

# A distribution and archiving system for Solar UV data

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## ABSTRACT

SUVIM is a Belgian Institute for Space Aeronomy (IASB-BIRA) network of stations measuring UV solar radiation with several instruments at each station. The described system distributes all the original SUVIM data obtained since 1993, it is also a mirror of the original archive which previously was not accessible to outside users.. The developed tools correspond both to a need of the existing SUVIM users and to the specifications of the ULISSE FP-7 project. Different graphical interfaces facilitate the retrieval of data by the user. In particular remote users may create compressed download files regrouping instrument data by instrument or by day or months in order to have rapid data transfer. The described system is compatible with the security requirements of both the Belgian Institute for Space Aeronomy and the USOC network.

Keywords: Solar ,ultraviolet, radiation, archive.

## INTRODUCTION

The Belgian Institute for Space Aeronomy initiated since the early nineties [1] [2], a network of stations delivering a set of operational parameters to the public including the UV index. This network now is composed of five stations combining several instruments monitoring both solar radiation and meteorological parameters.

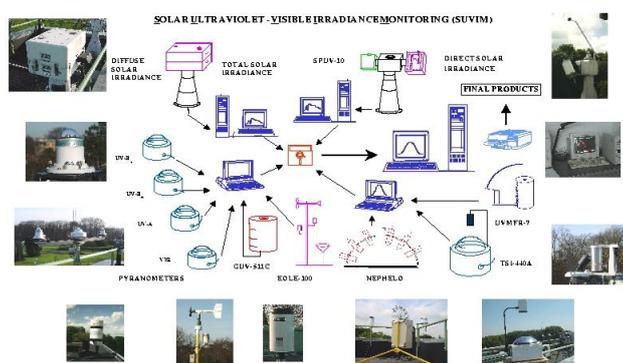


Figure 1: Description of the complement of ground-based instruments, these instruments measure spectral irradiance, spectral bands and total radiation both on the direct sun and in diffuse radiation.

## DATA DESCRIPTION

The stations operate all year in Ostend, Mol, Uccle, Redu and Virton. The data from a sixth station in Belgium (Mont Rigi, at a higher altitude near the German border) will soon be added to the collection. Data are also collected at a station in Diekirch in Luxembourg but are not yet in the current database. The stations are automatic but instruments could be from time to time off due to local problems or scheduled maintenance, the compliment of instruments is standardized at each station. Uccle, as the main station, has some more instruments used either for more scientific studies or for the validation of the complete set. The network distributes averaged and derived products through an operational web site: (<http://www.aeronomie.be/en/topics/interplanetary/solarradiationdetail.htm>).

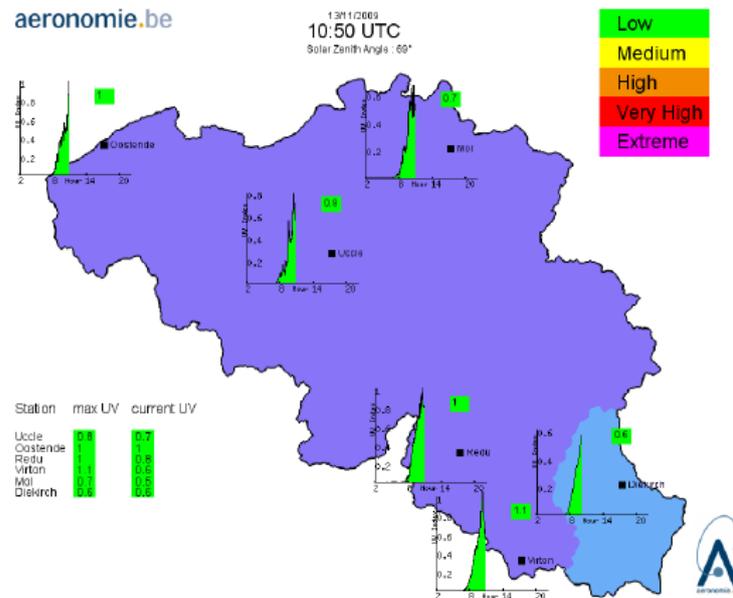


Figure 2: Screen capture showing the UV index for each of the stations at the time of acquisition.

The different instrumental outputs are recorded in the FLEXTOR format which the network uses since its participation in the European FP-4 SUVDAMA and EDUCE projects in the middle nineties [3]. This format has the advantage of providing a detailed header which can be used for the production of metadata. Its disadvantage is that its use has become limited and its documentation is no longer maintained. The original data were not originally intended to be distributed as their main interest is in scientific analysis and in the derivation of new products.

