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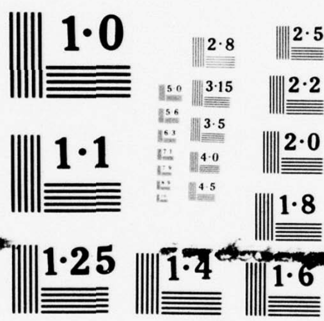
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FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

DETERMINATIONS OF POLLUTION CONCENTRATIONS BY MEASUREMENT TECHNIQUES AND CALCULATIONS, WITHIN THE RANGE OF INFLUENCE OF LARGE EMITTERS, AS A BASIS FOR EVALUATION FOR TERRITORIAL PLANNING

by

H. Mohry, Böhlen, et al.

FOREIGN TECHNOLOGY DIVISION

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TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

Herbert Mohry, Böhlen, Angela Lehmann, Potsdam, and Dieter Kahl, Vetschau[1]

DETERMINATIONS OF ~~EMISSION~~ POLLUTION CONCENTRATIONS BY MEASUREMENT TECHNIQUES AND CALCULATIONS, WITHIN THE RANGE OF INFLUENCE OF LARGE EMITTERS, AS A BASIS FOR EVALUATION FOR TERRITORIAL PLANNING.[2]

1. Statement of the Problem.

The knowledge of ~~emission~~ pollution concentrations is one of the important criteria for the assessment of a location and for the use of the land (residential and recreation areas, forestation and farming, etc.). The necessary bas~~i~~es for planning, investing, and reconstruction, are to be furnished by technical measurement of the ~~emissions~~ pollution on the one hand, and by theoretical calculations of ~~emission~~ pollution fields on the other hand. Measurements are the

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[1]Dr.-Ing. Herbert Mohry, VEB "Otto Grotewohl" Bohlen, Dipl.-Met. Angela Lehmann, Meteorological Service of the DDR, Potsdam, and Dipl.-Ing. Dieter Kahl, ORGREB - Institute for Power Plants, Vetschau.

[2]Report of the National Committee of the DDR in the WEC at the ninth world energy conference.

primary source of analysis of an actual burden condition in the territory. Since both the particulars of the emitters of the ~~emission~~ pollution area and the totality of the meteorological spreading conditions have their effect on the results, measurements that are carried out in sufficient depth in time and space have a high information content.

Calculations are useful for estimating fairly predicted burden tendencies depending on changes in emission land registers, and in optimizing variations for observing prescribed rates of growth while considering the cost-use relationship. Furthermore, an association of the effect on the surroundings with the emitter can be carried out only with the help of calculations. Measurements and calculations must be correlated with one another in such a way that they fulfill complementary tasks in the preparation of the information.

2. Analysis of the ~~Emission~~ Pollution Measurements

2.1 Statement of Objective and Coordination

In the DDR, various regions work together in the technical measurement determination of ~~emissions~~ pollution. The meteorological service lacks locations that are influenced hardly at all by local emitters, and therefore, determines the large scale burden and its long term development propensities for the entire area of the DDR. This basic material serves among other purposes, for the investigation of the mutual effects between meteorological influence factors and air impurity components and their long term changes.

Corresponding to the territorial structure, the responsibility for ~~emission~~ pollution supervision lies with the authorized hyg~~ei~~ienic supervision for each district as the national control organ.

This organization uses its measuring capacity primarily for determining the ~~emission~~ pollution burden in residential regions, municip~~le~~al centers, and city industrial complexes. Not only the so called leading components, sulfur dioxide and dust, but as far as possible, the locally occurring air impurity components are determined. In this way already, a certain control of the emitters can be undertaken. The central point of these studies is directed toward the protection of human health.

If industrial operations with large amounts of emission are present, whose effects on the surroundings are determining for the area, then they are called upon for measurement technical determination in the sphere of specific supervision [1]. Position and size of the measuring network suitable for the industry, as well as the time and method of carrying out the measurements, are coordinated by the district hygienic inspection. The measurement results obtained in certain territories are a basis for planning of residential areas, recreational areas, etc.

Forestry and farming carry out ~~emission~~ pollution measurements for determining the effects on their cultivations. The results are the basis for damage evaluation and the planning of adaptive measures.

2.2 Principles for carrying out ~~emission~~ pollution measurements.

The ~~emission~~ pollution measurements are conducted according to uniform guidelines that are set forth by the Ministry of Health. To these instructions belong the following:

- Measurement network planning,
- Organization and carrying out of the measurements,
- Measurement apparatus and procedures,
- Analytical determination in the laboratory,
- Evaluation and presentation of the ~~emission~~ pollution results.

