THE NEXUS OF CLIMATE CHANGE, LAND USE, AND CONFLICT

Complex Human–Environment Interactions in Northern Africa

BY P. MICHAEL LINK, TIM BRÜCHER, MARTIN CLAUSSEN, JASMIN S. A. LINK, AND JÜRGEN SCHEFFRAN

Northern Africa, especially the Sahel, is considered to be particularly vulnerable to climate change because of the region's strong exposure to increasing temperature, higher precipitation variability, and extended population growth. Primary connectors between the climate system and the human societies in this region are land use and the associated land-cover changes, which mainly affect the areas where substantial subsistence farming occurs. This international workshop,[1] held at the Hotel Hanseatischer Hof in Lübeck, Germany, in the fall of 2014, was a follow-up of the workshop "Northern Africa—Past, Present, and Future Climate Changes" in Hamburg, Germany, in February 2011, to study the dynamics of the natural climate system. Whereas the workshop in 2011 emphasized the lessons learned about the North African climate from paleoclimate modeling and reconstruction, this event focused on current and future interactions of humans and climate in northern Africa, mainly via land use and land-use changes. The connections between all these issues were of particular interest: How strongly do climate change and land-use change affect each other? And to what extent are climate-induced water, food, and wood shortages associated with land degradation, migration, and conflict?

CLIMATE, LAND USE, AND CONFLICT IN NORTHERN AFRICA

WHAT: An international group of scientists discussed issues of climate change, land use, and conflict in northern Africa and assessed the implications of interactions between these aspects, providing current research results and identifying knowledge gaps and emerging research questions.
WHEN: 22–24 September 2014
WHERE: Lübeck, Germany

Almost 60 participants from many different disciplines, such as the natural sciences, sociology, economics, and peace research, and from various research institutes, as well as participants of governmental and nongovernmental organizations from a dozen countries, met to address these questions. The workshop covered the nexus of climate change, land use, and conflict in Northern Africa using several mediums including 20 brief impulse presentations and 17 poster contributions, together with several in-depth discussions and a concluding panel.

RECENT CLIMATE CHANGE IN NORTHERN AFRICA AND POSSIBLE FUTURE CLIMATE CHANGE. According to

[1] The conference was organized by the Max Planck Institute for Meteorology (MPI-M) in Hamburg, Germany, and the Research Group Climate Change and Security (CLISEC) of the Cluster of Excellence "Integrated Climate System Analysis and Prediction" (CliSAP) at the University of Hamburg. The conference program is available at www.mpimet.mpg.de/en/staff/tim-bruecher/climate-land-use-and-conflict/agenda.html. The workshop was funded by MPI-M and by CliSAP (DFG EXC 177/2).

the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), estimates of possible precipitation changes in northern Africa vary, except for the region adjacent to the Mediterranean Sea, where a clear signal of reduced precipitation emerges. Therefore, according to phase 5 of the Coupled Model Intercomparison Project (CMIP5) models, it remains unclear whether greenhouse-gas-induced climate warming will lead to more or less rainfall in most parts of the Sahara, Sahel, and Sudan. Models that include atmosphere–land surface interaction indicate that there could be some greening in parts of the Sahel.

The presentations on climate change highlighted that the near-surface atmosphere over the Sahara has warmed at a rate that is 3 times the global mean of the last 30 years. This phenomenon is most likely triggered by still increasing fossil fuel emissions and can be observed in model simulations, as well as in reanalyses. This amplified warming strengthens the Saharan heat low, as well as the meridional temperature and geopotential height gradients, which in turn leads to an increased transport of moisture into the Sahel, particularly in the eastern part of the continent. Very few models show a significant increase, while others show a significant decrease; the vast majority of models, however, reveal only minor changes in rainfall intensity. Climate models that predict the dynamics of vegetation change reveal some greening in the coming decades that extends into the Sahara. In some models this greening is caused by a stimulation of plant growth due to enhanced atmospheric CO_2, the so-called CO_2 fertilization. However, there are differences in the results of the various simulation models regarding the underlying atmospheric dynamics and plant processes and the time horizon in which these occur.

