

# R and L<sup>A</sup>T<sub>E</sub>X: typesetting graphs in a reproducible way

Vic van Dijk

Set your Text — [setyourtext.com](http://setyourtext.com)

August 8, 2021

# Introduction

*This talk centers on:* How to typeset graphs in a document

- › dynamically,
- › in corresponding style,
- › transparent on calculations performed.

I bring my experiences forward, please bring your wisdom as well!

# Introduction

*In hindsight:* if only I knew during my studies what I know now...

I was tossing around spreadsheets and graphs for study reports...

# Outline

Overview of techniques

Examples

Possibilities

# Software used

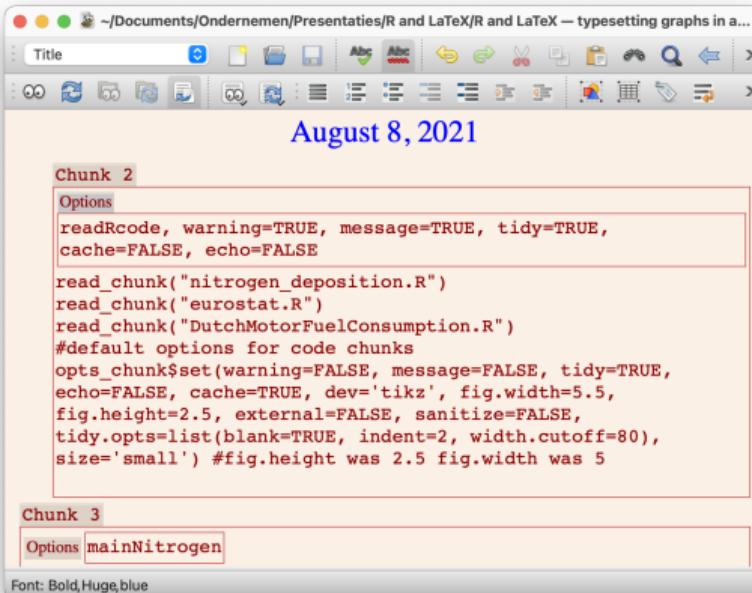
- › L<sup>A</sup>T<sub>E</sub>X, via LYX
- › R, via RStudio
- › knitr
- › Ti<sub>k</sub>Z

# About R

- › Free open source programming language
- › Used in statistics, finance
- › Packages for many more applications available
- › Connection to other languages possible
- › Great plotting features (ggplot2)

# Knitr ties R and L<sup>A</sup>T<sub>E</sub>X together

- › Loading R code in L<sup>A</sup>T<sub>E</sub>X



The screenshot shows a LaTeX editor interface with a toolbar at the top and a main workspace below. The workspace displays two R code chunks:

```
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Chunk 2
Options
readRCode, warning=TRUE, message=TRUE, tidy=TRUE,
cache=FALSE, echo=FALSE

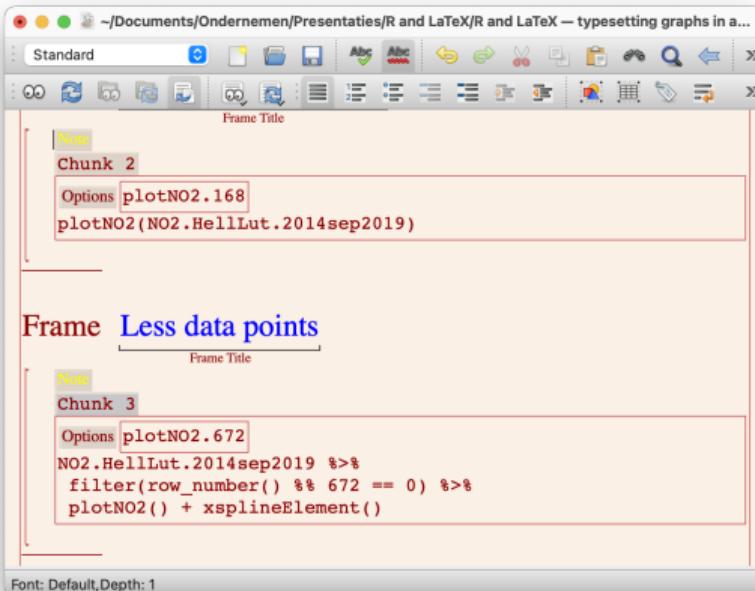
read_chunk("nitrogen_deposition.R")
read_chunk("eurostat.R")
read_chunk("DutchMotorFuelConsumption.R")
#default options for code chunks
opts_chunk$set(warning=FALSE, message=FALSE, tidy=TRUE,
echo=FALSE, cache=TRUE, dev='tikz', fig.width=5.5,
fig.height=2.5, external=FALSE, sanitize=FALSE,
tidy.opts=list(blank=TRUE, indent=2, width.cutoff=80),
size='small') #fig.height was 2.5 fig.width was 5

Chunk 3
Options mainNitrogen

Font: Bold,Huge,blue
```

