Faster Flood Extents Using Satellite Imagery

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Using Machine Learning to generate faster flood extents from satellite imagery.

Background

In the last 10 years, availability, and accessibility of satellite imagery has vastly increased. Spiral Blue (SB) developed a satellite imagery tasking portal that provides data within hours, at a fraction of the cost and time of aerial imagery. In collaboration with WMS, SB have explored the applications of satellite imagery in the flooding industry. Together WMS and SB have been able to increase the efficiency of defining flood extents following flood events using satellite imagery, Machine Learning (ML) and the Shepparton flood event as a pilot study.

Defined Flood Extents

Table 1: Timeline of events

Date	Time	Occurrence
18/10/22	18:00	WMS placed order for imagery through Spiral Blue (SB)
18/10/22	18:01	SB system processed requests and selected appropriate satellite
19/10/22	11:06	Satellite captured image
19/10/22	21:41	Image was available from SB after being downlinked and processed.
20/10/22	09:00	WMS downloaded, imported to GIS and extracted flood extent

Following the water level peaking at Shepparton (Gauge No. 405204) on the Goulburn River, WMS placed an order request for satellite imagery through SB's portal.

Within 28 hours WMS were able to access the satellite imagery, process the image to clearly see the flooding and manually trace a flood extent, see Table 1 and Figure 1.

a) b) c)

Figure 1: a) Satellite imagery, b) Processed imagery, c) Defined flood extent

Machine Learning Model

Spiral Blue (SB) used the flood extent generated by WMS to train a Machine Learning (ML) algorithm to automatically define flood extents.

New satellite imagery of the same area was acquired by SB, captured on 23/10/2022, see Figure 2. The ML model was run on new imagery and the flood extent output was generated in less than a minute, and validated visually, see Table 2.

Table 2: Duration of processes to generate ML flood extent from satellite imagery.

Duration	Occurrence
~5 hrs	SB prepared WMS data, and satellite imagery for training of ML model (see Fig. 1).
~30 mins	ML model trained on prepared data.
<1 min	SB mapped flood extent by running ML model on new satellite image

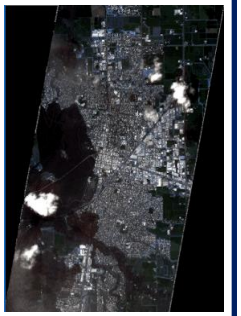

Figure 2: ML flood extent output, and the testing image.

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Limitations

Events with significant cloud coverage are difficult to accurately capture and flash flooding events may not be captured.

Outcomes

Demonstrated a use case of Machine Learning (ML) to define flood extents. Proved the capability of new data acquisition and ML processing technologies to benefit the floodplain management industry.

Future Opportunities

Running Machine Learning (ML) in real-time on-board satellites with Space Edge Computing. Onboard image processing reduces downlink volumes, and dependence on engineers on the ground - leading to faster, and cheaper flood extent maps.