2022 PROJECT BOOKLET

Bachelor of Science (Honours) LHSC



Editor: Gunnar Keppel

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Bachelor of Science (Honours)

A Bachelor of Science (Honours) degree provides the perfect platform to develop your skills as a scientist and gives you the opportunity to become highly experienced in your chosen field of research. This provides a pathway for further research as part of a PhD or Masters program and assists with gaining the skills and knowledge that many employers consider valuable for graduate employment.

The BSc (Honours) program at UniSA brings together a diversity of researchers and students from a broad range of undergraduate degrees at UniSA and elsewhere in Australia. This booklet provides an overview of some of the projects that are available to students planning to undertake their Honours degree in 2020. UniSA offers flexible entry timing for the Honours degree and students can commence at the start of the year or as mid-year entry.

Entry into the Honours degree requires a GPA of 5 (Credit average) for a relevant undergraduate degree. Applications for entry into the degree are made through SATAC, and we prefer if students contact their potential supervisor and the Program Director prior to application. The Program Director will guide you through the enrolment process and may also be able to put you in contact with other potential supervisors if your interest fall outside those projects included in this booklet.

The projects in this booklet are loosely grouped into discipline areas. If you are interested in undertaking one of the projects or would simply like more information on the projects we encourage you to contact the listed supervisor/s – they will be more than happy to discuss their research projects with you.

Project Areas

Applied Chemistry

Environmental Management

Environmental Science – Biodiversity and Ecology

Environmental Science – Pollution & Water Treatment

Environmental Health and Food Safety

Geospatial Science



The University of South Australia, Australia's University of Enterprise, possesses a diverse range of researchers and research excellence in pure and applied science.

We welcome you to join us in our search for new scientific knowledge.



A Note From the Program Director

I'm Gunnar, the Program Director for the Bachelor of Science (Honours) program, and hope to welcome you soon into our Honours program.

I'm based in UniSA STEM but our Honours Supervisors are spread across a range of Schools, Research Institutes and Centres at the University.

As all of these supervisors can tell you, the Honours year is easily the most rewarding of your undergraduate career and the friendships and professional networks you form during the year can often last a lifetime!

If you have any questions about the degree or entry requirements then feel free to contact me and I can either answer your questions or provide you with the appropriate contact that can help. I can also advise you on scholarship options at UniSA.

Applied Chemistry

 Nanoengineering with Unusual Liquids: Understanding Ionic Liquids in Nanochannels

Nanoengineering with Unusual Liquids: Understanding Ionic Liquids in Nanochannels

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FIELD/S of STUDY

Engineering, Chemistry, Micro/ Nanofabrication, Interfaces, Defence, Space

RESEARCH PROJECT

Ionic liquids contain only ions and are not volatile in vacuum, making them particularly unusual and potentially very useful in Space. In nanoscale channels, water takes on unusual physical properties. However, very little is known about ionic liquids, including their structure and how they might be manipulated for nanoengineering applications.

This project will study ionic liquids in nanochannel environments, considering their physical structure and the effect of channel dimension, molecular chemistry, and certain external stimuli. Nanochannels and related nanostructures (see Figure 1) will be prepared in UniSA's world-class micro/nanofabrication facility and tested in collaboration with Australian and international partners.



Figure 1: A scanning electron microscope image of nanostructure array in silicon, prepared by e-beam lithography and deep reaction ion etching.

Environmental Management

- Impact Monitoring of Coastal Developments
- Defining input and output components of a user-friendly resident's bushfire reporting system
- Investigate an integrated fire detection and resource suppression system framework development and data synthesis

Impact Monitoring of Coastal Developments

RESEARCH PROJECT

There are currently several proposals to develop energy and resources projects in the upper parts of the gulfs in South Australia - including a copper mine and a hydroelectricity plant.

Some baseline work has been done to consider how the developments might affect the adjacent marine environment and to mitigate impacts where possible. But such assessments are predictions and so if/when the developments start, monitoring will be required to test whether any impacts have occurred.

However, sometimes the monitoring programmes put in place for these sorts of developments are not designed with enough or appropriately located replication to be able detect anything other than the most extreme of impacts; i.e. monitoring may be almost pointless because it is not statistically powerful enough to detect small or moderate changes that we might be concerned about.

Focusing on one of the intertidal systems near a proposed development, this project will collect/collate pilot (preimpact) information on populations/assemblages at various spatial and temporal scales and then do statistical modelling to help inform cost-efficient and informative impact monitoring programmes.



SUPERVISORS

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FIELD/S of STUDY

Marine Ecology, Environmental Science, Impact Assessment and Monitoring

Defining input and output components of a user-friendly resident's bushfire reporting system

RESEARCH PROJECT

Human reporting of bushfire ignition has been ranked as the one of the most efficient and fast methods of fire detection.

Traditionally, human towers were built for hired spotters to observe bushfires on catastrophic fire danger days. In recent years, facing the pressure of safety concerns and the high cost of tower maintenance and driven by advanced technology development, more and more bushfire agencies are considering smart approaches to fire reporting systems, such as using mobile phones.

It is of high value to investigate a smart system that can collect useful information on bushfire ignition from residents, including location, time or video reporting.

This project aims to investigate the possible input and output components of a smart fire reporting system which enables residents to easily upload information and fire suppression decision makers to obtain processed information including location, fire behaviour and level of certainty. The project output is a theoretical framework of information input and output from a smart fire reporting system.

SUPERVISORS

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FIELD/S of STUDY

Climate change, Conservation, People's behaviour, Environmental Science

Investigate an integrated fire detection and resource suppression system framework development and data synthesis

RESEARCH PROJECT

Bushfires have always been catastrophe disasters and have become more severe in recent years due to climate change. The importance of early fire detection and access to fire ignition points has increasingly gained attention. Investigation of one of the current UniSA National Institute for Forestry Product Innovation projects found that fire detection systems, such as 'person in a tower', human phone call, camera detection systems, sensor networks, unmanned aerial vehicles detecting systems, earth-orbiting and geostationary satellite systems and smart media reporting online systems, have specific disadvantages and

advantages. However, it is possible to apply some of these systems into a combined system that can fulfil fire detection and resource suppression tasks.

