What is unique about convection in the coastal tropics?
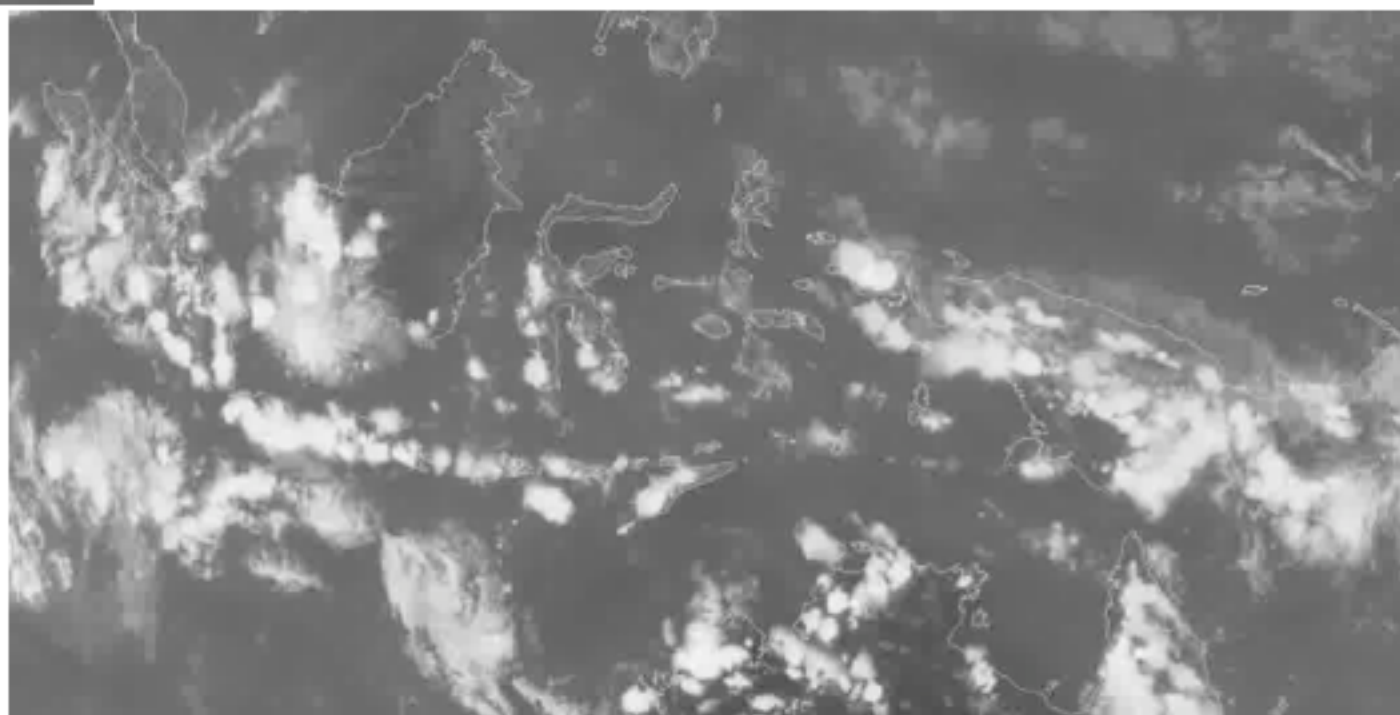
Martin Bergemann, Chrsitian Jakob & Todd Lane
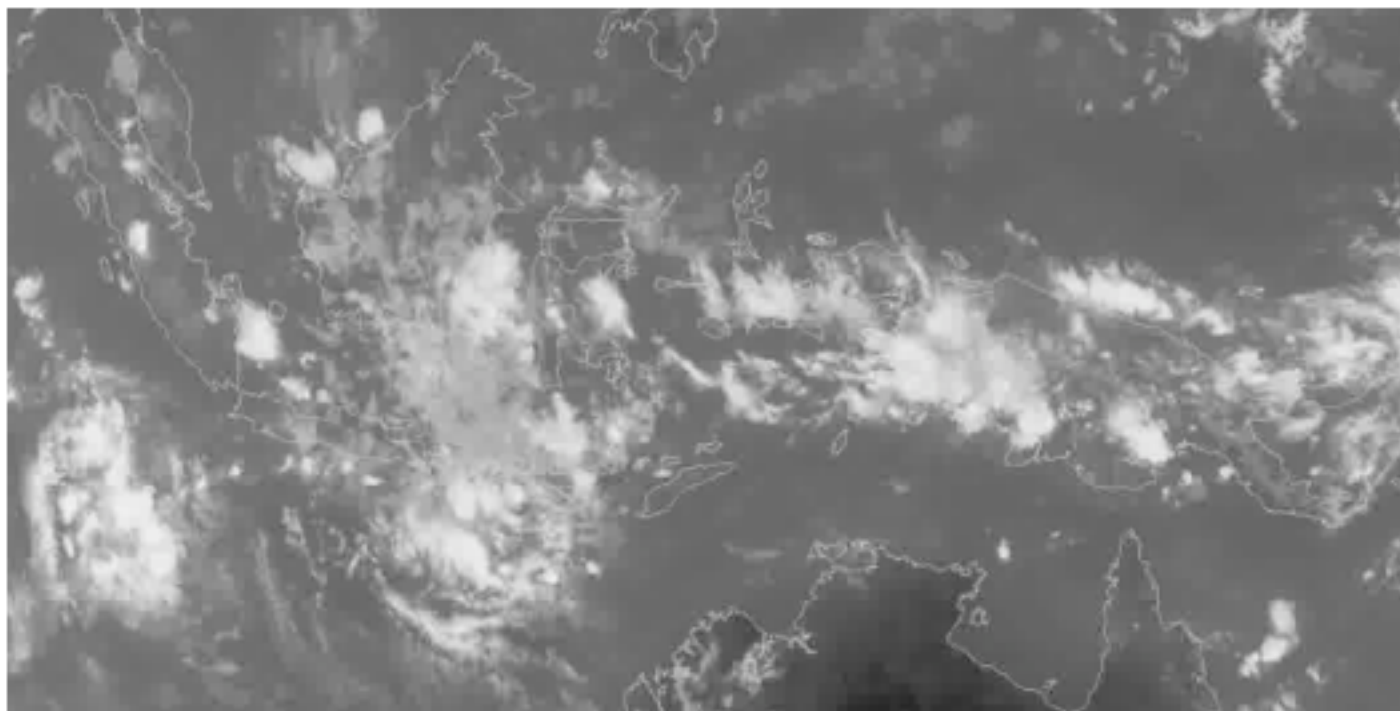
MONASH University

