# Analysis of Antarctic Scintillation Measured at McMurdo and South Pole Station

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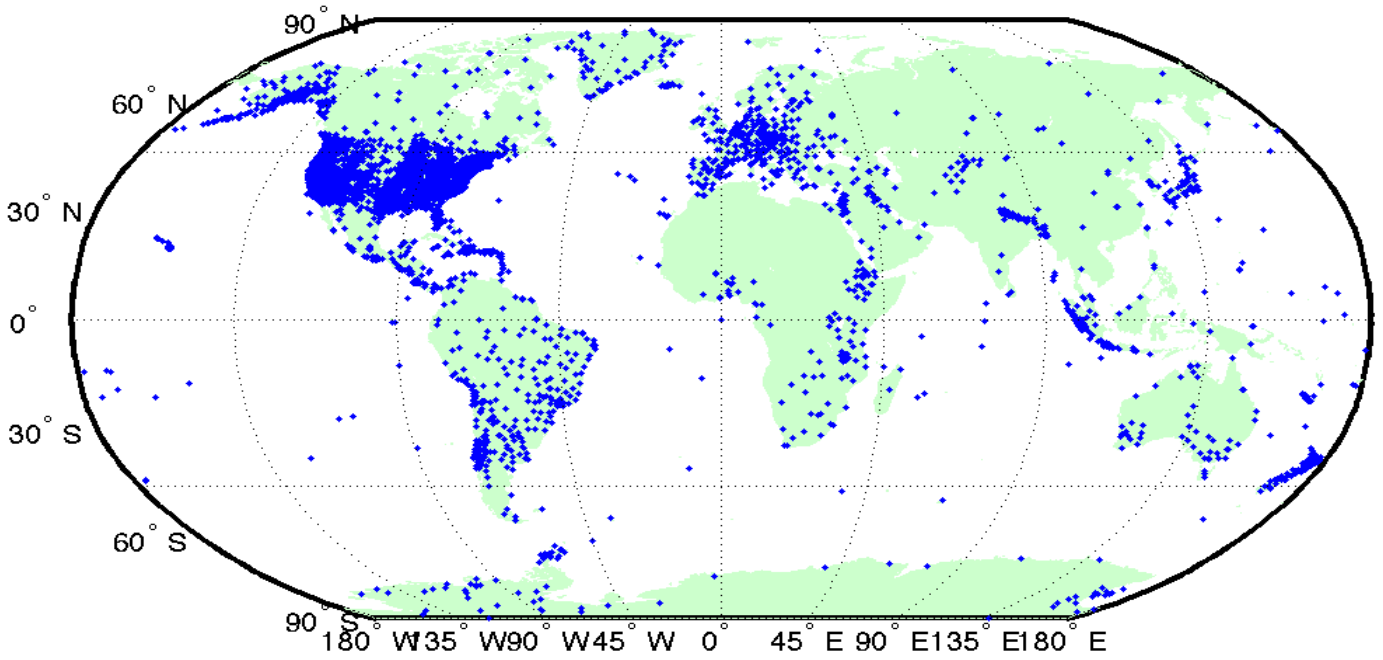
2. Virginia Tech, Blacksburg, VA
3. Siena College, NY
4. Johns Hopkins Applied Research Laboratory, MD
5. RISH, Kyoto University

IES 2015

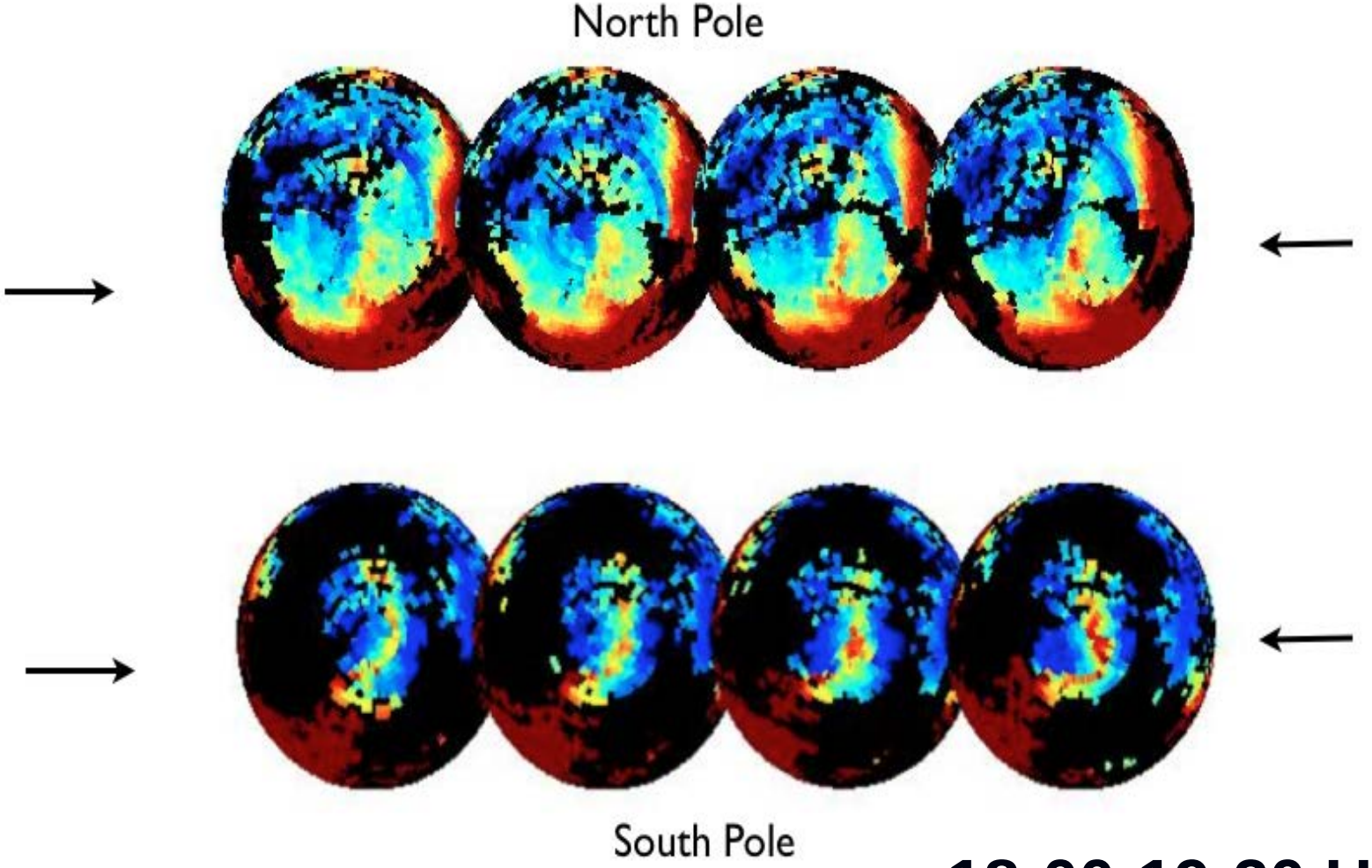
# OUTLINE

- Introduction
- 17 March 2013
- New TEC/ Scintillation inputs into Madrigal

# Map of GPS receivers



# Location of Base of Plume stays fixed in longitude




**18:00-19:20 UT**

# Scintillation - GNSS

- Ionospheric irregularities cause rapid fluctuations of radio signal amplitude and phase, called scintillation
- Issues with GNSS receivers measuring amplitude scintillation measurements in polar regions
- Issues of loss of lock issues with certain receivers

# Where Scintillation is Observed

**Auroral/Polar Cap**

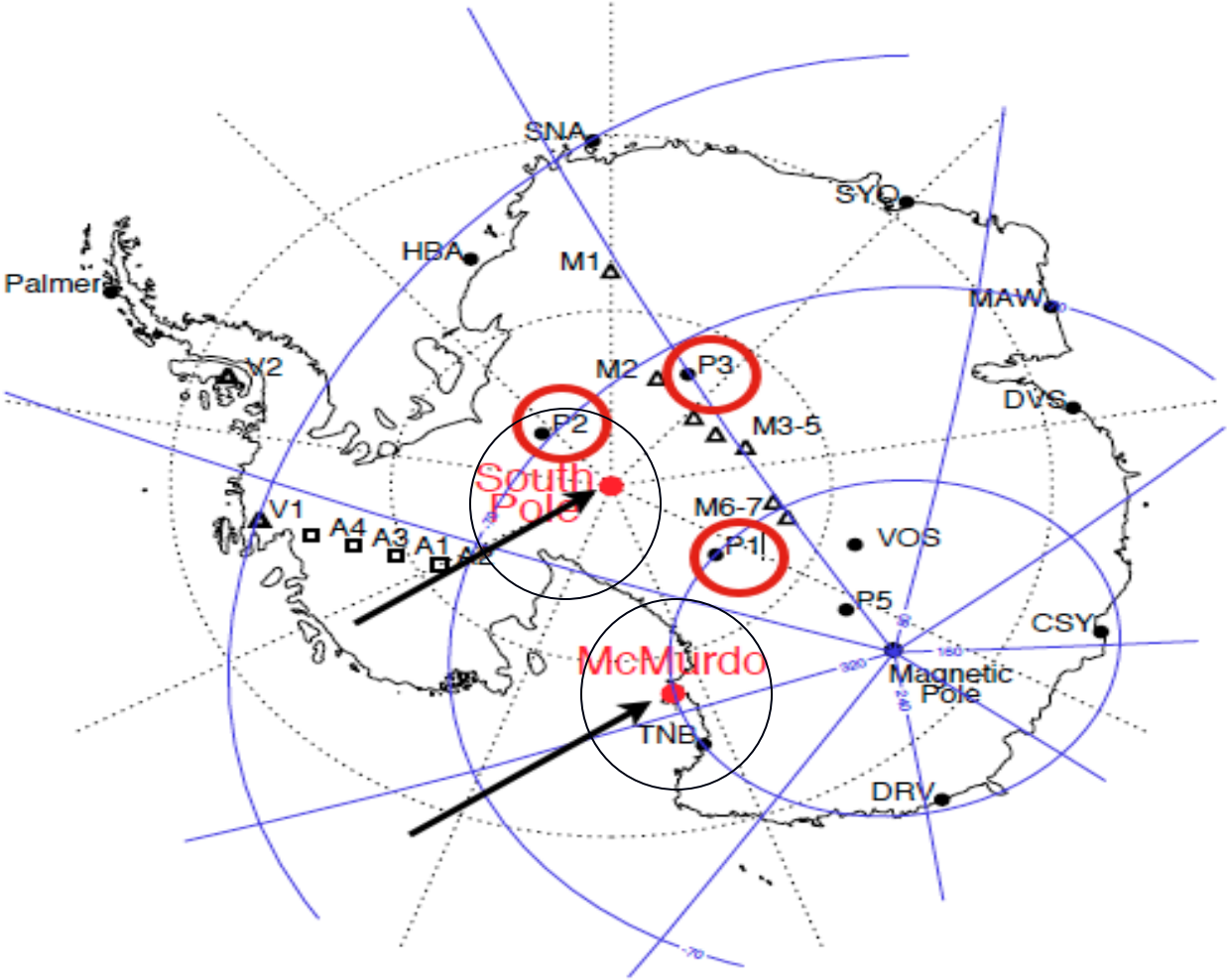
**1) Dayside: Phase scintillation is observed on the dayside within a tongue of ionization (TOI) and dayside aurora (cusp).**

**2) Nightside: scintillation is collocated with (a) strong post-midnight return convection (TOI) and (b) auroral breakups in pre-midnight sector.**

**Subauroral latitudes**

**3) Scintillation maps to the poleward edge of main trough and is collocated with subauroral polarization stream (SAPS) and storm-enhanced plasma density (SED).**

