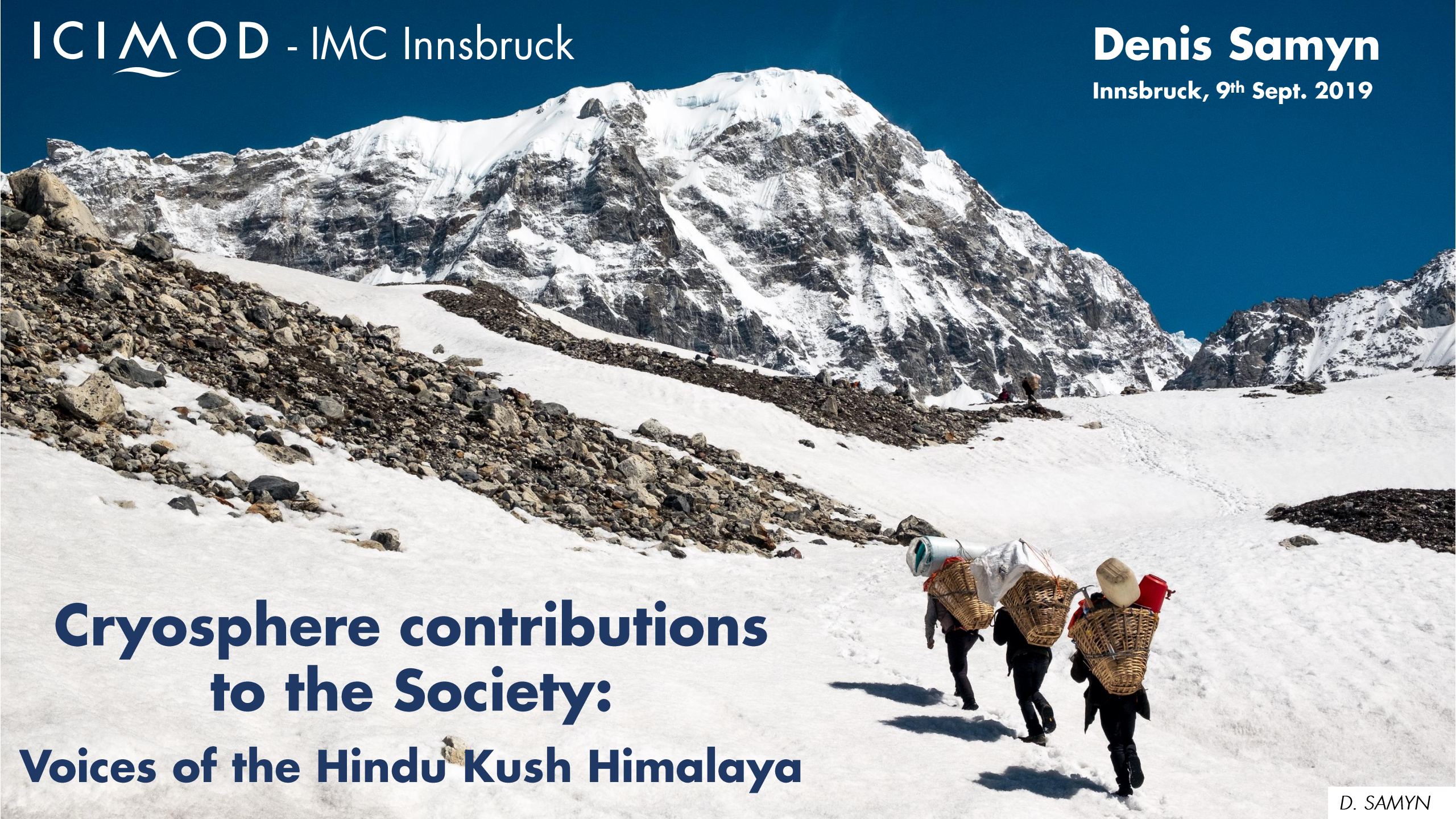
ICIMOD - IMC Innsbruck

Denis Samyn

Innsbruck, 9th Sept. 2019



Cryosphere contributions to the Society:

