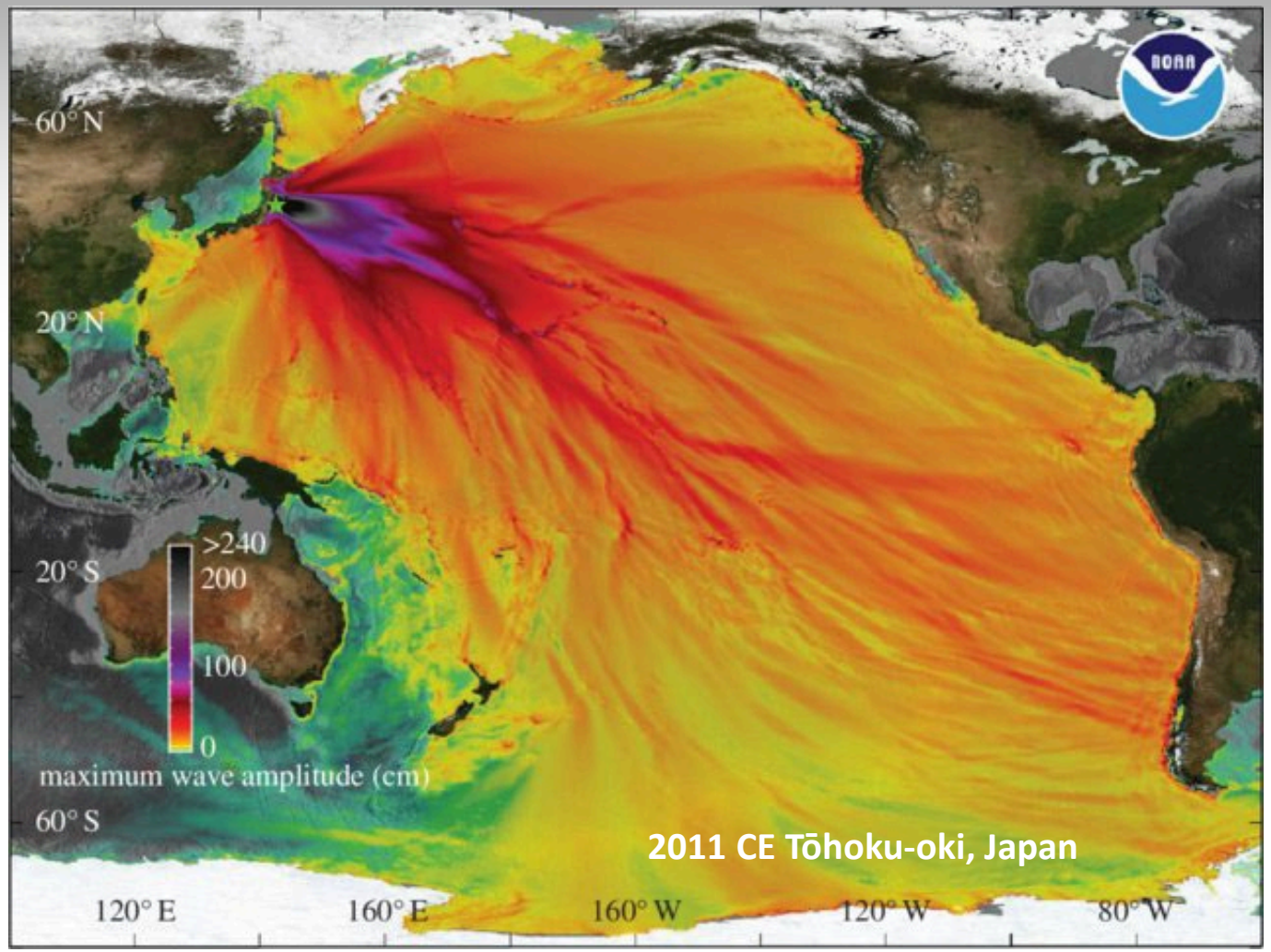
Trans-Pacific tsunamis

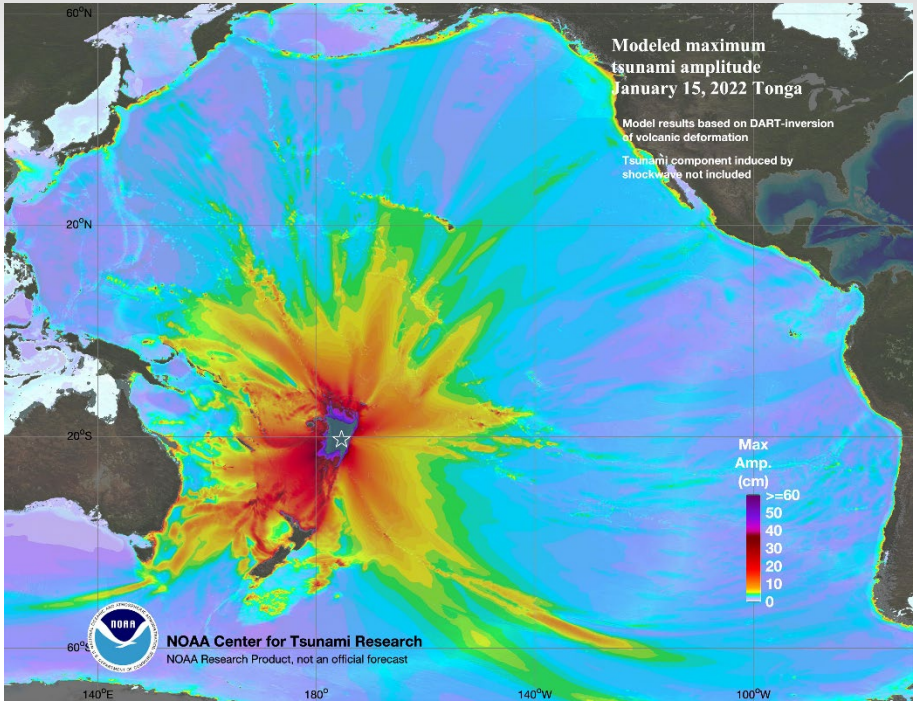


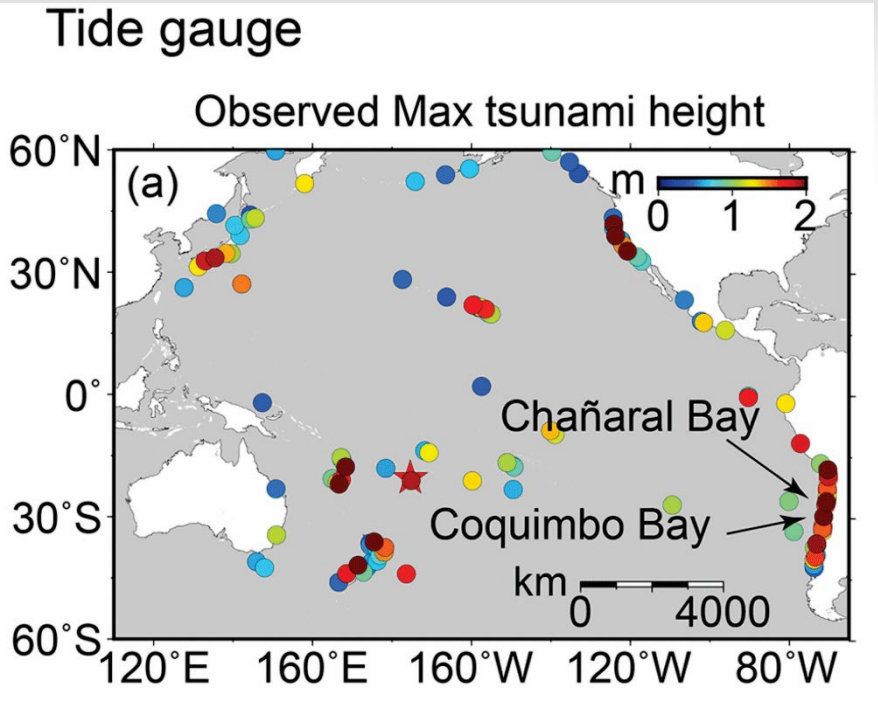
James Goff