In this way the comparability of the ~~emission~~ pollution values determined by different institutions is guaranteed. The processing is generally carried out by means of electronic data processing installations.

2.3 Central storage of ~~emission~~ pollution data.

Gaining ~~emission~~ pollution data is associated with a considerable expense. It is therefore important that the information content obtained by these measured values be used to the maximum. ~~Emission~~ Pollution measurement data are required by various institutions for:

- Supervising the observation of legal limits,
- Justification for reconstruction and restoration measures by the emitters,
- Coordination of the multi-faceted demands for use of the land,
- Planning of adaptive measures in the farming and forestry,
- Justification for payments ~~to~~ by industry for compensation and adjustment of ~~management~~ economic aggravations,
- The basic study with respect to the ~~appearance~~ occurrence and effects of air impurities.

If the measured ~~emission~~ pollution data are stored by a uniform code in an electronic data processing installation, a multi-faceted use is possible in a simple manner. Since the data are on hand in processed form for whatever useful purpose, use of them is considerably simplified. The central data storage for ~~emissions~~ pollution is set up at the meteorological service of the DDR. The organization is handled in a similar fashion to the data storage for meteorological measurement data (figure 1).

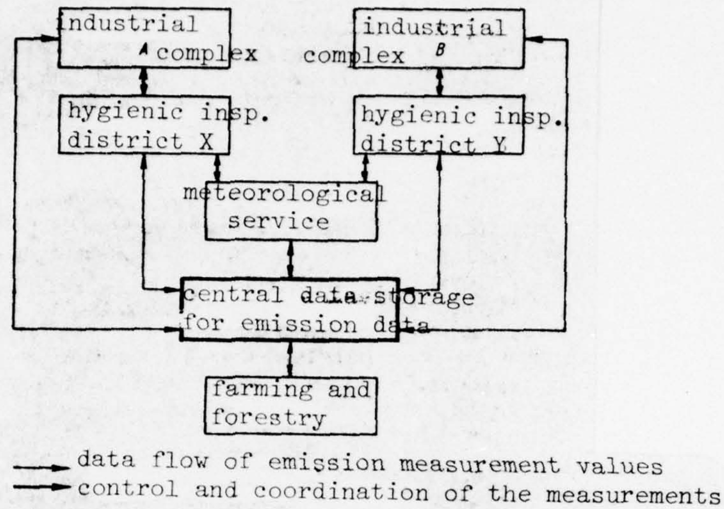

Figure 1: Coordination of ~~Emission~~ Pollution Measurements and Central data storage.

2.4 Results of ~~emission~~ pollution measurements

~~Emission~~ Pollution measurements within the range of influence of large emitters, and in development areas, are carried out as discontinuous short term measurements in temporary measurement networks, or with permanent measuring stations. The presentation of the results is made in charts for better review, in which both symbolic shading and contour lines are used for denoting the various degrees of burden.

Figure 2 shows as an example the contour line presentation for sulfur dioxide in the area of influence of two factories: while the amount of the sedimentation dust in an industrial area is shown in figure 5.

3. Calculated determination of ~~emissions~~ pollution.

In order to be able to determine by calculation the expected concentrations of ~~emission~~ pollutants, three essential assumptions must be made:

- the choice of a mathematical model for the spreading of gas and dust types of air impurities corresponding to the circumstances,
- the preparation of suitable and representative meteorological data,
- the assembly of the necessary emission data.

3.1 Mathematical models of the spreading calculation.

The mathematical modeling of the dissemination process has two different objectives:

- to show (or predict) an actual individual case (real time),
- to express dissemination conditions on a statistical basis (non-real time).

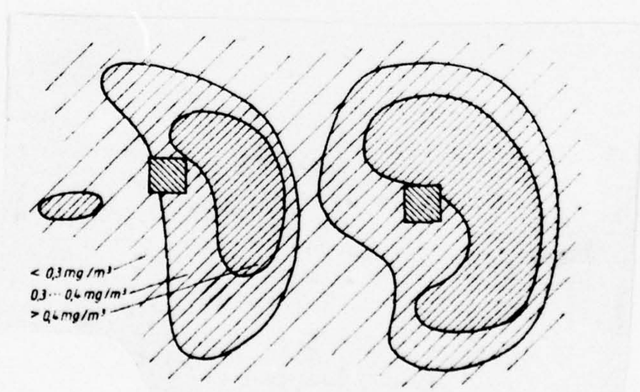

Figure 2: ~~Emission~~ Pollutant concentrations for sulfur dioxide in the area of influence of two factories.

