

# Seismic Hazard under Cities Pleiades Stereo Data

John Elliott, Ruth Amey & Scott Watson



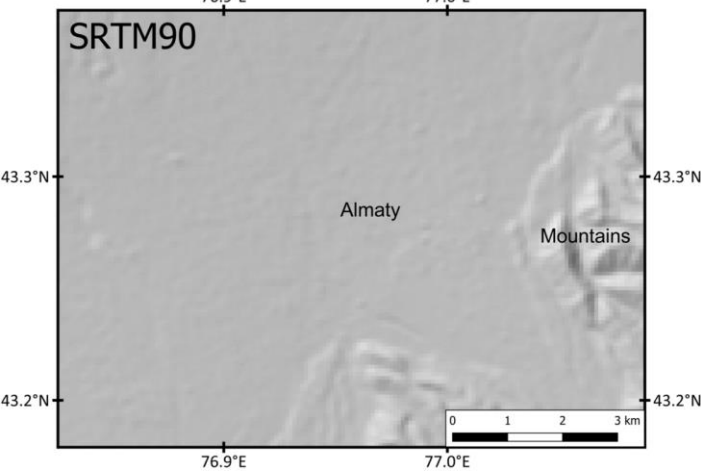
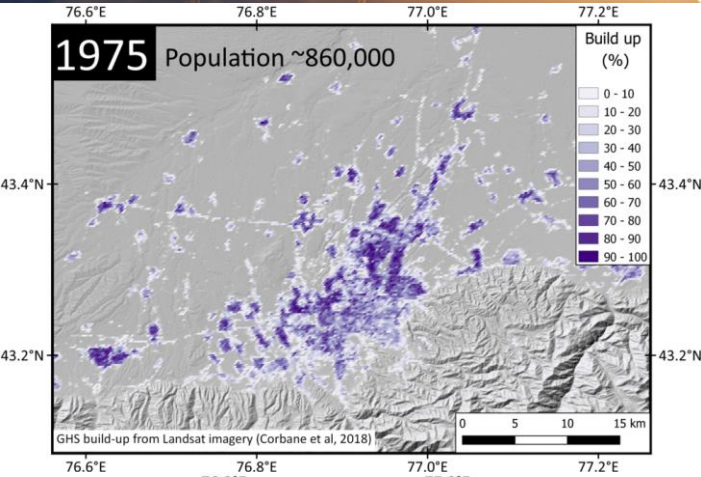
Natural Environment Research Council



COMET CENTRE FOR OBSERVATION & MODELLING OF EARTHQUAKES, VOLCANOES & TECTONICS



# Almaty, Kazakhstan



## Earth and Space Science

RESEARCH ARTICLE  
10.1029/2021EA001664

### Key Points:

- Digital elevation models derived from high-resolution satellite imagery can map active faulting near cities and determine building heights
- Scenario risk calculations show a moderate earthquake on a fault in north Almaty would cause considerable damage and loss due to proximity
- Properly characterizing fault location and geometry close to cities is key to quantifying the relative level of seismic hazard and risk

### Supporting Information:

Supporting Information may be found in the online version of this article.

### Correspondence to:

## Significant Seismic Risk Potential From Buried Faults Beneath Almaty City, Kazakhstan, Revealed From High-Resolution Satellite DEMs

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**Abstract** Major faults of the Tien Shan, Central Asia, have long repeat times, but fail in large ( $M_w$  7+) earthquakes. In addition, there may be smaller, buried faults off the major faults which are not properly characterized or even recognized as active. These all pose hazard to cities along the mountain range front such as Almaty, Kazakhstan. Here, we explore the seismic hazard and risk for Almaty from specific earthquake scenarios. We run three historical-based earthquake scenarios (1887 Verny  $M_w$  7.3, 1889 Chilik  $M_w$  8.0 and 1911 Chon-Kemin  $M_w$  8.0) on the current population and four hypothetical scenarios for near-field faulting. By making high-resolution Digital Elevation Models (DEMs) from SPOT and Pleiades stereo optical satellite imagery, we identify fault splays near and under Almaty. We assess the feasibility of using

