

# ISDC for the INTEGRAL USERS GROUP

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ESOC, 11-12 June 2019

# Organization status

- Swiss funding for 2019: approved with minimal direct funding (1 FTE). Operations guaranteed.
- Funding for 2020 asked and expected at the same level.
- Manpower allocation:  $\frac{1}{2}$  operator,  $\frac{1}{2}$  scientist.  
Contribution from infrastructure (CDCI project, led by S. Paltani) for web mastering, DB support and web-analysis. Contribution from ESA for operations.
- Synergies with other projects and past savings is essential.  $\frac{1}{2}$  scientist in 2019 from ESA.
- Operator retires in November 2019, very difficult to replace him. Started hiring process.

# Routine tasks

- Updates of IC files provided by instrument teams
- monitoring of SPI gain at each revolution with automated procedure
- SPI gain coefficients updated last time in 2018
- Processing and archiving of CONS data
- Solve issues in transmission of aux files from MOC

# ISDC Operations/data distribution

- NRT data are available within 3 hours. Smooth processing (monitoring issues more closely now for MMA).
- Page to distribute data since AO13, public for serendipitous science. Handled Russian peculiarity.
- Need for OSA energy reconstruction step both for JEM-X and ISGRI. NRT data for JEM-X2 are not always available due to difficult energy reconstruction.
- Occasional gaps in NRT telemetry due to hardware failure of the University infrastructure supporting the data transfer (switch).
- **CONS data are obtained now from virtualized DVD transfer from MOC**
- Service widely used for SPI-ACS data in NRT

# INTEGRAL SPI-ACS public data service

In 2011, a public service was set up to promptly provide SPI-ACS data with the best timing accuracy

It was extensively used for years by IPN and Konus colleagues

Since 2015, Fermi/GBM team used the service to verify their detections and challenge SPI-ACS

Several other groups started to use it. In total >100 Gb has been served.

IPN format SPI-ACS light curve	<input type="text" value="2008-03-19T06:12:46 200"/>	<input type="button" value="Submit"/>
IPN format INTEGRAL ephemeris	<input type="text" value="2008-03-19T06:12:46"/>	<input type="button" value="Submit"/>
Plot SPI-ACS light curve	<input type="text" value="2008-03-19T06:12:46 200"/>	<input type="button" value="Submit"/>
INTEGRAL Attitude	<input type="text" value="2008-03-19T06:12:46"/>	<input type="button" value="Submit"/>
INTEGRAL HK light curves	<input type="text" value="SPI_VETOGATE 2008-03-19"/>	<input type="button" value="Submit"/>

Try using the [script](#) to access the lightcurves

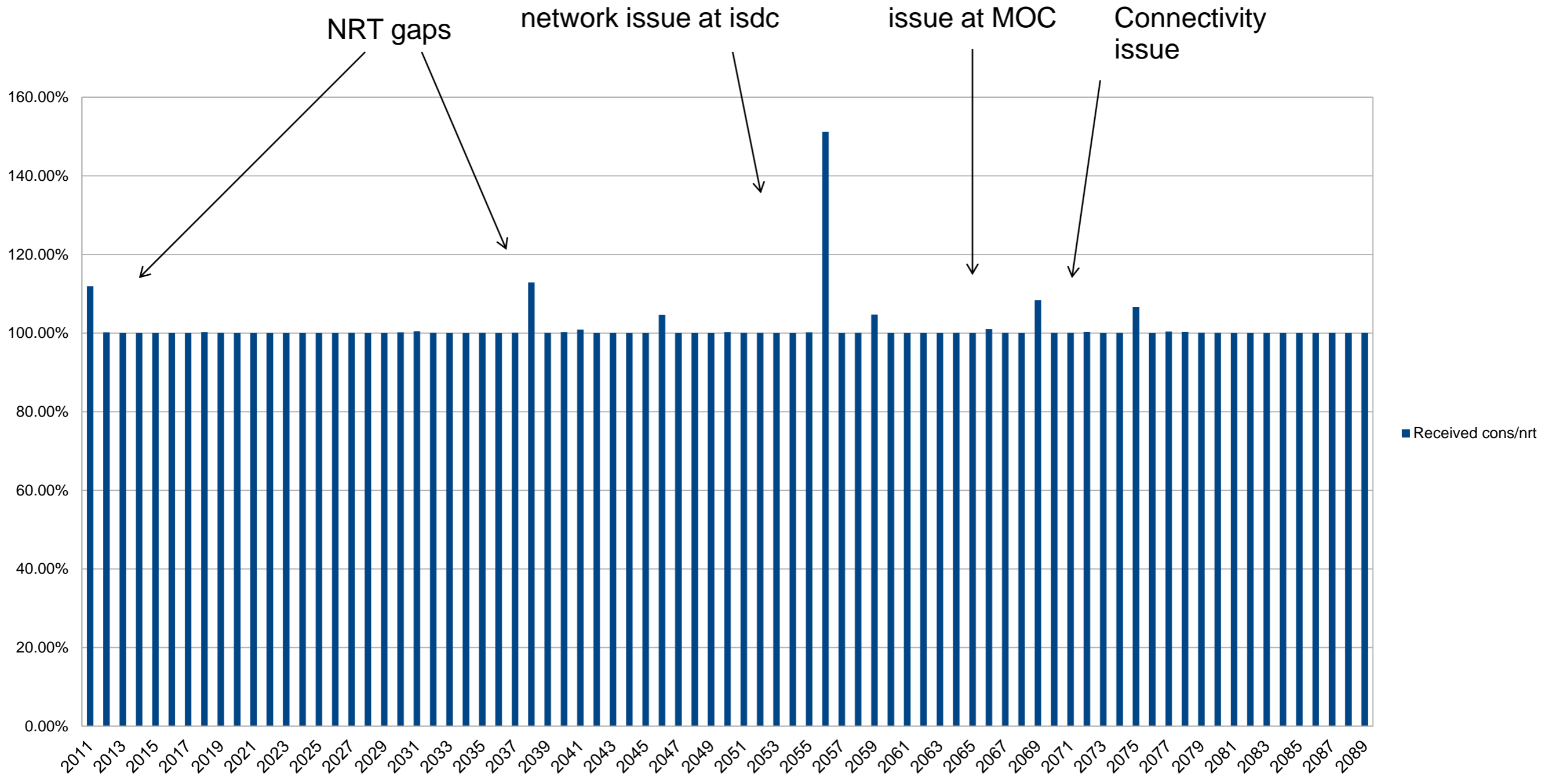
RESTful service, providing various public INTEGRAL data as well as auxiliary information

