# CRITICAL EVALUATION OF CZECH ODOUR DISPERSION MODEL COMPARISON WITH OTHER APPROACHES



**Josef Keder**

*Czech Hydrometeorological Institute*

CHMI

# Overview

- Motivation
- Adaptations of Czech SYMOS´97 model for odour modelling
- Comparison with advanced model - procedure
- Results of comparison - examples
- Conclusions, ideas for further work

# Motivation – odours as a serious social problem

# Model adapted

- The gaussian dispersion model SYMOS'97, used as a reference modelling method in Czech, adapted for odour dispersion modelling *http://air-climate.eionet.eu.int/databases/mds.html* )
- Model designated for calculations of dispersion of passive buoyant, continuous release from single or multiple sources (point, area or line) sources.
- Five stability classes by Czech national stability scheme applied within the model.
- The system enables , among others, the calculation of maximal possible hourly concentration
- Complex terrain corrections based on digital terrain model included as a routine part of model calculations.

# Adaptation of SYMOS´97 (1)

- Odour subjective perception by humans proportional to the instantaneous peak concentration of the odorant rather then to mean values (well known and documented in the literature anywhere)
- SYMOS model, similarly as other dispersion models of this class, is set for calculation of hourly mean concentrations
- **The basic procedure how to modify the SYMOS for odour concentration**: recalculation of hourly means reached in particular hours into corresponding peak values which might occur during these hours
- Widely used peak-to-mean ratio (P/M ratio) approach (e.g. *Katestone Scientific,1998*) selected as suitable solution of this task, (*Keder, 2003*)

# Adaptation of SYMOS´97 (2)

- The main advantage of the proposed approach: most input data management and calculation procedures included in the SYMOS modelling system could be maintained.
- The procedure
  - → fields of maximum possible hourly concentrations calculated from the input data on source parameters and meteorology
  - → corresponding stability category recorded for each grid value
  - → output concentration field is subsequently recalculated into peak values using the set of peak-to-mean ratio coefficients
  - → coefficients value depends on the source type, stability class and on the distance of the reference point to the source
- Set of P/M ratios, derived by Katestone Scientific (*Freeman and Cudmore, 2002*), has been selected and incorporated into model

# Validation against measured data

- Presented at HARMO 10, Crete, 2005
- Result: despite of relative simplicity of adaptation procedure, the model provides **reasonable results applicable in the practice**
- *At least for neutral stability and in flat terrain*
- Validation for other conditions is of great interest
- **Problem**: lack of approprite data sets
- **Solution**: comparison with some more sophisticated approach used

# Model selected: ADMS 3.3

- ADMS, version 3.3, e.g. *CERC, 1999* and later
- Advanced Gaussian model
- Fluctuation module included
- Computes concentration STDs, PDFs and percentiles
- Enables advanced modelling, among others odours

# Comparison procedure - basic features

- Flat terrain, agricultural area, surface roughness 0.3 m
- Latitude $50^0$
- Area size: 1500 x 1000 m
- Stable, neutral and convective conditions
- Elevated point and ground-based area source

# Parameters of sources – point source

- **Elevated point source**
- Height 10m
- Diameter 1.5m
- Effluent temperature $25^0$C
- Exit velocity 4 m/s
- Emission rate 25 000 $OU_e$/s

# Parameters of sources – area source

- **Ground-based area source**
  - Height 1 m
  - Area 10x10 m
  - Effluent temperature $20^0$C
  - Exit velocity 1 m/s
  - Emission rate 25 000 $OU_e$/s

# Meteorology (ADMS default)

- Wind direction: west
- Wind velocity:

