Subject: Re: gaussian air dispersion model
Posted by Mark Hadfield on Tue, 29 Nov 2005 04:00:18 GMT
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guillaume.drolet.1@ulaval.ca wrote:
>> If the distances in question are
>> small you can get away with
>
>
>> sigma-y = sigma-theta * x
>
>
> Are distances between 500 and 1500 m considered small?

Damn, I hoped you weren't going to ask!

I'm reaching way back into my memory banks here. The short answer is that 500 to 1500 m is probably small enough that the above formula will be an overestimate, but good enough to get started with. The long answer is that the distance at which the growth of sigm-y starts to drop away from the linear formula depends on the correlation time scales of the cross-wind turbulent fluctuations. You can estimate the Eulerian time scale from your anemometer. The problem is that what you really want is the time scale for the fluctuations experienced by a Lagrangian particle (ie one moving with the wind) and these will generally be longer. There is a lot of info about this in the literature so you should eventually be able to come up with reasonable values. Right now I suggest you use the linear relation.

> Yes. Since the mean wind direction for a 30-minute period comes from
> high frequency measurements (10 Hz), I should be able to get
> sigma-theta.

Good.

> You are right. I definitely need to do some reading and maybe I posted
> in the wrong forum.

No worries. I just did a quick search on Google Scholar and came up with the following. It's rather old and has an urban focus rather than an agricultural one, but it might help...

Applied dispersion modelling based on meteorological scaling parameters.
Gryning, S E | Holtslag, A A M | Irwin, J S | Sivertsen, B |
Atmospheric Environment. Vol. 21, no. 1, pp. 79-89. 1987

A method for calculating the dispersion of plumes in the atmospheric boundary layer is presented. The method is easy to use on a routine basis. The inputs to the method are fundamental meteorological parameters, which act as distinct scaling parameters for the turbulence. The atmospheric boundary layer is divided into a number of regimens. For each scaling regime the authors suggest models for the dispersion in the vertical direction. The models directly give the crosswind-integrated concentrations at the ground, chi sub(y), for non-buoyant releases from a continuous point source. Generally the vertical concentration profile is proposed to be other than Gaussian. The lateral concentration profile is always assumed to be Gaussian, and models for determining the lateral spread sigma sub(y) are proposed. The method is limited to horizontally homogeneous conditions and travel distances less than 10 km. The method is evaluated against independent tracer experiments over land. The over land. The overall agreement between measurements and predictions is very good and better than that found with the traditional Gaussian plume model.

Descriptors: atmosphere | boundary layers | meteorology | pollutant dispersion; mathematical models | atmospheric conditions |

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