IMPROVING CLOUD REPRESENTATION FOR MORE RELIABLE CLIMATE PROJECTIONS

MARENOSTRUM5 GPP

Led by



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1 WHY DO CLOUDS MATTER FOR CLIMATE PROJECTIONS?

Climate change is increasing the **risks** associated with heatwaves, heavy rainfall and other **extreme weather events**



Clouds play a key role in regulating Earth's climate by influencing how much solar energy reaches the surface and how much heat escapes into space

Representing them accurately is therefore essential for **improving climate projections**



Reliable climate projections are crucial for developing effective adaptation and **mitigation strategies**

WHY ARE CLOUDS SO CHALLENGING TO MODEL? 2

Clouds are **a major source of uncertainty** in climate projections

Mixed-phase clouds are especially difficult to model because they contain **both liquid water and ice crystals**

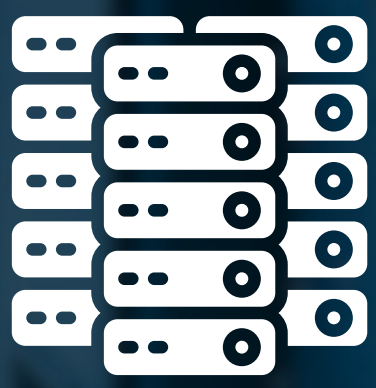
Ice formation can be initiated by **tiny atmospheric particles** that provide a surface for **ice crystals to form**, followed by processes that generate **more crystals** from the initial ones

These processes are **hard to predict** and strongly affect cloud development

3 HOW DID HPC RESOURCES HELP?

Understanding these complex processes requires simulations that capture **interactions between atmospheric particles and clouds** over long periods





HPC made it possible to run **hundreds of high-resolution climate simulations** that would have been unfeasible with conventional computers

These simulations were essential for improving the way **cloud formation and ice production** are represented in climate models



4 WHAT DID THE SIMULATIONS REVEAL?

The simulations provided insights into **how ice formation and multiplication** within clouds can be **better represented** in climate models

They also showed that the **importance of processes** such as ice formation, sedimentation, and transport **differs among climate models**

These findings highlight the **complexity of mixed-phase clouds** and the need to represent them **more accurately**

Ultimately, this work helps **reduce uncertainties** in climate projections and **improve our understanding** of future climate



Image. Montserrat Costa-Surós presenting project results at the EGU General Assembly 2026 (06/05/26) in Vienna.

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