MeLi Dos

Metrology for wearable light loggers and optical radiation dosimeters

Going forward

February 2025 – July 2025

This period has been rich in progress for MeLiDos but also prepares the final year of the project, during which the deliverables are expected.

Update on device characterisation

In Work Package 1, significant progress has been made in developing and testing methods for characterizing solar UV dosimeters and wearable light loggers. These devices are intended for use in large numbers—worn by multiple individuals simultaneously or across repeated study campaigns—for both scientific and clinical research. Given their role in capturing time-series data of point-specific light exposure, it is essential that the characterization methods are not only accurate but also cost- and time-efficient.

- For solar UV dosimeters, the evaluation focused on key performance parameters such as directional response, linearity, robustness, and performance in measuring solar erythemal weighted irradiance, using both laboratory light sources and measuring against the sun.
- For wearable light loggers, the methods assessed included spectral and directional response, linearity, sensitivity to TLM and polarized light, limit of detection, and influence of temperature and humidity.
- The outcomes of these evaluations is being compiled into a Good Practice Guide, which outlines recommended methods, highlights challenges, and discusses limitations. The primary goal is to ensure traceability here, but it became even apparent that more research is needed to transfer these characterization results to error evaluation in the field.
- Additionally, selected findings were presented at the CIE JTC 20 meeting in Vienna (July 2025), contributing to the ongoing international dialogue on wearable alpha-opic dosimetry and light logging standards and ensuring recommendations from both JTC20 and MeLiDos complement each other.

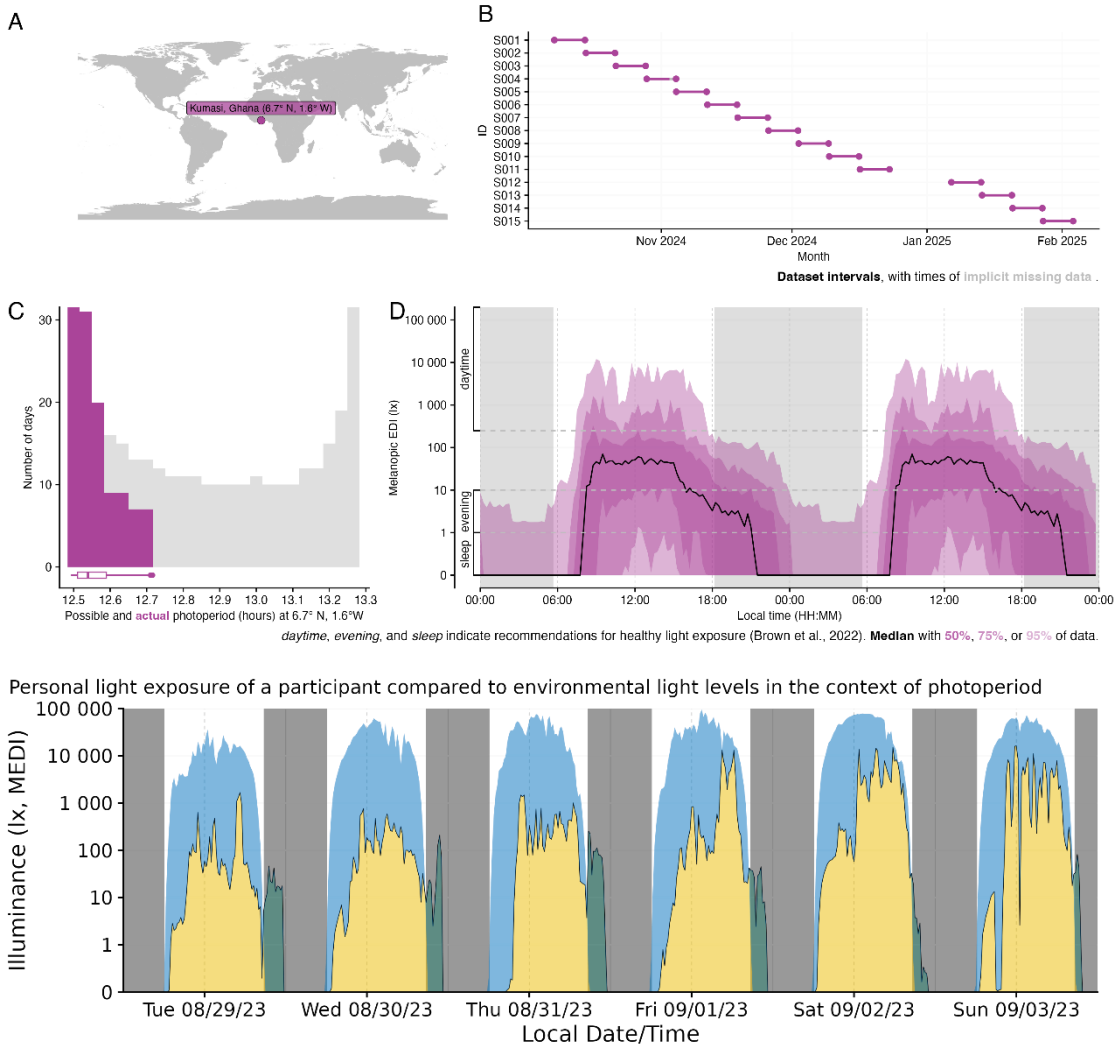
The next step will involve an inter-laboratory comparison to validate the proposed characterization methods and ensure consistency across different testing environments.

