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Swiss Federal Institute of Technology Zurich

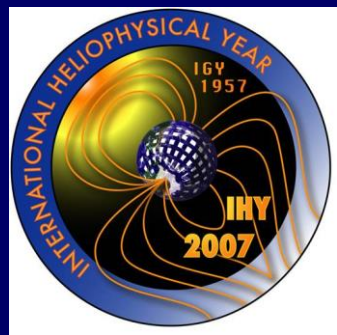
Institute of
Astronomy
ETH Zurich

„CALLISTO and The e-Callisto network“

- Solar Radio Burst Observation

- Education and Training
- Radio Monitoring

Christian Andreas Monstein
Institute for Astronomy
ETH Zürich
Switzerland



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Callisto as Swiss - contribution to IHY2007 and ISWI

C	ompound
A	stronomical
L	ow cost
L	ow frequency
I	nstrument for
S	pectroscopy and
T	ransportable
O	bservatory

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What is the radio spectrometer Callisto 'good' for?

- Real-time observation of dynamic, electromagnetic solar radio bursts.
- Long term radio-monitoring, environmental studies, site evaluation for future radio-telescopes.
- Education & outreach
- Electronics training for physics apprentices and students

Key specifications of Callisto

Parameter	Specification
Frequency range	45.0 MHz … 870.0 MHz (34 cm < λ < 6.7 m) any other range, using heterodyne converters
Frequency step size	62.5 KHz
Radiometric bandwidth	300 KHz
Integration time	1 ms
Time resolution	1.25 ms per spectral pixel
Dynamic range	> 50 dB
Noise figure	< 10 dB
Measuring rate	800 pixels/s maximum
Sweep length	4…400, nominal 200 frequencies per sweep
Power consumption	12 V / ~225 mA (2.7 Watt)
Dimensions/weight	110 mm x 80 mm x 205 mm, ~ 1 kg
Cost	Hardware US490$
Inputs	4 files (configuration, frequency, scheduler, calibration)
Outputs	4 files (FITS-files, logfile, light curve file, spectral overview)

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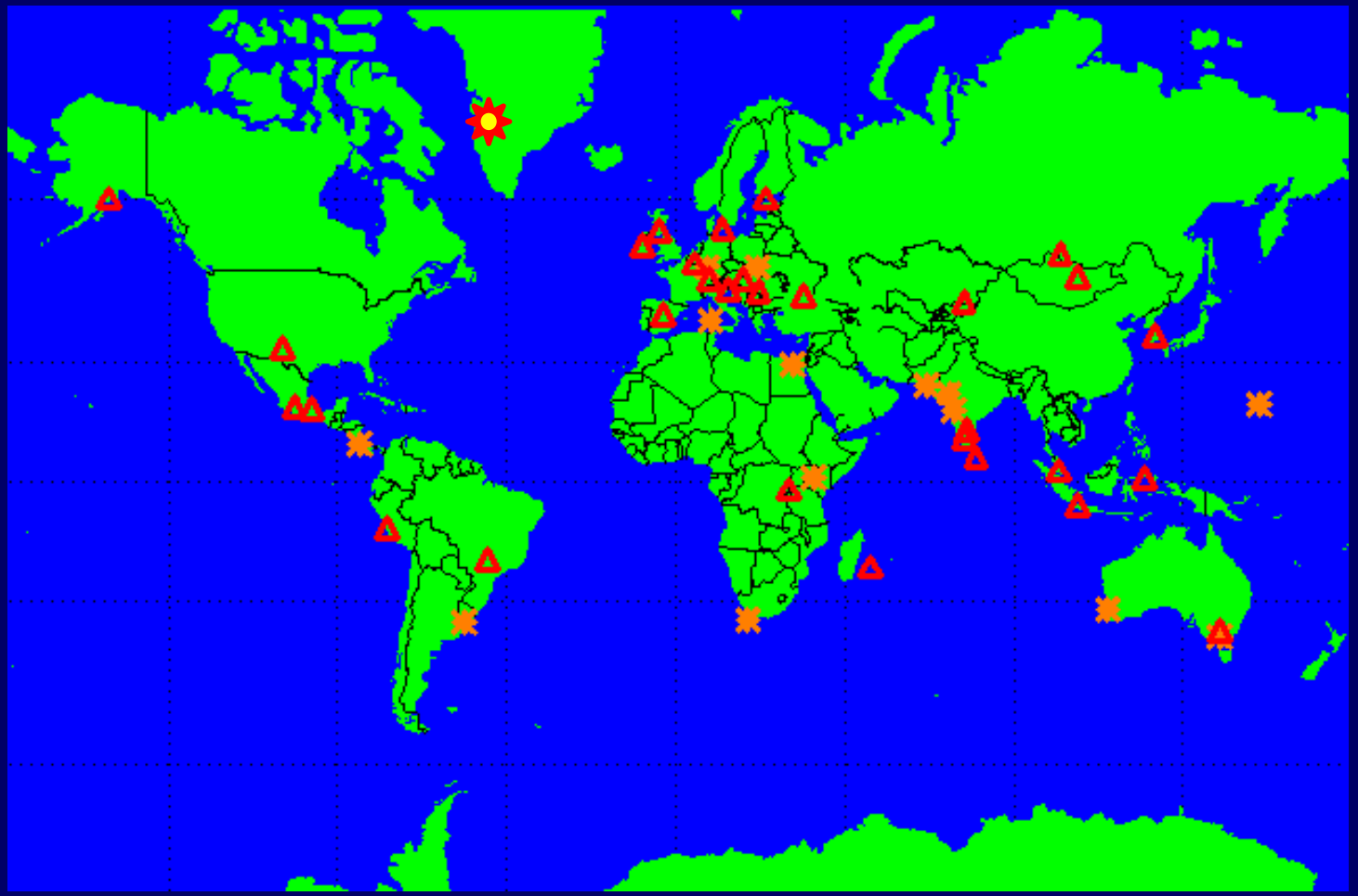
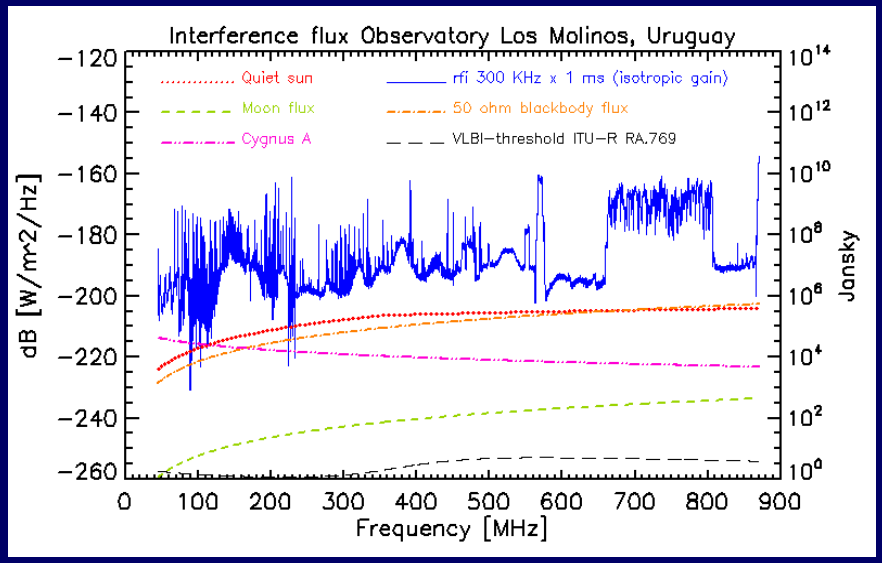
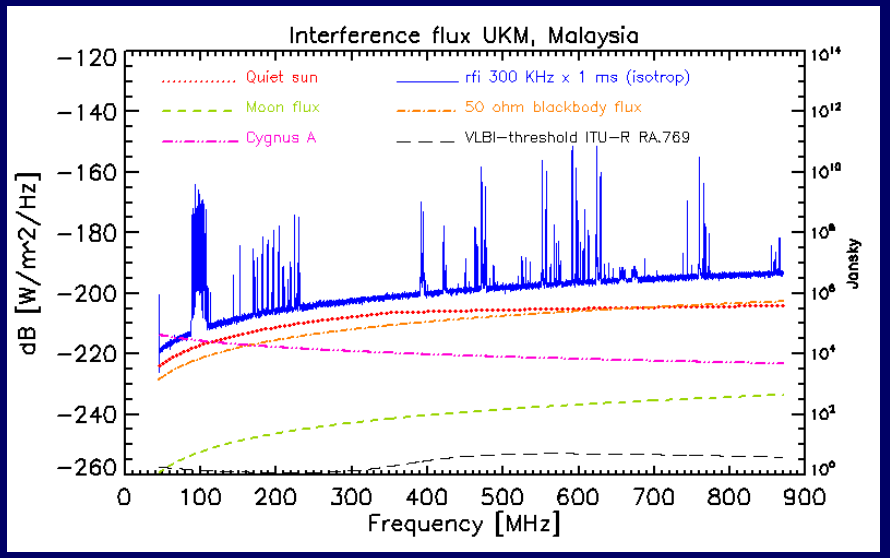
Coverage

