EPA 600/3-85/052

SURVEY OF METEOROLOGICAL AND TRACER DATA FOR DEMONSTRATING A DATA ARCHIVE

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OFFICE OF RESEARCH AND DEVELOPMENT
U. S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

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by

R. K. Woodruff
C. S. Glantz
Battelle, Pacific Northwest Laboratories
Richland, Washington 99352

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Project Officer

John S. Irwin
Meteorology and Assessment Division
Atmospheric Sciences Research Laboratory
Research Triangle Park, North Carolina 27711

Battelle, Pacific Northwest Laboratories
Richland, Washington 99352

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ABSTRACT

The Meteorology and Assessment Division of the U.S. Environmental Protection Agency's Atmospheric Sciences Research Laboratory has initiated a project to develop and establish an archive of original experimental data and documentation for use by atmospheric dispersion and boundary layer researchers.

The specific scope of the project includes a survey of atmospheric tracer and meteorological data sets for use in dispersion model development and validation, development of a process for accurately archiving and documenting such data sets, and demonstration of the process and documentation by archiving two data sets.

This report describes the results of a survey of available pre-1980 micrometeorological and tracer dispersion data sets. The purpose of the report is to:

(1) identify data of potential interest for archiving and

(2) provide information about the general character of the body of data of interest to guide the design of the archive structure and documentation, and archiving procedures.

The assessment of existing pre-1980 data sets identified 22 micrometeorological and 41 tracer diffusion data sets of primary interest for potential future archiving. Primary interest was in data sets for relatively flat to gently rolling uniform rural terrain with small to moderate roughness elements. Only diffusion studies with controlled tracer releases were considered. From these, a subset of 5 micrometeorological and 5 tracer diffusion data sets are recommended for first archiving. The recommended data sets include:

<u>Micrometeorological</u>

Minnesota 1973
Cabauw 1977-1979
Koorin Expedition
Cooperative Atmospheric Boundary Layer Experiment (CABLE)
Pheonix Project

Tracer Diffusion

Hanford 1964
Hanford Secondary Series
Cabauw
Karlsruhe 1969-1974
Ocean Breeze

Tabular summaries for these data sets are provided.

From the above lists, one micrometeorological and one tracer diffusion data set are recommended for use in developing and testing the archive structure, process, procedures, and documentation. These data sets, the Minnesota 1973 and Hanford 1964 Series data sets, represent a balance of several technical and nontechnical factors useful in the archive development process.

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ACKNOWLEDGMENT

The authors wish to acknowledge the foresight of the U.S. Environmental Protection Agency's Atmospheric Sciences Research Laboratory in initiating a project with the intent of ensuring the preservation of past investments in valuable data bases and of making these more readily available to the technical community at a reasonable cost. John S. Irwin's contribution in conceiving and guiding the effort as Project Officer is gratefully acknowledged.

This effort was dependent upon information graciously provided by others. We especially thank Yutaka Izumi of the Air Force Geophysical Laboratory who provided the original Minnesota 1973 rawinsonde data so that it could be added to the data set. The contributions of information from our foreign colleagues, Dr. Frans Nieuwstadt (Royal Netherlands Meteorological Institute), Drs. Pierre Durand and Aime' Druilhet (Laboratoire d'Aerologic, France), Dr. Sven-Erik Gryning (Riso National Laboratory, Denmark), and Dr. J. R. Garratt (CSIRO, Australia) are gratefully appreciated.

SECTION 1

INTRODUCTION

The Meteorology and Assessment Division of the U.S. Environmental Protection Agency's Atmospheric Sciences Research Laboratory has initiated a project to develop and establish an archive of original experimental data and documentation for use by atmospheric dispersion and boundary layer researchers. The intent of the effort is to establish an archive of data sets that will be useful for modern dispersion model evaluation and improvement, to ensure the retention of these data for the future, and to make these data more readily available to the research community.

The specific scope of the project includes a survey of atmospheric tracer and meteorological data sets for use in dispersion model development and validation, development of a process for accurately archiving and documenting such data sets, and demonstration of the process and documentation by archiving two data sets.

This report describes the results of the assessment of available pre-1980 data obtained by Battelle, Pacific Northwest Laboratories. The purpose of the report is to:

(1) identify data of potential interest for archiving and

(2) provide information about the general character of the body of data of interest to guide the design of the archive structure and documentation, and archiving procedures.

This report is structured as follows: the conclusions and recommendations resulting from the assessment appear in Section 2. Section 3 describes the type of data primarily sought at this time, how the survey was performed, and the general character of the data identified; this section concludes with separate tables listing the 22 micrometeorological data sets and the 41 tracer data sets identified from which the first data sets to be archived are to be selected. Section 4 recommends the subset of data sets for consideration for initial archiving. Each of the subsets is described in further detail in a narrative discussion. The appendix lists the bibliography for the identified data sets.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

An assessment of existing pre-1980 data sets identified 22 micrometeorological and 41 tracer diffusion data sets of primary interest for potential future archiving. These data sets are summarized in Figures 1 and 2. From these data sets, a subset of five micrometeorological and five tracer diffusion data sets are recommended for first archiving. The recommended data sets include the following:

Micrometeorological

- Minnesota 1973
- Cabauw 1977-1979
- Koorin Expedition
- Cooperative Atmospheric Boundary Layer Experiment (CABLE)
- Phoenix Project

Tracer Diffusion

- Hanford 1964 Series
- Hanford Secondary Series
- Cabauw
- Karlsruhe 1969-1974
- Ocean Breeze

Tabular summaries for these data sets are provided in Figures 3 and 4.

Selection of these pre-1980 sets over others is the result of a number of technical and nontechnical considerations, some of which are unique to the objectives of this study. Inclusion or exclusion is not necessarily meant to imply relative technical merit.

Experiment Terrain type Location, Year Reference	Roughness	Meteorological Conditions: Stability	Meteorological Conditions: Mixing Height m.	Measurements: Depth m.	Measurements: Means D T D R R H W A T H	Measurements: Fluctuations U V W T R P A H	Methods T B S A R O A O R E W L N C M E L D C O R O E R T S O S F E N T
ASHCHURCH: 1976 * ASHCHURCH, U.K. CAUGHEY, S.J. AND S.G. PALMER, 1979	MODERATE	U	1800	1400	* Y Y * * Y	Y Y Y Y * *	* Y Y * Y
BOULDER ATMOSPHERIC OBSERVATORY: CURRENT GENTLY ROLLING BOULDER, COLORADO, USA KAIMAL, J.C., AND J.E. GAYNOR, 1983	SMOOTH	ALL	1500	300	Y Y Y Y Y Y	Y Y Y Y Y N	Y * Y * *
CABAUW FLAT CABAUW, NETHERLANDS DRIEDONKS, A.G.M., ET AL., 1978	SMOOTH-MOD	ALL	9999	213	Y Y Y Y Y Y	* * * * * *	Y * * * Y
CABAUW 77-79: TURBULENCE MEASUREMENTS FLAT CABAUW, NETHERLANDS, 1977-1979 DRIEDONKS, A.G.M., 1981	SMOOTH-MOD	ALL	9999	200	Y Y Y Y Y Y	Y Y Y Y Y N	Y N Y N Y
CABLE HOMOGENEOUS S.E. ENGLAND MOORES, W.H., ET AL., 1979	MODERATE	U	2000	1000	Y Y Y Y Y Y	Y Y Y Y * N	Y Y Y Y Y
FRANGI CBL STUDY * FRANCE AND SPAIN 1973-1976 FRANGI, J.P., 1979	SMOOTH-ROG	U	9999	3000	N Y Y Y N Y	Y N Y Y Y N	N N N Y N
GREAT PLAINS TURBULENCE FIELD PROGRAM FLAT O'NEILL, NEBRASKA, USA 1953 LETTAU, H.H. AND B. DAVIDSON, 1957	SMOOTH	ALL	9999	2000	Y Y Y Y Y Y	Y Y Y Y * N	Y N Y Y N
I.T.C.E 1976 FLAT CONARGO, N.S.W. AUSTRALIA 1976 DYER, A.J., ET AL., 1981; GARRATT, J.R., ET AL., 1979	SMOOTH	ALL	9999	16	Y Y Y Y Y N	Y Y Y Y Y N	Y N N N N
KANSAS 1968 FLAT S.W. KANSAS, USA 1968 IZUMI, Y., 1971	SMOOTH	ALL	9999	32	Y Y Y Y Y N	Y Y Y Y N N	Y N N N N

Figure 1. Data base output: selected micrometeorological data sets.

