XXVII FIG CONGRESS
11–15 SEPTEMBER 2022
Warsaw, Poland

Volunteering for the future – Geospatial excellence for a better living

Fusion of inhomogeneous geodetic data for Rock Cliff Monitoring: a Case Study of the Lianziya Cliff in Three Gorges National Geological Park in China

Aiham Hassan, Li Zhang, Gabriel Kerekes, Volker Schwieger

University of Stuttgart, Germany

ORGANISED BY FIG SGP

PLATINUM SPONSORS esri Trimble.

Outline

1. Overview of Measurement Methods
2. Test Scenario Lianziya Cliff
3. Data Acquisition and Processing
4. Data Fusion
5. Deformation Analysis
6. Conclusion and Outlook

Image: Symbolic chain in one of the Lianziya Cliff crack

Overview and Characteristics of The Measurement Methods

Goal:

Verify the stability of the Lianziya Rockcliff

Expected horizontal deformation of

4.2 mm/year

GB-SAR

GNSS

Approach:

Fusion of inhomogeneous geodetic data for monitoring

TLS

TS

Test Scenario Lianziya Cliff

- 2 campaigns: 2018 & 2019 by

武漢大學測绘学院
SCHOOL OF GEODESY AND GEOMATICS

武漢大學
WUHAN UNIVERSITY

University of Stuttgart

Institut für Ingenieurgeodäsie

Test Scenario Lianziya Cliff

Epoch	GNSS	TLS	TS	GB-SAR
March 2018	x	x		x
September 2019	x	x	x	x

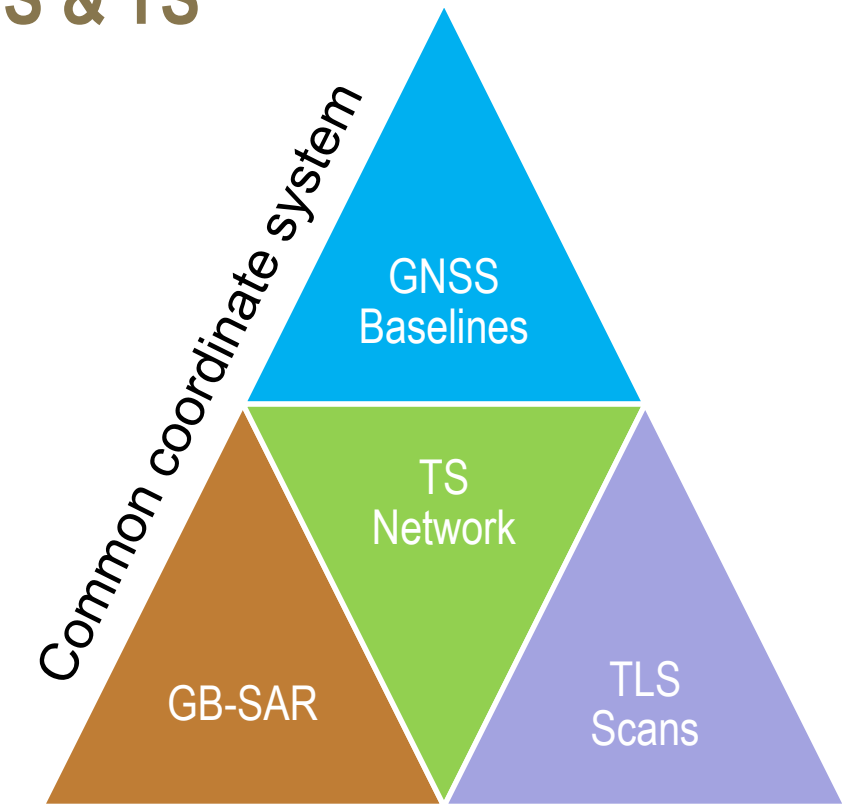
Concept:

