get_rsigra_v01.ipynb:

Google Colab notebook for tropospheric analysis

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1 Introduction

This document describes the Jupyter Notebook get_rsigra_v01.ipynb, tool for tropospheric analysis.

The notebook can be executed in Google Colab, a free Jupyter notebook environment that no requires setup.

With Google Colab, the notebook runs entirely in cloud.

NOTE:

You must have a valid Google account to be enabled to use all the features in Google Colab.

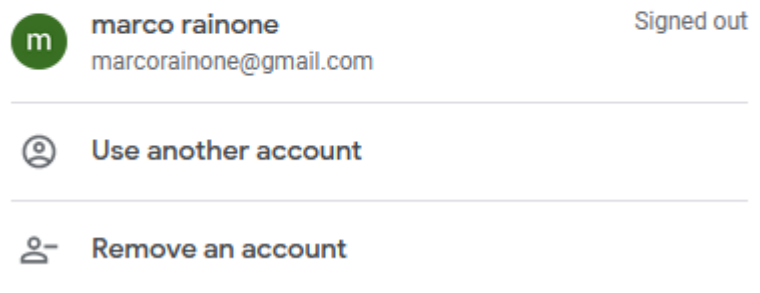You can create a new google account following this tutorial:

https://support.google.com/accounts/answer/27441?hl=en

2 Start Google Colab environment

To start working with Colab, open a browser and go to this link

https://colab.research.google.com
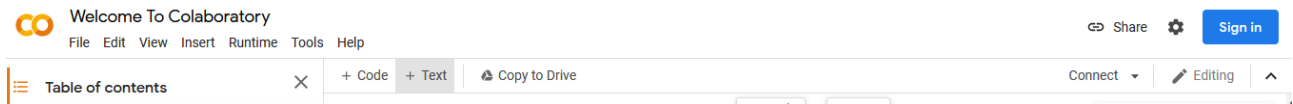
At the top right of the page, click on "Sign In"

Set username / password of your google account.
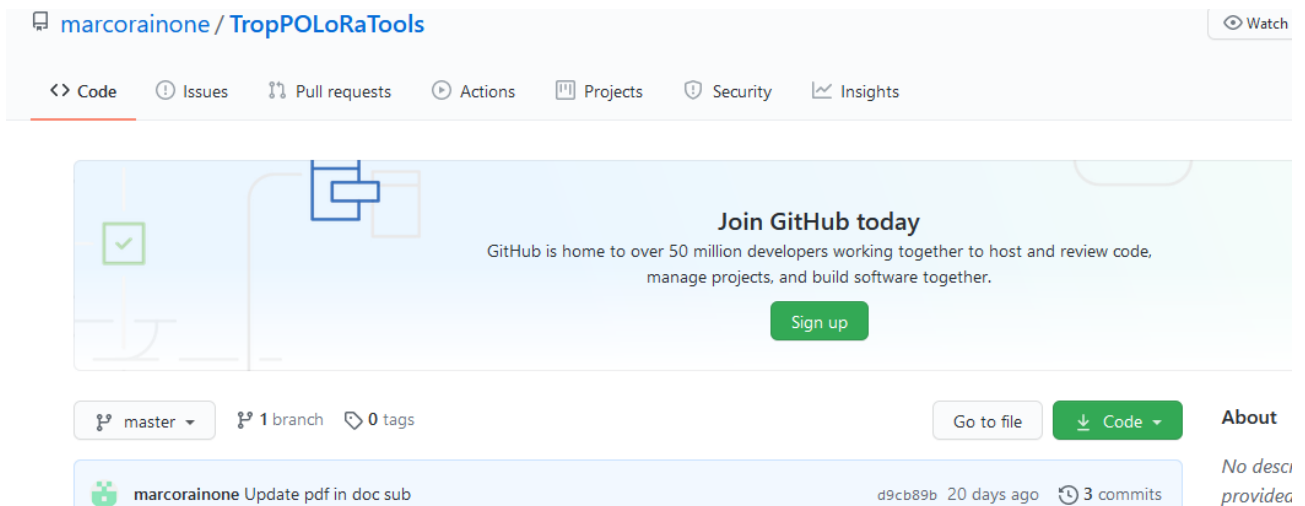
3 Notebook installation

3.1 Get the notebook and other tropospheric tools from github

The notebook **get_rsigra_v01.ipynb** is part of the TropPOLoRaTools project.

The project consists of a series of tools for Tropospheric Analysis, written in python3 and can be downloaded from github:

https://github.com/marcorainone/TropPOLoRaTools

If git is installed in your computer, to clone the repository use the command:

git clone https://github.com/marcorainone/TropPOLoRaTools.git

Otherwise, open the github webpage:

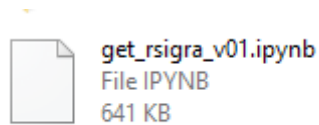https://github.com/marcorainone/TropPOLoRaTools

press the **"Code"** button and **"Download ZIP"** to get the files in github repository in a zip archive.

