NDVI and accumulated antecedent precipitation in the drylands of Mendoza, Argentina

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Abstract: Considering the relationship between normalized difference vegetation index (NDVI), biomass and precipitation result essential for the sustainability of the livestock production and avoiding overgrazing, particularly in arid and semi-arid regions. The correlation between NDVI and accumulated antecedent precipitation (AAP) is a useful method to support decision making.

Vegetation dynamics in dryland systems is highly dependent on soil moisture availability. Arid and semi-arid ecosystem are under the pressure of climate change and are facing overgrazing and logging, which has led to increased degradation and desertification processes. Drylands of Mendoza, Argentina, are fragile ecosystem devoted to cattle breeding on native bushes and rangelands. Livestock farming relies on the productivity of natural resources, closely related to the monthly, annual, and seasonal rainfall, which is a critical driver of vegetation productivity and dynamics.

This study is aimed at determining the relationship between NDVI and Accumulated Antecedent Precipitation (AAP) in natural dryland as a basis for decision support in cattle grazing. NDVI from MODIS-Terra (MOD13Q1 V6.1) and AAP estimated by satellite using GPM (Global Precipitation Measurement) were correlated using Pearson's Correlation Coefficient at monthly timesteps over a period of 20 years (June 2000 to May 2020) considering 0 APP (monthly) and 1, 3-, 6-, 9- and 12-months AAP. The analysis was carried out spatially (pixel-to-pixel) in 100 randomly selected points of each 4 primary vegetation types of the interest area (Bush steppe with low land cover; Open Bush; Forest of *Prosopis Flexuosa*; and Psammophilous Grassland).

All vegetation types showed a similar response and behaviour to AAP, with a higher correlation between NDVI and 3-month of AAP, followed by 1-mont of AAP for Open Bush, Forest of *Prosopis Flexuosa* and Psammophilous grassland. These semi-arid bushlands share the characteristic of having most of the root systems up to 1 meter depth, which make them more sensitives short term changes in soil moisture (Joiner et al. 2018). Previous studies analysing the vegetation fractions' dependence on antecedent accumulated precipitation for Australia, found the best response for a accumulated period lower than 12 months AAP (Guerschman et al. 2020). Other researchers in arid rangelands also found the higher correlation between NDVI and AAP between 3 months during summer and up to six months in winter (Long et al. 2019).These variation in ecosystem productivity measured through NDVI associated to changes in AAP and then to water availability where also found in dryland globally but especially greater in the southern hemisphere (Zhao et al. 2022).

For cattle grazing management based on natural vegetation, the relationship between NDVI, biomass and precipitation result essential for the sustainability of the production and avoiding overgrazing. Tracking vegetation responses to rainfall in this region is of outmost importance for management of the limited water resources. However, spatial, and temporal scales of analysis and land use management must be considered in comparing patterns of responses of vegetation to antecedent accumulated precipitation.

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