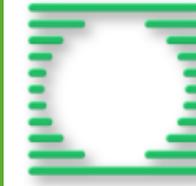


German Environment Agency

Umwelt  
Bundesamt



Janicke Consulting  
Environmental Physics

**HARMO23 15-19 September 2025 Hamburg**

# **BESTAL – Stack height determination by dispersion modelling with selected, unweighted meteorological situations**

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## Wanted: the safeguard calculation model for stack heights

### INDUSTRIAL EMISSIONS DIRECTIVE (IED)

#### Directive 2010/75/EU as amended by Directive (EU) 2024/1785

- Waste gases [...] shall be discharged in a controlled way by means of a **stack** [...] the **height** of which is **calculated** in such a way as to **safeguard** human health and the environment.

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with the IED.

- So **EU Member States must bring into force stack height calculation requirements.**
- By which **calculation method?**
- According to which **safeguard criterion?**

This talk explains the procedure according to the German Technical Instructions on Air Quality Control (TA Luft).

Special provisions for **combustion, waste incineration and waste co-incineration plants**

Information / feedback to the authors regarding implementation in other EU member states (and elsewhere) is welcome

The TA Luft is an administrative provision

## TA Luft safeguard criterion: maximum tolerable ground-level concentration (In force since 1964)

- The **criterion** for adequate dilution of exhaust gases is the **maximum ground-level concentration** of each emitted substance [for which an S-Value is specified] in a stationary dispersion situation.  
**The stack height must be determined so that this concentration does not exceed the S-Value.**
- The values specified in Annex 6 shall be used for the S-Value.

Safeguard criterion:  
**S-Value** concentration

**Hypothetical S-Value** in this talk:  
**1 mg/m<sup>3</sup>**

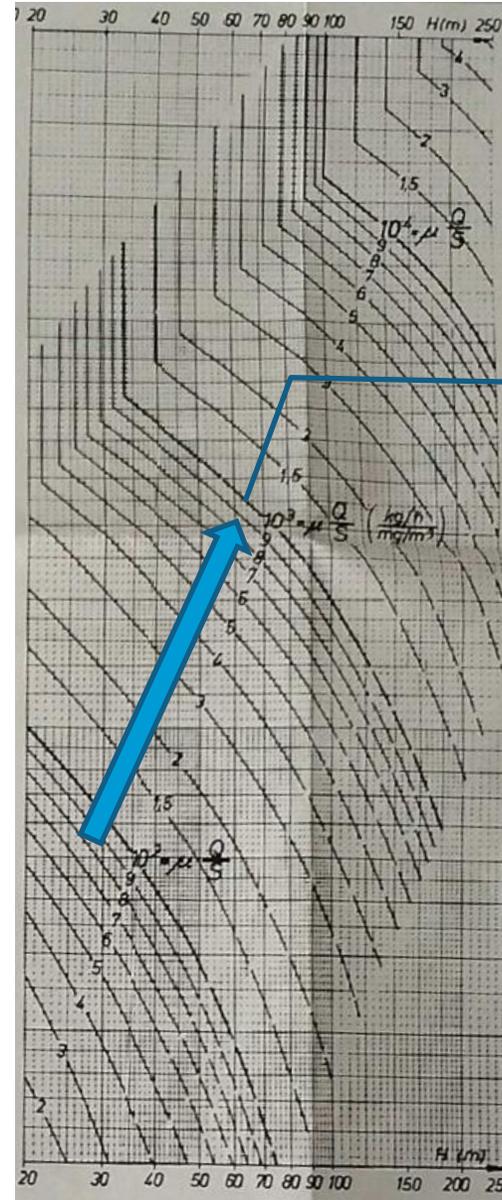
### AMENDMENT IN TA LUFT 2021

- For **multiple stacks** in the plant, compliance with the S-Value [...] must be checked by **superimposing the concentration plumes of the stacks.**
- The concentration must be determined using a dispersion calculation [according to the new procedure].

New procedure: this talk

## Legacy procedure: stack height nomogram (In force 1964–2020)

- **Nomogram** according to standard VDI 2289-1:1963-06 [9]



References [9] etc.:  
see extended abstract

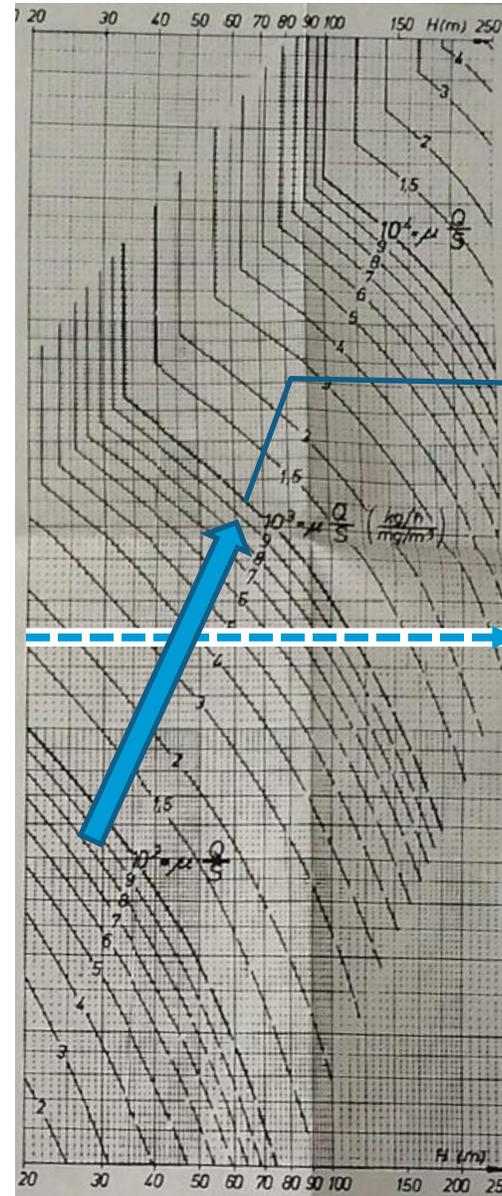
$$\frac{Q \left( \frac{\text{kg}}{\text{h}} \right)}{S\text{-Value} \left( \frac{\text{mg}}{\text{m}^3} \right)}; 2 \cdot 10^1 - 4 \cdot 10^4$$

**Log. Scale**

<b>Q</b>	<b>Emission rate</b>
<b>S-Value</b>	<b>Maximum tolerable short-term ground-level concentration</b>
<b><math>\mu</math></b>	<b>factor to account for concentration averaging time (here: 1)</b>

## Legacy procedure: stack height nomogram (In force 1964–2020)

- **Nomogram** according to standard VDI 2289-1:1963-06 [9]



References [9] etc.:  
see extended abstract

$$\frac{Q \left( \frac{\text{kg}}{\text{h}} \right)}{S\text{-Value} \left( \frac{\text{mg}}{\text{m}^3} \right)}; 2 \cdot 10^1 - 4 \cdot 10^4$$

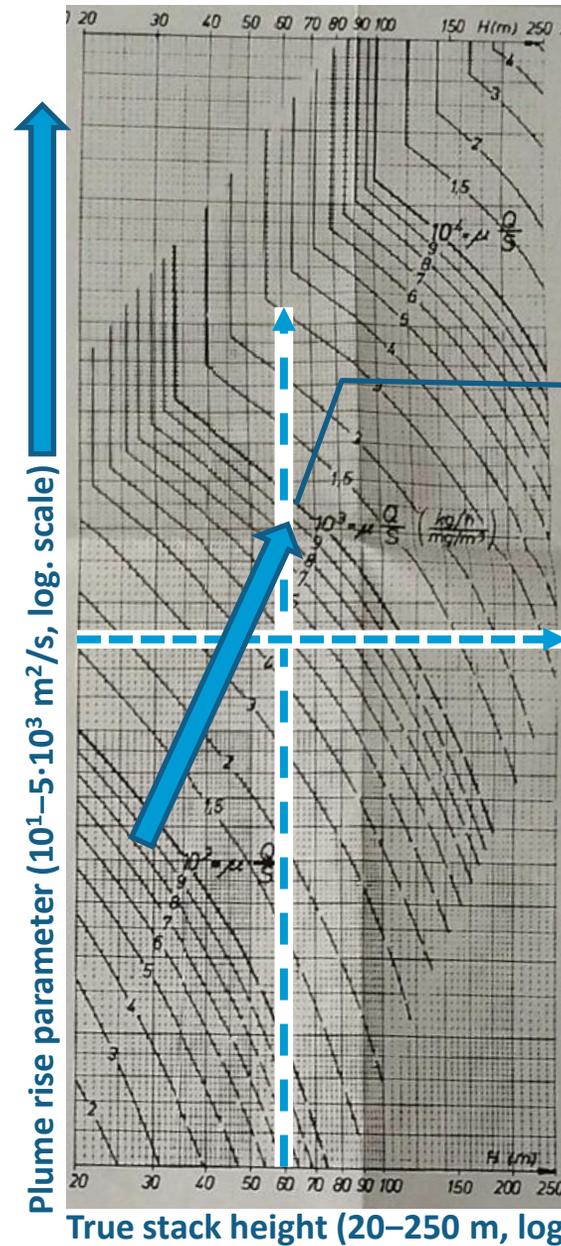
**Log. Scale**

<b>Q</b>	<b>Emission rate</b>
<b>S-Value</b>	<b>Maximum tolerable short-term ground-level concentration</b>
<b><math>\mu</math></b>	<b>factor to account for concentration averaging time (here: 1)</b>

