

CERCCambridge Environmental Research Consultants
Environmental Software and Services

Meteorological data requirements for ADMS

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Royal Meteorological Society Workshop, 28th March 2012
Meteorological measurements for dispersion models

Overview

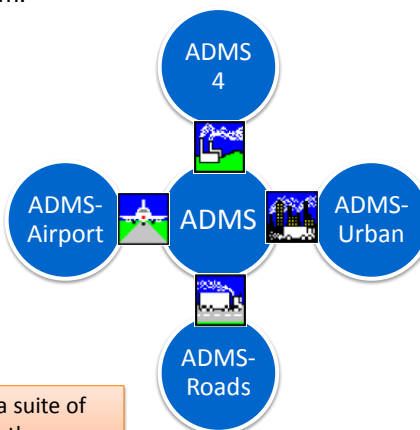
- What is ADMS?
- Basic met data requirements of ADMS
- More advanced met data options
- Recent work

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What is ADMS?

Atmospheric Dispersion Modelling System:

- 'New generation' Gaussian dispersion model
- Atmospheric boundary layer properties characterised by two parameters:
 - Boundary layer depth
 - Monin-Obukhov length
- Dispersion under convective met conditions uses skewed Gaussian concentration distribution
- **Advanced meteorological pre-processor developed by the UK Met Office**



'ADMS' refers to a suite of software, all with the same underlying dispersion model

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Meteorological data requirements for ADMS

Basic met data requirements for ADMS

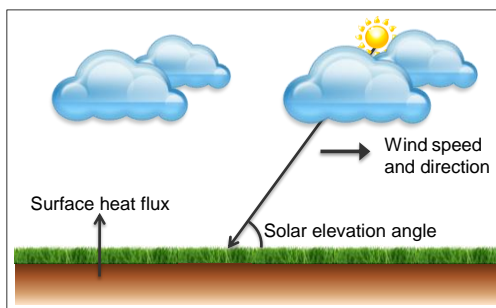
• For each hour or met condition to be modelled:

- Wind speed (m/s)
- Wind direction (degrees)
- Some measure of surface heating;
 - surface heat flux (W/m^2), or
 - date, time and cloud cover (oktas)

• Static data:

- Surface roughness (m)
- Wind measurement height (m)

This information is enough for ADMS to estimate the structure of the boundary layer

