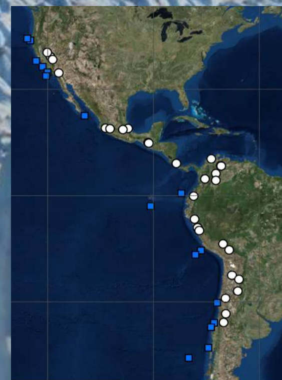
EGU General Assembly 2020

Amplification of high-altitude temperature changes in the American Cordillera driven by precipitation during the Last Glacial Maximum



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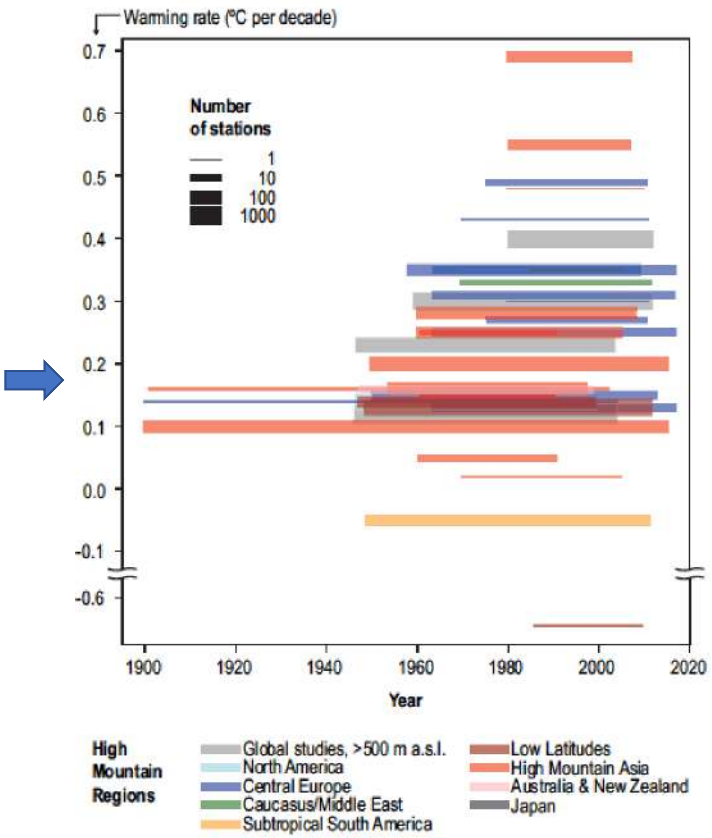
Present tropical glaciers retreat: hazard for water ressources

Average Sea Level warming



IPCC SROCC Special report 2019 (Fig 2.2) : recent trends in air temperature at high elevation

- **Spatially variable recent warming trend at high elevation**

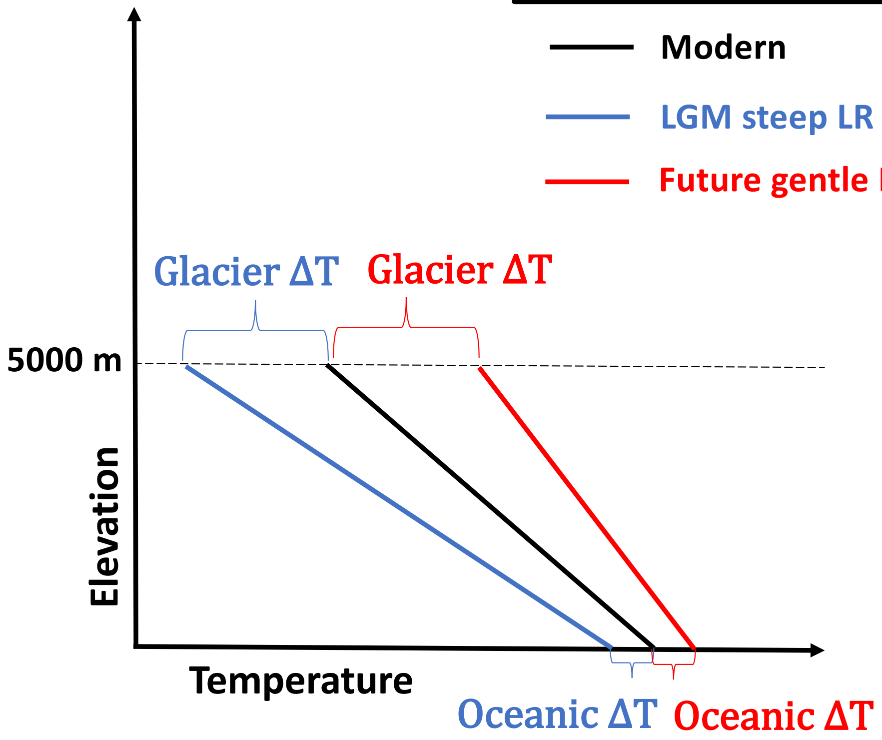
- **Several possible forcing mechanisms: e.g. role of humidity, albedo**