Voices of the Hindu Kush Himalaya

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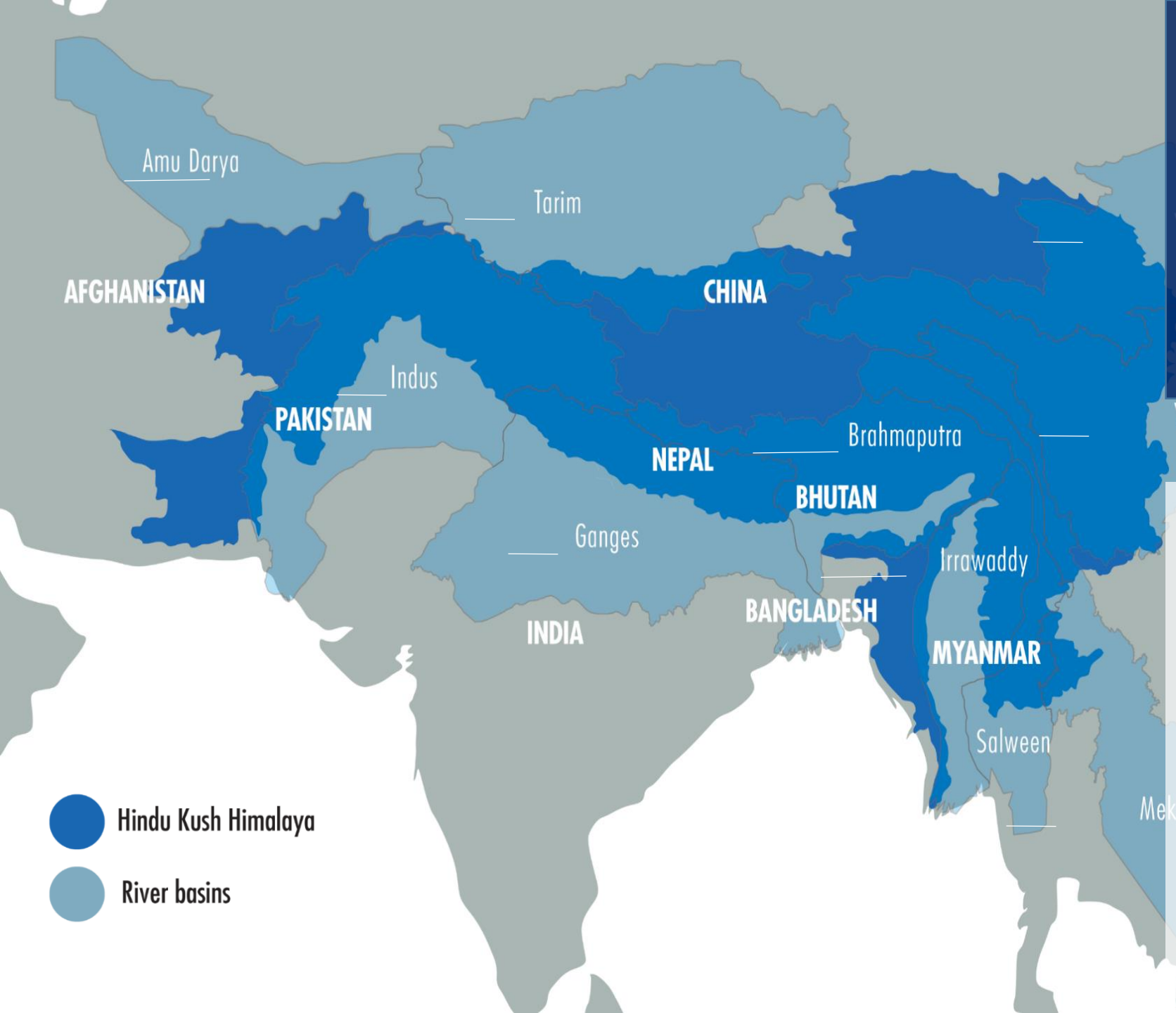
What happens here affects > one-fourth of humanity



10 major Asian river systems

55,000 glaciers

240 million people in the HKH mountains and hills

1.65 billion people downstream

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In a 1.5°C world, glaciers in the HKH will lose 1/3 of their volume by 2100

And 2/3 of their volume under current emission trends (RCP8.5)

Snow covered areas and volumes will decrease, and snowline elevations will rise;