Experiment Terrain type Location, Year Reference	Roughness	Meteorological Conditions: Stability	Meteorological Conditions: Mixing Height m.	Measurements: Depth m.	Means: D W	T A	D T	R H	R	H	Fluctuations: U	V	W	T A	R H	P	Methods: T O W E R S	B A L L O O N	S O N D E S	A R C C R F T	R E M O T E
KERANG AND HAY FLAT KERANG AND HAY, AUSTRALIA 1962-64 SWINBANK, W.C. AND A.J. DYER, 1968	SMOOTH	ALL	9999	16	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	N	N	N	N
KOORIN FLAT DALY WATERS, NTHRN. TRTY. AUSTRALIA MCILROY, I.C., 1979	MODERATE	ALL	9999	3000	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N
LIMAGNE AND BEAUCE EXPERIMENTS FLAT FRANCE 1974, 1976 JOUVENAUX,B., 1978; TUZET, A., 1982	MODERATE	U	2700	3000	Y	Y	Y	*	*	Y	Y	Y	Y	Y	Y	*	Y	*	*	Y	*
MARSTA SLIGHTLY ROLL MARSTA, SWEDEN 1969-1971 SMEDMAN-HOGSTROM, A. AND U. HOGSTROM, 1973	MODERATE	ALL	9999	30	Y	Y	Y	Y	Y	*	Y	Y	Y	Y	Y	N	Y	N	N	N	N
MINNESOTA, 1973 FLAT DONALDSON, MINNESOTA, USA 1973 IZUMI, Y., AND J.S. CAUGHEY, 1976	SMOOTH	U	2360	1220	Y	Y	Y	Y	*	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N
NSSL/WKY-TV TOWER: CURRENT GENTLY ROLLING OKLAHOMA CITY, OKLAHOMA, USA 1972 GOFF, R.C. AND W.D. ZITTEL, 1974	SMOOTH-MOD	ALL	9999	481	Y	Y	Y	Y	*	*	N	N	N	N	N	N	Y	*	N	N	N
PHOENIX GENTLY ROLLING BAO BOULDER, COLORADO, USA 1978 HOOKE, W.H., 1979	SMOOTH	ALL	9999	9999	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
RUSH FLAT MANILLA, INDIANA, USA, 1977 SISTERSON, D.L., ET AL, 1983.	SMOOTH-MOD	ALL	1500	2000	Y	Y	Y	*	Y	Y	Y	*	Y	Y	*	N	Y	Y	Y	Y	Y
SANGAMON FLAT AUBURN, ILLINIOS 1975, 1976 USA HICKS, B.B., ET AL, 1981	SMOOTH-MOD	ALL	9999	2000	Y	Y	Y	Y	Y	Y	Y	*	Y	Y	*	N	Y	Y	Y	Y	Y

Figure 1. (continued)

Experiment Terrain type Location, Year Reference	Roughness	Meteorological Conditions: Stability	Meteorological Conditions: Mixing Height m.	Meteorological Measurements: Depth m.	Means D T D R R H W A T H	Fluctuations U V W T R P A H	Methods T B S A R O A O R E W L N C M E L D C O R O E R T S O S F E N T
SRL-WJBF-TV: CURRENT GENTLY ROLLING BEECH ISLAND, S.C., USA, 1973 WEBER, A.H., 1975	MODERATE	ALL	9999	335	Y Y Y * * *	Y Y Y Y * N	Y * * * *
TSIMLYANSK, 1981 FLAT TSIMIYANSK FLD. STN. ROSTOV, USSR TSVAND, L.R., 1982	SMOOTH-MOD	***	9999	500	Y Y Y * * *	Y Y Y Y * *	Y * * Y Y
WANGARA FLAT ITAY, N.S.W. AUSTRALIA 1967 CLARKE, R.H., ET AL, 1971	SMOOTH-MOD	***	9999	2000	Y Y Y Y Y Y	Y N Y Y N N	Y N Y N N

Figure 1. (continued)

NOTES TO FIGURE 1

1. This figure is intended for qualitative comparison and, by its nature, may not be numerically precise, and may not treat data set entries entirely consistently.

2. Stability: U = Unstable, All = Unstable, Near Neutral or Neutral, and Stable.

3. * and 9999 have been used to indicate no information for alphabetic and numerical entries, respectively.

4. Mixing Depth = an approximate maximum for convective data.

5. Depth = the approximate maximum atmospheric column depth observed by measurements.

6. DW = vertical wind profile
   TA = temperature profile
   DT = vertical temperature profile
   RH = moisture (whether measured as pH or some other measure of air moisture)
   R = radiation
   H = mixing height
   U = longitudinal or total wind fluctuation
   V and W = lateral and vertical wind component fluctuations
   TA = temperature fluctuation
   RH = moisture fluctuation
   P = pressure fluctuation
   Towers: indicates tower was part of measurement program
   Balloon, Sonde: The former has been indicated when tethered balloons or other forms of constant level balloons (Tetroons) have been used. The latter has been used to indicate free flight balloons such as pibals or rawinsondes.
   Aircraft: indicates their use for quantitative measurements.
   Remote: indicates use of acoustic or electromagnetic techniques for quantitative measurements of some parameter.

7. Y and N: indicate Yes or No response to whether the measurement was made or technique used.

Experiment Name and Year Terrain Type Roughness Location Reference	Source Time min - max minutes	Release Height min - max m.	Num ber	Tra cer	Stabi lity	Tracer Distances min - max km	Measurements Period min - max min	Type SSSE YZUL RE FV AA CT EE D	Method IR NE SM IO TT UE	 VA II SR UC AR LA F T	Meteorological Measurements M T S E A R E U U L I E A R R E R M N B F V C O S U A A R T L C T A E N E E F T D T
AGESTA: '60 -'63 * SMOOTH AGESTA NUCLEAR POWER STA., SWE HOGSTROM, U., 1964	999.99 999.99	50.00 50.00	24	S	NS	999.99 999.99	999.99 999.99	NNYN	NN	YN	Y N Y Y N N
BROOKHAVEN: '49-'56 FLAT WOODS MODERATE BROOKHAVEN, NEW YORK, USA SMITH, M.E. 1956; SINGER I.A. AND M.E. SMITH 1966; ISLITZER, N.F. AND D.H. SLADE 1968	30.00 90.00	2.00 110.00	0	S	ALL	0.05 60.00	999.99 999.99	YYYN	YN	YY	Y N Y Y N Y
BROOKHAVEN: EARLY '70'S FLAT FOREST MODERATE BROOKHAVEN, NEW YORK, USA RAYNOR, G.S. ET AL. 1972, 1973 AND 1974	20.00 40.00	1.80 14.00	72	P	U	999.99 0.10	999.99 999.99	YYYY	YN	NN	N * Y Y N Y
CABAUW: '77-'78 FLAT COUNTRY VARYING CABAUW, NETHERLANDS AGTERBERG, R., ET AL., 1983; NIEUWSTADT, F.T.M. AND H. VAN DUUREN, 1979	999.99 60.00	20.00 200.00	15	G	NU	3.00 7.00	30.00 60.00	YNYN	YN	NN	Y Y Y Y N N
CALIFORNIA COASTAL: HAYNES PLAIN -- 1974 COASTAL LONG BEACH, CALIFORNIA, USA LAMB, B.K. ET AL., 1978	999.99 999.99	76.00 76.00	3	G	S	999.99 85.00	999.99 999.99	YYYY	YN	NY	Y N Y Y Y N
CALIFORNIA COASTAL: LOS ALAMITOS -- 1974 COASTAL LONG BEACH, CALIFORNIA, USA EPRI EA-1159, 1979	999.99 999.99	67.00 67.00	3	G	S	999.99 85.00	999.99 999.99	YYYN	YN	NY	Y N Y N Y N
CALIFORNIA COASTAL: MOSS LANDING -- 1974 COASTAL MOSS LANDING, CALIFORNIA, USA EPRI EA-1159, 1979	999.99 999.99	152.00 152.00	3	G	S	999.99 44.00	999.99 999.99	YYYY	YN	NY	Y N Y Y Y N
CALIFORNIA COASTAL: MONTEZUMA HILLS -- 1974 COASTAL VARYING MONTEZUEMA HILLS, CALIFORNIA, LAMB, B.K. ET AL., 1978	120.00 540.00	5.00 5.00	8	G	ALL	0.02 60.00	0.20 0.20	YYYY	YN	NY	Y Y Y Y N N
CALIFORNIA COASTAL: OXNARD PLAIN -- 1975 COASTAL LARGE VENTURA, CALIFORNIA, USA LAMB, B.K., 1978	520.00 845.00	70.00 70.00	2	G	ALL	0.14 1.10	0.20 60.00	YNYN	YN	NN	Y N Y Y N N

Figure 2. Data base output: selected tracer dispersion data sets.

Experiment Name and Year Terrain Type Roughness Location Reference	Source Time min (minutes)	Source Time max (minutes)	Release Height min (m.)	Release Height max (m.)	Number	Tracer	Stability	Tracer Distances min (km)	Tracer Distances max (km)	Measurements Period min (min)	Measurements Period max (min)	Meteorological Type	Meteorological Method	Meteorological Measurements
CANADIAN: BAIE DU DORE-'64 SHORELINE * LAKE HURON, CANADA STEWART, R.E., 1968	4.00	17.00	19.00	19.00	5	P	ALL	0.04	0.24	999.99	999.99	YNYN	YN NN	Y Y Y Y N N
CANADIAN: SUFFIELD-'65 SHORELINE * RALSTON, ALBERTA, CANADA STEWART, R.E., 1968	10.00	43.00	71.00	92.00	2	P	U	0.18	3.60	999.99	999.99	YNYN	YN NN	Y Y Y Y N N
CHARLESTON DENSE FOREST LARGE FRANCIS MARION NAT. FOREST, SC METEOROLOGY RESEARCH LABORATORY, 1968	999.99	999.99	999.99	999.99	13	PS	*	999.99	0.60	999.99	999.99	YYYY	YN YN	Y * Y Y N N
CHIPPEWA NATIONAL FOREST FLAT FOREST LARGE NORTH CENTRAL, MINNESOTA, USA TOURIN, M.H. AND W.C. SHEN, 1969	999.99	999.99	999.99	999.99	24	P	*	0.50	2.00	15.00	15.00	YYYY	YN NN	Y * Y Y N N
DUGWAY FLAT DESERT * DUGWAY PROVING GROUND, UTAH, USA CRAMER, H.E., 1964	0.10	0.50	999.99	999.99	33	PG	S	0.10	1.70	999.99	999.99	YYYY	YN NN	Y N Y * N N
FORT DETRICK: '55-'56 FLAT SMOOTH FREDERICK, MARYLAND, USA HALLANGER, N.L. ET AL., 1962	3.00	3.00	1.00	4.00	130	P	ALL	0.10	2.64	999.99	999.99	YNYN	YN NN	Y N Y Y N N
GREEN GLOW: 1959 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA BARAD, M.L. AND J.J. FUQUAY, 1962; FUQUAY, J.J. ET AL., 1964	20.00	60.00	2.00	2.00	28	P	S	0.20	25.60	999.99	999.99	YYYY	YN NN	Y N Y Y N N
HANFORD 30 SERIES:'59-'62 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA FUQUAY, J.J. ET AL., 1964; NICKOLA, P.W. ET AL., 1983	15.00	196.00	2.00	2.00	42	P	NS	0.10	12.80	999.99	999.99	YYYY	YN NN	Y N Y Y N N
HANFORD 63 SERIES: 1963 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W., ET AL., 1983	26.00	79.00	7.00	7.00	18	P	NS	0.20	3.20	999.99	999.99	YYYY	YN NN	Y N Y Y N N

