

CMSC 6950 Open Science Project

NEWFOUNDLAND AND LABRADOR AVIATION WIND DATA

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1 Introduction

Great strides to better understand and display historical climatological data have been made in the past decade due to growing concerns over climate change among other things. One climatological data set that has a diverse range of importance when addressing these problems is wind data. Changes in major wind patterns, such as increases in the power of wind systems over time, can be used as a gauge to measure how the strength of storms is changing due to climate change (Mendelsohn et al. 2012). Another application of study of wind data, in particular directional wind data, is designing wind power farms (Cetinay, Kuipers, and Guven, 2016) for a source of clean, renewable energy. For optimal placement of wind turbines, prominent wind directions and the associated wind speeds need to be plotted and analyzed. Other applications of studying wind data include mapping air pollution sources (Adams and Kanaroglou, 2016) and knowledge of dominate wind directions at airports, important information for pilots and air traffic controllers (Bellasio, 2014).

Here we will look at the last of the applications in connection to airports in Newfoundland and Labrador. Wind speed and directional data are collected at each airport through out the province, making data access relatively simple. A Python based wind data visulization package Windrose (Roubeyrie and Celles, 2018) will be employed to show several variations of polar diagrams used to plot each airport’s respective wind data. Although we propose the purpose of this study to be that of knowledge gathering for pilots and air traffic controllers, a broad connection to the potential for wind energy production in the province of Newfoundland and Labrador (a long discussed topic) can be made. We are merely limited by the availability of data to fully engage in the study of wind power potential.

The remainder of this report is structured as follows, in section (2.1) we discuss data access and collection, in section (2.2) we introduce the Windrose package and show multiple visualizations of directional wind data for a user-defined airport (see README), finally in section (??) we briefly discuss and conclude on some key points.

2 Methodology

2.1 Data Access

The README file should be consulted for preliminary data access information and for instructions on how to call data from a particular airport. Here we talk about where the data is from and how it is collected. All the data (fifteen sets) available from the windData repository was accessed through the Canadian Climate Data Accessibility Portal (CCDAP). The CCDAP is a public data query platform which holds Canadian historical climate data collected and maintained by Environment and Climate Change Canada. CCDAP was made at the Water Security and Climate Change Lab (WSCC) at Concordia University. As mentioned above, each data set was collected at an airport in Newfoundland and Labrador over some range of time (given in data set name). The data has been stripped to only include data/time, wind speed and wind direction information; full data sets for each locality include multiple additional weather measures such as temperature and visibility. The decision to only include wind data in this report (as other data, visibility in particular, is also important information for air travel) was for two main reasons, firstly, the CCDAP limits the size of data sets and thus including additional weather measurements would restricted the range of time of each data set subsequently degraded the historical aspect of the information gathered by this study. Secondly, the Windrose package currently provides no mechanism for analyzing weather data other than wind data.

Each data set was collected by an aviation weather station. Since the age range of all the data is quite broad, no one system was used to collect each data set. We will therefore briefly discuss a commonly used aviation weather station, the Automated Weather Observation System (AWOS) shown in figure (??). AWOS is a core component of NAV Canada’s weather monitoring system with over 100 systems in place across the country. Each system is installed on the airfield and collects

weather data (e.g. wind speed and direction) continuously, in real-time and sends the information directly to the airport and pilots. This weather data is then stored and accessed via public portals such as CCDAP for a variety of studies such as this one.



Figure 1: Automated Weather Observation System (AWOS) used to monitor weather at many airports throughout Canada. Older data sets or data sets from remote areas would have been collected on a similar, less-advanced weather station.

2.2 Wind Data Visualization

The Windrose package is a graphic tool used to give a view of how wind speed and direction are typically distributed at a particular location (Roubeyrie and Cellers, 2018). The package is backend my Matplotlib to produce multiple polar (rose) diagrams for a given data set. These Windrose diagrams can subsequently be used in applications mentioned in section (1), among others. When these diagrams are tied with positional digrams, such as the one seen in figure (??) showing the location of the data presented in this report, links can be made between environmental aspect (wind tunnel effects, proximity to oceans, etc.) and the preferred wind directions.

