Preface

In the mid 1990s the research community and operational agencies saw an emerging opportunity for near-realtime ocean forecasts similar to those produced in Numerical Weather Prediction: combining numerical models and observations via data assimilation in order to provide ocean prediction products on various space and time scales. This development was facilitated through an international framework provided by the Global Ocean Data Assimilation Experiment (GODAE). GODAE aimed at advancing ocean data assimilation by synthesizing satellite and in-situ observations with state-of-the art models of global ocean circulation. In the past few years ocean forecasting has matured to a stage where many nations have implemented global and basin-scale ocean analyses and short-term forecast systems that provide routine products to the oceanographic community serving a variety of applications in areas such as marine environmental monitoring and management, ocean climate, defense and industry applications.

The authors within this book provide an up to date description of the major components of ocean analyses and forecasting systems. The chapters cover a wide range of topics including, but not limited to, scientific advances and challenges in ocean forecasting, the associated descriptions of the forecasting systems and end user applications. This integrated view of ocean forecasting is the end result of an International Summer School for Observing, Assimilating and Forecasting the Ocean held in Perth, Australia, in January 2010.

The flow diagram (Fig. 1) captures the main functional components and sources of inputs implemented under GODAE and required by any ocean forecasting system. These are: the data and product servers, the assimilation centres and the users of the outputs. It captures many of the interactions required to ensure or enhance the quality of the systems and their outputs (Bell et al. 2009).

The measurement network and data assembly and processing centres provide the main inputs to the assimilation centres (top centre and right of Fig. 1). In this book Le Traon (2011), Josey (2011), Ravichandran (2011) and Oke and O'Kane (2011) provide concise overviews of the in situ and satellite components of the current global observing system and discuss the continuing work required to sustain and optimise it. The GODAE-sponsored Global High Resolution Sea Surface Temperature (GHRSST) project has resulted in a coordinated network of centres disseminating

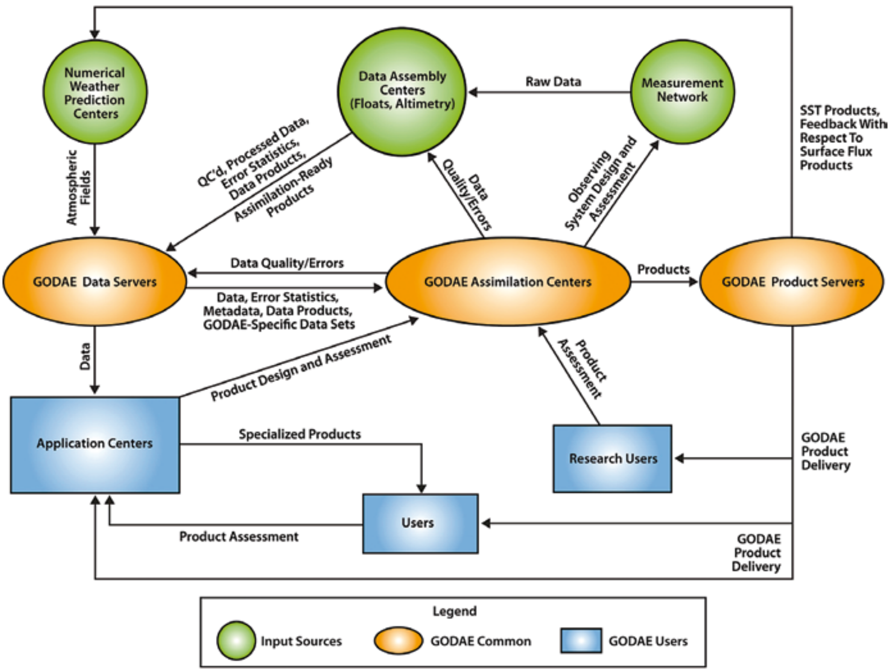

Fig. 1 Functional components of operational ocean forecasting systems developed during GODAE

SST data in real-time in a common format to agreed standards from a wide range of microwave and infra-red instruments on polar orbiting and geostationary satellites. Cummings (2011) summarizes the substantial achievements during GODAE in the quality control of observational data and the joint use of in situ and satellite data.