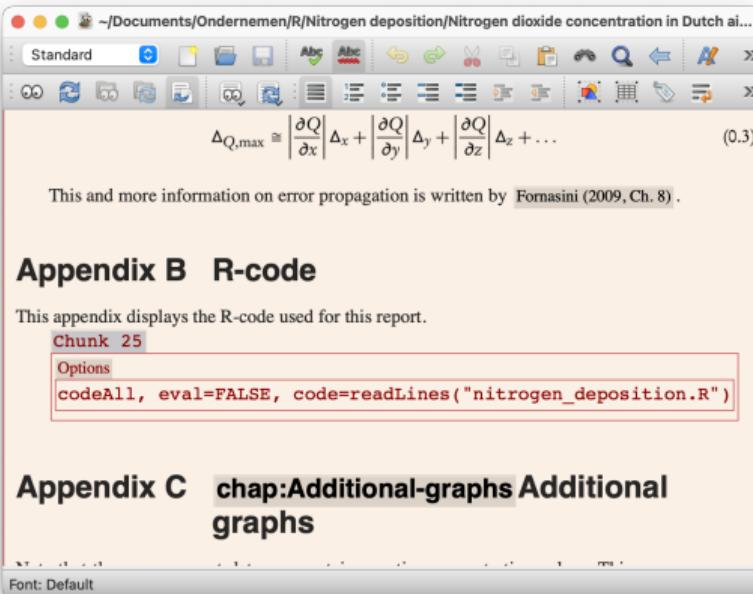
# Knitr ties R and L<sup>A</sup>T<sub>E</sub>X together

- › Typesetting plots at the right position in LyX



# Knitr ties R and L<sup>A</sup>T<sub>E</sub>X together

- › Typesetting the R-code used



The screenshot shows a LaTeX editor window with a toolbar at the top. Below the toolbar, there is a typeset equation and a note about error propagation. At the bottom, there is an R code chunk labeled "Chunk 25".

$$\Delta Q_{\max} \approx \left| \frac{\partial Q}{\partial x} \right| \Delta_x + \left| \frac{\partial Q}{\partial y} \right| \Delta_y + \left| \frac{\partial Q}{\partial z} \right| \Delta_z + \dots \quad (0.3)$$

This and more information on error propagation is written by [Fornasini \(2009, Ch. 8\)](#).

**Appendix B R-code**

This appendix displays the R-code used for this report.

**Chunk 25**

**Options**

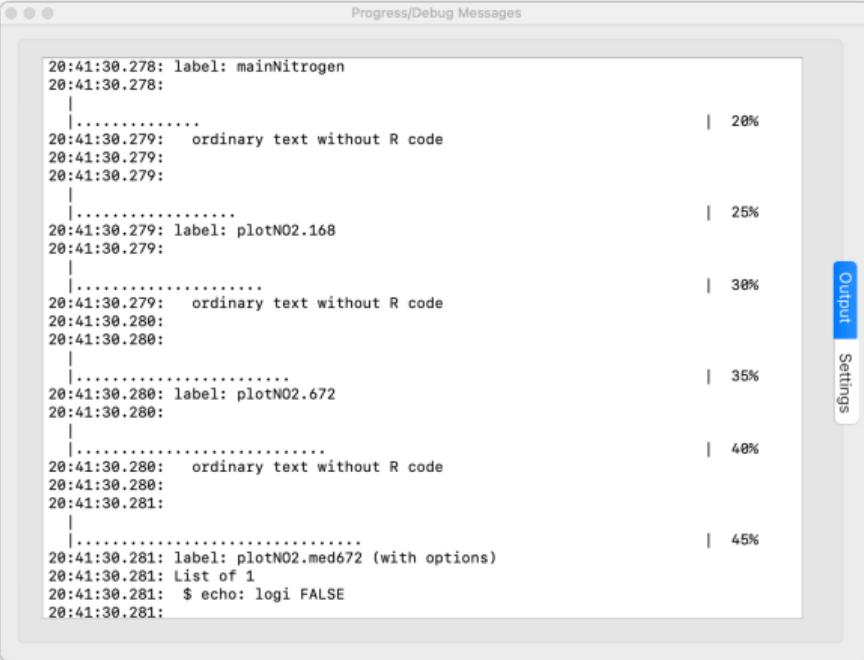
```
codeAll, eval=FALSE, code=readLines("nitrogen_deposition.R")
```

