



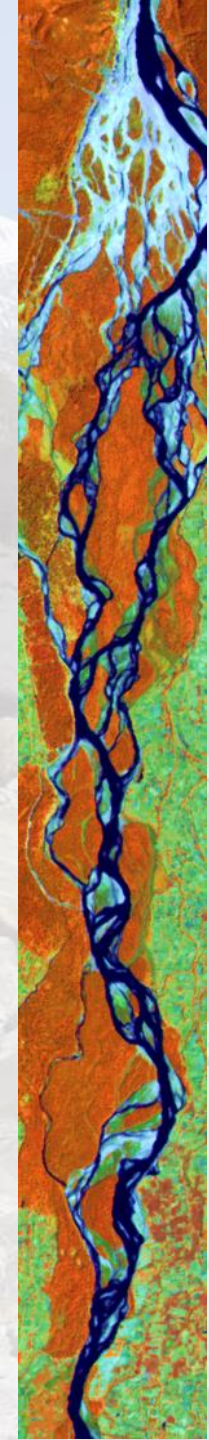
# **Hugh Sinclair, Lizzie Dingle, Mikael Attal, Maggie Creed, Simon Mudd, Laura Quick**

Edinburgh Land Surface Dynamics Group

**Extreme precipitation events and flood models  
in the Himalaya**







Nepal | May 22, 2017

# The Himalaya

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### Heavy rainfall causes flooding, landslides in Nepal

Heavy rainfall since Wednesday has caused flooding, landslides in some parts of Nepal damaging bridges, houses and affected vehicular movement.

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### Suspension bridge collapses during flash flood in Nepal

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#### Video Shows Dramatic Moment of Bridge Collapse During Deadly Nepal Floods

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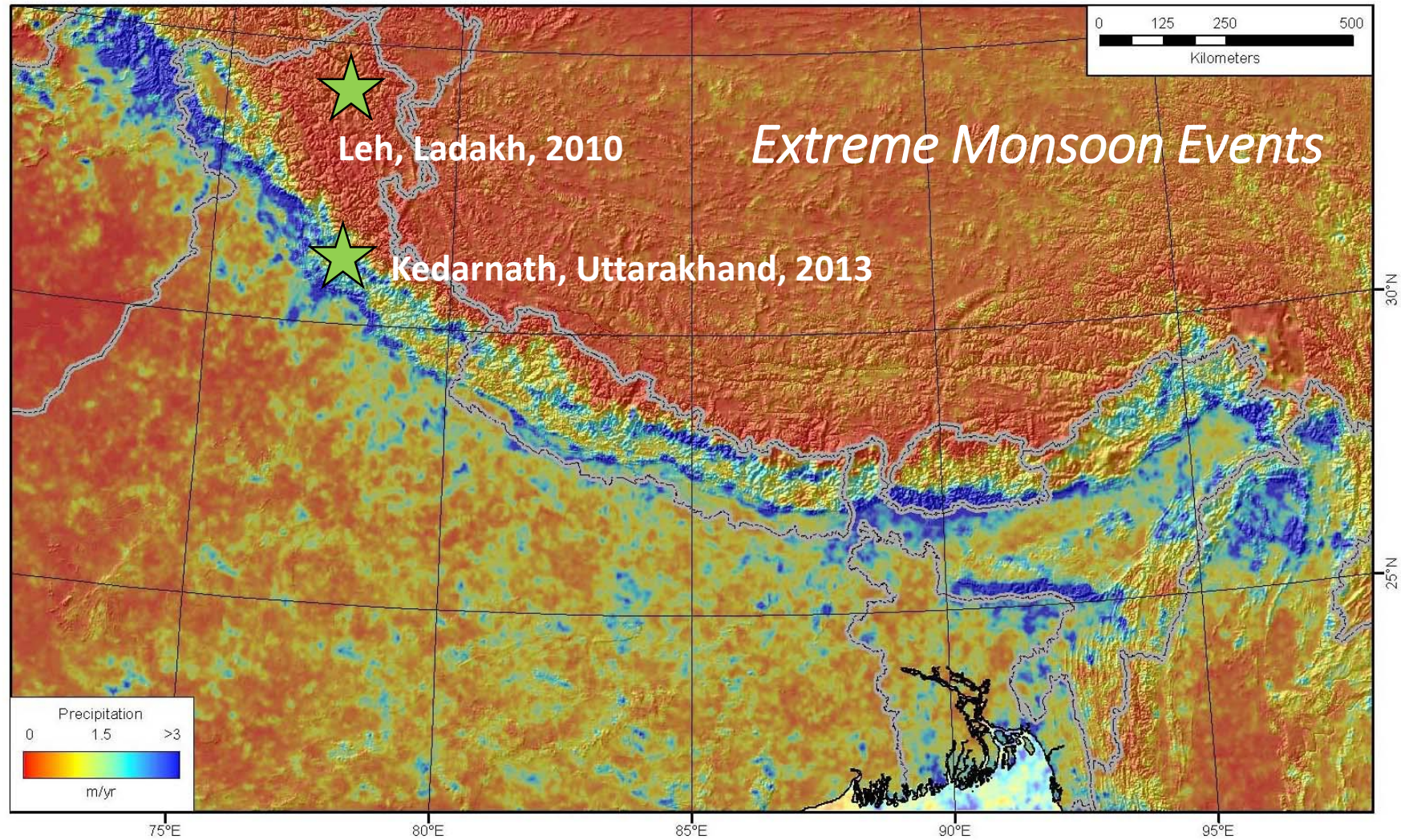
By **Keely Lockhart**, VIDEO NEWS PRODUCER, RISHABH SHRESTHA VIA STORYFUL  
27 JULY 2016 • 3:38PM

A bystander filmed the horrifying moment a huge suspension bridge was swept away by flash flooding in Nepal.





*How can we use geomorphic data to understand the nature and relative magnitude of these events?*

