CLIMATE SERVICE CENTER

Report 22

Adaptation to Climate Change in Mountain & Coastal Areas

Building an interface between providers and users of climate change knowledge

Insights from a Transatlantic Dialogue

ASPEN GLOBAL CHANGE INSTITUTE

Climate Service Center Germany 2.0

Eine Einrichtung des Helmholtz-Zentrums Geesthacht

Citation:
J. Jäger, S. Moser, J. Arnott, M. Schaller (2014): Adaption to Climate Change in Mountain & Coastal Areas: Building an interface between providers and users of climate change knowledge – Insights from a Transatlantic Dialogue. Report 22, Climate Service Center, Germany

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BACKGROUND

As the impacts of climate change become more immediate, adaptation to these changes is becoming a greater area of interest and concern among resource managers, planners, and other stakeholders at all scales. However, in spite of advancements in the scientific understanding of climate change, much progress is needed in developing, translating, and disseminating usable knowledge to inform both individual and collective actions, especially at local levels of decision making. As part of this, increased emphasis has been placed on fostering sustained engagement between research communities and users of climate information. Additionally, the documentation of case studies as well as the development of networks that include researchers, practitioners, decision-makers and stakeholders have been identified as helpful mechanisms to support a growing number of communities developing climate change adaptation strategies.

CHALLENGES

The diversity of climate change risks, physical, socioeconomic, and ecological contexts, available resources and response options, decision-making processes, and cultural norms shape the societal response to climate change across political and physical geographies. The resulting diversity of approaches makes it difficult to establish best practices and common ground for interaction between research and stakeholder communities.

APPROACH

Working under the hypothesis that comparing these significant differences can help to identify transferable lessons useful for improving strategies for climate change response (adapting to climate change impacts and reducing emissions), we compared experiences in mountain and coastal areas, in the United States and Europe: In 2013, the Aspen Global Change Institute and the Climate Service Center in Hamburg, Germany, hosted two innovative workshops that brought together an international group of scientists, stakeholders, resource managers, and elected officials from six specific case regions:

- Bay of Kiel, Germany
- Grindelwald, Switzerland
- Virgen, Austria
- Roaring Fork Valley, Colorado, U.S.A.
- Chesapeake Bay, U.S.A.
- Outer Banks, North Carolina, U.S.A.

A group of scientists and stakeholders from mountain and coastal areas join together in Aspen, CO (left) and Timmendorfer Strand, Germany

The diversity of institutions, cultures, political economies and biophysical and societal impacts included in these case study regions provided a unique opportunity for the cross-pollination of ideas and expansion of networks across institutional, disciplinary and national boundaries. After all, mountain and coastal communities face a number of immediate impacts of climate change from sea level rise on the shores to altered streamflow in mountain streams. The rationale of convening these regional communities therefore was to extract best practices, support the implementation of adaptation measures at regional and local levels, and promote the development, comparison and transfer of scientific and human approaches in areas where climate change is already and will continue to be a critical component of planning and resource management.

The ***objectives*** of the workshops were thus to:

1. better understand the information needs of practitioners
2. integrate bottom-up and top-down approaches to climate adaptation;
3. facilitate knowledge exchange and learning across different situations;
4. identify “best practices“ or lessons about useful approaches in adaptation planning;
5. build and expand adaptation networks; and
6. identify barriers to adaptation and how actors overcome them.

The ***results*** of the dialogues are summarized in the following three sections:

1. Preparing to Climate Change in Mountain & Coastal Communities
2. Enhancing Interaction between Scientists & Practitioners
3. Climate Change Adaptation Experiences in the US and Europe.

For more information about the project see also the www.climate-service-center.de

Part 1 - Adaptation to Climate Change in Mountain & Coastal Areas

COASTS AND MOUNTAINS: SURPRISING COMMONALITIES AND DIFFERENCES

Adaptation involves various place-based strategies for reducing the physical, ecological and social vulnerabilities and managing the impacts of climate change. In spite of the diversity and differences between specific communities, we convened a series of dialogues among resource managers, planners, elected officials, researchers from various disciplines, and others working on climate change adaptation to identify lessons through the commonalties and differences between mountain and coastal areas. At first glance, mountains and coasts would seem to differ in just about every conceivable physiogeographic and socioeconomic way, making such a dialogue and learning experience difficult. Their historical roots and development patterns, as well as the climate-related resources that attract people there, and the climate change threats faced by each only add to the perceived differences. But are these characteristics really so different, and do they adequately capture the two environments? Moreover, can the diversity of experiences contained in communities across distinct geographies shed light on common strategies for improving—and possibly hastening—societal response to climate change?

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KEY FINDINGS

- Dialogue between mountain and coastal communities addressing the impacts of climate change offers rich opportunities for learning, despite geographical and other differences.
- Climate change may involve risks to lives, livelihoods and lifestyles in coastal and mountain regions, and the differences surface not just through variation in physical risks but also in socioeconomic vulnerabilities and adaptive capacities.
- Both the risks and attractiveness of coasts and mountains are important entry points for science and practice interaction.
- To adequately meet the climate change challenge, integrative solutions with multiple co-benefits (i.e., meeting adaptation and/or mitigation, as well as non-climate policy goals) across sectors locally and across space, are required.
- Strong leadership and a robust social process are needed to advance adaptation effectively.

Table 1. Comparison of mountain and coastal experiences in adapting to climate change

	MOUNTAINS	COASTS
Historical roots	Mountain communities evolved originally around mineral exploitation, pastoralism, and more recently forestry and tourism.	Coastal communities grew up around seafaring/trade and shipping, fishing, and military installations; more recently tourism, oil/gas and a diversification of the economy play a role, all of which have contributed and continue to foster intense urbanization and economic growth.
Human geography	Most high-mountain communities are small, isolated, contained, and less intensively developed, often surrounded by extensive natural areas. In the U.S. much land is held in public ownership, though used in diverse ways. A high degree of resource dependence and seasonality characterize these areas. Demographic changes (e.g., aging population, outmigration) and economic conditions (limited local job opportunities, high level of commuters) add to challenges. Important highland-lowland interactions link people and the economy.	Very diverse environments (depending on geology/geomorphology), ranging from small (barrier) island communities that are isolated and contained, to contiguous, well-connected, highly developed, urbanized, diversified, and industrialized mainland cities with coastal plains of varying extent. Range from vibrant cosmopolitan coastal centers to laid back, economically constrained or single-sector dependent rural communities. Important coast-hinterland interactions link people, infrastructure, and the economy.
Challenges	Tourism-dependent, wealthier communities exhibit a resort-town development "syndrome" with cyclical development, "Aspenization" (establishment of second homes by wealthy elites), boom-bust economy and demography, and problems with land use, housing, and transportation.	Second-home and seasonal vacation rental economies are common on the shorefront and on islands. In U.S. only limited publicly owned land, most land highly developed and privately owned. Urbanized economies mixed and non-seasonal. Much of urban development is intensive, older, and protected by hard measures. Sprawl, encroachment on natural areas and wetland loss are pervasive. Emergency evacuation problematic on some coasts, islands.
Climate-related resources	The cold/cool climate is a critical resource, as are orographic precipitation, very cold streams and lakes, the seasonality, and diverse landscapes creating multiple microclimates that support a diverse ecology, forests, and refugia.	The generally cool(er)/mild(er) climate than inland areas at the same latitude, along with ocean views, open landscape, beaches and wetlands are key resources.
Climate-related risks	Higher temperatures will enhance melting of mountain glaciers and lead to more precipitation falling as rain than as snow. Earlier run-off and longer dry periods increase wildfire risk and affect aquatic habitat. Melting permafrost will increase risk of rock fall, mudslides.	Intense extratropical or tropical storms with high winds and floods constitute the major hazards. Coastal erosion, wetland loss, permanent land inundation – as well as the extent of flooding and height of storm surges will all be increased by sea level rise.

