Preparing for the flood: Visualizations help communities plan for sea-level rise

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The municipality of Delta, B.C. is a low-lying coastal community surrounded by water on three sides Credit: CALP

Researchers at the University of British Columbia have produced computer visualizations of rising sea levels in a low-lying coastal municipality, illustrating ways to adapt to climate change impacts such as flooding and storms surges.

The researchers are working with a municipality south of Vancouver, Canada that is surrounded by water on three sides and is expecting the sea-level to rise by 1.2 metres by 2100 – a change that would affect a number of waterfront homes, inland suburban developments, roads and farmland.

Considerable infrastructure has been built below current and projected high water levels, and could be inundated in the event of a dike breach. The images produced show how different adaptation strategies that could be implemented in the municipality and are being used to help make decisions about how to best prepare for the future.

"To me, the visualizations are the only way that you can tell the complete story of climate change and its impacts in a low-lying coastal community," says David Flanders, a UBC research scientist with the Collaborative for Advanced Landscape Planning (CALP), who will present this research at the 2012 Annual Meeting of the American Association for the Advancement of Science (AAAS) in Vancouver on Sunday. "In other words, seeing really is believing in this case."

"It can be hard to mentally grasp what rising sea-levels can mean on the ground but our visualizations give people a glimpse of what their future world will look and feel like in their own backyards. They help community members understand how their quality of life can be affected by climate change, and by the decisions they make to deal with climate impacts."

The municipality of Delta, B.C. is in an agricultural region with a population of about 100,000. Historically, the municipality has used dykes to protect the land from flooding and tides – a common strategy used by coastal communities.

Visualizations of higher water levels in Delta portray what would happen to the

community if it does nothing to prepare for rising sea levels. Credit: CALP

New provincial guidelines for the construction of new homes have more than doubled the recommended finished floor elevation to compensate for rising high water lines. Similarly, the guidelines for sea dike construction have increased considerably, in some cases suggesting a top-of-wall more than two times their current elevation above mean sea level.

Working with the municipality, Flanders and his colleagues at CALP have created visualizations of sea-level rise in Delta and four alternate scenarios that show different ways Delta could adapt. These were constructed using a cutting-edge 3D geovisualization process that integrates climate modeling scenarios, inundation modeling, Geographic Information Systems (GIS) data, land use and urban design.

Visualizations of higher water levels in Delta portray what would happen to the community if it does nothing to prepare for climate change.

"Combine the sea-level rise with bigger storms, more wind, more waves and high-tide and that's an enormous amount of water," says Flanders.

The four alternate scenarios show Delta over the next century where the municipality adopts various strategies to prepare for sea-level rise including: raising the dikes; building offshore barrier islands to absorb the impact of incoming storms; moving parts of the community out of the floodplain and on to higher ground; and reducing vulnerability through design by raising homes, roads and critical infrastructure above the floodplain.

Visualization: The municipality of Delta adopts a strategy of raising the dikes to prepare for sea-level rise. Credit: CALP

The visualizations packages not only show what the region could look at the end of the century but also takes into account other important factors like the cost of each solution for the municipality, the cost to individual property owners, and the trade-offs between protecting roads, habitat, homes, waterfront views and agricultural production.

"What is becoming evident is that there is no single, perfect solution. Each alternative pathway has trade-offs associated with it, and this planning process has been very effective at communicating those trade-offs, and assessing acceptability," says Flanders.

"Communities will have to decide what their priorities are, and likely plan for a mosaic of different solutions, because each neighbourhood has its own set of concerns and its own idea of what will be possible. This visioning process can help inform these kinds of tough decisions that many low-lying communities will have to make over the next 20, 50 and 100 years."

To produce the visualizations, Flanders is working with other landscape planning researchers at CALP, climate scientists on the climate forecasts, coastal engineers who can calculate what water will do during a storm when it slams against the dikes, land-use planners who know current policies and how strategies could potentially roll-out on the

ground, and a working group of members of the public. These participants helped to build the scenarios and assess their acceptability.

Flanders and his colleagues have begun to show these visualizations to city planners and engineers, local elected officials, and members of the community. He notes that "many individuals seeing the images for the first time had a very emotional response."

The work borrows from international precedents, but CALP is unique in combining visualization, stakeholder input, and evaluation of results comprehensively in the Delta study.

"Other communities around the globe could gain insight from this on how to address their own local concerns, whether it's sea level rise, forest fire risk, changing snow pack, or other issues."

More information: Simulated images are available at www.aaas.ubc.ca/media-resources/photos/

Provided by University of British Columbia