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The Climatology of the Equivalent Winds Derived from Global Ionosonde Database

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The large observational ionosonde database from the 1950s to nowadays makes a global investigation on the equivalent winds available. The vertical equivalent winds (VEWs) are defined as the combined contribution of both the neutral meridional winds and the north perpendicular electric field drifts. Using our developed method, the climatology behaviors of VEWs involving their diurnal, seasonal, latitudinal and solar cycle dependence are analyzed not only at individual station, but also in a global scope. The diurnal variation of VEWs is different in directions and magnitudes from low to higher latitudes. Prominent seasonal variations are also identified. The equinox asymmetry feature is investigated based on global ionosonde measurements. Appreciable equinox asymmetry trend is found during daytime while absent at night over most stations. At moderate solar activity, the magnitude of VEWs is consistently smaller by an average of around 5-10 m/s in spring than that in fall. The latitudinal dependence of VEWs has two prevailing trends: one is a mid-latitude maximum at magnetic latitude of about 30-40o. The other is a maximum at the highest latitudes (as far as the latitudes concerned in the present work). These two latitudinal trends are mostly dependent on season, while they depend relatively weakly on local time and solar activity. The solar cycle variability of thermospheric circulation, one of the outstanding questions involving the upper atmosphere, is also examined with global ionosonde data more than one solar cycle. With increasing solar activity, the derived equivalent winds are found of nonlinearly decreased diurnal amplitudes in all seasons at most stations. This implies that the increase in ion drag more than compensates for pressure gradients and thus restrains the diurnal amplitude at high solar activity. The diurnal phase of the derived equivalent winds generally shifts later at higher solar activity.