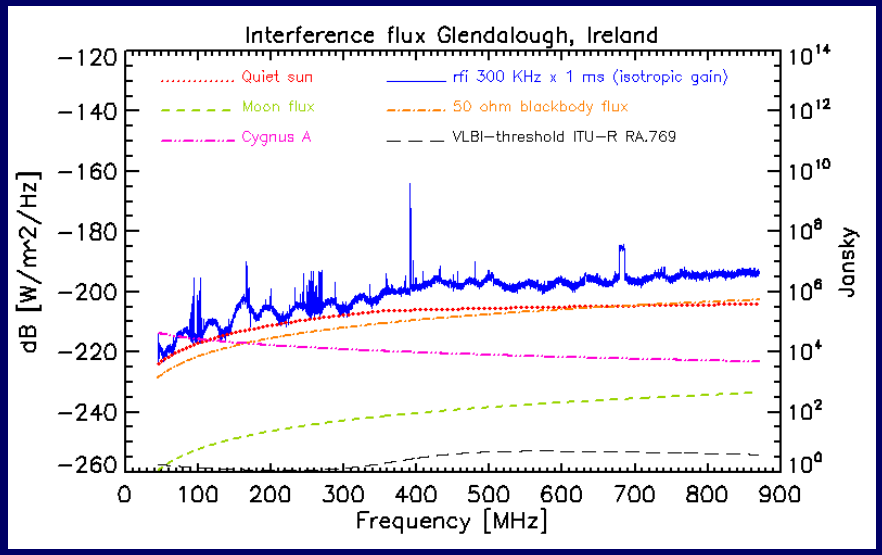


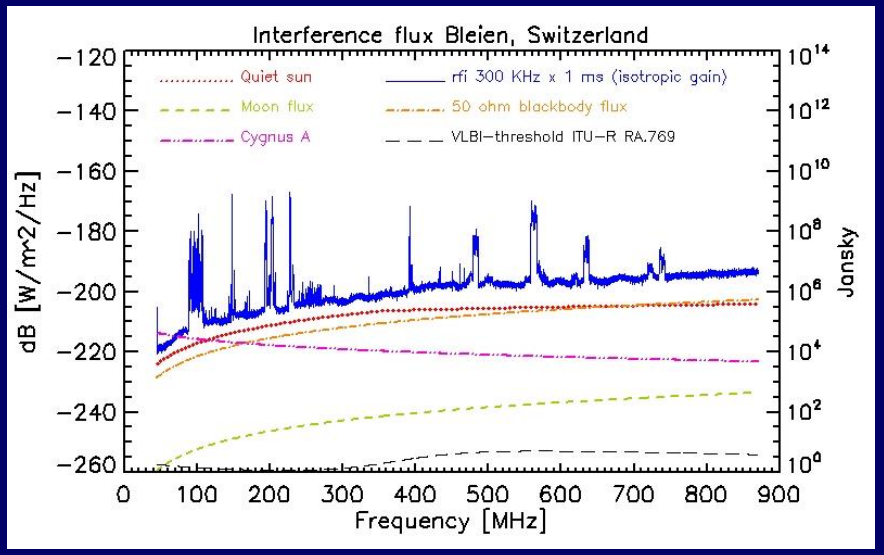
Status September 2016: ~121 instruments at 67 different locations worldwide.
Reached 100 % coverage all over all seasons in March 2013

Interference situation worldwide









A few selected examples of Callisto stations

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Callisto at Institute of Solar-Terrestrial Physics (*ISTP*) in Badary / Siberia, Russian Federation

5 GHz antenna farm of SSRT in Siberia

Antenna attached to dish

Sergey and Andrey at SSRT

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Callisto at University of Mauritius

