A13B-0219: Geographic differences in the vertical structure of the MJO from IGRA radiosonde data

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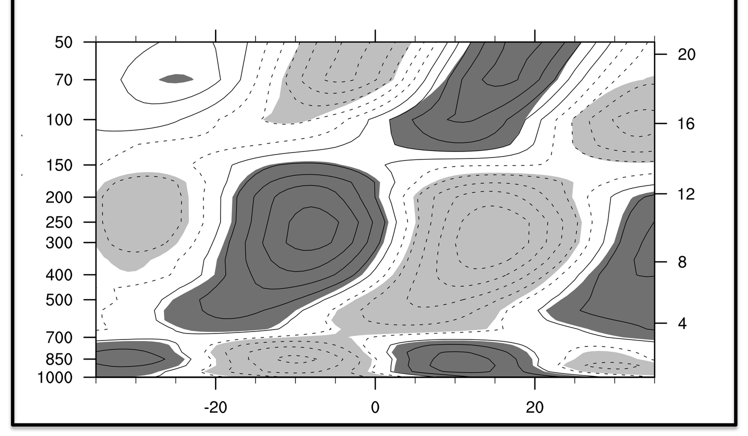
INTRODUCTION

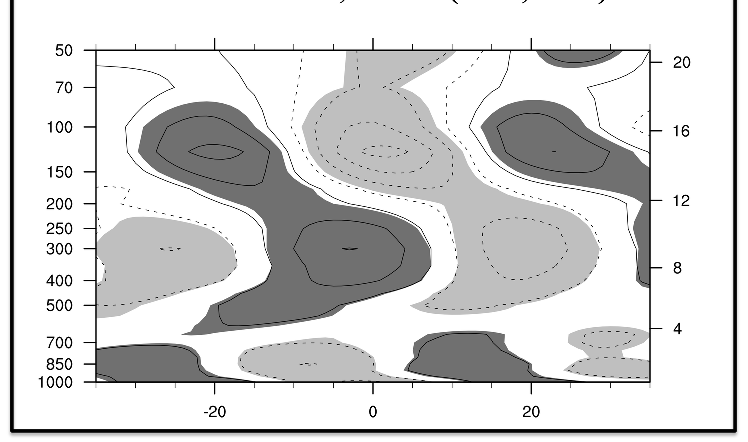
Radiosonde data from 120 tropical stations in the Integrated Global Radiosonde Archive (IGRA; Durre 2006; Fig. 1) for the period 1979-2012 are used to calculate the observed local vertical temperature structures during the convective phase of a typical Madden-Julian Oscillation (MJO) event. MJO events are identified using daily wavenumber-frequency filtered outgoing longwave radiation (OLR), and vertical structures are calculated via linear regression. Results for overlapping stations are very consistent with the vertical structures published in Kiladis et al. (2005).

Based only on the regressed temperature structures, station data are classified into 8 distinct groups, which are identified by the colored station location markers in Fig. 1. One or more examples from each group are shown in the plots surrounding the central map, and are color- and/or symbol-coded to match the station identifiers on the map.

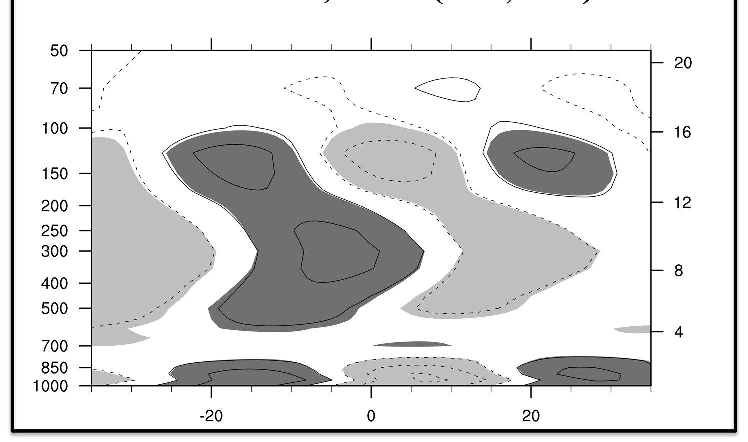
+ Mumbai, India (19N, 73E)