2 m/s for stable and convective, 5 m/s neutral

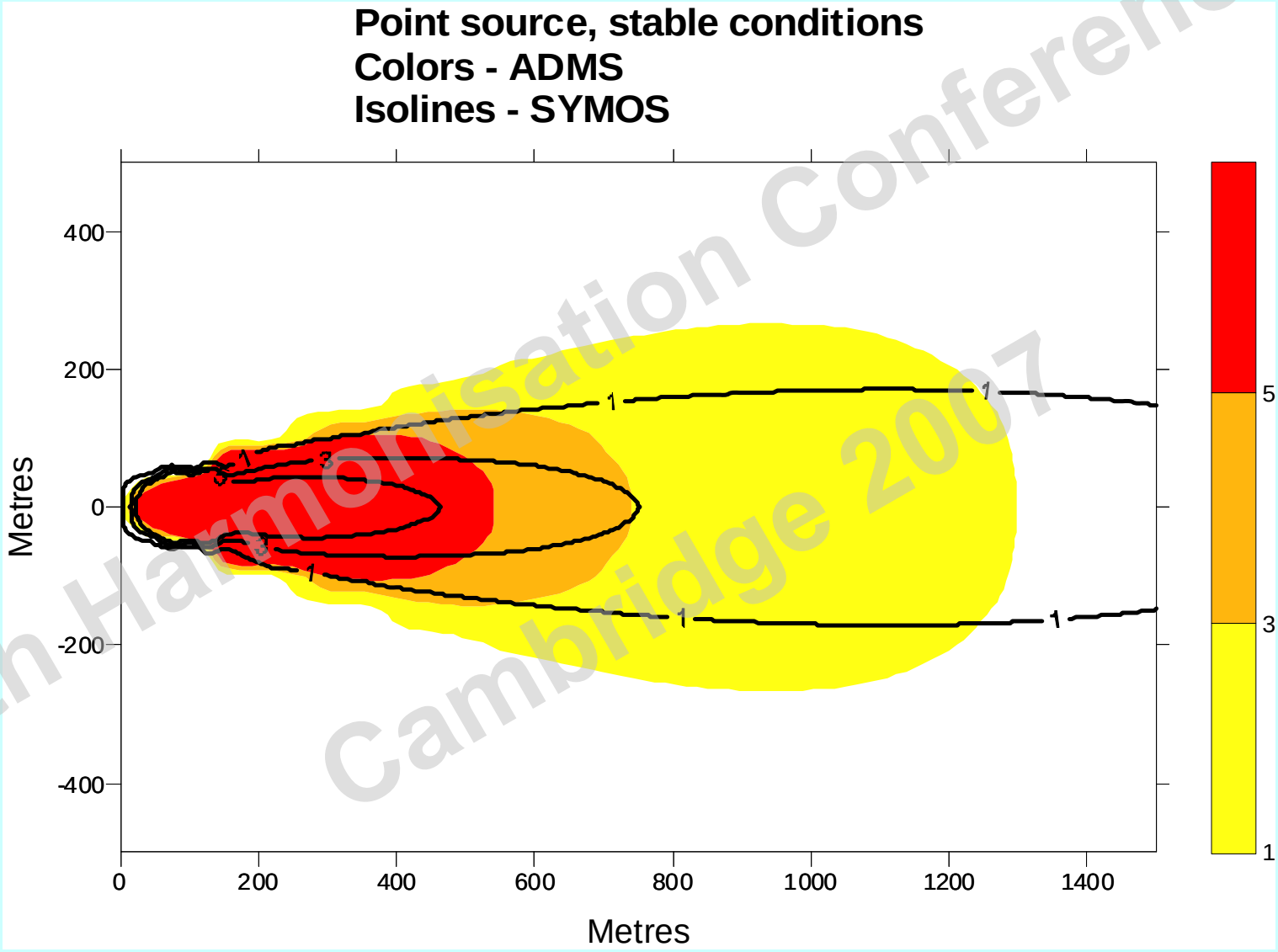
- Mixing height

900m convective, 800m neutral, 100m stable

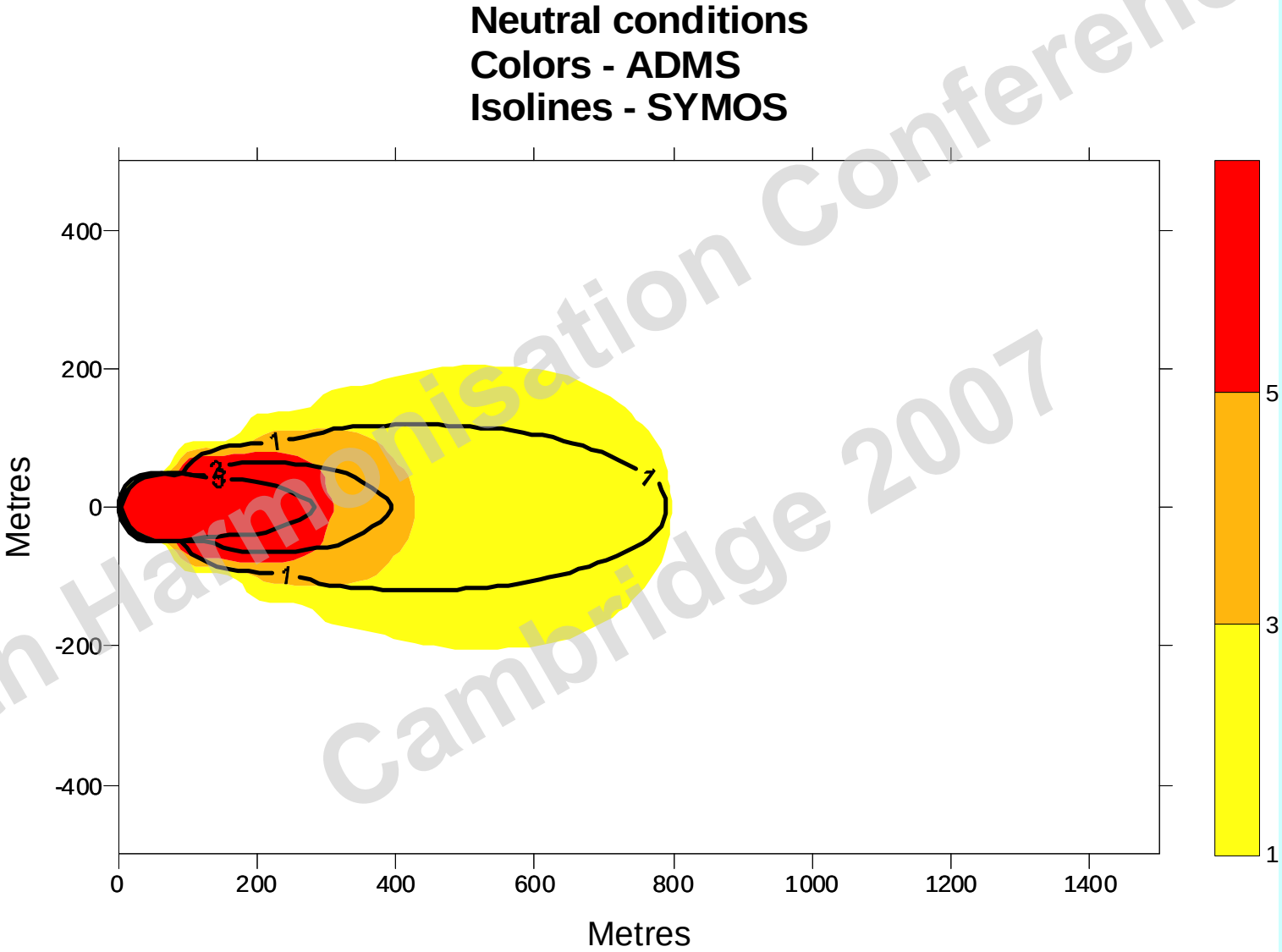
# Data compared

- **SYMOS**: maximum peak odour concentrations recalculated from hourly means by P/M ratio coefficients (SYMOS approach)
- **ADMS**: Percentile 99% taken as maximum peak concentration estimate
- **Odour concentration 2D fields and ground concentraions profiles under plume axis compared**

