Variability Of Air Temperature And Atmospheric Precipitation In The Arctic

#arctic climate change #polar temperature fluctuations #arctic precipitation trends #atmospheric variability arctic #climate science polar regions

Explore the critical topic of arctic climate variability, focusing on the significant fluctuations in air temperature and atmospheric precipitation across the polar region. This analysis delves into arctic precipitation trends and the broader implications of polar temperature variability on the sensitive arctic environment and global climate systems, offering insights for climate science research in polar regions.

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It has been known at least since the end of the century that the polar areas play a very important role in the formation of the Earth’s climates. It is also known today that they are the most sensitive regions to climatic change, and are thus perfect case studies for the detection of such changes. The most serious obstacle to the study of climatic and other geographical elements of the polar areas (including the Arctic) has always been the severe climatic conditions which prevail in these regions. Because of these extreme con- tions, research into particular elements of the climatic system (including the atmosphere) began here much later than it did in lower latitudes. For instance, the whole area of the Arctic was not sufficiently covered with a network of meteorological stations until the late 1940s (and even then there were large areas of the central Arctic and the Greenland interior for which no data were available). This is probably why it was not until the start of the 1990s that a body of work began to appear which analysed in any depth climatic variability for the Arctic as a whole. While a considerable number of papers had been p- lished before this period, most of them were local studies presenting highly localised information, providing air temperature measurements but often little else.

Climate Variability and Extremes during the Past 100 years

This volume provides an up to date overview of climate variability during the 20th century in the context of natural and anthropogenic variability. It compiles a number of contributions to a workshop held in Gwatt, Switzerland, in July 2006 dealing with different aspects of climate change, variability, and extremes during the past 100 years. The individual contributions cover a broad range of topics. The volume fills a gap in this exciting field of research.

The Climate of the Arctic

th Towards the end of the 19 century some researchers put forward the hypothesis that the Polar regions may play the key role in the shaping of the global climate. This supposition found its full confirmation in empirical and th model research conducted in the 20 century, particularly in recent decades. The intensification of the global warming after about 1975 brought into focus the physical causes of this phenomenon. The first climatic models created at that time, and the analyses of long observation series consistently showed that the Polar regions are the most sensitive to climatic changes. This aroused the interest of numerous researchers, who thought that the examination of the proc esses taking place in these regions might help to determine the mechanisms responsible for the "working" of the global climatic system. To date, a great number of publications on this issue have been published. However, as a re view of the literature shows, there is not a single monograph which comprises the basic information concerning the current state of the Arctic climate. The last study to discuss the climate of the Arctic in any depth was published in 1970 (Climates a/the Polar Regions, vol. 14, ed. S. Orvig) by the World Survey of Climatology, edited by H. E. Landsberg. This publication, however, does not provide the full climatic picture of many meteorological elements.

Variability of Air Temperature Andatmospheric`prediction in the Arctic

This volume reflects the current state of scientific knowledge about natural climate variability on decade-to-century time scales. It covers a wide range of relevant subjects, including the characteristics of the atmosphere and ocean environments as well as the methods used to describe and analyze them, such as proxy data and numerical models. They clearly demonstrate the range, persistence, and magnitude of climate variability as represented by many different indicators. Not only do natural climate variations have important socioeconomic effects, but they must be better understood before possible anthropogenic effects (from greenhouse gas emissions, for instance) can be evaluated. A topical essay introduces each of the disciplines represented, providing the nonscientist with a perspective on the field and linking the papers to the larger issues in climate research. In its conclusions section, the book evaluates progress in the different areas and makes recommendations for the direction and conduct of future climate research. This book, while consisting of technical papers, is also accessible to the interested layperson.

Natural Climate Variability on Decade-to-Century Time Scales

This book provides a comprehensive, up-to-date assessment of the key terrestrial components of the Arctic system, i.e., its hydrology, permafrost, and ecology, drawing on the latest research results from across the circumpolar regions. The Arctic is an integrated system, the elements of which are closely linked by the atmosphere, ocean, and land. Using an integrated system approach, the book’s 30 chapters, written by a diverse team of leading scholars, carefully examine Arctic climate variability/change, large river hydrology, lakes and wetlands, snow cover and ice processes, permafrost characteristics, vegetation/landscape changes, and the future trajectory of Arctic system evolution. The discussions cover the fundamental features of and processes in the Arctic system, with a special focus on critical knowledge gaps, i.e., the interactions and feedbacks between water, permafrost, and ecosystem, such as snow pack and permafrost changes and their impacts on basin hydrology and ecology, river flow, geochemistry, and energy fluxes to the Arctic Ocean, and the structure and function of the Arctic ecosystem in response to past/future changes in climate, hydrology, and permafrost conditions. Given its scope, the book offers a valuable resource for researchers, graduate students, environmentalists, managers, and administrators who are concerned with the northern environment and resources.

