

# Momme Butenschön (PhD, MSc)

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Marine Ecosystem Modeller

Euro-Mediterranean Center on Climate Change (CMCC), Viale B. Pichat, 6/2, Bologna (BO), Italy

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## Professional experience

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### Current Position (since September 2017)

Lead Scientist of the Earth System Modelling Research Unit at the Euro-Mediterranean Center on Climate Change (CMCC) (<http://www.cmcc.it>) coordinating the development of the coupled Earth System Model of the institute and the Biogeochemical Flux Model (BFM) (<http://bfm-community.eu/>) for the Marine Ecosystem. Studies on impacts of anthropogenic and climate change on the marine ecosystem and ecosystem services, natural variability and model uncertainty.

### Since March 2012

Nominated Member of the ICES Expert Group on Integrative, Biological-Physical Modelling.

### April 2016 - August 2017

Co-chair of the Activity Group for Next Generation Biogeochemical Model Development in the National Partnership for Ocean Prediction of the UK.

### July 2012 - August 2017

Senior Scientist position at the Plymouth Marine Laboratory as Marine Ecosystem Modeller. Leading and coordinating the development of the ecosystem model ERSEM (<http://www.pml.ac.uk/Modelling/Models/ERSEM>) developed in-house and in collaboration with teams at the UK met-office, the National Oceanographic Centre (NOC) and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), as well as the development of coupled physical biogeochemical systems based on current models for ocean physics such as NEMO, POLCOMS and GOTM, in particular the modelling system for the North-West European Shelf within the Copernicus Marine Environmental Monitoring Service (CMEMS). Strong involvement in a multitude of research initiatives such as the EU Horizon 2020 projects NOWMAPS (CMEMS), CERES, TAPAS, the EU framework 7 projects MEECE, EURO-BASIN, MyOcean 2, OPEC, VECTORS and MEDINA as well as the NERC funded projects UKESM, SSB, MERP, UKOA and others. Manager for High Performance Computing resources at the Plymouth Marine Laboratory and Co-Manager of Ocean Modelling Consortium at the UK National Supercomputing Service "archer".

### February 2008 - July 2012

Scientist position at the Plymouth Marine Laboratory (<http://www.pml.ac.uk>) as Marine Ecosystem Modeller on the development of the ecosystem model ERSEM (<http://www.pml.ac.uk/Modelling/Models/ERSEM>) and its coupling to general circulation models; strong involvement in a multitude of research initiatives.

### 2007 - 2008

Post-Doc (Full time employee) - Università di Bologna: Development of a coupled marine ecosystem dynamics model including data assimilation based on the Princeton Ocean Model and the Biogeochemical Flux Model.

### 2003 - 2007

Post-Graduate (Full time employee) - Università di Bologna: Development of a coupled marine ecosystem dynamics model including data assimilation as part of the EU FP5 MFSTEP project.

### 2002 - 2003

Post-Graduate (Full time employee) - Centro di Ricerca Nazionale Bologna: Development of an Air-pollution/Atmospheric-Chemistry-Dynamics Model.

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2001

Graduate Student (Full time employee, 8 month) – FOI, Stockholm: Turbulence modelling in compressible flow, air wing simulations, rocket nozzle flow.

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2000 – 2001

Graduate Student (Part time employee, 60h/month for 1 year) – Technische Universität Berlin: Research projects on turbulence modelling and air wing simulations.

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Jun 1999 – Sep 1999

Graduate Student (Full time employee) – Flygteknisk Försöksanstalt Stockholm: Research project on flow simulations of rocket nozzles.

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## Advanced Courses

25–27 June 2013 Leadership In Science Course

8–10 May 2012 High Performance Computing Course: Debugging, Profiling and Optimisation

8–9 Decemeber 2010 Project Management Course

14–18 April 2008 High Performance Computing Course: Introduction to MPI and Python

10–14 Sept 2007 EUROCEAN/CARBOCEAN Summer School on Inverse Modelling and Data Assimilation

## Academic Educational Background

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Alma Mater Studiorum Università di Bologna, 25 June 2007

Dottorato di Ricerca (PhD): Geophysics, Marine Ecosystem Modelling

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Technische Universität Berlin, Kungliga Tekniska Högskolan Stockholm, 2002

Dipl. Ing. (MSc): Physikalische Ingenieurwissenschaft/Engineering Physics

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## Teaching and Supervision

- Contract lecturer at the Università Ca'Foscari di Venezia in the PhD program "Science and Management of Climate Change" (since 2018)
- Line manager of three permanent scientists at the Plymouth Marine Laboratory. (2011–2017)
- Supervision of two placement students (1 year full time placement in the 3rd year of the undergraduate program, 2008–2010).
- Supervision of a scientific trainee (6 month) leading into a permanent position at Scientist level. (2010–2011)
- Lecturer on coupled models for marine ecosystem dynamics at the SESAME summer school in Malta 2008.
- various Workshops on the use and development of the ecosystem models and their products within the CMEMS program, the EU FP7 project MEDINA for knowledge transfer to North African countries, the UK Shelf Seas Biogeochemistry and Marine Ecosystem Research Program as well as at the Korean Institute of Ocean Science and Technology.

