Muhammad Tahir Javed

Date of birth: 01/03/1991 | **Nationality:** | **Phone number:**

Email address:

Address:

ABOUT ME

Geophysicist with **Ph.D.** specializing in **coseismic** and **postseismic deformation modelling**, **gravity-field simulations**, and **spherical harmonic** analysis for **major** and synthetic **earthquakes**. Experienced in evaluating satellite gravimetric mission sensitivity (**NGGM, MAGIC, GRACE/GRACE-FO**) through **forward modelling** of displacement, gravity, and geoid variations.

APPLICATION/DOMANDA DI PARTECIPAZIONE:

Satellite gravimetric missions sensitivity to tectonic events

I am writing to express my interest in the position within the project *"Satellite gravimetric missions sensitivity to tectonic events – NGGM and MAGIC Science and Application Impact Study"*. My academic background and research experience align closely with the scientific objectives and requirements of the call. Below, I address each requirement explicitly:

PhD with topics similar to the call / Modelling of coseismic and postseismic deformation / Definition of dislocation models for M > 7.5 earthquakes:
I hold a PhD in *Earth Science, Fluid Dynamics, and Mathematics* from the University of Trieste, where I specialised in earthquake-cycle deformation using space geodesy. My work includes advanced InSAR processing, finite-fault modelling, and inversions of coseismic, afterslip, and visco-elastic postseismic deformation across complex tectonic regions such as the Sulaiman Fold-and-Thrust Belt and the East Anatolian Fault zones. I routinely process satellite observations, perform linear and Bayesian inversions to estimate surface displacement and fault dislocation parameters, and construct finite-fault models to derive slip distributions for large earthquakes, including those above Mw 7.5.

Sensitivity analysis of the gravimetric potential field from selected satellite constellations:
Since March 2024, I have been a Research Fellow at ICTP, hosted by the University of Trieste, contributing to the ESA project *"Studying the Impact of the NGGM and MAGIC missions (SING)"*. My work focuses on evaluating the capability of NGGM and MAGIC to detect co- and post-seismic gravity and deformation signals through forward modelling of displacement, gravity, and geoid variations using QSSP synthetic modelling. I assess detectability thresholds and compare mission performance with GRACE, GRACE-FO, QSG, NGGM, and MAGIC configurations.

Knowledge of modelling software for geodetic deformation and gravimetric variations / Modelling of coseismic and postseismic gravity fields:
I have extensive experience modelling co- and post-seismic gravity signals using **QSSPSTATIC**, dedicated software to compute displacement (East, North, Up), gravity changes, and geoid variations. I have applied these workflows to major earthquakes such as the 2010 Maule Mw 8.8, the 2023 Kahramanmaraş Mw 7.8, and the 2025 Kamchatka Mw 8.5, as well as to synthetic Mw > 8.0 scenarios with varying depths, focal mechanisms, and degrees of self-gravitation. I have also run large-scale finite-fault simulations for the Maule 2010 and Kahramanmaraş 2023 events on HPC systems, optimising QSSPSTATIC workflows for efficient modelling.

Definition of spherical harmonic spectra of the gravimetric potential field:
After computing forward models for real and synthetic events, I generate spherical harmonic spectra of the gravity potential field and perform sensitivity analyses using mission-specific error curves, supporting the evaluation of detectability thresholds and cross-mission comparisons among GRACE, GRACE-FO, QSG, NGGM, and MAGIC.

Programming in scientific languages and knowledge of HPC systems:
I am proficient in MATLAB, bash, awk, and scientific workflows, with substantial experience in high-performance computing. I have developed custom scripts for batch processing real and synthetic earthquake scenarios and time-dependent postseismic models running QSSPSTATIC on HPC clusters.

Based on my skills, research background, and direct experience with all activities listed in the call, I am confident in my ability to contribute effectively to the NGGM and MAGIC project and to support the goals of your research group. Thank you for considering my application.

EDUCATION AND TRAINING

01/11/2020 – 29/05/2024 Trieste, Italy
PH.D. IN EARTH SCIENCE, FLUID DYNAMICS, AND MATHEMATICS: INTERACTIONS AND METHODS
University of Trieste, Italy

- Mechanics of earthquake and faulting from Spaceborne Geodesy.
- Processing of Sentinel-1 and ALOS-2 ScanSAR data for inversions and time series analysis.

