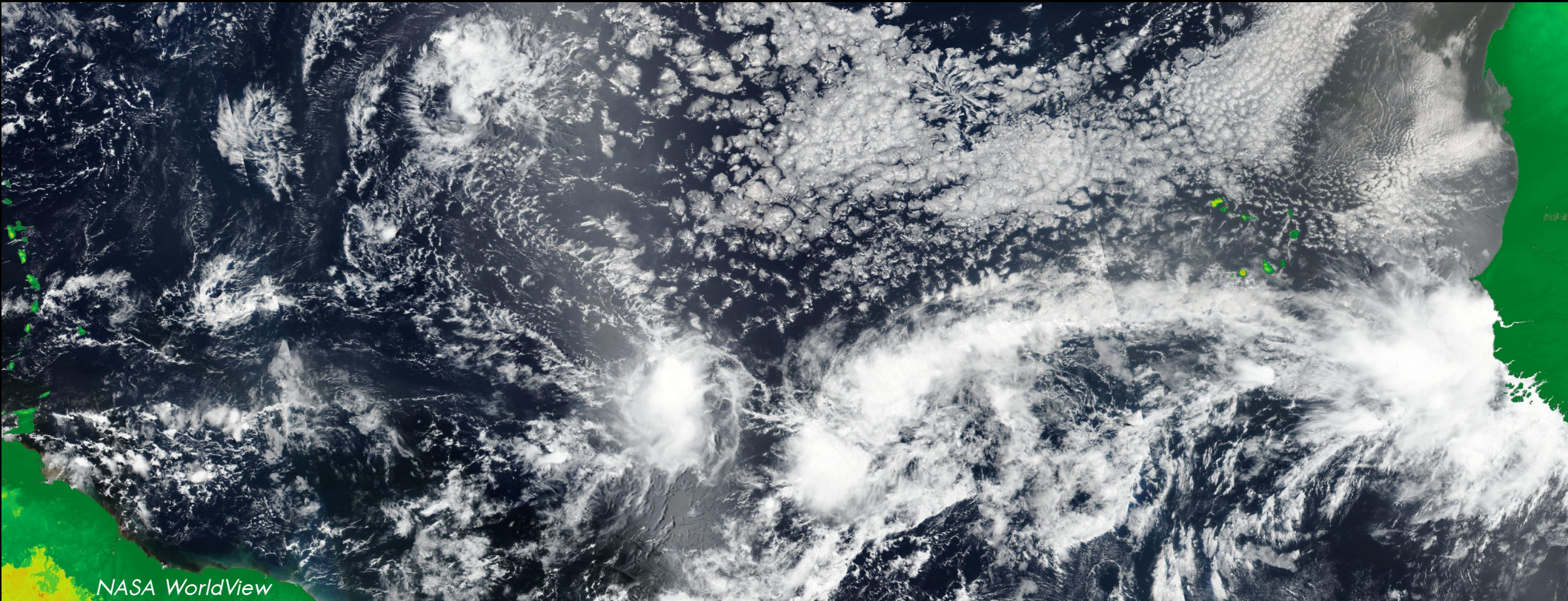
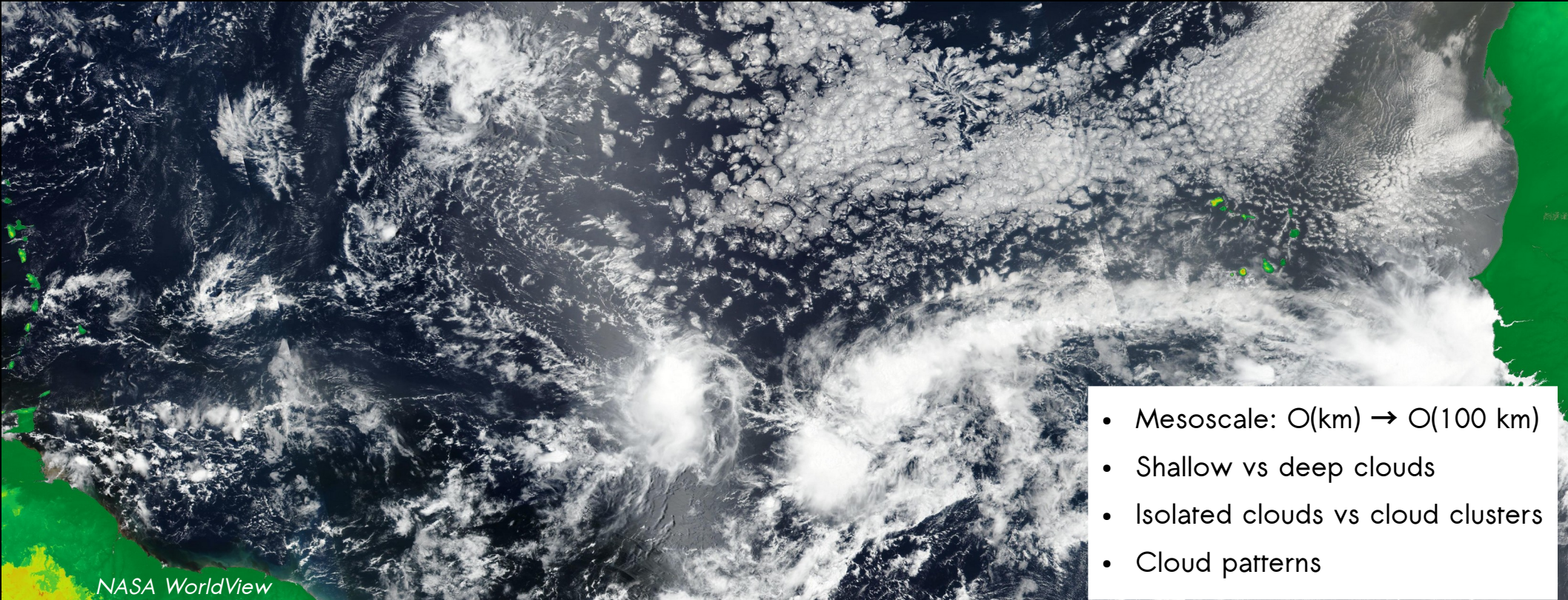


Mesoscale cloud organization: Why should we understand it?

Sandrine Bony (LMD/IPSL, CNRS, Sorbonne University, Paris)



Cloud mesoscale organization: ubiquitous and highly variable

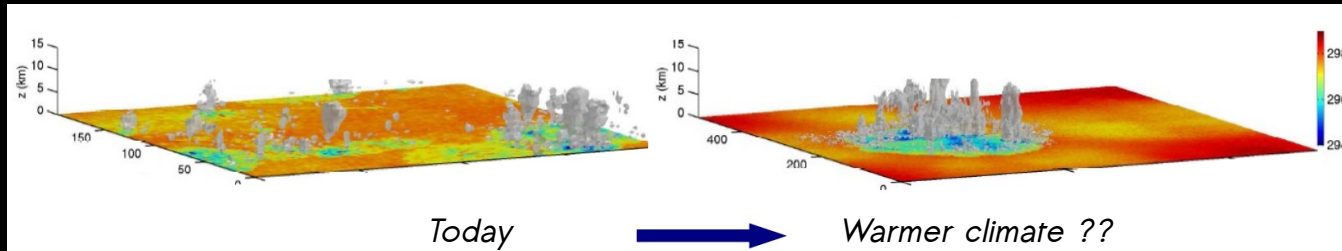
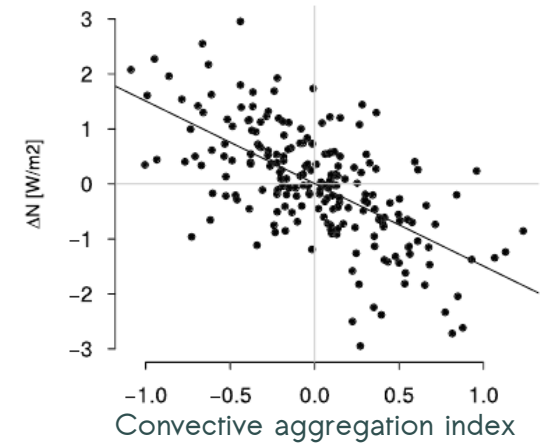


- Mesoscale: $O(\text{km}) \rightarrow O(100 \text{ km})$
- Shallow vs deep clouds
- Isolated clouds vs cloud clusters
- Cloud patterns

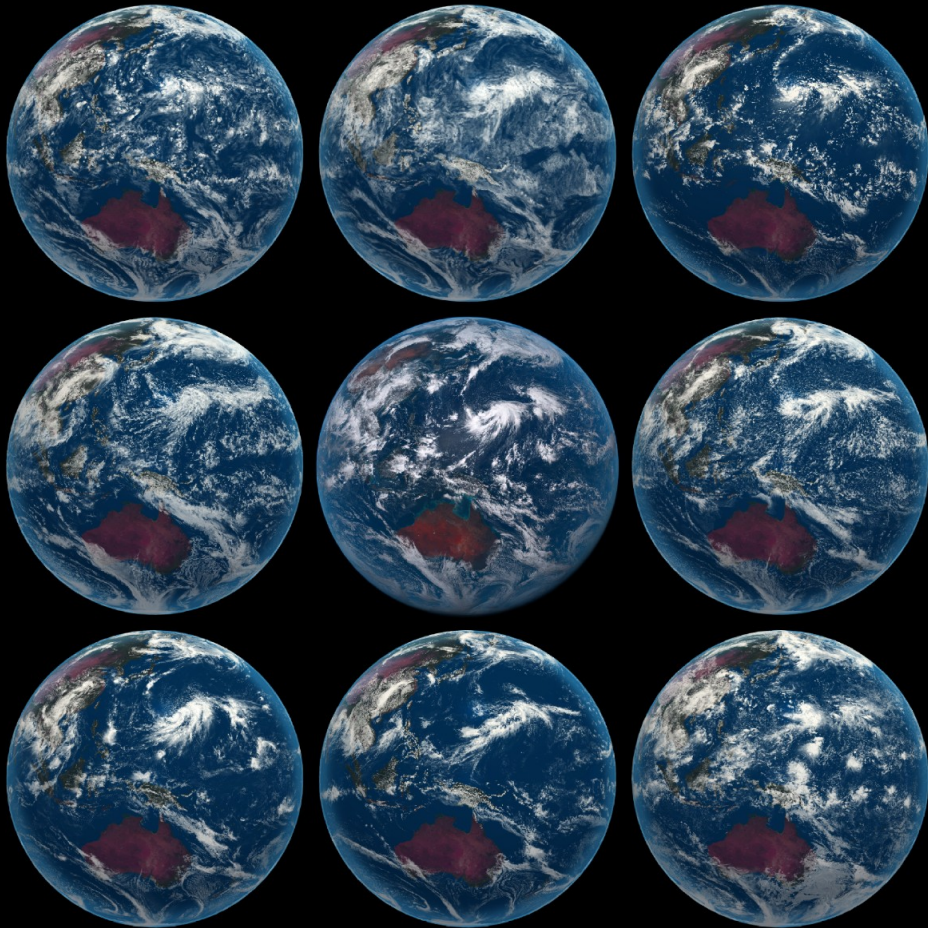
Cloud mesoscale organization: does it matter?

- Modulation of the Earth's radiation budget
(e.g. Bony et al. 2020a, b)
- Precipitation extremes
(e.g. Pendergrass et al. 2016, Bao et al. 2017, Semie and Bony 2020)
- Role in climate change at global and regional scales?

Tropical mean radiation budget (CERES)

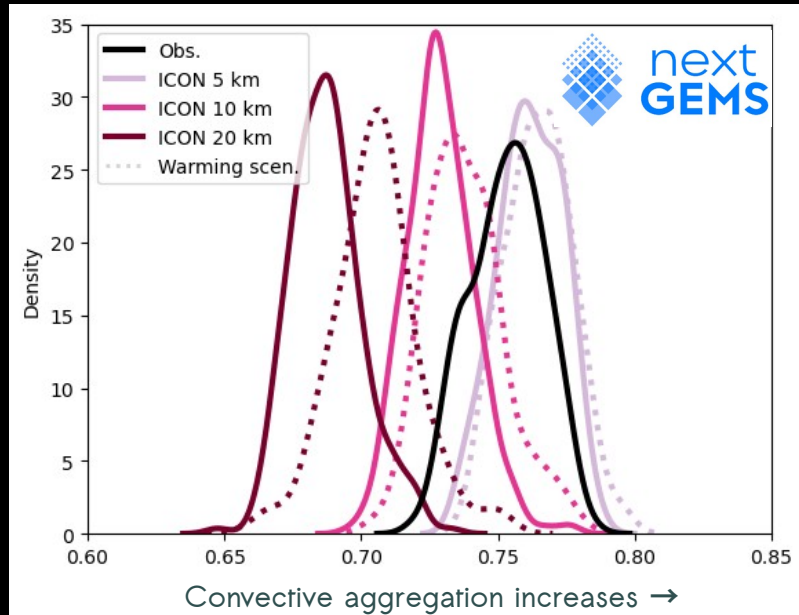
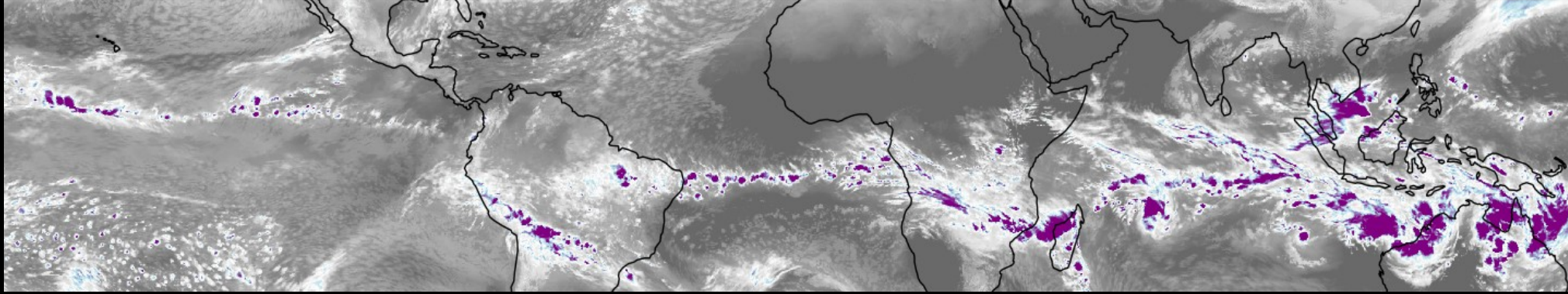


A new generation of km-scale climate models



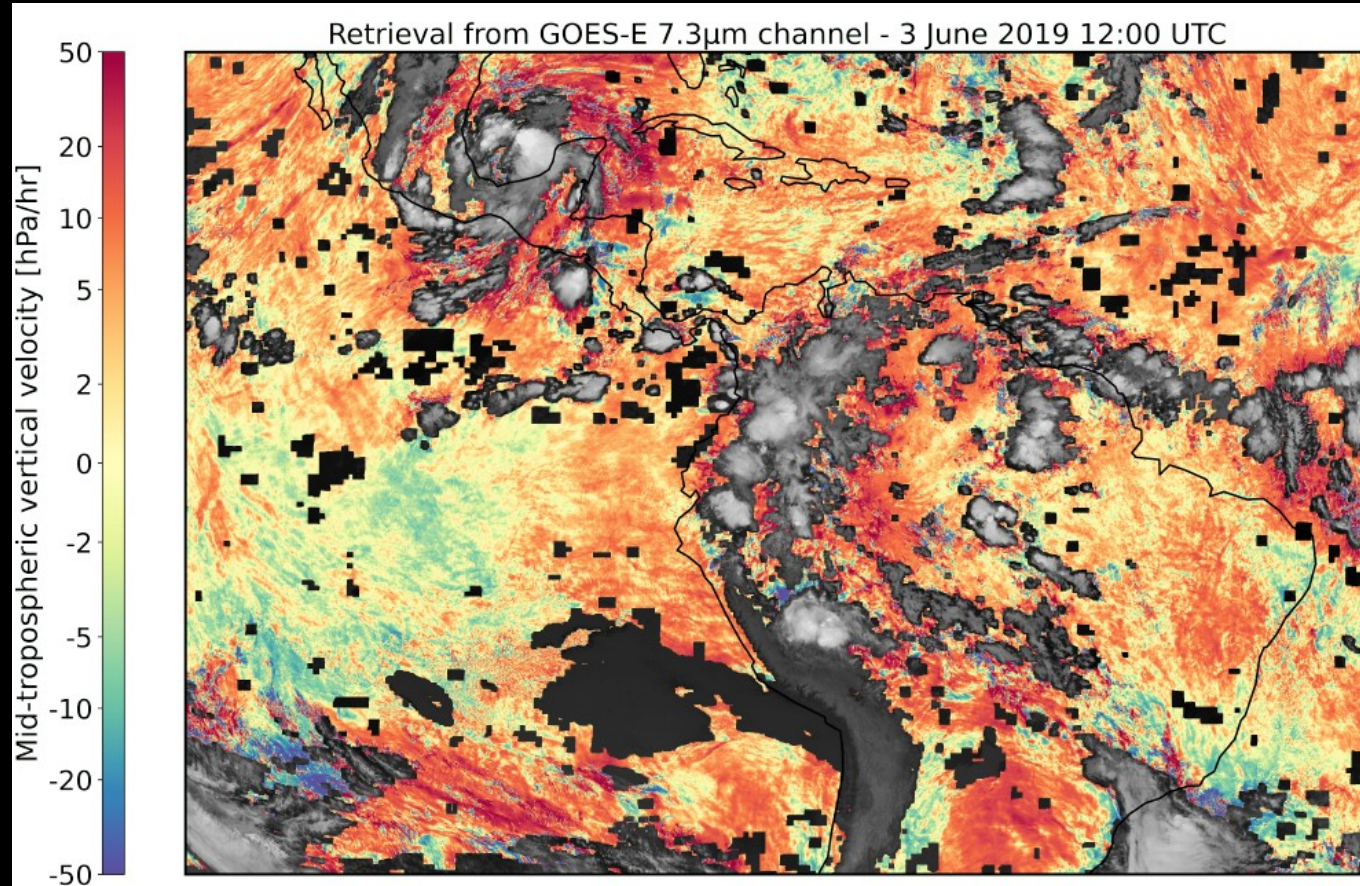
- Global km-scale resolution
- Mesoscale organization of clouds and convection
- How realistic is it?

Convective organization predicted by global km-scale climate models



- Response of cloud clustering to global warming depends on model and resolution
- Physical processes?
 - Observations needed to test insights from modelling studies and theories

First measurements of clear air vertical velocities from space



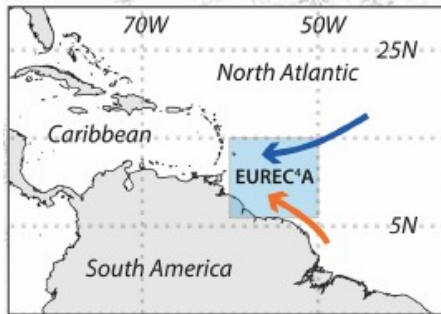
- km-scale, hourly
- reveals a rich dynamics in the clear-sky atmosphere!

e.g.: clear-sky vertical motions in the mid-troposphere are much more heterogeneous than previously thought

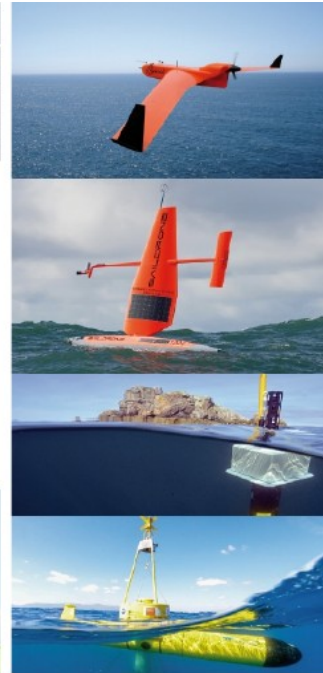
EUREC⁴A field campaign

(Elucidating the role of couplings between clouds, convection and climate)

Barbados, Jan-Feb 2020



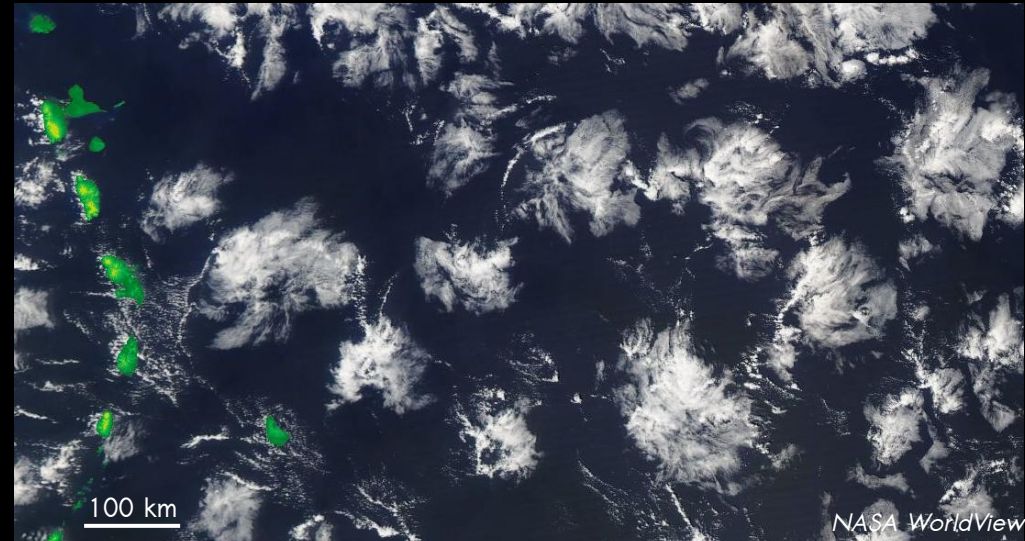
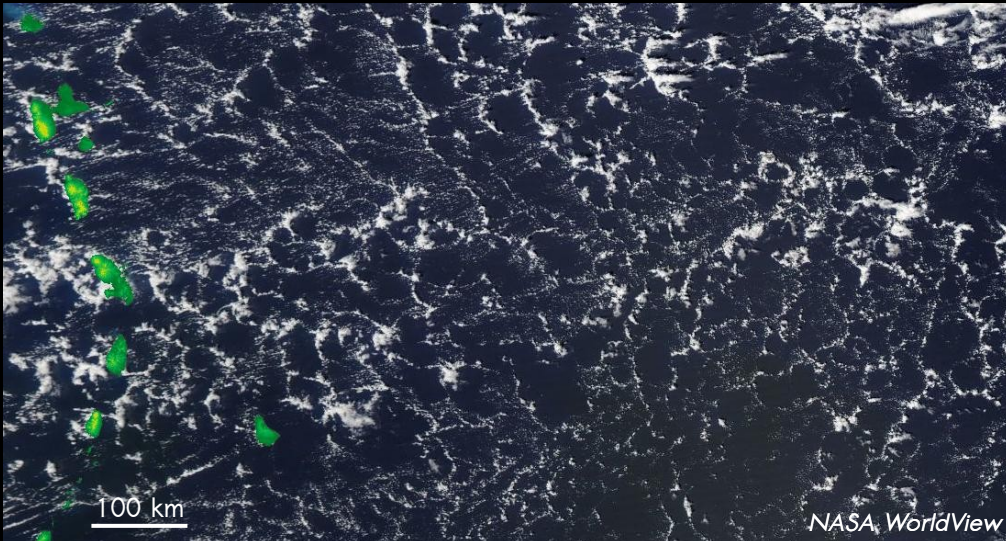
- Cloud feedbacks
- OA interactions
- Mesoscale organization



EUREC⁴A field campaign

(Elucidating the role of couplings between clouds, convection and climate)

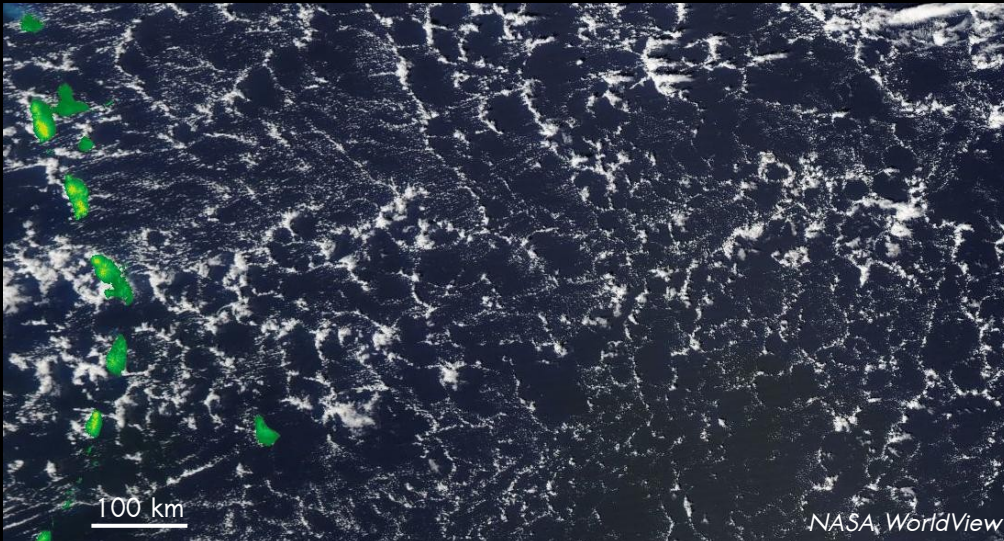
Barbados, Jan-Feb 2020



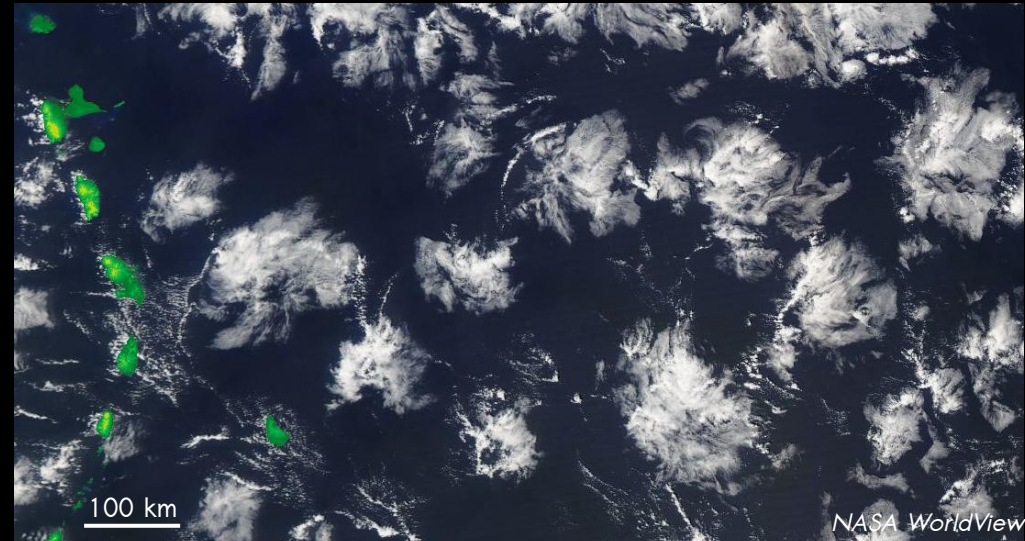
EUREC⁴A field campaign

(Elucidating the role of couplings between clouds, convection and climate)

Barbados, Jan-Feb 2020

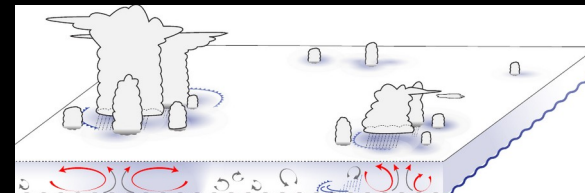


Weak thermal merging



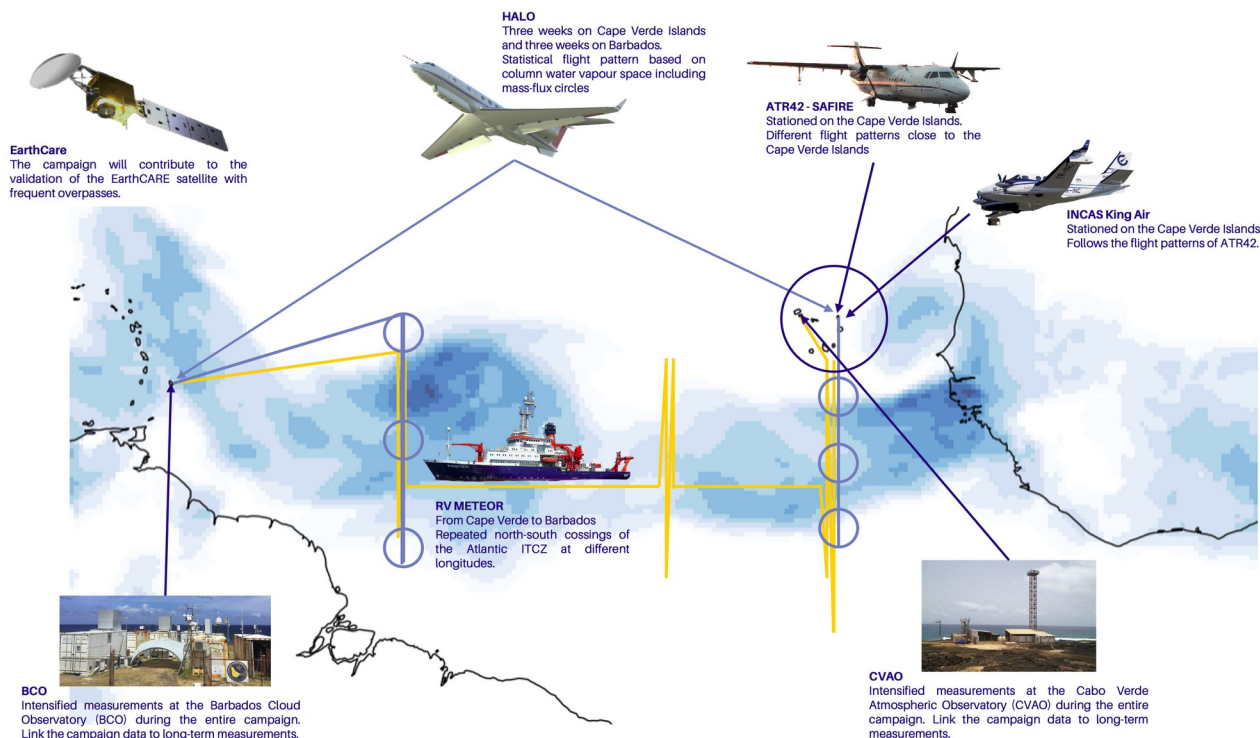
Strong thermal merging

→ Observational evidence for the role of thermal merging in the control of cloud mesoscale organization



Bony et al. (in prep)

MAESTRO (Mesoscale organisation of tropical convection) field campaign part of ORCESTRA field campaign (tropical Atlantic, Aug-Sep 2024)



EarthCare
The campaign will contribute to the validation of the EarthCare satellite with frequent overpasses.

HALO
Three weeks on Cape Verde Islands and three weeks on Barbados. Statistical flight pattern based on column water vapour space including mass-flux circles

ATR42 - SAFIRE
Stationed on the Cape Verde Islands. Different flight patterns close to the Cape Verde Islands

INCAS King Air
Stationed on the Cape Verde Islands. Follows the flight patterns of ATR42.

RV METER
From Cape Verde to Barbados. Repeated north-south crossings of the Atlantic ITCZ at different longitudes.



BCO
Intensified measurements at the Barbados Cloud Observatory (BCO) during the entire campaign. Link the campaign data to long-term measurements.



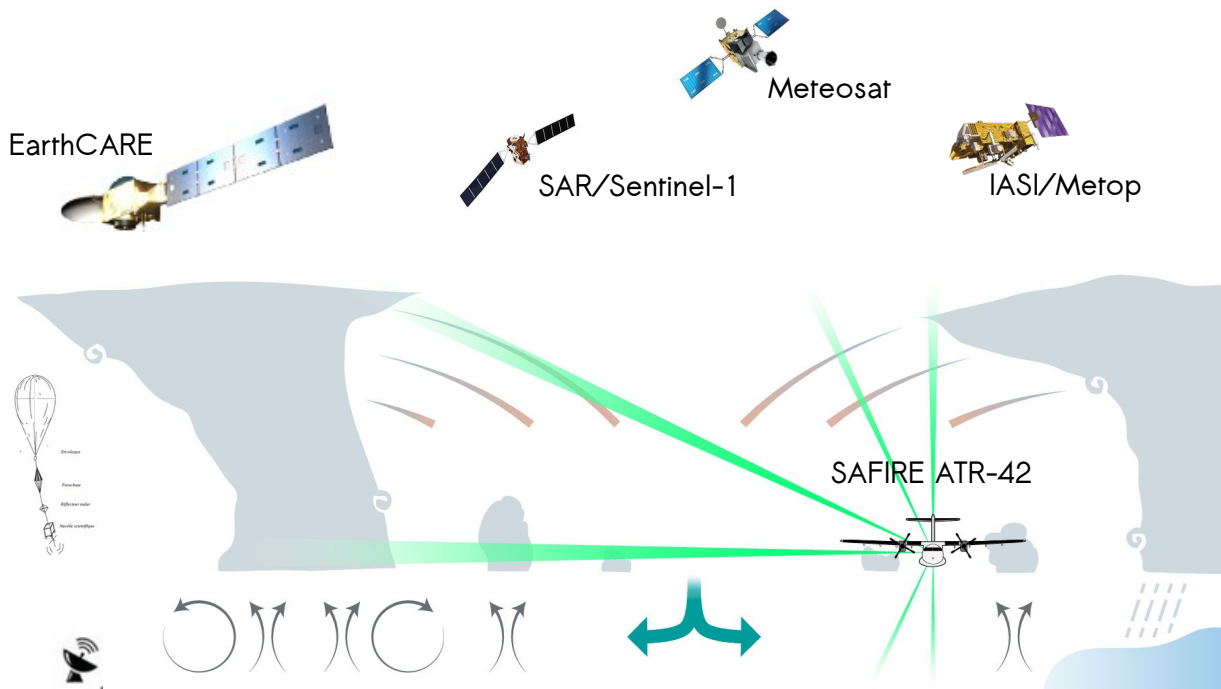
CVAO
Intensified measurements at the Cabo Verde Atmospheric Observatory (CVAO) during the entire campaign. Link the campaign data to long-term measurements.

