Atmospheric Physics

Lecture 1

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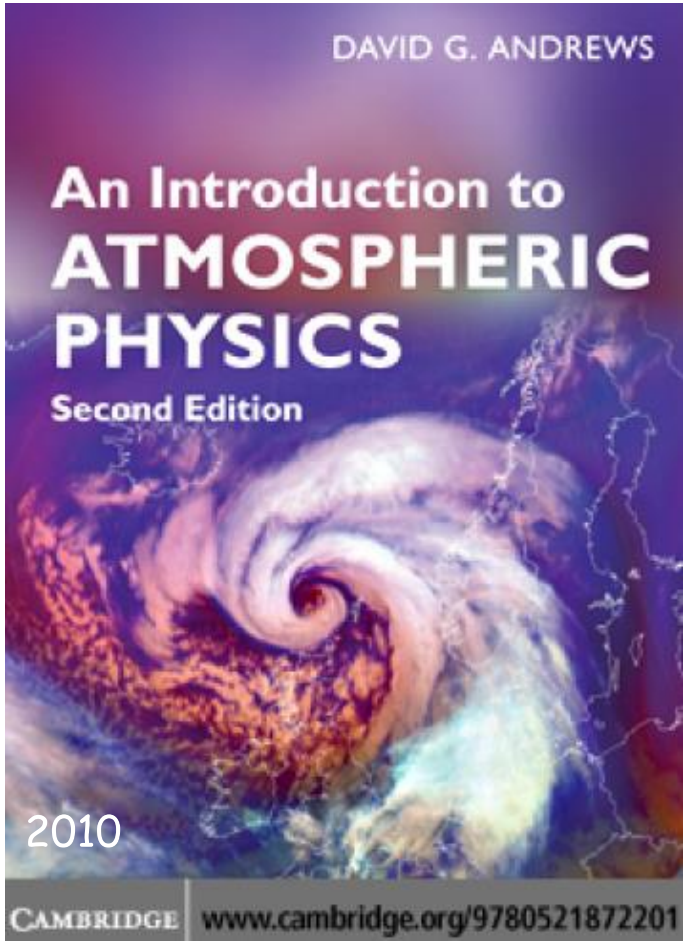
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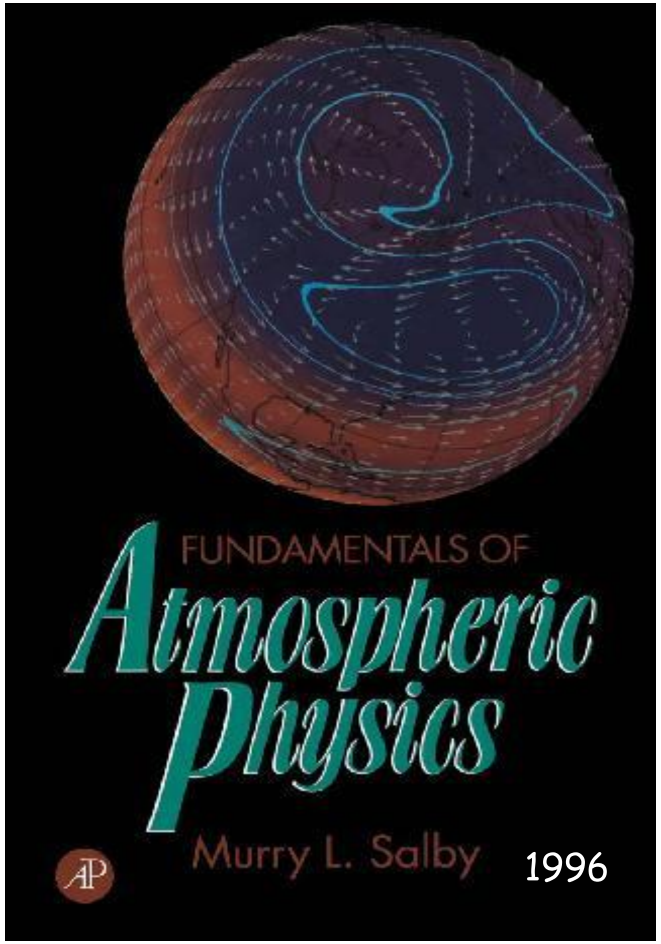