ESSRC, University of New South Wales, Australia

School of Ocean and Earth Science, University of Southampton, UK

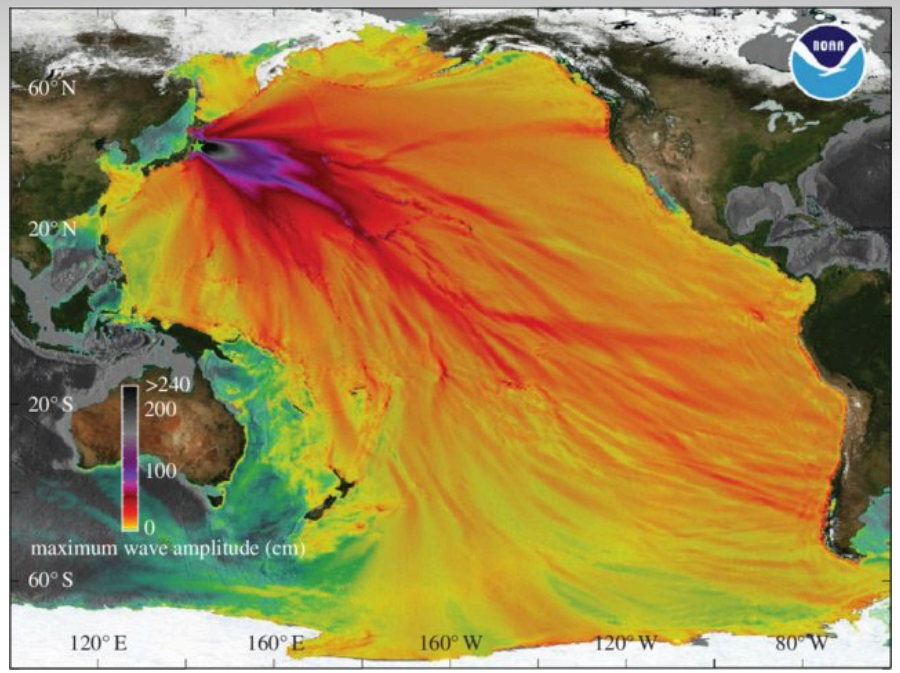
Focus on subduction zone tsunamis, BUT..



