ЦАИИЗ

Central Asian Institute of Applied Geosciences

Joint NASA LCLUC Science Team Meeting with GOFC-GOLD CARIN, NEESPI and MAIRS on Land Use and Water Resources in Central Asia

Monitoring and study of glacier systems in Kyrgyzstan under conditions of climate change (under the CAWa and GCO projects)

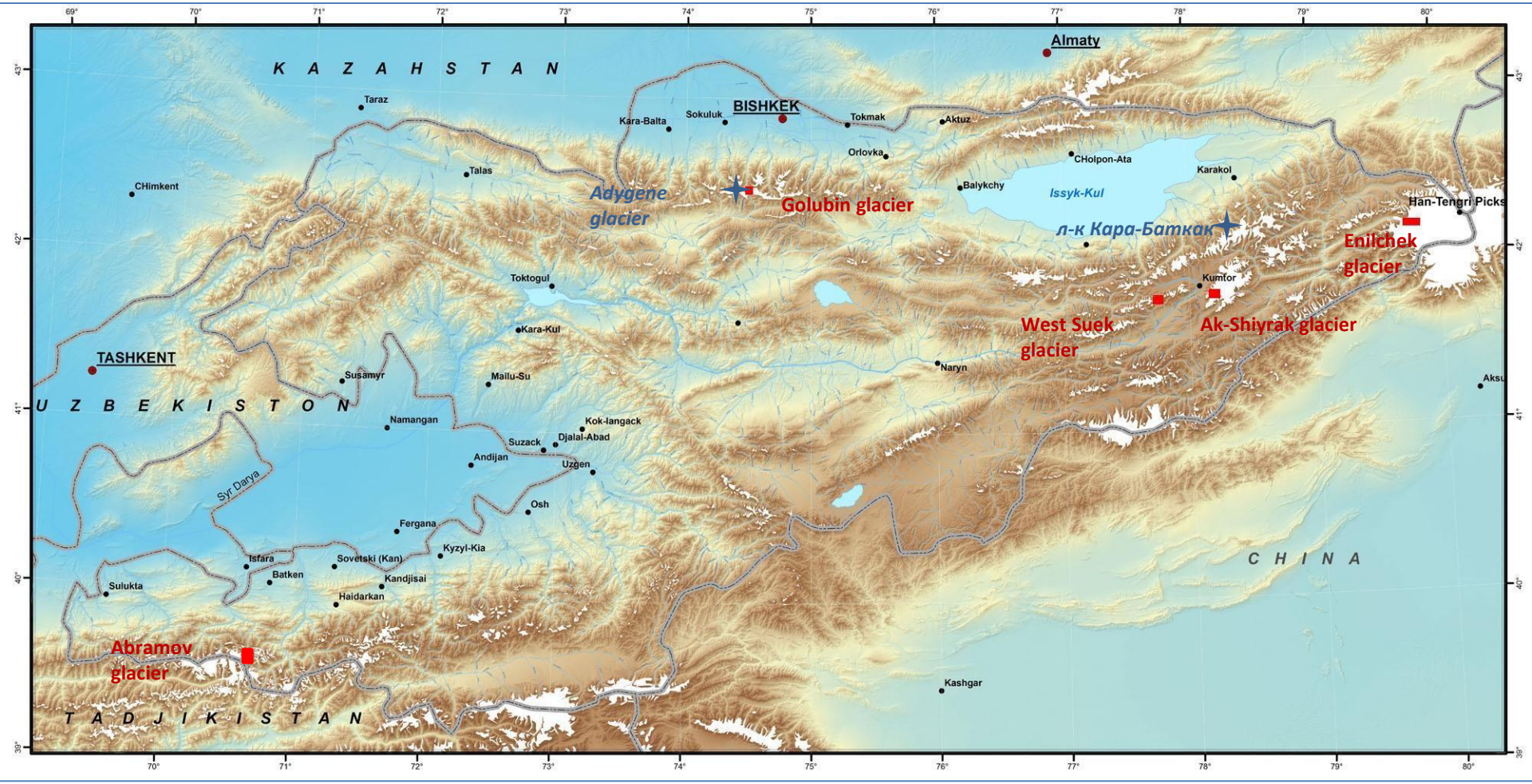
Co-director : Bolot Moldobekov

CAWA Project Coordinator: Katy Unger-Shayesteh

Glacier research programmes and projects implemented by CAIAG

- ***International projects:***
- «Central Asia Water». Under this project studies of Golubin glacier and Akshiyrak massif are conducted. These include such activities as installation of ablation stakes, measurements of ablation volume, measurements of ice thickness using georadar. Based on results of satellite image interpretation, values of regression of glacier tongue are estimated.
- «Global Change Observatory in Central Asia». In the frame of this project ,field and theoretical studies are implemented. Hydrological, meteorological and glaciological measurements are presently made at the Mertzbacher station established by CAIAG jointly with GFZ. Preliminary data on features of Southern and Northern Inylchek glacier were obtained.
- ***Research programme of CAIAG:***
- Study and monitoring of Inylchek glacier with the purpose to identify the glacier balance (budget), its morphological and dynamical features, climatological and hydrological conditions.

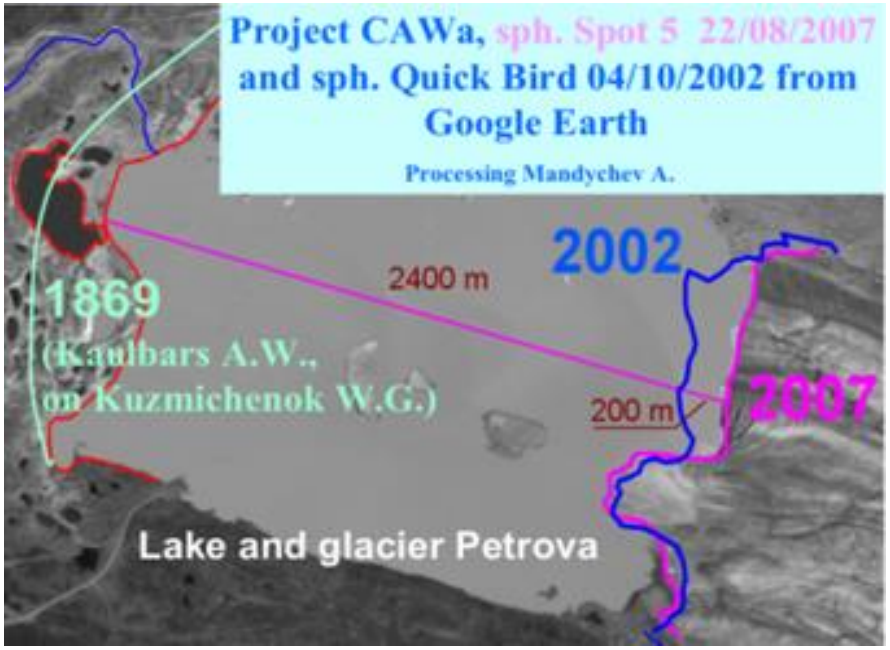
Representative glaciers in Kyrgyzstan which are monitored



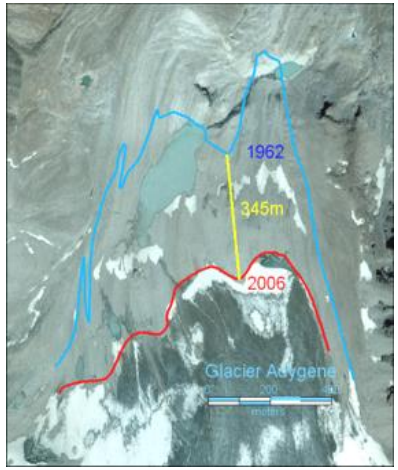
objects of CAIAG's research

objects of research by other organisations

Study of the glaciers within CAWa project



- "Water in Central Asia" covers study of principal components of the water resources in Kyrgyzstan. One of them is focused on glaciers. Research activities of glaciers were carried out both by field methods as installation of ablation rods, measurements of topographical parameters using GPS by georadar, and through decoding of space images.
- **Results:** Within CAWa project in 2010 research activities on the Golubin glacier and Ak-Shyirak area were conducted; as well as installation of ablation rods and measurements of ablation level.
- Jointly with specialists from GFZ measurements of ice thickness were conducted using georadar. According to the results of decoding of space images, levels of the glacier tongue retreat were obtained.



