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Extratropical Cyclones in a Changing Climate Regime

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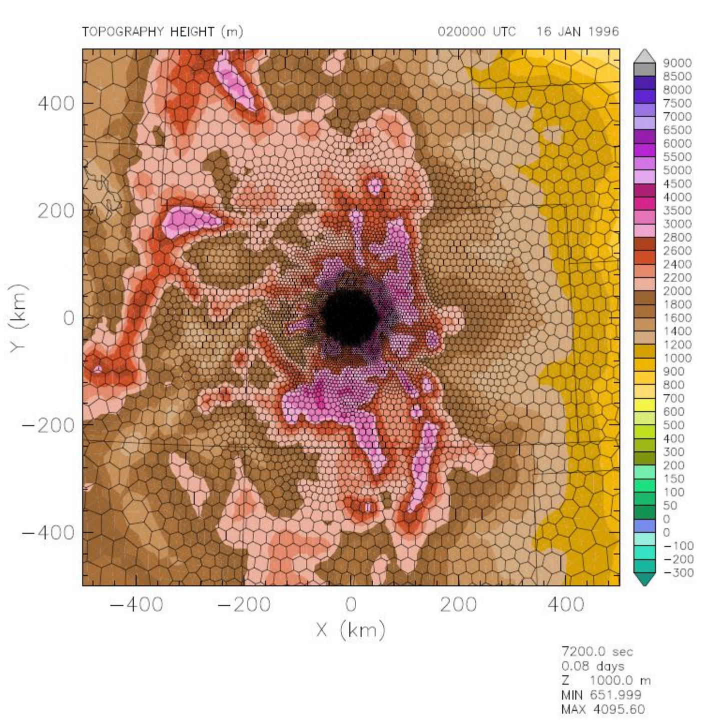
Overview

Current projections for the evolution of extratropical cyclone tracks in the Northern Hemisphere utilize tracking codes that remove topography > 1000 m from climate simulations. The three phases of this project include: 1) Identify case study days where extratropical cyclone tracks are substantially impacted by terrain; 2) Use numerical modeling to study sensitivity of cyclone tracks to terrain resolution and; 3) Develop parameterization to include sub grid scale terrain effects in climate models.