**True stack height (20–250 m, log. scale)** →

## Legacy procedure: stack height nomogram (In force 1964–2020)

- **Nomogram** according to standard VDI 2289-1:1963-06 [9]
- **Plume rise parameter:** function of
  - Internal diameter of the stack
  - Waste gas temperature
  - Waste gas volume flow
  - cf additional nomograms in [9]; [13] eq. (2.48)



References [9] etc.:  
see extended abstract

$$\frac{Q \left( \frac{\text{kg}}{\text{h}} \right)}{S\text{-Value} \left( \frac{\text{mg}}{\text{m}^3} \right)}; 2 \cdot 10^1 - 4 \cdot 10^4$$

Log. Scale

<b>Q</b>	<b>Emission rate</b>
<b>S-Value</b>	<b>Maximum tolerable short-term ground-level concentration</b>
<b><math>\mu</math></b>	<b>factor to account for concentration averaging time (here: 1)</b>

## New procedure: dispersion modelling with selected, unweighted meteorological situations TA Luft 2021 Annex 2 No. 14

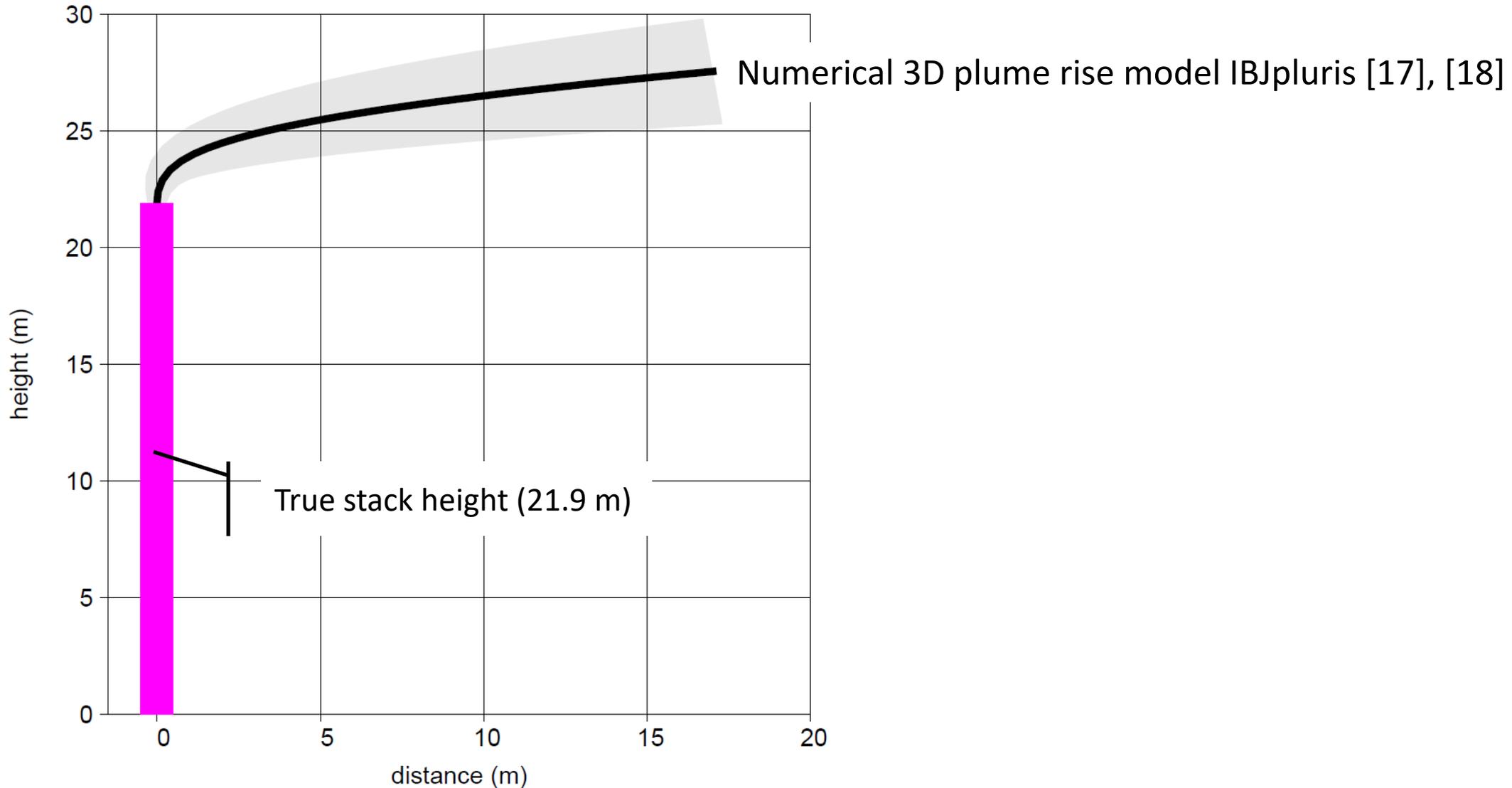
[...] the following **simplifications** and **specifications** are to be made:

- a) The dispersion calculations must be performed for **flat terrain**.
- b) The **roughness length is set to 0.5 m**,  
the displacement height to 6 times the roughness length and  
the anemometer height to 10 m above the displacement height.
- c) The **unweighted meteorological situations**  
defined as classified dispersion situations in standard VDI 3782 Part 6 [14] are considered,  
excluding Klug/Manier dispersion categories [stability classes] IV and V.
- d) Plume rise is taken into account by using the **effective stack height**  
(true stack height plus final plume rise) as the release height.
- e) The dispersion calculation is performed for a **passive, non-depositing trace gas**.
- f) The relative statistical **standard deviation of the concentration** value  
that determines the stack height **should not exceed 5 percent**.

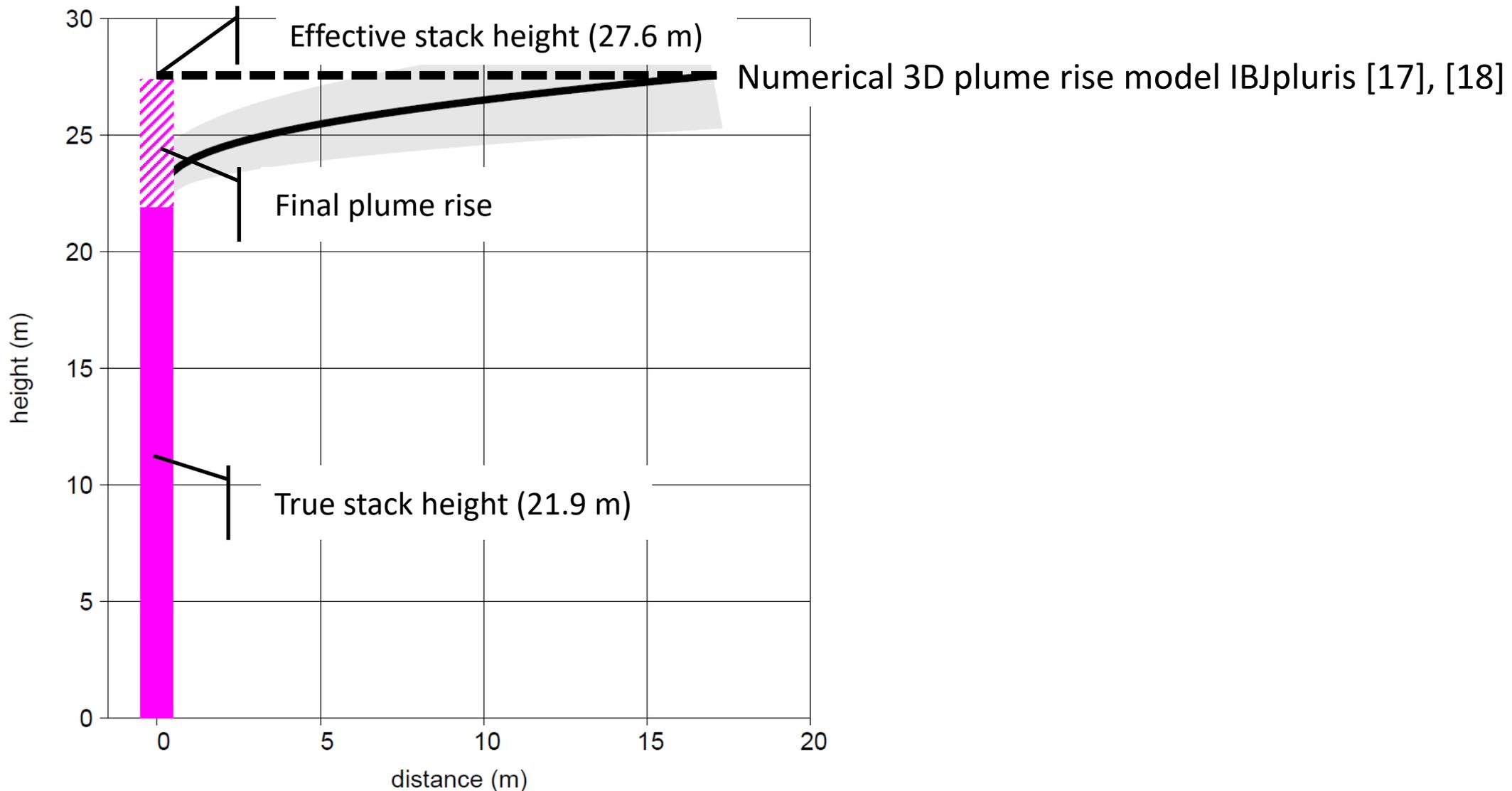
### Reference:

