3A.1 A LOOK AT GLOBAL TROPICAL CYCLONE ACTIVITY WITH RESPECT TO THE ATLANTIC CHANGE-POINT YEAR OF 1995

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1. INTRODUCTION

During 1995 there was a near-record number of named tropical cyclones in the North Atlantic basin. This unusual event fueled speculation that it marked a tangible signal of global climate change, or that it marked a return to a period of higher tropical cyclone activity in the Atlantic such as that which has been documented to have occurred during the decades of the 1940s through the 1960s. Less publicized, the tropical cyclone activity in other basins in 1995 was almost everywhere below normal (Lander and Guard 1998). Since 1995, the Atlantic basin has seen a striking increase in the annual number of tropical cyclones (with a respite during the major El Niño of 1997) (Fig. 1). In the eastern and western North Pacific basins, the years since 1995 have seen a general decrease in tropical cyclone activity. The data suggests that inter-decadal shifts of tropical cyclone climate are occurring in most basins. However, the change-point between periods of enhanced tropical cyclone activity and decreased tropical cyclone activity differ (Table 1). For example, in the Atlantic, a period of generally below normal annual tropical cyclone counts occurred during 1972-94, with an upswing occurring in 1995 that continues today. In the western North Pacific, a period of generally below normal annual numbers of tropical cyclones occurred during 1973-88, followed by an upswing of tropical cyclone activity during 1989-97. After 1997, the annual numbers of tropical cyclones in the western North Pacific decreased markedly with the lull continuing today. Strong variations of tropical cyclone climate associated with ENSO and the Quasi-biennial Oscillation (QBO) are superimposed on longer-period changes of the tropical cyclone climate in the North Atlantic and the western North Pacific. The link between inter-decadal changes in each ocean basin's tropical cyclone climate and inter-decadal variations in other basin and regional climate oscillations and patterns is less obvious.

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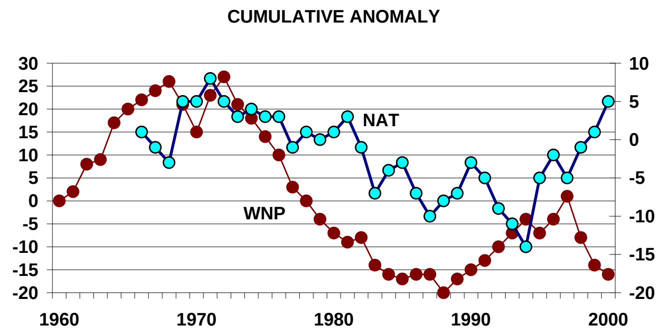

Figure 1. A time series of the running accumulation of the anomalies of the annual number of Atlantic named tropical cyclones (NAT) and for the anomalies of the annual number of western North Pacific typhoons (WNP).

Basin	Trend	Period	Avg Rate
WNP	Surplus	1960-72	+2.2/yr
	Deficit	1973-88	-3.2/yr
	Surplus	1989-97	+2.3/yr
	Deficit	1998-01	-4.2/yr
NAT	Surplus	1966-71	+1.6/yr
	Deficit	1972-94	-0.8/yr
	Surplus	1995-01	+2.4/yr
ENP	Deficit	1966-81	-1.6/yr
	Surplus	1982-94	+2.0/yr
	Deficit	1995-01	-3.4/yr

Table 1. A tabulation of the periods of TC deficits and surpluses for the western North Pacific (WNP), the North Atlantic (NAT), and the eastern North Pacific (ENP).

