training_data_parser

March 18, 2020

0.1 .top file parser functions

[1]:

```python
import re
import glob
from typing import Tuple
import matplotlib.pyplot as plt
import pandas as pd
```

[2]:

```python
def read_rawdata(file_nr):
    folder = "../Parameter files (.top)/"
    filename = "NVE_par_"+str(file_nr)+".top"
    filepath = folder + filename

    with open(filepath, 'rb') as f:
        rawdata = f.readlines()

    return rawdata
```

[3]:

```python
def get_param_value(data, key: str):
    value = 0
    for line in data:
        if (" "+key+" ") in str(line):
            value = re.findall("\d+\.\d+", str(line))

    return float(value[0])
```

0.2 Key data to read from .top file

[4]:

```python
## Interesting key data to read

# Elevation data
ELEVS = ["ELEV"+str(i) for i in range(11)]

# Evaporation per month
EVAPOS = ["EPJAN", "EPFEB", "EPMAR", "EPAPR", "EPMAY", "EPJUN", "EPJUL",␣
 ↪"EPAUG", "EPSEP", "EPOKT", "EPNOV", "EPDES"]
```

```
# Other params
OTHER = ["RCORR", "SCORR", "PGRAD", "TPGRAD"]

interesting_keys = [ELEVS, OTHER, EVAPOS]
# Flatten lists inside list
interesting_keys = [val for sublist in interesting_keys for val in sublist]
```

[5]:

```
def read_interesting_params(file_nr, keys):
    data = read_rawdata(file_nr)
    params_dict = {}
    for key in keys:
        params_dict[key] = get_param_value(data, key)
    return params_dict
```

[6]:

```
file_nr = 1
read_interesting_params(file_nr, interesting_keys)
```

[6]:

```
{'ELEV0': 670.0,
 'ELEV1': 894.0,
 'ELEV2': 1023.0,
 'ELEV3': 1109.0,
 'ELEV4': 1196.0,
 'ELEV5': 1261.0,
 'ELEV6': 1304.0,
 'ELEV7': 1335.0,
 'ELEV8': 1361.0,
 'ELEV9': 1391.0,
 'ELEV10': 1534.0,
 'RCORR': 1.594,
 'SCORR': 1.768,
 'PGRAD': 0.05,
 'TPGRAD': 0.5,
 'EPJAN': 0.1,
 'EPFEB': 0.2,
 'EPMAR': 0.7,
 'EPAPR': 1.0,
 'EPMAY': 2.3,
 'EPJUN': 3.5,
 'EPJUL': 3.5,
 'EPAUG': 2.3,
 'EPSEP': 1.0,
 'EPOKT': 0.7,
 'EPNOV': 0.2,
 'EPDES': 0.1}
```

0.3 NVE specific data loader function

[7]:

```
# Read input txt files
def dateparse(dates, times):
    return [
        pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
        for date, time in zip(dates, times)
    ]

def load_forcing_and_discharge(catchment: int) -> Tuple[pd.DataFrame, int]:
    """Load the meteorological forcing data of a specific catchment.

    :param catchment: number (id)

    :return: pd.DataFrame containing the meteorological forcing data.
    """
    path = '../Input files (.txt)'
    all_files = glob.glob(path + "/*.txt")

    file_exist = False

    # Loop through files and find correct catchment
    for file_path in all_files:
        # Name is formatted `./Input files (.txt)/nve_inp_XX.txt`
        number = int(file_path.split('_')[-1].split('.')[0])

        if number == catchment:
            file_exist = True
            df = pd.read_csv(
                file_path,
                encoding='cp1252',
                skiprows=[0],
                delimiter=r"\s+",
                parse_dates=[['dd.mm.yyyy',  'hh:mm:ss']],
                date_parser=dateparse)
            df = df.rename(columns={"dd.mm.yyyy_hh:mm:ss": "timestamp"})

    # Return None if catchment does not exist
    if file_exist == False:
        print("Catchment does not exist")
        return None
    else:
        return df
```

