

A NEW MODEL VALIDATION DATABASE FOR EVALUATING AERMOD, NRPB R91 AND ADMS USING KRYPTON-85 DATA FROM BNFL SELLAFIELD

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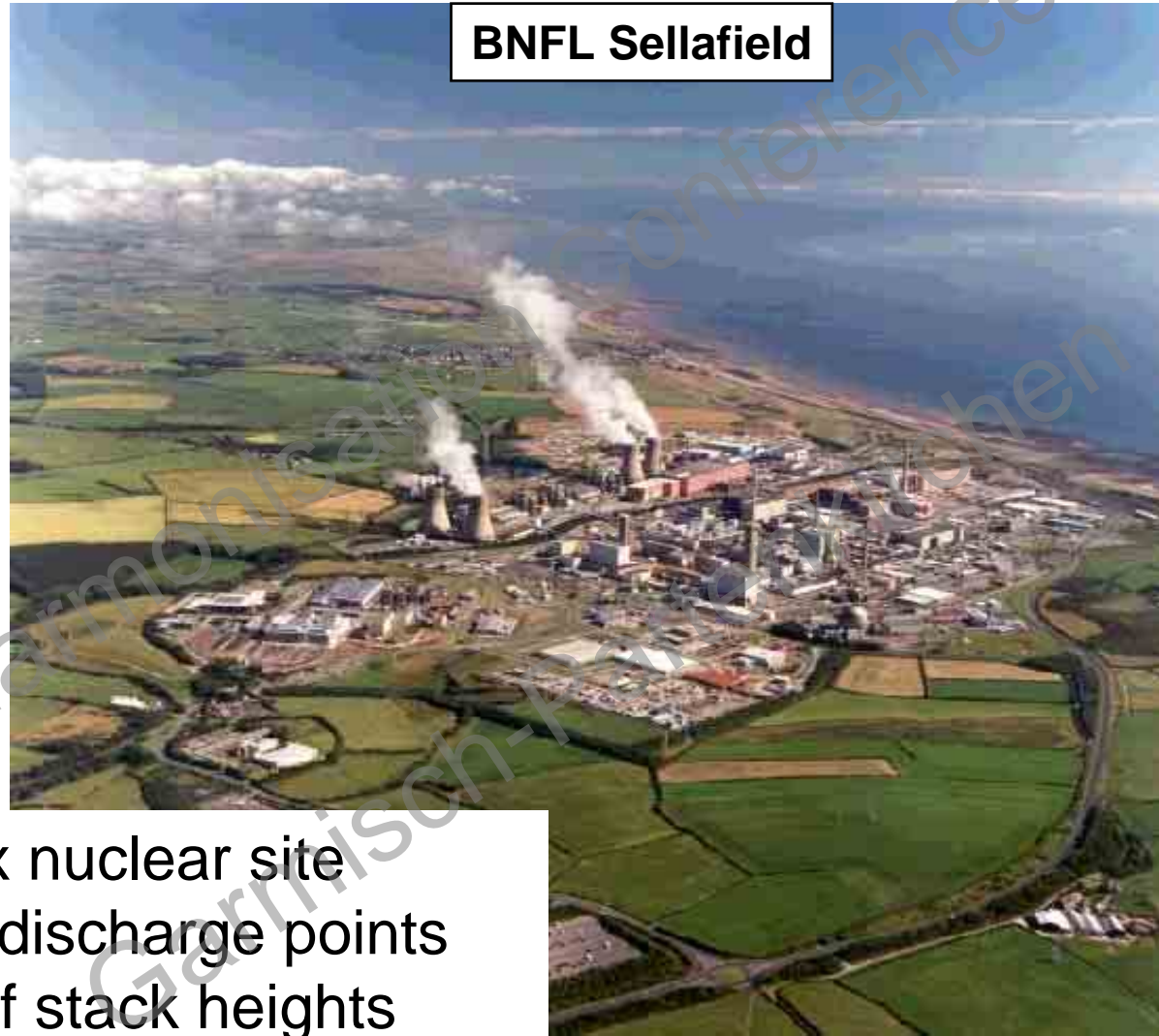
Use of ^{85}Kr for validation

- ◆ 2 main sites in N Europe are Sellafield and Cap La Hague – backgrounds are low!
- ◆ Inert- no deposition or chemical conversion
- ◆ 10.7 year halflife
- ◆ Dose consequences
 - ◆ 99% of radioactivity discharged
 - ◆ <6% of the critical group dose (< 8 micro Sv)

Use of ^{85}Kr for validation

- ◆ **The main advantage...**
 - ◆ **This is validation using real emissions from a real site**
- ◆ **The main disadvantage...**
 - ◆ **Measurements are time consuming (1 day per sample!)**

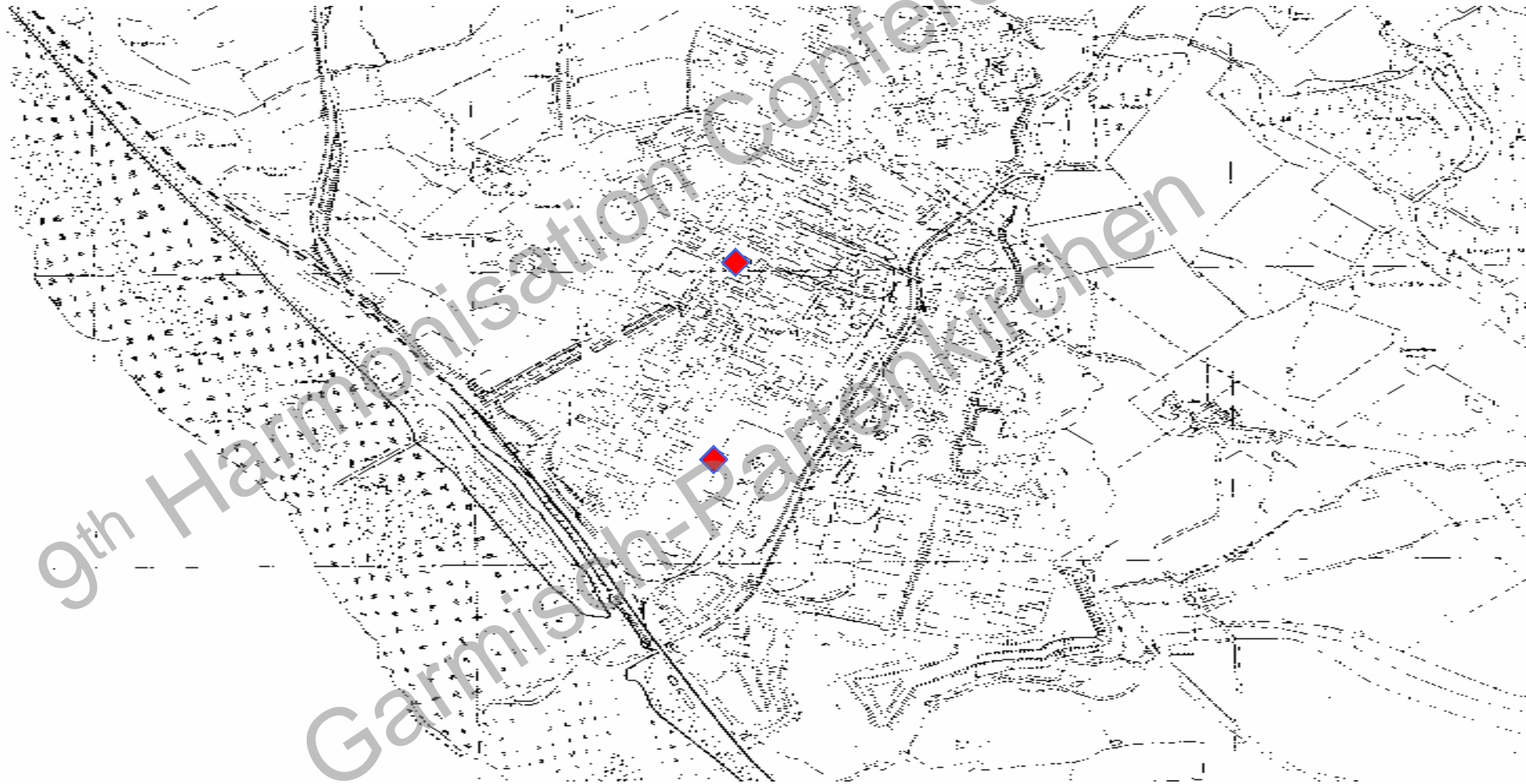
Background- the site



- Complex nuclear site
- Multiple discharge points
- Range of stack heights
- Building effects
- Coastal effects

