THE CHARACTERIZATION OF SURFACE BOUNDARY CONDITIONS WHEN MODELLING DISPERSION OVER A COMPLEX SITE

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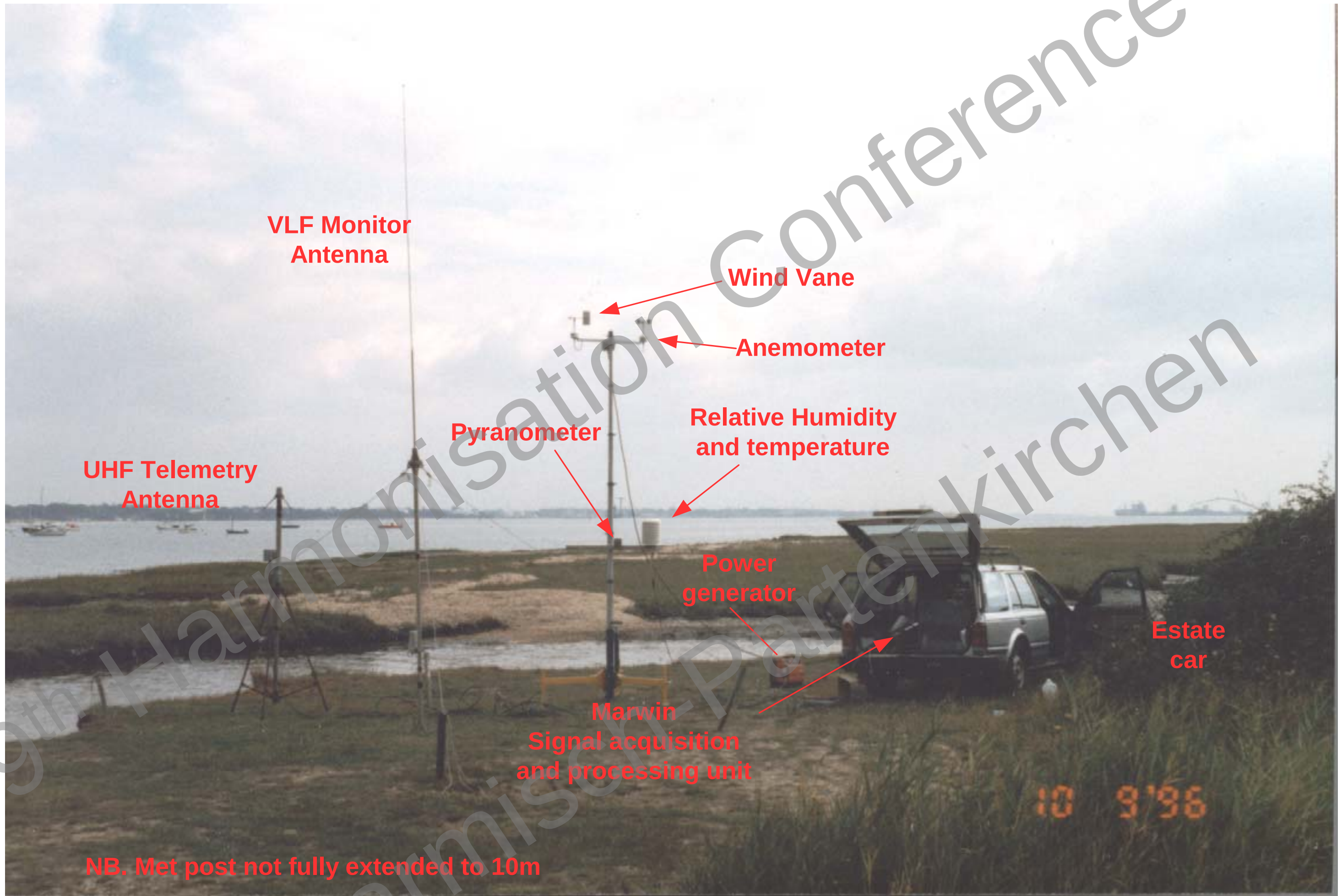
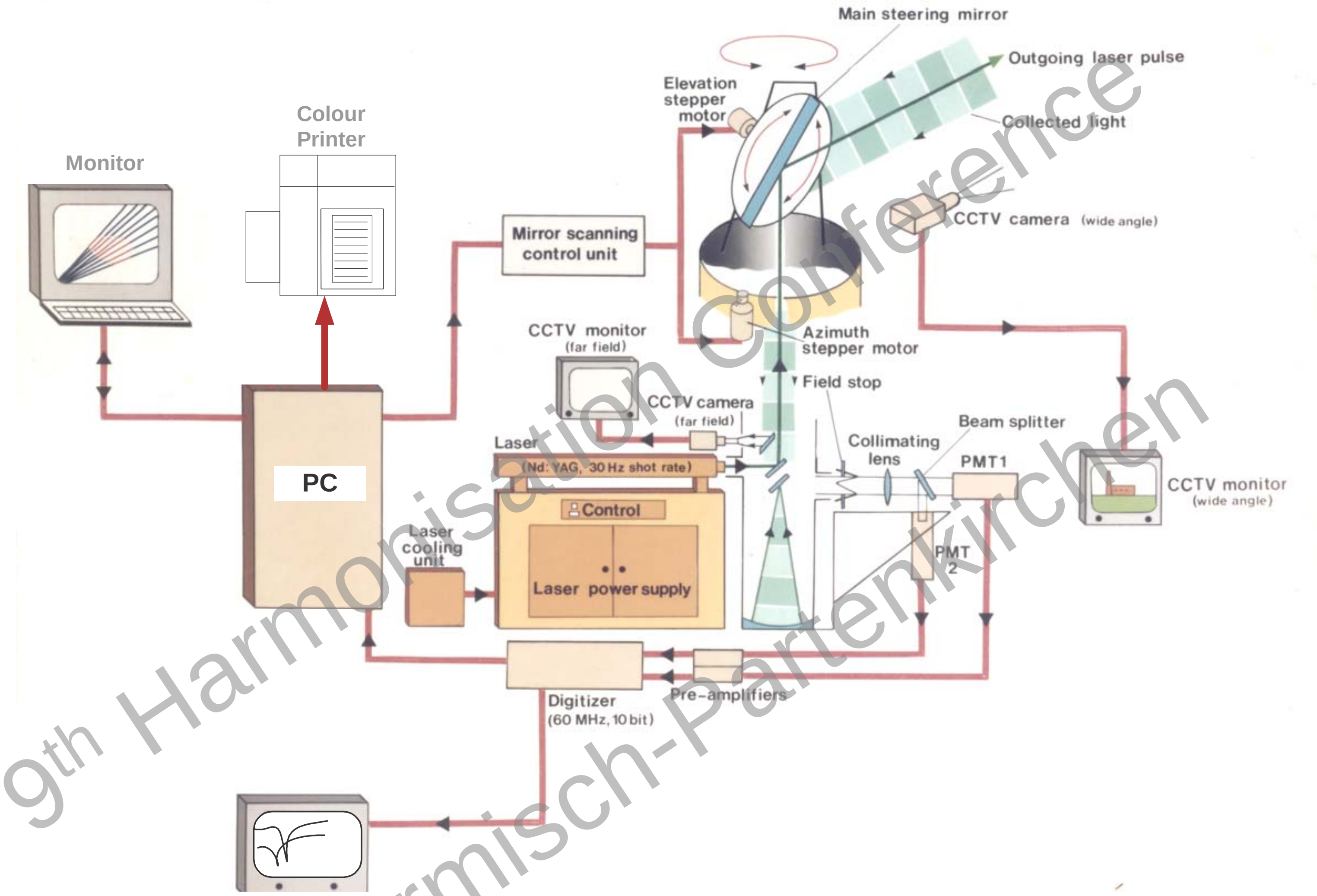
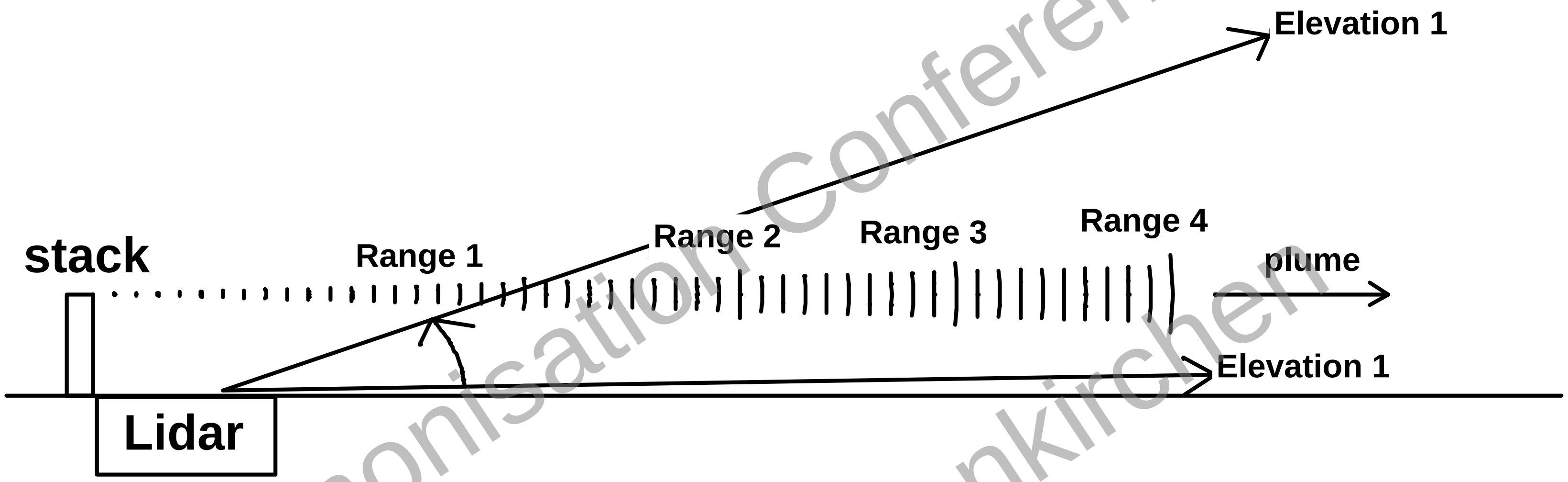

