Convection over midlatitudes mountains
Insights from WWLLN

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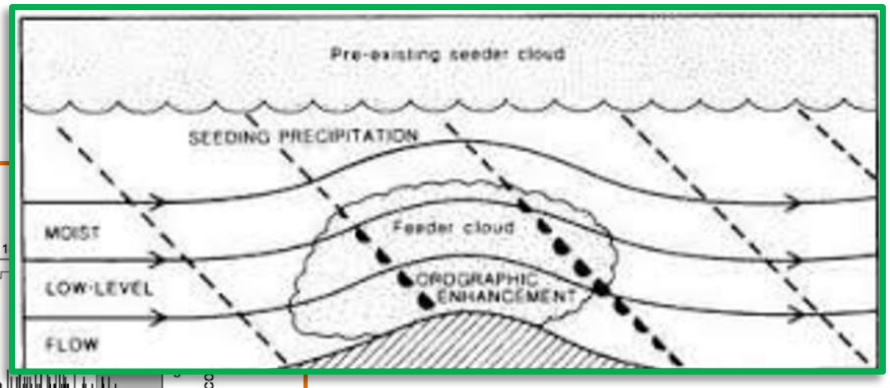
Thanks to: Ron Smith, Alison Nugent, Campbell Watson, Chris Kruse

We often envision (and model) midlatitudes orographic precipitation as a stable, near linear process….yet, tree rings chronologies suggest past fire activity in humid, cool western Patagonia



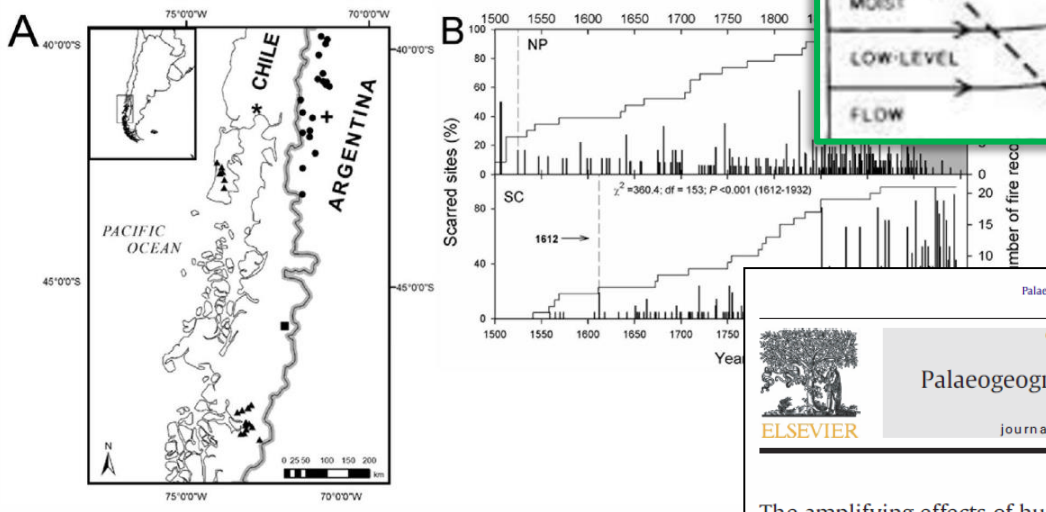


Figure 2. (a) Locations of the regional fire-chronologies in northern Patagonia (N
triangles), and of the Puerto Montt (asterisk), Bariloche (cross) and Balmaceda (squa
(1500–2004) of all fire events and sample depth of each region's chronologies (grey
period (post-1932) in the NP area). Chi-square and p-value are shown for the two
(≥10% of all sites in each area, with a minimum of two scarred trees per site, and of 5
Vertical dashed-lines and "1612→" indicate the start year of the fire chronology and of analysis.

Palaeogeography, Palaeoclimatology, Palaeoecology 311 (2011) 82–92

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Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

The amplifying effects of humans on fire regimes in temperate rainforests in western Patagonia

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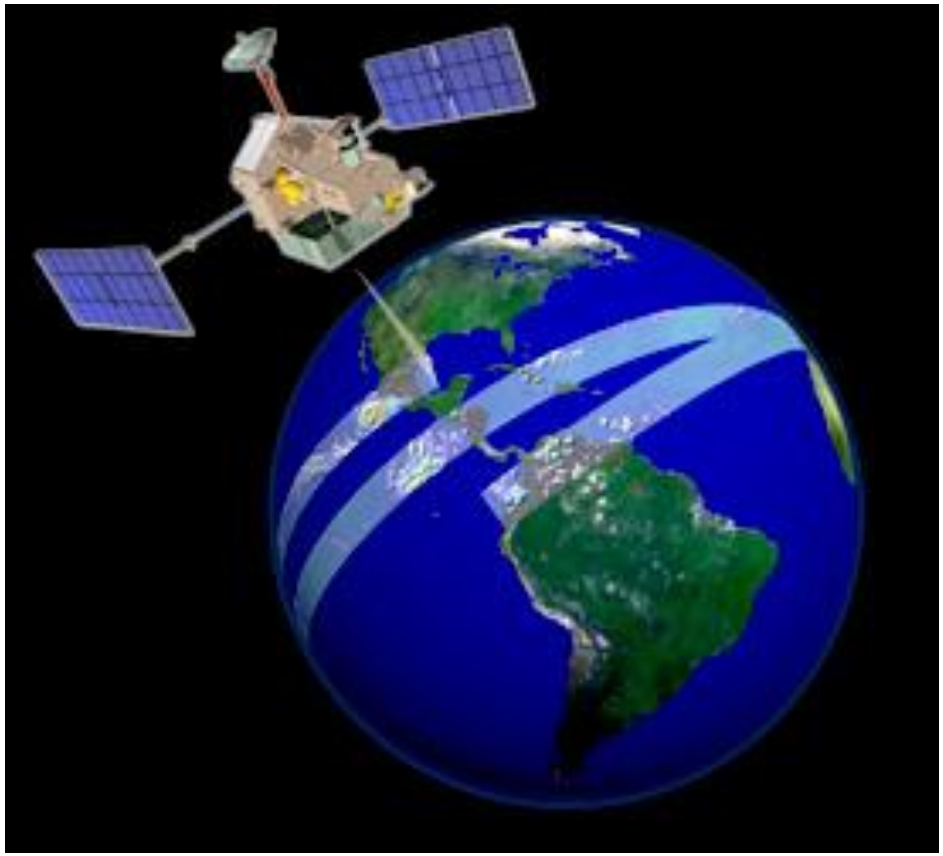
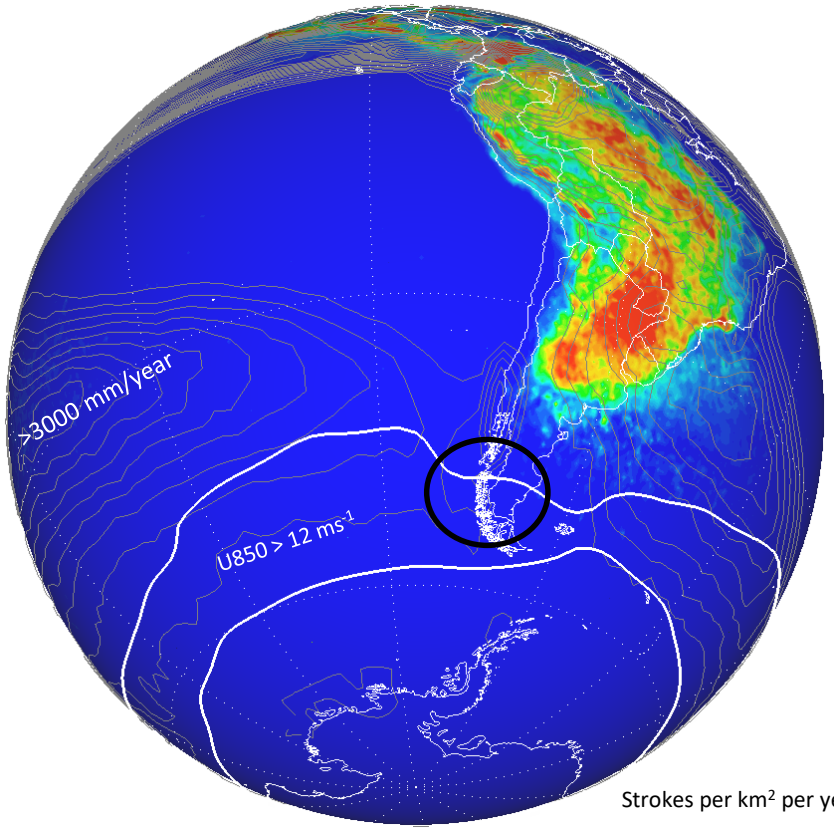
The Lightning Imaging Sensor (LIS)

LIS is on board of the Tropical Rainfall Measuring Mission (TRMM) detecting the discrete optical pulses associated with changes in cloud brightness at each pixel.

