

Techniques for Deriving Land Use - Land Cover and Forest Information from Polarimetric SAR Interferometry

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Based on the experience accumulated and gained during the DRAGON-1 and DRAGON-2 projects, we intend, under the DRAGON-3 project to strengthen the established and already fruitful collaborations between European and Chinese partners and experts in polarimetric interferometric SAR (Pol-InSAR) and quantitative forest sciences. Due to the successful already launched space borne polarimetric radar sensors, it is now shown that the accelerated advancement of PolSAR and Pol-InSAR techniques is of direct relevance and of priority to local to- global environmental monitoring of the terrestrial covers. The proposed project contains 3 main scientific topics with the following objectives:

- 1) Information on the land cover is of paramount importance for monitoring and management of the environment on a local, regional and global scale. In natural areas, land cover presents complicated structures and highly complex scattering responses, due to various scattering contributions, dielectric and shape properties and volumetric structures. The complementarities of polarimetric and interferometric observations will be necessary to provide enough information for general land classification, characterization and mapping. The proposed research activities that will be conducted in this first topic will aim at developing and validating a general and original PolSAR and Pol-InSAR analysis methodology of land-use land-cover (including the topics of scattering modelling, decomposition, segmentation) and investigating time-series analysis and impact of quad-pol, dual-pol and compact-pol mode configuration. In addition, vegetation (agriculture crops, wetland vegetation and forest) parameters such as leaf area index (LAI), vegetation water content, height and biomass are of important information for environmental change study. The proposed research activities that will be conducted in this topic will aim at developing vegetation parameters extraction methods based on PolSAR and Pol- InSAR.
- 2) The structure of forest vegetation is a key ecosystem parameter for biomass stock successions, and growth dynamics. Tree (forest) height parameter is a critical input to biomass determination and his estimation from spaceborne and airborne sensors would enable ecosystem change monitoring and modeling. The proposed research activities that will be conducted in this topic will aim at developing and validating a general methodology approach to forest type classification from PolSAR and Pol-InSAR data and forest parameters extraction (FAGB = forest above ground biomass) with the introduction of new scientific concepts like the Multi-Baseline Pol-InSAR or Pol-TomSAR for Polarimetric Tomography SAR, or Compressive Sensing Pol- TomSAR technique.
- 3) PolSARpro Software v5.0 is a polarimetric SAR data processing and educational tool developed under contract to the European Space Agency. It is proposed in this project to include all the new algorithms and scientific procedures that will be developed during the DRAGON-2 project. It will thus increase the great collection of well-established algorithms and tools designed to handle PolSAR and Pol-InSAR data from airborne and spaceborne sensors. The PolSARpro software could thus become also an important communication tool, advertising the international Geoscience and Remote Sensing community for promoting the most important scientific developments conducted during the DRAGON-3 project.

"龙计划"三期项目执行摘要 ID.10609

极化干涉SAR土地利用/覆盖和森林信息提取技术

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基于"龙计划"一期和二期项目的知识和经验积累，中欧双方已在极化干涉SAR（PoLInSAR）和森林定量遥感科学领域建立了良好的合作关系，在"龙计划"三期我们将进一步增强中欧双方专家已经建立的富有成效的合作关系。星载极化SAR（PoLSAR）传感器的成功发射和PoLSAR和PoLInSAR技术的快速发展，都显示了本项目相关技术属于与区域和全球陆表生态环境监测紧密相关的优先研究领域。本项目主要包含三个研究主题，主要目标如下：

1) 土地覆盖信息对当地、区域和全球尺度的生态环境监测和管理至关重要。在自然区域，土地覆盖表现为复杂的结构，由于散射贡献、介质特性、形状特征以及体结构的多样性，通常具有很复杂的散射效应。极化与干涉观测的互补性将有助于为一般性的土地分类、特征提取及制图提供足够的信息。本项目将发展验证适用大区域和具有原创性的土地利用土地覆盖PoLSAR和PoLInSAR分析方法，包括构建散射模型、极化分解和分割；研究时间序列分析方法和全极化、双极化及紧缩极化模式的影响；该主题拟开展的研究活动目的是发展和验证基于PoLSAR和PoLInSAR对森林类型进行分类的通用方法。

2) 森林植被结构是反映生物量积累及其动态变化的关键生态系统参数；森林树高参数是生物量测定的关键输入，应用星载和机载传感器对树高的估测将能够用于生态变化监测和建模。另外，植被（农作物、湿地植被和森林）参数，比如叶面积指数（LAI）、植被含水量、高度、生物量都是环境变化研究所需的重要信息。本项目拟研究基于新概念，比如多基线PoLInSAR、极化层析SAR、或压缩传感极化层析SAR的植被参数（如森林地上生物量，FAGB）提取技术。该主题拟开展研究活动的目标在于基于PoLSAR和PoLInSAR发展植被结构参数提取方法。

3) PoLSARpro软件第5版是极化SAR数据处理和教学工具，该软件是在欧空局的合同下开发的。在该项目中拟包含"龙计划"三期期间开发的所有新的算法和科学程序。这样将汇集很多确定性高的算法和工具，为机载和星载PoLSAR和PoLInSAR数据处理提供支持。PoLSARpro软件也可以成为一种重要的交流工具，向国际地理科学和遥感学会宣传，在"龙计划"三期项目中本项目为推动最重要科学方向的发展所做出的贡献。