Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02087, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02087
EGU General Assembly 2008

A calibrated, non-invasive method for measuring the internal interface height field at high resolution in the rotating, two-layer annulus

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We describe a remote sensing method for measuring the internal interface height field in a rotating, two-layer annulus laboratory experiment. The method is non-invasive, avoiding the possibility of an interaction between the flow and the measurement device. The height fields retrieved are accurate and highly resolved in both space and time. The technique is based on a flow visualization method developed by previous workers, and relies upon the optical rotation properties of the working liquids. The previous methods returned only qualitative interface maps, however. In the present study, a technique is developed for deriving quantitative maps by calibrating height against the colour fields registered by a camera which views the flow from above. We use a layer-wise torque balance analysis to determine the equilibrium interface height field analytically, in order to derive the calibration curves. With the current system, viewing an annulus of outer radius 125mm and depth 250mm from a distance of 2m, the inferred height fields have horizontal, vertical and temporal resolutions of up to 0.2mm, 1mm and 0.04s, respectively.