Summer Work at the Met Office

Overview

I was provided with two academic papers outlining algorithms for detecting weather features similar to tornados and used these to write a Python program to detect atmospheric vortices from Doppler radar data. Previously to working at the Met Office I had no experience of either programming in Python or using Linux but I was provided with good guides to both. There was the option to alternatively code in Octave (similar to Matlab) or C++ . I personally felt suitable supervision was given at the start of the project and later contact was more dependent on how much I asked for.

How do radars work?

Radio waves emitted from the radar reflect off water molecules in the air. The strength of the returned signal gives an indication of the amount of moisture present. This reflectivity value is studied using a logarithmic scale. If the water molecules are moving towards or away from the radar, a Doppler effect causes the frequency of the reflected wave to be different than the outgoing wave. This frequency change tells you the radial wind speed.

How were vortices detected?

Sample points were positioned on a polar grid (centred at the radar) at different elevation angles. The radial wind speed was studied at adjacent azimuthal bins at the same radial distance, to detect evidence of cyclonic shear (increasing radial velocity with increasing azimuth). This was compared at successive radial distances to combine 1D detections of cyclonic shear into 2D features. These 2D features were kept if their aspect ratio and size were appropriate. 2D features at successively higher elevations were then compared to see if 2D features were observed above each other, and in which case they were combined into 3D features. These are the detected vortices. The movement of these vortices were then predicted and vortices compared across time to track the vortex movement.

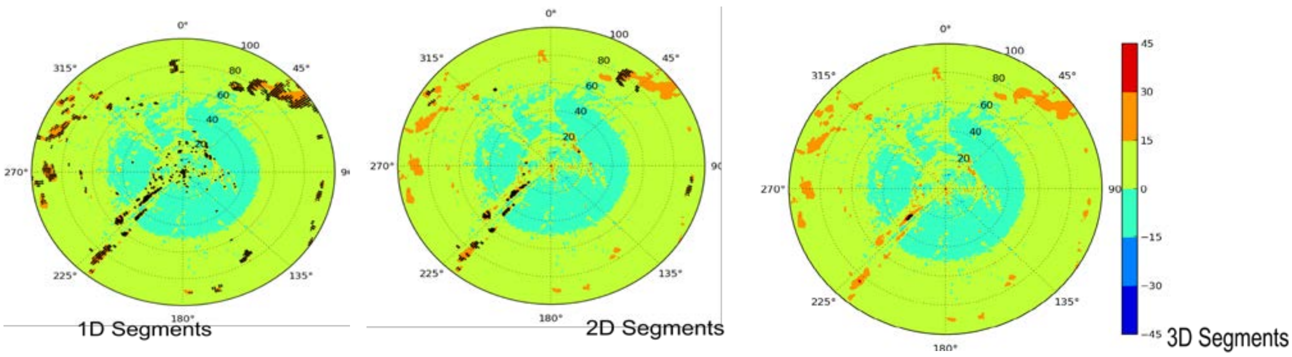

***Figure** 1: Output from the code after the 1D, 2D and 3D association was completed. Black dots mark each grid point involved in a 1D, 2D or 3D feature. The centre of each diagram is the position of the radar with the two axes being angle and radial distance (in km) from the radar. The colour plot is of the reflectivity data.*

Outcome

The final code successfully tracked the position of the vortices over time (figure 2) for the 5 cases considered. However there was an issue with false detections and further work is required.

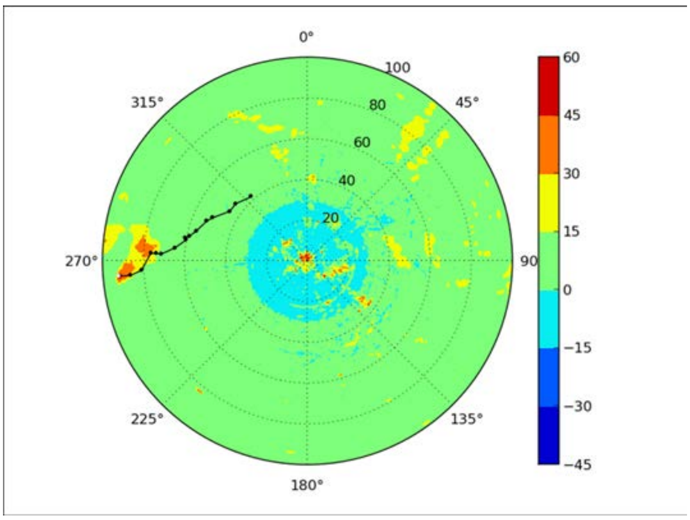

***Figure 2**: Code output tracking the movement of the storm. The white dot marks the current position of the vortex, with the black dots and line marking future and past positions.*