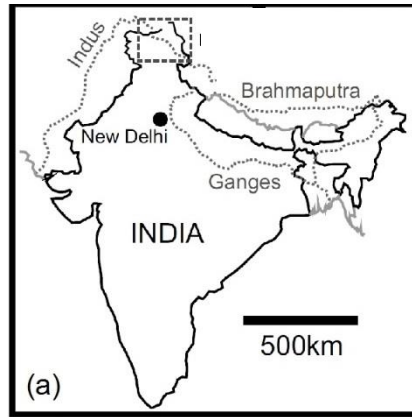




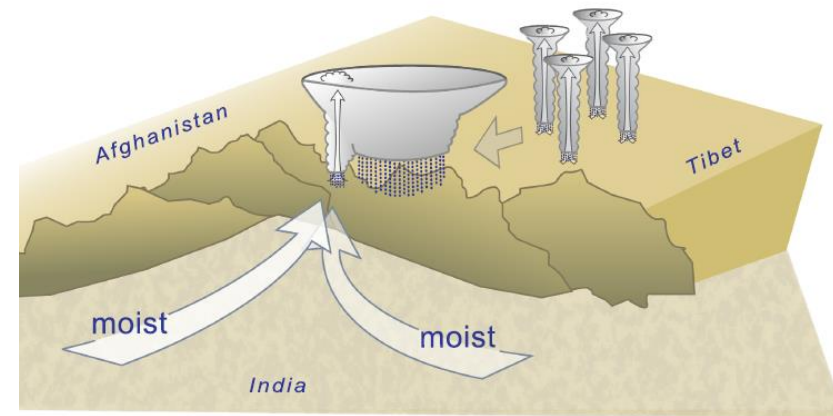
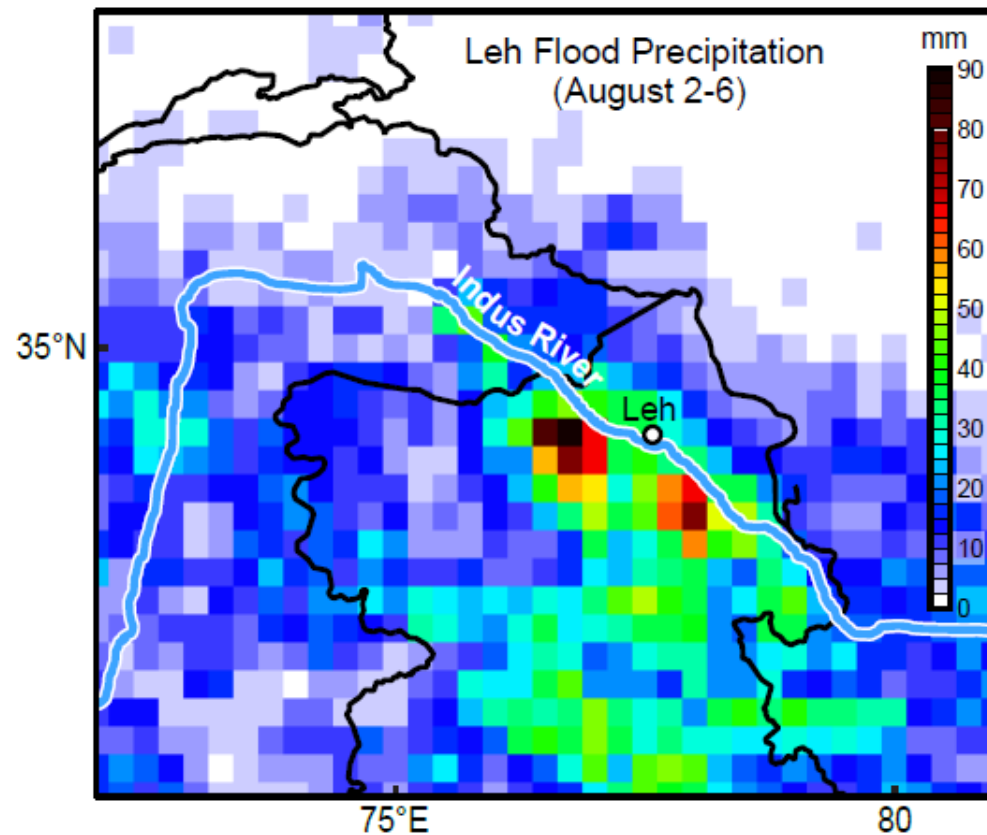


On Aug 6th 2010 a 'cloudburst' devastated the region – one rain gauge recorded just 28mm of rain in 24 hrs.

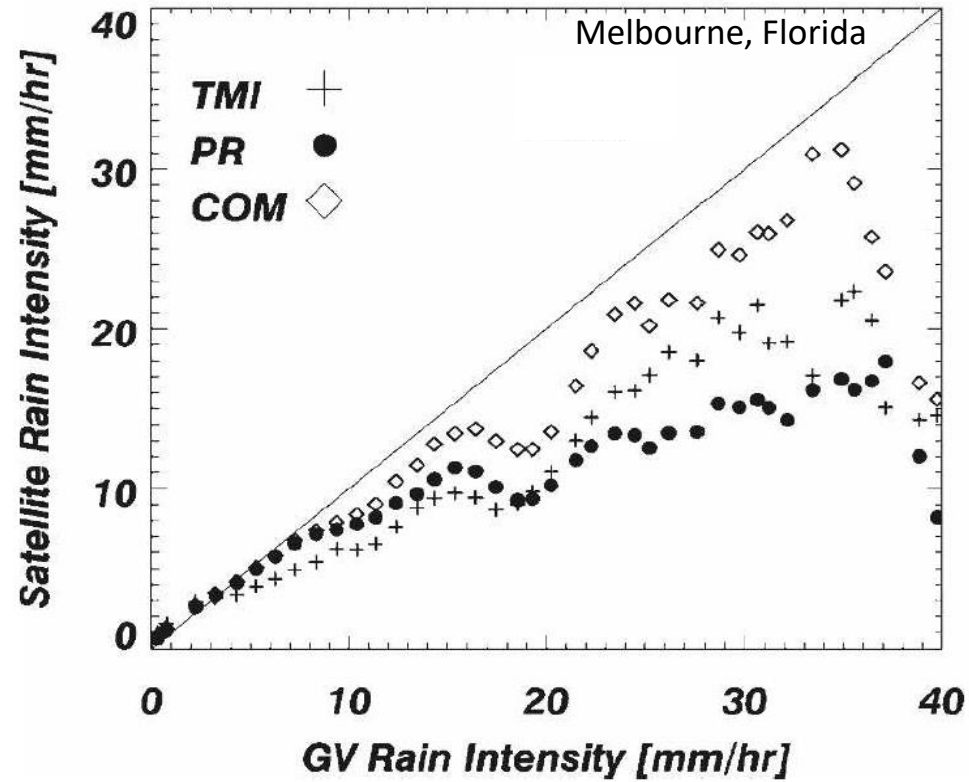
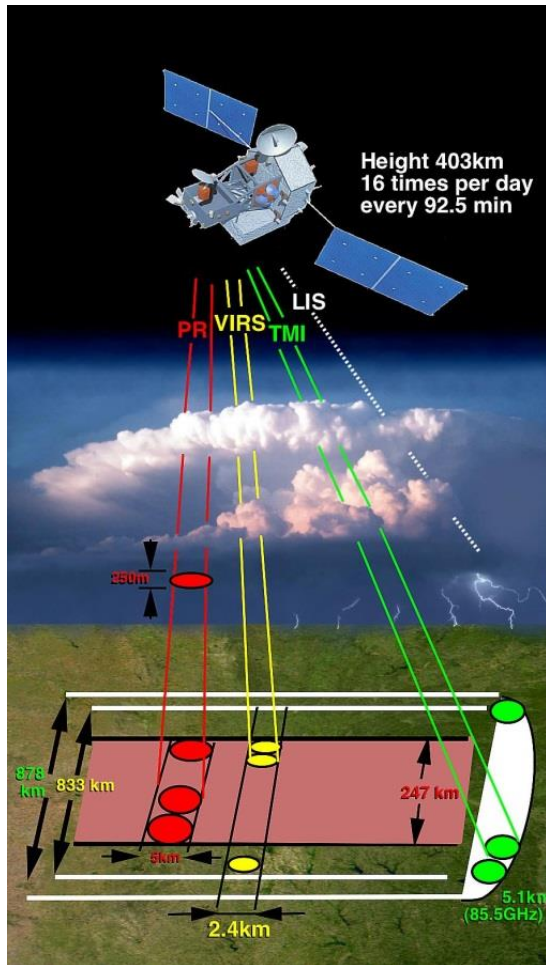