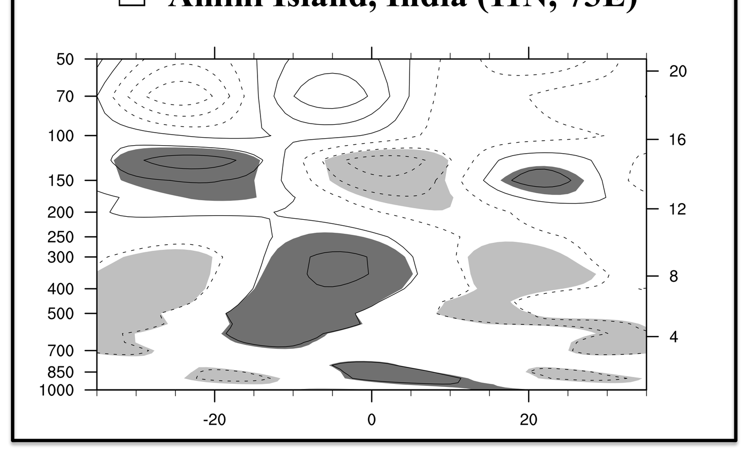
• Panambur, India (13N, 75E)



Δ Madras, India (13N, 80E)



☐ Amini Island, India (11N, 73E)

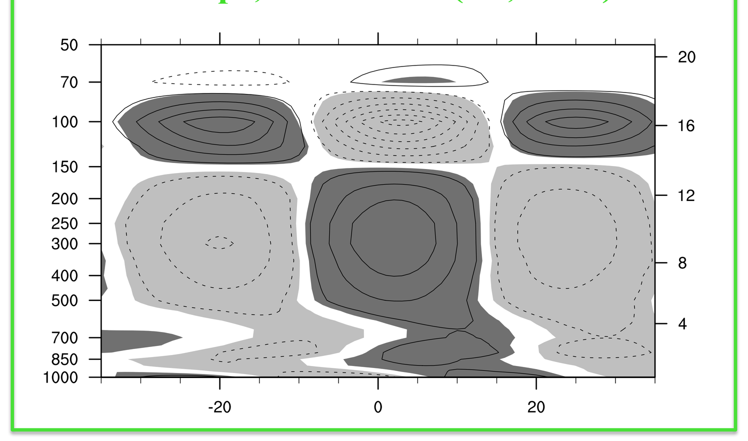


METHODOLOGY

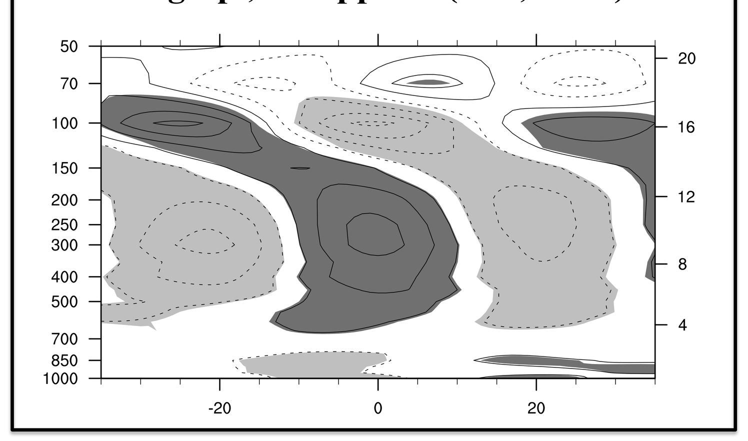
Each individual radiosonde profile was linearly interpolated to 26 regular levels from 1000 to 10 hPa, then averaged to daily resolution. Data were then linearly interpolated in time if either 1 or 2 profiles were missing. Each interpolated radiosonde station dataset was then linearly regressed against a wavenumber-frequency filtered MJO index based on OLR (k=0-6, periods = 30-96 days) averaged over a 5 degree box surrounding the closest grid point to the station location for all seasons in the 1979-2012 (or as available) period.

