INTERNATIONAL CONFERENCE ON
MOUNTAINS AND CLIMATE CHANGE

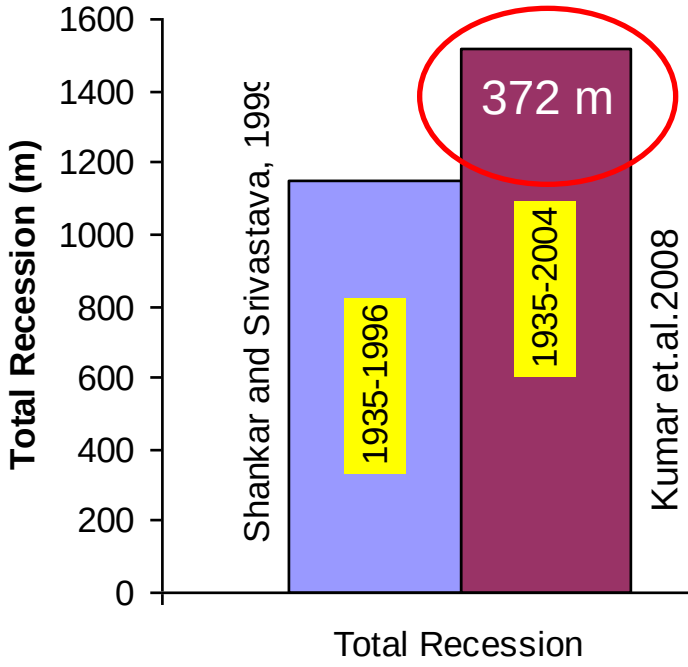
MULTIPLE VULNERABILITY FORCERS TO HIGH ALTITUDE HYDROLOGICAL PATTERNS

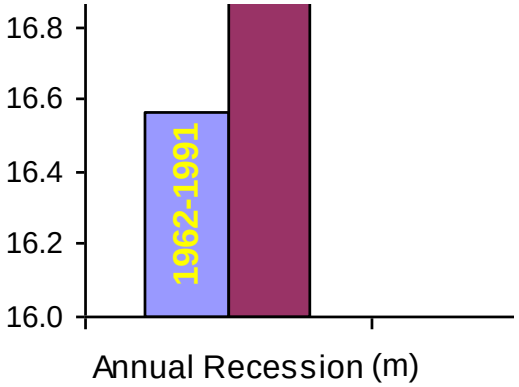
Shresth Tayal
Fellow and Faculty
The Energy and Resources Institute

