

Ocean Acidification Monitoring In New Zealand

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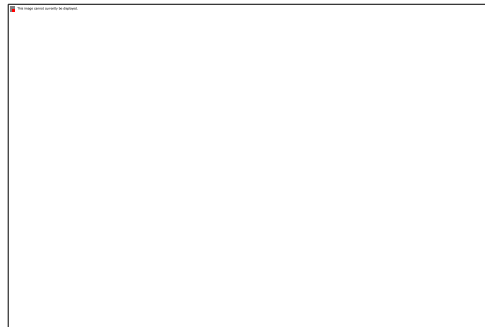
The New Zealand Experience in Setting up Ocean Acidification Observations

- Experience in carbon chemistry
 - have been mainly research focussed
 - collaborative, inter-disciplinary projects
- Time series for marine carbon research
 - role of ocean in carbon cycle
- Extending expertise and developing collaborations to develop OA coastal monitoring programme

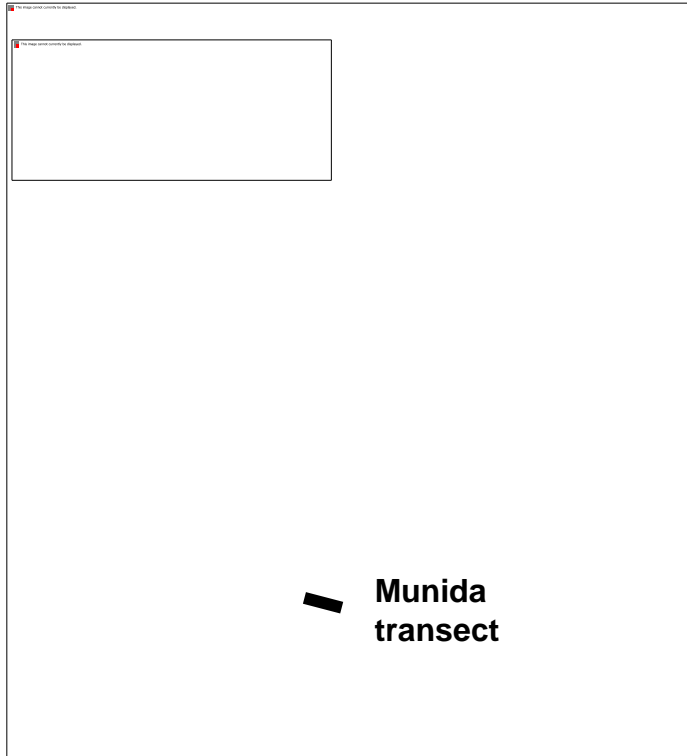


Munida Time Series

- A carbon chemistry time series was established in 1998, off the coast near Dunedin, New Zealand – **Munida Time Series**
- Part of research programme looking at uptake of atmospheric carbon dioxide by SW Pacific waters
- Now is longest running carbon time series in the Southern Hemisphere
- Collaboration between NIWA and the University of Otago
- Carbon chemistry → ocean acidification parameters



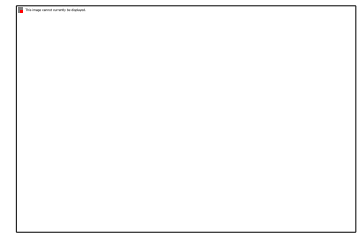
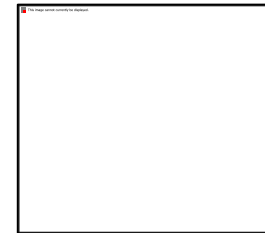
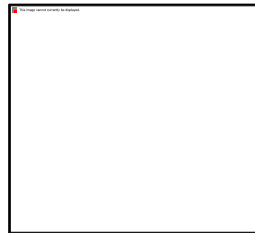
Munida Time Series



- surface transect, 65 km long
- neritic, modified subtropical water, subantarctic surface water (SASW)
- SASW cast (500m)
- bi-monthly since 1998