[8]:

```
print("Input file data:")
load_forcing_and_discharge(file_nr).head()
```

```
Input file data:
```

```
<ipython-input-7-ecc3a6e4ca2c>:4: FutureWarning: The pandas.datetime class is
deprecated and will be removed from pandas in a future version. Import from
datetime module instead.
  pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
```

[8]:

```
    timestamp     mm   grC  grC.1  m3/s
0  2000-01-01   3.30 -3.75  -3.75  0.27
1  2000-01-02   3.79 -2.02  -2.02  0.27
2  2000-01-03   6.98 -3.84  -3.84  0.27
3  2000-01-04  16.53 -3.80  -3.80  0.29
4  2000-01-05   4.44 -4.78  -4.78  0.31
```

0.4 Read Output, Simulated and Residuals data

[9]:

```python
def read_output_simulated_residual_data(file_nr):
    # Read raw csv
    folder = "../Residual, Output, Simulated data/"
    filename = "HBV_output_"+str(file_nr)+".txt"
    filepath = folder + filename

    df = pd.read_csv(filepath)

    # Rename columns to match LSTM notebook
    df = df.rename(columns={"DATE": "timestamp"})

    # Cast timestamp to datetime
    df['timestamp'] = pd.to_datetime(df['timestamp'], format='%Y/%m/%d',␣
 ↪yearfirst=True)

    # Remove first column
    df = df.drop(['Unnamed: 0'], axis=1)

    return df
```

[10]:

```python
print("Residual file data:")
read_output_simulated_residual_data(file_nr).head()
```

```
Residual file data:
```

[10]:

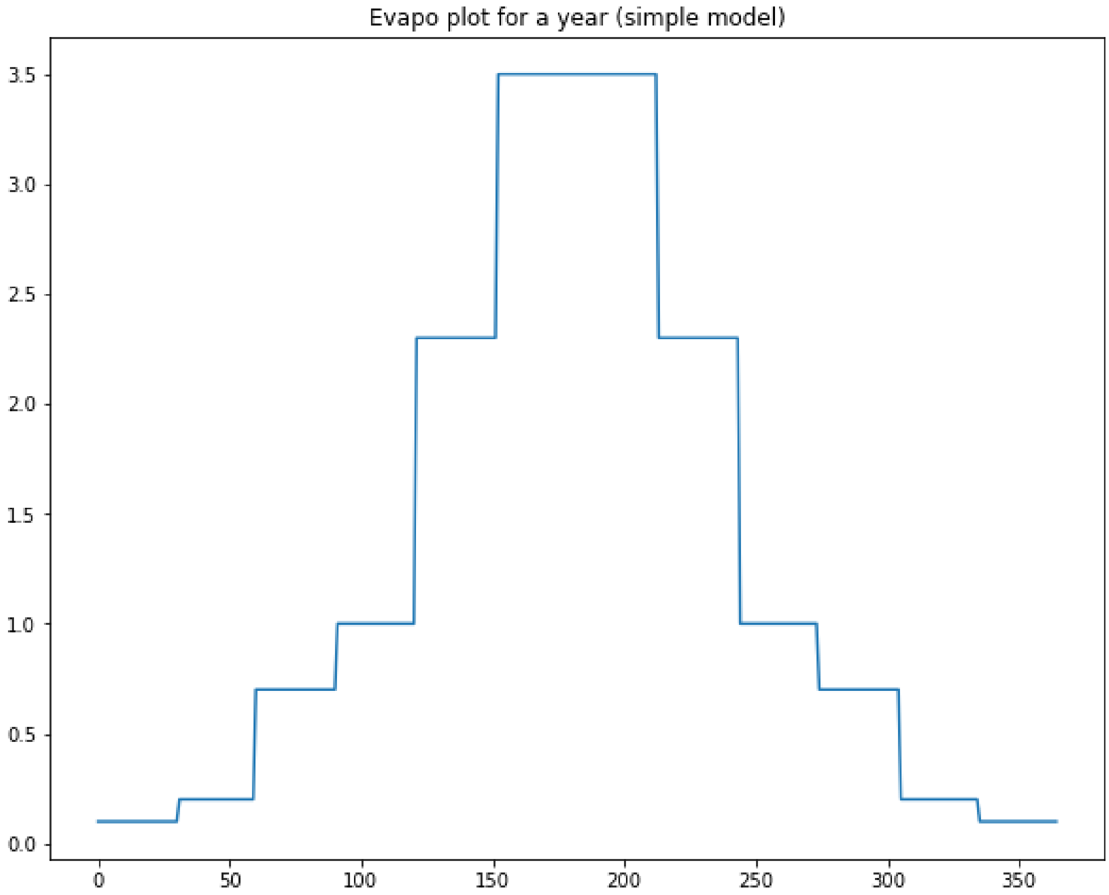
```
    timestamp  OBSRUNOFF  SIMRUNOFF  RESIDUAL
0  2000-01-01      0.597      0.013     0.584
1  2000-01-02      0.597      0.055     0.542
2  2000-01-03      0.597      0.103     0.494
3  2000-01-04      0.641      0.177     0.464
4  2000-01-05      0.685      0.222     0.463
```

