

Abrupt Climate Change

Final Report, Synthesis and Assessment Product 3.4

U.S. Climate Change Science Program
And the Subcommittee on Global Change Research

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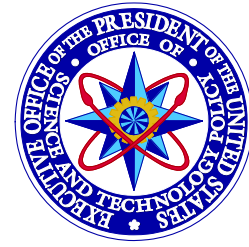
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December 2008

Members of Congress:

On behalf of the National Science and Technology Council, the U.S. Climate Change Science Program (CCSP) is pleased to transmit to the President and the Congress this Synthesis and Assessment Product (SAP) *Abrupt Climate Change*. This is part of a series of 21 SAPs produced by the CCSP aimed at providing current assessments of climate change science to inform public debate, policy, and operational decisions. These reports are also intended to help the CCSP develop future program research priorities.

The CCSP's guiding vision is to provide the Nation and the global community with the science-based knowledge needed to manage the risks and capture the opportunities associated with climate and related environmental changes. The SAPs are important steps toward achieving that vision and help to translate the CCSP's extensive observational and research database into informational tools that directly address key questions being asked of the research community.

This SAP assesses abrupt climate change events where key aspects of the climate system change faster than the responsible forcings would suggest and/or faster than society can respond to those changes. It was developed in accordance with the Guidelines for Producing CCSP SAPs, the Information Quality Act (Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554)), and the guidelines issued by the Department of Interior and the U.S. Geological Survey pursuant to Section 515.

We commend the report's authors for both the thorough nature of their work and their adherence to an inclusive review process.

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Synopsis

For this Synthesis and Assessment Report, abrupt climate change is defined as:

A large-scale change in the climate system that takes place over a few decades or less, persists (or is anticipated to persist) for at least a few decades, and causes substantial disruptions in human and natural systems.

This report considers progress in understanding four types of abrupt change in the paleoclimatic record that stand out as being so rapid and large in their impact that if they were to recur, they would pose clear risks to society in terms of our ability to adapt: (1) rapid change in glaciers, ice sheets, and hence sea level; (2) widespread and sustained changes to the hydrologic cycle; (3) abrupt change in the northward flow of warm, salty water in the upper layers of the Atlantic Ocean associated with the Atlantic Meridional Overturning Circulation (AMOC); and (4) rapid release to the atmosphere of methane trapped in permafrost and on continental margins.

This report reflects the significant progress in understanding abrupt climate change that has been made since the report by the National Research Council in 2002 on this topic, and this report provides considerably greater detail and insight on these issues than did the 2007 Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4). New paleoclimatic reconstructions have been developed that provide greater understanding of patterns and mechanisms of past abrupt climate change in the ocean and on land, and new observations are further revealing unanticipated rapid dynamic changes of moderns glaciers, ice sheets, and ice shelves as well as processes that are contributing to these changes. This report reviews this progress. A summary and explanation of the main results is presented first, followed by an overview of the types of abrupt climate change considered in this report. The subsequent chapters then address each of these types of abrupt climate change, including a synthesis of the current state of knowledge and an assessment of the likelihood that one of these abrupt changes may occur in response to human influences on the climate system.

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