

Do sub 1-hour met data within CALPUFF
improve odour predictions ?

Overview of future CALPUFF upgrades

CALPUFF can explicitly treat calm conditions

- No inverse wind speed dependence
- Puff will diffuse and grow but not be advected anywhere
- Through the sub-hour time interval, model will account for variations in the wind
- Suited for modelling stagnation and accumulation events

User options for light wind speed conditions

- Hourly or sub-hourly meteorological and emissions data
- Model has a default minimum calm wind speed threshold, of 0.5 m/s, below which model switches from distance dependent to time dependent sigmas
- Default sigma v (0.5 m/s) and sigma w values.

```
----- LAND -----      ----- WATER -----  
Stab Class : A  B  C  D  E  F      A  B  C  D  E  F  
Default SVMIN : .50, .50, .50, .50, .50, .50,   .37, .37, .37, .37, .37, .37  
Default SWMIN : .20, .12, .08, .06, .03, .016,   .20, .12, .08, .06, .03, .016
```

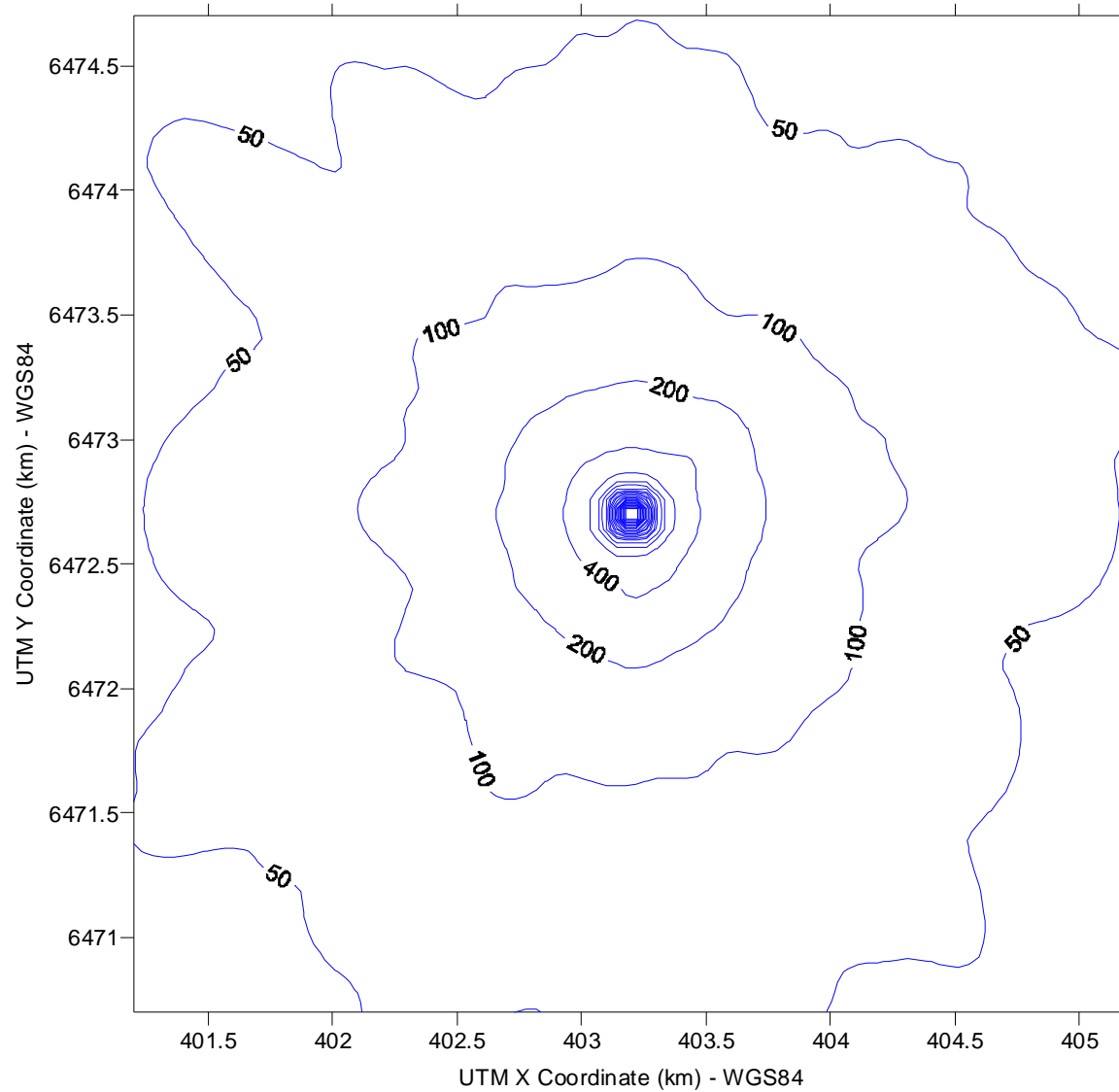
- Model can read real sigma v and sigma w data and use this in replacement of computed turbulence parameters, or PG curves