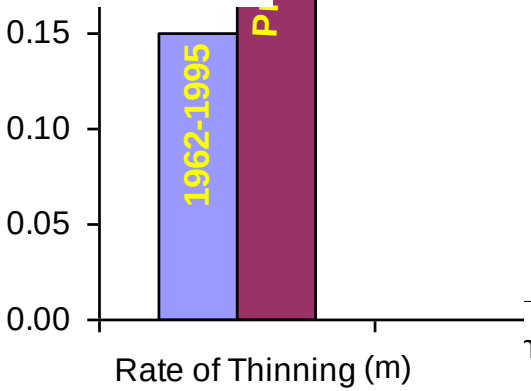
High Summit
LECCO 2013

ACCELERATING MELT RESPONSE OF HIMALAYAN GLACIERS IN LAST DECADE

Gangotri glacier

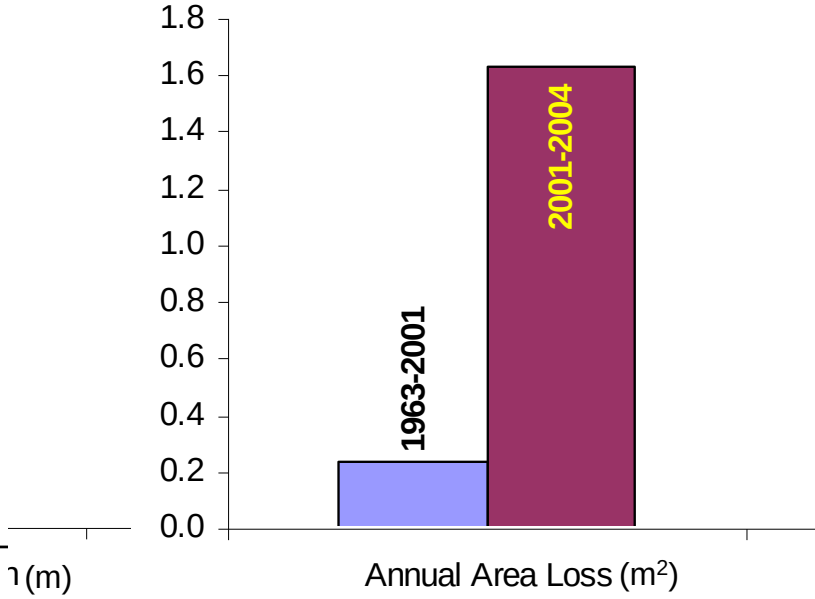






from data in Dobhal et.al. 2004

Dratapu Glacier, HP

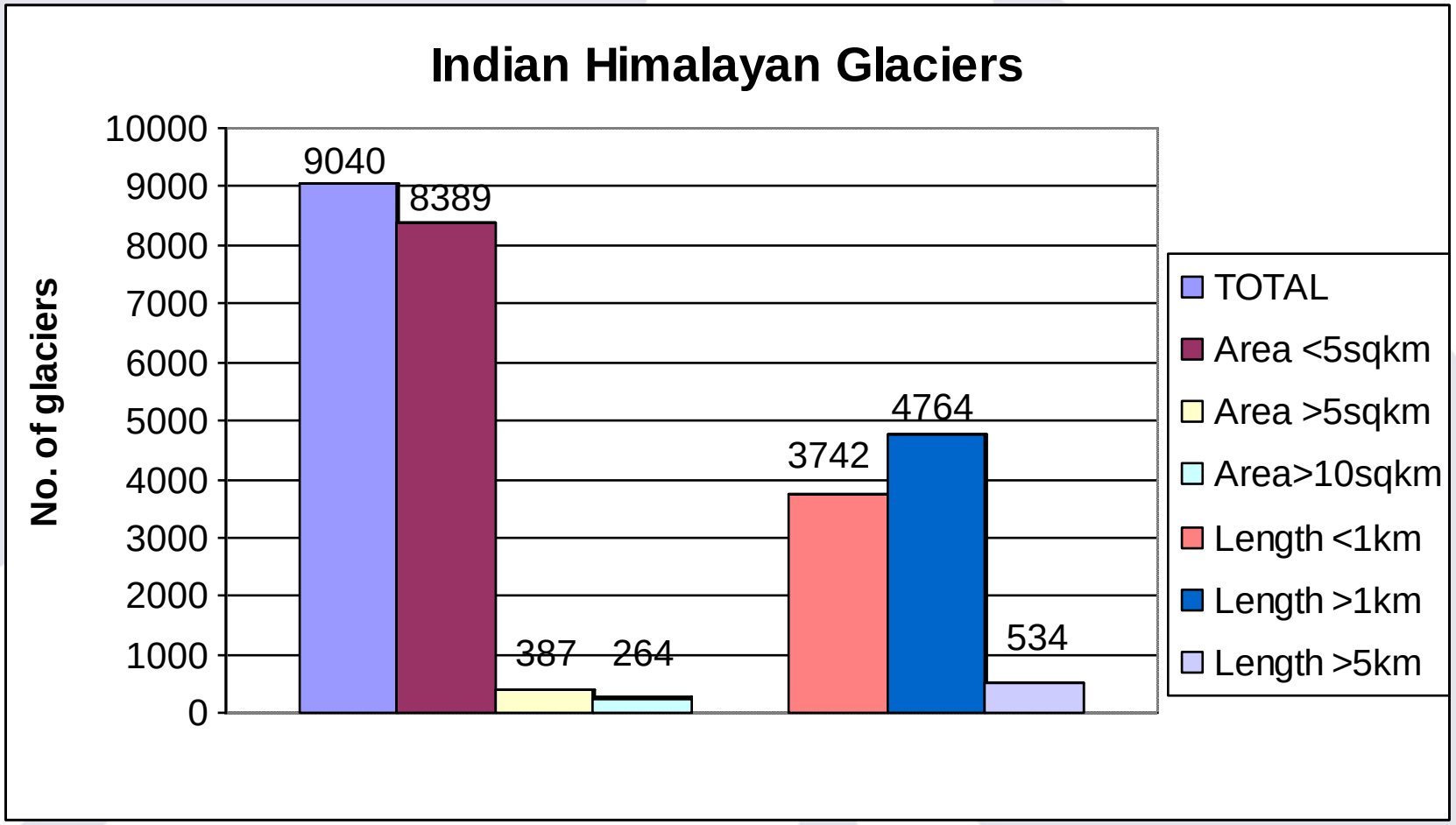


from data in Shukla et.al., 2009

NATURAL VULNERABILITY FORCERS

