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Sand and Dust Storm Attenuation Prediction Using Visibility and Humidity Measurements

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Abstract
Sand and dust storms present significant challenges to microwave and millimeter-wave propagation, directly impacting communication systems. Despite the existence of various theoretical and analytical models for predicting dust storm attenuation, many have overlooked the crucial factor of humidity. This study had conducted a year-long monitoring of visibility, humidity, and received signal levels for two microwave links operating at 14 GHz and 22 GHz in Khartoum, Sudan. The percentage variation in visibility during a dust storm is 95%, and the percentage variation in humidity is 78%, as the received signal level varies from -42.17 dB to -82 dB. The research unveils a notable correlation between fluctuations in humidity and the complex permittivity of sand and dust particles. Furthermore, this study proposes an empirically developed prediction model for sand and dust storm attenuation, surpassing existing models by incorporating both visibility and humidity data. In contrast to models that solely rely on measured visibility and neglect humidity, this research methodology takes into account both of these measured parameters during dust storms to predict attenuation at any desired frequency. The model's performance is validated through measurements at 14 GHz, 22 GHz, and 40 GHz, demonstrating robust agreement with the collected data. This comprehensive model provides a more accurate representation of the complex weather conditions during sand and dust storms, enhancing the readability of microwave links design by accurate prediction and mitigation of their impact on communication systems. © 2013 IEEE.

Author Keywords
complex permittivity; micro and millimeter wave propagation; Sand and dust storm attenuation; terrestrial communication; visibility and humidity

Index Keywords
Atmospheric humidity, Dust, Forecasting, Millimeter waves, Permittivity, Sand, Visibility, Wave propagation; %moisture, Atmospheric measurement, Attenuation, Complex permittivity, Dust storm, Humidity measurements, Micro and millimeter wave propagation, Millimeter wave propagation, Sand and dust storm attenuation, Sand storms, Storm attenuation, Terrestrial communication, Visibility and humidity; Storms

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