Field data collection

Data collection is nearing the end of its process. Almost all partners have reached the required minimum number of participants and we are excited to have gained a new external collaborator and geographical site: Andrea Sancho from the University of Costa Rica (UCR) started data collection following the MeLiDos protocol and contacted the project for guidance and to contribute data. This is a tremendous gain for the project, expanding the six sites in Europe and Africa (Sweden, Netherlands, Germany, Spain, Turkey, and Ghana) to the Americas.

- Data collection for the sites in Ghana, Turkey, and Spain was successfully wrapped up, with each site collecting a rich dataset from a minimum of 15 participants with a week's worth of data each. These datasets will be published one by one and brought into a FAIR structure (Findable, Accessible, Interoperable, Reusable). The Ghana dataset from Akuffo et al. is the first (see image), and is openly available under a permissive CC0-1.0 license.
- LightLogR v0.9.2 Sunrise was published and extends the wide range of analysis functions for data from wearable light loggers with over twenty new functions and metrics, and a slew of articles and tutorials. LightLogR is a one-stop shop for everything to do with data from wearable data, from import, cleaning, processing, visualizing, and metric calculation. It now makes these tasks even more powerful with new visualization functions, the ability to reconstruct light spectra, adding photoperiod information (see image), and searching for conditions in the data based on duration (cluster finding).
- LightLogR is now also citable as a paper, as the software was published in the Journal of Open-Source Software (JOSS), available here.
- Personal light exposure data exhibit special distributional properties that make them challenging to analyse. One such example is the logarithmic nature of the data and an excess of zero-lux measurements (i.e. complete darkness). In the publication „How to deal with darkness: modeling and visualization of zero-inflated personal light exposure data on a logarithmic scale", the authors from the MeLiDos project go into detail on how to handle these data with scientific rigor. The tools and methods described there are also already integrated into LightLogR 0.9.2 Sunrise.

A webinar for the use of LightLogR is planned in the future along with the release of its version 1.0. Once a date is selected, invitations will be communicated through the website, diffusion list for stakeholders and other channels available to the project.



Data glance of Ghana's data collection. Several other datasets have been published on Zenodo, accessible from our website.

