

EO KEEPS MEDICINE MOVING

WITH FLOODING AND BUSH FIRES ON THE RISE IN AUSTRALIA, SECURING MEDICAL SUPPLY CHAINS IS BECOMING A HUGE CHALLENGE. SO, HOW CAN PHARMACEUTICAL COMPANIES ENSURE THAT CRITICAL MEDICATION CONTINUES TO REACH THOSE IN NEED? **MIKE PANZERI** EXPLAINS HOW SPACE TECHNOLOGY COULD PROVIDE VALUABLE SOLUTIONS

You only need to look through the history books to see that fires and floods have shaped life in Australia. But with climate change, the problem is getting worse. The past few years alone have seen devastating floods and the unprecedented 2019-2020 bush fire season. The latter swept through an area the size of Syria, led to 34 deaths, destroyed 80% of the Blue Mountain Heritage Area, 53% of the Gondwana World Heritage Rainforest and, according to the Insurance Council, generated AU\$1.9 billion in insurance claims.

These events have the potential to block transport routes, delaying or preventing delivery of essential medical supplies, so healthcare providers such as Roche Australia need to be prepared for the logistical challenges that climate disruption will bring.

In 2021, Roche Australia set a task as part of Deloitte's GRAVITY Challenge – a global technology innovation programme that encourages corporates, entrepreneurs and universities to use innovative space technology to solve real-world problems. Roche's challenge was to explore how the use of earth observation (EO)

products and technologies could enable better access to healthcare services and supplies during natural hazard events.

HR Wallingford has long-used EO data, geospatial automation, mathematical modelling and AI to provide innovative, potentially life-saving solutions. Nevertheless, predicting the impact of natural disasters on the natural and built environment and on communities is a promising new field. The latest methods combine the use of EO data with expertise in hydrometeorology, statistical modelling, AI, GIS automation and the development of cloud processing chains and web-based portals.

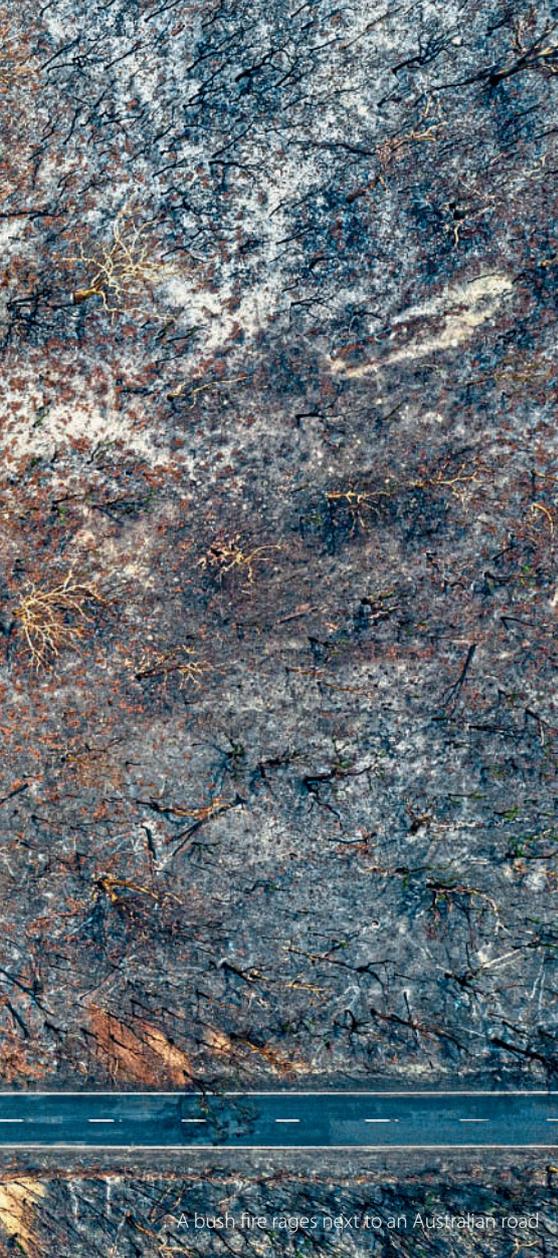
Building the right team to take on the challenge was key, and the partners were: Kapsule, a healthcare logistics start-up company that has developed a Software as a Service (SaaS) platform and chain-of-custody applications that enable companies to order pharma products, track products, monitor quality compliance in real-time and receive notifications; and Seanasol Research, a community interest company with a focus on building stronger communities to deliver innovation for better access to healthcare.