Use of ^{85}Kr for validation

- ◆ Known locations on site



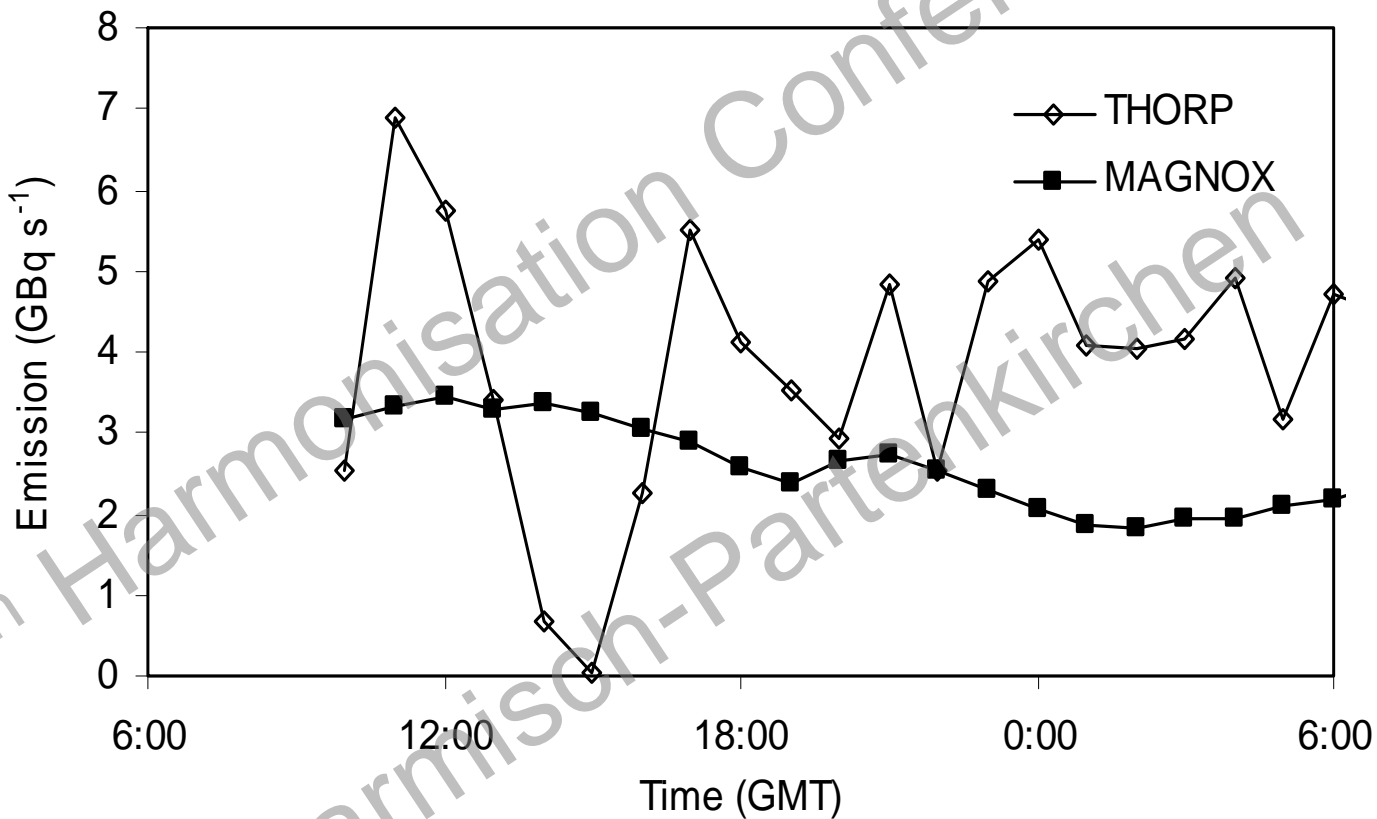
- ◆ Non-buoyant release



Certificate No. Q12990

Emission of ^{85}Kr

- ◆ Detailed emissions monitoring from both stacks



Measurement of ^{85}Kr in air

- ◆ Crude separation
- ◆ Fine separation
- ◆ β scintillation
- ◆ Discreet sampling



