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Solar flare effects on the Earth's ionosphere as measured by the Arecibo incoherent scatter radar

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Surprisingly, there are only very few direct electron density measurements during solar flare events reported that have been made with incoherent scatter radars (ISR), particularly the powerful ISR at Arecibo. Here, we take advantage of an existing data base to report on solar flare-related electron density measurements made with the Arecibo radar which monitored the ionosphere from 60 to 430 km altitude with a height resolution of $\sim$600 m and a time resolution of $\sim$ 1.8 min. The results to be discussed refer to several solar flares in the range from about C50 to X50, that is, the X-ray fluxes in the 1.0 – 8.0 Å band range from 5 μW/m2 to 5 mW/m2, as measured and classified by the GOES satellite space environment X-ray monitor. The emphasis is placed on the structure of the modified electron density profiles and the temporal altitudinal variations of electron densities relative to the radiation changes measured by GOES in the long (XL) and short (XS) X-ray bands of 0.5 to 4.0 Å and 1.0 to 8.0 Å, respectively. These results can be useful in the validation of existing D region photochemical models as well as VLF (very low frequency) and HF (high frequency) radio wave propagation models. In addition, they can provide a judgement on the significance of ionospheric TEC (total electron content) changes anticipated during solar flare events of different magnitude.