Neufassung der Ersten Allgemeinen  
Verwaltungsvorschrift zum Bundes-  
Immissionsschutzgesetz  
(Technische Anleitung zur Reinhaltung der  
Luft – **TA Luft**)  
Vom **14.09.2021**.  
In: GMBL. 2021 Nr. 48–54, S. 1050.  
[https://www.verwaltungsvorschriften-im-internet.de/bsvwvbund\\_18082021\\_IGI25025005.htm](https://www.verwaltungsvorschriften-im-internet.de/bsvwvbund_18082021_IGI25025005.htm)

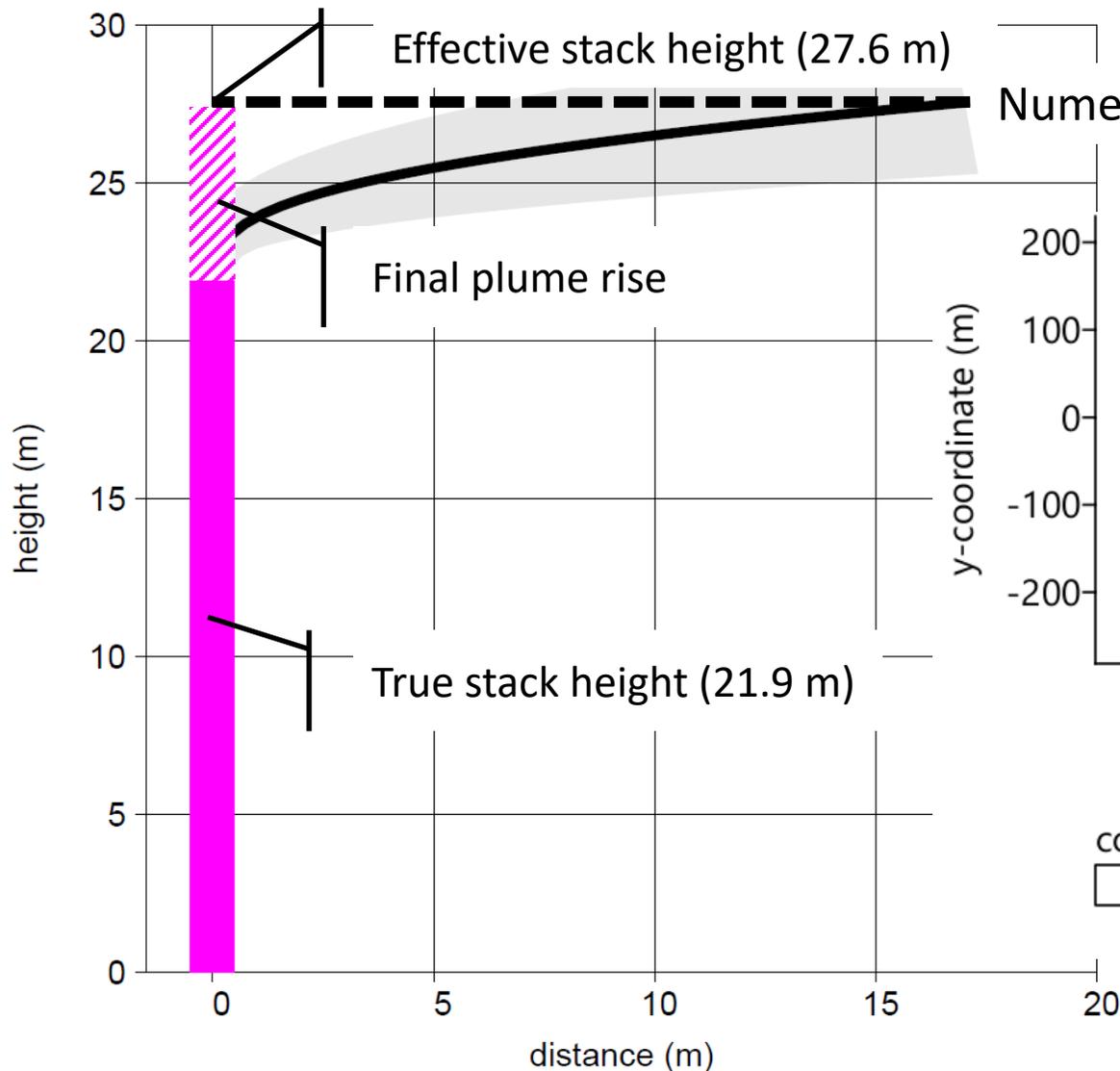
## Effective stack height: True stack height + final plume rise



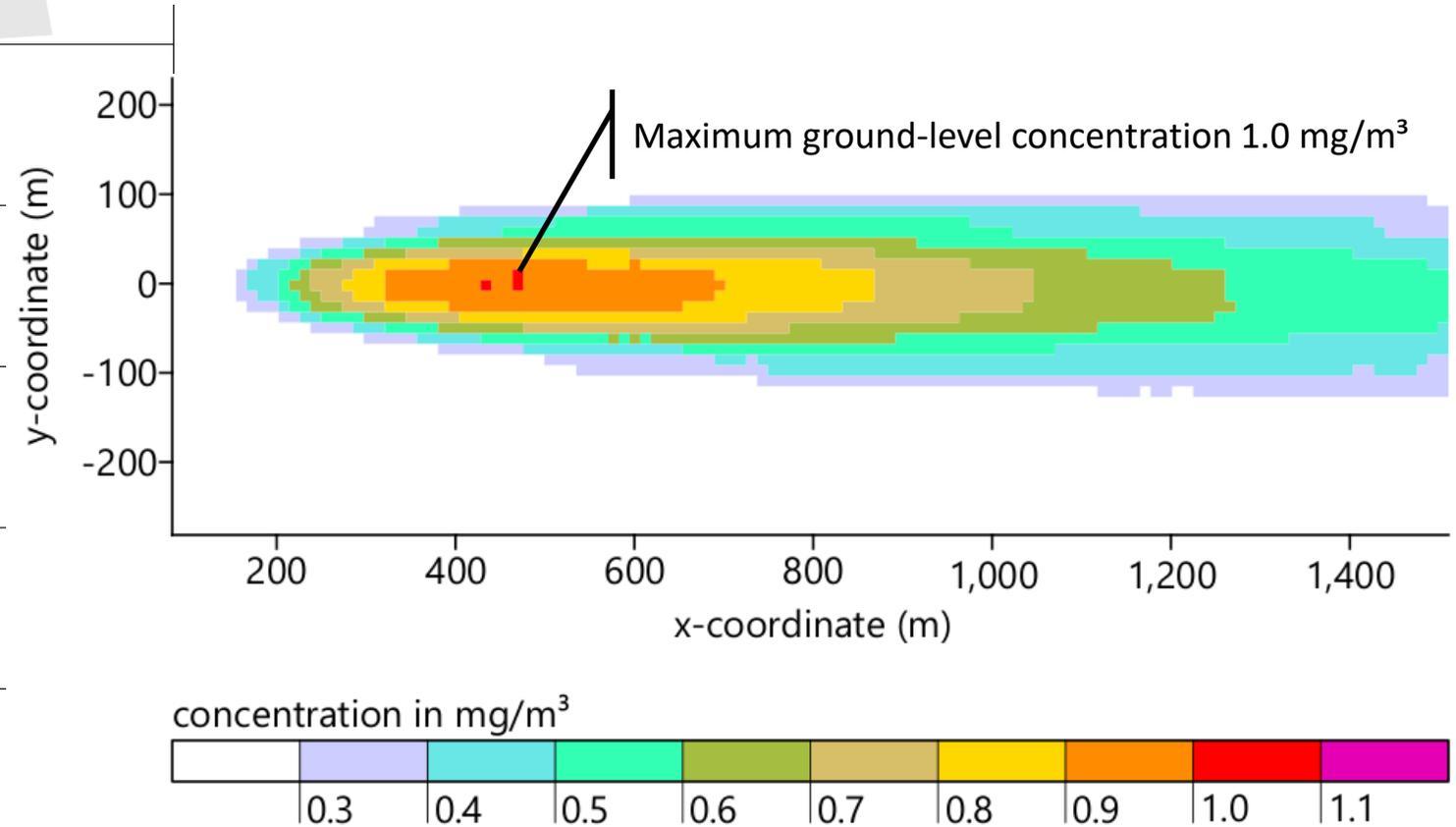
## Effective stack height: True stack height + final plume rise



## Effective stack height: True stack height + final plume rise



Numerical 3D plume rise model IBJpluris [17], [18]



## Selected, unweighted meteorological situations

The screenshot displays the BESMAX software interface, version 1.3.0. The window title is "BESMAX - Version 1.3.0". The main content area is titled "Maximum concentration near ground according to No. 5.5.2.1 Para. 5 TA Luft (2021)".

