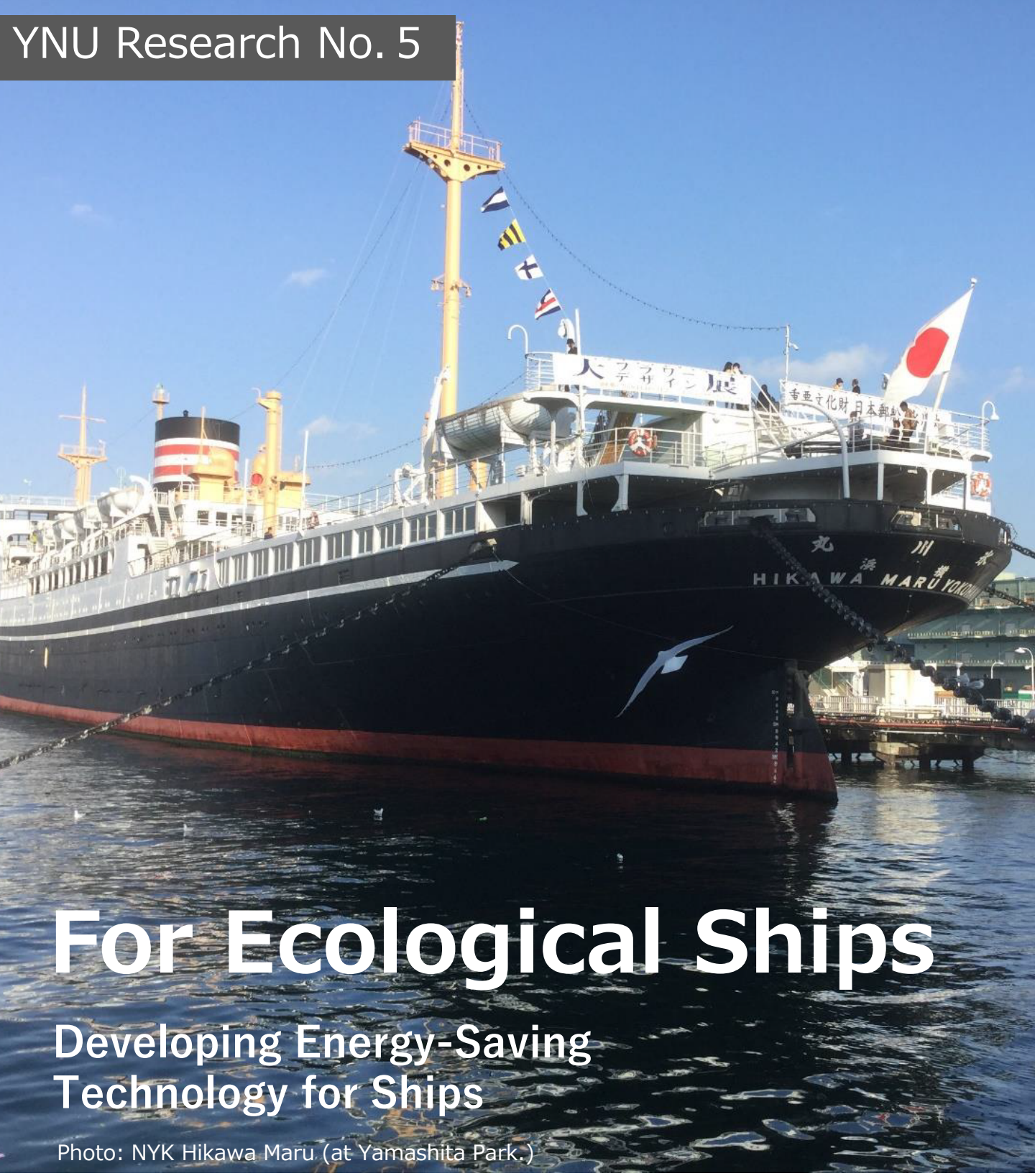
YNU Research No. 5



For Ecological Ships

Developing Energy-Saving Technology for Ships

Photo: NYK Hikawa Maru (at Yamashita Park.)

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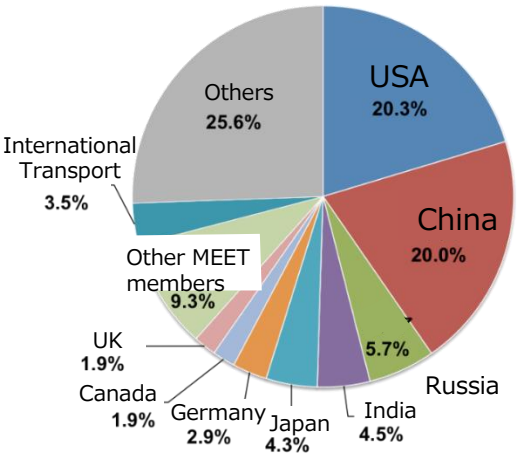
CO_2 emitted from ships

Marine transport and transportation were traditionally essential for distribution and trade and still play an important role in transportation today. The CO_2 emitted from international marine transportation is approximately 870 million tons per year, which is equivalent to the annual CO_2 emissions of all of Germany. However, it is difficult to apply national CO_2 emission regulations to marine transportation because the transportation activities cross borders. Thus, the International Maritime Organization (IMO) established a CO_2 emission regulation for international marine transportation in 2013, requiring ships subject to the regulation to keep their fuel consumption per ton-mile at the regulation value or lower.