Self built log-per 20 MHz … 150 MHz and

Callisto in air-conditioned receiver room
in Bras d'Eau, Poste de Flacq, Mauritius

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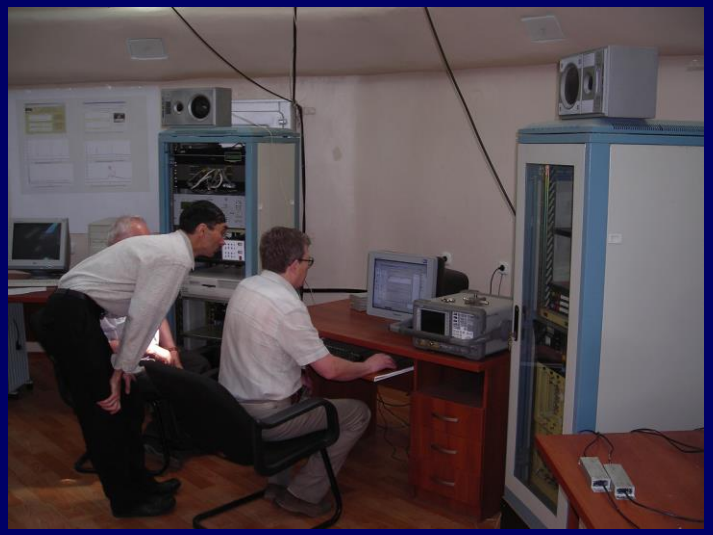
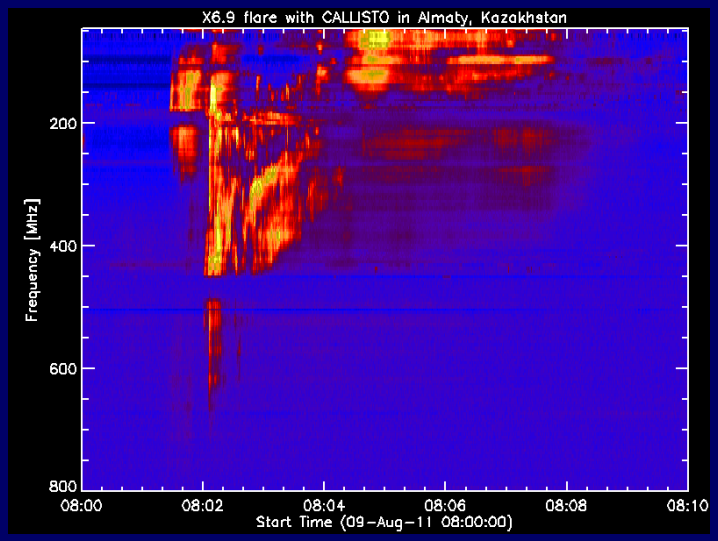
Callisto at Institute of Ionosphere Almaty, Kazakhstan





12 m parabolic dish
Tian Shan mountains,
2735 m asl

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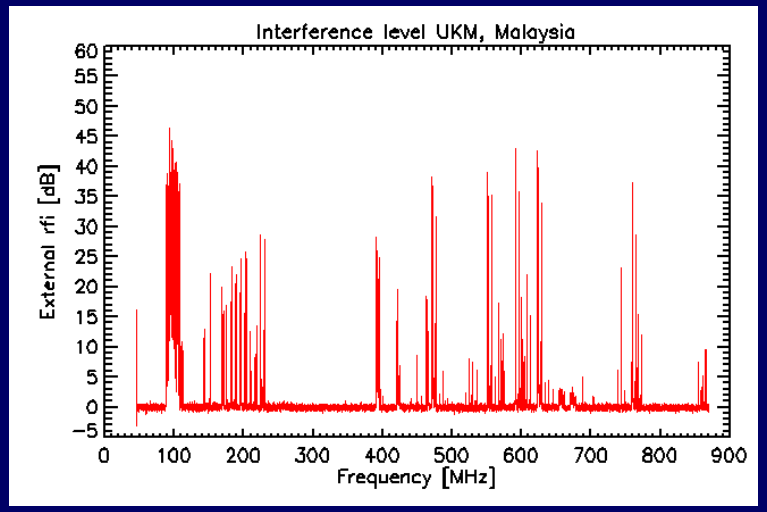
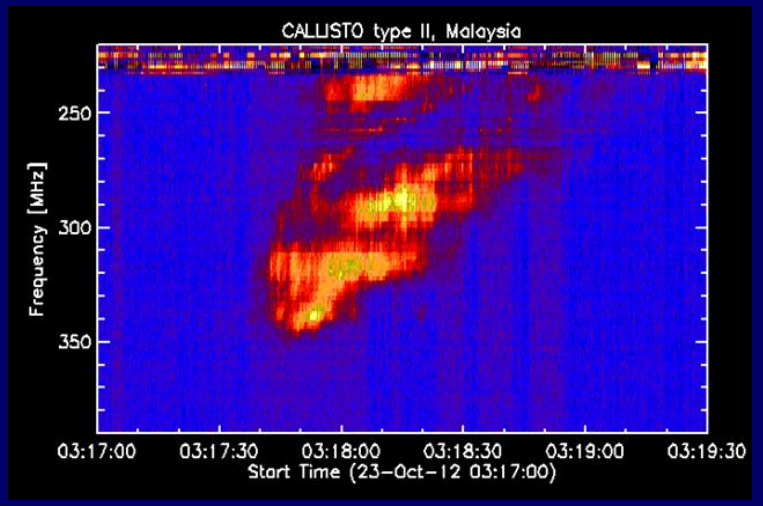
Callisto at National Space Centre in Kuala Lumpur, Malaysia





