Global Terrestrial Network for Glaciers (GTN-G) Mass Balance Measurements as part of an Integrated monitoring strategy

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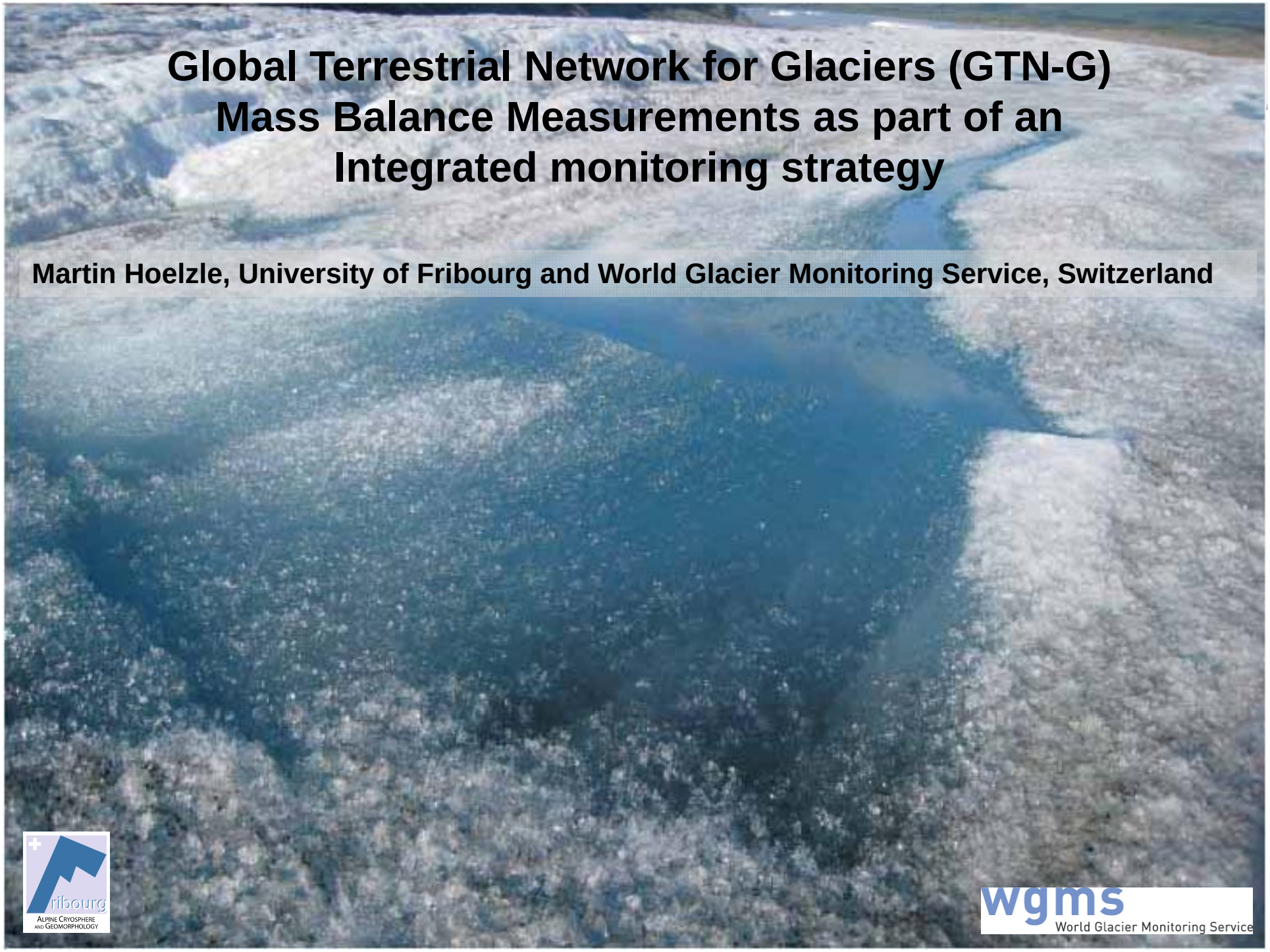

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Global Terrestrial Network for Glaciers (GTN-G): strategy

main goals of long-term observations:

- process understanding
- model validation
- change detection
- impact assessments

change detection:

- rate of change
- acceleration trends
- pre-industrial variability
- change patterns

integrated / tiered observing strategy

Tier 1: multi-component obs. system across environmental gradients

Tier 2: process understanding and model calibration
=> extensive energy/mass balance, flow

Tier 3: regional indicators
=> mass change (index stakes, photogrammetry, LIDAR)

Tier 4: regional representativeness
=> cumulative length change; DEM differencing

Tier 5: global coverage
=> inventories (remote sensing/geoinformatics)