Its sampling is restricted to the ±38° latitude band





World Wide Lightning Location Network (WWLLN)

It monitors the VLF radio waves (sferics) emitted by lightning and uses a time of group arrival technique to locate lightning strokes within ~5 km and <10 μs. Online data available at: http://wwlln.net/

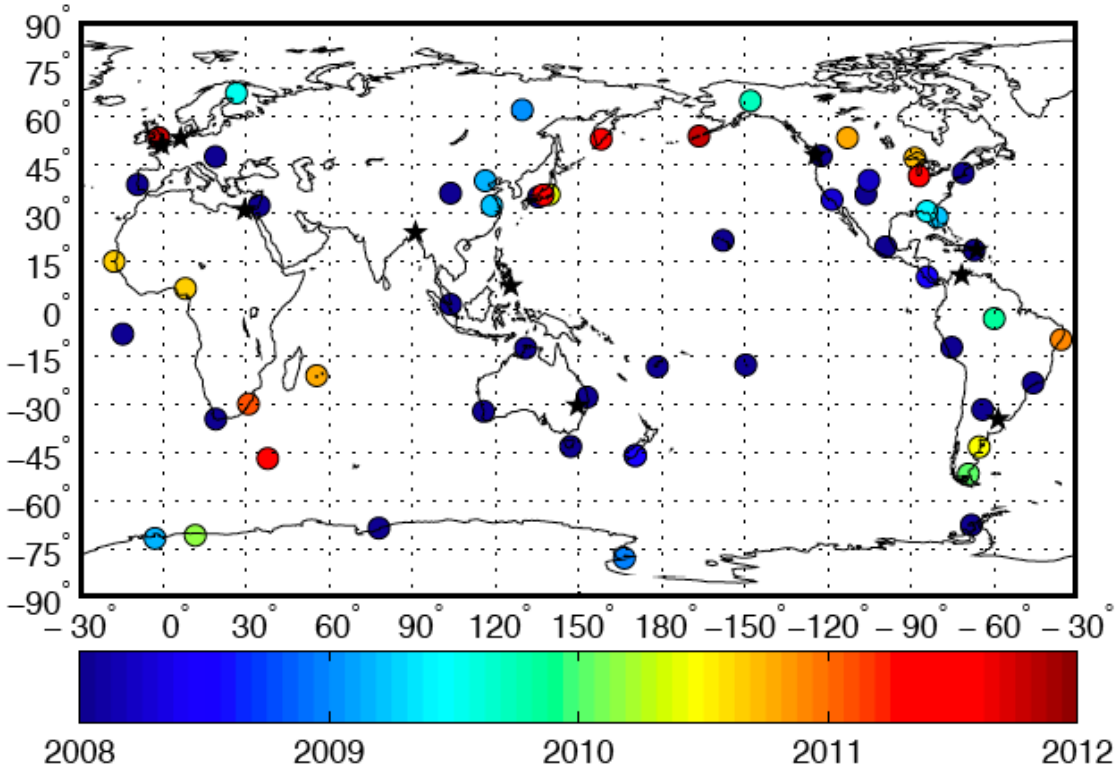
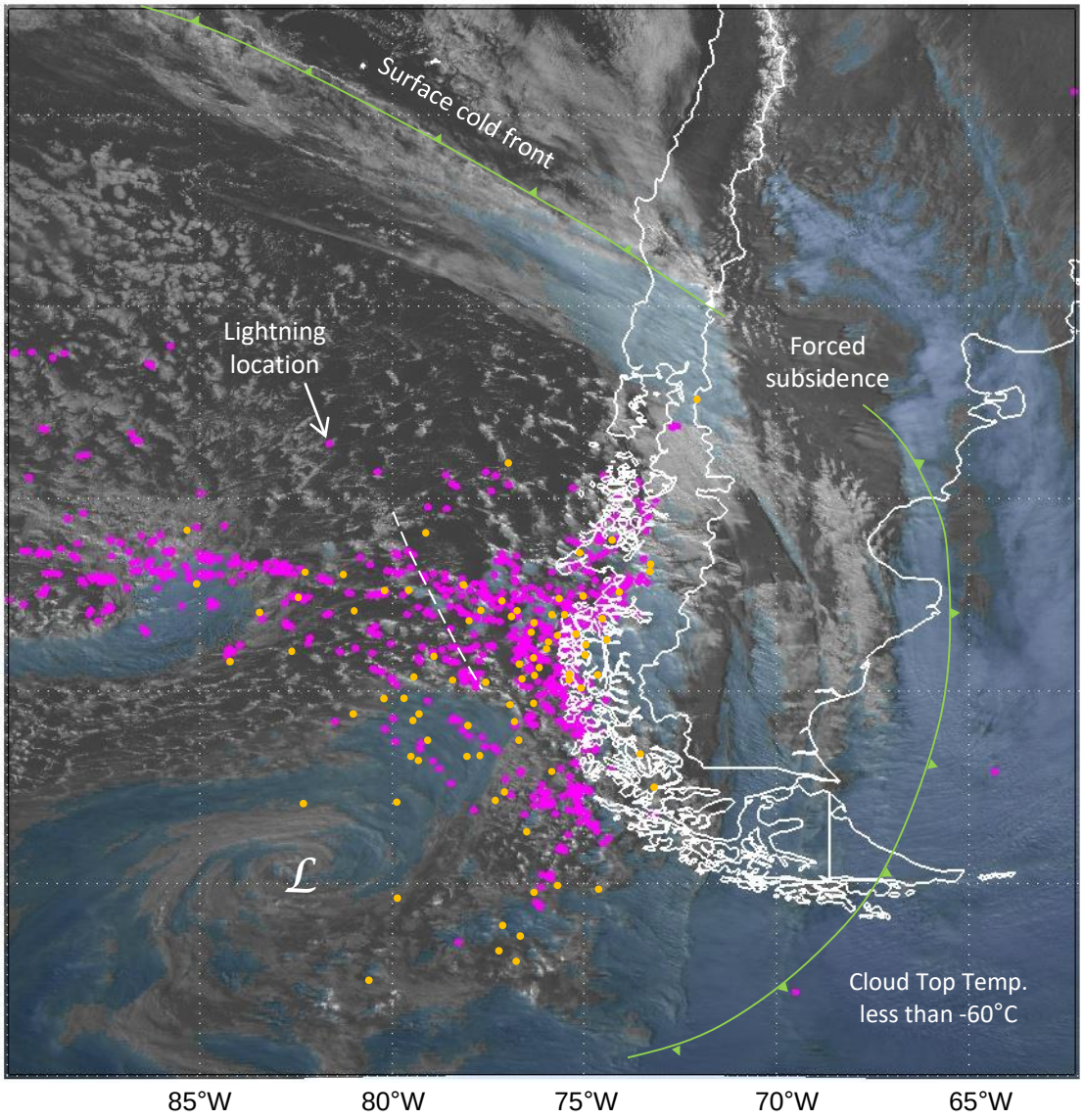


Figure 1. Location of WWLLN sensors, color-coded according to the date each was established. Stations established prior to 2008 are shown in dark blue; black stars indicate stations established 2012-present.

