

# Modeling the Relationship between Environmental Change and Conflict on a Tactical Level

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US Army Corps  
of Engineers®

**ERDC**

Engineer Research and  
Development Center



# Agenda

- Army Corps of Engineers mission and project purpose
- Review of literature
- Method and description of statistics
- Moving forward



# Army Corps of Engineers mission and project purpose

- The U.S. Army Corps of Engineers' (USACE) Engineer Research and Development Center (ERDC) helps solve our Nation's most challenging problems in civil and military engineering, geospatial sciences, water resources, and environmental sciences for the Army, Department of Defense, civilian agencies, and our Nation's public good.
  - ▶ Projects within ERDC must align with Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology (ASAALT) identified research thrust areas. ASAALT's mission is to meet current and future Army needs.
- ERDC is seeking a way to model the relationship between conflict and the environment on a tactical level.
  - ▶ *Where* is there a relationship between the environment and conflict? How will it impact soldier movement and safety?
  - ▶ Can civilians and soldiers derive environmental data independently and in a timely manner?



# Review of literature

- Majority of literature focuses on a general relationship between the environment and conflict and does not examine the spatial association. The literature below contains research that examines the relationship between conflict and the environment, as modeled by the Normalized Difference Vegetation Index (NDVI). NDVI is a measure of vegetative greenness.
  - ▶ *Relationship exists between environment and conflict.*  
(de Beurs, K., et al. "Linkages between Land Surface Phenology Metrics and Natural and Anthropogenic Events in Drylands." *AGU Fall Meeting Abstracts*. Vol. 1. 2013.)
  - ▶ *No relationship between environment and conflict.*  
(Brown, Ian A. "Assessing eco-scarcity as a cause of the outbreak of conflict in Darfur: a remote sensing approach." *International Journal of Remote Sensing* 31 (2015): 2513-2520.)
- Little research has been done to examine the spatial association between the environment and violence.
  - ▶ De Juan (2015) examined this relationship in Darfur.  
(De Juan, Alexander. "Long-term environmental change and geographical patterns of violence in Darfur, 2003–2005." *Political Geography* 45 (2015): 22-33.)

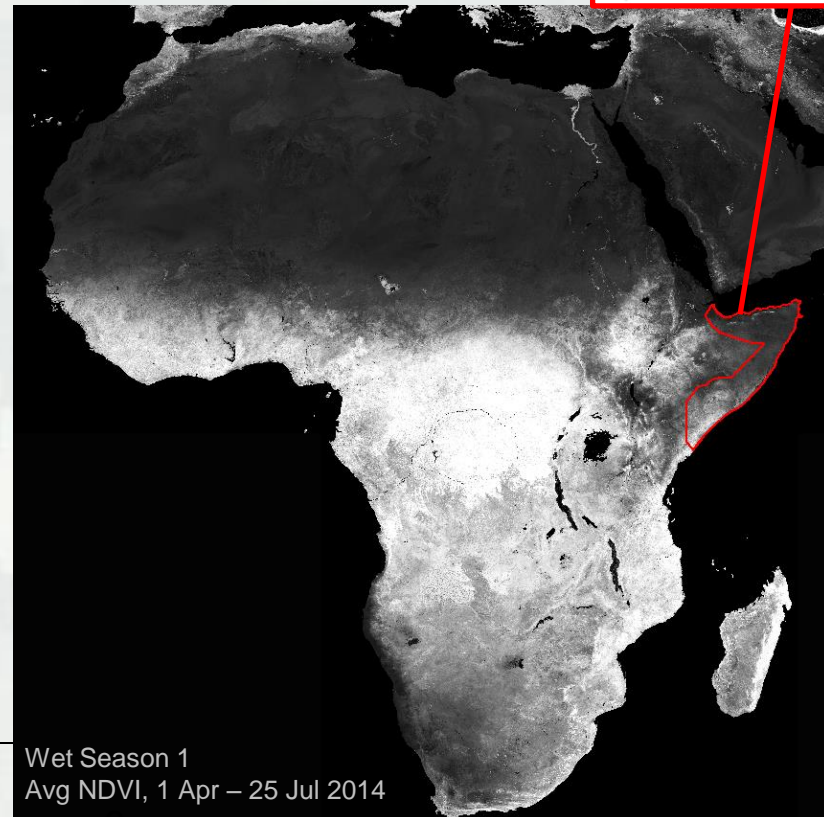


# Applying remote sensing and statistics to examine the relationship between conflict and environment across time



# Variables

- Environmental: NDVI composites from the MODIS satellite, taken between January 1 and December 2, 2014, were averaged to correspond to two wet and two dry seasons in Somalia.