Figure 2. (continued)

Experiment Name and Year Terrain Type Roughness Location Reference	Source Time min	Source Time max (minutes)	Release Height min	Release Height max (m.)	Number	Tracer	Stability	Tracer Distances min	Tracer Distances max (km)	Measurements Period min	Measurements Period max (min)	Type SSSE YZUL RE FV AA CT EE D	Method IR VA NE II SM SR IO UC TT AR UE LA F T	Meteorological Measurements M T S E A R E U U L I E A R R E R M N B F V C O S U A A R T L C T A E N E E F T D T
HANFORD 64: 1964 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W., ET AL., 1983	20.00	72.00	56.00	111.00	15	P	NS	0.20	3.20	999.99	999.99	YYYY	YN NN	Y N Y Y N N
HANFORD SECONDARY SERIES FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA, '62- NICKOLA, P.W., ET AL., 1983	4.00	65.00	2.00	26.00	20	PG	NS	0.20	3.20	999.99	999.99	YYYY	YN NN	Y N Y Y N N
HANFORD U SERIES: '60-JUNE '67 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W., ET AL., 1983	17.00	61.00	2.00	111.00	55	PG	ALL	0.10	3.20	999.99	999.99	YNYN	YN NN	Y N Y Y N N
HANFORD U SERIES: JULY '67-'69 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W. 1977	15.00	30.00	2.00	111.00	41	PG	ALL	0.20	12.80	999.99	999.99	YNYN	YN NN	Y N Y Y N N
HANFORD KRYPTON SERIES: '67-'74 FLAT DESERT SMOOTH HAHFORD, WASHINGTON, USA NICKOLA, P.W., 1977	10.00	20.00	1.00	2.00	5	PG	ALL	0.20	0.80	999.99	999.99	YYYY	YN NN	Y N Y Y N N
HANFORD V SERIES: '72-'73 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W., 1977	10.00	31.00	26.00	26.00	8	P	ALL	0.20	3.20	999.99	999.99	YYYY	YN NN	Y N Y Y N N
INEL: '70'S FLAT DESERT SMOOTH IDAHO FALLS, IDAHO, USA SAGENDORF, J.F. AND C.R. DICKSON, 1974	60.00	60.00	60.00	999.99	11	G	S	0.10	0.40	999.99	999.99	YYYY	YN NY	Y Y Y Y N N
JULICH: '67-'76 FLAT MODERATE JULICH, FEDERAL REP. OF GER. VOGT, K.J., ET AL., 1973; VOGT, K.J., 1977A AND 1977B, VOGT, K.J. AND H. GEISS, 1974	60.00	60.00	50.00	100.00	60	P	NU	0.10	10.00	999.99	999.99	YYYY	YN NN	Y N Y Y N N
KARLSRUHE: PRIOR TO '74 FLAT MODERATE KARLSRUHE, FEDERAL REP. OF GER. THOMAS, P., ET. AL., 1974; THOMAS, P. AND K. NESTER, 1976	20.00	30.00	60.00	100.00	33	G	ALL	0.10	5.00	999.99	999.99	YYYY	YN NN	Y * Y Y N *

Figure 2. (continued)

Experiment Name and Year Terrain Type Roughness Location Reference	Source Time min (minutes)	Source Time max (minutes)	Release Height min (m.)	Release Height max (m.)	Number	Tracer	Stability	Tracer Distances min (km)	Tracer Distances max (km)	Measurements Period min (min)	Measurements Period max (min)	Type (SY, SZ, SURFACE, ELEVATED)	Method (IN SITU, REMOTE)	Method (VISUAL, AIRCRAFT)	Meteorological Measurements (MEANS, TURBULENT, SURFACE, ELEVATED, AIRCRAFT, REMOTE)
KARLSRUHE: 1980 FLAT MODERATE KARLSRUHE, FEDERAL REP. OF GER. SCHUETTELKOPF, H., ET AL., 1981	999.99	999.99	160.00	195.00	999	G	N	0.50	8.50	30.00	30.00	YYYY	YN	NN	Y * Y Y N *
LOISACH VALLEY VALLEY MODERATE LOISACH VAL., FEDERAL REP. OF GER. REITER, R., 1974 AND 1975; REITER, R. AND R. SLADONIC, 1976	999.99	999.99	999.99	300.00	11	P	U	3.00	16.00	999.99	999.99	Y*Y*	**	**	* * * * * *
MT. RAINIER FOREST LARGE MT. RAINIER, WASHINGTON, USA FRITSCHEN, L.J., ET AL., 1970; FRITSCHEN, L.J. AND R. EDMONDS, 1976	999.99	999.99	1.00	20.00	31	P	*	999.99	0.24	999.99	999.99	YYYY	YN	NN	Y * Y Y N N
NATIONAL REACTOR TEST STA. FLAT DESERT SMOOTH IDAHO FALLS, IDAHO, USA ISLITZER, N.F., 1961 AND ISLITZER, N.F. AND R.K. DUMBAULD, 1963	30.00	60.00	1.00	46.00	16	P	U	0.10	3.20	30.00	60.00	YYYY	YN	NN	Y N Y Y N *
NORWAY VALLEY * NORTHERN NORWAY GOTAAS, Y., 1975; MINOTT, D.H., ET AL., 1977	60.00	999.99	0.00	150.00	46	PS	NS	3.00	13.00	999.99	999.99	YYYY	YN	YY	* * * * * *
OAK RIDGE: 1974 HEAVILY WOODED LARGE OAK RIDGE, TENNESSEE, USA WILSON, R.G., ET AL., 1976	60.00	60.00	1.00	31.00	11	GS	NS	0.10	4.00	999.99	999.99	YYYY	NN	YY	Y N Y Y N Y
OCEAN BREEZE: '61 ROLLING MODERATE CAPE KENNEDY, FLORIDA, USA HAUGEN, D.A., AND J.J. FUQUAY, 1963	30.00	30.00	2.00	2.00	76	P	ALL	1.20	4.80	999.99	999.99	YNYY	YN	NN	Y Y Y Y N N
PORTON FLAT SMOOTH PORTON, WILTSHIRE, UK HAY, J.S., AND F. PASQUILL, 1957	30.00	30.00	152.00	152.00	19	P	ALL	0.10	0.50	30.00	30.00	YYYY	YN	NN	Y Y Y Y N N
PRARIE GRASS: 1956 FLAT GRASSLAND SMOOTH O'NEILL, NEBRASKA, USA BARAD, M.L., 1958; HAUGEN, D.A., 1959	10.00	10.00	46.00	150.00	70	G	S	0.05	0.80	10.00	10.00	YYYY	YN	NN	Y Y Y Y N N

Figure 2. (continued)

Experiment Name and Year / Terrain Type, Roughness / Location / Reference	Source Time min (minutes)	Source Time max (minutes)	Release Height min (m.)	Release Height max (m.)	Number	Tracer	Stability	Tracer Distances min (km)	Tracer Distances max (km)	Measurements Period min (min)	Measurements Period max (min)	Type SY SZ SURFACE ELEVATED	Meteorological Method INSITU REMOTE	Meteorological Method VISUAL AIRCRAFT	MEANS	TURBULENT	SURFACE	ELEVATED	AIRCRAFT	REMOTE
RISO: 1976-1977 GENTLY ROLLING SMOOTH ROSKILDE, DENMARK GRYNING, S.E. AND E. LYCK, 1980	60.00	60.00	60.00	60.00	5	G	N	999.99	5.00	22.00	67.00	YNYN	YN	NN	Y	Y	Y	Y	N	N
ROUND HILL: 1950'S FLAT MODERATE ROUND HILL, MASS., USA CRAMER, H.E., ET AL., 1957	10.00	10.00	1.00	1.00	20	G	*	0.05	0.20	10.00	10.00	YNYN	YN	NN	Y	N	Y	Y	N	N
SAND STORM FLAT SMOOTH EDWARDS AIR FORCE BASE, CA., U TAYLOR, J.H., 1965	0.10	0.20	999.99	999.99	43	P	U	0.10	2.00	999.99	999.99	YNYN	YN	NN	Y	Y	Y	Y	N	N
SUFFIELD: PRE-1965 GENTLY ROLLING * RALSTON, ALBERTA, CANADA WALKER, E.R., 1965	30.00	60.00	7.00	15.00	12	P	ALL	0.03	0.80	999.99	999.99	YNYN	YN	NN	Y	Y	Y	Y	N	N
THREE MILE ISLAND FLAT RIVER ISLE * THREE MILE ISLAND, PENN., USA GPU, 1972; HALITSKY, J. AND K. WOODWARD, 1975	45.00	45.00	1.00	999.99	10	G	S	0.09	0.25	999.99	999.99	YYYY	YN	NN	Y	*	Y	Y	N	N

Figure 2. (continued)

NOTES TO FIGURE 2

1. This figure is intended for qualitative comparisons and, by its nature, may not be numerically precise and may not treat data set entries entirely consistently.

2. * or 999.99 indicate information was not available.
   - Source Time = duration of tracer release (min)
   - Release Height = height above ground of tracer release (m)
   - Number = number of experiments in the series
   - Tracer = class of tracer, P is particle, S is smoke, G is gas. If more than one class of tracer is released, the symbol for each is given.
   - Stability = atmospheric stability, U is unstable, N is neutral, S is stable, and ALL means experiments were conducted under all three stabilities.

