A distribution and archiving system for Solar UV data

C. Muller [(1)], D. Gillotay [(2)], D.Moreau, [(1)], C.Depiesse[(2)],A. Muller [(1)]

B.USOC-IASB-BIRA

Avenue Circulaire, 3, 1180 Brussels, Belgium

Christian.Muller@busoc.be

[(2)] *IASB-BIRA*

Avenue Circulaire, 3, 1180 Brussels, Belgium

Didier.Gillotay@aeronomie.be

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.

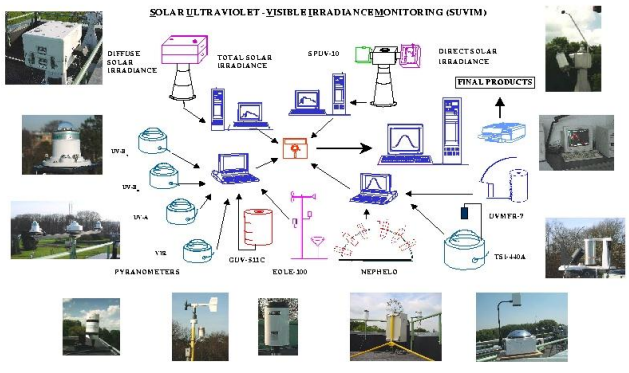

Figure 1: Description of the complement of ground-based instruments, these instruments measure spectral irradiance, spectral bands and total radiation both on the direct sun and in diffuse radiation.

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).

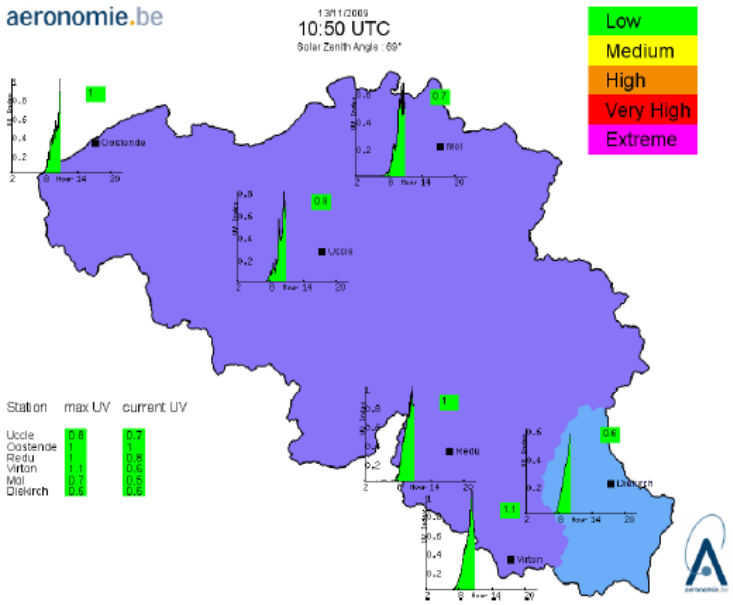

Figure 2: Screen capture showing the UV index for each of the stations at the time of acquisition.

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.

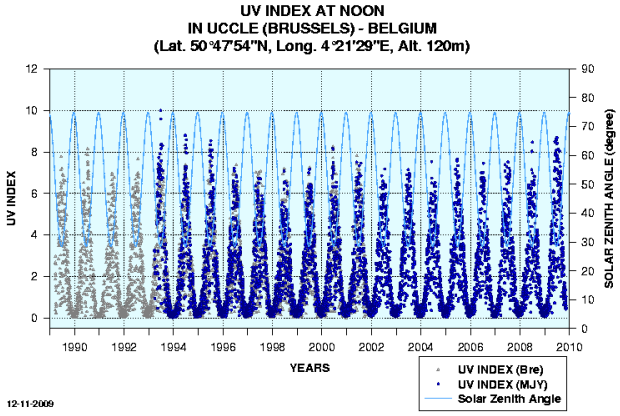

Figure 3: series of UV indexes at noon from Uccle.

Year: Uccle station	Data type
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 meta-data was not pursued for the sake of homogeneity of approach in the ULISSE project.