Snowmelt induced run-off peak will be stronger and occur earlier in the year

Source: HIMAP climate change and cryosphere chapters, and Kraaijenbrink et al. 2017, *Nature*

Amplified HKH warming at $\Delta T_{1.5}$

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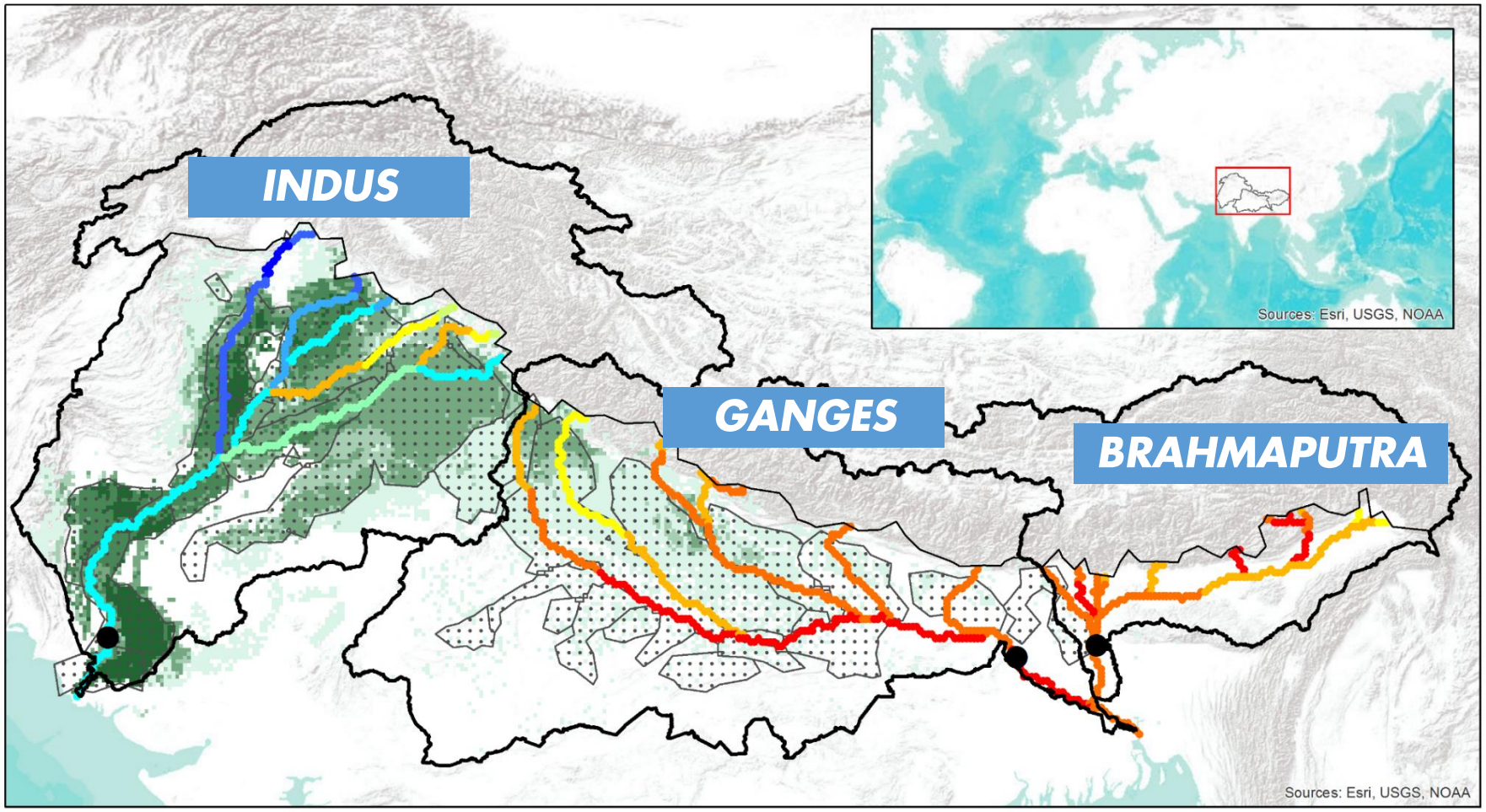
Contribution of mountain water to irrigation



< 10 % | 10 - 20 % | 20 - 40 % | 40 - 60 % | > 60 %

Mean annual contribution of snow and glacier melt to irrigation water supply (%).