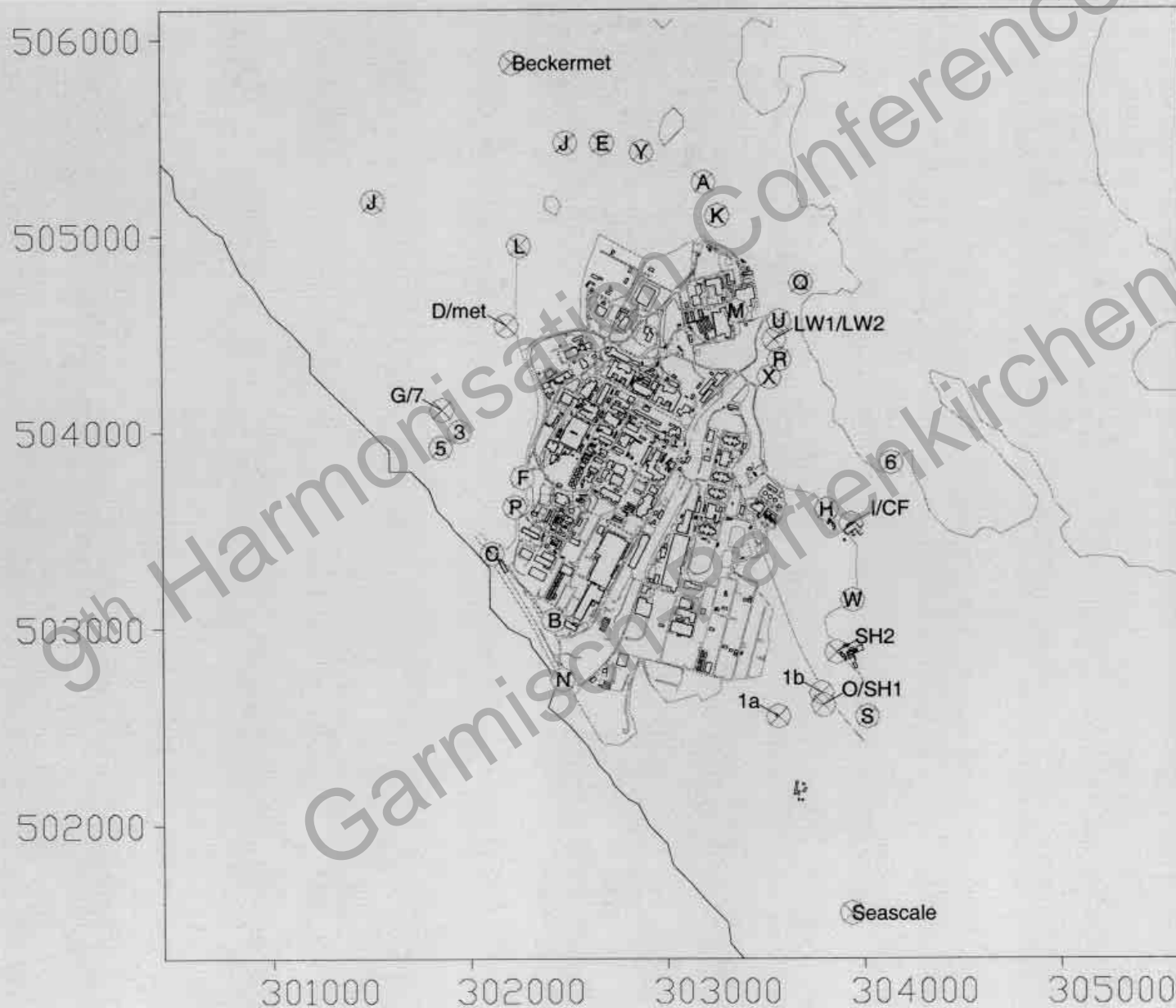
PTFE sample bag

Nitrogen cooled
molecular sieve trap

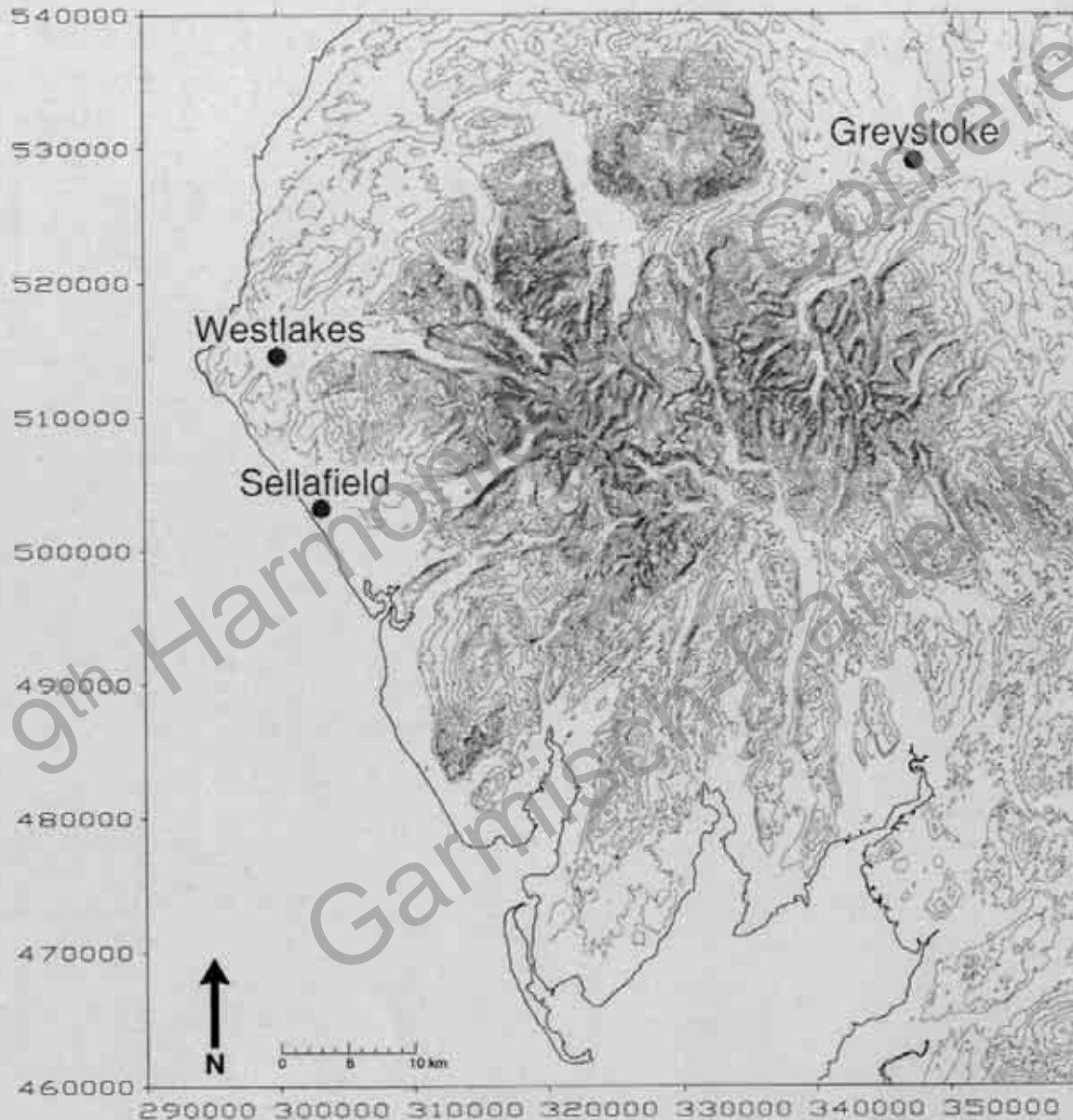
H₂O trap

Activated charcoal
trap

Measurement Sites- Local dispersion

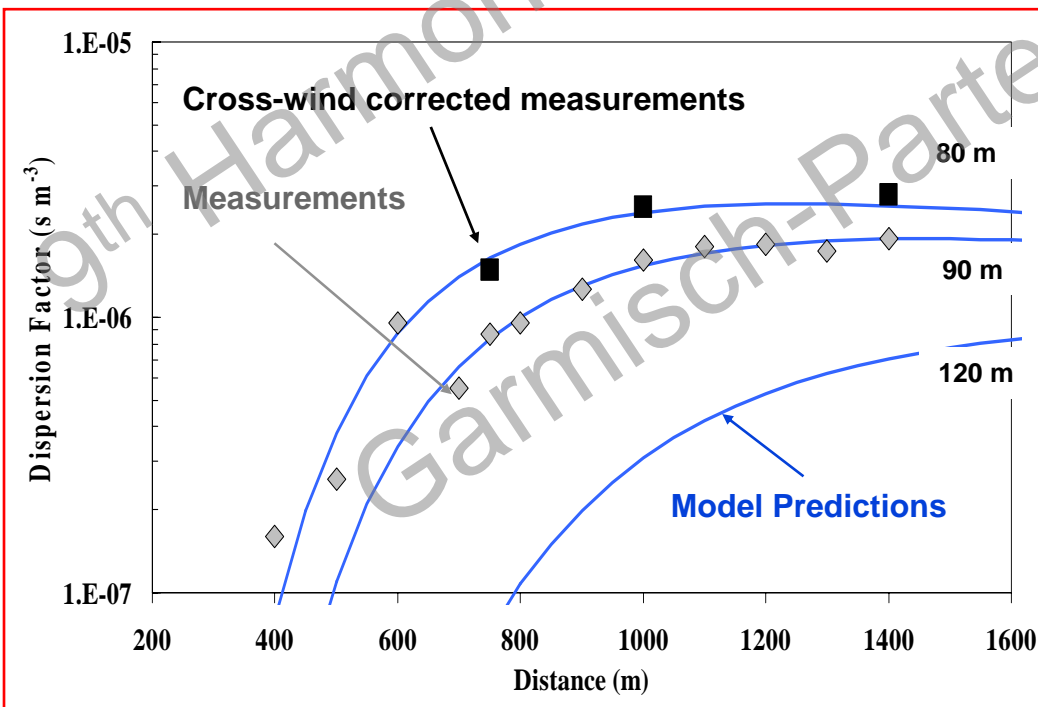


Measurement Sites- Regional dispersion



Modelling Methods- R91

- Site effects
- Effective stack height method
- THORP
 - Physical 125m
 - Effective 92.5m
- MAGNOX
 - Physical 122 m
 - Effective 80 m



Modelling Methods- R91

- Meteorological data
- 48 m meteorological mast
- Wind speed, temperature and wind direction gradients
- Flux-profile estimate of L_{MO}
- Estimation of stability class from L_{MO} using Golder (1972)
- Sigma theta included in optimised configuration



9th Harmonisation Conference
Garmisch-Partenkirchen

Modelling Methods- AERMOD

• Site effects

- Effective stack height method
- BPIP/ PRIME
- 2 different model kernels

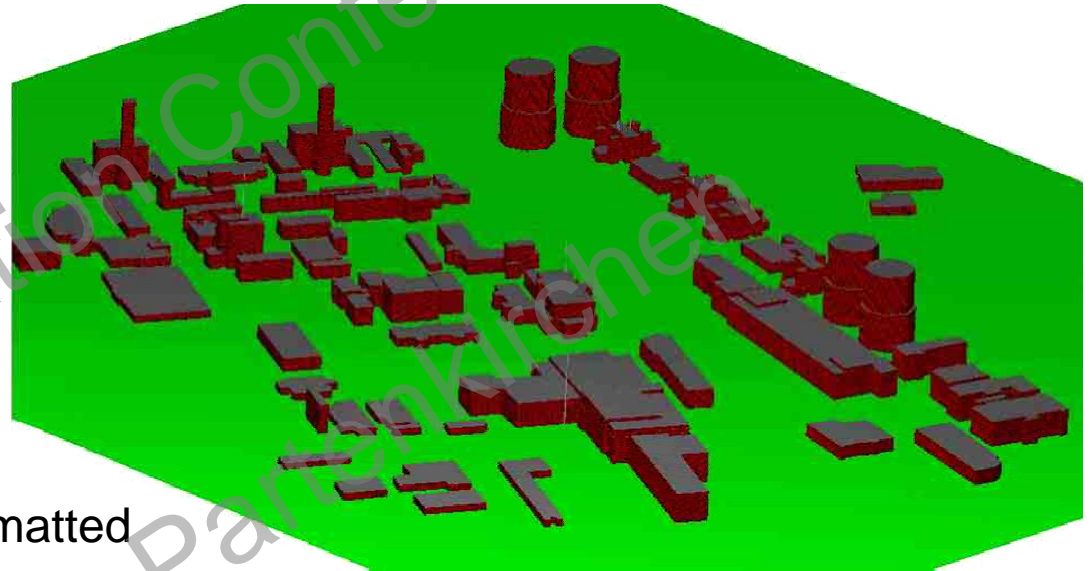
• Meteorological data

• Problems

- Rigid and complex US met formatted data
- Met office converter available but requires cloud cover

• Solutions

- Back estimated cloud cover from solar radiation
- Compiled “profile” data from 10 minute data at each height



