

HILARY KATHERINE McMILLAN

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HIGHER EDUCATION

- 2002-2006 **PhD** Department of Geography, Cambridge University, UK
Thesis '*End-to-End Flood Risk Assessment: A Coupled Model Cascade with Uncertainty Estimation*'
- 2001-2002 **MRes Science of the Environment, Distinction** Lancaster University, UK
Thesis '*Discharge Estimation in ungauged sub-catchments of the River Eden, UK*'
- 1996-1999 **MA Mathematics, 1st Class** Cambridge University, UK

WORK HISTORY

- 2016 to date **Associate Professor of Water Resources.** Dept of Geography, San Diego State University, US.
- 2007-2016 **Hydrological Scientist.** Hydrological Processes group, National Institute of Water and Atmospheric Research (NIWA), Christchurch, New Zealand.
- 2006-2007 **Marsden Postdoctoral Fellow.** Massey University, Palmerston North, New Zealand.
'*Hyperconcentrated flow dynamics in volcanic lahars*'

RESEARCH GRANTS HELD

- 2012-2016 MBIE (Ministry for Business, Innovation and Employment) research grant: *Waterscape*. Project Leader (\$1.4M / yr)
- 2010-2016 MBIE research grant: *Reducing the impacts of Weather Related Hazards*. Objective Leader for '*Terrestrial Hazards*' (Flooding and Inundation) (\$650,000 / yr ongoing)
- 2010-2012 MBIE research grant: *Waterscape*. Objective Leader for '*Catchment Hydrology*' (\$175,000/yr, 3 yrs)
- 2012-2013 Freshwater Short Term Core Funding: *Waterscape Hawkes Bay* (\$35,000, 1 yr)
- 2011-2012 Freshwater Short Term Core Funding: *Water tracking hydrological model for contaminant transfer* (\$70,000, 1 yr)
- 2010-2011 Innovation Seed Fund: *Water and Contaminant Tracking* (\$60,000, 1 year)
- 2009-2010 MAF (Ministry for Agriculture and Forestry) research grant '*Flood Risk under Climate Change*' (\$168,000, 1 yr)
- 2008-2010 FRST Capability Fund research grants '*Improvements in hydrological process modelling for applications in flow forecasting*' (\$80,000, 1 yr) and '*Hydrological model calibration in catchments with heterogeneous geology*' (\$80,000, 1 yr)

HONOURS AND AWARDS:

- 2015 Keynote speaker to Berkeley Catchment Symposium, San Francisco, "*Where do national hydrology models perform well or badly and why?*"
- 2015 Invited speaker at American Geophysical Union conference, San Francisco, "*Hydrological Uncertainty: Reasons to Be Cheerful*"
- 2015 Keynote speaker to Gordon Research Conference on Catchment Science, Boston, '*Hydrological signatures: use and abuse*'.
- 2013 Invited speaker at American Geophysical Union conference, San Francisco, '*Benchmarking Uncertainty for Hydrology*'
- 2013 Invited speaker at European Geosciences Union conference, Vienna, Austria, '*Spatial organisation in hydrological model structures for New Zealand catchments*'
- 2012 Keynote speaker '*Making the most of hydrological data in the coming decade*' and invited speaker '*Using data from research basins to identify appropriate model structures*' at IAHS Conference in Delft, Netherlands
- 2012 American Geophysical Union 2012 Editor's Citation for Excellence in Refereeing
- 2009 International Science and Technology Linkages Fund (Royal Society of NZ) Travel Award
Hydrological Model Diagnostics using Spectral Calibration Methods.

2009 European Geophysical Union Young Scientist Travel Award
 2002-2005 Natural Environment Research Council UK (NERC) PhD Scholarship
 NERC PhD CASE Award (Co-operative Award in Science and Engineering)
 2002-2003 Selwyn College Graduate Scholarship (for distinction in postgraduate study)
 2001-2002 Natural Environment Research Council UK (NERC) Masters Scholarship
 1998-1999 Pembroke College Foundress Prize and Scholarship (for achievement in examinations)

TEACHING AND EDUCATIONAL EXPERIENCE:

2016 **Lecturing.** Undergraduate course “*Environmental Hydrology*”, Department of Geography, San Diego State University, US.