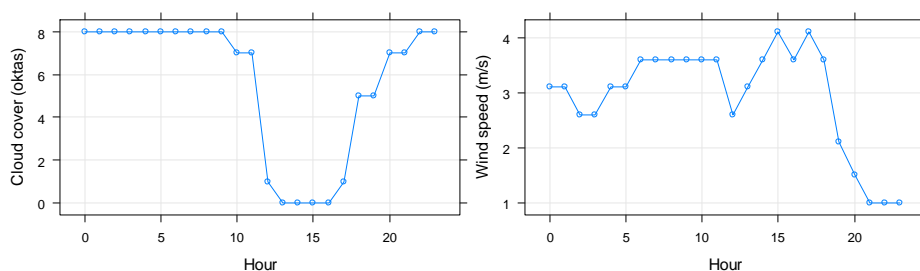


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Example: typical sunny day

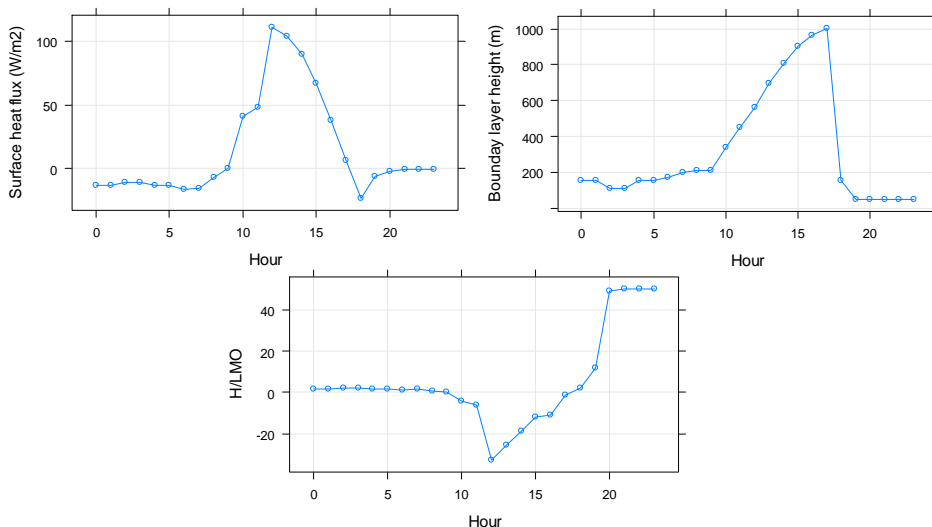
- One day in early September
- Met data: Year, day, hour, wind speed, wind direction, cloud cover
- Wind measurement height = 10m
- Roughness length = 0.1m



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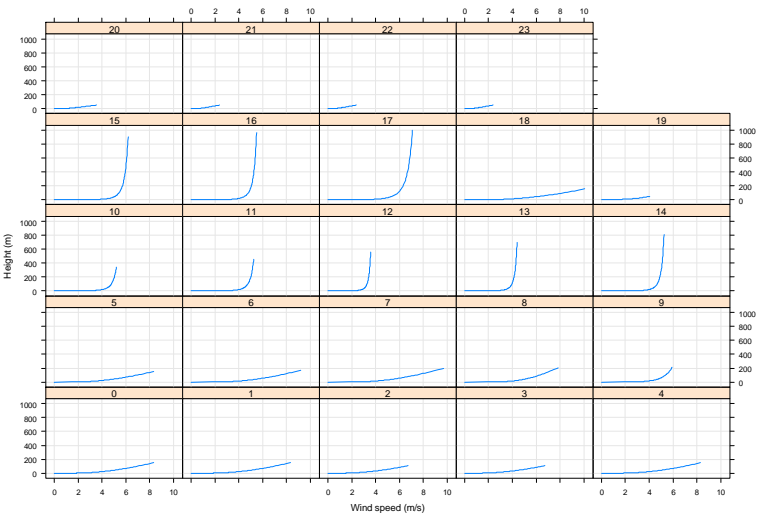
Calculated met parameters



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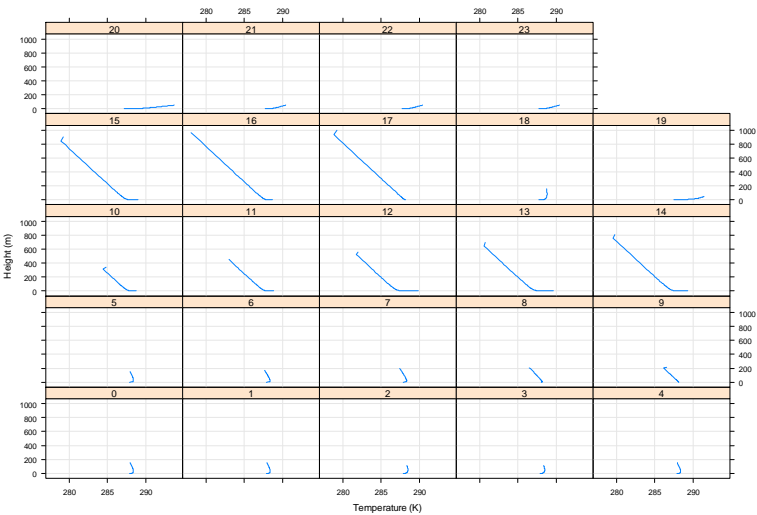
Calculated vertical wind speed profile



