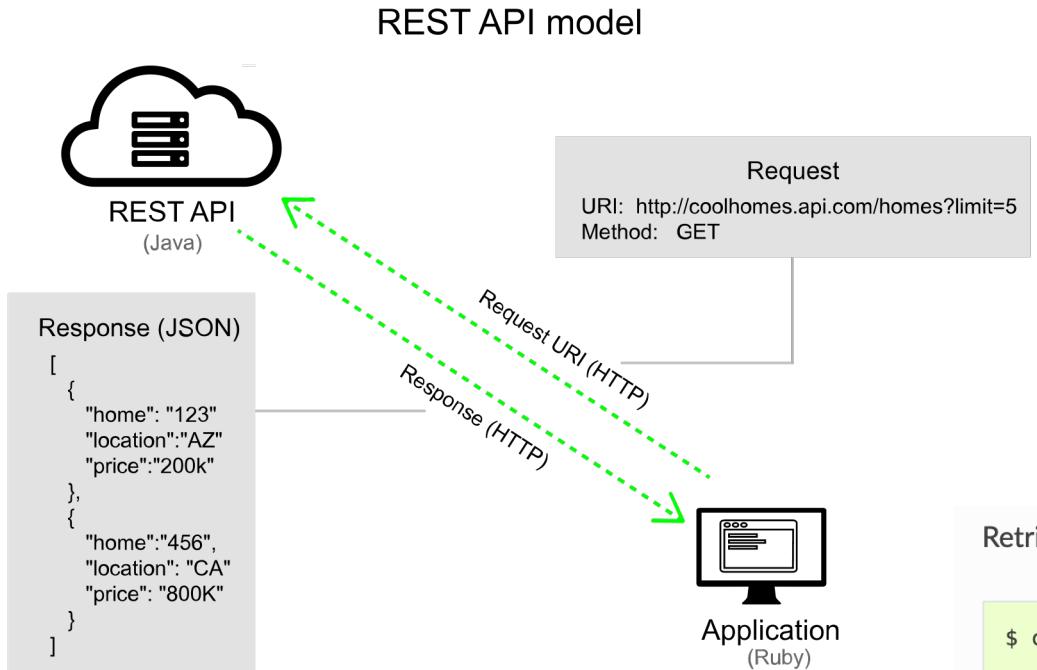
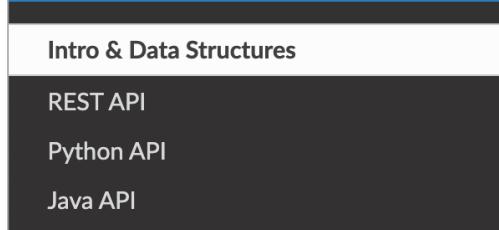


# REST API Request



- Http – hvad er det?
  - Chrome dev-tools
- Shell – hvad er det?
  - Git Bash
  - Curl – hvad er det?



Retrieve all states as an anonymous user:

```
$ curl -s "https://opensky-network.org/api/states/all" | python -m json.tool
```

- R – hvordan?
  - httr + jsonlite

```
6 library(httr)
7
8 rurl <- "https://opensky-network.org/api"
9 res <- httr::GET(totalurl, authenticate(user,pw))
```

# REST API Request

1. Introduction
2. Protocols
3. Data Formats
4. Authentication, Part 1
5. Authentication, Part 2
6. API Design
7. Real-Time Communication
8. Implementation

X	Headere	Nyttedata	Forhåndsvisning	Svar	Iværksætter	Timing	Cookies
▼ Generelt							
Webadresse For Anmodning:							
				https://opensky-network.org/api/flights/aircraft?icao24=3c675a&begin=1517184000&end=1517270400			
Anmodningsmetode:							
				GET			
Statuskode:							
				● 200 OK			
Fjernadresse:							
				194.209.200.2:443			
Politik For Henviser:							
				strict-origin-when-cross-origin			

# API Intro

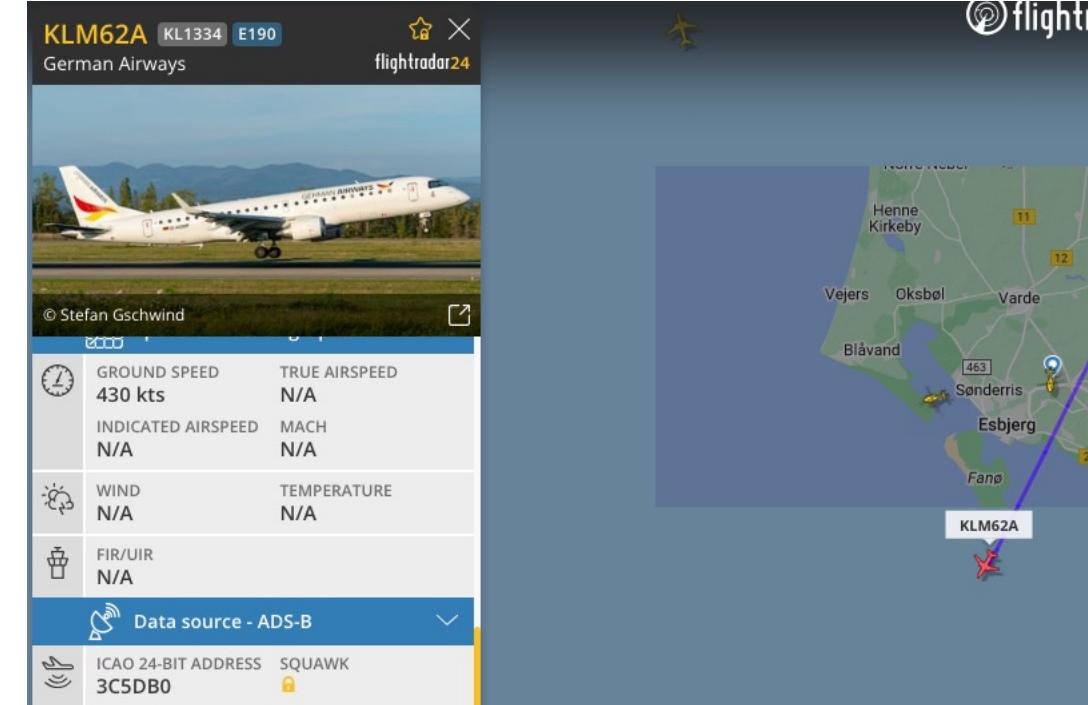
## What An API Is and Why It's Valuable

Unfortunately, the characteristics that make websites optimal for humans make them difficult for computers to use.

The solution is an API. An API is the tool that makes a website's data digestible for a computer. Through it, a computer can view and edit data, just like a person can by loading pages and submitting forms

## How An API Is Used

One side we have already talked about:  
the server. This is the side that actually provides the API.  
The other side is the "client." This is a separate program that  
knows what data is available through the API and can  
manipulate it, typically at the request of a user.