# Quick look analysis of INTEGRAL data

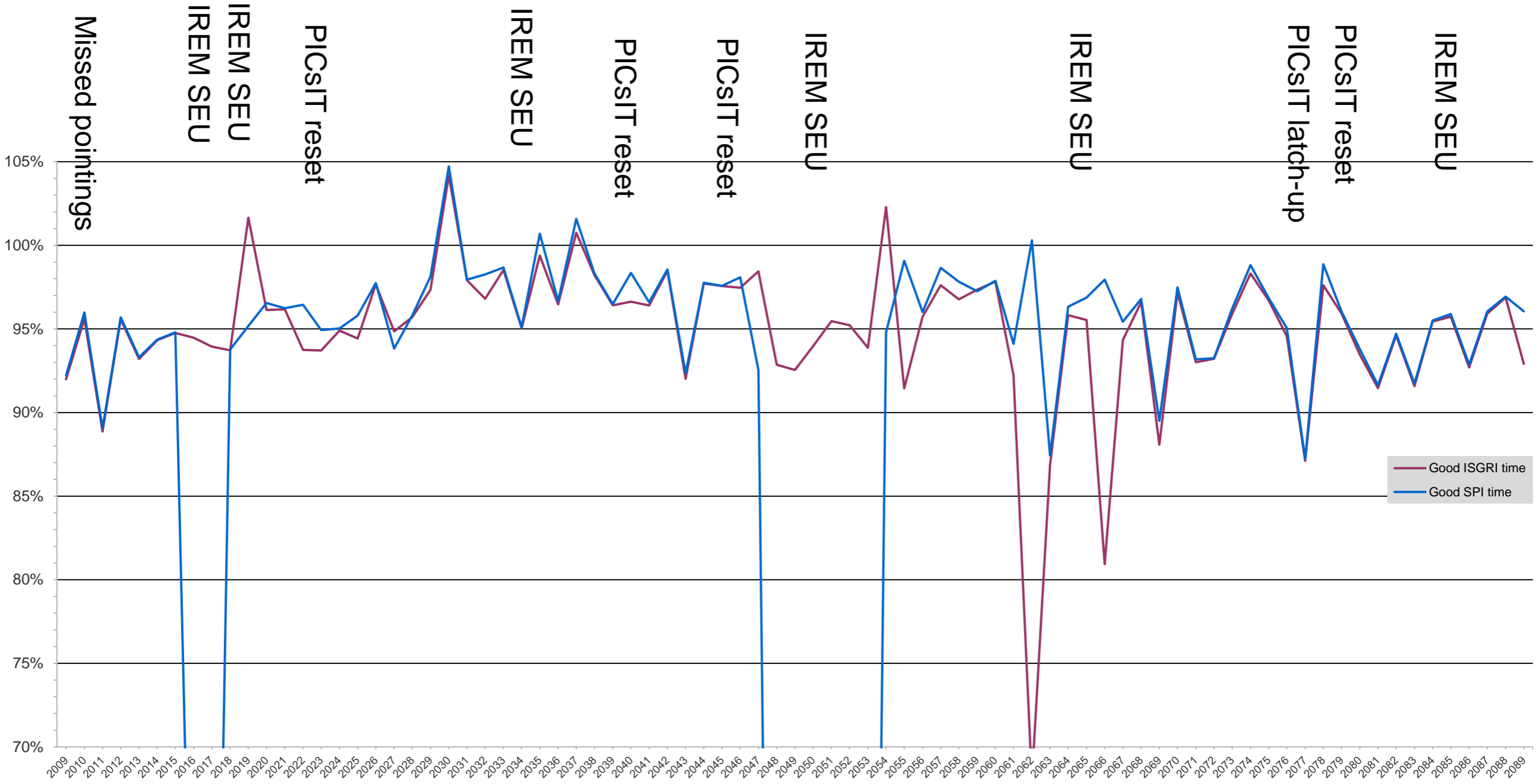
- No GRB in the IBIS FOV in 2019, 7 in 2018 (IBAS energy calibration not updated, waiting for D. Goetz's input).
- ~200 GRB/year in SPI ACS. Used for IPN triangulation.
- Inform all PIs of data rights only in case of outstanding problems or relevant serendipitous sources (no data rights).
- 14 ATeLs (3 lead by ISDC) and 23 GCNs related to INTEGRAL discoveries in 2019 (included GW and neutrino follow-up)