How Calpuff treats calm and light wind periods

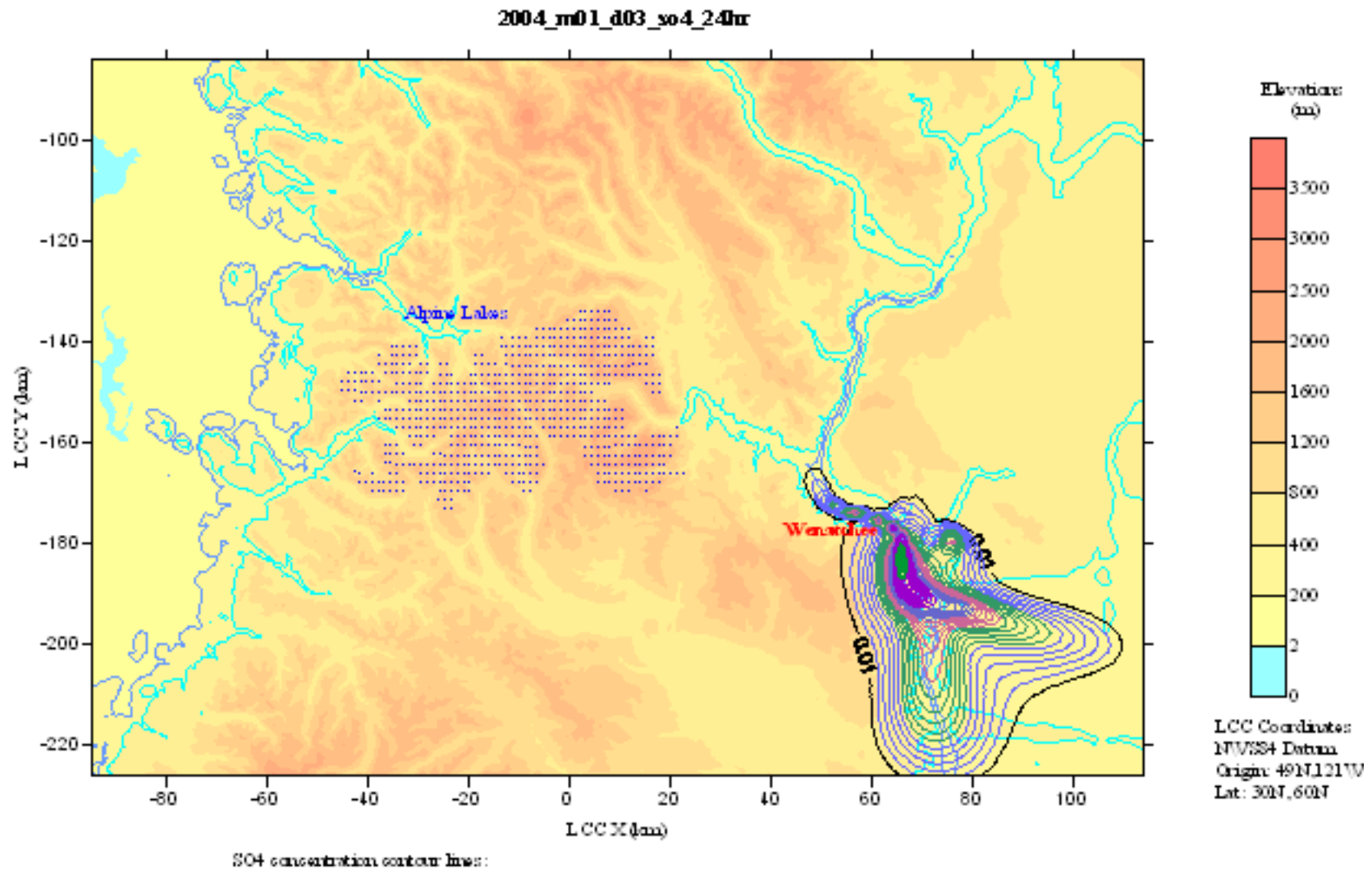
For puffs released into a calm atmosphere, determined by those wind speeds $<$ the minimum calm wind speed threshold of 0.5 m/s, the following happens;

