An Access Point to ESA's Space Debris Data: The Space Debris Office Web Based Tools

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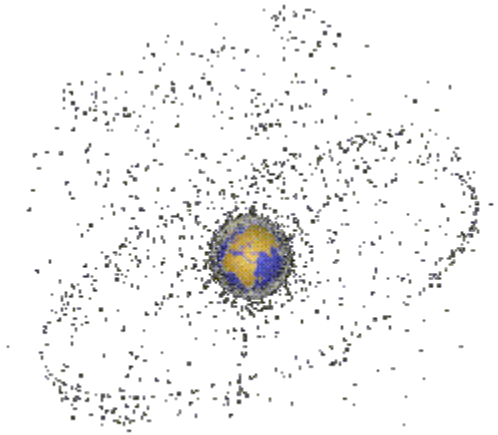
07/03/2016

Issue/Revision: 1.0
Reference:
Status: Issued

DISCOS

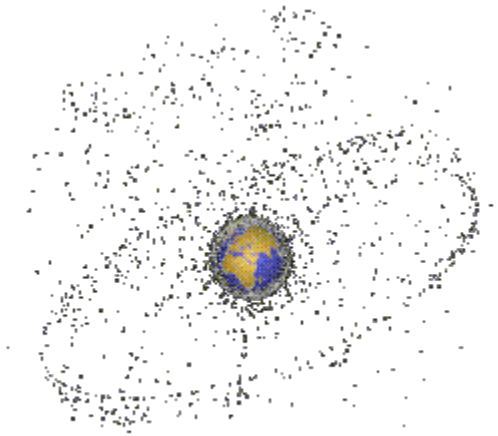
- **D**atabase and **I**nformation **S**ystem **C**haracterising **O**bjects in **S**pace
- Launch, spacecraft and orbit information of all unclassified launches
- Developed in 1989, continuously maintained and upgraded since then
- Object mass, shape, dimensions, cross section, owner, mission objectives, image, lifetime prediction
- Detailed physical properties of launch vehicles
- Detailed information on fragmentations



DISCOS in Numbers

As of 7. March 2015 DISCOS comprises:

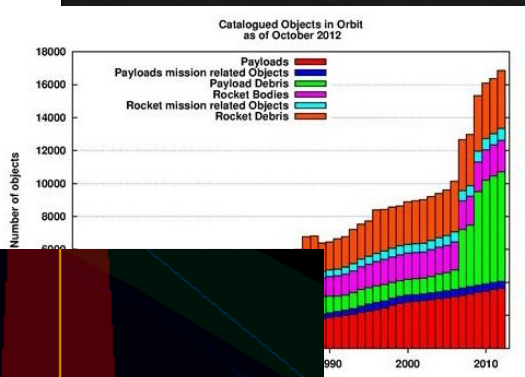
- 41379 objects (17805 in orbit)
- 15408 with physical properties (6386 in orbit)
- 7272 payloads (4127 in orbit)
- 5413 rocket bodies (1944 in orbit)
- 28632 debris pieces (11675 in orbit)
- 296 launch vehicles (including failures)
- 278 fragmentations



Applications Based on DISCOS

Example applications based on DISCOS data

- Orbital lifetime and re-entry predictions
- Statistics
- Reports
- Collision avoidance
- Active debris removal target identification