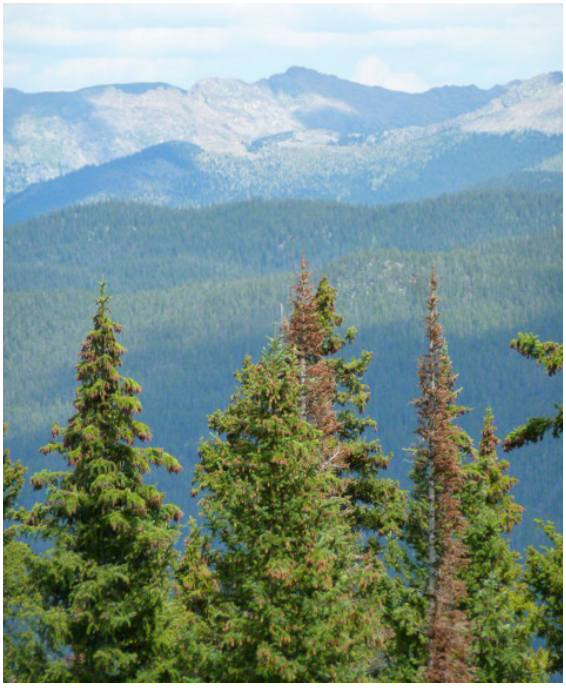
CLIMATE CHANGE THREATS TO COASTAL AND MOUNTAIN REGIONS

Together, the geography and historical patterns of development create different climate change-related threats and social-ecological vulnerabilities that combine in place-specific risks. These risk profiles show important similarities and differences across the coastal and mountain communities involved in the Hamburg and Aspen transatlantic dialogues.

Mountains

In the U.S. Rocky Mountains and European Alps, climate change is already being observed. Some of the experienced and expected changes offer opportunities, while others pose significant threats to ecosystems, human communities, infrastructure, and locally, regionally, and nationally significant economies:

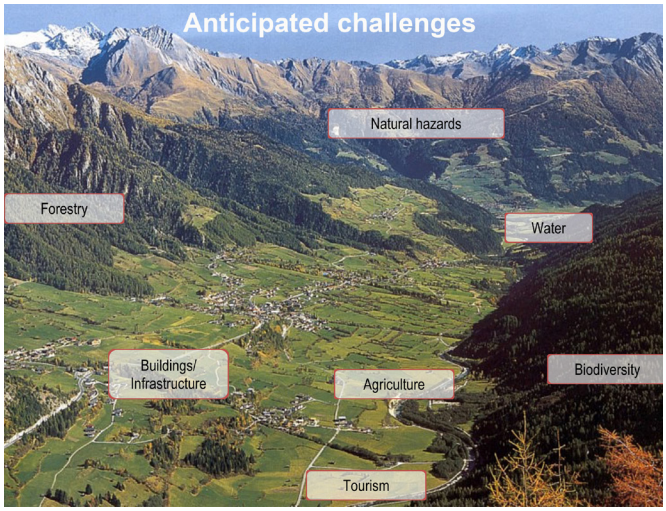
- Lengthening of the summer season and frost-free period;
- Declining snow cover due to higher temperatures and aggravated by land-use driven dust on snow; increased likelihood of mid-to-late winter thaws and rain-on-snow events;
- Decrease of precipitation as snow due to higher temperatures, resulting in more precipitation falling as rain and earlier run-off, as well as more intense rainfall events and longer dry periods, even if annual totals remain relatively unchanged;
- Shift in peak runoff resulting in greater challenges for water management (supplies, timing and equitable distribution);
- Worsening of familiar natural hazards such as melting of permafrost, mudslides and debris flows (mainly in the Alps), extreme rainfall events, wind storms, droughts and wildfire (mainly in the U.S.) posing growing threats to increasing populations in high-risk areas (e.g., wildland-urban interface, valleys);
- Intensifying impacts on terrestrial and aquatic ecosystems and biodiversity as a result of higher temperatures, changes in precipitation, runoff, stream/lake temperatures, and extreme events: suitable habitats move upland, thereby declining in size, ecosystems become disjointed, number and composition of species is changing with particular threats to habitat “specialists“;
- Growing economic and socio-cultural impacts, some of which are negative, positive, or neutral depending on the opportunities and limits to adaptation:
    - A longer growing season can benefit agriculture/ranching, such as extending the suitable area for production (as long as water supply is sustained);
    - Forest growth may benefit to some extent from higher CO_2 levels and more efficient water use, but become threatened by increasing drought risk, spread of pests and increasing wildfire danger;



In many places in the U.S. and Canadian Rocky Mountains, warming temperatures and drying conditions have led to enhanced tree mortality caused by insect and disease. Credit: Susanne Moser.

Extreme precipitation intensifies natural hazards like debris flows in mountanious regions e.g. the Alps. Credit: DeWe/fotolia.

- Impacts on outdoor recreation (e.g., trout fishing, hiking) can be negative or mixed;
- Tourism (e.g., hiking, cultural offerings);
- Winter (snow-dependent) tourism may see increasing challenges from higher temperatures and competition for water resources for snowmaking, while summer tourism will be impacted by changes in extreme events, wildfire risks and direct impacts on hydrological and ecological resources, but also benefit from lowland visitors seeking temperature relief; opportunities lie in extending summer and shoulder season;
- Growing damages to transportation infrastructure from extreme events, causing challenges for access and emergency evacuation, and entailing growing maintenance costs.



How vulnerable mountain communities are to these changes depends in large measure on the size, and distribution of the exposed population and on the wealth, stability and diversity of the economic basis of the community. Generally, mountain populations are smaller, spread over large and difficult-to-access regions. Resource-dependent communities have different vulnerabilities than resort communities. In some of the case study regions, the threats from climate change are perceived as less serious than the threats from the resort industry or distant economic drivers to “mountain culture“ and traditional, “outdoor“ lifestyles.

A presentation from the Mayor of Virgen, Austria outlines the many issues of concern for mountain communities facing the impacts from climate change. Credit: Dietmar Ruggenthaler.

Coasts

Along the U.S. Mid-Atlantic coast (Virginia, and North Carolina) and Chesapeake Bay, as well as the coast of the Baltic Sea and Bay of Kiel, climate change and sea-level rise are also experienced realities, albeit to varying degrees. Contrary to the mountain areas, fewer of the expected changes are viewed as potential opportunities. Indeed, while not too serious in the case locations yet, many expected coastal impacts pose significant and even transformative threats to ecosystems, human communities, infrastructure, and local (and nationally significant) economies:

Flooding in Crisfield, Maryland following Hurricane Sandy in 2012. Credit: Maryland National Guard.

- Higher air (and coastal water) temperatures and a longer summer season;
- Variable rates of sea-level rise (global and large-scale regionally varying rates are superimposed on local land movement), resulting in
  - Different rates of permanent inundation and land loss;
  - Increases in the inland extent and height of periodic flooding, including higher storm surges (smaller increase along the Baltic Sea, greater for the Chesapeake Bay);
  - An increase in erosion of beaches (e.g., North Carolina), cliffs (Schleswig-Holstein);
  - Wetland loss, where wetlands can‘t migrate inland and grow upwards (e.g., Chesapeake Bay)

These risks are generally larger for exposed, open ocean areas of the Atlantic than for the more sheltered Baltic Sea or estuarine shorelines of the Atlantic seaboard.

- Variable regional changes in precipitation but everywhere more intense rainfall events, resulting in growing flood risks in areas where runoff from coastal and inland areas combine;
- Threats to coastal ecosystems magnified by the high degree of human development and related stressors (constraints on habitats and migration corridors, pollution, overuse);
- Impacts on buildings, property, infrastructure such as water supply and sewer systems, energy installations, and roads, as well as on economies are increasingly experienced, especially in those coastal regions already experiencing higher rates of sea-level rise (e.g., Chesapeake Bay, Virginia); these infrastructure impacts can have far-reaching implications, even for inland areas:
    - Greater erosion of beaches will negatively impact recreation and tourism as well as private properties unless beaches can be replenished;
    - Flooding is more frequent and reaching further inland, disrupting lifelines, urban communities, local/regional economic activity, and requiring greater flood protection;
    - Higher air and water temperatures may be a potential benefit as tourists come from hotter inland areas to cool-off at the coasts; extended summer and shoulder seasons offer new and additional opportunities for tourism.