In order to achieve better early fire detection and suppression, this study aims to utilise the theory of temporal and spatial information flow (for example Graph Theory) framework that can help test and synthesise different types of detection data in a logical operation system. The expected output should be a data operation system that has the ability to identify fire ignition locations and inform fire suppression operations. Research tasks will be:

1) Understanding different fire suppression systems and their data characteristics (literature review).

2) Developing a fire detection and resource management framework and incorporating different suppression systems into logical processes.

3) Utilising of relevant data sets and producing hypothetical outputs for early fire detection and resource suppression operations.



Figure 2: Fire Detection and Extinguishing Decision Making Framework

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FIELD/S of STUDY

Climate change, Bushfire, Resource suppression, Environmental Science

Environmental Science: Biodiversity and Ecology

- Quantifying and understanding stringybark dieback in the Mount Lofty Ranges
- Current and Future Impacts of Tropical Cyclones on Forests
- Ecology and microclimate of woodland edges in South Australia
- South Australian jetties as artificial reefs
- Intertidal Reefs that Rock 'n Roll
- Should we cuddle? Assessing the value of the koala hold at Cleland Wildlife Park
- Tackling big environmental issues with cute animals

Quantifying and understanding stringybark dieback in the Mount Lofty Ranges

RESEARCH PROJECT

Stringybark forests are important wildlife habitats and store considerable amounts of carbon. Increasing drought and heat wave conditions linked to climate change are believed to be impacting stringybark forests. All three South Australian stringybark species are mostly restricted to mesic (cooler and higher rainfall) regions and therefore potentially threatened by climate change. Dieback of stringybark canopy has been widely reported in the Mount Lofty Ranges, where the species are iconic elements of the landscape.

As there is little known about the extent and causes of stringybark dieback, we urgently need to understand the extent of the dieback and what is causing it. In this context, several projects are available at different scales (local or regional) and related to 1) mapping dieback, 2) investigating the health of stringybarks in relation to topography, fire and human disturbance, and 3) identifying

This project will map and quantify dieback occurring in stringybark forests of the Mount Lofty Ranges in relation to climate and other environmental factors. Results will contribute to developing adaptive management approaches through climate-resilient stand management and reafforestation..

In Europe, dolines are well-known refugia for biodiversity when environmental conditions change. Dolines are common in South Australia's extensive karst landscapes, but have not been studied with respect to biodiversity, microclimate or as potential microrefugia. This study will investigate the microclimate, plant diversity and conservation status of these unique habitats. Some background in ecology or conservation biology would be advantageous.

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FIELD/S of STUDY

Climate change, Conservation, Ecology, Environmental Science

Figure 3: Stringybark dieback in Spring Gully Conservation Park, Clare Valley.





Current and Future Impacts of Tropical Cyclones on Forests

RESEARCH PROJECT

Tropical cyclones are frequent, large-scale events that cause severe damage to nature and ecosystems. They are predicted to increase in intensity and to occur at higher latitudes dues to anthropogenic climate change (for more background see: Ibanez T, Keppel G, Menkes C et al. 2019, Globally consistent impact of tropical cyclones on the structure of tropical and subtropical forests, Journal of Ecology 107, 279-292).

This project investigates the impacts of tropical cyclones on the structure and functioning of rain forests and how these are likely to change as a result of climate change. It will use published literature and available plot data to investigate the short- and long-term impacts of cyclones on forests using meta-analyses. Furthermore, it will involve the collection of functional data on various islands of the South Pacific (including Fiji, Samoa and Vanuatu). Functional trait data will be related to cyclone intensity to infer how forecast changes in cyclone dynamics will affect the functioning of forests. Finally, multi-level analyses will be used to predict the effects of climate change on forest structure and functioning.



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FIELD/S of STUDY

Climate change, Conservation, Ecology, Environmental Science

Figure 4: Defoliated forests after Cyclone Pam in Vanuatu (©T. Ibanez).





Figure 5: The edge of a woodland in the Fleurieu Peninsula.

RESEARCH PROJECT

Forest cover is decreasing on a global scale. As a result, landscapes are increasingly fragmented, meaning that the total proportion of habitat close to the woodland edge bordering more disturbed vegetation types is increasing. Due to this increasing prevalence of edge habitats, it is important that we understand how environmental gradients (e.g., changes in temperature and humidity) from the edge to the interior of the woodland affect biodiversity.

In South Australia, woodlands are also highly fragmented, but little is known about the ecology of these edge habitats. This project will investigate how the microclimate, and the diversity and ecology of plants and animals, vary in the edge habitats using transects extending from the edge towards the centre of the woodland. You may focus on only one or all of these aspects. Some background in ecology or conservation biology would be advantageous.

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FIELD/S of STUDY

Climate change, Conservation, Ecology, Environmental Science



South Australian jetties as artificial reefs

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FIELD/S of STUDY

Marine Ecology, Environmental Science, Environmental Monitoring

RESEARCH PROJECT

Jetties are iconic in South Australia and important economically in regional areas as a focus for coastal tourism and fishing. With lots of hard surfaces underwater to colonise, jetties are effectively artificial reefs, albeit usually quite shaded and harbouring different assemblages to adjacent reef areas. While jetties provide habitat, probably attract fish and are important for people, their wider ecological role(s) in nearshore coastal systems are not well understood. There also seem to be clear differences in assemblages among jetties, even those situated close to each other, but there is surprisingly little data on this. Resolving this requires better understanding of what lives on/near jetties, how this varies spatially and temporally and an understanding of what sort of functional roles organisms are playing.

We have a small observation-class ROV, 360° video, baited remote underwater videos etc. and can access a range of jetties, including some areas with limited public access. A range of Honours projects in this area are available that will remotely collect data on a) invertebrate and algal cover on piles, b) seagrass and benthic invertebrate abundances, or c) fish to characterise the ecological assemblages associated with jetties and to assess changes in assemblages among or across jetties over time.