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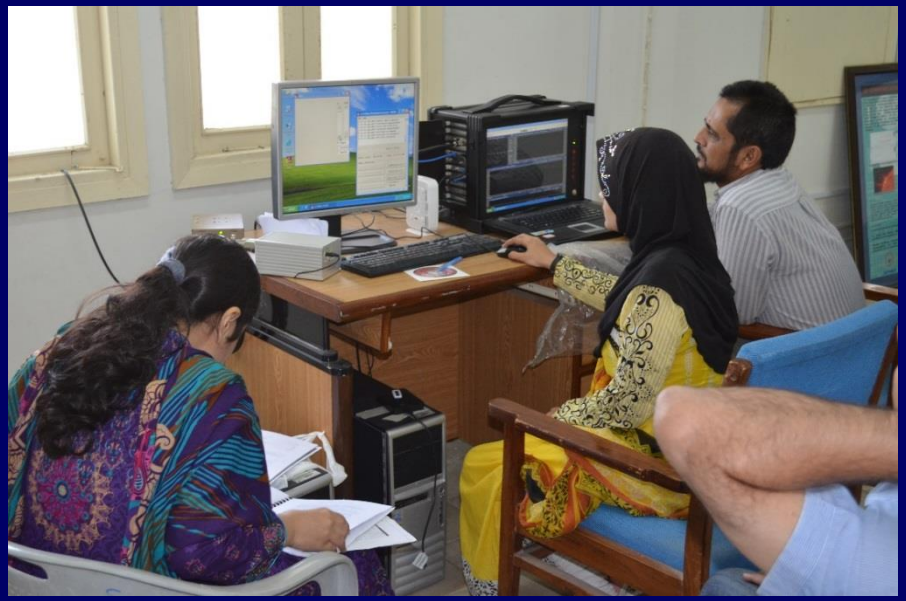
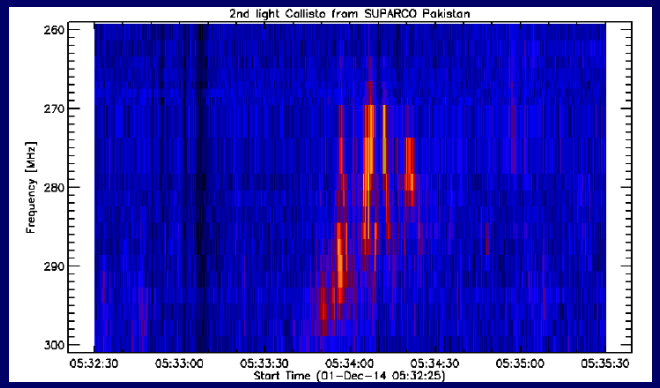
Callisto installation in Karachi, Pakistan





1st light:
a type I burst
=
noise storm

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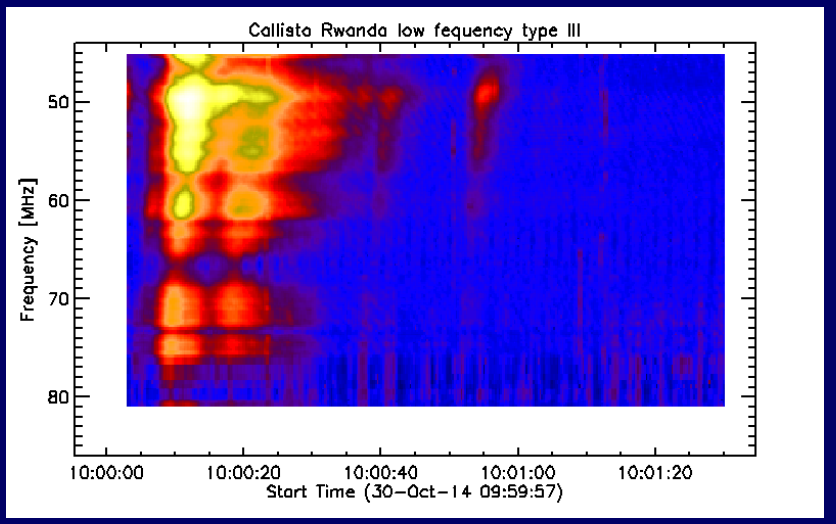
Callisto in Kigali, Rwanda



Hosted by:
Jean Uwamahoro
University of Rwanda
College of Education
Maths & Physics Department
5039 Kigali

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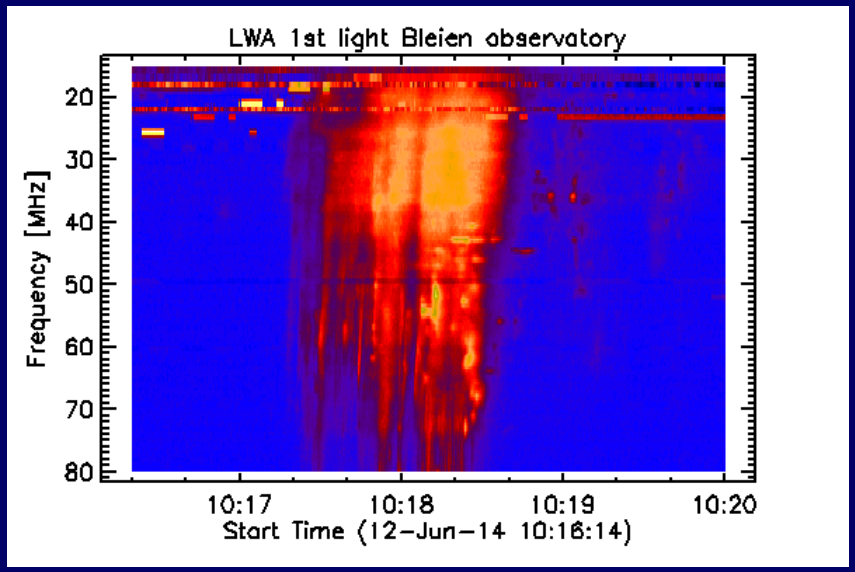
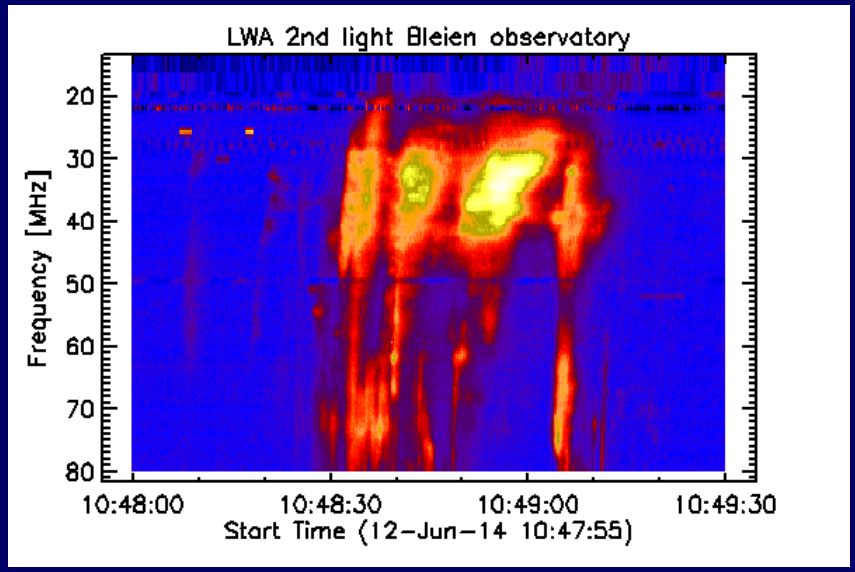
Callisto in BLEIEN, Switzerland





