

# Quasi-Geostrophic Equations for Atmospheric Dynamics with Clouds and Phase Changes

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Clouds and rainfall are among the most challenging aspects of predicting weather and climate. Moreover, many fundamental aspects of clouds and rainfall, including both physical and mathematical aspects, remain to be understood.

Here, we aim to understand a singular limit, the quasi-geostrophic (QG) approximation, which is a fundamental approximation of atmospheric science, but which is not well understood in the presence of clouds. We describe a new system of partial differential equations (PDEs) that arises in a new, cloudy version of the QG approximation. Our aim is to gain a well-rounded understanding of this new limit and new PDEs, including asymptotics, rigorous analysis, numerical methods, and physical insight. We describe the main challenges that are introduced by clouds and also some progress and open questions in elucidating the fundamental properties of a cloudy atmosphere.

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## References

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