DATA QUEST

2020
Bushfire Challenge Handbook

MINDEROO FOUNDATION

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DATA QUEST 2020
WELCOME

I am thrilled and honoured to be the first Program Director for Trillium Tech, creating and leading programs across Australia and New Zealand.

Data Quest is our first local event and aims to do great science by connecting brilliant researchers. By drawing on a wide range of experience, skills and viewpoints, the teams will naturally create better outcomes. We harness the best practices from the private, academic and non-profit sectors, and believe that agile methods can accelerate research for the benefit of all humanity.

The immediate research sprint is only a small part of why we are organising the Data Quest. We also want to build a long-term, resilient and friendly network of interdisciplinary scientists in Australia and New Zealand. We are better together, especially when our shared connections inspire us to new achievements and support us to get there. We hope individual researchers will be challenged, motivated and supported by their teammates, and come away from the experience a little wiser.

CORMAC PURCELL
DATA QUEST LEAD
AUSTRALIA AND NEW ZEALAND PROGRAM DIRECTOR
TRILLIUM TECH

BUSHFIRES CHALLENGE BRIEFING

WHY NOW?

As we enter into the third decade of the 21st century and a global population approaching 8 billion, problems once confined to the future are now the unprecedented challenges of our present.

Australia's tragic and debilitating '19–'20 Bushfire season is both a case-study and call to arms to acknowledge this new category of 'future problem' – one that demands and measures the best of our resources and skills.

In parallel, geospatial technology and machine learning (ML) have recently matured to be genuine game-changers in tackling these challenges. For decades satellite data was limited by the constraints of low temporal refresh rates, moderate spectral and pixel resolution, high cost and complex access workflows. Over the past few years a revolution in availability, quality and capability has opened up the field of 'geospatial information' – allowing us to observe our planet in the petabyte scale for the first time. Meanwhile, the recent ability for machines to learn through ingestion of large data-sets presents new opportunities for mining peta-scale data from space.

ML can stream-line workflows, detect anomalies, featurise and characterise – and when added together into pipelines can be used to make powerful tools to assist decision makers.

AI will always require humans in the loop. This last feature of machine learning is an important part of understanding the opportunity before us. AI is just a tool and as with any bleeding edge engineering, requires diligent validation. This is quite different from the 'fail fast and break things' philosophy (Facebook founder Mark Zuckerberg reported mantra) of the web and social technologies that fueled vast growth at scale in software development and platforms. Despite ML's close relationship to software development, the actual practice of making tools to enhance decisions demands a completely different attitude to production of these tools. Processes like 'hackathon' and skunkworks – where off-the-shelf tools are strung together in inventive ways – need deeper thinking and greater rigour for the rapid development of new approaches and applications of ML enabled decision making.

The goal of the Data Quest is twofold. **(1) To create an opportunity to catalyse the powerful outcomes of interdisciplinary skills** – particularly individuals steeped in the 'problem space' (i.e. individuals who know the complex nuances of a challenge) and individuals in the 'solution space' (people who are tracking the rapid evolution and associated toolbox of a technology domain.) and **(2) provide a framework for rigour and evaluation**, so nascent AI ideas can be assessed as genuine opportunities, rather than just a flash in the pan demo.

The Data Quest team brings over five years experience in developing cutting edge AI for grand challenges. Over those five years we have learnt that the strongest solutions with the greatest potential are built on the strength of the community that brings brilliant minds together to crack big questions. Data Quest 2020 is the first step, our ambition is focused on building a movement for the good of humankind to tackle a range of challenges so important to Australia and New Zealand's future.

Ad astra per algorithmos.

Cormac Purcell and Sarah McGeehan

DATA QUEST METHODOLOGY

Data Quest is an accelerated basic research methodology to develop proof of concept AI4EO applications in a very short period of time. It focuses on delivering a significant utility and (perhaps most importantly) a strong development and advisory bench around the opportunity – establishing a strong foundation to take results to deployment.

Data Quest's primary goal is to create confidence around a high-risk / high reward application of machine learning for Bushfire defence.

In the parlance of NASA / DARPA's TRL (Technology Readiness Level) system, Data Quest products are a level 2 outcome: *Technology Concept Formulation*, providing enough evidence to proceed from the concept stage to an experimental proof of concept.

Another way of saying this is that 'the Quest' aims to show something is solvable (as opposed to solved) in just 7 days.

The flow of activity isn't to be confused with a 'hackathon' – where the goal is to go from clean sheet of paper to demo – rather, the Quest format begins with a clear definition of desired outcome and the goal is to develop a plausible ML pipeline.

This acceleration methodology is built on 5 key success factors.

01 START WITH LASER-FOCUSED PROBLEM DEFINITION

By starting with a tightly articulated goal, Data Quest contributors can more effectively search for relevancy – in other words, focus matters – especially as a team learns to work together.

02 TEAMS OF INTERDISCIPLINARY EXPERTS

Breakthroughs invariably happen when domain specialties collide, or to use a visual metaphor, at the edges of the bell curve. Psychologists point to group think, attention blindness and other cognitive biases (such as the Asch conformity bias) as the reasons why seasoned experts often can't see what fresh eyes can.

03 CO-OPETITION

Rather than working competitively on the same problem (without sharing resources), our teams are tasked to work on related but adjacent challenges within a culture of co-operation and open discussion – building on each other's work in a generative way. The net result is a much broader set of skills – and fresh heads – applied to the challenges at hand.

04 ENCOURAGE OBLIQUE DISCOVERY THROUGH RAPID ITERATION

Doing things, iterating, making mistakes and learning comprise the unspoken engine of invention. However, as Stephen Covey points out in his book, 'Where good ideas come from', chance favors the prepared mind. Where experience has immense benefit is the ability to see the value in a wrong turn or accidental ('oblique') discovery. Everything from Superglue to the Big Bang was discovered this way. Hence we are supporting our Data Quest teams with a diverse faculty.