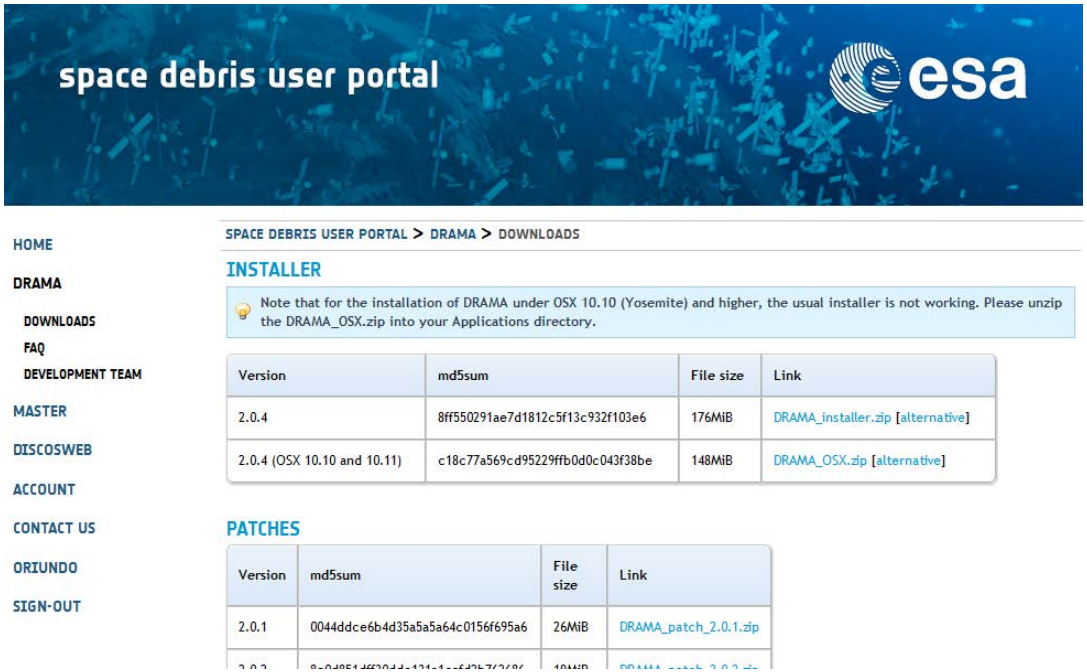


Web Based Tools

- Making our products available to the public
- Already existing front-ends for
  - Downloading DRAMA and MASTER (SDUP)
  - Accessing Oriundo for casualty risk estimations (SDUP)
  - Getting our solar activity predictions (SOLMAG)
  - Browsing DISCOS (DISCOSweb)
- Front-ends currently in development for
  - Automatic querying of DISCOS (REST API)
  - Re-entry predictions
  - Fragmentation event analyses

Space Debris User Portal

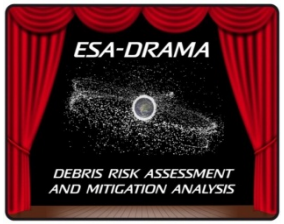
- Download portal for
  - DRAMA
  - MASTER
- Access to Oriundo
- No country limitation



https://sdup.esoc.esa.int

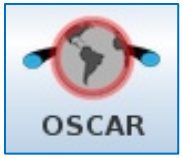
The DRAMA Software Tool Suite

*"The **aim of DRAMA is** to support the objectives of the ESA Space Debris Mitigation Requirements by **enabling satellite programs** in Europe **to assess their compliance** with the recommendations contained in that document."*



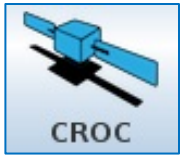
ARES
Assessment of Risk Event Statistics:
Analyse requirements for collision avoidance manoeuvres expected for a mission.

MIDAS
MASTER (-based) Impact Flux and Damage Assessment Software:
Modelling of the collision flux and damage statistics for a mission.



OSCAR
Orbital Spacecraft Active Removal:
Analyse disposal manoeuvres of spacecraft and compliance with ESA's mitigation requirements.

CROC
Compute projected cross-sectional areas of complex bodies



SARA *(upgrade in development)*
Spacecraft Entry Survival Analysis Module (SESAM):
Modelling the re-entry of a spacecraft.
Spacecraft Entry Risk Analysis Module (SERAM):
Assessing the on-ground risks of objects surviving re-entry.