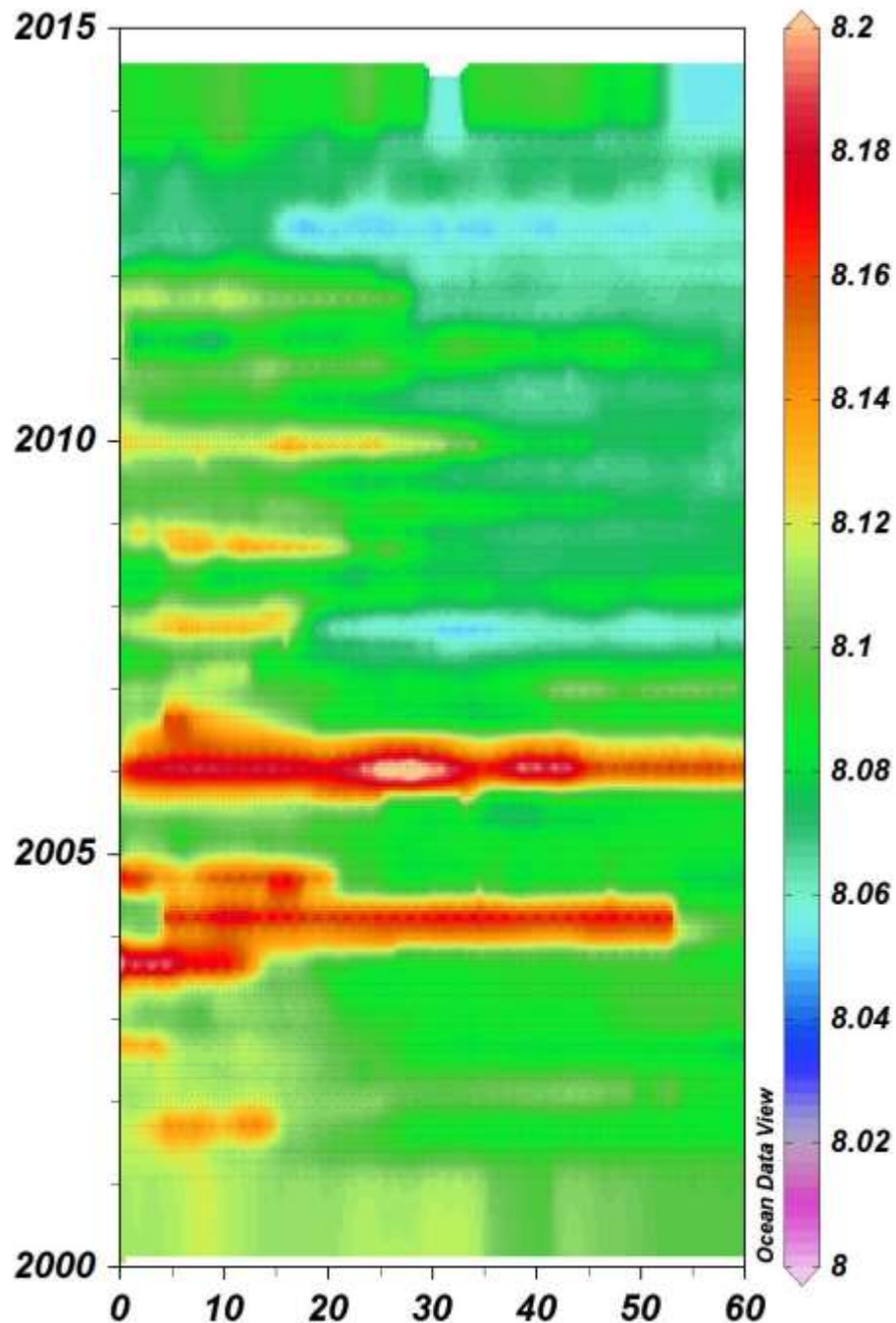
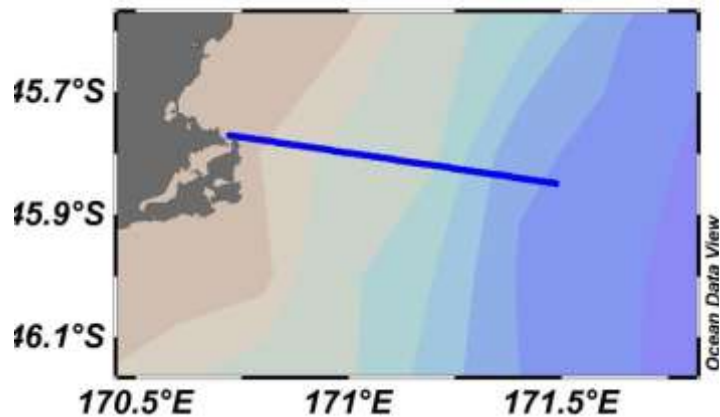
core measurements:

- | | |
|---------------|-----------------|
| • temperature | • alkalinity |
| • salinity | • C_T |
| • pCO_2 | • nutrients |
| • pH | • chlorophyll a |



Continuing Value

- 1 voyage
- 1 year
- many years,
one location
- many years



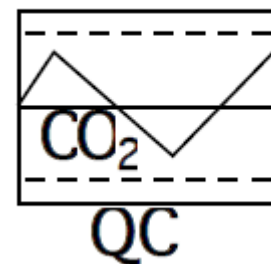
Added Value

- Core measurements, plus add-ons to make the most use of boat time –
 - directly related to carbon time series
 - seaweed, birds, trace metals, bacteria, enzymes, nitrogen cycling, science communication ...
- Students, either directly involved in add-on projects, or general oceanographic experience
- Training platform for international students



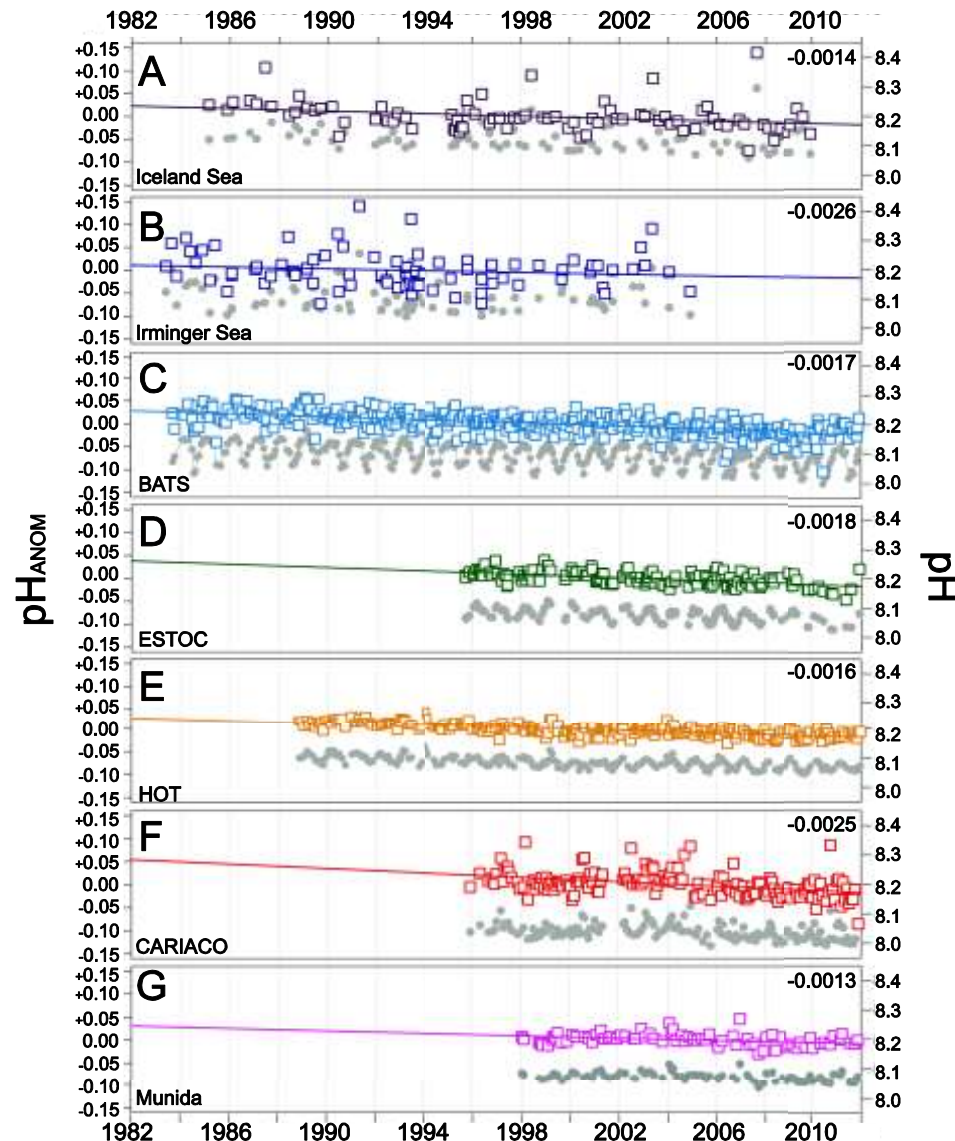
Capability and Resources

- Started simple, added capacity as we have grown
- Kept core measurements, same personnel
