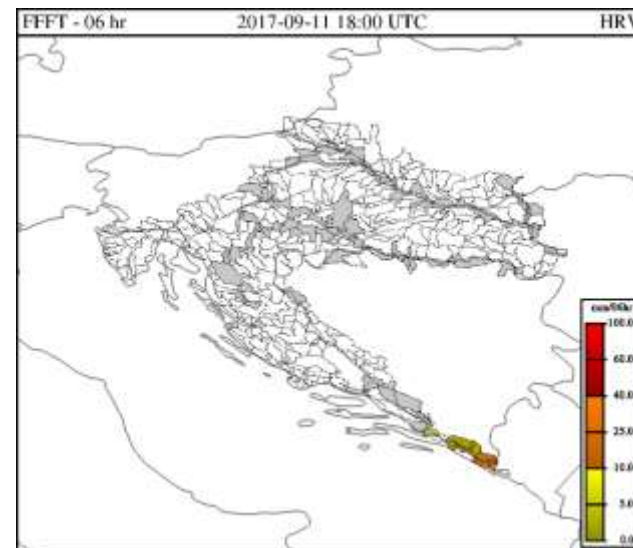
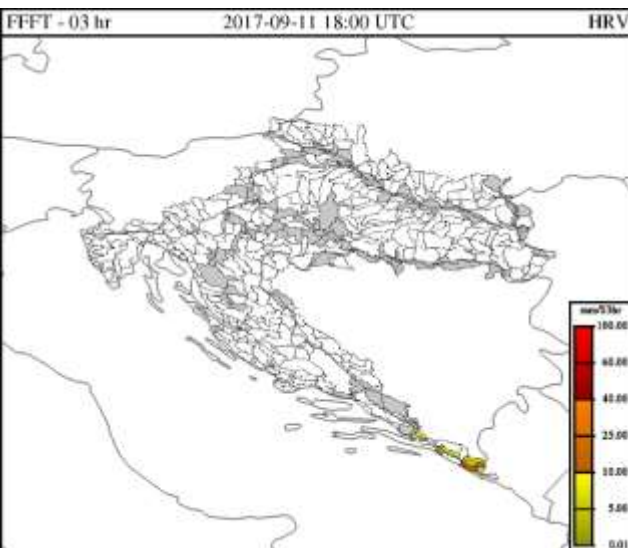
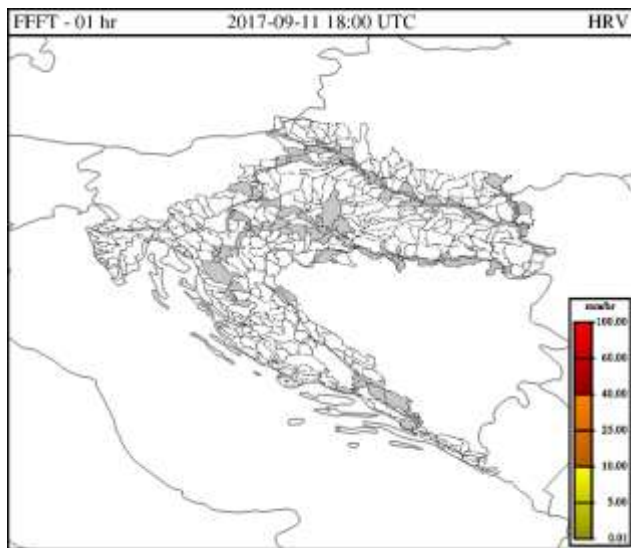