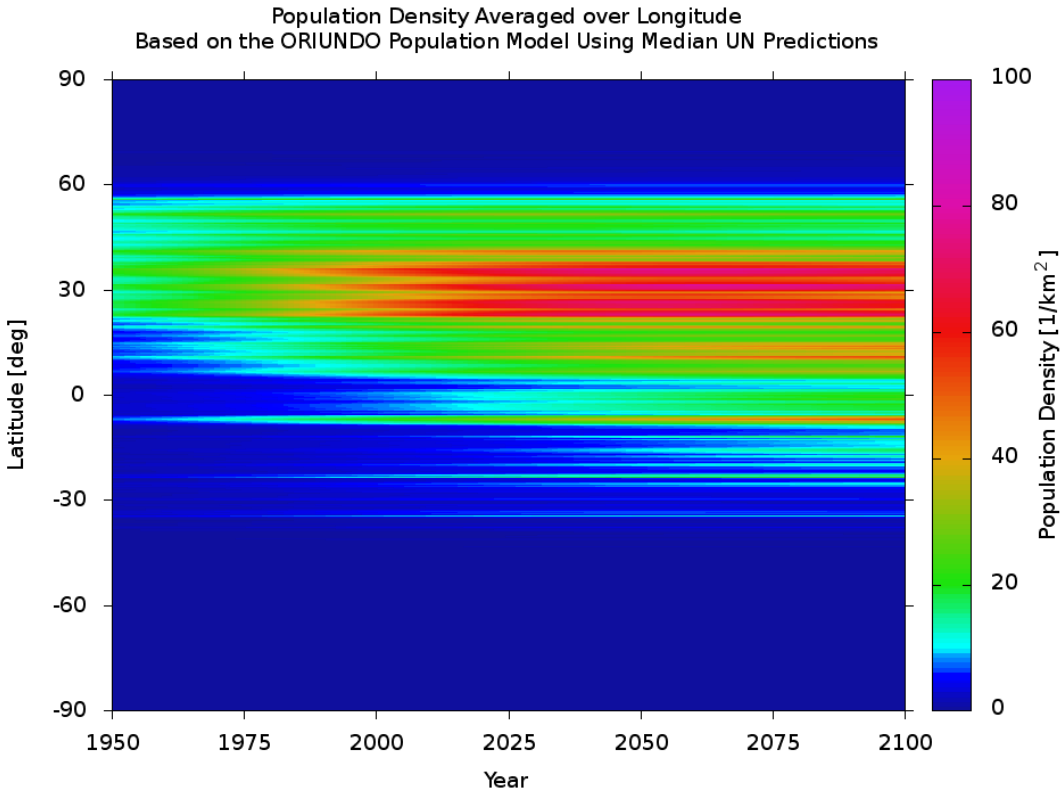
The MASTER Software

- Meteoroid And Space Debris Terrestrial Environment Reference Model
- Statistical flux analysis (especially for long-term missions)
- Determination of averaged collision rates
- Generates input to analyse probability of failure
- Planning of missions
- Describes the space debris environment

Quelle: en.wikipedia.org

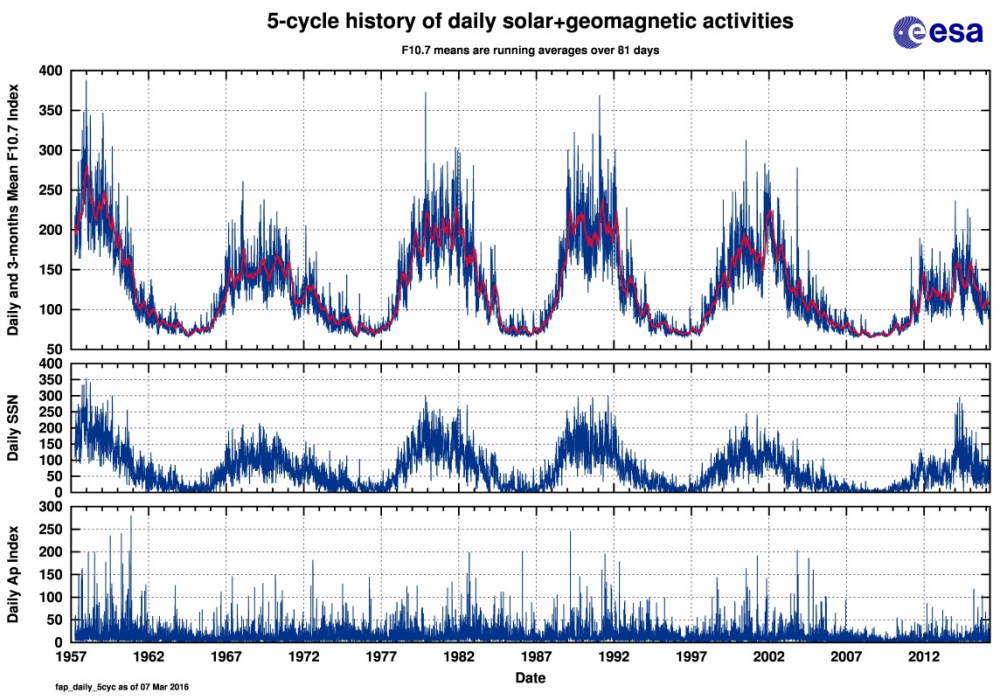
Oriundo

- Population density prediction model
- Based on
  - Gridded Population of the World
  - UN world population predictions
- Compute
  - Casualty probability
  - Casualty cross section threshold



SOLMAG

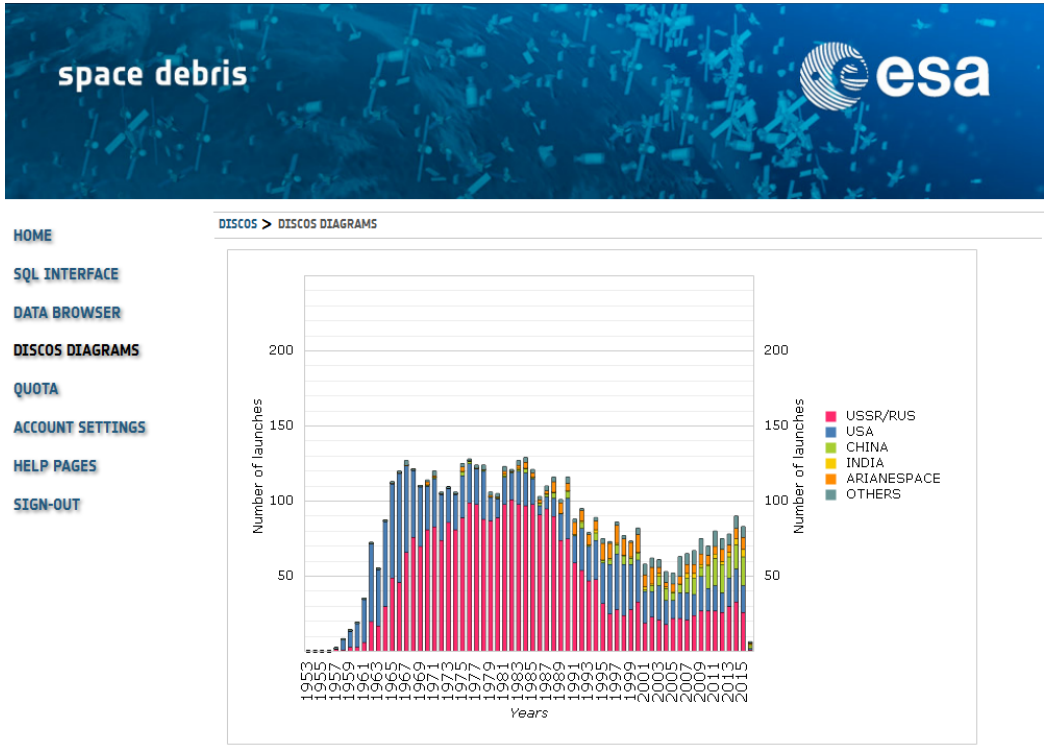
- Solar activity records and predictions
- Daily historic records
- Daily prediction for 28 days
- Monthly predictions for 98 years
- Updated daily based on NOAA data



