# Soil Water Prop. Derived Data (FIFE)

## Summary:

During the 1989 FIFE field campaign, measurements were made of soil moisture release parameters and hydraulic conductivity. Bulk density and soil moisture release data were collected at five FIFE sites representing the major soil types in the FIFE study area. These data were used to model the porosity, saturated water potential, and the b-factor (the exponent of the power curve function) following the method of Clapp and Hormberger (1978). These soil moisture characteristics can be used to describe plant-available water and water movement through soils.

## Table of Contents:



## 1. Data Set Overview:

### Data Set Identification:

Soil Water Prop. Derived Data (FIFE) .
(Soil Water Properties).

### Data Set Introduction:

The Soil Water Properties Data Set contains the porosity, saturated water potential, and the b-factor (the exponent of the power curve function) data that were determined from the bulk density and soil moisture release data collected at five FIFE sites representing the major soil types in the area.

### Objective/Purpose:

During the 1989 FIFE field campaign, measurements were made of soil moisture release data and hydraulic conductivity. These data were then used to determine parameters, which can be used to describe plant available water and water movement through soils.

### Summary of Parameters:

Porosity and saturated water potential.

### Discussion:

Soil moisture characteristics are modeled as a power curve following the method of Clapp and Hormberger (1978). Bulk density and soil moisture release data collected at five FIFE sites representing the major soil types in the area are used to determine the porosity, saturated water potential, and the b-factor (the exponent of the power curve function).

### Related Data Sets:

- Soil Moisture Release.
- Soil Hydraulic Conductivity.

### FIS Data Base Table Name:

SOIL_WATER_PROP_DERV.

## 2. Investigator(s):

### Investigator(s) Name and Title:

Staff Science.

### Title of Investigation:

Staff Science Ancillary Data Acquisition Program.

### Contact Information:

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### Requested Form of Acknowledgment.

The Soil Water Properties data set was produced by the FIFE Information System staff using data collected by the FIFE staff science team.

# 3. Theory of Measurements:

Not available at this revision.

# 4. Equipment:

### Sensor/Instrument Description:

Not applicable.

**Collection Environment:**

Not applicable.

**Source/Platform:**

Not applicable.

**Source/Platform Mission Objectives:**

To derive parameters useful to hydraulic modeling describing the soil water properties of the major soil types at the FIFE study area.

**Key Variables:**

Porosity, saturated water potential, and b-factor.

**Principles of Operation:**

Not applicable.

**Sensor/Instrument Measurement Geometry:**

Not applicable.

**Manufacturer of Sensor/Instrument:**

Not applicable.

### Calibration:

**Specifications:**

Not applicable.

**Tolerance:**

Not applicable.

**Frequency of Calibration:**

Not applicable.

**Other Calibration Information:**

Not applicable.

## 5. Data Acquisition Methods:

The data were extracted from the FIFE Information System.

## 6. Observations:

### Data Notes:

Not available.

### Field Notes:

None.

## 7. Data Description:

## Spatial Characteristics:

The FIFE study area with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM zone 14.

### Spatial Coverage:

Five different soil series are represented in this data set.

| SITEGRID | STATION_ID | SOIL_SERIES | DEPTHS (CM) |
|---|---|---|---|
| 2915-SMR | 12 | BENFIELD | 10, 60 |
| 2133-SMR | 906 | CLIME | 10, 30 |
| 4439-SMR | 916 | DWIGHT | 10, 30 |
| 4168-SMR | 925 | FLORENCE | 10, 35 |
| 2655-SMR | 936 | TULLY | 10, 30 |

The data from these sites can be linked to other FIFE sites by matching the soil series. Information on the soil series are described in the Soil Properties Reference Information Data Set.

### Spatial Coverage Map:

Not available.

### Spatial Resolution:

Parameters were derived from point data collected at two soil depths.

### Projection:

Not available.

### Grid Description:

Not available.

## Temporal Characteristics:

### Temporal Coverage:

Not applicable.

### Temporal Coverage Map:

Not available.

**Temporal Resolution:**

Not applicable.

## Data Characteristics:

The SQL definition found in this table is the SOILDERV.TDF file located on FIFE CD-ROM Volume 1.

| Parameter/Variable Name | Parameter/Variable Description | Range | Units | Source |
|---|---|---|---|---|
| SITEGRID_ID | This is a FIS grid location code. Site grid codes (SSEE-III) give the south (SS) and east (EE) cell number in a 100 x 100 array of 200 m square cells. The last 3 characters (III) are an instrument identifier. | | | |
| STATION_ID | The station ID designating the location of the observations. | | | |
| SOIL_SERIES | The name of the soil series at the site. | | | |
| DEPTH | The depth of the measurements. | | [cm] | |
| SOIL_POROSITY | The average porosity calculated from bulk density measurements (d) were Porosity = 1 - (d/2.65). | | | |
| SATRTD_WATER_POTNTL | The saturated water potential, | | [bars] | |

calculated from the intercept of
log-log plot of water potential vs
soil wetness.

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B_FACTOR
The b-factor calculated from the
slope of log-log plot of water
potential vs soil wetness.

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R_SQUARED
The regression coefficient of the
log-log plot of water potential vs
soil wetness.

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FIFE_DATA_CRTFCN_CODE *
The FIFE Certification Code for
the data, in the following format:
CPI (Certified by PI), CPI-???
(CPI - questionable data).

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LAST_REVISION_DATE
data, in the format (DD-MMM-YY).

