PACIFIC CLIMATE IMPACTS CONSORTIUM

PCIC UPDATE JULY 2016

CLIMATE IMPACTS SUMMARIES FOR THE CITY OF VANCOUVER AND WHISTLER

Though global in extent, the impacts of anthropogenic climate change are felt at the level of the municipality. In order for municipalities to prepare for climate change, planners and policy makers need projections of climate change and its associated impacts at the scale of their communities. To meet this need, PCIC scientists have developed projections of future climate including maps and climate-impacts summaries for the City of Vancouver and the Whistler region. Using a statistical downscaling method developed at PCIC, they downscaled output from twelve global climate models that were driven using greenhouse gas emissions from a "business as usual" scenario. Using this downscaled output they examined how projections of the future climate of the 2050s (2041-2070) differ from the climate of the 1971-2000 period.

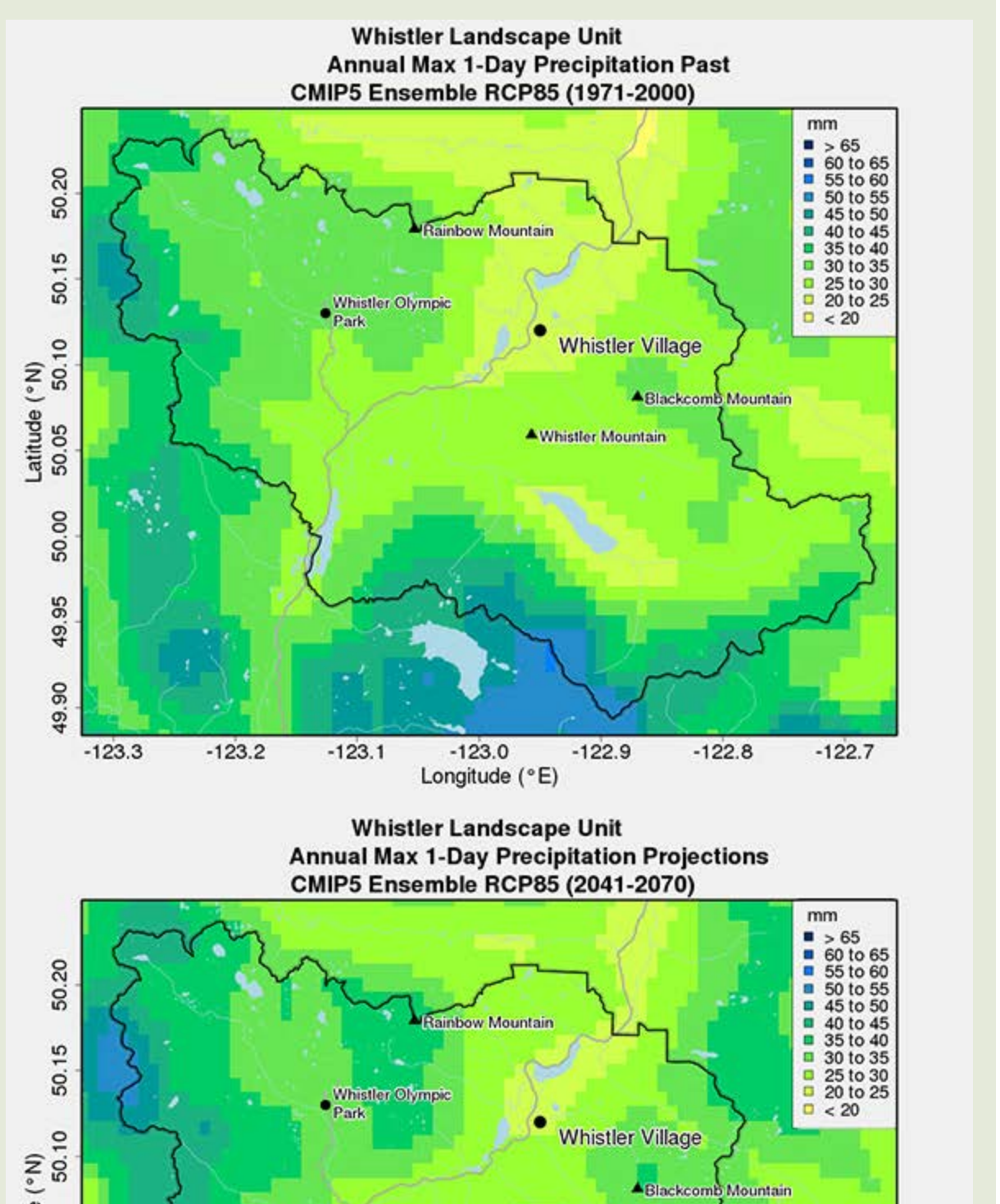
Whistler Landscape Unit
Annual Max 1-Day Precipitation Past
CMIP5 Ensemble RCP85 (1971-2000)
mm
> 65
60 to 65
55 to 60
50 to 55
45 to 50
40 to 45
35 to 40
30 to 35
25 to 30
20 to 25
< 20
Rainbow Mountain
Whistler Olympic Park
Whistler Village
Blackcomb Mountain
Whistler Mountain
Latitude (°N)
Longitude (°E)
Whistler Landscape Unit
Annual Max 1-Day Precipitation Projections
CMIP5 Ensemble RCP85 (2041-2070)

