Intelligent imager set to accelerate on-Earth response times to climate emergencies

A next-generation intelligent imager which delivers better identification of cloud cover to improve the onboard operations of small satellite missions is set to launch in October 2026.

The AI-powered Context Imager, which has been developed by Craft Prospect, works as both an intelligent context sensor and an optical imaging payload for Earth observation and space domain awareness applications.

Its primary role is to identify cloud cover and enable satellite operations accordingly. Other applications include detection of features of interest – such as wildfires or floods for near-real-time alerting, and generation of useful data products such as thematic maps.

The instrument provides a solution to a common problem facing satellite missions – information latency. This is the time between the generation of Earth observation data and the moment it becomes actionable. Reducing this translates to quicker decision-making and actions when it comes to climate emergencies, which has the potential to save lives and allow more time for damage limitation measures.

Satellite operations such as imaging and data downlink processes are typically scheduled on the ground and sent to be actioned on the satellite during limited communication windows.

The Context Imager optimises satellite operations by detecting the onboard conditions that impact their overall value. For example, the Context Imager can check for cloud cover on the approach to a ground location targeted for imaging, to make sure that satellite resources are only spent capturing visible ground data.

The background

The precursor to the Context Imager was Craft Prospect's Forwards Looking Imager (FLI), which began life in 2021 after the company received funding of £271,976 from the Centre for Earth Observation Instrumentation (CEOI) for two projects focussing on:

- Onboard data autonomy for next generation Earth observing satellites
- Autonomy assurance for small satellite Earth observation missions.

FLI is a camera system which provides analysis of the upcoming environment of the satellite to allow real-time decision making. It has a vital role in mission operations impacted by cloud cover, such as remote sensing and optical communications.

For users imaging a specific area of Earth, the FLI provides data on cloud coverage ahead of time. This allows users to choose how to task their instruments on board. With cloud coverage preventing a useful capture for many different applications, FLI aids decision making and gives operators the option whether to capture images or not, helping to preserve on-board resources.

Context Imager and cloud masking output combined

Enter the Context Imager

A successor to FLI got under way in 2024 when Craft Prospect partnered with XCAM to develop the Context Imager, thanks to a further grant of £201,083 from CEOI. The Context Imager is a low-SWaP (size, weight and power), high-quality Earth observation camera with an integrated AI processor.

It is made up of a Craft Prospect data processing module and software framework of AI-augmented software applications, alongside a state-of-the-art camera module developed by XCAM.

The Context Imager incorporates the advances made in space technologies in the years since the inception of the FLI. These include onboard AI toolchains and devices, software-defined satellites and modular spacecraft architectures. The Context Imager reflects the modularity and reconfigurability of modern space systems.

In terms of non-Earth imaging, the Context Imager can support activities including space domain awareness and rendezvous and proximity operations.