Virts et al. 2013

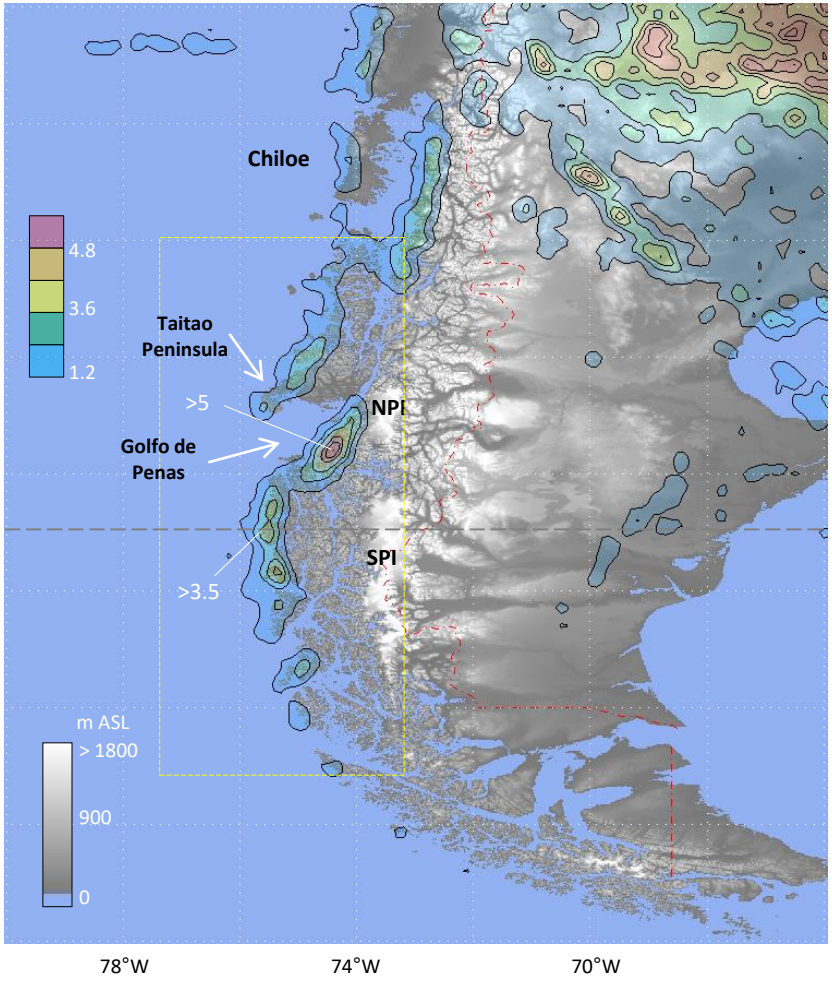
April 30, 2012 – 1800 UTC

GOES-13 Visible (BW) and IR4 (light shading) + WWLLN Lighting (dots) + Starnet

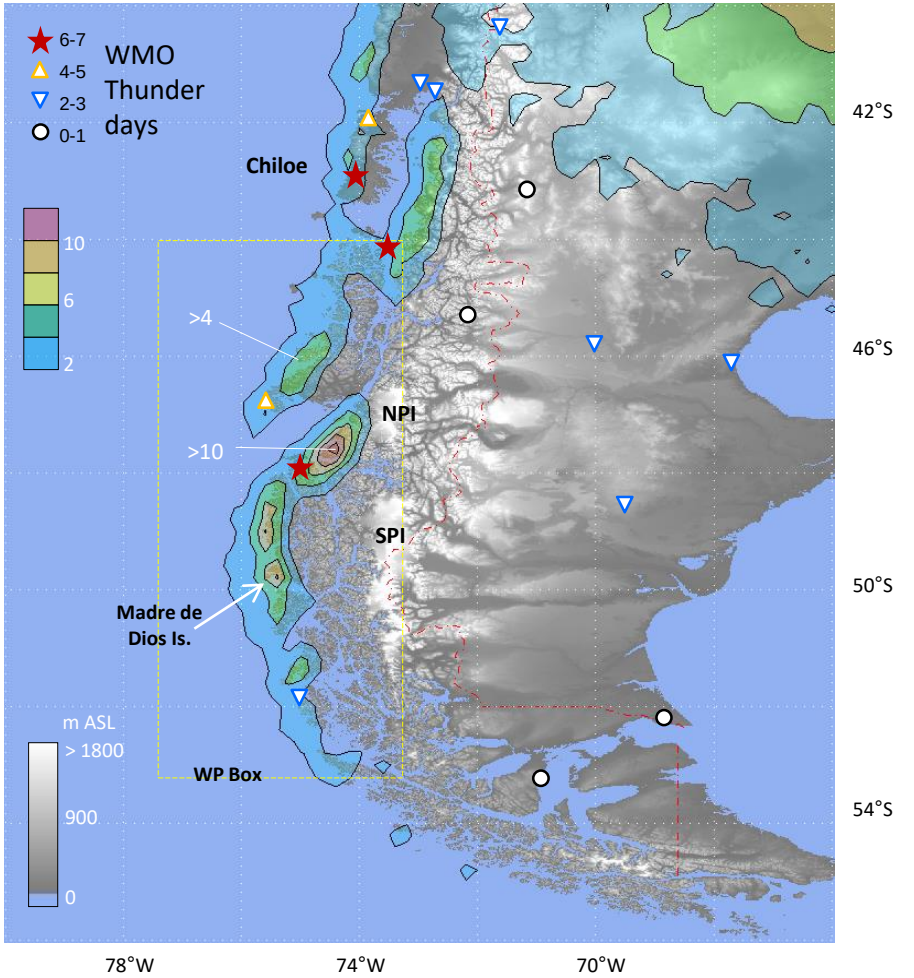


Spatial Distribution (2008-2012)

Lightning density, 0.1×0.1 lat-lon boxes



Number of lightning-days, 0.2×0.2 lat-lon boxes



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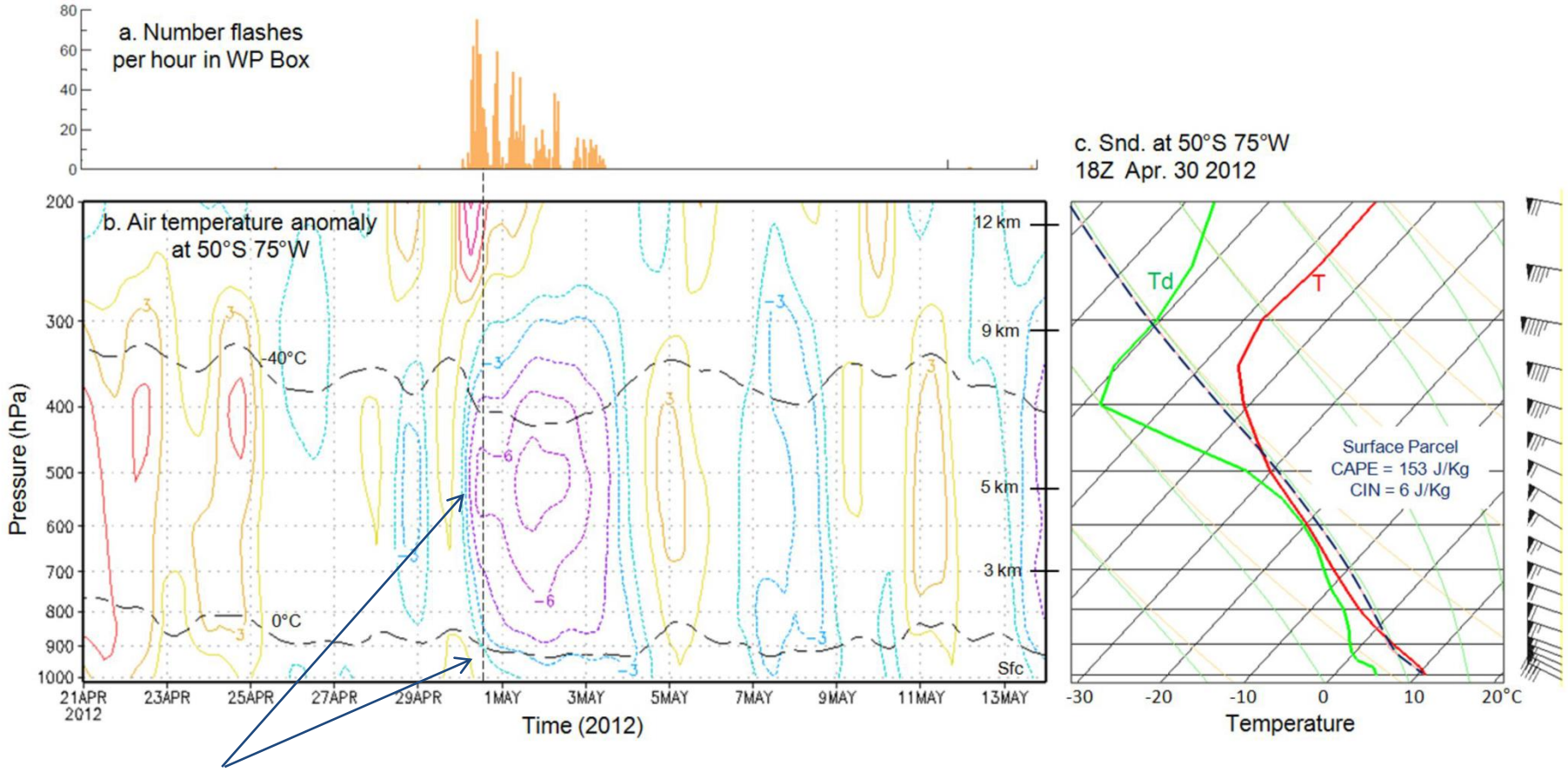
Electric activity in a slightly unstable environment and strong Westerly flow



