PRE-CONVECTIVE ENVIRONMENTS FOR LAKE VICTORIA USING ERA5 REANALYSIS: IDENTIFYING SEVERE WEATHER INDEXES FOR ENHANCED FOREACASTS

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NCAR | ADVANCED STUDY PROGRAM

LAKE VICTORIA

Urgent need for the development and improvement of Early Warning Systems (EWS) around Lake Victoria Basin (LVB)

- Global hotspot for severe thunderstorm activity: ~**1,000 fishermen die annually due to severe weather-related accidents**
- **In Africa,** more than **60% population** has **no access to Early Warning** systems and there are large gaps in weather observations: in 2019 **just 26%** of reporting **stations met** WMO **standards**
- **Only one upper-air station for East Africa** (OSCAR database-WMO 2023)
- The **Oct-Dec Nairobi sounding observations** you used in this study were available as a **result of the 2019 WMO HIGHWAY** Project

METHODS

ERA 5 convective mode pseudo-soundings:

- Retrieved for each storm centroid Lat/Lon identified in the automatic storm classification from Mwanza radar data (see poster WCRP#265)
- 6-h before storm maximum organization
- 20 pressure levels + surface, 30-km grid resolution

Comparison with the Nairobi sounding-derived convective parameters :

- Oct-Dec 2019 (First sounding released on August 5, 2019 during HIGHWAY)
- 00 and 12 UTC
- 187 sounding profiles

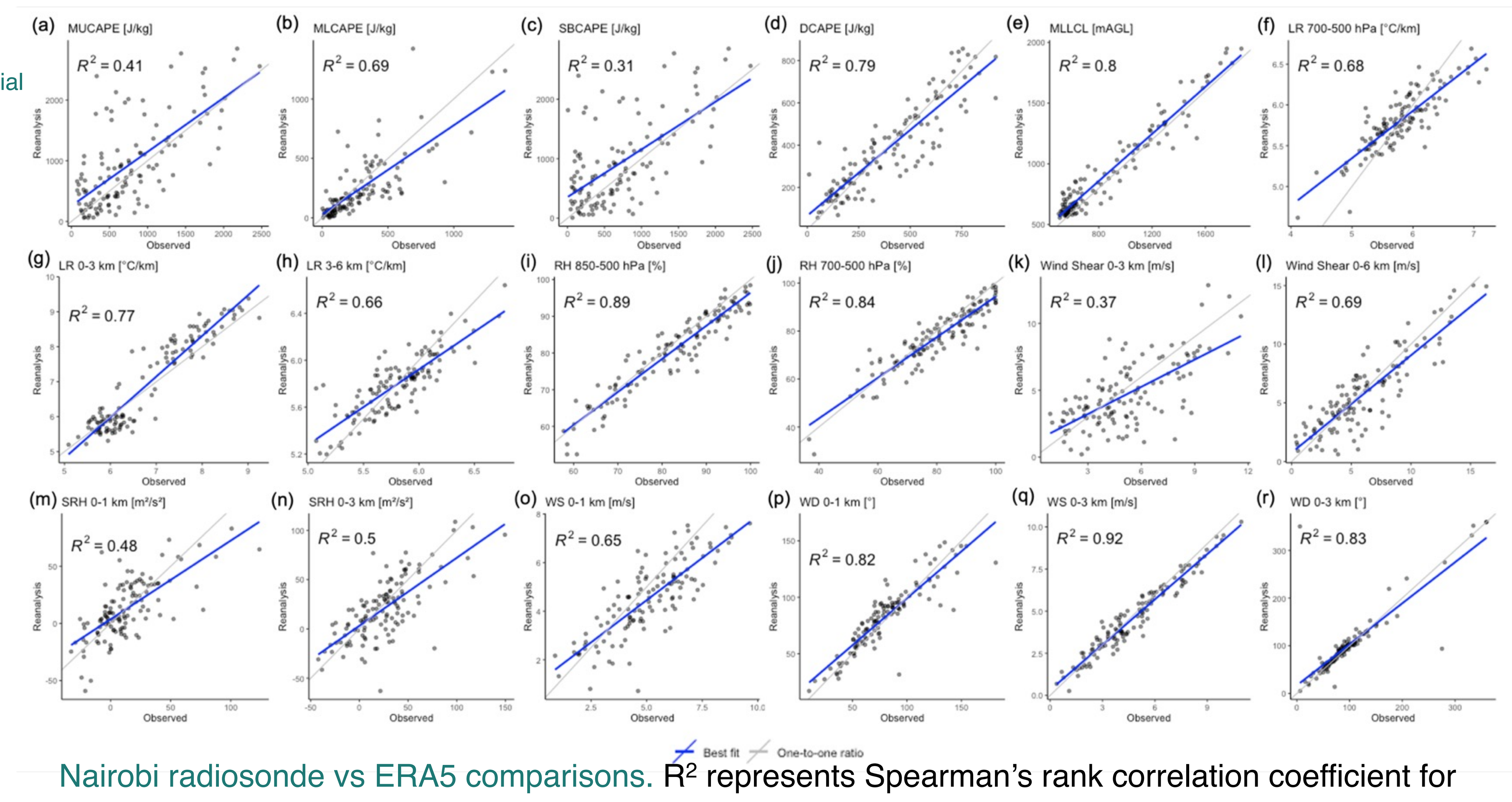
Instability and moisture parameters:
Allow for the identification of convective initiation potential, updraft strength, and potential thunderstorm intensity
Kinematic parameters: Allow for the identification of storm development, organization and propagation