At least half of the available stations have data with high enough temporal resolution to produce twice-daily datasets at the same vertical resolution. In addition, the choice of MJO index is flexible; it is presently based on daily resolution wavenumber-frequency filtered OLR but has also been successfully tested with daily and twice-daily Cloud Archive User Service (CLAUS) brightness temperature data.

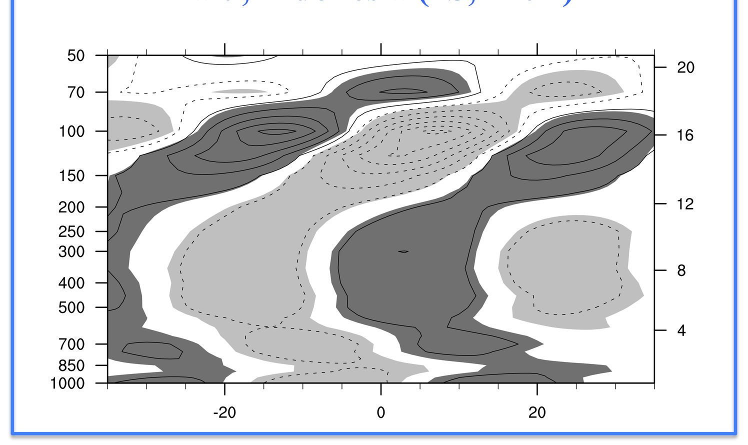
Ponape, Micronesia (7N, 158E)



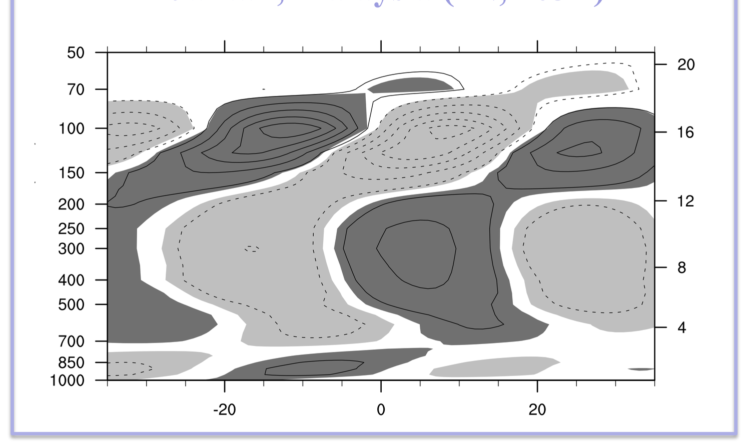
Legaspi, Philippines (13N, 124E)



Palu, Indonesia (1S, 120E)



Kuantan, Malaysia (4N, 103E)