**Appendix C chap:Additional-graphs Additional graphs**

Font: Default

# Knitr ties R and L<sup>A</sup>T<sub>E</sub>X together

- › R-code is executed during the pdfL<sup>A</sup>T<sub>E</sub>X run



The screenshot shows a 'Progress/Debug Messages' window with a list of R code execution logs. The logs are timestamped and include labels for R code and L<sup>A</sup>T<sub>E</sub>X labels. A vertical progress bar on the right indicates the percentage completion of the process, starting at 20% and ending at 45%. The 'Output' tab is selected in the bottom right corner.

```
20:41:30.278: label: mainNitrogen  
20:41:30.278:  
|.....  
20:41:30.279: ordinary text without R code  
20:41:30.279:  
20:41:30.279:  
|.....  
20:41:30.279: label: plotN02.168  
20:41:30.279:  
|.....  
20:41:30.279: ordinary text without R code  
20:41:30.280:  
20:41:30.280:  
|.....  
20:41:30.280: label: plotN02.672  
20:41:30.280:  
|.....  
20:41:30.280: ordinary text without R code  
20:41:30.280:  
20:41:30.281:  
|.....  
20:41:30.281: label: plotN02.med672 (with options)  
20:41:30.281: List of 1  
20:41:30.281: $ echo: logi FALSE  
20:41:30.281:
```