Final parameters:

- SBCAPE (Surface-Based Convective Available Potential Energy) [J/kg]
- MUCAPE (Most Unstable CAPE) [J/kg]
- MLCAPE (Mean Layer CAPE) [J/kg]
- MLLCL (Mean Layer Lifting Condensation Level) [m AGL]
- DCAPE (Downdraft CAPE) [J/kg]
- $RH_{0\text{-}850hPa}$ (Low Level Relative Humidity) [%]
- $RH_{700\text{-}500hPa}$ (Mid Layer Relative Humidity) [%]
- $LR_{0\text{-}3km}$ (Low Level Lapse Rate) [°C/km]
- $Shear_{0\text{-}6km}$ (Bulk Wind Shear) [m/s]
- $SRH_{0\text{-}1km}$ (Storm Relative Helicity) [m²/s²]
- $SRH_{0\text{-}3km}$
- $WS_{0\text{-}1km}$ (Wind Speed) [m/s]
- $WD_{0\text{-}1km}$ (Wind direction) [deg]

Stratification:

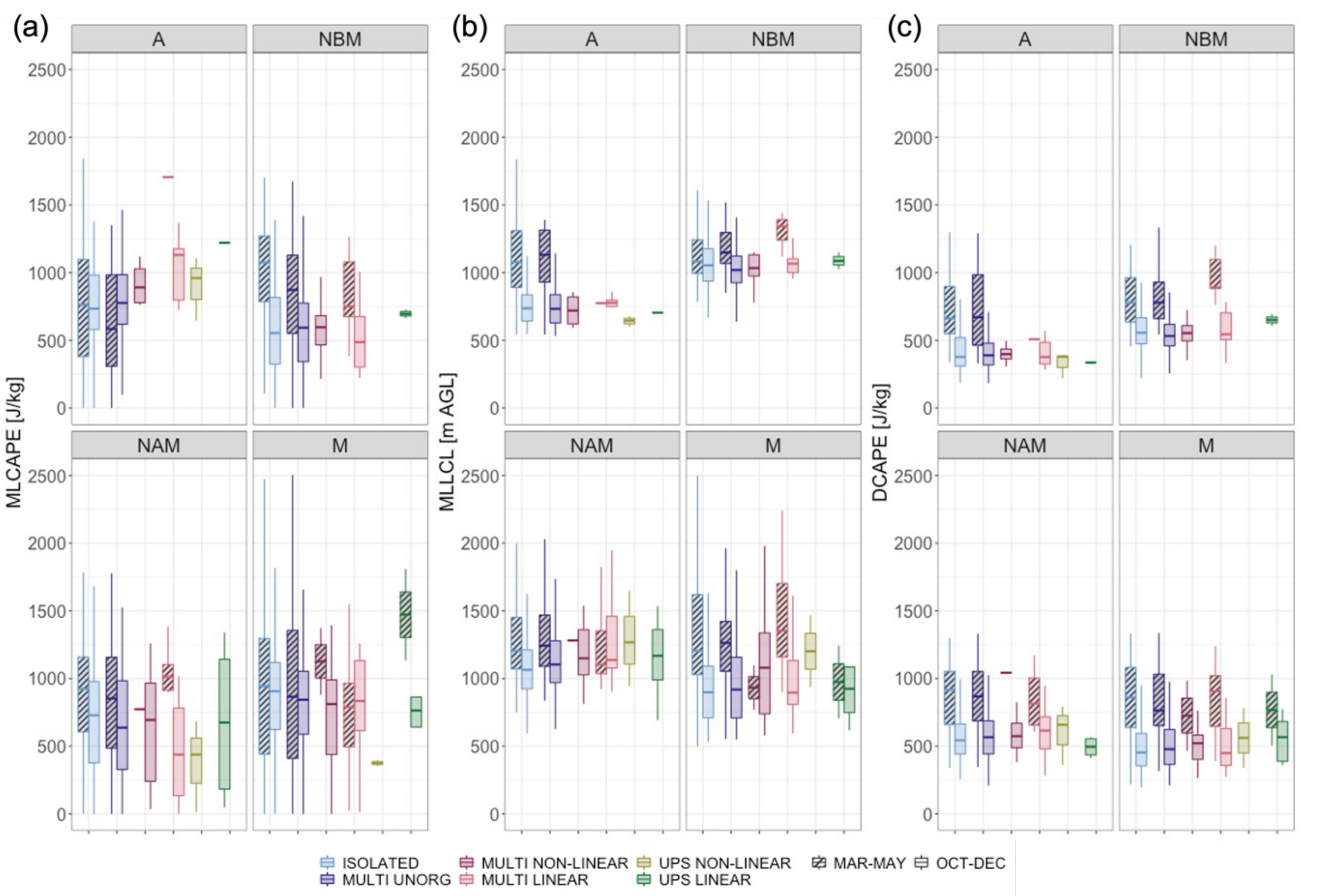
- Time of day: Morning (M) / Afternoon (A) / Night before midnight (NBM) / Night after midnight (NaM) (see poster WCRP#265)
- Season I: Mar-May; Season II: Oct-Dec

