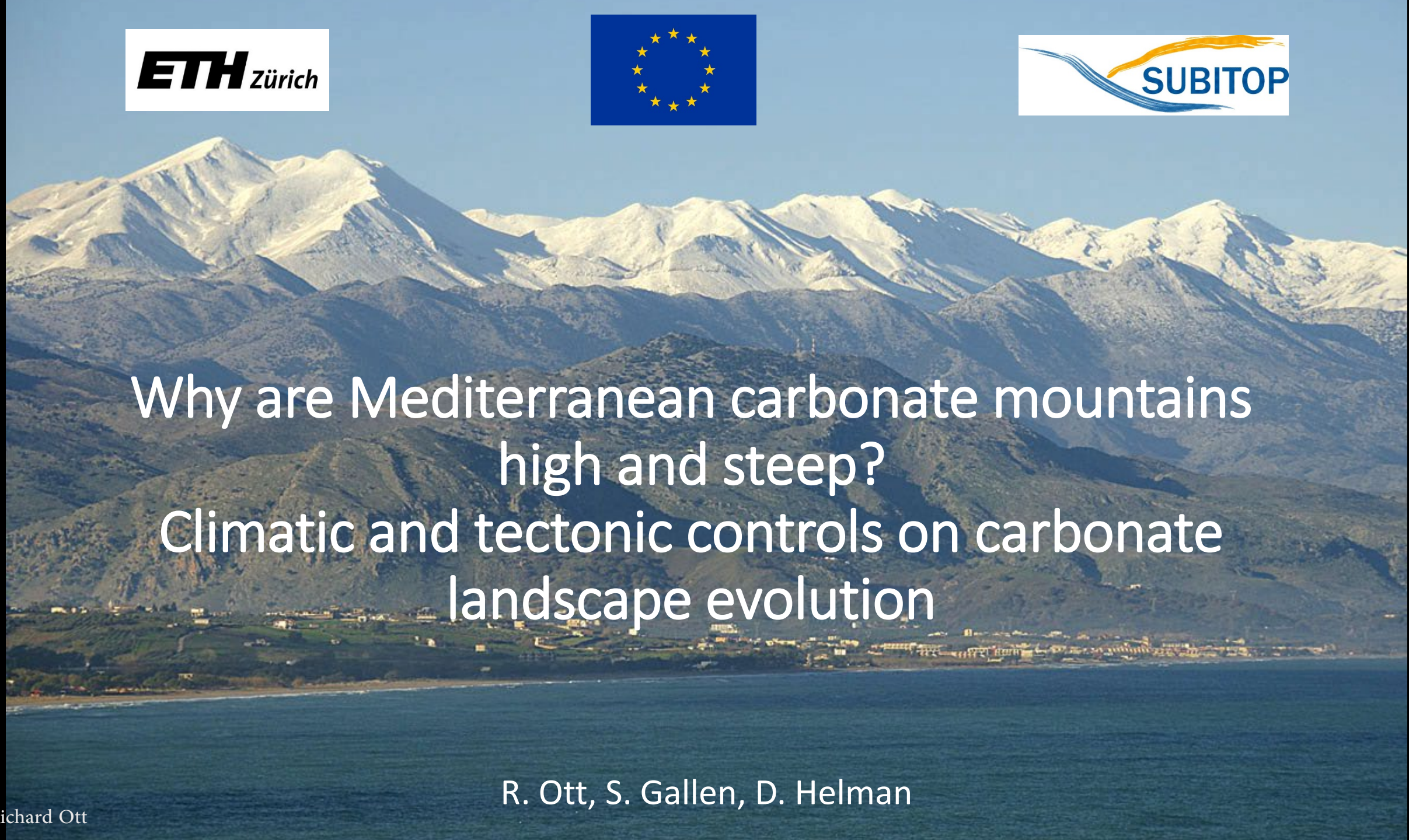
