BASS2000, database of Solar ground-based observations

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ABSTRACT

BASS2000 is a French Solar database archiving and distributing ground-based solar observations. At the beginning only French data were there, but quite soon it extended to other observations and added-values. It has been supported by the PNST (Programme National Soleil-Terre - National Sun-Earth Programme) since its beginning, in the mid-90s (1994, precisely).
Its access can be made through the following URL: http://bass2000.obspm.fr/home.php?lang=en.
BASS2000 gives access to several sets of observations, in visible, near infra-red and radio wavelength. It provides also several tools that are helpful for people dealing with the Sun and with stars. In this paper we want to present all that can be done - and how - using BASS2000 in order to help the users to optimise their use of the provided services.
BASS2000 can be referenced by users using its general DOI: https://doi.org/10.25935/yvm9-gk52.

Key words. Sun – Database – heliosphere – data access - virtual observatory – Observations

1. Introduction

BASS2000 has been first developped in the 90s in order to archive and distribute French solar observations in two locations:

- Meudon (near Paris) for full Sun and synoptic data
- Tarbes (in the Pyrénées mountains) for high resolution and high cadence data

At the time of this paper (2020), the Tarbes site of BASS2000 is closed, and only the Meudon site is maintained, which will be the only subject of this paper.. For more information concerning Tarbes site, the reader can refer to Meunier, 2007.

BASS2000-Meudon (hereafter BASS2000) is a French national facility with the label of INSU (Institut National des Sciences de l'Univers). It is also World Data Center for

Solar Activity, regular member of the World Data System of ICSU (International Science Council, https://www.icsu-wds.org/community/membership/regular-members) and has a Core Trust Seal certification (https://www.coretrustseal.org/why-certification/certified-repositories/).
This is a guarantee that data are controlled, in free access, and will be long-term archived.
At the time of this paper, BASS2000 provides data from five instruments:

- Meudon spectroheliograph
- Coimbra spectroheliograph
- USET-Brussels refractor telescop
- Climso Pic du Midi coronograph
- Nançay Decametric Array (NDA)

Nançay Radioheliograph (NRH) should appear in this list but the instrument is currently being renovated, at the time of this paper.
Former instruments data are also available, but we won't go deep in details about them:

- Meudon Heliograph: Refractor equipped with a Lyot filter with a 0.5 $\dot{A}$ bandpass, providing 3 images, in the centre of Hα line and + or - 0.5 $\dot{A}$.
- Pic du Midi Hα coronograph, a 150 mm diameter refractor with a narrow-band Hα filter and an occulting disk, giving observations of the solar corona.

Instruments will be describes in section 2.
Section 3 will explain the various query possibilities that users can take into account, including the use of Virtual Observatory (VO) tools.
Several added-values are available in BASS2000 web site. Let's mention the main ones:

- Solar Spectrum (section 4.1)
- Ephemeris (section 4.2)
- Synoptic maps of solar activity (section 4.3)

Some other resources will be described in section 5.

The Heliophysics Feature Catalogue (HFC), developed in the frame of the HELIO European project, has been included in BASS2000 and provides a daily picture of the solar features on the main page of BASS2000. We'll go further in HFC in section 6. Specific HFC queries will be described in this section.

In this paper, we shall present the state of BASS2000 as it is in 2020. If major modifications occur, we'll provide a new version of this paper. It can be used as a reference for BASS2000, using its DOI.

2. Full Sun

By 'full Sun', we mean observations that give a complete image of the solar disc or part of the solar corona, if the disc is occulted. The following subsections give a short description of the various instruments' observations hosted by BASS2000.
A short description of each instrument can be found in the following web page: http://bass2000.obspm.fr/instru_guide.php?lang=en (accessed through the GUIDES/Instruments item of the left menu).

2.1. Meudon

BASS2000 Meudon was first created in order to give access to spectroheliograph observations, but as time goes, new kinds of data have been proposed.

2.1.1. Spectroheliograph

Meudon spectroheliograph began observations in 1908. The instrument evolved during all that time but its functioning remains the same: slit and diffraction grating (providing a very narrow band observation). The latest upgrade of the instrument was in 2018. It provides every day - weather permits - the following observations:

- Hα (6562.8 $\dot{A}$) center of line, ± 0.5 $\dot{A}$ wings, prominence (an occulting disc hides the solar disc), and blue continuum (at central wavelenght - 1.5 $\dot{A}$)
- Ca II H3 (centre of line: 3968.5 $\dot{A}$), H1v (violet wing, -1.5 $\dot{A}$) and prominence
- Ca II K3 (centre of line: 3933.7 $\dot{A}$), K1v (violet wing, -1.5 $\dot{A}$) and prominence

Centre of line observations give images of chromosphere while line wings images show photosphere.

2.1.2. Variable wavelength heliograph

This instrument is currently not in use. If was providing movies at 3 wavelengths simultaneously: Hα line and ± 0.5 $\dot{A}$.

