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Multilayer Flows: Hyperbolicity, Stability and Mixing.

Abstract:

Multilayer shallow water flows model the internal waves in the atmosphere and ocean. Their study is more challenging than surface waves due to the inherent coexistence of waves and shear. We discuss the simplest nonlinear models which are expressed in systems of mixed type PDEs: the system is hyperbolic when wave-like behaviour dominates, and elliptic when the shear is sufficiently strong to "destabilise" the flow. For these models we find sharp conditions that guarantee hyperbolicity for all time. We then turn to shocks, and discuss a selection principle from the possible conservation laws that could be imposed and study the consequences of that choice.