# Global Identification of Previously Undetected Tropical Cyclone Candidates in NOAA/CIRES 20<sup>th</sup> Century Reanalysis Data

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Prior to the advent of the satellite era, limited in situ synoptic observations led to an indefinite number of tropical cyclones remaining undetected in tropical basins globally. This era of poor confidence in climatological data extends until 1966 in the Atlantic Basin and until roughly 1979 in most other global tropical basins. Tropical cyclones prior to those years were not identified operationally and therefore are not a part of the consensus tropical cyclone climatology. While prior studies (Vecchi and Knutson 2008) suggest that this historical undersampling exists, there remains considerable disagreement regarding its true magnitude in existing literature. This disparity has led to difficulties in interpreting long-term trends in tropical cyclone activity as well as ambiguities regarding the potential existence of multi-decadal oscillations in tropical cyclone count. These uncertainties hamper the ability of public and private interests to accurately quantify and manage the risks tropical cyclones pose to coastal communities both now and in the future.

Previous research utilized the NOAA/CIRES 20th Century Reanalysis, a new reanalysis dataset that assimilates only surface-based observations and extends back in time to the late 19<sup>th</sup> Century, to develop a scheme that identified previously unknown Atlantic Basin potential cyclones in the pre-satellite era (Truchelut and Hart 2011). This was accomplished through compositing the mean three-dimensional thermodynamic structure, estimated low-level vorticity, and surface pressure fields of historical tropical cyclones and identifying similar signatures in the reanalysis that did not correspond to known Best-Track cyclones. Synoptic verification using historical surface ship observations from the ICOADS dataset as well as supplemental observations from land-based platforms showed the reanalysis-derived technique effectively identified around 1.5 such cases per year for the 1951-1958 Atlantic Basin hurricane seasons as well as several cases per year suggestive of significant track extensions to existing cyclones.

This research expands the scope of the original methodology in both spatial and temporal dimensions by using a filtering algorithm that dramatically improves the efficiency and speed with which candidate events are identified in the NOAA/CIRES 20th Century Reanalysis dataset. This scheme was then applied this to the Atlantic, East Pacific, West Pacific, North Indian, and South Indian Ocean Basins for the years 1891-1979. These results allow quantitative and objective estimates of global tropical cyclone candidate counts to be made for the first time for several decades prior to the advent of formal climatological records. Track and longevity data for each candidate event identified are also presented, along with an estimated probability that the event was actually a tropical cyclone. While synoptic verification has not yet been performed on each of the candidate events identified, verification has been performed on a subset of the events which confirms that the algorithm is able to identify potential missing tropical cyclones at a rate neari3ng that of the manual technique. These preliminary findings continue to suggest that reanalysis models are a useful means of efficiently and effectively adding new information to the tropical cyclone climatological record and are a promising basis upon which to improve our understanding of long-term trends in tropical cyclone activity.

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