

MeteoCH.output

August 4, 2023

1 Meteoschweiz

1.1 Cleanup and required imports

```
[1]: # conda install -c conda-forge pandas matplotlib jupyter pyyaml papermill
      ↪nbconvert pandoc ipynbname
      # '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(['WIGOS-ID', 'CoordinatesE', 'CoordinatesN', 'URL Previous years',
              ↪(verified data)',
              'URL Current year'], axis=1)
```

```
[2]:
```

| | Station | station/location | Data since | \ |
|----|-------------------------|------------------|------------|---|
| 0 | Altdorf | ALT | 01.01.1864 | |
| 1 | Andermatt | ANT | 01.01.1864 | |
| 2 | Basel / Binningen | BAS | 01.01.1755 | |
| 3 | Bern / Zollikofen | BER | 01.01.1864 | |
| 4 | La Chaux-de-Fonds | CDF | 01.01.1900 | |
| 5 | Château-d'Oex | CHD | 01.01.1879 | |
| 6 | Chaumont | CHM | 01.01.1864 | |
| 7 | Davos | DAV | 01.01.1864 | |
| 8 | Elm | ELM | 01.02.1878 | |
| 9 | Engelberg | ENG | 01.01.1864 | |
| 10 | Grächen | GRC | 01.01.1864 | |
| 11 | Grimsel Hospiz | GRH | 01.01.1932 | |
| 12 | Col du Grand St-Bernard | GSB | 01.01.1818 | |
| 13 | Genève / Cointrin | GVE | 01.01.1753 | |
| 14 | Jungfrauoch | JUN | 01.01.1933 | |

| | | | |
|----|-------------------|-----|------------|
| 15 | Lugano | LUG | 01.01.1864 |
| 16 | Luzern | LUZ | 01.01.1864 |
| 17 | Meiringen | MER | 01.07.1889 |
| 18 | Neuchâtel | NEU | 01.01.1864 |
| 19 | Locarno / Monti | OTL | 01.12.1882 |
| 20 | Payerne | PAY | 01.08.1964 |
| 21 | Bad Ragaz | RAG | 01.06.1870 |
| 22 | Säntis | SAE | 01.01.1864 |
| 23 | Samedan | SAM | 01.01.1864 |
| 24 | S. Bernardino | SBE | 01.01.1864 |
| 25 | Segl-Maria | SIA | 01.12.1863 |
| 26 | Sion | SIO | 01.01.1864 |
| 27 | Zürich / Fluntern | SMA | 01.01.1864 |
| 28 | St. Gallen | STG | 01.01.1864 |

| | Station height m. a. sea level | Latitude | Longitude \ |
|----|--------------------------------|-----------|-------------|
| 0 | 438.0 | 46.887069 | 8.621894 |
| 1 | 1438.0 | 46.630914 | 8.580553 |
| 2 | 316.0 | 47.541142 | 7.583525 |
| 3 | 553.0 | 46.990744 | 7.464061 |
| 4 | 1017.0 | 47.082947 | 6.792314 |
| 5 | 1028.0 | 46.479819 | 7.139656 |
| 6 | 1136.0 | 47.049169 | 6.978825 |
| 7 | 1594.0 | 46.812969 | 9.843558 |
| 8 | 958.0 | 46.923747 | 9.175350 |
| 9 | 1036.0 | 46.821639 | 8.410514 |
| 10 | 1605.0 | 46.195314 | 7.836822 |
| 11 | 1980.0 | 46.571689 | 8.333256 |
| 12 | 2472.0 | 45.869092 | 7.170683 |
| 13 | 411.0 | 46.247519 | 6.127742 |
| 14 | 3571.0 | 46.547556 | 7.985444 |
| 15 | 273.0 | 46.004217 | 8.960322 |
| 16 | 454.0 | 47.036439 | 8.301022 |
| 17 | 589.0 | 46.732222 | 8.169247 |
| 18 | 485.0 | 47.000067 | 6.953297 |
| 19 | 367.0 | 46.172256 | 8.787494 |
| 20 | 490.0 | 46.811581 | 6.942469 |
| 21 | 497.0 | 47.016631 | 9.502594 |
| 22 | 2501.0 | 47.249447 | 9.343469 |
| 23 | 1709.0 | 46.526247 | 9.879469 |
| 24 | 1639.0 | 46.463542 | 9.184700 |
| 25 | 1804.0 | 46.432331 | 9.762325 |
| 26 | 482.0 | 46.218650 | 7.330203 |
| 27 | 556.0 | 47.377925 | 8.565742 |
| 28 | 776.0 | 47.425475 | 9.398528 |