05 PLAN FOR COLLECTIVE RECOGNITION

As a team makes its journey of discovery, it self-educates, creating a deeper understanding of a problem. This mature understanding allows collective recognition when a solution presents itself. Invariably true breakthroughs take this form – rather than a light bulb moment, or lone act of genius, the team arrives at a powerful piece of thinking in the form of a 'slow hunch'.
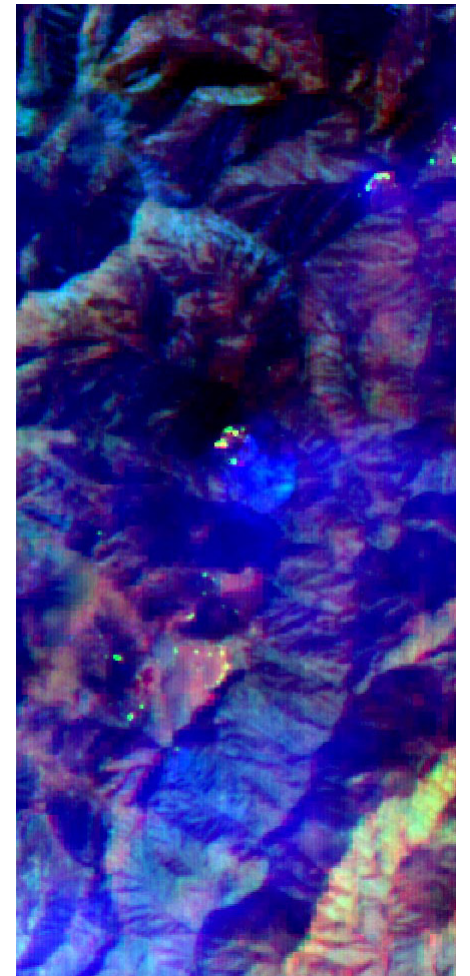
AI IS
A TEAM SPORT

One of the success factors of Data Quest is the close attention we pay to creating the "psychological safety" for world-beating interdisciplinary work. In other words, healthy culture is crucial in enabling a safe space for teams to probe deeper, turn over concepts more thoroughly, try things out more frequently and – perhaps most importantly – allow flashes of genius to get nurtured rather than squashed.

Data Quest is space-camp for geniuses. The art of a successful project is 'collective genius', which allows high functioning teams to imagine bolder approaches and deliver far beyond what might be achieved alone.

We rely on everyone at Data Quest to foster a respectful and creative work environment. We ask everyone to be scientifically and academically enquiring and encourage (and expect) lively debate. But, we also insist on collegial attitudes and mutual respect for differing opinions and ways of working through challenging problems. We expect everyone who joins us to use their best endeavours to promote the interests and objectives of the program within and beyond their team.

We have enshrined these principles in our 6 "C"s

COMMUNITY
Together we are even more awesome

CURIOSITY
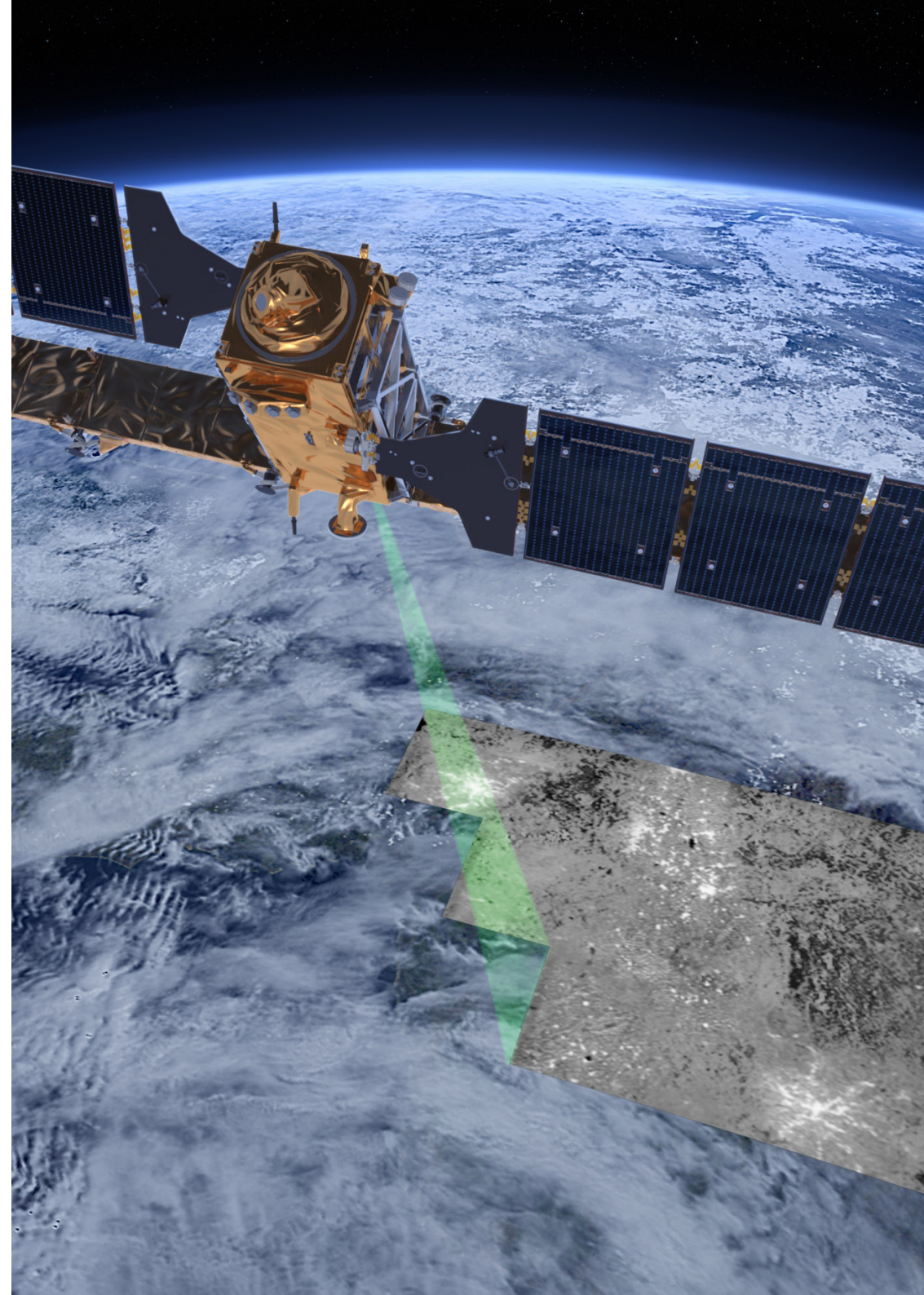It leads you and your team to new places

COMPASSION
This level of intense focus is hard. Be kind

COURAGE & CO-CREATION
Be radical and build together

COMEDY
See your problem with fresh eyes

ML
LEADERSHIP
FROM TRL 0 TO TRL 2 IN JUST SEVEN DAYS

A key principle of Data Quest is that the outcome is clearly established as an explicit need with:

- **Clear boundaries**
- **Definition of beneficiaries**
- **The data required**

The reason for embarking on 'the Quest' is therefore well understood, however the way to get there; the ML pipeline – or map – remains to be defined and most importantly, validated.