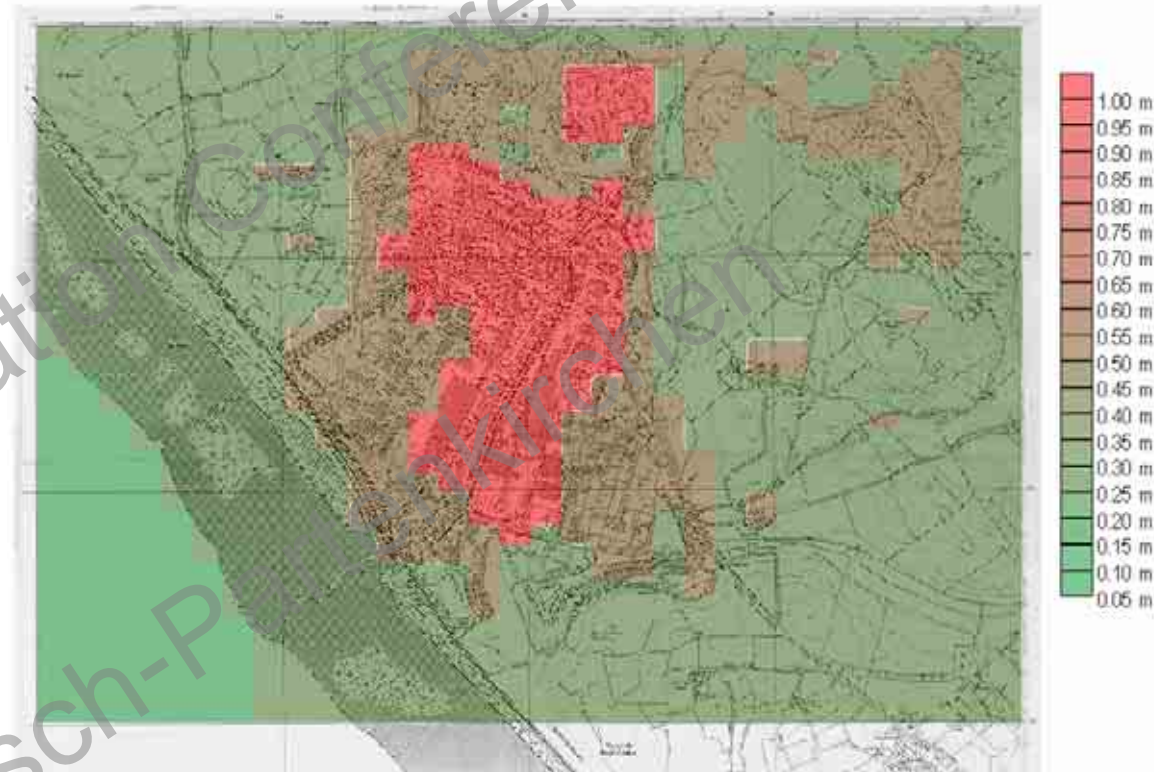
Modelling Methods- ADMS

• Site effects

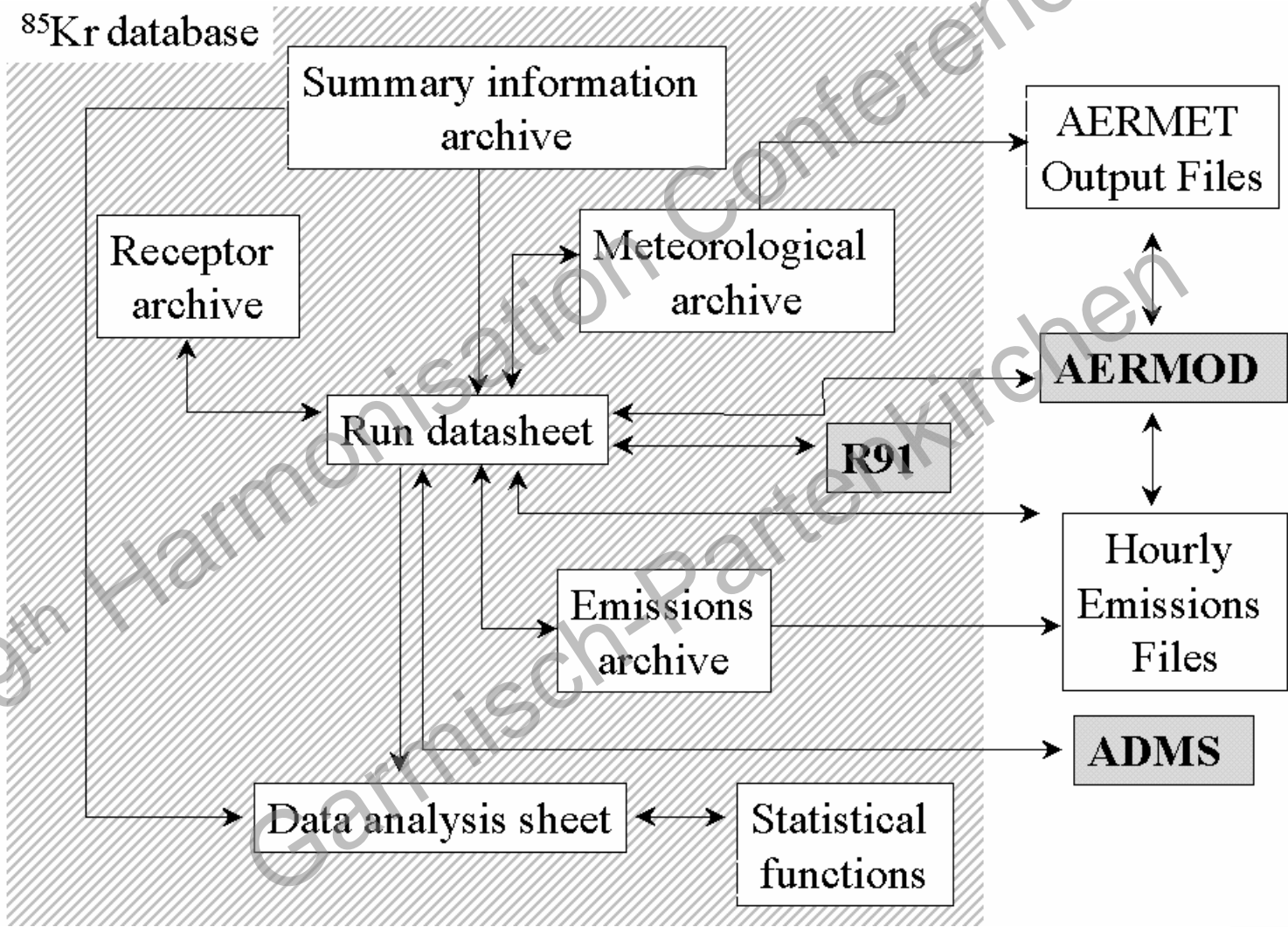
- Effective stack height method
- Main building
- Roughness length map
- Coastline

• Meteorological data

- Can use flexible user formatted met data (L_{MO} , U10, WDIR, SIGMATHETA)
- Much easier to import than AERMOD



Database Structure



Database functionality

The screenshot displays the Microsoft Excel interface with a custom dialog box titled "Select Worksheets" overlaid. The dialog box is divided into several functional areas:

- Select Worksheets:** A list of worksheet names, including 010200_1, 010299_1, 010300_1, 010300_2, 010399_1, 010697_1, 011298_1, 020200_1, 020299_1, 020399_1, 020497_1, 020497_2, 020697_1, 020899_1, 020899_2, 020996_1, 021298_1, 021299_1, 030698_1, 030698_2, 030899_1, 030998_1, 030999_1, 040398_1, 040697_1, 040899_1, 041099_1, 041099_2, 041198_1, 050297_1, and 050397_1. Below the list is a "Worksheet" dropdown menu.
- Editing:** Contains buttons for "Create DataSheets", "Data Analysis", "Delete Results", "Hide Sheets", and "Show Sheets". It also features two checked checkboxes: "Automatically run R-91" and "Include graph".
- Modelling:** Contains buttons for "Work With ADMS", "Work With AERMOD", and "Run R-91".
- Navigation:** Buttons for "Select None", "Quick Sort", "View Sheet", and "Advanced Sort" are located at the bottom of the dialog.

The Excel window title is "Microsoft Excel - Krypton data archive V3_3_Aermod_paper.xls". The status bar at the bottom shows "Ready" and "CAPS NUM".

Database functionality- ADMS

Microsoft Excel - Krypton data archive V3_3_Aermod_paper.xls

File Edit View Insert Format Tools Data Window Help

Working with ADMS

Create Files For Running ADMS Import ADMS data

Results directory c:\progra~1\cerc\adms3\runs\kr85\ncfx31\

Select a simulation identity number 5

Caption for simulation ADMS CFX ST

Which stacks were modelled BOTH

Import Data

Exit Form

Worksheet

Select N

View Sheet Advanced Sort

Ready

MACROS /

CAPS NUM



Certificate No. QJ3950



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Database functionality - AERMOD

Microsoft Excel - Krypton data archive V3_3_Aermod_paper.xls

Work with AERMOD

Create Files For Running AERMOD | Run and Import AERMOD data

Select a simulation identity number: 98 Kernel ESH

Select a simulation identity number: 3

Caption for simulation: R91 AC-OPT

Run AERMOD

Import Data

Exit Form

Worksheet: Select N, View St

Ready | MACROS | CAPS NUM

Database functionality - Selecting results

The screenshot displays the Microsoft Excel interface with a 'Select Worksheets' dialog box open. The dialog box is titled 'Select Worksheets' and contains a list of worksheets. The 'Advanced Sort Options' dialog box is also open, showing the following settings:

- Sort By: Site
- Then Sort By: Duration (hours)
- Then Sort By: Meas

The 'Advanced Sort Options' dialog box has 'OK' and 'Cancel' buttons. The 'Select Worksheets' dialog box has 'Select None', 'Quick Sort', 'View Sheet', and 'Advanced Sort' buttons. The background shows a list of worksheets in the 'Select Worksheets' dialog box, including:

- 010200_1
- 010299_1
- 010300_1
- 010300_2
- 010399_1
- 010697_1
- 011298_1
- 020200_1
- 020299_1
- 020399_1
- 020497_1
- 020497_2
- 020697_1
- 020899_1
- 020899_2
- 020996_1
- 021298_1
- 021299_1
- 030698_1
- 030698_2
- 030899_1
- 030998_1
- 030999_1
- 040398_1
- 040697_1
- 040899_1
- 041099_1
- 041099_2
- 041198_1
- 050297_1
- 050397_1

The 'Advanced Sort Options' dialog box is also showing 'ADMS' and 'AERMOD' buttons, and a 'Run R-91' button.

