CLIM-RUN Product Information Sheet: March 2014

Seasonal forecasts of heavy rain events in the North Adriatic.

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CMCC

Keywords: Heavy precipitation, seasonal forecast, coastal tourism, flood risk.

Target groups

- **Local/Regional Autorithies**
- **Private Stakeholders**
- **Regional met offices**

The relevance to the case-study requirements

The coastal zone of the North Adriatic Sea is a representative example of Mediterranean coastal zone including various fragile ecosystems such as coastal wetlands and lagoons, and high value cultural and socio-economic locations (e.g. the city of Venice). Moreover, the Northern Adriatic coastal zone is considered to be particularly vulnerable to the increase in flood risk, which is an expected outcome of climate change. Here we explore the predictive capabilities of a state-of-the-art seasonal forecast system (the CMCC-SPS), applied to the occurrence of heavy precipitation events over Europe, with a particular focus on the Northern Adriatic region.

The approach

The seasonal predictability associated with heavy precipitation events over Europe is assessed using the CMCC Seasonal Prediction System (hereafter CMCC-SPS; Borrelli et al., 2012; Materia et al., 2014).

Heavy rainfall events are defined using a percentile based counting method applied to daily gridded observations and corresponding model forecasts. Here we focus on moderate extremes, with a 10% probability of occurrence (i.e., 1 in 10 day events) so as to ensure that the selected events feature a sufficiently large frequency of occurrence and, at the same time, a sizeable impact on the environment. More specifically, we base our analysis on an index defined as the number of wet days exceeding the 90th percentile of daily total precipitation. This type of events can be more appropriately referred to as “heavy rain” (rather than extreme) events. This analysis is restricted to the European region, using the E-OBS (Haylock et al., 2008) gridded precipitation data as observational reference.

For the analysis shown here we use daily model output from six-month long retrospective forecasts (also referred to as hindcasts) for the the 1989-2005 period. Each hindcast consists of nine ensemble members, initialized with a realistic estimate of the states of atmosphere and oceans (Materia et al., 2014). The model (which has a nominal horizontal resolution of 200 Km) is initialized every year at four different start dates, corresponding to the first of February, May, August and November.

References

Bellucci et al., 2013: Seasonal predictability of heavy rain events using the CMCC-SPS system. CLIM-RUN Newsletter 4, 2013. [Published on-line: http://www.climrun.eu/newsletter]

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This information sheet was developed in the framework of the CLIM-RUN FP7 EU project. The product it describes should not be used without acknowledging the project and, particularly for any operational use, interaction with the authors is welcome and strongly encouraged.

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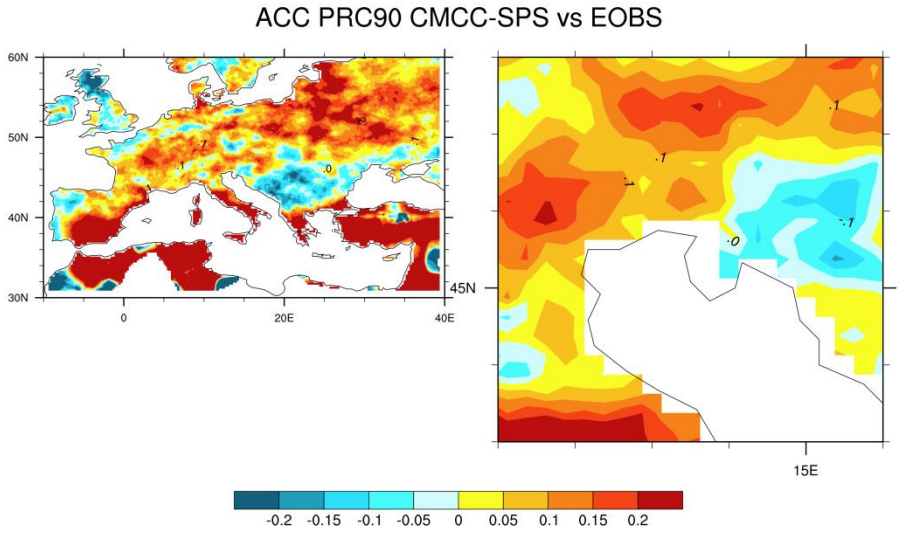
The product



(Left) Skill of seasonal hindcasts for precipitation: anomaly correlation patterns for heavy rain days (i.e., the fraction of days exceeding the 90th percentile). (Right) A close-up view of anomaly correlations (shown in the left panel) for the North Adriatic region.

The predictive skill associated with the representation of heavy rain events in the CMCC-SPS system is quantified through a specific statistical index, the anomaly correlation coefficient (ACC). The ACC pattern from CMCC-SPS hindcasts (left panel), features positive, but overall modest, values over most of the European area, with a marked north-south gradient, highlighting an enhanced forecast skill (compared with northern-central Europe) in the Mediterranean region, including most of the Italian and Iberian peninsulas, Turkey, Middle-East and Northern Africa. On the other hand, negative ACC values (corresponding to no skill) are found over the Balkan area, and over north-western Europe. Concerning the North Adriatic region (right panel), relatively low skill is found, with anomaly correlations ranging from 0.1-0.2 over north-eastern Italy, to negative values over parts of Slovenia and Croatia. Therefore, the potential for using seasonal forecasts as a tool to forecast intense precipitation events in advance is fairly limited for this region at the moment.

Making the product usable

The results presented here are broadly consistent with a similar analysis performed by Eade et al. (2012) using the UK Met Office Decadal Prediction System, where a similar enhancement of the skill associated with heavy rain events (compared with the skill for mean precipitation) is found over Europe, except for the eastern European region (see Fig. 2 in Eade et al., 2012).

These analogies corroborate the indication that reliable forecasting of intense rainfall on seasonal timescales are still a challenge for state-of-the-art seasonal prediction systems. The poor representation of regional scale features in the low-resolution models which are currently used to perform seasonal forecasts, and the limited predictability associated with mid-latitude processes (particularly pronounced for precipitation) contribute to the overall modest skill found for heavy rain events. Interestingly, while generally low, the correlations found for wet extremes are mostly higher than for the mean precipitation, pointing to a higher signal-to-noise ratio associated with this type of event as a possible explanation (Eade et al., 2012).

With specific reference to the North Adriatic case study, possible ways to enhance our current seasonal forecast capabilities may rely on the use of statistical downscaling techniques, allowing for a better representation of regional scale features, based on an optimal use of observations and model results.

Contact: alessio.bellucci@cmcc.it. **Further information:** http://www.climrun.eu/seasonal-predictability-of-heavy-precipitation-events-using-the-cmcc-sps-system-02-slash-07-slash-2013.