- International collaboration where possible
- Inter-calibrations, certified reference materials
- Quality, Quality, Quality
- International databases
- Will be up-graded to comply with GOA-ON Goal 1 requirements



Results

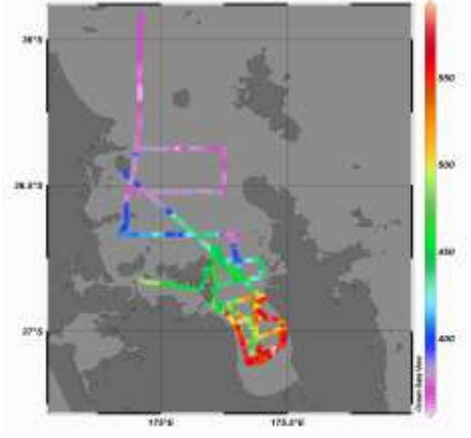
- Area is a sink for atmospheric carbon dioxide
- Biological activity is main driver of seasonal variability
- Long term pH decrease in sub-antarctic water is similar to that observed at other long-term monitoring sites



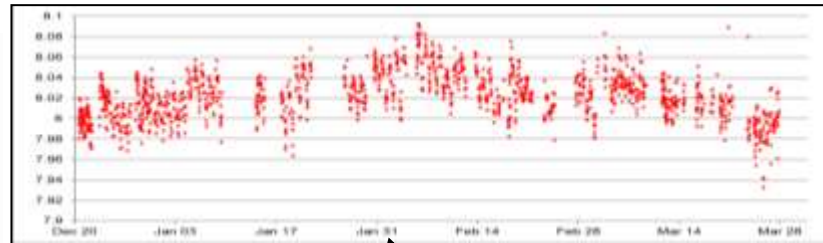
Bates, N.R et al., 2014. Changing ocean chemistry: A time-series view of ocean uptake of anthropogenic CO₂ and ocean acidification. *Oceanography* 27 (1), 126-141.

OA data available in NZ region

Hauraki Gulf - pCO₂

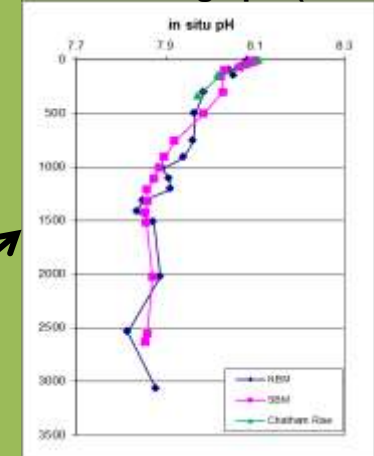


Wellington Harbour pH (16 oC)

