



Fisheries New Zealand

Tini a Tangaroa

Ministry for Primary Industries
Manatū Ahu Matua



New Zealand Fisheries and Climate Change Effects on the Ocean: a Wake-up Call for Fisheries Management

Mary Livingston, Fisheries New Zealand,
ECCWO Meeting, June 2018, Washington DC.

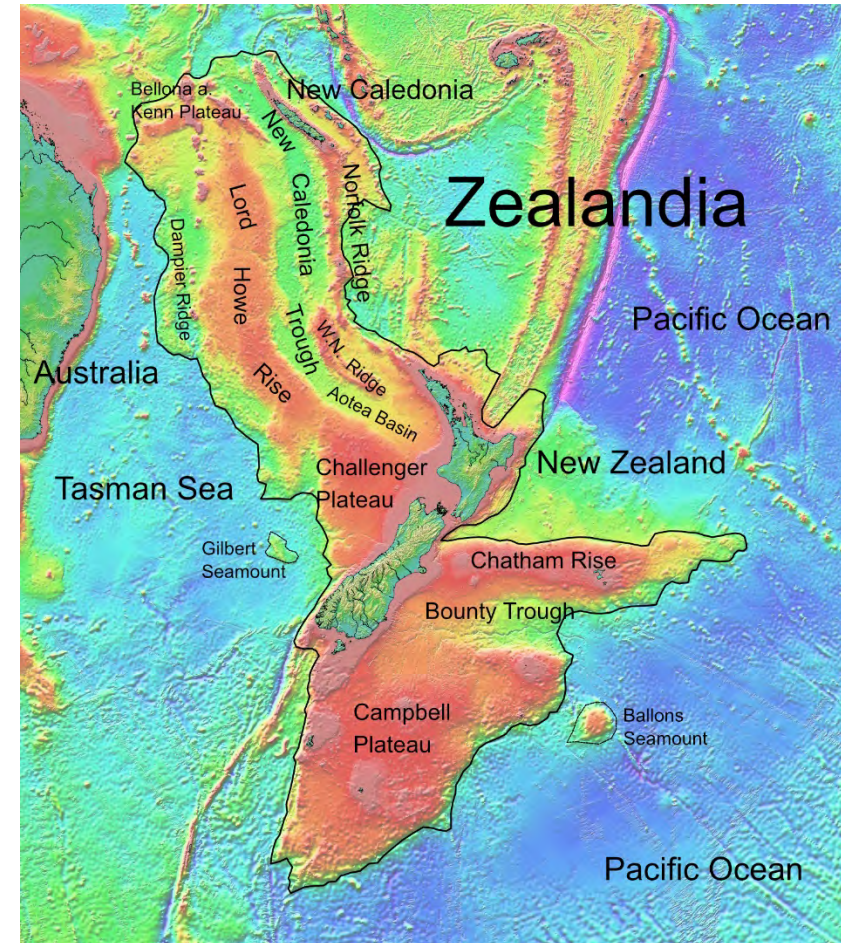
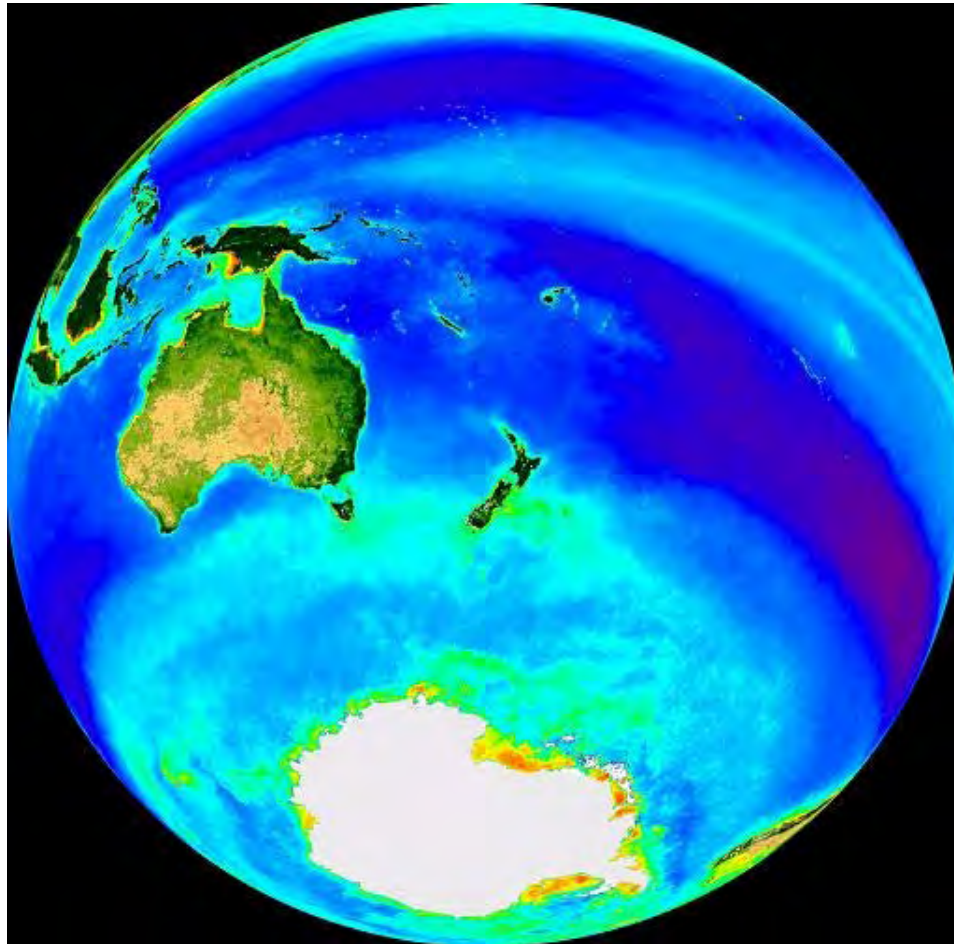
Growing and Protecting New Zealand



