

# EPOCA

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Notes:

Reporting Period is January 2011 – December 2011

Information will be used for: reporting, fundraising, networking, strategic development & outreach

## 1. Key scientific SOLAS-relevant highlights/findings (you may include figures and references)

- The decrease in summer sea ice in the Arctic Ocean could **increase the uptake of atmospheric CO<sub>2</sub>** thus lowering pH. In the Siberian shelf, the **degradation of organic matter has a major impact** causing high pCO<sub>2</sub> and low pH levels.
- The key nitrogen fixer *Trichodesmium* **will likely be a “winner”** of ocean acidification with large implication for the future C and N cycling. It also has an unforeseen role in biogeochemical cycling due to its ability to induce CaCO<sub>3</sub> precipitation.
- New transient simulations up to 2050 demonstrate the **accelerated rate of acidification in the California Current System (CCS)**, particularly in the north. **By 2050, the aragonite saturation horizon shoals by 180 m to reach an annual average depth of 40 m.**
- A model of the **Northwestern European Seas** forced with an atmospheric CO<sub>2</sub> of 1000 ppm projects that seawater **will become corrosive to aragonite over the entire shelf during winter**; in the stratified areas on the shelf, this undersaturation persists throughout the year.
- Global and basin-scale models dramatically **underestimate the magnitude, extent, and evolution** of ocean acidification in **Eastern boundary upwelling systems** compared to high resolution regional models.
- Climate change is projected to **shift the total abundance and diversity of foraminifera deeper and polewards** into waters that have lower and decreasing calcite saturation states.
- A **decrease in marine emissions of two major climate-active gases** is projected for the end of the 21<sup>st</sup> century.
- The **changes in CaCO<sub>3</sub> production and dissolution** induced by ocean acidification provide only a **small negative feedback on atmospheric CO<sub>2</sub>.**
- A Pinatubo-scale **volcanic eruption has a much lower influence on ocean pH than past anthropogenic emissions.**
- The **volume of supersaturated water providing habitat to calcifying organisms is reduced** from preindustrial 40 to 25% in 2100 and to 10% in 2300 for a high 21<sup>st</sup> century emission commitment scenario.
- The largest simulated pH changes worldwide occur in Arctic surface waters, where hydrogen ion concentration increases by up to 185%. **Projected climate change amplifies the decrease in Arctic surface mean saturation and pH** by more than 20%, mainly due to freshening and increased carbon uptake in response to sea ice retreat.

## 2. Activities/main accomplishments (research projects, cruises, special events, workshops, remote sensing used, model and data intercomparisons etc)

- The documentary “Tipping Point”, following the EPOCA Svalbard 2010 experiment and other EPOCA work was released in the beginning of the year.
- The book “Ocean Acidification” was released in September 2011 as the first book on the subject, edited by J.-P. Gattuso and L. Hansson and with contributions from many EPOCA scientists.
- EPOCA organized an information event for EU officials and the general public in Brussels, on 9 May 2011. The 1-day event entitled “Ocean acidification – European contribution and perspectives” included presentations by J.-P. Gattuso, U. Riebesell, D. Laffoley, C. Turley, N. Cyr, S. Seitzinger, L. Hansson and F. Gazeau, a screening of the 52’ documentary “Tipping Point”, as well as an exhibition with hands-on chemistry experiments, models of research tools, screenings of short movies and cartoons and a the opportunity to talk to EPOCA scientists.
- The year 2011 was a very productive one for the EPOCA data management. Part of the Svalbard

2010 mesocosm experiment data has been archived:

<http://doi.pangaea.de/10.1594/PANGAEA.769833> and more is expected before the end of the project. 215 data sets are archived from which 88 are EPOCA, combining in a total of 241 studies. All the archived EPOCA data sets are listed here: <http://www.epoca-project.eu/index.php/data/data-sets.html>. All the EPOCA/EUR-OCEANS data compilation with additional meta data are available here: <http://doi.pangaea.de/10.1594/PANGAEA.735138>

- The SOLAS-IMBER working group on ocean acidification (SIOA), in which the EPOCA Executive Board are members, continued to strengthen international collaboration outside Europe and put extensive efforts into a proposal for an international coordination office on ocean acidification.

### 3. Human dimensions (outreach, capacity building, public engagement etc)

EPOCA public day in Brussels (see above), numerous outreach and educational activities at the partner institutes. Several EPOCA scientists contributed to the 52-minute long documentary, "Tipping Point", by Laurence Jourdan. The movie covers several aspects of EPOCA research and in particular the Svalbard 2010 campaign.

