

# Cloud and precipitation distribution in storm-resolving simulations

Cathy Hohenegger, Hans Segura and the Sapphire team



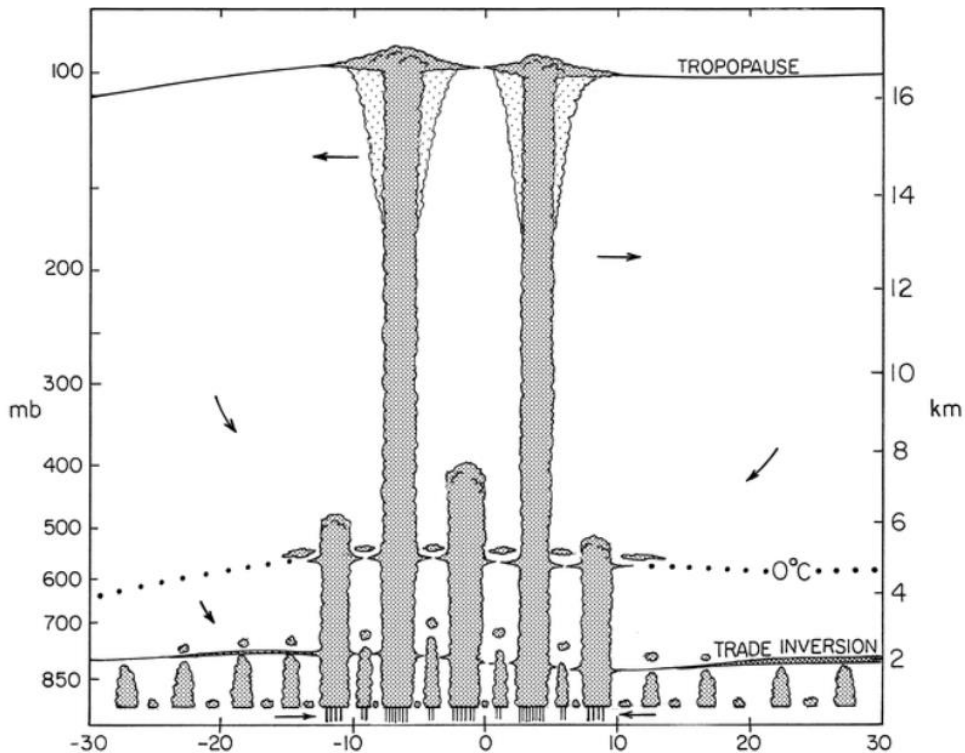
# Conceptual tropical cloud distribution: the 3 modes

Coarse-resolution models cannot really reproduce the partitioning of clouds

1.

How well can ICON-Sapphire reproduce the partitioning of clouds?

What is the contribution of each cloud type to precipitation?

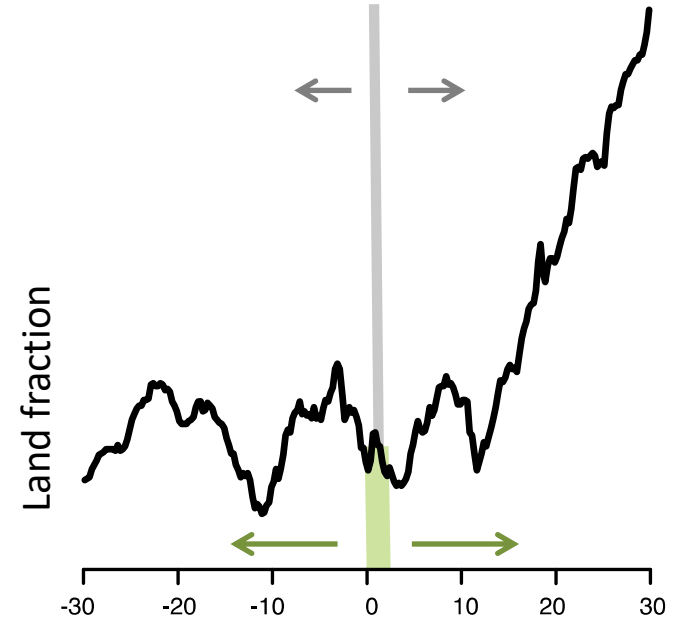


# Conceptual tropical rain distribution: the rainbelt

Coarse-resolution models cannot reproduce the partitioning of precipitation and they misrepresent the underlying main control

## 2.

How well can ICON-Sapphire reproduce the partitioning of precipitation and its underlying main control?



