

Using Signals of the Global Navigation Satellites for Diagnostics of Above Land Troposphere Refraction.

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Abstract— Possibility of global navigation systems using for troposphere refraction coefficient determination is considered. Relation between measured altitude and troposphere state is determined. The method of reflecting sources number, altitude of sources location and troposphere refraction estimation on GPS and GLONASS received signal spectrums of amplitude fluctuation is proposed.

I. INTRODUCTION

It is known the efficiency of the radiotechnical systems of the different purpose (navigation, radar, communication), substantially depend on condition of radio wave propagation is conditioned on atmosphere refraction state. The refraction for one's turn is conditioned on spatial-time distribution of the refraction coefficient « n ». Long time the traditional methods of the refraction coefficient determination were contact measurement of atmosphere parameters – temperature, pressure, humidity by means of meteorological sensors or direct refractometric measurements of n both in fixed points of space and while sensors are moving [1]. During last tens years methods of non contact atmosphere sounding are developed actively: radiometric, radar, radioraying methods and so on. The base for surface layer parameters determination could be radioraying method [2, 3] (known as method of radio eclipse), having some types. Physical background of the method is relations between distortion of signal parameters (level or frequency) during source movement and measure of atmosphere refraction [4].

This evident low allows H.V. Hitney to patent an invention of refraction coefficient profile determination in an atmosphere surface layer receiving satellite signal on shipborne antenna to which comes direct and reflected from sea surface beams [3]. First this idea was realized by Anderson [4] which performed experiments at frequencies 1239 MHz and 2891 MHz and shows the possibility of approximate profile $n(h)$ reconstruction. On the basis of reconstruction method is [3, 4] is comparison of signal realization received from satellite to set (pool) of analogous

dependences are calculated preliminarily analytically for different atmosphere conditions.

More complicated is a diagnosis of troposphere refraction above the land surface. In contrast to sea surface land lots differ of substantially greater heterogeneity owing to both variability of electrophysical characteristics and presence of different type of vegetation. In addition land surface in contrast to sea has high roughness. On the sea gaps presence in interference structure of the field is determined of direct signal interaction with signal mirror-imaged from sea surface and raised inversion layers. Over the land at the receiving point the field is formed in addition by random so called diffuse reflections from land roughness. When satellite moving along orbit it could happened change of diffuse scatterers that complicates obtaining of interference picture of field and reconstruction of refraction coefficient profile. First in papers [5, 6] were proposed using moments of the global navigation satellites radio sets and spectral composition of signal received from satellite for estimation of troposphere condition above land as well. Present paper is further development of ideas are proposed in earlier papers.

II. EQUIPMENT AND MEASURING TECHNIQUE

Experimental investigations are carried out in Smela city, Cherkassy region in Ukraine. Antennas of GPS and GLONASS receivers were situated at height about 30 m above ground surface on the plane covering on 1m beds. The ground surface at measuring point about 125 m relative to geoid. For comparison the data are obtained at Kharkov city measuring center by GPS receiver were used [5, 6]. Antenna height is the same (about 30 m), the ground surface relative to sea level about 170m. Measuring was carried out for different season. In Kharkov city the standard receiver of GPS signal was used [5, 6], and in Smela city receiver is developed by specialists Co Ltd “Navis-Ukraine” is provided possibility of reception and processing signals of several navigation systems: GPS and GLONASS, and joint co-processing as