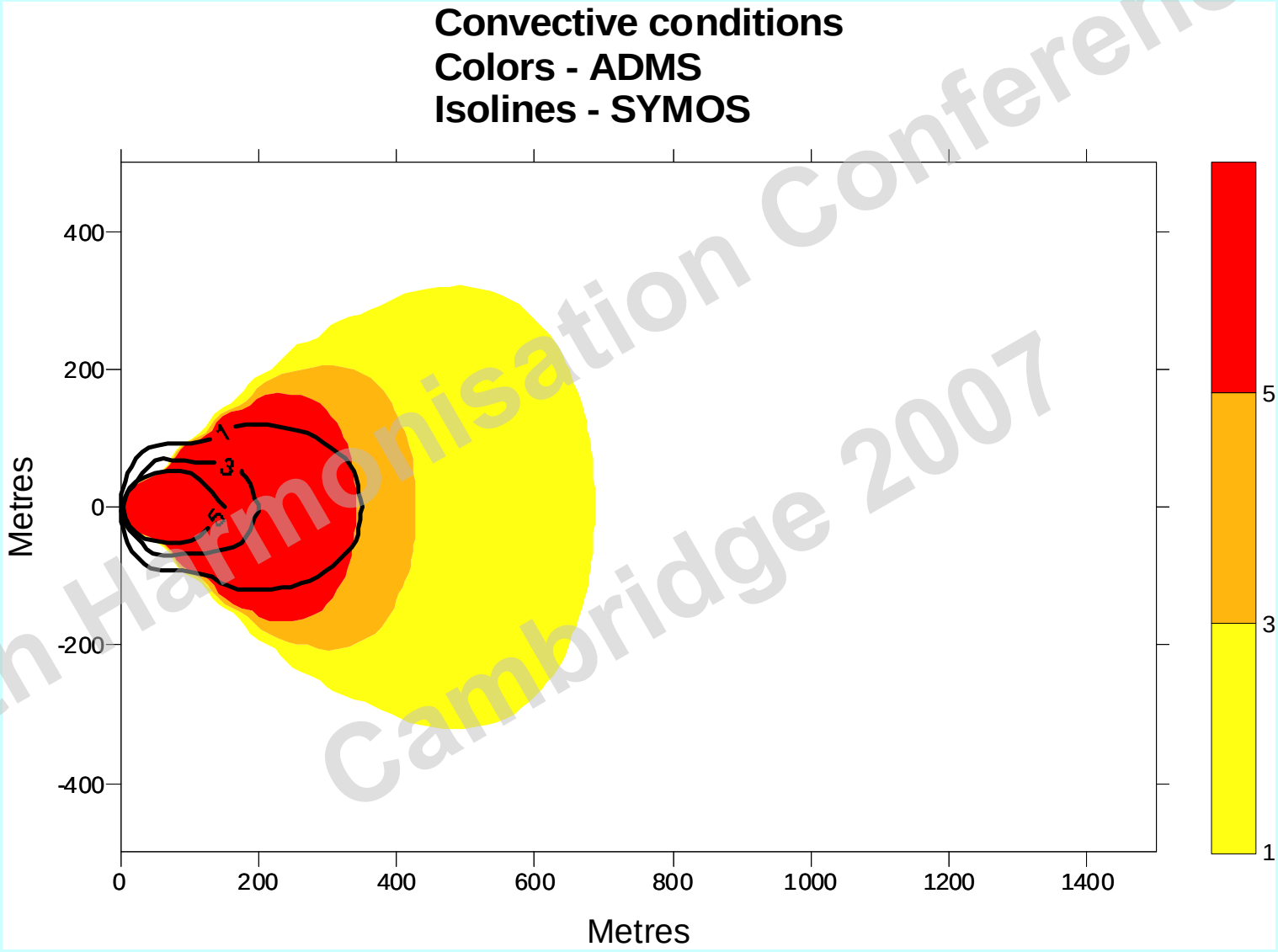
# Point source 2D fields stable



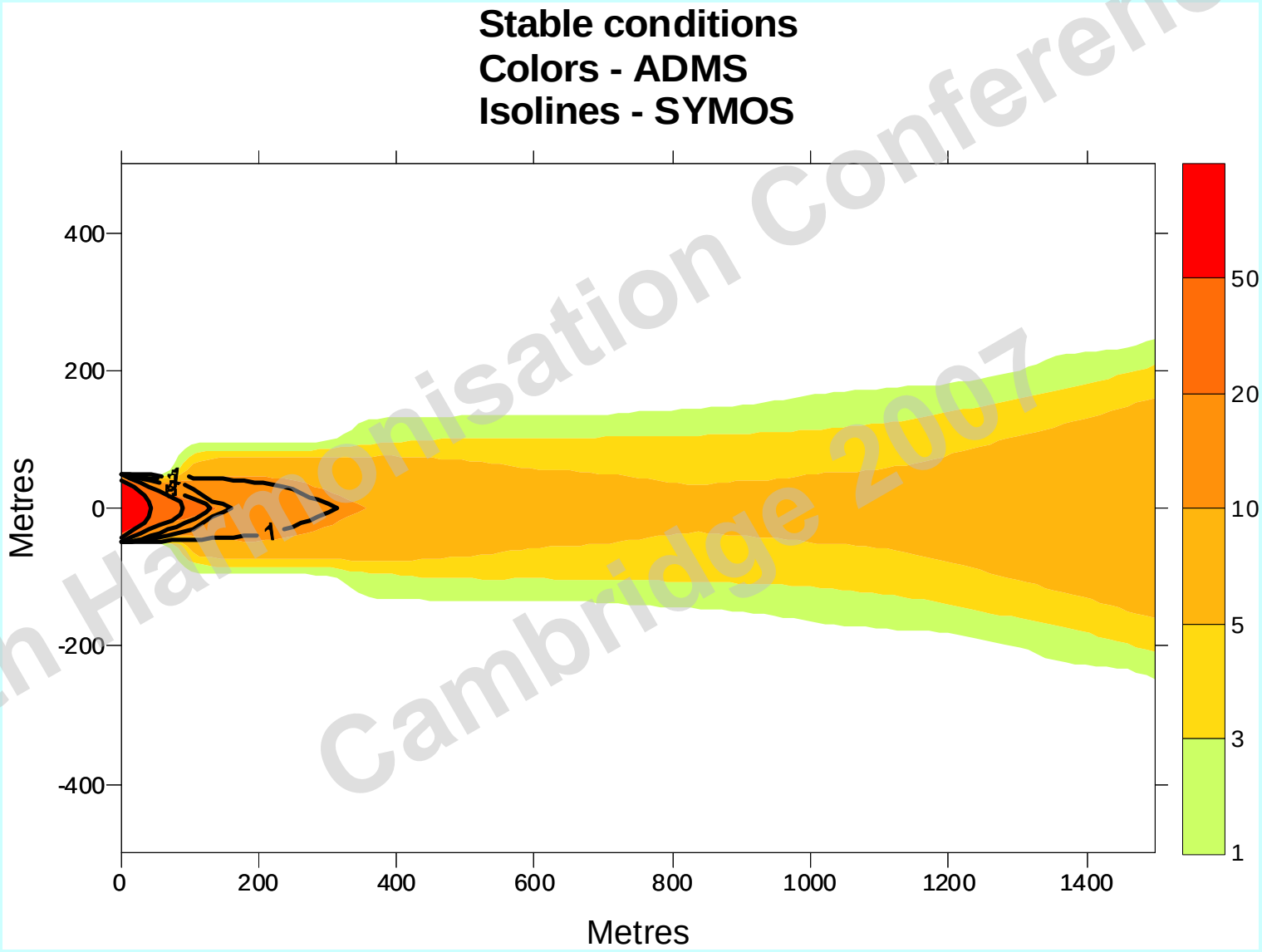
# Point source 2D fields neutral



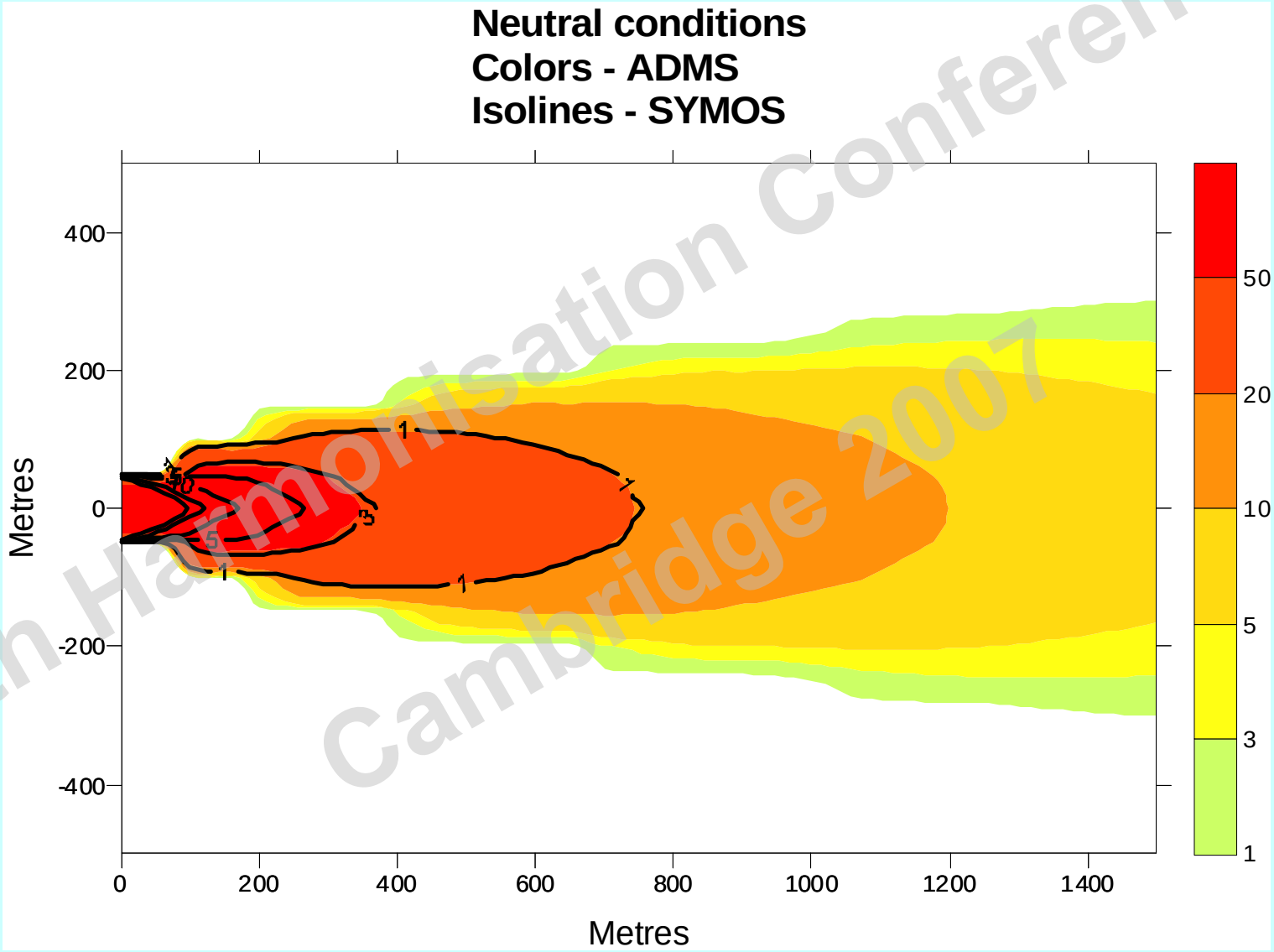
# Point source 2D fields convective