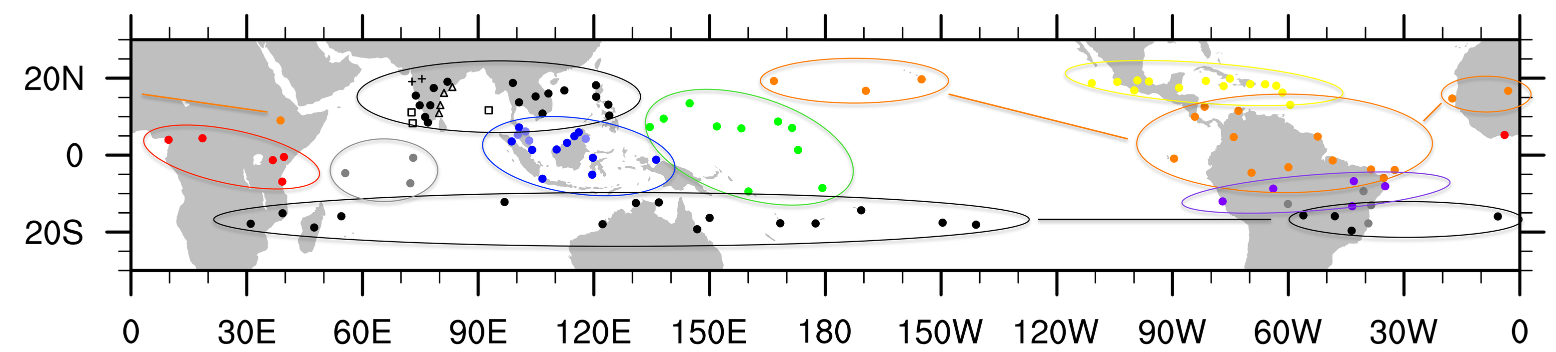
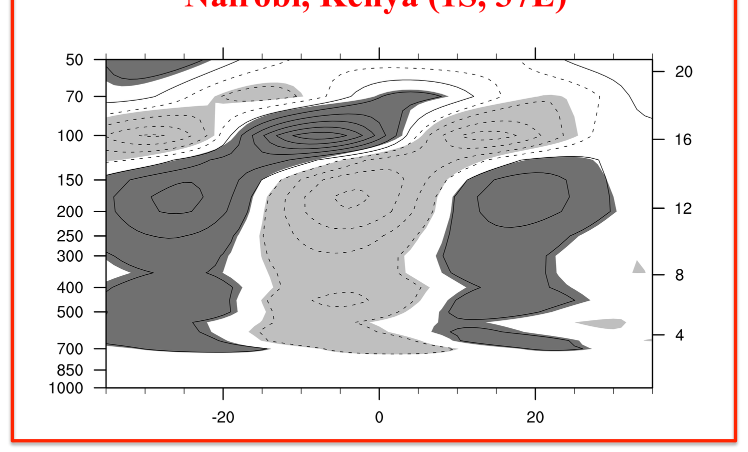
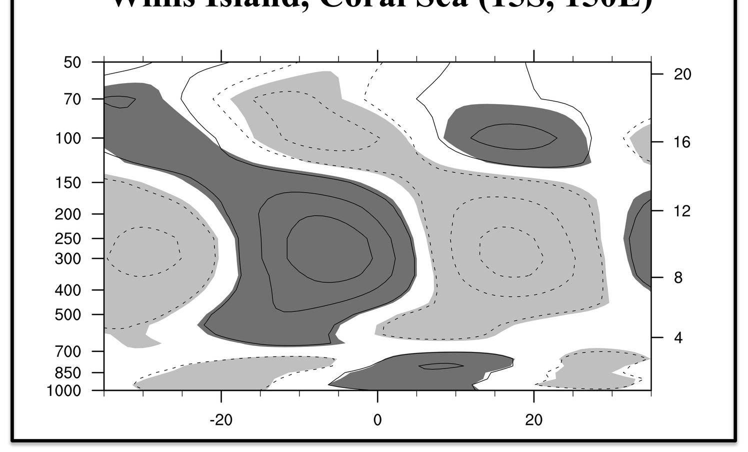


Fig. 1. Locations of the 120 IGRA tropical (20N – 20S) radiosonde stations used in this study, grouped by MJO temperature structure.

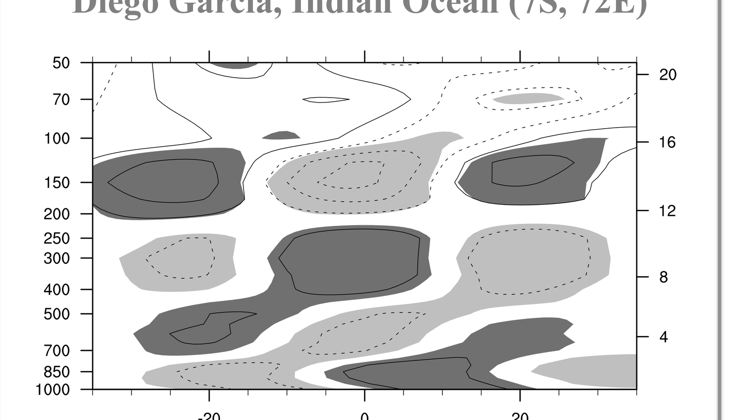
Nairobi, Kenya (1S, 37E)



