EMIT Documentation

https://emit.sero-systems.de

EUROCONTROL

Table of contents

1. European Monitoring of Interrogators and Transponders (EMIT)

Welcome to the documentation of the European Monitoring of Interrogators and Transponders (EMIT) system.

Download Manual as PDF

2. Changelog

2026-01-14

- Switched Archive and FIR Statistics downloads from GZIP to ZIP to improve interoperability.

2025-11-21

- Added number of corrected bits and number of low confidence bits to the raw message CSV export

2025-06-12

- User Alerts: The machine-readable HTTP endpoint, similar to email alerts, now provides the interrogator code that contributed most to the DF11 rate.
- User Alerts: To improve data relevance, positions in both email reports (alerts, warnings) and the machine-readable HTTP endpoint are now only shown if they are not older than 10 minutes relative to the event's timestamp.

2023-10-19

- Downlink: Added ability to display radars' Surveillance and Lockout Coverage Maps for MICA users

2023-02-20

- FIR stats: add Unix time to exported CSV file
- UI improvement: back/forward arrows in date-time picker are always at the same position
- UI improvement: lower bound for y-axis in DF11 aircraft chart no longer dynamic. It's always 0 now.
- UI fix: prevent hanging date-time picker under some circumstances

2023-02-03

- User alerts: the machine-readable HTTP endpoint now returns data of the last 24h instead of data from start of the current day
- User alerts: the most contributing IC for DF11 has been added to alert emails and warning reports. This will be visible in events that happened after Feb 1st 13:15 UTC.
- Hosts of a receiver will be notified via email if problems with their device were resolved.

2022-09-14

- Uplink/Archive: added strength of P5 (side-lobe suppression) pulse to CSV download

2022-07-13

- Archive and Statistics: highlight own receiver
- Use `-100 dB` for missing values in charts which illustrate RF signal strength

2022-06-23

- Downlink/Uplink: Fixed memory leak which eventually led to a crashing browser tab

2022-06-22

- Statistics: added more charts for
  - Downlink occupancy
  - Downlink noise floor
  - Downlink average power
  - Uplink occupancy
  - Uplink noise floor
  - Uplink average power
- Downlink/Uplink: Added channel occupancy in Misc table and the receiver charts
- Uplink: Additional counters for
  - Mode A/C Plain
  - Mode A/C P4Short
  - Mode A/C P4Long
- Uplink/Downlink: The counters named Mode A and Mode C have been renamed to Mode A Total and Mode C Total.
- For receiver operators, their own receiver is now highlighted in the receiver filter dialog.

2022-02-15

- Downlink: added receiver chart for DF11 rates by IC
- Allow custom time range for historical data (up to 4 hours)

2021-12-21

- Added CSV export functionality for tables and charts
- Added ability to save and restore a custom combination of FIRs

2021-09-23

- Added frequency offset (kHz) and signal strength (dBm) in CSV export

- Added ability to (de)select all series in charts
- Added ability to set a fixed y-axis limit in charts

2021-08-10

- Added client-side caching. The web browser stores recently viewed scenarios (time and filter settings) of the Uplink and Downlink module locally. Switching back to such a scenario will not trigger a request to the server and data is displayed almost instantly.
- Uplink: Added table with BDS statistics
- Uplink: fixed receiver chart. The IC filter is now applied for all uplink formats, except UF 0 and 16.

2021-07-14

- Added autoload data toggle in uplink and downlink module. It allows users to disable automatic updates of displayed data after changing filter settings.

2021-03-26

- Filters now also affect dedicated receiver charts
- Downlink: added DF11 rates to the dedicated aircraft charts
- Added a distance measurement tool to the map (right-click on a free spot in the map)
- Changed placemark names in KML export from Unix time to human-readable transponder address and date

2021-02-16

- Updated FIRs: include ELLX
- Status: show warning if a receiver does not send data for at least one hour
- Uplink: Added leading zeroes to Interrogator Codes to allow sorting

2021-02-02

- Downlink: added KML export feature
- Downlink: allow user-defined color scheme for aircraft and history markers

2020-12-21

- Added new module for FIR Statistics
- Renamed existing Statistics module to Receiver Statistics
- Added BDS register in uplink CSV export

2020-12-02

- Downlink: included message rates for aircraft not airborne in the selected minute. In the table, rows with non-airborne aircraft have lighter color.
- Downlink: in the category "Peak 1s (last 4 hours)" of the table, show tooltips with the time and FIR when peaks happened by hovering values with the mouse.
- Downlink: add a button in the top menu bar to hide state vectors of currently airborne aircraft from the map.
- Downlink: changed coloring for grey and light green history points
- Downlink: show FIR filter dialog on very first use of the tool.

2020-10-23

- Added user alerts and warnings for automatic alerting and reporting

2020-10-02

- Downlink: added legend with ability to enable/disable history points of certain colors
- Downlink: changed rendering order of current states and history points to get a better understanding of regions with high rates. Current states are always behind the history. History points indicating higher rates are drawn in front of the ones with lower rates.
- Charts: added ability to hide time series through the legend
- Archive: allow extraction with time granularity of one second (instead of one minute)

2020-08-21

- Downlink: replaced altitude filter with flight level filter
- Downlink: clarified values of receivers' Peak Aircraft 24h chart by extending its description
- Downlink: added GND flag in table
- Downlink: Highlight 3 highest interrogator message rates for each aircraft in DF11 table
- Uplink: apply receiver filter for Misc and Pulses table as well
- Map: Smaller zoom steps for map view
- Map: Receivers can be hidden from the map view using a checkbox toggle
- Charts: highlight time series when hovering an entry in the legend
- Added descriptive tooltips in DF/UF table headings
- Changed table header "Average" to "Average (last 60s)"

3. Incidents

This page provides an overview of incidents that impact the availability of expressive data in EMIT.

Incidents might be caused by maintenance, hardware defects, human errors or network issues and result in full or partial outages. In the following, we list only events that affected the receiver network and data collection as a whole or in large parts.

2026-02-25

An unexpected outage of the data center network led to an interruption of the data collection and made the EMIT Web application unavailable between 21:00 and 21:11 UTC.

2025-05-15

There was an unexpected outage of data collection from the 1030/1090 MHz monitoring receivers. The collection of messages was gradually dropping since 10:13 UTC until it finally reached 0 at 11:10 UTC. After fixing the problem, feeding continued at 12:19 UTC and data rates have been reestablished. Message counters have been recovered even from the outage period, but raw Mode S messages (available through Archive module) will not be recovered.

2024-12-28

Multiple simultaneous hardware failures caused an overload in the cluster, resulting in a system-wide stabilization effort. To address the issue, data collection was temporarily paused from 20:42 to 23:27 UTC, leading to a gap in the collected data during this period.

Once the platform was stabilized, all user alerts were resent.

2024-12-06

Planned maintenance of the data center network led to an interruption of the data collection between 4:00 and 4:17 UTC.

2024-08-22

On August 22 at 11:20 UTC, it was observed that emails for certain users were not being delivered. Upon investigation, it was determined that our mail servers were functioning correctly. They were not listed on any blacklists and maintained a good reputation with all major email reputation services.

Given these findings, it is likely that the issue originated from external factors beyond our control. The situation resolved itself by August 27 at 17:00 UTC, with normal email delivery resuming for all users.

2024-08-08

Planned maintenance to expand the cluster's capabilities led to an interruption of the data collection at 7:56, 8:49 and 8:58 UTC. The interruptions were taking between 2 and 5 minutes.

2024-06-30

Deployment of a new version of the deduplication service led to a short glitch in the processing that resulted in messages being processed twice for a subset of aircraft. As a result, some aircraft had briefly double the rates. The time period affected is between 06:58:30 and 06:59:06 UTC.

2024-06-26

A temporary overload situation in the cluster caused unavailability of the EMIT UI between 8:05 and 21:00 UTC. There is a gap in the collected data between 8:05 and 9:02 UTC.

Data backlog has been reprocessed and user alerts have been re-sent after the platform was stabilized.

2024-05-23

Planned maintenance for the network equipment led to a downtime of the data collection and user interface between 9:00 and 21:30 UTC. No data has been collected during the maintenance window.

2024-03-12

A significant internal network outage occurred due to a software issue within the routers of our IT service provider. This resulted in the inability of our cluster nodes to communicate effectively, leading to a severe decline in service quality. The incident began at 11:05 UTC on March 12 and persisted until 21:50 UTC, when stability was restored to the network. Approximately 20% of data was lost during the period of degradation.

2023-02-11

A problem with the email service resulted in user alerts and warning reports not being sent starting at Feb 11 20:35 UTC. The situation was resolved Feb 14 13:11 UTC. The system started sending pending email alerts and warning reports at this time. Data collection was not affected, no data has been lost.

2023-02-09

An expired VPN server certificate led to receiver connection failures. Data has been lost between Feb 09 13:55 and Feb 10 09:40 UTC.

2022-10-27

A database misconfiguration led to inaccesibility of the web interface between Oct 27 12:30 and Oct 28 13:00 UTC. Additionally, user alerts have not been sent out during that period of time. Data collection was not affected, no data has been lost.

2022-10-04

A hardware defect and an unforeseen chain of consequences led to inaccesibility of the web interface between Oct 04 15:00 and 18:00 UTC. Data collection was not affected, no data has been lost.

2022-04-28

Networking problems that affected central data collection led to data loss between Apr 28 19:48 and 20:00 UTC.

2021-12-14

A problem with the email service resulted in user alerts and warning reports not being sent starting at Dec 14 16:15 UTC. The situation was resolved Dec 20 15:00 UTC. The system started sending pending email alerts and warning reports at this time and the backlog was fully processed until the evening. Data collection was not affected, no data has been lost.

2021-10-06

Problems caused by maintenance in the central data processing infrastructure caused a delayed calculation of transponder rates that occurred between Oct 6 22:20 UTC and Oct 7 13:30 UTC. As a result, no alerts and warnings were generated during this period.

2021-05-20

Due to an unexpected effect of a receiver software update, the deduplication was affected. Rates between 2021-05-20 and 2021-05-26 might be higher than reality. The root cause has been found and fixed.

2021-03-05

Due to a system upgrade that required changes in the configuration, the system did not allow queries between 13:30 and 14:15 UTC. Data collection was not affected, no data has been lost.

2021-03-03

Replacement of a router within the data center caused a downtime of the whole system between 4:00 and 4:30 UTC.

2021-01-26

A configuration change in the data collection infrastructure forced all receivers to close their connection and re-connect. As a result, there is a slight drop in the message rates around 10:40 UTC.

2020-12-30

A hanging process caused user alert emails to be sent several days later. The process stopped sending alerts at Dec 24. The situation was resolved Dec 30. No data has been lost.

2020-11-24

An outage that affected central data collection led to partial data loss between Nov 23 22:50 and Nov 24 7:50 UTC.

2020-11-01

An outage that affected central data collection led to lost data between Nov 1 21:23 UTC and Nov 2 8:51 UTC.

2020-10-08

An outage that affected the receivers led to data loss roughly between Oct 8 0:40 UTC and Oct 8 9:00 UTC. Receivers recovered one after another.

4. User Manual

User Manual

Introduction

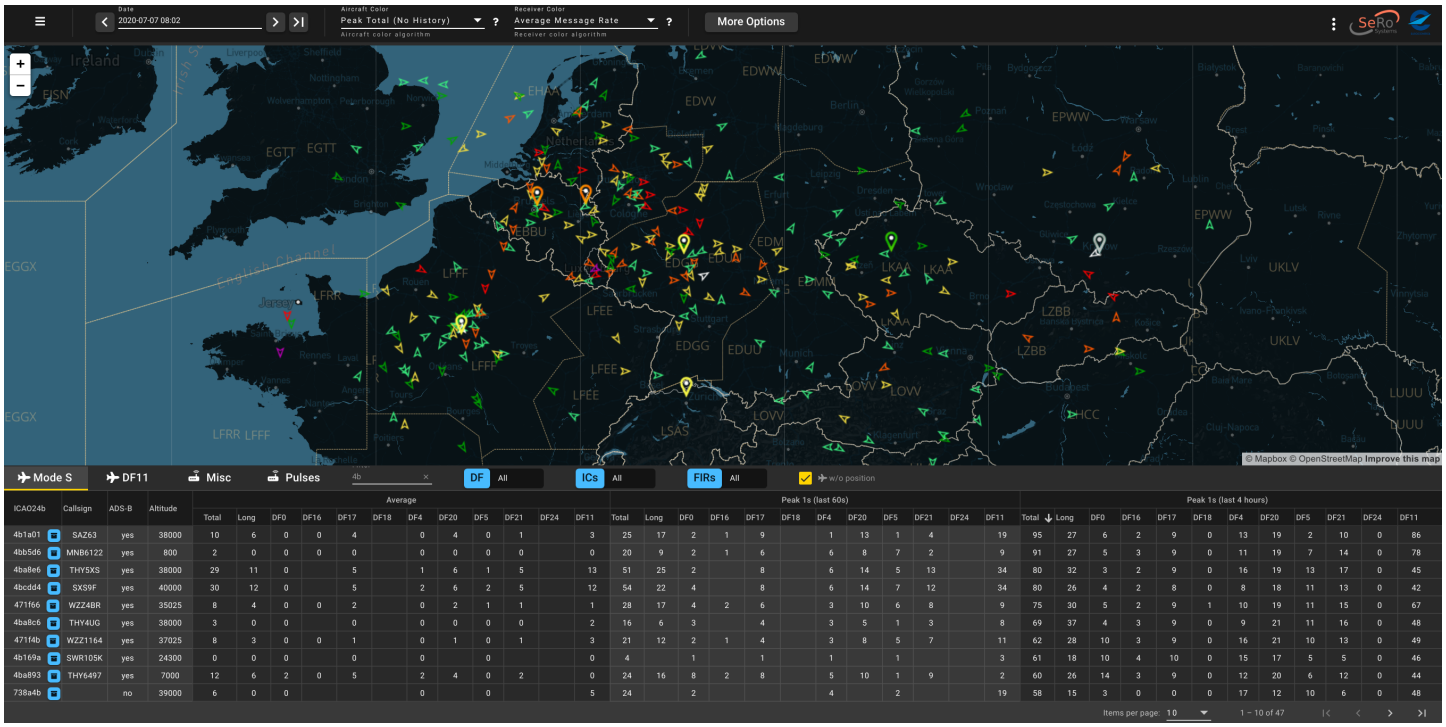
The user manual shows how to use the European Monitoring of Interrogators and Transponders system. There are several use cases, each illustrated as a workflow:

- Assess the current situation in your airspace
- Examine problematic aircraft
- Examine interrogator transmissions
- Examine RF load and transmissions
- Check receiver status
- Set up automatic alerting
- Set up automatic warnings
- Assess interrogator code conflicts

Assess the current situation in your airspace

1. Open the tool

You will be presented with the downlink monitoring module. By default, aircraft colors are based on the peak-1s total Mode S message rate.



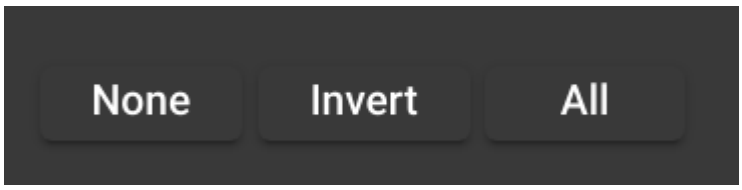
2. Filter for your own FIR

Click on the FIR filter in the bottom part of the interface.

A dialog opens where you can select and de-select FIRs of interest.


None
Invert
All
BGGL
BIRD
DAAA
DTTC
EBBU
EDGG
EDMM
EDVV
EDWW
EETT
EFIN
EGGX
EGPX
EGTT
EHAA
EISN
EKDK
ENOB
ENOR
EPWW
ESAA
EVRR
EYVL
GCCC
GMMM
GOOO
HECC
HLLL
LAAA
LBSR
LCCC
LDZO
LECB
LECM
LFBB
LFEE
LFFF
LFMM
LFRR
LGGG
LHCC
LIBB
LIMM
LIRR
LJLA
LKAA
LLLL
LMMM
LOVV
LPPC
LPPO
LQSB
LRBB
LSAS
LTAA
LTBB
LUUU
LWSS
LYBA
LZBB
OEJD
OIIX
OJAC
OLBB
ORBB
OSTT
UATE
UBBB
UDDD
UGGG
UKBV
UKFV
UKHV
UKLV
UKOV
ULLL
ULMM
ULOL
ULPB
UMKK
UMMV
URRV
UTAK
UUWV
Cancel
Ok

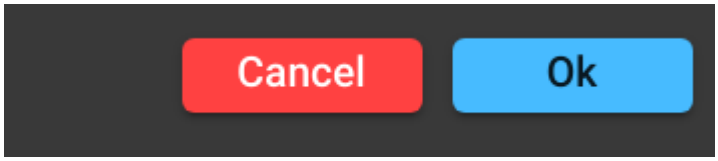
Note the buttons in the upper part of the dialog which allow you to quickly (de-)select all FIRs.



Warning

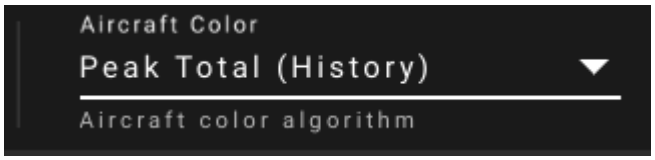
Selecting all FIRs is not advised as it might cause performance issues depending on your browser and graphics card.

Close the dialog and apply the filters by clicking "Ok".

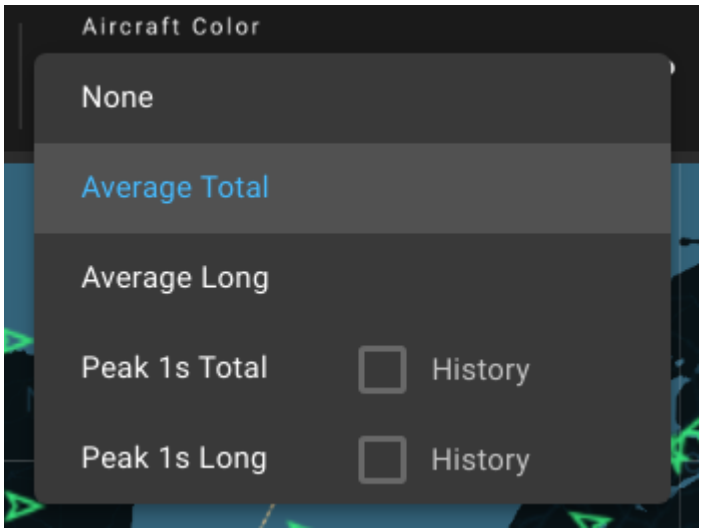


3. Choose coloring

The upper part of the main interface allows to configure the aircraft coloring scheme.



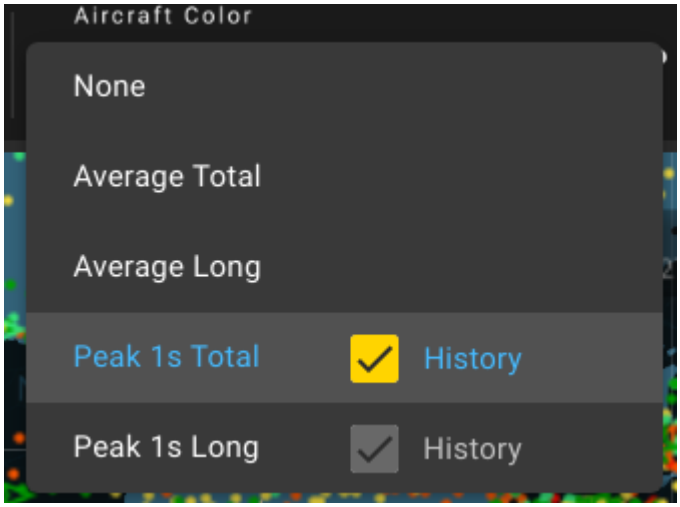
Click on the selector to open the menu.



Choose among the following options.

- **None** - all aircraft are grey
- **Average Total** - average total Mode S message rate over the last minute, excluding squitters (DF17,18)
- **Average Long** - average message rate of Mode S long frames (DF>=16) over the last minute, excluding squitters (DF17,18)
- **Peak 1s Total** - peak 1 second total Mode S message rate within the last minute excluding squitters (DF17,18)
- **Peak 1s Long** - peak 1 second message rate of Mode S long frames (DF>=16) within the last minute excluding squitters (DF17,18)

The dropdown allows to enable or disable colored aircraft position history.



As indicated in the list, history can only be colored by peak 1 second rates. It shows past position for every aircraft (with ADS-B) in the map. The resolution is one minute.

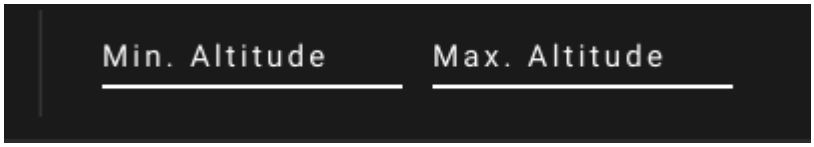
The displayed position corresponds to the last received position within the minute.

4. Include or exclude aircraft without ADS-B

The system infers aircraft positions from ADS-B messages. The FIR filter solely relies on these positions. To get the full picture of all aircraft (which are not necessary in the filtered FIR), it is possible to show aircraft without position in the table as well. This can be controlled with a checkbox right below the map.

5. Add an altitude filter

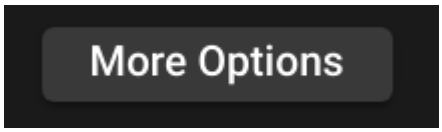
The altitude filter is located in the top menu bar. It allows you to set a minimum and maximum altitude (in feet) for filtering shown aircraft positions and their history.



