12. HOMOGENEOUS TROPICAL CYCLONE INTENSITIES FROM THE COMMUNITY DVORAK ANALYSIS

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1. INTRODUCTION

Tropical cyclone (TC) intensity, distribution and frequency significantly impact life and property. Understanding these aspects of cyclones, however, requires a uniformly constructed dataset. The International Best Track Archive for Climate Stewardship (IBTrACS, Knapp et al. 2010) project has provided a centralized collection of TC best track data. Despite efforts to minimize discontinuities in IBTrACS, inhomogeneities remain caused by changes in instrumentation, personnel, forecast agencies and operational procedures, which has led to a catalog of storms that is incongruous. To ameliorate this issue, efforts are underway in the North Atlantic to perform a reanalysis of storm intensity, however no global effort is currently in progress.

In lieu of in situ observations of storm conditions, forecast agencies rely solely on satellite observations of storms to infer storm intensity (reportedly 90% of storm observations). Storm intensity is derived using the Dvorak technique that provides (as output) the T-number, which is estimated from visual analysis of the satellite image by an analyst. The T-number can be related intensity, but in essence, is really the fundamental climate data record from which the intensity (as a thematic climate data record) is derived. This project will work to reduce the heterogeneities of the T-number record, thereby allowing a more consistent record of tropical cyclone intensity to be derived.

We plan to build upon work already completed at the National Climatic Data Center (NCDC) to develop and archive a homogeneous record of satellite intensity. NCDC is uniquely positioned to start this project given the datasets and expertise on hand. IBTrACS is a global inventory of known tropical cyclones, while the HURSAT dataset is a collection of all satellite brightness temperatures from polar and geostationary satellites for the storms in IBTrACS. Using these NCDC resources, the Dvorak technique (Velden et al. 2006) can be applied to estimate TC intensity during the satellite era.

Rather than develop an objective algorithm which is subject to large errors, we plan to develop a graphical user interface (GUI) to allow manual satellite-based reanalysis using the Dvorak technique for the entire HURSAT period of record (1978-2009). This is ambitious given the 3000+ storms that must be reanalyzed, but is achievable with an anticipated global, open, and collaborative working group. For instance, Wikipedia, open source software development and many websites are successful through volunteers with an interest in the success of the project. The success of the "Zooniverse" (http://www.zooniverse.org) and its associated projects such as "MoonZoo," "GalaxyZoo," and "OldWeather," and the 345,000+ registered citizen scientist's working on these projects along with their resulting scientific discoveries attest to the possible success of a distributed, web-based project such as the one we are planning. The tropical community already has numerous dedicated followers, as demonstrated by 1000+ participants on the tropical storm listserv, who could launch a successful participation effort.

2. KEY PROJECT COMPONENTS

This work has four aspects: GUI development, storm selection, project promotion and data analysis.

a) GUI Development

A Java GUI of the Dvorak technique will allow maximum inter-operability and allow intensity estimate for individual storm

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imagery. As each user "classifies" a storm, all selections made during the process are recorded to a database. We plan to develop integrated training aspects for this tool.

b) Storm Selection

A key to this project is in how users are provided storms. First, users will be given storm imagery in a normalized projection such that it will not be obvious which storm is being analyzed in order to keep from biasing users toward a specific intensity of a known storm. Second, users will, at a minimum, be identified by a user name that will allow tracking which storms they classify. Third, the storm selection algorithm will frequently provide users with "calibrating" storms. These storms will be of a known intensity based on high quality *in situ* or aircraft observations. This proposal will focus on two periods to demonstrate the effectiveness of the tool.

c) Project promotion

The success of the effort will depend on an enthusiastic user-base. The community is already energetic, so efforts will be made to direct those energies toward not only using the GUI to classify cyclones, but also to garner additional worldwide participation. An important part of this process will be the project website. The website designed for this project will provide real time insight into the progress. Active users will have access to storms they have processed as well as see their progress compared to others. Progress can also be categorized in ways to encourage more participation (e.g., global contributions grouped by academic institutions, current affiliations, countries, etc.).

d) Data analysis

Based on each user's performance against calibration storms, their resulting classifications can be normalized to derive a satellite-based intensity estimate. This project aims to remove the temporal and spatial problems in the current best track record. While it will not replace the current best track, it will enhance the best track record by providing a stepping stone toward a global reanalysis. The result will be a refined TC intensity record that will provide insight into TC variability, intensity, and uncertainty.

3. CONCLUSION

By developing a long term, consistent archive of tropical cyclone satellite intensity estimates, the CoDA project will serve to enhance our current understanding of their distribution, variability and intensity. As the current best track record is heterogeneous (owing to changes in operating procedures and personnel), the resulting global reanalysis using digital satellite data and applying the Dvorak technique will provide a stable dataset of cyclone intensity estimates.

4. REFERENCES

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