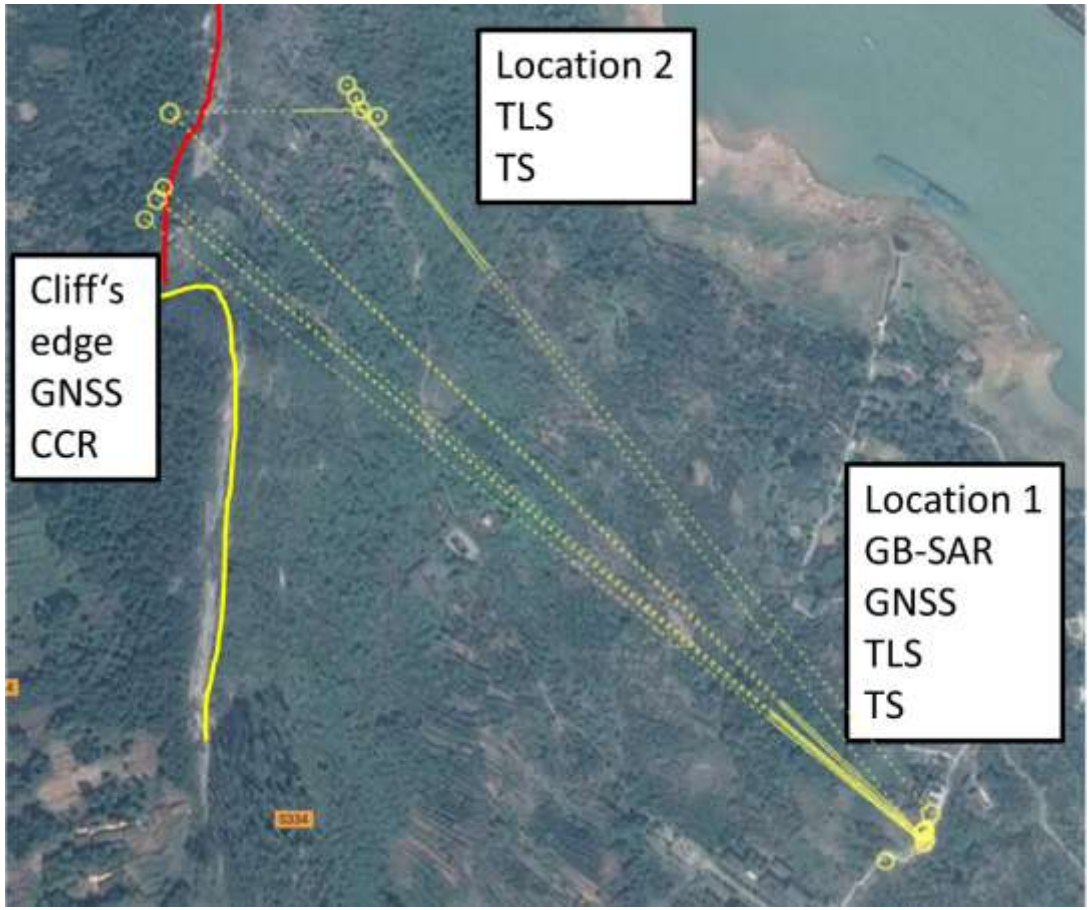
1. Define a coordinate system
2. Integrate measurements in this system
3. Deformation analysis between epochs

Problems:

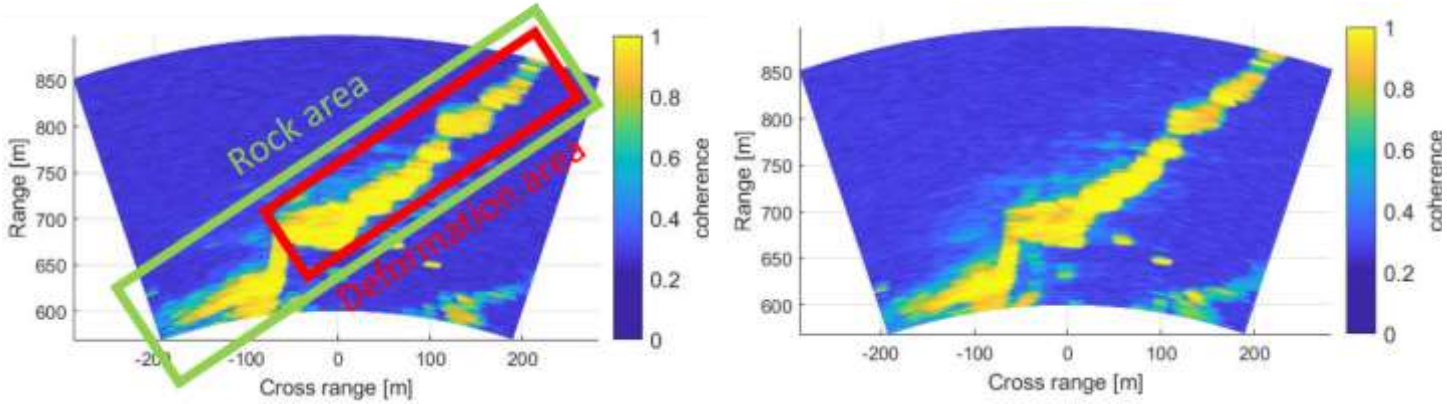
1. Unavailability of measurements in one epoch (e.g. TS)
2. Data integration of some measurements (e.g. GB-SAR)