Intertidal Reefs that Rock 'n Roll



RESEARCH PROJECT

Rhodoliths are free-living crustose coralline (red) algae (CCA) that, in aggregation, form beds of moving, hard substrate in otherwise soft sediment habitats. Typically spherical (but with complex branching or foliose structure; see above) and ranging in size up to ~ 10cm, rhodoliths form when a piece of CCA breaks off an existing rhodolith or other CCA, or can develop from spores settling onto a small rock or shell. They then grow slowly, forming their spherical shape and free-living nature only in areas with low sedimentation and enough currents and/or waves to ensure rotation (leading to their rounded shape and exposing all surfaces to light). Globally, rhodolith beds are an important habitat, commonly found in deeper (mesophotic) waters. But their importance often goes unrecognised and beds are easily destroyed by activities like trawling or dredging. Rhodoliths also provide an important habitat for many other organisms, often supporting very diverse assemblages of invertebrates and other algae. There are few records of rhodoliths in South Australia, but we have recently come across some places in upper Gulf St. Vincent where patches are found in the intertidal zone, something not recorded in southern Australia. This project will use field surveys to determine the distribution, abundance (and taxonomic) composition of intertidal rhodoliths and potentially investigate the diversity within invertebrate assemblages found in beds.

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FIELD/S of STUDY

Marine Ecology, Environmental Science, Biodiversity



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FIELD/S of STUDY

Human Dimensions of Environmental Management, Human-animal interactions, Conservation, Environmental Science

Should we cuddle? Assessing the value of the koala hold at Cleland Wildlife Park

RESEARCH PROJECT

Koalas are considered one of the world's most iconic species and the outpouring of concern following the Black Summer fires demonstrated the world's commitment to this species. International tourists often flock for the opportunity to hold a koala. Research suggests the size, softness and forwardlooking eyes, mean koalas are a magnet to us, in a similar way human babies can be a magnet to people. However, is the "koala cuddle" an integral part of maximising the value of the species from a conservation perspective?

While cuddling a koala is no longer possible in many states, Cleland Wildlife Park still provides the "koala cuddle" opportunity. As we get set to open our international borders, is it time to reconsider this practice? Is holding an animal sending the "wrong message"? Or does the benefit of connecting with nature in this way outweigh any negative impacts? Can you receive the same benefit from just observing a koala? And what should the big message about koalas be?

This project is in collaboration with the Department of Environment and Water and Koala Life (the International Koala Centre for Excellence) and seeks to identify the key user patterns at Cleland to determine the centrality of the koala experience. It will determine the importance of the koala experience in influencing people's decision to visit Cleland and their satisfaction from the visit and assess the key message about koalas that people are leaving the park with. The end goal is to make recommendations about how to improve the koala experience at Cleland.

Tackling big environmental issues with cute animals

RESEARCH PROJECT

Together with tigers, panda, elephants, dolphin and polar bears, koalas are among the world's most iconic species. People think they are "cute". While their ecological importance is undisputed, their role in conservation could be more than the focus of photos. The World Wildlife Fund suggests they are a flagship or umbrella species that can help promote the importance of conservation more broadly, but is that happening in South Australia?

Cleland Wildlife Park is one of few areas in Australia that promotes koala holds but is this just for entertainment and revenue or can it, and other educational programs, help people to connect with koalas and larger conservation issues such as habitat loss and climate change? This project will use an educational intervention study to see if different interpretive offerings can lead to improved understanding of conservation messages and increase pro-environmental behaviours. This project is in collaboration with the Department of Environment and Water and Koala Life (the International Koala Centre for Excellence) and seeks to assess the effectiveness of current koala-related interpretive offerings (e.g. signs, keeper talks, koala hold, koala photos and interpretive programs) in terms of retention of key messages. Working in consultation with Cleland educators, you will develop a series of new offerings that align with key conservation messages and assess the change in effectiveness of messaging in terms of knowledge and behaviour. The overall goal is to make recommendations about how to improve interpretation of koalas at Cleland to enable key conservation messages to be communicated successfully.

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FIELD/S of STUDY

Human Dimensions of Environmental Management, Human-animal interactions, Conservation, Environmental Science



Environmental Science: Pollution & Water Treatment

- Are biodegradable plastic bags an environmental risk?
- Distribution of Arsenic in Australian rice
- Distribution and speciation of metals in traditional medicinal plants
- Electro-Coagulation influences on organic matters and turbidity contents of surface water sources
- Environmental Effects of Pollution Near a Coastal Smelter
- Ecotoxicity of lead contaminated soils after remediation to reduce childhood lead exposure
- Develop a 2D image scanning method to determine nutrient concentrations and profiles in water lagoons
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- Low toxicity carbon quantum dots for enhanced photosynthesis in globally important food crops.
- Artificial Trees: Plants Inspired Biomimetic Solar Evaporators for Efficient Environmental Remediation.
- Refining antimony exposure assessment in contaminated soil
- Spatial and temporal trends in potentially toxic elements and organic compounds in road dust
- Transforming Agricultural Wastes: Biogenic synthesis of nanocomposites for wastewater treatment.

Are biodegradable plastic bags an environmental risk?

SUPERVISORS

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FIELD/S of STUDY

Environmental Science and Engineering: biodegradation, composting, environmental risk assessment, heavy metals.

RESEARCH PROJECT

Biodegradable plastic bags are becoming increasingly attractive in Australia because of an associated "green" image. However, residual metals present in many biodegradable plastic bags may potentially pose a longterm threat to the environment. This project aims to provide baseline information on the type and potential for environmental harm from existing biodegradable plastic bags currently used in Australia and will assess the toxicological effect on the environment associated with the adoption of biodegradable plastic shopping bags when disposed to landfill or following composting.

Distribution of Arsenic in Australian rice

SUPERVISORS

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FIELD/S of STUDY

Environmental Science and Engineering: arsenic, environmental risk assessment, food security, speciation, rice

RESEARCH PROJECT

Arsenic (As) is a colourless and odourless poison where long-term sub-lethal exposure is associated with increased human health risk and the development of various cancers. In many South East Asian countries and the USA rice is often found to contain elevated levels of As. In Asia, these elevated levels are commonly associated with the irrigation of rice contaminated groundwater. In the USA, such levels are more commonly associated with the ubiquitous use of As based pesticides. In Australia very little is known about the source or extent of As in rice. In this project the distribution and severity of As in rice commercially available in Australian markets and/or grown in Australia will be determined and the risk of human health effects quantified.