CURRENT LAND USE AND LAND-COVER CHANGE IN NORTHERN AFRICA. In addition to perturbation of the atmospheric composition, changes of land surface have profound impacts on the environment. A continuously increasing population in northern Africa imposes growing pressure on ecosystem resources and alters the land surface itself. How much of the land and its resources have been used in the past in comparison to today? Can we deduce all forms and intensities of land management relevant to climate and conflict in this region from available inventories and remote sensing, or are new approaches needed for monitoring? This session addressed the extent of the contribution of human activities to current observations of greening or drying of the land. In particular, the effect of land use on key variables of the biosphere was of interest, as changes in these quantities may trigger conflicts.

New evidence was presented for a strong relationship between a large-scale Sahel greening and the recent decline in the area that was burned for human cultivation and precipitation variability. However, in addition to climate there are several socioeconomic drivers that affect land use and subsequently vegetation change. These act either locally (e.g., through land-use decisions) or globally (through land grabbing, etc.), but the extent of their influence on land use in comparison to climatic factors remains unclear. Furthermore, it has to be noted that despite a greening tendency in the Sahel, there may be concurrent land degradation nonetheless. This is referred to as the Sahelian paradox; that is, the greening of the region is contradicted by hydrological evidence that points to a degradation of ecosystems. Such degradation can be observed locally and occurs at much smaller scales than the overarching greening trend. This emphasizes the importance of scale in analyses of land-use issues and their interdependence with the climate system and with human action.

CURRENT CONFLICT AND CONFLICT POTENTIAL IN NORTHERN AFRICA. Changes in land use directly affect humans through

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resource abundance or scarcity and their reactions to these land-use changes can occur in a conflictive or cooperative manner. The production of agricultural goods is sensitive to changing climate conditions across northern Africa, as economies strongly depend on agriculture or livestock. If reduced precipitation and droughts affect water security and crop yields in a negative way, then human security is at stake, particularly if the population increases in size. Regional water and food crises, combined with forced migration, can disrupt established networks, for example, between farmers and herders. It can even destabilize societies and provoke additional violence in a region that is already considerably affected by violent conflict. This session assessed the latest empirical results on climate–conflict linkages in northern Africa and focused on the potential pathways to conflict with regard to water, food, and migration.

Several speakers presented case studies in which the interplay of land use and climate change tends to aggravate existing conflicts between resource users, in particular between water users along the Nile River or farmers and herders in eastern parts of northern Africa. Various methodological tools provide important insights, including interviews with stakeholders, statistical analysis of data, assessment of GIS-based indicators of conflict risk, as well as agent-based modeling and social network analysis of human interaction. There is no clear message with regard to a possible causal relationship between climate variables and the onset of new conflict, as the consequences of temperature and precipitation changes are diverse. Because they act through multiple pathways in the nexus of water, food, energy, and migration in the climate hot spots of northern Africa, it is hard to attribute observed developments to particular paths. Furthermore, there are other conflict factors, including political instability, economic crisis, marginalization, population growth, and land-use policies that are possibly even stronger drivers. However, these are not independent of climate change, which complicates the assessments.

Evidence from recent empirical research suggests that at least short-term weather events cannot be considered to be conflict drivers in the Sahel. Also, there is no simple pathway from climate change to conflict via food production. Even though there is a clear impact of climate variability on food production in sub-Saharan Africa, the agricultural output has no or very little effect on political violence in the region. This suggests that there are other, predominantly social variables that concurrently influence conflict incidence very likely in a nonlinear way.

SYNTHESIS OF THE CLIMATE–LAND–CONFLICT NEXUS IN NORTHERN AFRICA. The results from the previous session suggest that to adequately consider all the complex linkages of human–environment interactions in northern Africa, an integrative framework is needed to analyze and model the pathways between climate change, land use, and conflict. First of all, it is important to identify the crosscutting issues in order to determine how the combined effects, such as tipping points and risk cascades, could interact in a destabilizing way. This session addressed these issues by focusing on water cooperation, codevelopment in migration, and a renewable power grid between Europe and northern Africa, which are suggestions for the prevention of regional conflict and for fostering regional stability and cooperation.