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# Bishkek, Kyrgyzstan

Bishkek, Capital of Kyrgyzstan, 1.1 million inhabitants



Pleiades Tri Stereo Archive from 2013

- Project Wrap-up meeting 23<sup>rd</sup> September to The Institute of Seismology, Bishkek, for Seismic Risk Assessment Delivery



# Bishkek, Kyrgyzstan

## Improving urban risk estimates for Bishkek, Kyrgyzstan, from improved geological knowledge of hazards

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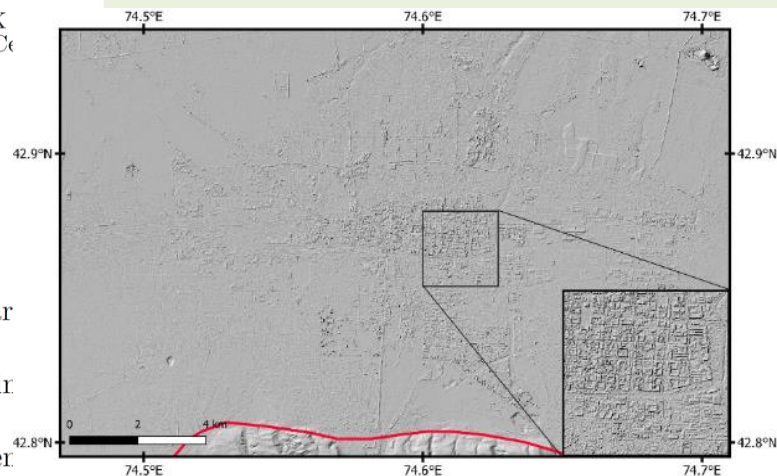
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### Key Points:

- We calculate seismic hazard and risk to Bishkek, Kyrgyzstan, for defined earthquake scenarios on significant active faults in the region
- Ruptures on the closest faults, Issyk Ata and a potential fault beneath foldir the north east, would cause considerable damage and loss
- Determining geometry of faults close to, and potentially under, cities is essential to understand the degree of earthquake hazard and risk

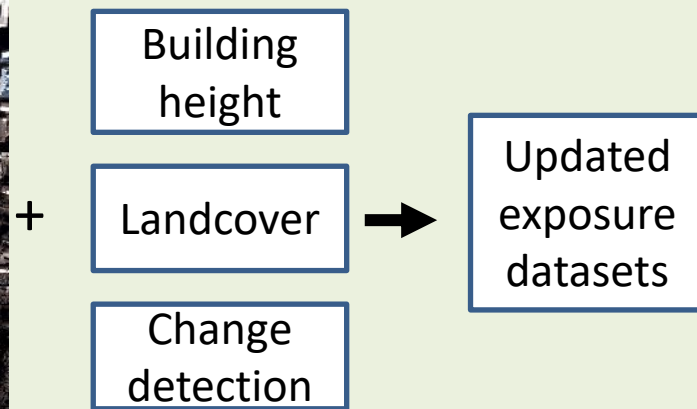
Manuscript to be submitted at the end of the month



# Bishkek, Kyrgyzstan



- Ongoing next project for Bishkek – Deep learning building detection



# Kathmandu, Nepal

## Examples of work done as part of Tomorrow's Cities Kathmandu WP2 (flood modelling) using the Pleiades 2 m Digital Elevation Map (DEM)

