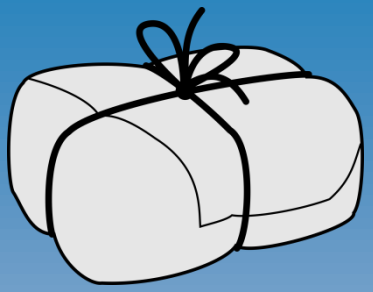
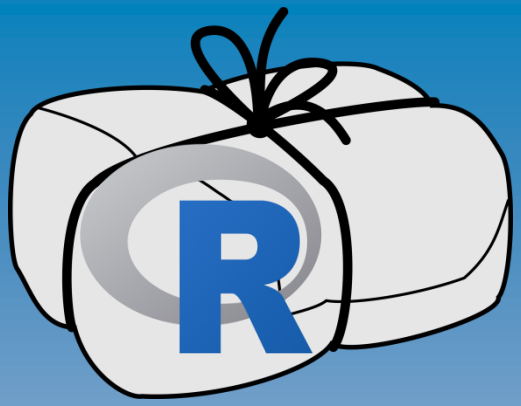


your

in an



!

slides at https://github.com/mrustl/useR-2016

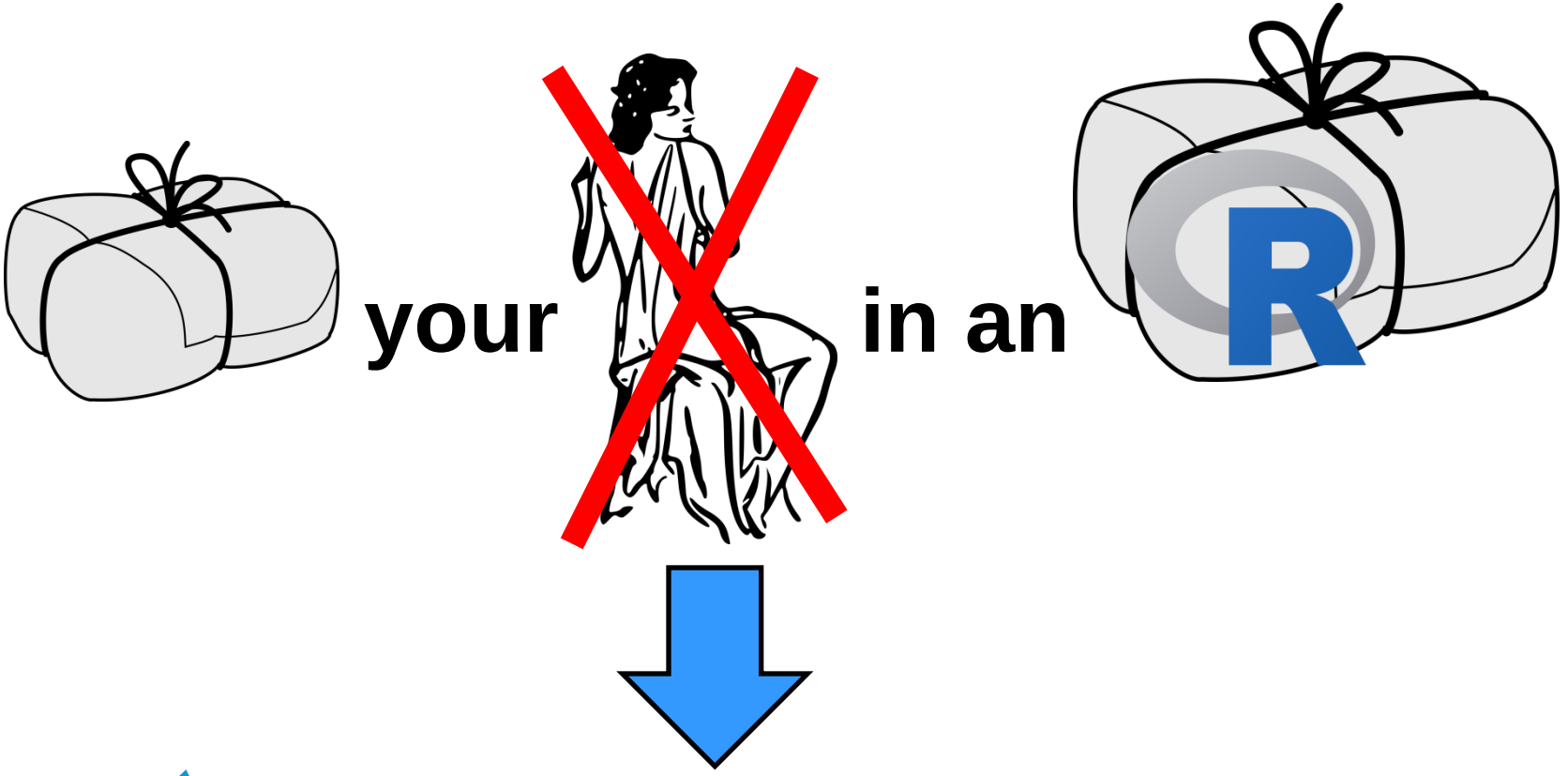
Michael Rustler

Kompetenzzentrum Wasser Berlin

@MichaelRustler

mrustl

Introduction



Environmental models

Challenge

Environmental models

- (Usually) not implemented in R
- Generic
  - Case-specific
    - Sensitivity analysis
      - Calibration

Challenge

Environmental models

- **(Usually) not implemented in R**
- **Generic**
  - **Case-specific**