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Footnote:

Decode the FIFE_DATA_CRTFCN_CODE field as follows:

The primary certification codes are: EXM Example or Test data (not for release). PRE Preliminary (unchecked, use at your own risk). CPI Checked by Principal Investigator (reviewed for quality). CGR Checked by a group and reconciled (data comparisons and cross-checks).

The certification code modifiers are: PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data that are "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

## Sample Data Record:

| SITEGRID_ID | STATION_ID | SOIL_SERIES | DEPTH | SOIL_POROSITY | SATRTD_WATER_POTNTL |
|---|---|---|---|---|---|
| 2133-SMR | 906 | CLIME | 10 | .552 | .2137 |
| 2133-SMR | 906 | CLIME | 30 | .461 | .2801 |
| 2915-SMR | 12 | BENFIELD | 10 | .585 | .0149 |
| 2915-SMR | 12 | BENFIELD | 60 | .483 | .6895 |

| B_FACTOR | R_SQUARED | FIFE_DATA_CRTFCN_CODE | LAST_REVISION_DATE |
|---|---|---|---|
| 5.744 | .855 | CPI | 21-MAY-92 |
| 11.629 | .648 | CPI | 21-MAY-92 |
| 6.829 | .905 | CPI | 21-MAY-92 |
| 7.354 | .387 | CPI | 21-MAY-92 |

# 8. Data Organization:

## Data Granularity:

Parameters were derived from point data collected at two soil depths.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

## Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begins with five header records. Header records contain the following information: Record 1 Name of this file, its table name, number of records in this file, path and name of the document that describes the data in this file, and name of principal investigator for these data. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites (sequentially numbered by SITEGRID_ID)). Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

# 9. Data Manipulations:

## Formulae:

### Derivation Techniques and Algorithms:

From the field measurements, parameters useful for modeling soil water properties were determined. Total porosity or the saturated water content (thetas) is calculated from the bulk density (d) using:

**1. thetas = 1 - (d/2.65)**

The soil moisture release curve can be described as a power curve:

**2. psi = psis W^(-b)**

Where **psi** is the water potential of the sample, **W** is the soil wetness and is equal to theta/thetas with theta being the volumetric water content, **psis** is the saturated water potential, and the exponent **b** is referred to as the b-factor. Both **b** and **psis** can be determined from a log-log plot of equation 2.

### Data Processing Sequence:

Not applicable.

**Processing Steps:**

Not applicable.

**Processing Changes:**

Not applicable.

### Calculations:

Porosity (thetas) was determined from Equation 1 (see the *Derivation Techniques and Algorithms Section*) using bulk density data from the Soil Hydraulic Conductivity Data Set. Volumetric soil water contents were determined at 1/5, 1/3, 2/3, 1, 3, 5, 10, and 15 bar tensions using a pressure plate apparatus. These data are in the Soil Moisture Release Data Set. The soil wetness was calculated from the soil water content and the porosity. The values for **psis** and **b** were determined by a regression to a log-log plot of Equation 2 (see the *Derivation Techniques and Algorithms Section*). The regression coefficient of the log-log plot of water potential vs. soil wetness was also calculated.

**Special Corrections/Adjustments:**

Not applicable.

**Calculated Variables:**

- Total porosity or the saturated water content,
- Volumetric soil water contents, and
- Soil wetness.

### Graphs and Plots:

None.

## 10. Errors:

### Sources of Error:

Not available at this revision.

## Quality Assessment:

### Data Validation by Source:

Not available at this revision.

### Confidence Level/Accuracy Judgment:

Not available at this revision.

### Measurement Error for Parameters:

Not available at this revision.

### Additional Quality Assessments:

Not available at this revision.

### Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM;
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS); and
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.
- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

# 11. Notes:

### Limitations of the Data:

Not available.

### Known Problems with the Data:

None.

### Usage Guidance:

Not available.

### Any Other Relevant Information about the Study:

Soils of the FIFE site are generally silty clay loams. Clapp and Hornberger (1978) provide values of the variables for this soil as:

- thetas = 0.477
- psis = 0.0349 bars
- b = 7.75.

The values found at the top horizon for FIFE are seen to be in line with these reported values; however, the lower horizon values may differ significantly.

# 12. Application of the Data Set:

These soil moisture characteristics can be used to describe plant available water and water movement through soils.

# 13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

# 14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

# 15. Data Access:

### Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

### Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

### Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

### Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

## 16. Output Products and Availability:

The Soil Water Properties data are available on FIFE CD-ROM Volume 1. The CD-ROM file name is as follows:

\DATA\SOILPROP\SOIL_H20\1987MULT.SWP

## 17. References:

### Satellite/Instrument/Data Processing Documentation.

None.

### Journal Articles and Study Reports.

Clapp, R. B. and G. M. Hornberger, Empirical equations for some soil hydraulic properties. Water Resour. Res. 14(4). Pp.601-604, 1978.

### Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

# 18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

# 19. List of Acronyms:

CD-ROM Compact Disk (optical), Read-Only Memory DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment FIS FIFE Information System ISLSCP International Satellite Land Surface Climatology Project ORNL Oak Ridge National Laboratory URL Uniform Resource Locator UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

# 20. Document Information:

May 6, 1994 (citation revised on October 15, 2002).

Warning: This document has not been checked for technical or editorial accuracy by the FIFE Information Scientist. There may be inconsistencies with other documents, technical or editorial errors that were inadvertently introduced when the document was compiled or references to preliminary data that were not included on the final CD-ROM.

Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data.

### Document Review Date:

June 26, 1996.

### Document ID:

ORNL-FIFE_SOILDERV.

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## Document Curator:

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