

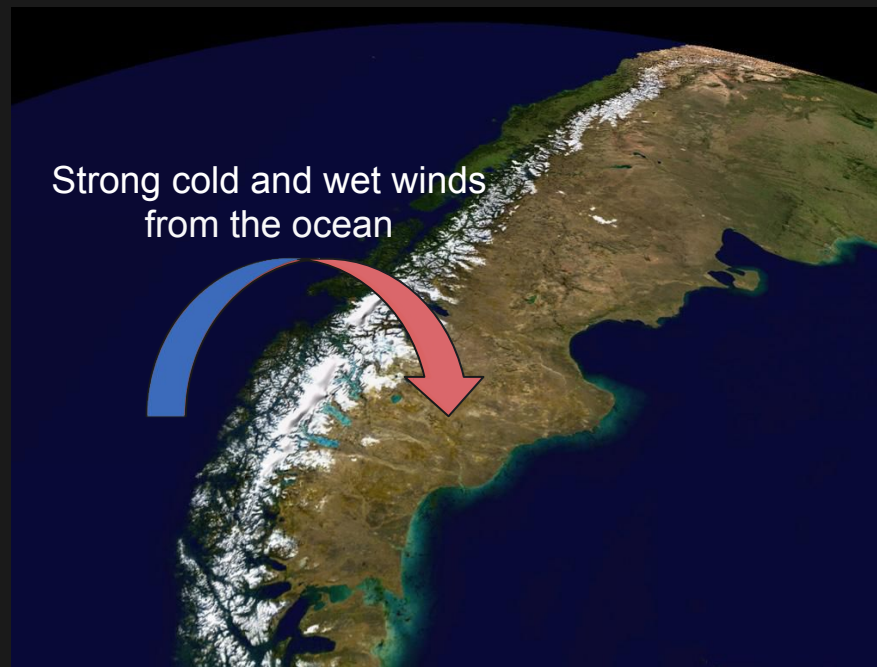


Impact of topographic aggregation in the Modèle Atmosphérique Régional (MAR) in Patagonia

Thesis presented by Adrien Damseaux
Promoters: Xavier Fettweis, Yves Cornet

PATAGONIAN CLIMATE

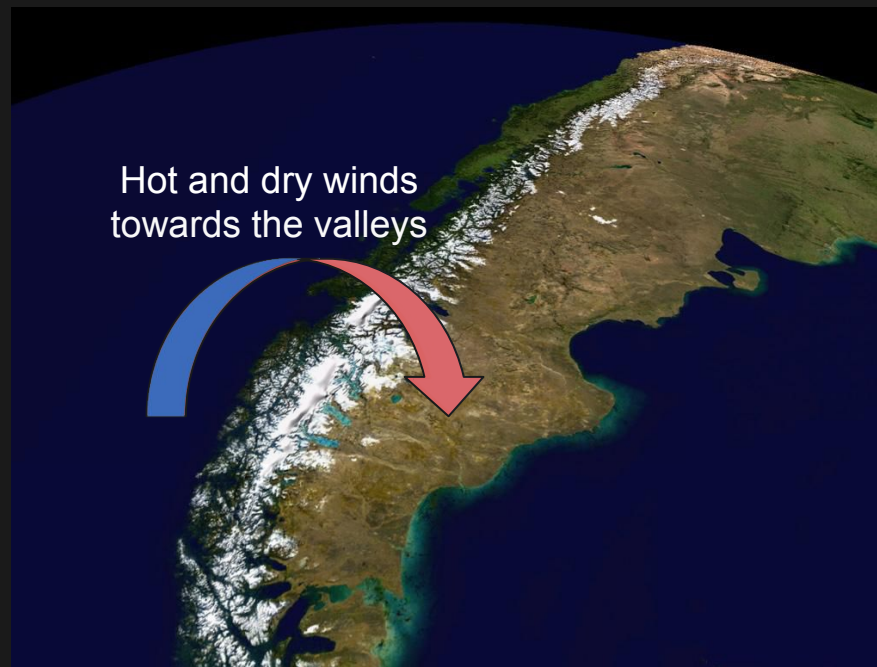
Topography is a main controlling factor in Foehn winds modelling



Satellite view of Patagonia (argentour.com)

PATAGONIAN CLIMATE

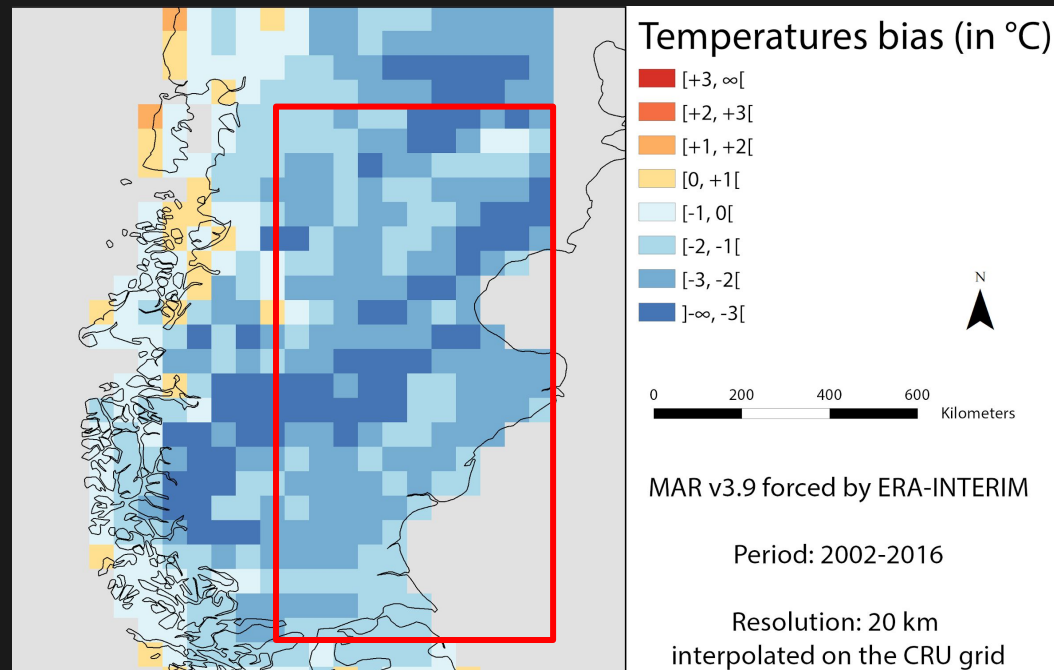
Topography is a main controlling factor in Foehn winds modelling