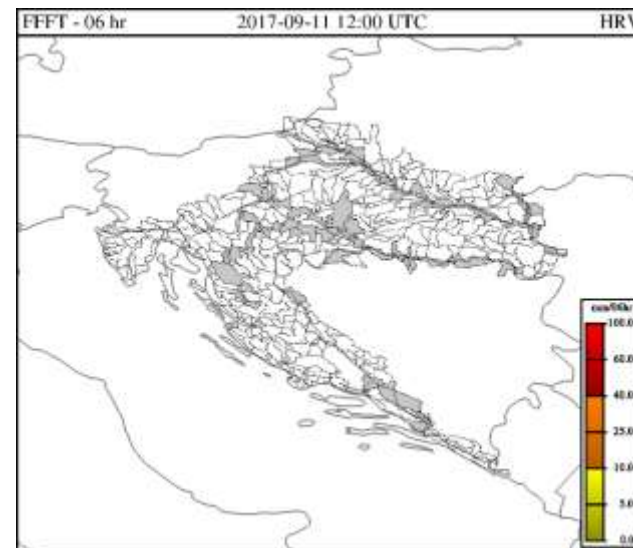
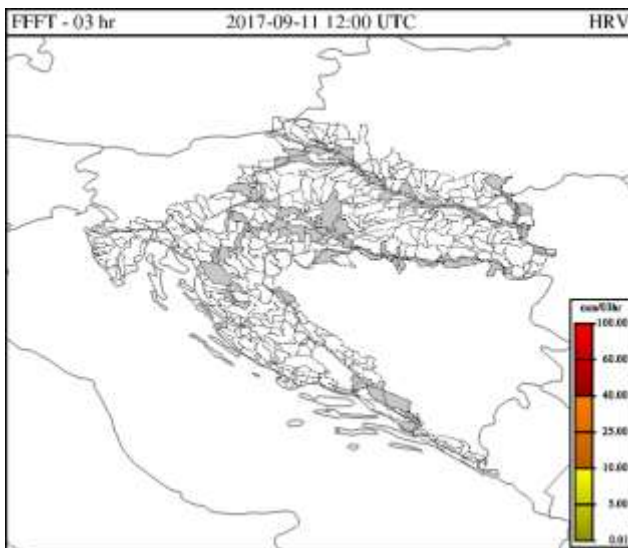
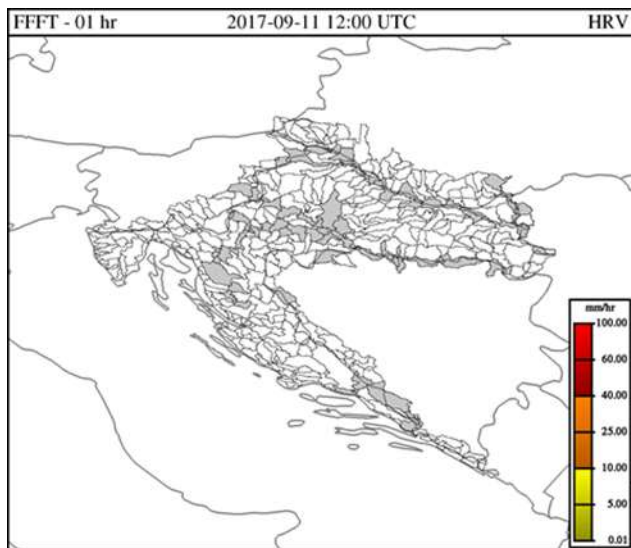
Persistent Flash Flood Threat (PFFT)