Flooding in the city of Hamburg after a storm surge. Credit: Matthias Krüttgen/fotolia

Accelerated erosion near Baltic coastline results in damage to infrastructure. Credit: Horst Sterr

Coastal communities are generally highly vulnerable to climate change threats due to higher concentrations of people in high-risk areas, direct threats to buildings, and the disruption of essential infrastructure functioning and economic activity. Wealthy, economically diverse and stable communities may have the resources to implement a range of adaptation strategies, but those can cause negative impacts themselves (e.g., impacts on coastal ecosystems, neighboring properties, moral hazards, high costs, constraints on coastal access).

There are physical limits to adaptation in both geographies (e.g., sea level encroaching on land, orographic limits to upward movement of species) as well as risks to lives, livelihoods and lifestyles unfolding as a result of climate change. In particular, the vulnerability to extreme events is very high along coasts and in mountain areas, but mountains are relatively neglected as regions deserving special attention (the Second IPCC assessment in 1995 included a mountain chapter, but no other assessment since has focused specifically on mountains while there have always been chapters focused on coastal areas). Both regions have long histories of changing economies, people migrating in and out. Change thus is not unfamiliar and in many ways inevitable regardless of climate change. However, because of the high concentration of people, infrastructure, development and economic activity in coastal areas, change – and adaptation to that change – seems more daunting there.

ADAPTATION: PLANNING, ACTIONS, AND CHALLENGES

The physical- and human-geographic contexts, the climate change risks experienced or expected, and the adaptation efforts underway in the case examples explored during the transatlantic dialogues reveal interesting similarities and differences between coastal and mountain communities.

Similarities between Coasts and Mountains

Adaptation opportunities and constraints arising from the geographic setting:

- Coasts and mountains are among the ***most dynamic physical environments*** on Earth. In both, the extremes in physical and climatic conditions are attraction and peril at once; the impacts of climate change are already visible, either through gradual and in many ways familiar changes, or through more extreme events. Where extreme events have happened in the recent past, they help focus public and policy-maker attention on the risks of climate variability and change and the need for greater disaster preparedness and adaptation.
- The ***coast-hinterland and upland-lowland connectivity*** creates teleconnections that link local impacts and distant events in complex and underappreciated ways. Often it is difficult to involve those further away in conversations about local adaptation; cross-scale governance is needed to enable dialogue, planning, and support for implementation.
- Both regions have seen (or continue to experience) the ***greatest increase of population in the highest-risk areas***, such as coastal floodplains, mountain valley bottoms, and at the wildland-urban interface, with planning inadequately considering current and growing risks.
- The ***influence of wealth*** on local economies and political culture is significant. “Aspenization“ has a coastal counterpart in Europe “Syltization“ (referring to the German North Sea island Sylt).
- While not true in all mountain or coastal communities, those explored here have a strong ***economic basis in tourism***, shaping not only the dominant local risks but also the “delicate balance” (Aspen Mayor, Steve Skadron) that needs to be struck in reducing socio-economic vulnerability and shaping adaptation options that manage growth, protect local values and meet tourist expectations.

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Climate change risks:

- In most communities examined, there is still relatively low ***awareness of local climate change risks*** in the general public, which speaks to a need for awareness raising and education, but also to the difficulty in communicating climate change: people easily get overwhelmed by gloom-and-doom messaging and leaders struggle to find ways to positively engage people in active solutions.
- ***Water issues*** – while manifesting differently – are key issues in both regions: coastal areas, being very close to sea level, face challenges with sewage, runoff and water treatment; many mountain areas face challenges with water supply and storage.
- The ***prospect of having to abandon current land uses*** due to climate change in the future is a real possibility in both regions as there are real limits to technological adaptation options.

- Coastal and mountain communities face both ***lifestyle and existential risks***. They point not just to the physical nature of risks but to the underlying socioeconomic vulnerabilities and adaptive capacities that different communities have.

Adaptation activities to date:

- ***Extreme events and climate variability are key entry points to adaptation***, both for scientists and for practitioners. ("Never let a good crisis go to waste," as per a comment made during the community dialogue).
- In all cases, ***a strong local leader or champion*** has been key to getting climate action and adaptation planning efforts launched (e.g., Mayor of Virgen; former Mayor of Timmendorfer Strand; former and current mayors of Aspen). Far from merely an artifact of the cases included in the transatlantic dialogue, this is found repeatedly elsewhere.
- ***Legacies of the past shape adaptation approaches and options*** considered and perceived as feasible now, be they structural, institutional, political, or related to the civic culture and history of community engagement.
- At this early stage of adaptation planning, there is a strong emphasis on ***raising individual awareness of climate risks and household-level actions*** (e.g., "Klimapavillon" along the Bay of Kiel; exhibits and public education at several nature centers in the Aspen area; "Klimapfade" [climate trail] in Grindelwald; individual home or property protection in U.S. cases; public education and household water conservation in Aspen).
- Not only are ***climate change risks perceived negatively, but so are many of the proposed (or imposed) adaptation strategies***. Participants stressed the importance – as familiar and beloved aspects of the communities are lost – of making the alternative attractive. This can happen through multi-functional, beautifully designed adaptation measures and creating immediate community benefits (health, economic opportunities, jobs, safety, local pride).
- Generally, adaptation strategies to date in the cases explored, ***lack a strategic approach*** and are instead ad hoc, opportunistic or focused on small, individualized responses. Communities need to learn how to be more strategic, how to think about future, more frequent, converging and amplifying crises, and how to overtly address things people don't want to talk about.
- Adaptation, and especially the more transformational changes needed in the future, constitute ***fundamental changes to long-standing social contracts and expectations of government***. These cannot be achieved immediately and need sustained community dialogue (e.g., denial of development rights, loss of private property protection, help in and after disaster).
- To date, communities ***inadequately consider synergies and trade-offs between mitigation and adaptation*** and how they change over time (e.g., reforestation with young trees leads to greater water need and greater flood protection now, will change over time).

After nearly a decade of planning and discussion between community members, scientists, and regional officials, the coastal resort community of Timmendorfer Strand completed a sea wall. In many places the structure blends into the natural landscape, thereby minimizing aesthetic impairment while protecting the community from the impacts of storm surges. Credit: Susanne Moser.

Differences between Coasts and Mountains

Adaptation opportunities and constraints arising from the geographic setting:

- As described above, there are ***obvious biophysical differences which compound differences in socioeconomic vulnerability*** (among all cases). Aspen, for example, is very wealthy, while Virgen is quite constrained in financial means; Grindelwald falls somewhere in between and North Carolina and Chesapeake Bay communities can vary considerably along the socioeconomic spectrum, as well as in the physical risks and the extent to which climate change impacts are already emerging.
- Coastal regions have much ***larger population concentrations exposed to climate change*** than mountain communities.
- The ***longer occupation of coastal areas*** also generally means there are a greater number of older, historical buildings at risk, which makes it more difficult to implement structural adaptations (if at all) due to historic preservation rules

Climate change risks:

- In mountain areas, climate change is causing predominantly ***temporal shifts*** in physical and ecological processes (e.g., snowmelt, runoff, length of fire season) while coastal areas can expect predominantly ***spatial shifts*** (inland movement of shoreline, freshwater/saltwater lens, extent of inland flooding).
- In most of the cases examined (though not necessarily true with all or elsewhere), mountain communities may have a shorter ***lead time before adaptation measures will need to be implemented*** as changes are unfolding rapidly; for some coastal communities, impacts are still further in the future, allowing more time to determine appropriate adaptation strategies (though this will depend on the rate of local sea-level rise and concurrent stressors).
- In mountain areas, ***competition for water uses*** may be greater than in some coastal areas.

