M&M Kłapa RESEARCH STATION

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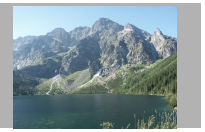
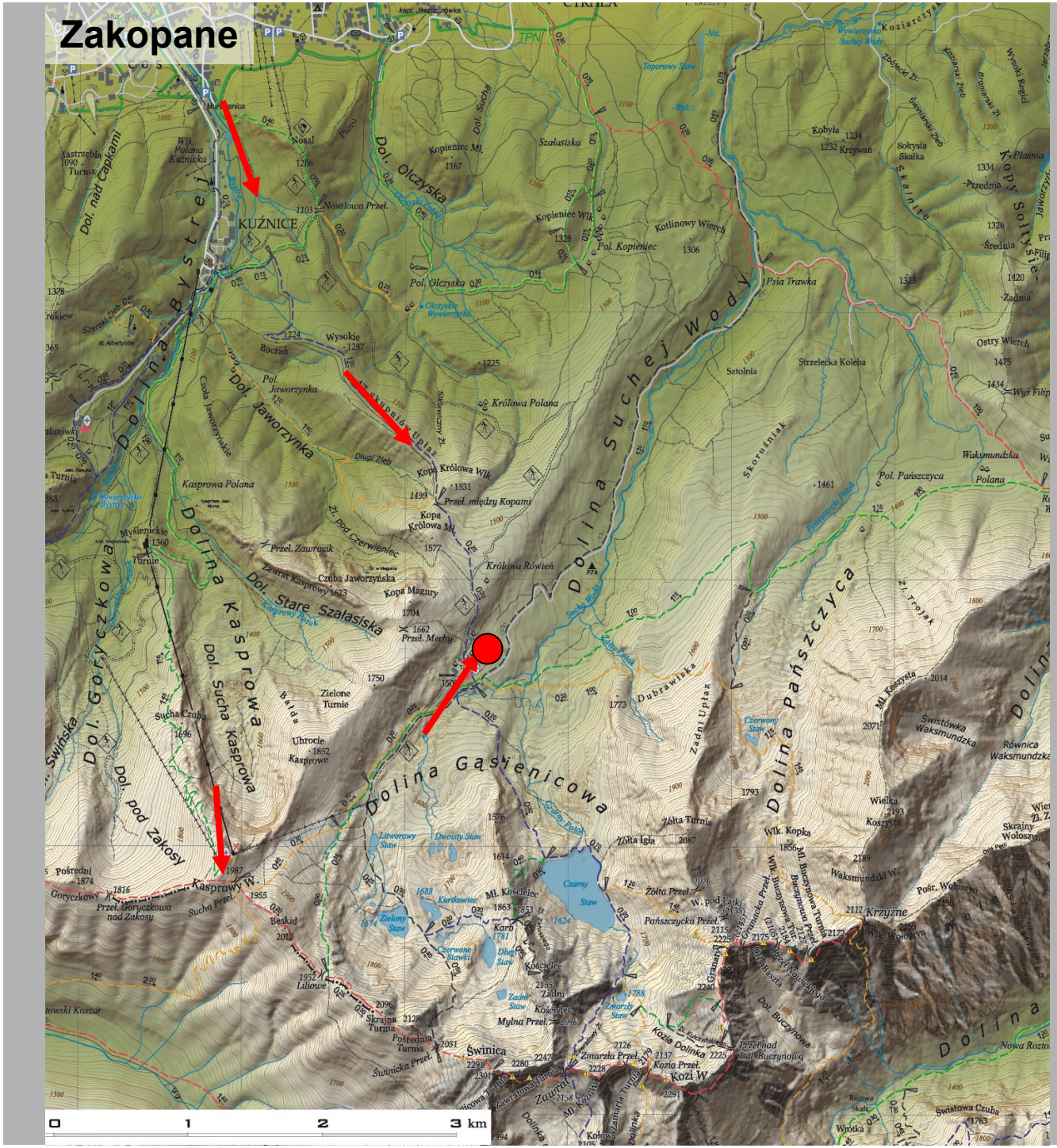
Gerlachovský štít 2655 m a.s.l., area: 808 km^2, Tatra National Park





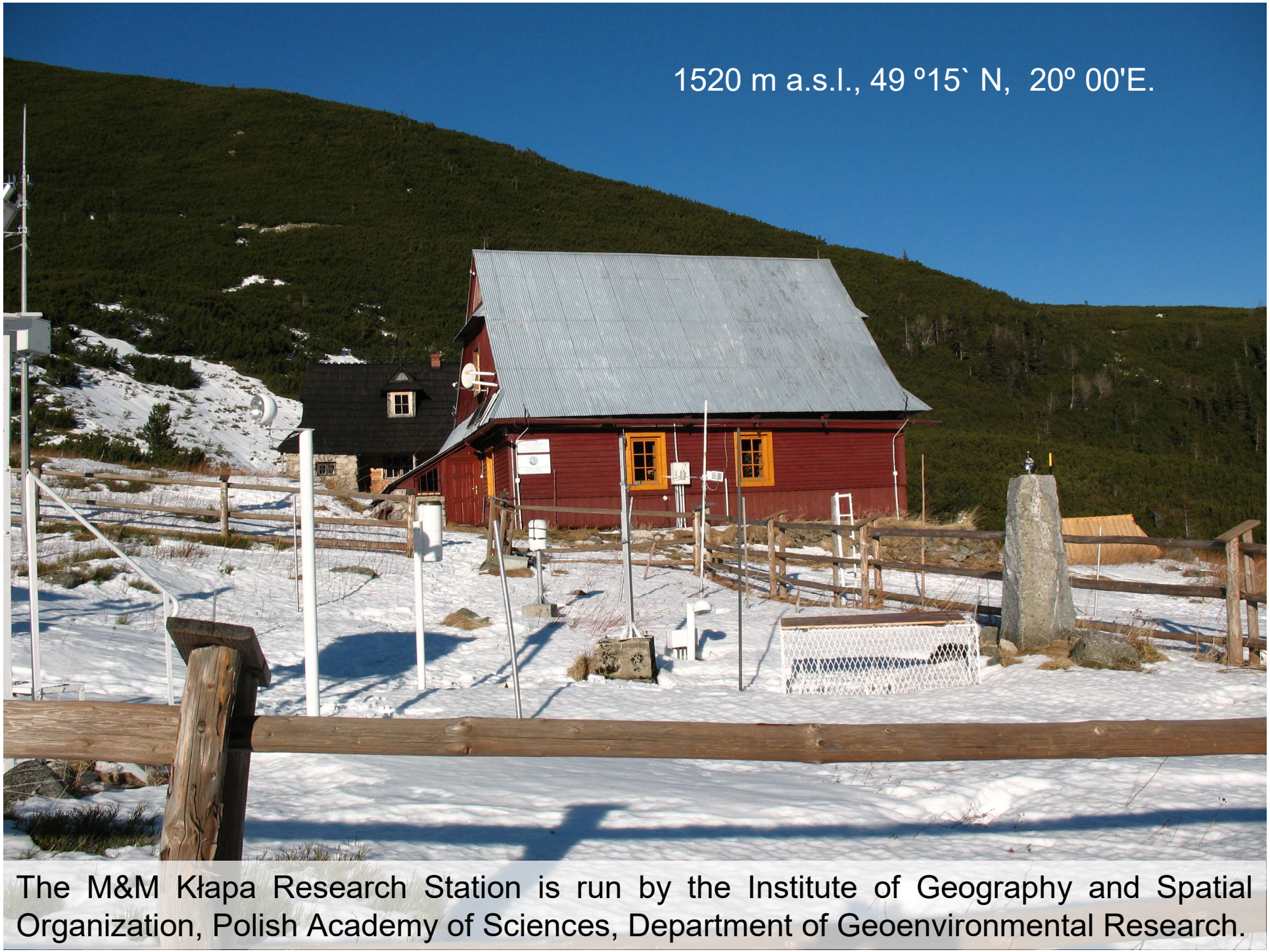
Sucha Woda Valley

Hala Gąsienicowa


2301 m a.s.l.
walking up

walking down


Beskid Mt., 2012 m a.s.l.
Kasprowy Wierch Mt., 1987 m a.s.l.
path to the Station form cable car

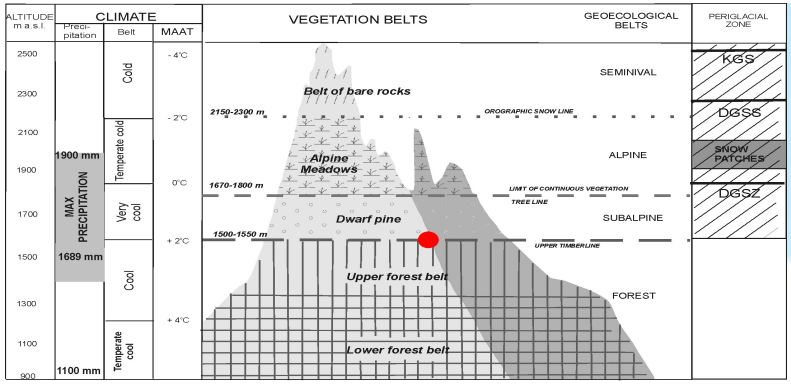


The M&M Kłapa Research Station is run by the Institute of Geography and Spatial Organization, Polish Academy of Sciences, Department of Geoenvironmental Research.

The building has central heating, running water, electric charge.

