Development of a parallel spherical harmonic transform library: design and performance

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The spherical harmonic transform (SHT) is a typical method to describe the dynamical core in climate models (e.g. MIROC). SHT is a combination of two transformation: a Fourier transformation in longitude and an associate Legendre transformation in latitude. Therefore, a simple way to introduce SHT in parallel computing is to apply domain decomposition in latitudes only, involving a relocation in latitudes before/after the Legendre transformation. However, the number of maximum processors is limited by the size of latitude dimension, which is an obstacle to more efficient computing. Recently the `physics' routines in a climate model have become more and more complex and expensive, thus the heavy computation significantly suffers from the limitation. A new (yet-another) library, Flageolet, has been developed to help parallel processing of SHT in particular for climate models like MIROC, to support more flexible domain decomposition, following the approach adopted in several 3D FFT libraries and also some climate models. As a continuation of last-year's presentation, which reports the design and performance of FFT part, those of SHT part as well as transposition part between FFT and ALT are reported in this study for various sizes of domain around T213 etc, examined on the Earth simulator.

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