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Preface

It is a great pleasure to present this special issue of *American Journal of Fluid dynamics* dedicated to *Oceanic Fluid dynamics* with the primary focus on the *Hydrodynamics of the Northern Arabian Sea and the Gulf of Oman*. The objective for proposing this special issue is providing scientists, technology departments, and engineering companies with the state of the art knowledge about the atmospheric and oceanographic phenomena that contribute to the hydrodynamics of the Arabian Sea and the Gulf of Oman and affect all activities associated with marine transportation and exploiting marine resources.

Selection of the study area was based on the increasing importance of these water bodies in the northern Indian Ocean regarding fishery, marine transportation, and international/regional trade. Northern Arabian Sea, especially its western shelf waters is one of the richest marine regions in the world regarding fishery which is the result of intense and persistent coastal upwelling caused by monsoons. Several important ports including Chabahar, Karachi, Gwadar, and Port Sultan Qaboos in the region provide services to commercial vessels that significantly shape the economy of countries like Iran, Oman, and Pakistan. In response to the increasing rate of commercial activates in the region, during the recent years billions of dollars have been invested in development plans of some of these ports. The Gulf of Oman is the connection between the open ocean and the Persian Gulf. About 20% of the world's petroleum is transported from the Persian Gulf and through the Strait of Hormuz and the Gulf of Oman to all over the world. Along the coasts of the northern Arabian Sea and the Gulf of Oman, many fishery ports support fishery activities. Most of these fishery ports suffer from intense sedimentations that are mainly caused by the specific wave climate of the region. All the activities mentioned above need high-level understanding of the hydrodynamics and climatology aspects including wind, wave, water circulation, and ocean mixing over the area.

Unique atmospheric circulation and climatology of the Gulf of Oman and the northern Arabian Sea govern its hydrodynamics and oceanography. The main meteorological aspect is the annual cycle of monsoon that significantly form water circulation, wave climate, and distribution of biogeochemical parameters over the region. For example, the persistent summertime monsoon from southwest form one of the most persistent upwelling zones in the world. During the coastal upwelling, surface waters move away from the coast and are replaced by the nutrient-rich deep waters that highly intensify primary production and thereby fishery. Gravity waves generated by these seasonal monsoons are combined with swell waves from the Indian Ocean and result in bi-modal wave spectra that are dominant along the northern coasts of the Gulf of Oman and western and eastern coasts of the Arabian Sea. This bi-modal spectral shape along with the relatively persistent waves from a specific directional sector, significantly alter the nearshore hydrodynamics and sediment transport pattern in these regions. Although tropical cyclones that are formed in the Indian Ocean, rarely enter the northern Arabian Sea and the Gulf of Oman, during the recent years several of them affected these areas. The historical cyclones Gonu and Ashobaa are examples of these events. These cyclones can have substantial long-term and short-term impacts on the region including changing the design wave height for coastal structures and inducing low-frequency oscillations and coastal flooding. Since the frequency and intensity of these cyclones can potentially increase in a changing climate, studying the hydrodynamic response to these cyclones in the region could be relevant for scientific research and engineering designs.

Papers included in this special issue address some of the most important topics related to the hydrodynamics of the northern Arabian Sea and Gulf of Oman. They also present some new developments in study approaches for the region. Papers are summarised as follows:

Chapter 1: *Overview of Wind Climatology for the Gulf of Oman and the Northern Arabian Sea*

This chapter investigates and summarises the central atmospheric phenomena governing the wind patterns over the northern Arabian Sea and the Gulf of Oman. Mainly, monsoons and their atmospheric origin are addressed. Data from different atmospheric models are used to examine the contributing pressure fields and the resulting wind fields for different seasons. Furthermore, timseries of modelled winds speed and direction are used for the more detailed representation of temporal and spatial wind variations over the study area.

Chapter 2: *Cyclone-generated Storm Surge in the Northern Gulf of Oman: A Field Data Analysis during Cyclone Gonu*

Regarding the significant effect of the historical cyclone Gonu on the hydrodynamics of Gulf of Oman and the northern Arabian Sea, this chapter was designated to investigate one crucial aspect of this impact which is storm surge generation in the coastal area. A blend of field data analysis for water level, pressure data analysis from the atmospheric models, and analytical models for estimating wind-induced storm surge are applied. The study presents a valuable analysis of the recorded water level during Gonu at several coastal stations using spectral analysis and data filtering method and quantifies contributions from atmospheric pressure and direct wind stress on producing storm surge for these locations.

Chapter 3: *Observed Response to Cyclone Ashobaa Along Coasts of the Arabian Sea and the Gulf of Oman*

This chapter presents another example of cyclone impacts on the study area. Low-frequency oscillations generated during and in the wake of tropical cyclones significantly impact the hydrodynamics characteristics over the oceanic, shelf, and coastal waters through transporting energy within the sub-inertial band. In this chapter, Wavelet analysis method along with oceanographic data (current speed an direction, water temperature, and water level) at several coastal stations are used to deduce the sub-inertial dominant frequencies in the wake of cyclone Ashobaa that was dissipated in the northern Arabian Sea. As another tremendous scientific contribution, water level data were used to investigate the propagation of Kelvin-type waves along the coasts of the study area.

Chapter 4: *Wave-induced Currents in the Northern Gulf of Oman: A Numerical Study for Ramin Port along the Iranian Coast*

The last chapter of this issue presents a case study for diagnosing one of the most extensive problems of the fishery ports in the northern Gulf of Oman and along the Iranian coast that can be a problem for other ports along this coastal area. Ramin port on the Iranian coasts of the Gulf of Oman is one of several ports in this area suffering from the extensive sedimentation. This sedimentation is mainly induced by waves due to specific wave climate in this area. The study investigates wind and wave climate of the area and employes a coupled Mike 21 flow-wave model to determine the pattern of nearshore currents in the vicinity and inside the port and investigate its contribution on sedimentation in the port basins.

The four chapters mentioned above cover different aspects of hydrodynamics in the study area including wind climatology, storm surge, long wave propagation, wave climate, and coastal circulation. The editor hopes that these articles are beneficial for scientists and engineers who are studying the area and stimulate further research on the hydrodynamics of this area.

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Guest editor