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Rationale and geophysical evidence for quasi-geostrophic rapid dynamics within the Earth's outer core

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In this paper, we present arguments supporting the hypothesis that the flow in the Earth core for the time scales of the secular variation, is well described by a quasi-geostrophic (QG) model (that is almost invariant along the rotation axis).

A previous study showed that for axisymmetric motions, even at Elsasser numbers of order unity, the short time-scale flow is geostrophic inside the Earth core. Here, we extend this result to non-axisymmetric motions. The numerical simulations exhibit a columnar behaviour at parameters representative of the Earth core.

In addition, we present the results of several inversions of the core flow, showing that:

a) for the same number of parameters, a symmetric (QG) flow model explains more of the secular variation than a tangentially geostrophic (TG) flow,

b) the flow seems to be more and more symmetric with time, possibly a consequence of the better quality of the measurements at magnetic observatories.