- slugs are released as puffs
- all mass for the period is placed into 1 puff
- no gradual plume rise
- no building downwash
- growth of σ_v and σ_w is based on time (rather than distance)
- minimum values of σ_v and σ_w are imposed

Typical glc 'footprint' for light wind speeds in flat terrain



Typical glc 'footprint' for light wind speeds in complex terrain



Next slides show through a progression of plots the difference in the glc foot print that can be attained by using;

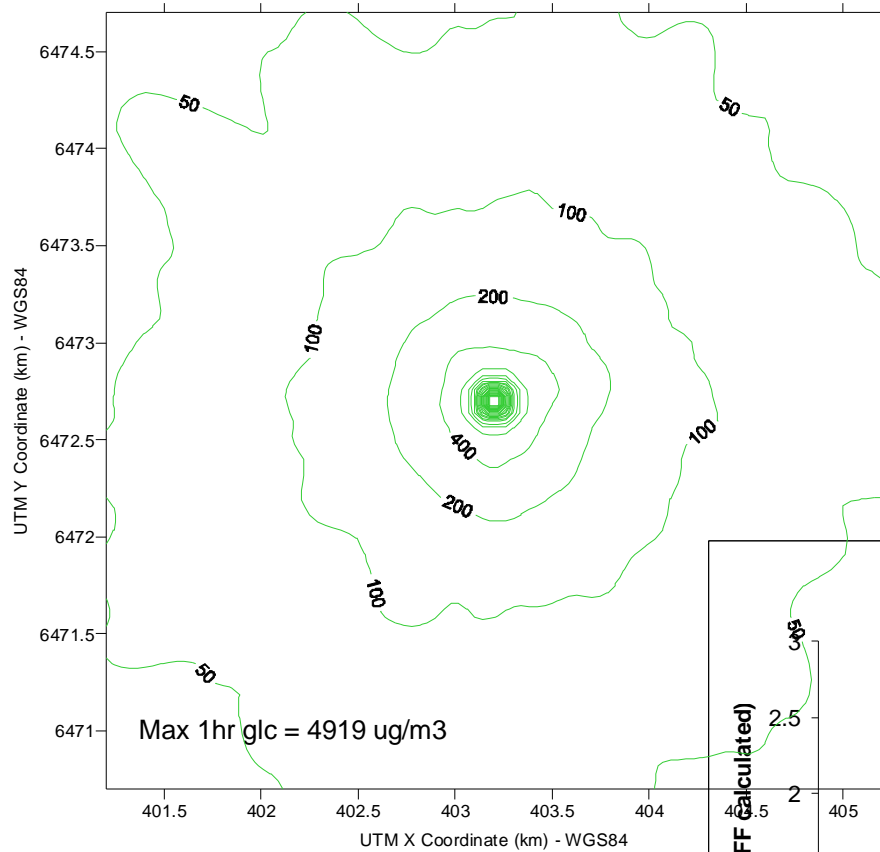
1. model default values
2. introducing real measured lateral turbulence data and altering the default sigma v values, and,
3. using real measured sigma v values, altering the default sigma v values and using 10-min meteorology