Arctic Hydrology, Permafrost and Ecosystems

A presentation given at the regular plenary session of the Academy of Sciences of Saxony in Leipzig (Germany) on October 12, 2012, is thoroughly summarized. Additional aspects important to the theme but not covered in the talk have been added to complete the text. The characteristic conditions and processes leading to the so-called Arctic amplification are outlined. The phenomenon of Arctic amplification comprises an enhanced variability and amplified increase of the near-surface air temperature in the Arctic in comparison to the average near-surface warming at lower latitudes. Observations and simulations show the magnitude of the observed Arctic near-surface air temperature increase is more than double the air temperature increase at lower latitudes. To illustrate the phenomenon of Arctic amplification, several examples of observed Arctic near-surface air temperature increases

are presented. In general, Arctic amplification also implies serious Arctic climate changes other than near-surface air temperature, such as the dramatic summer melting of Arctic Sea ice and the Greenland ice sheet, and the decrease of snow cover and surface albedo of the Greenland ice sheet. Numerous reasons for the Arctic climate changes are discussed; the direct and indirect surface albedo feedback and the related increase of near-surface water vapor and cloudiness, meridional heat and water vapor transports in the atmosphere and ocean, and increased soot amounts in both the atmosphere and snow/ice surfaces. The special role of low-level clouds under Arctic conditions (low Sun, polar day and night, high surface albedo) for the self-enforcing amplification processes is described. In particular, the impact of ice in Arctic mixed-phase clouds on the cloud radiative forcing is investigated. Methods of ice detection in mixed-phase Arctic clouds are presented along with verification examples.

Amplified Climate Changes in the Arctic

The Arctic is now experiencing some of the most rapid and severe climate change on earth. Over the next 100 years, climate change is expected to accelerate, contributing to major physical, ecological, social, and economic changes, many of which have already begun. Changes in arctic climate will also affect the rest of the world through increased global warming and rising sea levels. The volume addresses the following major topics: - Research results in observing aspects of the Arctic climate system and its processes across a range of time and space scales - Representation of cryospheric, atmospheric, and oceanic processes in models, including simulation of their interaction with coupled models - Our understanding of the role of the Arctic in the global climate system, its response to large-scale climate variations, and the processes involved.

Arctic Climate Change

This booklet highlights the importance of the polar regions in the entire Earth system, particularly in climate. It describes some of the major environmental changes that have taken place in the Arctic and Antarctic in recent years and considers possible changes over the next century.--Publisher's description.

Polar Meteorology

This is the first book to provide a comprehensive overview of climate change–related investigations carried out by Indian researchers through initiatives in southern high latitude regions. It explains climate variability over the Southern Ocean and Antarctica; air, sea, ice, and atmosphere interactions; and the impact of climate variability on sea ice and the polar atmosphere. The data were gathered at two Indian research bases, Maitri and Bharti, which are ideal sites to study and understand climatic evolution in Antarctic in the past and recent changes. This book helps to understand climatological perspectives and to evaluate some of the most pressing issues in the south polar region. FEATURES Highlights the achievements of India in the contemporary field of Antarctic climatology Presents four decades of research by Indian scientists in Antarctica, which is now shared for the first time with the global community Includes case studies on climatological and environmental conditions of natural archives to shed light on climate scenarios in the Southern Ocean and Antarctic regions Covers various aspects of climate variability and induced air-sea-ice-atmosphere interactions This book is edited by one of the top scientists and researchers of India in the field of paleoclimatology, and the contributors are experts in the Antarctic region.