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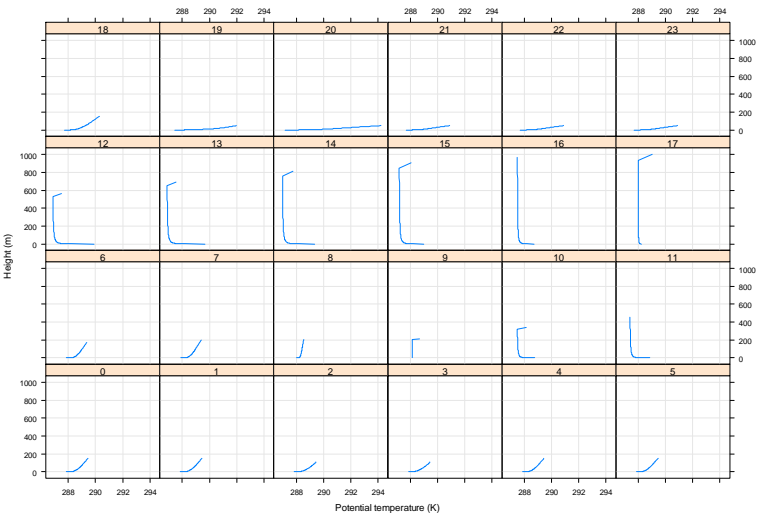
Calculated vertical temperature profile



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Calculated vertical potential temperature profile



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Other met parameters that may be input

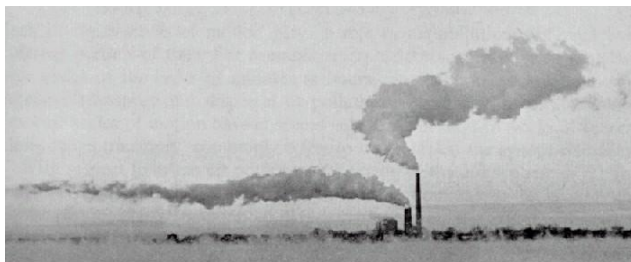
General met parameters	Met parameters required for particular model options
Sensible heat flux	Relative humidity (Plume Visibility)
Boundary layer height	Sea surface temperature (Coastline)
Solar radiation	Precipitation (Wet deposition)
Temperature	
Buoyancy frequency above the boundary layer	

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More advanced met data options

- Using measured vertical profiles to improve concentration predictions
 - Example: Tracy power plant validation study
- Using upper air soundings to calculate buoyancy frequency above the boundary layer
 - Example: recent investigations for Beijing



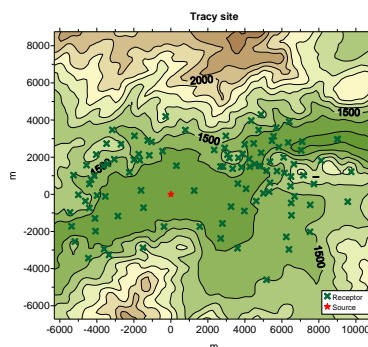
- Complex terrain: using FLOWSTAR to generate 3D flow field from single site met data

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Tracy power plant validation study

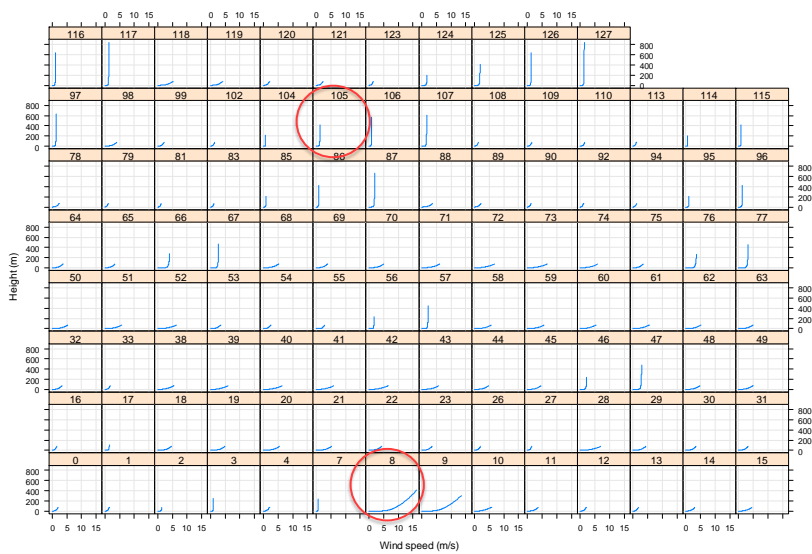
- Power plant 27km east of Reno, Nevada, in complex terrain
- 1984: USEPA carried out series of 14 experiments in August
- Collected 128 hours of data, mainly in late evening and early morning
- Tracer gas released from 91m stack
- 110 receptors
- Met mast 1.2km east of the plant, recording vertical profiles of wind speed, temperature and vertical turbulence.
- Modelled in ADMS 4, with and without vertical profile data