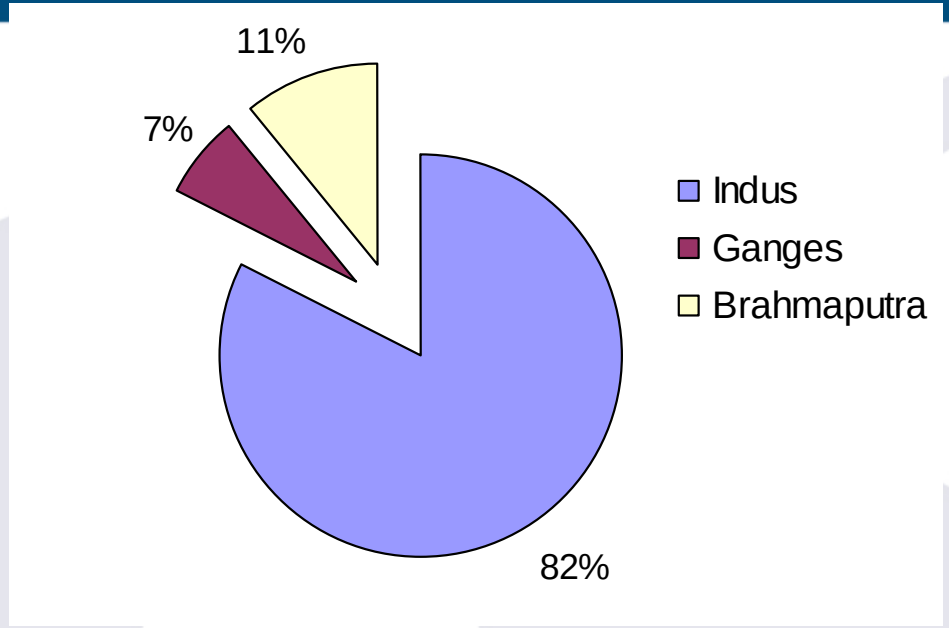
- Low latitudes (closest to tropic of cancer)
- South facing slopes of Himalaya
- Dominant season - summers
- Highly inhabited states of Indian Himalaya

- 94.09 % of glaciers are smaller than 5 km in length
- 92.8% of glaciers are smaller than 5 km^2 in area
- 2.92% are larger than 10km^2 but occupy 44.59 of total glacierised area