3. Tracer Measurements
   - Tracer Distances = distance from release point to samplers
   - Measurements Period = duration of tracer sampling (min)
   - SY = sigma Y, measured plume width
   - SZ = sigma Z, measured plume vertical thickness
   - Surface = an indicator of whether ground level sampling was conducted
   - Elevated = an indicator of whether aboveground or tower sampling was conducted

4. Plume Measurement Methods
   - In Situ = an indicator of whether in situ sampling was conducted
   - Remote = an indicator of whether remote sampling was conducted
   - Visual = an indicator of whether visual or photographic observations of the tracer (smoke) were made
   - Aircraft = an indicator of whether aircraft sampling was conducted

5. Meteorological Measurements
   - Means = an indicator of whether the data consists of mean values
   - Turbulence = an indicator of whether turbulence measurements were made
   - Surface = an indicator of whether surface meteorological measurements were made
   - Elevated = an indicator of whether elevated (i.e., tower, rawinsonde, tethersonde) meteorological measurements were made
   - Aircraft = an indicator of whether meteorological measurements were made from aircraft
   - Remote = an indicator of whether remote sensing devices were used to make meteorological measurements

Experiment Terrain type Location, Year Reference	Roughness	Conditions: Stability	Conditions: Mixing Height m.	Depth m.	Meteorological Measurements — Means: DW	TA	DT	RH	R	H	Fluctuations: U	V	W	TA	RH	P	Methods: TOWERS	BALLOON	SONDES	AIRCRAFT	REMOTE
CABAUW 77-79: TURBULENCE MEASUREMENTS FLAT CABAUW, NETHERLANDS, 1977-1979 DRIEDONKS, A.G.M., 1981	SMOOTH-MOD	ALL	9999	200	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y
CABLE HOMOGENEOUS S.E. ENGLAND MOORES, W.H., ET AL., 1979	MODERATE	U	2000	1000	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	*	N	Y	Y	Y	Y	Y
KOORIN FLAT DALY WATERS, NTHRN. TRTY. AUSTRALIA CLARKE, R.H. AND R.R. BROOK, 1979	MODERATE	ALL	9999	3000	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N
MINNESOTA, 1973 FLAT DONALDSON, MINNESOTA, USA 1973 IZUMI, Y., 1976	SMOOTH	U	2360	1220	Y	Y	Y	Y	*	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N
PHOENIX GENTLY ROLLING BAO BOULDER, COLORADO, USA 1978 HOOKE, W.H., 1979	SMOOTH	ALL	9999	9999	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Figure 3. Recommended micrometeorological data sets (see notes for Figure 1).

