

Appendix A: Informational Resources

The following resources are divided into two broad categories: (i) data resources, including climate models, visualization tools, and impact assessments; (ii) decision support tools, such as guidebooks and toolboxes, to help decision-makers interpret climate data and select appropriate adaptation measures. Each category includes links to generally applicable resources as well as resources that have been specifically prepared for different impacts, sectors, and regions.

Note: This list is still a work in progress and we encourage workshop participants to recommend additional resources for inclusion in the Appendix.

Data Resources: Models, Visualization Tools, and Impact Assessments

1. Key Resources

Intergovernmental Panel on Climate Change (IPCC)

- Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of the Working Group II to the Fifth Assessment Report of the IPCC (AR-5) (2014), <https://www.ipcc.ch/report/ar5/>

U.S. Global Change Research Program (USGCRP)

- National Climate Assessment (2014), <http://nca2014.globalchange.gov>

2. U.S. Federal Government Data and Impact Assessments

Climate Data, <https://www.data.gov/climate/>

- Database of resources to help companies, communities, and citizens understand and prepare for the impacts of climate change. The website currently contains a variety of datasets on coastal flooding, flood resilience, water, ecosystem vulnerability, and human health. Over time, the website will include more datasets, web services, and tools, as well as other themes such as the vulnerability of the food supply and the threats to human health from climate change.

National Aeronautics and Space Administration (NASA)

- NEX Global Daily Downscaled Climate Projections, <https://nex.nasa.gov/nex/projects/1356/>
 - The NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset is comprised of downscaled climate scenarios for the globe that are derived from the General Circulation Model (GCM) runs conducted under the Coupled Model Intercomparison Project Phase 5 (CMIP5) and across two of the four greenhouse gas emissions scenarios known as Representative Concentration Pathways (RCPs).

National Center for Atmospheric Research (NCAR)

- Climate Data Guide <https://climatedataguide.ucar.edu/>
 - Web-based source for scientifically sound information and advice on the strengths, limitations, and applications of climate data. Experts who construct, evaluate, and compare climate data sets contribute their perspectives and advice on climate data and analysis methods for a broad community of data users. Users may participate by posting comments, questions, and links. NCAR has designed the tool to act as a living repository for the climate community's collective knowledge and expertise on a broad array of observational datasets and their appropriate use in analyses and model evaluation.

National Oceanic and Atmospheric Administration (NOAA)

- Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, http://www.nesdis.noaa.gov/technical_reports/142_Climate_Scenarios.html
- Climate data, www.climate.gov
- Climate Monitoring: Extremes, <http://www.ncdc.noaa.gov/extremes/> (includes links to various records and indices of extreme weather events in the U.S.)
- Severe Weather Data, <http://www.ncdc.noaa.gov/data-access/severe-weather> (includes links to databases and indices for severe storm events)
- Digital Coast, <http://coast.noaa.gov/digitalcoast>

U.S. Climate Resilience Toolkit, <http://toolkit.climate.gov/>

- Compendium of resources and a framework for understanding and addressing the impacts of climate change. Includes links to resources such as the *Climate Explorer*, a digital mapping tool which allows for the visualization of climate stresses and impacts across geographic regions (<http://toolkit.climate.gov/tools/climate-explorer>).

U.S. Environmental Protection Agency (EPA)

- Climate Change and Adaptation to Climate Change, <http://www.epa.gov/climatechange/impacts-adaptation/>

U.S. Geological Survey (USGS)

- National Climate Change Viewer, http://www.usgs.gov/climate_landuse/clu_rd/nccv.asp
 - This is a climate-visualization website tool from the Interior Department's U.S. Geological Survey. The tool gives citizens and resource managers the opportunity to look at climate-driven impacts on watersheds and map projected changes at the local, regional, state and watershed levels. The tool includes the historical and future climate projections from 30 of the downscaled models for two of the RCP emission scenarios, RCP4.5 and RCP8.5. The tool also allows users to visualize projected changes in climate (maximum and minimum air temperature and precipitation) and the water balance (snow water equivalent, runoff, soil water storage and evaporative deficit) for any state, county and USGS Hydrologic Units (HUC).