A screenshot of the Airframes.org website. At the top, there is a banner featuring a blue and yellow biplane with the text "Airframes.org". On the left, a sidebar menu includes links for "Airframes.org", "Aircraft", "Airlines", "Information", "Files", "Resources", "About this DB", and "...". The main content area is titled "Aircraft Registration Database Lookup" and contains a form for searching aircraft databases. The form fields include "Registration" (with placeholder "[e.g. N12345]"), "Selcal" (with placeholder "[e.g. 12345678]"), "ICAO24 address" (containing the value "3C5DB0"), and buttons for "submit" and "reset". Below the form, there is a note: "Passenger airliners, cargo airplanes, business jets, helicopters, private aircraft, civil and military, s..." and a link to "Aircraft database".

# Protocols

## Knowing the rules

Computers are as polite as people, though it goes by the term "protocol." A computer protocol is an accepted set of **rules** that govern how two computers can speak to each other.

## The Protocol of the Web

On the web, the main protocol is the Hyper-Text Transfer Protocol, better known by its acronym, HTTP.

## HTTP Requests

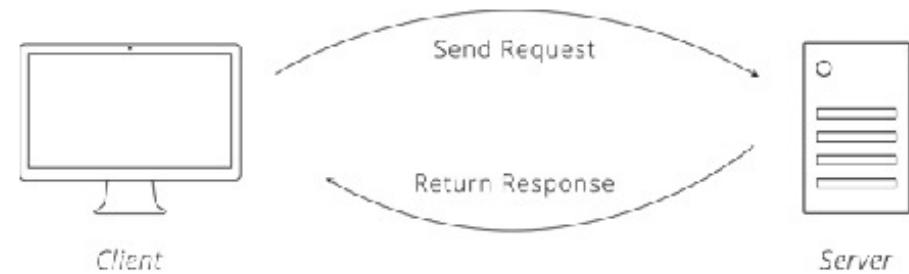
Communication in HTTP centers around a concept called the Request-Response Cycle.

## A valid request

- 1 URL (Uniform Resource Locator) [1](#)
- 2 Method
- 3 List of Headers
- 4 Body

## HTTP Response

After the server receives a request from the client, it attempts to fulfill the request and send the client back a response. HTTP responses have a very similar structure to requests.



# Protocols

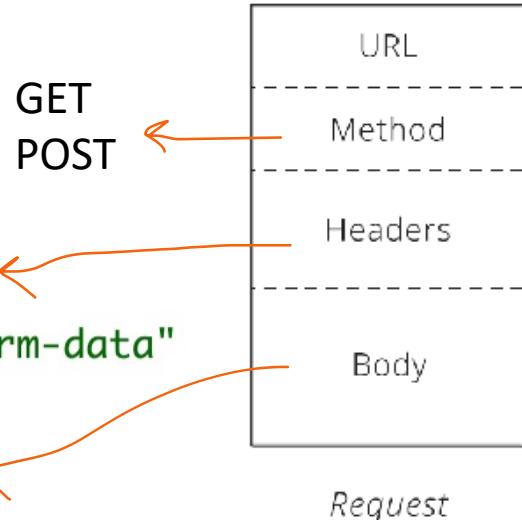
```
custom_headers <- c(  
  "User-Agent" = "Mozilla/5.0",  
  "Content-Type" = "multipart/form-data"  
)
```

Header Nyttedata

Formulardata se kilde

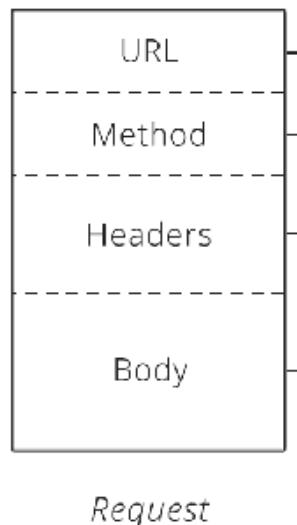
reg1:  
selcal:  
ica024: 4ACA08  
submit: submit

```
{  
  "Id": 78912,  
  "Quantity": 1,  
  "Price": 18.00  
}
```

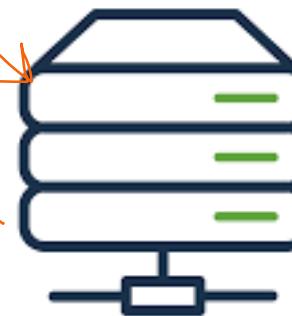


Request

# Protocols



response



Example of error response

```
{  
    "cod": 400,  
    "message": "Invalid date format",  
    "parameters": [  
        "date"  
    ]  
}
```

HTML-kald

▼ Svarheaders  Rå  
HTTP/1.1 200 OK  
Date: Wed, 25 Oct 2023 13:49:07 GMT  
Server: Apache  
Cache-Control: no-transform  
Vary: Accept-Encoding  
Content-Encoding: gzip  
Content-Length: 2767  
Keep-Alive: timeout=5, max=100  
Connection: Keep-Alive  
Content-Type: text/html; charset=utf-8

API kald

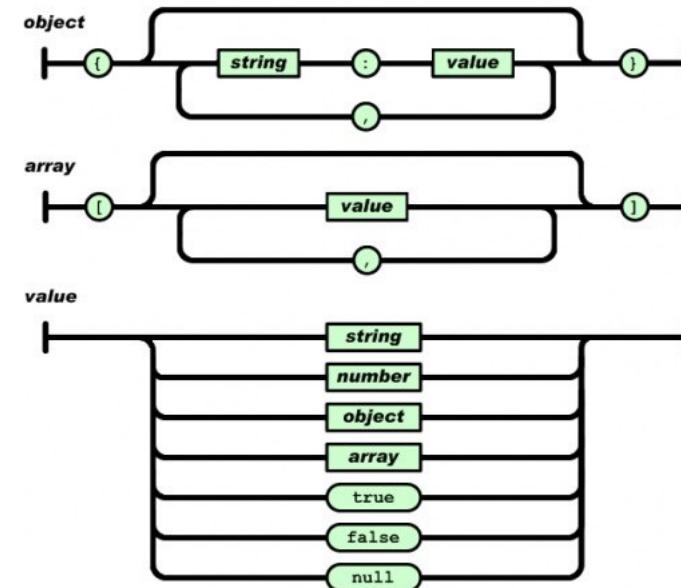
	Header	Nyttedata	Forhåndsvisning	Svar	Iværksætter	Timing
▼ Generelt						
Webadresse For Anmodning:				https://api.open-meteo.com/v1/forecas		
Anmodningsmetode:				GET		
Statuskode:	200 OK					
Fjernadresse:				202.61.229.161:443		
Politik For Henviser:				strict-origin-when-cross-origin		
▼ Svarheaders						
Content-Encoding:				deflate		
Content-Type:				application/json; charset=utf-8		
Date:				Wed, 25 Oct 2023 14:31:04 GMT		

# Representing data

- “The above command returns JSON structured like this”
- JSON – JavaScript Object Notation

JSONLint - The JSON Validator

```
1 {  
2     "id": "e00fce68c573b4acca2089ce",  
3     "type": 150,  
4     "location": 216,  
5     "latitude": 56.1632767,  
6     "longitude": 10.2105122,  
7     "location_name": "Nørrebrogade",  
8     "city": "Aarhus",  
9     "country": "Denmark",  
10    "roles": [  
11        4  
12    ],  
13    "permissions": [],  
14    "tags": [  
15        "Randersvej"  
16    ]  
17 }
```



# Organizing API

REST API
All State Vectors
Own State Vectors
Flights in Time Interval
Flights by Aircraft
Arrivals by Airport
Departures by Airport
Track by Aircraft

## Operation

`GET /states/all`

## Request

You can (optionally) request state vectors for particular airplanes or times using the following request parameters:

Property	Type	Description
<code>time</code>	integer	The time in seconds since epoch (Unix time stamp to retrieve states for. Current time will be used if omitted.
<code>icao24</code>	string	One or more ICAO24 transponder addresses represented by a hex string (e.g. <code>abc9f3</code> ). To filter multiple ICAO24 append the property once for each address. If omitted, the state vectors of all aircraft are returned.

