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ICON Community Interface (ComIn) - An infrastructure overview

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Numerical modeling has a long history in climate and weather forecasting, with advancements being made continually over the last century due to technological progress. In the early 2000s, the development of ICON as an icosahedral grid-based, nonhydrostatic model started. It is Germany's primary model for weather predictions and climate studies (https://www.icon-model.org/). ICON is a flexible, high-performance modelling framework that enhances our understanding of Earth's climate system, providing critical data for societal use. In technical terms, the ICON model constitutes a sophisticated software package designed to function on massively parallel hardware. Currently, ICON development impacts approximately 1.5 billion people globally with its numerous applications, and more than 200 developers actively contribute to the project.

A major milestone in January 2024 was the transition of ICON into an open source software. This allows scientists to contribute their own codes as separate modules, greatly increasing ICON's versatility. However, certain limitations remain: The fact that ICON was originally programmed in Fortran presents some challenges, and integrating changes into ICON can be a difficult and lengthy process. This is most pronounced due to its use for operational numerical weather prediction, which imposes severe restrictions on runtime. These limitations fuelled the need for a standardized long term solution and recently, a team of ICON developers introduced an innovative Community Interface for ICON (ComIn). The objective of ComIn is to simplify the interaction with external software, so-called plugins, to further enhance ICON predictions and to significantly reduce maintenance efforts. Plugins can range from individual routines, e.g. diagnostics or physical parameterizations, to Earth System model components, e.g. atmospheric chemistry and land models.

This ICON-ComIn infrastructure has multifold benefits:
1. During ICON runtime, plugin's functions can be called from fixed locations within ICON via ComIn.
2. ComIn also provides access to ICON data and metadata, as well as the option to create addtional ICON data.
3. By providing APIs for Fortran, C/C++ and Python, ComIn bridges legacy code in Fortran with more "modern" Python-based developments.

In this talk we will present the motivation behind the standardised interface for ICON and provide an in-depth examination of the details of ComIn's infrastructure. Additionally, we will introduce diverse ComIn use cases and present first results from a complex plugin, which drove innovation and development in ComIn. In summary, we will introduce the audience to a modern and innovative software infrastructure from the climate and weather domain.

I want to participate in the youngRSE prize

yes

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