VLF Monitor Antenna
Wind Vane
Anemometer
Pyranometer
Relative Humidity and temperature
UHF Telemetry Antenna
Power generator
Estate car
Marwin Signal acquisition and processing unit
10 9 '96
NB. Met post not fully extended to 10m

Lidar at Hythe

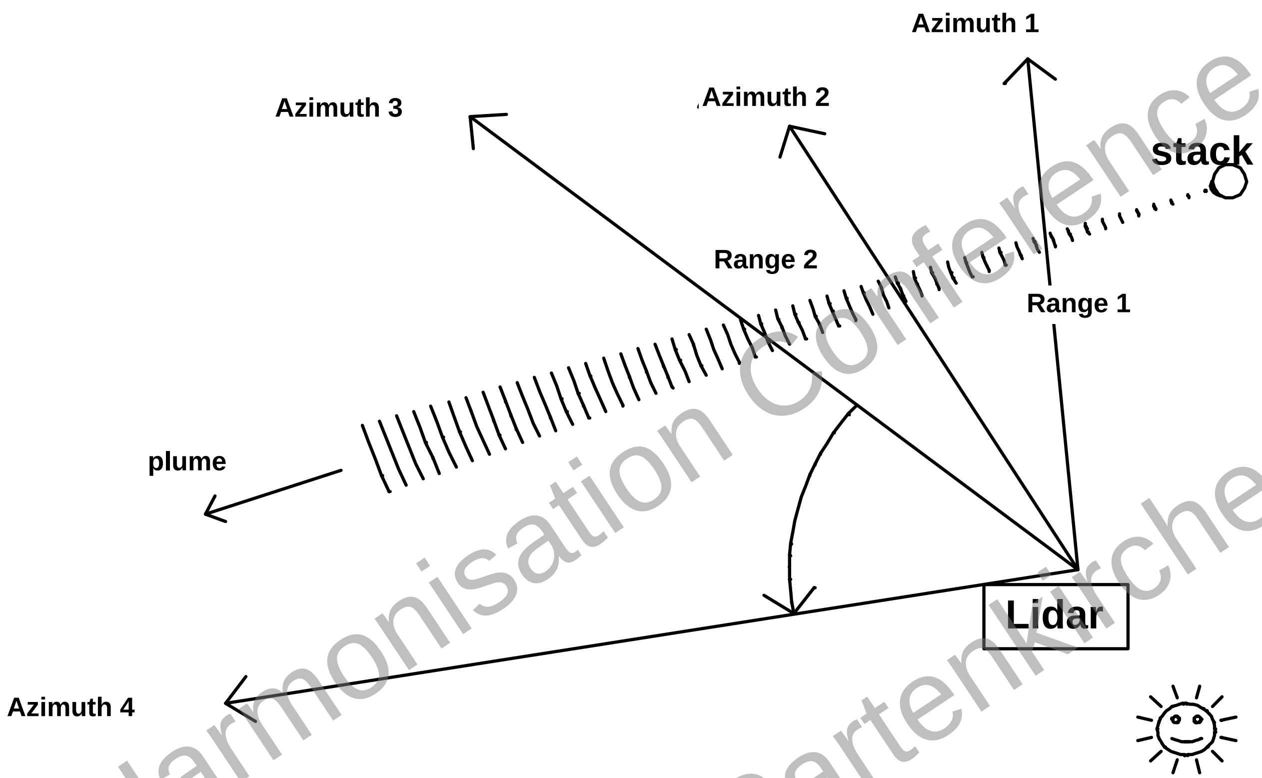


Schematic of Rapid-Scanning Lidar



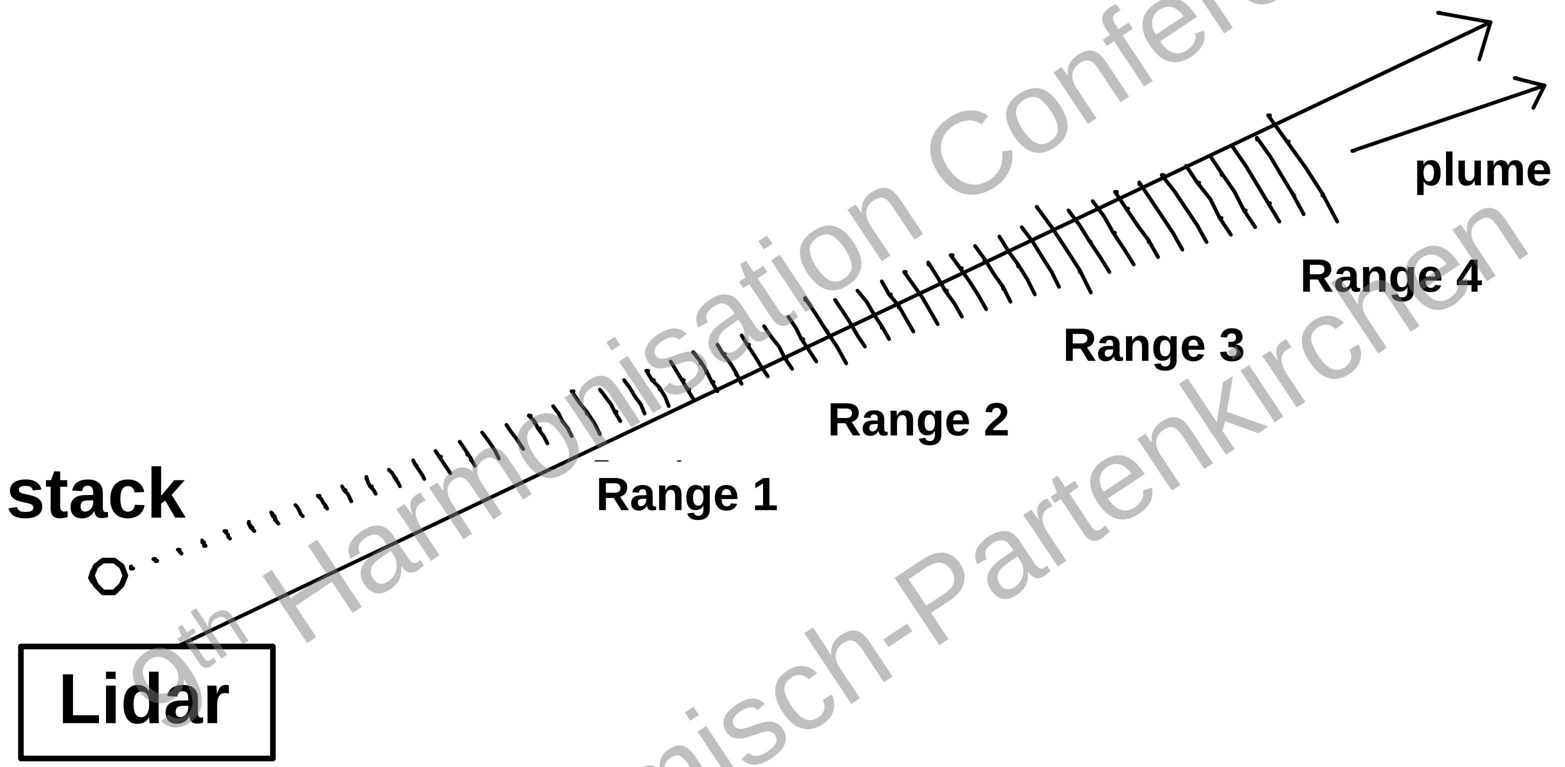
Lidar Scanning Modes

Longitudinal-vertical

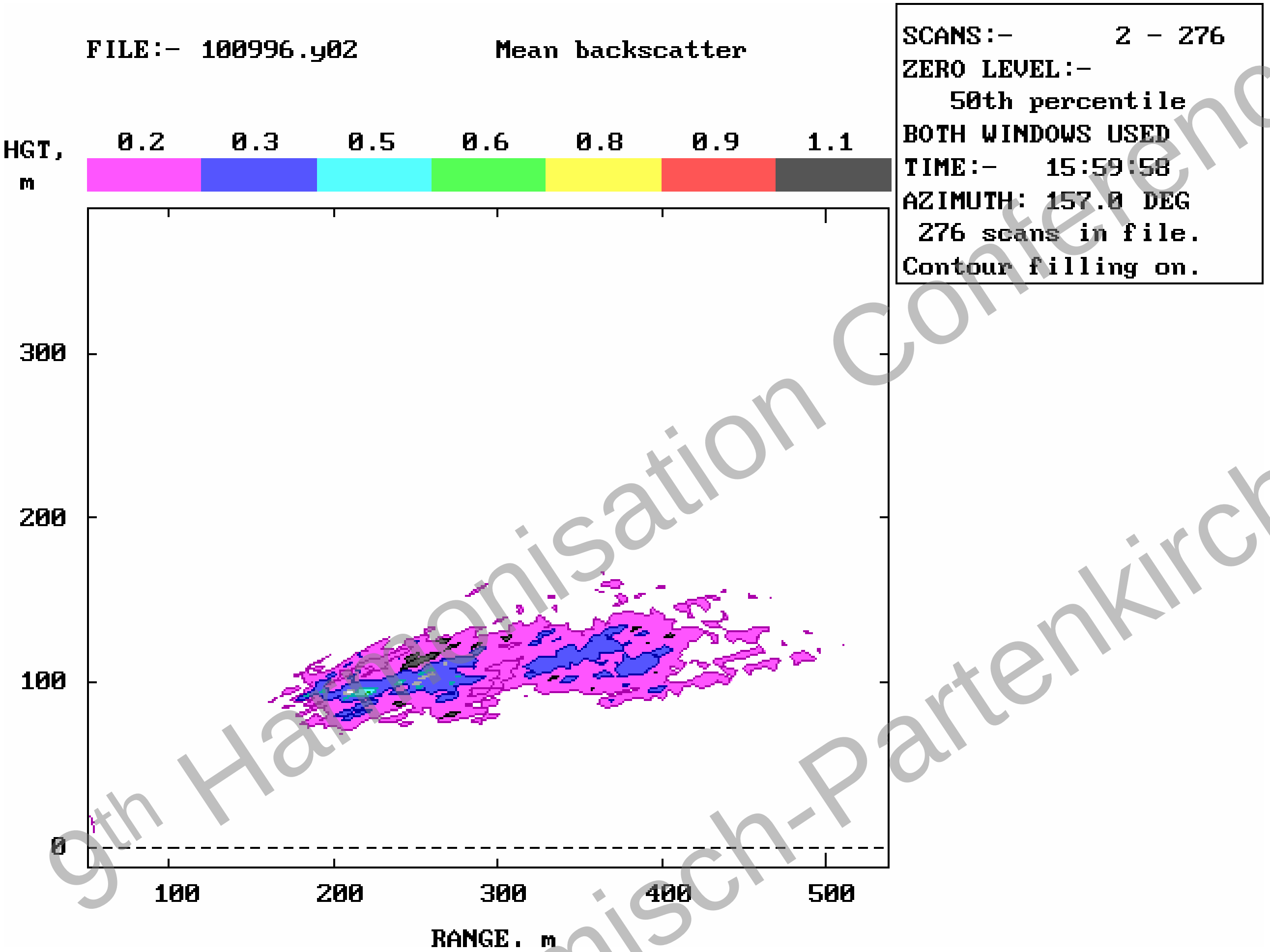


Lateral-vertical (azimuths 1 & 2)