# ICON-Sapphire

- Global simulation
- Coupled ocean-atmosphere-land simulation
- Horizontal grid spacing of 5 km
- Run for a bit more than 1 year

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Geoscientific  
Model Development



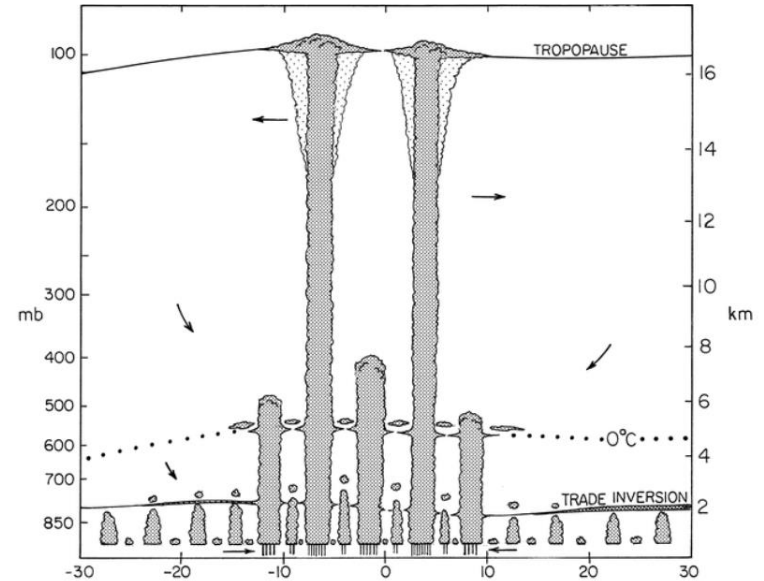
## **ICON-Sapphire: simulating the components of the Earth system and their interactions at kilometer and subkilometer scales**

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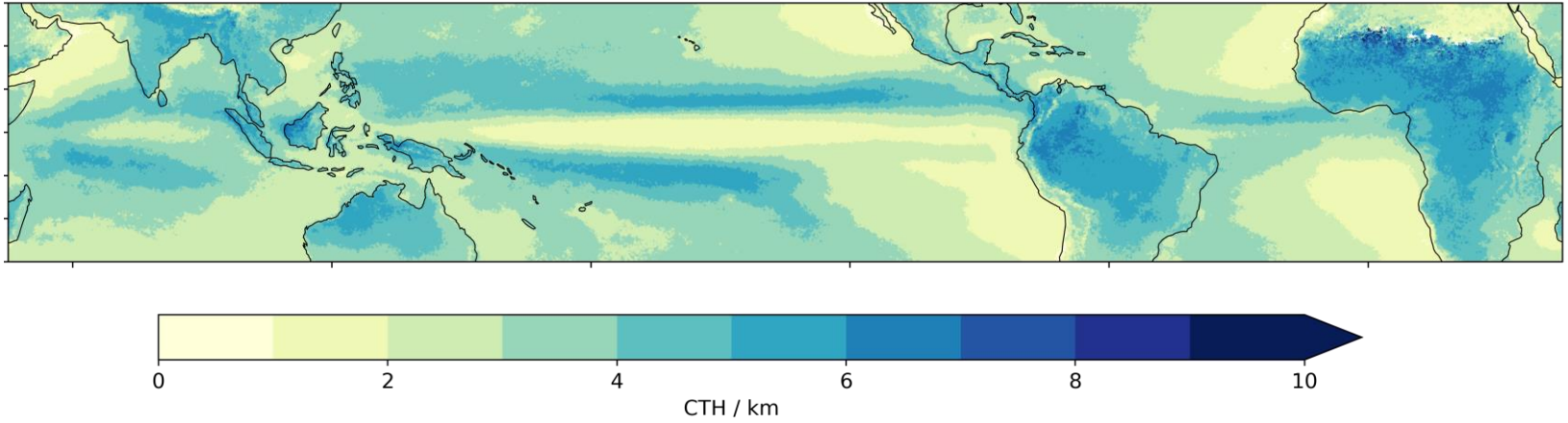
# 1.

