Supplementary Material: ECL wind speed change calculations.

In the following section we describe in detail how we identify and track ECLs and how we construct SLP and 10-m wind composites using data from the NARCliM RCM ensemble (Evans *et al*. 2014).

East Coast Lows are identified and tracked within the region denoted with a black line in Fig. SM1. The detection and tracking algorithm is based on the method developed by Browning and Goodwin (2013) with modifications that were detailed in Di Luca *et al*. (2015). The main characteristics of the detection algorithm used in this study are described below.

Lows are identified by searching for both a local minima in the SLP field and a SLP gradient around the local minima that exceeds a given threshold. The use of the local minima criterion implies that only closed lows are identified by the algorithm. The pressure gradient is computed by averaging differences between the central SLP and the SLP in grid points located within a radius of 200 km around the central pressure. The value of the 200-km SLP gradient threshold was chosen to be 0.8 hPa/100 km and is thus very similar to the threshold used by Browning and Goodwin (2013) of 1 hPa/1.5 degree.

Once lows have been detected for individual time steps, cyclone events are generated by grouping lows that are close in both time and space. Tracks are constructed by a nearest neighbour search in the following 6-hourly SLP field around a cyclone position. The search extends to a maximum distance that depends on the temporal resolution of the data assuming that a cyclone will not move faster than 60 km/h. The resulting radius of search thus extends to about 360 km for 6-hourly data. Events must spend at least two time steps (i.e. 12 hours) in the region of analysis (white rectangle in

Fig. SM1).

Based on the criteria described above, ECL events are identified using 6-hourly SLP fields from an ensemble of simulations generated as part of the New South Wales / Australian Capital Territory Regional Climate Modelling (NARCliM) project. This ensemble consists of a 12-member regional climate model (RCM) simulation ensemble performed using three versions of the Weather Research and Forecasting (WRF) RCM driven by four different low-resolution global climate model simulations for present (1990-2009) and far-future (2060-2079) climate conditions.

Once ECL events are identified in present and future simulations, ECL composites are constructed by averaging SLP and 10-m winds from two subsets of ECLs: a subset that contain events with 10-m wind speeds larger or equal to 8 m/s (i.e. includes all ECLs; Fig. SM2) and a second subset that only contains events with 10-m wind speeds greater or equal to 20 m/s (more extreme ECLs; Fig. 1 in main article). Composites use instantaneous wind speeds and MSLP fields every 6 hours and, in order to weight each event once, we select a single low from every event that corresponds to the low with the maximum wind speed at any grid point in a radius of 750 km from the center.

Only results for the average across all members of the NARCliM ensemble are shown in Figs. 1 and SM2 for the more extreme ECLs and all ECLs respectively. According to the NARCliM ensemble, more extreme summer ECLs show a general increase in wind speeds in the future mainly by extending the region of high wind speeds towards the east of the low center. Moreover, the NARCliM ensemble projects about 30% more summer ECLs with very high maximum wind speeds compared to the present (25 events in present versus 32 in the future). By comparison little change, or perhaps a weakening, of winter extreme ECLs occurs, including no change in the frequency of these very high wind events. This differs from a ~20% decrease in the frequency of all winter ECLs (see Figure SM2).

The composite for each season is a mixture of systems with tropical and extra-tropical origins. The summer (DJF) has a higher proportion of both tropical origin systems and locally generated small scale systems, compared to winter (JJA) producing different wind fields overall. It has previously been shown that winter has a higher proportion of spatially large systems (Di Luca et al., 2015). In the future, changes in the mixture of winter storms coming from the north or south also changes the location of the highest wind speeds in the composite.

It is important to note that when averaging across a large number of ECLs, especially far from the center of the low, the averaged wind speed is not necessarily proportional to the averaged SLP gradients. For example, in a given grid point (far from the centre) we can have opposite SLP gradients (e.g., one north-south SLP gradient and another south-north SLP gradient) that cancel each other out when calculating the average (i.e. mean SLP gradient is zero) but that lead to the same wind speed (e.g. 10 km/h wind speed in both cases). As a consequence, in the composites regions with the largest mean 10-m wind speeds are not necessarily accompanied by regions with the largest mean SLP gradients or mean wind components that create the wind vectors. For individual events, of course, the wind speed is proportional to the SLP gradients and to the wind components.

