

# MeteoCH.output

April 2, 2023

## 1 Meteoschweiz

### 1.1 Current meteorological observations

```
[1]: # 'Soft' reset: Only clears your namespace, leaving history intact.
%reset -sf
import pandas as pd
from datetime import datetime
import matplotlib.cbook
```

### 1.2 Available weather stations

```
[2]: url = 'https://data.geo.admin.ch'
path = 'ch.meteoschweiz.klima/nbcn-tageswerte'
wsurl = url + '/' + path + '/' + 'liste-download-nbcn-d.csv'
ws = pd.read_csv(wsurl, sep=";", header=0, encoding = "ISO-8859-1").dropna()
ws.drop(['URL Previous years (verified data)', 'URL Current year'], axis=1)
```

```
[2]:
```

	Station	station/location	WIGOS-ID	Data since	\
0	Altdorf	ALT	0-20000-0-06672	01.01.1864	
1	Andermatt	ANT	0-20000-0-06695	01.01.1864	
2	Basel / Binningen	BAS	0-20000-0-06601	01.01.1755	
3	Bern / Zollikofen	BER	0-20000-0-06631	01.01.1864	
4	La Chaux-de-Fonds	CDF	0-20000-0-06612	01.01.1900	
5	Château-d'Oex	CHD	0-20000-0-06627	01.01.1879	
6	Chaumont	CHM	0-20000-0-06608	01.01.1864	
7	Davos	DAV	0-20000-0-06784	01.01.1864	
8	Elm	ELM	0-20000-0-06682	01.02.1878	
9	Engelberg	ENG	0-20000-0-06655	01.01.1864	
10	Grächen	GRC	0-20000-0-06728	01.01.1864	
11	Grimsel Hospiz	GRH	0-20000-0-06744	01.01.1932	
12	Col du Grand St-Bernard	GSB	0-20000-0-06717	01.01.1818	
13	Genève / Cointrin	GVE	0-20000-0-06700	01.01.1753	
14	Jungfrauoch	JUN	0-20000-0-06730	01.01.1933	
15	Lugano	LUG	0-20000-0-06770	01.01.1864	
16	Luzern	LUZ	0-20000-0-06650	01.01.1864	
17	Meiringen	MER	0-20000-0-06637	01.07.1889	

18	Neuchâtel	NEU	0-20000-0-06604	01.01.1864
19	Locarno / Monti	OTL	0-20000-0-06760	01.12.1882
20	Payerne	PAY	0-20000-0-06610	01.08.1964
21	Bad Ragaz	RAG	0-20000-0-06686	01.06.1870
22	Säntis	SAE	0-20000-0-06680	01.01.1864
23	Samedan	SAM	0-20000-0-06792	01.01.1864
24	S. Bernardino	SBE	0-20000-0-06783	01.01.1864
25	Segl-Maria	SIA	0-20000-0-06779	01.12.1863
26	Sion	SIO	0-20000-0-06720	01.01.1864
27	Zürich / Fluntern	SMA	0-20000-0-06660	01.01.1864
28	St. Gallen	STG	0-20000-0-06681	01.01.1864

	Station height m. a. sea level	CoordinatesE	CoordinatesN	Latitude \
0	438.0	2690181.0	1193564.0	46.887069
1	1438.0	2687445.0	1165044.0	46.630914
2	316.0	2610909.0	1265612.0	47.541142
3	553.0	2601934.0	1204410.0	46.990744
4	1017.0	2550919.0	1214862.0	47.082947
5	1028.0	2577040.0	1147655.0	46.479819
6	1136.0	2565060.0	1211007.0	47.049169
7	1594.0	2783519.0	1187459.0	46.812969
8	958.0	2732266.0	1198425.0	46.923747
9	1036.0	2674162.0	1186069.0	46.821639
10	1605.0	2630738.0	1116062.0	46.195314
11	1980.0	2668583.0	1158215.0	46.571689
12	2472.0	2579191.0	1079754.0	45.869092
13	411.0	2498904.0	1122632.0	46.247519
14	3571.0	2641939.0	1155287.0	46.547556
15	273.0	2717874.0	1095883.0	46.004217
16	454.0	2665545.0	1209850.0	47.036439
17	589.0	2655844.0	1175930.0	46.732222
18	485.0	2563087.0	1205560.0	47.000067
19	367.0	2704167.0	1114316.0	46.172256
20	490.0	2562131.0	1184612.0	46.811581
21	497.0	2756911.0	1209351.0	47.016631
22	2501.0	2744188.0	1234920.0	47.249447
23	1709.0	2787251.0	1155685.0	46.526247
24	1639.0	2734116.0	1147294.0	46.463542
25	1804.0	2778576.0	1144976.0	46.432331
26	482.0	2591633.0	1118584.0	46.218650
27	556.0	2685118.0	1248066.0	47.377925
28	776.0	2747866.0	1254588.0	47.425475