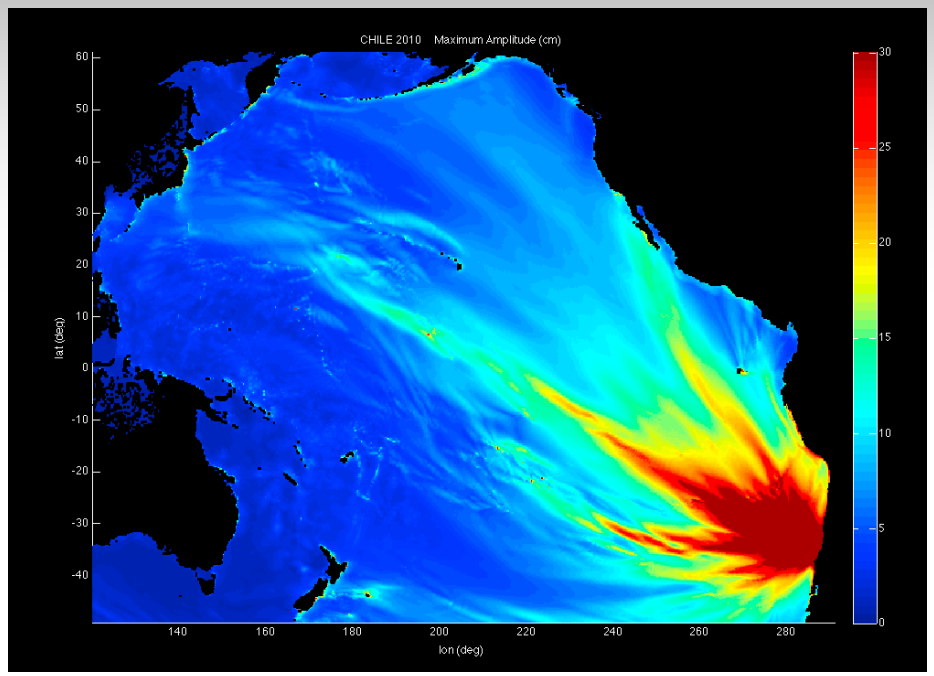


2022 CE Hunga Tonga–Hunga Ha'apai, Tonga volcanic tsunami

Trans Pacific subduction zone tsunamis



2011 CE Tōhoku-oki, Japan (NOAA/PMEL)
Earthquake = Mag 9.1

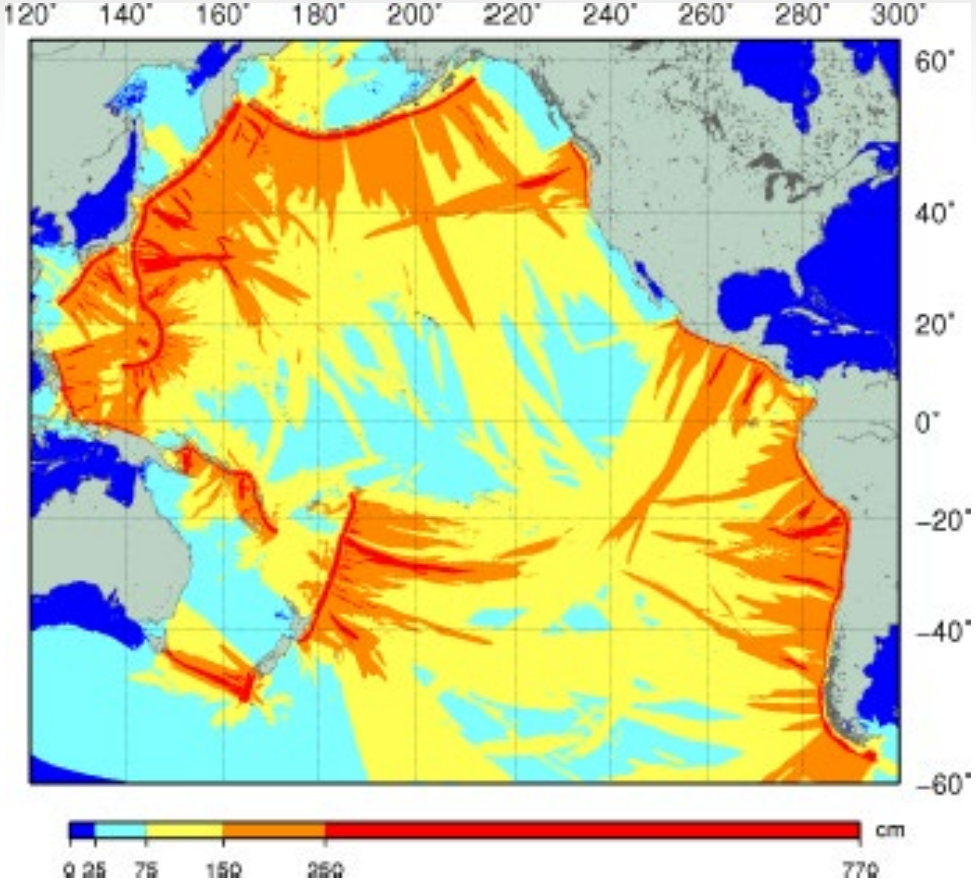


2010 CE Maule, Chile (NOAA/PMEL)
Earthquake = Mag 8.8

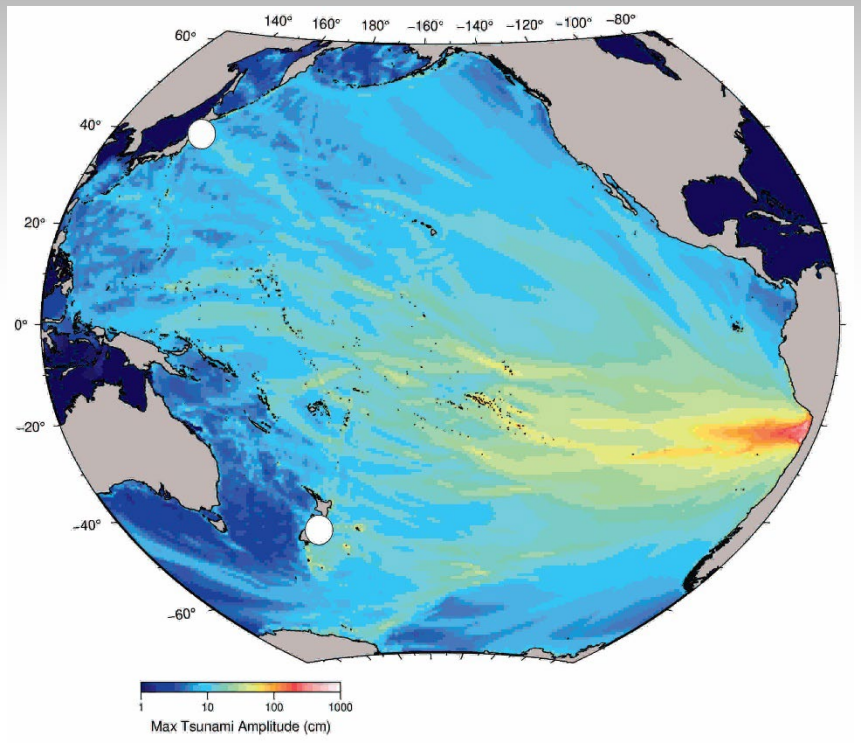
a) Such events affect the entire Pacific basin
b) They can be devastating on the other side of the Pacific
c) Recorded on many of the intervening islands