**Input Parameters:**

Parameter	Value	Unit
Description	nq	1
Emission mass flow	eq	100.0 kg/h
X-coordinate	xq	0.0 m
Y-coordinate	yq	0.0 m
Stack height	hb	21.9 m
Inner diameter	dq	1.0 m
Exit temperature	tq	40.0 °C
Exit velocity	vq	10.00 m/s
Water load	zq	0.0000 kg/(kg dry)
Liquid water	lq	0.0000 kg/kg
Norm volume flow (wet)	nF	24663 m³/h
Norm volume flow (dry)	nt	24663 m³/h

**Output Results:**

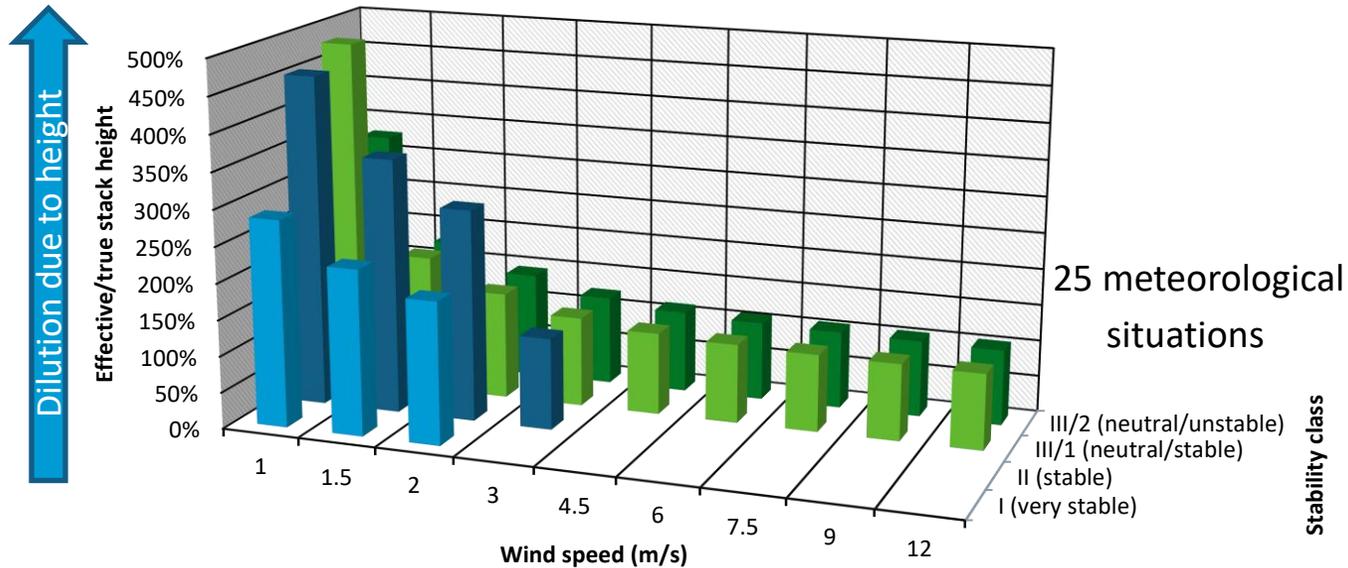
Parameter	Value	Unit
Concentration value	cm	1.008E+00 mg/m³
Uncertainty	dm	0.7 %
X-coordinate	xm	469.7 m
Y-coordinate	ym	-2.1 m
Stability class	k1	2.0 KM
Exit velocity	ua	3.0 m/s
Wind direction	ra	270.0 deg

Annotations on the screenshot include a blue box labeled "Input" pointing to the input fields, a blue arrow labeled "Stack height 21.9 m" pointing to the stack height input field, a blue arrow labeled "Result: 1.0 mg/m³" pointing to the concentration value output, and a blue box labeled "Output" pointing to the output results table.

Buttons at the bottom of the interface include "Calculate maximum concentration", "Save emission sources and calculated concentration", and "Graph".

At the bottom of the window, there are additional controls: "Kl, Ua: 2.0 3.0", "Ra: 270", "Tick: 118.921", "Cref: 1.008E+00", and a "Graph" button.

## Selected, unweighted meteorological situations



BESMAX - Version 1.3.0

Maximum concentration near ground according to No. 5.5.2.1 Para. 5 TA Luft (2021)

Description	nq	1	+
Emission mass flow	eq	100.0	kg/h
X-coordinate	xq	0.0	m
Y-coordinate	yq	0.0	m
Stack height	hb	21.9	m
Inner diameter	dq	1.0	m
Exit temperature	tq	40.0	°C
Exit velocity	vq	10.00	m/s
Water load	zq	0.0000	kg/(kg dry)
Liquid water	lq	0.0000	kg/kg
Norm volume flow (wet)	nF	24663	m³/h
Norm volume flow (dry)	nt	24663	m³/h

Input

Stack height 21.9 m

Calculate maximum concentration

Maximum concentration near ground:

Concentration value	cm	1.008E+00	mg/m³
Uncertainty	dm	0.7	%
X-coordinate	xm	469.7	m
Y-coordinate	ym	-2.1	m
Stability class	kl	2.0	KM
Exit velocity	ua	3.0	m/s
Wind direction	ra	270.0	deg

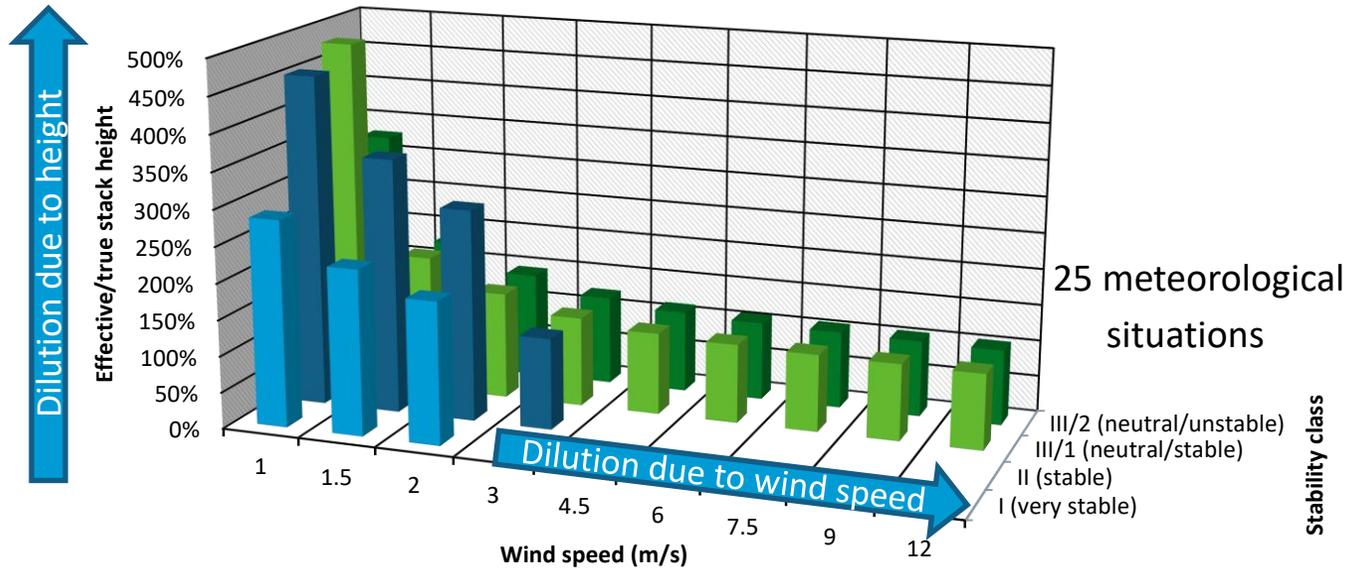
Result: 1.0 mg/m³

Output

Save emission sources and calculated concentration

Kl, Ua: 2.0 3.0 Ra: 270 Tick: 118.921 Cref: 1.008E+00 Graph

## Selected, unweighted meteorological situations



BESMAX - Version 1.3.0

Maximum concentration near ground according to No. 5.5.2.1 Para. 5 TA Luft (2021)

Description	nq	1	+
Emission mass flow	eq	100.0	kg/h
X-coordinate	xq	0.0	m
Y-coordinate	yq	0.0	m
Stack height	hb	21.9	m
Inner diameter	dq	1.0	m
Exit temperature	tq	40.0	°C
Exit velocity	vq	10.00	m/s
Water load	zq	0.0000	kg/(kg dry)
Liquid water	lq	0.0000	kg/kg
Norm volume flow (wet)	nF	24663	m³/h
Norm volume flow (dry)	nt	24663	m³/h

Input

Stack height 21.9 m

Calculate maximum concentration

Concentration value	cm	1.008E+00	mg/m³
Uncertainty	dm	0.7	%
X-coordinate	xm	469.7	m
Y-coordinate	ym	-2.1	m
Stability class	kl	2.0	KM
Exit velocity	ua	3.0	m/s
Wind direction	ra	270.0	deg