Forecast Flash Flood Threat (FFFT)



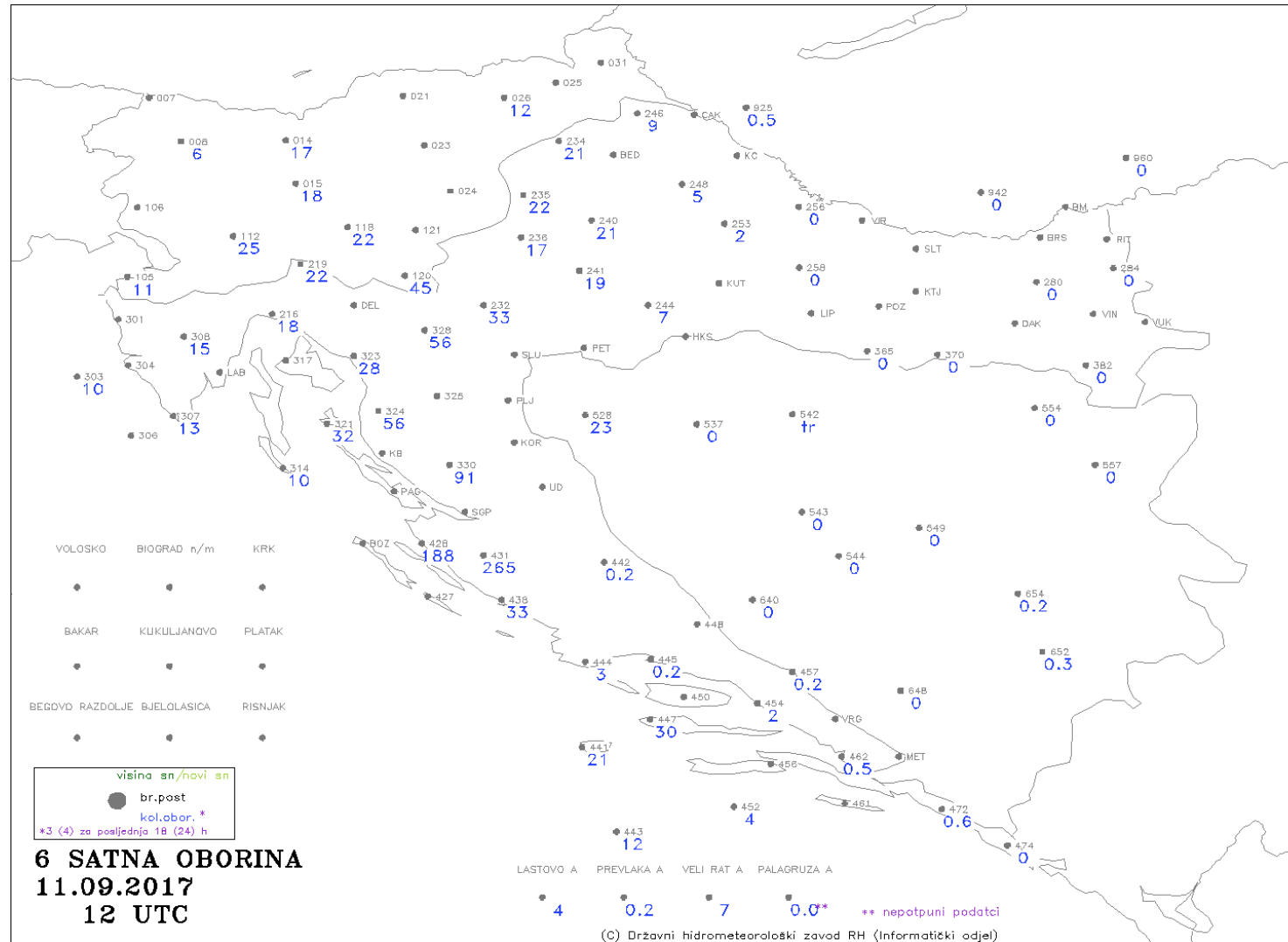
Forecast Flash Flood Threat (FFFT)