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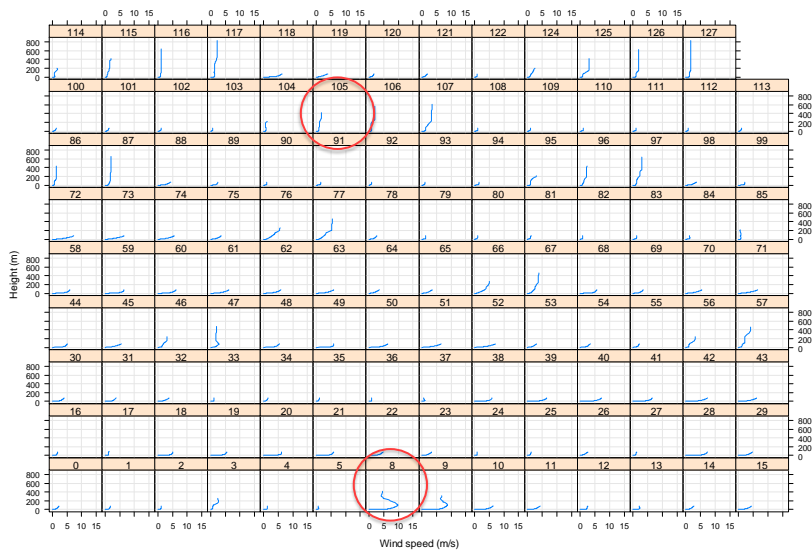
Vertical wind speed profiles: No PRF file



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Vertical wind speed profiles: With a PRF file

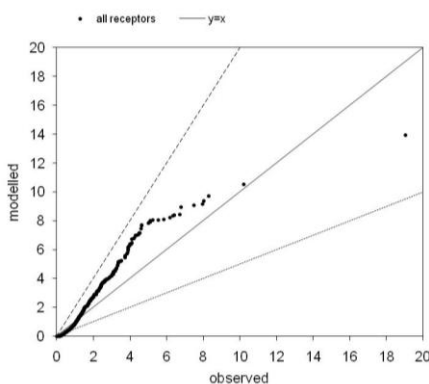


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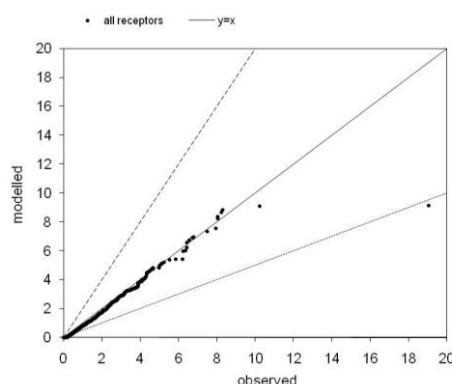
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Tracy validation study results

Quantile-quantile plots of concentrations ($\mu\text{g}/\text{m}^3$)



Without PRF file



With PRF file

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Meteorological data requirements for ADMS

Using upper air soundings to calculate buoyancy frequency above the boundary layer

