Abstract. Let $\mathcal{M}$ be the space of properly embedded minimal surfaces in $\mathbb{R}^3$ with genus zero and two limit ends, normalized so that every surface $M \in \mathcal{M}$ has horizontal limit tangent plane at infinity and the vertical component of its flux equals one. We prove that if a sequence $\{M(i)\}_i \subset \mathcal{M}$ has the horizontal part of the flux bounded from above, then the Gaussian curvature of the sequence is uniformly bounded. This curvature estimate yields compactness results and the techniques in its proof lead to a number of consequences, concerning the geometry of any properly embedded minimal surface in $\mathbb{R}^3$ with finite genus, and the possible limits through a blowing-up process on the scale of curvature of a sequence of properly embedded minimal surfaces with locally bounded genus in a homogeneously regular Riemannian 3-manifold.