U.S. Global Change Research Program (USGCRP)

- National Climate Assessment (2014), <http://nca2014.globalchange.gov>

3. Other Sources of Climate Change Data and Impact Assessments

A. Online Tools and Databases

Climate Commons, <http://climatecommons.earthjournalism.net/map/>

- This is an interactive map-based platform that contains layers of news and information on climate change in the United States. The map combines recent data on climate change indicators and emissions with geo-tagged stories on climate change.

Climate Wizard, <http://www.climatewizard.org/>

- Tool developed by the Nature Conservancy which allows users to view historic temperature and rainfall maps as well as future predictions of temperature and rainfall.

EU MEDIATION Project

- MEDIATION Toolbox, Modeling Future Impacts, http://www.mediation-project.eu/platform/tbox/modelling_future_impacts.html
- Outlines methods for projecting future climate change impacts as well as a list of impact studies, divided by sector and geographical focus, and highlighting the methods employed.

OpenClimateGIS, <https://earthsystemcog.org/projects/openclimategis/>

- This is an open-source tool which aids users in accessing and interpreting complex climate data. OpenClimateGIS serves users who are already familiar with GIS systems, enabling them to access data for specific regions and sectors and providing access to recent data such as outputs from climate models.

Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections, http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

- This archive contains fine spatial resolution translations of climate projections over the contiguous United States (U.S.) developed using two downscaling techniques (monthly BCSD Figure 1, and daily BCCA Figure 2), CMIP3 hydrologic projections over the western U.S. (roughly the western U.S. Figure 3), and CMIP5 hydrology projections over the contiguous U.S. corresponding to monthly BCSD climate projections.

PRECIS Regional Climate Modeling System, <http://www.metoffice.gov.uk/precis/>

- This tool generates high-resolution climate change information on a regional scale, which can be used in impact, vulnerability and adaptation studies.

United Nations Framework Convention on Climate Change (UNFCCC)

- UNFCCC Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change, http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5457.php

- The UNFCCC Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change is designed to assist Parties and other potential users in selecting the most appropriate methodology for assessments of impacts and vulnerability, and preparing for adaptation to climate change. The Compendium was developed in 1999 and updated in 2003, 2005, 2008, and 2009.

World Bank Climate Change Knowledge Portal, <http://sdwebx.worldbank.org/climateportal/>

- The Climate Change Knowledge Portal (CCKP) Beta is a central hub of information, data and reports about climate change around the world. Here you can query, map, compare, chart and summarize key climate and climate-related information.
- One of the most useful resources on the CCKP is the availability of downscaled climate data: “A collaborative effort between The World Bank, The Nature Conservancy, Climate Central, and Santa Clara University has now produced the first standardized set of daily DOWNSCALLED GCM projections that span the entire globe.” On the portal, these data is available at the country and major water basin level with an interface that will allow the user to map, chart, query, and compare downscaled data across historical and future time periods. See: http://sdwebx.worldbank.org/climateportal/index.cfm?page=forthcoming_downscaled_data

World Resources Institute (WRI) Climate Analysis Indicators Tool, <http://cait.wri.org/>

- The Climate Analysis Indicators Tool (CAIT) is an information and analysis tool on global climate change developed by the World Resources Institute. CAIT provides a comprehensive and comparable database of greenhouse gas emissions data (including all major sources and sinks) and other climate-relevant indicators

B. Reports and Academic Articles

E. Monier & X. Gao, *Climate Change Impacts on Extreme Events in the United States: An Uncertainty Analysis* (2014)

L. Larson et al., *Green Building and Climate Resilience: Understanding Impacts and Preparing for Changing Conditions*, report prepared by the University of Michigan and the U.S. Green Building Council (2011), <http://www.usgbc.org/Docs/Archive/General/Docs18496.pdf>