Click in one of the fields and enter the desired min or max altitude. The filter is applied immediately while you type.

Note

Depending on the width of your screen, you will either see the filter in the menu bar, or there is a button More Options. Clicking the button will reveal additional controls including the altitude filter.



6. Sort table

The table at the bottom of the interface can be sorted by any column. Click the column heading to sort by the underlying value. An arrow down indicates descending order, an arrow up ascending order. In th example below, the table is sorted by the peak DF11 message rate of the last 4 hours in descending order.

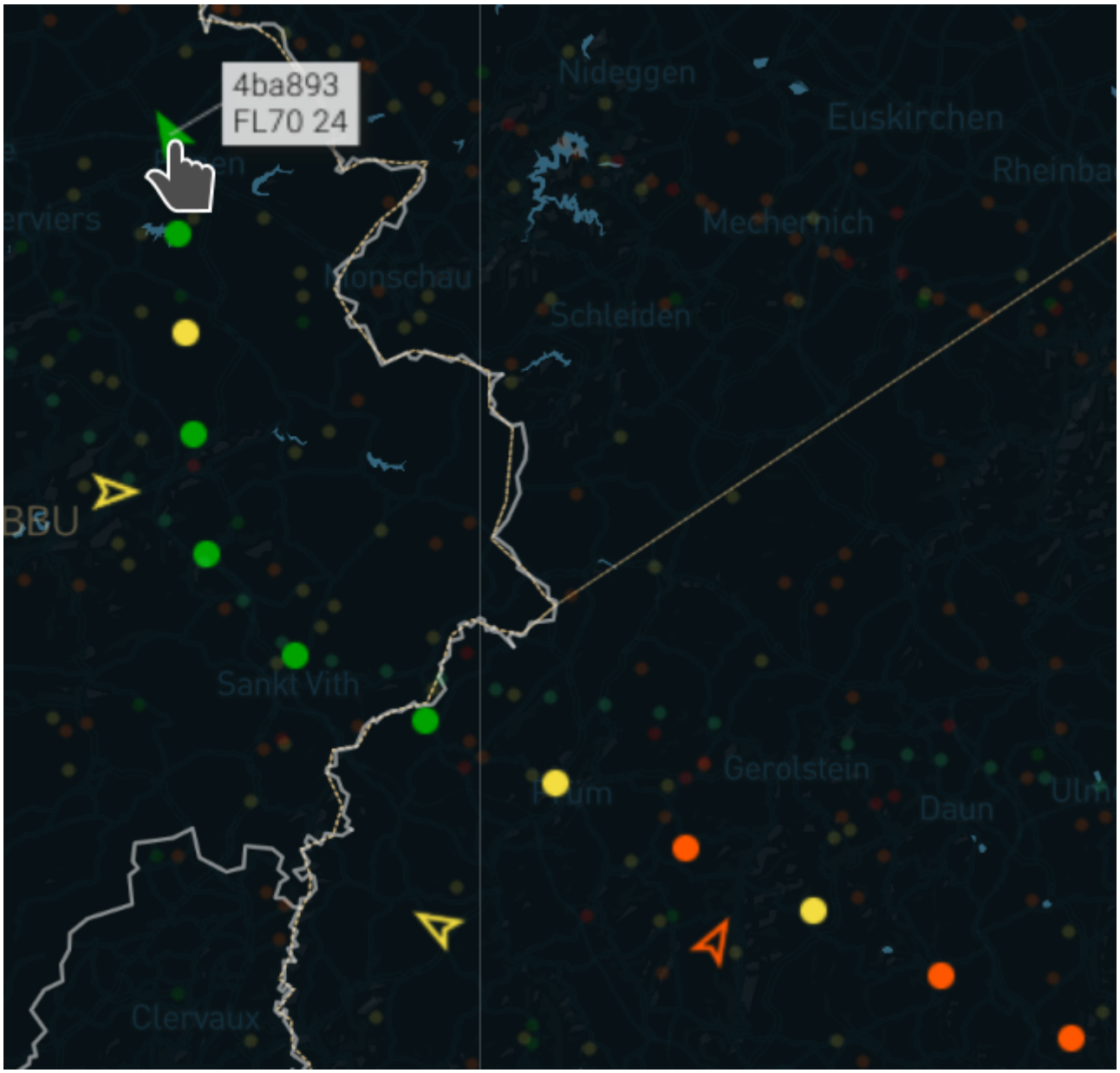
Peak 1s (last 4 hours)											
Total	Long	DF0	DF16	DF17	DF18	DF4	DF20	DF5	DF21	DF24	DF11 ↓
61	22	6	3	9	0	12	19	7	8	0	54
62	13	8	1	8	0	10	11	2	4	0	45
48	12	6	2	8	0	10	9	2	5	0	43
49	17	8	2	8	0	10	13	3	6	0	42
48	14	4	3	9	0	11	11	3	4	0	41
55	11	8	2	9	0	8	11	2	3	0	41
54	27	10	3	8	0	11	21	5	10	0	41
53	19	7	4	7	0	12	16	3	6	0	40
58	23	9	2	9	0	15	18	6	8	0	40
66	27	8	3	9	0	17	18	5	14	0	39

7. Select an aircraft

An aircraft can be selected for further inspection, either by clicking on the triangle in the map, one of its historical positions, or, clicking a row in the table.

ICAO24b	Callsign	ADS-B	Altitude	Average											
				Total	Long	DF0	DF16	DF17	DF18	DF4	DF20	DF5	DF21	DF24	DF11
484b91	KLM1651	yes	38000	29	8	2	0	3		4	5	1	1		14
4ba893	THY6497	yes	7000	12	6	2	0	5		2	4	0	2		0
484b92	KLM91J	yes	33325	25	8	2	0	3		3	6	1	2		9

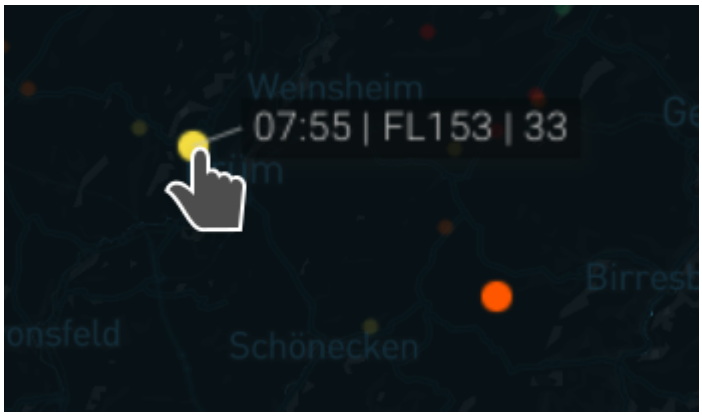
When an aircraft got selected, the respective row in the table will have yellow background color and the triangle in the map is filled out. If the history is enabled, all other trajectories are blurred out and the trjectory of the selected aircraft is highlighted.



8. Inspect the trajectory

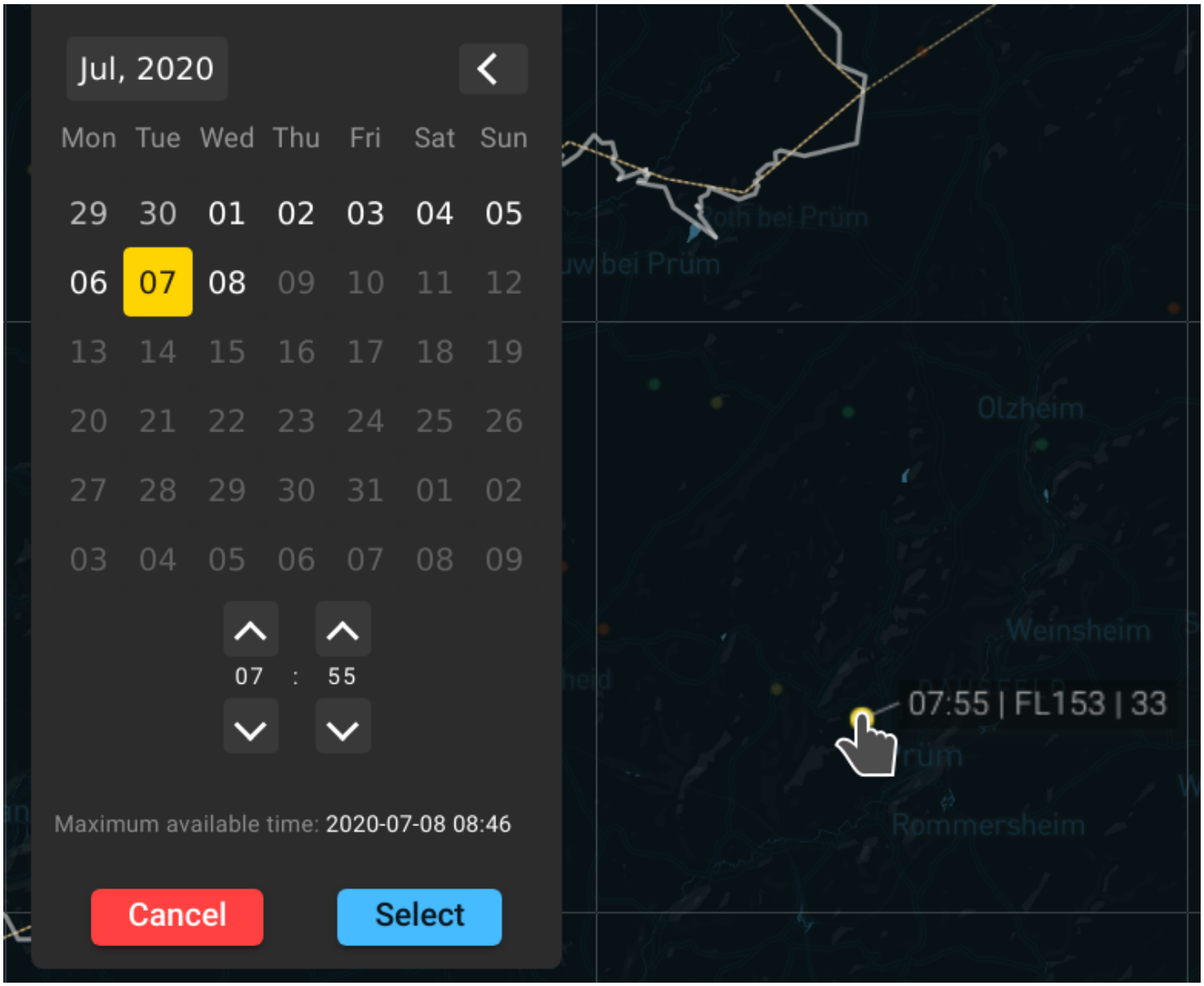
The map has pan and zoom functionality. Use the mouse wheel to increase and decrease the zoom level, hold the left mouse button and move the mouse to drag the map to a different location.

Hovering a point in the map will reveal the time of applicability and the message rate according to the chosen scheme of the Aircraft Color selector, i.e., either the average total, average long, peak 1s total or peak 1s long message rate in messages per second.



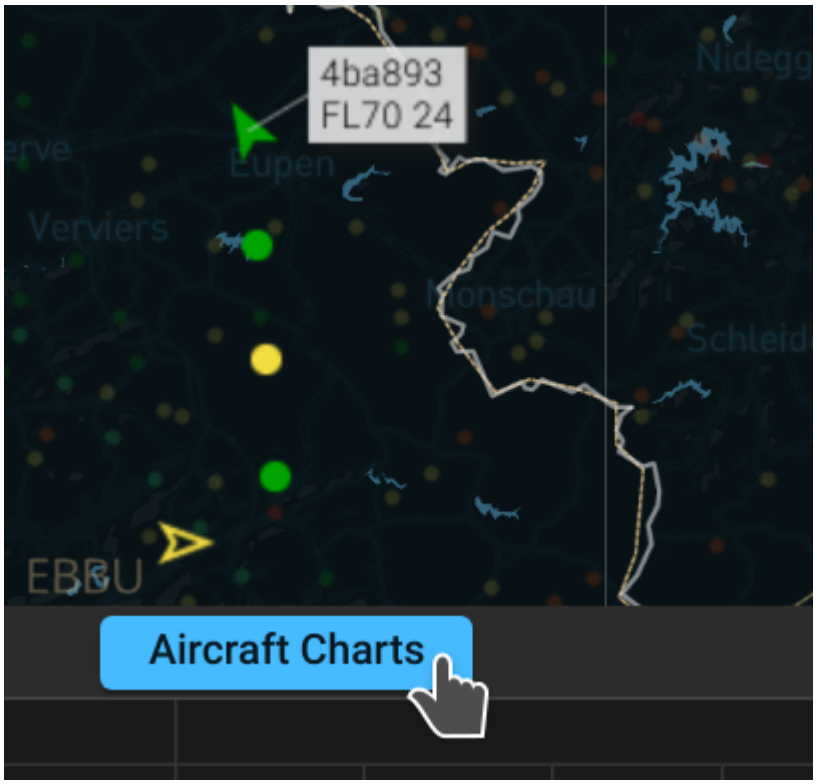
9. Go to the time of interest

Double-clicking a point of the trajectory opens the datepicker with the given time. Just click Select to load data for the time of interest.



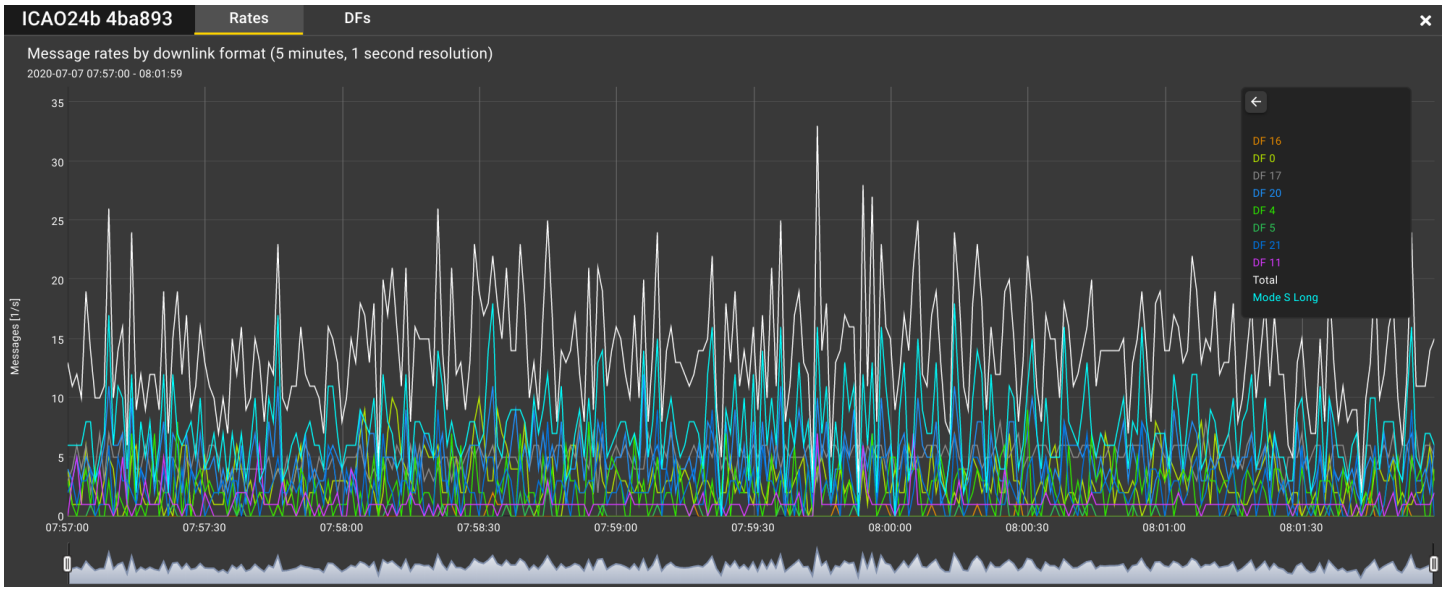
10. Inspect aircraft charts

To open charts for the selected aircraft, either double-click on its triangle symbol in the map, or click the Aircraft Charts button in the bottom part of the interface right above the table

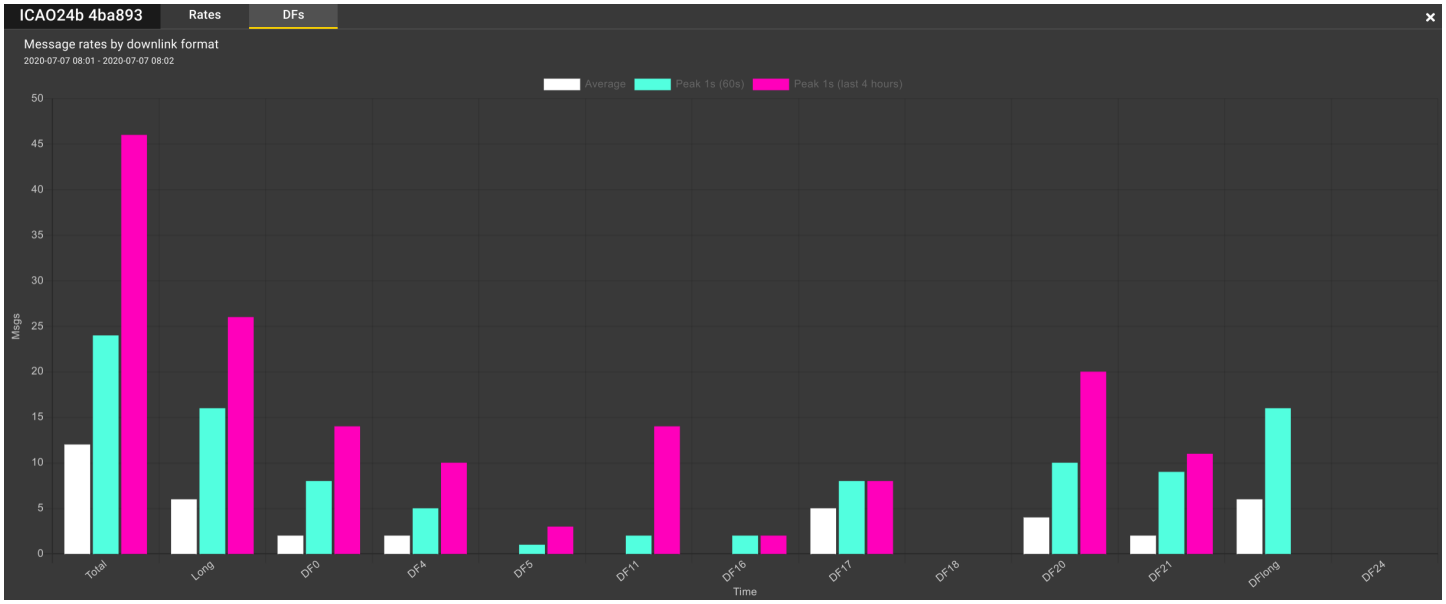


A new dialog opens which allows to investigate two types of charts for the aircraft

- A time series chart (line plot) displaying message rates of different DFs with a resolution of one second for the past five minutes



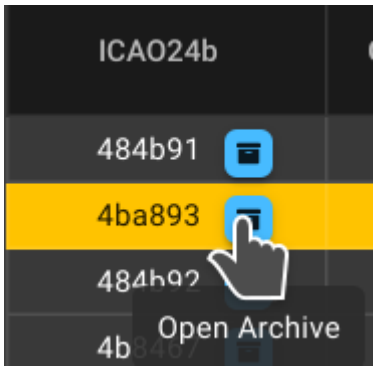
- A bar chart depicting the distribution of different DFs' average and peak over the last minute and the peak over the last 4 hours.



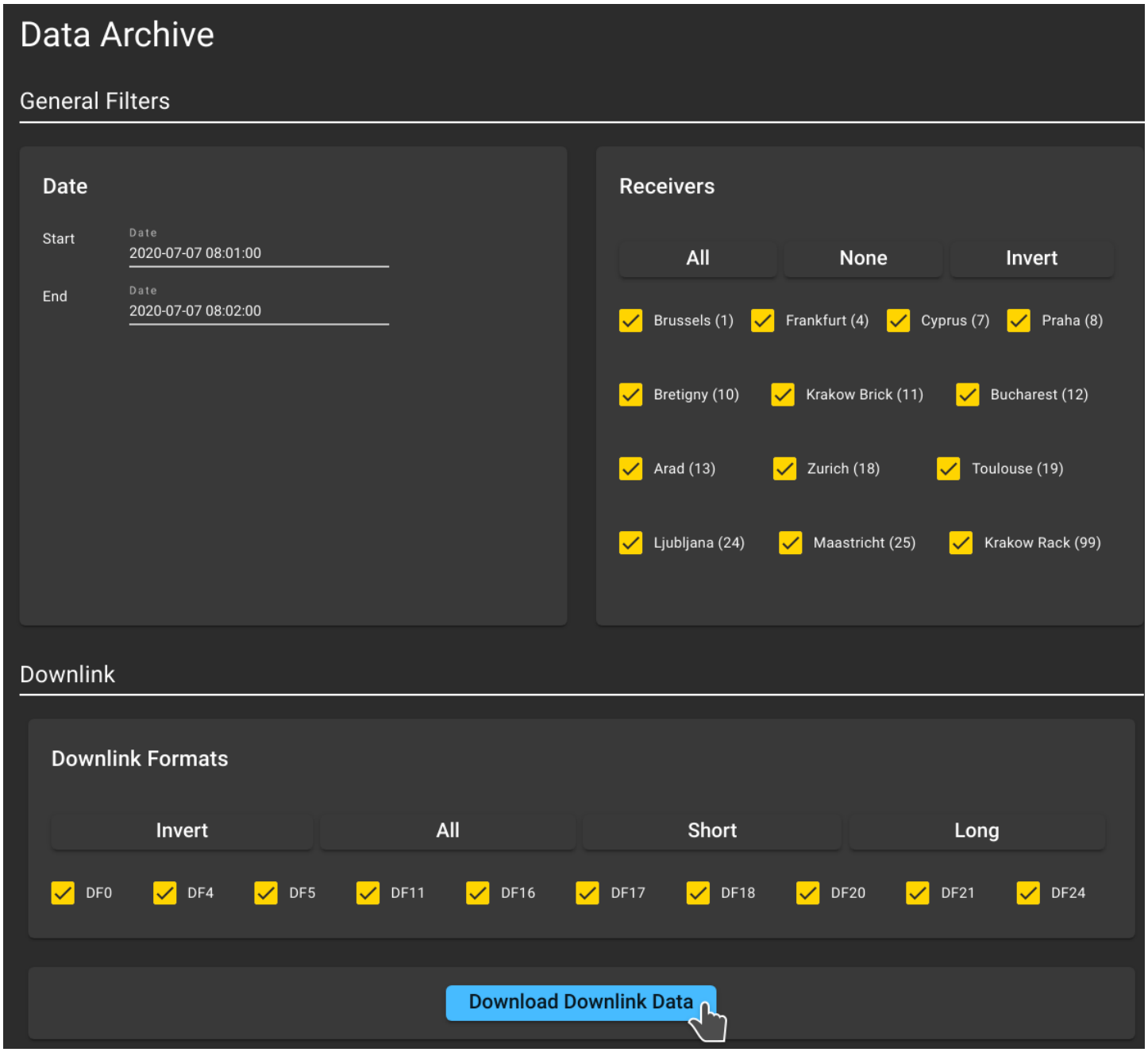
To switch from one chart to the other, click on the tabs named Rates and DFs in the upper part of the dialog.

