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processes -- Introduction -- Lateral entrainment rate -- Heat capacity of mixing -- Polytropic potential temperature.
Effect of entrainment on dry engines.

Sommario/riassunto

There are large-scale fluid systems in the gravity field, such as the Earth's atmosphere and oceans, which posses some features different from those of classical thermodynamic systems. For example, the oceans and atmosphere possess in homogeneous melt equilibrium states with the same amount of mass and energy. The zeroth law of classical thermodynamics can be applied for the inhomogeneous thermodynamic systems, and the irreversible variations may not be explained only by the change of classical thermodynamic entropy. Therefore, there has been a need for a new theory to study the particular systems. This book introduces a new science, called large-scale inhomogeneous thermodynamics, to study the inhomogeneous thermodynamic systems. The first eight chapters of the book illustrate the basic theories of inhomogeneous thermodynamics. Special attention is paid to the differences between the irreversible processes in a classical thermodynamic system and an inhomogeneous thermodynamic system. New physical concepts and relationships are introduced to study irreversible processes in the inhomogeneous thermodynamic systems which the classical thermodynamics fails to explain. With the new theories introduced, we are able to estimate more realistically how much the kinetic energy is created everyday in, for example, the Earth's atmosphere and oceans and improve greatly the predictions for development and movement of atmospheric set disturbances such as hurricanes and tornadoes. Examples are given in the book, together with the successful interpretation of the climatological distributions of the baroclinic storm tracks, blockings, tropical cyclones and thunderstorms in the troposphere. The energyconversions, related to different floor patterns, are studied by the theory of air engines in which the p-V diagrams are different from those studied in the classical thermodynamics and maybe interesting to engineering. In particular, a new reversible heat engine is forwarded to study the mean meridional circulations in the atmosphere. The Carnot engine is only an example of the new reversible engine. The important conditions for the development of super storms, such as the low-temperature inversion and vertical winds hear, may be interpreted by the air engine theory. The effect of entrainment and detrainment in convective processes is studied by the polytropic mixing theory. Some other applications, such as in the frontogenesis, slantwise convection and multi-equilibrium states of the atmosphere, are also demonstrated. The last two chapters are devoted to the study of uncertainties in current weather and climate prediction models related to various error sources. The predictability and chaos of various physical systems are also discussed. Most of the chapters are original. As the new theories are more rigorous and the applications are more successful than in the old theories, this book brings the current science to a higher level. The problem solved in the book could not be solved before. This book is unique and it is supported solidly and by the actual data from observations. It will essential reading for professional people, and should be accepted by readers at different levels, as it is concerned more with physical philosophies other than mathematics. The mathematics is given in the easy-to-understand form. understanding. The book should be used as a text book for the students ofmeteorology, oceanography, geophysics and environmental sciences. It also provides a good reference source for those working in and studying hydrodynamics, thermodynamics, statistical mechanics and other physics subjects.