OA-ICC data compilation on the biological response to ocean acidification

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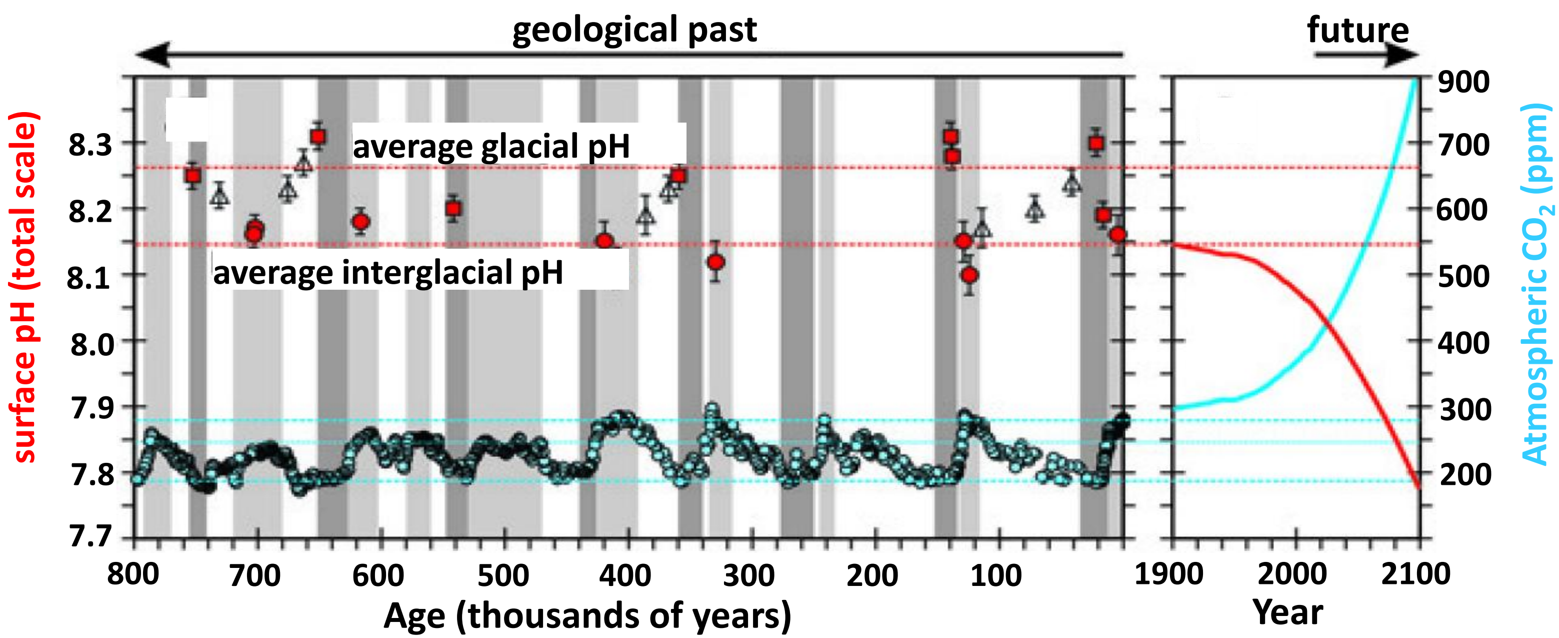
IAEA OA-ICC

MEL State Key Laboratory of Marine Environmental Science

What is "Ocean Acidification"

- 30% increase in acidity (H^+) of surface ocean during industrial era
- 100% increase (or more) projected by 2100



Barker and Ridgwell (2012)

Ocean Acidification International Coordination Centre (OA-ICC)

Communicating, promoting and facilitating global actions in a changing ocean world

OA-ICC products

(1) the **OA-ICC news stream** informs scientists of recent publications, media coverage, meeting announcements, and jobs (news-oceanacidification-icc.org)

(2) the **OA-ICC web site** provides, among others, resources on ocean acidification listed according to audience and language (http://www.iaea.org/ocean-acidification/page.php?page=2195)

(3) the **OA-ICC data compilation** on the biological response to ocean acidification provides easy access to regularly updated experimental data (http://www.iaea.org/ocean-acidification/page.php?page=2205)

(4) the **OA-ICC bibliographic database** with currently more than 2000 references includes citations, abstracts and keywords to simplify searches and bibliographic statistical analysis