How well can ICON-Sapphire reproduce the partitioning of clouds?

What is the contribution of each cloud type to precipitation?

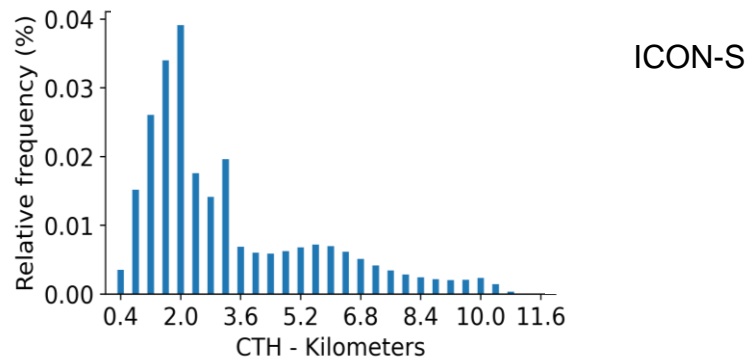
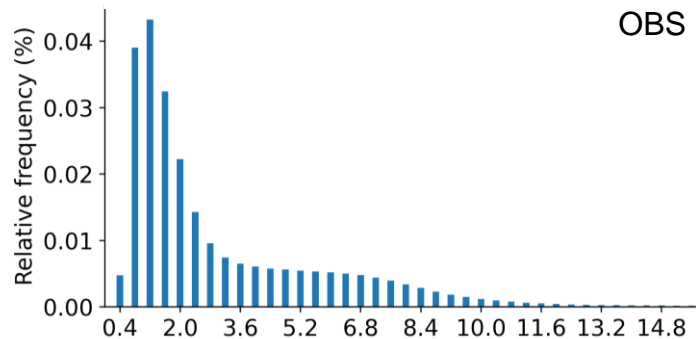