Satellite view of Patagonia (argentour.com)

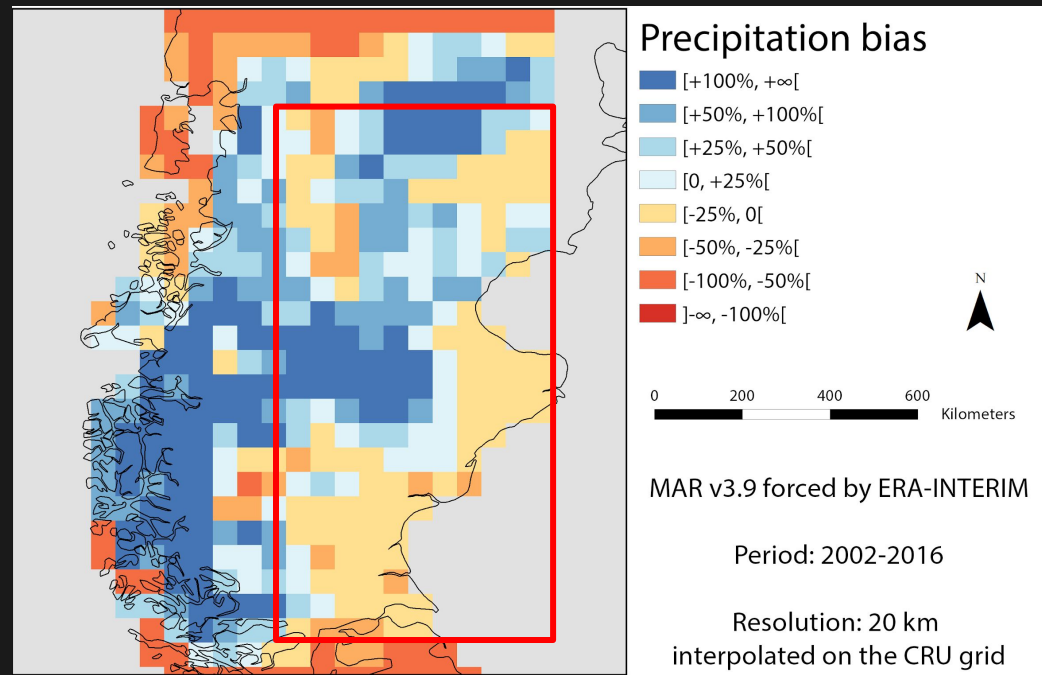
MAR vs CRU

- Colder temperatures on the east of the mountains



MAR vs CRU

- Too much precipitation on the east of the mountains

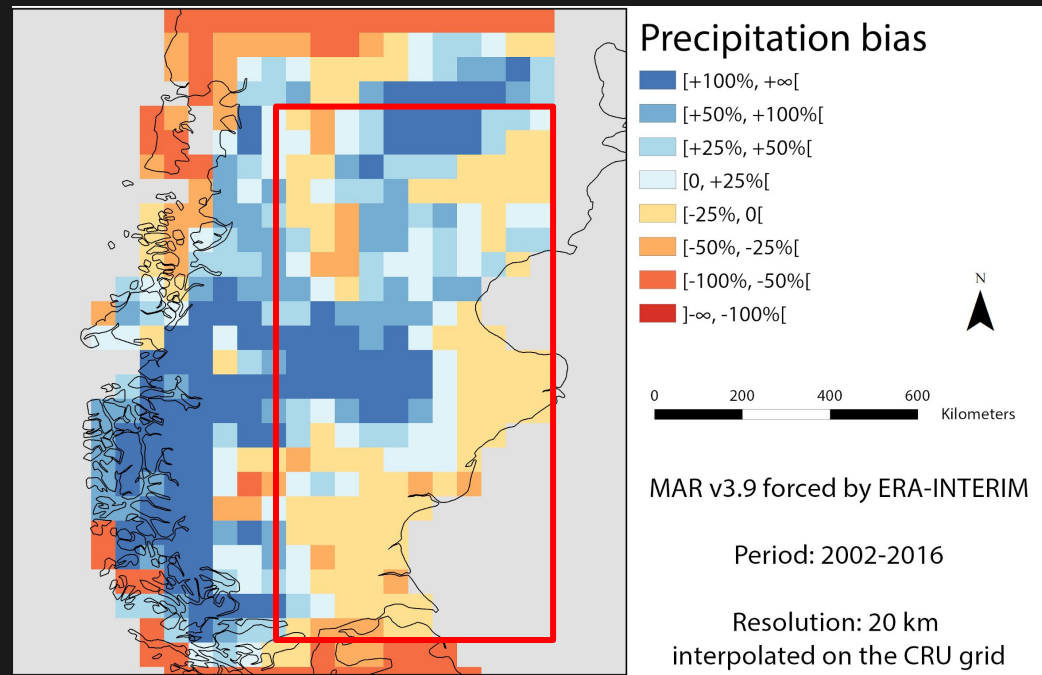


MAR vs CRU

- Too much precipitation on the east of the mountains

Conclusion: Actual 20 km resolution MAR is unable to reproduce Foehn winds

Due to topography underestimation?