2010 - 2014 **Research Supervision.** PhD, Masters and Undergraduate NZ and foreign exchange students undertaking theses at NIWA:

- Tanja Euser, 2015. TU Delft, Netherlands. PhD internship ‘*Influence of soil and climate on root zone storage capacity*’.
- Mélanie Douziech, 2014. ETH Zürich, Switzerland. Undergraduate Thesis ‘*Analysis of high and low resolution numerical weather prediction model inputs and their influence on hydrological model flow predictions*’ (co-supervisor).
- Aude Gago, 2013. Montpellier University, France. Undergraduate Internship ‘*Storm responses of soil moisture, groundwater and flow in Langs Gully catchment, NZ*’
- Terri Finucane, 2013. Birmingham University, UK. Undergraduate Thesis ‘*Groundwater and surface water interactions interpreted from piezometer, flow gauge and shallow well data at the Langs Gully catchment, Waipara, NZ*’
- Myriam Gueguen, 2012. Montpellier SupAgro, France. Undergraduate Internship ‘*Controls on runoff ratio in the Mahurangi Catchment, NZ*’.
- David Gawith, 2011. Otago University. Masters Thesis ‘*Climate change effects on runoff in the Lindis and Matukituki catchments, Otago, NZ*’ (co-supervisor).
- Elizabeth Grimon, 2010. Birmingham University, UK. Undergraduate Thesis ‘*Controls on recession behaviour in small catchments*’.
- Marcel Gaj, 2010. University of Freiburg, Germany. Masters Thesis ‘*Hydrological soil response in New Zealand*’

2012 **Invited Lecturer.** Two undergraduate seminars at Department of Geography, Canterbury University, on hydrological processes and modelling approaches

2010 **Workshop Organiser.** *Hydrological Impacts of Climate Change*. New Zealand Hydrological Society Conference, Dunedin, NZ. December 2010

2009 **Workshop Organiser.** *Managing with Uncertainty*. New Zealand Hydrological Society Conference, Whangarei, NZ. November 2009

2006 **Lecturer.** Second-year undergraduate course ‘*Hydrology and Water Resources*’, Department of Geography, Cambridge University, UK.

PROFESSIONAL SERVICE:

2017 External PhD examiner for Dr. T. de Boer-Euser, TU Delft, Netherlands

2016 to date Associate Editor for *Hydrological Processes* and *Hydrology and Earth System Sciences*

2015 to date Chair of International Association of Hydrological Sciences (IAHS) Flagship project ‘*Panta Rhei: Hydrology, Society and Change*’

2014 to date Hydrology Editor for EGU/Copernicus journal *Geoscientific Model Development*

2013 to date Invited member of USGS Powell Center international working group on ‘*Water Availability for Ungauged Rivers*’

2013 to date Objective Leader ‘Science Understanding’ IAHS *Panta Rhei* Biennium 2013-2015

2010 to date Grant proposal reviewer for Swiss National Science Foundation, Luxembourg National Research Fund, Netherlands Organisation for Scientific Research.

2007 to date Regular reviewer for *Water Resources Research*, *Journal of Hydrology*, *Hydrological Processes*, and *Hydrology and Earth System Sciences*

PUBLICATIONS:

Journal articles

1. **McMillan, H.**, Seibert, J., Petersen-Overleir, A., Lang, M., White, P., Snelder, T., Rutherford, K., Krueger, T., Mason, R., Kiang, J., (*in press*). How uncertainty analysis of streamflow data can reduce costs and promote robust decisions in water management applications. *Water Resources Research*.
2. **McMillan, H.**, Booker, D.J., Cattoën, C., (2016). Validation of a national hydrological model. *Journal of Hydrology*. 51 (b): 800:815.
3. de Boer Euser, T., **McMillan, H.**, Hrachowitz, M., Winsemius, H. C., Savenije, H. H. (2016). Influence of soil and climate on root zone storage capacity. *Water Resources Research* 52, 2009–2024.
4. Yang, J., **McMillan, H.**, Zammit, C. (2016) Modeling surface water–groundwater interaction in New Zealand: Model development and application. *Hydrological Processes*, doi: 10.1002/hyp.11075.
5. Kreibich, H., Krueger, T., Van Loon, A., Mejia, A., Liu, J., **McMillan, H.**, & Castellarin, A. (2016). Scientific debate of Panta Rhei research—how to advance our knowledge of changes in hydrology and society? *Hydrological Sciences Journal* 0, 0:1-3.
6. Singh, S.K., **McMillan, H.**, Bárdossy, A., Chebana, F., (2016). Non-parametric catchment clustering using the data depth function. *Hydrological Sciences Journal* 61, 15: 2649-2667.
7. **McMillan, H.**, Montanari, A., Cudennec, C., Savenije, H., Kreibich, H., Krueger, T., Liu, J., Mejia, A., Van Loon, A., Aksoy, H., Di Baldassarre, G., (2016). Panta Rhei 2013–2015: global perspectives on hydrology, society and change. *Hydrological Sciences Journal*, 61(7), pp.1174-1191.
8. Cattoen, C., **McMillan, H.**, Moore, S. (2016) Coupling a high-resolution weather model with a hydrological model for flood forecasting in New Zealand, *Journal of Hydrology (NZ)* 55 (1), 1
9. Archfield, S., Clark, M., [...] **McMillan, H.** et al. (2016) *Water Resources Research*. Accelerating advances in continental domain hydrologic modeling. 51(12): 10078-10091
10. Westerberg, I., Wagener, T., Coxon, G., **McMillan, H.**, Castellarin, A., Montanari, A., Freer, J. (2016) Uncertainty in hydrological signatures for gauged and ungauged catchments. *Water Resources Research*. 52, 1847–1865
11. Srinivasan, MS., Duncan, M., **McMillan, H.**, (2016) Field measurement of recharge under irrigation in Canterbury, New Zealand, using drainage lysimeters. *Agricultural Water Management* 166, 17 – 32.
12. Mizukami, N., Clark, M. [...] **McMillan, H.** (2016) mizuRoute (version 1) - river network routing tool for continental domain water resources applications. *Geoscientific Model Development* 9 (6), 2223-2238.
13. Westerberg, I., **McMillan, H.** (2015) Uncertainty in hydrological signatures, *Hydrol. Earth Syst. Sci.*, 12, 4233-4270, doi:10.5194/hessd-12-4233-2015, 2015.
14. Pechlivanidis, I., Jackson, B., **McMillan, H.**, Gupta, H. (2016). Robust informational entropy-based descriptors of flow in catchment hydrology. *Hydrological Sciences Journal*. 61 (1), 1 – 18
15. **McMillan, H.**, Srinivasan MS. (2015) Characteristics and controls of variability in surface and groundwaters in a headwater catchment. *Hydrology and Earth System Sciences* 19, p 1767-1786.
16. **McMillan, H.**, Westerberg, I. (2015) Rating curve estimation under epistemic uncertainty. *Hydrological Processes* 29: 1873–1882.
17. Pechlivanidis, I., Jackson, B., **McMillan, H.**, Gupta, H. (2014). Use of an entropy-based metric in multi-objective calibration to improve model performance. *Water Resources Research* 50(10): 8066–8083.
18. **McMillan H.**, Guegen M, Grimon E, Woods R, Clark M, Rupp D, (2014). Spatial variability of processes and model structure diagnostics in a 50 km² catchment. *Hydrological Processes* 28(18): 4896–4913.
19. Ackerley D, Bell RG, Mullan AB, **McMillan H.** (2013) Estimation of regional departures from global-average sea-level rise around New Zealand from AOGCM simulations. *Weather and Climate (NZ)* 07/2013; 33(1):2-22.
20. Montanari, A., [...] **H. McMillan**, et al. (2013) “Panta Rhei – Everything Flows”: Change in hydrology and society – The IAHS Scientific Decade 2013-2022. *Hydrological Sciences Journal* 58(6): 1256–1275.
21. **McMillan H.**, Hreinsson E.O., Clark M.P., Singh S.K., Zammit C., Uddstrom M.J. (2013) Operational hydrological data assimilation with the Recursive Ensemble Kalman Filter. *Hydrology and Earth System Sciences*, 17: 21-38
22. Singh SK, **McMillan H.**, Bardossy A. (2013) Use of the data depth function to differentiate between cases of interpolation and extrapolation in hydrological model prediction. *Journal of Hydrology*, 477: 213–228

