How to improve the International Terrestrial Reference Frame?

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Abstract: Plate tectonics, earthquakes, ice melting and so on, are constantly deforming the Earth's surface. How can scientists observe and study those processes using spatial data if the Earth is rotating and globally deforming over time? We need a universal reference that allows us to locate and compare data, no matter where and when it is recorded. The reference recommended by the International Earth Rotation and Reference Systems Service (IERS) for the geo-scientific community that needs precise positioning, is the International Terrestrial Reference System (ITRS). It is an ideal spatial reference system co-rotating with the Earth; its origin is the center of mass of the Earth, its orientation is conventional and its unit of length is the meter. The numerical realization of such a system is a reference frame. Thus, the ITRS realization is called the International Terrestrial Reference Frame (ITRF). It can be seen as a polyhedron of stations that discretize the Earth's surface, where a station is a geodetic instrument. Nowadays, the ITRF model used to describe the time evolution of station positions is a piecewise linear model. However, the Earth's surface does not deform linearly and this simplification has limits for certain applications such as the study of sea level. To reach the required level of precision, a paradigm change might be needed. Would it be relevant to consider a reference frame in the form of time series? Such a frame would in principle allow to fit to the instantaneous shape of the Earth, but is it achievable considering the errors of spatial geodetic techniques?

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