RELATED ARTICLES

 EN 13432 (2000) Requirements for packaging recoverable through composting and biodegradation
Test scheme and evaluation criteria for the final acceptance of packaging; English version of DIN EN 13432 (FOREIGN STANDARD).

2. Gary Owens, Megharaj Mallavarapu and Ravendra Naidu (2006) Metal levels for inclusion in the Australian standard for compostability/biodegradability, University of South Australia, Final Project Report for the Department of Environment and Heritage, June 2006.

3. Gál J., Hursthouse A., Tatner P., Stewart F. and Welton R. (2008) Cobalt and secondary poisoning in the terrestrial food chain: Data review and research gaps to support risk assessment. Environ. Int., 34(6).

RELATED ARTICLES

1. Nasreen Islam Khan, Gary Owens, David Bruce and Ravi Naidu (2009) Human Arsenic Exposure and Risk Assessment at the Landscape Level: A Review, Environmental Geochemistry and Health, 31 (Suppl. 1), 143-166.

2. Nasreen Islam Khan, Gary Owens, David Bruce and Ravi Naidu (2009) An Effective Dietary Survey Framework for the Assessment of Total Dietary Arsenic Intake in Bangladesh: Part-A – FFQ Design, Environmental Geochemistry and Health, 31 (Suppl. 1), 207-220.

3. Nasreen Islam Khan, David Bruce, Ravi Naidu and Gary Owens, (2009) Implementation of Food Frequency Questionnaire for the Assessment of Total Dietary Arsenic Intake in Bangladesh: Part-B – Preliminary Findings, Environmental Geochemistry and Health, 31 (Suppl. 1), 221-238.

4. William Maher, Elliott Duncan, Hayden Martin, Peter Snell, Frank Krikowa, Rajani Jagtap, Simon Foster, Tariq Ezaz and Michael J. Ellwood, Arsenic concentrations and speciation in Australian and imported rice and commercial rice products, Environmental Chemistry, https://doi.org/10.1071/EN18073.

Distribution and speciation of metals in traditional medicinal plants

RESEARCH PROJECT

In many countries worldwide, traditional medicine using locally grown plants continues to be a common practice. However, there is a growing concern that this practice can potentially lead to detrimental health effects related to heavy metal toxicity when medicinal plants are consumed which accumulate high levels of heavy metals. The aim of this project is to determine the magnitude and severity of heavy metal contamination in medicinal plants and to understand the soil-toplant transfer patterns of these heavy metals for a number of common medicinal plants. This study could be applied to medicinal plants from India or traditional Chinese medicines, or indeed any cultural background that has a tradition of medicinal plant use

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FIELD/S of STUDY

Environmental Science and Engineering: analytical chemistry, biogeochemistry, heavy metals, human health risk assessment, medicinal plants, phytoavailability, plant uptake.

Figure 6: Two masters students examinine the growth of Perilla frutescens, a member of the mint family, which is widely cropped and used throughout South East Asia in both cooking and as a traditional medicinal herb. Of potential concern is that the exact same plant species is also identified as an efficient hyperaccumulator of the toxic heavy metal Cadmium (Cd). Thus there is concern that Perilla cropped on contaminated soils may accumulate metals in its edible parts and thus pose a potential threat to human health.

RELATED ARTICLES

1. Preeti Tripathi, Sanjay Dwivedi, Aradhana Mishra, Amit Kumar, Richa Dave, Sudhakar Srivastava, Mridul Kumar Shukla, Pankaj Kumar Srivastava, Debasis Chakrabarty, Prabodh Kumar Trivedi, Rudra Deo Tripathi (2012) Arsenic accumulation in native plants of West Bengal, India: prospects for phytoremediation but concerns with the use of medicinal plants, Environ Monit Assess, 184, 2617–2631.

2. P. Dzomba, T. Chayamiti and E. Togarepi (2012) Heavy Metal Content of Selected Raw Medicinal Plant Materials: Implication for Patient Health, Bulletin of Environment, Pharmacology and Life Sciences, 1(10), 28-33.

3. Mohammad Rahimi, Reza Farhadi and Mojib Salehi balashahri (2012) Effects of heavy metals on the medicinal plant, International Journal of Agronomy and Plant Production, 3(4), 154-158.



Electro-Coagulation influences on organic matters and turbidity contents of surface water sourceslead exposure

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1. Hasani G, Maleki A, Daraei H, Ghanbari R, Safari M, McKay G, et al. A comparative optimization and performance analysis of four different electrocoagulation-flotation processes for humic acid removal from aqueous solutions. Process Safety and Environmental Protection. 2019;121:103-17.

2. Hasani G, Daraei H, Shahmoradi B, Gharibi F, Maleki A, Yetilmezsoy K, et al. A novel ANN approach for modeling of alternating pulse current electrocoagulation-flotation (APC-ECF) process: Humic acid removal from aqueous media. Process Safety and Environmental Protection. 2018;117:111-24.

3. Xing L, Fabris R, Chow CWK, van Leeuwen J, Drikas M, Wang D. Prediction of DOM removal of low specific UV absorbance surface waters using HPSEC combined with peak fitting. Journal of Environmental Sciences. 2012;24(7):1174-80.

Figure 7: Electro-Coagulation lab-scale unit



RESEARCH PROJECT

Application of electrocoagulation in water/wastewater industry has gained more attention recently because of its potential high efficiency, lower pollutant production and feasibility to be controlled through online systems. The increasing rate of green electricity production through reversible sources e.g. solar, wind, geothermal, and marine power plants, as well as the other mentioned advantages of electrochemical based coagulation is making this technology more competitive than traditional chemical coagulation technique (1, 2).

Increase in organic matter content of surface water sources occurs because of accumulation and discharge of terrestrial organic matter from catchments into waterways along with increasing biological activities in surface water bodies like algae blooms. Recent focus of the drinking water production industry is to remove organic content from drinking water at the same time as turbidity to minimize disinfection by-product formation potential in treated supply water (3).