Climate region Canton

| | | |
|----|------------------------------|----|
| 0 | Central Alpine north slope | UR |
| 1 | Central Alpine north slope | UR |
| 2 | Eastern Jura | BL |
| 3 | Central plateau | BE |
| 4 | Western Jura | NE |
| 5 | Western Alpine north slope | VD |
| 6 | Western Jura | NE |
| 7 | Northern and central Grisons | GR |
| 8 | Eastern Alpine north slope | GL |
| 9 | Central Alpine north slope | OW |
| 10 | Valais | VS |
| 11 | Western Alpine north slope | BE |
| 12 | Alpine south side | VS |
| 13 | Western plateau | GE |
| 14 | Western Alpine north slope | VS |
| 15 | Alpine south side | TI |
| 16 | Central plateau | LU |
| 17 | Western Alpine north slope | BE |
| 18 | Western plateau | NE |
| 19 | Alpine south side | TI |
| 20 | Western plateau | VD |
| 21 | Northern and central Grisons | SG |
| 22 | Eastern Alpine north slope | AI |
| 23 | Engadine | GR |
| 24 | Alpine south side | GR |
| 25 | Engadine | GR |
| 26 | Valais | VS |
| 27 | North-eastern plateau | ZH |
| 28 | North-eastern plateau | SG |

1.3 Specific 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 \
#   -p wsno $i; done
#
# The time command at the beginning of the call may be omitted.
```

```
[4]: # Parameters
wsno = 27
```

```
[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}.")
```

27

The label of weather station Zürich / Fluntern is SMA.

1.4 Current online observations

```
[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 Summary statistics

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

```
[7]:
```

| | gre000d0 | hto000d0 | nto000d0 | prestad0 | rre150d0 | sre000d0 | \ |
|-------|------------|------------|------------|------------|------------|------------|---|
| count | 400.000000 | 400.000000 | 399.000000 | 400.000000 | 400.000000 | 400.000000 | |
| mean | 153.480000 | 0.222500 | 66.741855 | 952.579250 | 2.658000 | 316.550000 | |
| std | 107.500654 | 1.037151 | 31.249218 | 6.495531 | 5.220111 | 280.640589 | |
| min | 6.000000 | 0.000000 | 0.000000 | 923.200000 | 0.000000 | 0.000000 | |
| 25% | 57.750000 | 0.000000 | 44.000000 | 949.775000 | 0.000000 | 45.750000 | |
| 50% | 129.000000 | 0.000000 | 75.000000 | 952.600000 | 0.000000 | 277.500000 | |
| 75% | 238.000000 | 0.000000 | 96.000000 | 956.000000 | 3.100000 | 549.250000 | |
| max | 366.000000 | 8.000000 | 100.000000 | 970.700000 | 32.100000 | 853.000000 | |

| | tre200d0 | tre200dn | tre200dx | ure200d0 |
|-------|------------|------------|------------|------------|
| count | 400.000000 | 400.000000 | 400.000000 | 400.000000 |
| mean | 12.08225 | 8.305000 | 16.485250 | 73.155000 |
| std | 7.54502 | 6.452112 | 9.056351 | 13.689424 |
| min | -5.90000 | -7.700000 | -4.400000 | 38.500000 |
| 25% | 6.47500 | 3.600000 | 9.475000 | 63.550000 |

| | | | | |
|-----|----------|-----------|-----------|-----------|
| 50% | 11.90000 | 8.850000 | 16.150000 | 74.450000 |
| 75% | 18.90000 | 14.200000 | 24.700000 | 84.400000 |
| max | 27.30000 | 20.600000 | 35.500000 | 97.700000 |

