



ACRE Antarctica: improving our understanding of high latitude climate with old weather observations

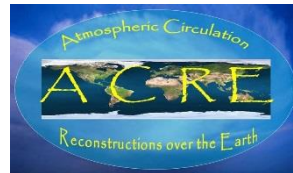


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NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

National
Science
Challenges

THE DEEP SOUTH

Te Kōmata o
Te Tonga

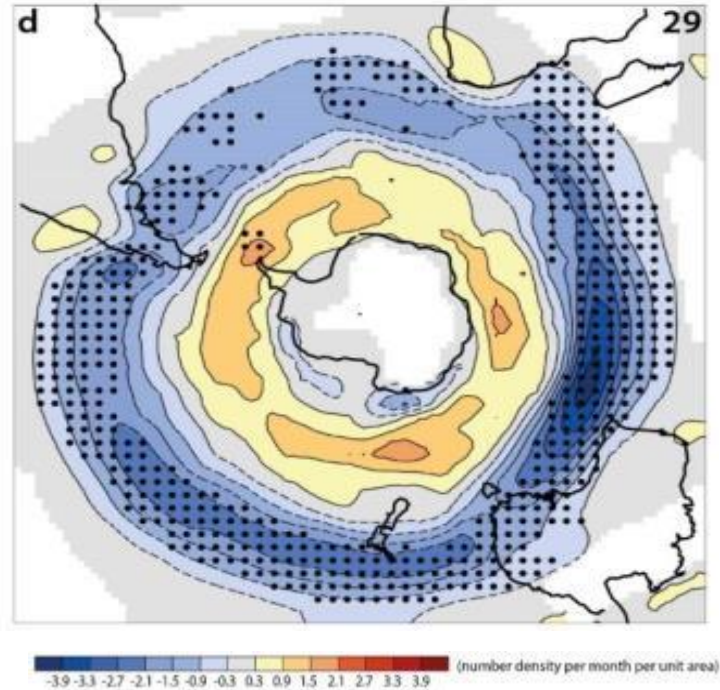
Outline

- The Deep South and New Zealand's weather and climate
- The Deep South National Science Challenge
- ACRE and data rescue
- Why do we need historic climate data?
- ACRE Antarctica
 - Progress so far
 - Where to next



The Deep South and NZ's weather and climate

- Antarctica and the Southern Ocean have significant impacts on New Zealand's weather and climate
 - Southern Annular Mode (Ummenhofer and England, 2007)
 - Pacific-South American Mode (Mo and Paegle, 2001)
 - Zonal Wave 3 (Raphael, 2004)
 - Sea ice (Yuan and Li, 2008)
- The nature of climate change in the Deep South will deeply impact NZ's future climate
- Problem = Deep South's natural climate and weather variability is poorly understood



IPCC (2013)

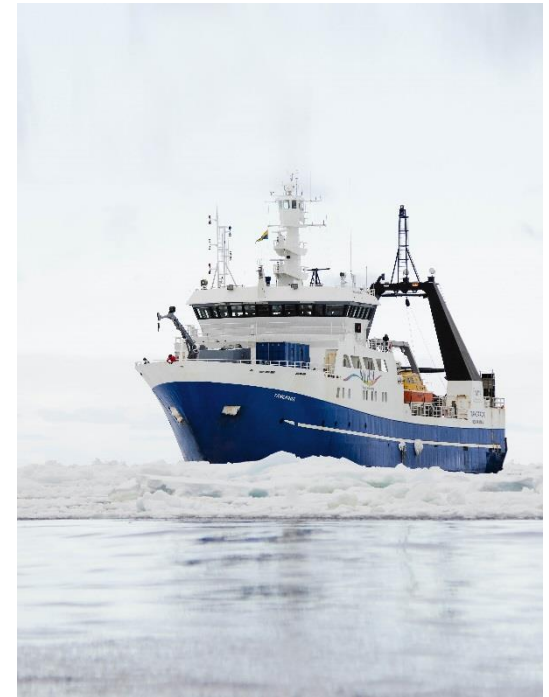
Change in winter Southern Hemisphere storm track between 1986-2005 and 2081-2100, RCP 8.5 (IPCC AR5)

Shading (dots) where 90% of models agree on the sign of the change.