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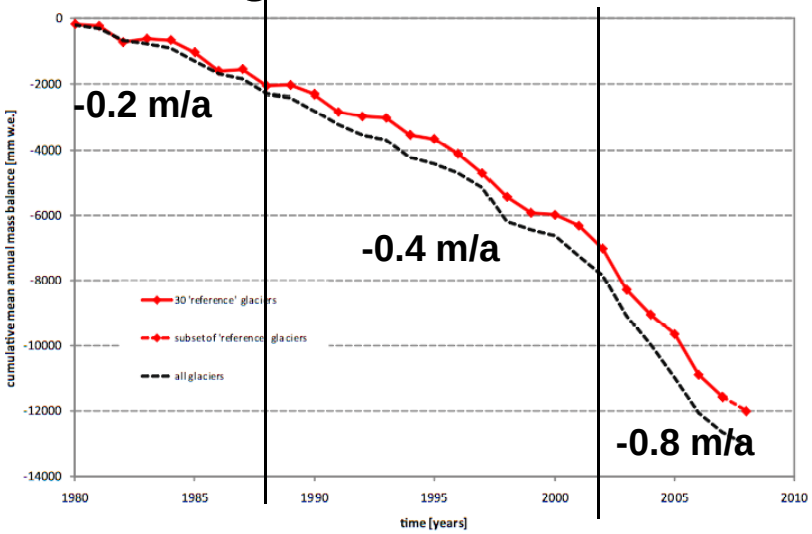
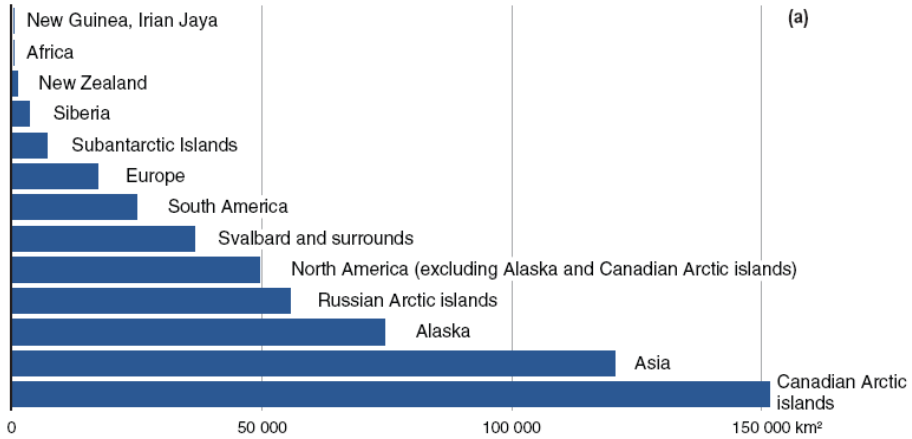
Time and space

