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| PERSONAL INFORMATION | Alan Seed |
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| A picture containing person, person, outdoor, posing  Description automatically generated | 108/1 Encounter Way, Docklands, VIC |
| +61405581067 |
| Alan.seed@gmail.com |
| Nationality Australia |
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| ***SUMMARY*** |  |

I am a research scientist with a strong engineering background, and as such am motivated to conduct high quality research that delivers practical outcomes. I am well known within Australia and internationally for my research into space-time stochastic models of rainfall and for quantitative radar rainfall estimation and nowcasting. I have a deep and wide-ranging expertise in rainfall; spanning atmospheric physics, stochastic space-time models, geo-statistics, weather radar (hardware, quality control, precipitation estimation), rain gauge network design, field experiments, nowcasting, and hydrometeorology. Throughout my career I have been interested in the transition of research into operations and building capacity through the appropriate use of science and technology. This has led me to develop and deliver two major operational systems, Rainfields for radar rainfall estimation and STEPS for ensemble nowcasting of rainfall, and to undertake a range of business development projects both nationally and internationally

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| ***SCHOLASTIC RECORD*** |  |

Bsc Civil Engineering, University of Natal, Durban, South Africa. 1975-1979.

Msc Agricultural Engineering, University of Natal, Pietermaritzburg, South Africa. 1981-1986 (part time)

Title: The techniques of rainfall mapping.

PhD Agricultural Engineering, McGill University, Montreal, Canada. 1987-1989.

Title: Statistical problems in measuring convective rainfall.

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| ***SCIENTIFIC RESEARCH EXPERIENCE*** |  |

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| Short Term Ensemble Prediction System (STEPS) | Starting in around 2002, I have been collaborating with the Met Office (U.K.) on the development of the Short Term Ensemble Prediction System (STEPS). STEPS represents a major advance in the science of stochastic space/time rainfall modelling and provides a robust and fast algorithm for generating large stochastic ensembles of rainfall forecasts.  The key advances are   * the use of a Fourier filter to generate a field of correlated noise in the context of a bounded log-normal multiplicative cascade model, * the use of a hierarchy of auto-regression lag 2 models to model the Lagrangian rate of change of the rainfall field in a scale-dependent manner, and * the technique for blending two sets of forecasts in a way that recognises the skill of the forecasts as a function of scale and lead time.   It was the first operational ensemble rainfall nowcasting system that is based on the concepts of multi-fractals through the use of multiplicative cascades. STEPS blends an advection nowcast that is based on radar observations with high resolution NWP forecasts. My role in the collaboration was to develop the theoretical framework for STEPS based on multiplicative cascades and to write the C++ code for the first version of STEPS.  STEPS is designed to provide operational guidance for the heavy rainfall and flash flood warning services. Licenses STEPS have issued for use in Japan, Canada, Russia, Belgium, Finland, Singapore, and SELEX (a major radar manufacturer) has integrated the code into their operational radar software.  International collaboration on stochastic space-time rainfall modelling and nowcasting includes hosting a visitor from Swiss Science Foundation for a year to work on the spatial distribution of nowcasting errors, and supervising a PhD student from Aalto University, Finland, on modelling spatial anisotropy in stochastic space-time models of rainfall. |
| Radar rainfall estimation | My other major contribution in science has been developing and maintaining the operational radar rainfall estimation and nowcasting system Rainfields. Rainfields is a significant operational system that generates 5000 products an hour from 60 radars around Australia that are used as guidance for flash flood forecasting and heavy rain warning. I have contributed to Rainfields through my own research into radar rainfall estimation. I am especially interested in developing robust algorithms and managing the complexity of the system overall. I provide scientific oversight to PhD students, scientists in my team, and visiting Research Fellows who have developed or improved the algorithms. I supervised the development of the operational software that was based on a prototype that I had written, worked with weather forecasters to develop a forecast process, and assisted with developing training material. |
| Strategic Radar Enhancement Project | I was the Lead Scientist for the Strategic Radar Enhancement Project (SREP) from 2010 to 2014. My duties were to manage the delivery of the project milestones, to supervise the development of the next version of the operational quantitative precipitation estimation and forecasting system, and to supervise research into radar data quality control and radar rainfall estimation errors.  I was the Lead Scientist for the Sydney 2014 Forecast Demonstration Project. The aim was to demonstrate the use of 1.5 km convection allowing NWP and advanced nowcasting products for convective weather forecasting. I initiated the project; contributed to writing the Business Case, managed the technical aspects of the preparations, and went to Sydney to lead the 10-week real-time trial. The results of the FDP will have a significant impact on the way the Bureau delivers a nowcasting service that is based on both radar and high resolution NWP. |