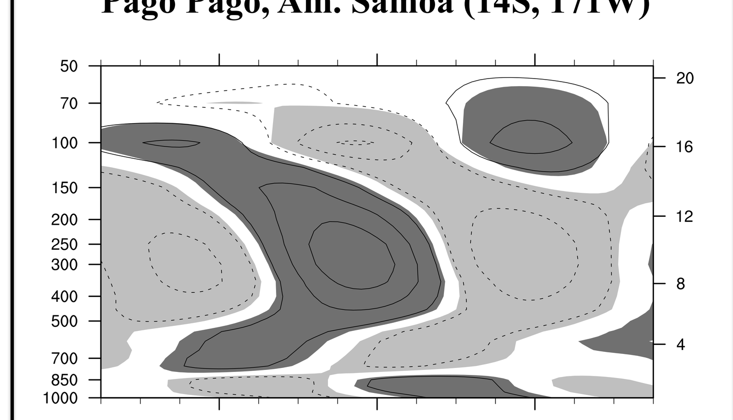
Willis Island, Coral Sea (15S, 150E)



Diego Garcia, Indian Ocean (7S, 72E)



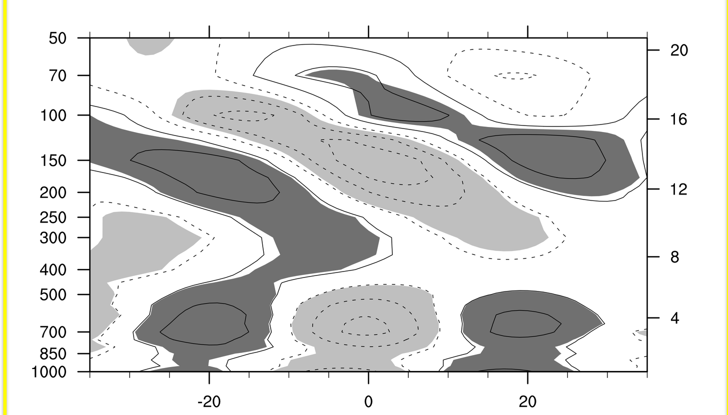
Pago Pago, Am. Samoa (14S, 171W)



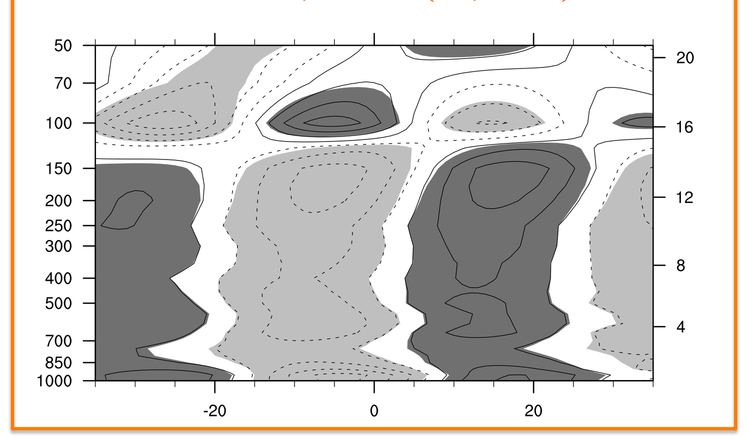
READING THE PLOTS

All plots are oriented with time on the x-axis and pressure/height on the y-axis. Time runs from **right to left** (despite the incorrect labeling!), from -35 to +35 days, so that the plots are comparable to west-to-east cross-sections for an eastward-propagating disturbance. On day 0, OLR in the 5-degree box centered on the grid point closest to the station location is a minimum. Temperature values are scaled to a -20 W m^{-2} OLR anomaly on day 0. Solid (dashed) lines represent positive (negative) temperature anomalies, starting at +/- 0.1 K with a contour interval of 0.2 K. Shading represents statistical significance at the 95% level.