This project will investigate electrocoagulation for the technique's capabilities in removing organic content along with the turbidity, in the drinking water production process. The study will start by the design and construction of a flexible and modular pilot-scale EC unit. After successfully passing the pre-tests, the unit will be used to treat different water resource samples by electro-coagulation. The water quality will be analysed for the following parameters, e.g., TOC/DOC, UV-Vis, turbidity, EEM fluorescence, and zeta potential, before and after treatment to determine process efficiency.

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FIELD/S of STUDY

Water Treatment; Water Chemistry; Civil Engineering

University of South Australia

Environmental Effects of Pollution Near a Coastal Smelter

RESEARCH PROJECT

Port Pirie hosts the world's largest lead and zinc smelter, in constant operation for more than 130 years. Although discharges and emissions from the plant have reduced in recent years, there are elevated levels of metals such as zinc, lead, arsenic, cadmium and copper in the surrounding marine system. As part of a larger project addressing how contaminants are affecting the marine ecosystem of the upper Spencer Gulf, two projects are available:

a) Measuring metal contamination in seagrass

Seagrasses are an important and extensive component of the marine ecosystem in the upper Spencer Gulf and significant stands surround the smelter at Port Pirie. This project will measure metal contamination in seagrasses to determine stocks of metals in live and also dead (washed up, wrack) seagrass across Germein Bay, potentially an important route by which primary production (and contamination) enters the food chain. The project will assess the possibly dual role seagrass has in the way metals impact in the marine ecosystem of the Upper Spencer Gulf: facilitating the dispersal of metals via accumulation into leaves that are eventually dispersed as wrack that floats away, but also in the sequestration of metals in sediments as wrack is accumulated into areas like mangrove forests where it breaks down and/or is eaten.

b) Development of ecotoxicology tests for metal exposure in reverse estuaries

The shipping channel at Port Pirie is soon going to need dredging to allow the port (and adjacent smelter) to continue to operate, a process that will necessarily involve removing 1000s of cubic metres of highly contaminated sediments. This project will build on work in our group to develop ecotoxicology assays to assess the potential impacts of dredging/metal liberation on different species, relevant to South Australian conditions. While a range of ecotoxicological tests exist for assessing the risk of metals, few are appropriate for South Australia (using local species) and almost none consider that the upper parts of our gulfs are hypersaline (i.e. salinity > 35 ppt). Most assays we use in our lab focus on reproduction and early development in marine invertebrates and algae, but we are also interested in developing survival assays for benthic invertebrates and colonial groups like bryozoans and ascidians.



SUPERVISORS

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FIELD/S of STUDY

Marine Ecology, Environmental Science, Ecotoxicology, Pollution

Ecotoxicity of lead contaminated soils after remediation to reduce childhood lead exposure

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FIELD/S of STUDY

Remediation, Ecotoxicology, Metal Exposure, Soil Science; Environmental Science

RESEARCH PROJECT

Lead is a well-known neurotoxin, negatively affecting childhood neurological and cognitive development. Incidental ingestion of surface dust during hand-to-mouth activities in children living near lead smelters often exhibit high blood lead levels. A promising approach has been developed at UniSA to reduce childhood lead exposure by treating soil with iron amendments. Using this method, the chemical form of lead may be changed from a readily bioavailable form to a less mobile form, thereby reducing lead absorption from the gastro-intestinal tract. This study will assess the ecotoxicity of lead contaminated soil after iron amendment has been applied to immobilize lead in situ. Earthworms will be used as a bio-monitor to assess if the application of iron amendment will reduce oxidative potential and/or DNA damage (biomarkers). This study will use OECD protocol 207: Earthworm, Acute Toxicity Test and investigate the uptake of lead, arsenic and antimony in pre and post remediated soil, as well as monitor the potential reduction of reactive oxygen species generation and damage to DNA using enzyme-linked immunoassay (ELISA) and molecular techniques (Q-PCR). This study will provide valuable ecotoxicological information regarding field application of lead immobilization strategies that have been developed at UniSA.

Develop a 2D image scanning method to determine nutrient concentrations and profiles in water lagoons

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FIELD/S of STUDY

Environmental Science and Monitoring, Biogeochemistry, Nutrients, Sediment



RESEARCH PROJECT

Significant and widespread nitrogen and phosphorus pollutions have been reported in many water bodies globally and excessive nutrient loadings to lakes, rivers and estuaries are one of the major concerns for water quality management. The excessive nutrients in the water bodies have led to eutrophication and the associated problems of phytoplankton and algal blooms, and subsequent water column hypoxia or anoxia when these blooms collapse and decompose. A large amount of inorganic and organic nutrients can be trapped in the sediment. Through various biological, physical, chemical and mechanical processes, nutrients can be brought back from sediment to the free water and cause eutrophication. Understanding nutrient cycling between the sediment and water will be useful from a water management perspective and reduce nutrient loads in the aquatic environments.

Coorong is now facing severe environmental issues, such as acid sulfate soils/sediments, hypersalinity, algal blooms, etc. The Commonwealth and South Australian governments are investing \$70 million in a "Healthy Coorong, Health Basin" action plan, aiming to get the Coorong back on track. One of the projects is to apply the passive sampling techniques and other techniques to measure the nutrient profiles and fluxes in the Coorong sediment. This can help to provide the scientific data to inform what management actions can be taken to reduce nutrient loads and algae abundance in the Coorong. This project will collaborate with different researchers of multiple-disciplinary backgrounds from the University of Adelaide, Flinders University, Griffith University and other organisations.

RELATED ARTICLES

1. Preeti Tripathi, Sanjay Dwivedi, Aradhana Mishra, Amit Kumar, Richa Dave, Sudhakar Srivastava, Mridul Kumar Shukla, Pankaj Kumar Srivastava, Debasis Chakrabarty, Prabodh Kumar Trivedi, Rudra Deo Tripathi (2AO12) Arsenic accumulation in native planAts of West Bengal, India: prospects for phytoremediation but concerns with the use of medicinal plants, Environ Monit Assess, 184, 2617–2631. 2. P. Dzomba, T. Chayamiti and E. Togarepi (2012) Heavy Metal Content of Selected Raw Medicinal Plant Materials: Implication for Patient Health, Bulletin of Environment, Pharmacology and Life Sciences, 1(10), 28-33.

