A Methodology for Assessing Doses from Short-term Planned Discharges to Atmosphere

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Introduction

- Authorisation of proposed discharges
- Techniques used for annual discharges may not be appropriate for short-term releases
- Need to formulate a generic methodology for the assessment of short-term releases of radionuclides to the atmosphere
- "Realistically cautious" approach
- Relatively simple to apply

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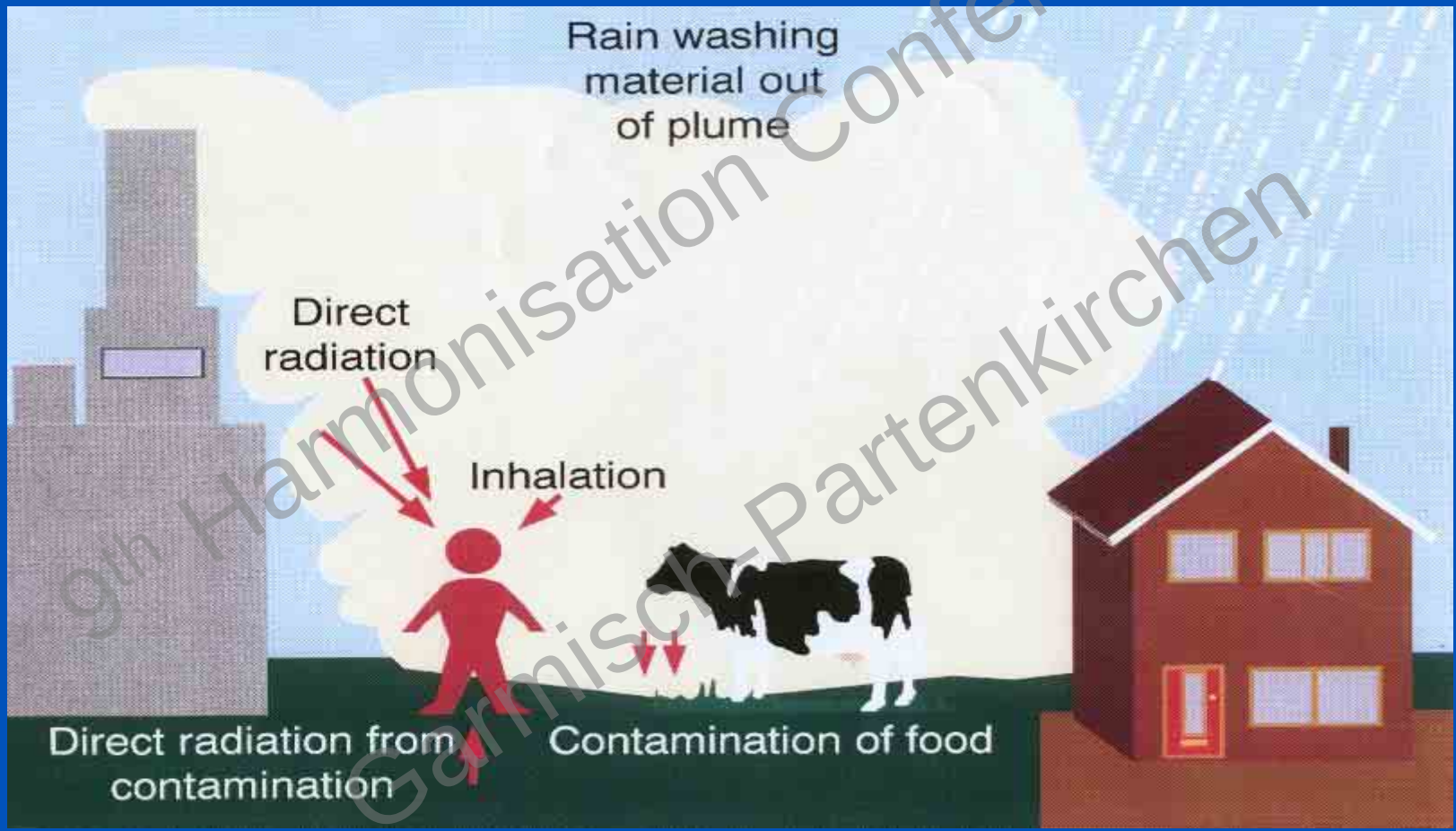
Exposure Pathways



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Methodology

- Variability in all assessment parameters, focusing on meteorological data
- The adopted approach had to be one that could be implemented relatively easily in a readily available dispersion model
- Release durations of 30 minutes and 12 hours considered
- Need to represent changing meteorological conditions