From the lists in Figures 3 and 4, one micrometeorological and one tracer diffusion data set are recommended for use in developing and testing the archive structure, process, procedures, and documentation. These data sets, the Minnesota 1973 and Hanford 1964 Series data sets, represent a balance of several technical and nontechnical factors useful in the archive development process.

```
                                                                                Meteorological
                                                                     Type Method Measurements
                                                                     SSSE IR  VA  M T S E A R
                                                                     YZUL NE  II  E U U L I E
                                                                       RE SH  SR  A R R E R M
                                                                       FV IO  UC  N B F V C O
                                                                       AA TT  AR  S U A A R T
                                                                       CT UE  LA    L C T A E
                                                                       EE      F    N E E F
                                                                        D      T    T   D T
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Experiment Name and Year / Terrain Type Roughness / Location / Reference	Source Time min (minutes)	Source Time max	Release Height min (m.)	Release Height max	Number	Tracer	Stability	Tracer Distances min (km)	Tracer Distances max	Measurements Period min (min)	Measurements Period max	Type	Method	VA	M	T	S	E	A	R
CABAUW: '77 - '78 FLAT COUNTRY VARYING CABAUW, NETHERLANDS AGTERBERG, R., ET AL., 1983; NIEUWSTADT, F.T.M. AND H. VAN DUUREN, 1979	999.99	60.00	20.00	200.00	15	G	NU	3.00	7.00	30.00	60.00	YNYN	YN	NN	Y	Y	Y	Y	N	N
HANFORD 64: 1964 FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA NICKOLA, P.W., ET AL., 1983	20.00	72.00	56.00	111.00	15	P	NS	0.20	3.20	999.99	999.99	YYYY	YN	NN	Y	N	Y	Y	N	N
HANFORD SECONDARY SERIES FLAT DESERT SMOOTH HANFORD, WASHINGTON, USA, '62- NICKOLA, P.W., ET AL., 1983	4.00	65.00	2.00	26.00	20	PG	NS	0.20	3.20	999.99	999.99	YYYY	YN	NN	Y	N	Y	Y	N	N
KARLSRUHE: PRIOR TO '74 FLAT MODERATE KARLSRUHE, FEDERAL REP. OF GER. THOMAS, P., ET. AL., 1976; THOMAS, P. AND K. NESTER, 1976	20.00	30.00	60.00	100.00	33	G	ALL	0.10	5.00	999.99	999.99	YYYY	YN	NN	Y	*	Y	Y	N	*
OCEAN BREEZE: '61 ROLLING MODERATE CAPE KENNEDY, FLORIDA, USA HAUGEN, D.A., AND J.J. FUQUAY, 1963	30.00	30.00	2.00	2.00	76	P	ALL	1.20	4.80	999.99	999.99	YNYY	YN	NN	Y	Y	Y	Y	N	N

Figure 4. Recommended tracer dispersion data sets (see notes for Figure 2).

SECTION 3

DATA SELECTION AND ASSESSMENT PROCESS

There is a relatively large and diverse body of data from micrometeorological and tracer dispersion experiments that have been and could be used for model development and evaluation. For this reason, general characteristics were established for selecting the data sets of primary interest for initial archiving. The characteristics selected include those of interest based on historic, unique, or the comprehensive nature of the data set with primary attention given to continuous point sources. Instantaneous point sources were identified as a secondary interest at this time. Because of the relatively larger uncertainties in source terms, interest was limited to controlled tracer releases to the exclusion of data based only on tracers of opportunity (e.g., monitored industrial stack emissions). The vertical scale of interest was identified to be through the mixed layer, and the horizontal scale was out to 100 km. While there is a great need for and interest in complex terrain, urban, and shoreline diffusion modeling, initial emphasis in this assessment was limited to relatively flat homogeneous rural terrain, although a clear division is not possible. Recent assessments of available data sets for complex terrain, vegetated canopies, and fugitive emissions have been completed by Orgill et al. (1984), Orgill and Lindsey*, Droppo and Orgill†, and Droppo and Ballinger‡.

Candidate data sets were identified by three methods: from existing surveys of data sets, through a computer search of the Meterological and Geophysical Abstracts for the period generally post dating the existing surveys, and through hand searches of the major scientific journals for

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* Orgill, M. M., and C. G. Lindsey. Complex Terrain Meteorological Data Base, Phase II. Prepared for U.S. Army Atmospheric Sciences Laboratory by Pacific Northwest Laboratory, Richland, Washington (to be published).

† Droppo, J. G., and M. M. Orgill. Survey of Canopy Micrometeorological Data Bases. Prepared for U.S. Army Atmospheric Sciences Laboratory by Pacific Northwest Laboratory, Richland, Washington (to be published), and Documentation of Archived Canopy Micrometeorological Data Bases. Prepared for U.S. Army Atmospheric Sciences Laboratory by Pacific Northwest Laboratory, Richland, Washington (to be published).

‡ Droppo, J. G., and M. Y. Ballinger. Development of Near-Source Emission, Dispersion and Deposition Data Bases. Prepared for U.S. Environmental Protection Agency, Atmospheric Sciences Research Laboratory by Pacific Northwest Laboratory, Richland, Washington (to be published).

recent publications not yet included in the Abstracts. The prior surveys utilized included Draxler (1984), Irwin (1983), Vanderborght and Kretzschmar (1983), Ramsdell (1983), and Sklarew and Joncich (1979). The journals included Boundary Layer Meteorology, Quarterly Journal of the Royal Meteorological Society, Journal of Climate and Applied Meteorology, Atmospheric Environment, and Journal of Atmospheric Sciences.

Selected information describing the data sets of interest was organized into a minicomputer data base system for ease of use and summarization. The micrometeorological data sets identified and selected for consideration are summarized in Figure 1. The legend of abbreviations and guidance for interpretation is shown at the end of the figure.

The survey revealed a number of additional studies that do not appear in the figure because they were not of primary interest for archiving at this time. These data sets were for the marine boundary layer, internal boundary layers, complex terrain, or of very limited scope. The data sets that were selected were for sites that ranged from very flat with uniformly small roughness, to gently rolling and sloping sites with larger and less uniform roughness. The former are generally associated with the earlier surface layer studies and the latter with the more recent studies emphasizing the total planetary boundary layer. While the earlier studies seemed to give relatively equal emphasis to all stability conditions, recent studies emphasize the convective boundary layer, reflecting the relative difficulty in making flux measurements in stable conditions and the attendant relative lack of success in modeling the nocturnal boundary layer. The fact that measurement techniques have changed rather dramatically over the period of years represented in the selected data sets is significant for the design of an archive. The measurement techniques have expanded from primarily short portable towers, as represented by the Kansas 1968 data set, to tall permanent and continuously operated towers, tethered balloons, high-resolution temperature and windsondes, aircraft turbulence measurements, and an array of acoustic and electromagnetic sensing techniques, as represented by Project Phoenix.

Through contacts with researchers and literature reviews, 41 tracer dispersion experiments were identified that met our criteria and for which we were able to obtain adequate descriptions of the experiments. These data sets are listed in Figure 2. In addition, an almost equal number of series of experiments were identified that may have met our criteria, but for which adequate information was not readily available. Many of these experiments were conducted by private utilities or the military, and their results were not widely available.

With the number and diversity of techniques, and the volumes of data being generated, archiving a significant number of different data sets could represent a significant technical and resource problem. Therefore, a primary consideration in developing an archiving process, structure, and procedure is the need to deal with large quantities of diverse data types in a manner that minimizes both the costs involved in the archiving process and the potential for introducing errors.

SECTION 4

SELECTED DATA

The data sets identified in Figures 1 and 2 were reviewed to select a subset to be recommended for consideration for first archiving. Separate subsets have been selected for micrometeorological and tracer diffusion data sets. In both cases, a rather arbitrary number of five data sets was selected. The criteria for selection were flexible and included such considerations as potential level of current interest in the data set, the comprehensiveness of measurements, the degree to which state-of-the-art techniques were employed, the degree to which measurements cover the total mixed layer, the existence or potential existence of both micrometeorological and tracer diffusion data sets, the variety of experimental conditions, the availability of the original data, and the attributes of the data set for initial development and testing of the archive structure process and procedures.

The selected data sets are listed in Figures 3 and 4. The following is a narrative description of each data set and the features that led to its selection.

MINNESOTA 1973

A full-scale planetary boundary layer field experiment was conducted in northwestern Minnesota in the late summer of 1973 (Izumi and Caughey, 1976; Readings and Butler, 1972). The site was at the middle of the southern edge of an extremely flat, square-mile section of farmland about 3 km east of Donaldson. The surface cover was wheat stubble and harrowed soil. Observations were made for winds from directions that had undisturbed fetch for 10 km. Only data obtained during unstable periods are recommended as reliable by the experimenters based on stationarity considerations. The measurement program is summarized in Table 1.

The data from the surface to 32 m were collected from a tower, and those from 61 to 1220 m with a 330-m^3 kite balloon. Tower and balloon data were collected continuously during each run. Slow ascent rawinsondes were launched every 2 hours during the day and evenings, and every 3 to 4 hours at night. Eleven 75-minute runs were documented. These runs span the early-to-late afternoon period, although data were collected through the nocturnal transition. The nocturnal data were not originally analyzed or

TABLE 1. MINNESOTA 1973 MEASUREMENT PROGRAM

Measurements	Location	Method
Mean wind speed, wind direction	1, 2, 4, 8, 16, 32 m	Two-axis sonic anemometers
	5 levels from 61-1220 m	Turbulence probe
Mean temperatures	0.5 m plus above 5 levels from 61-1220 m	Quartz thermometers, platinum wire
Fluctuating longitudinal, lateral and vertical wind, and temperature	4 and 32 m	Three-axis sonic anemometers
	5 levels from 61-1222 m	Hot wire inclinometers, cup, platinum wire
Pressure, temperature, moisture, wind speed	to 3 km	Slow ascent rawinsonde

published because winds and turbulence levels dropped below reliable measurement levels. Drag plate measurements were reportedly attempted, but apparently were not successful and/or not reported.

Some unique aspects of the Minnesota 1973 data are the high vertical spatial density of comparable turbulence measurements in the surface layer and the fact that they extend to a height of 1220 m in the mixed layer. Profile and turbulence measurements above 32 m were obtained using the balloon-borne instrumentation and techniques developed by the Meteorological Research Unit (MRU) of the British Meteorological Office, Royal Air Force, Cardington, England (Readings and Butler, 1972). The comparability of the tower and balloon-borne instruments and measurements was established prior to Minnesota 1973 by Readings and Butler (1972) and Haugen et al. (1975). In addition, comparability tests were made prior to each field run during the experiment. These comparisons and the Minnesota experiment have an added significance in that they establish a basis for comparability to a significant body of data generated by the MRU over many years in the United Kingdom. Specifically, the Aschurch and CABLE data, to be discussed later in this report, were collected with basically the same instrumentation and balloon technique. The analysis of the data set has been reported by Kaimal et al. (1976), and frequent references to and comparisons with the data set have been made by other researchers in subsequent publications.

The original data for the 11 reported runs are contained in the report by Izumi and Caughey (1976). Dr. Izumi was not aware of the status of the magnetic tapes containing the original data. The data for the nocturnal transition period was transferred to and analyzed and reported by Caughey et al. (1979).

CABAUW 1977-1979