	Longitude	Climate region	Canton
0	8.621894	Central Alpine north slope	UR
1	8.580553	Central Alpine north slope	UR
2	7.583525	Eastern Jura	BL

3	7.464061	Central plateau	BE
4	6.792314	Western Jura	NE
5	7.139656	Western Alpine north slope	VD
6	6.978825	Western Jura	NE
7	9.843558	Northern and central Grisons	GR
8	9.175350	Eastern Alpine north slope	GL
9	8.410514	Central Alpine north slope	OW
10	7.836822	Valais	VS
11	8.333256	Western Alpine north slope	BE
12	7.170683	Alpine south side	VS
13	6.127742	Western plateau	GE
14	7.985444	Western Alpine north slope	VS
15	8.960322	Alpine south side	TI
16	8.301022	Central plateau	LU
17	8.169247	Western Alpine north slope	BE
18	6.953297	Western plateau	NE
19	8.787494	Alpine south side	TI
20	6.942469	Western plateau	VD
21	9.502594	Northern and central Grisons	SG
22	9.343469	Eastern Alpine north slope	AI
23	9.879469	Engadine	GR
24	9.184700	Alpine south side	GR
25	9.762325	Engadine	GR
26	7.330203	Valais	VS
27	8.565742	North-eastern plateau	ZH
28	9.398528	North-eastern plateau	SG

### 1.3 Select one weather station

```
[3]: # Define the default parameters and tag the cell accordingly
wsno = -1 # default -1 selects the last index, 2 sets BAS weather station
#
# Calling syntax from shell:
#
# time for i in {0..28}; do \
#   papermill MeteoCH.ipynb \
#   MeteoCH.output.ipynb \           # ...or /dev/null
#   -p wsno $i; done
#
# The time command at the beginning of the call may be omitted.
```

```
[4]: # Parameters
wsno = 15
```

```
[5]: wstation = ws['Station'].tolist()[wsno]
print(wsno)
ws[ws.Station==wstation]
```

```
label = ws[ws.Station==wstation]['station/location'].to_string()[::-1][0:3][::-1]
print(f"The label of weather station {wstation} is {label}.")
```

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The label of weather station Lugano is LUG.

## 1.4 Read online observations from selected weather station

```
[6]: maxrows = 400 # displayed number of past days
filenm = "nbcn-daily_"
ext="csv"
currurl = url + "/" + path + "/" + filenm + label + "_current." + ext
prevurl = url + "/" + path + "/" + filenm + label + "_previous." + ext
cf = pd.read_csv(currurl, sep=";", index_col='date', converters={'date':pd.
    to_datetime}).drop(['station/location'], axis=1) #, engine='pyarrow')
for col in cf.columns:
    cf[col] = pd.to_numeric(cf[col], errors='coerce')
pf = pd.read_csv(prevurl, sep=";", index_col='date', converters={'date':pd.
    to_datetime}).drop(['station/location'], axis=1) #, engine='pyarrow')
for col in pf.columns:
    pf[col] = pd.to_numeric(pf[col], errors='coerce')
df = pd.concat([pf, cf], axis=0).tail(maxrows)
```

