Séminaire du CETHIL

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Amphi Claude Chappe

Transport and mixing mechanisms in littoral waters induced by the absorption of solar radiation and varying surface temperature

Auteur :

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Résumé :

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 visualization 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.

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