High-Resolution Radiation Mapping to Evaluate Fukushima Derived Contamination Migration.

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In March 2017, the accident at the Fukushima Daiichi Nuclear Power Plant (FDNPP) will have reached its sixth anniversary. Over these six years, close to 160,000 people that were initially displaced by the radiological release have yet to return to their homes within the vast plume-affected region. Whilst much work studying the nature of the contamination has occurred, alongside its environmental behaviour, in addition to the remediation of parts of this contaminated zone –much detail is still to be understood with regards to the physical transport of the contributing radiocesium, the rate at which it occurs and the total environmental “budget”.

To assess this evolving distribution of radiocesium, high-resolution radiation mapping conducted over a three year period has been performed on a site within the heavily contaminated Iitate Village. This time-resolved radiation mapping, coupled with various modelling scenarios, has provided information on the mobility of material within the environment, its residence time as well as the rate of input into the Abukuma River network that dissects the region.

Through the use of an unmanned aerial vehicle (UAV) developed at the University of Bristol (UK), the radiation distribution across the site was determined without the effects of any operator induced attenuation. The aerial platform also permitted the mapping of radiological contamination over portions of the site not physically possible, or with considerable access limitation.

The results of the radiation mapping over time highlighted the changes in activity apparent on the 100 × 150 meter site. Remediation of the majority of the northern extent has proven to be effective in significantly reducing the dose-rate measured –with the waste material relocated to a single point (“Bail Store”), for subsequent removal.

Radioactivity levels to the south of the site, are shown to still exhibit elevated levels of radioactivity attributable to contamination from radiocesium. Whilst no remediation efforts were observed to have occurred here, the value anticipated to exist (as a result of a reduction entirely from radioactive decay) was greater than that measured. Through the application of a model to simulate previously measured depth dispersion (and associated attenuation) [1] [2] the value measured was still significantly less than that predicted. This loss is attributed to transport away from the site via the stream that dissects it –hence providing a budget to the riverine flux of radiocesium contamination.

As well as work on monitoring and modelling contamination on sites such as this in Iitate Village, the system has also been applied to studying the transport of contamination away from the large storage sites containing the surface materials removed as part of the remediation works. The impact of precipitation and groundwater flow in these scenarios is of significant importance to the safe, long-term storage of these wastes.

Figure: Results of the time-resolved radiation mapping over the Iitate Village site; the effectiveness of the

remediation is apparent, as is the increased activity brought about by the location of the radiological wastes forming the Bail Store. The reduction in activity to the south of the site is apparent, but lower than that achieved through either remediation or expected solely as a result of radioactive decay or ground infiltration (and induced attenuation).

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