Mid level cooling stronger and before than at surface

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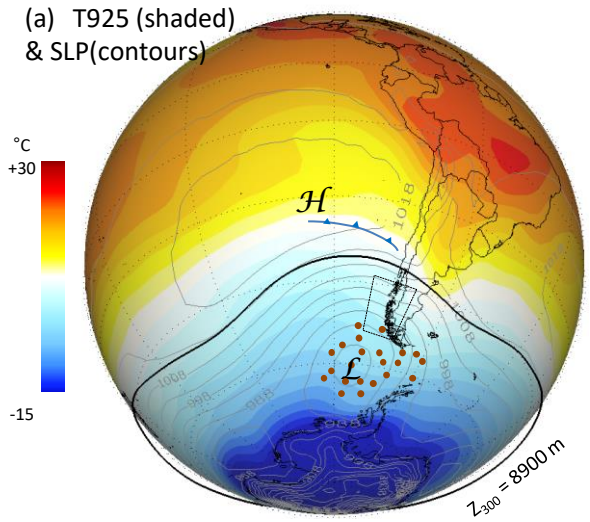
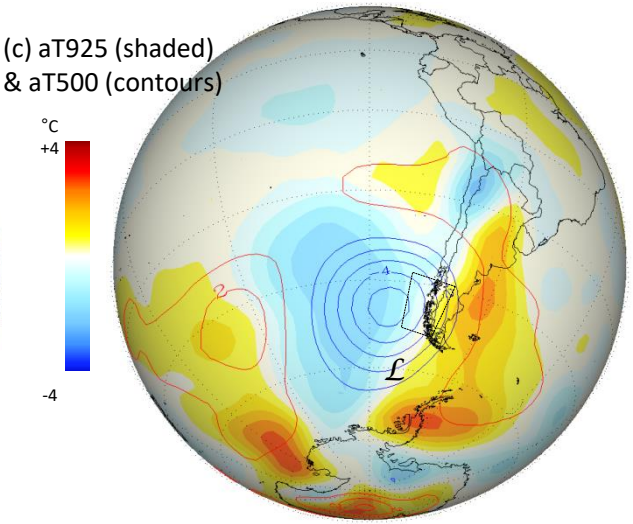
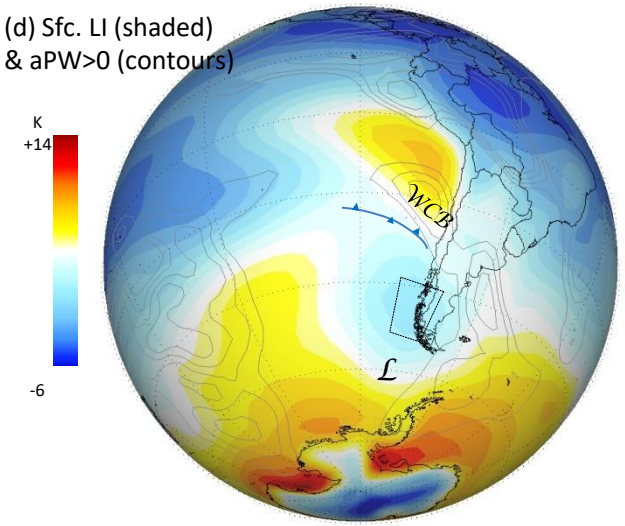
Compositing analysis for days with more than 50 flashed in WP Box (89 days)