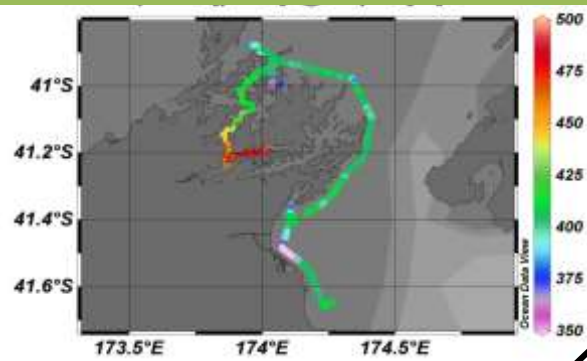


Vonda Cummings and Neill Barr

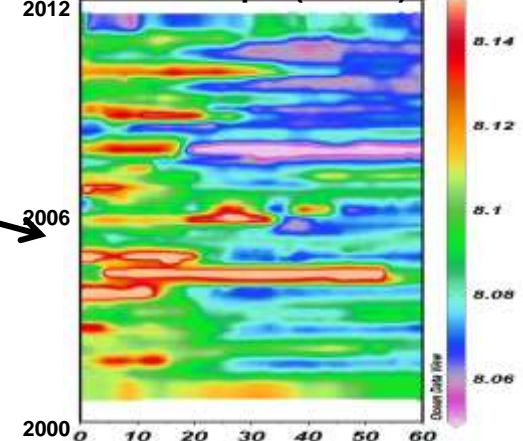
Moorings pH (in situ)



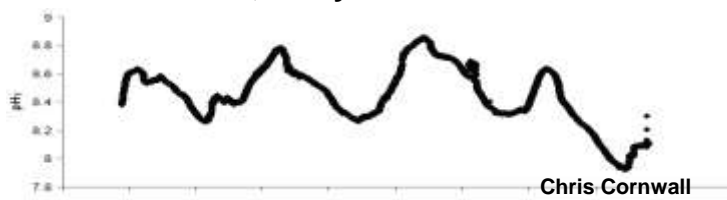
Marlborough Sounds – pCO₂



Munida pH (in situ)

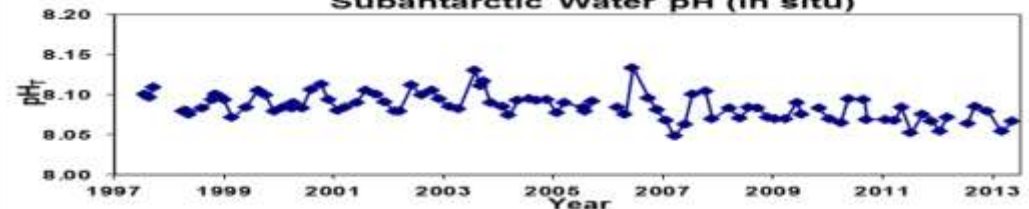


Karitane, 3 days



Chris Cornwall

Subantarctic Water pH (in situ)



Need for more OA data

- Clear that waters around NZ are variable
 - spatially, different time scales
- OA important for aquaculture, culturally, also scientific interest
- International effort to set up observing network – GOA-ON
- Need a bigger picture of NZ base-line conditions
- Need to get an understanding of the variability
- Identify areas of vulnerability and potential resilience
- Inform coastal management plans



