Tropical Cyclones in the IPSL HighResMIP simulations

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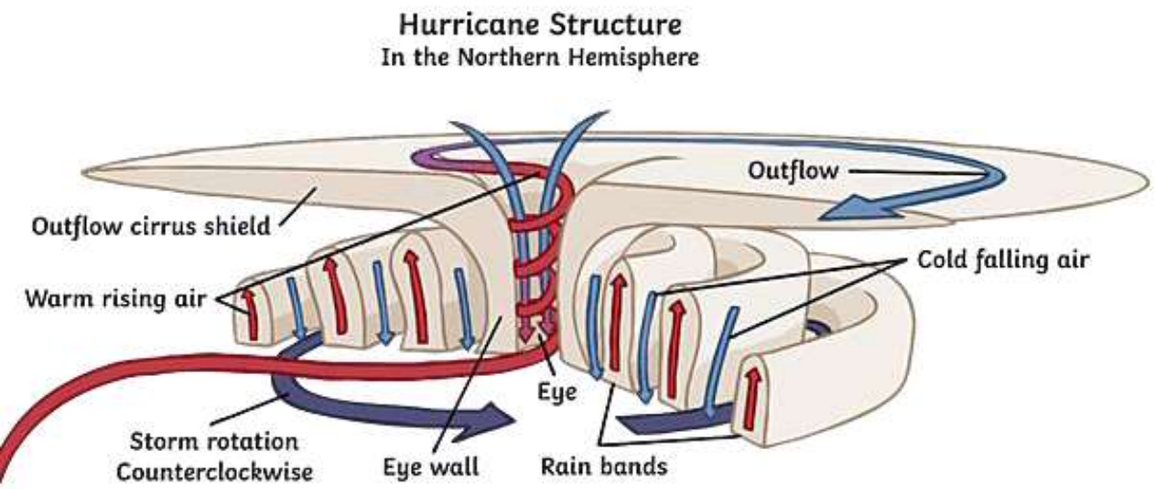
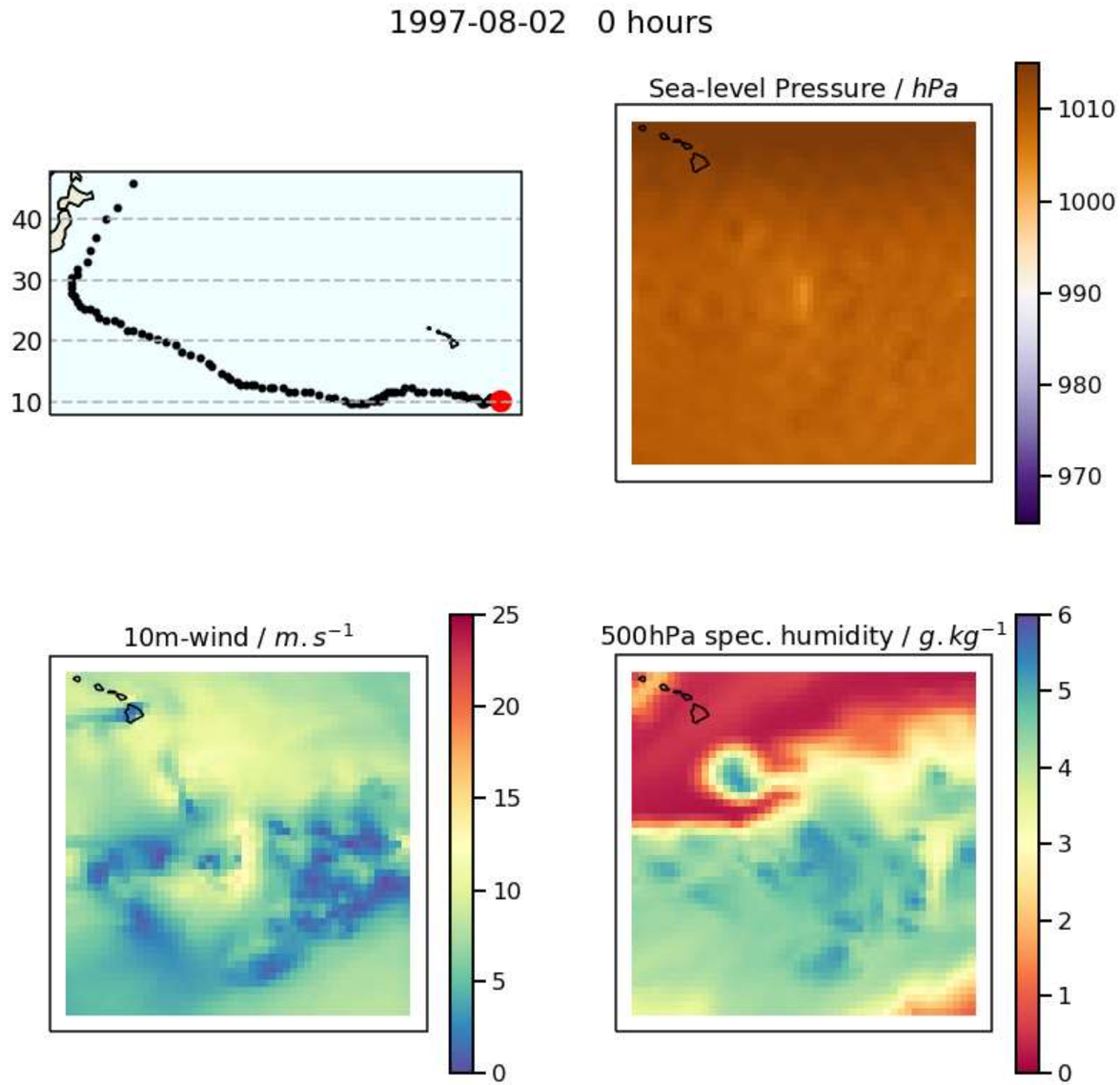
Context



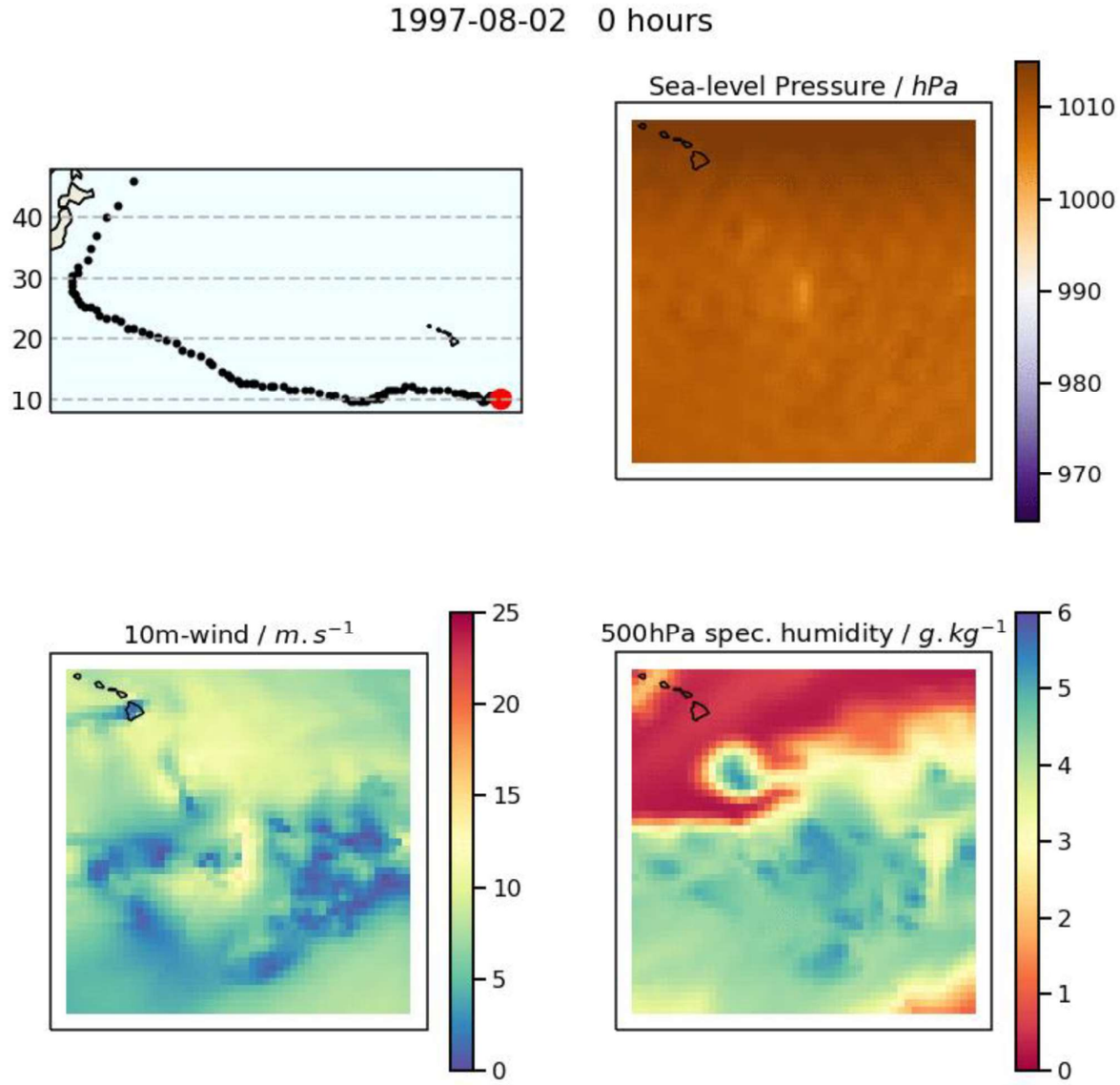
Original Image from twinkl.com

- Are there tropical cyclones (TC) in the IPSL model's simulations?
- If yes, how well are they represented and what is the impact of resolution?

Animation of one « strong » TC in the 50km IPSL-CM7A HighResMIP simulation

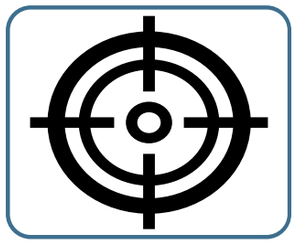


Animation of one « strong » TC in the 50km IPSL-CM7A HighResMIP simulation



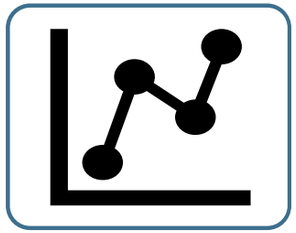
TC detection algorithm : UZ

- UZ = Ullrich & Zarzycki (2021)
- Implemented in the TempestExtremes framework



Detect candidate points

- Tracks a local slp minimum associated with a warm core (geopotential thickness)



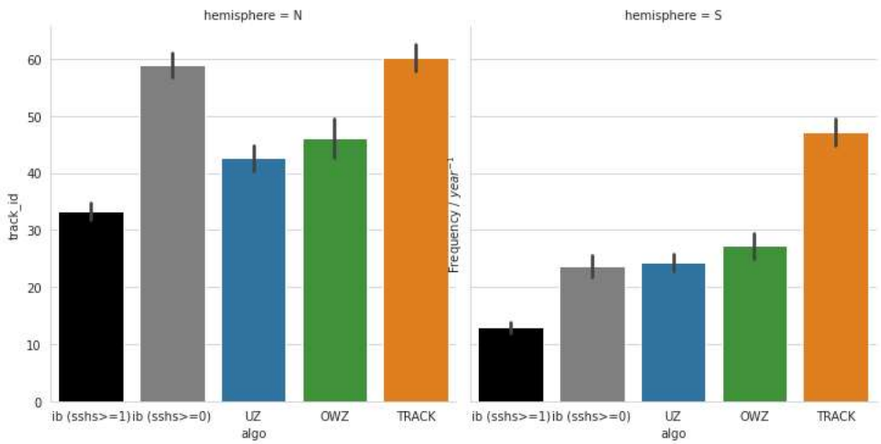
Stitch candidate points

- **Path must last at least 56h**
- **Storm must form between 10 and 40° latitude**, in a region with a topographic height < 10m
- **Surface wind must reach 10 m/s**

Tracker performance on ERA5

Tropical cyclones tracked in ERA5 on the 1980-2020 period, and compared to the IBTrACS database

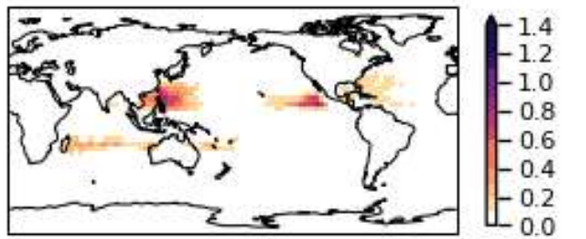
TC Frequency



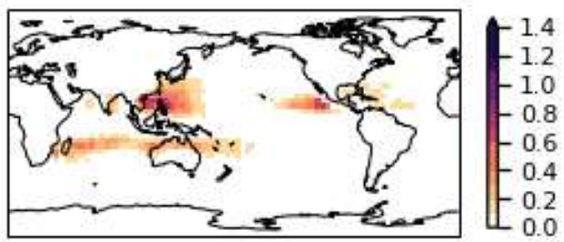
Identification scores

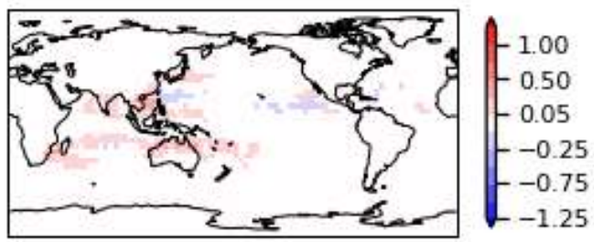
Algo	Missing $SSHS \geq 0$ / 1	False Alarms All/sshs>=0
UZ	29% / 11%	7% / 4%
OWZ	30% / 11%	17% / 5%
TRACK	27% / 15%	36% / 35%

Obs



ERA5





Choice of the UZ algorithm because of good performance on ERA5 + uses variables available for IPSL-CM6A simulations

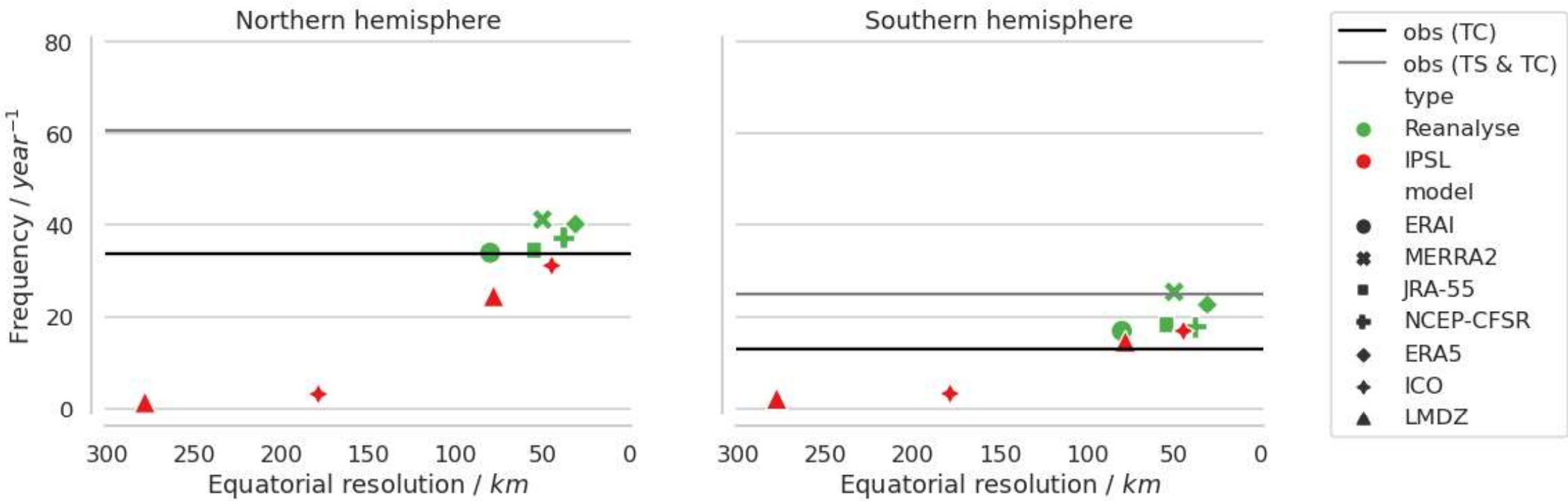
The HighResMIP Framework

- Atmosphere-only global simulations with forced SST over 65 historical years (1950-2014)

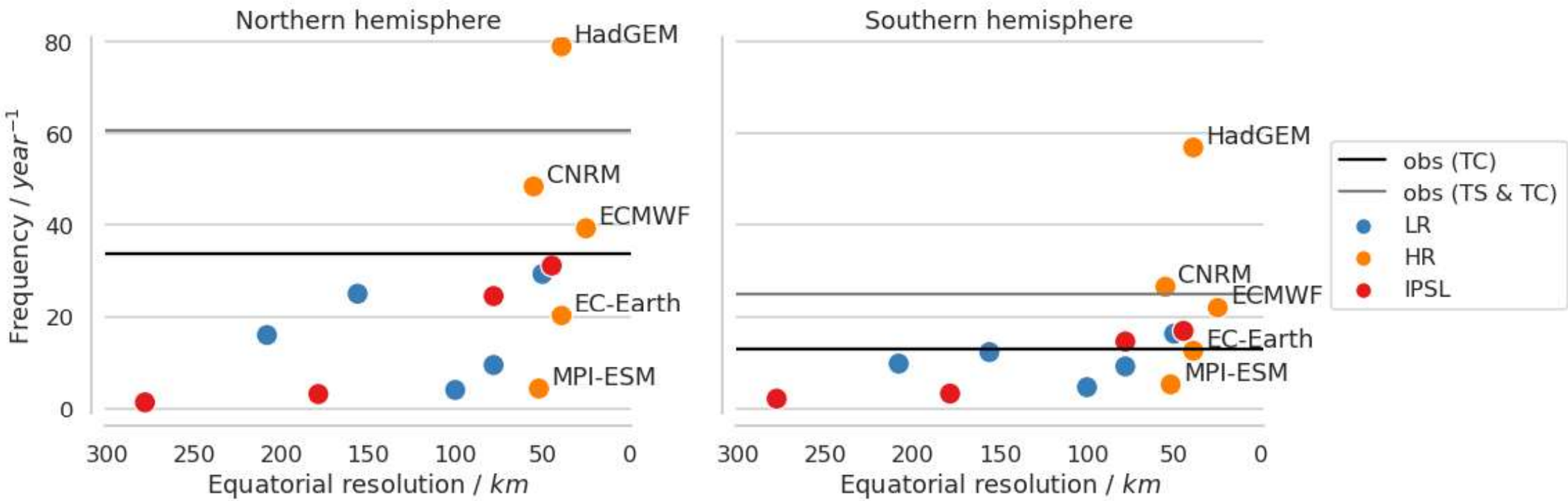
Name	Physics	Dynamics	Resolution at equator	
			LR	HR
IPSL-CM6A-ATM	LMDz	LMDz	278 km	78 km
IPSL-CM7A-ATM		Dynamico	179 km	45 km

- UZ algorithm applied to the 4 simulations

Impact of resolution



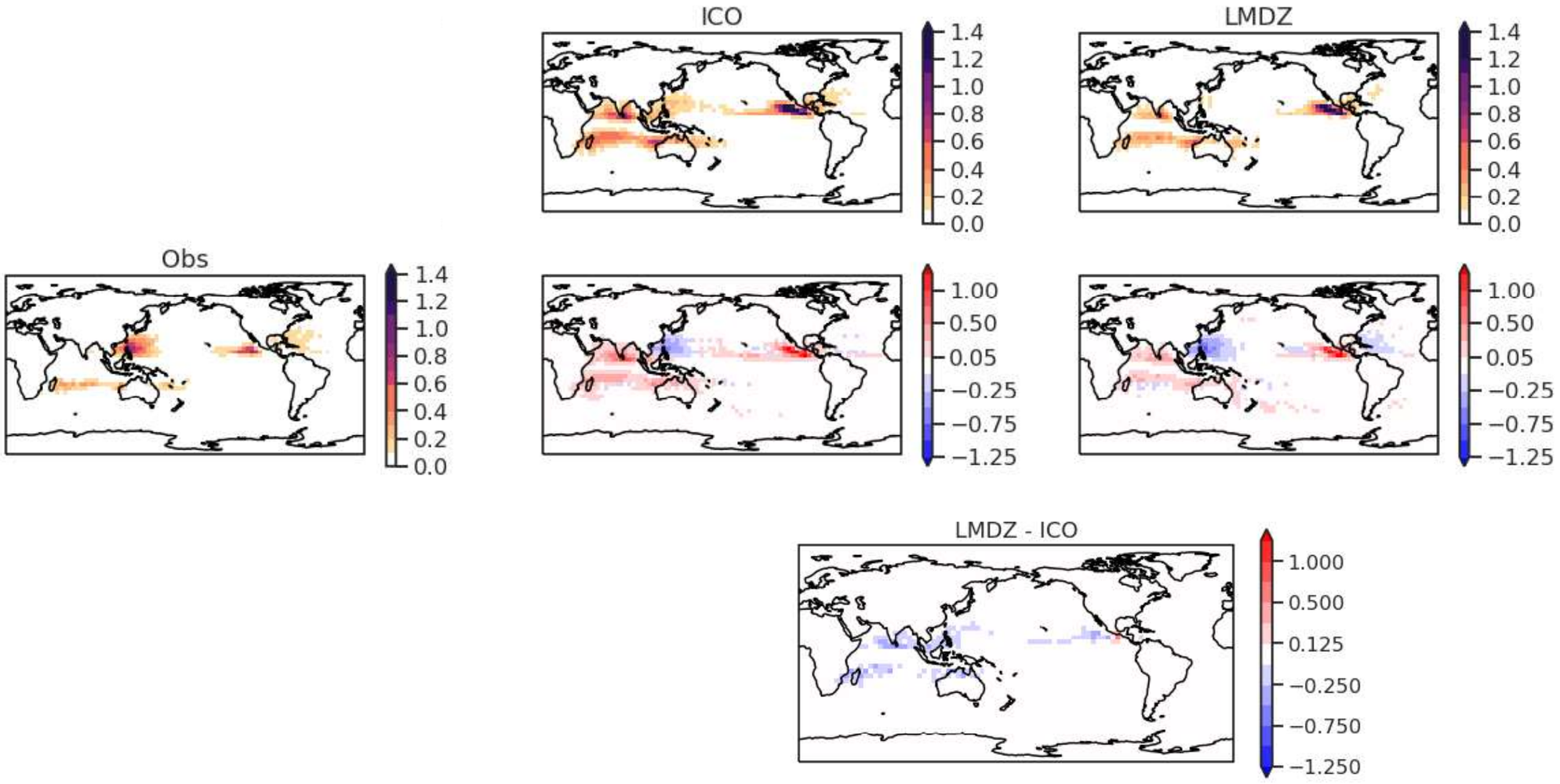
Impact of resolution

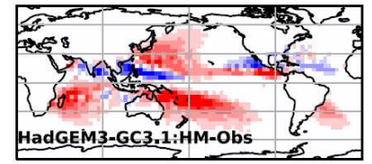


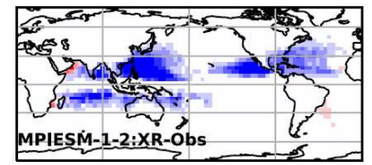
Data from other models obtained in Roberts 2020b with the same detection method.

