



o2r opening reproducible research

<https://o2r.info/>

Twitter: @o2r_project, @MarkusKonkol

<https://github.com/o2r-project>

Funded by:



In the next 45 minutes...

- Lack of reproducibility
- a big problem?
- o2r project
- Executable research compendium -
and what it buys you
- o2r2



Presentation

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Reproducibility - a big problem?

Replicability refers to coming to similar conclusions based on an independent experiment.

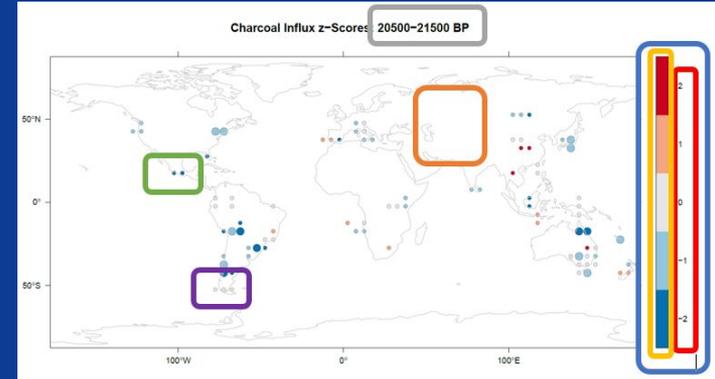
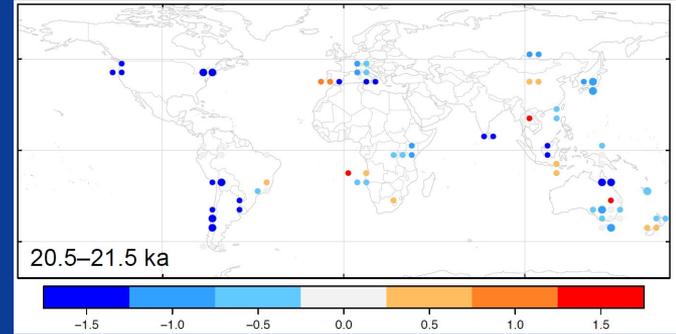
Reproducibility refers to achieving exactly the same results (e.g. tables, figures) as reported in the paper by using the same source code and data.

Replicability & reproducibility are essential for scientific work.

Reproducibility - a big problem?

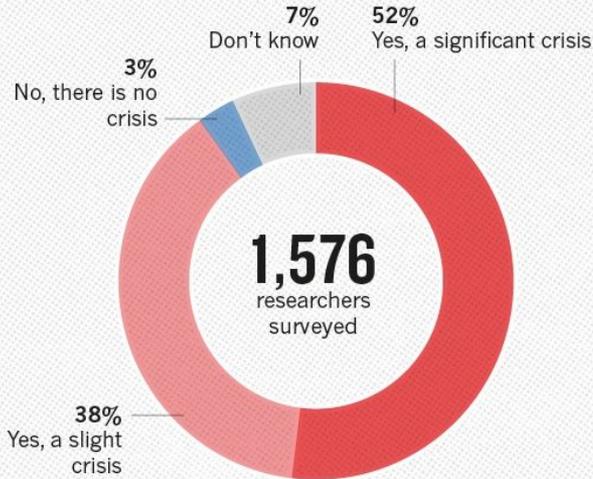
Ran several studies that showed

- geoscientific papers rarely contain materials
- even with available materials, reproduction not always possible
- reproducibility requires extensive effort
- output often different from the results in the paper



Reproducibility - a big problem?

IS THERE A REPRODUCIBILITY CRISIS?

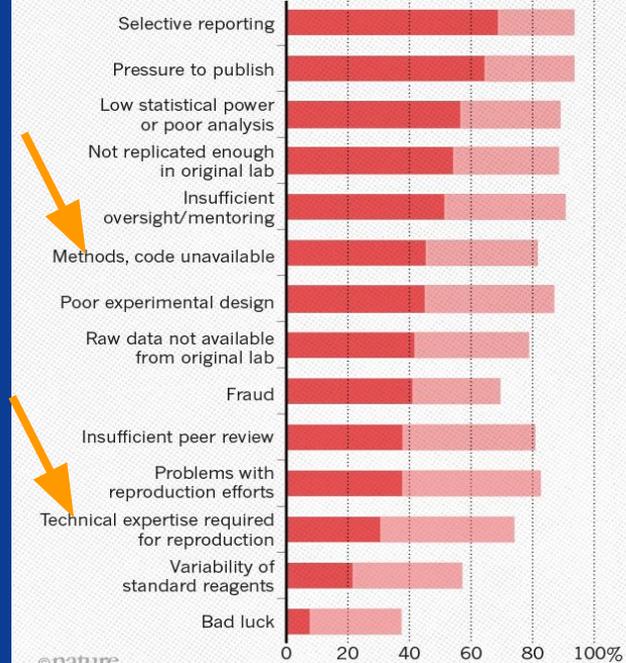


©nature

WHAT FACTORS CONTRIBUTE TO IRREPRODUCIBLE RESEARCH?

Many top-rated factors relate to intense competition and time pressure.

