

## Topics (T)

Earth Observing Missions and Systems to Address Climate Change and Its Impacts [1] (3A)

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## ENTERING THE THIRD DECADE OF GLOBAL MASS CHANGE OBSERVATIONS: CLIMATE AND APPLICATIONS CONTRIBUTIONS FROM GRACE, GRACE-FO AND BEYOND

**Abstract**

Many of today's most pressing climate challenges and their impacts on society hinge on having accurate and current knowledge of how water is moving on Earth – and where it is stored in abundance, and where it is scarce. Since 2018, the GRACE Follow-On twin-satellites continue the essential climate data record of Earth system mass change initiated by the GRACE mission (2002-2017). The combined GRACE (2002-2017; NASA/DLR) GRACE-FO (NASA/GFZ) data records now span 21 years, providing unique observations of monthly to decadal global mass changes and transport in the Earth system derived from variations in the Earth's gravity field. These observations are a core component of GCOS's Essential Climate Variables, and have become indispensable for climate-related studies that enable process understanding of the evolving global water cycle, including ocean dynamics, polar ice mass changes, and near-surface and global ground water changes. Mass Change data support monitoring of flood potential and droughts to track groundwater and aquifer volume changes, and to inform freshwater availability, irrigation, and data-driven agriculture practices.

In this presentation, we will provide updates on contributions, capabilities, and applications from the 'smart water meters' GRACE through GRACE-FO over the last 21 years, such as changes of ice sheet mass, sea level and ocean heat content, as well as land water storage trends. As the Earth's water cycle becoming more unstable and extreme, the increasing length and continuity of the Mass Change data record is essential to accurately measure potential tipping point events (e.g., rapid ice sheet melt), and aquifer and water storage recharge (e.g., in response to extreme precipitation).

The scientific evidence continues to mount that the consequences of climate change extend into the very core of the political and security agendas and drives flood, disease, famine, economic disruptions, and migrations on unprecedented scales, often in regions of the world that are already under pressure. The 2017-2027 US National Academy of Sciences Decadal Survey for Earth Science and Applications from Space identified Mass Change as a foundational Designated Observable to better understand the Earth system over the next decades, and to supply critical data for applications, adaptation, and mitigation. A core component of NASA's Earth System Observatory, the Mass Change project is targeting a mission launch in late 2027, jointly with its European partners. We will provide an update in the project, and discuss its planned capabilities and goals for climate research and applications.