- **High altitude temperature change is dependent on lapse rate**

Atmospheric lapse rate sensitivity?
Idea: look at the large LGM lapse rate

Examples of temperature variation amplification at high altitude

Modern average LR value : -6.5°C/km
Dry LR : -9°C/km Wet LR: -4.5°C/km



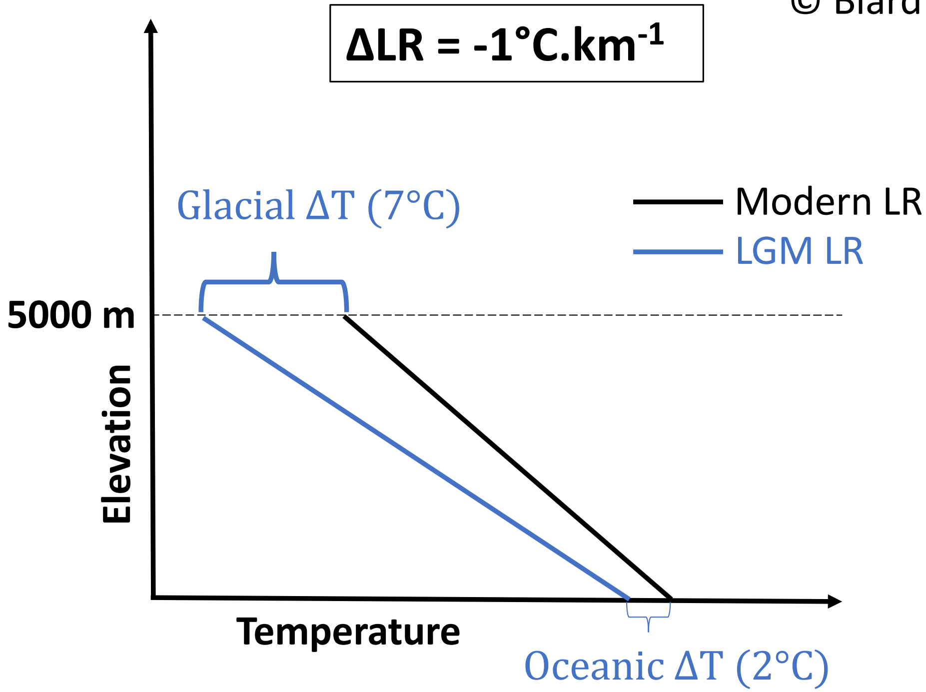
Amplification of LGM cooling at high altitude – drier atmosphere

