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A Wish List for Updating PREM: Lessons we learnt

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It has been several years since a workshop held in La Jolla started the discussion on the needs and strategies to compile a new Reference Earth Model (REM). Initially, coming up with a new Reference Earth Model appeared to be an easy task. After all, the quality and quantity of constraining data have increased tremendously since PREM, the Preliminary REM, was published in 1981. Yet, despite considerable efforts and additional workshops, the new REM remains somewhat elusive. This talk summarizes some of the issues involved, progress that has been made and recommendations for the European reference model.

To start with, the community has to agree on what a REM should be. Seismologists tend to search for a model to fit an average of a specific dataset or groups thereof. This model may or may not represent the true average structure that is sought by other geoscientists who wish to use a physically consistent REM for their purposes. On global scale, many seismic datasets are weighted heavily toward sampling continental areas and a true spherical Earth model may not be easy to obtain without modeling simultaneously Earth's 3-dimensional structure. As normal mode and surface wave data are measured more accurately, the need for a transversely isotropic model becomes quite evident, especially for the upper mantle. Though data may be too sparse to constrain a global average, body wave data do suggest that the new REM should also include a transversely isotropic D" layer. Last but not least, the inner core is anisotropic and discussions remain on just how many recently discovered features (e.g. an inner core boundary) should appear in the new REM.

Though the asthenosphere may be a global feature it is hotly debated whether the new REM should include a low velocity zone that would complicate the calculation of body wave travel times. It also remains unclear which mantle discontinuities should be included. The 520 is a physical discontinuity but does not seem to stand out as a

uniform global seismic discontinuity such as the 410 or the 660. The 220 has been seen beneath continents but also does not appear to be a global discontinuity. In PREM, the 220 served as truncation limit for upper mantle anisotropy but perhaps there are better ways to parameterize this. Finding the most optimal parameterization for the new REM is subject of ongoing research but it is becoming clear that preference should be given to a set of local basis functions (e.g. B-splines or layers).

Not to be underestimated is the understanding that compiling a REM is a community effort. A group of investigators may lead the initiative but the success of compiling a REM depends on the acceptance of this group and the willingness of all to share data, preliminary models, computer codes and ideas.