## Operation

`GET /flights/aircraft`

## Request

These are the required request parameters:

Property	Type	Description
<code>icao24</code>	string	Unique ICAO 24-bit address of the transponder in hex string representation. All letters need to be lower case
<code>begin</code>	integer	Start of time interval to retrieve flights for as Unix time (seconds since epoch)
<code>end</code>	integer	End of time interval to retrieve flights for as Unix time (seconds since epoch)

The given time interval must not be larger than 30 days!

## Response

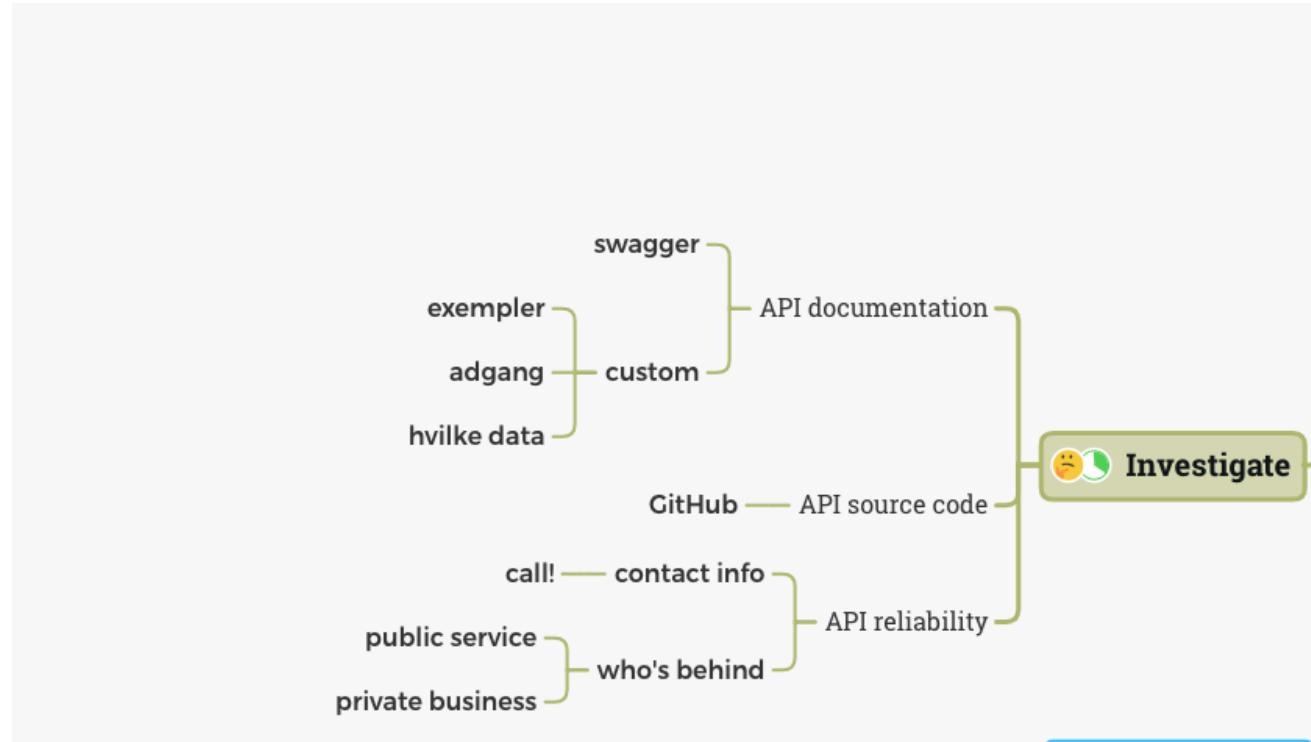
The response is a JSON array of flights where each flight is an object with the following properties:

# ØVELSE m. json

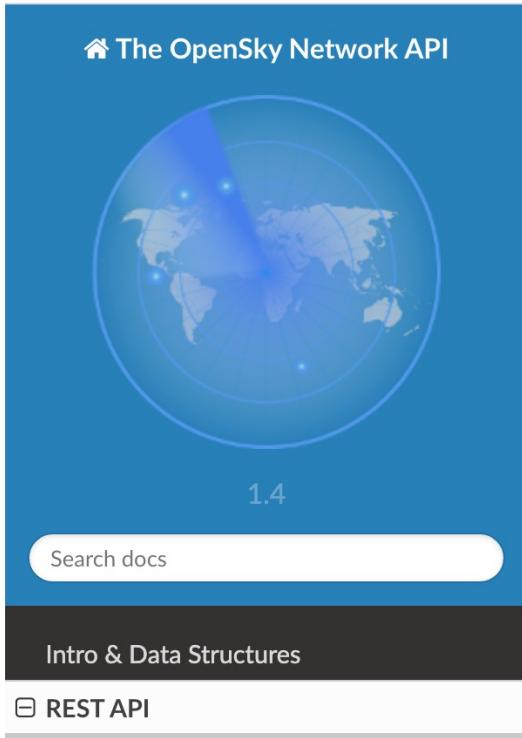
- Hent filen m.json fra [github/cphstud/DALE23W43](https://github.com/cphstud/DALE23W43) og konstruer en datastruktur i R som bliver til denne fil når du `writeLines(dftiljson,"mym.json")`

Pause

# Data-retrieval: Public API -> Investigate



# Recap OpenSky API



- 1) registrer dig på tjenesten
- 2) beskriv api'ets endpoints
  - 1) Overordnet
  - 2) Detaljer

## Request endpoints

### Intro & Data Structures

#### ⊖ REST API

- ⊕ All State Vectors
- ⊕ Own State Vectors
- ⊕ Flights in Time Interval
- ⊕ Flights by Aircraft
- ⊕ Arrivals by Airport
- ⊕ Departures by Airport
- ⊕ Track by Aircraft

GET /states/all

GET /flights/all

GET /flights/aircraft

GET /flights/arrival

# ØVELSE m. curl i terminalen

Retrieve all states as an anonymous user:

```
$ curl -s "https://opensky-network.org/api/states/all" | python -m json.tool
```

Request:

```
https://opensky-
network.org/api/states/all?lamin=45.8389
&lomin=5.9962&lamax=47.8229&lomax=
10.5226
```

```
[  
  51110b,  
  SAS646 ,  
  Estonia,  
  1664437945 ,  
  1664437945 ,  
  9.9992 ,  
  53.629 ,  
  null ,  
  true ,  
  4.89 ,  
  239.06 ,  
  null ,  
  null ,  
  null ,  
  null ,  
  false ,  
  0  
,  
]
```

Response

Example query with bounding box covering Switzerland: [https://opensky-](https://opensky-network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226)

network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226

1	callsign	string	Callsign of the vehicle (8 chars). Can be null if no callsign has been received.
---	----------	--------	--

Hvad er det?

