OCELAND: A Conceptual Model to Explain the Partitioning of Precipitation between Land and Ocean

Luca Schmidt and Cathy Hohenegger

24. May 2022

luca.schmidt@mpimet.mpg.de

International Max Planck Research School on Earth System Modelling

MAX-PLANCK-INSTITUT FÜR METEOROLOGIE

What constrains the partitioning of precipitation between land and ocean?

$$\chi = \frac{\bar{P}_\ell}{\bar{P}_o}$$

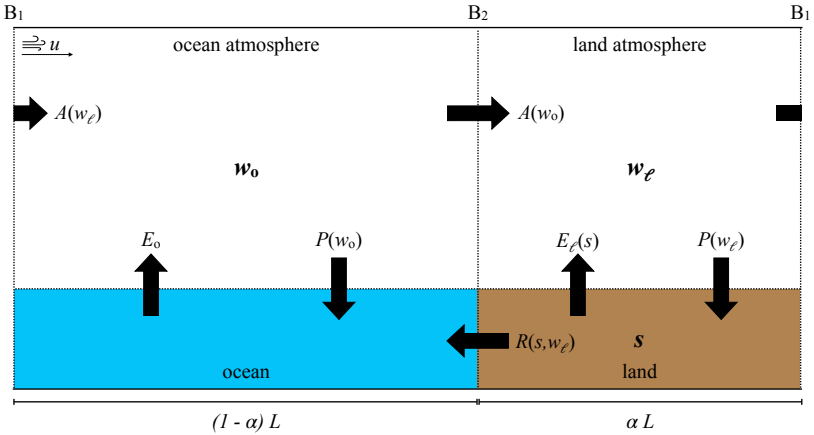
Ratio of spatial mean precipitation rates

Observations for the tropics locate χ in a range between 0.9 and 1.04

Hohenegger and Stevens (2022)

… very close to 1!

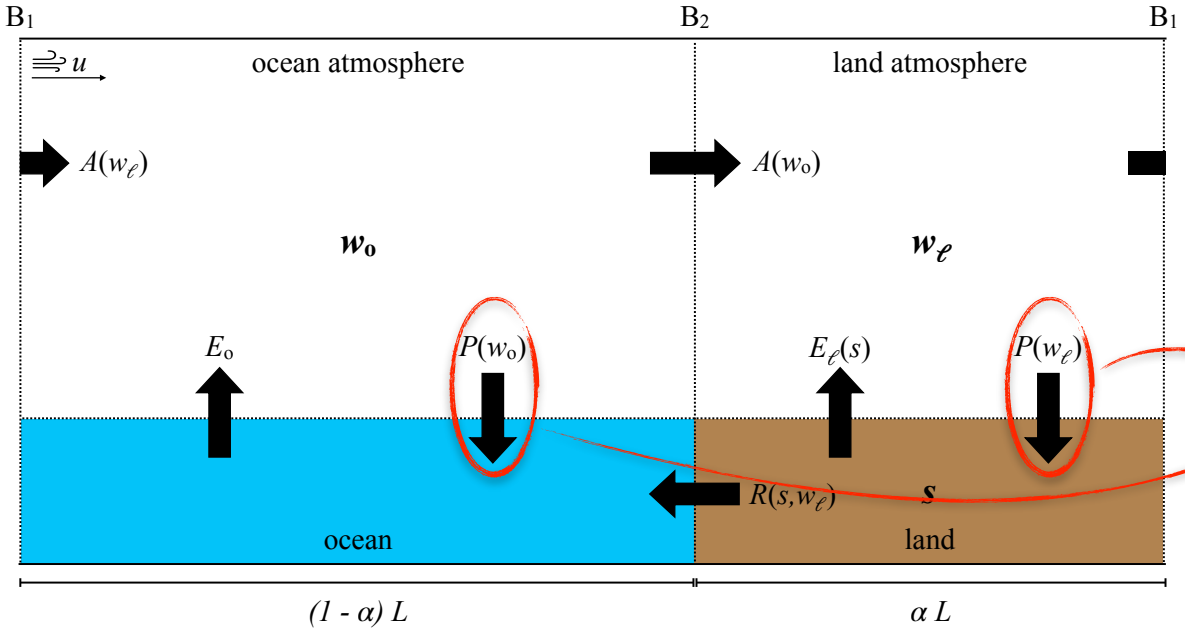
Conceptual water balance model

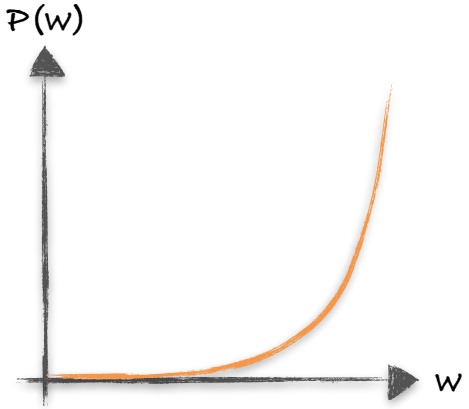


From 50000 equilibrium solutions across the parameter space:

- constrain the possible range of χ
- test the sensitivity to parameter choices

Moisture fluxes





Motivated by Bretherton et al. (2004)

