PROFILE

Emily Lane

Emily Lane is proof that a background in mathematics can lead into many directions in life and work. As Principal Scientist, Natural Hazards and Hydrodynamics at NIWA (National Institute of Water and Atmospheric Research), Emily has woven a career that invariably has incorporated water and been influenced by some of our biggest recent natural disasters including Cyclone Gabrielle.

Emily carried out her undergraduate studies and then a MSc in applied maths at the University of Auckland. Her topic: Switching induced by complex eigenvalues within a structurally stable heteroclinic network was supervised under Professor Vivien Kirk. Emily continued her education doing a PhD at the University of Arizona. Over the course of this she studied a "variety of things" before the arid Tucson environment brought on homesickness for the coast. Emily's research went back to water.

"I looked at wave-current interactions, deriving equations to understand and model the interactions between waves and currents using a vortex force analogy," says Emily.

Emily then moved to the University of California, Los Angeles joining the earth science department to further her wave-current research in a post-doctoral position.

During this time Emily's eldest daughter was born so the family decided to move back to New Zealand.

The family settled in Christchurch – where they have remained – with Emily picking up a six-month visiting position at the University of Canterbury. This led to a post-doc position at NIWA that became a permanent position in coastal hydrodynamics where Emily focuses on natural hazards and coastal hazards. Emily has now been at NIWA for nearly 18 years.

An outdoor enthusiast, more than once at university she was "busted" while out climbing or tramping when she should have been in lectures or studying for exams.

Emily is recognised for her unicycle exploits and she knows Christchurch's Port Hills intimately. Along with her husband, they are the first people to complete the Old Ghost Road on munycycles – mountain unicycles. Her happy

place is belaying at the top of a crag and "going bush". She's recently taken up skiing at Broken River Ski field in the Craigieburns where her mathematical mind has been put to work splicing together the tow ropes.

Since her early days at university Emily has been aware of the mathematics behind patterns you see in nature. She remembers modelling a simple dynamical system involving a sine function and it producing a picture that looked like smoke swirling up in a chorus.

"I was entranced that you could get patterns you see in nature through mathematics. It made me keen to pursue maths."

Working at NIWA, Emily's background in waves and currents opened her next research path, modelling coastal hazards and tsunamis.

"When I was doing my PhD, I got interested in seismology," says Emily who minored in geophysics. "But then I ended up studying wave-current interactions – I thought the earthquakes had just been a dead end. Then the Indian Ocean tsunami happened around when I graduated (2004). My interest in tsunamis sprang from this event and suddenly those seismology papers came into their own."

Over the years Emily has studied different tsunami sources, including submarine landslides and volcanoes. In 2018 she gained a Marsden project to study volcanic tsunamis with a team from GNS, University of Auckland and University of Otago using physical and numerical experiments. The Hunga Tonga-Hunga Ha'apai underwater volcanic eruption at the start of 2022 played into Emily's mathematical modelling on volcanic-generated tsunamis.

"People went from not caring about volcanic tsunamis to being very interested and very involved. Our work became really timely."

Widening her focus to include freshwater hazards, Emily also leads a highly collaborative MBIE-funded Endeavour project to undertake a nationally consistent flood hazard and risk assessment. At the start of 2023 when Cyclone Gabrielle hit New Zealand, Emily's work was again timely. Using processes developed from the national project she is contributing the Extreme Weather Science Response leading a project with a focus on the flooding in Tairāwhiti and Hawke's Bay.

Prolific in her work, in the last 18 months alone Emily has co-authored 12 research articles in high impact scientific journals. In that same time period, she has been cited approximately 150 times. Her overall h-index is 17 and overall i10-index is 21.

Emily is NIWAs representative on the Tsunami Expert Panel and she regularly communicates science through invited talks, lectures and keynote addresses at scientific conferences. She really enjoys collaborating with colleagues in other CRIs and universities and has helped co-supervise a number of masters and PhD students. She is an active promoter of NIWAs work on social media.

The list of accolades and firsts is extensive. But perhaps the one Emily is most proud of is knitting the only Klein Hat with a one-knot.

"I'm pretty sure it's topologically distinctive from all other hats," she says proudly.

Melissa Bray