→ **Last Glacial Maximum ?**

Amplification of warming at high altitude – wetter atmosphere

→ **Future ?**

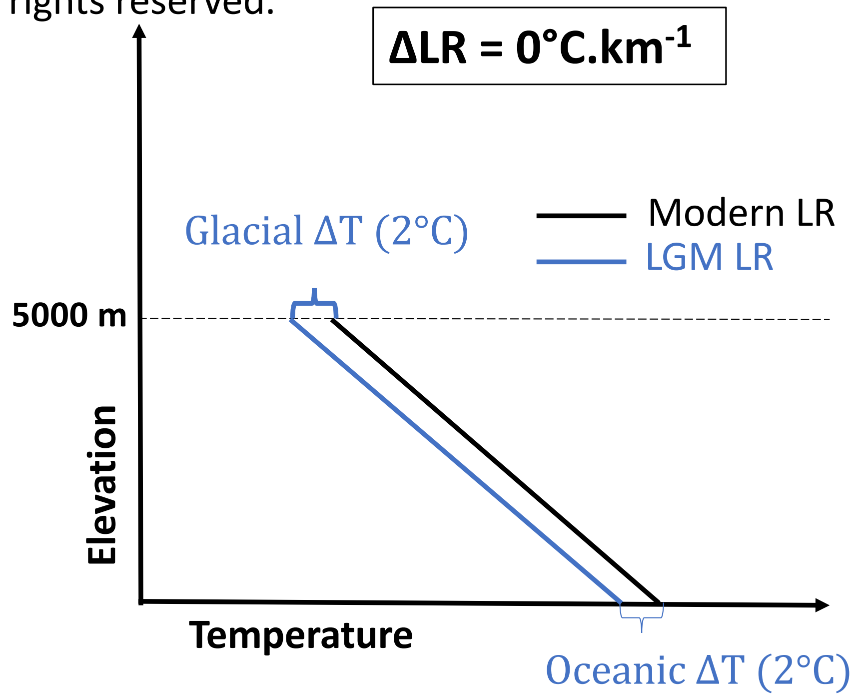
LGM steeper lapse rate : amplified cooling at high altitude?



Africa Loomis, 2017	Central Pacific Blard, 2007

Steeper LR : High altitude amplification of cooling

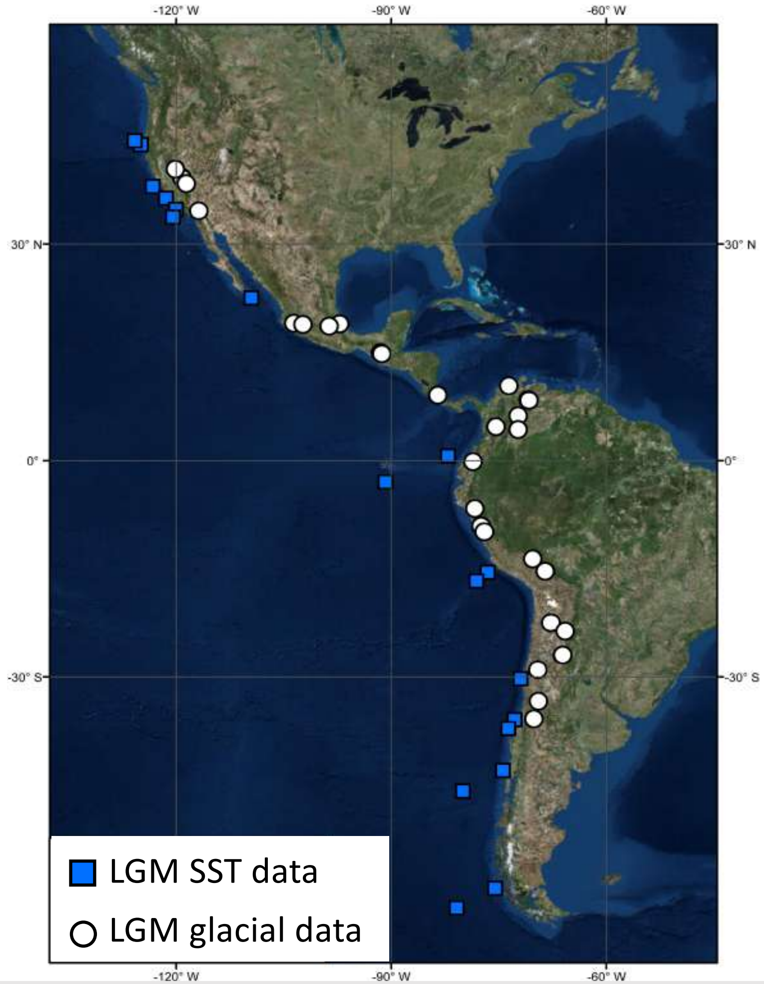
?