In the assessment of the key human–environment interactions, the concepts of vulnerability and adaptive capacity are of particular importance. Northern Africa is highly vulnerable to the consequences of climate change because of its strong exposure to increases in temperature, changes in freshwater availability, and population growth. Also, there is a high sensitivity owing to already existing water scarcity and a strong dependence on rain-fed agriculture. These have to be placed in the context of an adaptive capacity that is limited by poverty and political instability. In this setting, climate change places an additional burden on the abundance of resources, aggravating already existing conflicts and reducing the options of people to successfully address these challenges to their livelihoods.

In this context, migration plays a vital role. Migration can be the trigger of conflict by increasing the pressure on resources and people in the receiving areas, thus leading to a destabilization of society. On the other hand, migration can be an adequate tool to prevent the onset of conflict because people voluntarily move to other areas to work and to send back remittances, which help increase prosperity and development in the originating areas. So far, research on the link between migration induced by environmental change and environmental disasters has produced inconclusive results. The application of insights from migration and conflict theory, which allow a differentiation of different types of climate change–related migration, provides a more solid basis for the identification of the most significant interactions with regard to migration. This issue was further addressed in an empirical assessment of the drivers that have caused the migration of West African fishermen to the Spanish Canary Islands after the depletion of the fisheries in their home countries.

CONCLUSIONS. The workshop highlighted the importance of considering the drivers and interactions in the nexus of climate change, land use, and conflict in northern Africa in a combined manner, as there is no simple causal relationship from climate change to land-use change to possible conflict. Feedbacks need to be considered, as well as the roles of resource abundance, migration, and human livelihood, in the assessment of whether large-scale environmental changes lead to conflict or to increased cooperation.

In the discussion of the linkage between climate and land-use change, it was pointed out that the sensitivity of this relationship was found to be highly scale dependent. Two presentations explicitly showed that the response of the climate system to land-use change appears to be weak compared to the overall effects that global warming imposes on the Sahel and the adjacent regions. Therefore, one important conclusion of the workshop is that efforts in modeling the interaction between climate, land use, and conflict can treat climate change as external forcing.

Furthermore, participants in the concluding panel discussion highlighted the role of vulnerability and adaptive capacity, as well as governance and institutional mechanisms, when it comes to containing security risks and strengthening cooperation. Successful adaptation to the challenges imposed by climate change requires interdisciplinary exchange, such as the one at this workshop. However, this event can only be regarded as one step in the process of deepening the understanding of human–environment interaction in a region of the world that is highly vulnerable to climate change. This exchange and debate of ideas and concepts needs to be continued.

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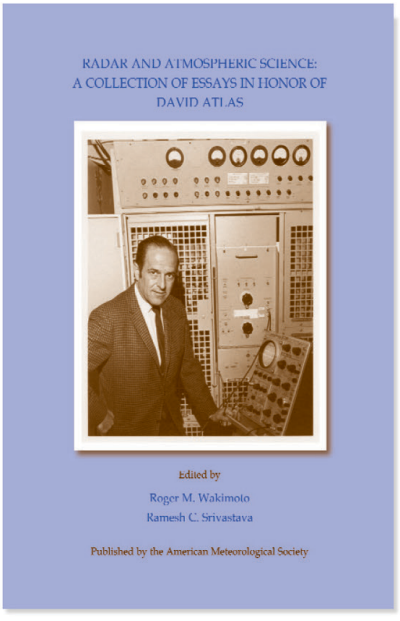

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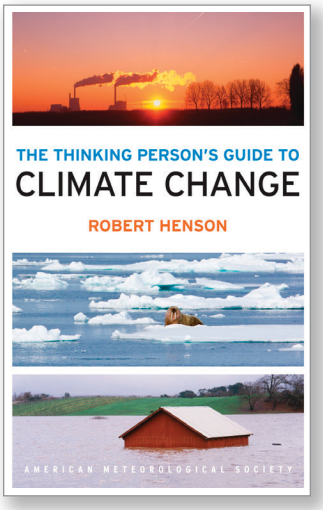

