REDISCOVERING THE ORINOCO LOW-LEVEL JET

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1. Objective

To characterize the OLLJ structure, evolution, and mechanisms of formation using finer horizontal, vertical, and temporal resolution than possible in previous studies.

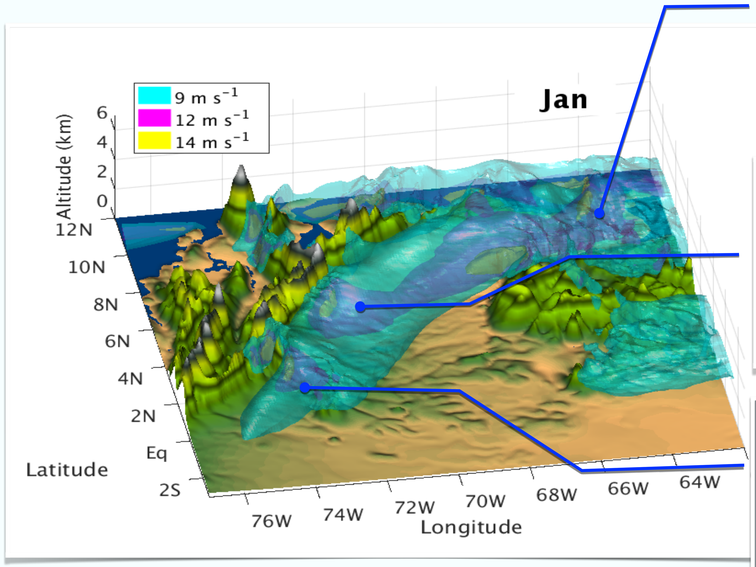
2. Why?

Because the low-level wind shear created by the OLLJ jet poses a risk for more than one million airline passengers per year.

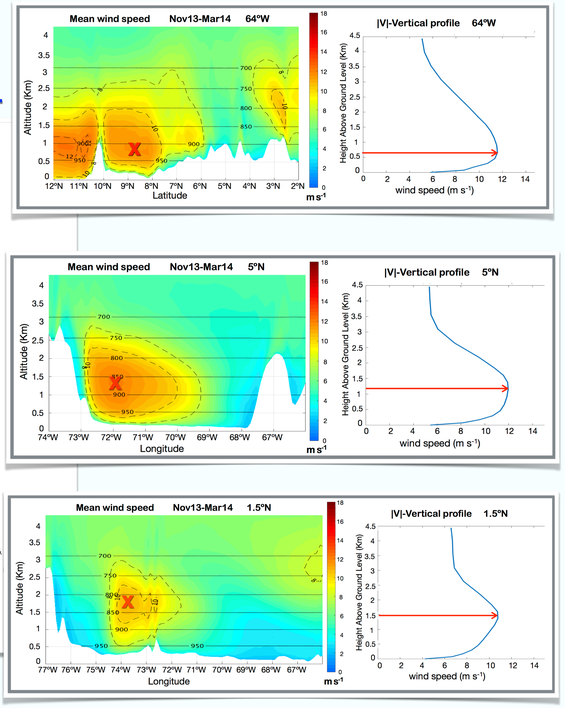
The OLLJ dynamics cannot be explained via the well-known Holton or Blackadar mechanisms.

3. How?

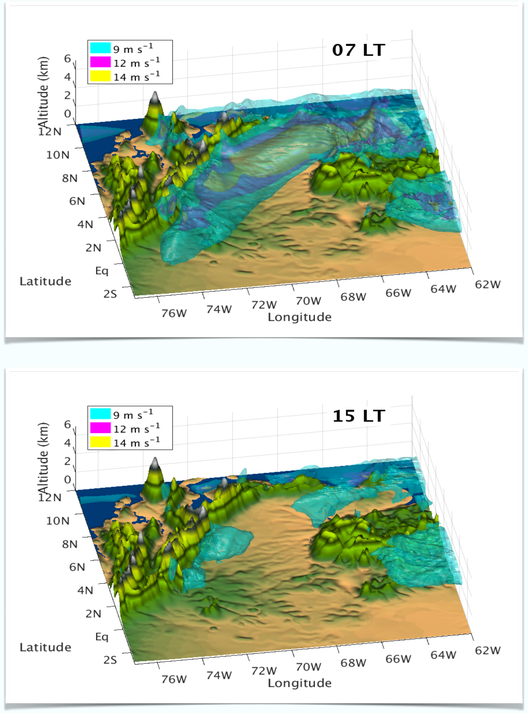
The investigation relies on a 5-month-long simulation (November 2013-March 2014) performed with the Weather Research and Forecasting model, with initial and boundary conditions provided by the Global Forecast System analysis.