The State of Canada's Climate

This second edition brings this definitive book up to date with the many advances in our understanding of Arctic climate since the first edition was published in 2005. The book has also been extensively reorganized to weave issues of Arctic change throughout the text, rather than confining them to a single chapter. It is the first to provide an integrated assessment of the Arctic climate system, recognizing that a true understanding of how the Arctic functions lies in appreciating the interactions among its various components. The book begins with a historical perspective, followed by discussion of the basic physical and climatic characteristics of the Arctic. Following a review of past climates (paleoclimates), the book closes with an assessment of the Arctic's uncertain future. Though targeted mainly at advanced students and researchers, this book is accessible to anyone with an interest in the Arctic and a basic understanding of climate science.

Atmospheric Theory of the Open Polar Sea

The Arctic is now experiencing some of the most rapid and severe climate change on earth. Over the next 100 years, climate change is expected to accelerate, contributing to major physical, ecological, social, and economic changes, many of which have already begun. Changes in arctic climate will also affect the rest of the world through increased global warming and rising sea levels. Arctic Climate Impact Assessment was prepared by an international team of over 300 scientists, experts, and knowledgeable members of indigenous communities. The report has been thoroughly researched, is fully referenced, and provides the first comprehensive evaluation of arctic climate change, changes in ultraviolet radiation and their impacts for the region and for the world. It is illustrated in full color throughout. The results provided the scientific foundations for the ACIA synthesis report - Impacts of a Warming Arctic - published by Cambridge University Press in 2004.

Climate Variability of Southern High Latitude Regions

For the very first time, this book provides updated, integrated and organized, theoretical and methodological information on regional climate change and the associated environmental and socio-economic impacts on a regional scale. The most recent findings in the field of long-term climate change, which improve our understanding of the global climate puzzle, will be presented. Readers are introduced to state-of-the-art research in downscaling and GCMs, which involve the construction of reliable regional climate scenarios and the solution to key problems regarding the assessment of the impacts of climate change in the most important geographical areas of the world, from the Arctic to Antarctic regions, with special emphasis on the Northern Hemisphere.

Climate Variability and Climate Change

A group of authors from the Arctic and Antarctic Research Institute in St Petersburg, Russia, have all achieved individual doctoral theses on various aspects of Arctic and Antarctic research. This book is written by experienced group of researchers and authors.

Internal Variability of Sea Ice and Surface Air Temperature in a Warming Arctic Climate

This study was conducted to document the variability of the Arctic heat sink; to investigate possible effects of these variations on northern hemispheric circulation patterns; and to look for relationships between Arctic heat sink variations and sea-surface temperature anomalies. To meet these objectives, several characterizations of the Arctic heat sink were proposed; relevant datasets for investigating these characterizations are either provided or described; and preliminary analyses of the relationships between variations in the Arctic heat sink (in accordance with these characterizations), sea-surface temperature anomalies, and circulation patterns are presented.

The Arctic Climate System

This book gives a comprehensive presentation of our present understanding of the Earth's Hydrological cycle and the problems, consequences and impacts that go with this topic. Water is a central component in the Earth's system. It is indispensable for life on Earth in its present form and influences virtually every aspect of our planet's life support system. On relatively short time scales, atmospheric water vapor interacts with the atmospheric circulation and is crucial in forming the Earth's climate zones. Water vapor is the most powerful of the greenhouse gases and serves to enhance the tropospheric temperature. The dominant part of available water on Earth resides in the oceans. Parts are locked up in the land ice on Greenland and Antarctica and a smaller part is estimated to exist as groundwater. If all the ice over the land and all the glaciers were to melt, the sea level would rise by some 80 m. In comparison, the total amount of water vapor in the atmosphere is small; it amounts to ~ 25 kg/m2, or the equivalent of 25 mm water for each column of air. Yet atmospheric water vapor is crucial for the Earth’s energy balance. The book gives an up to date presentation of the present knowledge. Previously published in Surveys in Geophysics, Volume 35, No. 3, 2014

Arctic Climate Impact Assessment - Scientific Report

Reconstruction of the climate variability of the past 500 years is a topic of great scientific interest not only in global terms, but also at regional and local levels. This period is interesting on account of the increasing influence of anthropogenic forcing and its overlap with natural factors. The Polish Climate in the European Context: An Historical Overview summarises the results of research into climate variability based on a combination of instrumental, documentary, dendrochronological and borehole

data from Poland. The first part of the book provides a Central European perspective of research in these fields, which forms the general background for a presentation of the state of the art of climatic change studies in Poland during the past 500 years (Part 2). This is followed by a selection of papers dealing mainly with different aspects of climate variability in Poland and Central Europe (Part 3). "This book is a valuable tool integrating Polish, Central and Eastern European climate research into the global context. It is, as such, a must for climate researchers worldwide." (Gaston Demarée, Royal Meteorological Institute of Belgium) "This volume marks a significant step forward in our understanding of European climatic history." (Christian Pfister, University of Bern)