11. Download raw data from the archive

Raw Mode S messages can be downloaded by clicking the small blue button next to the aircraft's transponder address in the table.



The archive module is opened with filters set for the chosen aircraft and the last minute. Click the Download Downlink Data button to start the CSV export.


Data Archive
General Filters
Date
Start
Date
2020-07-07 08:01:00
End
Date
2020-07-07 08:02:00
Receivers
All
None
Invert
Brussels (1)
Frankfurt (4)
Cyprus (7)
Praha (8)
Bretigny (10)
Krakow Brick (11)
Bucharest (12)
Arad (13)
Zurich (18)
Toulouse (19)
Ljubljana (24)
Maastricht (25)
Krakow Rack (99)
Downlink
Downlink Formats
Invert
All
Short
Long
DF0
DF4
DF5
DF11
DF16
DF17
DF18
DF20
DF21
DF24
Download Downlink Data

The web browser will ask for a location to store the file. It is a compressed CSV file with the following columns:

- **Time UTC** - ISO8601 UTC timestamp
- **Timestamp** - Unix time in seconds since epoch (before decimal dot) and nanoseconds after the decimal dot. The timestamp corresponds to the first receiver in the Receivers list.
- **Message** - the raw message in hexadecimal representation
- **ICAO24b** - 24 bit transponder address
- **DF** - downlink format
- **IC** - interrogator code (only applicable for DF11 messages, empty otherwise)
- **Latitude** - latitude according to WGS84 reference system of the last position of the aircraft reported via ADS-B
- **Longitude** - longitude according to WGS84 reference system of the last position of the aircraft reported via ADS-B
- **Altidue** - last reported altitude (barometric) according to ADS-B or Mode S reports in feet
- **Squawk** - last reported squawk code in octal representation
- **Signal strength** - measured in dBm by the first receiver in the Receivers list
- **Frequency offset** - offset from the 1090MHz frequency measured in kHz by the first receiver in the Receivers list
- **Number of corrected bits** - number of bits flipped by the message error correction of the first receiver in the Receivers list
- **Number of low confidence bits** - reported by the first receiver in the Receivers list
- **Receivers** - a list of receiver IDs that received the underlying message

Example CSV output:

```
time_utc,timestamp,message,icao24b,df,ic,latitude,longitude,altitude_ft,squawk,signal_strength,frequency_offset,num_corrected_bi
```

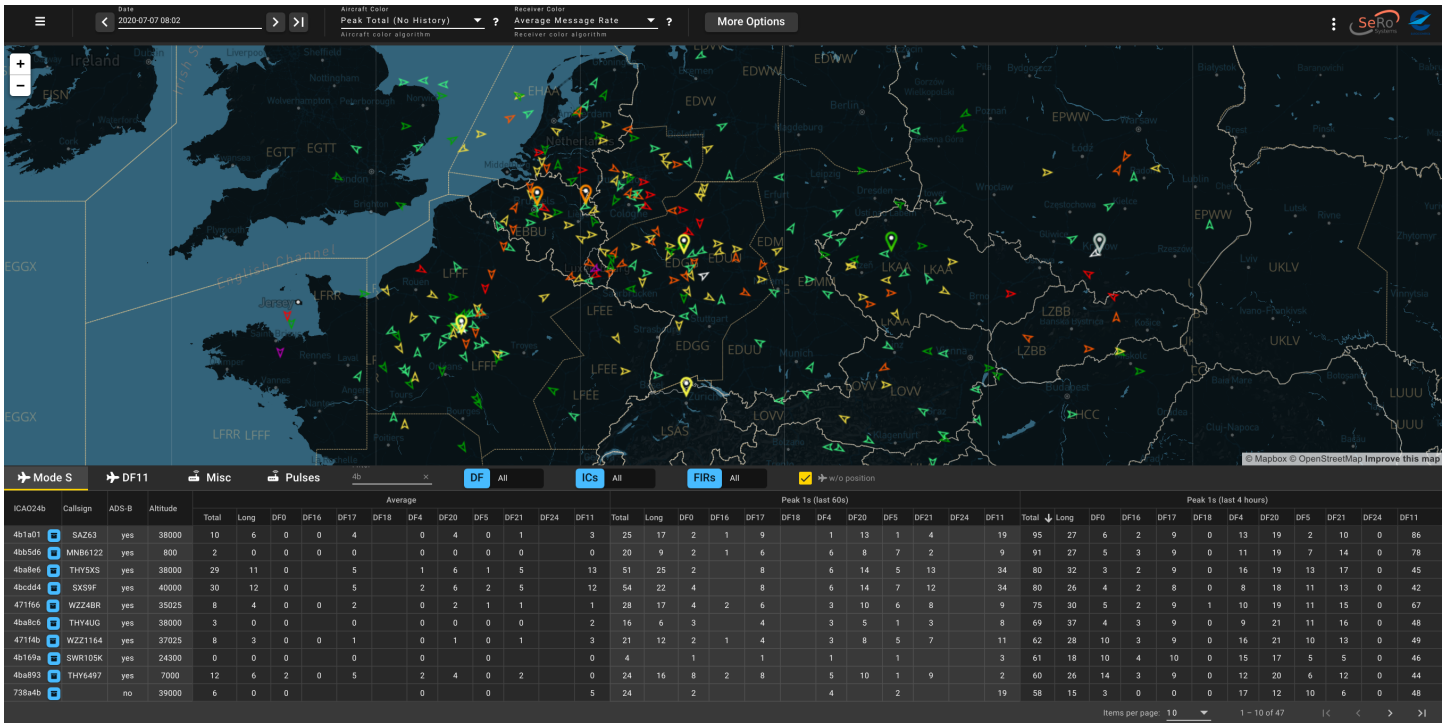
Note

You will be able to download data for aircraft and interrogators seen by your own receivers or by public receivers.

Examine problematic aircraft

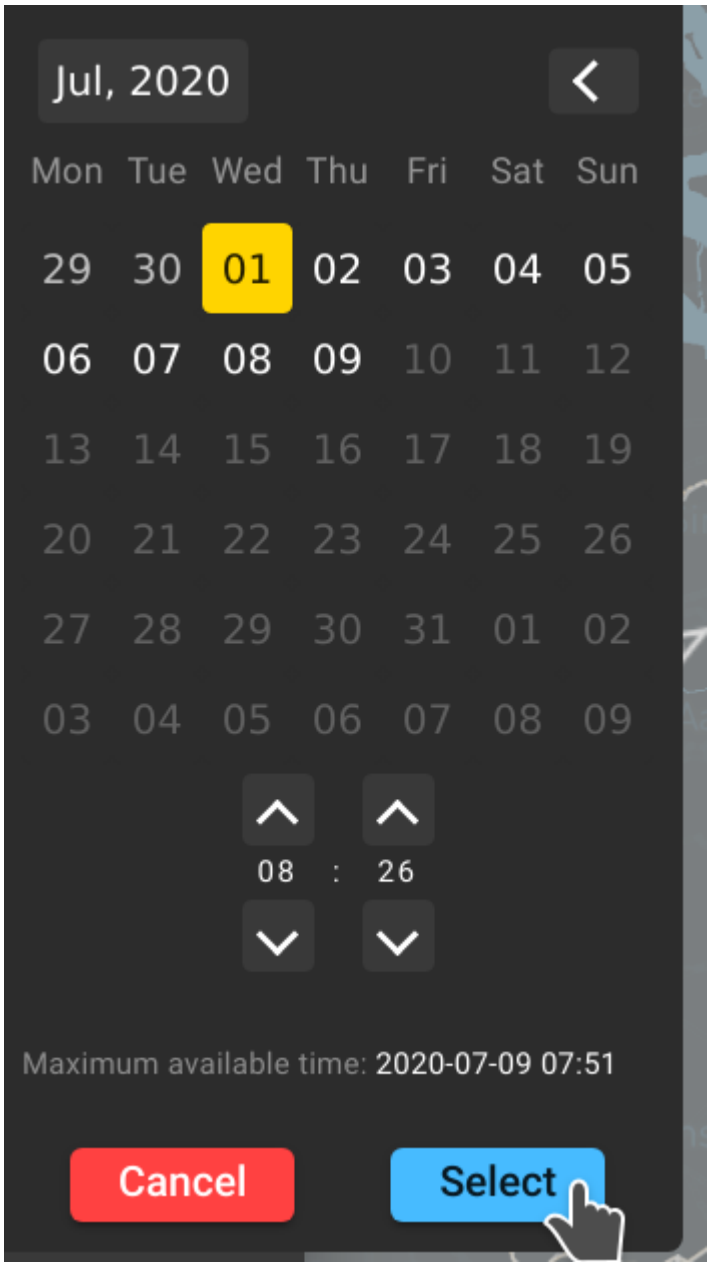
1. Open the tool

You will be presented with the downlink monitoring module. By default, aircraft colors are based on the peak-1s total Mode S message rate.



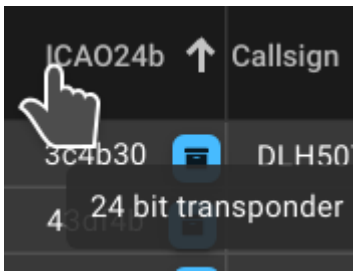
2. Select time of interest

Click on the date in the top menu bar to open the datepicker. Adjust to the time of interest and click Select to start data retrieval.

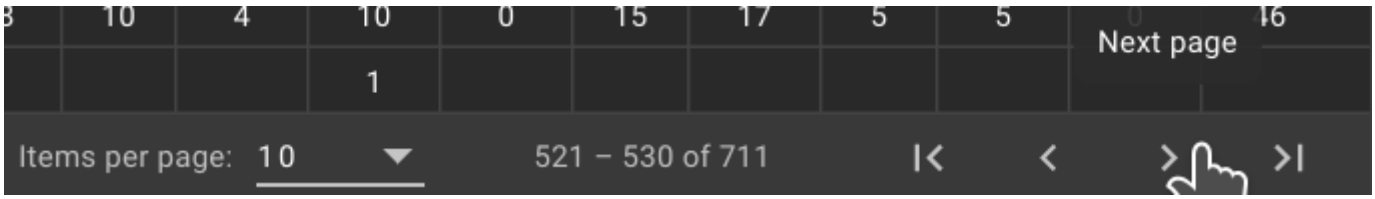


3. Find specific aircraft

To find a specific aircraft, you can sort the table by transponder address. Click on the ICAO24b column header to sort. An arrow will indicate ascending or descending order.



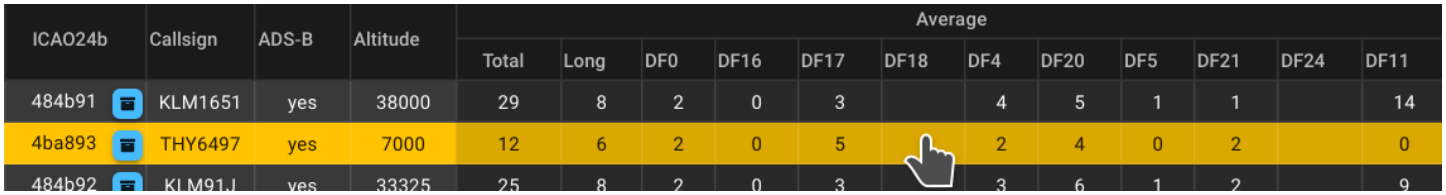
Go through the table until you have found the problematic aircraft. Use the controls at the bottom to navigate.



You can also use the search field over the table:

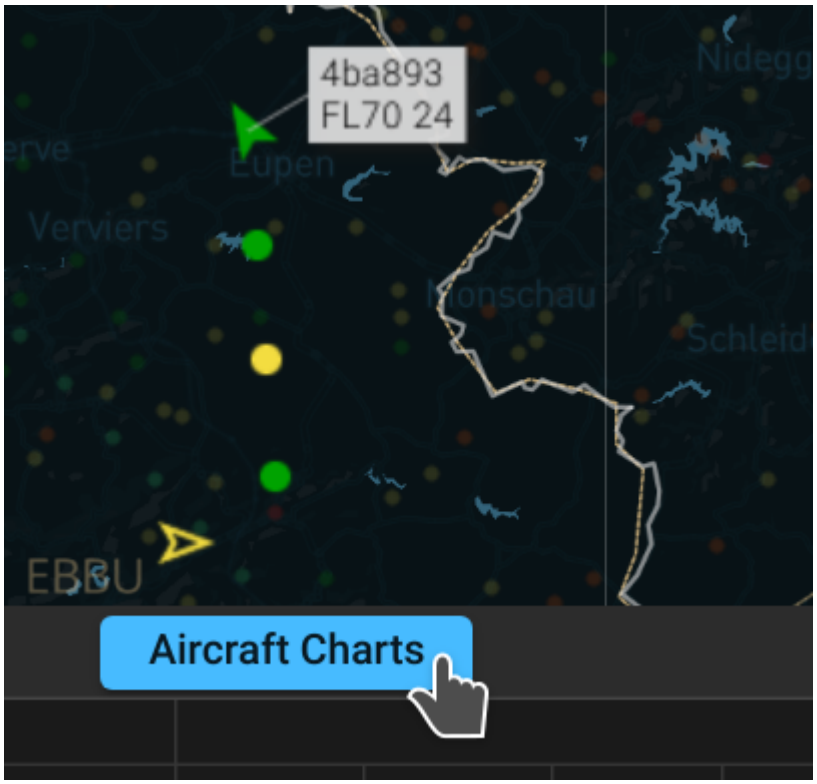
Click into the field and start typing. The filter is applied while you are typing. It filters by any type of value within the table, e.g. callsign, ICAO 24 bit address or message rate.

Click on the row in the table to select the entry.



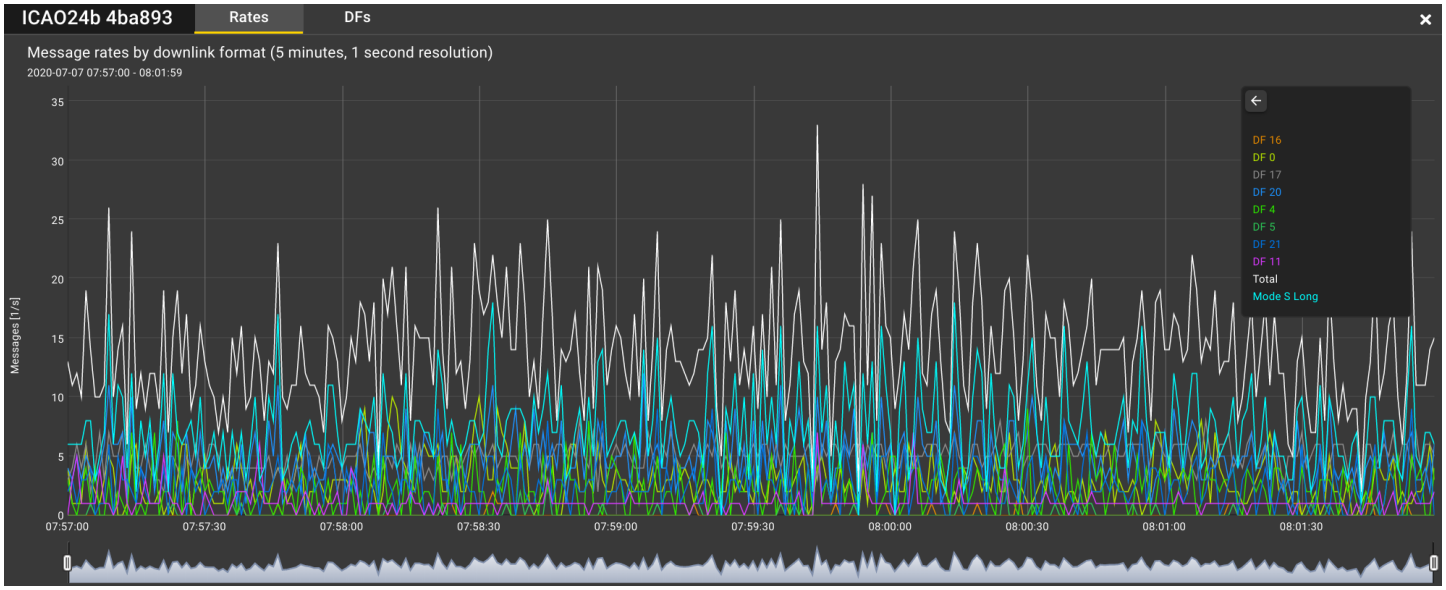
4. Inspect aircraft charts

To open charts for the selected aircraft, either double-click on its triangle symbol in the map, or click the Aircraft Charts button in the bottom part of the interface right above the table

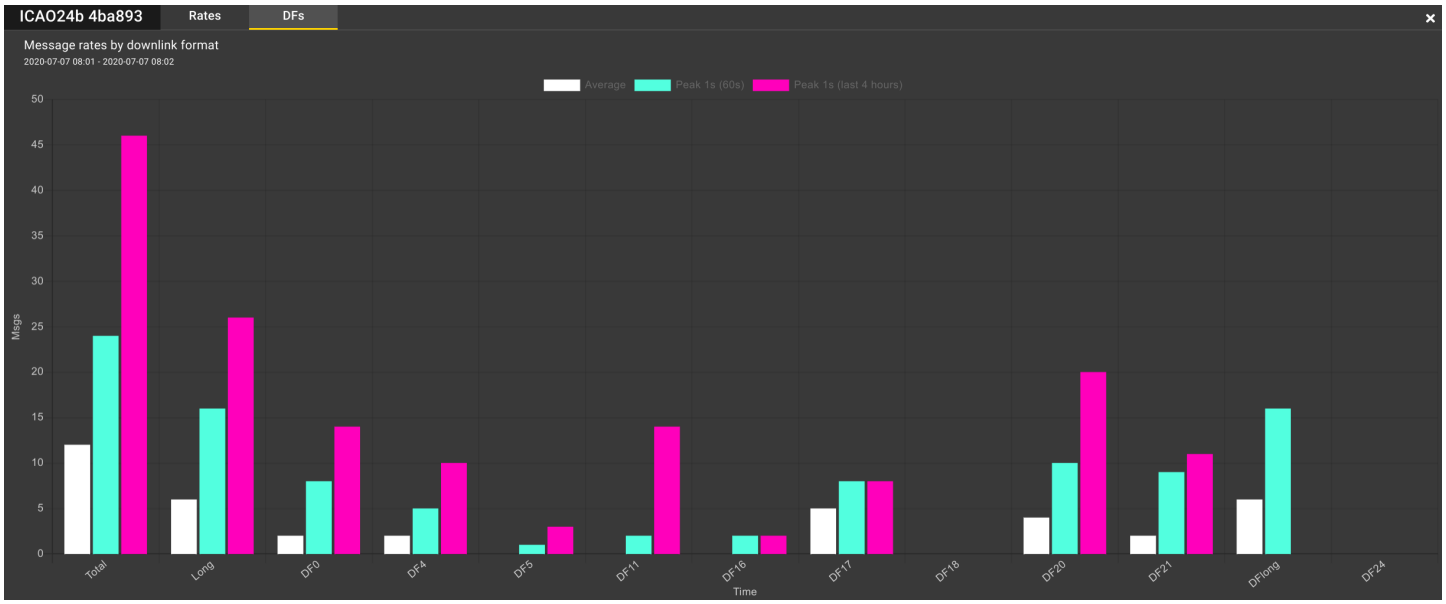


A new dialog opens which allows to investigate two types of charts for the aircraft

- A time series chart (line plot) displaying message rates of different DFs with a resolution of one second for the past five minutes



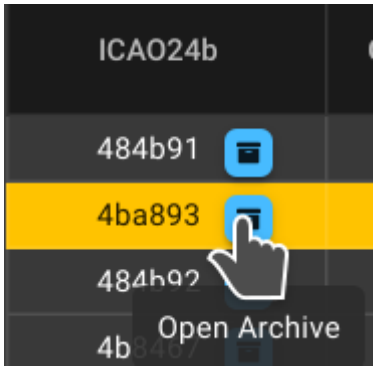
- A bar chart depicting the distribution of different DFs within the last minute