Postfrontal condition



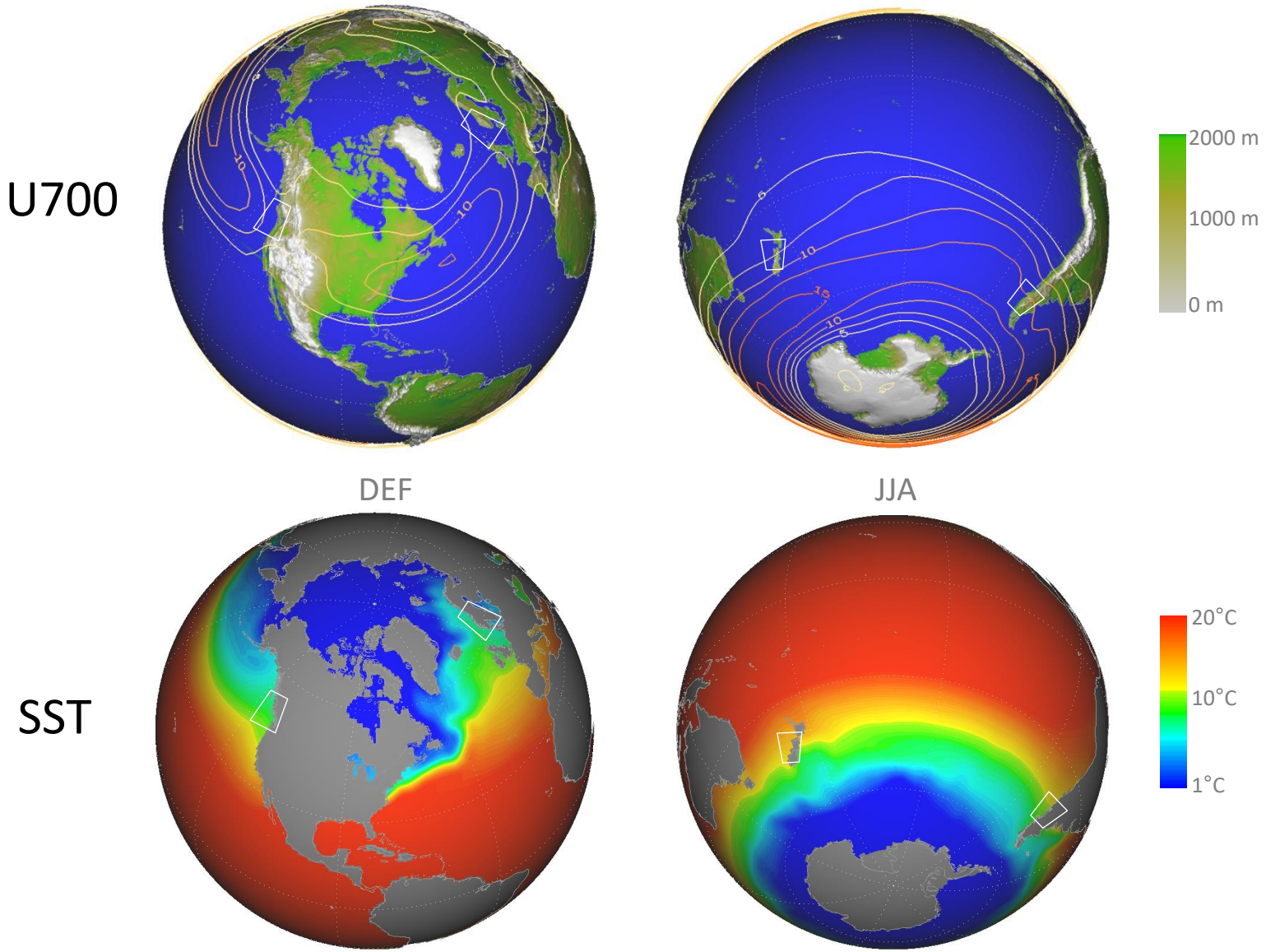
Stronger cooling aloft



Weakly unstable environment

Garreaud, Nicora et al. 2014

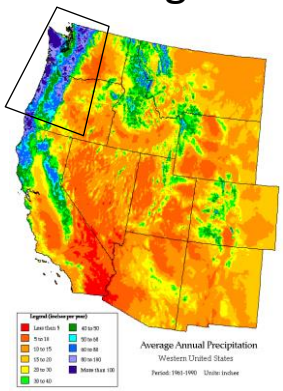
Study regions - Large Scale Context

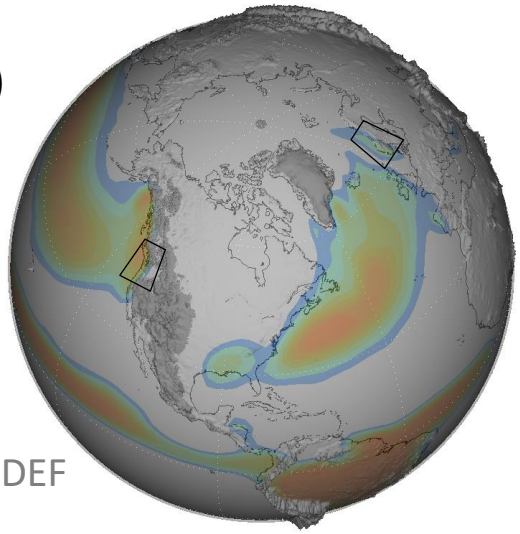


Study regions – GPCP mean Precipitation

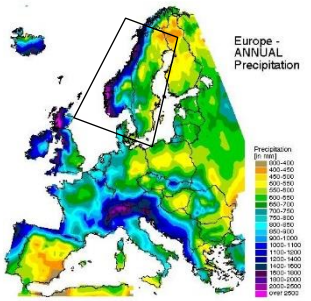
Note the strong orographic precipitation enhancement

Western North America
(coastal range + Rocky mnts)

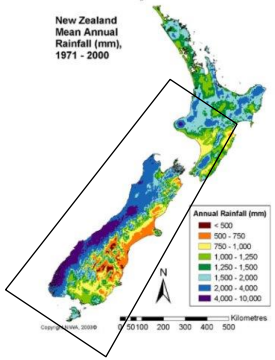


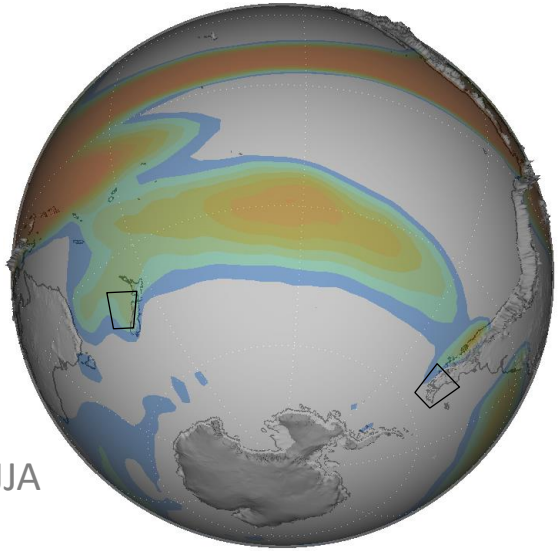


Scandinavian
mountains

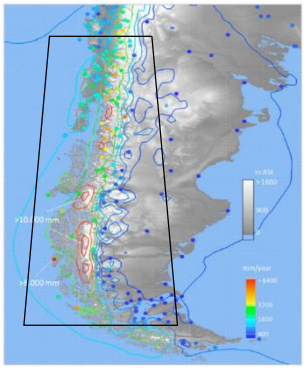


New Zealand
(Southern Alps)





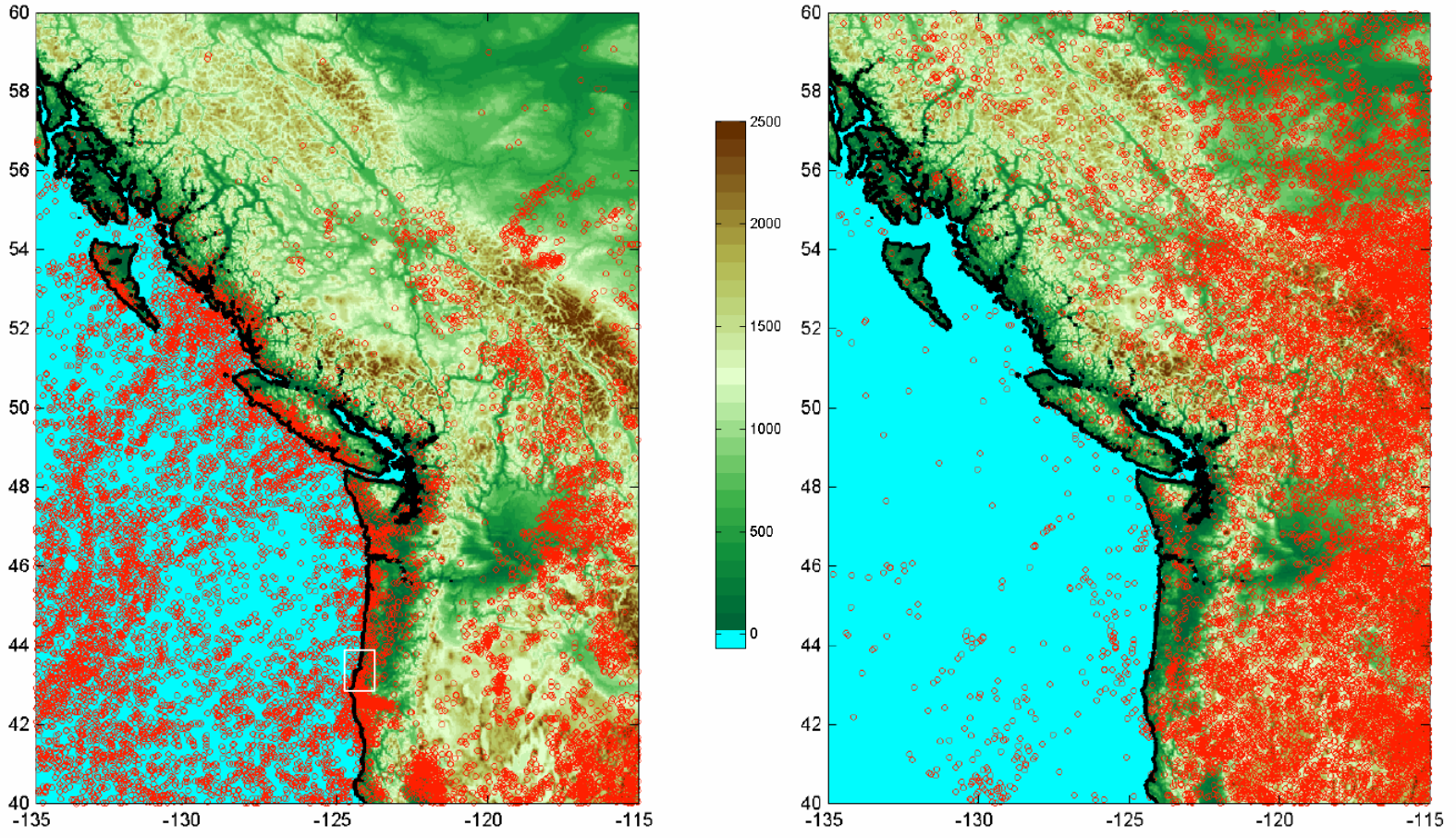
Western Patagonia
(Austral Andes)



Lightning position (1 every 10), 2013-2014-2015

Winter (October-March)

Summer (April-Sept.)



