THE UNIVERSITY OF MELBOURNE

School of Geography, Earth and Atmospheric Sciences

Faculty of Science

Geography, Earth and Atmospheric Sciences Research Prospectus

Contents

About the School

We are passionate about our planet. We are fascinated by the interconnected web of systems – water, air, people, and earth – that help sculpt our complex Earth and our human societies.

The School of Geography, Earth and Atmospheric Sciences is a modern multidisciplinary community. We benefit society through outstanding education, research, and engagement in geography, geoscience, atmospheric science, and allied multidisciplinary areas, including climate change, environmental studies, and archaeological science.

We love to share our knowledge with the world, and we are dedicated to achieving a better future for our students, societies and the environment.

The University of Melbourne's Faculty of Science acknowledges the Traditional Owners of the lands on which we work: the Wurundjeri Woi-Wurrung and Bunurong peoples (Burnley, Fishermans Bend, Parkville, Southbank and Werribee campuses), the Yorta Yorta Nation (Dookie and Shepparton campuses), and the Dja Dja Wurrung people (Creswick campus). We pay respect to their Elders, past and present. We also acknowledge and respect that Aboriginal and Torres Strait Islander people are this country's first scientists, with deep and enduring knowledge of the land, waters and skies.

Professor Celia McMichael

Interim Head of the School of Geography, Earth and Atmospheric Sciences

Professor Celia McMichael

- Migration
- Climate change
- Population health
- Refugee

celia.mcmichael@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/5164-celia-mcmichael

Climate change is already affecting the health of people worldwide, including through exposure to extreme weather conditions, altered food yields, water insecurity and changes in the geographic range of disease vectors and transmission. However, the health consequences of human migration and mobility in a warming world are not well understood. What will be health risks and opportunities for people who move into sites of climate-related health risk, who are displaced by climate-related disaster, or who move away from places of emerging climate risk? My research seeks to understand the health consequences of mobility in a warming world. Insights from this research will inform policy and practice in the areas of climate adaptation and human migration.

I am a health geographer and my research focuses primarily on human migration and the social determinants of health. I conduct research in relation to the health and wellbeing of people with refugee backgrounds in Australia and climate-related migrants in the Pacific region. I have also been engaged in applied work in this field, including on returning refugees and infectious disease/immunisation in Angola (with the World Health Organization) and the health of forcibly displaced populations in Sri Lanka following the tsunami (with UNFPA).

My current research examines the associations between climate change, migration and population health. It aims to better understand pathways via which climate change affects the health of mobile populations (eg health consequences of climate-related migration and migration into sites of climate health risk). I am currently working in small island developing states, including Fiji. I work closely with local and Indigenous researchers to develop and disseminate research in this area. Our research typically uses qualitative and participatory methods. I also collaborate on a global initiative — The Lancet Countdown on Climate Change and Health — to produce global indicators focused on climate-related migration and health.

Preparing sea urchins to cook, Taveuni, Fiji.

Rock revetment to slow coastal erosion and flooding, Karoko, Fiji.

Dr Linden Ashcroft

Dr Linden Ashcroft

- Climate history
- Australian weather
- Climate change
- Science communication
- Data quality

linden.ashcroft@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/187319-linden-ashcroft

My work reveals the climate of our past, to help us better prepare for the future. I believe the recovery of historical climate information improves understanding of our planet from a scientific point of view, and also connects people to the need for climate action through storytelling. My goal is to extend Australia's climate history, and bring as many people as I can along for the adventure.

Rescuing our past to prepare for the future

Droughts and floods are a dangerous part of Australia's climate, and they are likely to behave differently under climate change. But our record of weather data is so short that we still don't know a lot about how these kinds of extreme events behaved in the past. Therefore, I hunt for and study historical weather observations from before Australia's Bureau of Meteorology was formed, to extend our climate record. These dusty old records contain vital information about the weather and climate of the past, which improves and informs our predictions of how our climate has changed, and will change in the future.

Science is not finished until it's communicated

When I am not conducting research into Australia's past climate I am a science communication educator. I use the science of science communication to equip our graduates with world class communication skills, so their research can change the world. My work in this space compliments my climate science studies, as historical weather observations provide a unique opportunity to engage the community with climate science, and the need for strong action on climate change.

Flooding in Brisbane in 1890. Significant events like these are covered extensively in historical documents and datasets, but are not yet incorporated into future models of risk or impact because the data about their severity have not been explored. Source: State Library of Queensland

School strikes for climate in 2019. Climate action is needed now, and communicating climate science clearly and accurately has never been more important. Source: School Strike 4 Climate Australia

Professor Jon Barnett

Professor Jon Barnett

- Climate change
- Adaptation
- Vulnerability
- Coasts
- Islands

jbarn@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/8871-jon-barnett

My research aims to push the envelope of thinking about climate change adaptation, exploring all ideas and possibilities for solutions in order to create hope for present and future generations.

I am a political geographer whose research examines the dynamic interactions between social and environmental change, which is a core contribution of geography to the sciences. Humans have always adapted to local conditions, most often through modifications of the environment. Such modifications have amplified over the course of history, accelerating in the past 60 years such that human activity is a powerful influence on the climate and earth system. Humans now have to adapt to global environmental changes that are more rapid and profound than at any time since the advent of civilisation, and it is this critical intellectual and practical challenge that my research addresses.

My research combines critical theories and theories of progressive social change with empirical data collected through fieldwork, which is mostly in the Pacific Islands and in Australia. My research has helped explain the effects of climate change on cultures, food security, inequality, political stability, migration, and water systems. I aim to produce knowledge about ways to adapt to climate change that promote social justice and peace, and to work with decision makers to find ways to institutionalise these practices.

Coastal erosion, Lifuka, Ha'apai Tong.

Ad hoc sea walls, Majuro, Marshall Islands.

Professor Simon Batterbury

Professor Simon Batterbury

- Political ecology
- Resource management
- West Africa
- Pacific
- Human geography

simonpjb@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/28896-simon-batterbury

I use interdisciplinary techniques from political ecology and environmental studies to investigate human-environment interactions and problems, including responses to climate change, conservation, and environmental injustice.

Livelihoods and landscapes

I applied a political ecology approach to drought management and soil conservation in West Africa in the 1990s, exploring links between farming activities, landscape changes and environmental management. I undertook similar work in East Timor. In recent years, I have worked in New Caledonia with Kanak peoples affected by nickel mining and the stalled transition to political independence from France.

Sustainable urban mobility

In parallel, I study the phenomenal spread of community bike workshops around the world over the past 20 years, highlighting the culture of repair, re-use, active travel, conviviality, and solidarity that they embody in cities dominated by the car. I am working hands-on with community bicycle repair workshops, interviewing participants in the UK, Australia, France, Belgium, and the USA.

Mining landscape in New Caledonia.

Working with community bike workshops.

Dr Graeme Beardsmore

Dr Graeme Beardsmore

- Geothermal energy exploration
- Geothermal energy economics
- Crustal heat flow

g.beardsmore@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/192983-graeme-beardsmore

I want to see geothermal energy play a significant role in Australia and the world's future energy systems. Geothermal energy presents a tantalising opportunity to produce clean, sustainable heat and electricity for millennia. Identifying and tackling the barriers to its large-scale adoption is what drives me. Those barriers are not only technical, but financial, societal and political, requiring multidisciplinary solutions.

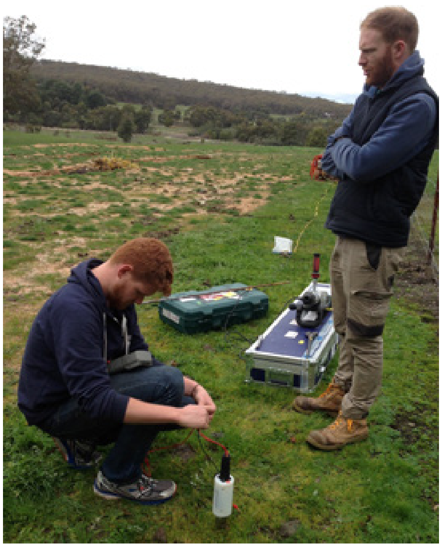
Exploring for geothermal energy resources

I investigate ways to find and characterise geothermal energy resources for direct use and electricity generation. My work includes collaborations at the global scale, to define and standardise methods of finding, quantifying and classifying geothermal resources, and at the local scale, to understand the economics of geothermal energy production and utilisation. It incorporates the development of new geophysical tools to measure crustal heat flow, understanding the role and value of process heat in industrial applications (including power generation), the interplay of competing demands for groundwater, the complexities of energy markets, and the consideration of all those elements in financial models of geothermal energy developments.

Mapping heat in the Earth's crust

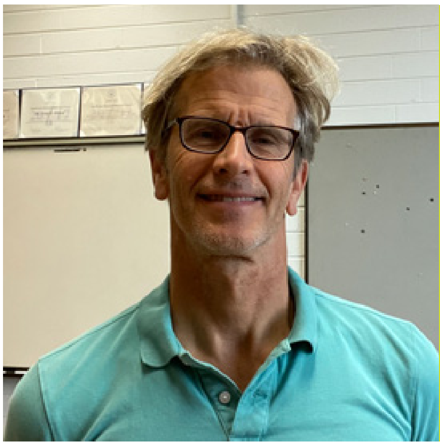
Related but parallel research develops new tools and modelling methods for understanding the distribution of heat in the Earth's crust, and applies those tools to mineral exploration, groundwater investigations, regolith studies, climate history modelling and other fields.

CSIRO colleagues installing a fibre-optic cable in a bore drilled by Geoscience Australia in the Northern Territory in December 2020. The cable will allow measurements of temperature and thermal conductivity to 500m depth to investigate crustal heat, aquifer properties and atmospheric temperature changes.



Earth science and engineering researchers trialling the measurement of soil thermal conductivity with a Heat Needle near Ballarat in 2016. Thermal conductivity is a key parameter for the optimal design of shallow geothermal heating and cooling systems.

Professor Craig Bishop



Professor Craig Bishop

- Atmospheric and oceanic data assimilation
- Ensemble forecasting
- Ensemble climate projection
- Atmospheric and oceanic dynamics
- Statistical forecasting

craig.bishop@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/826552-craig-bishop

Combining physics, applied mathematics, machine learning, statistics, and philosophy, I focus on inventing data assimilation methods that will better initialise weather forecasts, and improve forecasting models.

Data assimilation techniques for bounded variables like clouds and precipitation

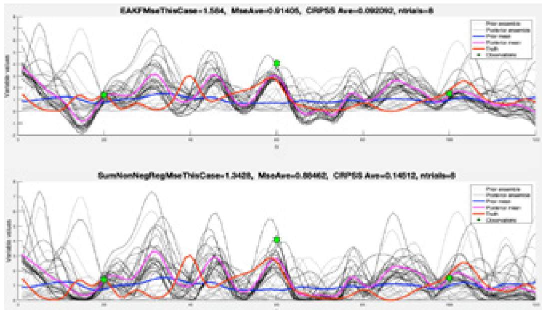
Weather and climate modelling errors are dominated by the misrepresentation of processes associated with clouds, precipitation, and aerosols. To identify and correct such errors, my group is researching and developing new data assimilation schemes that better account for the non-linear, non-Gaussian and multiscale nature of forecasting and observational uncertainty associated with these bounded variables.

Improving climate projections of extremes using a dvanced ensemble post-processing

Current ensembles of climate projection models misrepresent the frequency of extreme events. My group is researching and developing new ensemble post-processing methods that preserves models' key climate change predictions while better representing historical frequencies of extreme events.

Improvement of forecast error covariances

The introduction of hybrid forecast error covariance models led to some of the biggest forecast improvements of the past decade. At first seen as 'ad-hoc', my group's research has established a firm theoretical foundation for these models and is developing new methods to further improve them.



Top panel shows how old data assimilation method leads to a state estimate that includes physically impossible negative values while new GIG method yields realistic and much more accurate results (bottom panel).