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| ***BUSINESS DEVELOPMENT EXPERIENCE*** |  |

Business development projects are an important tool for me to facilitate the uptake of my research by operational end users and to deepen my understanding of the needs of a wide range of clients both nationally and internationally. I am particularly interested in the process of building capacity in developing countries and in understanding how to deploy appropriate technology to a range of end users.

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| Australian Projects | * 2016 – Chair of the Radar tender evaluation committee for the procurement of new dual-pol radars for the Australian network * 2015 - Provided stochastic design storms to Melbourne Water so that they could test their proposed extensions to Melbourne's sewer system * 2015 – Delivered a tailored set of real-time radar rainfall estimation and nowcasting products with a web interface to Sydney Catchment Authority so that they could operate a dam more effectively. * 2014 - Delivered a tailored set of real-time radar rainfall estimation and nowcasting products to the Victorian water industry * 2012 – Worked with Jordan, a civil engineering consulting company, to provide stochastic design storms for a project to optimise the operating rules of Wivenhoe Dam |
| International Projects | * 2015 – Vietnam. World Bank project to advise on how to upgrade their radar network and how to integrate their radars into a network that is able to provide improved services * 2014 – Thailand. Prepared a tender for a project to implement a radar network in Thailand, * 2009 to 2010, China. Deployed Rainfields and STEPS to provide nowcasting support for the Shanghai 2010 World Expo * 2007 to 2009 – China. Deployed Rainfields and STEPS to provide nowcasting support for the Beijing 2008 Olympics * 2005 – Malaysia. Worked in a consortium to prepare a tender for the use of radar data to provide nowcasting support for flood forecasting * 2000 – Pakistan. Consultant for Delft Hydraulics, Netherlands, advising the Pakistan Meteorological Service on the use of radar data for flood prediction in the Punjab basin * 1999 - Turkey. World Bank Project to design weather radar network for flood warning in Turkey |

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| ***ACADEMIC EXPERIENCE*** |  |

Maintaining close links with academia has been an important aspect of my career. I use these links to maintain my scientific development. I enjoy my occasional co-supervision of post graduate students and research fellows since this gives me the opportunity to mentor and develop the next generation of scientists.

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| Academic Positions | * 2020 – present: Adjunct Associate Professor, School of Engineering and Built Environment, Griffith University. * 2014 - 2016: Adjunct Associate Professor, School of Civil and Environmental Engineering, University of New South Wales. * 2004: Visiting Research Fellow: McGill University, Montreal, Canada, March - June 2004. * 2002: Visiting Professor: Technical University of Catalonia, Barcelona, Spain, April 2002. |
| Phd Examiner | * 2015: Aalto University, Helsinki, Finland. “Object-oriented analysis and nowcasting of convective storms in Finland”. * 2013: Department of Physics, Auckland University, New Zealand. “Resolution requirements for the spatial sampling of rainfall”. * 2010: Physics Department, McGill University, Canada. |
| Graduate Student Supervision | * Aalto University, Helsinki, Finland * Monash University, Australia * University of Adelaide, Australia * University of Melbourne, Australia * University of New South Wales, Australia * University of Wollongong, Australia |
| Research Grants | * 2015 – 2019 Principal Investigator for an ARC Discovery Grant with Prof. Jeff Walker, Department of Civil, Surveying, and Environmental Engineering, Monash University, on the use of transmissions between mobile phone towers to measure rainfall. |

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| ***SCIENTIFIC EXPERIENCE*** |  |

I maintain an active profile in the International Scientific Community through my work for scientific journals, membership of a range of committees, and participation in conferences.

