Modelling and Forecasting Facility internal report

MATLAB Codes for Atmospheric Pressure Verification of the WRF model

Matjaz Licer

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Contents

1 Objective

This report serves as documentation for modifications made by M. L. to Matlab code `plot_pressure_WRF_BRIFS_OBS.m` which is based on the code `plot_pressure_WRF_BRIFS.m`, written by Baptiste Mourre. In short, the modifications are the following:

- Plotting of 2-minute time-series of the MSLP field was disabled since it takes a long time and is not relevant for verification. (The mean pressure field plot is still generated.)
- A list of points of interest was expanded by the locations of *in situ* pressure sensors.
- A call to function `readPressureObservations` was added to read and post-process the *in situ* data.
- Measured atmospheric pressures were added to the plots next to WRF pressures at the same locations

2 Added Points of Pressure Sensors

In `plot_pressure_WRF_BRIFS_OBS.m`, the following locations of pressure sensors were added:

Station Index	Station Name	Latitude $\phi\,[^\circ]$	Longitude $\lambda\,[^\circ]$
13	Sarapita	39.360312	2.953257
14	Sant Antoni	38.977089	1.298776
15	Pollensa	39.904646	3.088467
16	Lamola	39.868333	4.309566
17	Colonia Sant Pere	39.737312	3.273354
18	Andratx	39.546164	2.38539

3 The `readPressureObservations.m` code

This Matlab function reads atmospheric pressure time series from in situ stations for a given time window. The call to the function is as follows:

```
function barometers = readPressureObservations(strdate)
```

where `strdate` is a string date of YYYYMMDD form. The workflow within the function is as follows:

1. The code sets the time window - by default: [`strdate`, `strdate + 2 days`] time interval.
2. The code reads available data from SOCIB THREDDS server using the `readBarometerObs` function.
3. If the event takes place at the end of the month (year), the code reads also next month of data from SOCIB THREDDS server.
4. If neccessary, the code merges both so obtained datasets.

5. The code crops the entire dataset (one or two months of measurements) to the BRIFS time window [`strdate`, `strdate + 2 days`].

6. The code exits and returns `barometers` Matlab structure, which contains available data for stations `santantoni, sarapita, pollensa, lamola, coloniasantpere, ciutadella, andtratx`.

3.1 The `readBarometerObs.m` code

This Matlab function performs the actual reading of barometer observations from SOCIB THREDDS server. The call to the function is as follows:

```
function data = readBarometerObs(station,instrument,type,code,level,year,month)
```

where the input arguments are as follows:

Input Argument	Meaning
`station`	string station name (i.e. `'ciutadella'`)
`instrument`	string instrument name (`'scb','pib', 'ime'...`)
`type`	string `'baro'`
`code`	string number `'007', '004', ...`
`level`	string QC level: `'L1'`
`year`	string `yyyy` year
`month`	string `mm` month

The function then constructs a filename and reads the netCDF into a data structure. The data at each of the stations consists of the following fields:

Key	Value
`URL`	THREDDS data server URL of the netCDF file
`dataExists`	a logical flag. TRUE if any data was available, FALSE otherwise
`LAT`	station latitude
`LON`	station longitude
`time`	Matlab datenumbers of measurement times
`AIR_PRE`	observed air pressures in mbar [hPa]
`QC_AIR_PRE`	quality control flag for `AIR_PRE`

3.2 The `mergeDataStructures.m` code

This Matlab function merges data from two consecutive months, if the rissaga happens to occur on the last day of the month (year). The function is invoked with:

```
function outstruct = mergeDataStructures(struct1,struct2)
```

where the input arguments are as follows:

Input Argument	Meaning
`struct1`	first month data structure, as returned from the `readBarometerObs` function
`struct2`	second month data structure, as returned from the `readBarometerObs` function

The function loops over all the data fields in both structures and concatenates them in time. A merged structure, containing both months of data, is returned. If one of the structures is empty, the other structure is returned as output. If both structures are empty, `dataExists` flag is set to FALSE, a warning is displayed, and the code returns to the parent function.

3.3 The `cropObservationTimeWindow.m` code

This Matlab function subsets timewindow of observations to WRF model times, by default: [`strdate`, `strdate + 2 days`]. The function is invoked with:

```
function outstruct = cropObservationTimeWindow(startdate,enddate,struct)
```

where the input arguments are as follows:

Input Argument	Meaning
`startdate`	matlab datenumber with start date
`enddate`	matlab datenumber with start date
`struct2`	data structure that needs to be cropped to [startdate,enddate] interval

The function determines the indices within the [`strdate`, `strdate + 2 days`] time window:

```
[idx, ] = find(struct.time>=startdate & struct.time<=enddate);
```

and loops over all the data fields in both structures and crops them in time. A cropped structure, containing only the required interval of data, is returned.

4 Adding Observations to Figures

A simple `switch-case` clause over `ks`-counter is added at the end of the `plot_pressure_WRF_BRIFS_OBS.m` code to plot WRF and measurements at the pressure sensor locations. This is done as follows. We check if the data exist for the given location and if they do, we plot a new figure with `subplot(3,2,ks)` indices.

5 Relevant Folders

Working directory where all the codes are located:

```
/home/mlicer/BRIFSverif/
```

Directory with plots of WRF-observation comparisons:

`/home/mlicer/BRIFSverif/plots/WRF/`

Appendices

A Programs used

Programs used to perform this work:

- `plot_pressure_WRF_BRIFS.m`
- `plot_pressure_WRF_BRIFS_OBS.m`
- `readPressureObservations.m`
- `readBarometerObs.m`
- `mergeDataStructures.m`
- `cropObservationTimeWindow.m`