2.2. Nançay

Nançay radioastronomy station is a part of Paris Observatory. Two radio telescopes provide solar data, Nançay decametric array (NDA) and Nançay radio heliograph (NRH), which are partly distributed via BASS2000. Only a synthesis of daily observations are available there. The full resolution data can be accessed (quite soon for NDA) through the Radio Solar DataBase (RSDB, https://rsdb.obs-nancay.fr). ORFEES instrument (5m diameter antenna working between 130 MHz and 1 GHz) used for solar flares prediction, has its data available only in RSDB.

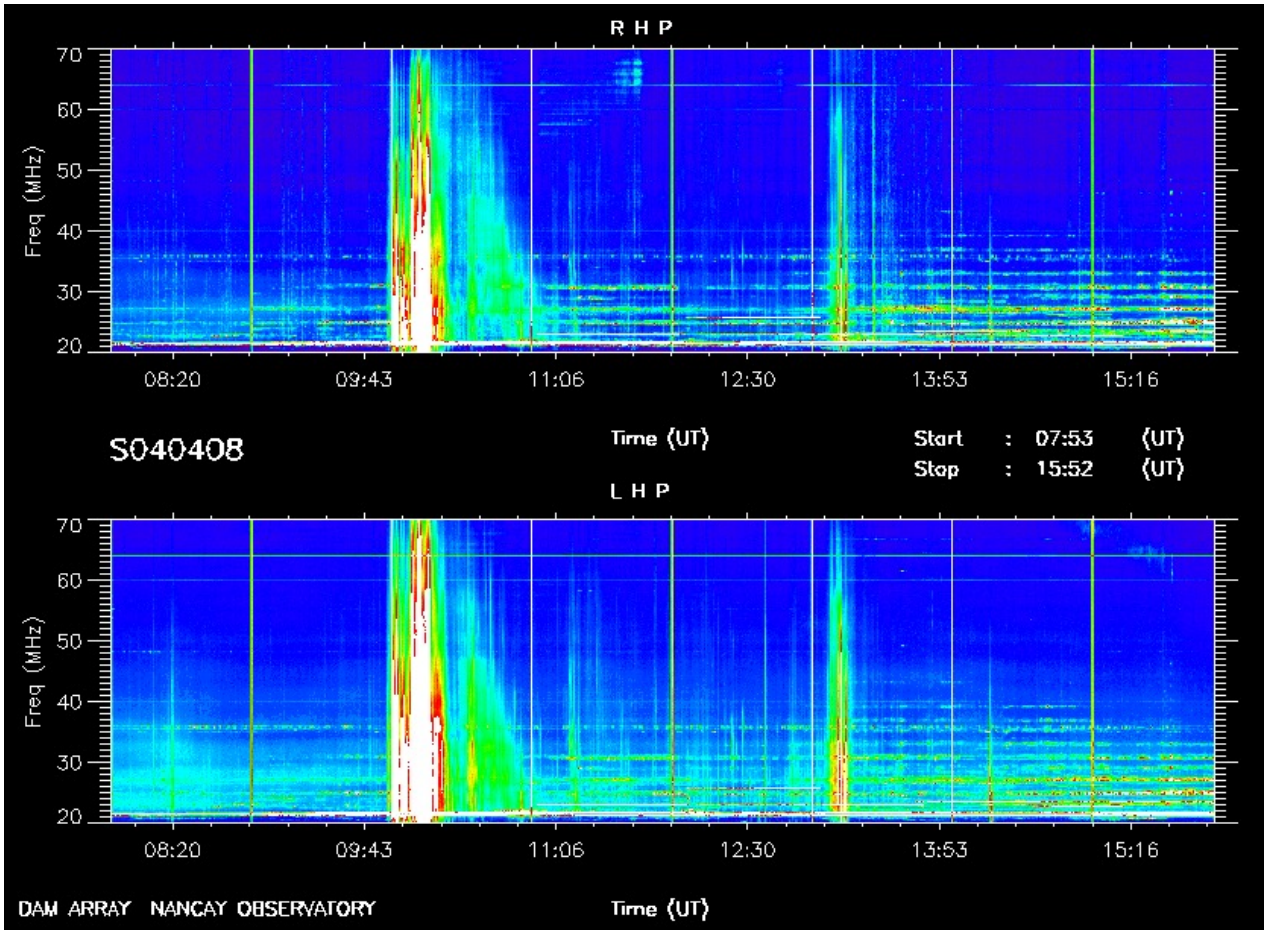

Fig. 1. Nançay Decametric Array observation. Dynamic spectra for both circular polarizations.

2.2.1. NDA

Fig. 1 shows a typical dynamic spectrum obtained by this instrument. It plots frequency (20 to 70 MHz) vs. time. This very low resolution plot gives an overview of the daily solar activity.

2.2.2. NRH

NRH provides observations at 164 and 327 MHz. At the time of this paper, the instrument is being repaired but we hope that no later than the end of 2020 it will again observe the Sun.

