Improved GPS time series analysis for geoscience applications including sea-level, GIA, tectonics, hydrology & volcanology (Ref IAP2-18-40)

University of Glasgow, Geographical and Earth Sciences
In partnership with Newcastle University, School of Engineering

Supervisory Team
- Dr Elizabeth Petrie, University of Glasgow
- Prof Peter Clarke, Newcastle University
- Dr Surajit Ray, University of Glasgow

Key Words
Precise GPS rates; sea-level; tectonics; volcanology; hydrology; glacial isostatic adjustment; vertical motion; time series analysis; statistics; functional data analysis; GNSS

Overview
Using Global Positioning System (GPS) data to measure the motion of bedrock is highly useful in many areas of geoscience:
- calibrating tide gauges for land motion
- understanding glacial isostatic adjustment and elastic rebound as ice load changes,
- hydrologic loading
- tectonics
- volcanology
This project will test innovative strategies for optimising analysis of GPS time series. It is open to the student to select the application area which they find of most interest.

CAS1 GPS site, East Antarctica

Methodology
Dr Petrie has substantial expertise in precise long-term GPS analysis, particularly on the Antarctic continent. Prof Clarke will contribute expertise in sidereal filtering and in tectonic applications of GPS if that is the student’s application area of interest. Dr Ray is an expert in statistics, with a particular interest in the technique of functional data analysis applied to environmental datasets.

Rates obtained from the GPS time series may be seriously affected by unattributed/unmodelled effects on the GPS. Effects may include offsets (sudden jumps in the time series), ionospheric and tropospheric effects and local environmental changes. The student will investigate one or more of these and develop a ground-breaking approach to improve the GPS analysis procedure and/or time series analysis. Depending on the student’s interest and background, the project may lean more towards innovation in GPS processing, developments aimed more at a particular application area, or innovation in statistical techniques – functional data analysis has not yet been applied to GPS time series. GPS processing of the GPS data will be performed using the GIPSY-OASIS or GAMIT scientific software packages.

Timeline
Year 1: Review existing literature, select GPS dataset of interest, learn to process GPS data in precise scientific GPS software, and develop and run initial tests on novel processing strategy suitable to area of interest.


**Year 2:** Write paper on testing results, present results at conference. Develop processing strategy methodology further and perform advanced statistical analysis on time series.

**Year 3 – 3.5:** Either apply developed techniques to specific application area data set, further develop statistical techniques, or develop a second processing advance. Write paper on results, present at conference. Complete thesis.

The above represents a broad general overview of the project – to discuss the potential possibilities in more detail, please contact Dr Petrie at the address below in the first instance.

The student will make several visits to Newcastle during the course of the PhD, and depending on the exact application area of interest, one trip to an additional external collaborator, for fieldwork and/or modelling assistance. She will become expert in least one scientific GPS processing package, and develop skills in scripting, Matlab, R, statistics, including functional data analysis if the student has the mathematical background needed, and the use of version control. There will be the opportunity for the student to gain a hands-on familiarity with GPS data collection. If the project leans strongly towards a particular application area, further skills will be developed in this area. Technical/paper writing skills and presentation skills will also be developed. Conference attendance is likely to be AGU or EGU once and a second national/international conference.

A variety of backgrounds would be suitable for this project – a degree in any of Earth Science, Physics, Mathematics, Statistics, Computing Science and Engineering would all be useful. Familiarity with Linux and basic programming/scripting skills would be an advantage. For a project which leans more towards developing new statistical frameworks, a suitable mathematical background would be needed.

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**References & Further Reading**


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**Further Information**

**Contact details**

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