# Location of GPS scintillation receivers in Antarctica: South Pole and McMurdo



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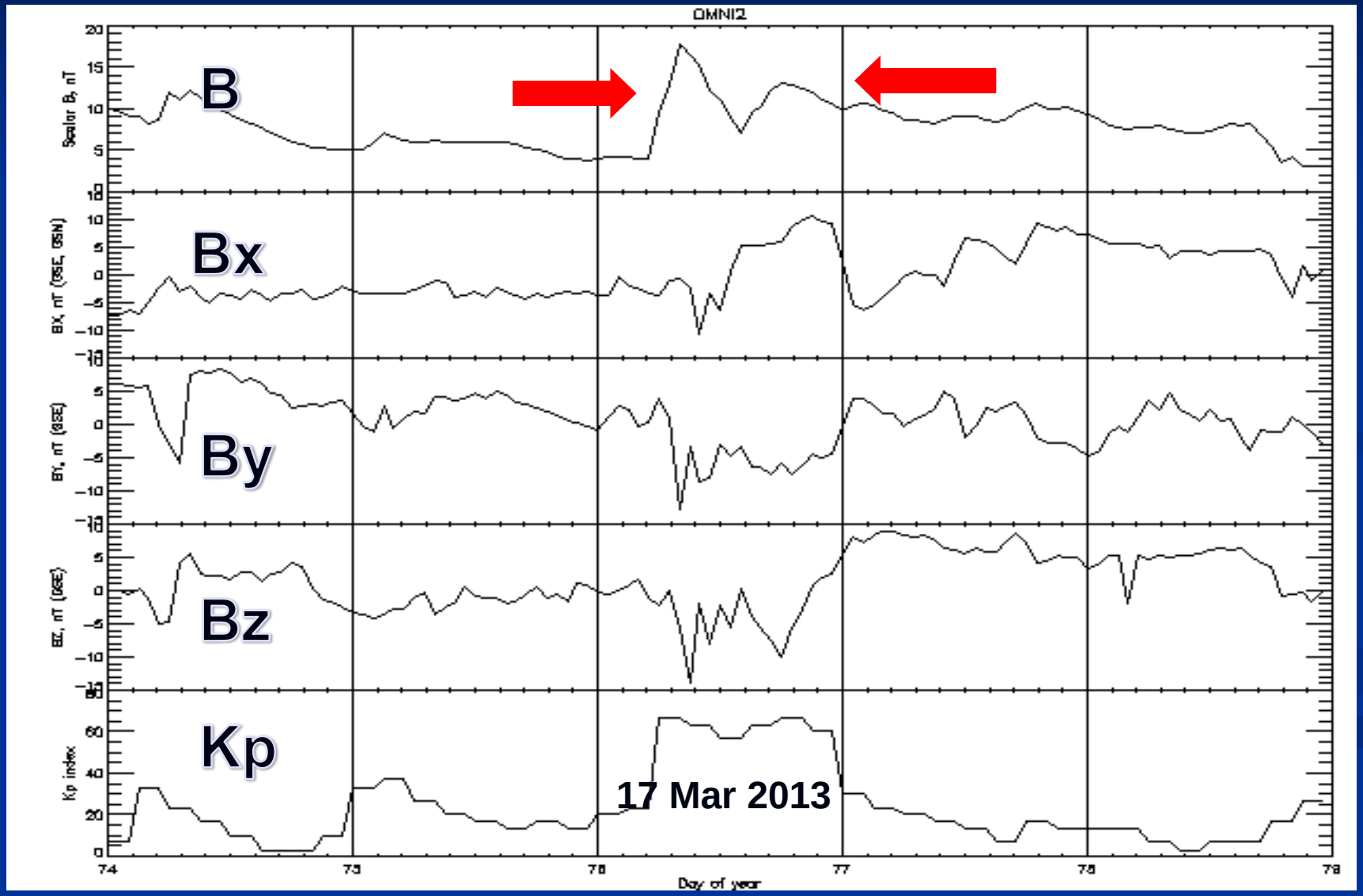
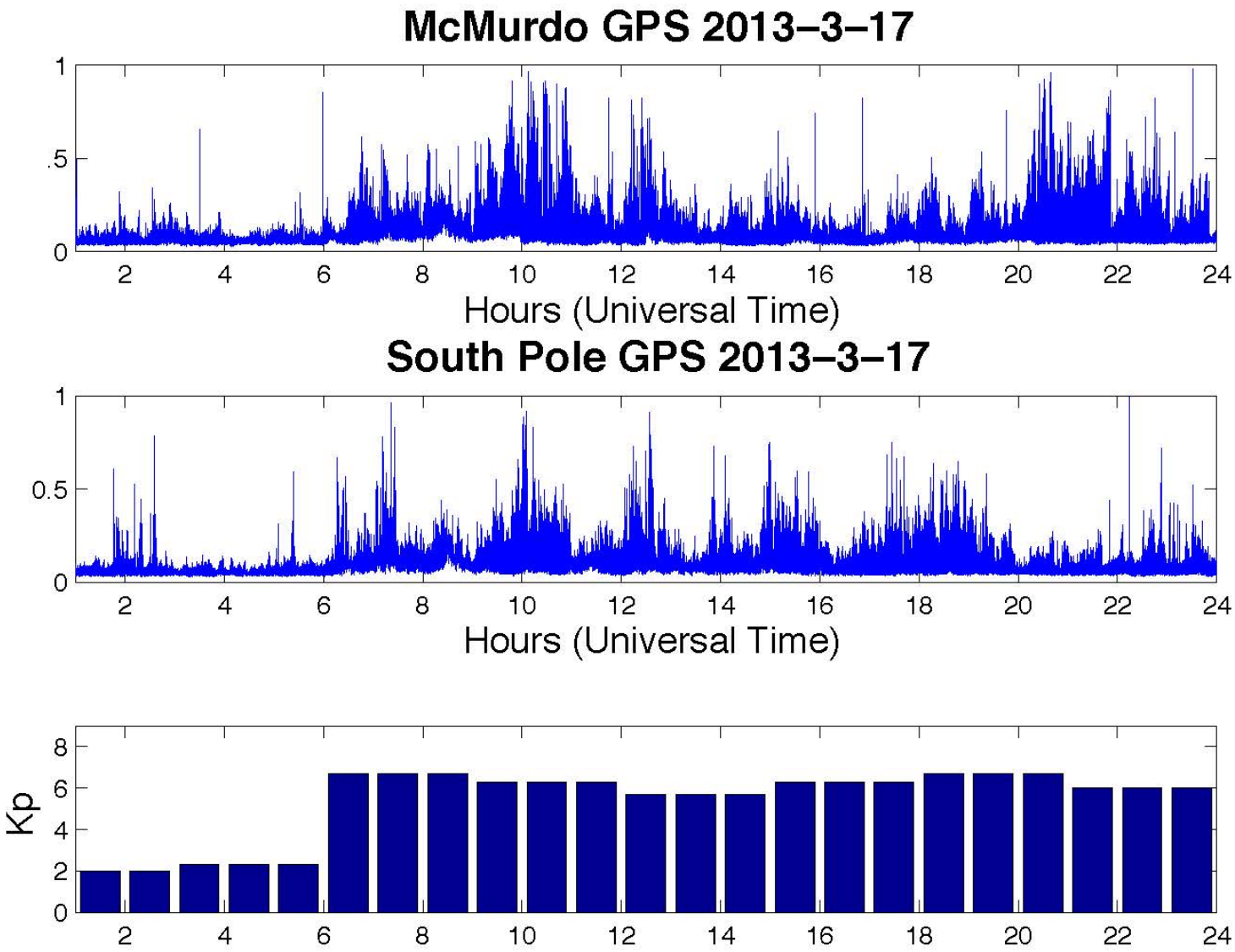
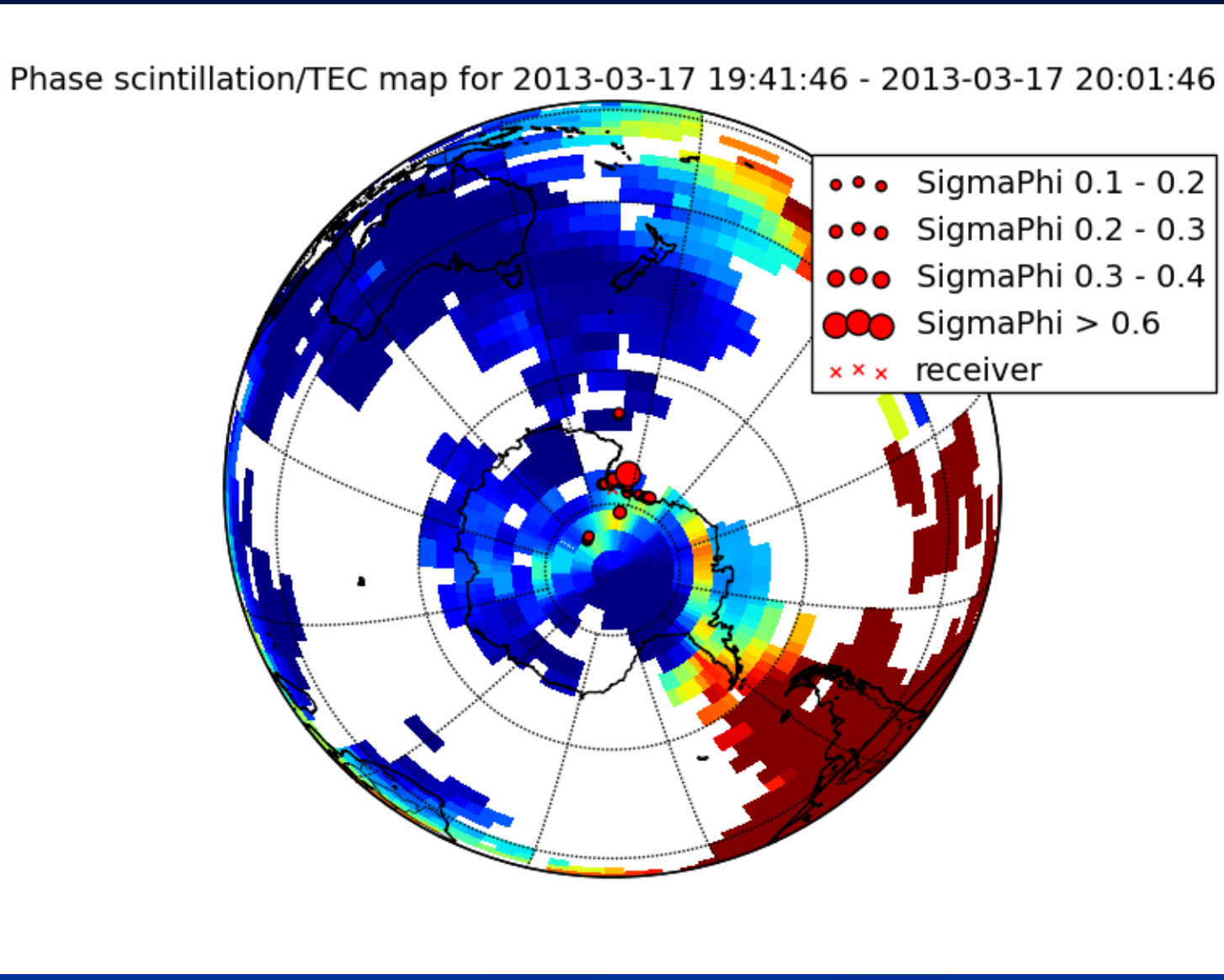
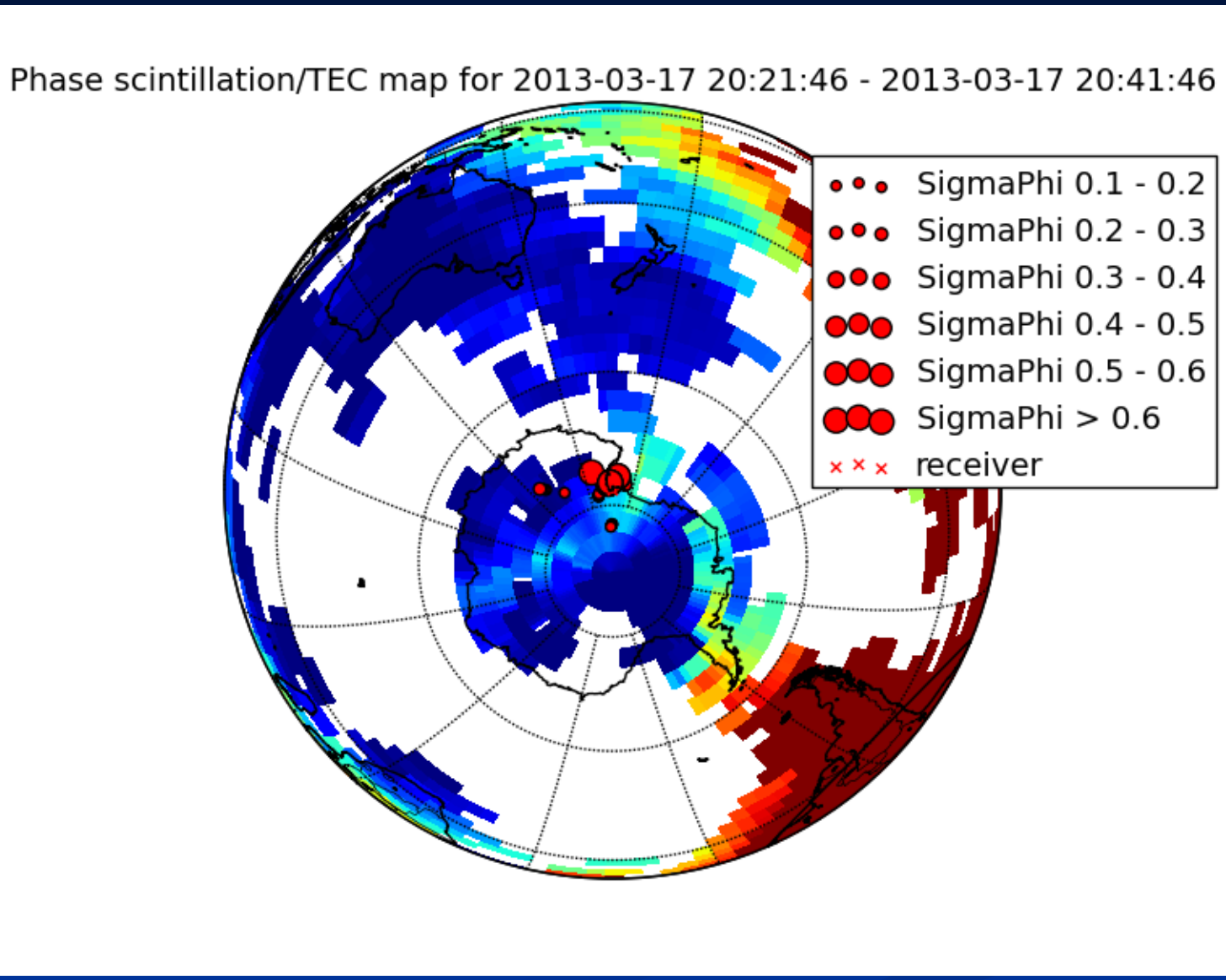
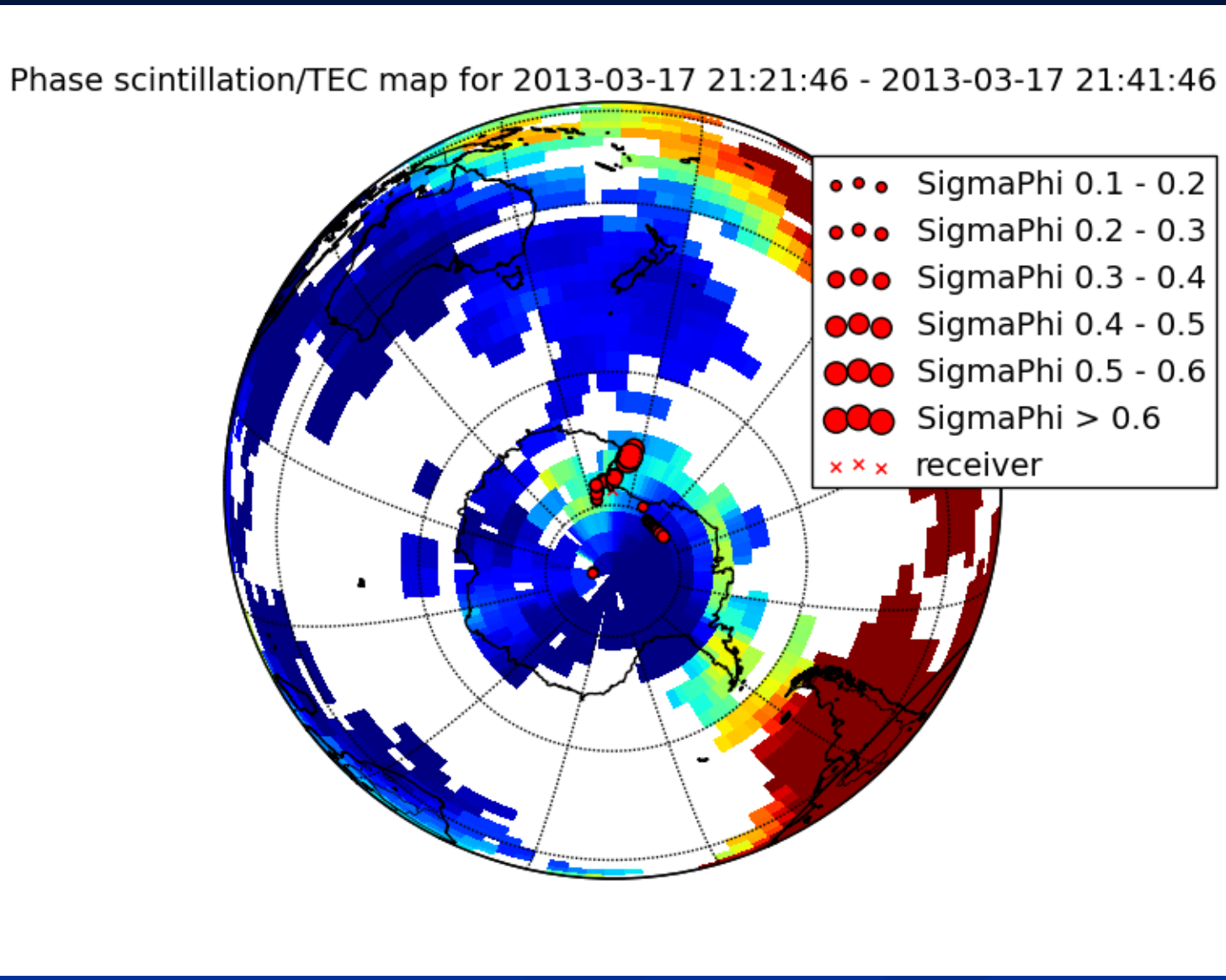
# 17 Mar 2013 Conditions