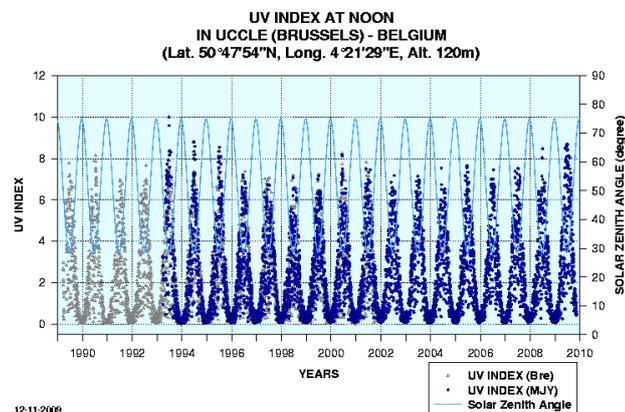


Figure 3: series of UV indexes at noon from Uccle.

<b>Year: Uccle station</b>	<b>Data type</b>
1993	Spectral irradiance data
1994	Spectral irradiance data
1995	Spectral irradiance data + UV-A, UV-B and total irradiance.
1996	Spectral irradiance data + UV-A, UV-B ,total and direct irradiance.
1997	Spectral irradiance data + UV-A, UV-B ,total and direct irradiance.
1998	Spectral irradiance data + UV-A, UV-B ,total and direct irradiance.
1999	Spectral irradiance data + UV-A, UV-B ,total and direct irradiance.
2000	Spectral irradiance data + UV-A, UV-B ,total and direct irradiance.
2001	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance
2002	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance
2003	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance
2004	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, UV data obtained by supplementary Bentham instr.
2005	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, UV data obtained by supplementary Bentham instr., diffuse UV.
2006	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, UV data obtained by supplementary Bentham instr., diffuse UV.
2007	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, diffuse UV.
2008	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, diffuse UV.
2009	Spectral irradiance data + UV-A, UV-B ,nebulosity, total and direct irradiance, diffuse UV.
2010 and further	Spectral irradiance data + UV-A, UV-B, nebulosity, total and direct irradiance, diffuse UV. There is no planned date for the end of the service.
Note: Bentham instrument	The Bentham data is now included in the 2007, 2008, 2009, 2010 and further files, this instrument is to become the standard for solar irradiance climatology.

Table 1: Uccle data showing instrument evolution

## Distribution of the data

All the original data is stored in FLEXTOR format on a secure server of the Belgian Institute for Space Aeronomy (BISA), this server may not be accessed from the outside and creating files on the server is a very restricted operation even for inside users. B.USOC owns also servers for which an even tighter security is enforced to satisfy ESA requirements, so to consider manipulating and distributing the data, B.USOC had to procure a server outside the B.USOC-BISA firewall to be used for both the distribution of data and the preparation of compressed data sets A mirror of the original data on the distribution server is refreshed every day at 1 a.m. so that the BISA server is never used for other manipulations than receiving new data from the stations. This operations is part of the preservation objective because it constitutes a daily check of the integrity of the original archive.