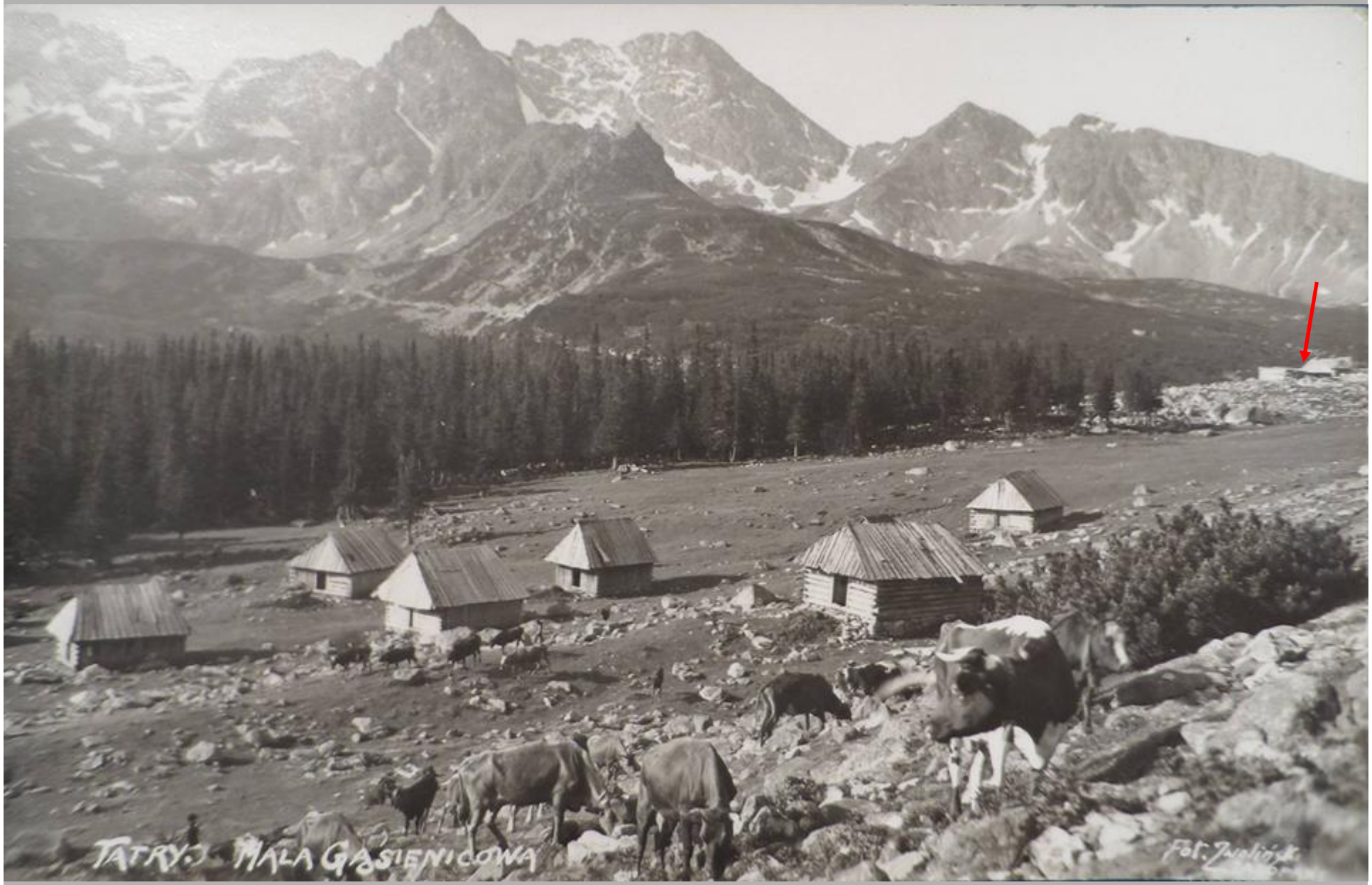
The station is 3 rooms, equipped kitchen, pantry, bathroom, magazines.

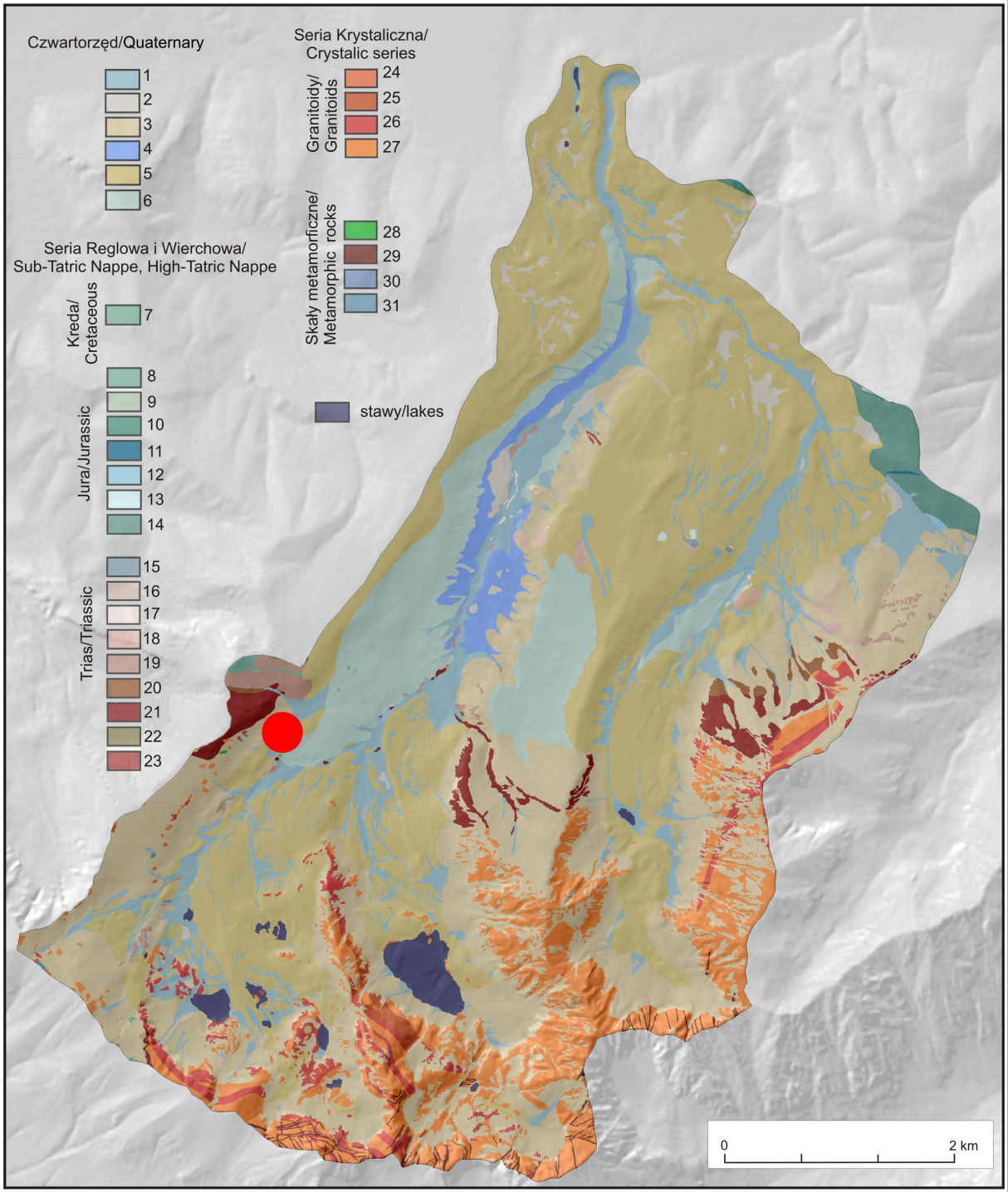
Present facilities include internet access, library, portable measuring instruments.



After A. Kotarba (1976) and T. Gerlach (1966), modified (Rączkowska 2008)

The station is located at the upper timberline, the lower limit of periglacial climatic zone. Average annual temperature is approximately 2.4 ºC. Annual precipitation total is 1666 mm, and varies in particular years from 1043 mm to 2626 mm. The vegetation varies from coniferous forest in forest zone, trough *Pinus mugo* shrubs in subalpine zone, alpine meadows in alpine zone and bare rocks in subnival zone.

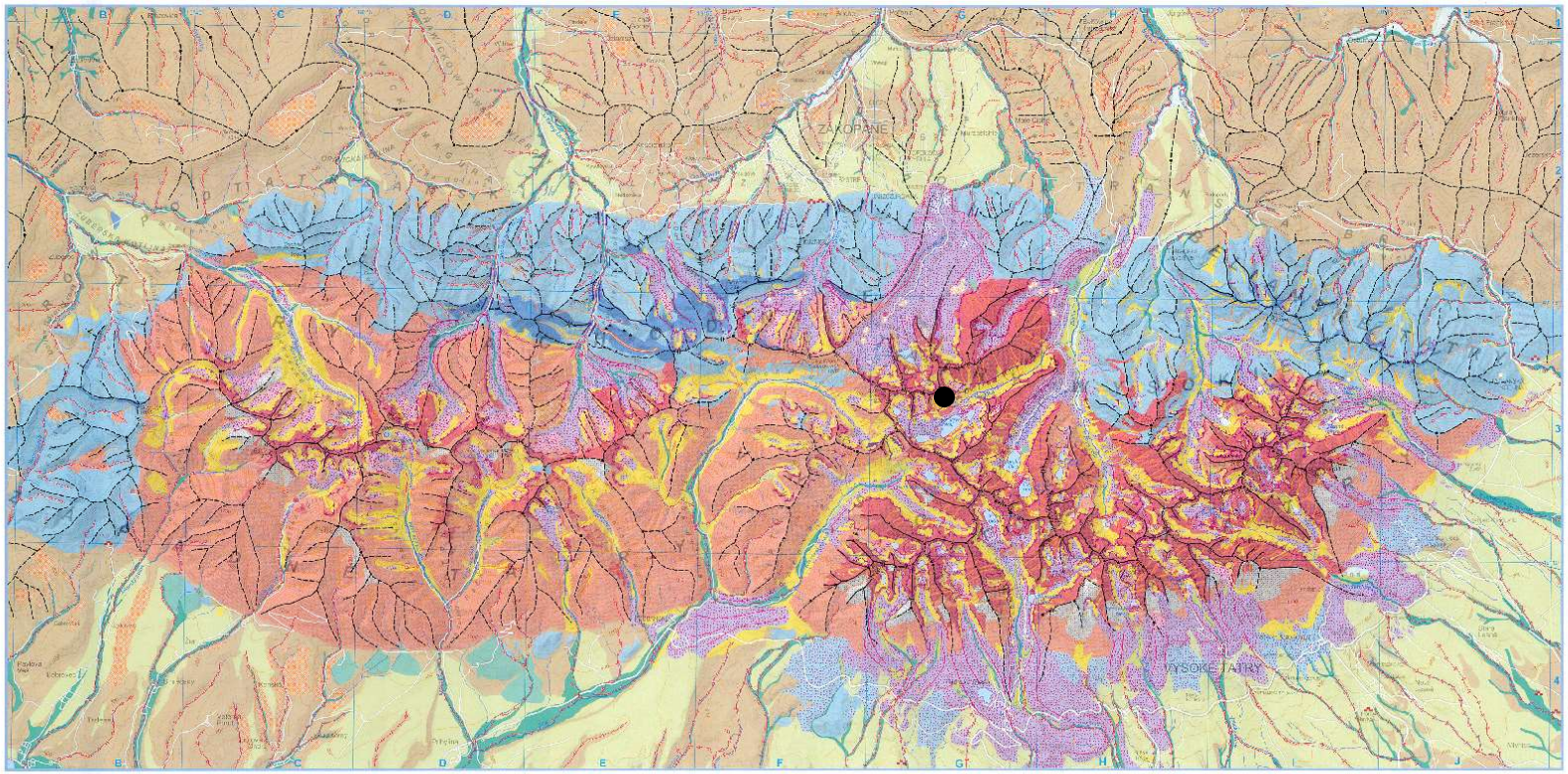

TATRY. MAŁA GĄSIENICOWA
Fot. Zwoliński



The Sucha Woda Valley – Geology. Explanations: 1 – gravel and river sediments, 2 – peat and peat mud deposits, 3 – clay, rubble clay and weathered rocky, 4 – river sediments (Plejstocene/Holocene), 5 – moraine cover, 6 – fluvioglacial sediments, 7 – white limestone and dark gray limestones, 8 – pink and red limestones, 9 - dark gray limestones and marls, 10 – matt black sandstones with black sandstones, 11 – dark gray sandstones with limestone, 12 – dark gray shale and marls with sandstones and limestone, 13 – marl shale, marls and banded limestones, 14 – quartzite and sandstones, 15 – gray-blue banded limestones, reef limestones, 16 – red and green shales, sandstones, conglomerates and unseparated dolomites, 17 – dolomites, dark and light gray banded dolomites, 18 – crystalline dolomites, banded dolomites with limestones, 19 – dark gray dolomites and limestones, 20 – red and green clay-slates with sandstones, 21 – quartzites and sandstones with shales, 22 - quartzites and sandstones, red and green clay-slates with dolomites, 23 – banded dolomites with black limestones, 24 – withe aplogranites, 25 – biotite granite, 26 – muscovite and pegmatite granite, 27 - granodiorite, 28 – amphibolite, 29 – mylonite, breccias, 30 – biotite slates, 31 – graphite slates (Guzik et. al. 1959, Guzik, Jaczynowska 1978, Sokołowski, Jaczynowska 1979a, 1979b, 1980, compiled **by M. Długosz**).