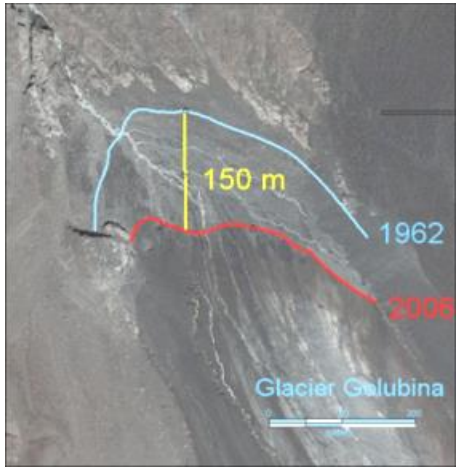
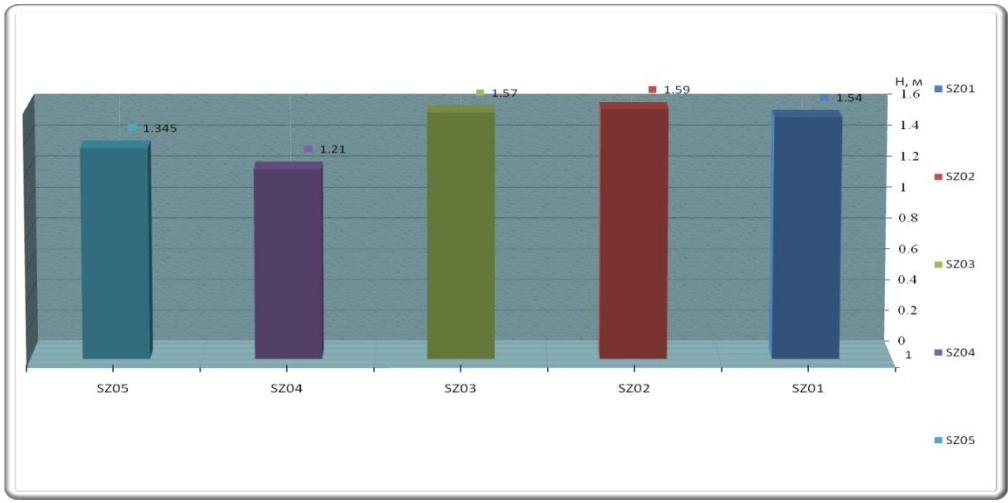
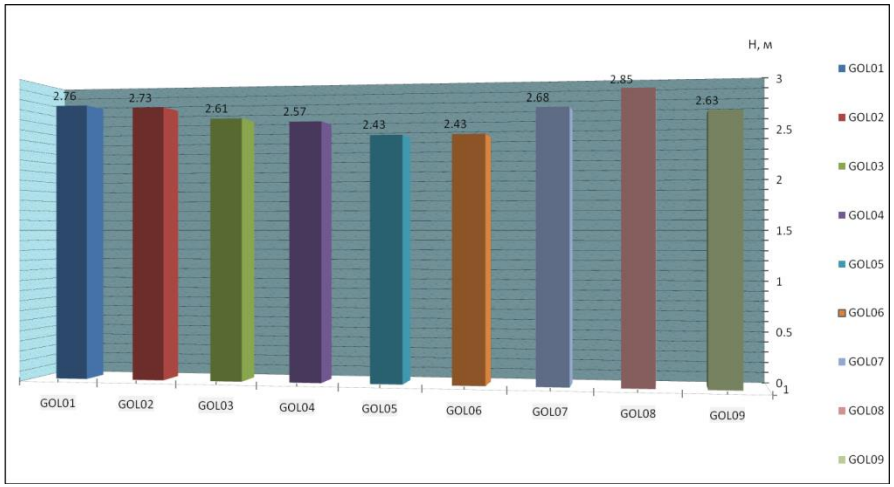