    - **Sensitivity analysis**
      - **Calibration**

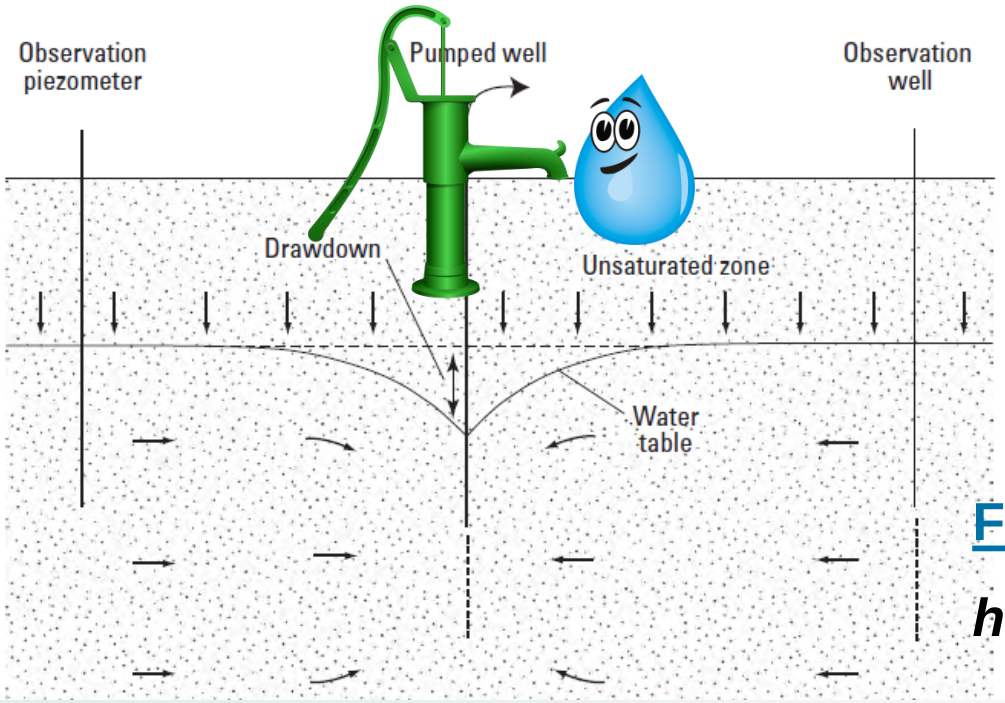
"If you're going to do something **three times or more**, *you should think about* **writing a small package"** ***(Peng,2016)***

Well drawdown model

USGS
science for a changing world

Groundwater Resources Program

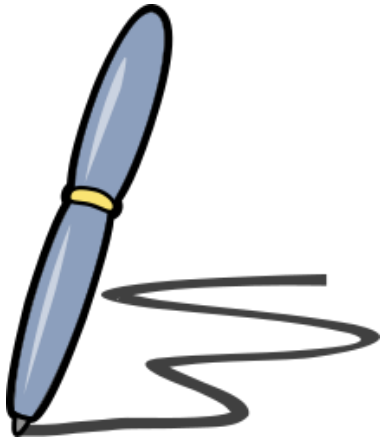
WTAQ Version 2—A Computer Program for Analysis of Aquifer Tests in Confined and Water-Table Aquifers with Alternative Representations of Drainage from the Unsaturated Zone