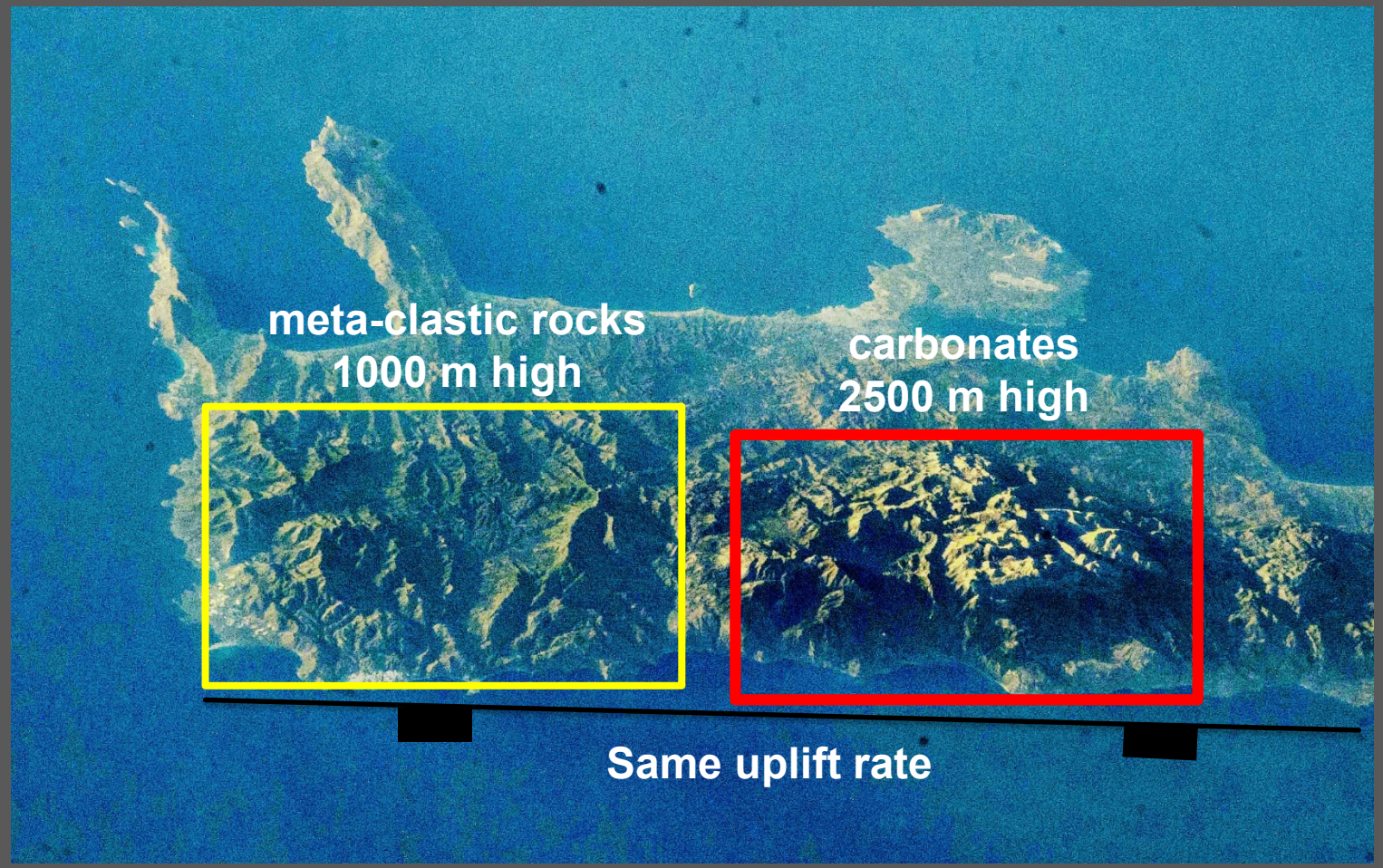


