Geophysical Research Abstracts
Vol. 16, EGU2014-9980-2, 2014
EGU General Assembly 2014
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Turbulent recirculation cells

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Recent measurements of the flow in a large straight river (Reynolds number $7 \cdot 10^6$) show steady recirculation cells across the entire channel. They are arranged in pairs of counter-rotating vortices which diameters scale with the flow depth. This observation is reminiscent of the laboratory experiment of Blanckaert el al. (2010). New measurements in a smaller stream (Reynolds number $2 \cdot 10^4$) suggest that these flow structures are ubiquitous in sheared turbulent flows. This limited data set shows no clear dependence of the velocity of these cells with respect to the Reynolds number.

The physical mechanism by which they appear remains unknown. In particular, preliminary numerical simulations using classical turbulent models such as $k - \epsilon$ or Reynolds-stress model do not reproduce these structures.

Finally, we present recent results on the influence of these structures on lateral diffusion. We show that their efficiency in transferring momentum is comparable to the classical turbulent transfer.