Chapter 12

Space Weather Effects on Aircraft Operations

An Introductory Overview

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Abstract
European airlines are now monitoring occupational exposure of aircrew to cosmic radiation, but the impacts of SW on other systems used for day-to-day operations are not considered. Future civil and military aircraft will use increasingly complex avionics and will operate in a satellite-based air-space management network. However, to maximise effectiveness of this globally interoperable system and maintain safe operations will require a greater understanding of the SW risks with increasing technology. This chapter describes the SW effects on aircraft operations and includes brief details of an ESA project to quantify those risks.

Keywords
Aircraft, avionics, cosmic radiation, solar energetic particles, space weather, FANS, Network-Centric, air-space management, operational risks.

1. INTRODUCTION

The introduction of European Union (EU) legislation requiring the monitoring of aircrew exposure to Cosmic Radiation (CR), including any variations at aircraft altitudes due to solar activity, has briefly raised the profile of SW in the airline industry. However, SW phenomena can affect all areas of aircraft operations including avionics, communications and satellite navigation systems.

Since man first launched into the air 100 hundred years ago, day to day aircraft operations, whether civil or military, have developed into incredibly complex and structured events, requiring careful planning and control to
ensure above all else that Flight Safety is maintained at all times. The envisaged developments in aircraft and support systems over the next 10 to 20 years suggest that aircraft operations are about to enter a new era of technology infrastructure utilising satellites and micro-electronics. This increasing reliance upon such technologies means that all aspects of civil and military aircraft operations will become increasingly susceptible to the impacts of Space Weather (SW).

Despite the World Trade Centre terrorist attacks of 9/11 and the current poor economic situation for airline companies the demands for commercial air travel continue to grow at ~5% per annum. Airline companies are continually investing in new technologies and services in a bid to improve efficiency and drive down the costs per seat mile. This includes the introduction of onboard flight data and performance monitoring systems, Electronic Flight Bags for pilots, enhancing the passenger experience with on-demand in-flight entertainment, and wireless and satellite communication systems for aircraft operations, email and internet.

At the same time the management of the air traffic infrastructure is being developed and enhanced to provide more airspace for more aircraft. Improved Command, Control, Communication and Information (C³I), via satellites, bring the benefits of increasing navigational accuracy and greater connectivity while outside of ATC radar coverage, thus reducing the separation between aircraft during all stages of the flight, and ensuring the availability of accurate real-time information for operational and commercial decisions. In a similar manner, future military capabilities are being planned around the concept of multi-national “Network-Centric” operations, utilising the latest technologies in avionics, secure data-link communications and pilot-sensory integration. For military aircraft operations this will provide a quantum leap in the situational awareness of the pilots, mission planners and Command Centres for their whole Theatre of Operations.

With the introduction of new ultra-long-haul “over-the-pole” routes, “more-electric” aircraft in the future, and the increasing use of satellites in the operation, the need for a better understanding of the SW impacts on future aircraft operations will become all the more compelling as we look towards the next solar maximum around 2011/12. These impacts will be discussed further in this chapter.

2. SPACE WEATHER EFFECTS

The accepted definition of SW is “conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of space-borne and ground-based technological