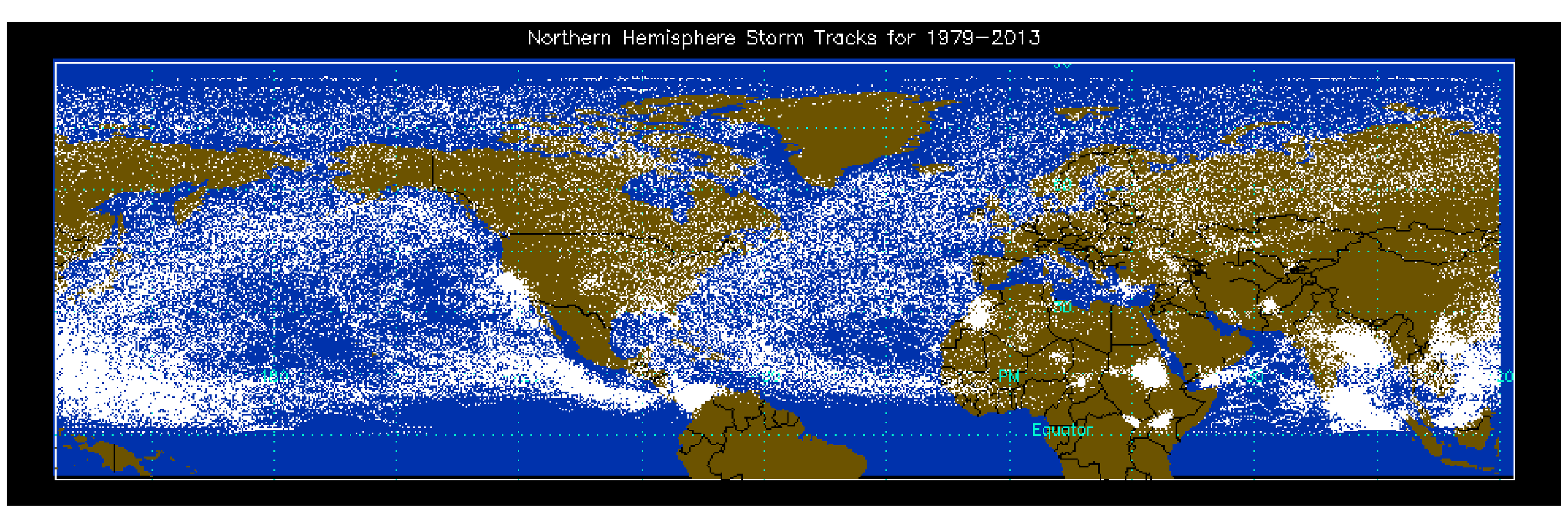


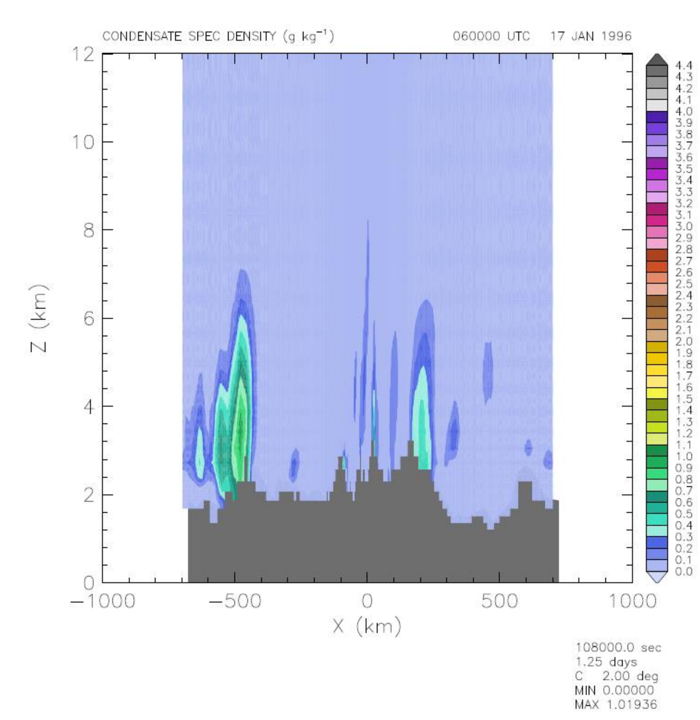
Figure 1. Top: OLAM gridmesh plotted over terrain. OLAM will be used in phase 2 of the project. Bottom: Northern Hemisphere cyclone tracks greater than 15 days from 1979-2013.

Impact

Extratropical cyclones are the primary source of precipitation for the mid- to high-latitudes. Understanding how tracks of extratropical cyclones shifts over time is important for establishing sustainable agricultural for an increasing demand nationally. Tracking extratropical cyclones can also provide decision makers with an idea of how the water supply will change for their region over time. Recent studies have projected a northward shift of cyclone tracks by up to 181 km by 2100 (Wang et. al, 2006). The inclusion of topography coupled with high resolution modeling capable of resolving mesoscale and smaller scale features provides a more accurate projection of how cyclones will change in the future.

Key Findings

The influence of topography on extratropical cyclone track is something that should be retained in climate models to optimize the accuracy of future projections. Terrain interactions lead to initialize a general spin-down of cyclones on the windward side due to vorticity dynamics terrain induced mesoscale momentum fluxes. On the leeward side of elevated terrain, topography tends to initialize a regeneration and intensification of cyclones because of increases in vorticity and momentum transfer down the terrain.



