

## Electromagnetic Signatures of European North Atlantic Winter Thunderstorms

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We present results of three-component VLF measurements of unusual daytime tweek atmospherics, which we have recorded in a favorable electromagnetic environment on the summit of La Grande Montagne (1028 m, 43.9410N, 5.4836E), Plateau d'Albion, France in January 2015. The observed daytime tweek atmospherics have a clear frequency dispersion which we are able to analyze above the first ionospheric cutoff. We estimate model parameters of the characteristic frequency dispersion as a function of time. Using the obtained parameters we are able to evaluate the tweek reflection heights and propagation distances from their source lightning discharges. The three-component measurement allows us to estimate the arrival direction. The source lightning strokes of observed unusual daytime tweeks were found to originate in a sequence of severe winter thunderstorms which hit Ireland, the UK, Norway, Denmark, Germany, and Poland in January 2015. Based on our analysis we show that a thunderstorm occurring at higher latitudes of northern and north-western Europe during winter months is an ideal candidate for the source of tweeks, which could be observed unexpectedly during the day.