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Judul Jurnal Ilmiah (Artikel) : Anomaly detection on displacement rates and deformation pattern features using tree-based algorithm in Japan and Indonesia

Jumlah Penulis : Enam (Adi Wibowo\*, Satriawan Rasyid Purnama, Cecep Pratama, Leni Sophia Heliani, David P. Sahara, Sidik Tri Wibowo)

Status Pengusul : penulis ke 1 (Satu) / Korespondensi

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- a. Nama Jurnal : Geodesy and Geodynamics
- b. Nomor ISSN : 1674-9847
- c. Vol, No., Bln Thn : Volume 14, Issue 2, March 2023, Pages 150-162
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**2. Ruang lingkup dan kedalaman pembahasan:**

Ruang lingkup paper ini membahas penggunaan analisis berbasis data untuk mendeteksi anomali dalam aktivitas kerak temporal dan spasial yang terkait dengan gempa bumi besar menggunakan data Global Navigation Satellite System (GNSS) dari Indonesia dan Jepang. Kedalaman pembahasan baik dalam mengusulkan teknik machine learning untuk mengekstraksi pola deformasi dan tingkat perpindahan dari data GNSS harian untuk mengidentifikasi anomali terkait gempa bumi besar dalam dua dekade terakhir.

**3. Kecukupan dan kemutakhiran data/informasi dan metodologi:**

Data GNSS yang digunakan mutakhir dan hasil yang diperoleh dalam penelitian baik dengan didukung metodologi yang tepat dengan jumlah referensi kurang dari 5 tahun sejumlah 22.

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Paper ini diterbitkan dalam jurnal berkualitas Q2 dengan SJR 0,46 oleh Elsevier dengan unsur-unsur yang lengkap serta kualitas yang baik.

Semarang, 2 April 2023

Reviewer 1



Prof. Dr. Kusworo Adi, S.Si., M.T..

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Unit Kerja: Fakultas Sains dan Matematika

Universitas Diponegoro

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**LEMBAR  
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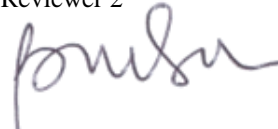
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- Ruang lingkup dan kedalaman pembahasan:**  
Ruang lingkup artikel ini tentang data sains untuk data GNSS wilayah Indonesia dan Jepang. Kedalaman pembahasan sangat baik dengan banyak experiment menggunakan beberapa metode machine learning.
- Kecukupan dan kemutakhiran data/informasi dan metodologi:**  
Dalam studi tersebut, telah diperoleh sekumpulan informasi yang didukung oleh metodologi yang tepat dan didukung oleh referensi yang terbaru.
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Semarang, 3 April 2023  
Reviewer 2



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# Anomaly detection on displacement rates and deformation pattern features using tree-based algorithm in Japan and Indonesia

Wibowo, Adi<sup>a</sup> ; [Purnama, Satriawan Rasyid<sup>a</sup>](#); [Pratama, Cecep<sup>b</sup>](#); [Heliani, Leni Sophia<sup>b</sup>](#); [Sahara, David P.<sup>c</sup>](#); [Wibowo, Sidik Tri<sup>d</sup>](#)[Save all to author list](#)<sup>a</sup> Department of Informatics, Universitas Diponegoro University, Semarang, Indonesia<sup>b</sup> Department of Geodetic Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia<sup>c</sup> Global Geophysics Research Group, Faculty of Mining and Petroleum Engineering, Institute of Technology Bandung, Bandung, Indonesia<sup>d</sup> Geospatial Information Agency, Indonesia

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## Abstract

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## Abstract

Research on strain anomalies and large earthquakes based on temporal and spatial crustal activities has been rapidly growing due to data availability, especially in Japan and Indonesia. However, many research works used local-scale case studies that focused on a specific earthquake characteristic using knowledge-driven techniques, such as crustal deformation analysis. In this study, a data-driven-

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based analysis is used to detect anomalies using displacement rates and deformation pattern features extracted from daily global navigation satellite system (GNSS) data using a machine learning algorithm. The GNSS data with 188 and 1181 continuously operating reference stations from Indonesia and Japan, respectively, are used to identify the anomaly of recent major earthquakes in the last two decades. Feature displacement rates and deformation patterns are processed in several window times with 2560 experiment scenarios to produce the best detection using tree-based algorithms. Tree-based algorithms with a single estimator (decision tree), ensemble bagging (bagging, random forest and Extra Trees), and ensemble boosting (AdaBoost, gradient boosting, LGBM, and XGB) are applied in the study. The experiment test using real-time scenario GNSS daily data reveals high F1-scores and accuracy for anomaly detection using slope windowing 365 and 730 days of 91-day displacement rates and then 7-day deformation pattern features in tree-based algorithms. The results show the potential for medium-term anomaly detection using GNSS data without the need for multiple vulnerability assessments. © 2022 Editorial office of Geodesy and Geodynamics

