

An Easy-to-use Cloud-Based Computing System For Comprehensive InSAR Time Series Analysis

LI Yongsheng¹, ZHANG Jingfa¹, LI Zhenhong²

¹ National Institute of Natural Hazards, Ministry of Emergency Management of China

² College of Geological Engineering and Geomatics, Chang'an University

Summary

InSAR technology currently stands as a prominent field within remote sensing monitoring techniques, finding widespread application in diverse areas such as ground subsidence monitoring and geological hazard investigation, among others. The processing workflow of InSAR data involves a blend of knowledge across multiple disciplines, including computer science, geodesy, signal processing, and remote sensing. The theoretical models underlying InSAR are intricate, and the steps involved in processing are numerous. Furthermore, the sheer volume of data necessitates significant computing power, storage resources, and other hardware devices. Harnessing the vast SAR remote sensing data and cloud computing resources available on the "AI Earth" Cloud platform, we have introduced a cloud-based InSAR comprehensive computation system. This system effectively dismantles barriers and complexities associated with InSAR technology, empowering users to directly apply InSAR results to address diverse industry applications without becoming overly focused on the intricacies of the technology itself. The algorithms employed by the system encompass a range of application scenarios, satisfying the requirements for comprehensive surveys and the emergency monitoring of natural disasters.

GPU-assisted InSAR processing

This paper aims to employ Graphic Processing Unit (GPU) techniques to accelerate the deformation extraction process from big Interferometric Synthetic Aperture Radar (InSAR) datasets, using Geospatial Cyber-Infrastructure (GCI) from AI Earth Geoscience Cloud Platform to bridge GPU with InSAR domain knowledge. Our GCI integrates GPU and parallel deformation extraction algorithms to achieve near real-time extraction of deformation areas from big Sentinel-1 InSAR images, which also provides a high-performance computing platform for other InSAR data analytics in future studies. Using GPU technology and high-performance computing cluster to realize massive InSAR data calculation issues in a wide area is a critical technical problem, including efficient registration and high-precision ESD estimation methods

1. Optimizing GPU algorithms to address key steps in InSAR Enabling fast computation of massive InSAR data with low cost.
2. Achieving more than a 20 times increase in processing efficiency on a single machine, particularly beneficial for emergency scenarios