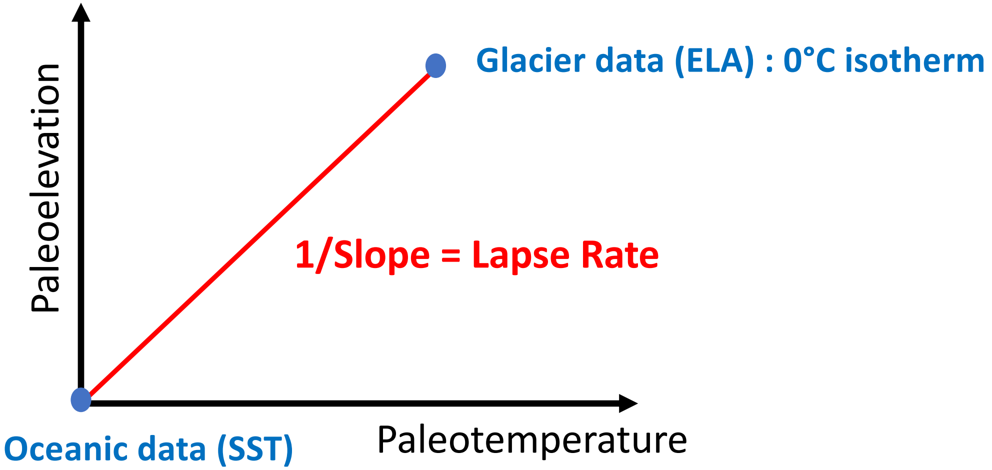
Western Pacific Tripati, 2014

Constant LR : No high altitude amplification of temperature changes

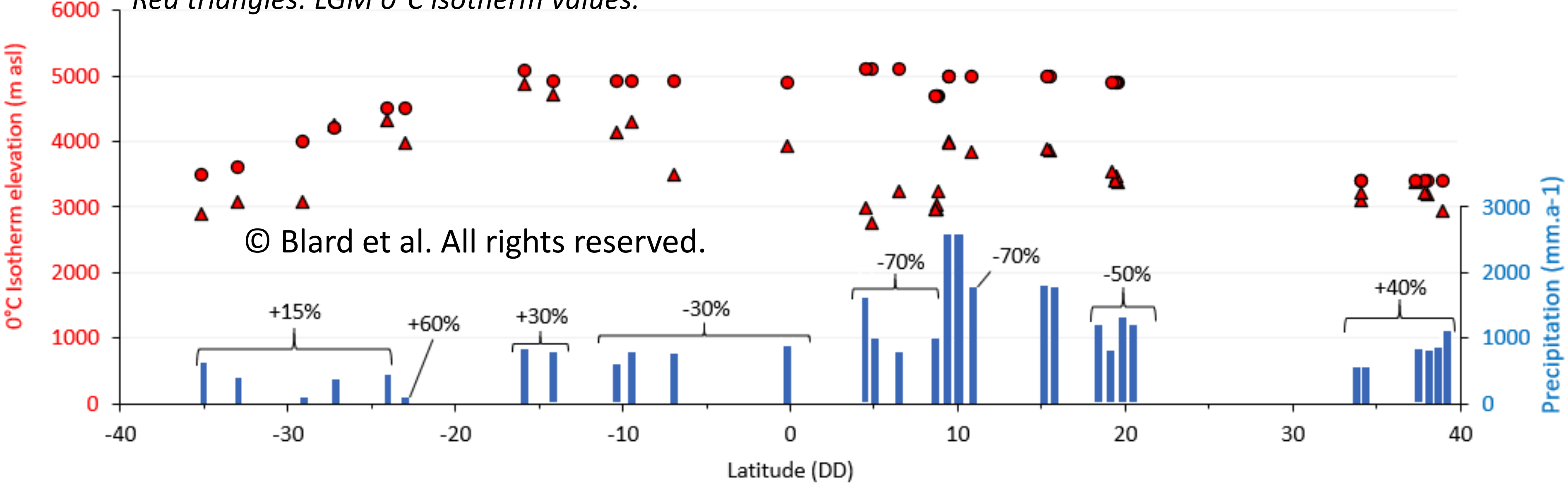
Studied area: the American Cordillera



- **Coastal range**
- **High latitudinal extent (60°N – 50°S**
- **Processed dataset : 18 oceanic cores - SST from alkenones, 34 LGM glacial site dated by cosmogenic nuclides (^{10}Be, ^{3}He)**



