Report on the Second Workshop of the IAG Working Group on Denudation and Environmental Changes in Different Morphoclimatic Zones (DENUCHANGE) held in Calpe (Spain), 12-14 September 2019

The Second Workshop of the IAG Working Group on *Denudation and Environmental Changes in Different Morphoclimatic Zones (DENUCHANGE)* took place in Calpe (Spain), 12-14 September 2019. The workshop was scientifically hosted and co-sponsored by the *Geomorphological Field Laboratory (GFL) (http://geofieldlab.com)* and was successfully organized by Achim A. Beylich and Katja Laute (both GFL). The workshop venue was the Suitopia Hotel in Calpe with kind support from Marina Renner Jorro.

The workshop included an introductory session with an introductory lecture by Achim A. Beylich on *The IAG Working Group on Denudation and Environmental Changes in Different Morphoclimatic Zones (DENUCHANGE, 2017-2021): Working group objective, key research questions, overview of activities and planned outcomes*, followed by extended discussions on further steps to be taken and on the preparation of *IAG DENUCHANGE test site fact sheets* (see below). Eleven oral and eight poster presentations were provided by workshop participants and DENUCHANGE core members spanning a wide spectrum of scientific and methodological aspects related to the quantitative geomorphological analysis of denudation in various morphoclimatic zones. In addition, a practical workshop on the sediment source fingerprinting technique with the *Model FingerPro as Open Source R Package* was provided by Leticia Gaspar (Zaragoza) for the workshop participants.

A half-day fieldtrip (guided by Achim A. Beylich and Katja Laute) introduced the workshop participants to the Mediterranean landscape of the Calpe region where hillslope and fluvial denudational processes in three selected test catchments of the Geomorphological Field Laboratory (GFL) in this anthropogenically modified Mediterranean landscape were discussed.

The twenty participating and/or contributing colleagues from ten countries (Austria, Bulgaria, Germany, Norway, Poland, Romania, South Africa, Spain, UK, USA) provided, presented and shared ideas and discussed various aspects of denudation in a range of different morphoclimatic zones including cold, temperate, semi-arid and Mediterranean environments. Selected contributions from the workshop shall, together with selected contributions from the DENUCHANGE scientific session on *Denudational hillslope and fluvial processes, sedimentary budgets, and landscape responses to global environmental changes* at the EGU General Assembly 2019 in Vienna (Austria, 7-12 April 2019) and

selected contributions from the DENUCHANGE scientific session on *Denudation in the Mediterranean Zone* at the IAG Regional Conference on Geomorphology in Athens (Greece, 19-21 September 2019), be published in a DENUCHANGE special issue of the journal *Geomorphology* (Elsevier).

Part of the workshop participants in the workshop venue (photo by Suitopia Hotel, 12.09.2019).

Explanations during the half-day field trip (photo by Katja Laute, 13.09.2019).

Significant progress was made in the development of *IAG DENUCHANGE test site fact sheets* (**see Tables 1 and 2 below**) which will be circulated (Geomorph-List) to the global geomorphology community together with a call for providing key data on relevant catchment characteristics, meteorological data, runoff data, data on fluvial solute and sediment transport, and catchment-wide chemical and mechanical denudation rates from studied catchment systems worldwide. The collected data will be used for an integrated geomorphological analysis of key drivers and quantitative rates of contemporary chemical and mechanical denudation in catchment systems in different morphoclimatic zones (see also the *IAG DENUCHANGE working group objective* for further details).

Next years` DENUCHANGE activities will include a new DENUCHANGE scientific session at the EGU General Assembly 2020 in Vienna (Austria, 3-8 May 2020), planning and progress meetings of DENUCHANGE steering committee and core members (including also meetings with chairpersons of other IAG working groups) and the Third DENUCHANGE workshop to be held in Israel in October 2020.

First workshop dinner in Calpe (photo by Katja Laute, 12.09.2019).

Further information on the Second DENUCHANGE workshop, including the detailed workshop programme and the published volume of abstracts (http://geofieldlab.com/gfl-geomorphological-field-laboratory-publication-series/), as well as on the DENUCHANGE working group, the defined DENUCHANGE working group objective and the DENUCHANGE test site fact sheets (A and B) is available at the frequently updated DENUCHANGE website under http://www.geomorph.org/denuchange-working-group/.