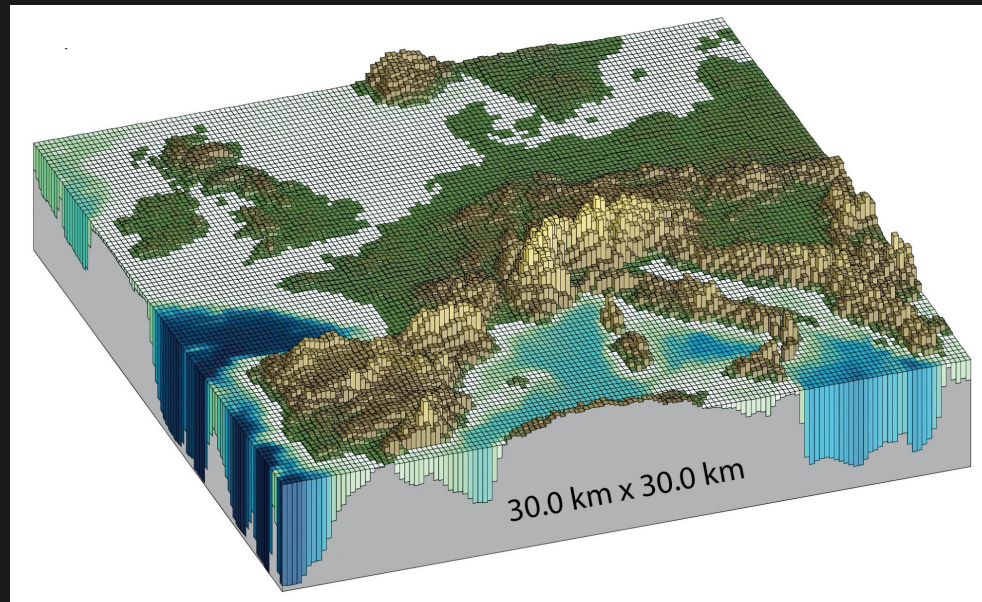


How can we represent
a blocking effect
at low resolution?

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TOPOGRAPHIC AGGREGATION

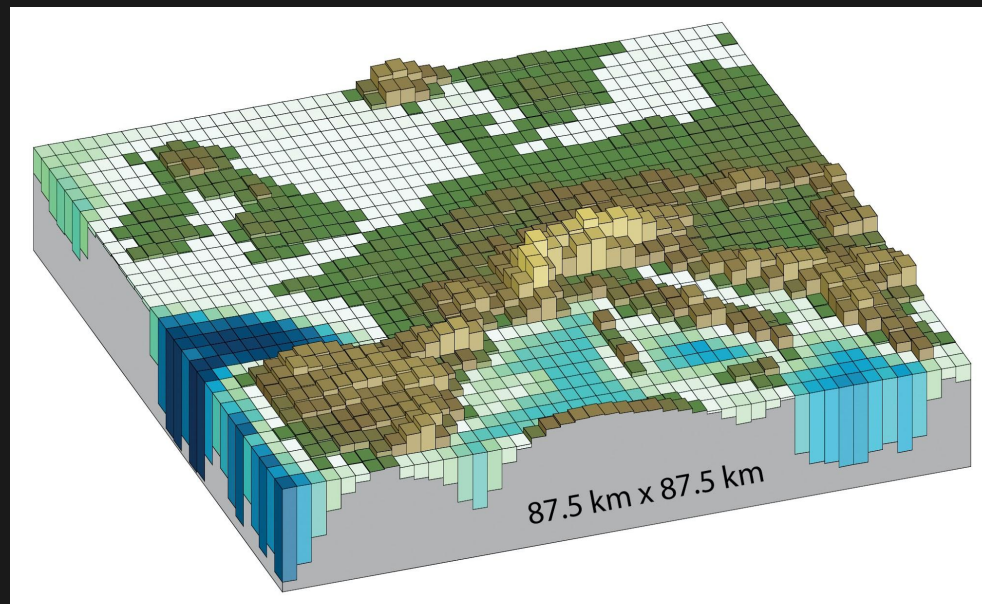
- Generalization of the topography from a high resolution grid to a low resolution grid



From IPCC AR5 (2014)

TOPOGRAPHIC AGGREGATION

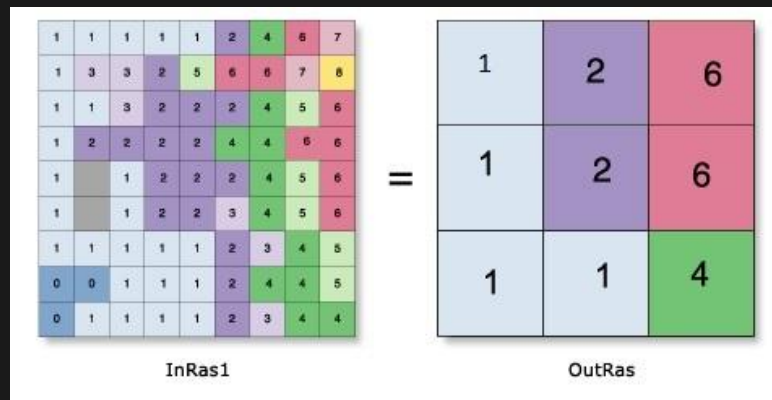
- Generalization of the topography from a high resolution grid to a low resolution grid



From IPCC AR5 (2014)

DIFFERENT METHODS

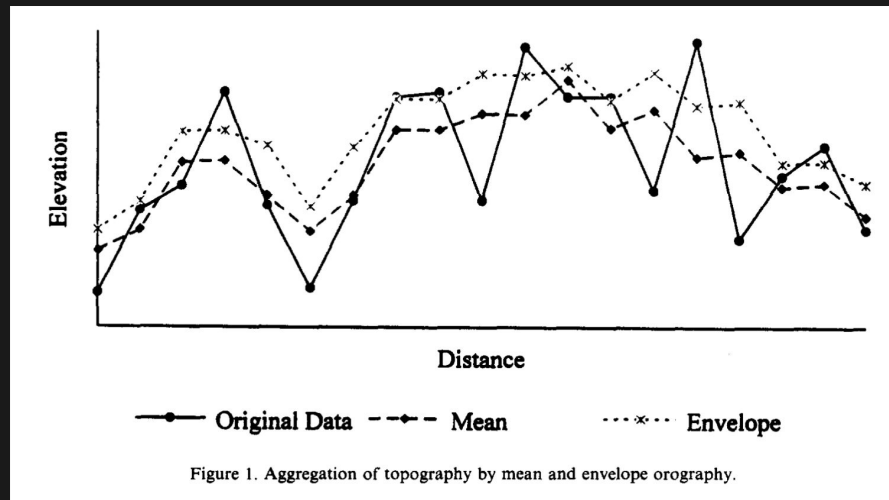
- Blur box or filter
 - Mean method



From ESRI documentation

DIFFERENT METHODS

- Blur box or filter
 - Mean method



Comparison of aggregation topography methods
(Bindlish and Barros, 1996)

