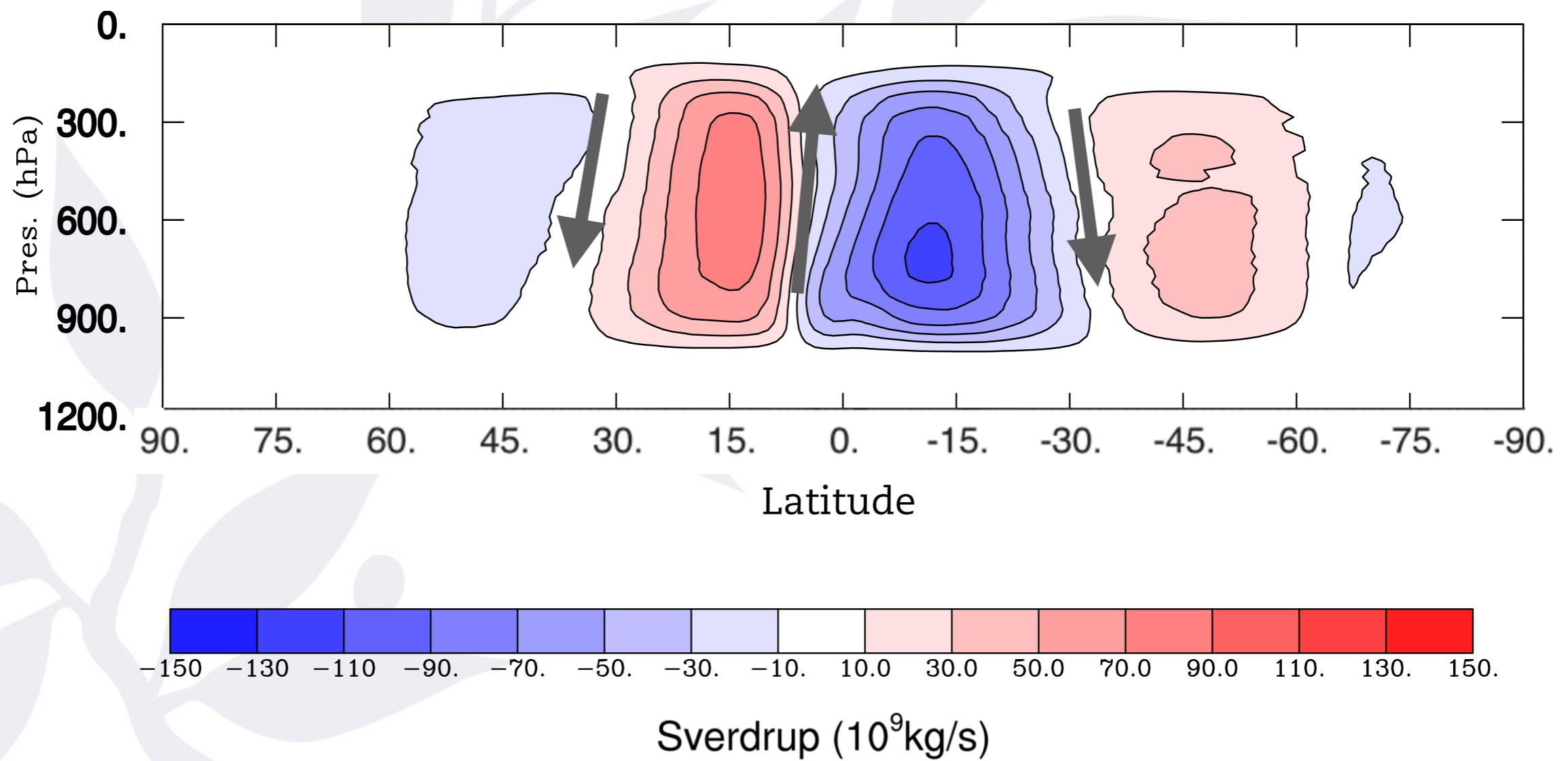


Decomposition of the general atmospheric circulation on a thermodynamic space

Aitor Aldama-Campino, Kristofer Döös

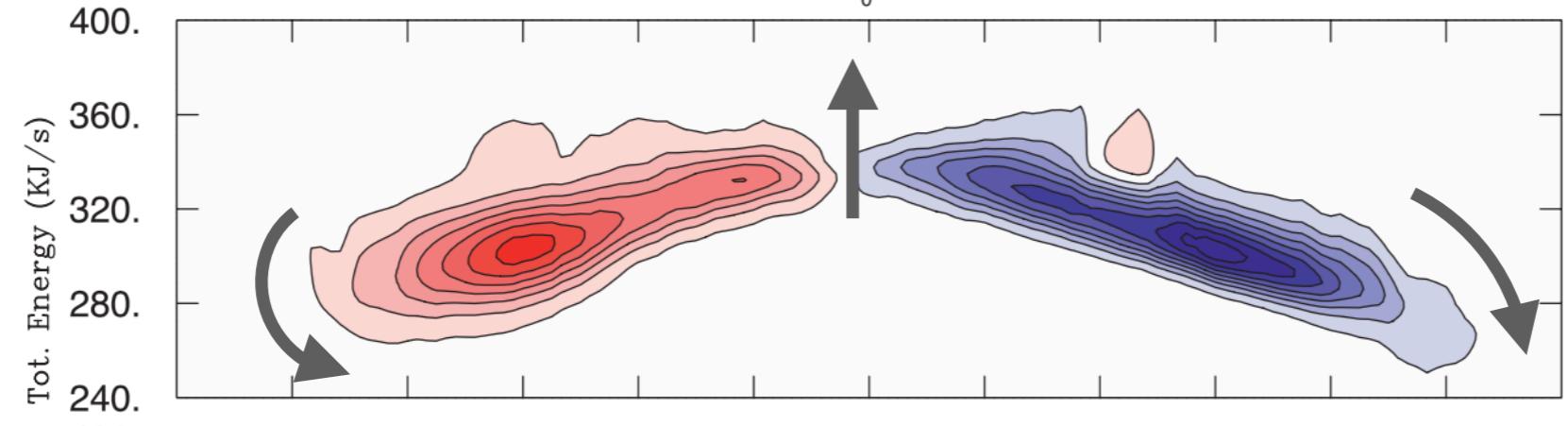
Department of Meteorology
Bolin Centre for Climate Research Stockholm University
Sweden