1. Rzeźba/ *Reliéf*/ Relief

1:100 000




Fot. 2./ Foto 2./ Photo 2.


Fot. 3./ Foto 3./ Photo 3.


Fot. 4./ Foto 4./ Photo 4.


Fot. 5./ Foto 5./ Photo 5.


Fot. 6./ Foto 6./ Photo 6.

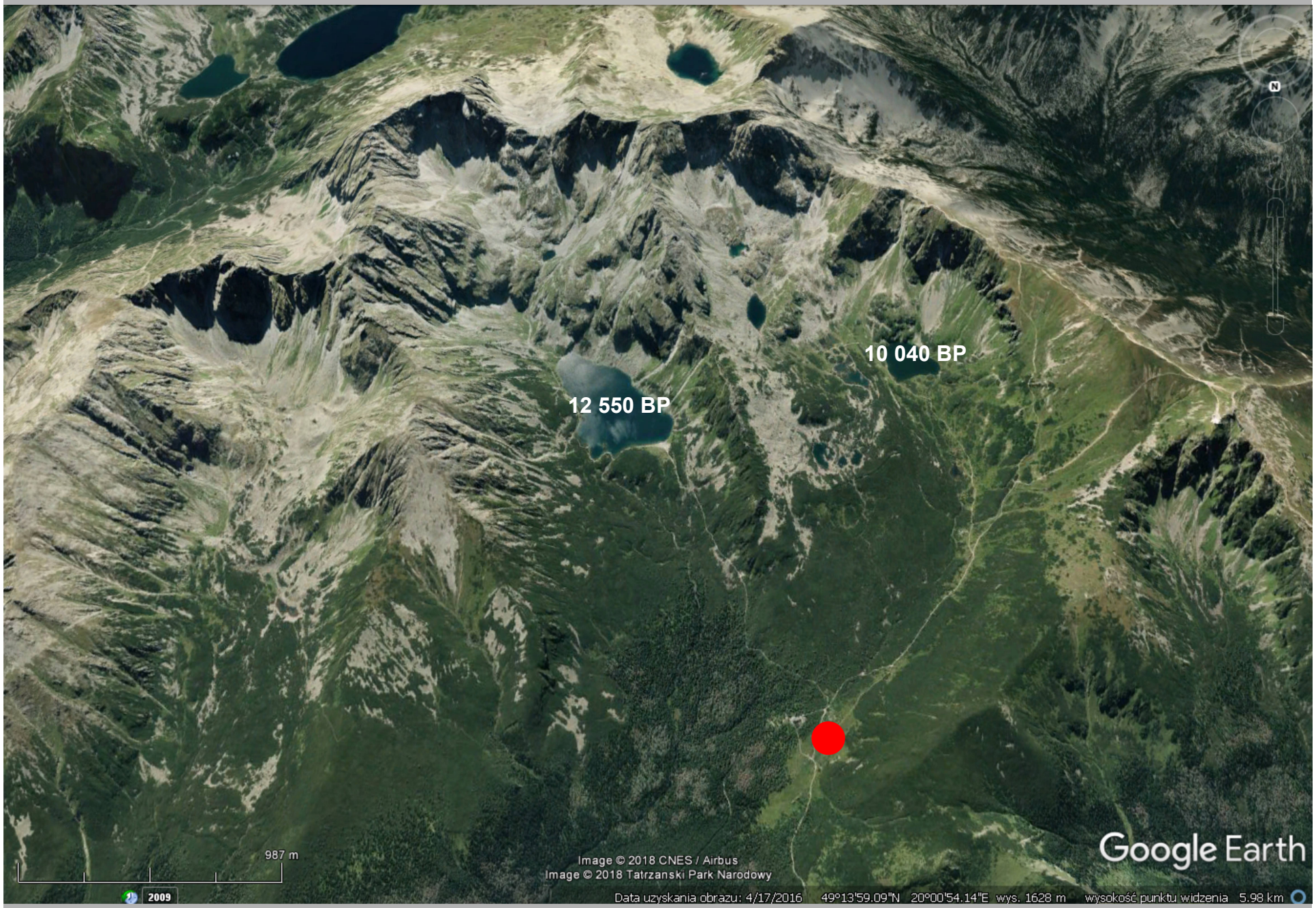

Fot. 7./ Foto 7./ Photo 7.

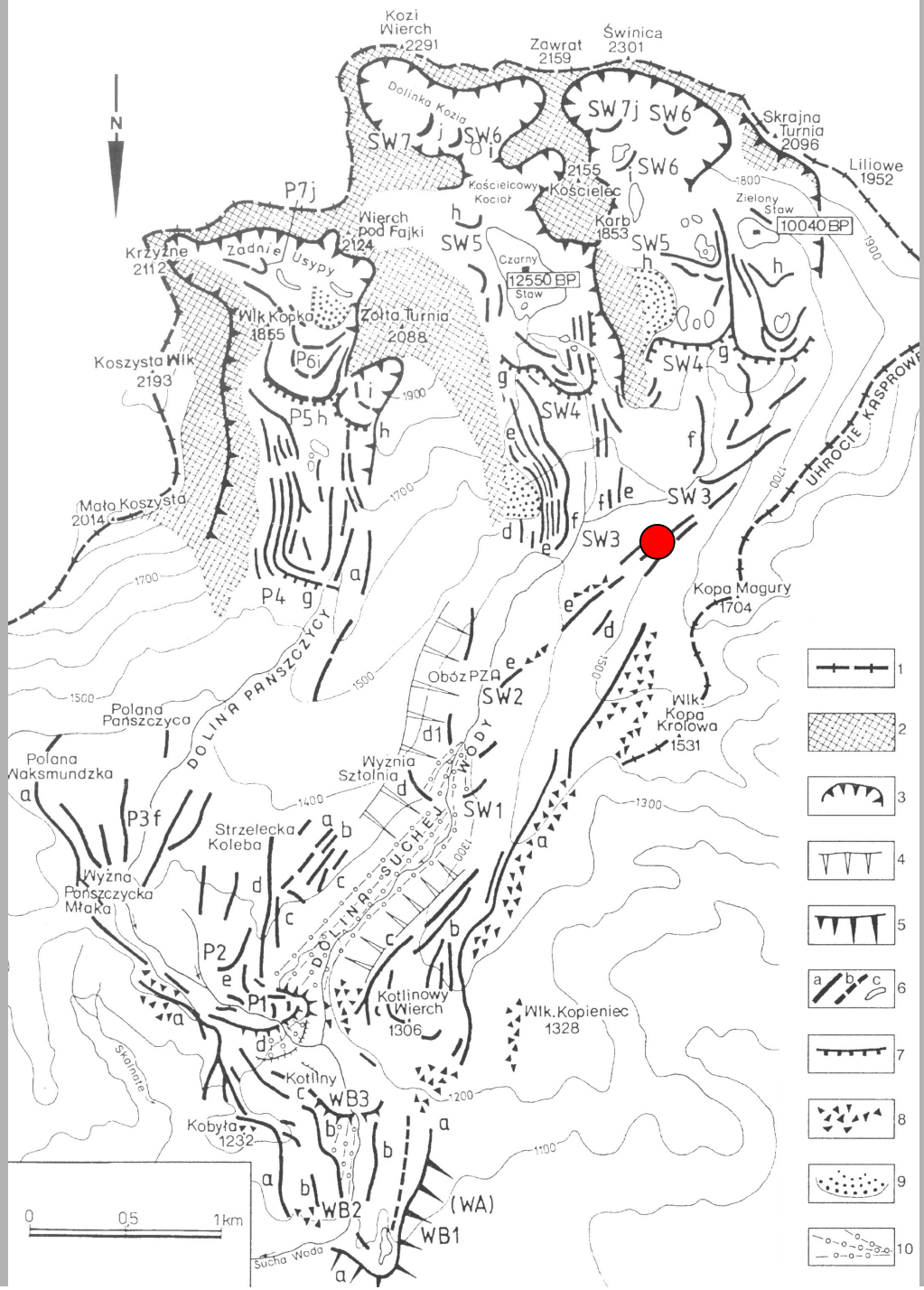

Fot. 8./ Foto 8./ Photo 8.


Fot. 9./ Foto 9./ Photo 9.