Lower confidence over Southern Ocean! More historical data could increase this confidence.

The Deep South National Science Challenge

- The New Zealand Government has provided >\$130m NZD to promote several areas of science over 10 years; \$24m to DSNSC in Phase 1 (to 2019)
- The objective of the DSNSC is to understand the role of the Antarctic and Southern Ocean in driving New Zealand's climate and future environment
- The mission of the DSNSC is to enable New Zealanders to adapt, manage risk, and thrive in a changing climate
- Constructing a New Zealand Earth System Model (NZESM) to produce improved projections of climate change
- Assessing and validating the NZESM is one DSNSC project
- How does data rescue fit in?



National
SCIENCE
Challenges

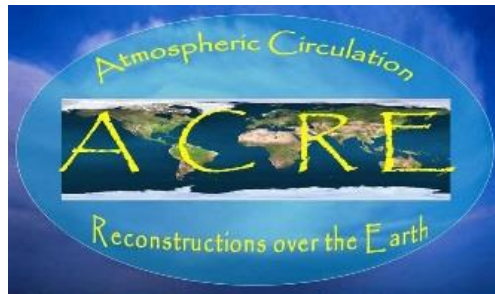
THE DEEP SOUTH

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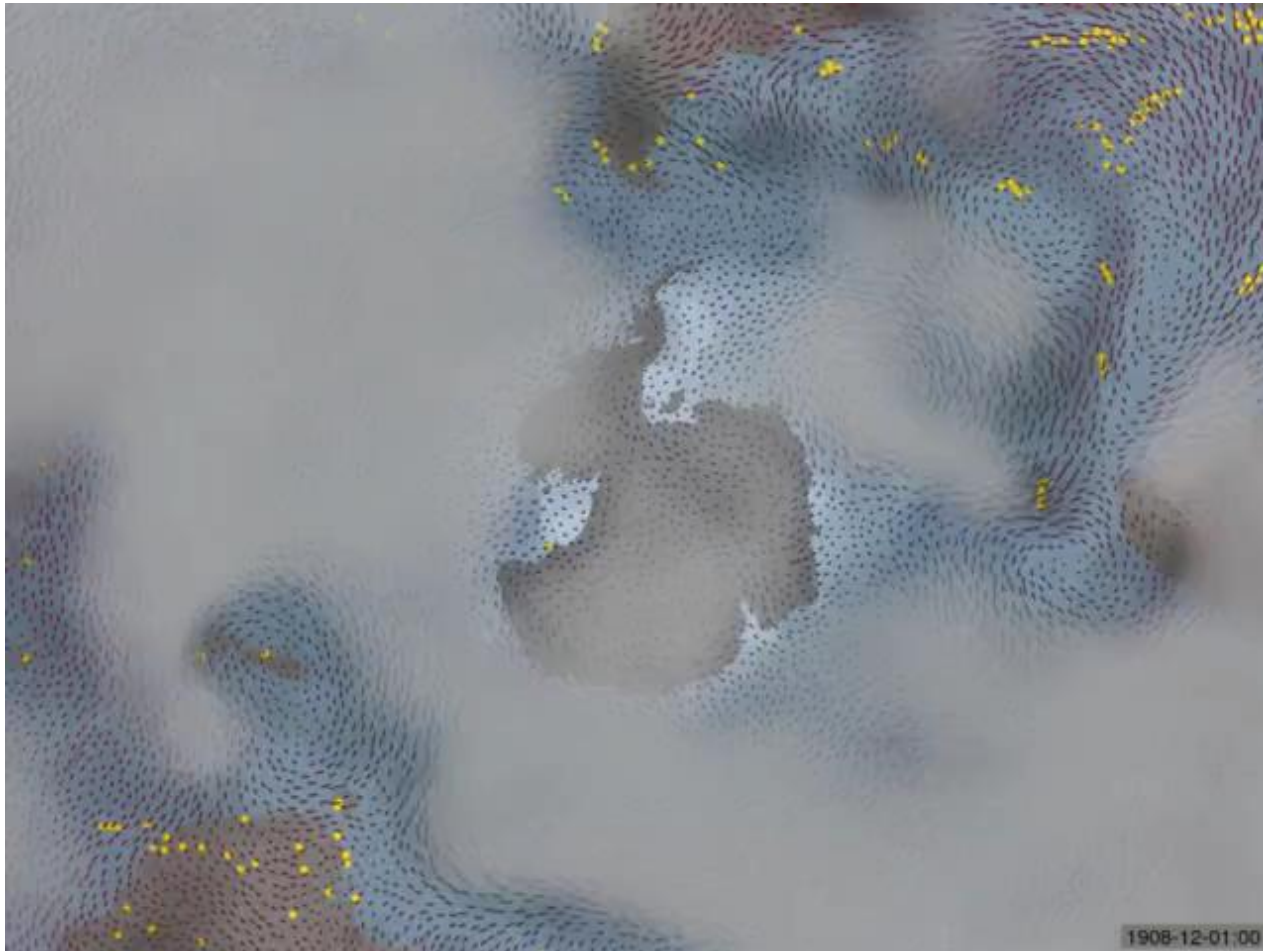