Øvelse:

Hvornår fejrer man 1234567890 dag?

Hvad skete der på denne dag:

2017-07-14 04:40:00 CEST

# Task: Find all SAS-flights

[

```
51110b,  
SAS646 ,  
Estonia,  
1664437945,  
1664437945,  
9.9992,  
53.629,  
null,  
true,  
4.89,  
239.06,  
null,  
null,  
null,  
null,  
false,  
0
```

],

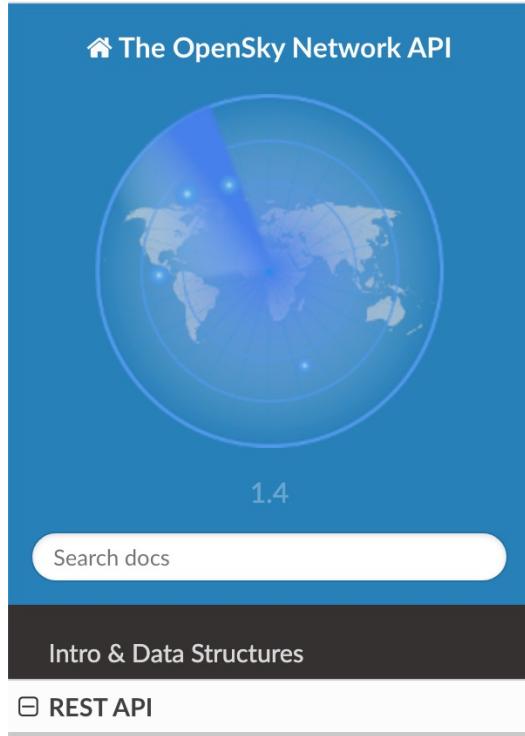
1	callsign	string	Callsign of the vehicle (8 chars). Can be null if no callsign has been received.
---	----------	--------	--

```
18 # get rows where string matches substring  
19 retcount <- str_detect(statedf$V2,"SAS")  
20 sasdf <- statedf[retcount,]  
21 sum(retcount)
```

```
> sum(retcount)  
[1] 68
```

Response

# Data-retrieval CASE: OpenSky API



- 1) Hvor mange SAS fly er der i luften lige nu?
- 2) Hvor mange flyver over Point Reyes i løbet af en time?
  - 1) i løbet af et minut
  - 2) i løbet af 3 døgn
    - 1) lav et script som gemmer din dataframe i en fil
    - 2) kør det i konsollen/terminal
- 3) Find jeres eget område og sæt det op i et script (til fredag)
- 4) Lav en liste over fly over DK
  - 1) Konstruer en algoritme som spotter "cirklende" fly

# Data-retrieval CASE: OpenSky API

liste over Point Reyes

The OpenSky Network API

1.4

Search docs

Intro & Data Structures

REST API

**ROPER33**  
United States - US Air Force (USAF)

flightradar24 LIVE AIR TRAFFIC

© CJMoeser

N/A N/A

ACTUAL 21:36 ESTIMATED

AIRCRAFT TYPE (T38)  
Northrop T-38A Talon

REGISTRATION  
64-13285

COUNTRY OF REG.

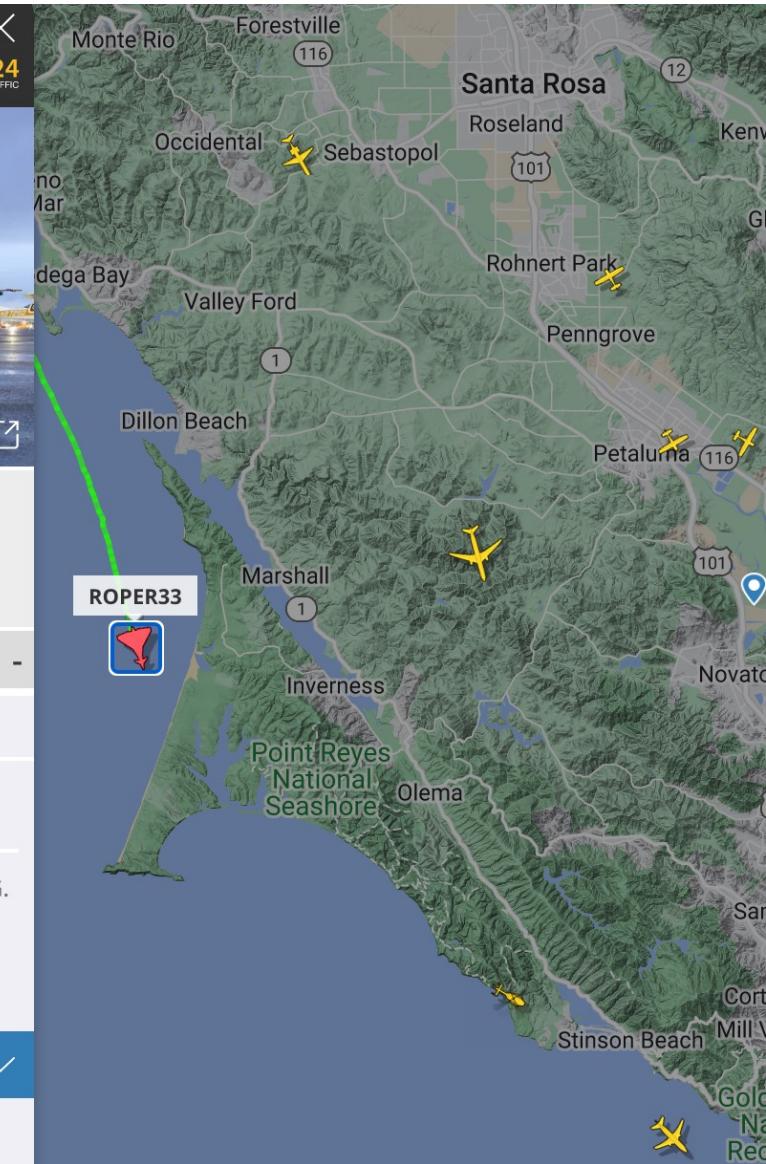
SERIAL NUMBER (MSN)

AGE  
N/A

Recent 64-13285 flights

CALIBRATED ALTITUDE  
3 000 ft

VERTICAL SPEED



# Point Reyes flight-data-collection

## Fra api-dokumentation

Example query with bounding box covering Switzerland: [https://opensky-](https://opensky-network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226)

[network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226](https://opensky-network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226)