Snowmaking is one practice adopted by ski resorts in mountain communities to adapt to variability in winter snowfall patterns.

Adaptation activities to date:

- In the mountain communities studied here, ***mitigation*** was the first ***entry point into climate action*** whereas addressing experienced or preparing for immanent impacts (adaptation) was the entry point in the coastal cases.
- Due to the different degree of urbanization and development, ***adaptation in mountain areas – while challenging – is expected to cost less overall than adaptation in coastal environments.***

Overcoming Barriers – Advancing Adaptation Action

Originally, the transatlantic dialogue was designed to surface barriers to adaptation that research and better science-policy/practice interactions could address. The dialogue revealed, however, that the challenges to adaptation in coastal and mountain communities were not primarily, much less only, rooted in lack of science or inadequate climate services. Instead, barriers to adaptation were overcome (or proposed to be overcome) through communication, governance, resources and cultural and behavioral shifts:

Improved Communication and Connection to the Public

- ***Raising public awareness of emerging and growing climate change risks*** is an important component of effective community engagement.
- ***More consistent and clearer communication from scientists*** would be helpful, although scientists are not alone in shaping a difficult communication environment. There are many areas in which climate science is firm and consensual while continually changing still in others. Vested interests play a big role in muddying the waters about what the public hears about climate change.

Extreme rainfall events, such as those experienced in Boulder County, CO in September 2013 pose direct hazard to mountain communities as well as the longer term challenge of deciding whether to re-build or relocate. Credit: FEMA.

- Because climate change and adaptation options may be difficult for the public to take in (both cognitively and emotionally), there is an overriding need to ***find ways to communicate that resonate with the public's values.*** Tapping into the local sense of place, (place identity or, in German *Heimat*) have proven effective. Focusing on something that benefits the community in the near- and longer-term (health, safety, welfare, civic pride, economic development/job, sense of place) is also important as are adaptation strategies that solve multiple problems at once.
- The ***language of adaptation*** is challenging for some audiences, as it can be jargon-laden or holds different meanings for different people. For others it is simply not resonant or familiar yet. A more resonant language must offer concrete, imaginable activities, highlight benefits and opportunities, show how selected strategies help avoid suffering, and contribute to community health, innovation, and the protection of what locals consider "sacred."
- ***Improved social relationships*** (built on mutual respect, trust, operating in good faith) need time to develop. In many localities they also need to undo and work against existing polarization and antagonism. ***Time and dialogue*** are needed to get to acceptability of climate change and adaptation.

Modified Governance Structures and Procedures

- ***Legal frameworks need to be established to facilitate adapting to changes.*** Existing ones do not allow for the consideration of changing baselines or for different future scenarios. However, historical values are no longer an adequate guide to the future; regular updates with the latest science should be required, as well as not foreclosing future adaptive options in light of uncertainty.

Chesapeake Bay Bridge closed in anticipation of Hurricane Isabel in 2003. Credit: FEMA.

- Given the teleconnections between mountains and lowland areas and between coasts and hinterlands, and the multi-scale governance systems that shape resource management and investment decisions, ***cross-scale connections in governance*** need to be established at higher levels of government. For example, tree planting in mountain areas can support flood prevention in

lowland areas. Connecting adaptation plans across communities, ensuring two-way flow of information, helping to clarify roles and responsibilities and even cost-sharing mechanisms may be aspects of such trans-local governance.

- Moving toward ***regional and more widely collaborative approaches*** helps overcome silos in thinking and management (e.g., sharing information, joint planning along littoral cells, around bays; integrated forest and water management in a watershed).
- In light of continued and substantial uncertainties (e.g., precipitation changes in mountain areas, sea level rise projections along coast), managers must ***manage for uncertainty, not expect resolution of uncertainty*** ("you do the best you can"); generally, uncertainty causes managers to get started with low-regrets planning (e.g., system reliability, diversification, flexibility), focusing on establishing a good process, not just achieving narrow outcomes, planning for multiple futures through scenarios, and carefully assessing a portfolio of response options.

Adequate financial backing and investment

- Cost of adaptation is not as big a barrier as it may become in the future (although anticipation of negative economic impacts of climate change and, particularly, of adaptation measures e.g. development restrictions, is already impacting the political debate). Communities, regions, states need to ***pool resources, find ways to compensate losses or damages, and reduce their financial liabilities.***
- Communities need to find ways to ***create jobs with adaptation*** (similar to experience with mitigation) so it becomes more attractive to people.

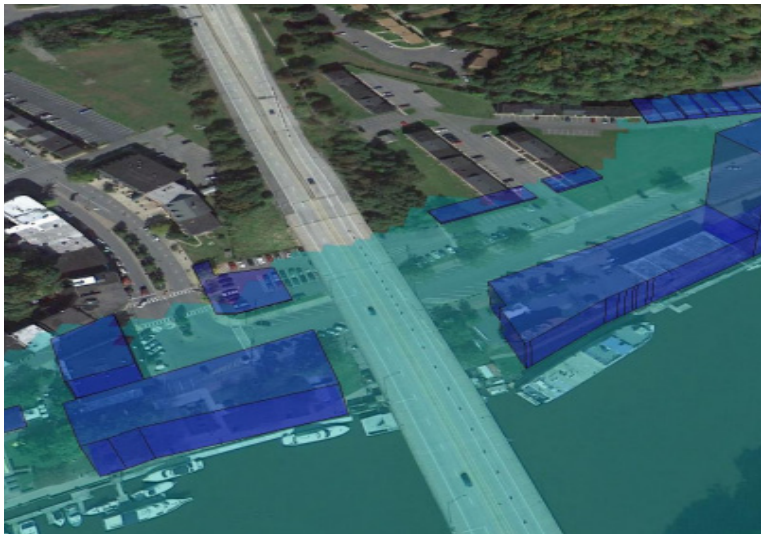
Work toward slow, but crucial cultural shifts

- Governments and local authorities may need to ***plan for worst-case scenarios, long before the public accept the possibility of such major threats.*** It is the obligation of government to think beyond individual interests and productively use this "luxury time" before impacts get worse and come faster.
- Adaptation to climate change demands that the ***roles and responsibilities of private sector, individual and public entity actors be reexamined.***
- Adaptation, especially deeper, transformational adaptation, will ***require cultural shifts***. For example, what are now considered fundamental rights – such as access to sufficient water or protection of private property – may well need to change in the future. Moving toward a "culture of drought," in which water is not expected as a given coming out of the faucet, or a "culture of preparedness," in which post-disaster bail-out becomes replaced by self-reliance and local resilience, are conceivable cultural shifts in situations grappling with drastic climatic changes.

Part 2 - Enhancing Interaction between Scientists & Practitioners

DIALOGUE AND DECISION SUPPORT TOOLS

To address the growing need for resources designed to help decision-makers, resource managers, planners, and other stakeholders make sense of climate change impacts and adaptation options, there has been a proliferation of "tools" that help guide planning discussions, translate and visualize scientific information, and enable tool users to explore future scenarios and the impacts of considered responses within their region or community. Tools comprise one important type of instrument for making scientific information usable for climate adaptation planning, though careful attention to their design, development, and use is imperative.



Visualizations, such as those that explore scenarios of coastal inundation, can serve as the basis for community discussion and decision-making. Credit: Catalysis Adaptation Partners

CONTEXT AND RESOURCES

At the initial dialogue in Hamburg, the participants examined and discussed tools for illustrating climate change impacts on local communities. Examples of presentation included *a systems model designed for* a *mountain watershed in British Columbia*, an *early warning forecast tool designed for the Chesapeake Bay*, and a multi-criteria *assessment for development of adaptation paths in the Elbe River Basin*. Group discussions focused on the perspectives of both developers and users of tools to support decision-making for adaptation to climate change.