Summary of model configurations

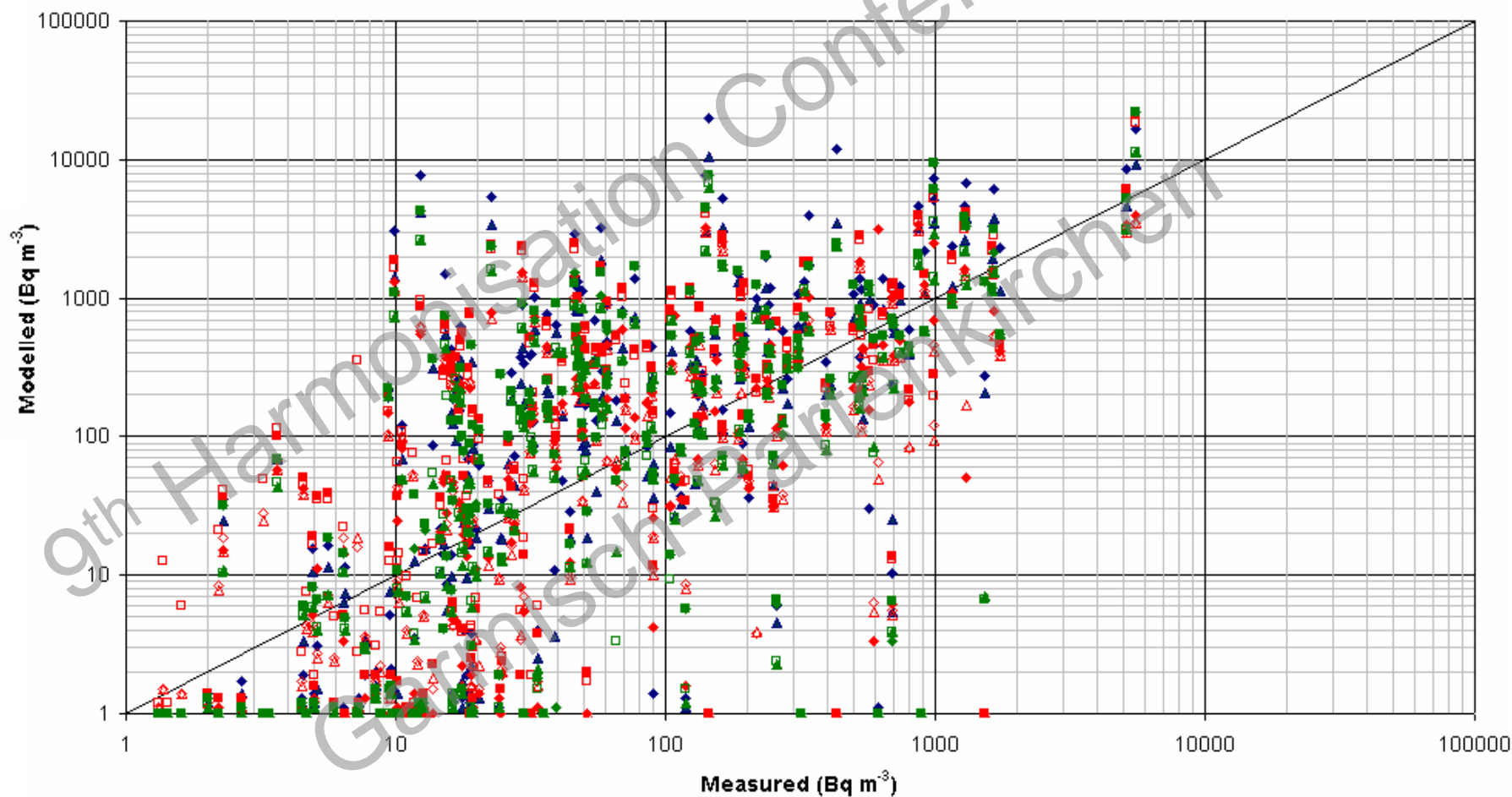
- ◆ **NRPB R91 (2)**
 - ◆ **Standard on axis simulations**
 - ◆ **Modified- wind speed at stack height and measured sigma theta values**
- ◆ **ADMS (5)**
 - ◆ **Effective stack height (ESH)**
 - ◆ **ESH with coastlines**
 - ◆ **BUILD, Flat terrain, roughness (local)**
 - ◆ **BUILD, Terrain heights, roughness (local)**
 - ◆ **ESH and Terrain heights (regional)**

Summary of model configurations

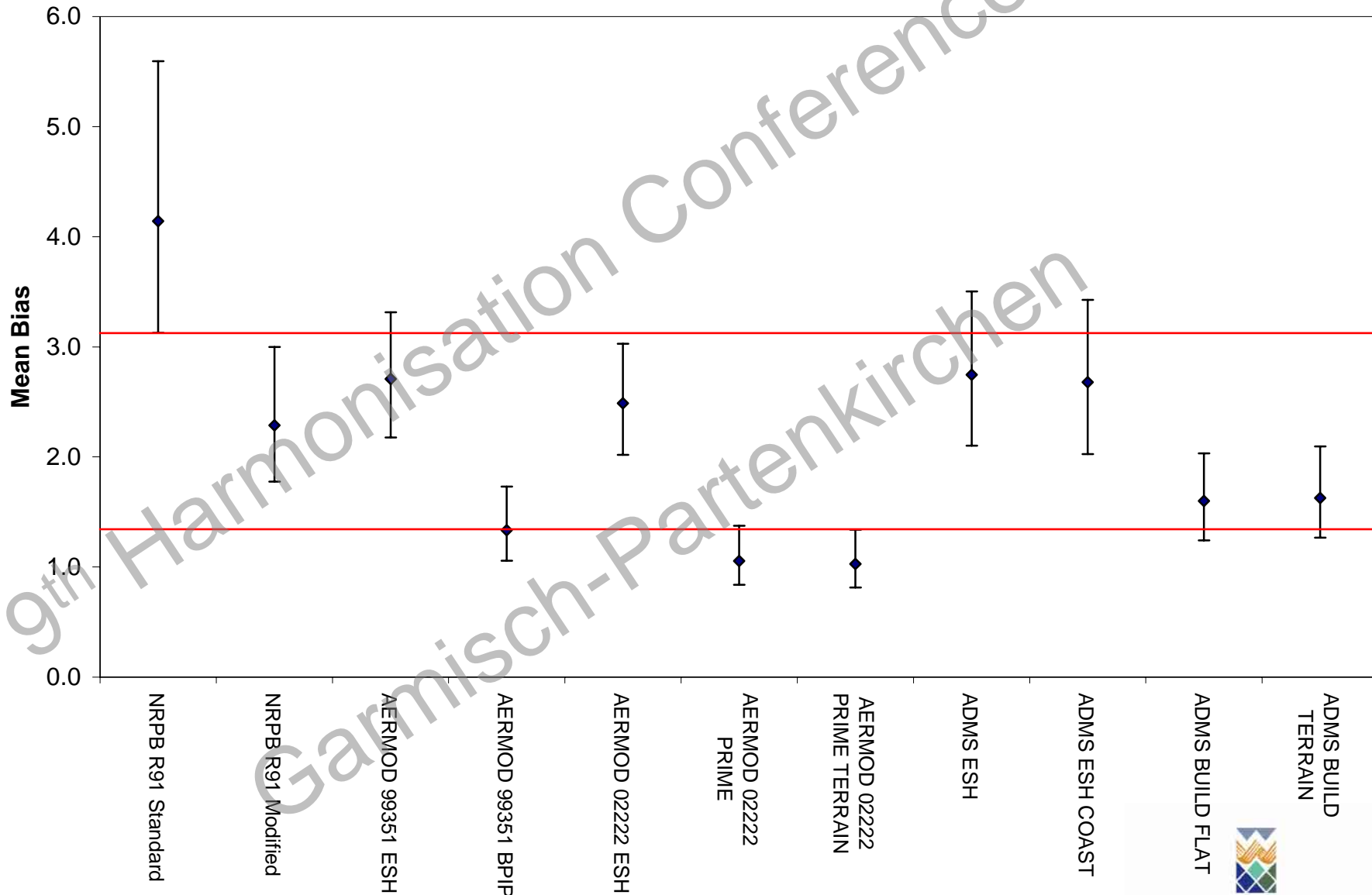
◆ AERMOD (5)

- ◆ Version 99531ESH
- ◆ Version 99531BPIP
- ◆ Version 02222 ESH
- ◆ Version 02222 PRIME
- ◆ Version 02222 PRIME and Terrain heights