R.L Wilby, *A Review of Climate Change Impacts on the Built Environment*, 33 *Built Environment* 31 (2007)

S. Roberts, *Effects of Climate Change on the Built Environment*, 35 *Energy Policy* 4552 (2008).

4. Impact-Specific Data and Assessments

A. Coastal Impacts

Climate Central Flooding Map, <http://ss2.climatecentral.org/>

- A map showing what coastal areas would be submerged at what levels of flooding. However, it does not account for sea walls and other protective mechanisms, and is thus not useful on a very small scales. However, on a city- or state-wide scale, it can be useful to identify areas with higher levels of risk.

Coastal Resilience 2.0, <http://maps.coastalresilience.org/network/>

- This is an interactive suite of tools that help users visualize risks to coastal communities and habitats, and help decision makers reduce and mitigate the risks from storms and other hazards like coastal erosion and flooding. This interactive suite of tools allows users to examine storm surge, sea level rise, natural resources, and economic assets. It also allows users to develop risk reduction and restoration solutions. The Coastal Resilience tools build from critical resources provided by many groups and agencies including the National Oceanic and Atmospheric Administration (NOAA), The Department of the Interior's U.S. Geological Survey (USGS), the Department of Homeland Security's Federal Emergency Management Agency (FEMA), the Department of the Interior's Fish and Wildlife Service (USFWS), The Nature Conservancy, and the Natural Capital Project.

National Oceanic and Atmospheric Administration (NOAA)

- NOAA Digital Coast, <http://coast.noaa.gov/digitalcoast/> (compendium of data, tools, and training modules for coastal management and risk reduction, some of which incorporate sea level rise and other climate change projections)
- Sea Level Rise and Coastal Flooding Impacts Viewer, <http://coast.noaa.gov/slr/> (mapping tool showing potential coastal inundation, flood frequency, social vulnerability, and marsh impacts for different sea level rise scenarios)
- NOAA Coastal Services Center, Mapping Coastal Inundation Primer, http://coast.noaa.gov/digitalcoast/_pdf/guidebook.pdf?redirect=301ocm
- CanVis, <http://coast.noaa.gov/digitalcoast/tools/canvis/?redirect=301ocm> (visualization tool which allows users to see impact of sea level rise on a photograph of a coastal area)

U.S. Geological Survey (USGS)

- Coastal Change Hazards Portal, <http://marine.usgs.gov/coastalchangehazardsportal/> (mapping tool accompanied by vulnerability index to assess risk of sea level rise, shoreline change, and extreme storms)
- National Assessment of Coastal Vulnerability to Sea-Level Rise <http://woodshole.er.usgs.gov/project-pages/cvi>

National Research Council (NRC)

- *Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future* (2012), http://www.nap.edu/catalog.php?record_id=13389

National Oceanic and Atmospheric Administration (NOAA)

- Digital Coast, <http://www.csc.noaa.gov/digitalcoast/>
 - Includes specific tools such as the “coastal inundation toolkit” and the “hurricane planning and response toolkit”

U.S. Environmental Protection Agency

- Storm Surge Inundation and Hurricane Strike Frequency Map, <http://water.epa.gov/infrastructure/watersecurity/climate/stormsurge.cfm>
- This is an interactive map that illustrates the current worst-case storm surge and inundation scenarios on the American Gulf and Atlantic coasts, including Puerto Rico and the U.S. Virgin Islands. The map combines data layers from FEMA 100 and 500 year flood maps as well as NOAA's Sea, Lake, and Overland Surge from Hurricanes (SLOSH) and National Hurricane Center's coastal county hurricane strike maps.

B. Precipitation and Watersheds

National Oceanic and Atmospheric Administration (NOAA)

- Lake Level Viewer (U.S. Great Lakes), <http://coast.noaa.gov/digitalcoast/tools/llv>
 - This tool helps users visualize lake level changes that range from six feet above to six feet below historical long-term average water levels in the Great Lakes, along with potential shoreline and coastal impacts. Communities can use this information to determine what preparations make the most sense in planning for water level change scenarios. Preparations might include zoning restrictions, infrastructure improvements, and habitat conservation. Information obtained from this tool also provides a good lead-in for community discussions about climate change.

