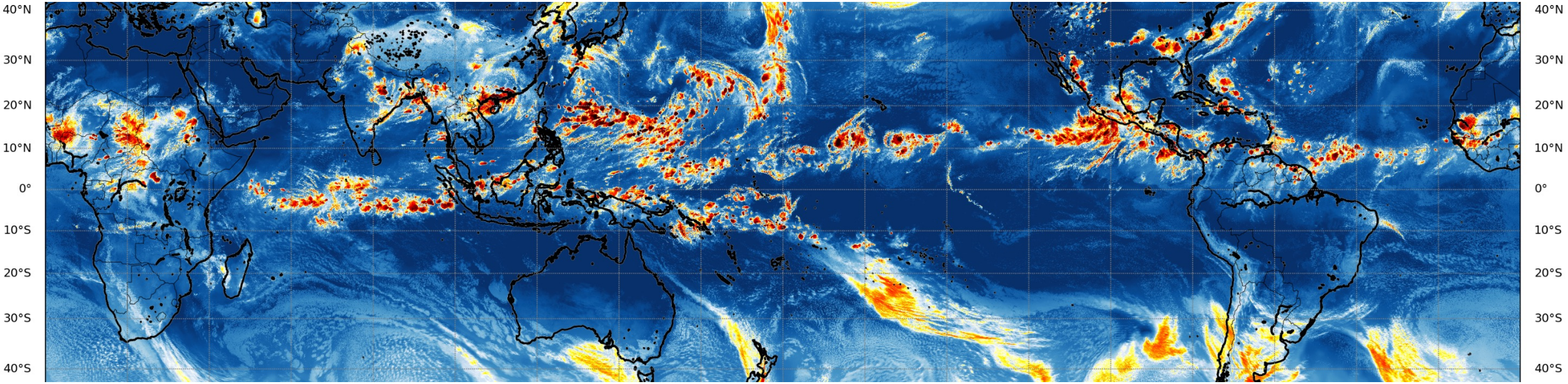
Towards an object-oriented evaluation of global convection permitting model simulations using satellite observations

Focus on Mesoscale Convective Systems in the Tropics



R.Roca and T. Fiolleau

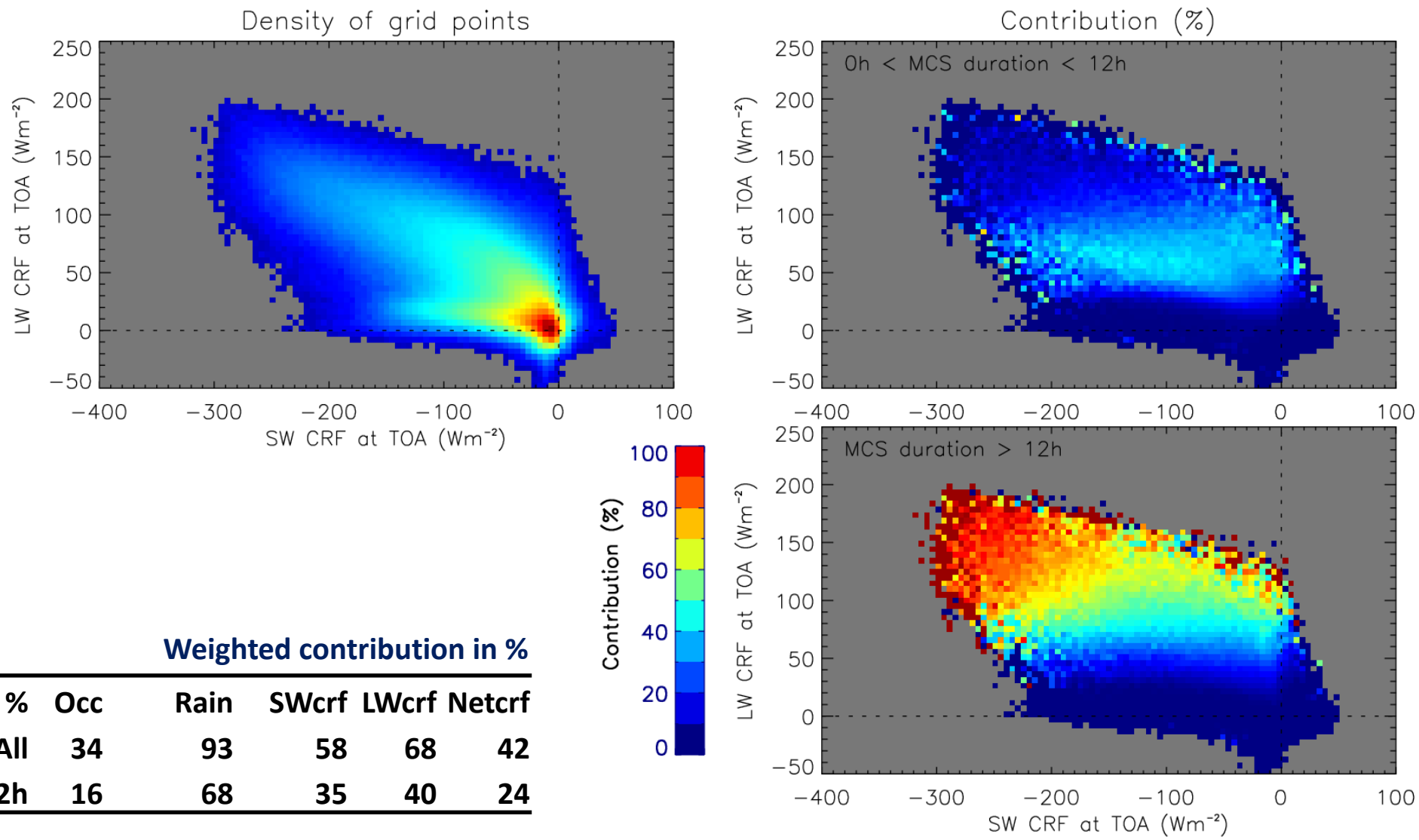
LEGOS/CNRS

Toulouse, France

with contributions from: S.Abramian, D. Bouniol, C. Müller, C. Risi, J.P. Chaboureau,

Importance of long lasting systems to the distribution of CRF

JJAS 2009 / 30°s-30°n / 1°-1day/ SYN products + « Most representative MCS of the day » product



Weighted contribution in %

%	Occ	Rain	SWcrf	LWcrf	Netcrf
All	34	93	58	68	42
>12h	16	68	35	40	24

Outline of the presentation

1. Introduction
2. **MCS tracking on high resolution model outputs**
3. First results of the evaluation of SAM DYAMOND summer simulations
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4. Next steps

MCS tracking

A global 2012-2020 MCS database from IR

https://toocan.ipsl.fr/

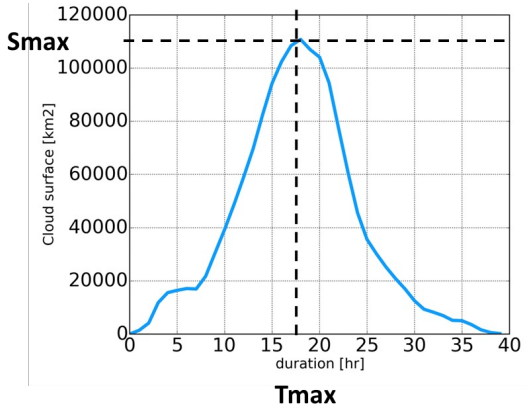
TOOCAN database

1- integrated morphological parameters of each MCS

- Lifetime duration [h]
- Smax [km²]
- Tbmin [K]
- Time/localization of initiation/dissipation
- Propagated distance [km]
- …

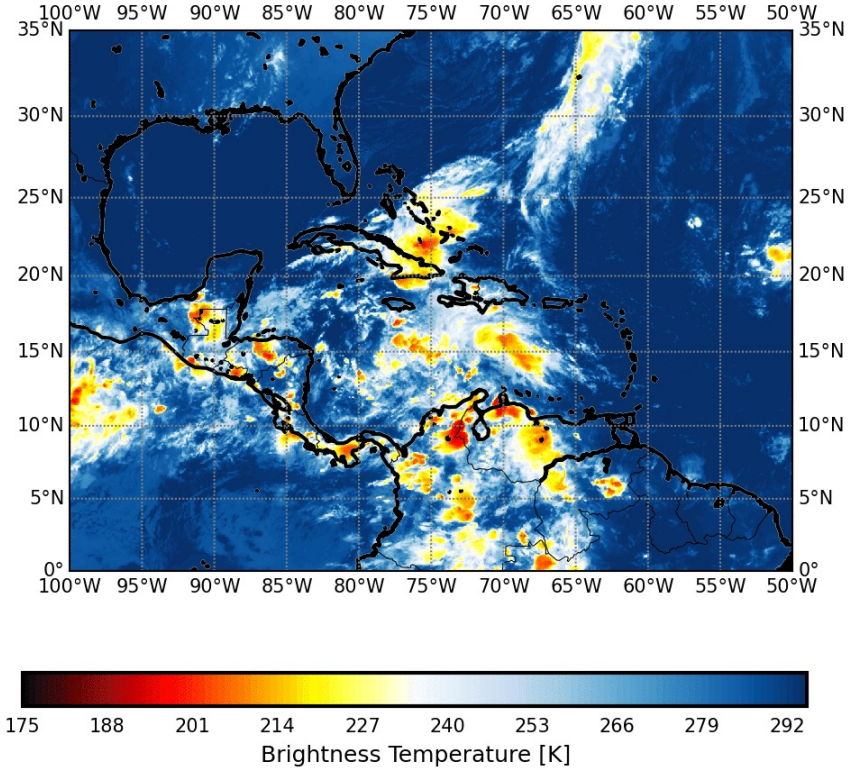
2- morphological parameters along the life cycle of each MCS

- cold cloud surfaces at various Tb threshold [km²]
- Tbmin [k]
- …

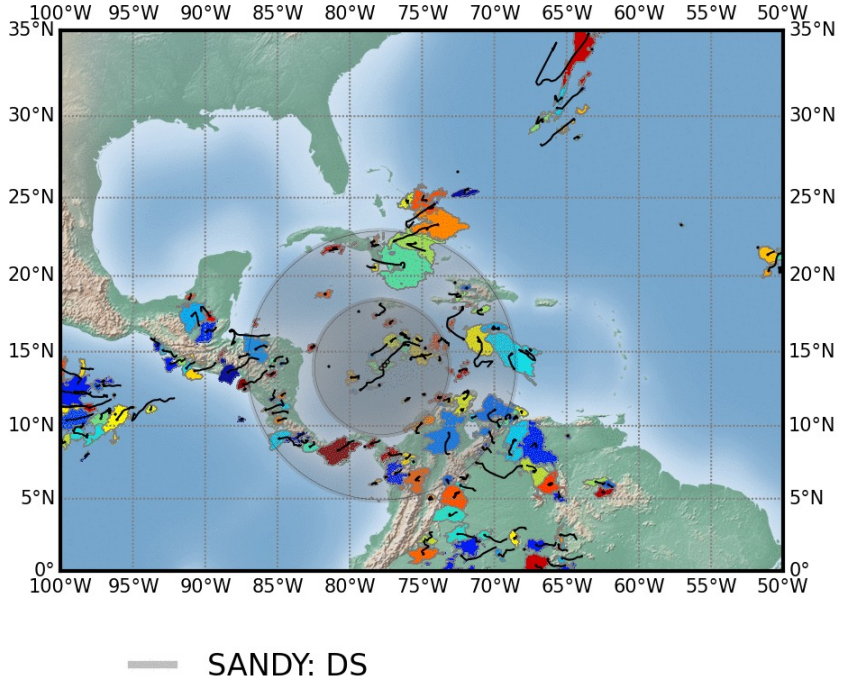


+ cyclone classification from IBTRACS

2012-10-22T00-15

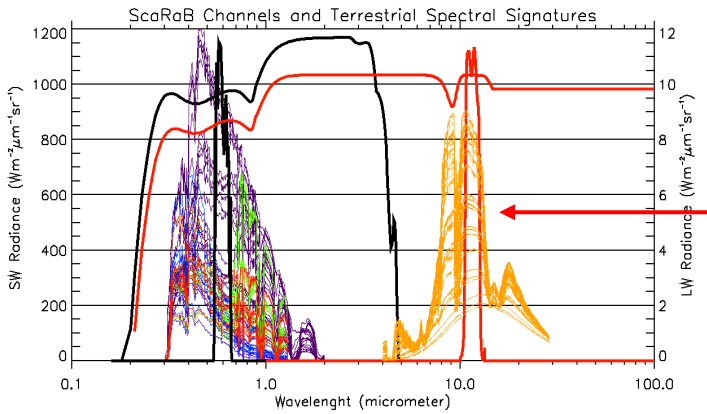


TOOCAN MCS



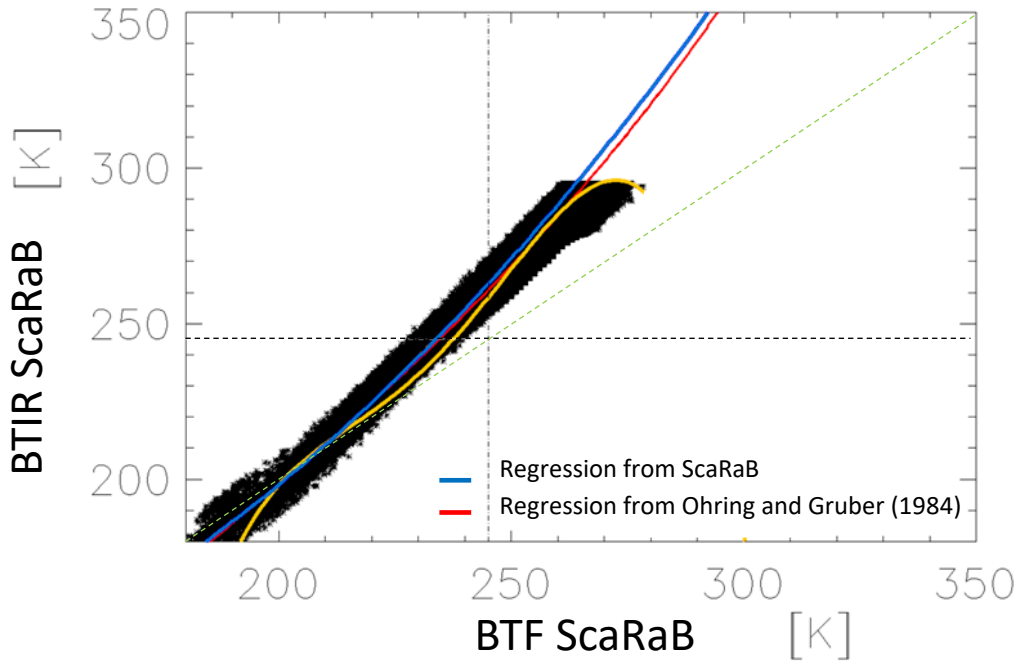
From model OLR to BT

DYAMOND SAM simulations reports OLR -> need BT thermal IR for TOOCAN application and comparison to OBS



Use of LW flux estimate from SCARAB
Use of IR flux estimate from SCARAB ancillary channel 4

$$BTF_{ScaRaB} = \sqrt[4]{\frac{LWflux_{ScaRaB}}{\sigma}}$$



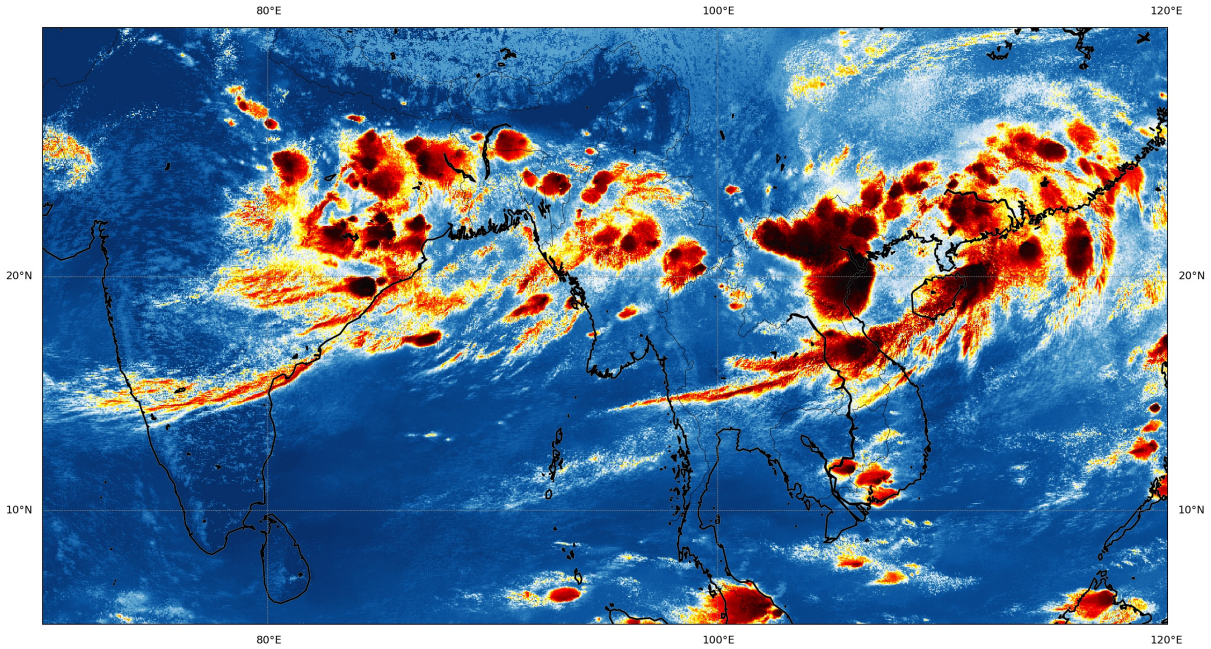
Broad band to narrow band conversion

$$BTIR = 0.004 \times BTF_{ScaRaB}^2 - 0.543 \times BTF_{ScaRaB} + 129.544$$

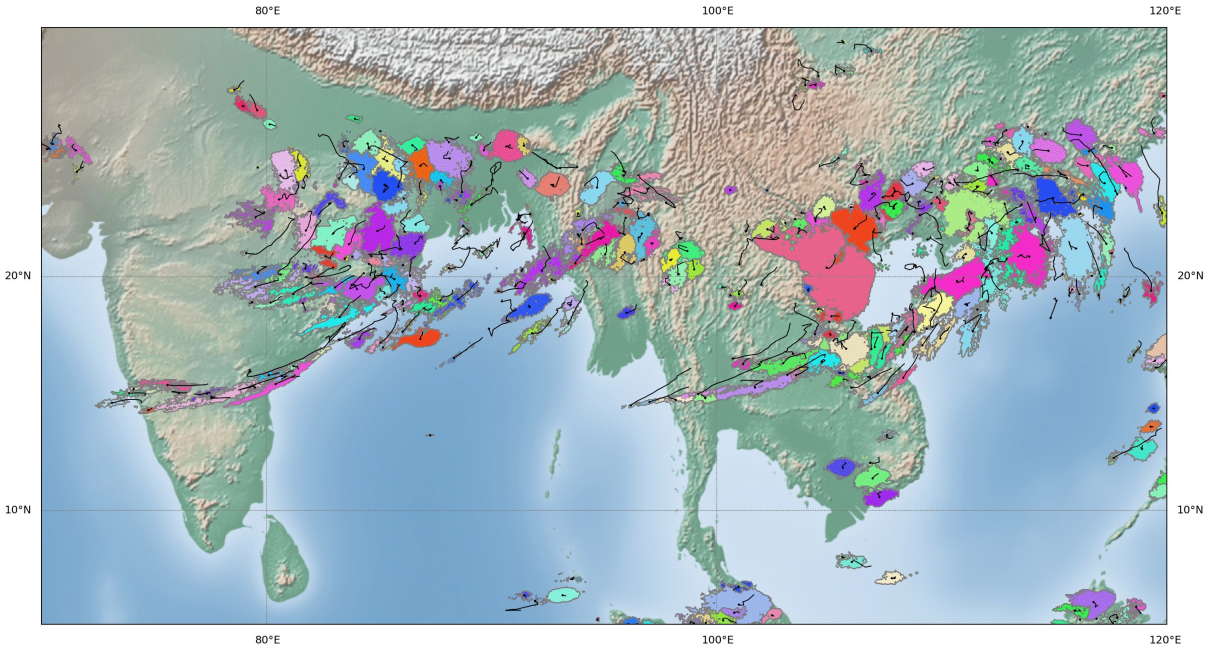
➔ Application of TOOCAN on the BTIR estimated from OLR
➔ Ideally in the futur, make use of satellite simulator on-line to remove this step

TOOCAN on SAM simulation of DYAMOND summer

SAM-4km / TOA net longwave [W/m2]



TOOCAN MCS - 2016-08-15 12:00



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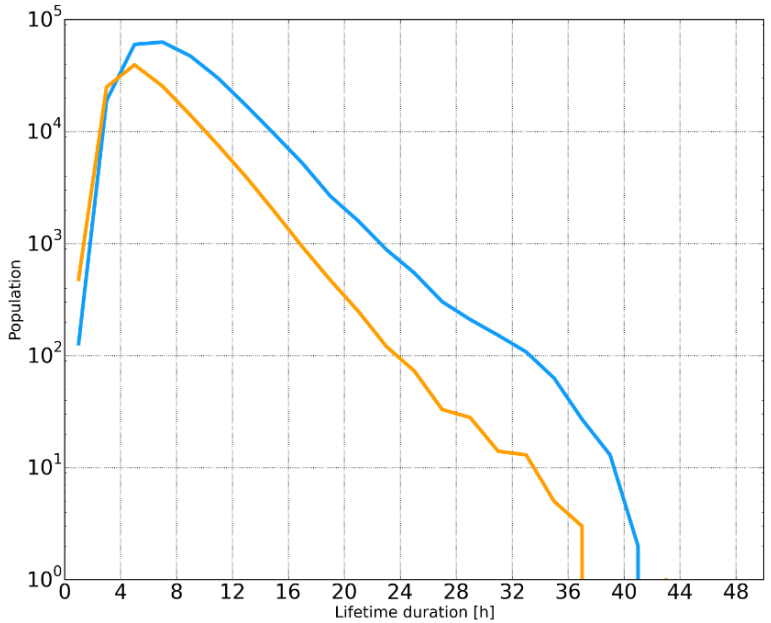
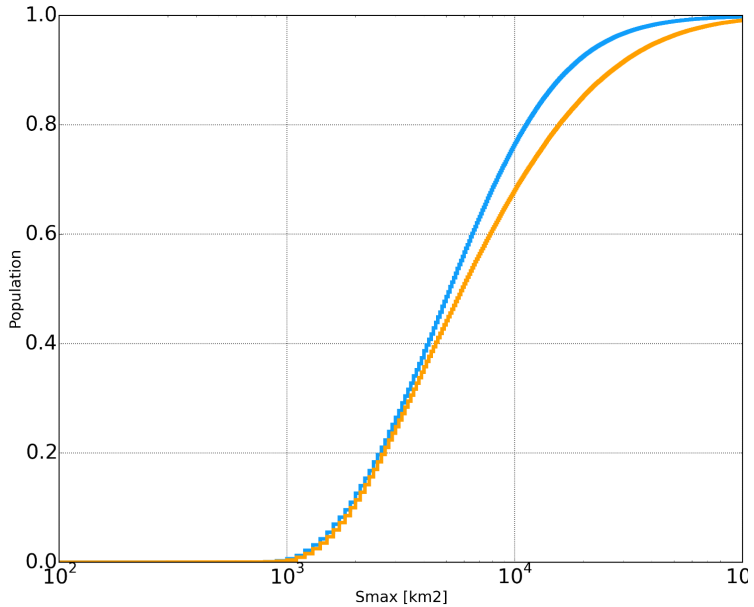
General features

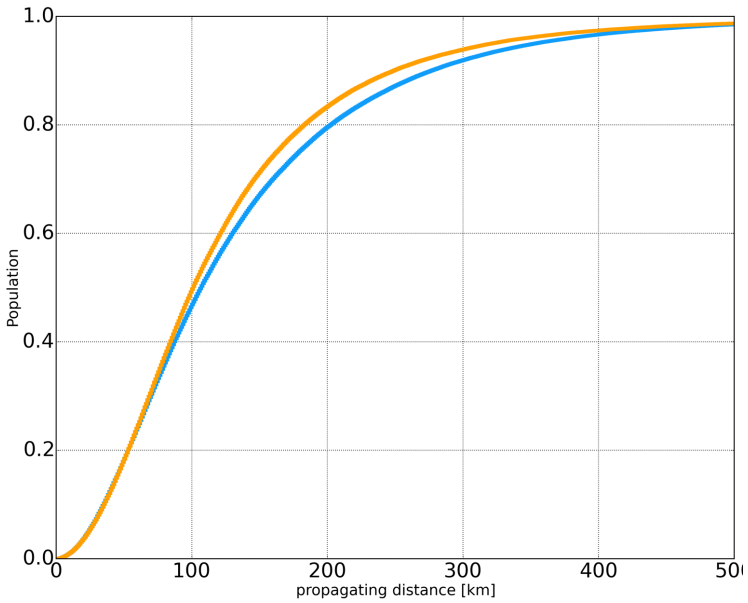
Tropical ocean + land



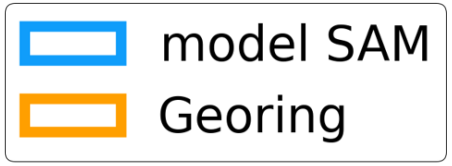
Duration (h)



Max Size (km^2)



Propagating distance (h)



Realistic distribution of Lifetime duration
More occurrence than observed.

Simulated MCS have a smaller Smax

Propagate slightly farther than observed

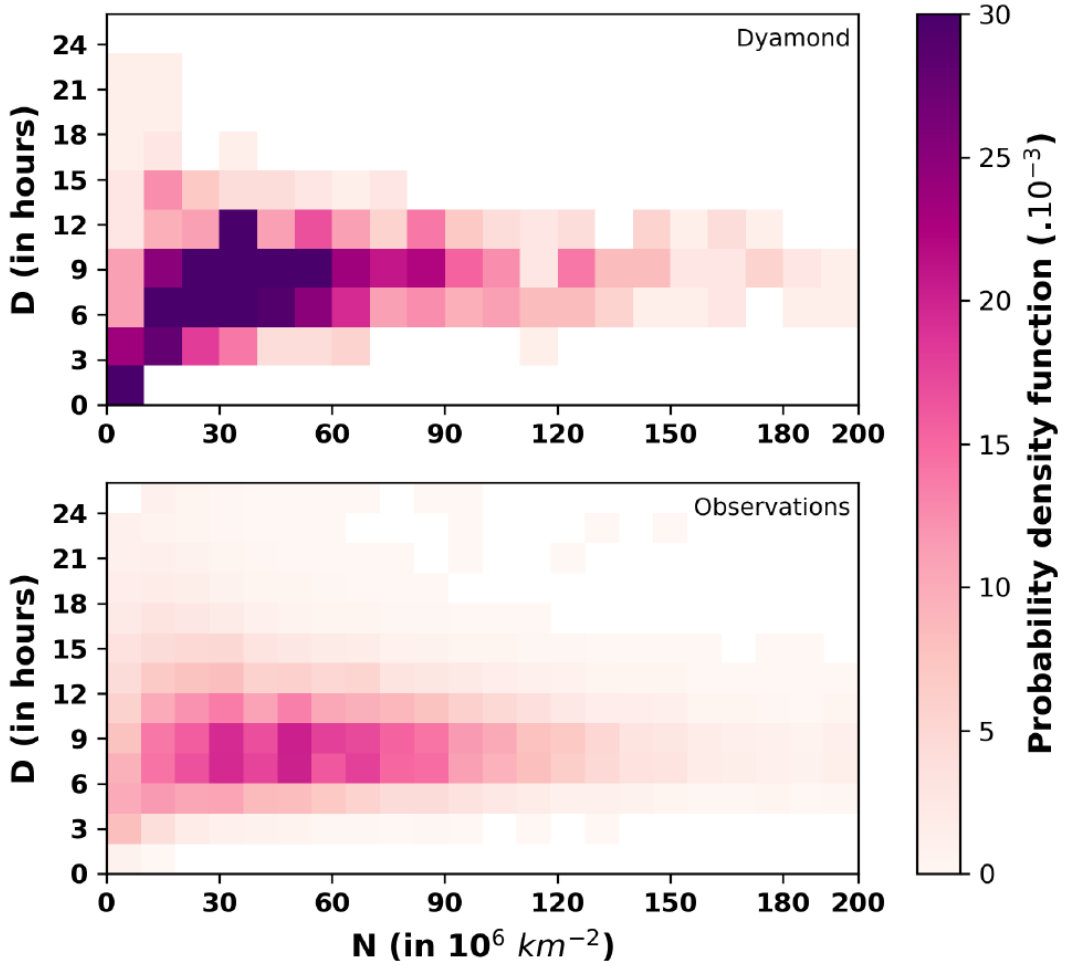
Agregation and MCS characteristics

Contribution from C. Risi and A. Iraqi LMD/Paris

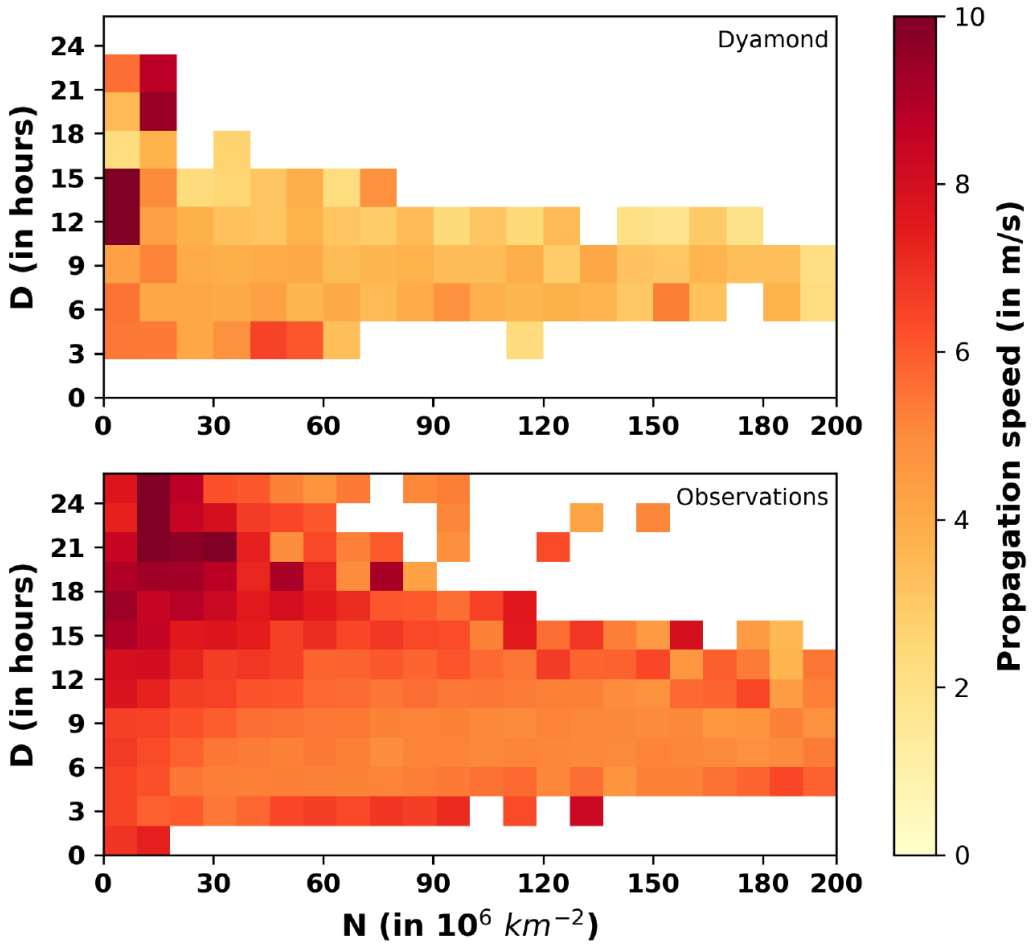
Tropical ocean only

N : number of systems in 4°x4° boxes
with domain mean precip **~5 mm/day**

Occurence



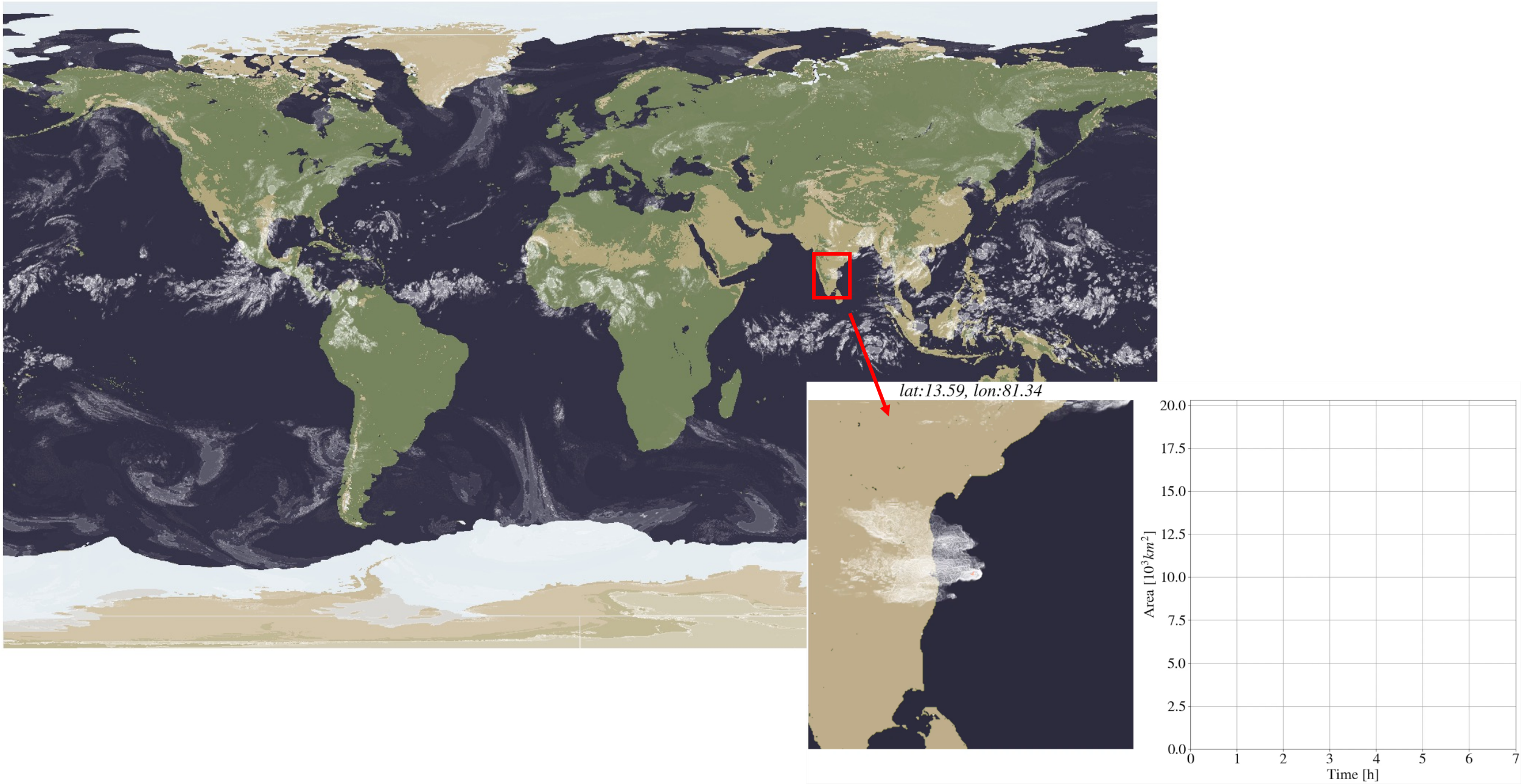
Propagation speed



19/08/2016 to 09/09/2016

Environment and duration

Contribution from S. Abramian LMD/Paris C Muller IST Vienna



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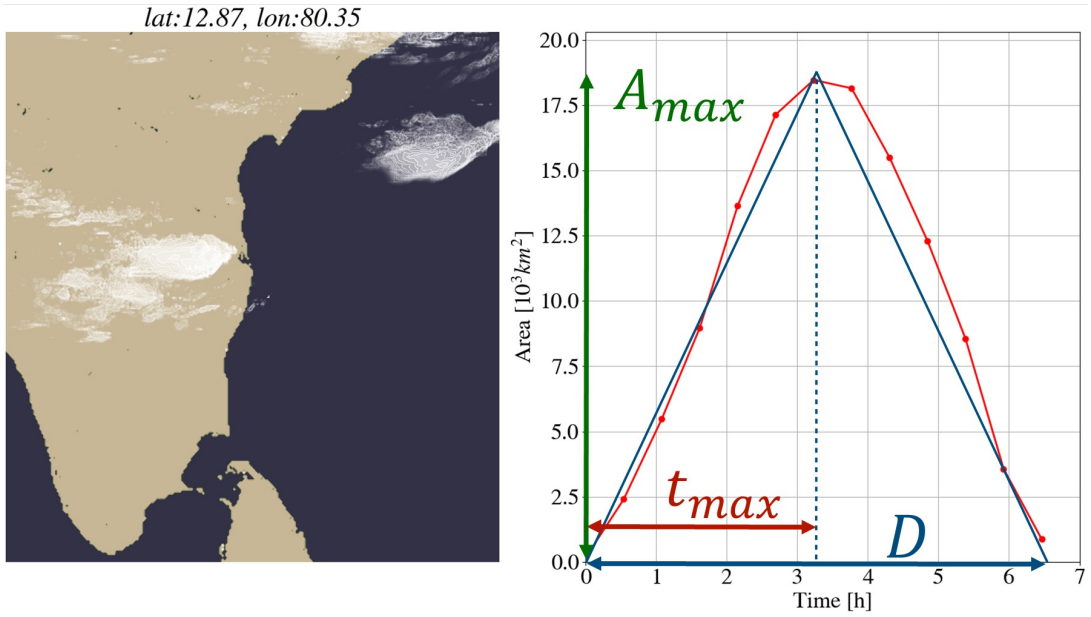


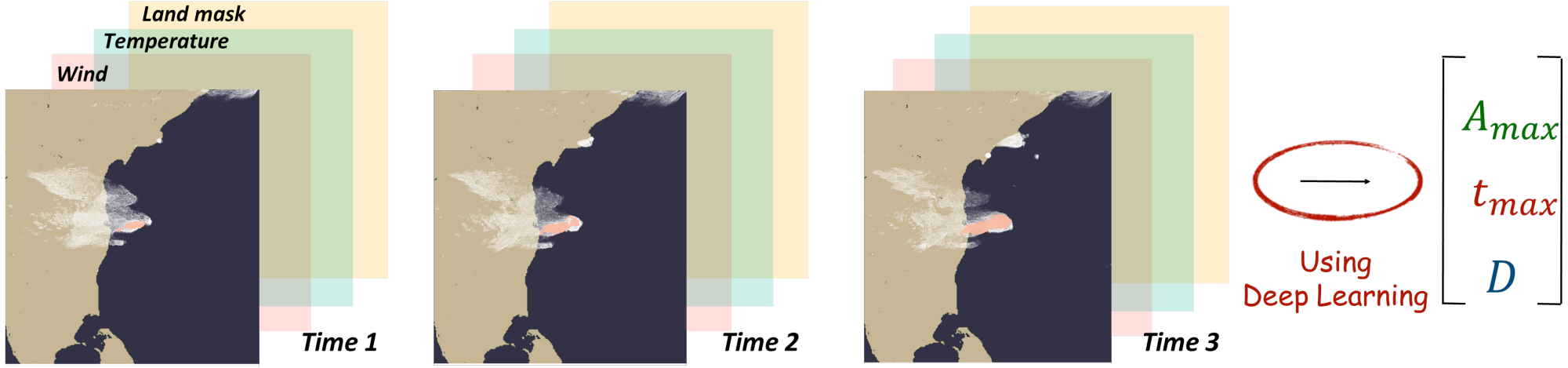
A linear growth-decay model of cloud system shield (Roca et al., 2017)

A_{max} Maximal Extension

t_{max} Duration of Growth

D Total Duration

What controls these 3 parameters and why ?



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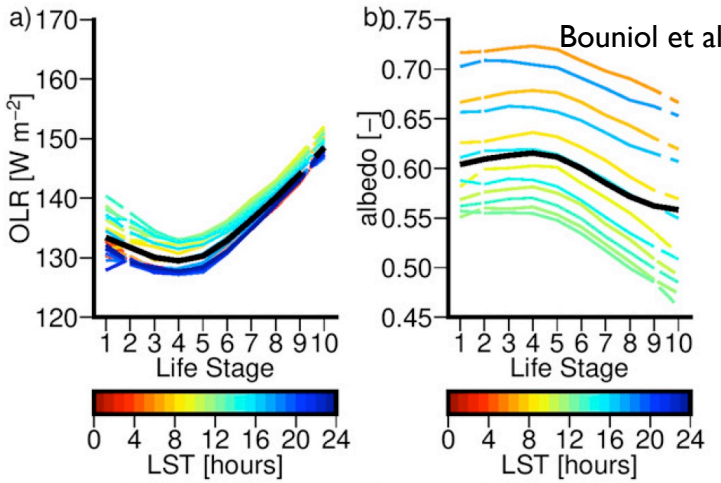
Next: using combined LEO+GEO for model evaluation

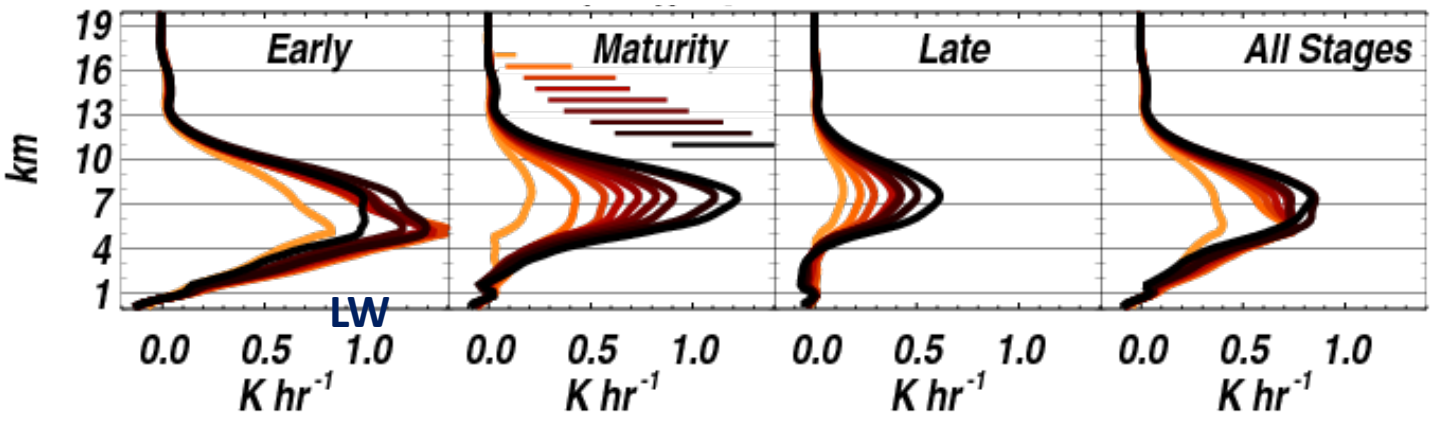
TOA radiation (SCARAB on MT)



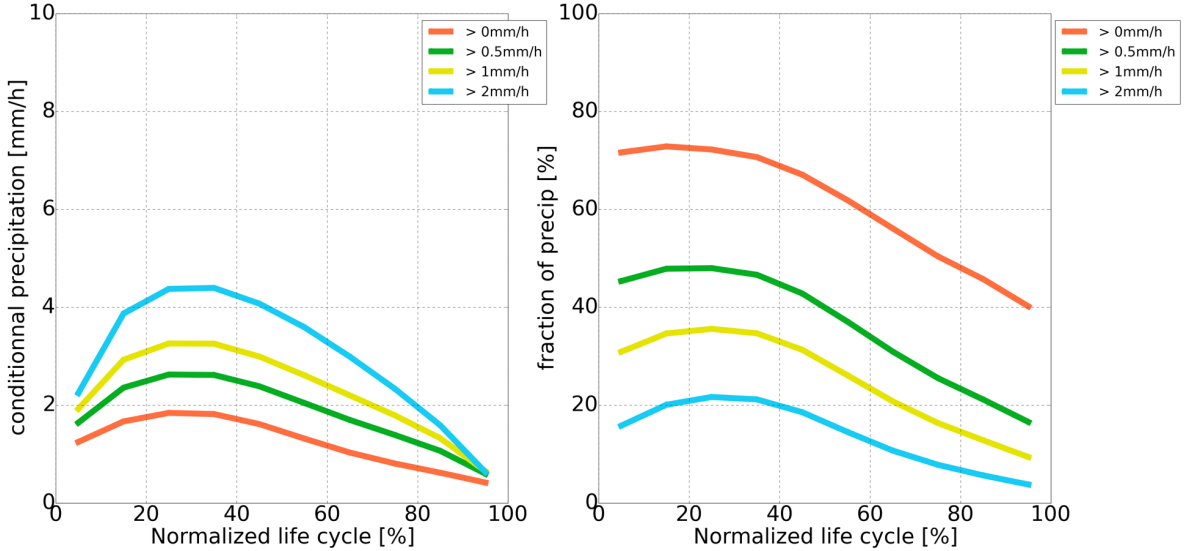
Bouniol et al, 2021

Latent heat (DPR on GPM)

Elsaesser et al., 2022

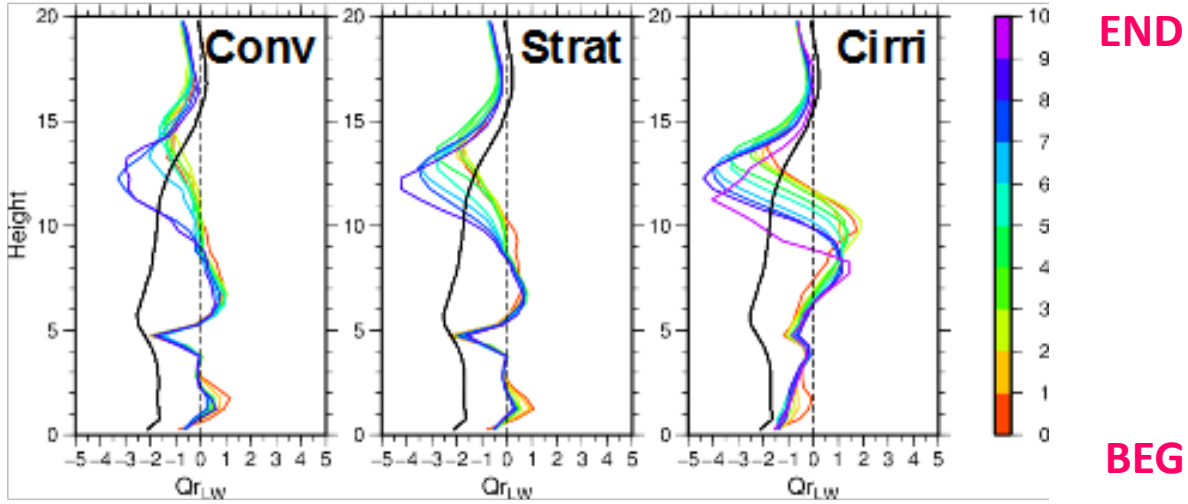


Precip (SAPHIR on MT)



Updated from Fiolleau and Roca, 2013

Radiative cooling (A-TRAIN synergy)



Roca et al., 2020

Conclusions and outlook

A lot of expectations from these gCPM simulations: dynamics !

Object-oriented evaluation and analyse is under way
Preliminary results are encouraging !

A small group of french scientists are working on these simulations to explore agregation and the relationship to the environment amongst other things

More to the evaluation using LEO observations

More models ? New simulations ? Climate change simulations ?
Towards a release of the tracking outputs ?