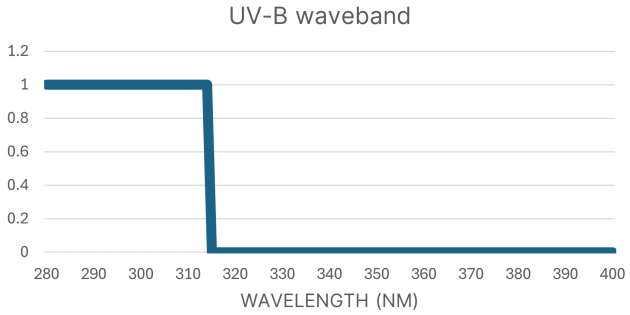
ExpoDose

Dosimeters specifications & Smartphone devices compatibility

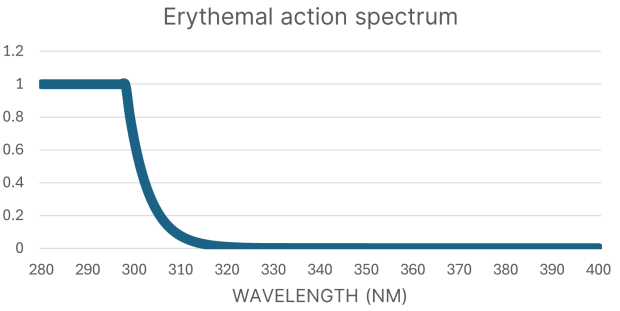
UV-B Dosimeter

The UV-B dosimeter measures the solar dose in the UV-B waveband, i.e. in the wavelength range between 280 nm and 315 nm. This part of the ultraviolet solar spectrum is responsible for skin damage (e.g. sunburn) and is associated with skin cancer risk, but it can also have therapeutic effects such as for treating psoriasis or vitiligo.



Erythemal Dosimeter

This dosimeter measures the erythema-effective solar dose, i.e. the exposure dose to the solar radiation that causes an erythemal reaction in the skin (skin redness, eventually leading to sunburn). In this case, the spectral solar radiation is weighted with the erythema action spectrum according to the ISO/CIE 17166:2019 standard, that mainly covers the UV-B and UV-A parts of the solar spectrum.



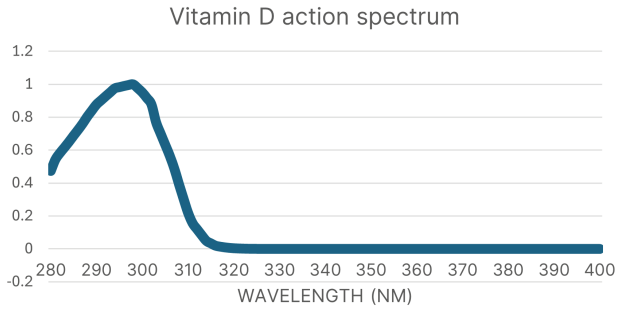
The accuracy of the ExpoDose's satellite-based technology in measuring the erythemal dose has been validated by several scientific studies, including

- Morelli M et al. (2016) Photoch. Photobio. Sci. 15(9), 1170
- Young AR, Schalka S et al. (2022) Photoch. Photobio. Sci. 21, 1853

When inter-compared with ground-based highly accurate measurements (e.g. calibrated spectroradiometers) on the horizontal plane, the accuracy of ExpoDose's erythemal dose had a maximum error (MAE) of 9.1% or lower and a correlation (R coefficient) of 90% or higher.

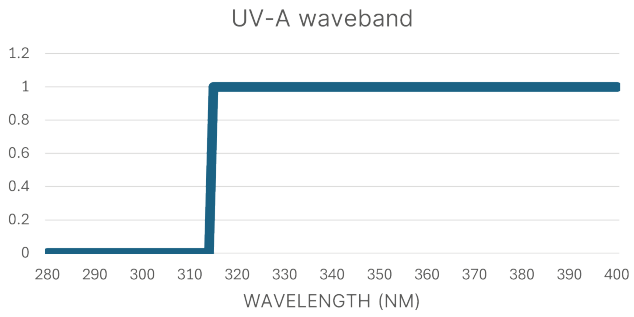
Vitamin D Dosimeter

This dosimeter measures the vitamin D-effective solar dose, i.e. the exposure dose to the solar radiation responsible for the synthesis of vitamin D (pre-vitamin D3) into the human skin. In this case, the spectral solar radiation is weighted with the action spectrum for the production of previtamin D3 in human skin to the CIE 174:2006 standard, mainly covering the UV-B and UV-A parts of the solar spectrum.



UV-A Dosimeter

The UV-A dosimeter measures the solar dose in the UV-A waveband, i.e. in the wavelength range between 315 nm and 400 nm. This part of the ultraviolet solar spectrum has longer wavelengths with respect to the UV-B and it reaches deeper layers into the skin. It's correlated with tanning and it damages the skin DNA, causing skin ageing and potentially having an impact on skin cancer risk. This waveband can also play a therapeutic role in some therapies, like the "PUVA" (i.e. psoralen and UV-A) for psoriasis.