2.3. Coimbra

Coimbra is also a spectroheliograph of the same conception as Meudon's one. It is located in Coimbra in Portugal. More information about solar observations in Coimbra can be found in Lourenço, 2019.
The available wavelengths are Hα centre of line, violet wing and dopplergram, Ca II K centre of line (K3) and violet continuum (K1v).

2.4. Brussels

USET (Uccle Solar Equatorial Table), the instrument of Royal Observatory of Belgium, near Brussels, is a set of refractor telescopes. Its Hα observations, made with a narrow band filter, are available in BASS2000 daily, weather permits. More information about the instrument can be found in http://sidc.be/uset/.

2.5. Climso

CLIMSO instrument, located at Pic du Midi observatory (French Pyrénées) provides several observations every days. Only a few of them, in order to have a daily context, are available in BASS2000. To get full set of images, go to http://climso.fr.
The data available in BASS2000 are Hα full Sun and coronographic images, Ca II K integrated images and He I coronographic images

3. Description of web site and data search

3.1. Web site

Fig. 2 show the home page of BASS2000. The various parts of it are surrounded and numbered. Descriptions follow:

1 - **Fast query** It's possible here to enter directly the date one wants observations then click OK button to validate, and move day after day, forward or backward.

2 - **Language & Selection** First button toggles between English and French language. The second one goes to the selection page where user can find all the observations that have been previously selected, in order to download them.

3 - **Daily observations** All the available observations are showed on that part of the page.

- a - **Scroll** Just scroll there to have the various available observations appear in the window. If you want to see them all once at a glance, click on the small arrow and the window will extend.
- b - **Image info** Gives the date/time and kind of observation.
- c - **Data types** Here are listed all the available formats for data.
- d - **Observatory** Name of the observatory providing the observation.
- e - **Thumbnail** Thumbnail of the corresponding observation.

4 - **Home menu** Direct access to current data and information.

5 - **Query menu** Links to various more complex kinds of queries (see next subsection for the way to use it).

6 - **Tools menu** Gives access to utilities (see section 4).

7 - **Guides menu** Some information about instruments and data format.