In order to satisfy the primary objective, the most far-reaching specialized mathematical dissemination model is required, which considers in the optimum way the given marginal and initial conditions of the dissemination and dilution process. Possibilities of use and declarative force of the calculation model are determined by this to an important extent, outside of the specific emission conditions and the local characteristic of the emission and area of pollution ~~influences~~, insofar as a determination of the meteorological extent of influence determining the distribution and dilution of the harmful materials is possible in its space and time fine structure.

For all routine and predictive statements in the non-real time sense, such a detailed analytical work to prepare the input information is not possible, nor does it seem necessary. That is to say, if it is considered that the totality of the meteorological condition, weighted for the frequency of its appearance should be decisive for estimating a source in constant operation, then the following requirements are to be placed on the calculation model to be used.

- extensive general usefulness with respect to the realities of the location and the meteorological conditions,
- easy accessibility in the form of tables, nomographs, machine programs, etc.

Since it is a legal requirement in the DDR that, for all air polluting objects of investment and reconstruction, etc. measures for maintaining air purity are an intregal part of the planning, and, for this purpose, as a rule, meteorological air hygienic advice must be brought into play [2], it is of special importance to regulate the granting of advice to the extent that the declarations

- represent the highest scientific knowledge,
- impart uniform points of view,
- are recognized as binding.

Corresponding to the expert knowledge principle, the meteorological service of the DDR is authorized for the working out of methods for advising on the question of dissemination and dilution of air impurities in the atmosphere in the DDR.

They are prepared, on the basis of uniform, binding mathematical models that are prepared ahead of time in the form of computer programs for machine processing and/or in the form of tables and nomographs, to such an extent that the expense for working out consulting advice is minimal. By guidelines for working out the consultations and for interpretation of the computer results, an extensive objectivity and homogeneity of the declaration is assured. Corresponding to a requirement of the political economy, currently in the DDR the estimating measures for judging a source are to be expanded from the consideration of an unfavorable individual situation to frequency statistical statements.

In this paper, the new processes will be considered exclusively.

3.1.1 Gaseous air impurities.

A two-dimensional Gaussian distribution as given by Pasquil and others is used for calculating the dissemination of gaseous air impurities and solid particles of negligible weight (suspended dust) in the atmosphere:

(1)
$$\chi(x,y,o) = \frac{Q_s \cdot 10^6}{\pi \sigma_y \sigma_z u} \exp\left(-\frac{H^2}{2\sigma_z^2} - \frac{y^2}{2\sigma_y^2}\right)$$

Q_s	emitted harmful materials (in kg/sec),
H	effective chimney height (in m),
$\bar{u}$	average wind velocity in the dissemination layer in m/sec),
σ_y, σ_z	spreading parameter in y or z direction,
χ	Pollution concentration (in mg/m^3),

x, y, z   Cartesian coordinates with x lengthwise of the central flow line.

Formula (1) in the given form is valid for a continuously acting point source at point 0, 0, h.

In particular, the following definitions apply:

The wind velocity u increases exponentially with the altitude.

It is

(2)
$$u_h = u\left(\frac{h}{z_0}\right)^n$$

where u signifies the measured wind velocity at the anemometer height z_o, u_h is the wind velocity at the considered level h.

The exponent n depends on the stability.

If the dissemination layer is assumed to be the layer up to the effective chimney height, then:

(3)
$$\bar{u} = \frac{u}{n+1}\left(\frac{H}{z_0}\right)^n$$

The effective chimney height $H = h + \Delta h$ is calculated according to the formula of Carson and Moses [3].

(4)
$$\Delta h = \frac{CE}{u_h}$$

where $E = 82.6 \times Q^{0.5} - 0.029$ vd.

Q   Heat content of the effluent gasses (in MW), v exit velocity of the effluent gasses (in m/sec.),

d chimney diameter at the outlet (in m),

C Stability-dependent correction factor.

The spreading parameters σ_y and σ_z are used with the estimates

$$\sigma_y = A x^a, \; \sigma_z = B x^b$$

They are stability dependent.