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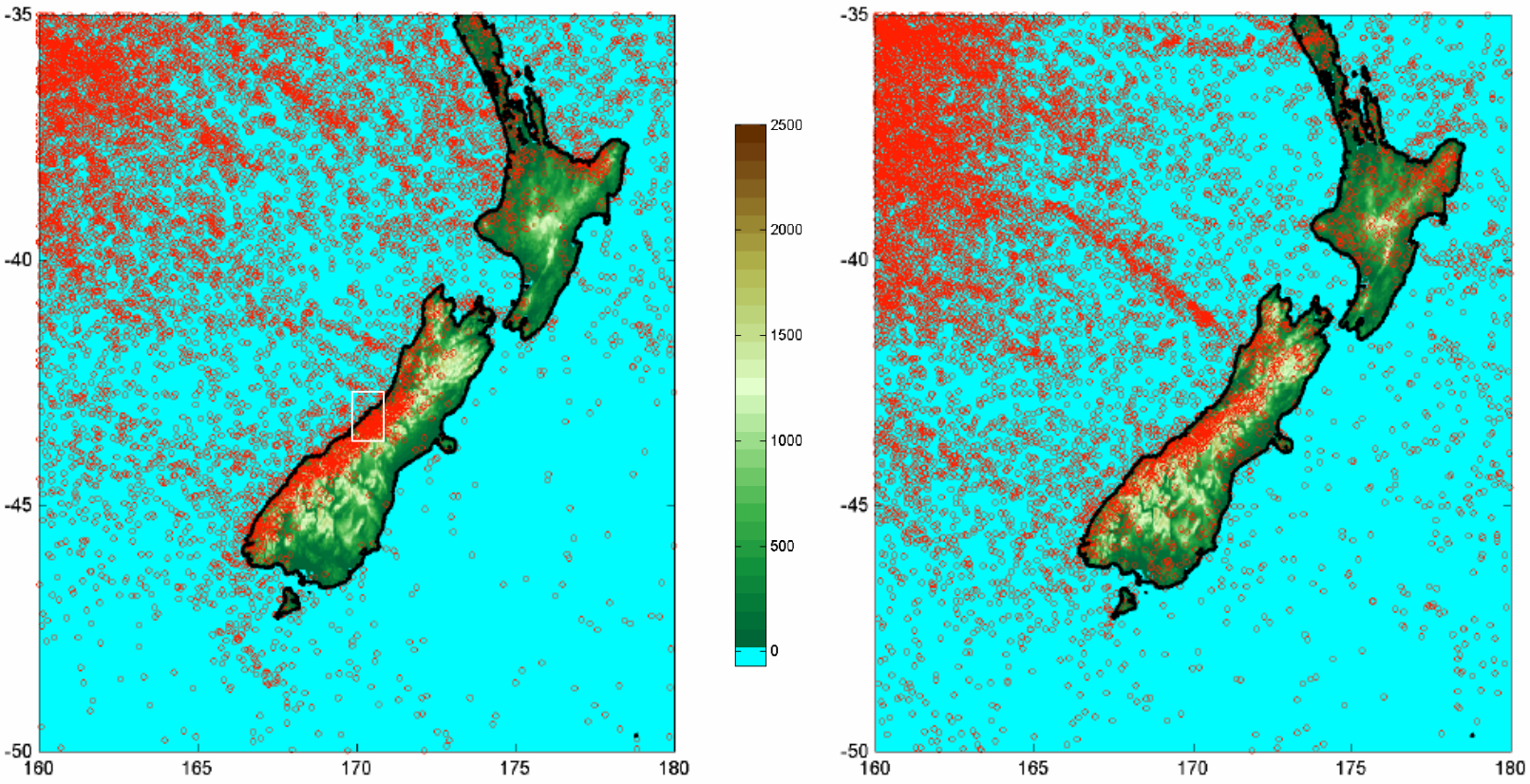
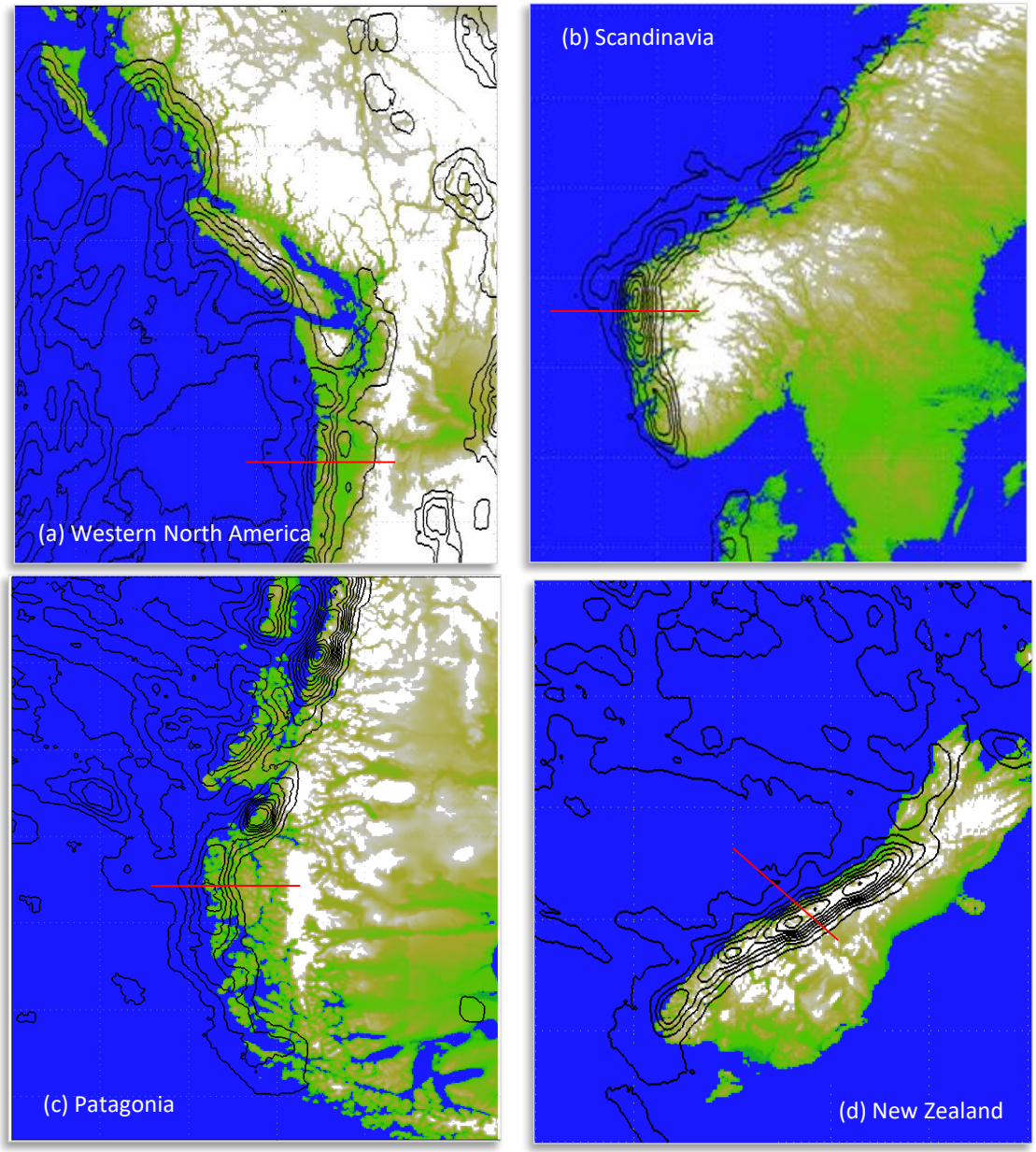
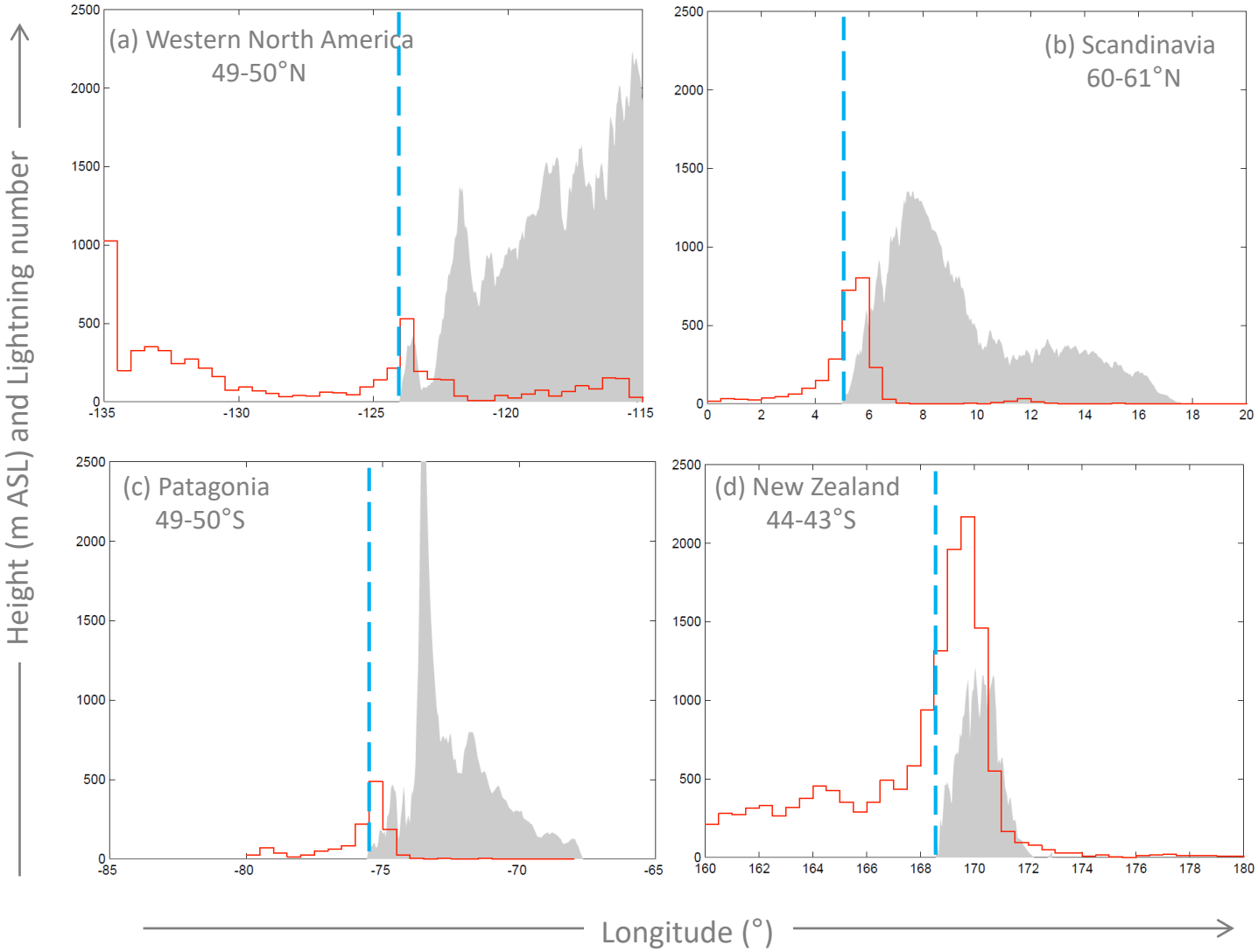


