Science & Technical Support Section's
SciFYI
King County
Department of Natural Resources and Parks
Water and Land Resources Division
A science section digest of current environmental issues in King County
October 2017

Modeling Climate Change Impacts on Extreme Precipitation, Stormwater Design Requirements, and Wastewater Conveyance

By Jim Simmonds

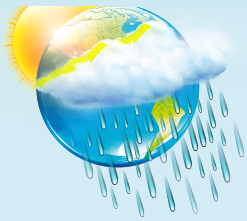
King County's 2015 Strategic Climate Action Plan calls for assessments of climate change effects on large rainstorms in King County and the ensuing impacts on stormwater and wastewater management. These assessments were prioritized in response to recent findings from the University of Washington that large rain events known as "atmospheric rivers" are projected to hold an average of 22 percent more moisture by the end of the century (Warner et al., 2015).

Most extreme precipitation events along the West Coast are associated with winter atmospheric river events. Atmospheric rivers are relatively long, narrow bands of moisture-laden air that can deliver intense rain when they intersect land. Atmospheric rivers that affect western Washington often originate in the subtropical Pacific Ocean near Hawaii; these are sometimes referred to as "pineapple express" events. About one-half to two-thirds of Western Washington's annual precipitation falls during atmospheric river events.

King County partnered in 2016 with the University of Washington's Climate Impacts Group to model hourly rainfall throughout the county under climate change conditions. This modeling was funded by King County's Stormwater Services Section,Wastewater Treatment Division, and a grant from the Washington State Department of Ecology. The innovative modeling approach relies on "nesting" a regional weather model within two global weather models to allow for more refined predictions. The nested modeling approach is critical for understanding climate change impacts on storms in the Pacific Northwest.

The regional model used was the Weather Research and Forecasting model applied by the University of Washington, which is the same model used to make short-term weather

ATMOSPHERIC RIVERS



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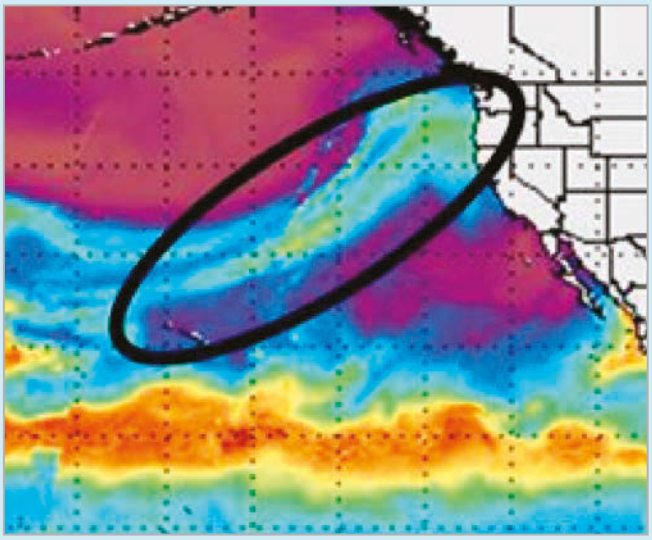
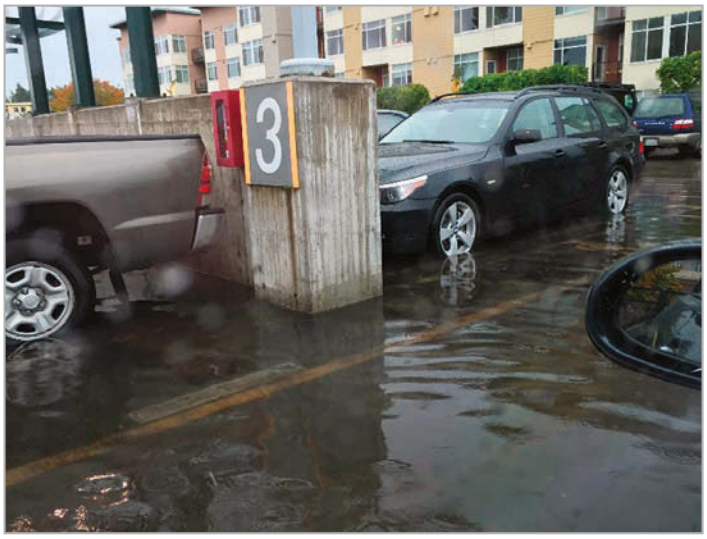
(Warner et al., 2015)



This image of total precipitable water contained in the atmosphere shows a long band of wet air crossing the Pacific Ocean towards the Pacific Northwest, known as an "atmospheric river" (from Warner et al 2015).



Intense rainstorms can overwhelm the stormwater system and cause urban flooding.

forecasts for the region. The climate scenario modeled is based on ongoing, unabated global carbon emissions through the end of the century.

Preliminary modeling results show about 20 to 40 percent more rain will fall during each year's heaviest hour of rainfall by the end of this century. Increases are also projected for less-frequent storms and longer-duration storms. For the official Seattle weather station at SeaTac, this means that the one-hour annual peak rain event is projected to increase by 2100. Model results to date do not suggest that "atmospheric rivers" will occur more frequently under climate change conditions, only that they are projected to deliver more precipitation.

These modeling results have important implications for stormwater management. In accordance with requirements by the Washington State Department of Ecology, King County requires developers to use a manual to size and design stormwater flow control and water quality treatment. The design relies on the past 68 years of rainfall data for ensuring proper sizing. Because future storm sizes are projected to increase, this implies that stormwater systems designed today may be undersized for future conditions. A sensitivity analysis of stormwater facility design to future rainfall conditions will be completed in 2018, along with an analysis of options for updating the design requirements.

King County also owns and operates the regional wastewater conveyance and treatment system for the greater Seattle area. Portions of the City of Seattle have combined wastewater and stormwater conveyance systems, which allow for substantially greater flows during rain events than dry periods. King County is investing heavily to reduce overflows from the combined system during large rain events, and is interested in incorporating future storm conditions in the planning process. To do this, the King County Wastewater Treatment Division will be modeling the wastewater conveyance and treatment system under both historical and projected future climate conditions to determine possible changes in flow timing and volume. The results from this modeling will be incorporated into future plans for maintaining and upgrading the facilities. ■

Contributors to King County's Sci FYI

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Jim is the Water Quality Unit Supervisor of King County's Science and Technical Support Section. He has over 25 years' experience monitoring and modeling environmental conditions, managing environmental investigations, managing environmental data, and assessing potential impacts of stormwater, wastewater, and environmental contamination. He has been with King County for 17 years.

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