ACRE and Data Rescue

- International ACRE (Atmospheric Circulation Reconstructions over Earth) initiative
- ACRE undertakes and facilitates climate data rescue
 - Recovery, imaging, digitisation of data
- Terrestrial and marine global weather observations
- Rescued data underpins 3D weather reconstructions (reanalyses)
- High quality extension through the 19th century is desired (and possibly longer)
- Makes observations available to all international reanalyses



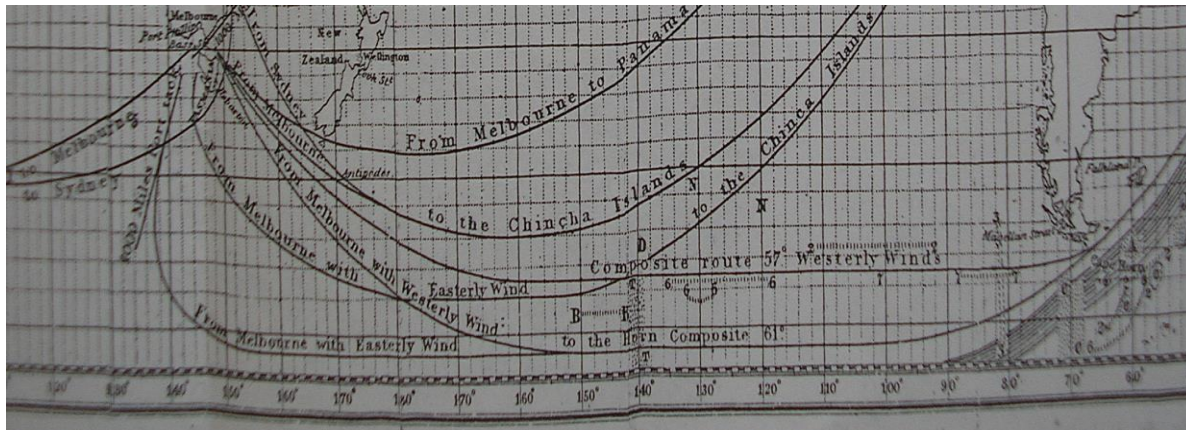
Antarctic weather 1909-1910



Wind (arrows) and air temp (blue/red)