● Always/often contribute ● Sometimes contribute



©nature

First phase:

- Two-year project, 3 RAs, came to an end recently
- follow-up proposal o2r2 accepted
- Collaboration between ULB, ifgi, and publishers

Goals:

- Identify key barriers to working reproducibly
- Design and evaluate ways to overcome these barriers
- Develop approach to reap the benefits of reproducible research
- Implement platform that realises approach and test it

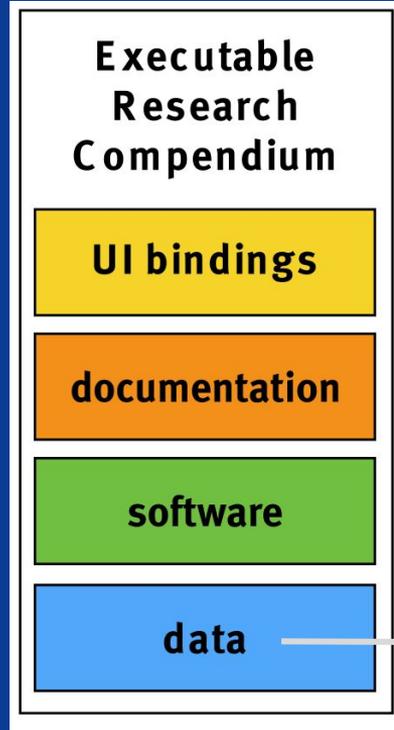
o2r project - basic ideas

- Provide way to easily publish data, analysis, and paper together
- Integrate this with existing publication procedures
- Investigate potential incentives for publishing reproducibly

Core concept: Executable Research Compendium (ERC)

- Replaces traditional paper/article and includes all relevant info
- Paves the way for new possibilities that empower authors and readers

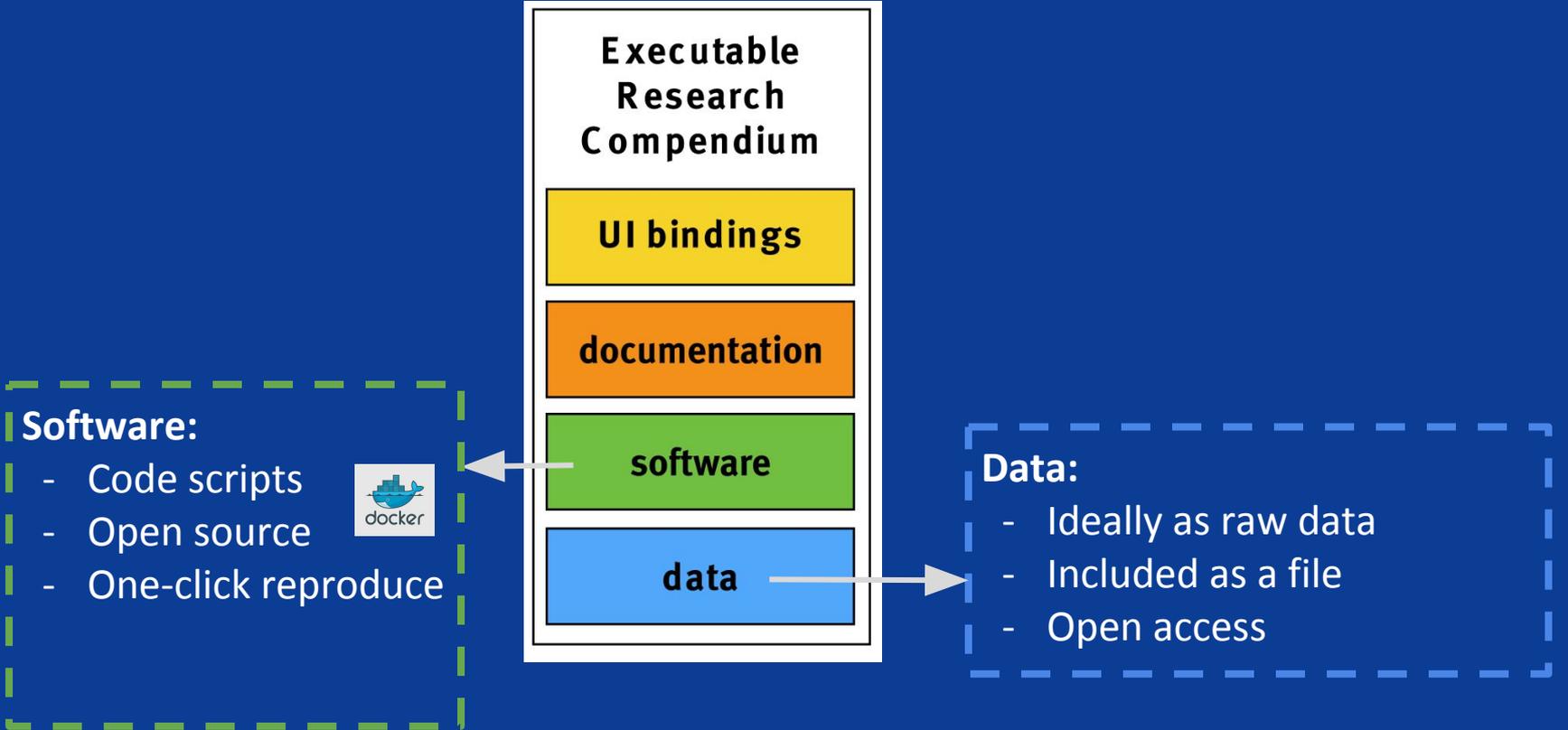
Executable Research Compendia (ERC)