# Telemetry

CONS / NRT, rev. 2011 - 2089



# Operations: Good times vs programmed 2009 – 2089



SPI DPE crash

JMX DPE crash

SPI annealing

Missed pointings

IBIS DPE crash

Radiations

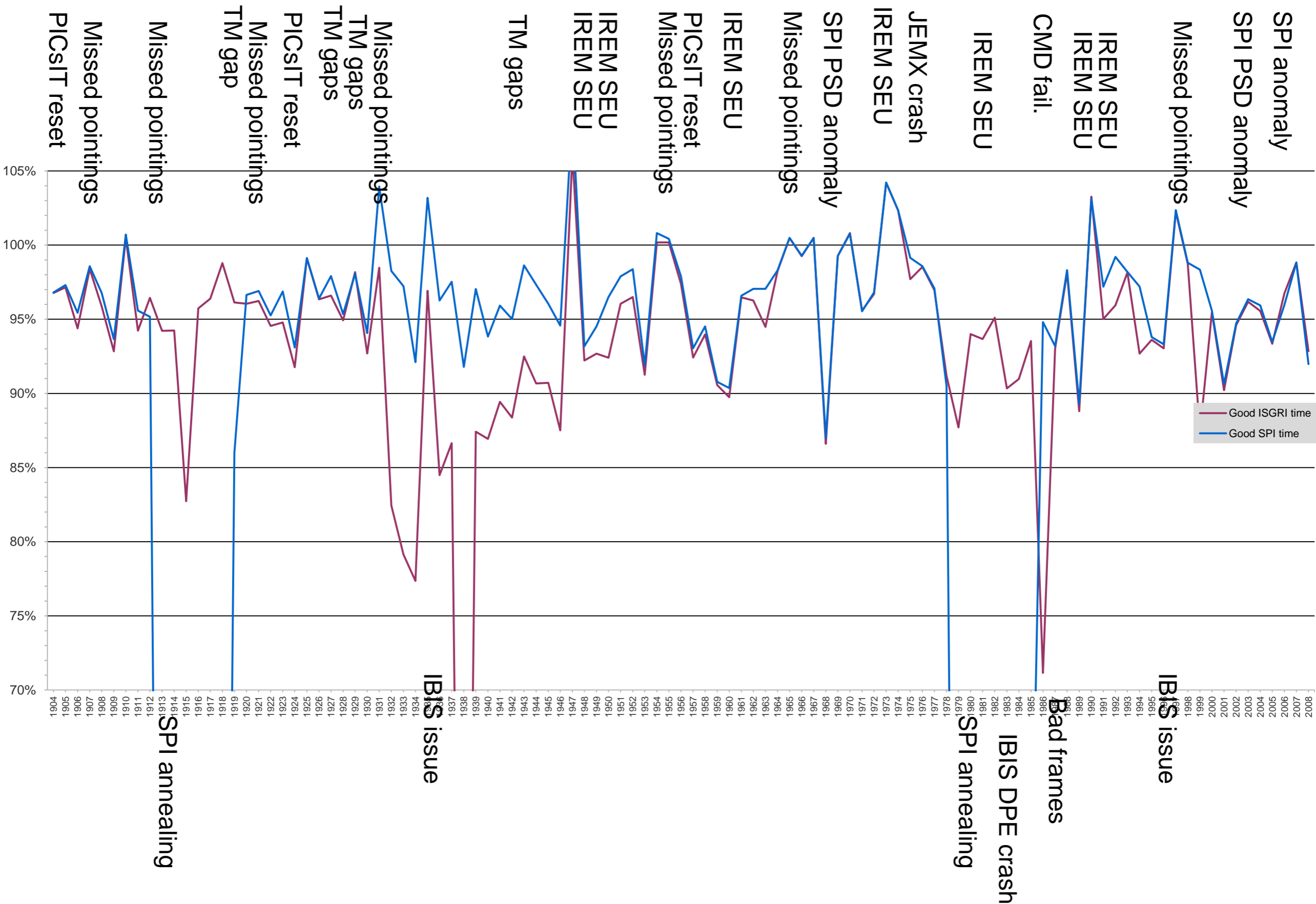
Network issue

Missed pointings

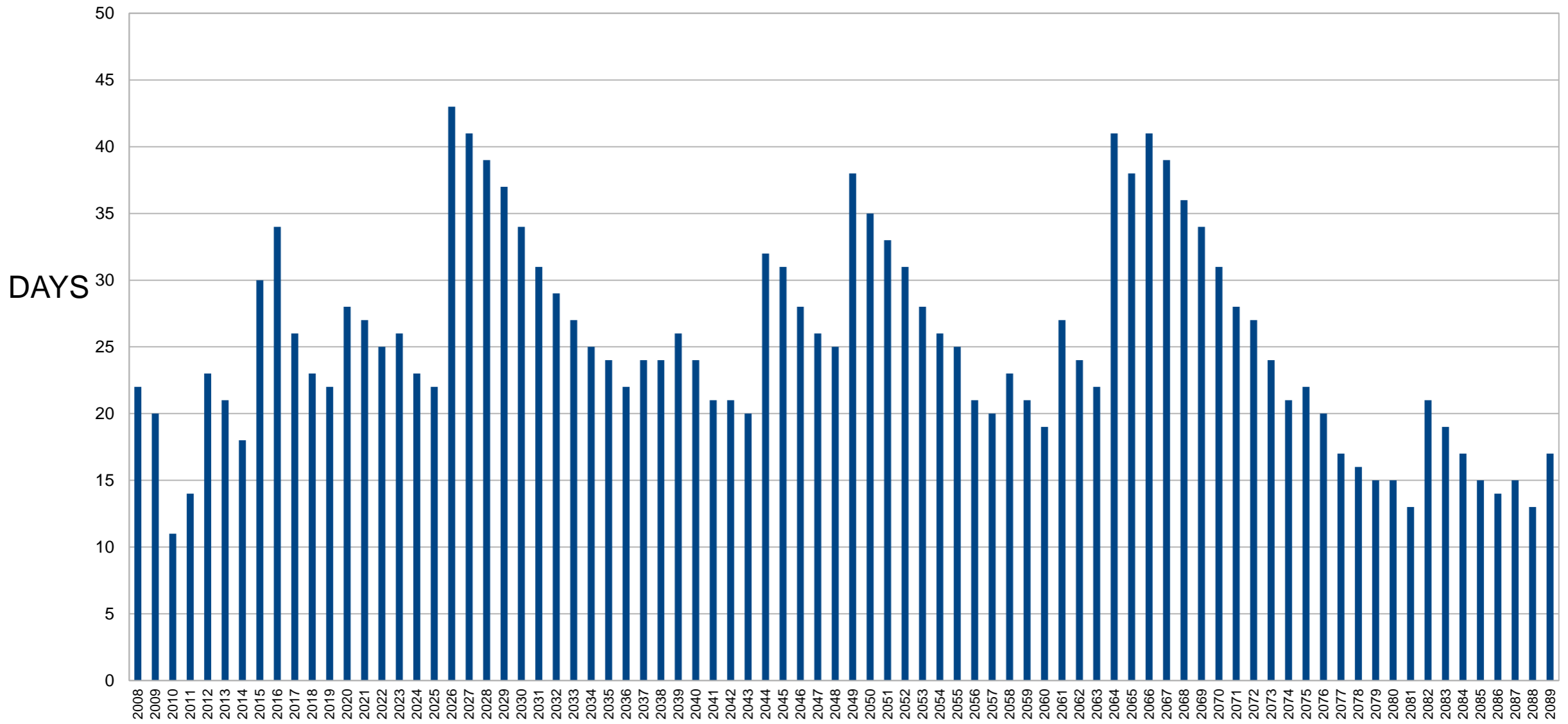
IBIS time wrap-around



# Operations: Good times 1904 – 2008

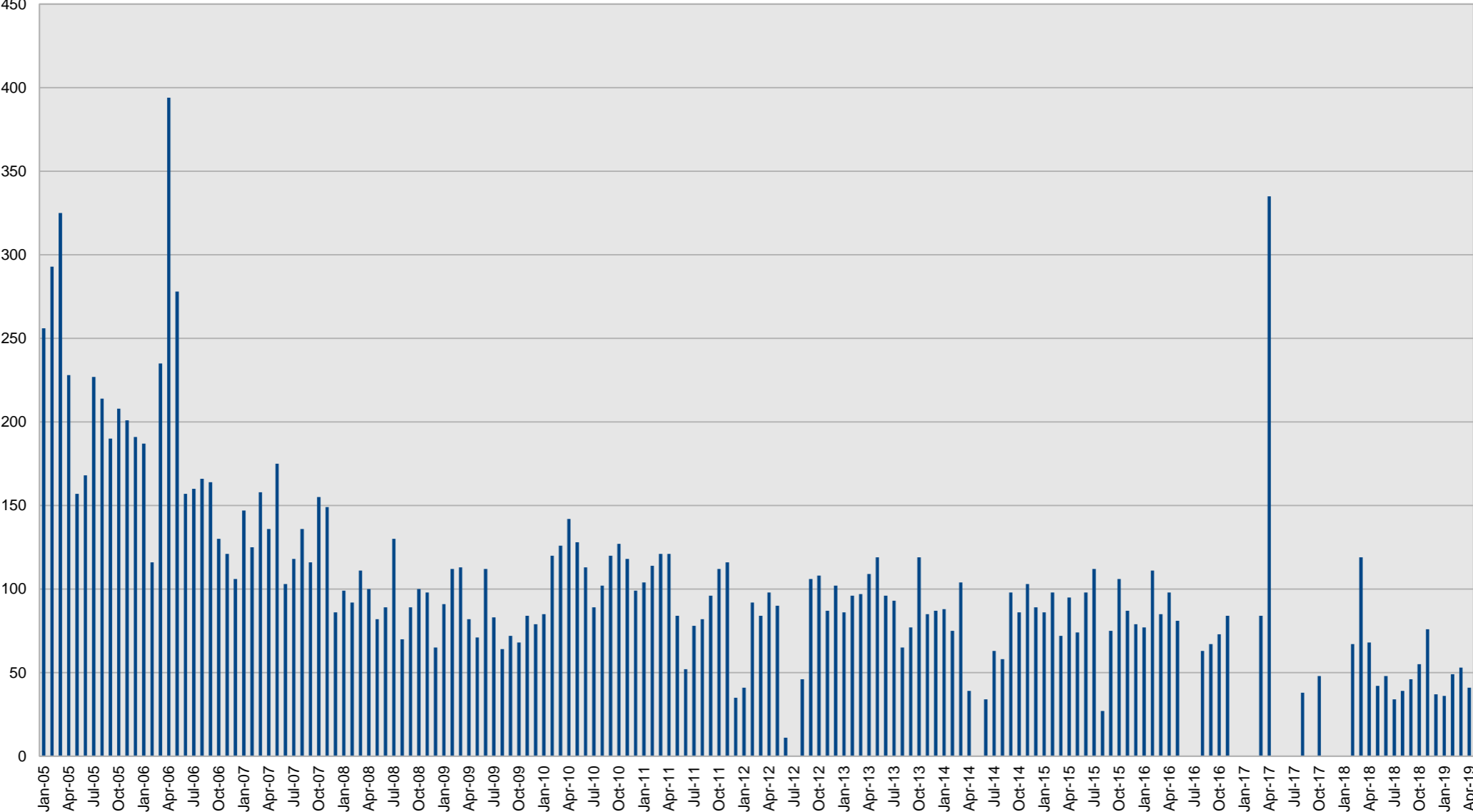


# Delay between observation and distribution rev. 2008 - 2089



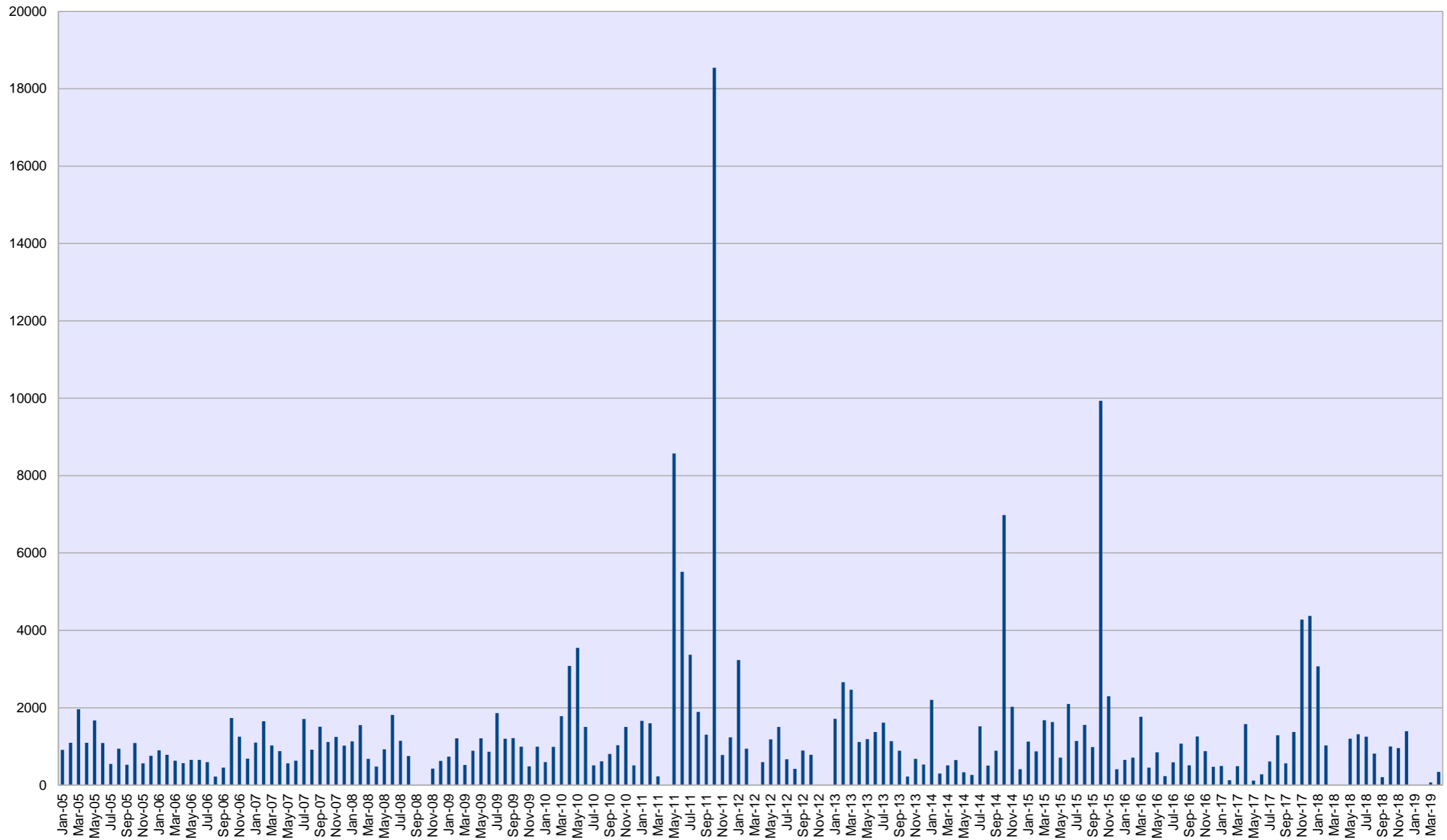
# Browse unique visitors

Number of visitors



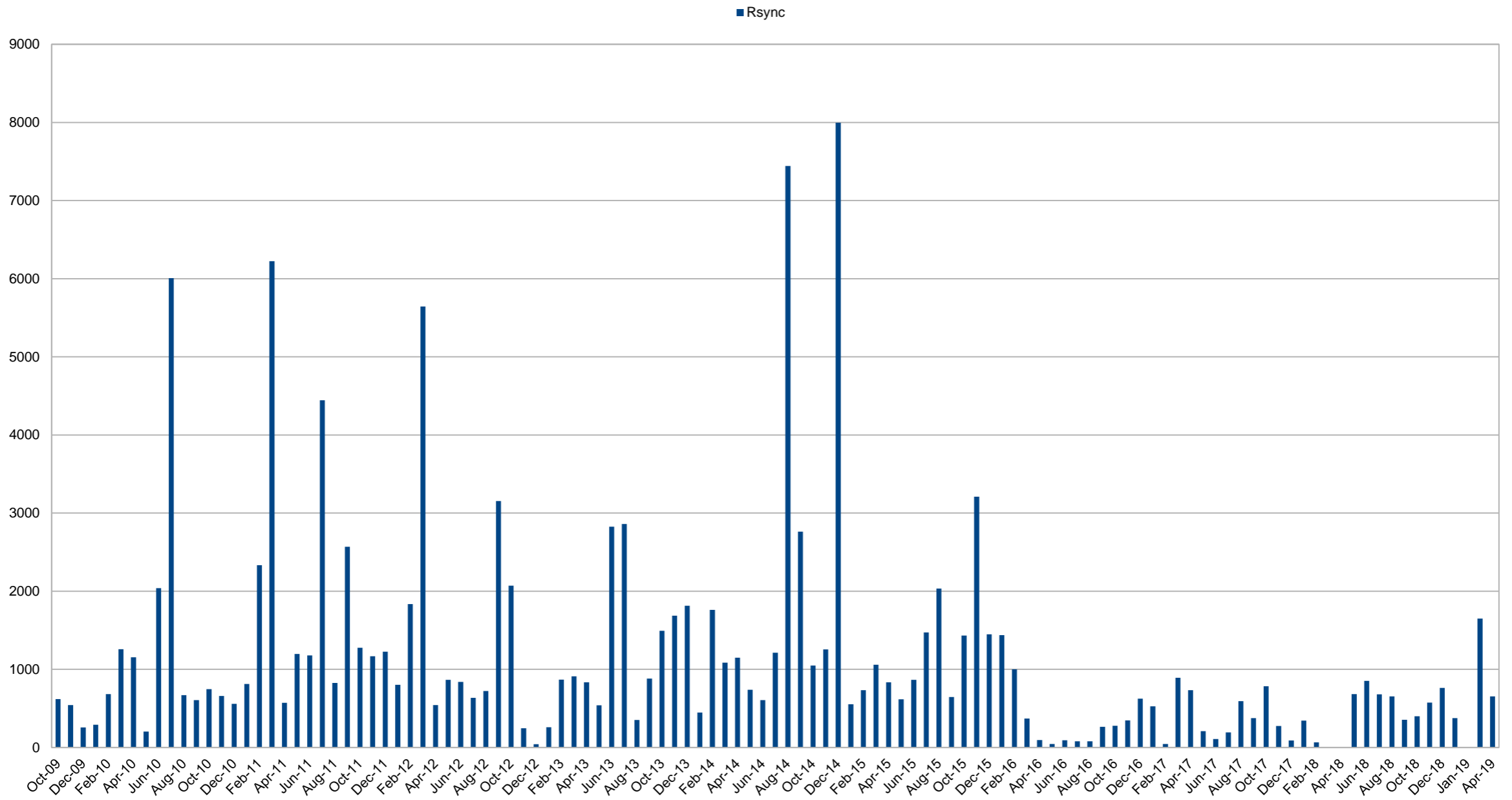
# FTP access statistics

Bandwidth (GB)



# Rsync

Bandwidth (GB)



# High level quick-look products, HEAVENS

The screenshot displays the HEAVENS web interface. At the top left is the ISDC logo. The header includes a list of instruments: ISDC, INTEGRAL, Planck, Gaia, FACT, ASTRO-H, POLAR, CTA, LOFT, SAFARI, JEM-EUSO, ATHENA, CAP, and HEAVENS. The word 'HEAVENS' is prominently displayed in the center of the header. Below the header is a 'Query parameters' section with a 'Basic | Advanced' toggle. The 'Basic' view includes fields for 'Source name' (with a dropdown for 'or select a famous object'), 'or RA DEC' (with a dropdown for 'Equatorial FK5'), and 'Time interval' (with a dropdown for 'MJD (TT)'). Below these are checkboxes for various instruments: Planck, INTEGRAL