

Ocean Sci. Discuss., author comment AC3
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Reply on RC4

Peter Chu

Author comment on "Gravity disturbance driven ocean circulation" by Peter C. Chu, Ocean Sci. Discuss., <https://doi.org/10.5194/os-2022-12-AC3>, 2022

Dear Professor Marshall,

Thank you very much for your quick response.

The statement should be clarified by "The z surface can never be defined as an equipotential surface of the true gravity (i.e., the true equipotential surface)."

The critical point is that the gravity used in oceanography and meteorology is not the TRUE GRAVITY.

The two attached figures illustrate the difference between the normal gravity which is called the effective gravity and used in oceanography and meteorology, and the true gravity which is the most important variable in geodesy.

Figure A shows the main features of the effective gravity $[-g(\varphi)\mathbf{K}]$: (1) it is obtained from the solid Earth with rotation and uniform mass density; (2) the unit vector \mathbf{K} is perpendicular to the z surface ($z = \text{constant}$) and points the normal vertical; (3) the z surface is the normal horizontal and coincides with the normal geopotential surface; (4) any movement on the z surface (i.e., normal geopotential surface) is not against the normal gravity.

Figure B shows the main features of the true gravity $[\mathbf{g}(\lambda, \varphi, z) = -g(\varphi)\mathbf{K} + \delta\mathbf{g}]$: (1) it is obtained from the solid Earth with rotation and non-uniform mass density; (2) the true gravity has never been used in oceanography and meteorology; (3) the true gravity vector $\mathbf{g}(\lambda, \varphi, z)$ is perpendicular to the true geopotential surface such as the geoid surface, which represents the true horizontal; (4) any movement on the true geopotential surface is not against the true gravity; (5) any movement on the z-surface is against the true gravity. An additional force, the gravity disturbance, shows up in the z-surface momentum equations.

I would like to know your opinion if the ocean dynamics needs to be advanced due to the fact that water particle is not against the true gravity while it climbs roughly 100 m following the geoid surface from boundary, to the center, of the Indian Ocean.

Best regards,

Peter Chu

Please also note the supplement to this comment:

<https://os.copernicus.org/preprints/os-2022-12/os-2022-12-AC3-supplement.pdf>