SOLAR-TERRESTRIAL DATA ANALYSIS AND REFERENCE SYSTEM (STARS) - ITS HIGH POTENTIALITY FOR COLLABORATIVE RESEARCH

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ABSTRACT

Cross-sectional studies have become important for an improved understanding of various Solar-Terrestrial Physics (STP) fields given the great variety and different types of observations from the sun to the earth. In order to better combine, compare and analyze different types of data together, a system named STARS (Solar-Terrestrial data Analysis and Reference System) has been developed. Cross-sectional study requires cooperative work. The STARS has two functions for cooperative work, "Stars Project List (SPL)" and "Event Listing". The SPL is used for exchanges of plotting information by cooperating persons. Event list database provides all users of STARS hints for recognizing typical occurrences of STP phenomena.

Keywords: Cross-sectional studies, Cooperative work, Combined plot, XML, Collaborative analysis, Common knowledge, Experience sharing, Solar-terrestrial physics, Common use

1 INTRODUCTION

A variety of cross-sectional studies have become important for further understanding of Solar-Terrestrial Physics (STP) fields. We need to combine, compare, and analyze different types of data together, for example, both satellite-based and ground-based observation data. To support such cross-over searches and analyses of data, we have developed a system named STARS (Solar-Terrestrial data Analysis and Reference System) (Murata, Yahara, & Toyota, 2005), (Ishikura, Kimura, Murata, Kubo, & Shinohara, 2006). The URL of the brief explanation of STARS is "http://aoswa.nict.go.jp/application.html". The URL of detailed description of STARS is "http://seg-web.nict.go.jp/e-sw/download/data/STARS5manual_e.pdf".) Figure 1 shows the overview of the STARS including meta-data and data flow. The STARS has functions to search whether the expected data exist or not, to make a combined plot, and to save the plot or data. Figure 2 shows an example of a combined plot.

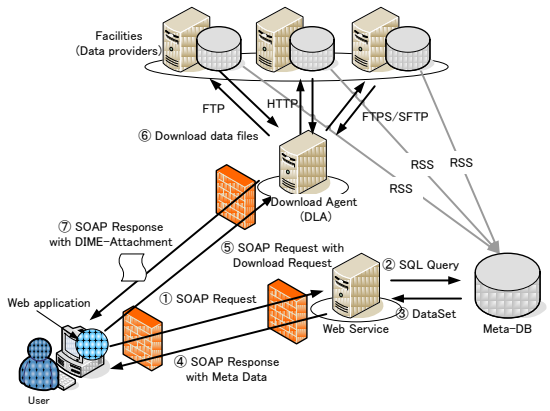


Figure 1. The structure of the STARS and the flow of meta-data and data

Cross-sectional study often requires cooperative work by researchers whose own specialties are different from each other. Usually, a single researcher cannot cover all of the fields, but one or some of the fields. If findings and experiences of each researcher are exchanged with each other, these exchanges boost to do cooperating analysis. The STARS has two special functions for cooperative work. These are “Stars Project List (SPL)” and “event listing”. In this paper, we focus on these two functions.

2 STARS PROJECT LIST (SPL)

After a user makes a combined plot on the STARS, information about the plot can be stored in an file known as a Stars Project List (SPL). The SPL includes information with which any user can the same combined plot in the STARS. Figure 3 shows an example of the SPL. The information contains start/end date and time, data ID number, plotting status, and details for plotting. Using the any user can easily make the same plot without checking detailed download file options and plotting options. Further, any user can revise the combined plot by adding data file or by changing plotting options. We introduce two use cases of cross-sectional studies by using the SPL.

Case 1. Plotting information exchange for cooperating analysis

The SPL is used for plotting information exchange between the user “X” and the user “Y”. The detailed example is as following. After the user “X” makes a combined plot, the user “X” stores the plotting information in an SPL file. When the user "X" sends the SPL to another user "Y", the user "Y" can make the same plot on the STARS based on the information stored in the SPL. So, the user “Y” can easily reach the same standpoint as the user "X" did. Then, the user “Y” modifies the plot based on Y’s own special knowledge after viewing original plot. After the user “Y” makes revised plot, saves an SPL as a new name, and sends the new SPL to the user “X”, the user "X" can know the additional viewpoints by looking through the modified plot. Such an interactive way by exchanging of S PL gives a quick way to do collaborative analysis.