McMurdo GPS 2013–3–17
1
.5
0
2
4
6
8
10
12
14
16
18
20
22
24
Hours (Universal Time)
South Pole GPS 2013–3–17
1
0.5
0
2
4
6
8
10
12
14
16
18
20
22
24
Hours (Universal Time)
Kp
8
6
4
2
0
2
4
6
8
10
12
14
16
18
20
22
24


Phase scintillation/TEC map for 2013-03-17 19:41:46 - 2013-03-17 20:01:46
SigmaPhi 0.1 - 0.2
SigmaPhi 0.2 - 0.3
SigmaPhi 0.3 - 0.4
SigmaPhi > 0.6
receiver


Phase scintillation/TEC map for 2013-03-17 20:21:46 - 2013-03-17 20:41:46
SigmaPhi 0.1 - 0.2
SigmaPhi 0.2 - 0.3
SigmaPhi 0.3 - 0.4
SigmaPhi 0.4 - 0.5
SigmaPhi 0.5 - 0.6
SigmaPhi > 0.6
receiver


Phase scintillation/TEC map for 2013-03-17 21:21:46 - 2013-03-17 21:41:46
SigmaPhi 0.1 - 0.2
SigmaPhi 0.2 - 0.3
SigmaPhi 0.3 - 0.4
SigmaPhi 0.4 - 0.5
SigmaPhi 0.5 - 0.6
SigmaPhi > 0.6
receiver

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Madrigal Database

cedar.openmadrigal.org

Apple Google Maps Popular YouTube News

Madrigal Database | Inbox (45,424) – ajcoster@gmail.com – Gmail

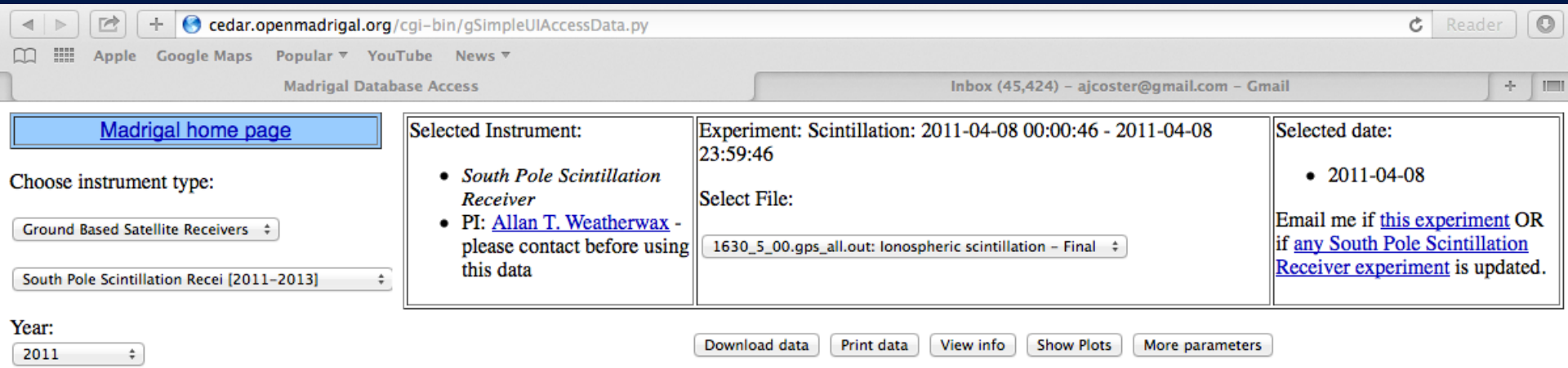
# Welcome to the CEDAR Archival Madrigal Database

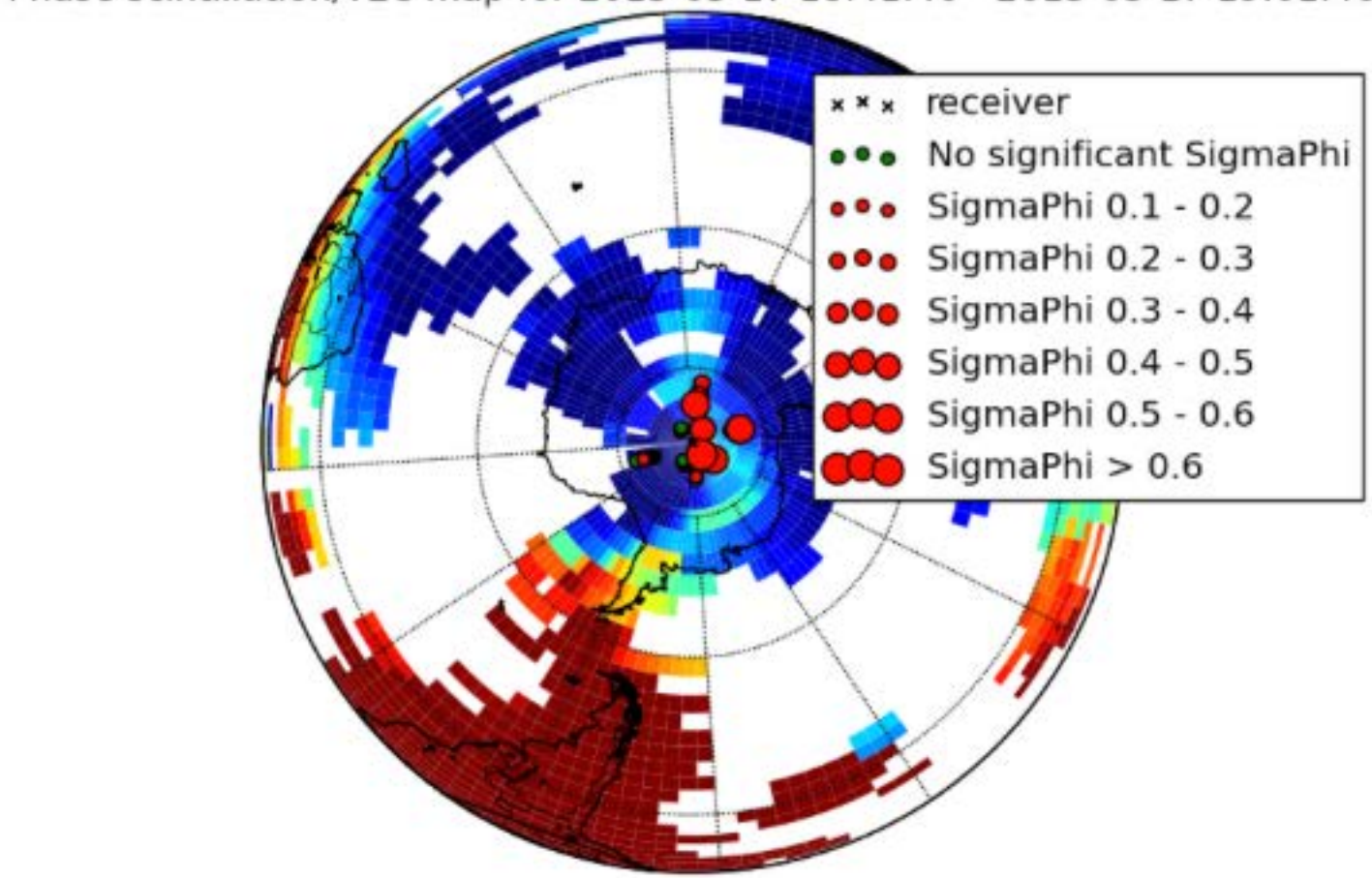
- Tutorial
- Simple Local Data Access
- Full Data Access
- Run Models
- Documentation
  - Web access
  - Script access
- Open Madrigal

The is the archival Madrigal site, where all data from all Madrigal sites is automatically imported for archiving. Since all Madrigal data from all sites is local here, you can use the Simple Local Data Access link to search for all Madrigal data from any site. Using the Full Data Access link will allow you to search data in the normal way, where your search will take you to the host Madrigal site.