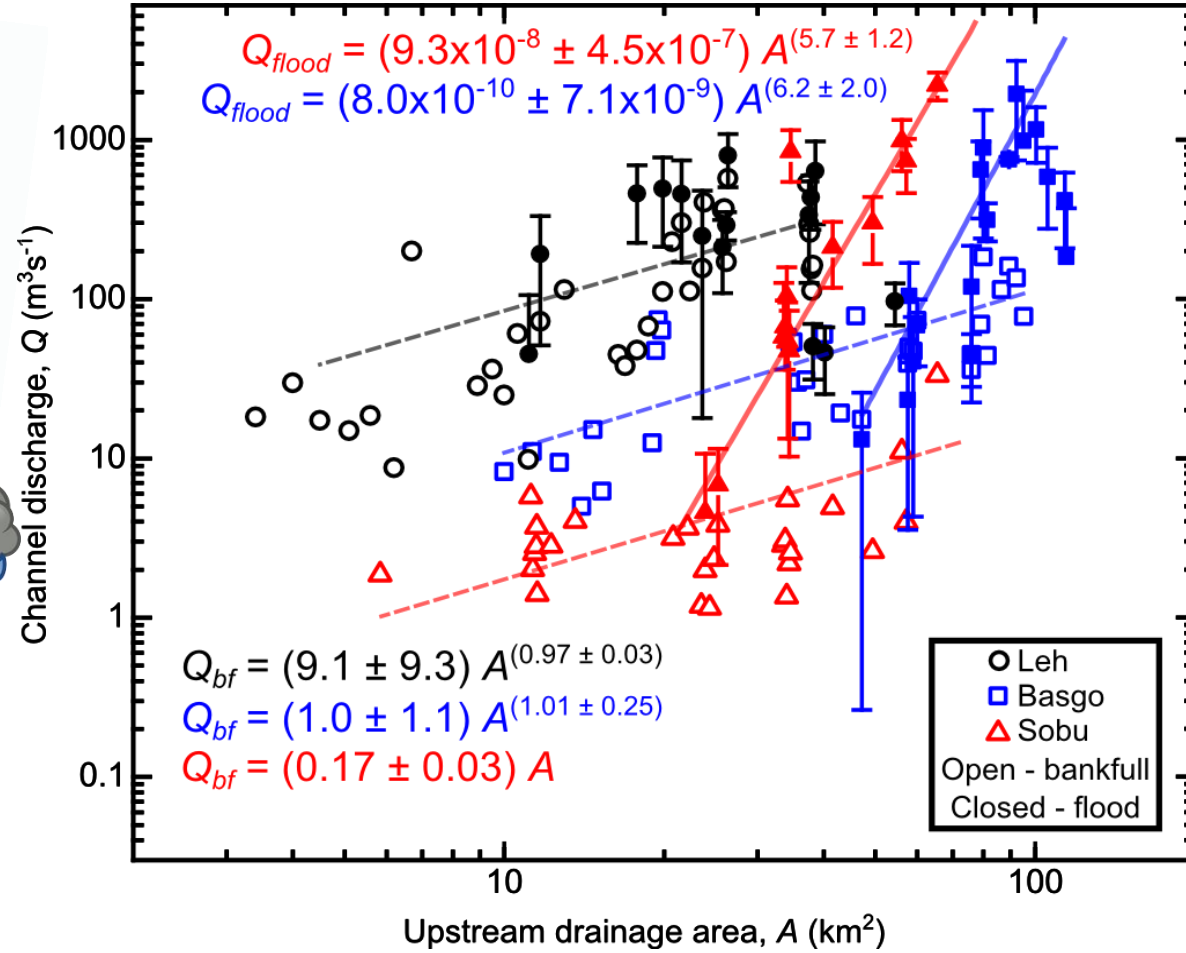
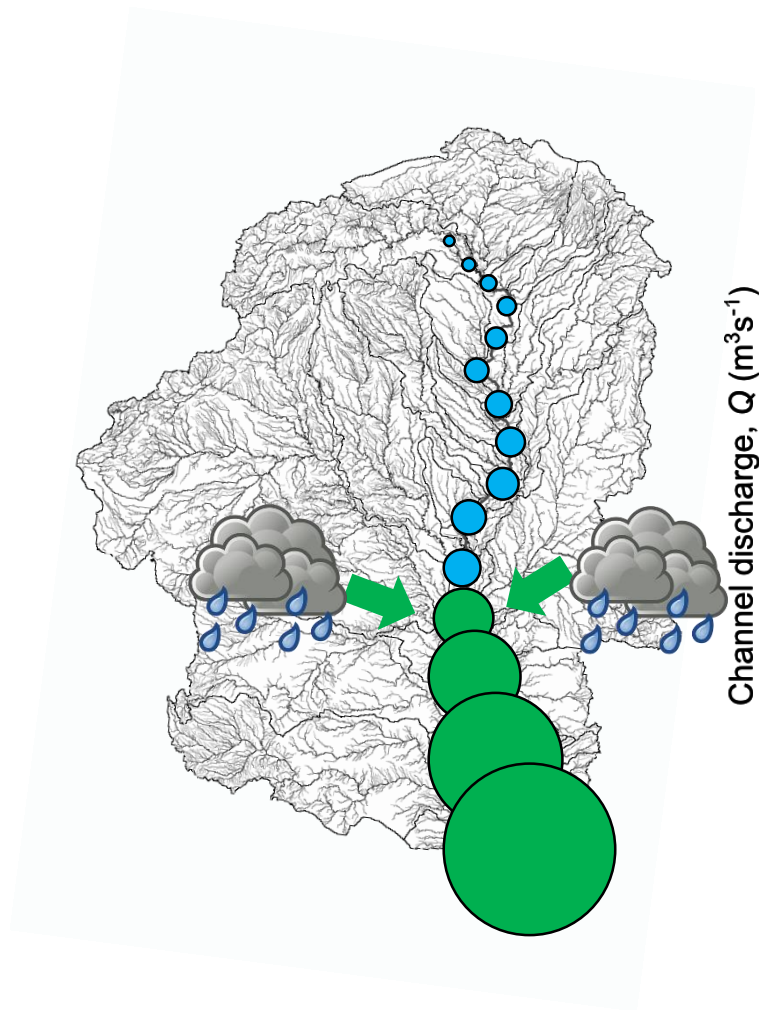
Event reconstructed using TRMM and  
modelled  
as a Mesoscale Convective System