Moisture fluxes

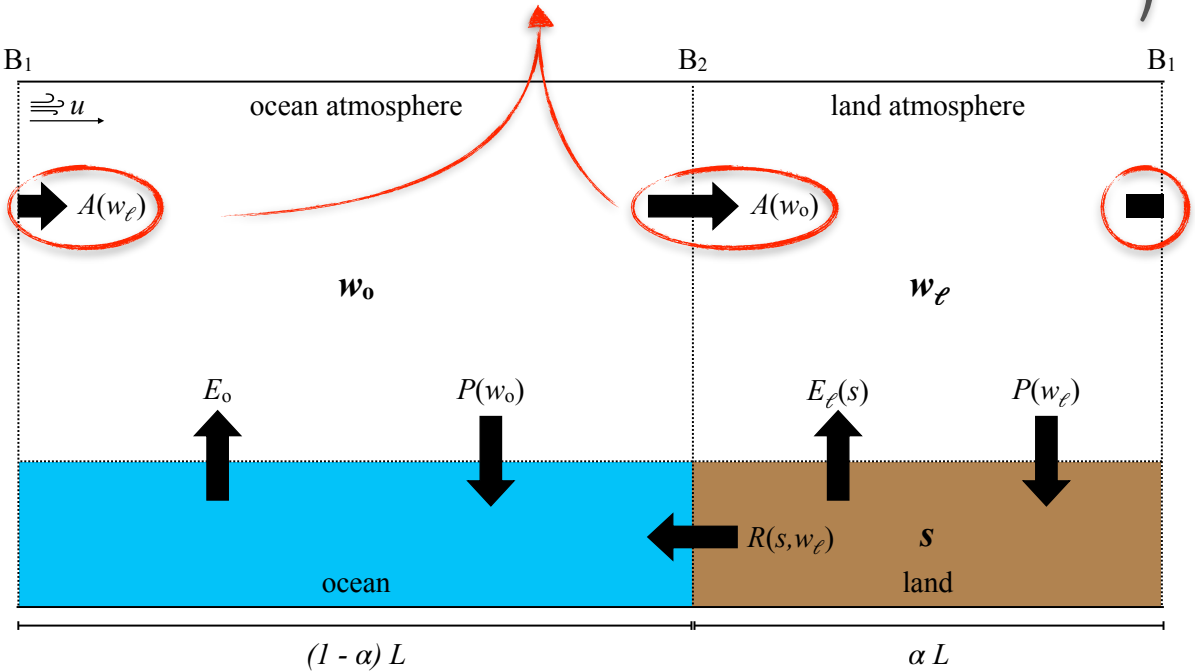
Net advection into land domain:

$$A_\ell(w_o, w_\ell) = (w_o - w_\ell)\frac{\tau}{\alpha}$$

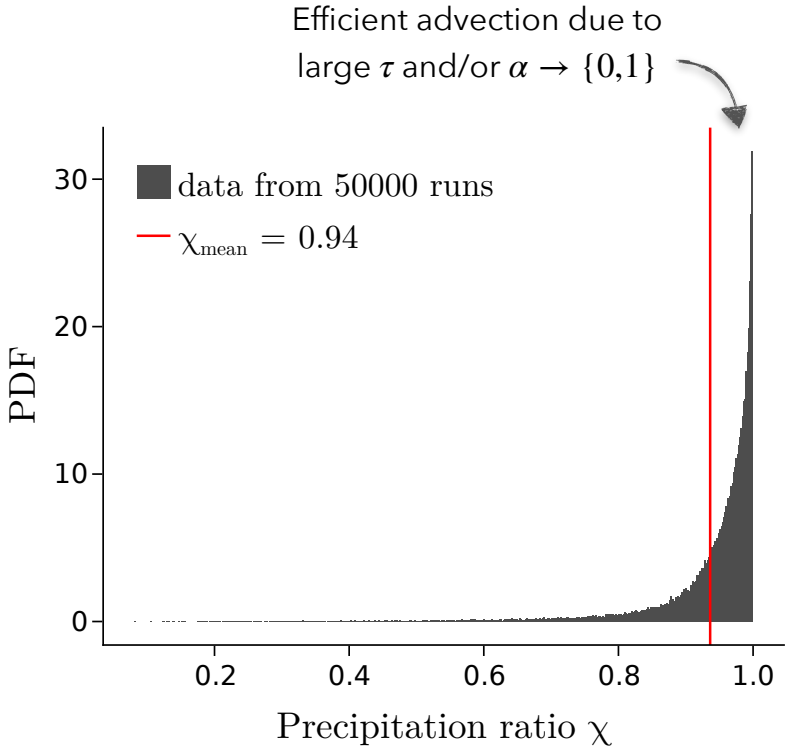
atmospheric transport parameter

land fraction

control how effectively advection assimilates the moisture conditions over land and ocean



The modelled precipitation ratio is bounded between 0 and 1.



Why can χ not be larger than one?

- Equilibrium requires a net advection from ocean to land which compensates for soil runoff
- Ocean atmosphere equilibrates to moister value than land atmosphere and therefore yields more rain:

$$\chi = P(w_\ell)/P(w_o) < 1.$$

To get $\chi > 1$, it has to rain differently over land and ocean.