Results: Isotherm 0°C

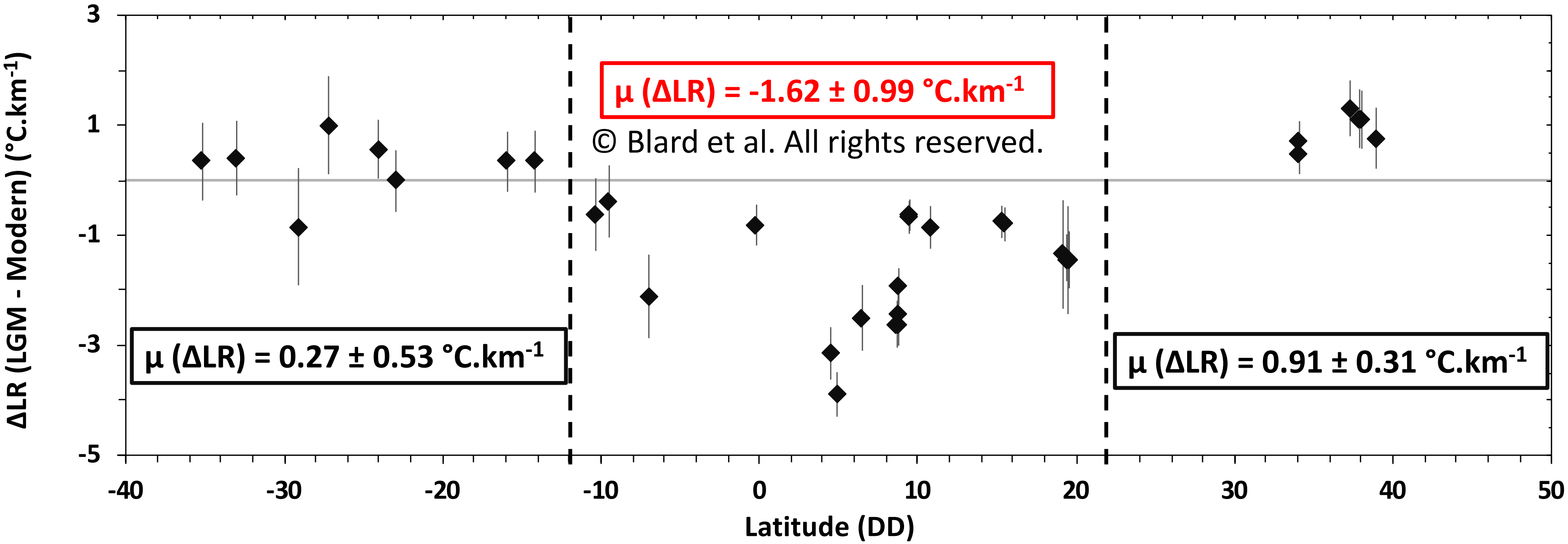


Modern mean annual precipitation are plotted for each computed sites (blue sticks). Percent values refers to LGM mean annual precipitation changes relative to present. If no value are mentioned, LGM mean annual precipitation equal modern mean annual precipitation.