[https://opensky-  
network.org/api/states/all?lamin=45.8389  
&lomin=5.9962&lamax=47.8229&lomax=  
10.5226](https://opensky-network.org/api/states/all?lamin=45.8389&lomin=5.9962&lamax=47.8229&lomax=10.5226)

Finde bbox omkring Point Reyes

lamin=

lamax=

lomin=

lomax=

**-123.143884, 37.841183, -122.573969, 38.228414**

# Point Reyes flight-data-collection

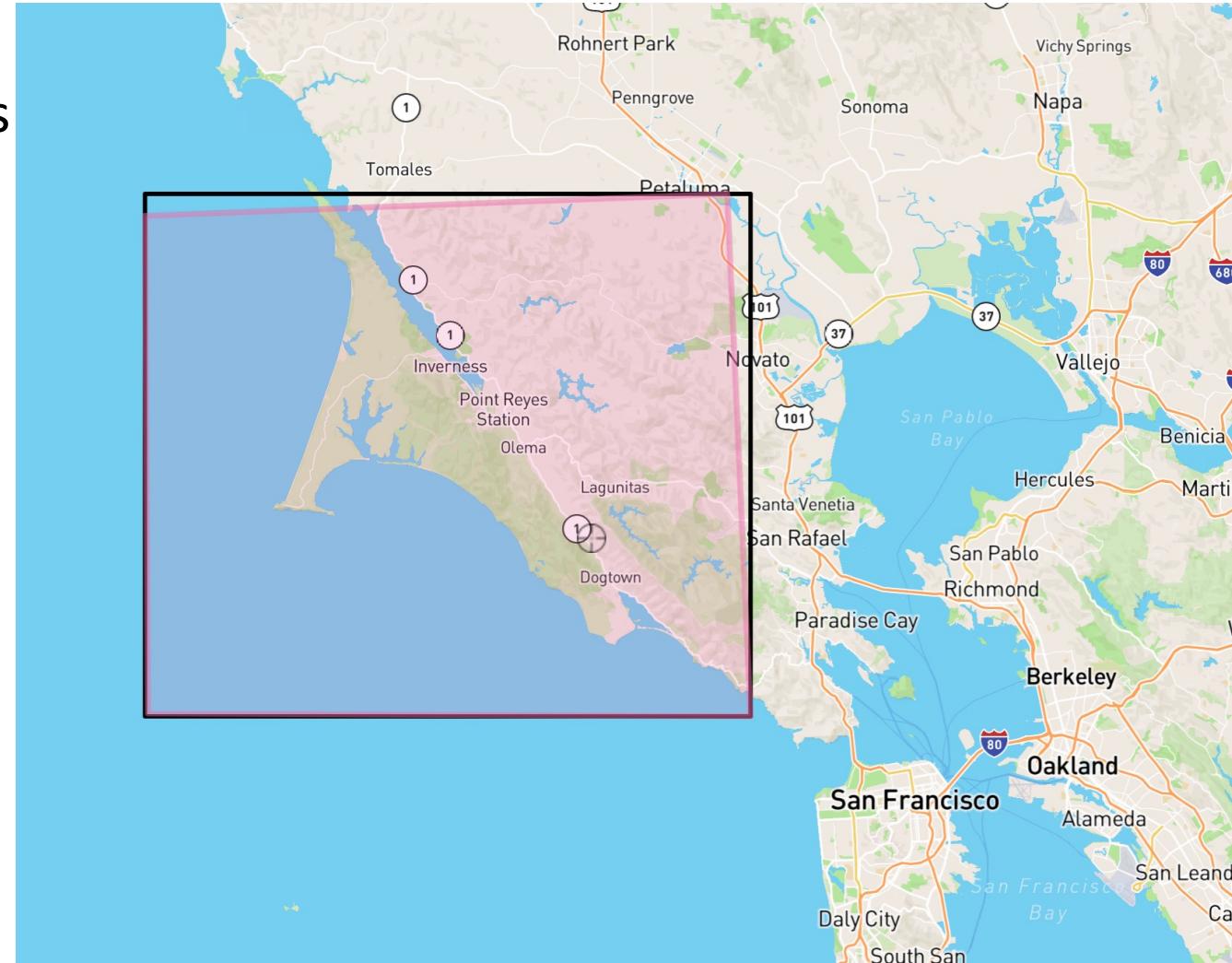
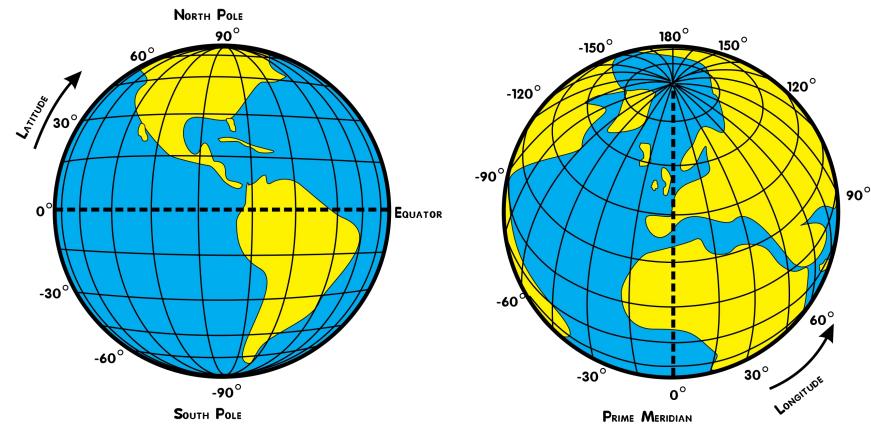
Finde bbox omkring Point Reyes

