Low clouds over the subtropical Indian Ocean and sub-seasonal circulation associations with the Indian summer monsoon

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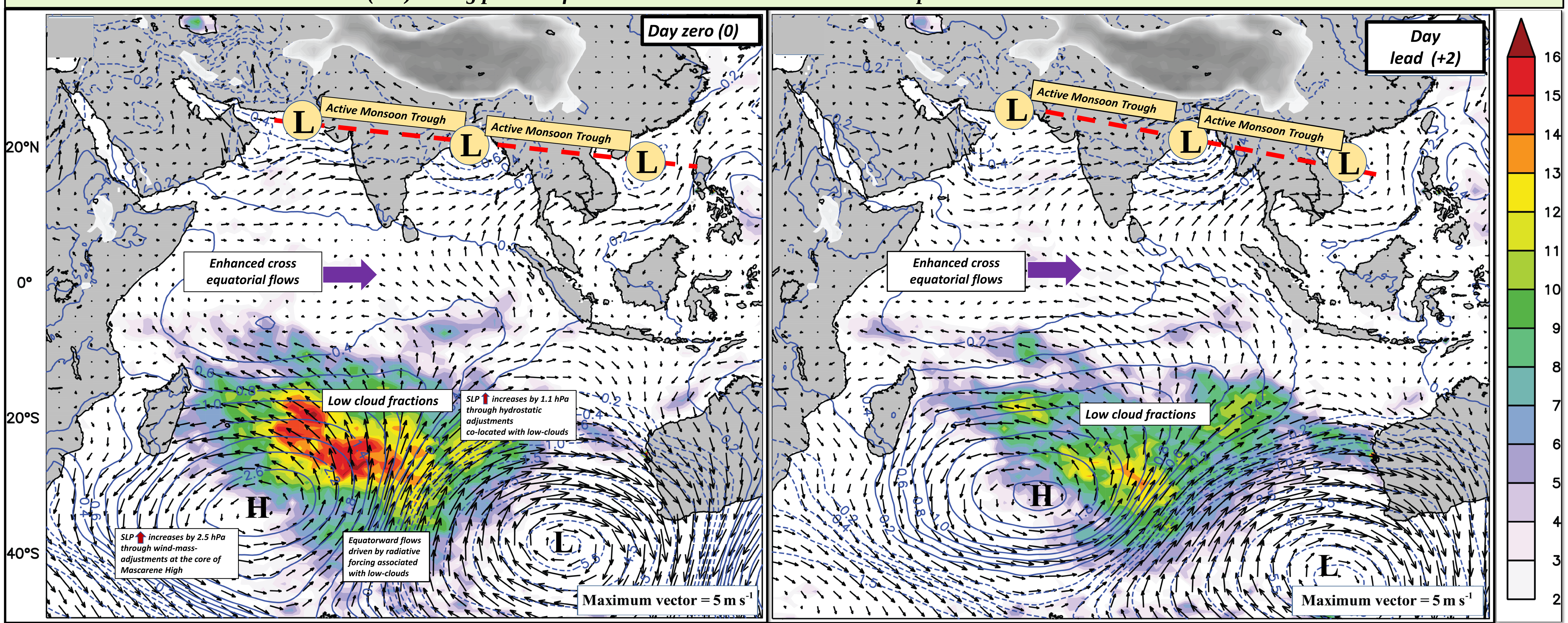
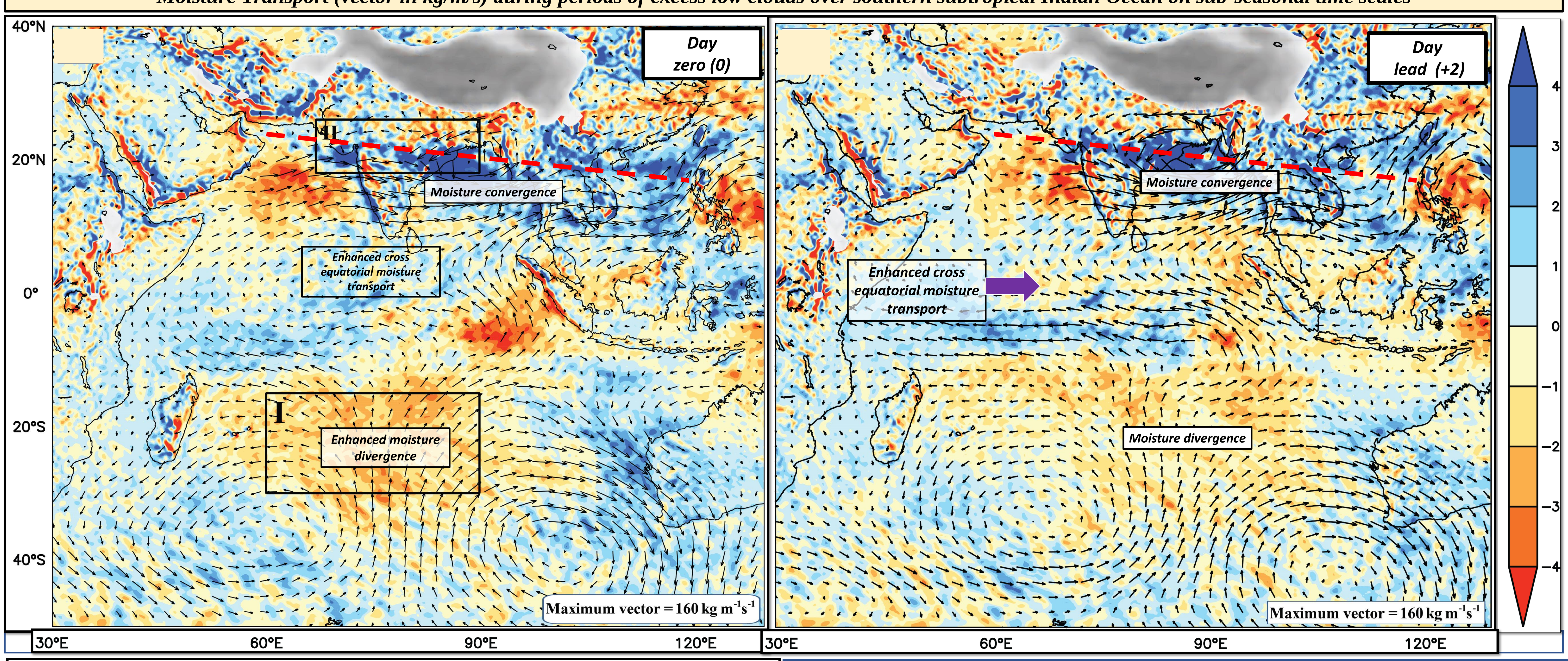