OMC, RXTE ASM, INTEGRAL JEM-X, RXTE PCA, INTEGRAL ISGRI (highlighted in red), INTEGRAL PICsIT, INTEGRAL SPI, INTEGRAL SPI ACS, FERMI LAT, HEGRA, and INTEGRAL IREM. There are also checkboxes for 'Sky image', 'Lightcurve with a bin size of [ ] hours', and 'Spectrum'. The 'Energy band [keV]' is set to '17.3-80.0', with 'Min - Max' values of '13.0' and '520.9'. At the bottom are 'Submit' and 'Reset' buttons.

- Development on hold
- Used OSA9

~60 single accesses per month

# Cross calibration

- We are working on integrating the dashboard concept to a living cross calibration archive (sketched at IACHEC)
- We will implement automatic fetching of calibration observations from IACHEC and provide comparison with INTEGRAL
- We plan to perform automated tests to check the cross-calibration of INTEGRAL instruments
- This is very relevant also for the development of ISGRI calibration

# INTEGRAL conference + AHEAD workshop



## → INTEGRAL LOOKS AHEAD TO MULTI-MESSENGER ASTROPHYSICS

12th INTEGRAL Conference - 1st AHEAD Gamma-ray Workshop

11-15 February 2015 - Campus Biotech, Geneva, Switzerland

### Invited Speakers

Maria Brando, Ugo Fusco,  
Ralf Falcke, Vasily Pavlov,  
Jed Kravins, Richard Jones,  
Andri Karas, Peter Mesica,  
Massimo Paoletti, Frank Ferraro,  
Julio Pérez González, Wolfgang  
Scheidt, Wynn Dolan, Thomas Torgler,  
and more to be announced.

