Journal Of Anthropological And Archaeological Sciences
DOI: 10.32474/JAAS.2026.12.000389
ISSN: 2690-5752

Mini Review

A Medical Experiment Shows That There is a Mistake in the Classical Diffusive/Advective Model of Fluid Dynamics: Some Consequences for Ocean Modelling
A Surprising Synergy

John A T Bye*

School of Geography, Earth and Atmospheric Sciences, The University of Melbourne, Victoria, Australia

***Corresponding author:** John A T Bye, School of Geography, Earth and Atmospheric Sciences, The University of Melbourne, Victoria, Australia

Received: June 01, 2026 **Published:** June 05, 2026

Abstract

The results of a simple medical experiment in which feces are injected into a closed container are presented, which show that the diffusive/advective model as presented in classical fluid dynamics is in error. The interior advective velocity, which maintains the diffusion, has been omitted in the formulation. This interior advective velocity ensures that in the absence of external forcing, a local zero net flux of property or of substance is maintained, which is necessary for the existence of a steady state.

The implications of this omission are of coarse fundamental, as we demonstrate for continental shelf upwelling studies and ocean basin vorticity studies in which the diffusive/advective model is used.

Introduction

In Bye and James (2024) [1] it was shown that in the steady state, a vertical diffusive/advective balance of heat exists in the water column. This balance controls the thermodynamic properties in the vertical structure of the temperature field.

The same balance occurs for other quantities including dissolved substances.

A great example of a trace substance is feces, which has been studied over the decades by medical experts. However, without the knowledge of the upward vertical transport which is essential in maintaining a balance between advective upward and diffusive downward processes, it is impossible to fully understand the health of a living organism such as a human being.

An exact vertical balance, is of course, unlikely to occur as a steady state, but rather it is anatomically maintained over the life span of the being.

The Experiment

An elegant experiment was conducted in the Research Laboratory at The Flinders Medical Centre in South Australia, that illustrates this balance, during which an actively defecating being [JATB] was monitored over several prolonged daily periods whilst the diffusively generated feces fell to the bottom of a sealed container, and the liquid base fluid remained essentially clear. In this simple experiment, the steady state balance was found to be maintained by the upward vertical advective transport originating at the bottom of the container.

Here the downward diffusive process can be represented by the turbulent motions of the base fluid and there is no imposed vertical motion jn the sealed container. Rather the upward vertical velocity that occurs is an innate property of the downward diffusion, which ensures that the net vertical flux of substance, in this case feces (or of heat) is zero, thus allowing a steady state to exist.

The physically correct expression for the vertical flux of solute

The physically correct expression for the normalized vertical flux of a solute of concentration (c) at 0x is Q(z) = [$w_o + w_1 - K_v$ /H] c(z), where 0z is the vertical co-ordinate, K_v is the coefficient of vertical diffusion, H is the depth of the fluid, w_o is the exterior vertical velocity and w_1 is the interior vertical velocity. wo is due to advective velocities exterior to 0x, which are all included in the classical advective/diffusive model. w_1 is due to the interior upward advective velocity which directly opposes the downward diffusion, and ensures that the vertical flux, Q(z) = 0 when w_o = 0. This is a necessary condition for a steady state in which a zero vertical flux occurs in the absence of exterior forcing, as observed in the experiment.

Implications for oceanic upwelling

This balance also forms a major part of that occurring in oceanic upwelling, as observed along the Southern Shelf of Australia (Bye and James 2024) [1] where the upwelling occurs due to the interaction of downward diffusion of heat originating in the coastal circulations, and upward advection of heat from the deeper gyral circulation of the Flinders Current (Middleton and Bye 2007) [2].

This hybrid paper shows experimentally how a basic bodily function, when properly understood from a classical hydrodynamics perspective can transform our understanding of geophysical scale dynamics, as outlined theoretically in Section 3, and demonstrated:

1. For the Southern Shelf in Bye and James (2024) [1]; and,

2. For the major ocean gyres in Bye (2025) [3] as highlighted below for the Gulf Stream.

At the sea surface, the vertical velocity, directly available to the air-sea dynamics, is $w_2 = w_0 + w_1$ as shown in Section 3. On inserting w2 into the Stommel (1948) [4] vorticity equation, the forcing due to the vertical sea surface velocity is f w_2 where f is the Coriolis parameter (Bye 2025) [3], This forcing is additional to that due to the wind stress curl. On evaluating the two forcing mechanisms, we find that the strength of the Gulf Stream due to the sea surface vertical velocity is similar to that due to the wind stress curl. This is an important prediction, which is fully discussed in Bye (2025) [3].

It also awaits the numerical solution of a dedicated ocean global circulation vorticity model (OGCVM), which includes forcing by the sea surface vertical velocity, in addition to that by the wind stress curl, in order to see the significance of the sea surface vertical velocity for the World Ocean circulation.

Conclusions

In summary, we argue that two insights, which flow from the incorporation of feces as a complementary player to nutrients in the fluid dynamics of the food cycle. lead to a conceptually complete theoretical solute model, that has fundamental consequences for geophysical and of course medical dynamics, on all scales, see Section 3. Here in particular, we focus on, (i) the thermal balance in the upwelling which occurs on the continental shelves, and on, (ii) the resulting vorticity balance which occurs in the ocean gyres.

Classical hydrodynamics. as presently understood appears to completely ignore the vital theoretical and experimental results discussed in Sections 3 and 4 of this paper. in which there is no fundamental reference to Ekman dynamics.

References

1. Bye J A T, C E James (2024) SEAFRAME time series for the Southern Shelf reveal a neglected major upwelling mechanism. Trans. R. Soc. South Australia. 148(1): 79-98.
2. Middleton J F, J A T Bye (2007) A Review of the shelf-slope circulation along Australia's Southern Shelves: Cape Leeuwin to Portland. Progress in Oceanography 75(1) 1-41
3. Bye J A T (2025) The importance of Potential Vorticity in addition to Streamline Vorticity in Oceanic and Planetary Scale Circulation Modelling. J. Anthro and Archeo Sci 11(4): 1581-1584.
4. Stommel H E (1948) The westward intensification of wind-driven currents Trans. Amer Geophys. Union 20(2): 202-306.