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

400 observations from 2022-06-29 00:00:00 to 2023-08-02 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 ² | 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 Air temperature

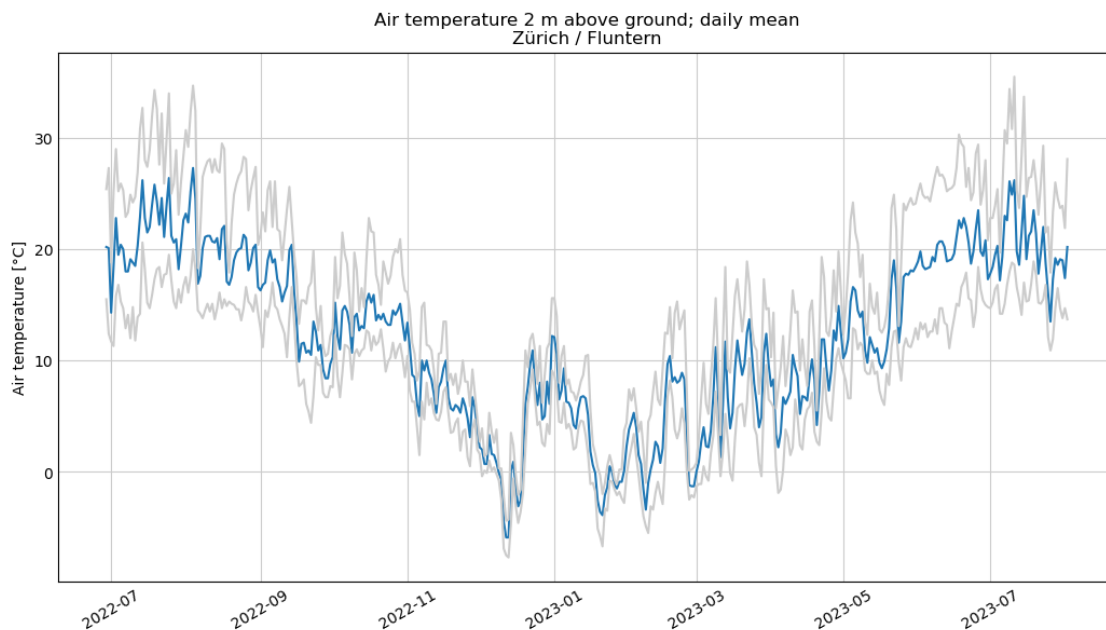
```
[10]: import matplotlib.pyplot as plt
plt.style.use('_mpl-gallery')
fswidth = 10
fsheight = 5
```

```
[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()
```



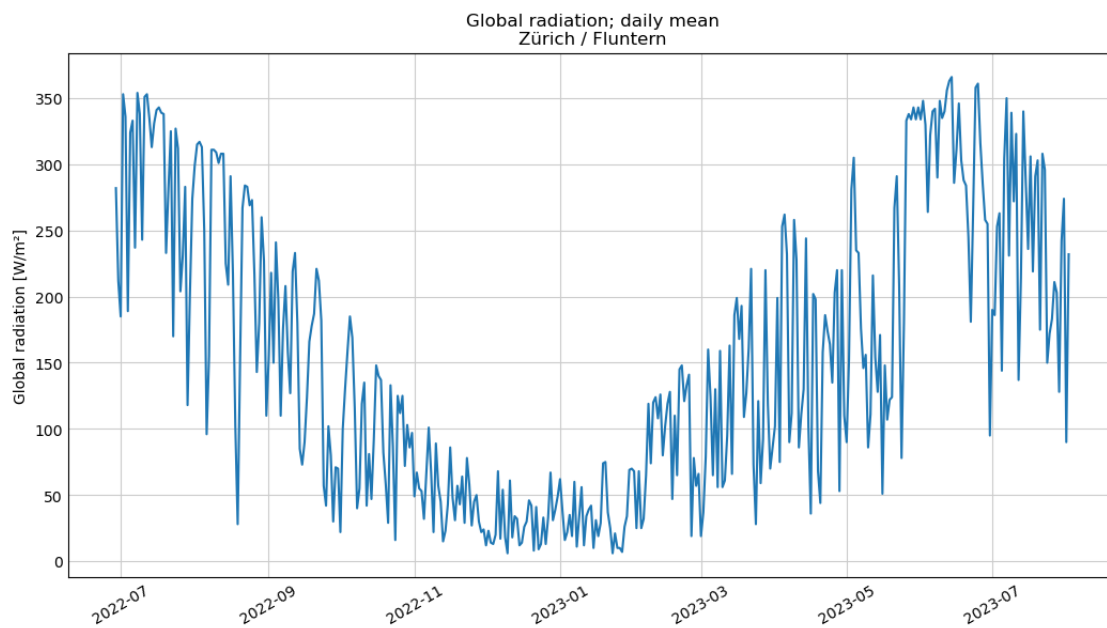
1.8 Global radiation

```
[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()
```