0.5 Merge parameter data with rainfall-runoff data

[14]:
```
def generate_evapo_data(df, params):
    # Copies evapotranspiration given for a month to every days in the same month
    evapos = []
    for d in range(len(df)):
        # Calculate index based on month number
        month_idx = df["timestamp"][d].month - 1
        evapos.append(params[EVAPOS[month_idx]])

    # Returns list
    return evapos

# Load rain, discharge and params file
df = load_forcing_and_discharge(file_nr)
params = read_interesting_params(file_nr, interesting_keys)

# Evapo plot for a year (simple model)
plt.figure(figsize=(10,8))
plt.plot(generate_evapo_data(df, params)[0:365])
plt.title("Evapo plot for a year (simple model)")
```

```
<ipython-input-7-ecc3a6e4ca2c>:4: FutureWarning: The pandas.datetime class is
deprecated and will be removed from pandas in a future version. Import from
datetime module instead.
  pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
```

[14]:
```
Text(0.5, 1.0, 'Evapo plot for a year (simple model)')
```

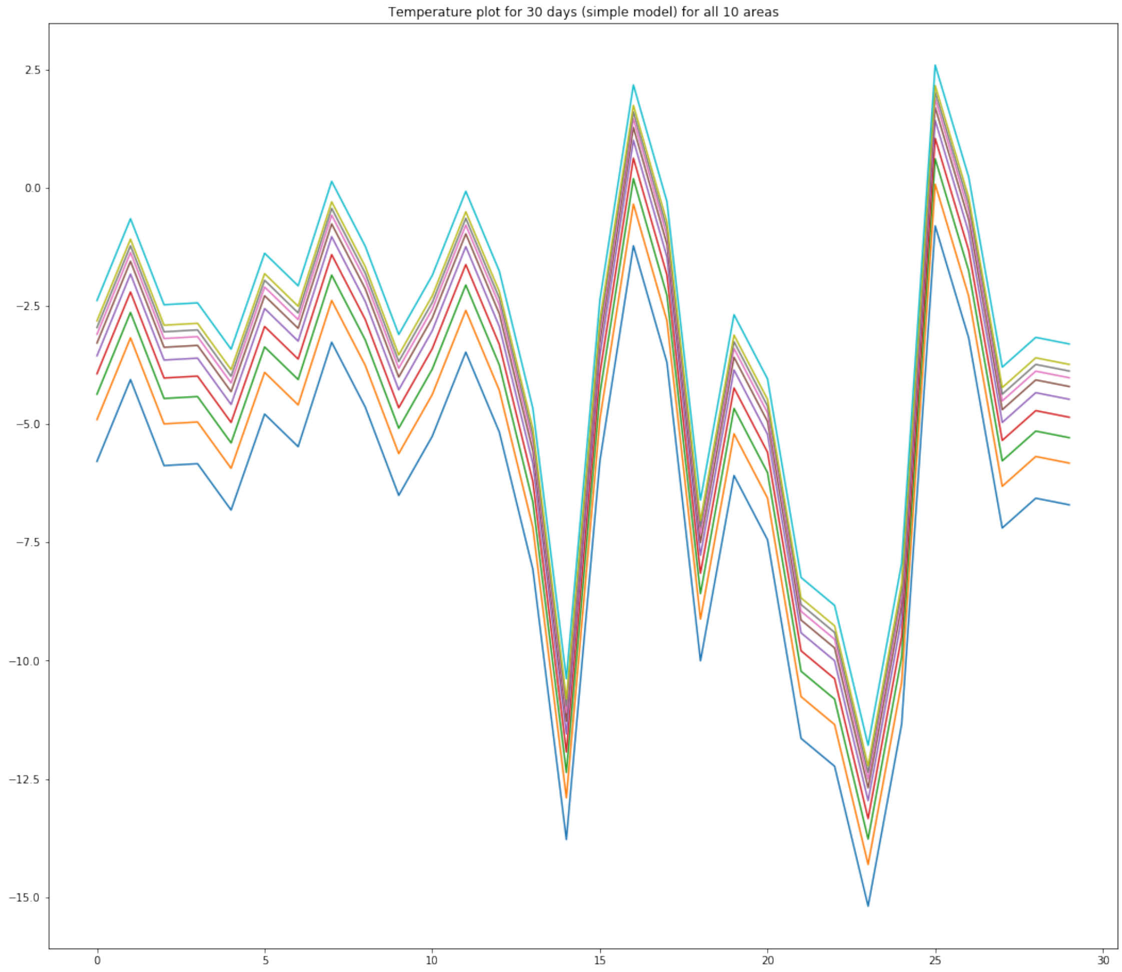


[15]:

```
def generate_temp_data(df, params):
    temps = []
    for d in range(len(df)):
        # Loop through 10 distributed areas
        elevation = []
        sum_height = params[ELEVS[0]]

        for i in range(10):
            # Calculate height of a given area by averaging lowest and highest height
            height_low = params[ELEVS[i]]
            height_hig = params[ELEVS[i+1]]
            elevation.append((height_hig + height_low) / 2.0)

            sum_height += params[ELEVS[i+1]]

        # Find average height of catchment
        avg_height = sum_height / 11.0
        # Calculate elevation corrected temperature
        temp = []
        for i in range(10):
            temp.append(df["grC"][d] + params["TPGRAD"] * (elevation[i] -␣
↪avg_height) / 100.0)
        temps.append(temp)
    return temps

# Tempeature plot for a year (simple model) for all 10 areas
df = load_forcing_and_discharge(file_nr)
temps = generate_temp_data(df, params)

plt.figure(figsize=(18,16))
plt.plot(temps[0:30])
plt.title("Temperature plot for 30 days (simple model) for all 10 areas")
```

```
<ipython-input-7-ecc3a6e4ca2c>:4: FutureWarning: The pandas.datetime class is
deprecated and will be removed from pandas in a future version. Import from
datetime module instead.
  pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
```

```
[15]: Text(0.5, 1.0, 'Temperature plot for 30 days (simple model) for all 10 areas')
```