ARC CENTRE OF EXCELLENCE FOR
CLIMATE SYSTEM SCIENCE

(image: thanks to Shannon Herley)

MC Feb. 07 2010 01:30 UTC

MC Feb. 07 2010 09:30 UTC

(images: thanks to Steve Sherwood)
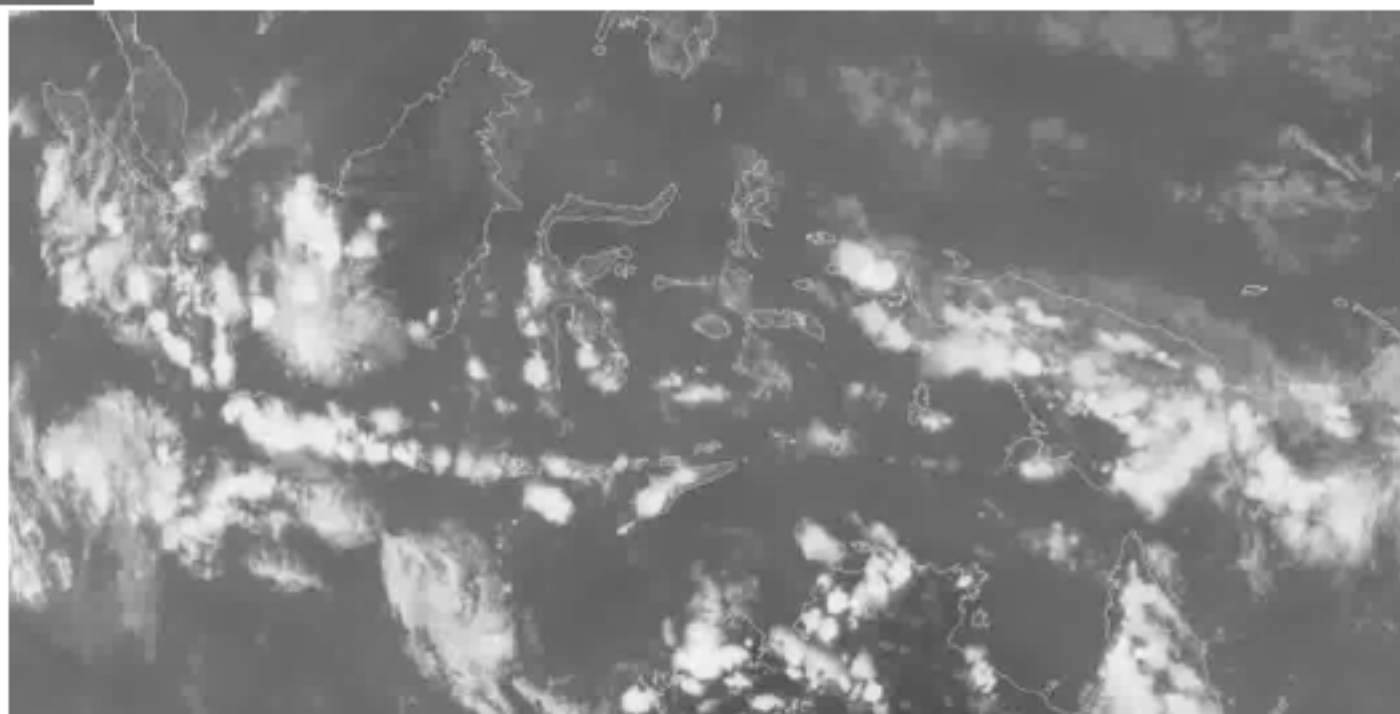
"... *the convection provides nearly a perfect map of the region ....*"

Holland & Keenan (1980)

MC Feb. 07 2010 01:30 UTC

(images: thanks to Steve Sherwood)

MC Feb. 07 2010 09:30 UTC

Coastal convction is highly oranised

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land-sea-breeze
orographic graphity waves
mountain-valley breezes.