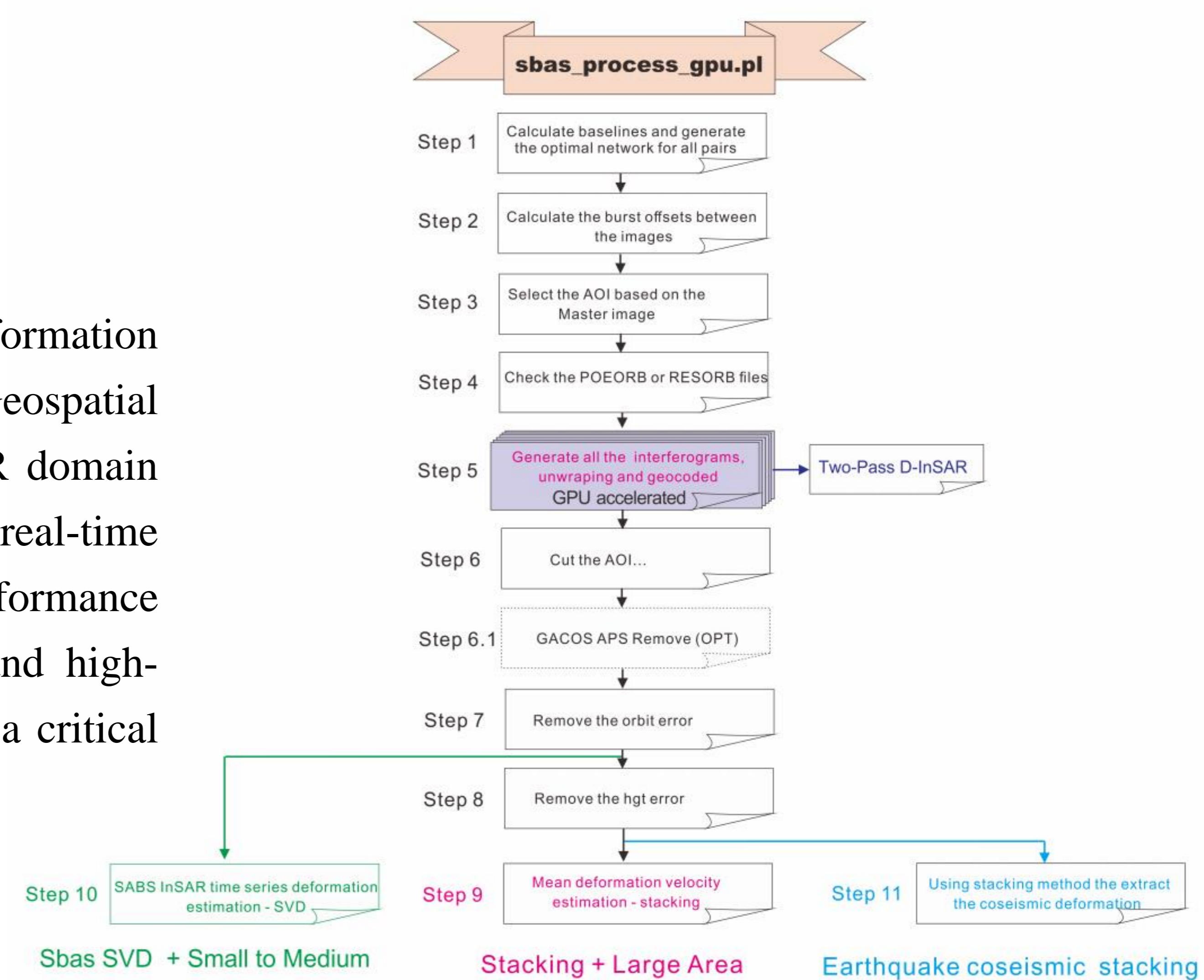


Fig. 1 High-performance computing for massive InSAR data

Easy-to-use service cloud-based computing system

The InSAR comprehensive computation system, built on cloud services, surmounts traditional limitations such as data downloading, storage, parameter configuration, and computing resources. It simplifies the input of parameters for various types of surface deformation and applications (Fig.1), providing users with rapid deformation analysis outcomes. At present, the InSAR processing environment has been successfully launched on the AI Earth cloud platform. Users can promptly submit tasks and leverage its capabilities via the platform (<https://engine-aiearth.aliyun.com/>).