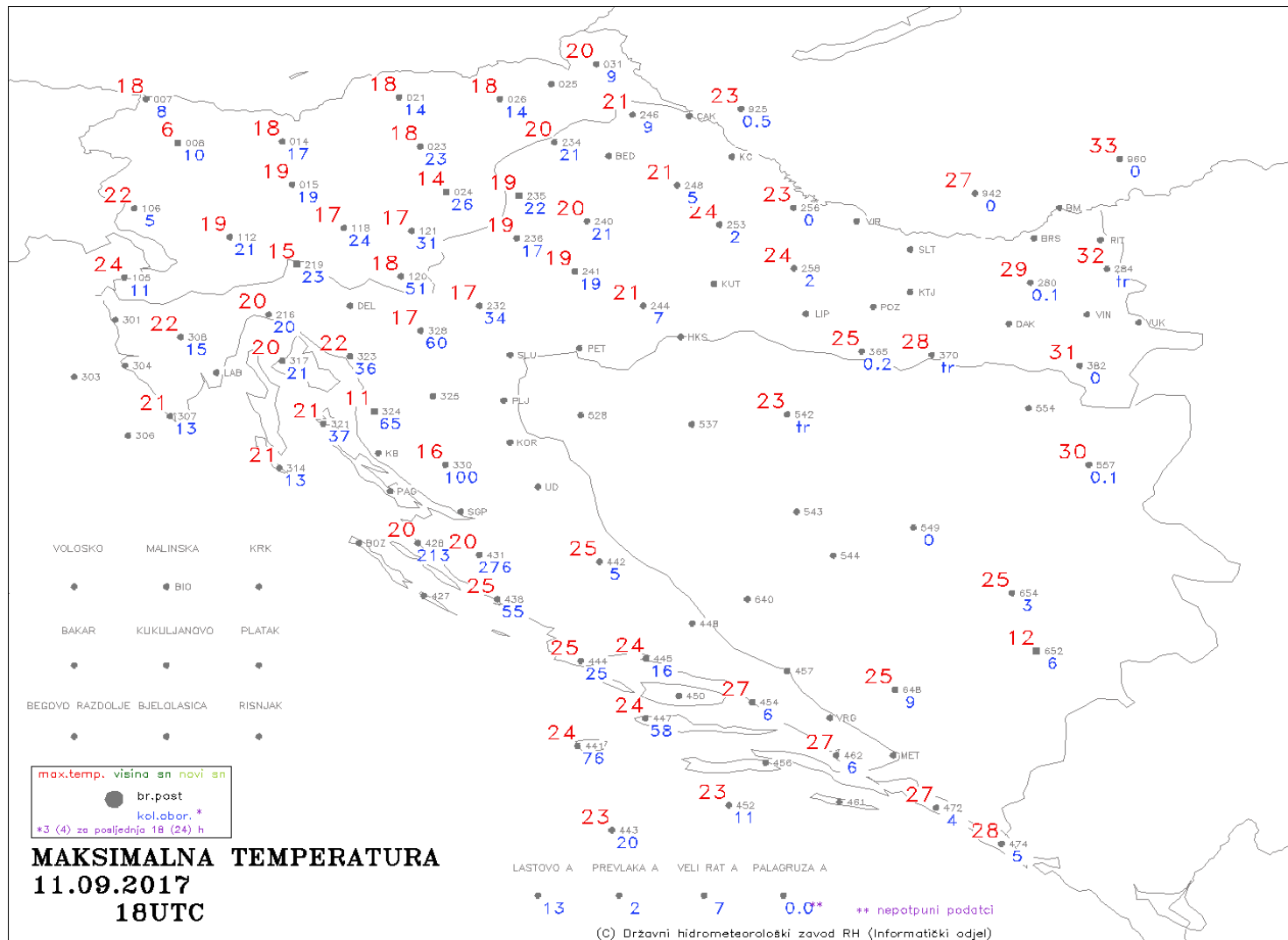
Warning!



6-hours precipitation amount



12-hours precipitation amount



Precipitation data

| 24-hours precipitation amounts (mm) | | | | |
|-------------------------------------|--------|--------|--------|-------|
| Meteo station | 10/09/ | 11/09/ | 12/09/ | total |
| Zadar | 91,9 | 213,4 | 8,6 | 313,9 |
| Zemunik | 74,2 | 279,6 | 11,8 | 365,6 |
| Bozava | 36,0 | 8,0 | 17,0 | 61,0 |
| Sibenik | 22,1 | 55,3 | 19,2 | 96,6 |
| Knin | 15,2 | 5,6 | 17,6 | 38,4 |
| Split Resnik | 19,4 | 25,0 | 17,1 | 61,5 |
| Split Marjan | 12,0 | 16,2 | 16,5 | 44,7 |
| Hvar | 43,8 | 57,9 | | 101,7 |
| Komiza | 12,7 | 76,7 | | 89,4 |
| Makarska | 29,4 | 24,1 | 17,0 | 70,5 |
| Imotski | 37,6 | 11,0 | 1,5 | 50,1 |
| Lastovo | 3,3 | 11,3 | | 14,6 |
| Mljet | 6,5 | 9,9 | 0,6 | 17,0 |
| Ploce | 21,2 | 21,0 | 4,7 | 46,9 |
| Metkovic | 46,0 | 44,0 | 24,0 | 114,0 |
| Dubrovnik | 0,9 | 36,2 | 13,9 | 51,0 |
| Cilipi | 1,4 | 11,0 | 2,6 | 15,0 |