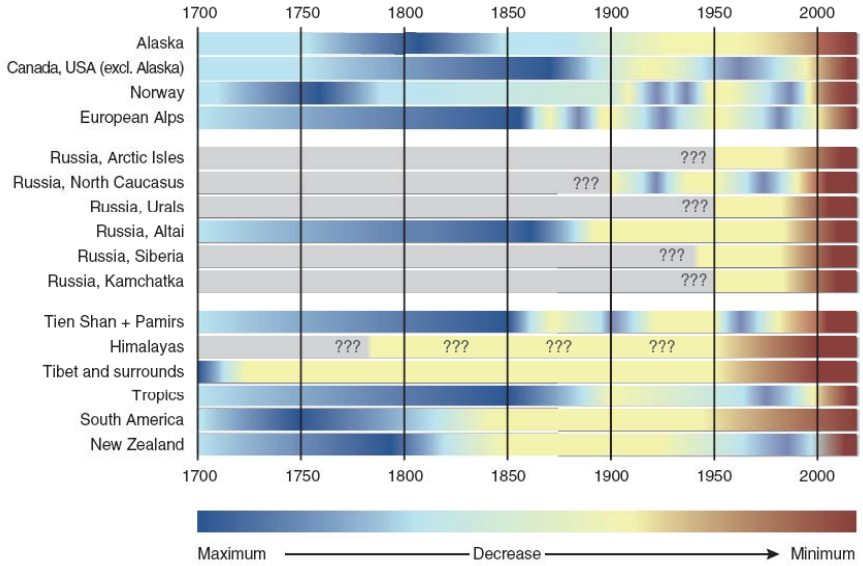
glacier mass balance



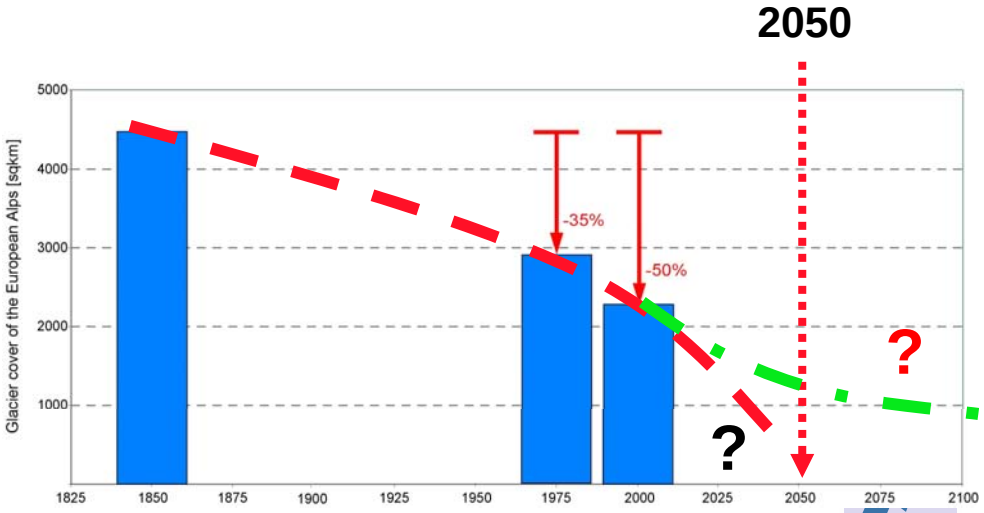
glacier inventories



glacier length change



impact assessment



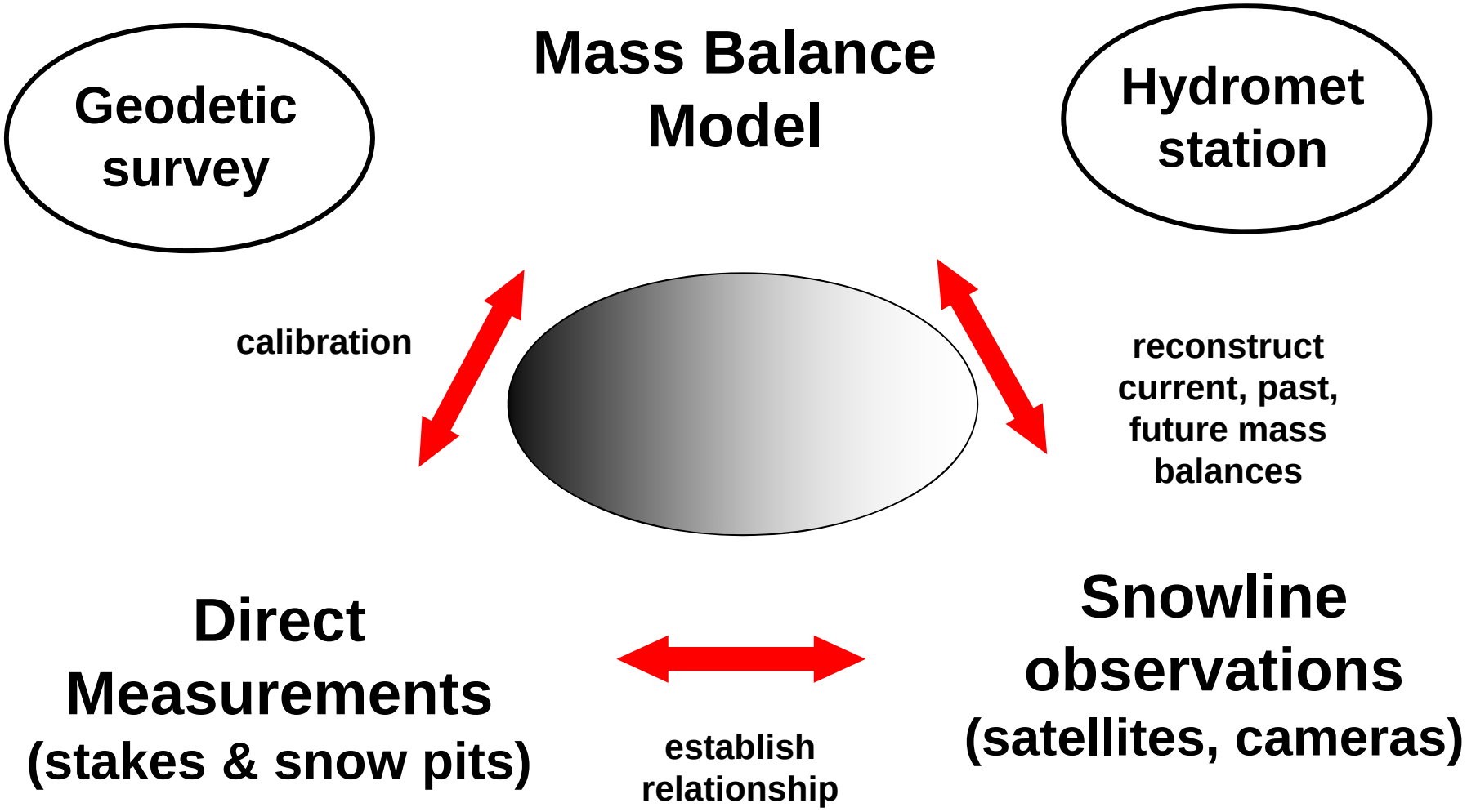
GTN-G: Objectives

a) combining in-situ observations with remotely sensed data

b) combining process understanding with global coverage

c) combining traditional measurements with new technologies by using an integrated and multi-level strategy