Data:

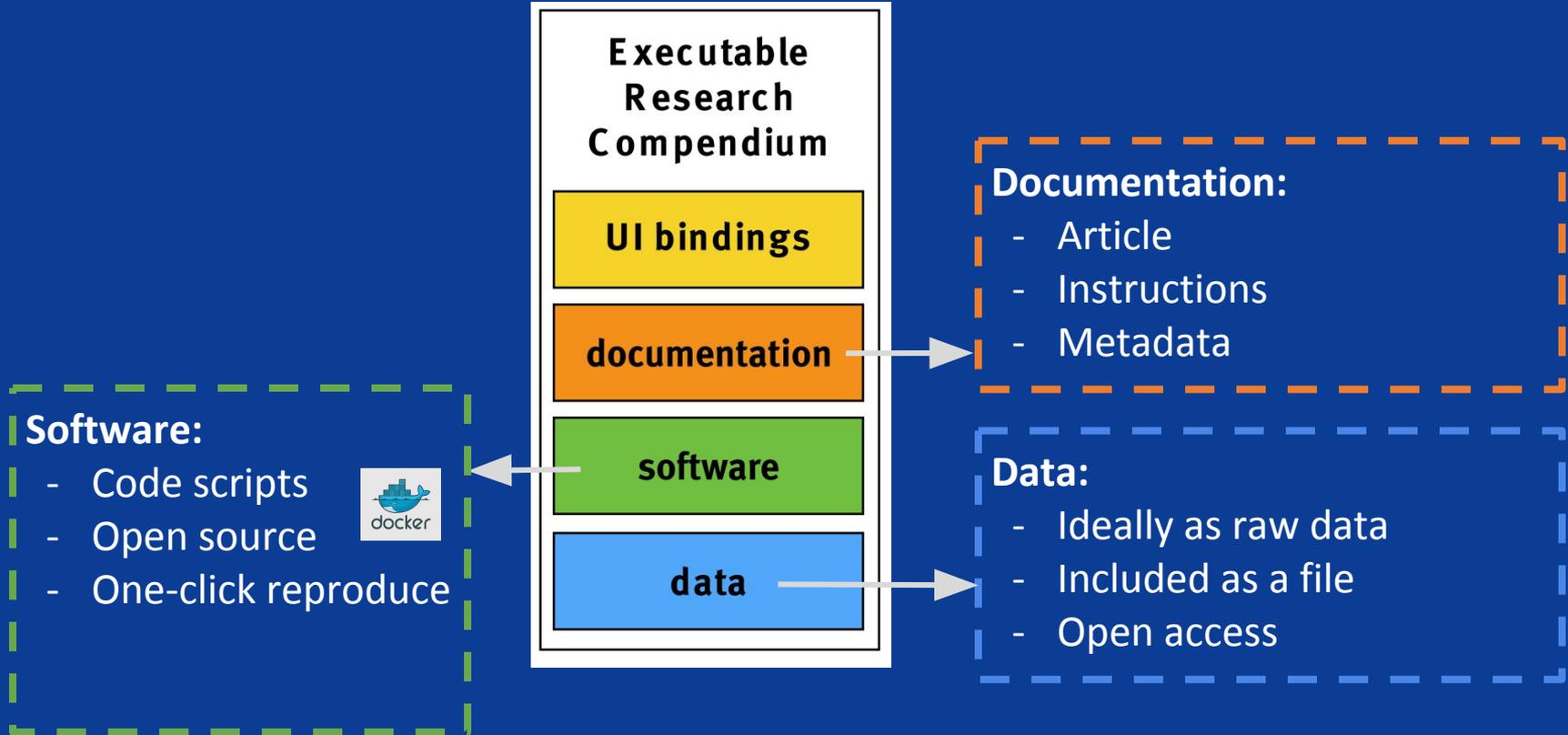
- Ideally as raw data
- Included as a file
- Open access

Executable Research Compendia (ERC)