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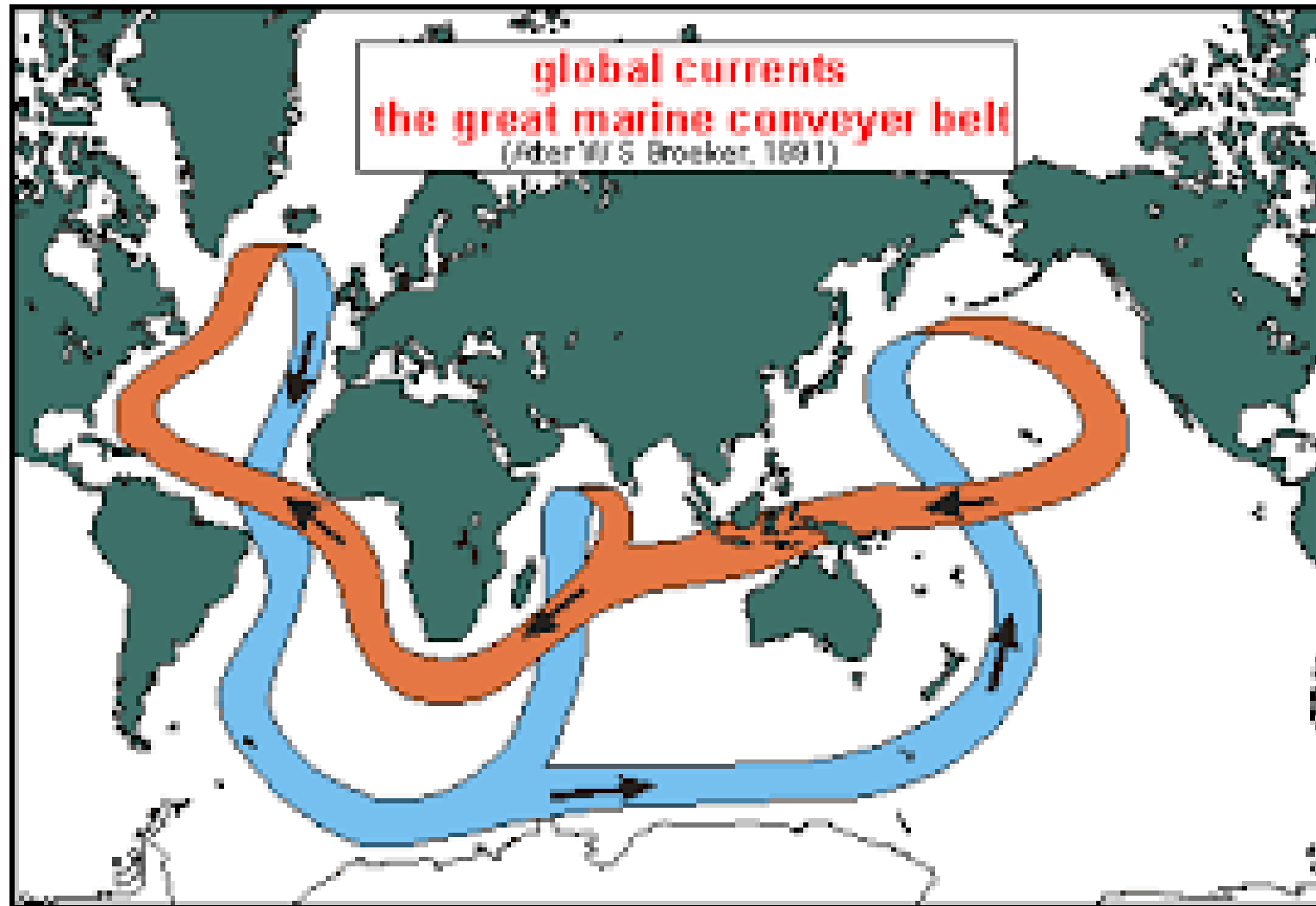