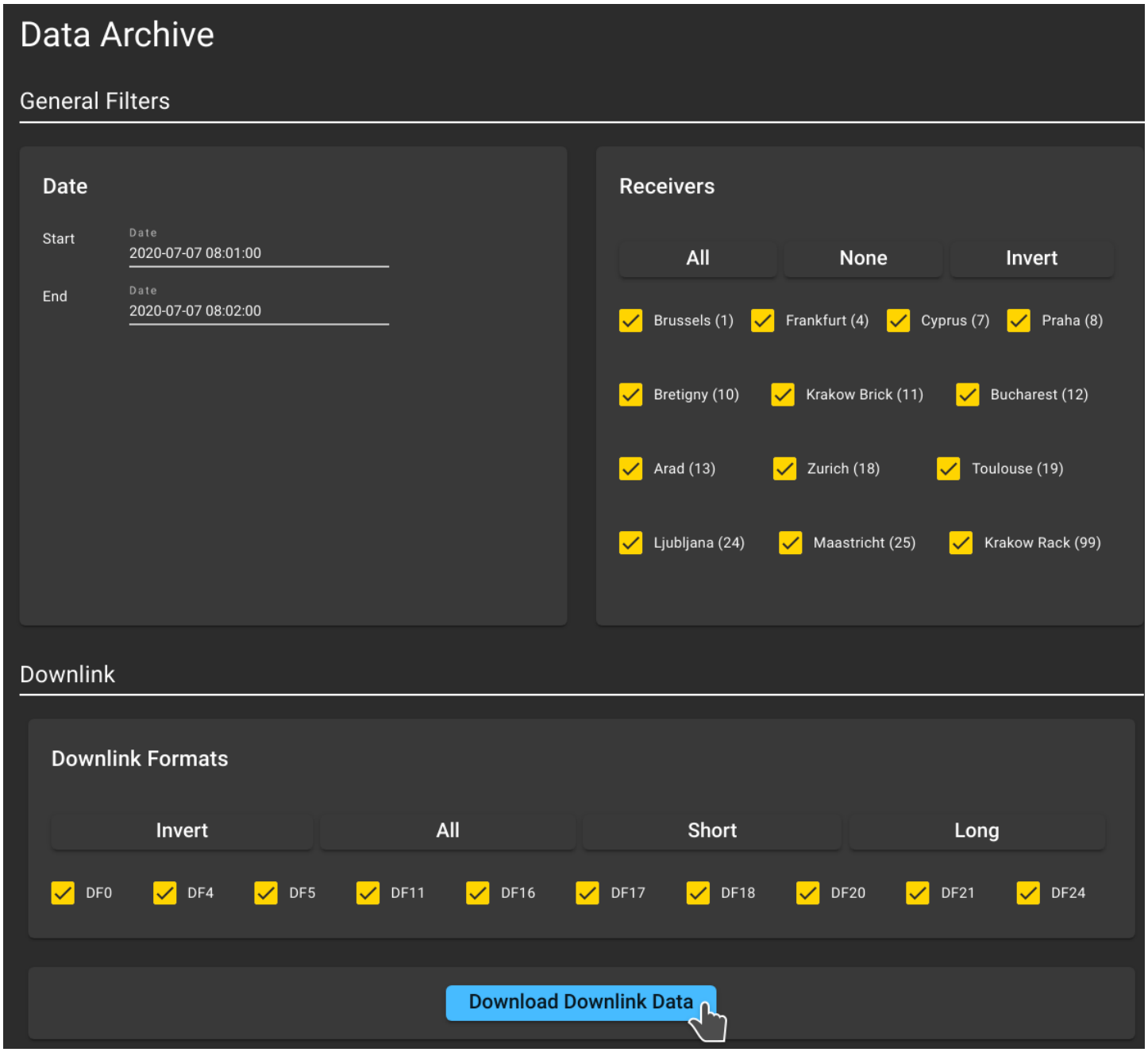
To switch from one chart to the other, click on the tabs named Rates and DFs in the upper part of the dialog.

5. Download raw data from the archive

Raw Mode S messages can be downloaded by clicking the small blue button next to the aircraft's transponder address in the table.



The archive module is opened with filters set for the chosen aircraft and the last minute. Click the Download Downlink Data button to start the CSV export.


Data Archive
General Filters
Date
Start
Date
2020-07-07 08:01:00
End
Date
2020-07-07 08:02:00
Receivers
All
None
Invert
Brussels (1)
Frankfurt (4)
Cyprus (7)
Praha (8)
Bretigny (10)
Krakow Brick (11)
Bucharest (12)
Arad (13)
Zurich (18)
Toulouse (19)
Ljubljana (24)
Maastricht (25)
Krakow Rack (99)
Downlink
Downlink Formats
Invert
All
Short
Long
DF0
DF4
DF5
DF11
DF16
DF17
DF18
DF20
DF21
DF24
Download Downlink Data

The web browser will ask for a location to store the file. It is a compressed CSV file with the following columns:

- **Time UTC** - ISO8601 UTC timestamp
- **Timestamp** - Unix time in seconds since epoch (before decimal dot) and nanoseconds after the decimal dot. The timestamp corresponds to the first receiver in the Receivers list.
- **Message** - the raw message in hexadecimal representation
- **ICAO24b** - 24 bit transponder address
- **DF** - downlink format
- **IC** - interrogator code (only applicable for DF11 messages, empty otherwise)
- **Latitude** - latitude according to WGS84 reference system of the last position of the aircraft reported via ADS-B
- **Longitude** - longitude according to WGS84 reference system of the last position of the aircraft reported via ADS-B
- **Altidue** - last reported altitude (barometric) according to ADS-B or Mode S reports in feet
- **Squawk** - last reported squawk code in octal representation
- **Signal strength** - measured in dBm by the first receiver in the Receivers list
- **Frequency offset** - offset from the 1090MHz frequency measured in kHz by the first receiver in the Receivers list
- **Number of corrected bits** - number of bits flipped by the message error correction of the first receiver in the Receivers list
- **Number of low confidence bits** - reported by the first receiver in the Receivers list
- **Receivers** - a list of receiver IDs that received the underlying message

Example CSV output:

```
time_utc,timestamp,message,icao24b,df,ic,latitude,longitude,altitude_ft,squawk,signal_strength,frequency_offset,num_corrected_bi
```

Note

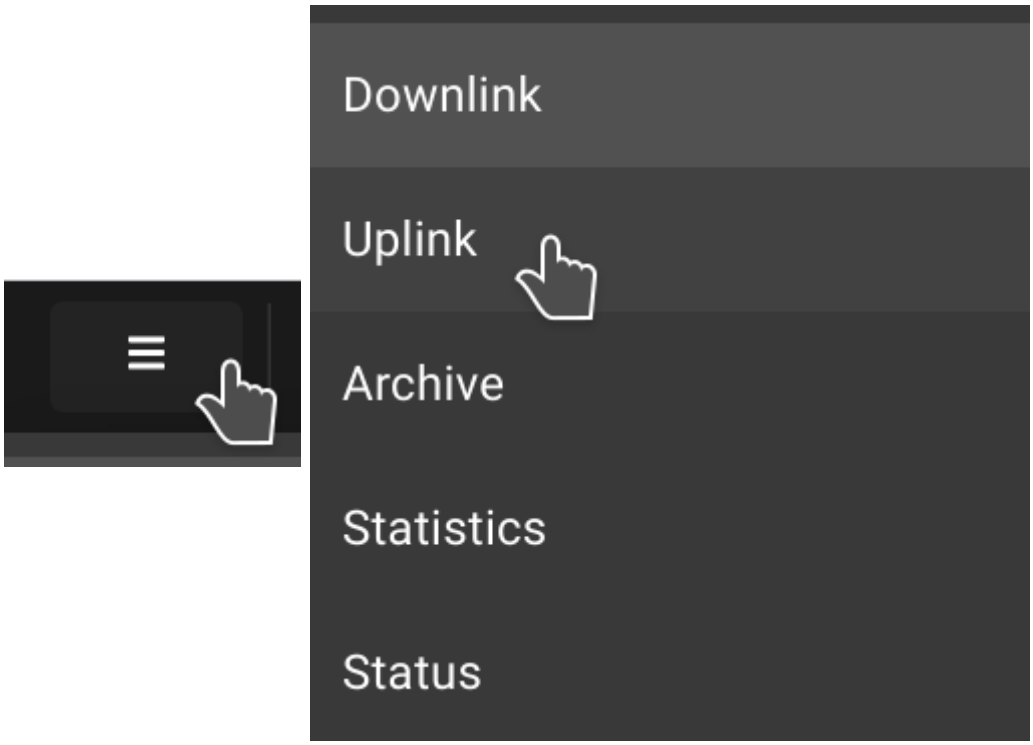
You will be able to download data for aircraft and interrogators seen by your own receivers or by public receivers.

Examine interrogator transmissions

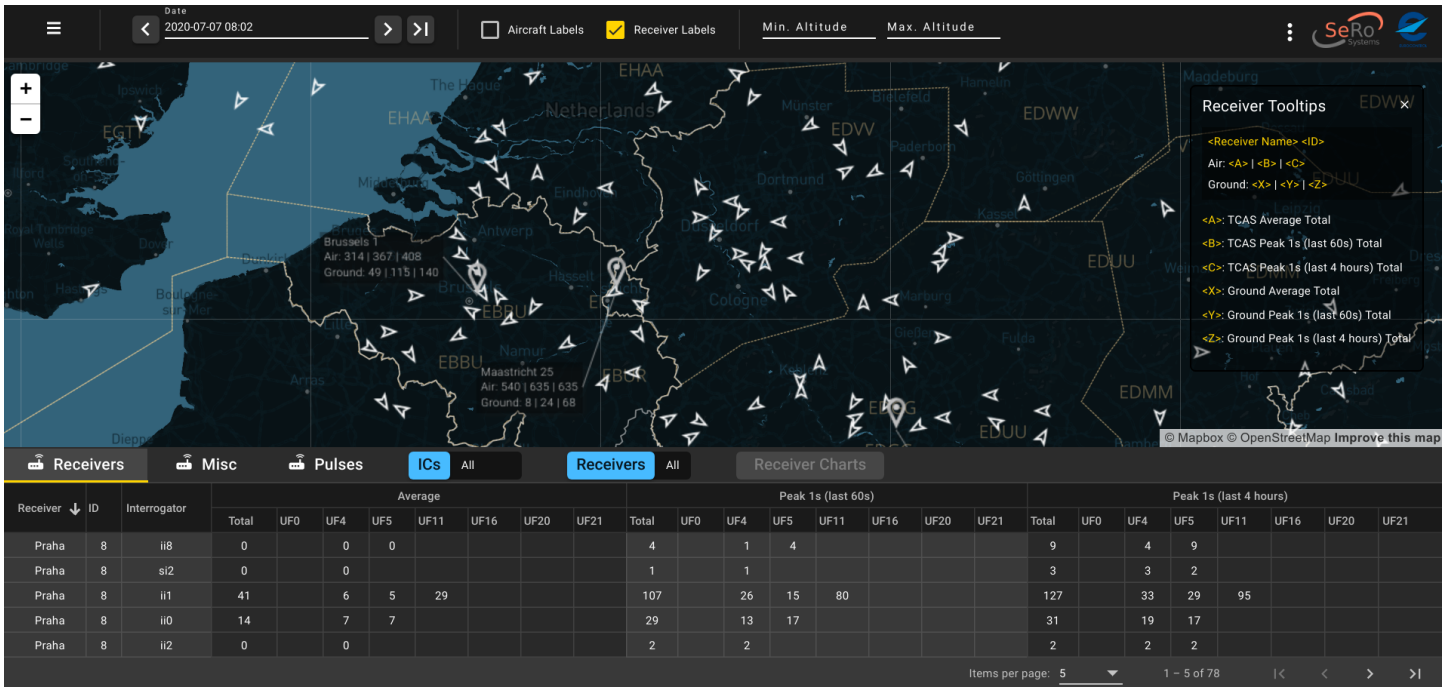
1. Open the tool

You can reach the uplink module via the menu.

Click the menu button in the upper left corner and select Uplink.



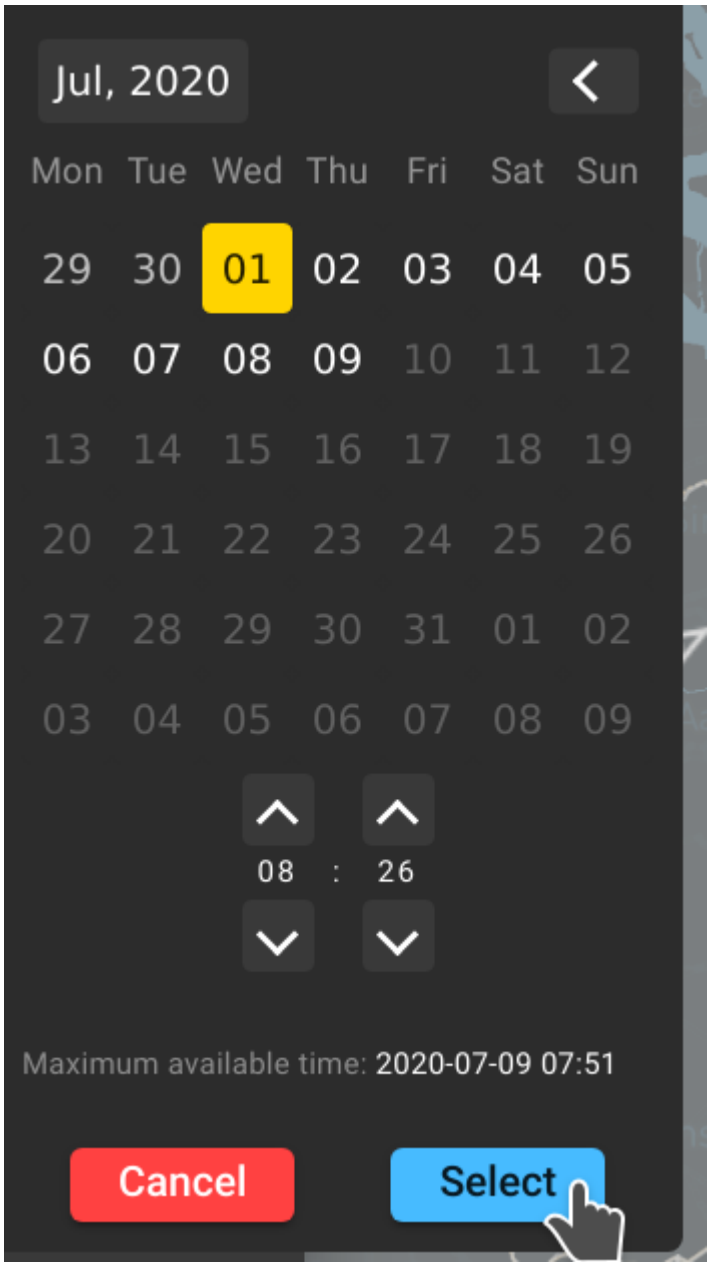
The uplink module will show up.



Receiver	ID	Interrogator	Average								Peak 1s (last 60s)								Peak 1s (last 4 hours)							
			Total	UF0	UF4	UF5	UF11	UF16	UF20	UF21	Total	UF0	UF4	UF5	UF11	UF16	UF20	UF21	Total	UF0	UF4	UF5	UF11	UF16	UF20	UF21
Praha	8	ii8	0		0	0					4		1	4					9		4	9				
Praha	8	si2	0		0						1		1						3		3	2				
Praha	8	ii1	41		6	5	29				107		26	15	80				127		33	29	95			
Praha	8	ii0	14		7	7					29		13	17					31		19	17				
Praha	8	ii2	0		0						2		2						2		2	2				

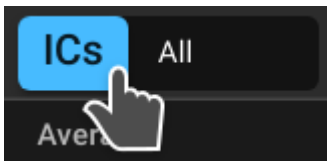
2. Select a time

To go to the time of interest, click on the date in the top menu bar. A time picker shows up where you can select date and time and click Select to retrieve data.

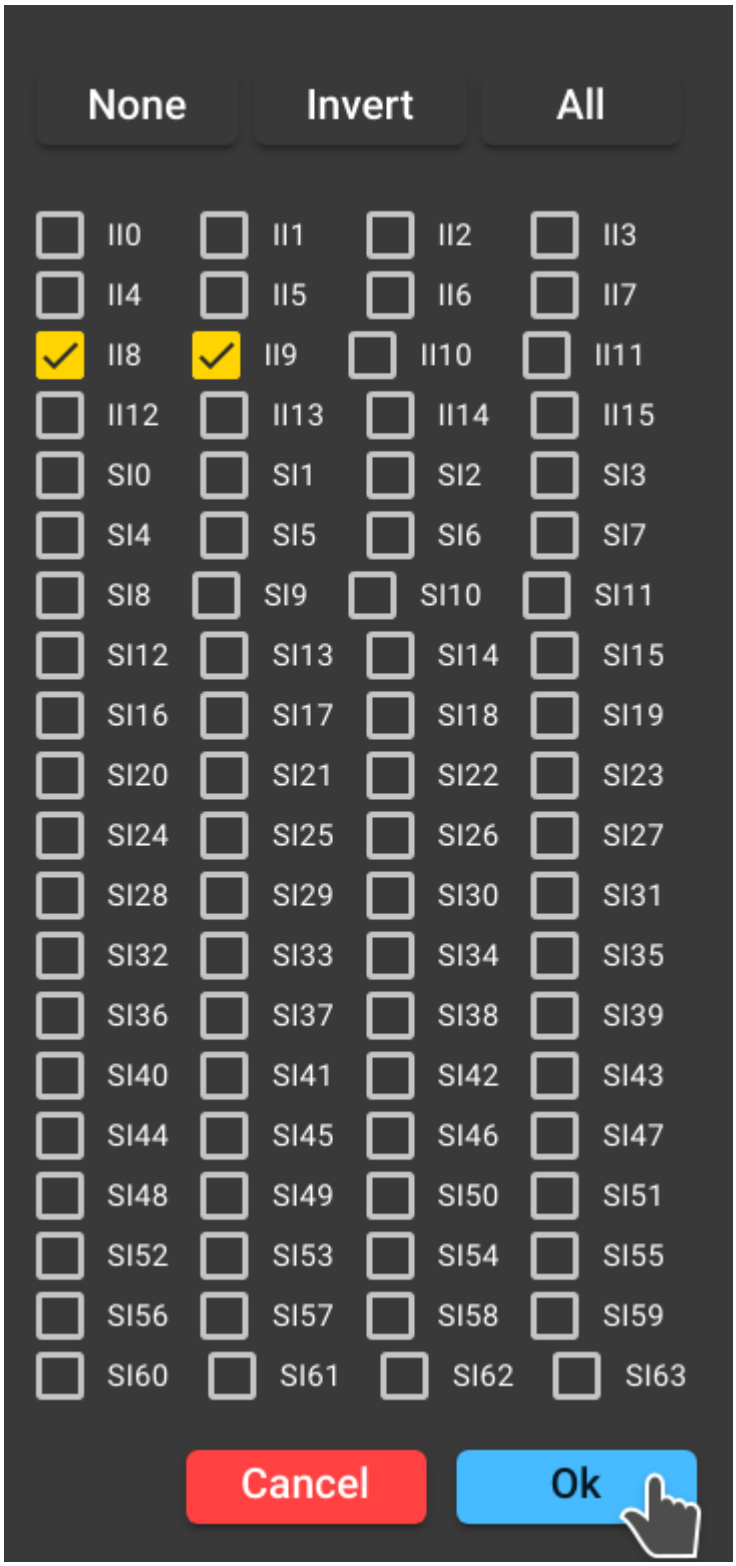


3. Filter for interrogator code

You can filter for an interrogator code of interest by clicking on the IC button below the map.



A dialog shows up where you can select one or multiple interrogator codes to filter for.

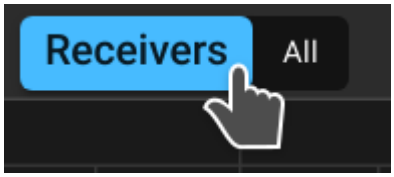


Note the buttons in the upper part of the dialog which allow to quickly (de-)select all interrogators.

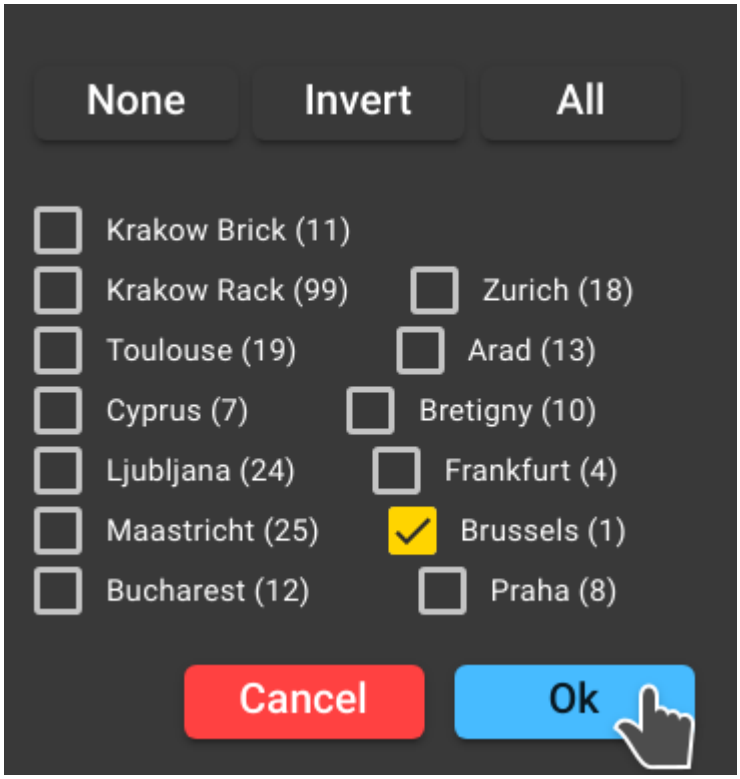
Click the Ok button to retrieve data.