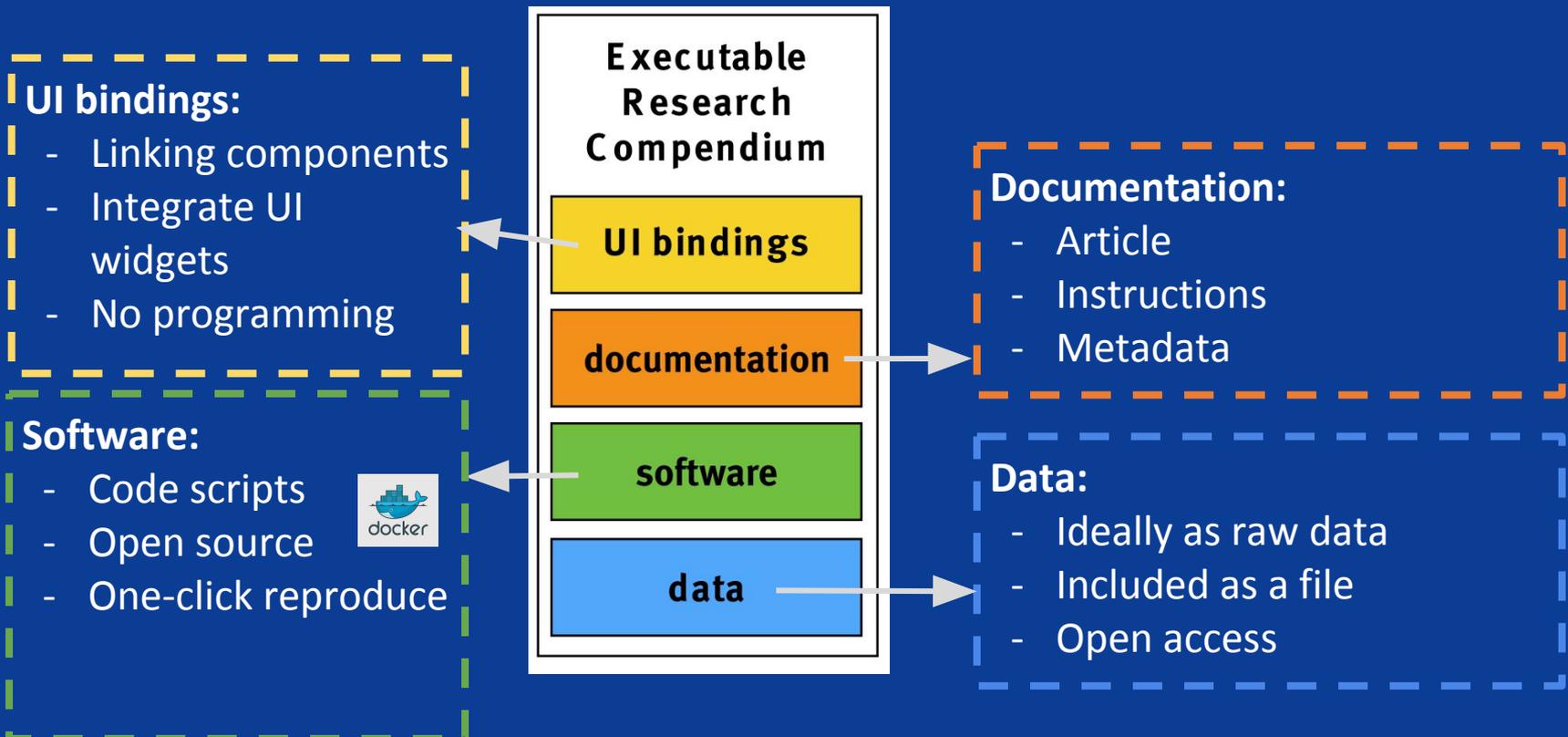


Executable Research Compendia (ERC)

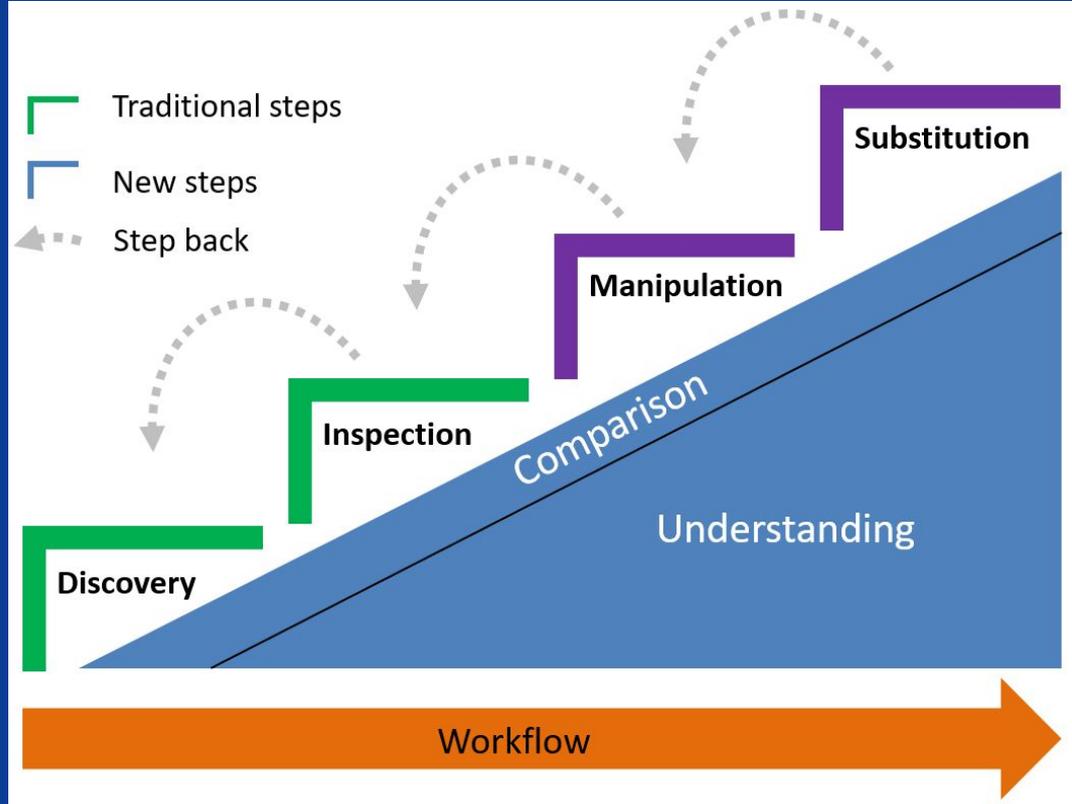
Konkol et al. (2017): Opening the publication process with executable research compendia. <http://www.dlib.org/dlib/january17/nuest/01nuest.html>



Executable Research Compendia (ERC)



Extended workflow for readers



Bindings

Bindings connect those parts of the R script and data subsets that were used to compute a specific computational result reported in a scientific paper.