Figures produced by

**Dr. Maggie J. Creed** (University of Glasgow)

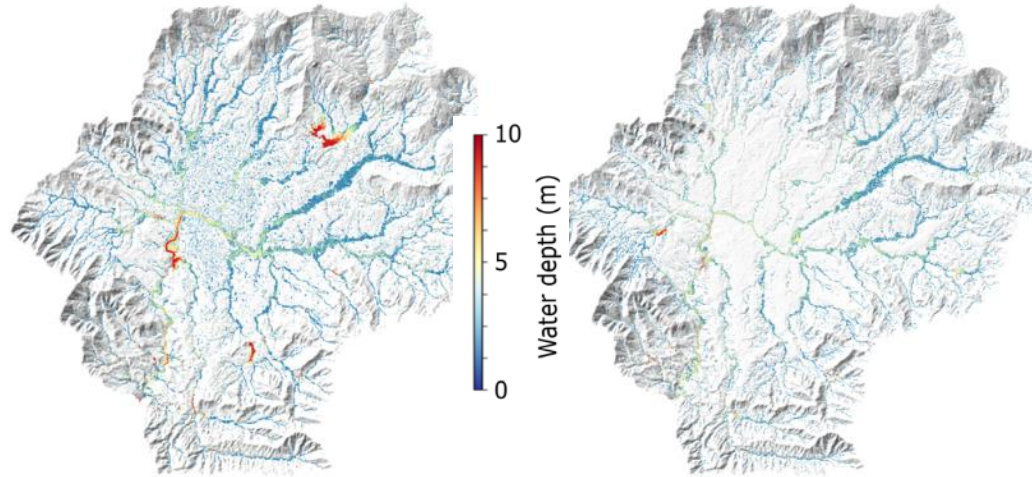
**Dr. Manoranjan Muthusamy** (University of Edinburgh)

In collaboration with

**Prof. Simon Mudd and Saraswati Thapa** (University of Edinburgh)

**Anup Shrestha** (Tribhuvan University, Nepal)

Flood maps of Kathmandu generated using 2D flood modelling (20 yr. return period flood)

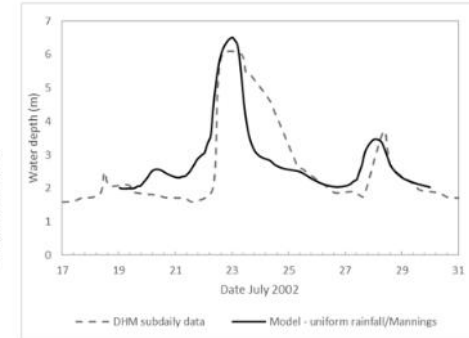


30 m SRTM DEM

Pleiades DEM resampled from 2m to 10m

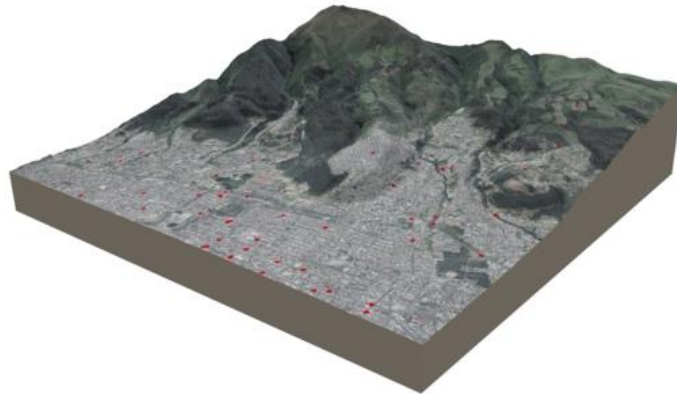
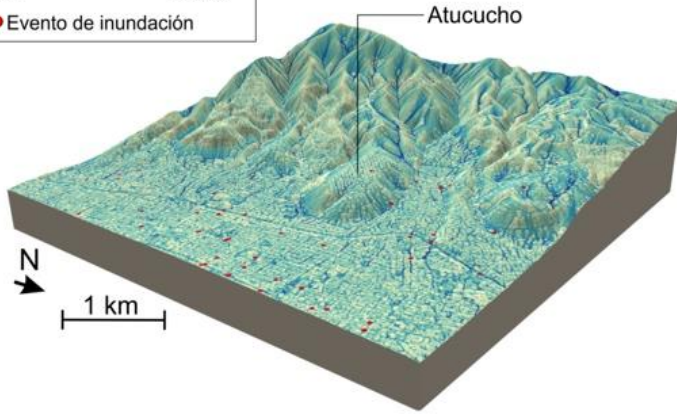
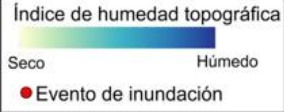