Selbustrand, 11 October 2019

Achim A. Beylich

Chair of IAG DENUCHANGE and workshop organizer

Appendix

- IAG DENUCHANGE test site fact sheets A and B (Tables 1 and 2)

Table 1. IAG DENUCHANGE test site fact sheet A (Table compiled by Achim A. Beylich)

Parameter	***Information***	***Additional comments (if applicable)***
DENUCHANGE test site (catchment/field site name and country where the test site is located)		
Climatic zone/region		
Responsible investigator (name, postal and e-mail address of contact person)		
Are the requested data for SWAT modelling available (see **Table 2**) (yes/no)? If **yes**, please complete also **Table 2**.		
Period of field investigations (years, seasons)		
Geographical coordinates for studied catchment/field site		
Catchment area (km^2)		
Lithology within the catchment area		
Elevation range of catchment (m a.s.l.)		
Topographic relief (m)		
Mean slope angle within the catchment (°)		
Relevant storage elements within the catchment area		
Glacier coverage (yes/no); if yes, surface area with glacier cover (% of total catchment surface area)		
Surface area with bedrock surfaces (% of total catchment surface area)		
Surface area with sedimentary covers (% of total catchment surface area)		
Vegetation coverage in surface areas with sedimentary covers (type of vegetation and % of surface area covered by vegetation)		
Permafrost (yes/no); if yes, surface area with permafrost (% of total catchment surface area)		

Human impact (yes/no); if yes, please describe briefly		
Mean annual air temperature (°C)		
Annual precipitation (mm)		
Runoff period		
Runoff regime		
Annual solute yield (atmospherically corrected) (t $km^{-2}yr^{-1}$)		
Annual suspended sediment yield (t $km^{-2}yr^{-1}$)		
Annual bedload yield (t $km^{-2}yr^{-1}$)		
Description of methods and techniques applied or reference(s) to published methods descriptions (methods/techniques used for quantifying fluvial transport and/or yields)		
Most important slope processes within the catchment		
Most important sediment sources for fluvial transport		
Any other relevant catchment information		
Relevant publications and/or sources related to the information/data provided		

Table 2. IAG DENUCHANGE test site fact sheet B: Requested catchment data for SWAT modelling (Table compiled by Joanna Gudowicz, Małgorzata Mazurek and Zbigniew Zwoliński)

1. Hydrological data: daily discharge as well as dissolved load (for chemical denudation) and suspension and/or bed load (for mechanical denudation) at the closing point of catchment (can also be additionally on inflows) - based on this data the model will be verified:

NO	
YES	Average daily discharge [m^3 s^{-1}] - at the closing point: Yes / No - at the inflows: Yes / No - time range of measurements: from ..... to ..... Concentration of dissolved load [mg dm^{-3}] - at the closing point: Yes/No - at the inflows: Yes/No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Concentration of suspended load [mg dm^{-3}] - at the closing point: Yes/No - at the inflows: Yes/No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Concentration of bed load [kg dm^{-3}] - at the closing point: Yes/No - at the inflows: Yes/No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Organic nitrogen [kg N] - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Organic phosphorus [kg P] - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Nitrate (NO_3) - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): ……

	Nitrite (NO_2) - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Ammonium (NH_4) - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Mineral phosphorus - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): …… Other ..... - at the closing point: Yes / No - at the inflows: Yes / No - time range and frequency of measurements: form ..... to .....; frequency (daily, monthly etc.): ……

2. Meteorological data:

NO	
YES	Sum of precipitation falling during the day [mm]: Yes / No - time range of measurements: ..... - number of recording gages: ..... Daily minimum temperature [°C]: Yes / No - time range of measurements: ..... - number of recording gages: ..... Daily maximum temperature [°C]: Yes / No - time range of measurements: ..... - number of recording gages: ..... Daily average wind speed [m s^{-1}]: Yes / No - time range of measurements: ..... - number of recording gages: ..... Daily average relative humidity [%]: Yes / No - time range of measurements: ..... - number of recording gages: ..... Daily total solar radiation [MJ m^{-2}] - time range of measurements: ..... - number of recording gages: .....

For modeling to be comparable among different catchments, the spatial input data, i.e. DEM, soils, types of land cover and land use should have the same quality. The following questions will help to unify the structure of input data to the model, which will allow comparability of results between catchments:

1. Digital Elevation Model (DEM)

NO	
YES	Data based on: LIDAR / contour map / field measurements / other: ..... Spatial resolution of data: ..... Timeliness of data: .....

2. Land Cover and Land Use map (LULC)

NO	
YES	Data based on: database / satellite image / aerial photo / topographic map / field measurements / other: ..... Spatial resolution (raster data) or scale of data (vector data): ..... Timeliness of data: .....

3. Soil map

NO	
YES	Data based on: database / satellite image / aerial photo / thematic map / field measurements / other: ..... Spatial resolution (raster data) or scale of data (vector data): ..... Timeliness of data: .....

4. Hydrographic network

NO	
YES	Data based on: database / satellite image / aerial photo / topographic map / field measurements / other: ..... Spatial resolution (raster data) or scale of data (vector data): ..... Timeliness of data: .....