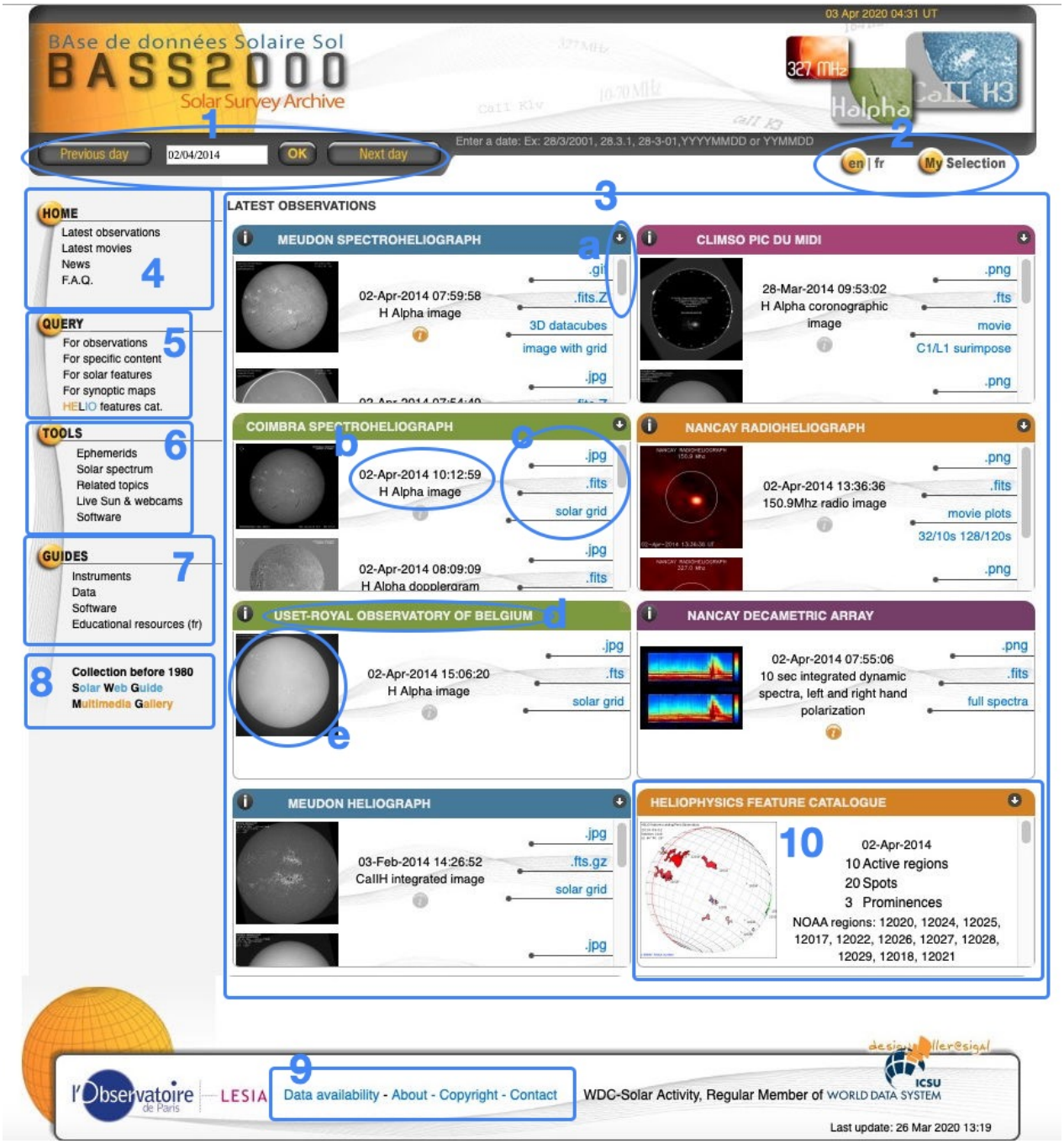

Fig. 2. BASS2000 home page. The numbers refer to text.

8 - **Others menu** Various links and acces to other solar data from Paris-Meudon observatory, including historical observations.

9 - **General information** All you need to know about the way to use the data.

10 - **HFC** Daily plot of the solar features, extracted from the Heliophysics Features Catalogue.

3.2. Data query

The easiest way to query data is the one mentioned above, in item 1, where you just have to enter the date in format dd/mm/yyyy and click OK. When you get the list of available observations, you can click on one of the proposed format and a new window will open with the image (if the format is compatible: fits files cannot be viewed, but only downloaded). The top of this new window is made of a header (see Fig. 3) giving information about the image. You can there add the image to your selection (don't forget to click the OK button after selecting this option). There is also a zoom factor that you can ajust from 1:2 to 2:1 (and click on the zoom button to make it effective).

Fig. 3. Header of the page where individual observations are plotted.

Another possibility consists in choosing the "QUERY/For observations" item on the left menu. There, you access a new page. The first part of the query interface is for date selection. You can choose either up to the 10 last days, or up to one month after a given date, or the period of visibility of an NOAA region.
The second query panel gives you the choice of the observed region of the Sun, or of the wavelength/frequency band of observation, or of instrument(s).
The third panel is for output organisation.
The lower query panel is the way to show all observations of one instrument for the **current** month. It means that if you are the 1st of April and you select this option, only the observations of that day will be obtained.

Another query form can be accessed using the left menu "QUERY/For specific content" item. Here again, the first part of the form is for the date. Here, you can also choose date by Carrington rotation number. The second panel let you choose the specific kind of observation you want (e.g. 164 MHz radio image, or Hα -0.5 $\dot{A}$ image, ...). In the third part of the query form you can select the kind of file format you look for (FITS, JPEG, ...).

Note that the detail of available data can be obtained using the link, at the bottom of the page, called '*Data availability*' which gives access to a web page giving for each kind of instrument's observation the beginning and end date, as well as a plot of it. This could help to build a valuable search in the database.

The "QUERY/For solar features" menu lets you build queries concerning a limited amount of features (faculae, spots, filaments and prominences) when available and obtain a map of the Sun with features as a disc or as a planisphere, with the corresponding tables giving some information about features, for a given date. The result is built either from the description of features obtained for Synoptic maps of solar activity, either from HFC, or from both of them when possible. When

the map of features is plotted from the data used for synoptic maps, a caption in it gives key-colours for R-1, R and R+1 rotations. This corresponds to the previous, current and next Carrington rotation because features can have their maximum extension not necessarily in the current one. This query form goes from 1990 up to now . For detailed information about features and the time range available, "QUERY/HELIO features cat." menu is more suitable.

The QUERY/HELIO features cat. menu will be detailed in section 6 devoted to HFC.

3.3. VO access

BASS2000 data are described using EPN-TAP protocol (Erard, 2014). The complete list of metadata, corresponding to the table information needed for *epn-core* can be found there:
http://voparis-tap-helio.obspm.fr/__system__/dc_tables/show/tableinfo/bass2000.epn_core.
And the TAP service that VO tools can use to query BASS2000 data is available at:
http://voparis-tap-helio.obspm.fr/__system__/tap/run/info

4. Tools and added-values

In this section, we'll only focus on the main services: Solar spectrum, Ephemerides, and Synoptic maps of solar activity.

4.1. Solar spectrum

The user can there enter a central wavelength, a range and click on 'OK' button in order to visualise the corresponding spectrum for quiet Sun. You can click on a location on the plot and a small window will open, containing main information about the spectral line you clicked on. Such as chemical element, energy levels of transition, ... Atomic and molecular information come from two sources:
NIST (National Institute of Standards and Technology) (web site: https://physics.nist.gov/PhysRefData/ASD/lines_form.html)
VAMDC (Virtual Atomic and Molecular Data Centre) (web site http://www.vamdc.org) which groups worldwide data providers, based on virtual observatory syntax and methods.