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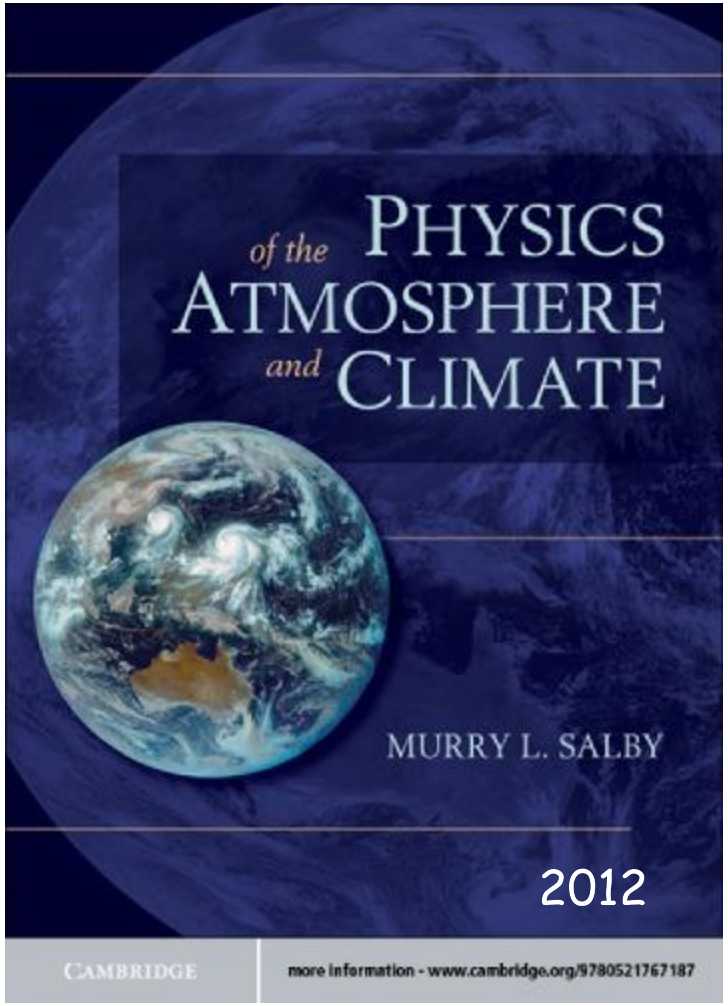
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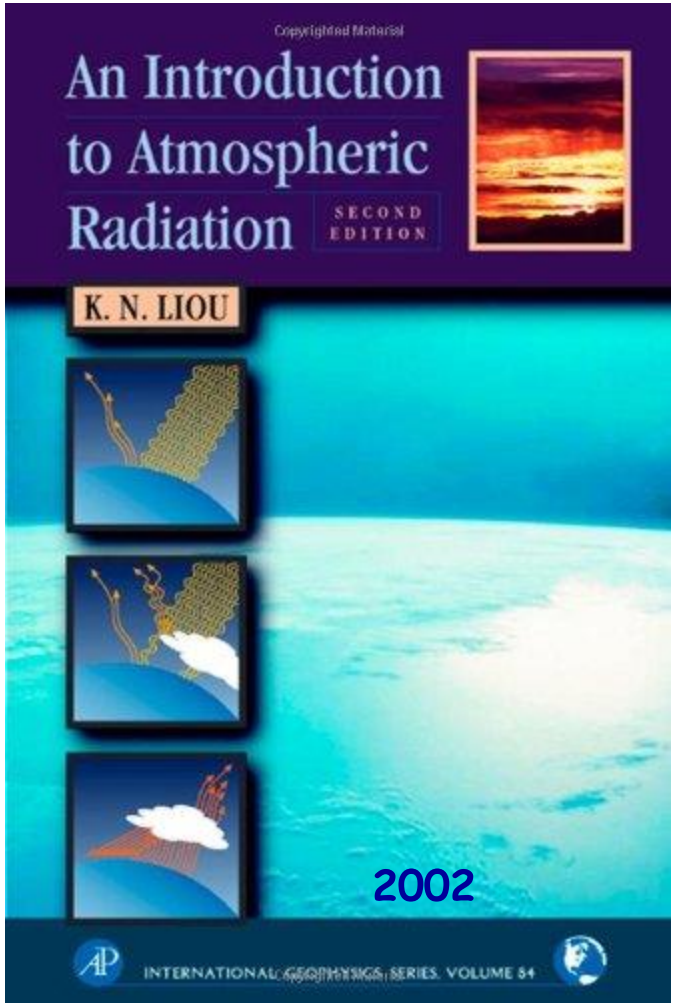
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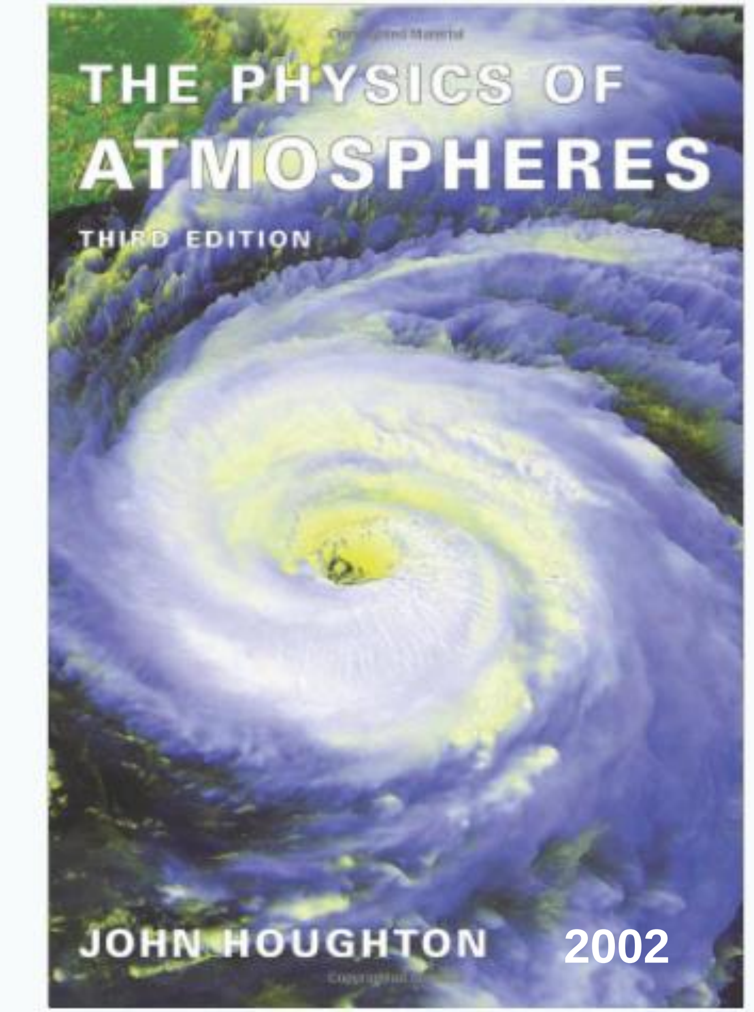
