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IUTAM Symposium Wind Waves, 4-8 September 2017, London, UK

# Preface

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## 1. Background

Wind-driven water waves play an essential role, both on the large scale ocean dynamics, with implications for weather and climate, and on the local scale where they affect transfer processes across the ocean-atmosphere interface, including extreme forces on marine structures, ships and submersibles. After 150 years of research, the dynamics of ideal linear and nonlinear waves, including their interaction and their evolution are broadly understood, although only recently have extremely large waves been identified through observations and in laboratory experiments. There are still conflicting theories, however, about how wind generates waves, and there are only tentative theories about how wind forces affect the dynamics of extreme waves and wave groups. Current research on wind-wave dynamics by the proposers, and by other groups, is focussing on what is still a major question for water waves, namely, how in the presence of wind, do they form into characteristic groups (with or without white caps) and what are their essential properties, depending on the local atmospheric and oceanic conditions. The prediction of extreme events, such as rogue waves in the open ocean, or in shallow water, and waves driven by tropical cyclones, is becoming of increasing concern due to effects induced by climate change. Further, wind-driven waves, especially through their effect on small-scale motions and turbulence near the surface, need to be better understood in order to improve predictions of heat and mass transfer at the atmosphere-ocean interface, essential for the development of climate models. Improved satellite observations and laboratory experiments are now becoming available to guide theoretical and modeling progress. Also, the general theme of transfer processes across a gas-liquid interface is relevant for flows in large pipes.

## 2. Symposium

The IUTAM Symposium took place at University College London (UCL) from September 4-8 2017 with the theme “Research on wind wave groups, applications to improved ocean wave modelling, and estimation of wave hazards”. This brought together theoreticians, numerical modellers, experimentalists and end-users in a forum where the latest research developments were presented, provided an environment with constructive interchanges, and with the outcome that clear directions were established for future research, and for the implementation of research advances into operational use. All sessions were held in the seminar room in the Mathematics Department at UCL, and all lunches, tea/coffee breaks and the reception were held in an adjacent room on the same floor. This enabled a relaxed environment where as well as the scientific talks there was ample opportunity for informal discussions. A special

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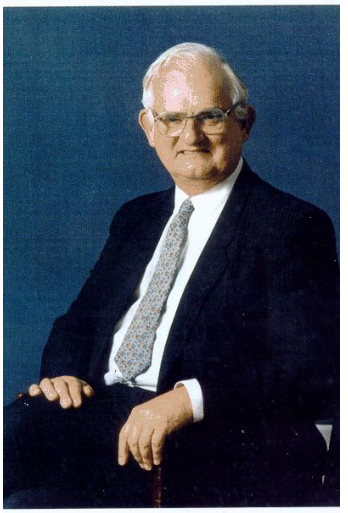

Sir James Lighthill
( 1924 - 1998 )

feature was the Lighthill lecture honouring the contribution of the eminent applied mathematician and fluid dynamicist Sir James Lighthill, who made profound contributions to wind wave research amongst his many accomplishments and was Provost at UCL 1979-1989.

There were 5 plenary talks and 41 contributed talks. The plenary talks were:

- Peter Janssen: Progress in operational wave forecasting
- Julian Hunt: (Lighthill Lecture) Mechanisms and modeling of wind-driven waves
- Guillemette Caulliez: Wind wave evolution observed in a large wind-wave tank: statistical wave properties, wave groups and wave breaking
- Ken Melville: Wind-wave breaking
- Vladimir Zakharov: Analytic Theory of Wind Driven Sea

Some highlights of the symposium were:

- Robust discussion of generation mechanisms, with some agreement about the importance of wave groups, either directly or by the necessity to consider non-monochromatic waves.
- Demonstration in laboratory experiments of the rapid development of fully two-dimensional (horizontally) wave fields, from uni-directional wind forcing.
- Role of wave-breaking in the formation and maintenance of wave groups, and through observations and numerical simulations the development of universal scaling laws for dissipation due to breaking.
- The increased capacity of DNS and LES simulations to study the air flow over wind waves in great detail, although the analogous capacity for two-phase (air and water) simulations is still in a developmental stage.
- The increased understanding and potential importance of rogue waves, not just for impact on shipping and marine structures, but for a full understanding of the wave spectrum.
- Wide range of applications for wind-wave forecasting, including surf conditions and tropical cyclone forecasts
- Importance and lack of current knowledge of the directionally of the fully-developed wind wave sea.

These proceedings contain articles emanating from four of the plenary talks, in alphabetical order of the first author, and a further sixteen articles, also in alphabetical order, emanating from the contributed talks. Altogether representing the flavour of the meeting.