Figure 1: This figure shows the climatological average annual maximum one-day precipitation for the Whistler region over the recent historical period (1971-2000, top panel) and those projected for the 2050s (2041-2070, bottom panel).

The projections show Vancouver warming by about 2.9°C (with a range of 1.7°C to 4.0°C) and the Whistler area warming by a similar amount, about 3.0°C (with a range of 1.8°C to 4.0°C) by the 2050s. This would make the annual average temperature in Vancouver similar to that of Eugene Oregon, some 500 kilometres to the south. This increase in temperature would more than double the number of summer days above 25°C in both areas, as temperatures on the warmest summer days increase by about 3.9°C in Vancouver and about 3.8 °C in the Whistler area. This warming is also seen in projected temperatures for the coldest winter nights, for which temperatures are again projected to increase by similar amounts in both regions, 4.9°C in Vancouver and 4.8°C in the Whistler area. While this would decrease energy demands for heating, it would also increase energy demands for cooling in Vancouver.

The difference between wet and dry seasons is expected to increase. Slight increases to precipitation are projected for all seasons except summer, for which precipitation is expected to decrease. Dry spells are projected to increase in length even as the amount of rain falling in the most extreme precipitation event annually increases by roughly 11% to 12% (Figure 1).

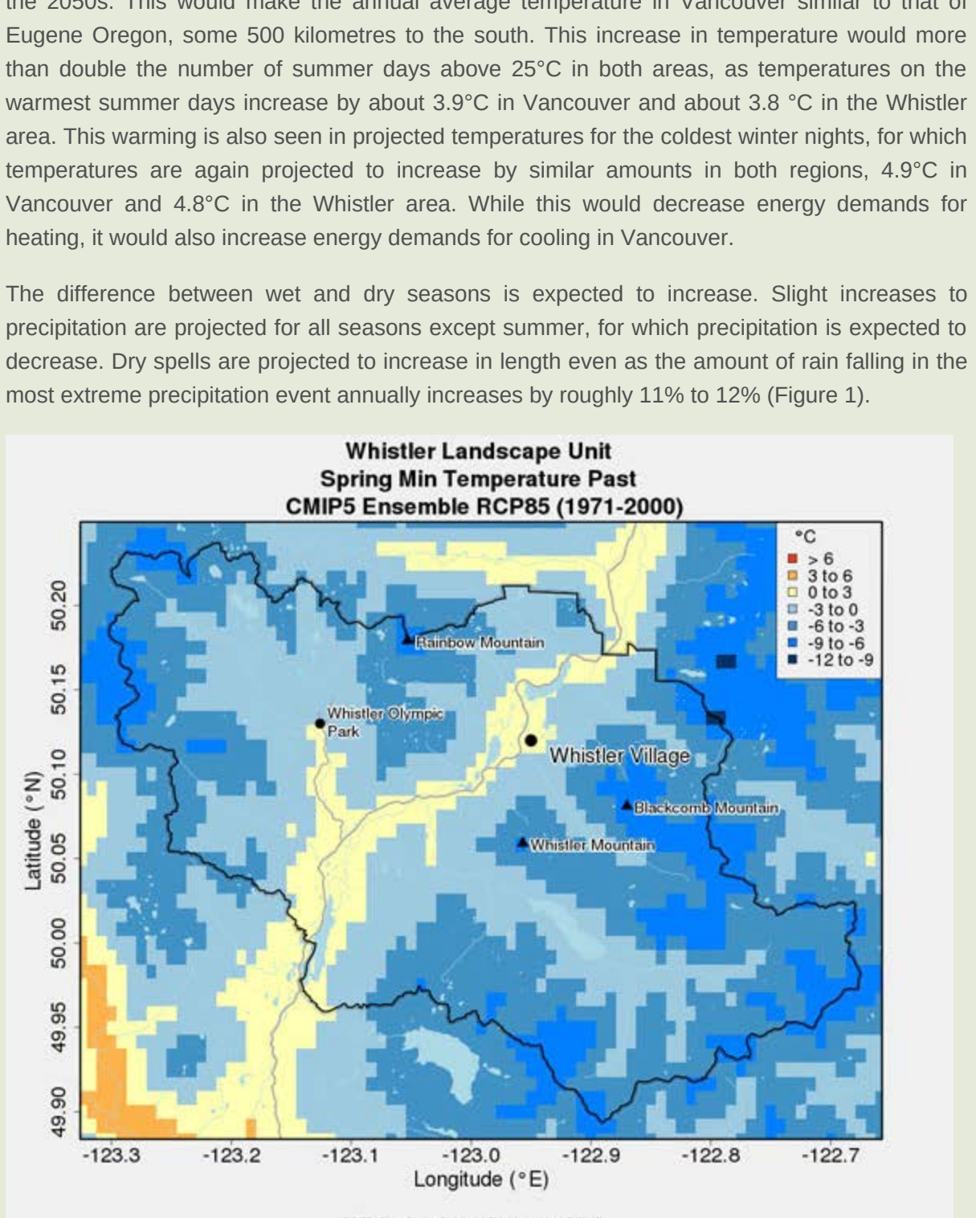
Whistler Landscape Unit
Spring Min Temperature Past
CMIP5 Ensemble RCP85 (1971-2000)
°C
> 6
3 to 6
0 to 3
-3 to 0
-6 to -3
-9 to -6
-12 to -9
Rainbow Mountain