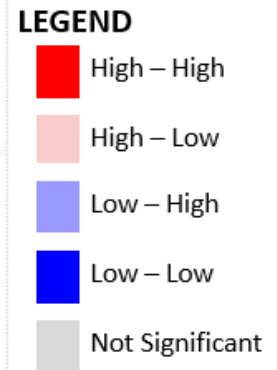
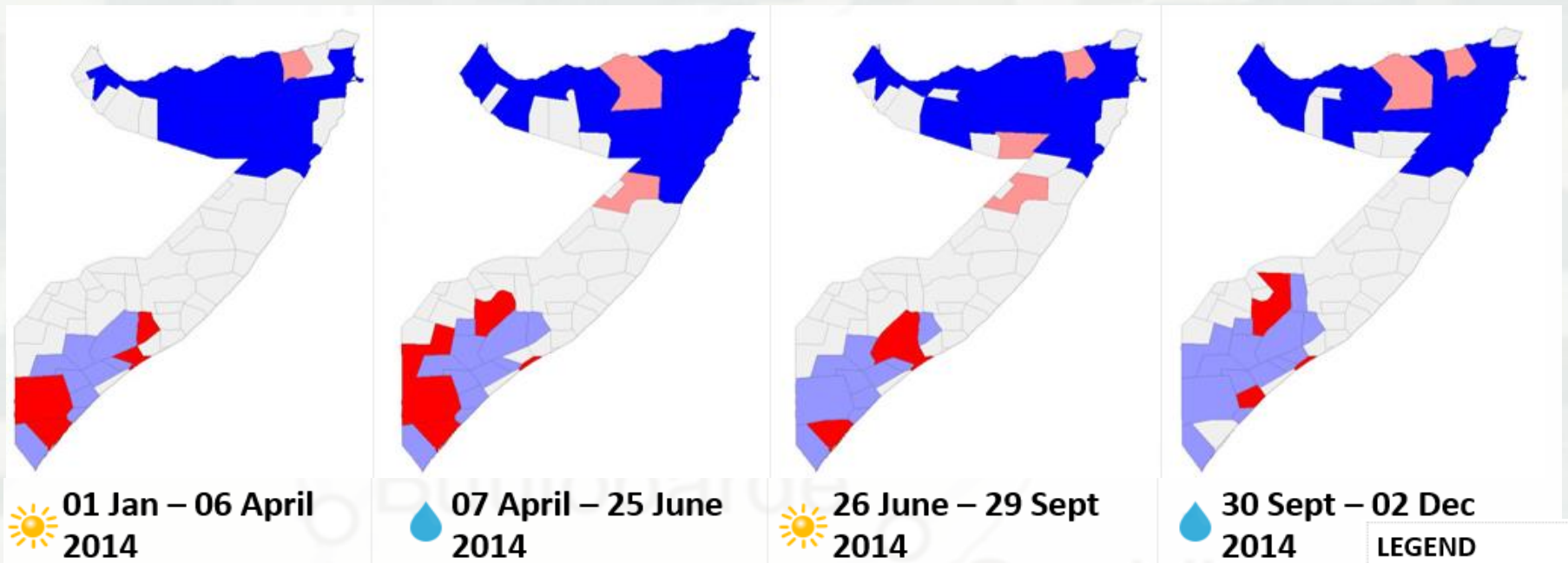


# Variables

- Conflict: Data from the Armed Conflict Location and Event Data Project. Captures incidences of political violence that take place in the context of civil war and/or political instability. Events are geo-located allowing for disaggregated analysis.