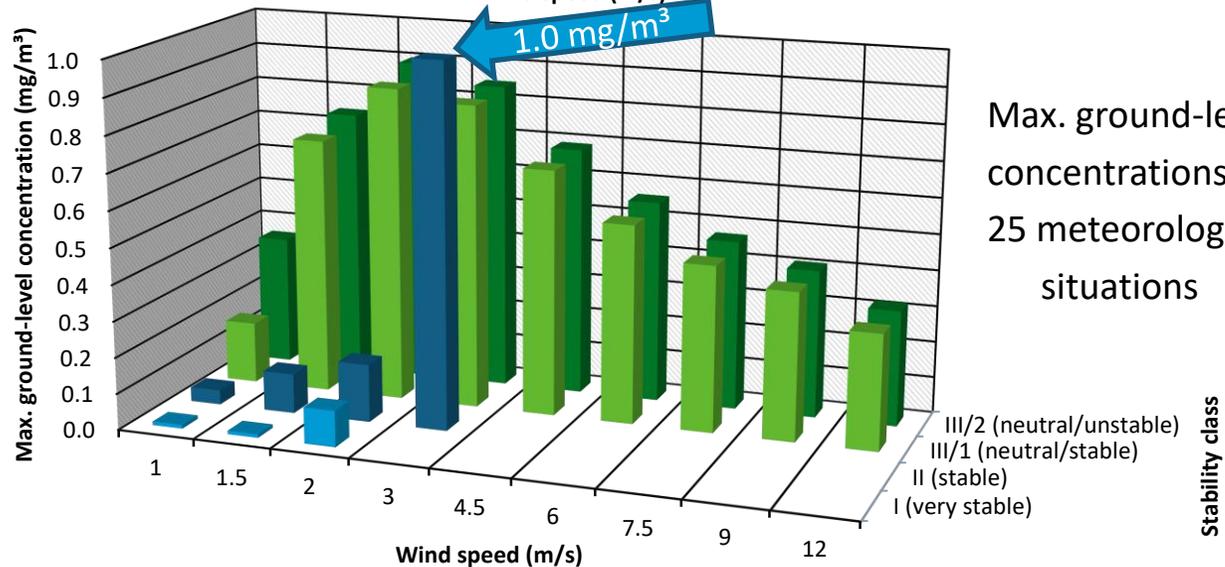
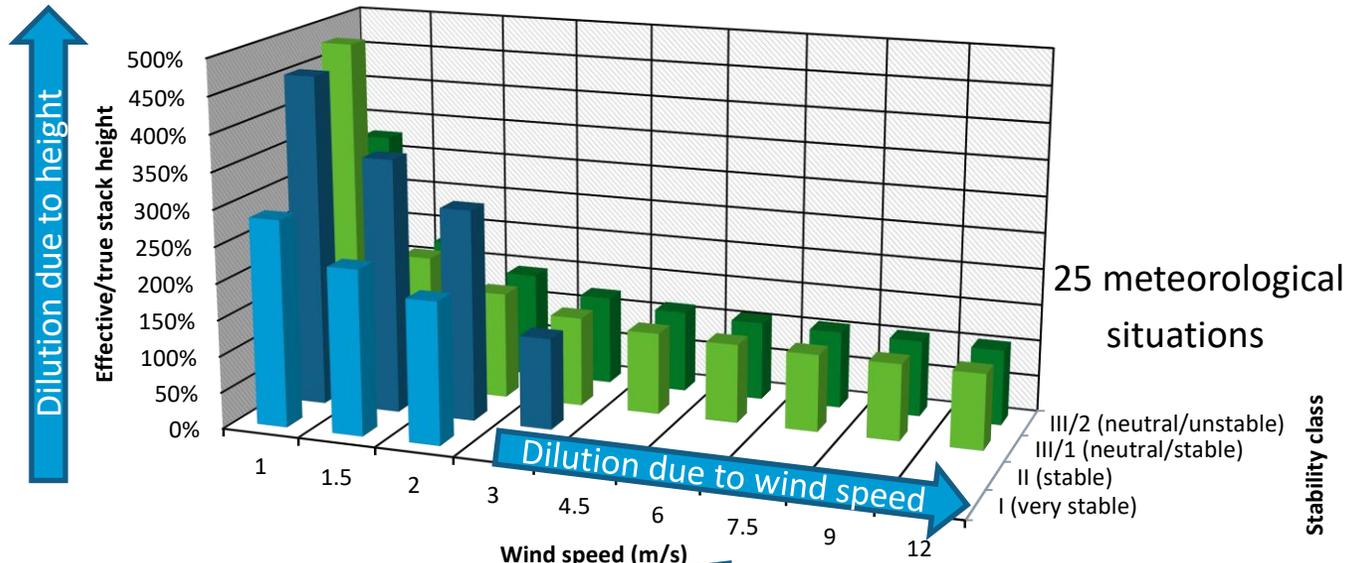
Result: 1.0 mg/m³

Output

Save emission sources and calculated concentration

Kl, Ua: 2.0 3.0 Ra: 270 Tick: 118.921 Cref: 1.008E+00 Graph

## Selected, unweighted meteorological situations



BESMAX - Version 1.3.0

Maximum concentration near ground according to No. 5.5.2.1 Para. 5 TA Luft (2021)

Description	nq	1	+
Emission mass flow	eq	100.0	kg/h
X-coordinate	xq	0.0	m
Y-coordinate	yq	0.0	m
Stack height	hb	21.9	m
Inner diameter	dq	1.0	m
Exit temperature	tq	40.0	°C
Exit velocity	vq	10.00	m/s
Water load	zq	0.0000	kg/(kg dry)
Liquid water	lq	0.0000	kg/kg
Norm volume flow (wet)	nF	24663	m³/h
Norm volume flow (dry)	nt	24663	m³/h

Calculate maximum concentration

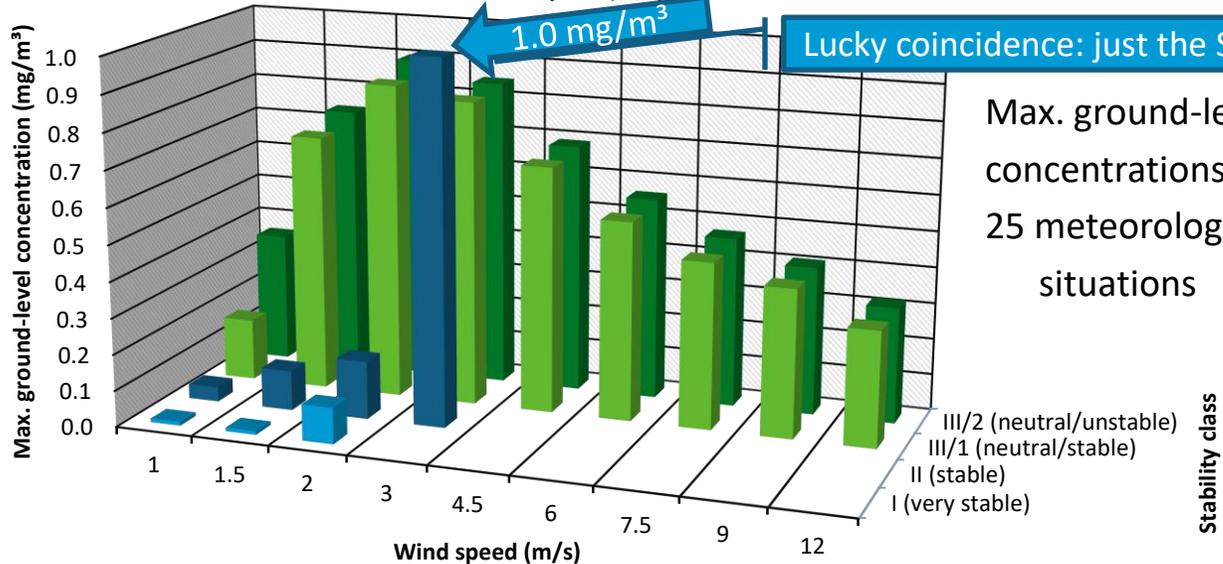
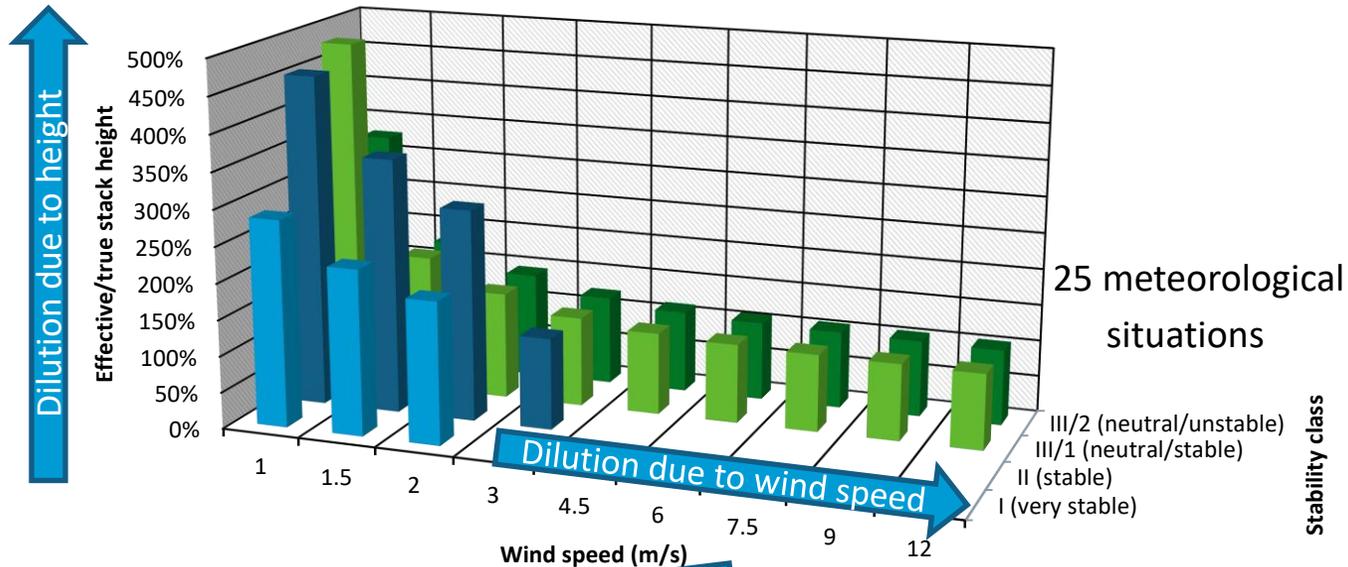
Maximum concentration near ground:

Concentration value	cm	1.008E+00	mg/m <sup>3</sup>
Uncertainty	dm	0.7	%
X-coordinate	xm	469.7	m
Y-coordinate	ym	-2.1	m
Stability class	kl	2.0	KM
Exit velocity	ua	3.0	m/s
Wind direction	ra	270.0	deg

Save emission sources and calculated concentration

Kl, Ua: 2.0 3.0 Ra: 270 Tick: 118.921 Cref: 1.008E+00 Graph

## Selected, unweighted meteorological situations



BESMAX - Version 1.3.0

Maximum concentration near ground according to No. 5.5.2.1 Para. 5 TA Luft (2021)

Description	nq	1	+
Emission mass flow	eq	100.0	kg/h
X-coordinate	xq	0.0	m
Y-coordinate	yq	0.0	m
Stack height	hb	21.9	m
Inner diameter	dq	1.0	m
Exit temperature	tq	40.0	°C
Exit velocity	vq	10.00	m/s
Water load	zq	0.0000	kg/(kg dry)
Liquid water	lq	0.0000	kg/kg
Norm volume flow (wet)	nF	24663	m³/h
Norm volume flow (dry)	nt	24663	m³/h

Input

Stack height 21.9 m

---

Calculate maximum concentration

Maximum concentration near ground:			
Concentration value	cm	1.008E+00	mg/m <sup>3</sup>
Uncertainty	dm	0.7	%
X-coordinate	xm	469.7	m
Y-coordinate	ym	-2.1	m
Stability class	kl	2.0	KM
Exit velocity	ua	3.0	m/s
Wind direction	ra	270.0	deg

Output

Result: 1.0 mg/m<sup>3</sup>

---

Save emission sources and calculated concentration

Kl, Ua: 2.0 3.0 Ra: 270 Tick: 118.921 Cref: 1.008E+00 Graph

## Plume Library

29 heights · 25 meteorological situations → 725 ground-level concentration fields

29 Effective stack heights	4 Stability classes	9 Wind speed categories								
6 m	I (very stable)	1 m/s	1.5 m/s	2 m/s						
	II (stable)	1 m/s	1.5 m/s	2 m/s	3 m/s					
	III/1 (neutral/stable)	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s
	III/2 (neutral/unstable)	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s
8 m	I	1 m/s	1.5 m/s	2 m/s						
	II	1 m/s	1.5 m/s	2 m/s	3 m/s					
	III/1	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s
	III/2	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s
...	...	...	...	...	...	...	...	...	...	...
905 m	I	1 m/s	1.5 m/s	2 m/s						
	II	1 m/s	1.5 m/s	2 m/s	3 m/s					
	III/1	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s
	III/2	1 m/s	1.5 m/s	2 m/s	3 m/s	4.5 m/s	6 m/s	7.5 m/s	9 m/s	12 m/s



25 different ground-level concentration fields per effective stack height

29 effective stack heights

725 different ground-level concentration fields in total

BESTAL – Stack height determination by dispersion modelling with selected, unweighted meteorological situations

BESMIN - Version 1.3.0

### Stack height according to No. 5.5.2.2 TA Luft (2021)

Substance: unknown  $s = 1.0 \text{ mg/m}^3$  **S-Value 1.0 mg/m<sup>3</sup>**

Emission mass flow:  $e_q = 100 \text{ kg/h}$

Inner diameter:  $d_q = 1 \text{ m}$

Exit temperature:  $t_q = 40 \text{ }^\circ\text{C}$

Exit velocity:  $v_q = 10 \text{ m/s}$

Water load:  $z_q = 0 \text{ kg/(kg dry)}$

Liquid water:  $l_q = 0.0000 \text{ kg/kg}$

Norm volume flow (wet):  $n_F = 24663 \text{ m}^3/\text{h}$

Norm volume flow (dry):  $n_T = 24663 \text{ m}^3/\text{h}$

**Input**

Slide 7 inverted

Calculate stack height

Calculated stack height  $h_b = 21.9 \text{ m}$  **Result: 21.9 m**

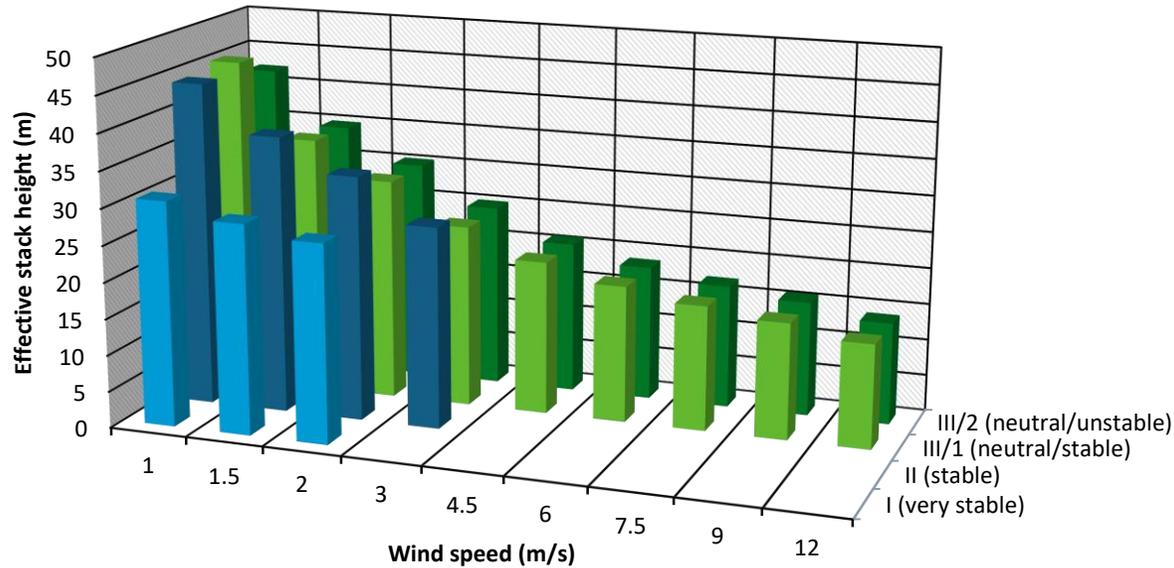
Processed calculations | Intermediate results

$k_l$	$u_a$	$h_{eff}$	$dev$	$h_b$
1.0	1.0	30.9	1.6%	6.0
1.0	1.5	28.8	1.5%	6.0
1.0	2.0	27.2	1.2%	6.0
2.0	1.0	44.4	1.0%	6.0
2.0	1.5	38.0	0.9%	6.0
2.0	2.0	33.5	0.7%	6.0
2.0	3.0	27.6	0.7%	21.9 *
3.1	1.0	45.4	0.9%	6.0
3.1	1.5	35.3	0.8%	13.6
3.1	2.0	30.4	0.8%	19.8
3.1	3.0	25.0	0.7%	19.7
3.1	4.5	21.1	0.7%	18.1
3.1	6.0	18.8	0.7%	16.8
3.1	7.5	17.2	0.6%	15.6
3.1	9.0	16.0	0.6%	14.8
3.1	12.0	14.3	0.5%	13.6
3.2	1.0	42.3	0.9%	6.0
3.2	1.5	34.9	0.8%	16.0
3.2	2.0	30.3	0.9%	20.2
3.2	3.0	25.1	0.6%	19.9
3.2	4.5	20.9	0.7%	18.1
3.2	6.0	18.6	0.6%	16.6
3.2	7.5	17.0	0.7%	15.5
3.2	9.0	15.8	0.6%	14.6
3.2	12.0	14.0	0.5%	13.3

**Result: 21.9 m**

**Output**

# 1) Plume library iteration to find effective stack height



BESMIN - Version 1.3.0

Stack height according to No. 5.5.2.2 TA Luft (2021)

Substance: unknown  $s = 1.0 \text{ mg/m}^3$  (S-Value 1.0 mg/m<sup>3</sup>)