This spectrum is made of three parts:

– **UV**: From 760 to 1609 $\dot{A}$ obtained from the SOHO/SUMER instrument, with a resolution of 0.04 $\dot{A}$

– **Visible**: From 3000 to 10 000 $\dot{A}$ obtained from the Jungfraujoch observatory, with a resolution of 0.002 $\dot{A}$ (i.e. 500 pixelx/$\dot{A}$)

– **Infra Red**: From 10 000 to 54 000 $\dot{A}$ obtained from the Kitt Peak observatory, with a resolution varying respectively from 0.005 to 0.1 $\dot{A}$.

Note that the spectra are in vacuum wavelengths. As the UV spectrum is obtained from space, there are no atmospheric lines in it, but for other wavelength ranges obtained from ground-based observatories, atmospheric lines appear.
Visible and IR spectra give intensity as a percentage of the local quiet Sun. The case of UV spectrum is more complex and the user must refer to Curdt, 2001.

At the end of the page is proposed a pdf version of the solar spectrum between 380 and 870 nm, including line identification and Lande factors. This spectrum has been compiled by Jean-Marie Malherbe (Paris Observatory), based on Delbouille, Neven and Roland solar atlas, with line and Lande factors deduced from Charlotte Moore (1971).

4.2. Ephemerides

This link leads to a page where user can get standard solar ephemerides of the Sun. Just enter date and time, and you'll get usual solar parameters: Carrington rotation (with its start and end dates), longitude of the central meridian , B0 and P angles.

4.3. Meudon synoptic maps of solar activity

Meudon synoptic maps of solar activity give on a single image an overview of the activity of solar features (faculae, filaments and sunspots) during a whole Carrington rotation. Filaments are not directly plotted. What is drawn is a synthesis of their behaviour: the more green is the plot, the more steady was this part of the filament. Active regions (sunspots + plage) are shown at their activity maximum (i.e. maximum sunspot area or, if no sunspot, maximum plage area). Detailed explanation can be found following "GUIDES/Data" item of the left menu.

The first synoptic map begins on March 16th, 1919 and the last one ends on October 23d, 2003, with a gap between end of 1991 till end of 1997, due to both a strong upgrade of Meudon spectro-heliograph and building of a semi-automatic method to draw the synoptic maps.
An example of synoptic map is given in Fig. 4.
The associated tables, for filaments, appear also on the web page. A scroll bar lets you list all the filament's information, which is most of the time quite long.. Plots and table can be downloaded, or added in "My Selection".

5. Other resources

We refer here to item of the left menu after the "GUIDES" title.

5.1. Instruments' description

Following this link brings your to a web page where all the instruments that have provided or are providing data to BASS2000 are listed. By clicking on one name you get a short description of the instrument. In most of the cases, you find there links to more detailed information about it.

