SON Number: RCSON-18-L2 **September 14, 2017**

Strategic Environmental Research and Development Program (SERDP)

FY 2018 STATEMENT OF NEED

Resource Conservation and Resiliency (RC) Program Area

QUANTIFYING THE EFFECTS OF ENVIRONMENTAL NONSTATIONARITY AT DOD RELEVANT SCALES

1. Objective of Proposed Work

The objective of this limited-scope Statement of Need (SON) is to advance an improved understanding of nonstationarity as it relates to environmental shifts (e.g., mean and extreme temperature change) at temporal and spatial scales relevant to improving future DoD infrastructure planning processes.

Specific research objectives include the following:

- Discernment of relationships (e.g., mean temperature and heat wave frequency or severity) as revealed in both historical observations and climate models with an emphasis on describing model heterogeneity.
- Elucidation of shifts with a focus on the transition of one "like" region to another "like" region, the temporal and spatial resolution of the shift, and the extent to which the relationships, if they appear to exist, have importance at DoD relevant scales.
- Determination if and to what extent, mean and extreme temperature shifts relationships may inform DoD on extreme risks under future scenarios or an assessment of the extent downscaling results is needed to produce meaningful assessment.

Limited-scope proposals are sought to develop proof of concept or conceptual approaches to an improved understanding of nonstationarity at temporal and spatial scales relevant to future DoD infrastructure. Proposers must specifically state the rationale for their analytic research approach, describe their understating of current practice, and explain how their approaches will result in new insight into the understanding of nonstationarity as it relates to environmental shifts.

2. Expected Benefits of Proposed Work

The proposed work benefit the DoD in efforts to improve focus, generate positive change, and improve the velocity of DoD infrastructure planning.

3. Background

Nonstationarity describes the process by which the distribution of climatic events in a particular region or sector shifts as a result of overall changes. This can result through shifts in mean climate or changes in the distribution shape and often involves changes in the intensity or frequency of extreme events. These shifts are crucial to understand, as they determine how well the past can be used to predict the future, particularly with regard to low probability, high consequence events.

Despite its importance, nonstationarity is difficult to quantify. Recognizing changes in distributions requires long observation times to obtain sufficient statistics. As an example, changes in the frequency of 1000-year floods are difficult (or impossible) to observe over periods of several decades, yet understanding whether 1000-year floods will begin to occur every 10-20 years is a crucial piece of information. Even with long time series of data, statistically insignificant shifts in distributions are thought to have serious practical consequences.

By way of an example, consider the distribution of precipitation events in a region undergoing desertification. While it may be difficult to observe shifts in the distribution of precipitation events in that region, one may use knowledge that the region being studied is or will become more "like" a desert region as desertification occurs. As a result, it may be possible to use observations of the distribution of precipitation events in a desert region to understand what the distribution might look like in the region of interest at some point in the future. This idea has been explored to some extent in terms of Köppen climate classes (Kottek et al., 2006). In this approach, classes possess typical profiles of behavior so that evidence that a region is shifting from one class to another provides information into what climate class the region of interest will next reside.

However numerous questions related to quantification and scale result when considering this approach. Questions include metrics of shifting or how can one measure that a region "is beginning to look like" another region or another climate? Measures of shifts in mean climate or the occurrence or intensity of extreme events? How spatial and temporal scale influence observed and report changes. To what extent do observe fine-scale changes best quantify the risks to a particular site or area?

DoD relevant scales are regional and decadal since shifts at these temporal and spatial scales are enormously important for ecosystem dynamics, natural and built infrastructure, and risk to systems. Prospers may wish to consult current DoD approaches to infrastructure risk mitigation and adaptation such as the Climate Change Planning Handbook Installation Adaptation and Resilience Final Report (Naval Facilities Engineering Command Headquarters, 2017) for a further understanding of relevant temporal and spatial scales. Nonetheless, fundamental research into understanding shifts and the underlying dynamics are sought under this statement of need given that such research has the potential to inform future DoD estimations of risk and associated processes.

Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel (2006), World map of the Köppen-Geiger climate classification updated, Meteorologische Zeitschrift, 15, 259-263, doi:10.1127/0941-2948/2006/0130.

Naval Facilities Engineering Command Headquarters (2017), Climate Change Planning Handbook Installation Adaptation and Resilience Final Report. Leidos, Inc., Louis Berger, Inc. Delivery Order No. 0005, Contract No. N62470-15-D-8005, January 2017

4. Cost and Duration of Proposed Work

Limited-scope proposals for funding up to $200,000 and duration of approximately one-year are sought. Such proposals may be eligible for follow-on funding if they result in a successful initial project.

5. Point of Contact

Kurt Preston, Ph.D.
Program Manager for Resource Conservation and Resiliency
Strategic Environmental Research and Development Program (SERDP)
4800 Mark Center Drive, Suite 17D08
Alexandria, VA 22350-3605
Phone: 703-405-8294
E-Mail: kurt.t.preston.civ@mail.mil

For proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website.