Thesis Kinematic Inversion of Earthquake Cycle Deformation using Space Geodesy (Supervisors: Prof. Carla Braitenberg (University of Trieste, Italy), Prof. Sylvain Barbot (University of Southern California, USA))

30/06/2017 – 15/11/2019 Islamabad, Pakistan
MASTER OF PHILOSOPHY IN GEOPHYSICS, VERIFIED LAUREA SPECIALISTICA IN GEOFISICA Quaid-i-Azam University, Islamabad

- Coseismic and postseismic deformation modeling using space geodetic data.
- Seismic exploration methods and Seismic Inversions.

Thesis Modeling of crustal deformation caused by 2015 Mw 5.6 earthquake using InSAR observations and related seismic hazards assessments (Supervisors: Prof. Amir Ali, Dr. Farhan Javed)

01/09/2015 – 31/08/2016 Trieste, Italy
PRE-PHD DIPLOMA IN EARTH SYSTEM PHYSICS The Abdus Salam International Centre of Theoretical Physics (ICTP), Trieste

- Solid Earth and Tectonic, Theoretical and computational seismology.
- Mechanics of earthquake, faulting, and tectonophysics.
- Seismic waveform modeling, Numerical Modeling, and Inverse Theory.

Thesis Understanding the continental collisional processes of Peri-Adriatic region using GPS (Supervisors: Prof. Abdelkrim Aoudia, Dr. Alessandra Borghi)

WORK EXPERIENCE

▦ THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, – TRIESTE, ITALY
POSTDOCTORAL RESEARCH FELLOWSHIP (ESA SING PROJECT) – 01/12/2024 – 30/11/2025

- Evaluated the sensitivity of **NGGM/MAGIC** constellations on detecting gravity variations from plate boundary earthquakes.
- Investigated the **detectability and sensitivity** of NGGM/MAGIC over GRACE-FO for Solid Earth applications.
- **Point source and finite fault modeling** for earthquakes with **Mw > 7.5** using QSSPSTATIC software on **HPC and Linux** environments.
- Assistance in **report writing** and presentations for the **ESA SING project.**

▦ THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS (ICTP) – TRIESTE, ITALY
RESEARCH FELLOWSHIP – 01/03/2024 – 30/11/2024

- **Point source modeling** for earthquakes with **2023 Kahramanmaraş Mw 7.8** using **QSSPSTATIC** software.
- Processed **time-series InSAR data** using SBAS and MintPy for the East Anatolian Fault Zone.
- Evaluation of potential seismic gap on the Pütürge segment based on **time series** from SAR **observation from 2015 to 2020, and 2020 to 2024**.
- Interpretation of **tectonic complexity due to a triple junction fault system** resulting in transpression at the western zone of the **SFT belt** using **time series InSAR** observations.

▦ CENTRE FOR EARTHQUAKE STUDIES, NATIONAL CENTRE FOR PHYSICS – ISLAMABAD, PAKISTAN
RESEARCH SCIENTIST – 29/07/2019 – 29/01/2020

- Modeled coseismic crustal deformation using InSAR techniques.
- Analyzed land subsidence by integrating InSAR and groundwater data.

TEACHING EXPERIENCES

- **Teaching Assistant to Prof. Carla Braiteberg** in the **Ph.D. course**: Earth Monitoring with Space Geodetic Interferometry in 2025 (4 hours), University of Trieste, Italy.
- **Teaching Assistant to Prof. Carla Braiteberg** in the **Ph.D. course**: Earth Monitoring with Space Geodetic Interferometry in 2024 (6 hours), University of Trieste, Italy.
- **Visiting Faculty on the course Earthquake Seismology for Bachelor** (Theory and Lab. Practical) 4 February 2019 to 30 August 2019 (48 hours teaching and 60 hours Lab), Quaid-i-Azam University, Islamabad, Pakistan.

PROJECTS

01/03/2024 – CURRENT
ESA's Studying the Impact of the Next Generation Gravity Missions (SING) in Solid Earth Sciences Applications

- Monitoring and **modeling earthquake cycles** with a range of **magnitudes (7.5 to 9.2)** along major plate boundaries and evaluating the **detection limits** of earthquakes using **NGGM and MAGIC** constellations.
- Investigating the **benefits of NGGM and MAGIC** in constraining **co-seismic and post-seismic** rupture models, and **comparing the accuracy with GNSS, InSAR**, and seismological data.

