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A classification of the sea level pressure daily fields in southern South America: an application to daily rainfall in the Pampas region.

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The Pampas covers Argentina's most productive agricultural land, extending more than 1600 km in the heartland of the country. The impact of climate adversities on agricultural activities makes it necessary to determine to what extent climate spatial and temporal variability is responsible for crop yields and to generate elements to monitor, estimate impacts and design an alert system. Local atmospheric conditions depend, among other factors, on the major scale fields. Consequently, an objective classification of daily circulation fields in the South of South America is proposed using a long database. Daily rainfalls within the Argentine Humid Pampas are also investigated in connection to the weather type categories.

Daily mean sea level pressure (SLP) fields corresponding to the NCEP_Reanalysis 2 data provided by the NCEP-NCAR were used as representative of atmospheric circulation at low levels which is of great importance in determining moisture advection in the region. The period of study was 1979-1999. The chosen domain extends from 15ºS to 60ºS and from 40ºW to 90º W on a 2.5º latitude-longitude grid. This domain extends over the Pacific and the Atlantic Oceans and the Andes Mountains, all of which have a significant influence on the atmospheric circulation over South America. The analyzed seasons correspond to summer (December-January- February) and winter (June-July-August). Daily rainfall series located in the core region for growing different crops in the Argentine Humid Pampas were also used. These series were provided by the Argentine National Meteorological Service.

Cluster analysis was performed coupled with Principal Component Analysis (PCA) to determine the atmospheric circulation patterns. PCA was used as a synthesis method and the cluster analysis was carried out in the subspace given by the leading unrotated principal components. The 'k-means' partitioning method with Euclidean distance was used. The choice of the optimal number of clusters was established by the pseudo-F statistic.

Winter and summer sea level pressure daily fields were stratified into 7 and 5 weather type categories (respectively). The derived atmospheric patterns comprise a wide variety of flows over southern South America, with a clear distinction between Atlantic and Pacific disturbances. The frequency, transition, distribution and temporal variability of these atmospheric structures were analyzed. During summer, dry days are significantly favoured by structures which denote an intensification of the semipermanent subtropical Atlantic high, inducing stability at low levels. It is interesting to mention that this atmospheric structure is one of the most persistent together with the weather type that resembles the mean pattern for summer. On the other hand, rainy days are significantly benefited by patterns with a cyclonic disturbance at the centre of the continent. This pattern could be associated to a frontal passage and it is the less frequent (9.9%) of the season. During winter, rainy days are significantly benefited by structures with a high pressure system at the south of the continent, enhancing an anomalous flow from the east-southeast in the central region of Argentina and its corresponding moisture advection at low levels. This weather type is the less persistent showing the 83% of the events in sequences of one- or two-day. Dry days are significantly favoured by a high pressure system situated right inside the continent. The most persistent weather types for winter are also the most frequent ones.

Classification of the atmospheric circulation structures and knowledge of their main properties and links with surface variables provides a tool that could help to improve short and middle term forecasts, could be introduced as an element to be incorporated in impact studies and could also be useful as a downscaling tool in order to prospect possible climate evolution for the 21st century.