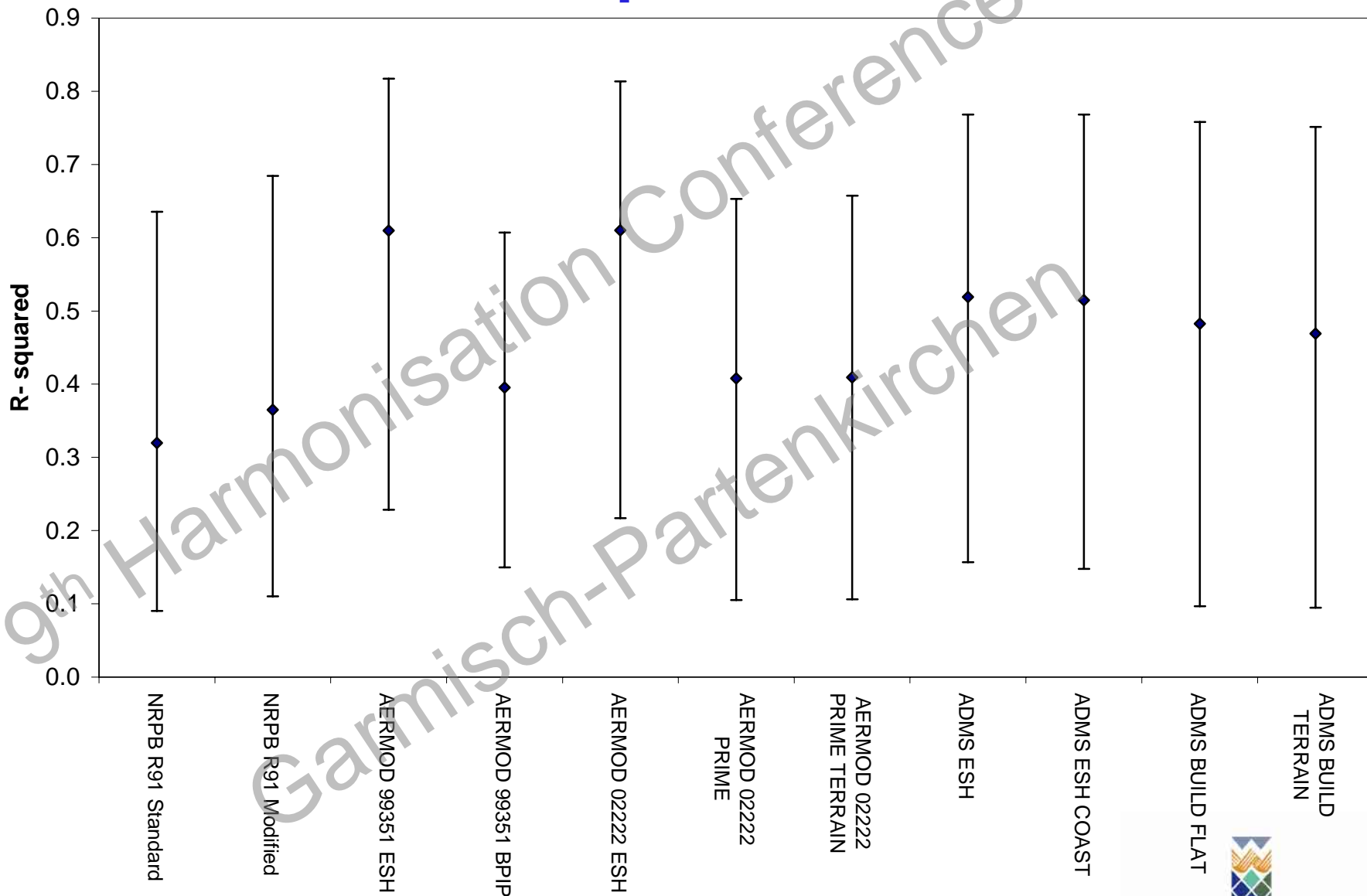
Results for local dispersion



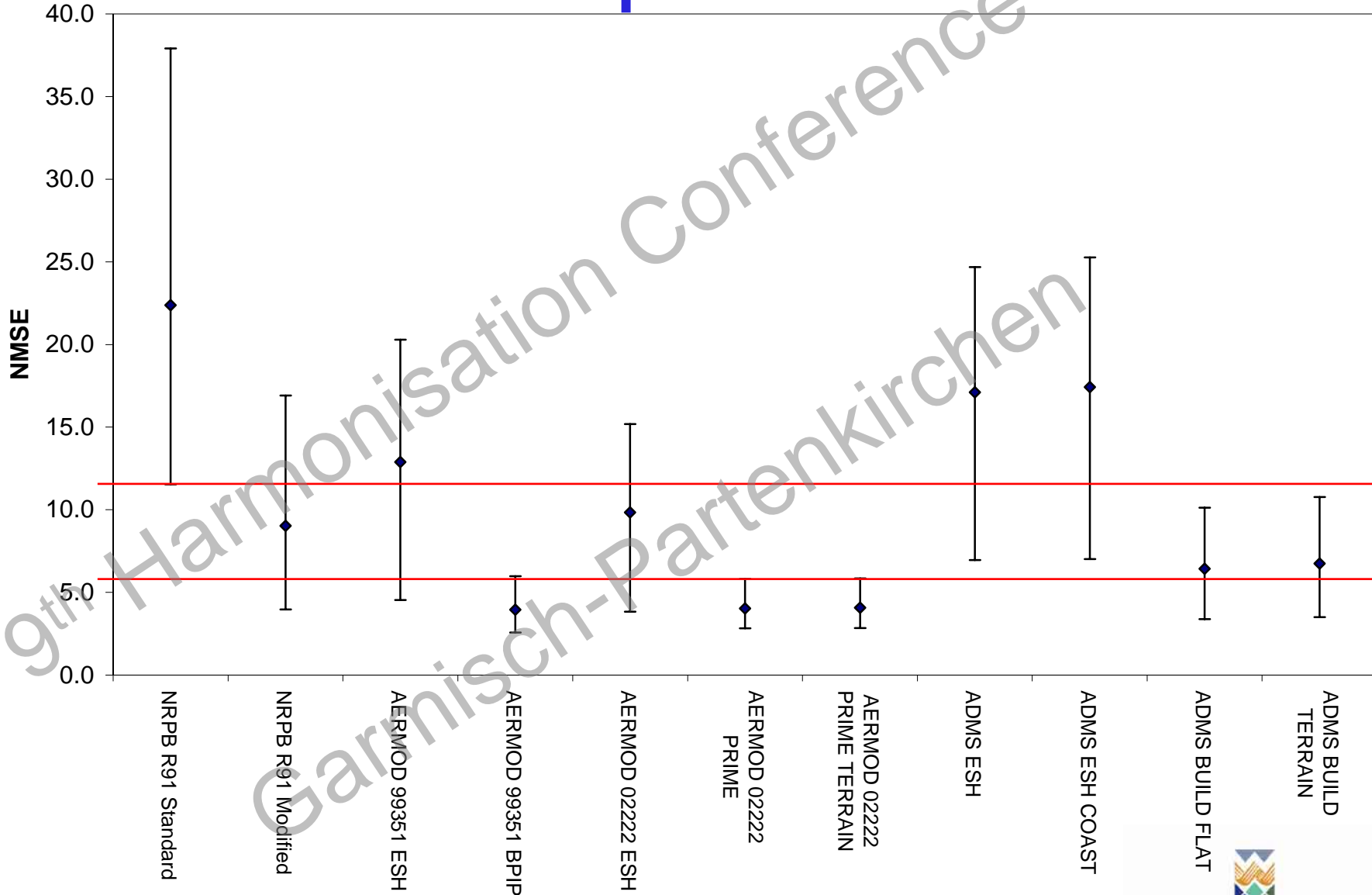
Results for local dispersion- statistics



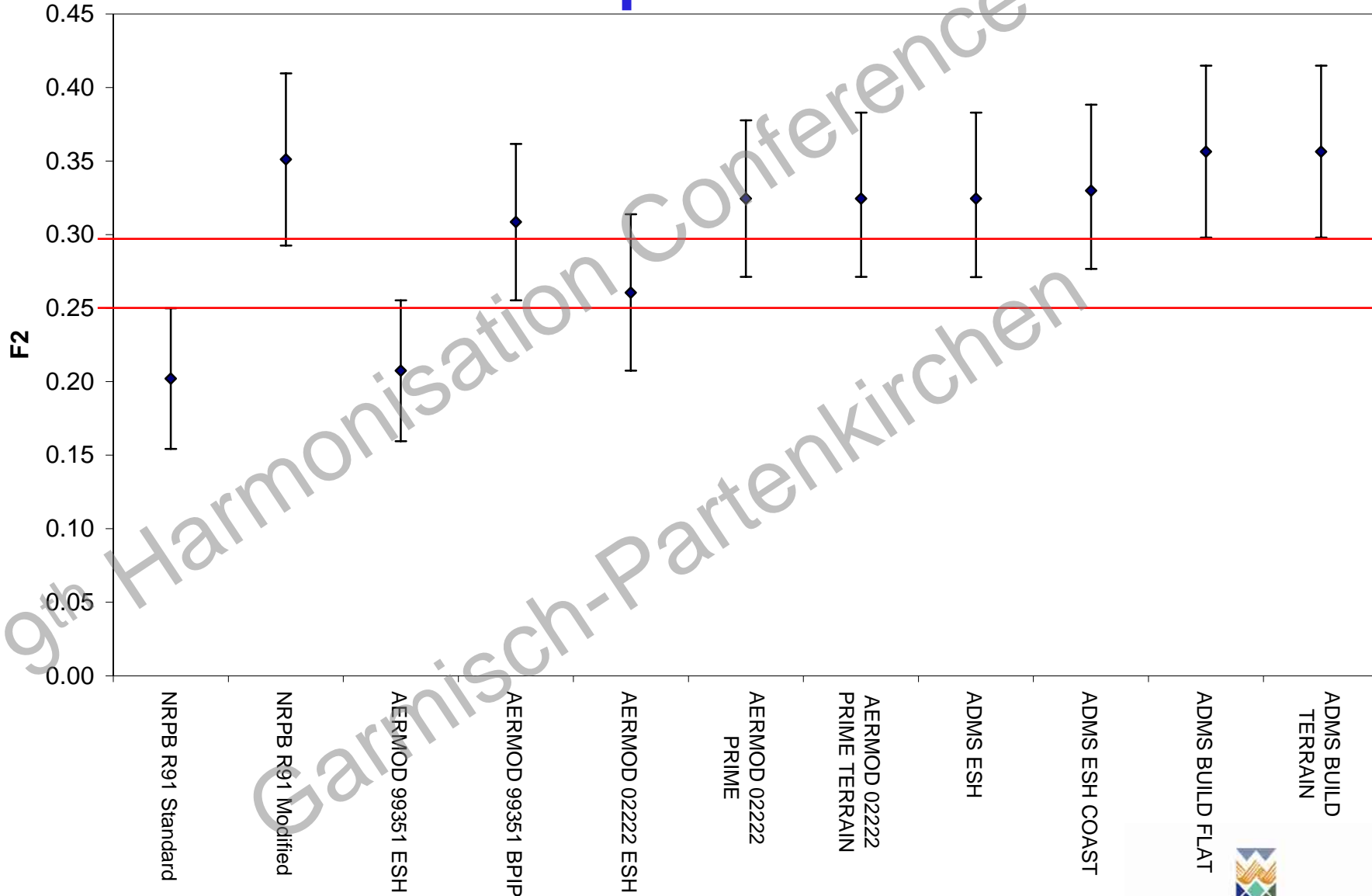
Results for local dispersion- statistics