Professor David Bissell

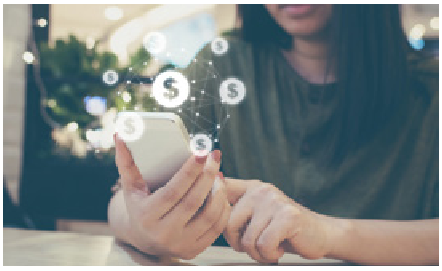
Professor David Bissell

- Mobilities
- Cities
- Labour
- Digital technologies
- Automation

david.bissell@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/792958-david-bissell

We are living in an age defined by rapid technological advances that are changing how and where people work. Our research team explores the uneven social and spatial impacts of these technological developments on workers, families and communities. This knowledge is vital for understanding how people's relationships with places are changing. We use this knowledge to identify socially just interventions through which the future of work can be shaped.



Labour mobilities

More people are on the move than ever before. Our research team explores how different forms of work-related mobility are changing people and places in the process. From the daily commute to work that takes people away from home for weeks at a time, our research develops new ways of understanding how individuals, households and communities are transforming as a result. An important strand of this research is concerned with identifying how different experiences of enablement and constraint affect people's wellbeing. We are especially interested in exploring the experiential dimensions of these mobilities in terms of how the stresses and strains of travel emerge, play out through home and work life, and impact on people's longer-term wellbeing. Through this research, we seek to identify how workers, families and communities can be better supported by employers, communities and governments.

Digital technologies and labour automation

New digital technologies are changing how and where work gets done. Our research team responds to these developments in two ways. One strand of this research is exploring the impacts of digital automation on workers. This research is evaluating how new automated technologies are changing the skills required by workers and how people make sense of their changing relationships with new automated technologies. A second strand of this research is exploring how on-demand digital platforms associated with rideshare and food delivery are having diverse impacts on work, consumption and governance in cities. Through research with gig economy users, workers and stakeholders, this research is expanding understanding of the geographically uneven impacts of on-demand digital technologies on cities. Through this research we seek to identify opportunities for socially just interventions by the state, urban governance, industry and the community.

Dr Jay Black

Dr Jay Black

- Aqueous geochemistry
- Experimental geochemistry
- Hydrogeology

jay.black@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/639143-jay-black

My research seeks to gain a better understanding of physical-chemical processes that govern water-rock interactions allowing us to study problems such as contaminant/metal transport in waters and the impact of elevated CO2 on the environment.

Water-rock interactions

Understanding mineral weathering processes during water-rock interactions in near- and sub-surface aquifers relating to groundwater quality and effects of elevated CO2-water-rock interactions.

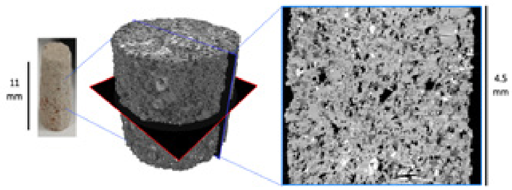
Aqueous geochemistry

Experimental and theoretical studies to determine the formation and stability of aqueous complexes needed to model the transport of metals in the environment and industrial processes.

Micro-CT studies

Using x-ray micro-computed tomography to visualise and quantify processes occurring at the pore scale within geological and other material structures.

Sampling groundwater from a well bore for water quality analysis.



Micro-CT scan of small sandstone core plug (pictured on left), showing a 3D rendering of the micro-CT data (middle) and representative 2D cross-sectional slice through the data (pictured on right) displaying the internal pore and mineral structure within the rock. Advanced analysis allows for the quantification of different material phases including grain size and porosity distributions through the rock.

Dr Samuel Boone

Dr Samuel Boone

- Tectonics
- Thermochronology
- Structural geology
- Geochemistry
- Geochronology

samuel.boone@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/344913-samuel-boone

Earth's geodynamic and tectonic processes have governed the evolution of our planet's surface, its climate and the life which inhabits it. As part of the Melbourne Thermochronology Research Group, my work aims to better understand Earth's dynamic evolution by studying the thermal and tectonic history of the crust in relation to the growth and breakup of continents.

Why do continents break apart?

The breakup of continents along rift systems plays a fundamental role in the theory of plate tectonics, leading to the creation of new oceans and continental margins instrumental in driving the evolution of the Earth's climate and biosphere. Active rift systems also host important economic resources, such as low-carbon geothermal energy systems. Yet despite the important role of continental breakup in how our planet has evolved and operates, the mechanisms controlling the initiation and localisation of rifting remain enigmatic. Our group aims to quantify the natural processes controlling the inception and early evolution of continental rifts by integrating geochemical and field observations of active rift systems, namely in East Africa, and 3D numerical geodynamic modelling.

The growth of supercontinents

The distribution of continents, mountain ranges and oceans associated with the growth of supercontinents is thought to be instrumental in driving the most dynamic periods of evolution for the interior of Earth, the climate, and life. Nevertheless, details of the development of supercontinents often remain poorly constrained. Using a range of geochemistry techniques in combination with structural geology and field observation, our group aims to restore the amalgamation history and configuration of ancient supercontinents to better understand the most dynamic periods of Earth's history.

Developing tools to constrain the thermal evolution of Earth's crust

Our group specialises in the development and application of temperature-sensitive radiometric dating techniques that can be used to constrain the thermal evolution of the crust in relation to mountain building events, continental breakup and landscape evolution. To develop these so-called low-temperature thermochronology methods, our group integrates microscopy, chemistry, spectrometry, software engineering and machine learning in laboratory and field work.

Supercontinent assembly occurs via episodic periods of tectonic plate collision, resulting in the growth of the largest mountain belts on Earth. But long after these peaks have eroded away, the signature of ancient collisional events can still be detected by the structural, magmatic and chemical fingerprints they leave behind. Mt Everest and the Nepalese Himalaya (pictured from the summit of Gokyo Ri) record the collision of India with Asia over the last 55 million years. Image credit: S.C. Boone.

Continental margins record the signature of ancient periods of rifting, lithospheric plate rupture, ocean basin formation, the growth of topography and mass sediment transportation. The southeast margin of Madagascar (pictured) records the breakup of central Gondwana, when Africa, Madagascar, Antarctica, India and Australia began gradually dispersing approximately 180 million years ago, forming the Indian Ocean in their wake.
Image credit: S.C. Boone.

Dr Josephine Brown

Dr Josephine Brown

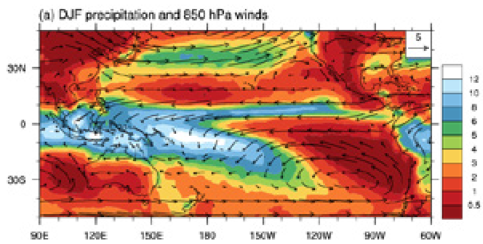
- Palaeoclimate
- Climate variability
- Climate change
- Climate modelling

josephine.brown@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/6381-josephine-brown

My research seeks to understand the dynamics of the climate system and how this system responds to past and future change. In particular, I focus on tropical climate including monsoons, El Nino-Southern Oscillation and tropical rainfall. I also aim to evaluate whether climate models are able to realistically simulate the key components of the climate system and their sensitivity. With improved understanding of the climate system and evaluation of its representation in climate models, we can produce more robust projections of future climate change, and constrain uncertainty in these future projections.

Climate change billboard in Niue: Pacific Islands are highly vulnerable to climate change.



Tropical rainfall zones and winds: climate models can be used to project future changes.

Modelling past climates

I use climate models to investigate past climates including the Last Glacial Maximum (21,000 years ago) and the Holocene (the past 11,000 years). Climate models can be used to better understand past climates and provide comparison with reconstructions from proxy records such as corals and speleothems (cave deposits). Simulating past climates can also provide information about the climate system and how it may vary in future. For example, how does rainfall change in the subtropics in past warm climates, and is this similar to expected future trends?

Understanding tropical climate variability and change

Our region experiences a highly variable climate on yearly and decadal time scales, as well as being vulnerable to human-induced warming. Using observations and climate model simulations, my research aims to explore drivers of climate variability in Australia and the Pacific to better understand how and why change is occurring. For example, I seek to understand causes of recent trends towards wetter conditions in northern Australia and whether these may continue in future decades.

Improved climate projections for Australia and the Pacific

My research contributes to improved understanding of historical and future variability of climate in the Australian and Pacific regions. Using climate models, we can explore variability of the Australian summer monsoon and examine changes in the major rainfall systems influencing the tropical South Pacific such as the South Pacific Convergence Zone. I also contribute to the evaluation of climate models and work with researchers at the Bureau of Meteorology and CSIRO to develop more robust future climate projections.

Associate Professor Brian Cook

Associate Professor Brian Cook

- Risk
- Flooding
- Agrarian change
- Sustainable development
- Participation

brian.cook@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/472833-brian-cook

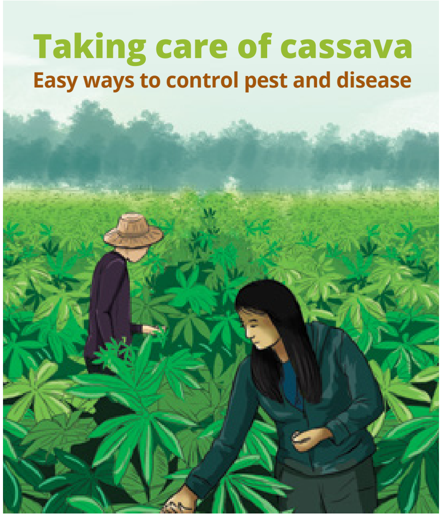
I conduct applied research in order to contribute to lasting risk reduction in service of affected communities.

I am a human geographer who analyses risk management controversies using participatory methods focusing on expert-public relations. My contributions to academic inquiry explore how risk management controversies persist despite repeated failure, critique, and efforts to improve. Through participation and expert-public relationship building, my work opens pathways for conflict resolution and risk reduction.

My research program is divided into three overlapping themes:

- Disaster risk reduction
- Expert-public relations, and
- Water governance and agrarian change.

My work produces insights into the expert-public interactions needed to respond to risk management controversies, often focusing on conflicts over water management or agrarian change. Projects begin by engaging with experts and risk managers, who often ask, 'Why won't people do what is good for them?'. Through bridging stakeholders to generate participatory findings and identify and develop collaborative pathways forward, my research program applies empiricism to behaviour change, rare in participatory research, producing direct impacts on communities and organisations as they struggle to respond to the proliferation of risk.



Cassava pamphlet co-created with Cambodian farmers.

Cassava harvest in northwest Cambodia.

Demonstration farm in northwest Cambodia.

Dr Ling Chung

Dr Ling Chung

- Thermochronology
- Geochronology
- Tectonics

ling.chung@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/460173-ling-chung

I apply thermochronological techniques to study the evolution of ancient continents and landscapes, and advance dating approaches to improve the efficiency and quality of analysis.

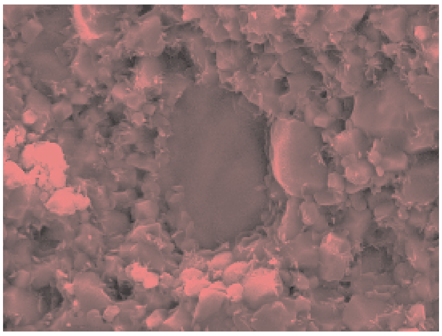
Thermochronology and rifted margin

I investigate processes of plate tectonics at continental margins to better understand the origin and dynamics of Earth's crust and continents. I focus on applying low-temperature thermochronological approaches to various geological settings to understand landscape evolution and development.

Advancing techniques used for constraining thermal history

I focus on deciphering fundamental factors influencing the reproducibility of fission-track dating and the development of matrix-matched standards for laser ablation applications. My research group has also developed a more efficient way to deliver the traditionally labour-intensive, laboratory-based, fission track training routine to analysts, using an image-based protocol.