Whistler Olympic Park
Whistler Village
Blackcomb Mountain
Whistler Mountain
Latitude (°N)
Longitude (°E)
Whistler Landscape Unit
Spring Min Temperature Projections
CMIP5 Ensemble RCP85 (2041-2070)

Figure 2: This figure shows the climatological average spring (March, April and May) daily minimum temperatures for the Whistler region over the recent historical period (1971-2000, top panel) and those projected for the 2050s (2041-2070, bottom panel).

These changes could mean an increase in both growing degree days and the length of the growing season. Snow and snow pack are expected to decrease, with a total loss projected for some areas near Vancouver and an overall decrease of around 50 cm to 100 cm (about 60% to 70%) at Whistler Village relative to historical values. Overall, and importantly for regional water supply and watersheds, this would mean a decrease of about 58% in the April 1st snow pack. Spring minimum temperatures also have an impact on the latter part of the ski season and projections (Figure 2) that show large areas above 0°C in those months are a cause for concern.

UPDATED PUBLICATIONS LIBRARY

Our researchers deliver many talks and poster presentations at a variety of scientific conferences and other events each year. Often, after our researchers deliver a presentation, members of the audience ask if they can get a copy of the presentation materials. To facilitate this, PCIC is pleased to announce that our Publications Library now offers posters and slides from presentations in addition to our other published materials. We will keep these on our site for one year after the presentations are delivered, so that anyone interested can access these materials.

