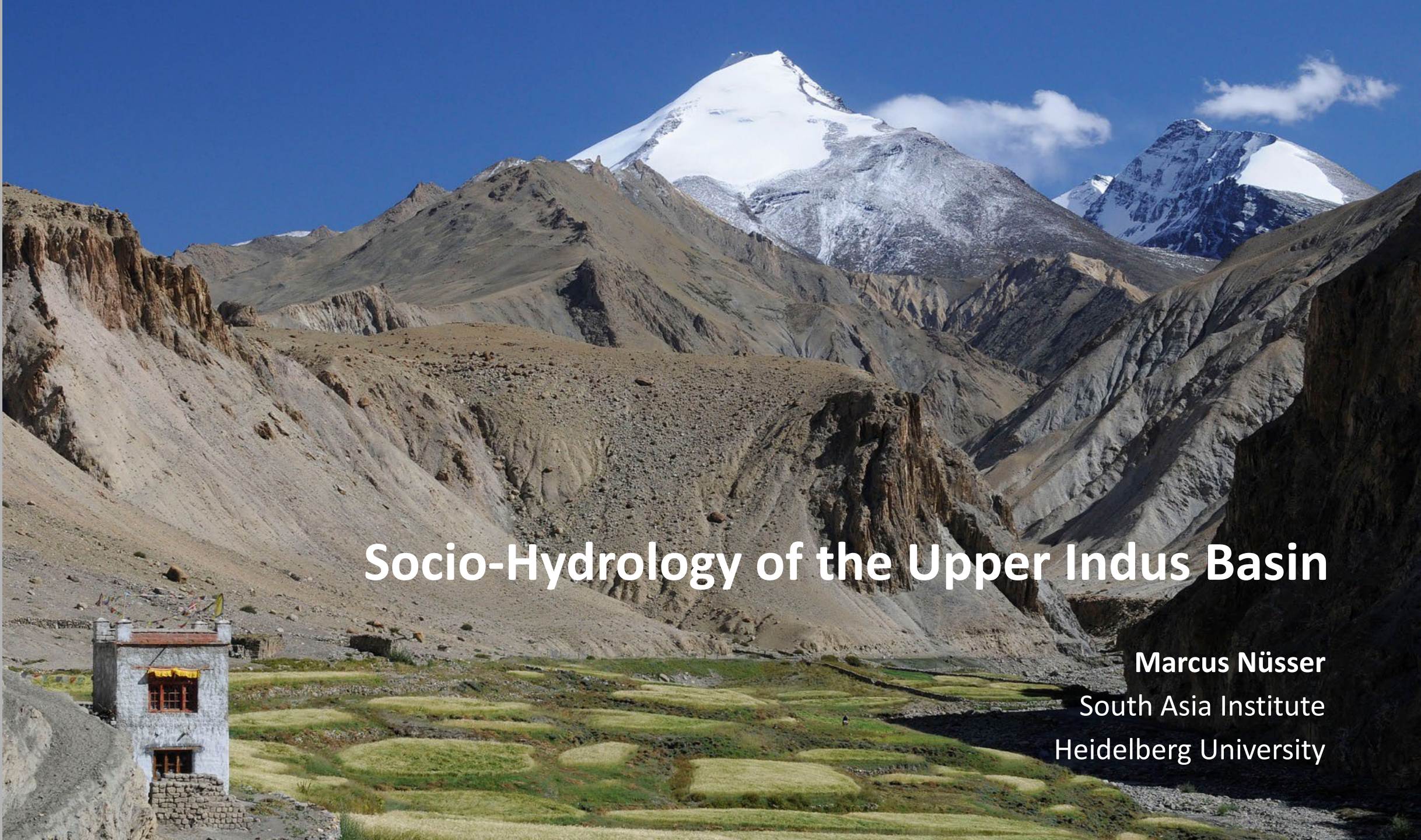



Socio-Hydrology of the Upper Indus Basin

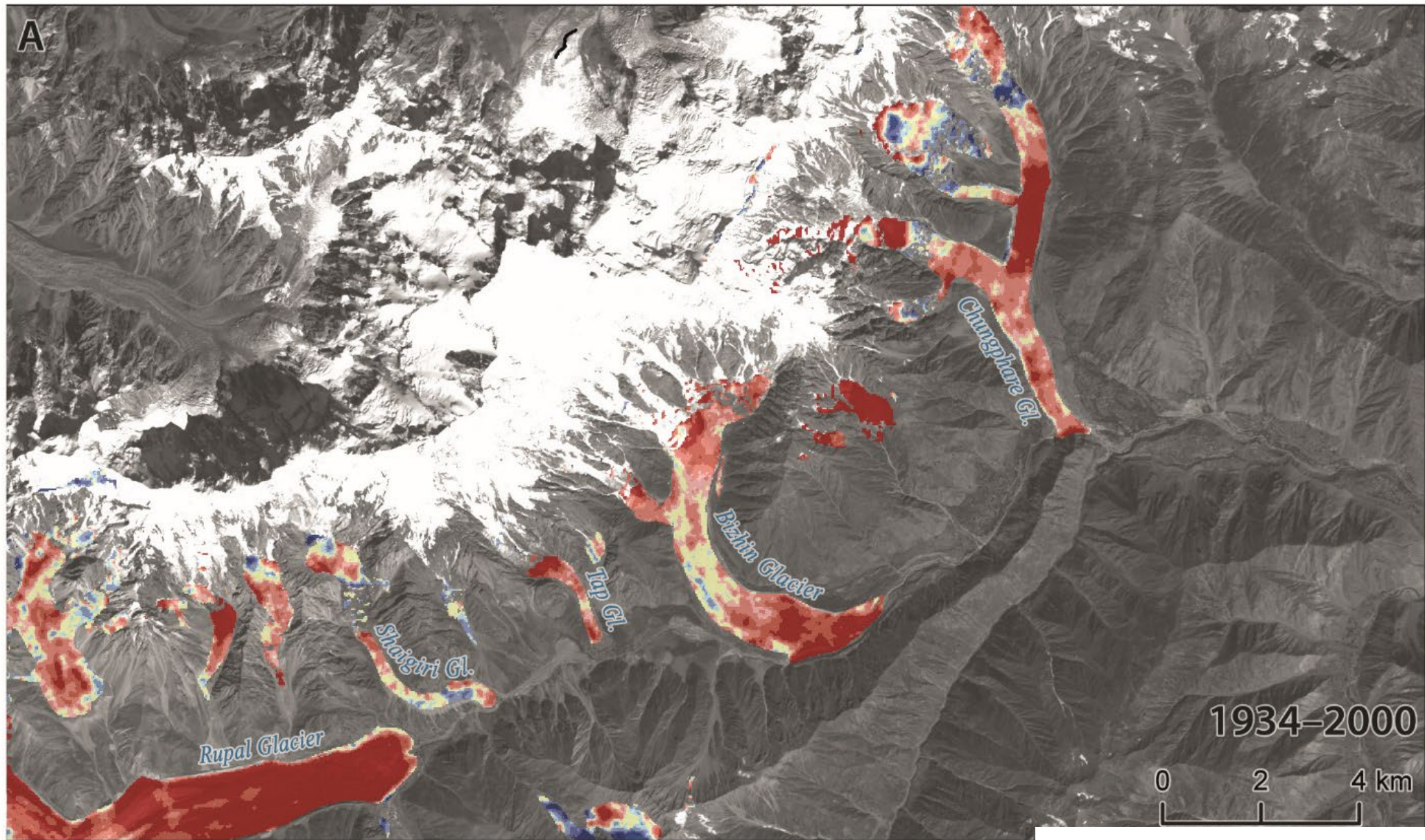
Marcus Nüsser
South Asia Institute
Heidelberg University



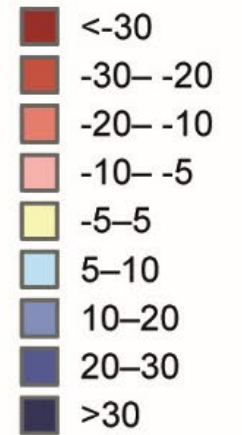


Meltwater-dependent irrigation systems
Mostly subsistence-based
Crucial for rural livelihoods and food security