3. Mohammad Rahimi, Reza Farhadi and Mojib Salehi balashahri (2012) Effects of heavy metals on the medicinal plant, International Journal of Agronomy and Plant Production, 3(4), 154-158.

Image Analysis Technique for Coagulation Process Control

RESEARCH PROJECT

Application of particle characteristics techniques e.g. photometric dispersion analyser (PDA), turbidity analyser, and particle size analyser have been developed commercially for coagulation control purposes. These techniques can be employed as an online feed-backward control system for the coagulation process and to find the optimum dose of coagulant for the coagulation process through formed flocs characteristics. Light scattering is the key optical mechanism for these techniques because of its simple optical basics and because of its easy and practical operation and signals analysis. However, light scattering always suffers from serious noise and errors which influences particle shape, material, density, etc (Figure 8).

In this study, floc imagery will be investigated because it provides potentially reliable, more accurate and informative data. The proposed aim is to gain clearer information on the shape, size, density, and frequency in occurrences of particles and flocs. The main challenge in this technique will be the image analysis and the time needed to make this technique a the real-time coagulation control system (2).

This project aims to develop a new modular rapid image analysis instrument and to assess its capabilities for coagulation process control in comparison with the established PDA technique. The study will start by designing and constructing a flexible and modular lab-scale image analysis unit for jar test experiments. An image analysis code will be developed for this specific purpose. After successfully passing the pre-tests, the unit will be implemented in a real-scale coagulation unit of a drinking water treatment plant for further tests and assessments.

SUPERVISORS

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FIELD/S of STUDY

Water Treatment; Water Chemistry; Civil Engineering

REFERENCES

1. Ramphal S, Sibiya SM. Optimization of Time Requirement for Rapid Mixing During Coagulation Using a Photometric Dispersion Analyzer. Procedia Engineering. 2014;70:1401-10.

2. Juntunen P, Liukkonen M, Lehtola M, Hiltunen Y. Characterization of Alum Floc by Image Analysis in Water Treatment Processes. IFAC Proceedings Volumes. 2012;45(2):959-63.

Figure 8: A pre-test results of image analysis technique (left) in compare with PDA technique (right)





26 · University of South Australia



Figure 9: The Zeigler Experimental Station at the headquarters of the International Rice Research Institute (IRRI) in the Philippines, also known as the IRRI farm, is the home of the world's longest-running continuous rice research project, and as a living field laboratory provides a practical platform to explore how the latest advances in crop production can sustainably enhance rice production.

RELATED ARTICLES

1. Rosegrant and Cline (2003), Global food security: challenges and policies, Science, 302(5652), 1917.

2. Liu and Lal (2015) Potentials of engineered nanoparticles as fertilizers for increasing agronomic productions, Science of the Total Environment, 514, 31.

3. Rico et al. (2014) Cerium oxide nanoparticles impact yield and modify nutritional parameters in wheat (Triticum aestivum L.), Journal of agricultural and food chemistry, 62(40), 9669.

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5. Chandra et al., (2014) High throughput electron transfer from carbon dots to chloroplast: a rationale of enhanced photosynthesis, Nanoscale, 6, 3647.

Low toxicity carbon quantum dots for enhanced photosynthesis in globally important food crops

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FIELD/S of STUDY

Environmental Science and Engineering: agronomy, agriculture, biogeochemistry, environmental science and materials science, nanomaterials, nanotechnology

RESEARCH PROJECT

It is estimated that by 2050 the world's population will exceed 9 billion people with the consequential global increase in the demand for food currently beyond the means of current food production levels. To avoid this impending global food crisis, food production needs to at least double, but without compromising nutritional quality or increasing environmental degradation. Thus, inspired by recent advances in nanotechnology, this project addresses the approaching food crisis by developing new avenues for increased global food production via augmented photosynthesis.

Plants harvest sunlight via photosynthesis and convert it to electrochemical energy to drive important biochemical processes. However, photosynthesis is surprisingly a rather inefficient process, harvesting only a fraction of the available light energy. In this project a range of nontoxic carbon based nanomaterials, such as carbonaceous quantum dots (QDS), suitable for enhancing photosynthesis in rice and/or green algae will be synthesised and their photosynthetic potential evaluated. The project thus has the potential to increase crop yield via enhanced photosynthesis and thus directly affect the lives of millions of people in developing countries where agricultural operates on modest margins.

Artificial Trees: Plant Inspired Biomimetic Solar Evaporators for Efficient Environmental Remediation

RESEARCH PROJECT

Worldwide water pollution is a major issue, especially in developing countries where limited water resources are already stretched to breaking point and governments lack the resources to implement full wastewater treatment. Thus, with environmental pollution severely compromising food production and endangering human and ecological health globally, there is an urgent need to develop highly efficient remediation technologies which are simple, cheap, low in energy consumption, generate no secondary pollution and are applicable to a wide variety of contaminants. While phytoremediation, which uses plants to clean up contamination, has been proposed as an environmentally friendly option, it is slow and limited by contaminant phytotoxicity. What is required is a plant-like device capable of removing contaminants quickly, but which is immune to



Figure 10: Natural plant evapotranspiration and enhamced photothermal driven water sampling

contaminant toxicity. This project combines recent advances in photothermal technologies with traditional remediation approaches to achieve enhanced in situ environmental remediation.

Inspired by natural plant evapotranspiration (Figure 10), enhanced photothermal driven water sampling will be achieved using bionic plant-like structures to increase water evaporation and hence contaminant removal efficiency. This technique will be applied to both heavy metal (e.g. As, Cd, Pb) removal by incorporating an efficient adsorbent material, and to persistent organic pollutants including organochlorine pesticides (e.g. DDT) and emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) by incorporating efficient photocatalysts.

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FIELD/S of STUDY

Environmental Science and Engineering: environmental remediation, heavy metal, materials science, nanomaterials and nanotechnology, photothermal materials, solar steam generation, water treatment.