3 months of data were kindly supplied to me by Ken for Caversham WA, March – May 2003

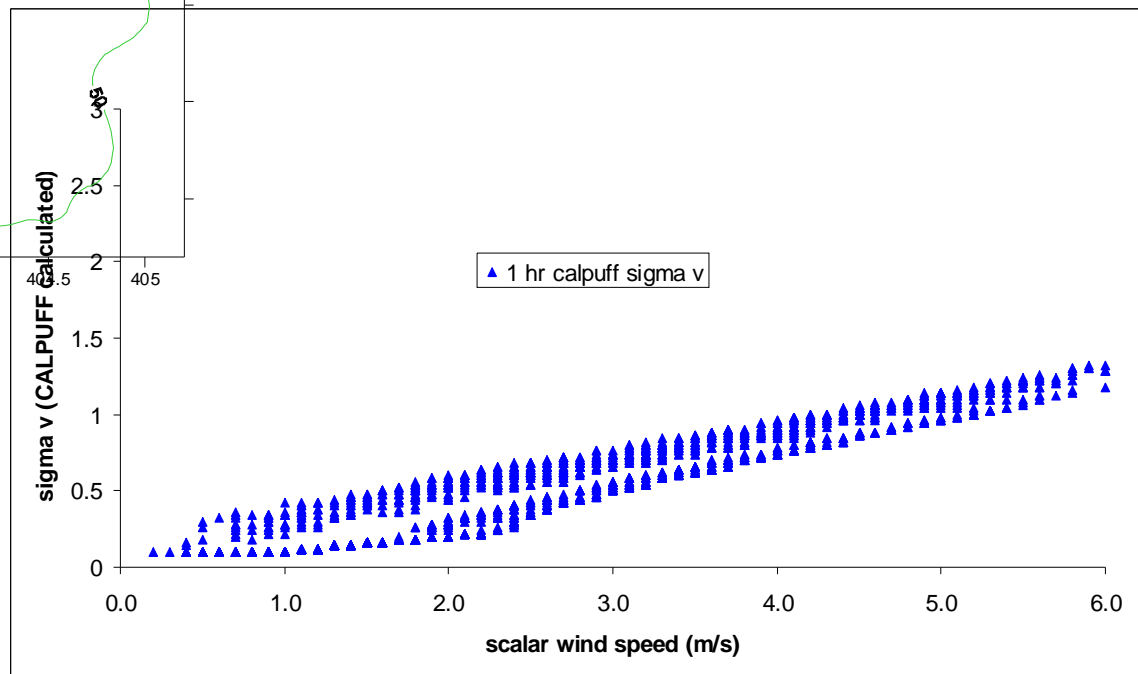
CALMET provided CALPUFF with 3D meteorological data.

These plots are not valid since certain model options have been hard-wired in order to single out the effects of lateral meander