### Scientific Organising Committee

Julian Homan, Carlos Simeó, Tony Bell,  
Maria Brando, Susana Donato, José  
García, David Jentsch, Felix Leising, David  
Serra, Gail, Maria Ondrej, Maria  
García, Carlos Simeó, Carlos Simeó,  
Margherita Ferraro, Franca Ferraro, Ed  
Kochan, Jan-Peter, Philippe Laurent,  
Massimo Paoletti, Angelo Weiss, John  
McEvoy, Peter Mesica, Lorenzo Sestini,  
Stephanie Perini, Alessandro Facchi, Elena  
Pani, Luigi Piro, José María Rodríguez, An-  
thony S. Wilson, Sébastien, John Torgler,  
Giovanni Tosti, Frank Ferraro, Peter von  
Delboscq, David Jentsch, José Simeó



integral2015@unige.ch  
http://www.unige.ch/integral2015/

### Local Organising Committee

Luigi Ferraro, Franca Ferraro, Sébastien,  
David Jentsch, Wynn Dolan, Gail Simeó,  
Peter von Delboscq





# INTEGRAL conference 2019

<https://www.astro.unige.ch/integral2019/>

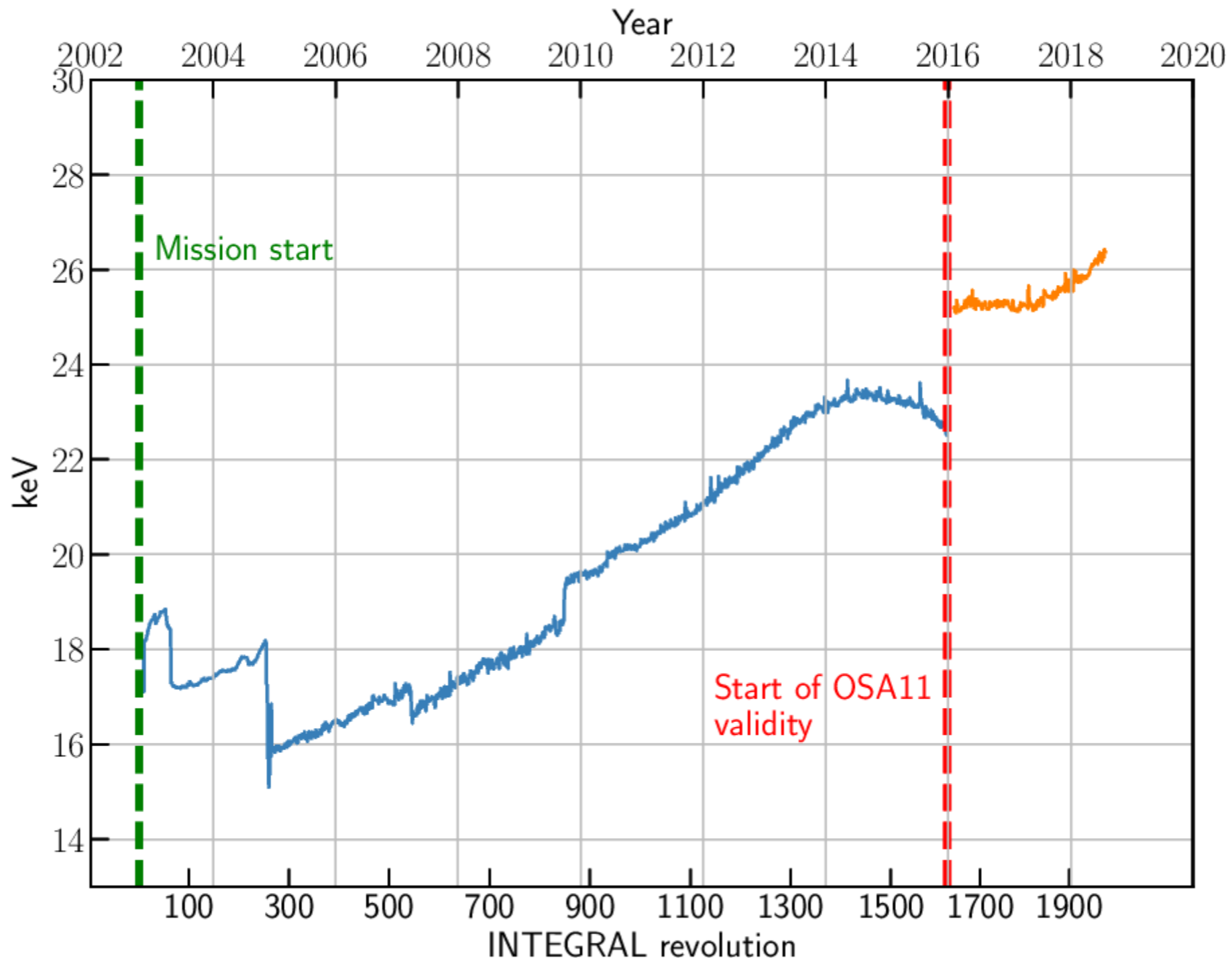
- 11-15 February 2019 at Campus Biotech in Geneva
- Co-organized AHEAD workshop on future gamma-ray missions (two half days)
- Fee was 200 CHF per person including three lunches (several waived)
- 146 participants + a couple local ones
- 106 presented: 14 invited, 33 solicited, 41 contributed, 18 posters
- We received 50 proceeding contributions so far. Maybe a few more will arrive in the next days
- The Mike Revnivtsev prize was given to T. Siegert
- Dinner at Ecole hoteliere de Geneve
- Contributions from ESA, INAF, UNIGE, Ville de Geneve

# OSA 11 and catalog 42

- Released catalog v. 41 in June 2018
- Released catalog v. 42 in December 2018
- OSA 11 was released on 19 October 2018
  - 4 Linux binaries, source code, **docker image for portability on all platforms**
  - New JEM-X light-curve extraction method with `j_ima_iros`
  - Automatic burst detection in JEM-X
  - SPI: implemented the PE, SE discriminator and tool to stitch spectra in different energy ranges with flatfield background
  - New ISGRI energy calibration and response from rev 1627
  - No Updates for OMC

# Evolution of low threshold

- Due to drift of gain, the energy scale is much more compressed and signal starts at  $\sim 25$  keV rather than at  $\sim 15$  keV as at the mission start



# User manuals

- We updated the User manuals and the installation guide
- We updated the “known issues” in collaboration with instrument teams.
- ISDC did not and (will not) update any inter-calibration document or advanced analysis guide etc.
- No additional documents are currently foreseen
- No major revision is feasible

# OSA downloads

(since release and until 5 June)

- 220 downloads
- 3 source code (often the same user as for binaries)
- 63 test data
- 200 catalog bundles
- >1400 pulls of the docker image (not possible to trace provenance on dockerhub)

# OSA future activities

- ~200 more revolutions of ISGRI calibration files in second half 2019 to cover from rev ~1400.
- Soon after, completing the mission life time with ~100 revolution/month (or larger chunks)
- Discussion to support Volodymyr with a bright Swiss trainee at ESA
- Outcome of collaboration could be also an ISGRI calibration document in collaboration with the IBIS team
- Waiting for Compton imaging from Paris to release a delta version of OSA (11.1) with updates also for JEM-X

# From ISDC to CDCI

- Raw data are not enough, we need to have the ability to run a streamlined analysis and easily access high-level data.
- Unige has obtained financial support for a **common data center infrastructure (CDCI)**
- As part of this, we are making **a pilot project** for an online tool for INTEGRAL data analysis and long-term preservation of S/W and archive
- It was extended also to another missions at UNIGE: Polar

# Offline Data Analysis (from OSA to ODA)

- We run OSA executable from a web tool (only IBIS/ISGRI for now and 50 scw per chunk).
- We will have a public version for public data (~1-year old)
- We have a private internal version with access to NRT data for operations and transients.

The screenshot shows a web browser window with the URL `https://analyse-staging-1.1.reproducible.online/astrooda/astrooda`. The browser tabs include "The Astronomer's Telegram", "Department Xmas party", "INTEGRAL Science Data", "Online Data Analysis | Ast", "INTEGRAL Target and Sch", and "HEASARC: Coordinate Co". The browser's address bar shows the URL and navigation icons. The browser's toolbar includes "Apps", "ISDC Operations", "Notizie", "Astro Tools", "Papers", "Missions", "Viaggi & Meteo", "Institutes", "ProgramsTips", "Varie", "Astrophysics", "Statistics", "Private Online", "SWITCHfilesend", and "Cisco Phone Con".

The main content area is a form for "INTEGRAL ISGRI" data analysis. The form has a green header bar and a "Help" link in the top right corner. The form is divided into several sections:

- Object name \***: A text input field containing "Sgr a\*" and a green "Resolve" button.
- RA \***: A text input field containing "266.416817" with a green checkmark.
- Dec \***: A text input field containing "-29.007825" with a green checkmark.
- Start time \***: A text input field containing "2018-10-29T00:44:57" with a green checkmark.
- End time \***: A text input field containing "2018-10-29T04:26:46" with a green checkmark.
- Time unit**: A dropdown menu set to "ISO/ISO".

