

# Marine Forecasting Systems in Caspian Sea, Persian Gulf and Oman Sea

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## ARTICLE INFO

### Article History:

Received: 30 Jun. 2016

Accepted: 15 Sep. 2016

### Keywords:

marine forecast

wind

wave

current

Persian Gulf

Caspian Sea, Oman Sea

## ABSTRACT

There are several global marine forecast systems based on large scale regional data covering Iranian seas which are freely available on their websites. They are also several local marine forecast systems in Iranian waters. This paper performs an inter-comparison among different marine forecasting systems in Iranian seas in order to evaluate the accuracy and difference between them and give a proper ground for further investigation and research in this crucial issue. For this purpose, the results of two forecasting system in several points in the Persian are compared and the reason of differences are investigated.

## 1. Introduction

The marine forecasting is of great importance for several reasons including planning marine operations, scheduling shipping movements, dredging, survey, berth maintenance or construction. There are several global marine forecast systems based on large scale regional data which do not consider the localized effects of seabed and land topography on local wave and wind climate. They are also several local marine forecast systems in Iranian waters. This study aims to perform an inter-comparison among different marine forecasting systems in Iranian seas in order to evaluate the accuracy and difference between them and give a proper ground for further investigation and research in this subject.

### Global Marine Forecast Project Covering Iranian Seas

MetOcean Solutions Ltd (MSL) operates a GIS tool for a 3-hourly 10-days wave forecasting namely WXTiles which does not include closed seas such as the Caspian Sea [1].

NOAA Environmental Modeling Center operates a 3-hourly 7-days wave forecast project using WWIII wave model and 0.5 degree GFS wind boundary conditions in Indian Ocean including Oman Sea and half of the Persian Gulf [2]. This project provides wind sea, primary and secondary swell parameters separately as output as well as spectrum, sources and bulletin in several point in Indian Ocean. Figure 1

shows NOAA Indian Ocean forecast in one time step for instance.

ECMWF Company provides three global wave forecast projects namely HRES-WAM (10 days, 0.25 degree), HRES-SAW (10 days, 0.125 degree) and ENS-WAM (15 days, 0.5 degree) by running WAM Cy41r1 model which are not freely available [3]. They do forecast every 3 hrs for the first 6 days and every 6 hrs afterwards.

### Iranian Authorities Forecasts in Iranian Seas

Currently, there are three different authorities which are performing wave forecasts in Iranian Seas.

Iranian Meteorological Organization (IRIMO) runs a 6-hourly 4-days wind and wave forecast system in Iranian seas. They first run a WRF local wind model with resolution of 10 km using GFS boundary condition and the output is the input to a SWAN wave model with resolution of 2.5km to generate wave field [4]. There is two open boundaries in Oman Sea wave model (18N, 66E) without applying any boundary conditions.

Iranian National Center for Ocean Hazards (INCOH) at Iranian National Institute for Oceanography (INIO) runs a 6-hourly 4-days wave forecast system in Iranian seas using WWIII wave model (spatial resolution 0.05 degree) forced by GFS wind boundary condition [5]. There is an open boundary at 15N without applying any boundary condition.

Isfahan Technical University (ITU) performs a 6-hourly 4-days wave forecast system for Ports and



The time series of the forecast data are only presented by DHI (covering only Persian Gulf) and INCOH (covering all Iranian seas) websites, therefore it is only possible to compare the time series from these two forecast projects in the Persian Gulf. For instance, Fig.1-3 illustrate the comparison between DHI (belongs to G3) and INCOH (belongs to G2) forecasts in south of Qeshm Island, vicinity of Bushehr port and Asaluyeh areas, respectively. DHI forecast is higher in Qeshm, as DHI's wind in Strait of Hormuz is higher and more accurate ( $CC=0.85, bias=0.3m$ ). INCOH's coarse GFS wind field is underestimated as this island is not well resolved in the wind model due to coarse land-sea mask and as a result high and unreal surface roughnesses in both sides of the strait. As for Bushehr Port, although two comparison points are 15 km away but results look very different and the reason for such a difference needs to be investigated. At Asaluyeh, despite their similar wave time series pattern, DHI point is located onshore while INCOH point is located offshore and they are 22 km away. This implies the necessity of application of a well-calibrated fine resolution model in Iranian waters via improvement of available forecasting systems for operational purposes.

**Recommendation**

For forecasting in Oman Sea, it is recommended to apply spectral or parametric wave boundary condition in open boundary or alternatively extending the Oman Sea mesh to cover the whole Indian Ocean to be able to capture properly the swells coming from the South Pole. Neither of the local forecasts have considered

the open boundary conditions. NOAA Indian Ocean forecast model is extended to South Pole and has no open boundary.