Scoping the boundaries of the ML opportunity and the most appropriate approach for benchmarking is the role of our AI technical committee co-chairs, Chedy Raissi and Yarin Gal.

Chedy Raissi received his PhD in Computer Science from the Ecole des Mines d'Ales in July 2008. After completing his PhD, Chedy worked as a research fellow (post-doctoral researcher) at the National University of Singapore on privacy-preserving data mining with emphasis on the anonymization of clinical trial data.

In 2010, Chedy was appointed as a permanent research scientist (chargé de recherche) at the French Institute for Research in Computer Science and Automation (INRIA), France where he joined the orpailleur team and worked in the field of sequence and graph combinatorics and concept lattices (also known as "Galois lattices").

Since 2019, Chedy is on a sabbatical leave from INRIA and joined Ubisoft Singapore as the Data Science Director where he leads a new team of researchers and engineers to shape up innovative projects for machine learning and video games.

Yarin Gal leads the Oxford Applied and Theoretical Machine Learning group (OATML) at the University of Oxford. He is the Associate Professor of Machine Learning at the Computer Science department, and is also the Tutorial Fellow in Computer Science at Christ Church, Oxford, and an AI Fellow at the Alan Turing Institute, the UK's national institute for AI. Prior to his move to Oxford he was a Research Fellow in Computer Science at St Catharine's College at the University of Cambridge.

He obtained his PhD from the Cambridge machine learning group, working with Zoubin Ghahramani FRS and funded by the Google Europe Doctoral Fellowship.

Yarin made substantial contributions to early work in modern Bayesian deep learning—quantifying uncertainty in deep learning—and developed ML/AI tools that can inform their users when the tools are "guessing at random". These tools have been deployed widely in industry and academia, with the tools used in medical applications, robotics, computer vision, astronomy, in the sciences, and by NASA.

Beyond his academic work, Yarin works with industry on deploying robust ML tools safely and responsibly. He is a technical advisor with numerous startups, and was named one of MIT Technology Review's 35 Under 35 in Europe 2019.

Chedy and Yarin started their journey with Frontier Development Lab (FDL) in 2015. In 2016, they were appointed as the technical co-directors for FDL and they both share the role of leading FDL and the Data Quest's AI Technical Committee – a cross challenge function that ensures 'solvability' from an ML perspective and maintains the commitment to robust, explainable models.

Over the years, Yarin and Chedy have been working across teams on crafting project definitions, risk mitigation and project planning, and advising on ML methodology. Their contributions further include supporting teams through academic publications, and structuring high-risk projects.

Outside of Data Quest and Science in general, you can often hear Yarin and Chedy discussing different "gastronomical finesse" and recipes.

AITC CO-CHAIR
CHEDY RAISSI

AITC CO-CHAIR
YARIN GAL

THANKS TO OUR PARTNERS

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WELCOME FROM **OUR PARTNERS**

Challenge Partner

Natural hazards are becoming more frequent, damaging and costly. People, infrastructure and assets are more exposed and vulnerable. The physical, societal, environmental and economic effects are long lasting and complex. There has never been a more important time to lift national and global resilience in the face of natural disasters and crises.

Innovation and development of approaches to disaster resilience can be aided by a contemporary philanthropic model that offers: speed of response, innovation and the ability to mobilise the best in Australia and from around the world, equity to ensure that the disadvantaged are taken care of, direction by rapidly delivering outcomes, and convening networks with a motive for delivering high impact outcomes.

Established by Andrew and Nicola Forrest in 2001, Minderoo Foundation is a modern philanthropic organisation seeking to break down barriers, innovate and drive positive, lasting change. Minderoo Foundation's Fire Fund was launched in 2020 and pledged AUD$70 million to help rebuild communities, revitalise local economies and develop a long-term blueprint for natural disaster resilience in Australia.

The objective of Minderoo Foundation's Wildfire and Disaster Resilience Program (WDRP) is to drive a new model for global leadership in climate-induced disaster resilience, reducing societal, environmental and economic harm, and positioning Australia as the emerging global leader in fire and flood resilience by 2030.

The program is convening leading experts to develop a globally relevant national blueprint for fire and disaster resilience, piloting new practices and investing into the application of evidence-based techniques applicable to bushfire prone regions around the world. This global effort aims to engage contributors and funders to grow the initial investment to AU$500 million and launch a mission model to deliver multi-disciplinary, multi-organisational and multi-jurisdictional systemic interventions aligned to the core objectives of the program.

We are proud to be the Challenge Partner of the Bushfire Data Quest 2020 and supporting novel approaches to innovation and translation of science into practice for social benefit and systemic change in building natural disaster resilience for Australia and the world.

"**Minderoo Foundation Wildfire and Disaster Resilience Program is excited to be the Challenge Partner of the Bushfire Data Quest 2020.** With this year's fire season fast approaching and communities still feeling the disastrous effects of Australia's bushfire crisis last summer make our collective work – including piloting new ways of preparing for and responding to disasters more vital than ever.

Minderoo Foundation's experience working on the ground in fire affected communities this year has highlighted that existing technology and systems leave us ill-equipped to deal with large-scale disasters like fire, flood and other unforeseen challenges. We know further threats and shocks will come in the future, and this is why we need new approaches to lift national resilience. The Bushfire Data Quest 2020 builds on the excellent work many are already doing in this space, tackling change through the system as a whole, and supporting out of the box thinking and solutions. I'm pleased that we can support the great minds that have come together to solve parts of the problem and trial new methods to overcome the grand challenges we face in this area."