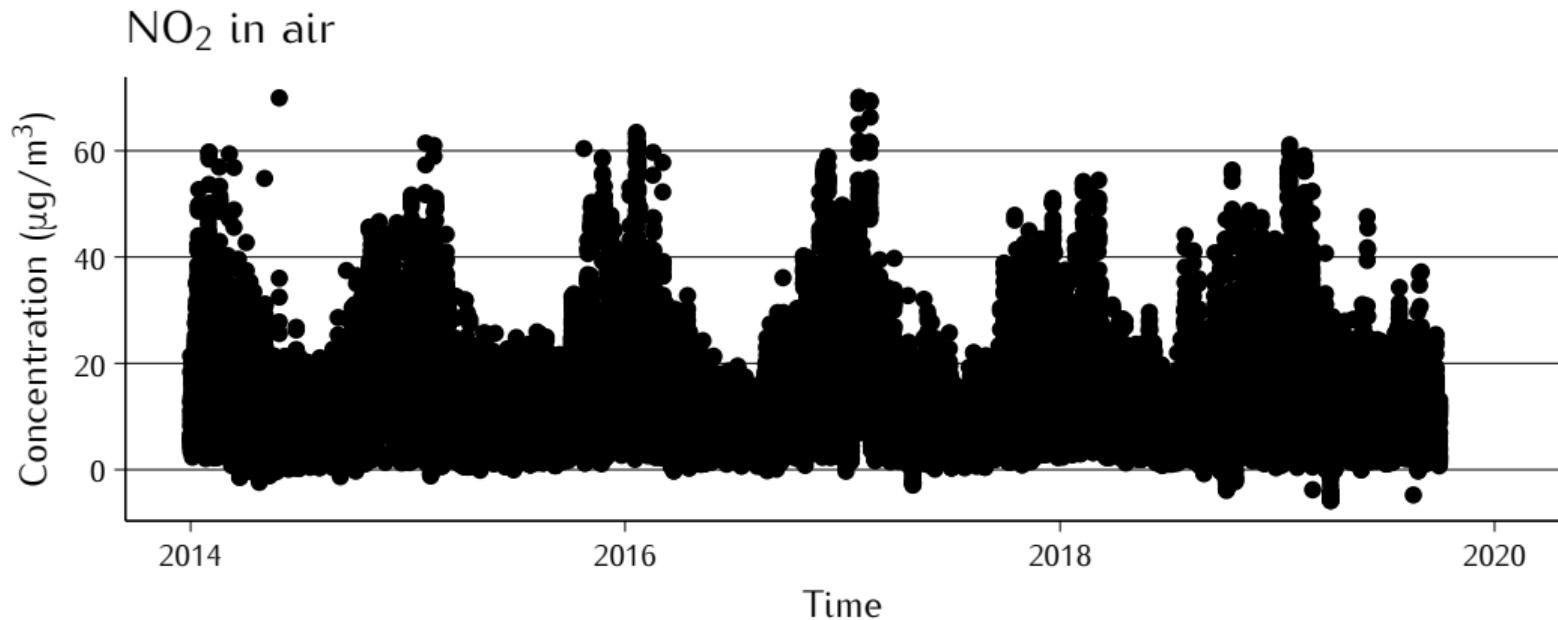
# Outline

Overview of techniques

Examples

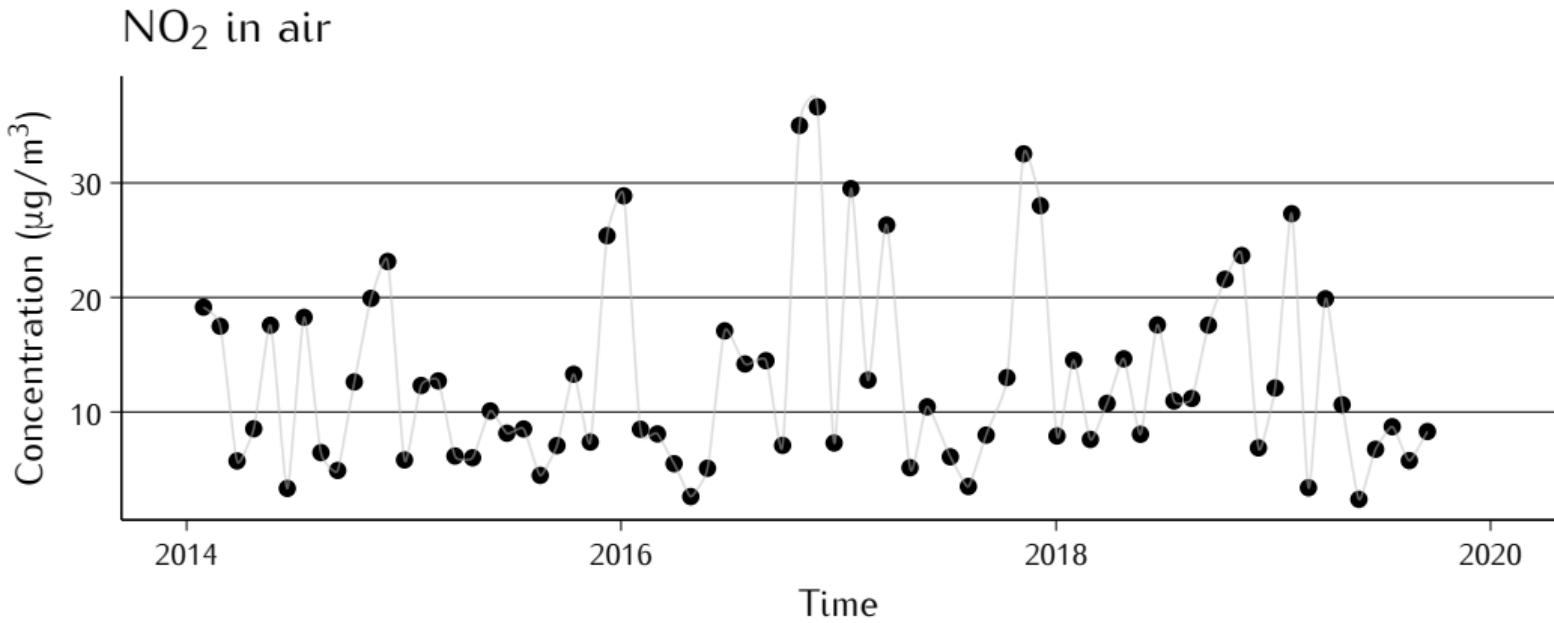
Possibilities