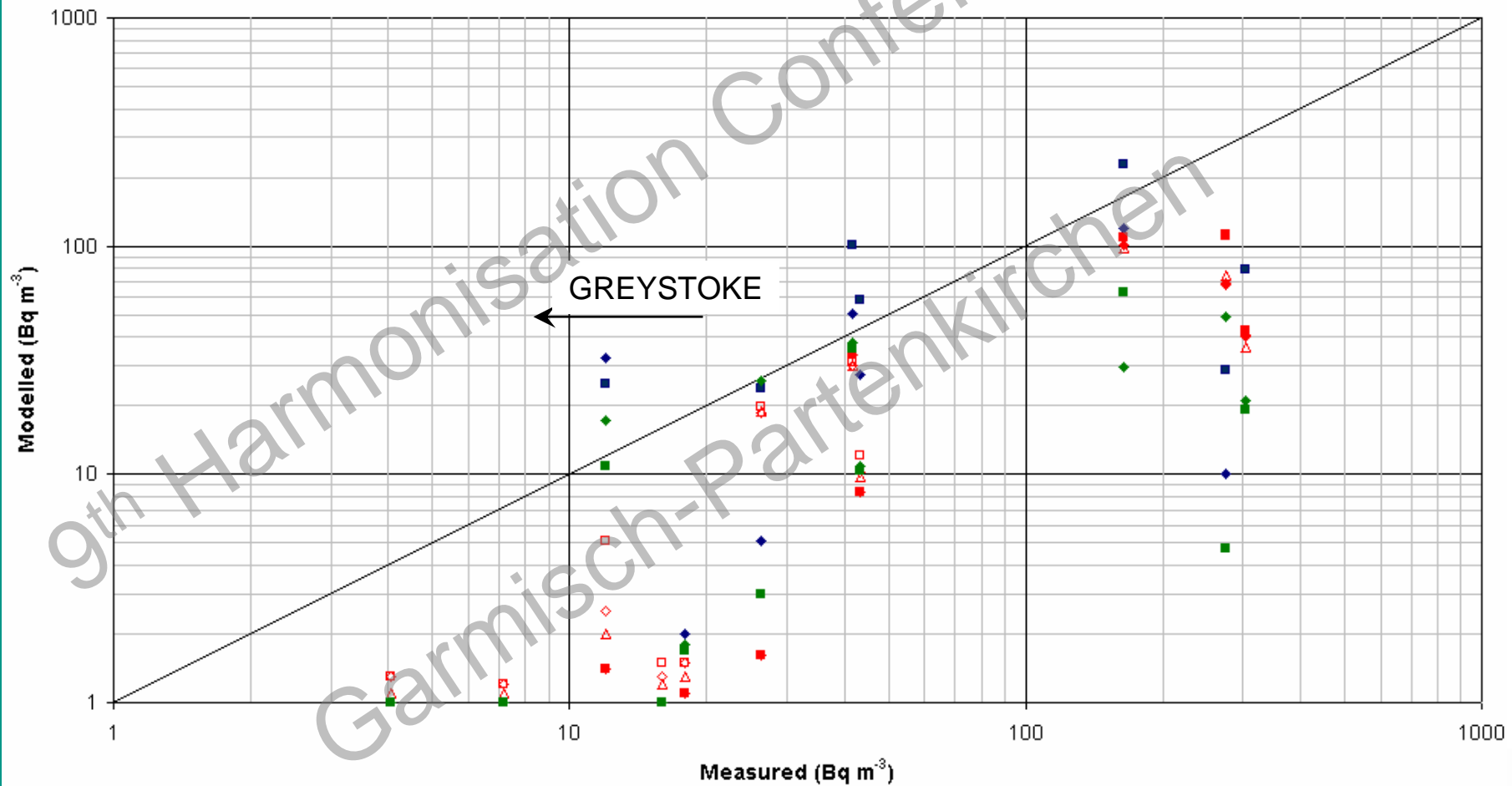
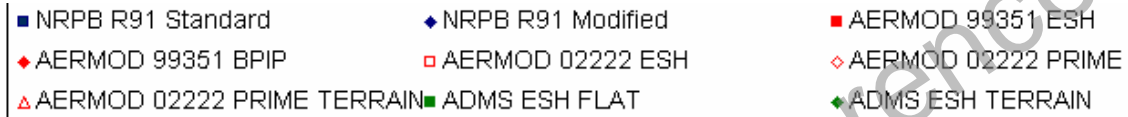
Results for local dispersion- statistics



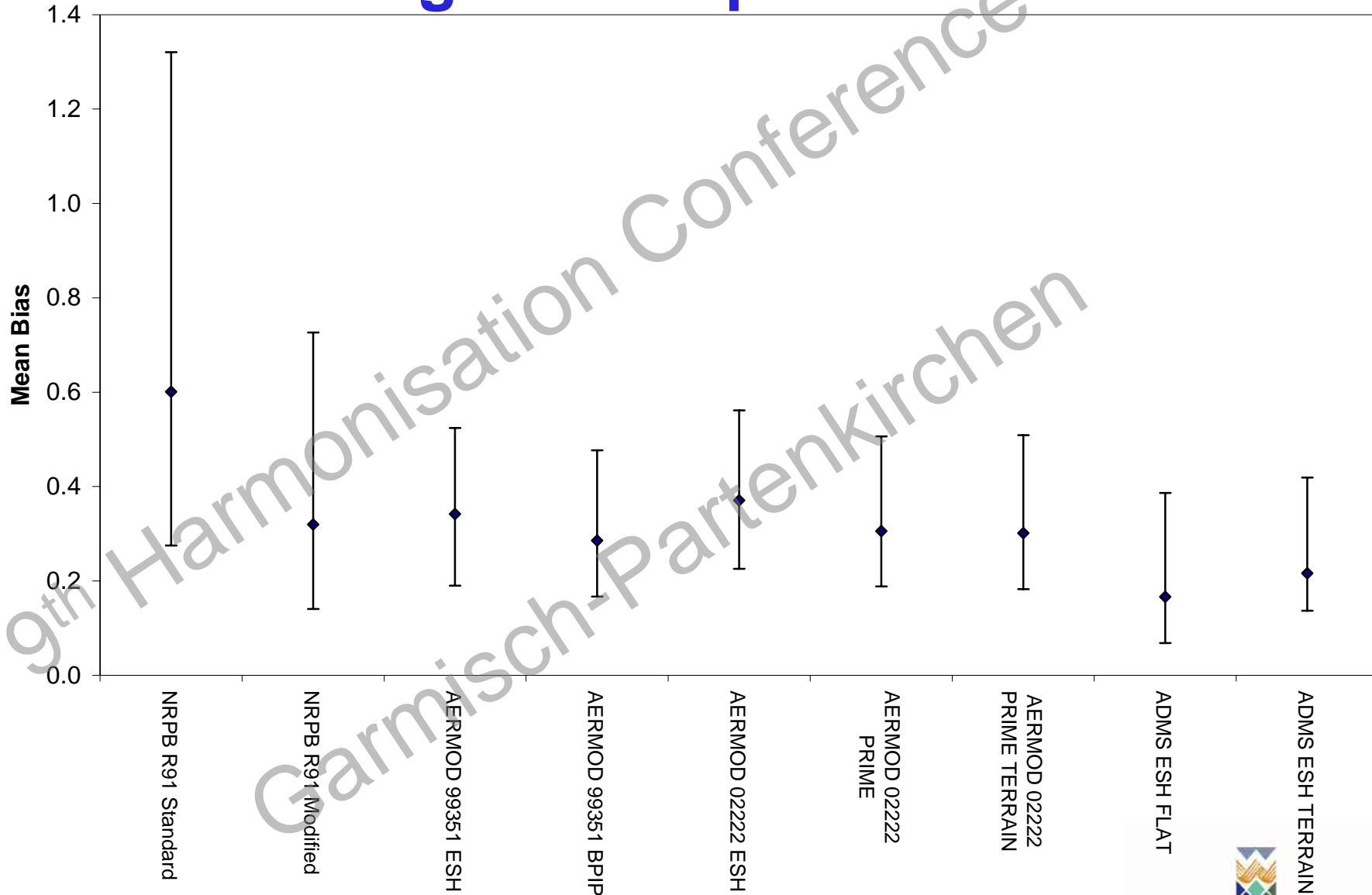
Results for local dispersion- statistics