Freely available at:

http://water.usgs.gov/ogw/wtaq

Workflow



s01.inp

```
1  Sensitivity analysis: hypothetic case study (uni
2  DIMENSIONAL                                    FOR
3  WATER TABLE                                    AQT
4  10 1.0E-03 1.0E-03 1.E-05 0.10                 BB
5  0 0                                            IDR
6  1.0E9
7  0 0                                            ITS
8  1.0E6 6 5                                      TLA
9  1                                              ISO
10 1.0E-09 0  0  30  8                            RER
11 1 0 1                                          IPW
```

D:\test\wtaq.2.0.exe

```
                    WTAQ version 2.0, April 2011

  Enter name of file containing input data:
s01.inp
  Enter name of file for program results:
s01.out
  Enter name of plot file (return for no plo
s01.plot
```

s01.inp | s01.out | s01.plot

	TIME	HDPW
2	0.100E+01	0.305E+01
3	0.158E+01	0.306E+01
4	0.251E+01	0.306E+01
5	0.398E+01	0.306E+01
6	0.631E+01	0.307E+01

Our approach

configure()

input$

- general
- aquifer
- drainage
- times
- solution
- pumpwell
- obswells

writeInputFile()

```
s01.inp
 1  Sensitivity analysis: hypothetic case study (uni
 2  DIMENSIONAL                                    FOR
 3  WATER TABLE                                    AQT
 4  10 1.0E-03 1.0E-03 1.E-05 0.10                 BB
 5  0 0                                            IDR
 6  1.0E9
 7  0 0                                            ITS
 8  1.0E6 6 5                                      TLA
 9  1                                              ISO
10  1.0E-09 0  0  30  8                            RER
11  1 0 1                                          IPW
```

```
D:\test\wtaq.2.0.exe
                    WTAQ version 2.0, April 2011

  Enter name of file containing input data:
s01.inp
  Enter name of file for program results:
s01.out
  Enter name of plot file (return for no plo
s01.plot
```

s01.inp | s01.out | s01.plot

	TIME	HDPW
2	0.100E+01	0.305E+01
3	0.158E+01	0.306E+01
4	0.251E+01	0.306E+01
5	0.398E+01	0.306E+01
6	0.631E+01	0.307E+01

Our approach

configure()

```
input$
```

- general
- aquifer
- drainage
- times
- solution
- pumpwell
- obswells

writeInputFile()

runModelEngine()

```
s01.inp
 1  Sensitivity analysis: hypothetic case study (uni
 2  DIMENSIONAL                                    FOR
 3  WATER TABLE                                    AQT
 4  10 1.0E-03 1.0E-03 1.E-05 0.10                 BB
 5  0 0                                            IDR
 6  1.0E9
 7  0 0                                            ITS
 8  1.0E6 6 5                                      TLA
 9  1                                              ISO
10  1.0E-09 0  0  30  8                            RER
11  1 0 1                                          IPW
```

```
D:\test\wtaq.2.0.exe
                    WTAQ version 2.0, April 2011

  Enter name of file containing input data:
s01.inp
  Enter name of file for program results:
s01.out
  Enter name of plot file (return for no plo
s01.plot
```

s01.inp | s01.out | s01.plot

	TIME	HDPW
2	0.100E+01	0.305E+01
3	0.158E+01	0.306E+01
4	0.251E+01	0.306E+01
5	0.398E+01	0.306E+01
6	0.631E+01	0.307E+01

Our approach

configure()

