

ARPANSA UV data measurements at Australian locations – an overview

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Abstract. For over 25 years ARPANSA has been measuring solar UVR levels at major population centres in Australia in order to determine what the levels are, what their impact on the Australian population might be, and whether they are changing. While the annual solar UVR levels at each site can change from year to year due to variations in seasonal effects and weather conditions, the variability between years at each site is generally only 2 to 6%. Annual levels are lowest in the Southern regions of Australia but are 2 to 3 times as high in the North closer to the equator. The UV levels in Australia are significantly higher than those measured in Europe, where a substantial proportion of the Australian population originally came from. As a result there are high skin cancer rates, particularly for non melanoma skin cancer (NMSC). The burden of the massive numbers of NMSC treatments each year has added significantly to Australia's health care costs. Education campaigns to modify the population's behaviour to seek shade and cover up when outdoors, in order to adapt to these higher UV levels, have been a major task but may at last be gradually having some effect.

Introduction

As a radiation protection agency and a regulatory body, ARPANSA has a role in reducing radiation exposures in both science and industry, where there are appropriate rules and regulations in place to ensure both ionizing and non-ionizing radiation exposures do not exceed allowable limits. For example, significant progress has been made in workplaces over the last few years in ensuring outdoor workers in Australia are provided with protective clothing, hats and sunglasses and are required by their employers to use them while at their workplace, thereby protecting them from excessive solar UVR exposures (ARPANSA, RPS 12:2006). However, one of the major issues is to reduce the solar UVR exposures of the general population when outside, given the significant impact UVR from the sun can have, particularly in terms of skin cancer rates. To that end, ARPANSA provides near-real-time UV Index measurements of the solar UV for major population centres around Australia. These forecasts can alert the general public to the solar UVR hazards that can be expected and hopefully begin to initiate behaviour changes. These measurements are available at:

<http://www.arpansa.gov.au/services/monitoring/ultraviolet-radiation-monitoring/ultraviolet-radiation-index>

The Bureau of Meteorology has a weather app for mobile phones and also forecasts UV index values for numerous locations around Australia at the following website: <http://www.bom.gov.au/uv/index.shtml>

While awareness of the hazards of solar UVR is increasing amongst the general population, there is still

some way to go before behavioural changes, such as always utilising sun protection when heading outdoors, becomes the normal response (Makin et al. 2007).

In 1994 ARPANSA published a comparison of solar UVR levels in Australia and the UK (Gies et al. 2004) as well as a summary of measured solar UVR levels annually from sites around the world in Standard Erythral Doses (1 SED = 100 mJ m⁻² of erythral radiation; 2 SEDs will give someone with fair skin detectable skin reddening (CIE 1998)). There was also a clear latitude gradient, where the annual solar UVR in SEDs each year increased towards the equator. There are numerous measurement sites in both the Northern and Southern Hemispheres where ambient monitoring of solar UVR currently takes place (Roy et al. 1996, Cordero et al. 2008, Liley et al. 2017). A number of papers have examined possible changes to the levels of solar UVR with time due to changing cloud cover and ozone (e.g., Bais et al. 2015). ARPANSA plans further papers for Australian sites and the Australian Antarctic stations.

Table1. Annual SEDs and maximum UV index measurements for major Australian Cities. The variation with latitude of annual solar UVR in SEDs for Australian cities and towns can be clearly seen in the Table below.

Location	Latitude (South)	Altitude (m)	Annual SEDs	Max UV Index
Darwin	12° 30'	30	17140	17.7
Cairns	16° 55'	5	14374	16.8
Townsville	19° 19'	10	15029	17.4
Alice Springs	23° 20'	550	15413	15.8
Brisbane	27° 28'	20	12262	16.3
Perth	31° 54'	15	12233	15.0
Newcastle	33° 00'	20	10593	15.1
Sydney	33° 55'	20	10038	15.2
Adelaide	34° 52'	10	10866	15.1
Canberra	35° 17'	580	9928	13.5
Melbourne	37° 40'	60	8822	14.4
Kingston	42° 59'	50	7564	12.7

Given the high solar UVR levels in Australia shown above, there have been a number of studies carried out looking at skin cancer rates. Staples et al (1998) found that basal cell carcinoma (BCC) rates in Australia in 1995 were 788 per 100,000, an increase of 19% since 1985, and squamous cell carcinoma (SCC) rates rose by 93% over the same period, from 166 to 321 per 100,000. BCC rates in latitudes < 29°S remained at about 3 times those in latitudes > 37°S over the decade. Another study by Fransen et al (2012) in Australia found that in 1997 and 2010, Medicare claims were made for 412,493 and 767,347 NMSC treatments respectively, representing an increase of 86%. Fransen et al (2012) also found that the total MBS benefit for NMSC treatments in 2010 was \$93.5 million and they

estimated this would increase to \$109.8 million by 2015, whereas the total cost with inflation was \$510 million in 2010, estimated to increase to \$703 million by 2015.

Subsequently Shih et al (2009) found that more than 103,000 skin cancers (9000 melanomas; 94,000 NMSC's) were prevented in Victoria from 1988 to 2003 due to SunSmart campaigns, with over 1,000 deaths averted! Economic evaluations of skin cancer prevention were also conducted in 2015, where with an additional \$AUD 0.16 per capita investment into future skin cancer prevention across Australia, 140,000 skin cancer cases would be prevented over the 20 year period 2011 to 2030 (Shih et al 2017) and return on investment would be \$AUD 3.20 per dollar invested and a social benefit of \$AUD 1.43 billion.

Brougham et al (2010) estimated the NMSC rates in New Zealand as approximately equal to those in Australia. Subsequently the Health Promotion Agency (HPA) and the Melanoma Network of New Zealand (MelNet) introduced the New Zealand Skin Cancer Primary Prevention and Early Detection Strategy 2017 to 2022, which will hopefully start to reduce NMSC numbers.

Lomas et al (2012) published a systematic review of the worldwide incidence of NMSC and concluded "compared with other malignancies the incidence rate of NMSC is high and is increasing, and the study's findings are important as they highlight the need for early prevention."

Conclusion

Australia (and New Zealand) both have significant problems with high levels of solar UVR and subsequent skin cancer rates due to their mostly fair-skinned populations. Awareness campaigns are slowly making a difference, particularly in Australia, but more still needs to be done, in particular

- Funding for a range of prevention programmes, where there are signs and indications that these can be effective.
- Lobbying Federal and State governments to provide extra funding to expand the programmes that are shown to be effective.

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