Spatial and temporal variability of weather system contributions to rainfall in the Murray-Darling Basin

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Abstract: It is well documented in the literature that rainfall characteristics are related to weather systems and the different weather types result in different rainfall characteristics, such as rainfall amount, number of rainfall days, mean rainfall intensity, rainfall probability, and extreme rainfall. In this study, the contributions of changing synoptic weather types to annual rainfall characteristics in the Murray-Darling Basin (MDB) are investigated using a multi-method weather type database for 1979–2015 and the SILO (Scientific Information for Land Owners) rainfall data that provide daily climate variables across Australia. The annual rainfall anomalies before, during and after the Millenium Drought (MD, 2001–2009) are inter-compared to quantify the temporal and spatial variability of rainfall characteristics to weather type changes in a changing climate.

Results show: 1) Three weather systems (Front, Cyclone and Thunderstorm) and their combinations explain 89% of the total rainfall over the period of analysis (Figure 1); 2) The weather system contributions to rainfall vary from region to region. For example, rainfall in the northern MDB mainly comes from the thunderstorm only (TO) weather type, while all the different weather types contribute to rainfall in the southern MDB (Figure 2); 3) The contributions of weather types to rainfall also vary from month to month in terms of both absolute rainfall amount and its relative percentages. Winter season rainfall comes from more diverse weather types than summer rainfall; and 4) A wetter period before the MD with positive rainfall anomaly, a drier period during the MD with negative rainfall anomaly, and a mixed period after the MD can be observed in the study region. This is linked to changes in prevailing weather types, with an increased contribution of FT to rainfall during the post-drought period.

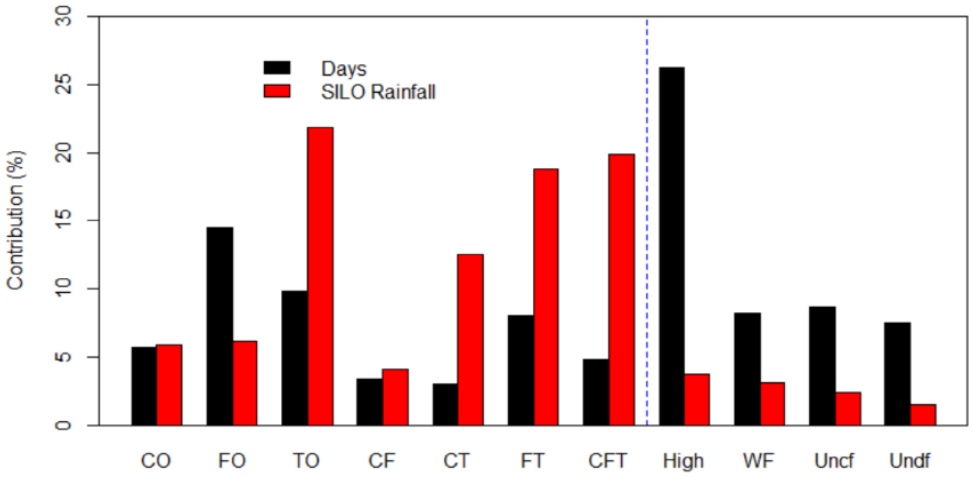

Figure 1 Contributions of three weather systems and their combinations to total annual rainfall in the MDB (CO: Cyclone only; FO: Front only: TO: Thunderstorm only; CF: Cyclone-Front; CT: Cyclone-Thunderstorm; FT: Front-Thunderstorm: CFT: Cyclone-Front-Thunderstorm) and other dry-weather types (High: Days with Highs; WF: Warm Fronts; Uncf: Fronts or Lows identified by only one method; Undif: when no weather system is defined)

Keywords: *Cyclone, Front, Murray-Darling Basin, Rainfall, Thunderstorm*