Figure 3: Example of INSYDE damage functions considering the following event variables: flow velocity = 2.24 h, sediment concentration = 0.05, and water quality = presence of pollutants. Damage functions for entire building components.

```
```{r, echo=FALSE, results="hide", message=FALSE, warning=FALSE, comment=FALSE, warning=FALSE}
```

```
138 par(mar = c(5, 4.2, 4, 4.5))
```

```
plot(he, modelOutput$absDamage, type = "l", lwd = 2, ylim = c(0, max(modelOutput$absDamage) * 1.12), xlab =
```

```
lines(he, modelOutput$groupDamage[, "dmgCleanup"], lwd = 2, col = "green4")
```

```
lines(he, modelOutput$groupDamage[, "dmgRemoval"], lwd = 2, col = "blue4")
```

```
lines(he, modelOutput$groupDamage[, "dmgNonStructural"], lwd = 2, col = "darkorange")
```

```
lines(he, modelOutput$groupDamage[, "dmgStructural"], lwd = 2, col = "firebrick1")
```

```
lines(he, modelOutput$groupDamage[, "dmgFinishing"], lwd = 2, col = "gold2")
```

```
lines(he, modelOutput$groupDamage[, "dmgSystems"], lwd = 2, col = "green1")
```

```
par(new = TRUE)
```

```
plot(he, modelOutput$relDamage, type = "l", lwd = 2, axes = FALSE, ylim = c(0, max(modelOutput$relDamage)
```

```
axis(side = 4)
```

```
mtext(side = 4, line = 3, "Relative damage")
```

```
153 legend("topleft", bg = "white", c("damage total", "cleanup", "removal", "non structural", "structural", "finis
```

## Instructions

STEP 1: Select a figure

Select figure

Figure 3

STEP 2: Mark the code lines for Figure 3



# Bindings

Bindings connect those parts of the R script and data subsets that were used to compute a specific computational result reported in a scientific paper.

```
Hazard variables

he <- seq(0, 5, 0.01) # water depth (m)
v <- 2.0 # velocity (m/s)
s <- 0.05 # sediment concentration (-)
d <- 24 # flood duration (h)
q <- 1 # water quality (presence of pollutants) 1=yes 0=no

Exposure variables

Geometry
FA <- 100 # Footprint area (m2)
IA <- 0.9 * FA # Internal area (m2)
BA <- 0.5 * FA # Basement area (m2)
EP <- 40 # External Perimeter (m)
IH <- 3.5 # Interstorey height (m)
BH <- 3.2 # Basement height (m)
GL <- 0.1 # Ground floor level (m)
NF <- 2 # Number of floors