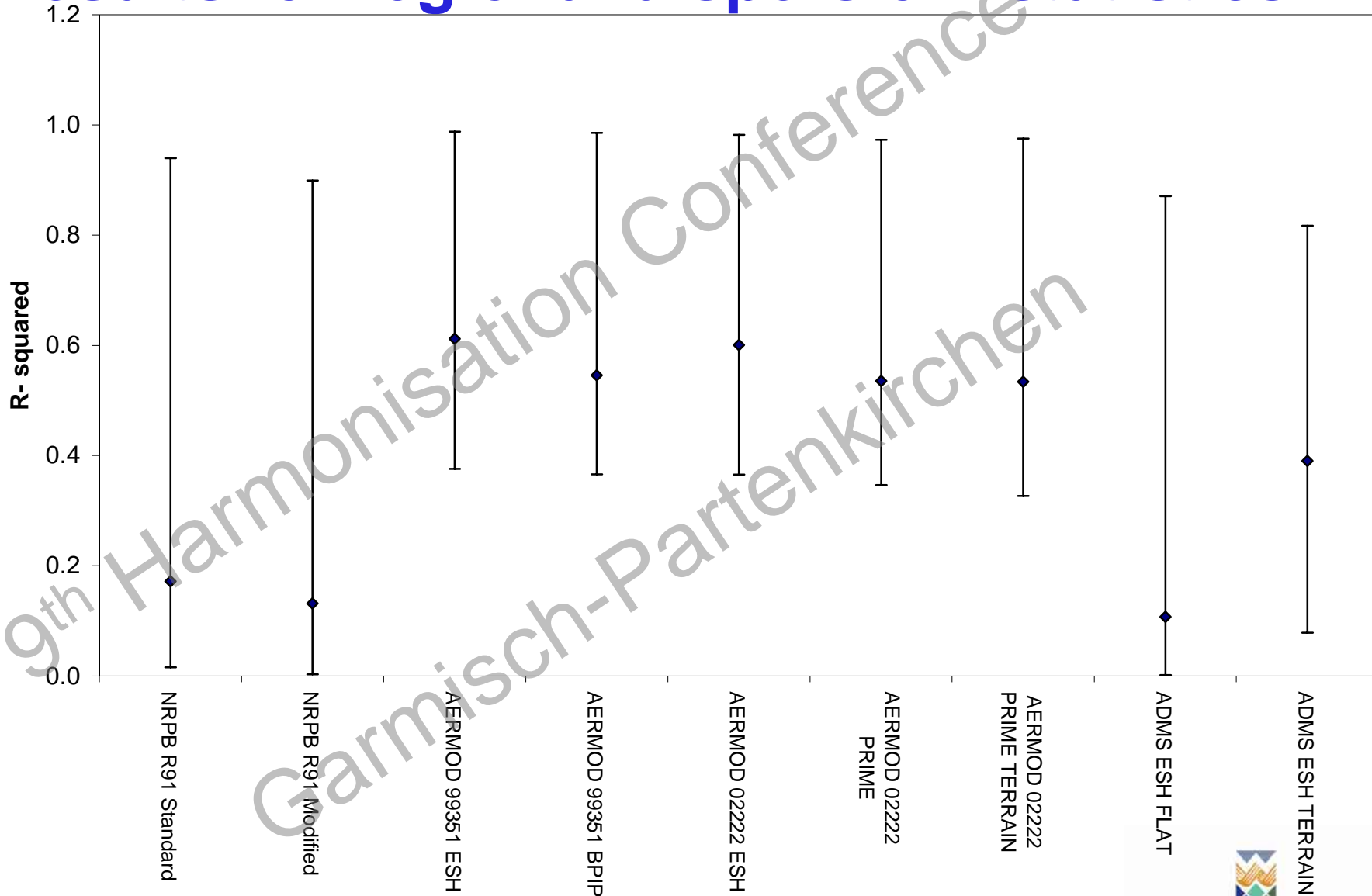
Results for regional dispersion



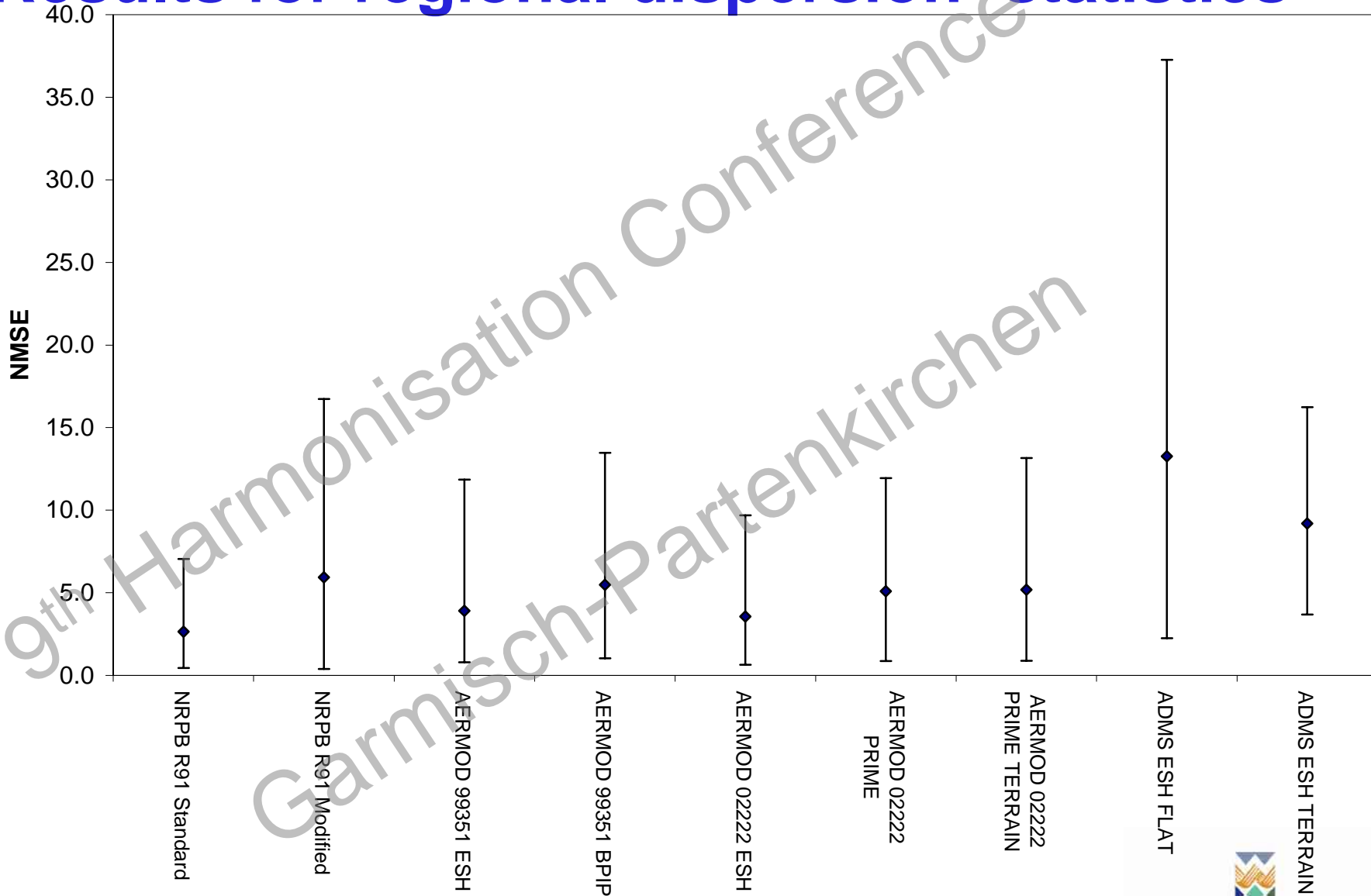
Results for regional dispersion- statistics



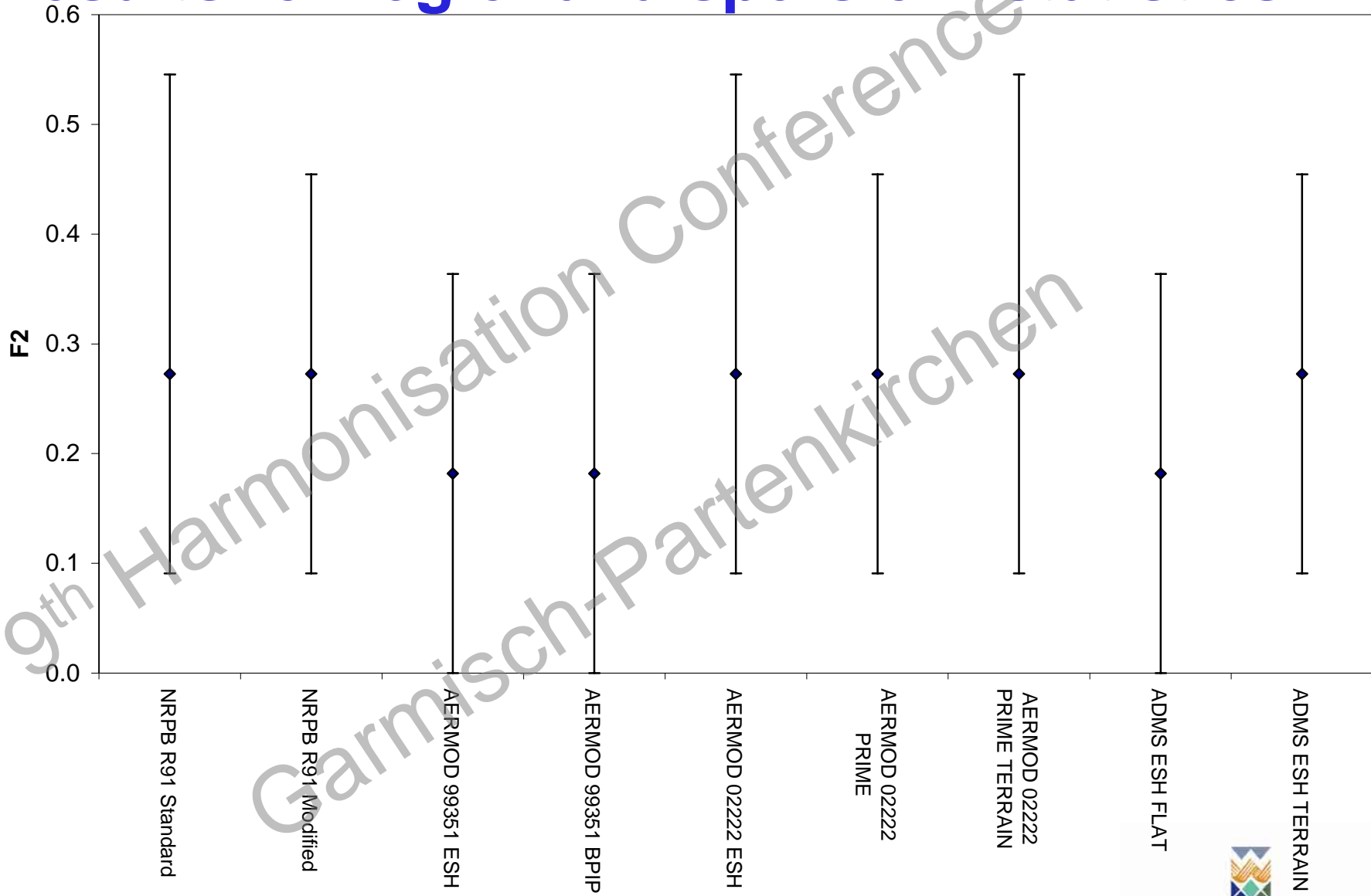
Results for regional dispersion- statistics



Results for regional dispersion- statistics



Results for regional dispersion- statistics



Conclusions

- A model validation database has been developed using the ^{85}Kr release from the BNFL Sellafield site as a tracer.
- For dispersion within a few kilometres of the site configurations of ADMS and AERMOD using their buildings and terrain modules were found to outperform the effective stack height configurations.
- When effective stack heights were used, the modified configuration of the NRPB R91 model was found to provide similar results to the AERMOD or ADMS models.
- For dispersion over longer distances no statistically significant differences were found between the model configurations though further model validation experiments at a regional scale are required.