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## "地-电离层"模式有源电磁场一维正演

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One-dimensional electromagnetic fields forward modeling for "earth-ionosphere" mode

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摘要

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**摘要** "地-电离层"模式有源电磁法由于其在地球物理勘探和地震预报方面的良好应用前景,成为地球物理电磁法研究新的热点.近年来国内开始了"地-电离层"模式有源电磁法研究,作者已经实现了当地球层为均匀半空间时的正演,但实际上地球并不是均匀半空间.本文在此基础上,采用R函数法进行公式推导,以高采样密度的Hankel滤波系数实现数值模拟,给出多层地球层的正演结果.结果表明,"地-电离层"模式有源电磁法的探测能力,与CSAMT/MT类似,但由于电离层的影响,导致在大收发距的时候,出现了波导场,场强衰减变小;由于空气中位移电流的影响,导致电磁场在轴向和赤道两个方向上的衰减出现了差异,轴向方向的衰减更小.

**关键词:** "地-电离层"模式 电离层 电磁波场 正演 数值模拟

**Abstract:** With the development of ELF (extremely low frequency: less than 300 Hz) technologies, scientists proposed that ELF technologies be applied to geophysics and earthquake prediction. ELF application in geophysics was one kind of electromagnetic methods, and the study we concerned was not the same as that in communication domain. Because of the long-range of ELF, we should consider the coupling between ionosphere, air and earth media (called "earth-ionosphere" mode), especially the coupling with earth media, which were not taken into account when ELF was used only for communication. So we should study "earth-ionosphere" mode in geophysics domain. The authors have been studying the "earth-ionosphere" mode for a period of time, and have carried out "earth-ionosphere" mode forward calculation when the earth is uniform half-space. But that is not enough because the earth is not uniform half-space. So in this paper, we first established the model for "earth-ionosphere" mode, applied R function method for theoretical derivation, and we deduced the formulas of electric and magnetic field component on the surface of the earth. High sampling density Hankel digital filters were used for numerical simulation. We carry out "earth-ionosphere" mode forward calculation for a multi-layer earth model, and we examine the EM fields' behavior in the model of the "earth-ionosphere" mode. The result shows that, due to the influence of the ionosphere and displacement current in the air, the "earth-ionosphere" model EM field has an extra wave-guide zone, where the field behavior was very different from the far field zone.

**Keywords:** "Earth-ionosphere" mode Ionosphere Electromagnetic field Forward Numerical simulation

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