& Olsson (1993), Nielsen (1993), is very powerful in revealing the degree and directions of anisotropy of the variables under study and also in its depiction of range of influence and nugget effect. The circles in Figure 1.1 are the ordinary 1-D lag limits for averaging in the magnitude of $\boldsymbol{h}$.

1.3.1 2-D Semivariogram Models

In this section I introduce several anisotropy models, an elliptic cone model, single and multiple elliptic spherical models, all with nugget effect. The multiple spherical models allow for range and sill anisotropy and for nested or un-nested spheres. All these models are intended for use with small lags and are not meant to describe the long range spatial behavior of the phenomena under study. Similar models are hinted in Isaaks & Srivastava (1989). The models presented allow for neither nugget effect anisotropy, periodicity nor non-linear behavior for $|\boldsymbol{h}| \to 0$. The parameters in these models can be estimated by means of iterative, non-linear least squares methods from the experimental semivariograms. It might be possible to estimate them directly from the data also.

An Elliptic Cone Model

The linear model with nugget effect is one of the simplest 1-D semivariogram models traditionally in use. A natural extension of this model into 2-D is a cone. If we want the ability to detect range of influence anisotropy (also known as geometric as opposed to zonal anisotropy) we must apply an elliptic cone. A sketch of this model is shown in Figure 1.2.

The equation for the elliptic cone is

$$(\frac{x_1}{a_1})^2 + (\frac{y_1}{b_1})^2 - (\frac{\gamma^* - c_0}{c})^2 = 0 \tag{1.20}$$

where x_1 and y_1 are the Cartesian coordinates of the displacement vector $\boldsymbol{h}$ in a coordinate system with x- and y-axes parallel to the major and minor axes

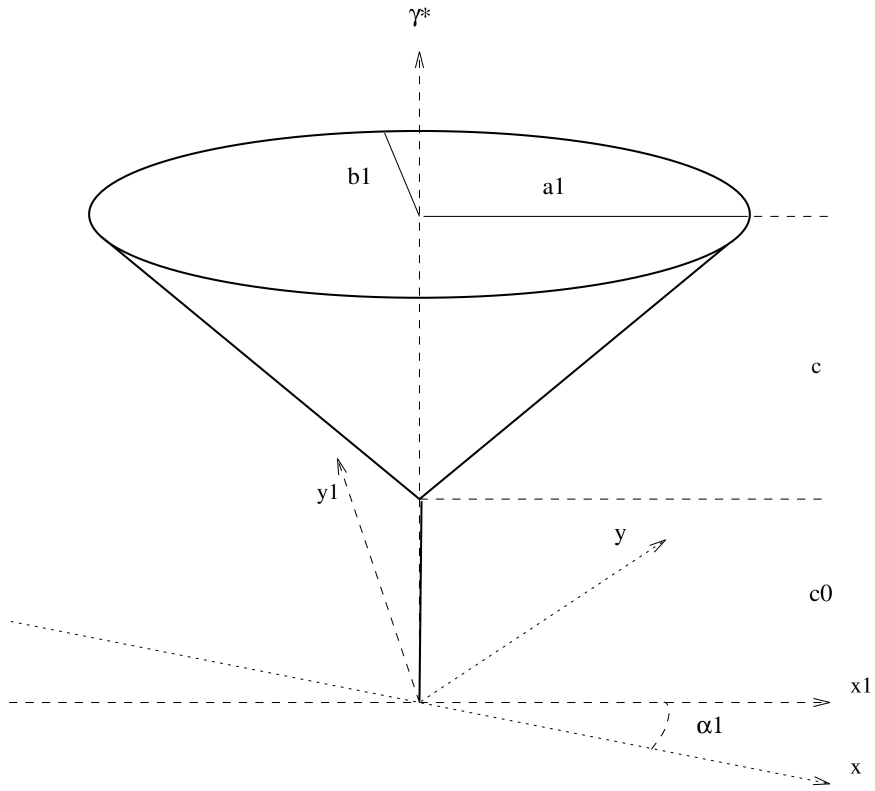

Figure 1.2: Sketch of elliptic cone 2-D semivariogram model