lamin= **37.841183**

lamax=**38.228414**

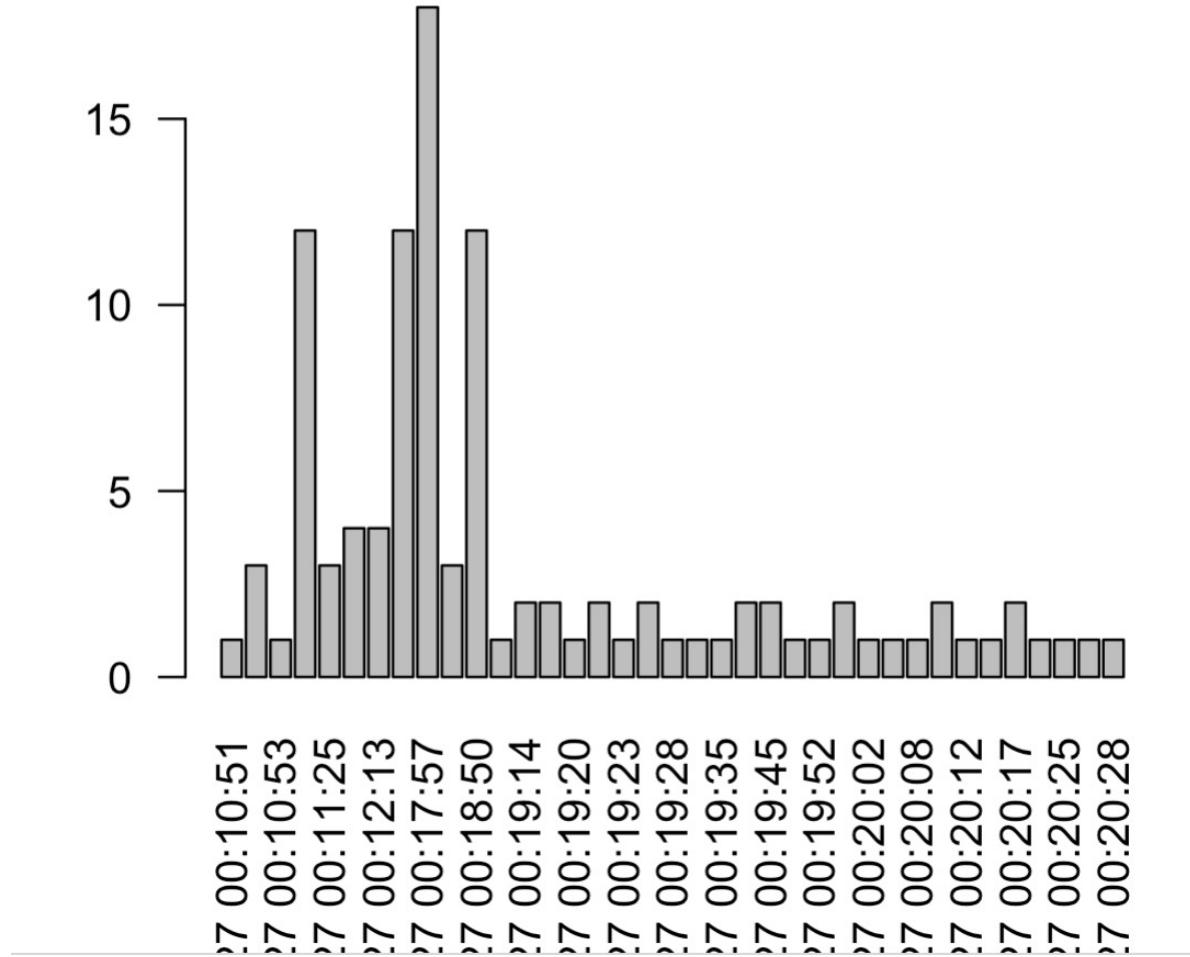
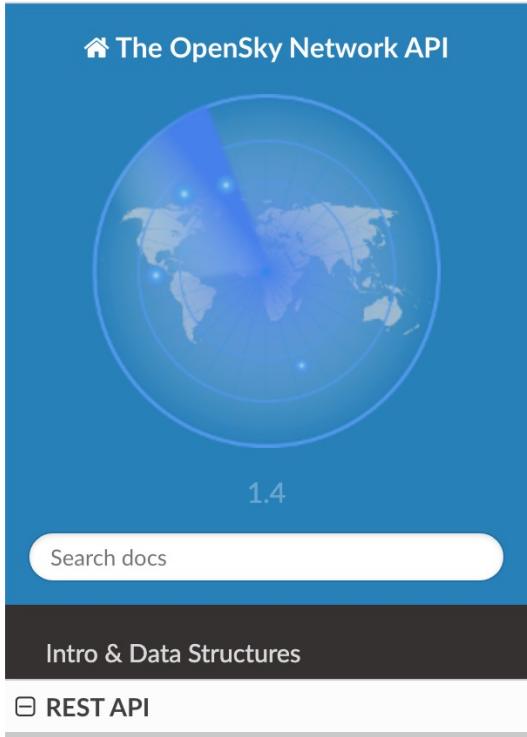
lomin= **-123.143884**

lomax= **-122.573969**



# Data-retrieval CASE: OpenSky API

liste over Point Reyes



# ØVELSE:

## kør snippet

<https://gist.github.com/cphwulf/a661c2ea17493615cd82a2b663c43704>

og find vektoren med colnames

Pause

# Data-retrieval CASE: OpenSky API

Liste over fly som krydser eget spor

prflightlist	list [11]	List of length 11
[[1]]	list [38 x 17] (S3: data.frame)	A data.frame with 38 rows and 17 columns
[[2]]	list [38 x 17] (S3: data.frame)	A data.frame with 38 rows and 17 columns
[[3]]	list [39 x 17] (S3: data.frame)	A data.frame with 39 rows and 17 columns
[[4]]	list [39 x 17] (S3: data.frame)	A data.frame with 39 rows and 17 columns
[[5]]	list [39 x 17] (S3: data.frame)	A data.frame with 39 rows and 17 columns

totaldf <- do.call('rbind',mydf)

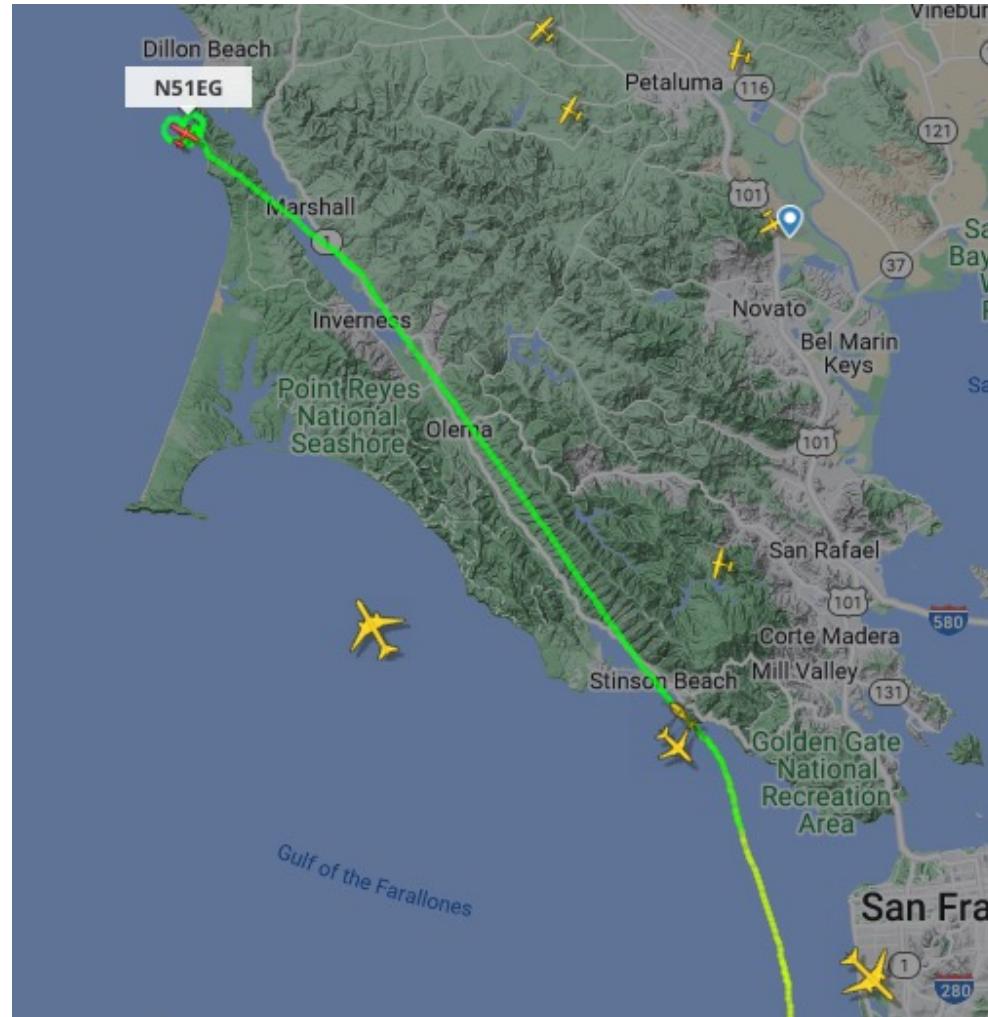
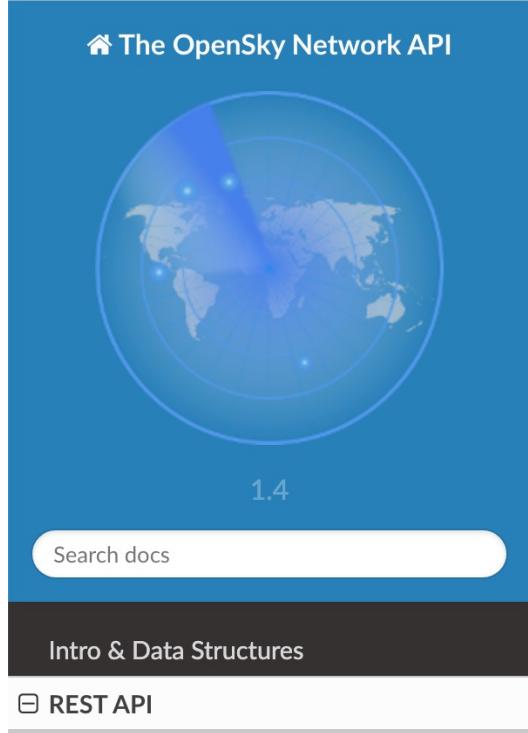
as.POSIXct(as.numeric(pltdf[1,3]), origin="1970-01-01")