Lateral-horizontal (3 and 4)



Longitudinal-vertical

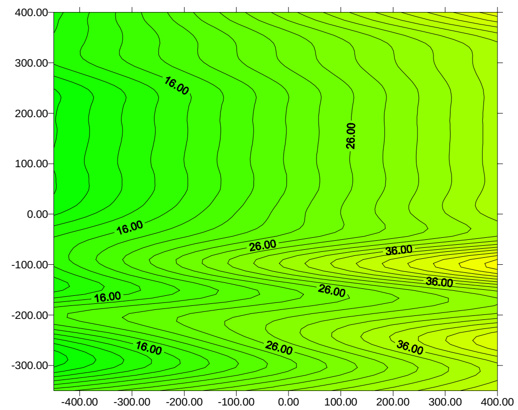


Typical Lidar scan

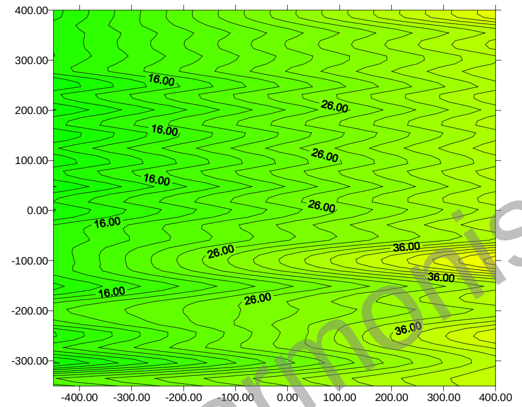
Interpolators

- ***Inverse Distance*** – Smoothing possible. Fast.
- ***Kriging*** – Smoothing possible. Flexible.
- ***Nearest Neighbour*** – Useful for regularly spaced grids.
- ***Polynomial regression*** – Smoothing possible.
- ***Radial Basis Functions*** – Smoothing possible. Flexible.
- ***Shepard's Method*** – Smoothing possible. Similar to inverse distance.
- ***Triangulation with Linear Interpolation*** – Fast.

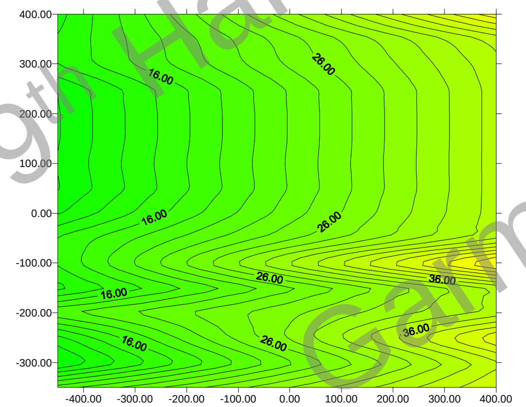
Examples of diffrent Interpolations on the same Enichem grid file