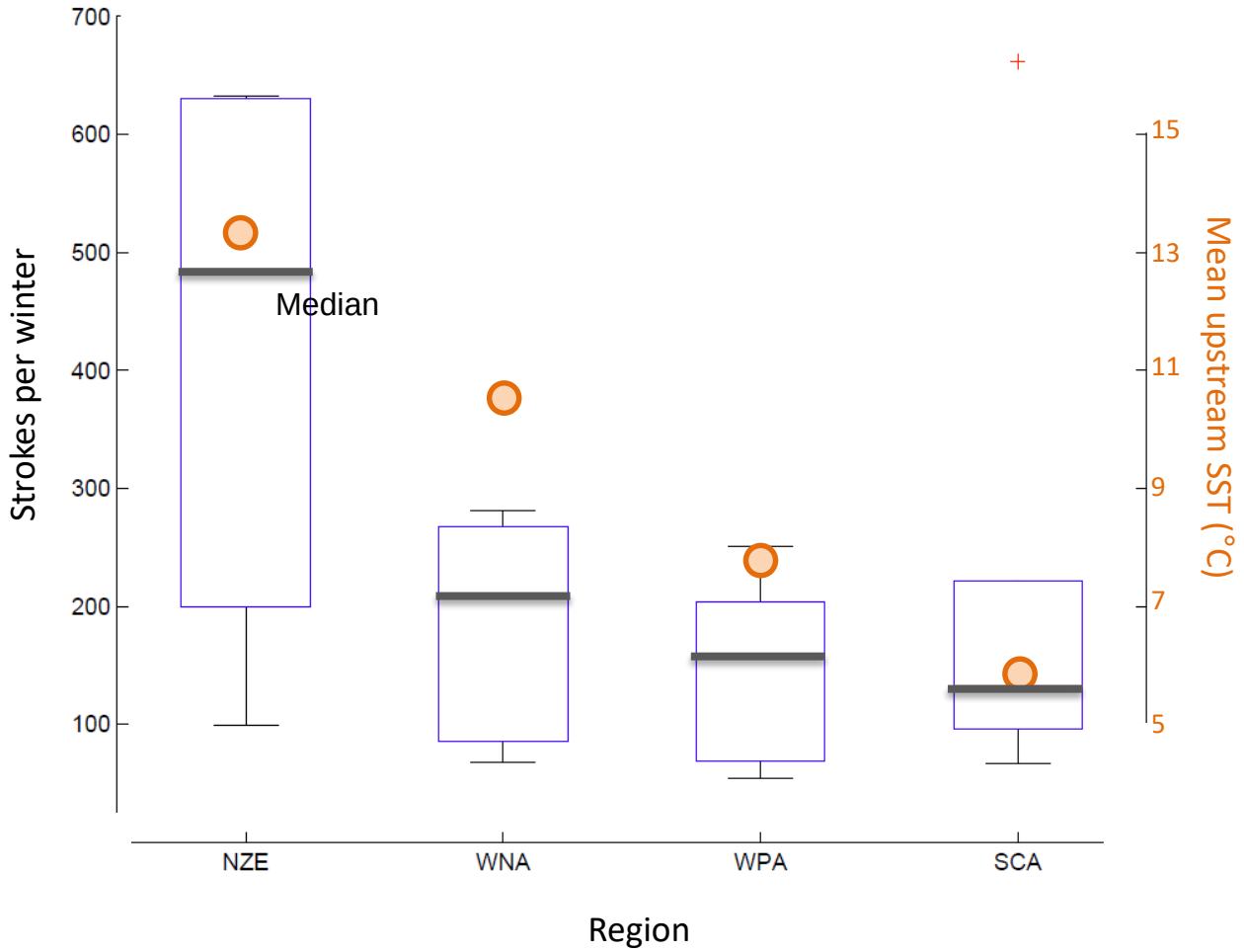
Winter Density (0.1 × 0.1 lat-lon) All data 2013-2015