Coastal convction is highly oranised

meso-scale dynamic features

Convection in global climate models

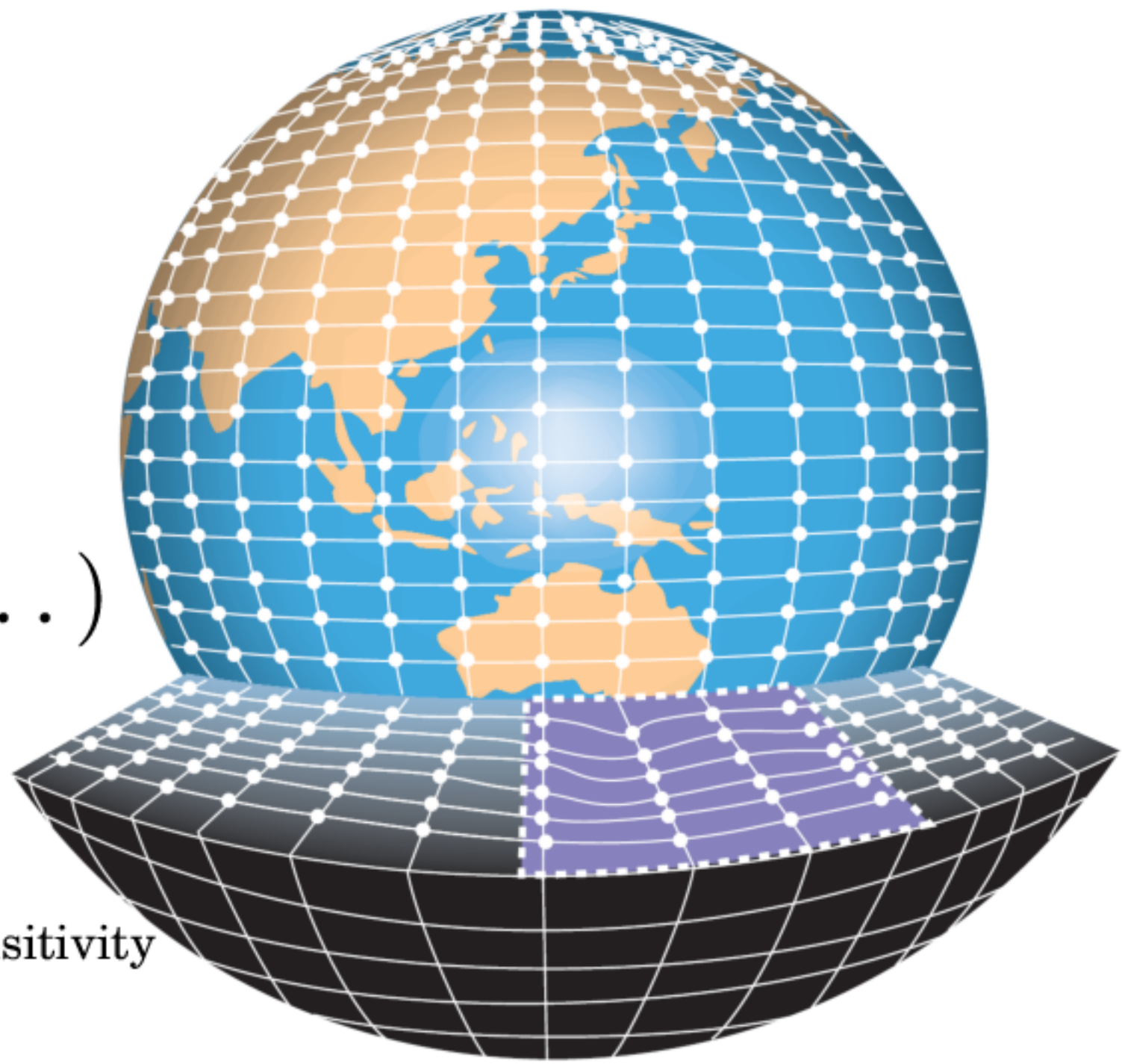$$M_c = F(\bar{q}, \overline{\mathrm{cape}}, \nabla\bar{\omega} \dots)$$