## 1.5 Compute summary statistics

```
[7]: df.describe()
```

```
[7]:
```

	gre000d0	hto000d0	nto000d0	prestad0	rre150d0	sre000d0	\
count	400.000000	400.00	399.000000	400.000000	400.000000	400.000000	
mean	167.995000	0.01	51.812030	982.104500	2.885500	397.377500	
std	99.637715	0.20	31.474441	7.774177	10.495171	250.919222	
min	8.000000	0.00	0.000000	954.900000	0.000000	0.000000	
25%	84.750000	0.00	25.000000	978.100000	0.000000	184.000000	
50%	155.500000	0.00	54.000000	982.350000	0.000000	426.000000	
75%	249.500000	0.00	79.000000	986.600000	0.325000	624.000000	
max	363.000000	4.00	100.000000	1000.900000	156.100000	774.000000	

	tre200d0	tre200dn	tre200dx	ure200d0
count	400.000000	400.000000	400.000000	400.000000
mean	13.997000	10.185000	18.300500	67.635250
std	7.232923	6.577799	8.081546	15.657345
min	0.900000	-2.100000	4.000000	23.700000
25%	7.800000	4.500000	11.375000	56.475000
50%	12.850000	9.350000	17.300000	68.300000
75%	20.725000	16.025000	25.625000	79.725000
max	28.300000	23.700000	34.200000	99.200000

```
[8]: (rows, cols) = df.shape
print(f"{rows} observations from {min(df.index)} to {max(df.index)}.")
```

400 observations from 2022-02-25 00:00:00 to 2023-03-31 00:00:00.

## 1.6 Description of observed parameters

```
[9]: from urllib.request import urlopen
from io import BytesIO
from zipfile import ZipFile

zip_url = url + "/" + path + "/" + "data.zip"
plist = [] # parameter
ulist = [] # unit
dlist = [] # description

with urlopen(zip_url) as f:
    with BytesIO(f.read()) as b, ZipFile(b) as myzipfile:
        rf = myzipfile.open('1_how-to-download-nbcn-d.txt')
        blines = rf.readlines()
        rf.close()
        for i in range(14, 25):
            line = blines[i].decode('unicode-escape').rstrip('\r\n')
            plist.append(line[0:21].strip())
            ulist.append(line[21:38].strip())
            dlist.append(line[38:].strip('\n'))

# list of lists instead of list of tuples
##zipped = zip(plist[1:], ulist[1:], dlist[1:])
list_of_lists = [list(tup) for tup in zip(plist[1:], ulist[1:], dlist[1:])]
cols = [plist[0], ulist[0], dlist[0]]

par = pd.DataFrame(list_of_lists, columns = cols)
print(par)
```

	Parameter	Einheit	Beschreibung
0	gre000d0	W/m <sup>2</sup>	Globalstrahlung; Tagesmittel
1	hto000d0	cm	Gesamtschneehöhe; Morgenmessung von 6 UTC
2	nto000d0	%	Gesamtbewölkung; Tagesmittel
3	prestad0	hPa	Luftdruck auf Stationshöhe (QFE); Tagesmittel
4	rre150d0	mm	Niederschlag; Tagessumme 6 UTC - 6 UTC Folgetag
5	sre000d0	min	Sonnenscheindauer; Tagessumme
6	tre200d0	°C	Lufttemperatur 2 m über Boden; Tagesmittel
7	tre200dn	°C	Lufttemperatur 2 m über Boden; Tagesminimum
8	tre200dx	°C	Lufttemperatur 2 m über Boden; Tagesmaximum
9	ure200d0	%	Relative Luftfeuchtigkeit 2 m über Boden; Tage...

