Monitoring and Early Warning of Epidemic Diseases in China by Earth Observation Data Mining

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Among those diseases threatening human health and well-being, many epidemic and infectious diseases are closely related to natural environment due to the presence, breeding and evolution of their pathogens or reservoir hosts, especially vector-borne diseases (e.g. schistosomiasis, malaria and dengue, etc.) which rely heavily on their vectors. Therefore, monitoring the diseases' vector is an important way to prevent and control the vector-borne diseases.

Because of complex spatial distribution and dispersion of typical diseases and their vectors, it is difficult to acquire relevant environmental factor data by traditional in-situ measurements. Remote sensing technology provides the capability of obtaining temporal-spatial variations of ground environmental factors. However, remote sensing experts may not exactly know what environmental factors are required to identify the incubators of vector-borne diseases. On the other hand, effective RS data processing and parameters retrieval techniques are also challenges for hygiene experts who are lack of experience of remote sensing applications. Taking into account of different type of massive data are involved, computing scientists with substantial intelligent data analysis expertise is crucial to successfully incorporate advance intelligent data analysis, such as data mining, pattern analysis. Consequently, any single of these disciplines is insufficient, it is essential to bring together scientists from computing science and remote sensing along with domain experts to foster a substantial collaboration.

This proposed project aims to apply advanced remote sensing and computing technologies into monitoring and early warning of vector-borne diseases, e.g. schistosomiasis, malaria and dengue. First is to reveal environmental factors which have significant influences on the breeding of epidemic disease and its vectors. Then the project will make full use of the advantage of European and Chinese earth observation resources and the partners capability to develop parameter inversion, feature extraction and pattern analysis methods that will be used to characterise environmental features and habitants that are mostly suitable for the growth and dispersion of vector-borne disease and dynamic monitoring. Furthermore, temporal-spatial models of the distribution of vector-borne diseases will be developed by data mining techniques. Finally, the driving mechanism and data assimilation methods of land surface process model will be explored in order to implement identification and early warning of vector-borne disease transmission areas. All the institution of the project can provide sufficient funding to run the whole project successfully.

The outcomes of the project will help to decrease the scope and extent of vector-borne diseases, and improve prevention & control capabilities to vector-borne diseases. Additionally, the research results can be used to assess environmental characteristics around the sits of major infrastructure and facilities, and provide the suggestion on site selection and implementation of infrastructures. The synthetic feature extraction techniques developed for multi-source multi-level remote sensing data can also be applied to other service fields, sustainably making contribution to knowledge within the communities.

基于对地观测数据挖掘技术的中国传染性疾病监测与预警

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在威胁人类健康与福利的各类疾病中，许多流行性/传染性疾病，特别是媒介传播疾病（如血吸虫病、疟疾、登革热等）与其病原体或媒介的存在、孳生及消长密切相关，监测疾病及其媒介发生的相关环境要素成为阻断和控制此类疾病的一种重要途径。

疾病及其媒介空间分布的复杂性，使得传统地面调查方法很难获取大范围的致病媒介关联环境要素信息，遥感技术则提供了获取地面环境因素时空变异信息的能力。然而，卫生专家由于缺乏遥感应用经验，在遥感数据处理和参数反演过程中面临巨大挑战；而遥感专家又难以准确把握识别媒介传播疾病孳生的环境因子；另外，此研究必将涉及大量不同类型的数据，需要融入先进的智能数据分析技术（如数据挖掘、模式分析等）。因此，本研究迫切需要来自计算机、遥感以及卫生领域的科学家的通力合作。

本项目以运用先进的遥感技术和计算机技术对媒介传播疾病（如血吸虫病、疟疾、登革热等）进行监测和预警为研究目标，充分利用中欧双方的对地观测资源以及项目参与各方的技术优势，通过开展参数反演、特征提取以及模式分析方法研究，准确描述并动态监测适宜于媒介传播疾病生长和扩散的环境特征，进而基于数据挖掘技术建立媒介传播疾病分布的时空模型，通过探索地表过程模型驱动机制和数据同化方法，实现媒介传播疾病传播区域的识别和早期预警。

项目成果将有助于降低传染性疾病危害的程度和范围，提高传染性疾病防控能力；同时，该研究成果可用于重大工程设施环境效益评估，指导工程布设与实施；此外，该研究发展的多源多级遥感数据信息综合提取技术有望推广至其它领域，服务于社会可持续发展。