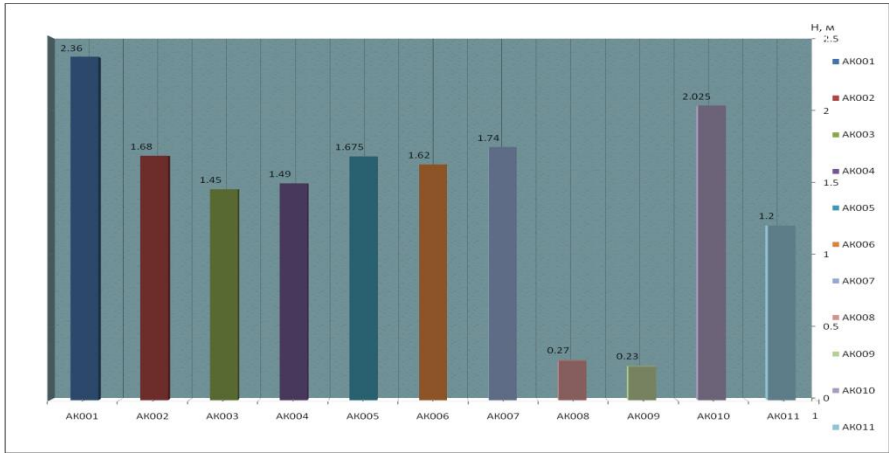
Diagram of ablation values



West Suek glacier

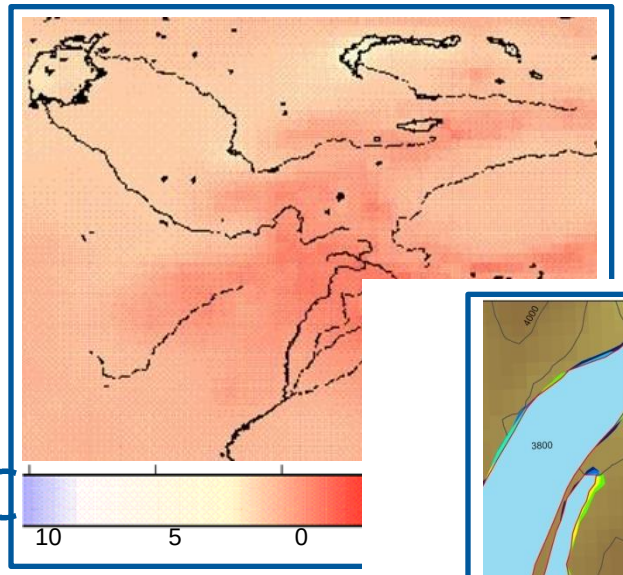


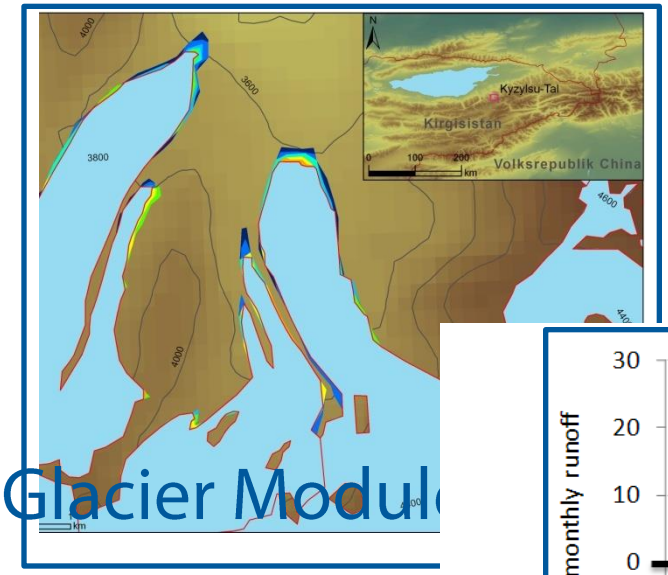
Golubin glacier



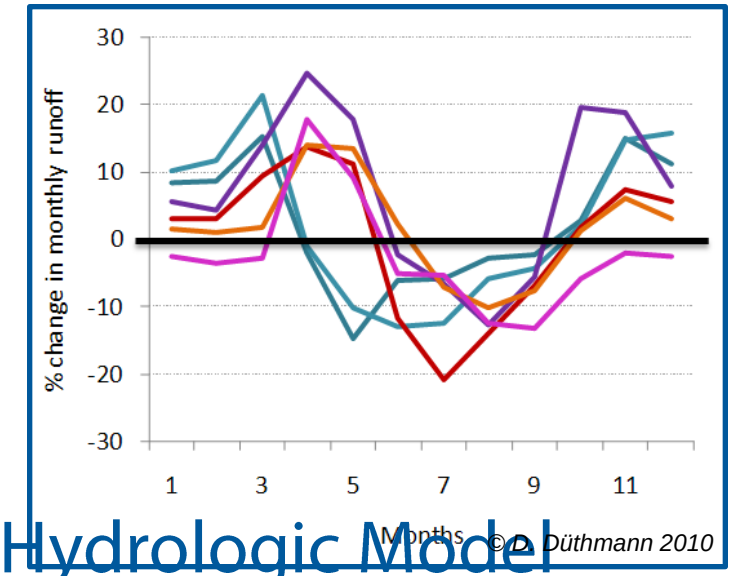
Glacier №354 (Ak-Shiyrak massif)

