Journal of Marine Systems 203 (2020) 103263

Contents lists available at ScienceDirect

Journal of Marine Systems

journal homepage: www.elsevier.com/locate/jmarsys

Comparison of QuikSCAT, WRF and buoy ocean surface wind data off Valparaiso Bay, Chile

M. Cáceres-Soto[a,b,*], H.H. Sepúlveda[c], K. Muñoz-Mellado[c], O. Artal[d]

[a] Programa de Magister en Oceanografía, Escuela de Ciencias del Mar, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile.
[b] Chilean Navy Hydrographic and Oceanographic Service, Valparaíso, Chile
[c] Geophysics Department, University of Concepcion, Concepcion, Chile
[d] Departamento de Medioambiente, Instituto Fomento Pesquero, Castro, Chile

ARTICLE INFO

Keywords:
Winds
Buoy
Chile
QuikSCAT
ERA-Interim
WRF

ABSTRACT

The winds that affect the surface of the ocean are also important for a vast array of activities, either operational or scientific, hence the importance of being able to adequately predict this quality. Because of the preceding fact, a Weather Research and Forecasting model was used to perform simulations at the surface of the Ocean, for winds derived from different boundary conditions (NCEP-CFSR, ERA-Interim and NCEP-FNL) and configured with different spatial resolution (25, 5 and 1 km), with the objective of evaluating which of these data sets delivers the more precise wind simulation at the surface of the ocean.

A comparative analysis was performed between the different outputs of the WRF model, QuikSCAT satellite and *in situ* observations of a buoy installed off the central coast of Chile. The results showed that the WRF model, overestimates the wind magnitudes, across all boundary conditions or spatial resolution. Additionally, depending on the *in situ* wind magnitude ($> 6\,ms^{-1}$), the model predicts adequately wind magnitude and direction. Spatial comparisons were performed between QuikSCAT and WRF outputs at the Chilean coast to evaluate any possible differences. The modeled winds showed a tendency to be stronger than those measured by Satellites and the bigger differences appeared closer to the shore. The wavelet coherence and phase analysis, confirmed that the model delivers precise wind information for frequencies greater than the daily cycle. Finally, the results of the simulation produced by the ERA-Interim analysis showed lower errors in terms of temporal and spatial variability of surface winds.

1. Introduction

The winds that affect ocean surfaces and coastal areas have significant impact on diverse activities, such as fishing, tourism, port operations, commercial navigation and recreational sailing. The upwelling is a characteristic process forced by the surface wind on the Chilean-Peruvian coast. Upwelling zones play an important role for the global climate system, since they are areas of high primary productivity with considerable biological capture of atmospheric carbon (Aguilera et al., 2009). This upwelled water is normally cold, rich in nutrients and CO_2, and poor in oxygen. This primary production due to the nutrient stimulus in the euphotic zone will tend to balance or even reverse the air–sea fluxes of CO_2 and O_2 (Torres et al., 2002).

Winds also play an important role in ocean-atmosphere exchange, which is critical for meteorological and oceanographic studies because of the important role they play in processes like Ekman pumping (Capet et al., 2004), subsurface currents (Aguirre et al., 2014) and wave formation (Stopa and Cheung, 2014). For example, a seasonal decrease in low-cloud cover produces peak coastal winds in the austral summer due to the greater thermal contrast land-sea (Rutllant et al., 2004).

Numerical atmospheric models are commonly used to predict surface winds at distinct spatial scales. Modeled wind fields are used as forcing agents in circulation (Renault et al., 2012) and wave models (Caires et al., 2004). Errors in modeling surface winds can affect the output of ocean models that use this variable as a forcing agent (Sousa et al., 2013), because of which its correct representation and validation by different methods is critical.

Numeric oceanic models have been validated by different instruments (Rutllant and Garreaud, 2005; Sánchez et al., 2007; Ruti et al., 2008; Balzarini et al., 2011; Purba et al., 2014) with different logistical complications. Oceanographic buoys are costly to maintain and operate, and can be affected by vandalism and adverse environmental

* Corresponding author at: Programa de Magister en Oceanografía, Escuela de Ciencias del Mar, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile.
E-mail address: mario.caceres.s@mail.pucv.cl (M. Cáceres-Soto).

https://doi.org/10.1016/j.jmarsys.2019.103263
Received 17 April 2019; Received in revised form 17 September 2019; Accepted 31 October 2019
Available online 13 November 2019
0924-7963/ © 2019 Elsevier B.V. All rights reserved.