Quaternary Science Reviews 198 (2018) 15–36

Contents lists available at ScienceDirect

Quaternary Science Reviews

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

A continuous record of vegetation, fire-regime and climatic changes in northwestern Patagonia spanning the last 25,000 years

Patricio I. Moreno [a, *], Javiera Videla [a], Blas Valero-Garcés [b], Brent V. Alloway [c], Linda E. Heusser [d]

[a] Instituto de Ecología y Biodiversidad, Departamento de Ciencias Ecológicas, Universidad de Chile, Santiago, Chile
[b] Pyrenean Institute of Ecology, Spanish Scientific Research Council, Zaragoza, Spain
[c] School of Environment, The University of Auckland, Private Bag 92019, Auckland, New Zealand
[d] Lamont-Doherty Earth Observatory, Columbia University, New York, United States

ARTICLE INFO

Article history:
Received 25 May 2018
Received in revised form
11 August 2018
Accepted 13 August 2018

Keywords:
Vegetation history
Fire disturbance
Northwestern patagonia
Southern westerly winds
Last glacial termination
Last glacial maximum
Holocene

ABSTRACT

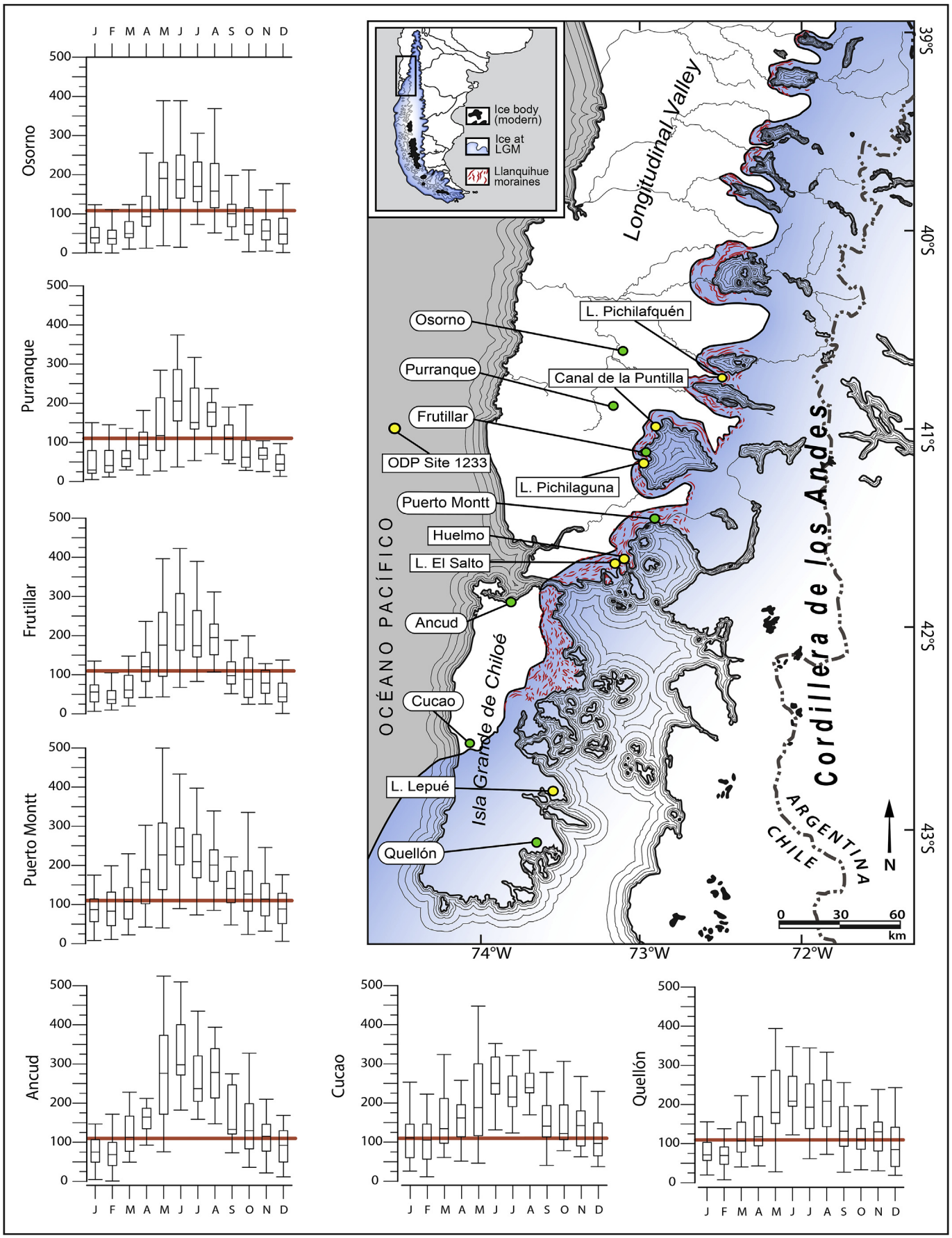
We present a high-resolution precisely dated terrestrial paleovegetation/paleoclimate record from Lago Pichilaguna, northwestern Patagonia (40°–44°S), which spans continuously from the Last Glacial Maximum (LGM) to the present. We find abundant and continuous presence of arboreal pollen (chiefly *Nothofagus*) during the LGM, accompanied by other trees, shrubs, and alpine herbs. These results suggest Subantarctic parkland and/or scattered woodlands under a cold and hyperhumid climate during the LGM (~25,000–17,800 cal. yr BP) with expansion of *Nothofagus* under relatively warm interstadial conditions between 25,000 and 19,200 cal. yr BP. This was followed by cooling and a precipitation increase between 19,200 and 17,800 cal. yr BP, which was contemporaneous with the youngest LGM advance of Andean glaciers in the region and maximum influence of the Southern Westerly Wind (SWW). The Last Glacial Termination (T1) started at 17,800 cal. yr BP and featured the spread of thermophilous trees and ferns characteristic of North Patagonian rainforests, along with lake level lowering. These results suggest a warm pulse and southward shift of the SWW, concurrent with a rapid collapse of Andean glacier lobes. Subsequent changes led to the establishment of closed-canopy rainforests under peak interstadial warmth between ~16,000 and 15,000 cal. yr BP. We detect a shift to cold/wet conditions during the Antarctic Cold Reversal (14,800–12,700 cal. yr BP) and a precipitation decline during Younger Dryas time, followed by maximum temperature, relatively lower lake level and minimum SWW influence between 11,300 and 7700 cal. yr BP. Precipitation then rose punctuated by centennial-scale variations since 6200 cal. yr BP. Chilean-European deforestation and spread of invasive exotic species started at ~350 cal. yr BP aided by fire. We conclude that temperate rainforests have persisted with little interruption since T1, with major changes in floristic composition driven by climate change and fires. Rainforest composition and heterogeneity declined in response to Chilean/European disturbance during the 1600s and intensified since the 1800s. These events constitute the fastest/largest-magnitude vegetation changes of the last ~25,000 years.

