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Study of ionospheric TEC phenomena using the 13-year TOPEX data series: Annual Asymmetry, Semi-annual Anomaly and seasonal variation

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During the first decades of ionospheric research, the physical description of the ionospheric free electron vertical density was mainly given by the Chapman theory in which the main driving parameters were the solar irradiance level and the solar zenith distance from the observation point. Whatever a new observed phenomenon that could not be explained by the Chapman theory was considered an 'anomaly'. After more than 50 years of continuous aeronomic research, many of these phenomena then called 'anomalies' were physically explained but some of them are still open to discussions, like the so called Semi-annual Anomaly that produces global mean TEC values larger for Equinoxes than for Solstices; and the Annual Asymmetry that causes larger mean global TEC during the December than June solstice (far larger than the 7% due to the change on the Sun-Earth relative distance). Using the high-precision TEC 13-year data series provided by the TOPEX/Poseidon mission, we have obtained a detailed characterization of the Semi-annual Anomaly and the Annual Asymmetry. In this work, we have computed a daily mean TEC series for each geographic hemisphere and found that the global effects of both phenomena appear enhanced for the Southern Hemisphere and significantly attenuated for the Northern hemisphere. These distinctive behaviours can be explained by considering the seasonal variation (modelled by Chapman theory and dependent on the Sun's declination) and thus with effects in opposition of phase on both hemisphere.