A TROPICAL CYCLONE DATA TAPE FOR THE NORTH ATLANTIC BASIN,[1] 1886-1982: CONTENTS, LIMITATIONS, AND USES

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ABSTRACT

The National Hurricane Center maintains a computer file on North Atlantic tropical cyclones. The file contains dates, tracks, wind speeds, and central pressure values (if available) for all tropical cyclones occurring over the 98-year period, 1886 through 1983 and is updated annually. The data organization, format, and limitations are discussed and several uses of the data are demonstrated.

1. INTRODUCTION

The National Hurricane Center (NHC) is essentially a forecasting, rather than a data collecting, agency of NOAA. However, pursuant to its operational responsibility in the detection, tracking, and forecasting of tropical cyclones, and its additional responsibility in the applied research and public service area, the Center maintains detailed computer files on North Atlantic tropical storms and hurricanes. This report describes the content, format, limitations, and uses of the data, hereafter referred to as the HURDAT (HURricane DATa) data set.

2. BACKGROUND OF DATA SET

The initial requirement for computerized tropical cyclone data at NHC can be traced to a requirement of the NASA Space Program in the mid-1960's. At the request of Space Program officials, Hope and Neumann (1968) of the Spaceflight Meteorology Group, formerly collocated with the National Hurricane Center, studied the climatological impact of tropical cyclones on launches of space vehicles from the Kennedy Space Center. An extension to the authors' studies led to the operational HURRAN (HURRicane ANalog) program (Hope and Neumann, 1970) for the prediction of tropical cyclone motion out through 72 hr.

Originally, Hope and Neumann based their studies on a now obsolete card deck 988 (CD 988) obtained from the National Climatic Center.

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[1]The North Atlantic tropical cyclone basin includes most of the North Atlantic, Gulf of Mexico, Caribbean Sea, and adjacent land areas.

However, the original card deck has been extensively revised by NHC and tailored to its specific needs. Under the sponsorship of the U.S. Navy, the National Climatic Center has also revised card deck 988 and reissued it as card deck 993. The tropical cyclone tracks for the 1886 through 1963 portion of this latter deck correspond to those given by Cry (1965). The tropical cyclone tracks in HURDAT correspond to those given by Neumann, et al. (1981) in a revision to Cry, in which tracks are extended through the 1980 hurricane season. The revision also includes a few changes to some of Cry's original tracks. A copy of this data set may be purchased from NOAA/NESDIS, National Climatic Center, Federal Building, Asheville, NC, 28801. In requesting the tape, specific referrence should be made to the NHC edition.

3. THE HISTORY OF DATA OBSERVATIONS

The four basic pieces of information recorded on the computer file are the tropical cyclone's position (latitude and longitude), maximum sustained wind speed in knots, the central pressure in millibars (if available), and the time and date. The availability and accuracy of these parameters has by no means been constant throughout the years. Figure 1 indicates graphically the technical advances in observing systems that have occurred since the formation of the Hurricane Warning Service in 1871. This figure shows that, until organized reconnaissance began in 1944, the two major sources of information on tropical cyclones were land stations and ships at sea. Undoubtedly, during this early period some storms went undetected. However, ships encountered tropical cyclones more frequently in earlier years because they did not always have the benefit of forecasts. Many times a storm was detected and then "lost" for several days before it was encountered by another ship or observed from a land station. At other times a storm moved over land stations and through the major shipping lanes, thus allowing its track and intensity to be determined with a reasonable degree of accuracy. Therefore, during this early period of data the most useful information is track rather than wind data, although some of the tropical cyclones do have useful maximum wind information. Nevertheless, the user of the wind information is cautioned not to make an overly precise interpretation of this parameter for the entire period of record and especially before 1944. The reader is referred to Neumann, et al. (1981) for a list of additional references on tropical cyclone tracking.

Organized aircraft reconnaissance has allowed continuous monitoring of the storm's track, maximum sustained wind field, and central pressure. This is reflected in the increase of pressure data beginning in 1944. The coastal radar network has improved the track information mainly for landfalling storms.

The largest single advance in the detection and tracking of tropical cyclones has been the introduction of weather satellites with their associated visible and infrared sensors. With the initial position of a tropical cyclone determined from satellite a reconnaissance aircraft is dispatched to measure the more precise wind field, central pressure, and location of the center.