Radial Basis Function

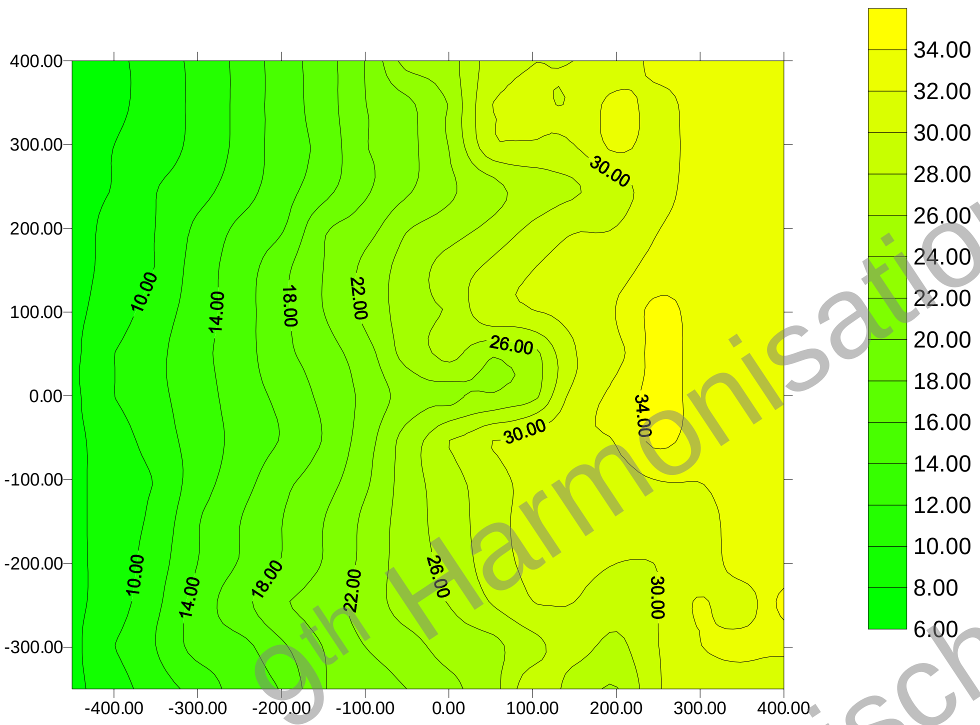


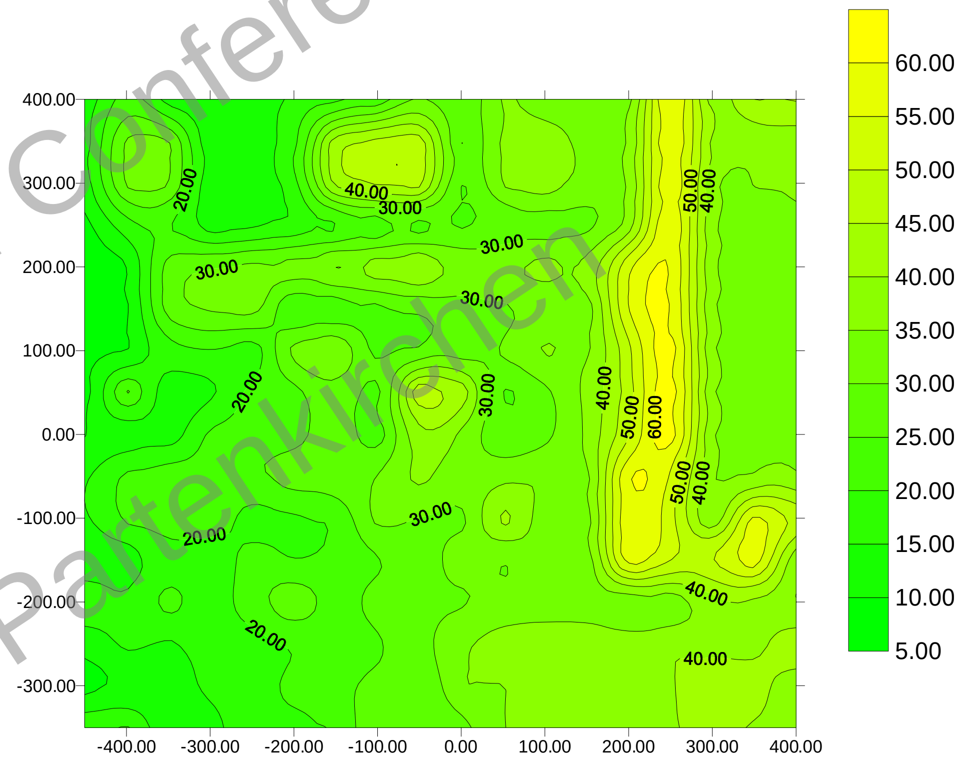
Shepard's method



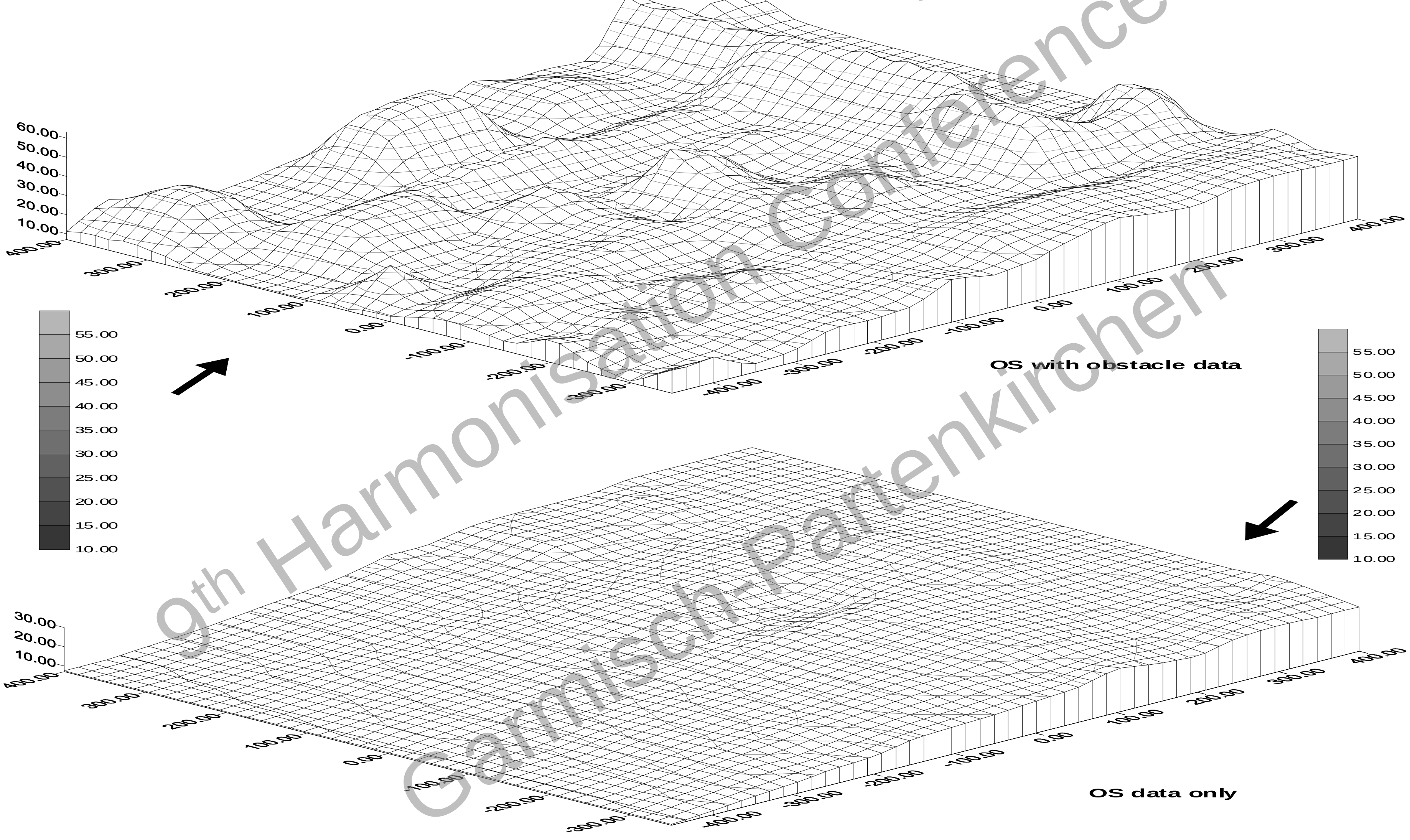
Triangulation method

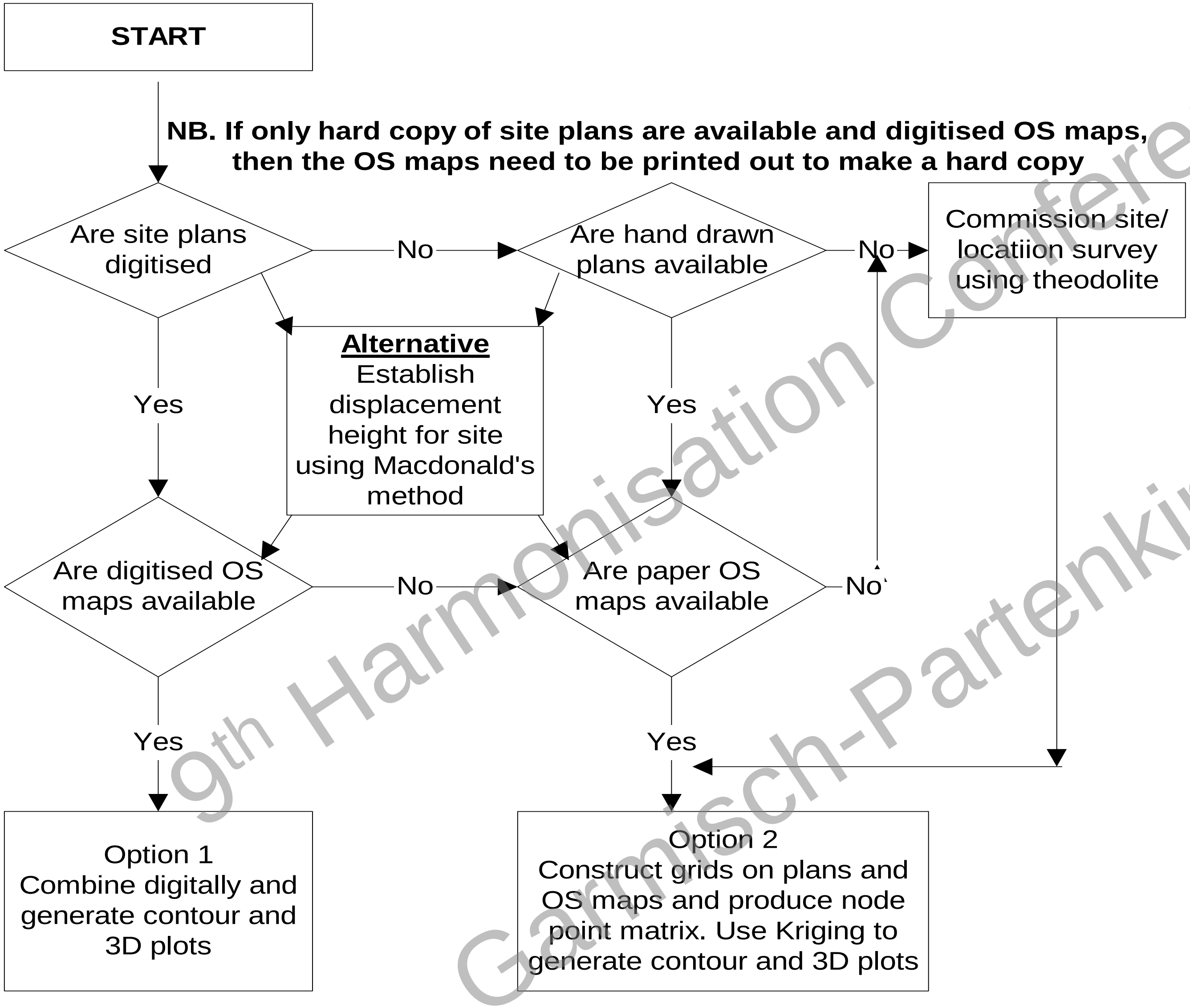
Contour plots of site as OS only and OS with obstacles
(m)



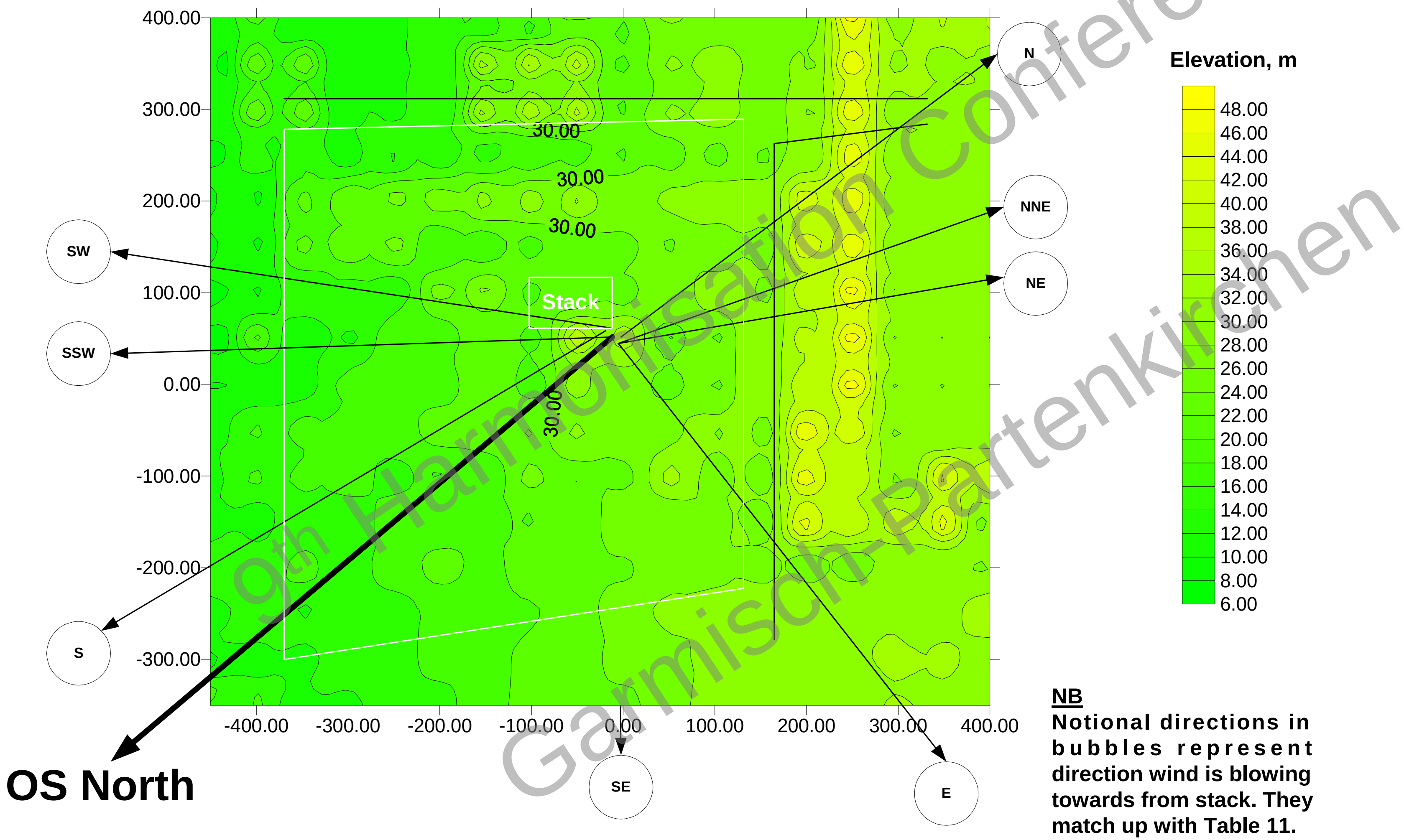


Surface plots of OS and OS with obstacle data




START
NB. If only hard copy of site plans are available and digitised OS maps, then the OS maps need to be printed out to make a hard copy
Are site plans digitised
No
Are hand drawn plans available
No
Commission site/ locatiion survey using theodolite
Yes
Alternative
Establish displacement height for site using Macdonald's method
Yes
Are digitised OS maps available
No
Are paper OS maps available
No
Yes
Yes
Option 1
Combine digitally and generate contour and 3D plots
Option 2
Construct grids on plans and OS maps and produce node point matrix. Use Kriging to generate contour and 3D plots