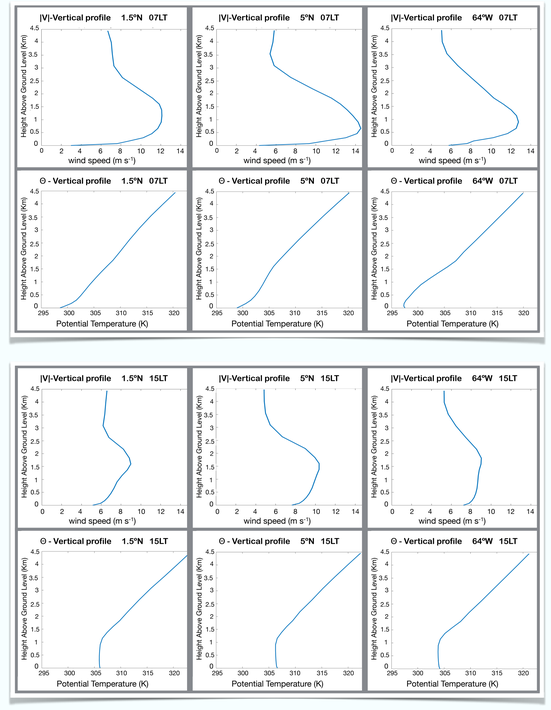
The Orinoco low-level jet (OLLJ) in northern South America simulated by WRF-ARW using dynamical downscaling.
The higher spatial resolution better depicts the topography and improves the characterization of the low-level jet, which was identified as a single stream tube over Colombia and Venezuela with the greatest wind speeds (~15 m s-1) occurring in January.



Vertical cross-sections and horizontal wind speed vertical profiles for the entrance, mid-corridor, and exit regions.
The core of the OLLJ has different heights and intensities depending on the location.

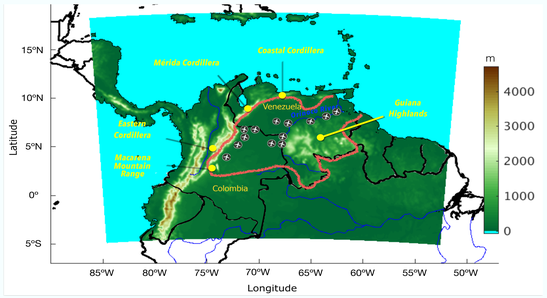


Horizontal characterization of the diurnal evolution.
The OLLJ exhibits the greatest wind intensity in the morning (~15 m s^{-1}) and the least intensity in the afternoon (~9–10 m s^{-1}).



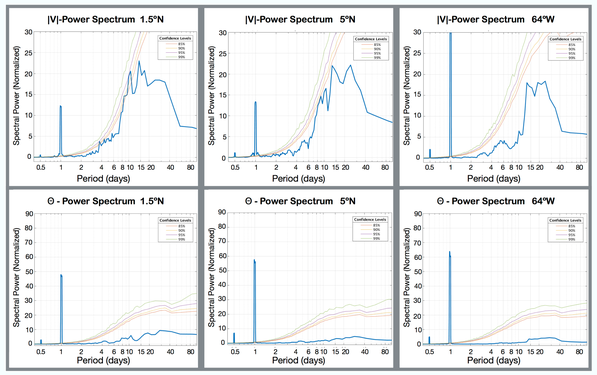
OLLJ diurnal wind speed behavior is related to low-level static stability behavior.
Maxima wind speeds occur in the morning when low-level static stability is maximized, whereas minima wind speeds occur in the afternoon when the boundary layer is approximately neutrally stratified.

WRF dynamical downscaling



- *Hourly outputs*
- *9-km grid spacing*
- *51 vertical levels*
- *Nov. 2013–Mar. 2014*

Topographic map of northern South America showing the WRF domain (colors), the Orinoco River basin limits (red), and locations of the main airports along the OLLJ corridor.
Boundary conditions from 0.5º x 0.5º GFS Analysis were updated every 6 hours and the model was reinitialized every four days with a preceding spin-up of 12 hours.



Intraseasonal Variability

Fourier series analysis

Wind speed and potential temperature exhibit strong diurnal and semi-diurnal signal, which implies a modulation of the wind speed via radiative heating.

Future work

- Formation mechanisms.
- Model sensitivity to:
  - Non-local PBL.
  - Topography height reduction.
  - 3-km grid spacing.
  - No shortwave/longwave radiation.
  - No latent heat.

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