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Chapter 1 : Atmospheric Chemistry and Physics: From Air Pollution to Climate Change by John H. Seinfeld

Atmospheric Chemistry and Physics (ACP) is an international scientific journal dedicated to the publication and public discussion of high-quality studies investigating the Earth's atmosphere and the underlying chemical and physical processes.

Download Course Materials This course has no required text. The optional reference Seinfeld, J. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. Below are a selection of additional references organized by topics to be covered in class. Aerosol Physics Friedlander, S. Smoke, Dust, and Haze: Fundamentals of Aerosol Dynamics. Oxford University Press, Microphysics of Clouds and Precipitation. Reidel Publishing Company, Internal Combustion Engine Fundamentals. Theoretical and Numerical Combustion. Introduction to Internal Combustion Engines. Internal Combustion Engine in Theory and Practice: Combustion, Fuels, Materials, Design. The MIT Press, Atmospheric Chemistry Brimblecombe, P. Air Composition and Chemistry. Cambridge University Press, Introduction to Atmospheric Chemistry. Cambridge University Press, a. Basic Physical Chemistry for the Atmospheric Sciences. Cambridge University Press, b. Princeton University Press, Chemistry of the Upper and Lower Atmosphere. Chemistry of the Natural Atmosphere. Atmospheric Physics Andrews, D. An Introduction to Atmospheric Physics. Air Pollution Meteorology and Dispersion. Cloud Dynamics International Geophysics Series. Coastal Meteorology International Geophysics Series. A First Course in Atmospheric Radiation. An Introduction to Atmospheric Thermodynamics. Fundamentals of Air Pollution Engineering. Upper Saddle River, NJ: Sources and Control of Air Pollution. Fundamentals of Atmospheric Radiation: An Introduction with Problems. John Wiley and Sons, Inverse Methods Bennett, A. Inverse Methods in Physical Oceanography. The Ocean Circulation Inverse Problem.

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Includes bibliographical references and index. Contents Preface to the Second Edition. Preface to the First Edition 1. Atmospheric Radiation and Photochemistry. Chemistry of the Stratosphere. Chemistry of the Troposphere. Chemistry of the Atmospheric Aqueous. Properties of the Atmospheric Aerosol. Dynamics of Single Aerosol Particles. Mass Transfer Aspects of Atmospheric Chemistry. Dynamics of Aerosol Populations. Interaction of Aerosols with Radiation. Meteorology of the Local Scale. General Circulation of the Atmosphere. Climate and the Chemical Composition of the Atmosphere. Atmospheric Chemical Transport Models. Units and Physical Constants. Rate Constants of Atmospheric Chemical Reactions. It continues to be the premier text for both a rigorous and a complete treatment of the chemistry of the atmosphere, covering such pivotal topics as: All chapters develop results based on fundamental principles, enabling the reader to build a solid understanding of the science underlying atmospheric processes. Among the new material are three new chapters: In addition, the chapters Stratospheric Chemistry, Tropospheric Chemistry, and Organic Atmospheric Aerosols have been rewritten to reflect the latest findings. Readers familiar with the First Edition will discover a text with new structures and new features that greatly aid learning. Many examples are set off in the text to help readers work through the application of concepts. Advanced material has been moved to appendices. Finally, many new problems, coded by degree of difficulty, have been added. A solutions manual is available. Thoroughly updated and restructured, the Second Edition of Atmospheric Chemistry and Physics is an ideal textbook for upper level undergraduate and graduate students, as well as a reference for researchers in environmental engineering, meteorology, chemistry, and the atmospheric sciences. Nielsen Book Data Subjects.

Chapter 3 : Atmospheric Chemistry and Air Pollution - Environmental Health Sciences - University of Birmi

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The mean molecular mass of air is Ozone O3 is not included due to its high variability. History[edit] Schematic of chemical and transport processes related to atmospheric composition. The ancient Greeks regarded air as one of the four elements. The first scientific studies of atmospheric composition began in the 18th century, as chemists such as Joseph Priestley , Antoine Lavoisier and Henry Cavendish made the first measurements of the composition of the atmosphere. In the late 19th and early 20th centuries interest shifted towards trace constituents with very small concentrations. In the 20th century atmospheric science moved on from studying the composition of air to a consideration of how the concentrations of trace gases in the atmosphere have changed over time and the chemical processes which create and destroy compounds in the air. Two particularly important examples of this were the explanation by Sydney Chapman and Gordon Dobson of how the ozone layer is created and maintained, and the explanation of photochemical smog by Arie Jan Haagen-Smit. Atmospheric chemistry is increasingly studied as one part of the Earth system. Instead of concentrating on atmospheric chemistry in isolation the focus is now on seeing it as one part of a single system with the rest of the atmosphere , biosphere and geosphere. An especially important driver for this is the links between chemistry and climate such as the effects of changing climate on the recovery of the ozone hole and vice versa but also interaction of the composition of the atmosphere with the oceans and terrestrial ecosystems. Progress in atmospheric chemistry is often driven by the interactions between these components and they form an integrated whole. For example, observations may tell us that more of a chemical compound exists than previously thought possible. This will stimulate new modelling and laboratory studies which will increase our scientific understanding to a point where the observations can be explained. Observation[edit] Observations of atmospheric chemistry are essential to our understanding. Routine observations of chemical composition tell us about changes in atmospheric composition over time. One important example of this is the Keeling Curve - a series of measurements from to today which show a steady rise in of the concentration of carbon dioxide see also ongoing measurements of atmospheric CO2. Observations of atmospheric chemistry are made in observatories such as that on Mauna Loa and on mobile platforms such as aircraft e. Surface observations have the advantage that they provide long term records at high time resolution but are limited in the vertical and horizontal space they provide observations from. Some surface based instruments e. LIDAR can provide concentration profiles of chemical compounds and aerosol but are still restricted in the horizontal region they can cover. Many observations are available on line in Atmospheric Chemistry Observational Databases. Laboratory studies[edit] Measurements made in the laboratory are essential to our understanding of the sources and sinks of pollutants and naturally occurring compounds. These experiments are performed in controlled environments that allow for the individual evaluation of specific chemical reactions or the assessment of properties of a particular atmospheric constituent. Also of high importance is the study of atmospheric photochemistry which quantifies how the rate in which molecules are split apart by sunlight and what resulting products are. Modeling[edit] In order to synthesise and test theoretical understanding of atmospheric chemistry, computer models such as chemical transport models are used. Numerical models solve the differential equations governing the concentrations of chemicals in the atmosphere. They can be very simple or very complicated. One common trade off in numerical models is between the number of chemical compounds and chemical reactions modelled versus the representation of transport and mixing in the atmosphere. For example, a box model might include hundreds or even thousands of chemical reactions but will only have a very crude representation of mixing in the atmosphere. In contrast, 3D models represent many of the physical processes of the atmosphere but due to constraints on computer resources will have far fewer chemical reactions and compounds. Models can be used to interpret observations, test understanding of chemical reactions and predict future concentrations of chemical compounds in the atmosphere. One important current trend is for atmospheric chemistry modules to become one part of earth system models in which the links between climate, atmospheric composition and the biosphere can be studied. Some models are constructed by automatic code generators e. In this approach a set of constituents are chosen and the automatic code generator will then select the reactions involving those constituents from a set of reaction databases. Once the reactions have been chosen the ordinary differential equations ODE that describe their time evolution can be automatically constructed.

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The study of atmospheric chemistry as a scientific discipline goes back to the eighteenth century, when the principal issue was identifying the major chemical components of the atmosphere, nitrogen, oxygen, water, carbon dioxide, and the noble gases.

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