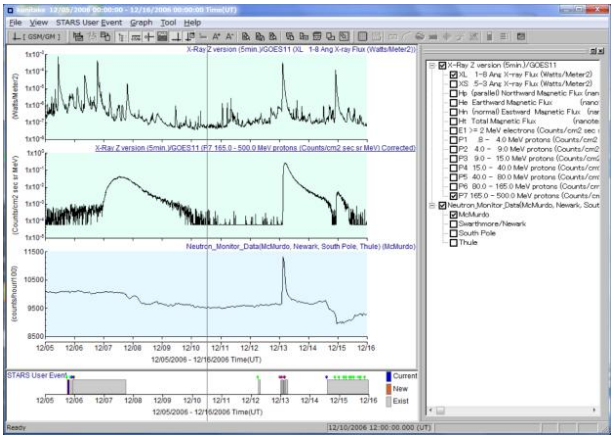
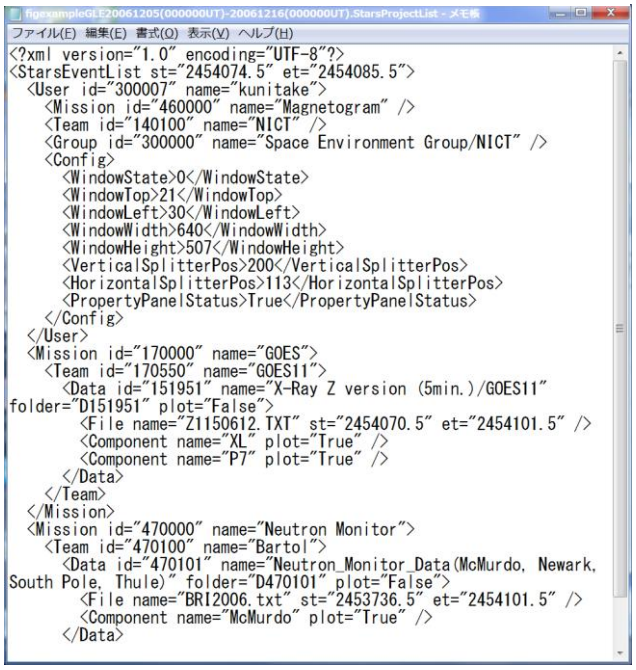


Figure 2. An example of combined plot by using the STARS. The time period of the plot includes several phenomena in Solar-Terrestrial physics. The top panel of the plot shows the solar X-ray flux observed at GOES 11 geostationary satellite. The second panel shows the proton flux observed at GOES 11 geostationary satellite. The third panel shows cosmic ray counts observed by neutron monitor on the ground (McMurdo station).