## Language Skills

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German

Native

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English

Fluent

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Italian

Fluent

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Swedish

Fluent

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French

Moderate

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Spanish

Moderate

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## Scientific Publications in peer-reviewed Journals

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*Abstracts available at*

<http://publications.mommeworld.com> (<http://publications.mommeworld.com>)

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- Artioli, Y., Blackford, J.C., Butenschön, M., Holt, J.T., Wakelin, S.L., Thomas, H., Borges, A.V., Allen, J.I., 2012. The carbonate system in the North Sea: Sensitivity and model validation. *Journal of Marine Systems* 102–104, 1–13. doi:10.1016/j.jmarsys.2012.04.006
- Artioli, Y., Blackford, J.C., Nondal, G., Bellerby, R.G.J., Wakelin, S.L., Holt, J.T., Butenschön, M., Allen, J.I., 2014. Heterogeneity of impacts of high CO<sub>2</sub> on the North Western European Shelf. *Biogeosciences* 11, 601–612. doi:10.5194/bg-11-601-2014
- Barange, M., Butenschön, M., Yool, A., Beaumont, N., Fernandes, J.A., Martin, A.P., Allen, J.I., 2017. The Cost of Reducing the North Atlantic Ocean Biological Carbon Pump. *Front. Mar. Sci.* 3. doi:10.3389/fmars.2016.00290
- Beaulieu, C., Cole, H., Henson, S., Yool, A., Anderson, T.R., de Mora, L., Buitenhuis, E.T., Butenschön, M., Totterdell, I.J., Allen, J.I., 2016. Marine regime shifts in ocean biogeochemical models: a case study in the Gulf of Alaska. *Biogeosciences* 13, 4533–4553. doi:10.5194/bg-13-4533-2016
- Butenschön, M., Clark, J., Aldridge, J.N., Allen, J.I., Artioli, Y., Blackford, J., Bruggeman, J., Cazenave, P., Ciavatta, S., Kay, S., Lessin, G., van Leeuwen, S., van der Molen, J., de Mora, L., Polimene, L., Salliey, S., Stephens, N., Torres, R., 2015. ERSEM 15.06: a generic model for marine biogeochemistry and the ecosystem dynamics of the lower trophic levels. *Geosci. Model Dev.* 9, 1293–1339. doi:10.5194/gmd-9-1293-2016
- Butenschön, M., Zavatarelli, M., 2012. A comparison of different versions of the SEEK Filter for assimilation of biogeochemical data in numerical models of marine ecosystem dynamics. *Ocean Modelling* 54–55, 37 – 54. doi:10.1016/j.ocemod.2012.06.003
- Butenschön, M., Zavatarelli, M., Vichi, M., 2012. Sensitivity of a marine coupled physical biogeochemical model to time resolution, integration scheme and time splitting method. *Ocean Modelling* 52–53, 36 – 53. doi:10.1016/j.ocemod.2012.04.008
- Christensen, A., Butenschön, M., Gürkan, Z., Allen, J.I., 2013. Towards an integrated forecasting system for fisheries on habitat-bound stocks. *Ocean Science* 9, 261 – 279. doi:10.5194/os-9-261-2013
- Chust, G., Allen, J.I., Bopp, L., Schrum, C., Holt, J., Tsiaras, K., Zavatarelli, M., Chifflet, M., Cannaby, H., Dadou, I., Daewel, U., Wakelin, S.L., Machu, E., Pushpadas, D., Butenschön, M., Artioli, Y., Petihakis, G., Smith, C., Garçon, V., Goubanova, K., Le Vu, B., Fach, B.A., Salihoglu, B., Clementi, E., Irigoien, X., 2014. Biomass changes and trophic amplification of plankton in a warmer ocean. *Glob Change Biol* 20, 2124–2139. doi:10.1111/gcb.12562
- Ciavatta, S., Kay, S., Saux-Picart, S., Butenschön, M., Allen, J.I., 2016. Decadal reanalysis of biogeochemical indicators and fluxes in the North West European shelf-sea ecosystem. *J. Geophys. Res. Oceans* 121, 1824–1845. doi:10.1002/2015JC011496
- de Mora, L., Butenschön, M., Allen, J.I., 2016. The assessment of a global marine ecosystem model on the basis of emergent properties and ecosystem function: a case study with ERSEM. *Geosci. Model Dev.* 9, 59–76. doi:10.5194/gmd-9-59-2016
- de Mora, L., Butenschön, M., Allen, J.I., 2013. How should sparse marine in situ measurements be compared to a continuous model: an example. *Geosci. Model Dev.* 6, 533–548. doi:10.5194/gmd-6-533-2013
- Edwards, K.P., Barciela, R., Butenschön, M., 2012. Validation of the NEMO-ERSEM operational ecosystem model for the North West European Continental Shelf. *Ocean Sci.* 8, 983–1000. doi:10.5194/os-8-983-2012
- Fernandes, J.A., Cheung, W.W.L., Jennings, S., Butenschön, M., de Mora, L., Frölicher, T.L., Barange, M., Grant, A., 2013. Modelling the effects of climate change on the distribution and production of marine fishes: accounting for trophic interactions in a dynamic bioclimate envelope model. *Global Change Biology* 19, 2596 – 2607. doi:10.1111/gcb.12231

