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Seamless Climate Information for climate extremes through merging of forecasts across seasonal to multi-annual timescales

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Predicting tailored climate extreme events seamlessly from seasons to multi-annual timescales is one of the challenges in the forecasting community. Novel post processing methodologies are required to address this issue, which is discussed in the present study. A new climate application is designed in co-production framework with the agriculture sector to develop the climate information for them on season to two-years timescale using seasonal to the extended seasonal forecast dataset available from the European Centre for Medium-Range Weather Forecasts (ECMWF) Seasonal Forecasting System (SEAS5) for the period 1981-2022. A temporal merging technique is developed to combine the forecasts on season to multi-annual timescale for the actionable climate information for the Frost risk, which affects the vineyard industry in southwestern Europe, in particular focus over Spain, during Spring (March-April) season. We noted a varying level of forecast skill for the Frequency of Frost Days (FFDs) during spring season (target season) in different start dates from lead month-0 (i.e., March start date) to lead month-23 (i.e., May start date). No Forecast Skill is noted for spring FFDs at lead month-2 (i.e., January start date), while a prominent skill is noted at lead month-11 (i.e., May start date). Temporally merging from lead month-23 to month-0 provide a large ensemble size, which have positive feedback onto the FFD's forecast skill during the spring season. We also noted most of the forecast skill is mainly modulated by the long-term trends in most of the start dates, except for lead month-11 (May start date), while a combination of long-term trends as well as of internal variability (about 60%) is noted to the forecast skill for the FFDs in spring season. This post-processed seamless climate information will be useful for the local vineyard community to take some preventive measures well in advance from the frost risk, which may help to minimize the losses.