Data Acquisition and Processing - GNSS & TS

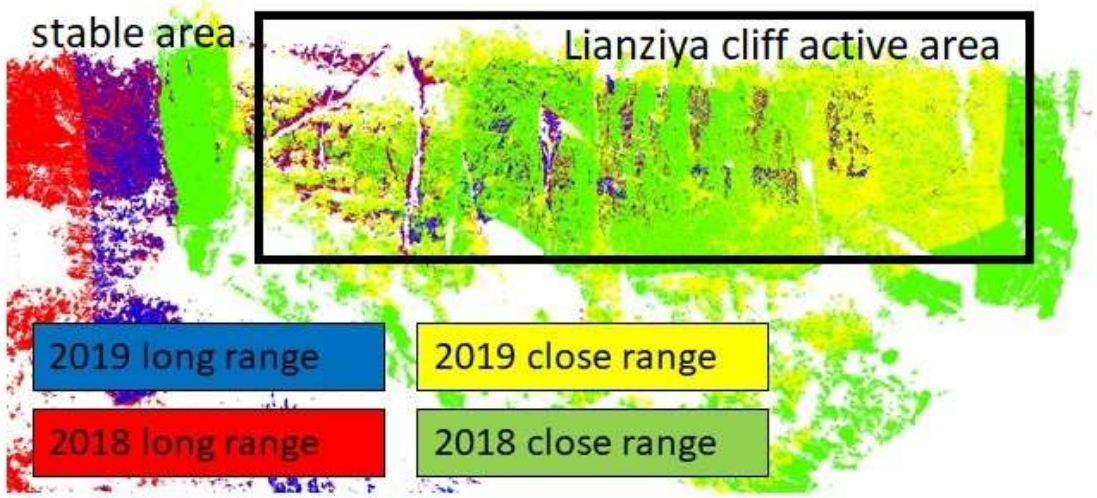




Data Acquisition and Processing - TLS & GB-SAR

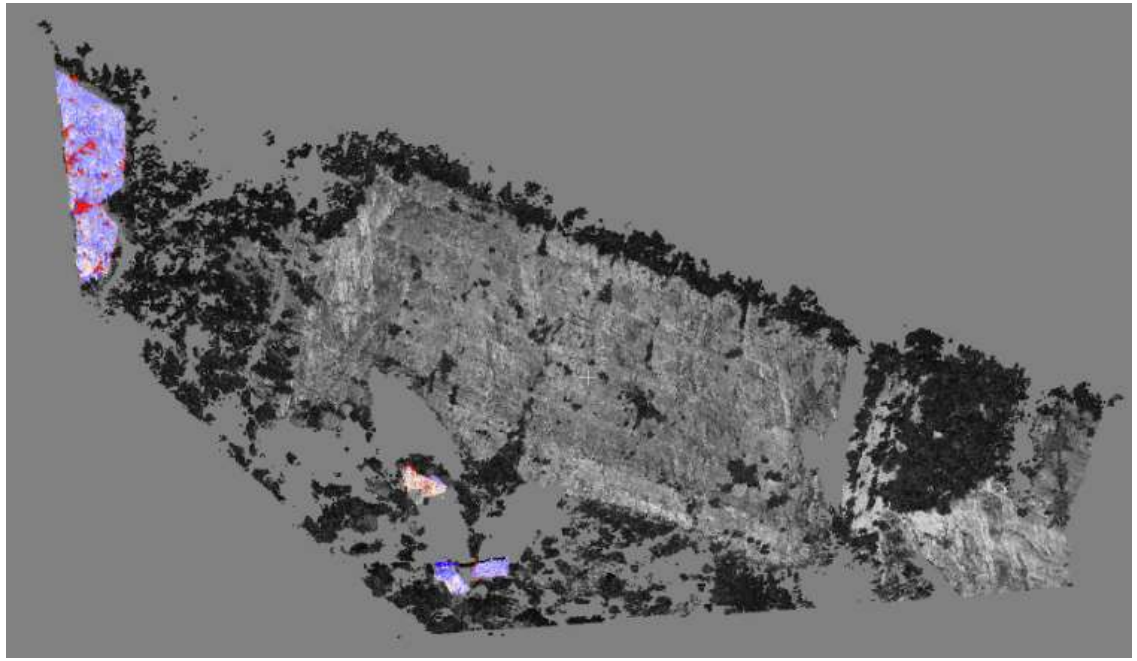