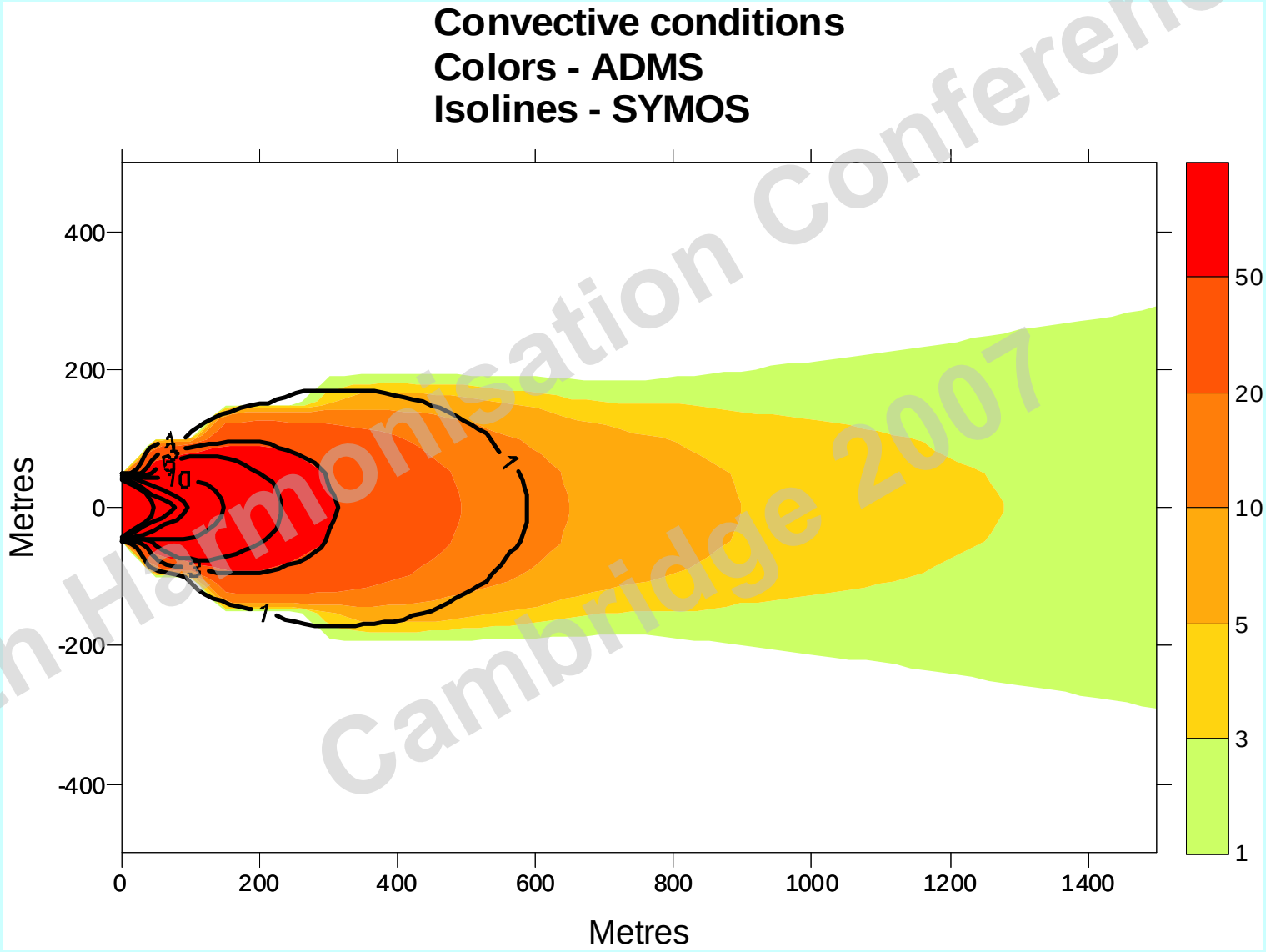
# Area source 2D fields stable



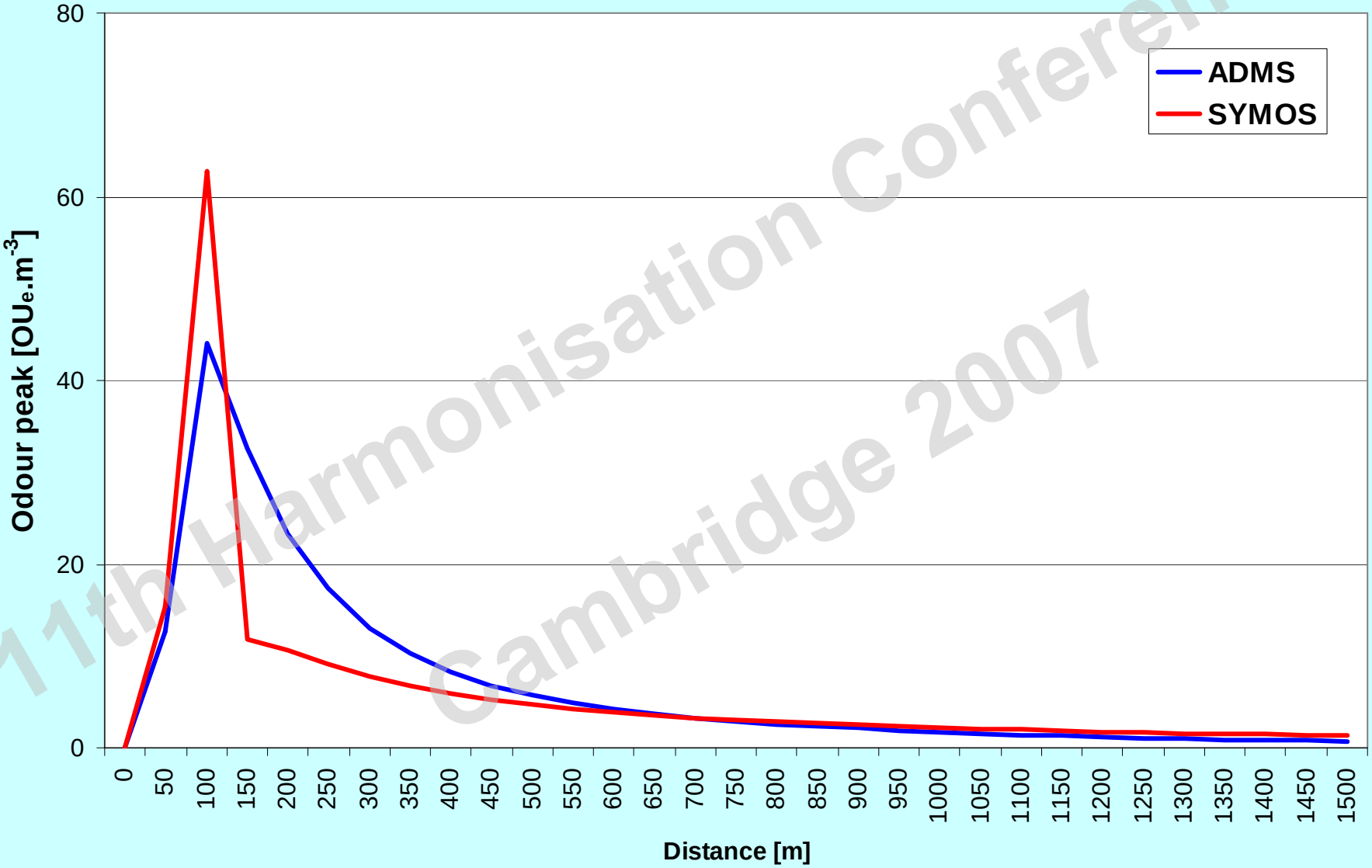
# Area source 2D fields neutral



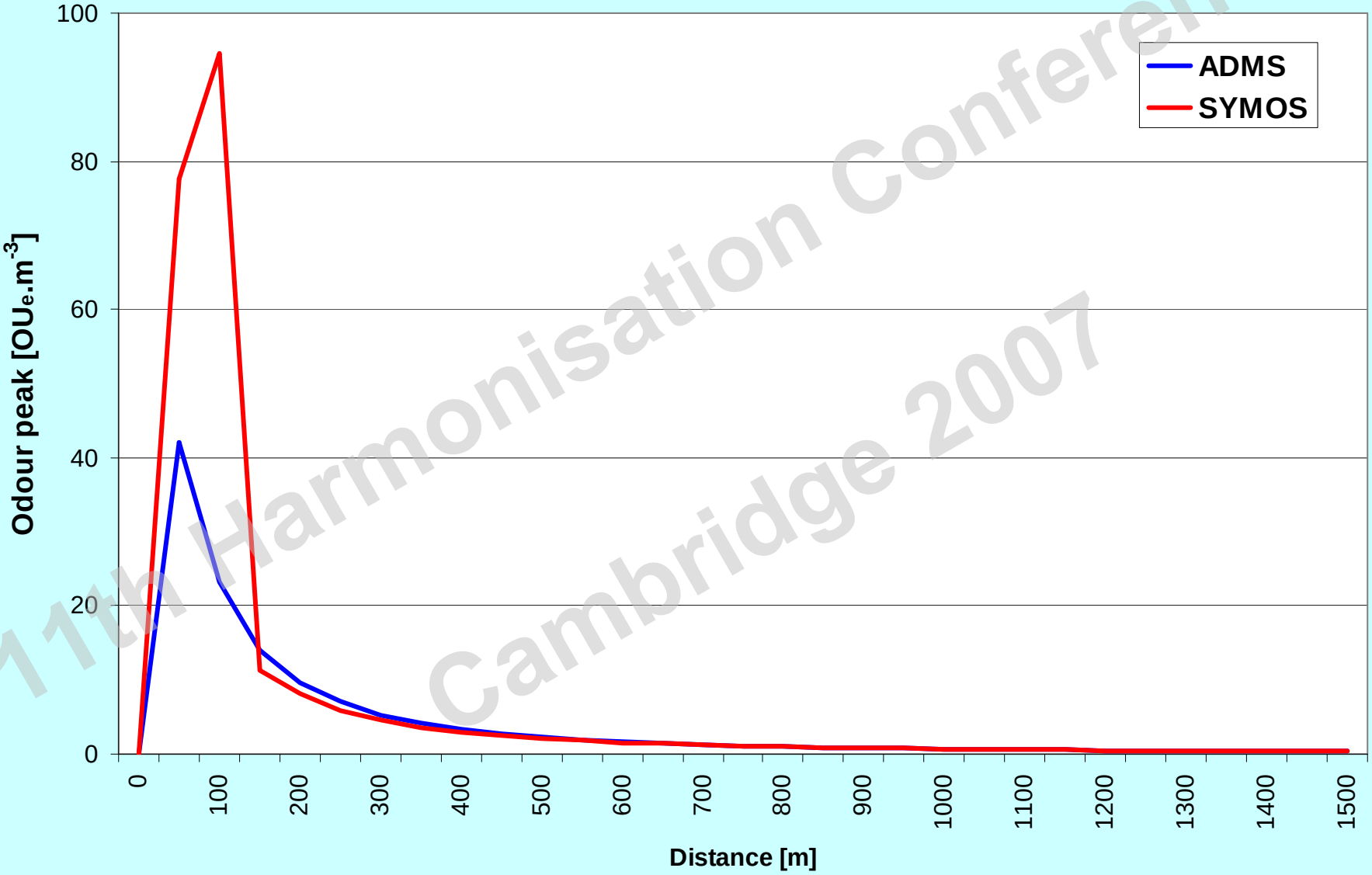