New Zealand and its continental status as Zealandia

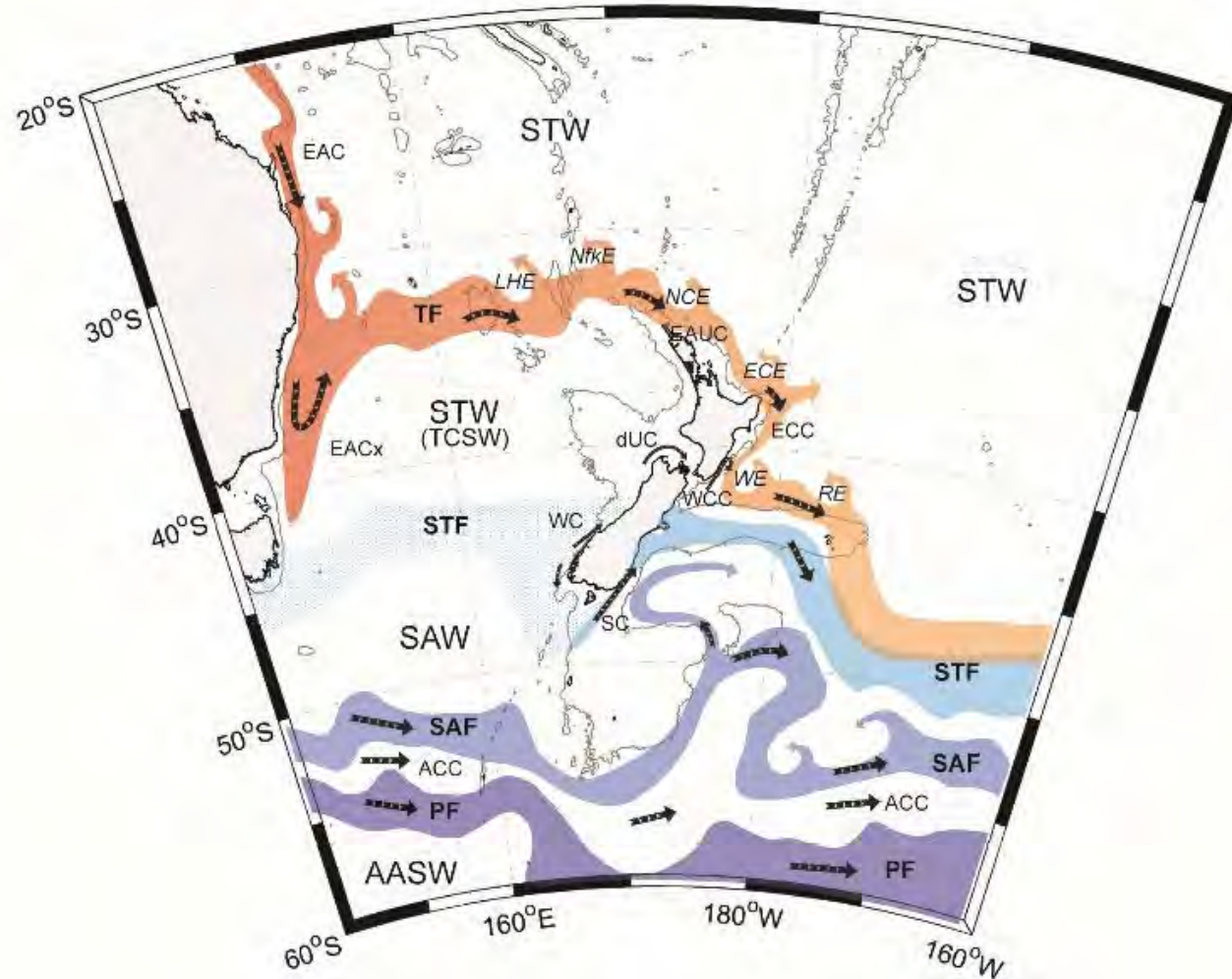


Images courtesy of NOAA and Scripps Institute

Part of the great marine conveyor belt

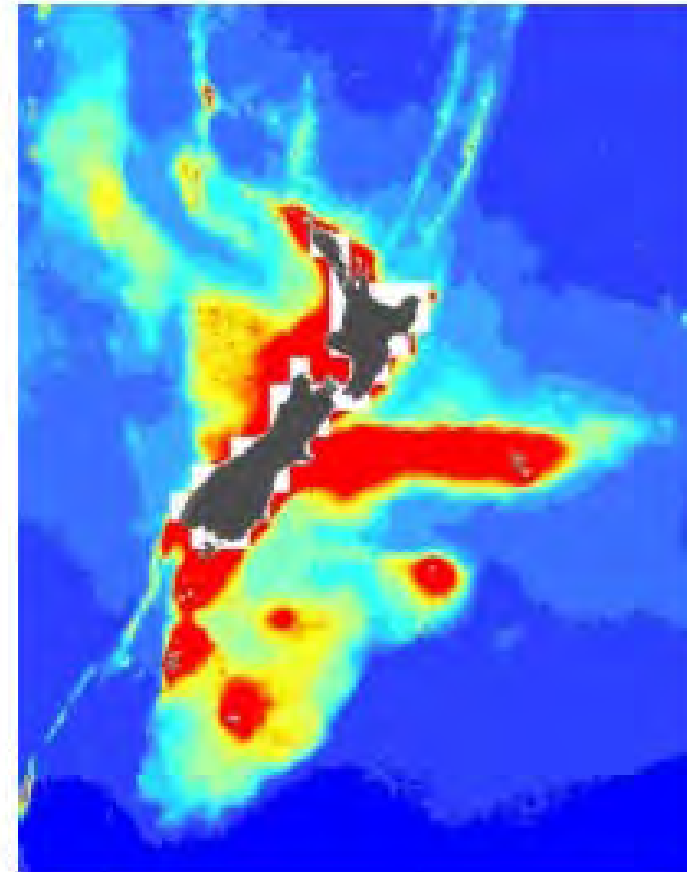
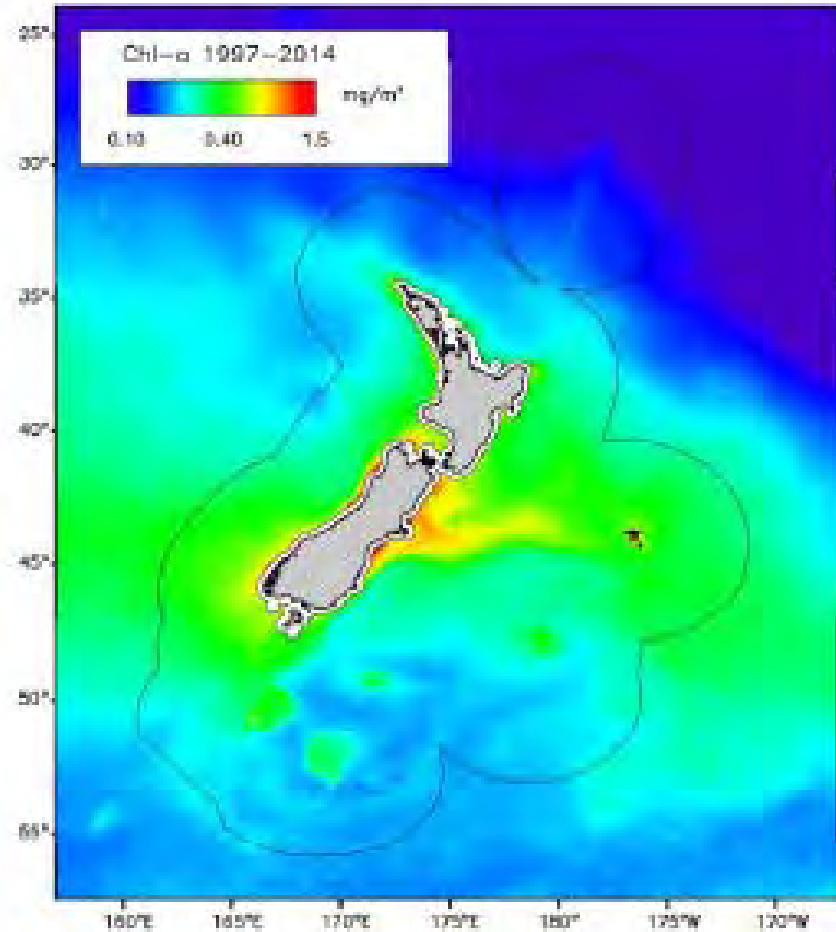


Water masses and currents



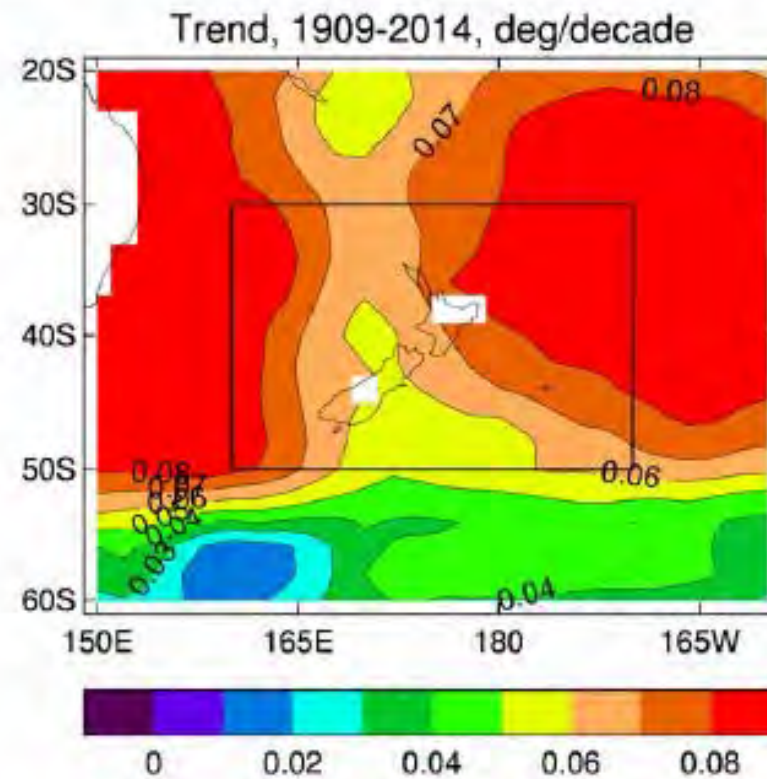
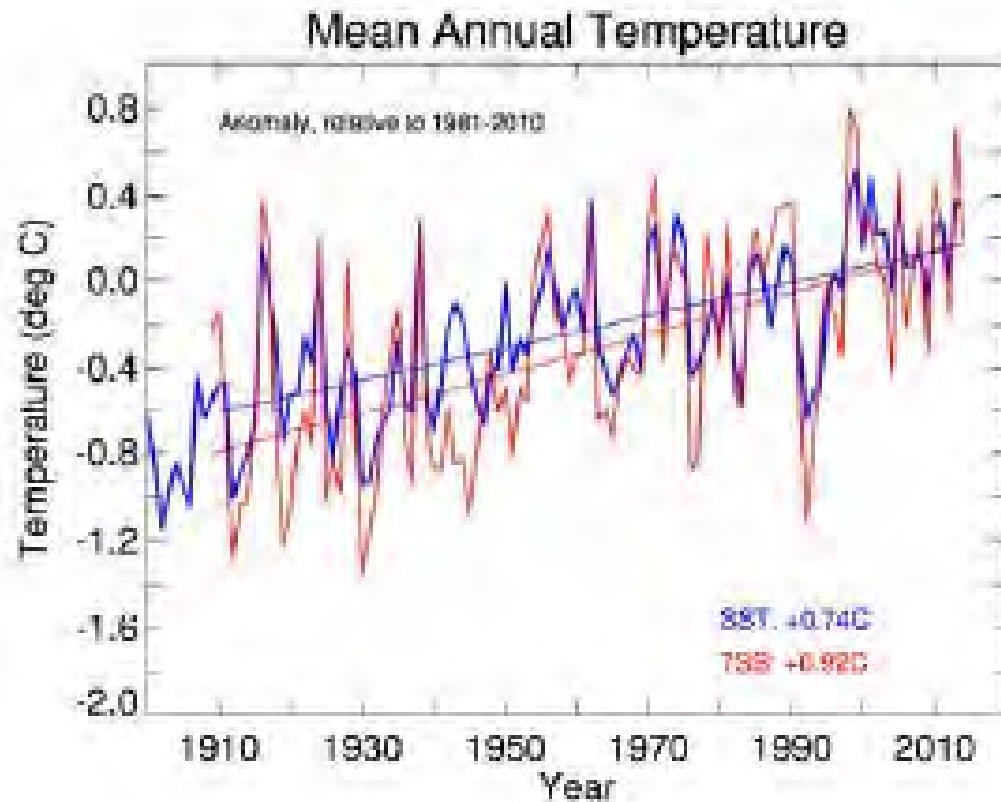
Chiswell et al 2015