ACRE Antarctica

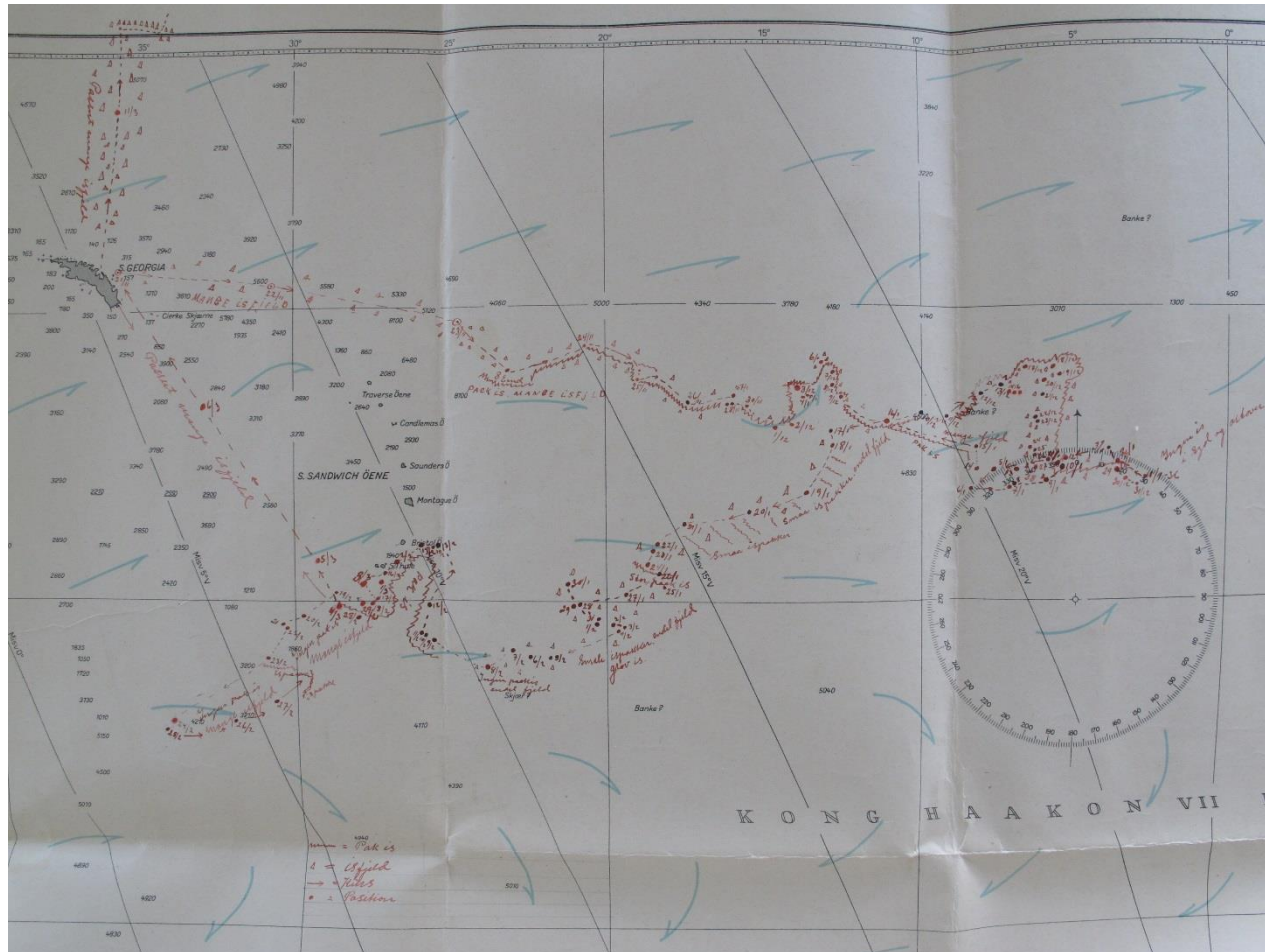
- ACRE Antarctica has been supported under the DSNSC at NIWA
- ACRE Antarctica will contribute to the validation of the NZESM using historic and observational data
- Data rescue of ship's logbooks from the Antarctic/subantarctic region between 1850 and 1960
- Imaging, keying, submission to databanks for assimilation into reanalyses
- Priority data: barometric pressure, sea ice observations, air temperature, sea surface temperature