With these assumptions, equation 1 has the following appearance:

(5)
$$\chi_{iklN}(X_P, Y_S) = \frac{10^6 (Q_s)_N (n_l + 1) Z_O^{n_l}}{\pi (AB)_l (X'_{PN})^{(a+b)_l} u_k \left[h_N + \frac{C_l E_N Z_O^{n_l}}{u_k h_N^{n_l}} \right]^{n_l}} \times$$
$$\times \exp \left\{ - \frac{\left[h_N + \frac{C_l E_N Z_O^{n_l}}{u_k h_N^{n_l}} \right]^2}{2 B_l^2 (X'_{PN})^2 b_l} - \frac{[Y'_{SN}]^2}{2 A_l^2 (X'_{PN})^2 a_l} \right\}$$

where

(6)
$$X'_{PN} = (X_{ON} - X_P) \sin\varphi_i + (Y_{ON} - Y_S) \cos\varphi_i,$$

(7)
$$Y'_{SN} = (Y_{ON} - Y_S) \sin\varphi_i - (X_{ON} - X_P) \cos\varphi_i.$$

Symbols:

X_P, Y_S Screening point in the fixed coordinate system (in m),

X_0 Y_0 Source coordinates in the fixed coordinate system (in m).

ϕ wind direction

Indices: i wind direction

k wind velocity

l stability

N source number

The indexing of the quantities indicates the dependence on wind direction, wind velocity, and degree of turbulence, and indicates their source association. The formula allows processing of statistical information on the dissemination conditions in the form of frequency distributions, where the simultaneous appearance of wind direction, wind velocity, and degree of stability are considered along with it.

3.1.2 Dust-like air impurities

Dust-like air impurities of significant weight settle after some time of dissemination. A formula of Bosanquet, Carey, Halton is used [4] in the DDR for calculating the amount of deposition:

$$F_i = 1.27 \cdot 10^6 \frac{W \cdot p \cdot b_K \cdot c_i \cdot f_i}{H^2 u \Gamma\left(1 + \frac{f_i}{p \cdot u}\right)} \left(\frac{H}{p \cdot r}\right)^{2 + \frac{f_i}{p \cdot u}} \exp\left(-\frac{H}{p \cdot r}\right) \tag{8}$$

which shows the dust deposition distance dependent at any given time for a 45° sector.

F	dust deposition (in g/m^2 x 30 d),
W	Total dust emission (in t/30 d),
c_i	Constituents of the grain fraction i at a total emission $\Sigma c_i = 1$
f_i	settling speed of the grain fraction i (in m/sec),
H	effective chimney height (in m),
u	average wind velocity in the dissemination layer (in m/sec),
r	radial distance (in m),
Γ	gamma function,
exp	exponential function.

The calculation formulas for neutral classification relationships given by the authors of the formula serve here for H.

$$H = h + \Delta h$$

$$h = 0.75(h_{v_{max}} + h_{t_{max}}). \quad (9)$$

$$h_{v_{max}} = \frac{4.77\sqrt{V_t}}{u(1+0.43\,u/v)} \quad (10)$$

$$h_{t_{max}} = \frac{0.23\,VTZ}{u^3} \quad (11)$$

$$Z = \ln I^2 + 2/I - 2. \quad (12)$$

$$I = \frac{u^2}{\sqrt{V \cdot v}}\left(22{,}70 - 7{,}79\,\frac{v}{T}\right) + 1; \quad (13)$$

V	Exhaust gas amount in the standard condition (in m^3 i.N.s.).
T	Temperature of the exhaust gases (in °C).
v	Exit velocity of the exhaust gases (in m/sec.).

3.2 Meteorological input values

The classification of the input parameters necessary for the frequency statistics is projected for the turbulence condition according to a schedule of Uhlig [5], which was adjusted to the regional peculiarities of the DDR by Fiedler [6]. Along these lines, 7 degrees of stability appear (from 1 = very stable to 7 = very labile), which utilize the following meteorological base information from routine measurements in the network of the meteorological observation stations: wind velocity, cloudiness, air masses, precipitation, ground condition, related to the time of year and time of day and local station location. Statistical evaluations of the degree of stability are available for the plains of the DDR.

The wind is a quantity that is strongly dependent on location. Since the dissemination of harmful materials, however, takes place at a definite height above ground and across sometimes considerable distances, it is particularly important with very high sources to use such wind data that are as independent as possible ~~from~~ of local influences on the anamometer reading and are representative of a large area. For the interior plains of the DDR, for example, a general wind direction distribution was calculated from the wind registers of 14 meteorological stations, which can be used as representative of the dissemination in undisturbed regions. The wind direction observation in general are available in statistical determinations according to an 8 point compass array (occaisionally 16 point or 36 point). Since this classification is too coarse for the dissemination calculation, linear interpolations are made between neighboring wind directions.