- Highly spatially variable contributions of meltwater
- In Indus, meltwater forms a major contribution to all canal-fed irrigated areas.
- In Ganges, substantial contribution in the intensely cropped NW part of the basin. Elsewhere, run-off is generated by precipitation in the plains.
- In Brahmaputra Basin, meltwater plays a minor role, as large irrigation systems are absent and high precipitation levels suffice.

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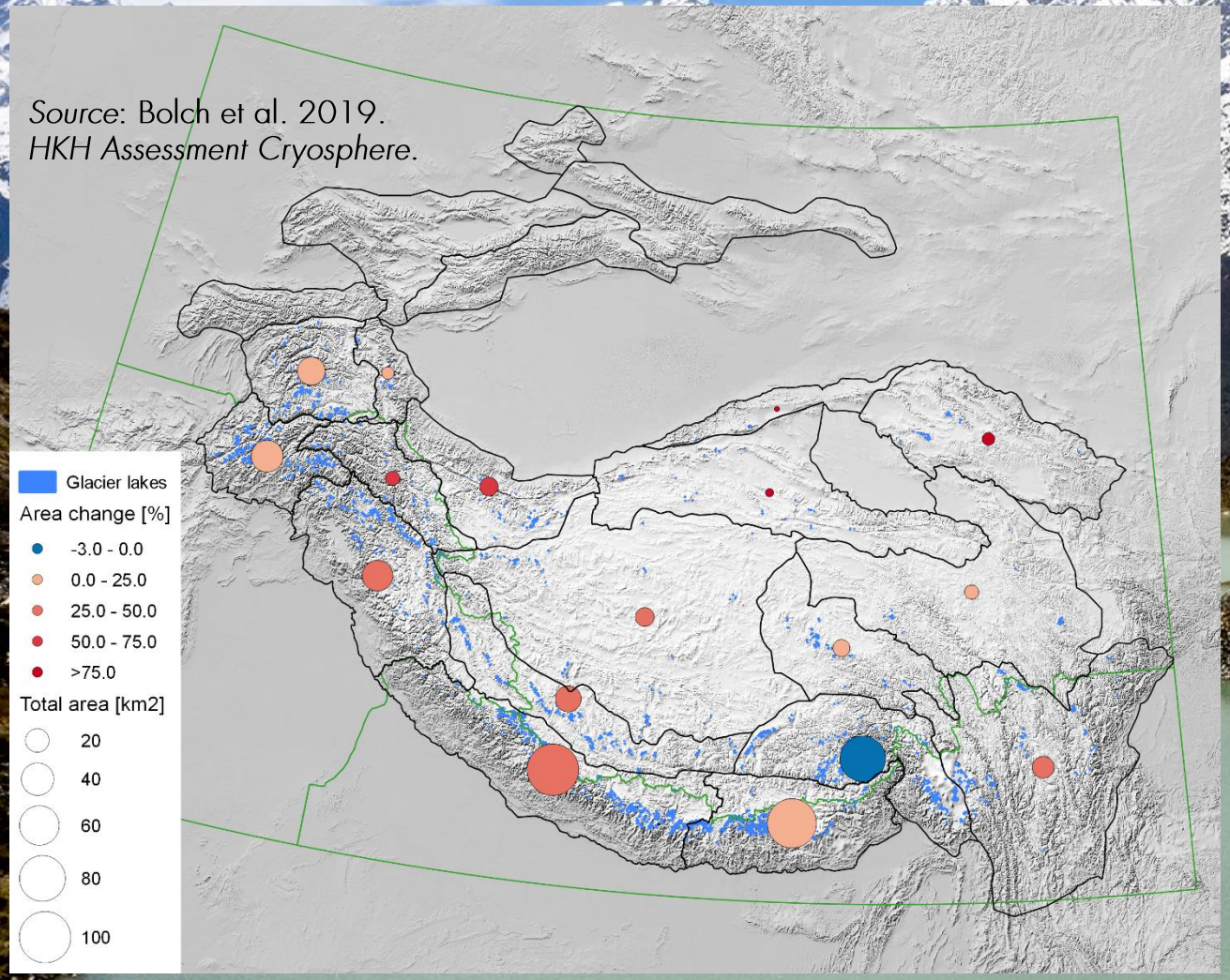
Glacier lake expansion