Primary productivity



LEFT Chlorophyll a Seawifs and Modis Aqua 1997-2014, RIGHT Benthic POC after Lutz et al 2017

Water temperatures have been rising



SST Data from NOAA, updated after Mullan et al 2010

Ocean acidification is happening

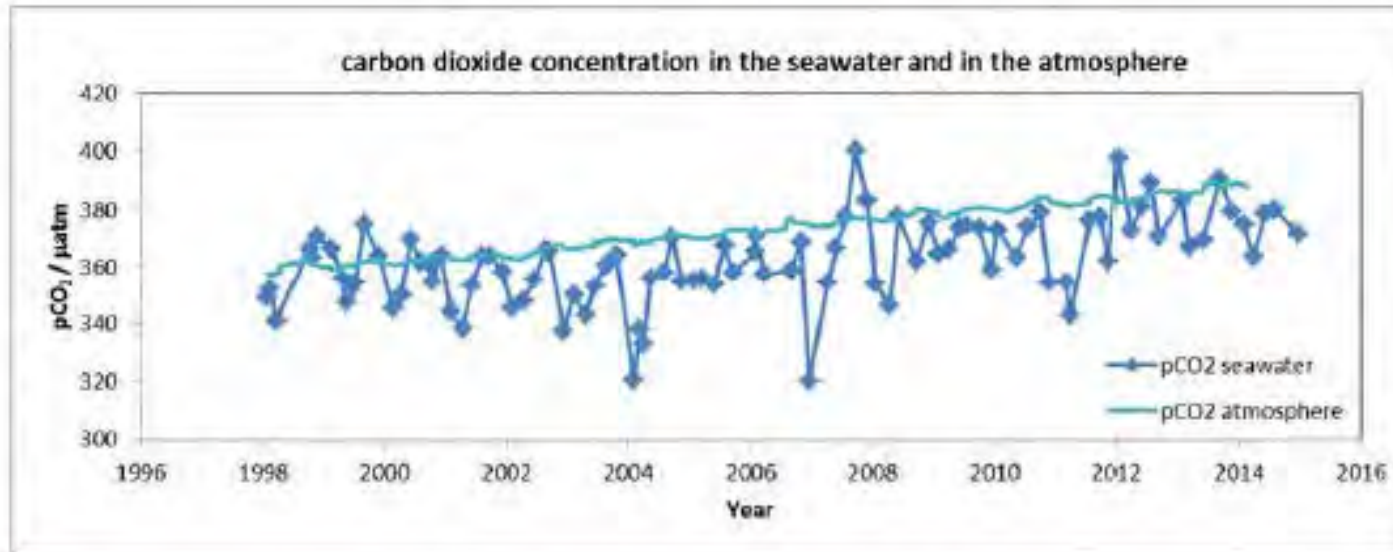
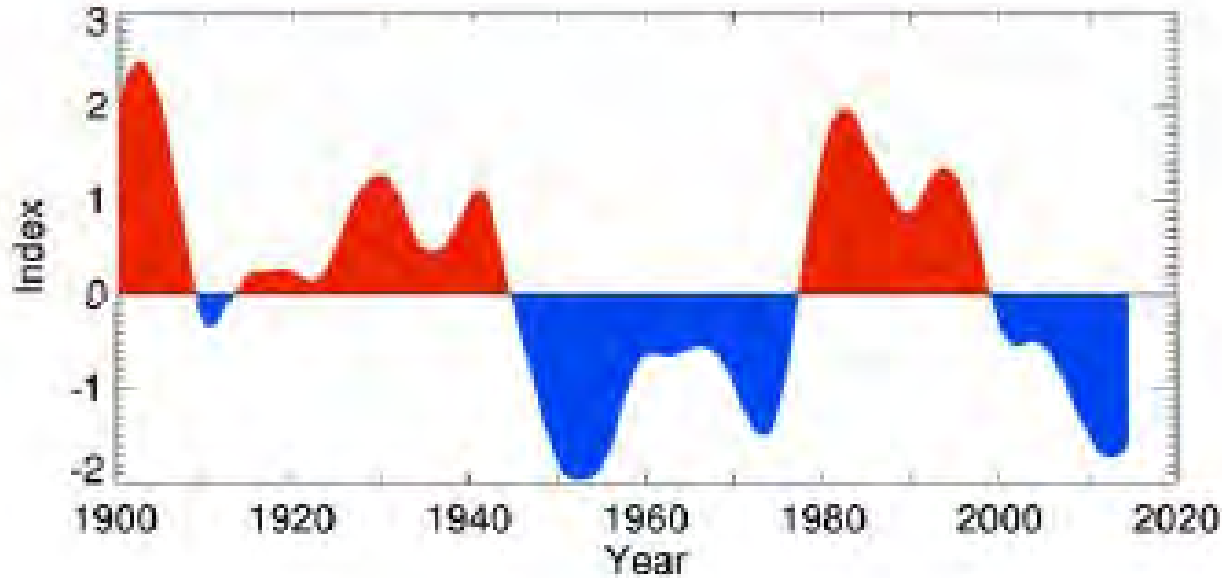


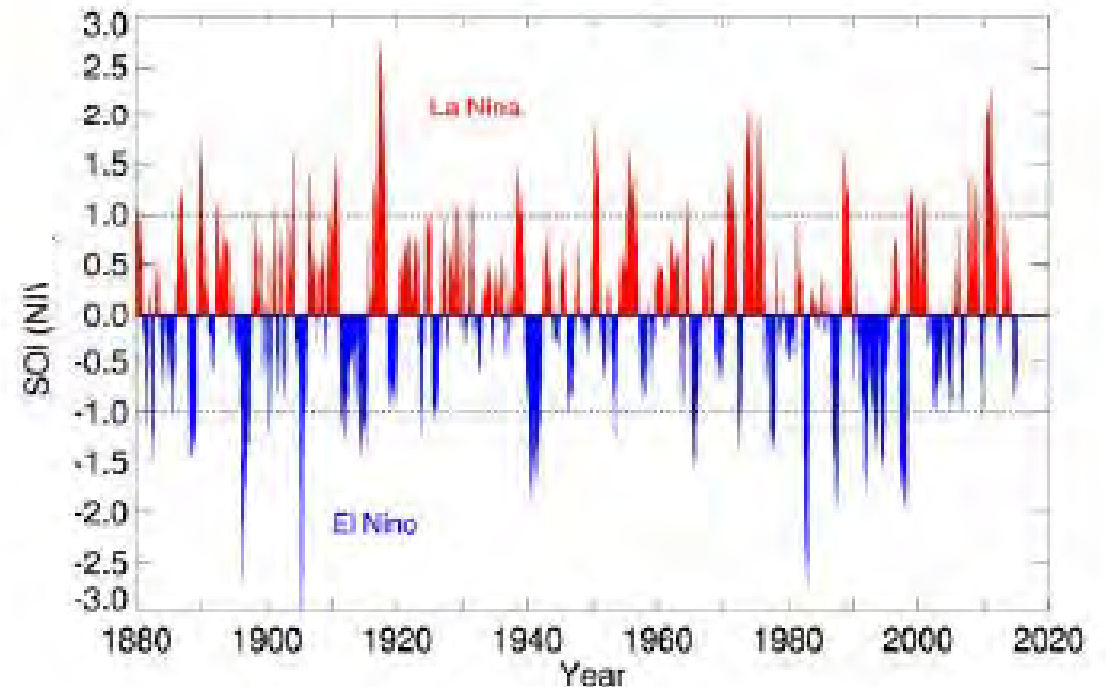
Figure 12.13: pCO₂ (partial pressure of CO₂) in subantarctic surface seawater and the overlying atmosphere from the Munida Time Series Transect, 1998–2014. Image courtesy of K. Currie, NIWA.