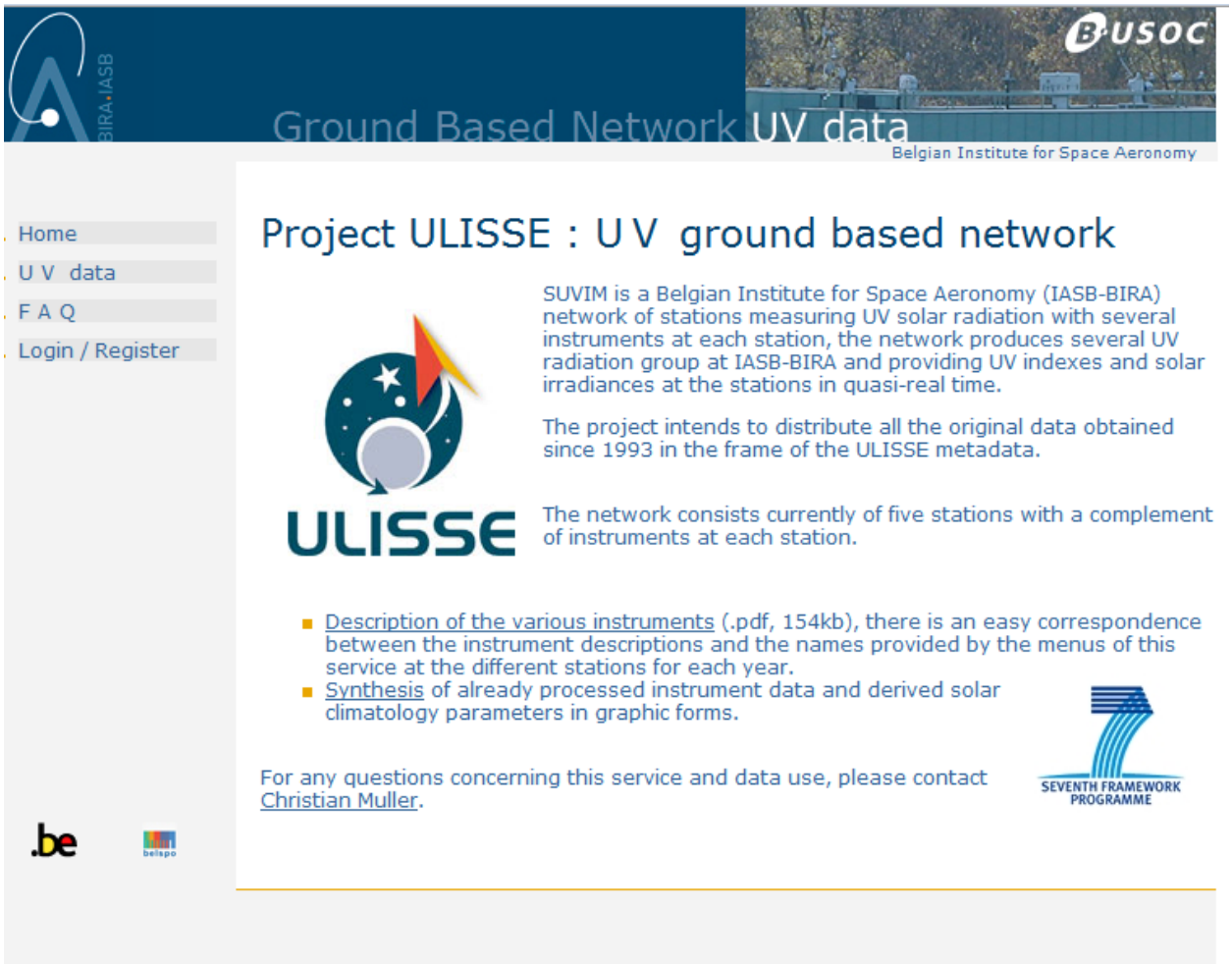

Figure 4: The home page of the ULISSE graphical interface.

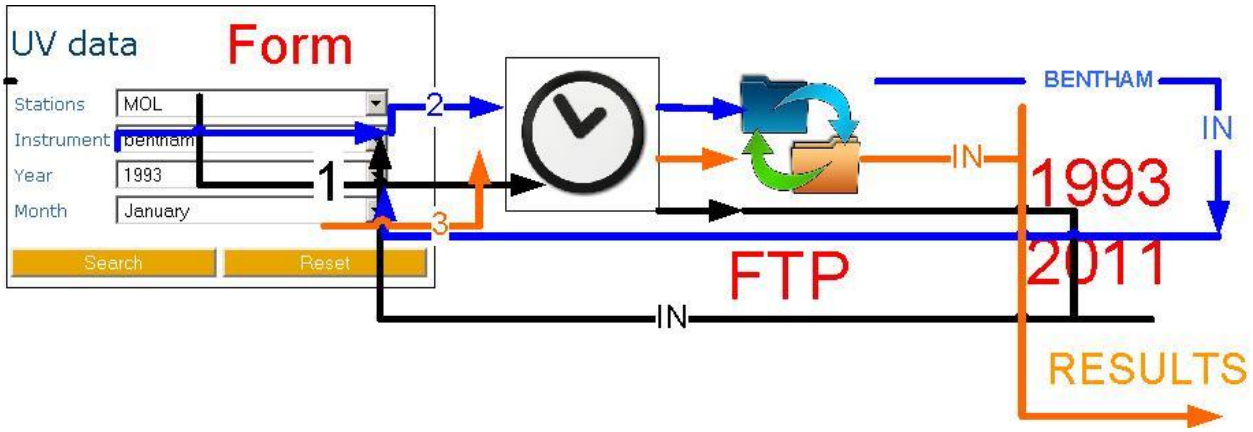

Figure 5: data flow in the user interface, the user communicates through the forms and produces the results only if the requested file exists at the interrogated station.

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

The following work was funded through the European Commission FP-7 ULISSE programme, the Belgian UV network was supported by European Commission SUVDAMA and EDUCE projects.

REFERENCES

[1] - Gardiner B.G., Webb A.R., Bais A. F., Blumthaler, M., Dirmhirn I., Forster P., Gillotay D., Henriksen K., Huber M., Kirsch P.J., Simon P.C., Svenoe T., Weihs P. and Zerefos C.S., 1993, European Intercomparison of ultraviolet spectroradiometers, Environ. Technol., 14, 25-43.

[2] - Gillotay D., 1996, UV monitoring in Belgium: Past, present and future. in Measurements and Trends of Terrestrial UVB Radiation in Europe, (Ed. B. L. Diffey), pp. 41-53.

[3] - Gillotay, D., and D. Bolsee , 2003, 14 years of UV monitoring in Belgium; A first approach of UV climatology Geophys. Res. Abs., 5, 14250.

[4] – Muller, C. and Moreau, D. , 2010, ULISSE : a knowledge management project for life and physical sciences from the. International Space Station., Origins of Life and Evolution of Biospheres, Volume 40, Number 6, 603-607.