RELATED ARTICLES

1. Yida Wang, Xuan Wu, Xiaofei Yang, Gary Owens and Haolan Xu (2O2O) Reversing heat conduction loss: Extracting energy from bulk water to enhance solar steam generation, Nano Energy, 78, 105269. https://doi.org/10.1016/j. nanoen.2020.105269

2. Daniel Storer, Jack Phelps, Xuan Wu, Gary Owens, Nasreen Islam Khan and Haolan Xu (2020) Graphene and Rice Straw Fibre Based 3D Photothermal Aerogels for Highly Efficient Solar Evaporation, ACS Applied Materials & Interfaces, 12(13), 15279-15287. 3. Xuan Wu, Max Edward Robson, Jack Leslie Phelps, Jeanette Sorupia Tan, Bo Shao, Gary Owens and Haolan Xu (2019) A flexible photothermal cotton-CuS nanocage-agarose aerogel towards portable solar steam generation, Nano Energy, 56, 708-715.

4. Durr-e-Shahwar Noman and Gary Owens (2018) Chapter 12: Wastewater Treatment and Role of Green Synthesized Metal Oxide Nanocomposites, In: Nanotechnology Applications in Environmental Engineering (Ed. Rabia Nazir), Pakistan Council of Scientific and Industrial Research Laboratories Complex, Pakistan), pg 268-307.

Refining antimony exposure assessment in contaminated soil

RESEARCH PROJECT

Antimony is suspected to be a human carcinogen and contamination of soil may result from industrial activities. Although mining and smelting activities have been linked to antimony contamination in many regions, the extent of this contamination in Australia is largely unknown. Consequently, methods to assess antimony exposure, for example bioaccessibility (dissolution in simulated gastrointestinal fluid) or bioavailability (absorption into systemic circulation) is currently lacking. This study aims to investigate factors affecting antimony bioaccessibility (e.g. pH, composition of simulated gastrointestinal solutions and other physicochemical and experimental parameters) to refine an approach for predicting antimony exposure in humans. Results of this study will be used to assess the influence of antimony co-contamination in mining/smelting impacted Australian soil, as well as to refine exposure for human health risk assessment.

Spatial and temporal trends in potentially toxic elements and organic compounds in road dust

RESEARCH PROJECT

Particulate matter generated from vehicular exhaust is increasingly being recognised as a potential source of environmental contaminants that may adversely impact on human health. Paved road dust acts as a sink for potentially toxic elements and organic compounds which may be distributed throughout the environment as a result of aeolian movement. Direct emission from tailpipes contributes to a large fraction of the particulate matter pollution in cities however, they can also be generated during tire braking and general wear and tear of cars. This project aims to study the spatial and temporal variability in the concentration of road dust, as well as the toxic components within. Exposure assessment techniques will also be utilised to determine the potential risk associated with exposure to vehicular dust.

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FIELD/S of STUDY

Metal Exposure; Soil Science; Bioavailability; Environmental Science

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FIELD/S of STUDY

Metal Exposure; Polyaromatic Hydrocarbons; Bioavailability; Environmental Science

Transforming Agricultural Wastes: Biogenic synthesis of nanocomposites for wastewater treatment

RESEARCH PROJECT

Two of the most important global issues today are the sustainable provision of clean water and nutritious food. However, driven by an ever increasing world population and industrialisation, water pollution is increasing. Methodologies that allow wastewater to be reused are therefore of significant national benefit allowing pristine water to be allocated for alternative uses. In addition, agricultural waste, which is already a significant issue, will only increase in the future. This project simultaneously provides a novel solution to both of these problems by developing advanced biogenic engineered nanomaterials (ENMs) from agricultural waste biomass for wastewater treatment.

In this project metal oxide nanomaterials will be prepared via a green synthetic route and characterised for removal efficiency for one or more common pollutants (i.e. arsenate, azo dyes cadmium, DDT,).nitrate, phosphate). The project further embraces the latest advances in green techniques ENM fabrication by not only using agricultural waste plant extracts to facilitate ENM reduction and capping but also uses the modified residual plant waste biomass simultaneously as an ENM biosupport, thus obtaining better water treatment efficiencies.

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FIELD/S of STUDY

Environmental Science and Engineering: environmental rehabilitation, green synthesis, materials science, nanomaterials, nanotechnology, plant extracts, recycling, waste reuse, water treatment.



STRAW



BIOSUPPORT



nFe

Figure 11: The figure above represents the overall process from raw waste (straw) to biosupport and finally to a biogenic ENM (nFe) decorated nanocomposite.

RELATED ARTICLES

1. F. Luo, Z. Chen, M. Megharaj, R. Naidu, RSC Adv., 4 (2014) 53467-53474.

2. Y. Xie, B. Yan, H. Xu, J. Chen, Q. Liu, Y. Deng, H. Zeng, ACS Appl Mater Interfaces, 6 (2014) 8845-8852.

3. X. Jin, Y. Liu, J. Tan, G. Owens, Z. Chen, J. of Clean. Prod., 176 (2018) 929-936.

4. J. Fang, X.Q. Shan, B. Wen, J.M. Lin, G. Owens, S.R. Zhou, Environ. Pollut., 159 (2011) 1248-1256.

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Environmental Health and Food Safety

- Assessment of remediation strategy efficacy for Port Pirie leadcontaminated soil
- Assessment of indoor exposure to environmental contaminants the use of passive samplers for organic exposure analysis
- Accumulation of environmental contaminants in home grown vegetables
- Unpacking exposure pathways of PFAS from seafood
- Developing proteomic methods to track the authenticity and provenance of seafood to combat seafood fraud

Assessment of remediation strategy efficacy for Port Pirie leadcontaminated soil

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FIELD/S of STUDY

Environmental Science, Exposure Assessment, Human Health Risk Assessment, Remediation

RESEARCH PROJECT

Port Pirie is one of several environments in Australia which has been impacted through lead mining/ smelting activities. Elevated concentrations of lead have been detected in the peri-urban environment in addition to elevated blood Pb levels in Port Pirie's children. Lead exposure is a significant global concern due to its negative impact on neurological and cognitive development in children. As a consequence, risk management / remediation strategies are required in order to minimise the impact of lead exposure on childhood health. This project aims to assess the efficacy of remediation strategies for reducing exposure to lead-contaminated soil and dust. Research will focus on immobilisation strategies that can promote the formation of lead species (e.g. pyromorphites, tertiary lead phosphates, plumbojarosite), which exhibit low solubility in the acidic conditions of the stomach, thereby limiting availability for absorption in the small intestines. In vitro techniques will be utilised to assess treatment efficacy. Data will be used as input parameters into the Integrated Exposure Uptake Biokinetic Model (IEUBK) to determine the potential impact of immobilisation strategies on reductions in childhood blood lead levels.