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| Journal Reviewer | * Journal of Hydrology. * Journal of Applied Meteorology and Climate. * Water Resources Research. * Advances in Water Resources. * Quarterly Journal of the Royal Meteorological Society. |
| Journal Editor | * 2013 – 2018: Associate Editor (radar hydrology) for the Journal of Hydrology. |
| Committee memberships and affiliations | * Member of the WMO/CAS/WWRP Nowcasting and Mesoscale Research Working Group. * Co-chair and now member of the International Organising Committee on Radar Quality Control and Quantitative Precipitation Intercomparisons (RQQI), WMO/CIMO. * Member of the Task Team on the Development of Guidelines on Nowcasting Techniques (TT-DGNT), WMO/CBS/OPAG-DPFS. * Member of the International Science Steering Committee of the Tokyo Metropolitan Area Convection Study for Extreme Weather Resilient Cities (TOMACS), WMO/CAS/WWRP. * Member of the International Organising Committee for the Hydrological Applications of Weather Radar Symposia. * Member of the International Programme Committee for the International Symposium on Nowcasting and Very Short Range Forecasting. * Member of the Science Steering Group for the World Expo 2010 Nowcasting Services Forecast Demonstration Project (WENS) 2008 – 2011. * Member of the International Scientific Steering Committee for the Beijing 2008 Forecast Demonstration Project (B08FDP), WMO/CAS/WWRP, 2005-2009. * Member of the Precipitation & Climate sub-division of Hydrological Sciences of European Geosciences Union, 2007 – 2009. * Australian Meteorological and Oceanographic Society. * European Geosciences Union. * American Meteorological Society. |
| Keynote addresses | * Seed, A.W., and M. Curtis, 2014. “*A close shave with Occam's razor: managing complexity in a radar rainfall estimation system*”. 8th European Conference on Radar in Meteorology and Hydrology, Garmish-Partenkirchen, Germany, 1-5 September 2014. Opening keynote address for the conference. * Seed, A.W., 2008. “*Quantitative Precipitation Forecasting: A Review*”. International Symposium on Weather Radar and Hydrology, Grenoble, France, 10-12 March 2008. * Seed, A.W., 2008. “*On the blending of advection and NWP forecasts: issues and examples*”. Fifth European Conference on Radar in Meteorology and Hydrology, Helsinki, Finland, 30 June – 4 July 2008. * Seed, A.W., Pierce, C., 2006. “*Forecasting rainfall at short time and space scales*”.in: Second International Symposium on Quantitative Precipitation Forecasting and Hydrology, Boulder, Colorado, USA, 4-8 June 2006. * Seed, A.W., N. Bowler and C Pierce, 2005. “*Short Term Ensemble Prediction System (STEPS): An empirical treatment of forecast uncertainty*”. World Weather Research Program Symposium on Nowcasting and Very Short range Forecasting, Toulouse, France. |

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| ***TRAINING EXPERIENCE*** |  |

Training is a critical element in the transition of scientific research into operations and I have participated in a wide range of training events both nationally and internationally.

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| Australia | * Contributed regularly to the Bureau’s Advanced Meteorological Course. * Provided a specialist lecture series to Bureau staff on the statistical structure of rainfall in space and time and the theoretical concepts that underpin the STEPS algorithms. * Contributed training sessions and workshops for the Sydney 2014 FDP. * Work with Bureau of Meteorology Training Centre to provide content for their training material for Rainfields and STEPS. * 2004 to 2006- Department of Civil and Environmental Engineering, Melbourne University; Taught a 6-lecture series on rainfall to 4th year undergraduates. |
| International | * 2009: Presented a 3-day course on nowcasting at the Hong Kong Observatory, Hong Kong. * 2008: Presented a series of lectures at the SELEX radar end user workshop in Neuss, Germany. * 2005: WMO Nowcasting Workshop, Pretoria, South Africa. * 2003: WMO Nowcasting Workshop, Brazilia, Brazil * 2000: Presented a 3-day course on precipitation observation and nowcasting at the Hydrometeorological College, Hanoi, Vietnam |