## 1.7 Scatter plot air temperature

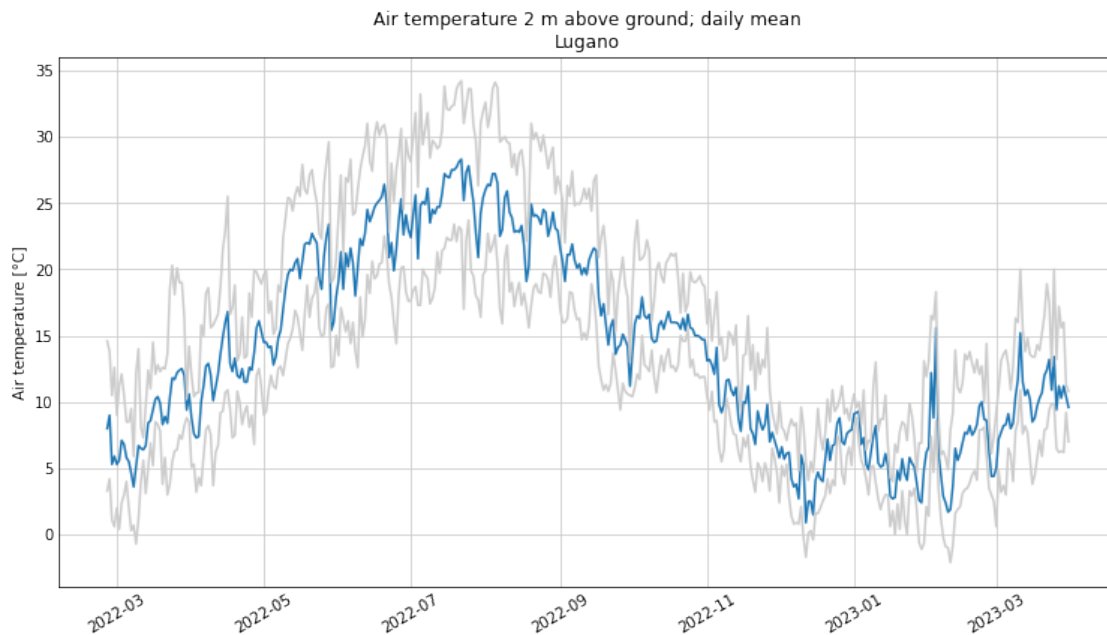
```
[10]: import matplotlib.pyplot as plt
plt.style.use('_mpl-gallery')
fswidth = 10
fsheight = 5
```

```
[11]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.tre200d0)
axs.plot(df.index, df.tre200dn, color='0.8')
axs.plot(df.index, df.tre200dx, color='0.8')
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')
#axs.grid(which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Air temperature [°C]')
plt.title('Air temperature 2 m above ground; daily mean\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



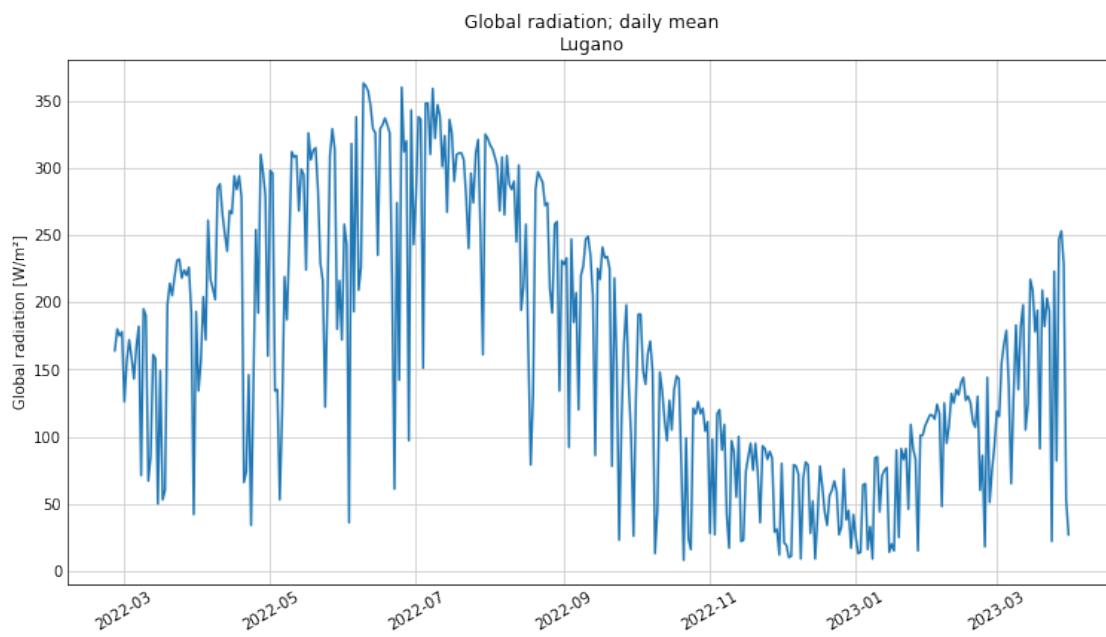
## 1.8 Scatter plot global radiation

