



Rainfall Trend Analysis and Its Relationship with the North Atlantic Oscillation on São Miguel Island (Azores, Portugal)

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São Miguel Island (Azores archipelago - Portugal), is located in the North Atlantic and exhibits high spatial and temporal variability in rainfall, strongly controlled by its volcanic morphology and the influence of large-scale atmospheric circulation. The analysis of rainfall trends on São Miguel Island was conducted at annual and seasonal scales using 17 rainfall series (1978/79–2019/20), applying non-parametric statistical methods, namely the Mann–Kendall test to assess trend significance and Sen's slope estimator to quantify trend magnitude. The analysis reveals a clear predominance of negative trends in both annual and seasonal rainfall, with marked spatial heterogeneity. Statistically significant trends are mainly concentrated in autumn and winter, the seasons accounting for the largest fraction of annual rainfall. Autumn emerges as the season with the highest number and magnitude of negative trends, indicating a consistent transition toward progressively drier conditions. At several rainfall stations, annual trends exceed -20 mm/year, reaching maximum values of -31.6 mm/year at high-altitude sites. These rainfall stations also exhibit significant decreases across multiple seasons, indicating a persistent weakening of the rainfall regime throughout the study period. The relationship between rainfall and the NAO shows a negative annual correlation, with a stronger seasonal signal during autumn. Several stations present statistically significant correlations, indicating that positive NAO phases are associated with reduced rainfall on São Miguel Island. This relationship is particularly consistent in autumn, suggesting that the intensification and persistence of atmospheric patterns associated with positive NAO phases have contributed substantially to the observed negative trends. In contrast, winter correlations are weaker and spatially less coherent, while in spring and summer the influence of the NAO is residual. Overall, the results confirm the dominant role of the NAO as the primary driver of interannual variability and recent rainfall trends on São Miguel Island, highlighting a drying signal in an insular environment that is highly sensitive to changes in North Atlantic atmospheric circulation.