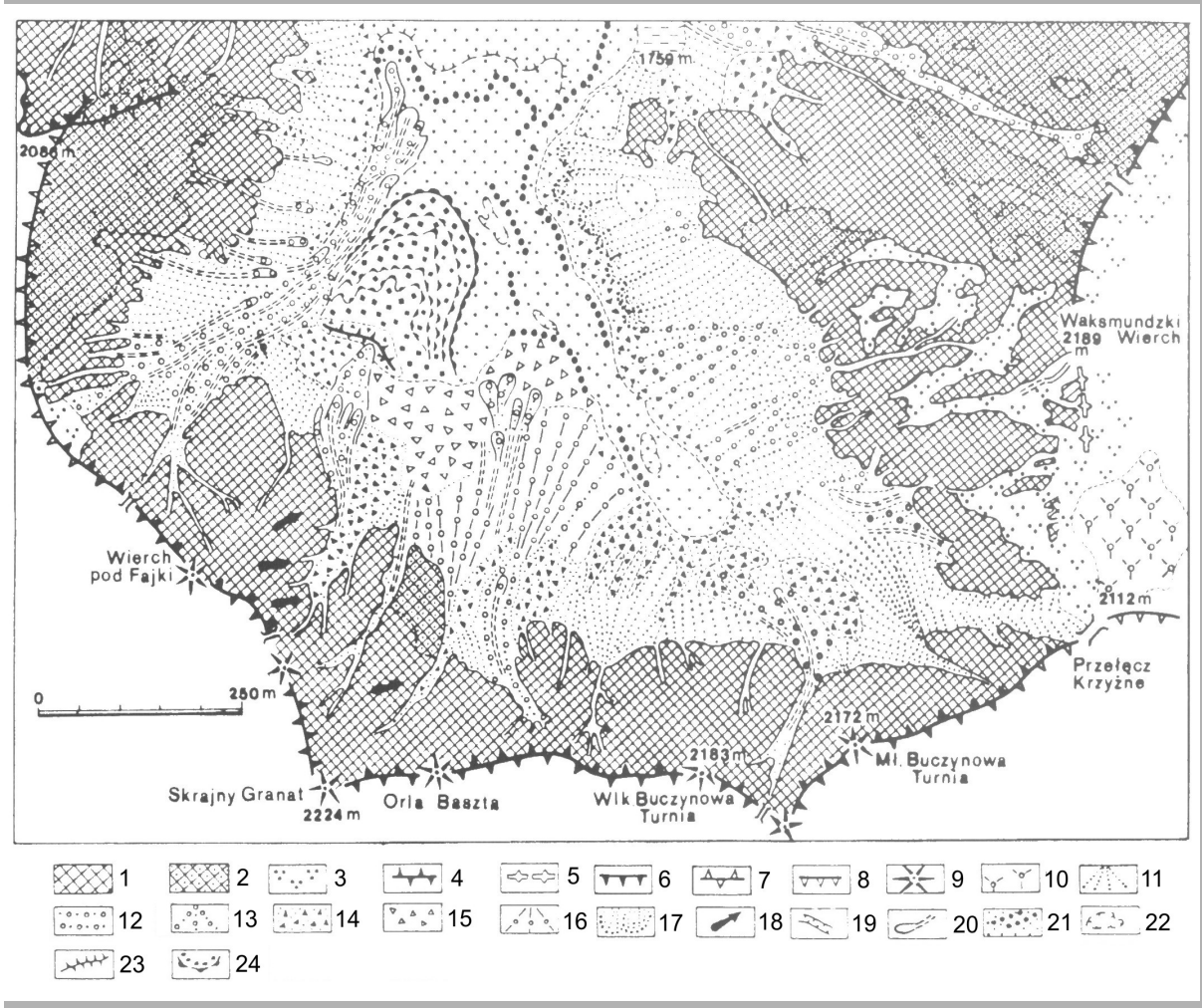

Fot. 10./ Foto 10./ Photo 10.

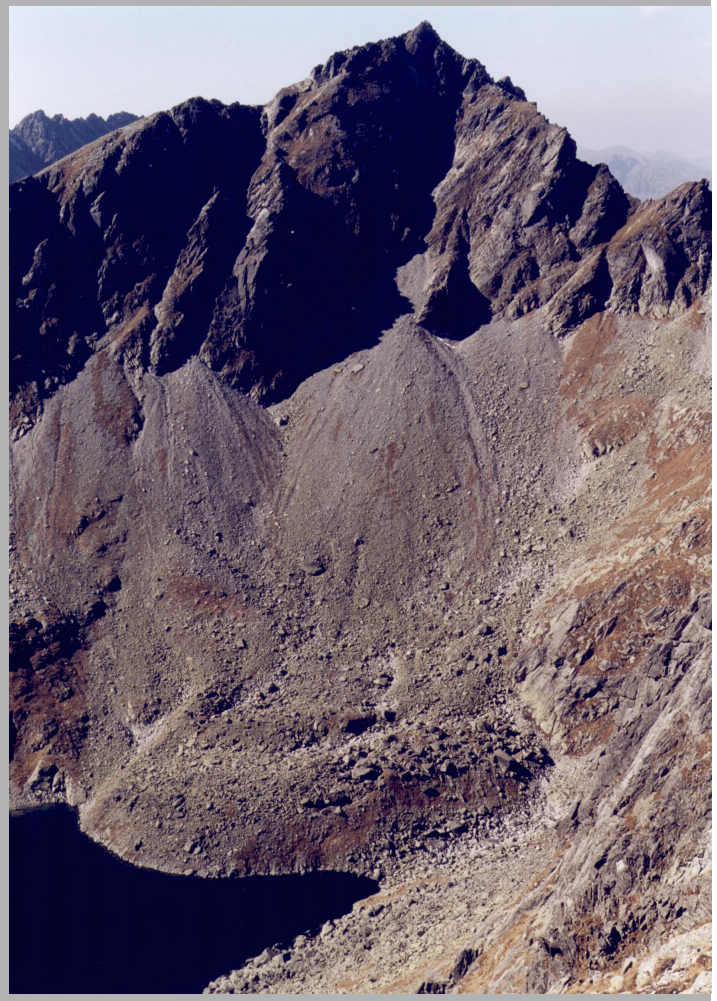
(Rączkowski W., Boltiziar M, Rączkowska Z., 2015)


10 040 BP
12 550 BP
N
987 m
2009
Image © 2018 CNES / Airbus
Image © 2018 Tatrzanski Park Narodowy
Google Earth
Data uzyskania obrazu: 4/17/2016 49°13'59.09"N 20°00'54.14"E wys. 1628 m wysokość punktu widzenia 5.98 km



Postglacial relief of the Sucha Woda and Pańszczyca valleys (after Baumgart-Kotarba, Kotarba 2001). 1 – valley divide, 2 – rockwall/rocky slope, 3 – glacially-steppened rockwall, 4 – steep slope of glacial trough, 5 – steep slope of moraine, 6 – moraine ridge distinct (a), reconstructed (b), postglacial lake (c), 7 – toe of oscillation moraine, 8 – moraine boulder field, 9 – relict rock glacier, 10 – glacio-fluvial fan



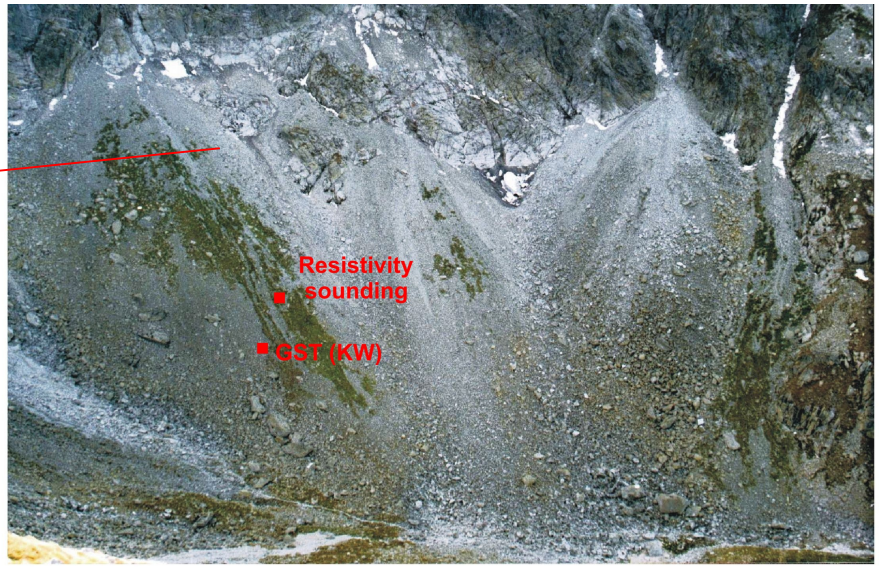


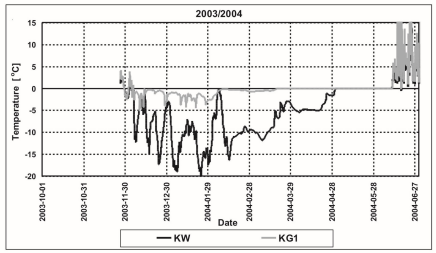
(Kotarba 2002)

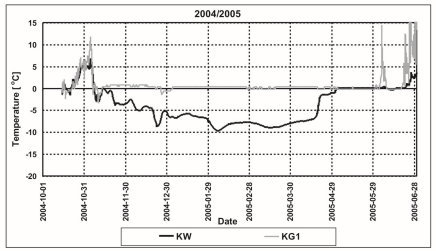
. Geomorphological map of the uppermost part of the Pańszczyca Valley (after Kotarba 1992). 1 – rockwall or rocky slope, 2 – debris-mantled slope, 3 – block slope, 4 – sharp, rocky ridge, 5 – rounded ridge crests, 6 – convex break on rockwall/rocky slope, 7 – narrow rocky ridge crest partly covered by debris and alpine vegetation, 8 –convex rounded break above rockwall or rocky slope, 9 – sharp, rocky summit, 10 – mountaintop detritus with sorted polygons, 11 – rockwall gravity-sorted talus slope, 12 – alluvial talus slope, 13 – alluvial talus cone, 14 – rockslide/rockfall slope (Holocene), 15 – rockslide/rockfall slope related to lateglacial period, 16 – avalanche cone, 17 – rockslide/rockfall slope related to lateglacial period, 18 – rockfall route, 19 – rocky gorge, 20 – debris-flow track, 21 – distinct moraine ridge, 22 – undrained depression within glacial drift deposits, 23 – protalus rampart, 24 – relict rock glacier

Photo 1. Infrared orthophoto map of the Sucha Woda divide, from Świnica Mt to Buczynowe Turnie ridge. The oldest radiocarbon age (BP) of lacustrine deposits in the Zielony Staw Gąsienicowy Lake and Czarny Staw Gąsienicowy Lake. ©www.GoogleEarth.com, Eurosense s.r.o. 2003