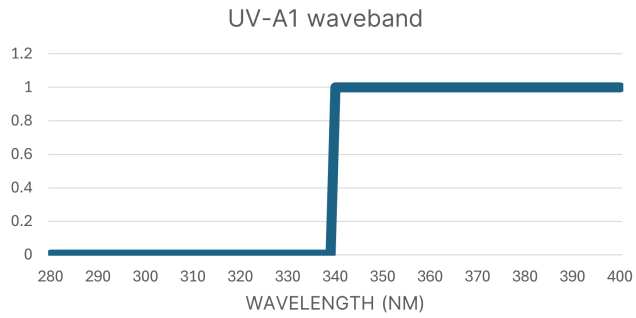


The accuracy of ExpoDose in this spectral range was scientifically validated in collaboration with Public Health England, demonstrating an accuracy of 88% on average (R coefficient from inter-comparison with ground-based measurements). The validation results are reported in the following publication:

- Morelli M et al. (2021) J. Atmos. Sol-Terr. Phys. 215, 105529

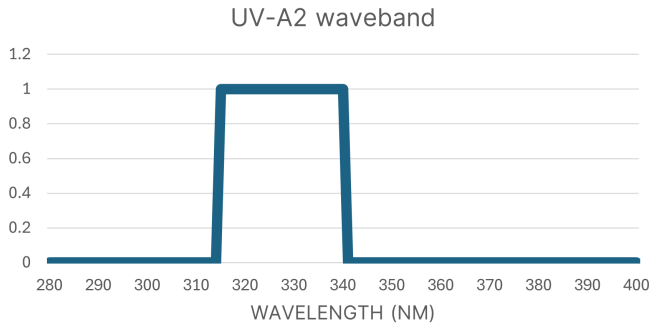
UV-A1 Dosimeter

The UV-A1 dosimeter measures the solar dose in the UV-A1 waveband, i.e. the part of the UV-A waveband with wavelengths between 340 nm and 400 nm. This part of UV-A goes deeper into the skin, being less involved in causing superficial reactions (e.g. erythema) but causing DNA damages that are correlated with skin ageing and skin cancer risk. But on the other hand, UV-A1 can be used for phototherapy of a number of skin diseases, including atopic dermatitis and sclerotic skin diseases.



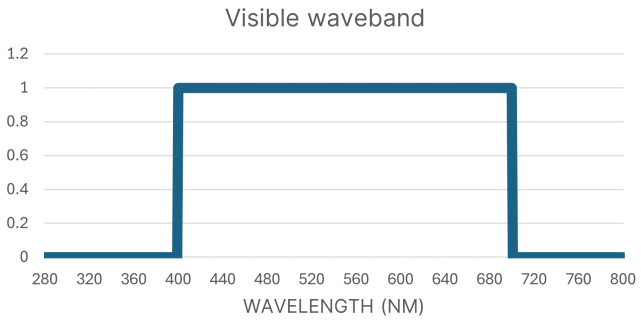
UV-A2 Dosimeter

The UV-A2 dosimeter measures the solar dose in the UV-A2 waveband, i.e. the part of the UV-A waveband with wavelengths between 315 nm and 340 nm. The UV-A2 radiation penetrates less into the skin with respect to UVA1, so it contributes more to superficial reactions like erythema, but it can also contribute to skin aging and DNA damage. It's not typically used for phototherapy, since it has a very similar effectiveness to UV-A1 but more side effects particularly on the short term (e.g. erythema).



Visible Dosimeter

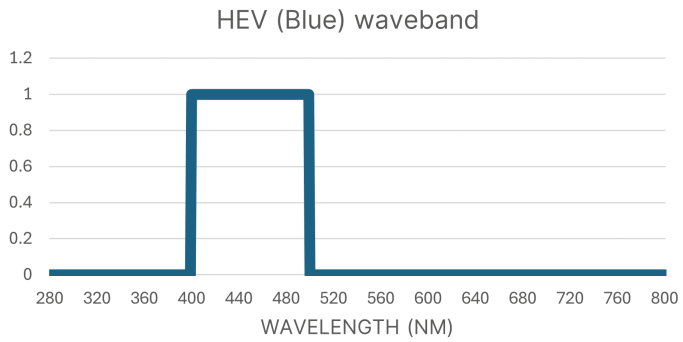
The Visible dosimeter measures the solar dose in the visible waveband, i.e. the part of the solar spectrum ranging from 400 nm and 800 nm that is considered visible to human eye. Apart from human vision, this part of the solar radiation has other important effects. Indeed, it seems to play a relevant role in myopia prevention (particularly in children and teenagers) and it's essential for skin phototherapies mediated by visible-activated photosensitisers, such as the Photodynamic Therapy (PDT).



Moreover, the visible solar radiation incident on the skin has an impact on skin damage by inducing reactive oxygen species (ROS) that contribute to skin ageing (photoageing) and pigmentation issues, e.g. hyperpigmentation (darkening of skin) and melasma (dark patches on the skin) particularly for people with darker skin tones.