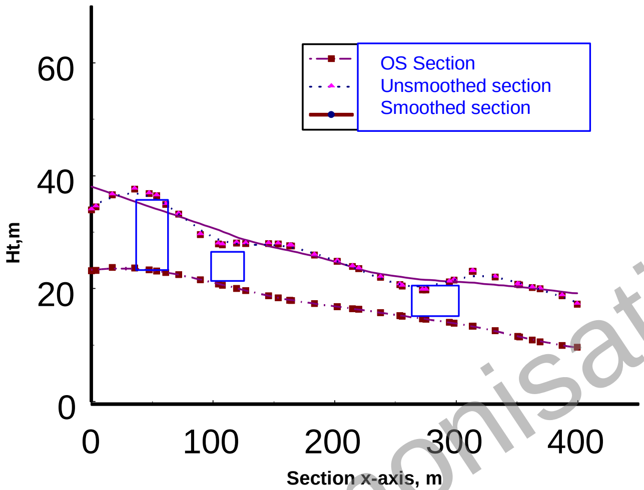
Wind direction sectors imposed upon site contour map



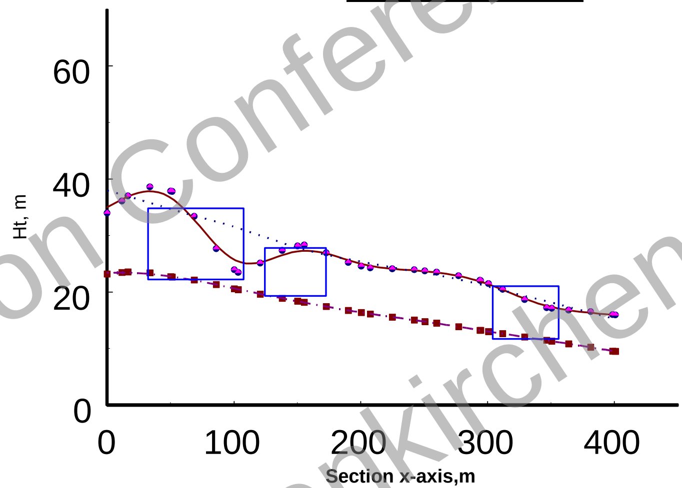
NB
Notional directions in bubbles represent direction wind is blowing towards from stack. They match up with Table 11.