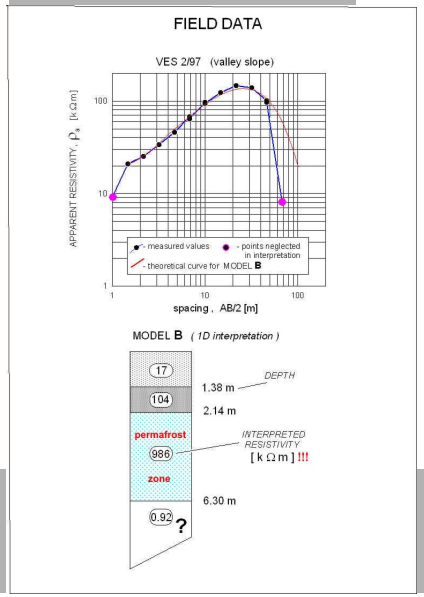
Permafrost

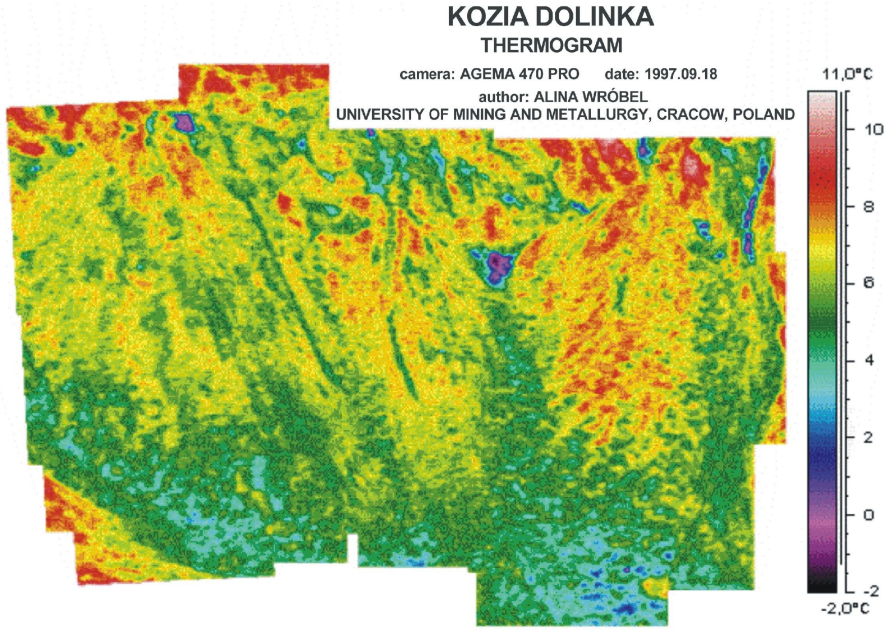


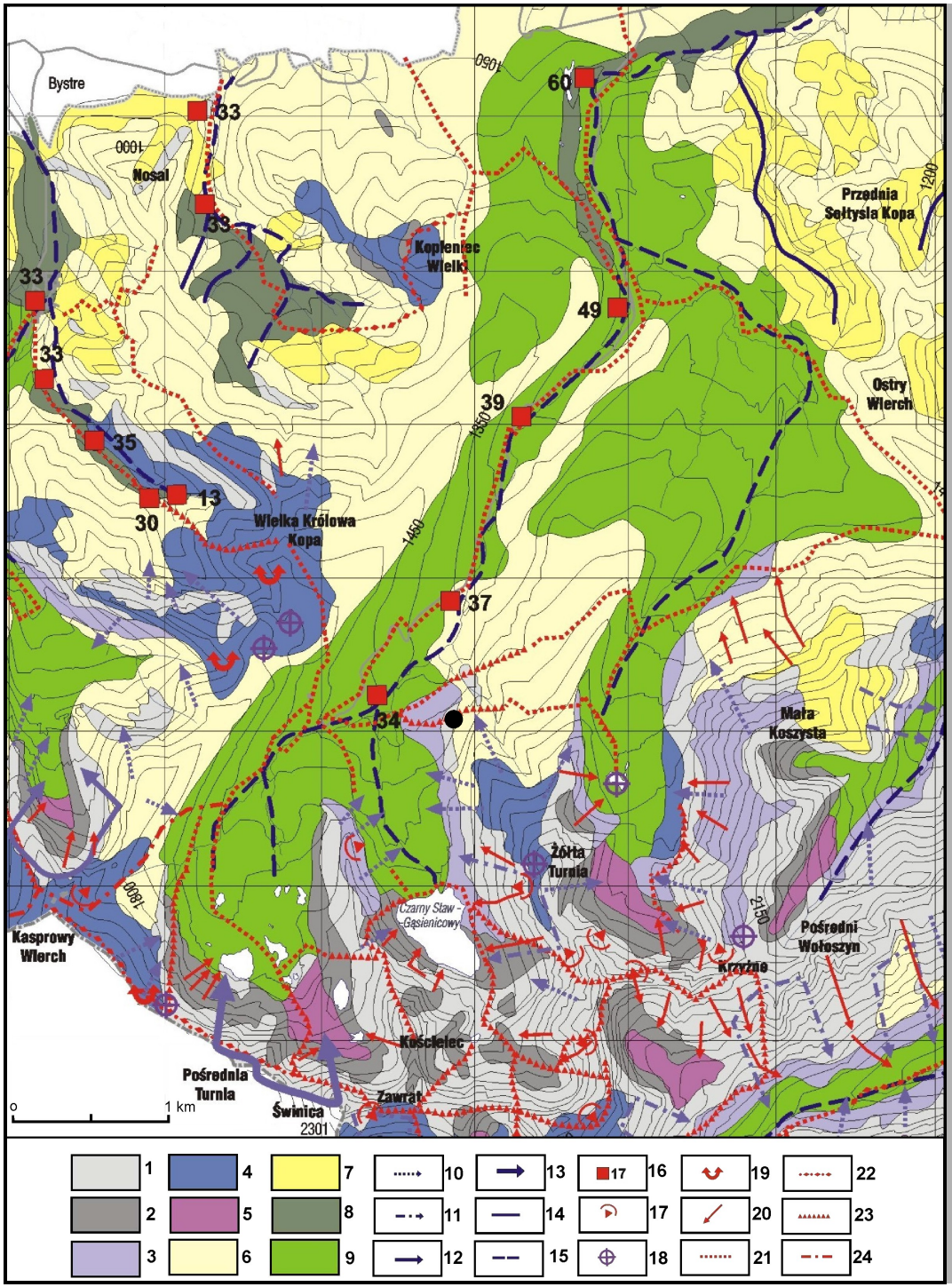




Changes in winter GST at the permafrost occurrence (KW) and permafrost-free (KG1) sites in Kozia Dolinka valley (Gadek, Kedzia 2009).







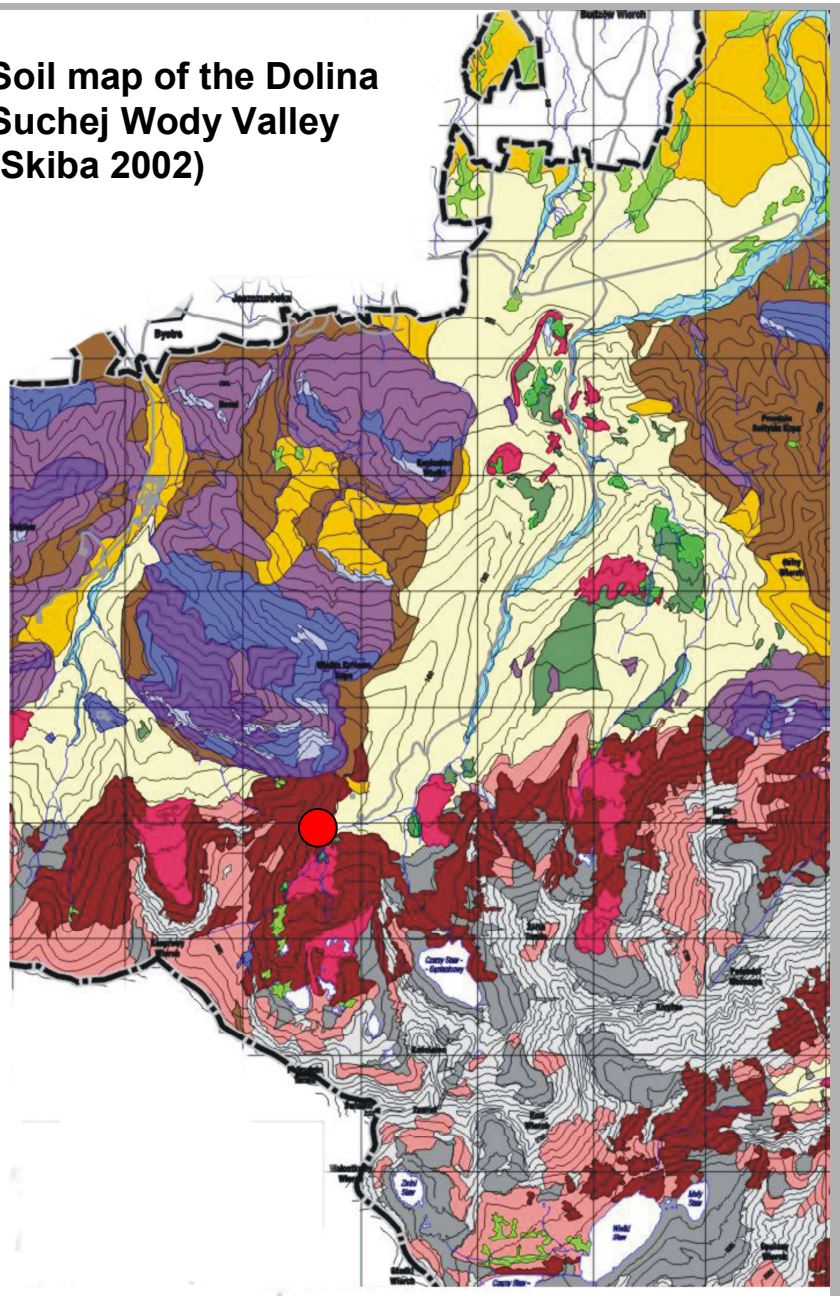
Map of the present-day geomorphic processes

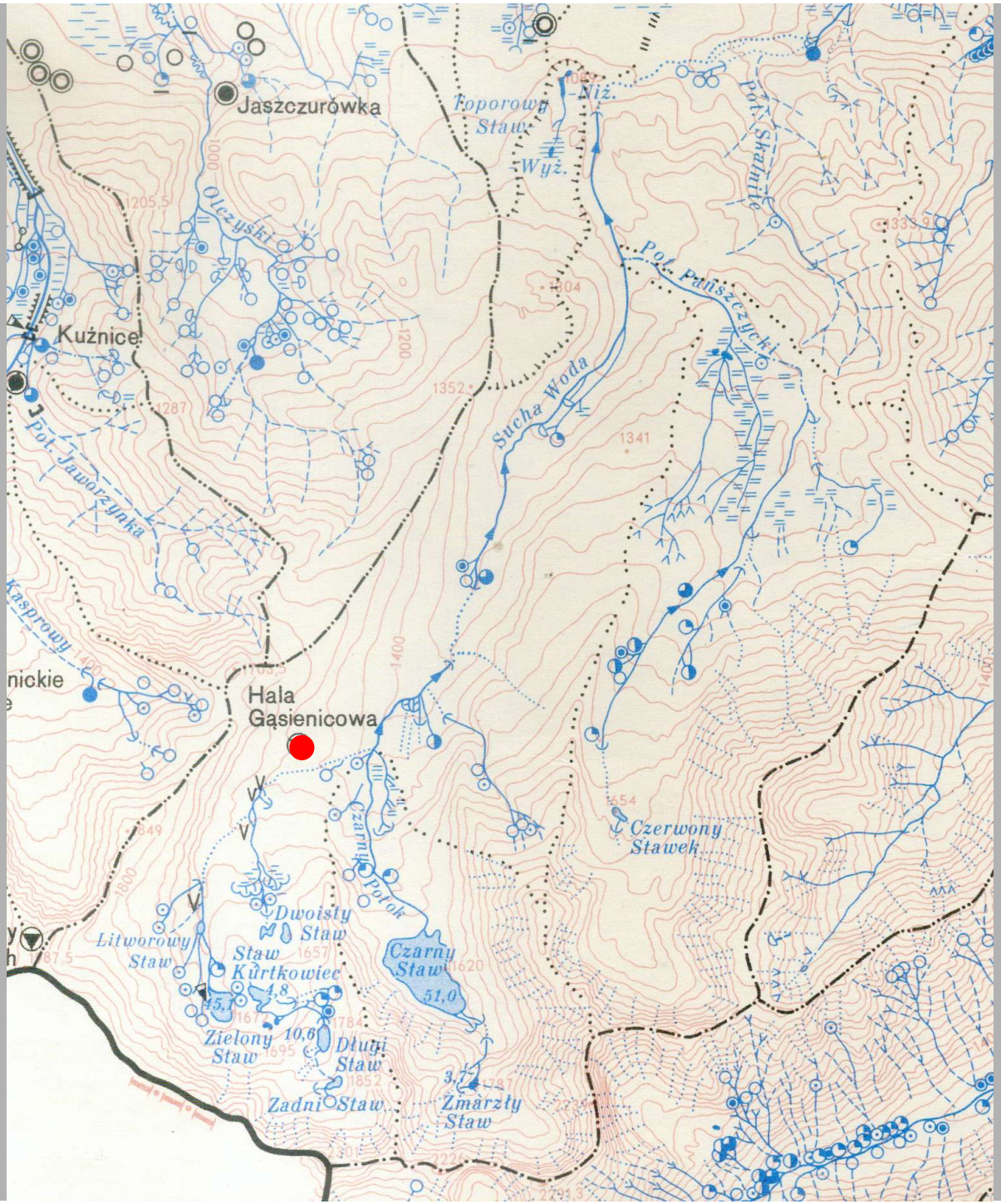
(after Kotarba 2002, changed)