View from the top of the Jacob's Ladder (hair-pinned road passing dramatic dolerite cliffs), Ben Lomond Range, Tasmania. Tasmanian dolerites represent an important geological marker documenting the East Gondwana break-up history of the southeast Australian margin.



Scanning electron microscope (SEM) image of sintered pulverised Mud Tank apatite. This material has a homogeneous U content and consistent ablation characteristics and, thus, is a potential matrix-matched standard for laser ablation applications for apatite-related studies.

Dr Matt Cupper

Dr Matt Cupper

- Geochronology
- Geomorphology
- Archaeological science
- Quaternary environments
- Palaeoecology

cupper@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/20521-matthew-cupper

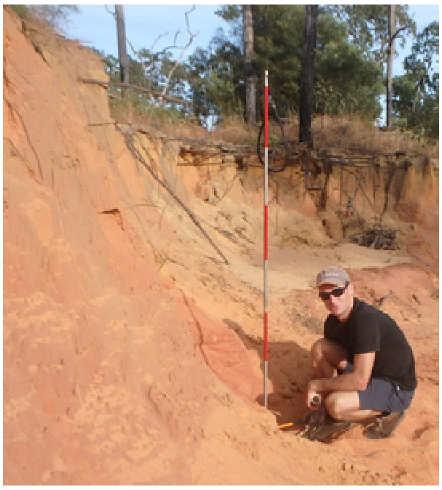
Climatic and environmental changes have been important drivers of human evolution over millions of years. In the geologically recent past, the last glacial cycle (~125,000-11,000 years ago) dispersal of Homo sapiens across the globe has been influenced by climate and ecosystems and their resources. Knowledge of how environmental change affects human societies can contribute to understanding population subsistence, health, resilience, persistence and migration, cultural change and social interaction.

Early human occupation of coastal environments

People have always had important ecological, cultural and economic links to coastlines. Forty percent of modern populations (and 80% of Australians) live near oceans. In Australia, coastal environments were the first ecosystems occupied by humans and continued to be significant habitats over time. Our research examines the cultural remains of past societies at archaeological sites in the context of the landscapes and geology of coasts. We study Late Pleistocene and Holocene coastal sand plain and shoreline sequence, including those of the Mediterranean, the Arafura Sea of northern Australia, and the Pacific Rim in south-eastern Australia, New Zealand, and Central and South America.

Extinction of Australia's giant marsupials

A fauna of giant animals including marsupials, birds and reptiles became extinct in Australia around the time of the last ice age some 20,000 years ago. Our current collaborative research projects include investigating the geomorphic contexts and ages of extinct megamarsupial fossil localities across southern Australia.



Dating dunes in upper case East Arnhem Land.

Collecting sediment samples in the Wessel Islands of the Arafura Sea.

Dr Hayden Dalton

Dr Hayden Dalton

- Geochemistry
- Geochronology
- Igneous petrology

hayden.dalton@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/820186-hayden-dalton

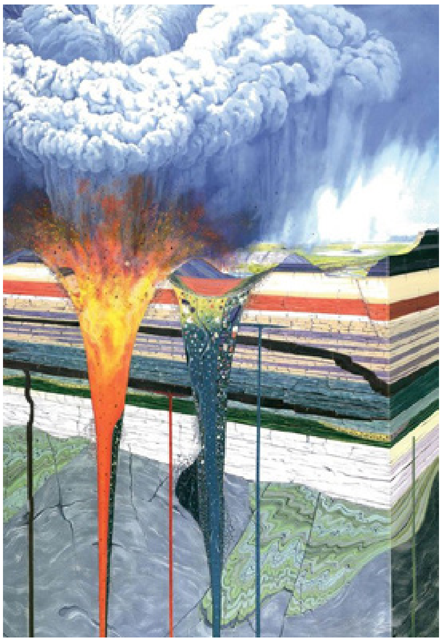
I study the geochemical evolution of the Earth's mantle through isotopic analysis of kimberlites, the deepest derived magmas. I also employ a range of geochronological methods to constrain the timing of volcanic eruptions, providing vital insights into mantle processes.

Diamond-bearing volcanos: where, when and why?

Kimberlites are rare, small-volume, ultramafic, igneous rocks found on every continent on Earth, with eruption ages spanning almost 3 billion years. Deriving from the deepest magmas that reach the surface, these diamond-bearing rocks provide unique insights into the Earth's mantle. I combine petrographic, geochemical, and geochronological techniques to date kimberlites and determine the composition of their source region.

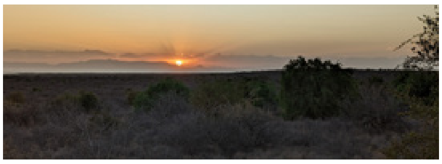
Determining human evolution timelines by analysing volcanic ash

Lake Turkana, Kenya, and the surrounding basin have produced significant hominin fossils. My research group is developing a high-precision geochemical and geochronological framework to distinguish between distinct eruption pulses in the region and therefore provide more accurate time constraints for the evolution of our species.



Artist's impression of a deeply derived kimberlite eruption. The pipe to the right highlights the diversity of the cargo that a kimberlite can transport to the Earth's surface.

The team sampling one of the famous volcanic ash (tuff) layers on the eastern side of Lake Turkana, Kenya.



Sunset over Lake Turkana, as seen from the Turkana Basin Institute at Ileret.

Professor Wolfram Dressler

Professor Wolfram Dressler

- Forest governance
- Conservation
- Rural livelihoods
- Southeast Asia

wolfram.dressler@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/669773-wolfram-dressler

My research examines how regional political economic processes shape resource access and use, exchange relations and environmental change at different societal scales in Southeast Asia.

I examine the historical origins and contemporary consequences of changes in environmental governance and conservation practices on the livelihoods and landscapes of rural, resource-reliant peoples in southeast Asia.

Research involving Dayak Ga'ai riverine livelihoods in East Kalimantan

Fire ethnoecologies on Palawan Island, the Philippines.

Conservation and development in Southeast Asia.

Professor Russell Drysdale

Professor Russell Drysdale

- Palaeoclimatology
- Isotope geochemistry
- Geochronology
- Karst geomorphology and hydrology

rnd@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/169478-russell-drysdale

Palaeoclimatology is a rapidly evolving, interdisciplinary field. We work with people from so many different fields. Slowly but surely the jigsaw of past climate is coming together. New analytical breakthroughs help us glean more information from natural archives. My research is driven by both a fascination with Earth's natural history and geography, and a strong belief that understanding past climates gives us insights on future climate.

Understanding changes in Earth's past climate to improve future predictions

When I first learnt about Earth's recent climate history, it completely blew me away – the fact that ice sheets up to 3 km thick covered parts of North America 20,000 years ago, and that due to lower sea levels at the time you could walk from Tasmania to New Guinea.

Information on Earth's climate history provides a context for better understanding current greenhouse warming. It can also give insights on how future climate may evolve. My group's research uses information preserved in 'natural archives' to investigate the nature, timing and causes of past climate change, particularly over the Quaternary Period – the last 2.6 million years. This involves generating time series of palaeoclimate change from cave mineral deposits called speleothems. We combine these with ice-core and ocean-sediment data, as well as climate-model simulations, to better understand global, hemispheric and regional palaeoclimate changes.

We have worked on cave systems from across Europe, the tropical western Pacific and Australasia. We have a strong interest in when and why ice ages come and go (Milankovitch Theory), as well as why abrupt climate changes proliferate during glacial climates and how those changes propagate globally. Our recent work explores the hydrological response of arid central Australia to these abrupt changes. We're also investigating what happened to ice sheets and regional climate during the last major warm interval – a period known as the Last Interglacial (between 130,000 and 116,000 years ago).

Professor Jane Dyson

Professor Jane Dyson

- Youth
- Inequality
- India
- Politics
- Gender

jane.dyson@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/755274-jane-dyson

My research is driven by a commitment to understanding the often hidden ways in which inequalities are experienced, particularly in the lives of young people. Whether in the context of work, education, food or health, both in India and Australia, I seek to examine the active ways in which youth are shaping their own lives in order to inform policies that put young people's needs at the centre. I seek to do this through academic work, through working with policy makers and through engaging international public audiences.

I am a social geographer whose work has focused on young people as a lens through which to understand everyday action and inequalities in India and Australia.

My long-term ethnographic research in the Indian Himalayas has provided a picture of the shifting lives of young people in the context of dramatic regional development and change. In some instances, I have worked with the same individuals since 2003, following them from their teens into their 20s and 30s. This place-based, longitudinal perspective has enabled me to make theoretical and empirical contributions to young people's lives from three key perspectives. First, I have demonstrated how these transformations have shaped young people's educational aspirations and shifted employment and migration strategies with implications for the agrarian economy. Second, I set out to examine young people's political role in regional change. I have shown how young people were not the passive 'subjects' of development processes but were actively and creatively shaping their experience of modernity. Finally, I have examined shifting cultural practices in the region and the role of gender and social networks in these practices. This ARC-funded research has been presented in books, articles and two award-winning ethnographic films and has contributed to debates across human geography, anthropology, development studies and Asian Studies.

I have more recently extended this work on youth action to examine food insecurity among students at Australian higher educational institutions. We have highlighted youth agency in managing access to food and explored citizenship-based inequalities in the context of COVID-19 driven financial hardship. This interdisciplinary research is co-produced with students who have experienced food insecurity and has expanded from the University of Melbourne campus to other institutions in Victoria.

View over my research site in Uttarakhand, in the north India Himalayas.

Dr Damien Finch

Dr Damien Finch

- Geochronology
- Australian rock art
- Archaeological science
- Radiocarbon dating

damien.finch@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/881033-damien-finch

The most common question when visitors first see some of the spectacular Aboriginal rock art in northern Australia is 'How old is it?'. Until recently, there has been very little robust scientific evidence on which to base any answer to that question. My work aims to provide answers that allow this very rich body of ancient art to be placed in chronological context, alongside other evidence of past environments and human cultural development.

Dating ancient rock art

Throughout the world, most of the oldest rock art still visible today cannot be directly dated. The ochre-based pigments contain nothing that can be dated with any of the existing geochronological techniques. My research applies radiocarbon dating to estimate the age of rock art. It does this by dating mud wasp nests and mineral accretions that are found either under or over rock art. This method has been used to determine that a painting of a kangaroo in the Kimberley region of Western Australia, is around 17,300 years old, making it the oldest painted figure dated in Australia so far.

Remnant fossilised mud wasp nests overlying a hand stencil from the Kimberley region in Western Australia.

Preparing to sample a mud wasp nest with Traditional Owner Lucas Karadada.

Kimberley Rock Art Dating Research team collecting samples of mud wasp nests. (Damien Finch, Helen Green, Ian Waina).

Professor Michael-Shawn Fletcher

Professor Michael-Shawn Fletcher

- Biogeography
- Palaeoecology
- Pyrogeography
- Fire ecology
- Indigenous Knowledge

michael.fletcher@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/6089-michael-shawn-fletcher

I am interested in the long-term interactions between humans, climate, disturbance, vegetation and landscapes in the southern hemisphere. I have a particular focus on how Indigenous burning has shaped the Australian landscape and how Indigenous knowledge needs to be meaningfully incorporated into landscape management to tackle many of the environmental challenges we face today.

My work spans human impacts of landscapes, ecosystem dynamics, the causes and consequences of changing fire regimes and landscape evolution. My main unit of observation is time, based on the fact that the modern world is the product of the past and without an adequate understanding of the past, we cannot understand and manage the future.

My current research is focused on 3 key areas:

1. Understanding why catastrophic bushfires are becoming more common
2. Understanding the impact of human arrival on landscapes
3. Understanding how changing fire regimes impact biota and ecosystems.

Cultural burning with traditional owners in Arnhem Land.

Sediment coring in on the Central Plateau of Tasmania.