2. INTERDECADAL CHANGES

There is intense pressure on the scientific community to predict the long-term (next 50-100 yr) fate (e.g., warming) of earth's climate; and further, to show the impact of such long-term climate change on each geo-political region (e.g., tropical Pacific islands, Antarctica, and the world's grain belt). It has been suggested by some that the global TC climate could change (perhaps for the worse) under scenarios of a warmer world (e.g., Lighthill *et al*. 1994 and Emanuel 1995). Recent climate change research has been focused on the problem of climate fluctuations at periods of one to several decades. These inter-decadal climate variations are troubling because they may mask, or may be mistaken for, longer-term climate changes. A plethora of local and regional climate patterns have been defined, for example: the Pacific Decadal Oscillation (PDO), the North Atlantic Oscillation (NAO), the Southern Oscillation, the East Atlantic Pattern (EP), and the Pacific/North American Pattern (PNA). Nearly all of these have prominent inter-decadal variations (e.g., Fig. 2). Attempts to link the inter-decadal variations of the major defined climate patterns with tropical-cyclone climate variations have proved to be difficult. Some hold that the link between tropical cyclone inter-decadal variation and inter-decadal variation of other climate patterns is changes to the ocean thermohaline circulation. The Broeker (1987) and Gordon (1986) descriptions of the thermohaline circulation as a conveyor belt graphically emphasize the interconnections amongst the waters of the world's oceans. The North Atlantic thermohaline circulation has many effects on weather patterns and events, possibly including the distribution of Atlantic tropical cyclones (Gray et al. 2000). It is linked with the NAO, which is one of the most prominent teleconnection patterns in all seasons. The wintertime NAO exhibits significant interannual and interdecadal variability. The PDO is a long-lived El Niño-like pattern of Pacific climate variability. Several independent studies find evidence for just two full PDO cycles in the past century (e.g., Minobe 1997) (Fig. 2). No clear relationship between the PDO and WNP tropical cyclone climate has been found.

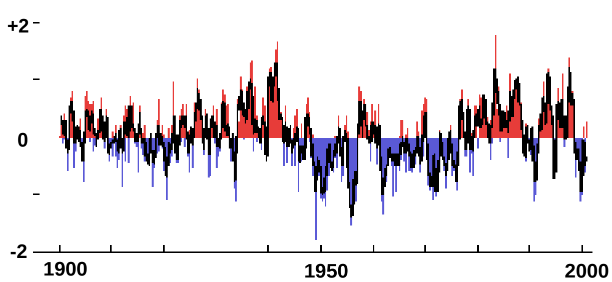

Figure 2. A time series of the Pacific Decadal Oscillation for the 20th Century showing prominent inter-decadal variations. (Adapted from the web site: http://tao.atmos.washington.edu/pdo/).

3. CONCLUDING REMARKS

The inter-decadal variations in the annual numbers of tropical cyclones in the North Atlantic, eastern North Pacific and western North Pacific show little overlap. Only the recent rise in Atlantic activity beginning in 1995 coincides with a drop in activity in the eastern North Pacific that also began in 1995 (Fig. 3). The tropical cyclone climate in all ocean basins appears to undergo inter-decadal variation (as do most local and regional climate patterns). There is scant evidence of overlap (simultaneous, or at a consistent time-lag) among any of the inter-decadal variations. Perhaps it will someday be shown that the complex ocean thermohaline circulation is governing much of these changes.

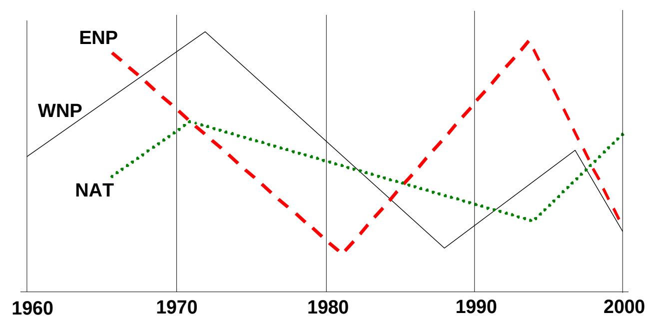

Figure 3. A graphical representation of the periods of surplus and deficits of tropical cyclones in the indicated basins.

ACKNOWLEDGEMENTS

This work was sponsored by the Pacific ENSO Applications Center (PEAC) (NOAA/NWS).

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