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Wind Meander

- Plume broadening due to wind meander can be represented using a model derived by Moore (1976)

$$\sigma_y^2 = \sigma_{yt}^2 + \sigma_{yw}^2$$

where

σ_{yt} is a boundary layer turbulence component

σ_{yw} is a wind direction unsteadiness component

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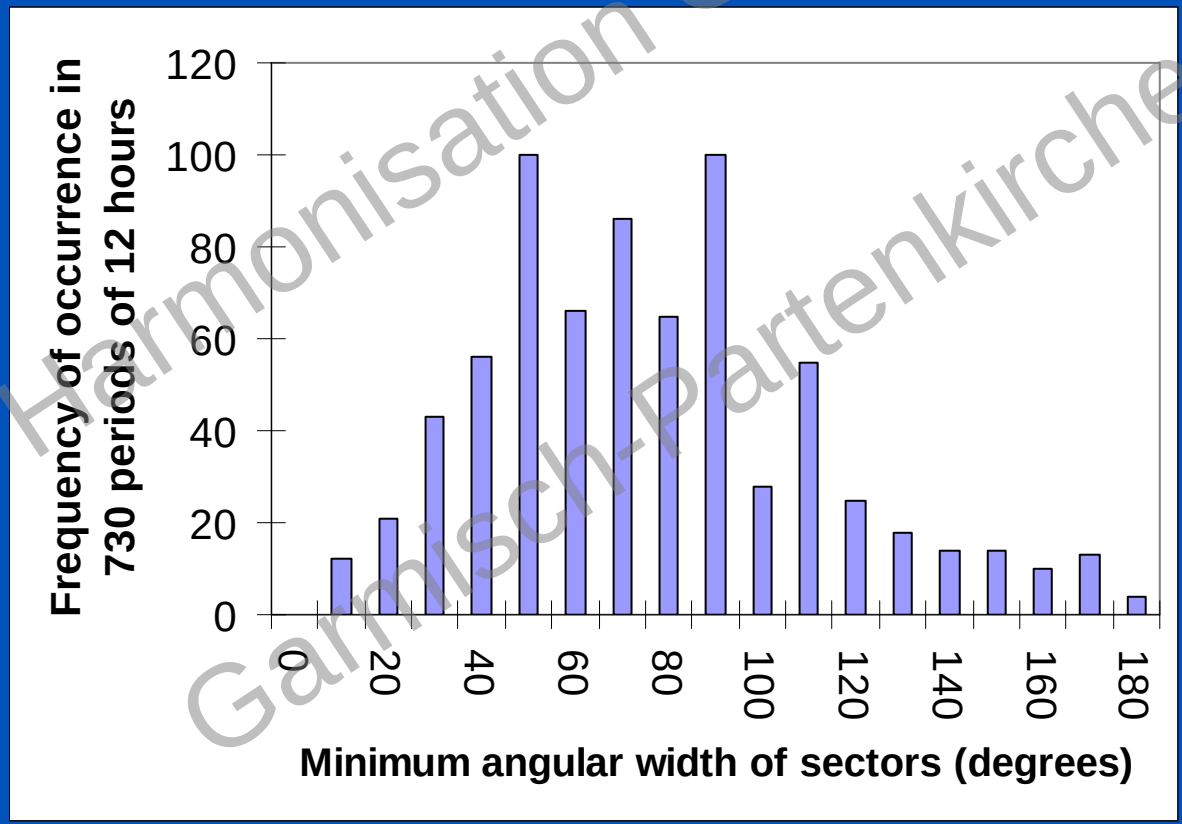
Changes in Wind Direction

- Using meteorological data for Heathrow the angle over which the wind blows in a 12 hour period was determined



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Impact of Release Duration

- Wind meander and changes in wind direction are two separate processes
- A wind meander model is included in ADMS 3.1 although the impact of release duration appears to be small compared to other implementations of this model
- An attempt has been made to account for wind meander and changes in wind direction by assuming the short-term 12 hour release occurs into a 60 degree sector

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Comparison of ADMS 3.1 with NRPB-R91