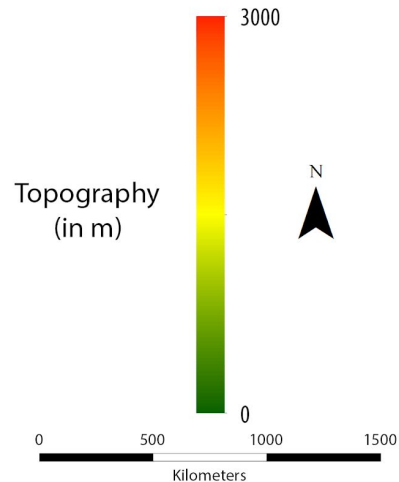
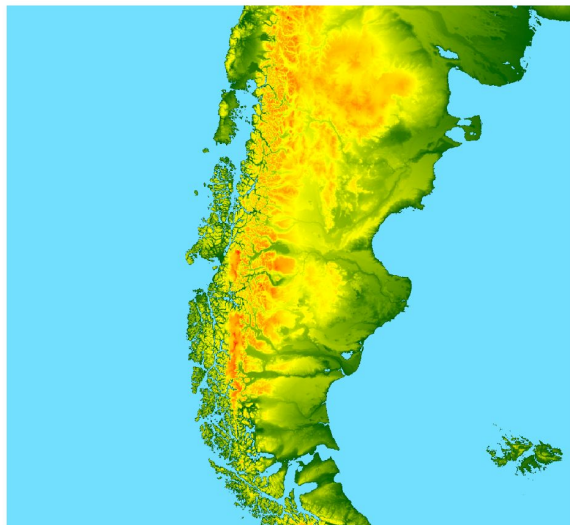
DIFFERENT METHODS

- Blur box or filter
 - Mean method
 - Percentile 90 method
- Envelope (maximum) method

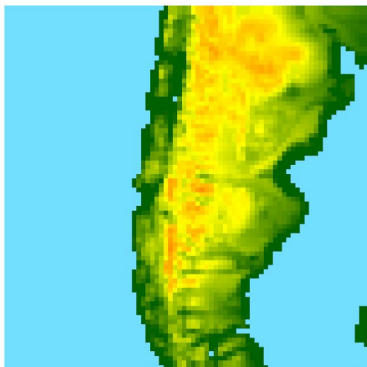
Two additional methods
performed in this study

Different topographic aggregation methods in Patagonia

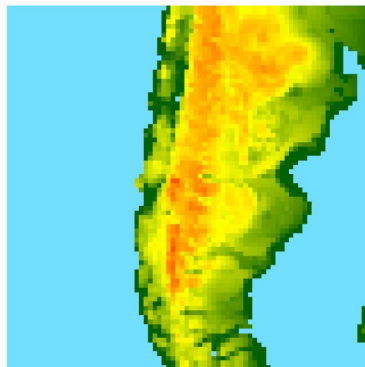
Input ETOPO1 (1 arc-m reso.)



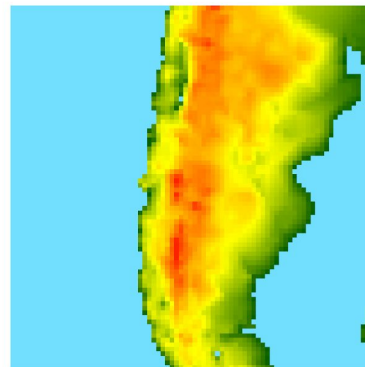
Mean (20 km reso.)



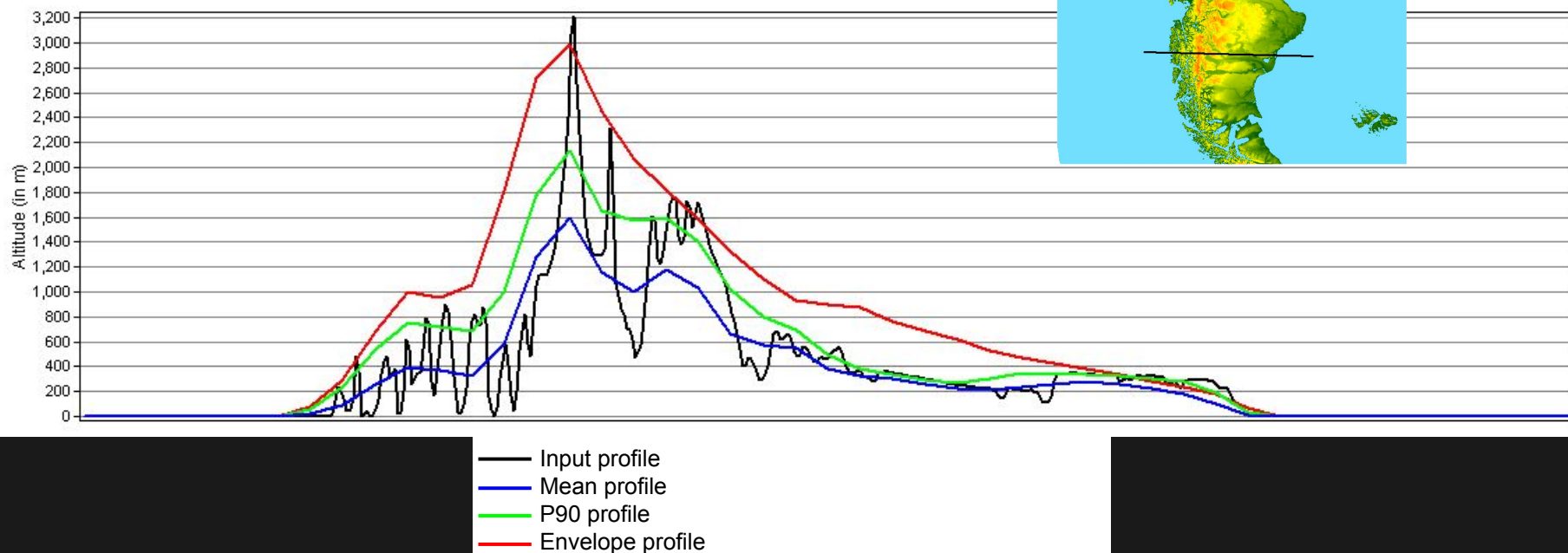
Percentile 90 (20 km reso.)



