The MADRIGAL Database

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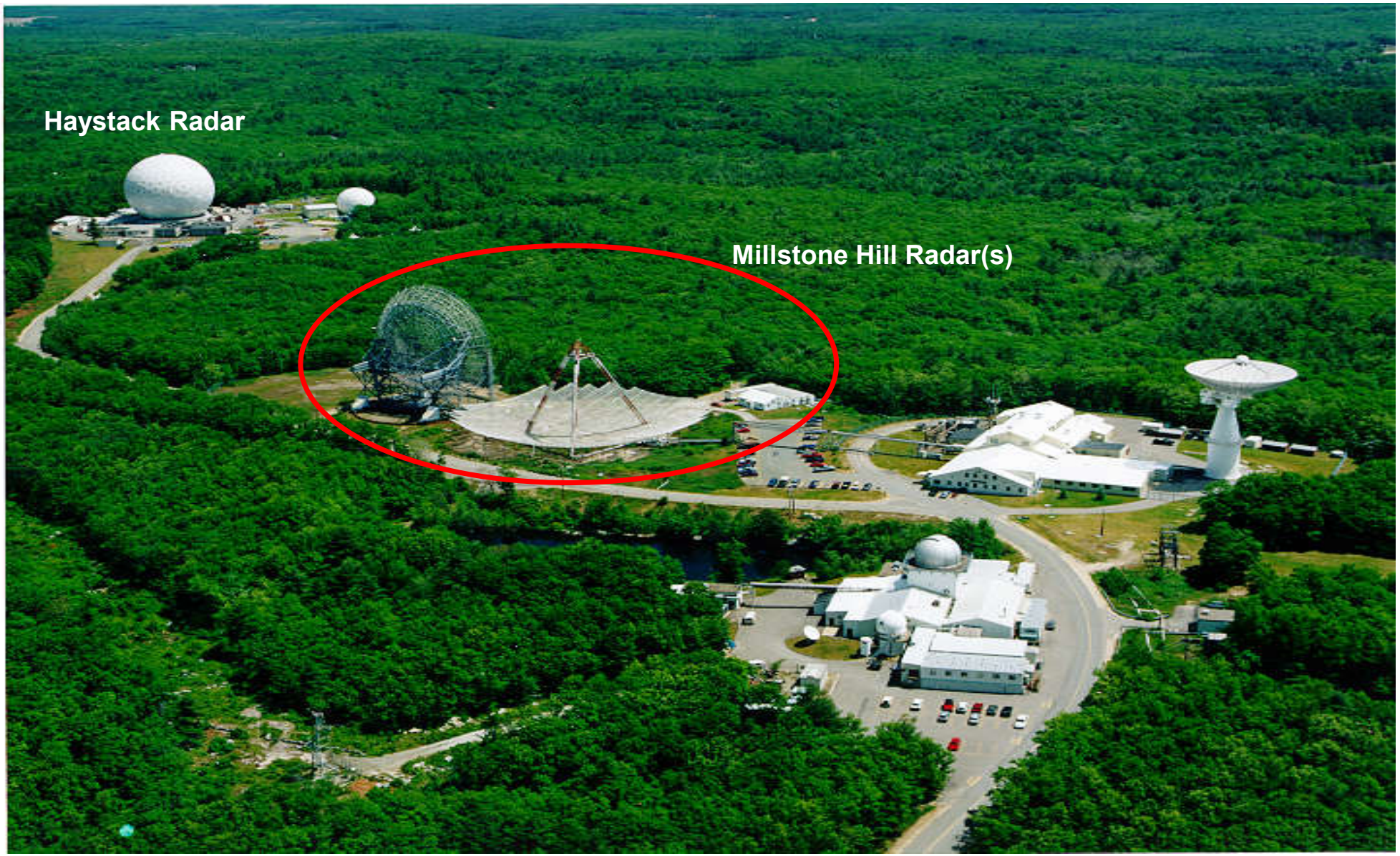
MIT Haystack Observatory

http://cedar.openmadrigal.org/index.html/

Madrigal is an upper atmospheric science database used by groups around the world. The US National Science Foundation supports it.


Haystack Radar
Millstone Hill Radar(s)

Outline

- Where to find Cedar Madrigal database/?
- What is Madrigal?
- How to get TEC data from Madrigal?
- Ask for handout! I will provide to group.