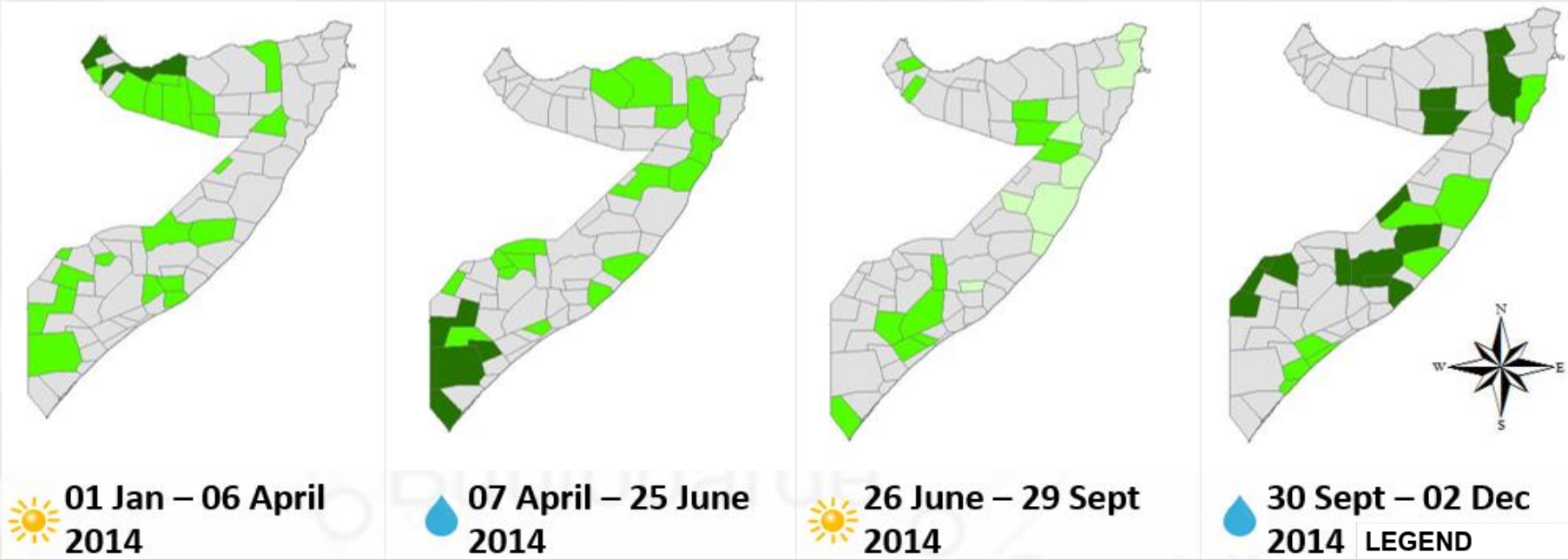


# Conflict-NDVI spatial association analysis using Bivariate Moran's I





# Conflict-NDVI exploratory analysis



# Moving forward

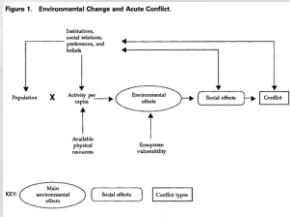
- Focus on creating a regression equation relating conflict to the environment.
- Broaden focus to other countries.
- Add more variables.
  - ▶ Independent variables: precipitation, land surface temperature, population or population density.
  - ▶ Dependent variables: conflict type, time lag from conflict after environmental event, escalating violence by number and type of events, how conflict changes over time.
- Examine other conflict data sources.
- Test at different spatial and temporal scales.



# Backup



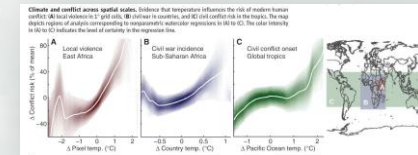
# Review of the Literature



**1991**  
**Environment Scarcity and Conflict**  
 On the Threshold: Environmental Changes as Causes of Acute Conflict | Thomas Homer-Dixon



**1997**  
**Conflict and the Environment**  
 “Environmental security must be part of both national and global security concepts...many conflicts are rooted in environmental degradation and resource scarcities” | N.P. Gleditsch, ed.

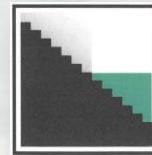


**2013**  
**Climate and Conflict**  
 Quantifying the Influence of Climate on Human Conflict | Solomon M. Hsiang, et al.

**1987**  
**Brundtland Report**  
 “Environmental stress can thus be an important part of the web of causality associated with any conflict and can in some cases be catalytic.”



**1994**  
**Human Development Report**  
 Dimensions of Human Security: Economic, Food, Health, Environment, Personal, Community, and Political



**2012**  
**Realizing the Future We Want for All**  
 Today’s global challenges include “growing environmental footprints” and “conflict, violence, and insecurity.”

