DETECTION OF SUBSURFACE HYPER-SALINE SOIL IN LOP NUR USING FULL-POLARIMETRIC SAR DATA

Yun Shao, Huaze Gong, Chou Xie, Aimin Cai

Institute of Remote Sensing Applications, Chinese Academy of Sciences
Datun Road, Chaoyang District, Beijing 100101, China
yunshao@irsa.ac.cn

ABSTRACT

This paper presents the research results about Lop Nur using full-polarimetric technology. Lop Nur Lake is one of the driest places in the world and finally lost its last drop of water in 1972. It is well known for its "Earth Ear" feature in optical remote sensing images. Likewise, "Ear" feature is shown in Synthetic Aperture Radar (SAR) images, and even larger because of penetration effect. With the penetration capability SAR is capable of detecting the subsurface targets and materials, especially in arid environment. As for SAR images, both C-band and L-band, there are two key features about Lop Nur area. One is the whole Lop Nur area is high-bright that means the backscattering is much stronger than other sites, such as Gobi, desert and so on. The other feature is the "Ear" pattern formation. We will conduct polarimetric analysis about these two questions based on past research results and field investigations.

In 2006 and 2008, we conducted two field investigations respectively. During latest investigation, we chose four profiles through "Ear" region, and collected 400 more soil samples. At the meanwhile, we also measured the surface roughness and spectroscopic data. In laboratory, we have got complex dielectric constants, mechanism composition, volumetric moisture and salinity. Based on the data, we conclude the possible reasons to the two questions above. The universal existence of lacustrine deposit at the subsurface with high water content and salinity is the fundamental cause of high-bright feature, and about "Ear" texture, various morphological surface conditions formed the perfect "Ear". That means Lop Nur phenomenon is the sum of these two contributions. Through analysis about scattering mechanisms during signals propagating a two-layer model was developed. In a sense, the two-layer model can explain "Ear" feature. However, the traditional SAR methods (intensity analysis) can not give perfect explanation. Polarimetric algorithm is anticipated as a useful tool, and with RADARSAT-2 launched, we can order multi-resolution and multi-incidence angle full-polarimetric SAR data.

SAR polarimetry is the science of acquiring, processing and analyzing the polarization state of an electromagnetic field. Radar polarimetry is concerned with the utilization of polarimetry in radar applications. In the past, several scientists devoted to develop classic polarimetric algorithms and put forward some parameters which can describe targets characteristics. Yannick Lasne figured out that the phase difference between HH polarization and VV polarization can represent shallow layer with higher moisture. There are a large mount of materials with high moisture and salinity at the subsurface in Lop Nur, and top layer materials are extremely dry. Thus, phase difference of co-polarizations is a possible detector about subsurface targets. This paper will present the analysis results using RADARSAT-2 full-polarimetric data. In this paper, the four parameters of the scattered wave presented by Touzi, are investigated as potential polarimetric discriminators, in addition to the conventional linear polarizations HH, HV, VH and VV and circular polarization. The Cloude and Pottier parameters entropy and α are also investigated to give us more information of detected targets. We expounded and analyzed about

polarimetric parameters, and concluded some rules about Lop Nur. Based on the conclusions above, we will generate an applicable procedure of detecting subsurface targets. Combining with past scattering mechanism analysis, we will provide comprehensive explanation about Lop Nur phenomenon.

In future research, optimal polarimetric synthesis will be conducted, and as for Lop Nur particular geologic and climatic conditions, we should make some appropriate amendments and the optimal results will be obtained.