1. Introduction:

Aim:
- Produce an automated approach to detect sting-jets in CPM simulations
- Assess added value of Convection Permitting Climate Model (CPM) for sting-jets compared to ERA-Interim reanalysis and a 25km GCM

Why?
- Coarse resolution simulations cannot fully resolve sting-jets, especially the small-scale structures, and may therefore underestimate their risk in present and future climates

What is a sting-jet?
- A mesoscale slanted core of strong winds within a Shapiro-Keyser type of cyclone that can lead to extremely damaging surface wind speeds close to southern side of a cyclone's centre

2. Data & Methods:

CPM Simulations
- Hindcast: 1999-2009 (driven by ERA-Interim)
- Control: 1997-2007 (driven by 25km GCM)
- Future: 10 years under RCP8.5 (driven by 25km GCM)

Configuration
- Horizontal resolution: 2.2km
- Vertical resolution: approx. 40m, 140m and 300m at heights of 100m, 1km, and 5km.

Data Required
- 6 hourly winds at 850hPa and 700hPa (only 5 levels available in total)
- 6-hourly Wet bulb potential temperature ($\theta_w$) at 850hPa
- 6-hourly MSLP

Added Value Assessment
- Sting-jets storms are only identified in CPM simulations
- 850hPa wind speeds are compared for the identified storms between CPM and GCM/ERAI. We are assessing for differences in wind speed and in future projections

Automated Identification of Sting-Jets in CPM: Storm Erwin Case Study (07/01/2005)

Step 1: Identify warm seclusion of Shapiro-Keyser Cyclone
- Identified when 850hPa $\theta_w$ within core of cyclone is 2K greater than $\theta_w$ in the surrounding area

Step 2: Identify slantwise descent of sting-jet within storm
- Indicated by a reversal in vertical wind gradient between 700hPa and 850hPa along wind trajectories at 850hPa

3. Results:

Frequency of Sting-Jet Storms

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<th>(a)</th>
<th>(b) Hindcast</th>
<th>(c) Control</th>
<th>(d) Future</th>
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Overall Wind Storm Severity – Hindcast Simulation: CPM vs. ERA Interim (850hPa Winds)

- (a) Non SK/SJ Storms
- (b) SK Storms (no SJs)
- (c) SJ Storms

95th Percentile of Winds within Storms – Climate Simulations: CPM vs. GCM (850hPa Winds)

- (a) Non SK/SJ Storms
- (b) SK Storms (no SJs)
- (c) SJ Storms

4. Summary & Conclusions:

- A method has been developed to identify Shapiro-Keyser and sting-jet storms. The method identifies all known cases from the literature (not shown here), and further verification will be performed.
- CPM produces higher wind speeds in SJ storms than seen in the GCM and ERAI, but no difference has been seen in the future projections. Further analysis is required to diagnose the source of the differences and future changes in CPM and GCM.

Reference: