THE CLIMATOLOGY OF THE ORINOCO LOW-LEVEL JET IN CMIP5/CMIP6 MODELS

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INTRODUCTION

The Orinoco low-level jet (OLLJ) develops in the Venezuelan and Colombian Llanos region. It reaches its maximum intensity in December-January-February (DJF) between 825 and 950 hPa.

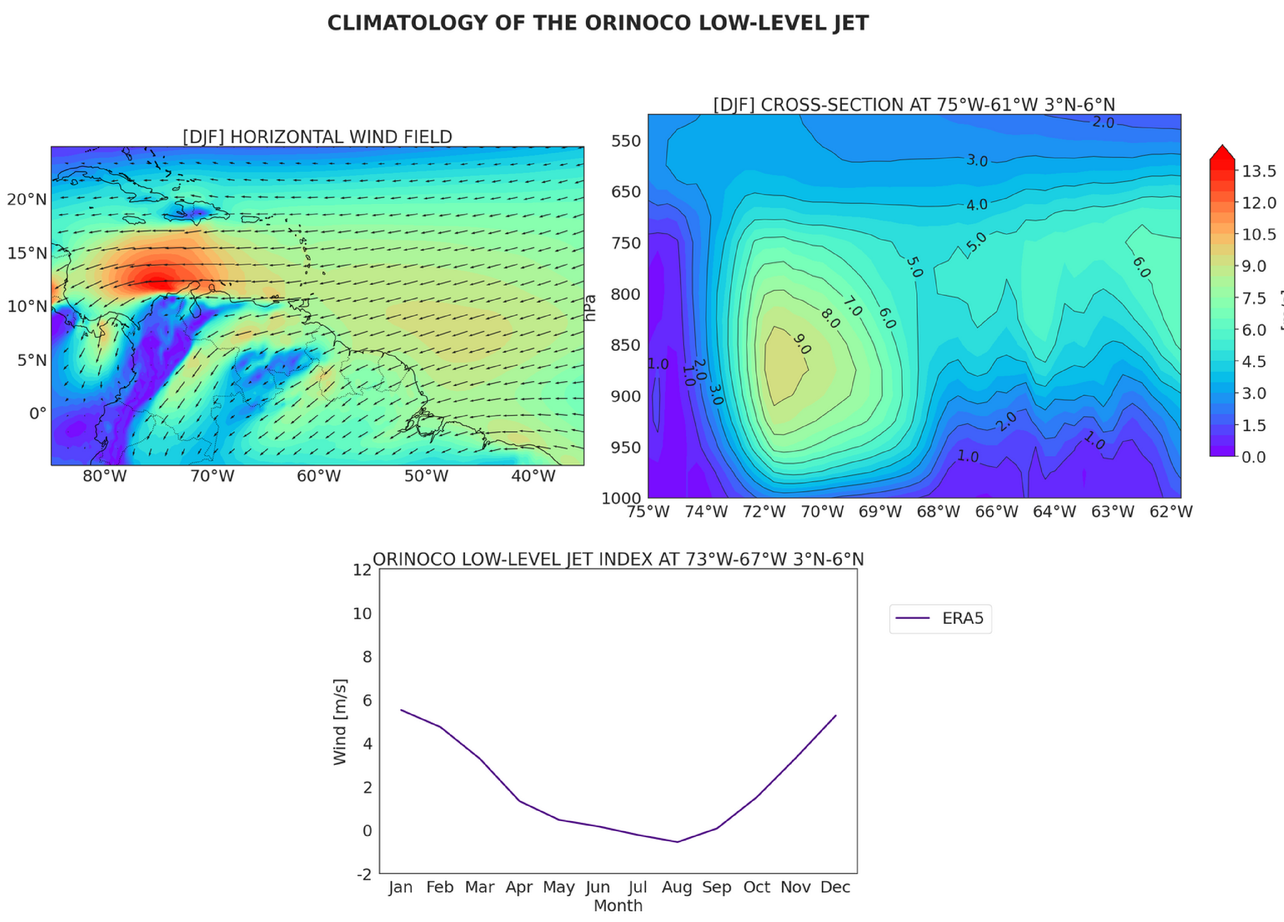

Fig 1. Horizontal wind field and vertical structure for DJF, and annual cycle of the OLLJ, estimated from ERA5 during 1979-2019.

OBJECTIVE

To assess the simulation of the climatological features of the Orinoco low-level jet from CMIP5/CMIP6 models in the historical experiment.

METHODS

Reference → ERA5

CMIP5: 37 models → 1979-2005

CMIP6: 34 models → 1979-2014

→ Historical simulations

Zonal and meridional wind (**u**, **v**), sea level pressure (**MSLP**), near-surface air temperature (**air temperature**) and surface sensible heat flux (**SSHF**)

Grouping of models: From Root Mean Square Error (RMSE) and Pattern Coefficient Correlation (PCC) as input to Factor Analysis, and factors as input to clustering (Sierra, 2017).

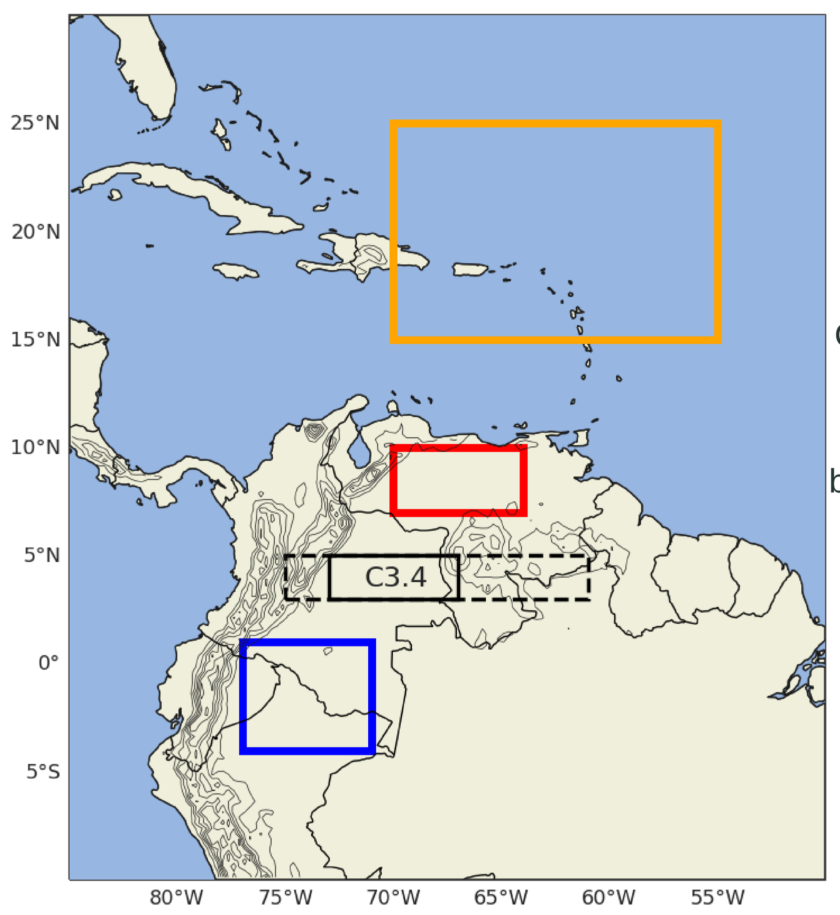

Fig 2. Tropical north Atlantic (orange), Orinoco (red), Andes-Amazon transition (blue), vertical structure (dashed black) and OLLJ index (black) domains.

OLLJ index: Spatial average of the meridional wind between 825 and 950 hPa at 3°N-6°N 73°W-67°W (black square - C3.4).

MSLP and near-surface air temperature gradients: Tropical North Atlantic - Andes-Amazon transition

Regional Gradients: Composites of MSLP, air temperature and SSHF during strong and weak OLLJ events

RESULTS

CMIP5 models exhibit **major differences in the simulation of the features of the OLLJ**. **CMIP6** models tend to **simulate the activation of the jet** in DJF.

CMIP5 **CMIP6**

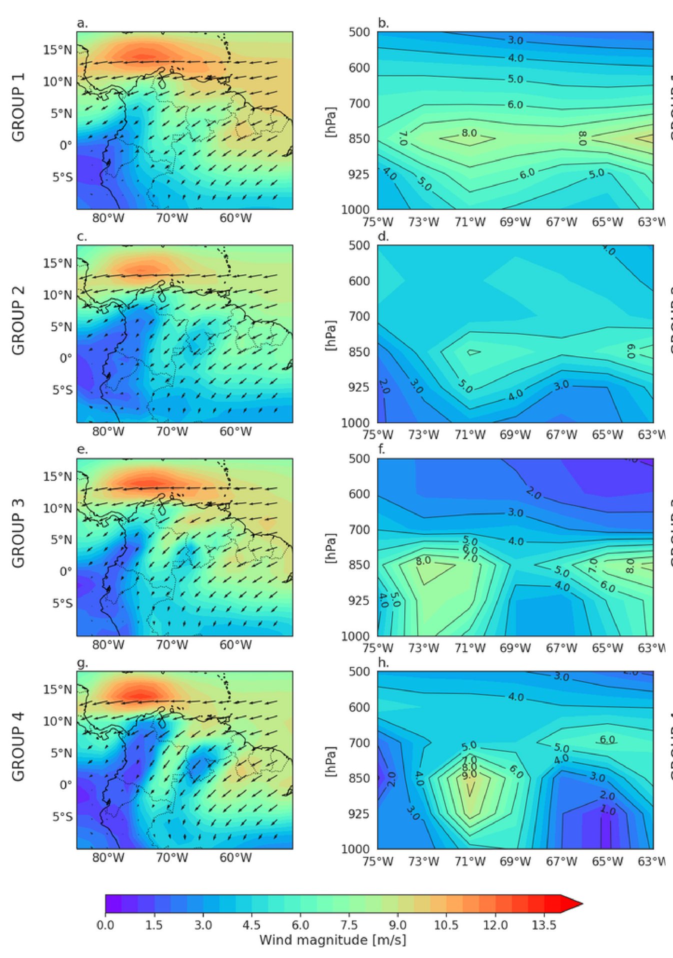

Fig 3. Multimodel mean of the horizontal wind (825-950 hPa) and vertical structure of the OLLJ during DJF from CMIP5 models.

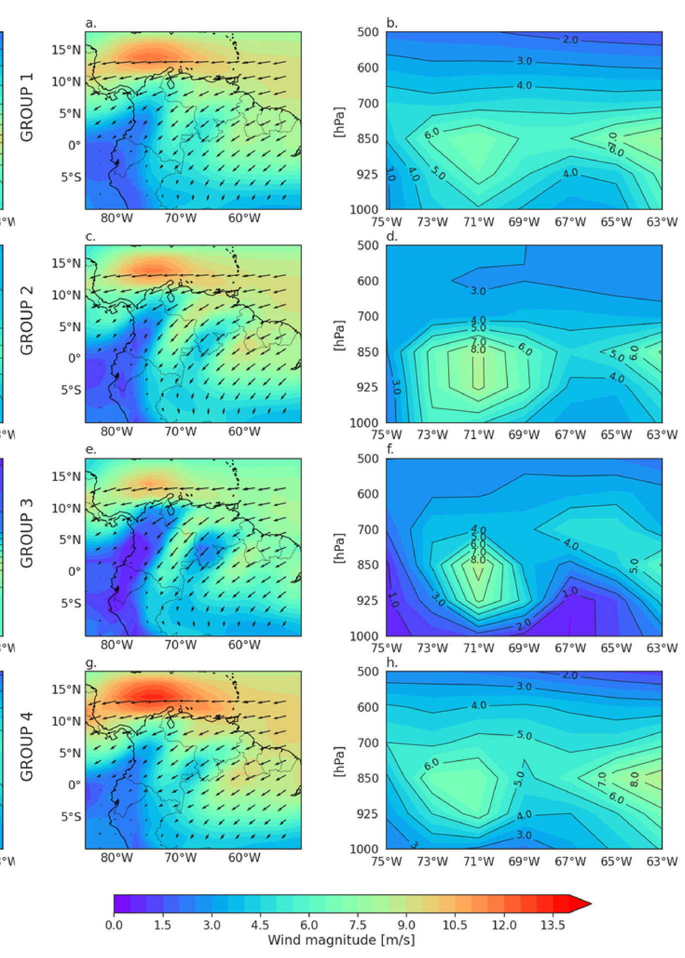

Fig 4. Multimodel mean of the horizontal wind (825-950 hPa) and vertical structure of the OLLJ during DJF from CMIP6 models.

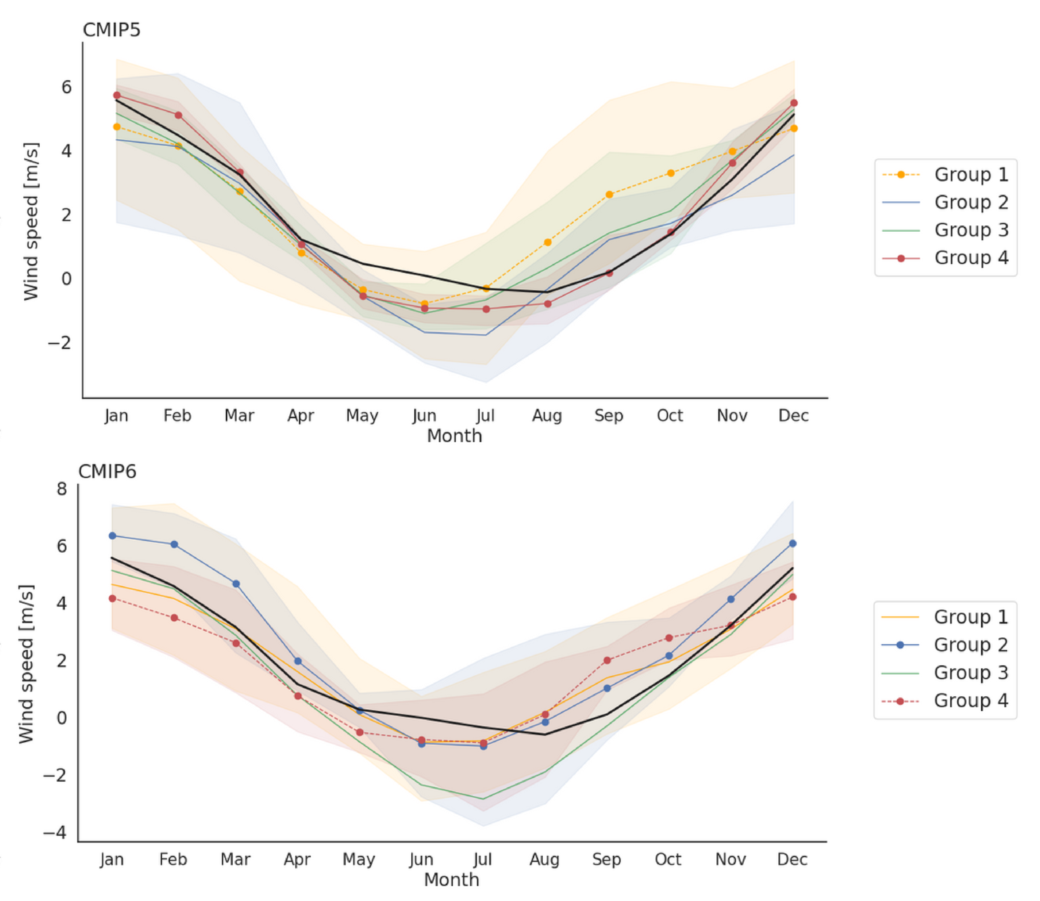

Fig 5. OLLJ index from CMIP5 (top) and CMIP6 (bottom) models. Solid dotted lines represent the best model cluster and dashed dotted represent the worst model cluster. Black lines represent the OLLJ estimated from ERA5.

CMIP5 models with **higher spatial resolution** tend to have a **better performance** in simulating the surface circulation in northern South America. The representation of the **regional topography** by GCMs is relevant when **simulating the OLLJ.**

The performance of **CMIP5 models may have a link with the simulation of the activation mechanisms** of the jet. However, this linkage is **not so clear for the CMIP6 models** since there is no specific group with an outstanding representation of these gradients and the main features of the jet.

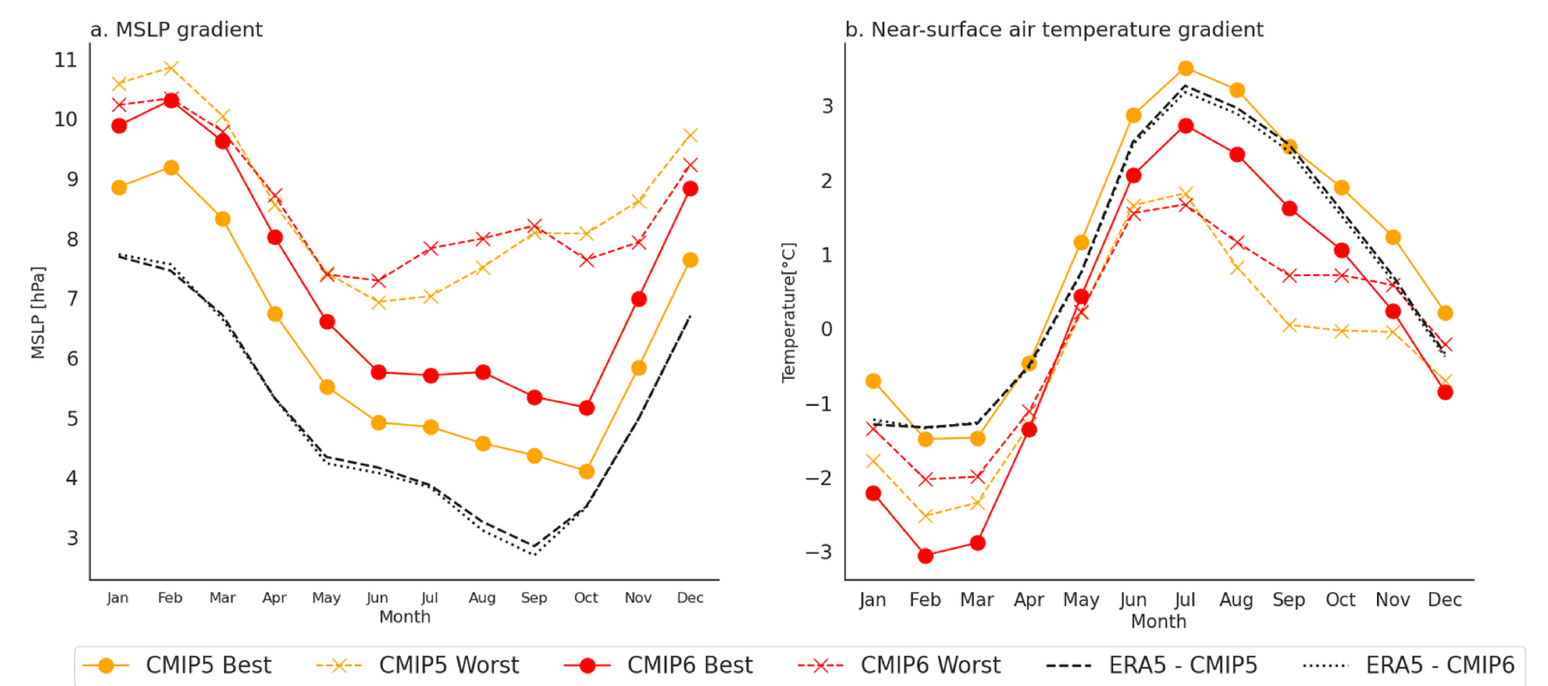

Fig 6. MSLP and near-surface air temperature gradients between the Atlantic and the Andes-Amazon transition regions from CMIP5 (orange) and CMIP6 (red) models. Dots represent the best groups, while crosses represent the worst groups. Black lines represent the ERA5 gradients.

Strong OLLJ events are accompanied by **increasing MSLP** and **decreasing air temperature and SSHF** over the **Orinoco** (red rectangle), while **weak OLLJ** events occur with **decreasing MSLP and increasing air temperature and SSHF over the Orinoco.**

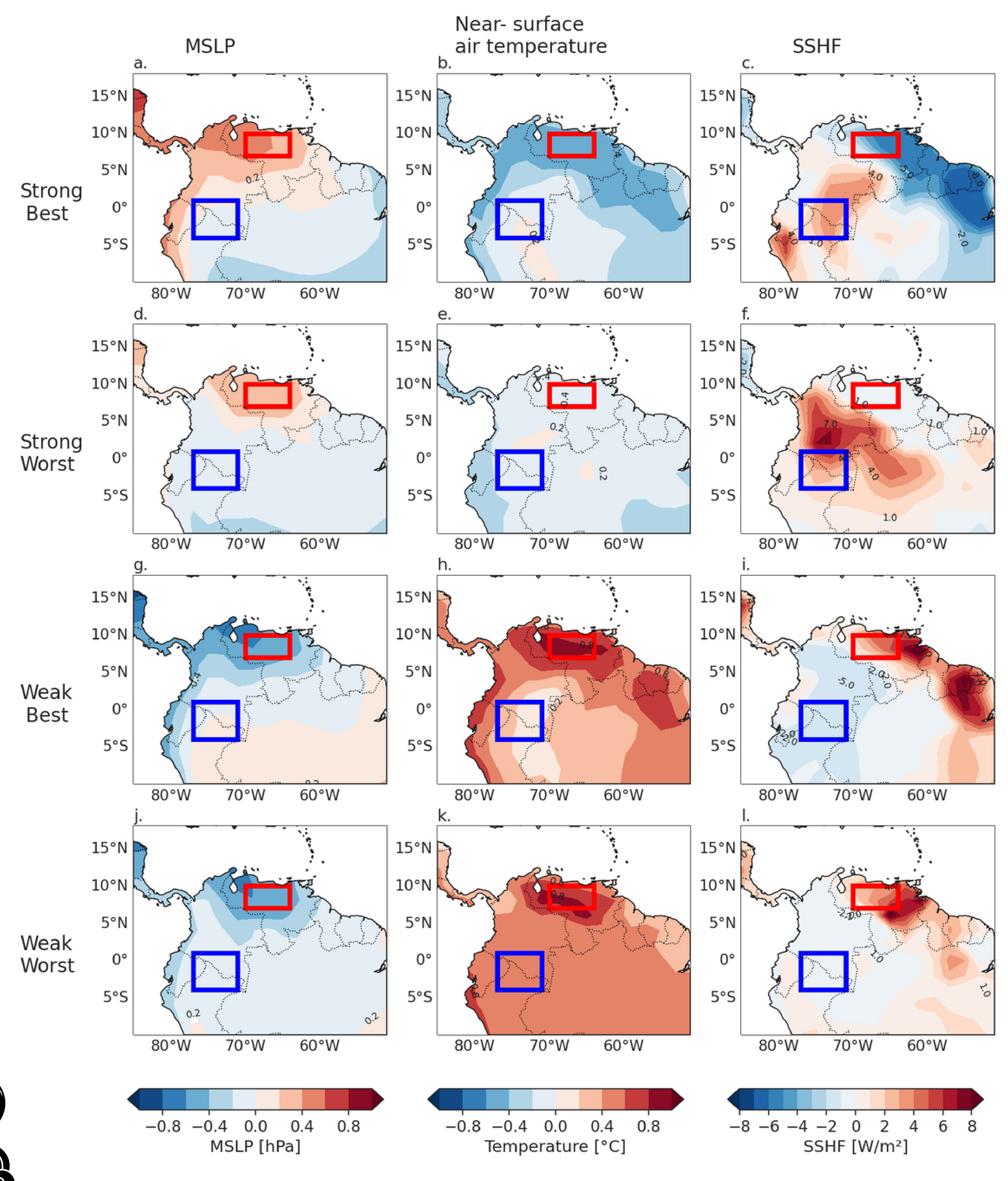

Fig 7. Composites of the anomaly fields of MSLP, air temperature and SSHF during strong and weak OLLJ events from CMIP6 models.

Supplementary material →

CONCLUSION

CMIP5/CMIP6 models can simulate the activation and development of **the OLLJ**. **CMIP5** models exhibit **greater contrasts** in the simulation of the features of the OLLJ. On the other hand, an accurate simulation of the **gradients between the ocean and the land** cover tend to be more **relevant for CMIP5 models**. Finally, **CMIP5/CMIP6 models capture the regional variations** that accompany **stronger and weaker OLLJ** events.

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