Nanga Parbat | Glacier Surface Changes between 1934 and 2000

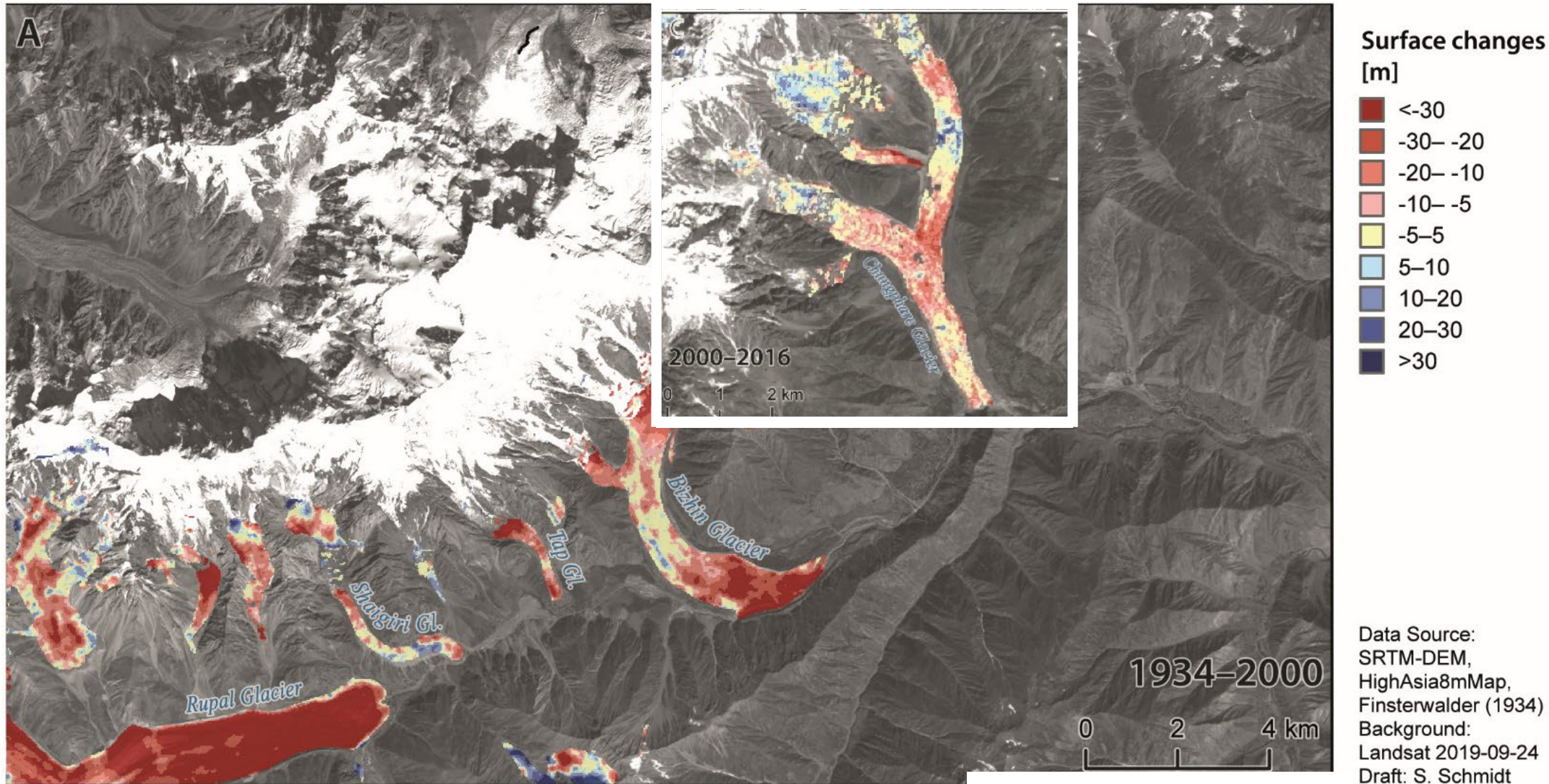


Surface changes [m]