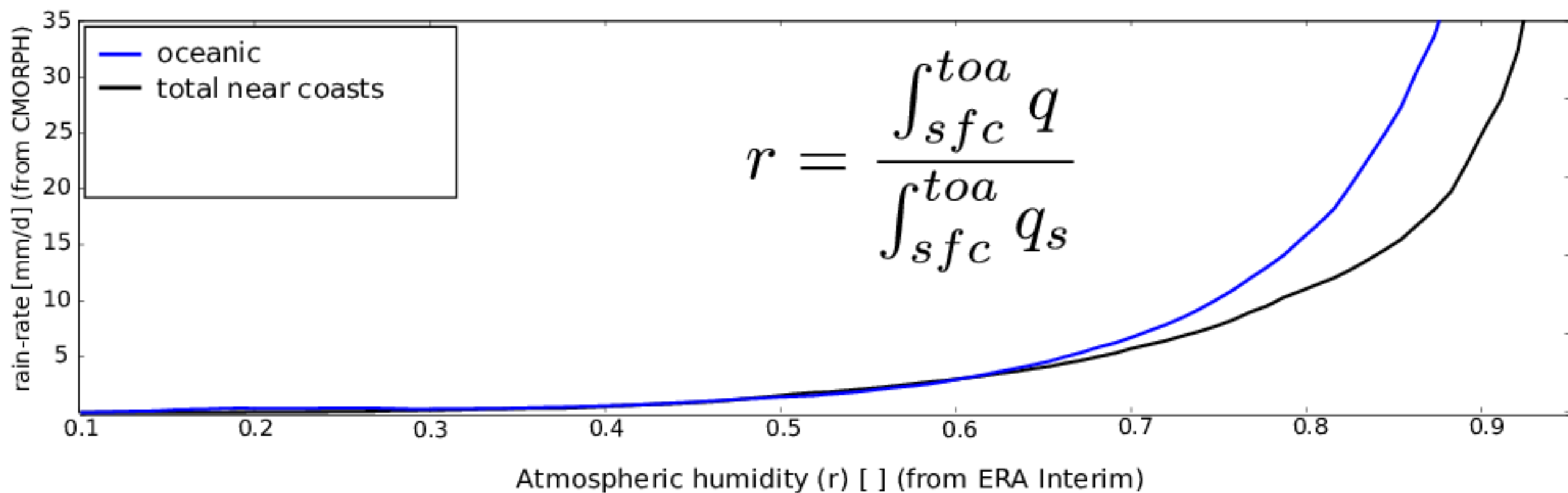Convection in global climate models

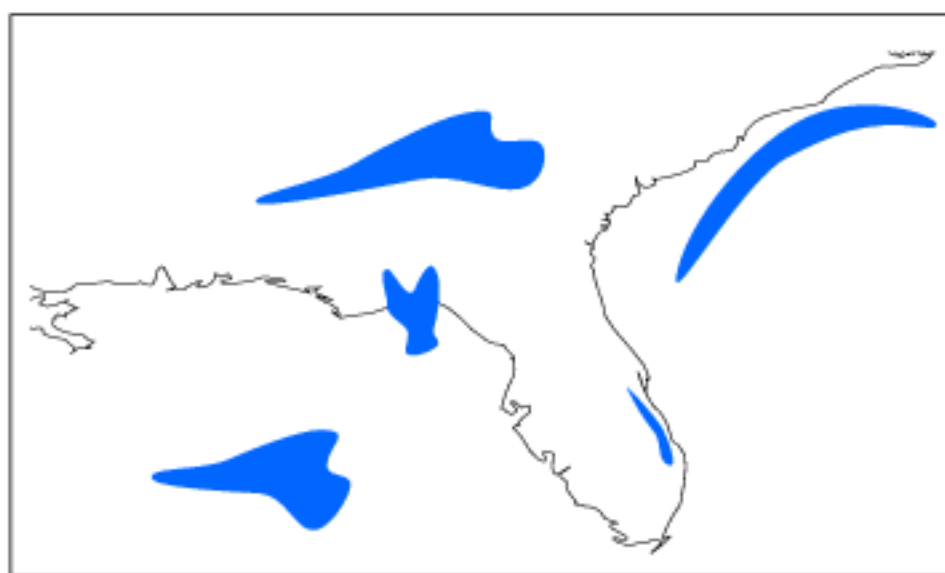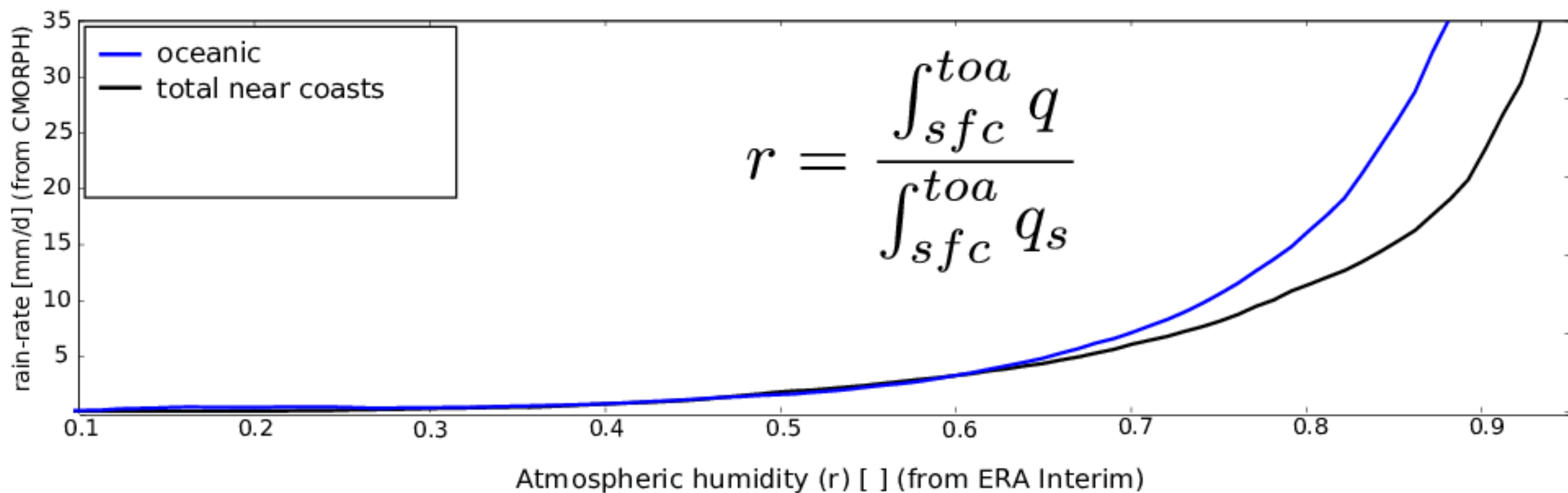$$M_c = F(\bar{q}, \overline{\text{cape}}, \nabla\bar{\omega} \dots)$$