Others
BT <- 1 # Building type: 1- Detached, 2- Semi-detached, 3- Apartment house
BS <- 2 # Building structure: 1- Reinforced concrete, 2- Masonry, 3- Wood
PD <- 1 # Plant distribution: 1- Centralized, 2- Distributed
```

**STEP 3: Mark the parameter that should be manipulated**

Selected parameter: v with the value 2



**STEP 4: Configure a UI widget for parameter v**

Select a Widget

Slider

Enter minimum value for variable \*

0.1

Enter maximum value for variable \*

3.5

Enter step size for variable \*

0.1

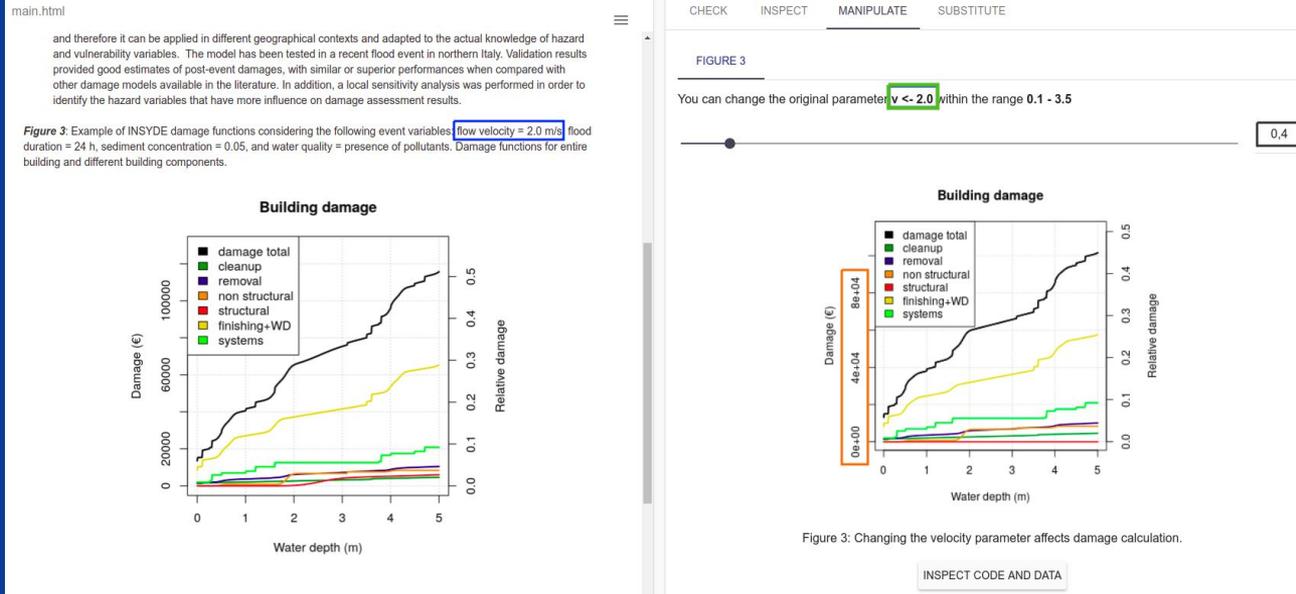
Enter a label \*

Changing the velocity parameter affects damage calc.



# Bindings

Bindings connect those parts of the R script and data subsets that were used to compute a specific computational result reported in a scientific paper.



# ERCs vs. current practice (PDFs)

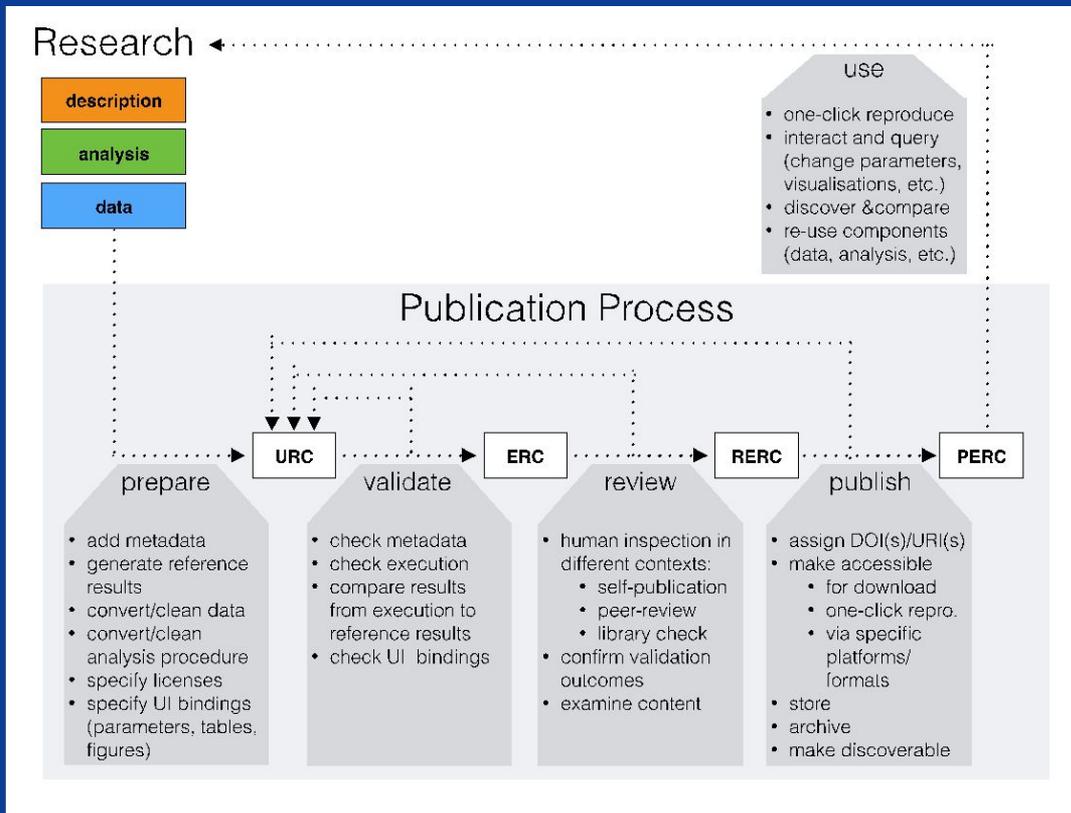
## ERCs offer

- one-click reproduce
- open everything
- new opportunities for re-use
- new interaction possibilities

## But:

- How to integrate ERCs in existing scientific processes?  
Therefore: Need to think further than “just” defining and implementing ERCs

# ERC-based publication process

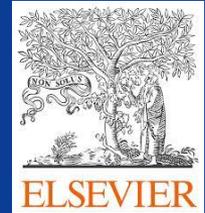


## Second phase:

- 2.5-year project, 2 RAs
- Collaboration between ULB, ifgi and publishers

### Goal 1

- Pilot applications
  - collaboration with journals
  - implementation of UI and the repro. services
  - Self-hosted pilot
    - Open journal system plugin
    - Host OJS instance
    - ERC @ education



## Goal 2

- Eliminate barriers
  - creating bindings
  - robust UI
  - Update specification and documentation

## Goal 3

- Evaluation
  - technology: stress tests, monitoring
  - user study about the understanding of ERCs

# o2r opening reproducible research

## Questions and comments

<https://o2r.info/>

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<https://github.com/o2r-project>

Funded by:

**DFG**



# o2r

Opening Reproducible Research

Create

Insert link to public folder

Folder name (optional)

LOAD FROM PUBLIC SHARE

OR

UPLOAD WORKSPACE AS .ZIP FILE

Upload ERC

Select a file or drag and drop it into area!

Click  
or  
Drag 'n Drop

SUBMIT CANCEL

Open File

Recent

Home

Desktop

Documents

Downloads

Music

Pictures

Videos

privat

SAMSUNG A...

git

2016-ORR

o2r-data

ownCloud

Other Locations

File list:

Name	Size	Modified
Aquestiondrivenprocess		17:09
Aspacetimemodel		9 Nov 2017
workspaceping		15:26
workspaceping-bad		17:36
workspace-rmd-data		17:22
workspace-rmd-data-other		11:42
workspace-rmd-data-random		Yesterday
workspace-rmd-data_wrong-displayfile		Yesterday
Aquestiondrivenprocess.zip	29.0 MB	17:09
Aspacetimemodel.zip	27.2 MB	8 Nov 2017
minimal-rmd.zip	233.0 kB	23 Oct 2017
minimal-script.zip	2.6 kB	23 Oct 2017
workspaceping.zip	557 bytes	15:26
workspaceping-bad.zip	552 bytes	17:35
workspace-rmd-data.zip	219.7 kB	16:48
workspace-rmd-data-other.zip	219.4 kB	11:22
workspace-rmd-data-random.zip	234.0 kB	9 Nov 2017
workspace-rmd-data_wrong-displayfile.zip	219.4 kB	Yesterday

\*.zip

Cancel Open

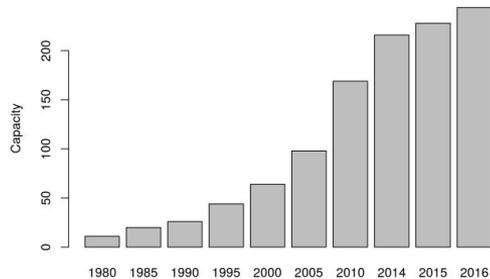
More information about the project can be found at our [project](#)

display.html



## Capacity of container ships in seaborne trade from 1980 to 2016 (in million dwt)\*

Daniel Nüst  
2017



© Statista 2017

This statistic portrays the capacity of the world container ship fleet from 1980 through 2016. In 2016, the world merchant container ship fleet had a capacity of around 244 million metric tons deadweight. As of January 2016, there were 5,239 container ships in the world's merchant fleet ([source](#)).

Sources: UNCTAD; Clarkson Research Services, via [statista](#).

CHECK INSPECT MANIPULATE SUBSTITUTE

main.Rmd

