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# On the Governing Equations for Quasigeostrophic Atmospheric Motions of Synoptic and Planetary Scales: Some New Results and Possible Implications.

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The traditional synoptic-scale quasigeostrophic (SQG) governing equations of atmospheric motion are subject to the assumption that the ratio of the characteristic horizontal scale of the motion to the radius of the Earth is small. These equations are often applied in circumstances where this underlying assumption is not valid. An alternative assumption that the above ratio is O(1) leads to the planetary-scale quasigeostrophic (PQG) equations. Though these are seldom used in meteorology, it will be argued here that they are more appropriate for studying some dynamical phenomena, for example the Charney-Drazin Reverse Mechanism (i.e. the mechanism of downward stratospheric dynamical influence on the troposphere through planetary wave reflection and interference), than the much-used SQG equations.

The SQG and PQG equations have traditionally been derived separately. However, Pedlosky (Geophysical Fluid Dynamics, 2nd Ed., 1987, Section 6.24) has derived them simultaneously for the oceanic case using a multiscale method. The results of applying the multiscale method to the atmospheric case, starting from the primitive equations of atmospheric motion in spherical log-pressure coordinates, will be presented here. The results are in part similar to and in part different from Pedlosky's oceanic results. It is found that the interaction between the PQG and SQG systems is one-way and linear; the PQG system is not influenced by the SQG system, but the SQG system is influenced in a linear way by the PQG dynamical fields. An important result is that, in the SQG system as derived using the multiscale method, the governing equation for the pseudopotential vorticity, q (a quantity that is conserved following the horizontal geostrophic flow in the traditional SQG system), has non-conservative dynamical terms involving the PQG fields (a result not found by Pedlosky). The PQG system, on the other hand, has a closed conservation law for an approximated PV following the three-dimensional planetary-scale flow. Possible dynamical implications of these results will be discussed.