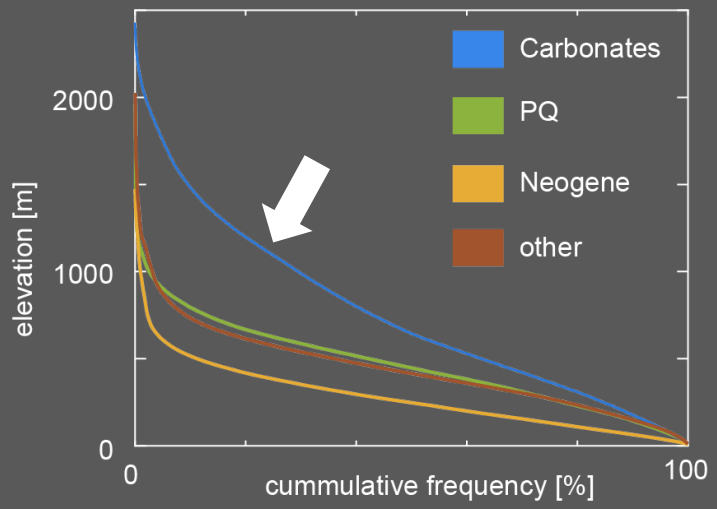
Why are Mediterranean carbonate mountains high and steep? Climatic and tectonic controls on carbonate landscape evolution

