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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

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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 (N₂) increasing by 3.61×10⁶ cm⁻³ day⁻¹ during the May sudden storm commencement (SSC) and by 1.40×10⁶ cm⁻³ day⁻¹ and 2.26×10⁶ cm⁻³ day⁻¹ and 2.26×10⁶ cm⁻³ day⁻¹ and 2.26×10⁶ cm⁻³ ady⁻¹ ady⁻¹ and 2.26×10⁶ cm⁻³ ady⁻¹ ady⁻¹

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