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## **GRACEFUL: Probing the deep Earth interior by synergistic use of observations of the magnetic and gravity fields, and of the rotation of the Earth**

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To understand the processes involved in the deep interior of the Earth and explaining its evolution, in particular the dynamics of the Earth's fluid iron-rich outer core, only indirect satellite and ground observations are available. They each provide invaluable information about the core flow but are incomplete on their own:

- The time dependent magnetic field, originating mainly within the core, can be used to infer the motions of the fluid at the top of the core on decadal and subdecadal time scales.
- The time dependent gravity field variations that reflect changes in the mass distribution within the Earth and at its surface occur on a broad range of time scales. Decadal and interannual variations include the signature of the flow inside the core, though they are largely dominated by surface contributions related to the global water cycle and climate-driven land ice loss.
- Earth rotation changes (or variations in the length of the day) also occur on these time scales, and are largely related to the core fluid motions through exchange of angular momentum between the core and the mantle at the core-mantle boundary.

Here, we present the main activities proposed in the frame of the GRACEFUL ERC project, which aims to combine information about the core deduced from the gravity field, from the magnetic field and from the Earth rotation in synergy, in order to examine in unprecedented depth the dynamical processes occurring inside the core and at the core-mantle boundary.