Change in Glacier lakes between 1990 and 2010

Increased Number
3350 to 4260 (~21%)

Increased Area
440 to 557 sq. km. (~21%)

Small lakes (< 0.2 km^2) are more sensitive to climate change

21 lakes identified as potentially prone to outburst in Nepal

Picture: D. SAMYN

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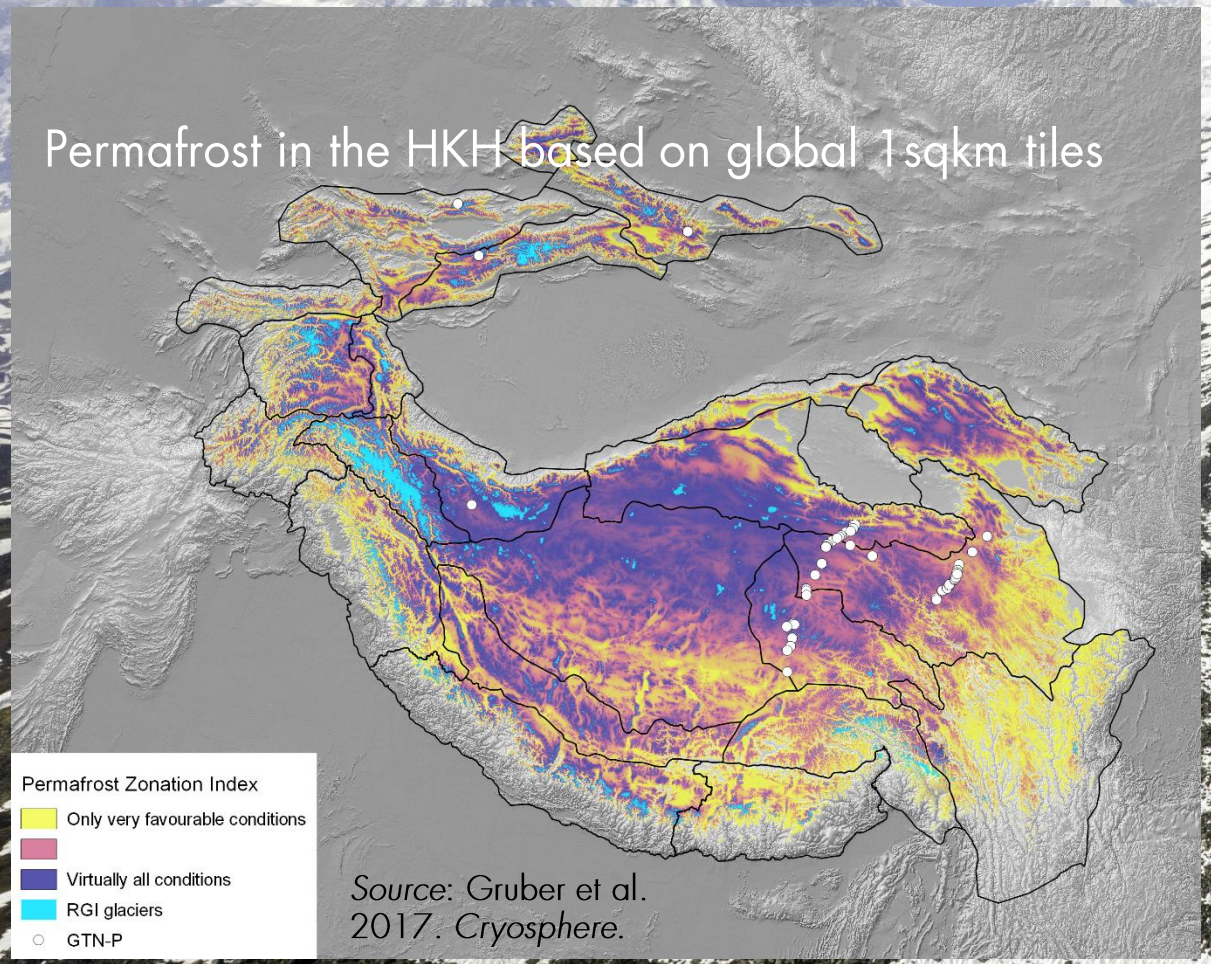
Thawing permafrost in a warming HKH