A series of comprehensive boundary layer experiments was conducted using the 213-m meteorological mast of the Royal Netherlands Meteorological Institute located near the village of Cabauw in the center of the Netherlands. The site is flat within a 20-km radius and is homogeneous on a scale of several kilometers with a surface roughness of 0.05 to 0.35 m, depending on the direction. The surface cover consists of meadows, with occasional lines of trees, river dikes, and small villages.

The data set was collected from August 1977 through February 1979 and includes observations under all stabilities including observations of the nocturnal boundary layer. Approximately 20 experimental runs of 5 hours to 3 days duration were obtained. The measurement program is summarized in Table 2.

TABLE 2. CABAUW 1977-1979 MEASUREMENT PROGRAM

Measurement	Location	Method
Mean wind speed, temperature	9 levels from 1.5-200 m	Cups and vanes or Young propeller vanes; thermocouple
Radiation and moisture fluctuation	2 and 213 m	Kipp and Suomi radiometers; wet-bulb thermocouples
Mixing height	Up to 1 km	Aerovironment monostatic
Fluctuating longitudinal, lateral and vertical wind, temperature and moisture	6 levels from 1.5-200 m 20 and 120 m	Propeller tri-vane; dry thermocouples wet thermocouples
Pressure, temperature, wind speed, wind direction	3 km	Rawinsonde with increased temperature resolution

In addition, the surface energy budget was measured using radiometers, soil flux plates, soil temperature profiles, soil moisture, surface temperature, and profiles of air temperature and moisture to determine the Bowen ratio. Geostrophic winds and synoptic scale temperature and velocity gradients were also measured.

The Cabauw 1977-1979 data set is unique in that it consists of 20 continuous runs for periods of 5 hours to 3 days, over a 200-m depth. This, coupled with the comprehensiveness of the data set, would appear to provide a substantive data set for understanding the diurnal pumping of the boundary layer and its effect on pollutant transport and vertical distributions, and for evaluating modeling simulations of a full diurnal cycle. Based on the literature survey, it appears that the Cabauw mast is the only facility routinely measuring gaseous air pollutant profiles simultaneously with micrometeorological profiles.

The Cabauw 1977-1979 data set has been analyzed and interpreted by Driedonks doctoral dissertation (Driedonks, 1982) which deals with the dynamics of the mixed layer. Nieuwstadt (1981) uses this and other Cabauw data to test nocturnal boundary layer theory. The Cabauw mast instrumentation, site, and measurement and data-handling practices have been outlined by Driedonks et al. (1978). The data are archived on magnetic tape and are available through F.T.M. Nieuwstadt or A.G.M. Driedonks of the Royal Netherlands Meteorological Institute, The Netherlands.

KOORIN

In 1967, the Australian Wangara expedition to Hay, New South Wales, resulted in a boundary layer data set, for a smooth, flat surface, that has been widely used and cited in the literature. Australian researchers of the CSIRO and Bureau of Meteorology launched an even more comprehensive study for 29 days in July and August 1974. The intent was to conduct a similar study for a region of greater roughness and change in the Coriolis effect. The site selected was Daly Waters, Northern Territory, a site approximately 18 degrees of latitude northward of the Hay site. The site is semiarid woodland and savannah with grass. Observations were collected at two micrometeorological and one surface-upper air site. The micromet sites (M1 and M2) were each flat and homogeneous on the macroscale, but represented clearly different roughness regimes. The M1 site was sparsely covered by 5-10-m-high trees and with a sparse under-storey of grasses. The M2 site was covered with a more dense and uniform height (10 m) tree cover and a more dense under-storey, although still far from full.

The surface-upper air and micrometeorological observational programs were carried out 24 hours per day for 29 days. Aircraft sampling was conducted on 5 days and 2 nights. The measurement program is summarized in Table 3.

The Koorin Expedition is similar in many respects to the Cabauw and Wangara experiments. The Cabauw data set is notable for the depth of layer studied and the duration of the study, whereas Wangara and Koorin both address the spatial variability of the surface and boundary layer over distinctly different homogeneous surfaces. In this respect, the Koorin Expedition provides additional insight into spatial variability by having obtained successive paired aircraft measurements of vertical fluxes of heat at separate locations. These measurements also provide limited data for comparison of aircraft and surface measured heat fluxes. On 2 days,

TABLE 3. KOORIN EXPEDITION MEASUREMENT PROGRAM

Measurement	Location	Method	Frequency
SURFACE			
Mean temperature, wind speed wind direction	Surface	Dry-bulb, *, *	Hourly
Mean moisture fluctuation weather	Surface	Wet-dry bulb, visual	Hourly
Soil temperature	4 levels 5-80 cm	Mercury-glass thermometers	3-hourly
Pressure	5 locations	Digital recording barometers	3/hour
UPPER AIR			
Vertical profiles of wind speed, wind direction, temperature	To 3 km	Radar and theodolite, temperaturesonde	Hourly 3-hourly
MICROMETEOROLOGY			
Mast 1			
Wind speed, temperature	5 levels, 12-49 m	Cup anemometers, quartz crystal thermometers	Continuous
Wind direction, Net radiation	25 m	Light vane, net radiometer	Continuous
Global radiation	2 m	Solarimeter	Continuous
Ground heat flux	-2.5 cm	Soil heat flux plates	Continuous
Surface temperature	15 m	Long-wave "blackball" radiometer, Barnes IR radiometer	Continuous
Soil temperature	5 levels, -2.5 to -40 cm	Mercury-glass thermometers	Hourly during day
Moisture fluctuation	2 levels	Wet-dry quartz thermometers	Occasional
Fluctuating longitudinal or total wind, vertical wind, temperature, moisture	17 m	Propeller anemometers (U&W) thermistor, IR hygrometer	2/hour
Mast 2			
Wind speed	5 levels, 10-28 m	Same as Mast 1 above	Same as Mast 1 above
Net radiation	23 m	Same as Mast 1 above	Same as Mast 1 above
Ground heat flux	-2.5 cm	Same as Mast 1 above	Same as Mast 1 above
Soil temperature	-5 and -20 cm	Same as Mast 1 above	Nominally twice daily
Fluctuating longitudinal or total wind, vertical wind, temperature, moisture	17 m	Same as Mast 1 above	2/hour
AIRCRAFT			
Mean and fluctuating temperature and moisture	Transects, vertical cross sections and profiles	Resistance thermometers	5 days, 2 nights
Fluctuating wind	Transects, vertical cross sections and profiles	Aircraft accelerometers and gust vanes	5 days, 2 nights
Surface temperature	Transects, vertical cross sections and profiles	Barnes IR radiometer	5 days, 2 nights
Air speed	Transects, vertical cross sections and profiles	Dynamic pressure	5 days, 2 nights
Altitude	Transects, vertical cross sections and profiles	Static pressure	5 days, 2 nights

*No information in references cited.

aircraft heat fluxes were measured over the same area at six altitudes. Eddy flux measurements of moisture by aircraft were not possible because of instrument limitations.

Some micrometeorological data recovery rates were low due to instrument problems. Because of this, tower humidity difference data were very limited and were described as suspect. The level 1 (lowest) temperature data for the M1 tower were also described as suspect prior to day 18. Surface temperature data from the "blackball" radiometer are available for only the last week of the experiment.

The Koorin Expedition data exist in report form (Clark and Brook, 1979) and on magnetic tape. The latter is available from J. R. Garratt, CSIRO, Victoria, Australia, or a copy exists at the Los Alamos National Laboratory (T. Yamada). The Koorin data have been extensively analyzed and reported in the literature by J. R. Garratt (Garratt, 1978a; 1978b; 1982; Garratt and Francey, 1978; and Garratt, Wyngaard and Francey, 1982).

CABLE

The Cooperative Atmospheric Boundary Layer Experiment (CABLE) was a study of the convective boundary layer conducted in southeast England in the relatively uniform country side of Cardington and Weston-on-the-Green. CABLE was a joint effort of the Meteorological Research Unit, Royal Air Force, Cardington; the Department of Meteorology, Reading University; and the Atmospheric Physics Group, Imperial College. The purpose of the experiment was to investigate the effects of spatial variability in the surface energy balance on heat flux profiles and boundary layer development, compare point and aircraft eddy correlation heat flux measurements, and compare the relative importance of processes contributing to the heat budget for a fair weather convective boundary layer.

Data were collected on 4 days in August 1976 from about about 9 to 16 GMT under summer anticyclonic conditions and with strong solar heating. Afternoon cumulus developed on most days. Maximum daily mixing depths ranged from about 800 to 1900 m. Clear nights and light winds generally resulted in the development of a nocturnal inversion.

The observational program consisted of simultaneous surface and aloft heat flux measurements at Cardington and Weston-on-the-Green. Various methods were used. At Cardington the mean surface energy budget terms and direct eddy correlation surface heat fluxes were measured, and aloft heat fluxes were determined using balloon-borne eddy correlation measurements, as well as a tethered radiosonde system.

At Weston-on-the-Green, simultaneous surface and balloon-borne eddy correlation heat flux measurements were made. In addition, four special radiosonde and two pibal sites were established to augment three routine radiosonde sites in the region.

A powered glider was used to obtain eddy correlation heat flux measurements at multiple altitudes to compare to the point balloon measurements. The second (Cessna) aircraft measured vertical profiles of mean temperature and humidity in a Lagrangian frame of reference, as well as the horizontal gradients of these parameters.

The Doppler radar at Defford was too far away from either field site to obtain spatially coincident data, but was sufficiently close to provide qualitatively comparable measurements of mixed layer depth, cloud base height and vertical velocities. The measurement program is summarized in Table 4.

Originally the Aschurch data set was selected for recommendation for consideration for archiving because the use of the MRU balloon-borne turbulence sensors and system extended the layer of in situ turbulence and flux measurements to values of 0.6 to 1.4 of the mixing depth height, well above those observed with in situ point measurements in previous studies. The Aschurch data, when analyzed in the context of current mixed layer theory, have shown good consistency with the lower (0.6 of the mixing depth height) Minnesota data, (Caughey and Palmer, 1979) however a deficiency in the Aschurch data is the lack of direct surface heat flux measurements.

The CABLE data set was subsequently identified, and while detailed documentation has not yet been identified or obtained, it appears to have the attributes of the Aschurch data set and does incorporate the desired direct heat flux measurements. The CABLE data set also provides a basis for comparing point, bulk, and path average (aircraft) methods for measuring heat flux.

The CABLE data have been analyzed by Moores et al. (1979), to address the above-stated objectives of the study. No reported analysis of the data in the context of mixed layer scaling laws has been identified. The status of the analysis and the availability of the data set for archiving can be determined by contacting the Meteorological Research Unit at Cardington.

PHOENIX

The Phoenix Project was carried out at the Boulder Atmospheric Observatory (BAO) during September 1978 by the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory and the Atmospheric Technology Division of National Center for Atmospheric Research, together with other agencies and institutions. Phoenix included a group of experiments to test, evaluate, and compare a number of remote sensing systems, and experiments to develop a comprehensive set of observations of the convective boundary layer.

The BAO is about 25 km east of the foothills of the Rocky Mountains and about 30 km north of Denver in an area of gently rolling terrain with a slight north-south grade (1 to 2%). Roughness lengths vary from about 2 to 30 cm depending on azimuth direction. Surface cover is predominately grass fields.

The field study ran from September 1 through 28 with most of the observations conducted during the daylight hours, although some systems

TABLE 4. CABLE MEASUREMENT PROGRAM

Measurement	Location	Method	Frequency
CARDINGTON SITE			
Net Radiation	Surface	*	Continuous
Soil Heat Flux	-4 to -8 cm	Heat flux plates	Continuous
Latent Heat Flux	Surface	Weighing lysimeter	Continuous
Profiles of longitudinal or total wind fluctuations, temperature	6 levels	Micromet mast	Continuous
Fluctuating wind, temperature	16 m 3 or 4 levels to 920 m	* Balloon-borne turbulence sensors	Continuous Continuous
Profiles of mean temperature, moisture fluctuation, wind speed	To 1 km	Tethered radiosonde ascents	Every 2 hours