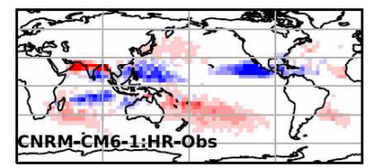
Roberts 2020b

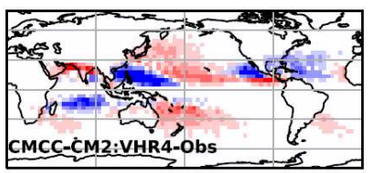
Spatial distribution

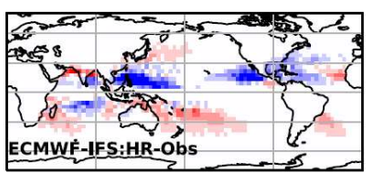


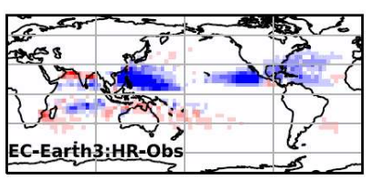


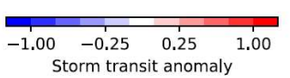




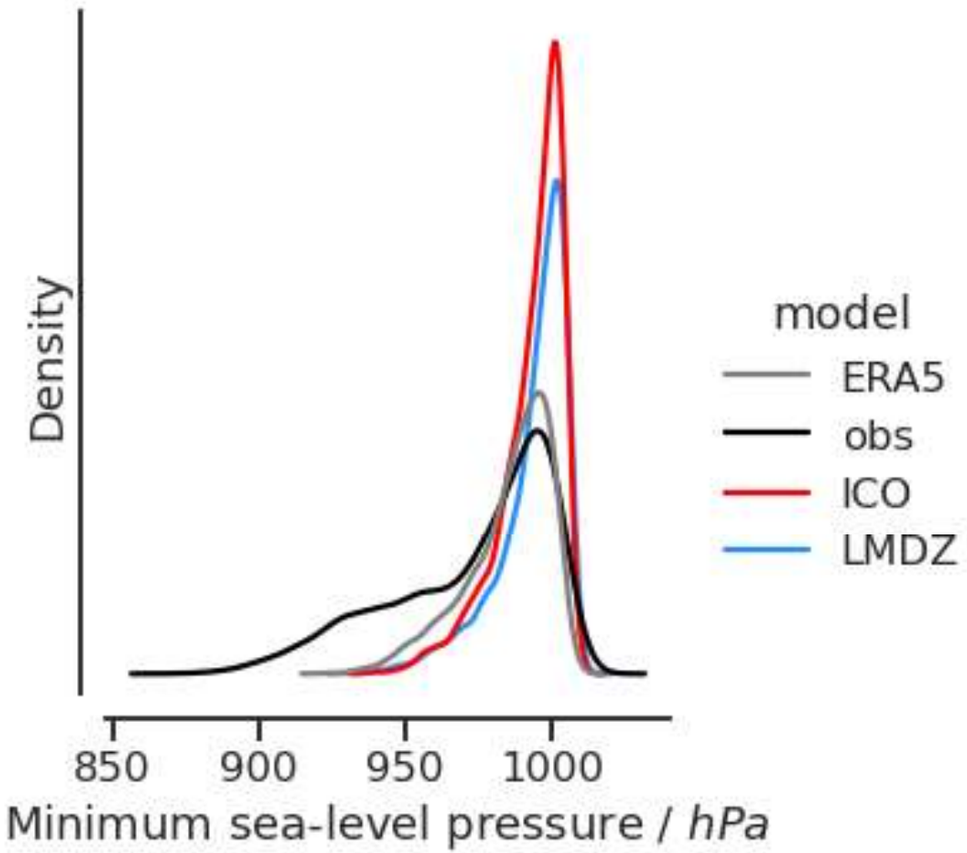


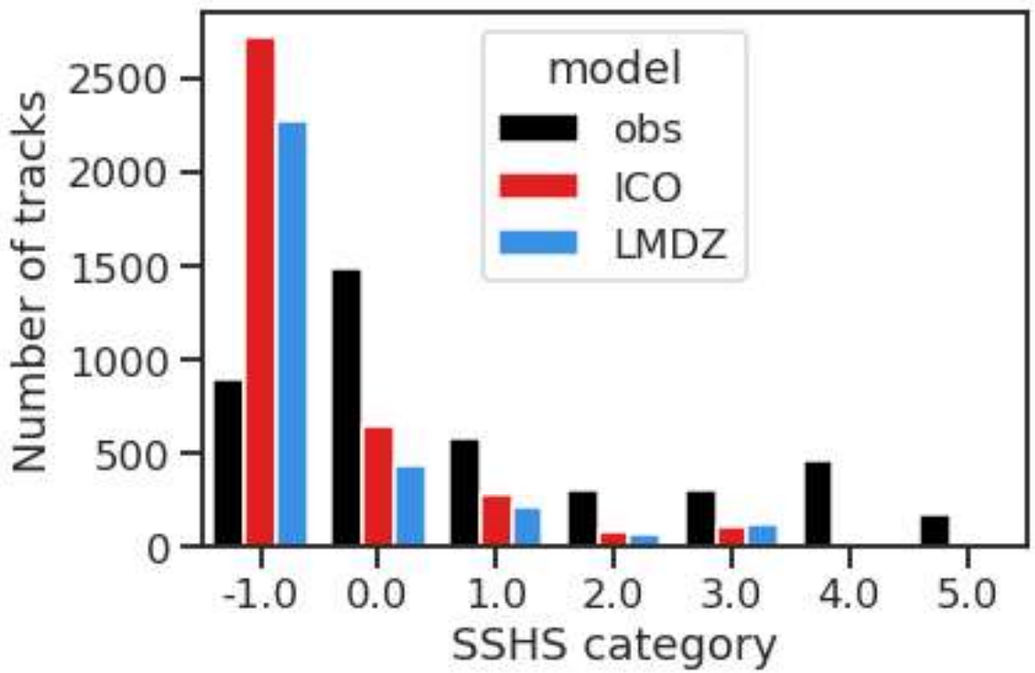






Intensity


Density
model
ERA5
obs
ICO
LMDZ
850
900
950
1000
Minimum sea-level pressure / *hPa*


Number of tracks
2500
2000
1500
1000
500
0
model
obs
ICO
LMDZ
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
SSHS category

Conclusion

- Great improvement with increasing resolution, the IPSL model compares with other similar models;
- Global frequency at 50km similar to obs and reanalyses
- The IPSL model generates too much TC in some basins, but they do not intensify enough.