Glacier monitoring strategy: mass balance measurements



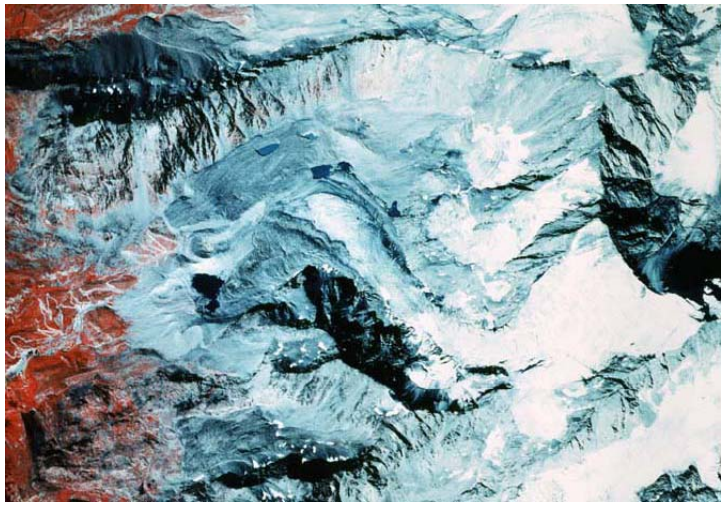
Stumm 2009

Mass Balance Methods

Glaciological method

Geodetic methods

- Aerial photogrammetrie
- Laser scanning



Index methods

- Snow line observations
- Index stakes

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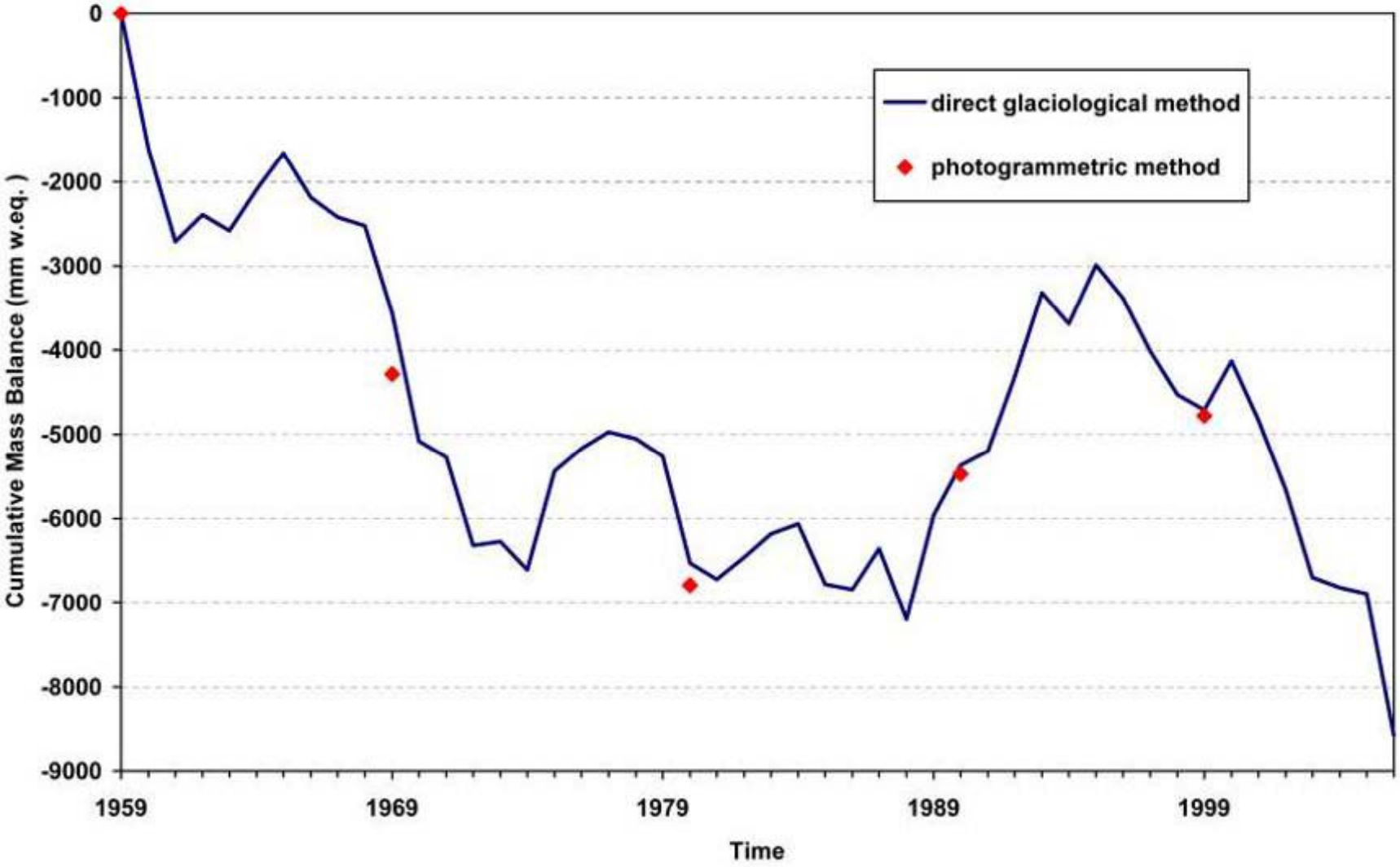
Mass Balance (comparison glaciological with geodetic method