Associate Professor Stephen Gallagher

Associate Professor Stephen Gallagher

- Palaeoclimate
- Climate change
- Paleoceanography
- Foraminifera microfossils

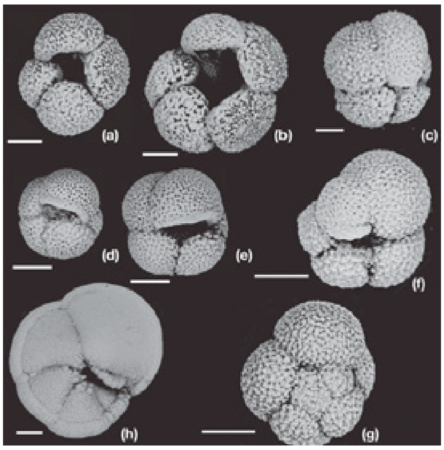
sjgall@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/105-stephen-gallagher

I analyse microfossils and sediments from marine strata to understand the ancient oceanography and environment, and track changes in global climate and sea levels over the past 100 million years.

I study carboniferous to recent microfossils and sedimentary strata to determine ancient bathymetry, oceanography and climates. My research has helped to interpret Cretaceous to Cenozoic shelf evolution in Australia.

I am interested in the 80-million-year climate and oceanography record of Australia's margin as an analogue for future climate change. My recent work has focused on climate variability in a greenhouse world and the descent into the Cenozoic Icehouse world.



Japan Sea planktonic foraminifera.

Two of the famous Twelve Apostles near Port Campbell. The microfossil ages are calibrated to the GTS2020 timescale. Height of cliff 45 m.

Myself and Fulthorpe (Co-Chief Scientist, University of Texas at Austin, USA) stop for a quick photo in front of the RV Joides Resolution prior to the beginning of Expedition 356. **Image credit: Bill Crawford, IODP JRSO.**

Professor Andrew Gleadow

Professor Andrew Gleadow

- Thermochronology
- Geochronology
- Tectonics
- Landscape evolution
- Archaeological science

gleadow@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/16040-andy-gleadow

I use hidden records in geological materials to understand how the continental crust of the Earth came to be as it is today. Within the Melbourne Thermochronology Group, we use temperature-dating methods to study key processes in plate tectonics such as continental breakup, mountain building, and long-term patterns of erosion. The group has been a world leader in this field for many years.

Thermochronology of the continental crust

The continents are much more complex than the oceanic crust and contain the accumulated history of Earth's dynamic evolution and the formation of its land surface over millions to billions of years. I have long-standing interests in understanding the evolution of the great East African Rift System, the development of Rifted Continental Margins, the formation of mountain belts and the long-term evolution of the more stable ancient cratons. Our studies have ranged widely across the continents of the word including Antarctica, the Americas, Africa and Asia.

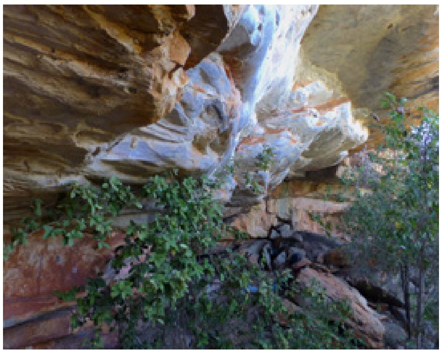
Advancing geological dating techniques

Our research group has long been at the forefront of new developments in the field of thermochronology, especially in the field of fission track analysis, and in other methods. Our Fission Track Laboratory is the most comprehensively equipped and our Automated Fission Track Imaging and Analysis (AFTIA) systems are the most advanced in the world. A key focus for our research is to continue developing the capabilities of these techniques and work with other collaborators nationally and internationally to build robust data systems for handling the large data sets than can now be produced.

My work also encompasses dating hominin evolution in the Great Rift Valley of northern Kenya over millions of years and dating Aboriginal rock art in northern Australia over tens of thousands. Over the last decade I have been Project Leader for the major multi-disciplinary Kimberley Rock Art Dating Project involving research collaborators from around Australia and elsewhere. This project is developing a time scale for the remarkable sequence of rock art in NW Australia based on hundreds of dates from multiple dating methods.

Bahia de los Angeles from the major Sierra la Libertad fault scarp on the Ballenas Transform Rifted Continental margin in Baja California, Mexico.

Plio-Pleistocene fossil-bearing sediments in the Turkana Basin, a key part of the East African Rift System in northern Kenya.



A typical rock shelter developed in the Paleoproterozoic Warton Sandstone in the north Kimberley region of tropical Western Australia. Such rock shelters host an abundance of Aboriginal rock paintings and engravings which are being dated under the Kimberley Rock Art Dating Project in collaboration with local traditional custodians.

Dr Eleanor Green

Dr Eleanor Green

- Thermodynamics
- Thermobarometry
- Igneous petrology
- Metamorphic petrology

eleanor.green@unimelb.edu.au

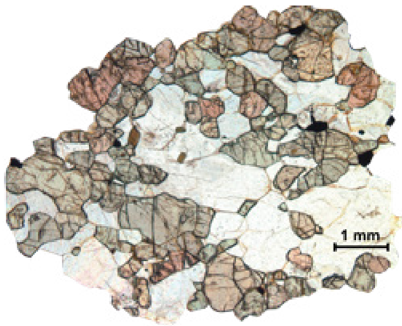
findanexpert.unimelb.edu.au/profile/186255-eleanor-green

I am endlessly delighted by the secret life of rocks – their diversity and beauty under the microscope, and the stories they can tell us about the inside of our planet. I work to decipher these stories via equilibrium thermodynamic modelling. Throughout my career I have sought to develop this approach, applying it to a wider range of contexts, with a deeper understanding of the uncertainties and nuances involved.

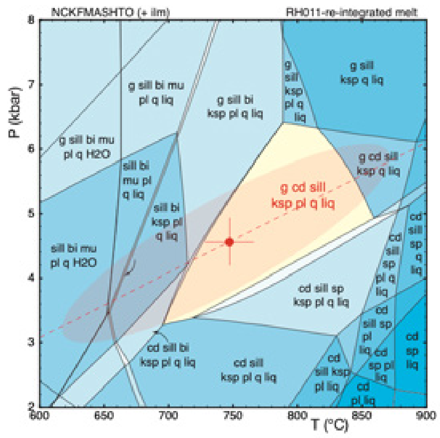
Igneous and metamorphic rocks record processes that take place inside our evolving Earth. I develop and apply modelling methods, based on mineral equilibrium thermodynamics, that help us read this rock record. My group is at the heart of an international project that builds the concepts, computational tools, thermodynamic data and software needed to do this.

The approach assumes that the minerals inside many metamorphic and igneous rocks reflect a thermodynamic equilibrium, on a lengthscale of micrometres to centimetres, that was locked in during the rock's evolution inside the Earth. The drive that the rock experienced towards equilibrium controls the types and chemistries of minerals in the rock, as a function of the pressure and temperature of locking-in, and the chemistry of the rock as a whole. It creates the systematic patterns of minerals that we see in rocks with similar chemistry from across the globe, reflecting the systematic tectonic and magmatic processes that create and modify the rock record.

I develop thermodynamic descriptions (equations of state) and other computational tools that relate a rock's mineral assemblage to the pressure and temperature of locking-in. Using the tools I provide, metamorphic and igneous petrologists can interrogate rocks collected in the field, and make key deductions about their tectonic or magmatic histories. All such interrogations begin with careful examination of the rock under a petrographic microscope, as shown in the photomicrograph of a two-pyroxene granulite. The output is some form of thermobarometry – a mapping between the observed mineral assemblage and the pressure and temperature conditions under which it ceased to evolve, accompanied by an uncertainty estimate.



Photomicrograph in plane-polarised light of a two-pyroxene granulite from Broken Hill, Australia – an excellent candidate for thermobarometry.



Two ways to do thermobarometry:
(1) Map out all the groups of minerals that you would expect your rock to contain under different conditions, and match the rock to the region on the map.
(2) Directly invert the mineral compositions to estimate pressure and temperature, here represented as an uncertainty ellipse. I develop and calibrate the thermodynamic relationships and software that allow igneous and metamorphic petrologists to make calculations like these.

Dr Helen Green

Dr Helen Green

- Archaeological science
- Isotope geochemistry
- Geochronology
- Rock art
- Archaeometry

helen.green@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/405880-helen-green

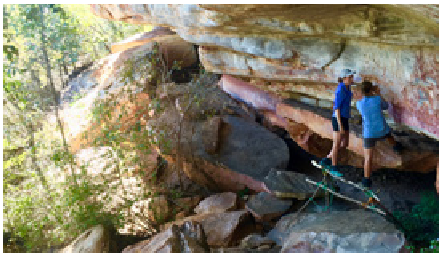
Communicating the age of Indigenous rock art to national and global audiences helps to prioritise its preservation in the face of increasing human and environmental threats. I use a range of geochemical techniques to characterise layered mineral accretions and assess their use in reliable dating of Australian cultural sites.

Dating calcite-free minerals associated with rock art

Ochre, which is used in Indigenous rock paintings, contains no dateable material. Working with local communities, traditional custodians and the Balanggarra Aboriginal Corporation, I use geochemical techniques to characterise materials found under or overlying Indigenous rock art in Australia's Kimberley region, producing bracketing ages for each of the region's distinct art styles.

Elsewhere, this approach has been used to date ancient rock art by analysing associated calcite minerals, but these are rarely found with art in the Kimberley so I am exploring the potential for applying radiocarbon and uranium-series dating techniques to calcite-free minerals.

Sampling mineral accretions to understand surface processes in Australia's Kimberley region (Cecilia Myers, Helen Green, Balanggarra Aboriginal Corporation).



Working in rock art shelters in NW Australia's Kimberley region (Helen Green, Cecilia Myers, Balanggarra Aboriginal Corporation).

Surveying potential sampling sites in a Kimberley rock art shelter (Traditional Owner Scotty Unghango, Helen Green, Damien Finch).

Professor Ralf Haese

Professor Ralf Haese

- Geological carbon storage
- Fluid-rock reactions
- Reactive-transport modelling

ralf.haese@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/578838-ralf-haese

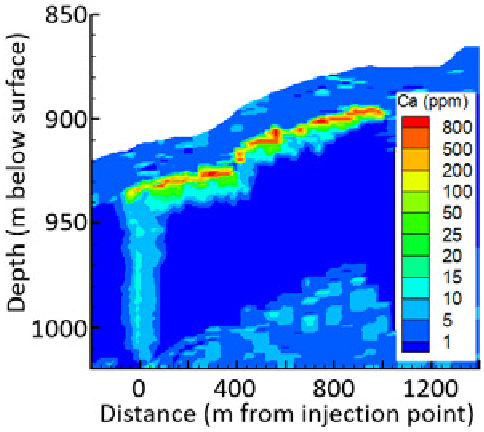
As a researcher and lecturer, I am committed to making this a better world by advancing the science and developing technologies to mitigate climate change. I am keen to train, educate and lead by example so that future generations will have at least the same opportunities I have had.

Development of workflows and technologies for safe and efficient geological carbon storage

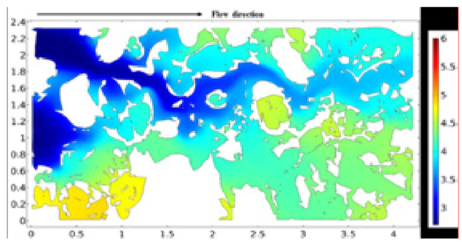
Geological carbon storage allows us to permanently dispose of large amounts of CO2 from any industrial source and is therefore considered an important CO2 emission reduction technology. While industrial-scale geological carbon storage has been operational for over 20 years, several aspects can still be improved. My recent research has addressed the following questions: how can salt precipitation and the associated loss of CO2 injection capacity be avoided in hypersaline deep aquifers? How important is cm-scale lithological heterogeneity for the CO2 trapping capacity, and how can we account for such heterogeneity in our geological and numeric models? And finally, what technologies can be developed to increase the pore space utilisation and associated CO2 storage efficiency?