Morphodynamic areas modelled by: 1 – rockfall, debris sliding and corasion, avalanche erosion and transport, debris flows; 2 – accumulation of debris delivered by gravitational processes, debris flows, debris sliding and corasion, accumulation of debris delivered by avalanches, piping, nivation; 3 – piping, debris flows or mud flows, accumulation of debris delivered by avalanches; 4 – cryogenic processes, nivation, debris flows or mud flows, deflation and aeolian accumulation, sheetwash, avalanche erosion and transport; 5 – nivation, accumulation of debris delivered by gravitational processes and sheetwash, cryogenic processes, accumulation of debris delivered by avalanches, piping; 6 – creeping and sliding, piping, fallen tree driven denudation; 7 – sliding and creeping, fallen tree driven denudation; 8 – piping, sheetwash, creeping; 9 - piping, sheetwash, accumulation of debris delivered by avalanches. Areas strongly modelled by avalanches, occurring with frequency (after K. Chomicz 1957): 10 – 0,0-0,5 avalanche*year-1, 11 – 0,6-1,0 avalanche*year-1, 12 – 1,6-2,0 avalanche*year-1, 13 – > 2,0 avalanche*year-11. 14 – stream channel modeled by deep erosion of low intensity, 15 – stream channel cut in alluvia modeled by transportation and erosion, 16 – maximum size of fraction (in cm) transported during extreme floods (for example at 01.07.1973), 17 – fresh gravitational forms, 18 – cryogenic microrelief, 19 - deflation microrelief, 20 – fresh debris flows (in 1994). Touristic routs and trails modeled by: 21 – sheetwash and rill erosion, needle ice activity; 22 – sheetwash and rill erosion, needle ice activity, mass movements; 23 – gravitational processes, 24– sheetwash and rill erosion, needle ice activity, mass movements and deflation.

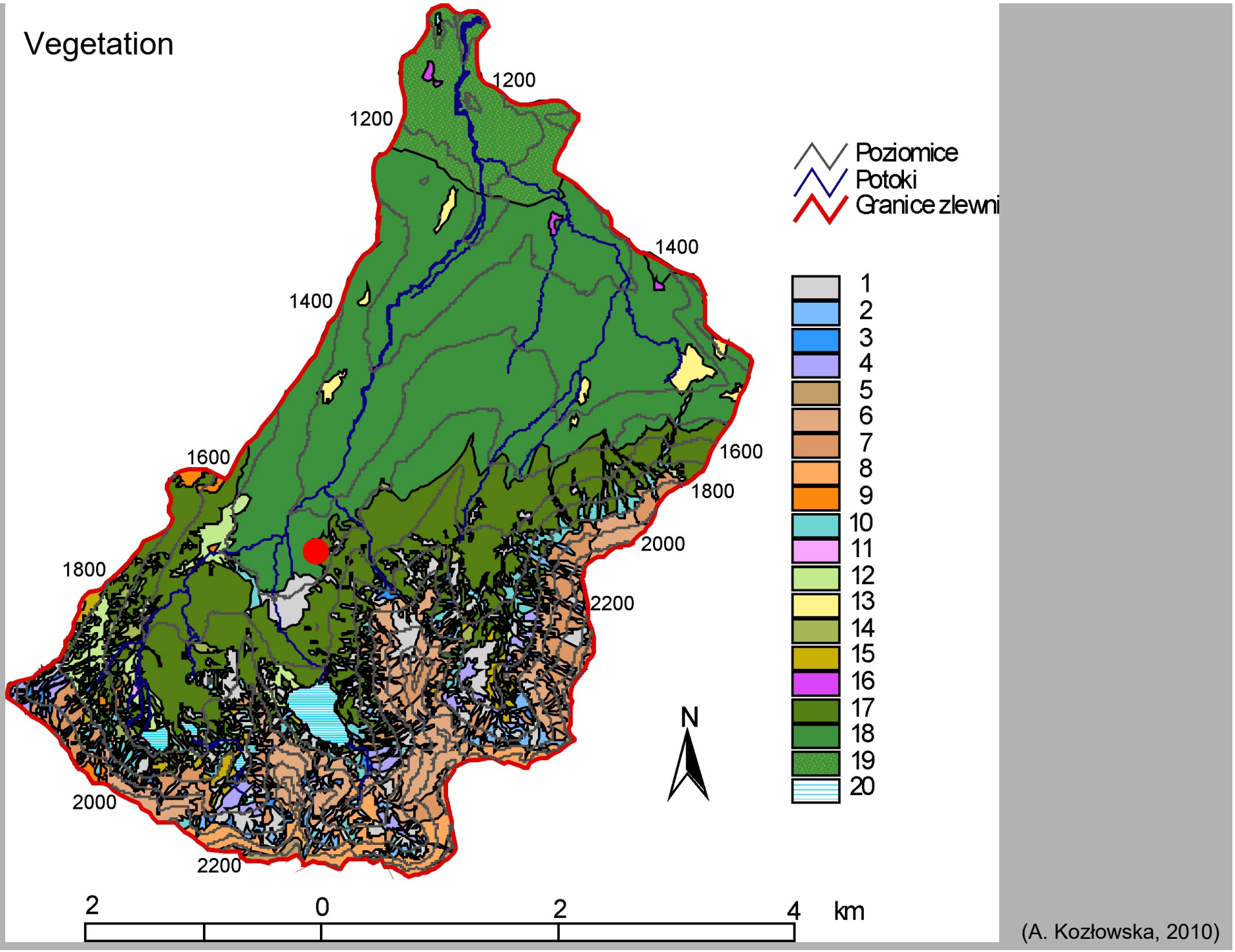
Soil map of the Dolina Suchej Wody Valley (Skiba 2002)

	Gleby główne *Dominant soil units*	Gleby towarzyszące *Associated soil units*
Gleby litogeniczne wykształcone ze skał bezwęglanowych (Noncarbonate lithogenic soils)		
1	Litosole (Lithic Leptosols)	Regosole (Regosols), Rankery butwinowe (Umbric Leptosols), *ściany skalne - utwory bezglebowe*
2	Regosole (Regosols)	Litosole (Lithosols), Rankery butwinowe (Umbric Leptosols), *ściany skalne - utwory bezglebowe*
3	Regosole bielicowe (Podzolic Regosols) + Bielice (Orthic Podzols)	Rankery bielicowe (Podzolic Rankers), Rankery butwinowe (Umbric Leptosols)
4	Rankery bielicowe (Podzolic Rankers)	Rankery butwinowe (Umbric Leptosols), Litosole (Lithosols), Regosole (Regosols), Bielice (Orthic Podzols)
5	Rankery butwinowe (Umbric Leptosols) + Rankery bielicowe (Podzolic Rankers)	Gleby bielicowe (Orthic Podzols), Litosole (Lithosols), Regosole (Regosols)
Gleby litogeniczne wykształcone ze skał węglanowych (Lithogenic calcareous soils)		
6	Rędziny inicjalne (Rendzic Leptosols)	Rędziny butwinowe i próchniczne (Umbric-Rendzic Leptosols)
7	Rędziny inicjalne rumoszowe (Calcaric Regosols)	Rędziny butwinowe (Umbric-Rendzic Leptosols), Rędziny brunatne (Cambic-Rendzic Leptosols)
Gleby semihydrogeniczne i hydrogeniczne (Hydrogenic & semihydrogenic soils)		
14	Gleby gruntowo-glejowe (Eutric Gleysols)	Gleby brunatne właściwe oglejone (Eutric Cambisols), Gleby torfowo-glejowe (Histic Gleysols)
15	Gleby torfowo-bielicowe (Histic Podzols)	Gleby bielicowe (Orthic Podzols), Gleby gruntowo-glejowe (Eutric Gleysols), Gleby torfowe i murszowe (Histosols)
16	Gleby torfowe (Histosols)	Gleby murszowe (Histosols), Gleby gruntowo-glejowe (Histic Gleysols), Gleby torfowo-bielicowe (Histic Podzols)
Gleby napływowe (Fluvisols)		
17	Gleby deluwialne brunatne (Cambic Fluvisols)	Gleby brunatne właściwe typowe i wyługowane (Eutric Cambisols) Gleby brunatne kwaśne (Dystric Cambisols)
18	Mady próchniczne (Mollic Fluvisols)	Mady właściwe (Haplic Fluvisols), Mady brunatne (Cambic Fluvisols)
19	Mady właściwe (Haplic Fluvisols) i Mady brunatne (Cambic Fluvisols)	Mady próchniczne (Mollic Fluvisols), Gleby deluwialne brunatne (Cambic Fluvisols)
Gleby litogeniczne wykształcone ze skał węglanowych (Lithogenic calcareous soils)		
8	Rędziny próchniczne (Humic-Rendzic Leptosols)	Rędziny butwinowe (Umbric-Rendzic Leptosols), Rędziny inicjalne (Rendzic Leptosols), Rędziny brunatne (Cambic-Rendzic Leptosols)
9	Rędziny butwinowe (Umbric-Rendzic Leptosols) + Rędziny próchniczne (Humic-Rendzic Leptosols)	Rędziny inicjalne (Rendzic Leptosols), Rędziny brunatne (Cambic-Rendzic Leptosols)
10	Rędziny brunatne (Cambic-Rendzic Leptosols)	Gleby brunatne właściwe typowe (Eutric Cambisols), Rędziny próchniczne (Humic-Rendzic Leptosols)
Gleby autogeniczne (Autogenic soils)		
11	Gleby brunatne właściwe typowe i wyługowane (Eutric Cambisols)	Rędziny brunatne (Cambic-Rendzic Leptosols), Gleby brunatne kwaśne (Dystric Cambisols)
12	Gleby brunatne kwaśne (Dystric Cambisols)	Gleby bruntane właściwe wyługowane i oglejone (Eutric Cambisols)
13	Gleby bielicowe i bielice (Orthic Podzols)	Rankery bielicowe (Podzolic Rankers), Gleby brunatne kwaśne (Dystric Cambisols)





(K. Wit-Jóźwik, 1974)



(A. Kozłowska, 2010)

High-mountain vegetation of the Tatras

(central part)