Explore our Publications Library.

NEW REPORT ON EXTREME WEATHER EVENTS

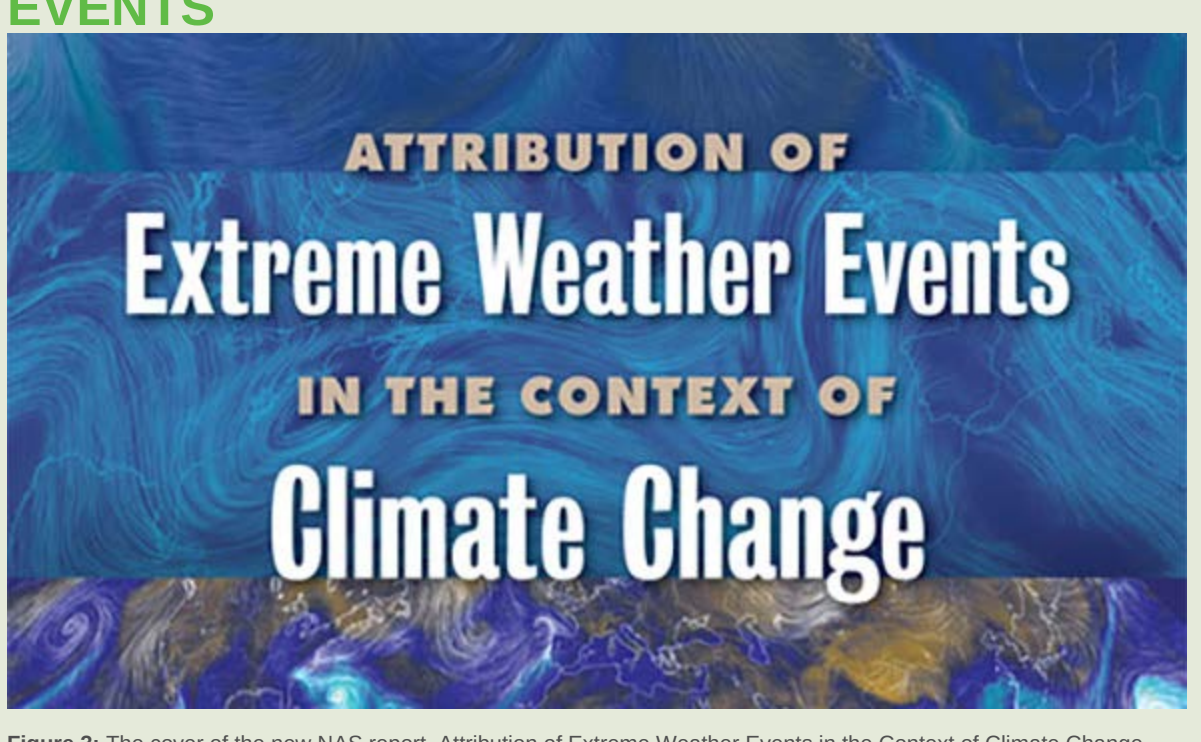

Figure 3: The cover of the new NAS report, Attribution of Extreme Weather Events in the Context of Climate Change.

This spring, the National Academy of Sciences released their report, Attribution of Extreme Weather Events in the Context of Climate Change, authored by a committee of experts that includes PCIC Director Francis Zwiers. The report covers current research in attributing weather events to their causes, both natural and anthropogenic. It breaks down the different observational and model-based approaches and discusses the reliability of event attribution. It also discusses the various factors that influence how questions about the potential influence of anthropogenic climate change on extreme events are framed and how best to interpret the results of extreme event attribution studies. The report also explores nine specific types of weather events in detail and outlines the research efforts that will be needed in order to increase our ability to tease out the influences on extreme weather events.

Electronic copies of the report can be accessed for free from the National Academies Press. Read the report online.

