

1. Record Nr.	UNISA990006155050203316
Autore	GIODICE SABBATELLI, Venanzia
Titolo	Fideicommissorum persecutio : contributo allo studio delle cognizioni straordinarie / Venanzia Giodice Sabbatelli
Pubbl/distr/stampa	Bari : Cacucci, 2001
ISBN	88-8422-132-3
Descrizione fisica	303 p. ; 25 cm
Collana	Pubblicazioni della Facoltà giuridica dell'Università di Bari ; 126
Disciplina	346.37056
Soggetti	Fedecomesso - Diritto romano
Collocazione	XVI.5. 680
Lingua di pubblicazione	Italiano
Formato	Materiale a stampa
Livello bibliografico	Monografia

2. Record Nr.	UNINA9910786262403321
Autore	Wang Pao K.
Titolo	Physics and dynamics of clouds and precipitation / / Pao K. Wang, University of Wisconsin, Madison [[electronic resource]]
Pubbl/distr/stampa	Cambridge : , : Cambridge University Press, , 2013
ISBN	1-107-23425-5 1-107-30123-8 1-107-25421-3 1-107-31406-2 1-107-30631-0 1-299-27632-6 1-107-31186-1 0-511-79428-2 1-107-30851-8
Descrizione fisica	1 online resource (xvi, 452 pages) : digital, PDF file(s)
Classificazione	SCI042000
Disciplina	551.57/6
Soggetti	Cloud physics Precipitation (Meteorology)
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Title from publisher's bibliographic system (viewed on 01 Feb 2016).
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Cover; Contents; Preface; 1 Observation of clouds; 1.1 Water vapor in the atmosphere; 1.2 Where do clouds occur in the atmosphere?; 1.3 Conventional classifications of clouds; 1.3.1 High clouds (base height greater than 6000 m); 1.3.2 Middle clouds (base height between 2000 and 6000 m); 1.3.3 Low clouds (base height lower than 2000 m); 1.3.4 Clouds with vertical development; 1.4 Precipitation; 1.5 Observing clouds from an aircraft; 1.6 Cloud classification according to the phase of water substance; 1.7 Remote-sensing techniques of cloud observation; 1.7.1 Radar and lidar techniques 1.7.2 Satellite techniques Problem; 2 The shape and size of cloud and precipitation particles; 2.1 Clouds as a colloidal system; 2.2 Frequency of liquid water and ice clouds in subfreezing environment; 2.3 Types of particles in clouds and precipitation; 2.4 Sampling of cloud and precipitation particles; 2.5 Cloud droplet size distributions; 2.5.1

Mathematical expressions of cloud drop size distributions; 2.6
Raindrop size distributions; 2.6.1 Double-gamma distribution; 2.7
Raindrop shape problem; 2.7.1 Quasi-spheroid approach; 2.7.2 Conical
particle approach
2.8 Size and shape of graupel and hail2.9 Shape and size of ice crystals
and snowflakes; 2.9.1 Habit of ice crystals; 2.9.2 Magono-Lee
classification; 2.9.3 Dimensional relations; 2.9.4 Ice crystal and
snowflake size and shape distribution; 2.9.5 Mathematical
representations of ice and snow crystal shapes; Problems; 3 Molecular
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Electronic structure of the water molecule; 3.1.2 Electric dipole
moment; 3.1.3 Water isotopes; 3.2 Hydrogen bonds; 3.3 Structure of
water vapor; 3.4 Molecular structure of ice; 3.4.1 Ice-Ih
Defects in ice-IhQuasi-liquid layer on ice surface; 3.4.2 Ice-Ic; 3.4.3
Other forms of ice; 3.5 Molecular structure of liquid water; Problems; 4
Bulk thermodynamic equilibrium among water vapor, liquid water, and
ice; 4.1 Thermodynamic systems; 4.2 The first law of thermodynamics
- conservation of energy; 4.3 Closed systems; 4.4 Adiabatic process for
a closed system; 4.5 A simple conceptual model for small cumulus
cloud formation; 4.6 Entropy; 4.7 Open systems; 4.8 Gibbs-Duhem
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Clausius-Clapeyron equation
4.11 Phase diagram for water substance4.12 Supercooling and the
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equilibrium among curved interface systems; 5.5 Contact angle and
wettability; 5.6 Component chemical potentials in an ideal gas mixture;
5.7 The chemical potential of water in an aqueous solution; 5.8 Ideal
and non-ideal solutions
5.9 Equilibrium between two phases separated by curved interface

Sommario/riassunto

This key new textbook provides a state-of-the-art view of the physics of cloud and precipitation formation, covering the most important topics in the field: the microphysics, thermodynamics and cloud-scale dynamics. Highlights include: the condensation process explained with new insights from chemical physics studies; the impact of the particle curvature (the Kelvin equation) and solute effect (the Kohler equation); homogeneous and heterogeneous nucleation from recent molecular dynamic simulations; and the hydrodynamics of falling hydrometeors and their impact on collision growth. 3D cloud-model simulations demonstrate the dynamics and microphysics of deep convective clouds and cirrus formation, and each chapter contains problems enabling students to review and implement their new learning. Packed with detailed mathematical derivations and cutting-edge stereographic illustrations, this is an ideal text for graduate and advanced undergraduate courses, and also serves as a reference for academic researchers and professionals working in atmospheric science, meteorology, climatology, remote sensing and environmental science.