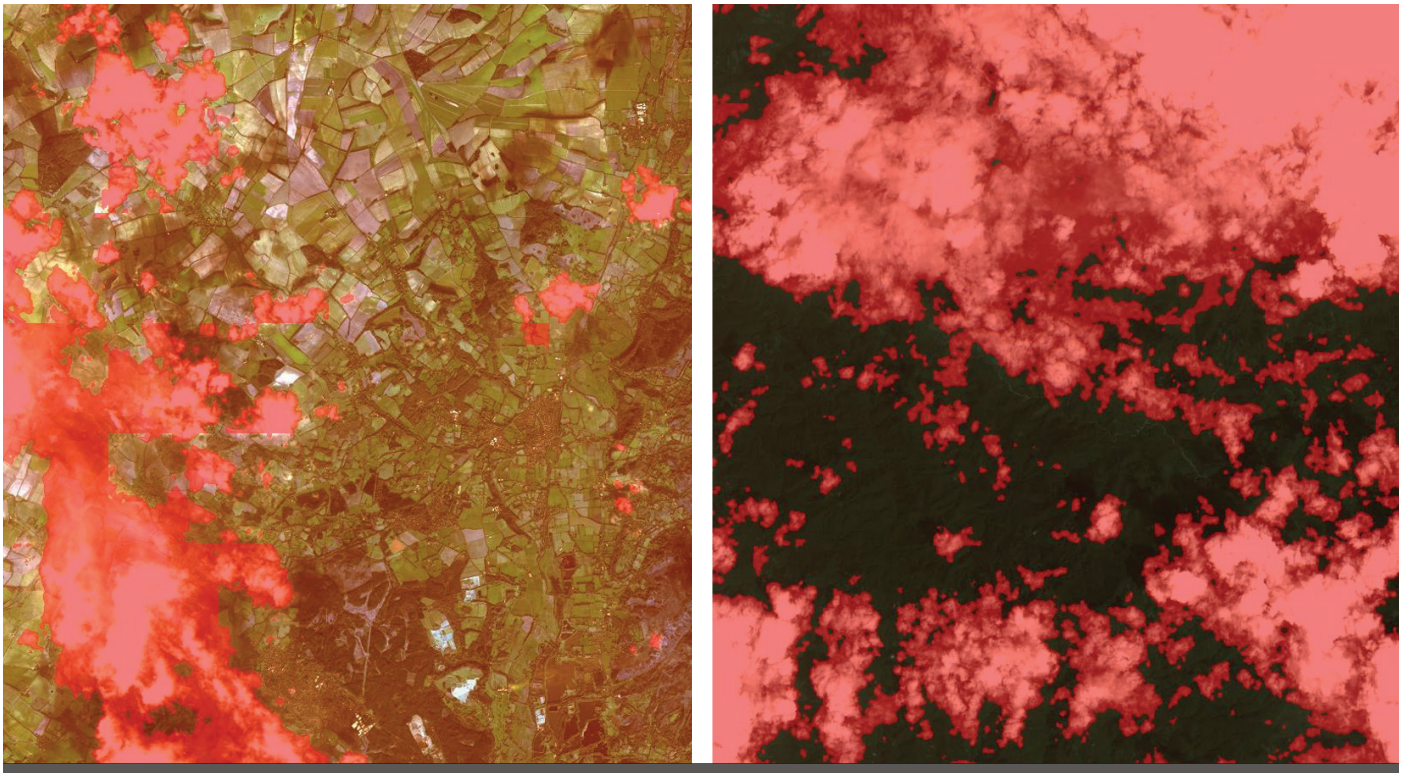
The technology

The Context Imager is a 0.5U intelligent camera system – the NuSCIS camera module, developed by XCAM, has two CMV4000 near infrared sensors. Dual cameras, one nadir-pointing and one at an oblique angle, allow imaging of both nadir and a specified relative point ahead of the nadir. The use of two cameras allows a superior ground sample distance and flexibility in applications without sacrificing the 'forwards-looking' capability of the system. Pointing ahead from nadir provides approximately 45 seconds for onboard data processing and adaptive tasking based on real time conditions at the ground location as the satellite approaches.

Current status

Development has since continued on the Craft Prospect data processing module in partnership with optical payload manufacturer, Simera Sense. Work is ongoing to ensure the data processing module is protected from radiation-related faults that may be encountered in flight.

The prototype for the Context Imager was quickly followed by the development of a flight model to take advantage of a flight demonstration opportunity through the OPS-SAT VOLT (Versatile Optical Laboratory for Telecommunications) mission. This is a next-generation satellite mission led by Craft Prospect, with support from the European Space Agency (ESA) and the UK Space Agency. The Context Imager configuration to be launched on VOLT will demonstrate the camera module and the intelligent software framework. A third-party on-board processing unit, which has flight heritage, will be flown in place of Craft Prospect's prototype data processing module in order to de-risk the mission.



Example of application outputs for cloud masking

What's next?

The Context Imager is being deployed on the OPS-SAT VOLT mission, with a launch date planned for October 2026. As part of ESA's ARTES ScyLight programme, the mission will test and demonstrate new optical and quantum communication technologies in a low Earth orbit environment.

Outside of this mission, the Context Imager is configurable for a great many applications. It can also be used for non-Earth imaging activities, enabling applications such as space traffic management, rendezvous and proximity operations, and in-orbit servicing and manufacture.

The NuSCIS camera module, developed by XCAM, is available as a standalone product and supports a variety of imaging sensors.

Assembled Context Imager Prototype

In the words of Lucy Donnell

Responsive Operations Lead, Craft Prospect Ltd

"The Context Imager is a full smart sensor with a camera module that can be easily added to missions – the idea is that it is not so large, expensive or power-hungry that it interferes with a mission's main instruments. What it allows is on-board decision making that operators wouldn't have otherwise. This enables intelligent tasking that can save resources and onboard storage, while increasing the value of the data captured.

An important part of the Context Imager is the intelligent software which is a product on its own and can be deployed on third party hardware. It is a really beneficial piece of technology for people who want to make their missions more intelligent – having some on-board processing is now seen as essential.

Sensors collecting Earth observation data are incredibly high resolution and they're capturing huge volumes of data. This data can only be stored on board satellites in between downlink opportunities and even when you get that opportunity, it's expensive. When instruments are capturing this much data, it's not realistic to expect all this data to be downlinked. This is where it is beneficial to have an understanding of the data you have captured. It means you can save your valuable data and get rid of any low value data or selectively compress the areas that are low value.

Getting information down to the ground more quickly has huge benefits if you need an on-ground response, for instance if it's a weather event or emergency. If you know what your data contains, you can prioritise it. We can also help get text alerts out for the most serious emergencies by generating insights on board and getting the information down to the ground without delay.

The Context Imager has the capability to run other types of models – we can also make models for land type classification and feature detection so there's many applications.

We are looking forward to deploying the Context Imager later this year. Flight heritage is a huge hurdle and accomplishment, and it leads to more customer engagement and other mission opportunities. To be able to say you've carried out an in-orbit demonstration means you're trusted and shows your components perform in space."

