



6-hours maximum rain in Friuli Venezia Giulia: climatology and ECMWF-based forecasts

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Friuli Venezia Giulia (FVG) is an Italian region with very complex orography, comprising the northern Adriatic Sea on the south side and the Julian and Carnic Alps on the north side. The annual rainfall varies from about 900 mm on the coast to more than 3200 mm in the Julian Prealps. A network of 108 raingauges placed around the FVG territory has been analyzed to extract the absolute maximum rain accumulated every 6 hours (0-6, 6-12, 12-18 and 18-0 UTC) during the period between 15 February 2006 and 26 June 2013, finding a database of 10743 6h-cases. Fifty-four percent of these cases have a maximum accumulated rain lower than 1 mm, 22% of cases have at least 5 mm and 5% of all cases have more than 40 mm, while the maximum value observed in the database is 271.2 mm. The probability density function is well fitted by a simple exponential curve in the range between 10 and 100 mm.

Interannual, annual, weekly and daily cycles of three classes of rain ($1 \leq \text{MaxRain} < 5$, $5 \leq \text{MaxRain} < 40$ and $\text{MaxRain} > 40 \text{ mm}$) are analyzed, as well as the spectral density estimate (smoothed periodogram) of the 6h-maximum rain time series. In particular, it is found that the significant rainfall ($5 \leq \text{MaxRain} < 40$) is more frequent in the May-to-mid August period, while the strongest rainfall ($> 40 \text{ mm}$) are more probable between May and the beginning of December, with a peak at the very beginning of November.

ECMWF 6h forecasts at 18 locations (spaced at 0.25 deg) above the FVG region have been analyzed for the same period, to find the maximum 6h rain forecasted by the ECMWF model from +6 to +48 hours of time lag. The linear correlation between the ECMWF "direct model output" maximum rain and the observed maximum rain by the 108 raingauges has been investigated. It is found that the correlation coefficients R is larger at 00-06 UTC (about 0.75 at +6 and +30 lead time) and minimum at 18-00 UTC (0.67 at +24 and 0.64 at +48). On the other hand, the ratio of the SD between forecast and observation is as low as 0.28 at 12-18 UTC and reaches its maximum of only 0.34 at 06-12 UTC (+6). The bias is always negative, varying between -3.4 and -6.6 mm.

In a more detailed analysis, the FVG region was divided in 4 subregions: coast, plain, Prealps and Alps. Considering only the cases of maximum rain with at least 1 mm in 6h, the maximum rain for the full domain comes at 47% of the time from the Prealps, 26% from the Alps, 13% from the plain and 14% from the coast. A similar exercise to the previous one has been repeated for each of the four subregions, finding a much worse bias, RMSE and ratio of SD for the Prealps area, while the correlation coefficient was lower for the plain and cost areas.

Lastly, a non-linear statistical method for forecasting the maximum

6h rain from ECMWF direct model output will be developed independently for the four subregions, dividing data into training and verification samples.