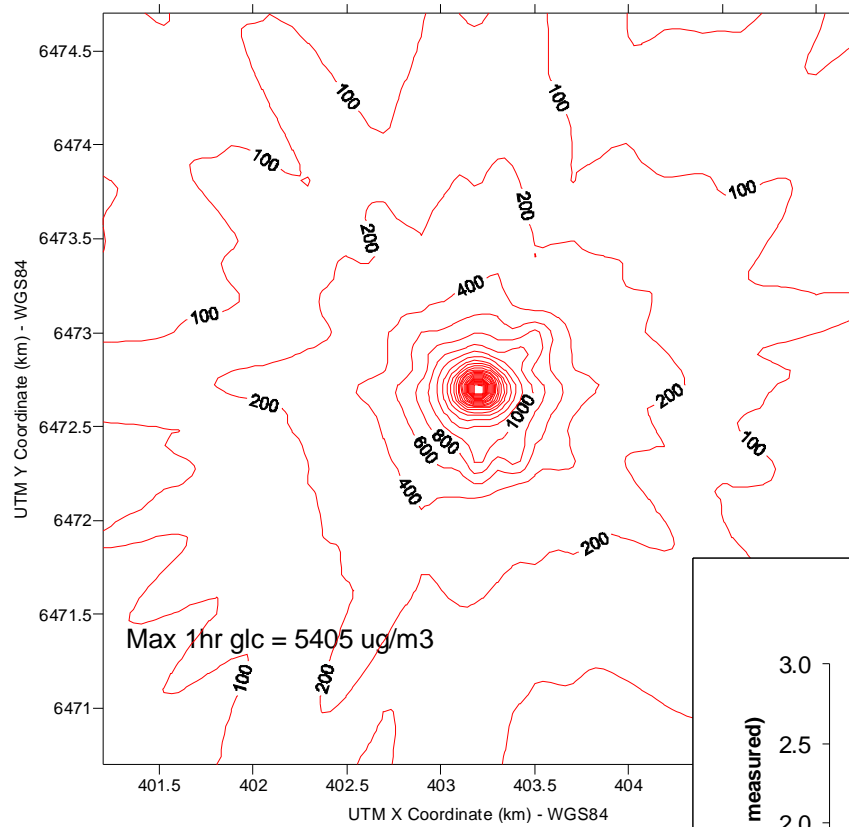
CALPUFF max glc 1-hr footprint using model defaults



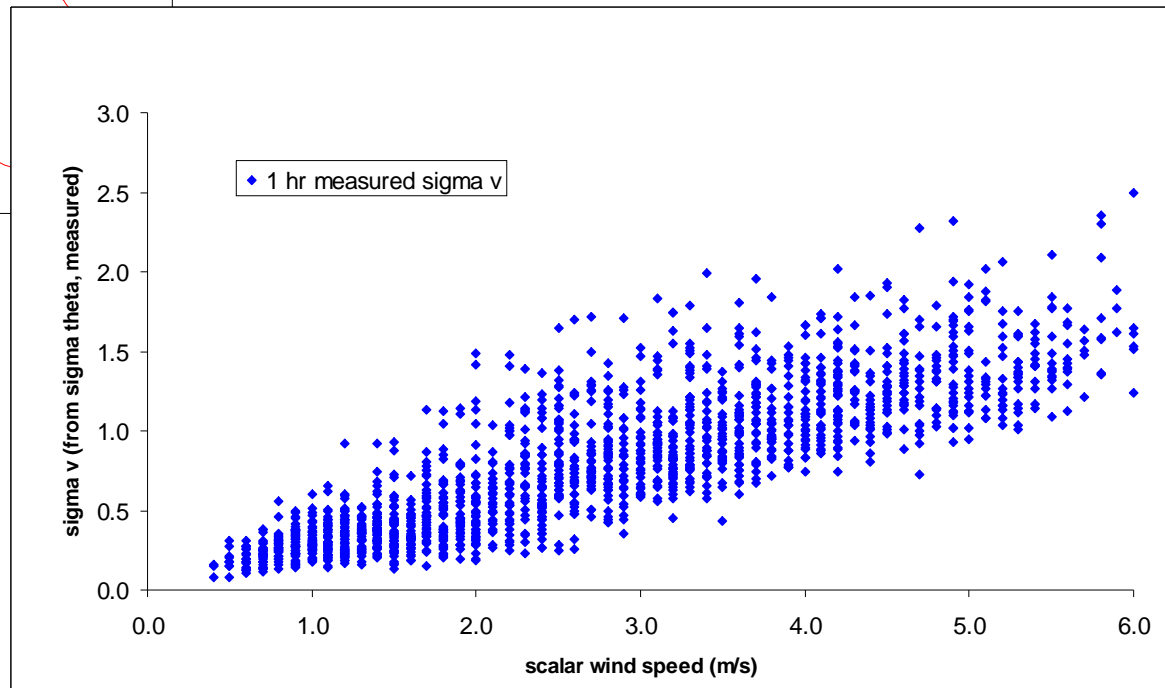
- Calculated sigma v
- Default min calm threshold at 0.5m/s
- Default min sigma v at 0.5m/s