Scott's *Discovery* and Mt Erebus. Source: coolantarctica.com

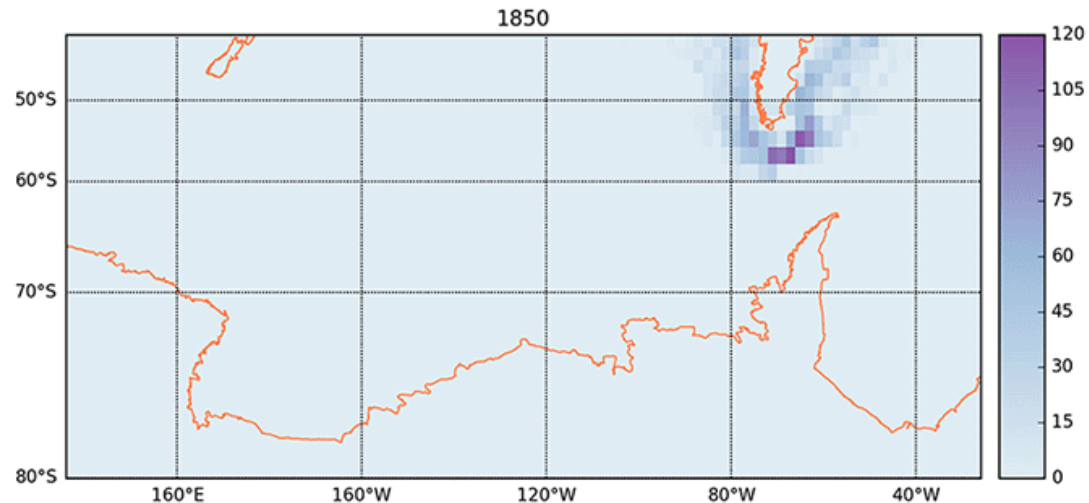
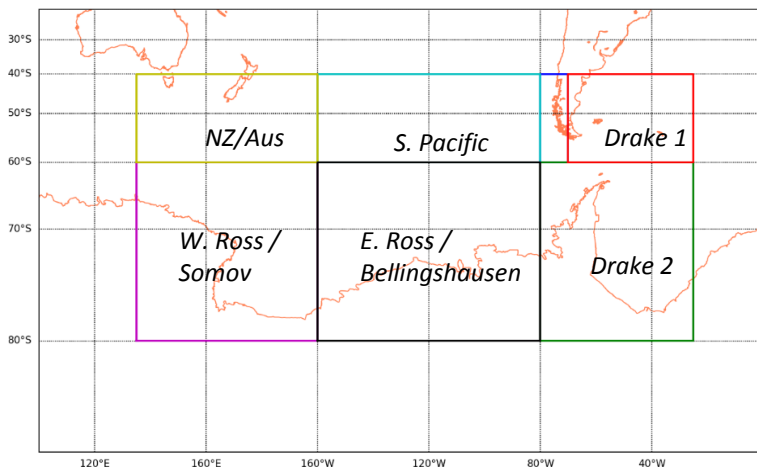
ACRE Antarctica – sea ice