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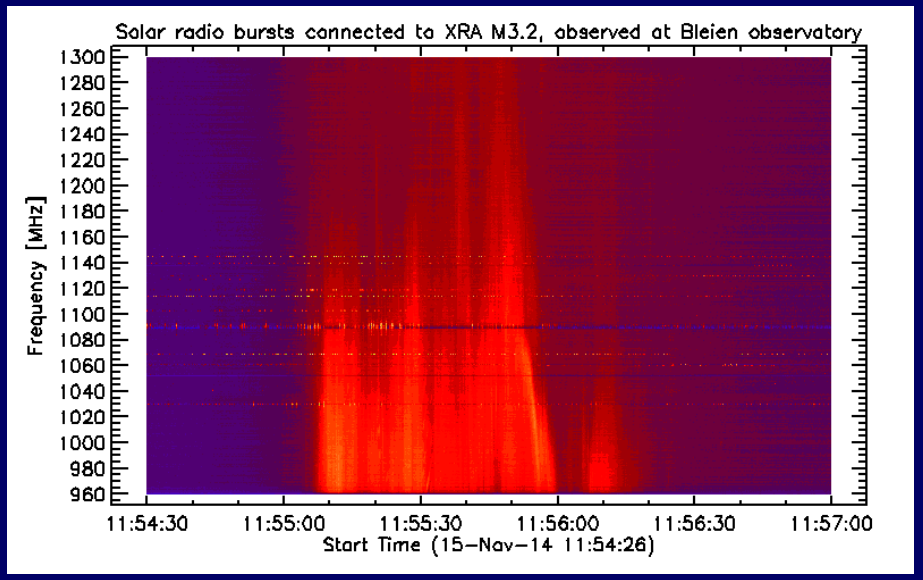
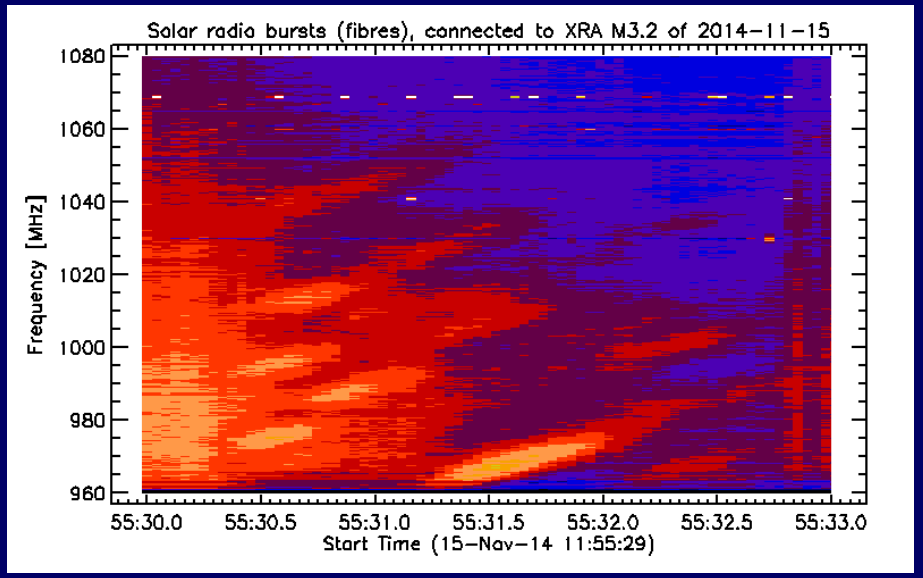
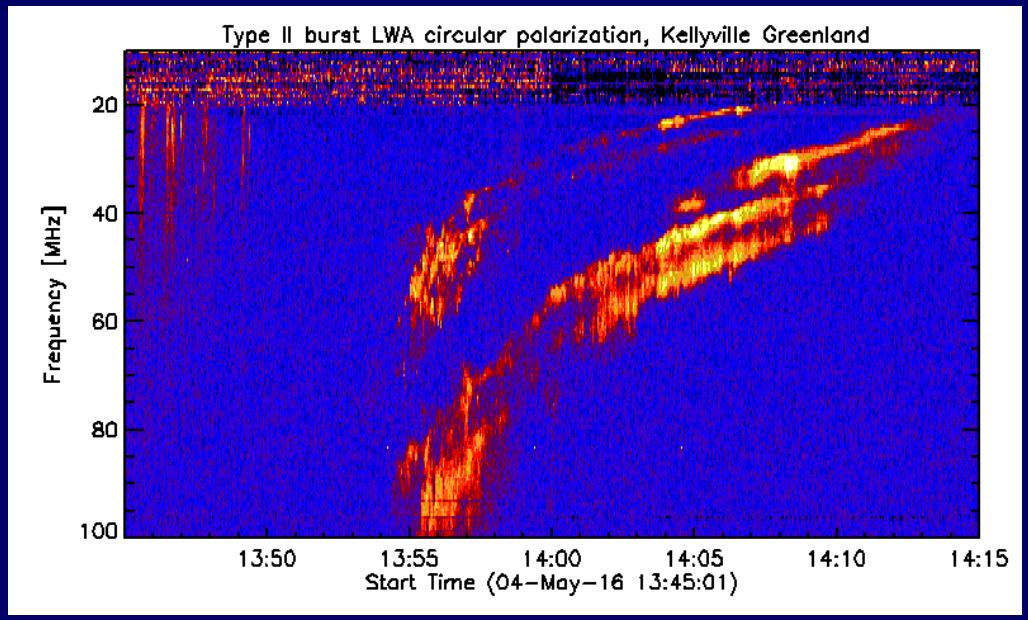
Callisto in BLEIEN, Switzerland





