

Abstract

The response of tropical cyclone activity to global warming is widely debated. It is often assumed that warmer sea surface temperatures provide a more favourable environment for the development and intensification of tropical cyclones, but cyclone genesis and intensity are also affected by the vertical thermodynamic properties of the atmosphere. Here we use climate models and observational reconstructions to explore the relationship between changes in sea surface temperature and tropical cyclone ‘potential intensity’—a measure that provides an upper bound on cyclone intensity and can also reflect the likelihood of cyclone development. We find that changes in local sea surface temperature are inadequate for characterizing even the sign of changes in potential intensity, but that long-term changes in potential intensity are closely related to the regional structure of warming; regions that warm more than the tropical average are characterized by increased potential intensity, and vice versa. We use this relationship to reconstruct changes in potential intensity over the twentieth century from observational reconstructions of sea surface temperature. We find that, even though tropical Atlantic sea surface temperatures are currently at a historical high, Atlantic potential intensity probably peaked in the 1930s and 1950s, and recent values are near the historical average. Our results indicate that—per unit local sea surface temperature change—the response of tropical cyclone activity to natural climate variations, which tend to involve localized changes in sea surface temperature, may be larger than the response to the more uniform patterns of greenhouse-gas-induced warming.

摘要

全球暖化對熱帶氣旋活動的影響一直是廣為爭論的議題，上升的海表溫度時常被認為提供的適當熱帶氣旋發展和增強的環境，然而氣旋的生成和強度也會受到大氣的垂直熱力能力影響。

在此我們藉由氣候模式和觀測資料重建，探討海表溫度改變和熱帶氣旋「潛在強度」間的關係，此方法提供了氣旋強度的上限，且反映了氣旋發展的相似環境。我們發現，區域海表溫度在潛在強度變化的表現上的不足；然而，潛在強度的長期變化與區域結構的暖化十分相近，除此之外，可明顯看出在比熱帶平均溫度高的地區潛在強度有增強的情形。

我們利用此關係，並藉由來自海表溫度的觀測重建資料，重建了二十世紀的潛在強度變化。我們發現，雖然熱帶大西洋海表溫度現在處於歷史新高，大西洋的潛在強度卻在 1930s 和 1950s 處於高峰期，而現今的值卻處於歷史平均值。

我們的結果指出，每單位地區海表溫度變化下，相應於自然氣候變化的熱帶氣旋活動，傾向於海表溫度的區域化，且可能比越來越規律的溫室氣體促成的暖化，造成的影響還來的大。