input$

- general
- aquifer
- drainage
- times
- solution
- pumpwell
- obswells

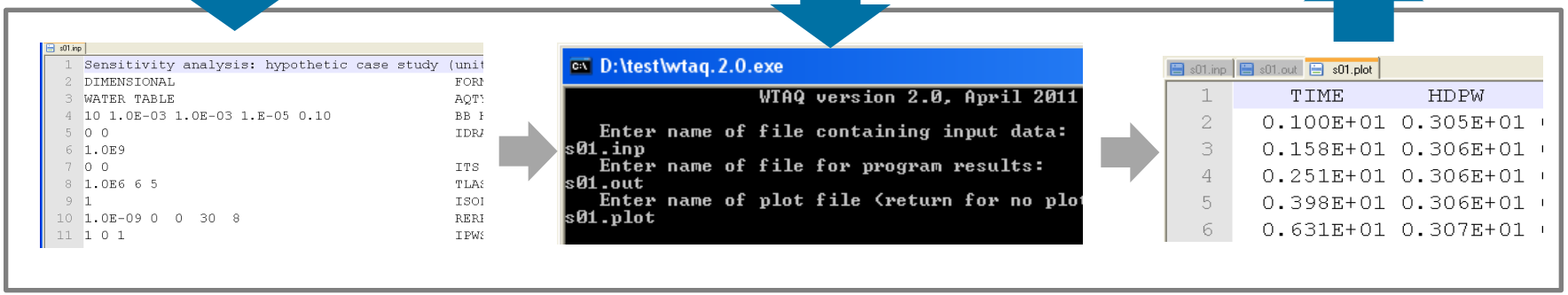
output$

- WELL
- TIME
- MEASDD
- CALCDD
- RELERR

writeInputFile()

runModelEngine()

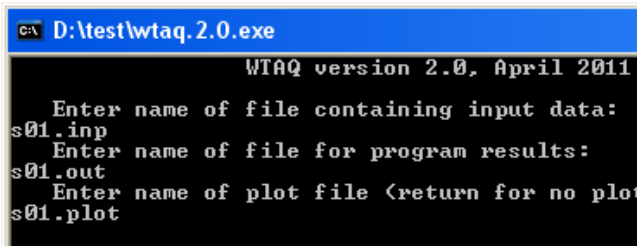
readOutputFile()



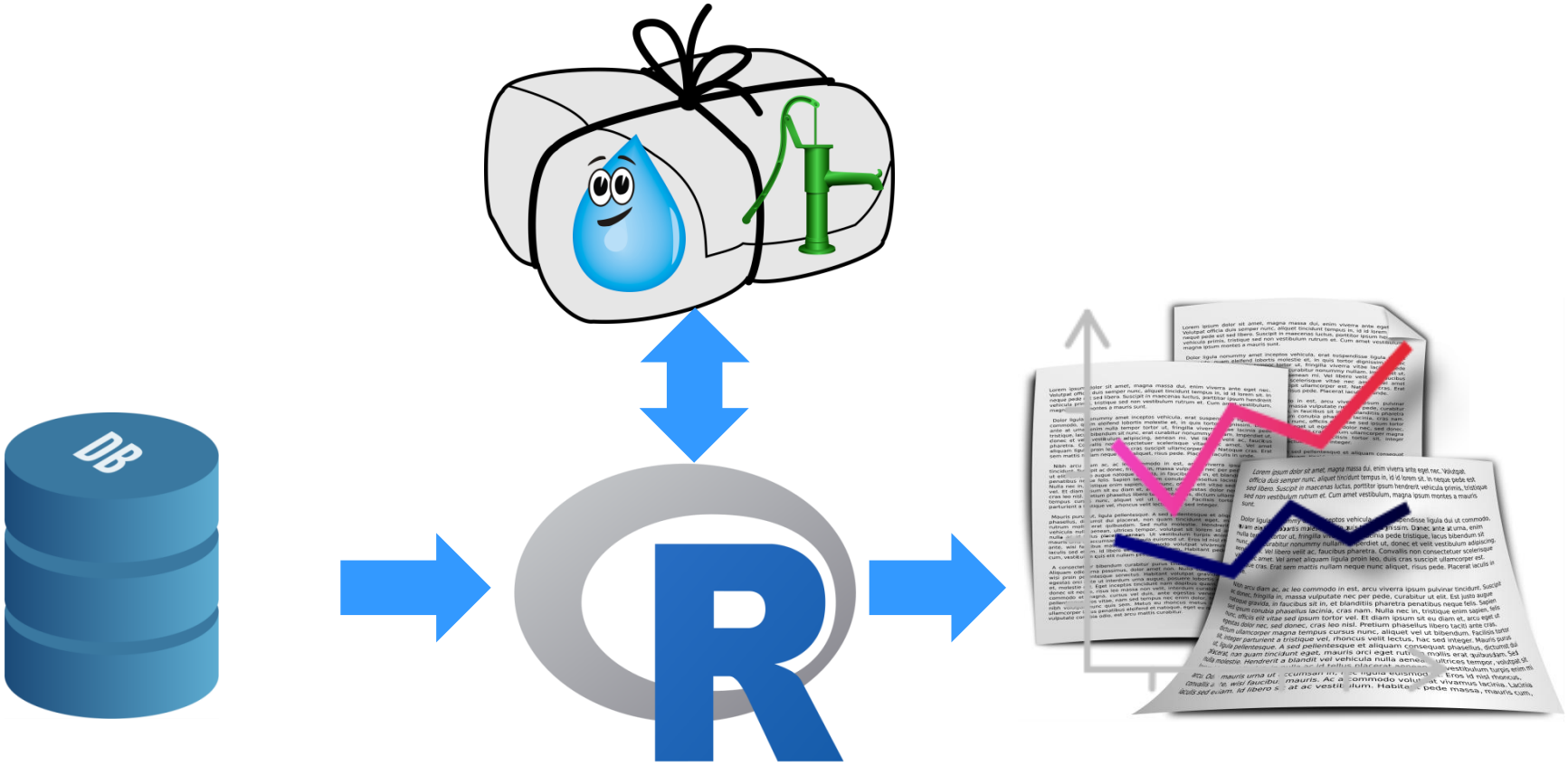
R functions:

- **read / write / modify** input file
- **run** model
- **read** output file

+ **Model engine**

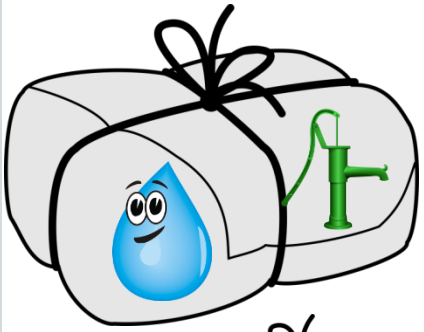


Automated workflow



Summary

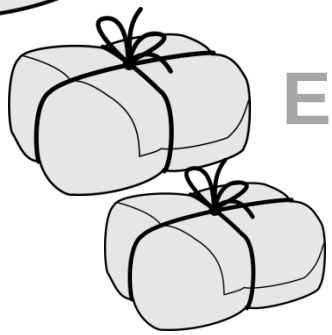
“Wrapped“ models:



WTAQ-2 (USGS)

https://github.com/KWB-R/kwb.wtaq

Tutorial: *https://kwb-r.github.io/kwb.wtaq*



EPANET (USEPA)

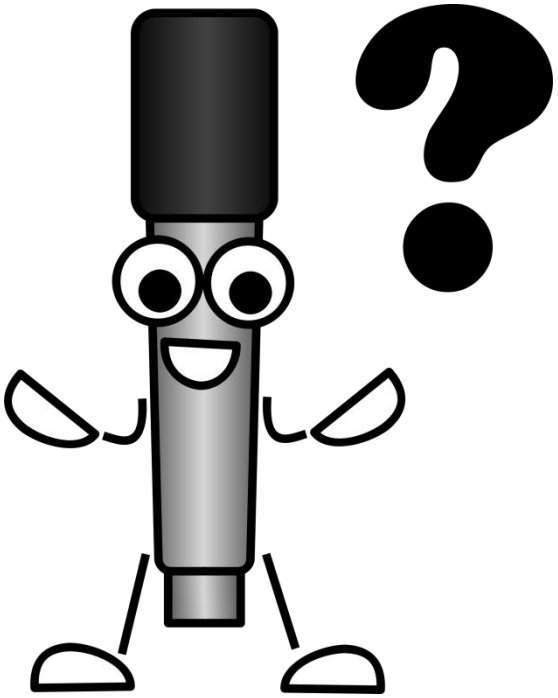
VS2DI (USGS)

Method:

“Wrap your model!“ (*Sonnenberg et al., 2014*)

Thanks to VEOLIA EAU *for sponsoring this work within the project* OPT WELLS

Any



slides at https://github.com/mrustl/useR-2016

Michael Rustler

Kompetenzzentrum Wasser Berlin

@MichaelRustler

mrustl