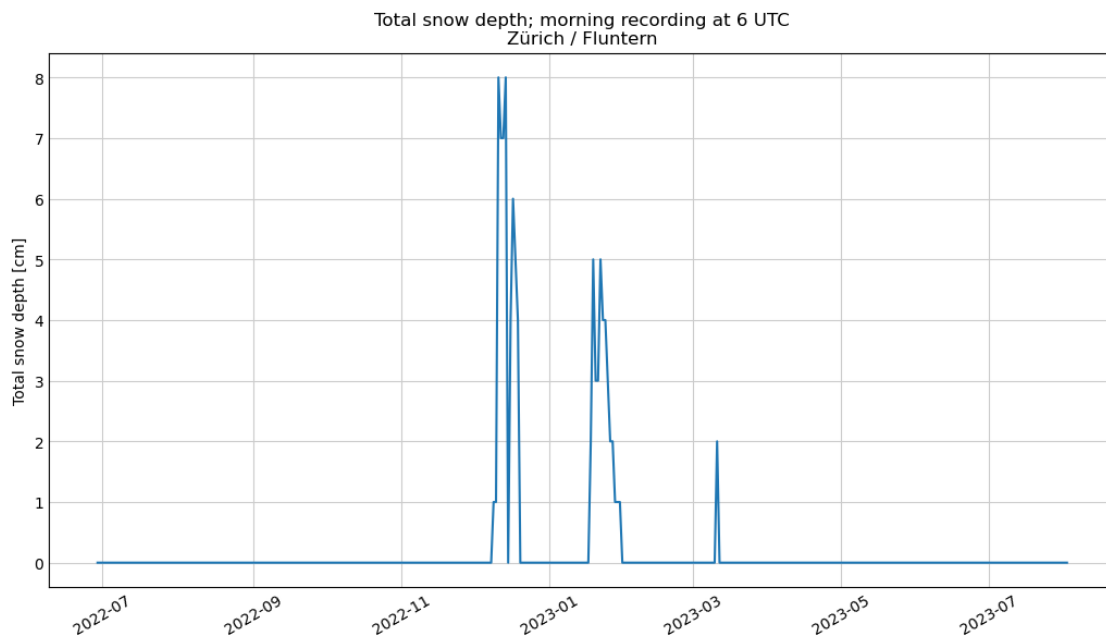
1.9 Total snow depth

```
[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()
```