After that, unzip the archive in a subdirectory on your disk to create the repository locally.
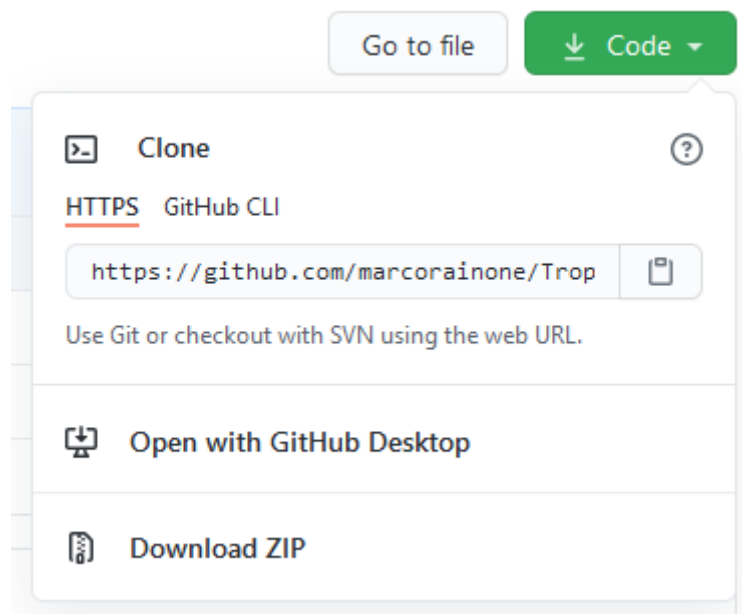
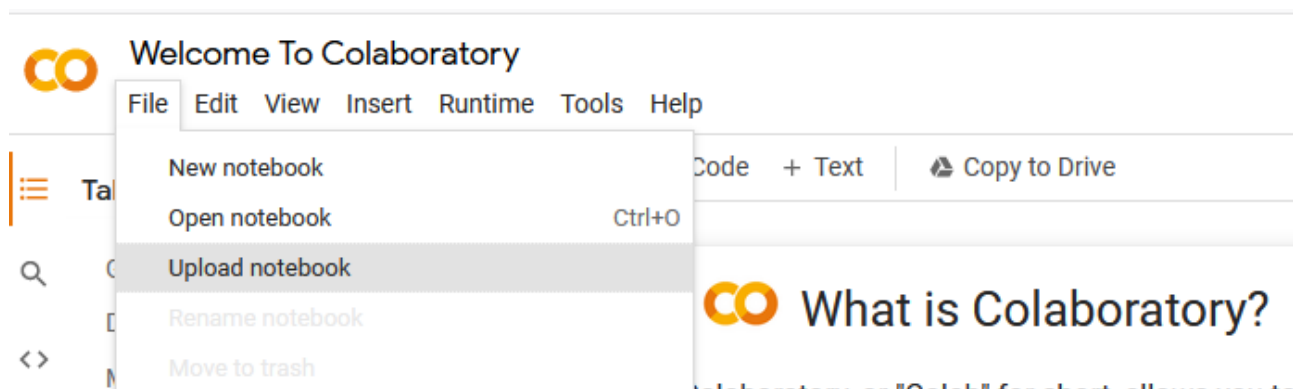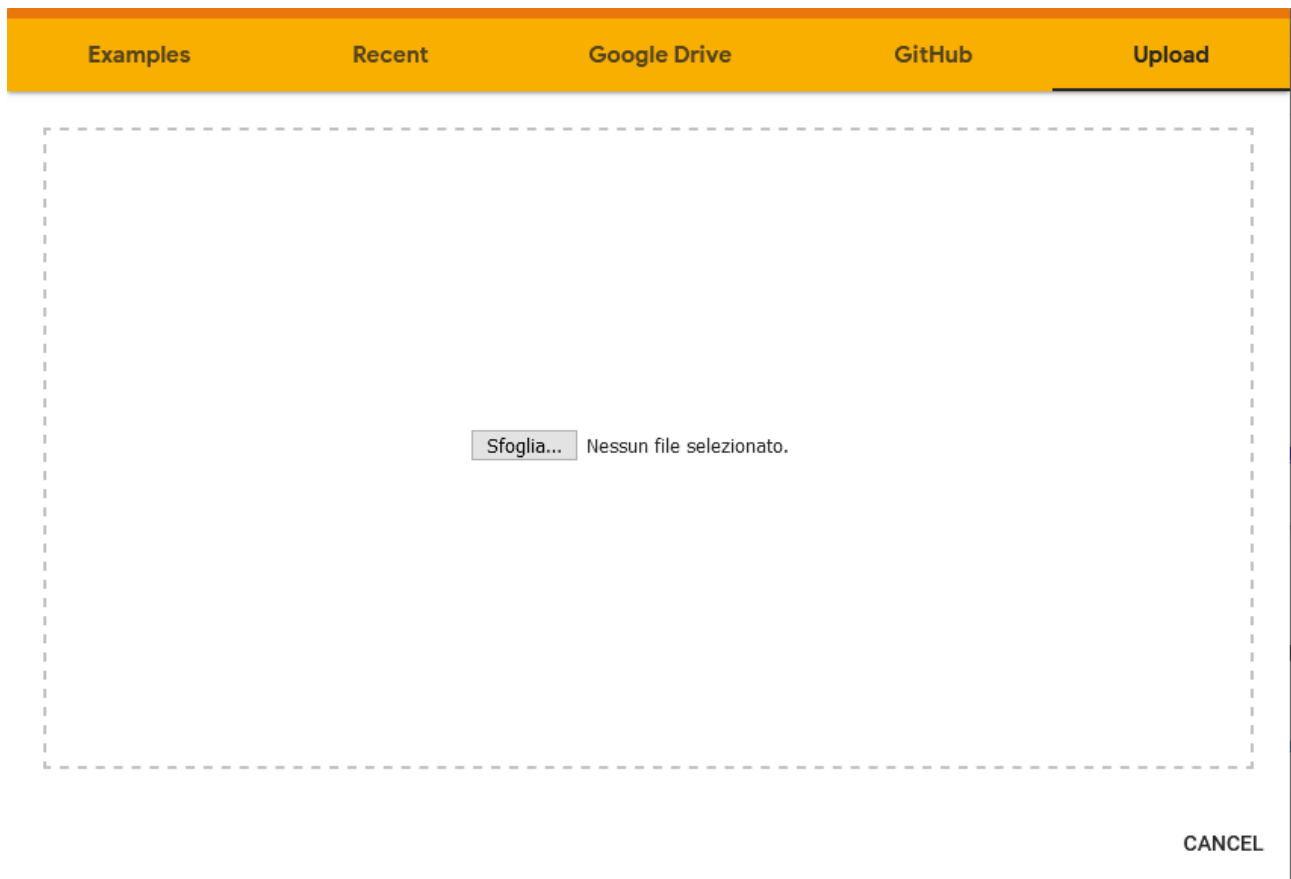The notebook get_rsigra_v01.ipynb is located in a directory of your the local repository.