Callisto in Kangarlussuaq, Greenland



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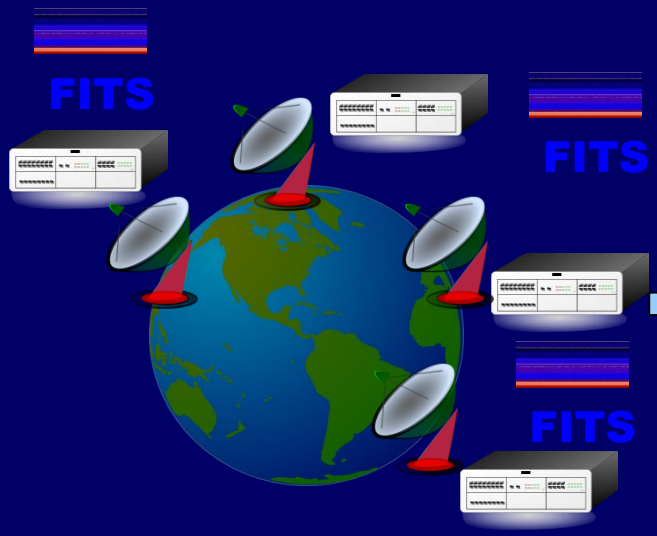
e-Callisto network



University of Applied Sciences in Brugg

FTP

NOAA / GOES

RHESSI

> 2018 → STIX

Callisto process control and management from ETH Zurich

Majority of hosts sends data actively via FTP to our data server. For very few we get data from their servers.

We provide:
→ FIT-files,
→ QuickViews and
→ Daily overview/station

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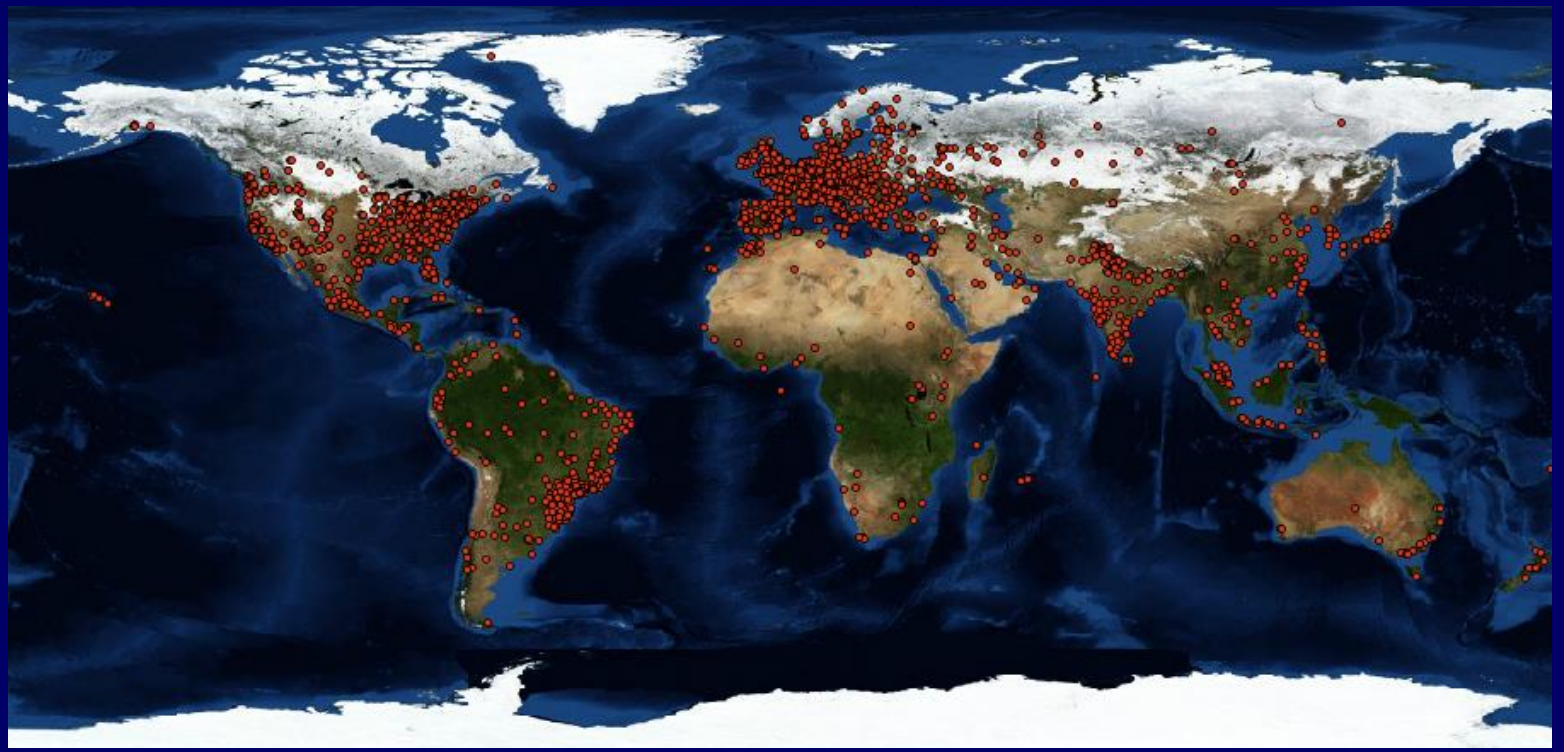
Current User Statistics



~ 700 worldwide visits per month from 130 countries
~ 60 GByte solar radio data per year (gzipped FIT-files)
freely accessible for everyone
40 Tera Byte data archive available at University of Applied Sciences, Institute for 4D technologies (FHNW).

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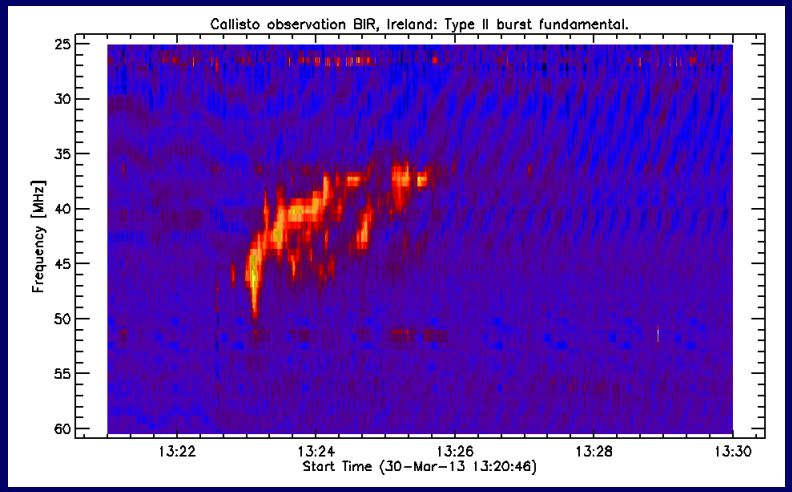
Advantage of distributed instruments