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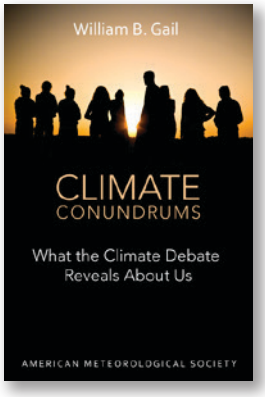

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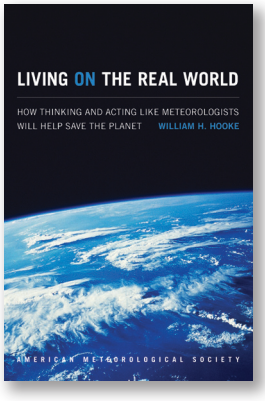

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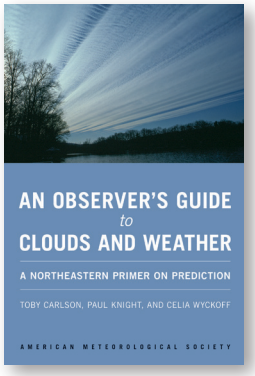

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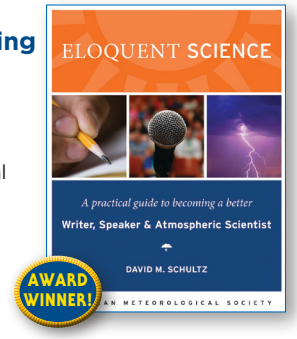

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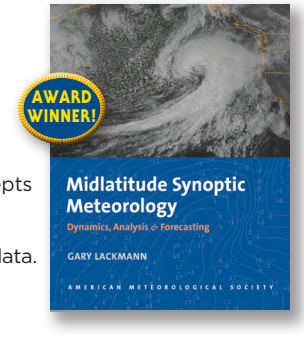

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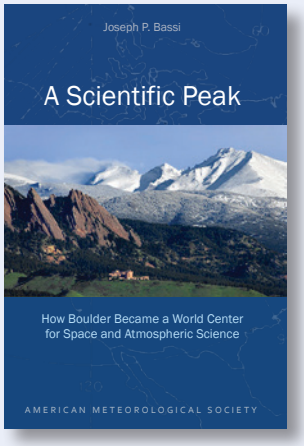

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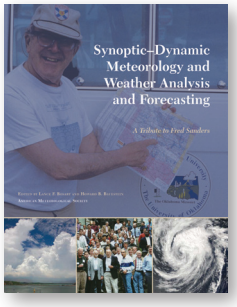

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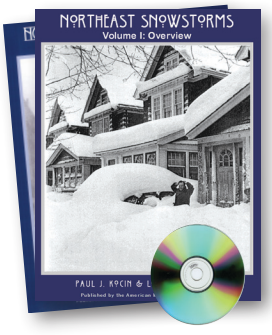

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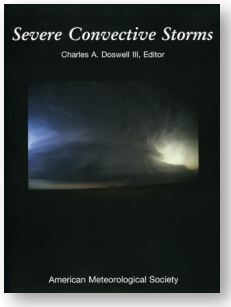

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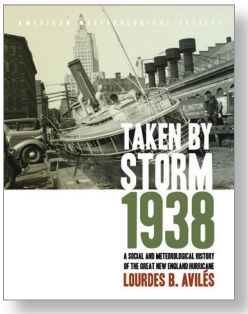

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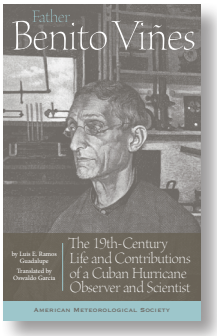

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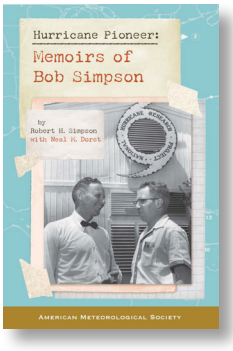

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