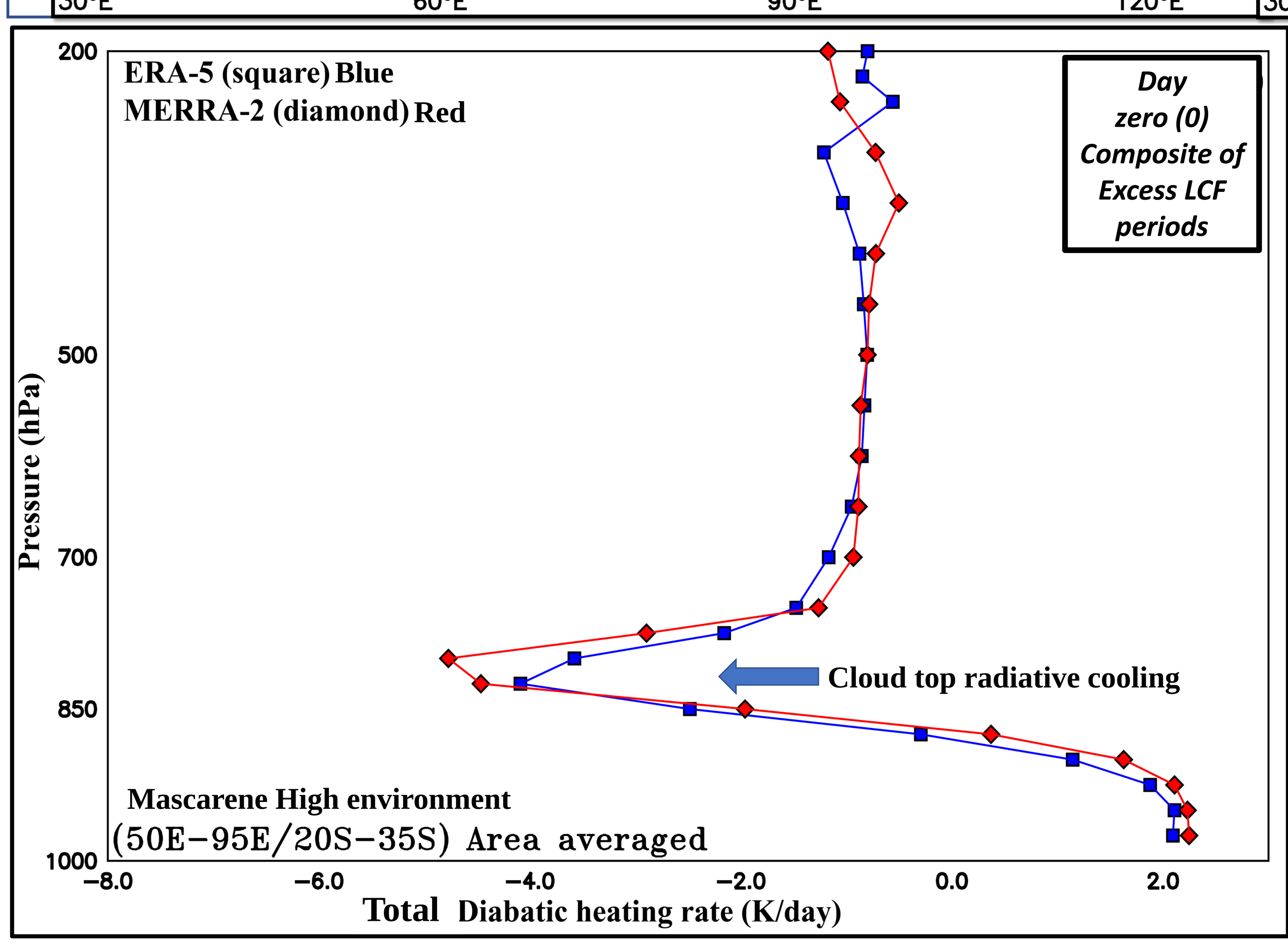
Anomalous composite evolution of Low clouds (shaded in %) and 925 hPa winds (m/s) during periods of excess low clouds over southern subtropical Indian Ocean on sub-seasonal time scales