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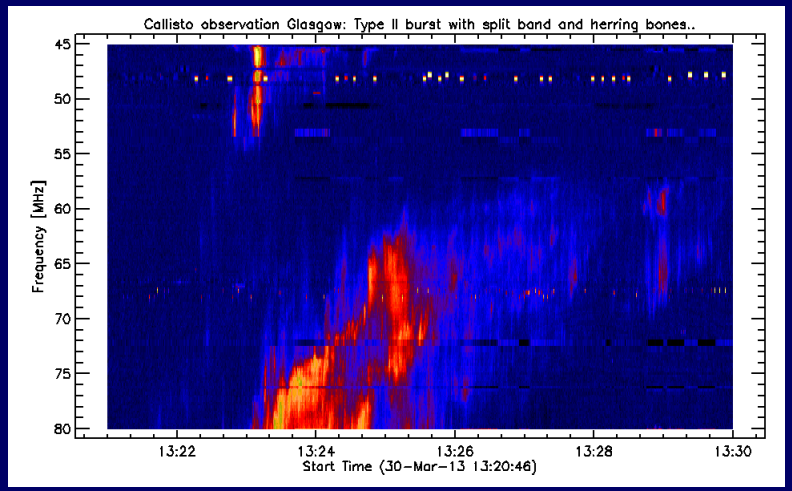

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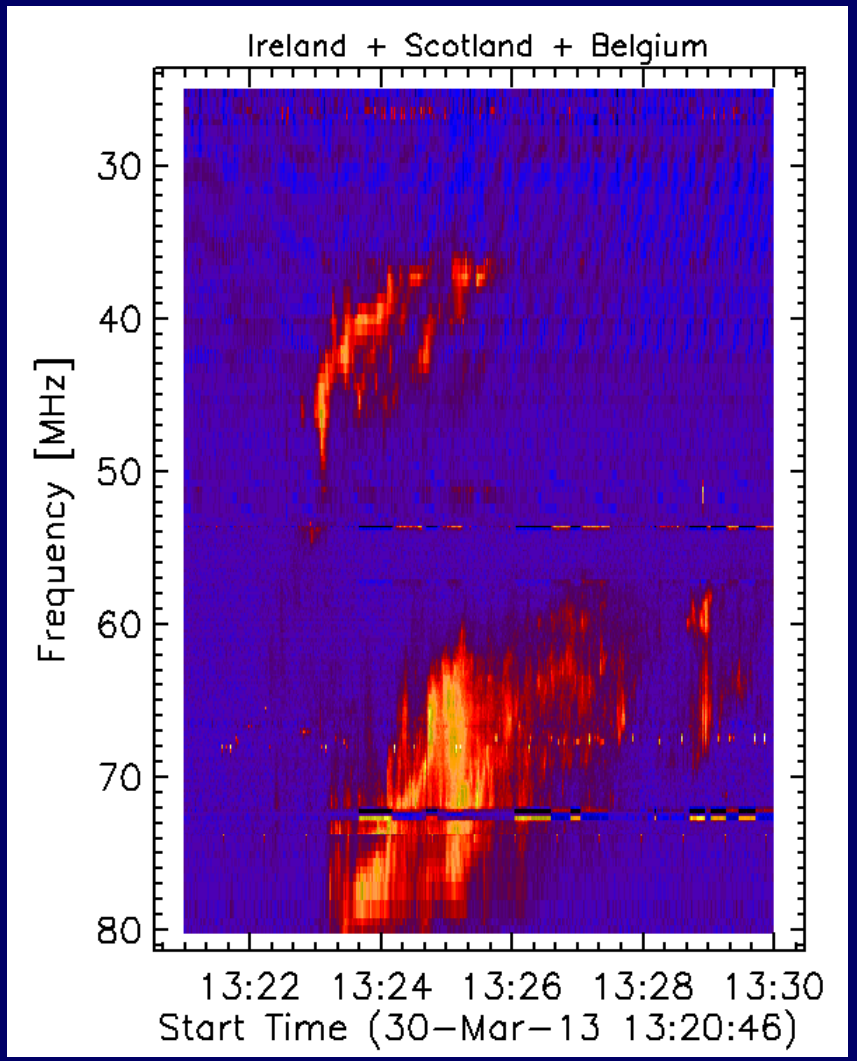
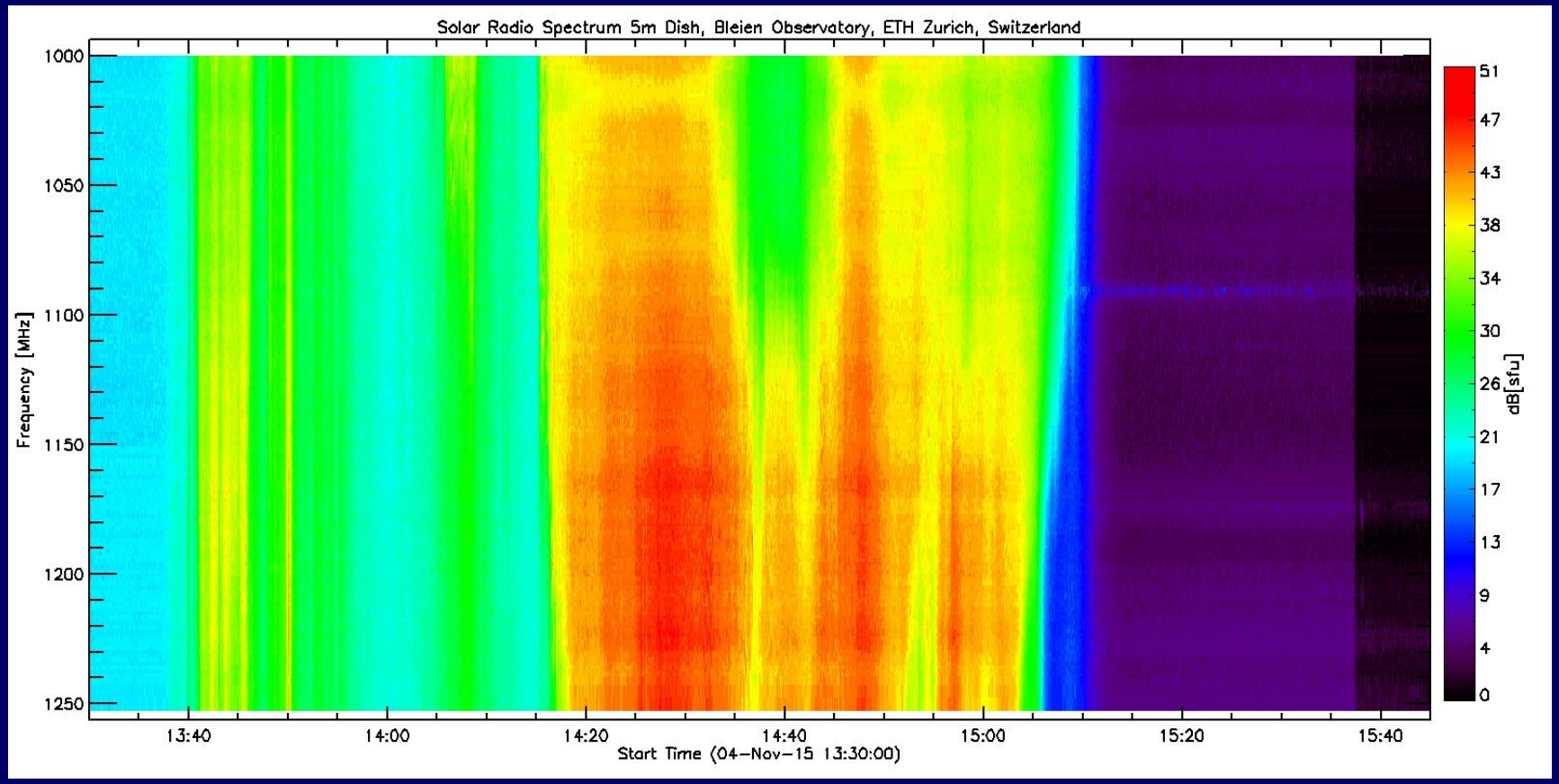


