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GENESIS-1 mission for improved reference frames and Earth science applications.

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Improving and homogenizing time and space references on Earth and, more directly, realizing the terrestrial reference system with an accuracy of 1 mm and a long-term stability of 0.1 mm/yr are relevant for many scientific and societal endeavours. The knowledge of the terrestrial reference frame (TRF) is fundamental for Earth system monitoring and related applications. For instance, quantifying sea level change strongly depends on an accurate determination of the geocenter motion but also of the position of continental or island reference stations, such as those located at tide gauges, as well as the ground stations of the tracking networks. Also, numerous applications in geophysics require absolute millimetre precision from the reference frame, as for example monitoring tectonic motion or crustal deformation for predicting natural hazards. The TRF accuracy to be achieved (mentioned above) represents the consensus of various authorities, including the International Association of Geodesy, which has enunciated geodesy requirements for Earth science (see GGOS-2020). Moreover, as stated in the A/RES/69/266 United Nations Resolution: "A global geodetic reference frame for sustainable development", the UN recognizes the importance of "the investments of Member States in developing satellite missions for positioning and remote sensing of the Earth, supporting a range of scientific endeavours that improve our understanding of the Earth system and underpin decision-making, and... that the full societal benefits of these investments are realized only if they are referenced to a common global geodetic reference frame at the national, regional and global levels". These strong statements by

international bodies underline that a dedicated mission is highly needed and timely. Today we are still far away from this ambitious goal. It can be achieved by combining and co-locating, on one satellite platform, the full set of fundamental space-time geodetic systems, namely GNSS and DORIS radio satellite tracking systems, the satellite laser ranging (SLR) technique, and the very long baseline interferometry (VLBI) technique, that currently operates by recording the signals from quasars. This platform can then be considered as a dynamic space geodetic observatory carrying all these geodetic instruments referenced to one another on a unique well-calibrated platform through carefully measured space ties and a very precise atomic clock. It is necessary to set up a co-location of the techniques in space to resolve the inconsistencies and biases between them. Such a mission will be proposed as the first one of a series of missions in the GNSS/NAV Science Programme. The purpose of this abstract/talk is to revive the support of the scientific community for this mission.