# Too much data points



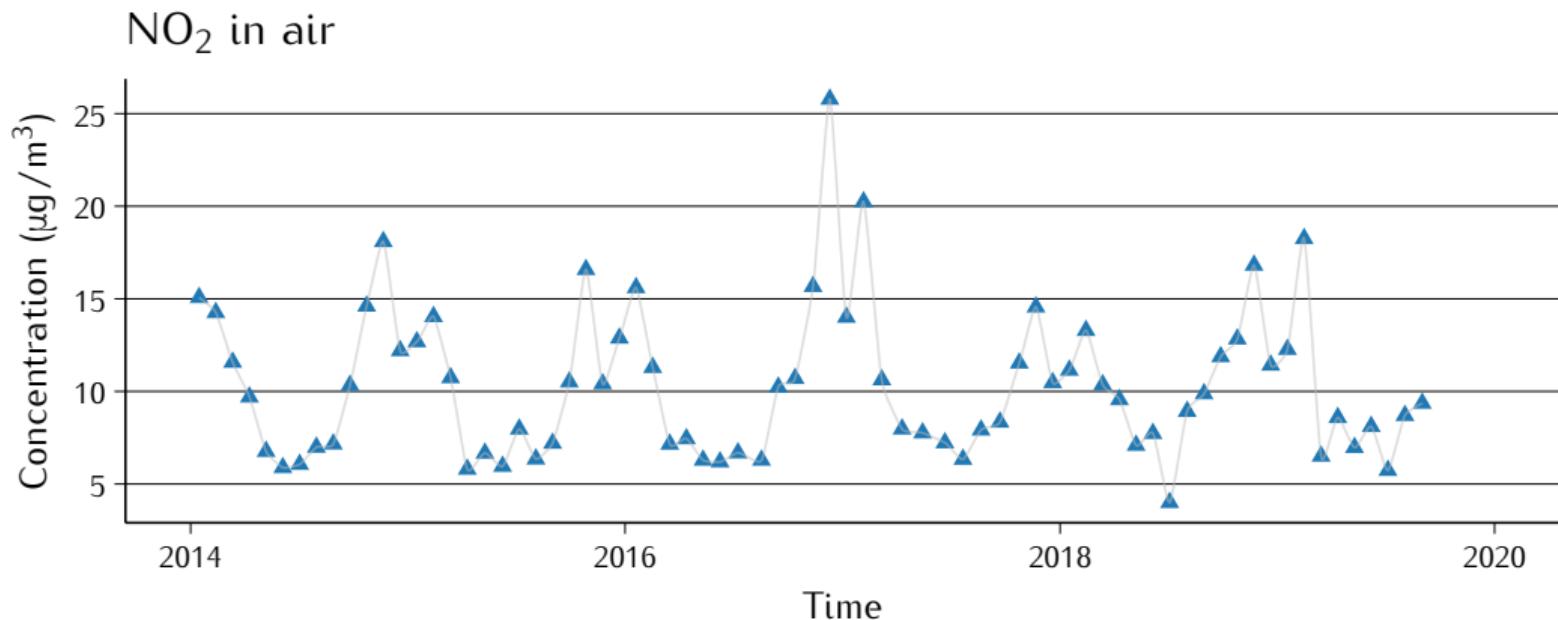
Source: Luchtmeetnet (NL)

# Less data points



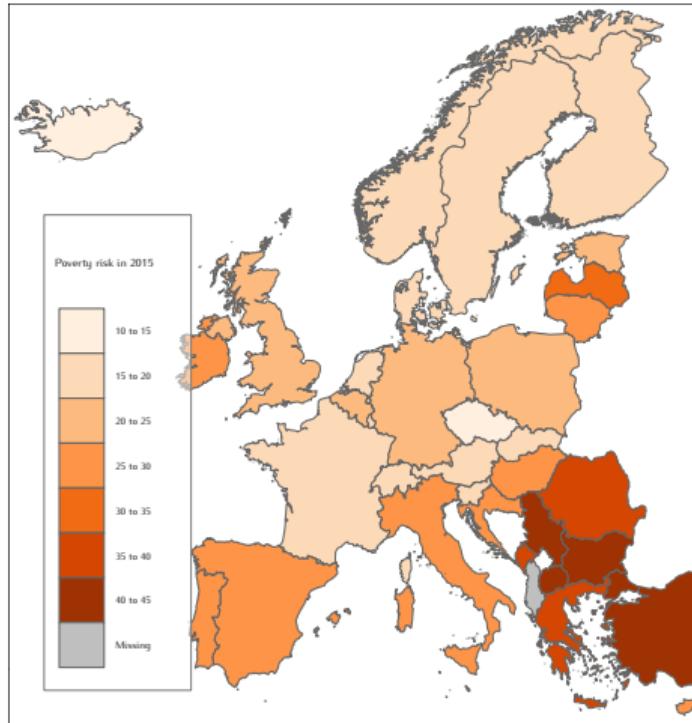
Source: Luchtmeetnet (NL)