WESTON-ON-THE-GREEN			
Net Radiation	Surface	*	Continuous
Fluctuating wind, temperature	3 m 2 or 3 levels in mixed layer	* Balloon-borne turbulence sensors	Continuous Continuous
AIRCRAFT			
Fluctuating temperature, wind, moisture	25 km transsects, vertical profiles, and cross sections from 300 to 1000 m	Powered glider, thermistor variometer, lymanalpha hygrometer	2 to 3 flights per day, 20 to 60 min each
Vertical profiles and horizontal gradients of temperature, moisture fluctuation	Through and above CBL	Cessna aircraft	Every few hours
RADAR			
Mixing height, cloud base, wind	Air volume near Weston	Doppler radar	*
OTHER			
Profiles of temperature, moisture fluctuation	Through CBL 4 sites, 3 sites	Radiosondes (supplemental) Radiosondes (routine)	Every 2 hours Every 12 hours
Profiles of wind speed, wind direction	2 sites	Pilot balloons	*

*No information in references cited.

could continue measurements unattended overnight. The cornerstone observing system was the BAO 300-m tower, but the experiment included an unprecedented array of measurement systems including three research aircraft, a 25-station surface mesoscale network, five radars, a lidar, acoustic sounders, three microwave radiometers, path averaging laser anemometers, rawinsondes, and neutrally buoyant balloons. Table 5 summarizes the observational program.

The Phoenix Project data set is unique in the number of measuring systems available and operating simultaneously for long periods. In many instances this supplemental data provides additional estimates of a given parameter. In others, it provides quantitative spatial or temporal sampling not possible with the more standard instrumentation. In some cases, the quantitative meaning of some remote sensing data may not be totally understood, but provides a useful insight into processes occurring in the convective boundary layer. Even without the multiplicity of complementary remote measurement systems, the core Phoenix boundary layer measurement program appears to represent a large and important data set. Based on our survey, there is no comparable facility that can provide in situ state-of-the-art turbulence, eddy flux, and profile measurements continuously to 300 m.

The location of the BAO facility with respect to the foothills of the Rocky Mountains suggests that the generality of results from the site will need to be carefully examined. However, it is a real-world site and a valuable facility for examining the generality of current models.

While the emphasis of the total Phoenix Project was on the daytime convective periods, it should be noted that the BAO tower and surface observations were essentially continuous around the clock. Several of the supplemental observational programs were carried into or through the night on at least some nights.

The Phoenix Project has been described by Hooke (1979). Hooke also outlines how to gain access to and examine data collected by the basic BAO systems and retained there on tape. A dedicated computer and existing software allows users to utilize a terminal to ascertain what data and formats exist, and to then examine either numerical or graphical presentations of the actual data. The special Pheonix data (e.g., remote sensing, aircraft, etc.) exists on tape, but is available separately from the individual principal investigators as identified in Hooke's (1979) report. Our survey did not identify any published analyses of the Phoenix data in the literature through 1983.

HANFORD

Various diffusion experiments, involving several hundred tracer releases, have been conducted since 1959 at the U.S. Department of Energy's Hanford site. The Hanford site is located in a 40-km-wide basin in south-southeastern Washington state. The region has a semiarid climate with local vegetation consisting of steppe grasses and sagebrush (with a maximum height of 2 m). A typical roughness length for the area is 3 cm (Nickola et al., 1983).

TABLE 5. PHOENIX PROJECT MEASUREMENT PROGRAM

Measurement	Location	Method	Frequency
BAO TOWER			
Fluctuating longitudinal or total wind, lateral and vertical wind components, temperature	8 levels, 10-300 m	Sonic anemometer, platinum wire thermometer	Continuous
Mean temperature, dew point	8 levels, 10-300 m	Quartz thermometer, cooled mirror hygrometer	Continuous
Wind speed, wind direction	6 levels, 10-300 m	Propeller-vane anemometer	Continuous
SURFACE			
Absolute and fluctuating surface pressure	5 sites	WPL absolute pressure sensor and microbarographs	Continuous
Wind speed, wind direction convergence and refractive index structure parameter	450 m and 6 km Equilateral triangles	Laser path anemometers	Continuous
Solar radiation	Surface	Eppley pyranometer	Continuous
Horizontal array of wind speed, wind direction, temperature, dew point	Surface	National Center for Atmospheric Research 25-station portable automatic Mesonet	Continuous
RADAR			
Longitudinal or total wind fluctuations, lateral and vertical wind component fluctuations, 3-D wind fields	On 200-m grid spacing Over 10 x 10 x 1.5 km volume	Three doppler radars	Runs of a few to several hours per day on 14 days
Refractive index fluctuation	Vertical profiles to 4.5 km	FM-CW radar in range mode	Quasi-continuous in range or range doppler mode most days
Wind profiles and longitudinal or total wind fluctuations, lateral and vertical wind component fluctuations	Vertical profiles to 4.5 km	FM-CW radar in doppler mode	Quasi-continuous in range or range doppler mode most days
MICROWAVE RADIOMETERS			
Mean temperature, moisture profiles	Through PBL	SCAMS, NEMS and MTS radiometers	Quasi-continuous on most days
AIRCRAFT			
Mean temperature, moisture, wind speed, wind direction	Vertical plane cross sections, soundings, 150 m to above PBL	Platinum resistance temperature, thermoelectric dew point, INS navigation	Few-several flights per day on 10 days
Fluctuating temperature, moisture, longitudinal or total wind, lateral and vertical wind component	Vertical plane cross sections, soundings, 150 m to above PBL	*,*,NCAR gust probe	Few-several flights per day on 10 days
Mean pressure fluctuation, refractive index, surface temperature	Vertical plane cross sections, soundings 150 m to above PBL	Capacitance transducer, *,IR radiometer	Few-several flights per day on 10 days
Aerosol Concentrations, Size Distributions	Vertical plane cross sections, soundings 150 m to above PBL	2-D Optical spectrometer, forward scattering spectrometer, active scattering aerosol spectrometer	Quasi-continuous on 9 days
OTHER			
Wind speed, wind direction, temperature, moisture profiles	To 500 mb	GMC/Rawinsonde	2 per day from 60 to 14 MDT
Mixing Depth		Lidar	Quasi-continuous on 15 days
Solar Extinction		Multi-channel solar radiometer	Quasi-continuous on 15 days
Lagrangian Turbulence	100-900 m	Pibals and tetroons	33 Releases on 11 days

Diffusion experiments at Hanford are conducted in a relatively flat area, at roughly 200 m above sea level. Tracer release sites are located near, and on, Hanford's 122-m instrumented weather tower. Two partially overlapping grids are used for tracer sampling. The two grids are identified as the "S" and "U" grids, with the "S" grid designed primarily for studies of the stable atmosphere and the "U" grid for studies of the unstable atmosphere. Sampling arcs are situated at distances ranging from 100 m to 25.6 km from the designated release points. In total, there are over 1000 surveyed sampling positions available for any given experiment, including 350 samplers on the "S" grids' 20 sampling towers.

Hanford 1964 Series

In 1964, tracer releases were made at Hanford during five series of diffusion experiments. The group of experiments labeled the "Hanford 1964 Series" consisted of 15 tracer releases conducted between May and September 1964. These experiments were the first at the Hanford site to examine diffusion from elevated sources under stable atmospheric conditions.

The tracer used in the Hanford 1964 Series was zinc sulfide (ZnS), a fluorescent pigment. The tracer was dispersed through a commercially available insecticide sprayer. Releases were made from the 56-m level on the meteorological tower in 12 of the experiments and from the 111-m level in 3 experiments. Release durations ranged from 20 to 72 minutes. At each sampler location on the arcs, air was drawn through a membrane filter at a constant rate by a vacuum pump. After collection, the filters were assayed for ZnS by Rankin counter. Details on release and sampling procedures are available in Nickola et al. (1983).

Of the 15 experiments conducted in the Hanford 1964 Series, 14 were classified as successful; in one experiment the tracer was not detected on the diffusion grid. The sampling arcs used during the 1964 series included the 200-, 800-, 1,600-, 3,200-, 7,000- and 12,800-m arcs, although no more than four arcs were used at any one time. Ground-level sampling was conducted at each of the arcs at a height of 1.5 m above the ground. Early results indicated the tracer was not being detected in significant concentrations on the 200- and 800-m arcs (due to the substantial height of the tracer release). Therefore, after experiment number 7, only the 1,600- through 12,800-m arcs were used.

When activated for an experiment, the four interior arcs each covered approximately 90 degrees, with ground-level samplers spaced at 2-degree intervals on the 200- and 800-m arcs and 1-degree intervals on the 1,600-and 3,200-m arcs. The 7,000-m arc covered roughly 45 degrees, with samplers spaced at 4-degree intervals. The 12,800-m arc also covered roughly 45 degrees; however, the samplers here were spaced at 1-degree intervals.

Five towers, with 15 samplers per tower, were used on each of the 200-, 800-, 1,600- and 3,200-m arcs if the particular arc was activated. The maximum sampling heights on the towers were 27 m on the 200-m arc, 40 m on the 800-m arc, and 62 m on the 1,600- and 3,200-m arcs.

Meteorological data were provided by instruments on the 122-m tower. Averages of temperature, wind speed, wind direction, and the standard deviation of wind direction were based on measurements at the 2.1-, 15.2-, 30.5-, 45.7-, 61.0-, 76.2-, 91.4-, and 122-m levels of the tower. Atmospheric stability was calculated from the temperature data. Stabilities for this series of experiments ranged from stable to neutral. A portable meteorological mast was deployed near the release point during three of the experiments in order to provide supplementary, low-level information.

The tracer and meteorological data for the Hanford 1964 Series have only recently been published in Nickola et al. (1983). These data are also stored on magnetic tape at Battelle, Pacific Northwest Laboratories in Richland, Washington.

Hanford Secondary Series: Xenon Experiments

In 1965, five experiments were conducted in which up to three tracers, xenon-133, zinc sulfide, and fluorescein, were simultaneously released. These experiments were conducted to evaluate xenon-133 as a nondepositing tracer for use in studies of the dry deposition of zinc sulfide and fluorescein. These experiments were originally labeled the Xenon Series, but because of the relatively small number of experiments in this series (relative to other Hanford experimental series), the Xenon Series is referred to in the literature (Nickola et al., 1983) as part of the Hanford Secondary Series.

In the Xenon Series, zinc sulfide was released by an insecticide sprayer and sampled on membrane filters (as in the Hanford 1964 series). The tracer fluorescein was released in the same fashion as zinc sulfide and sampled on the same filters. Fluorescein, or more accurately the specific salt of fluorescein, is a uranine dye. It was assayed using a spectrophotofluorometer. The tracer xenon-133 is a chemically inert gas and a moderately short-lived radioisotope. It was released from gas cylinders and collected on charcoal filters. The filters were assayed for xenon-133 using a liquid scintillation counter.

The Xenon Series, like the Hanford 1964 Series, was conducted on the "S" diffusion grid. Tracer releases were all conducted at 1.5 m above the ground. In the first experiment only zinc sulfide and xenon were released. Zinc sulfide was sampled at ground level and on the towers on the 200-, 800-, 1,600-, and 3,200-m arcs. Xenon was not successfully sampled. In the second experiment only zinc sulfide and xenon were again released. Zinc sulfide was sampled only at ground level on the 200- through 3200-m arcs. Xenon was sampled on the 200- and 1,600-m arcs. In experiments 3 through 5 all three tracers were released. Zinc sulfide and fluoroscein were sampled at ground level and on the towers on the 200-, 800-, and 1,600-m arcs. Xenon was sampled at ground level on the same three arcs.

Measurements of temperature, wind direction, wind speed, and the standard deviation of the wind direction were made at the 2.1-, 15.2-, 30.5-, 45.7-, 61.0-, 76.2-, 91.4-, and 122-m levels of the 122-m meteorological tower. Atmospheric stabilities were calculated from the temperature data. Stabilities ranged between neutral and stable.

The tracer and meteorological data for the Hanford 1964 Series have also only recently been published in Nickola et al. (1983). These data are also stored on magnetic tape at Battelle, Pacific Northwest Laboratories in Richland, Washington.

