Application of Clutter Polygons in Terminal Doppler Weather Radar for Improving the Detection of Terrain-induced Windshear in Hong Kong

*Shuk Mei Tse[1], Ying Wa Chan[1]

1. Hong Kong Observatory

The Hong Kong Observatory (HKO) installed a Terminal Doppler Weather Radar (TDWR) at Tai Lam Chung (TLC) in 1996 for detecting hazardous weather, including windshear and microburst events associated with convective storms, to support the operation of the Hong Kong International Airport (HKIA). A new TDWR installed at Brothers Point (BP), about 1 km east-southeast of TLC, commenced operation in April 2015 while the aging TLC TDWR was deployed as a backup system.

As HKIA is located just north of the Lantau Island over the western part of Hong Kong, winds blowing across the Lantau mountains from the east or southeast would become disturbed by terrain and might bring about significant windshear or turbulence downstream. Terrain-induced windshear is a major type of low-level windshear at HKIA, accounting for about 70% of all pilot windshear reports (Shun and Chan 2008). It occurs predominantly in the late Spring season and may be caused by different types of flows which tend to have a high spatial and temporal variability. These include reverse flows in mountain wakes, wind jets emerging from the various gaps of the Lantau Island, and vortices shedding from lee slopes of mountains, etc. All these terrain-related flow features might propagate to the HKIA runway arenas and affect the safety of aircrafts taking off or landing at the runways.

In 2016-2018, HKO experimented the use of clutter polygons and fine-tuned parameters of the TDWR windshear and microburst detection algorithm (WMDA) for improving the detection of terrain-induced windshear, particularly in correcting suspicious large magnitudes of windshear detected on some occasions which might be attributed to the presence of terrain-induced reverse flows in the wakes of Lantau mountains. The opportunity was taken to minimize the impact of strong sidelobe return echoes due to the transit of marine vessels near HKIA. Different tropical cyclone and thunderstorm cases were used in the experiment. The results as verified using over 300 pilot reports and Quick Access Recorder (QAR) data from aircrafts showed that there was apparent improvement in the detection of terrain-induced windshear by TDWR after applying clutter polygons and optimizing the WMDA parameters. The adverse impact of marine traffic on the derivation of windshear could also be effectively mitigated.

This paper summarizes the comparison results of the effectiveness of terrain-induced windshear detection between the new and the original TDWR settings. The salient features of TDWR’s WMDA as well as the characteristics of terrain-induced windshear occurred near HKIA are highlighted. Future work of compiling the climatology of windshear and microburst occurred near HKIA is also described.

Keywords: Terminal Doppler Weather Radar, Terrain-induced Windshear, Clutter Polygons, Windshear and Microburst Detection Algorithm