U.S. Department of Interior (DOI), Bureau of Reclamation

- Streamflow Projections for the Western United States, http://gis.usbr.gov/Streamflow_Projections/
 - The site provides a straightforward interface to data for 195 sites on streams and rivers throughout the West. This tool is intended for western water managers and the public to help increase accessibility of science-based information and understanding of how climate variations will impact the availability of water to communities.

U.S. Environmental Protection Agency

- Better Assessment Science Integrating point & Non-point Sources (BASINS) 4.0 Climate Assessment Tool (CAT), <http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=203460>
 - Developed by EPA, BASINS is a multi-purpose, environmental analysis system that integrates a geographical information system (GIS), national watershed data, and state-of-the-art watershed modeling tools, including the Hydrologic Simulation Program FORTRAN (HSPF) model, into one package. Specifically, BASINS CAT provides flexible capabilities for creating climate change scenarios allowing users to quickly assess a wide range of what if questions about how weather and climate could affect their

systems. BASINS CAT does not provide climate change data for specific regions and watersheds. Combined with the existing capabilities of HSPF for assessing the effects of land-use change and management practices, BASINS CAT can be used to assess the coupled effects of climate and land-use change, and to guide the development of effective management responses.

- Water Erosion Prediction Project Climate Assessment Tool (WEPPCAT), <http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=153583>
 - Developed by EPA, this an on-line tool that provides a flexible capability for creating user-determined climate change scenarios for assessing the potential impacts of climate change on sediment loading to streams using the USDA s Water Erosion Prediction Project (WEPP) Model. In combination with the existing capabilities of WEPP for assessing the effectiveness of management practices, WEPPCAT also can be used to evaluate the effectiveness of strategies for managing the impacts of climate change.

U.S. Department of Interior (DOI), Bureau of Reclamation

- Streamflow Projections for the Western United States, http://gis.usbr.gov/Streamflow_Projections/
- The site provides a straightforward interface to data for 195 sites on streams and rivers throughout the West. This tool is intended for western water managers and the public to help increase accessibility of science-based information and understanding of how climate variations will impact the availability of water to communities.

5. Downscaled Data and Region-Specific Assessments

Climate Central State Reports (2012-2014), <http://sealevel.climatecentral.org/research/reports>

- State reports accompanying the map for all coastal states. They vary in their level of quantitative depth and in their focuses.

Federal Highway Administration (FHWA)

- Regional Climate Change Effects: Useful Information for Transportation Agencies, Part 3: Projected Climate Change by Geographic Region, http://www.fhwa.dot.gov/environment/climate_change/adaptation/publications_and_tools/climate_effects/effects03.cfm

U.S. Environmental Protection Agency

- Climate Change Impacts and Adapting to Change, <http://www.epa.gov/climatechange/impacts-adaptation/> (offers summaries of regional effects of climate change)

U.S. Global Change Research Program (USGCRP)

- 2014 National Climate Assessment, Region Summaries, <http://nca2014.globalchange.gov/highlights#section-5681>
- Climate Change Impacts by Region, <http://scenarios.globalchange.gov/regions>

Globally Downscaled Climate Data, http://www.engr.scu.edu/~emaurer/global_data/

A. *Great Plains*

Union of Concerned Scientists

- *Confronting Climate Change in the Midwest: State and Regional Reports*, http://www.ucsusa.org/global_warming/science_and_impacts/impacts/climate-change-midwest.html#.VXCROGRViko

B. *Midwest*

University of Minnesota, Minneapolis Climate Change Impacts & Adaptation Strategies (2013), <http://www.ci.minneapolis.mn.us/www/groups/public/@citycoordinator/documents/webcontent/wcms1p-108963.pdf>

- While less detailed than comparable local impact/adaptation reports, this does have a thorough qualitative and basic quantitative analysis of impacts to Minneapolis. There is more depth in a few sectors, including stormwater management and public health.