pCO₂ in Subantarctic surface water and the overlying atmosphere, Munida Time Series Transect 1998-2014. Courtesy K. Currie NIWA

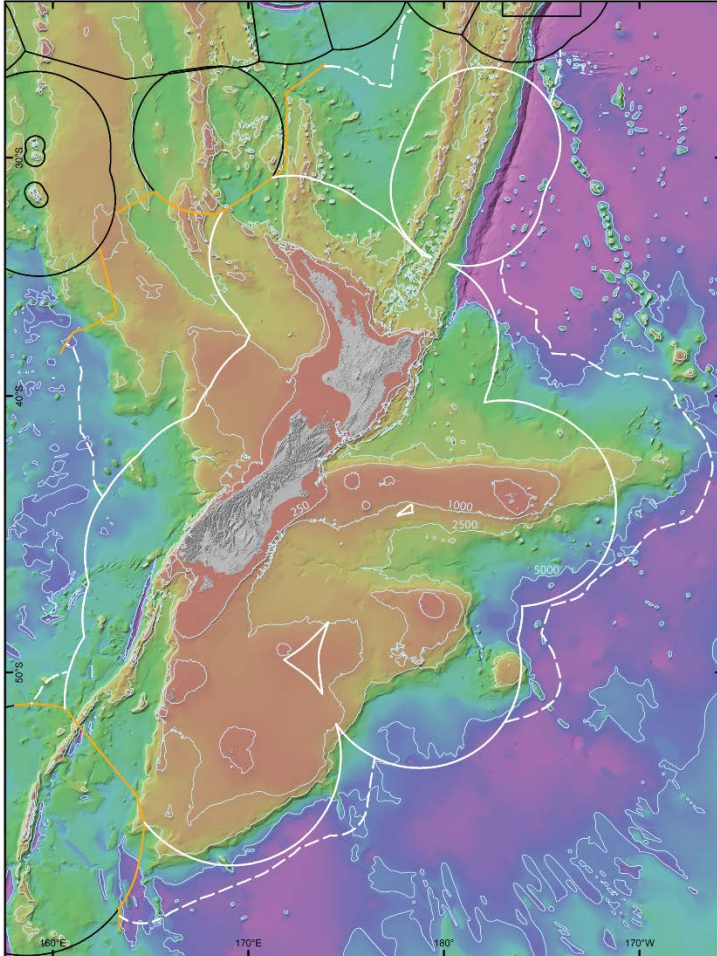
IPO and SOI cycles



ABOVE: Smoothed IPO since 1900, NIWA/UKMO.
RIGHT: Smoothed Southern Oscillation since 1880 Index NIWA



Fisheries Catch Statistics (Seafood NZ, Fisheries NZ)



- Approximately **600,000 tonnes of seafood (excluding aquaculture)** is harvested from New Zealand's waters each year.
- The seafood industry employs **over 20,000 people**.
- New Zealand earned **\$1.79 billion in seafood exports** in 2016.
- **287,864 tonnes** of seafood was exported in 2016.
- Managed through the **Quota Management System (QMS)** that controls harvest levels for each fish species and area.
- **123** species are commercially fished in New Zealand. **98** of those species are managed under the QMS in **642** stock areas.
- Maori own **50%** of New Zealand's fishing quota.
- Each year, the Ministry for Primary Industries reviews the **Total Allowable Commercial Catch (TACC)** for fish stocks and sets limits so that enough fish remain for breeding.
- **97%** of New Zealand's commercial catch is above management target catch levels

NZ Fisheries Legislation

The New Zealand Fisheries Act (1996) requires that the Total Allowable Commercial Catch (TACC) should have “regard to the interdependence of stocks, the biological characteristics of the stock, and any environmental conditions affecting the stock”.

OA and CC related research supported by MPI

- Added CC and OA to the biodiversity objectives for fisheries research in 2007
- Deepsea Corals: mapping, connectivity, laboratory experiments, survey work and saturation horizons
- Marine environmental monitoring programme-database review
- Ocean Climate Change Tier 1 statistics development, MfE Environmental Reporting
- Shellfish response-joint workshop with US in 2013
- OA modelling in EEZ
- Rhodoliths, coralline, macroalgae response, shellfish responses to OA and temperature
- Environmental indicators; metadata analysis of recruitment, fish diet change over time
- Primary productivity, plankton growth and microbial growth experiments at sea
- Empirical relationships between climate variables, trends and fish abundance, some modelled
- Taking Stock project looked at changes in NZ marine shelf ecosystems over a 1000 year window
- Initiated a CPR transect time series from NZ to the Ross Sea; OA research Ross Sea
- Also....participation in IPCC, Biodiversity Action Plan 2016 to meet Aichi targets, answering parliamentary questions on CC, advice to aquaculture sector

Remaining barriers for Fisheries and MPI

- Fishing Industry engagement for CC science research
- Political engagement re the ocean
- Internal MPI prioritisation
- Fisheries Management engagement
- Research funding
- Uncertainty and future scenarios
- The data “hose” and fatigue



"I don't know why I don't care about the bottom of the ocean, but I don't."