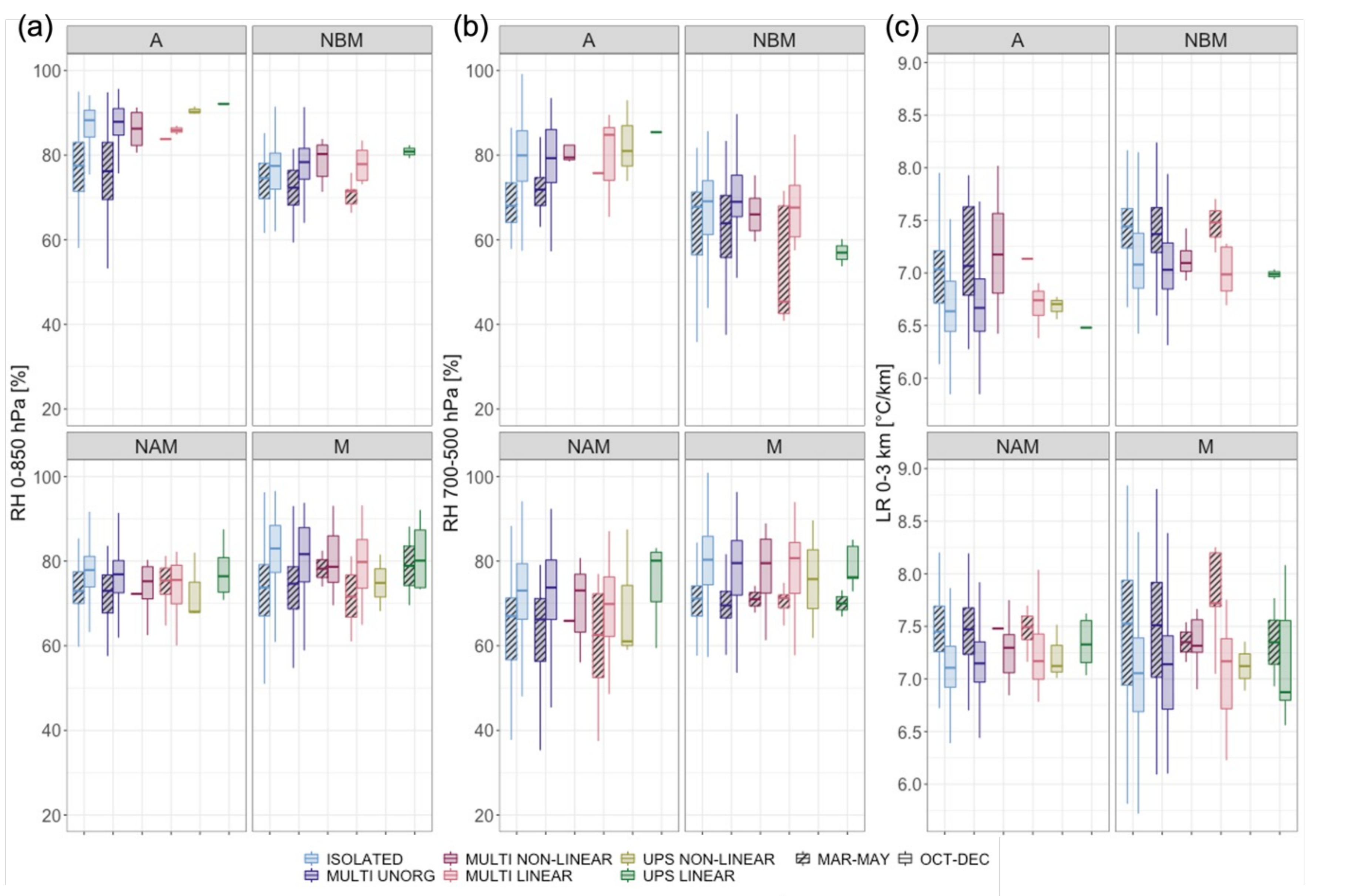


Nairobi radiosonde vs ERA5 comparisons. R^2 represents Spearman's rank correlation coefficient for non-normal data. The best fit and one-to-one lines are shown in blue and black, respectively.