https://www.haystack.mit.edu/

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Welcome to Haystack

Radio science & technology research center

- Pioneering radio astronomy
- Geodesy: measuring Earth
- Geospace from A to Z

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Update

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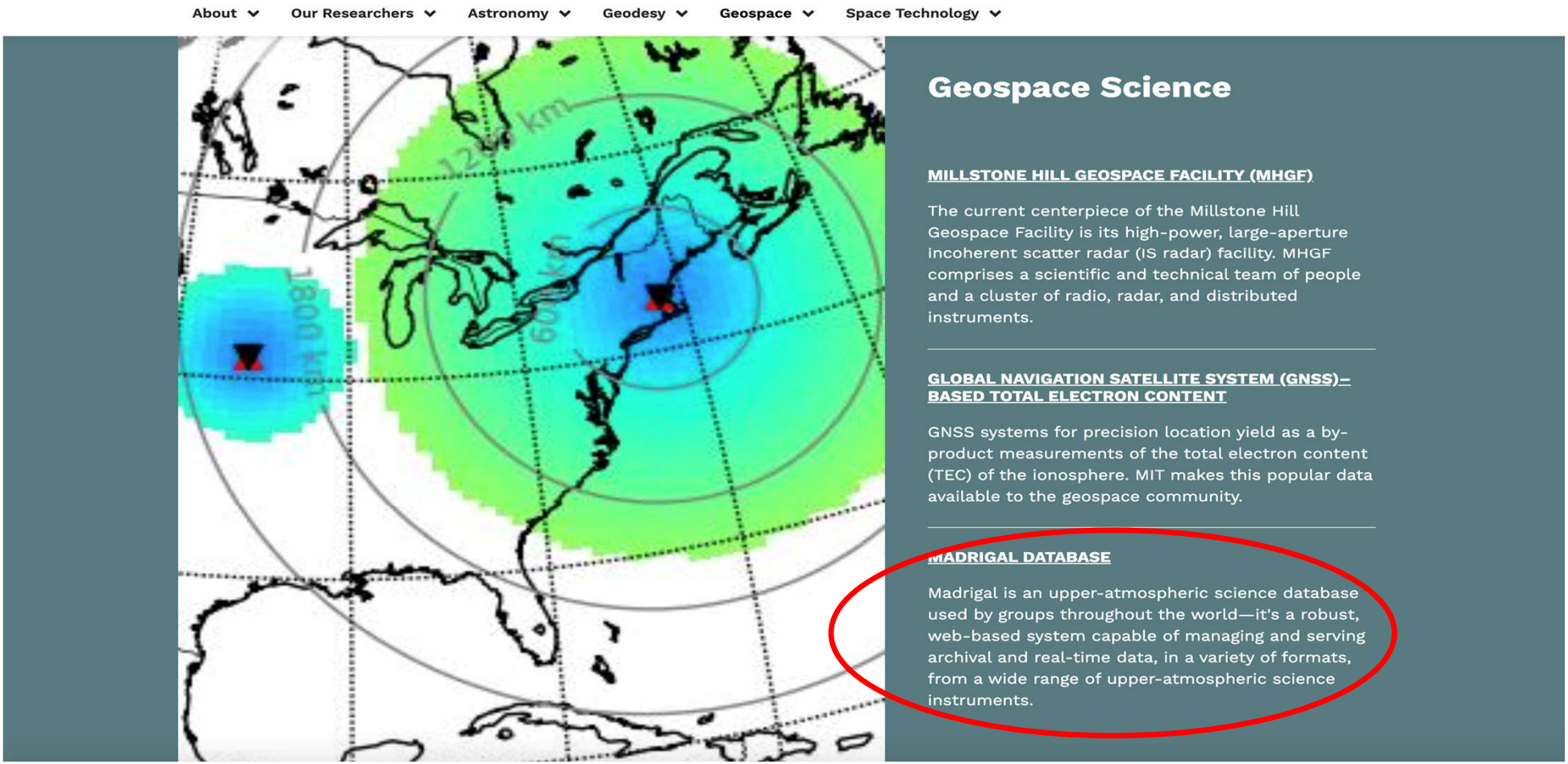
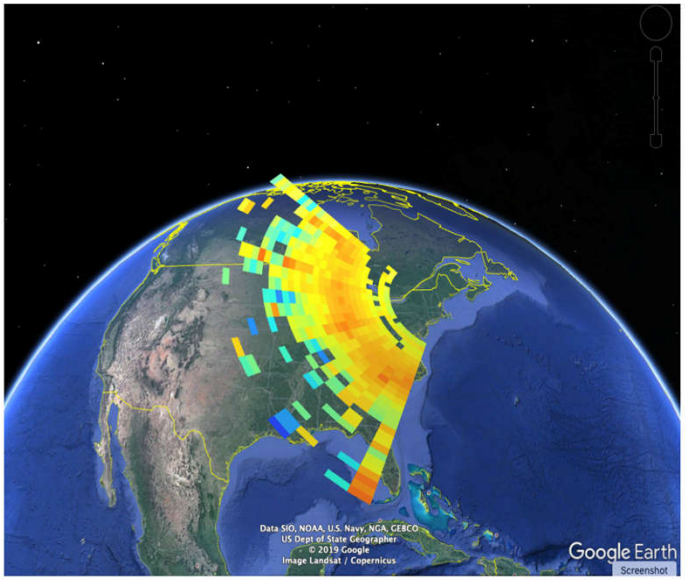
Geospace

Scroll down page until you find Madrigal database



Madrigal Geospace Database



Madrigal data on a globe showing the range of the Millstone antenna to the southwest

Madrigal is an upper-atmospheric science database used by groups throughout the world. Madrigal is a robust, web-based system capable of managing and serving archival and real-time data, in a variety of formats, from a wide range of upper-atmospheric science instruments. Data at each Madrigal site is locally controlled and can be updated at any time, but shared metadata between Madrigal sites allow searching of all Madrigal sites at once from any Madrigal site.

The main **CEDAR Madrigal site** contains a backup of all data at all site. All other sites can also be found from that page.

Millstone Hill has actively pursued the development of the Madrigal distributed data system to address the needs of staff and community scientists. A standard in the upper atmospheric community, Madrigal was created and launched at MIT Haystack in the early 1980s prior to being adopted as the basis for the CEDAR database. In 2012, the main CEDAR database moved to a modernized version of the Madrigal platform hosted by MIT. As of 2019, there was data from 159 instruments in the CEDAR Madrigal database, totaling over 27 TB of data, with rapid growth each year.