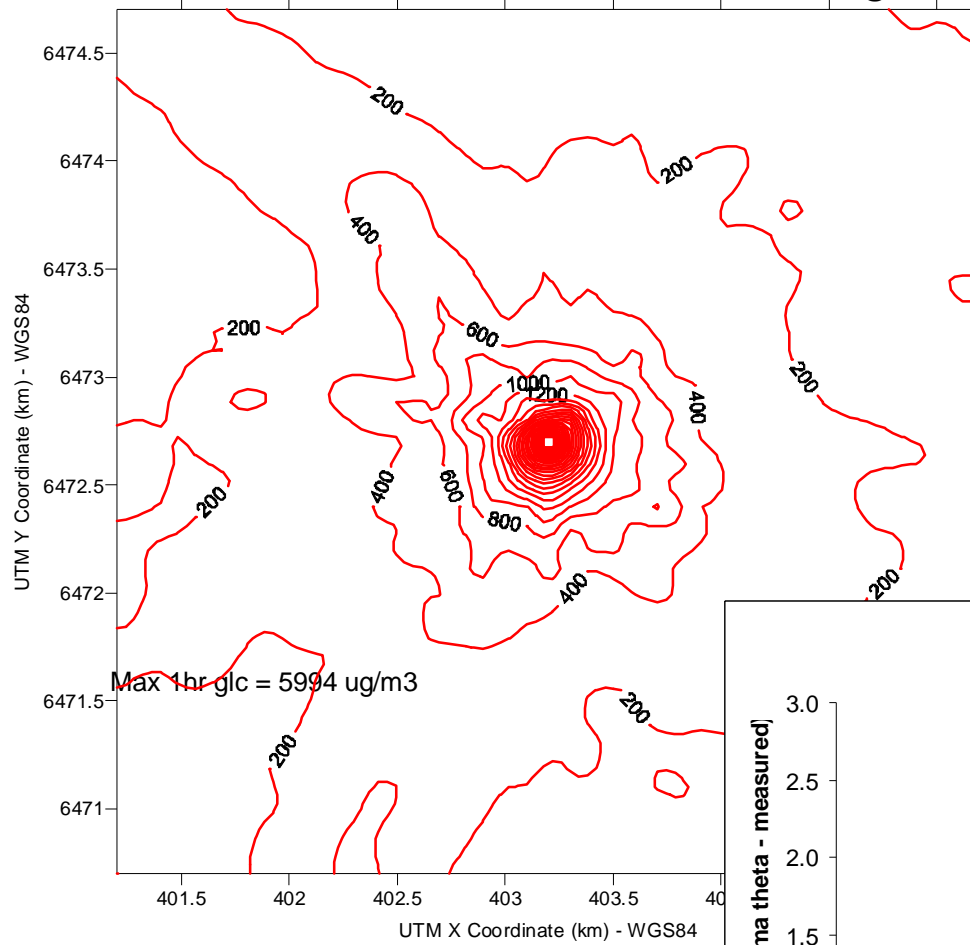
CALPUFF max glc 1-hr footprint



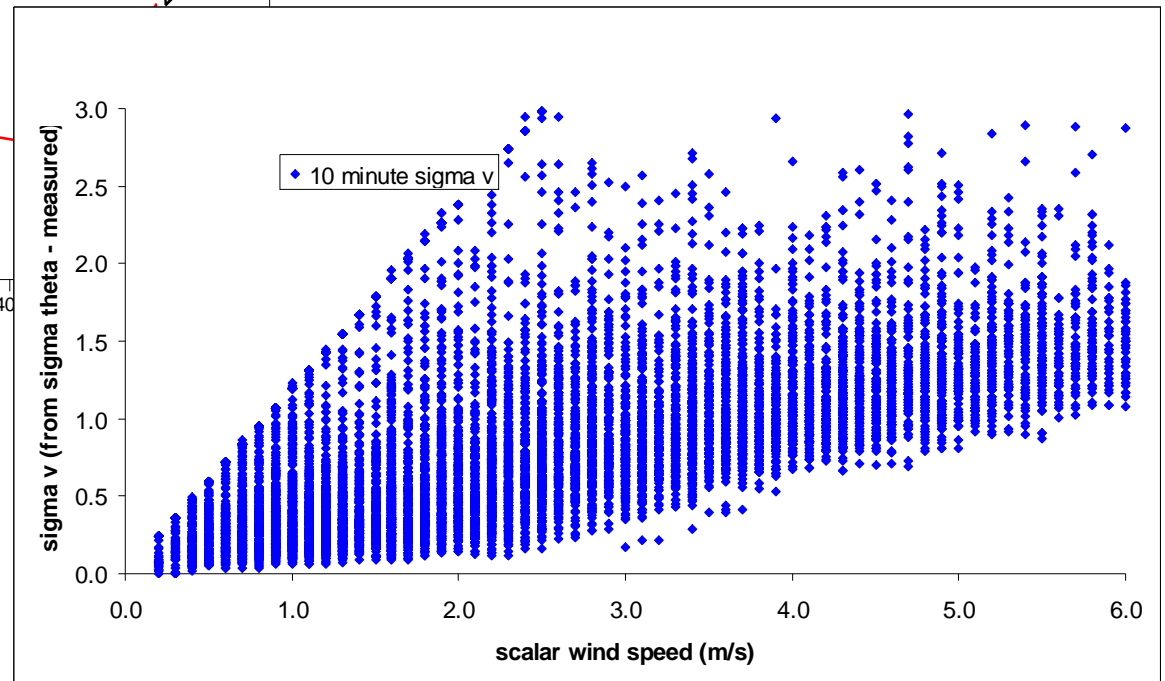
- Uses measured 1hr sigma v
- Default min calm threshold at 0.5m/s
- Altered min sigma v to 0.2m/s