Trans Pacific subduction zone tsunamis

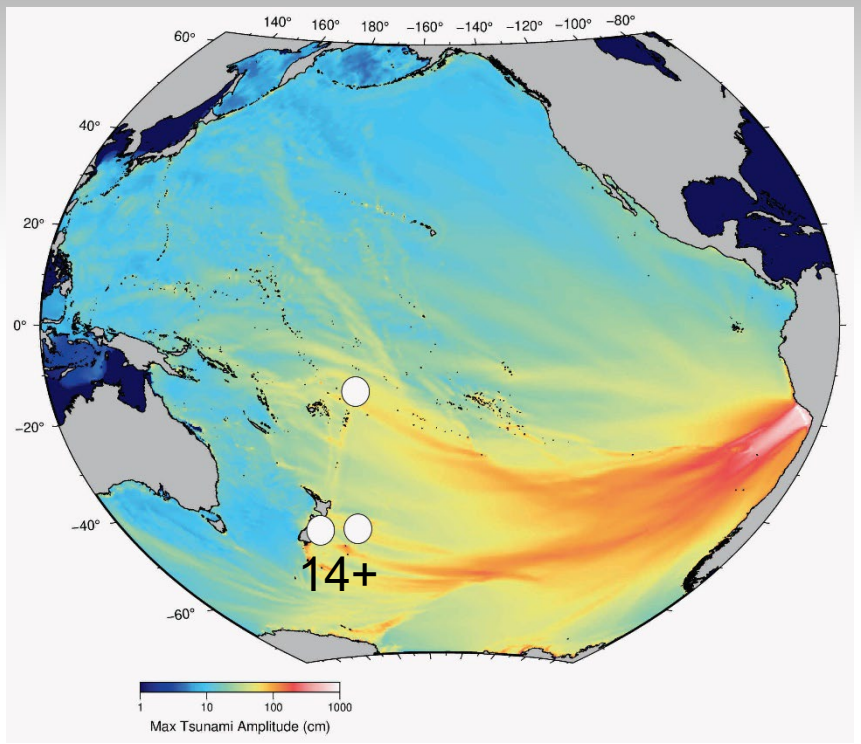
- 165 million km^2
- 20,000-30,000 islands – MANY volcanic
- Satake et al. (2020): "*Model data helps ID where look for ancient tsunami deposits*…."
- You need ~Mw 9.0 EQ to create BIG tsunami to leave distant deposit
- Mw >9.0, ~5 per century globally (85% happen in Pacific)
- BUT we know > Mw 8.5 in Pacific ~every 250 years for each subduction zone and many also leave distant deposits (e.g. Mw 8.5-8.8 1877 Iquique)



1877 CE and 1868 CE



1877 CE: Iquique (Goff et al., 2022)
Earthquake = Mag 8.5-8.8

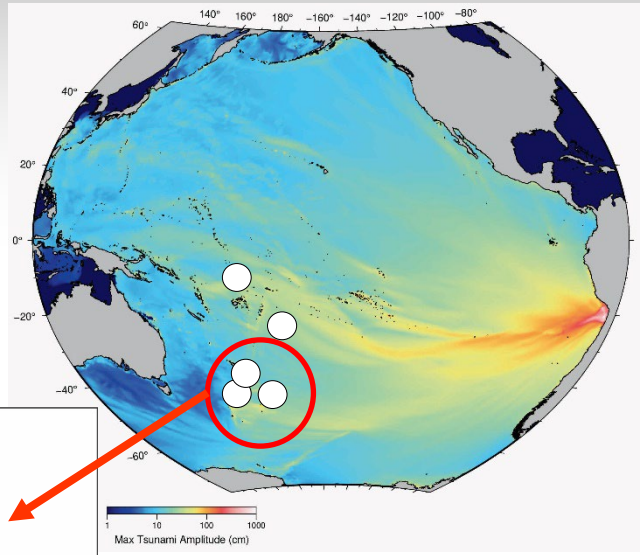


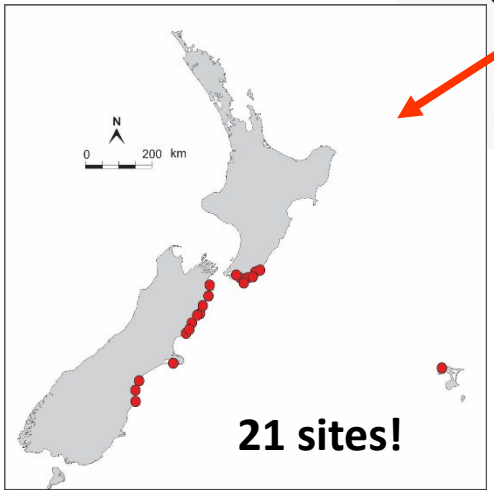
1868 CE Arica (Goff et al., 2022)
Earthquake = Mag 8.5-9.3

1586 CE, 1604 CE, 1687 CE and 1746 CE

Four EQs in 160 years

- 1586 CE Lima–Callao, Peru
  Earthquake = Mag 8.1
- 1604 CE Arica,
  Earthquake = Mag 8.7
- 1687 CE Peru
  Earthquake= Mag 8.4–8.7
- **1746 CE Lima–Callao, Peru**
  Earthquake = Mag 8.6–8.8





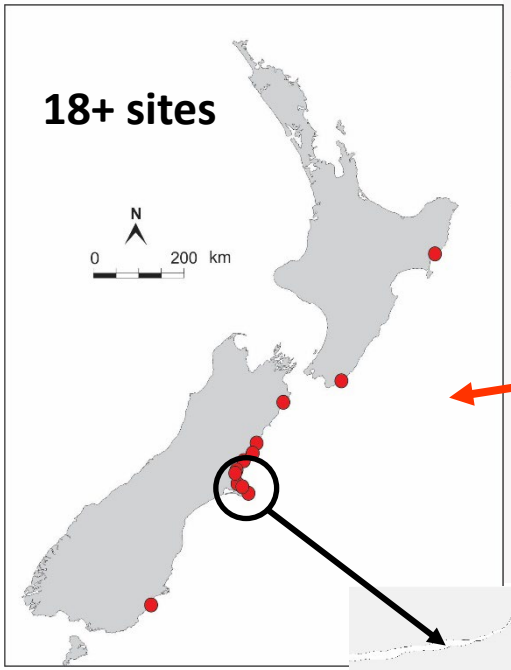
- Model 1604 CE Arica, Chile (Goff et al., 2022)
- New Zealand map (after Goff et al., 2010)