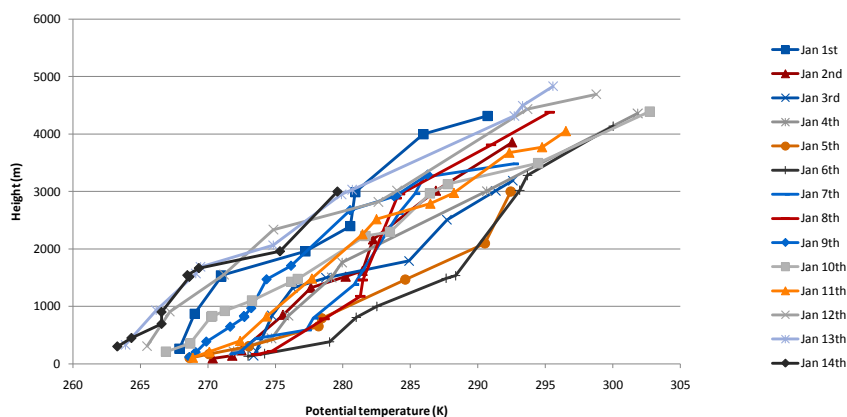
- Buoyancy frequency: indicates the stability of a stable boundary layer
- Buoyancy frequency above the boundary layer NU has default value 0.013s^{-1} , but can be entered in the met file if known
- Upcoming release of ADMS includes new option to use upper air sounding to calculate a more representative NU
- Upper air data includes temperature and pressure; first calculate potential temperature, then from that calculate buoyancy frequency
- NU is calculated as the average of the calculated buoyancy frequencies between 100m and 2000m

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Example 1: 2 winter weeks in Beijing

Potential temperature for January 1st - January 14th 2008 for Beijing
calculated using the 0000 GMT upper air sounding

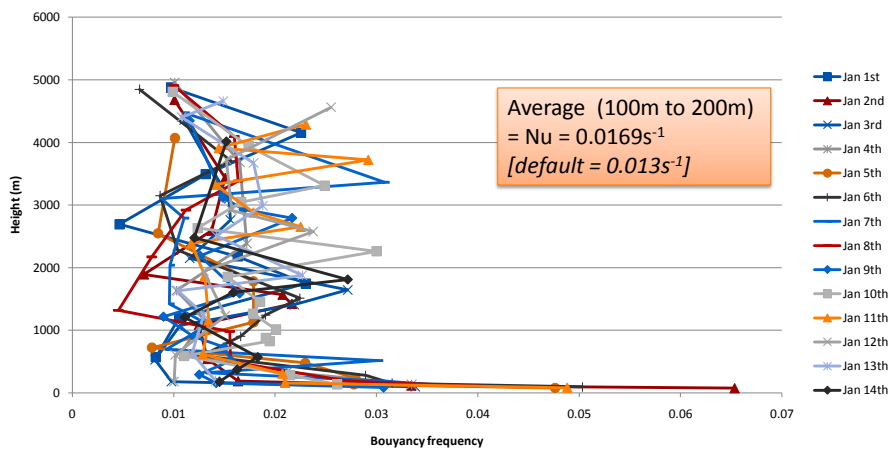


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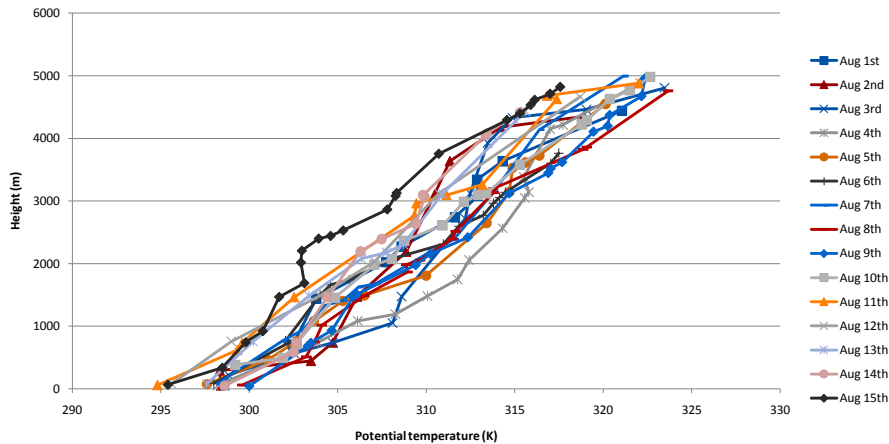


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Example 2: 2 summer weeks in Beijing