3.2   Upload the notebook in your google colab environment

To upload the notebook in your google colab environment, on the web page:

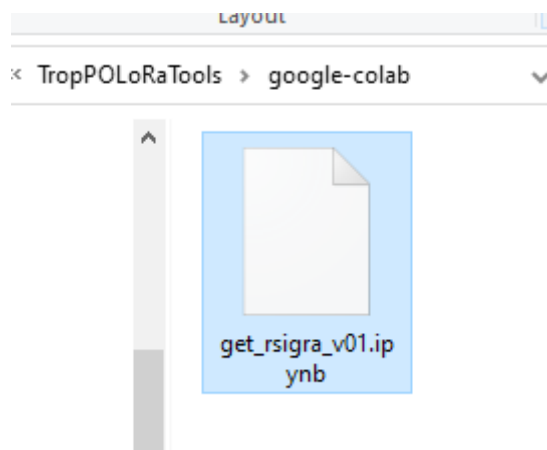https://colab.research.google.com/notebooks/intro.ipynb?hl=en

Select the menu items: **File → Upload notebook**

Press the **Browse** button.

Select the file **get_rsigra_v01.ipynb**, stored in your local github repository

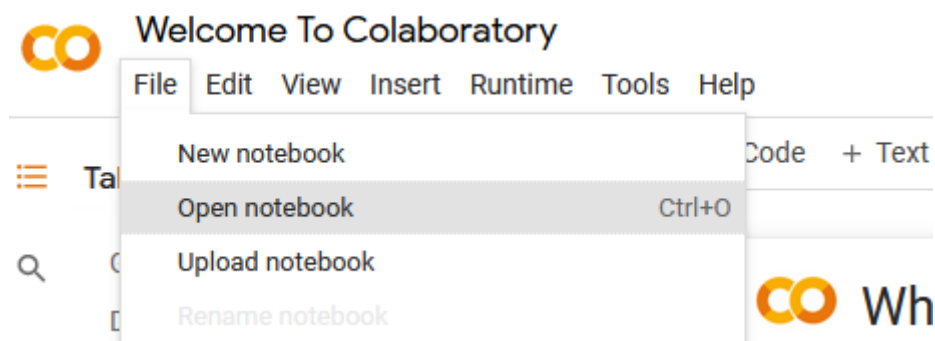In google colab webpage, select the menu items **Upload**.

3.3 Open the get_rsigra_v01.ipynb notebook

On the web page:
https://colab.research.google.com/notebooks/intro.ipynb?hl=en

Select the menu items: **File – Open notebook**

Click on **get_rsigra_v01.ipynb** to open the notebook.