Approach: chain of models





Glacier Modul



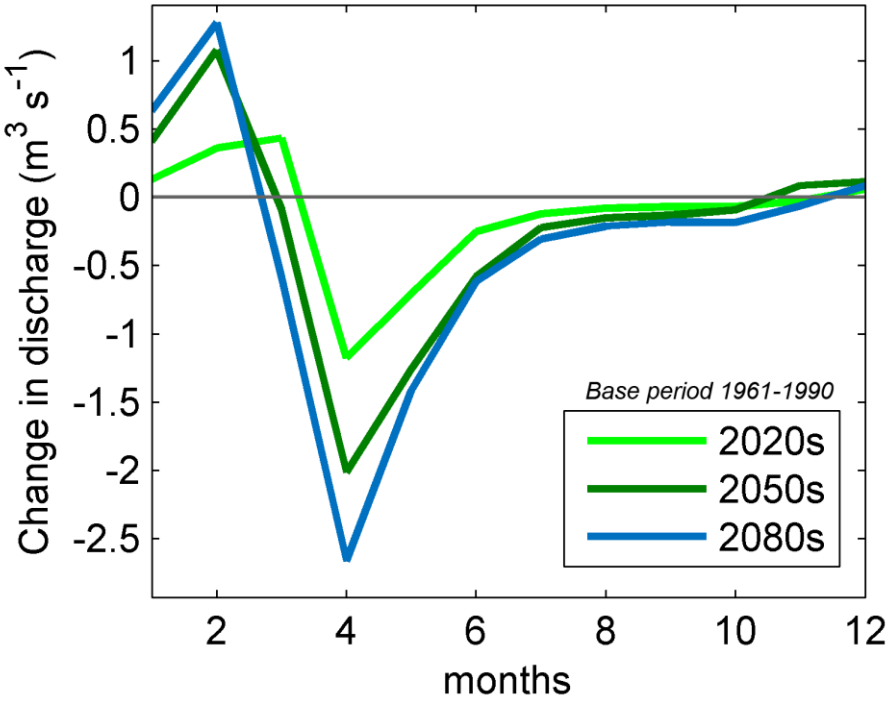
Hydrologic Model

Assessment of future climate change impacts on water resources

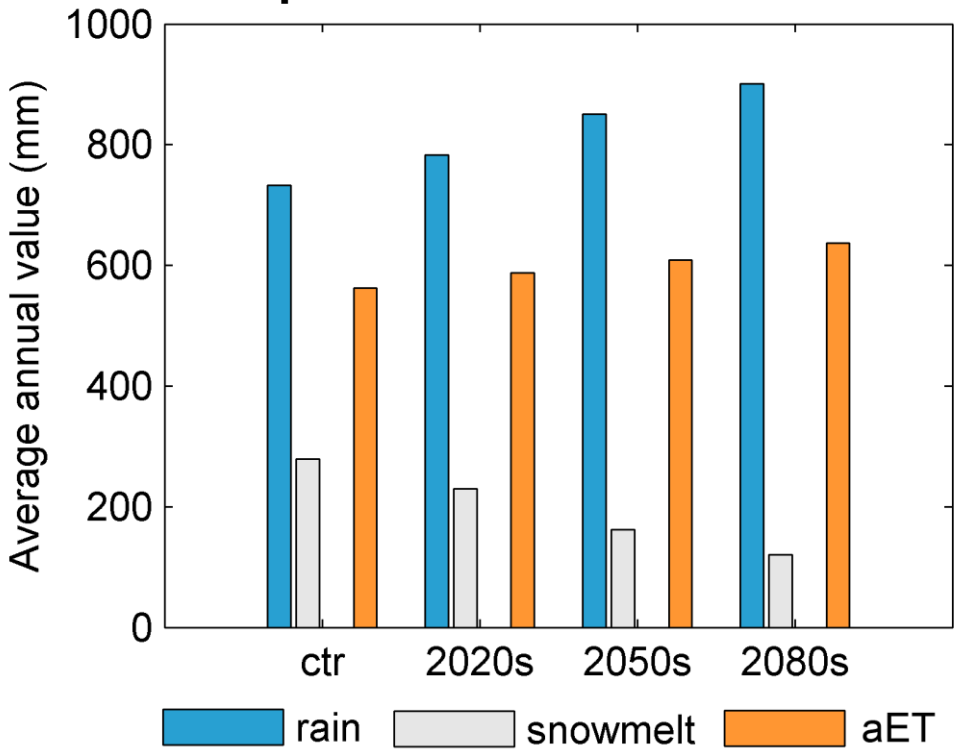
© D. Düthmann 2010

Expected change of river flow

Absolute changes of average monthly discharges



Changes of water balance components

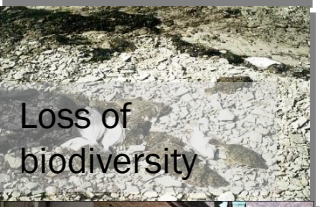


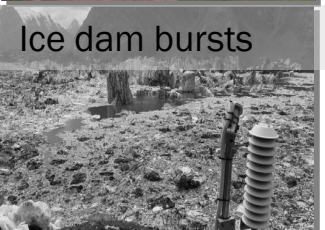
Kara-Daria river basin

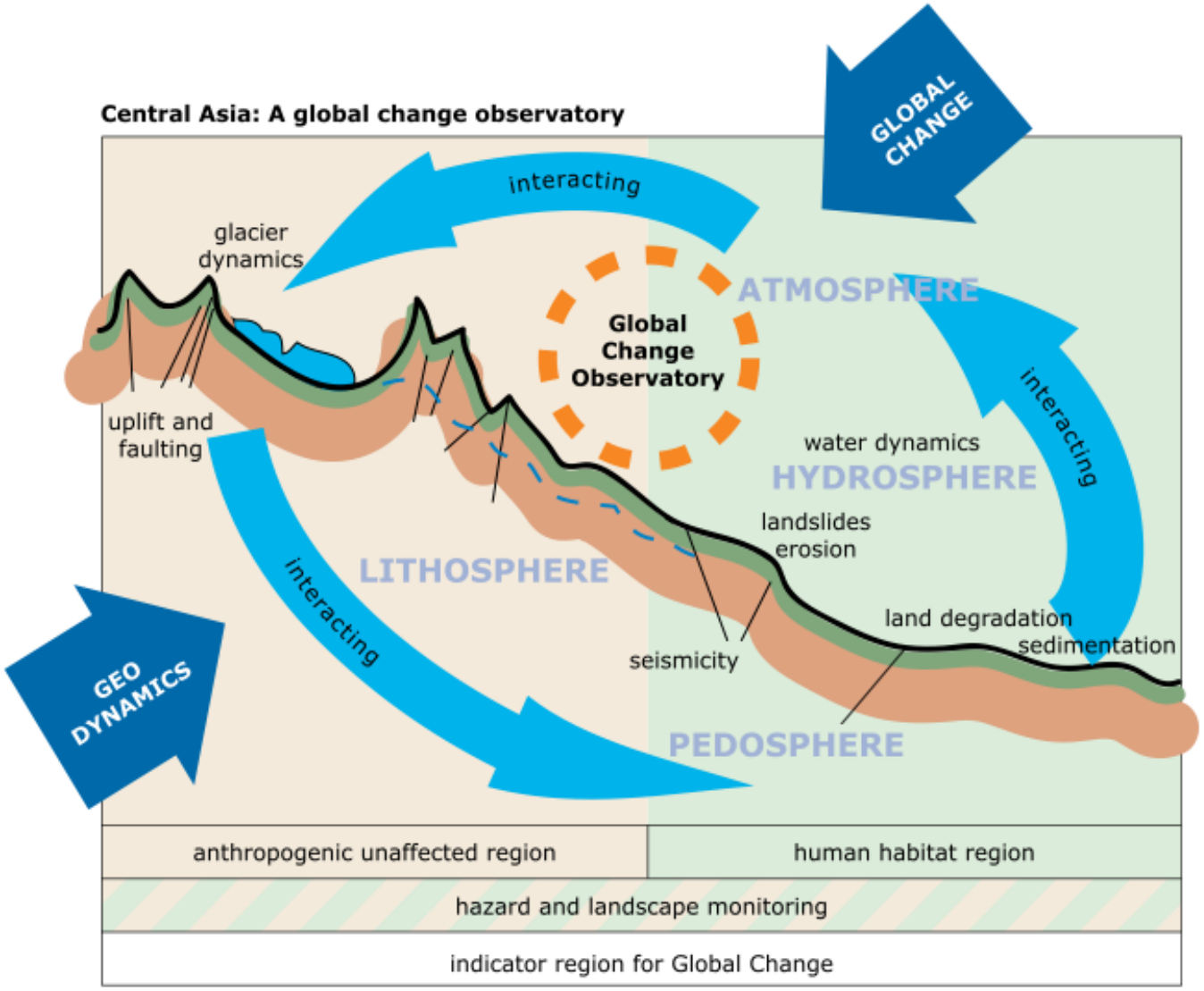
Expected changes of the river flow in the Kara-Daria river basin at the Donguztoo post by climatic scenario A1B (spatial resolution 0,5°) against the reference period of 1961-1990 (GFZ, WASA model)

Düthmann, 2012

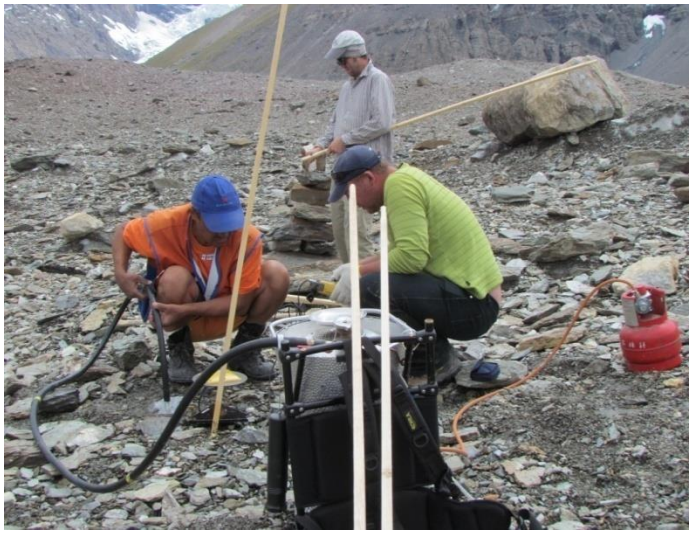
Global Change Observatory

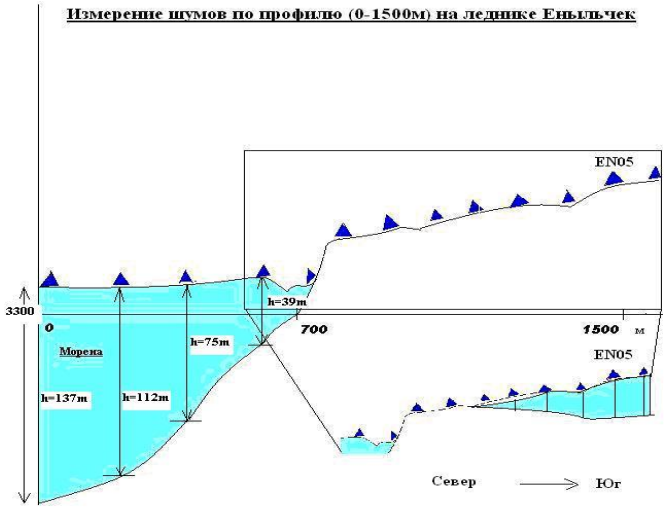






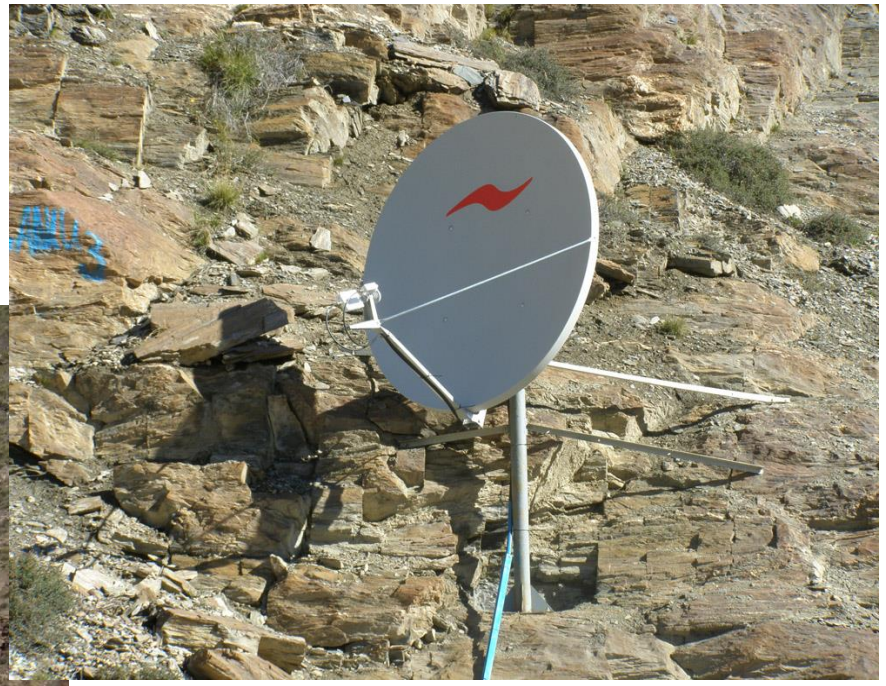
High-elevation geo-research station named after Gottfried Mertzbacher