Koblet et al. 2011

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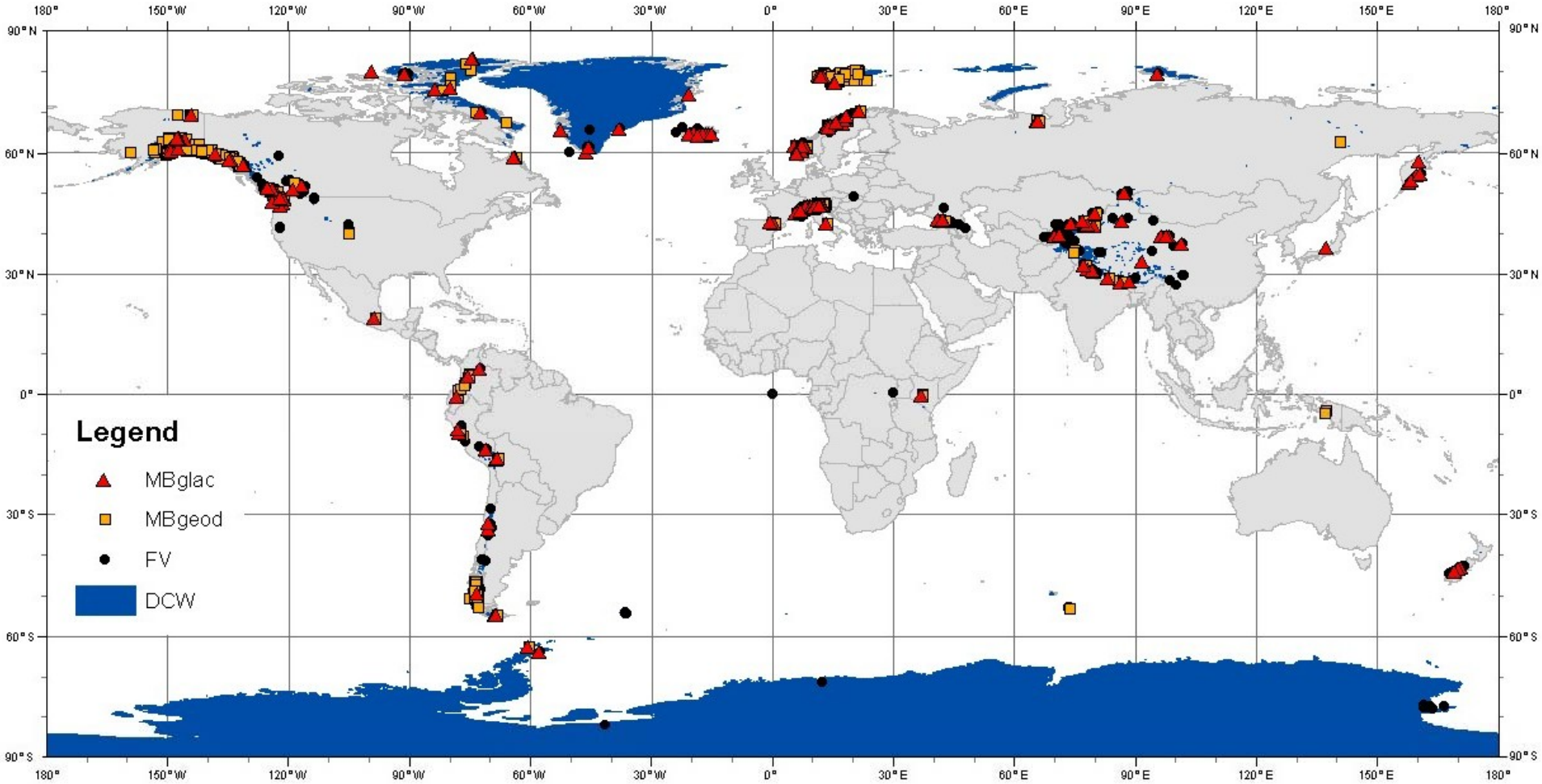
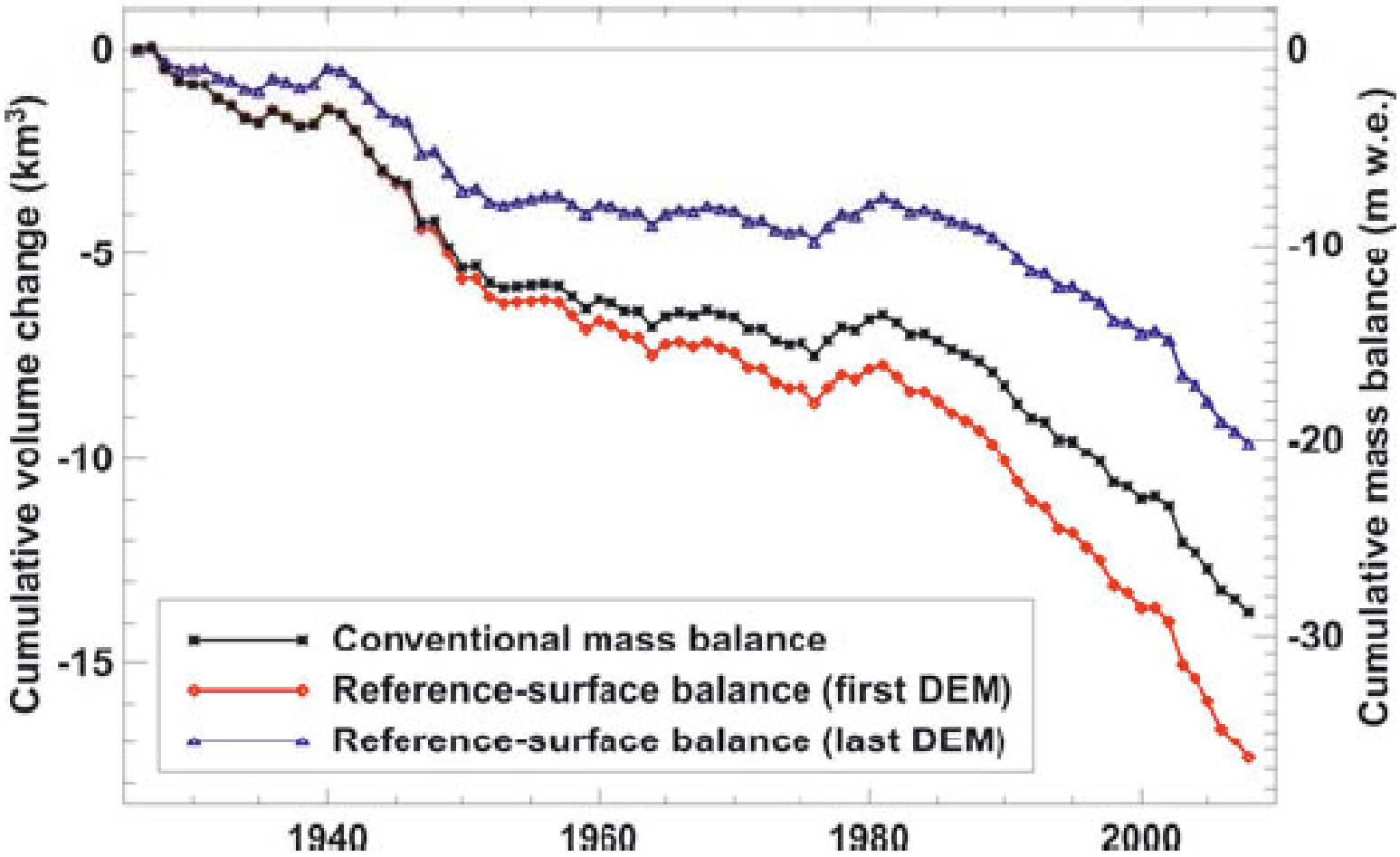
GTN-G: Fluctuations of Glaciers



	Front Variation	Glaciol. Mass Balance	Geod. Mass Balance
no. of glaciers	1,852	241	432
no. of observations	38,463	4,024	1,053

Mass Balance (Reference versus Conventional Mass Balance)