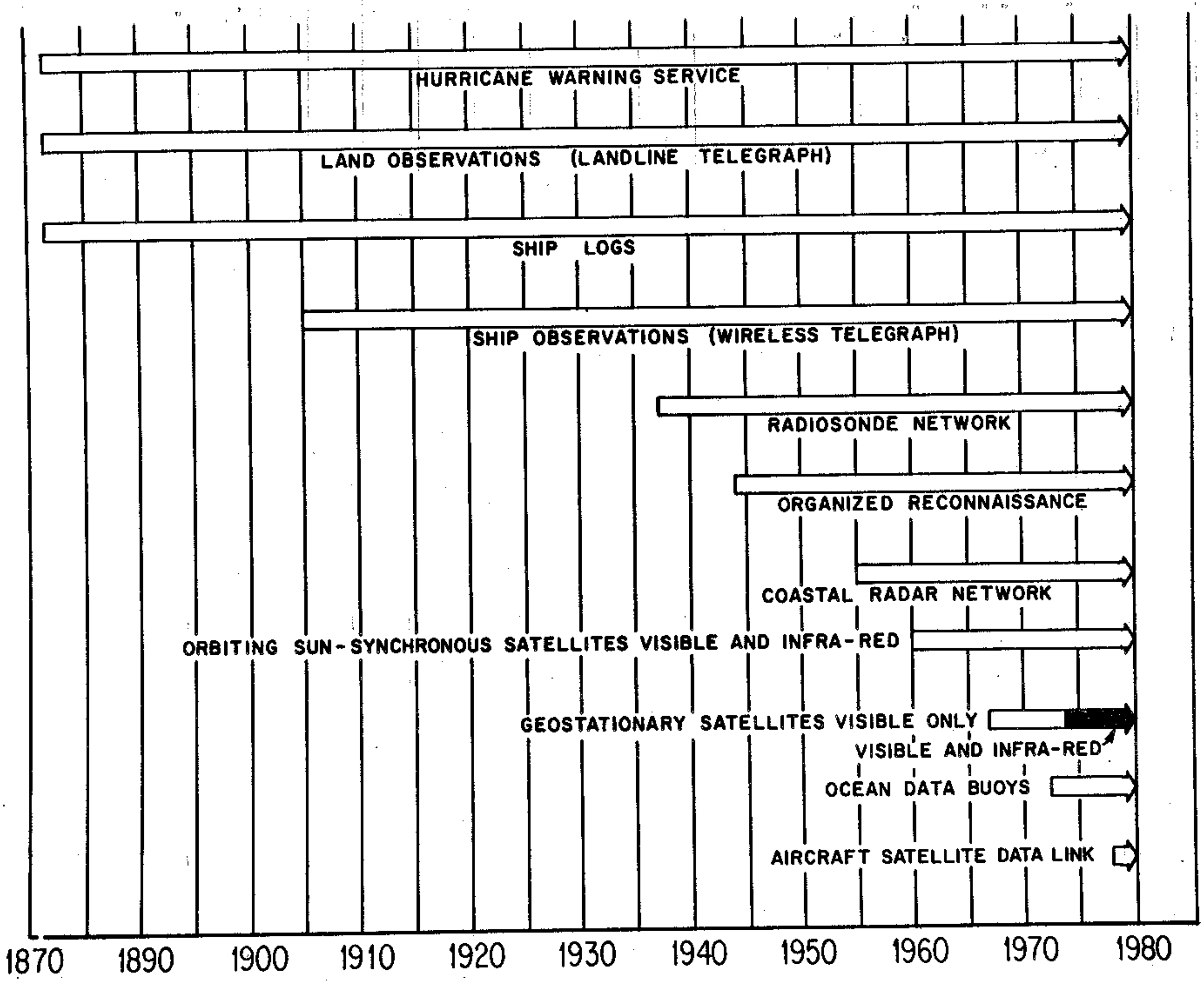

Figure 1. Technical advances in systems for observing tropical cyclones, 1871 through 1980.

