



## The low period atmospheric gravity waves observed using Very Low Frequency signals

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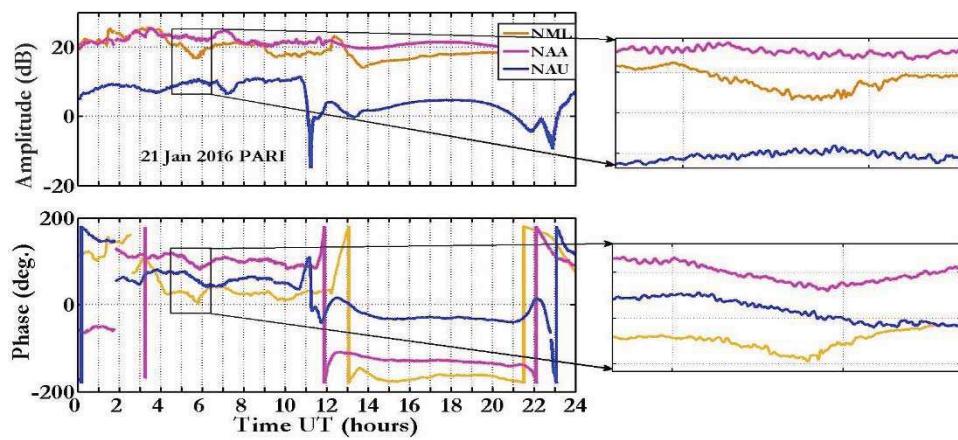
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### Abstract

It has been known that the atmospheric gravity waves (AGWs) play a major role in shaping up the structure and dynamics of lower, middle and upper atmosphere [1, 2], and relates to various phenomena in the thermosphere. VLF remote sensing is a well-established technique to monitor D-region conditions, including AGWs. We have analyzed various VLF navigation transmitter signals recorded at VLF recording station in North Carolina, USA, called PARI (35.2 N, 82.9 W) for a one-year period from May 2015 to April 2016. The VLF signal (both amplitude and phase) show wave like signature (WLS) in different Transmitter-receiver great circle path (TRGCPs). We have found three event days namely 02 May 2015, 21 January 2016 and 21 April 2016, with periodic variations of 1.2 -3 minutes. One example of observed Wavy signature on VLF transmitter on 21 January 2016 is shown as Figure 1. In general, the period of AGWs is longer than the background oscillations known as Brunt-Vaisala period (BV period) but in the present case observed periods are much lower than the BV periods (~5 minutes). Initial analysis suggests that the probable source of observed WLSs is convective (from lightning discharges/thunderstorm) generated AGWs propagating upward from troposphere. The source regions are identified using lightning location network and satellite data. The more details on the properties and possible source are discussed.



**Figure 1.** Three VLF transmitter signals (amplitude and phase) showing wave like signature (inset). The data was recorded at PARI station on 21 January 2016

1. Hines, C. O., "Internal atmospheric gravity waves at ionospheric heights", *Can. J. Phys.*, **38**, 1960, pp. 1441–1481.
2. Fritts, D. C., and M. J. Alexander, "Gravity wave dynamics and effects in the middle atmosphere, *Rev. Geophys.*, **41**(1), 2003, pp. 1003, doi:10.1029/2001RG000106,