01/11/2021 – 29/05/2024
Doctorate Project (Ph.D.): Kinematic Inversion of Earthquake Cycle Deformation using Space Geodesy

- Insights into **coseismic folding** during **ramp failure** at the frontal zone of the Sulaiman Fold-and-Thrust (SFT) belt using Geodesy.
- Interpretation of **tectonic complexity due to a triple junction fault system** resulting in transpression at the western zone of the **SFT belt** using **time series InSAR** observations.
- Coseismic **slip distribution due to the 2023 Kahramanmaraş** and Elbistan earthquake sequence and evaluation of the **potential seismic gap** at the **Pütürge segment** of the East Anatolian Fault (EAF) system.

PUBLICATIONS

Slip distribution of the February 6, 2023 Mw 7.8 and Mw 7.6, Kahramanmaraş, Turkey earthquake sequence in the East Anatolian Fault Zone

Barbot, S., Luo, H., Wang, T., Hamiel, Y., Piatibratova, O., **Javed, M.T.**, Braitenberg, C. and Gurbuz, G., *Seismica* 2, no. 3 (2023). https://doi.org/10.26443/seismica.v2i3.502

Coseismic Folding During Ramp Failure at the Front of the Sulaiman Fold-and-Thrust Belt

Javed, M.T., Barbot, S., Javed, F., Ali, A., and Braitenberg, C., *Geophysical Research Letters* 49, no. 23 (2022): e2022GL099953. https://doi.org/10.1029/2022GL099953

2019 M w 5.9 Mirpur, Pakistan Earthquake: Insights from Integrating Geodetic, Seismic, and Field Observations.

Barkat, A., Javed, F., Joe Tan, Y., Ali, A., **Javed, M.T.**, Ahmad, N., Awais, M., Ali Shah,& Iqbal, T. (2022). *Seismological Society of America*, 93(4), 2015-2026. https://doi.org/10.1785/0220210322

Ready to submit (2025): Insights into the Complicated Deformation Pattern in the Western Sulaiman Fold and Thrust Belt using SAR Interferometry.

Javed, M.T., Barbot, S., Javed, F., and Braitenberg, C

In preparation (2026): Distribution of shallow creep along the East Anatolian Fault from 2015 to 2024 Based on Space Geodesy

Javed, M.T., Barbot, S., Javed, F., and Braitenberg, C

CONFERENCES AND SEMINARS

Selected Oral Presentations

- Braitenberg, C., Fantoni, A., **Javed, M.T.**, Maurizio, G., Pastorutti, A. **(25 -30 August 2024)**. Detection limit to Earthquakes and seamounts of Quantum gravimeter payload combined with satellite-satellite tracking from single GRACE type to multiple couples constellations. **G-ETS 2024** Strasbourg (France). https://hdl.handle.net/11368/3087658 .
- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2024, April 14–19)**. *Insights into the transpressional deformation patterns in the western zone of the Sulaiman Fold-and-Thrust Belt from spaceborne geodesy* (Conference presentation). **EGU General Assembly 2024**, Vienna, Austria. https://doi.org/10.5194/egusphere-egu24-19891 .
- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2023, December 11-15)**. Distribution of shallow creep along the East Anatolian Fault prior to the 2023 Turkey earthquake sequence (Conference presentation). (**AGU 2023 Fall Meeting, San Francisco, USA, 2023**). https://ui.adsabs.harvard.edu/abs/2023AGUFM.S11A..02J .
- **Javed, M. T.**, Barbot, S., Javed, F., Braitenberg, C. (2023): The kinematic modeling at the front, and center of the Sulaiman fold-and-thrust belt from Sentinel-1A interferometry, XXVIII General Assembly of the International Union of Geodesy and Geophysics (**IUGG**) **(Berlin 2023)**. https://doi.org/10.57757/IUGG23-4718 .
- **Javed, M. T.**, Coseismic faulting at the eastern Sulaiman Fold-and-Thrust belt. (**Workshop AGLC** dei Giovani Ricercatori, GNGTS, Online, January 31 to **February 01, 2023**.
- **Javed, M.T.**, Barbot, S., Javed, F., Ali, A., and Braitenberg, C. **(2022)**. Coseismic ramp failure at the front of the Sulaiman Fold-and-Thrust Belt, **GNGTS 2022** Trieste, session 1.3 page 161 - 166. https://gngts.ogs.it/atti/GNGTS2022/HTML/160/ .