Emission mass flow:  $e_q = 100 \text{ kg/h}$

Inner diameter:  $d_q = 1 \text{ m}$

Exit temperature:  $t_q = 40 \text{ }^\circ\text{C}$

Exit velocity:  $v_q = 10 \text{ m/s}$

Water load:  $z_q = 0 \text{ kg/(kg dry)}$

Liquid water:  $l_q = 0.0000 \text{ kg/kg}$

Norm volume flow (wet):  $n_F = 24663 \text{ m}^3/\text{h}$

Norm volume flow (dry):  $n_T = 24663 \text{ m}^3/\text{h}$

Calculate stack height

Calculated stack height  $h_b = 21.9 \text{ m}$  (Result: 21.9 m)

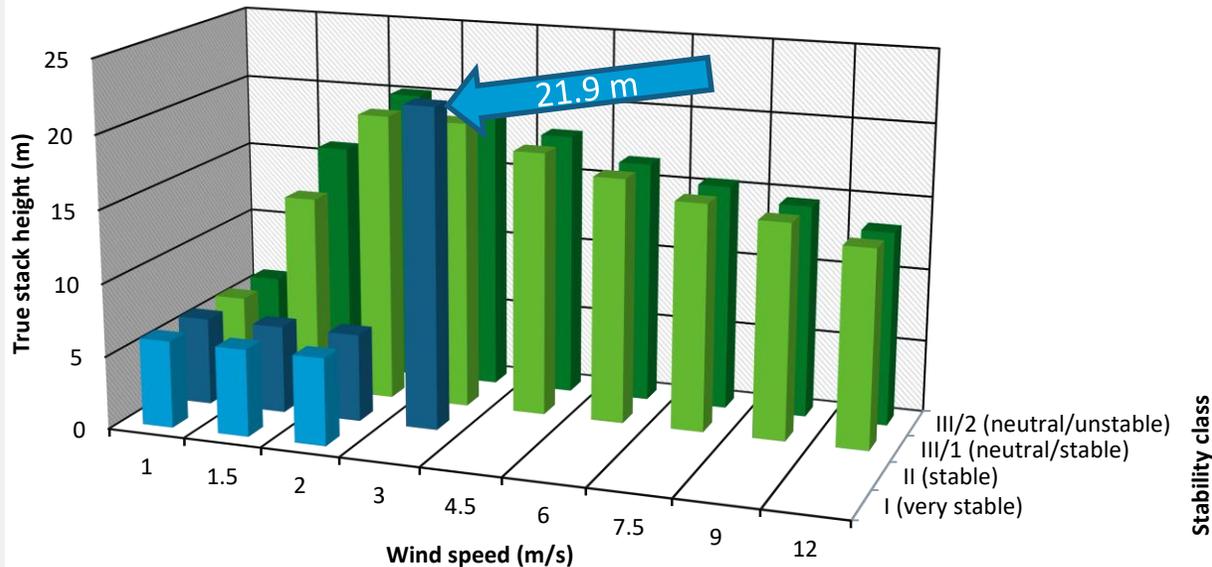
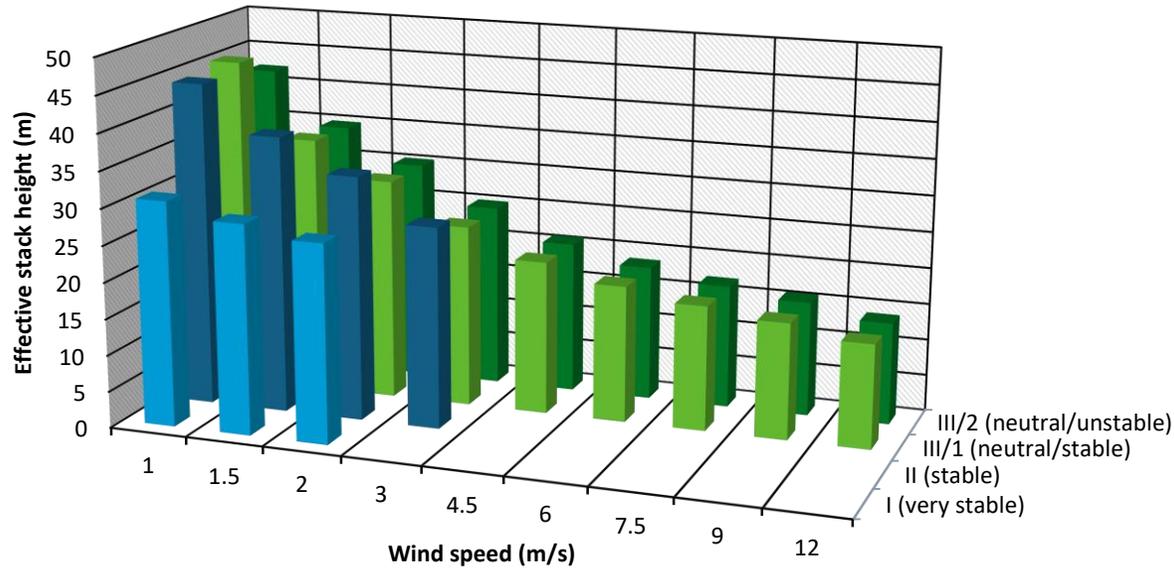
Processed calculations | Intermediate results

k1	ua	heff	dev	hb
1.0	1.0	30.9	1.6%	6.0
1.0	1.5	28.8	1.5%	6.0
1.0	2.0	27.2	1.2%	6.0
2.0	1.0	44.4	1.0%	6.0
2.0	1.5	38.0	0.9%	6.0
2.0	2.0	33.5	0.7%	6.0
2.0	3.0	27.6	0.7%	21.9 *
3.1	1.0	45.4	0.9%	6.0
3.1	1.5	35.3	0.8%	13.6
3.1	2.0	30.4	0.8%	19.8
3.1	3.0	25.0	0.7%	19.7
3.1	4.5	21.1	0.7%	18.1
3.1	6.0	18.8	0.7%	16.8
3.1	7.5	17.2	0.6%	15.6
3.1	9.0	16.0	0.6%	14.8
3.1	12.0	14.3	0.5%	13.6
3.2	1.0	42.3	0.9%	6.0
3.2	1.5	34.9	0.8%	16.0
3.2	2.0	30.3	0.9%	20.2
3.2	3.0	25.1	0.6%	19.9
3.2	4.5	20.9	0.7%	18.1
3.2	6.0	18.6	0.6%	16.6
3.2	7.5	17.0	0.7%	15.5
3.2	9.0	15.8	0.6%	14.6
3.2	12.0	14.0	0.5%	13.3

Result: 21.9 m

Output

- 1) Plume library iteration to find effective stack height
- 2) Plume rise iteration to find true stack height



BESMIN - Version 1.3.0

Stack height according to No. 5.5.2.2 TA Luft (2021)

Substance: unknown s: 1.0 mg/m<sup>3</sup> ← S-Value 1.0 mg/m<sup>3</sup>

Emission mass flow: eq: 100 kg/h

Inner diameter: dq: 1 m

Exit temperature: tq: 40 °C

Exit velocity: vq: 10 m/s

Water load: zq: 0 kg/(kg dry)

Liquid water: lq: 0.0000 kg/kg

Norm volume flow (wet): nF: 24663 m<sup>3</sup>/h

Norm volume flow (dry): nt: 24663 m<sup>3</sup>/h

Input

Slide 7 inverted

Calculate stack height

Calculated stack height hb: 21.9 m ← Result: 21.9 m

Processed calculations Intermediate results

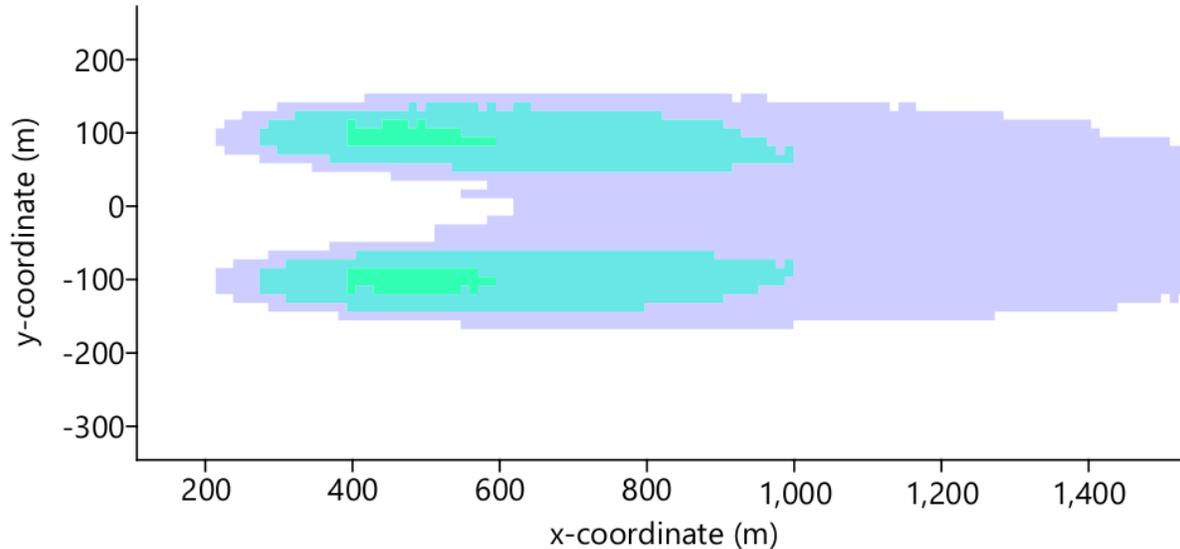
k1	ua	heff	dev	hb
1.0	1.0	30.9	1.6%	6.0
1.0	1.5	28.8	1.5%	6.0
1.0	2.0	27.2	1.2%	6.0
2.0	1.0	44.4	1.0%	6.0
2.0	1.5	38.0	0.9%	6.0
2.0	2.0	33.5	0.7%	6.0
2.0	3.0	27.6	0.7%	21.9 *
3.1	1.0	45.4	0.9%	6.0
3.1	1.5	35.3	0.8%	13.6
3.1	2.0	30.4	0.8%	19.8
3.1	3.0	25.0	0.7%	19.7
3.1	4.5	21.1	0.7%	18.1
3.1	6.0	18.8	0.7%	16.8
3.1	7.5	17.2	0.6%	15.6
3.1	9.0	16.0	0.6%	14.8
3.1	12.0	14.3	0.5%	13.6
3.2	1.0	42.3	0.9%	6.0
3.2	1.5	34.9	0.8%	16.0
3.2	2.0	30.3	0.9%	20.2
3.2	3.0	25.1	0.6%	19.9
3.2	4.5	20.9	0.7%	18.1
3.2	6.0	18.6	0.6%	16.6
3.2	7.5	17.0	0.7%	15.5
3.2	9.0	15.8	0.6%	14.6
3.2	12.0	14.0	0.5%	13.3