# Area source 2D fields convective



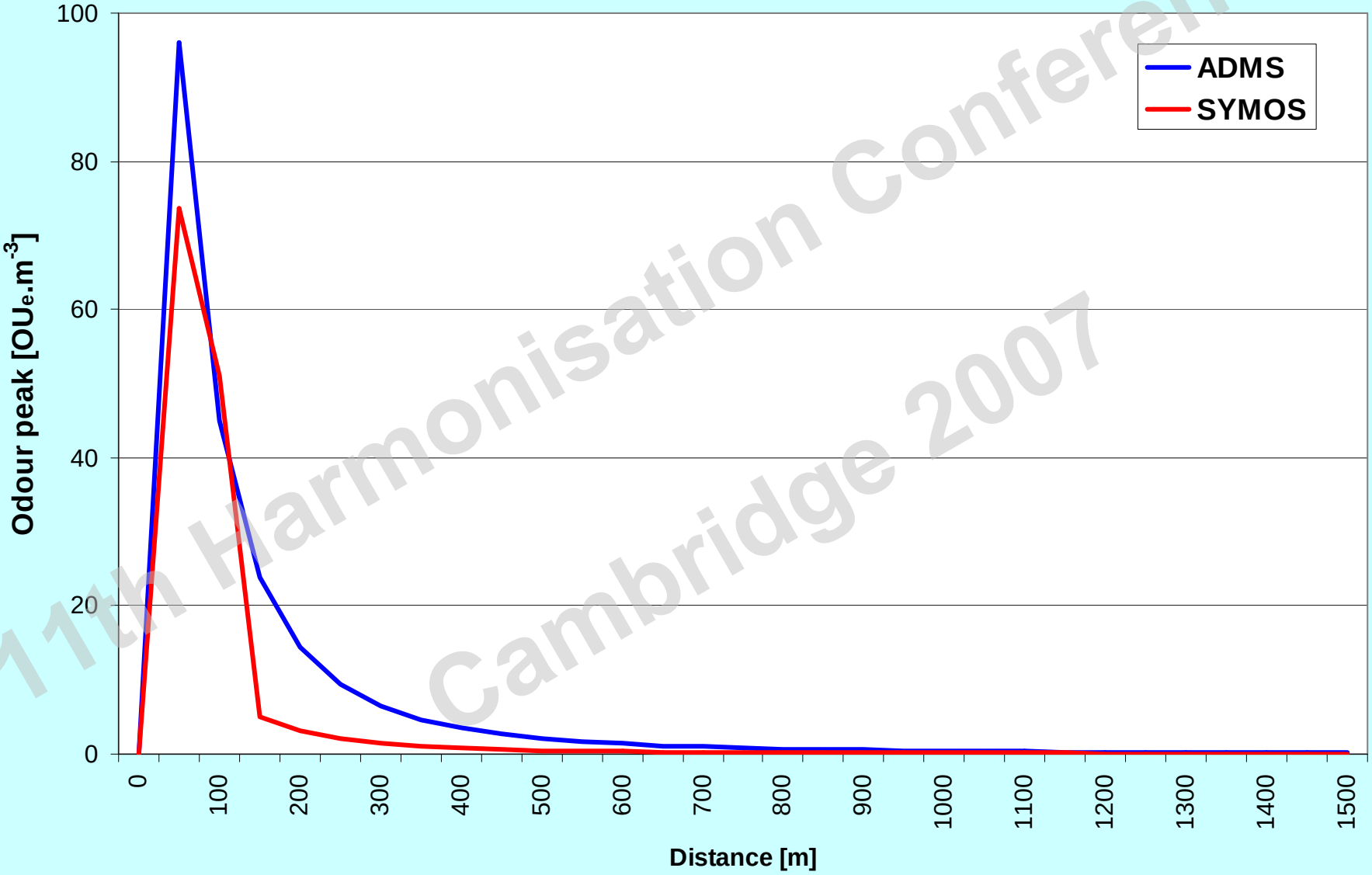
# Point source profiles stable



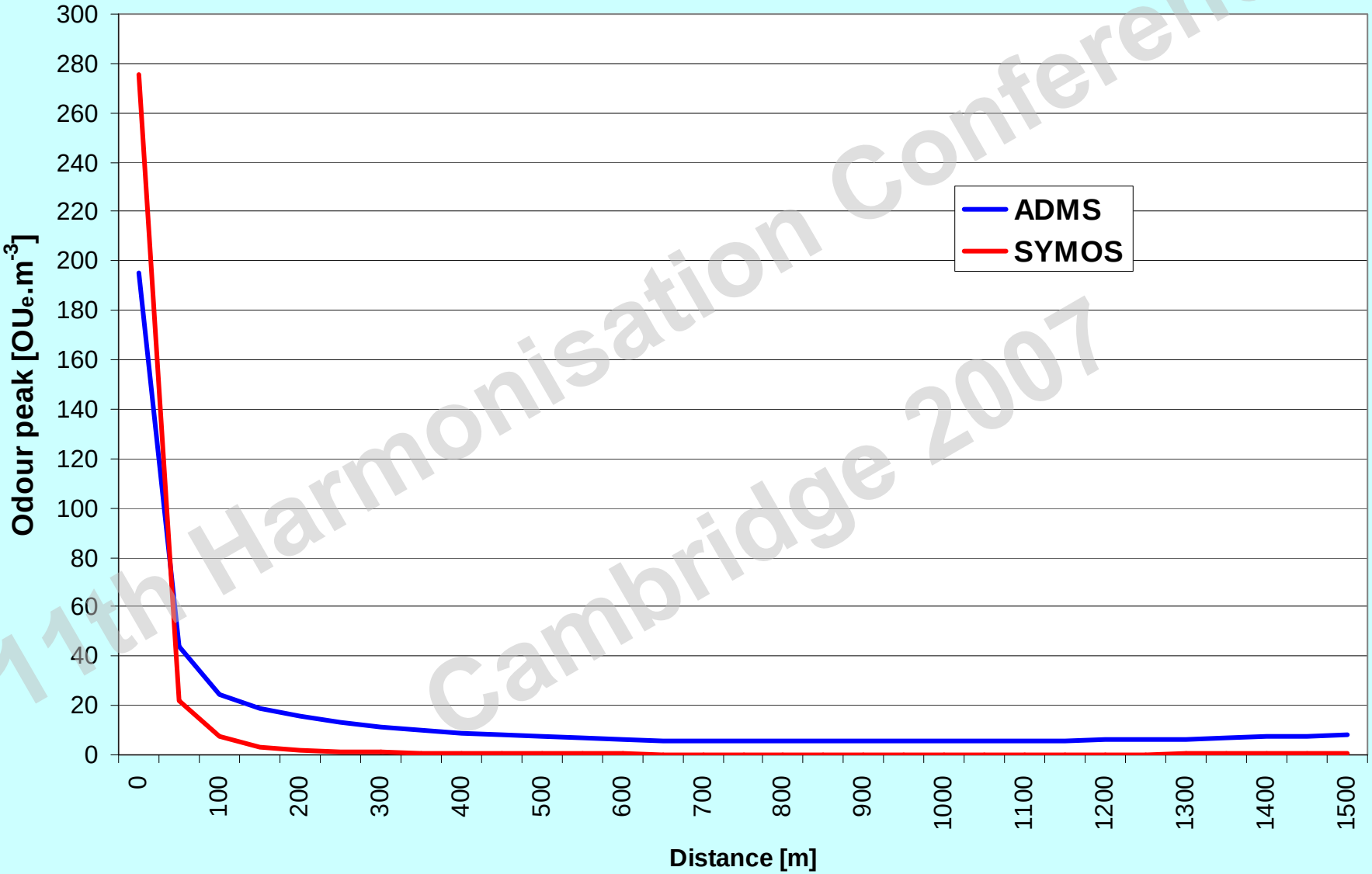
# Point source profiles neutral



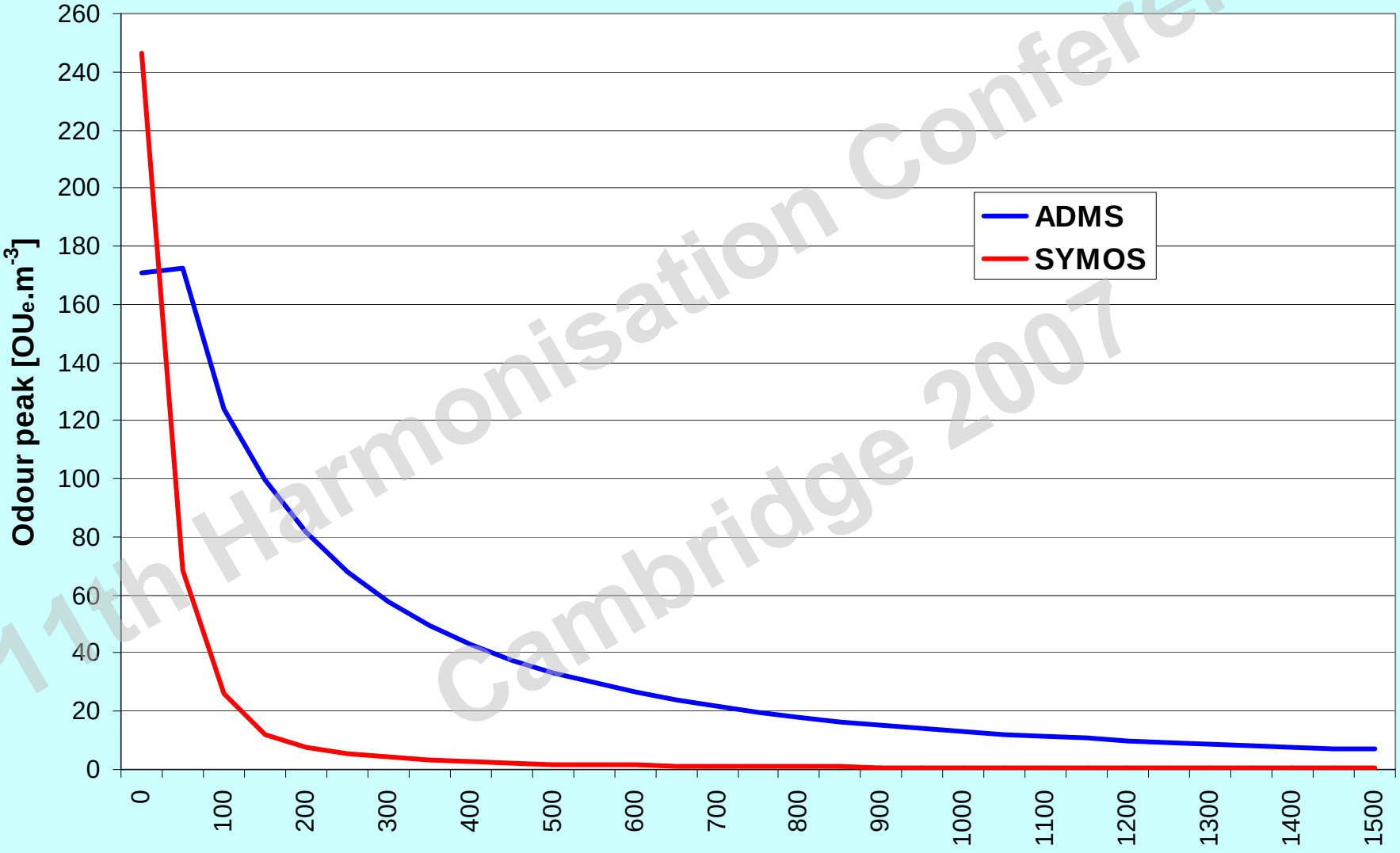