C. *Northeast*

ArcGIS

- Sea Level Rise Planning Tool for New York and New Jersey, <http://www.arcgis.com/home/item.html?id=2960f1e066544582ae0f0d988ccb3d27>
- Rhode Island Inundation Surfaces, <http://www.arcgis.com/home/webmap/viewer.html?webmap=f38c15a343af4e96be8f796242c357bd> (shows extent of inundation for 1', 3', and 5' sea level rise in Rhode Island)

Jacobson, G.L et al, *Maine's Climate Future: An Initial Assessment* (2009), http://climatechange.umaine.edu/files/Maines_Climate_Future.pdf

- A highly scientific, quantitative analysis of impacts of climate change on Maine ecosystems, with a particular focus on the Maine coast

J. Yin et al., *Model Projections of Rapid Sea-Level Rise on the Northeast Coast of the United States*, 2(4) *Nature Geoscience* 262 (2009).

Northeast Climate US.org (NExUS), <http://www.neclimateus.org/>

- This is a searchable online database that provides a gateway to climate information for the Eastern US. It summarizes needs for climate information as articulated in publications; identifies available data, products and services; and captures planned and on-going projects.

New York State Energy Research and Development Authority (NYSERDA)

- Responding to Climate Change in New York State (ClimAID), <http://www.nyserderda.ny.gov/climaid>

Massachusetts Executive Office of Energy and Environmental Affairs

- Massachusetts Climate Change Adaptation Report, <http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf>

Massachusetts Office of Coastal Zone Management,

- Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, <http://www.mass.gov/eea/docs/czm/stormsmart/slr-guidance-2013.pdf>

Rhode Island Coastal Resources Management Council

- Sea Level Affecting Marshes Model, http://www.crmc.ri.gov/maps/maps_slamm.html

Union of Concerned Scientists

- *Confronting Climate Change in the US Northeast*, http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/pdf/confronting-climate-change-in-the-u-s-northeast.pdf

D. Northwest

Washington State Department of Ecology

- Climate Change Clearinghouse: Impacts, Preparation, Adaptation Resources, http://www.ecy.wa.gov/climatechange/ipa_resources.htm

Climate Impacts Group, University of Washington

- Washington State Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate (2009), <http://cses.washington.edu/cig/res/ia/waccia.shtml>
- A.K. Snover et al., *Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers*, State of Knowledge Report prepared for the Washington State Department of Ecology by the Climate Impacts Group, University of Washington, Seattle (2013).

E. Pacific Islands

Pacific Islands Climate Information Website, <http://www.pacificislandsclimate.org/>

- This website is a gateway to a broad range of information related to climate in the Pacific Islands. It includes summaries of programs, projects, and activities, as well as products and services. Formed through the collaboration of and contributions from a family of agencies, institutions, and organizations, this website is intended to serve as a shared resource for research scientists, service providers, and decision-makers. The website provides access to a broad range of region specific information related to historical hindcasts and multi-decadal projections. For example, users can search, by region and/or climate variable, and find a list of relevant products along with a brief summary and a direct link to each. This developmental website was put together by

representatives of the NOAA National Climatic Data Center working in support of the Pacific Climate Information System

F. Southeast

National Oceanic and Atmospheric Administration,

- Climate Change and Sea Level Rise in Florida: An Update of the Effects of Climate Change on Florida's Ocean & Coastal Resources (2010), http://seagrant.noaa.gov/Portals/0/Documents/what_we_do/climate/Florida%20Report%20on%20Climate%20Change%20and%20SLR.pdf

North Carolina Coastal Resources Commission (NCCRC)

- North Carolina Sea-Level Rise Assessment Report (2010), <http://portal.ncdenr.org/web/cm/sea-level-rise>

Union of Concerned Scientists

- Southeast state reports (have not been updated since 2001), http://www.ucsusa.org/global_warming/regional_information/southeastern-states-1.html#.VXCQ3WRViko

G. Southwest

California Climate Change Portal, <http://www.climatechange.ca.gov/>

California Energy Commission, Cal-Adapt Climate Tools, <http://cal-adapt.org/tools/>

- Series of maps and charts displaying changes in temperature, precipitation, snowpack, wildfires, and frequency of extreme heat events in California and surrounding states until 2100.