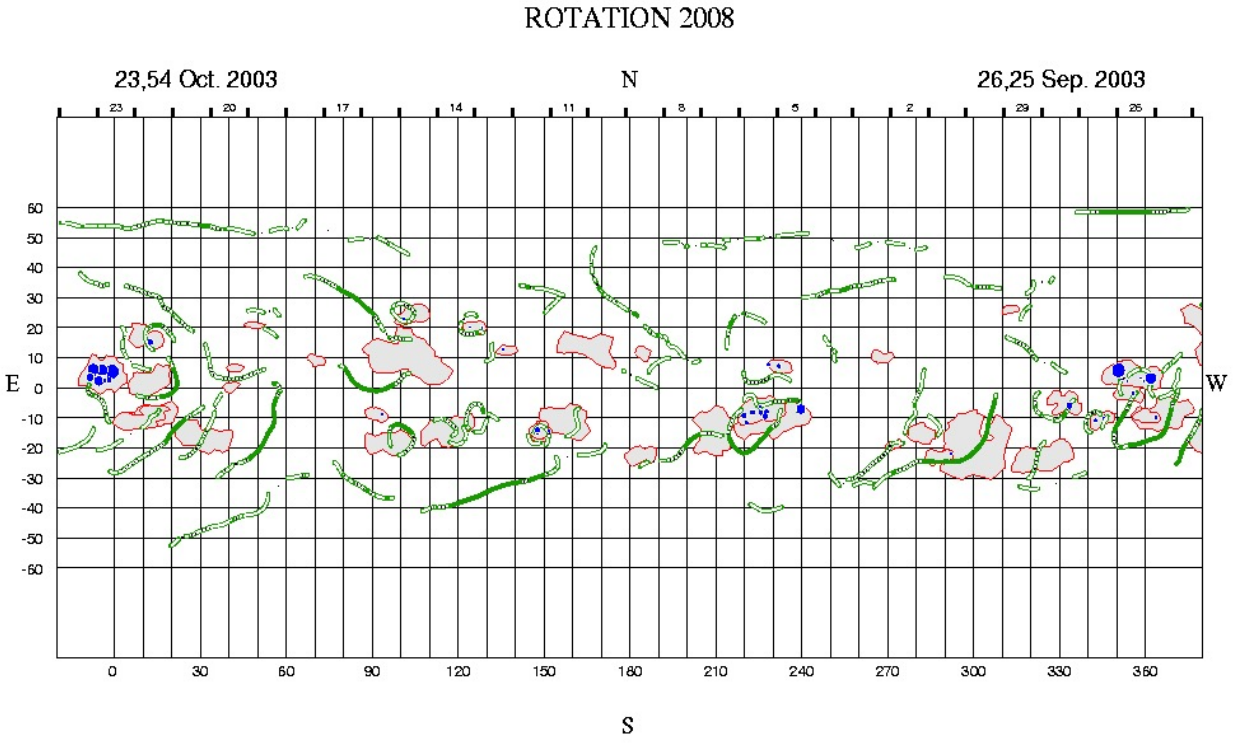

Fig. 4. Example of a typical Meudon synoptic map of solar activity. This one is the last one of a long series, begining in 1919. Green features give a synthesis of filaments' behaviour during the Carrington rotation; red-circled gray zones correspond to faculae at their maximum development during the rotation; blue dots are sunspots at the same time as faculae.

5.2. Data description

This link gives you a full description of the way data are organised in the files you download, including information about the header's content.

5.3. Softwares

It is possible there to find softwares that can do some specific process on data. At the time of this paper, it only concerns spectroheliograms.

5.4. Educational resources

This link gives access to various educational resources, but only in French. It concerns general information about the Sun for everyone, Solar physics and Optics for Master students, and history of solar observations for everyone.

5.5. Multimedia galeria

Following this link gives you access to various photographic albums, concerning the Meudon site of Paris Observatory as well as old solar images. It is there, in the Spectroheliogram album, that you can find scans of old spectroheliograms. The oldest one is from Septembre 21st, 1870. Starting in 1905, a quite continuous set of observations is available except during World War I.

5.6. THEMIS

THEMIS is a 1m-diameter spectropolarimeter telescope located in Canarie Islands, Tenerife, in Teide Observatory (http://161.72.34.10/dokuwiki/doku.php).
Observations were archived and distributed by the Tarbes component of BASS2000, which is now closed. So the observations have been transfered in Meudon.
It was not possible to maintain the THEMIS database, which was huge and very complex, so we only archive data. But the user who needs specific observations can get it the following way:
Choose the ”GUIDES/Instruments” item from the left menu.
Choose either ’SPECTRA: The THEMIS-MTR instrument’, either ’MSDP: The THEMIS-MSDP instrument’ in the list of instruments * Click on ”Data archive (1999 to 2010)” link and you’ll reach an ftp access where you can choose from the date the data to download.

6. Heliophysics Feature Catalogue (HFC)

Although query about features is possible directly using BASS2000 web site, a link is provided in the QUERY item from the left menu in order to access the specific HFC web site. Its address is: http://voparis-helio.obspm.fr/hfc-gui/. The home page corresponds to the beginning of the query form.

6.1. The HELIO project

HELIO is a project funded under Framework Program 7 of the European Commission. Thirteen partners were involved in it during forty two months, from June 2009 to November 2012.

HELIO is a service-oriented tool that aims at providing a new way to query and access data, and provide added values to the data. It can be mainly accessed through a global web interface (http://hfe.helio-vo.eu/Helio/), which provides a unique and simplified access to most of the services, or individually to each of them (http://www.helio-vo.eu/services/service_interfaces.php). Advanced use is possible using IDL software to connect to the services, or using a workflow method. The communication between services is based as often as possible on IVOA (International Virtual Observatory Alliance) standards, when they fit heliophysics descriptions.

HELIO gives access to observations from more than 200 instruments from more than 60 observatories in the world, and to 60 catalogues of heliophysics events, scattered all around the world and in space. A Heliophysics Feature Catalogue (HFC) provides a description of 10 features over at least a solar cycle for most of them. A ballistic propagation model allowed to connect phenomena through the whole solar system, onwards and backwards, but unfortunately, it has not been maintained and is no more available at the time of this paper.

HELIO makes it possible to select instruments by capabilities or by location and target, and a data query can be related to heliospheric phenomena. This powerful tool is then very appropriate for the study of the Solar-Terrestrial relationship.

HELIO is built by a consortium of science laboratories involved in solar, plasma physics as well as computer science. This mix ensures that developments use the most recent software developments in direct connexion with physics needs. This is fundamental to obtain a tool that is both efficient and user-friendly. Some global overview of HELIO can be found in Bentley, Csillaghy and Aboudarham (2009 and 2010a), in Bentley et al. (2010b) and in Aboudarham, Bentley and Csillaghy (2012).

The most obvious way to use HELIO is to use its main interface (see its URL above). In a very easy-to-learn manner, HELIO performs the following:

- Search for existing data from numerous data sets, using the usual (date-based) as well as unusual (event-based, solar system location, ...) query systems. That way, users can discover data unknown to them
- Search for events in various parts of the solar system
- Connect events in the solar system forwards and backwards to the Sun
- Perform data mining in heliospheric plasma data
- Have an overview of the solar or heliospheric context at a given time
- Automate complex queries to apply to huge datasets using workflows

See "HELIO, a powerful tool for Space Weather Science" (Aboudarham 2013) for more detailed information and description concerning HELIO project.