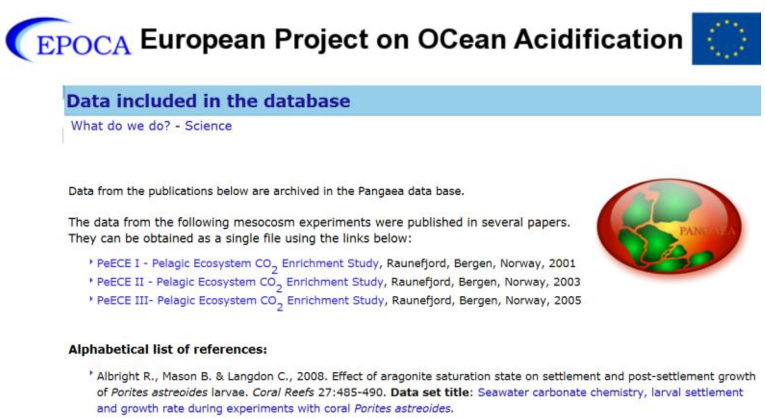
Data compilation on the biological response to ocean acidification

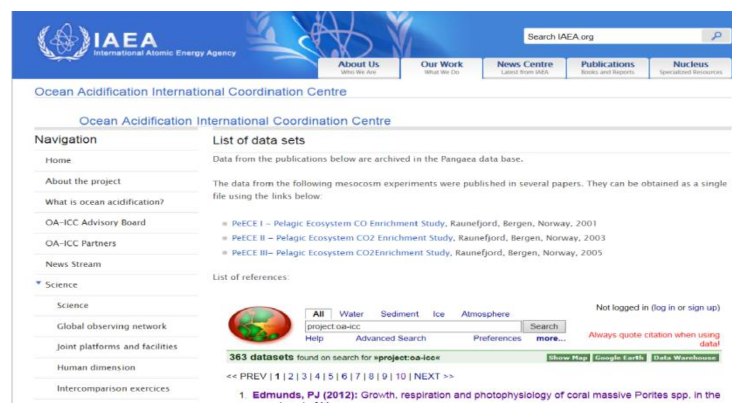
- Under two EU projects: EUR-OCEANS (2007) and EPOCA (2008-2012)

Anne-Marin Nisumaa (data manager of EPOCA)

Nisumaa, A.-M., Pesant, S., Bellerby, R. G. J., Delille, B., Middelburg, J. J., Orr, J. C., Riebesell, U., Tyrrell, T., Wolf-Gladrow, D. & Gattuso, J.-P., 2010. EPOCA/EUR-OCEANS data compilation on the biological and biogeochemical responses to ocean acidification. Earth System Science Data 2(2): 167-175.

- Maintained in the framework of the IAEA project OA-ICC
- Maintained by Yan Yang, under the supervision of Jean-Pierre Gattuso (OA-ICC focal point for data management)





Objectives

- Gather data on the biological response to ocean acidification (carbonate chemistry, biogeochemical processes and ancillary data) from published articles
- Transform the information into common framework (the carbonate system variables are recalculated in a consistent way)
- Make data freely available via the data publisher Pangaea (http://www.pangaea.de)

Numerous problems for data comparison

- pH are reported at different scales

  e.g., at pH = 8.08, DIC = 2 mmol/kg, S = 35, T = 25 °C:

pH scale	pH	*p*CO_2 µatm	CO_2 (aq) µmol/kg	HCO_3^- µmol/kg	CO_3^{2-} µmol/kg
Seawater	8.08	354	10	1735	255
Total	8.08	363	10.3	1739	250
Free	8.08	478	13.6	1786	201

- Carbonate chemistry are calculated using different dissolution constants,

  e.g., at DIC = 2 mmol/kg, TA = 2.35 mmol/kg, S = 35, T = 25°C:

Author	pHsws	*p*CO_2 µatm	CO_2 (aq) µmol/kg	HCO_3^- µmol/kg	CO_3^{2-} µmol/kg
Roy	8.08	354	10	1735	255
Hansson	8.10	343	9.7	1739	251
Mehrbach	8.11	327	9.3	1742	249

Zeebe & Wolf-Gladrow (2001)

