



## Investigating Uplift in the Afar Depression: Tectonic Complexity and Afar Plume through InSAR Time Series (2014–2024)

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The Afar Depression, a key tectonic and volcanic region in East Africa, is characterized by complex interactions between rifting processes and mantle dynamics, particularly the influence of the rising Afar plume. This study offers a detailed investigation of uplift patterns in the Afar Depression over a decade (from 2014 to 2024) using Interferometric Synthetic Aperture Radar (InSAR) time-series analysis. The objective of this study is to generate critical insights and key observations as a foundational resource for advancing and refining future geological research. Resolving subtle, spatially distributed uplift patterns linked to tectonic activity has historically been challenged by methodological limitations. To address this, we analyzed three ascending (14, 87, 116) and four descending (6, 35, 79, 108) Sentinel-1A paths, applying the Small Baseline Subset (SBAS) method, complemented by decomposition techniques to achieve precise deformation measurements. We categorized the Afar area according to regions with the highest uplift rates, aiming to identify zones exhibiting significant tectonic activity. Our analysis reveals significant spatial and temporal variations in uplift rates, providing new insights into the region's tectonic complexity and the role of the Afar plume. These findings highlight the intricate interplay between plume-driven uplift and tectonic structures, advancing our understanding of the Afar Depression's geological evolution and the broader dynamics of continental rifting and lithospheric deformation.