CONCLUSION

An analysis of the polarization–spectral signatures for bodies of various configurations has shown that these characteristics are intimately related to the geometry of the scattering target, reflecting its specific attributes, and can therefore be used as highly informative features for the identification of radar targets. Restrictions could be encountered in the practical implementation of the method, since real scatterers have local sources that are not rigidly fixed relative to the center of mass, but "meander" over the target surface as its line of sight changes. The presence of "meandering" spectral lines in the spectrum of the scattered signals can potentially encumber the analysis of the polarization–spectral signatures. This problem requires special investigation in each specific instance.

LITERATURE CITED


IONOSPHERIC DISTURBANCES PRODUCED BY POWERFUL EXPLOSIVES

P. M. Nagorskii and Yu. E. Tarashchuk

Results of a study of wave-like ionospheric disturbances initiated by powerful explosives are presented and analyzed. Three types of wave processes with differing physical natures which propagate in the upper atmosphere and ionosphere to distances of thousands of kilometers are distinguished. The effect of shock-acoustic waves on indirect short wave radio propagation is considered.

Introduction

Development of methods and means for actively affecting the Earth's ionosphere has led to creation of a new method for artificially disturbing the atmosphere–ionosphere–magnetosphere (AIM) system - a controlled on-ground explosion with strength equivalent to hundreds of tons of TNT. This method has definite advantages as compared to ejection of chemical substances into the ionosphere from spacecraft and rockets, plasma flux injection, and heating the ionosphere with high power radio beams, with regard to energy expended and the possibility of deeper study of the mechanisms where by the disturbance is transmitted from the atmosphere into the ionosphere and magnetosphere.

TABLE 1

<table>
<thead>
<tr>
<th>Date, observation point</th>
<th>D, km</th>
<th>ΔT, min</th>
<th>Δτ, min</th>
<th>Local time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alma-Ata</td>
<td>60</td>
<td>9</td>
<td>20</td>
<td>Morning</td>
</tr>
<tr>
<td>Tashkent</td>
<td>650</td>
<td>16</td>
<td>13 &quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Karaganda</td>
<td>750</td>
<td>19</td>
<td>15 &quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Novosibirsk</td>
<td>1400</td>
<td>24</td>
<td>15-20</td>
<td>&quot;</td>
</tr>
<tr>
<td>Irkutsk</td>
<td>2200</td>
<td>34</td>
<td>15-20</td>
<td>Day</td>
</tr>
<tr>
<td>Volgograd</td>
<td>2300</td>
<td>34</td>
<td>15</td>
<td>Night</td>
</tr>
<tr>
<td>4/25/82 Irkutsk</td>
<td>90</td>
<td>8.5</td>
<td>10</td>
<td>Day</td>
</tr>
<tr>
<td>12/26/82 Novokazalinsk</td>
<td>460</td>
<td>12.5</td>
<td>15</td>
<td>Day</td>
</tr>
<tr>
<td>Tbilisi</td>
<td>1300</td>
<td>21.5</td>
<td>16</td>
<td>Morning</td>
</tr>
</tbody>
</table>

In fact, for explosion of 300 tons of TNT in the lower atmosphere an energy of the order of 10^{12} J is liberated, which is transferred to the ionospheric level by an acoustic wave. The power acting on the ionosphere is then 10^3 MW, significantly exceeding power levels of the other methods noted above. Another important argument in favor of high power on-ground explosions is the similarity of the physical nature of their action to natural phenomena (earthquakes, volcanic eruptions, meteorological and other natural phenomena). In combination with a prior knowledge of source parameters such as local time, power level, and charge geometry this opens broad perspectives for studying the results of natural disturbances in the AIM system by various probe methods.

Reactions of the atmosphere and ionosphere to powerful chemical and nuclear explosions were analyzed by using experimental data obtained by vertical and oblique Doppler probing on a set of fixed frequencies, including data obtained during the first deliberate scientific-research explosion (the "Mass" project [1]), as well as results of modeling short wave signal response to ionospheric disturbances caused by shock-acoustic waves.

It is well known [2] that powerful explosions, being pulse sources, can excite waves of various physical nature in the surrounding medium. For the upper atmosphere and ionosphere we can distinguish three types of wave process: electrodynamic (waves in plasma), internal gravitational waves (IGW), caused by buoyancy forces, and acoustic waves, caused by compressibility of the medium. All of these have their own characteristic frequency and spatial scales.

Below we will consider the reaction of the ionosphere and an ionospheric communications channel to these three types of disturbance.

1. Plasma-Acoustic Ionospheric Disturbances

In this section we will analyze data obtained from a grid of vertical ionosphere probe stations during three on-ground chemical explosions and four nuclear explosions carried out near the Earth's surface.

1.1 Chemical Explosions. The initial data required for the analysis are summarized in Table 1. Here and below D is the distance from the explosion epicenter to the probe point, ΔT and Δτ are the time of appearance (measured from the moment of the explosion) and duration of the ionospheric disturbances. The power level of these chemical explosions was 260-1300 tons of TNT. Ionograms were taken at the probe stations every 1-5 min.

It follows from Table 1 that on November 28, 1981 during the "Mass" project explosion [3] six vertical probe stations at various distances from the epicenter were affected. This fact allows a detailed analysis of the space-time structure of the development of the ionospheric related to the chemical explosions.

We will note that the data for the Volgograd stations were taken from [4].

It was established by analysis of the entire set of experimental data that at practically all of the probe stations (with the exception of Irkutsk) there were well expressed