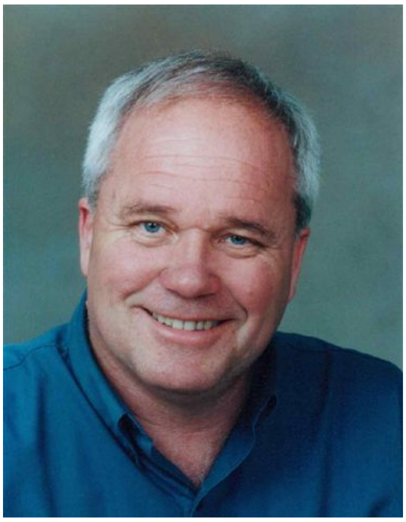
John Patterson short bio

John Patterson is the Professor of Fluid Mechanics in the School of Civil Engineering at the University of Sydney. He is also the Director of the Wind Waves and Water Centre (W3C) at the University, and until recently was the Associate Dean Research for the faculty of Engineering and IT. Prior to joining the University of Sydney, he was the Foundation Head of School of Engineering at James Cook University, and Head of the Department of Environmental Engineering at the University of Western Australia. He has published widely in a range of environmental fluid mechanics topics including water reservoir management through destratification, interactions between fluid mechanics and biology and, more recently, buoyancy driven flows in lakes and reservoirs. He also has long term interests in natural convection flows including boundary layer flows, stability, and transition to turbulence. He has practiced numerical, analytical, laboratory and field investigations, and is responsible for the fluid mechanics laboratory in Civil Engineering at the University of Sydney, which has a wide range of both teaching and research equipment. He has published over 120 journal articles, and a large number of conference papers.



TRANSPORT AND MIXING MECHANISMS IN LITTORAL WATERS INDUCED BY THE ABSORPTION OF SOLAR RADIATION AND VARYING SURFACE TEMPERATURE

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ABSTRACT

In the near shore region of lakes and reservoirs where the depth decreases towards the shore, the incidence of solar radiation results in a complex motion which provides a mechanism for natural convection heat and mass transfer between the shore and the main water body. Daily fluctuations in surface temperature also drive a motion. This has potentially significant consequences for water quality issues and therefore management of the resource. The flow also has wider implications for any contained fluid heated by radiation. The radiation induced mechanism operates as follows. Incident radiation is absorbed by the water column in an exponentially decaying manner. The absorption of the radiation in this fashion gives rise to stable temperature stratification in the upper regions of the water column. However, in the shallower parts, some radiation reaches the bed, and is re- emitted as a heat flux. There are two consequences of this: first, the volumetric rate of heating is greater in the shallow part than in the deep, which gives rise to a horizontal temperature gradient and therefore to a circulation up the slope and outward at the surface from the shore line; and second, the emission of heat from the bed gives rise to a potentially unstable temperature gradient at the bed which may cause intermittent rising plumes. Fluctuating surface temperatures also generate a circulation, and potential surface instabilities during the cooling phase. In this presentation I give a historical outline of the development of the understanding of the key characteristics of this complex flow, ranging from the first very simplistic models published in 1984, through to the numerical, scaling analysis and experimental investigations over the last decade. In particular I report some recent laboratory experiments using concurrent PIV and shadowgraph for measurement and visualisation which demonstrate both the underlying circulation and the presence of the rising plumes. The characteristics of these flows are compared with earlier scaling analysis results, and the underlying mechanism descriptions verified.