The Madrigal database stores data from a wide variety of upper atmosphere research instruments

Incoherent Scatter Radar

TEC via GPS

MF Radar

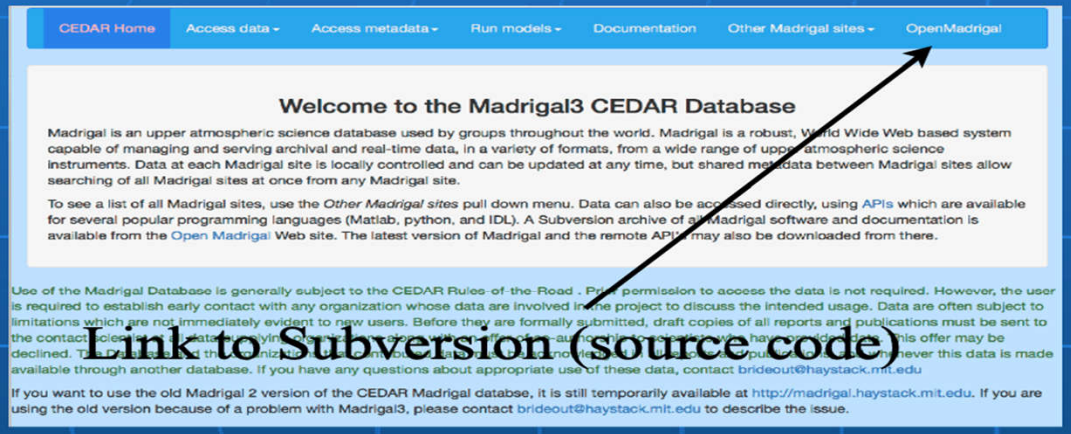
Examples of number of instruments in Madrigal:

- Incoherent scatter radars: 22
- MST radars: 3
- MF radars: 16
- Meteor radars: 11
- FPI: 32
- Michelson Interferometers: 6
- Lidars: 9
- Photometers: 7

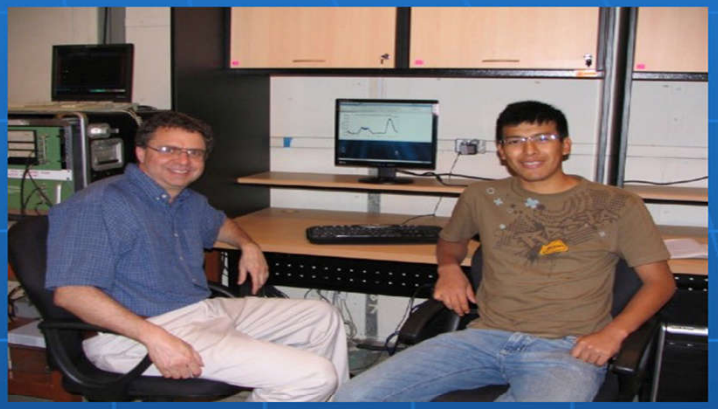
Other examples:

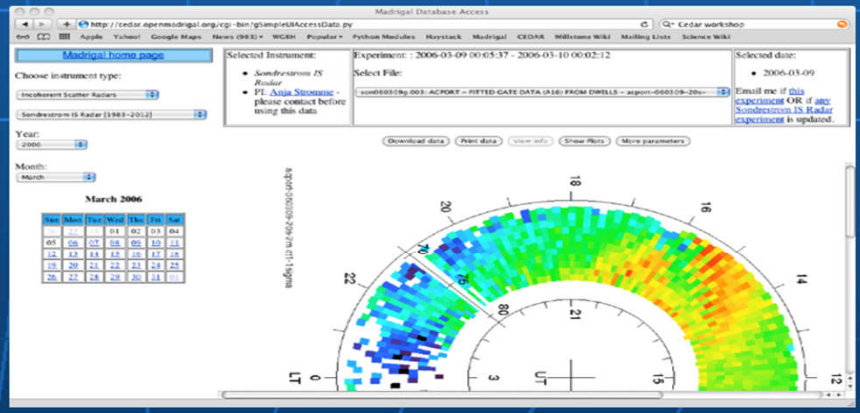
- GPS TEC
- DMSP

Madrigal is open-source



Link to Subversion (source code)

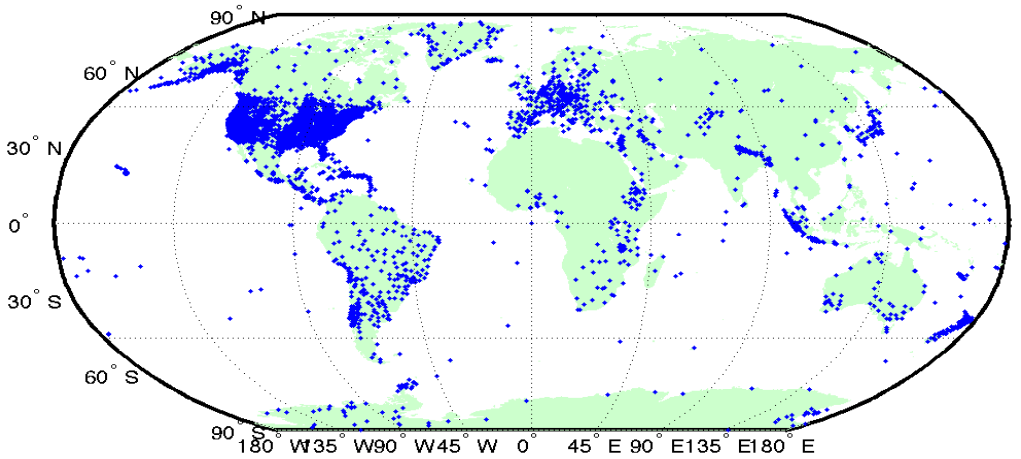




www.openmadrigal.org

- What is now available through CEDAR Madrigal Web
  http://cedar.openmadrigal.org/