The definition of the spreading parameters is problematical. The literature information on this showed differing values. For the sample calculations presented, values from the literature were interpolated and made homogeneous through the numerous connections among themselves (table 1).

3.3 Emission figures

The recognition of the emission sources and their harmful material output, are important pieces of information for calculating pollution. For a number of large emitters, as they are to be met with in the areas of industrial activity, it is shown to be convenient to take up the production installations according to their type and the number of sources in an emission source card index. This is preferably built according to the characteristic parameters of the various technological processes.

Table 1. Parameter values of the dissemination calculation

degree of stability			σ_y		σ_z	
	n	C	a	A	b	B
1	0,52	0.68	0,528	0.550	0,431	0,781
2	0,48	0,74	0,580	0.508	0.504	0,683
3	0,39	0,87	0,638	0,542	0.594	0.539
4	0,29	1,08	0,717	0,385	0,717	0,385
5	0,20	1.41	0,834	0,295	0,902	0,216
6	0,12	1.90	0,992	0,201	1,167	0,087
7	0,06	2,65	1,220	0,096	1,574	0.017

Figure 3 shows that important technological parameters of the installation, the fuel, the purification devices, and the chimney are to be taken into consideration. The qualitative and quantitative data about the fuel enters decisively into the calculation of the combustion products and determines the extent of the amounts of harmful materials, and, from this, the construction of the purification installations. The study of the emissions including their characteristic features is very costly in this respect and contains some problems in spite of several possible methods of determination. Both continuous and discontinuous measurement apparatus is available for measuring sulfur dioxide. Groups of measurements have shown that the determination of the sulfur content of the fuel is sufficient for quantifying the SO_2 emission. Dust emissions at the present time are still determined by discontinuous gravimetric processes.

The determination of the amounts of emission resulting is for the complete output of the installation that is to be installed or is threatened, as well as for a representative average value of the specific harmful material to be estimated. For installations that operate discontinuously (chemical and foundry industries), factors are computed from the output data that take into consideration the temporal and capacity output. Since sometimes several hundred emission sources are active in large industrial areas, the probability exists that the production variations of individual installations are compensated, and thereby, nearly constant pollution fields occur.

3.4 Calculation program

3.4.1 Gaseous pollutants

The following calculations are carried out with the stated models for dissemination calculations for gaseous pollutants, using the frequency statistics of the meteorological conditions:

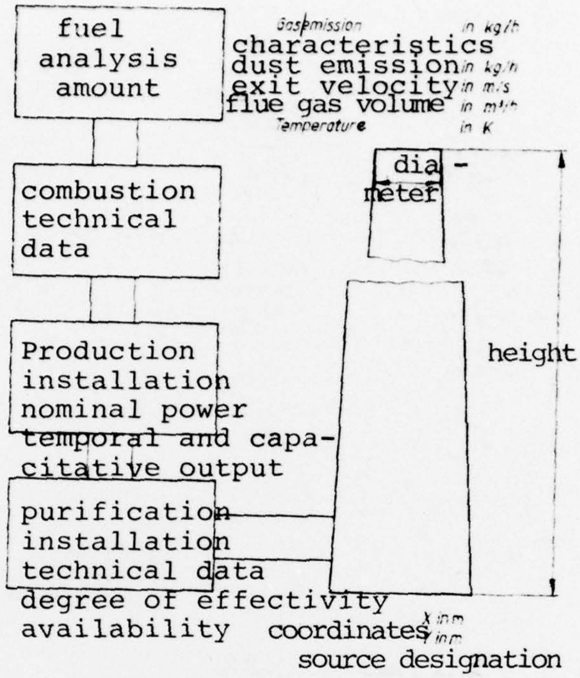

Figure 3: Data for emission source charts.