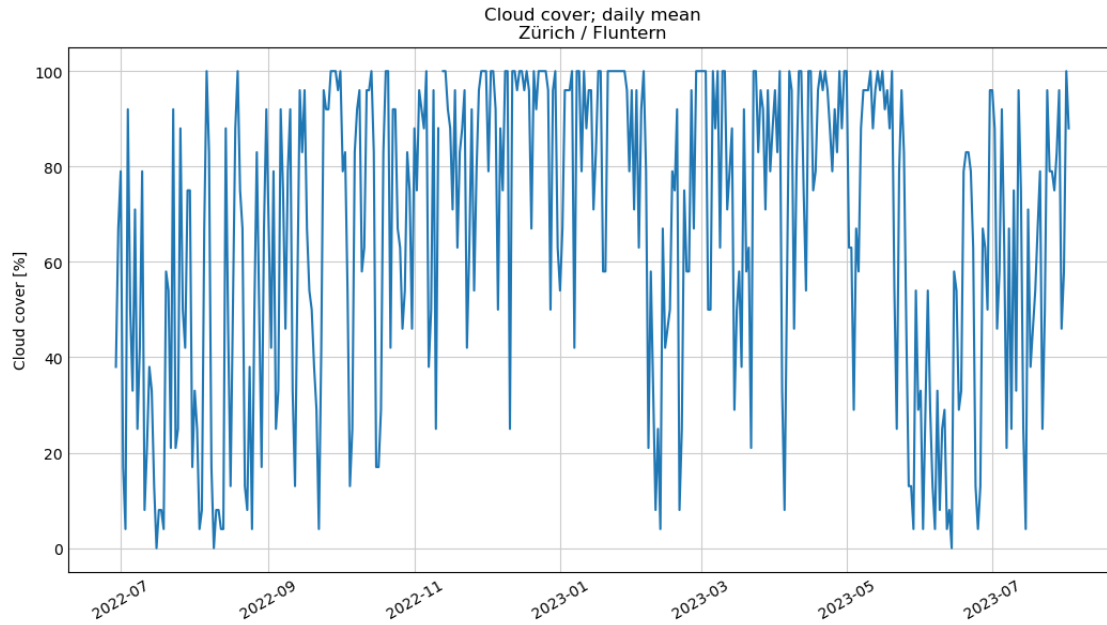
1.10 Cloud cover

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

axs.plot(df.index, df. nto000d0)
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()
```

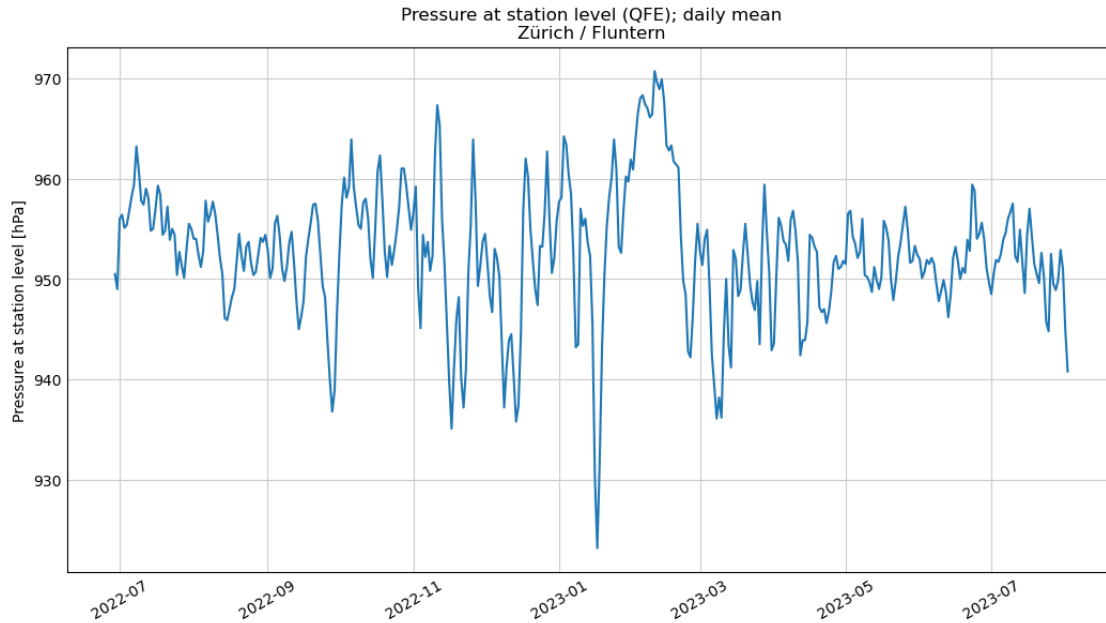
1.11 Pressure at station level