Map of GPS receivers



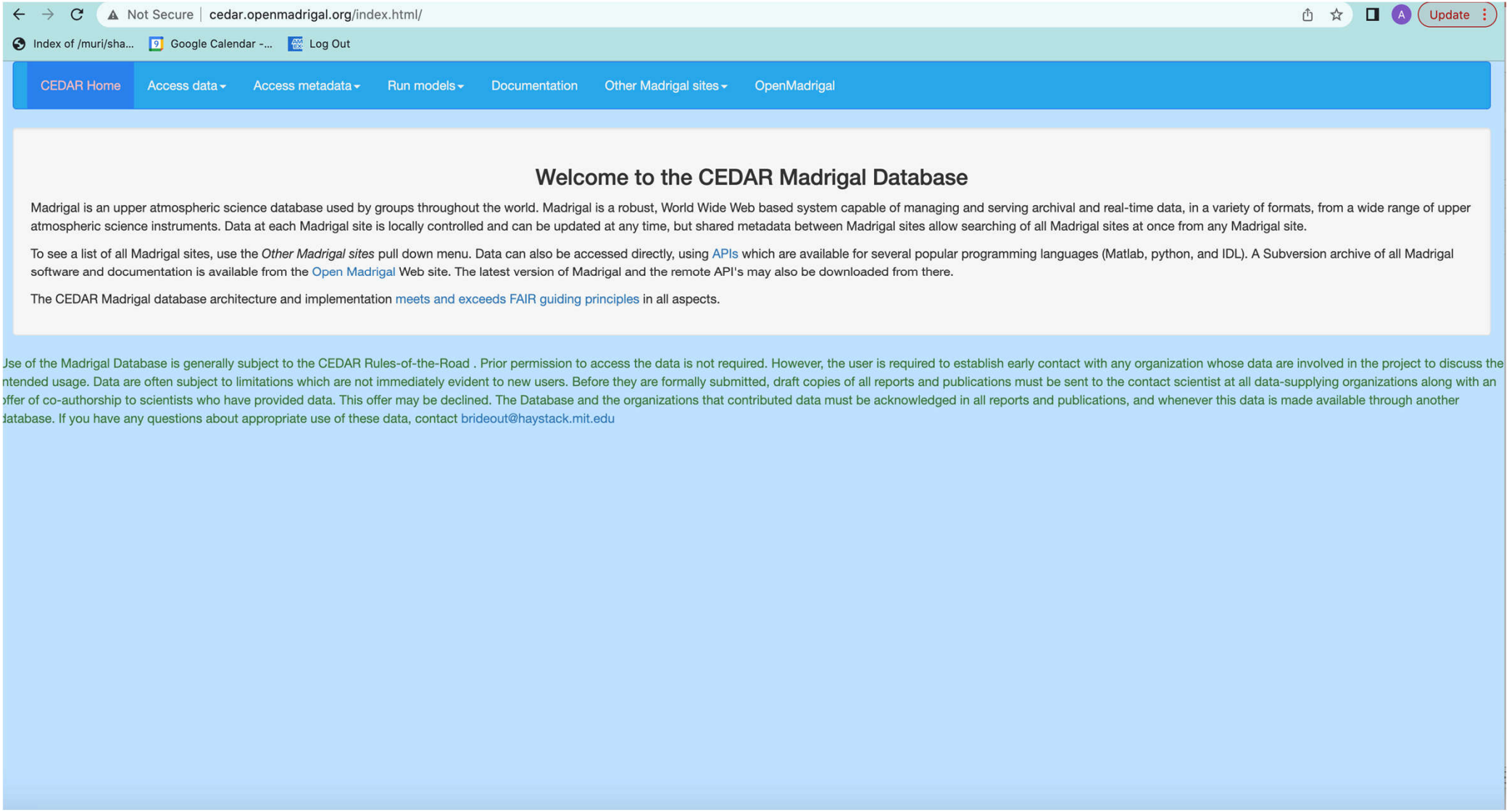
Standard binned TEC Data in Madrigal available since 2000