Sourabaya sea ice map



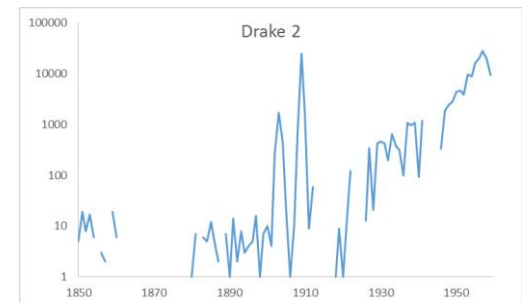
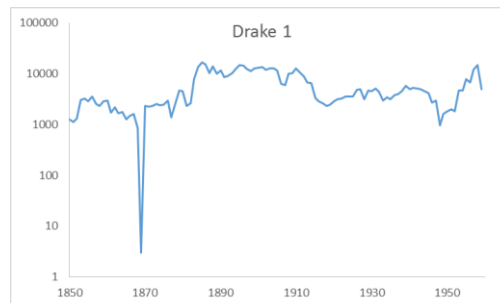
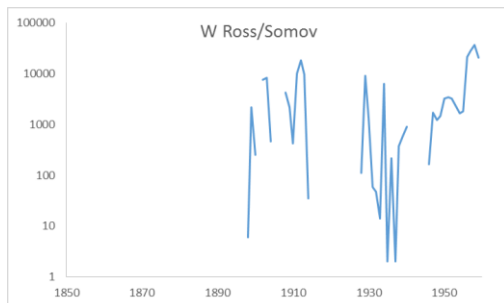
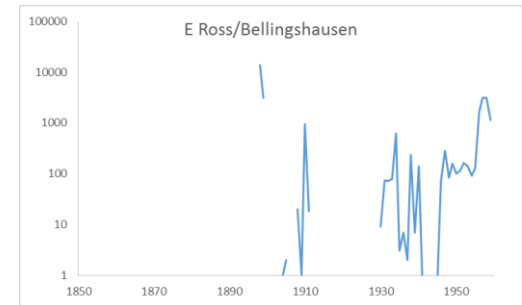
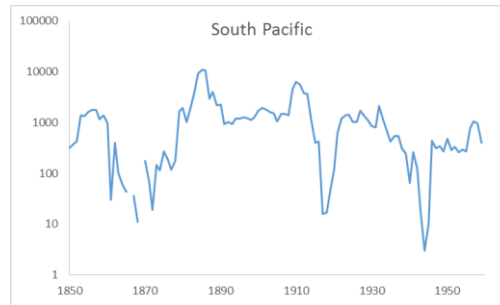
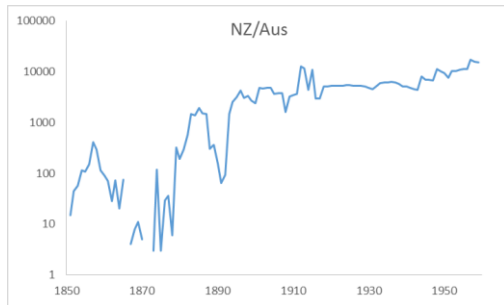
ACRE Antarctica

- Domain selection: covers the core action centres of drivers relevant to NZ weather and climate
- Goal: at least 6 daily data points for surface pressure added to the whole domain for 1850-1960 and build from there
 - ~250,000 new observations



