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Advancing Pollen-induced Health Risk Assessment with Geospatial Big Data

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Project Summary:
The global concern over allergenic pollen is rapidly growing as it is a vital contributing factor to allergic diseases such as asthma, affecting millions of people worldwide. As climate change and urbanization proceed at an accelerated rate, alterations to urban green spaces and plant species increase the complexity and concentration of pollen, thereby escalating pollen-related allergic diseases, which have now emerged as a substantial issue for both public health and the built environment.

This research proposes a novel integration of satellite-based observations, ground-based measurements, numerical simulations, and environmental exposure models to develop a holistic "monitoring-modeling-assessment" framework of pollen-induced health risk.

The focus of this study is on the Beijing-Tianjin-Hebei metropolitan region (JJJ) and Guangdong-Hong Kong-Macao Greater Bay Area (GBA) regions, which serve as a North-South cohort of two city clusters with contrasting geographies, climates, and urban developments. First, to generate spatially, temporally, and spectrally consistent seamless data cubes (SDCs) by fusing Landsat and Sentinel imagery and develop high-resolution tree species mapping. Second, to integrate these SDCs, tree species maps, and in-situ pollen observations to examine the relationship between vegetation phenology and pollen dynamics. This will allow the researchers to establish baseline mappings of pollen concentrations. Third, supported by the weather forecast model, to simulate pollens' spatiotemporal diffusions by considering meteorological conditions and realize near real-time pollen concentration forecasts. Fourth, using the IPCC "Hazard-Exposure-Vulnerability" framework, to assess urban pollen risk by accounting for both population and pollen dynamics. Finally, associate medical allergy incidence data to study the correlation between pollen risk and health outcomes, and devise optimization strategies to guide interventions for reducing pollen risk.

港大「聯合科研資助基金計劃」項目

基於時空大資料的致敏花粉健康風險評價研究

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項目簡介:
全球對過敏性花粉的關注正迅速增長，因為它是導致哮喘等過敏性疾病的重要因素，影響著全球數百萬人。隨著氣候變化和城市化以加速的速度進行，城市綠地和植物種類的變化增加了花粉的複雜性和濃度，從而加劇了與花粉相關的過敏性疾病，現在已成為公共衛生和建築環境的一個重大問題。

本研究提出一種新穎的整合衛星觀測、地面測量、數值模擬和環境暴露模型的方法，以開發全面的"監測--模型--評估"框架，以評估花粉引起的健康風險。

本研究的重點是京津冀都市區（JJJ）和粵港澳大灣區（GBA）地區，這兩個城市群以其不同的地理、氣候和城市發展，構成了南北走向的群組。首先，通過融合 Landsat 和 Sentinel 影像，生成時空和光譜一致的無縫數據立方體（SDCs），並開發高分辨率樹種映射。其次，將這些 SDCs、樹種地圖和實地花粉觀測結合起來，以檢驗植被物和花粉動態之間的關係。這使研究人員能夠建立花粉濃度的基線映射。第三，基於天氣預報模型，模擬花粉的時空擴散，考慮氣象條件，實現花粉濃度的近實時預測。第四，使用 IPCC 的"危害--暴露--脆弱性"框架，通過考慮人口和花粉動態來評估城市花粉風險。最後，研究人員將醫學過敏發生數據與花粉風險和健康結果之間的相關性聯繫起來，並構思優化策略，以指導減少花粉風險的干預措施。