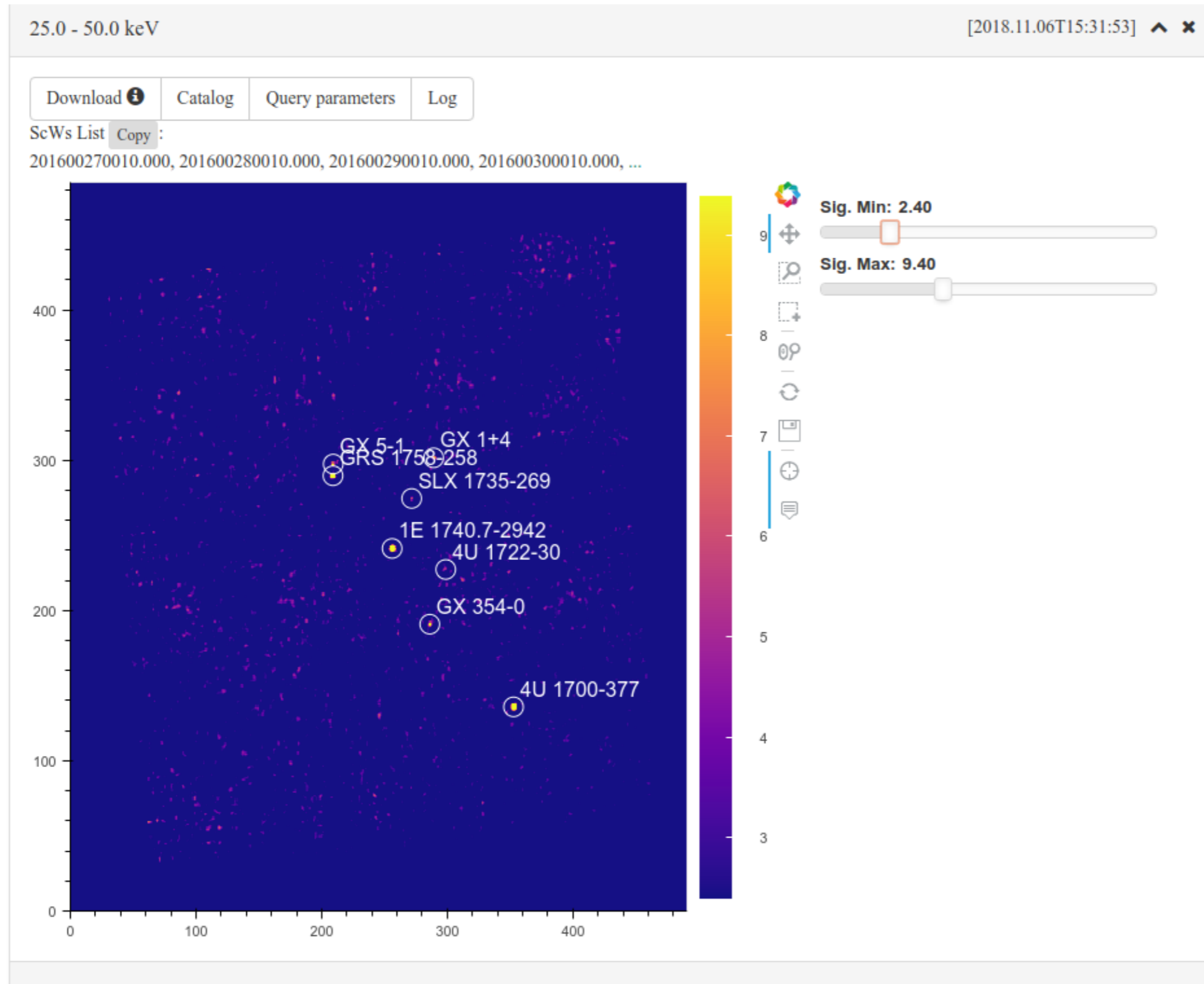
Below the main form is a section titled "INTEGRAL ISGRI" with a "Help" link. This section contains "Instrument query parameters":

- OSA Version**: A dropdown menu set to "OSA11.0".
- Radius**: A text input field containing "15" with a green checkmark.
- Use Science Windows - ScWs**: Radio buttons for "No" (selected), "List", and "File". Below it, the text "Maximum number of ScWs is 50." is displayed.
- Energy Min \***: A text input field containing "25.0" with a green checkmark. Below it, the text "The minimum of the energy band." is displayed.
- Energy Max \***: A text input field containing "50.0" with a green checkmark. Below it, the text "The maximum of the energy band." is displayed.
- Query Type**: A dropdown menu set to "Real". Below it, the text "Select query type" is displayed.
- Detection Threshold**: A text input field containing "5.0" with a green checkmark. Below it, the text "Output catalog significance threshold" is displayed.



# ODA v 1.0 - Imaging

- Possible to make images in one energy range



# ODA 1.0 - Central role of the catalog

- Easy handling of source catalog.
- You can delete, add sources found from imaging
- You can load a catalog from a file.

Source : Sgr a\* - Image catalog

Select all Deselect all New Edit Delete

Showing 1 to 8 of 8 entries

Search:

	src names	significance	ra	dec	NEW SOURCE	ISGRI FLAG	FLAG	ERR RAD
<input type="checkbox"/>	1E 1740.7-2942	39.7975	265.9794	-29.7482	0	2	0	0.0000
<input type="checkbox"/>	4U 1700-377	31.1975	255.9964	-37.8460	0	2	0	0.0003
<input type="checkbox"/>	4U 1722-30	5.4710	261.8883	-30.8019	0	2	0	0.0003
<input type="checkbox"/>	GRS 1758-258	27.0265	270.3057	-25.7378	0	2	0	0.0003
<input type="checkbox"/>	GX 1+4	8.6322	263.0458	-24.7477	0	2	0	0.0003
<input type="checkbox"/>	GX 354-0	10.7631	262.9798	-33.8281	0	2	0	0.0003
<input type="checkbox"/>	GX 5-1	9.7901	270.2689	-25.1035	0	2	0	0.0008
<input type="checkbox"/>	SLX 1735-269	6.0459	264.5713	-26.9941	0	2	0	0.0002

Show 25 entries

Previous 1 Next

Use catalog

# ODA 1.0 - Spectra and online fitting

- From the catalog, you get all spectra simultaneously at full 256 channel resolution
- Fit individual spectra and download in fits format

Processing ...  
 Session : 2a10871c8d4db1429e62d218acd7b2d1 | Job Id : -7594506992834016721

2018.11.06T15:48:58 Status : ready

Data unit		ISGRISpectraSum	ii_spectra_extract	ii_skyimage	ibis_gti	ibis_dead	ISGRIEvents
001	201600270010.000						
002	201600280010.000						
003	201600290010.000						
004	201600300010.000						
005	201600310010.000						
006	201600320010.000						

2018.11.06T15:49:56 done

[More details >](#)

Source : Sgr a\* [2018.11.06T15:49:56] ^ x

Query parameters Log

Showing 1 to 10 of 27 entries

Search:

Source Name	Xspec Model	Spectrum
1E 1740.7-2942	powerlaw	Fit
1RXS J175113.3-20121	powerlaw	Fit
4U 1700-377	powerlaw	Fit
4U 1722-30	powerlaw	Fit
Background	powerlaw	Fit
GRS 1758-258	powerlaw	Fit
GX 1+4	powerlaw	Fit
GX 349+2	powerlaw	Fit
GX 354-0	powerlaw	Fit
GX 5-1	powerlaw	Fit