4. Filter by receiver

To examine a particular interrogator, select a receiver near to the interrogator's location. For this purpose, click on the Receivers button below the map.



A dialog shows up where you can select one or multiple receivers.

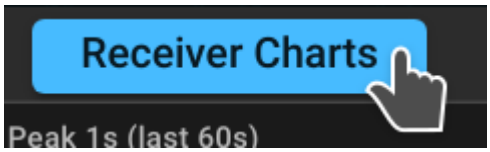


Note that there can be multiple receivers with the same name. Internally, they have a different ID. This situation can be caused by a receiver replacement. The dialog automatically selects all receivers with the same name if you choose one.

5. Receiver charts

You can inspect message rates over time for particular receivers. For this purpose, either click on a receiver marker in the map or click the receiver's name to investigate in the table on the bottom.

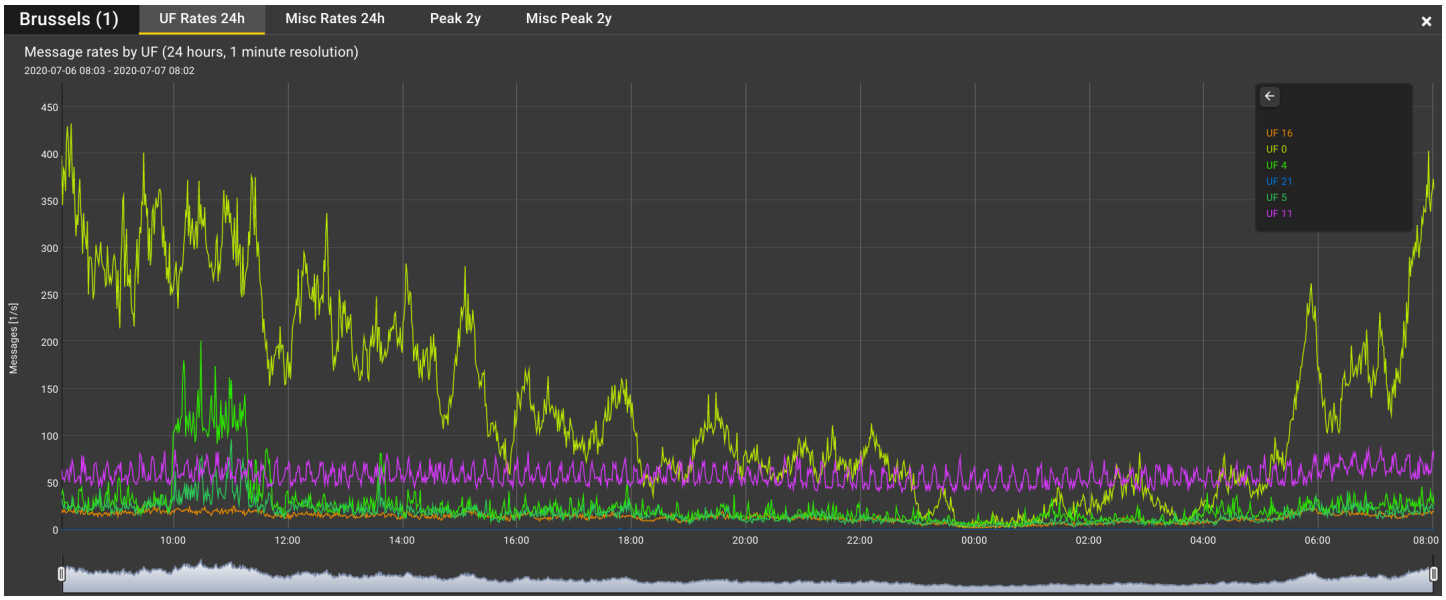
Open the receiver charts dialog by clicking the Receiver Charts button below the map.



There are four different charts.

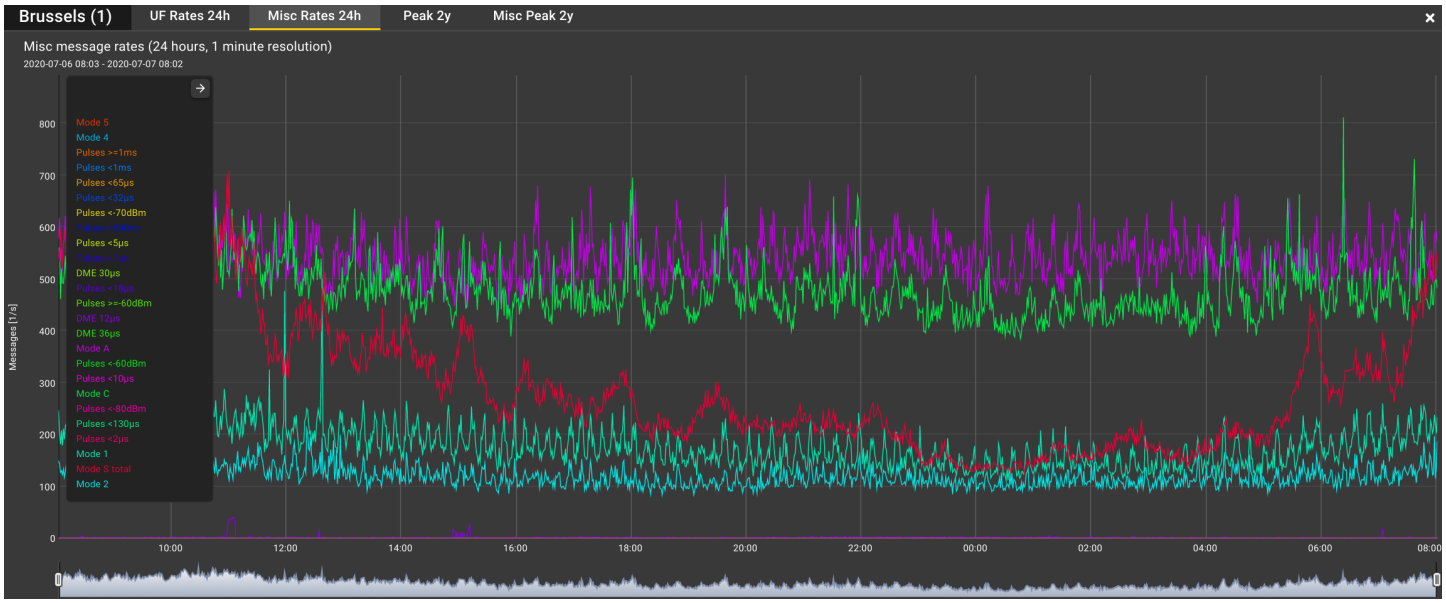
Uplink formats

The chart shows the peak 1s message rates for the last 24 hours with a resolution of 1 minute. There is a line for each uplink format.



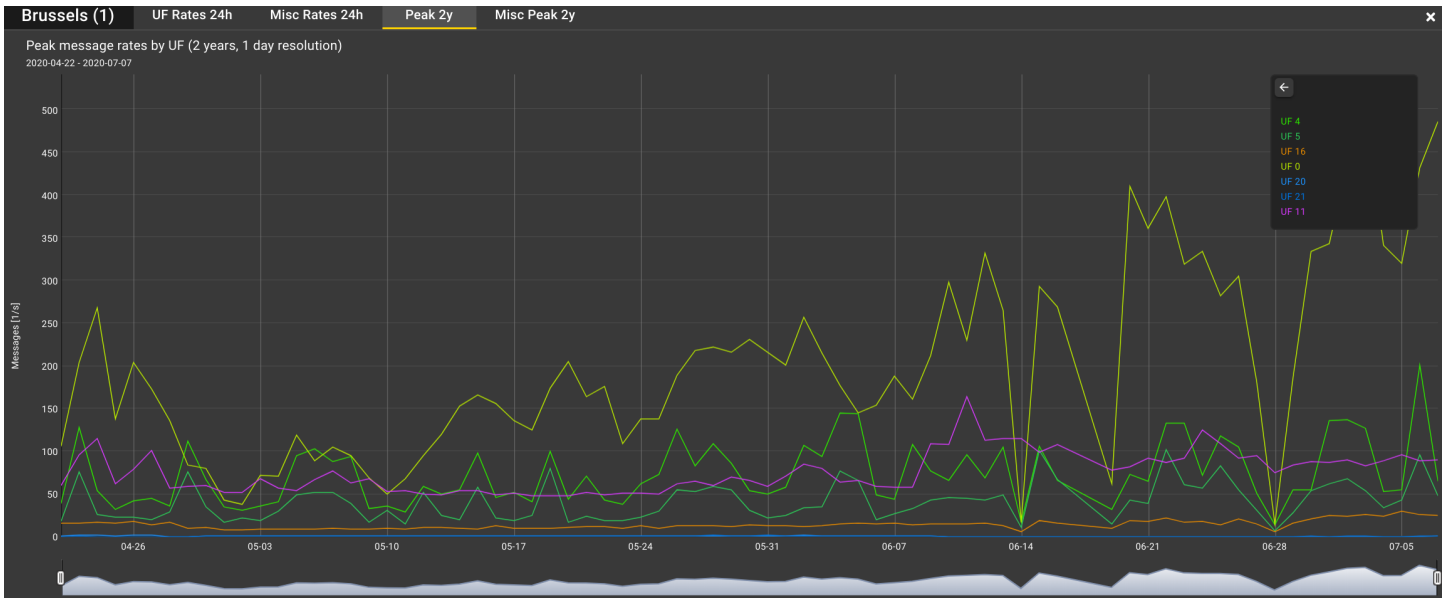
Misc rates

Miscellaneous message rates for DME, isolated pulses and other Modes than Mode S are presented in this chart. It shows peak 1s rates of the last 24 hours with a resolution of 1 minute.



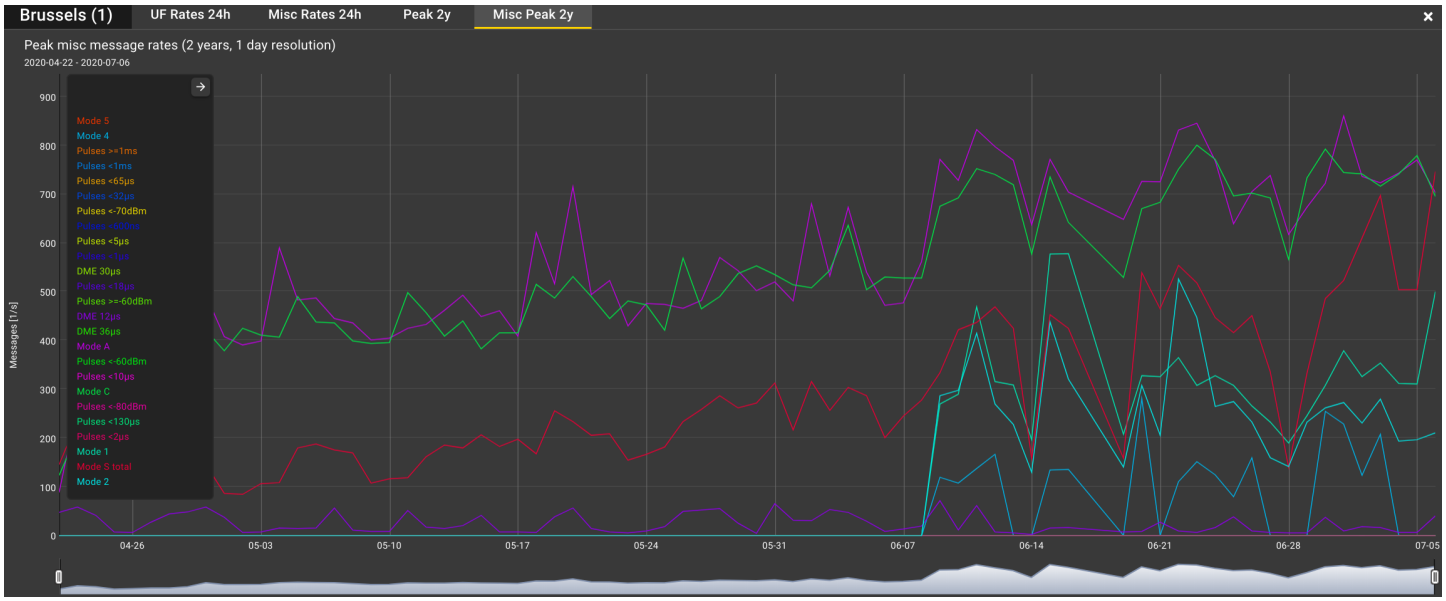
Uplink formats peak day

The Peak 2y charts shows the peak 1s message rate by day for each uplink format over the last 2 years.



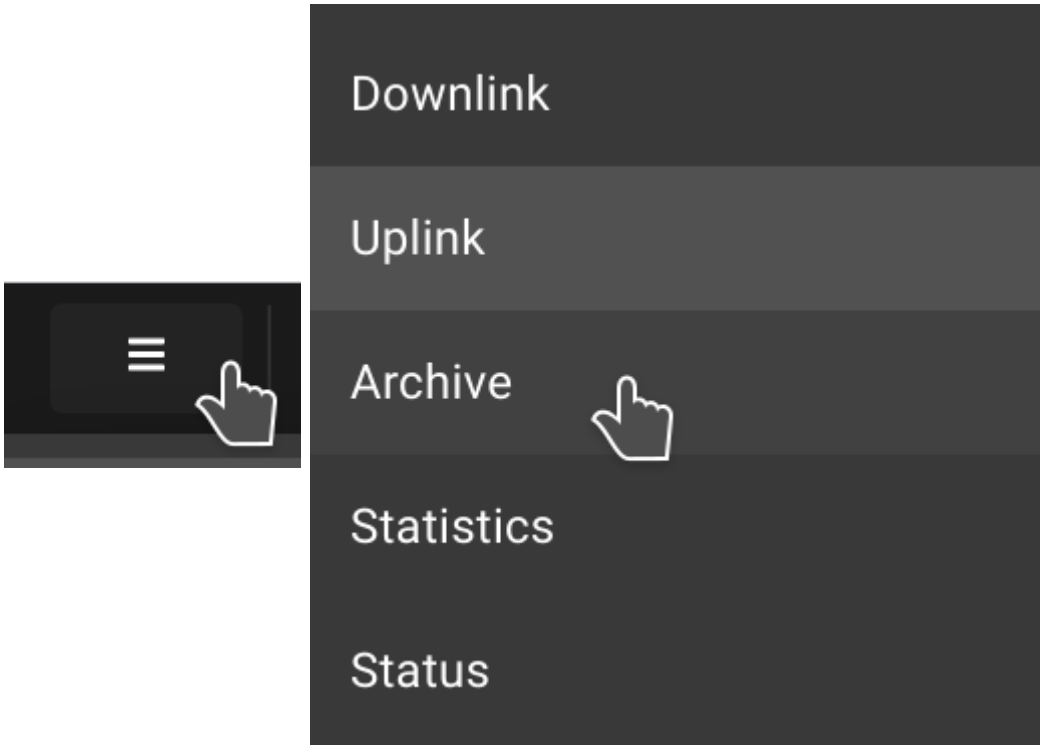
Misc rates peak day

The Misc Peak 2y chart depicts peak 1s message rates for DME, isolated pulses and other Modes than Mode S. The resolution is 1 day and it presents data for the last two years.



6. Download raw data

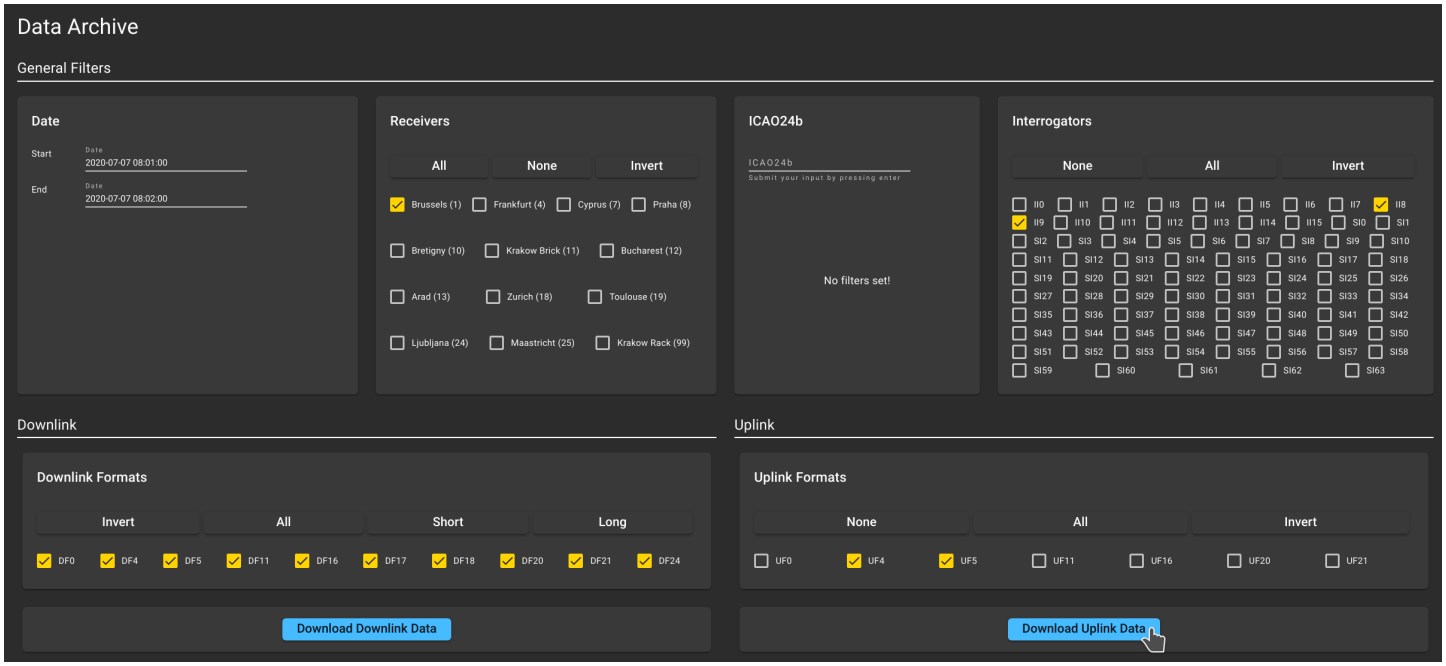
In order to retrieve raw messages from the Mode S uplink, change to the Archive module by opening the menu on the top left.



Adjust the start and end time for which to retrieve raw data, receivers and interrogators of interest and uplink formats.

Note

The system processes large amounts of data. If you select time ranges of several hours you will easily end up with files of multiple Gigabytes. Thus, data export is limited to 1 million messages. Please don't select time ranges of more than a few minutes without tight filters.



Finally, click Download Uplink Data to start CSV export.

The web browser ask for a location to store the file. It is a compressed CSV file with the following columns:

- **Time UTC** - ISO8601 UTC timestamp
- **Timestamp** - Unix time in seconds since epoch (before decimal dot) and nanoseconds after the decimal dot. The timestamp corresponds to the first receiver in the Receivers list.
- **Message** - the raw message in hexadecimal representation
- **ICAO24b** - 24 bit transponder address
- **UF** - uplink format
- **IC** - interrogator code
- **Receivers** - a list of receiver IDs that received the underlying message
- **LOS/LSS** - state of the LOS/LSS bits (where applicable)
- **Lockout-Override** - state of the lock-out override bit (only for UF11)
- **Probability of reply** - only for UF11, values per ICAO Annex 10, Vol IV, 3.1.2.5.2.1.1
- **BDS** - the BDS number
- **Signal strength** - measured in dBm by the first receiver in the Receivers list
- **Frequency offset** - offset from the 1090MHz frequency measured in kHz by the first receiver in the Receivers list
- **P5 Strength** - strength of P5 (side-lobe suppression) pulse in dB above signal level by the first receiver in the Receivers list

Example CSV output:

```
time_utc,timestamp,message,icao24b,uf,ic,receivers,los_lss,lo_override,reply_prob,bds,signal_strength,frequency_offset,p5_streng
```

Note

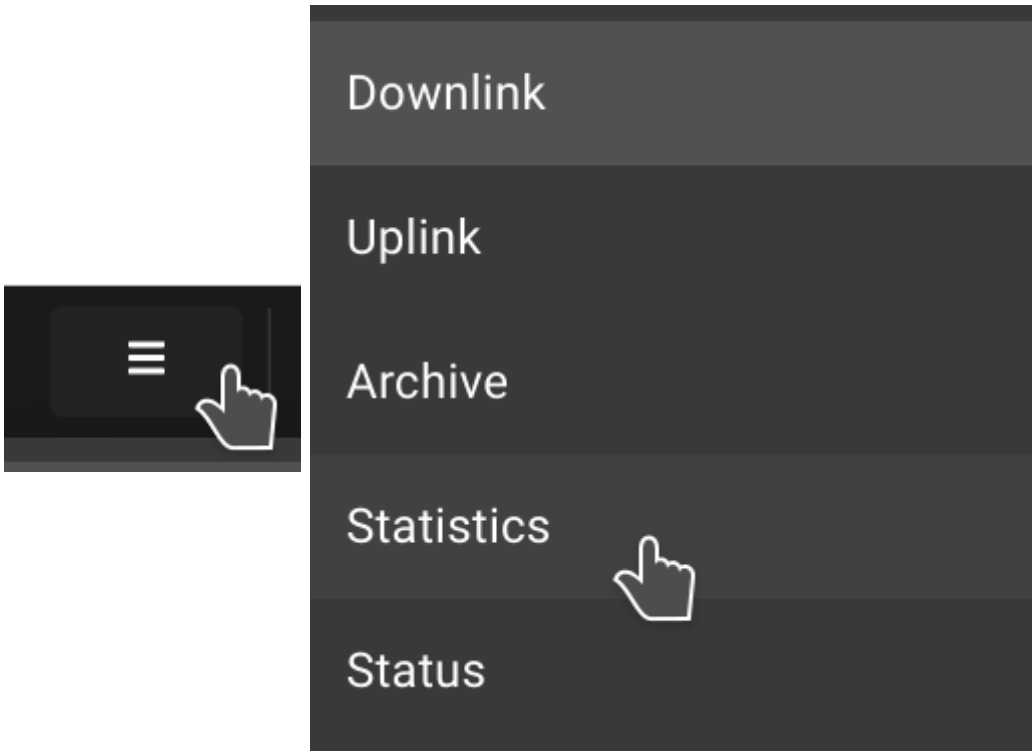
You will be able to download data for aircraft and interrogators seen by your own receivers or by public receivers.

