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Modelling the Water-Air Interactions of the Namibian Atmosphere: Meteorological Factors

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Namibia is characterized by a complex earth-atmospheric interactions system of high temperature, low relative humidity, high evaporation, and evapo-transpiration inland; low precipitation, low temperatures, and moist air at the Atlantic coast (Namib Desert); high temperatures and frequent floods in the north-east; and high temperatures and alternating floods and droughts in the central-north. The high temperature and wind speed, low relative humidity, greater insolation, and less cloud cover naturally lead to increased evaporation and transpiration; this results in meteorological drought, which can lead to soil water deficiency and plant water stress, reduced biomass and yield (agricultural drought); and finally, depending on the time period, a hydrological drought (reduced streamflow, inflow to reservoirs, lakes, and ponds; reduced wetlands and wildlife habitat).
There have been concerns for the problems associated with scarcity of water in Namibia in recent years. These problems require in-depth investigation of the various factors affecting the Namibian atmosphere and the contribution of evaporation to moisture for cloud formation.
This study developed mixed strategy game models to contribute to the water-air interaction investigations needed for generating baseline data on the water-holding capacity of the Namibian atmosphere. The mathematical modelling techniques employed in the project were designed to obtain the optimal meteorological factor values defined by relative humidity, temperature, wind speed and leaf wetness data obtained from 14 Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) stations, for the years 2012 to 2015.
Observation of year-orientation and station-orientation patterns from the data simulations for some of the meteorological factors suggests the need for large data from more stations for further investigation towards identifying generalised patterns for the whole country. The solutions obtained from the mixed strategy game modelling implemented via linear optimisation techniques identified the weather stations and the various months of the year contributing to the optimal values of the meteorological factors, for the combined 2012-2015 data.
Data values for shorter periods (for example, weekly data instead of monthly data) are needed for each year to obtain useful optimal values to resolve the extremely small and sparsely distributed solutions arising from the application of the game model optimisation algorithm to short-term data for each year.

Key words: Meteorological factors, evapotranspiration, water holding-capacity, mixed strategy game, linear optimisation.