3 Discussion and Conclusions

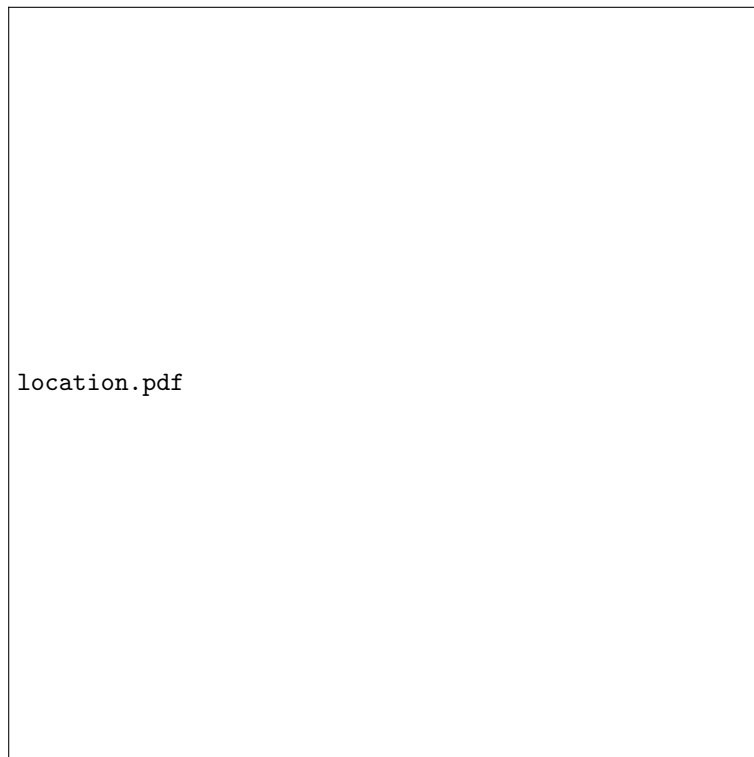


Figure 2: Map of Newfoundland and Labrador annotated by location of wind data collection (yellow star).

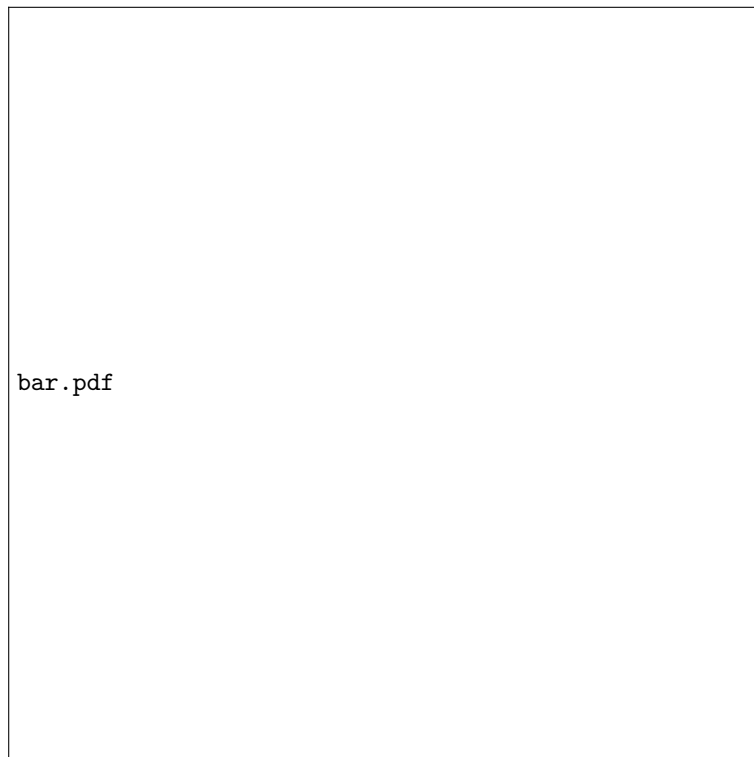


Figure 3: Directional wind data from user-defined Newfoundland and Labrador airport plotted on a bar polar diagram from the Windrose Python package.

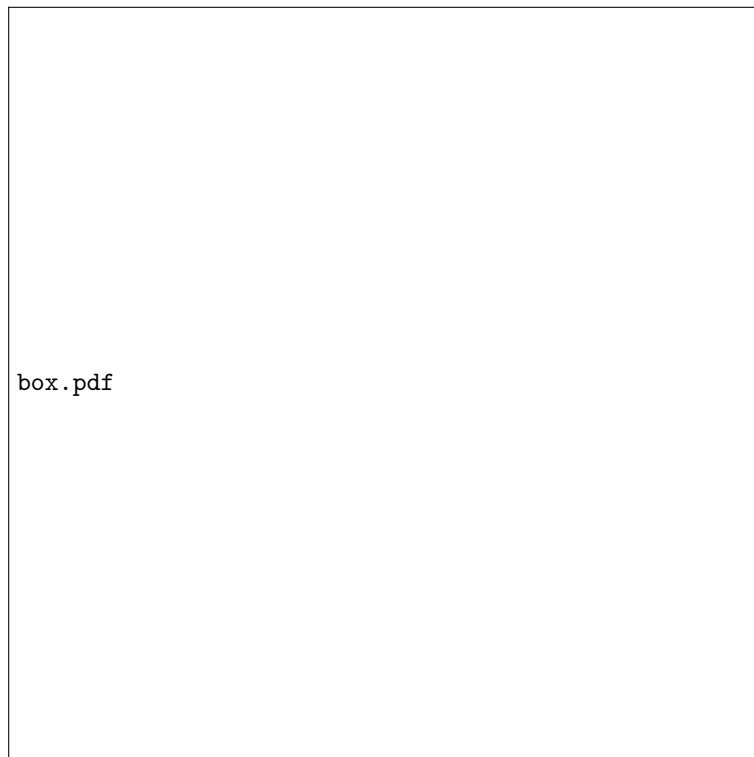


Figure 4: Directional wind data from user-defined Newfoundland and Labrador airport plotted on a box polar diagram from the Windrose Python package.