Stevens et al. (in prep)

<https://orcesta-campaign.org>

MAESTRO (Mesoscale organisation of tropical convection) field campaign

Cape Verde, Aug-Sep 2024



- To unravel the physical processes that control the mesoscale convective organization
- To evaluate EarthCARE, interpret SAR and evaluate the new generation of weather and climate models
- To connect the scales and understand the role of the mesoscale in climate

10 French INSU labs involved
Bony et al. (in prep)
<https://maestro.aeris-data.fr>

Conclusion

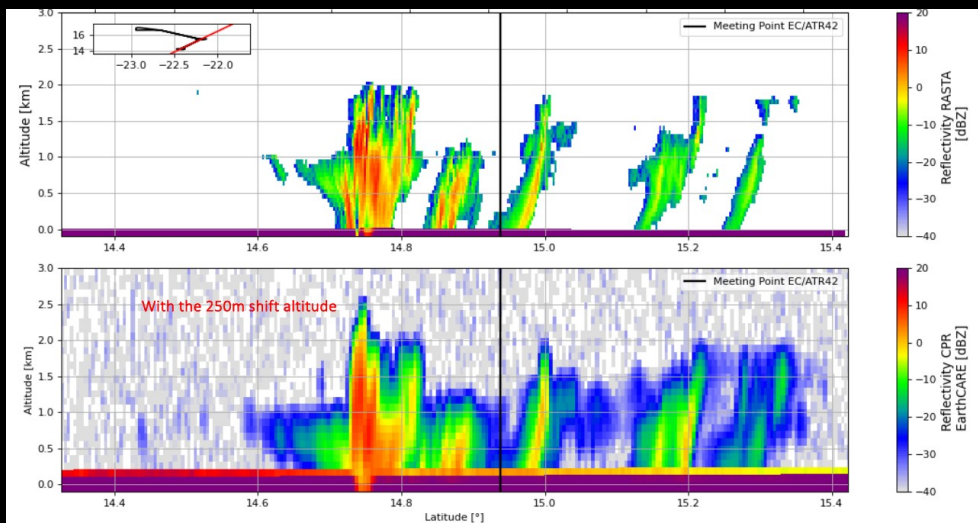
- Observing, simulating and understanding the role of the mesoscale in weather and climate pushes the frontiers of science
- We are finally connecting the scales!
Strong synergies between field campaigns, satellite observations and mesoscale models, from the km scale to the global scale
- Several WCRP activities connected to this topic (GEWEX/GASS, Digital Earth, CLIVAR, WGNE...)
The EUREC⁴A and ORCESTRA/MAESTRO field campaigns contribute to many of these activities

Thank you



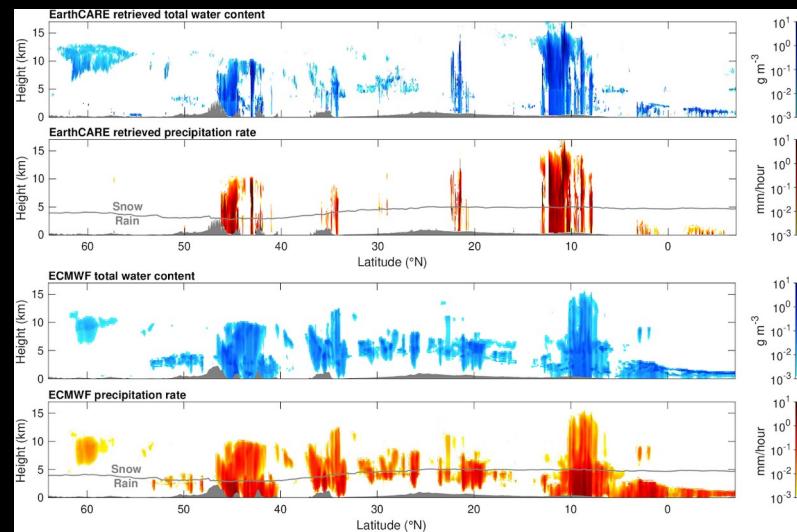
Strong synergy between field campaigns, satellites and mesoscale models

Airborne vs satellite radars (MAESTRO RASTA, EarthCARE CPR)

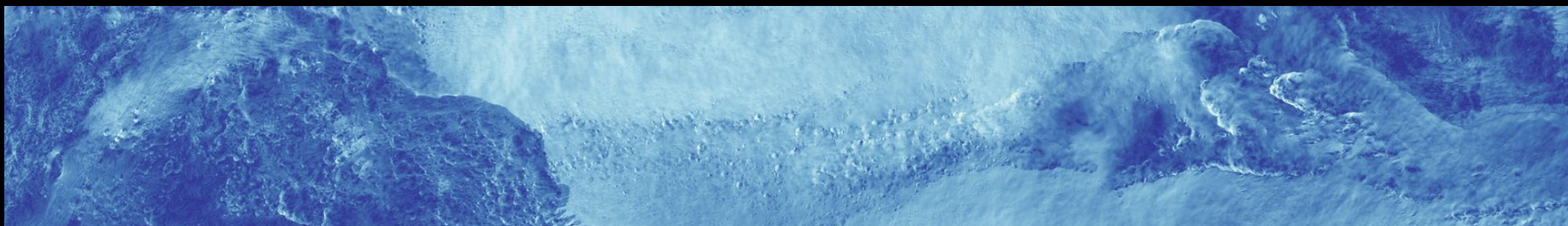


Julien Delanoë (LATMOS)

ECO-MIP (EarthCARE - GSRMs comparison)



<https://www.earthcarescience.net/science/model-evaluation>



EarthCARE

