REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

EXECUTIVE OFFICER SUMMARY REPORT
March 8, 2023

ITEM 6

SUBJECT
Atmospheric Rivers and Hydrometeorology with Dr. Marty Ralph, Director of the Center for Western Weather and Water Extremes at Scripps Institution of Oceanography *(Jimmy Smith)*

STAFF RECOMMENDATION
Informational item only; no recommendation.

KEY ISSUE
Atmospheric rivers are increasingly recognized as delivering most of the precipitation to California, as well as devasting and tragic consequences from the larger events. Dr. Marty Ralph is expert in this field and will address the San Diego Water Board.

PRACTICAL VISION
Chapter 8 of the 2021 Practical Vision: Provide Effective Community Engagement and Communication, is focused on implementing the core values of leadership, communication, and transparency, while Chapter 7 focuses on mitigating the impacts of climate change. This item provides an excellent opportunity for the San Diego Water Board and the public to learn about Atmospheric Rivers and the implications for the San Diego Region.

DISCUSSION
Relatively long and narrow regions of the atmosphere transport much of the water vapor to California. Their shape and large moisture content has led these flowing columns of condensed water vapor to be called “Atmospheric Rivers (ARs).” The west coast of the United States is not unique in experiencing these events as ARs are responsible for the transport of most of the water vapor outside of the tropics.

As ARs approach land and higher elevations, the vapor is condensed, cools and falls as rain and snow. Small and mid-size ARs are beneficial and bring much needed water to California. On average, 30-50 percent of annual West Coast precipitation occurs in just a few ARs. The largest ARs transport an amount of water vapor roughly 7-15 times the average flow at the mouth of the Mississippi River. The largest ARs, while delivering significant amounts of water, also cause extreme rainfall, flooding and mudslides that cause catastrophic damage to life and property.

Dr. Marty Ralph is one of the worlds experts on understanding and predicting ARs. He is a research meteorologist focused on understanding the physical processes that create extremes in precipitation and on advancing associated observations, predictions, climate projections and decision support tools. From 2001 – 2013 he was Chief of the Water Cycle Branch at NOAA’s Earth System Research Laboratory in Colorado where he led the development of the Hydrometeorology Testbed. He also managed NOAA’s Science,

Technology and Infusion Program, Chaired NOAA's US Weather Research Program Executive Committee, and led the creation of NOAA's Unmanned Aircraft Systems Program. In 2013 he moved to the University of California San Diego/Scripps Institution of Oceanography where he is developing the "Center for Western Weather and Water Extremes." The goal of the Center is to *"Revolutionize the physical understanding, observations, weather predictions, seasonal outlooks and climate projections of extreme events in Western North America, including atmospheric rivers, the North American summer monsoon and their impacts on floods, droughts, hydropower, ecosystems and the economy."*

A major goal of his career is to better understand, monitor, and predict key elements of the global water cycle including water vapor transport, precipitation, and runoff. Scientific understanding of atmospheric rivers, which are critical to both the global water cycle and to the distribution of precipitation and flooding in key parts of the world, is a major thrust. Using these results to evaluate and improve short-term precipitation forecasting and to provide reliable regional climate projections of flooding and water supplies in several areas of the world, are desired outcomes. The application of these findings to key users of weather and climate information on extreme events in the Western U.S. is being developed through new observing strategies, modeling and the creation of decision support tools tailored to user needs. His research provides valuable information to California water storage operators, flood control managers and provides important insights to rain runoff dynamics to inform storm water management, Clean Water Act Section 401 Water Quality Certifications and groundwater recharge efforts of the San Diego Water Board.

Dr. Ralph played a key role in the development of an AR impact scale called the Integrated Water Vapor Transport (IVT) that measures the amount of water vapor moving horizontally in the atmosphere. The scale ranges from IVTs of 250 to over 1250 kgs of vertically integrated water vapor transport per meter per second. These are binned into 5 categories of ARs: 1 = weak, IVT of 250 to 500; 2=moderate, IVT of >500 to 750; 3 = Strong, IVT of >750 to 1000; 4 = extreme, IVT of >1000 to 1250 and 5 = exceptional, IVT of >1250. Dr. Ralph notes that he 'usually pays attention to ARs when the IVT becomes greater than 250 and gives them undivided attention when the IVT is greater than 1000.' For reference, the last of the ARs to hit California in mid-January 2023 had an IVT estimated to be between 400 to 500.

Dr. Ralphs expertise has proven invaluable to the people of California. He developed a Forecast-Informed Reservoir Operations (FIRO) model with a pilot study at Lake Mendocino in Northern California. FIRO facilitates optimized reservoir management to reduce flooding and maximize hydroelectric power generation. He has recently partnered with California Department of Water Resources to apply FIRO to operations at Lake Oroville near Sacramento and at Bullard's Bar, a large reservoir in northeastern Yuba County. Closer to San Diego, Dr. Ralph is working to optimize groundwater recharge in the Santa Ana River in Orange County. His expertise in runoff dynamics should also prove informative when incorporating the latest scientific findings to updated design-storm criteria for water quality and hydromodification best management practices. Dr. Ralph was invited at the request of Board Member Abarbanel and will provide a 15-20 minute presentation.

LEGAL CONCERNS
None.

PUBLIC NOTICE
The agenda notice for today's meeting was posted on the San Diego Water Board's website and sent to subscribers to the email list for Board meetings. This satisfies the Bagley-Keene Open Meeting Act requirements to publish the meeting notice and agenda.

SUPPORTING DOCUMENTS
None.