GB-SAR Coherence in 2019 (left) and 2018 (right)

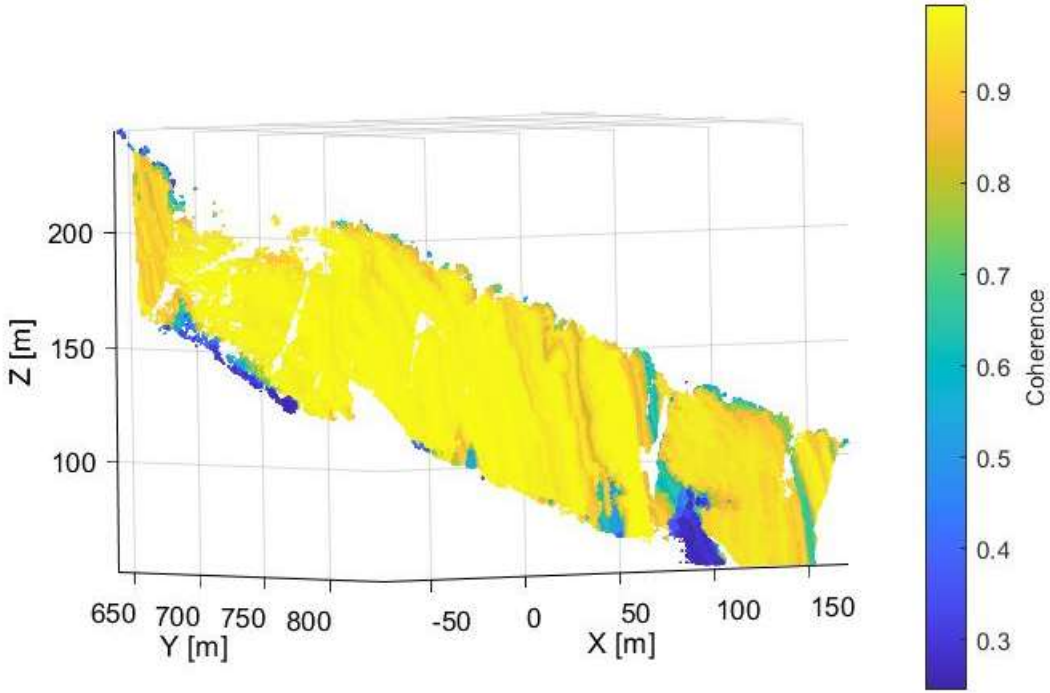


TLS point clouds in both epochs

Data Fusion
Registration of Point Clouds



Registration TLS point clouds by stable areas (colored)



