Propagation Modelling and Prediction for Trans-Polar Airline Routes

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For safe operations, commercial aircraft have to be able to communicate with air traffic control centres at all times. This communication is possible by VHF links whilst within range of the widespread network of ground stations and by HF links in remote areas such as the North Atlantic, Pacific, polar regions and areas of South Africa and Philippines. At high latitudes, and especially on polar routing, VHF ground infrastructure does not exist and the aircraft rely on HF radio for communications. However, at high latitudes, disturbances in the ionosphere can severely disrupt the ability for aircraft to stay in contact with air traffic control. At times when HF communication fails, or is anticipated to fail, the aircraft are routed over more southerly paths with a consequent increase in flight time and fuel usage. In addition to the financial impact, the latter point is highly relevant to current concerns over global warming.

The number of commercial airline flights over the northern polar region is rapidly increasing, producing a high demand for HF radio communications. Consequently there is a requirement for improved knowledge about the propagation characteristics of the polar ionosphere to facilitate accurate predictions, forecasts and nowcasts of the propagation conditions, and hence communications quality.

This paper summarises work already undertaken by the authors of relevance to this application, and secondly describes a new proposed research project to gain additional knowledge and hence develop an HF prediction service for aircraft on polar routes. In the research proposed, an experimental programme will be conducted in which a system of radio transmitters and receivers will be employed to investigate the reflecting properties of the ionosphere while a network of riometers will be used to quantify the absorption of radio waves. Combining these measurements with solar observations and data on interplanetary conditions will allow space weather disturbances to be traced from their origin on the Sun to the ionosphere. Algorithms will be developed to monitor these effects in real-time and provide information to commercial aircraft on trans-polar routes that use HF radio to communicate with air traffic control centres. This work, by improving the reliability of communications, will contribute to the safety of operations in polar regions.