R. Ott, S. Gallen, D. Helman

Western Crete from space (NASA)



Hypsometry Crete



Why are carbonate mountains so high and steep? (here despite the same uplift rate)

Carbonates forming the steep parts of the landscape –
Crete, Greece

Low carbonate topography, carbonates forming the low parts of the landsapce – southern Ireland

Research Questions

- 1) What mechanisms control differences in carbonate topography worldwide

  1 a) What mechanisms control the high topography of carbonates in some areas (and low topography in other places)?

  1 b) How do the differences in topography relate to differences in denudation partitioning (mechanical vs chemical)?

Worth checking out: A closely related manuscript investigating the development of carbonate topography on Crete, Greece.

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JGR Earth Surface

RESEARCH ARTICLE
10.1029/2019JF005142

Key Points:
- Quantifying chemical and mechanical denudation in meta-clastic and carbonate bedrock
- Dominance on mechanical denudation in karstic terrains
- Dissolution and infiltration in carbonate terrains influence the shape and response of river profiles to external forcing

Supporting Information:
- Supporting Information S1
- Table S1
- Table S2

Correspondence to:
R. F. Ott,

Chemical Versus Mechanical Denudation in Meta-Clastic and Carbonate Bedrock Catchments on Crete, Greece, and Mechanisms for Steep and High Carbonate Topography

Richard F. Ott[1], Sean F. Gallen[2], Jeremy K. Caves Rugenstein[1,3], Susan Ivy-Ochs[4], David Helman[5,6], Charalampos Fassoulas[7], Christof Vockenhuber[4], Marcus Christl[4], and Sean D. Willett[1]

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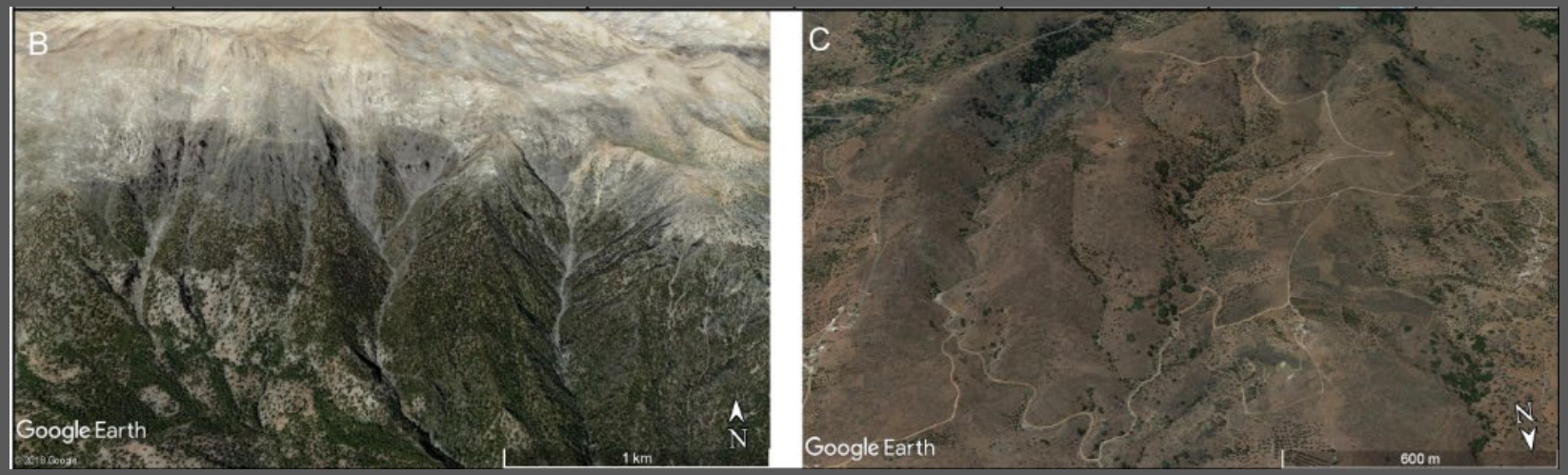
Abstract On Crete, as is common elsewhere in the Mediterranean, carbonate massifs form high