KEY FINDINGS

- Developing forums, networks, and institutional partnerships along with professional incentives for ongoing dialogue and mutual learning is crucial to create the joint production of practically useful knowledge and to increase its use in decision-making.
- The move toward integrative science (from reductionism to holistic systems perspectives) must be matched with more integrated planning and governance.
- Different kinds of tools serve different purposes such as supporting a dialogue among stakeholders, the decision-making process, and ongoing monitoring.
- There is a need for tools that are visually engaging, demonstrate possibilities and opportunities, inform about vulnerabilities, make the uncertainties clear, and broaden the use of scenarios.
- Tools are needed that compile and integrate local knowledge and scientific information about climate change and thus make it available for a wide range of users.

At the Aspen Workshop, participants were provided with more detailed information on four specific tools and discussed their experiences with these tools in a plenary session. The four tools were:

- ***Baltic Climate Toolkit*** (http://toolkit.balticclimate.org/) – an empowering knowledge transfer instrument for actors on the local and regional level, who have an important role to play in the preparation, financing and decision-making related to the implementation of climate change measures.
- ***COAST*** (http://catalysisadaptationpartners.com/the-coast-approach.html) – a decision-support tool that predicts damages from varying amounts of sea level rise and storm surge of various heights and evaluates relative benefits and costs of response strategies. It allows users to connect the technical aspects of sea-level rise, with an accounting of the economic assets and costs of adaptation given their preferences and values.
- ***ORTIS*** (http://www.alp-s.at/cms/en/consulting/history/ortis/) – as a community-based risk assessment tool, ORTIS identifies and assesses risks and their impacts and probabilities, illustrates the effects of implementing certain strategic, technical and organizational measures, and offers users the opportunity to monitor and evaluate the effectiveness of the measures as well as emerging risks. This is embedded in a process of facilitated workshops to bring in local knowledge and engage stakeholders.
- ***CLIMSAVE*** (www.climsave.eu) – the CLIMSAVE Integrated Assessment Platform allows the user to explore the complex issues surrounding impacts, adaptation and vulnerability to climate change at regional to EU scales. Impacts of climate and socio-economic change are visualized using maps and vulnerability to climate change is shown for 6 sectoral indicators.

DIFFERENT TOOLS FOR DIFFERENT PURPOSES

While noting that the development of any “tools” must be accompanied by clarification of values, beliefs and assumptions, so that they are clear to the users, the presentations and discussions during the two meetings highlighted three important uses of tools within adaptation processes:

Supporting the dialogue among stakeholders: Tools can provide a focal point for a controversial or value-laden discussion and stimulate learning processes. Through providing a way to represent the knowledge of all stakeholders and finding a common language, tools can assist in the joint reframing of problems and in finding acceptable solutions. Tools can increase awareness about an issue and facilitate increased understanding about what needs to be done or about the level of complexity and possible trade-offs that will have to be addressed. However, tools do not provide an unbiased focus for dialogue: when, for example, tools visualize impacts, they can have a powerful impact on the direction of the conversation.

Tools to support adaptation planning can help in a variety of ways, such as visualizing possible future impacts from climate change, exploring the costs and benefits of possible response options, or supporting dialogue during a community‘s planning process. Credit: Aleksander Kosev/fotolia

Supporting the deliberation and decision-making process: By organizing available knowledge, structuring decision processes into step-by-step menus, and showing “what happens if x happens” or “what are the costs and benefits of y choice“. Tools can show the options available to deal with a problem and the results they might produce, thus aiding the users to find a solution. The tools do not make the decision, but provide a basis for reaching one.

Monitoring effectiveness: Tools can be used to keep track of the impacts of measures taken and thus become part of a process of experimenting and learning.

WHAT IS NEEDED?

Tools cannot stand alone, their value lies in the process in which they are embedded. No tool can replace the dialogue and reflection that are needed in reaching a decision to do something. However, tools can trigger a desire to deal with climate change and point out specific possible adaptations to it. Much therefore depends on the process design itself, not just on the credibility and usefulness of the tool. The process could also involve stakeholder engagement in the development of the tool itself. Using tools within a process requires good facilitation and training so people can use tools appropriately. For instance, once a part of a decision-making process about the future of a community, tools can raise fear of loss or even anger about proposed responses and, therefore, this dialogue must be constructively facilitated.

In both Hamburg and Aspen, there were calls for tools that are ***visually engaging***, for example using pictures or maps that are easily understandable and thus support communication. Links to online sources of information are also useful. Other ideas for needs covered: online support tools that do not show concrete outcomes but ***demonstrate possibilities and opportunities***; tools to inform decision makers about what vulnerabilities are and give them an idea about what they want to change; tools that make the ***uncertainties*** clear and broaden the use of scenarios. Overall, there was a call for tools that are ***logical, transparent, interesting, and reliable***.

Climate change impacts and the adaptive responses to them lead to financial costs and benefits for a community, but consideration of non-financial factors, such as quality of life and love of place, can also play a prominent role in shaping community dialogue and preferences on response options. Credit: emillau/fotolia

The discussions at both meetings highlighted some particular needs for tools to be used in processes to develop strategies for adaptation to climate change:

Dealing with the costs and benefits of climate change

Tools to support decision-making are not one-size-fits-all. Matching tools to community needs and incorporating local knowledge and values into the process of using the tool is required for effective decision support. Credit: Michael Kranewitte

While it appears that many stakeholders would like to have tools that calculate the costs and benefits of adaptive measures, others point to the need for extending tools to look at subjective/non-market values, such as quality of life or love of place. While tools calculating costs and benefits could engage the business community in the dialogue about climate change, mitigation and adaptation, the issue of “cost“ speaks to more than the business community. However, for many people cost is not the central issue, or at least often not the one driving their acceptance or resistance to proposed measures. Participants from the USA in particular felt that economic tools need to be embedded in robust deliberative processes so that as agreement are made on the need to address climate change impacts, the question of how to fund the measures (mitigation and adaptation) can be addressed. Otherwise, the question of costs will be a significant barrier that some will try to exploit to prevent any action.

Incorporating local knowledge and values

Participants emphasized the need for more entry points for local experiences to inform local, provincial and national planning. That is, tools are needed that compile and integrate local knowledge and values, as well as scientific information about climate change, and thus make it available for a wider range of users. The possibility to update this material regularly would add further value. Qualitative information is also very useful.

Through incorporating local knowledge, the tool becomes open to "other ways of knowing" and can build trust in the user community through the use of stories. Furthermore, the elicitation of values and their use in tools require both special skills and disciplinary knowledge from the social sciences and humanities. It was also noted that keeping tools – and the data they use – locally relevant and updated is time consuming, and is rarely taken into account in the development and the propagation of the tool.

Outreach and tool selection

The discussions showed that there is already a wide range of tools, with different aims, level of detail and focus. Outreach is rarely included in tool development project budgets, so the availability of many tools is not widely advertised. Since it is clear that different tools will be needed in different situations, the participants not directly involved in tool development and use expressed the need for a platform that provides recommendations for tools or indeed some kind of decision tree that can be used to find a tool to fit specific requirements. While such platforms are available, e.g. CLIMATE-ADAPT (http://climate-adapt.eea.europa.eu/), weADAPT (http://weadapt.org/), ICLEI's adaptation toolkit (http://www.icleiusa.org/tools/adapt), or compilations of case studies such as CAKEX (http://www.cakex.org/), potential users do not yet know about them.

Overall, the two dialogues showed a wide availability of tools serving a variety of purposes. At the same time, explicit needs for tool development were expressed and the participants clearly felt that information about available tools was hard to find.