Infrastructure of the research station

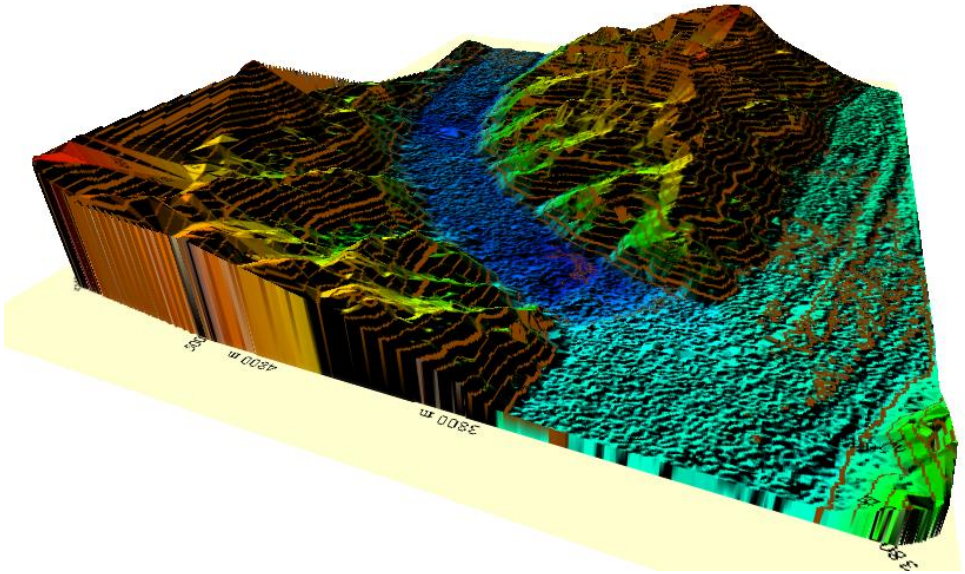
Meteorological, seismic and GPS stations, hydro posts for monitoring the lake dynamics



Data transfer from remote sensors is carried out using modems via satellite channel by VSAT antenna.

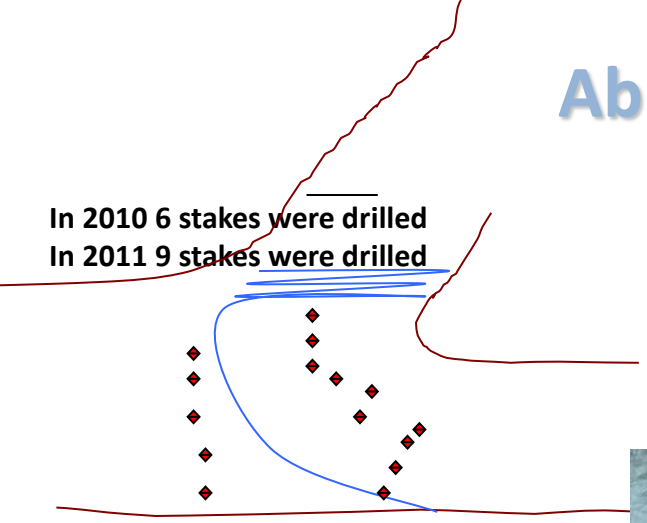
Project “Study of the Inylchek glacier for defining its balance, morphological, dynamic characteristics, as well as climatic and hydrological conditions”

Installation of ablation stakes and ablation measurements



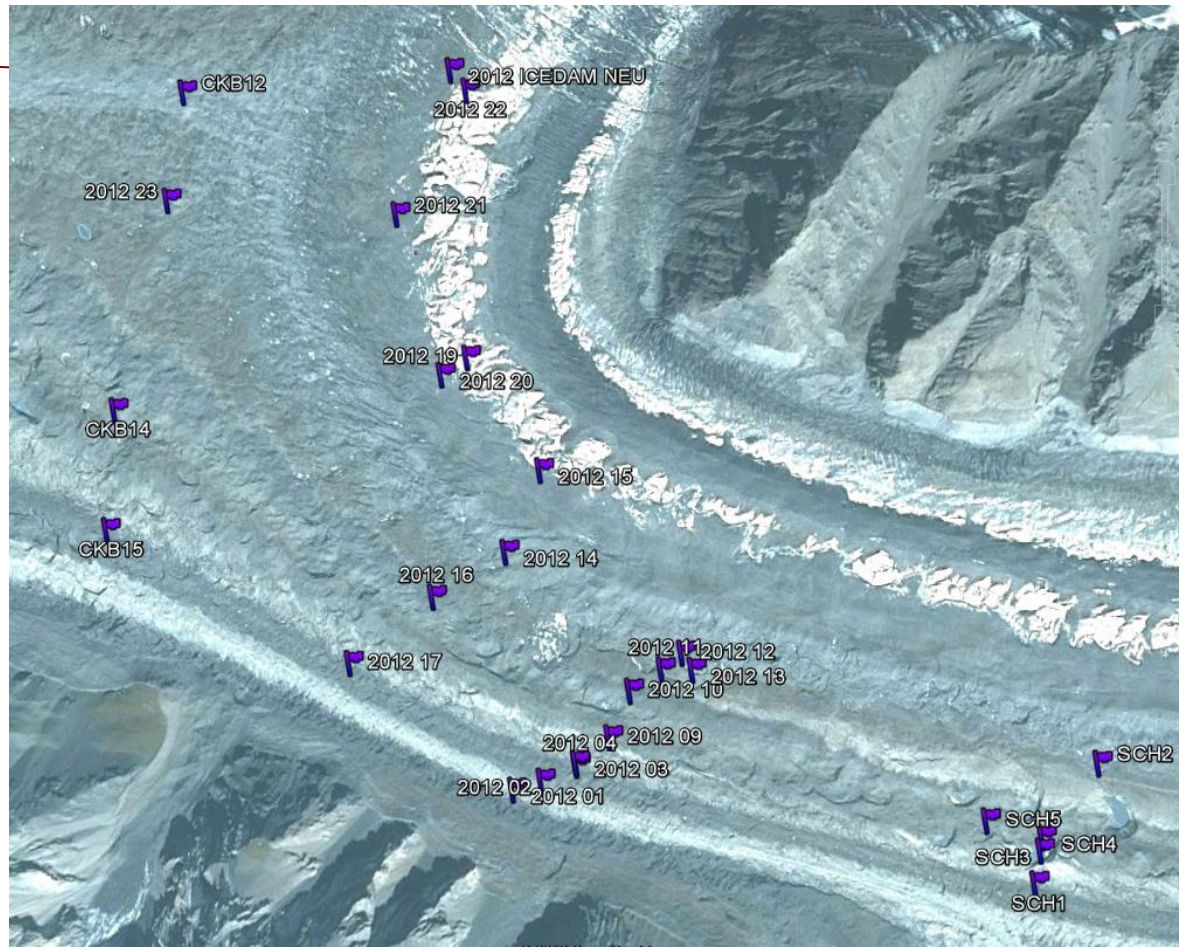
Based on the ALOS/PRISM data of 2006, after the lake outburst the DEM was built according to which contours of the terrain were generated.