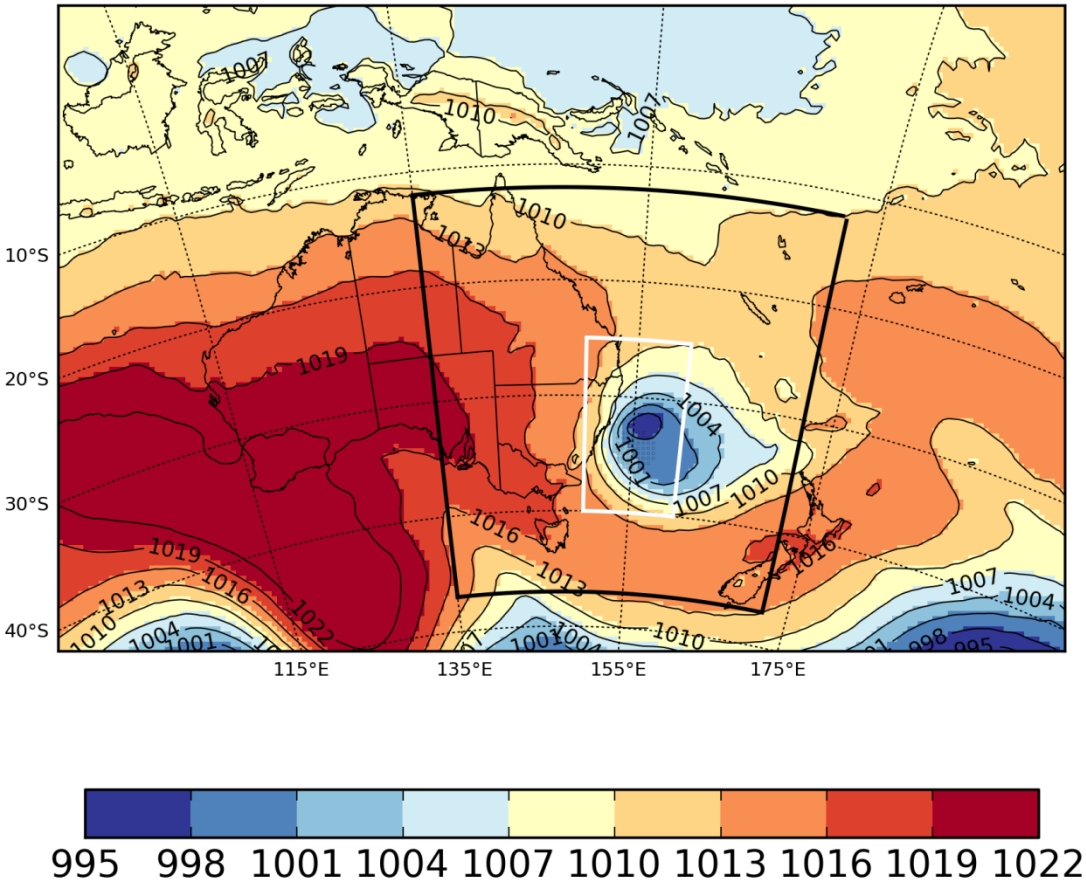

Figure SM1: RCM simulated instantaneous SLP field for a severe ECL at 1800 UTC 8 June 2007 over the outer NARCliM domain. The black rectangle shows the region where the tracking is applied and the white rectangle the region where the analysis is performed.

