Strong long-term cooling of the ionosphere observed by multiple incoherent scatter radars

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Compelling evidence for long-term changes in the upper atmosphere over the last several solar cycles has emergedfollowing a seminal modeling study by Roble and Dickson (1989), suggesting potential effects of increasedgreenhouse gases on the ionosphere and thermosphere. Direct measurements of the cooling trend come from in situ neutral density data available since 1960s, and from ground-based incoherent scatter radar (ISR) plasma temperature data available systematically at Millstone Hill (42.6N 288.5) since the late 1960s and elsewhere since the later years. Other observations also seem to show indirectly signs of the cooling which are not alwaysconsistent. However, the cool intensity from ISR data appear much more significant than expected from effects ofanthropogenic increases in the CO2 mixing ratio, as initially suggested by Millstone Hill data. We have now examined furth the strong cooling with additional new datasets of ISRs: the Sondrestrom (67.0N, 309.1E) ISR(1990-), which is typically located at cusp during the day, as well as Chatanika/Poker Flat (65.1N, 212.6E) ISRs(1976-) which is often considered as an aurora latitude site. New analyses of these observations continue toindicate strong ionospheric cooling, therefore imposing an important question as to what is really driving theselong-term changes in the upper atmosphere. We will make comparisons of these ISR results from mid- and highlatitudes, and discuss potential drivers for the unexpected strong cooling in the ionosphere.

Keywords: long-term change, ionosphere, incoherent scatter radar

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