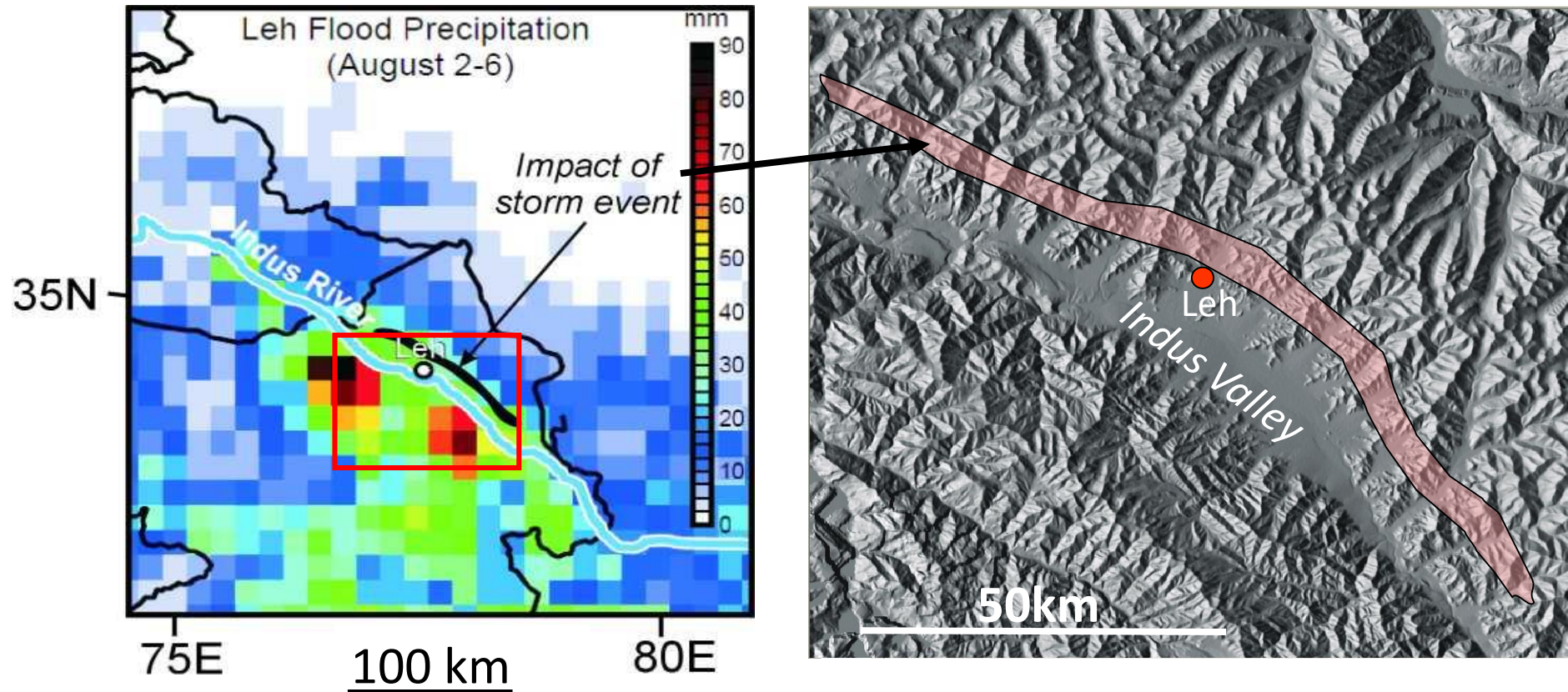




*So true scale of storm events and hence their relative magnitude difficult to assess from meteorology data*