Research for the future

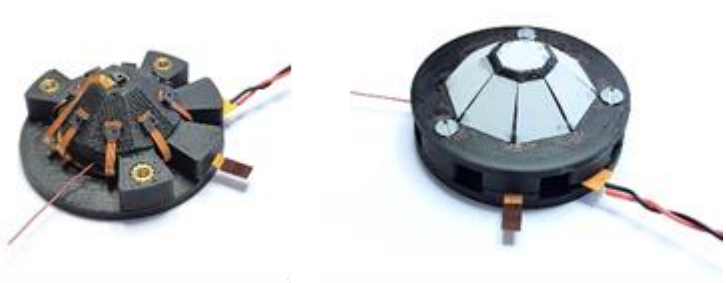
The WP3 team, working on the future technological development of wearable light loggers, is currently prototyping spatially resolved light loggers. A low-cost, spatially resolved wearable light logger, called **αΩ-meter**, based on a commercially available RGB camera has recently been developed by Frederic Rudawski at TU Berlin. In order to go one step further and approximate better the α-opic action spectra, the WP3 team decided to develop new prototypes with more than three spectral channels. Based on the previous evaluations, three different approaches are currently pursued:

- Iberoptics is working on a camera-based light logger where a micro-array of six different spectral filters and a micro-lens array are placed in front of the camera's pixel array. In this way, six images corresponding to six different spectral channels are obtained from the camera, which is read out by a microcontroller. Currently, the work focusses on the selection of suitable spectral filters and the data post-processing.

- METAS is developing a light logger prototype based on nine multi-spectral sensors, with 11 spectral channels each, mounted on a 3D-printed holder with different directional orientations. One sensor sits at the centre facing front, whereas the other 8 sensors are equally distributed around the centre at an angle of 45° with respect to the optical axis of the central sensor. All sensors are covered with a sheet diffuser to avoid directional-spectral correlations. The sensors are connected to a microcontroller by means of a flexible PCB. At the moment, METAS is improving and characterising their two prototype devices.
- INEGI follows a similar approach as METAS, however, the multi-spectral sensors are arranged in-plane and the spatial resolution is achieved by using a lens in front of the sensor array. The design of the PCB for this device has been completed and the device will be assembled and tested in the next few months.

The camera-based approach by Iberoptics will give access to metrics like the distributional homogeneity index or help with the environment identification and source type detection, however, only achieve a small field of view due to limitations connected with the micro-lens array. On the other hand, the approaches followed by METAS and INEGI only have a low spatial resolution (nine pixels), but can cover a larger field of view and potentially approximate better the α-opic action spectra as well as V(λ).

In the forthcoming months, the WP3 team will finalise and characterise their prototypes before comparing them with the spatially averaging devices investigated in WP1, trying to match some metrics and also list key differences in their characterisation.



Prototype of a spatially-resolved light logger in development by METAS, diameter of 44 mm

The project's dissemination activities and events

January 2025 – July 2025

The **activities** by the members of the MeLiDos consortium keep making visible the objectives:

January 2025 (GEF) + May 2025 (CIE) 	REUNIÓN DEL GRUPO ESPAÑOL DE FOTOBIOLOGÍA - Academia Española de Dermatología y Venereología + LI Simposium Nacional de Alumbrado - CEI - Comité Español de Iluminación Metrology for portable light recorders and optical radiation dosimeters. progress in the development of the project.
July 2025 	CIE Midterm Meeting in Vienna, July 2025. https://vienna2025.cie.co.at/ Showcase of MeLiDos data collection in an **oral presentation by Sofía Melero (FUSP-CEU) "Exploring daily light exposure: documenting real-life data with personal light loggers in Spain".**
July 2025 	CIE TC meetings Light dosimeters were also discussed during the Division 2 annual meeting, again highlighting the need expressed by CIE for standardised Light dosimetry. During the JTC 20 meeting chaired by Manuel Spitschan from WP2 leader TUM, progress in WP1 and WP2 were presented for discussion by Fabien Eloi (LNE) and David Baeza (FUSP-CEU) along with a showcase of the LightLogR software Johannes Zauner (TUM). Fruitful discussions related to the difficulties of calibration for field applications (lab vs scene based) were carried out. During RF08 hosted by David Baeza (FUSP-CEU), discussions regarding the circadian rhythm of the skin sparked interest. Light dosimetry is expected to also be important for future research on human physiology,

Upcoming events

- MeLiDos participants will present results at the ecuvm 2025 conference on Solar UV monitoring and personal UV exposure in Vienna, on September 9 to 11.

Vienna 2025

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