Examine RF load and transmissions

1. Open the tool

You can reach the statistics page via the menu.

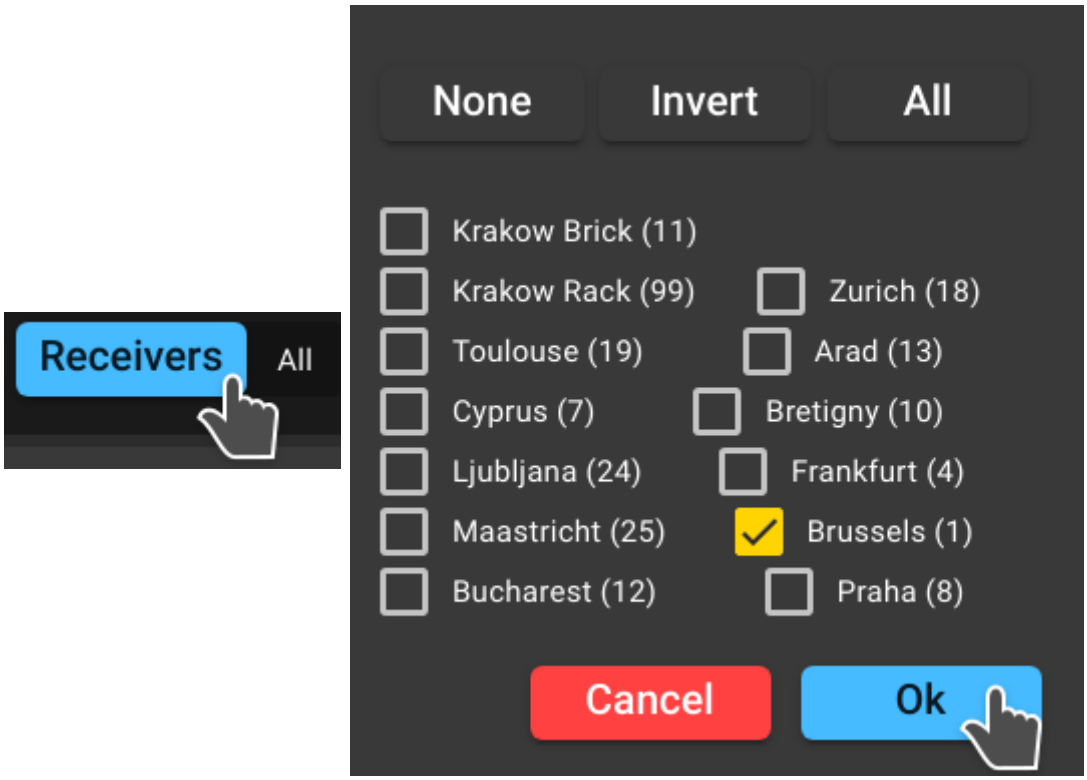
Click the menu button in the upper left corner and select Statistics



The statistics page will show up. By default, you will see RF load and transmissions for the current day and all receivers.

2. Select receivers of interest

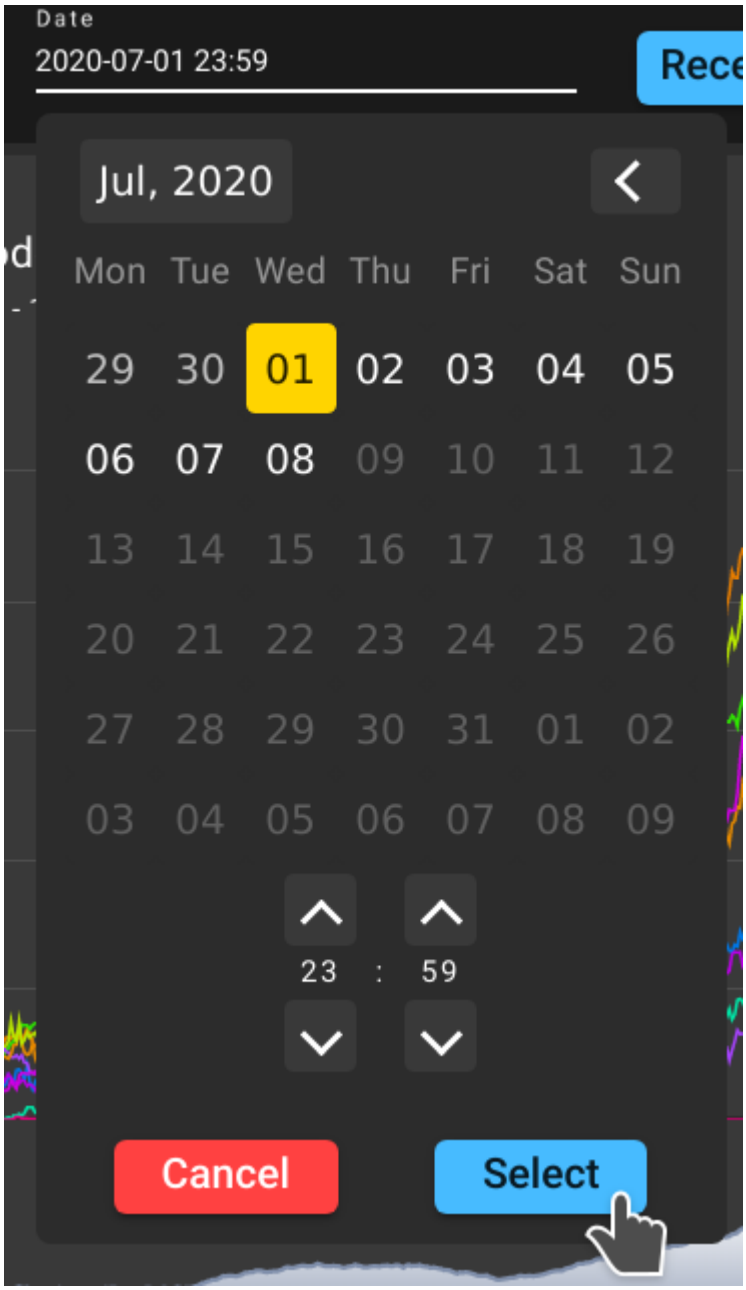
You can select a receiver of interest by clicking the Receivers button in the top menu bar. A dialog will show up where you can select one or multiple receivers to retrieve data for.



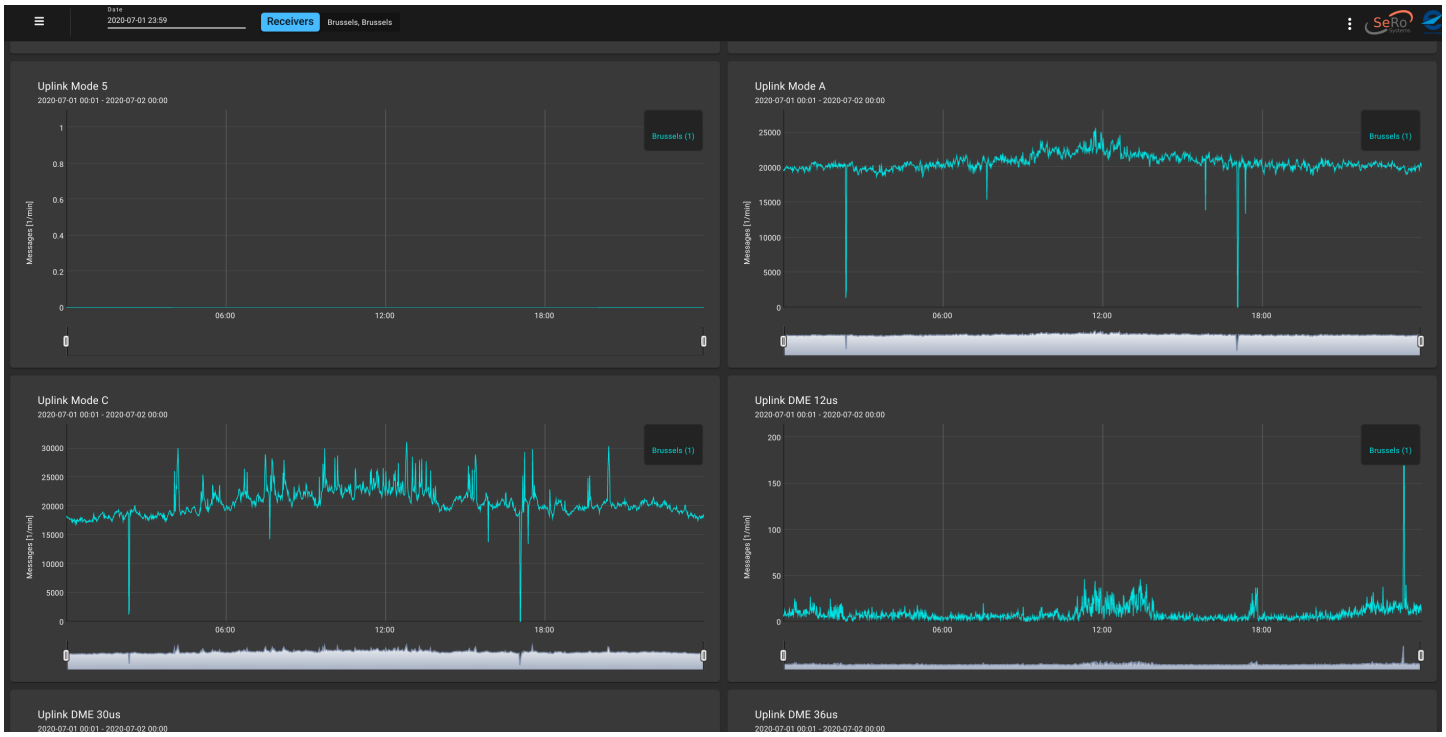
Note that there can be multiple receivers with the same name. Internally, they have a different ID. This situation can be caused by a receiver replacement. The dialog automatically selects all receivers with the same name if you choose one. Click Ok to load data for the selected set of receivers.

3. Choose different time

Open the datepicker by clicking on the date in the top menu bar. Select the desired date and time and click Ok to load the data.



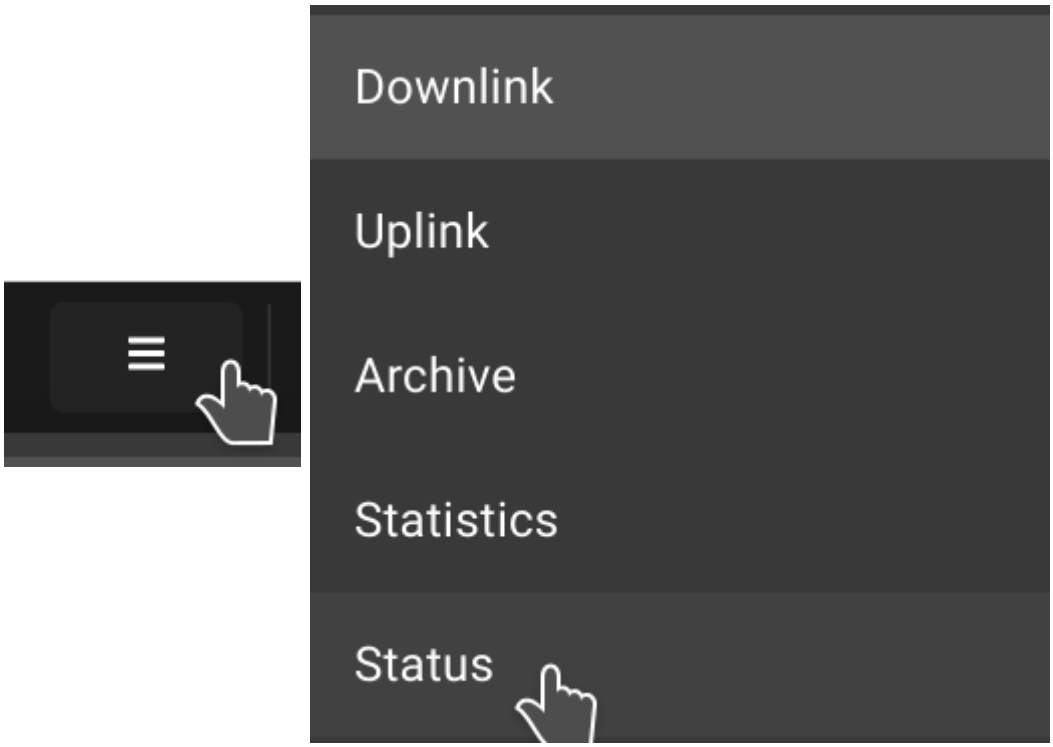
The charts will provide message counts per minute for a time period of 24 hours before the selected time.


Date
2020-07-01 23:59
Receivers
Brussels, Brussels
Uplink Mode 5
2020-07-01 00:01 - 2020-07-02 00:00
Brussels (1)
Messages [1/min]
Uplink Mode A
2020-07-01 00:01 - 2020-07-02 00:00
Brussels (1)
Messages [1/min]
Uplink Mode C
2020-07-01 00:01 - 2020-07-02 00:00
Brussels (1)
Messages [1/min]
Uplink DME 12us
2020-07-01 00:01 - 2020-07-02 00:00
Brussels (1)
Messages [1/min]
Uplink DME 30us
Uplink DME 36us
06:00
12:00
18:00

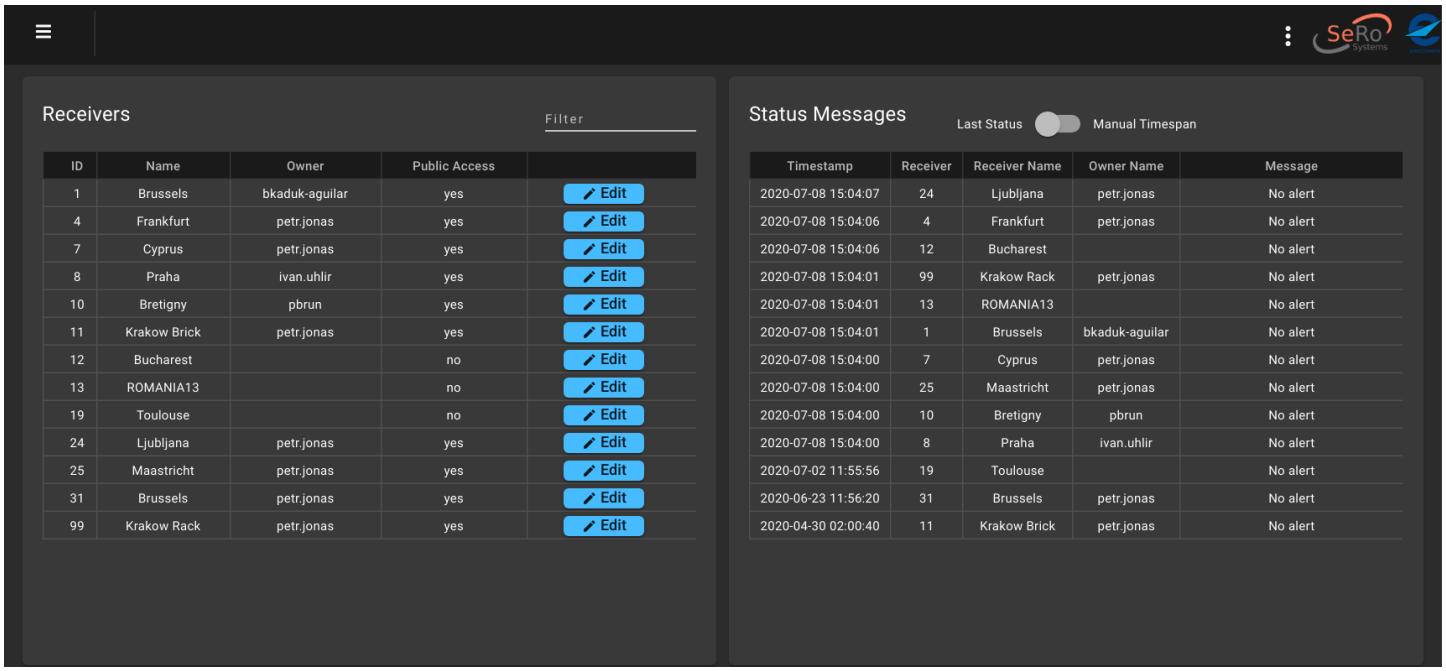
Check receiver status

1. Open the tool

You can reach the status page via the menu. Click the menu button in the upper left corner and select Status



The status page will show up.

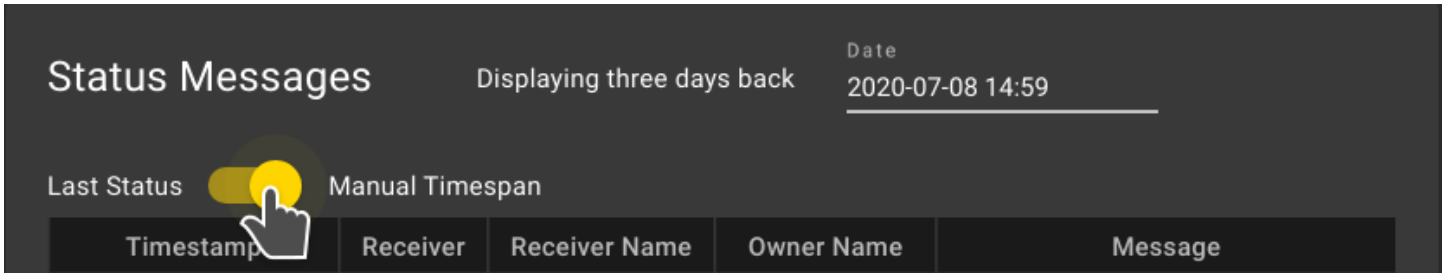


2. Check current status

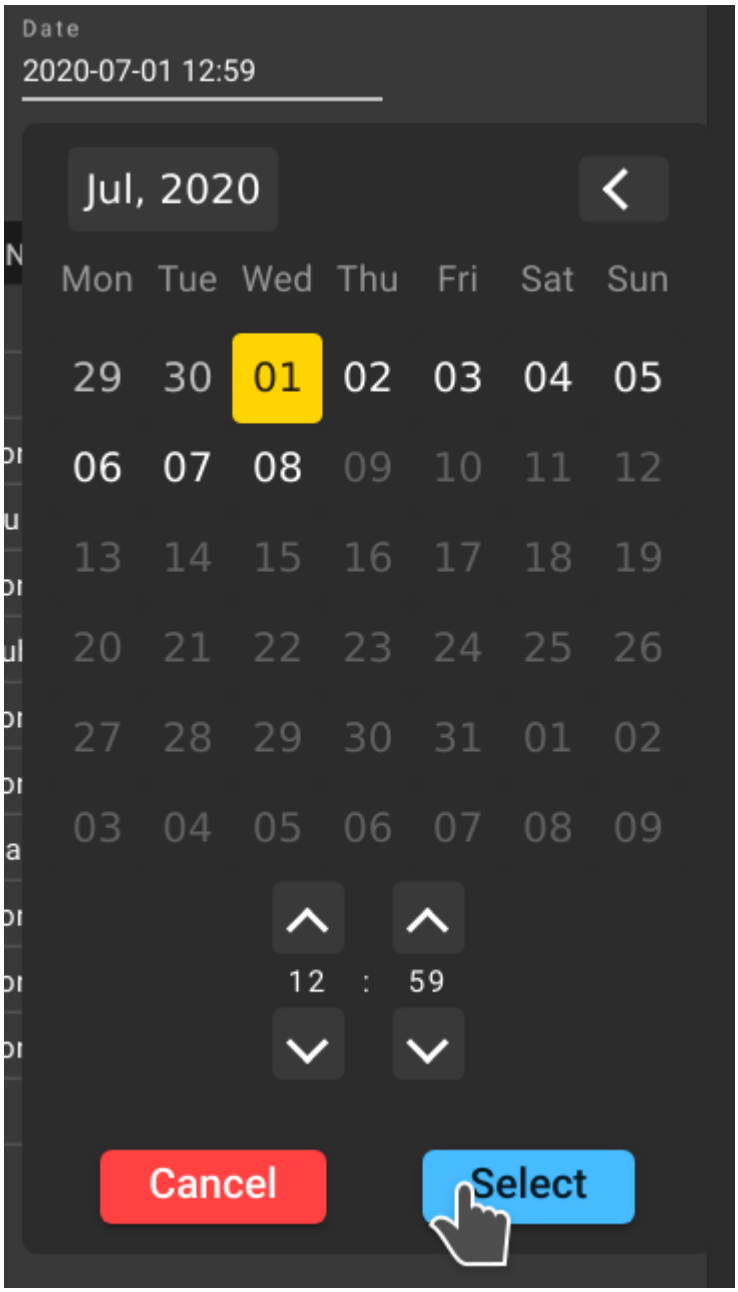
On the left side, there is an overview with all receivers and their owners. The right side by default shows the latest status message for each receiver.