Meridional overturning stream functions

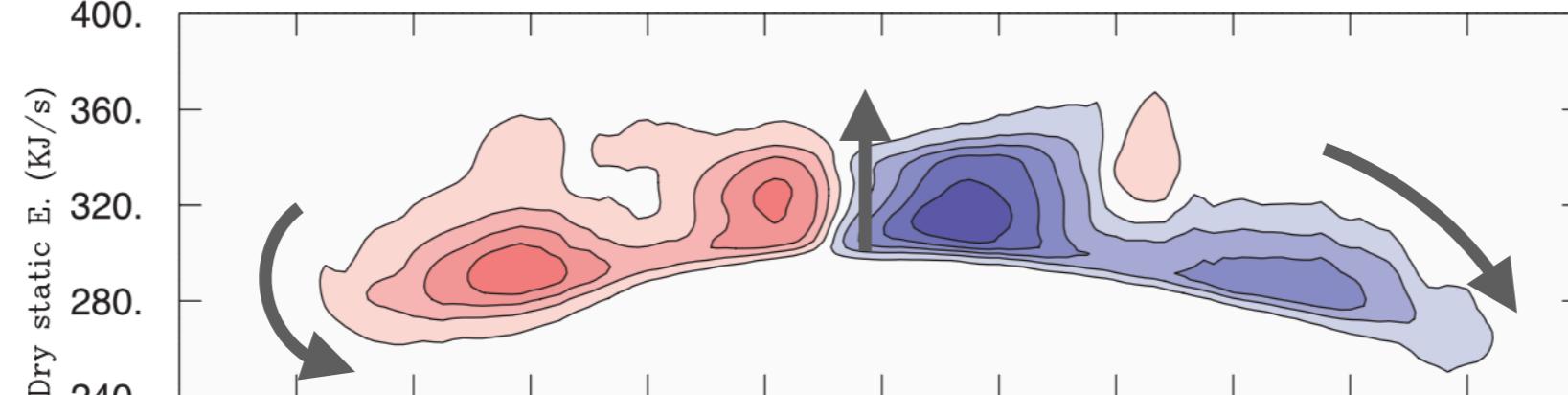


Döös et al., 2011

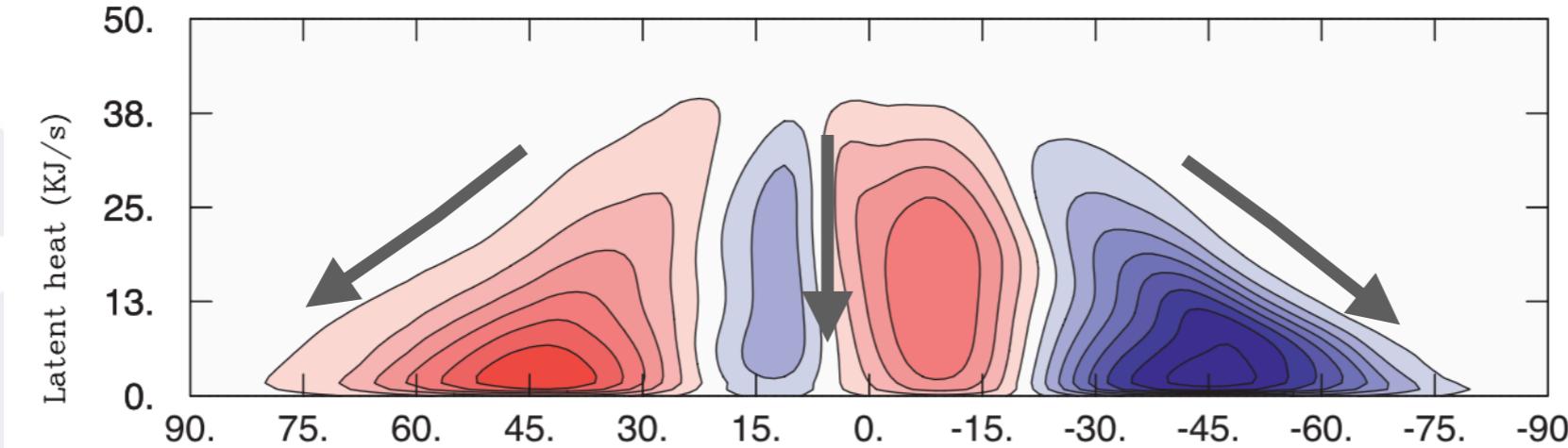
Meridional overturning stream functions



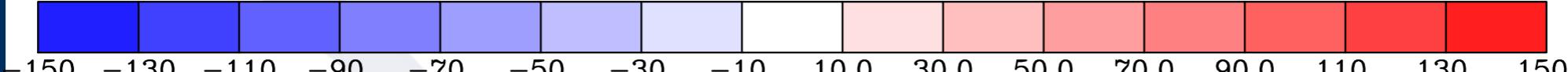
$$MSE = c_p T + gz + L_v q$$



$$DSE = c_p T + gz$$



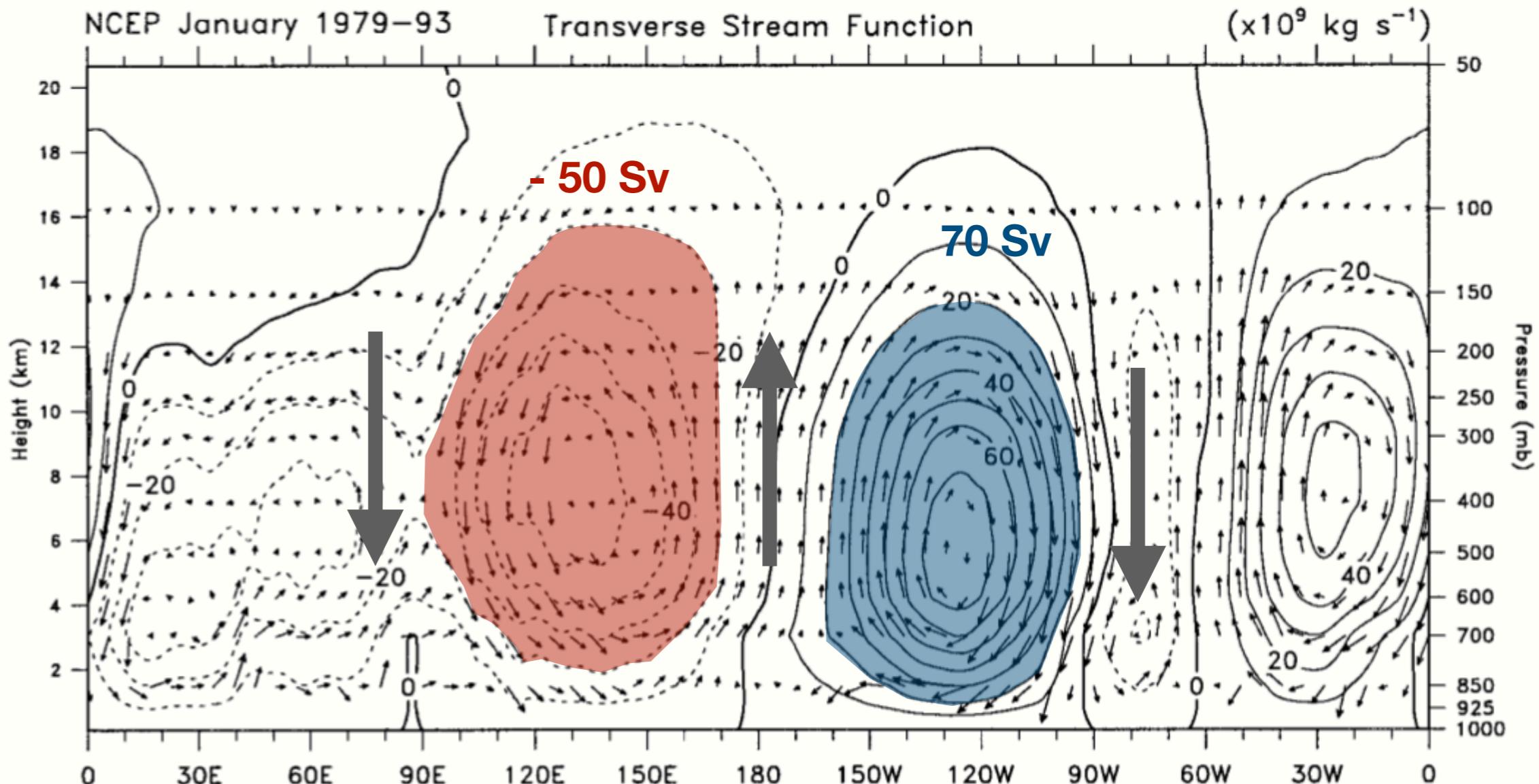
$$LH = L_v q$$



Sverdrup (10^9 kg/s)

Zonal streamfunction

$1 \text{ Sv} = 10^9 \text{ kg/s}$



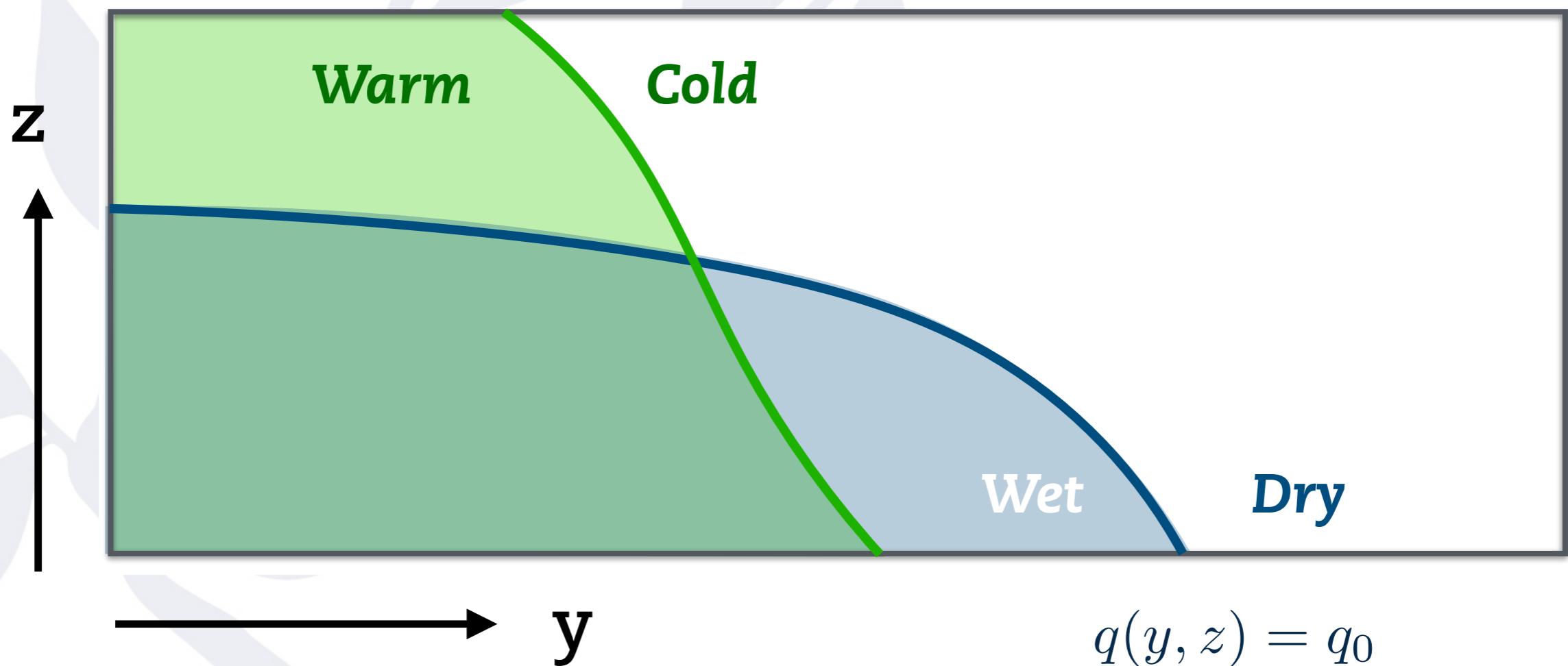
Trenberth et al., 2000

Theoretical background

Streamfunction $\psi(\chi, \zeta)$ in two general coordinates:

- ✓ We define $\chi = T$ and $\zeta \equiv q$

$$T(y, z) = T_0$$

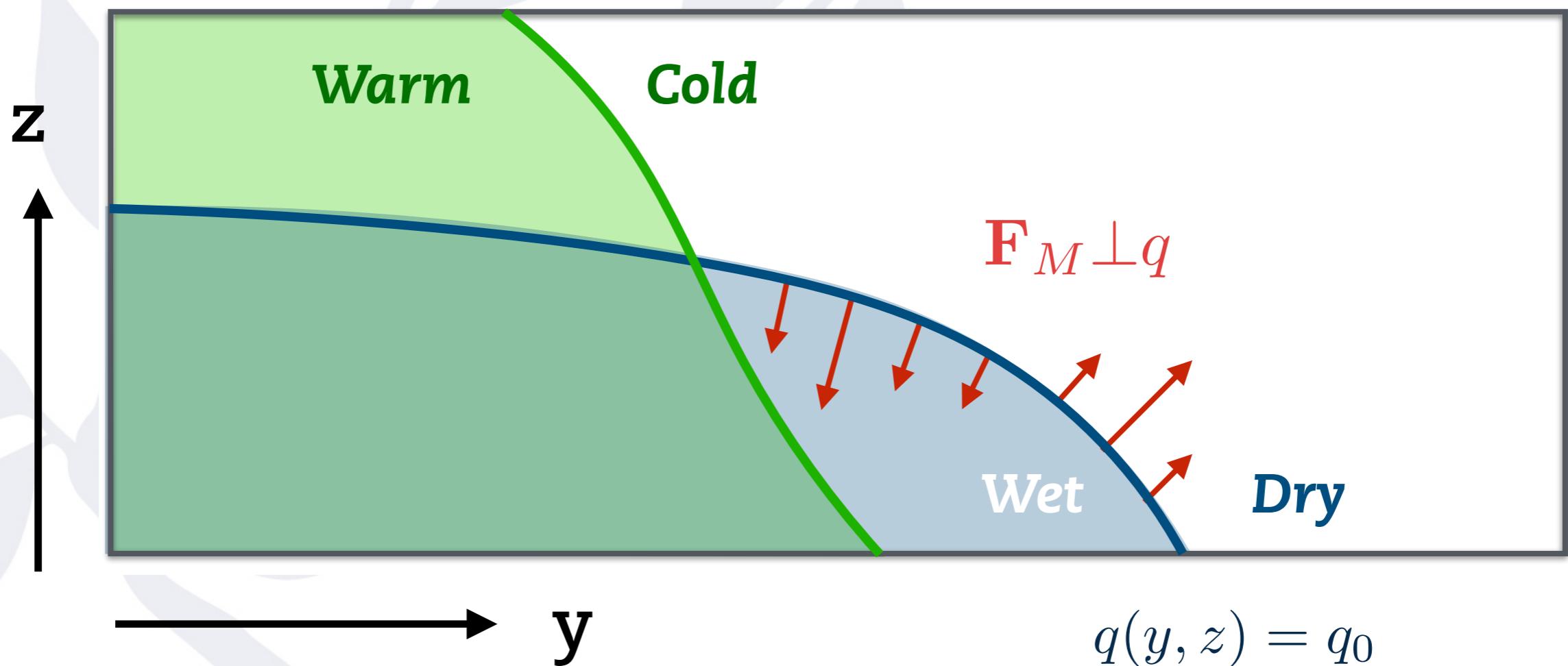


Theoretical background

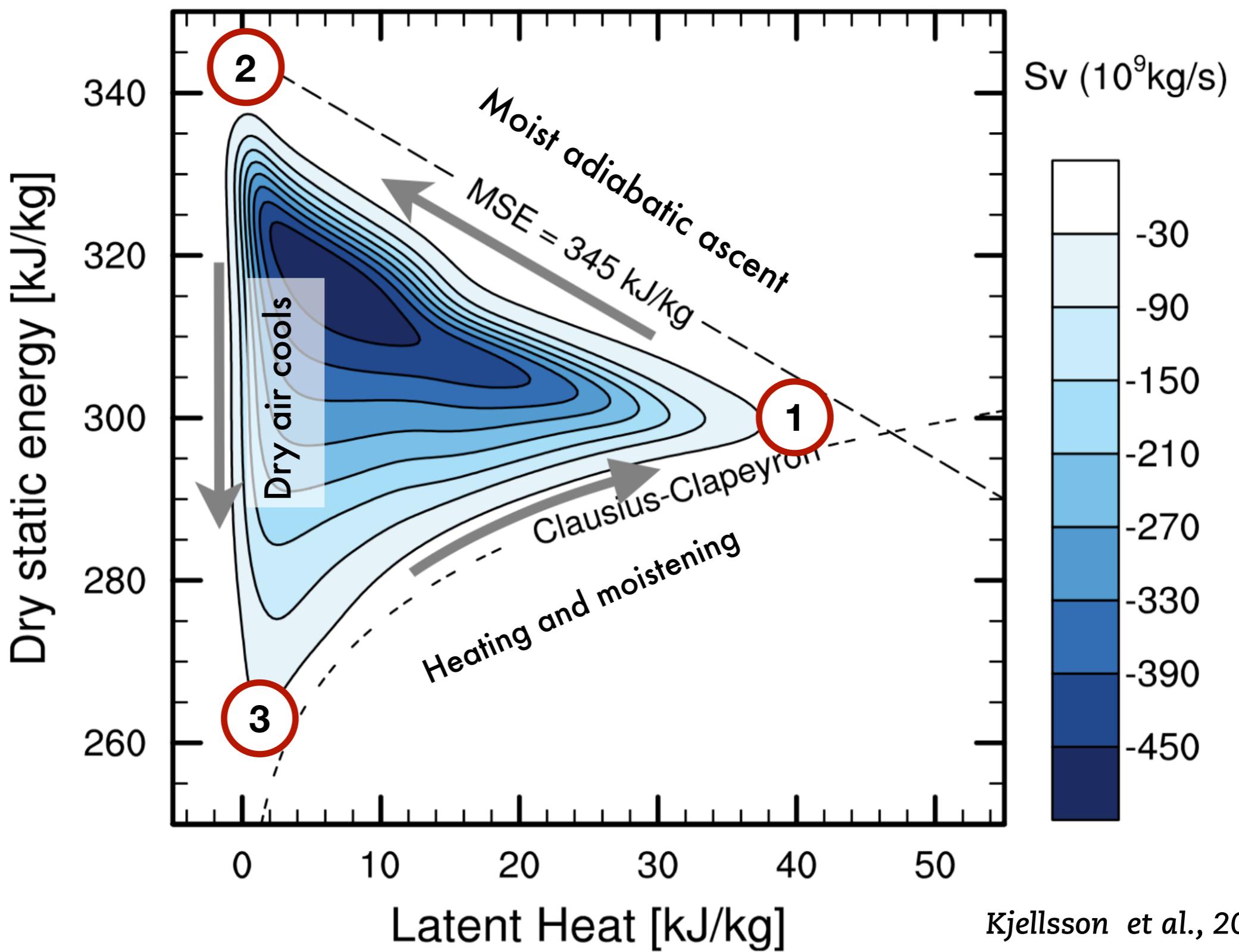
Streamfunction $\psi(\chi, \zeta)$ in two general coordinates:

- ✓ We define $\chi = T$ and $\zeta \equiv q$

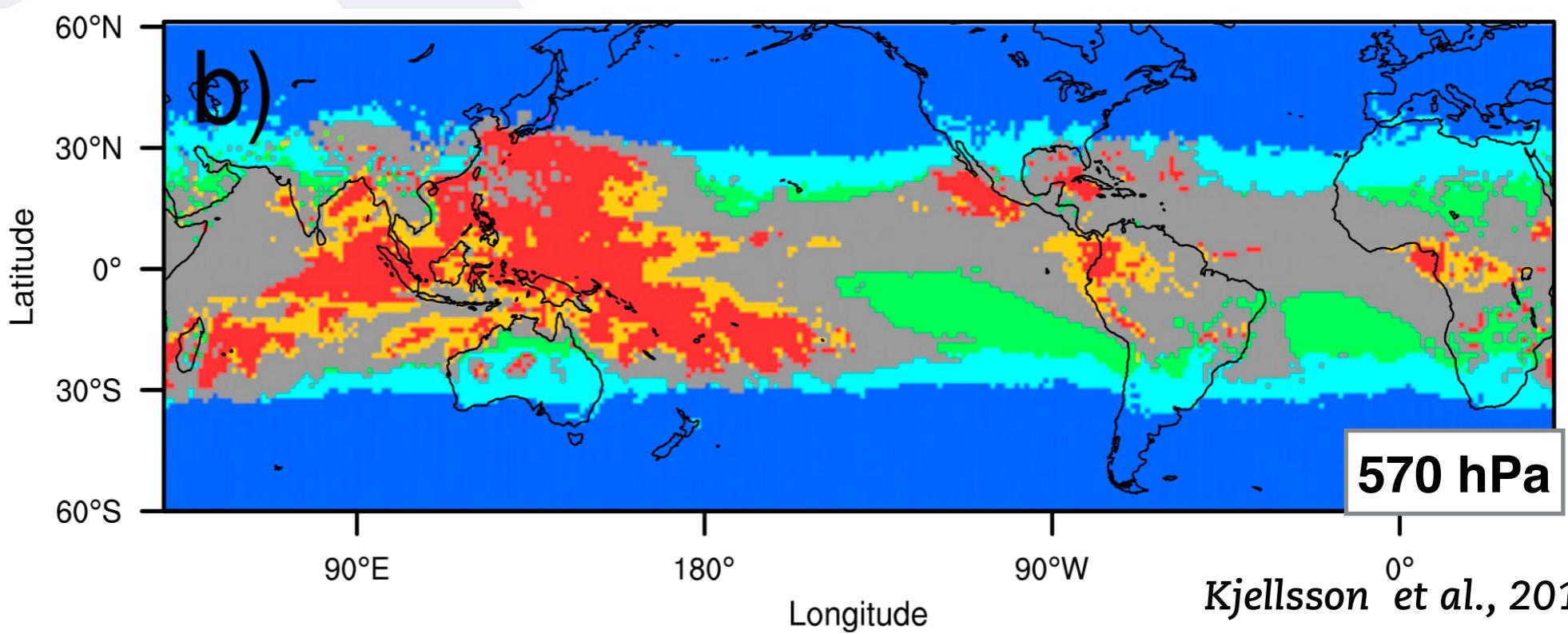
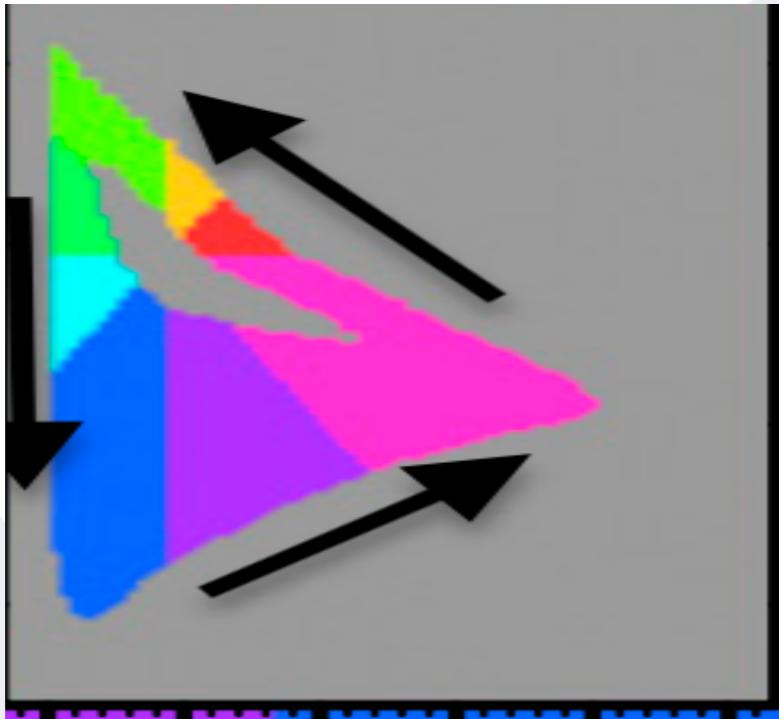
$$T(y, z) = T_0$$



