Abstract: The intensity of Earth's magnetic field, which forms an important shield for our habitat, drops dramatically during geomagnetic excursions and reversals (termed GERs). The Laschamps excursion (~41 000 years ago) occurred during profound climatic changes, possibly leading to drastic effects on the biosphere. While impacts of GERs on the atmosphere can be expected, the magnitude, time scales, and even the direction/sign of effects on our habitat are unknown. The significantly weakened magnetic field shrinks the magnetosphere, enhancing energetic particle fluxes from outer space to the middle and lower atmosphere and even ground. The impact of GERs on the energetic particle precipitation from the magnetosphere is also unknown. The dynamics of near-Earth space and the atmosphere during GERs and their potential impacts have not yet been addressed in full complexity, due to a lack of reliable data, precise models and interdisciplinary approaches. We will unravel key dynamics and connect physical processes during GERs and establish their environmental consequences by synergistically bringing together expertise from palaeomagnetism, magnetospheric, solar, heliospheric, atmospheric physics and climate. We will combine new data-based geomagnetic field models with state-of-the-art magnetospheric, atmospheric, and global Earth-system models for a complete process view. Expected breakthroughs will include new knowledge on the very existence and structure of the magnetosphere and radiation belts, radiation fields and ionization patterns in the atmosphere, and induced physical, chemical and dynamical effects and climate responses during GERs. Further emphasis will be put on potential hazards for our technological society during a potential future GER. GERACLE will go far beyond the current state–of–the–art, provide ground-breaking advances, and form a new paradigm of the consequences of past and yet unexplored GER events for our habitat and the impacts of possible future GERs.

More info: https://cordis.europa.eu/project/id/101166910