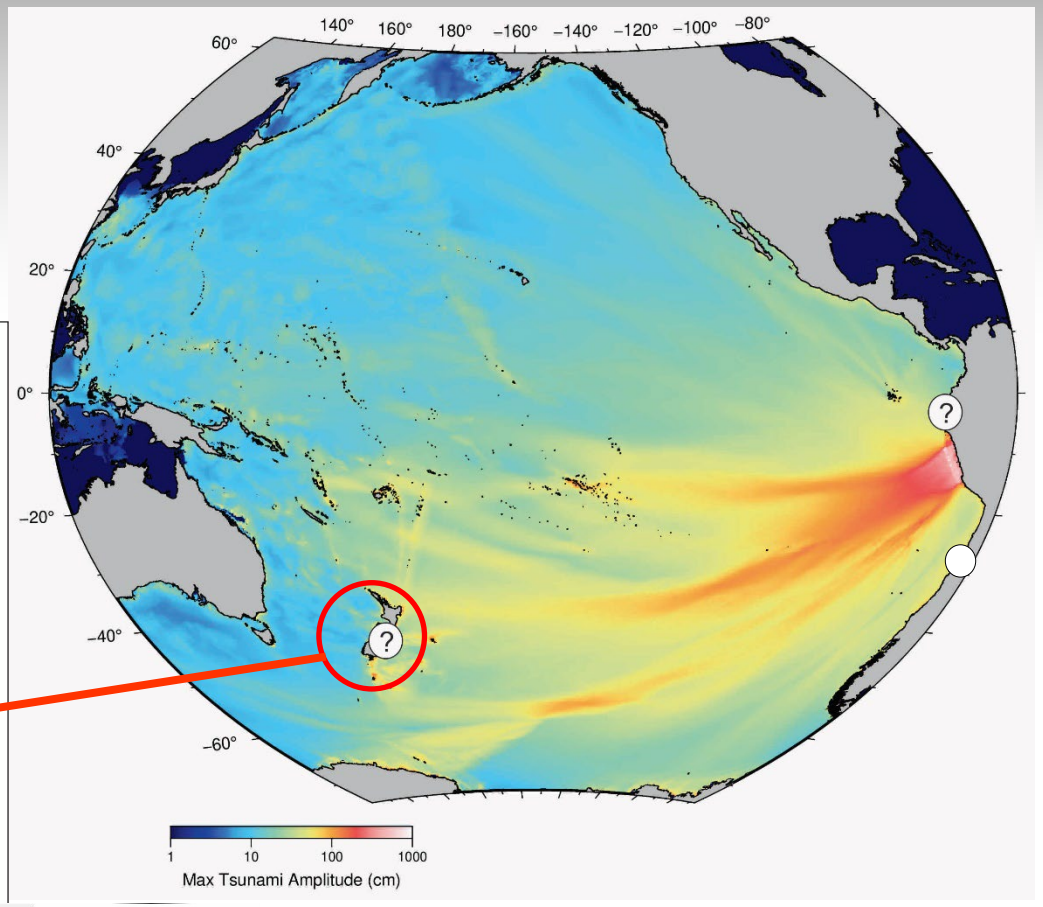
Pacific island palaeotsunami records ~1500-1750 AD

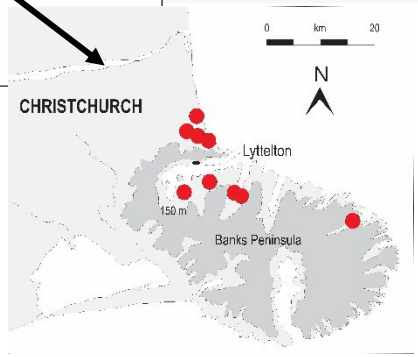
Precursor to 1746 CE?

Can distant deposits help?

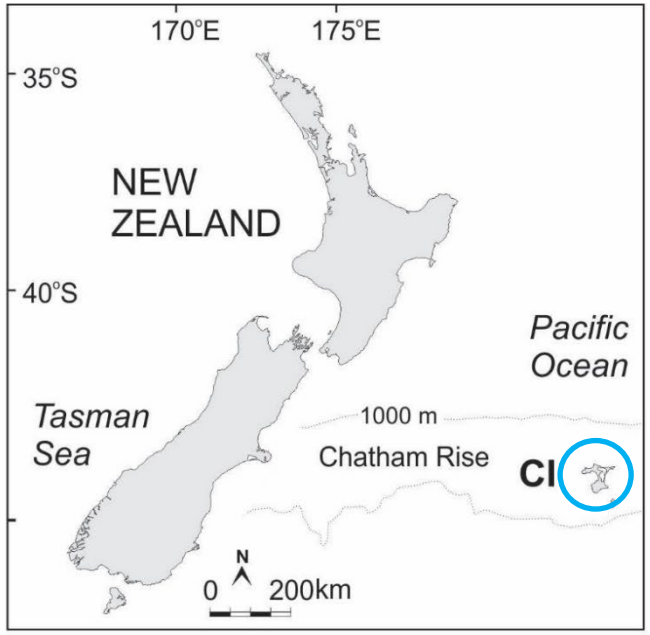
1300+/-50 CE? Est. Mag 9.4
(based on palaeotsunami evidence)







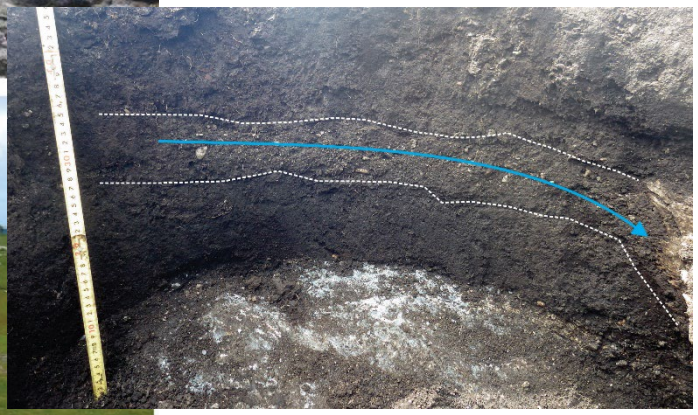
Such palaeotsunami deposit system works



~3800 yr BP event in NZ

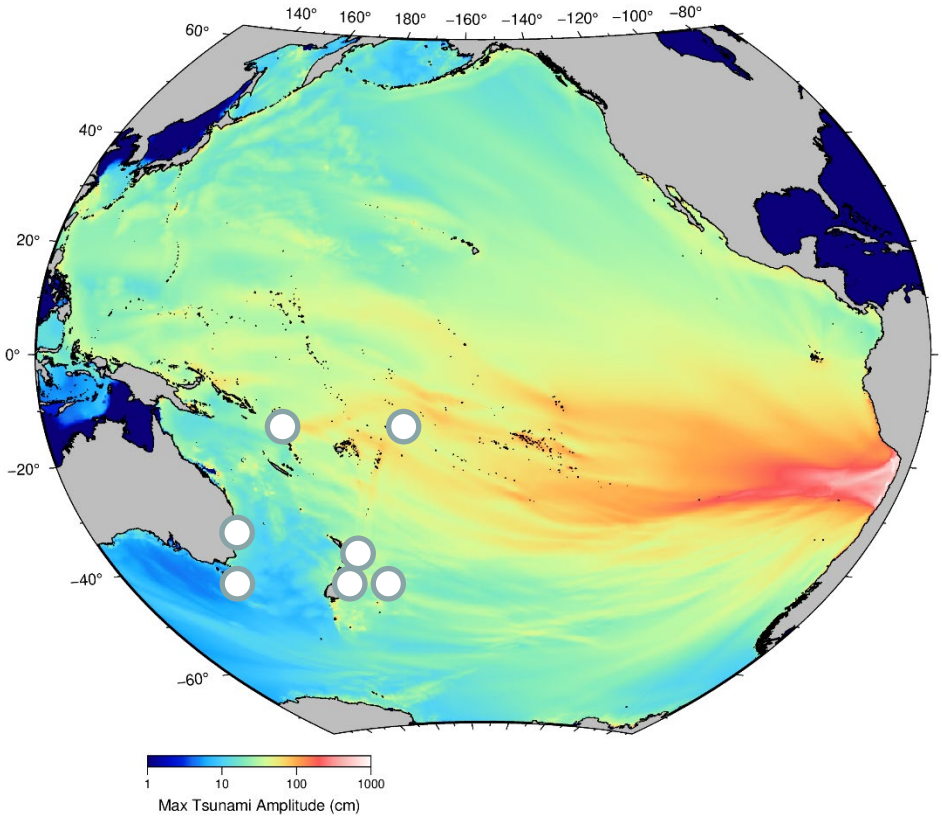
- Modelled – only one possible source, **Mag 9.5** from northern Chile

