# **≊USGS**

# INFORMATICS OF GROUNDWATER-LEVEL MEASUREMENTS, ANOMALOUS DATA DETECTION, AND EXPLORATORY LONG-TERM MONITORING NETWORK IDENTIFICATION FOR THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER, USA

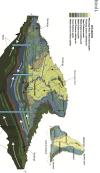
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**OUTLYING MEASUREMENTS AND OUTLYING WELLS** 

# THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER

**USGS Groundwater Database and Furnished Records** 

A SPART OF A REGIONAL WATER ANALABLITY STUDY, the U.S. Geological Surrey A (USGS) is comprehensively sudying and indeking the Mississiph River Yaller altu-vial aquiret (ARWA) and associated hydrogeologic units in an ancre he Mississiph River alluvial plain (MAP, fig. 1, https://www2.ucgs.gov/waterflowermississiphgint/index. team). WIELEVEL DOTA currently are (*dret*) Desember 2017, available for the two so one compression (*BER*) and *BER* and



the USOS and importantly in large part by numerous observed as A. State, and J. Schein al agencies. Records Tone other spaces within the USOS ANNUS database are referred to as "furnishing records." These furnished records to the USOS as invaluable. Figure 2 Dataserus from other spaces are observed with a state of the state of the state or y and litterates that disparate announts of wave-level data available (*x* as given well over time. For a large number of works low) as any figure measurement is analbed. Argument programmation analysis, and synthesis of MEON water-level data for the greater regional water availability analy seconder were it challenges of MEON water-level data for the greater regional water availability analy seconder were it challenges.

. Centralized oversight of data is needed to ensure that the reliable information that can be used with confidence to

that the aggregated database

prepare data products a

and inter

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Figure 1. Cross-sectional view of a /alley alluvial aquifer (MRVA) with p associated hydrogeologic units to the Mississippi River post-development flow (2006) conceptual water move-

A general and persistent regional groundwater-level monitoring network and program for the MRVA is lacking. The use of informatics could help develop such a network at the necessary spatial and temporal resolutions. Decumentation of historical and current groundwater-level conditions is paramount at both regional and local scales; and

The comprehensive study of the MRVA water-level d ress these challenges, offer mitigation strategies, and pre er synergy between database experts, USGS and other h

data using informatics

can help

prists, and seamlessly

rt interests of the many data-acquisition :

nent (Clark and others, 2011, fig. 10). nplex. Data The study is being done in MAP is an alluvial plain extending beyond the historic 1 iver and other proximal streams (for 1). The MAP is an e ge changes in information acquisition and storage practices, ranging from analog techods in the past century further complicates data syntheses. Data consistency hinder stakeholder ability to make informed management decisions. eval and use hesis is complicated by inconsistent data mat there are appreciable data completeness an nformatics — the systematic processing and storage of data for . The history of water-level data collection in the MRVA is long plain exending beyond the historic flocodplain of the Missis-nal streams (fig. 1). The MAP is an extensive, flat plain and a spanning in parts of seven states (Arkansas, Illinois, Kentucky, luation of water-level data and well-inventory info peration with more than 10 local, State, and Federal stake-and the set of the state of the stat practices that

**GROUNDWATER WATER-LEVEL INFORMATICS** 

DRMATICS involves the science and practice

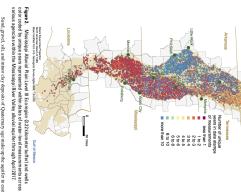
information proc

essing

• ● ○ Data anomalies potentially represent erroneous information and hinder scientific study — Objective large-scale identification of such data is the primary focus of groundwater informatics for the MRVA. ○ ● ●

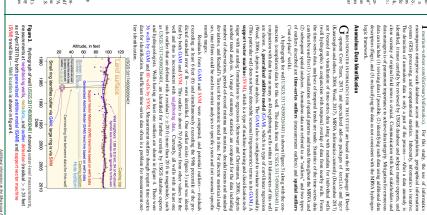
and Pine Bluff, Ark.; Baton Rouge and Monroe, La.; Cape Girardeau Clarksdale, Greenville, Yazoo City, and Vicksburg, Miss.; and Memp ouisiana, Mississippi, Mis f the MAP mostly are used rice, and a uri, and Tennessee [fig. 2]). The northern and central sect or intensive production agriculture, and primary crops inc and comm nd primary crops include Jonesboro, Little Rock, u and Poplar Bluff, Mo.;

The MAP (ii) and entropy and and Web (ii) Ference 21 initiations (iv) directly under the MAP (iii) and entropy and the state of the "Whiteshelp Entropy entropy merges with the casual low hask aquifer system hand of selfments in low-lying areas late one Gari Cost. The MRNA space and 3.3300 space miles and mage from erg7 smines where net the initiates of Normer erg Vestalong to do and U multi-swite near number of Little Rock. Many weth have been drilled into the MRNA (fig. 2).