Recent studies suggest more moisture sensitivity

How senstive is Coastal rainfall to humidity on scales, typical for a Climate model (75 - 150 km)?

$$r = \frac{\int_{sfc}^{toa} q}{\int_{sfc}^{toa} q_s}$$

rain-rate [mm/d] (from CMORPH)

Atmospheric humidity (r) [ ] (from ERA Interim)

oceanic
total near coasts

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Alogorithm to objectively find coastal rainfall

Detect rainfall pattern that:
- occurs in a coastal area
- has a considerable intesity
- not synoptic-scale
- is aligned with the coastaline

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Legend:
- oceanic
- total near coasts

y-axis: rain-rate [mm/d] (from CMORPH)

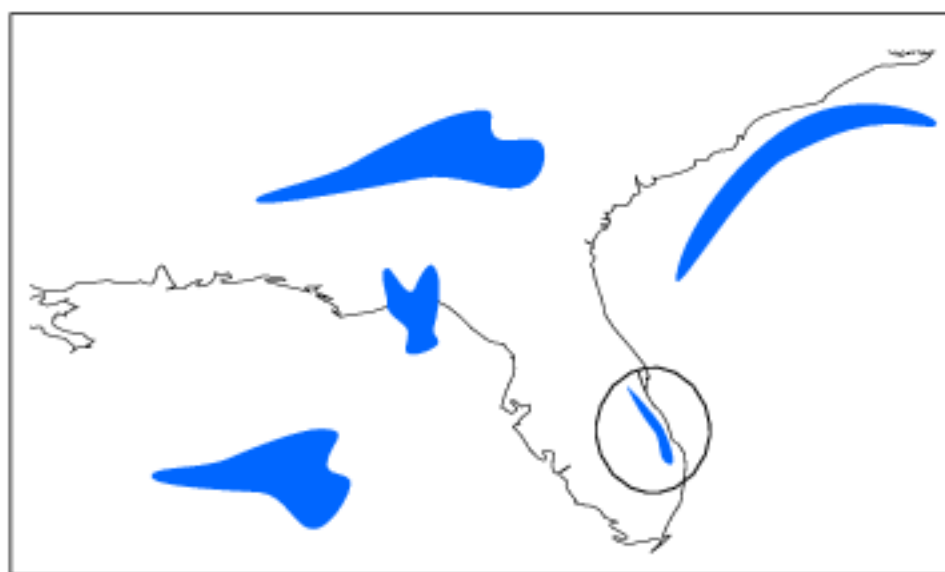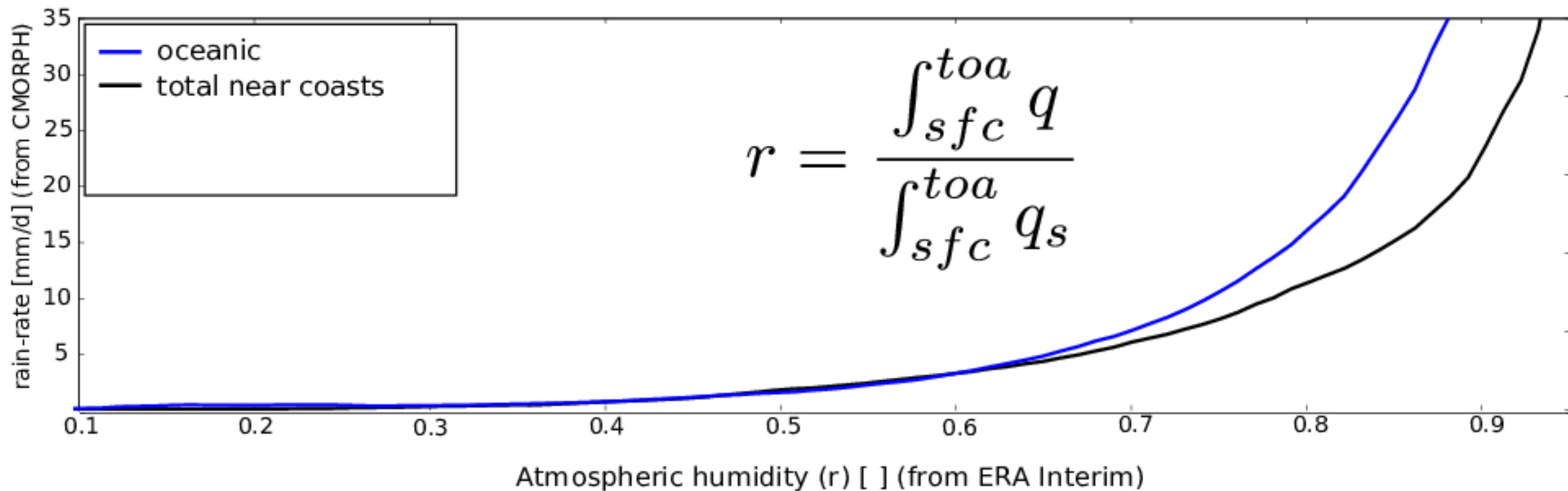x-axis: Atmospheric humidity (r) [ ] (from ERA Interim)