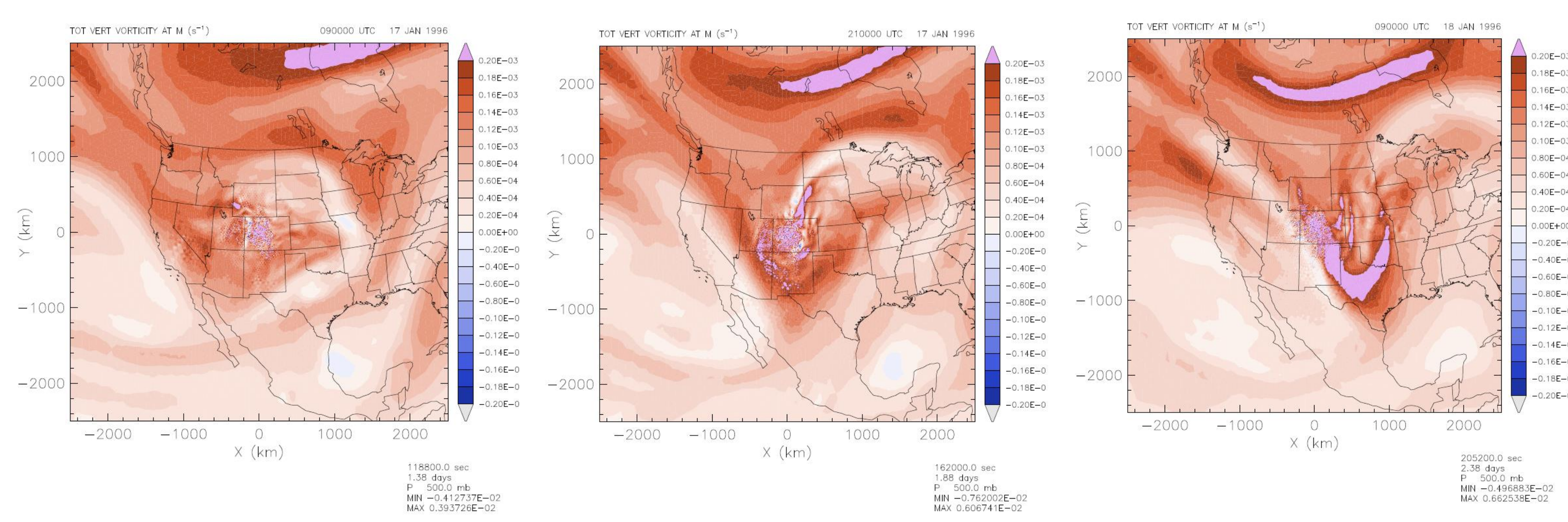


Figure 2. Top: Vertical distribution of condensate. Bottom: 500 mb vorticity for 24 hour period between 09Z 17 Jan – 09Z 18 Jan.

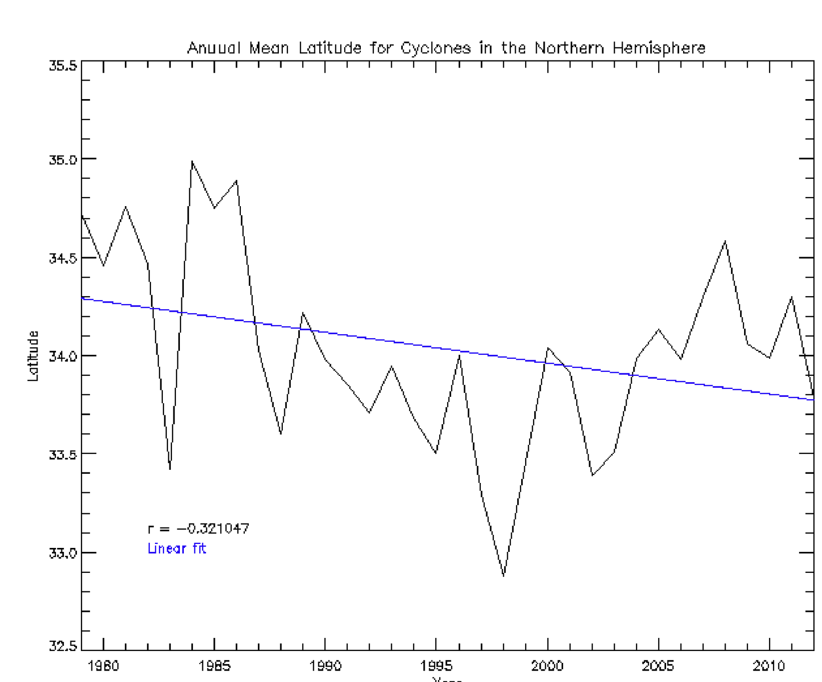


Figure 3. Annual mean latitude for extratropical cyclones identified by tracking code.

The trend of cyclone tracks over the past thirty years suggests a slight shift southward; however, tropical and extratropical cyclones have not yet been distinguished in the tracking code.

Explanation

The extratropical cyclone tracking algorithm is based on model output from MERRA reanalysis. MERRA is a model reanalysis that assimilates satellite data.

Acknowledgements

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