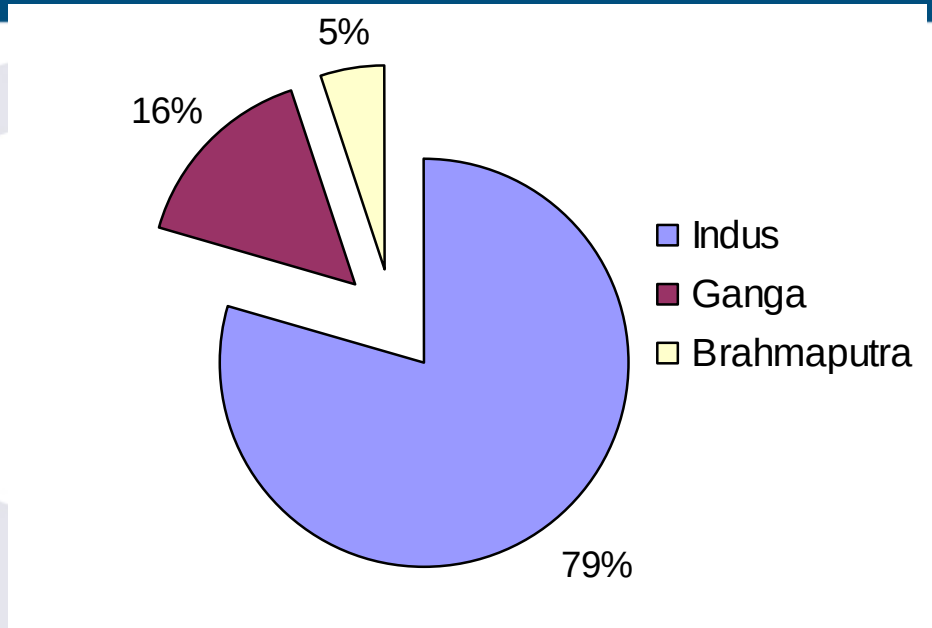


Source: GSI Inventory, 2009

High Summit LECCO 2013

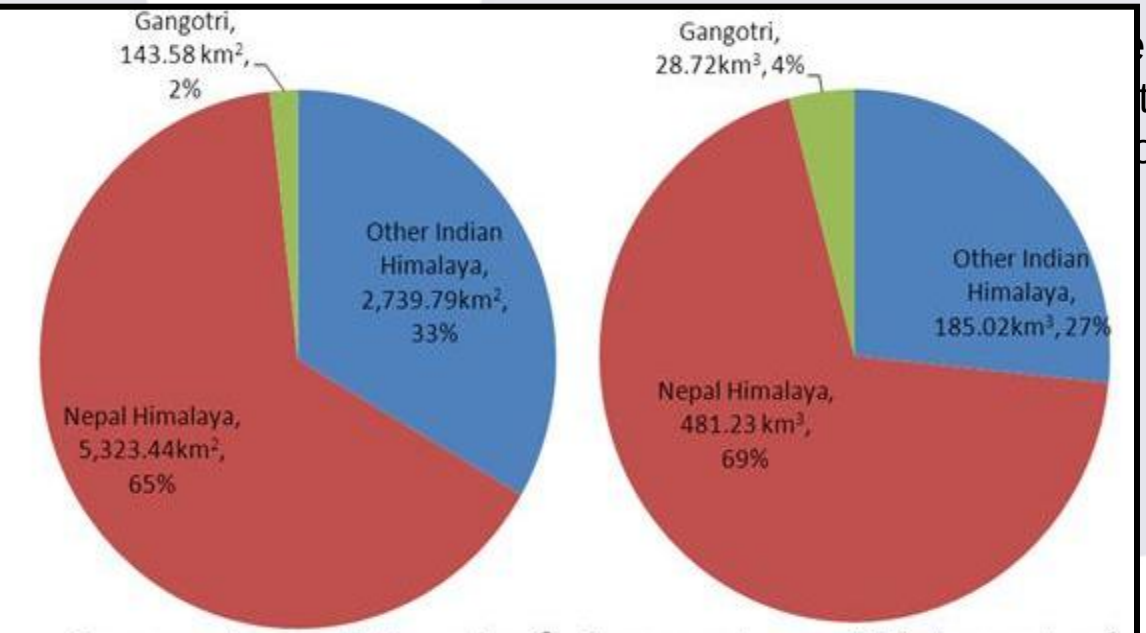


Total Number



Total Area

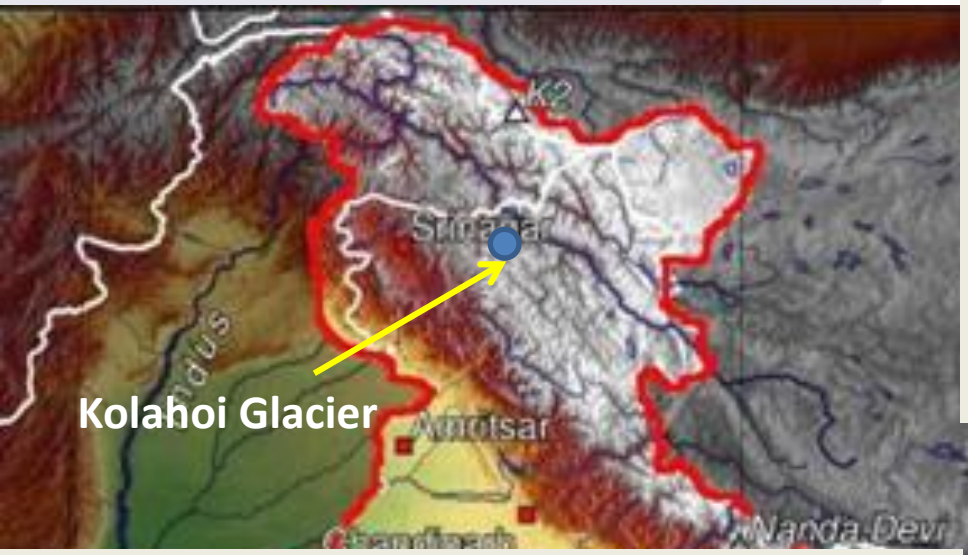
ead over larger area in Ganges
to be thinner and thicker in Brahmaputra
of their valleys



