
Subject: Re: gaussian air dispersion model
Posted by [Kenneth P. Bowman](#) on Thu, 24 Nov 2005 21:41:34 GMT
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In article <1132850938.403782.225280@o13g2000cwo.googlegroups.com>, guillaume.drolet.1@ulaval.ca wrote:

> Since I do almost all my work with IDL, I am looking for IDL ways of
> estimating along-wind distances of the footprints using a gaussian
> dispersion model (functions, procedures, etc.). I don't have a strong
> background in physics so I need some solutions I will understand. My
> background is mostly in forest sciences and remote sensing and I do a
> lot of programming.

This sounds like a pretty big problem. I think what you really need is a collaborator who can spend the necessary time with you.

Ken Bowman

Subject: Re: gaussian air dispersion model
Posted by [Mark Hadfield](#) on Thu, 24 Nov 2005 23:34:03 GMT
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Kenneth P. Bowman wrote:

> In article <1132850938.403782.225280@o13g2000cwo.googlegroups.com>,
> guillaume.drolet.1@ulaval.ca wrote:

>

>

>> Since I do almost all my work with IDL, I am looking for IDL ways of
>> estimating along-wind distances of the footprints using a gaussian
>> dispersion model (functions, procedures, etc.). I don't have a strong
>> background in physics so I need some solutions I will understand. My
>> background is mostly in forest sciences and remote sensing and I do a
>> lot of programming.

>

>

> This sounds like a pretty big problem.

Maybe. In a previous life I worked in pollution dispersion etc and am familiar with Gaussian dispersion models. In their simplest form they are semi-analytical expressions for concentration as a function of spatial coordinates (x, y, z). They model a plume as having a Gaussian profile in cross-wind (conventionally y, or is it x? I forget) and vertical (z) directions. They normally achieve their simplicity by neglecting plume growth in the alongwind direction (x) and also shear. I say *semi* analytical because the basic Gaussian plume expression is analytical and not very complicated, but it involves parameters sigma-y

and sigma-z that are functions of downwind distance, and those functions might be implemented as piecewise polynomial expressions of look-up tables or (in my day) graphs on paper.

Tell us more, Guillaume, about which bits you need help with. Your basic Gaussian plume model can be implemented as a function of x, y and z and containing just one line of code. This will contain references to your sigma-y and sigma-z, which will be implemented as functions of x, using whatever method you consider best. Calculating the ground-level concentration is then straightforward and then you might want to contour it to establish the horizontal extent of the footprint? That last bit requires a bit of IDL-specific knowledge, but it can be done.

--

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Subject: Re: gaussian air dispersion model
Posted by [guillaume.drolet.1](#) on Fri, 25 Nov 2005 17:28:28 GMT
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Hi Mark,

The following comes from N. Kljun. She developed the footprint model:

"...you'll get the along-wind extent, but it's a crosswind-integrated model (no y-information).
the full model gives you the y-information, but is not easy to be applied and it will be extremely time-consuming to run it for that many cases as you will have to.
it'll be easier to estimate the y-extent using a simple gaussian dispersion function."

I'm sorry, I made a mistake in my first post: I need to estimate the 'across-wind' extent (y-extent), and NOT the 'along-wind' (x-extent), which will be given by the model.

For this simple model, the following inputs are needed:

zm = Measurement height [m]
znot = Roughness length [m]
h = Boundary layer height [m]
sigmaw = sigmaw [m s-1]
ustar = u* [m s-1]
r = Percentage to be included [%]

Some inputs are available from flux towers measurements (zm, sigmaw, ustar) while others are estimates (znot, h). The outputs are:

xmax: location of maximum influence for the location
xr : distance from receptor which include r% of the area contributing to the measured flux.

Is that enough information? For more details on the model, see:
<http://footprint.kljun.net>

Thanks again.

Gui

Subject: Re: gaussian air dispersion model
Posted by [Mark Hadfield](#) on Mon, 28 Nov 2005 01:27:25 GMT
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guillaume.drolet.1@ulaval.ca wrote:

> Hi Mark,
>
> The following comes from N. Kljun. She developed the footprint model:
>
> "...you'll get the along-wind extent, but it's a crosswind-integrated
> model (no y-information).
> the full model gives you the y-information, but is not easy to be
> applied and it will be extremely time-consuming to run it for that many
> cases as you will have to.
> it'll be easier to estimate the y-extent using a simple gaussian
> dispersion function."
>
> I'm sorry, I made a mistake in my first post: I need to estimate the
> 'across-wind' extent (y-extent), and NOT the 'along-wind' (x-extent),
> which will be given by the model.

So are you going to estimate the cross-wind-integrated ground level concentration with the footprint model and the across-wind variation in concentration with a gaussian function? In which case you will need an estimate of across-wind width vs downwind distance (sigmay as a function of x). How are you going to estimate that?

> For this simple model, the following inputs are needed:
>
> zm = Measurement height [m]
> znot = Roughness length [m]

- > h = Boundary layer height [m]
- > sigmaw = sigmaw [m s-1]
- > ustar = u^* [m s-1]
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- > Some inputs are available from flux towers measurements
- > (zm,sigmaw,ustar) while others are estimates (znot,h). The outputs are:
- >
- > xmax: location of maximum influence for the location
- > xr :distance from receptor which include r% of the area contributing
- > to the measured flux.

By "this simple model" you mean the footprint model, right?

- > Is that enough information? For more details on the model, see:
- > <http://footprint.kljun.net>

I've looked at the URL, but not read the paper. It sounds like the footprint model is a simple set of formulae. Do you plan to implement this in IDL? Shouldn't be too hard.

So where do you want help?

--

Mark Hadfield "Kei puwaha te tai nei, Hoesa tahi tatou"
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Subject: Re: gaussian air dispersion model
Posted by [guillaume.drolet.1](#) on Mon, 28 Nov 2005 17:00:19 GMT
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- > So are you going to estimate the cross-wind-integrated ground level
- > concentration with the footprint model and the across-wind variation in
- > concentration with a gaussian function?

For my purpose, I am not interested in concentrations. What I need are the dimensions (major and minor axes of an ellipse) contributing to the measured fluxes.

The footprint model will give me one dimension: the distance of the footprint in the mean wind direction, for a given measurement period and a given percentage (r) to be included. This distance will be the major-axis of the ellipse. The length of the ellipse's minor-axis (i.e. across-wind width) will be missing and this is what I want to estimate with a gaussian function. How I will do that, honestly, I don't know???

This is where I need help.

> By "this simple model" you mean the footprint model, right?

Yes, this is what I meant.

> I've looked at the URL, but not read the paper. It sounds like the
> footprint model is a simple set of formulae. Do you plan to implement
> this in IDL? Shouldn't be too hard.

I don't plan to implement it in IDL. I've been given it implemented in Matlab. I will use this implementation to get the 'along-wind' distance (i.e. referred to as 'xr' in the footprint model, see previous post).

> So where do you want help?

As I said before, I need a way to estimate the 'across-wind width', knowing the 'along-wind extent' and other variables measured by the tower sensors (e.g., mean wind direction (x,y,z), etc.). I don't have a clue how I'm gonna find this but one thing is sure, I'm gonna need help!