```
[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()
```



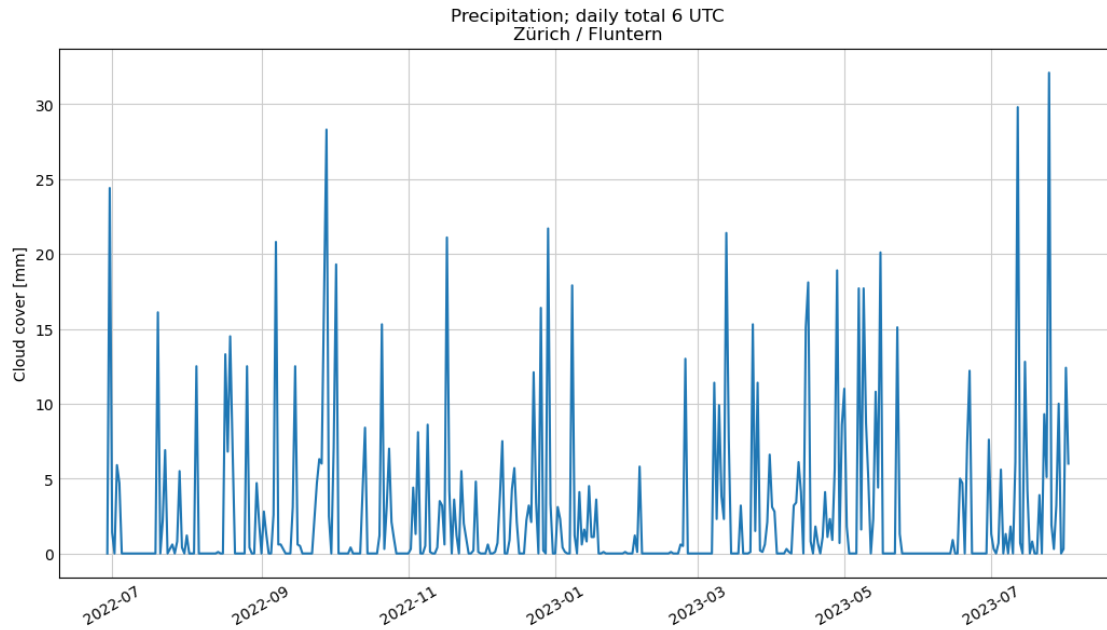
1.12 Precipitation

```
[16]: 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()
```



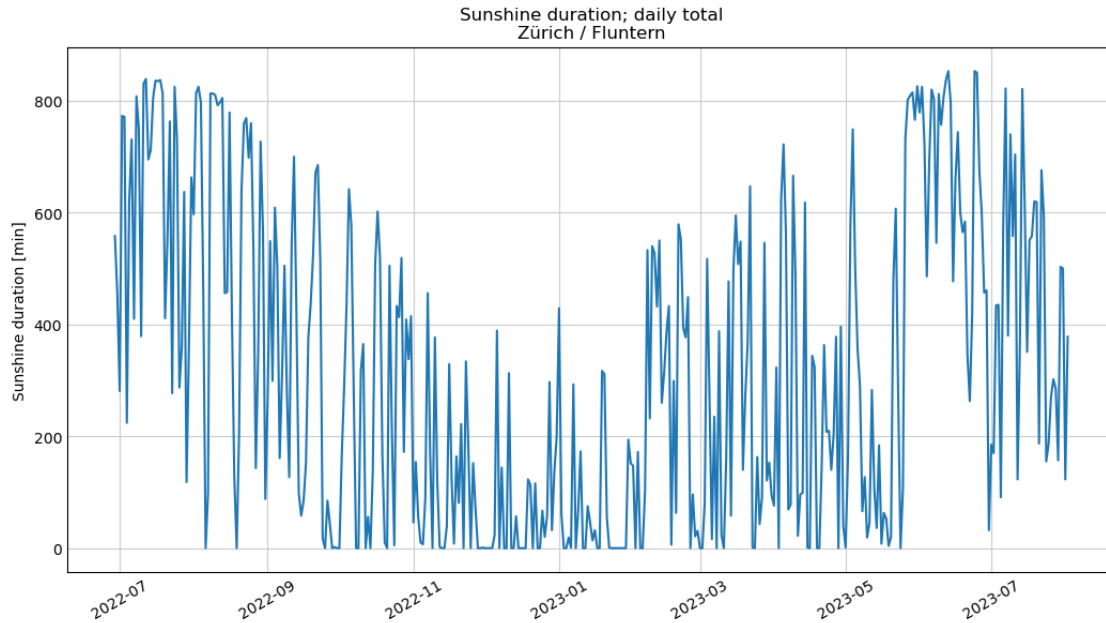
1.13 Sunshine duration

