

DETECTION OF UPPER LEVEL TURBULENCE VIA GPS OCCULTATION METHODS

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Turbulence at the upper levels of the atmosphere is a poorly understood phenomena. This is due in part to a lack of observations as well as fundamental questions regarding the mechanisms that produce the turbulence. This lack of understanding and real-time measurements is directly reflected in the significant impact that turbulence encounters have on commercial air transport operations. According to the US National Transportation Safety Board (NTSB) and Federal Aviation Administration (FAA) data, turbulence is the leading cause of in-flight accidents, injuring many hundreds of passengers and flight attendants and resulting in a financial burden to US air carriers at the level of an estimated 150M dollars per year. The only routine information available about upper level turbulence is derived from pilot reports of turbulence encounters. Over the oceans and other remote regions, even these observations are sparse. Better observations of upper level turbulence would surely lead to better turbulence avoidance strategies for commercial aircraft, and would also lead to a better understanding of this complex phenomenon. One novel source of data that has been used to obtain high-resolution vertical profiles of the upper atmosphere is GPS to Low Earth Orbiting (LEO) satellite occultations. GPS-LEO experiments have already proven the viability of this technique to derive mean temperature profiles, geopotential height data, and the usefulness of these in initializing NWP models. Some attempts have been made to derive statistics of the fluctuating component of the GPS signal as well, by using ground-based receivers. However, GPS data when received at the ground is characterized by strong humidity fluctuations in the boundary layer, making it difficult to separate out signal fluctuations due to turbulence from natural humidity fluctuations. Furthermore, as the GPS signal is a path-integrated value, from a single receiver, it is almost impossible to identify where along the path the turbulence is occurring. On the other hand, fluctuations of the GPS signals passing through the upper levels of the atmosphere are mainly influenced by temperature-induced turbulence. Therefore, to avoid the problems associated with humidity fluctuations, and also to derive high vertical resolution information about upper atmospheric turbulent structures, it seems more promising to investigate GPS signal fluctuations as received by another earth orbiting satellite (or by an aircraft in cruise) instead of those measured by a ground-based receiver.