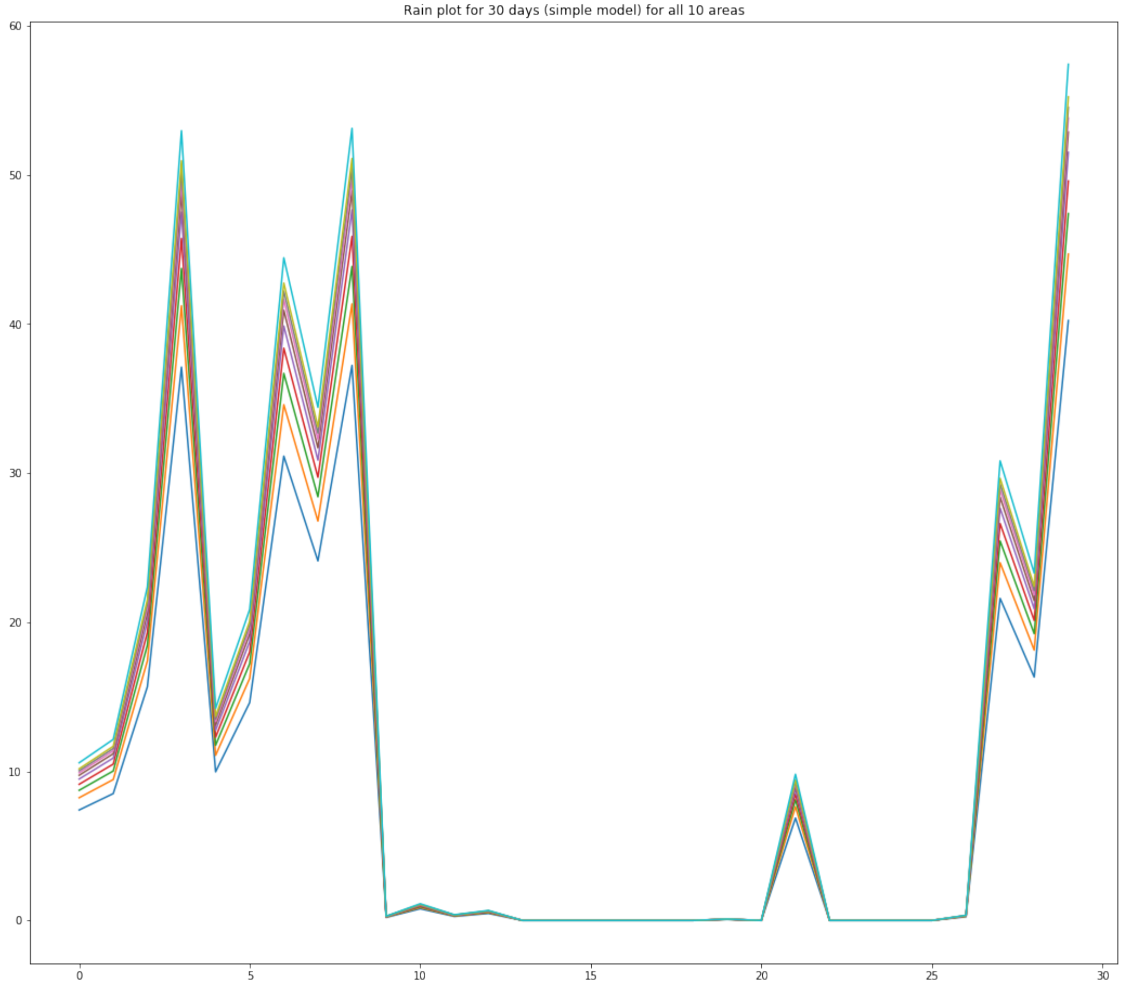


[16]:

```
def generate_rain_data(df, params):
    rains = []
    for d in range(len(df)):
        # Loop through 10 distributed areas
        elevation = []
        sum_height = params[ELEVS[0]]

        for i in range(10):
            # Calculate height of a given area by averaging lowest and highest␣
 ↪height
            height_low = params[ELEVS[i]]
            height_hig = params[ELEVS[i+1]]
            elevation.append((height_hig + height_low) / 2.0)

            sum_height += params[ELEVS[i+1]]

        # Find average height of catchment
        avg_height = sum_height / 11.0

        # Calculate elevation corrected rain
        rain = []
        for i in range(10):
            rain.append(params["RCORR"] * params["SCORR"] * df["mm"][d] * (1.0 + params["PGRAD"] * (elevation[i] - avg_height) / 100.0))
        rains.append(rain)
    return rains

# Rain plot for a year (simple model) for all 10 areas
df = load_forcing_and_discharge(file_nr)
rains = generate_rain_data(df, params)

plt.figure(figsize=(18,16))
plt.plot(rains[0:30])
plt.title("Rain plot for 30 days (simple model) for all 10 areas")
```

```
<ipython-input-7-ecc3a6e4ca2c>:4: FutureWarning: The pandas.datetime class is
deprecated and will be removed from pandas in a future version. Import from
datetime module instead.
  pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
```

```
[16]: Text(0.5, 1.0, 'Rain plot for 30 days (simple model) for all 10 areas')
```



```
[19]: def add_param_data_to_df(df, params):
          # Add evapotranspiration
          df["evapo"] = generate_evapo_data(df, params)

          # Add temperature
          temps = generate_temp_data(df, params)
          for j in range(len(df)):
              for i in range(10):
                  df["grC"+str(i+1)] = temps[j][i]

          # Add rain
          rains = generate_rain_data(df, params)
          for j in range(len(df)):
              for i in range(10):
                  df["mm"+str(i+1)] = rains[j][i]
```

```
    return df
```