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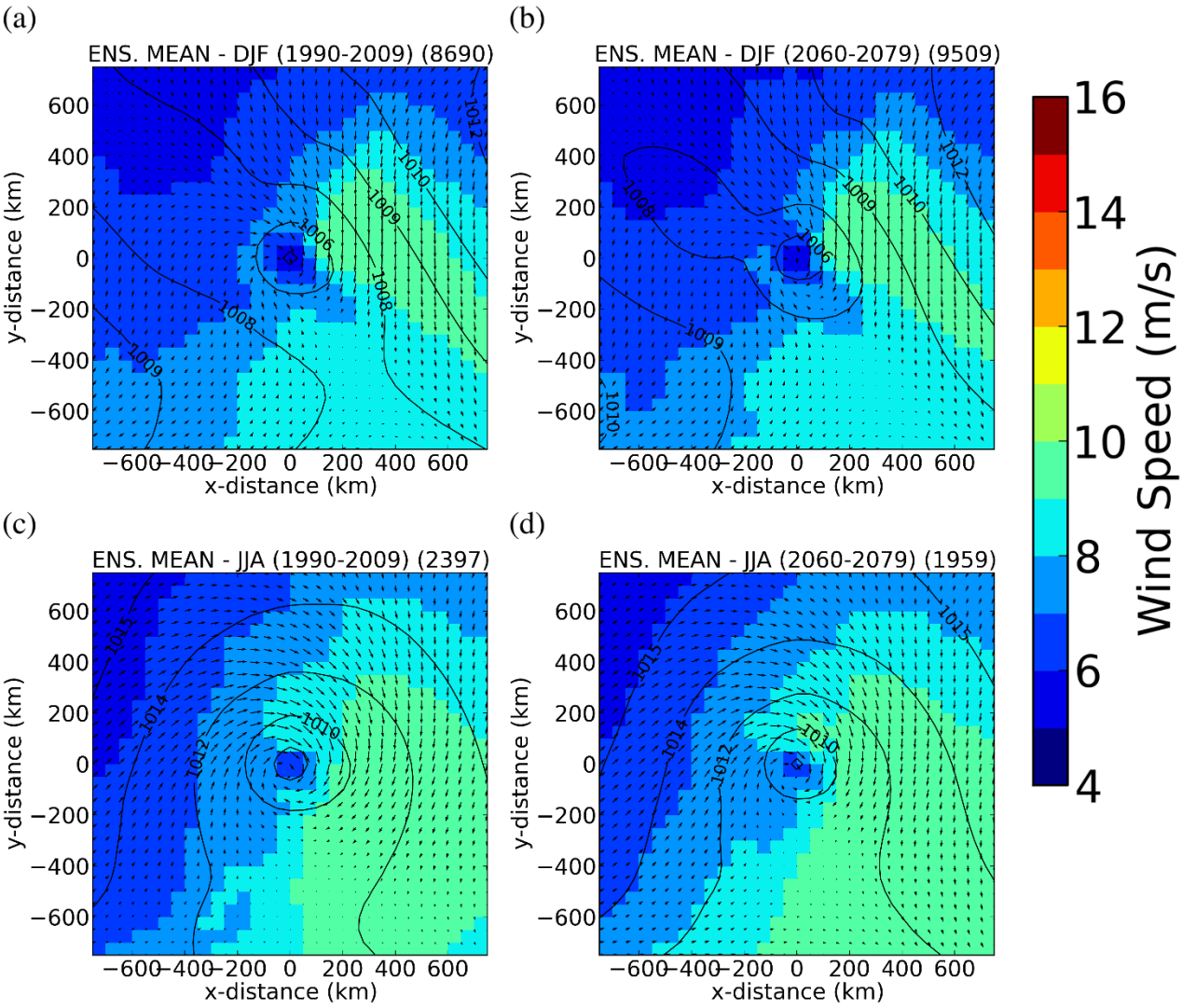

Figure SM2: Ensemble composites of summer (DJF: top row) and winter (JJA: bottom row) ECLs with a maximum wind speed greater than 8 ms^{-1} from the NARCliM ensemble for the recent past (1990-2010: left column) and the future (2060-2079: right column). Coloured contours and vectors indicate wind speed while solid line contours indicate the sea level pressure. The ensemble total number of events within the composite is indicated at the top right of each panel.

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