Permafrost temperatures have increased more for cold permafrost than when closer to the freezing point

More permafrost monitoring is needed in the mountains

Country	Permafrost area in HKH [10^3 km^2]	Glacier area in HKH [10^3 km^2]
Afghanistan	17.5 (5.9–31.6)	2.6/3.1
Bhutan	1.2 (0.3–3.5)	1.0/1.5
China	906 (486–1356)	29.2/33.6
India	40.1 (10.5–77.4)	11.8/19.6
Myanmar	0.1 (0.03–0.5)	0.04/0.06
Nepal	11.1 (6.4–16.1)	4.1/4.8
Pakistan	26.6 (7.2–53.3)	11.3/17.0
Total	1003 (516–1538)	60.1/79.8

Picture: D. SAMYN

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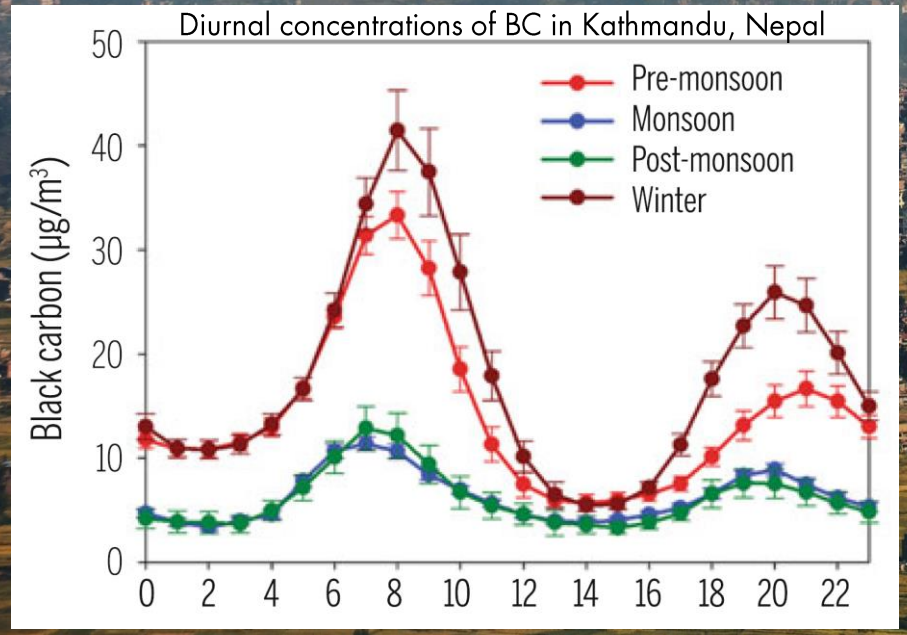
Air Pollution and Black Carbon



Source: Putero et al., 2015. Atm. Chem. & Phys..

- Air pollutants originating in and near HKH amplify climate change
- May contribute as much as CO_2 to the radiative forcing
- Accelerates glacier & snow melt
- Affects the circulation of monsoons and distribution of rainfall over Asia
- HKH population is largely exposed to air (BC) pollution levels much higher than WHO recommendations
- Negatively impacts health
- Reduces crop yield