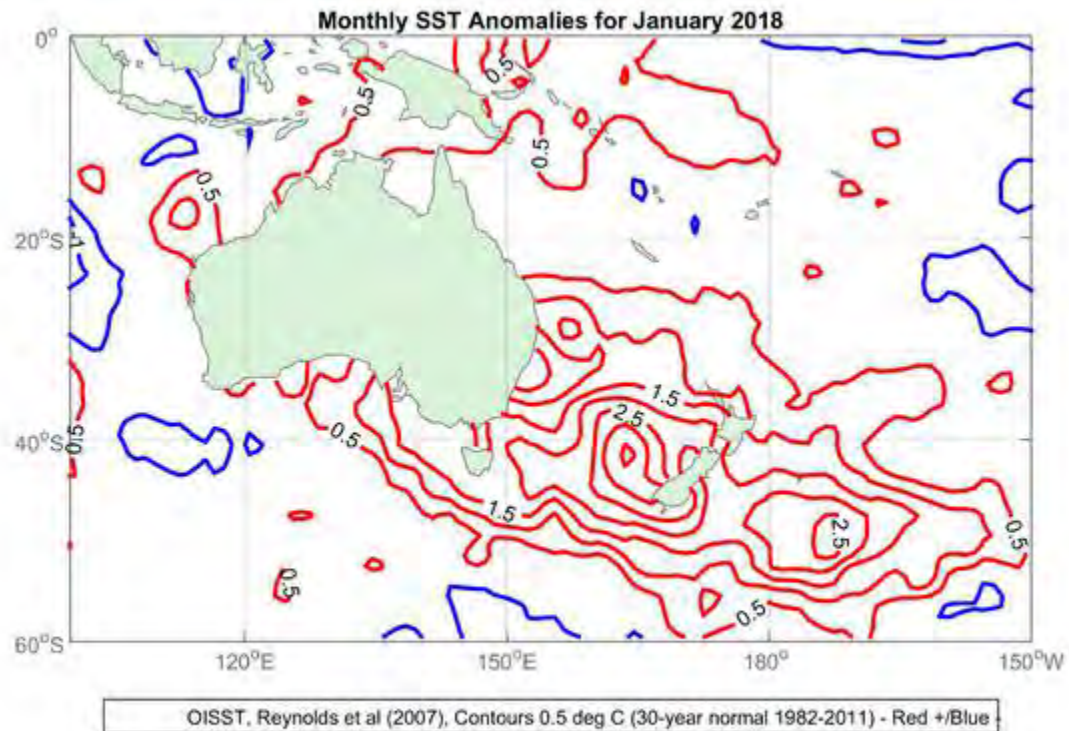
1983

CIN
COLLECTION

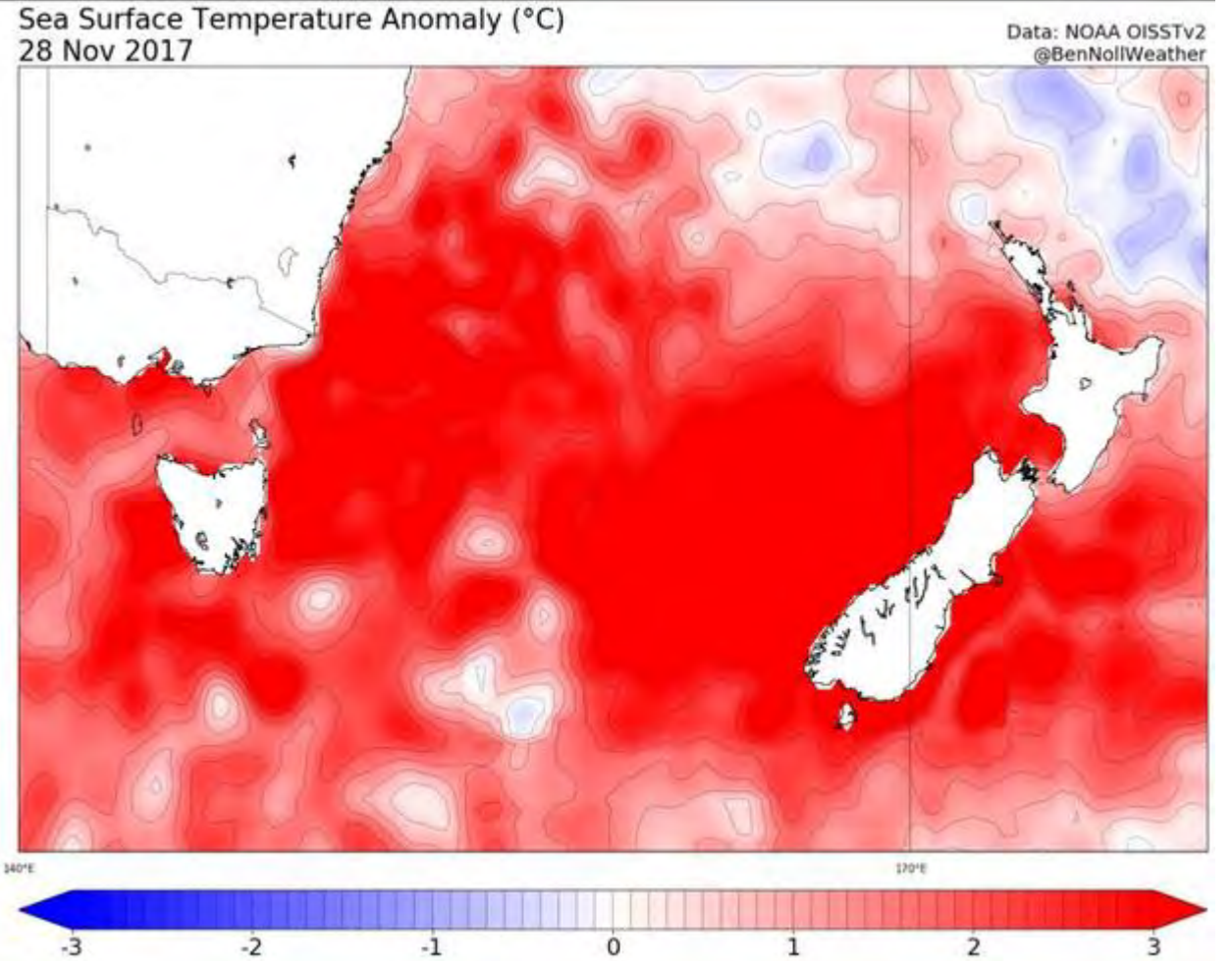
Still no response from fisheries management until...

- Anecdotal evidence from industry started to come in eg Queensland groper 3000 km off course; snapper in Fiordland, massive jellyfish blooms, kingfish off Otago, Stewart Island, scallop woes, paua woes
- Science evidence was summarised in pictorial form
- Realisation that CC is here now, not in the future
- **WAKE UP CALL** when NZ experienced the 2017/18 marine heatwave
- We had salmon farm mortalities, massive jellyfish blooms, unprecedented toxic shellfish closures
- NZ and Australia released a joint special climate statement

Summer 2017-18 Highest records ever, sea, and air



SST Ave +2 deg. C; some areas + 6 deg C. Down to 25 m depth



Now there is interest from stakeholders and managers-Key questions include

- What changes are we expecting? *We can answer this*
- How soon can we expect to see changes? *And this*
- Which species will move, adapt or die? *Needs work*
- Which zones, fishery management areas, species, habitats or processes will be most affected? *Needs work*
- Which stakeholders will be most affected and how? *Needs work*
- How significant are the likely effects on overall seafood productivity? *We have some indications*
- What can we do about it given the scale of the issue? *Needs work*

Climate Change Impacts and Implications Law et al. 2016

Climate Changes, Impacts and Implications for New Zealand to 2100

Synthesis Report: RA2 Marine Case Study

The NZ Exclusive Economic Zone and South West Pacific

Cliff S. Law^{1*}, Graham J. Rickard¹, Sara E. Mikaloff-Fletcher¹, Matt H. Pinkerton¹, Richard Gorman², Erik Behrens¹, Steve M. Chiswell¹, Helen C. Bostock¹, Owen Anderson¹ and Kim Currie³