Detecting and Modelling Regional Climate Change

In its ninth edition, Atmosphere, Weather and Climate is the essential introduction to weather processes and climatic conditions around the world, their observed variability and changes, and projected future trends. It presents a comprehensive coverage of global meteorology and climatology, and in this new edition the latest scientific ideas are expressed in a clear, non-mathematical matter.

The Arctic Basin

Society today may be more vulnerable to global-scale, long-term, climate change than ever before. Even without any human influence, past records show that climate can be expected to continue to undergo considerable change over decades to centuries. Measures for adaption and mitigation will call for policy decisions based on a sound scientific foundation. Better understanding and prediction of climate variations can be achieved most efficiently through a nationally recognized "dec-cen" science plan. This book articulates the scientific issues that must be addressed to advance us efficiently toward that understanding and outlines the data collection and modeling needed.

Study of the Arctic Heat Sink

The main focus of this book is the study of environmental dynamics in the Arctic, coupled with ecosystem dynamics. Particular emphasis has been placed on problems of the composition of the Arctic atmosphere, as well as changes in the composition due to human impacts. The book also analyzes observational data and numerical modeling results that characterize the Arctic basin pollution dynamics and its impact on ecosystems. Other topics covered include problems of general circulation in the atmosphere and oceans, beginning with the 1930s when the Arctic was regarded as the kitchen of global weather and climate.

The Earth's Hydrological Cycle

Sets of mean monthly reference atmospheres that describe seasonal changes in the vertical distributions of temperature, density, and pressure at altitudes up to 90 km are presented for latitudes 60 deg N and 75 deg N. Also provided are specialized atmospheric models that reflect longitudinal differences in the vertical structure of temperature and density at these latitudes. Estimates of the seasonal, day-to-day, diurnal, and spatial variations are given with special emphasis placed on density. (Author).

The Polish Climate in the European Context: An Historical Overview

Opening with a survey of contemporary global ecodynamics, including its basic components, this book goes on to discuss greenhouse effect problems in the context of global carbon cycle dynamics. The coverage includes land ecosystem changes, air-sea exchange models, high-latitude environmental dynamics, and a discussion of basic aspects of global environmental modelling and relevant monitoring systems. The volume concludes by examining society systems with emphasis on the problems of sustainable development.

Atmosphere,, Weather and Climate

Climate Change: Evidence and Causes is a jointly produced publication of The US National Academy of Sciences and The Royal Society. Written by a UK-US team of leading climate scientists and reviewed by climate scientists and others, the publication is intended as a brief, readable reference document for decision makers, policy makers, educators, and other individuals seeking authoritative information on the some of the questions that continue to be asked. Climate Change makes clear what is well-established and where understanding is still developing. It echoes and builds upon the long

history of climate-related work from both national academies, as well as on the newest climate-change assessment from the United Nations' Intergovernmental Panel on Climate Change. It touches on current areas of active debate and ongoing research, such as the link between ocean heat content and the rate of warming.

Decade-to-Century-Scale Climate Variability and Change

The Atlantic Ocean is the second-largest of the world's oceanic divisions. It is bounded by the continents of America, Europe and Africa and at its pole wards margins by the Arctic and the Southern Oceans. Different climatic patterns can be observed along its large latitudinal domain, which extends from the equator to sub-polar regions. Thus, different tropical and extra-tropical meteorological systems may have some influence on the characterization of precipitation regimes observed surrounding the basin, such as the Intertropical Convergence Zone (ITCZ), tropical monsoon systems, westerly storm tracks and atmospheric rivers. The subtropical regions of the Azores and South Atlantic high pressure systems are large evaporative areas which act as important moisture sources for the adjacent continents. Variations in the oceanic characteristics may influence the moisture transport towards the neighboring landmasses and alter the precipitation. The influence of climatic variability modes manifest not only over the Atlantic Ocean, but also over other oceanic regions, may also interact with the regional hydrological budget, thereby generating long periods of drought or excessive precipitation over the Atlantic rim landmasses. This Research Topic intends to highlight the advances of the scientific community in investigating the continental precipitation surrounding the Atlantic Ocean and its variability on various temporal and spatial scales.