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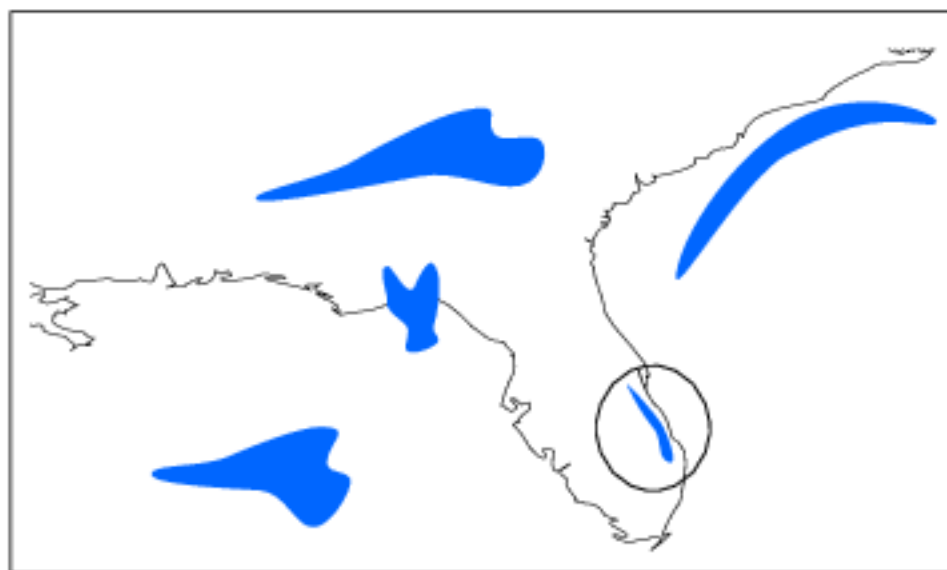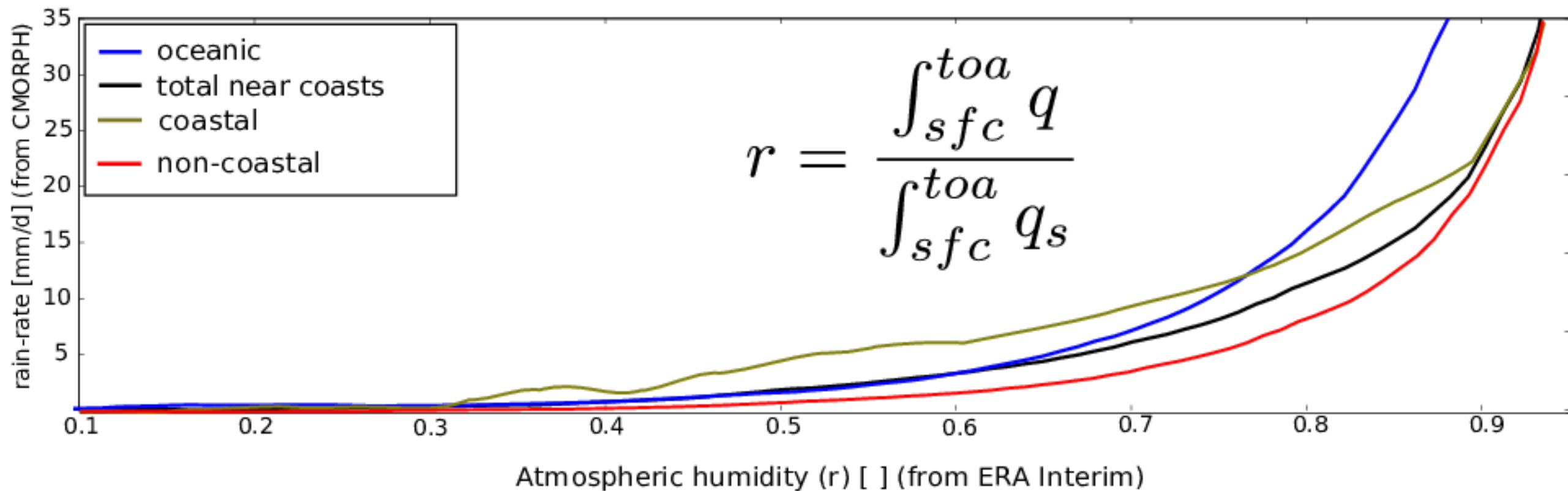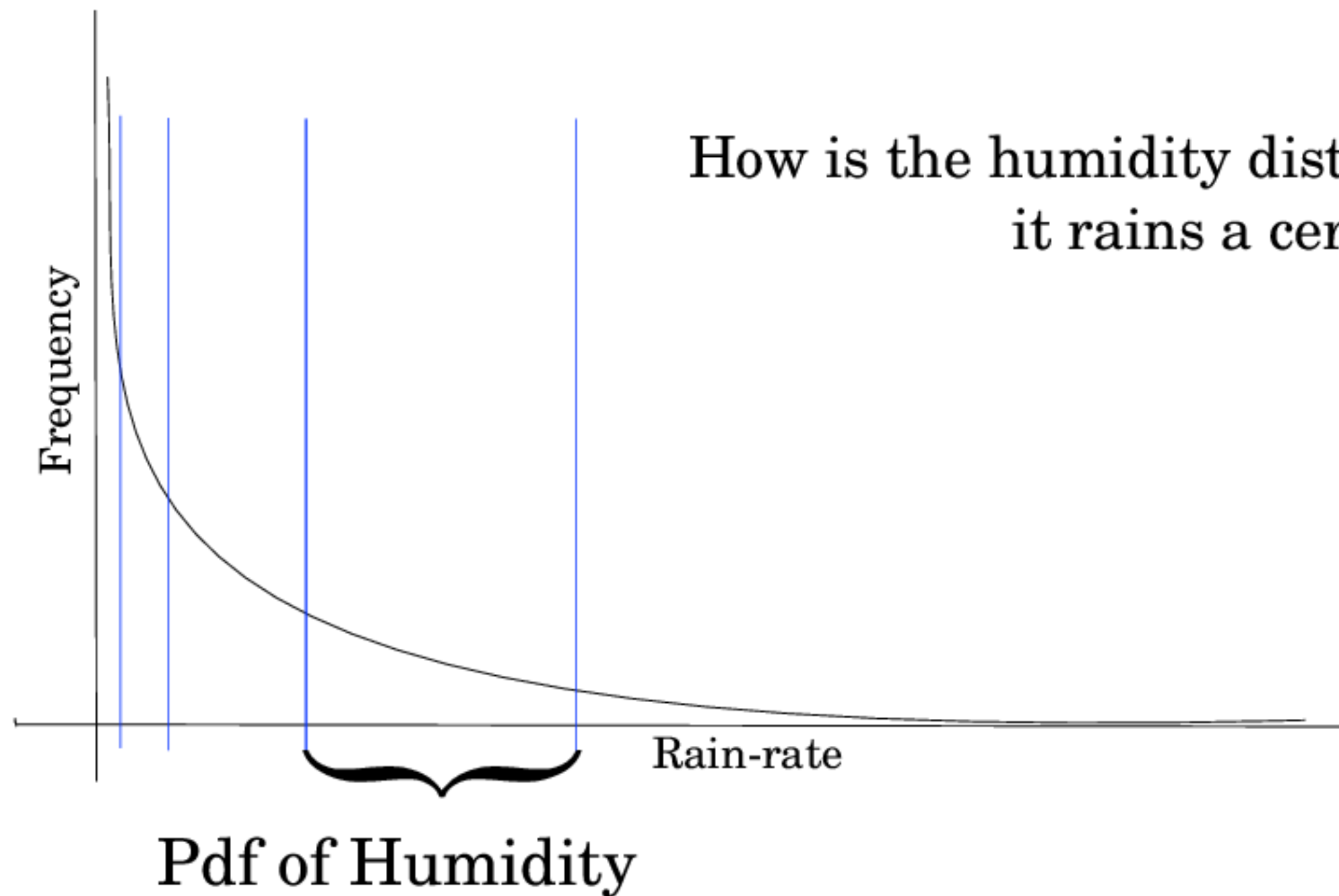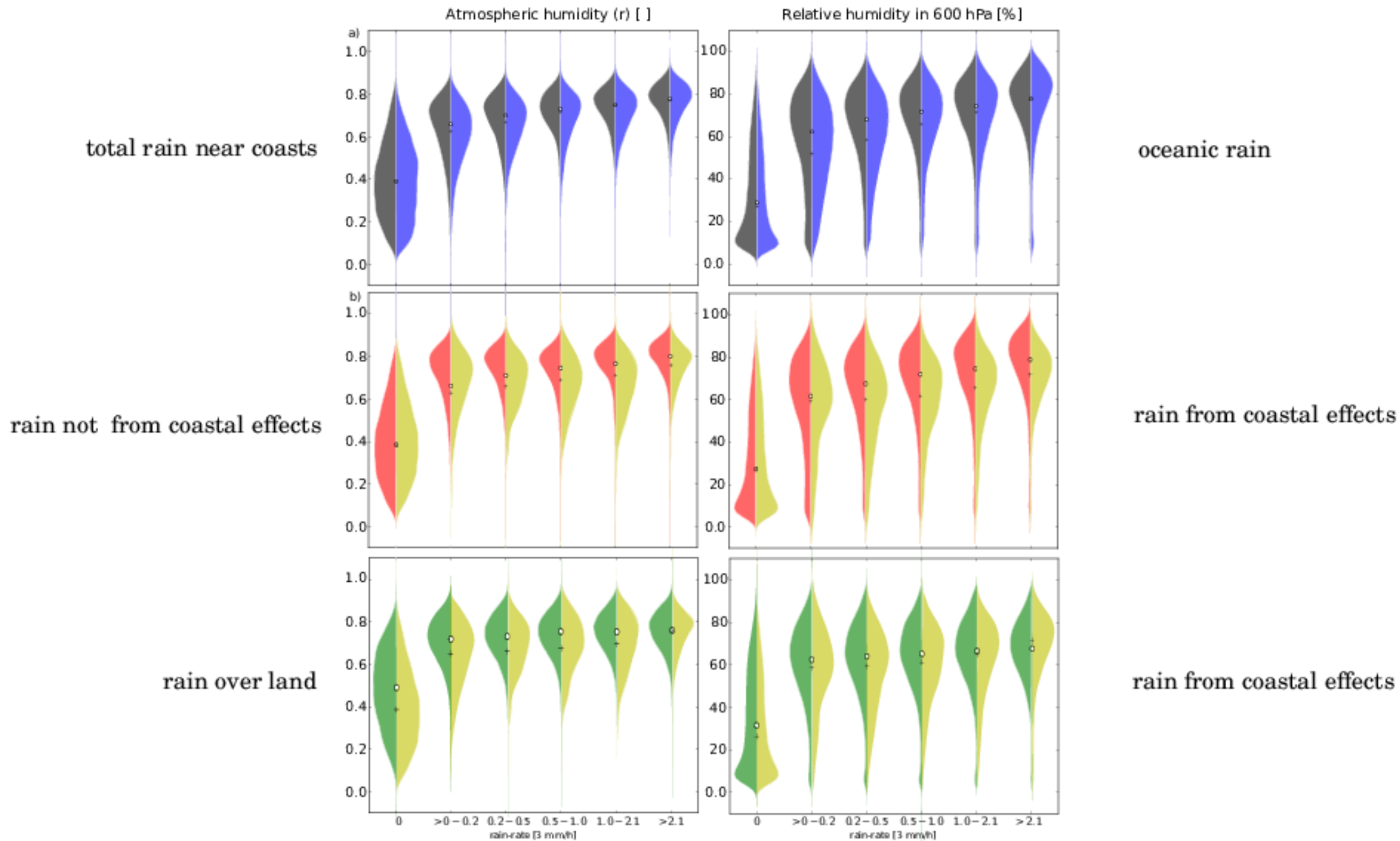- total near coasts
- coastal
- non-coastal

Alogorithm to objectively find coastal rainfall

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How is the humidity distributed when it rains a certain amount?

Pdf of Humidity

Atmospheric humidity (r) [ ]   Relative humidity in 600 hPa [%]

total rain near coasts   oceanic rain

rain not from coastal effects   rain from coastal effects

rain over land   rain from coastal effects

- Coastal rain constitutes $\approx$ 30% of the total rainfall near coasts

- It occurs in drier large-scale atmospheric conditions

- Making parametrization schemes more moisture sensitive won't improve coastal rainfall much

- Global models should incorporate this behavoir

I Sea-breeze-front

II Strong cumulus mixing

Moist convergence

III Less cumulus mixing

Cumulus-merger

IV Few cumulus mixing

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