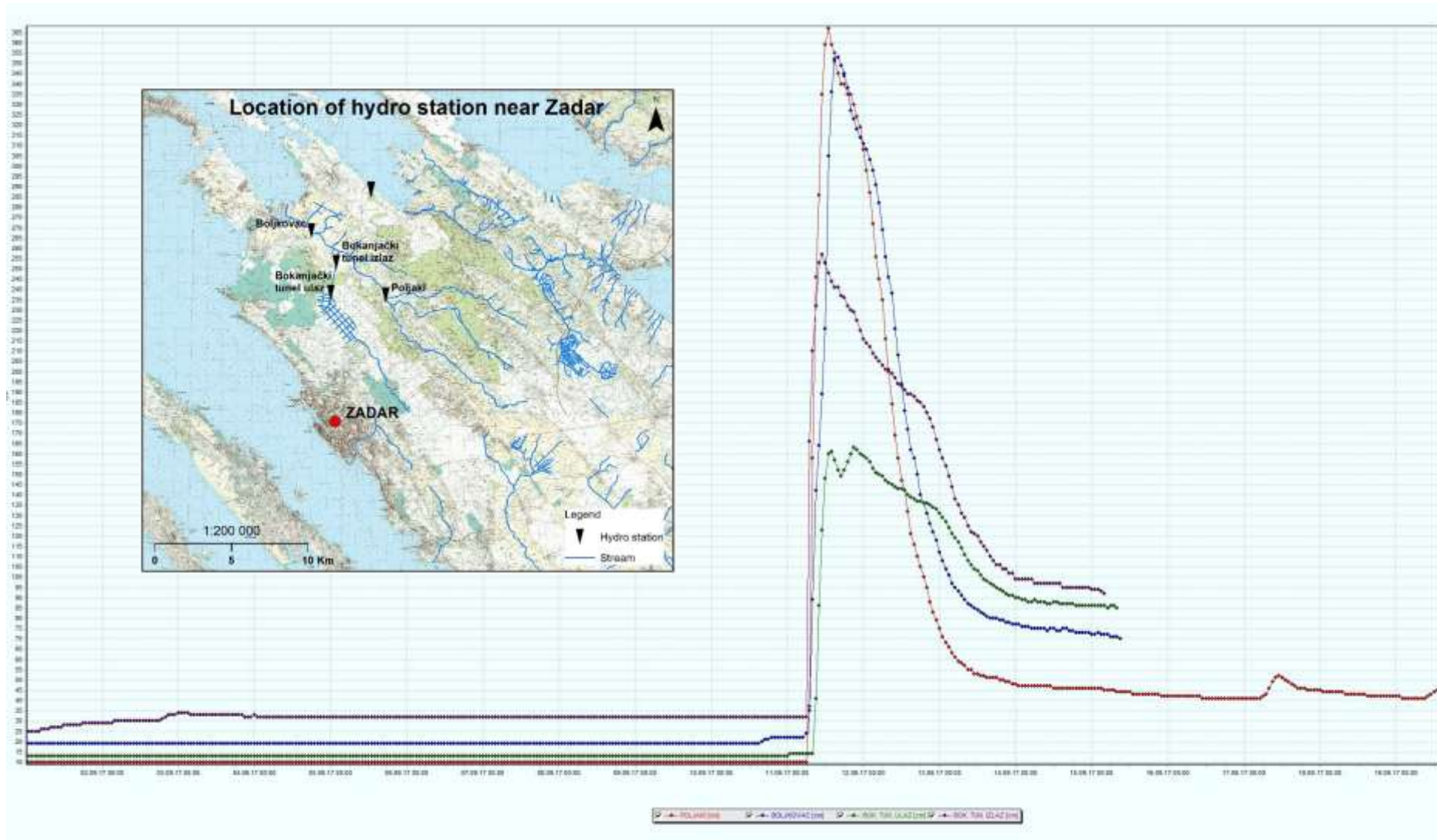


11 September, 1986 → 352.2 mm/24h

Monthly average amount: 105.5 mm

Maximum monthly amount: 374.5 mm
(1986)

Hydro station data



(Higra d.o.o. Split)

















Videos







Conclusion

- The SEFFGS was very valuable supplementary tool for forecasting flash floods events
- The short lead time is the biggest constraint to issuing flash flood warnings
- It is important for the forecasters of the national service to collaborate with Disaster Management Agency (DMA) of Croatia to prevent loss of life and minimize economic damages

Thank you for your attention

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