Ablation stakes on Southern Enilchek glacier

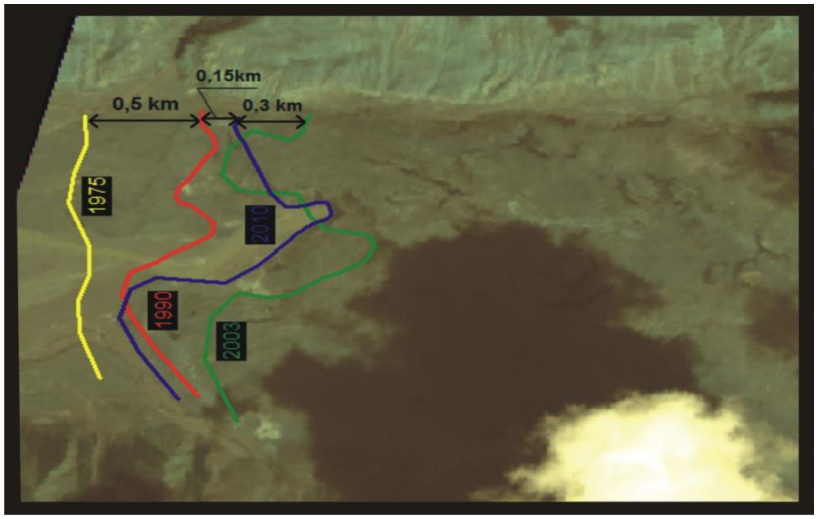


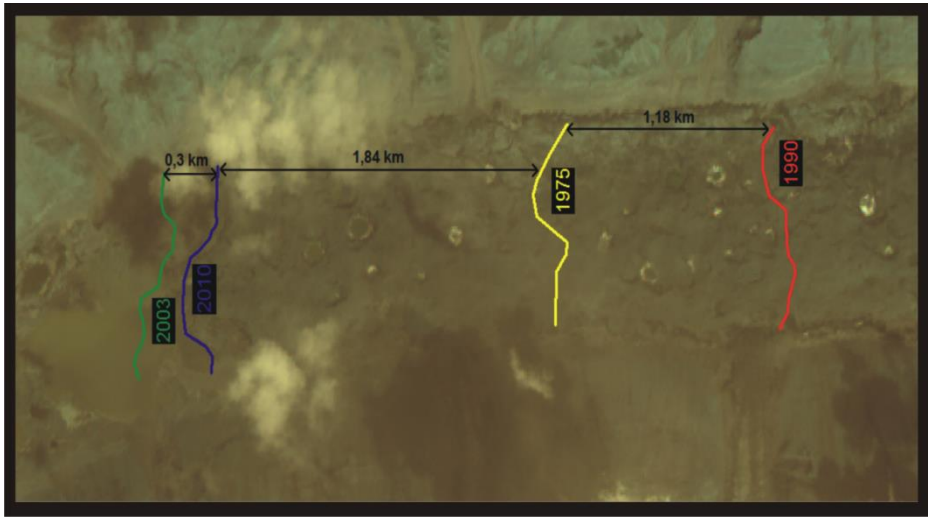
In 2010 6 stakes were drilled
In 2011 9 stakes were drilled

Ablation stakes of 2012



Speed of surface motion and retreat of glacier snouts of western and southern Enilchek