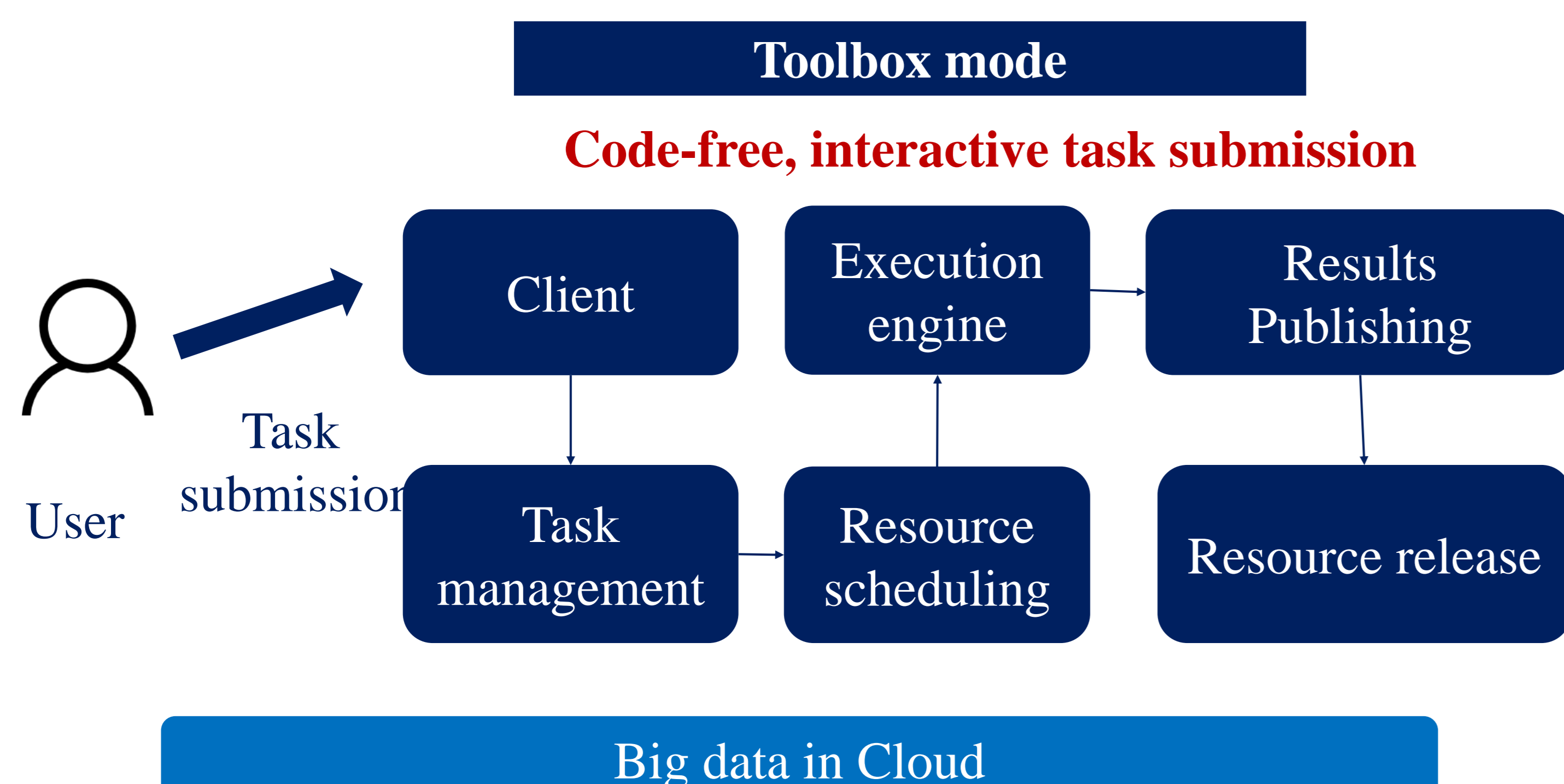


Fig. 2 How to work in Alibaba AI Earth cloud platform

Demonstration application

- Building an InSAR computation system on the Alibaba Cloud computing platform
- Open to everyone
- User-friendly and no expertise in InSAR required
- Results are visible and obtainable, supporting temporal change analysis, among other capabilities

