ANALISIS DEFORMASI GUNUNG MARAPI MENGGUNAKAN METODE *DIFFERENTIAL INTERFEROMETRY SYNTHETIC APERTURE RADAR*

ABSTRAK

Telah dilakukan analisis deformasi permukaan Gunung Marapi, Sumatera Barat, pasca-erupsi 3 Desember 2023 menggunakan teknik *Differential Interferometric Synthetic Aperture Radar* (DInSAR). Tujuannya adalah mengungkap dinamika deformasi sebagai indikator aktivitas vulkanik untuk mendukung mitigasi bencana. Citra Sentinel-1A (mode IW-SLC) periode 23 Oktober 2023 hingga 15 Januari 2024 diproses melalui tahapan koregistrasi, interferogram, koreksi topografi (DEM SRTM 30 m), *phase unwrapping*, dan konversi ke deformasi menggunakan SNAP dan QGIS. Hasil menunjukkan pola deformasi tiga fase: deflasi ringan pra-erupsi, inflasi signifikan menjelang erupsi, dan deflasi pasca-erupsi. Inflasi maksimum sebesar +0,84 m terjadi pada 28 November – 10 Desember 2023, diikuti oleh deflasi hingga –0,90 m pada 10 Desember 2023 – 15 Januari 2024. Arah vektor yang konvergen ke pusat kawah menunjukkan akumulasi tekanan akibat migrasi magma atau gas, selaras dengan erupsi eksplosif 3 Desember 2023. Pola deformasi juga menunjukkan migrasi tekanan ke arah barat daya, relevan dengan erupsi dan bencana lahar dingin Mei 2024. Hasil studi ini berkorelasi kuat dengan data aktivitas vulkanik dari PVMBG/MAGMA Indonesia, baik secara seismik maupun visual. Dapat disimpulkan bahwa metode DInSAR efektif memantau deformasi vulkanik secara spasial dan temporal, dengan keunggulan resolusi tinggi dan kemampuan mendeteksi perubahan mikro. Pendekatan ini berpotensi menjadi instrumen penting dalam sistem peringatan dini dan mitigasi bencana berbasis data.

Kata Kunci : DInSAR, Sentinel-1A, Deformasi Gunung Api, Gunung Marapi, Pemantauan Vulkanik.

DEFORMATION ANALYSIS OF MOUNT MARAPI USING THE DIFFERENTIAL INTERFEROMATRY SYNTHETIC APERTURE RADAR METHOD

ABSTRACT

This research analyzes the surface deformation of Mount Marapi, West Sumatra, post-eruption on December 3, 2023, utilizing the Differential Interferometric Synthetic Aperture Radar (DInSAR) technique. The main objective of the study is to reveal the dynamics of surface deformation as an indicator of volcanic activity that can be utilized for disaster mitigation. Sentinel-1A images (IW-SLC mode) from the period of October 23, 2023, to January 15, 2024, were processed through the stages of co-registration, interferogram generation, topographic correction using a 30 m resolution SRTM DEM, phase unwrapping, and phase-to-surface deformation conversion using SNAP and QGIS software. The processing results show a three-phase deformation pattern: mild pre-eruption deflation, significant inflation leading up to the eruption, and post-eruption deflation. Maximum inflation was recorded at +0.84 m during the period of November 28 – December 10, 2023, followed by deflation of up to –0.90 m in the period of December 10, 2023 – January 15, 2024. The spatial pattern of the deformation vector indicates pressure migration towards the southwest slope, which is relevant to the location of the eruption event and the lahar dingin (cold lava flow) disaster in May 2024. From these findings, it can be concluded that the DInSAR method is proven to be effective in monitoring volcanic deformation both spatially and temporally, with advantages in its wide coverage, high resolution, and ability to quantitatively detect micro-changes. The results of this study also show a strong correlation with volcanic activity data recorded by PVMBG/MAGMA Indonesia, in terms of both seismic parameters and visual observations. Therefore, this approach can be used as an important instrument in early warning systems and data-based disaster mitigation decision-making.

Keywords: DInSAR, Sentinel-1A, Volcanic Deformation, Mount Marapi, Volcanic Monitoring