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<?xml version="1.0" encoding="UTF-8"?>
<StarsEventList st="2454074.5" et="2454085.5">
  <User id="300007" name="kunitake">
    <Mission id="460000" name="Magnetogram" />
    <Team id="140100" name="NICT" />
    <Group id="300000" name="Space Environment Group/NICT" />
    <Config>
      <WindowState>0</WindowState>
      <WindowTop>21</WindowTop>
      <WindowLeft>30</WindowLeft>
      <WindowWidth>640</WindowWidth>
      <WindowHeight>507</WindowHeight>
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      <PropertyPanelStatus>True</PropertyPanelStatus>
    </Config>
  </User>
  <Mission id="170000" name="GOES">
    <Team id="170550" name="GOES11">
      <Data id="151951" name="X-Ray Z version (5min.)/GOES11"
folder="D151951" plot="False">
        <File name="Z1150612.TXT" st="2454070.5" et="2454101.5" />
        <Component name="XL" plot="True" />
        <Component name="P7" plot="True" />
      </Data>
    </Team>
  </Mission>
  <Mission id="470000" name="Neutron Monitor">
    <Team id="470100" name="Bartol">
      <Data id="470101" name="Neutron_Monitor_Data(McMurdo, Newark,
South Pole, Thule)" folder="D470101" plot="False">
        <File name="BRI2006.txt" st="2453736.5" et="2454101.5" />
        <Component name="McMurdo" plot="True" />
      </Data>
```

Figure 3. Example of SPL. The SPL is an XML file, which includes information with which user worked on the STARS: start/end date and time, the name of downloaded data file, and plot information.

Case 2. Accumulation of common research knowledge

If many researchers accumulate their SPLs into a common place, accumulated SPLs would be used for SPL database. If a coordinator makes a subset of the database from the SPL database with a clear aim, such an SPL subset is useful not only for plot makers but also for any users of the STARS.

One actual example is our SPL subset website for space weather researchers and users (Figure 4) (URL is http://seg-web.nict.go.jp/e-sw/spl/index_e.html). On the web site, typical outstanding space weather occurrences are collected. Any persons who are interested in one of the occurrences can select the corresponding SPL and download the SPL from this website and they can make a plot.

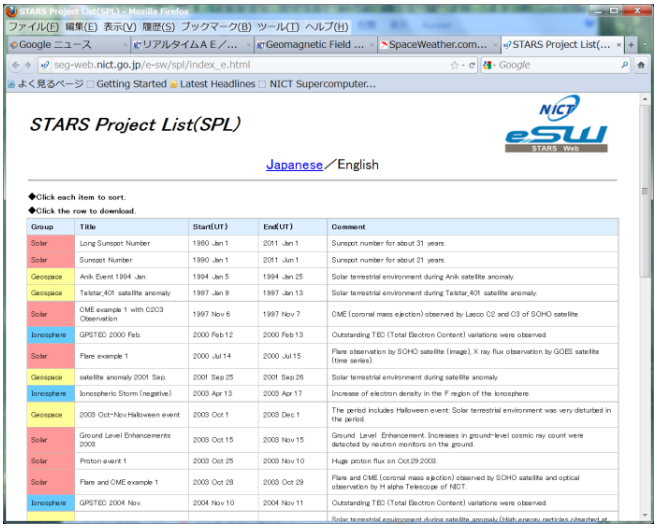

Figure 4. SPL subset website for space weather

3 EVENT LISTING

3.1 Making and viewing event list

When a user of the STARS finds an interesting variation of typical phenomena in the plot, then the user recognizes it as an "event". The user can in turn register the "event" in the event list in the STARS. Each "event" is described in XML and has detailed information (title, start/end time, name who registers the "event" etc.). Registered "events" have been accumulated in the event list database.

Any user can then view "events" which have been already registered by other users as well as by oneself. When many "events" are registered in the event list database by various users and many users share the "event" information by quick viewing, the event list would become common knowledge among users of the STARS.

When a user makes a combined plot on the STARS, the user can know any of the "events" which exist in the analyzing time period. There are two ways. One is to look through the extracted event list. From the whole registered event database, the extracted event list extracts "events" which exist in the analyzing time period. The other is to glance about "event" marks on the combined plot. Each "event" is shown as one pin mark in the combined plot. When a user does double-clicking on a pin mark, detailed information of the selected "event" appears.

3.2 Effectiveness of the event list

The "event" information is shared by users through the event list. As the Solar-Terrestrial Physics (STP) fields have been observed by a wide variety of technique, it is rather hard for one person to become a specialist in all of the observations. If some researchers come together for collaborative research, the total number and kinds of observation which anyone is not familiar with will be minimized. Figure 5 shows schematically the way for an effective usage of the event list to proceed. Suppose that three researchers participate in analyzing data which covers several different fields and that each participant has some special knowledge of one observation. If participant "C" is a specialist in "observation CCC", but not a specialist in "observation DDD or EEE", then participant "C" can make a contribution by the registration of "event" #C1. If participant "D" is a specialist in either "observation DDD", but is not a specialist in "observation CCC or EEE", then participant "D" can make a contribution by the registration of "event" #D1. After participants C, D, and E have all added their "events" which are related to each participant's own special observation to the event list, the event list eventually benefits from a richer and more informative set of participants contributing their specific expertise.

4 FUTURE WORK

A large number of "events" have been accumulated in the event list in the STARS. Many numbers of SPLs have been collected in another useful list. We are developing a useful website (I-space weather). It is a portal web site. Variety types of services are planned to be customized for space weather researchers in the web site. Information related to space weather forecast is to be shown also. One of the customized services has crossover search functions by key parameters of "event" or by SPL. Another customized service is adding information to SPL. It is possible to add comment description to SPL. It will be good for analysis by cooperating persons and for search by any user.

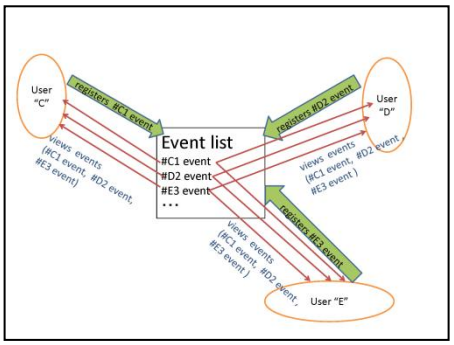

Figure 5. An effective usage of the event list. Each person can register each "event". Any person can view all of the accumulated events from the event list.

5 CONCLUSION

The STARS is a system which realizes the crossover searches and integrated analyses of ground-based and satellites observations of solar-terrestrial physics. The STARS has several advanced functions (data search, crossover comparison, plotting information exchange by SPL, and common use of event list). Plotting information exchange by Stars Project List (SPL) and common use of event list are useful for collaborating work.

As an SPL contains detailed information of a combined plot, not only the user who made the combined plot but also any other users can easily make the same plot without checking data file download options and plotting options. When any user modifies the plot, the modification can be saved in a new SPL. By information exchange by SPL, cooperating analysis by cross-sectional fields is to be progressed effectively.

If domain experts and specialists in other research fields are expected to register many "events" in the event list database, the database will in turn provide users of the STARS crossover hints for recognizing typical phenomena. In other words, event list database would be used as common research knowledge for all users of the STARS.

6 ACKNOWLEDGEMENTS

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7 REFERENCES

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