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# Reviews

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## The Gulf Stream

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by Bruno Voituriez, IOC Ocean Forum Series, UNESCO Publishing, Paris, 2006, 221 pp., including 44 figures.

This monograph by Bruno Voituriez is published in the IOC Ocean Forum Series dedicated to the most important contemporary problems of the World Ocean. It is the result of a discussion between the members of the *Club des Argonautes* (the author is a member) and Erik Orsenna of the *Académie Française*.

In his work, the author draws an elaborate portrait of the extraordinary natural phenomenon that is the Gulf Stream. This water flow has recently attracted a great deal of attention from both scientists and the general public in regard to its role in present and future climate dynamics.

The text is organised into four basic chapters, along with an introduction and conclusion. A very comprehensive glossary and a list of useful publications are appended to the text.

The first chapter *The scientific history of the Gulf Stream* describes the gradual discovery of the nature and properties of the Gulf Stream, from the time of Columbus to the present century. Before the early twentieth century, the Gulf Stream was considered to be simply a very strong current flowing northwards from the Gulf of Mexico; at the time it was not known how this current links up with the general oceanic circulation. It was the work of Sverdrup and Stommel in the mid-twentieth century which demonstrated that the Gulf Stream is merely one component in the great North Atlantic anticyclonic circulation. Contemporary explorations of the Gulf Stream are based on modern technology, including remote sensing, automatic measuring stations and current meter moorings distributed on the ocean surface.

The next chapter *What is the Gulf Stream?* contains basic information on the origins and anatomy of this famous water flow. Bruno Voituriez presents these subjects from the wider perspective of the western boundary currents and the thermohaline circulation. In particular, he examines the most important drivers of the oceanic circulation – the tides, the winds and the Earth's rotation.

The complete text of the paper is available at <http://www.iopan.gda.pl/oceanologia/>

The chapter *The Gulf Stream and Earth's Climate*, the most interesting one in my view, deals with the Gulf Stream's influence on the climate of our planet. The Gulf Stream is an important actor in the Earth's climate system, playing a vital role by transporting heat towards the high latitudes of the Atlantic. In particular, the transport of highly saline water to the Greenland Sea, its cooling down and subsequent sinking, is the starting point for the famous conveyor belt. Voituriez argues cogently that even though, in past glacial periods, this conveyor belt has slowed down and even stopped, the Gulf Stream itself has not stopped. This is due to the existence of the subtropical gyre of the Azores. In other words, the Gulf Stream is a necessary, but not a sufficient condition for the thermohaline circulation. So even if this circulation were to stop, the Gulf Stream would slow down but would continue its northward flow.

The future of the thermohaline circulation is strongly related to the global warming resulting from the increasing greenhouse gas concentration in the atmosphere. According to certain climate scenarios, global warming could result in the slowing down or a rapid cessation of the thermohaline circulation, which yields in a significant cooling of the temperate regions in the Northern Hemisphere. However, there is some uncertainty in such a scenario, as we lack a sufficiently long historical record to say whether the observed deep-circulation variations are indeed a consequence of global warming.

In the contrast to the previous chapters, the fourth chapter *The Gulf Stream and the ecosystems of the North Atlantic* contains a discussion on the ecology of the various Gulf Stream regions. Following Longhurst, the author introduces ecological oceanic regions called 'biomes' and provinces based on the dynamics of the surface layer and productivity of marine ecosystems. Within the Gulf Stream, he distinguishes two biomes – the polar biome and westerly-wind biome, and three provinces – the Atlantic Sub-Arctic Province (SARC), the North Atlantic Drift Province (NADR) and the Gulf Stream Province (GFST). He characterises each of these areas, taking into account their nutrient flows and biological production. He gives special attention to the cod and herring stocks exploited by fishing fleets.

In the conclusion to the book, the author discusses various international initiatives towards the creation of an operational oceanography. He refers to the global project of Earth observation as *Geoscology*. He believes that the currently running Global Earth Observation System of Systems (GEOSS) program will in the future result in *Geoscology*.

The monograph is written clearly and it is very rich in facts and data. It discusses the role of the Gulf Stream from a very wide perspective on various spatial and temporal scales, from the yearly variation of North Atlantic

Oscillation (NAO) to the periods of the Milankovich Cycle. The figures illustrating the text are very clear and useful for understanding the author's arguments.

This book should prove useful to dedicated oceanographers and seamen who share the author's vision that the role of the Gulf Stream can be fully appreciated only in the broader context of the global oceanic circulation.

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