Self-phase modulation of spherical gravitational wavepackets propagating in a flat space-time in the presence of a tenuous distribution of matter is considered. Analogies with respect to similar effects in nonlinear optics are explored. Self phase modulation of waves emitted from a single source can eventually lead to an efficient energy dilution of the gravitational wave energy over an increasingly large spectral range. An explicit criterium for the occurrence of a significant spectral energy dilution is established.