Hydrothermal stream function

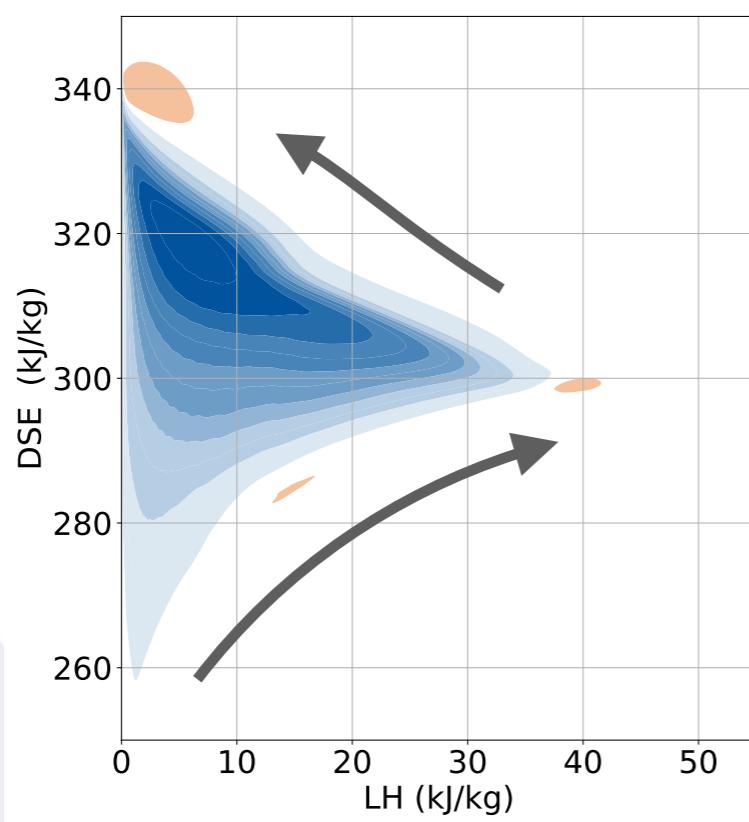


Hydrothermal stream function - Projection

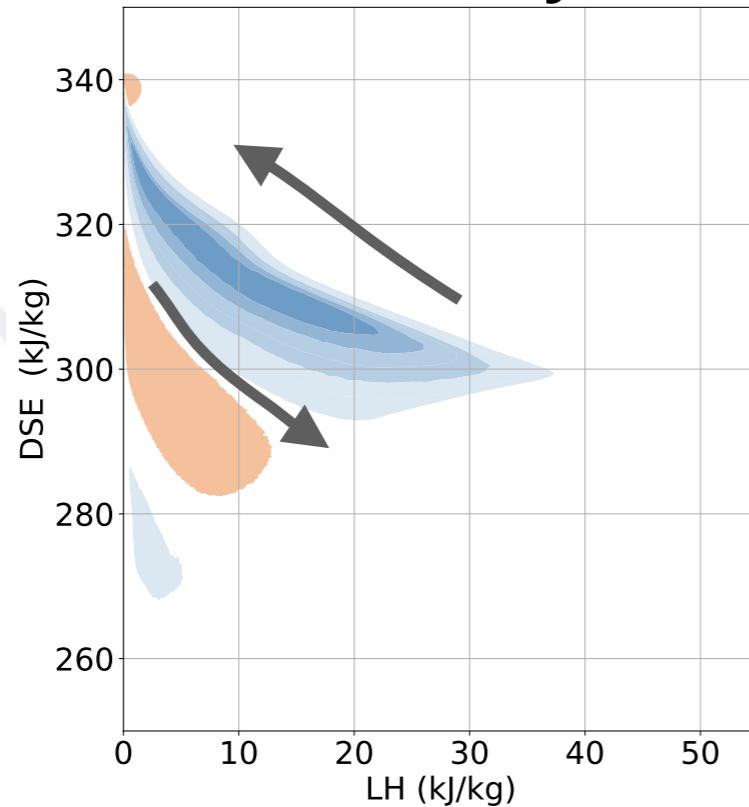


Kjellsson et al., 2014

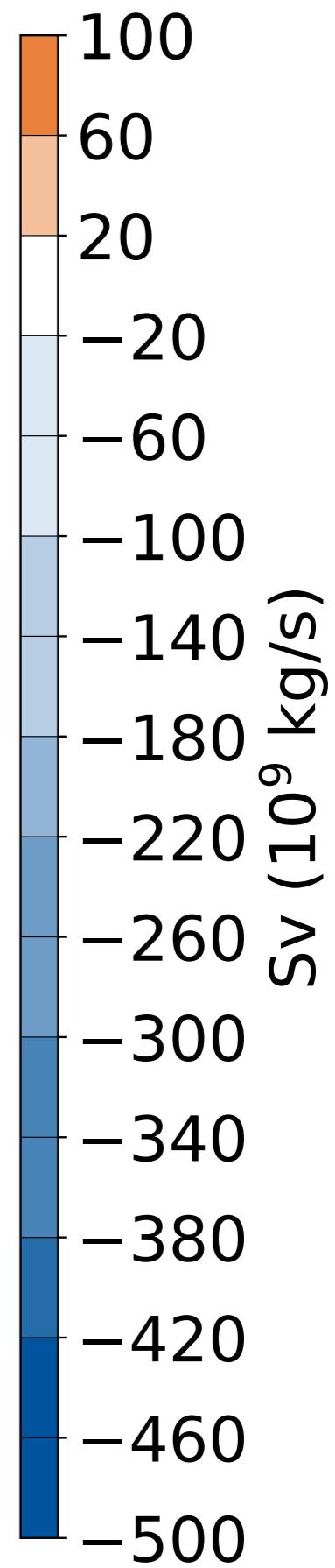
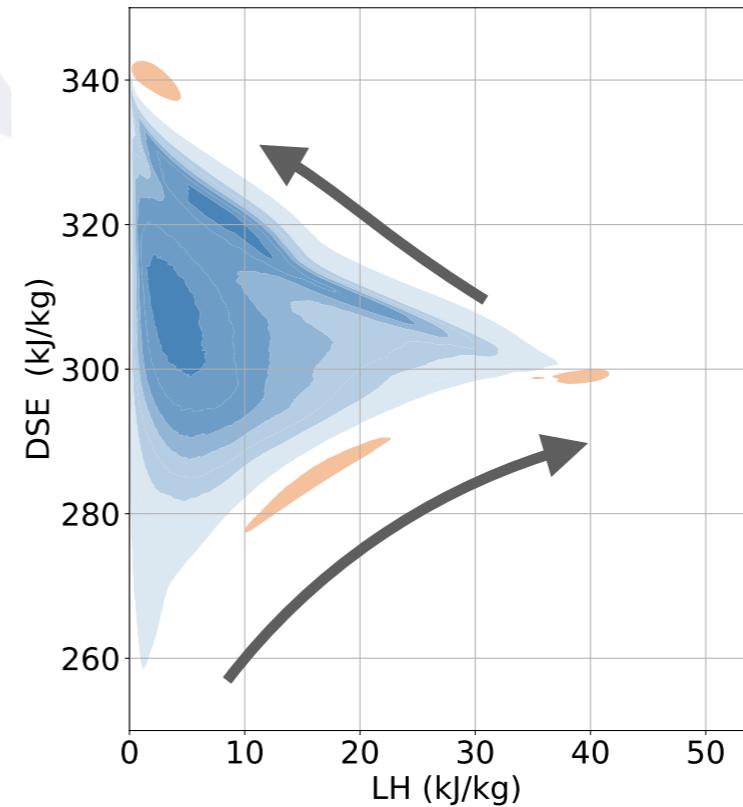