Winter lightning distribution (2013-2015)



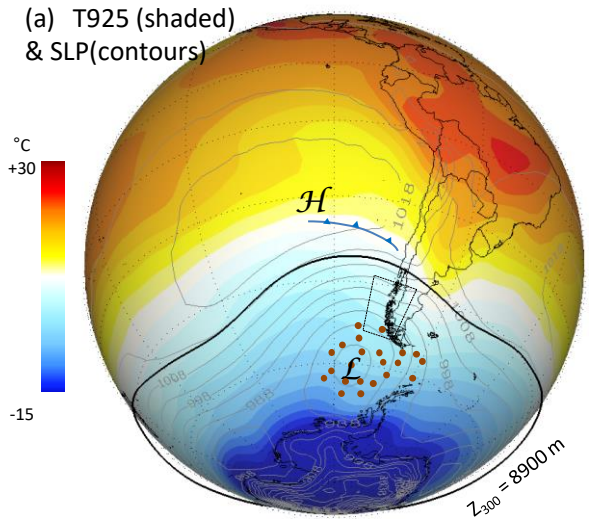
Number of lightning (1×1 lat-lon) during winter months (5). Distribution from 2009-2015



Preliminary conclusions

- Lightning occurs rather frequently in midlatitudes mountains (1 out of 3-4 storms)
- Consequently, convective precipitation may be a significant component of the total accumulation
- Maximum density located between the coastline and the first topographic rise (except over the Southern Alps)
- Broadly, lightning activity scale with upstream SST (but also water vapor flux and stability)

Compositing analysis for days with more than 50 flashed in WP Box (89 days)



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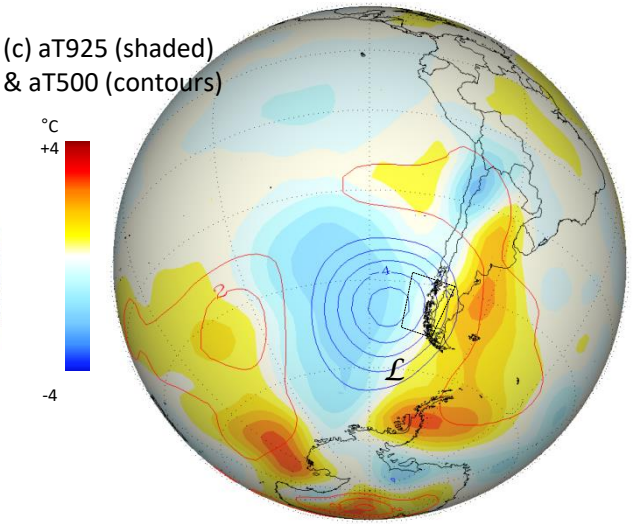

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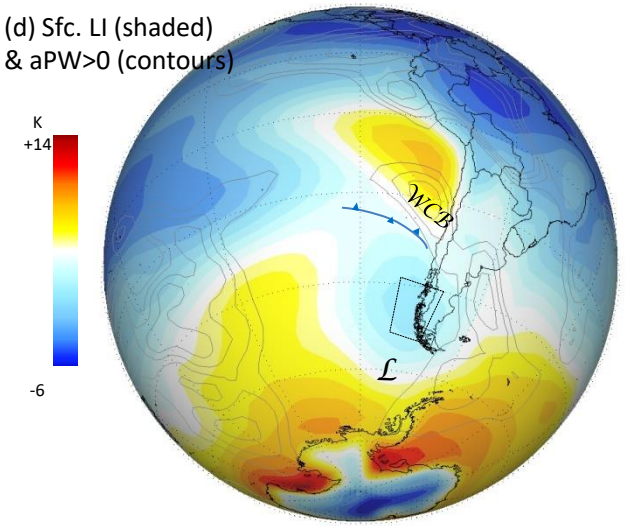

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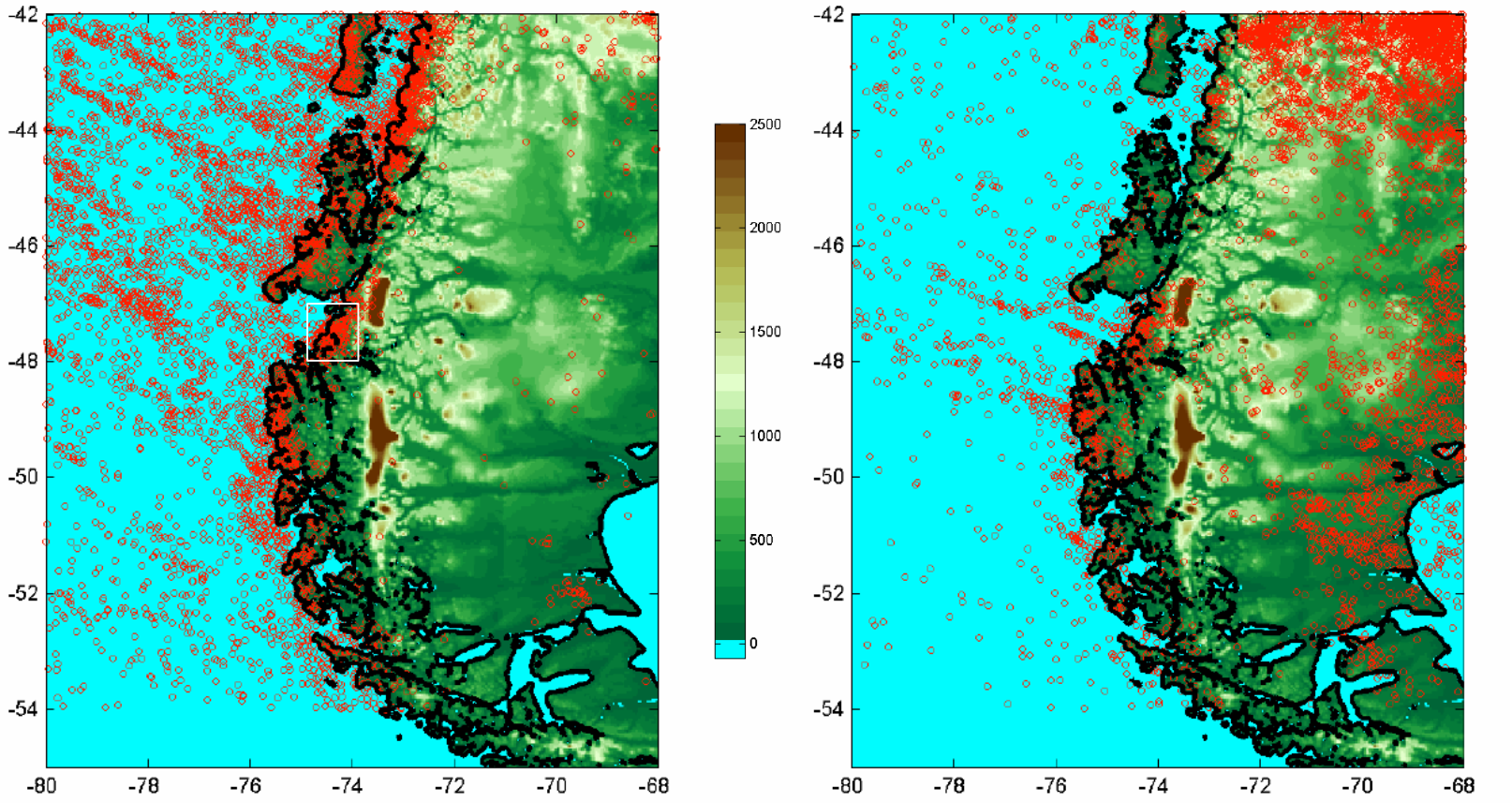

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