Assessment of indoor exposure to environmental contaminants – the use of passive samplers for organic exposure analysis

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FIELD/S of STUDY

Environmental Science, Exposure Assessment, Human Health Risk Assessment

RESEARCH PROJECT

Many people spend a large part of their lives indoors, and as such, the quality of the indoor environment is important. As part of everyday life, people are exposed to a wide variety of organic compounds (e.g. flame retardants, plasticisers, semi-volatile compounds) in everyday consumer products. Many of these compounds may exhibit adverse health effects at elevated doses or following chronic lowdose exposure. This project aims to assess the potential of passive samplers (for household, office or personal use) to measure the abundance of semivolatile compounds as a means of estimating human exposure. An interest in environmental contaminants and some background in chemistry would be advantageous for this project.



Figure 12: Yu, P.-F. et al. (2021). Variety-selective rhizosphere activation, uptake and subcellular distribution of perfluorooctanesulfonate (PFOS) in lettuce (Lactuca sativa L.). Environmental Science and Technology 55: 8730-8741.

Accumulation of environmental contaminants in home grown vegetables

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FIELD/S of STUDY

Environmental Science, Exposure Assessment, Human Health Risk Assessment

RESEARCH PROJECT

The presence of per- and polyfluoroalkyl substances (PFAS) in the environment has emerged as a significant environmental and human health issue. PFAS are highly persistent, man-made chemicals used in many manufacturing processes, found in numerous commercial products and environmental media (e.g. water). A potential PFAS exposure pathway is from the consumption of PFAS-contaminated food, although little research has been undertaken on the amount that may accumulate in homegrown vegetables. This project will assess PFAS uptake and accumulation in commonly grown varieties to determine whether vegetable consumption is a significant route for PFAS exposure.



Unpacking exposure pathways of PFAS from seafood

RESEARCH PROJECT

Per- and polyfluorinated alkyl substances (PFAS), otherwise known as "forever chemicals", are used in a wide range of industrial applications. They are extremely persistent in the environment and can bioaccumulate within marine ecological communities. The accumulation of PFAS within marine communities may not only impact the health of fish and invertebrates, but also humans via the consumption of seafood. Seafood consumption is believed to be one of the key exposure pathways of PFAS in humans but remains relatively undocumented in Australia. Seafood is an increasingly important source of food and high-quality protein and nutrients thus, it is important to unpack potential exposure pathways of PFAS via seafood products. For this project you will use liquid chromatography with tandem mass spectrometry (LC-MC-MC) to analyse exposure pathways of PFAS from both imported and local seafood.

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FIELD/S of STUDY

Environmental science, human health, marine biology



Developing innovative methods to track the authenticity and provence of seafood

SUPERVISORS

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FIELD/S of STUDY

Marine Biology, Sustainable Seafood, Environmental Science, Food Authentication and Provenance, Geochemistry

RESEARCH PROJECT

As global demand for food increases, so does the need to find reliable and sustainable sources of food. Seafood is an increasingly important source of food and high-quality protein, but it is also the most traded food product in the world and highly susceptible to fraud. Identifying the provenance and authenticity of seafood will empower authorities to combat seafood fraud and meet consumer expectations for safe and socially and environmentally responsible food. For this project you will adopt cutting-edge technology to obtain chemical signatures of marine species and to assess their authenticity and/or provenance. Project details and supervisory team will be refined to suit your interests as well as align with the latest research opportunities.

Geospatial Science

- Identification and mapping of potential habitat corridors
- How does vegetation respond to regional climate a study using UAV-LiDAR data and microclimate measures

Identification and mapping of potential habitat corridors

RESEARCH PROJECT

The global loss of biodiversity has exceeded boundaries for human populations to continue to develop and thrive. This loss of biodiversity is further beyond planetary boundaries than is evident for climate change and thus requires urgent action. Australian cities provide important habitats for threatened species, with more threatened species per unit of area found in cities than in non-urban areas. It is important to conserve populations of indigenous species in cities because local populations are genetically distinct and important for the resilience and productivity of local habitats.

This research project aims to use, identify and map habitat hotspots and potential habitat corridors within the City of Burnside. While many species have been lost, there are threatened species that persist within the City of Burnside, including: Southern Brown Bandicoots, Yellow-footed Antechinus, Yellow-tailed Black Cockatoos, Cunningham's Skinks and Bibron's toadlets. Using geospatial data and GIS analysis, the task is to determine the importance of local areas for biodiversity and to identify where future improvements could be made to Council's biodiversity network. There are two types of improvements to investigate:

1. Increasing the area of land being managed for biodiversity

2. Developing habitat corridors to connect or expand existing habitat

This project is designed to inform decision making and support Biodiversity Sensitive Urban Design (BSUD).

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FIELD/S of STUDY

Biodiversity, GIS, Spatial Analysis, Conservation, Ecology, Environmental Science





How does vegetation respond to regional climate – a study using UAV-LiDAR data and microclimate measures



Figure 13: Drone with LiDAR payload

RESEARCH PROJECT

Fine-scale climate data are required to get a better understanding of how South Australian forests and woodlands locally moderate regional climate. Currently at five trial sites, temperature and humidity measurements are taken along transects every 10 minutes. Moreover, LiDAR point clouds of the study areas have been captured via a drone. These point clouds provide valuable structural information about the vegetation in a three-dimensional space by the means of LiDAR metrics. These metrics are statistical descriptions of the Lidar point dataset.

This study will investigate correlations between vegetation structures and microclimate measures.

Some geospatial background would be advantageous.

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FIELD/S of STUDY

Geospatial Science, LiDAR, Climate change, Conservation, Ecology, Environmental Science



Figure 14: Exemplary UAV-LiDAR point cloud (altitude based color gradient)



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