#### Author keywords

Anomaly; Deformation pattern; Displacement rates; GNSS; Tree-based algorithm

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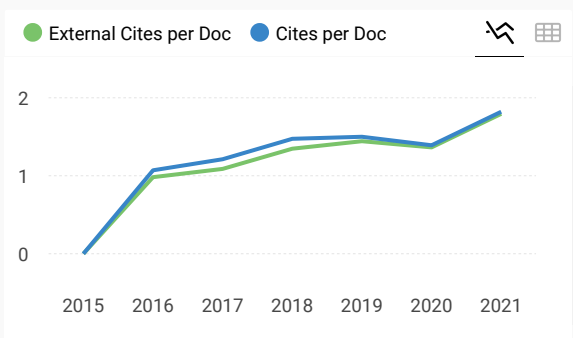
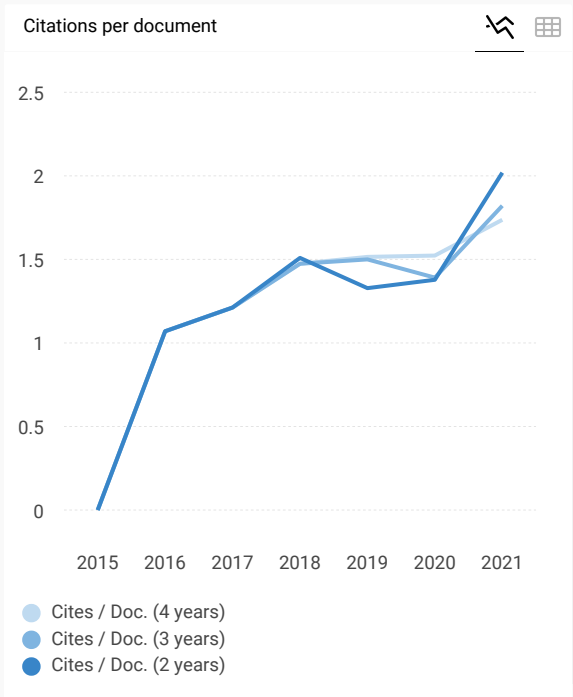
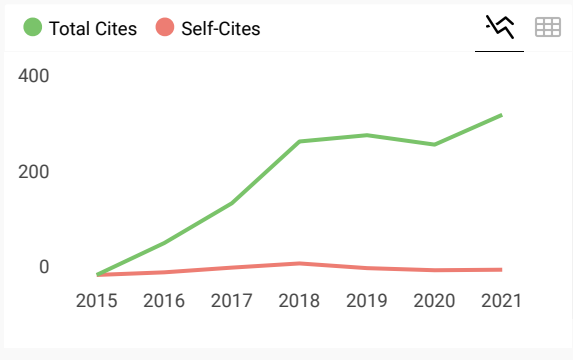
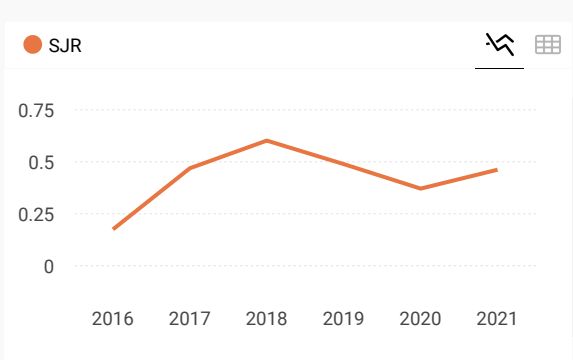
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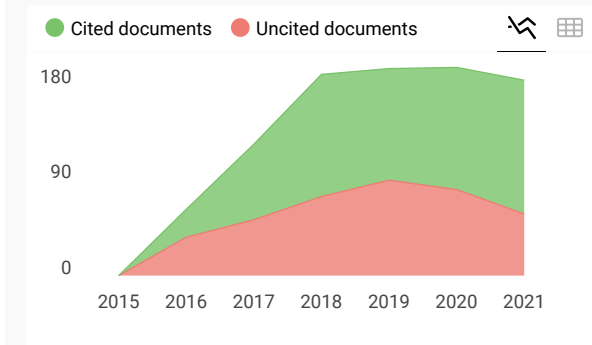
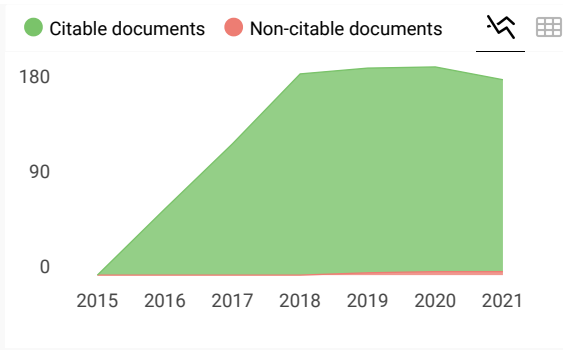
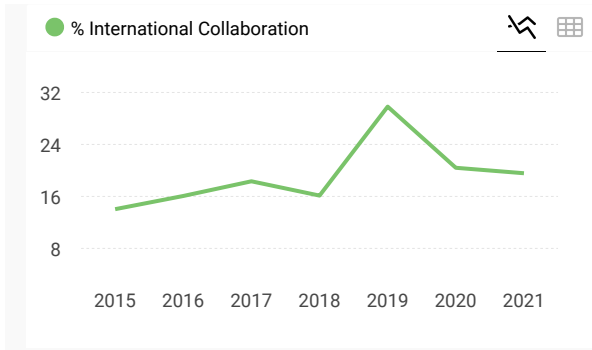
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