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How do environmental and behavioral factors impact ultraviolet radiation effects on health: the RISC-UV Project

M.P Correa (1,2), S. Godin-Beekmann (1), M. Haeffelin (3), P. Saiag (4), E. Mahe (5), C. Brogniez (6), J.C. Dupont (3), A. Pazmiño (1), F. Auriol (6), and B. Bonnel (6)

(1) Service d'Aeronomie – Institut Pierre Simon Laplace – Université Pierre et Marie Curie – 4 place Jussieu, 75252, Paris, France(mpcorrea@gmail.com), (2) Instituto de Recursos Naturais – Universidade Federal de Itajubá – Av. BPS, 1303 – CEP 37500-903, Itajubá, Brazil , (3) Site Instrumental de Recherche par Télédétection Atmosphérique (SIRTA) – Institut Pierre Simon Laplace – École Polytechnique – 91128 Palaiseau, France, (4) Université Versailles-Saint Quentin Yvelines –A CHU A Paré 92104 Boulogne, France, (5) Service de Dermatologie – Hôpital Ambroise Paré – 9 avenue Charles de gaulle, 92100 Boulogne-Billancourt, France, (6) Laboratoire d'Optique Atmospherique (LOA) – Université des Sciences et Technologies de Lille – F-59655 Villeneuve d'Ascq, France.

Introduction: RISC-UV is a research project on "Impact of climate change on ultraviolet radiation and risks for health", a research project in which physicists, meteorologists and physicians work together to assess the relative role played by environmental and behavioral factors in the UV-related diseases as skin cancer and vitamin D deficiency. Environmental factors are related to the role played by the alteration in intensity of UV radiation at the Earth's surface resulting from variation in several factors affected by climate change and human activities: stratospheric ozone, cloud cover, aerosols and the reflectivity of the surface. On the other hand, behavioral factors are related to the sun over/underexposure and the correct use of sun-protection (hats, caps, sunglasses, sunscreen lotion, etc.). RISC-UV is organized around three main areas: 1) Organization of a workshop, scheduled for January 2009, which aims to describe the state of the art in the subject within each community and define the requirements of pathologists for epidemiological studies; 2) A pilot study intended to evaluate the consistency between UV measurements delivered simultaneously by satellite-based instruments, ground instruments, radiometers and individual dosimeters. This study is based on measurements campaigns and an analysis of the long-term consistency of data series relating to UV radiation and associated parameters; and 3) Analysis of the weights of medical, behavioral and environmental parameters involved in skin carcinogenesis. A detailed description of these areas can be found in http://www.gisclimat.fr/Doc/GB/D_projects/RISC-UV_GB.html.

This presentation focuses on the first results of the UV experimental measurements performed between September 8^{th} and October 8^{th} 2008 in Palaiseau, France (48.7°N; 2.2°E; 170m – Haeffelin et al., 2005). A second campaign is foreseen for the spring of 2009. The purpose of these campaigns is to obtain, analyze and quantitatively link the UV radiation data obtained at various spatial scales (satellite, ground-based and spot measurements) by a variety of measuring systems. Moreover a set of atmospheric parameters (total ozone column, the vertical profile and optical thickness of aerosols, cloud cover and solar albedo) related to UV radiation is also collected.

Material: The instrumental set consisted of several instruments for: 1) UV radiation measurements (a spectroradiometer, UV-A, UV-B, Erythemal UV and broadband solar pyranometers); 2) cloud, ozone and aerosol observations (photometer, Lidar and radiometers); and 3) personal monitors for UV index measurements, as handhelds, watches and mini-station.

Results: Measurements performed in cloudy and sunny days around noon local time ($\pm$ 1h) showed mean values of 3.3 $\pm$ 1.0 UVI, and the maximum UVI was 5.5 at noon on a clear sky day (September 14). The influence of cirrus clouds and aerosols radiation attenuation is currently studied on several case studies. From the mean UVI values, we estimated the time of necessary exposure for the induction of erythema of the skin and for the synthesis 1000 UI of vitamin D per day (1000 UI). (McKenzie et al., 2008).

Preliminary results show that around solar noon (between 9 and 12 UTC that is 11 and 14 local time), on the one hand, about 45 min of exposure is required to cause skin redness and consequently lead to harmful effects on the

human health. On the other hand, this exposure can be insufficient to lead to beneficial effects if we consider only the generally exposed parts of the body, as the hands and the face. It is only in the extreme conditions – exposure of the whole body – that the synthesis of the vitamin D can be done in 10 to 20 minutes. Otherwise an exposure during several hours is necessary. These results are particularly interesting with respect to possible problems of lack of vitamin D in the French population, mainly rickets (children) and osteosporosis (old persons), as well as other diseases related to the lack of vitamin D (Holick, 2004).

A second campaign will be carried out during Spring 2009. This campaign will mainly focus on: 1) the comparisons of satellite retrievals and ground-based UV observations in order to relate different scales of UV measurements. Surface measurements will be performed in ten different sites located in the city of Paris and its suburbs; 2) the analysis of UV measurements in tilted surfaces using four pyranometers installed in different angles (horizontal, 45°, 90° and 180°) ; 3) the measurements of surface albedo; and 4) the evaluation of cirrus and aerosol impact on UV radiation at the surface using collocated measurements like Lidar and Sunphotometers.

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