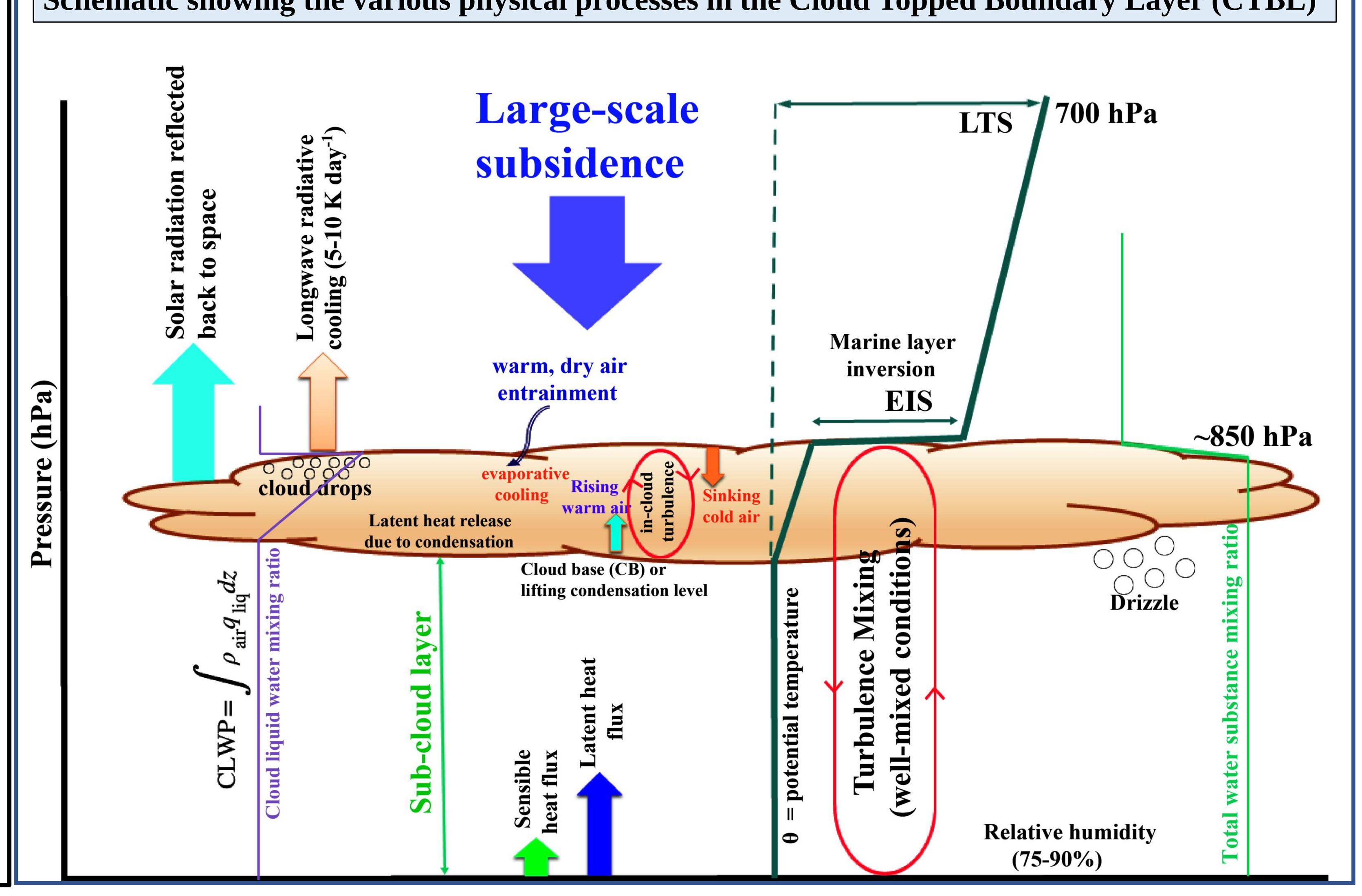


Anomalous composite evolution of Vertically Integrated Moisture Convergence (shaded in mm/day) and Moisture Transport (vector in kg/m/s) during periods of excess low clouds over southern subtropical Indian Ocean on sub-seasonal time scales



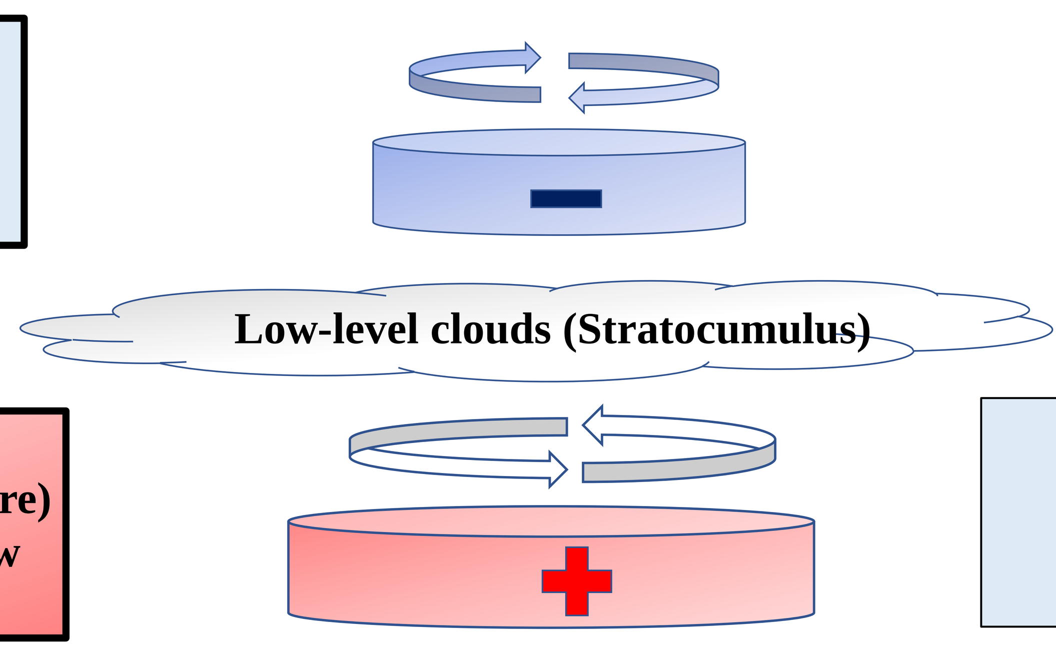


Schematic showing the various physical processes in the Cloud Topped Boundary Layer (CTBL)



Thermal forcing on Mascarene High circulation by low-level clouds is through PV (Potential Vorticity) generation associated with sharp vertical gradient in diabatic cooling rates resulting from large cloud top radiative cooling.

Cyclonic Potential Vorticity (negative in Southern Hemisphere) is generated above the low clouds



Anticyclonic Potential Vorticity (positive in Southern Hemisphere) is generated underneath the low clouds

The Vorticity Equation reduces to a simplified form in the subtropics which represents Sverdrup's balance

$$\frac{\partial \zeta}{\partial t} + \beta v \approx \left(\frac{\zeta + f}{\theta_z}\right)\frac{\partial Q}{\partial z}, \quad \theta_z \equiv \frac{\partial \theta}{\partial z} \neq 0$$

- *ζ = Relative Vorticity (s^{-1})*
- *f = Planetary Vorticity (s^{-1})*
- *$\beta = \partial f/\partial y$ (Rossby parameter)*
- *Q = Diabatic Heating Rate (K/day)*
- *θ = Potential Temperature (K)*