Central Arizona–Phoenix Long-Term Ecological Research III
Equipment Supplement Request for NSF Grant # DEB-1026865
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The Central Arizona–Phoenix (CAP) LTER focuses on an urban social-ecological system in a metropolitan area that includes the nation's sixth largest city, Phoenix. CAP LTER engages biological, physical, engineering, and social scientists in research that provides a foundation for understanding sustainability in an arid region with a rapidly growing urban population. Research activities take place across a site that includes more than 6400 km^2 of desert, agricultural, and urban lands. Field measurements, environmental sensors, modeling, survey instruments, remote sensing, and geographic information systems contribute to the database for this heterogeneous ecosystem. Equipment needs are therefore diverse, but we have identified two of the most urgent of these for this request.

The CAP LTER requests supplemental funds for two capital purchases: 1) a new field vehicle to replace one of our aging fleet vehicles recently mothballed, and 2) a gas chromatograph (GC) for analysis of trace gases, which would be shared with university users of the Goldwater Environmental Laboratory (the primary facility where CAP LTER samples are analyzed).

Equipment Item	**Proposed source**	**Specs**	**CAP LTER share of cost**	**Requested funds**
Vehicle	Ford F-150	4WD, club cab pickup truck	100%	$38,800*
Gas Chromatograph with gas autosampler	Agilent	Triple-detector GC with gas autosampler	15%	$11,200

*This is 95% of the vehicle cost. The other 5% of the cost plus sales tax, licensing fee, and document fee will be covered through funds granted to CAP LTER from Arizona State University.

Vehicle Justification

The working boundary of the CAP LTER site spans more than 6400 km^2 and encompasses an expansive mix of desert, agriculture, and urban/suburban habitats. As with most post-war, western-USA cities, the Phoenix metropolitan area (hereafter Phoenix) is automobile-centric, and access to a vehicle is required for all but the most minimal transportation needs. As a result, the CAP LTER relies heavily on a fleet of project vehicles to meet project goals. Project vehicles are used extensively for all long-term monitoring efforts, nearly all student projects, and to support project administration. The spatial extent of any given research initiative at the CAP LTER varies tremendously but most, particularly the CAP LTER's long-term monitoring efforts, cover vast distances to address the wide range of macro- and micro-habitats within the study area. The CAP

LTER's long-term monitoring of atmospheric deposition, for example, includes sites spanning more than 95 km.

Evidence for the heavy reliance on vehicles to support project research is exemplified in the approximately 65,000 km driven each year by CAP LTER investigators. To support investigations, the CAP LTER maintains a fleet of four vehicles that are available to all project participants. Rigorous oversight by the site manager (CAP staff) and project accounting manager (Arizona State University staff) ensures that vehicle use is limited only to LTER participants. Near constant demand and the exceptional number of kilometers driven necessitate periodic fleet updates. The CAP LTER's current fleet includes mostly older (average age > 11 years), high-mileage (> 150,000 km) vehicles. The CAP LTER requests supplemental equipment funds to be used toward the purchase of a new field vehicle that will enable retirement of one of the high-mileage vehicles. This will improve reliability and safety and reduce annual maintenance costs.,

Comparison of purchase option with rental option: The availability of vehicles is absolutely essential to address research at the CAP LTER owing to the unique nature of this highly urbanized study site. While renting vehicles for project use is an option, and is in fact appropriate in certain instances, rental vehicles provide far less utility than a project fleet and are substantially more expensive. For example, the annual cost of renting a vehicle for a conservative 4 days of use per week at Arizona State University's discounted rate of $105/day translates to an annual cost of $21,840 for vehicle rental. By comparison, using the most recent CAP LTER purchase, a 2012 Ford Escape, as an example, the purchase price ($26,012.97) amortized over the typical lifespan of a project vehicle (10+ years), with annual maintenance costs of approximately $500, translates to an annual operating cost of $3,101.30. Although maintenance costs for older vehicles are greater, they are unlikely to make up the difference between rental and amortized costs (estimated at $10,000-$18,000 savings per year).

Additional benefits of vehicle purchase: Additional financial incentives for purchase include umbrella insurance provided by and paid by Arizona State University and corporate rates for vehicle maintenance and repair, which result in savings compared to what typical vehicle owners pay. Owing to the long-term nature of LTER research, vehicles are used by the project to the end of their effective lives, at which time they may be sold as surplus by Arizona State University with the proceeds remitted to the CAP LTER. That the LTER is able to leverage Arizona State University's commitment to safety through mandatory driver education programs and background checks is an added benefit of maintaining a fleet of LTER vehicles associated with the University, and it contributes to a safe vehicle operating environment for LTER investigators and staff.

Gas Chromatograph Justification

CAP LTER has recently expanded its investigation of trace-gas fluxes in the urban environment. Research projects focusing on trace gas emissions from residential landscapes (Hall et al. 2008), wastewater treatment wetlands (Ramos et al. in preparation), and other urban patches (Grimm et al. in preparation) have been relying

on an older gas chromatograph in the Hall lab that has proved unreliable in recent months. Although it has been repaired several times, the company no longer provides updated software for the instrument and it is likely past its useful life.

The Goldwater Environmental Laboratory is a shared-use facility supported by the College of Liberal Arts and Sciences (CLAS) that maintains analytical equipment for water and soil chemical analyses. Most of the CAP LTER samples, particularly those from long-term monitoring projects, are analyzed here, and the CAP laboratory manager (50% FTE) is also a research specialist for the CLAS. The benefit to CAP is that the facility assumes responsibility for repair and maintenance of instruments, trains users and develops new methods, and periodically updates capabilities by arranging for purchase of new instrumentation. We have purchased or contributed to the purchase of other instruments in the past, many of which are primarily used by CAP investigators.

A recent Research and Technical Services internal competition awarded half of the funds needed to purchase a new triple-detector GC with gas autosampler, capable of measuring CO_2, CH_4, and N_2O. The full cost estimate is $75,000; however, several other users are contributing to the purchase and thus we request only $11,200 to contribute to this purchase of a major instrument that will meet our needs for trace-gas analysis for the foreseeable future.

Scheduling of analyses will be by established procedures, and costs will be billed to the investigator (including CAP investigators). Maintenance costs will be assumed by the facility as with other instrumentation, and set-up and training will be done by staff in the laboratory. The benefit to CAP is clear, in that we will have immediate access to a high-end instrument for a relatively small investment.

Justification for supplement request:

This supplement request is in response to an email call for LTER equipment supplement proposals from Dr. Saran Twombly, Program Director, Population and Community Ecology, Division of Environmental Biology, National Science Foundation, on March 15, 2015.