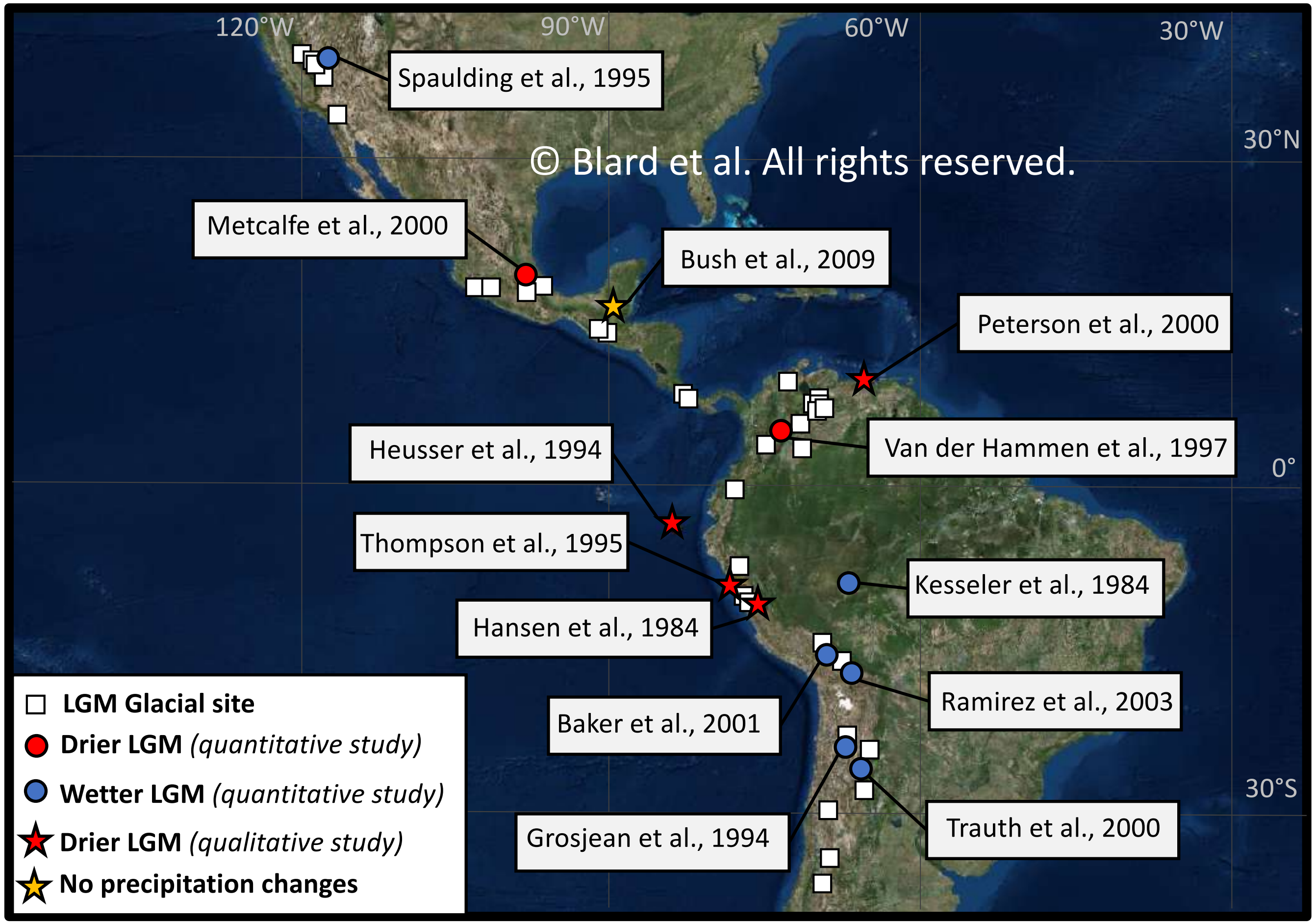
Moraines data from:

Martini et al., 2017; Martin et al., 2018; D'Arcy et al., 2019; Moreiras et al., 2017; Zech et al., 2006, 2007, 2017; May et al., 2011; Ward et al., 2015; Potter et al., 2015; Heine et al., 2011; Lachniet et al., 2005; Vazquez et al., 2004; Mason et al., 2016; Farber et al., 2005; Hall et al., 2009; Shakun et al., 2015; Pierce et al., 2017; Owen et al., 2003; Rood et al., 2011; Schaefer et al., 2006; Philipps et al., 1996; Carcaillet et al., 2013; Lachniet et al., 2005; Stansell et al., 2007

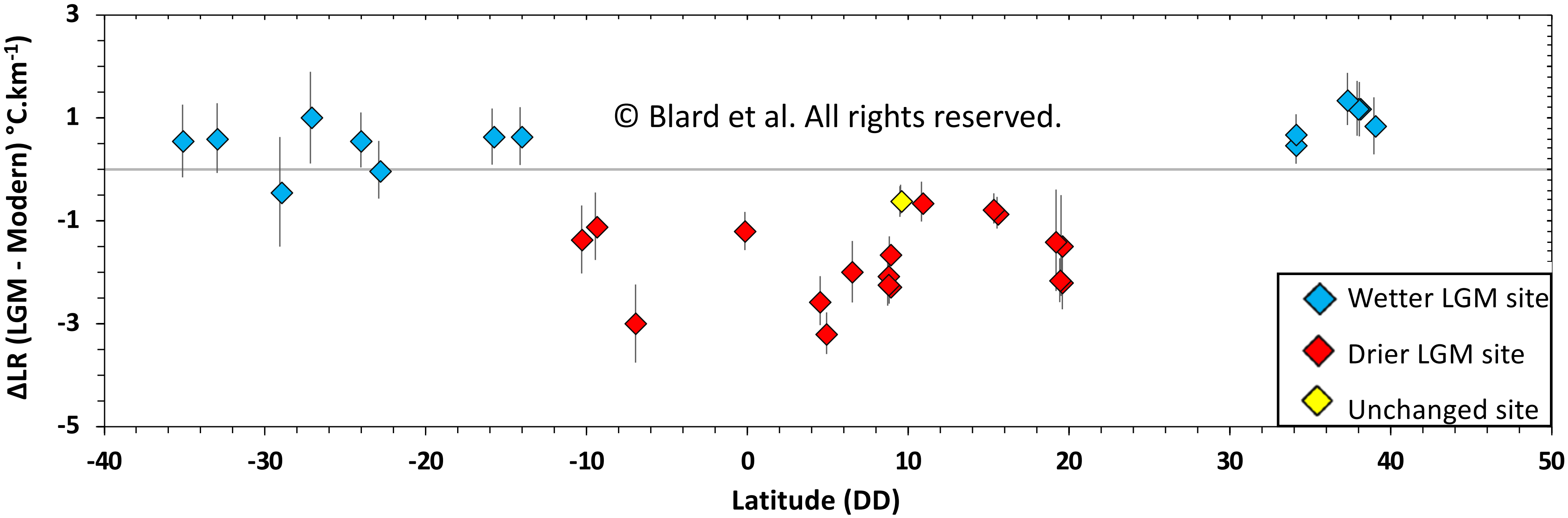
Steeper Lapse Rate in the -10°S – 20°N band – unchanged elsewhere