x- coordinate	y- coordinate	threshhold value (in mg/m³)									
(in m)	(in m)	0.010	0.050	0.100	0.150	0.200	0.300	0.400	0.500	0.700	0.900
10 000.000	66 000.000	13.729	8.729	6.538	4.901	4.493	3.308	2.927	2.510	2.057	1.495
14 000.000	66 000.000	15.900	8.767	6.458	5.150	4.564	3.428	2.860	2.302	1.801	1.322
18 000.000	66 000.000	16.973	9.951	7.613	6.363	5.311	4.209	3.139	2.732	2.089	1.351
22 000.000	66 000.000	18.075	10.353	7.354	6.410	5.422	4.555	3.412	2.753	2.145	1.081
26 000.000	66 000.000	16.672	10.124	7.388	5.991	5.139	3.879	3.119	2.653	1.647	0.932
30 000.000	66 000.000	16.230	9.764	7.065	5.897	5.078	3.472	2.700	2.230	1.537	0.957
34 000.000	66 000.000	17.702	10.323	7.359	5.292	4.497	3.445	2.631	1.930	1.125	0.710
38 000.000	66 000.000	18.395	11.215	8.074	6.291	4.758	3.683	2.760	2.325	1.434	0.984
42 000.000	66 000.000	18.581	10.112	7.299	5.965	4.575	3.101	2.087	1.407	0.848	0.566
46 000.000	66 000.000	17.460	10.209	6.115	4.993	4.425	2.946	2.323	1.815	1.089	0.883
50 000.000	66 000.000	17.481	9.943	6.794	4.737	3.865	2.378	1.789	1.479	1.065	0.685
54 000.000	66 000.000	18.978	10.570	6.622	4.941	3.832	2.716	2.197	1.850	1.078	0.713

Table 2: Result print out of total pollution. frequency of exceeding (in %).

- Burden calculations

  As results, tables are available that show the frequency for given points of an area with which definite concentration threshhold values are exceeded (table 2). The necessary information for comparison with measured values can be taken directly for the individual points of the table. To obtain a regional overview, chart diagrams are more suitable than tables. For a threshhold value at a given time of the pollution concentration, lines are drawn in a coordinate network of equal frequency of violation, in which the point sources are also shown. Optionally, the associated concentration values for given burden limits, and therefore, threshhold values of the frequency distribution, can also be shown by contour lines (figure 4).
- Calculations of pollutant proportion

  As a result, the frequency information ~~determined~~ for each individual source determined in the aforementioned point is available, so that the load produced by the various sources can be shown for every point of the region. The computer results provide detailed information on the distribution of pollution damage.
- Average value calculations

  With consideration of all meteorological dissemination situations, weighted for the frequency of their occurrance, long term average values of the burden are calculated and presented in charts.
- Calculation of pollution directional distribution

  For individual pollution points (for example, locations of objects sensitive to air-borne impurities), there are presented data on what pollution concentrations can be expected with what frequency from individual wind calculations.
- Calculation of minimum chimney heights

  As bases for decision in approval processes, the probability is presented for definite chimney heights to be sufficient to stay within the lawfully prescribed threshhold values of pollution.

3.4.2 Dust-like pollutants

According to the equation of Bosanquet, Carey and Halton, the calculation of the dust sedimentation for each coordinate point is worked out for a given area, which is defined by the information on the coordinates of three corner points as a rectangle with parallel axes, and in which a quadratic network of coordinates is laid out with a chosen separation of coordinates, as the summation value of all active emission sources.

The program is prepared for the electronic data processing installation ROBOTRON 300 in the MACRO-MOPS program language. The input data are visualized on overlays, and recorded before starting the calculations of the computer. As an example, table 3 shows the input data as well as the result print-out. According to the inquiry, the result print-out can be worked out in several variations for coordinate points:

- The pollution value at each point of the coordinates gives the degree of pollutant fallout of the affected area, where the action of all considered emission sources is taken into consideration.
- With the pollution amount for each source and point of the coordinates, the contribution of a specific stack in the total pollutant fall-out can be determined. In this way, quantitative bases for projected reconstruction measures on the one hand, and for the distribution of claims from pollution damages to the originators, on the other hand, can be provided.
- For Studies for economic principles of the relationship between meteorological dissemination conditions and dust sedimentation, a detailed print-out is possible, in which the pollution amounts can be displayed according to wind velocity, source, and coordinate position.

All areas in the vicinity of large industrial complexes were studied with respect to their degree of contamination by this calculation process. The presentation of the calculation results can be made on charts to exact scale for better comprehension, with the use of an automatic CARTIMAT precision coordinate plotter, as lines of equal degree of contamination (figure 5).