```
[12]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.gre000d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Global radiation [W/m²]')
plt.title('Global radiation; daily mean\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



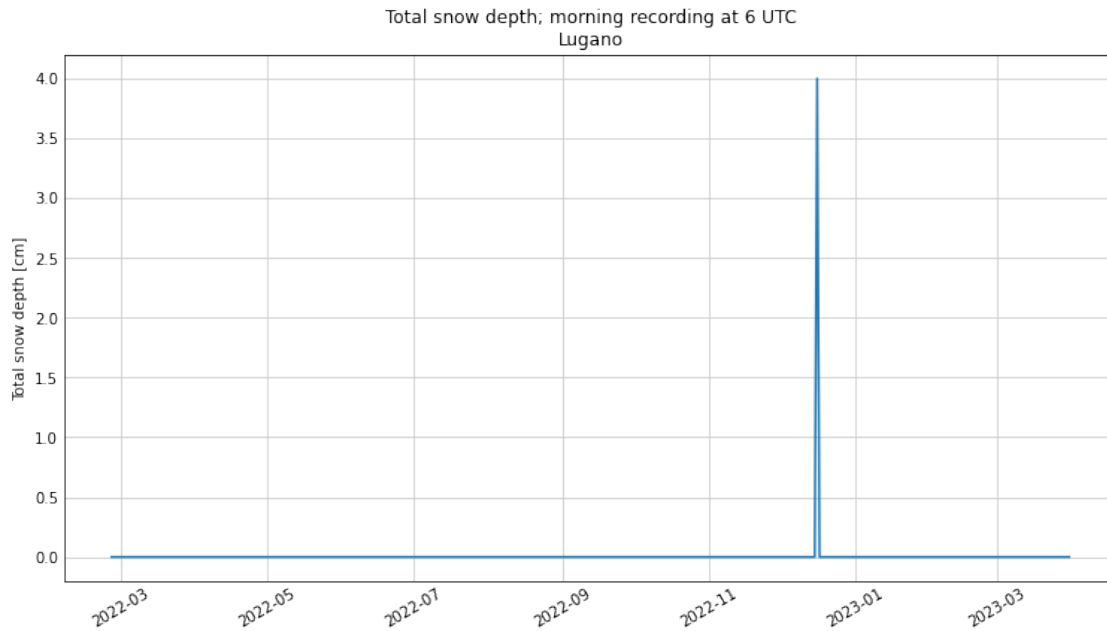
## 1.9 Scatter plot total snow depth

```
[13]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.hto000d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Total snow depth [cm]')
plt.title('Total snow depth; morning recording at 6 UTC\n' + wstation)
plt.xticks(rotation=30)
```

```
plt.show()
```