INTERACTION & DIALOGUE AT THE SCIENCE-POLICY-PRACTICE-PUBLIC INTERFACE

There is a long history – both in science and in practice – to ask how best to work together at the science-policy-practice-public interface: What are the differences in language, professional norms, cultures and institutional (dis)incentives between science and the world of practice, and how can they be overcome? Should they be overcome? How close should the interaction be? What should be the role of science be in decision-making, and what is the role of potential information users in influencing what research gets done?

The Hamburg and Aspen dialogues confirmed common barriers in that interaction and found them to be as prevalent in the U.S. as in the EU, in coastal as well as in mountain environments: the attitudes of those involved, the lack of mutual understanding between scientists and stakeholders/decision-makers, language differences, professional norms and incentives, limited capacity for self-reflection, and lack of time (on all sides) for building a well-functioning connection. To overcome them, they re-affirmed the need for a robust (effective and ongoing) social process, and in fact emphasized that such a process is more important than any science or any law to making progress on adaptation.

One goal throughout the transatlantic dialogues was to identify more effective approaches to science-practice interaction. Participants identified a range of approaches including the use of "boundary organizations" as intermediaries between science and practice communities as well as techniques for co-production where stakeholders work alongside researchers in accomplishing outcomes of mutual interest to both groups. Credit: Climate Service Cernter

A RANGE OF MODELS OF SCIENCE-PRACTICE INTERACTIONS

There is far from an agreement about how and how closely scientists and decision-makers should work together. While many scientists have developed significant experience and skill in doing so, among some there still is considerable hesitancy about a close and ongoing interaction.

While few would insist that there should be a tight “firewall“ separating scientists from practitioners (model 1), many would prefer a type of institutional arrangement whereby a designated “boundary organization“ serves as a meeting space, convening individuals – periodically or an a more permanent basis – to explore information needs and scientific feasibility, managing the interactions among participants, and ensuring mutual accountability, but leaving both scientists and decision-makers to do what each does best alone, except for the encounter at the “boundary“ (model 2). Over recent decades, experience has shown that direct and frequent dialogue in both formal and informal settings between scientists and decision-makers without a convening institution constitutes another often highly effective form of science-practice interactions (model 3). Finally, on the extreme opposite end from the firewall model is the complete merger of those doing research and those making decisions where lines of distinct responsibilities have been extinguished (model 4).

The extreme models have few subscribers among those who are serious about use-inspired research and useable science. Experience gained from collaborative work along the lines of the other two models suggests the following key lessons (see also the resources at the end):

- ***Effective co-production – and use – of science typically involves changes on both the science and the governance sides:*** scientists overcome institutional disincentives to meet with practitioners to understand information needs and decision contexts, help – step-by-step – to decentralize the provision of information and build capacity to understand and correctly interpret information; meanwhile practitioners ensure political authority and create a policy context in which climate change information can be used. Together, they build a culture of partnership and leadership capacity at all relevant levels. Both sides stay in the social negotiation of decisions to not just find the decision-analytically "optimal“ solution, but the socially acceptable and morally “right“ one.
- ***Several favorable baseline conditions facilitate effective science-policy/practice interactions***, including the involvement of scientists with long-term research experience and established credibility, established close cooperation with planning authorities, graduates from a local/regional university who have moved into public planning or private sector institutions (social and human capital), strong scientific allies in neighboring disciplines, and a network of experts to draw on so as to be able to respond to changing information requests over time.
- ***Skills and capacities – among scientists and practitioners – needed for effective interaction*** include the ability to:

  - ***Communicate, translate and facilitate dialogues by***
    - Listening first, speaking second
    - Learning how to address the audience before addressing it
    - Understanding the concerns and viewpoints of all involved, trying to “stand in their shoes“
    - Aiming for personal connection, not for persuasion
    - Linking science to people‘s experiences
    - Being honest but polite, without having to accept the other‘s point of view or beliefs
    - Balancing the need to raise awareness, assist understanding and be clear about the implications of scientific understanding
    - Facilitating constructive conversations about solutions
    - Connecting different types of knowledge

- ***Build trust and confidence by***
  - Being non-condescending
  - Being interested in the other
  - Involving stakeholders from the start
  - Being aware of and directly dealing with any legacies of distrust
  - Illustrating to stakeholders that they share common problems and that there are opportunities and common interests in solving them
  - Showing linkages between problems/risks and solutions
  - Understanding that you won‘t “get them to do something,“ but that all involved need to get to “us doing something difficult together“
  - Understanding that trust will take time to build; undoing distrust will take even longer
- ***Improve the interaction by***
  - Being observant, self-reflective and willing to change
  - Building alliances of interest and ensuring that all voices are heard
  - Sharing successes
  - Pooling resources to help overcome institutional and financial barriers
  - Scientists and practitioners being in constant and personal interaction
  - Identifying and strengthening ties to strong allies at the political level
  - Adjusting attitudes and perspectives by understanding that people may feel as threatened by climate change as by the proposed response to it, especially if they are being told what to do
  - Not telling the community what is right or wrong, but helping people determine how much risk they want to tolerate and what solution they find acceptable

LESSONS ON EFFECTIVE SCIENCE-PRACTICE INTERACTIONS ON ADAPTATION

There are opportunity costs, risks and opportunities involved in each of the above models of science-practice interaction, suggesting that different circumstances may require different arrangements. Regardless of these specifics, several overarching messages emerged:

- ***For practitioners, science is an “enabling capacity“ for adaptation***. It is needed for modeling, analysis, reasonable projections, assessment of uncertainties, and for ongoing monitoring of environmental changes and of the effectiveness of employed solutions.
- ***For scientists, engaging in specific adaptation contexts offers a way of “on-the-ground“ testing of scientific knowledge*** in applications to make it more robust over time. It offers a real-life opportunity to evaluate and transition tools and information products into operation.
- To ensure the lessons go beyond the specific context, ***the mutual learning from specific pilot projects must be shared*** and thus help build a community of practice.
- Importantly, the ***transfer of information from science to practice is not enough***. As one put it, it is important to avoid “helping people do the wrong thing more precisely“, but to provide help with applying information, assessing its use, adjusting and sharing better practice on a continual basis.
- There is a ***risk of “inconsequential“ science-practice interaction***, with perpetual “paralysis by analysis“ on the part of scientists, matched with “conspicuous consumption of information“ on the part of decision-makers, who might busily search for relevant information but never do anything (different) with it. Thus, using science-policy dialogues to clarify the implications of scientific findings, exploring action alternatives, and getting to a commitment to action are key to avoiding this risk.

MOVING FORWARD

Visions of functional interactions between scientists and practitioners exist and necessity may create greater pressure to work together in the future (e.g., planning for different climate futures, growing crises from impacts and extreme events). While some degree of "on-the-ground" learning for all involved is unavoidable, wider sharing of common lessons is important, as is mentoring and training of academics and professionals in relevant skills during graduate education. Seeing better outcomes of such interactions over time may also foster normalization of science-policy-practice interactions.

Most important, however, is to create space for such interactions and to enable interactions between scientists and practitioners through creating physical spaces, providing funding and training, and continually working against engrained institutional disincentives. As the participants in the Transatlantic dialogues confirmed, those seeking each other out are motivated to do so because they wish to have greater impact and do the best possible job in a very challenging situation. Learning from others is both enabled and limited by the differences in context and personalities involved. Beyond those lessons, however, they look to each other for inspiration to work together and do so well.

SUMMARY

Hamburg and Aspen workshop participants engaged in an exchange of ideas and experiences with climate change science and adaptation that stimulated joint learning and mutual inspiration, understanding and respect. Despite language barriers and cultural differences stemming from different mother tongues and professional backgrounds, the involved academics and practitioners recognized each other as experts in different realms. A sense of possibility emerged that scientists, decision-makers and stakeholders could find acceptable solutions to climate change together if they engaged, remained open-minded, and used sophisticated tools and robust processes, including clear, respectful two-way communication, to understand the difficult choices society faces. There is hope and opportunity in further dialogues across the Atlantic, across the science-policy-society interface, and across different physical and socioeconomic environments such as coasts and mountains. In short, there is a continued hunger for more "***TIDAL & ROCKS***": Transformative, Interactive Dialogues on Adaptation and Learning & Reflective, Open Climate Knowledge Systems.