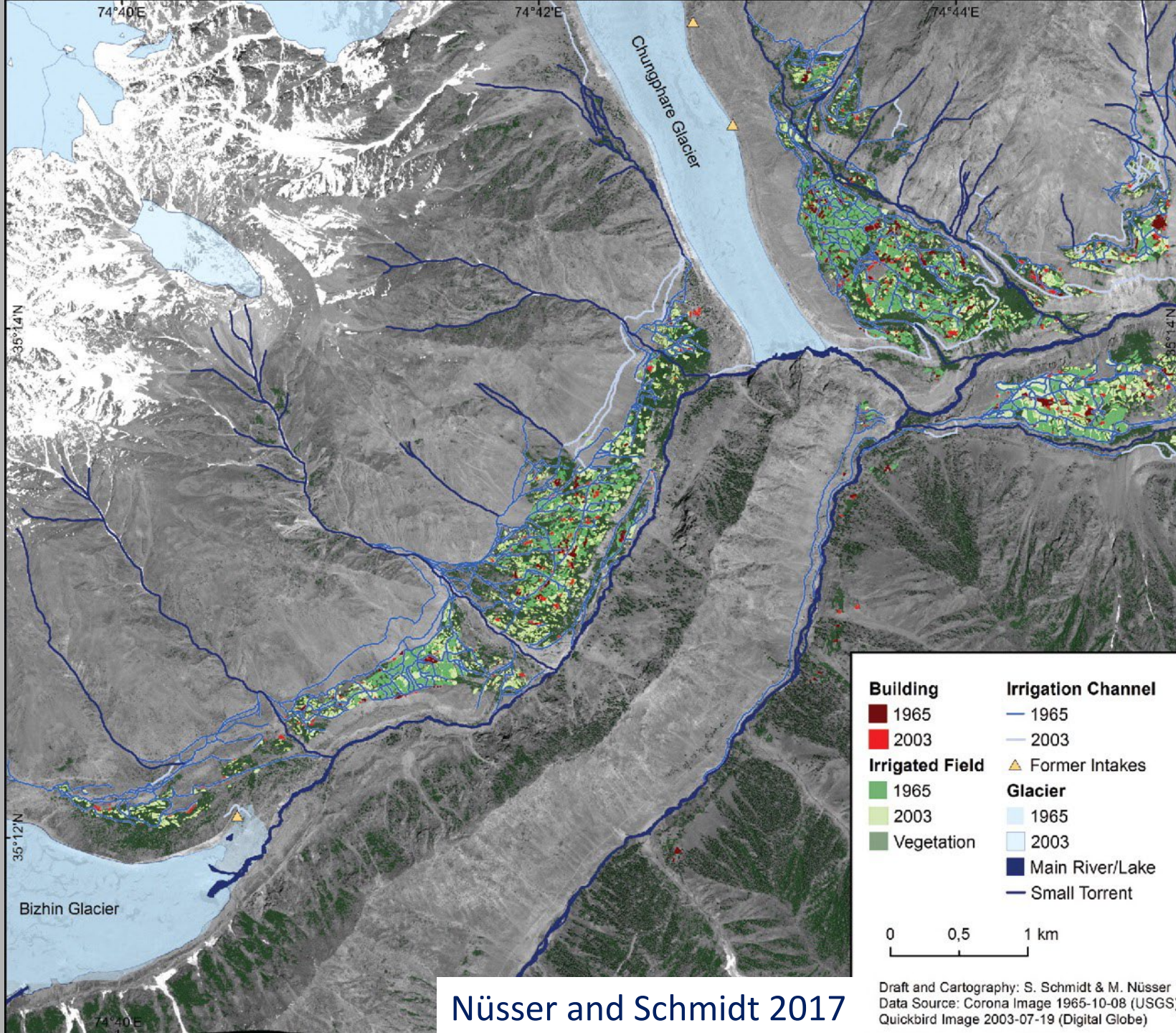


Data Source:
SRTM-DEM,
HighAsia8mMap,
Finsterwalder (1934)
Background:
Landsat 2019-09-24
Draft: S. Schmidt

Nanga Parbat | Chungphare Glacier Surface Changes between 2000 and 2016



Data Source:
SRTM-DEM,
HighAsia8mMap,
Finsterwalder (1934)
Background:
Landsat 2019-09-24