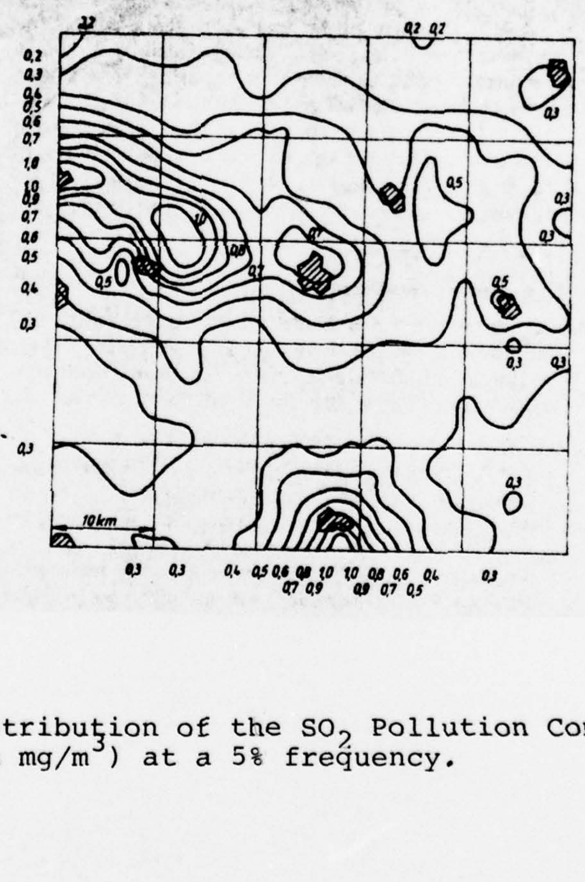

Figure 4. Distribution of the SO_2 Pollution Concentrations (in mg/m^3) at a 5% frequency.

Table 3: Input data and result print-out for the method of calculating sedimentation of dust.

Input Data

Area: Industrial Complex A

Coordinates of the corner points	x 1 (in m) : 24 000	y 1 (in m) : 68 000	Screen Separation:	500 m

Frequency Distribution of the Wind Direction and Velocity

NE	E	SE	S	SW	W	NW	N	Turbulence factor	wind velocity
					Proportion related to 1				
.024	.035	.034	.030	.051	.048	.035	.027	0.02	2.00
.029	.045	.034	.037	.075	.064	.043	.022	0.04	4.00

Nr.	Desig. of Source	Type of Dust	Build height (in m)	Exit velocity (in m/s)	Temp. at top of chimney (in °C)	Effluent gas quantity (in m³/s)	Total pollution (in t/Monat)	Coordinaten x (in m)	y (in m)
1	KWA 1	1	300	24	180	1225	720	26 480	71 300
7	BF A 1–7	2	33	4	95	48	230	27 320	72 580

Frequency distribution of the particle fractions

Type of dust	Source	F 4	C 4	F 3	C 3	F 2	C 2	F 1	C 1
1	1–6	1.560	0.030	0.512	0.180	0.128	0.260	0.016	0.330
2	7–109	0.760	0.020	0.256	0.110	0.064	0.180	0.008	0.360

Print-out:

x (in m)	y (in m)	Proportion of the particle fractions (in g/m² · 30 d)				
24 500	69 000	F 4	F 3	F 2	F 1	Sum
KWA 1	NE	0.182	1.331	0.052	0.005	1.570
BF A 1–7	NE	0.186	1.722	0.890	0.108	2.905

From these charts, the stages of development of contamination can be recognized that are produced by the erection of new plants, reconstructions, shut-downs, etc. The chart material, therefore, serves as a basis for the decisions of planning and control organizations.

4. Comparison of pollution calculations with measurement results.

4.1 Gaseous air impurities

The comparison of pollution measured values with calculated results is recognized internationally as an extraordinarily complicated problem, which is attributed especially to the impossibility of an exact determination and consideration of proper models of all the complex acting influence factors. An important assumption for comparison in each case is that of identical conditions for obtaining and processing the values by measurement and by calculation. The calculation process used in the DDR comes exceptionally close to this requirement. The agreement of the calculation results with measured values of pollution is also correspondingly good. The localization of burden centers is clearly obtained. Frequencies of exceeding specific threshhold values of pollution are satisfactorily protrayed according to current experience, expecially for higher stages of burden, while larger differences appear in the case of lower values of pollution (less than 0.2 mg/m^3), for which the following explanations can be given.