Result: 21.9 m

Output

## Multiple stacks: Superimpose concentration plumes of the stacks for comparison with the S-Value

BESMAX: KI=2.0 KM, Ua=3.0 m/s, Ra=180 deg

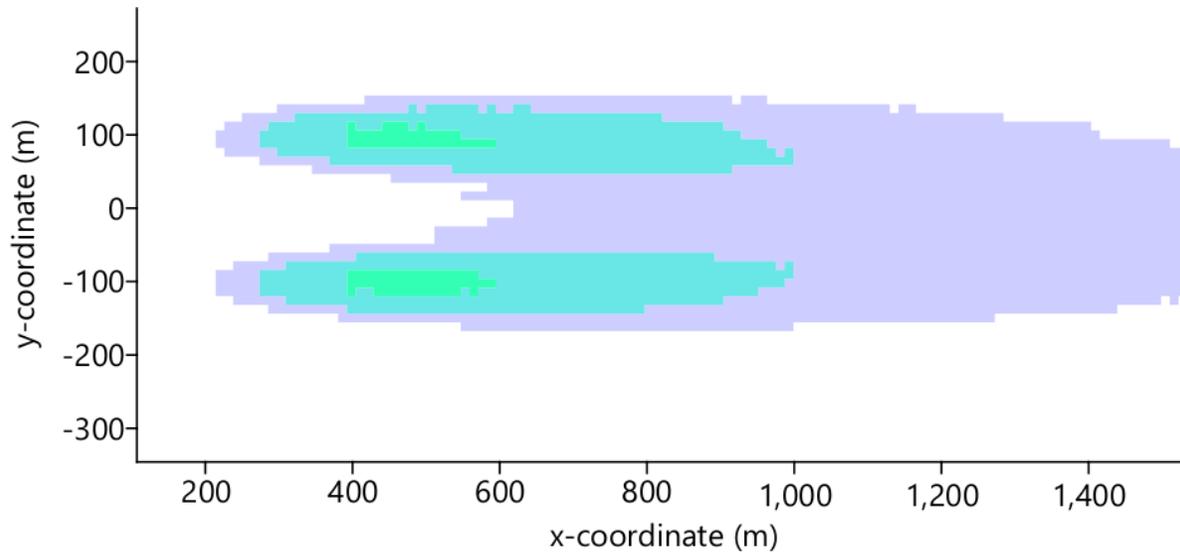


Two stacks like the one in slide 6, but

- 200 m apart, crosswind
- both with approximately **half the emission mass flow:**
- concentration peaks at approximately **half the S-Value**

## Multiple stacks: Superimpose concentration plumes of the stacks for comparison with the S-Value

BESMAX: KI=2.0 KM, Ua=3.0 m/s, Ra=180 deg



concentration in mg/m<sup>3</sup>



Ground-level concentration field is evaluated

- for all wind directions at steps of 5 degrees to identify the worst case wind direction

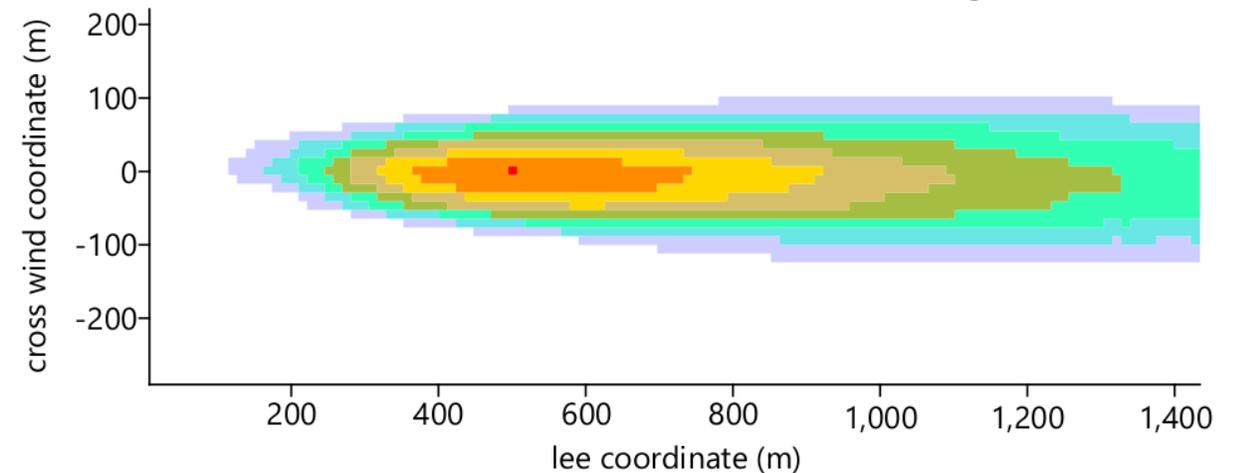
Two stacks like the one in slide 6, but

- 200 m apart, crosswind
- both with approximately **half the emission mass flow**:  
→ concentration peaks at approximately **half the S-Value**

**But** – consider the **worst case wind direction**:

- same two stacks 200 m apart, **along wind**  
→ concentration peaks at **the S-Value**

BESMAX: KI=2.0 KM, Ua=3.0 m/s, Ra=85 deg



concentration in mg/m<sup>3</sup>



## Conclusions

### SAFEGUARD CRITERION

- Pollution from the stack near the ground must not exceed **S-Value concentration** at any place, any hour of the year

### MULTIPLE STACKS

- Superimpose near-ground concentration fields of all stacks
  - for any (of 25 selected) meteorological condition
  - including any wind direction (at steps of 5 degree)to check compliance with the safeguard criterion

### METHOD

- Based on → consistent with – the national regulatory dispersion model

**THANK YOU**

**HAPPY TO TAKE QUESTIONS / COMMENTS**

**SEND ME AN E-MAIL IF YOU WOULD LIKE TO RECEIVE THE SLIDES**

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## Discussion

### How to define S-Values

**Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe. Section 1, Table 1, of Annex I: Limit values for the protection of human health to be attained by 1 January 2030**

Pollutant	Averaging period			
	1 hour	Maximum daily 8-hour mean	1 day	Calendar year
PM <sub>2,5</sub>			25 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>
PM <sub>10</sub>			45 µg/m <sup>3</sup>	20 µg/m <sup>3</sup>
Nitrogen dioxide (NO <sub>2</sub> )	200 µg/m <sup>3</sup>		50 µg/m <sup>3</sup>	20 µg/m <sup>3</sup>
Sulphur dioxide (SO <sub>2</sub> )	350 µg/m <sup>3</sup>		50 µg/m <sup>3</sup>	20 µg/m <sup>3</sup>
Benzene				3.4 µg/m <sup>3</sup>
Carbon monoxide (CO)		10 mg/m <sup>3</sup>	4 mg/m <sup>3</sup>	
Lead (Pb)				0.5 µg/m <sup>3</sup>
Arsenic (As)				6.0 ng/m <sup>3</sup>
Cadmium (Cd)				5.0 ng/m <sup>3</sup>
Nickel (Ni)				20 ng/m <sup>3</sup>
Benzo(a)pyrene				1.0 ng/m <sup>3</sup>
	not to be exceeded more than 3 times per calendar year	8-hour running averages, updated each hour	not to be exceeded more than 18 times per calendar year	

Obviously, S-Values should not exceed air quality limit values for the 1 hour average

Actually, they must be smaller to allow for background concentration from other sources

S-Values of the German administrative provision Technical Instructions on Air Quality Control (TA Luft) have developed historically

There is currently no fundamental relationship with air quality limit values (except they are less than one hour limit values)

In TA Luft 1974, S-Values were based on 95<sup>th</sup> percentiles, similar to the future EU air quality limit values for the 1 day average