ARIES DLA COMPETITIVE PHD STUDENTSHIP

Sustainable cooling of the London Underground network

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Scientific 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, have 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. 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

You will identify feasible locations for the operation a proof-of-concept cooling 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, you will conduct field tests and a scale model that cools a theoretical subsurface railway station using groundwater and/or subterranean river water that flows through a GSHP.

Training

You will be trained and gain skills in the computer laboratory (in using GIS and numerically modelling water flow in Python), 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 analytical/numerical modelling experiments. Experience in electronics (e.g. soldering) is beneficial but not essential.

ARIES is awaiting confirmation of funding under the BBSRC-NERC DLA award scheme, which is expected shortly. Funding for this studentship is subject to this confirmation and UKRI terms and conditions