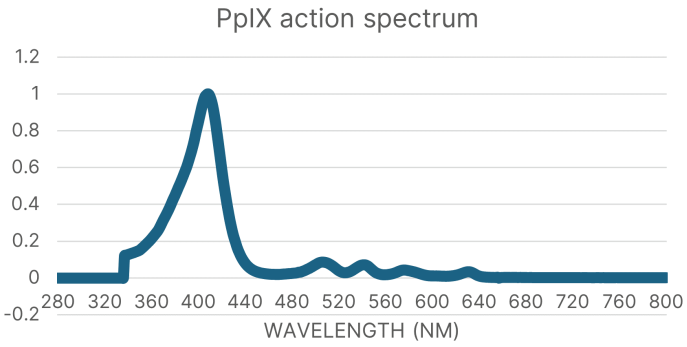
HEV (Blue) Dosimeter

This dosimeter measures the exposure dose to High-Energy Visible (HEV) solar radiation. This part of the solar spectrum is in the blue/violet waveband from 400 nm to 450 nm, and it has several photobiological effects. In particular, HEV radiation has an impact on circadian rhythm (and its potential disruption), it poses risks for retinal health and it can cause skin damages. Indeed, HEV light can penetrate farther into skin than UV light, causing deeper damage that eventually shows up as premature skin aging (photoageing), wrinkles, uneven pigmentation, rough texture and brown spots. Anyway, even if HEV light can damage the skin in several ways, it can also support the treatment of some skin dermatoses.



PpIX Dosimeter

This dosimeter measures the PpIX-effective solar dose, i.e. the exposure dose to the solar radiation that is absorbed by Protoporphyrin IX (PpIX), that is a photosensitiser commonly used in Photodynamic Therapy (PDT). PDT is a skin therapy that can be used to treat Actinic Keratosis (AK), Bowen's disease, acne and other diseases as well as for skin photorejuvenation. In this case, the spectral solar radiation is weighted with the PpIX absorption spectrum taken from Taniguchi and Lindsey (2018), that has a peak in the blue part of the solar spectrum (around 450 nm).



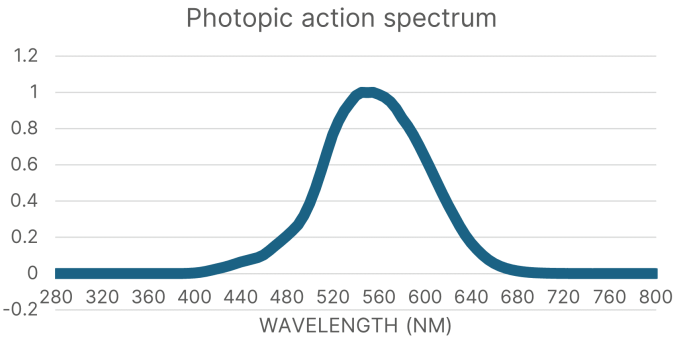
The accuracy of ExpoDose in assessing the PpIX solar dose was scientifically validated in collaboration with the National Health Service (NHS) in the UK, as reported in the following publication:

- McLellan LJ et al. (2020) Photodiagnosis Photodyn Ther 31, 101914

Also in this case, the accuracy of ExpoDose resulted 90% or higher (R correlation coefficient) when inter-compared with ground-based measurements performed by the NHS (calibrated spectroradiometer for assessing PpIX-weighted solar irradiance) in all weather conditions.

Photopic Dosimeter

This dosimeter measures the photopic-effective solar dose, i.e. the exposure dose to the solar radiation visible to human eye (photopic radiation). In this case, the spectral solar radiation is weighted with the photopic action spectrum according to the CIE 018:2019 standard, that expresses the relative effectiveness of different wavelengths in causing a biological response (vision) of the human eye, having a peak in the green-yellow part of the solar spectrum (around 555 nm).



Automatic Indoor – Outdoor Detection

The ExpoDose app includes an AI-powered system for automatically detecting when a smartphone user is indoor or outdoor throughout the day, called "AutoIOD". It's based on the continuous processing of the signals measured by the smartphone sensors (e.g. satellite geo-location, air pressure, motion) and it works in background even when the app is not in use, such as when the smartphone is left in a pocket or purse. The detection accuracy of AutoIOD was validated scientifically in the frame of a study conducted by the Dermatology Department of the University of Brescia (Italy), resulting to range from 84% (iOS) to 92% (Android) on average.

Minimum requirements for the ExpoDose app

Operative System (software) requirements

- iOS: iOS 13.4 (released in 2020) or later
- Android: Android 6.0 (released in 2017) or later

Device (hardware) requirements

In general, the app works correctly on any smartphone device released in the last 5 years, as far as all the smartphone sensors necessary for the indoor/outdoor detection (i.e. location, pressure, motion sensors) are not disabled or broken in the device.

In particular, as tested directly by the siHealth team, ExpoDose works correctly on the following smartphones:

- iPhone 6s (2015) or later
- Huawei P8 (2015) or later
- Samsung Galaxy S6 (2015) or later
- Google Pixel 4a (2020) or later.