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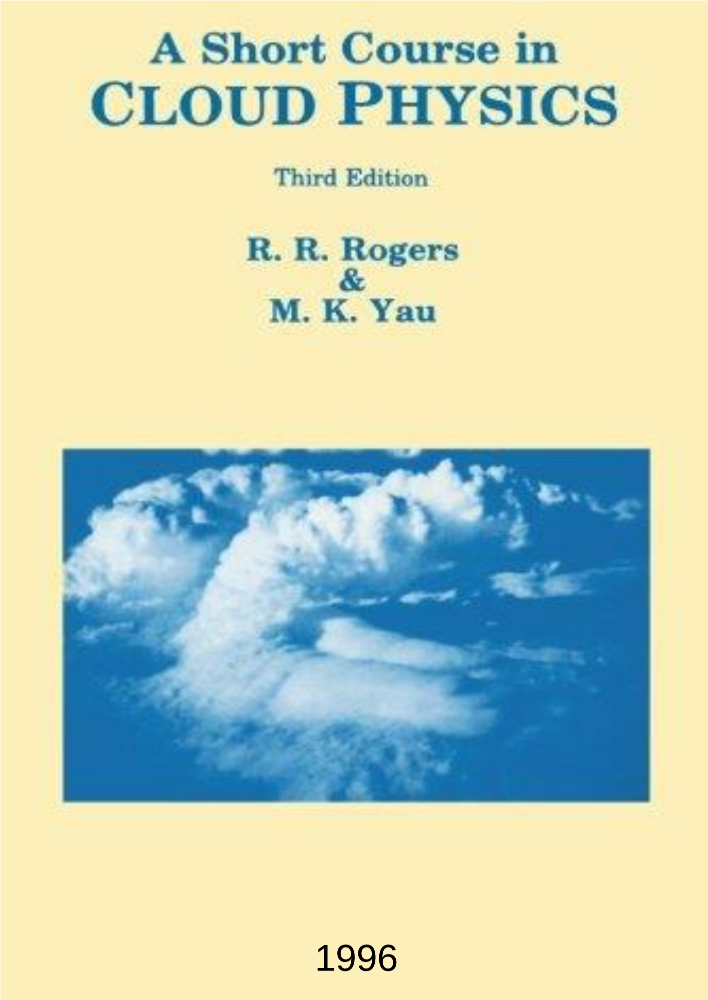
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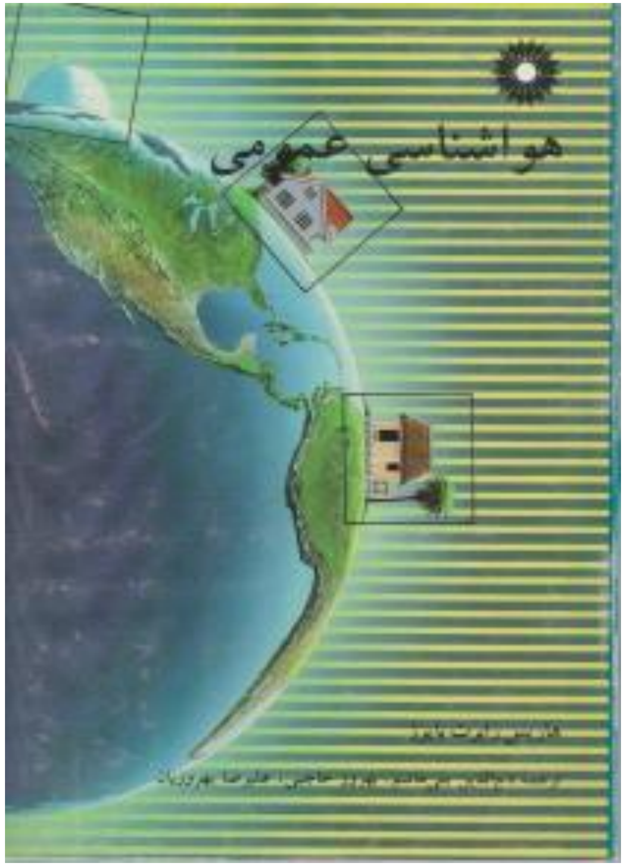
هواشناسی عمومی