[20]:

```
# Add evapo, temp (10 areas) and rain (10 areas)
df = load_forcing_and_discharge(file_nr)
params = read_interesting_params(file_nr, interesting_keys)

df = add_param_data_to_df(df, params)

# Add observed, simulated and residual runoff
residual_df = read_output_simulated_residual_data(file_nr)
df["OBSRUNOFF"] = residual_df["OBSRUNOFF"]
df["SIMRUNOFF"] = residual_df["SIMRUNOFF"]
df["RESIDUAL"] = residual_df["RESIDUAL"]

df.head()
```

```
<ipython-input-7-ecc3a6e4ca2c>:4: FutureWarning: The pandas.datetime class is
deprecated and will be removed from pandas in a future version. Import from
datetime module instead.
  pd.datetime.strptime(date + time, "%d.%m.%Y%H:%M:%S")
```

[20]:

```
   timestamp     mm   grC  grC.1  m3/s  evapo      grC1      grC2      grC3  \
0 2000-01-01   3.30 -3.75  -3.75  0.27    0.1 -3.324545 -2.442045 -1.904545
1 2000-01-02   3.79 -2.02  -2.02  0.27    0.1 -3.324545 -2.442045 -1.904545
2 2000-01-03   6.98 -3.84  -3.84  0.27    0.1 -3.324545 -2.442045 -1.904545
3 2000-01-04  16.53 -3.80  -3.80  0.29    0.1 -3.324545 -2.442045 -1.904545
4 2000-01-05   4.44 -4.78  -4.78  0.31    0.1 -3.324545 -2.442045 -1.904545

       grC4  ...        mm4        mm5        mm6       mm7       mm8  \
0 -1.472045  ...  11.482586  11.927014  12.242793  12.45916  12.62582
1 -1.472045  ...  11.482586  11.927014  12.242793  12.45916  12.62582
2 -1.472045  ...  11.482586  11.927014  12.242793  12.45916  12.62582
3 -1.472045  ...  11.482586  11.927014  12.242793  12.45916  12.62582
4 -1.472045  ...  11.482586  11.927014  12.242793  12.45916  12.62582

         mm9       mm10  OBSRUNOFF  SIMRUNOFF  RESIDUAL
0  12.789557  13.295388      0.597      0.013     0.584
1  12.789557  13.295388      0.597      0.055     0.542
2  12.789557  13.295388      0.597      0.103     0.494
3  12.789557  13.295388      0.641      0.177     0.464
4  12.789557  13.295388      0.685      0.222     0.463

[5 rows x 29 columns]
```

0.6 Save to csv file

[21]:

```
df.to_csv('rainfall_runoff_training_data.csv')
```

[ ]:

```

```