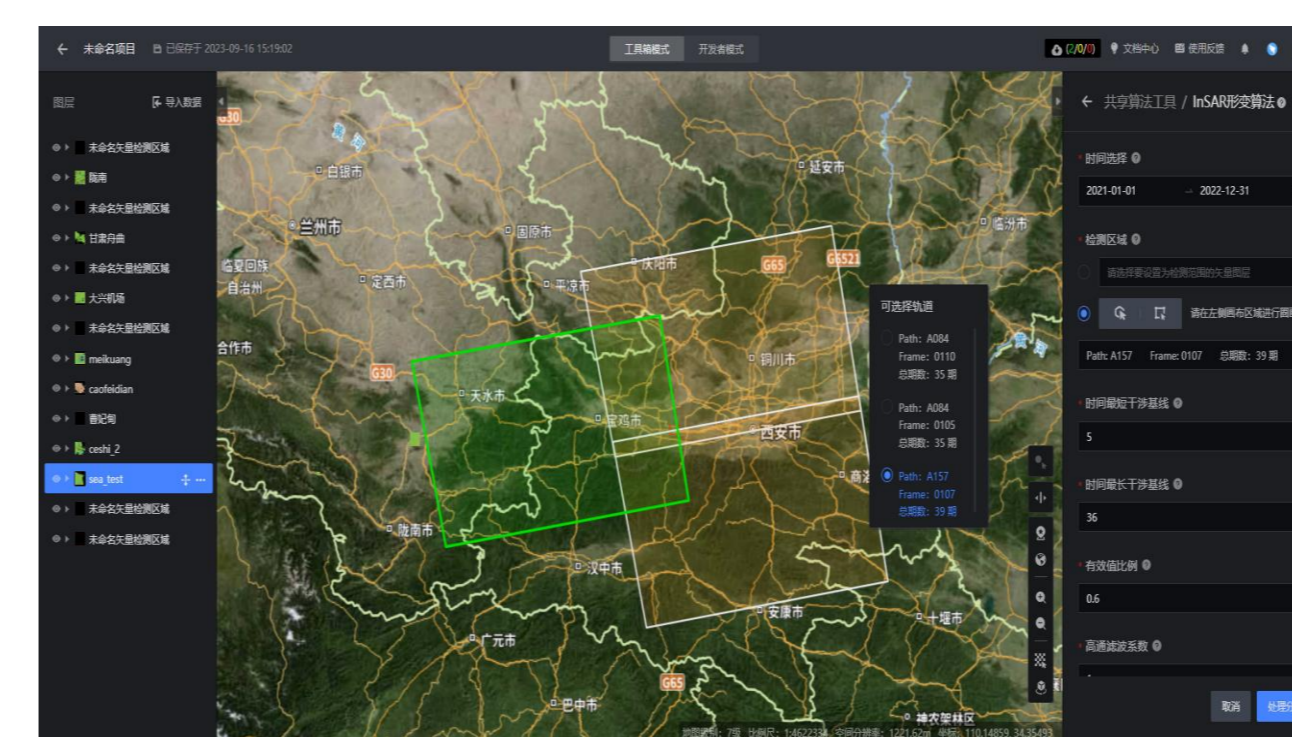


Fig. 3 Web-InSAR Open Processing System

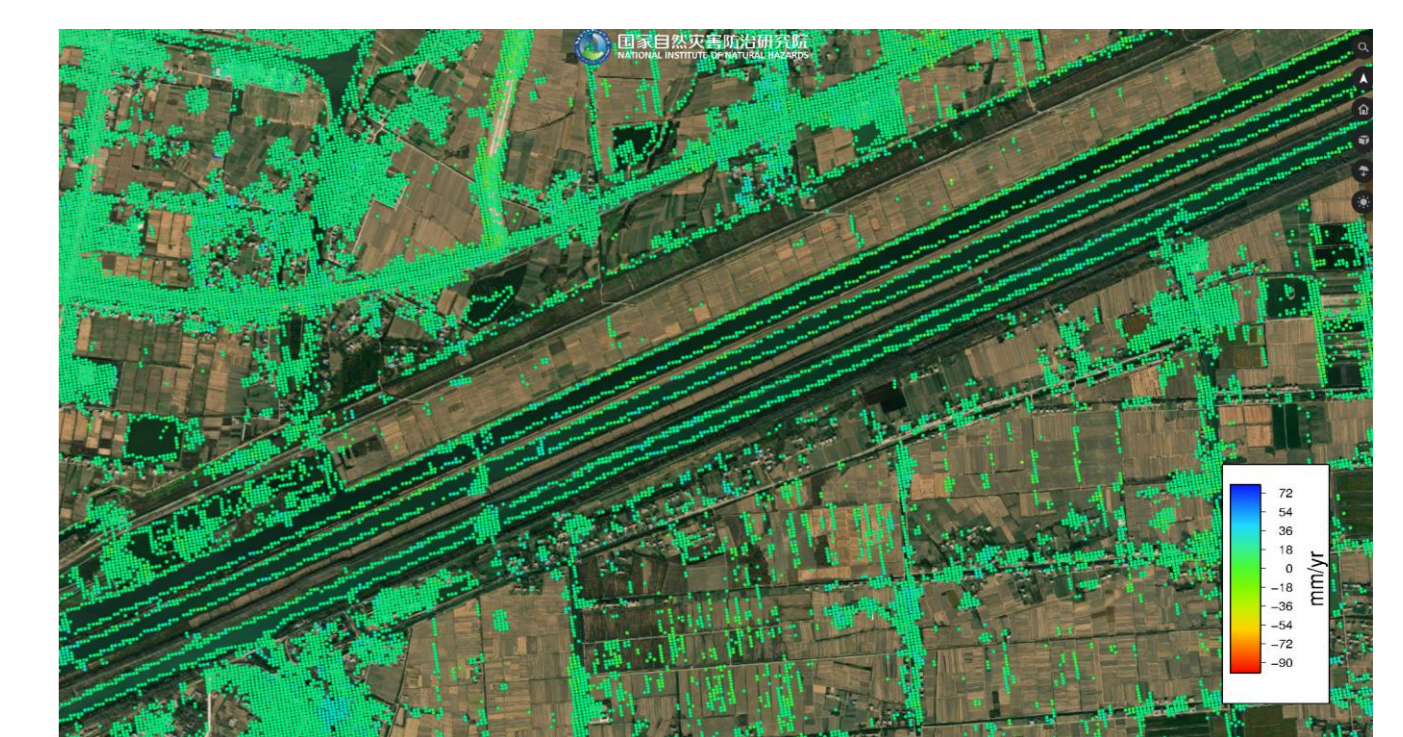


