SOLAR RADIATIVE VARIABILITY FORCING OF CLIMATE CHANGE ON SEASONAL TO DECADAL SCALES IN KENYA

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ABSTRACT

The study focused on solar forcing of the Earth's climate by looking at how indices of the various solar spheres relate to the climatic parameters measured on the Earth.

The daily meteorological data for nine climatic parameters: Relative Humidity, Maximum Temperature, Minimum Temperature, Wind speed, Sunshine duration, Solar Radiation, Evaporation, Rainfall and Average Temperature obtained from the Kenya Meteorological Department (KMD) for the five representative synoptic meteorological stations covering the period 1986 to 2005 were filtered and reduced to Monthly means. The same procedure was done to the solar indices (Sunspot numbers, F10.7 cm solar radio flux and Mg II core-to-wing ratio) data obtained from NGDC, Boulder, Colorado through their website. The cross-correlation method was applied to calculate the correlation coefficients between the various meteorological variables and solar indices at each station. Significant periodicities in the meteorological variables at each station were determined from the periodograms that were obtained by applying the Fourier transform technique Scargle periodogram (Scargle, 1982) to the monthly means of the meteorological variables. Modeling of the meteorological and solar indices was done using the proposed linear Multivariate model, and the empirical coefficients determined by applying least square fittings. Validity of the models was tested using the statistical indicators: The Mean Bias Error (MBE) and Root Mean Square Error (RMSE). Periodicities in the drought occurrences were determined. Employing the stepwise multivariate regression analysis in SPSS, the proposed model was then applied to the cases where solar indices were lagged.

Results show that above 95% level of statistically significant correlations exist between

wind speed and sunspot numbers in Kericho; between minimum temperature and sunspot numbers in Kisumu; between sunshine duration and sunspot numbers in Garissa; and between solar radiation and sunspot numbers in Garissa. Above 95% level of statistically significant correlations exist between relative humidity and F10.7 cm radio solar flux in Mombasa; between wind speed and F10.7 cm radio solar flux in Kericho, Kisumu, Mombasa and Garrisa; between solar radiation and F10.7 cm radio solar flux in Nairobi and Kisumu; between evaporation and F10.7 cm radio solar flux in Garissa; and between average temperature and F10.7 cm radio solar flux in Kericho. Also above 95% level of statistically significant correlations exist between relative humidity and Mg II core-to-wing ratio in Mombasa; between wind speed and Mg II core-to-wing ratio in Kericho, Mombasa and Garissa; between solar radiation and Mg II core-to-wing ratio in Nairobi; and between evaporation and Mg II core-to-wing ratio in Kericho.

Modal periodicities of 6 and 12 months are detected in climatic parameters in all the meteorological stations apart from Kericho.

The models from the Fast Fourier analysis technique, show variations of solar forcing on climatic parameters at different locations in Kenya. Periodicities of 3.5 and 11 years in drought occurrences obtained in some meteorological stations in the drought occurrences are also comparable to the literature reports on solar activity periodicities, thus confirming solar signature on the Kenyan climate. Stepwise regression models manifest in specific meteorological stations, and for different climatic parameters. These are seen from the above 95% level of statistically significant correlations between the observed and predicted values from the Fast Fourier analysis models. Solar control is evident on the climate of Kenya.