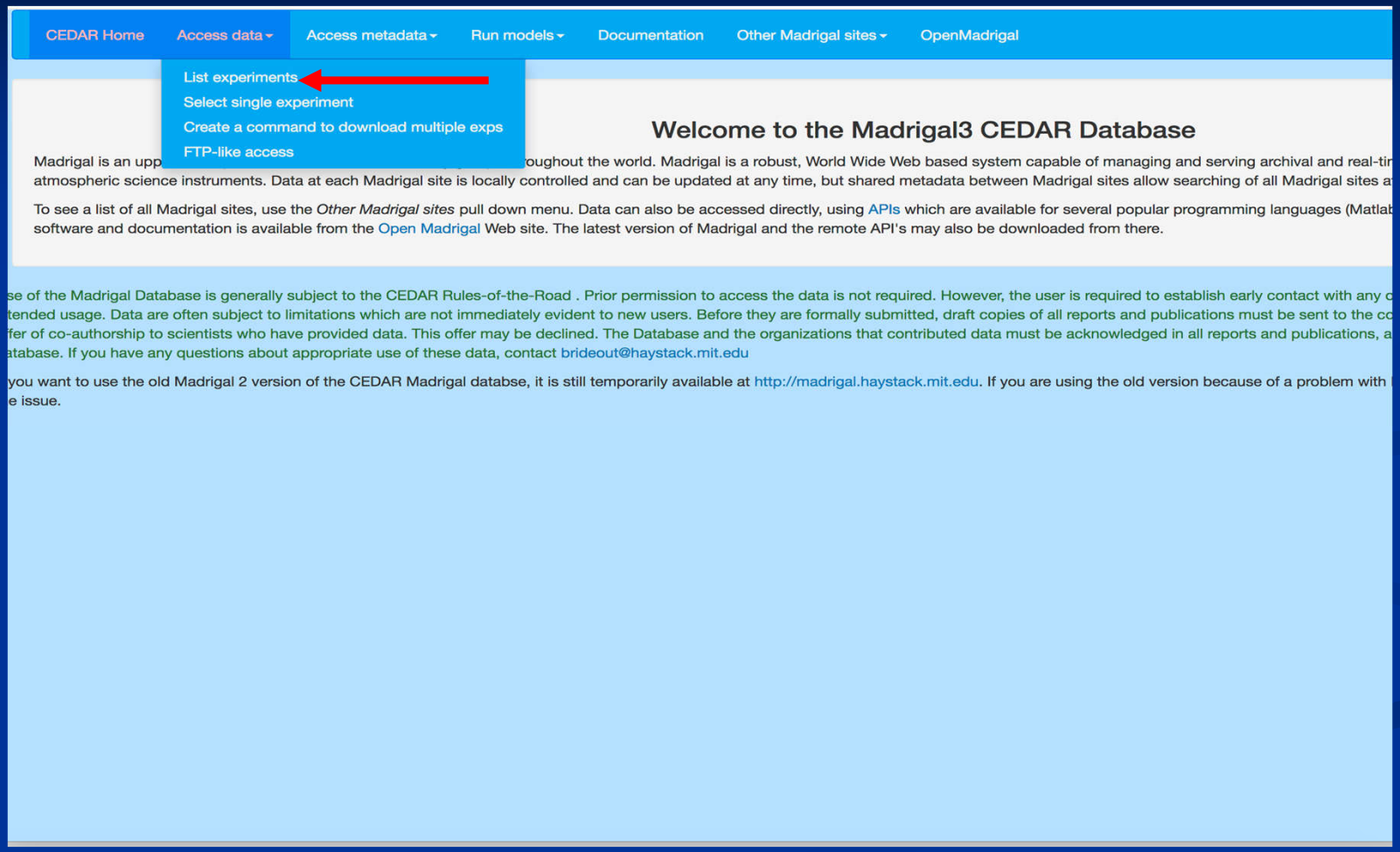
1. Provided in 1 degree by 1 degree bins
2. Provided every 5 minutes
3. Vertical TEC data estimates and Errors on these estimates
4. Geographic Lat and Long
5. Only provides data where observations are available. Does not attempt to model TEC where data is not available. Uses all GNSS data available.
6. New TEC products are on the horizon …i.e. GLONASS observations

Line of Site TEC Data in Madrigal available now

1. Provided for every receiver
2. Provided every 20 second
3. Satellite and Receiver ID
4. Geographic Lat and Long of Receiver
5. Pierce Point: Altitude, Lat and Long
6. Azimuth and Elevation to Satellite
7. Files are LARGE
8. HDF5 format