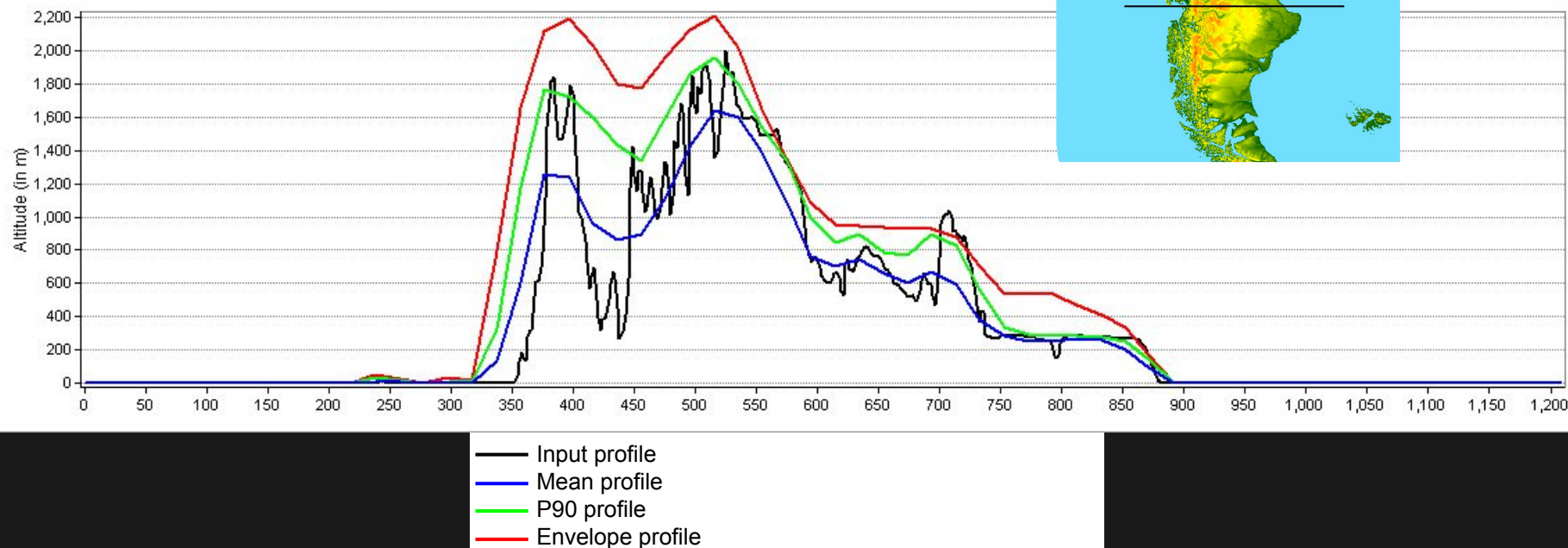
Envelope (20 km reso.)



TOPOGRAPHIC PROFILE



TOPOGRAPHIC PROFILE

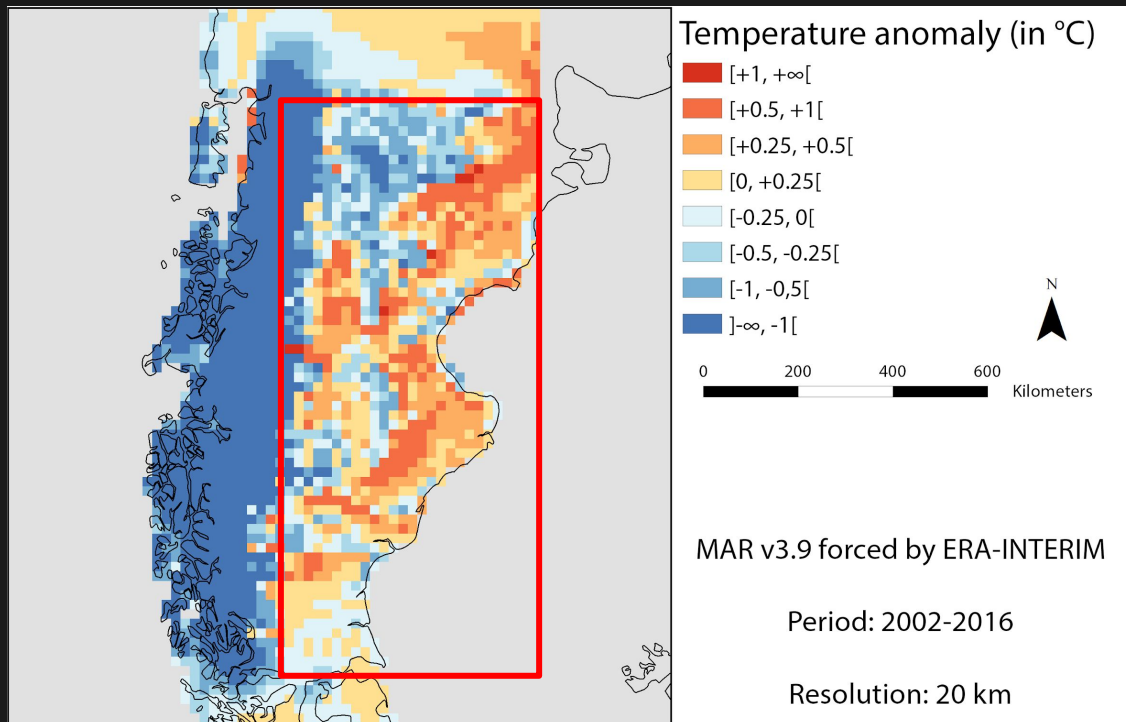


What is the impact of the different aggregation methods in MAR?