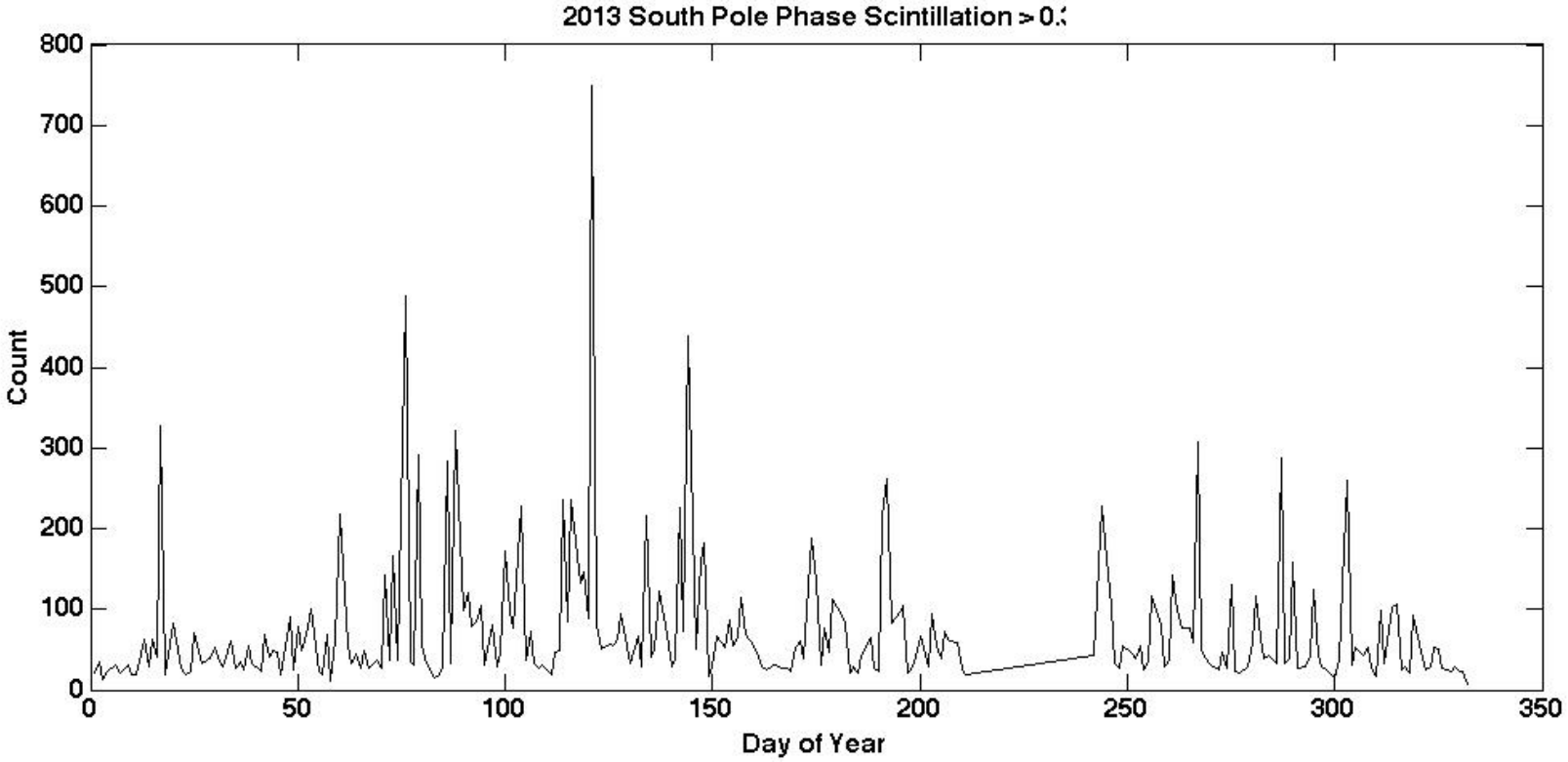
Madrigal is an upper atmospheric science database used by groups throughout the world. Madrigal is a robust, World Wide Web based system capable of managing and serving archival and real-time data, in a variety of formats, from a wide range of upper atmospheric science instruments. Data at each Madrigal 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.

Data can be accessed from a variety of Madrigal sites, including (but not limited to) Millstone Hill, USA, Arecibo, Puerto Rico, EISCAT, Norway, SRI International, USA, Cornell University, USA, Jicamarca, Peru, ,the Consortium of Resonance and Rayleigh Lidars, the Institute of Geology and Geophysics, the Chinese Academy of Sciences, the University of Oulu, Finland, and finally, the archival CEDAR site. To see a list of all Madrigal sites, choose Full Data Access and select *Go to a different Madrigal site*. Data can also be accessed directly, using APIs which are available for several popular programming languages (Matlab, python, and IDL). A Subversion archive of all Madrigal 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.

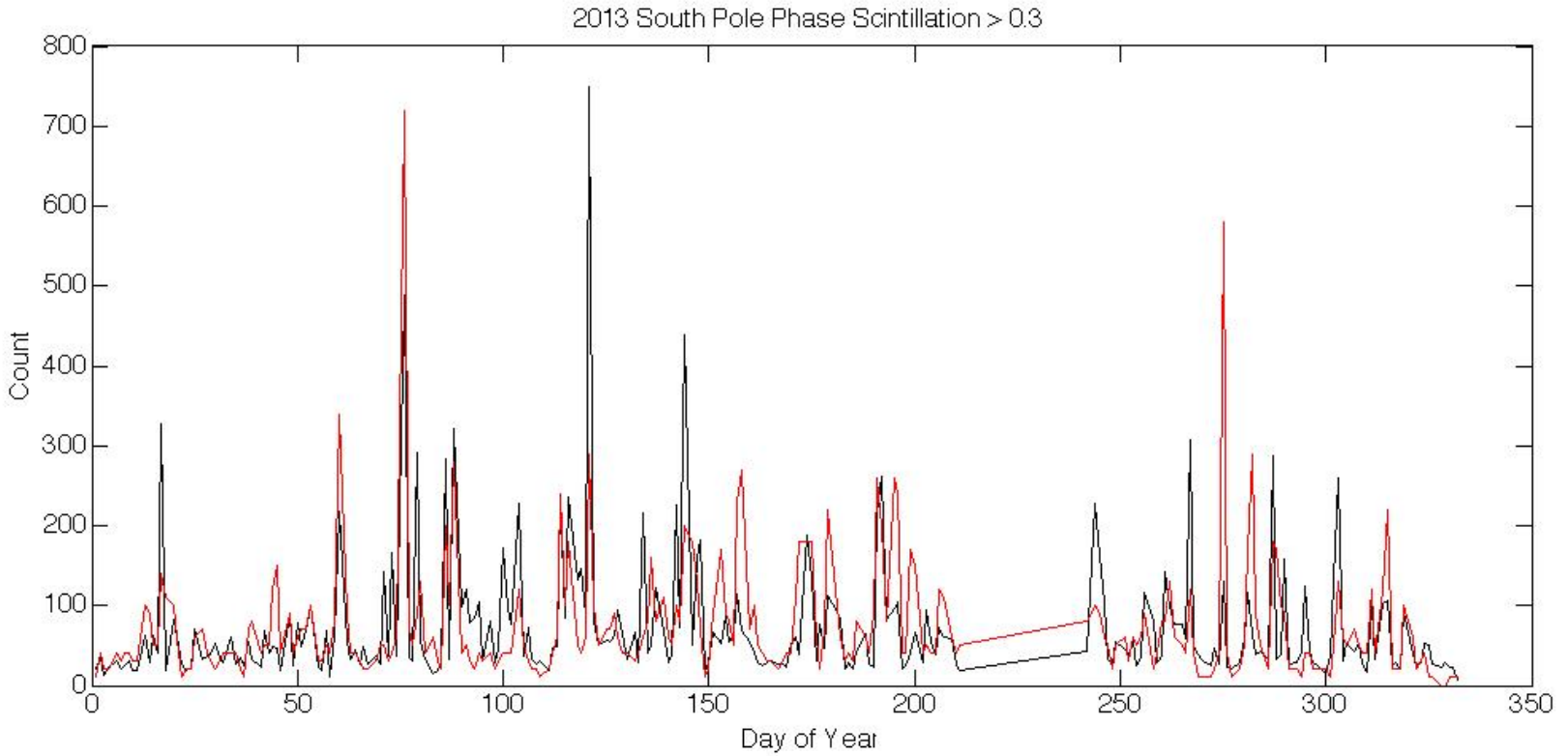

cedar.openmadrigal.org/cgi-bin/gSimpleUIAccessData.py
Reader
Apple
Google Maps
Popular
YouTube
News
Madrigal Database Access
Inbox (45,424) – ajcoster@gmail.com – Gmail
Madrigal home page
Choose instrument type:
Ground Based Satellite Receivers
South Pole Scintillation Recei [2011-2013]
Year:
2011
Month:
April
April 2011
Sun Mon Tue Wed Thu Fri Sat
27 28 29 30 31 01 02
03 04 05 06 07 08 09
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30
Selected Instrument:
South Pole Scintillation Receiver
PI: Allan T. Weatherwax - please contact before using this data
Experiment: Scintillation: 2011-04-08 00:00:46 - 2011-04-08 23:59:46
Select File:
1630_5_00.gps_all.out: Ionospheric scintillation - Final
Selected date:
2011-04-08
Email me if this experiment OR if any South Pole Scintillation Receiver experiment is updated.
Download data
Print data
View info
Show Plots
More parameters
Click here for combined scintillation/TEC maps for 2011-04-08


Phase scintillation/TEC map for 2013-03-17 18:41:46 - 2013-03-17 19:01:46
receiver
No significant SigmaPhi
SigmaPhi 0.1 - 0.2
SigmaPhi 0.2 - 0.3
SigmaPhi 0.3 - 0.4
SigmaPhi 0.4 - 0.5
SigmaPhi 0.5 - 0.6
SigmaPhi > 0.6

# South Pole Phase Scintillation > 0.3 Counts per Day 2013



# South Pole Phase Scintillation > 0.3 Counts per Day 2013 versus Ap



Aurora over South Pole Station

www.southpole-aurora.org

Apple Google Maps Popular YouTube News

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# Aurora over South Pole Station

## Kyoto University / NIPR / NJIT / Siena College / NSF

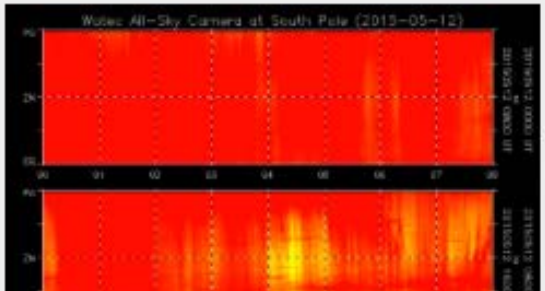
日本語

Optical observation of aurora australis (southern lights) at South Pole Station and McMurdo Station.