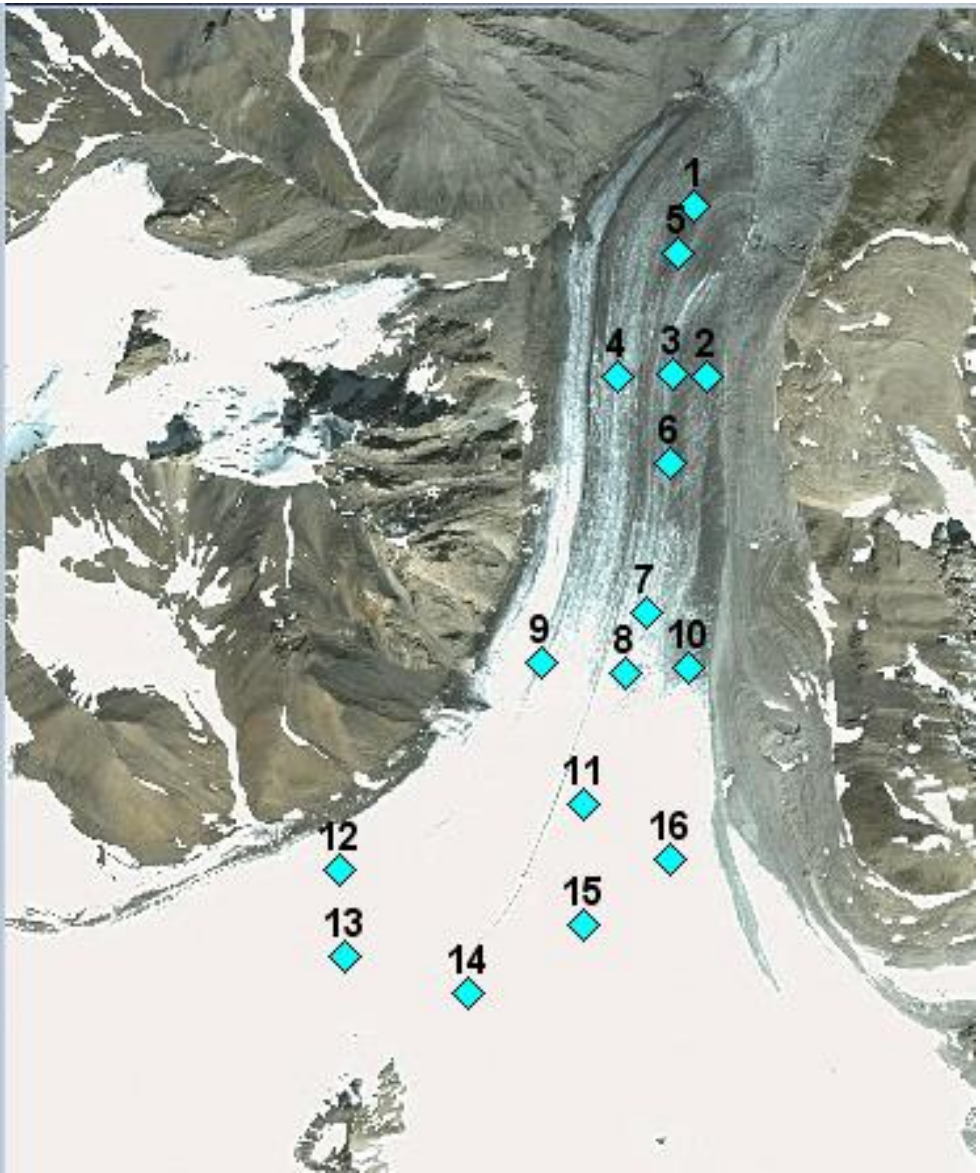


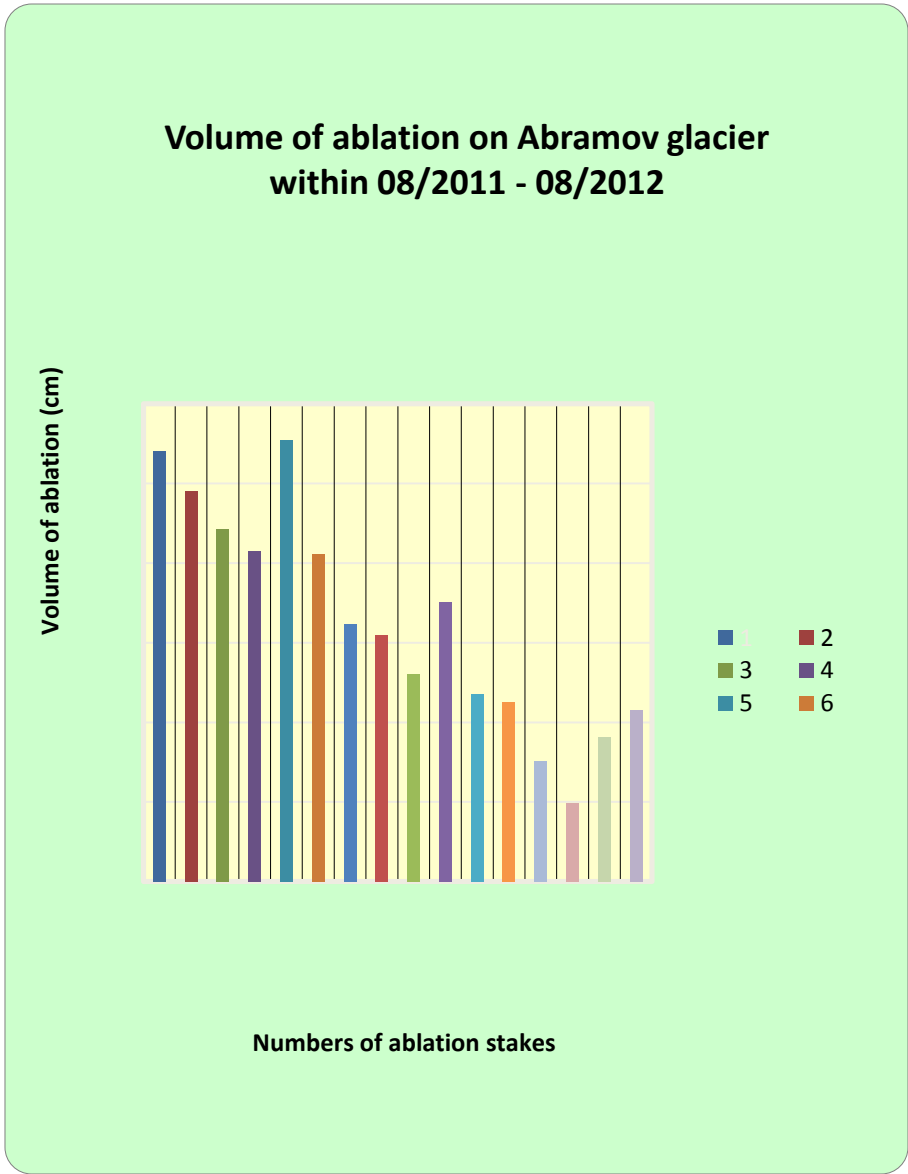
Sary-Djaz river basin

Glacier number and area changes in the SJR1990-2010

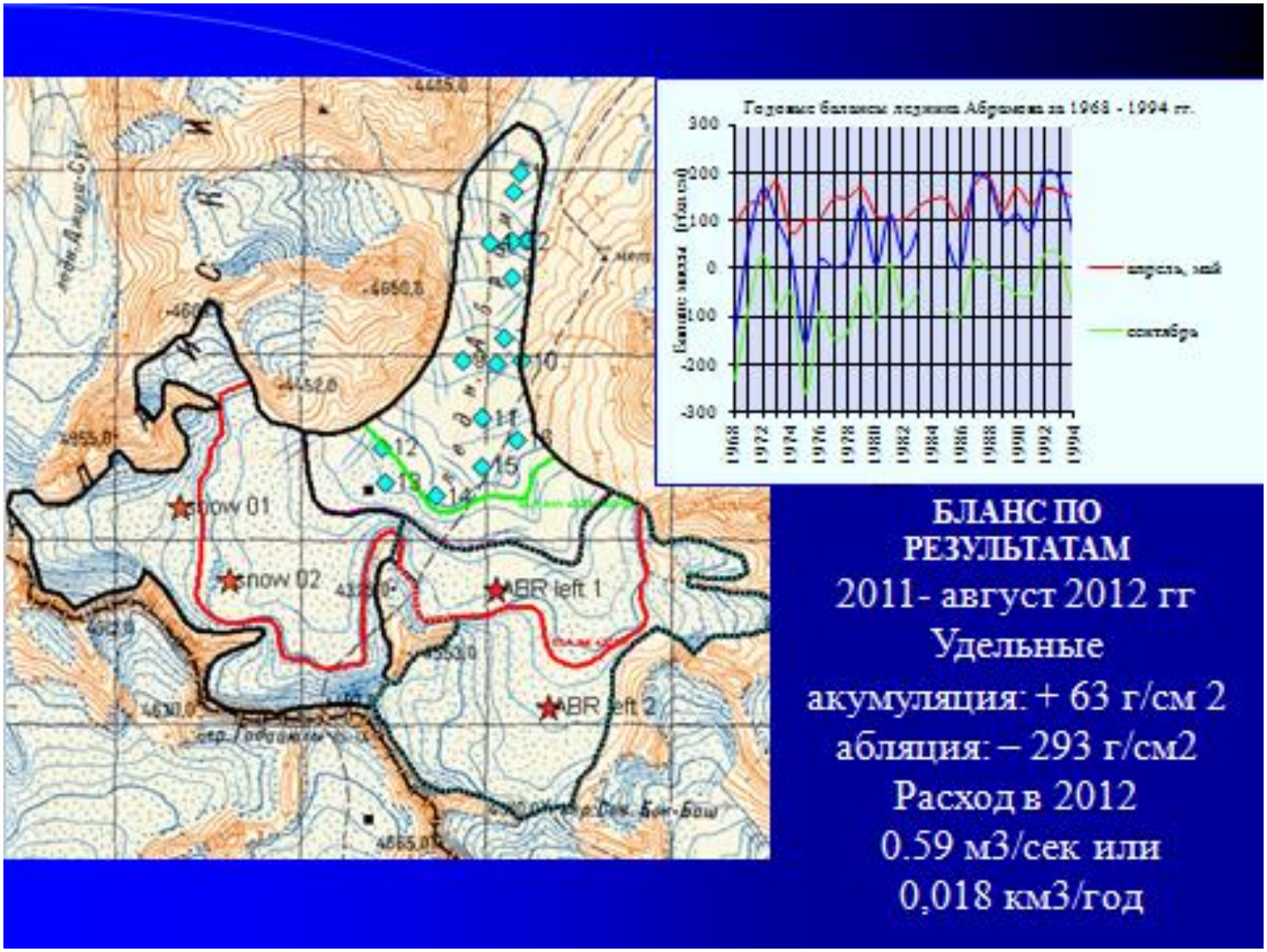
Region	River sub-basins	Area of region, km^2	Count	Glaciers area, km^2		Glaciers area change (1990-2010)	
				1990	2010	Abs. (km^2)	Rel. (%)
North	Koiluu, Upper stream of the Sary-Jaz	2818.9	348	487.4±9.7	455.8±9.1	-31.6±13.4	6.5±2.7
East	Inilchek, Kaiyngdy	2329.8	318	926.8±18.5	912.8±18.3	-14.0±26.0	1.5±2.7
South	Below-Jangart, Jangart, Jaman-Suu, Taldy-Bulak, Uch-Chat, Koikap	1662.9	146	130.1±2.6	124.1±2.5	-6.0±3.6	3.4±2.7
West	Ak-Shyirak, Uch-Kol, Terekti, Kichi-Terekti	4389.8	498	510.7±10.2	485.2±9.7	-25.5±14.1	5.0±2.7
Total		11201.4	1310	2055±41.1	1977.9±39.6	-77.1±57.0	3.7±2.7

