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Integrating TWES and Satellite-based remote sensing: Lessons learned from the Honshu 2011 Tsunami

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The Boxing Day Tsunami killed 240,000 people and inundated the affected shorelines with waves reaching heights up to 30m. Tsunami Early Warning Capabilities have improved in the meantime by continuing development of modular Tsunami Early Warning Systems (TEWS). However, recent tsunami events, like the Chile 2010 and the Honshu 2011 tsunami demonstrate that the key challenge for TEWS research still lies in the timely issuing of reliable early warning messages to areas at risk, but also to other stakeholders professionally involved in the unfolding event.

Until now remote sensing products for Tsunami events, including crisis maps and change detection products, are exclusively linked to those phases of the disaster life cycle, which follow after the early warning stage: Response, recovery and mitigation.

The International Charter for Space and Major Disasters has been initiated by the European Space Agency (ESA) and the Centre National d'Etudes Spatiales (CNES) in 1999. It coordinates a voluntary group of governmental space agencies and industry partners, to provide rapid crisis imaging and mapping to disaster and relief organisations to mitigate the effects of disasters on human life, property and the environment. The efficiency of this approach has been demonstrated in the field of Tsunami early warning by Charter activations following the Boxing Day Tsunami 2004, the Chile Tsunami 2010 and the Honshu Tsunami 2011.

Traditional single-satellite operations allow at best bimonthly repeat rates over a given Area of Interest (AOI). This allows a lot of time for image acquisition campaign planning between imaging windows for the same AOI. The advent of constellations of identical remote sensing satellites in the early 21st century resulted both in daily AOI revisit capabilities and drastically reduced time frames for acquisition planning. However, the image acquisition planning for optical remote sensing satellite constellations is constrained by orbital and communication requirements: Defined time slots exist to commandeer the tasking of image acquisitions. If such a time slot has been missed, another attempt to image an AOI again can only be attempted ca. 24 hours later, due to the sun-synchronous satellite orbits

Therefore it is critical to establish automated Disaster Early Warning dissemination services for the remote sensing community, to supply them with the timeliest opportunity to trigger the tasking process for the affected AOI. For very large events like a Tsunami in the Pacific, this approach provides the chance to gain additional pre-disaster imagery as a reference for change detection.

In the case of the Tohoku earthquake, an ad-hoc warning dissemination process was manually dispatched by the Centre for Geoinformation Technology (CeGIT) at the German Research Centre for Geoscience, contacting RapidEye AG, once the severity of the earthquake event had been confirmed by the GEOFON geoseismic network. RapidEye AG decided to launch an imaging campaign which yielded 78 georectified image tiles (L3A) of Honshu island during the next imaging window. Of these, 26 tiles cover the affected coastline, resulting in 16,250km^2 of content for crisis mapping effort such as the Humanitarian Open Street Map (OSM) Team. This data was made available by RapidEye as a part of the Charter Activiation requested by Japan on March 11 2011.

[1] Hoja, D., Schwinger, M.,Wendleder A.,Löwe, P., Konstanski, H., Weichelt, H.: Optimised Near-Real Time Data Acquisition for Disaster Related Rapid Mapping