



## **Long-term variability of mean winds in the mesosphere and lower thermosphere within $\pm 22^\circ$**

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We studied the long-term variability of mean zonal and meridional winds in the Mesosphere and Lower Thermosphere (MLT) at seven locations using MF radar observations from Kauai ( $22^\circ\text{N}$ ,  $154^\circ\text{W}$ ), Tirunelveli ( $8.7^\circ\text{N}$ ,  $77.8^\circ\text{E}$ ) and Pameungpeuk ( $7.4^\circ\text{S}$ ,  $107.4^\circ\text{E}$ ) and meteor radar observations from Christmas Island ( $2^\circ\text{N}$ ,  $157^\circ\text{W}$ ), Koto Tabang ( $0.2^\circ\text{S}$ ,  $100.3^\circ\text{E}$ ), Jakarta ( $6^\circ\text{S}$ ,  $107^\circ\text{E}$ ), and Rarotonga ( $21.2^\circ\text{S}$ ,  $159.7^\circ\text{W}$ ). Locations with nearly similar latitudes such as Christmas Island and Koto Tabang, and Jakarta and Pameungpeuk are treated as single location (thus, ignored longitudinal variation) and the data are appended at each latitude to get long-term data. Thus, we have five distinct latitudes. The length of the data is different at different latitudes and spans a maximum of two decades. The mean meridional winds show a distinct annual oscillation at all locations. But, the time at which winds change direction (from north to south or south to north) is different at different latitudes, suggesting that pole-pole circulation is not taking place during equinoxes. Furthermore, the meridional winds show similar long-term variability at conjugate locations of  $\sim \pm 8^\circ$ . The zonal wind shows a distinct semiannual oscillation at all locations. The annual mean zonal winds within  $\pm 8^\circ$  are westward biased and are eastward biased outside. The zonal winds does not show any significant long-term trends. The Quasi-Biennial variability of MLT winds (called MQBO) is observed at all locations.