https://static.sdo.esoc.esa.int/SOLMAG/

DISCOSweb

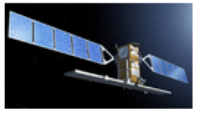
- Web interface to DISCOS
- Browse information on:
  - Objects
  - Launches
  - Launchers
  - Launch Sites
  - Launching nations
  - Launching organisations
  - Fragmentations
- Many search options
- Diagrams



https://discosweb.esoc.esa.int

DISCOSweb – Object Information

- Detailed concatenated information on one page
- Direct access by name, COSPAR ID or SATNO
- Search by
  - Orbit type
  - Perigee and apogee altitude
  - Inclination
  - Mass
  - Average cross section
  - Launcher
  - Launch site
  - Launching country
  - Launch date
  - Re-entry date
  - On-orbit / re-entered

Name	Sentinel-1A
COSPARID	2014-016A
SATNO	39634
Mass	2157.000 kg
Classification	Payload
Shape	Box + 4 Pan
Lenght	1.600 m
Height	3.420 m
Depth	21.040 m
X_SECT_MAX	57.919 m^2
X_SECT_MIN	2.560 m^2
X_SECT_AVG	23.488 m^2
X_SECT_RCS	10.694 m^2
Re-Entry Epoch	(value not available)
Country	EUROPEAN SPACE AGENCY (ESA)
Organization	European Space Agency
Image	
Image Source	http://space.skyrocket.de ESA
COSPARLaunchNumber	2014-016
LauncherName	Soyuz-ST-A Fregat
Site	Guiana Space Center (Kourou)
PRED_DECAY_DATE	2731-08-27
REMAINING LIFETIME UNCERTAINTY	143.09424
Mission Type	Earth observation
Activity Status	ACTIVE

DISCOSweb – Object Information

INITIAL ORBITS

Status	Regime	Orbit Epoch	SMA [km]	ECC	INC [deg]	A_PER [de
... No filter applied						
	Low Earth Orbit	2014-04-04	7066.14	0.00028304	98.17	67

1 - 1 of 1 item 5 | **15** | 25 | 50 | 100 | All **1**

RELATED FOOTNOTES

Sentinel-1 is an European two satellite constellation with the prime objectives of Land and Ocean monitoring. The goal of the mission is to provide C-Band SAR data continuity following the retirement of ERS-2 and the end of the Envisat mission. To accomplish this, the satellites carry a C-SAR sensor, which offers medium and high resolution imaging in all weather conditions. The C-SAR is capable of obtaining night imagery and detecting small movement on the ground, which makes it useful for land and sea monitoring.

DISCOSweb REST API

```
$ curl -u user:password https://discosweb.esoc.esa.int/api/objects/39634
{ "satno":39634,
  "cosparId":"2014-016A",
  "name":"Sentinel-1A",
  "objectClass":"Payload",
  "mass":2157.0,
  "shape":"Box + 4 Pan",
  "length":1.6,
  "height":3.42,
  "depth":21.04,
  "xSectMax":57.919,
  "xSectMin":2.56,
  "xSectAvg":23.4875,
  "xSectRcs":10.6944,
  "country":"EUROPEAN SPACE AGENCY (ESA)",
  "reentryEpoch":null,
  "visMagnitude":null,
  "organisation":"European Space Agency"
}
```

- RESTful Application Programming Interface
- Returns data in JSON format
- Easy to interface in programs and scripts
- Currently in closed beta testing
- Release planned within the next months

