Decadal trends in convection from satellite microwave observations of near-surface wind and deep precipitating clouds

Ziad Haddad¹, Svetla Hristova-Veleva¹, and Nobuyuki Utsumi²

¹University of California, Los Angeles, Joint Institute For Regional Earth System Science and Engineering, United States of America (zsh@alum.mit.edu)
²Jet Propulsion Laboratory, California Institute of Technology

Since the past decade, evidence derived from model reanalysis (including outgoing longwave radiation, tropopause height, the latitude where zonal mean precipitation exceeds evaporation, and the latitude where the zonal mean 500-hPa meridional streamfunction crosses from positive to negative) indicate that the tropics have been expanding since at least 1979, by a very approximate one degree per decade. To the reanalysis evidence, we have added our direct analysis of near-surface wind estimated from satellite radar scatterometry. These show a widening of the Hadley circulation, with a distinct poleward migration of the zonally-averaged crossing latitudes (from easterly trade winds in the tropics to the mid-latitude westerly winds) by about 1 degree per decade. This begs the question: are the precipitation patterns changing accordingly? The brief answer, derived from analysis of the Tropical Rainfall Measuring Mission radar data, is that deep storm top heights in the tropics showed a monotone increase over the 16-year TRMM record, but their occurrences became steadily less frequent. This will be described in more detail, along with a method to increase the sample size from the rather poor temporal sampling by the TRMM radar to a 50-fold larger sample from the microwave radiometer constellation.