- Data from Imager #1
- Data from Imager #3

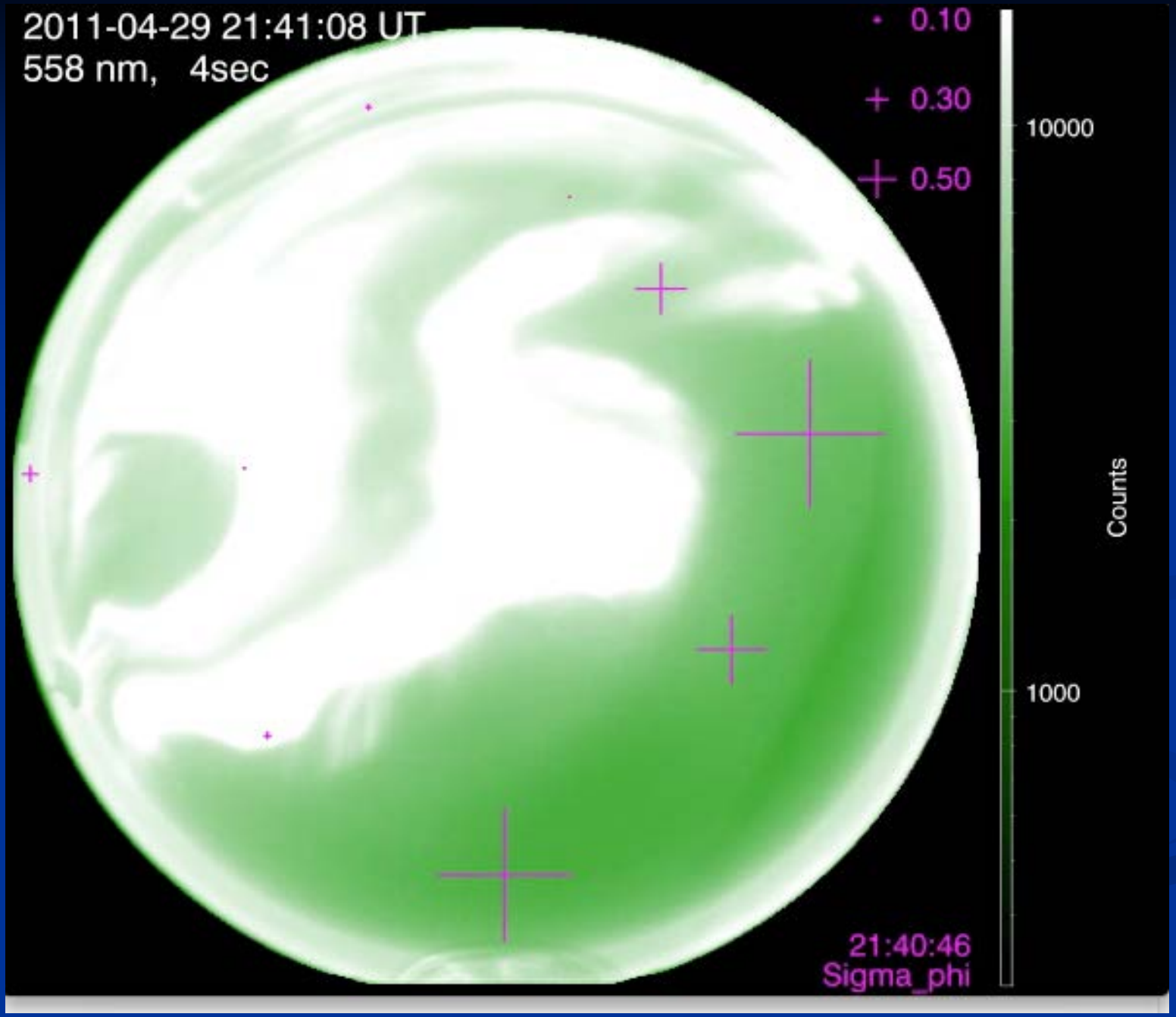
- Sample images
- Instrument
- Publication
- Presentation

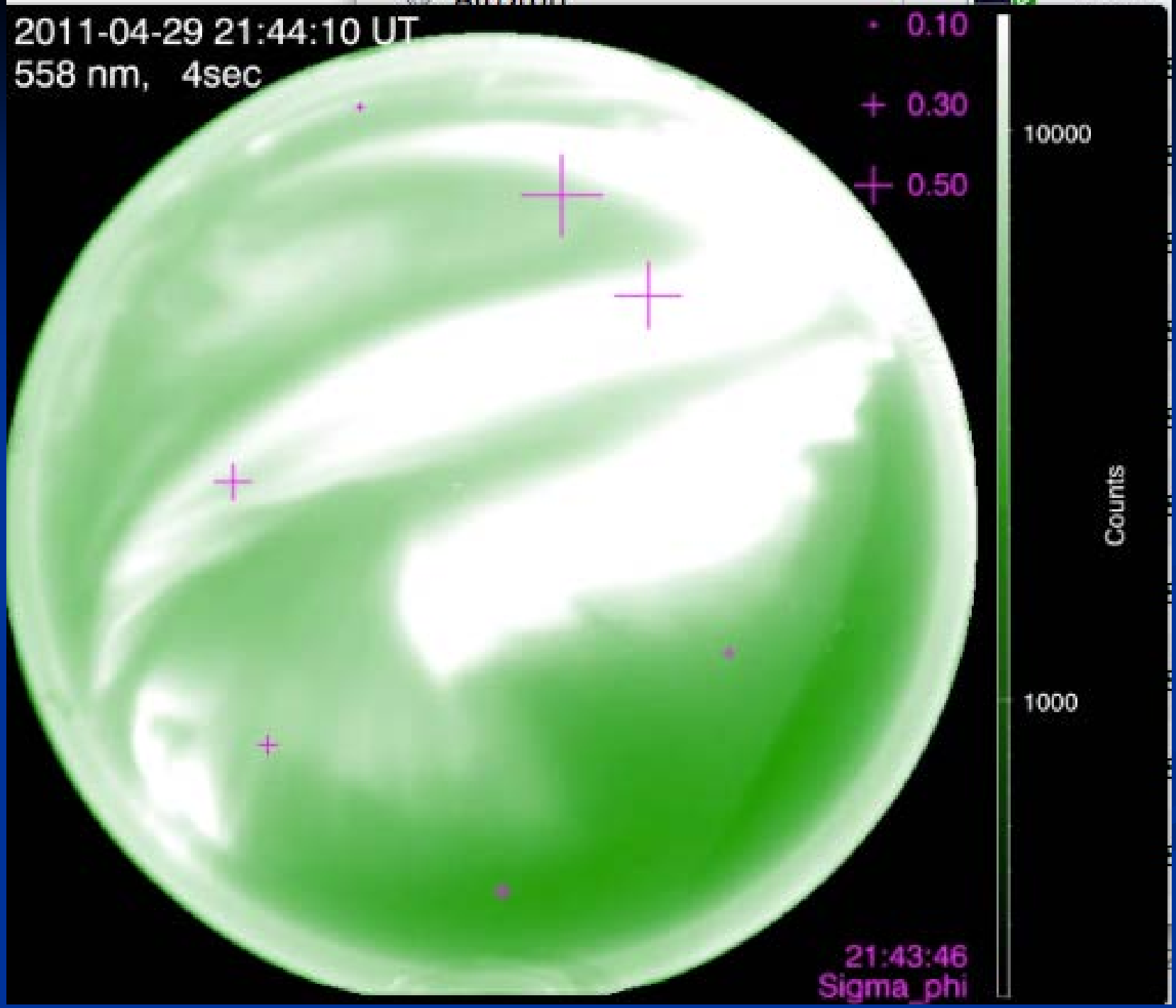
### Latest images from South Pole

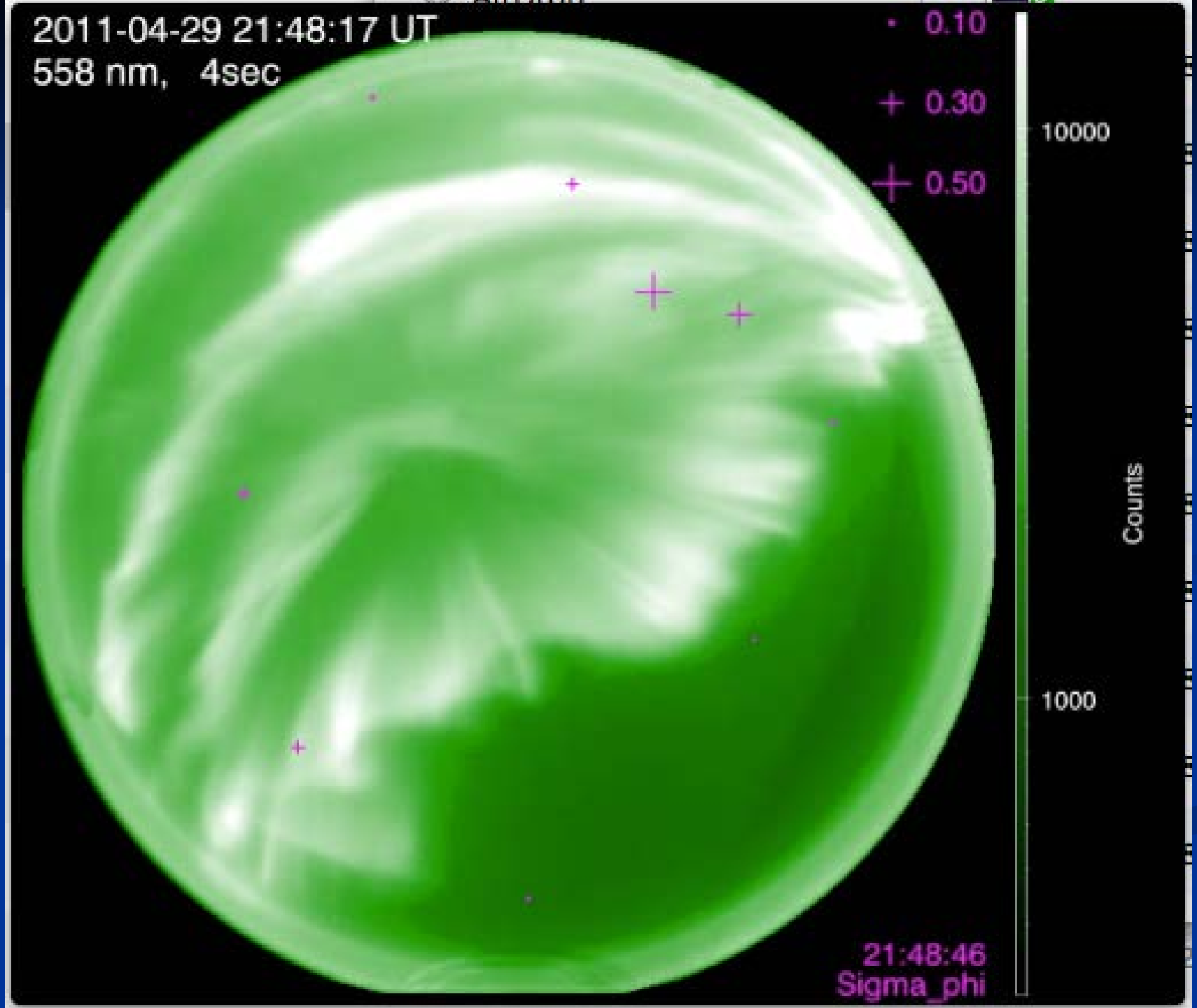


South Pole is a unique location where we can observe both the nightside aurora (substorm) and the dayside aurora (cusp).

# Nighttime Aurora - Substorms


2011-04-29 21:41:08 UT
558 nm, 4sec
0.10
0.30
0.50
10000
1000
Counts
21:40:46
Sigma_phi