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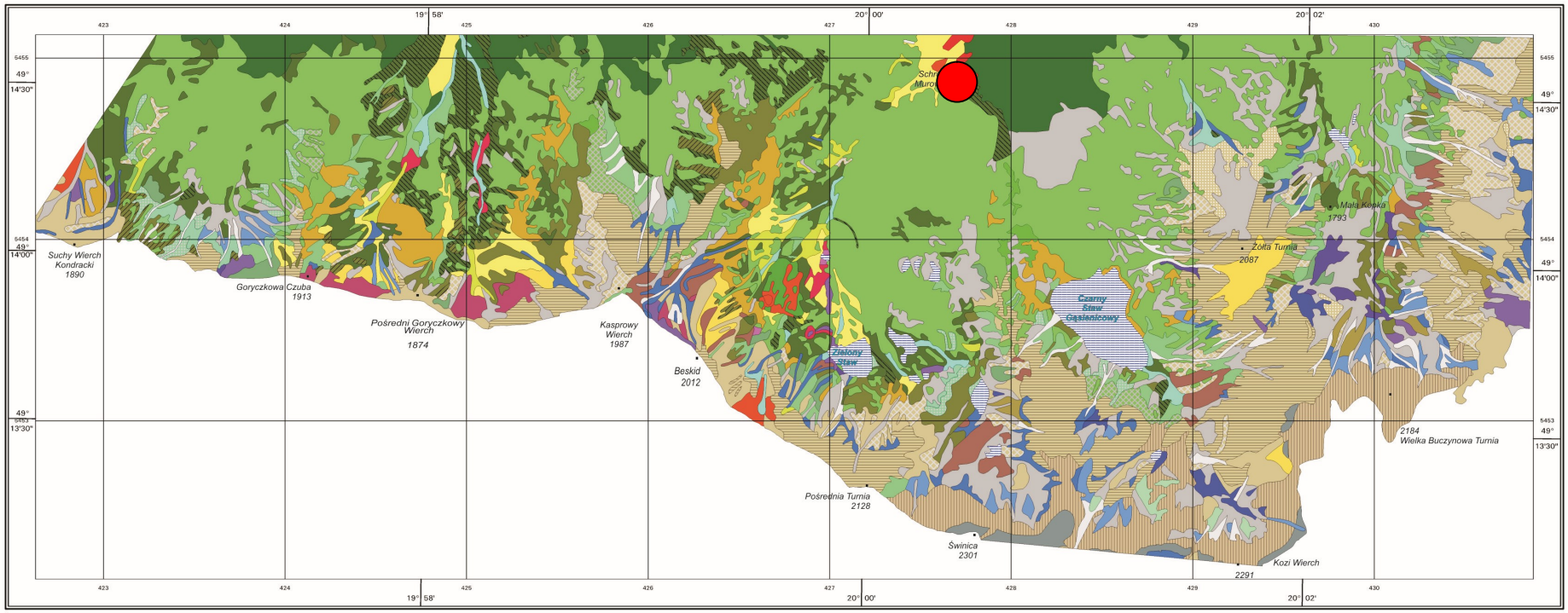
Author: **Anna Kozłowska** (map concept, field mapping, final version elaboration)
in cooperation with: **Joanna Plit** (field mapping) and **Bogdan Zagajewski** (digital elaboration)



Legend

Initial cryptogamic plant communities

Epilithic lichen communities (*Rhizocarpetalia geographici*)

Scree vegetation (*Androsacetalia alpinae*)

Snow-bed vegetation (*Salicetea herbaceae*)

Luzuletum alpino-pilosae

Salicetum herbaceae, Polytrichetum sexangularis

Salicetum herbaceaea in a complex with *Empetro-Vaccinietum*

Alpine swards on siliceous rocks (*Oreochloo distichae-Juncetum trifidi*)

Oreochloo distichae-Juncetum trifidi subnivale form in a complex with *Oreochloetum distichae subnivale*

Oreochloo distichae-Juncetum trifidi typicum

Oreochloo distichae-Juncetum trifidi cetrarietosum

Oreochloo distichae-Juncetum trifidi typicum in a complex with *O.d.-J. t. cetrarietosum*

Oreochloo distichae-Juncetum trifidi sphagnetosum

Oreochloo distichae-Juncetum trifidi salicetosum herbaceae

Oreochloo distichae-Juncetum trifidi salicetosum retusae

Oreochloo distichae-Juncetum trifidi scree form with *Juncus trifidus*

Oreochloo distichae-Juncetum trifidi caricetosum sempervirentis

Oreochloo distichae-Juncetum trifidi subalpine form

Oreochloo distichae-Juncetum trifidi in a complex with *Salicetea herbaceae*

Oreochloo distichae-Juncetum trifidi in a complex with *Calamagrostietum villosae*

Oreochloo distichae-Juncetum trifidi in a complex with *Festuco versicoloris-Agrostietum*

Alpine swards on calcareous rock (*Elyno-Seslerietea*)

Seslerion tatrae

Fens, transition mires and peat-bogs

Caricetum fuscae subalpinum

Sphagno-Nardetum, Polytricho-Nardetum

Sphagno-Nardetum, Polytricho-Nardetum in a complex with *Caltha laeta* community

Tall herb and tall grass vegetation (*Betulo-Adenostyletea*)

Calamagrostietum villosae tatricum

Calamagrostietum villosae tatricum in a complex with *Luzuletum alpino-pilosae* pioneer form

Calamagrostietum villosae tatricum in a complex with wet post-grazing grasslands

Calamagrostietum villosae tatricum in a complex with *Pinetum mugo* and subalpine post-grazing grasslands

Adenostylion

Semi-natural vegetation after grazing

Festuca picta community in a complex with *Luzuletum alpino-pilosae*

Festuca picta community and wet forms of *Hieracio alpini-Nardetum*

Deschampsia flexuosa community and *Hieracio alpini-Nardetum, Agrostis rupestris* community

Semi-natural vegetation after grazing in a complex with *Rumicetum alpini, Rumici obtusifoliae-Urticetum*

Subalpine dwarf scrub communities (*Loiseleurio-Vaccinion*)

Empetro-Vaccinietum

Empetro-Vaccinietum in a complex with *Pinetum mugo carpaticum*

Vaccinium myrtillus community in a complex with *Pinetum mugo carpaticum*

Vaccinium myrtilus community in a complex with *Betulo-Adenostyletea*

Deciduous shrub communities of clearings (*Epilobietea angustifolii*)

Chamaenerion angustifolium-Salix silesiaca community, *Rubus idaeus* community

Dwarf pine shrubs (*Pinetum mugo carpaticum*)

Pinetum mugo carpaticum silicicolum

Pinetum mugo carpaticum silicicolum in a complex with *Rhizocarpetalia*

Pinetum mugo carpaticum calcicolum

Upper-montane spruce forest (*Plagiothecio-Piceetum*)

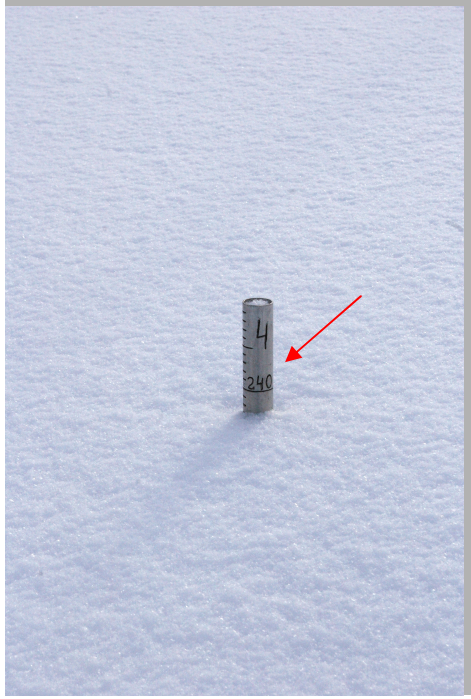
Lakes

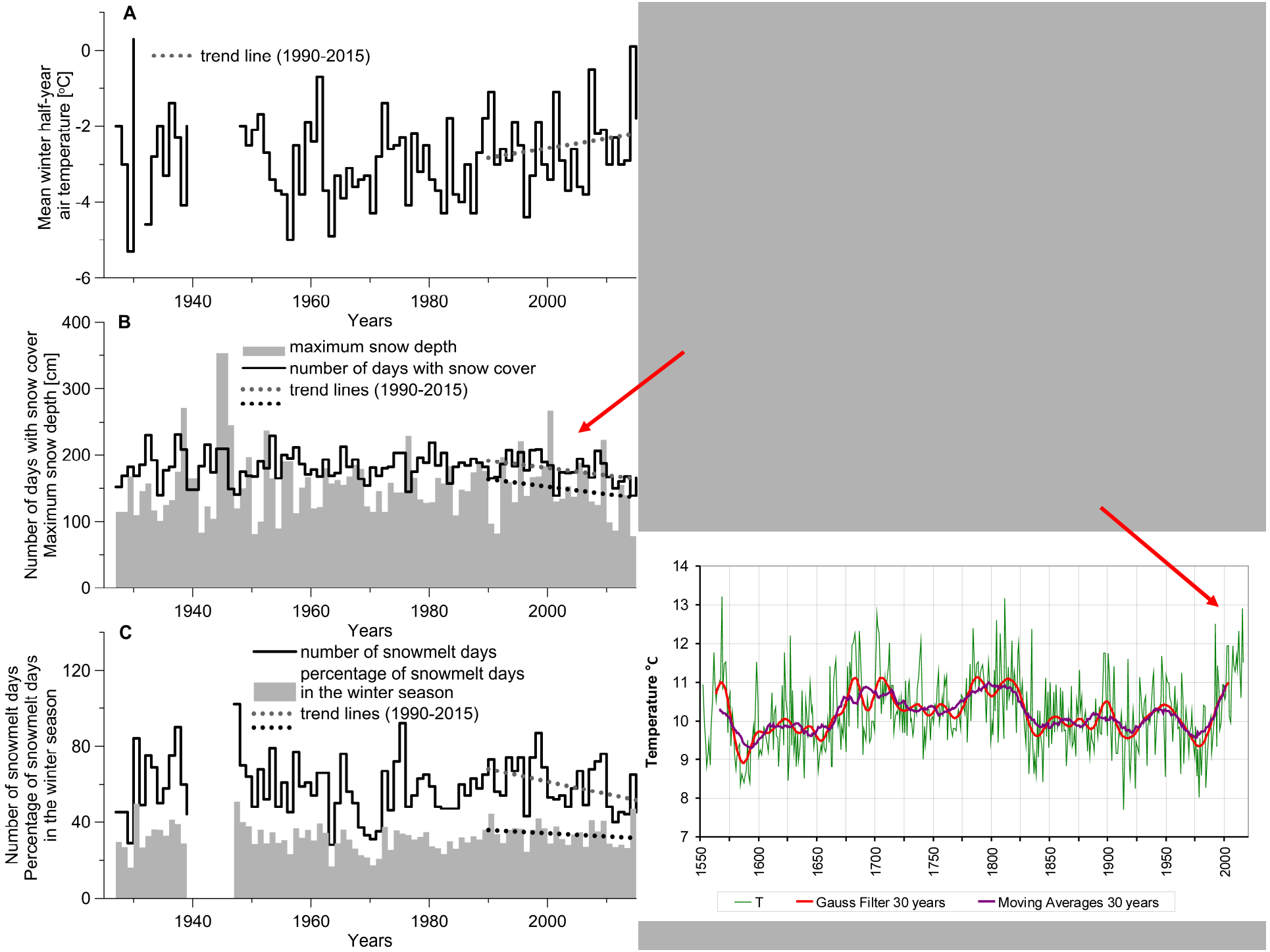
Projection Type: UTM; Zone: 34; Spheroid Name: WGS 84