# Mean cloud top height

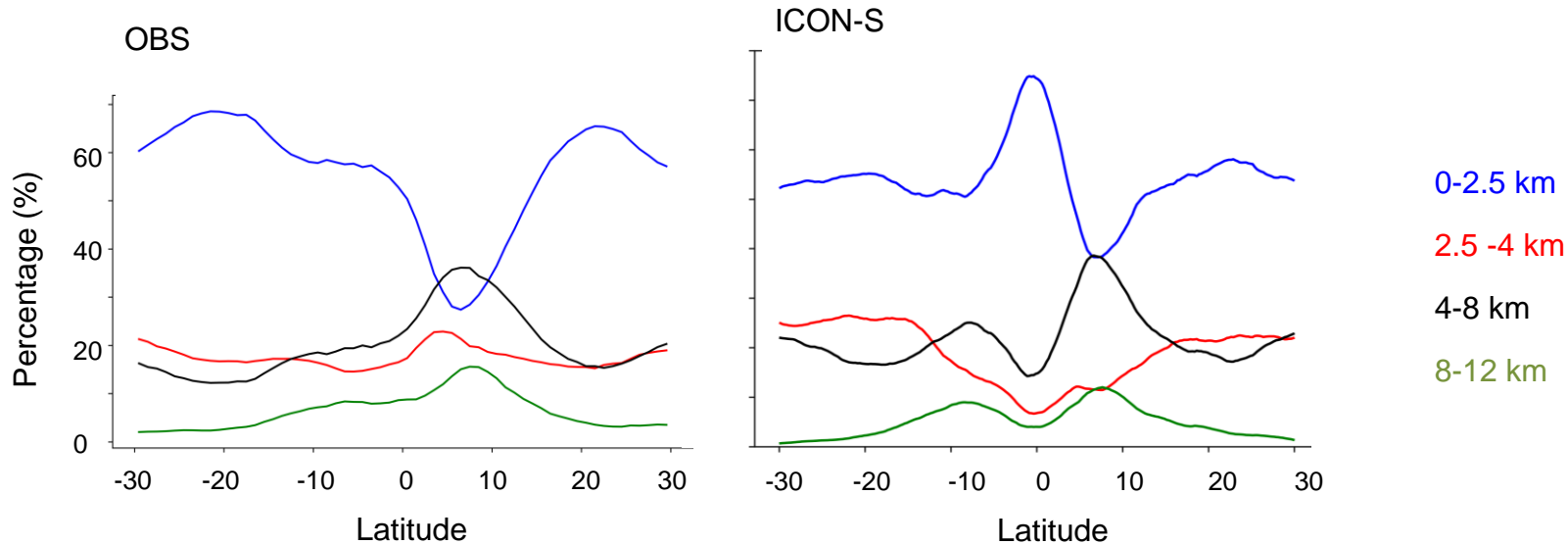


## Cloud top height distribution ocean: 3 modes, very well reproduced

Type	OBS	ICON-S
All	80	97
< 2.5 km	56	54
2.5-4 km	18	19
4-8 km	20	22
> 8 km	6	5



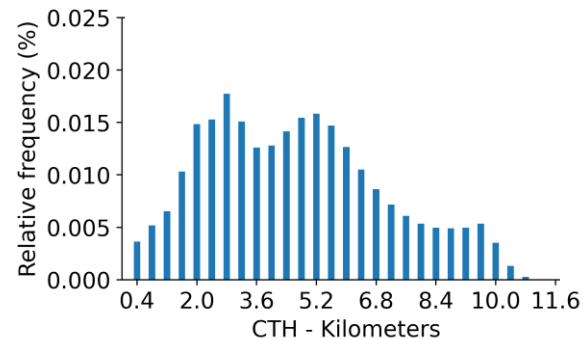
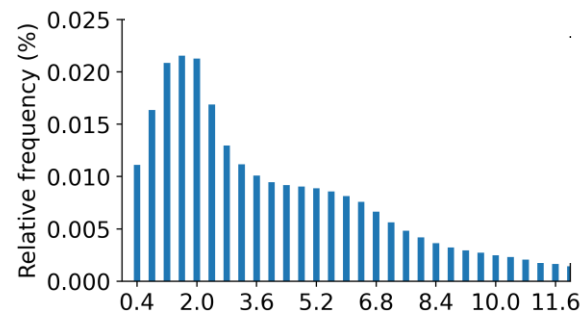
## Cloud top height distribution: equator region stands out



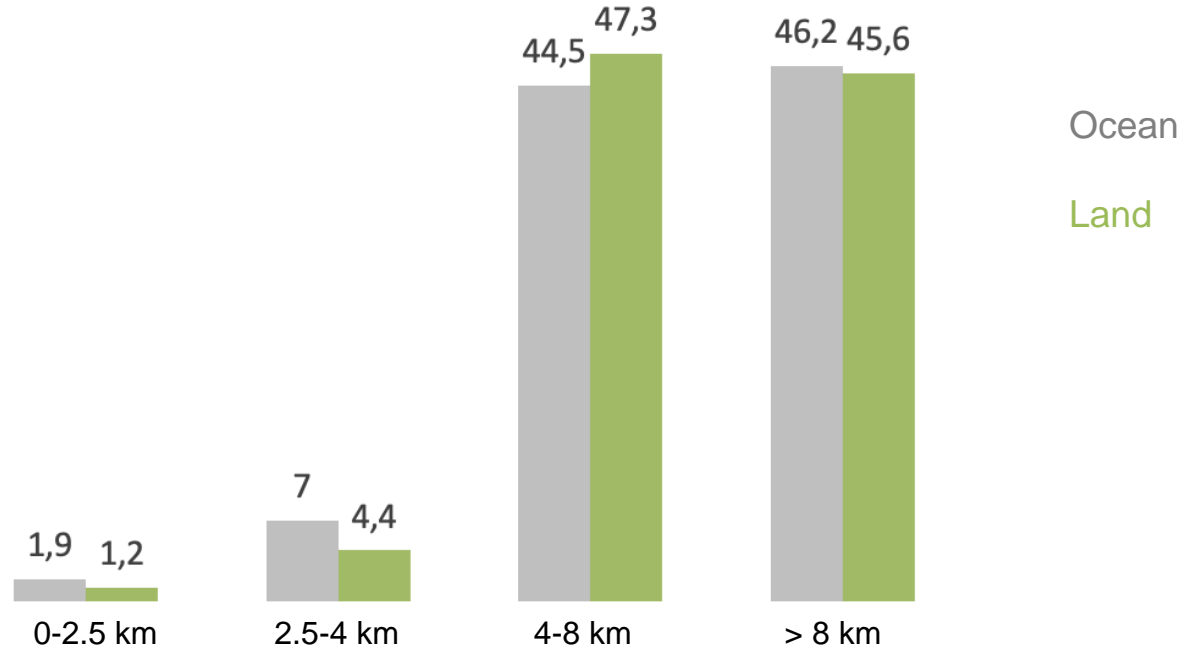


## Cloud top height distribution land: 3 modes, congestus overestimated?

Type	OBS	ICON-S
All	61	58
< 2.5 km	36	24
2.5-4 km	23	22
4-8 km	28	44
> 8 km	13	10