3. Check different time

If you want to check the status of a receiver at a different time, select Manual Timespan.



Open the date picker by clicking on the date.



Click Select to retrieve data for the selected time.

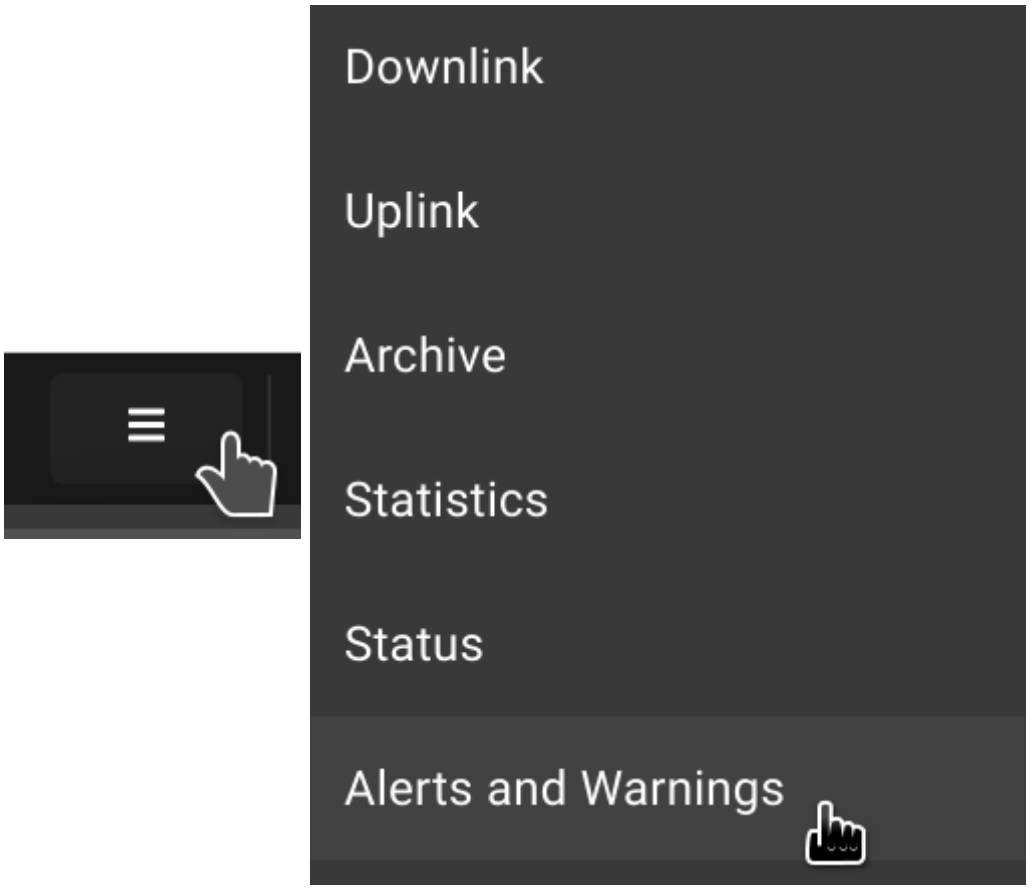
You will be presented with the latest valid receiver status of the selected time:

Timestamp	Receiver	Receiver Name	Owner Name	Message
2020-07-01 14:59:00	31	Brussels	petr.jonas	No alert
2020-07-01 14:59:00	10	Bretigny	pbrun	No alert
2020-07-01 14:59:00	25	Maastricht	petr.jonas	No alert
2020-07-01 14:59:00	8	Praha	ivan.uhlir	No alert
2020-07-01 14:59:00	7	Cyprus	petr.jonas	No alert
2020-07-01 14:59:00	1	Brussels	bkaduk-aguilar	No alert
2020-07-01 14:59:00	99	Krakow Rack	petr.jonas	No alert
2020-07-01 14:59:00	4	Frankfurt	petr.jonas	No alert
2020-07-01 14:59:00	11	Krakow Brick	petr.jonas	No alert
2020-07-01 14:59:00	24	Ljubljana	petr.jonas	No alert

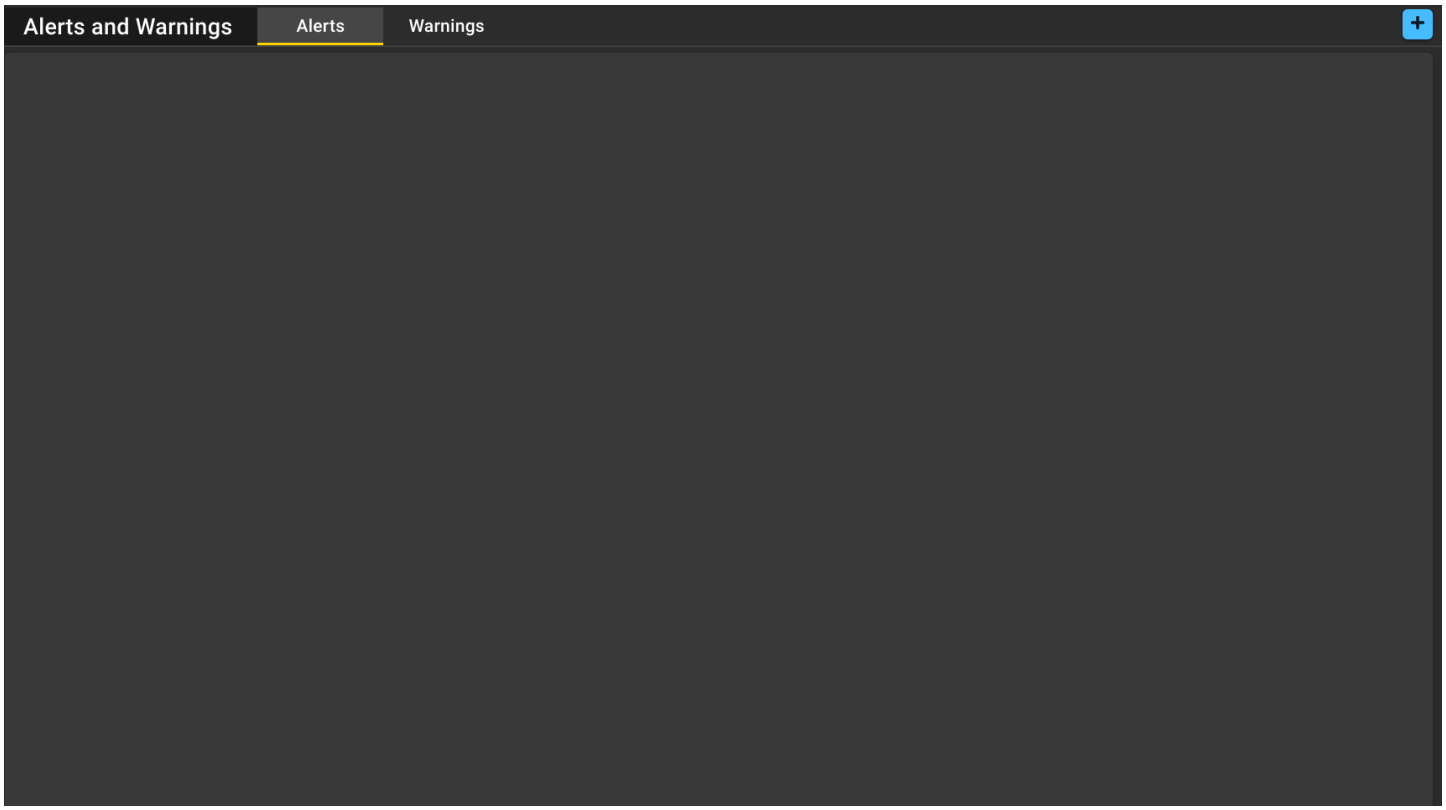
Set up automatic alerting

1. Open the tool

You can reach the alerts page via the menu. Click the menu button in the upper left corner and select Alerts and Warnings

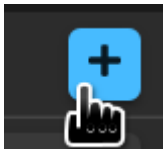


The alerts page will show up.

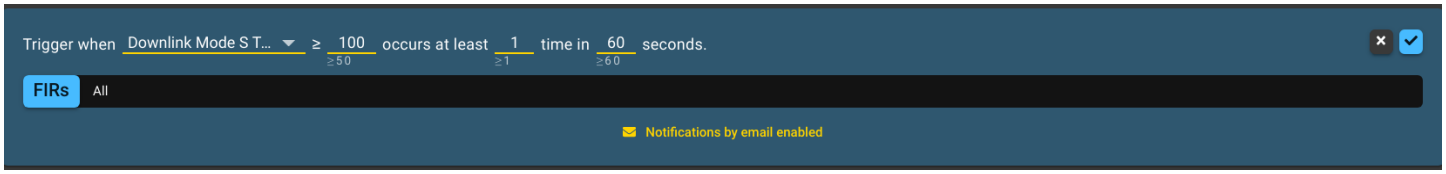


2. Add an alert

Initially, the list of defined alerts is empty. To add a new one, click the + button in the upper right corner.

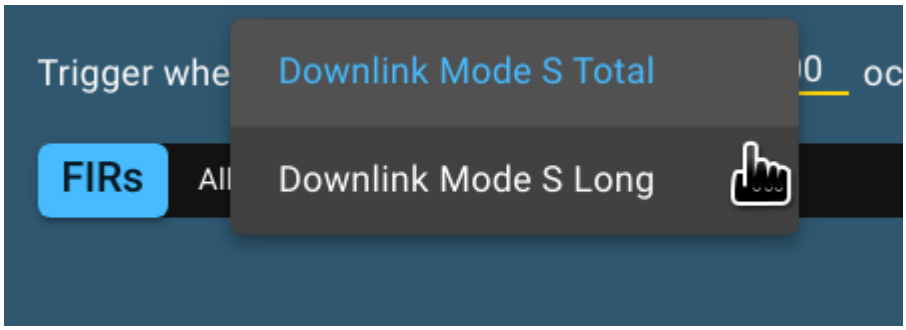


A new alert will show up:



3. Define thresholds

You can define thresholds for downlink Mode S Total and Mode S Long message rates. Click on the drop-down field and select the desired rate:

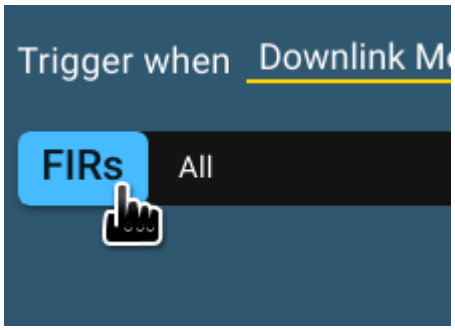


Set the message rate and condition for the alert to trigger.

The system checks for alerts once every minute. Thus, multiple aircraft could exceed the threshold within that time, and trigger an alert event. Whenever the alert is fired, you will receive an email with all events immediately. To avoid email overload, there will be at most one email every hour. In case of multiple successive triggers, the deferred mails contain all events of the previous hour, so you don't miss anything.

4. Select FIRs

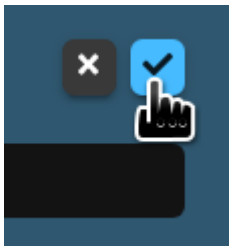
You can filter events for one or more FIRs by clicking the FIR button:



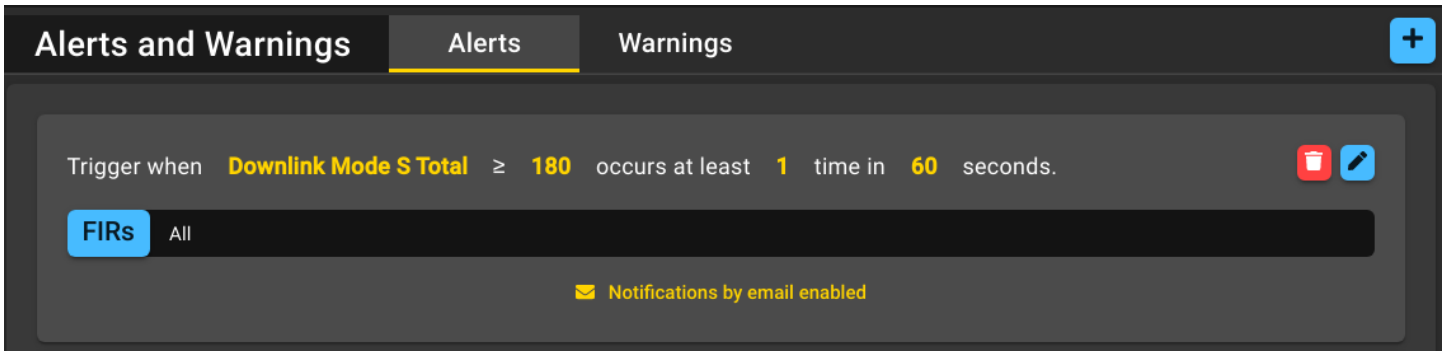
A dialog appears, which allows you to select one or multiple FIRs. Click Ok to confirm your choice.


None
Invert
All
BGGL
BIRD
DAAA
DTTC
EBBU
EDGG
EDMM
EDVV
EDWW
EETT
EFIN
EGGX
EGPX
EGTT
EHAA
EISN
EKDK
ENOB
ENOR
EPWW
ESAA
EVRR
EYVL
GCCC
GMMM
GOOO
HECC
HLLL
LAAA
LBSR
LCCC
LDZO
LECB
LECM
LFBB
LFEE
LFFF
LFMM
LFRR
LGGG
LHCC
LIBB
LIMM
LIRR
LJLA
LKAA
LLLL
LMMM
LOVV
LPPC
LPPO
LQSB
LRBB
LSAS
LTAA
LTBB
LUUU
LWSS
LYBA
LZBB
OEJD
OIIX
OJAC
OLBB
ORBB
OSTT
UATE
UBBB
UDDD
UGGG
UKBV
UKFV
UKHV
UKLV
UKOV
ULLL
ULMM
ULOL
ULPB
UMKK
UMMV
URRV
UTAK
UUWV
Cancel
Ok

Finally, save the alert by clicking the checkmark button in the upper right corner:



Your active alert is now shown in the list:



5. Define multiple alerts

To get alerts for both downlink Mode S total and long rates, repeat the previous steps. All defined alerts will be included in a single email notification.

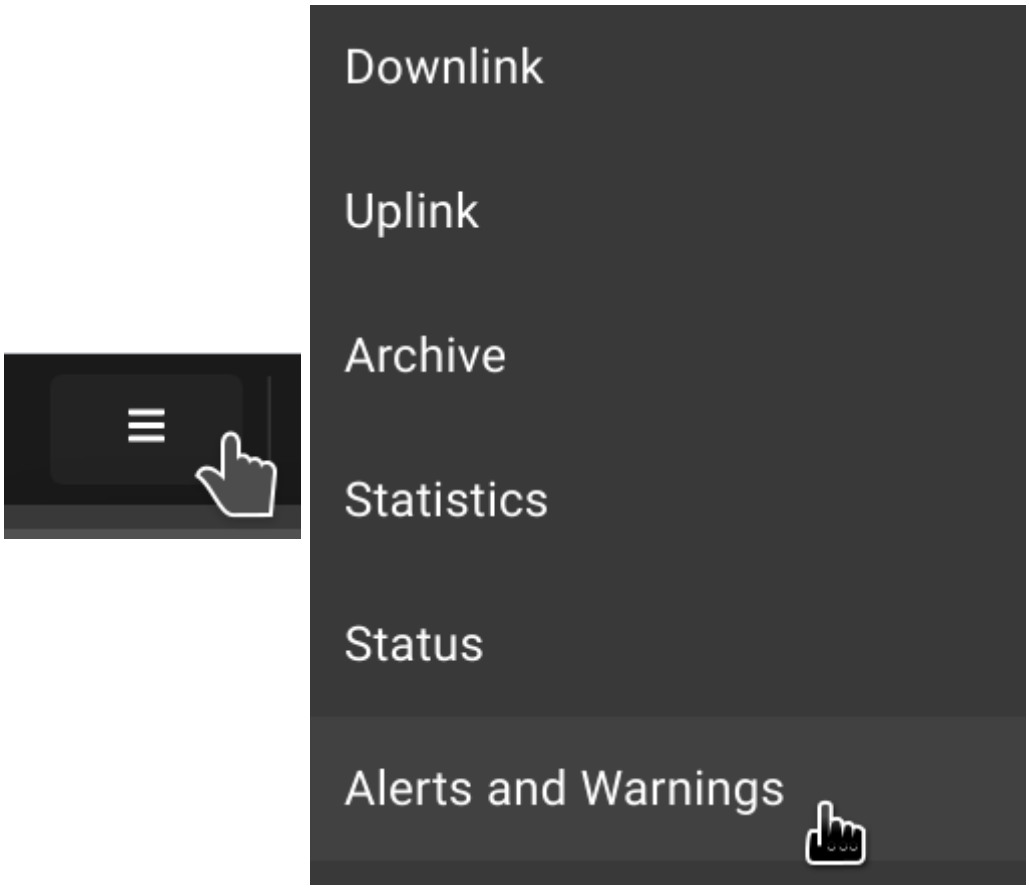
Set up automatic warnings

In contrast to alerts, warnings are regular reports of events. There is a mail notification for each warning at the configured interval (daily, weekly, monthly). Reports are sent at the beginning of

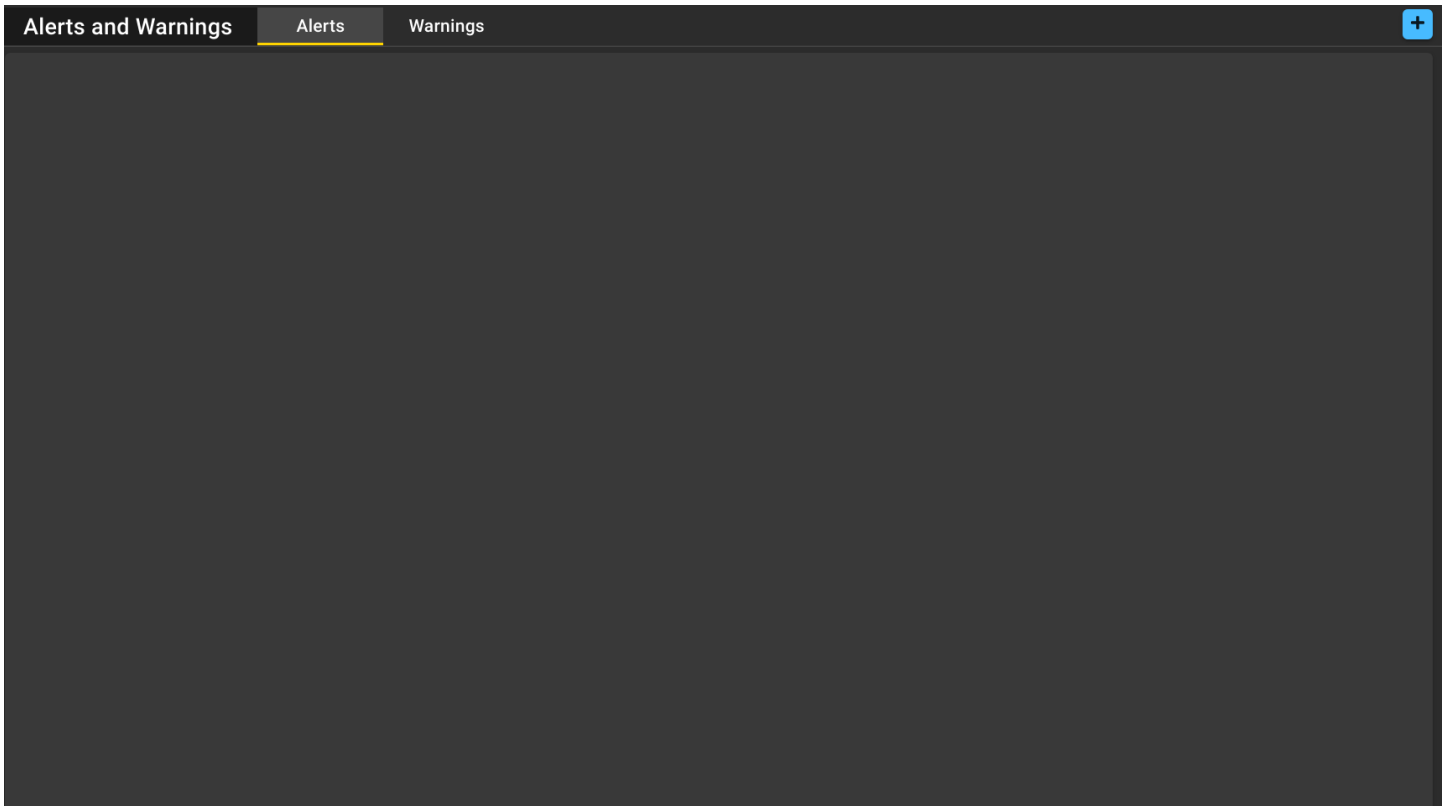
- a new day: 0:00 UTC
- a new week: Mondays 0:00 UTC
- a new month: 1st of the month 0:00 UTC

1. Open the tool

You can reach the alerts page via the menu. Click the menu button in the upper left corner and select Alerts and Warnings



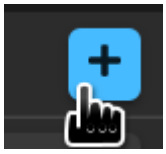
The alerts page will show up.