Reactive-transport modelling at pore scale

Porous rocks are inherently heterogenous in terms of the mineral distribution, local fluid flow velocities and fluid-mineral reaction rates, even at sub-mm scale. Recent advancement in technologies allow us to image porous rocks with a micro-meter resolution, characterise the geometry of connected and unconnected pores, and predict local mineral dissolution and precipitation altering the pore network and its control on fluid flow. We integrate all of these technologies in our research, with the aim to fully account for small-scale heterogeneity when predicting fluid flow and geochemical reactions. Another area of research is concerned with the upscaling of processes observed and predicted at pore scale.



Predicted changes in water composition (calcium concentration) in a CO_2 storage reservoir.



Simulated pH distribution in limestone at pore scale when acid is injected (on the left side). Note the domain size of 2.4 x 4.0 mm.

Dr Ashleigh Hood

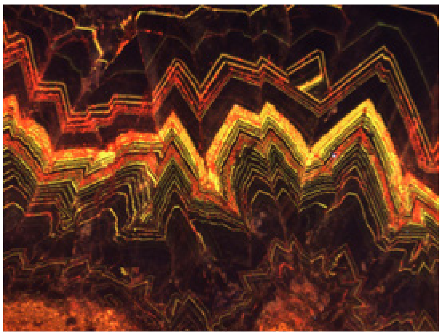
Dr Ashleigh Hood

- Sedimentology
- Stratigraphy
- Geochemistry

ashleigh.hood@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/179414-ashleigh-hood

Our research addresses some of the most fundamental questions in science — how did life evolve on Earth, and how has life survived environmental and climate changes through our planet's history? A strong understanding of the history of environmental change on Earth is critical for addressing current and future changes to our environment and their impacts on ecosystems.



Co-evolution of life and environment

The origin and evolution of life on Earth is intimately tied to environmental conditions at Earth's surface. Our research group studies the co-evolution of life and surface conditions over the last several billion years of our planet's history. We are interested in the impact of large changes in the Earth system, including climate change and the oxygenation of the atmosphere-ocean system in driving the radiation and extinction of life. We focus on marine sediments, including reef systems preserved in the geological record as windows into ancient ecosystems and seawater conditions. Our research emphasizes how unusual ancient oceans and reefs were compared to today's and highlights the complexity of Earth's environmental evolution.

Astrobiology

Earth's early ocean-atmosphere conditions may inform us of the limits of habitability on our planet, but they can also be used to understand surface conditions and evidence of life elsewhere. Our group has been working on methods to refine the use of paleo-redox and paleo-environmental proxies in order to develop a broader understanding of these tools in deciphering the origin and evolution of life. Based on some of this work, it is possible that our own planet's 'biosignature' may have only been remotely detectable quite late in its history.

Dr Yi Huang

Dr Yi Huang

- Cloud dynamics and physics
- Precipitation and hydrometeorological processes
- Atmospheric remote sensing
- Mesoscale meteorology
- Boundary layer meteorology

yi.huang4@unimelb.edu.au

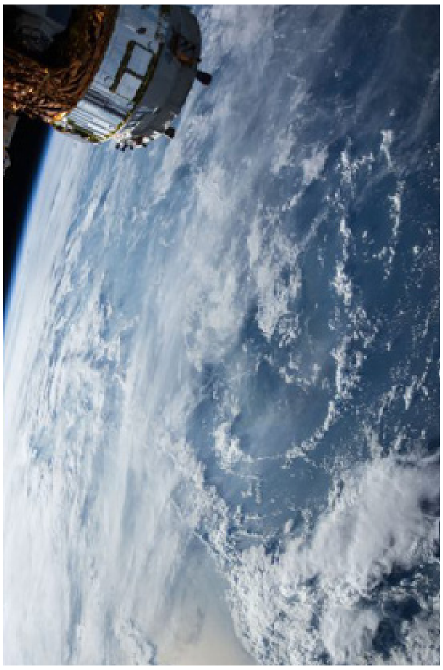
findanexpert.unimelb.edu.au/profile/844217-yi-huang

My research seeks to address some of the fundamental yet climatically important questions that underpin the understanding of atmospheric processes, Earth's energy budget and water cycle. I believe this can only be achieved by innovative use of targeted field observations, state-of-the-art remote-sensing data and numerical modelling. Ultimately, my work aims to harness the critical knowledge that will help improve weather and climate predictions at multiple scales.

Our research addresses some of the fundamental questions in atmospheric science. How do clouds and precipitation modulate Earth's climate system? What processes control the properties of clouds and precipitation? How do these processes differ geographically? How may these processes change in a warming climate?

Cloud dynamics and physics

Clouds are a key component of Earth's water cycle and exert a strong influence on radiative balance. Yet clouds remain one of the biggest sources of uncertainty in understanding how the climate will change due to global warming. Our research uses in-situ observations, remote-sensing observations, and numerical modelling in unison to investigate the dynamical and physical processes that determine the characteristics of clouds and precipitation in shallow and deep convection, from the tropics to polar regions.



A satellite view of a vast cloud field consisting of various types of clouds and associated dynamical features.

Precipitation and hydrometeorological processes

Water is a most precious commodity across Australia. Precipitation over the alpine regions is a primary input into the hydrological models which underpin the hydro-energy production and water management. Our research seeks to identify the key dynamical and microphysical mechanisms that enhance and redistribute precipitation across the Australian alpine regions, using targeted field observations, numerical simulations and satellite observations. Our aim is to improve precipitation estimates and forecasts that will benefit renewable energy production and water management.

A wintertime snow storm over an alpine area.

Cloud-climate interactions over the Great Barrier Reef

Climate change poses a serious threat to coral reef ecosystems. Our research aims to understand how clouds, in combination with other factors, interact with the regional climate systems over the Great Barrier Reef through their impact on regional radiative budget, ocean temperatures and coral bleaching events. This is achieved using a range of field observations, satellite, and reanalysis data. Our work also aids in developing warning systems for future bleaching events, and for regional land and water management.

Associate Professor Rachel Hughes

Associate Professor Rachel Hughes

- Reparation
- Justice
- Activism
- Tribunals
- Diasporas

hughesr@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/3808-rachel-hughes

I am a cultural geographer working in the interdisciplinary field of legal geography. Through my research, I seek to understand the ways in which communities who are affected by conflict seek justice for the harms they have experienced.

My work explores examples of informal justice-seeking by individuals and communities – such as through activism and creative response – in the past and present. I also work on the social dimensions of formal processes of justice-seeking like internationalised tribunals and truth-telling processes, as well as reparation measures. Given that these processes work in and through specific places and types of spaces, such as court rooms, public hearings, museums and memorials, my work is highly geographical.

I am internationally recognised for my analyses of sites of public remembrance in the wake of Khmer Rouge rule of Cambodia (1975-1979). I have more recently published on contemporary justice-seeking for Khmer Rouge crimes. My ARC DECRA fellowship examined the legacies of the United Nations-supported tribunal – the Extraordinary Chambers in the Courts of Cambodia (ECCC) – including its reparation projects and victim participation scheme.

I have also co-researched museum exhibitions on other traumatic histories, and on community experiences of these exhibitions, in Italy and Australia.

Entrance to the Fortieth Anniversary exhibition at Cambodia's national Tuol Sleng Genocide Museum.

Reparation theatre project in Kompong Chhnang, Cambodia.

View from the public gallery of the courtroom of the Extraordinary Chambers in the Courts of Cambodia.

Professor David Kennedy

Professor David Kennedy

- Coastal geomorphology
- Hazards
- Sea level change
- Environment
- Climate change

davidmk@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/349411-david-m.-kennedy

Understanding how environmental and climate variability combined with human activities drive change on the physical environment is my passion. Communication this understanding through training the next generation of practitioners, academic publishing, public speaking and media interviews is how I translate this passion into action.

I am a coastal geomorphologist who seeks to understand how climatic and environmental change affects the dynamics of the coast through utilisation of the latest technical advances from drones to ground-penetrating radar and wave sensors. I conduct research on coastal landforms across the world from New Zealand to Fiji & Niue, UK and the Americas, investigating the impacts of sea level rise, storms and tsunami on beaches, dunes, rocky cliffs, estuaries and coral reefs. A passion for communication of this research has seen the findings presented in the academic literature, invited community forums, government panels and the domestic and international media. I have also successfully conducted a range of professional consultancies, including clients such as: Victorian Coastal and Marine Council, Parks Victoria, Alluvium P/L, West Gippsland Catchment Management Authority, Department of Conservation (New Zealand), The Pacific Community (Fiji) and AusAID.

Preparing for an aerial survey of rocky coasts along the Great Ocean Rd.

A Phantom 4 RTK drone used for citizen-science surveying as part of the Eureka Award winning Victorian Coastal Monitoring Program.

Drone-based aerial laser (LiDAR) surveying of beach change in Victoria to enhance coastal resilience to climate change.

Dr Andrew King

Dr Andrew King

- Climate extremes
- Climate change and variability
- Climate projections
- Seasonal prediction
- Meteorology

andrew.king@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/690702-andrew-king

It is imperative that we understand how and why climate extremes will change as the world continues to warm. These extreme events can have major impacts, and it is vital that we are well prepared for these events so that we may mitigate their effects as much as possible.

Changing weather and climate extremes in a warming world

I am interested in how the characteristics of extreme weather and climate events change as the planet warms. While we know how some types of weather and climate extremes are evolving, we have limitations in our theoretical understanding and ability to simulate the processes that result in the extreme occurring. We also have an incomplete understanding of how extremes and associated processes change as a function of amount and speed of global warming. I am using climate models to try and understand this better.

Subseasonal-to-seasonal prediction of rainfall extremes

Subseasonal-to-seasonal (S2S) climate prediction, the prediction of climate conditions beyond the timescale of weather forecasts, has grown in popularity in recent years as forecasting skill has increased. Typically, S2S forecasts have involved making predictions for wetter or drier than average conditions. I have led work suggesting that for S2S, outlooks may be extended to extreme rainfall indices so that we can prepare for the increased likelihood or intensity of such events. However, there are still many unanswered questions in this area which I am seeking to address, such as: how do climate change and variability affect the performance of seasonal outlooks?

Heavy rain.

Drought.

Professor Todd Lane

Professor Todd Lane

- Atmospheric science
- Meteorology
- Atmospheric dynamics
- Severe weather
- Climate extrem

tplane@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/122660-todd-lane

How do severe weather events form? How will they change in the future? And how do we improve weather and climate predictions? Extreme weather events cost the Australian economy billions of dollars every year. Our research aims to better understand the processes causing these events and how they might change with climate change. We work with state-of-the-art weather and climate models on some of the world's most powerful computers to study a range of phenomena, including storms, fire weather and extreme rain. The ultimate goal of this work is to help improve the prediction of high-impact weather events and help understand the changing risk of climate extremes.

Severe weather in a changing climate

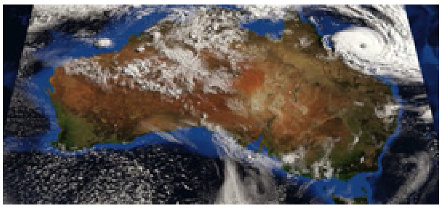
Much of our experience of climate change will be felt as a change in the severe weather events that affect society. Yet there are still many unanswered questions about some of our most impactful events like thunderstorms and extreme fire weather. For example: how do thunderstorms form? What controls the strength of storms? How will changes in the temperature, moisture and atmospheric circulation associated with climate change affect storm occurrence and intensity? Answering these questions will help untangle the complexity of our changing severe weather events.