http://cedar.openmadrigal.org/index.html/




CEDAR Home
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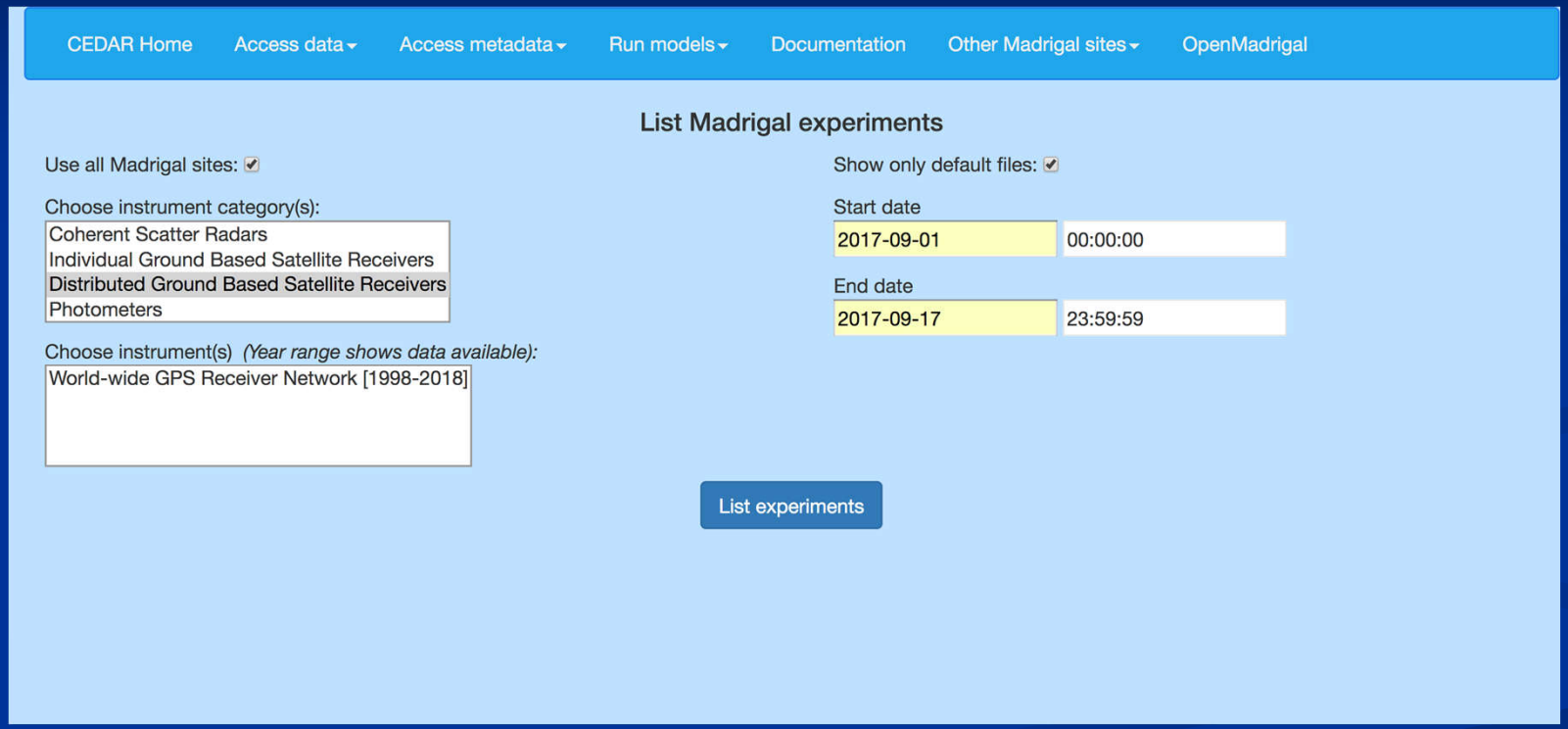
OpenMadrigal
List experiments
Select single experiment
Create a command to download multiple exps
FTP-like access
Welcome to the Madrigal3 CEDAR Database
Madrigal is an upp
roughout the world. Madrigal is a robust, World Wide Web based system capable of managing and serving archival and real-tir
atmospheric science instruments. Data at each Madrigal site is locally controlled and can be updated at any time, but shared metadata between Madrigal sites allow searching of all Madrigal sites a
To see a list of all Madrigal sites, use the Other Madrigal sites pull down menu. Data can also be accessed directly, using APIs which are available for several popular programming languages (Matlat
software and documentation is available from the Open Madrigal Web site. The latest version of Madrigal and the remote API's may also be downloaded from there.
se of the Madrigal Database is generally subject to the CEDAR Rules-of-the-Road . Prior permission to access the data is not required. However, the user is required to establish early contact with any c
tended usage. Data are often subject to limitations which are not immediately evident to new users. Before they are formally submitted, draft copies of all reports and publications must be sent to the co
fer of co-authorship to scientists who have provided data. This offer may be declined. The Database and the organizations that contributed data must be acknowledged in all reports and publications, a
atabase. If you have any questions about appropriate use of these data, contact brideout@haystack.mit.edu
you want to use the old Madrigal 2 version of the CEDAR Madrigal databse, it is still temporarily available at http://madrigal.haystack.mit.edu. If you are using the old version because of a problem with
e issue.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List Madrigal experiments
Use all Madrigal sites:
Show only default files:
Choose instrument category(s):
Coherent Scatter Radars
Individual Ground Based Satellite Receivers
Distributed Ground Based Satellite Receivers
Photometers
Start date
2017-09-01
00:00:00
End date
2017-09-17
23:59:59
Choose instrument(s) (Year range shows data available):
World-wide GPS Receiver Network [1998-2018]
List experiments

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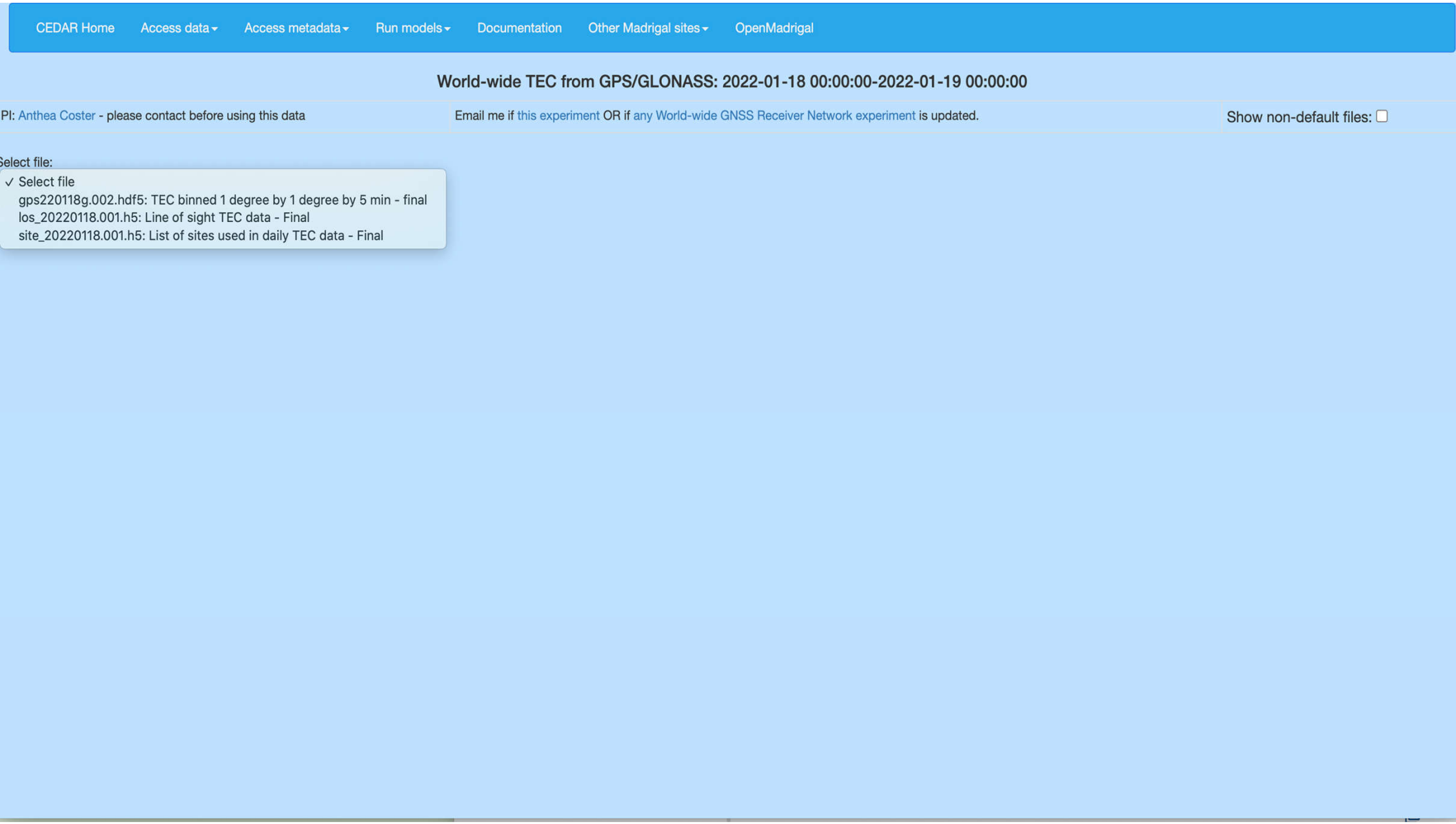
CEDAR Home | Access data | Access metadata | Run models | Documentation | Other Madrigal sites | OpenMadrigal