Fig. 4 Deformation monitoring of river embankments

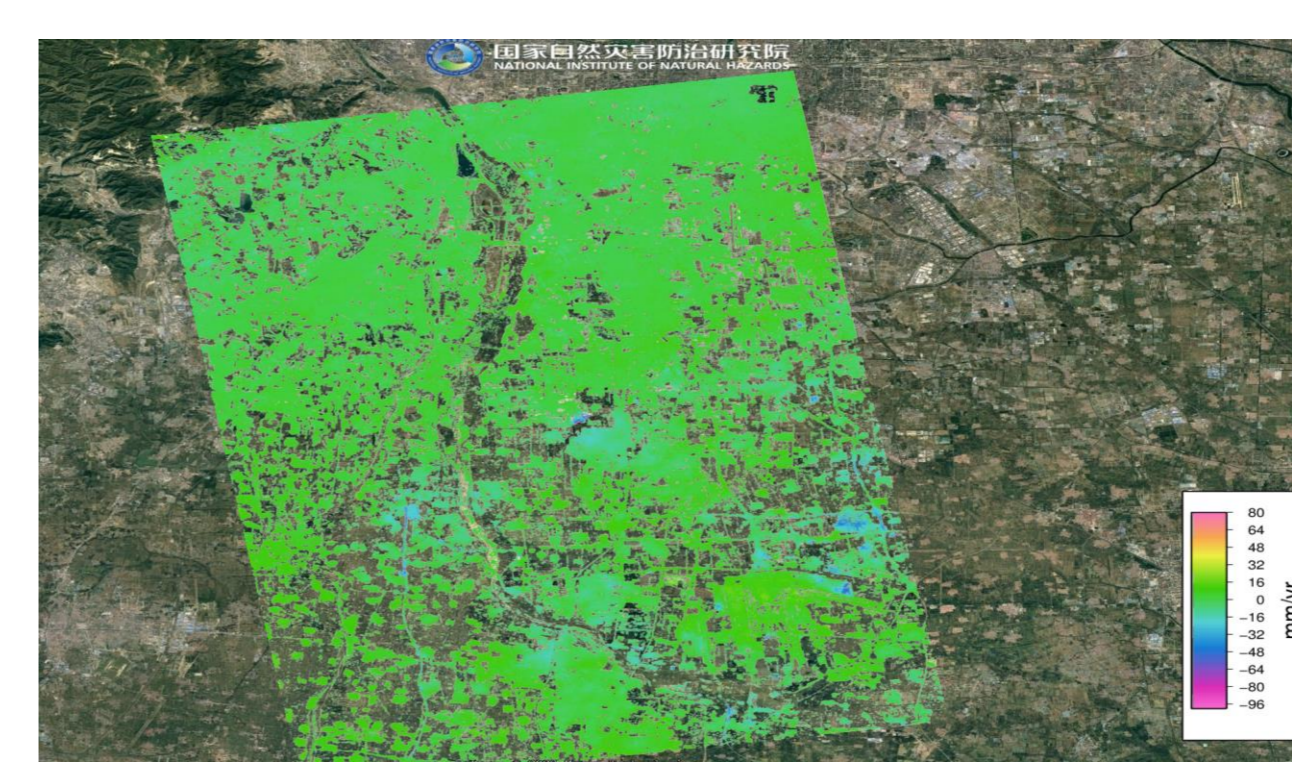