California Institute for Energy and the Environment

- California Vulnerability and Adaptation Study (2012), <http://uc-ciee.org/climate-change/california-vulnerability-and-adaptation-study>

Colorado Climate Preparedness Project, <http://www.coloadaptationprofile.org/>

- Colorado Climate Preparedness Project: Final Report (2011), http://www.colorado.edu/publications/reports/WWA_ColoClimatePreparednessProject_Report_2011.pdf

Colorado Water Conservation Board (CWCB)

- Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation (2d ed. 2014), <http://cwcb.state.co.us/environment/climate-change/Pages/main.aspx>

- Joint Front Range Climate Change Vulnerability Study (2012), <http://cwcb.state.co.us/environment/climatechange/Pages/JointFrontRangeClimateChangeVulnerabilityStudy.aspx>

Union of Concerned Scientists

- *Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California*, <http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf>

Western Water Assessment (WWA)

- Colorado Climate Change Vulnerability Study (2015), http://wwa.colorado.edu/publications/reports/co_vulnerability_report_2015_final.pdf

Decision Support Tools

Note: for specific guidance on integrating climate risk into EIA, please refer to the guidance documents listed in Section 3 of the workshop paper.

1. Clearinghouses and Databases of Decision Support Tools and Adaptation Approaches

Climate Adaptation Knowledge Exchange (CAKE), <http://www.cakex.org/>

- Offers a virtual library of guidebooks, adaptation plans and case studies, including a map search feature. The site also hosts a directory of organizations and climate change professionals, and climate change tools.

Georgetown Climate Center

- Adaptation Clearinghouse, <http://www.georgetownclimate.org/adaptation/clearinghouse>

MEDIATION - Methodology for Effective Decision-making on Impacts and Adaptation

- Main Project Page: <http://www.mediation-project.eu/platform/>
 - The MEDIATION Toolbox is a structured database of methods and tools that are available to support the assessment of climate change impacts and vulnerability, and adaptation decision-making. <http://www.mediation-project.eu/platform/toolbox/toolbox.html> (includes tools for gathering, assessing and acting on adaptation-related information. Toolbox is divided into the following categories: participation & engagement, impact analysis, capacity analysis, behavioral analysis, institutional analysis, decision-making, planning and implementation, monitoring and evaluation, learning and reflection, valuation, scenario analysis, treating uncertainty)
 - Impact analysis: http://www.mediation-project.eu/platform/tbox/impact_analysis.html

- Case Study Navigator (<http://www.mediation-project.eu/platform/>)
- Adaptation Pathfinder: http://www.mediation-project.eu/platform/apf_entry/entry_point.html

United Nations Framework Convention on Climate Change (UNFCCC)

- UNFCCC Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change, http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5457.php
 - The UNFCCC Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change is designed to assist Parties and other potential users in selecting the most appropriate methodology for assessments of impacts and vulnerability, and preparing for adaptation to climate change. The Compendium was developed in 1999 and updated in 2003, 2005, 2008, and 2009.

U.S. Climate Resilience Toolkit, <http://toolkit.climate.gov/>

Compendium of resources and a framework for understanding and addressing the impacts of climate change. Includes links to resources such as the *Climate Explorer*, a digital mapping tool which allows for the visualization of climate stresses and impacts across geographic regions (<http://toolkit.climate.gov/tools/climate-explorer>).

WeADAPT - <https://weadapt.org/>

- WeADAPT is an online “open space.” It’s a platform that “which allows practitioners, researchers and policy makers to access credible, high quality information and to share experiences and lessons learnt.”

