

1 Abstract

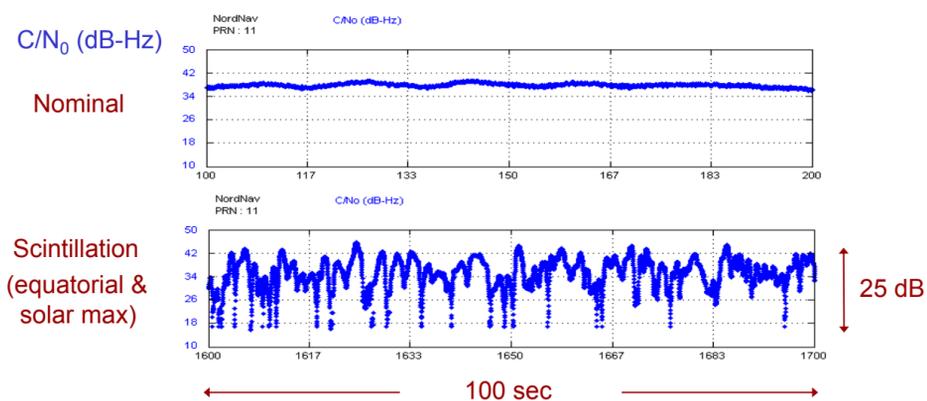
Deep and frequent GPS signal fading due to strong ionospheric scintillation is a major concern for aircraft navigation in the equatorial region during solar maximum periods. Deep signal fading can break a receiver's carrier tracking lock on a satellite channel and the satellite cannot be used for position solution until a receiver reacquires the lost channel. Frequent signal fading also causes frequent reset of the carrier smoothing filter of aviation receivers.

This research analyzes navigation availability during a strong scintillation period based on real scintillation data from the previous solar maximum (March 2001). Both effects from satellite loss due to deep fading and shortened carrier smoothing time due to frequent fading are considered for the availability simulation.

The authors gratefully acknowledge the support of the Federal Aviation Administration CRDA 08-G-007.

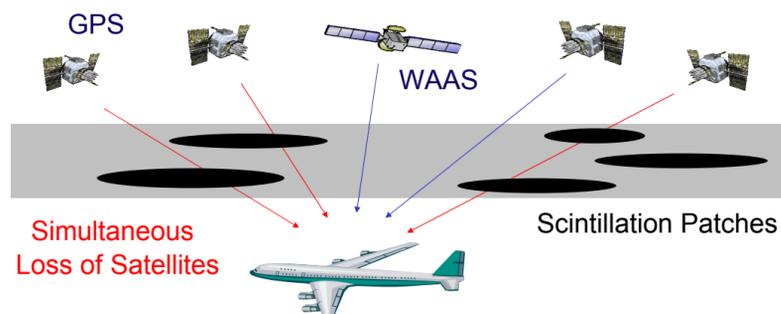
2 Scintillation and Deep Signal Fading

Signal to Noise Ratio (C/N_0) of PRN 11 (Ascension Island, 18 Mar 2001)



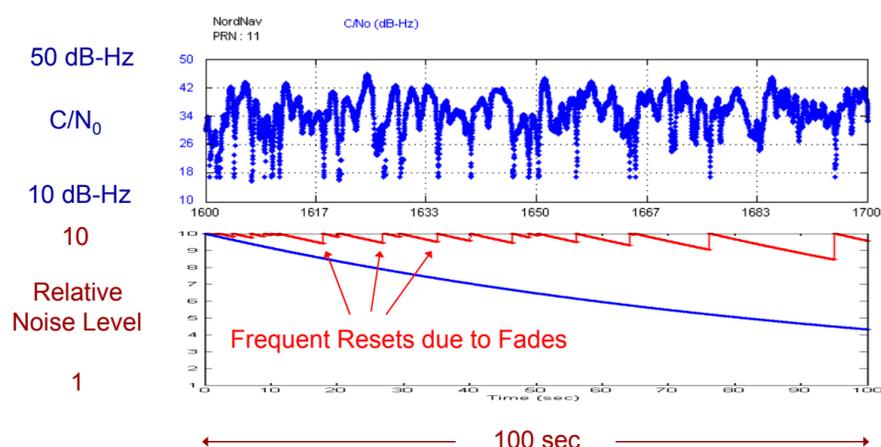
Scintillation causes deep GPS signal fading (more than 25 dB fading sometimes) which leads to carrier lock loss of a GPS receiver.