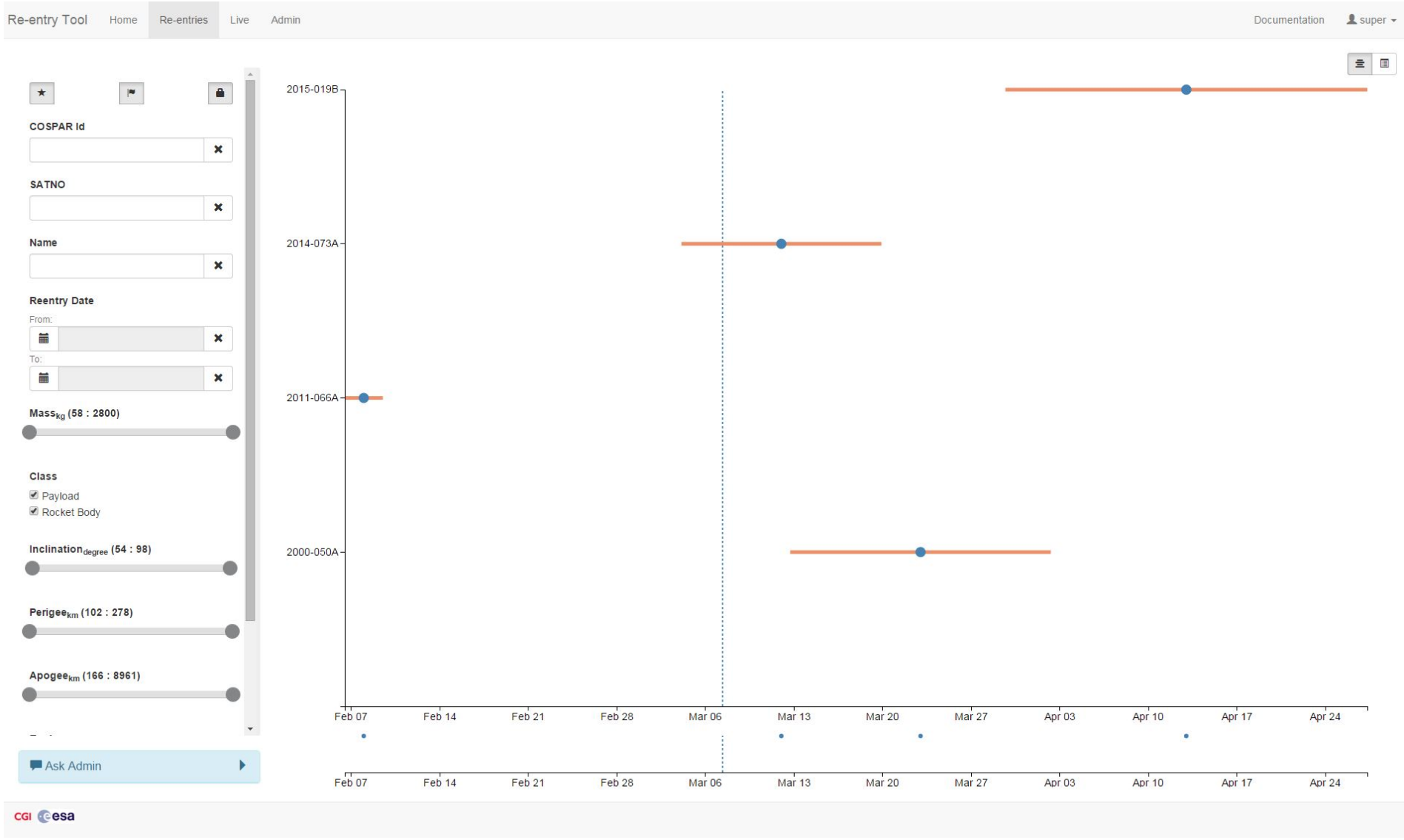
Re-entry Front-end

- Currently in development
- Daily updated re-entry predictions
- Subscription to re-entries of interest
- Advanced service with more detailed predictions available for national alert centres

