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Darwin VAAC Response to the 2010 Merapi Eruption

Christopher Davies and Andrew Tupper
Australian Bureau of Meteorology, Northern Territory Regional Office, Casuarina, NT, Australia (A.Tupper@bom.gov.au)

The Darwin Volcanic Ash Advisory Centre (VAAC) was established as part of the International Airways Volcano Watch to provide advice to the aviation industry on the location and forecast movement of volcanic ash clouds. The area of responsibility of the VAAC lies within one of the most volcanically active parts of the world, encompassing Indonesia, Papua New Guinea and part of the Philippines. Previous eruptions of Merapi observed by the VAAC include the 22 November 1994 dome collapse, which produced a clearly visible cloud to a height of over 10 km.

During the eruption of Merapi in October and November 2010, Darwin VAAC used a combination of modelling, remote sensing and ground reports to issue a total of 106 Volcanic Ash Advisories to the aviation industry. The first advisory was issued on the 25th of October in response to advice from the Centre for Volcanological and Geological Hazard Mitigation (CVGHM) in Indonesia to warn the aviation industry of an imminent eruption. Subsequent advisories regularly included western Java including Jakarta within the forecast ash area, with Bali, Cocos Island and Christmas Island included at various times.

The significant eruption on the 3rd of November produced a sulphur dioxide (SO2) gas-rich cloud between 14,000 and 18,000 metres in altitude that covered a large area of the Indian Ocean. This cloud remained detectable using the Ozone Measuring Instrument (OMI) carried on the Aura satellite until the 15th of November. This was the first experience for Darwin VAAC with a long lived diffuse ash cloud that was well removed from the source volcano and detectable only via its SO2 signature.

The Merapi eruption presented a number of challenges, particularly in the area of dispersion modelling. Currently in operations, Darwin VAAC makes use of the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT), using winds derived from the Australian Community Climate and Earth System Simulator (ACCESS) numerical weather prediction system. Due to limitations of the model and the way in which it is run for VAAC operations, it had only limited utility in forecasting the movement of the high altitude SO2 -rich cloud. In addition, the simple source term currently in use does not allow for useful volcanic ash concentrations. Another significant challenge was eruption observation, as cloud frequently obscured the volcano and it also proved difficult to obtain useful radar data. A real-time operational exchange of meteorological and volcanological observations, building on the strong cooperation between Indonesia and Australia, will assist in the future.

Despite the challenges, the Merapi eruption was also an opportunity to utilise a range of new data sources and techniques that had previously been unavailable to the VAAC. During the eruption, a new X-Band satellite receiving station in Darwin became available to VAAC forecasters, allowing timely access to the Moderate-Resolution Imaging Spectroradiometer (MODIS) and the Atmospheric Infrared Sounder (AIRS) instruments. In addition, the VAAC was able to use the expedited dataset from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) platform to provide near real-time verification of the forecast high level volcanic ash heights for the first time. The Merapi eruption was also the first major event since the introduction of a competency based training and assessment program in the VAAC and the performance of VAAC staff, many with less than 12 months of VAAC experience, was to a high standard.

An aircraft engine issue reported by media and attributed to Merapi on 28th October was investigated and shown through trajectory modelling and a manufacturer's inspection to have been from a different cause; otherwise there were no aviation issues reported apart from the disruption caused by preventative routing. Given the many significant volcanic ash encounters in the region in the pre-1993 period (before the VAAC commenced operations) and the overall gravity of the eruption, this was a welcome outcome. Learnings from the eruption will be used to continue to improve the service provided to the aviation industry.