```

title: "Capacity of container ships in seaborne trade from 1980 to 2016 (in
author:
 - name: "Daniel Nüst"
 affiliation: o2r team
date: "2017"
output: html_document
abstract: |
 Capacity of container ships in seaborne trade of the world container shi
keywords:
 - container
 - ship
 - trade
 - statistic
doi: http://dx.doi.org/10.5555/66665554444
```

data.csv

"year"	"capacity"
"1980"	11
"1985"	20
"1990"	26
"1995"	44
"2000"	64
"2005"	98
"2010"	169
"2014"	216
"2015"	228
"2016"	244



Check Results

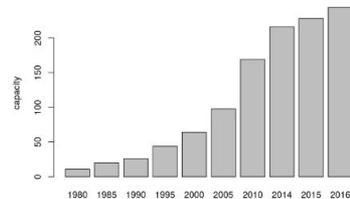
Original File

## Capacity of container ships in seaborne trade from 1980 to 2016 (in million dwt)\*

Daniel Nüst  
o2r team  
2017

### Abstract

Capacity of container ships in seaborne trade of the world container ship fleet.



(c) Statista 2017

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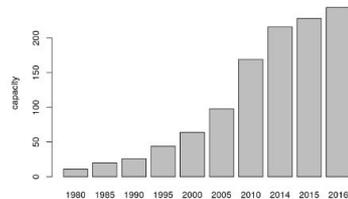
Reproduced File

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2017

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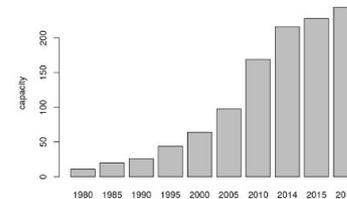
Differences

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prepare



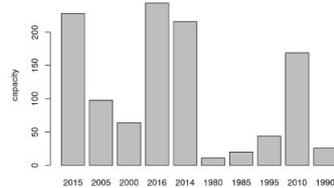
Check Results

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Sources: UNCTAD; Clarkson Research Services, via [statista](#).

Created at Thu Nov 9 12:58:02 2017

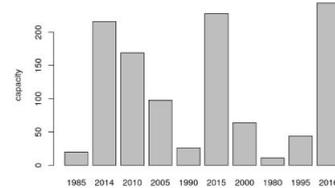
(c) Statista 2017

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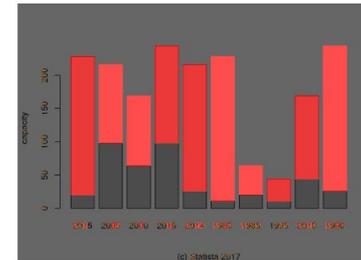
Created at Thu Jan 16 14:56:20 2018

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Daniel Nüst  
o2r team  
2017

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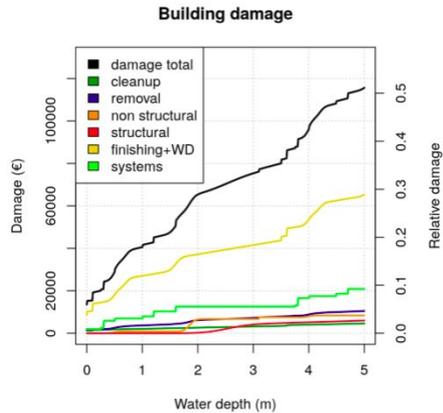
Created at Thu Nov 9 12:58:02 2017

Get:7 <http://security.debian.org/stretch/updates/main amd64 Package>  
Get:8 <http://deb.debian.org/debian/stretch/main amd64 Packages> 19...

main.html

and therefore it can be applied in different geographical contexts and adapted to the actual knowledge of hazard and vulnerability variables. The model has been tested in a recent flood event in northern Italy. Validation results provided good estimates of post-event damages, with similar or superior performances when compared with other damage models available in the literature. In addition, a local sensitivity analysis was performed in order to identify the hazard variables that have more influence on damage assessment results.

**Figure 3:** Example of INSYDE damage functions considering the following event variables: flow velocity = 2.0 m/s, flood duration = 24 h, sediment concentration = 0.05, and water quality = presence of pollutants. Damage functions for entire building and different building components.



CHECK INSPECT MANIPULATE SUBSTITUTE

FIGURE 3

You can change the original parameter  $v < 2.0$  within the range 0.1 - 3.5

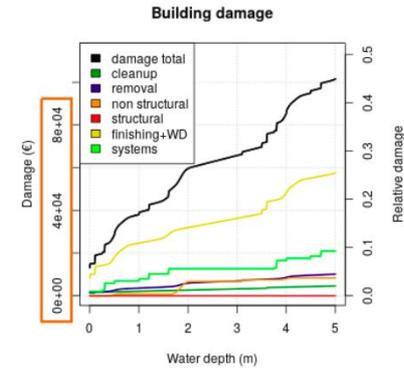


Figure 3: Changing the velocity parameter affects damage calculation.

INSPECT CODE AND DATA

display.html

CHECK INSPECT MANIPULATE SUBSTITUTE

SHIP TO ...

# Capacity of container ships in seaborne trade from 1980 to 2016 (in million dwt)\*

## CAPACITY OF CONTAINER SHIPS...

Created on: 2018-01-17 16:42  
by: 0000-0001-6532-2025

base ERC:	overlay ERC:
Capacity of container ships in seaborne trade from 1980 to 2016 (in million dwt)*	Better capacity of container ships in seaborne trade from 1980 to 2016 (in million dwt)*
data.csv ▾	data.csv ▾
-	
+	

- keep metadata of base ERC
- extract metadata of new ERC
- extract and merge metadata for new ERC

CANCEL    START SUBSTITUTION





SHIP TO ...

display.html



CHECK

INSPECT

MANIPULATE

SUBSTITUTE

## Compare Files



Base File