Dombrowsky (2011) provides an overview of progress in the capabilities of ocean prediction systems and data and product servers (see left of middle row of Fig. 1). Brassington (2011) examines key properties of the real-time system and their impact on operational system design. They provide an overview of the underpinning concepts and technologies which enable the observed data to be discovered, visualised, downloaded, intercompared and analysed all over the world. Progress in ocean data assimilation (the central item in Fig. 1) is described in a number of papers (Zaron 2011; Moore 2011; Brasseur 2011). The tables and descriptions in Dombrowsky (2011) and Zhu (2011) provide a useful overview of the present modelling and assimilation components of the major systems involved in coastal and basin-scale ocean forecasting. Most centres now operate systems with 1/10° or finer horizontal grid spacing; have a global capability; make use of community ocean models (e.g. HYCOM, MOM4 or NEMO; see Barnier et al. 2011, Chassignet 2011; Hurlburt et al. 2011 and Matear 2011); and assimilate in situ profile data, altimeter data and some form of surface temperature data. Martin (2011) illustrates the skill of the high-resolution systems in forecasting sea surface currents and sea surface temperature.

Product assessments and interactions with research users (lower right area of Fig. 1) have been key activities since the inception of operational ocean forecasting systems. Hernandez (2011) describes the procedures developed to intercompare forecasts produced by different centres and illustrates the insights these can give into the performance of the systems. Alves et al., (2011) describe some examples of how systems developed for ocean state estimation have been used for climate variability/seasonal forecasting research and how intercomparisons of results from the systems are being used to assess the consistency and uncertainty of the state estimates.

Oke and O'Kane (2011) summarise results gathered by observing system design research and outline the exciting prospects for future work. They illustrate the complementarity of the SST, altimeter and profile data for mesoscale prediction, and present statistics on the dependence of the accuracy of 7-day forecasts, real-time analyses and delayed mode analyses on the availability of altimeter data. Wilkin et al. (2011) summarise the wide-ranging coastal applications in ocean forecasting. Finally Matear and Jones (2011) outline a number of categories of potential ecological and biogeochemical applications and discuss the challenges this area poses to the fidelity of the physical models and assimilation schemes and to the measurement technologies.

The lower left part of Fig. 1 depicts the information flows to application centres (also known as downstream services) and users. Barras (2011) and King et al. (2011) describe the legal framework and use of ocean forecasting outputs in monitoring and prediction of marine pollution (such as oil spills) and the value of GODAE forecasts for safety and effectiveness of operations at Sea. Woodham (2011) provides examples of the wide variety of information and tactical decision aids generated using GODAE products to assist Naval operations. Ivey (2011) summarises the current operational use of upper ocean heat content information to forecast the intensity of tropical cyclones and current research in this area.

Fundamentals and applications of sea-level variability, surface waves and tsunamis are discussed by Pattiaratchi (2011) and Greenslade and Tolman (2011). Huckerby (2011) and Mann (2011) provide an introduction to and overview about the emerging field of ocean renewable energy and the corresponding need for ocean state information to determine the available energy resources as well as the impact of ocean renewable energy on the physical environment.

The editors gratefully acknowledge the students and lecturers listed below who actively contributed to the success of the summer school as well as the first round of reviews of the draft manuscripts. Primary support for this summer school was provided by the National Oceanographic and Atmospheric Administration (NOAA), USA, the Bureau of Meteorology, Australia, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia. This support is gratefully acknowledged.

The editors would like to thank the speakers for their contributions during the summer school and for providing their manuscripts within a tight time frame. We also express our appreciation to the GODAE OceanView Science Team who contributed in numerous ways to the success of the summer school and this book. We thank Charitha Pattiaratchi, Diana Greenslade, Tim Pugh, Roger Proctor, Bernard Barnier, Clothilde Langlais, Fabrice Hernandez, Marie Drevillon and Andy Taylor for preparing and conducting an excellent set of student exercises. We thank all the attendees (see list in Appendix) for participating actively in the lectures and in the lecture review process. Finally, our thanks go to Val Jemmeson, Nick D'Adamo and Charitha Pattiaratchi who spent considerable time with the logistics of the summer school. A special thank goes to Denise McMullen for her help in coordinating the editorial process of the manuscripts.

Australia
28 May 2010

Andreas Schiller
Gary B. Brassington

http://www.springer.com/978-94-007-0331-5

Operational Oceanography in the 21st Century
Schiller, A.; Brassington, G.B. (Eds.)
2011, XVI, 746 p. 130 illus., 100 illus. in color., Hardcover
ISBN: 978-94-007-0331-5