

Application of an Ocean Nowcast/Forecast System

Dong S. Ko, Paul J. Martin, Gregg A. Jacobs, and Ruth H. Preller
Naval Research Laboratory

Abstract

To provide real-time short-term forecast of ocean current, temperature, salinity, and sea level an Ocean Nowcast/Forecast System (ONFS) has been developed [Ko et al. 2008]. The system is an integration of a data-assimilating, dynamical ocean model, a statistical data-analysis model, and various data streams for ocean bathymetry, climatological data, surface forcing, open boundary forcing, and observations for data assimilation. The Modular Ocean Data Assimilation System (MODAS) is used within the ONFS as the data analysis model. MODAS uses satellite altimeter data and MCSST, in-situ observations, and historical statistics to generate three-dimensional ocean temperature and salinity analyses. The analyses are then assimilated into the dynamic model to produce an estimation of current ocean state or nowcast. From the nowcast, the forecast is conducted forced with a meteorological forecast without the data assimilation.

The ONFS was first implemented for the North Pacific Ocean. This was called the North Pacific Ocean Nowcast/Forecast System (NPACNFS) and operated in real-time from 1999 to 2004. The NPACNFS produced daily nowcasts and 72-hr forecasts and the predictions were subjected to several evaluations and used for a number of studies [e.g., Ko et al. 2003; Pun et al. 2007]. During 2000 and 2001, the ONFS was implemented for the northern South China Sea (NSCSNFS) to provide mesoscale ocean descriptions for the Asian Seas International Acoustics Experiment [Chapman et al. 2004]. The NSCSNFS was coupled to the NPACNFS. The dynamical ocean model used in these two applications was based on the Princeton Ocean Model (POM).

Later, the ONFS was implemented for several other regions including the Intra-Americas Sea (IASNFS) [Ko et al. 2003], which covers the Gulf of Mexico, Caribbean Sea, and Straits of Florida, and the East Asian Seas (EASNFS), which covers all the Asian Marginal Seas. The ocean model applied in the IASNFS, EASNFS and the later ONFS is based on the Navy Coastal Ocean Model (NCOM).

Three high-resolution ONFS (NGOMNFS, LSUNFS and EPACOM) which covers the northern Gulf of Mexico are imbedded in the IASNFS. Together with IASNFS, they have been used for various applications [e.g., Arnone et al. 2007; Chassignet et al. 2004; D'Sa et al. 2008; Green et al. 2008; Haltrin et al. 2007; Mendoza et al. 2009]. The East Asian Seas Nowcast/Forecast System with a coupled high-resolution Luzon Strait Nowcast/Forecast System have been applied to study large amplitude internal waves at South China Sea [Chao et al. 2007; Shaw et al., 2009], ocean current at Korea/Tsushima Strait [Jacob et al. 2005; Teague et al. 2006], sediment transport in the Gulf of Papua [Keen et al. 2006] and Typhoon-ocean interaction [Ko et al. 2009; Lin et al. 2008].

Reference:

1. Arnone, R.A., B. Casey, D. Ko, P. Flynn, L. Carrolo, and S. Landner, 2007: Forecasting coastal optical properties using ocean color and coastal circulation models, *Proc. SPIE*, 6680, doi:10.1117/12.737201.
2. Chao S.-Y., D.S. Ko, R.-C. Lien, and P.-T. Shaw, 2007: Assessing the west ridge of Luzon Strait as an internal wave mediator, *J. Oceanogr.*, 63, 897-911, doi:10.1007/s10872-007-0076-8.
3. Chapman, D.C., D.S. Ko, and R.H. Preller, 2004: A high-resolution numerical modeling study of subtidal circulation in the northern South China Sea, *IEEE J. Ocean. Eng.*, 29, 1087-1104, doi: 10.1109/JOE.2004.838334.
4. Chassignet, E.P., H.E. Hurlburt, O.M. Smedstad, C.N. Barron, D.S. Ko, R.C. Rhodes, J.F. Shriver, A.J. Wallcraft, and R.A. Arnone, 2005: Assessment of Data Assimilative Ocean Models in the Gulf of Mexico Using Ocean Color, Geophysical Monography 161 - Circulation in the Gulf of Mexico: Observations and Models, ed. W. Sturgers and A. Lugo-Fernandes, AGU, Washington D.C., 87-100.
5. D'Sa, E.J., and D.S. Ko, 2008: Short-term influences on suspended particulate matter distribution in the northern Gulf of Mexico: Satellite and model observations, *Sensors*, 8, 4249-4264, doi:10.3390/s8074249.
6. Green, R.E., R.W. Gould, and D.S. Ko, 2008: Statistical models for sediment/detritus and dissolved absorption coefficients in coastal waters of the northern Gulf of Mexico, *Cont. Shelf Res.*, 28, 1273-1285.
7. Haltrin, V.I., R.A. Arnone, P. Flynn, B. Casey, A.D. Weidemann, D.S. Ko, 2007: Restoring number of suspended particles in ocean using satellite optical images and forecasting particle fields, *Proc. SPIE*, 6615, doi: 10.1117/12.740435.
8. Jacobs, G.A., D.S. Ko, H. Ngodock, R.H. Preller, and S.K. Riedlinger, 2005: Synoptic forcing of the Korea Strait transport, *Deep Sea Res. II*, 52, 1490-1504.
9. Keen, T.R., D.S. Ko, R.L. Slingerland, S. Riedlinger, 2006: Potential transport pathways of terrigenous material in the Gulf of Papua, *Geophys. Res. Lett.*, 33, L04608, doi:10.1029/2005GL025416.
10. Ko, D.S., R.H. Preller, G.A. Jacobs, T.Y. Tang and S.F. Lin, 2003: Transport Reversals at Taiwan Strait during October and November, 1999, *J. Geophys. Res.*, 108(C11), 3370, doi:10.1029/2003JC001836.
11. Ko, D.S., R.H. Preller, and P.J. Martin, 2003: An Experimental Real-Time Intra Americas Sea Ocean Nowcast/Forecast System for Coastal Prediction, *Proceedings, AMS 5th Conference on Coastal Atmospheric and Oceanic Prediction and Processes*, 97-100.
12. Ko, D.S., P.J. Martin, C.D. Rowley, and R.H. Preller, 2008: A real-time coastal ocean prediction experiment for MREA04, *J. Mar. Syst.*, 69, 17-28, doi:10.1016/j.jmarsys.2007.02.022.
13. Ko, D.S., S.-Y. Chao, P. Huang, and S.F. Lin, 2009: Anomalous upwelling in Nan Wan: July 2008, *Terr. Atmos. Ocean. Sci.*, 20, 839-852, doi:10.3319/TAO.2008.11.25.01(Oc).
14. Lin, I-I, C.-C. Wu, I.-F. Pun, and D.S. Ko, 2008: Upper ocean thermal structure and the western North Pacific category-5 typhoons, Part I: Ocean features and category-5 typhoon's intensification, *Mon. Wea. Rev.*, 136, 3288-3306, doi:10.1175/2008 MWR2277.1.

15. Mendoza, W.G., R.G. Zika, J.E. Corredor, D.-S. Ko, and C.N.K. Mooers, 2009: Developmental strategy for effective sampling to detect possible nutrient fluxes in oligotrophic coastal reef waters in the Caribbean, *J. Operational Oceanogr.*, 2, 35-47.
16. Pun, I.-F., I.-I. Lin, C.-R. Wu, and D.S. Ko, 2007: Estimation of upper ocean thermal structure by satellite altimetry & its validation in the Western Pacific Ocean for typhoon intensity forecast, *IEEE TGRS*, 45, 1616-1630, doi:10.1109/TGRS.2007. 895950.
17. Shaw, P.-T., D.S. Ko, and S.-Y. Chao, 2009: Generation of internal solitary waves in the northern South China Sea, *J. Geophys. Res.*, 114, C02019, doi:10.1029/ 2008JC004797.
18. Teague, W.J., D.S. Ko, G.A. Jacobs, H.T. Perkins, J.W. Book, S.R. Smith, K.-I. Chang, M.-S. Suk, K. Kim, S.J. Lyu, and T.Y. Tang, 2006: Currents across the Korea/Tsushima Strait: Review of LINKS Observations, *Oceanography*, 19, 53-65.

http://www7320.nrlssc.navy.mil/IASNFS_WWW/

http://www7320.nrlssc.navy.mil/NGOMNFS_WWW/

http://www7320.nrlssc.navy.mil/NLIWI_WWW/EASNFS_WWW/