PhD Studentship – Competition funded

ROYAL HOLLOWAY UNIVERSITY OF LONDON

Sustainable cooling of the London Underground network

Supervisors: Dr Jonathan Paul (RHUL), Dr Ian Watkinson (RHUL), Prof. Adrian Butler (Imperial College London)

Project background

Subsurface rail networks across the globe are becoming increasingly overheated because of climate change. More prolonged and extreme summers, combined with a rapidly increasing urban population, has led to devastating impacts on both public health and rail engineering. Surprisingly, little attention has been paid to mitigating this situation, even in major cities like London, whose Underground network currently only uses temporary fans to shift warm air around in summer. At the same time, any proposed cooling scheme should be fully environmentally sustainable and must not contribute towards climate change, so should not contain refrigerants. In this way, this project will elucidate a proof-of-concept scheme that harnesses water from buried rivers and the Chalk aquifer to cool Tube stations via a process of heat exchange (using ground-source heat pumps – GSHPs).

Research methodology

First, the student will identify feasible locations for the operation of such a proof-of-concept scheme from a hydrological point of view, by mapping subterranean rivers and groundwater levels across central London. Then, the effects of abstracting and re-injecting heated water on the subsurface will be investigated using a variety of numerical modelling tools. An economic cost-benefit analysis will also be undertaken. Field mapping at several proxy Chalk outcrops across southeast England will elucidate fracture patterns, which will allow the numerical modelling to be calibrated. Following the development of self-build water level sensors and GSHPs, the student will conduct field tests, together with a scale model that cools a theoretical subsurface railway station using groundwater and/or subterranean river water that flows through a GSHP.

Training

The student will be trained and gain skills in the computer laboratory (in using GIS and numerically modelling water flow), field, and workshop (developing self-made environmental sensors and GSHPs).

Person specification

The student will ideally be numerate, with a Physical Science or Engineering degree, and will be willing to conduct field and modelling experiments. Experience in electronics (e.g. soldering) is beneficial but not essential.

Key references

Paul J.D., 2016. High-resolution geological maps of central London, UK: Comparisons with the London Underground. Geoscience Frontiers, 7(2), 273–286
Upton K.A., Jackson C.R., **Butler A.P**., et al., 2020. An integrated modelling approach for assessing the effect of multiscale complexity on groundwater source yields. Journal of Hydrology, 588
Paul J.D., W. Buytaert, N. Sah, 2020. A technical evaluation of lidar-based measurement of river water levels. *Water Resources Research*, 56(4), e2019WR026810

Application details

This project has been shortlisted for funding by the ARIES NERC DTP and will start on 1st October 2022. The closing date for applications is 23:59 on 12th January 2022.

Successful candidates who meet UKRI's eligibility criteria will be awarded a NERC studentship, which covers fees, stipend (£15,609 p.a. for 2021-22) and research funding.

International applicants (EU and non-EU) are be eligible for fully-funded UKRI studentships.

Please note ARIES funding does not cover visa costs (including immigration health surcharge) or other additional costs associated with relocation to the UK. ARIES students benefit from bespoke graduate training and ARIES provides £2,500 to every student for access to external training, travel and conferences. Excellent applicants from quantitative disciplines with limited experience in environmental sciences may be considered for an additional 3-month stipend to take advanced-level courses in the subject area.

ARIES is committed to equality, diversity, widening participation and inclusion in all areas of its operation. We encourage enquiries and applications from all sections of the community regardless of gender, ethnicity, disability, age, sexual orientation and transgender status. Academic qualifications are considered alongside non-academic experience, and our recruitment process considers potential with the same weighting as past experience.

Applications should be made via the Royal Holloway Direct website

Please contact jonathan.paul@rhul.ac.uk for further information.