- local influences (for example, where smaller emitters are not included in the calculations),
- deviations between the average values for the meteorological parameters used for the calculation (generally averaged over a number of years, and the actually observed parameters within the period of measurement,
- Errors in the measurements of pollution determined by analysis and apparatus,
- Character of the model used for the dissemination calculation, that is not correct for some situations of dissemination.

The result of the calculations must be evaluated altogether, and it must be determined that, in relation to the earlier practice of an observation of selected individual situations, a significant yield of information relative to the actual burden of an area is given.

4.2 Dust sedimentation

If the measured amounts of dust sedimentation are placed next to the contour lines for the calculated pollution concentrations, as shown in figure 5, a relatively good agreement is obtained. The following basis is standard for this purpose: The time of integration of the measured values amounts to one month. From these results, yearly average values are shown, which are used for comparison with the calculated values. A characteristic two-parameter frequency distribution of the wind enters into the calculation program, which is taken as a profile over several years. The emission value in tons per 30 days introduced into the calculation was used in the same time unit, for which the dust deposit was calculated and measured. No momentary values are used as a basis for either measurement or calculation. The technical measurement over a period of a month by nature considers a frequency distribution. This is used in calculation operations whose input data take it into account. Corresponding conclusions result therefrom.

In making preparations for new plants, and in the reconstruction or shut-down of existing operations, decisions are necessary that must aim at the observation of the legally prescribed maximum pollution concentrations (MIK-values). The following assumptions are appropriate for the fulfillment of these requirements:

- Pollution measurements are to be carried out by uniform methods by the institutions with consideration of the measurement network configuration, and the results are to be stored in a data bank.
- Calculation models for the statement of pollution are to be so configured that frequency statistical information, especially meteorological parameters, are to be weighted according to the probability of their occurrence, and weighted capacity and temporal dependent emission data are to be used.
- Only the agreement of the measured pollution with that calculated for an existing condition warrants the use of calculation models for obtaining actual

information on the projected development of the pollution situation in the most widely varying industrial areas.

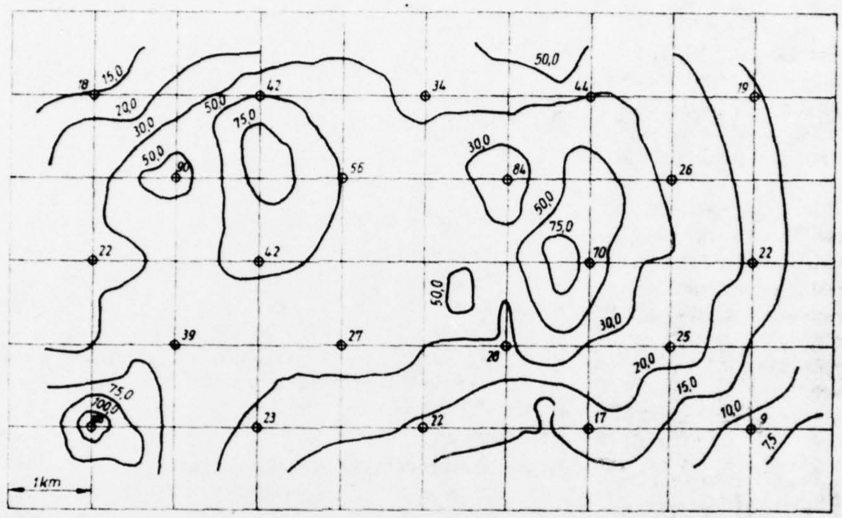

Figure 5: Measured and calculated dust sedimentation (in g/m^2 · 30days) in an industrial area.

5. Summary.

It is shown how technical measurement analyses are carried out on pollution burden in the German Democratic Republic, corresponding to the regulation on the maintenance of pure air by various institutions for different purposes, but coordinated by uniform methods. With the help of a data bank it is being attempted to give condensed information on the air hygiene situation to the responsible institutions and operations, primarily for use in the industrial areas. They form the basis for territorial planning and the adaptation measures necessary because of the environmentally determined political economy.

Newly developed mathematical models for the dissemination and dilution processes of air impurities can make prognostications on the development of the atmospheric hygienic burden in the area as a function of structural changes for hundreds of emission sources, by the use of electronic data processing installations. In these calculations, frequency statistical information on the dissemination conditions is taken into consideration. The results can be presented in tabular hard copy as well as in scaled charts according to the desired interrogation.

Comparisons of measured and calculated pollution yield satisfactory agreement, so that they can be drawn upon as a basis for evaluation for planning for new industrial operations.

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