Huss et al, 2012

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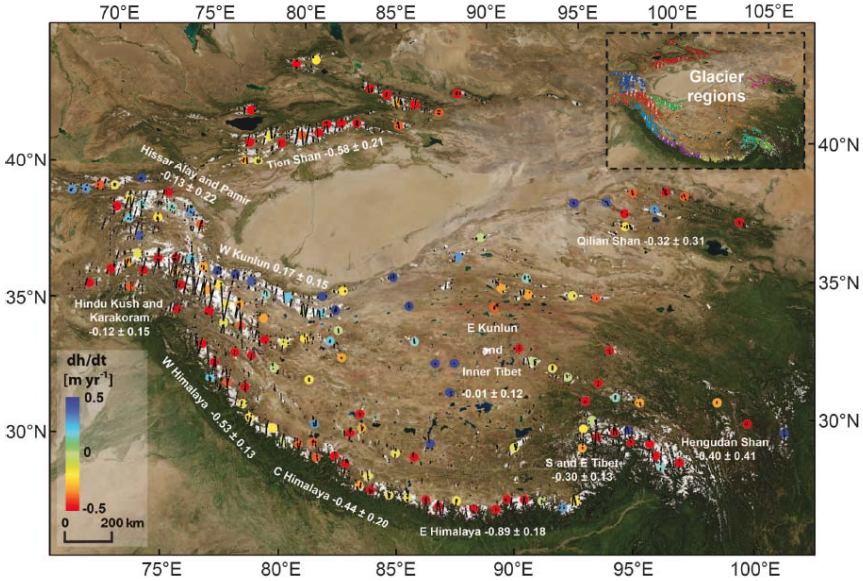
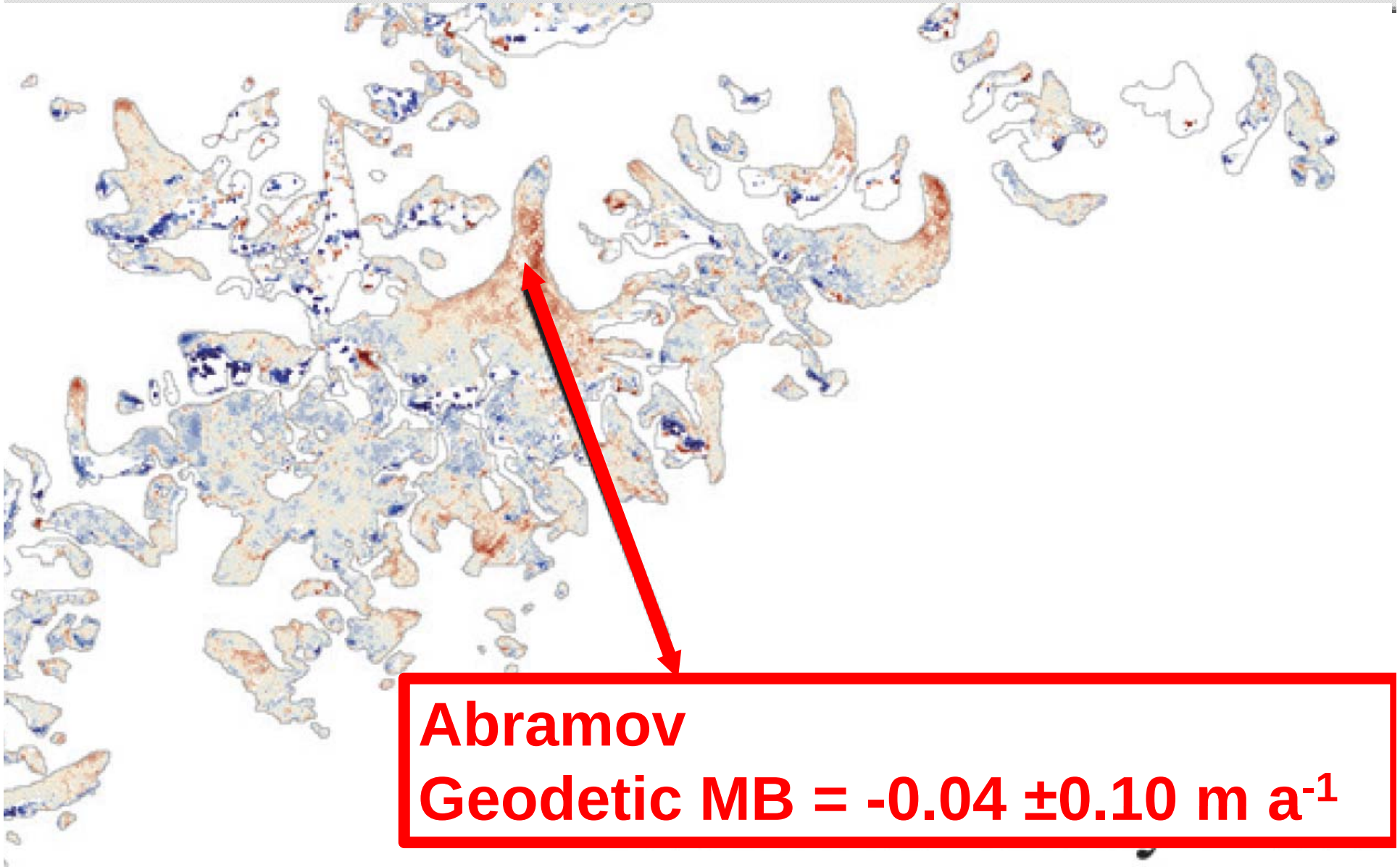
Newest data about mass balance change in Central Asia