### 1.10 Scatter plot cloud cover

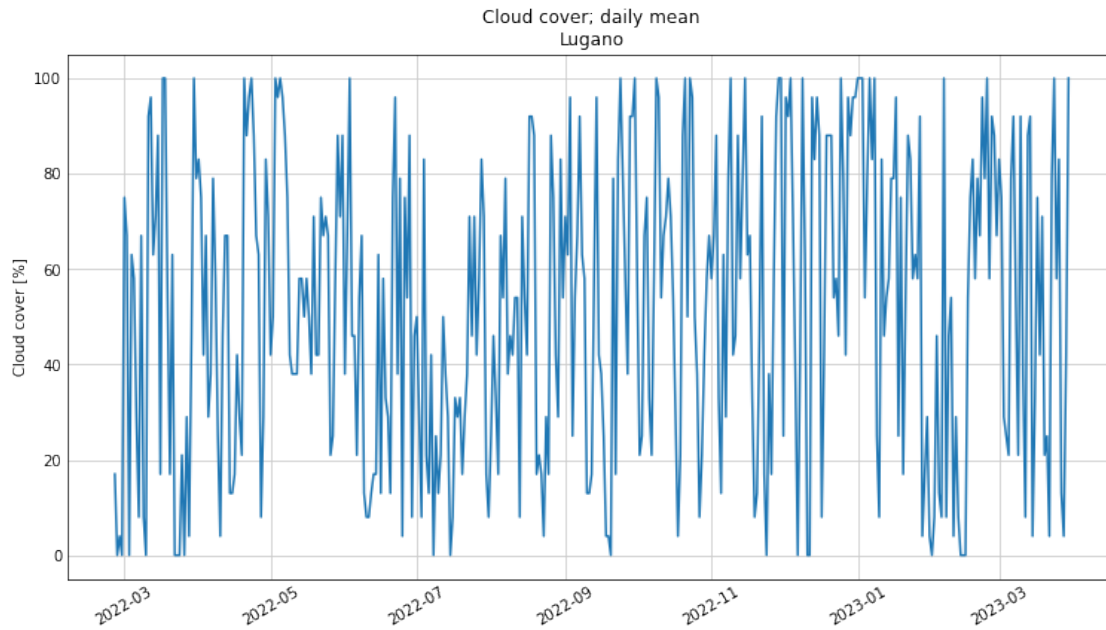
```
[14]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.nton000d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='--')

plt.xlabel('')
plt.ylabel('Cloud cover [%]')
plt.title('Cloud cover; daily mean\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```





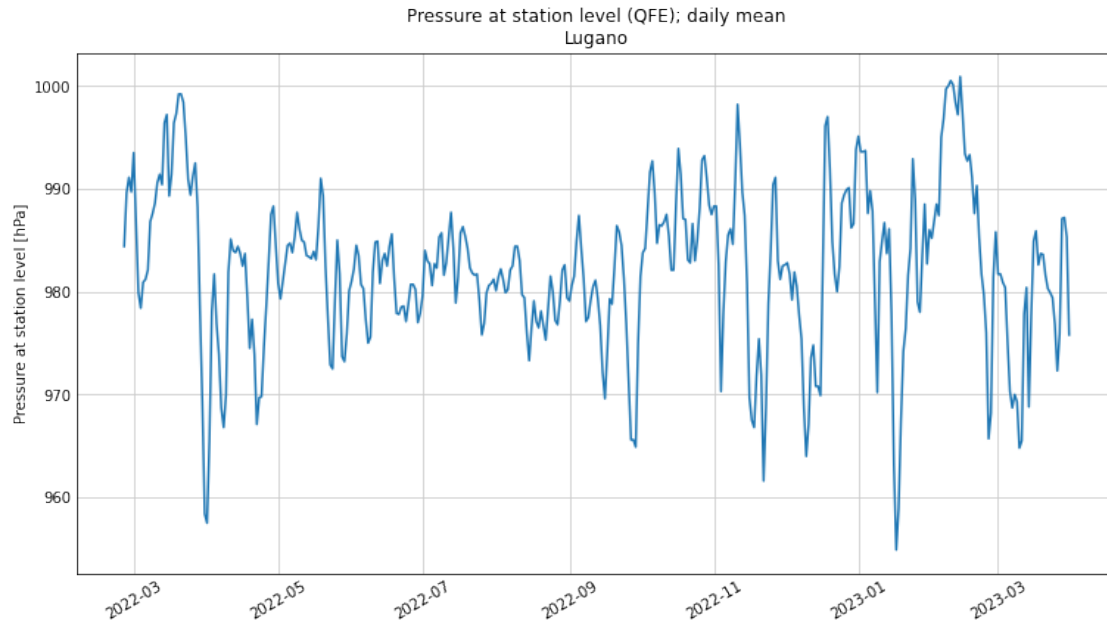
### 1.11 Scatter plot pressure at station level

```
[15]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.prestad0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Pressure at station level [hPa]')
plt.title('Pressure at station level (QFE); daily mean\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