List of selected Madrigal experiments

Madrigal site	Instrument name	Start	End	Experiment name
CEDAR	World-wide GNSS Receiver Network	2021-12-31 00:00:00	2022-01-01 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-01 00:00:00	2022-01-02 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-02 00:00:00	2022-01-03 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-03 00:00:00	2022-01-04 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-04 00:00:00	2022-01-05 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-05 00:00:00	2022-01-06 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-06 00:00:00	2022-01-07 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-07 00:00:00	2022-01-08 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-08 00:00:00	2022-01-09 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-09 00:00:00	2022-01-10 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-10 00:00:00	2022-01-11 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-11 00:00:00	2022-01-12 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-12 00:00:00	2022-01-13 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-13 00:00:00	2022-01-14 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-14 00:00:00	2022-01-15 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-15 00:00:00	2022-01-16 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-16 00:00:00	2022-01-17 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-17 00:00:00	2022-01-18 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-18 00:00:00	2022-01-19 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-19 00:00:00	2022-01-20 00:00:00	World-wide TEC from GPS/GLONASS
CEDAR	World-wide GNSS Receiver Network	2022-01-20 00:00:00	2022-01-21 00:00:00	World-wide TEC from GPS/GLONASS



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World-wide TEC from GPS/GLONASS: 2022-01-18 00:00:00-2022-01-19 00:00:00

PI: Anthea Coster - please contact before using this data

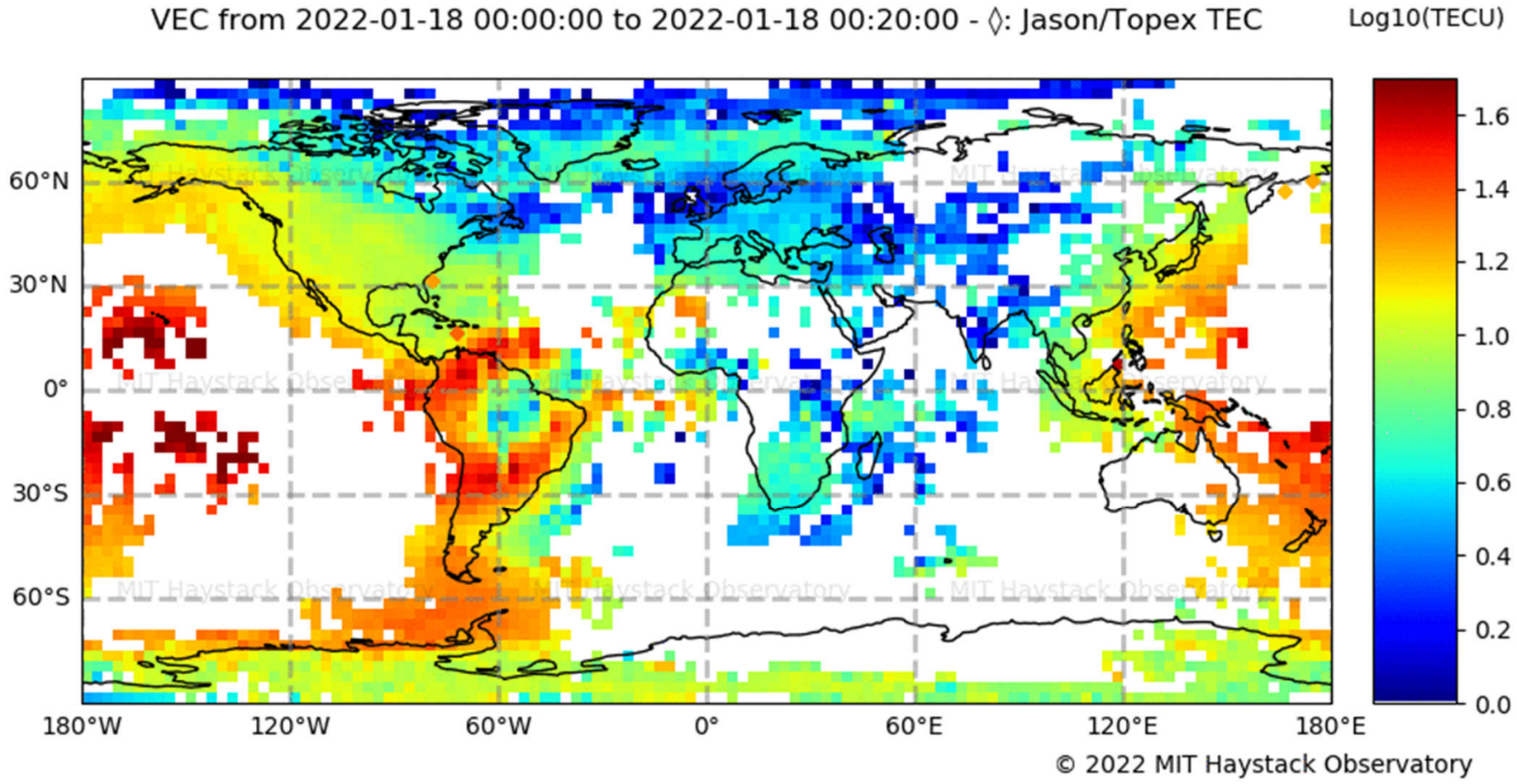
Email me if this experiment OR if any World-wide GNSS Receiver Network experiment is updated.

