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Characterization of human behavior in records of personal solar ultraviolet exposure records

David Jean du Preez[1,8], Suzana Blesic[2,3], Caradee Y. Wright[1,4], Djordje Stratimirovic[5], Jelena Ajtic[6], Martin Allen[7], and Hassan Bencherif[8]

[1]Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa
[2]Department of Environmental Sciences, Informatics and Statistics, Ca'Foscari University of Venice, Italy
[3]Institute for Medical Research, Serbia
[4]Environment and Health Research Unit, South African Medical Research Council, South Africa
[5]Faculty of Dentistry, University of Belgrade, Serbia
[6]Faculty of Veterinary Medicine, University of Belgrade, Serbia
[7]MacDiarmid Institute, University of Christchurch, New Zealand
[8]LACy, Laboratoire de l'Atmosphère et des Cyclones (UMR 8105 CNRS, Université de La Réunion, Météo France), Saint Denis de La Réunion, France

We investigated scaling properties of measurements of personal exposure to solar ultraviolet radiation (pUVR) using the 2nd order detrended fluctuation analysis (DFA2) and the wavelet transform spectral analysis (WTS). Studies of pUVR are important to identify populations at-risk of excess and insufficient exposure given the negative and positive health impacts, respectively, of time spent in the sun. These very high frequency recordings are collected by electronic UVR dosimeters. We analyzed sun exposure patterns of school children in South Africa and construction workers and work site supervisors in New Zealand, and we found scaling behavior in all our data. The observed scaling changed from uncorrelated to long-range correlated with increasing duration of sun exposure. We found peaks in the WTS spectra that mark characteristic times in pUVR behavior, which may be connected to both human outside activity and natural (solar) daily cycles. We further hypothesized that the WT slope would be influenced by the duration of time that a person spends in continuum outside and addressed this hypothesis by using an experimental study approach. To that end we performed combined DFA2-WTS analysis on a subset of individual records taken on the same day under very similar outdoor conditions and used the theoretical superposition rule provided by systematic assessments of effects of trends and nonstationarities on DFA2 as a methodological mean to trace and subsequently model human behavioral patterns in pUVR time series.