Flood extent near Khokana for 1 in 20 year flood



Calibrating discharge at Khokana against DHM stage readings

# Quito, Ecuador



## Tomorrow's Cities:

-Transfer of previous work into multiple Museum exhibits, including digital displays

-Pleiades data contributed a wetness index that was used to show movement of water around and into the city

un proyecto de:



con el apoyo de:



# Nairobi, Kenya

- Still awaiting acquisition of the final area which has been very difficult due to persistent cloud cover

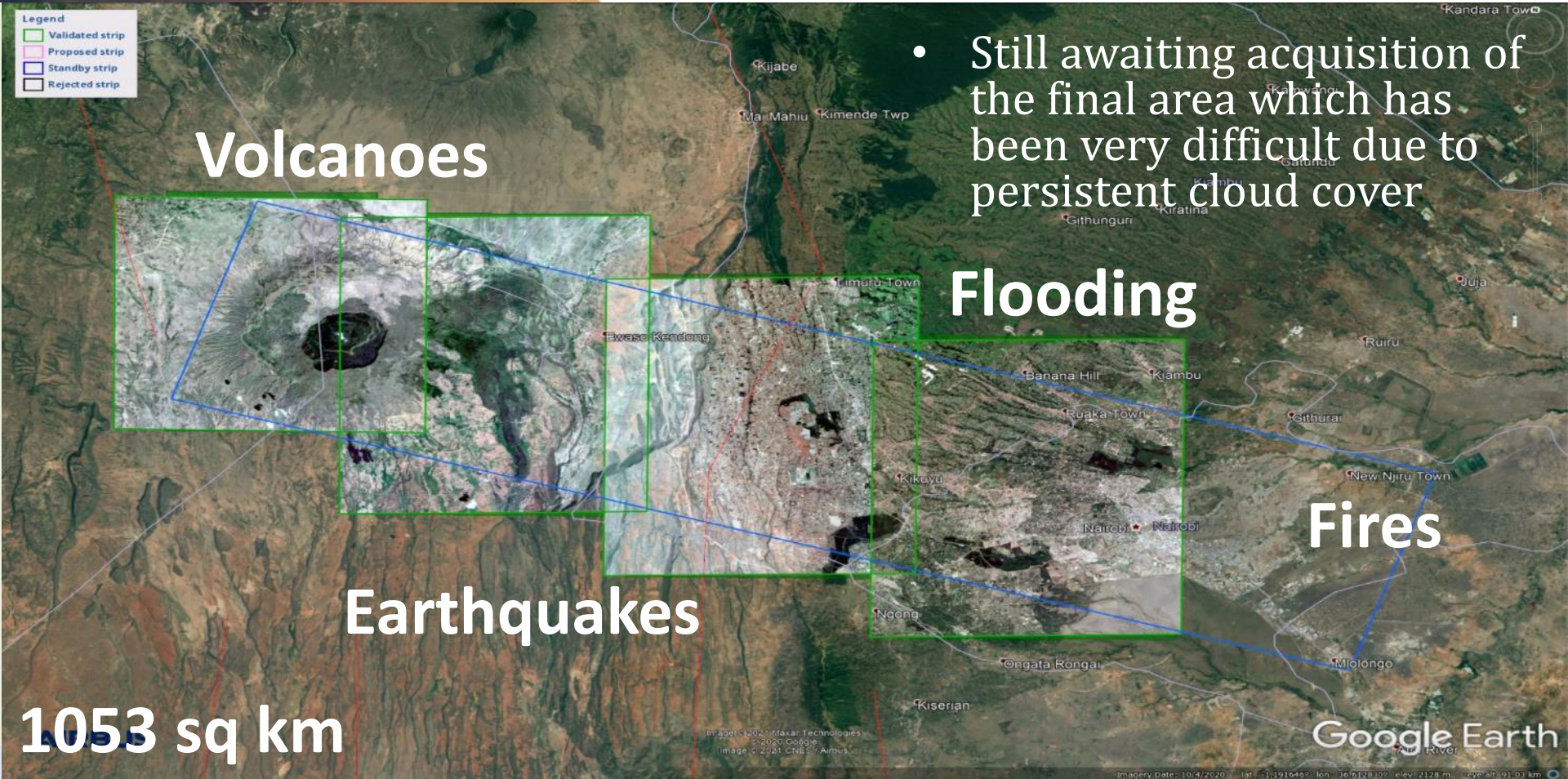