Region	Mass change ($m\ a^{-1}$ w.e.)
Pamir period 1999-2011(after Gardelle et al. 2013)	+0.14±0.10
Pamir period 2003-2009 (after Gardner et al. 2013)	-0.12±0.24



Gardner et al. 2013

Geodetic mass balance 1999-2011



Abramov
Geodetic MB = -0.04 ±0.10 m a^{-1}

Gardelle et al. 2013

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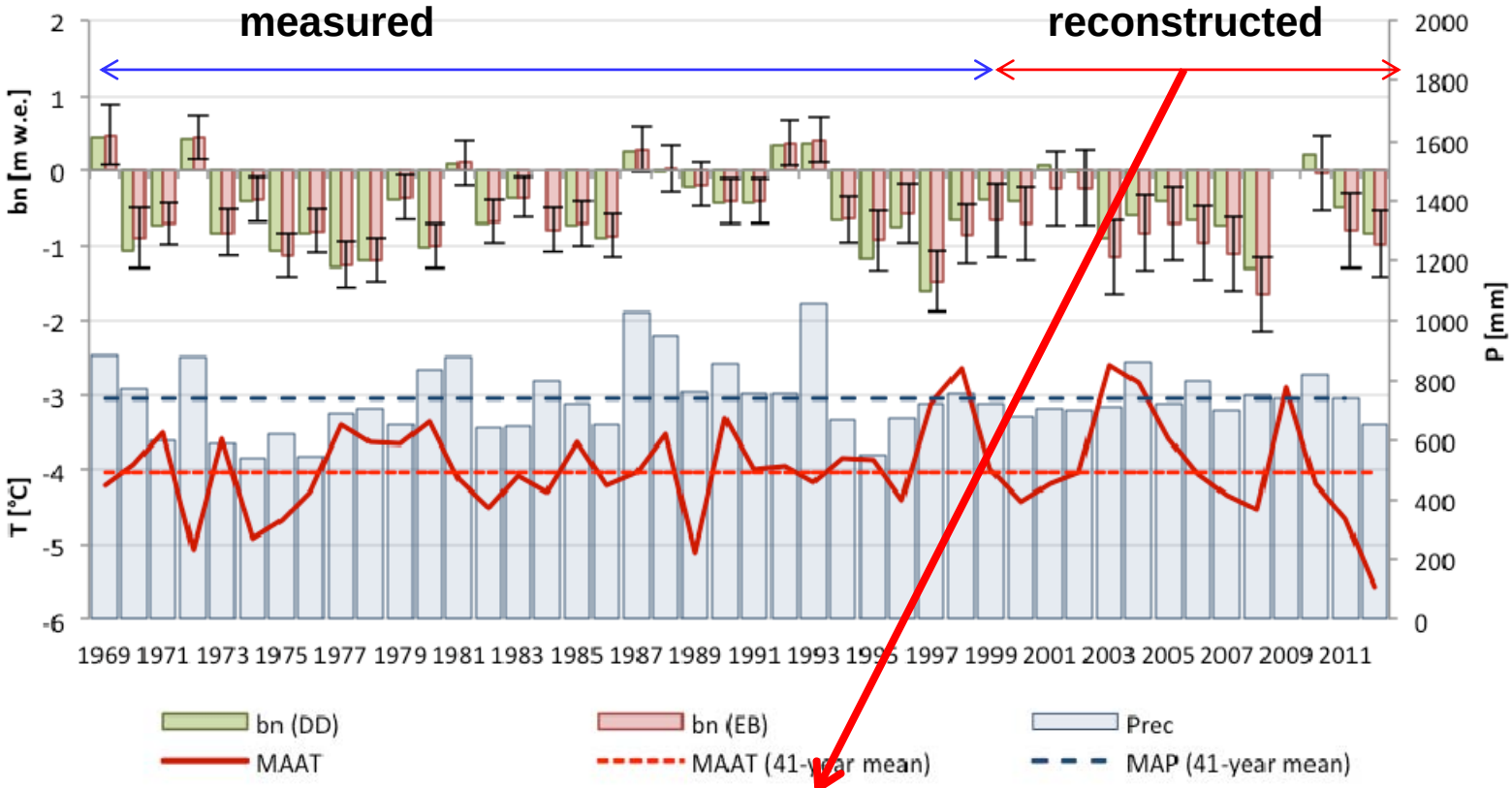
Mass balance 1969-2011 of Abramov glacier



DD-model 1999-2011 --> -0.42 ± 0.52 m a^{-1} w.e.

EB-model 1999-2011 --> -0.70 ± 0.56 m a^{-1} w.e.

Barandun et al. 2013

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