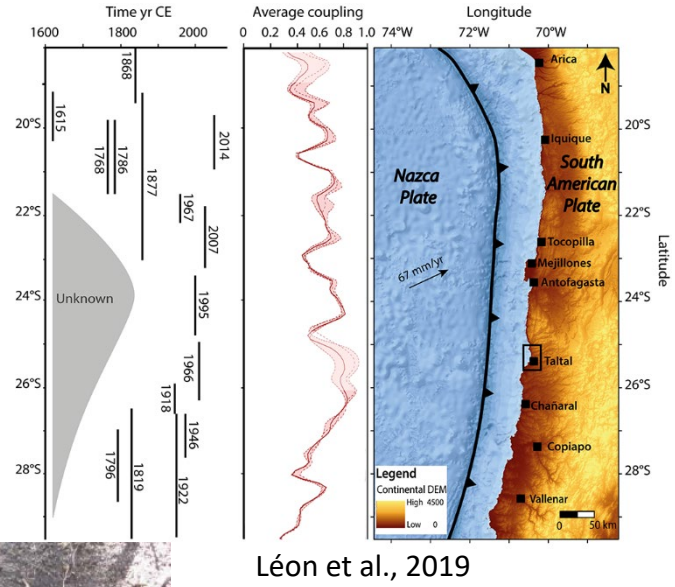
Goff et al., 2018



Northern Chile

- Some thoughts
  - ~3800 yr BP, 1000 km long subduction zone fault: geological/archaeological evidence
  - Context – 2011 Japan tsunami ruptured *only* 500 km, 1960 Chile – up to 1000 km
  - Geological AND modelling data match – worked together, although seismologists in NZ say could not happen???



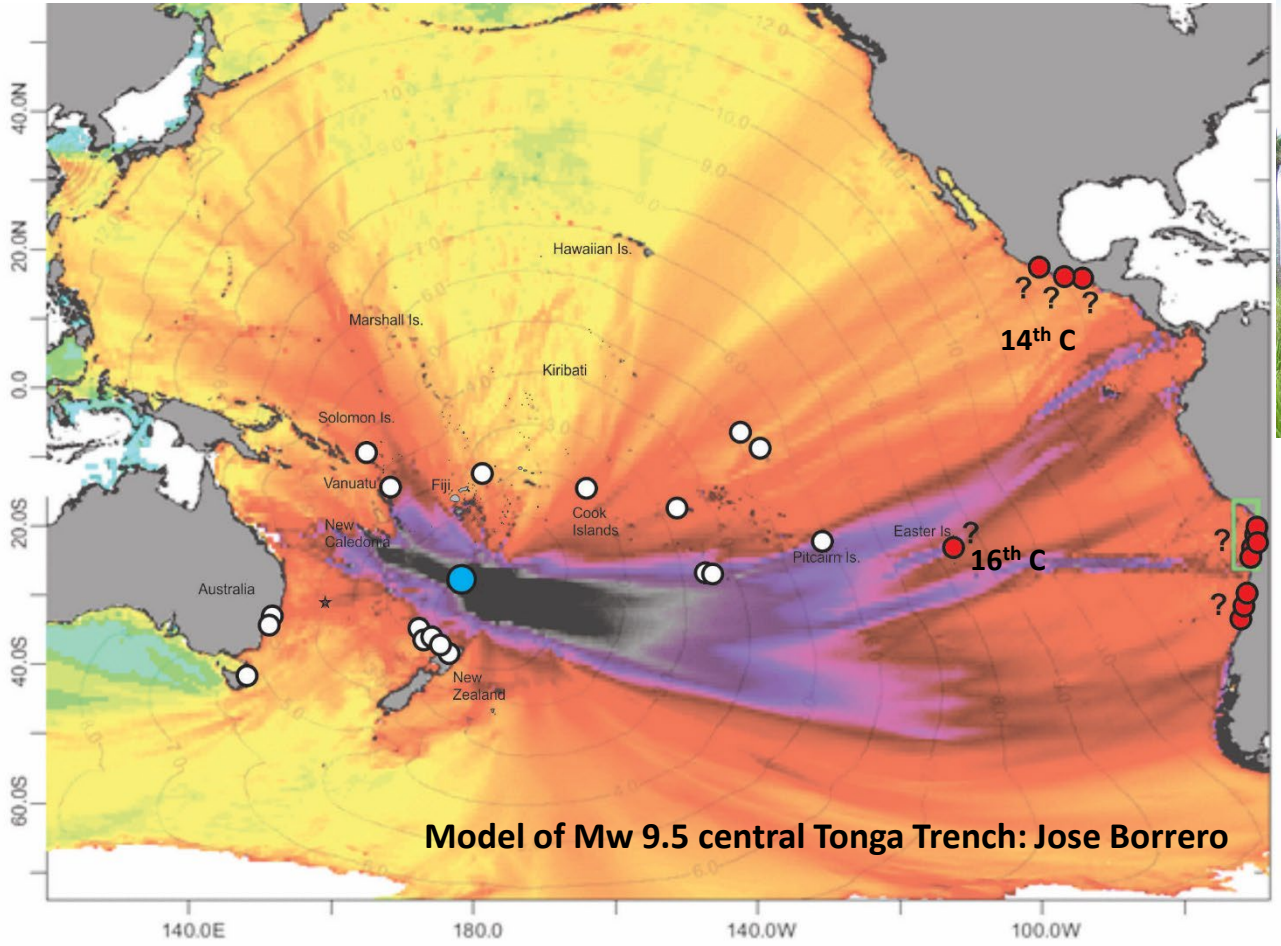


Léon et al., 2019

Vanuatu
Goff et al., 2008

Tsunamis also come from the Pacific

- One of three from Tonga trench – 15th century, 2000 yr BP, 3000 yr BP
- Geology first – Model second, Geology third! Dates fit BUT are they all related to the same event? Work in progress. Another Mag 9.5 *at least*