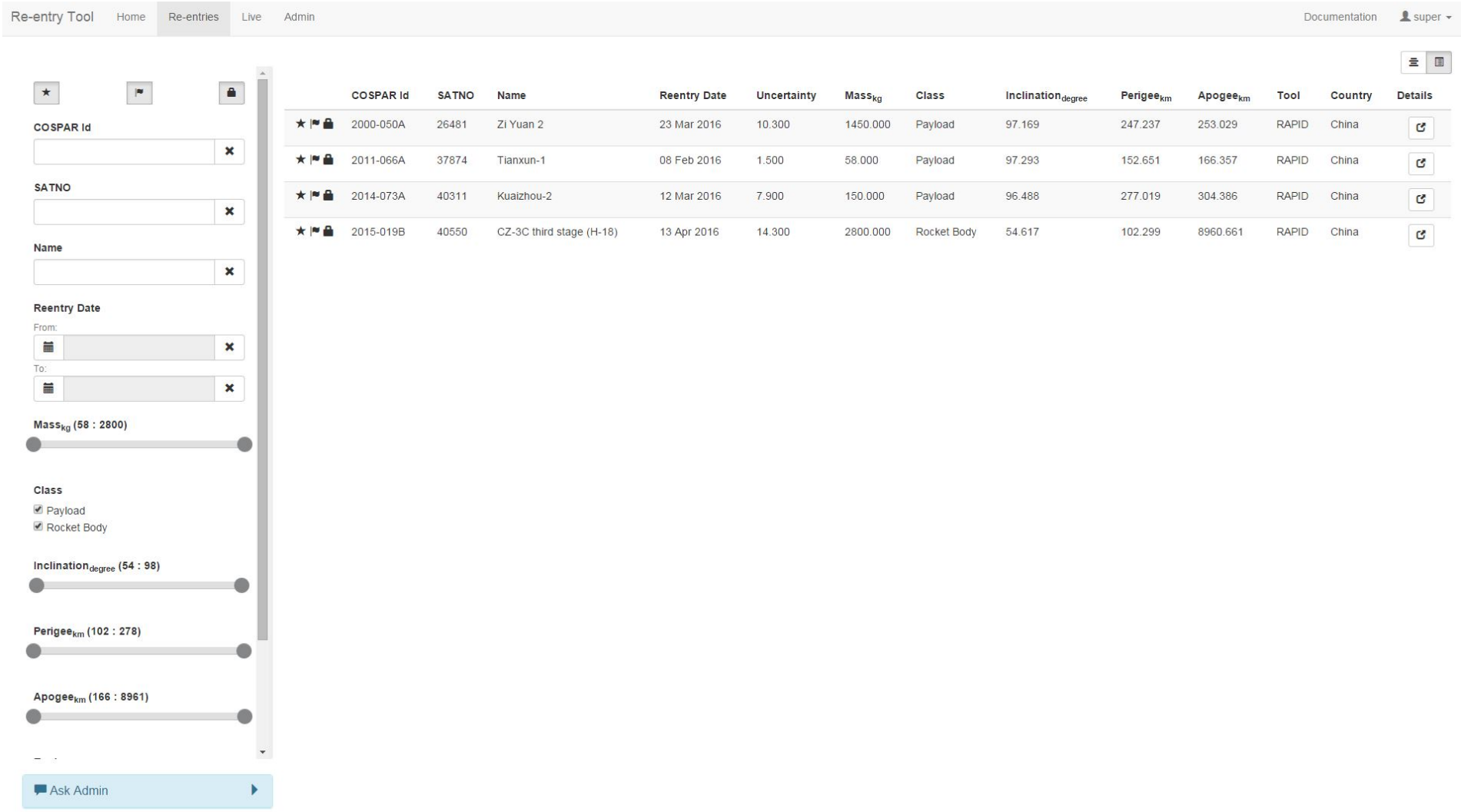
© ESA/D.Ducros - 2007

https://reentry.esoc.esa.int

Re-entry Front-end – Preview

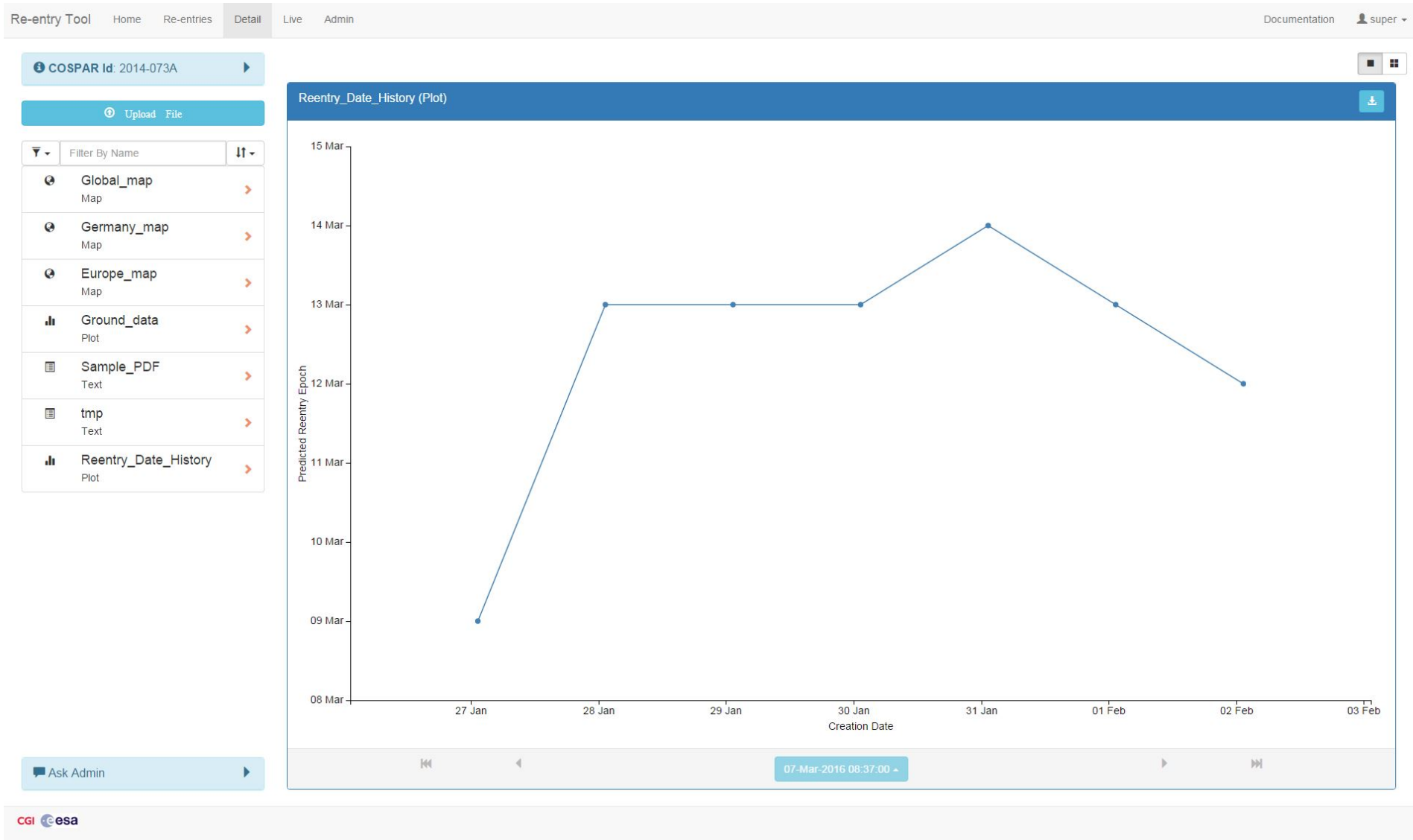


Re-entry Front-end – Preview



	COSPAR Id	SATNO	Name	Reentry Date	Uncertainty	Mass$_{kg}$	Class	Inclination$_{degree}$	Perigee$_{km}$	Apogee$_{km}$	Tool	Country	Details
★ ⚑ 🔒	2000-050A	26481	Zi Yuan 2	23 Mar 2016	10.300	1450.000	Payload	97.169	247.237	253.029	RAPID	China	
★ ⚑ 🔒	2011-066A	37874	Tianxun-1	08 Feb 2016	1.500	58.000	Payload	97.293	152.651	166.357	RAPID	China	
★ ⚑ 🔒	2014-073A	40311	Kuaizhou-2	12 Mar 2016	7.900	150.000	Payload	96.488	277.019	304.386	RAPID	China	
★ ⚑ 🔒	2015-019B	40550	CZ-3C third stage (H-18)	13 Apr 2016	14.300	2800.000	Rocket Body	54.617	102.299	8960.661	RAPID	China	