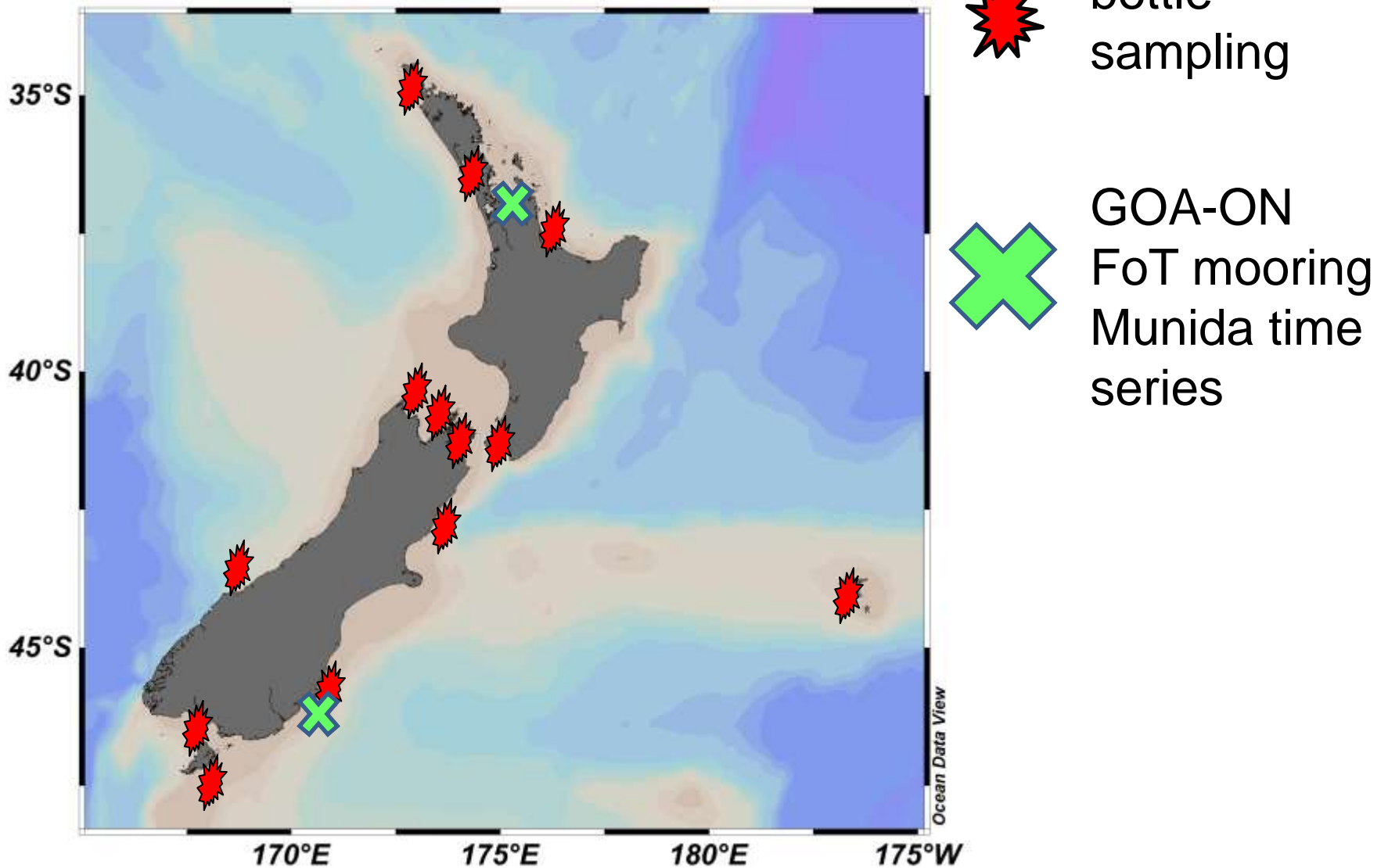
NZOA-ON:

New Zealand Ocean Acidification Observing Network

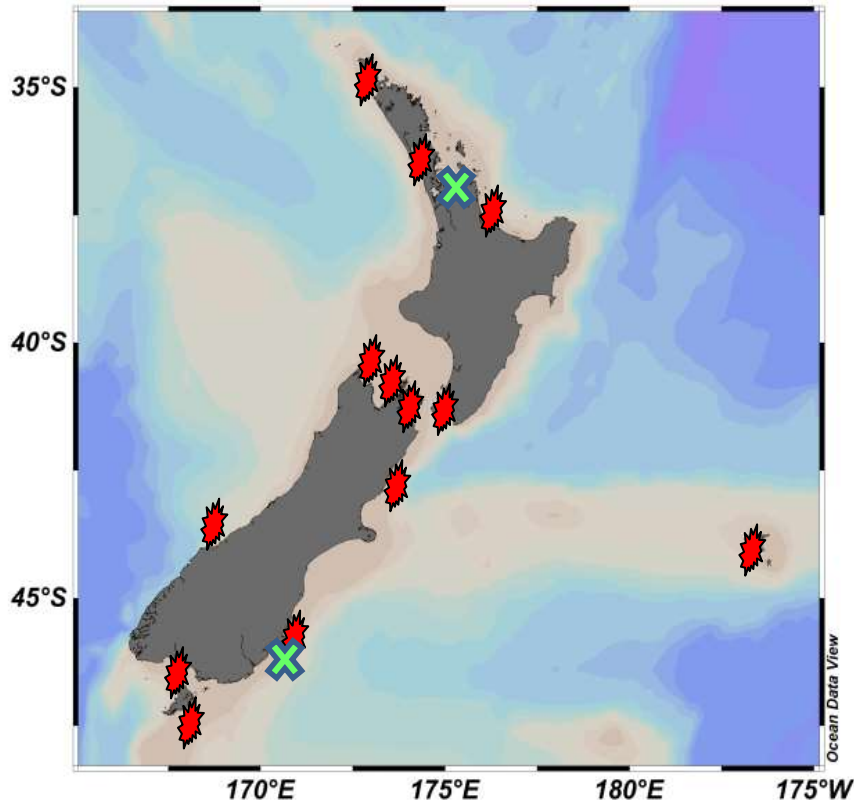
- Establish a network for coastal OA observations
- Fortnightly bottle sampling + moored pH sensor
- alkalinity and DIC measurements → pH, Ω , $[\text{CO}_3^{2-}]$
- Central analytical facility - NIWA/University of Otago Research Centre for Oceanography
- Sampling Sites - 14
 - Utilise existing monitoring sites (regional councils, marine labs, port authorities, DOC, research platforms...)
 - Pristine / high impact / aquaculture sites
 - Target particular ecosystems, species...