هواشناسی فیزیکی
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Grading

Homework- 20%

Providing Lecture – 20%

Final Exam - 60%

فصل اول –مقدمه

سامانه فیزیکی جوّ،جوّ استاندارد، مدل‌های جوّی، یک مدل تابشی ساده، مدل ساده‌ای برای اثر گلخانه‌ای، گرمایش زمین، برخی مشاهدات جوّی شامل میدان‌های دما و باد؛ امواج گرانی، راسبی؛ ازن.

فصل دوم – ترمودینامیک جوّ خشک

قانون گاز ایده‌آل، ترکیب جوّ، توازن آب‌ایستایی (هیدروستاتیک)، آنتروپی و دمای بالقوه (پتانسیلی)، مفهوم بسته و پایداری ایستایی، انرژی پتانسیل دسترس‌پذیر و شکل همرفتی آن ($CAPE$)، انرژی بازدارنده همرفت ($CINE$)، نقش $CAPE$ و $CINE$ در توسعه توفان تندری.

فصل سوم – ترمودینامیک جوّ نمناک

توصیف هوای نمناک،تغییرات سه‌گانه فاز، فشار بخار اشباع،میعان و آزاد شدن گرمای نهان، آهنگ کاهش دمای بی‌دررو اشباع، اثر رطوبت بر پایداری ایستایی،اثر صعود لایه بر پایداری ایستایی، نمودار *skew-T* محاسبه آب بارش‌شو.