```
"year", "capacity"
"1980", 11
"1985", 20
"1990", 26
"1995", 44
"2000", 64
"2005", 98
"2010", 169
"2014", 216
"2015", 228
"2016", 244
```

Overlay File



```
"year", "capacity"
"1980", 11
"1985", 20
"1990", 26
"1995", 44
"2000", 64
"2005", 98
"2010", 142
"2014", 217
"2015", 229
"2016", 245
```



SAVE EDIT



SUBSTITUTION ERC

BASE

OVERLAY



SHIP TO ...

erc.yml

BACK TO PAPER

```
id: g0t1G
spec_version: '1'
main: main.Rmd
display: display.html
execution:
 cmd: >-
 'docker run -it --rm --volume $(pwd):/erc --volume
 $(pwd)/overlay_data.csv:/erc/data.csv:ro erc:ShaBZ'
bind_mounts:
 - type: bind
 source: ''
 destination: /erc
 readonly: true
 - type: bind
 source: overlay_data.csv
 destination: /erc/data.csv
 readonly: true
```

CHECK INSPECT MANIPULATE SUBSTITUTE

RUN ANALYSIS



JOB (RAW)

ERC (RAW)

#### Last finished analysis

No analysis finished yet.

#### Last started analysis

No currently running analysis.

Check Results

o2r

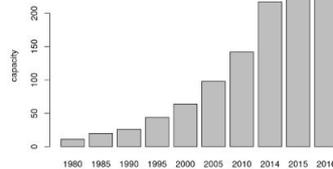
Daniel Nüst

o2r team

2017

Abstract

Capacity of container ships in seaborne trade of the world container ship fleet.



(c) Statista 2017

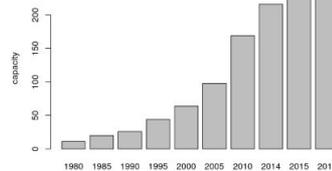
This statistic portrays the capacity of the world container ship fleet from 1980 through 2016. In 2016, the world merchant container ship fleet had a capacity of around 244 million metric tons deadweight. As of January 2016, there were 5,239 container ships in the world's merchant fleet ([source](#)).

Sources: UNCTAD; Clarkson Research Services, via [statista](#).

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2017

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o2r

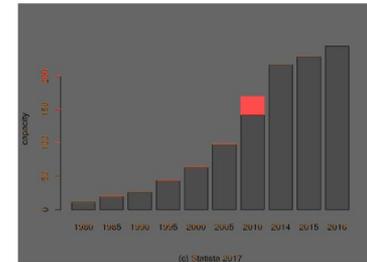
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