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Operational application of deep learning model for auto-detection of atmospheric gravity waves over the Asia-Pacific region

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The Hong Kong Observatory (HKO) applied high-pass filtering technique to 6.2μm water vapour channel of the Japan Meteorological Agency's Himawari-8 (H-8) geostationary satellite imageries for identifying atmospheric gravity waves (AGW) over the Asia-Pacific region. In 2018-2022, HKO collaborated with NVIDIA to develop a deep learning model with object detection technique using the Faster Region-based Convolutional Neural Network (FasterRCNN) for auto-detection of AGW. The network was pre-trained with the Microsoft Common Objects in Context (COCO) dataset. It was then trained using over 750 pilot reports collected in January 2018 – June 2021 which reported AGW triggered severe turbulence as depicted by human. AGW events detected by the model would be enclosed by standard rectangular boxes. To enhance visualization, AGW events in close proximity would be merged into polygons. The model achieved reasonable skill with an average precision of 0.782 for intersection-over-union (IoU) of 0.50. Verification using pilot reports obtained in July – December 2021 showed a POD of around 55% for severe turbulence locations falling within ±1° of AGW polygons outputted from the model. That increased to about 87% for locations within ±2° of AGW polygons. The model is now used operationally by HKO to facilitate forecasters to identify locations of AGW that may be triggered by upper-level jets, high mountains or deep convection.