1. Introduction

A growing body of empirical (Denton et al., 2010) and modelling studies (Toggweiler, 2009; Toggweiler et al., 2006) have stressed the central role of the Southern Westerly Winds (SWW) as a critical paleoclimate link in the Southern Hemisphere. The SWW are fundamental in driving the Antarctic Circum-Polar Current, global deep-water circulation, upwelling of CO_2-enriched deep waters in the Southern Ocean (SO) and, consequently, atmospheric CO_2 concentrations. Despite their importance in modern and past climate dynamics, large uncertainties linger in the literature regarding their evolution and underlying mechanisms during and since the Last Glacial Maximum (LGM). In modern climate, the SWW are affected by tropical and extra-tropical modes of variability which modulate their strength, breadth and latitudinal position and, therefore, the delivery of moisture to all southern mid-latitude landmasses affecting natural environments and economic activities.

* Corresponding author.

https://doi.org/10.1016/j.quascirev.2018.08.013
0277-3791/


J F M A M J J A S O N D
Osorno
Purranque
Frutillar
Puerto Montt
Ancud
Cucao
Quellón
0
100
200
300
400
500
Ice body (modern)
Ice at LGM
Llanquihue moraines
Longitudinal Valley
Cordillera de los Andes
OCÉANO PACÍFICO
Isla Grande de Chiloé
Osorno
Purranque
Frutillar
ODP Site 1233
Puerto Montt
Huelmo
L. El Salto
Ancud
Cucao
L. Lepué
Quellón
L. Pichilafquén
Canal de la Puntilla
L. Pichilaguna
ARGENTINA
CHILE
N
0 30 60
km
39°S
40°S
41°S
42°S
43°S
74°W
73°W
72°W