فصل چهارم – ابر و بارش

هواویزهای جوّی، رشد قطرک از طریق میعان، هسته‌زایی همگن، فرمول کلوین، هسته‌زایی ناهمگن، منحنی کوهلر، رشد قطرک از طریق برخورد، رشد ذرات یخ، فرآیند برجران.

فصل پنجم – تابش جوّی

مفاهیم فیزیکی پایه، تابع پلانک، ترازمندی تابشی محلی، معادله انتقال تابش، طیف‌نگاری پایه، تراگسیلایی، جذب حاصل از اجزاء جوّ، آهنگ گرمایش، اثر گلخانه‌ای، مدل ساده‌ای برای پراکندگی.

Chapter 1 - Introduction

Definitions

The atmosphere as a physical system

Atmospheric models

Two simple atmospheric models

Some atmospheric observations

Weather and climate Further reading

Some atmospheric observations include :

The mean temperature and wind fields, Gravity waves, Rossby waves, Ozone, Weather and climate

Atmospheric physics – A definition

Atmosphere is the gaseous envelope of a celestial body that is confined due to gravitational attraction.

Physics of the Atmosphere - ie the study of all physical phenomena in the atmospheric system.

Meteorology

Atmospheric chemistry is a branch of atmospheric science in which the chemistry of the Earth's atmosphere and that of other planets is studied.

Atmospheric science is a relatively new, applied discipline that is concerned with the structure and evolution of the planetary atmospheres and with the wide range of phenomena that occur within them.

The role of physics

Thermodynamics
phase transitions - condensation and evaporation
adiabatic processes & T- gradients

Quantum Mechanics
interaction of radiation & matter

Hydrodynamics: the branch of science concerned with forces acting on or exerted by fluids
Navier-Stokes-Eq

Transport Phenomena
turbulence
diffusion
matter & energy

DESCRIPTION

Composition and structure of the earth's atmosphere,

Atmospheric thermodynamics,

Atmospheric Radiation

Atmospheric dynamics,

Clouds and precipitation.

The atmosphere as a physical system

The Earth's atmosphere is a natural laboratory, in which a wide variety of physical processes takes place.

The purpose of this book is to show how basic physical principles can help us model, interpret and predict some of these processes.

This section presents a brief overview of the physics involved.

The atmosphere consists of a mixture of ideal gases: although molecular nitrogen and molecular oxygen predominate by volume, the minor constituents carbon dioxide, water vapour and ozone play crucial roles.

The forcing of the atmosphere is primarily from the sun, though interactions with the land and the ocean are also important.

The atmosphere is continually bombarded by solar photons at infra-red, visible and ultra-violet wavelengths.

Some solar photons are scattered back to space by atmospheric gases or reflected back to space by clouds or the Earth's surface; some are absorbed by atmospheric molecules (especially water vapour and ozone) or clouds, leading to heating of parts of the atmosphere; and some reach the Earth's surface and heat it.

Atmospheric gases (especially carbon dioxide, water vapour and ozone), clouds and the Earth's surface also emit and absorb infra-red photons, leading to further heat transfer between one region and another, or loss of heat to space.

Solar photons may also be energetic enough to disrupt molecular chemical bonds, leading to photochemical reactions;

The atmosphere is generally close to hydrostatic balance in the vertical, except on small scales; that is, the weight of each horizontal slab of atmosphere is supported by the difference in pressure between its lower and upper surfaces.

An alternative statement of this physical fact is that there is a balance between vertical pressure gradients and the gravitational force per unit volume acting on each portion of the atmosphere.

On combining the equation describing hydrostatic balance with the ideal gas law we find that, in a hypothetical isothermal atmosphere, the pressure and density would fall exponentially with altitude.

In the real, non-isothermal, atmosphere the pressure and density variations are usually still close to this exponential form, with an *e-folding* height of about 7 or 8 km.

Gravity thus tends to produce a density stratification in the atmosphere

Thermodynamic principles are essential for describing many atmospheric processes.

For example, any consideration of the effects of atmospheric heating or cooling will make use of the First Law of Thermodynamics.

The concept of entropy (or the closely related quantity, potential temperature) frequently assists interpretation of atmospheric behaviour.