CONFERENCES

The past few months have been very busy with conferences, with PCIC Director Dr. Francis Zwiers chosen to be the chair and local convener of the 13th International Meeting on Statistical Climatology and PCIC staff members delivering presentations at this, two other conferences and an important workshop. The 13th IMSC, a meeting series which started 1979, brings together scientists and statisticians in order to promote good statistical practice in climate and atmospheric science. Three PCIC researchers chaired sessions and four presented at this year's conference, which was held in Canmore, Alberta between June 6th and June 10th. Dr. Zwiers also gave the Chair's invited address, "Our shared responsibility as users of statistics and consumers of results from its application in the climate sciences." Dr. Zwiers was a co-organizer of the Uncertainty Modelling in the Analysis of Weather, Climate and Hydrological Extremes workshop from June 12th to June 17th at the nearby Banff International Research Station. Both he and another PCIC staff member also presented at this workshop, which focused on the use of extreme value theory and other statistical tools for the representation and analysis of climate extremes as well as techniques to model such extremes.

Three PCIC researchers presented at the Canadian Meteorological and Oceanographic Society and Canadian Geophysical Union Joint Congress and four members of our team attended in total. This is the largest annual meeting of Canadian ocean and atmospheric scientists, and it was held this year in Fredericton, New Brunswick, from May 29th to June 2nd. PCIC's Hydrologic Impacts Theme sent one researcher to the 69th National Conference of the Canadian Water Resources Association (CWRA), held this year in Montreal, from May 25th to 27th.

Finally, members of our computational support group attended two recent conferences. From May 2nd to 5th, PCIC's geospatial programmer attended and presented at the Free and Open Source Software for Geospatial (Foss4G) North America 2016 conference in Raleigh, North Carolina from May 2nd to 5th. Two members of our team also presented at Pycon, the largest conference for those working with the programming language Python, held in Portland from May 28th to June 5th.