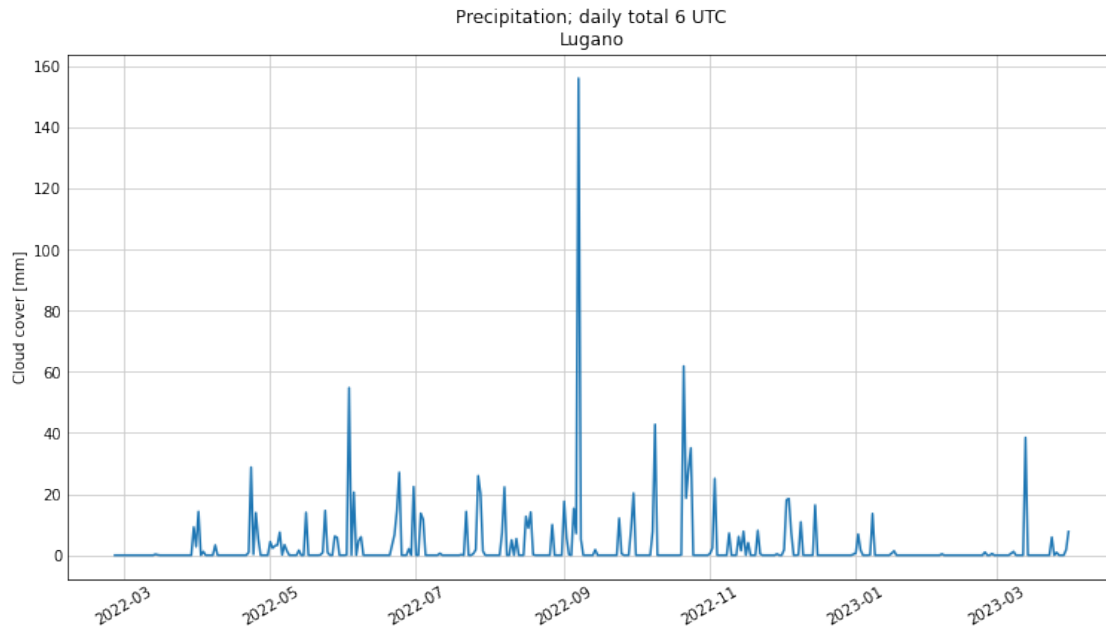
```
[16]: ## Scatter plot cloud cover
```

```
[17]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.rre150d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='--')

plt.xlabel('')
plt.ylabel('Cloud cover [mm]')
plt.title('Precipitation; daily total 6 UTC\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



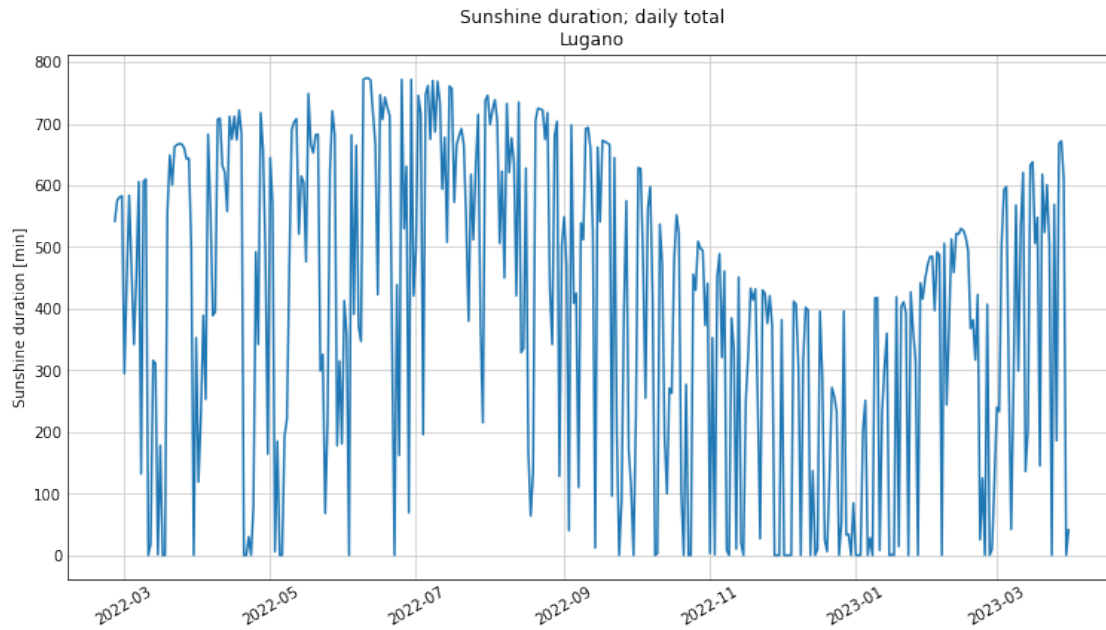
## 1.12 Scatter plot sunshine duration