ADRIAN TURNER
CEO, MINDEROO FOUNDATION FIRE FUND

WELCOME FROM **OUR PARTNERS**

Technology Partner

"**As the clock ticked over to welcome in the year 2020, we watched in horror as bushfires ravaged our country.** More than 20% of our native forests burned, an estimated one billion Australian animals perished, lives were lost, and homes destroyed. All that we held so dear as Australians was severely damaged.

Data Quest aims to push the frontiers of research and develop new tools to help solve some of the biggest challenges that humanity faces. This year's Bushfire Data Quest 2020 is indeed addressing a challenge close to our hearts.

The team at DUG is excited to be part of a collaboration of industry, technology, science and research that will push the boundaries of conventional thinking in the quest to discover real solutions to improve our planet. We are honoured to provide the technology platform that will be the launching pad of truly powerful thinking."

DR MATTHEW LAMONT PH.D.
MANAGING DIRECTOR

PHIL SCHWAN
CHIEF TECHNOLOGY OFFICER

DR TROY THOMPSON PH.D.
RESEARCH PRINCIPAL

DR STUART MIDGLEY PH.D.
SYSTEM ARCHITECT

CLAIRE SIGWALT
BUSINESS MANAGER – HPCAAS

MARIE SMYTH
MCCLOUD BD MANAGER

Australian
National
University

InSpace
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Research Partner

"**Using AI and geospatial data, the Bushfire Data Quest has the potential to unlock new ways to protect Australian, communities and wildlife from devastating bushfires.**

We are proud to support this collaborative and innovative effort which has the potential to enhance worldwide bushfire management and prevention.

We look to support initiatives with the potential to solve profound problems and save lives. We are honoured to be part of the extremely valuable work of the Bushfire Data Quest. With only a few months until the next bushfire season, this research sprint could have an important role in protecting our nation."

PROF ANNA MOORE
DIRECTOR OF THE AUSTRALIAN NATIONAL UNIVERSITY INSTITUTE FOR SPACE AND THE ADVANCED INSTRUMENTATION AND TECHNOLOGY CENTRE

DR MARTA YEBRA
SENIOR LECTURER IN ENVIRONMENT AND ENGINEERING AT AUSTRALIAN NATIONAL UNIVERSITY

NSW GOVERNMENT

Research Partner

NSW Treasury

NSW GOVERNMENT

Research Partner

Office of the NSW Chief Scientist & Engineer

THE HON. STUART AYRES MP
MINISTER FOR JOBS, INVESTMENT, TOURISM
AND WESTERN SYDNEY

"In a country with a high bushfire risk, satellite images and data play an increasingly vital role in protecting our communities and environment. Not only do satellites help detect bushfires, they can allow us to predict their movement and assess the damage they cause.

The NSW Government is supporting the development of local capability through our $5 million Space Industry Development Strategy, generating investment and jobs in this important sector and contributing to safety and well-being in our fire-prone landscapes. We're proud to support FDL's Bushfire Data Quest and look forward to seeing the unique solutions developed to manage and prevent bushfires."

PROFESSOR HUGH DURRANT-WHYTE
NSW CHIEF SCIENTIST & ENGINEER

"Bushfire Data Quests collaborative, data-led approach will not only consolidate our historic knowledge in this crucially important environmental area, but also allow for the development of strategies to plan for, and mitigate, future bushfire events."

WELCOME FROM **OUR PARTNERS**

"In response to the devastating Australian bushfires in January the Minister for Industry, Science and Technology, the Hon Karen Andrews MP, tasked the Australian Space Agency to consider the role of space-based Earth Observation to support planning, response and recovery efforts related to bushfires.

We now have the opportunity to further innovate how we use satellite data through Earth Observation imagery. In partnership with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Geoscience Australia (GA) and the Bureau of Meteorology, the Australian Space Agency has established a taskforce which has engaged with emergency management agencies, state and territory governments, and the research community.

The taskforce is working together to understand this issue and consider opportunities for the future, including how we can effectively apply satellite data to mitigate the risk of bushfires occurring and further enhance our response during bushfires."

DR MEGAN CLARK AC
HEAD

ANTHONY MURFETT
DEPUTY HEAD

ANNTONETTE (ANNY) DAILEY
EXECUTIVE DIRECTOR, OPERATIONS AND COMMUNICATIONS

KARL RODRIGUES
EXECUTIVE DIRECTOR, INTERNATIONAL AND NATIONAL ENGAGEMENT

ADAM SEEDSMAN
EXECUTIVE DIRECTOR, STRATEGY AND POLICY

ALEXANDRA SENETA
EXECUTIVE DIRECTOR, REGULATION AND INTERNATIONAL OBLIGATIONS

AUDE VIGNELLES
EXECUTIVE DIRECTOR, PROGRAM AND CAPABILITY

PROFESSOR RUSSELL BOYCE
DIRECTOR OF UNSW CANBERRA SPACE AND CHAIR FOR INTELLIGENT SPACE SYSTEMS

"UNSW Canberra Space gets out of bed each day to develop and demonstrate the art of the possible for combining artificial intelligence and space technologies, to help meet challenges and opportunities on the ground. Intelligent space systems offer a pathway to rapidly turn remotely sensed data into actionable information, piped directly to the user. The Bushfire Data Quest is an excellent specific example of the broader opportunity offered by FDL, to develop both the science and the talent pool that are needed for that future, and UNSW Canberra Space is excited to be closely involved"

"The recent bushfire seasons have been startlingly severe. The impacts are felt throughout the entire community. At Fireball we use sensor fusion and machine learning to detect bushfires within minutes of ignition and to model bushfire behaviour.

It is exciting for Fireball to be a part of Data Quest and to contribute to the development of new technologies that may help us better understand and respond to bushfire risks."

TIM BALL
CO-FOUNDER/CEO, CHAIRMAN USA

CHRISTOPHER C.E. TYLOR
CO-FOUNDER/CEO, CHAIRMAN AUSTRALIA

Australian Government

Geoscience Australia

SIMON OLIVER
GEOSCIENCE AUSTRALIA

"The Bushfire Data Quest represents a fantastic opportunity to advance our thinking, and to help realise the true potential of near-time Earth Observation applications to emergency management."

MACQUARIE University

PROFESSOR DAN JOHNSON
PRO VICE-CHANCELLOR (RESEARCH INNOVATION)

"Macquarie University is delighted to support Data Quest in their first Australian Data Quest: Detecting and Responding to Bushfires.