- In ADMS a 60 degree sector has been modelled for the 12 hour release

Distance downwind of release point on plume centre line (km)	Activity concentration in air (Bq m^{-3}), 30 m stack at 1 MBq s^{-1}				
	ADMS		NRPB R-91		
	30 minute	12 hour (60 degree sector)	30 minute	12 hour	60 degree sector
Category D no rain					
1	$4.04\ 10^{0}$	$1.42\ 10^{0}$	$1.33\ 10^{1}$	$4.33\ 10^{0}$	$2.00\ 10^{0}$
2	$1.48\ 10^{0}$	$4.60\ 10^{-1}$	$4.78\ 10^{0}$	$1.53\ 10^{0}$	$7.0\ 10^{-1}$
5	$3.84\ 10^{-1}$	$9.25\ 10^{-2}$	$1.11\ 10^{0}$	$3.39\ 10^{-1}$	$1.6\ 10^{-1}$
10	$1.40\ 10^{-1}$	$2.70\ 10^{-2}$	$3.83\ 10^{-1}$	$1.15\ 10^{-1}$	$5.5\ 10^{-2}$

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Variation in Meteorological Data

- Full range of meteorological conditions possible
- Probabilistic assessment gives a range of possible outcomes
- Regulators would rather have single values
- Representative meteorological data are needed

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Influence of Meteorological Data on Dose

- Inhalation and ingestion doses estimated for different meteorological conditions
- Exposed group located 300 m and 1 km downwind of source on plume centre line
- All food derived from these locations
- Meteorological data for Heathrow were used
- ADMS 3.1 was used to model dispersion and results input to the dose assessment

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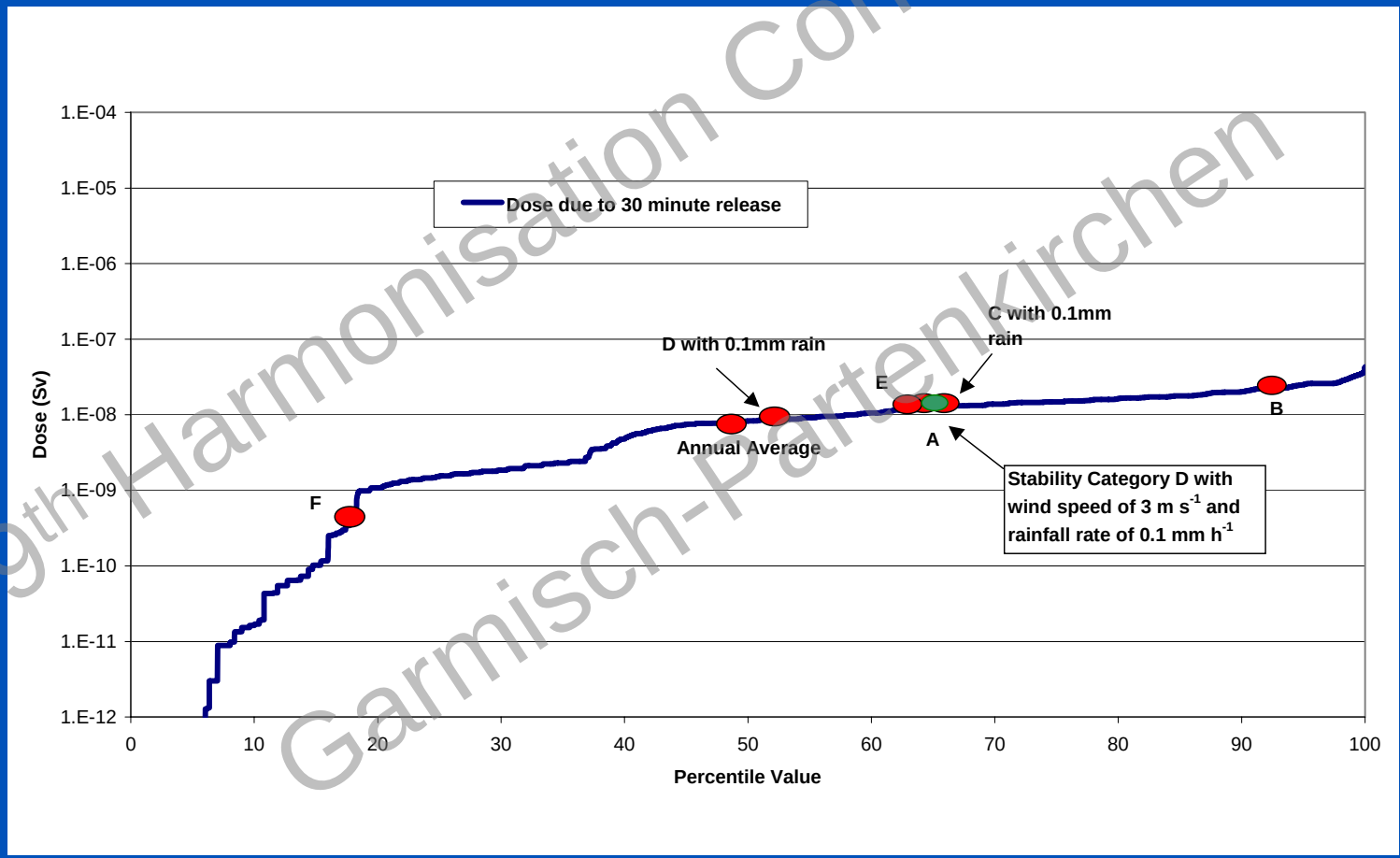
Dose percentiles calculated for inhalation of ^{90}Sr