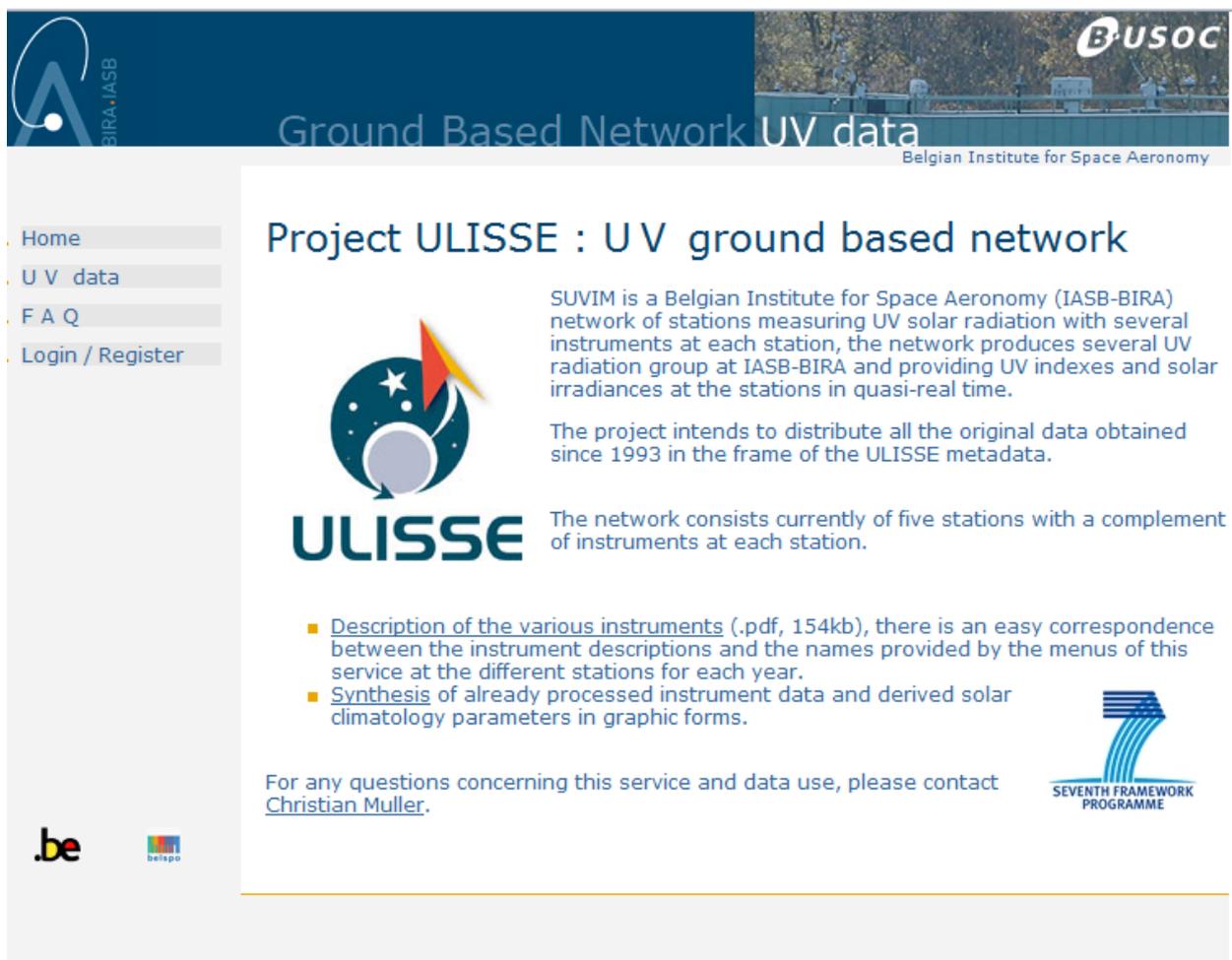
As the data is fully the property of BISA and as it was validated through several European programmes, SUVIM was chosen as a demonstration case for the FP-7 ULISSE [4] programme which studies the distribution and preservation of space data through the

### First step: ftp data distribution.

The server can be accessed directly by FTP on <ftp://ulisse.busoc.be/> There, an experienced user can retrieve all the files of the archive, this could have been a sufficient step for distribution if a tool like SI TOOL were used. However, the periods of missing data can make this retrieval more complicated and it was decided to develop a graphical interface.

### Second step: graphical interface.

The graphical interface is based on a PHP manipulation of the headers of the FLEXTOR files so that the user can only request existing data, it can then be used in ULISSE using the GEONETWORK programme to produce metadata. Figure 5 shows a schematics of this interface. This graphical interface corresponds also to an internal need of the current SUVIM data users which was not fulfilled by the previous products developed in earlier programmes. As the user has the possibility to produce a compressed file with grouped requested data, the user has to register to avoid server abuse. A third solution involving the inclusion of the archive in a MySQL data base and the direct production of metadata was not pursued for the sake of homogeneity of approach in the ULISSE project.



The screenshot shows the home page of the ULISSE graphical interface. At the top, there is a banner with the BIRA-IASB logo on the left and the BUSOC logo on the right, with the text 'Ground Based Network UV data' and 'Belgian Institute for Space Aeronomy' below it. The main content area is titled 'Project ULISSE : U V ground based network'. On the left, there is a navigation menu with links for 'Home', 'U V data', 'F A Q', and 'Login / Register'. The main content area features the ULISSE logo, which consists of a stylized globe with a star and a red and yellow flag. To the right of the logo, there is text describing the SUVIM network: 'SUVIM is a Belgian Institute for Space Aeronomy (IASB-BIRA) network of stations measuring UV solar radiation with several instruments at each station, the network produces several UV radiation group at IASB-BIRA and providing UV indexes and solar irradiances at the stations in quasi-real time.' Below this, it states: 'The project intends to distribute all the original data obtained since 1993 in the frame of the ULISSE metadata.' Further down, it says: 'The network consists currently of five stations with a complement of instruments at each station.' There are two bullet points: '■ [Description of the various instruments](#) (.pdf, 154kb), there is an easy correspondence between the instrument descriptions and the names provided by the menu of this service at the different stations for each year.' and '■ [Synthesis](#) of already processed instrument data and derived solar climatology parameters in graphic forms.' At the bottom left, there is contact information: 'For any questions concerning this service and data use, please contact [Christian Muller](#).' At the bottom right, there is the logo for the 'SEVENTH FRAMEWORK PROGRAMME'.