Re-entry Interface – Preview

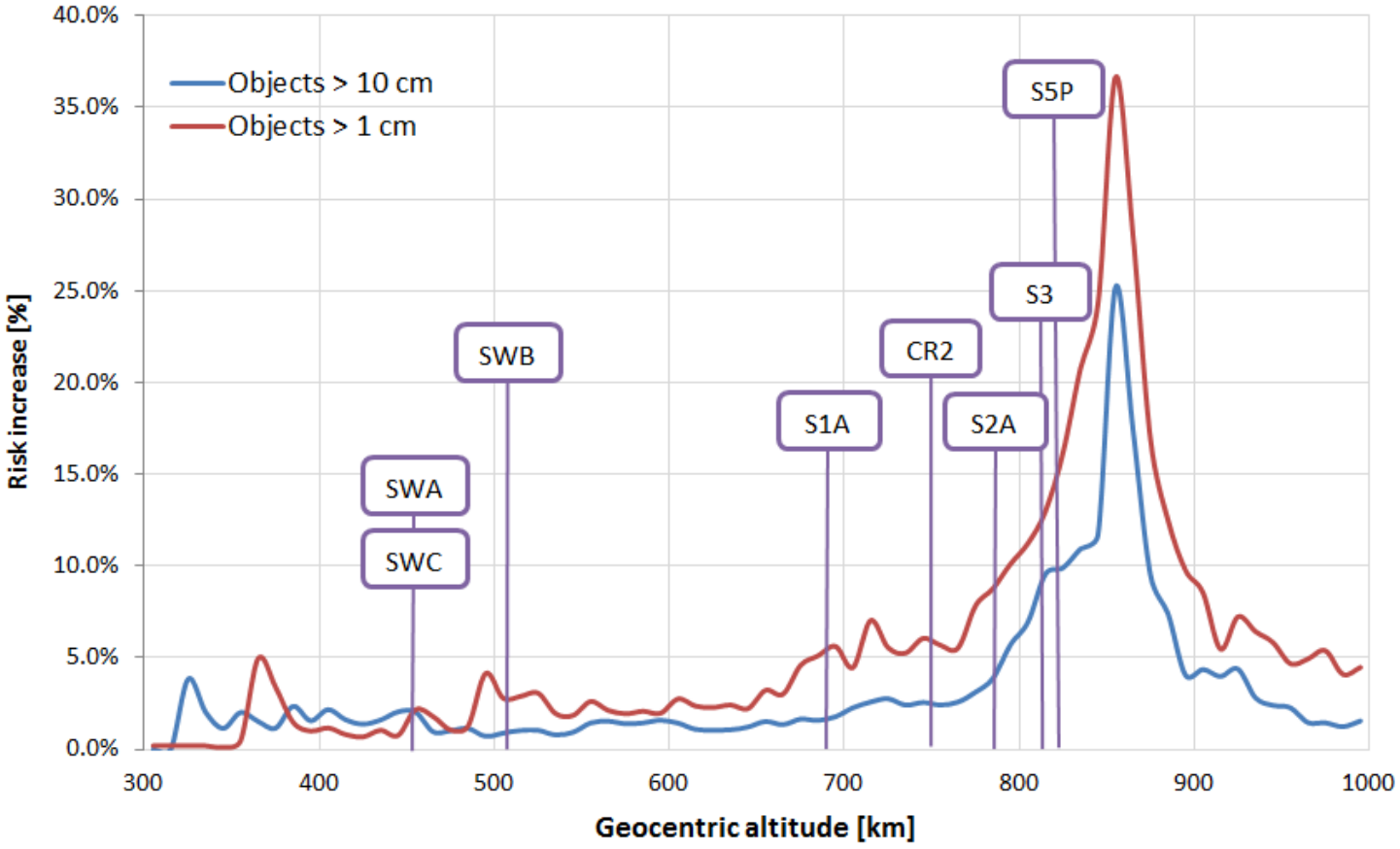


Fragmentation Front-end

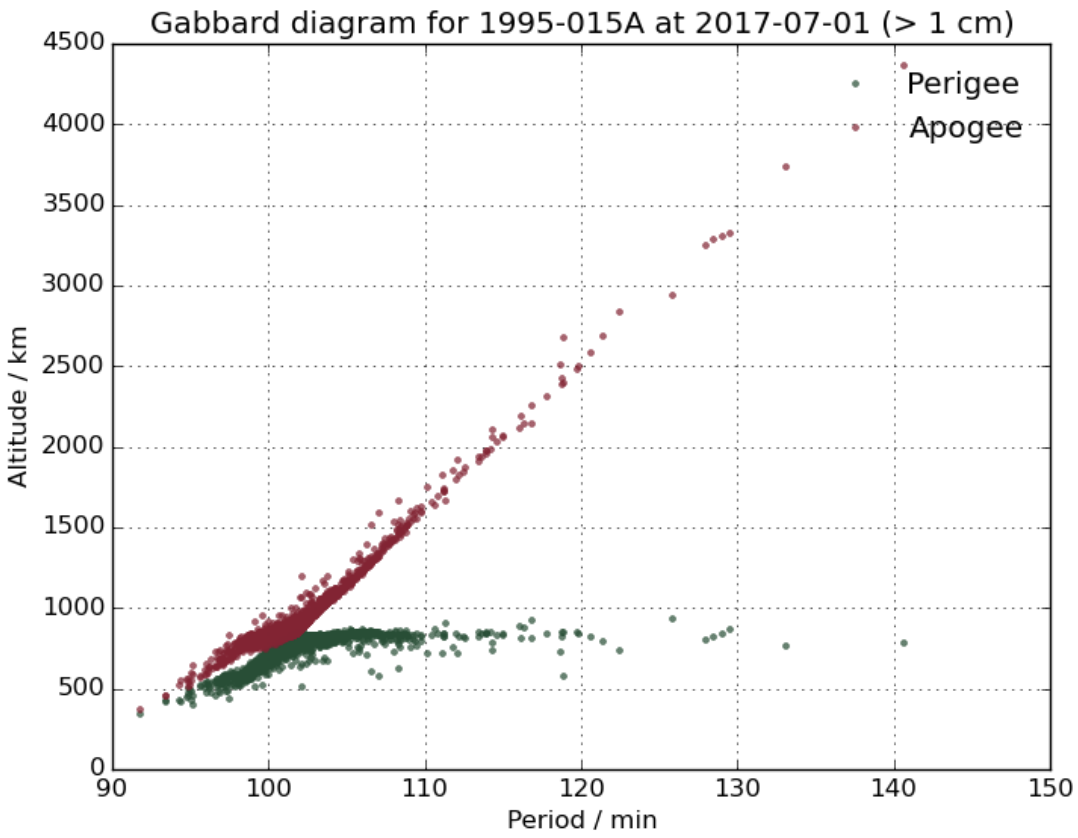
- Currently in development
- Details on recent fragmentations
- Compute risk increase of a fragmentation
- Based on MASTER model
- Determine effect on your satellite
- Updated as soon as new fragments appear in the USSTRATCOM catalogue

https://fragmentation.esoc.esa.int

Fragmentation Front-end – Preview



Fragmentation Front-end – Preview



Summary

- Already existing
  - SDUP with DRAMA, MASTER and Oriundo
  - SOLMAG
  - DISCOSweb
- In development
  - DISCOSweb REST API
  - Re-entry front-end
  - Fragmentation front-end
- One account for all front-ends in the future
- Reduce account limitations where possible