Regional Comparison

High Summit LECCO 2013

Study Area



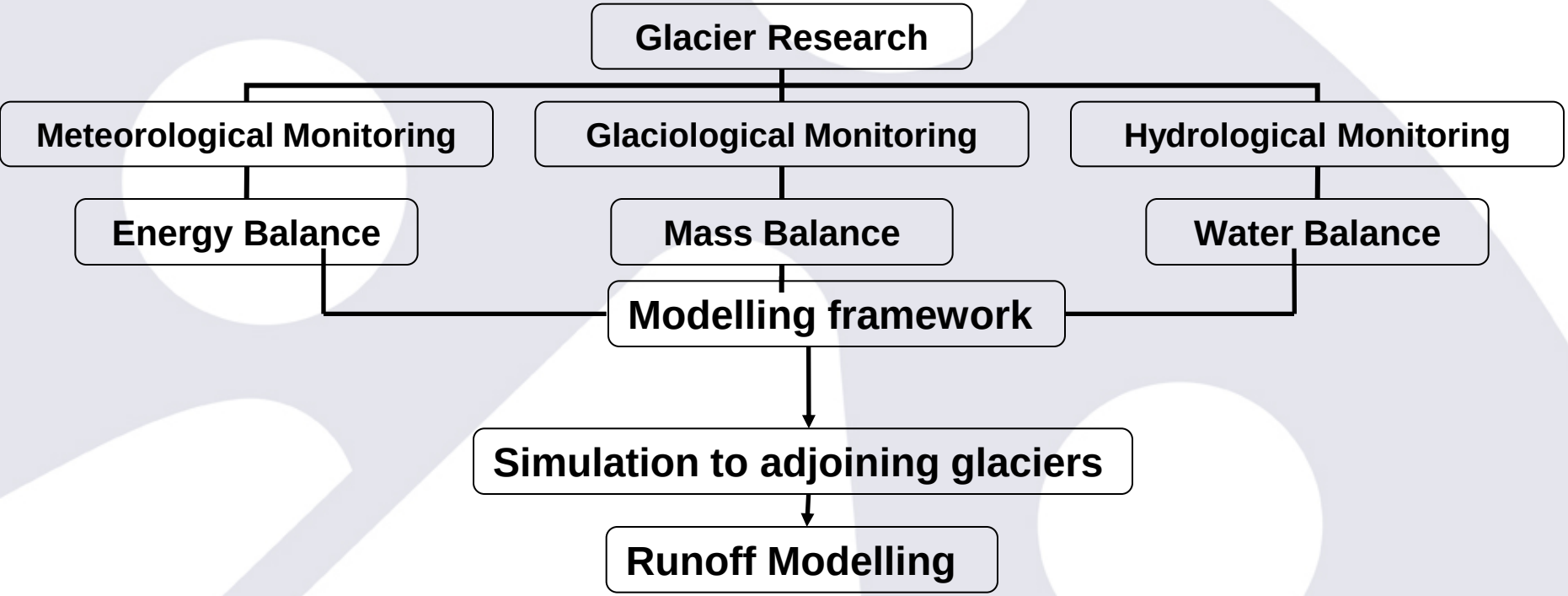
Kolahoi Glacier (Kashmir)
Lidder Valley, Jammu and Kashmir (N 34° 07‘-34° 12‘: E 75° 16‘-75° 23‘, snout elevation: 3700 masl north facing)
Western Himalaya
Characterized by the frontal activities of westerly winds in winter and by dry subtropical climate in summer
Snow accumulation occur during the winter season

East Rathong Glacier (Sikkim)
West Sikkim (N 27° 33‘, 27°48‘: E 88° 46‘, 88°51‘, snout elevation: 4675 masl, south facing)
Snow accumulation between June and September accounts for around 80% of annual accumulation
Wet in summer due to monsoon and dry in winter
Overlap: Immediate melting of accumulated snow

High Summit
LECCO 2013

APPROACH: TRIPLET

- An integrated research with more reliance on field measurements covering the 3 dimensional dynamism of glacier melting



