4.1 SENSITIVITY OF THE MODEL:

A sensitivity analysis provides a formalised means for checking the behaviour of the model under a variety of conditions. It allows the users to gauge the sensitivity of the model to each input parameter, and thereby emphasising those input parameters which need to be most accurately measured. It also provides benchmark values against which user may check their models.

Rao and Pasha (1993) carried out the sensitivity analysis of Gaussian Plume model (GPM) under different wind speeds. The study concluded that wind speed could considerably influence the model result and identified critical velocities for thermal power plants under different stability condition.

In the Indian context, Shirvaikar and Kapoor (1989) studied sensitivity analysis of the GPM under data uncertainty in a comprehensive framework. They have studied uncertainty due to fluctuating meteorology related variable like stability, plume rise, temperature, wind speed etc. Wind direction, stability category, plume rise estimation, dispersion coefficient were identified as critical parameters.

Aggrawal, A. (2011) have done sensitivity of CALINE4 under mixed traffic condition for Delhi and concluded that wind speed and direction have a great effect on pollution concentration and the regression analysis of worst case prediction and observed concentration was found to be 0.76.

In this study, sensitivity analysis of the CALINE4 model to various input parameter is carried out. While determining the sensitiveness of different parameter, worst case prediction is considered. Minimum wind speed of 0.5 meters/sec, mixing height 400, traffic volume is considered as 20000 at Kohora and maximum weighted emission factor for Kohora was considered (2.9546 g/mile). Here contribution of variation of one parameter
at a time was considered for characterizing the overall sensitivity of the model.

**4.2 SENSITIVITY OF SOURCE STRENGTH:**

The source strength used for the model CALINE4 is the product of vehicle emission factor and the traffic volume. So, the model is used to compute for both the parameter traffic volume and emission factor and predicted the values of CO are shown in figure 4.1 and 4.2. The predicted values of CO concentration are directly proportional to source strength. A similar observation was made by Benson P. E. (1989).

![Figure 4.1: Source strength (Traffic Volume) V/S CO concentration](image1)

![Figure 4.2: Source Strength (Emission Factor) v/c CO concentration](image2)
4.3 SENSITIVITY TO WIND SPEED:

As the wind speed increases the pollutant spread faster in the atmosphere. Thus the concentration of the pollutant at a particular location decreases as the wind speed increases. The model is run with the traffic volume 20000 and emission factor 2.9546 grams per vehicle per mile for Kohora monitoring station to predict the concentration of CO for different wind speed. The predicted values obtained are shown in figure 4.3 which reflects the decreasing trend of CO with increasing wind speed. A similar observation is also made by Bratterman et.al., (2010).

![Figure 4.3: Wind speed (m/s) V/S CO concentration (ppm)](image)

4.4 SENSITIVITY TO WIND ANGLE:

For sensitivity analysis wind angle was varied from $0^\circ$ to $300^\circ$. The computed concentrations are shown in the figure. The model is found to be sensitive to the wind angle. Figure 4.4 shows the change in concentration of CO concentration in Kohora with different wind angle. Agrawal, A., (2011) suggested that for every $5^\circ$ increase in the wind angle average 8% change in the CO concentration when the receptor distance is within 2 meters. The observation of the present work is in agreement with the result of Agrawal A., (2011).
4.5 SENSITIVITY TO MIXING HEIGHT:

The model is used to compute for Kohora monitoring station for different mixing height and results are plotted in figure 4.5. The mixing height plays an important role in the vertical dispersion of pollutant. The model sensitivity to the mixing height is only significantly for extremely low values (50 meters). The variation is significant up to 50 meters beyond that variation of mixing height is insignificant. The response of the model from 50 meters to 500 meters is almost same. This is essential because of the small amount of vertical dispersion that can take place (under stable condition) within the limit of micro-scale region (Bension, P. E. 1989, Batterman et al., 2010). Sahlodina et al., (2007) also concluded that mixing height has no significant effect on the concentration of pollutant.
4.6 SENSITIVITY TO SURFACE ROUGHNESS:

An increase in the surface roughness increases the amount of mechanical turbulence generated. This enhances both vertical and horizontal dispersion of pollutants in the surface layer, especially near to the ground releases. For sensitivity analysis, surface roughness was varied from cm to 300 cm. But it has been found that for very small values less than 10 cm it has a minor effect. Figure 4.6 shows the different values obtained against the surface roughness. Sahlodina, et al., (2007) and Sripraparkorn, et al., (2003) had done the sensitive analysis of CALINE4 model and found that surface roughness had no or very little effect on pollutant concentration.

![Figure 4.6: Sensitivity to Surface Roughness](image)

4.7 SENSITIVITY TO RECEPTOR HEIGHT:

Kaziranga National Park is a natural habitat of different types of endangered animal and plants. So, the model sensitivity is also carried out from 0.2 meters to 20 meters at Kohora monitoring station. The results are shown in figure 4.7. It was observed that up to 1.5 m of receptor height there was very little change in pollution concentration but after that, to 8 meters there was a sharp change in concentration and thereafter it decreased slowly.
4.8 SENSITIVITY TO ROAD WIDTH:

The model CALINE 4 is sensitive with the road width. The model is used to compute for road width from 10 meters to 50 meters and predicted the concentration of CO is plotted in figure 4.8. It is observed that as the road width increases pollution concentration decreases.

From the sensitivity analysis, it is observed that model CALINE4 used in the present study is working satisfactorily. The sensitivity of the model showed that model output is dependent on the parameters like emission factor, traffic volume, and wind speed and direction stability class. So, these parameters must be applied to the model very carefully.