CO   🔺 get-rsigra-v01.ipynb ☆

File   Edit   View   Insert   Runtime   Tools   Help

💬 Comment   👥 Share   ⚙   m

+ Code   + Text   Connect ▾   ✏ Editing   ⌃

Anomalous Tropospheric Propagation Analysis using IGRA Radiosonde Data

[IGRA, National Oceanic and Atmospheric Administration](#)

The Integrated Global Radiosonde Archive (IGRA) consists of radiosonde and pilot balloon observations at over 2,700 globally distributed stations.

▶   Notebook initialization

▶   Get IGRA radiosonde index

4 Example of Tropospheric Propagation Analysis performed with the notebook

Suppose we want to analyze an event that took place in Germany, providing these data:

ID Node	**node1**
Gps coordinates of the Node	**(48.7066 , 13.5429)**
ID gateway	**gateway**
Gps coordinates of the Gateway	**(47.5769 , 10.1749)**
Start day and time of analysis	**13/9/2020**
n. days to analyze	**4**

Scroll the notebook and you find the cell with the title
“Input parameters”

Here set the input values:

First point: TX node

ID_point_1:   **node1**

Latitude range from -90 to 90 (-90: South Pole +90: North Pole)

Latitude_1:   **48.7066**

Longitude range from -180 to 180.

Longitude_1:   **13.5429**

Second point: RX node or gateway

ID_point_2:   **gateway**

Latitude range from -90 to 90 (-90: South Pole +90: North Pole)
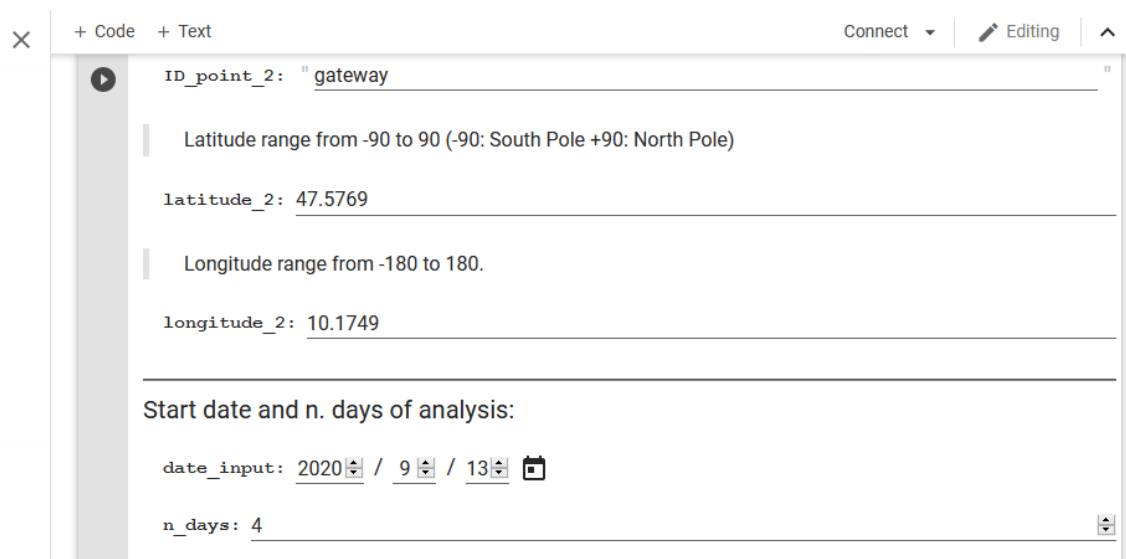
Latitude_2:   **47.5769**

Longitude range from -180 to 180.

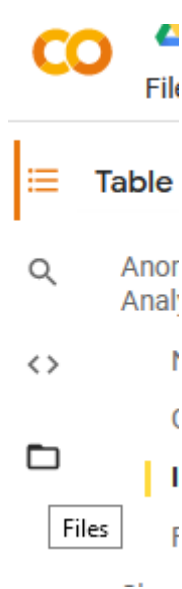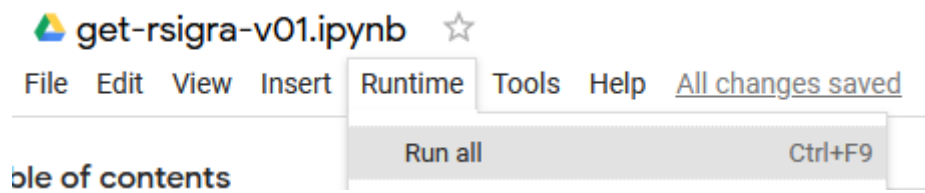Longitude_2:   **10.1749**

Start date and n. days of analysis:

date_input: **2020/09/13**

n_days: **4**

Completed the insertion of parameters, to start the analysis, select the menu items **Runtime - Run All** (shortcut: **Ctrl+F9**).

get-rsigra-v01.ipynb

File   Edit   View   Insert   Runtime   Tools   Help   All changes saved

Run all   Ctrl+F9

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Files

The analysis creates a series of files and graphs.

In the left side of notebook there is a folder icon.
Click on folder icon appear a set of sub-folders.

Data is the sub-dir that store the files generated by
the analysis.