Volcanoes

Flooding

Fires

Earthquakes

1053 sq km



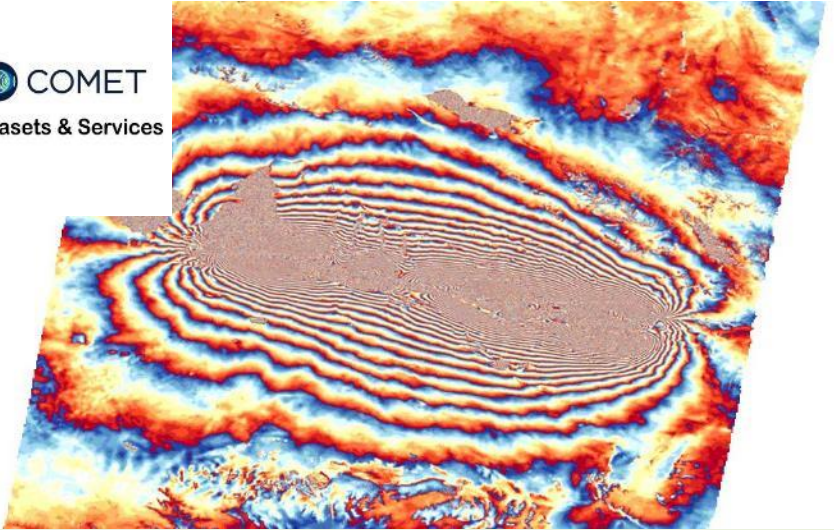


# 2021 Qinghai Earthquake, China

## USGS Information:

Location	Date.Time.UTC	Magnitude	Depth.km
Southern Qinghai, China	2021-05-21 18:04:13	7.4	10

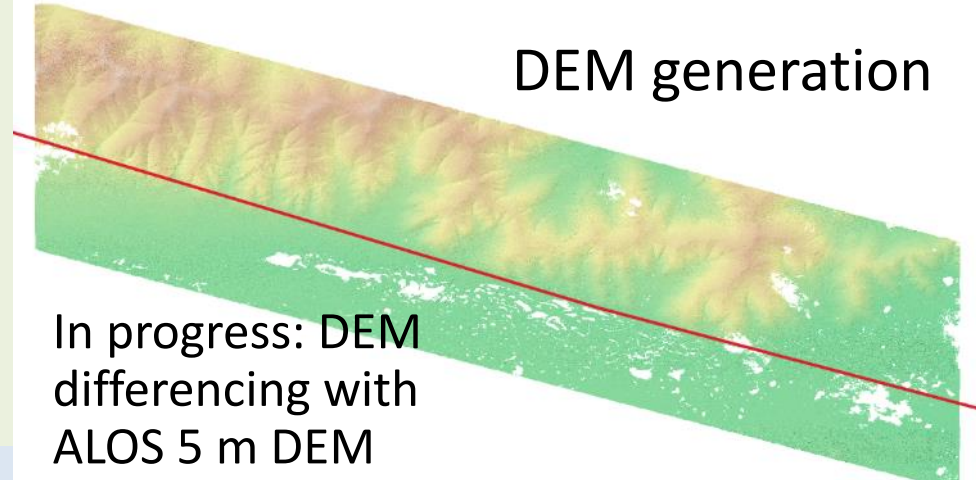
 COMET  
Datasets & Services



- Pleiades acquisitions



DEM generation



In progress: DEM  
differencing with  
ALOS 5 m DEM

- Artefacts found in Pleiades stereo DEM generation – currently investigating with technical support with Airbus