Abramov glacier monitoring

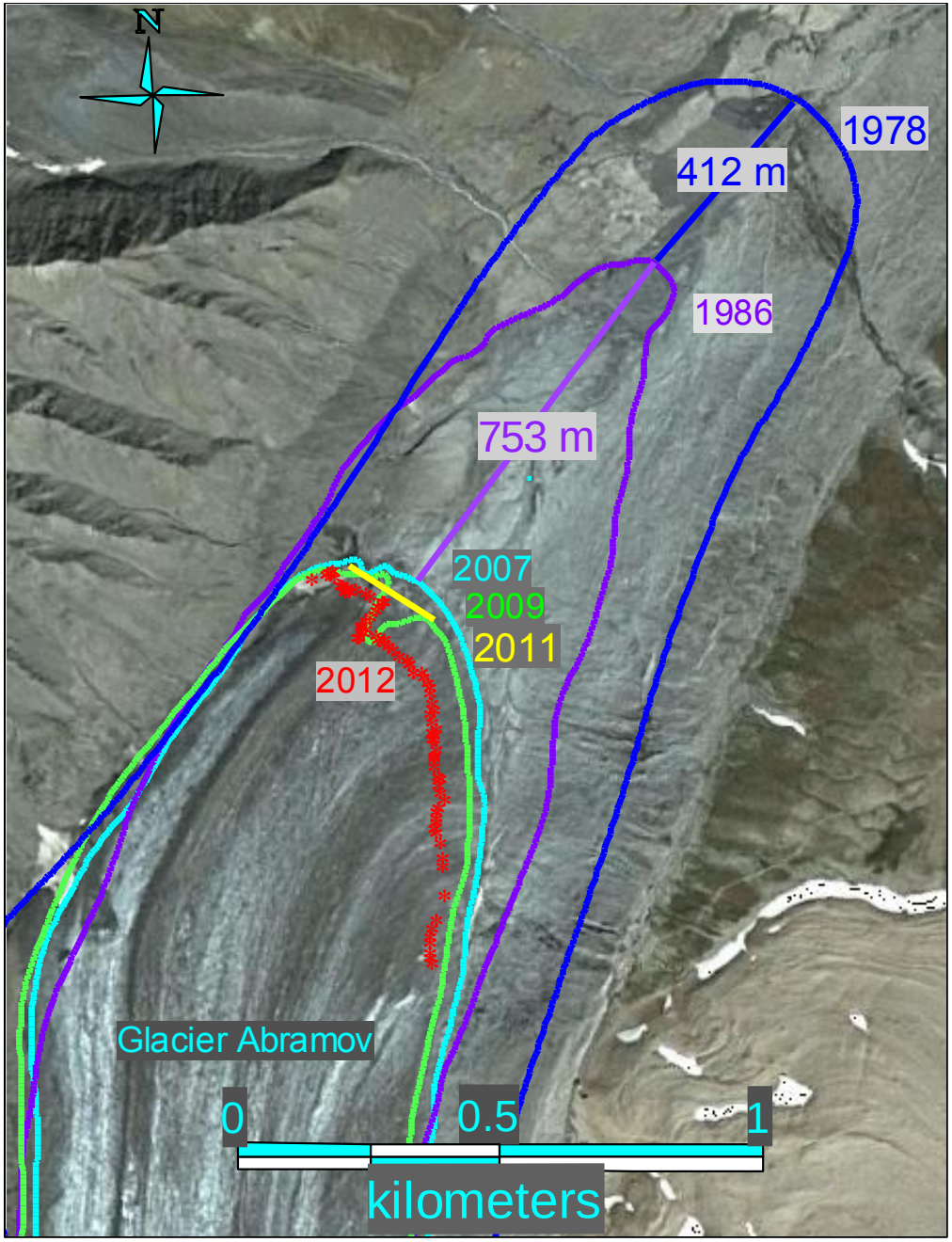




Balance by results for 2011 – Aug 2012
Accumulation: +63g/cm2, ablation: - 293 g/cm2
Discharge (ablation) in 2012: 0.59 m3/sec or 0,018 km3/year



1850-1900 = 0,014 sq.km/year
1900-1936 = 0,013 “Abramov glacier regime”
1936-1967 = 0,027 G.Glazyrin, G.Kamnianski
1967-1970 = 0,077 F.Pertsiger, 1993.
1970-1973 = +0,18
1973-1974 = +0,007
1974-1984 = 0,024
1978-1986 = 0.064 CAIAG
1986-2007 = 0,018
2007-2012 = 0,014



Glaciation changes

Mountain range	Area in 1970s [km²]	Relative loss of area [%]
Akshiyrak	204	13
Djetim	532	34
Borkoldoi mountain	234	19
Nijniy Naryn	83	10
At-Bashi	151	15

Naryn river basin

Changes of glaciation area of upper river of Naryn from 1970s to mid 2000. Average changes make 23%.

Conclusions:

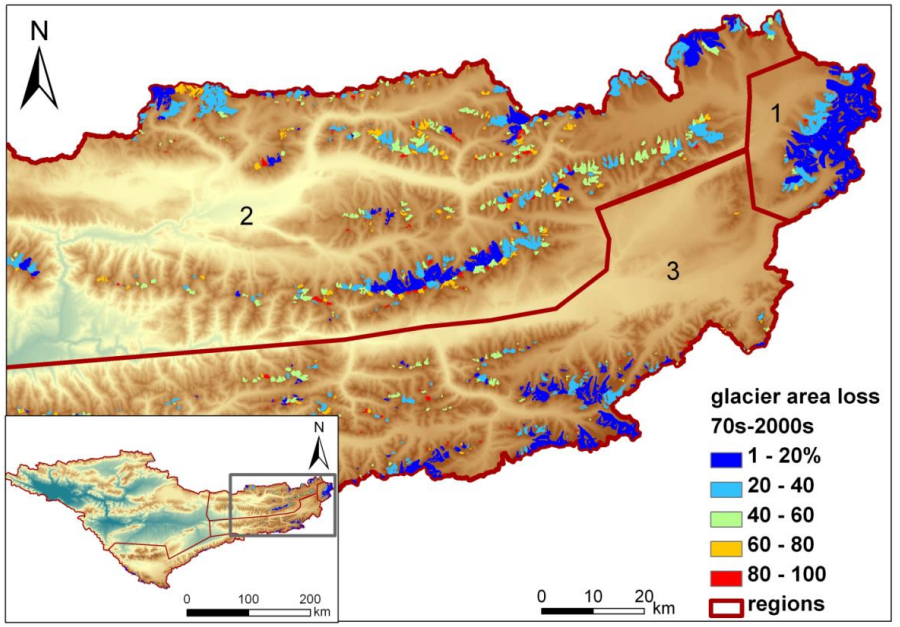
⇨ Big losses of area for small glaciers

⇨ Disruption of lower parts of large glaciers

⇨ Occurrence of big losses on the southern slopes

⇨ Increase of glacial retreat rate in the period of 1970-1990.

Kriegel et al., submitted



Monitoring of atmospheric dust

Tasks of the station:
- study of meteorological parameters and dust particle concentration in the atmosphere for 30 gradations of particle sizes which are regularly measured in 1 minute time interval.
- collection of mineral aerosols, particles of which is over 2 micrometers in size for further mineralogical, chemical and isotopic research.

CAIAG monitoring network of stations

CAWa: Meteo+GNSS
+ VSAT
- BAYT (Baytik)

GCO: Meteo + GNSS
+ VSAT
- MRZ1 (Merzbacher)

GNSS:
- KRGT (Kerege-Tash) + EDGE
- KRBK (Kara-Batkak) + EDGE
- TKUM (Tash-Komur) + EDGE
- ARSL (Arslanbob)
- BIS2 (Bishkek; GFZ & CAIAG station)

Smart (VSAT+seismo
+ meteo + GNSS):
- TARA (Taragai)
- ENEL (Enelchek)
- ASAI (Aksai)

Сейсмологич:
(Network
Caremon):
- SUFI (Sufikurgan)

Monitoring network stations

➡ **appropriate for highland areas**

- ✓ Automatic
- ✓ Hi tech
- ✓ Easy to maintain
- ✓ Autonomous system of power supply
- ✓ Power supply management
- ✓ Data transfer in real time mode
- ✓ Remote control
- ✓ Different sensors

Kokomeren

Abramov glacier

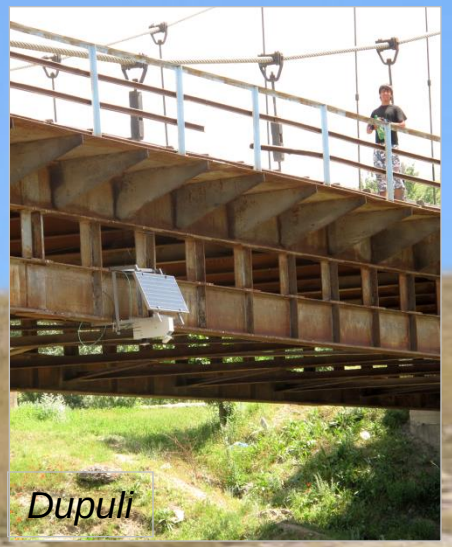
Hydro-meteorological sensors

Meteorological sensors:

- ✓ Air temperature
- ✓ Air humidity
- ✓ Atmospheric pressure
- ✓ Wind speed and direction
- ✓ Precipitations
- ✓ Solar radiation / radiation balance
- ✓ Soil temperature

Hydrological sensors:

- ✓ Water level
- ✓ River flow
- ✓ Depth of snow cover
- ✓ Density of snow cover
- ✓ Water equivalent of snow cover
- ✓ Water content in soil



Dupuli

Taragai


Thank you
for your attention!