# Contribution to precipitation



# 1.

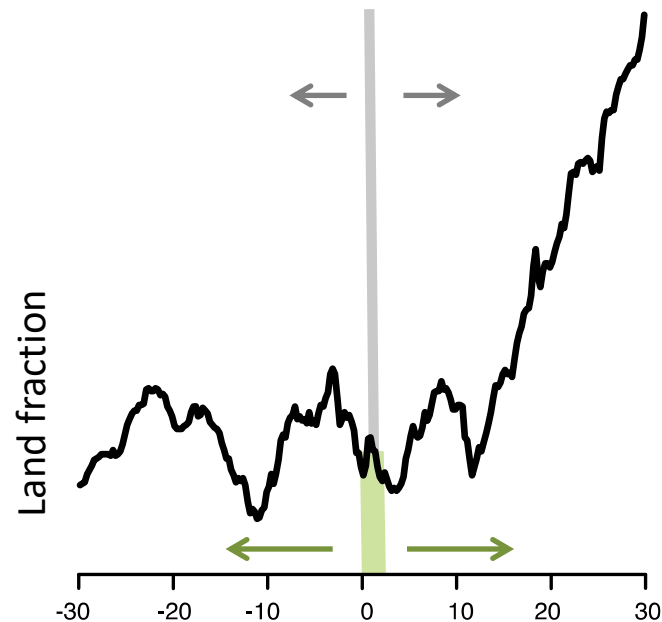
How well can ICON-Sapphire reproduce the partitioning of clouds?

What is the contribution of each cloud type to precipitation?

- We get the 3 modes
- Partitioning is reproduced extremely well over ocean
- Contribution to precipitation from the different modes similar over land and over ocean

## 2.

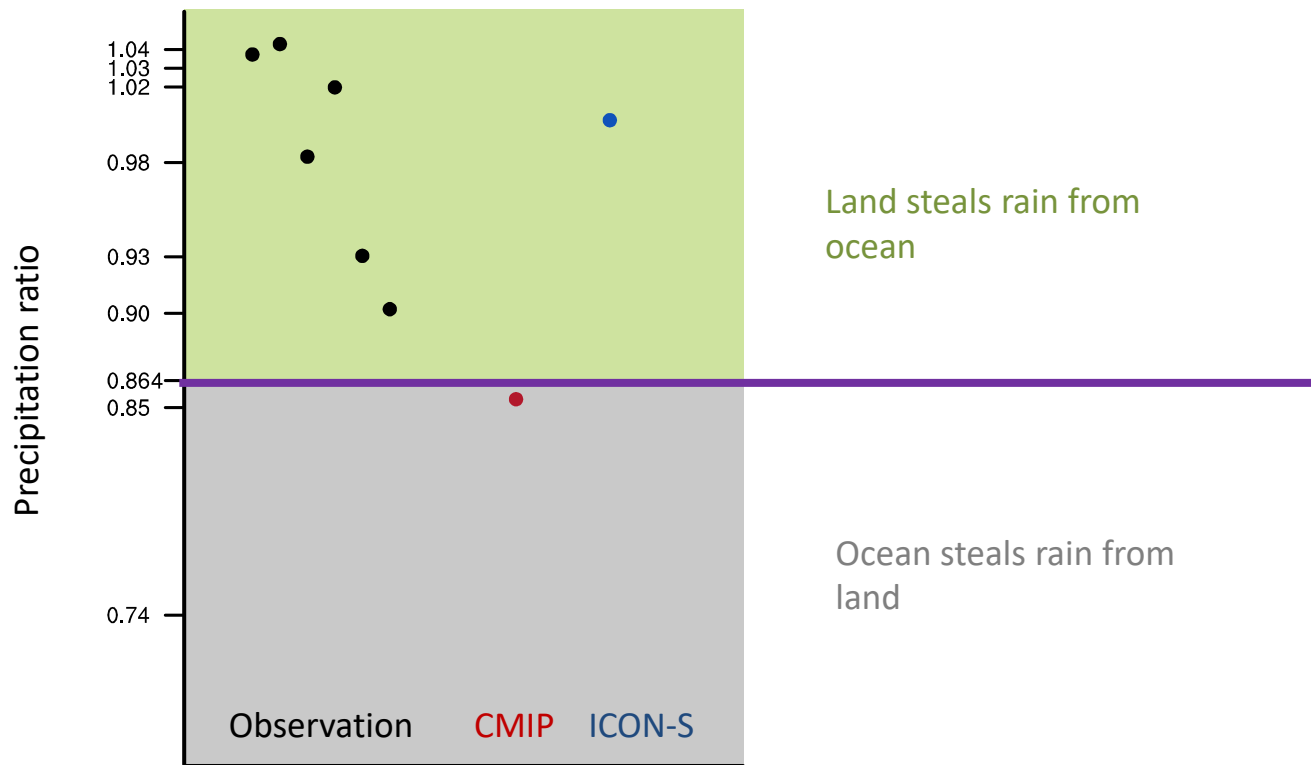
How well can ICON-Sapphire reproduce the partitioning of precipitation and its underlying main control?