Files

..

data

sample_data
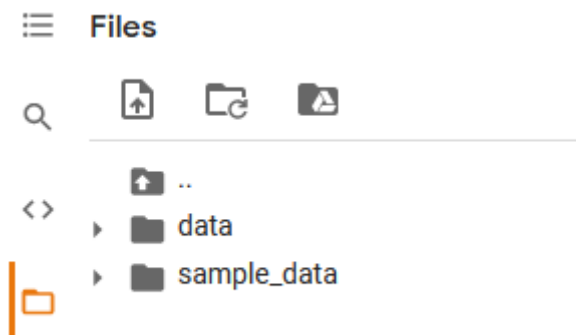
Clicking on the subfolder data, appears the list of files gener-
ated during the analysis.

Some files are used during the intermediate stages of the analysis.

For the user, these are the most interesting files generated with the data provided

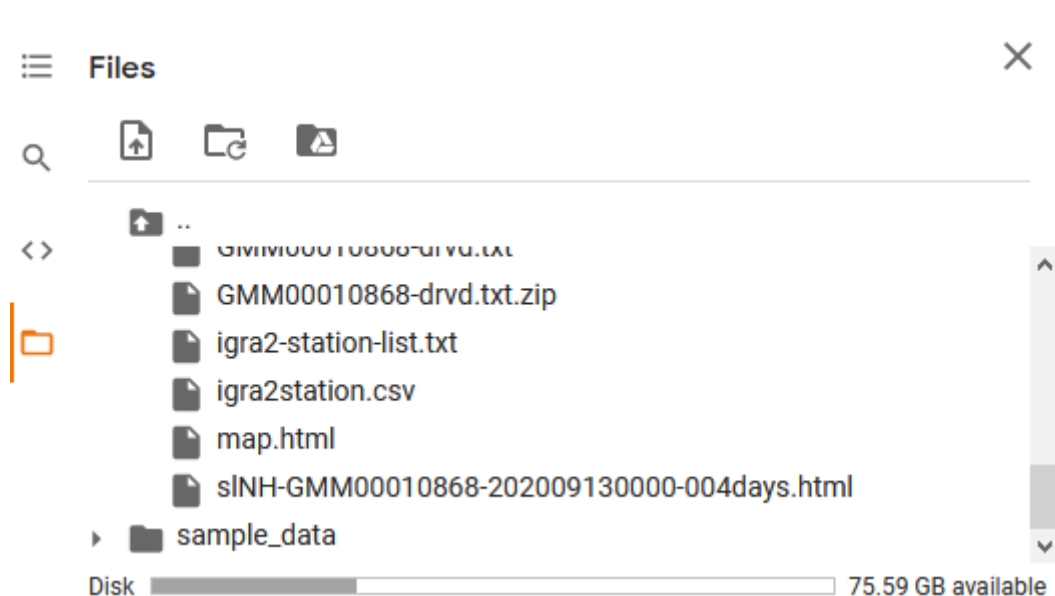| igra2-station-list.txt	List of radiosondes downloaded from IGRA site
GMM00010868-drvd.txt.zip	Data acquired from the radiosonde GMM00010868. This is the radiosonde that has the closest position to the node and gateway coordinates provided in input to the notebook.
map.html	Map with positions of radiosonde, node and gateway in html format.
slNH-GMM00010868-202009130000-004days.html	Graph in html format generated by the analysis

Each file in data can be downloaded locally:

Point the file name and right click on it.

Appears a menu.

Select **download** to save the file locally in your disk.
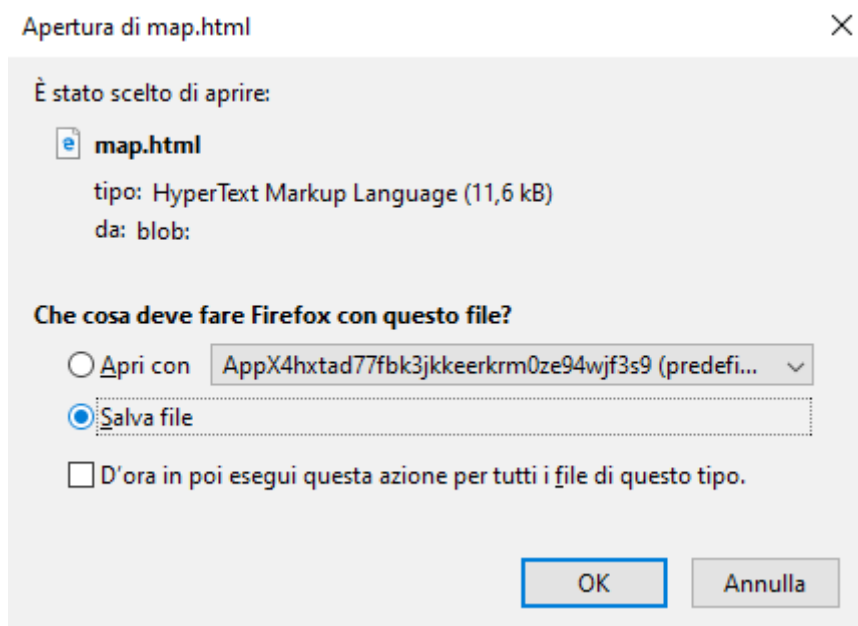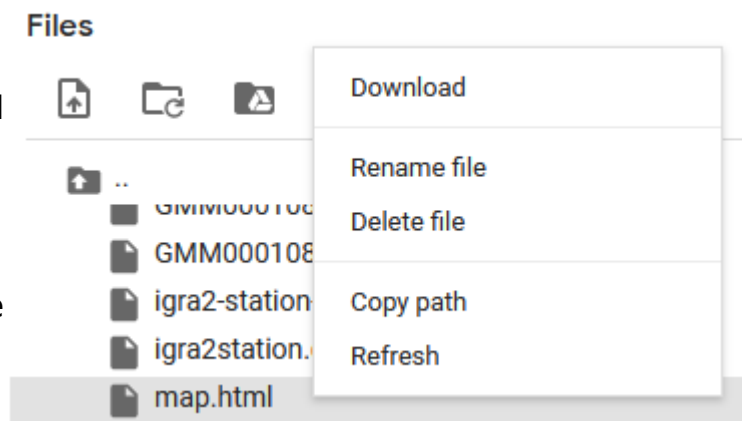
5 Map and graph generated by the analysis