- For a 30 minute release at 300 m downwind of 30 m high source



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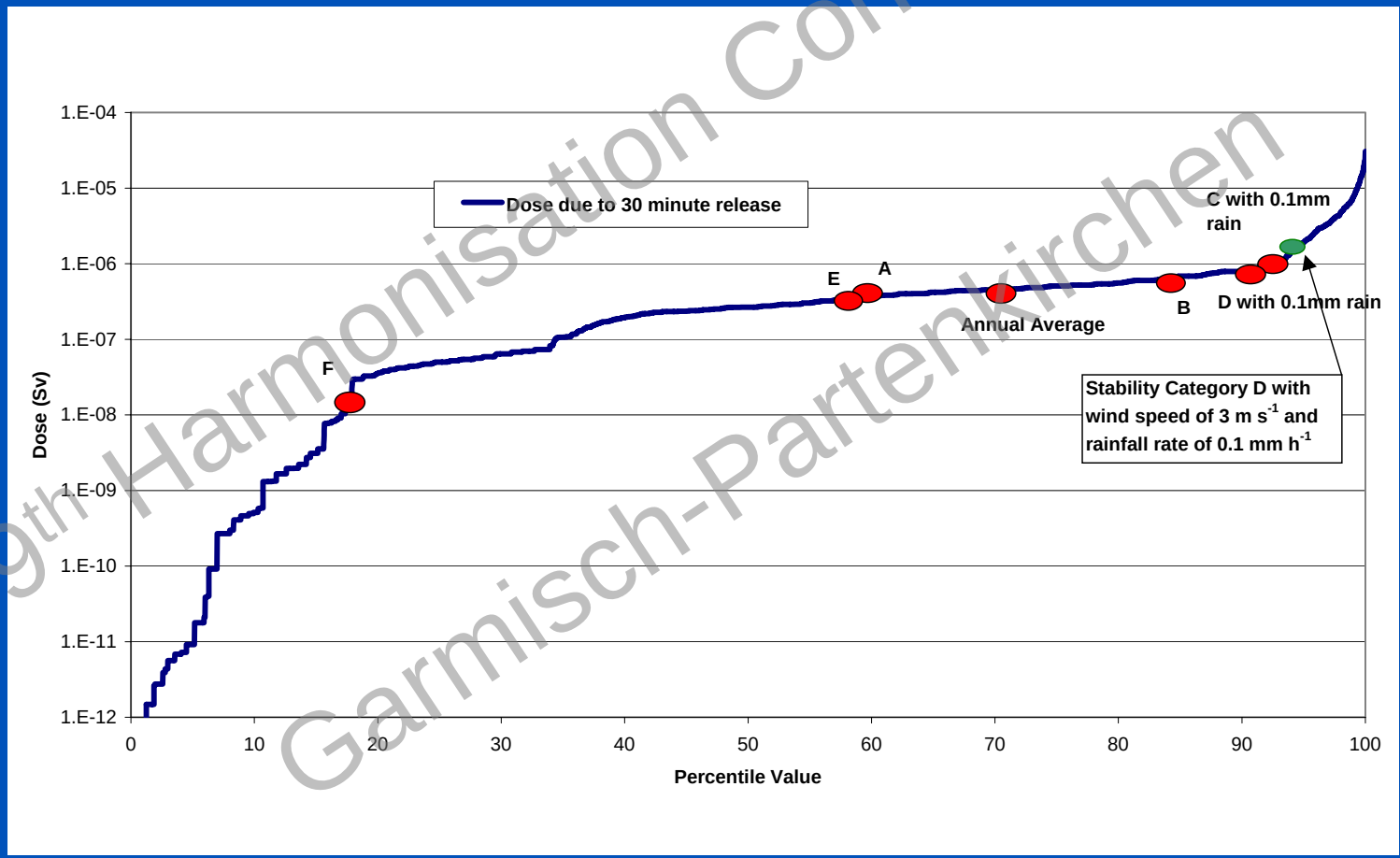