Figure 4: The home page of the ULISSE graphical interface.

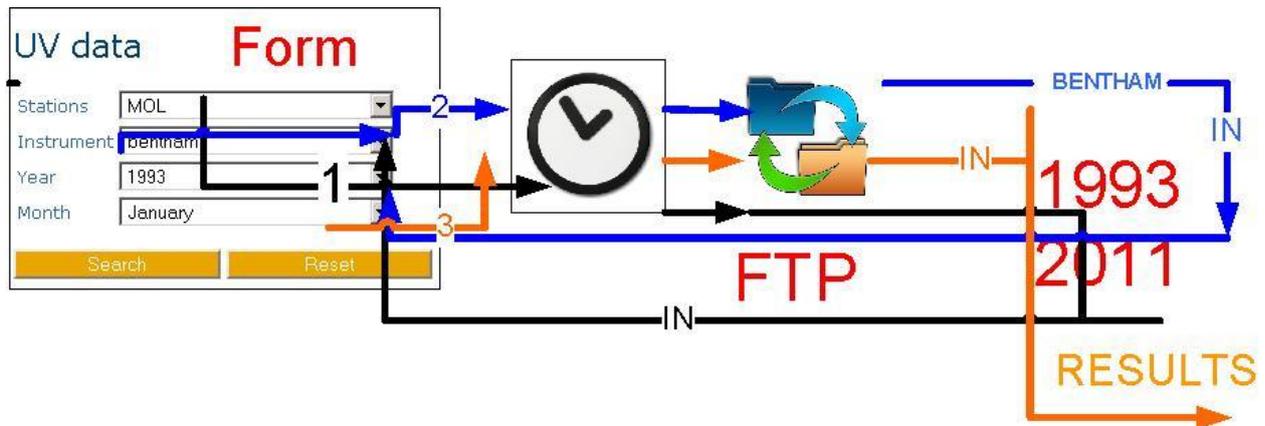


Figure 5: data flow in the user interface, the user communicates through the forms and produces the results only if the requested file exists at the interrogated station.

## EXTENSION TO OTHER DATA SETS.

The ULISSE FP-7 programme is intended to produce distribution and preservation tools for the data stored in the USOC network and corresponding to results acquired aboard the International Space Station and other spacecrafts related to the USOC activities. The COLUMBUS module of the space station carries the SOLAR package, a set of three instruments operated from B.USOC and ultimately, their data should also be part of their distribution scheme. This is not yet done because the different PI's of the solar package prefer to distribute only fully validated and verified data, ESA has recently granted USOC's the right to distribute data and thus the release can be prepared, its first step will be to order the recorded data in a data base. Practically, it would require to replay the entire mission using the data acquisition programme and to archive the replayed parameters to which a treatment similar to the SUVIM interfaces can be then applied. The same process can be applied to solar radiation data obtained by other space instruments as for example SCIAMACHY on ENVISAT as well as the solar intensity data from PROBA-2 or PICARD. Again, these evolutions require the organization of the data sets in an archive and the subsequent generation of metadata. The final use would be to develop a solar status product which could be directly use for scientific studies or even be assimilated in a model to perform forecasts of the solar output

## CONCLUSIONS: PRESERVATION AND DISTRIBUTION.

The current action achieves two objectives: first, it makes accessible to users data sets which were previously not available and allows the user to analyse the data in original ways compared to the original plan determined almost twenty years ago; second by exercising the data base every day at the synchronization time, it provides a check on status and contributes to preservation of the data.

The final objective will be the use of the data in climate and space weather models. The sun constitutes the overwhelming energy input to the climate system and its variations constitute an important forcing, space weather, related to high energy solar radiations constitute a hazard for human activities by disrupting communication. Space weather effects on biological phenomena including human health are

still the object of speculation and the cross-checking of various data sets allowed by this action and wider projects like ULISSE.

## **ACKNOWLEDGEMENTS**

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