

Example: using the National Water Model (NWM) Data Component to download data

The NWM Data Component is implemented with a Python class called `BmiNwmHs`.

Import `BmiNwmHs` class and instantiate it. A configuration file (yaml file) is required to provide the parameter settings for data download.

```
In [1]: import matplotlib.pyplot as plt
import numpy as np
import cftime

from nwm import BmiNwmHs

# initiate a data component
data_comp = BmiNwmHs()
data_comp.initialize('config_file.yaml')
```

Use variable-related methods from `BmiNwmHs` class to check the variable information of the NWM dataset. This data component stores a flow forecast variable.

```
In [2]: # get variable info
var_name = data_comp.get_output_var_names()[0]
var_unit = data_comp.get_var_units(var_name)
print(' variable_name: {}\n var_unit: {}'.format(var_name, var_unit))

variable_name: Flow Forecast
var_unit: cfs
```

Use time-related methods to check the time information of the NWM dataset. The time values are stored in a format that follows the [CF convention](http://cfconventions.org/Data/cf-conventions/cf-conventions-1.8/cf-conventions.pdf) (<http://cfconventions.org/Data/cf-conventions/cf-conventions-1.8/cf-conventions.pdf>).

```
In [3]: # get time info
start_time = data_comp.get_start_time()
end_time = data_comp.get_end_time()
time_step = data_comp.get_time_step()
time_unit = data_comp.get_time_units()
time_steps = int((end_time - start_time)/time_step) + 1
print(' start_time:{}\n end_time:{}\n time_step:{}\n'
      ' time_unit:{}\n time_steps:{}\n'.format(start_time,
                                              end_time,
                                              time_step,
                                              time_unit,
                                              time_steps))

start_time:1503450000.0
end_time:1503511200.0
time_step:3600.0
time_unit:seconds since 1970-01-01 00:00:00 UTC
time_steps:18
```

Loop through each time step to get the flow and time values. `stream_array` stores flow forecast values. `cftime_array` stores the numerical time values. `time_array` stores the corresponding Python datetime objects. `get_value()` method returns the flow forecast value at each time step. `update()` method updates the current time step of the data component.

```
In [4]: # initiate numpy arrays to store data
stream_value = np.empty(1)
stream_array = np.empty(time_steps)
cftime_array = np.empty(time_steps)

for i in range(0, time_steps):
    data_comp.get_value(var_name, stream_value)
    stream_array[i] = stream_value
    cftime_array[i] = data_comp.get_current_time()
    data_comp.update()

time_array = cftime.num2date(cftime_array, time_unit, only_use_cftime_datetimes=False)
```