High-resolution weather and climate modelling

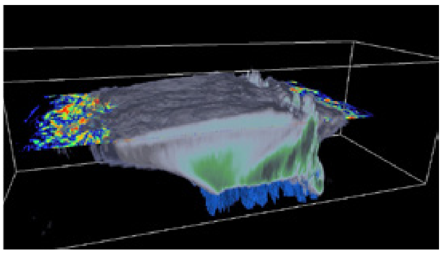
Weather prediction has been at the forefront of supercomputing developments since its inception decades ago. The models are built using mathematical approximations to the physical laws that govern fluid flow, creating software with millions of lines of code. With ever-increasing computing power, our weather prediction models are capable of realistically representing complex and small-scale features like thunderstorms and clouds. These models will also form the basis of our future climate models. Yet there is still a great deal of research needed to develop the science underpinning model developments, as well as extensive efforts required to evaluate them.

Turbulence and atmospheric waves

The atmosphere contains many scales of motion, including a rich spectrum of atmospheric waves and smaller-scale turbulence. In addition to being fascinating problems in fluid mechanics, atmospheric waves and turbulence have important influences on our weather systems and hazards, including for aviation. For example, atmospheric waves can create clouds and are fundamentally important for the formation of thunderstorms. In addition, the waves can break (similar to water waves), and recent research has identified wave breaking as one of the leading causes of turbulence that affects commercial aviation. Our research in this area aims to improve the avoidance and prediction of turbulence for the aviation industry to increase the safety and efficiency of air travel.



A high-resolution weather simulation over Australia.



An idealised simulation of turbulence generated by a thunderstorm.

Dr Agathe Lisé-Pronovost

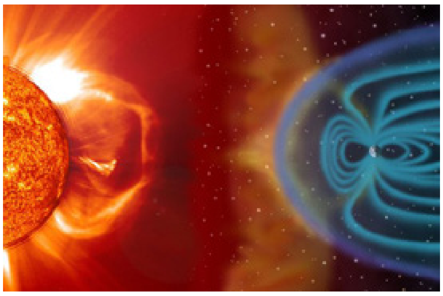
Dr Agathe Lisé-Pronovost

- Geochronology
- Magnetism and paleomagnetism
- Archaeological sciences
- Paleoclimatology
- Marine Geosciences

agathe.lise@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/807221-agathe-lise-pronovost

We rely on the Earth's magnetic field every day to protect life and our technologies from space radiation. Yet, the geological record shows that dramatic changes in Earth's magnetic field behaviour such as magnetic polarity reversals, geomagnetic excursions and other instabilities have happened in the past and will happen in the future. Our research unlocks data from the past to better understand future changes that will impact our societies.



Geomagnetic field changes

We use materials that have the fantastic capacity to record the Earth magnetic field (such as lava flows, fired archaeological artefacts, cave deposits, lake and marine sediments) to reconstruct the behaviour of the geomagnetic field through time. We focus on the Quaternary period in the Australasia region, which is an under-documented region of the globe – or paleomagnetic 'blind spot'. New high-quality paleomagnetic data from the Southern Hemisphere is useful to improve geomagnetic field models, better understand our planet's geodynamo and eventually predict future geomagnetic instabilities, such as reversal and excursions.

Regional paleomagnetic dating

Our recent work focuses on 'human timescale' records (millennial to decadal resolution) in Australia. We work with various types of archives (marine and lake sediments, archaeological and historical artefacts, speleothems, volcanic rocks) to develop practical regional paleomagnetic dating tools for archaeology and paleosciences.

Magnetism for archaeology and paleoclimate

The magnetic properties of geological material and artefacts is a versatile tool. We engage in multi-disciplinary investigations about past climates and ocean currents, ancient technologies and cultural heritage, site occupation, and sourcing.

Dr Jan-Hendrik May

Dr Jan-Hendrik May

- Quaternary environments
- Landscapes
- Geomorphology
- Dryland research
- Sediment

janhendrikmay@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/795469-jan-hendrik-may

Landscapes are complex systems that change dynamically over multiple spatial and temporal scales and are characterised by often non-linear links between the various processes acting at the Earth's surface. I believe that the recognition of this complexity holds the key to understanding landscapes and their reaction to changing climate and, more recently, human impact. In particular, this requires exploring landscape-scale sediment cycling with a stronger focus on the interplay between the wide range of water and wind-driven processes involved in shaping the landscape.

Our group works to unravel the evolution of Quaternary landscapes and environments in response to global-scale climatic changes. A major part of our research has concentrated on fluvial and alluvial systems as principal conveyors of terrestrial sediment, drivers of landscape change and constraints on human habitat and activities. Recently, increasing attention has been given to semi-arid desert margins as ecologically and culturally sensitive landscapes that are often characterised by marked climatic variability over late Quaternary timescales. Therefore, desert margins offer large potential to assess the impact that global climatic changes have had on sedimentary dynamics — and thus on our human environment over time.

As part of cross-disciplinary ARC funded projects we are currently trying to improve our understanding of the long-term climate-driven interplay between fluvial, lacustrine and aeolian sediment cycling in Australia's semi-arid desert margins in various parts of Lake Eyre and the Murray-Darling Basin. In this context, particular focus is given to assessing proximal source-to-sink pathways of aeolian sediments in arid Australia, and quantifying wind and wave-driven erosion, sediment transport and resulting shoreline morpho-stratigraphy around some of the largest ephemeral lakes in the world (ie Lake Chad and Eyre).

Dr Roland Maas

Dr Roland Maas

- Geochemistry
- Geology
- Economic geology
- Environmental tracing
- Agricultural tracing

maasr@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/8879-roland-maas

My work broadly aims at exploring isotopic tracing as a kind of chemical/nuclear DNA of solids and fluids from diverse fields including geosciences, agriculture and archaeology.

Isotopic tracing and authentication of Australian premium wine

Aims to identify if the 'terroir' of high-end shiraz wine from several Australian wine regions is expressed in Sr-Pb-Li-B-O isotopic signatures. Currently funded directly by the federal Government, the project looks at what controls these isotope signatures (soil, water, climate, agricultural/winemaking practices). Outputs include additional authenticity tests. Great potential for expansion to other agricultural products.

Formation of ore deposits

As an isotope geochemist, I can contribute to studies of ore formation through the use of isotopic tracing and radiometric dating of ore, gangue and alteration minerals. For example, Rb-Sr, Sm-Nd, Lu-Hf and U-Pb dating can be applied to a wide range of minerals common in ore deposits (sulfides, quartz, carbonates, many more). Likewise, the origin and history of ore-forming solutions can be explored using Sr-Pb-Nd isotope tracing. This can be done using solution-mode or laser sampling approaches.

Petrogenesis of granites

Radiogenic isotope studies of granites have a long tradition, yielding important insights on the timing of crustal melting and the nature of the magma source rocks. Such data can be used to constrain tectonic models and map/characterise lower crustal architecture.

Collecting soil. Image credit: L. Shewan.

Collecting rocks with PhD student Y Liu.
Image credit: O. Apukhtina.

Professor Malte Meinshausen

Professor Malte Meinshausen

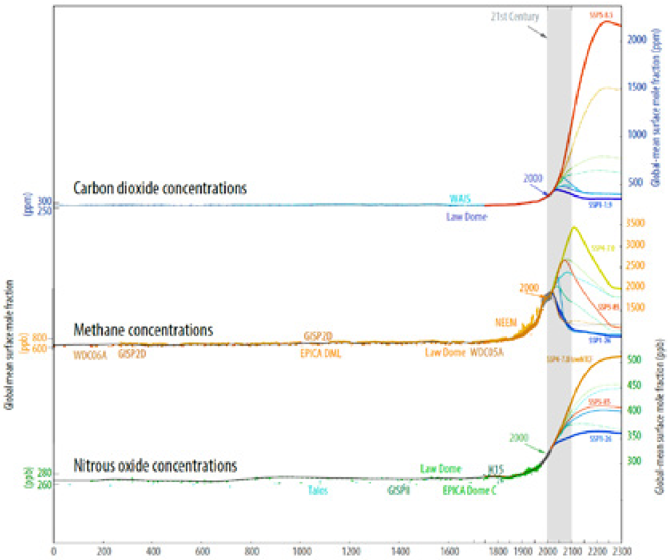
- Carbon budgets
- Climate scenarios
- 1.5C and 2C
- Paris Agreement

malte.meinshausen@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/428214-malte-meinshausen

Supporting informed decision making around climate change issues.

My primary research area is climate science at the climate science-policy interface, relating to remaining carbon budgets, Representative Concentration Pathway and Shared Socioeconomic Pathway climate scenarios, carbon and other gas cycles and emissions milestones compatible with the 1.5C and 2C temperature goals under the Paris Agreement. My primary research tool is the MAGICC model: a reduced-complexity climate and carbon cycle model we maintain also used by the Intergovernmental Panel on Climate Change. Also, I do research on Nationally Determined Contributions, which are the emission targets that countries put forward under the Paris Agreement.



Greenhouse gas concentrations over the last 2000 and next 300 years.

Dr Amy Prendergast

Dr Amy Prendergast

- Palaeoclimate
- Archaeological science
- Sclerochronology
- Geochemistry

amy.prendergast@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/782464-amy-prendergast

Working in North Africa, Western Asia, Southeast Asia, and Australia, I study how humans and our hominin ancestors have responded to rapid environmental changes at various times in the ancient past.

Focusing on archaeological sites, I generate high-resolution records of environmental change and seasonality using geochemical records and growth increment analyses (sclerochronology) from biogenic carbonates, to facilitate reconstructions of human-environment interaction.

My projects include:

- Reconstructing the environments that Homo species encountered when they first left Africa over a million years ago.
- Investigating whether rapid environmental changes may have played a role in the extinction of Neanderthals and the expansion of early modern humans around 40,000 years ago.
- Studying how Indigenous peoples adapted to Australia's changing environments and landscapes over millennia.

Associate Professor Mark Quigley

Associate Professor Mark Quigley

- Earthquakes
- Natural hazards
- Geomorphology
- Tectonics
- Geology

mark.quigley@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/24685-mark-quigley

My work aims to increase fundamental knowledge of geological hazards and contribute this knowledge to the betterment of global society. We are first science responders to large earthquakes in Australia and provide science to diverse communities to aid in natural hazard assessment and management, engineering design and disaster risk reduction. We use a variety of field, remote sensing, and dating techniques to characterise a diversity of geological hazards in our research.

Paleoseismology

We use the geological record of past earthquakes, uncovered through excavations into active faults, geospatial mapping and dating of earthquake-affected landforms and sediments, and statistical analyses of observational data, to characterise the size, timing, and behaviour of past earthquakes and forecast the characteristics of future ones. Our work informs decision-making in the critical infrastructure, energy, and water industries, amongst others.

Earthquake geology

We respond rapidly to contemporary earthquakes with seismometers, drones, and other survey instruments to characterise earthquake environment effects. Our data informs us of the fundamental physics of earthquake rupture and strong shaking in built and natural environments.

Geological hazards and surface processes

We observe, characterise, and model a diversity of other geological hazards and surface processes such as erosion, landslides and rockfalls, floods, and liquefaction. Our data contributes to a broader understanding of natural hazards globally. We work with a diversity of partners across government, academia, and industry.

Field work on active faults in the picturesque Southern Alps of New Zealand

Field work in the East African Rift in Tanzania.

Dr Rebecca Runting

Dr Rebecca Runting

- Land-use planning
- Ecosystem services
- Climate change adaptation
- Ecological economics

rebecca.runting@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/830915-rebecca-runting

How can we achieve environmentally sustainable land management in an era of rapid climatic and economic changes while meeting the needs of people? Our research centres around finding spatial solutions to these complex environmental challenges. This includes developing spatial plans to adapt to climate change impacts, balancing competing objectives and advancing methods to account for multiple uncertainties across space. In doing so, this research provides tangible spatial solutions to manage our environment in an era of global change.

Conservation planning under climate change

Climate change is expected to profoundly affect environmental, biological and social systems in the coming decades, but predicting how climate change will be manifested and how exactly it will affect these systems is uncertain. If uncertainties are ignored, spatial conservation plans may ultimately fail to protect species and ecosystem services in the long term, yet these risks are not typically accounted for in planning. We tackle this issue by developing risk-sensitive, spatially-explicit approaches to planning that maximise conservation objectives whilst hedging risk under climate change uncertainty and ensuring functional connectivity. We also test the value of using complex spatial modelling relative to simpler approaches. This research is primarily undertaken in coastal ecosystems that are impacted by sea-level rise.