Time scale : 6h



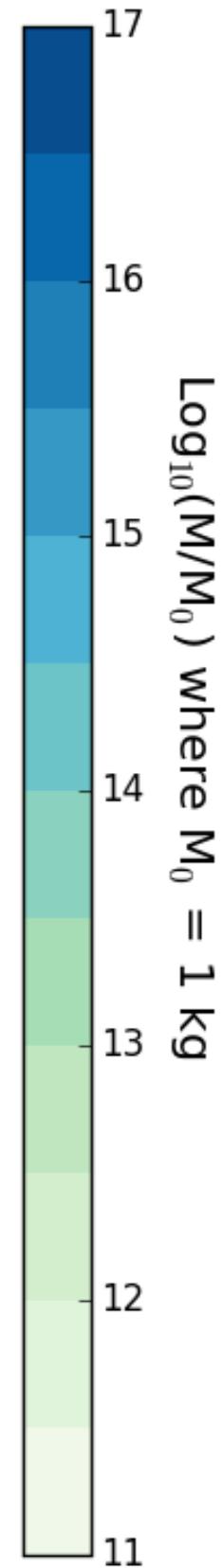
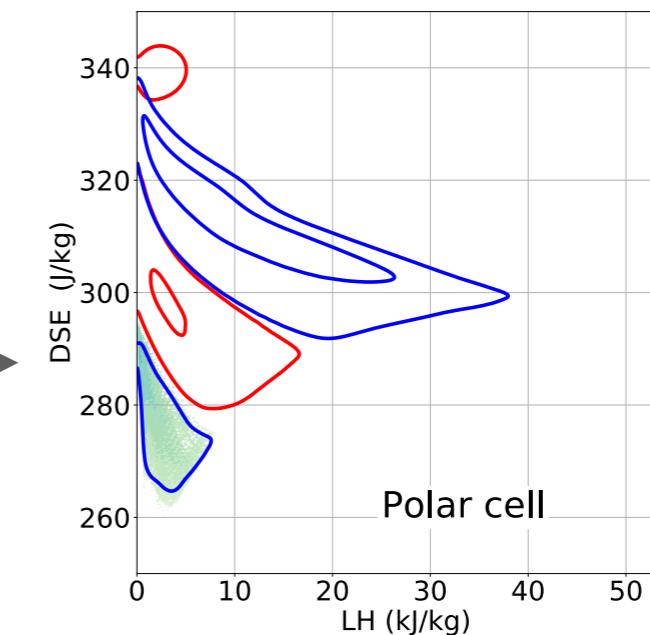
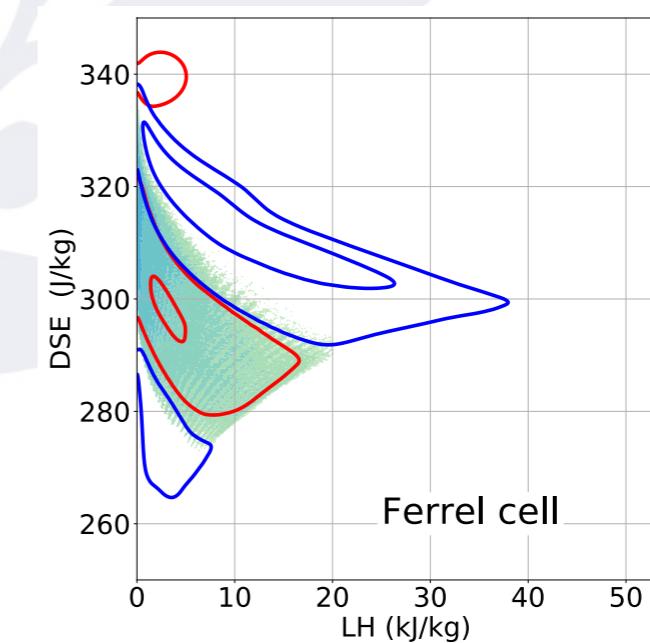
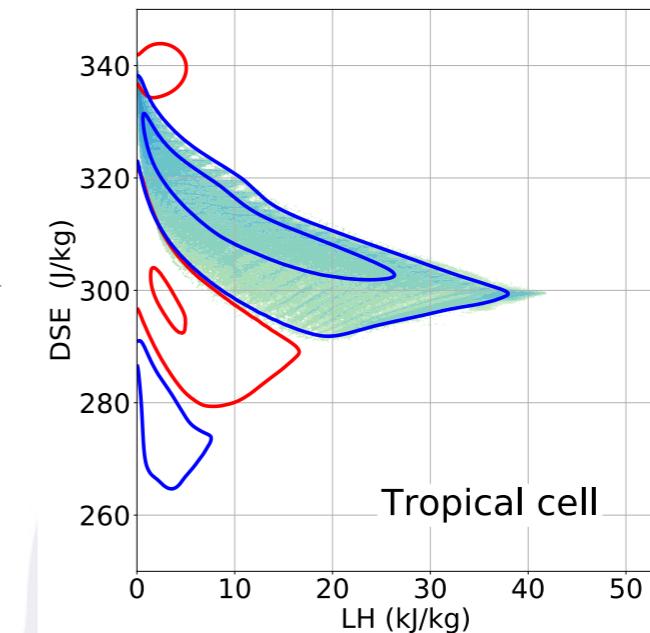
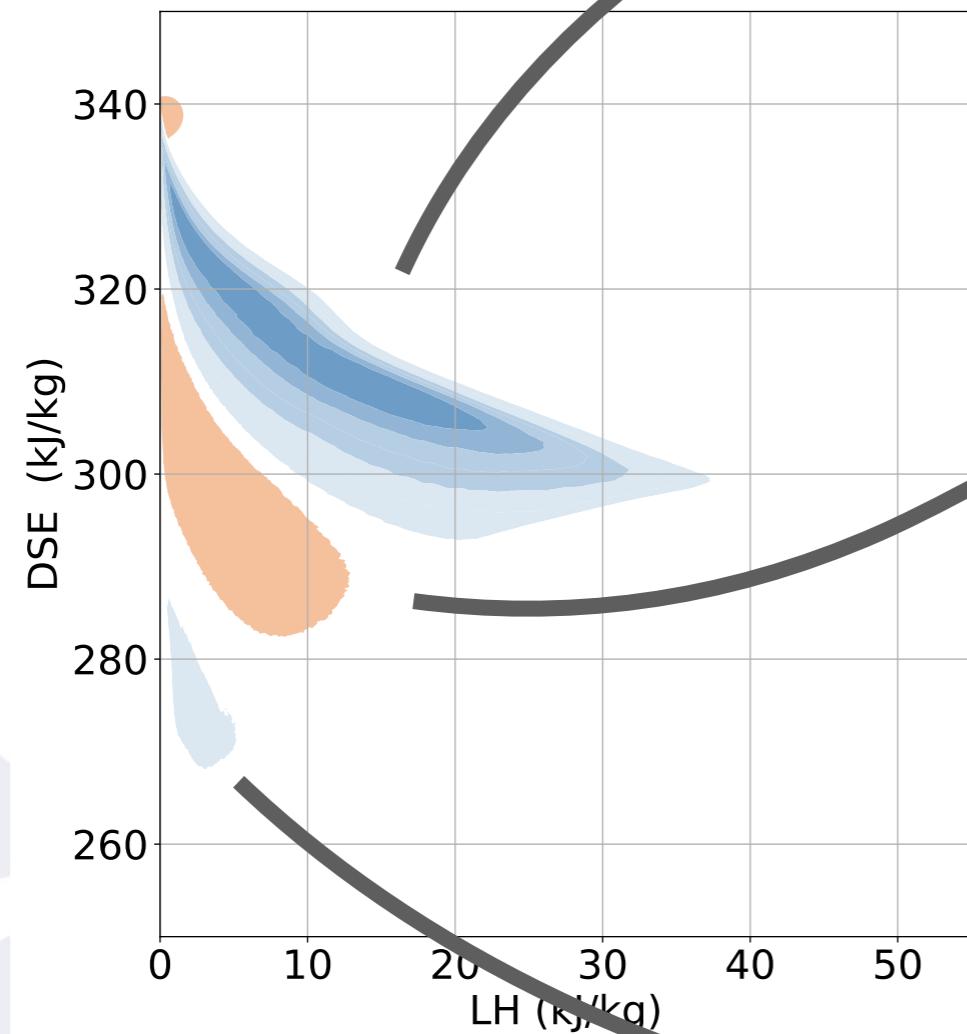
Time scale : 1y



