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Spatiotemporal variability of fog and dew occurrence in the Atacama Desert - a view from a network of weather stations

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In hyperarid regions, such as the Atacama Desert, fog and dew provide essential water supply to sustain unique ecosystems and drive geomorphological processes. While some studies have quantified the spatiotemporal variability of fog, it remains mostly unclear which phenomenon, i.e. fog or dew, constitutes the more important water source. However, such knowledge is crucial for a better understanding of the interplay between atmospheric, biological and geological processes. In this study, we determine fog and dew occurrence from observations provided by a network of weather stations deployed in the Atacama Desert by the Collaborative Research Center "Earth – Evolution at the Dry Limit" (https://sfb1211.uni-koeln.de/) of the German Science Foundation (DFG SFB1211). The stations are aligned in three west-to-east transects covering the coastal region, the central depression and the Andean foothills, thus, including multiple altitudinal regimes which are affected differently by the marine moisture from the nearby Southeast Pacific. Fog, dew and dry situations are distinguished according to data from a leaf wetness sensor and incoming terrestrial irradiation together with some additional constraints. Terrestrial irradiation is only available for three master stations. To obtain it for all other stations, we trained a multilayer perceptron with relative humidity, incoming solar radiation, 2m and surface temperature together with some auxiliary data as input data. For validation, the final classifications are compared to camera images available for morning and evening hours which constitute the most challenging times when fog and dew dissipate or form. Spatiotemporal variability, including diurnal and seasonal cycles of fog and dew are investigated. Furthermore, the relationship between the derived fog and dew frequencies and soil moisture variability is assessed to provide a more quantitative assessment of the moisture supply. The derived classification can be used as ground truth to build and evaluate satellite-based fog and dew retrievals in future studies.