A scrum in a hackathon

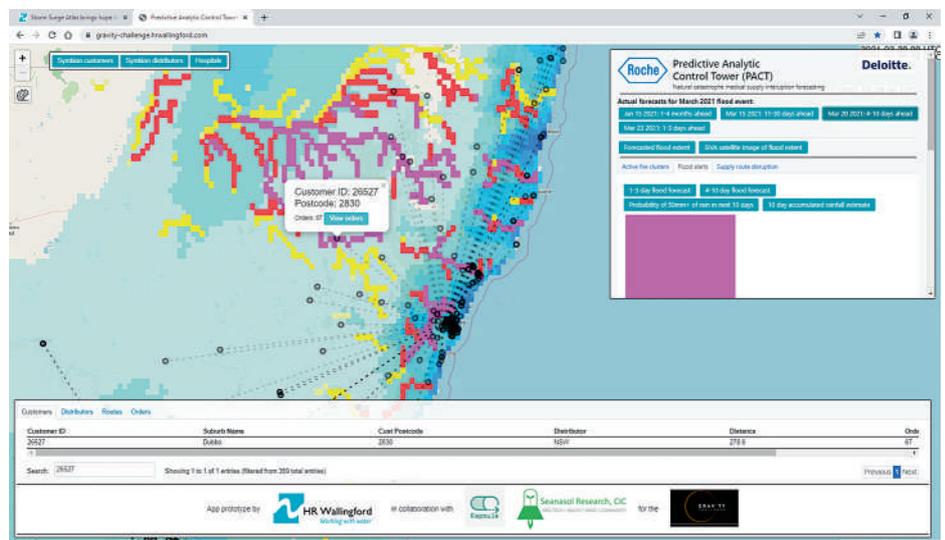
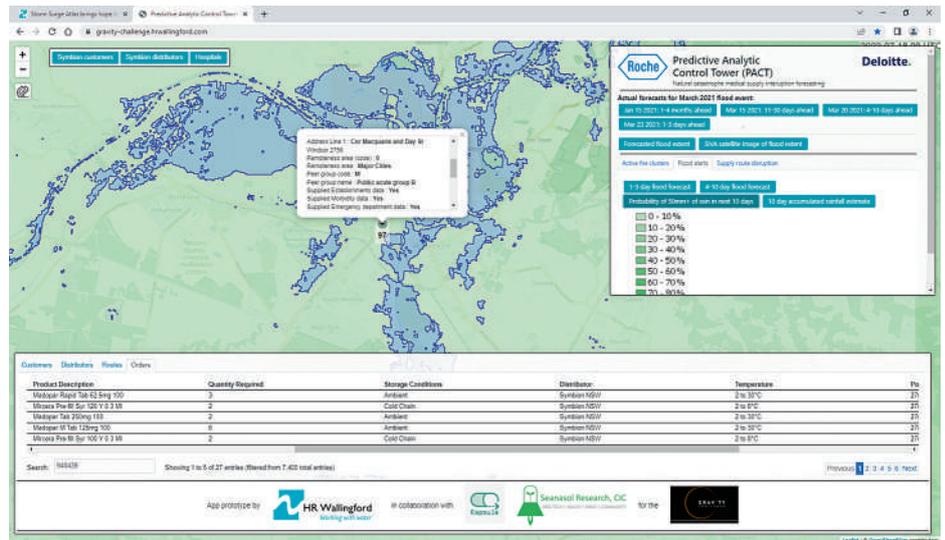
The challenge resembled a 12-week extended 'hackathon'. Using a Scrum approach to software development, the consortium met with the Roche team weekly to present the latest work, learn more about the problem, share data and ideas and to discuss the next development stages.

During this time, the team developed the Predictive Analytic Control Tower (PACT), a map-based web tool that gives Roche information about the potential impact of floods and bush fires on medical supplies. It brings together nowcasts of bushfires and floods based on satellite data and forecasts of rainfall extremes and floods with information about Roche's products, distributors, customers and their orders. PACT then uses the data to forecast where problems are likely to occur, or are already happening, and connects to the Kapsule logistics apps, used to place, plan, track and monitor orders.

The data on natural disasters included: near real-time flood extent polygons produced via a workflow that was developed by HR Wallingford during the Satellites for Impact and Vulnerability Assessments



A bush fire rages next to an Australian road



(SIVA) project; near real-time wildfire event data loaded into the map from the Fire Information for Resource Management System dataset, which is part of NASA's Land, Atmosphere Near real-time Capability for EOS, and extreme flood and rainfall event forecasts for the one-to-three day, four-to-10 day, 11-30 day and one-to-three month periods, as well as probability of extreme rainfall in the next 10 days and the 10-day accumulated rainfall estimate fed by the Global Flood Awareness System.

The PACT App has been developed using a full open source stack. Python-automated geospatial processing workflows are used to download Sentinel-2 data and process these for detection of areas of transient flood water. These, together with other spatial data, are served to the web app using the FLASK web framework. The resulting web app uses Leaflet the JavaScript library for mobile-friendly interactive maps to create a user-friendly, map-based system for exploring different impact layers.

The tool's interactive map interface shows Roche's supply chain managers where bushfires and floods are already occurring or

are likely to happen across New South Wales and Victoria and forecasts several months in advance and over four different time horizons. Monitoring the forecasts as they evolve also provides Roche with greater certainty that a significant event will occur. The dashboard then shows the team impact of these potential natural disasters on their supply routes and enables them to confidently take steps to proactively manage deliveries to help ensure uninterrupted supplies.

During the GRAVITY challenge, the HR Wallingford team demonstrated the potential two-way connectivity of the PACT app with the Kapsule logistics systems. The nowcast flood extents and fires can be fed to the logistics route planner as geofences so that delivery routes (planned or in-progress) can be modified to avoid affected areas. Orders placed, as well as those en-route, can be plotted in real-time on the PACT map, giving a holistic view of the live logistics.

Champions over GRAVITY

At the end of the task the team was named 'GRAVITY Challenge Champions' and have since gone on to develop a roadmap for

Roche. The roadmap will lead to a fully modular system comprising a range of different components including: hazard forecasting; impact and risk assessment; and alerting modules. Another development is that the flood nowcast data has since been validated, and performed well, against the severe flooding that was experienced in New South Wales and Queensland in March this year.

In the future it will also be possible to extend these bespoke systems in several ways. A simple example would be adding more risk aversion in the route planner so cargos containing products that require 'cold chain' storage conditions are diverted well away from bush fires.

Of course, the pharmaceuticals industry is not the only one to be affected by an increase in natural disasters and Australia is far from the only country to experience disruption. But solutions are at hand and the HR Wallingford team hopes that the PACT system could help supply chain managers worldwide to adapt to the effects of our changing climate.

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