```
[18]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.sre000d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Sunshine duration [min]')
plt.title('Sunshine duration; daily total\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



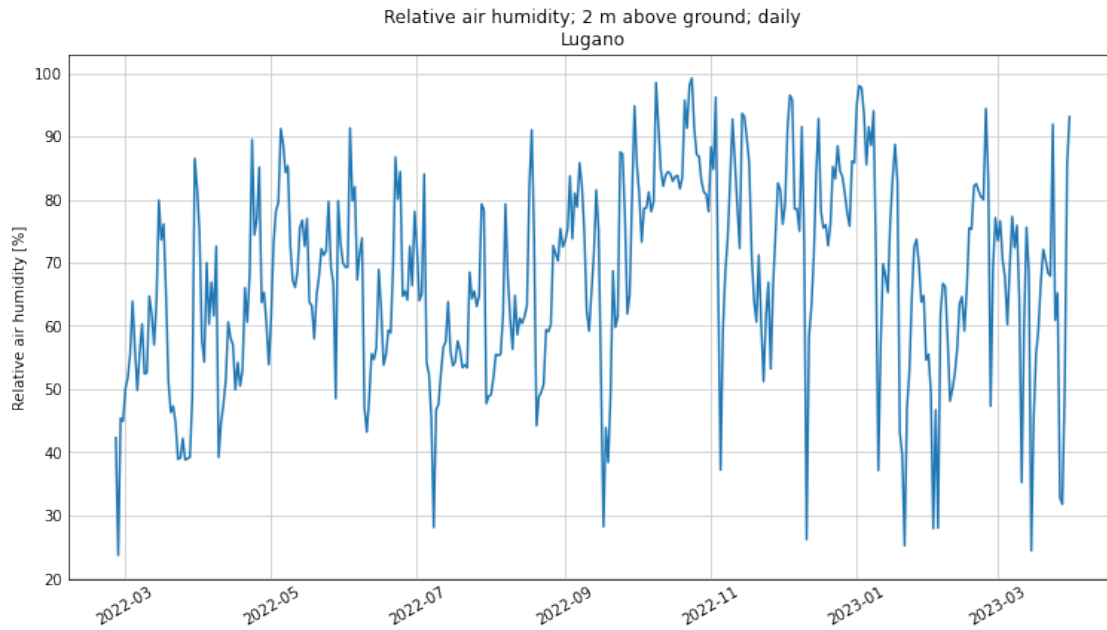
### 1.13 Scatter plot relative air humidity

```
[19]: fig, axs = plt.subplots(figsize=(fswidth, fsheight))

axs.plot(df.index, df.ure200d0)
axs.grid(visible='visible', which='major', color='0.8', linestyle='-')

plt.xlabel('')
plt.ylabel('Relative air humidity [%]')
plt.title('Relative air humidity; 2 m above ground; daily\n' + wstation)
plt.xticks(rotation=30)

plt.show()
```



## 1.14 Export as HTML Report

```
[ ]: import os
      #import ipynbname
      #nb_fname = ipynbname.name()
      nb_fname = 'MeteoCH' # hard-coded: import ipynbname raises an exception...
      #nb_path = ipynbname.path()
      #print(f"{nb_fname=}")
      #print(f"{nb_path=}")

      out_fname = nb_fname + ".output"
      static_format = 'pdf' # pdf or html, etc.
      os.system(f'jupyter nbconvert --to {static_format} {out_fname}.ipynb')
      os.system(f'mv {out_fname}.{static_format} {label}.{static_format}')
```

```
[ ]:
```