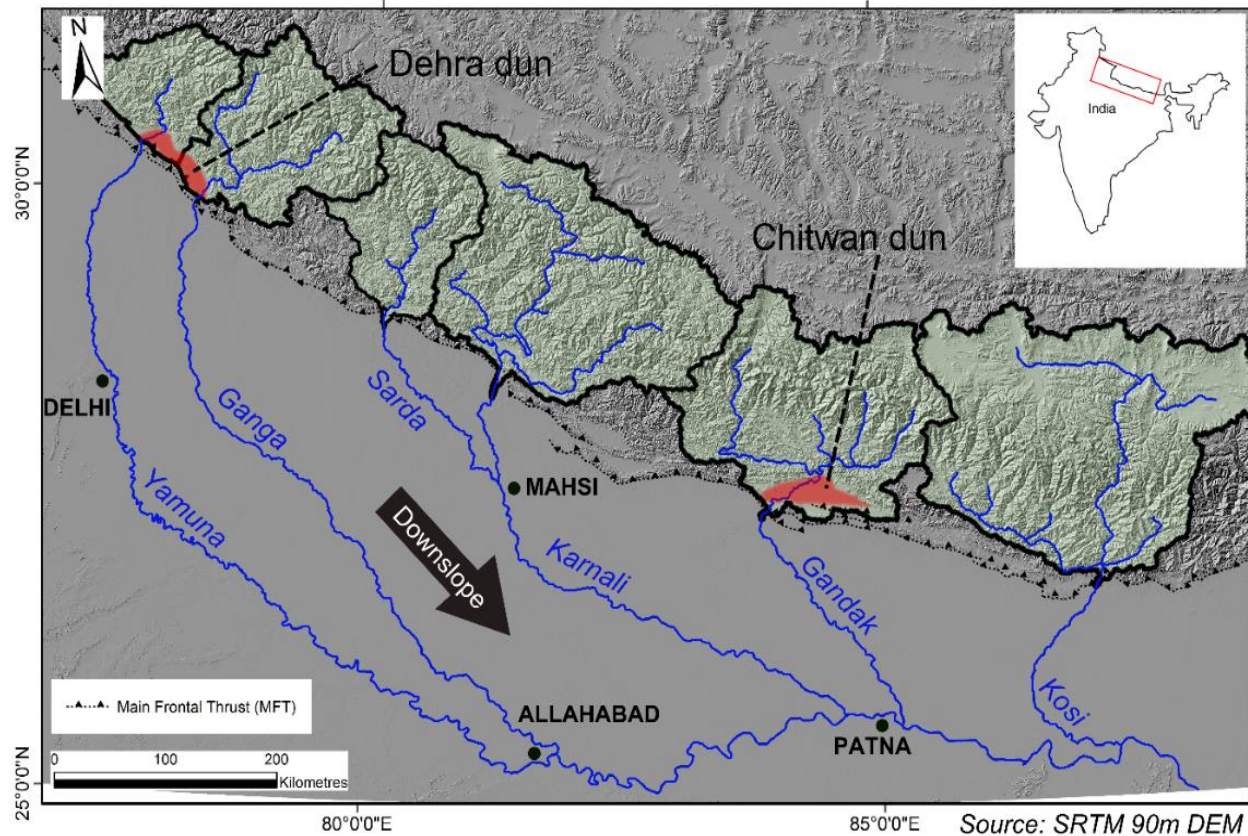


*Geomorphic data relocates highest impact storm to northeast of Indus River*

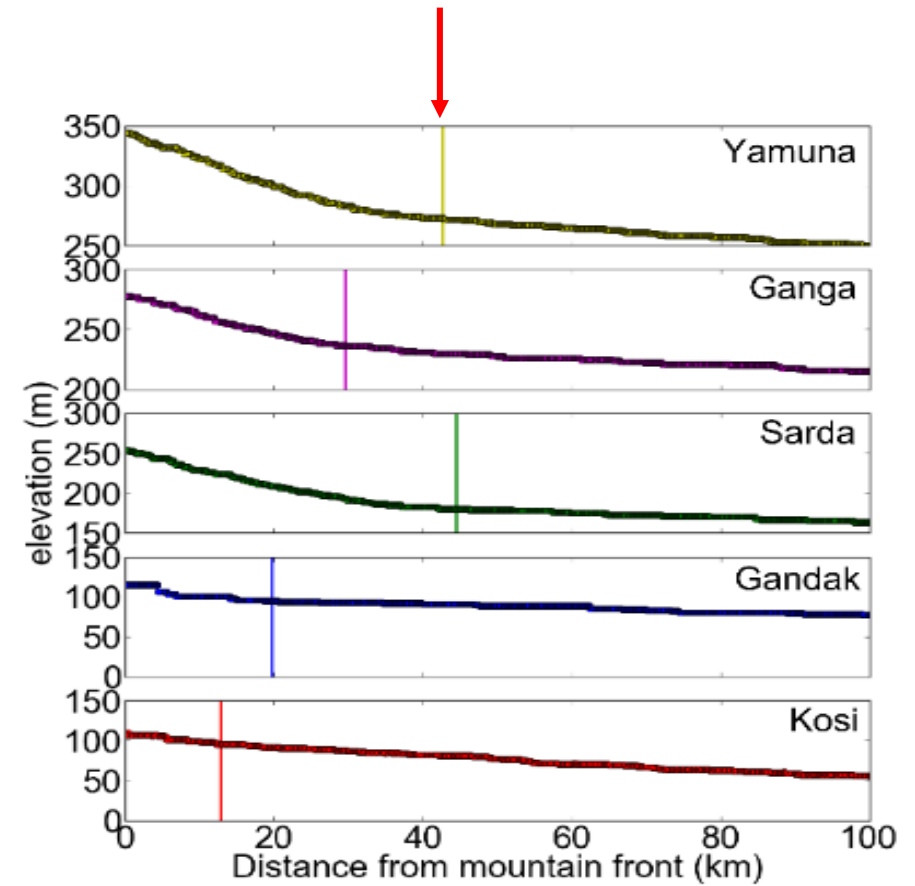


*But how significant was this event?*





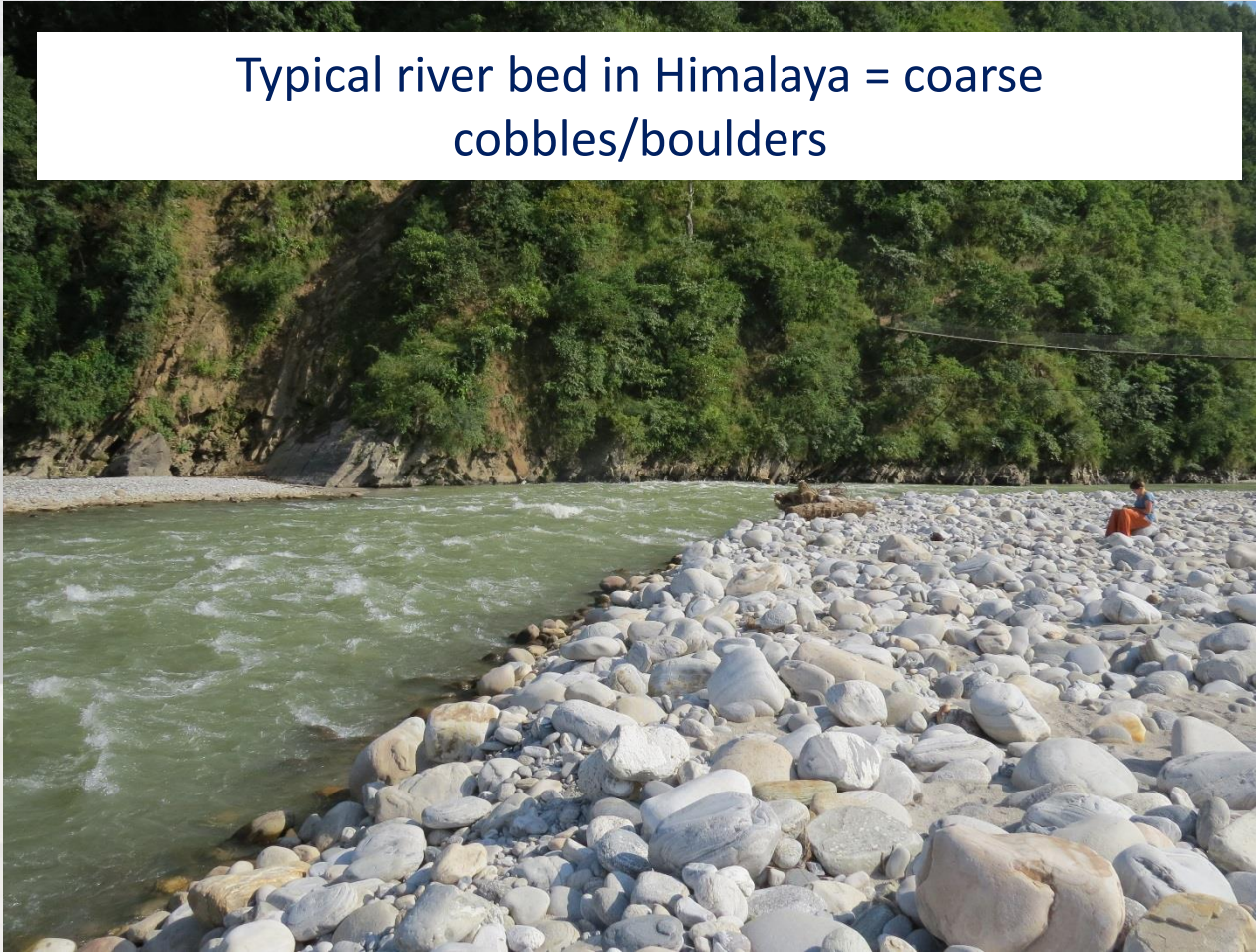
## Gravel-sand transition





# Coarse sediment is trapped close to the mountains

Typical river bed in Himalaya = coarse  
cobbles/boulders

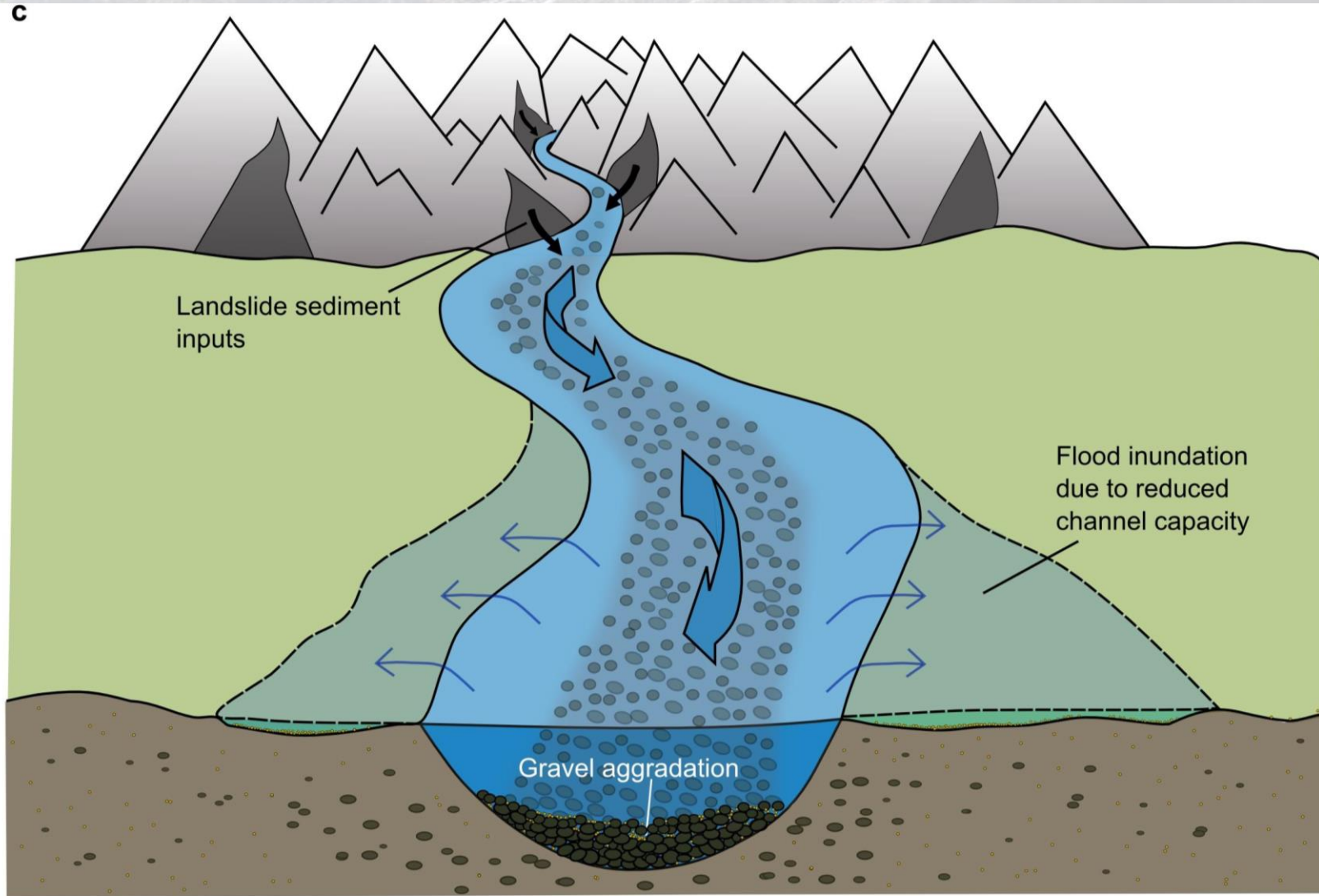