Model of Mw 9.5 central Tonga Trench: Jose Borrero

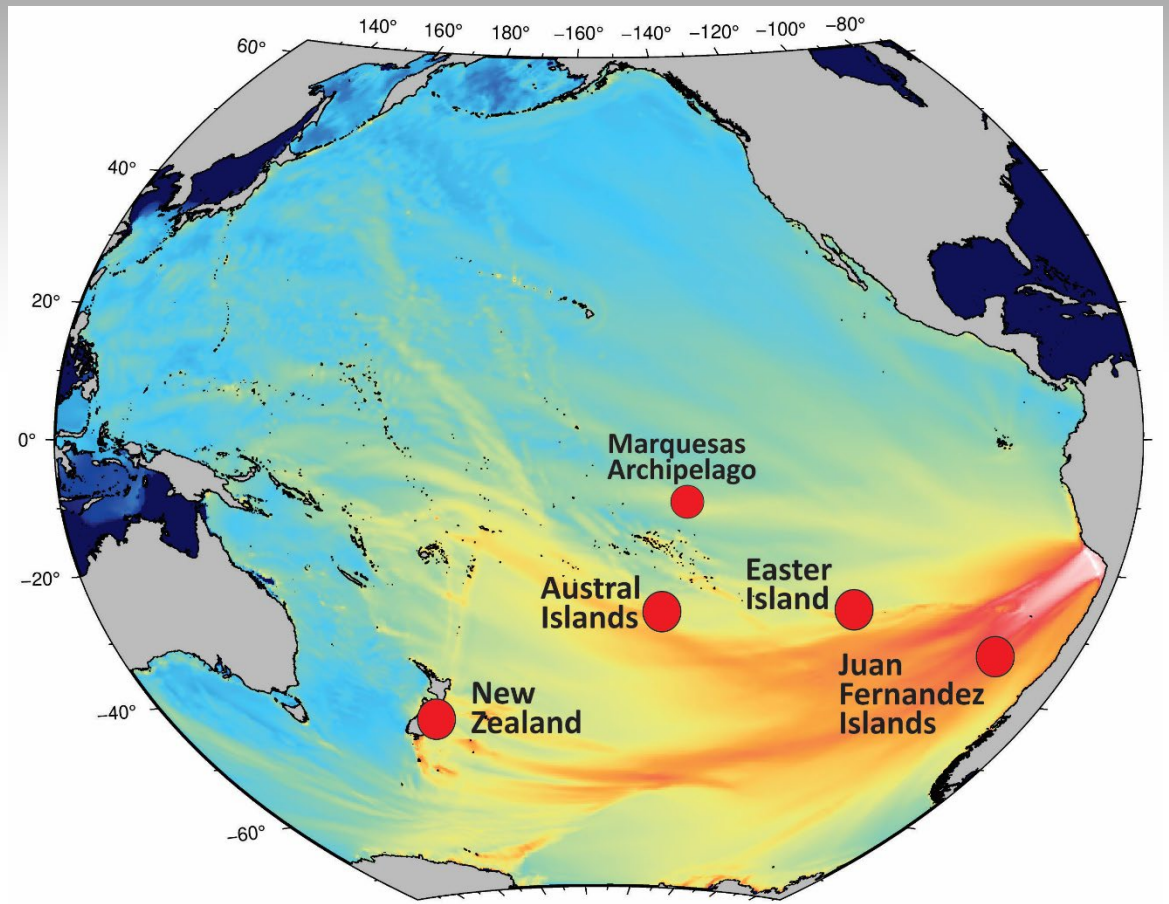

1600 ton boulder, Tonga
(F. Taylor)

Taltal area

La Serena, Coquimbo

Tirúa, Quidico

Where to from here?



