

Chapter 6

fort.22 File - Meteorological Conditions

The ability of ADCIRC to incorporate meteorological forcing is extremely sophisticated. As ADCIRC was developed, in part, to facilitate hurricane simulations, this flexibility is no surprise. As just a few examples, meteorological data can be specified either at all grid points in the domain, or on a regular grid, such as the National Weather Service's ETA 29 km grid. Additionally, data can be input at time steps corresponding to the model, or at any user-specified time step.

The use of meteorological forcing in the Glacier Bay domain warrants some discussion. First of all, predictions of storm surges due to storms / hurricanes is not an objective of this project, so the need to rely upon and incorporate NWS forecast data does not exist. That said, however, it is of interest to this project to assess the extent to which winds and pressure might influence the circulation patterns and tidal heights predicted to occur. A significant obstacle to this goal is the severe lack of meteorological data that exists in the vicinity of Glacier Bay. Thus, this chapter discusses what limited data exist and how they might be incorporated, in a simplistic way, into the present simulations.

6.1 Data Availability

Figure 6.1 illustrates the availability of historical and present data in the vicinity of Glacier Bay, as taken from the National Climatic Data Center

(NCDC). Note that, while many stations are shown, several of these prove to be of little use. For example, the availability of data at a station may be limited to only a short period. As another example, a station may have wind data, but not pressure data.

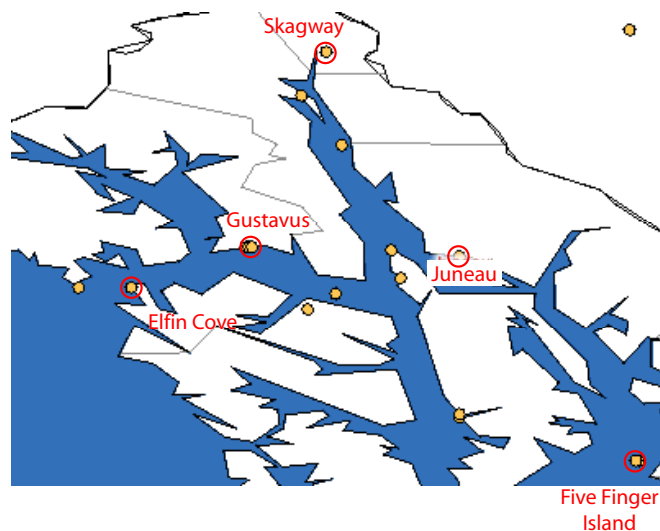


Figure 6.1: Select climate data stations in the vicinity of Glacier Bay.

6.2 Preparation of Data

Given these constraints, the following approach was taken. The goal is to have a climatic database, with values of wind speed, wind direction, and surface pressure available on an (roughly) hourly basis. When an ADCIRC user then desires to conduct a run with meteorological forcing, a fort.22 data file can be prepared based upon this database. To that end, wind data were extracted from the Gustavus station from the period of January 1988 to April 2006. Note that, during the extraction process from the NCDC website, the user has the ability to select options such as what parameters to output and what time reference to use. For the present study, all data were output relative to GMT time.

In the extracted file, there are columns corresponding to the date / time, the wind direction, and the wind speed, among others. These data are generally available on the top of the hour, but, in some instances, data are reported

at other times within the hour. During some lengthy intervals, no data are available, perhaps due to a sensor malfunction. These ‘missing’ data points were filled in by averaging the data values from the most closely available bracketing times.

With regards to surface pressure, the Gustavus station has no values available. Therefore, pressure values were obtained, for the same time period, from three stations in the vicinity: Skagway Airport, Juneau International Airport, and Five Finger Island. These data were then binned and averaged on an hourly basis. For example, all existing data values between 00:00:00 (GMT) and 01:00:00 (GMT) on 1 January, 2000 were collected and averaged in order to determine a regionally-averaged value of surface pressure for that hour long period. These average pressure values were then added to the Gustavus data file.

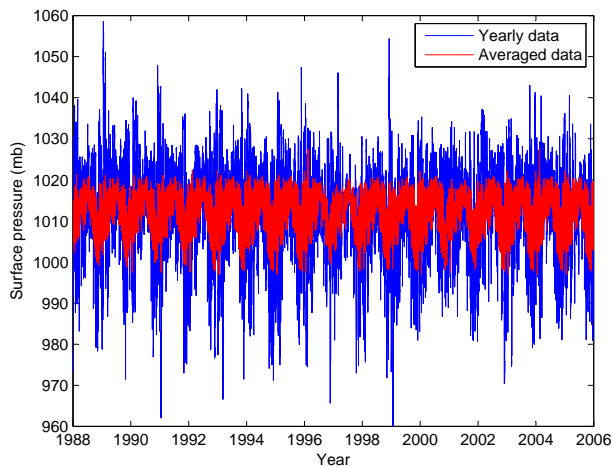


Figure 6.2: Plot of surface pressure over an 18 year period. Also shown is the data, binned hourly and averaged over the 18 year period of the record.

Also included in the final data file, `glba_climate.txt`, are columns giving the direction, speed, and pressure, in hourly bins, averaged over the 18 year period of the record. These data are helpful in revealing longer-term trends in the climatic records. For example, Fig. 6.2 shows the 18 year record of surface pressure, averaged over the three stations given above. It also shows the pressure data when averaged on an annual basis. This latter curve shows a clear annual cycle, with relatively low pressures in winter and high

pressures in summer. These annually-averaged values could, in principle, be of use in terms of estimating the climatic conditions for a time period that lies outside the range (1988-2006) of the generated climate data file. However, this extrapolation must be viewed with considerable caution, given the wide variation (shown in Fig. 6.2) that can exist between the conditions of a given year and the long-term average.

6.3 fort.22 Creation

With the existence of the Glacier Bay climatic data base, stored in the `glba_climate.txt` data file, a `fort.22` file can easily be created. It should be reiterated that the approach adopted here is assuming that meteorological parameters, while functions of time, are constant in both horizontal directions. Of the many choices for input format, the author is using the case where $NWS = 5$. In this case, wind speed in the x direction, wind speed in the y direction, and surface pressure are input, for every grid point, at a specified time interval. Given that climatic data are available on an hourly basis, the obvious choice is to include climatic data in the `fort.22` file on the same time interval.

Upon execution, the Matlab script `write_fort22.m` prompts the user (i) for the start time of the simulation (GMT) and (ii) the duration of the simulation. Based upon these selections, the script interpolates the data in the climatic database to the times required for the `fort.22` file. As an example, assume that the ADCIRC user wished to conduct a run that began at 11:34:50 (GMT) on August 2nd, 2002 and was to run for 6 hours. The script would then go in to the climate database on that date and linearly interpolate between 11:00:00 and 12:00:00 in order to determine the conditions at 11:34:50. These values would be used for the first hour of the model run, and then new values would be obtained.