- Garmendia, M., Borja, Á., Breton, F., Butenschön, M., Marín, A., Miller, P.I., Morisseau, F., Xu, W., 2015. Challenges and difficulties in assessing the environmental status under the requirements of the Ecosystem Approach in North African countries, illustrated by eutrophication assessment. *Environ Monit Assess* 187, 1–22. doi:10.1007/s10661-015-4316-x
- Gehlen, M., Barciela, R., Bertino, L., Brasseur, P., Butenschön, M., Chai, F., Crise, A., Drillet, Y., Ford, D., Lavoie, D., Lehodey, P., Perruche, C., Samuelsen, A., Simon, E., 2015. Building the capacity for forecasting marine biogeochemistry and ecosystems: recent advances and future developments. *Journal of Operational Oceanography* 8, s168–s187. doi:10.1080/1755876X.2015.1022350
- Groeneveld, R.A., Bosello, F., Butenschön, M., Elliott, M., Peck, M.A., Pinnegar, J.K., 2018. Defining scenarios of future vectors of change in marine life and associated economic sectors. *Estuarine, Coastal and Shelf Science, Vectors of change in the marine environment* 201, 164–171. doi:10.1016/j.ecss.2015.10.020
- Holt, J., Butenschön, M., Wakelin, S.L., Artioli, Y., Allen, J.I., 2012. Oceanic controls on the primary production of the northwest European continental shelf: model experiments under recent past conditions and a potential future scenario. *Biogeosciences* 9, 97–117. doi:10.5194/bg-9-97-2012
- Holt, J., Icarus Allen, J., Anderson, T.R., Brewin, R., Butenschön, M., Harle, J., Huse, G., Lehodey, P., Lindemann, C., Memery, L., Salihoglu, B., Senina, I., Yool, A., 2014. Challenges in integrative approaches to modelling the marine ecosystems of the North Atlantic: Physics to fish and coasts to ocean. *Progress in Oceanography, North Atlantic Ecosystems, the role of climate and anthropogenic forcing on their structure and function* 129, Part B, 285–313. doi:10.1016/j.pocean.2014.04.024
- Holt, J., Schrum, C., Cannaby, H., Daewel, U., Allen, I., Artioli, Y., Bopp, L., Butenschön, M., Fach, B.A., Harle, J., Pushpadas, D., Salihoglu, B., Wakelin, S., 2016. Potential impacts of climate change on the primary production of regional seas: A comparative analysis of five European seas. *Progress in Oceanography* 140, 91–115. doi:10.1016/j.pocean.2015.11.004
- Kay, S., Butenschön, M., 2018. Projections of change in key ecosystem indicators for planning and management of marine protected areas: An example study for European seas. *Estuarine, Coastal and Shelf Science, Vectors of change in the marine environment* 201, 172–184. doi:10.1016/j.ecss.2016.03.003
- Kwiatkowski, L., Yool, A., Allen, J.I., Anderson, T.R., Barciela, R., Buitenhuis, E.T., Butenschön, M., Enright, C., Halloran, P.R., Le Quéré, C., de Mora, L., Racault, M.-F., Sinha, B., Totterdell, I.J., Cox, P.M., 2014b. iMarNet: an ocean biogeochemistry model intercomparison project within a common physical ocean modelling framework. *Biogeosciences* 11, 7291–7304. doi:10.5194/bg-11-7291-2014
- Lewis, H.W., Castillo Sanchez, J.M., Graham, J., Saulter, A., Bornemann, J., Arnold, A., Fallmann, J., Harris, C., Pearson, D., Ramsdale, S., Martínez-de la Torre, A., Bricheno, L., Blyth, E., Bell, V.A., Davies, H., Marthews, T.R., O'Neill, C., Rumbold, H., O'Dea, E., Brereton, A., Guihou, K., Hines, A., Butenschön, M., Dadson, S.J., Palmer, T., Holt, J., Reynard, N., Best, M., Edwards, J., Siddorn, J., 2018. The UKC2 regional coupled environmental prediction system. *Geosci. Model Dev.* 11, 1–42. doi:10.5194/gmd-11-1-2018