Sections through site matching nominal wind directions

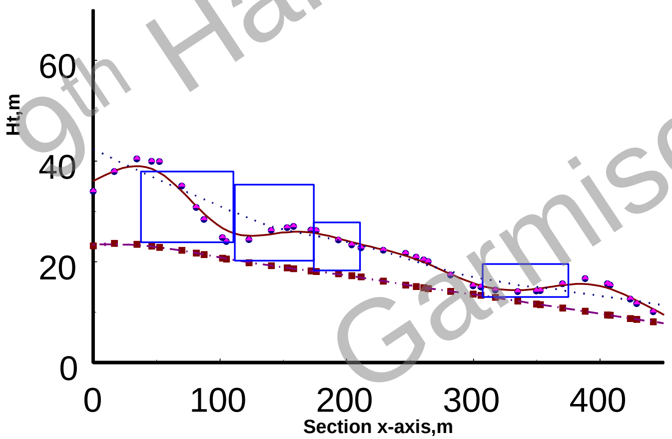
Direction S



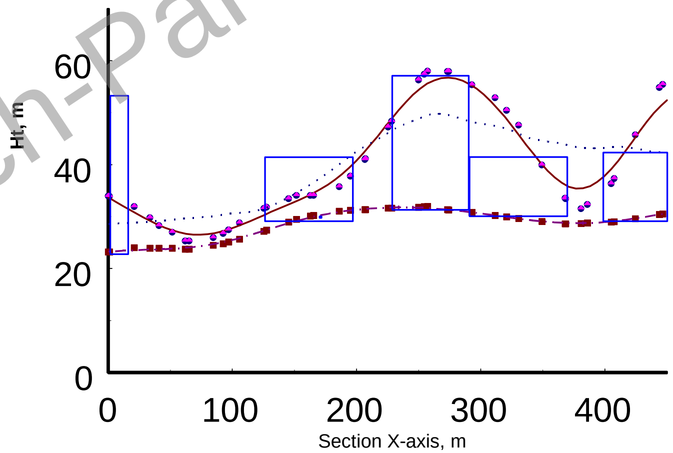
Direction SSW

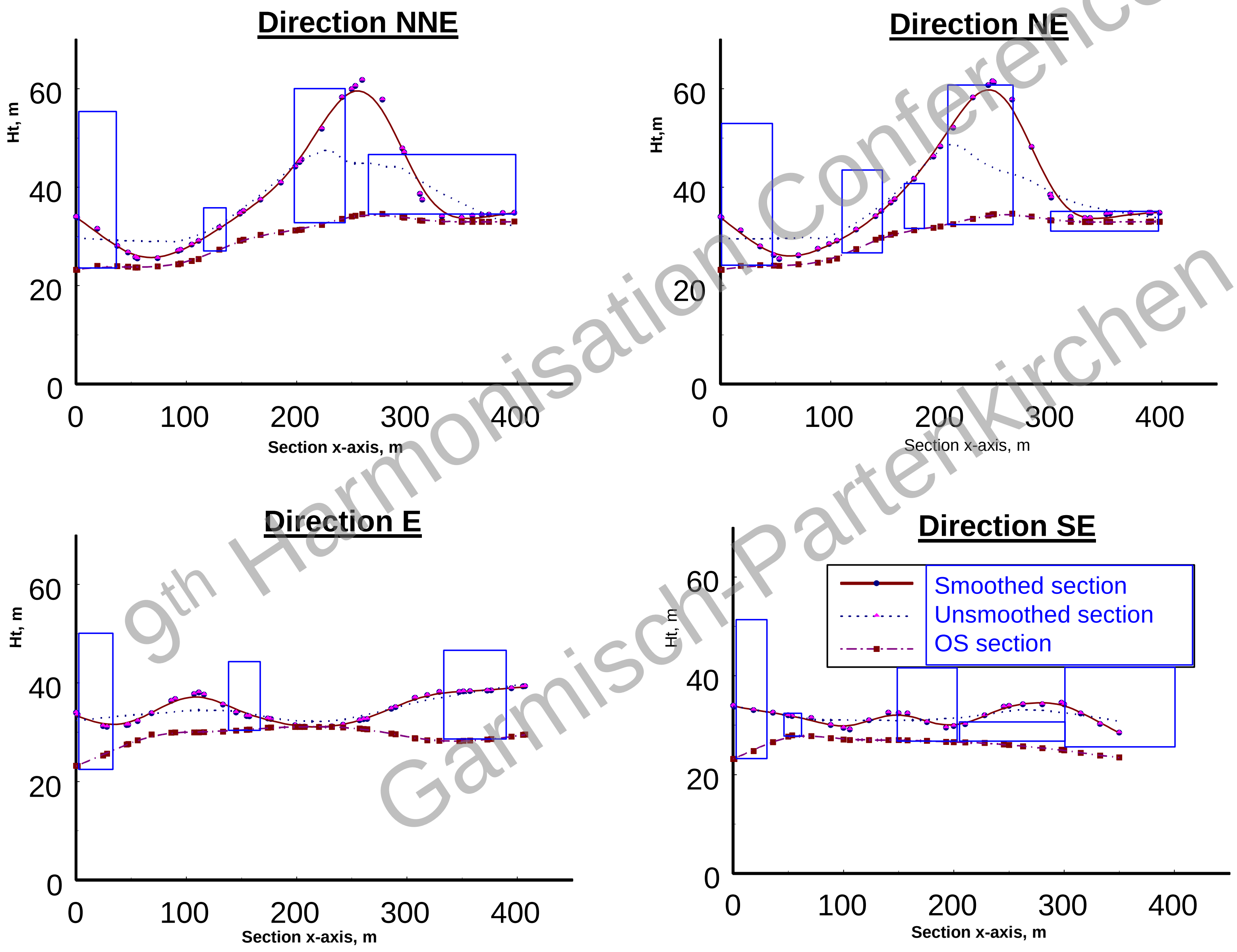


Direction SW



Direction N




Direction NNE
Ht, m
Section x-axis, m
Direction NE
Ht,m
Section x-axis, m
Direction E
Ht, m
Section x-axis, m
Direction SE
Ht, m
Section x-axis, m
Smoothed section
Unsmoothed section
OS section
0
20
40
60
0
100
200
300
400

Briggs' Model of Plume Rise

Buoyant rise, *z*, of plume above the streamline into which it is emitted:

$$z = \frac{C_B \left(\frac{F_b}{\pi}\right)^{1/2} x^{2/3}}{u} \left(1 + \frac{u\tau}{x}\right)^{1/3} = C_B Br\,(F_b, x, u) \quad , \qquad (3)$$

where,

$C_B \approx 1.6$ is a numerical parameter,

$F_b \approx 86\ \mathrm{m^4\ s^{-3}}$ is the buoyancy flux,

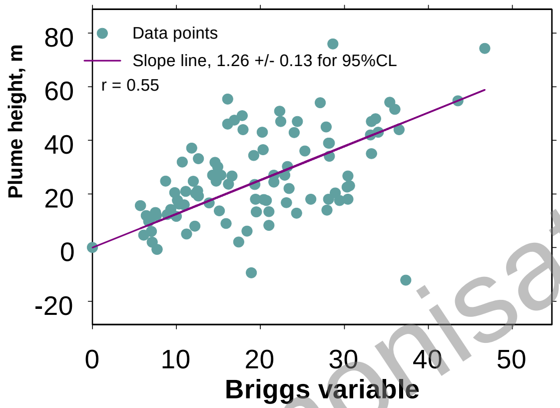
u the wind speed at plume height,

x the distance downwind, and

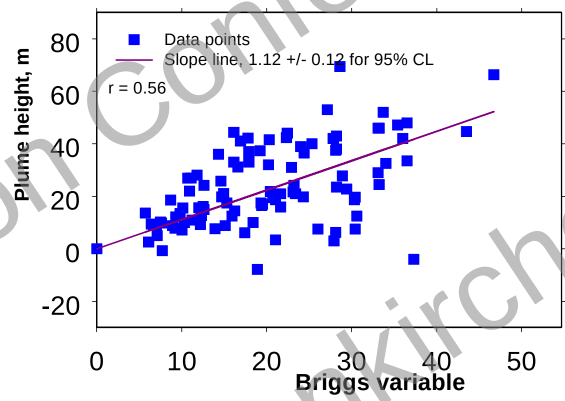
$\tau \approx 1.4$ s the cross-over time from a momentum-dominated jet to a buoyancy-dominated plume.

Plots of plume rise vs. Briggs' variable for Flat, OS, and OS with building correction

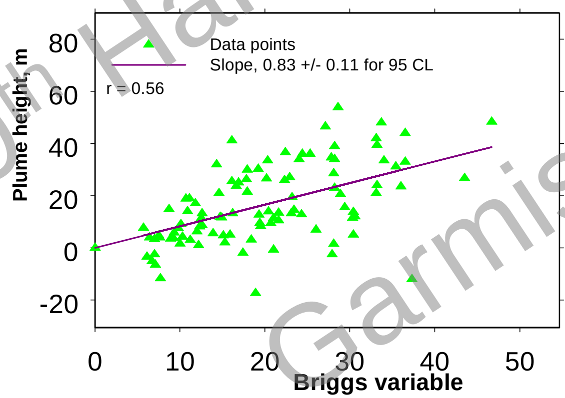