During the 2011, EPOCA continued to actively disseminate key research on ocean acidification, in particular via the Reference User Group (RUG). The RUG produced a new guide to policymakers, following the 2 previous guides, called "Acting on evidence" launched at the COP17 conference in Durban in December 2011. All guides are available in several languages at the EPOCA web site: <http://www.epoca-project.eu/index.php/what-do-we-do/outreach/rug.html>.

Dissemination also took place via regular updates of the project web site ([www.epoca-project.eu](http://www.epoca-project.eu)) and the blog: <http://oceanacidification.wordpress.com/>. EPOCA also contributed to an "Ocean Under Stress" guide presented at COP17: <http://epoca-project.eu/index.php/what-is-ocean-acidification/key-documents/256-oceans-under-stress.html>.

### 4. Top 10 publications in 2011 (Reports, articles, models, datasets, products, website etc)

- Anderson L. G., Björk G., Jutterström S., Pipko I., Shakhova N., Semiletov I. P. & Wåhlström I., 2011. East Siberian Sea, an Arctic region of very high biogeochemical activity. *Biogeosciences* 8:1745-1754.
- Beaufort L., Probert I., de Garidel-Thoron T., Bendif E. M., Ruiz-Pino D., Metzl N., Goyet C., Buchet N., Coupel P., Grelaud M., Rost B., Rickaby R. E. M. & de Vargas C., 2011. Sensitivity of coccolithophores to carbonate chemistry and ocean acidification. *Nature* 476:80-83.
- Charalampopoulou A., Poulton A. J., Tyrrell T. & Lucas M. I., 2011. Irradiance and pH affect coccolithophore community composition on a transect between the North Sea and the Arctic Ocean. *Marine Ecology Progress Series* 431:25-43.
- Franke A. & Clemmesen C., 2011. Effect of ocean acidification on early life stages of Atlantic herring (*Clupea harengus* L.). *Biogeosciences Discussions* 8:7097-7126.
- Gattuso J.-P. & Hansson L., 2011. *Ocean acidification*, 352 p. Oxford: Oxford University Press.
- Gruber N., 2011. Warming up, turning sour, losing breath: ocean biogeochemistry under global change. *Philosophical Transactions of the Royal Society A* 369:1980-1996.
- Gangstø R., Joos F. & Gehlen M., 2011. Sensitivity of pelagic calcification to ocean acidification. *Biogeosciences* 8:433-458.
- Hoppe C. J. M., Langer G. & Rost B., 2011. *Emiliania huxleyi* shows identical responses to elevated pCO<sub>2</sub> in TA and DIC manipulations. *Journal of Experimental Marine Biology and Ecology* 406:54-62.
- Krug S., Schulz K. & Riebesell U., 2011. Effects of CO<sub>2</sub>-induced changes in seawater carbonate chemistry speciation on *Coccolithus braarudii*: a discussion of coccolithophorid sensitivities. *Biogeosciences Discussions* 8:771-777.
- Rodolfo-Metalpa R., Houlbrèque F., Tambutté E., Boisson F., Baggini C., Patti F. P., Jeffrey R., Fine M., Foggo A., Gattuso J.-P. & Hall-Spencer J. M., 2011. Coral and mollusc resistance to ocean acidification adversely affected by warming. *Nature Climate Change* 1:308-312.

### 5. International interactions and collaborations (including contributions to international assessments such as the IPCC, links with observation communities etc)

Continued links have been established with EU (CARBOOCEAN, MESOAQUA, EUROSITES, ATP, CALMARO and MEECE) and national projects (BIOACID, UK Ocean Acidification Programme, CHOICE-C and US initiatives as part of the FOARAM Act). EPOCA has developed particularly strong interactions with BIOACID, UKOA and the recently launched EU FP7 project MedSea. The EPOCA Executive Board members sit in the SOLAS-IMBER subgroup on ocean acidification. International links have also been continued via the International Scientific Advisory Panel (ISAP) with members from the US and Korea.

Several EPOCA scientists are lead or contributing authors of the IPCC AR5 Report.

#### **6. Goals, priorities and plans for future activities/events**

Results from the project will be published in time for consideration in the Fifth Assessment Report of the IPCC and be available for studies of the socio-economic impact of ocean acidification. Results will cover new information on the rate at which ocean acidification proceeds and the hotspots where critical pH values will be reached first; the consequences of ocean acidification in terms of biodiversity, ecological services provided by marine ecosystems, biogeochemical processes and feedbacks on the climate system; the ecosystems which are most vulnerable to ocean acidification. EPOCA will come to an end on 30 April 2012. The final meeting will take place in Saint Jean Cap Ferrat (close to Nice) from 2-6 April 2012.

#### **7. Other comments**