Land-use planning for competing objectives

Finding solutions where objectives are competing is vital, particularly in the context of meeting human demands for food, materials and energy while maintaining the integrity of the natural environment. A major question in sustaining biodiversity in production landscapes is whether land uses should be separated to deliver diverse objectives (sparing) or if management should be integrated for both objectives (sharing). Our research challenges the dichotomy of the sparing versus sharing debate by exploring the sparing-to-sharing continuum and accounting for the spatial heterogeneity of biodiversity and ecosystem services. Case studies include timber production in tropical forests and pollination in coffee production landscapes.

Conservation planning under climate change.

Competing objectives.

Associate Professor Robyn Schofield

Associate Professor Robyn Schofield

- Atmospheric chemistry
- Air quality and health
- Climate change
- Environmental science
- Sustainability

robyn.schofield@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/433184-robyn-schofield

The air is often forgotten as we can't see it, yet without it we would die in three minutes. Poor air quality is the single most preventable environmental health risk factor. As a common good, poor air disproportionately affects lower socio-economic communities. Through policy, legislation and regulations this often forgotten area of the environment can be improved for the economic and health benefit of all.

Atmospheric observations

I manage the AIRBOX facility (airbox.earthsci.unimelb.edu.au), taking observations in remote and unique environments to urban airsheds. I have conducted and led field work on ships and remote coastal areas. My research has focused on aerosol sizes and composition and their climate impacts. I have worked extensively on ozone formation and loss processes involving nitrogen, halogen, mercury and sulfur biogeochemical cycles.

Chemistry climate modelling

Aerosols, ozone and ozone depleting substances have climate radiative forcings that are highly variable both spatially and temporally. These reactive trace gases also affect the chemical lifetime of long-lived greenhouse gases. Changes to these chemistry-climate processes have regional, seasonal and hemispheric impacts. For example, the banning of CFCs and now HFCs under the Montreal protocol remains the most effective climate mitigation action we have taken to date. While climate mitigation now rightly focuses on greenhouse gas reductions, understanding the role of these short-lived climate forcing agents is vital to reducing uncertainties in our climate models and to making improvements in planetary health.

Air quality and health

The health of the air we breathe has implications for food security and is the single most important and preventable environmental risk factor for human health. Australia is one of the most urbanised countries in the world (with 90% living in urban areas). We spend 90% of our time indoors. The health of our urban airshed (traffic, energy, biomass burning, industry and natural emissions) and indoor air (ventilation, filtration, heating, energy and airborne pathogen transmission) is vital for a healthy planet for all.

Dr Yawen Shao

Dr Yawen Shao

- Multi-model climate ensembles
- Projections of climate extremes
- Uncertainty quantification
- Ensemble post-processing
- Sub-seasonal and seasonal forecasting

yawen.shao@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/842448-yawen-shao

Multi-model ensembles are useful to represent the uncertainty of the chaotic climate system. Many techniques have been introduced to post-process and weight different ensemble members for predictions of climate variables in their mean states. However, these approaches are seldom designed or applied to changes in climate-extreme indices. My research aims to develop new ensemble bias-correction and weighting techniques to optimise the multi-model projections of climate extremes.

Multi-model projections of climate extremes

Accurate and reliable predictions of climate extremes and associated uncertainties are essential for long-term planning, decision making and impact assessment. Ideally, making use of a collection of bias-corrected independent climate models allows for a better quantification of the uncertainty. However, research centres widely share model codes, datasets and resources so that treating different models equally in uncertainty assessments may bias the representation of the climate system in future predictions. Multiple studies have proposed ensemble post-processing methods to weight and constrain future mean states, but these studies seldom investigated changes in extreme indices.

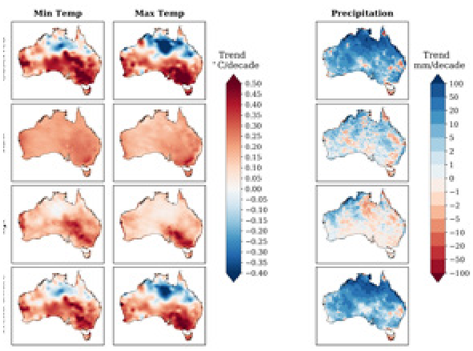
My research aims to:

1. Improve the accuracy of CMIP6 projections in extreme events through bias correction techniques
2. Reduce uncertainty errors in projections of climate extremes by optimally weighting the CMIP6 ensemble members based on model historical performance and model interdependence.

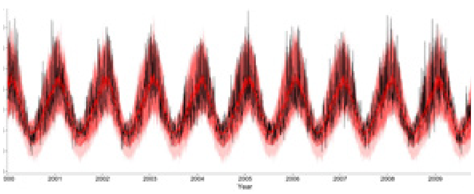
Post-processing sub-seasonal to seasonal climate forecasts under climate change

Land surface air temperature and precipitation have shown significant temporal trends in many parts of the world over recent decades. For managing the impacts of climate variability and change, skillful and reliable ensemble seasonal and sub-seasonal climate forecasts from global climate models (GCMs) are in high demand within climate-sensitive communities. However, GCMs are often reported to poorly reproduce observed trends in the model forecasts. This issue is not resolved by most existing statistical post-processing methods that aim to remove model biases, maximise forecast skill and improve forecast reliability in terms of the ensemble spread.

To address this gap, this past project aimed to develop and demonstrate the merit of a new, trend-aware forecast post-processing method that eliminates the trend disparity between climate forecasts and observations while making the resulting forecasts bias-free, skilful and reliable. This newly developed method has shown effectiveness for delivering quality sub-seasonal to seasonal climate forecasts and building user confidence in employing the forecasts in a changing climate.



Decadal trends for observations, raw, BJP (Bayesian joint probability modelling approach), and trend-aware calibrated forecasts of Australian summer (Dec-Jan-Feb) minimum and maximum temperature and precipitation with 1-month lead time over 1981-2016.



Time series of Sydney daily maximum temperature for the mean of raw and bias-corrected CMIP6 historical runs (lines) and 5-95% confidence interval (shading) over 2000-2009.

Dr Louise Shewan

Dr Louise Shewan

- Archaeological science
- Isotope geochemistry
- Provenance studies
- Megalithic jar sites
- Cultural heritage

louise.shewan@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/798233-louise-shewan

I am fascinated by the information we can glean about past populations from the chemical signatures preserved in human teeth. Through the isotopic analysis of enamel, we can learn about childhood domicile, health, habitat use and environmental change. All these pieces of information allow us to reconstruct human life histories, providing insights into key archaeological questions, including mobility, changing human-environmental interactions and climate variation.

Isotopic analysis of human enamel

Teeth provide an archive of diet, health and mobility. Isotopic analyses of human dental enamel is used to investigate the residential behaviour, habitat preference, life histories and cultural practices of past populations. In our research, we analyse the chemical residues that are preserved in the teeth of past individuals from archaeological and forensic contexts. By analysing chemical signatures preserved in the enamel, we can begin to understand more about where a person lived during childhood and the (geological and geographical) area over which people obtained their food resources. This helps us with questions regarding residential mobility and landscape use. Part of this work involves the development of baseline ‘isoscapes’ involving the isotopic analysis of plants, soil, water and fauna.

Isotopic analysis of wine

In our research, we aim to ‘fingerprint’ Australian wine regionality using a multi-isotopic approach to trace different aspects of the vineyard environment. We will determine which factors (eg soil, water, plant, climate) have the most impact on wine isotopic signatures and how this varies between the major wine regions. Methods used in this project can be applied to the traceability of other agricultural products.

Burial from Iron Age Phum Sophy, Cambodia.

Megalithic Jars from Site 2, Plain of Jars Laos.

Burial 5 and 7 from Site 1, Plain of Jar Laos.

Dr Anne-Marie Tosolini

Dr Anne-Marie Tosolini

- Palaeobotany
- Palaeoenvironments
- Palaeoclimates
- Sedimentology
- Stratigraphy

a.tosolini@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/23589-anne-marie-tosolini

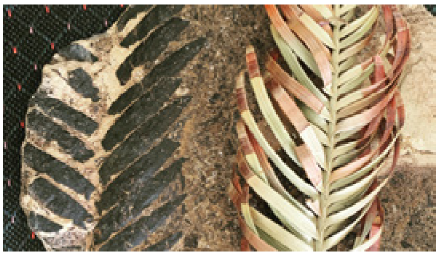
Earth's fossils record past mass extinctions and rapid warming events that provide important analogues for future extinctions and climate change. I am a palaeontologist who uses interdisciplinary research to combine sedimentary geology and fossil plants, understand changes in plant community ecosystems through time and understand plant relationships to past terrestrial environments and climates.

This interdisciplinary research has contributed fundamentally to the interpretation of Cretaceous terrestrial strata and plant evolution in Australasia, leading to a better understanding of environmental and climatic evolution at high latitudes. My expertise in basin analysis has enhanced sedimentological and stratigraphic understanding of Devonian carbonates and important Cretaceous hydrocarbon source rocks of the Gippsland and Otway basins. I was involved in the Linkage project Climate evolution of Cretaceous undertaken with industry partners Royal Botanic Gardens, Melbourne; Lakes Oil, Nexus Energy and Geotrack International.

I have published several papers from my palaeobotanical research on critical high-latitude floras from the Cretaceous to Paleocene of Gondwana. This research led to a fundamental change in perception of the resilience of flora to greenhouse world climate dynamics.

I have also worked with an international research team expanding on my initial research of Australian plant-insect interactions in the Cretaceous by analysing annelid and insect trace fossils from Triassic-Jurassic transition of Greenland. Our focus has now returned to Australia during the Eocene to understand trophic levels within ecosystems from plant-insect interactions in the tropical rainforests of the southeast region during a Greenhouse climate.

The project 'Biodiversity response to climate change: biodiversity, ecology and climate significance of Tertiary forest communities of Antarctica' formed my postdoctoral research that focused on globally significant climate change, greenhouse climate and biodiversity issues. I studied macroplant fossils of Paleocene to Eocene age collected from the Antarctic Peninsula to determine the ecological response of vegetation to climate change at high latitudes. Analysis of fossil wood and leaves using newly developed techniques provided new data on forest biodiversity and evolution under a former greenhouse climate, which can be used to test models of biodiversity change resulting from future global warming. Climate interpretations of the plants also produced new data about terrestrial climate change at high latitudes to test and validate climate models and can establish whether climate-induced changes in biodiversity occurred in a gradual or punctuated manner.



This fossil conifer branch belongs to the family Araucariaceae and similarities can be seen with modern Araucariaceae leaves of the 'living fossil' species Wollemi nobilis, of which fossils have been found dating back to the Early Cretaceous (100-130 million years ago).

Seymour Island, in the Weddell Sea to the east of the Antarctic Peninsula, is shown here after the pack ice had blown in during an intense Antarctic blizzard, where winds reached 100 knots.

Dr Ariane Utomo

Dr Ariane Utomo

- Marriage and the family
- Gender and the labour market
- Transition to adulthood
- Indonesia
- Migration

ariane.utomo@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/827278-ariane-utomo

My research seeks to understand the complex relationship between demographic transition, economic development, socio-political change, and globalisation in Indonesia, Australia, and the surrounding region. I primarily use the interconnected realms of work, marriage, and the family as a window to understand social change.

By focusing on family change in Indonesia, my work uncovers micro-level manifestations of development, throws light on the complexity of change in Indonesia, sets a foundation for comparison to Asia and the Muslim world, and guides academics and policy makers to identify competing ideas and aspirations in these regions.

My research agenda sits across four interrelated themes:

Marriage, development and social change in Indonesia

How individuals partner to form a family reveals a great deal about mobility, gender relations, inequalities, and social stratification – particularly in Indonesia. Drawing on mixed methods, my research provides insights into how marriage pairing relates to fertility, migration, development, and socio-political change in diverse societies.