RESOURCES

The following selected resources are valuable starting points for more information on effective science-policy-practice interactions on climate and sustainability issues.

- Gardner, J., Dowd, A.-M., Mason, C. and Ashworth, P. (2009). A framework for stakeholder engagement on climate adaptation. CSIRO Climate Adaptation Flagship Working paper No.3. http://www.csiro.au/resources/CAF-working-papers.html.
- Pathways through Participation Project. Various useful reviews and reports available from: http://pathwaysthroughparticipation.org.uk/
- Participation & Sustainability in Europe: http://www.partizipation.at/index.php?english
- Kasemir, B., J. Jäger, C. C. Jaeger, and M.T. Gardner (2003). Public Participation in Sustainability Science: A Handbook. Cambridge, UK: Cambridge University Press. Available at: www.amazon.com
- Moser, S.C. (2009). Making a difference on the ground: The challenge of demonstrating decision support effectiveness. Climatic Change 95(1): 11-21. Open access article, available at: http://escholarship.org/uc/item/3bc7655d
- National Research Council (2009). Informing Decisions in a Changing Climate. Washington, DC: national Academies Press. Available for free download from: http://www.nap.edu/catalog.php?record_id=12626

Part 3 - Climate Change Adaptation Experiences in the U.S. and Europe

ADAPTATION: PLANNING, ACTIONS, AND CHALLENGES

Similarities between United States and Europe

Facing similar challenges and using similar tools: At a broad geographical scale, both the United States and Europe face similar challenges with respect to climate change and adaptation. Both continents have mountainous areas where warming will later the timing and rate of snow and glacier melt or lead to more disturbances (e.g. pests, diseases and fires) to forest ecosystems. Both also have coastal areas that can be affected by storm surges and/or sea-level rise. Both are also relying on science and planning communities to help in finding solutions. Experiences shared in Hamburg and Aspen indeed showed that there are also strong similarities among some of the tools being developed to support decisions on adaptation to climate change. Especially during the early stage of adaptation planning in the United States and Europe, soft approaches, such as knowledge sharing/transfer, awareness raising and education are being used. On both continents, technological adaptation is also frequently discussed, while deeper societal changes and holistic strategies are very rarely considered.

Mayor of Virgen, Austria (left), Dietmar Ruggenthaler and Steve Skadron, Mayor of Aspen, CO (right) discuss common challenges in adressing the impacts of climate change. Credit: James Arnott

KEY FINDINGS

- Examining the similarities and differences between the United States and Europe with regard to adaptation to climate change provides a valuable opportunity for transatlantic learning for both researchers and practitioners.
- Both sides of the Atlantic face similar challenges and are using similar tools to plan and implement adaptation actions. Much of the consideration of impacts and implementation of responses is at the local level.
- Differences in government, culture, history and geography mean that the public debate on climate change adaptation and mitigation has evolved differently in Europe compared and the United States.
- On both continents, the barriers to climate change adaptation can be overcome through appropriate use of tools in a well-designed process with a focus on the local level, with adequate human, technical and financial resources and with strong leadership.

Initiatives at the local level: In both Europe and the United States there is considerable evidence of local initiatives to respond to climate change. Motives and values driving such initiatives and the bottom-up approaches taken are very similar on both sides of the Atlantic. Tool development for adaptation planning and outreach to local communities is also the same and process support that leads to an improved understanding of the role of values and the need for behavioural change is important. Small communities are taking action, guided by charismatic leaders with a vision and a commitment to make change happen. Federal policies /directives do not necessarily drive what happens at the local level in both the United States and Europe.

In both the U.S. and Europe many discussions and decisions about climate change adaptation occur at the local level as communities explore how to enhance their resiliency to current and future impacts. Aspen, Colorado, for example, has formed a climate action plan that includes adaptation and mitigation components.

Less vulnerable than developing countries: Both the United States and Europe have the technical capacity to adapt to climate change. Having the financial resources to do so helps, but the workshops also showed that money is not always the essential element for embarking on adaptation measures. Human capital in the form of a skilled, healthy population is essential in initiating, guiding, and implementing adaptation to climate change. Social capital in the form of networks and voluntary organizations is also an important contribution to successful adaptation. In all cases examined during the workshops, the need to act arises when places are financially affected (e.g. through declines in the tourism sector) or when life / health is in danger. As pointed out by the participants, however, the vulnerability to climate change – at least in the cases explored – is certainly lower than in some less industrialized countries.

Different perspectives on the role of government between the United States and Europe affect how adaptation to climate change is conceived, funded, and implemented. Shown here is the government building of the German federal state of Schleswig-Holstein, located on the bank of the Baltic Sea. Credit: deli/fotolia

Differences between United States and Europe

The role of government: Adaptation planning already takes place at the highest governmental level in Europe, whereas the United States has a more fragmented policy landscape, including a general framework and executive order directing federal agencies in the development of adaptation plans, state adaptation plans in nearly half of the states, and a highly uneven engagement among local governments (municipalities and counties). National and sub-national adaptation plans are being developed and implemented in Europe, where solutions are often driven by government rules and financing, and they appear more locally, privately or individually driven than in the U.S. cases examined.

The prominent role of government is accepted in Europe and viewed with considerable ambivalence in the United States: while financing and guidance is welcomed, regulations and directives are commonly resisted. European governments have taken a stronger position on climate change than the U.S. government and this is reflected in the differences in the political acceptance of and attitudes toward mitigation and climate change science.


Credit: Susanne Moser

Cultural differences: Given the ambivalence vis-à-vis government in the United States compared with an expectation of responsibility and leadership from public and government entities in Europe, there is more emphasis on risk management in the United States versus safety and protection in Europe. There appears to be greater literacy about climate and more generally about environmental policy in the broader population in Europe compared with a more polarized public discourse and considerable climate illiteracy in the U.S.. Culture, economy and polity have much more time depth in Europe than in the United States (2000 years vs. 200 years) and this affects the sense of and connection to place. The general population also has different attitudes. For example, forested areas are protected treasures in Europe, while they are intensive use areas in the United States. In Germany retreat from the coast is not seriously considered, while in some U.S. locations it is at least discussed, though strongly resisted.

In the United States messages have to be worded carefully, taking into account strong ideological differences and the polarization of the public debate, in particular in the U.S. House of Representatives. Such ideological devisions in the United States hinder facilitated participatory processes on climate change issues, which have occured more commonly in Europe.

Property rights: Property rights are different in the United States and Europe (e.g. for privately owned land or water) and in the U.S. property rights are a major barrier to some adaptation actions. In the United States attitudes about private property and taxation are close to the stereotypes of rugged individualist vs. more common-good, community-oriented attitudes of Europe. This affects which adaptation strategies are considered acceptable, including what role governments should play in implementing them.

Infrastructure and spatial planning: Spatial planning differs between the United States and Europe, in particular with respect to the legal situation of where and how it is possible to develop land. In at least one of the European case study regions (Tyrol) it is much easier for public authorities to regulate building activity than it is in the United States. With a much longer history of urban development in Europe, urban design differs very much between the United States and Europe, which affects adaptation opportunities. The availability of public transportation also differs quite considerably, with Europe having a much more extensive system.

Overcoming Barriers – Advancing Adaptation Action


Credit: Dietmar Ruggenthaler

The case studies presented at the Aspen and Hamburg Workshops and the ensuing dialogue pointed to four concrete ways in which barriers to adaptation can be overcome:

Working at the local level: Although there are significant cultural, political and legal differences between the United States and Europe, adaptation planning and implementation is proceeding on both sides of the Atlantic at the local level, both in response to perceived environmental changes (e.g. landslides or increased fires in mountain areas) or projected changes (e.g. sea-level rise in coastal areas).