Data Quest innovative approach exemplifies the tradition of cross-disciplinary, industry-engaged research upon which Macquarie University prides itself and we are excited to see the ideas and solutions generated at this ground breaking event."

NORTHWEST NAZARENE UNIVERSITY

JOEL PEARSALL
PRESIDENT

"Northwest Nazarene University is pleased to partner with the Bushfire Data Quest. This is an excellent opportunity for the faculty and students of NNUs College of Natural & Applied Sciences to share the benefits of our ongoing applied research in disciplines as diverse as Fire Ecology, Astronautics, Biomedical, Agriculture and Archaeology. We look forward to continuing our partnership in the Bushfire Data Quest, with the goal of assisting in the development of solutions specific to the problems faced with management of bushfires in Australia and New Zealand."

DALE HAMILTON
PROFESSOR OF COMPUTER SCIENCE

"The Bushfire Data Quest is an excellent opportunity for the Northwest Nazarene University Computer Science Department to apply our ongoing geospatial research into the application of artificial intelligence for mapping issues relevant to fire ecology. We look forward to exploring how our ongoing ecoinformatics research working with wildland fire in the United States can be enhanced by partnering with Data Quest in solving problems experienced in Australia and New Zealand specifically related to bushfire."

DATA QUEST TEAM

CORMAC PURCELL
DATA QUEST LEAD,
TRILLIUM TECHNOLOGIES

SARAH MCGEEHAN
DATA QUEST CO-LEAD,
TRILLIUM TECHNOLOGIES

RUSSELL BOYCE
UNSW SPACE &
DATA QUEST STEERING
GROUP

MARK CHEUNG
LOCKHEED MARTIN &
DATA QUEST STEERING
GROUP

JAMES PARR
FDL FOUNDER, CEO
TRILLIUM TECHNOLOGIES

EMELINE PAAT-DAHLSTROM
DATA QUEST TEAM

SUDANTHA BALAGE
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LEE SPITLER
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RICHARD STRANGE
DATA QUEST DATA
WRANGLER

JODIE HUGHES
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DATA QUEST SCIENCE FACULTY

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SCION CROWN RESEARCH
INSTITUTE, NZ

DR MARTA YEBRA
AUSTRALIAN NATIONAL
UNIVERSITY

A/PROF DALE HAMILTON
NORTHWEST NAZARENE
UNIVERSITY

DR RUTH LUSCOMBE
FIREBALL

BRAD CARTER
FIREBALL

DATA QUEST ML FACULTY

PROF YARIN GAL
AITC CO-CHAIR
UNIVERSITY OF OXFORD

DR CHEDY RAISSI
AITC CO-CHAIR
UBISOFT

DR SUDANTHA BALAGE
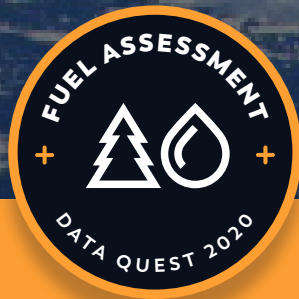UNSW CANBERRA SPACE

DR RICHARD GALVEZ
SENIOR DATA SCIENTIST

DATA QUEST OVERVIEW

The Data Quest is focused on an intensive week long quest from **7-14 August 2020**, with on-ramp and off-ramp shoulder periods to create the greatest chance of success and to finalize outcomes. The format will be entirely online, with researchers operating in a cloud-computing environment.
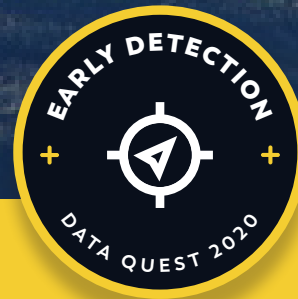
Four teams, each consisting of machine-learning specialists and bushfire researchers are supported by a faculty who are the leading scientists in their fields.

SATURDAY	**INTRO TO PROBLEM AND BENEFICIARY** **INTRO TO THE DATA**	**Concepting** – Articulate the 'Big Why' – Define evaluation metrics **Feature Engineering** – Get to know the data – Explore and visualize the data – Test two different transformation & scaling methods – Train a linear model – Train a decision tree ensemble model
SUNDAY		
MONDAY	**SUGGESTIONS ON ML APPROACH**	**Model iteration** – Train a ML model (whatever method is most valid) – Experiment with different architectures – Share back initial test results
TUESDAY	**OVERVIEW OF EVALUATION METHODS**	**Model iteration and baselining** – Compare / contrast relevant evaluation metrics for each ML solution and baseline – Refine machine learning approaches and test additional hyperparameter settings – Evolve and refine working ML pipeline
WEDNESDAY	**TROUBLESHOOTING**	
THURSDAY	**TROUBLESHOOTING**	**Model testing** – Evaluate two interpretation methods for the machine learning solution – Compare interpretation of baseline with new pipeline
FRIDAY	**ARTICULATING RESULTS**	**Validation** – Prepare Research Poster and 4 slide Deck – Submit code for full data processing and machine learning pipeline – Prepare and practice presentation to group of experts

BUSHFIRE CHALLENGES

FUEL ASSESSMENT
DATA QUEST 2020

EARLY DETECTION
DATA QUEST 2020

FIRE BEHAVIOUR
DATA QUEST 2020

How can we use historic fuel and moisture data to predict burn rate and intensity?

How can we use high resolution models and data fusion to detect fires earlier/faster?

How can we use historical satellite imagery to improve predictive models of the behavior of wildfires and, in turn, better inform fire risk management and response?
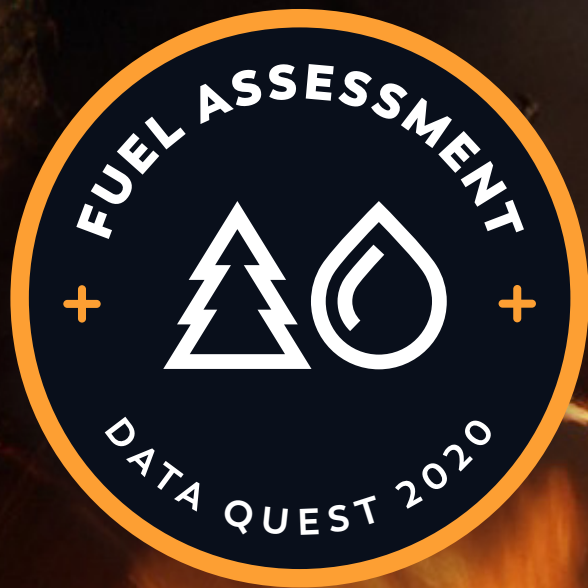
FUEL TEAM I

DETECTION TEAM

BEHAVIOUR TEAM

FUEL TEAM II

DATA QUEST 2020 TEAM
FUEL ASSESSMENT 1

How can we use historic fuel and moisture data to predict burn rate and intensity?