THE PACIFIC CLIMATE SEMINAR SERIES WRAPS UP FOR THE SUMMER

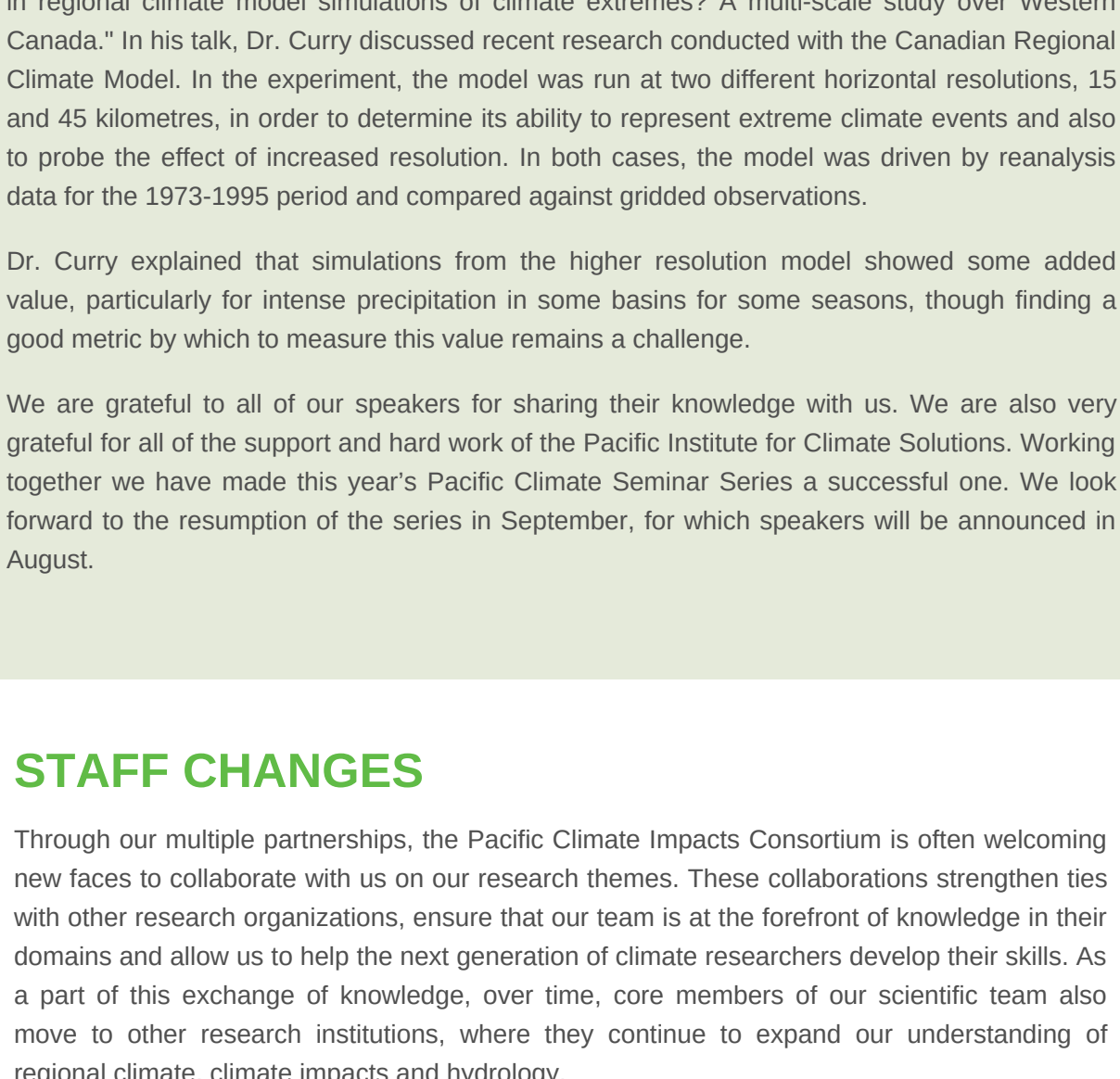

Figure 4: Dr. Charles Curry delivers the last talk of the 2015-2016 Pacific Climate Seminar Series.

To wrap up our 2015-2016 Pacific Climate Seminar Series, we invited incoming PCIC research associate Dr. Charles Curry to deliver a talk entitled, "Does increased resolution alone add value in regional climate model simulations of climate extremes? A multi-scale study over Western Canada." In his talk, Dr. Curry discussed recent research conducted with the Canadian Regional Climate Model. In the experiment, the model was run at two different horizontal resolutions, 15 and 45 kilometres, in order to determine its ability to represent extreme climate events and also to probe the effect of increased resolution. In both cases, the model was driven by reanalysis data for the 1973-1995 period and compared against gridded observations.

Dr. Curry explained that simulations from the higher resolution model showed some added value, particularly for intense precipitation in some basins for some seasons, though finding a good metric by which to measure this value remains a challenge.

We are grateful to all of our speakers for sharing their knowledge with us. We are also very grateful for all of the support and hard work of the Pacific Institute for Climate Solutions. Working together we have made this year's Pacific Climate Seminar Series a successful one. We look forward to the resumption of the series in September, for which speakers will be announced in August.

STAFF CHANGES

Through our multiple partnerships, the Pacific Climate Impacts Consortium is often welcoming new faces to collaborate with us on our research themes. These collaborations strengthen ties with other research organizations, ensure that our team is at the forefront of knowledge in their domains and allow us to help the next generation of climate researchers develop their skills. As a part of this exchange of knowledge, over time, core members of our scientific team also move to other research institutions, where they continue to expand our understanding of regional climate, climate impacts and hydrology.

Over the last few months PCIC has seen both. In April, we said a fond farewell to a member of PCIC's Hydrologic Impacts Theme, Dr. Rajesh Shrestha. He has moved a short distance across campus to work with the W-CIRC unit of Environment and Climate Change Canada. Dr. Shrestha joined PCIC in 2012. His expertise was key in the development of our ability to predict seasonal streamflow, assess hydrology model skill, and estimate the hydrologic impacts of climate change, including effects of extreme streamflow. His contribution to hydrologic impacts projects over the years has been invaluable. Though we miss having Raj in UH1, we look forward to collaborating with him and seeing the fruit of his future research projects.