Bringing together ^{10}Be, ^{36}Cl and water chemistry measurements with numerical modelling.

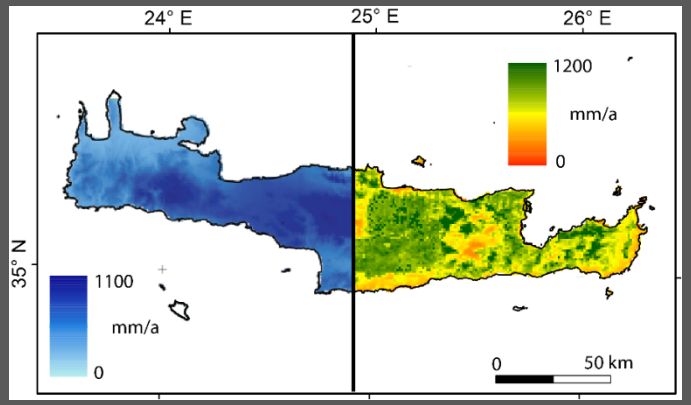
What we did:

- Global compilation of ^{36}Cl denudation rates (bedrock/alluvial)
- Alluvial rates only for Mediterranean
- For places with alluvial rates we calculated dissoution rates

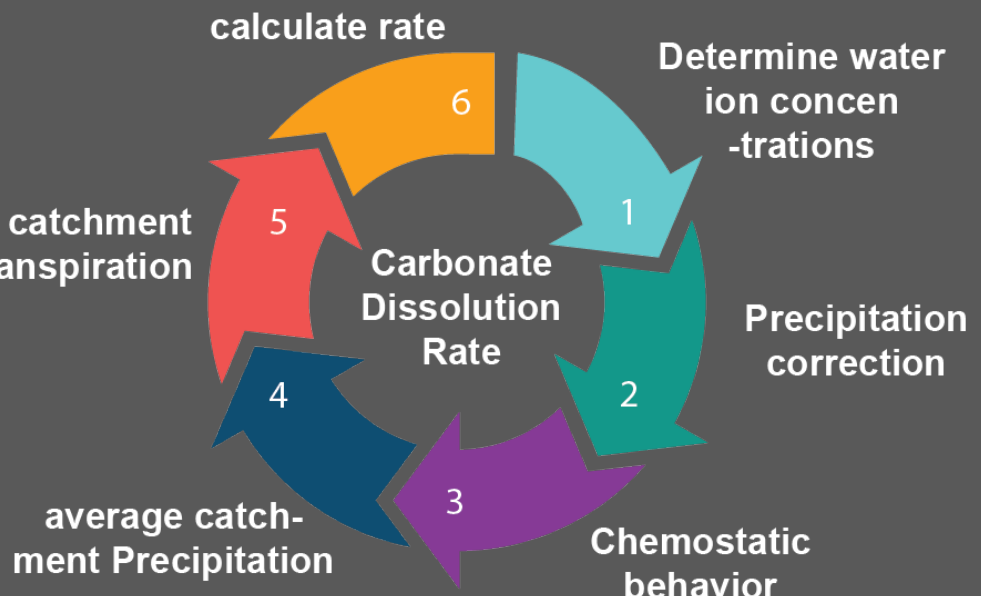


two example catchments

How we calculate carbonate dissolution rates



Use satellite data for precipitation and actual evapotranspiration

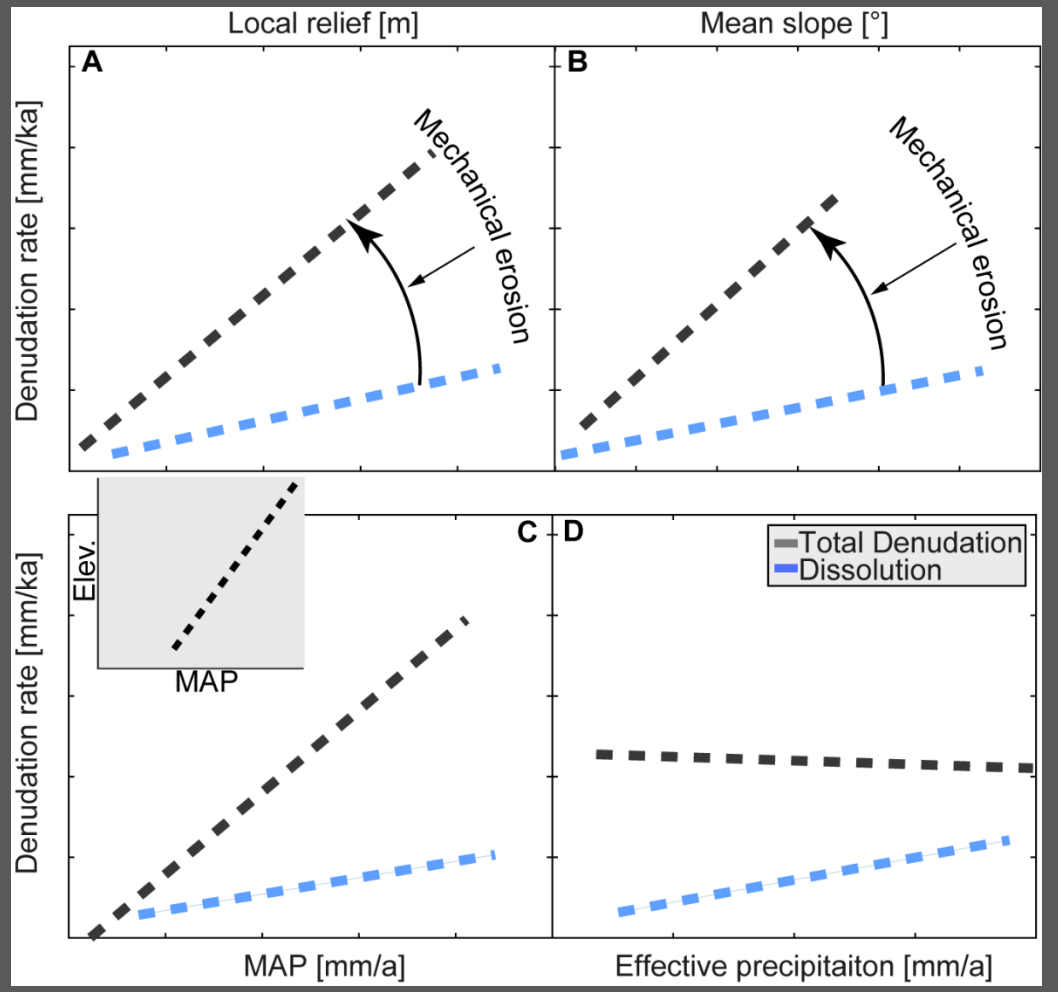


Investigate time series

From Ott et al., (2019) JGR: Earth Surface

Plots of compiled ^{36}Cl denudation and dissolution rates

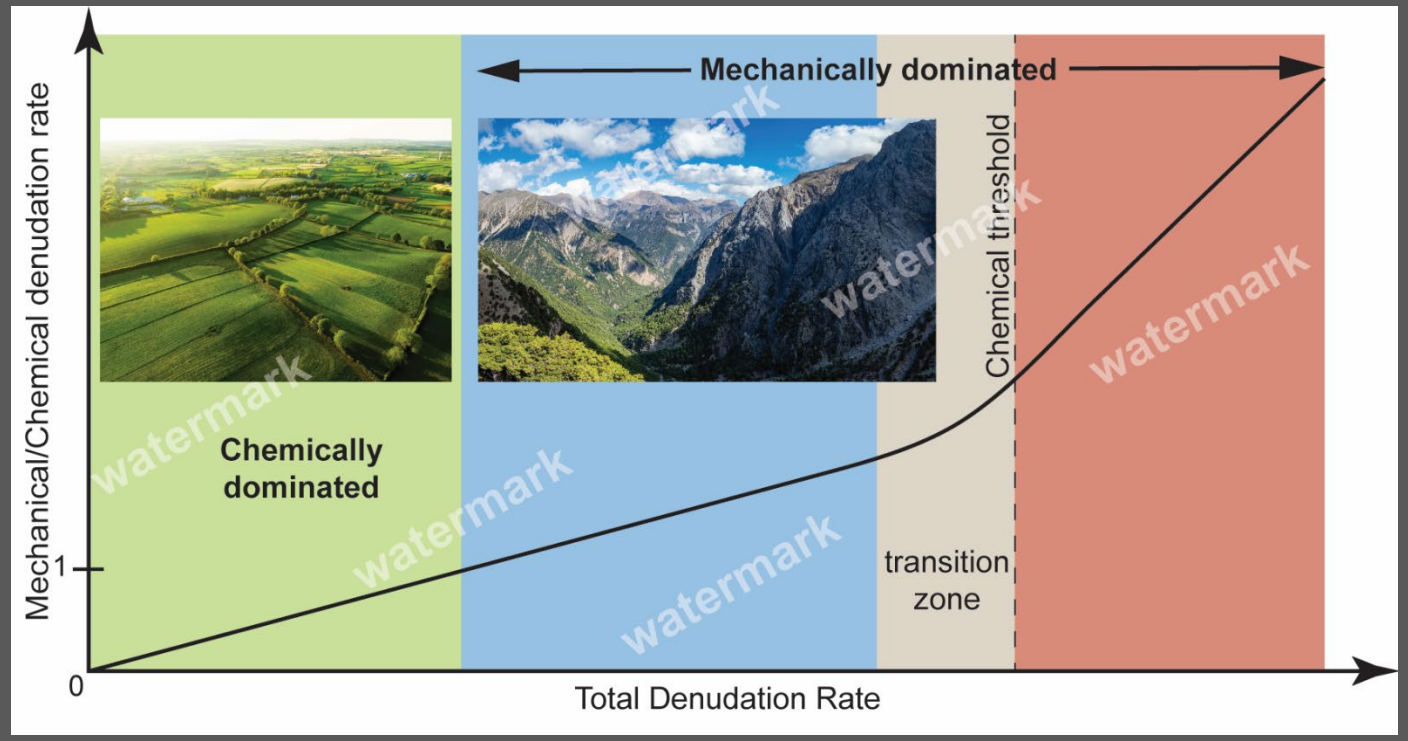
- Denudation >> Dissolution → mechanical erosion
- Denudation correlates with Mean Annual Precipiation (MAP) →Orographic effect
- Weathering correlates with effective precipiation (P_{eff} = Precipiation - Actual evapotranspiartion), denudation does not
- Discrepancy between denudation and weathering grows with increasing relief



For data protection we only show the regression lines and removed data points

Implications for carbonate landscape evolution

mostly set by climate



mostly set by tectonics

- Because weathering is a slope-independent process, areas with climate favorable of weathering form low carbonate topography (southern Ireland)
- Areas of higher uplift, and/or climate less favorable for weathering form steep carbonate topography because they require sufficient slopes for mechanical erosion (Mediterranean)