Fig. 5 Urban ground subsidence

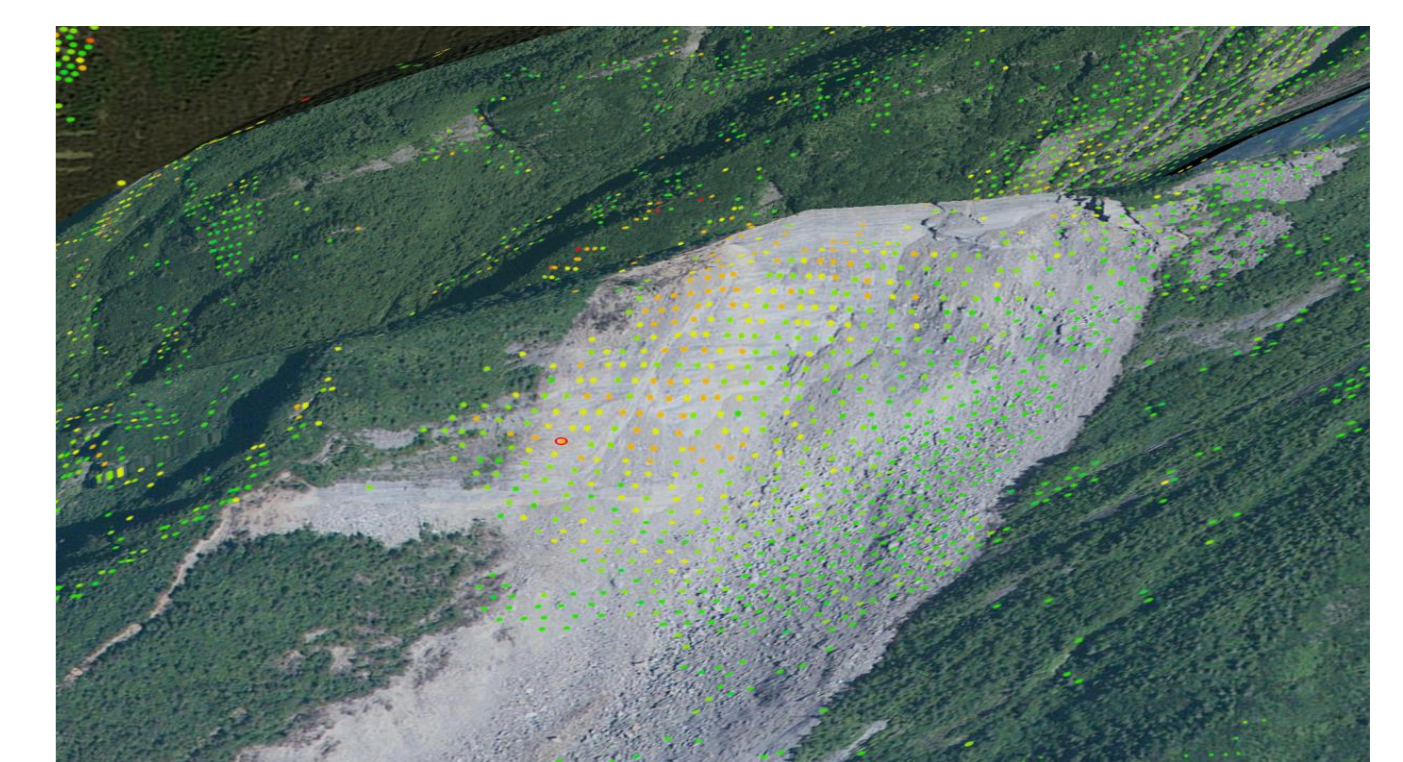


Fig. 6 Landslide monitoring