

Open Funding Invitation

The Importance of Monitoring of Ultraviolet Radiation in Southern Africa



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Nina Jablonski is a world authority in the field of effects of ultraviolet radiation (UVR) on biological systems. As a fellow of STIAS, Nina discovered the solar radiometry work at the University of Stellenbosch and approached the Solar Thermal Energy Research Group (STERG) to assist with research she is doing linking UV and the production of vitamin D. Nina funded a state of the art instrument to measure the specific bands of UV that are of interest. This instrument is a Kipp and Zonen UVS-AB-T sensor and it easily couples to the full Kipp and Zonen solar tracker at the university. STERG is now publishing the data with full access to the public.

UVR is a higher frequency electromagnetic radiation component of sunlight that has numerous impacts on health as well as on our physical environment as detailed more below. In some instances, we expect the dosage of UVR to be higher than usual for solar power plants and the effects of this are unknown but could have impact to the breakdown of materials at these plants.

With the GIZ & USAid funded project to establish 10 full solar measurement stations across Southern Africa, we believe that this is an ideal moment to add this single component to the systems. As UVR has such wide ranging impacts on people, other fauna and flora, and technologies, the benefit to science will be significant. **The additional cost for all 10 stations combined will be about \$100,000.**

Ultraviolet radiation (UVR) has many effects on biological systems and the built environment, and has been one of the most important creative forces in the evolution of life on earth (Rothschild 1999). Although 90% or more of medium wavelength UVR, UV-B, is absorbed by atmospheric ozone, almost all long wavelength UV-A passes through the atmosphere unimpeded. The mixtures of UV-A and UV-B that reach the earth's surface vary according to place, time of day, season, and amounts of atmospheric moisture and pollution. UV-A penetrates the human skin more deeply than UV-B, and action spectra for biological responses indicate that it is UV-B that is absorbed by DNA resulting in damage that can initiate DNA mutations leading cancer. Despite the mostly harmful effects of UV-B, small amounts are needed by humans and most other vertebrates in order to begin the process of vitamin D formation in the skin (Lucas, McMichael et al. 2006; Lucas 2010). UV-B has specific effects on plants and human food crops such as inhibition of seedling growth and changes in susceptibility to attack by insects and pathogens (Caldwell, Bjorn et al. 1998; Madronich, McKenzie et al. 1998). Both UV-A and UV-B also contribute

significantly to deterioration of structures and machinery of all types because of their destructive effects on natural and synthetic polymers.

South Africa has a highly varied and markedly seasonal UV-B regime because it spans almost 13° of latitude from 22°S to 35°S. The far north of the country receives moderate to high levels during the entire year, with peaks at the vernal and autumnal equinoxes. The far south of the country receives far less, especially during the winter (see attached figures of monthly UV-B based on NASA TOMS 7 satellite data). This is significant for health especially because the southern coastal margin is heavily populated (especially in the southwest), and people living there cannot produce vitamin D in their skin for anywhere between two and four months of the year, depending on pigmentation (Pettifor, Moodley et al. 1996; Jablonski and Chaplin 2000; Jablonski and Chaplin 2010). The resulting vitamin D deficiencies have been associated with the increased prevalence of infectious disease including TB (Martineau, Nhamoyebonde et al. 2011).

Ground-level monitoring of UVR is an essential complement to monitoring of solar radiation, and UV-A/B sensors can be readily accommodated onto platforms containing pyranometers and pyrgeometers. Monitoring of total UVR insolation and of UV-A/B separately allows for determination of spatial and temporal trends in UVR reaching the ground at different elevations and in different environments, and provides an estimate of the exposure of people and the human environment to UV-B to determine dose-response relationships. Stratospheric ozone has been reduced due to the release of chlorofluorocarbons into the atmosphere, and it is well known that this reduction in total column ozone has resulted in increasing amounts of UV-B reaching the surface, with the largest changes being observed in the polar regions. Changes in the arctic and antarctic ozone holes will continue to have effects on UV-B levels, which will in turn profoundly affect humans and their environment. Monitoring of UV-A/B under conditions of global climatic instability is essential for planning and mitigation purposes in public health and materials science.

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