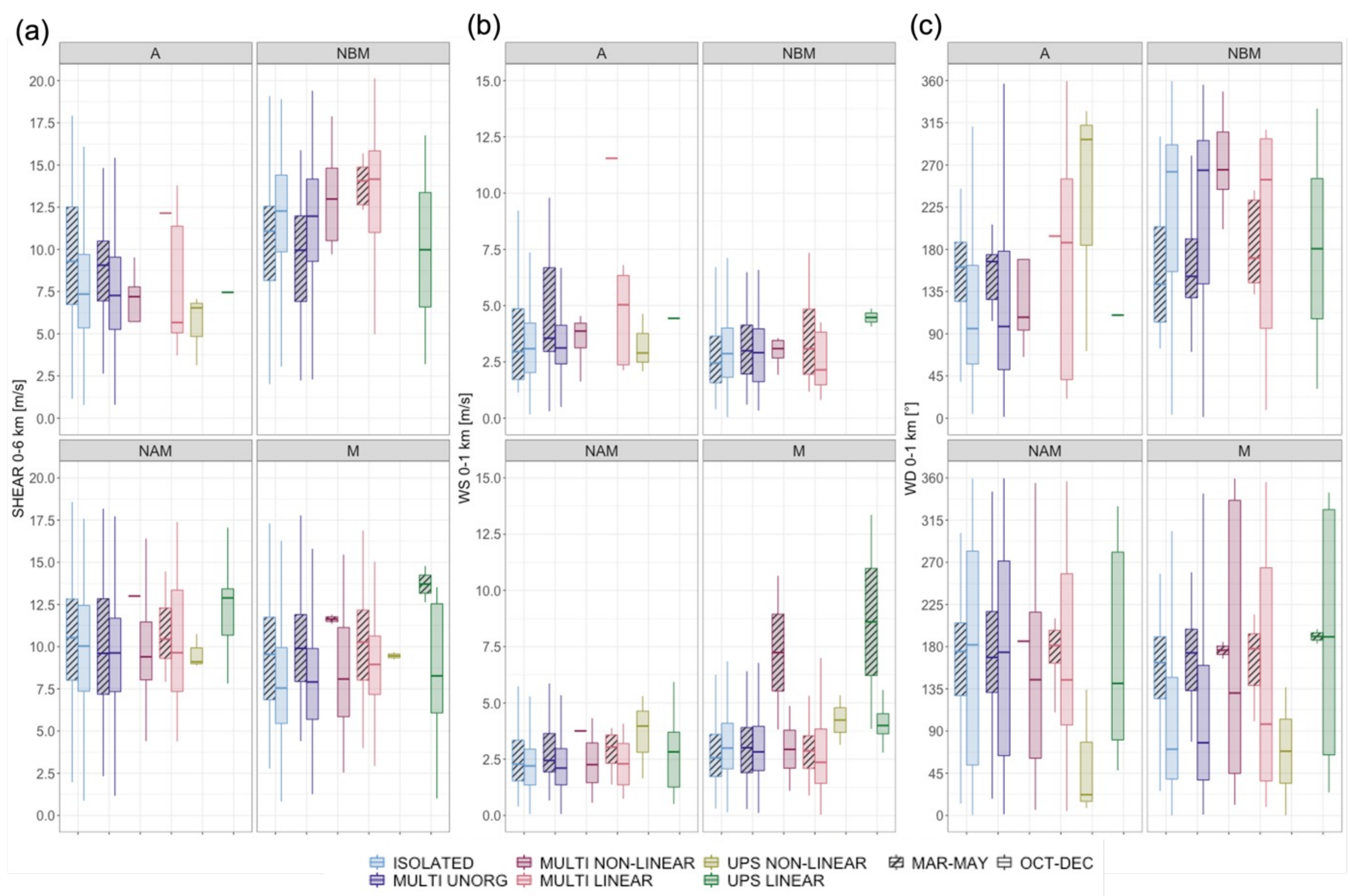
RESULTS

INSTABILITY AND MOISTURE PARAMETERS





KINEMATIC PARAMETERS



Instability:

- Season I presents generally higher values and more variability in the parameters.
- Isolated, multicell unorganized, and multicell non-linear modes, have higher MLCAPE values (see poster WCRP #265 for convective modes).
- Season I has highest values of DCAPE for all convective modes and timeslots: could imply downward transport of higher momentum air to the surface which might potentially result in strong and gusty winds at the surface.

Moisture:

- Season II has median RH values higher than 80% for almost all convective modes
- During NBM timeslot particularly low mean RH values of 45% are found for the multicell linear mode for the second season: this dry mid-level in this convective mode could lead to evaporation cooling, potentially resulting in strong winds at the surface.
- Season II presents low-level lapse rate values in all timeslots.

Kinematics:

- Higher $Shear_{0\text{-}6km}$ was observed for multicell linear storms, for storms occurring during NBM and during Season II, allowing systems to organize in linear mode and with long duration.
- Change of wind pattern (direction and speed) throughout diurnal cycle, in agreement with the land-lake breeze pattern in the lake.

How do we use this information now?
This ongoing research is expected to contribute toward forecasting severe weather and impacts of climate change.

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