

ARTICLE

Received 15 Jul 2016 | Accepted 20 Jan 2017 | Published 7 Mar 2017

DOI: 10.1038/ncomms14682

OPEN

Rapid emergence of climate change in environmental drivers of marine ecosystems

Stephanie A. Henson¹, Claudie Beaulieu², Tatiana Ilyina³, Jasmin G. John⁴, Matthew Long⁵, Roland Séférian⁶, Jerry Tjiputra⁷ & Jorge L. Sarmiento⁸

Climate change is expected to modify ecological responses in the ocean, with the potential for important effects on the ecosystem services provided to humankind. Here we address the question of how rapidly multiple drivers of marine ecosystem change develop in the future ocean. By analysing an ensemble of models we find that, within the next 15 years, the climate change-driven trends in multiple ecosystem drivers emerge from the background of natural variability in 55% of the ocean and propagate rapidly to encompass 86% of the ocean by 2050 under a 'business-as-usual' scenario. However, we also demonstrate that the exposure of marine ecosystems to climate change-induced stress can be drastically reduced via climate mitigation measures; with mitigation, the proportion of ocean susceptible to multiple drivers within the next 15 years is reduced to 34%. Mitigation slows the pace at which multiple drivers emerge, allowing an additional 20 years for adaptation in marine ecological and socio-economic systems alike.

¹National Oceanography Centre, European Way, Southampton, SO14 3ZH, UK. ²Ocean and Earth Sciences, University of Southampton, European Way, Southampton, SO14 3ZH, UK. ³Max Planck Institute for Meteorology, Bundesstr. 53, D-20146 Hamburg, Germany. ⁴NOAA/Geophysical Fluid Dynamics Laboratory, 201 Forrestal Road, Princeton, New Jersey 08540, USA. ⁵Climate and Global Dynamics, National Center for Atmospheric Research, PO Box 3000, Boulder, Colorado 80307, USA. ⁶Centre National de Recherches Météorologiques, Météo-France/CNRS, 42 Avenue Gaspard Coriolis, 31057 Toulouse, France. ⁷Uni Research Climate, Bjerknes Centre for Climate Research, Box 7803, NO-5020, Bergen, Norway. ⁸Atmospheric and Oceanic Sciences Program, Princeton University, 300 Forrestal Road, Sayre Hall, Princeton, New Jersey 08544, USA. Correspondence and requests for materials should be addressed to S.A.H. (email: S.Henson@noc.ac.uk).