On the possibility of rain rate estimation by observation of the scatter of satellite broadcasts

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We have investigated the possibility of coherently detecting the scatter of microwave broadcasts from satellites to synthesize Doppler radar measurements of precipitation. This study was motivated by our prior development of a passive VHF system observing commercial FM broadcasts to study plasma turbulence in the ionosphere.

In particular, we have investigated a system consisting of two antennas; one directed towards a Ka-band broadcast from geosynchronous orbit, and one directed to observe bistatic Rayleigh scatter. The first antenna provides a coherent reference which can be used to create very large processing gain to detect the second, much weaker signal. Ka-band is not used in ordinarly weather radar systems because the absorption may be large. In a conventional radar the signal must pass twice through the absorbing medium, while the net path would be approximately half as large for the passive system. In the proposed bistatic geometry the signal strength does not decrease with range.

As one would expect, the performance is severely limited by the low brightness of the illuminators. For time and space resolution that are comparable to NEXRAD, the proposed system would be approximately 50 dB less sensitive than the WSR-88D: the weakest observable signal is about 20-30 dBZ, depending upon choice of frequency, and time and space resolution. Although the RF hardware associated with this system should be inexpensive, the computing task is quite large (tens of Tera operations per second). We will present a short summary of this work, briefly providing an example of our VHF instrument. An extended technical report describing this work may be found at

https://www.ee.washington.edu/techsite/papers/refer/UWEETR-2002-0019.html