2. Guidebooks and Assessment Tools

Center for Science in the Earth System (The Climate Impacts Group), *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments* (2007), <http://www.icleiusa.org/action-center/planning/adaptation-guidebook>

Green Building and Climate Resilience: Understanding Impacts and Preparing for Changing Conditions, report prepared by the University of Michigan and the U.S. Green Building Council (2011), <http://www.usgbc.org/Docs/Archive/General/Docs18496.pdf>

Inter-American Development Bank, *Analytical Framework for Climate Change Action* (2010), <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=35149039>

Katharine Hayhoe et al., *An Integrated Framework for Quantifying and Valuing Climate Change Impacts on Urban Energy and Infrastructure: A Chicago Case Study*, 36 *Journal of Great Lakes Research* 94 (2010).

M. Burke et al, Incorporating Climate Uncertainty into Evaluations of Climate Impacts, 97(2) Review of Economics and Statistics 461 (2015).

3. Sector-Specific Decision Support Tools

A. Water Management

Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D. 2009. Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 p. Online. <http://pubs.usgs.gov/circ/1331/>.

California Department of Water Resources

- Climate Change Handbook for Regional Water Planning (2011), <http://www.water.ca.gov/climatechange/CCHandbook.cfm>

European Climate Adaptation Platform

- Handbook on Adapting Urban Water Systems to Climate Change (2011), http://climate-adapt.eea.europa.eu/viewaceitem?aceitem_id=2627

U.S. Environmental Protection Agency

- Climate Ready Water Utilities Toolbox, <http://www.epa.gov/safewater/watersecurity/climate/toolbox.html>
 - The Toolbox provides access to more than 500 resources that support climate adaptation planning at water utilities including: reports and publications; information about funding programs that could support climate-related actions by utilities and municipalities; upcoming workshops and training sessions; models and tools; and climate response materials that focus on mitigation and adaptive strategies. The Toolbox is organized into two sections: a highlighted resources section provides a selection of resources from each category and a map to help users select resources by geographic region; and a second section that features a search function that helps users to select resources based on their location, the size and type of their utility, and resources of interest.
- Climate Resilience Evaluation & Awareness Tool (CREAT), <http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm>
 - The United States' Environmental Protection Agency (EPA) has developed CREAT, a software tool to assist drinking water and wastewater utility owners and operators in understanding potential climate change threats and in assessing the related risks at their individual utilities. CREAT provides users with access to the most recent national assessment of climate change impacts for use in considering how these changes will impact utility operations and missions. CREAT allows users to evaluate potential impacts of climate change on their utility and to evaluate adaptation options to address these impacts using both traditional risk assessment and scenario-based decision making. CREAT provides libraries of drinking water and wastewater utility assets (e.g., water resources, treatment plants, pump stations) that could be impacted by climate change, possible climate change-related threats (e.g., flooding, drought, water quality), and

adaptive measures that can be implemented to reduce the impacts of climate change. The tool guides users through identifying threats based on regional differences in climate change projections and designing adaptation plans based on the types of threats being considered. Following assessment, CREAT provides a series of risk reduction and cost reports that will allow the user to evaluate various adaptation options as part of long-term planning.

WeAdapt

- Water Evaluation and Planning System, <https://weadapt.org/knowledge-base/adaptation-training/module-weap>
- NeWater – New Approaches to Integrated Adaptive Water Management <https://weadapt.org/knowledge-base/vulnerability/newwater-project>

B. Energy Sector

Energy Sector Management Assistance Program (ESMAP)

- Hands-on Energy Adaptation Toolkit (HEAT) - <http://esmap.org/node/312>

C. Mining and Metals Industry

C. Rodgers et al., *Assessing the Treatment of Climate Change Impacts and Adaptation in Project-Level EAs in the Canadian Mining Sector*, report submitted to Climate Change Impacts and Adaptation Division, Natural Resources Canada (2014), http://www.climateontario.ca/doc/p_ECCC/A_Review_of_Mining_Sector_Environmental_Assessments_OCCIAR_RSI.pdf

International Council on Mining & Metals (ICMM), *Adapting to a Changing Climate: Implications for the Mining and Metals Industry* (2013), <https://www.icmm.com/document/5173>.