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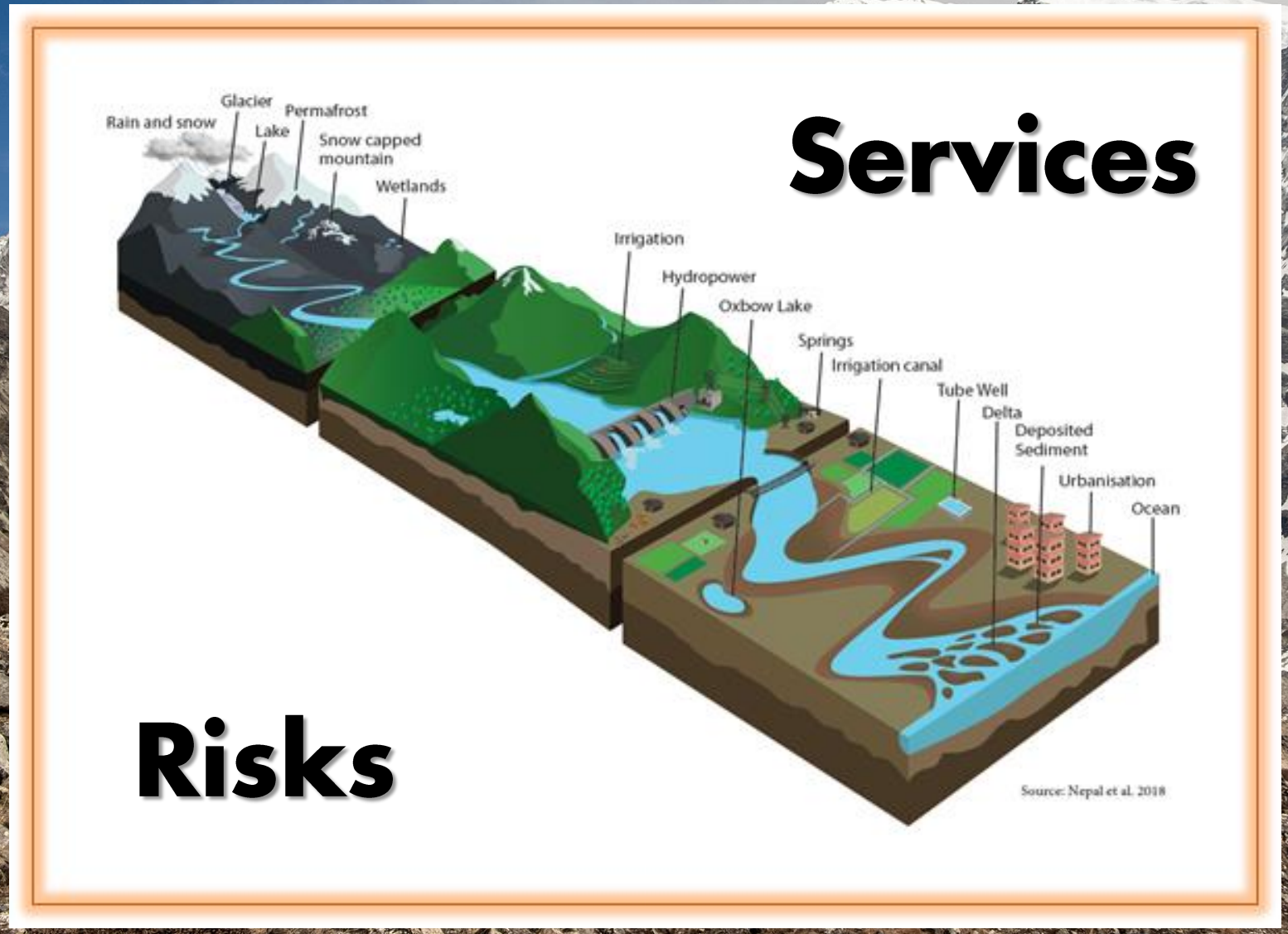
Cryosphere services, or contributions?

CONTRIBUTIONS



SOCIETIES

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Cryosphere services, or contributions?

	GLACIERS	SNOW	PERMAFROST	RIVER AND LAKE ICE	GLACIAL LAKES
Provisioning	• Irrigation and domestic use • Hydropower	• Irrigation • Hydropower • Feed and fodder production	• Groundwater and runoff	—	• Drinking water
Social / cultural	• Tourism, religion	• Tourism, religion	—	—	• Tourism, religion
Regulation	• Climate modulation • Runoff regulation	• Climate regulation • Runoff regulation	• Prevention of rockfall • Carbon storage • Regulation of hydr. cycle	• Climate regulation	—
Supporting	• Habitat for flora, fauna, and microorganisms • Bearing	• Habitat for flora, fauna, and microorganisms	—	• Bearing • Habitat for microorganisms	• Habitat for cold water ecosystems
Adverse impacts	• Ice avalanches	• Snow avalanches and storms	• Constraining rooting and habitat • Increasing sediment flow, slope instability, emissions of GHG when thawing	—	• Glacier lake outburst floods (GLOFs)