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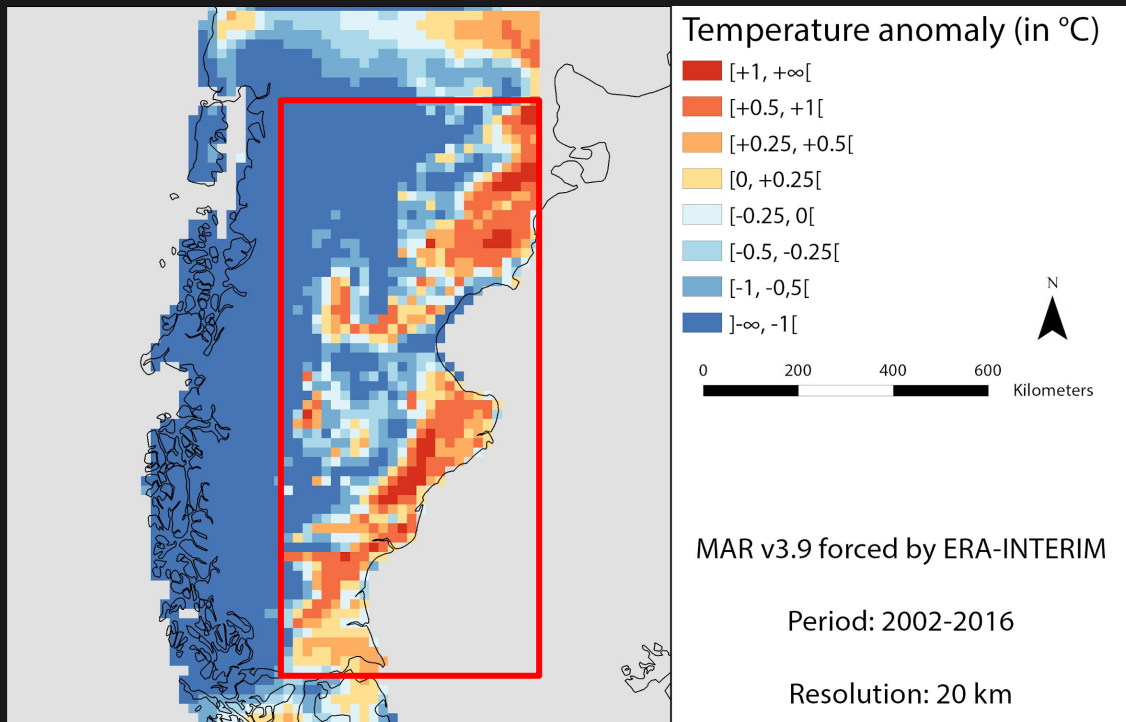
MAR (P90) vs MAR (MEAN METHOD)

- Temperatures significantly hotter on the east of the mountains



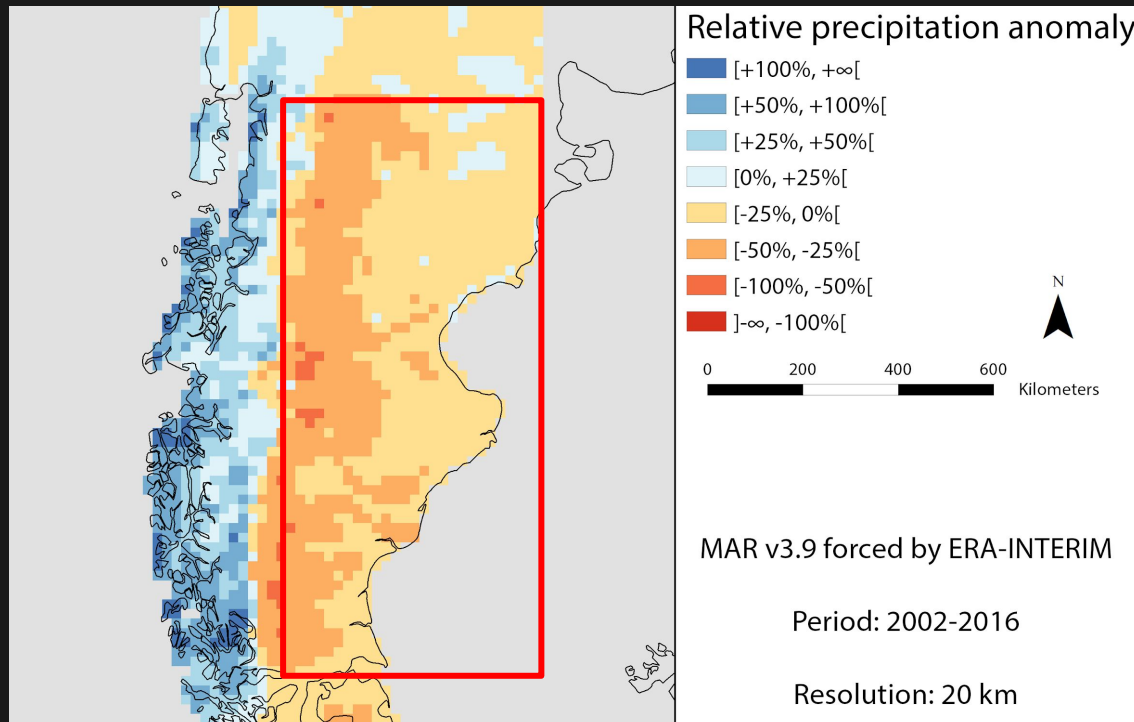
MAR (ENVELOPE) vs MAR (MEAN METHOD)

- Temperatures significantly hotter on the east of the mountains
- Cold temperatures exaggerated around the summits



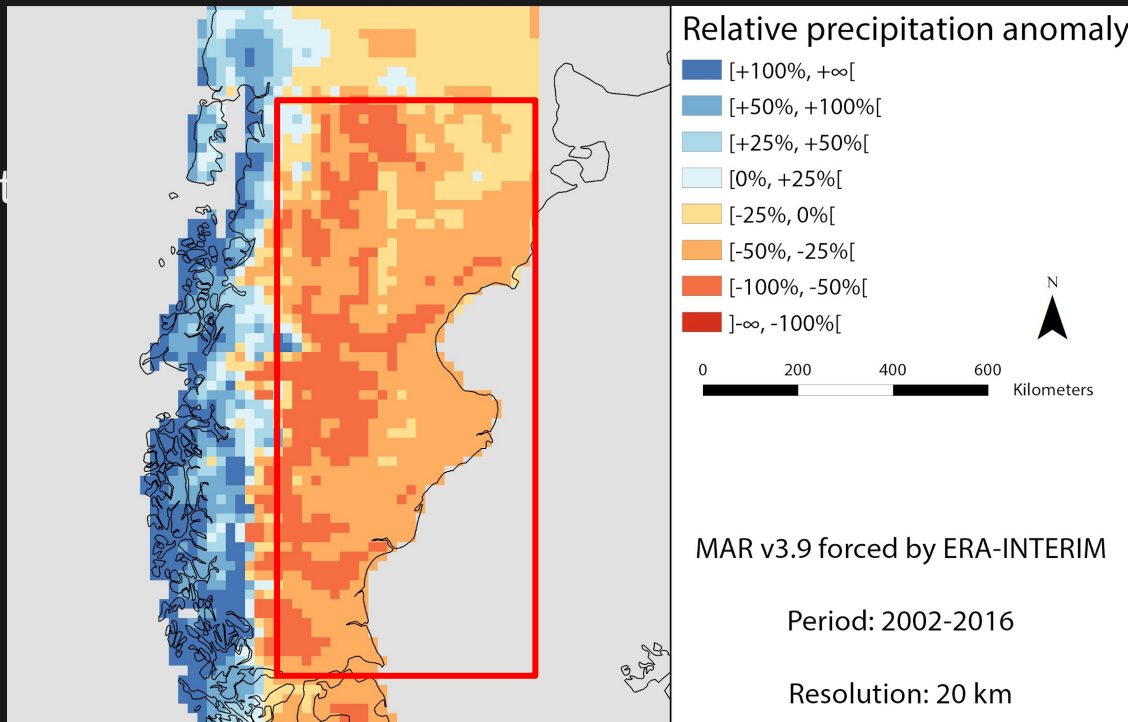
MAR (P90) vs MAR (MEAN METHOD)