Ht less 61m



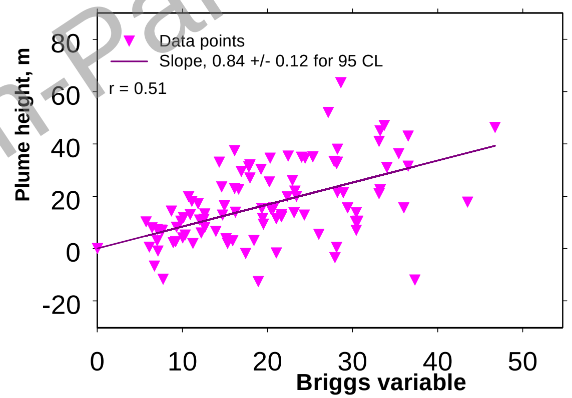
OS ground corrected



Obstacle unsmoothed



Obstacle smoothed



Regression of measured plume rise, Δh, against Br.

Streamline correction	Slope, C_B	Correlation coefficient, *r*	
None	1.26	0.61	$n = 92$
Ground surface	1.12	0.56	
+ buildings	0.83	0.62	
+ smoothed buildings	0.84	0.54	

AERODYNAMIC SURFACE ROUGHNESS

- ***Stull***

  Qualitative table.

- ***Kondo and Yamazoura***

$$z_o = \frac{0.25}{S_T}\sum_{i=1}^{N} h_i s_i = \frac{0.25}{L_T}\sum_{i=1}^{N} h_i w_i \quad , \qquad (1)$$

- ***Macdonald et al***

$$\frac{z_o}{H_o} = \left(1 - \frac{d}{H_o}\right) \exp - \left(0.5\,\beta\,\frac{C_D}{k^2}\left(1 - \frac{d}{H_o}\right)\lambda_f\right)^{0.5} \quad , \qquad (2)$$

- ***Wieringa***

  Gustiness

A summary of the aerodynamic roughness lengths z_o *derived for the site.* *EMcK = Elaine McKinney, KDH = Keith Harsham.*

Method	z_o (m)	Comment
1. Localised, site only, from 1:10000 OS (Ordnance Survey) map. *(e.g. Stull)*	0.25 – 0.8	EMcK
	0.8	KDH
2. Kondo and Yamazoura's method from 1:10000 OS map with 1.5 km radius.	0.08 – 0.2	EMcK
	0.15 – 0.18	KDH
3. Wieringa's method	0.3 – 2.1	Dependent upon wind direction.