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Newton vs. Munchhausen in upper-troposphere dynamics

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Atmospheric angular momentum (AM) balance depends crucially on the existence and magnitude of the planetary-scale AM transport by ‘eddies’ in the upper troposphere. Its divergence has to provide the torque, which is necessary to realise the upper-troposphere branch of meridional circulation. (In the boundary layer, the torque is provided by surface-friction.)

The torques in neighbouring circulation cells are opposed, so that the AM transport mediates a torque-interaction between the circulation cells.

This interaction corresponds to a clear requirement of Newton’s Third Law: torques (forces) exist only in interaction with other bodies, and their sum is equal to zero.

In Münchhausen’s physics, force (and torque) exists without interaction: In a famous tale, Münchhausen saves himself (and his horse!) from drowning in a swamp-hole by pulling himself up at his hair.

Münchhausen-physics situations arise in the dynamical analysis of the torque exerted by a single eddy and in analysis of the cause for the AM transport of the single eddy.

The local AM transport of the single eddy is defined by the difference in zonal velocity between the pole-ward and equator-ward branches (Δu) multiplied with meridional velocity-magnitude ($|v|$). For the average over many eddies, it transforms to the average product of the deviations of zonal and meridional velocities from their local averages ($<v^*u^*>$, eddy-correlation; the complete formulations include the local radius of rotation but it is omitted here for simplicity reasons).

This definition is phenomenological but not dynamical.

In dynamical analysis it turns out that the torque-related zonal equation of motion of an AM-transporting single eddy can be formulated without torque-interaction with other bodies (torque-free eddy). Newton III implies also the phenomenological torque (transport divergence $-\partial(|v|\Delta u)/\partial y$) to be zero for this case because there is no partner of torque-interaction. However, the dynamically torque-free single eddy has an unavoidable ‘transport’ divergence – especially in the turning-region of the meridional motion.

Thus, there is a phenomenological ‘torque’ (non-zero ‘transport’ divergence) without torque-interaction – a classical Münchhausen situation!

The dynamical cause of phenomenological ‘AM transport’ and associated phenomenological ‘torques’ of the dynamically torque-free single eddy is ‘hidden’ in the non-torque-related meridional equation of motion for steady-state:

$\partial v/\partial t = - u\, \partial v/\partial x - v\partial v/\partial y - f\, u(x) + F_y(x) = 0$.

Strong variation of the *meridional* pressure-gradient force $F_y(x)$ (*no torque!*) over the eddy-path (longitude x) produces varying zonal velocities $u(x)$ that are falsely interpreted as ‘AM transport’ on the phenomenological level (the ‘advective’ terms are negligible outside the eddy’s turning regions).

Thus, creation and destruction of phenomenological ‘AM transport’ (Δu) in a single eddy do not originate from torque-interaction with other bodies – another classical Münchhausen situation!

Should the previous analysis be ignored in favour of maintaining the ‘established’ ideas of upper-troposphere dynamics or should there be an effort to formulate new ideas that are in accordance with Newtonian physics?