Ireland 25-60 MHz + Glasgow 45-80 MHz + Belgium 45-80 MHz

Solar radio burst shut down Swedish airport



STOCKHOLM 04-Nov-2015 — Swedish aviation officials say a solar storm has knocked out their air traffic control systems, prompting them to shut down the country's airspace for more than an hour.

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Publications

Main activity from eastern countries (Malaysia and India),
some others from all over Europe
and very very few from the American continent
(mainly Brazil).

ADS:
~45 reviewed and published papers over a
period of ~10 years

Just in 2016: ~15 papers in MY

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Possible students projects

- Identification of - and statistics about - solar radio bursts
- Determine velocity of CME from type II bursts
- Occupancy of spectrum over a longer period of time → do we have free channels?
- Monitor local rfi and keep contact to OFCOM/FCC in case of illegal transmissions
- Far field calibration with an rf-generator/noise source/drone → calibration process
- Variability of UHF satellite transponders → potential calibration sources
- Invent a method to qualify Callisto observatories sites regarding rfi and regarding burst sensitivity as a measure for data quality. E.g. G/T
- Measurement campaign per country → find radio quiet zones
- Setup interferometer to determine the diameter of the solar corona
- Build a down- or an up-converter for other frequency ranges

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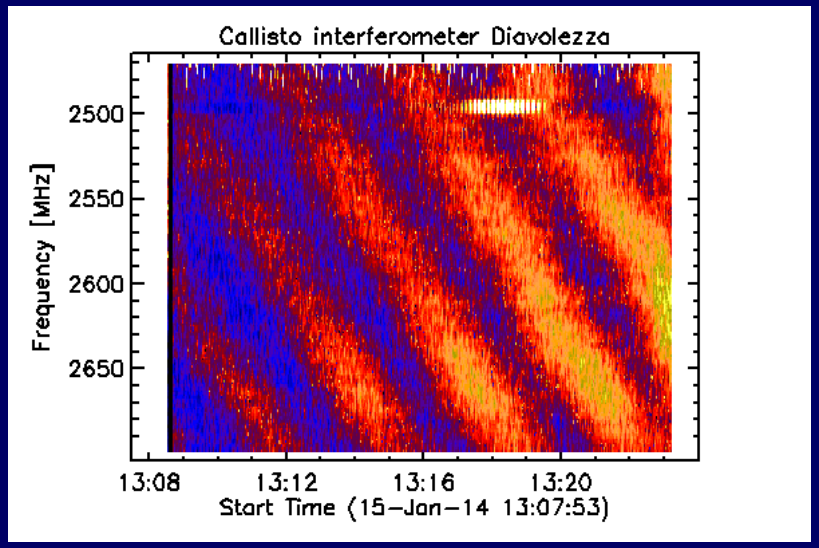
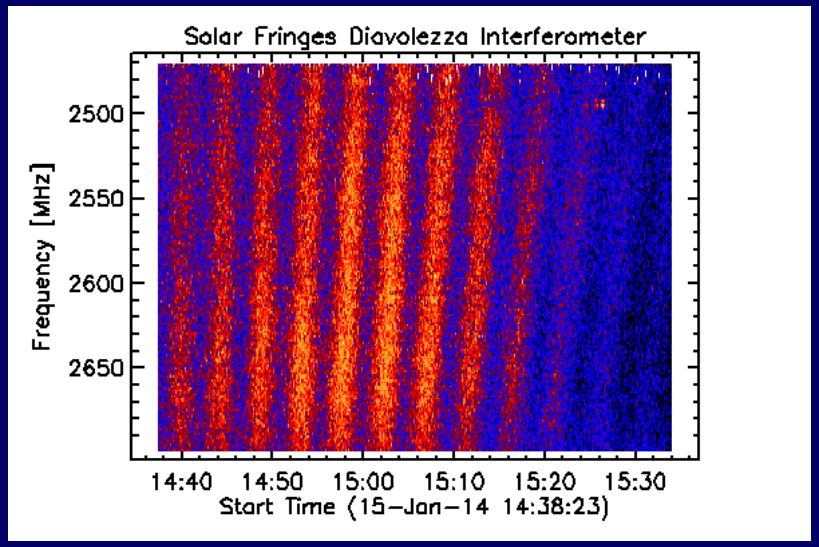
Solar Radio Interferometer





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Conclusions

- Network is still growing, currently requests from: India, Bulgaria, Oman. Ethiopia still on the agenda)

- Geographical coverage to be improved, especially American/Pacific region

- Data quality is improving (learning process)

- rfi situation is getting worse worldwide

- More science could be done (educational problem)

- Only very little funding available to further support instruments & training in developing countries.

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Additional information:

e-CALLISTO

http://e-callisto.org

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