Youth and transition to adulthood

I examine how the expansion of schooling in recent decades has delayed and shaped young people's transition into work and into marriage, how these transitions may differ between young people in different socio-economic segments, and the ways in which these transitions differ from those experienced by the previous generations of urban Indonesians.

Migration and population ageing

Owing to out-migration and declining fertility, rural areas in Indonesia are older relative to urban areas. My work focuses on associations between the changing family, migration, demographic transitionsy, economic growth, inequalities, and social policy in rural Indonesia.

Reproduction and reproductive work in times of crises

I have worked with colleagues from Indonesia, Cambodia, and Australia in a number of interdisciplinary research projects, including: forced evictions and the family in Jakarta; women and urban informal food networks in times of COVID-19 in Greater Jakarta; and on agricultural households, migration, and livelihoods in Northwest Cambodia.

A picture with my collaborator Dr Oki Rahadianto Sutopo and his teaam from Youth Studies Centre, Universitas Gadjah Mada before leaving for fieldwork in Gunung Kidul, Jogjakarta, 2019.

A photo of a neighbourhood in Jatinegara Barat, Jakarta, January 2020. I work with Clara Siagian (ANU), Kamil Muhammad (pppooolll, Jakarta) and Brian Cook (UoM) to study forced evictions/ relocations and the family.

Dr Claire Vincent

Dr Claire Vincent

- Maritime continent
- Tropical variability
- Wind energy meteorology
- Extreme rainfall
- Mesoscale meteorology

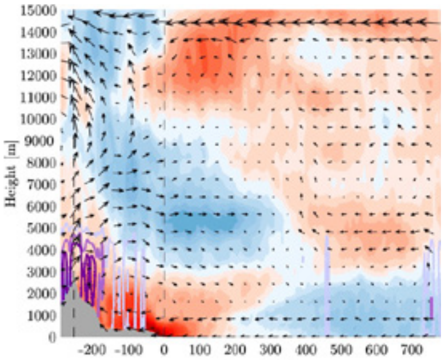
claire.vincent@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/19945-claire-vincent

I am passionate about understanding the causes of our mean and extreme weather in the current and future climates. In particular, I am fascinated by the role of local influences such as mountains and coastlines in controlling weather and climate. I am also committed to better understanding small-scale variations in the wind resource and their impact on renewable energy production.

My research interests include tropical variability, mesoscale meteorology, rainfall extremes and wind energy meteorology. I have worked on topics such as organised squall lines and rainfall extremes in the tropics, wind variability over the North Sea, and very short-term wind forecasting. I am particularly interested in the different scales of variability in the atmosphere and their interactions.

Afternoon thunderstorm forming over the mountain peaks of New Guinea as a result of converging seabreezes, topographic flows and surface heating.



Simulation of afternoon seabreeze impacting the coast of New Guinea, with precipitation (purple contours) forming over the coastal areas and mountain peaks.

Dr Ashlea Wainwright

Dr Ashlea Wainwright

- Geochemistry
- Archean
- Igneous geology
- Earth's mantle

awai@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/221317-ashlea-wainwright

The isotopic compositions of rocks and minerals provide vital clues in our study of the processes that have formed and continuously modify our planet. Our research group is at the forefront of these endeavours combining state-of-the-art geochemical instrumentation with novel analytical approaches to study Earth's geochemical composition and evolution.

Mantle evolution through time

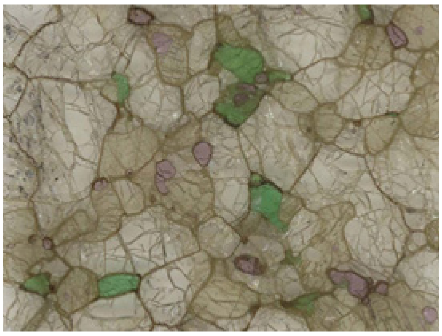
The geochemical characteristics of the Earth's mantle depend on global-scale cycles in which new crust is both formed during basaltic magmatism and ultimately returned to the planet's interior at subduction zones. Determining the nature and extent of these chemical exchanges and their influence on the continental crust upon which we live is central to our understanding of the modern Earth as a habitable world. By analysing basalts and peridotites of different ages using advanced geochemical techniques, we can document the chemical evolution of our dynamic planet.

Early earth geodynamics

The composition of the Early Earth (>2.5 Ga) is a critical component in our understanding of planetary evolution, the emergence of life and provides baseline information in the exploration for Earth-like exoplanets. However, this period remains relatively unknown to modern geoscientists, with few rock records remaining at the Earth's surface. We use state-of-the-art geochemical techniques to explore these rare rock records and help build a detailed picture of the Early Earth.

Advances in multi-collector inductively coupled plasma mass spectrometry

Recent technological advances have expanded the capabilities of multi-collector inductively coupled plasma mass spectrometers (MC-ICPMS), which widens the range of elements available for analysis, as well as enabling smaller isotopic differences to be detected. With the acquisition of Australia's only Nu Instruments Sapphire MC-ICPMS, our research group will develop new techniques specific to this instrument providing new tools for research across a range of disciplines, including geology, archaeology and biomedicine. Simultaneously, we will continue developments at the forefront of Laser Ablation research, analysing bones and teeth as well as producing isotopic maps of samples.



Dr Malcolm Wallace

Dr Malcolm Wallace

- Sedimentology
- Stratigraphy
- Geochemistry
- Earth history
- Past climates

mww@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/1774-malcolm-wallace

I use the sedimentary record to understand how and when life evolved on Earth and oxygen built up in the ocean-atmosphere system, and how these processes changed the environment and climate.

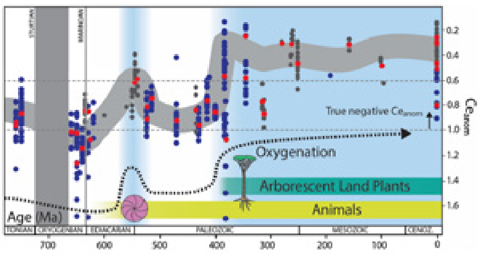
History of the Earth and the evolution of complex life

Sedimentary rocks are a record of nearly 4 billion years of Earth's history. My research group studies past ecosystems and environments using aspects of paleontology, sedimentology, stratigraphy, geochemistry, and paleoclimatology.

The marine carbonate record, including barrier reef systems, provides clues to ancient ocean chemistry, atmosphere and climate, including the Earth's oxygenation history. Oxygen accumulation in the atmosphere is intimately linked to the carbon cycle, so deeper understanding of the processes that drove oxygenation has implications for past climate change and the evolution of complex life.

A Precambrian barrier reef system preserved in the Ogilvie Mountains of the Yukon Territory, Canada.

Precambrian glacial sediments and modern desert dunes, near Death Valley, California..



A record of oxygen build up in the oceans from around 800 million years ago to the present day.

Professor Mark Wang

Professor Mark Wang

- Global China
- China's development
- Urbanisation
- Water/land management

myw@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/1569-mark-wang

I aim to understand China's ongoing social, economic and political transformations and its growing global influence.

I examine urbanisation, development and environmental issues in China. In recent years, I have worked in China's poverty alleviation, land acquisition, development-induced resettlement and inter-basin water diversion projects.

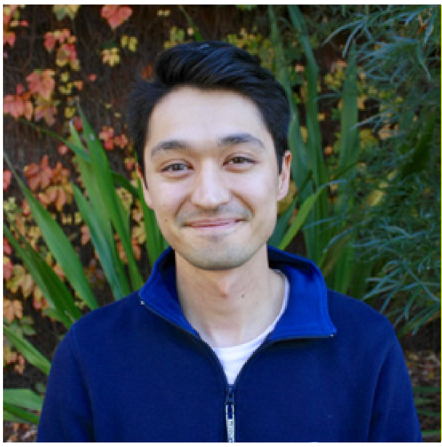
My current research is across three areas:

1. The technopolitics of China's south-to-north water transfer project
2. Local engagement of the Chinese investment projects in Southeast Asia and Oceania
3. China's new river chiefs/managers system.

China's South-to-North Water Transfer project — the middle route.

Resettled poor farmers in Shanxi, China, through the poverty alleviation resettlement program.

Dr Tim Werner



Dr Tim Werner

- Industrial ecology
- Remote sensing
- Geographic information systems
- Economic geology
- Sustainable mining

tim.werner@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/831918-tim-werner

My research aims to ensure that meeting the world's growing demands for metals comes at minimal cost to society and the environment. This involves identifying pathways to efficient use of materials across their life cycles. I also aim to promote best practice in mine governance by mapping the impacts that mining is having on landscapes around the world.

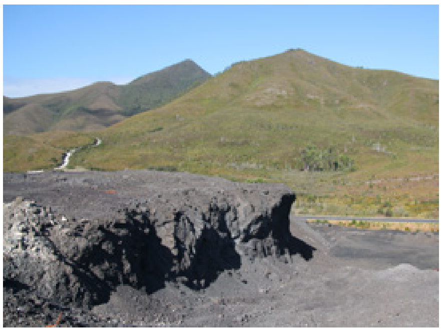
Assessing impacts of mining from above

As demand for virtually every element on the periodic table grows dramatically, mines around the world are expanding and new mines are developing. This is pushing the frontier of mining closer and deeper into pristine environments and surrounding communities. By looking at mine areas in satellite imagery, we can form an independent understanding of the type and extent of impacts that they are generating on surrounding areas. I engage in diverse mapping projects that examine the footprint of mining from tropical to desert settings.

Critical metal resources and sustainable metal supplies

My research also aims to quantify what mineral resources remain in the ground to meet future demand for geologically rare metals. Such metals like lithium, cadmium and the rare earths are key to renewable energy systems. By building comprehensive databases of mining projects and mineral deposits and analysing them for their economic feasibility and environmental risks, my research helps form a picture of where future supplies may come from and what sustainability challenges we may face in their extraction. Once rare metals are extracted, they are often wasted in mining and metallurgical wastes or disposed of in landfill. Identifying ways to take advantage of these wastes as potential resources is another key research focus.

Abandoned waste rock dump and mining machinery in central Tasmania.



Lead slag pile at Zeehan, Tasmania.

Abandoned machinery at the former Austral smelter, Zeehan, Tasmania.

Associate Professor Ilan Wiesel

Associate Professor Ilan Wiesel

- Urban geography
- Social geography
- Disability
- Housing

ilan.wiesel@unimelb.edu.au

findanexpert.unimelb.edu.au/profile/178914-ilan-wiesel

I aim to understand what a caring, just, and inclusive city might look like, and how we might achieve it in practice. I consider aspects of social diversity and inequality in cities, especially through the lens of social class, dis/ability, and cultural difference.

Socio-spatial advantage and disadvantage in cities

How does your home and neighbourhood shape your life opportunities? I examine how living in wealthy 'elite' neighbourhoods facilitates accumulation of social, cultural, and economic capital; how living in disadvantaged neighbourhoods can reinforce experiences of exclusion and marginalisation; how public expenditure for services and infrastructure is distributed by governments; and how redistribution might address inequalities.

The disability-inclusive city

I investigate how 'specialist' disability services and 'mainstream' public services can better facilitate the participation of people with disability (particularly intellectual disability) in the community and urban life. I explore everyday encounters between people with and without disability in cities, how these encounters shape inclusion and exclusion, and how more convivial encounters might be facilitated through better planning and support.

Housing for a just and caring city

I study the impact of inaccessible housing design on people with disability, and the impact of affordability stress on low-income households, and on broader social relations in cities. I have looked at the homes of wealthier middle-class and upper-class households, and how new forms of housing (such as luxury high-rise homes, and mansions developed through knockdown-rebuild) shape new class identities and relations.

Diversity and inclusion.

Disability-inclusive city.

UniMelb on-demand

Get to know us better in your own time

SciMelb