Potential temperature for August 1st - August 15th 2008 for Beijing
calculated using the 0000 GMT upper air sounding

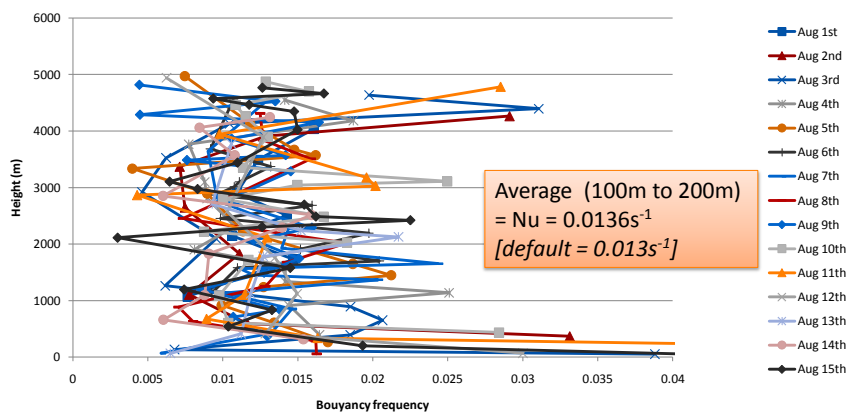


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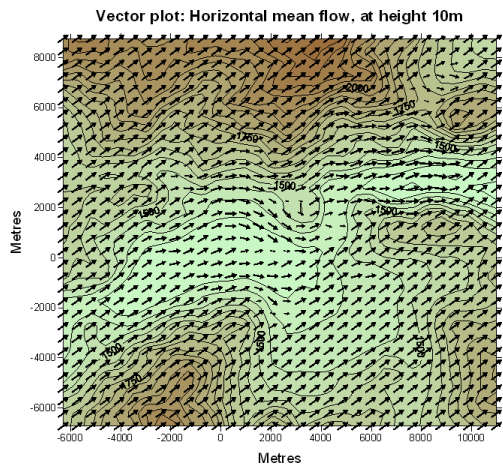
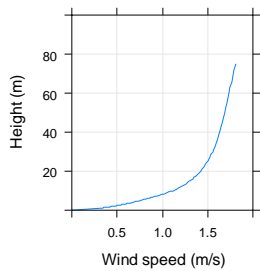


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Using FLOWSTAR to get spatially varying flow from single site met data

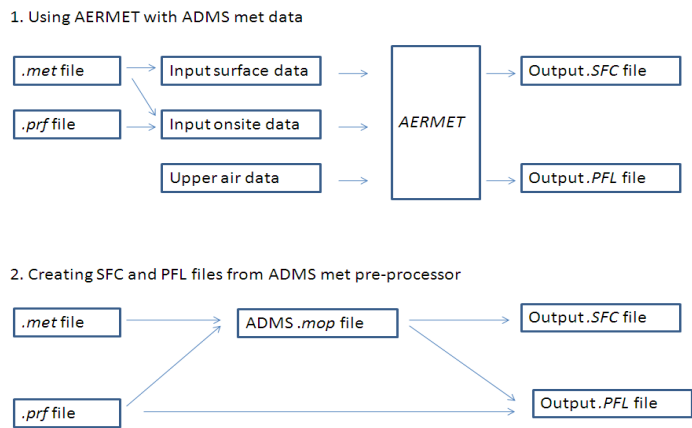
Tracy power station site: upstream vertical wind speed profile and FLOWSTAR flow field for one hour:



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Recent work

- ADMS 5 includes facility to run AERMET from ADMS data; 2 options for met:



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Summary

- Basic ADMS met data requirements
- Using more advanced met data options to improve results
 - Vertical profiles of wind and turbulence
 - Using upper air data to calculate buoyancy frequency above the boundary layer
 - Using FLOWSTAR to simulate 3D flow field in complex terrain from single site met data
- Upcoming release of ADMS has facility to run AERMOD from ADMS inputs, with two methods for converting ADMS met data to AERMOD met data; working on analysing the differences

**Thank you for your
attention**

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