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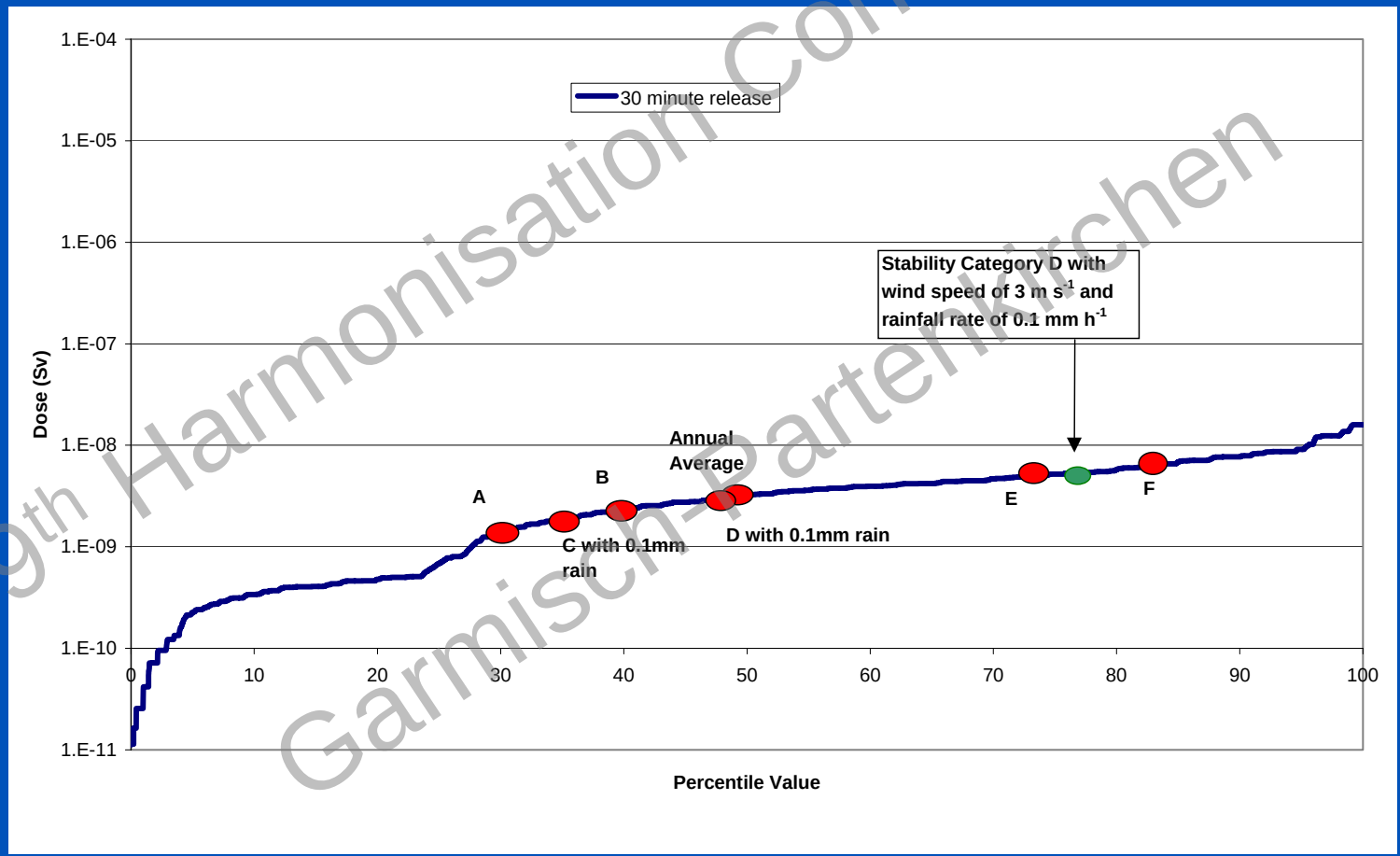
Dose percentiles calculated for inhalation of ^{90}Sr