RESEARCHER
MAOYING QIAO

Dr Maoying Qiao is a Postdoc Research Fellow in DATA61, CSIRO. She is focusing on applying deep learning based computer vision/machine learning techniques to provide solutions to a variety of real-world challenges in healthcare, food ang agriculture, and fisheries management. Maoying obtained her PhD (2016) in Computer Science at the School of Computer Science, University of Technology Sydney. Maoying has published on top-tier venues such as conferences AAAI Conference on Artificial Intelligence (AAAI), International Joint Conferences on Artificial Intelligence (IJCAI), Computer Vision and Pattern Recognition (CVPR) and journals IEEE Transactions on Cybernetics, IEEE Transactions on Knowledge and Data Engineering (TKDE). Her research interests include probabilistic graphical models, diversity modeling, Bayesian learning, and deep learning.

RESEARCHER
VLAD TUDOR

Vlad is a Data Scientist seeking to bring positive change to ordinary people and the natural environment by finding insights through data and conversations.

With a background in astrophysics, he always starts out by looking for simple answers to problems he's facing. The best solutions are often found by talking to those most affected by the problem.

When he's not at the office, he may be out exploring the bush, perhaps watching a creek flow in a grove of gum trees.

RESEARCHER
YANG CHEN

Yang Chen is a research scientist currently working at CSIRO Data61. She is specialised in Geospatial Sciences, Remote Sensing, Modelling, and Computer Vision. Her research interests lay in the fields of digital agriculture, forestry, and natural hazards within the domain of the geospatial sciences. Prior to her research scientist position, she worked as a postdoctoral fellow and helped to develop a semi-empirical model (Crop-SI) for crop yield prediction across the Australian Wheatbelt using time-series satellite observation and machine learning.

Yang also worked on crop type classification, shoreline detection, and data fusion to overcome sparse time-series RS data. During her PhD study, she was investigating the application of LiDAR in forest fuel structural measurements and fuel load modelling for bushfire hazard mitigation. Her current research is forced on fuel hazard assessment, grass fuel load estimation, forest fuel structure measurements using RS and AI.

RESEARCHER
CAITLIN ADAMS

Caitlin Adams is a deeply creative thinker with a passion for solving the complex problems humanity faces. Since completing her Ph.D. in Astrophysics at Swinburne University of Technology, she has been working as a Data Scientist at FrontierSI. In this role, Caitlin works to support the spatial sector; from helping Australians learn how to leverage free satellite imagery, through to detecting features in aerial imagery using machine learning.

Caitlin sees Data Quest as an incredible opportunity to enhance the way Australians use data to manage and mitigate bushfires.

DATA QUEST 2020 TEAM
FUEL ASSESSMENT II

How can we use historic fuel and moisture data to predict burn rate and intensity?

RESEARCHER
SAM VAN HOLSBEECK

Mr Sam Van Holsbeeck is a PhD candidate at the University of the Sunshine Coast's Forest Research Institute. Sam holds a master's degree in Industrial Engineering, specialized in Bioscience Technology: Agriculture and Horticulture at Ghent University, Belgium. Over the years, he gained experience in forestry and environmental science as a research assistant at the Royal Museum for Central Africa in Belgium, the University of Melbourne, Charles Darwin University, Griffith University and the University of the Sunshine Coast, Australia.

During his PhD, Sam was successful in receiving the Gottstein Trust Forest Industry Scholarship and an IEA Bioenergy Top-up Scholarship. He became the Inaugural Australian Bluegum Plantation Student Ambassador in 2018, received the USC Excellence in HDR Leadership Award and the EUBCE 2019 Student Award. Sam is an active committee member of the Future Foresters Initiative and the QLD division of the Institute of Foresters of Australia.

RESEARCHER
MAHDI KAZEMI

Mahdi is a PhD student at the Australian Institute for Machine Learning, Adelaide, Australia. Previously, he finished his Honours Degree of Bachelor of Computer Science at the University of Adelaide, with First class Honours, where he was awarded the Valedictorian (among eight schools in the faculty) and the Dean's Academic Excellence Award for his high performance throughout the degree.

Mahdi's research interest lies at the intersection of machine learning and computer vision. He pursues two parallel goals in his everyday professional life. Firstly, to research on the future of intelligent agents that are able to reason based upon visual inputs and to navigate towards a goal just like their human counterparts. Secondly, to bring as much impact on people's lives as possible with the current state-of-the-art research outcomes in the broader area of computer vision. Thus, Mahdi finds the Data Quest an amazing opportunity for the great potential impact it may have.

RESEARCHER
MARTYN ELIOTT

Martyn was born in Canberra (Australia), and moved to Bundaberg where he completed his secondary schooling. Following working for a decade, and growing a passion for the environment and fire, Martyn has been studying at the University of the Sunshine Coast (USC) for the last 10 years, with research focused courses related to fire management, ecology and geographic information systems. Martyn completed a Bachelor of Environmental Science in 2014. Following this, he completed his honours, investigating the response of a family of beetles (Cerambycidae: Coleoptera) to long-term fire frequency regimes in sub-tropical eucalypt forest, using a long-term (50+ years) fire experiment in southeast Queensland.

Martyn is a current PhD candidate at USC evaluating the economic efficiency of prescribed fire as a bushfire risk mitigation tool, using the southeast Queensland catchment area as a case study area. He is very excited about the next chapter of his life.

RESEARCHER
EHSAN ABBASNEJAD

Dr Ehsan Abbasnejad is a Senior Research Fellow at the Australian Institute for Machine Learning (AIML) in the University of Adelaide. He was awarded his PhD degree in 2015 in Computer Science from the Australian National University (ANU). He has extensive experience in deep learning for a range of applications in machine vision and language.

