Daylight simulation for generic environments involves visibility computations from an infinite area light source (the sky). In order to obtain accurate results, this task tends to be very time consuming and also requires a good model discretization that is not automatically done in general. This paper presents a daylight simulation method for interactive direct lighting visualization that performs adaptive mesh subdivision. In a first step, the visibility of the scene is computed from the sky by means of hardware parallel projections and occlusion queries. Visibility values at receiver surfaces serve to guide the subdivision of the scene using an iterative process, resulting in a final adaptive mesh where each element stores visibility from a set of hemispherical directions. Lighting visualization is then performed at interactive frame rates for any day-time condition, taking advantage of the precomputed visibility. The main contribution of our method is that it provides a fast automatic adaptive mesh operation over the model according to visibility values. In this way, no pre-meshed models are required, making the method well suited for generic environments such as indoors or outdoors of buildings and urban models. We show that our mesh subdivision method is also useful as an optimal input model for other lighting visualization techniques like Precomputed Radiance Transfer or a global illumination radiosity solver.