6.2. Description of the catalogue

Table 1 gives an overview of what is available in HFC. References to the detection codes can be found in HFC web page. The '*Tracking*' column means time tracking, i.e. the possibility to follow a feature day after day.
All features' information are obtained from automatic detection codes.

On the top and on the bottom of the front page is a set of 5 buttons:

- **Query form** This button brings you to the HFC home page, with the first tab (*Date and time selection*) on.

Table 1. Information concerning features available in HFC

Feature	Instrument	Code	Tracking
Active region	SOHO/MDI	SMART	No
	SOHO/EIT (171/195 $\dot{A}$)	SPOCA-AR	Yes
	SDO/AIA (171/193 $\dot{A}$)	SPOCA-AR	Yes
Coronal Hole	SOHO/MDI + SOHO/EIT (195 $\dot{A}$)	CHARM	No
	SOHO/EIT (171/195 $\dot{A}$)	SPOCA-CH	Yes
	SDO/AIA (193 $\dot{A}$)	SPOCA-CH	Yes
Filament	Meudon Hα spectroheliograph	SoSoft & TrackFil	Yes
Prominence	Meudon Ca II K3 spectroheliograph	SoSoPro	No
Sunspot	SOHO/MDI	MDISS	No
	SDO/HMI	SDOSS	Yes
Type III radio burst	Wind/Waves, STEREO/Swaves	RABAT3	No
Coronal radio emission	Nançay Radio Heliograph	NRH2D	Yes

– **Database and fields description** Opens a new window giving all the tables and fields of the HFC database, with short explanations about it. With this information, the user can build the precise query he or she wants.

– **Database content** This leads to a page where complete range of available data is given for each feature and each detection method. The information is also given for each feature on charts. And the caption of the plots on the charts appear when you move the mouth over the plot.

– **Free SQL query** This page will be explained in the next section.

– **Helio Front End** Opens a new page with Helio Front End, which is the general HELIO main user interface.

6.3. Queries

The query form is made of three tabs: *Date and time selection*, *Features selection* and *Output options*. These tabs allow to precise the query and obtain the desired features' descriptions.

6.3.1. Date and time selection

This tab (the default one when you click on the "Query form" button) allows you to choose the range of time during which you want to get features. You have to enter the 'From' frame, then either fill in the end frame or the duration. Another possibility is to upload the information from a VOTable. That way you can connect directly results from other tools (such as HELIO tools, but also most Virtual Observatory ones) to HFC.

6.3.2. Features selection

In this tab, choose which feature(s) you need. It is possible to limit the query to a latitude region (and possibly to longitude region also, but it's probably less used). That way you can limit the number of answers. It is possible, by clicking a tickbox, to get symmetric latitude bands. This could

be interesting for instance in order to get only polar filaments.
Once you select a feature, for most of them a menu appears on the right, where you can adjust some criteria (such as min or max area, intensity...).

6.3.3. Output options

The last tab lets you choose the information you want to retrieve from the database. If you click on a feature name, a list of feature's parameters is given. The marked boxes are the default result values and you can select all you need. The name of the field in the database is given in parenthesis.
Under this part, you can choose, if needed, an additional output format (additional to your screen): VOTable or standard CSV format (with comma delimiter, first line being the column title).
And below that you can choose if you want various kinds of maps to plot the results on:
Pixel draws a circle (the solar disc) with the contour and ID of detected features over it.
Carrington draws two maps. The first one is a grid of solar coordinates with features plotted on it, and NOAA regions numbers given. The second one overplots features' contours (and their ID) on a pre-processed solar image (i.e. corrected from center to limb darkening).
Daily Synoptic map shows the solar disc with grid, with all the low atmosphere features plotted on it (see Fig. 5), as well as NOAA regions.
If you click on any of the figures, it will open a new window with the figure in large format.

Note that you can go back and forth between the three tabs at will before you submit your query.

6.3.4. Result page

At any moment in the three tabs above, you can click the 'Submit' button.
The result page is built with the following elements, from top to bottom:
Information on the number of features retrieved. It is there that the user can download data in the selected format (if done).
A set of tabs corresponding to all the selected dates. You just have to click on one date in order to get the corresponding results.
The daily synoptic map, if asked for.
Then for each feature, the same organisation:
A set of tabs for detection hours for the chosen date.
If asked for, Pixel and/or Carrington maps.
Tabular results: you need to click on the "+" at the right of this line in order to unfold the results as a table with the columns you asked for. For features where tracking is available, you can click on the left on the underlined ID of the feature in order to open a new page where a list of information about the occurrences of the features that have been detected and plots of features on solar images at various dates.
After all the features are the following lines:
Query Sum up: Clicking on the right '+' will show a summary of your query
SQL log: The right '+' reveals the query (or list of queries), in SQL language, that have been sent to the HFC database. You can copy the SQL code and paste it after clicking on the 'Free SQL query' button (see section 6.3.6). You can also click on the 'Edit' button which will copy directly the SQL code to the 'Free QLS query' page, and list the complete result of the query.