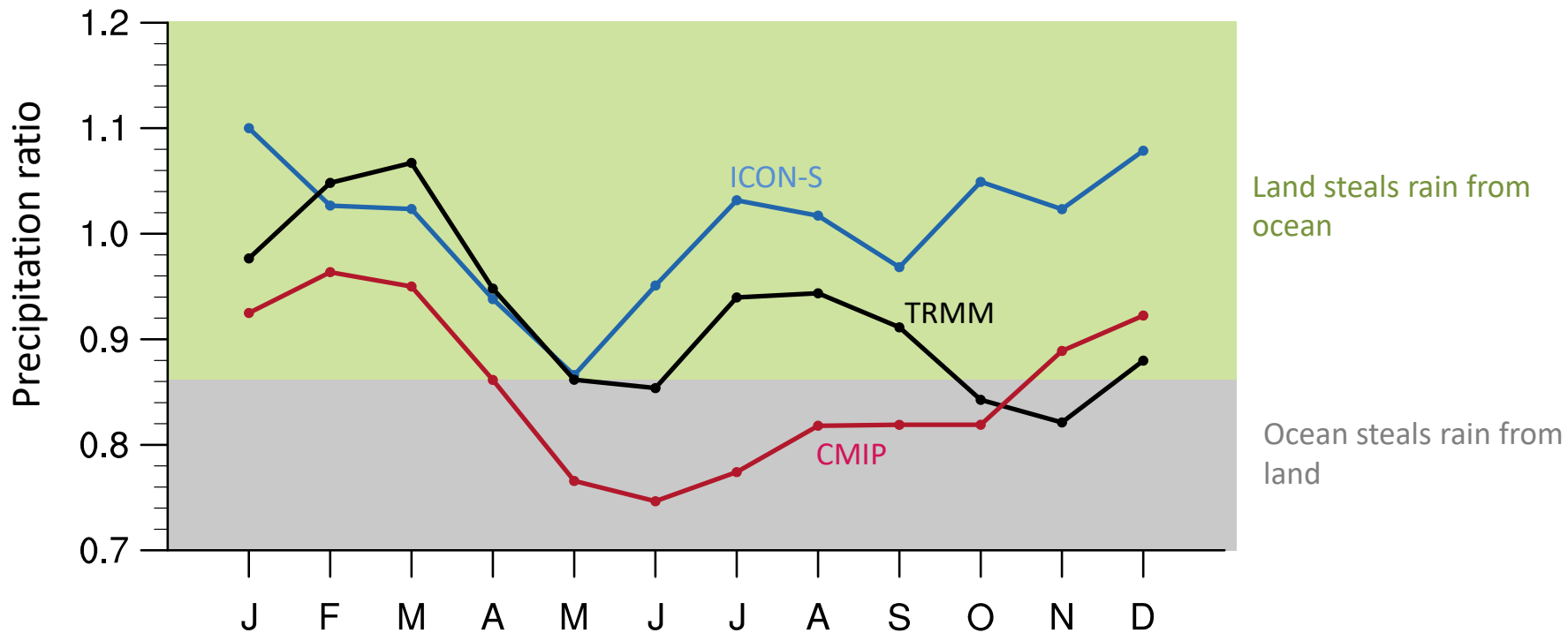
## Precipitation partitioning:



## Precipitation partitioning: ICON-S reproduces the correct surface control...



## Precipitation partitioning: ICON-S reproduces the correct surface control...



## ...for the right reasons?

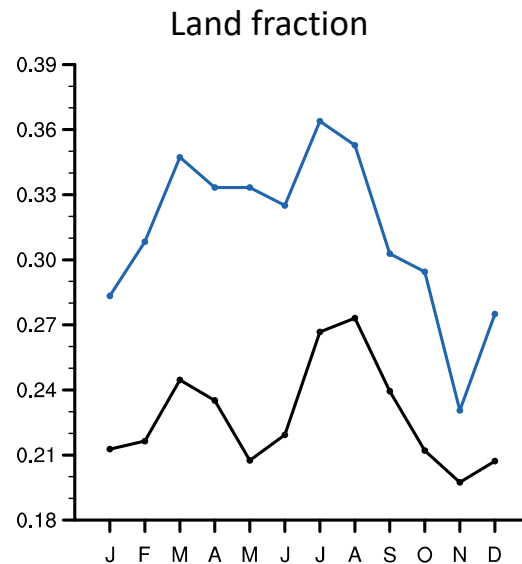
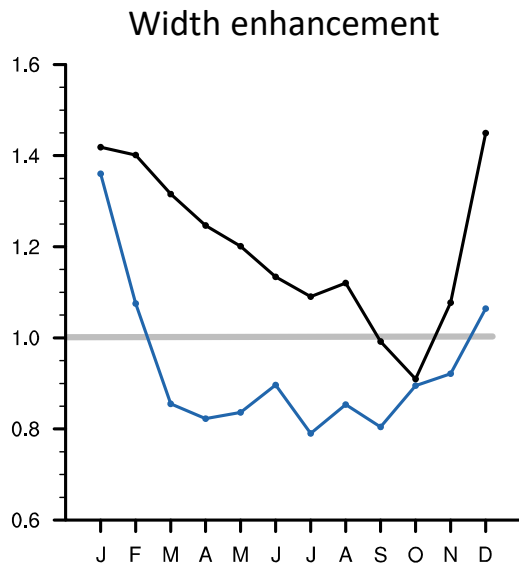
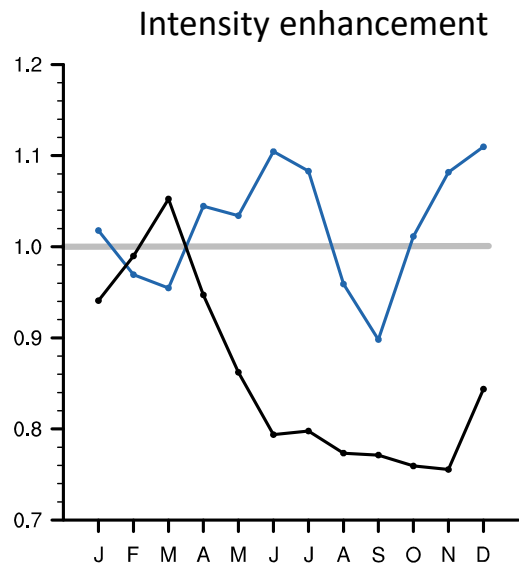
If the rainbelt approximation is valid, then the land may steal precipitation from the ocean by having:

- a more intense rainbelt
- a wider rainbelt
- a rainbelt that propagates further north





# Intensity and width enhancement not so well captured



OBS  
ICON-S

## 2.

How well can ICON-Sapphire reproduce the partitioning of precipitation and its underlying main control?

- Land steals rain from the ocean: correct!
- But land-ocean variations in rainbelt characteristics biased
- Too strong and too peaked maxima over land

# Too peaked and too strong maxima over land

Shifted precipitation distribution