Sites



Sites



Partners

Aquaculture / Fishing Industry

Mussel spat, farms
Fishing industry
Aquaculture NZ
Paua Industry Council

Councils

Waikato Regional Council
Environment Southland
Auckland Council
Bay of Plenty Regional Council

Government Departments

Ministry for Primary Industries

Research Institutes

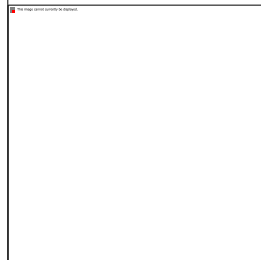
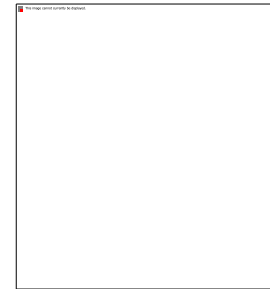
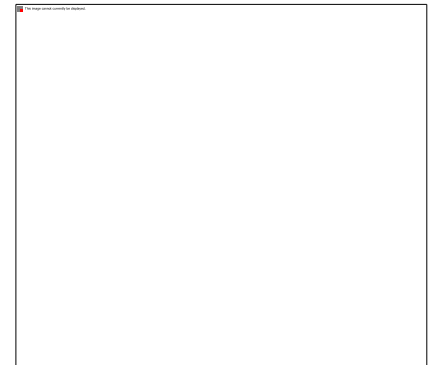
NIWA
University of Otago
Cawthron Institute
University of Auckland

Coastal Marine Guardians?




Iwi ?

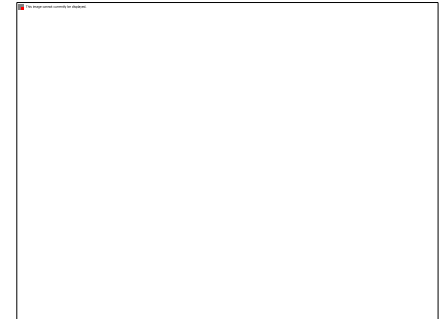
NZOA-ON




- Fourteen sites
- Fortnightly bottle sampling
- Duplicates every four sampling events
- Return bottles to lab when case is full
- Training for samplers (video)
- Issues**
 - use of mercuric chloride preservative (HASNO)



pH sensors (SeaFET™)

-  to establish short term variability (diel, tidal)
-  deploy on short-term basis (4-5 months)
-  move around sites

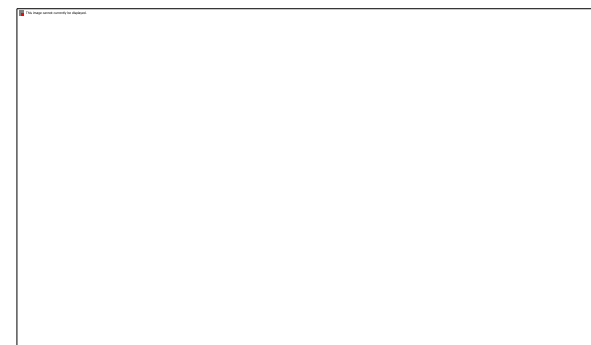
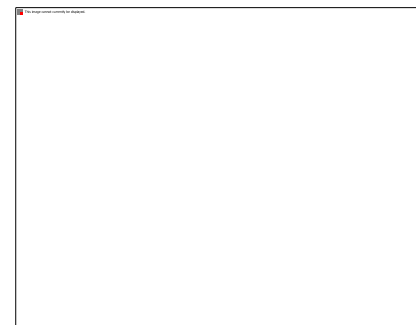
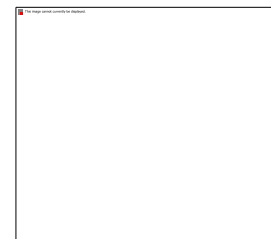


