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Spherical and Ellipsoidal Harmonic Field Transformation based on FFT

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High resolution transformations (synthesis and analysis) between regular geophysical data and harmonic model coefficients can be most efficiently computed by fast Fourier methods (FFT). Prerequisite however is the data to be given in the corresponding geometrical domain.
If the data are e.g. situated on the ellipsoid at equiv-spaced, reduced latitudes ellipsoidal harmonics can be employed and subsequently converted by Jekeli's transformation into spherical harmonic coefficients in the domain of geocentric latitudes. But the data are most likely given at geodetic latitudes where the FFT base would then need to be shifted by latitude dependent phase lags. This results in (appropriate) re-sampling that demands for Fourier summation and cannot be treated by FFT.
Alternatively, the linearization about the derivatives of the respective geopotential functional w.r.t. latitude can be used, that preserves the computational advances of FFT, but does not always converge quickly enough.
Another solution is discussed instead. The data are given on the ellipsoid at regular geocentric latitudes. They can be directly transformed by means of spherical harmonics if the variable heights to the reference sphere and the resulting signal attenuation are directly convolved into the constituents of the spherical harmonic base functions by means of a fast convergent series of Tschebysev polynomials. By subtracting this solution from the solution obtained in ellipsoidal harmonics the differential from the changeover between geocentric and reduced latitudes is obtained. A similar step, now being from reduced to geodetic latitudes, then resembles in an equivalent difference.