- Litt, E.J., Hardman-Mountford, N.J., Blackford, J.C., Mitchelson-Jacob, G., Goodman, A., Moore, G.F., Cummings, D.G., Butenschön, M., 2010. Biological control of pCO<sub>2</sub> at station L4 in the Western English Channel over 3 years. *J. Plankton Res.* 32, 621–629. doi:10.1093/plankt/fbp133
- Maar, M., Butenschön, M., Daewel, U., Eggert, A., Fan, W., Hjøllø, S.S., Hufnagl, M., Huret, M., Ji, R., Lacroix, G., Peck, M.A., Radtke, H., Saille, S., Sinerchia, M., Skogen, M.D., Travers-Trolet, M., Troost, T.A., van de Wolfshaar, K., 2018. Responses of summer phytoplankton biomass to changes in top-down forcing: Insights from comparative modelling. *Ecological Modelling* 376, 54–67. doi:10.1016/j.ecolmodel.2018.03.003
- Marras, S., Cucco, A., Antognarelli, F., Azzurro, E., Milazzo, M., Bariche, M., Butenschön, M., Kay, S., Bitetto, M.D., Quattrocchi, G., Sinerchia, M., Domenici, P., 2015. Predicting future thermal habitat suitability of competing native and invasive fish species: from metabolic scope to oceanographic modelling. *Conserv Physiol* 3, cou059. doi:10.1093/conphys/cou059
- Mullon, C., Steinmetz, F., Merino, G., Fernandes, J.A., Cheung, W.W.L., Butenschön, M., Barange, M., 2016. Quantitative pathways for Northeast Atlantic fisheries based on climate, ecological–economic and governance modelling scenarios. *Ecological Modelling* 320, 273–291. doi:10.1016/j.ecolmodel.2015.09.027
- Polimene, L., Archer, S.D., Butenschön, M., Allen, J.I., 2012a. A mechanistic explanation of the Sargasso Sea DMS “summer paradox.” *Biogeochemistry* 110, 243 – 255. doi:10.1007/s10533-011-9674-z
- Polimene, L., Brunet, C., Allen, J.I., Butenschön, M., White, D.A., Llewellyn, C.A., 2012b. Modelling xanthophyll photoprotective activity in phytoplankton. *Journal of Plankton Research* 34, 196 – 207. doi:10.1093/plankt/fbr102
- Polimene, L., Brunet, C., Butenschön, M., Martínez-Vicente, V., Widdicombe, C., Torres, R., Allen, J.I., 2014. Modelling a light-driven phytoplankton succession. *J. Plankton Res.* 36, 214–229. doi:10.1093/plankt/fbt086
- Peck, M.A., Arvanitidis, C., Butenschön, M., Canu, D.M., Chatzinikolaou, E., Cucco, A., Domenici, P., Fernandes, J.A., Gasche, L., Huebert, K.B., Hufnagl, M., Jones, M.C., Kempf, A., Keyl, F., Maar, M., Mahévas, S., Marchal, P., Nicolas, D., Pinnegar, J.K., Rivot, E., Rochette, S., Sell, A.F., Sinerchia, M., Solidoro, C., Somerfield, P.J., Teal, L.R., Travers-Trolet, M., van de Wolfshaar, K.E., 2018. Projecting changes in the distribution and productivity of living marine resources: A critical review of the suite of modelling approaches used in the large European project VECTORS. *Estuarine, Coastal and Shelf Science, Vectors of change in the marine environment* 201, 40–55. doi:10.1016/j.ecss.2016.05.019
- Queirós, A.M., Bruggeman, J., Stephens, N., Artioli, Y., Butenschön, M., Blackford, J.C., Widdicombe, S., Allen, J.I., Somerfield, P.J., 2015. Placing biodiversity in ecosystem models without getting lost in translation. *Journal of Sea Research, Protecting Marine Biodiversity to Preserve Ecosystem Functioning: a Tribute to Carlo Heip* 98, 83–90. doi:10.1016/j.seares.2014.10.004