Arctic Environment Variability in the Context of Global Change

Analysis of snow-cover observations made during November - March at 27 stations in Alaska, Canada and the northern United States for a 2 to 11 year period showed that the average snow density can be classified in four general categories. A nomograph in which the average winter air temperature and wind speed are the independent variables makes it possible to estimate the average snowcover density for any location in the Arctic, subarctic and North Temperate Zones. A comparison between observed and estimated densities for ten other test stations yielded a correlation coefficient of 0.91 with a standard error of estimate of 0.016 g/cu cm. An average snow density map of North America was drawn and the continent was divided into areas based on the four categories. (Author).

Arctic and Subarctic Atmospheres, 0 to 90 Km

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Global Ecodynamics

The Arctic can be viewed as an integrated system, characterised by intimate couplings between its atmosphere, ocean and land, linked in turn to the larger global system. This comprehensive, up-to-date assessment begins with an outline of early Arctic exploration and the growth of modern research. Using an integrated systems approach, subsequent chapters examine the atmospheric heat budget and circulation, the surface energy budget, the hydrologic cycle and interactions between the ocean, atmosphere and sea ice cover. Reviews of recent directions in numerical modelling and the characteristics of past Arctic climates set the stage for detailed discussion of recent climate variability and trends, and projected future states. Throughout, satellite remote sensing data and results from recent major field programs are used to illustrate key processes. The Arctic Climate System provides a comprehensive and accessible overview of the subject for researchers and advanced students in a wide range of disciplines.

Climate Change

This book discusses the water and carbon cycle system in the permafrost region of eastern Siberia, Providing vitalin sights into how climate change has affected the permafrost environment in recent decades. It analyzes the relationships between precipitation and evapotranspiration, gross primary production and runoff in the permafrost regions, which differ from those intropical and temperate forests. Eastern Siberia is located in the easternmost part of the Eurasian continent, and the land surface with underlying permafrost has developed over a period of seventy thousand years. The permafrost ecosystem has specific hydrological and meteorological characteristics in terms of the water and

carbon dynamics, and the current global warming and resulting changes in the permafrost environment are serious issues in the high-latitude regions. The book is a valuable resource for students, researchers and professionals interested in forest meteorology and hydrology, forest ecology, and boreal vegetation, as well as the impact of climate change and water-carbon cycles in permafrost and non-permafrost regions.

Wet and Dry Periods in Regions Surrounding the Atlantic Ocean Basin

This volume contains the ten most cited articles that have appeared in the journal Atmosphere-Ocean since 1995. These articles cover a wide range of topics in meteorology, climatology and oceanography. Modelling work is represented in five papers, covering global climate model development; a cumulus parameterization scheme for global climate models; development of a regional forecast modelling system and parameterization of peatland hydraulic processes for climate models. Data rehabilitation and compilation in order to support trend analysis work on comprehensive precipitation and temperature data sets is presented in four papers. Field studies are represented by a paper on the circumpolar lead system. While the modelling studies are global in their application and applicability, the data analysis and field study papers cover environments that are specifically, but not uniquely, Canadian. This book will be of interest to researchers, students and professionals in the various sub-fields of meteorology, oceanography and climate science.

Relationships Between Climate and Regional Variations in Snow-cover Density in North America

This is a print on demand edition of a hard to find publication. Contents: (1) Intro.; (2) Observed Warming and Metrics of Climate Change (CC); (3) Attribution of Observed Changes Due to Greenhouse Gases (GG): Human-Related Influences on CC; Trends in Atmospheric Concentrations of GG; GG Emissions and Growth Globally; (4) Impacts of CC: Extent of Arctic Sea Ice Near Lowest Recorded Levels; Melting of Greenland Ice Sheet; Melting and Thickening of Ice in Antarctica; Some Permanent Ice Fields Not Melting; Contributions of Melting Ice and Warming Oceans to Sea Level Rise; Hydrological Changes in the Western U.S.; (5) Without Further GHG Mitigation Policies, GHG Emissions Will Grow; (6) Future Climate Projections; (7) Abrupt ¿Tipping Points¿ in the Climate System; Projections of Future Impacts. Illus.

Prediction of Interannual Climate Variations

Bulletin of the American Meteorological Society