12 km downstream of the  
Himalaya = sand





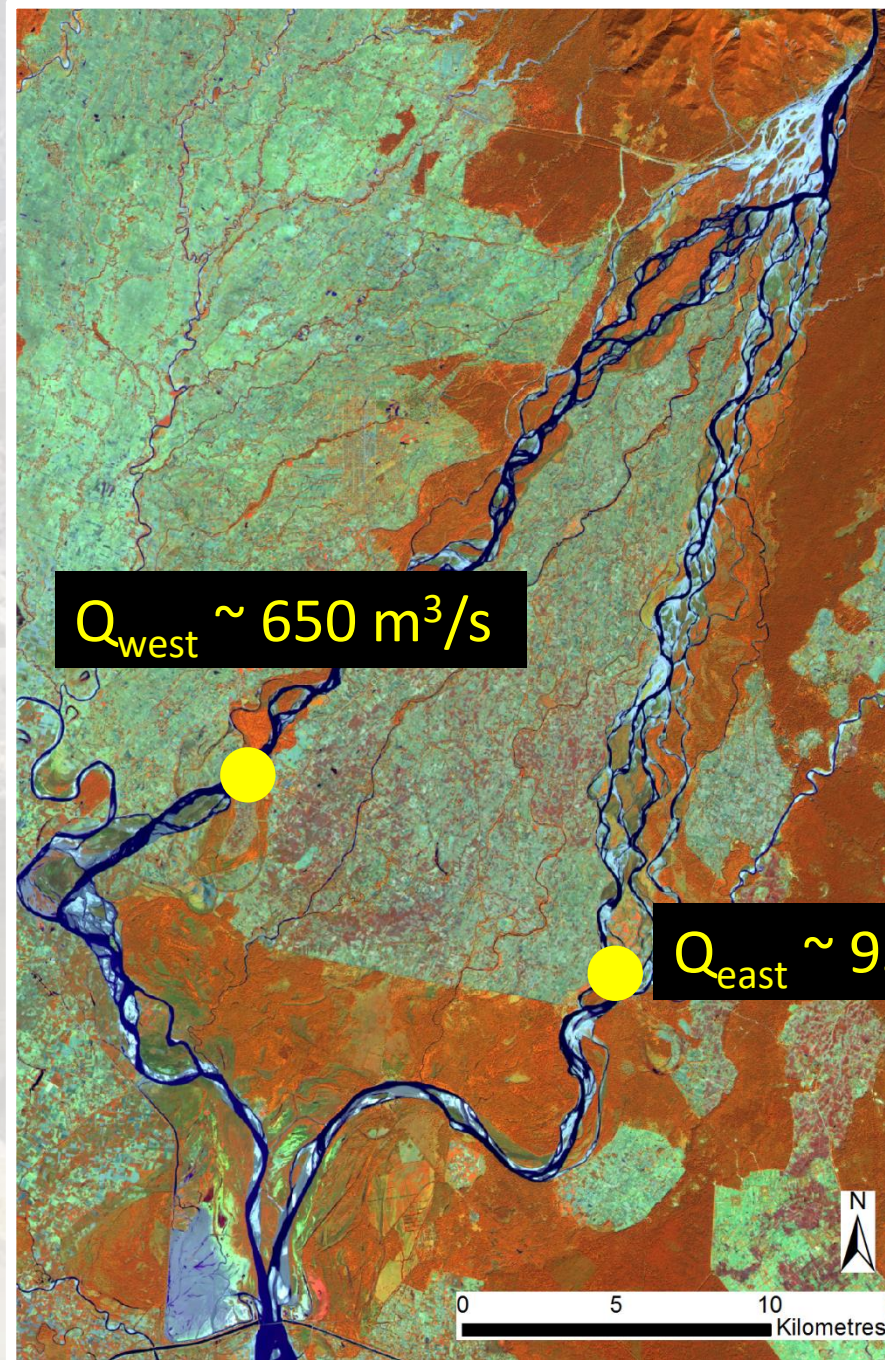
# Coarse sediment and flood risk





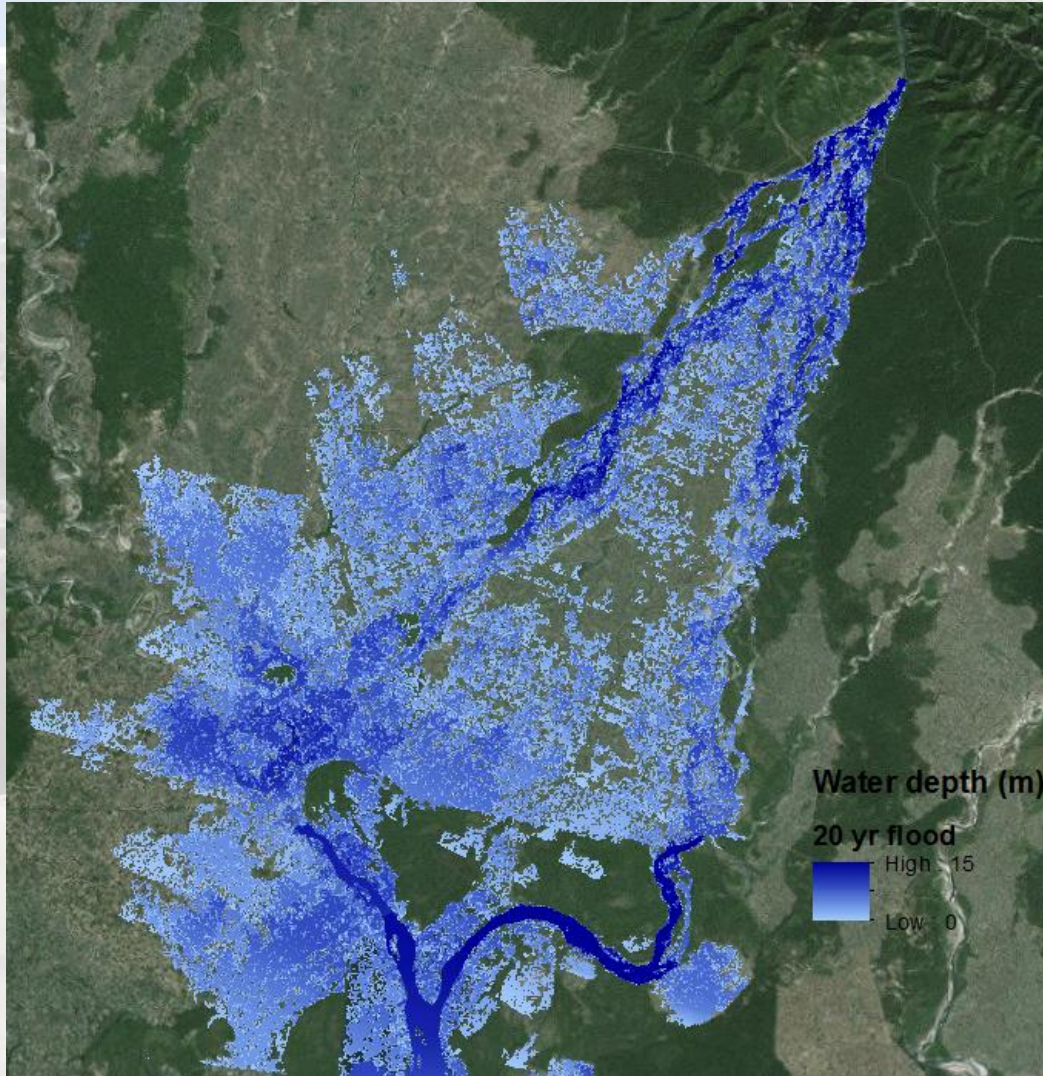
# The Karnali River

- Average annual discharge of  $4.31 \times 10^{10} \text{ m}^3$
- Rajapur district population  $>10,000$
- 2014 floods – **15 m deep** flow entering the Plain
- Hugely mobile river!