```
[17]: 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()
```



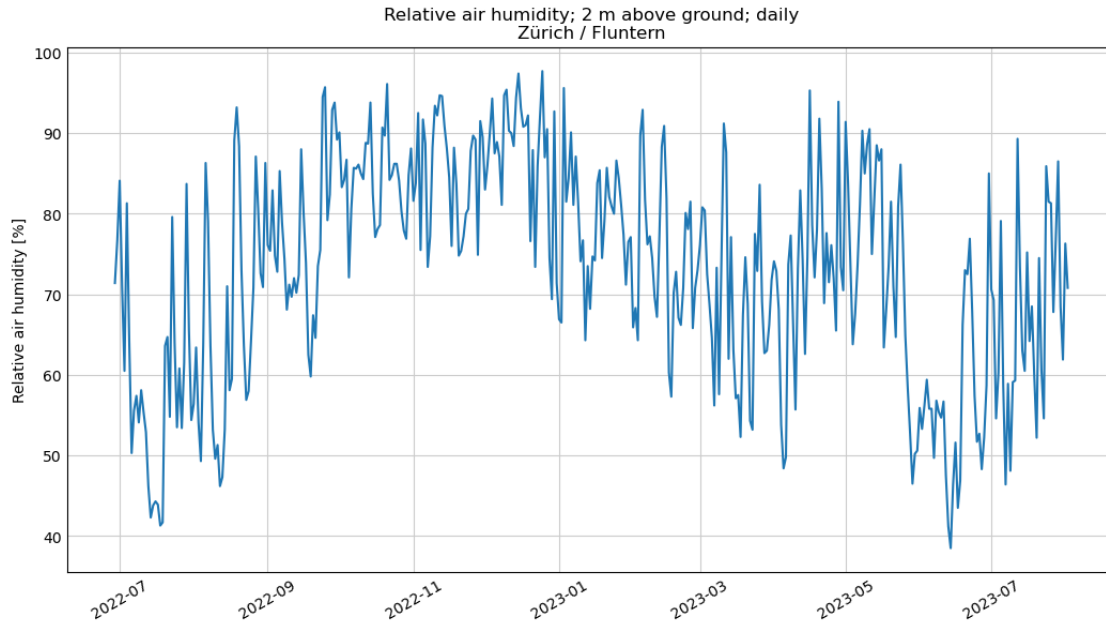
1.14 Relative air humidity

```
[18]: 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()
```



1.15 Export as HTML Report

```
[ ]: import os

# Note that this only reliably works when running a notebook in a browser.
# So it does not currently work for things like nbconvert or papermill.
#import ipynbname
nb_fname = 'MeteoCH' # hard-coded: import ipynbname raises an exception...

out_fname = nb_fname + ".output"
#out_fname = nb_fname
#label = "FOOBAR"

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}')
#os.system(f'echo {label} {out_fname}.{static_format} {label}.{static_format}')
os.system(f'del {label}.{static_format}')
os.system(f'ren {out_fname}.{static_format} {label}.{static_format}')
```