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| ***WORK EXPERIENCE*** |  |

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| 1 July 2018 – 1 November 2020 | Principal Research Scientist, Radar Science and Nowcasting, Research, Bureau of Meteorology. Contribute to the development of STEPS algorithms and the use of ensemble rainfall nowcasting in flash flood forecasting. |
| April 2015 – 30 June 2018  a/Manager Science and Engineering Section (a/STQI)  Observations and Infrastructure  BoM | I accepted a Temporary Assignment of Duties (TAD) to manage the Science and Engineering Section of the Infrastructure Management Branch, O&I. The section is responsible for building the Bureau’s observation network. I supervise 50 engineers and scientists who build the observation infrastructure, undertake observation research, and are the subject matter experts in the Bureau for a wide range of observation systems. As Manager, I supervise the specification and procurement of the new dual-pol weather radars that will be used to sustain the radar network, initiated the up-grade to dual-pol of the existing capital city radars, and have progressed the implementation of the Bureau’s strategy for a tiered automatic weather station network. |
| Jan 2013 – Apr 2015  Principal Research Scientist  CAWCR / R&D, BoM | As team leader of Radar Science and Nowcasting supervised the development and operational implementation of Rainfields, STEPS, 3DRapic (the Bureau's operational radar data visualisation system), and Seamless Rainfall (blends high resolution NWP with low resolution NWP and generates an ensemble). I led the SREP Science project and the Sydney 2014 FDP.  In 2015 I was awarded the Director’s Choice for Individual Excellence Award for my work on radar rainfall estimation and nowcasting. |
| Sep 2005 – Jan 2013  Senior Research Scientist  CAWCR, BoM | Undertook research radar rainfall estimation and supervised the development of the first operational version of Rainfields. Continued to develop STEPS and support the collaboration with the Met Office. |
| Sep 2002 – Sep 2005  Senior Professional Officer Grade B  BMRC, BoM | Joined the BMRC to conduct research into quantitative precipitation estimation and nowcasting, support radar science, and act as a liaison between Hydrology and BMRC. Developed the STEPS formulation and wrote the first operational version of STEPS. |
| Sep 1999 – Sep 2002  Senior Professional Officer Grade C  Hydrology Unit , BoM | On-going position in the Bureau working on radar quantitative precipitation estimation and developing stochastic space-time models of rainfall for hydrological simulations. Wrote my first rainfall nowcasting system that was tested at the Sydney 2000 FDP |
| Sep1997 – Sep 1999  Professional Officer Class 2  Hydrology Unit, BoM | Cooperative Research Centre for Catchment Hydrology project on the use of radar data for hydrological modelling. Started to develop the radar rainfall estimation software based on archived data. Fixed term contract at the Bureau. |
| Oct 1993 – Oct 1997  Research Fellow , Physics  Auckland University, New Zealand | Developed a mobile x-band radar for studies of orographic rainfall in the Southern Alps and conducted field trips to take observations in the Southern Alps |
| Oct 1989 – Oct 1993  Engineer, Hydrological Research Institute  Department of Water Affairs, South Africa | Research into the use of radar data in hydrological modelling, an analysis on cloud seeding, and established a satellite remote sensing capability to detect changes in land use |
| Oct 1987 – Oct 1989  PhD Student  McGill University | PhD studies on the statistical structure of rainfall based on the analysis of radar data |
| July 1979 – Oct 1987  Engineer  Department of Water Affairs, South Africa | Designed irrigation systems and farm dams as a Civil Engineer |

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| ***PUBLICATIONS*** |  |

I have published over 100 papers, reports, and abstracts for conference presentations.

A current list of publications can be found in this link to Google Scholar

<https://scholar.google.com.au/citations?user=XQGH2EQAAAAJ&hl=en>