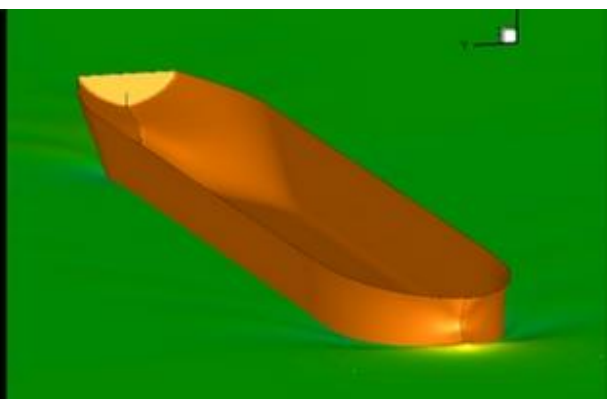
CO_2 Emissions from Fuel Combustion

CO_2 Emissions from Fuel Combustion, 2008 Edition; IEA, World Energy Outlook 2008.

Ship design and numerical simulation: An ecological ship design

IMO tightens the fuel consumption regulation in phases over time, with the intention of achieving its goal through the promotion of technological innovation. As ships are made to order in general, ecological ships that meet the fuel consumption regulation are designed one by one. In ship performance design, scale models were manufactured and experiments were conducted in experimental tanks to estimate their performance. Recently, the computer technology for analyzing the water flow around the ship is evolving, and efficient design methods that reduce time and cost are adopted as simulation-based design.

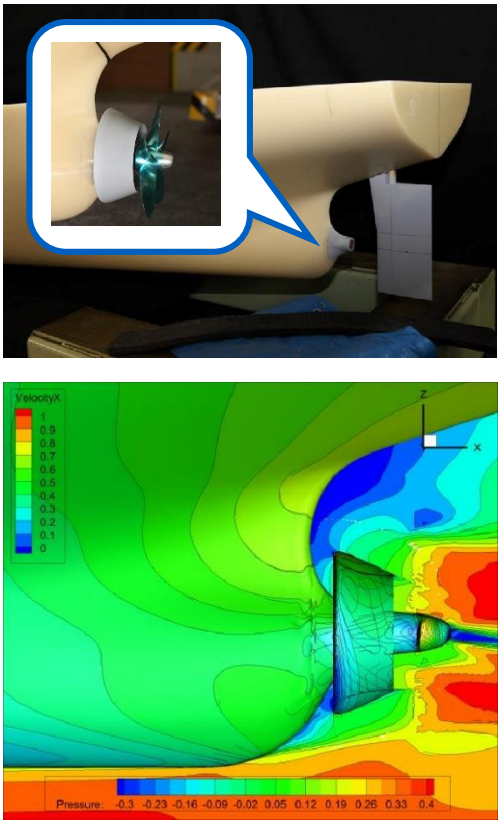
Towing test at the large experimental tank in YNU



Model testing (left) and numerical simulation (right) for predicting the performance of ships

Predicting the performance of energy-saving devices

To further reduce the fuel consumption of ships, various energy-saving devices are often adopted, in addition to ship shape optimization. Energy-saving devices are fins and ducts installed in front of or behind the propeller to control the water flow. As the performance evaluation of these energy-saving devices is largely affected by the difference in scale between the model and the actual ship, it is difficult to achieve a practicable design only based on model experiments. Our laboratory designed a model ship and an energy-saving duct, measured the performance and detailed flow in tank experiments, and compared the results with numerical calculation results to establish a method for evaluating the performance of an energy-saving device based on numerical simulations. By developing this simulation-based method, we can evaluate the performance of energy-saving devices on actual ships.



Tank test model for energy-saving devices (top) and numerical simulation results around the energy-saving duct (bottom)

Our research voyage continues

The current simulation technology can predict the ship performance to some extent, but the precise analysis of turbulence phenomena around ships remains as a challenging research topic in marine engineering. In the future, we want to accurately simulate the flow around the actual ship with the research of advanced turbulence models. The research for building ecological ships continues and we are fighting the rough seas of unknowns every day.

Prof. Takanori Hino

Graduate School of Engineering Science/ Faculty of Engineering, YNU

Completed the doctoral program at the School of Engineering, the University of Tokyo. Doctor of Engineering
Took up the current post after working for the National Maritime Research Institute.
Brought up near the seaside and loves ships. Wishes to search for the mechanisms of water flow with simulation technology.

URL : http://www.hydrodyn.ynu.ac.jp/