Moisture transport across south eastern Australia using stable isotopes in precipitation

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The relative abundances of the stable isotopes ^{18}O and ^{2}H in precipitation can reveal information about the condensation history of atmospheric moisture. Stable isotopes allow the diagnosis of atmospheric circulation (Lawrence et al., 1982), moisture source regions and atmospheric transport (Rindsberger et al., 1990). Investigation of precipitation records over south eastern Australia is being approached in two ways. Firstly, with the establishment of the Melbourne University Network of Isotopes in Precipitation (MUNIP). This is a series of collection sites across the Melbourne metropolitan region with the aim of sampling rain half hourly during particular rain events to document isotopic variability over small scales in time and space. The first full observational experiment occurred on June 9, 2004. Initial analysis of the atmospheric circulation around the hemisphere for this rain event has been performed using NCEP2 reanalysis data (Kanamitsu et al., 2002). From these fields it has been possible to reconstruct three dimensional backward trajectories for air parcels arriving at Melbourne at a number of different levels in the lower troposphere. The scheme described by Noone (2001) estimates the gridded wind field using a fourth order Runge-Kutta finite difference with the Lagrangian pathway approximated by applying the law of cosines on a sphere. The resulting six day backward trajectories (Figure 1a) show the convergence of low, relatively dry air with more moist upper level air as they pass towards south eastern Australia. The gradual uplift of the upper level parcels in the 24 hours preceding the rain event (Figure 1b) is associated with cloud formation and the majority of the fractionation of the air mass.

The second approach to this investigation is through simulation of events and experimentation using the Melbourne University General Circulation Model (MUGCM). The model is a development of that described by Simmonds (1985) with nine vertical levels and includes an isotopic fractionation module as described by Noone and Simmonds (2002). The MUNIP analyses provide an important basis for evaluating the moisture parametrisations within MUGCM with testing phases continuing.

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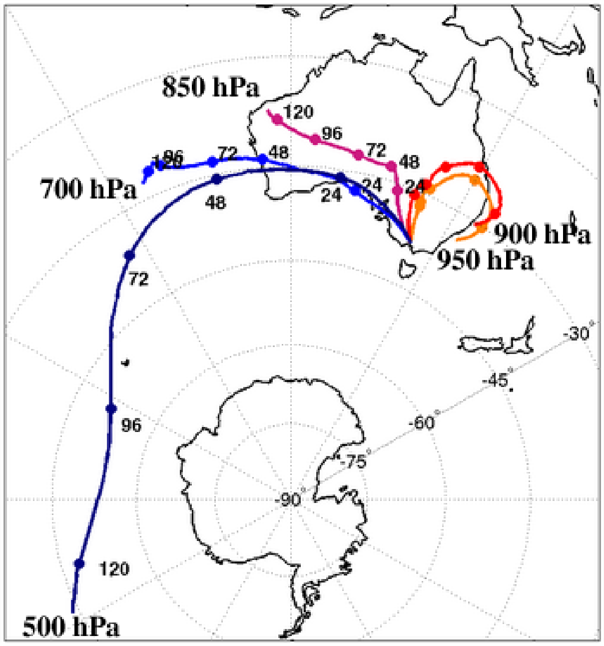
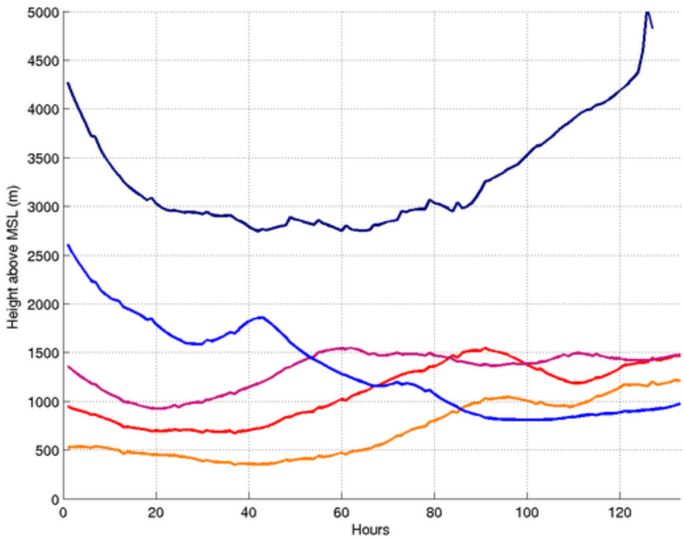


(a)



(b)

Figure 1: (a) 6 day backward trajectories for 9/6/2004 rain event in Melbourne. Trajectories released at 950, 900, 850, 700, 500hPa levels with markers indicating parcel position at 24 hourly intervals. (b) Parcel trajectory levels in metres above surface. Abscissa values are backwards in time from parcel launch at $x = 0$