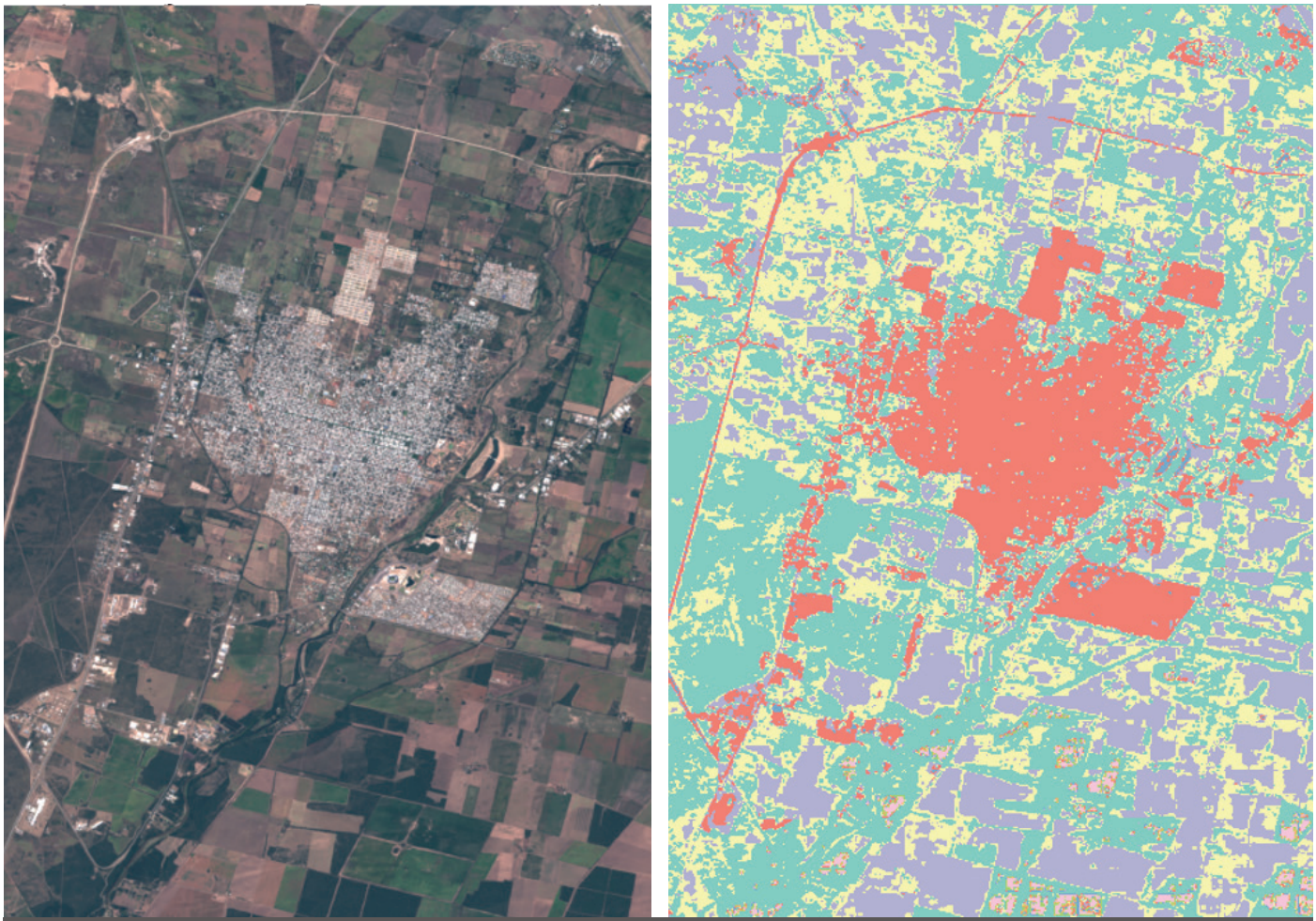
In the words of Charlotte Crawshaw

AI Software Engineer, Craft Prospect Ltd

> **The Context Imager incorporates all the latest developments in AI, and it can run more powerful machine learning models. Another major upgrade is the imageboard that XCAM has developed – it has a much higher resolution image sensor.**
> **Previously, the classification model was less powerful. It divides images into squares and identifies where there is cloud and where there isn't. The newer version allows for cloud masking, which is where algorithms identify pixels containing clouds. It produces a pixel-level mask showing which pixels contain cloud, making it more accurate and more granular while looking at a much smaller ground area.**

At a glance

- Funding from CEOI for Phase 1 and 2: **£473,059**
- Number of people in the Salient project CPL team: **5**
- Potential uses: Disaster monitoring and alerting, maritime monitoring, asset management and various agriculture applications
- Number of years in the making: **2.5 years**



Example of application output for thematic land mapping