2011-04-29 21:44:10 UT
558 nm, 4sec
0.10
0.30
0.50
10000
1000
Counts
21:43:46
Sigma_phi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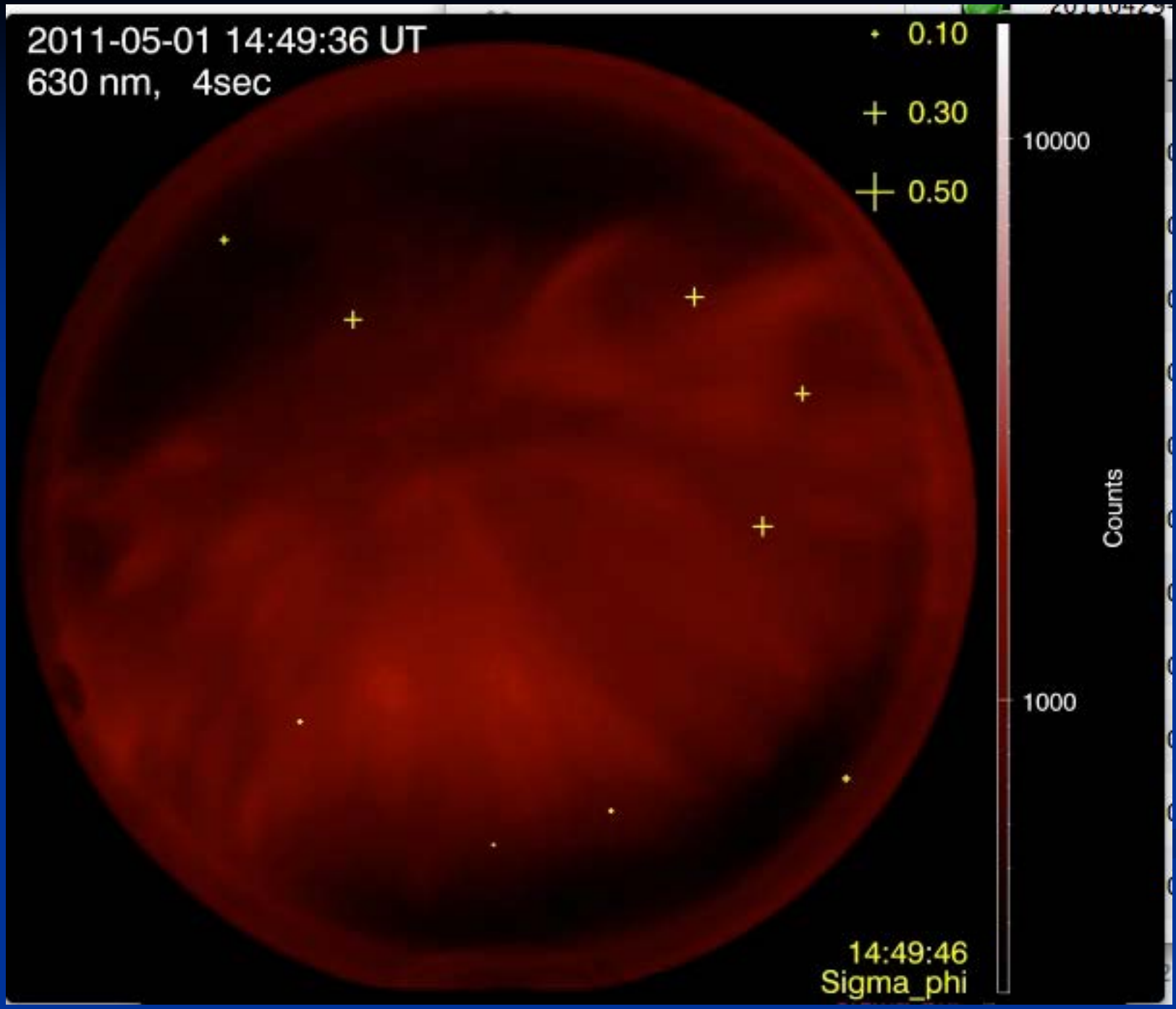
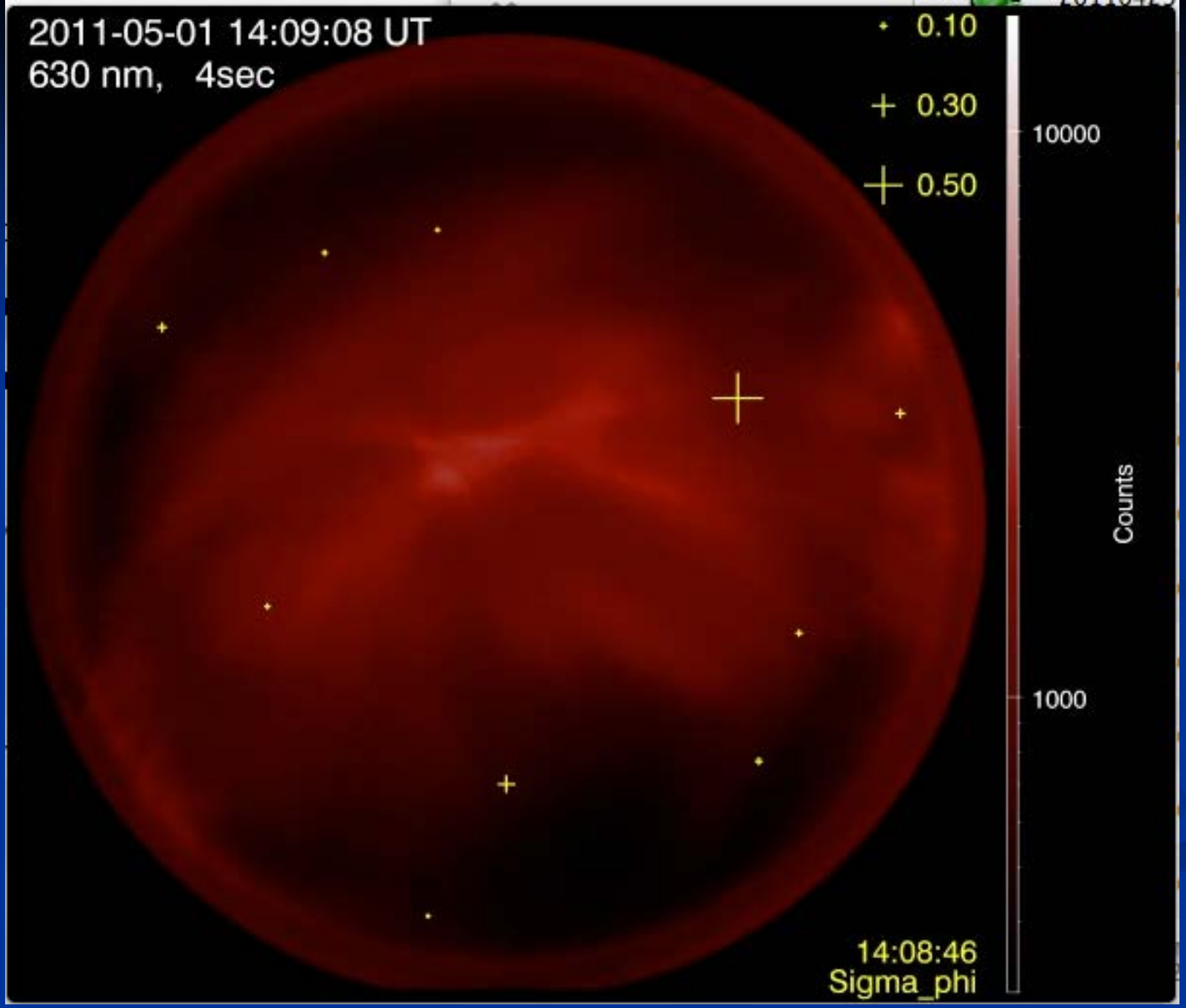
558 nm, 4sec
0.10
0.30
0.50
10000
1000
Counts
21:48:46
Sigma_phi

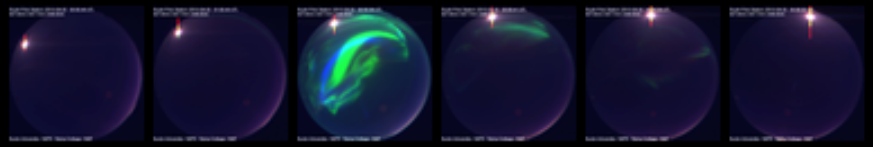

2011-05-01 14:49:36 UT
630 nm, 4sec
0.10
0.30
0.50
10000
1000
Counts
14:49:46
Sigma_phi


2011-05-01 14:09:08 UT
630 nm, 4sec
0.10
0.30
0.50
10000
1000
Counts
14:08:46
Sigma_phi

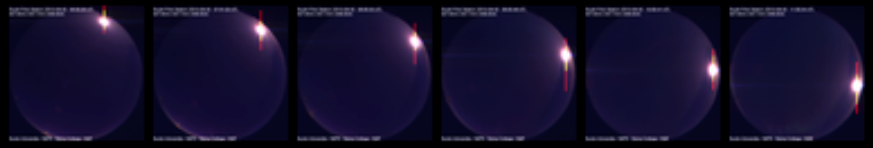
# South Pole ASI Quick Look
# Composite Images
# AUG 20, 2013

The image is only approximate true color, using green, red and blue filters, rather than the human red-green-blue.

