10.8 WIVERN, A PROPOSED SATELLITE TO PROVIDE GLOBAL IN-CLOUD WINDS, ICE WATER CONTENT AND RAINFALL

A. J. ILLINGWORTH[1], A. BATTAGLIA[2]

[1] University of Reading, UK

[2] University of Leicester

a.j.illingworth@reading.ac.uk

In response to ESA′s call for Earth Explorer-10 Mission ideas we propose WIVERN, (a WInd VElocity Radar Nephoscope), a conically scanning space-borne broad-swath Dopplerised dual-polarisation 94GHz radar to provide global measurements of in-cloud winds, rainfall and cloud ice water content using the returns from cloud and precipitation particles. The observations will have ˜60 km horizontal and 1 km vertical resolution with visits every day at European latitudes and an accuracy of 2 m/s for clouds with a reflectivity above -20 dBZ when averaged over a distance of 20 km. This satisfies the WMO requirements for horizontal winds for global NWP. Windstorms are the single most damaging meteorological phenomenon in Europe. Data assimilation studies by weather forecasting centres demonstrate that winds are the second most important class of observations in reducing forecast errors after IR and microwave humidity and temperature sounders and suggest that wind observations from WIVERN should improve forecast skill further, leading to better predictions of timing and location of windstorms so that mitigation activities can be better focused. The in-cloud winds from WIVERN should complement the predominantly clear-air winds to be measured by the Aeolus satellite when it is launched in 2018.

The 94 GHz (3 mm) frequency is needed to achieve a 1 km vertical resolution as the 500 m pulse approaches the earth′s surface at angles around 41°. The 3 by 2.28 m elliptical antenna rotates once every eight seconds sweeping out a circular ground track that advances 60 km for each revolution. The radar transmitter will be based on the one that has operated on Cloudsat since its launch in 2006. Observing Doppler winds from a moving space platform is challenging. Doppler velocities will be derived using the returns from cloud particles from a pair of pulses separated by 20μsec (3 km slant path) polarized in the horizontal (H) and vertical (V) so that the folding velocity is 40 m/s and high wind speeds can be measured. The H and V pulses must propagate, scatter and be received independently. ESA and UKSA funded ground-based and aircraft 94 GHz indicate that problems due to cross-talk between the H and V returns can be recognised and corrected of flagged, as can be biases in velocity due to non-uniform beam filling, or the biases due to wind shear in the presence of reflectivity gradients and that wind observations should be possible down to 1 km above the ocean surface and 2 km over land. From the climatology of the vertical profiles of radar reflectivity obtained from CloudSat, we expect WIVERN to observe about one million winds a day with an accuracy of 2 m/s for 20 km long in-cloud samples accompanied by quantified errors. Such winds should be representative of the large scale winds and suitable for data assimilation. The reflectivity profiles will provide continuity to those provided by CloudSat since 2006, and continued until ˜2025 by EarthCARE; the CloudSat data set has provided the best available global climatology of ice water content, light rainfall and snowfall.