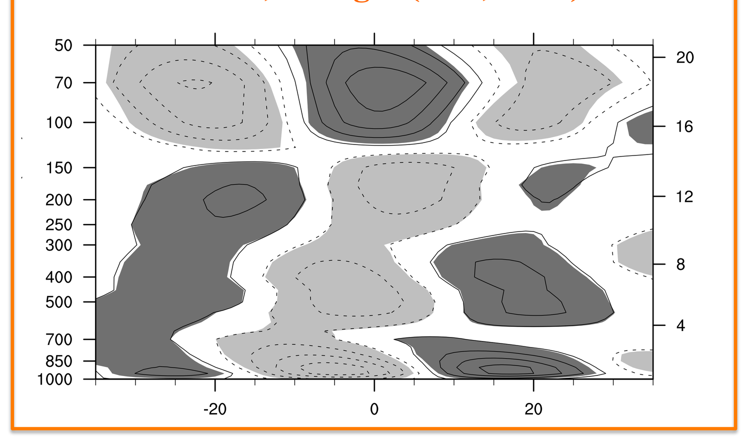
Grand Cayman, Cayman Is. (19N, 81W)



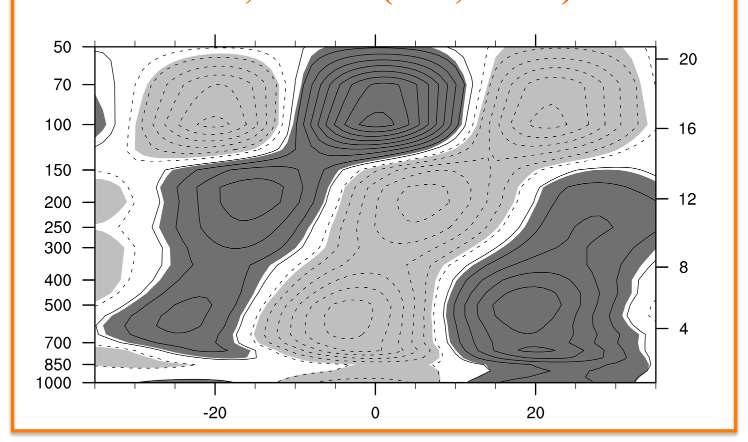
Manaus, Brazil (3S, 60W)



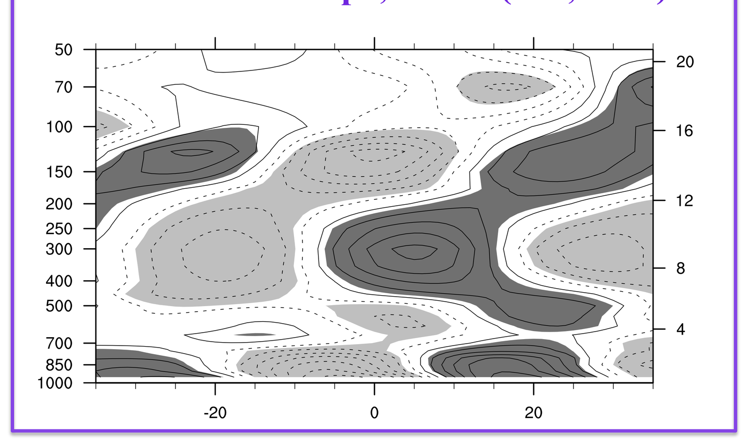
Dakar, Senegal (15N, 18W)



Hilo, Hawaii (20N, 155W)



Bom Jesus de Lapa, Brazil (13S, 43W)



FUTURE WORK

This is very much a work in progress. Specific humidity and zonal wind structures will also be calculated for each station, regressions will be calculated by season, twice-daily data will be generated for stations with higher resolution (about 50%), and alternative MJO indices such as the RMM index will be explored.

In addition, all station data will be regressed against a single MJO index to generate radiosonde-only horizontal maps of temperature, zonal wind, and specific humidity.

REFERENCES

Durre, I., R. S. Vose, and D. B. Wuertz, 2006: Overview of the Integrated Global Radiosonde Archive. *J. Climate*, **19**, 53-68.

Kiladis, G. N., K. H. Straub, and P. T. Haertel, 2005: Zonal and vertical structure of the Madden-Julian Oscillation. *J. Atmos. Sci.*, **62**, 2790-2809.