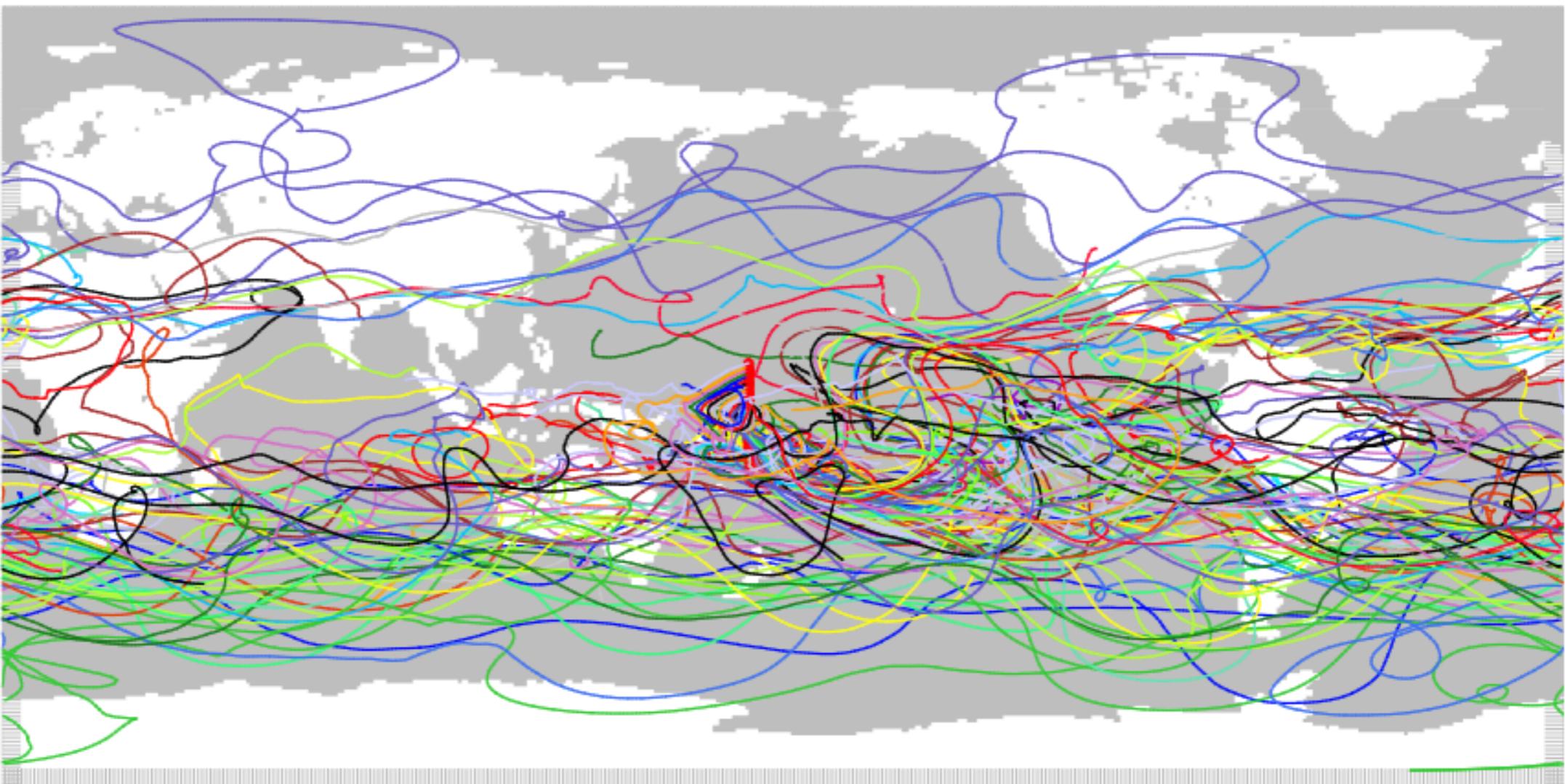
Residual



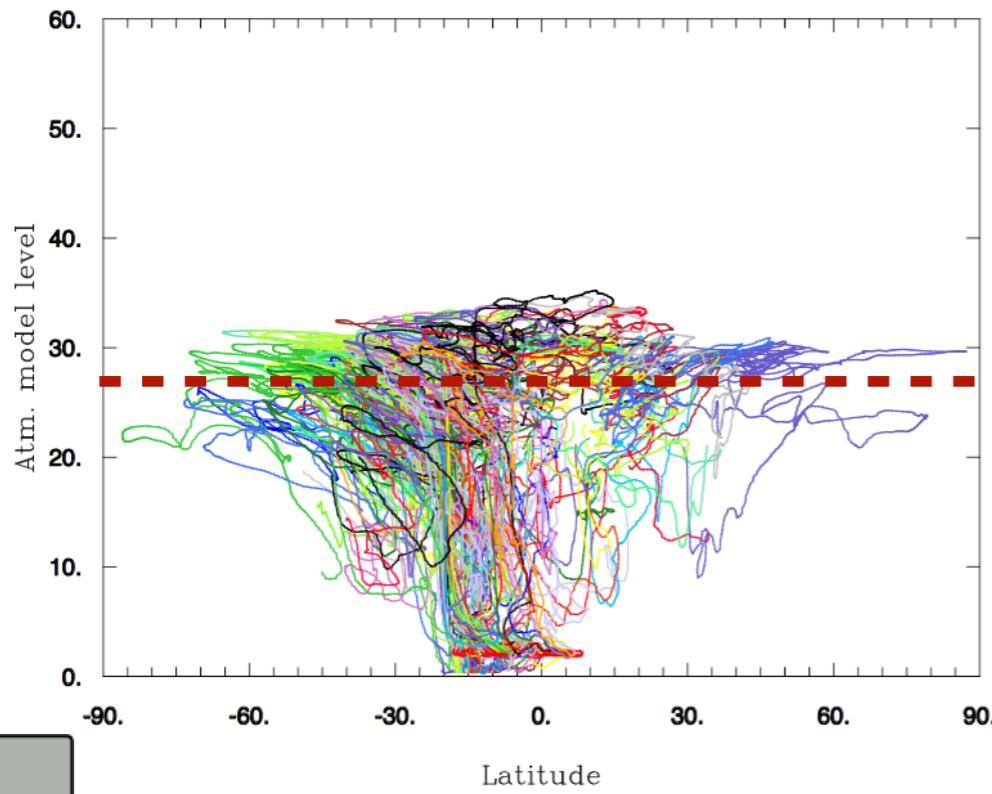
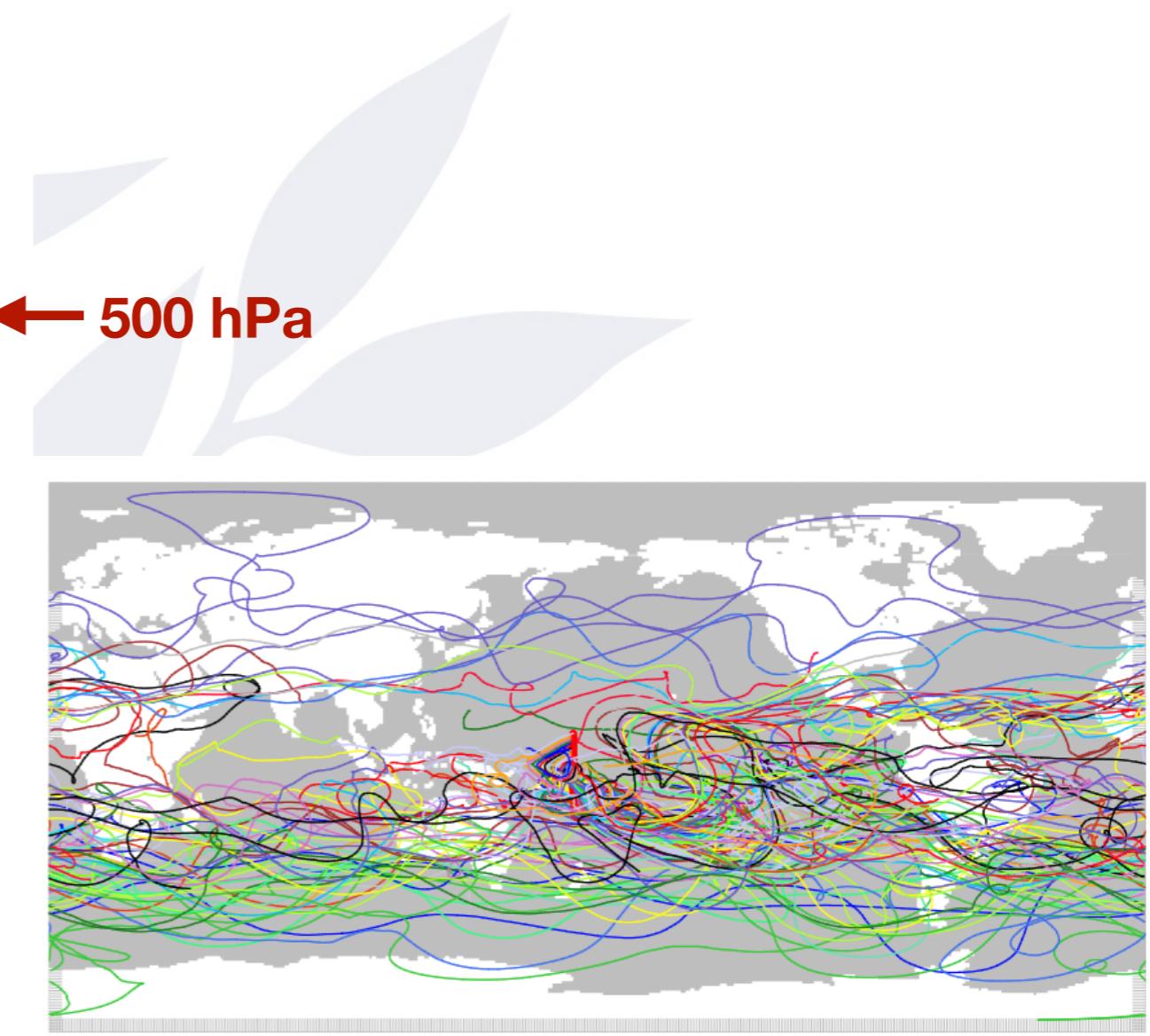
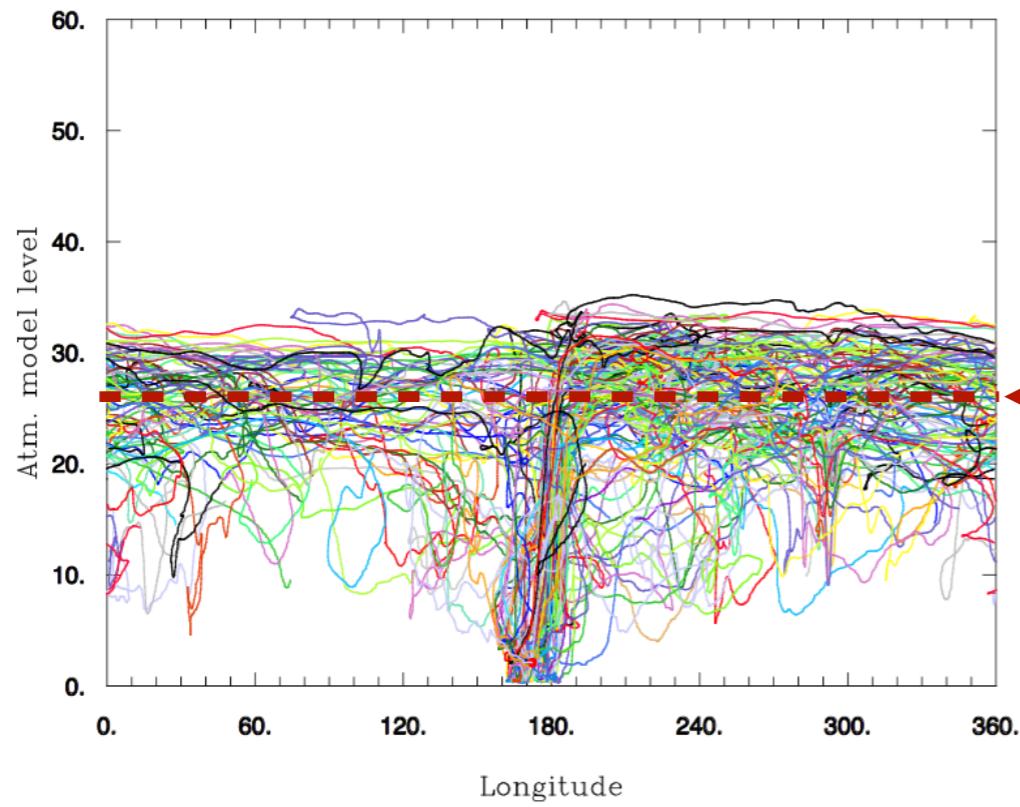
Decomposition of the thermocline circulation