Recently, ocean data buoys have been developed as observing platforms. These buoys fall into two classes; drifting or anchored. The larger are generally anchored to the bottom in a data sparse region. Since oceanographic instruments are suspended from cables beneath the buoy, it provides data useful to oceanographers as well. Because tropical cyclones receive sensible and latent heat from the ocean, the ocean buoy offers a means of measuring these fluxes directly.

In 1977, for the first time, continuous meteorological information was relayed from a reconnaissance aircraft to the National Hurricane Center through a geostationary satellite. This almost instantaneous reception of the tropical cyclone's position and information about its structure has undoubtedly aided the forecaster in improving his forecasts of movement and intensity.

4. POSITIONS

Archived tropical cyclone tracks are referred to as "best tracks." These are constructed during careful post-analysis and all available information, including aircraft reconnaissance fixes, satellite imagery, land based radar fixes, ship reports, station reports, and ocean data buoy reports. Figures 2 and 3 are examples of available information for determination of the best track. With the abundance of information available from these different observing platforms, conflicts often arise. Here, subjective interpretations are made by the analyst. Besides knowing the characteristics of the observing platforms, the analyst also takes into account two other phenomena associated with tropical cyclones.

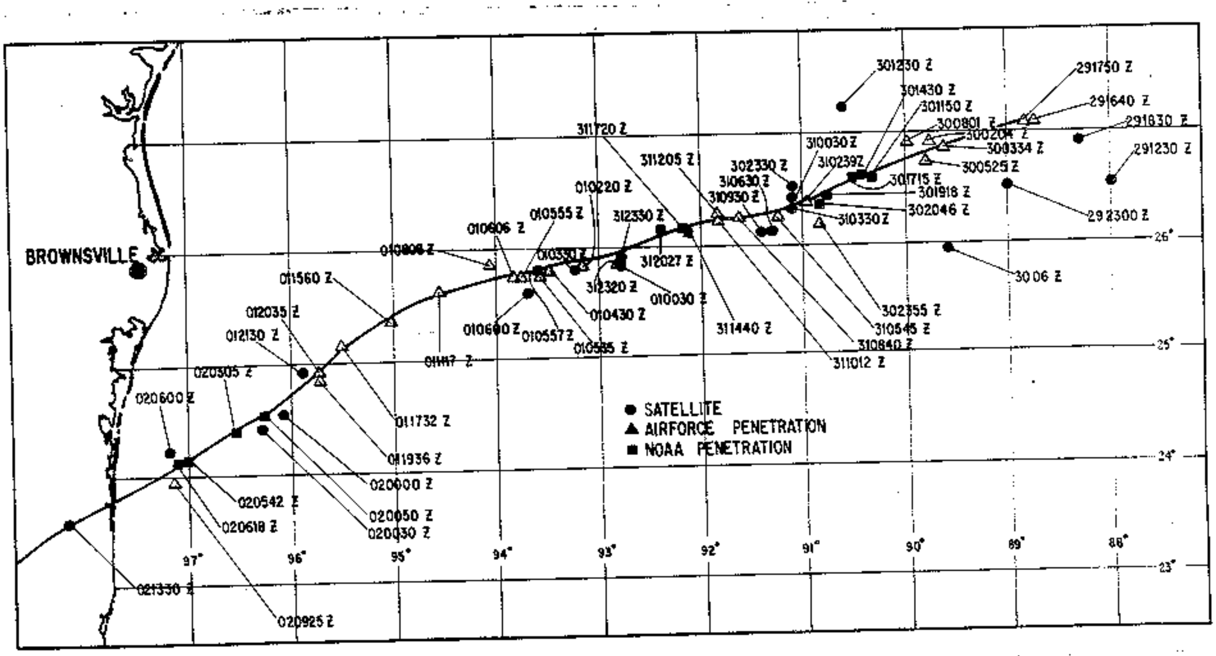

Figure 2. Satellite and aircraft center fixes for tropical cyclone Anita, 1977. The numerical value represents the day (leftmost two digits) and hour and minutes (rightmost four digits). Solid line represents the best track.