At the same time we are pleased to welcome a new research fellow, an intern and two research associates to our scientific team. Our new research fellow, Dr. Mohamed Ali Ben Alaya, joined us just after completing his PhD at the National Institute of Scientific Research - Research Center of Water, Earth and the Environment (INRS-ETE), in Quebec, Canada. While there, his research focused on probabilistic multisite models for precipitation and temperature downscaling. With the support of the Canadian Network for Regional Climate and Weather Processes, Dr. Ben Alaya will be conducting joint research on projections of precipitation extremes with PCIC and the the Climate Data and Analysis Section of Environment and Climate Change Canada. Our new intern, Laurine Pironti, joins PCIC from Polytech Montpellier in France. For the next two months she will be helping Hydrologic Impacts theme as they work to prepare the VIC hydrology model for climate change studies.

Our new research associates are Dr. Charles Curry and Norman Shippee. Dr. Curry is a research associate with the Canadian Sea Ice and Snow Evolution Network and also an adjunct professor with the School of Earth and Ocean Sciences. He joins us from UVic's Climate Modelling Group and his research at PCIC will focus on large-magnitude flooding events in BC basins. Norman Shippee is a research associate with the Marine Environmental Observation Prediction and Response Network and a doctoral student in UVic's Geography Department. While at PCIC, his research will focus on analyzing the ability of seasonal forecasting systems to simulate extra-tropical cyclones.

RECENT PAPERS AUTHORED BY PCIC STAFF

C.L. Curry, B. Tencer, **K. Whan**, A. J. Weaver, M. Giguère and E. Wiebe, Searching for added value in simulating climate extremes with a high-resolution regional climate model over Western Canada. *Atmosphere-Ocean*, early online access, doi:10.1080/07055900.2016.1158146.

Curry, **C.L.**, B. Tencer, **K. Whan**, A. J. Weaver, M. Giguère and E. Wiebe, 2016: Searching for added value in simulating climate extremes with a high-resolution regional climate model. II: Basin-scale results. *Atmosphere-Ocean*, in press.

Kumar, S., D. Lawrence, P. Dirmeyer, J. Sheffield, 2015: Less reliable water availability in the 21st century climate projections. *Earth's Future*, **2**, 3, 152 160, doi: 10.1002/2013EF000159.

Kumar, S., **F.W. Zwiers**, P.A. Dirmeyer, D.M. Lawrence., **R. Shrestha** and **A. Werner**, 2016: Terrestrial Contribution to the Heterogeneity in Hydrological Changes under Global Warming. *Water Resources Research*, **52**, 4, 3127–3142, doi:10.1002/2016WR018607.

Mueller, B., X. Zhang and **F.W. Zwiers**, 2016: Historically hottest summers projected to be the norm for more than half of the world's population within 20 years. *Environmental Research Letters*, doi:10.1088/1748-9326/11/4/044011.

Najafi, M.R., **F.W. Zwiers** and N.P. Gillett, 2016: Attribution of the Spring Snow Cover Extent Decline in Northern Hemisphere, Eurasia and North America to Anthropogenic Influence. *Climatic Change*, **136**, 3, 571–586, doi:10.1007/s10584-016-1632-2.

Ribes, A., **F.W. Zwiers**, J.-M. Azais and P. Naveau, 2016: A new statistical approach to climate change detection and attribution. *Climate Dynamics*, early online access, doi: 10.1007/s00382-016-3079-6.

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Sun, Y., X, Zhang, G. Ren, **F.W. Zwiers** and T. Hu, 2016: Contribution of urbanization to warming in China. *Nature Climate Change*, early online access, doi:10.1038/NCLIMATE2956.

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Whan, K., **F.W. Zwiers** and J. Sillmann, 2016: The influence of atmospheric blocking on extreme winter minimum temperatures in North America. *Journal of Climate*, early online access, doi:10.1175/JCLI-D-15-0493.1.

Werner, A. T. and A.J. Cannon, 2016: Hydrologic extremes – an intercomparison of multiple gridded statistical downscaling methods, *Hydrology and Earth System Sciences*, **20**, 1483-1508, doi:10.5194/hess-20-1483-2016.

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