# Flooding – not just about water



*Existing HEC-RAS output based on 20 yr flood discharge (Credit: Dr Dilip Gautam and the Department of Hydrology and Meteorology, Nepal)*

## Existing modelling - HECRAS

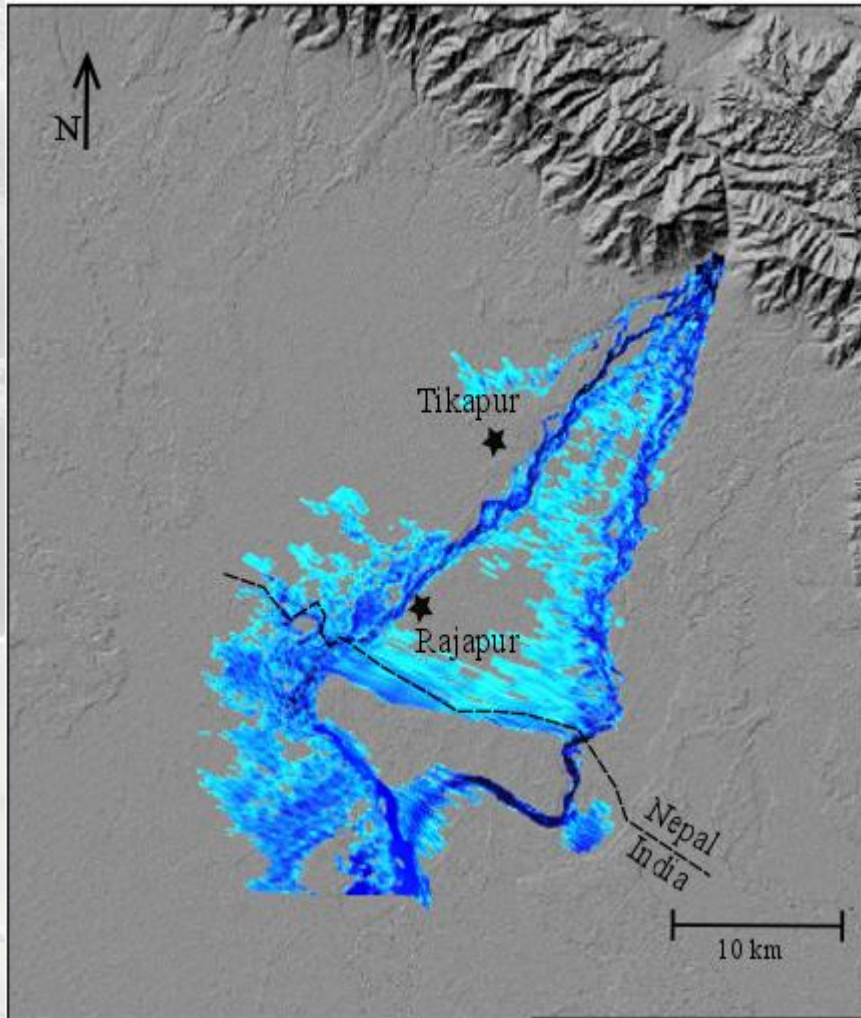
- 30 m SRTM DEM from 2001 with +/- 10 m vertical error
- **VERY LOW RELIEF LANDSCAPE**



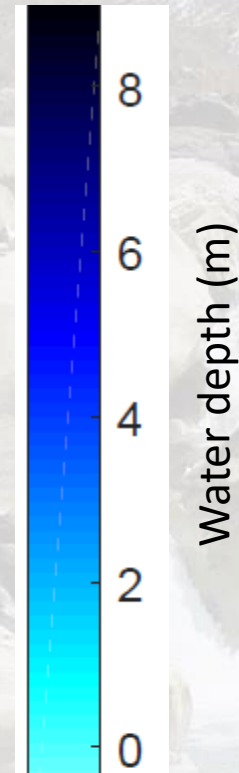
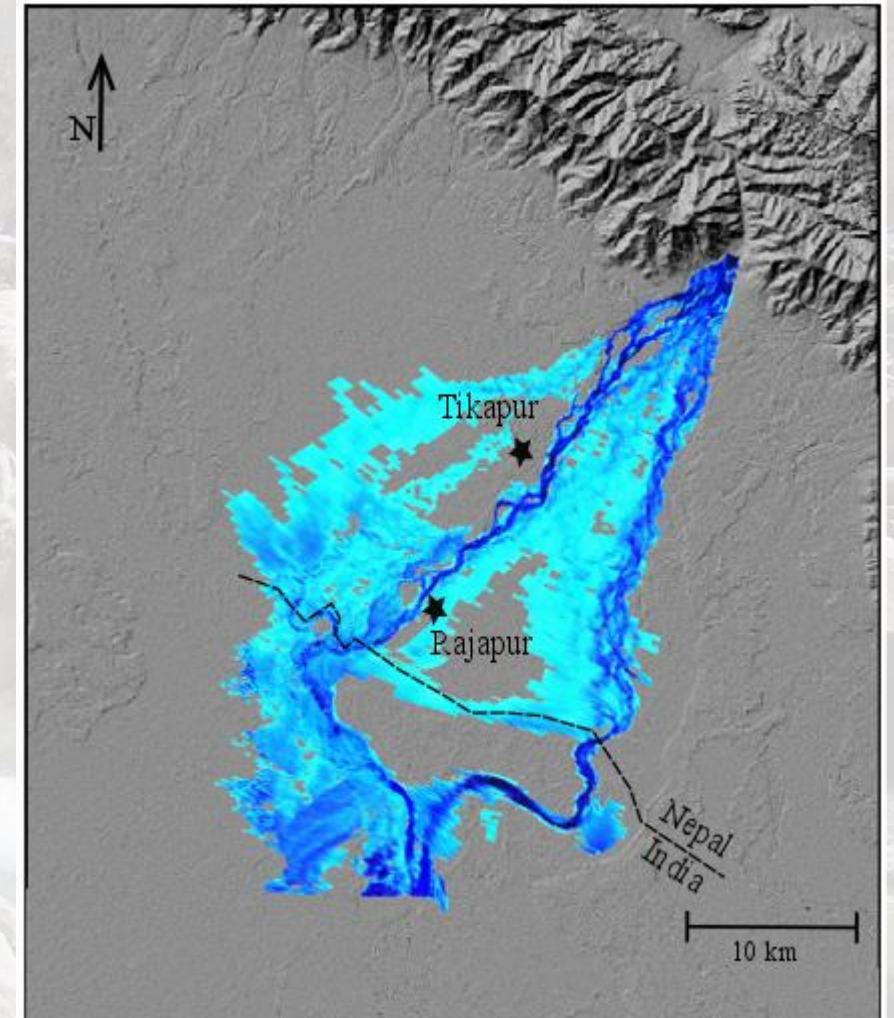
# Flooding – not just about water