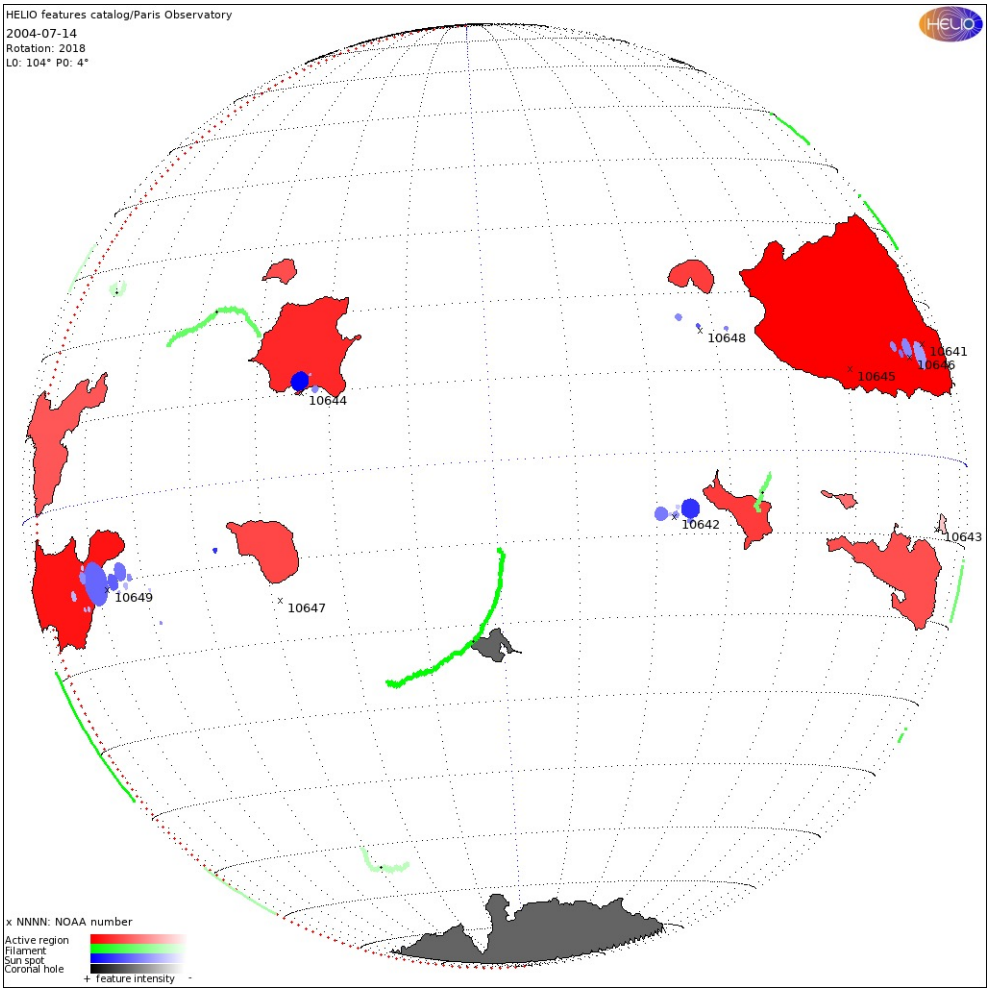

Fig. 5. An example of a daily synoptic map.

6.3.5. Bottom buttons

At the bottom of HFC web pages are three buttons:
API (Application Programming Interface) opens of window where you can get access to IDL-based routines that can directly query HFC.
Web Services gives information about the various VO-compliant technics that can be used to query HFC, and links to additional information.
About HFC gives some information about HELIO and links towards user guides for HFC.

6.3.6. Free SQL query

You can access this page through the corresponding button, or by clicking the 'Edit' button in the SQL log part of the result page.
In the edit window, you can directly write the SQL query you want to submit, knowing the database organisation (cf. 'Database and fields description' button) and that way obtain exactly the information you need on features.

7. Conclusions

BASS2000 provides a long time duration set of solar observations and added values. It is very useful for the study of solar activity, solar cycle and in general solar context. Very important added-values can be found there. If you have questions about it, you can look on the left menu at the "HOME/F.A.Q." item (Frequenly Asked Questions) which contains a synthesis of 20 years of questions we received about BASS2000. And if you don't find there the answer you need, go at the bottom of the page and click on 'Contact' to fill in the contact form, and we'll try to answer you as soon as possible.

As mentioned in section 3.3 EPN-TAP layer (EuroPlaNet Table Access Protocol, see Erard, 2014) has been added over BASS2000 and some features of the HFC, allowing the use of Virtual Observatory tools to access the data, such as VESPA (http://vespa.obspm.fr/planetary/data/). Table Access Protocole is described in IVOA documents (see http://www.ivoa.net/documents/TAP/ for TAP recommendation, or http://www.ivoa.net/documents/ for all Virtual Observatory standards).

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