Draft: S. Schmidt



Nüsser and Schmidt 2017

Nanga Parbat: Rupal Valley

Large valley glaciers are no longer used for irrigation purposes
 Former channels crossing lateral moraines are detectable



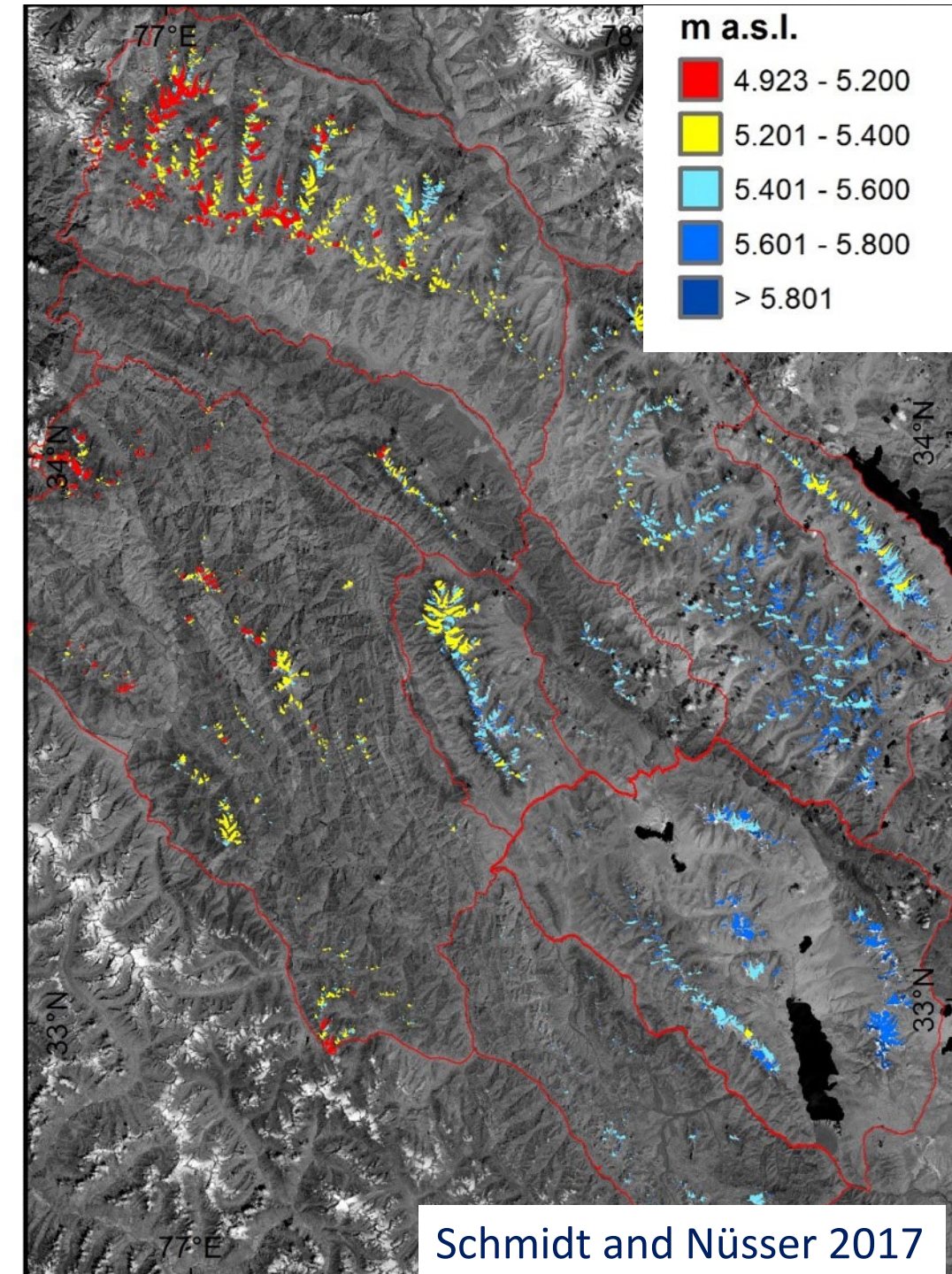
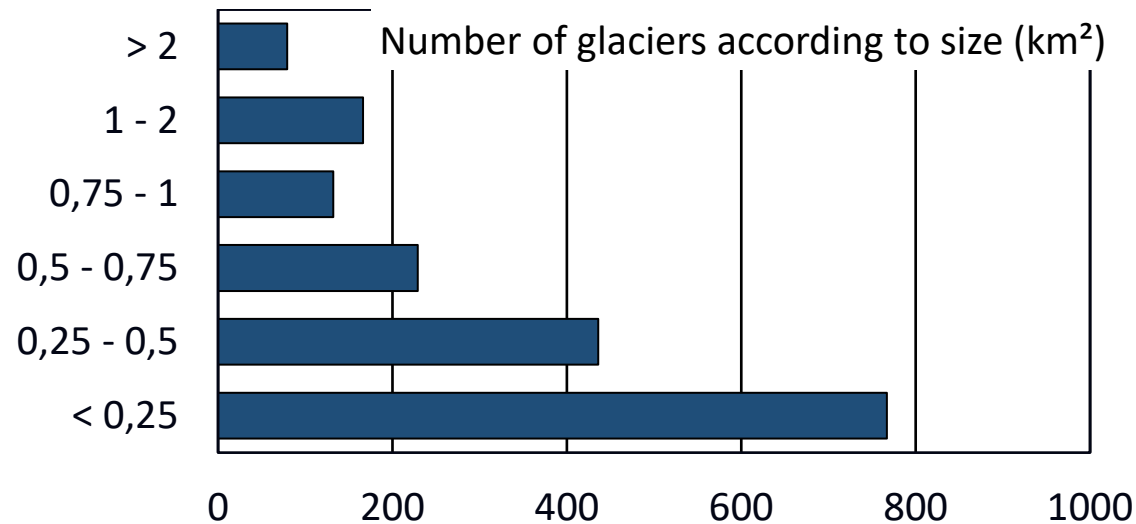
Ladakh | Glacier Distribution