Show 10 entries Previous 1 2 3 N

Source : 4U 1700-377 [2018.11.06T16:23:11] ^ x

Download ⓘ

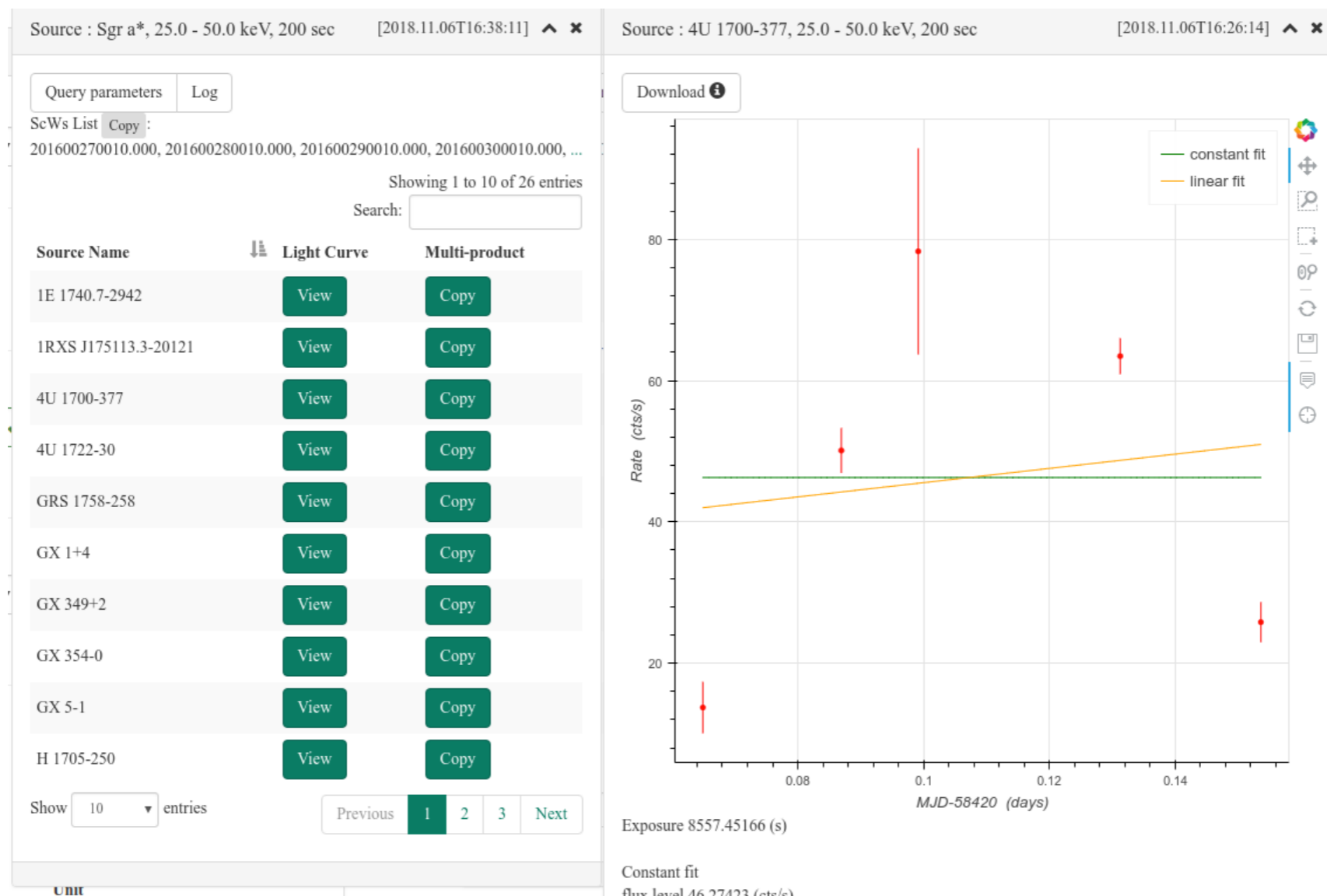
Exposure 4105.984863 (s)  
 Fit report for model powerlaw

Component	Par name	Value	UnitsError	Range-	Range+
powerlaw	PhoIndex	3.35404	0.17823	3.52918	3.68167
powerlaw	norm	180.31172	97.54068	349.13805	578.22412

dof 104  
 Chi-squared 131.64611

# ODA 1.0 Light curves

- From the catalog, you can create light curves with time bins larger than 10 seconds as for OSA limitations and display them individually
- Here at science window resolution
- Downloaded in OGIP format



# Reproducible and storable

- The system is built with internal cache to save intermediate products.
- The second time you make the same query, results are almost instantaneous.
- Backend can be deployed virtually anywhere, because it is based on a “singularity” cluster, which runs science windows in parallel.
- Singularity is very similar to docker as a principle, it runs virtual machines with OSA inside and passes commands while returning results

# ODA current limitations

- We have very limited computing resources and virtually no sysadmin supports (self administrated cluster)
- We need to limit science window number to 50 to avoid overcharge (it can be changed)
- We have very limited human resources (~2 FTEs)
- We have implemented Polar, SPI-ACS, IBIS VETO, and JEM-X.

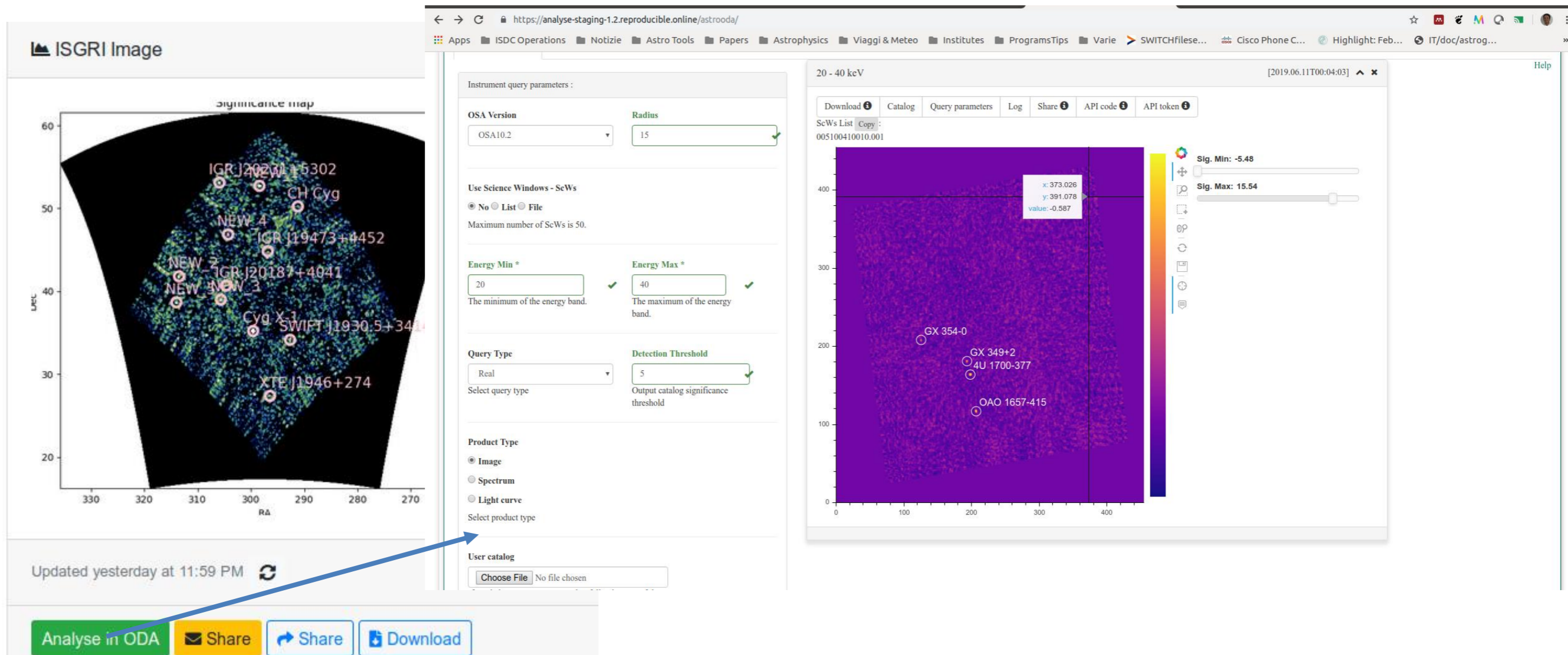
# Dynamic workflows instead of data

- The abstract concept of **workflow is a “morphism of data”**: the full procedure bringing from raw data to usable results and also their standardized analysis
- The workflow is based on a backend that builds the arborescence using the concept of class inheritance (with python). OSA is plugged into this framework using deployable software containers.
- Workflow can be materialized into a web interface
- Workflow can be materialized into a jupyter notebook
- Reproducibility is ensured, because changes are tracked into repositories (github) and they could, in principle, be explored.
- The building blocks are already available, but we need to develop usability.