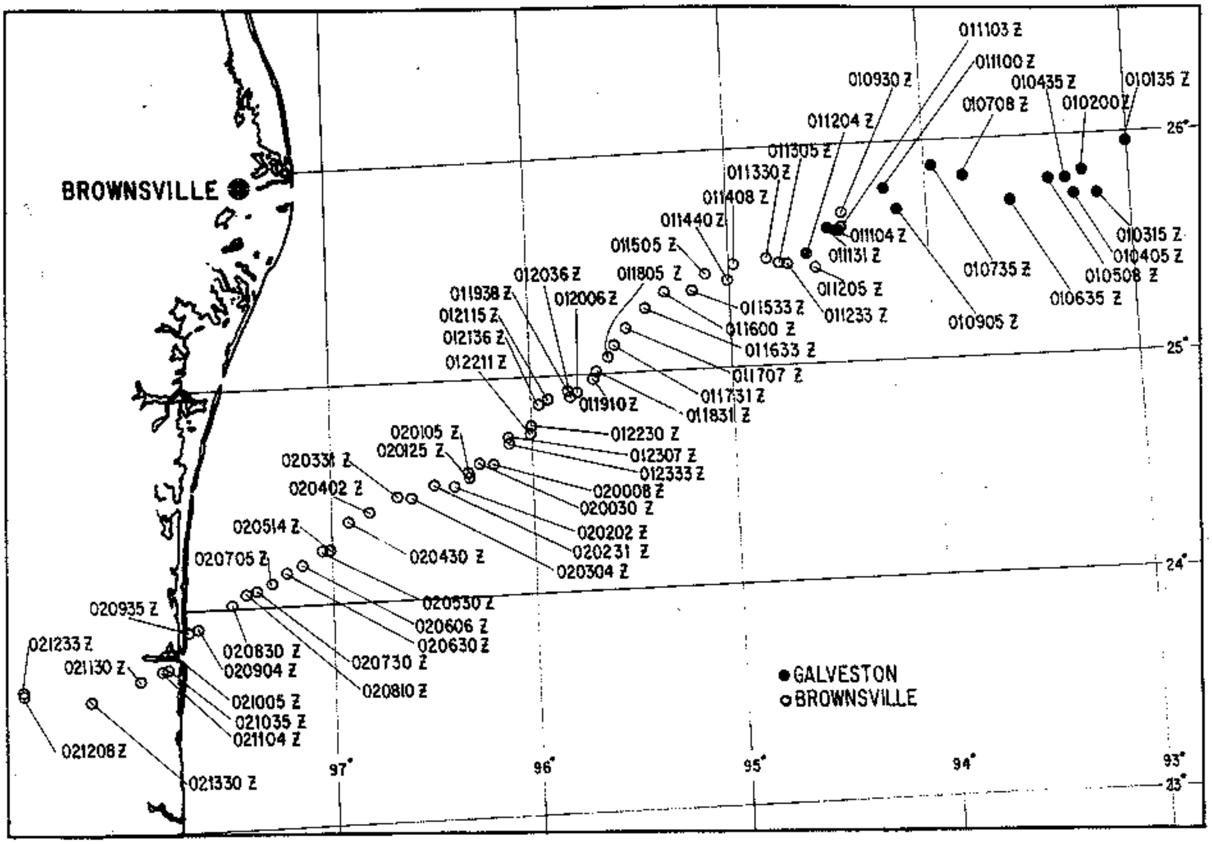

Figure 3. Radar center estimates for tropical cyclone Anita, 1977. The Galveston radar was able to make several estimates before the cyclone passed out of its range and into Brownsville's range. Note the small-scale oscillations in the track and compare this with the best track in Figure 2.

First, small-scale oscillatory (trochoidal) motions which are transitory in nature and not representative of the more conservative motion of the entire storm envelope must be considered. Smoothing is necessary to remove these small-scale motions, which are on the order of 5 to 20 n.mi. about some mean path. Radar documentation of these eye oscillations on tropical cyclone Carla, 1971, is presented in Figure 4. Recent evidence of similar motion based on satellite imagery of tropical cyclone Belle, 1976, is provided by Lawrence and Mayfield (1977). Therefore, final tracks should be considered as the best estimate of the larger scale storm motion, rather than precise locations of the eye.

Second, for a number of reasons, the pattern of wind, rainfall, and storm surge are typically higher in the right semicircle of a storm (looking towards the direction of motion) where the rotational and translational forces work in the same direction. Again, final tracks must take into account these asymmetries.