CABAUW

The Cabauw dispersion experiments were conducted in the center of The Netherlands between April 28, 1977, and October 31, 1978. The project was a joint effort by the Royal Netherland Meteorological Institute and the KEMA Laboratories. The objective of these experiments was to obtain data on dispersion from high stacks.

The Cabauw grid is centered on a 213-m instrumented meteorological mast (located at 51° 58' north latitude and 4° 56' east longitude). The land within 20 km of the mast is topographically flat, consisting of meadows, small villages, lines of trees, and river dikes (Agterberg et al., 1983). Samplers were deployed along three roads at an approximate distance of 4 km from the mast.

There were 15 separate "runs" conducted during the Cabauw dispersion study, with each run consisting of two consecutive experiments, each lasting 30 minutes. The tracer sulfur hexafluoride was used in all the experiments. In five of the runs the tracer was released from the 80-m level on the meteorological mast. In the ten other runs the tracer release was from the 200-m level. A maximum of 24 samplers were deployed along the 4-km arc for each run. Each sampler was stationed at one of the 168 possible sampler sites alongside the three roadways. Potential sampler sites were located approximately 1.5 degrees from adjacent sites.

Each sampling site was manually operated. At the site, air was continuously drawn into a glass vessel at a constant rate for the 30-minute sampling period. The air samples were analyzed the next day in the laboratory using a gas chromatograph and an electron capture detector. The data from one of the 15 experiments was lost because of a malfunction in the gas chromatograph.

Meteorological measurements were made on the 213-m mast on platforms that are located at 20-m intervals, starting at 20 m above ground level. The meteorological data that were collected on each platform during the experiments, and presently available, include the 30-minute averages of wind speed, wind direction, and temperature. Thirty-minute averages of turbulence parameters are also available, including the standard deviations of each of the wind velocity fluctuations, azimuth fluctuations, elevation fluctuations, and temperature fluctuations. Also available are the 30-minute averages of the horizontal turbulent stress, and the horizontal and vertical turbulent temperature flux.

A temporary 20-m meteorological mast was deployed during most of the experiments to provide information on surface, and near surface, wind and temperature conditions. Additional radiation, radiosonde, and acoustic sounder data are also available.

The data from the Cabauw experiments are available in the data volume by Agterberg et al. (1983), but are reported to not exist on magnetic tape.

KARLSRUHE 1969-1974

The Karlsruhe Nuclear Research Center is located in the southwestern portion of West Germany. The center is a major nuclear research center with several reactors. The area around the site has developed areas, open fields, and wooded land. Experiments were conducted at the center to determine dispersion parameters under various meteorological conditions. Twenty-five experiments were conducted at Karlsruhe between January 1, 1969, and July 9, 1974, 22 of which were characterized as having "good" data (Thomas et al., 1976).

Diffusion experiments at Karlsruhe involved the release of tracers through 100-m reactor stacks. In each experiment tritiated water vapor was released as a tracer. In addition, in experiments 14 through 25, a halogenated hydrocarbon was also released as a second tracer. CCl_4 was the halogenated hydrocarbon released in experiments 14 through 20. $CFCl_3$ was released as the second tracer in experiments 21, 22, and 23. CBr_2F_2 was released in the final two experiments.

In experiments 8 through 25 sampling was conducted on five arcs, each with 11 potential sampler locations. The distance of the arcs from the release stack varied from experiment to experiment as a function of the atmospheric conditions. Prior to experiment 8, only a small number of irregularly spaced sampling locations were used. The shortest distance from the base of the release stack to the first arc in any experiment was 96 m. The longest distance from the stack to the farthest arc in any experiment was 5 km. Sampling times ranged from 40 to 120 minutes.

Water vapor was collected at the sampling sites on aluminum plates, which were cooled by slabs of dry ice. In the laboratory a liquid scintillation spectrometer was used to determine the amount of tritiated water in the ice that had condensed out of the atmosphere onto each aluminum plate. Air samples were collected at the sampling sites in glass vessels and analyzed in the laboratory for their halogenated hydrocarbon content. The analyses were performed using a gas chromatograph and an electron capture detector.

Meteorological information was collected for each experiment on the 200-m instrumented tower at Karlsruhe. Meteorological parameters available with the diffusion data include the wind speed and direction at the 40-, 60-, and 100-m levels of the tower, the temperature gradient between 30 and 100 m, the wind profile exponent, net radiation, and various stability parameters. Some turbulence measurements are available from experiments 13 through 25.

The data from the Karlsruhe experiments is published in Thomas et al. (1976).

OCEAN BREEZE

The Ocean Breeze diffusion experiments were conducted at Cape Canaveral in 1961 and 1962. The objective of this project was to study the dispersion of a tracer ejected into the atmosphere under conditions that simulated a missile launching accident. The experiments were conducted by personnel from the Air Force Cambridge Research Center and Hanford Laboratories (Haugen and Fuquay, 1963).

The terrain at the Cape consists of gently rolling sand dunes 3 to 6 m high. Dense palmetto growth and brushwood cover the dunes. The palmetto has a maximum height of under 2 m, while the brushwood varies in height between 2 and 4 m. The tracer release site was located 300 m from the coastline.

The tracer used during the experiments was the fluorescent pigment zinc sulfide. The tracer was dispersed using a commercially available insecticide sprayer. The effective release height of the zinc sulfide was between 2 and 3 m. Sampling was conducted on three arcs arrayed at distances of 1.2, 2.4, and 4.8 km from the release point. The two interior arcs had an angular extent of 188 degrees, with samplers deployed every 2 degrees at 4.5 m above the ground. The outer arc had an angular extent of 84.5 degrees, with samplers deployed every 1.5 degrees at 4.5 m above the ground. During some of the experiments, sampling was also conducted at 1.5 m above the ground at 6-degree intervals along the two interior arcs. The tracer was collected on membrane filters. Air was drawn through the filters at a constant rate by vacuum pumps. The amount of zinc sulfide deposited on each filter was determined in the laboratory with a Rankin counter.

In total there were 76 experiments in the Ocean Breeze project. In 41 of these experiments only the two interior arcs were activated. In these, 2 of the experiments were conducted in very unstable conditions, 28 were conducted in moderately unstable conditions, and 11 were conducted in moderately stable conditions. In the remaining 35 experiments, all three arcs were activated. In these, 30 experiments were conducted in moderately unstable conditions, and the remaining 5 were conducted in moderately stable conditions.

Meteorological information for the experiments was collected by instruments deployed for the experiment and by the local Cape Canaveral weather station. At the release point, averages of wind speed, wind direction, and the fluctuations in the wind direction were recorded. Temperature information between the surface and 500 ft were recorded using three windsondes. Radiosondes were also periodically launched form the Cape weather station.

The data from the Ocean Breeze experiments are published in Haugen and Fuquay (1963).

RECOMMENDATION OF TWO DATA SETS FOR ARCHIVE DEVELOPMENT

In selecting two data sets for developing and testing the archiving structure, process, procedures, and documentation, it is considered desirable to select one micrometeorological and one tracer data set. This will provide a more general test than if just one type were selected. In addition, it is desirable to use the relatively more diverse data sets for any one type for the same reason. At the same time, the size of the data sets should be relatively small so that the focus of the effort can be on development and testing as opposed to production. Also, the data sets had to be reasonably available and in a form amenable to archiving. With these considerations in mind, the Minnesota 1973 and Hanford 1964 Series data sets are recommended for use in developing and testing.

Among the five micrometeorological recommended data sets shown in Figure 3, the Minnesota 1973 data set was selected because of its relatively smaller size, good diversity, and ready availability in hard copy form. The latter situation will provide the opportunity to test procedures for transferring hard copy data to the archive. Of the classes of measurements tabulated in Figure 3, this data set contains both mean and fluctuating values measured at the surface with a profile tower and aloft with a tethered balloon system. While not part of the original published data set, periodic slow ascent rawinsondes were observed and have been processed as part of this study for addition to the data set. These periodic soundings place a requirement on the archiving techniques to be able to properly relate different types of data in time and space. Neither aircraft nor remote sensing measurements are part of the Minnesota data set. This, however, is not considered to have the potential to reduce the applicability of the data archiving techniques to be developed, since they are to be applicable to any data which is or could be represented by printed tables. Furthermore, it can be noted that, from an archiving point of view, aircraft and much of the remote sounding data is not significantly different from these other forms of data. For example, an aircraft data-gathering track "looks" very similar to a rawinsonde run in that several variables are simultaneously measured with time along a track of spatial positions, and the data are typically reduced to discrete measurements which are associated with a time and position. Similarly, much remote sensing data is reduced to vertical profiles of discrete measurements analogous to tower profile measurements, although each profile will have an azimuth and elevation angle associated with it. Therefore, the Minnesota data set is recommended for the first data set to be used in developing the archiving techniques.

The Hanford 1964 Series tracer data set is also of manageable size, but (as shown in Figure 4) has a diversity that is representative of the list. It is readily available on magnetic tape and will permit the development and testing of procedures for transferring data from tape to the archive. While the Hanford 1964 Series does not contain measurements of fluctuating micrometeorological parameters, it does contain mean micrometeorological measurements from two towers. The absence of fluctuating parameter measurements is not a serious omission, since these will be addressed in archiving the Minnesota 1973 data.

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APPENDIX A

REFERENCES FOR MICROMETEOROLOGICAL DATA SETS

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APPENDIX B

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16. ABSTRACT

This report describes the results of a survey of available pre-1980 micrometeorological and tracer data sets. The purpose of the report is to: identify data of potential interest for archiving and provide information about the general character of the body of data of interest. This latter information is of interest to guide the design of the archive structure and documentation, and archiving procedures. The assessment identified 22 micrometeorological and 41 tracer diffusion data sets of primary interest for potential future archiving. The survey addressed data sets for relatively flat rural terrain with small to moderate roughness elements. Only diffusion studies with controlled tracer releases were considered. From these, a subset of 5 micrometeorological and 5 tracer diffusion data sets were recommended for first archiving. The recommended data sets include: Micrometeorological - Minnesota 1973, Cabauw 1977-1979, Koorin Expedition, Cooperative Atmospheric Boundary Layer Experiment (CABLE), Phenoix Project; Tracer Diffusion - Hanford 1964, Hanford Secondary Series, Cabauw, Karlsruhe 1969-1974, Ocean Breeze. Tabular summaries for these data are provided. From these data sets, the Minnesota 1973 and the Hanford 1964 were recommended for use in developing and testing the archive procedures and documentation.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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