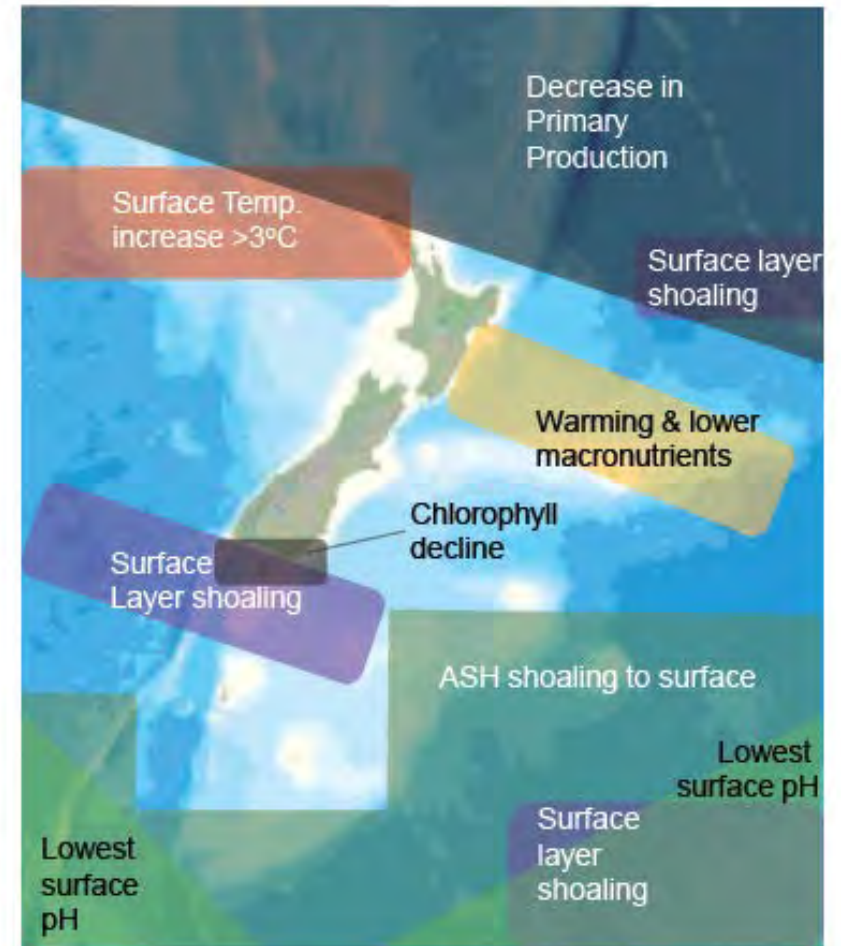


Figure 20. Regional extremes for climate-sensitive variables in the surface ocean around New Zealand projected for 2080-2100.

Key projections of interest under RCP8.5 to NZ Fisheries (Law et al. 2016)

Mean SST will increase by 2.5oC, and exceed 3oC in the north Tasman Sea, by 2100. Decreases in surface chlorophyll-a, nitrate, phosphate and pH will have occurred by 2100, accompanied by shallowing of the surface layer.

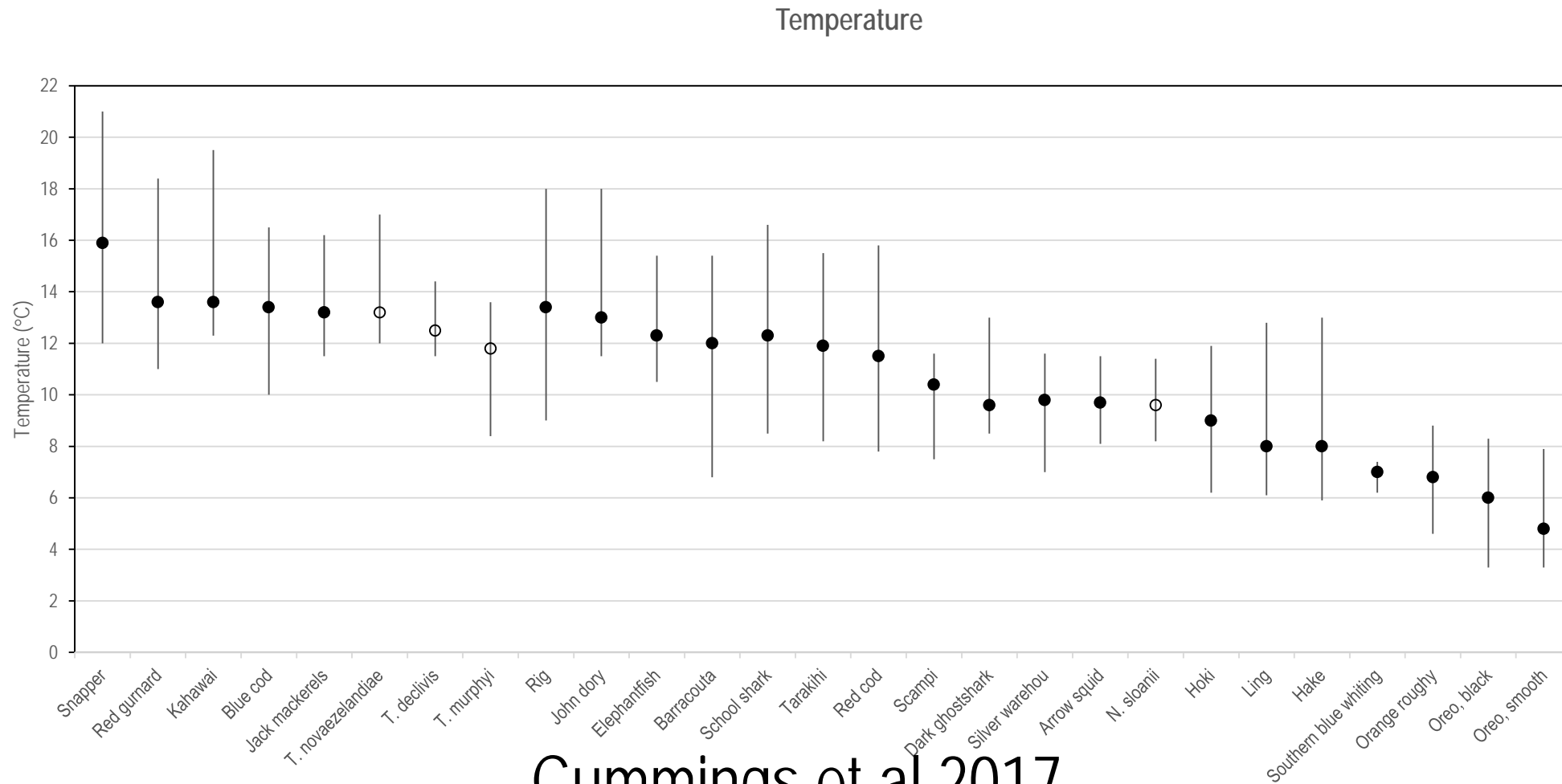
Surface pH will decline by 0.33 under RCP8.5 by 2100, with the resulting pH (7.77), and the rate of change in pH, being unprecedented in the last 25 million years. Subantarctic surface pH will fall below the current pH minimum around 2030, with acidification creating corrosive conditions for organisms with carbonate shells in Subantarctic waters.

Integrated Primary Production will decline by 6% from the present day under RCP8.5 by 2100, with Subtropical waters, which are already characterised by low primary production, experiencing the largest decline

Changes in particle flux will alter food available for fish. A decline in particle flux was identified for all 38 species assessed (including 30 commercial species), ranging from 2.2 to 24.6%, by 2100. The largest decline occurs in areas occupied by the northern spiny dogfish, gemfish, frostfish tarakihi, and lowest in areas occupied by black oreo, barracouta, southern blue whiting and blue warehou.