Author's affiliation:
- Anna Kozłowska and Joanna Plit: Institute of Geography and Spatial Organization, PAS
- Bogdan Zagajewski: Warsaw University Remote Sensing of Environment Laboratory (WURSEL)

Poland, Warsaw, 2006

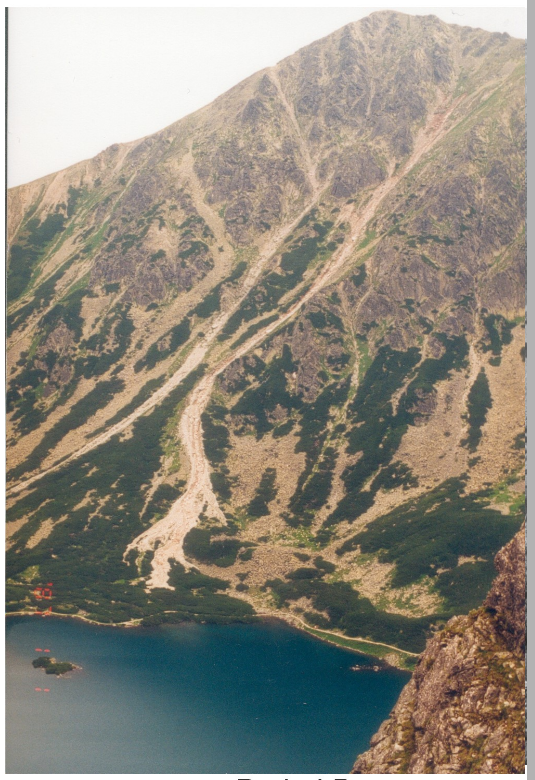
snow cover 100-300 days



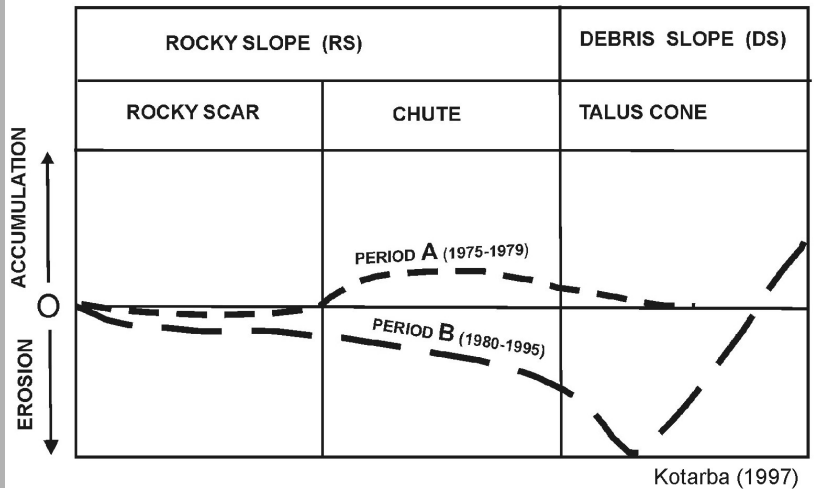

A
trend line (1990-2015)
Mean winter half-year air temperature [°C]
0
-2
-4
-6
1940
1960
1980
2000
Years
B
maximum snow depth
number of days with snow cover
trend lines (1990-2015)
Number of days with snow cover
Maximum snow depth [cm]
400
300
200
100
0
1940
1960
1980
2000
Years
C
number of snowmelt days
percentage of snowmelt days in the winter season
trend lines (1990-2015)
Number of snowmelt days
Percentage of snowmelt days in the winter season
120
80
40
0
1940
1960
1980
2000
Years
Temperature °C
14
13
12
11
10
9
8
7
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
T
Gauss Filter 30 years
Moving Averages 30 years

ŻÓŁTA TURNIA EXPERIMENTAL SLOPE

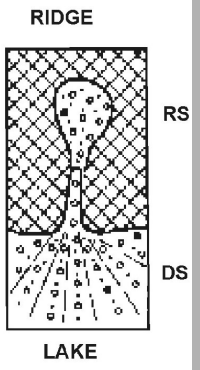
Period A



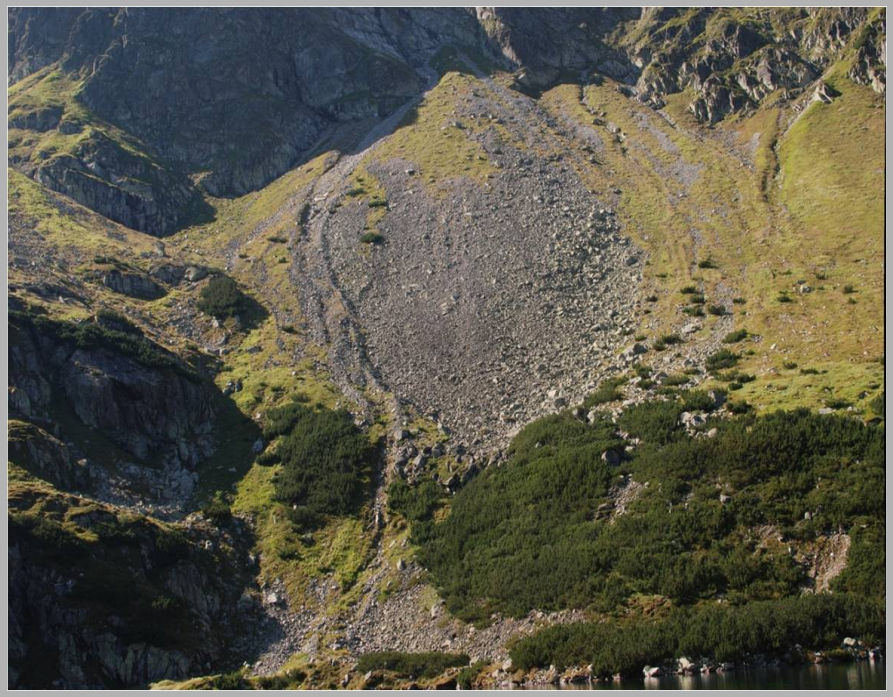
Period B

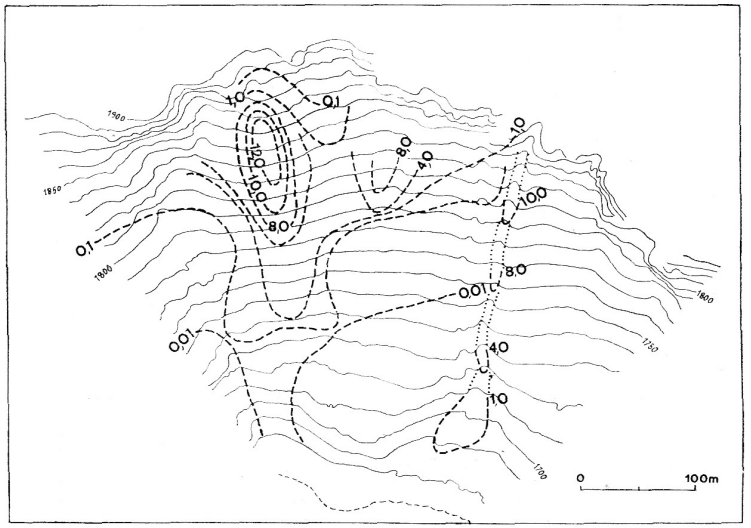


Kotarba (1997)



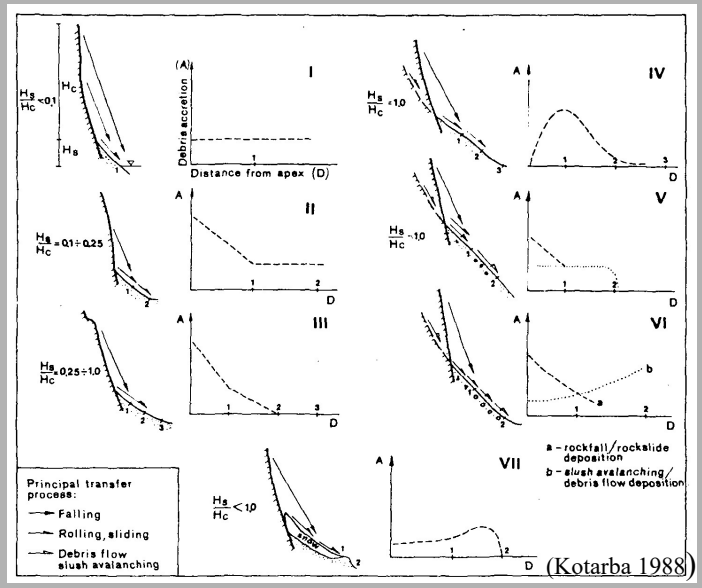
SKRAJNA TURNIA EXPERIMENTAL SLOPE





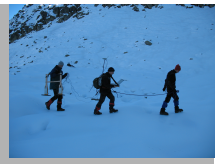
Wielkość nadbudowywania powierzchni stoku doświadczalnego Skrajnej Turni (akumulacja gruzu wyrażona w mm za okres 1975—1980) materiałem odpadającym ze ścian i działalnością lawinową

Paterrn of debris accumulation on the „Skrajna Turnia" experimental slope measured in mm for the period 1975—1980 (Klapa, Kotarba, Rączkowska 1983)



(Kotarba 1988)

RESEARCH:



➢ **geomorphology** - present day geomorphic processes (gravitational processes, periglacial processes, debris flows, snow avalanches, nivation, creeping), talus slope structure by GPR, lichenometric dating, lake deposits, postglacial relief
(Gerlach 1959; Kłapa 1967, 1970, 1980; Kotarba et al. 1983; 1987, 2013; Kotarba 1992, 1995, 1996, 1997, 2004; Baumgart-Kotarba, Kotarba 1993, 2001; Rączkowska 1993, 1995, 1997, 2007, 2008, 2012, 2016; Kot 1997; Kędzia 2014, 2015, 2017)

➢**climatology** (topoclimate, climate changes, bioclimate, microclimate v. relief at upper timberline)

(Szczęsna, Kłapa 1961; Baranowski 1999, 2003; Niedźwiedź 2003, Błażejczyk, Kunert 2010; Baranowski, Kędzia 20

➢**cryosphere** (permafrost, ground temperature, snow cover features and dynamic)

(Kłapa, Jahn 1967; Mościcki, Kędzia 2001; Kędzia 2005; Gądek, Kędzia 2011; Rączkowska 2011),

➢**hydrology** (mapping)
(Wit-Jóźwik 1974),

➢**geoecology** (relation between relief and vegetation in different spatial scale)
(Kozłowska, Rączkowska 1994; Kotarba, Kozłowska, eds., 1999; Kozłowska et al. 2007, 2011; Kozłowska, Rączkowska 2009, 2010, 2014),

➢**geobotany** (mapping in various scale, transition zone between vegetation belts, dynamic of chagnes of vegetation)
(Kozłowska 2006, 2007, 2010)

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