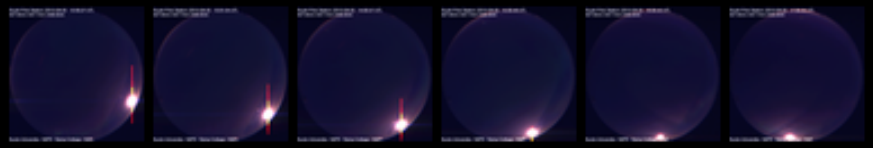
00 UT 01 UT 02 UT 03 UT 04 UT 05 UT

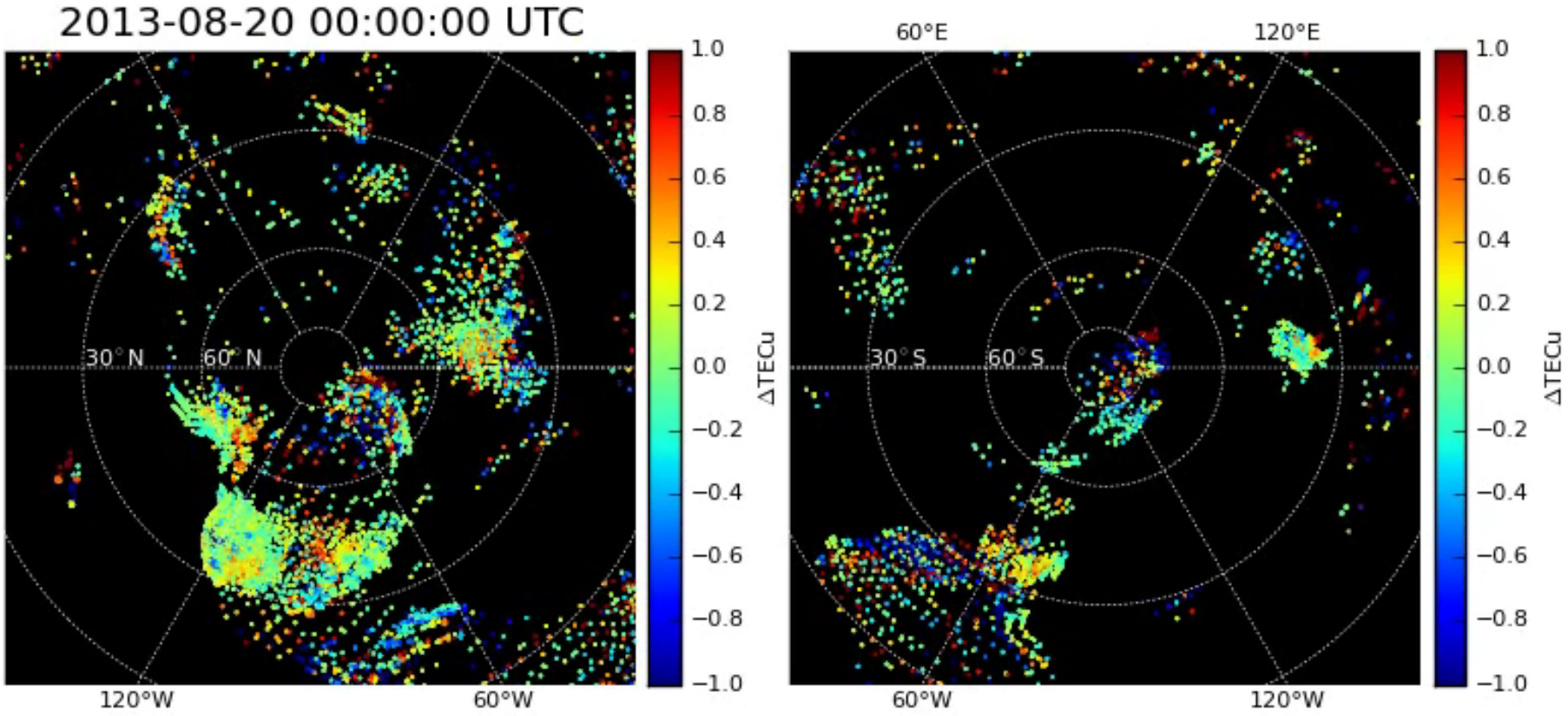


06 UT 07 UT 08 UT 09 UT 10 UT 11 UT



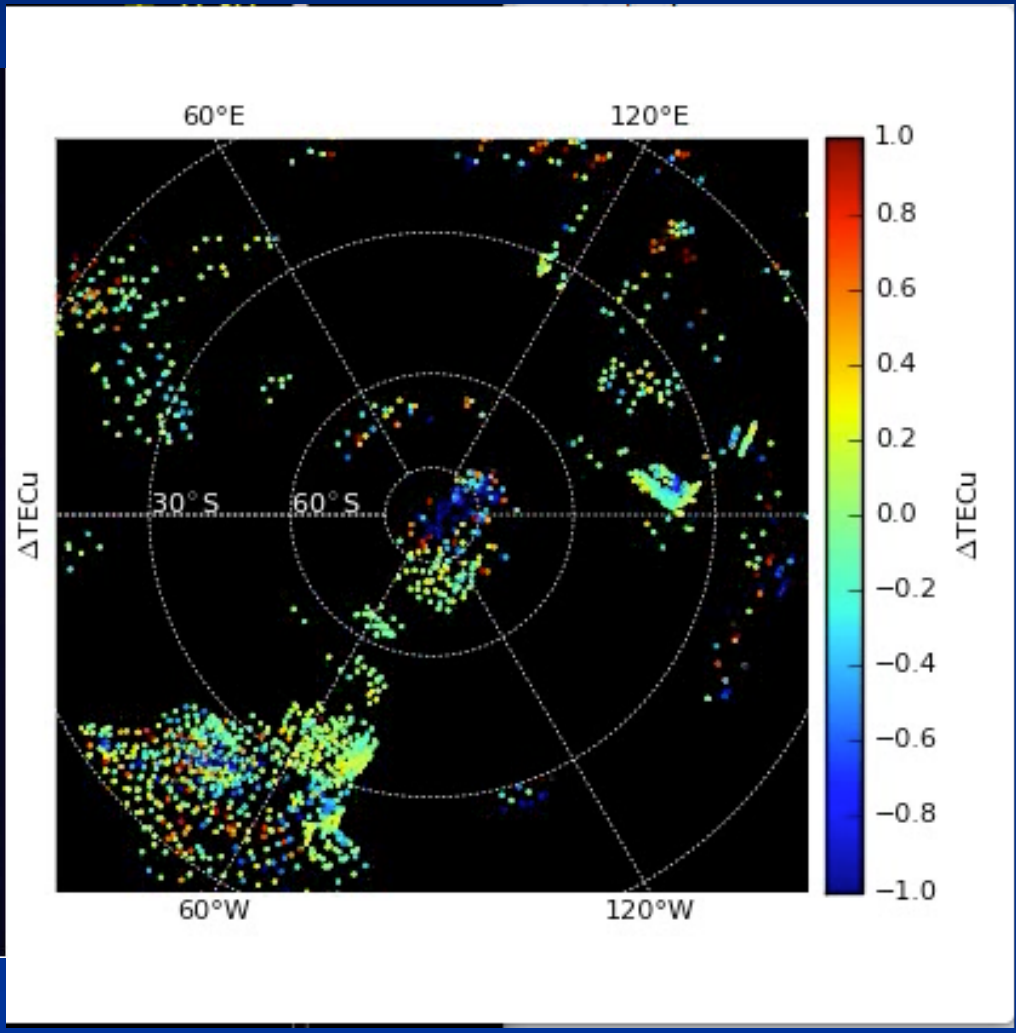
12 UT 13 UT 14 UT 15 UT 16 UT 17 UT



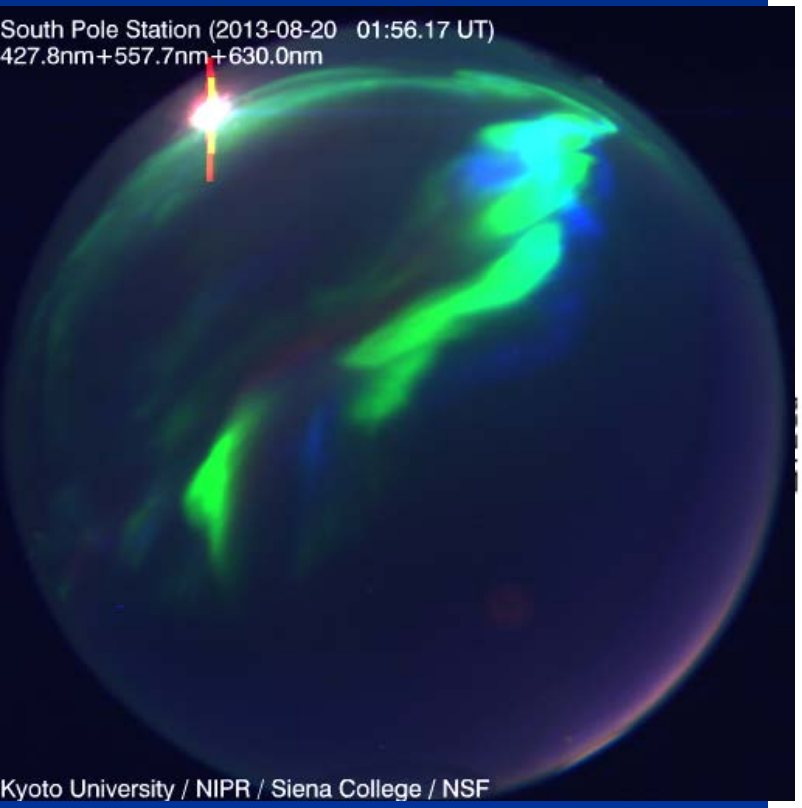

2013-08-20 00:00:00 UTC
30° N
60° N
120°W
60°W
60°E
120°E
30° S
60° S
60°W
120°W
ΔTECu
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0

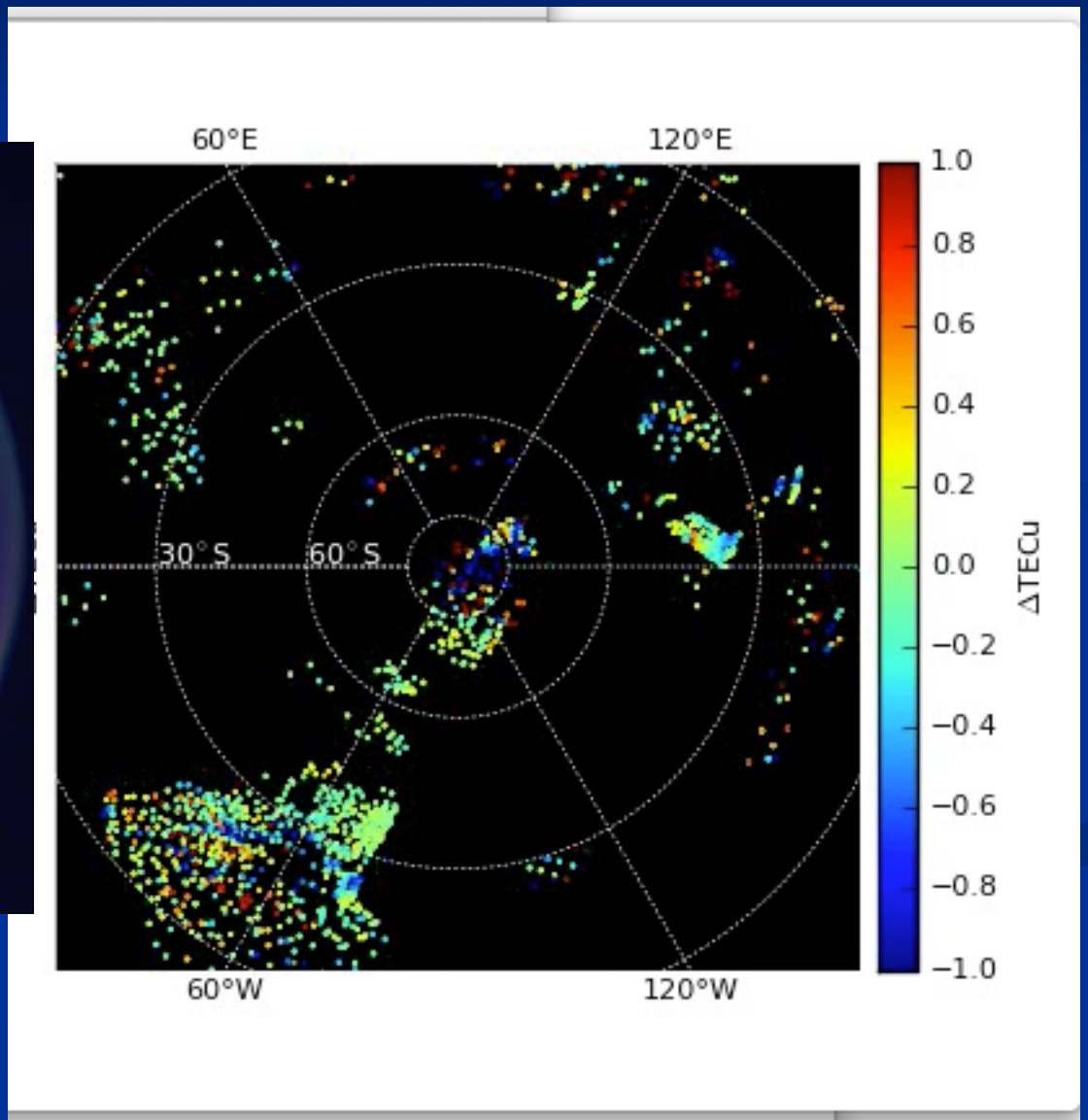
# 01:40 UT


South Pole Station (2013-08-20 01:40.24 UT)
427.8nm+557.7nm+630.0nm
Kyoto University / NIPR / Siena College / NSF

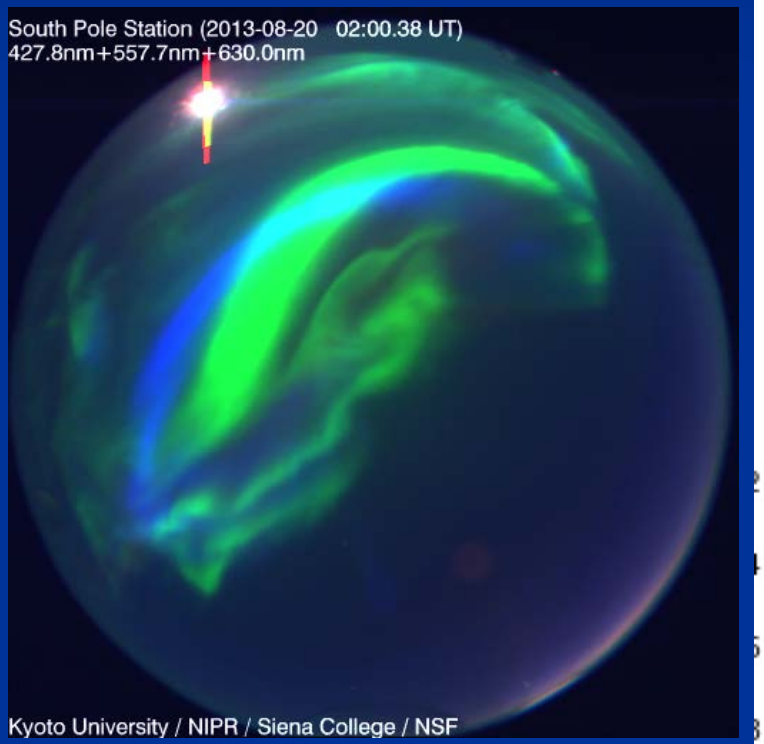

60°E
120°E
30°S
60°S
60°W
120°W
ΔTECu
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
ΔTECu

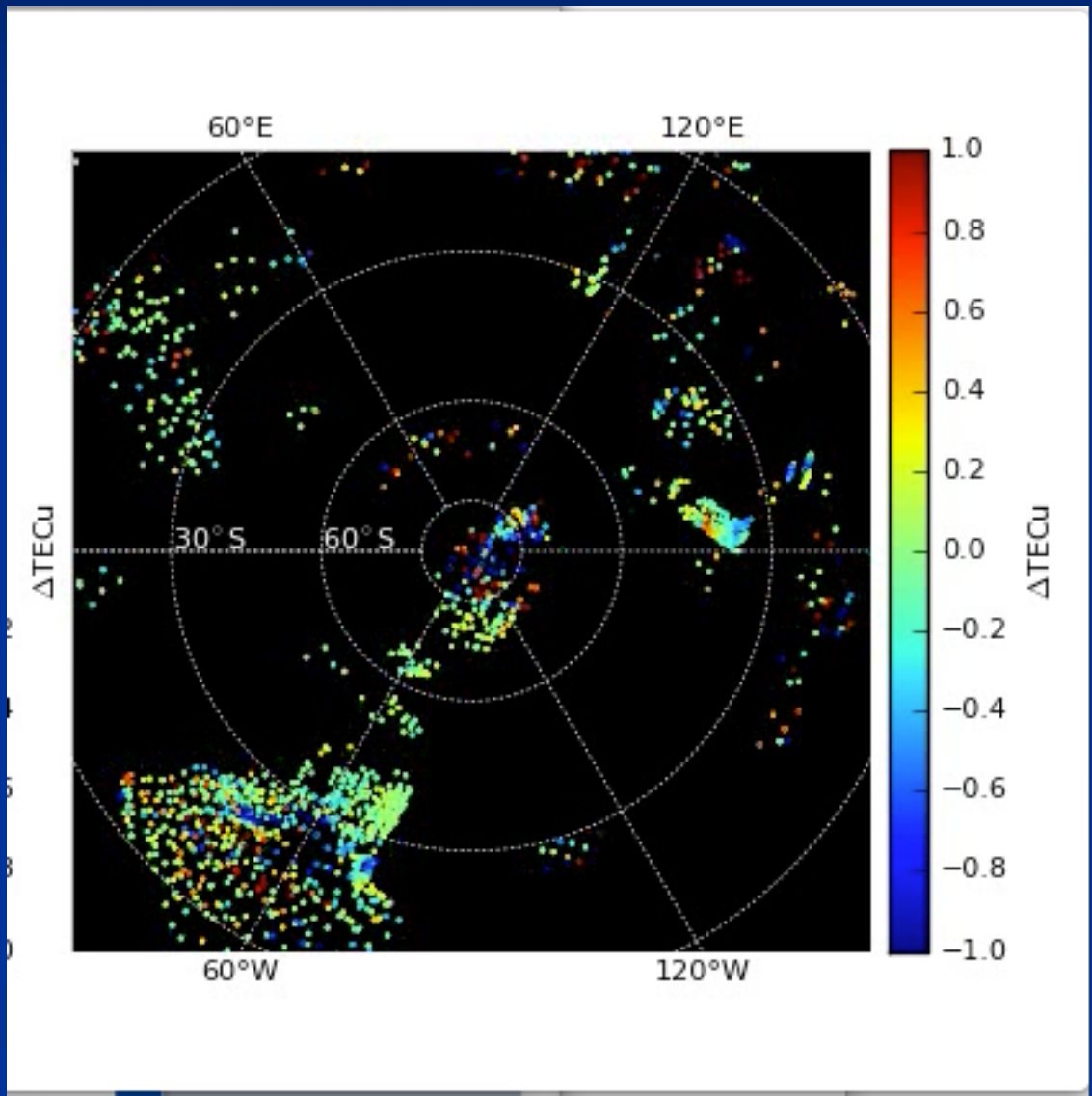
# 1:56


South Pole Station (2013-08-20 01:56.17 UT)
427.8nm+557.7nm+630.0nm
Kyoto University / NIPR / Siena College / NSF