- Precipitation significantly reduced on the east and increased on the west of mountains



MAR (ENVELOPE) vs MAR (MEAN METHOD)

- Precipitation considerably reduced on the east and increased on the west of mountains



CONCLUSIONS

- MAR using a topography derived from a mean aggregation method is not able to model Foehn winds in Patagonia
- MAR using a topography derived from the P90 or envelope (maximum) method is a better fit for Foehn winds modelling in Patagonia
- Is a higher resolution (>20 km) required to match observations?

NEXT STEPS...



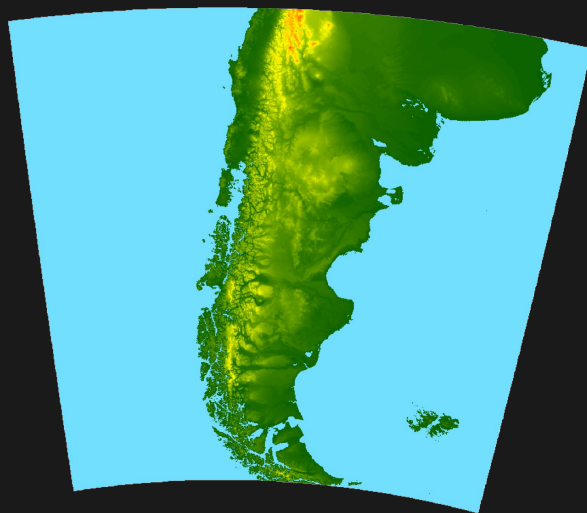
- Same study with a 10 km resolution
- Fourth method using watersheds instead of summits

QUESTIONS?

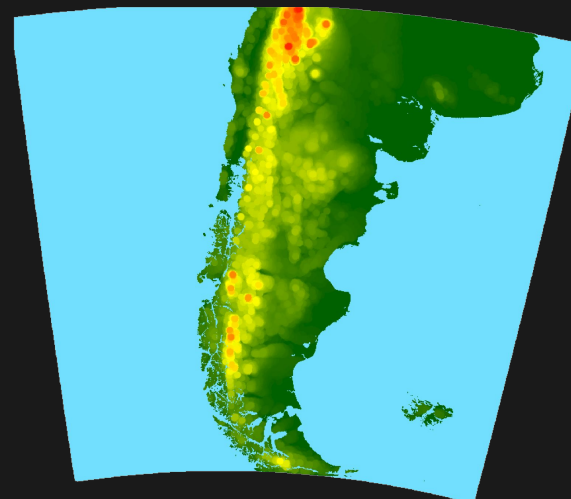
- Contact: adrien.damseaux@student.uliege.be
 - Meet me at poster “Assessing the future evolution of climate extremes favouring floods in Belgium by using the regional climate model MAR over the CORDEX.be domain, C. Wyard” during Regional climate modeling, including CORDEX posters presentation
- Reference
 - Bindlish, R. and Barros, A.P., 1996. Aggregation of digital terrain data using a modified fractal interpolation scheme. Computers & Geosciences, 22(8), pp.907-917.