-  Network is easily reproduced, expanded
-  Two sites upgraded to GOA-ON standard
-  Data will be available via website



NIWA/University of Otago Research Centre for Oceanography, Dunedin

- central analytical facility
- experience in carbonate chemistry analysis, calculations and interpretation
- international inter-comparisons, demonstrated high quality
- dedicated marine chemistry technician (2-years)
- commercial analytical service
 - additional samples (industry, councils...)
 - preparation and certification of buffers and dyes
- logistics - bottles, freight boxes
- database management



Medium-Long Term Goals

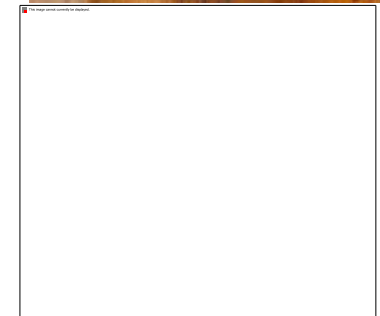
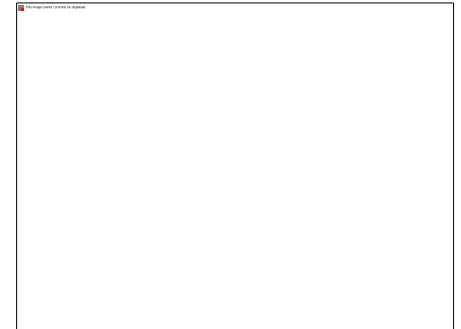
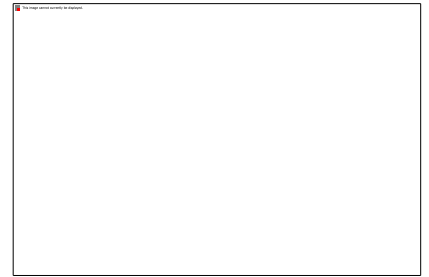
What will we do with the data?

- 🚦 Knowledge of present-day conditions, against which to assess future impacts
- 🚦 Knowledge of spatial and temporal variability in NZ coastal waters
- 🚦 Identification of vulnerable sites
- 🚦 Data for aquaculture industry, policy making, coastal management
- 🚦 Modelling – input to NZ coastal biogeochemical model
- 🚦 Secure funding to consolidate NZOA-ON



NZOA-ON: Summary

- Building on existing expertise
- Munida time series
- Working with partners
 - aquaculture / fishing industry
 - central and local government
 - research institutes
 - coastal management groups, iwi
- 14 Sites
- Fortnightly bottle sampling + roving pH sensors
- Central analytical facility
- High quality
- 2 GOA-ON sites



Fa'afetai

Thanks to:

- 🇳🇿 NZ Prime Ministers Science Prize
– funding for Marine Technician
- 🇳🇿 NIWA – Capex for infra-structure
- 🇳🇿 Many industry, council and institutional partners
- 🇳🇿 Ministry for Primary Industries
- 🇳🇿 IOCCP for funding to attend the GOA-ON meetings (Seattle, St Andrews)
- 🇳🇿 Anna Crosbie
- 🇳🇿 Norman Ragg
- 🇳🇿 Judith Murdoch
- 🇳🇿 John Zeldis
- 🇳🇿 Mary Livingston
- 🇳🇿 Colin Johnston
- 🇳🇿 Mike Hudson
- 🇳🇿 Hilke Giles
- 🇳🇿 Jeremy Cooper
- 🇳🇿 Julie Hills
- 🇳🇿 Steve Urlich
- 🇳🇿 Ted Culley
- 🇳🇿 Todd Capson