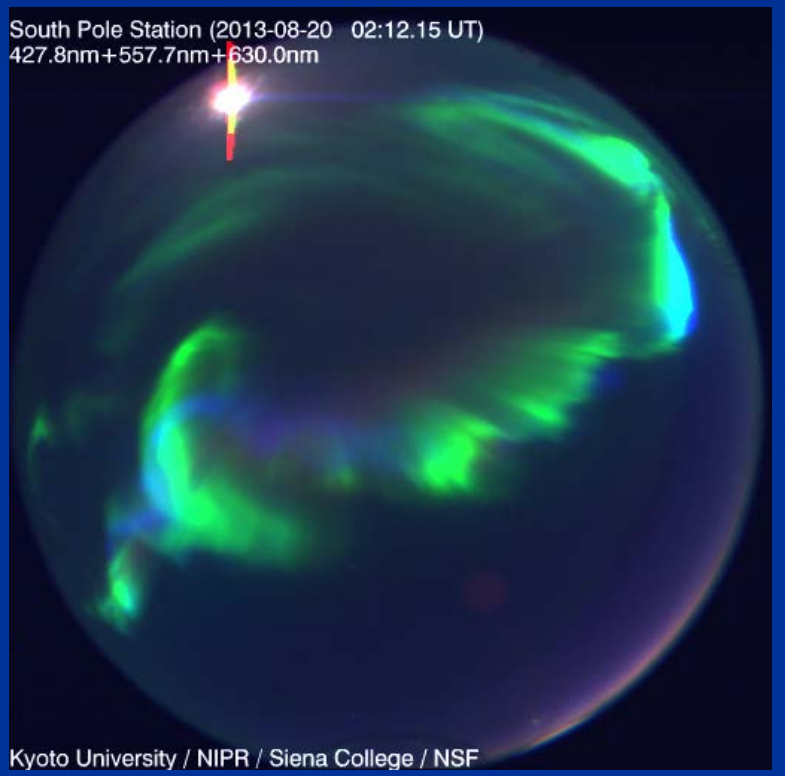

60°E
120°E
30° S
60° S
60°W
120°W
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
ΔTECu

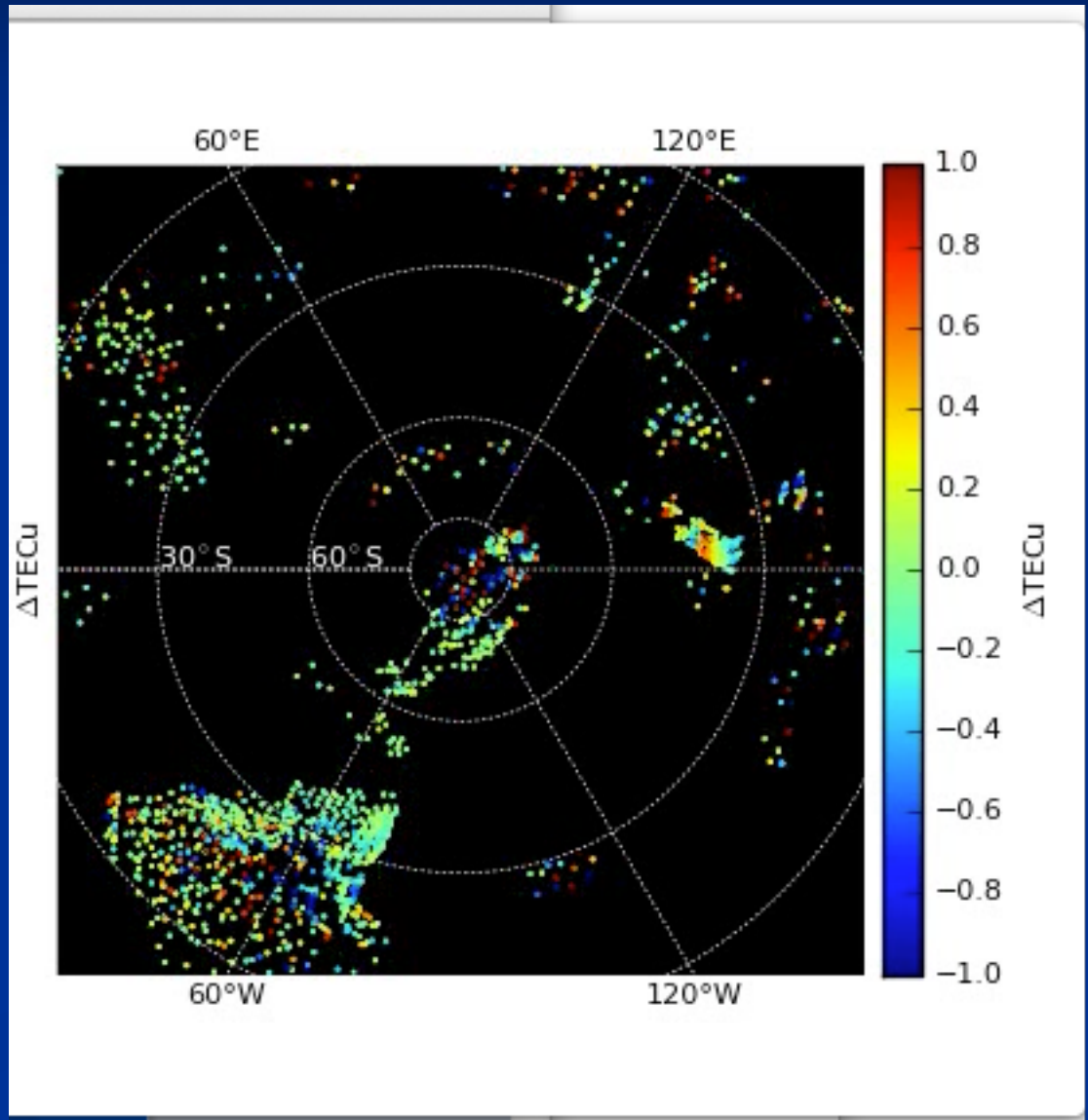
# 2:00


South Pole Station (2013-08-20 02:00.38 UT)
427.8nm+557.7nm+630.0nm
Kyoto University / NIPR / Siena College / NSF

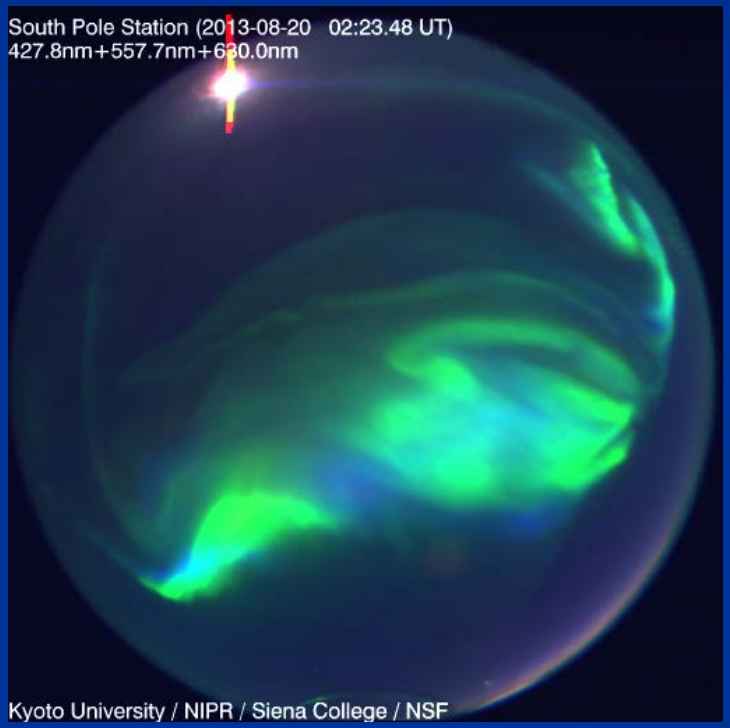

60°E
120°E
30° S
60° S
ΔTECu
60°W
120°W
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
ΔTECu

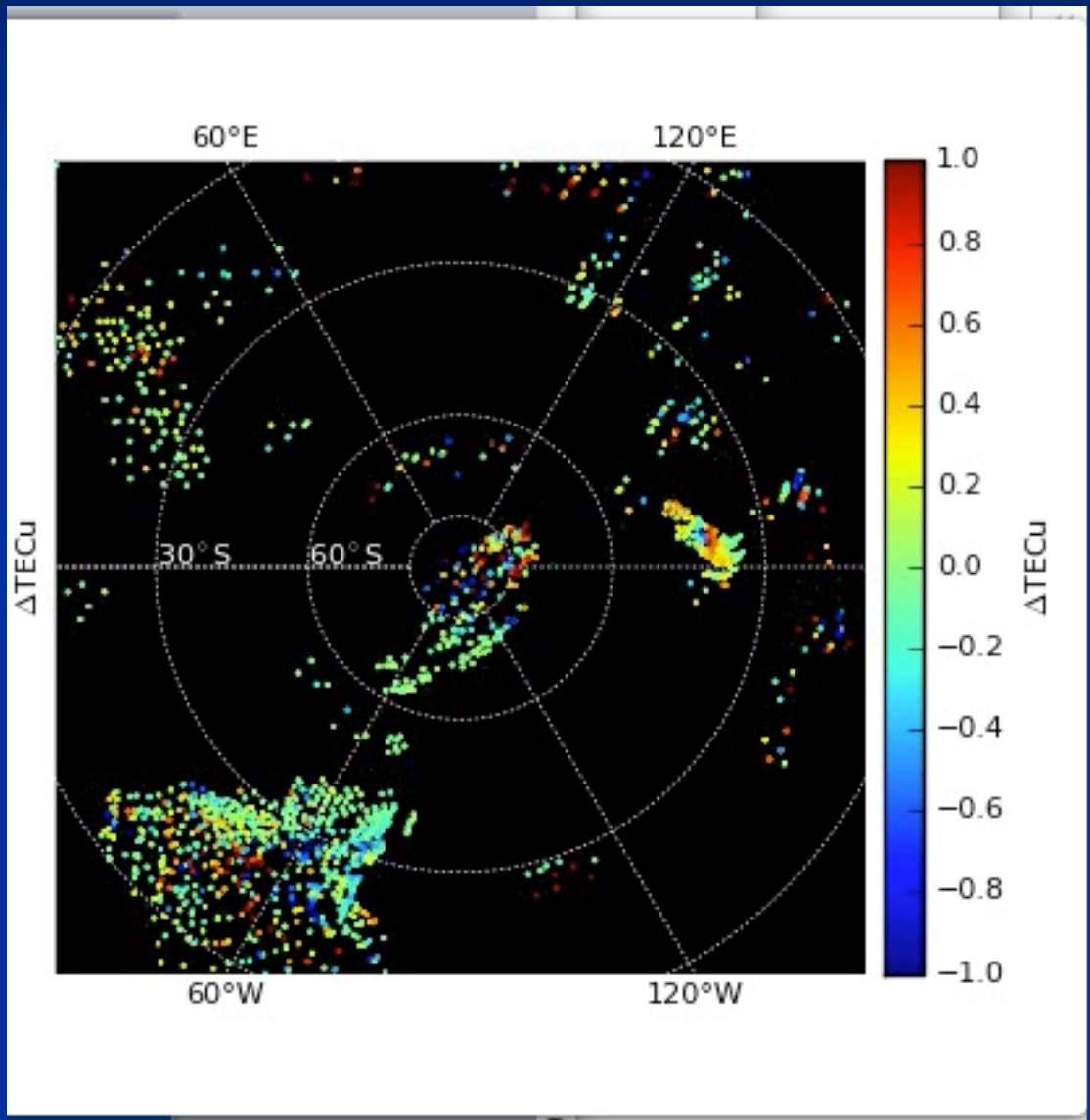
# 2:12


South Pole Station (2013-08-20 02:12.15 UT)
427.8nm+557.7nm+630.0nm
Kyoto University / NIPR / Siena College / NSF


60°E
120°E
30° S
60° S
60°W
120°W
ΔTECu
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
ΔTECu

# 2:23


South Pole Station (2013-08-20 02:23.48 UT)
427.8nm+557.7nm+630.0nm
Kyoto University / NIPR / Siena College / NSF


60°E
120°E
30° S
60° S
60°W
120°W
ΔTECu
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
ΔTECu

# Summary

**Presented case study of Antarctic scintillation associated with 17 March 2013 storm**

**McMurdo and South Pole scintillation data now available through Madrigal.**

**Capability of overlaying South Pole scintillation data onto auroral imaging data will be available in Madrigal soon.**