It is also suggested to plot the buoys data in a graph together with forecast data and put them in the forecasting website for comparison between "the forecast results and what is happening in reality in the seas" purpose. It is worthy to mention that IRIMO and PMO has 10 and 7 operating buoys in Iranian Seas, respectively [12, 13] which can be used in this regards. Figure 5 shows the location of these buoys in Iranian waters.

**References**

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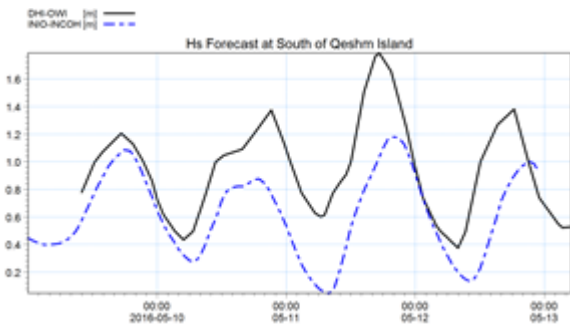


Figure 2 Comparison between DHI and INCOH forecasts at Qeshm

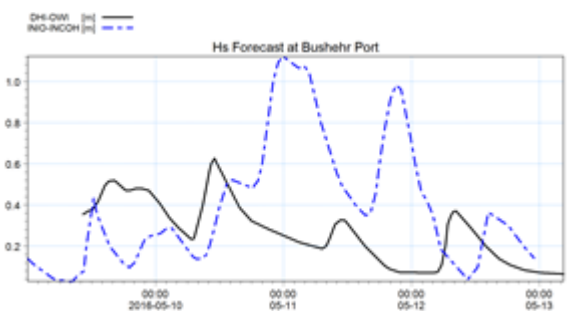


Figure 3 Comparison between DHI and INCOH forecasts at Bushehr



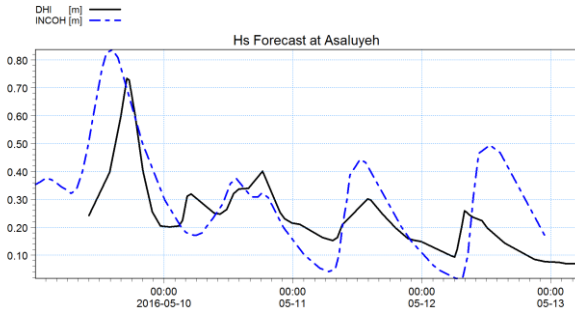


Figure 4 Comparison between DHI and INCOH forecasts at Asaluyeh

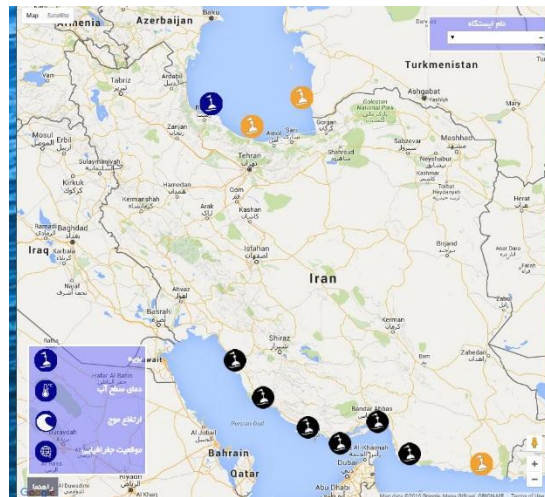
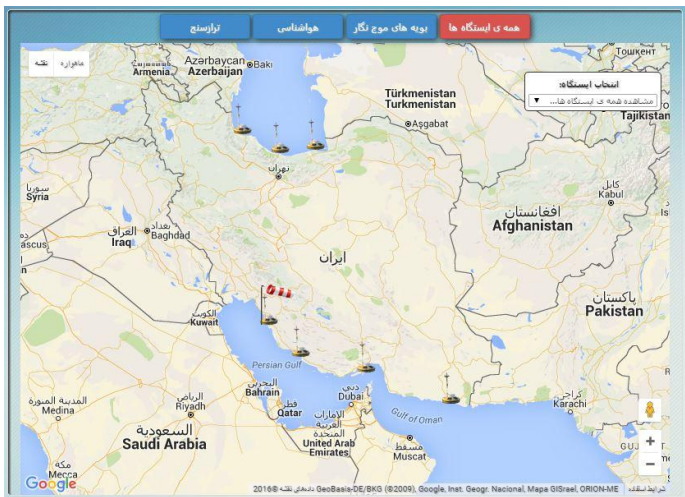


Figure 5 Location of operating buoys in Iranian Seas (left belongs to: PMO, right belongs to: IRIMO)