Cold arid region

Glaciers are located at altitudes above 5200 m

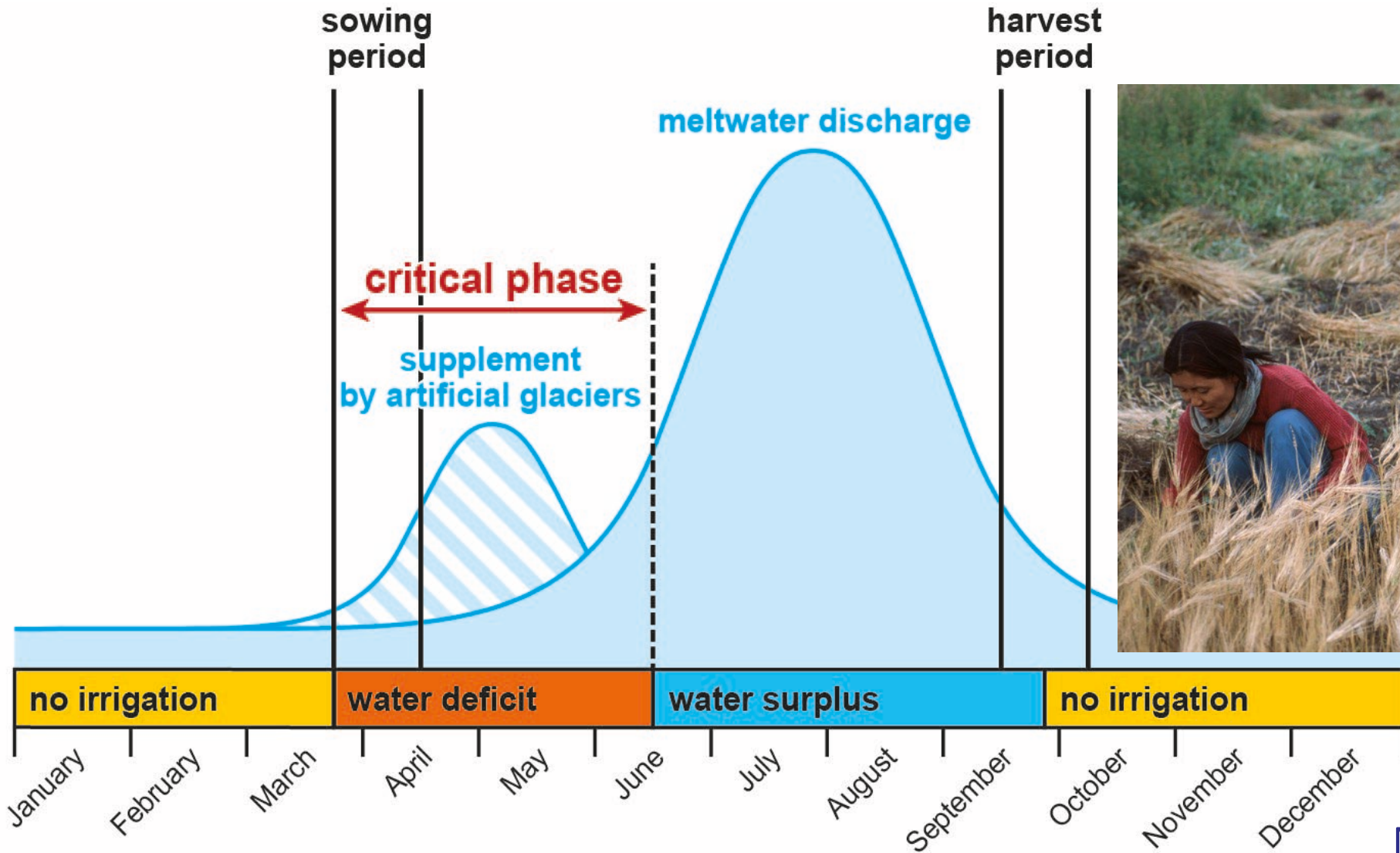
79 % are smaller than 0.75 km² and only 4 % are larger than 2 km²