Lagrangian perspective

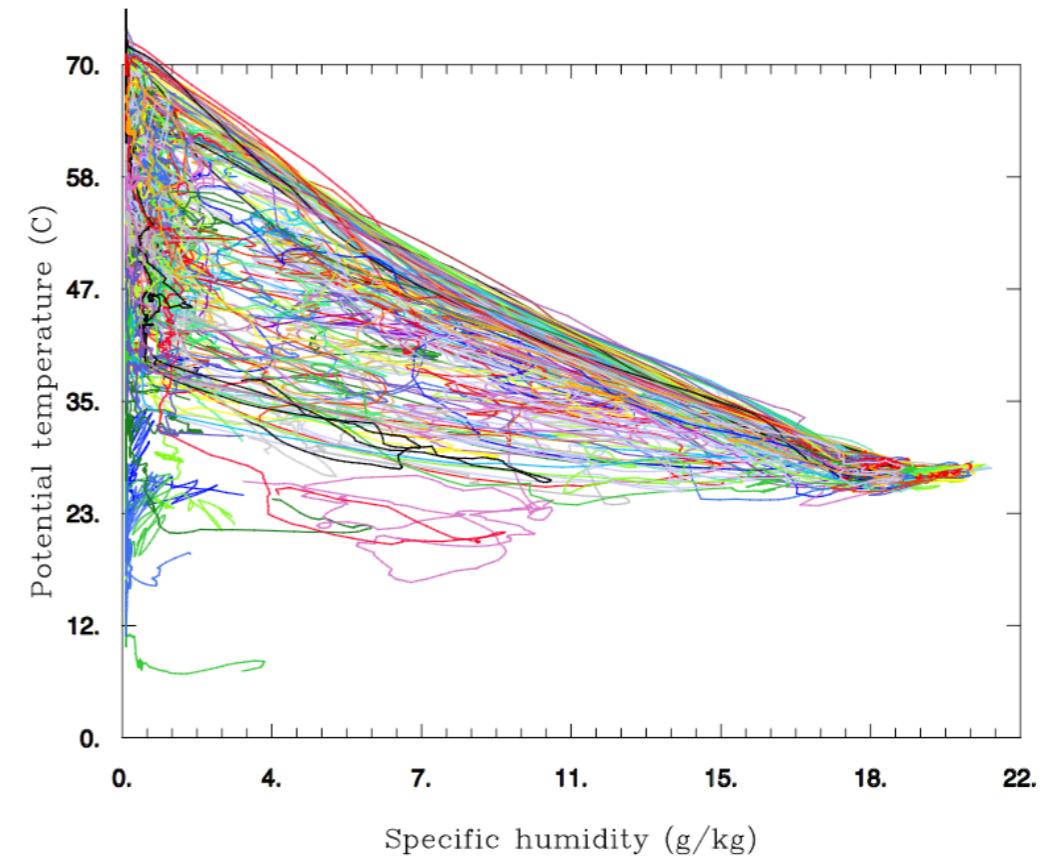
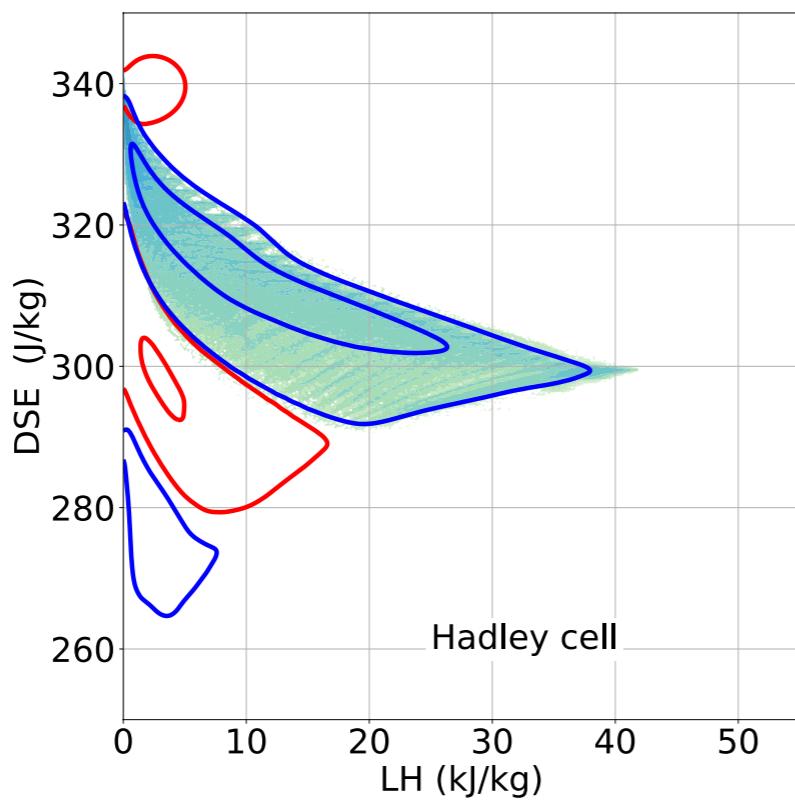
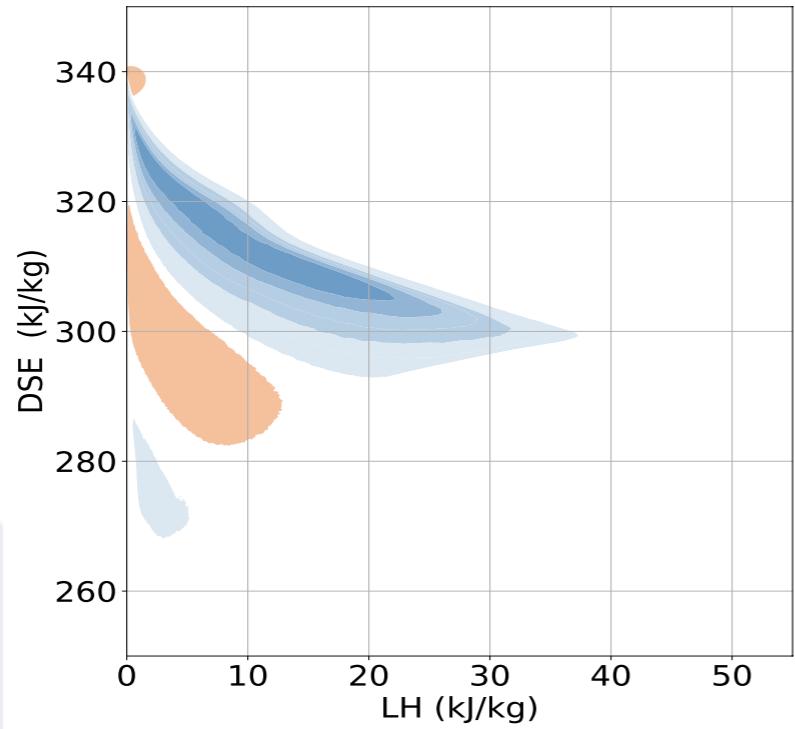


Lagrangian perspective



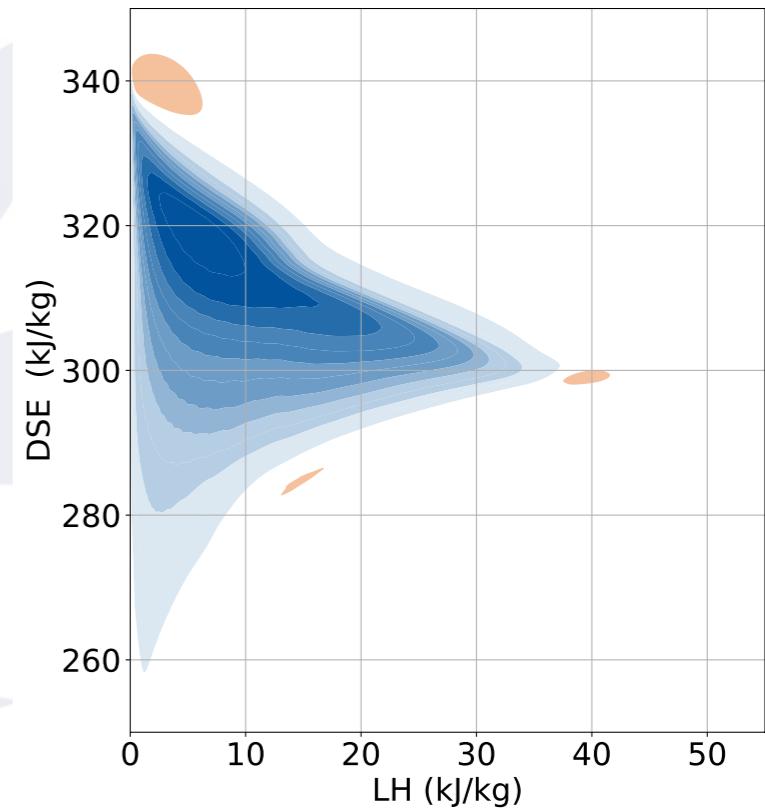
Lagrangian perspective

Time scale : 1y



Conclusions

- The hydrothermal stream function combines zonal and meridional DSE and LH fluxes (Hadley + Walker + midlatitude eddies) into a single cycle.
- It can be decomposed into 3 major cells



Perspectives

- Analyse historical runs from multiple climate models
- Evolution of the hydrothermal stream function in future scenarios (RCP 8.5)