- For a 30 minute release at 1 km downwind of 30 m high source



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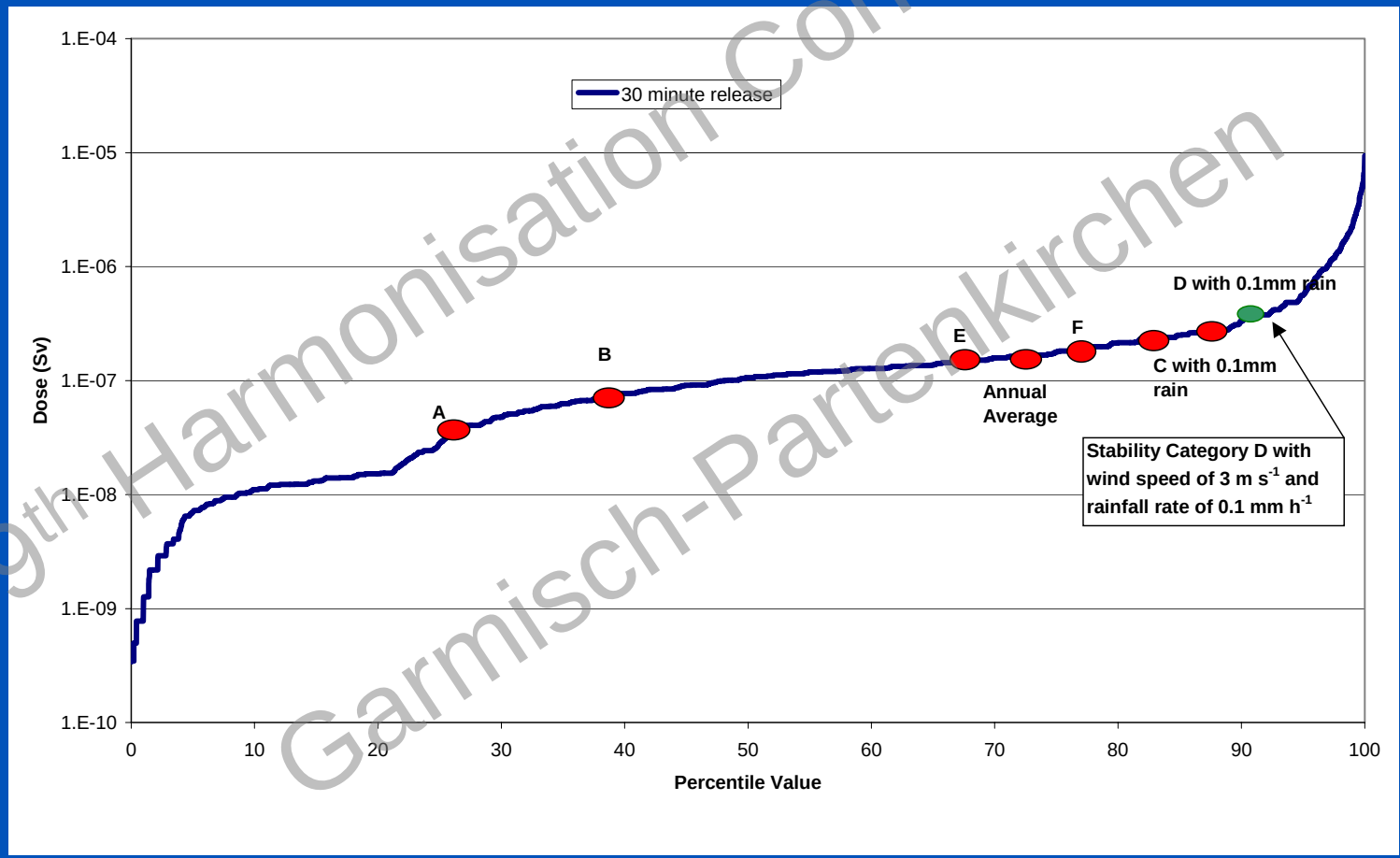
Dose percentiles calculated for ingestion of ^{90}Sr

- For a 30 minute release at 1 km downwind of 30 m high source



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Representative Meteorological Data

- The aim was to identify a single set of meteorological conditions that would reproduce critical group doses in the upper part of the dose distribution for the majority of radionuclides
- Specifically the meteorological conditions are: a Monin-Obukhov length of 0 (representing Category D), a wind speed of 3 m s^{-1}, boundary layer depth of 800 m and rainfall rate of 0.1 mm hr^{-1} for the duration of the release

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Conclusions

- Variability in critical group dose attributable to varying meteorological conditions is extremely large for a 30 minute release
- Dose distributions exhibit a plateau region where a large number of different meteorological conditions give rise to similar critical group doses
- Further investigations are needed to determine whether this is true for any distance downwind of the release, for other sites and for other dispersion models

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