# Point source profiles convective



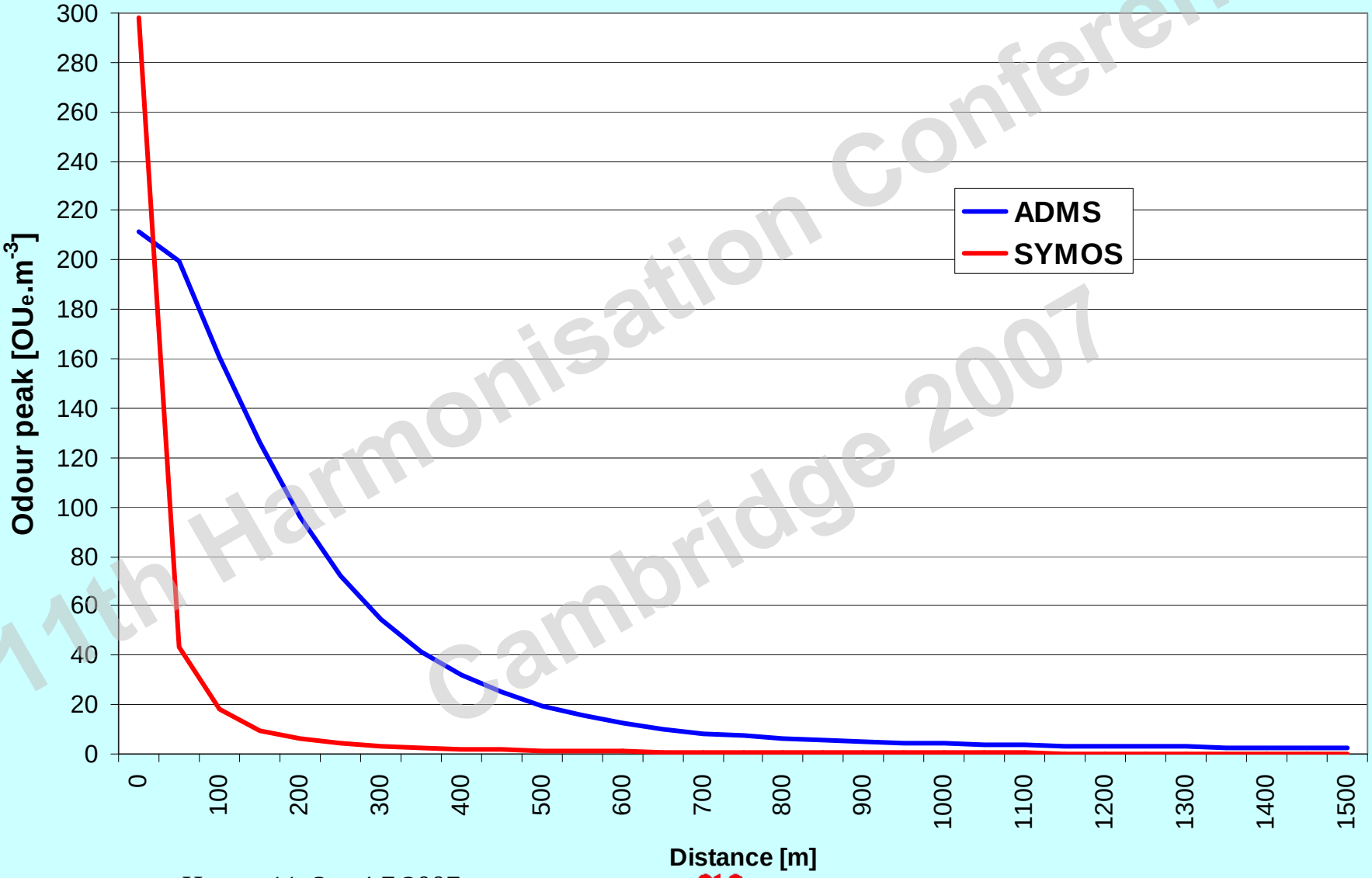
# Area source profiles stable



# Area source profiles neutral



# Area source profiles convective



# Conclusions and scope of future work

- Area size where odour could be perceived underestimted by SYMOS approach against ADMS
- Ground level peak odour concentrations mostly underestimated by SYMOS approach, in comparison with the ADMS model results
(ADMS considered as more sophisticated)
- Possible remedies

✓ change set of P/M ratios appropriately, e.g. try to assess them from raios $P99/C_{1h\ mean}$

✓ include fluctuation module into SYMOS

- Further work – to find new experimental data for validation

# Thank you for your time!