Show non-default files: ☐

Select file:

- ✓ Select file
- gps220118g.002.hdf5: TEC binned 1 degree by 1 degree by 5 min - final
- los_20220118.001.h5: Line of sight TEC data - Final
- site_20220118.001.h5: List of sites used in daily TEC data - Final

Gridded TEC Product



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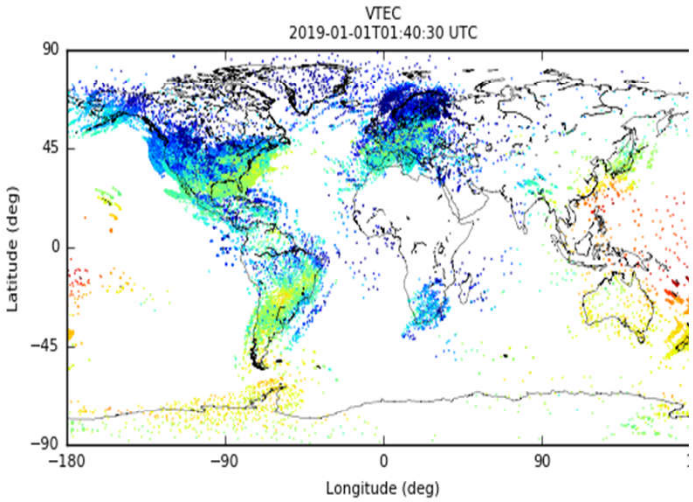
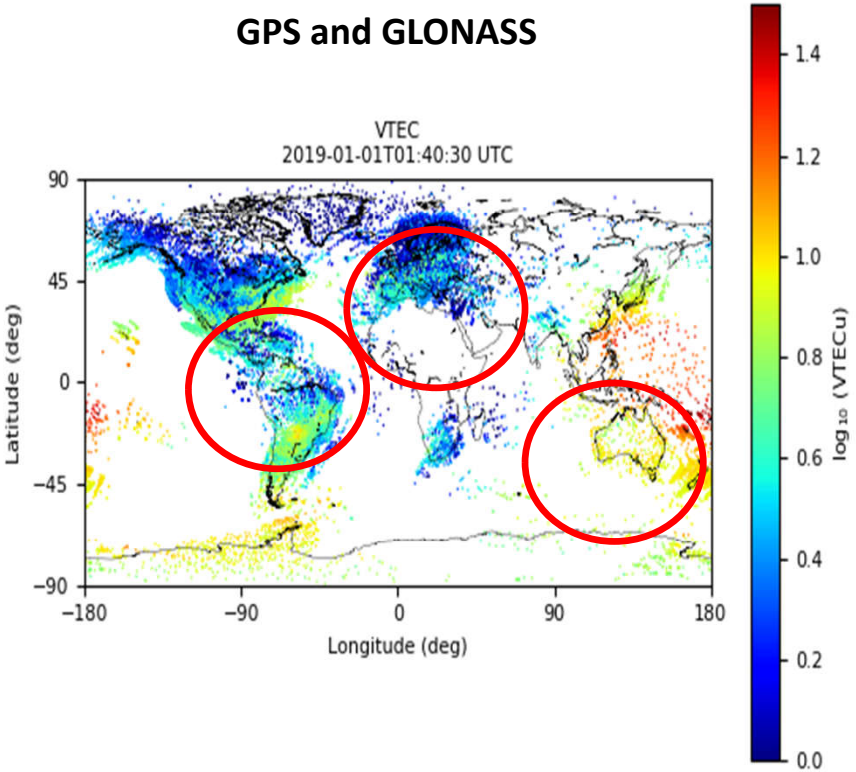
World-wide Total Electron Content: 2017-09-07 00:00:00-2017-09-08 00:00:00
PI: Anthea Coster - please contact before using this data
Email me if this experiment OR if any World-wide GPS Receiver Network experiment is updated.
Show non-default files:
Select file:
los_20170907.001.h5: Line of sight TEC data - Final
Show plots
Download file
Print file
View file info
Cite this file
Data source list for TEC processing
Papers describing processing algorithms used
Python programming tips for reading line-of-site TEC files
Create interactive TEC/SuperDARN plots
Click here for plots of raw LOS converted to vertical TEC for 2017-09-07
Click here for TEC maps for 2017-09-07

GPS ONLY



GPS and GLONASS



Summary

Exercise 1: Install hdfview
https://www.hdfgroup.org/downloads/hdfview/

- Download Madrigal file and Look at Hdf file

Follow my simple TEC instructions to download or look at on web