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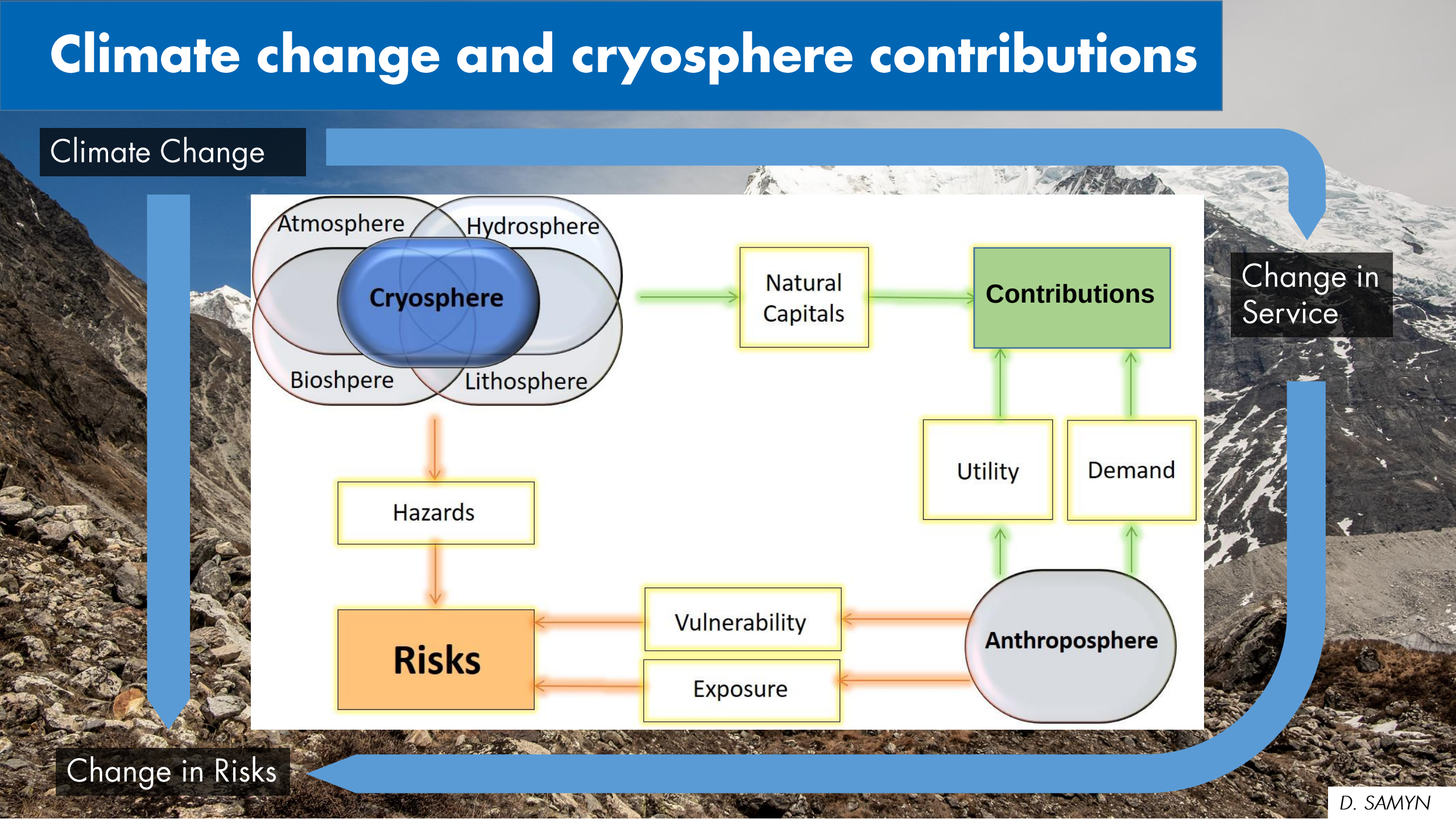
Climate change and cryosphere contributions



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ICIMOD - IMC Innsbruck
Kathmandu, 28-30 Aug. 2019
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Which issue related to cryosphere and society linkages requires more attention? Please respond in ONE WORD only

Mentimeter

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