As a final result, the notebook analysis generates two files in html format containing a map and a graph.

In this example:

map.html	Map with positions of radiosonde, node and gateway in html format.
slNH-GMM00010868-202009130000-004days.html	Graph in html format generated by the analysis

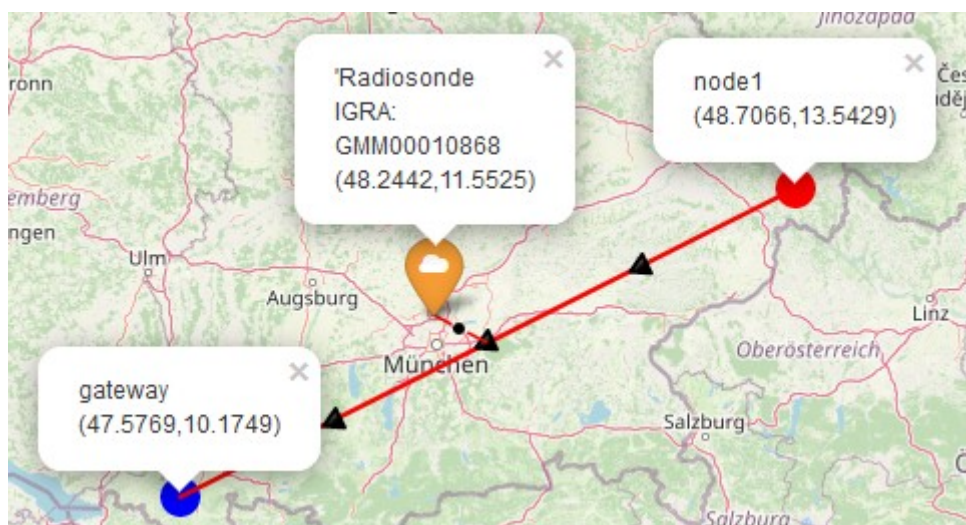The map and graph are also displayed in the notebook.
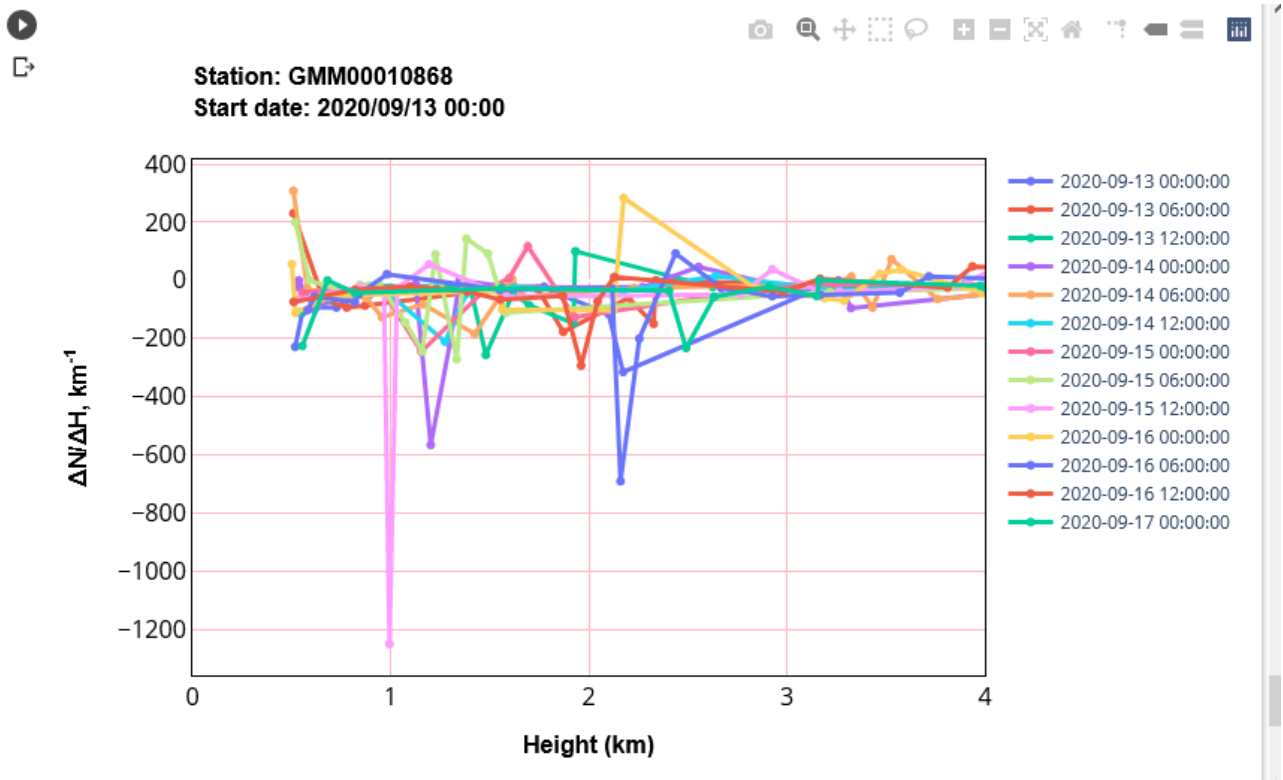
5.1 The interactive map
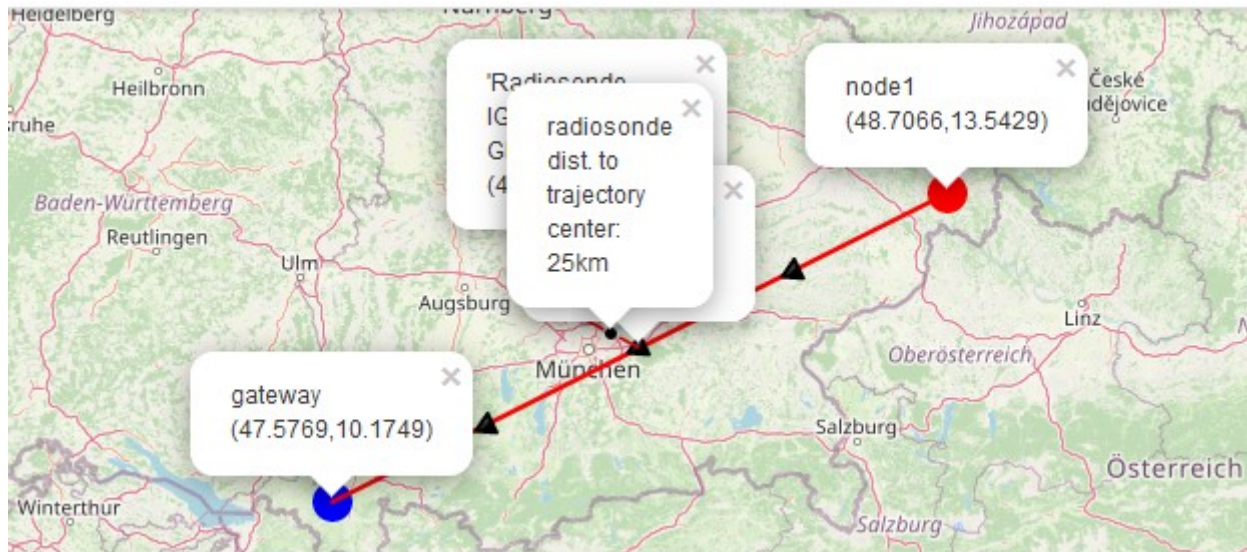
The map displays the location of the node, the gateway and the radiosonde (the analysis find the closest IGRA radiosonde to the two points).

You can:

- move and zoom in or out on the map.
- click to hide any overlapping textboxes.

5.2 Analysis graph

The graph displays the ratio between the ΔN and ΔH (height variation of radiosonde) as a function of the height reached by the radiosonde.

To distinguish each launch, each is drawn with different colors.

In this example, analyzing 4 days from the date provided, the graph shows that were made 13 launches of the GMM00010868 radiosonde.

