New report calls for attention to abrupt impacts from climate change

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Climate change has increased concern over possible large and rapid changes in the physical climate system, which includes the Earth's atmosphere, land surfaces, and oceans. Some of these changes could occur within a few decades or even years, leaving little time for society and ecosystems to adapt. A new report from the National Research Council extends this idea of abrupt climate change, stating that even steady, gradual change in the physical climate system can have abrupt impacts elsewhere—in human infrastructure and ecosystems for example—if critical thresholds are crossed. The report calls for the development of an early warning system that could help society better anticipate sudden changes and emerging impacts.

"Research has helped us begin to distinguish more imminent threats from those that are less likely to happen this century," said James W.C. White, professor of geological sciences at the University of Colorado, Boulder, and chair of the committee that wrote the report. "Evaluating climate changes and impacts in terms of their potential magnitude and the likelihood they will occur will help policymakers and communities make informed decisions about how to prepare for or adapt to them."

Abrupt climate changes and impacts already under way are of immediate concern, the report says. These include the disappearance of late-summer Arctic sea ice and increases in extinction rates of marine and terrestrial species.

Other scenarios, such as the destabilization of the west Antarctic ice

sheet, have potentially major consequences, but the probability of these changes occurring within the next century is not well-understood, highlighting the need for more research.

In some cases, scientific understanding has progressed enough to determine whether certain high-impact climate changes are likely to happen within the next century. The report notes that a shutdown in the Atlantic Ocean circulation patterns or a rapid release of methane from high-latitude permafrost or undersea ice are now known to be unlikely this century, although these potential abrupt changes are still worrisome over longer time horizons.

But even changes in the physical climate system that happen gradually over many decades or centuries can cause abrupt ecological or socio-economic change once a "tipping point" is reached, the report adds. For example, relatively slow global sea-level rise could directly affect local infrastructure such as roads, airports, pipelines, or subway systems if a sea wall or levee is breached. And slight increases in ocean acidity or surface temperatures could cross thresholds beyond which many species cannot survive, leading to rapid and irreversible changes in ecosystems that contribute to further extinction events.

Further scientific research and enhanced monitoring of the climate, ecosystems, and social systems may be able to provide information that a tipping point is imminent, allowing time for adaptation or possibly mitigation, or that a tipping point has recently occurred, the report says.

"Right now we don't know what many of these thresholds are," White said. "But with better information, we will be able to anticipate some major changes before they occur and help reduce the potential consequences." The report identifies several research needs, such as identifying keystone species whose population decline due to an abrupt change would have cascading effects on ecosystems and ultimately on

human provisions such as food supply.

If society hopes to anticipate tipping points in natural and human systems, an early warning system for abrupt changes needs to be developed, the report says. An effective system would need to include careful and vigilant monitoring, taking advantage of existing land and satellite systems and modifying them if necessary, or designing and implementing new systems when feasible. It would also need to be flexible and adaptive, regularly conducting and alternating between data collection, model testing and improvement, and model predictions that suggest future data needs.

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