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Plain Language Summary: Although the Global Positioning System (GPS) has been widely used to study long-term trends or diurnal and subdiurnal cycles of precipitable water vapor (PWV), it has been rarely used for the intra-seasonal scale. We used the zenith wet delay (ZWD) data from the Sumatran GPS Array (SuGAr) in Indonesia, with help from reanalysis data, to study the summer intra-seasonal variability of PWV over Sumatra in years without strong inter-annual variability, and to probe the underlying atmospheric processes that control the variability.

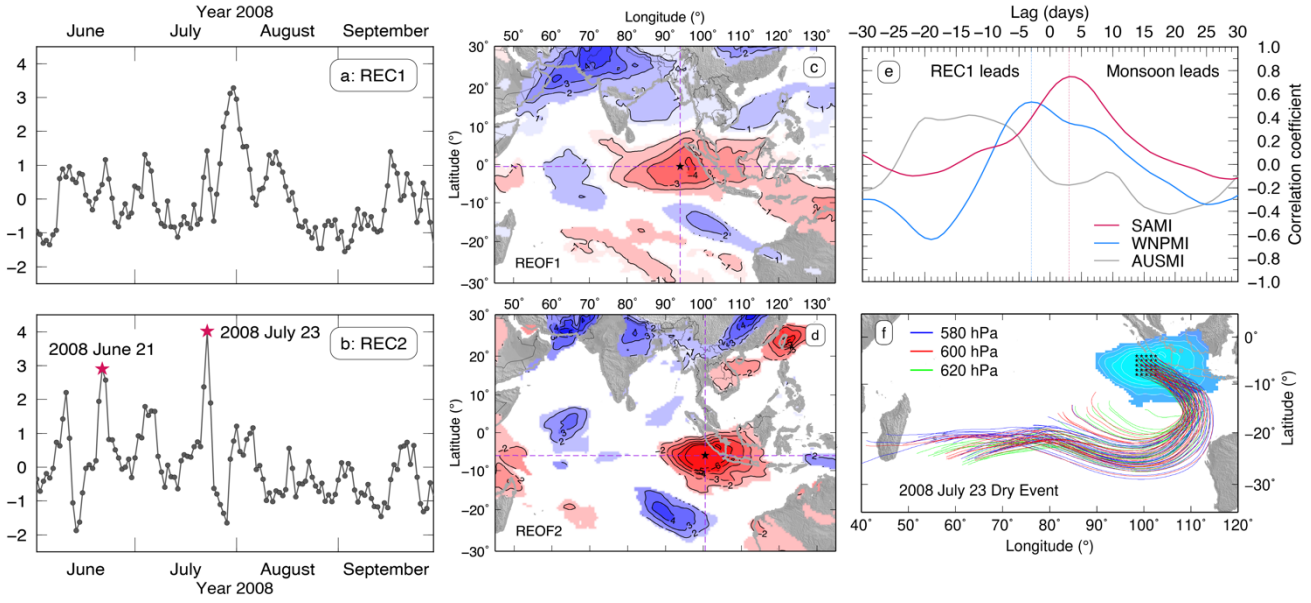

Figure 1. A case study of the 2008 northern summer. We decomposed the ZWD space-time field into modes of variability using rotated Empirical Orthogonal Function (EOF) analysis. (a, b) the rotated Expansion Coefficients (REC) for the two leading modes. (c, d) Linear regression coefficients for the first two modes with PWV in reanalysis data. (e) Lead-lag correlation coefficients between the REC1 and three monsoon circulation indices, including the South Asian monsoon index (SAMI), western North Pacific monsoon index (WNPMI), and Australian monsoon index (AUSMI). (f) The back trajectory of the REOF2 dry-air intrusion event on 2008 July 23, shown as a red star in (b).

- The summer intra-seasonal variability of daily ZWD over Sumatra in 2008, 2016, and 2017 is dominated by the South Asian Summer Monsoon, and further influenced by dry-air intrusions associated with eastward-propagating Rossby waves in the Southern Hemisphere midlatitudes.
- As the first ground-based GPS data used for studying dry-air intrusions, the SuGAr data provide new in-situ evidence that extratropical dry-air intrusions reach the deep tropics within 5° south of the equator over the Maritime Continent.