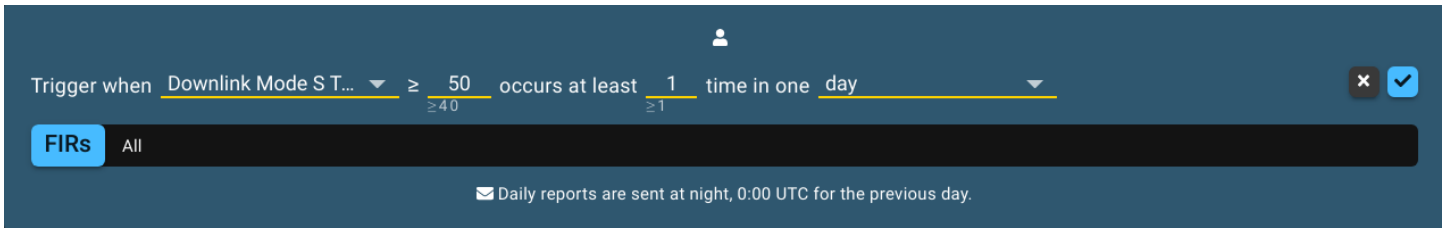
Change to the Warning tab

2. Add a warning

Initially, the list of defined warnings is empty. To add a new one, click the + button in the upper right corner.

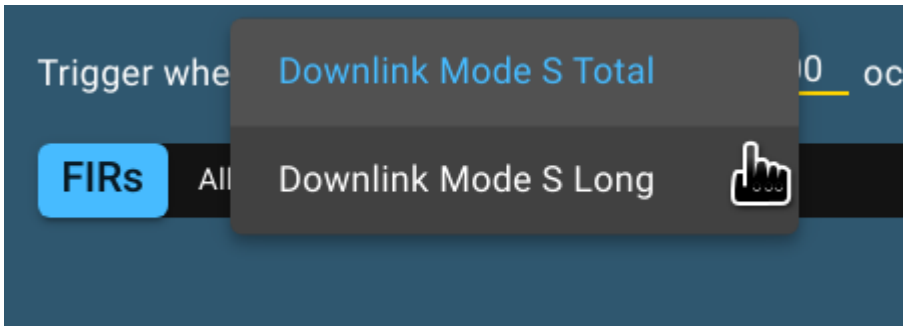


A new warning will show up:

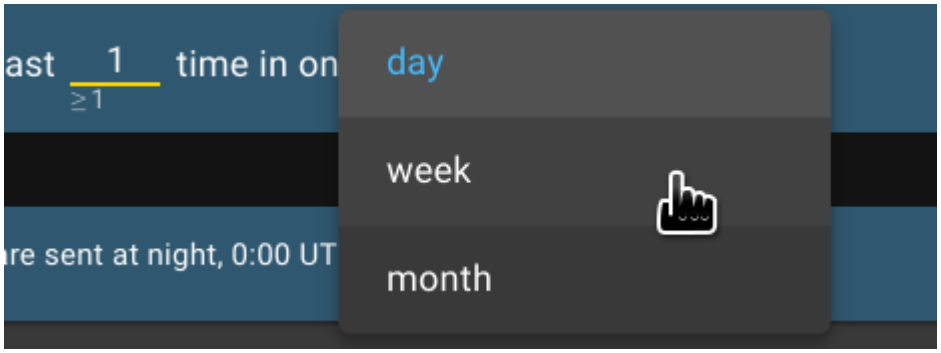


3. Define thresholds

You can define thresholds for downlink Mode S Total and Mode S Long message rates. Click on the drop-down field and select the desired rate:

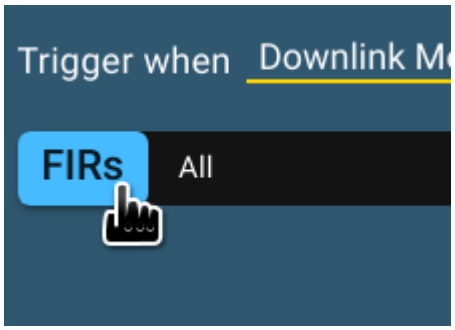


Whenever an aircraft exceeds the defined threshold, it will be included in your warning report. There is only one warning report per defined warning within the configured interval, containing all the recorded events. To set the interval, click on the select field and choose your preference:



4. Select FIRs

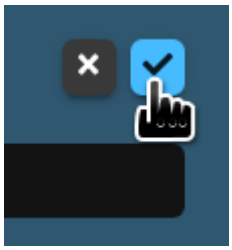
You can filter events for one or more FIRs by clicking the FIR button:



A dialog appears, which allows you to select one or multiple FIRs. Click Ok to confirm your choice.


None
Invert
All
BGGL
BIRD
DAAA
DTTC
EBBU
EDGG
EDMM
EDVV
EDWW
EETT
EFIN
EGGX
EGPX
EGTT
EHAA
EISN
EKDK
ENOB
ENOR
EPWW
ESAA
EVRR
EYVL
GCCC
GMMM
GOOO
HECC
HLLL
LAAA
LBSR
LCCC
LDZO
LECB
LECM
LFBB
LFEE
LFFF
LFMM
LFRR
LGGG
LHCC
LIBB
LIMM
LIRR
LJLA
LKAA
LLLL
LMMM
LOVV
LPPC
LPPO
LQSB
LRBB
LSAS
LTAA
LTBB
LUUU
LWSS
LYBA
LZBB
OEJD
OIIX
OJAC
OLBB
ORBB
OSTT
UATE
UBBB
UDDD
UGGG
UKBV
UKFV
UKHV
UKLV
UKOV
ULLL
ULMM
ULOL
ULPB
UMKK
UMMV
URRV
UTAK
UUWV
Cancel
Ok

Finally, save the warning by clicking the checkmark button in the upper right corner:



5. Define multiple warnings

To get warnings for both downlink Mode S total and long rates, repeat the previous steps. You will receive an email for every configured warning.

Note

Warning events are only included for the time after you have created the warning. For example, if you create a weekly warning on Wednesday 12:00, the next report which is sent Monday 0:00 will only contain events after Wednesday 12:00.

Note

To avoid confusion, it is not possible to edit warning thresholds. If you want to change certain values of a warning, delete it and add a new one. Events of deleted warnings will not be reported.

IC conflict assessment

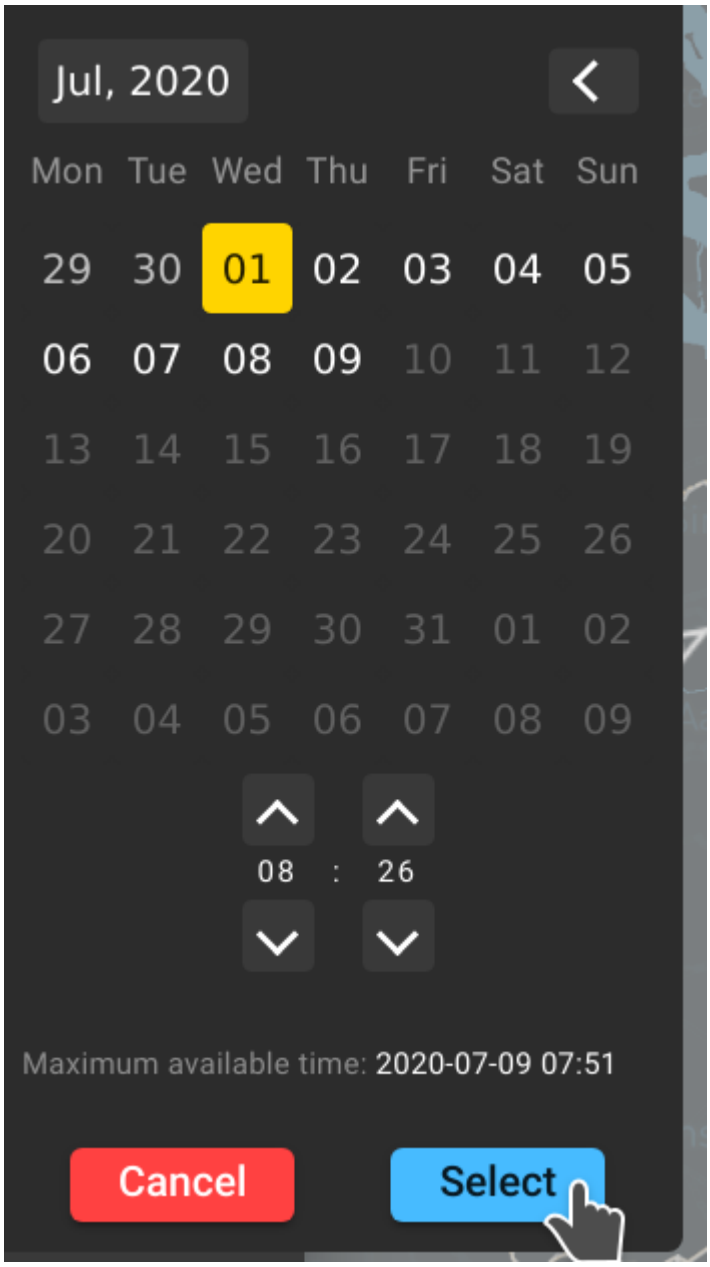
1. Open the tool

You will be presented with the downlink monitoring module. By default, aircraft colors are based on the peak-1s total Mode S message rate.

2. Go to the time of interest

By default, EMIT displays a time window of 4 hours, ending by the time selected.

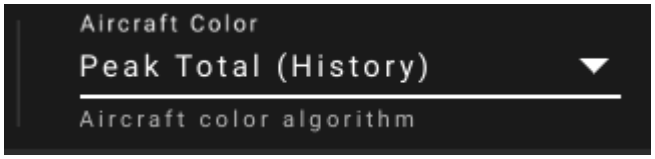
Click on the date in the top menu bar to open the datepicker. Adjust to the intended end time of interest and click Select to start data retrieval.



3. Enable the aircraft history

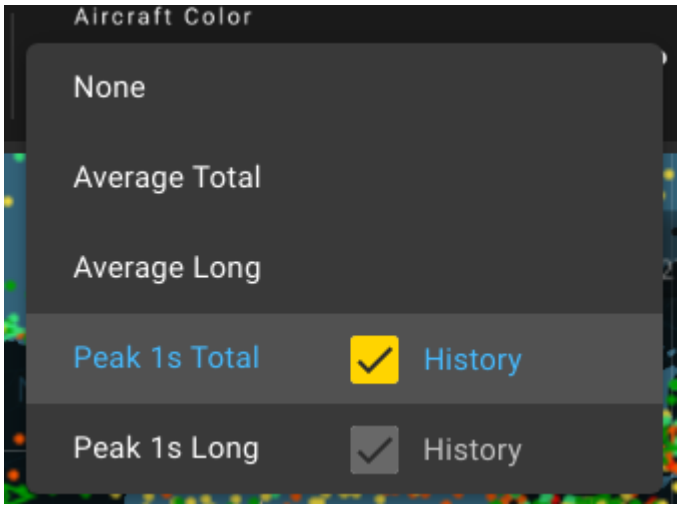
Set the view to display history dots within the desired time window.

The upper part of the main interface allows to configure the aircraft coloring scheme.



Click on the selector to open the menu.

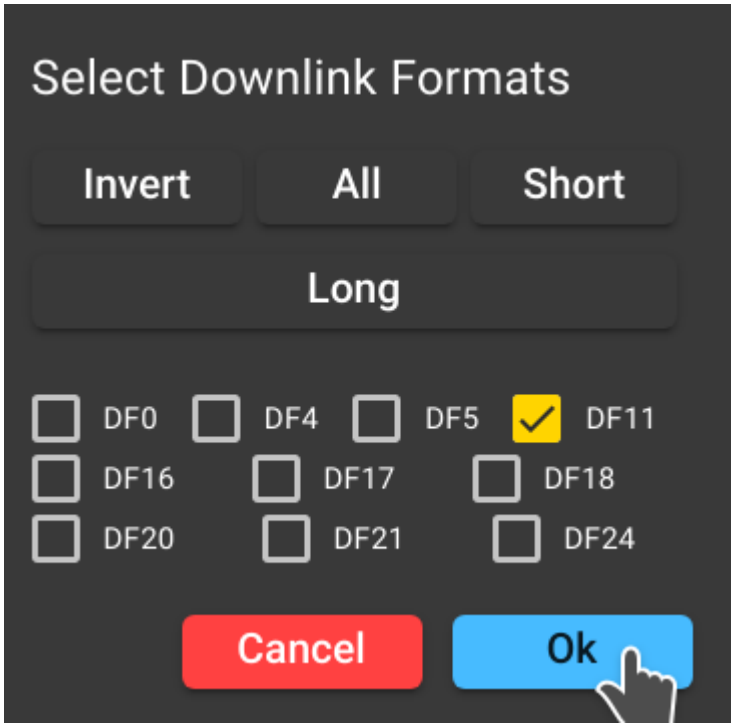
Enable the history dots:



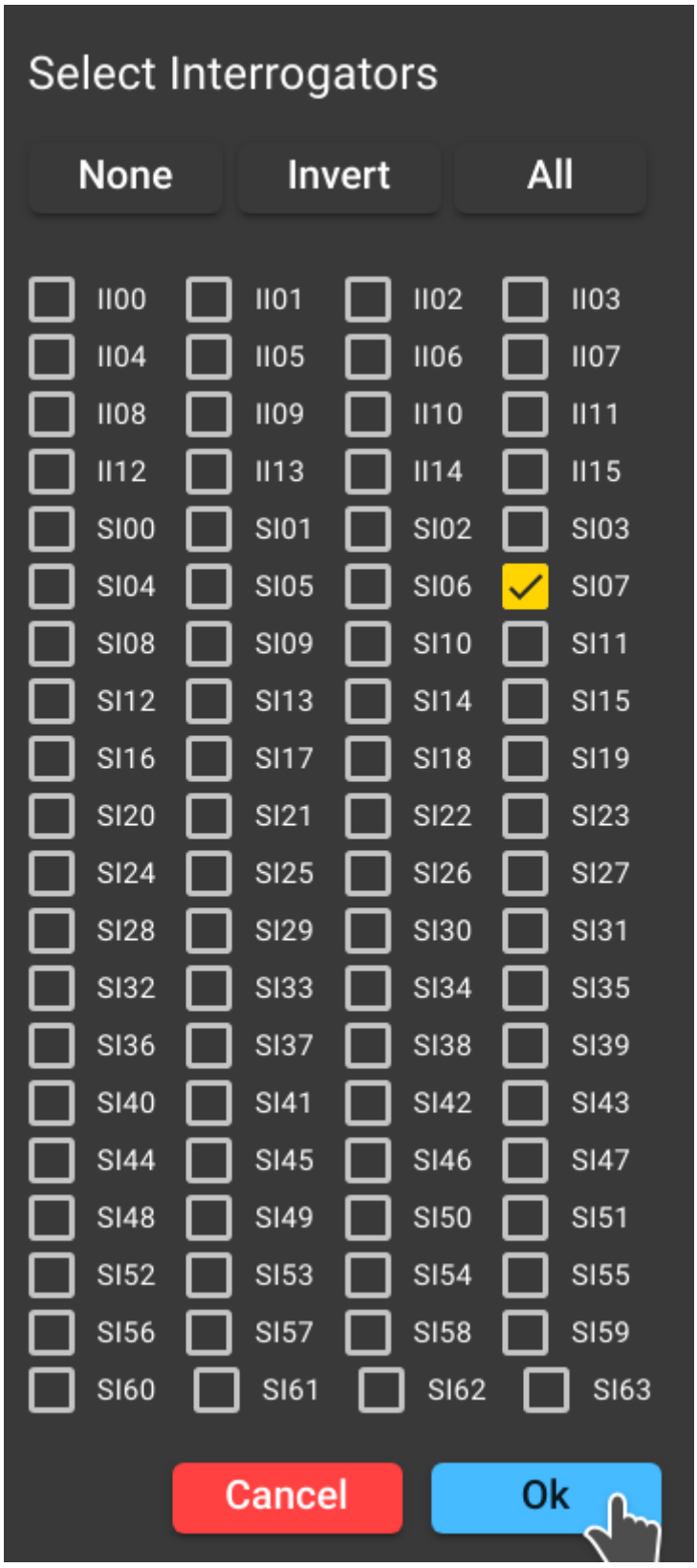
4. Filter for the right DF and IC code

In the bottom menu bar, open the DF filter dialog:

Disable all downlink formats, except DF11 and click Ok.



Choose the Interrogator Code with a suspected conflict in the IC filter dialog:



5. Adjust FIRs and history settings

Open the FIR dialog:

Select some FIRs that encompass the area of interest.

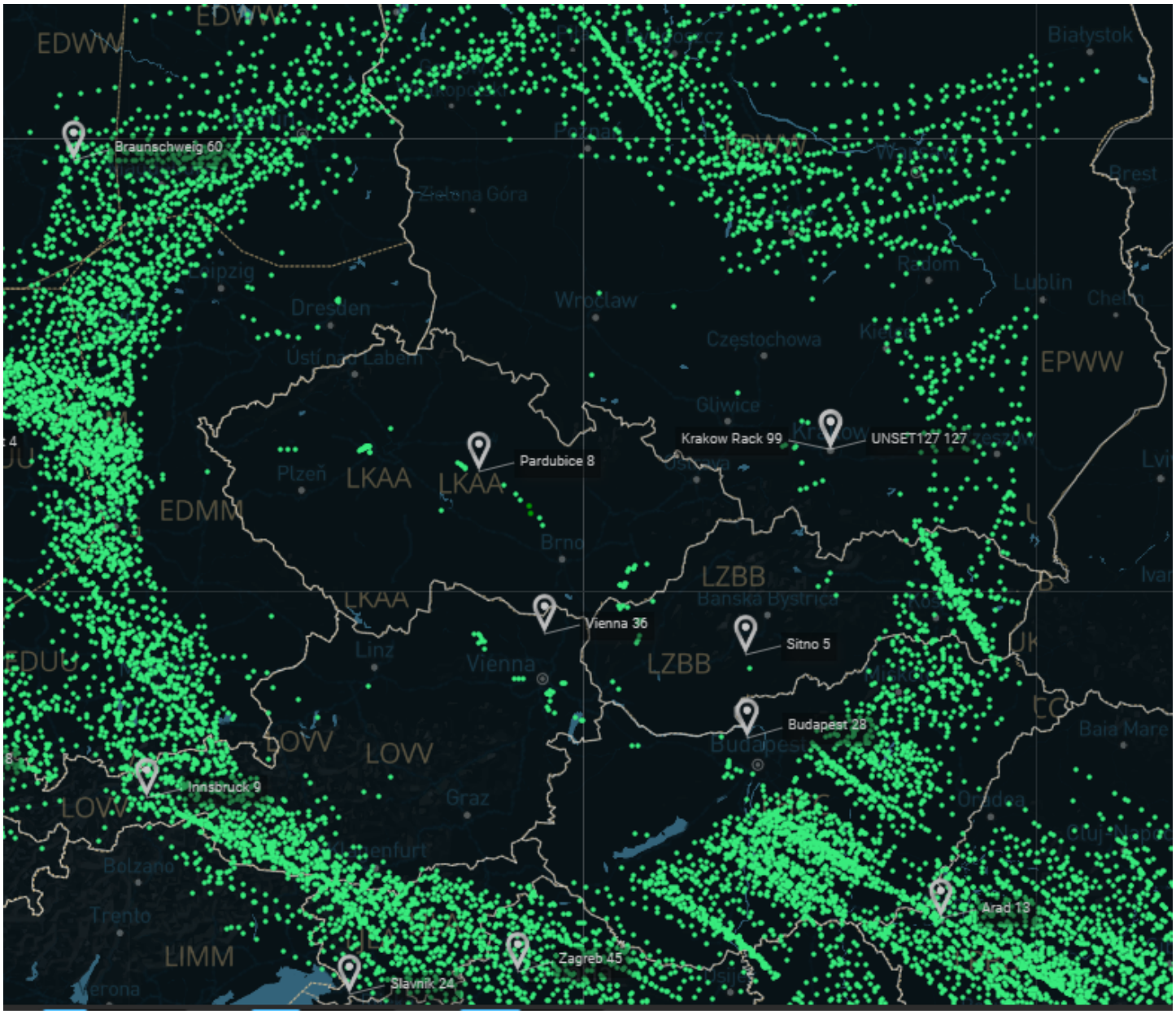
Warning

We generally advise against selecting all FIRs, because it will cause high response times and stress to the system.

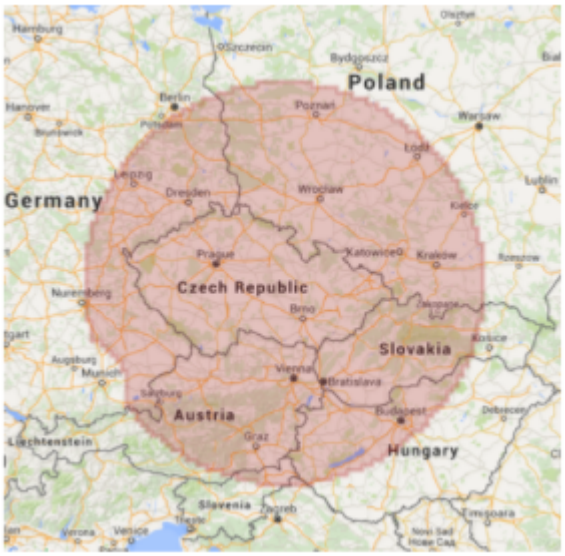
Finally, ensure that layers with low message rates are enabled in the legend on the upper right:

6. Evaluate

The map with history dots will be shown. The empty space pattern represents the lockout map.



From the comparison of the actual lockout map and the displayed pattern a potential conflict of the IC code can be detected.



Too many DF11 inside the lockout map may indicate an IC code conflict.