## Sensitivity of the tools

2001 SRTM – 30m



2013 TanDEMx – 10m

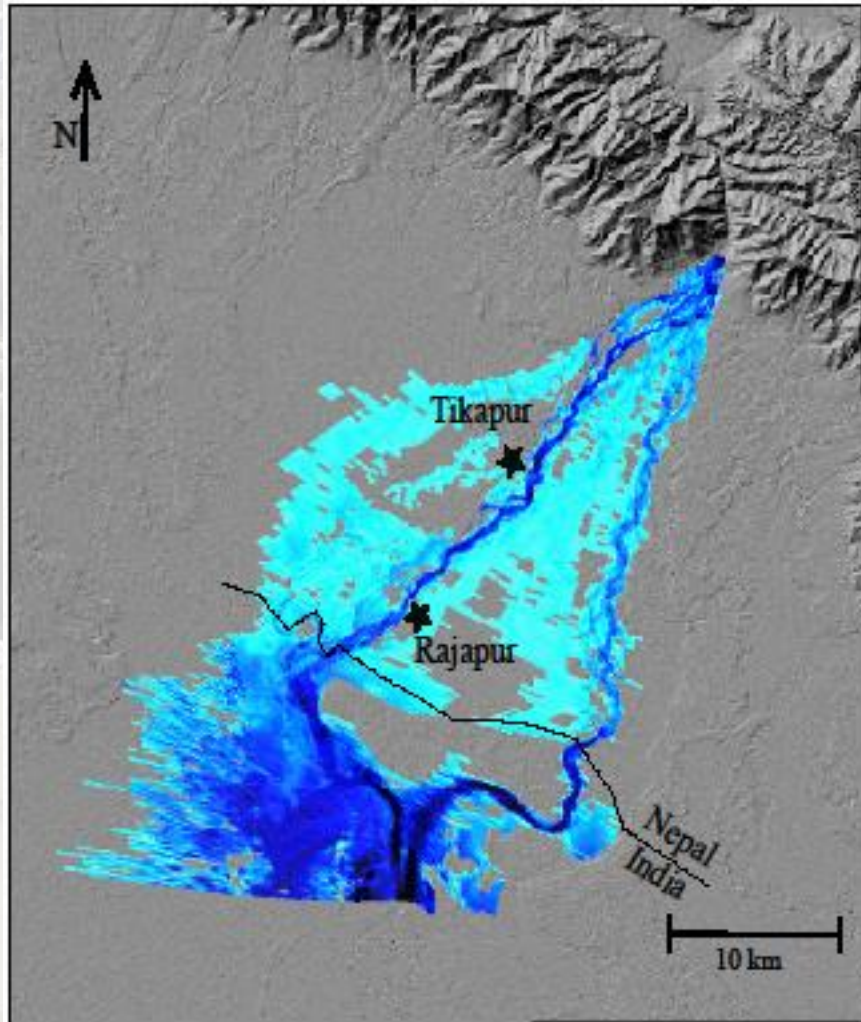




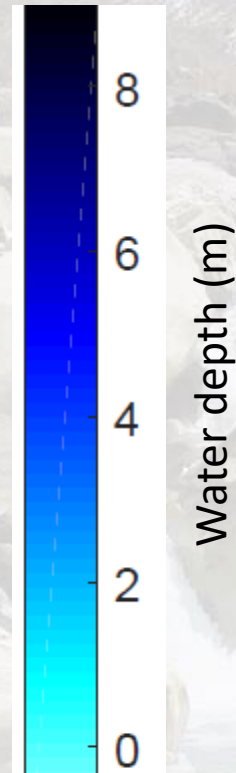
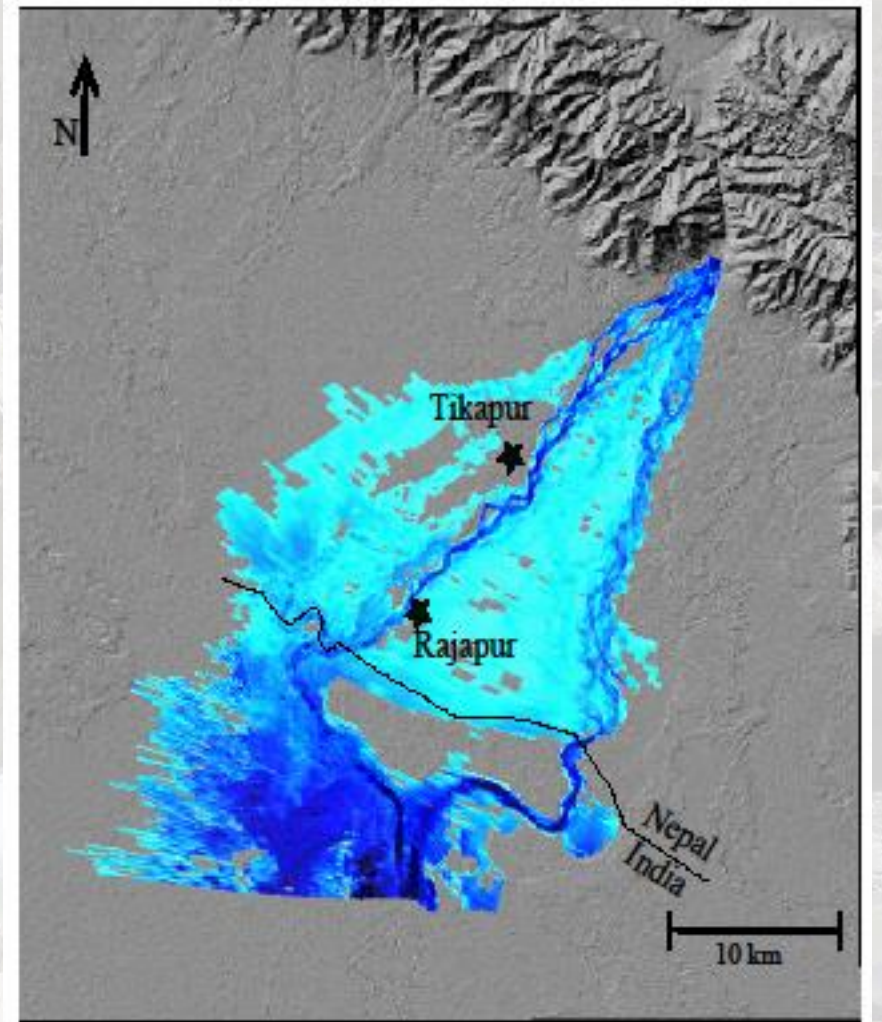
# Flooding – not just about water

Throw some sediment in....

Bed elevations in 2016



Bed aggradation 2 – 5 m along channel







## Conclusions

Extreme events are very localised and so require field-based reconstructions of storm precipitation

Flood models need high resolution DEMs and understanding of sediment transport

Future strategy involves increase hydrological monitoring and real time modelling linked to local communities