Increase of minimum altitude to the east

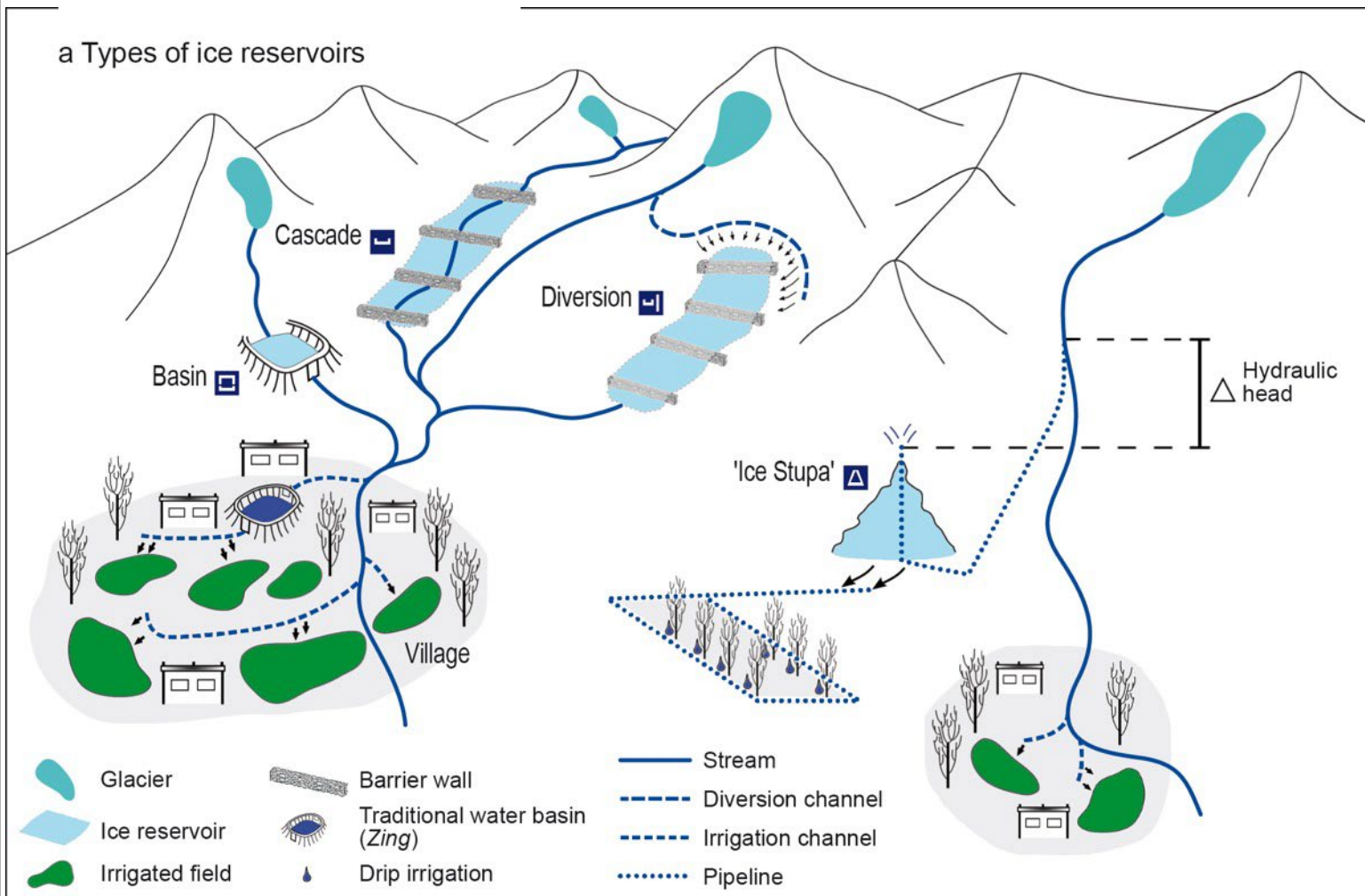


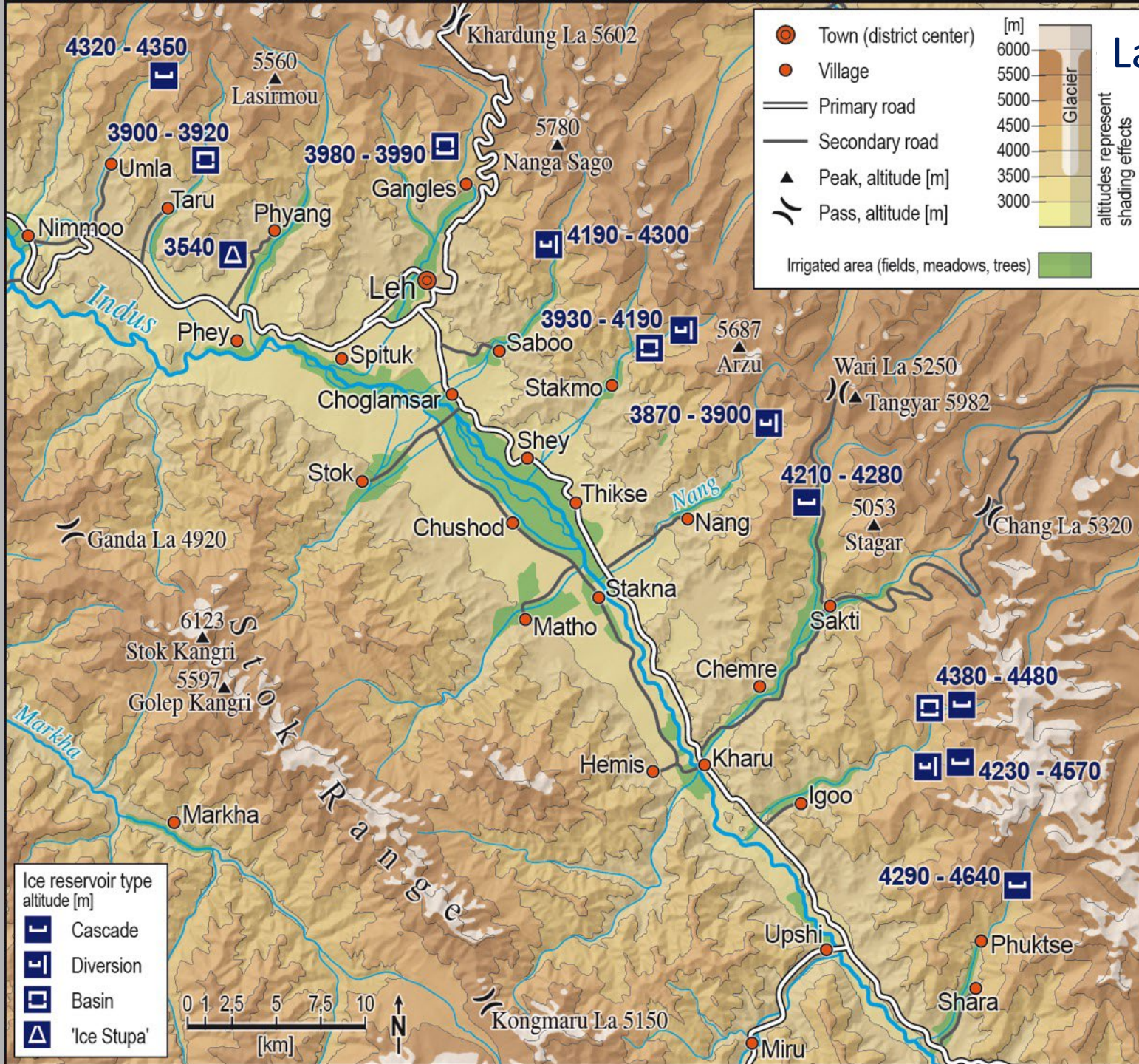
Schmidt and Nüsser 2017

Ladakh | Seasonal water scarcity



Ladakh | Types of ice reservoirs



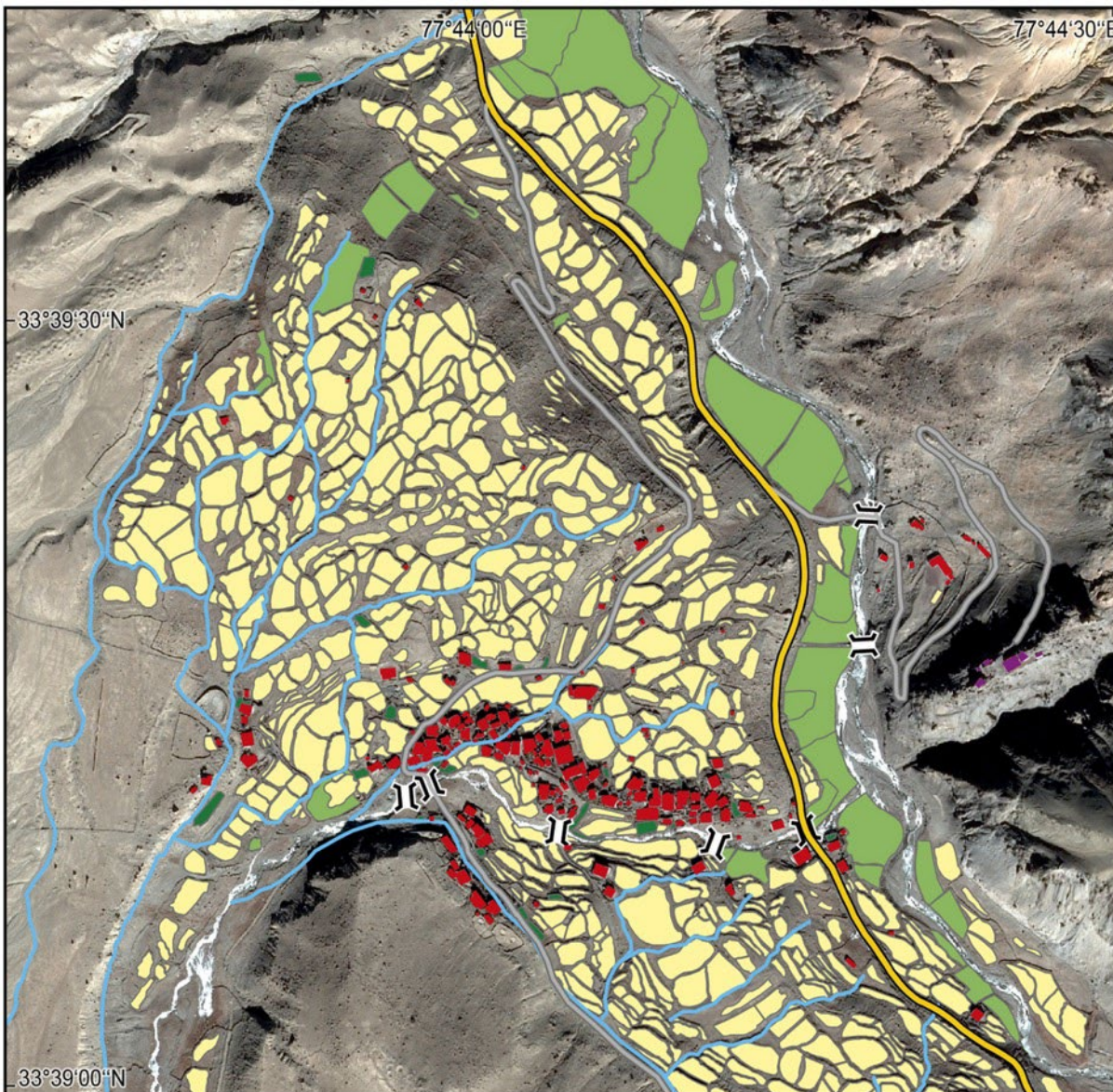


Ladakh | Location of ice reservoirs

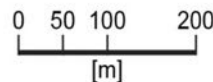


Cryosphere-related hazards and risks





- Building
- Gompa (Monastery area)
- Cultivated field
- Pasture
- Trees
- Highway NH3
- Road
- Bridge
- Canal



Background Image: SPOT 6 R-G-B 2013/11/18
Data Source: SPOT 6 2013/11/18
Draft & Cartography: S. Schmidt, N. Harm

Village Gya: Land use pattern in 2013

Altitude: 4100 m a. s. l.

Highway from Manali to Leh

700 inhabitants

(Government of Jammu & Kashmir 2011)

Irrigated cultivation of barley

Source: Schmidt et al. 2020



Destruction
2 houses and 1 link road washed away
3 houses and the hospital partly damaged
Fields of 14 families were affected

Photos: 30 September 2014



Gya Lake (5400 m), Ladakh

2 October 2014



Gya Lake

Satellite data from the day of the GLOF

Lake is ice-covered over the whole year with few exceptions

Size increased from 0.03 km² in 1969 to 0.09 km² in 2014

Pléiades
6 August 2014

Socio-Hydrology of the Upper Indus Basin

Socio-hydrology is a useful framework to analyze the interactions between cryosphere dynamics and local irrigation networks (site-specific particularities) and to understand risks from cryosphere-related hazards

Considering the local / regional scale: Even small glacier changes may have serious consequences; Even small GLOFS are potentially harmful for local populations

Local settings and adaptation strategies vary across the region and they include technological solutions (new irrigation channels, ice reservoirs, water pipes)

Thank you
for your attention