Sand grand, dit and mater day deposits of Quannay aga make phot squifer in asi-era Actawa, northwestern Moscinghe methement Lonisium, and also control too Galf. Coast in southeastern Lonisium (Eg. 2). For purposes of this study, the correct of the MRVA is intelegona and limited to the regione eccomparately generalized by the Materia and the Second S

ocd MRVA discharges to the streams



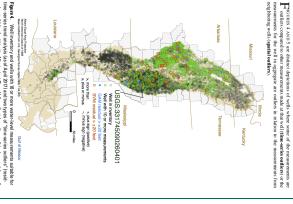


Figure 4. Well inventory and wells with 10 or more water-level measurements suitable for time-series tend analysis (as d. ppl 2017) and town types of "time-series outliers" (resid-ual > ± 20 feel within the Mississippi feer Valley allwall aquifer — A hydrograph for well USBS 2317450902604011 s shown in figure 3.

A protoc is the dark manner were and a learning wave being respectively for the state of the st MRVA that might be erroneo classification could exist bec: MRVA wells. On c cated in the hilly te st of the MAP.

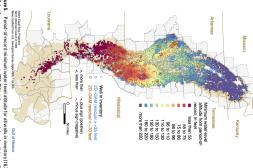


Figure 5. Period-of-record minimum water-level altitude for all wells in inventory (16,756 wells) with one or more measurements (285,429 total measurements) and outlying wells (as of August 2017) identified by the 20-GAM within the Mississippi River Valley all uvial aquifer.

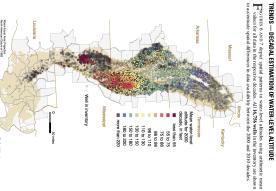


Figure 6. Mean decadal water-level altitude for the 2000 decade (January 2000-D ecember 2009) based on 2,533 wells and 20,759 measurements for the Mississippi River Valley alluvial aquifer — Note the disparity in data availability between states and in areas of rapid change n water levels

general similarity of thetake with longitudes and a given a limit of the MRVA, water levels decrease from moth to some with a general similarity of thetake with longitudes and a given latitude. The 2000 decade (Eq. 6) and has an obviously inprevalisment than the 2010 decade (Eq. 7), which is inputially combined to above mother three years all remaining in the 2010 decade. This difficult is discern sys-tematic charges from 2000 to 2010 or simulity, the ago solutional armshold of charges The transitional mother to dimer happens of the MRVA could be used to quantify such charges The too decades that have no fuencies for allow and or quantify such charges The too decades that have no genesis of canasive implation use of the MRVA for environ-ances and in teglons of canasive implation use of the MRVA for environ-Decadal mean water-level altitudes are useful for the general oothing the inherent variation of measurements at each well. A time period mean (well count) availwater levels by

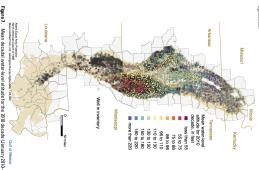
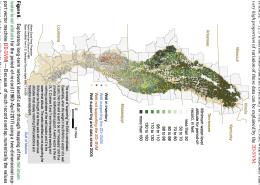


Figure 7. Mean decadal water-level altitude<sup>1</sup> for the 2010 decade (January 2010 April 2017) based on 1,207 wells and 22,838 measurements for the Mississippi River Valley alti-vial aquiler—Note reduction in data availability compared to the 2020 decade shown in figure 6.

# LONG-TERM MONITORING NETWORK - EXPLORATORY EFFORTS



port vector machine (2D-SVM) — Because of mu in green shades are similar to those in figure 4.

the description provided by the 2D SVM inclusion/contains, with actually that how with last record and testing a 200 mer 200 m wells on included 8,102 on engineering wells. SVM uses a relocation support of wells by the object, "buffaued wells," and identifies wells whose wells wells used to the support of the model. To augment the description provided by the 2D SVM theories relocation support the model. To augment and second and the start has a structure of the stru

## FINAL REMARKS

CONSTREMANT PROPERSY has been made by the authors towards the construction of a comprehensive informatics system for MRVA water-beel database review. Expansive routines for data manipulation and subsequent satisficial processing now exist. The system has substantial summary and visualization expatibilities. Complex variations in record availspressing, Bar neo't exp of analyses using familiar ratificies, such as minimums and music means, GS, and objectional expension is methods (GANO) and muchuse her schington (SYA), result in identification and ratificity of potentially terresones data. L4 machine herming testingtone pointies to help density individual worth porviding particu-mentime herming testingtone synthese local theorem in the might be especially analy-internative in a long-term. MRVA monitoring network. as substantial summary and visualization capabilities. Complex ability in time and space are present for the MRVA. Such variati s, such as minimums and arith (GAMs) and machine-learning omplicates statis

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