Money helps, but is not always necessary: Ongoing adaptation planning and implementation is supported, if financial resources are adequate, in particular for adaptation that requires (potentially large) investments in infrastructure. However, money is not always necessary. Less wealthy communities are also adapting by building up human and social capital to increase their coping and adaptive capacities.

Tools: On both sides of the Atlantic, a wide range of tools are being used to support decision making and dialogue about adaptation to climate change (see separate briefing sheet). These tools show the impacts of and vulnerabilities to climate change and/or help to guide stakeholders through a process of learning and planning. While there is still a long list of desired improvements to methods and tools to support dialogue and decision making for climate change adaptation, the use of tools is already supporting action on the local level.

Leadership: The case studies and the transatlantic dialogue clearly demonstrated the importance of leadership in overcoming barriers to climate change adaptation. Individuals who guide the decision making process with a clear vision of the need for adaptation to ensure the well-being and prosperity of the local population have been essential.

Case Studies for a Transatlantic Dialogue

Coasts

German Baltic

Timmendorfer Strand, Germany

Originally shaped by glaciers, the southern Baltic Sea coast is composed of easily erodible material and is gently subsiding. Its cliffs, low-lying bays and sandy beaches are exposed mainly to north-easterly winds, waves and storm surges eroding the shores. Timmendorfer Strand, one of the most desirable resort destinations in that region, has a population of ca. 8.800 people living at most 7 feet above sea level and a dominant coastal tourism sector. Though warming due to climate change favors seaside tourism in the Baltic region, negative effects are expected on water quality and beach width; in the long run sea-level rise will increase the risk of flooding. After years of discussion in the community and with funding from state and federal sources, the community recently decided to improve its coastal protection approach by reinforcing its shoreline promenade by a seawall surrounded with dunes; the latter formed naturally after beach replenishment measures.
Web: http://klimzug-radost.de/en and http://www.ecologic.eu/2926

Bay of Kiel, Germany

Until now, most costal defense along the German Baltic coast is focused on infrastructure protection against flooding; with respect to erosion and land loss problems, however, cities are hot spots of vulnerability. Most communities along the Bay of Kiel, with the state capital Kiel (population 250,000) at its southern end, are facing this problem. Kiel and 20 smaller communities formed a regional Climate Alliance to develop a coordinated approach to adaptation. Goals of the Alliance are to find joint answers to the high costs caused by coastal erosion, develop a climate-friendly tourism destination, educate residents about climate change and adaptation, reduce CO2 emissions, and lobby for the necessary financial and political support. Achievements to date include a feasibility study of using bicycle-carrying vehicles to create a more climate-friendly region; climate change Infotainment; discussions of retreat options for the community of Strande, public awareness raising and garnering support for a political declaration on creating a climate-resilient region.
Web: http://www.klimabuendnis-kieler-bucht.de/

U.S.Atlantic

Chesapeake Bay, United States

Sea level rise, permanent inundation, periodic flooding, and erosion as well as wetland losses are already significant challenges along the Chesapeake Bay and the open mid-Atlantic coastline. Thirteen islands have disappeared from the Bay due to relative sea-level rise. Existing problems will be aggravated by accelerating climate change, sea-level rise and continuing human development. Depending on location, sea level here has risen 1-2 feet (ca. 50 cm) since 1900 and is expected to rise at least this much again by 2050 (at twice the global average rate). The State of Maryland's response—one of two states with coastline on the Bay—has been progressive: Committed to using the best available science, the state has engaged in statewide adaptation planning and the governor has signed Executive Orders to help communities prepare for and become more resilient in the face of climate change impacts and extreme events and to build new construction in smarter ways.
Web: http://www.dnr.maryland.gov/climatechange/

North Carolina, United States

Some 200 miles (320 km) of narrow barrier islands strung together make up the Outer Banks off the coast of North Carolina and parts of Virginia. They shelter the wide coastal plains of the state and the extensive estuarine shorelines behind. Sea level along some parts of the coast has risen at about the global average rate, while other areas have seen close to 2 ft (60cm) of rise since 1900, due in part to land subsidence. While the state has one of the most progressive coastal zone management programs in the nation – demanding erosion-rate based setbacks and disallowing hardening of the shoreline, retreat in recent years has become more difficult as development has limited available space to move back to. Recent efforts to begin planning for sea-level rise have been opposed by development interests, forcing a more conservative approach to adaptation.
Web: http://dcm2.enr.state.nc.us/Hazards/slr.html

Mountains

European Alps

Virgen, Austria

Virgen is a small community located in East Tyrol, south of the main chain of the Alps. The main economic sectors are agriculture and tourism. Climate models suggest that by 2050 the average annual temperature could increase by about 2.5° C with a corresponding decrease in the snow cover duration by up to 30 - 50%. The community has good infrastructure and significant social capital. Challenges include aging population, outmigration of youth, limited financial resources, a scarcity of jobs, lack of local employment, need for commuting, and decreasing summer tourism. There has been extensive work on climate change mitigation.
Responses: Virgen is actively engaging with the challenges of climate change through awareness raising, optimizing early warning systems, and improving emergency services. In addition to installing irrigation and storage systems, it is exploring alternatives for agriculture and forestry, as well as the opportunities that result from the fact that in a hotter world, high altitudes are likely to be even more attractive for tourists.

Grindelwald, Switzerland

Grindelwald is a small rural village on the north side of the Central Alps of Switzerland; the region became a UNESCO World Heritage site in 2001, due to its remarkable natural landscape. With more than 1.1 million overnight stays per year the village is a touristic hot spot. Climate change in this region is mainly manifested by the extensive melting of the glacier, the loss of permafrost, landslide and rockfall hazards, as well as impacts on the montane ecology.
Responses:The measure presented at the workshop was an awareness-raising initiative using mobile phones to guide visitors on seven “climate paths” to show the impacts of climate change and to provide information on how to reduce CO_2 emissions.

Southern Rocky Mts.

Aspen, CO & Roaring Fork Valley, United States

The Roaring Fork Valley, situated in the Southern Rocky Mountain in western Colorado, USA includes the affluent resort community of Aspen. Until the silver market crash at the end of the 19th century, Aspen was a thriving silver mining community. Today, summer and winter tourism along with year-round cultural and athletic events drives the local economy. Changes in the timing and availability of water, including alterations to snowfall and snowpack, are the most significant risks to the Roaring Fork Valley. For instance, existing variability in snowfall, as well as temperature-driven changes in the fraction of precipitation coming as rain versus snow, will pose impacts to winter and summertime recreation as well as downstream agricultural and metropolitan water users. Forest ecosystems that dominate the landscape in this region are also undergoing change, including pressures from insect and disease agents as well as altered fire regimes.
Responses: Response strategies to natural variability in the arid mountain regions of the West have included the past construction of reservoirs for water storage and electricity production, development of snowmaking infrastructure for skiing resorts, as well as a complex legal framework for allocating water rights. In light of climate change, additional capacity in water storage and snowmaking infrastructure is contemplated along with more careful management of water demand through efficiency improvements. Additional transformative changes are envisioned, such as expanding recreational offerings beyond the traditional summer and winter time seasons (e.g. encouraging an earlier rafting season) and new legal frameworks that incentivize water conservation and other practices that enhance resiliency to variability and extremes.

Acknowledgements

Workshop Hosts: Climate Service Center & Aspen Global Change Institute

Funding Provided by: NASA, NOAA, Oak Foundation, and Climate Service Center

Workshop Organizing Committee: James Arnott (AGCI), Guy Brasseur (Climate Service Center), Jill Jäger (SERI), John Katzenberger (AGCI), Grit Martinez (Ecologic), Susanne Moser (Susanne Moser Research & Consulting), Michael K. Orbach (Duke University) and Michaela Schaller (Climate Service Center)

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ISSN 2199-4854