U.S. EPA, *EIA Technical Review Guideline: Non-Metal and Metal Mining Volume 1* (2011), <http://www2.epa.gov/sites/production/files/2014-04/documents/miningvol1.pdf> (instructing engineers to consider the impacts of global climate change, including projections of increased extreme weather events, in the design of tailings management systems).

D. Transportation

Alan Hamlet, *Impacts of Climate Variability and Climate Change on Transportation Systems and Infrastructure in the Pacific Northwest* (2011).

John MacArthur et al., Washington State Department of Transportation, *Climate Change Impact Assessment for Surface Transportation in the Pacific Northwest and Alaska* (January 2012), available at <http://www.wsdot.wa.gov/research/reports/fullreports/772.1.pdf>.

Guidance on Incorporating Sea Level Rise: For use in the planning and development of project initiation documents, California Department of Transportation (2011), http://www.dot.ca.gov/ser/downloads/sealevel/guide_incorp_slr.pdf

Thomas A. Wall & Michael D. Meyer, Risk-Based Adaptation Frameworks for Climate Change Planning in the Transportation Sector: A Synthesis of Practice (Transportation Research Board of the National Academies 2013).

U.S. Department of Transportation, Federal Highway Administration, Regional Climate Change Effects: Useful Information for Transportation Agencies (2010), http://www.fhwa.dot.gov/environment/climate_change/adaptation/publications_and_tools/climate_effects

4. Impact-Specific Assessment Tools

A. Coastal Impacts

Coastal Resilience 2.0, <http://maps.coastalresilience.org/network/>

This is an interactive suite of tools that help users visualize risks to coastal communities and habitats, and help decision makers reduce and mitigate the risks from storms and other hazards like coastal erosion and flooding. This interactive suite of tools allows users to examine storm surge, sea level rise, natural resources, and economic assets. It also allows users to develop risk reduction and restoration solutions. The Coastal Resilience tools build from critical resources provided by many groups and agencies including the National Oceanic and Atmospheric Administration (NOAA), The Department of the Interior's U.S. Geological Survey (USGS), the Department of Homeland Security's Federal Emergency Management Agency (FEMA), the Department of the Interior's Fish and Wildlife Service (USFWS), The Nature Conservancy, and the Natural Capital Project.

National Climate Change Adaptation Research Facility (NCCARF)

- Helen Scott et al., *Climate Change Adaptation Guidelines for Ports*, in *Enhancing the Resilience of Seaports to a Changing Climate Series* (NCCARF 2013)

U.S. EPA

- *Coastal Adaptation Toolkit*, <http://www2.epa.gov/cre/coastal-adaptation-toolkit>

USAID

- *Adapting to Coastal Climate Change: A Guidebook for Development Planners* (2009), <http://www.crc.uri.edu/download/CoastalAdaptationGuide.pdf>

B. Precipitation and Watersheds

U.S. Environmental Protection Agency

- Better Assessment Science Integrating point & Non-point Sources (BASINS) 4.0 Climate Assessment Tool (CAT), <http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=203460>
 - Developed by EPA, BASINS is a multi-purpose, environmental analysis system that integrates a geographical information system (GIS), national watershed data, and state-of-the-art watershed modeling tools, including the Hydrologic Simulation Program FORTRAN (HSPF) model, into one package. Specifically, BASINS CAT provides flexible capabilities for creating climate change scenarios allowing users to quickly assess a wide range of what if questions about how weather and climate could affect their systems. BASINS CAT does not provide climate change data for specific regions and watersheds. Combined with the existing capabilities of HSPF for assessing the effects of land-use change and management practices, BASINS CAT can be used to assess the coupled effects of climate and land-use change, and to guide the development of effective management responses.