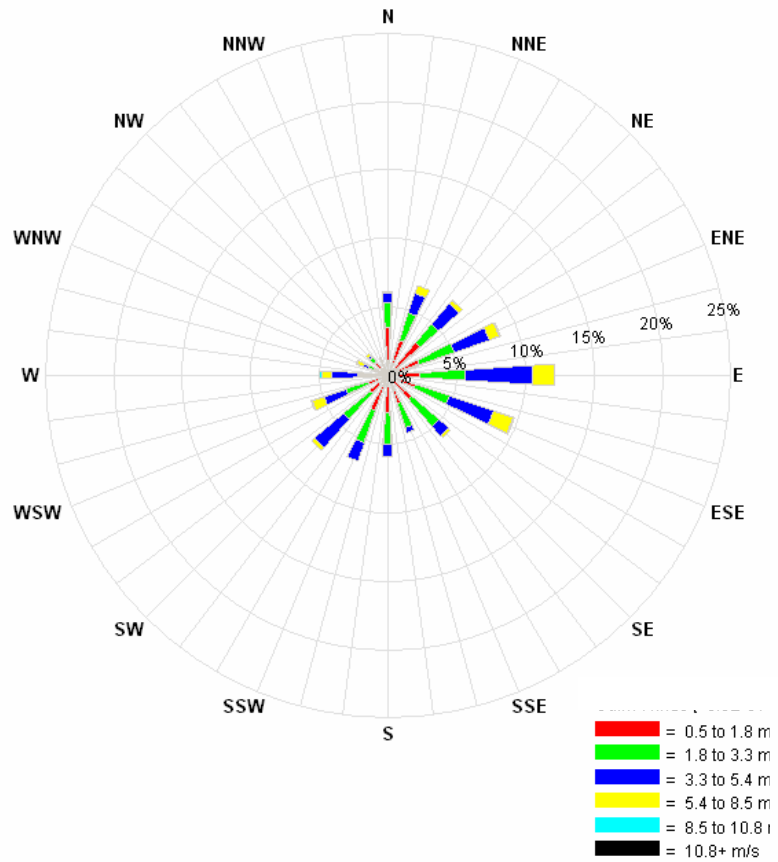
CALPUFF max glc 10 minute footprint



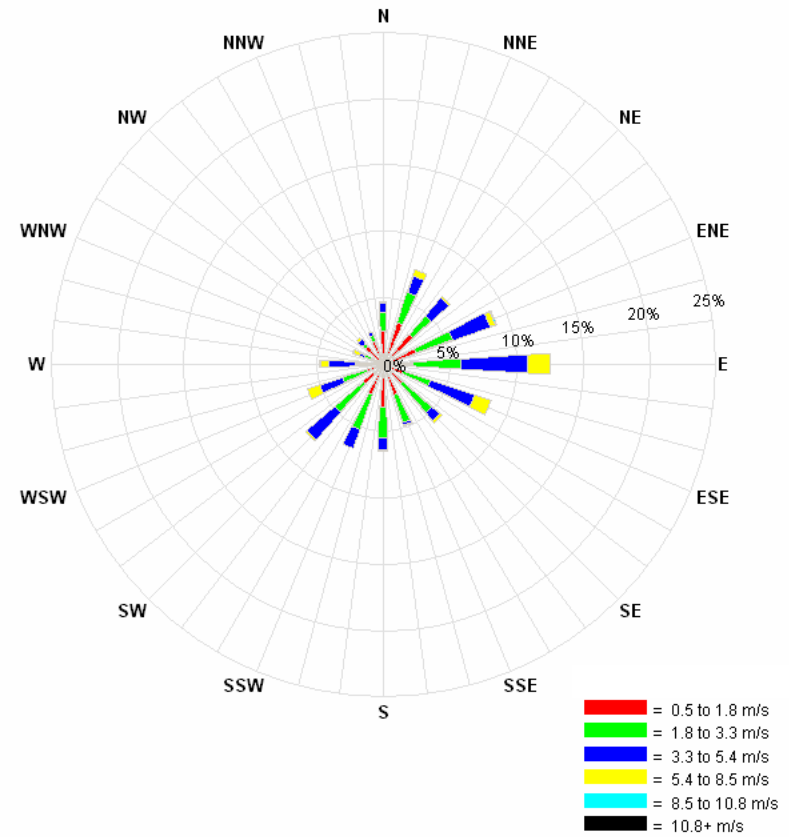
- Uses measured 10 min sigma v
- Default min calm threshold at 0.5m/s
- Altered min sigma v to 0.2m/s



10 minute data, 10m height



1 hour data, height 10m



Results

Combination of real sigma v and reduced minimum sigma v threshold allows puffs at very light wind speeds to be realistically advected and according to the natural variation of the 10-minute meteorology.

- Puffs are being advected at very light winds
- Sigma v minimum value of 0.2 m/s is clearly better fit for both 1-hr and 10 min data
- Measured values of sigma v and sigma w are preferential
- < 1hr meteorological data must be the key to capturing variation of light winds

Manual clearly states.....when Calpuff is applied with detailed wind and turbulence measures, care must be used to ensure valid measures are not superceded by minimum turbulence values and minimum calm threshold. These minima should reflect the characteristics of the wind sensors and the data collection system used'

Scalar vs vector wind speeds

- Calmet assumes all winds being fed to it are scalar as does Calpuff

This is consistent with USEPA Met. Monitoring Guideline (2000) which states, 'the hourly scalar mean wind speed and wind direction should be used in dispersion models'

- Individual puffs are advected according to the vector wind, but computation of meteorological fluxes is based on scalar winds.

Puff vs Plume Sigmas

Future enhancements to Calpuff

- Lack of good quality <1hr odor and meteorological data sets are missing, preventing progress
- Historically there has not been a focus on calms and light wind speeds
- We acknowledge that in the majority of odour applications sub-hourly meteorological and odour data will not be available.
- ASG is prepared to look and consider a 'lateral meander algorithm' for use with the 1-hour time interval, which can be invoked when required.
- ADMS employs a fluctuations model (Thomson 1990, 1997) and Aermod employs a lateral meander scheme
- Also considering aligning Calpuff with a Fluid dynamic model