3D point cloud colored by the coherence values of the GB-SAR data 2019

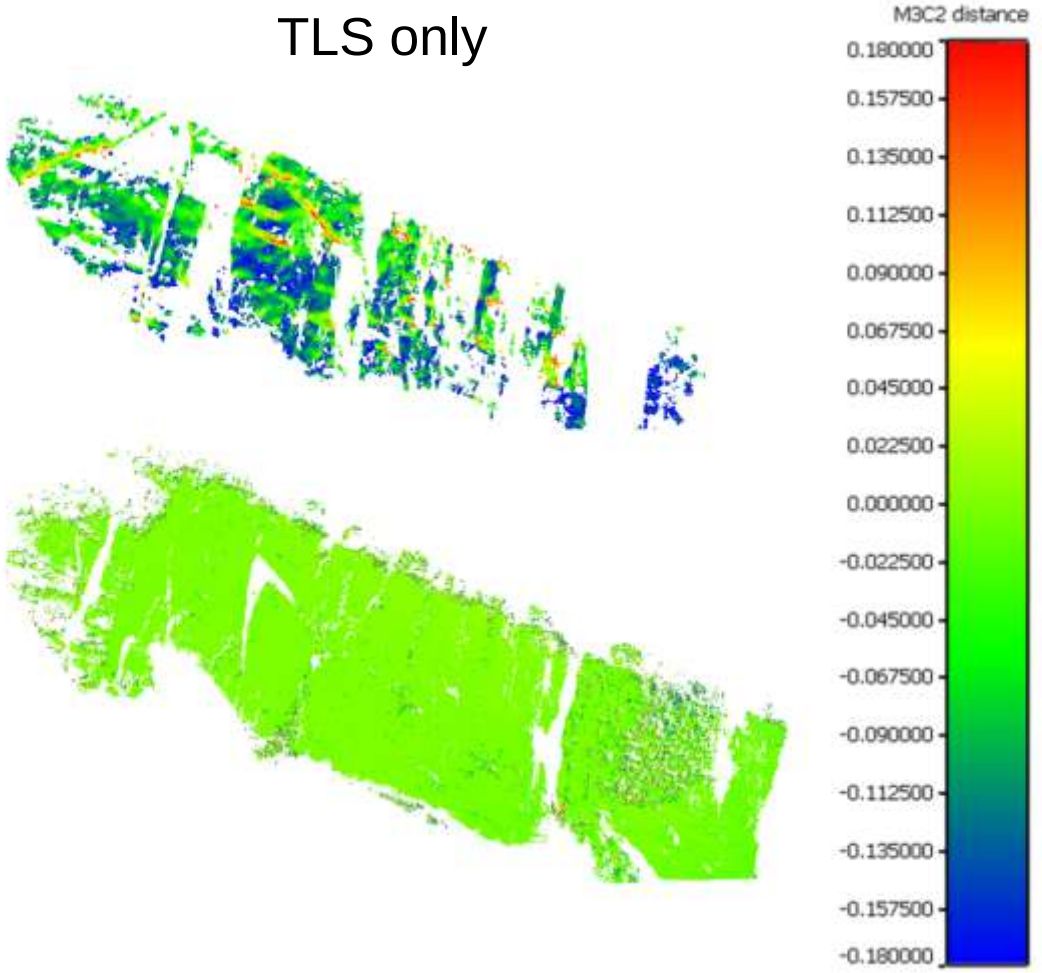
Deformation Analysis
Point-wise / Area-wise Deformation Analysis

GNSS only

	Baseline Differences (2018-2019)			Test values		
Baseline	ΔdE [mm]	ΔdN [mm]	Δdh [mm]	E	N	h
R-M1	-1.6	-16.7	1.7	0.15	1.58	0.07
R-M2	1.7	-13.0	-31.4	0.17	1.18	1.34

No significant movements detected within this period

TLS only



Conclusion and Outlook

- Attempts to fuse inhomogeneous data of point-wise and area-wise measurement methods
- Analyze deformations (after one year)

- Lessons learned:
  - Avoid incompleteness of the data
  - deformation analysis using GB-SAR recommended only for continuous monitoring
  - expected movements are detectable over a larger time span (e.g. 3-5 years)

Gabriel Kerekes

E-Mail Gabriel.Kerekes@iigs.uni-stuttgart.de
Telefon +49 (0) 711 685-
www. iigs.uni-stuttgart.de

University of Stuttgart
Institute of Engineering Geodesy
Geschwister-Scholl-Str. 24D, 70174 Stuttgart

Thank you!

Acknowledgement

Cooperation between:
DAAD (German Academic Exchange Service)
CSC (China Scholarship Council)
within PPP (Project Based Personnel Exchange Program)
Project ID: 57446528