Driving mechanisms of coastal cliff retreat in flysch deposits on the eastern Adriatic coast

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Rationale

- **cliffs in soft rocks** – rare coastal forms in Croatia

- Croatian Adriatic coast is **mostly built in carbonates** (> 90%)

- **flysch** is less present coastal rock (~6%)

- flysch cliff in Split urban zone
- occupied since 1980-ies
- tourism, urbanization

- cliff stability? cliff erosion?

- *flysch* → marl - siltstone - sandstone - breccia assemblage

Political and simplified lithological map of the Eastern Adriatic coast (modified after Pikelj & Juračić, 2013)
Study area and aims

- to recognize cliff erosion driving mechanisms
- to assess the erosional rate
Methodology

- cliff-face morphology was scanned 11 times over 6 years (2012-2018) by terrestrial laser scanner
- overlapped point clouds
- 4 representative profiles were chosen and compared
- cliff-top, cliff face and shore platform were examined 15 times during various seasons/weather conditions

Cliff face during scanning process (above) and examination during cold season (below)
Results

- **cliff retreat rates:** 3-18 cm/y
- **extreme erosion (up to 34 cm/y)** during 2014/2015 and 2017/2018 – higher precipitation
- occurrence of landslides 2018 – due to intensive rain
- **water related denudation processes:**
  - gullies formation,
  - groundwater seepage
  - sapping
  - slaking
- removal of material by waves

Position of chosen profiles (above) and example of compared profiles on the steepest part of the cliff
Results

- Initial landslide in 2010
- Re-occurrence in 2018 – due to intensive rain
Conclusions

- erosion of soft flysch cliff in the urban zone
- stronger erosion occurs during cold/wet season - slaking
- denudational processes related to intensive rain and higher precipitation rates
- flysch lithology – the main precondition of the enhanced weathering
- highly needed management of erosion

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