Space weather data services at Sodankylä Geophysical Observatory

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Introduction

Research on the solar-terrestrial environment requires access to large historical datasets for statistical purposes, but such datasets are often not easily accessible. Furthermore, the increasing demands for real-time awareness of the space environment also puts increasing demands on real-time accessibility of space weather data from both ground-based and satellite instruments.

Sodankylä Geophysical Observatory (SGO) is located some 120 km north of the Arctic Circle in northern Finland. The observatory recently celebrated its 100th anniversary and has some of the longest time series of geospace observations in existence: geomagnetic observations since 1914 and ionosoundings since 1957.

For the first 48 years, SGO ionograms were recorded on black-and-white film and scaled manually. Since 2005 a new digital chirp ionosonde is in operation, but ionospheric parameters are still scaled manually.
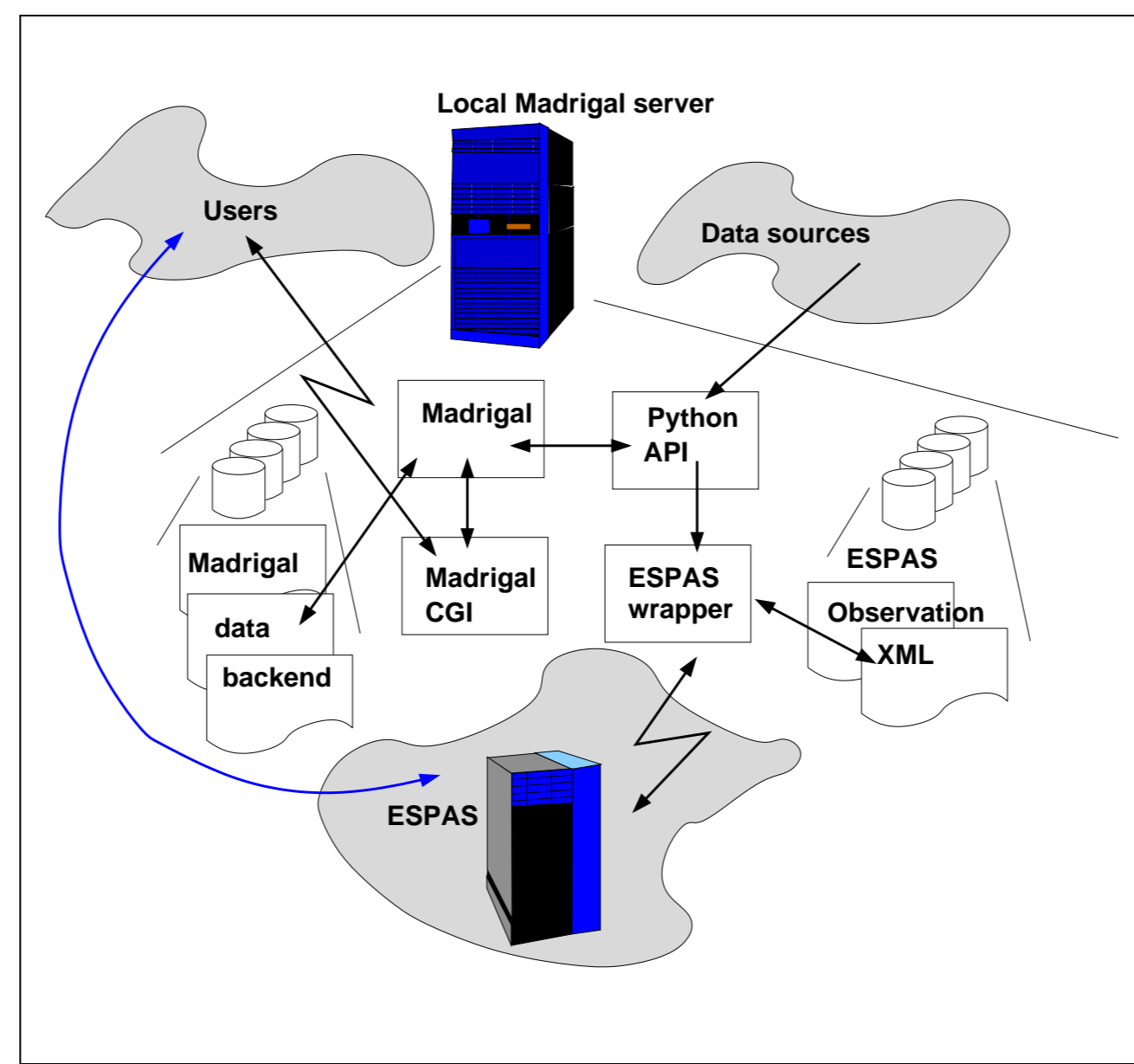
The Madrigal database

SGO data are available free of charge for non-commercial scientific use. As part of the ESPAS project the online availability and searchability of SGO data will be improved. The tool selected for this purpose is the **Madrigal** database, which is the de facto standard for distributing incoherent scatter radar data. Madrigal can be installed on most Unix systems with a C and Fortran compiler. The installation process compiles its own versions of Python, tclsh, required libraries and additional software such as geophysical models.

Madrigal is deployed at several sites including most incoherent scatter radars. Metadata are shared across these sites.

Schematics of Madrigal and ESPAS services at SGO

Interacting with Madrigal

There are several ways to query the Madrigal database and retrieve data.

- Web services (Python-based CGI)
- Matlab API
- Python API
- IDL API

Data are exported in several formats including HDF5. In the upcoming next release, HDF5 will also be the backend storage format in Madrigal.

Madrigal to ESPAS interface

The interfacing of Madrigal to the ESPAS data model and metadata system is straightforward through the Python API. A Python library `Espas.py` has been developed, defining Python classes for all ESPAS data model entities, each corresponding to an XML file of a strictly defined format. Most of these XML files are static and serve as as an option to using the online ESPAS data registration tool, whereas the class for generating an Observation XML file will be called every time new data are added.

SGO datasets

The following SGO datasets will be made available to ESPAS through the Madrigal service

Ionosonde

- Manually scaled parameters 1957–present
- Digital ionograms from 2005

Pulsation magnetometers Spectrograms 1995–present

Riometers 1 min absorption data 1994–present

Additionally SGO geomagnetic data are available through IMAGE (Finnish Meteorological Institute).

More information

Madrigal http://www.openmadrigal.org
ESPAS http://www.espas-fp7.eu
SGO http://www.sgo.fi

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