Selected Poster Presentations

- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2025, April 27–May 2)**. *Seismic potential and creep analysis of the Pütürge Segment (East Anatolian Fault Zone): Insights from SAR interferometry following the 2020 Mw 6.8 Elazığ and the 2023 Mw 7.8 Kahramanmaraş earthquakes* (Conference presentation). **EGU General Assembly 2025**, Vienna, Austria. https://meetingorganizer.copernicus.org/EGU25/EGU25-18055.html .
- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2021, December 13–17)**. *Coseismic fault-propagation folding on the Sulaiman Fold and Thrust Belt* (Conference presentation). **AGU Fall Meeting 2021**, New Orleans, USA & Online. https://www.authorea.com/users/543124/articles/601166-coseismic-fault-propagation-folding-on-the-sulaiman-fold-and-thrust-belt .
- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2023, October 16-27)**. Insights into the fault-bend-fold structures in the Sulaiman Fold-and-Thrust Belt from SAR interferometry (Workshop on Mechanics of the Earthquake Cycle, I**CTP, Trieste, Italy**).
- **Javed, M.T.**, Barbot, S., Javed, F., and Braitenberg, C. **(2021, June 23–26)**. *Fault propagation folding during the 2015 Mw 5.7 Dajal earthquake on the Sulaiman Fold and Thrust Belt from Sentinel-1A* (Conference presentation). International Symposium on Geodynamics and Earth Tides (**G-ET 2021)**, Wuhan, China / Online. https://hdl.handle.net/11368/3029642 .

SKILLS AND DECLARATIONS

Few Highlights Skills

- Modeling earthquake **gravity** and **displacements** using **QSSPSTATIC** Software codes.
- Strong experience in **computational** modeling processing InSAR data using GMTSAR, ISCE2, MintPy, LiCSBAS, and LiCSAR.
- Proficient in **scientific programming** and data analysis **(MATLAB, Bash).**
- Extensive experience in running **QSSPSTATIC** in **high-performance computing (HPC)** environments.
- Experienced in evaluating satellite gravimetric mission sensitivity (**NGGM, MAGIC, GRACE/GRACE-FO**) through **forward modelling** of displacement, gravity, and geoid changes due to earthquakes.
- Effective communicator with experience **presenting research at international conferences**, workshops, and collaborative meetings.
- Volunteered for peer-reviewed publications (2/2024, 2/2025 in PAAGEO).
- Strong experience in **scientific writing**, proposal preparation, and mentoring junior researchers (in Pakistan).
- Proficient experience in using **Jupyter notebooks.**

Declarations

Sulla base della mia esperienza, dichiaro formalmente di possedere tutte le competenze richieste nel bando, come autorizzato dal Direttore del Dipartimento di Matematica, Informatica e Geoscienze dell'Università degli Studi di Trieste (Rep. n. 622/2025 – Prot. 3196 del 04/11/2025), per lo svolgimento delle seguenti attività:

- modellazione del campo di gravità cosismico e postsismico generato da sorgenti sismiche;

- modellazione dello spostamento cosismico e postsismico generato da sorgenti sismiche;
- definizione del modello di dislocazione su faglia per terremoti di magnitudo superiore a M7.5 da utilizzare nella modellazione;
- definizione dello spettro in armoniche sferiche del campo potenziale gravimetrico generato da sorgente sismica;
- analisi di sensitività del campo potenziale gravimetrico da differenti costellazioni satellitari gravimetriche.

Autorizzo il trattamento dei miei dati personali ai sensi del Decreto Legislativo 101/20218 e del Regolamento UE 2016/679 (GDPR).

Trieste, 17-11-2025

ATTACHMENTS

1. Domanda di partecipazione.
2. CV with declarations
3. Diploma of Ph.D in Earth Science, Fluid Dynamics, and Mathematics: Interactions and Methods.
4. Verified Laurea Specialistica in Geofisica (Master of Philosophy in Geophysics)
5. Postgraduate diploma in Earth System Physics
6. Signed front and back carta di identita.
7. Signed passport front page

Trieste , 17-11-2025