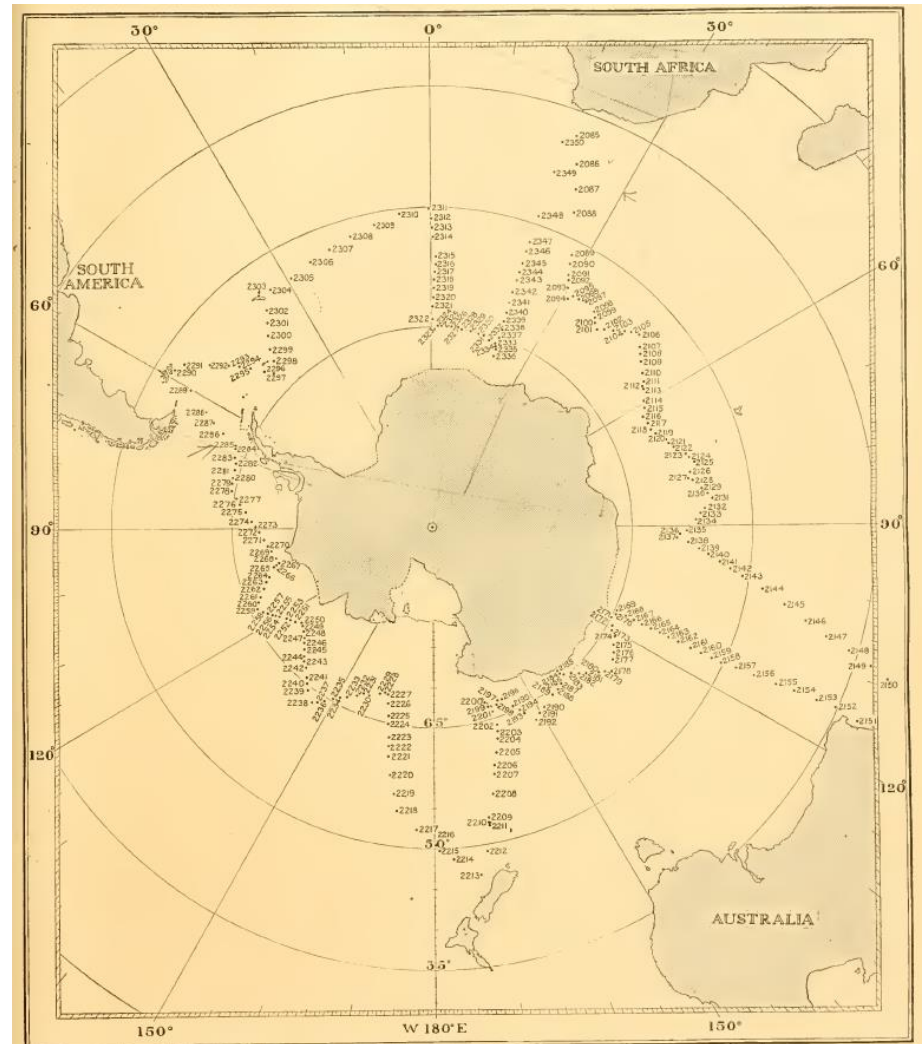
Progress so far

- Evaluated existing temporal data coverage in subdomains in 20CRv2c (1851)
- Clive Wilkinson has assessed archives and imaged logbooks in Europe and UK
- Evaluated 1 TB of images provided by Australia's SEARCH project
 - < 5% is directly relevant to ACRE Antarctica goals (first cut)
 - Issues with poor imagery and irrelevant data, but some potential
- Ursula Rack has investigated archives in NZ, Australia, some in Europe



Progress so far

- Keying of 'Discovery Reports'
 - UK research ship
 - 1930s
 - Antarctic circumnavigations
 - Oceanographic and biological (plankton) research
 - Sub-daily observations of air temp, barom. pressure, SST, ice observations
 - Determined by ACRE to not have been keyed already
 - NIWA team keyed ~5000 observations during 2016 within AA domain



Archive imaging

- Logbooks and other material imaged in 2016
 - Christian Salvesen Archive, University of Edinburgh
 - 2,700 images
 - Whaling ships
 - 1930s – 1960s
 - Vestfold Archive, Sandefjord, Norway
 - 30,500 images
 - Whaling ships, research vessels, land station in Antarctica
 - 1890s – 1960s
- National Meteorological Archive, UK
 - 18,000 images
- UK National Archive, Scott Polar Research Inst., British Antarctic Survey
 - 27,000 images

Driftsoversikt for uken 11/12

| 12 Dag | 13 Date | 14 Middagsposisjon | | 15 Vær og isforhold | | | | | | |
|---------------------|------------|-----------------------|-----------|------------------------|---------------------|---------------------|---------------------|-----|------|----|
| | | S. Breidde | V. Lengde | Luft-temp. kl. 0800 | Baro-meter kl. 0800 | Vann-temp. kl. 0800 | Vind-retning styrke | Sjø | Vær | Is |
| Søndag | 11/12 | 60°34' | 22°18' | 0° | 979 | +2.1° | 0.5 | 4 | elgi | BK |
| Mandag | 12/12 | 59°46' | 20°20' | ÷2° | 981 | +2.2° | 0.504 | 4 | el | HK |
| Tirsdag | 13/12 | 61°14' | 23°46' | ÷1° | 977 | +2.2° | 503 | 4 | dlq | AK |
| Onsdag | 14/12 | 60°48' | 20°14' | 0° | 979 | +3° | N02 | 3 | elgi | AK |
| Torsdag | 15/12 | 60°44' | 19°16' | 0° | 971 | +2.2° | 502 | 3 | elhi | BK |
| Fredag | 16/12 | 60°44' | 21°02' | ÷1° | 985 | +2.4° | SV3-5 | 3-4 | dlq | HK |
| Lørdag | 17/12 | 59°13' | 18°10' | 0° | 994 | +1.6° | VNV2 | 3 | dlq | HK |
| Antall fangst dager | 4 | | | | | | | | | |

Excerpt from log of Norwegian whaling ship *Thorshammer*, Dec 1955, from Vestfold Archive

What's next?