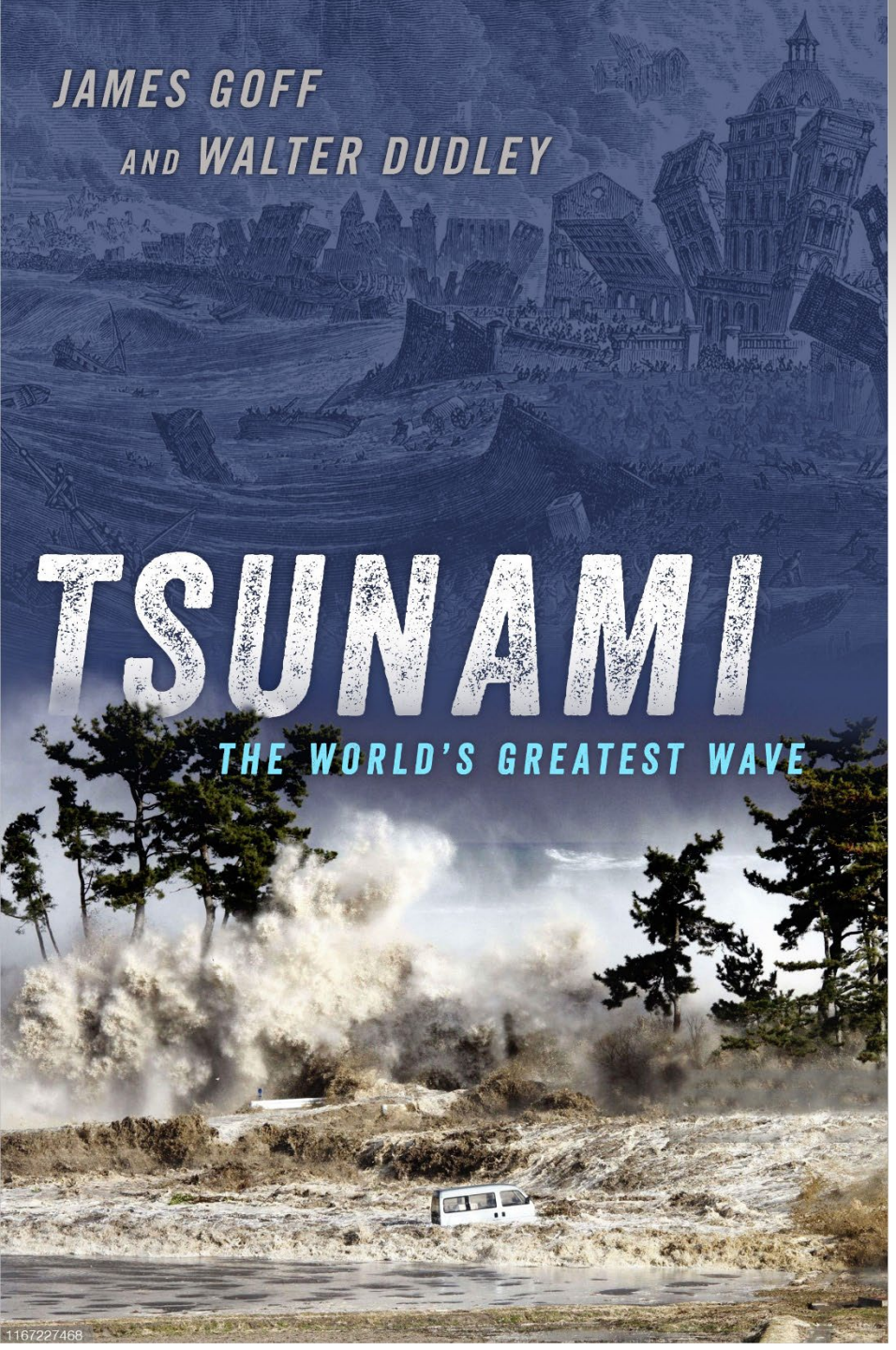
Let us not forget:

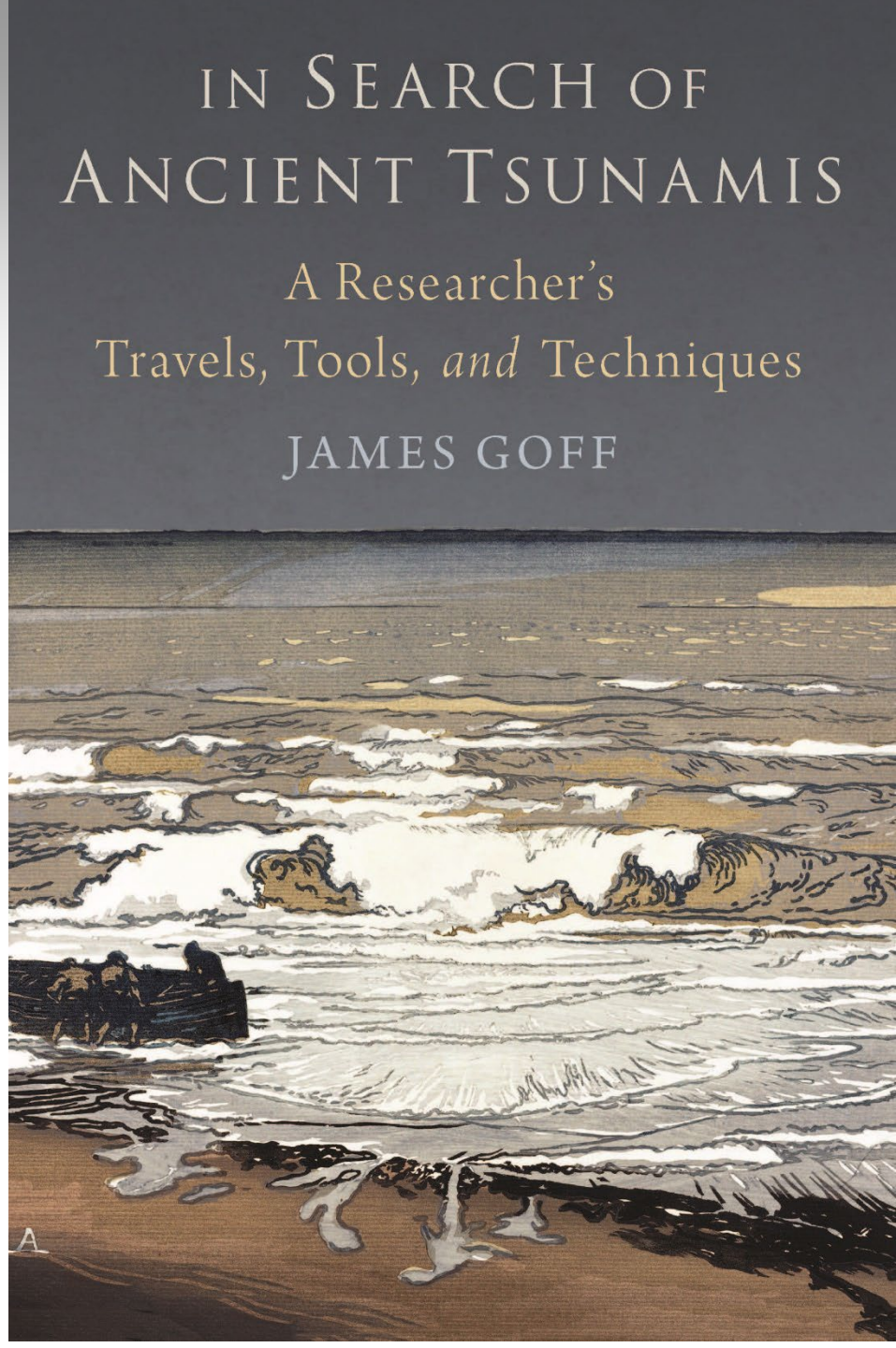
- **Peru: 1746 CE and precursors**
- **Chile: 3800 yrs BP and others**
- **Important for Peru, Chile, AND Pacific Islands**

- **Search for local/distant sourced events both in-country AND overseas**
- **Different preservation potential in different countries/climates**

We are making progress

Atacama Desert site


JAMES GOFF
AND WALTER DUDLEY
TSUNAMI
THE WORLD'S GREATEST WAVE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A Researcher's
Travels, Tools, and Techniques
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