Past experience in industry includes Microsoft, Xerox and NEC. He has been a research scientist and founding member of DeepSightX who won the second prize in the global mineral discovery challenge in 2019.

RESEARCHER
YURI SHENDRYK

Yuri is a Postdoctoral fellow at CSIRO specialising in the application of remote sensing and GIS for natural resource management. On a day-to-day basis he develops algorithms to process terabytes of satellite and airborne data – work that enables others to make decisions for a sustainable future. Before earning a PhD degree in Geography and Remote Sensing from UNSW in 2017, he spent multiple years working and studying geospatial engineering in Ukraine, Sweden and Germany.

Currently Yuri is supporting numerous organisations throughout Australia with spatial analysis, and most of his research projects combine remote sensing with machine learning for forest monitoring and precision agriculture.
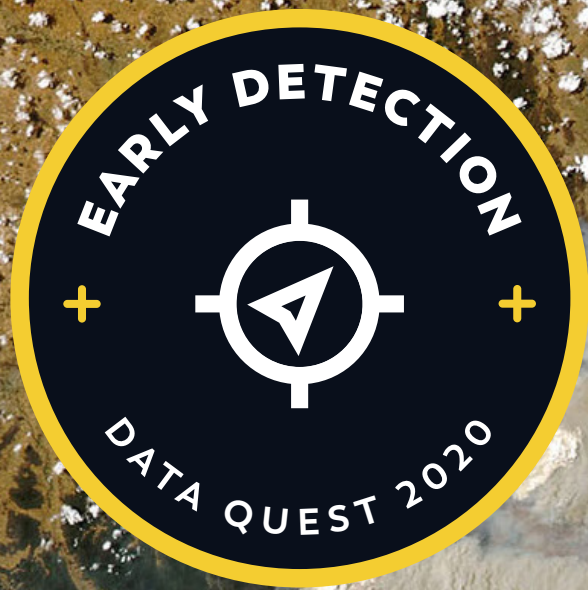
DATA QUEST 2020 TEAM
EARLY DETECTION

How can we use high resolution models and data fusion to detect fires earlier/faster?

RESEARCHER
ILZE PRETORIUS

Ilze is an atmospheric scientist who specializes in atmospheric transport. Originally from South Africa, Ilze settled in New Zealand in 2016. Ilze's research activities and interests include fire weather, atmospheric coherent structures, and the development and testing of a real-time wildfire decision support and smoke forecasting system for New Zealand. Ilze is often called upon to conduct smoke forecasts during New Zealand wildfires and, last summer, during the smoke events caused by the trans-Tasman dispersal of smoke from Australian bushfires.

Ilze is passionate about mathematical modelling and fire research, and believes that wildfire science and operations can greatly benefit from Data Quest's interdisciplinary approach to real-world problem solving. In her spare time Ilze enjoys drawing and going on adventures with her dog Buddy.

RESEARCHER
KATE MELNIK

Kate is a fire technician and data analyst in the rural fire research team at Scion. Her current projects include measuring rate of fire spread using remote sensing, evaluating the efficiency of different orchard waste combustion techniques, investigating factors leading to spontaneous combustion of forestry skid sites, and analysing New Zealand fire weather patterns. When doing fire research, Kate draws on her academic background in plant biology and ecological restoration, her work experience as a wildland firefighter in Canada, and volunteering experience as a rural firefighter in New Zealand.

Kate is passionate about incorporating data science and machine learning into rural fire research, and really enjoys coding in R and Python. When not doing fire science, Kate loves exploring the beautiful outdoors.

RESEARCHER
JACK WHITE

Jack White is a PhD student at Swinburne University of Technology studying the application of Deep Learning to creating visualisations for bandwidth constrained devices. Jack received his Bachelor's Degree with First Class Honours in Physics from Swinburne University during which time he undertook research relating to statistical and probabilistic methods for data driven applications. He then continued onto a PhD focused on the creation of a deep learning-based pipeline for feature extraction and enhancement for prosthetic vision devices.

Currently, Jack is working on a deep learning based super-resolution pipeline for enhancing satellite-based image data and exploring the utility of pre-trained networks for remote sensing applications.
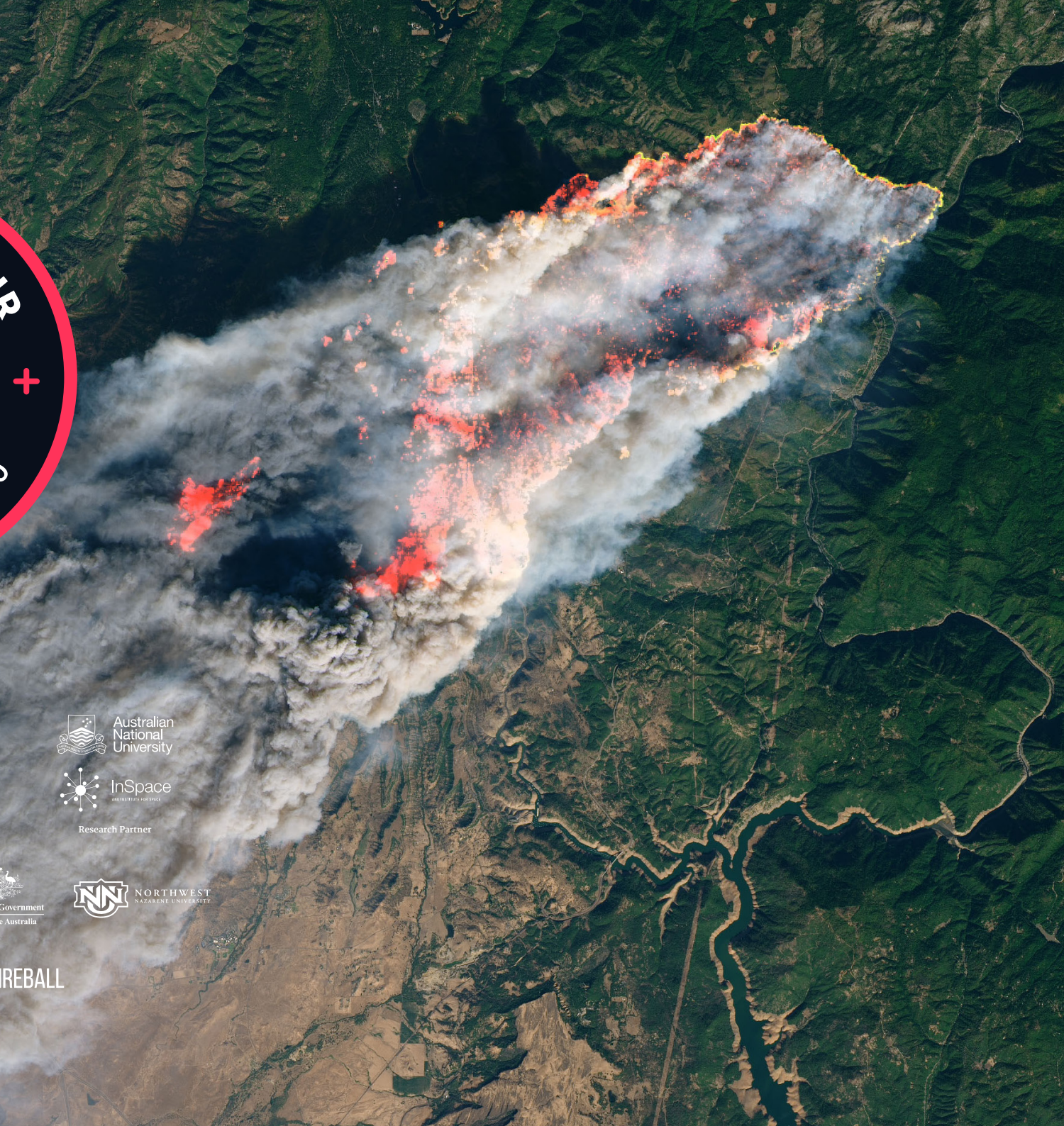
RESEARCHER
ALEX CODOREANU