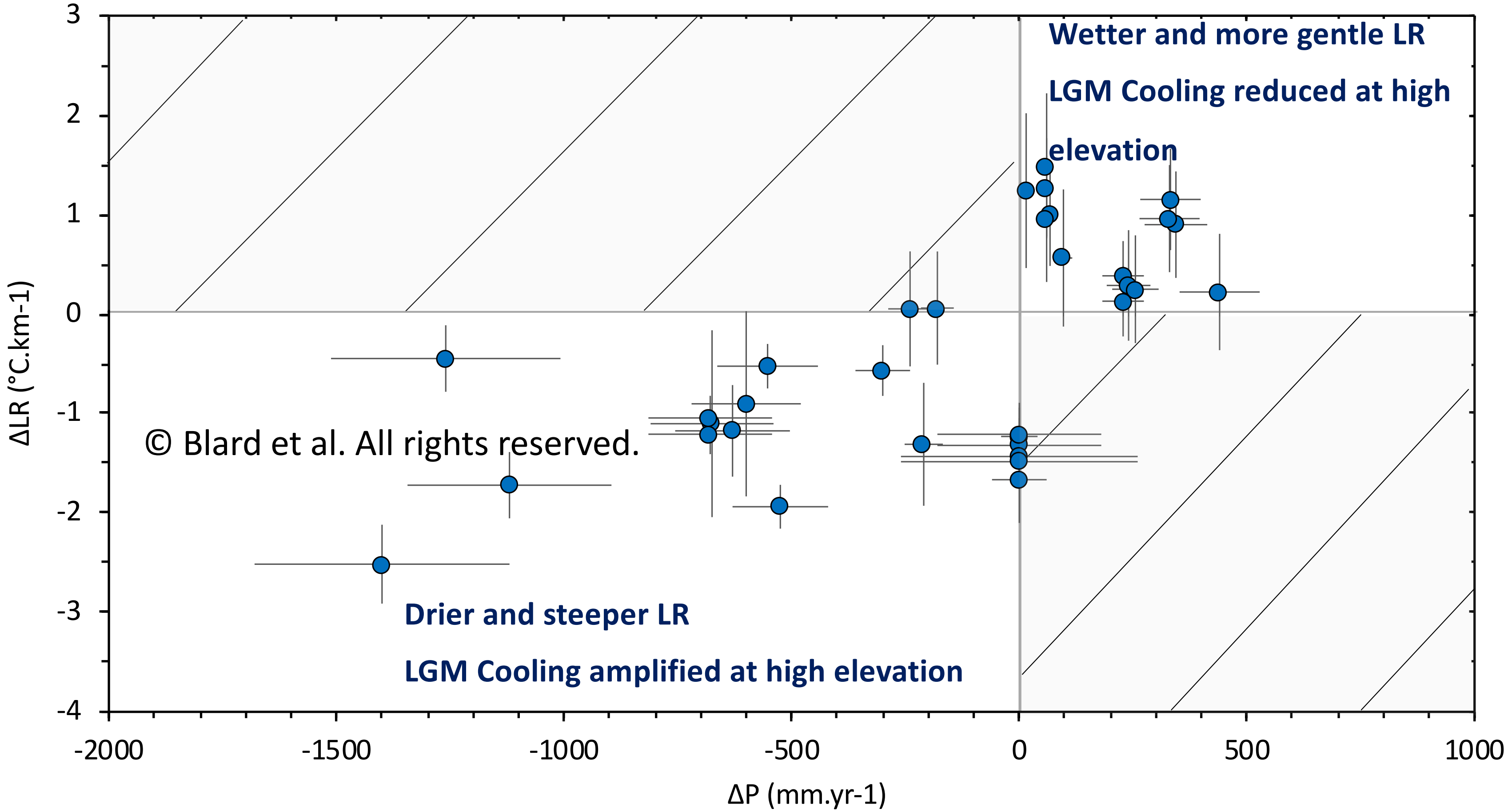
Precipitation changes during LGM



Lapse rate variations are driven by precipitation



LGM lapse rate variations are driven by precipitation



Conclusions

- Controls of precipitation on lapse rate variation

- Steeper lapse rate in tropics during the LGM in drier region

- Implication for ongoing warming at high elevation :
amplification of warming in regions that will become wetter
and
mitigation of warming in region that will become drier

- Comparison with GCM outputs (Kageyama et al., 2005): not clear

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