3 Impact on Navigation (Loss of Satellites)



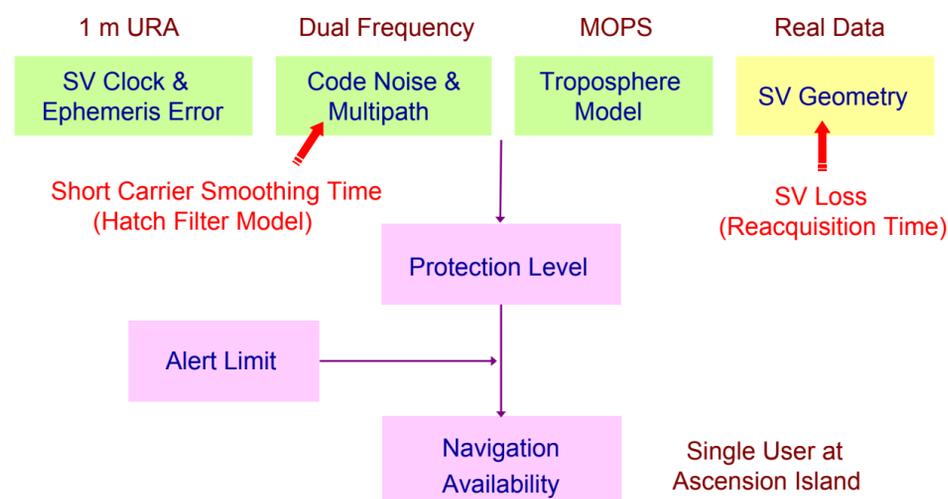
Chance of simultaneous loss of satellites is strongly dependent on a receiver's reacquisition time after losing carrier lock.

4 Impact on Navigation (Short Carrier Smoothing Time)

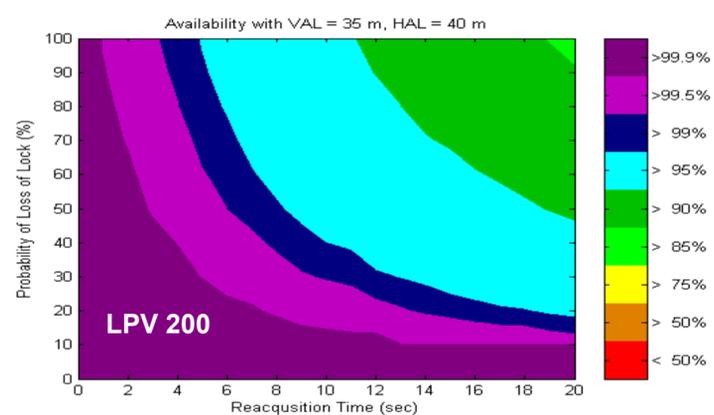


Frequent reset of carrier smoothing filter (Hatch filter) of an aviation receiver increases noise level of code measurements, which adversely affects navigation availability.

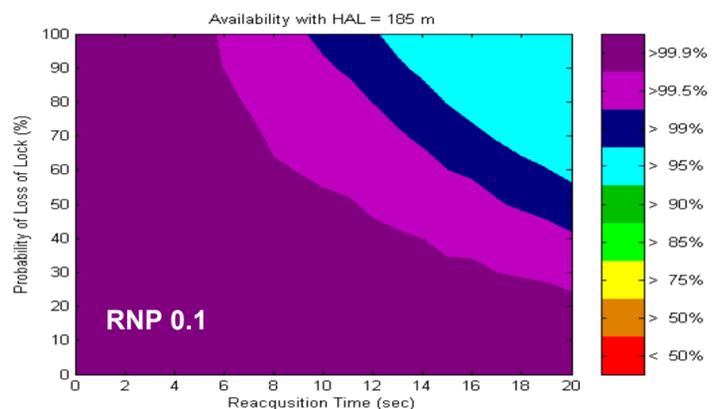
5 Availability Simulation Procedure



6 Availability of Vertical & Horizontal Navigation

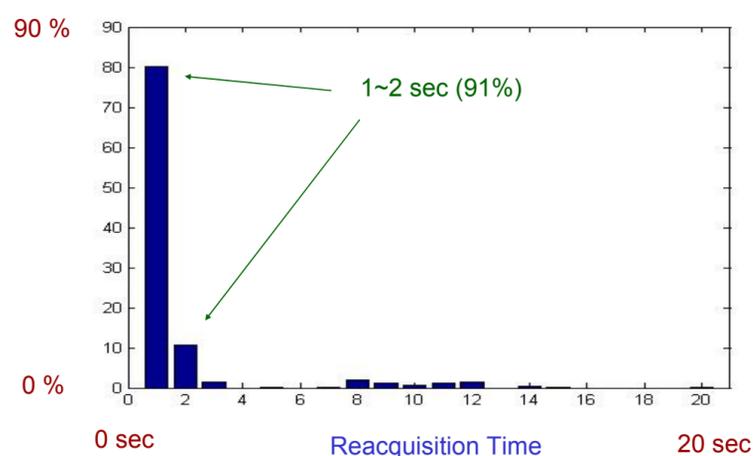


20 second reacquisition time, which is allowable limit of the current WAAS MOPS, does not necessarily guarantee enough availability during strong scintillation.



Horizontal navigation would not be a problem even during strong scintillation if the reacquisition time limit of the current WAAS MOPS is reduced.

7 Observed Performance of a Certified WAAS Receiver



Observed performance during 36 days in Brazil was much better than the WAAS MOPS requirement. Current receiver technology can accommodate shorter reacquisition time limit.