Dr. Codoreanu is a Senior Research Scientist with Swinburne University's Gravitational Wave Data Centre. He holds a Ph.D. in Computational Astrophysics and has extensive experience with scaling algorithms on HPC clusters and introducing software engineering best practices within research groups.

Alex has experience with multi-spectral analysis, data fusion/augmentation techniques and geo-spatial image analysis.

FIRE BEHAVIOUR

DATA QUEST 2020

Minderoo Foundation — Challenge Partner

dug — Technology Partner

NSW Government — Research Partner

Australian National University — Research Partner

InSpace

Australian Government — Australian Space Agency

Macquarie University — Sydney · Australia

Australian Government — Geoscience Australia

Northwest Nazarene University

UNSW Canberra

space — UNSW Canberra

FIREBALL

DATA QUEST 2020 TEAM
FIRE BEHAVIOUR

How can we use historical satellite imagery to improve predictive models of the behavior of wildfires and, in turn, better inform fire risk management and response?

RESEARCHER
TODD ELLIS

Todd analyses historical and projected trends in fuel moisture, using it as a proxy for fire potential. His focus is both on global and finer-scale regional patterns. His regional analyses include a jumping-off point for a) modelling NSW's fire history and identifying its climate controls in order to predict regional changes in wildfire risk under different climate projections, and b) modelling NSW's past fire regime and return intervals in order to reconstruct censored fire histories and benefit government fire management.

RESEARCHER
THOMAS MCCAVANA

Thomas is an ex-astronomer turned data scientist. He enjoys tackling problems holistically; integrating a streamlined technical solution with an intuitive, practical and well-gauged use case. His Ph.D. research looked at galaxy mergers using cosmological N-body simulations. Since completing his Ph.D. Thomas has had the pleasure of working on a variety of projects; many of which were in manufacturing, where he built solutions for system health and performance monitoring using sensors and predictive analytics.

More recently Thomas has have been involved in developing data-driven dashboards to help customers utilise their data, developed predictive models using machine learning techniques and worked with geospatial toolkits. Thomas enjoys projects where there is room to innovate and develop new technical approaches, but also where he is able to engage with the key stakeholders to help them achieve their goals.

RESEARCHER
STEPHANE MANGEON

Stephane is a CERC Postdoctoral Fellow in CSIRO's data 61 based in Brisbane. Originally from France he obtained a PhD in Space and Atmospheric Physics from Imperial College London in 2017 where he build INFERNO, a global fire model that was integrated in the UK Met Office's Unified Model. Since then, he moved to Singapore where he worked on South-East Asian peat fires with MIT and the UN-WMO. He also spent some exciting time in Singapore's start-up ecosystem, before arriving in Australia. Here, he iscontinuing my work at the interaction of Data and Environmental Sciences, with a particular focus on Ecological and Fire Data.

When Stephane's not at work, he plays the stock-market (mainly loosing right now), but also enjoys sailing, exploring, and other buccaneering activities.

RESEARCHER
ANNA MATALA

Dr Anna Matala has a strong background in technical physics and mathematics. Between 2007 and the beginning of 2019, she had been working with various topics of fire research at the Technical Research Centre of Finland (VTT). She received her degree of Doctor of Science (Tech) from Aalto University, Finland, in 2013. The dissertation studied methods and applications of pyrolysis modelling of polymeric materials.

Anna's core expertise is pyrolysis modelling and fire simulations using complex fuels, such as electrical cables. A major part of her work and research has been numerical, but she also has expertise in small and bench scale fire testing.

Originally from Finland, Anna moved to Tasmania in the beginning of 2019, and is currently working as Centre Manager at the Fire Centre Research Hub of University of Tasmania.

DATA QUEST MODEL BEHAVIOURS AND DIGITAL ETIQUETTE

Being present = Being productive
Data Quest is about focus. You are probably aware of mirror neurons. They basically ensure that if you're checked out or distracted, so will the rest of your team. Make your time together really matter. A little bit of intensity goes a long way.

Always be deeply respectful of time
The time we have together is precious. Arrive 5 minutes early to meetings so audio/visual can be tested, and the meeting can start and end on time. If you set a meeting time, stick to it and/or re-contract with your meeting partners if the content goes beyond the scope

Help everyone to become a great, unbiased, team harvester
Make sure you nominate a main scribe, and turn-take note capture duties. Good note-taking is a skill

Show us the real, professional you.
For Zoom meetings, please turn your camera ON

Always build and have each other's backs.So be accepting and build on each other's ideas. Lean in to creating solutions and trying things out before judging.

DATA QUEST