icao24	callsign	time_position
a808ba	N61696	1664482763
a4142f	MMY48	1664482763
a569c4	EJM448	1664482763
aaa590	UAL1728	1664482763
a8a608	N65647	1664482514
aca97c	N915CM	1664482763
a6b572	N531PI	1664482587

	icao24	callsign	time_position	xdate
36	a4ddcd	N412Z	1664482749	2022-09-29 22:19:09
21	a19c4b	N20230	1664482758	2022-09-29 22:19:18
59	a19c4b	N20230	1664482758	2022-09-29 22:19:18
19	a9d015	N731PP	1664482760	2022-09-29 22:19:20
22	a7da84	N605HC	1664482760	2022-09-29 22:19:20

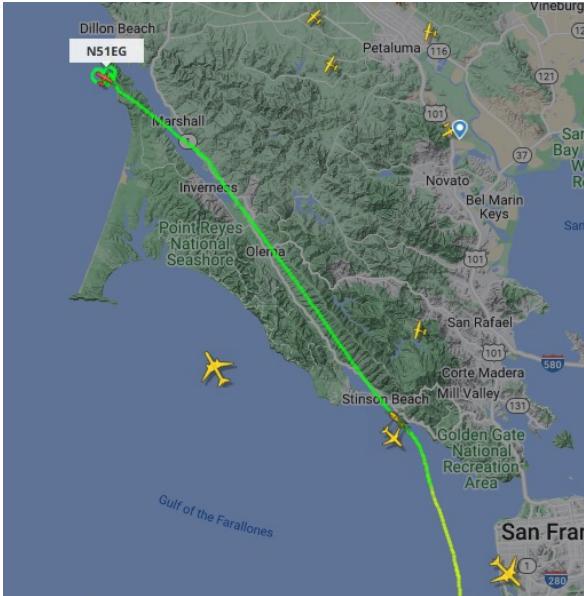
# Data-retrieval CASE: OpenSky API

Liste over fly som krydser eget spor



# Data-retrieval CASE: OpenSky API

Liste over fly som krydser eget spor

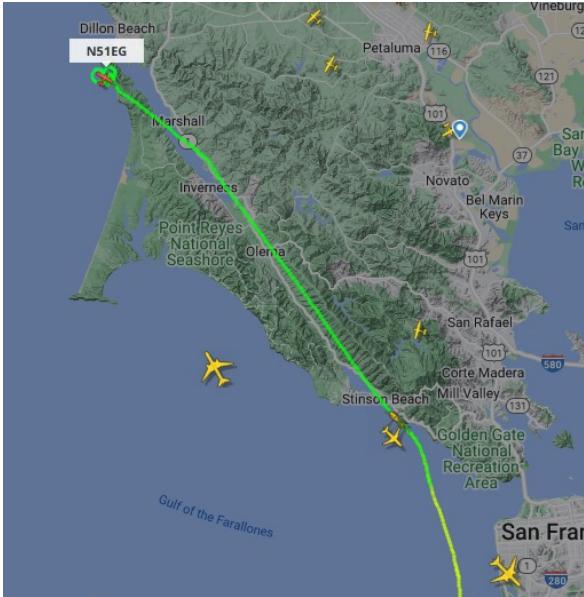


	icao24	callsign	origin_country	time_position	last_contact	longitude	latitude
155	a65f81	N51EG	United States	1664482732	1664482732	-122.9804	38.2029
139	a65f81	N51EG	United States	1664482715	1664482715	-122.9738	38.2145
123	a65f81	N51EG	United States	1664482693	1664482694	-122.9708	38.2024
108	a65f81	N51EG	United States	1664482676	1664482676	-122.9713	38.2064
94	a65f81	N51EG	United States	1664482656	1664482656	-122.9767	38.2068
81	a65f81	N51EG	United States	1664482631	1664482632	-122.9807	38.2071
65	a65f81	N51EG	United States	1664482606	1664482611	-122.9776	38.2028
49	a65f81	N51EG	United States	1664482596	1664482596	-122.9662	38.195
33	a65f81	N51EG	United States	1664482575	1664482575	-122.962	38.1907
18	a65f81	N51EG	United States	1664482551	1664482551	-122.9538	38.1865
4	a65f81	N51EG	United States	1664482530	1664482532	-122.9778	38.2045

	icao24	callsign	origin_country	time_position	last_contact	longitude	latitude
69	484368	KLM109	Kingdom of the Netherlands	1664482612	1664482612	-122.6345	37.863
53	484368	KLM109	Kingdom of the Netherlands	1664482596	1664482596	-122.6549	37.8829
37	484368	KLM109	Kingdom of the Netherlands	1664482576	1664482576	-122.6747	37.9112
22	484368	KLM109	Kingdom of the Netherlands	1664482552	1664482552	-122.6874	37.9491
8	484368	KLM109	Kingdom of the Netherlands	1664482532	1664482533	-122.6962	37.9798