EXTRA QUESTIONS

ENVELOPE (MAXIMUM) METHOD 1

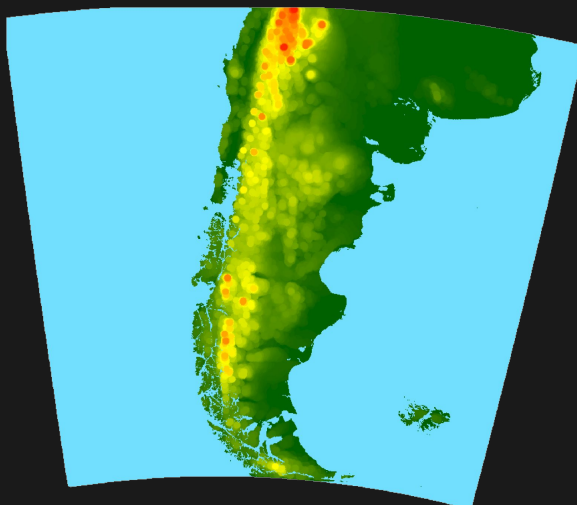


Input file ETOPO1
1 arc-minute resolution

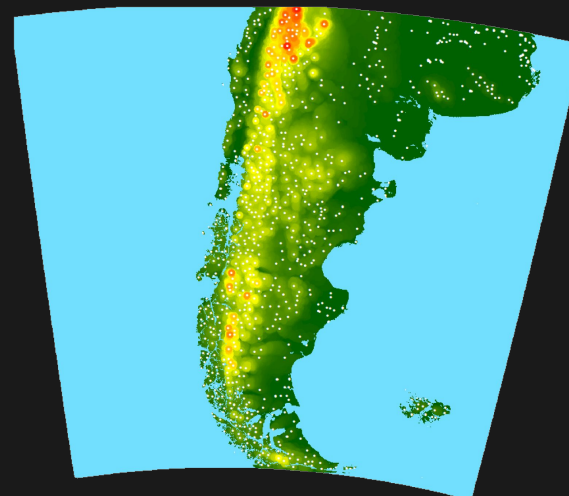


Maximum radius
Fit to output resolution

ENVELOPE (MAXIMUM) METHOD 2

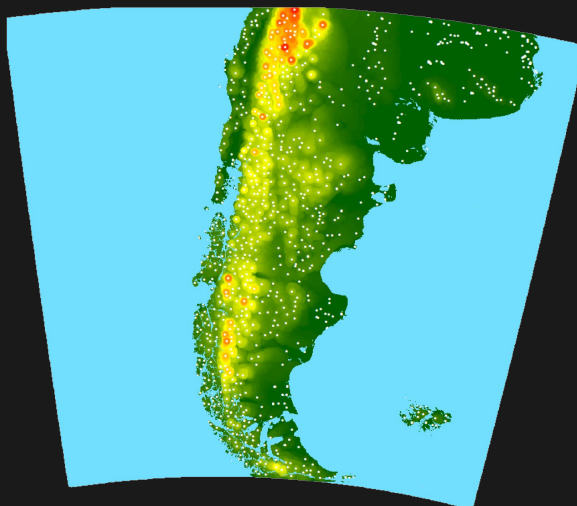


Maximum radius
Fit to output resolution



Isolate summits with a difference

ENVELOPE (MAXIMUM) METHOD 3

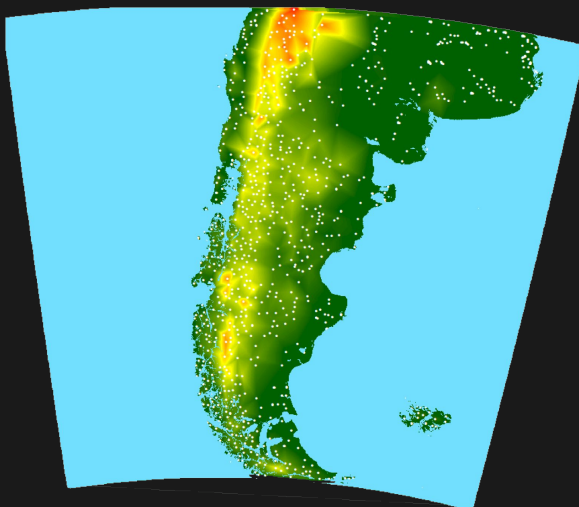


Isolate summits with a difference

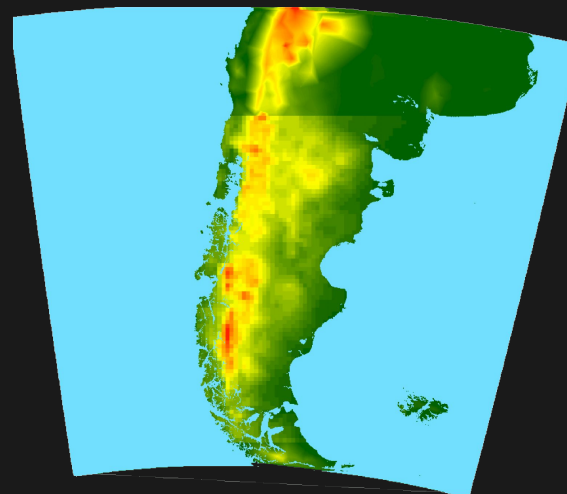


TIN interpolation from the isolated summits

ENVELOPE (MAXIMUM) METHOD 4

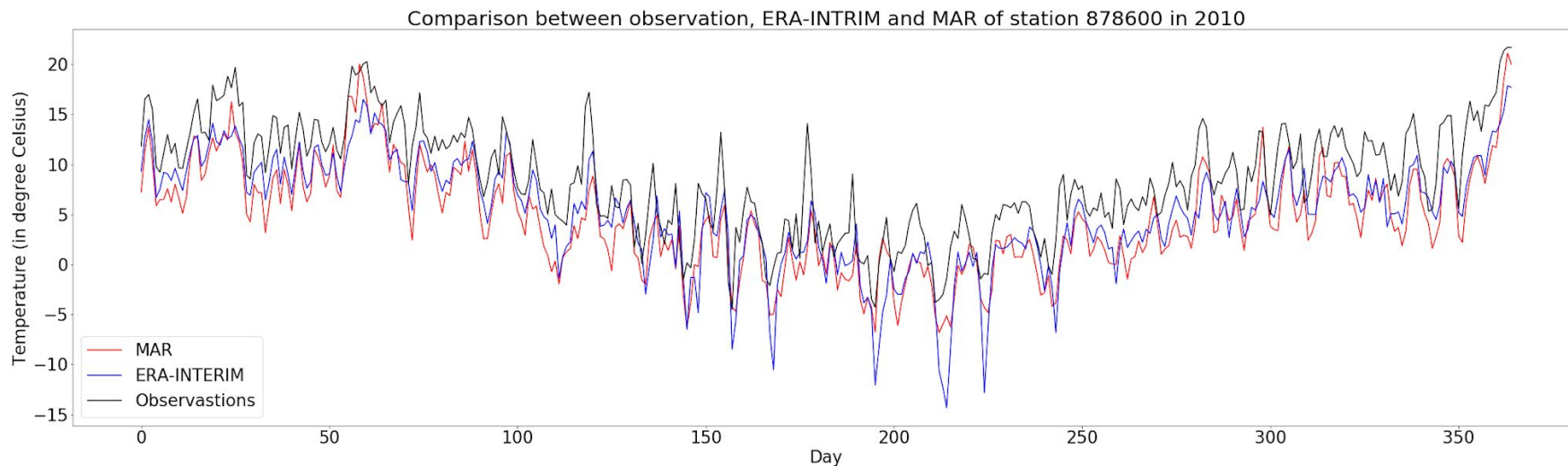


TIN rasterized from the isolated summits



Extraction of the topography at a given resolution by simple interpolation

ERA-INTERIM TOO COLD?



ERA-INTERIM TOO COLD?

- “a systematic underestimation of around 2 C is apparent along the Andes” (Solman et al. 2013)
- Further studies are needed...

The seasonal bias temperature for JJA (left) and DJF (right). The units of are in C. From Solman, SA., et al., 2013. "Evaluation of an ensemble of regional climate model simulations over South America driven by the ERA-Interim reanalysis: model performance and uncertainties." Climate Dynamics 41.5-6 (2013): 1139-1157.