Workflow

1. **LOCATE** DATA

2. **REQUEST** DATA AND METADATA

3. **RECEIVE** DATA AND METADATA

4. **CHECK** IF ALL **PARAMETERS** EXIST IN THE DATABASE

5. **ADD** OR **TRANSFORM** PARAMETERS

6. **RECALCULATE CARBONATE CHEMISTRY**

7. **ARCHIVE DATA**

8. ADD **METADATA** AND **COMMENTS**

9. **CHECK** ONLINE IF EVERYTHING IS CORRECT

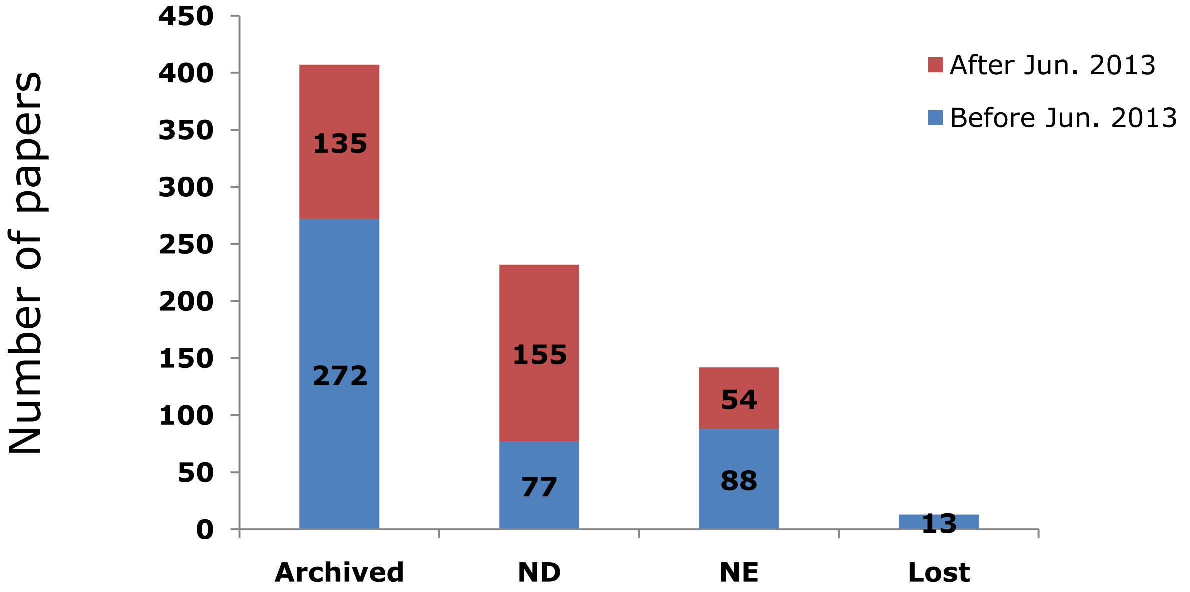
10. DATA PROVIDER IS ASKED TO **QUALITY-CHECK** THE DATA

11. MAKE DATA SET **PUBLIC**

DATA CURATOR

Statistics

Total of 652 papers were identified for inclusion in the compilation.
So far, data from 407 papers have been archived at Pangaea
(http://www.iaea.org/ocean-acidification/page.php?page=2205)



ND: data not provided by authors;
NE: not enough parameters (carbonate chemistry, salinity and/or temperature)
Lost: data lost by authors.

Four meta-analysis papers used the OA-ICC data compilation

- Harvey B. P., Gwynn-Jones D. & Moore P. J., 2013. Meta-analysis reveals complex marine biological responses to the interactive effects of ocean acidification and warming. Ecology and Evolution 3:1016-1030.
- Kroeker, K. J., Kordas, R. L., Crim, R. N., & Singh, G. G., 2010. Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms. Ecology Letters 13(11): 1419-1434.
- Kroeker K. J., Kordas R. L., Crim R., Hendriks I. E., Ramajo L., Singh G. S., Duarte C. M. & Gattuso J.-P., 2013. Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global Change Biology 19 (6): 1884-1896.
- Liu, J., Weinbauer, M. G., Maier, C., Dai, M., & Gattuso, J.-P., 2010. Effect of ocean acidification on microbial diversity and on microbe-driven biogeochemistry and ecosystem functioning. Aquatic Microbial Biology 61:291-305.

Papers cited the OA-ICC data compilation

- Hendriks I. E. & Duarte C. M., 2010. Ocean acidification: separating evidence from judgment. A reply to Dupont et al. Estuarine, Coastal and Shelf Science 89:186-190.

- Hoppe C. J. M., Langer G., Rokitta S. D., Wolf-Gladrow D. A. & Rost B., 2012. Implications of observed inconsistencies in carbonate chemistry measurements for ocean acidification studies. Biogeosciences 9:2401-2405.

- Koeve W., Kim H.-C., Lee K. & Oschlies A., 2012. Potential impact of DOC accumulation on fCO2 and carbonate ion computations in ocean acidification experiments. Biogeosciences 9:3787-3798.

- Muller E. B. & Nisbet R. M., in press. Dynamic energy budget modeling reveals the potential of future growth and calcification for the coccolithophore Emiliania huxleyi in an acidified ocean. Global Change Biology.

