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Atmospheric Conditions and Precipitation in Arid Environments: A Case of Namibia

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Of all precipitation received annually in Namibia, about 83% evaporates, 14% is consumed by vegetation, 2% becomes runoff, and 1% recharges groundwater. Due to shortages in surface water, the country relies heavily on groundwater reserves, which are subject to low recharge rates from rainfall and periodic ephemeral floods. The increasing occurrence and severity of floods, as well as water resource shortage, is one of the worst hazards to the global ecosystem linked to global warming.

This study evaluates the atmospheric conditions and precipitation interactions in Namibia to provide the basis for monitoring and improving conditions relating to water storage, recharge, and quality, as well as preserving small quantities of available fresh water, and improving existing water resource augmentation programs. Atmospheric conditions including temperature, wind speed, relative humidity, solar radiation, atmospheric water-holding capacity, and aerosol load, morphology, and size distribution were determined for the Southern African Science Service Centre for Climate Change and Adaptive Land Use (SASSCAL) weather/research stations situated in the Kuiseb, Cuvelai-Etosha and Okavango-Omatako Basin, in Namibia.

This paper thus communicates initial findings to prove the hypotheses implied by the International Panel on Climate Change (IPCC) simulations and empirical evidence, i.e. (1) warmer climate increases risks of both drought where it is not raining, and floods where it is, but at different times and/or places; (2) the water-holding capacity of the atmosphere increases (following the Clausius-Clapeyron relation) as temperature increases; and (3) aerosol pollution masks the ground from direct sunlight, thereby decreasing evaporation and reducing the overall moisture supply to the atmosphere. The premise of this study is thus: an understanding of the atmospheric water-climate interactions in Namibia can provide the basis for monitoring and improving our understanding of water storage, recharge, and quality; it can also lead to better preserving small quantities of available fresh water, improving existing water resource augmentation programs, and improving community adaptive capacity to climate change.

Inferential statistical analysis of the atmospheric conditions, and historical meteorological and hydrological data yielded information on the occurrence (onset, intensity, and frequency) of precipitation in Namibia. The study also showed that the water-holding capacity of the Namibian atmosphere increased as the temperature increased; aerosol pollution close to Cuvelai and Kuiseb masked the ground and reduced moisture supply; thus, the Namibian warm climate increased risks of drought during non-rainy periods, and floods during rainy periods, but at different times and/or places.

Keywords - Precipitation; Meteorological Parameters; Aerosol Load; Aerosol Morphology; Total Suspended Particles; Atmospheric Water-holding Capacity