23. **McMillan H.**, M. Duncan, G. Smart, J. Sturman, S. Poyck, S. Reese, A. Tait, E. Hreinsson, J. Walsh. (2013) The Urban Impacts Toolbox: An example of modelling the effect of climate change and sea level rise on future flooding. *Weather and Climate (NZ)*. 32(2), 21-39
24. **McMillan, H.**, T. Krueger, J. Freer (2012) Benchmarking observational uncertainties for hydrology: Rainfall, river discharge and water quality. *Hydrological Processes*, 26 (26): 4078 -4111
25. Gawith, D., Kingston, D.G., **McMillan, H.** (2012) The effects of climate change on runoff in the Lindis and Matukituki catchments, Central Otago, New Zealand. *Journal of Hydrology (NZ)* 51(2): 121-136
26. **McMillan, H.**, D. Tetzlaff, M. Clark, C. Soulsby (2012) Do time variable tracers aid the evaluation of hydrological model structure? A multi-model approach. *Water Resources Research*. 48, W05501
27. **McMillan, H.** (2012) Effect of spatial variability and seasonality in soil moisture on drainage thresholds and fluxes in a conceptual hydrological model. *Hydrological Processes* 26(18): 2838–2844
28. Pechlivanidis, I.G., B. Jackson, **H. McMillan**, H. Gupta (2012). Using an informational entropy-based metric as a diagnostic of flow duration to drive model parameter identification. *Global Network Environmental Science & Technology Journal*, 14(3): 325-334
29. Poyck, S., J. Hendrikx, **H. McMillan**, E.O. Hreinsson, R. Woods (2011) Combined snow- and streamflow modelling to estimate impacts of climate change on water resources in the Clutha, New Zealand. *Journal of Hydrology (NZ)* 50: 293-312
30. **McMillan H.**, Clark M., Bowden W., Duncan M., Woods R. (2011). Hydrological field data from a modeller's perspective: Part 1. Diagnostic tests for model structure. *Hydrological Processes*. doi: 10.1002/hyp.7841.
31. Clark M., **McMillan H.**, Collins D., Kavetski D., Woods R. (2011). Hydrological field data from a modeller's perspective: Part 2. Process-based evaluation of model hypotheses. *Hydrological Processes*, doi: 10.1002/hyp.7902
32. **McMillan, H.**, Jackson B., Clark M., Kavetski D., Woods R. (2011) Rainfall Uncertainty in Hydrological Modelling: An Evaluation of Multiplicative Error Models. *Journal of Hydrology*. 400(1-2): 83-94
33. **McMillan H.**, Freer J., Pappenberger F., Krueger T., Clark M. (2010). Impacts of Uncertain River Flow Data on Rainfall-Runoff Model Calibration and Discharge Predictions. *Hydrological Processes* 24(10): p 1270-1284. doi: 10.1002/hyp.7587
34. **McMillan H.**, Clark M. (2009), Rainfall-runoff model calibration using informal likelihood measures within a Markov Chain Monte Carlo sampling scheme, *Water Resources Research*, 45, W04418, doi:10.1029/2008WR007288.
35. **McMillan H.**, Brasington J. (2008). End-to-End Flood Risk Assessment: A Coupled Model Cascade with Uncertainty Estimation. *Water Resources Research* 44, W03419, doi:10.1029/2007WR005995.
36. **McMillan H.**, Brasington J. (2006). Reduced Complexity Strategies for Modelling Urban Floodplain Inundation. *Geomorphology*, 90: 3-4, p 226-243.
37. Freer J., **McMillan H.**, McDonnell J.J., Beven K.J. (2004). Constraining dynamic TOPMODEL responses for imprecise water table information using fuzzy rule based performance measures. *Journal of Hydrology* 291, p 254-277.

Book Chapters

1. **McMillan, H.**, Caruso, B., Srinivasan, M.S. (2016). *Lateral hydrological processes*. In: Advances in New Zealand Freshwater Science, Eds: Jellyman, P., Davie, T. Pearson, C., Harding, J., For New Zealand Hydrological Society and New Zealand Freshwater Sciences Society.
2. Srinivasan, M.S., Wohling, T., Campbell, D. **McMillan, H.** (2016). *Vertical hydrology*. In: Advances in New Zealand Freshwater Science, Eds: Jellyman, P., Davie, T. Pearson, C., Harding, J., For New Zealand Hydrological Society and New Zealand Freshwater Sciences Society.

Technical Reports

1. Larned, S., Snelder, T., Unwin, M., McBride, G., Verburg, P., **McMillan, H.** (2015). Analysis of Water Quality in New Zealand Lakes and Rivers: Data sources, datasets, assumptions, limitations, methods and results. Prepared for Ministry for the Environment. NIWA Technical Report No: CHC2015-033

2. Booker, D.J. Cattoën-Gilbert, C. Dudley, B. Henderson, R.D. **McMillan, H.** Yang J. (2015) A pressure-state-impact model for freshwater flows with example application to Canterbury. NIWA report to Ministry for the Environment, MFE14505, 116pp.
3. **McMillan H.**, Poyck S., Jackson B. (2010). Flood risk under climate change: A framework for assessing the impacts of climate change on river flow and floods, using dynamically-downscaled climate scenarios. NIWA Technical Report for Ministry of Agriculture and Forestry: CHC2010-033, 55 p.