- Rokitta S. D., 2012. Characterization of the life-cycle stages of the coccolithophore Emiliania huxleyi and their responses to ocean acidification. PhD, University of Bremen, 145 p.

Difficulties faced

- Slow feedback from authors

  652 papers were identified, data of 232 papers were not provided by authors;

- Different names for the same variable

Calcification rate	Growth rate, PIC production
Primary production	Carbon fixation, photosynthesis rate, POC production
Respiration rate	Oxygen consumption

- pH scales and ancillary data are not always reported

- How to handle data previously archived (in Pangaea for BIOACID, BODC, BCO-DMO, AADC) but without standardized carbonate chemistry?

Dataset including previously published data

Logged in as **yangyan** (log out, profile)

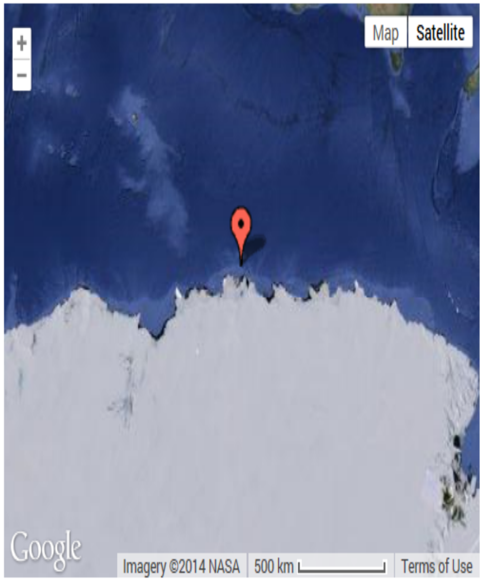
PANGAEA®
Data Publisher for Earth & Environmental Science

Always quote citation when using data!

Data Description

Show Map | Google Earth

Citation: **Kawaguchi, S; Ishida, A; King, R; Raymond, Ben; Waller, N; Constable, A; Nicol, S; Wakita, M; Ishimatsu, Atsushi (2013):** Seawater carbonate chemistry and hatch rates of Antarctic krill. doi:10.1594/PANGAEA.826460



Abstract: Marine ecosystems of the Southern Ocean are particularly vulnerable to ocean acidification. Antarctic krill (Euphausia superba; hereafter krill) is the key pelagic species of the region and its largest fishery resource. There is therefore concern about the combined effects of climate change, ocean acidification and an expanding fishery on krill and ultimately, their dependent predators-whales, seals and penguins. However, little is known about the sensitivity of krill to ocean acidification. Juvenile and adult krill are already exposed to variable seawater carbonate chemistry because they occupy a range of habitats and migrate both vertically and horizontally on a daily and seasonal basis. Moreover, krill eggs sink from the surface to hatch at 700-1,000 m, where the carbon dioxide partial pressure (pCO2) in sea water is already greater than it is in the atmosphere. Krill eggs sink passively and so cannot avoid these conditions. Here we describe the sensitivity of krill egg hatch rates to increased CO2, and present a circumpolar risk map of krill hatching success under projected pCO2 levels. We find that important krill habitats of the Weddell Sea and the Haakon VII Sea to the east are likely to become high-risk areas for krill recruitment within a century. Furthermore, unless CO2 emissions are mitigated, the Southern Ocean krill population could collapse by 2300 with dire consequences for the entire ecosystem.

Related to: **Kawaguchi, S; Ishida, A; King, R; Raymond, Ben; Waller, N; Constable, A; Nicol, S; Wakita, M; Ishimatsu, Atsushi (2013):** Risk maps for Antarctic krill under projected Southern Ocean acidification. *Nature Climate Change*, **3(9)**, 843-847, doi:10.1038/nclimate1937

Original version: **Kawaguchi, S; Ishida, A; King, R; Raymond, Ben; Waller, N; Constable, A; Nicol, S; Wakita, M; Ishimatsu, Atsushi (2013):** Risk maps for Antarctic krill under projected Southern Ocean acidification. *Australian Antarctic Data Centre*, http://data.aad.gov.au/aadc/metadata/metadata_redirect.cfm?md=AMD/AU/krill_risk_maps

Further details: **Lavigne, Héloise; Gattuso, Jean-Pierre (2011):** seacarb: seawater carbonate chemistry with R. R package version 2.4. http://CRAN.R-project.org/package=seacarb

Project(s): **Ocean Acidification International Coordination Centre** (OA-ICC)

Coverage: *Latitude:* -64.150000 * *Longitude:* 100.766670

Thank you

Please contribute to the OA-ICC data compilation!