地球物理学报 2008 50 (6): 1917～1928 ISSN: 0001-5733 CN: 11-2074/P

扩展功能

本文信息

Supporting info

PDF(5116KB)

[HTML全文](0KB)

参考文献

服务与反馈

把本文推荐给朋友

加入我的书架

加入引用管理器

引用本文

Email Alert

文章反馈

浏览反馈信息

相关信息

本刊中 包含“‘地-电离层’模式”的 相关文章

本文作者相关文章

- 底青云
- 王妙月
- 王若
- 王光杰

长偶极大功率可控源电磁波响应特征研究

底青云,王妙月,王若,王光杰

中国科学院地质与地球物理研究所，北京 100029

收稿日期 2007-12-3 修回日期 2008-7-18 网络版发布日期 2008-11-17 接受日期

摘要 地球物理学中关于电磁波勘探研究通常采用的是地球半空间模型.然而，对于几十公里的有限长电缆源（长偶极源），远距离电磁波场探测必须要考虑电离层的影响，它是一个全空间问题.关于包含电离层、空气层和地球介质（我们称“地-电离层”模式）的电磁波场特征的研究在国外较少，国内几乎是空白.本文采用全空间积分方程法首先对小尺度的可控源电磁波场特征进行了研究，由于此时电离层的影响可忽略，它应该和半空间成熟的CSAMT模拟结果一致，对比结果表明，二者是一致的，验证了全空间模拟方法的可靠性和有效性.随后进行了50 km长电缆电离层和空气层高度都为100 km的“地-电离层”模式大尺度电磁波场模拟，以探讨大尺度可控源电磁波场的特征.给定频率的“地-电离层”模式电磁场的衰减曲线表明长电缆远距离电磁波场由于受电离层的作用存在衰减逐渐变小的过渡场和衰减变小的波导场.为了探讨复杂介质“地-电离层”模式电磁波特征，对“地-电离层”模式的典型地盾和地台多层介质模型进行了数值模拟，得到了偶极源长度50 km、电流200A、收发距离远达1600 km和2500 km的合理的电磁场结果.最后，对一简单含油储层结构模型进行了长偶极、大功率、远距离电磁波场响应计算.储层横向不均匀复杂结构模拟的结果表明，考虑电离层和大气层的“地-电离层”模式大尺度深层复杂介质模拟时，电磁场对深部目标体仍有很好的异常响应.

关键词 “地-电离层”模式 长偶极 大功率 远距离 电磁波场 数值模拟

分类号 P631

DOI:

Study of the long bipole and large power electromagnetic field

DI Qing-Yun, WANG Miao-Yue, WANG Ruo, WANG Guang-Jie

Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China

Received 2007-12-3 Revised 2008-7-18 Online 2008-11-17 Accepted

Abstract Generally, the geoelectrical structure of the earth′s crust and upper mantle only is considered in electromagnetic exploration. However, for a long bipole source (approximately several tens kilometers long), the effect of the ionosphere on the electromagnetic (EM) field should be taken into account when observations are carried out at a very remote locations far away from the source (several thousand kilometers). Especially, the configuration which includes the ionosphere, the atmosphere and the earth, called the “earth-ionosphere” case, should be considered. However, there are only a small number of publications related to this problem. In our study, we analyze first the electromagnetic field excited by an electric dipole within the traditional control source electromagnetic (CSEM) configuration using the integral equation method. We consider a three-layer model of the earth-ionosphere media. The modeling results closely match the half-space analytical data, since the effect of the ionosphere for this small scale bipole source is negligible. This confirms that the integral equation method is a reliable and effective method for modeling earth-ionosphere media. We examine the EM fields’ behavior in the model of the complicated earth-ionosphere media with the field excited by a long bipole source in the far-field and wave-guide zones. We model the decaying properties of electromagnetic fields for three-layer earth-ionosphere model considering a 50 km long current bipole source. Due to the influence of the ionosphere, the earth-ionosphere EM fields, excited by a long bipole source, has an extra wave-guide zone, where the field behavior is very different from the far field zone. We also model the EM fields for multi-layer models typical for continental shield and platform with 50 km long bipole and 200 A current source, and for the petroleum reservoir model including the ionosphere layer that is 100 km thick, and an air layer with the same thickness using a bipole that is 50 km in length. The modeling results show that the targets can still be easily identified in the earth-ionosphere EM fields with a very large offset (more than 1000km).

Key words Earth-ionosphere mode; Long bipole; Large power; Large offset; Electromagnetic field; Numerical simulation

通讯作者:

底青云 gydi@mail.igcas.ac.cn
作者个人主页: 底青云;王妙月;王若;王光杰