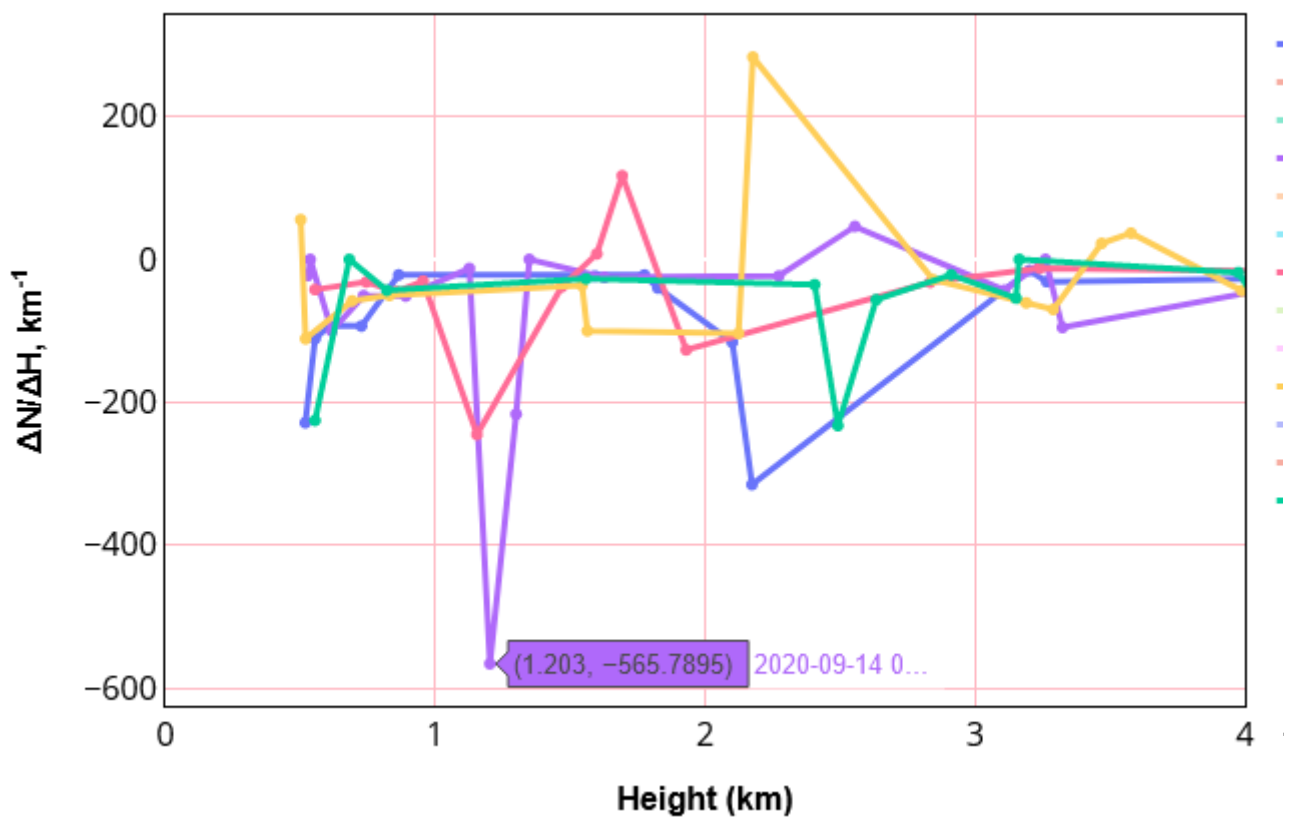Every day, 3 launches of the radiosonde were made:

at 00:00, 06:00 and 12:00.

It is possible that two or only one launch per day are made for other radiosondes.
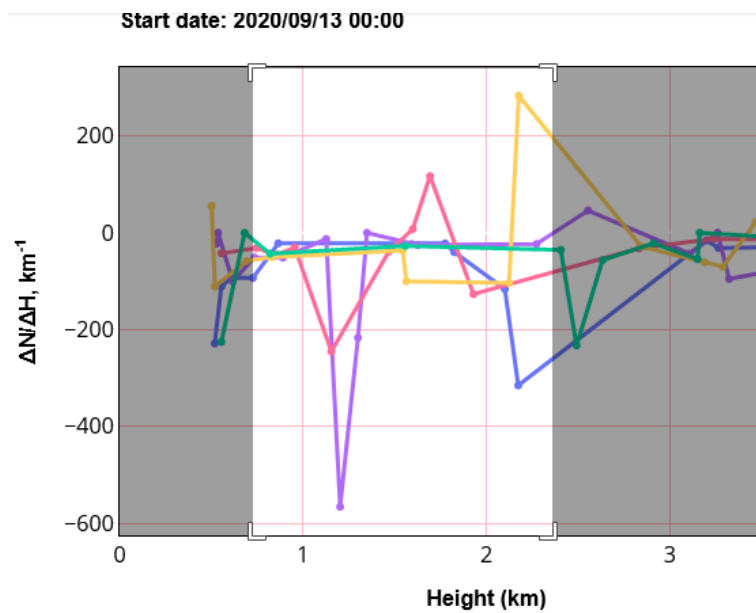
On the graph, we can hide or display any traces:

on the legend to the right of the graph, click on the line corresponding to the launch.

passing with the mouse on the trace the values of (height, ΔN/ΔH) are displayed.

It is possible to select a zone and zoom the selection.

Start date: 2020/09/13 00:00