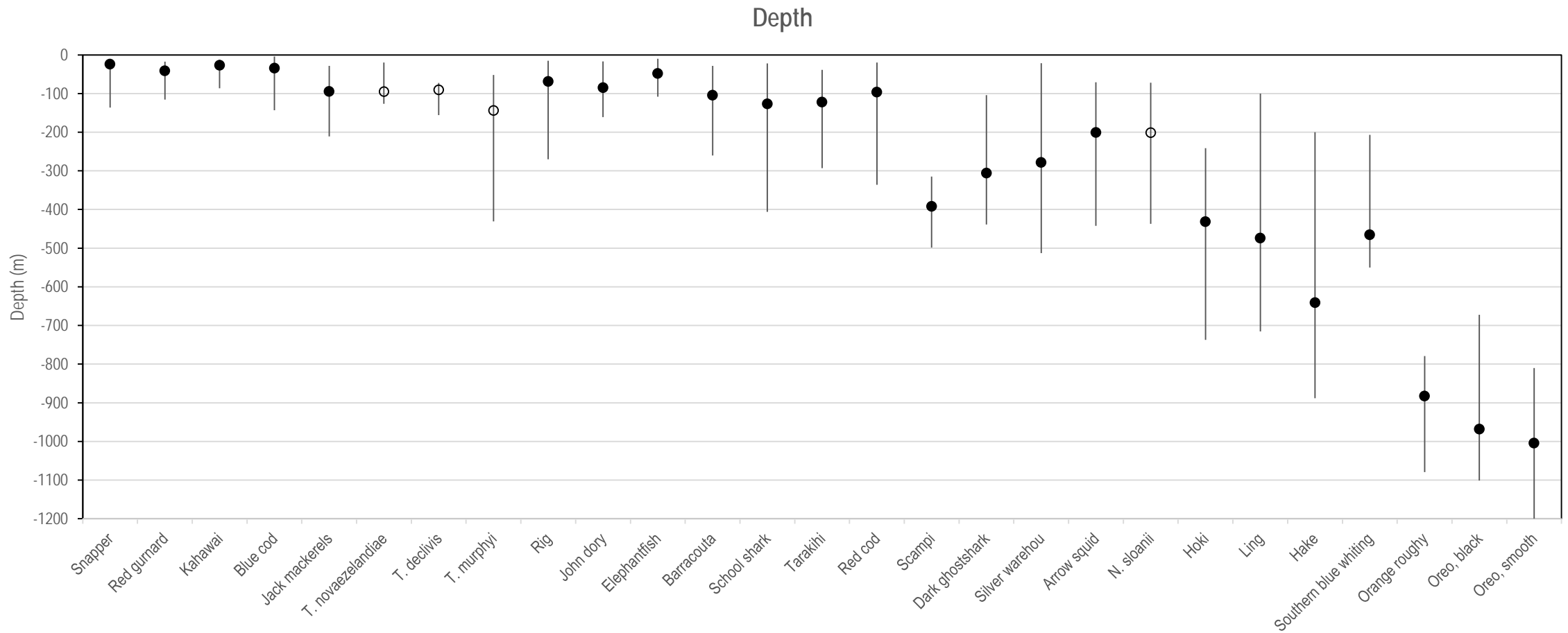
Climate change will not significantly lower dissolved oxygen in the mid-water around NZ, but the depth at which carbonate dissolves will be significantly more shallow.

Now assessing CC risk across key fisheries – thermal range



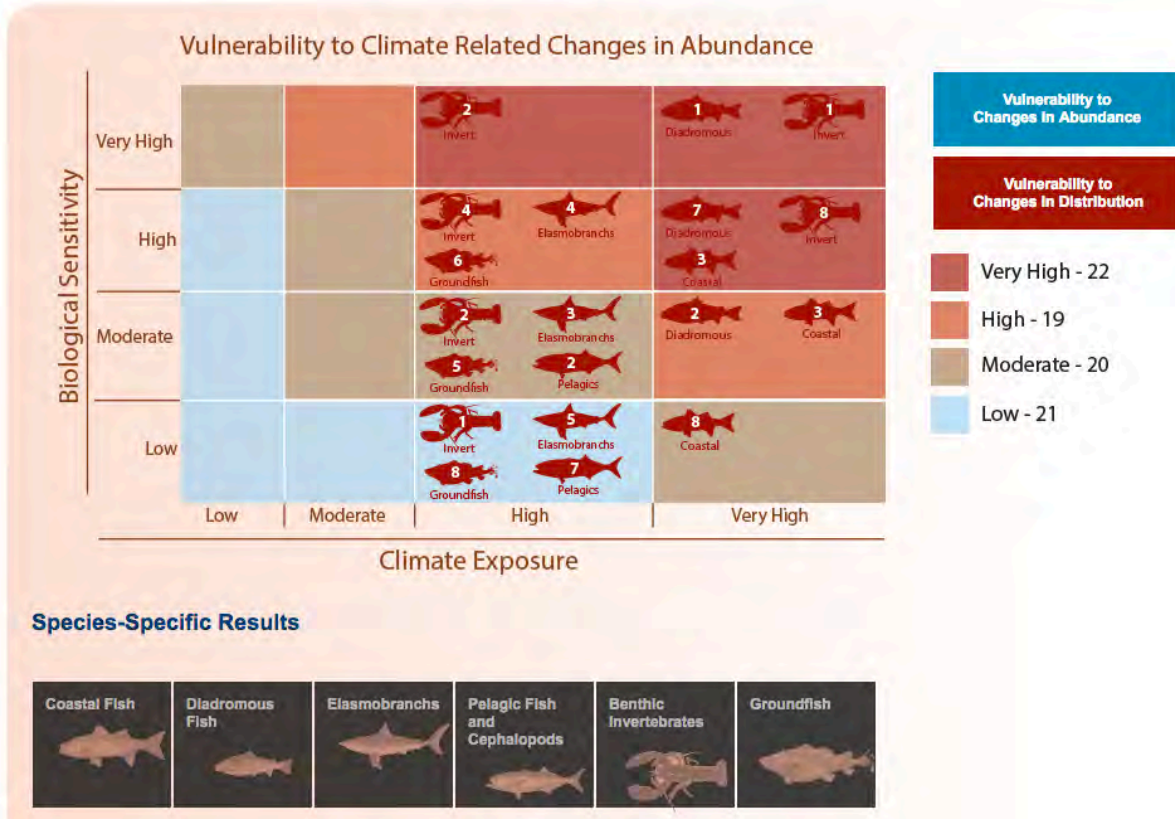
Cummings et al 2017

Assessing CC risk to NZ Fisheries – Depth range



Cummings et al 2017

Rapid risk assessments, regional assessments underway



Rapid risk and vulnerability assessments Hansen et al. 2017, Regional assessments Morrison et al 2015

New Projects planned for 2018-19

- Investigation of productivity parameter change and variability in relation to environmental change
 - Recruitment, age at maturity, stock-recruit relationship, natural mortality assumptions and rates, growth sex ratios, stock management, stock affinity, ecosystem change, yield estimation uncertainty
- Species on the move investigation
 - Catch data, observer data, survey data, temporal and spatial trends
- Full parameter investigation of Sea lion interactions in Subantarctic Islands to identify synchrony of indicators for regime shift or change
 - Oceanographic data, fisheries catch effort data, Marine mammal risk assessment data Satellite data, argo data, Trawl survey catch data, environmental data, Climatic data, plankton and trophic data, sealion dietary and foraging behaviour, pupping rates, seabird diet and foraging data etc

Hopefully in the longer term....

- Develop strategic plan for EBFM and climate change research
- Fisheries management dashboard on Climate Adaptation Knowledge Exchange website (CAKEx.org)
- Determine if the extremes are likely to be more important than the mean trends; develop MICE models where appropriate
- Consider citizen science and recreational co-operation project, and leverage biosecurity methods for reporting species distribution
- Develop bio-socio-economic modelling and forecasting skill
- Facilitate forecasting marine alerts for aquaculture and fishing industry re extreme conditions such as marine heatwaves

The bridge is slowly being built and fisheries management is starting to think more broadly in New Zealand

I acknowledge the helpful discussions and research by my colleagues Alistair Dunn, Martin Cryer and Rich Ford at Fisheries New Zealand; Vonda Cummings, Carolyn Lundquist, Matt Dunn, Matt Pinkerton, Cliff Law, Di Tracy and Mike Williams at NIWA

Thanks for your attention!



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