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# The impact of geomagnetic storms and solar proton events in May and October 2024 on South Africa's upper atmosphere, compared to the historical event of October 2003

This study investigated the impact of solar proton events (SPE) on the upper atmosphere over South Africa during intense geomagnetic storms in May (Dst = -412 nT) and October 2024 (Dst = -333 nT). Utilizing the NRLMSISE-2.0 atmospheric model and SOHO data, we characterized storm-time atmospheric composition and energetic particle fluxes. Significant fluctuations in atmospheric constituents were observed, with molecular nitrogen (N<sub>2</sub>) increasing by 3.61×10<sup>6</sup> cm<sup>-3</sup> day<sup>-1</sup> during the May sudden storm commencement (SSC) and by 1.40×10<sup>6</sup> cm<sup>-3</sup> day<sup>-1</sup> and 2.26×10<sup>6</sup> cm<sup>-3</sup> day<sup>-1</sup> during the two-step SSC of October. A decrease in atomic hydrogen (H) of about 3.0×10<sup>4</sup> cm<sup>-3</sup> day<sup>-1</sup> occurred in May, while the largest decrease of approximately 8.60×10<sup>3</sup> cm<sup>-3</sup> day<sup>-1</sup> was noted during the October storm. These changes, driven by particle precipitation that enhances nuclear and molecular interactions at GNSS altitudes (400 –450 km), affect the total electron content (TEC) and may compromise GNSS signal accuracy. The results are compared with the historical event of solar cycle 23 in October 2003 (Dst = -353nT). This research enhances our understanding of space weather's impact on the upper atmosphere and related technologies.

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None

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Yes, I ACCEPT

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