TERI's GRP: Distributed into 3 Phases

Phase 1: **Establishment of Glacier Monitoring Observatories/ field laboratories**

completed

Phase 2: **Analysis of satellite data and field experiments for calculation of modelling constants**

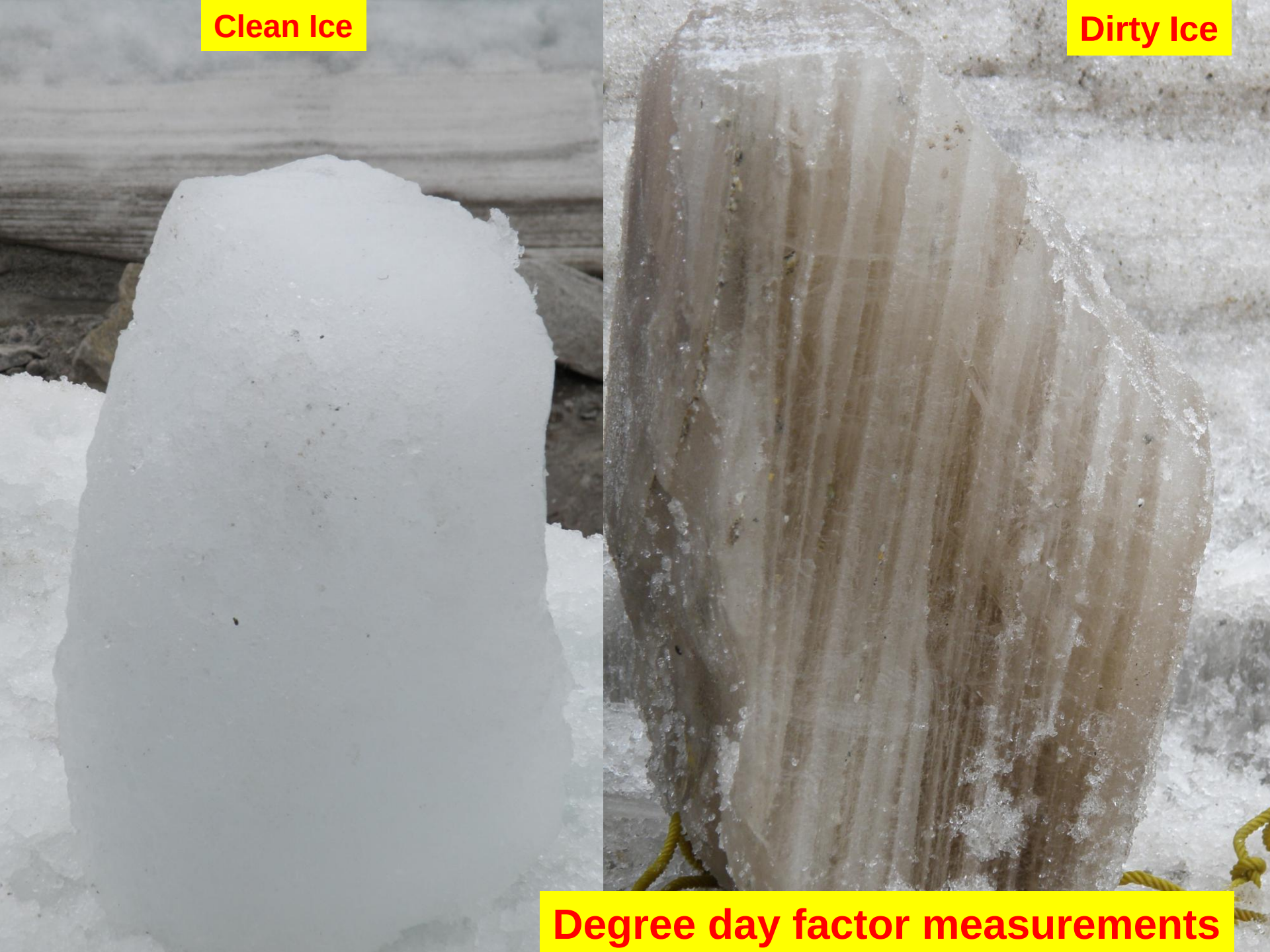
On going

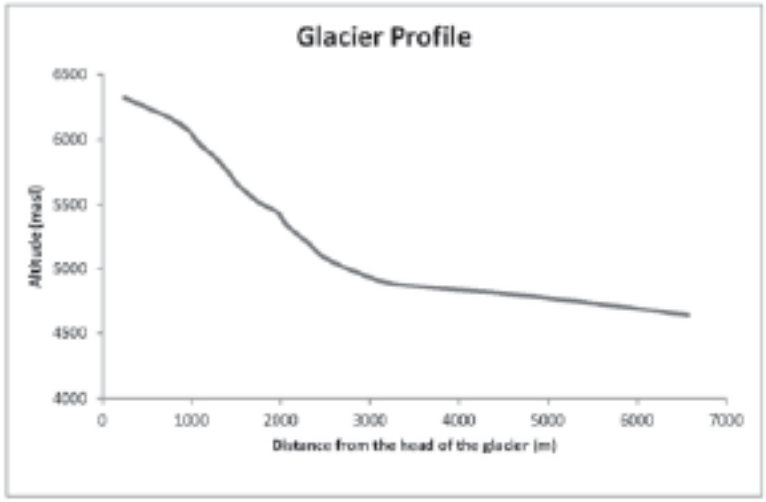
Phase 3: **Development of integrated runoff model**

To be started

STILLING WELL AT EAST RATHONG CHU

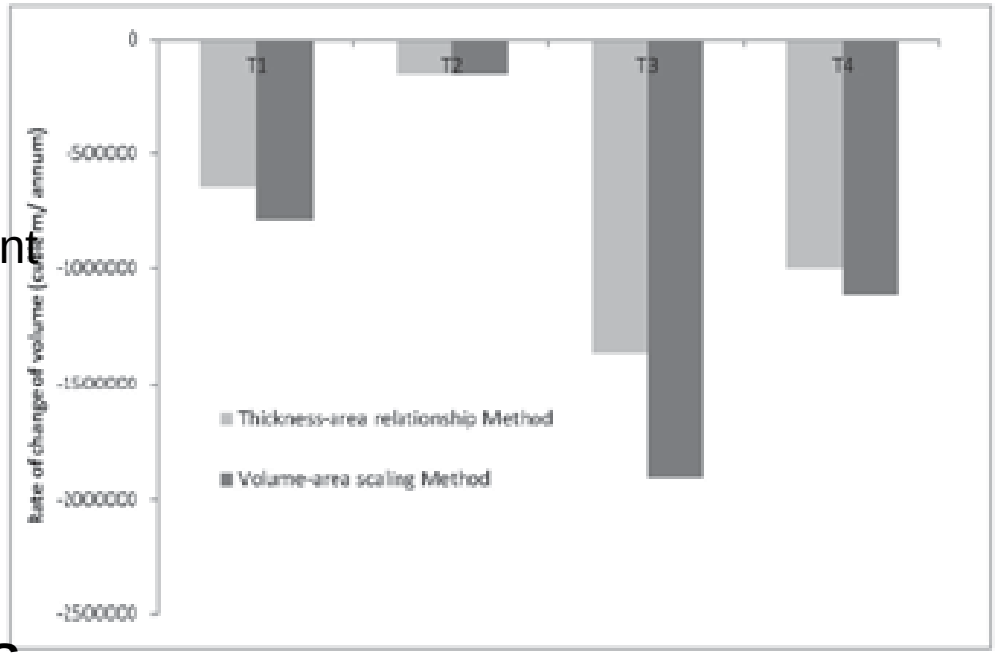
AWS, Sikkim, 4619m


Clean Ice
Dirty Ice
Degree day factor measurements



T1: 1962-1976; T2: 1976-1989; T3: 1989-2000; T4: 2000-2011

Average retreat15.1 m/ yr
Total Area Loss 15%
Cumulative loss of 20-23% in ice content



VOLUME-AREA SCALING ANALYSIS

Source: Agrawal and Tayal 2013

High Summit LECCO 2013

CONCLUSION

- Himalayan glaciers are naturally vulnerable and anthropogenic climate warming lead only to additive affects
- Majority of Himalayan glaciers are small-very small in their extent, which bear maximum impact of climate warming
- High degree of interdependance exist among different countries receiving water from Himalayan glaciers- India, Nepal and Pakistan
- Greater coordination among scientists for cryospheric research in Himalayas is necessary to improve the understanding about glacier dynamism