# Data-retrieval CASE: OpenSky API

Liste over fly som krydser eget spor

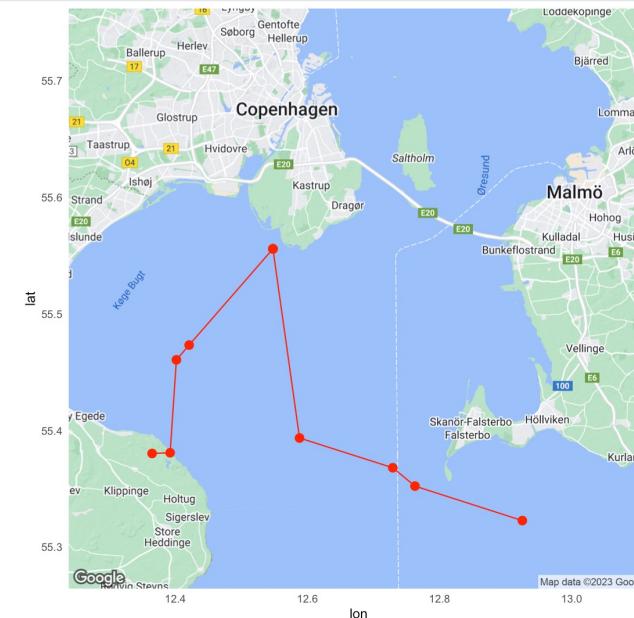


cphwulf final	
<code>dkplay.sh</code>	first try
<code>newsapi.R</code>	first try
<code>opensky.R</code>	final
<code>openskylistofplanes.R</code>	final
<code>openskyprep.R</code>	final

# Data-retrieval CASE: OpenSky API

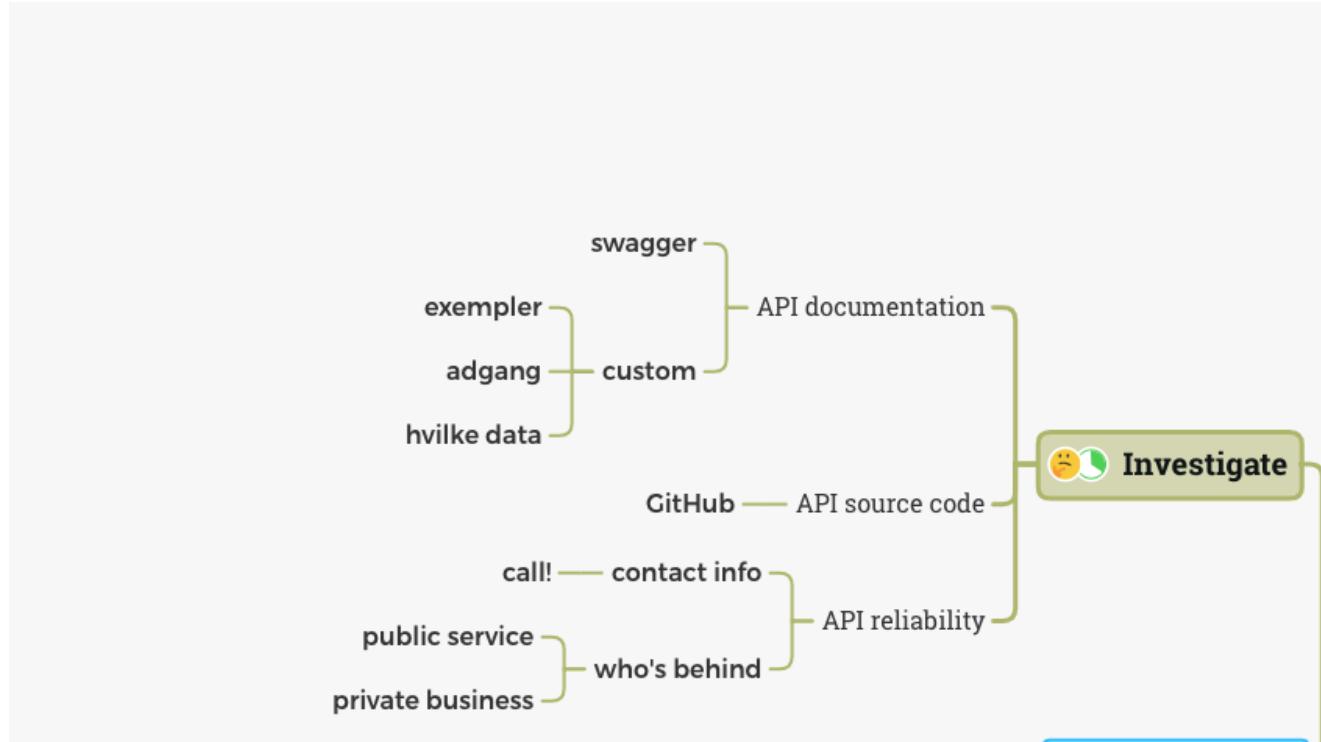
Liste over fly som krydser eget spor

	icao24	callsign	origin_country	time_position	last_contact	longitude	latitude
602	45ab54	SAS2590	Denmark	1698345141	1698345172	12.5252	55.5416
412	471f58	WZZ0F	Hungary	1698344502	1698344503	13.6309	55.4475
427	471f58	WZZ0F	Hungary	1698344518	1698344519	13.5916	55.4489
442	471f58	WZZ0F	Hungary	1698344659	1698344659	13.2605	55.4567
455	471f58	WZZ0F	Hungary	1698344683	1698344683	13.2097	55.4436
468	471f58	WZZ0F	Hungary	1698344703	1698344703	13.1655	55.4316
481	471f58	WZZ0F	Hungary	1698344839	1698344839	12.9252	55.3224
495	471f58	WZZ0F	Hungary	1698344922	1698344923	12.7626	55.3521
512	471f58	WZZ0F	Hungary	1698344944	1698344944	12.7290	55.3679
528	471f58	WZZ0F	Hungary	1698345019	1698345019	12.5878	55.3935
548	471f58	WZZ0F	Hungary	1698345124	1698345124	12.3918	55.3808
561	471f58	WZZ0F	Hungary	1698345139	1698345140	12.3645	55.3802
578	471f58	WZZ0F	Hungary	1698345259	1698345259	12.4013	55.4607
591	471f58	WZZ0F	Hungary	1698345282	1698345283	12.4206	55.4734
613	471f58	WZZ0F	Hungary	1698345449	1698345449	12.5475	55.5559



kl 11: Fremlæggelse af jeres bud på  
algoritme til at spotte ”cirklende” fly

# Data-retrieval: Find et api og en historie



# Data-retrieval: Find et api og en historie

- <https://openweathermap.org/api>
  - Hvor stormer det lige nu?
- <https://api.smk.dk/api/v1/docs/#/Artists/searchPersons>
  - Hvor mange værker er der af kvindelige kunstnere
  - Hvor god har man været til at købe kunst af kvinder op igennem tiden
- <https://data.smartdublin.ie/dublinbikes-api>
  - Hvor mange cykler er ledige på Blessington Street
- <https://newsapi.org/>
  - Hvor mange omtaler af Mette Frederiksen er der?