Saux Picart, S., Allen, J.I., Butenschön, M., Artioli, Y., Mora, L. de, Wakelin, S., Holt, J., 2014. What can ecosystem models tell us about the risk of eutrophication in the North Sea? *Climatic Change* 132, 111–125. doi:10.1007/s10584-014-1071-x

Saux Picart, S., Butenschön, M., Shutler, J.D., 2012. Wavelet-based spatial comparison technique for analysing and evaluating two-dimensional geophysical model fields. *Geosci. Model Dev.* 5, 223–230. doi:10.5194/gmd-5-223-2012

Villarino, E., Chust, G., Licandro, P., Butenschön, M., Ibaibarriaga, L., Larrañaga, A., Irigoien, X., 2015. Modelling the future biogeography of North Atlantic zooplankton communities in response to climate change. *Marine Ecology Progress Series* 531, 121–142. doi:10.3354/meps11299

Wakelin, S.L., Artioli, Y., Butenschön, M., Allen, J.I., Holt, J.T., 2015. Modelling the combined impacts of climate change and direct anthropogenic drivers on the ecosystem of the northwest European continental shelf. *Journal of Marine Systems* 152, 51–63. doi:10.1016/j.jmarsys.2015.07.006

Wakelin, S.L., Holt, J.T., Blackford, J.C., Allen, J.I., Butenschön, M., Artioli, Y., 2012. Modeling the carbon fluxes of the northwest European continental shelf: Validation and budgets. *J. Geophys. Res.* 117, C05020 –.

## Other Publications:

Austen, M.C., Malcolm, S.J., Frost, M., Hattam, C., Mangi, S., Stentiford, G., Benjamins, S., Burrows, M., Butenschön, M., Duck, C., Johns, D., Merino, G., Mieszkowska, N., Miles, A., Mitchell, I., Pimm, E., Smyth, T., 2011. Chapter 12: Marine, in: *The UK National Ecosystem Assessment Technical Report*. UK National Ecosystem Assessment. UNEP-WCMC, Cambridge, pp. 459–498.

Butenschön, M., 2007. Numerical simulations of the coastal marine ecosystem dynamics: integration techniques and data assimilation in a complex physical-biogeochemical model. *Università di Bologna*.

Butenschön, M., Allen, I., Yool, A., Anderson, T., Lehodey, P., 2015. Ensemble of climate forced basin-scale ecosystem simulations (2000–2040) (No. D6.7). *European Union Basin-scale Analysis, Synthesis and Integration (EURO-BASIN)*, European Commission FP7 Grant Agreement No. 264933.

Butenschön, M., Allen, I., Bruun, J., Yool, A., Anderson, T., 2015. Atlas of past & future changes in basin-scale biogeography & fisheries habitat based on model output (No. D6.8). *European Union Basin-scale Analysis, Synthesis and Integration (EURO-BASIN)*, European Commission FP7 Grant Agreement No. 264933.

Butenschön, M., Allen, I., Salley, S., Yool, A., Anderson, T., Memery, L., 2015. Report on the sensitivity of the planktonic ecosystem of the North Atlantic to climate changes (No. D6.9). *European Union Basin-scale Analysis, Synthesis and Integration (EURO-BASIN)*, European Commission FP7 Grant Agreement No. 264933.

Butenschön, M., Kay, S., 2013. Future scenarios of the biogeochemistry of the three regional seas (No. D51.1). *VECTORS of Change in Oceans and Seas Marine Life, Impact on Economic Sectors*, European Commission FP7 Grant Agreement No. 266445.

Cheung, W., Bruggeman, J., Butenschön, M., 2018. Chapter 4: Projected changes in global and national potential marine fisheries catch under climate change scenarios in the twenty-first century, in: Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., Poulain, F. (Eds.) *Impacts of Climate Change on Fisheries and Aquaculture: Synthesis of Current Knowledge, Adaptation and Mitigation Options.*, *FAO Fisheries Technical Paper* 627 (2018), 63–86. FAO, Rome, Italy. ISSN 2070-7010 <http://www.fao.org/3/I9705EN/i9705en.pdf> (<http://www.fao.org/3/I9705EN/i9705en.pdf>)