- Images from Northern Hemisphere archives recently received at NIWA
- NIWA team will prioritise logs for keying based on:
 - Subdomain coverage
 - Temporal coverage
 - Climate variables recorded
- Key priority logs – working on citizen science to assist with this (e.g. OldWeather)
- Meanwhile, Clive will image logs in more archives in the UK and Europe
- Engage with researchers who can assist in contributing to data rescue for ACRE
- Help other 'overlap' regions for ACRE (Chile and Argentina) by identifying data sources

Whale Fishery Catch Book
 Factory Ship *Terje Viken* Nov/Dec 1937
 Hubert. Lamb Archive, CRU/UEA

| 5 | | | | | | | | | | DAILY RECORD | | | | | | | | | | | | | | | | | | | |
|-----|----------|----------|---|-----------|---|---|---|----------------------|---|--|---|---------------------------|---|-------------------|-------------------------|--------|---|---|--|--------------------------|--|--|--|--|----------------------------|--|--|--|--|
| | | | | | | | | | | SUNDAY 28 th | | | | | MONDAY 29 th | | | | | TUESDAY 30 th | | | | | WEDNESDAY 31 st | | | | |
| DAY | LINE No. | LATITUDE | | LONGITUDE | | BAROMETER THERMOMETER Reading Centigrade | | WIND DIRECTION FORCE | | WEATHER | | PACK ICE BEARING DISTANCE | | BERGS NUMBER SIZE | | WHALES | | | | | | | | | | | | | |
| | 1 | 58-48 S | | 45-20 E | | 73.98 ÷ 15°C | | NW - 5 | | drizzle - snow squalls in the passage | | some small | | | | | | | | | | | | | | | | | |
| | 2 | 58-50 S | | 45-50 E | | 73.80 ÷ 1°C | | NNW - 4 | | fog & snow squalls | | S - close | | some small | | | | | | | | | | | | | | | |
| | 3 | S 58-15 | | E 46-37 | | 73.81 ÷ 1°C | | NW - 5 | | swell, overcast, clear | | S - close | | some small | | | | | | | | | | | | | | | |
| | 4 | 58-21 S | | 44-16 E | | 73.00 ÷ 2° | | SW - 3 | | clear - overcast | | S - close | | few small | | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | S | B | F | H | S | B | F | H | S | B | F | H | S | B | F | H | S | | | | | | | | | | | |



Thank you

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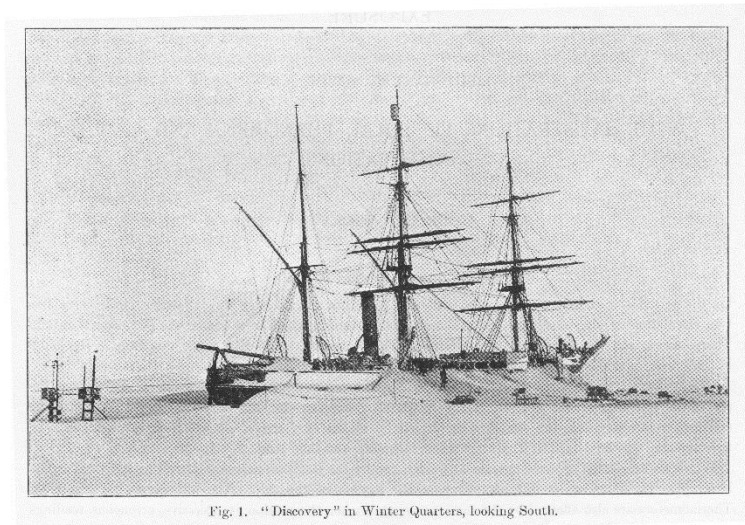


Fig. 1. "Discovery" in Winter Quarters, looking South.