# A prototype of data gallery



- We plan to populate an archive of relevant results with links to the online analysis results (images, spectra, lightcurve), but above all to the workflow having generated it.
- With a simple click, we can pass from the image to the workflow producing it. Access source files and in case modify the analysis.

# Transient event dashboard

- Every input (GCN notice) is automatically processed and it generates results.
- We developed a repository of “manually checked” results with public static results (layout to be improved)
- Link to the workflow is private
- Limiting factor in development is manpower

# The private dashboard to work on data

<https://analyse.reproducible.online/transients/dashboard/>

### INTEGRAL status

Snapshot at 2019-06-09T18:16:25 UTC  
Orbit 2100, 151.93 Mm to Earth

	State/last	Latency	RA	Dec
Real-time	ONLINE	66.0 s	4.7	59.6
NRT	210000250010	1.2 h	4.3	61.7
CONS	209000990010	25.3 d	320.0	-45.0

[INTEGRAL status](#) [Schedule](#)

next break in data in 29 hr: 2019-06-10T23:32:59, for 9.6 hr

### Gravitational Wave Detector Network

Operational Snapshot as of Jun 09, 18:16 UTC

Detector	Status	Duration
GEO 600	Observing	2:40
LIGO Hanford	Observing	15:40
LIGO Livingston	Observing	9:08
Virgo	Troubleshooting	2:53
KAGRA	Future addition	

[Detector status summary pages](#) [LVC links](#)

[Events](#)
[Observations](#)
[LIGO/Virgo](#)
[AMON/IceCube](#)
[INTEGRAL](#)
[SPI-ACS](#)
[Fermi](#)
[All](#)

Event	Origin	Role	UTC	Sky Location	Orientation (θ, φ)	FoV exposure	ScW	Data	Visibility	Planning urgency	Raw Notice
<a href="#">S190602aq</a>	LIGO Virgo	observation	2019-06-02T17:59:27.0	73.39 -7.03	bottom (127.8, -20.2)	0.0 ks	209700520010	NRT	1.3%		<a href="#">VOEvent JSON</a>
<a href="#">S190602aq</a>	LIGO Virgo	observation	2019-06-02T17:59:27.0	73.39 -7.03	bottom (127.8, -20.2)	0.0 ks	209700520010	NRT	1.3%		<a href="#">VOEvent JSON</a>
<a href="#">S190602aq</a>	LIGO Virgo	observation	2019-06-02T17:59:27.0	73.39 -7.03	bottom (127.8, -20.2)	0.0 ks	209700520010	NRT	1.3%		<a href="#">VOEvent JSON</a>

# An internal limited interface (with public links)

<https://www.astro.unige.ch/cdci/mm-events>

The screenshot shows the top navigation bar of the CDCI website. On the left, there is the logo of the University of Geneva (UNIVERSITÉ DE GENÈVE) and the Faculty of Sciences (FACULTÉ DES SCIENCES) Department of Astronomy (Département d'astronomie). In the center is the CDCI logo, which includes the text 'Astronomy Astroparticle Cosmology'. On the right, there are links for 'My account', 'Log out', and a search box. Below the navigation bar is a dark header with the text 'Home INTEGRAL MM' and 'MM Events'.

	Event time	Event type	Light Curve	Sensitivity Maps	SNR maps	Dashboard Link	GCN
IceCube-190503A	2019-05-03 17:23:08	Neutrino	INT-LC-IceCube-190503A-SPI-ACS	INT-COMBINED-Sensitivity-map-IceCube-190503A		Dashboard	1. IceCube-190503A: INTEGRAL observation
LVC S190426c	2019-04-26 15:21:55	GW	INT-LC-LVC S190426c-SPI-ACS	INT-COMBINED-Sensitivity-map-LVC S190426c		Dashboard	1. LIGO/Virgo S190426c: INTEGRAL prompt observation
LVC S190425z	2019-04-25 08:35:05	GW	INTEGRAL-LC-LVC S190425z-SPI-ACS INTEGRAL-LC-LVC S190425z-SPI-ACS	INT-COMBINED-Sensitivity-map-LVC S190425z	INT-ISGRI-SNR-map-LVC S190425z	Dashboard	1. LIGO/Virgo S190425z: INTEGRAL prompt observation 2. LIGO/Virgo S190425z: further analysis of INTEGRAL data
LVC S190421ar	2019-04-21 21:38:56	GW	INT-LC-LVC S190421ar-SPI-ACS	INT-COMBINED-Sensitivity-map-LVC S190421ar		Dashboard	1. LIGO/Virgo S190421ar: INTEGRAL prompt observation
LVC S190412m	2019-04-12 05:30:44	GW	INT-LC-LVC S190412m-SPI-ACS	INT-COMBINED-Sensitivity-map-LVC S190412m		Dashboard	1. INTEGRAL prompt observation of S190412m

# The complete set at LIGO and Virgo

## GraceDB – Gravitational Wave Candidate Event Database

<a href="#">HOME</a>	<a href="#">SEARCH</a>	<a href="#">LATEST</a>	<a href="#">DOCUMENTATION</a>	<a href="#">LOGIN</a>
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Latest – as of 11 June 2019 08:29:34 UTC

Test and MDC events and superevents are not included in the search results by default; see the [query help](#) for information on how to search for events and superevents in those categories.

Query:

Search for: Superevent ▾

UID	Labels	t_start	t_0	t_end	FAR (Hz)	UTC Created
<a href="#">S190602aq</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1243533584.081266	1243533585.089355	1243533586.346191	1.901e-09	2019-06-02 17:59:51 UTC
<a href="#">S190524q</a>	ADVNO SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242708743.678669	1242708744.678669	1242708746.133301	6.971e-09	2019-05-24 04:52:30 UTC
<a href="#">S190521r</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242459856.453418	1242459857.460739	1242459858.642090	3.168e-10	2019-05-21 07:44:22 UTC
<a href="#">S190521g</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242442966.447266	1242442967.606934	1242442968.888184	3.801e-09	2019-05-21 03:02:49 UTC
<a href="#">S190519bj</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242315361.378873	1242315362.655762	1242315363.676270	5.702e-09	2019-05-19 15:36:04 UTC
<a href="#">S190518bb</a>	ADVNO SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242242376.474609	1242242377.474609	1242242380.922655	1.004e-08	2019-05-18 19:19:39 UTC
<a href="#">S190517h</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1242107478.819517	1242107479.994141	1242107480.994141	2.373e-09	2019-05-17 05:51:23 UTC
<a href="#">S190513bm</a>	ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1241816085.736106	1241816086.869141	1241816087.869141	3.734e-13	2019-05-13 20:54:48 UTC
<a href="#">S190512at</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1241719651.411441	1241719652.416286	1241719653.518066	1.901e-09	2019-05-12 18:07:42 UTC
<a href="#">S190510g</a>	ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1241492396.291636	1241492397.291636	1241492398.293185	8.834e-09	2019-05-10 03:00:03 UTC
<a href="#">S190503bf</a>	ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1240944861.288574	1240944862.412598	1240944863.422852	1.636e-09	2019-05-03 18:54:26 UTC
<a href="#">S190426c</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1240327332.331668	1240327333.348145	1240327334.353516	1.947e-08	2019-04-26 15:22:15 UTC
<a href="#">S190425z</a>	ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK	1240215502.011549	1240215503.011549	1240215504.018242	4.538e-13	2019-04-25 08:18:26 UTC
<a href="#">S190421ar</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1239917953.250977	1239917954.409180	1239917955.409180	1.489e-08	2019-04-21 21:39:16 UTC
<a href="#">S190412m</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1239082261.146717	1239082262.222168	1239082263.229492	1.683e-27	2019-04-12 05:31:03 UTC
<a href="#">S190408an</a>	PE_READY ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	1238782699.268296	1238782700.287958	1238782701.359863	2.811e-18	2019-04-08 18:18:27 UTC
<a href="#">S190405ar</a>	ADVNO SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK	1238515307.863646	1238515308.863646	1238515309.863646	2.141e-04	2019-04-05 16:01:56 UTC



# Time-domain astronomy

- MoU with Antares
- MoU with IceCube for non-public alerts
- LVC issues public notices
- Implemented the real-time dump of SPI-ACS stream to be used in fast triangulation with GBM and IPN satellites.
- Developed an API to access real-time services via python notebook and quickly react to alerts
- System of “burst advocates”