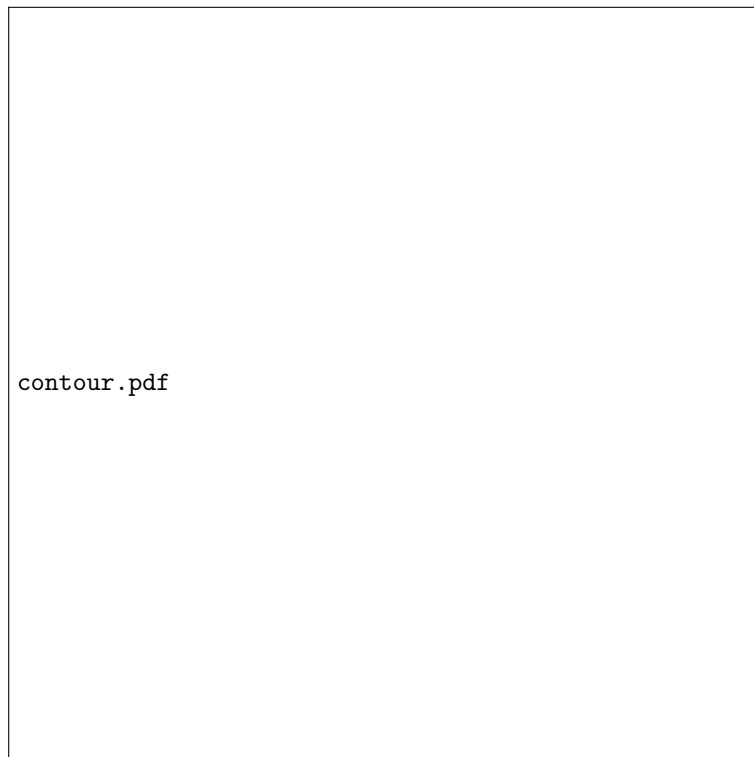


Figure 5: Directional wind data from user-defined Newfoundland and Labrador airport plotted on a contour polar diagram from the Windrose Python package.

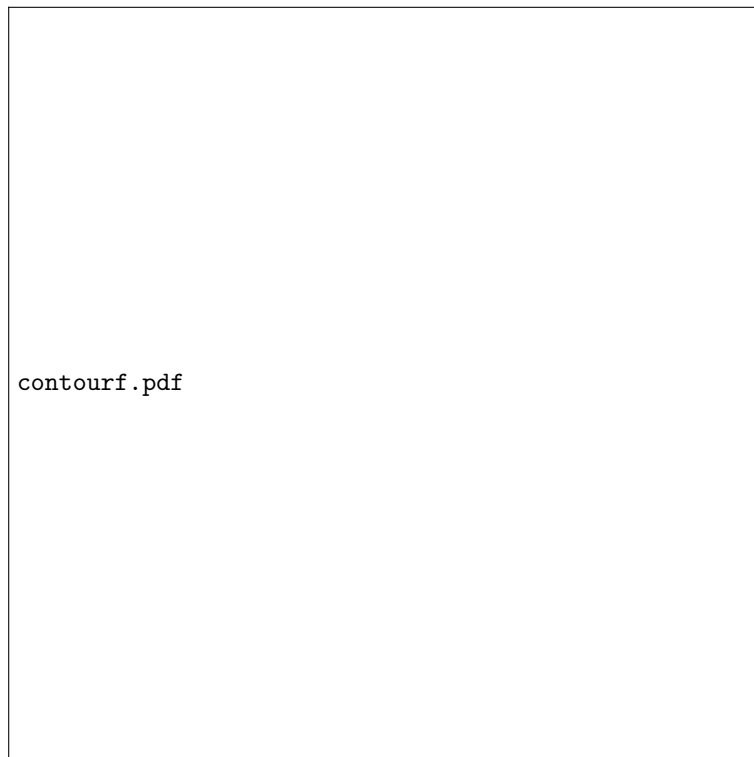


Figure 6: Directional wind data from user-defined Newfoundland and Labrador airport plotted on a filled contour polar diagram from the Windrose Python package.