# Median values

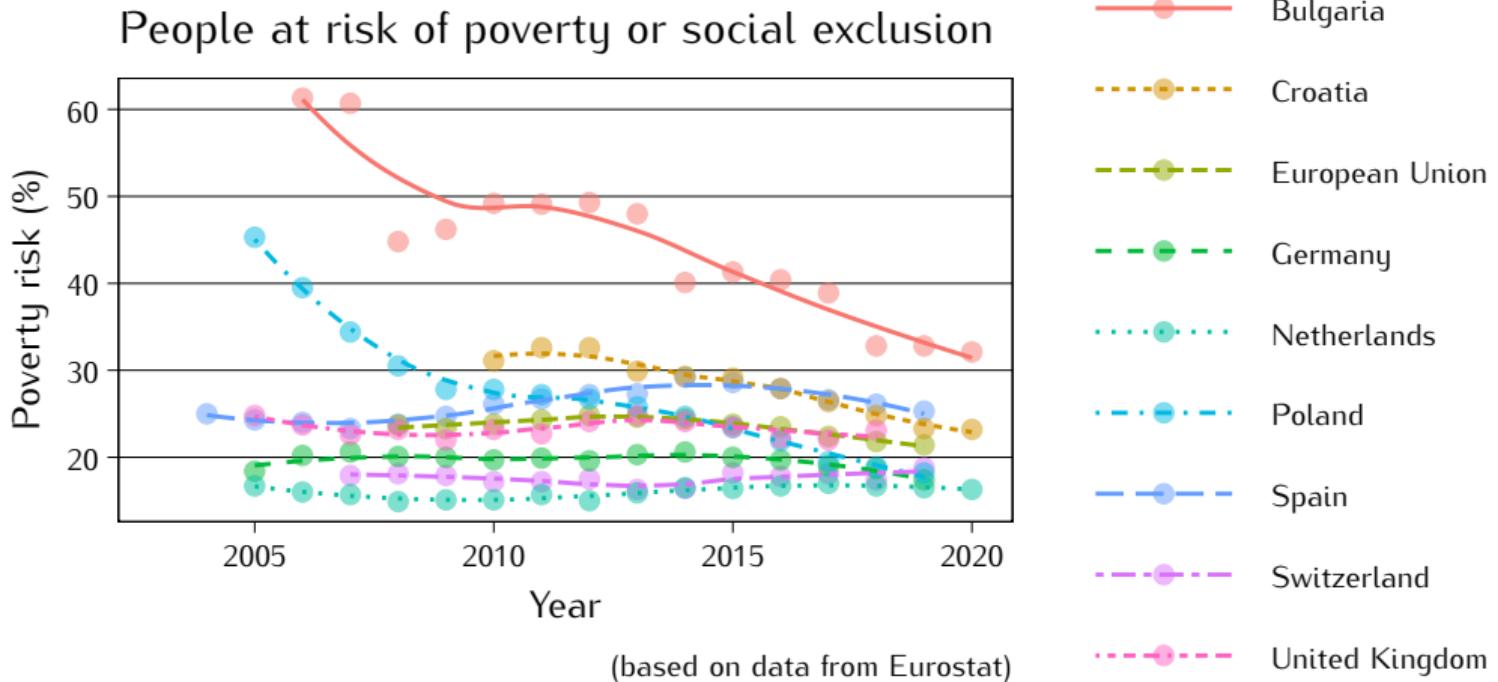


Source: Luchtmeetnet (NL)

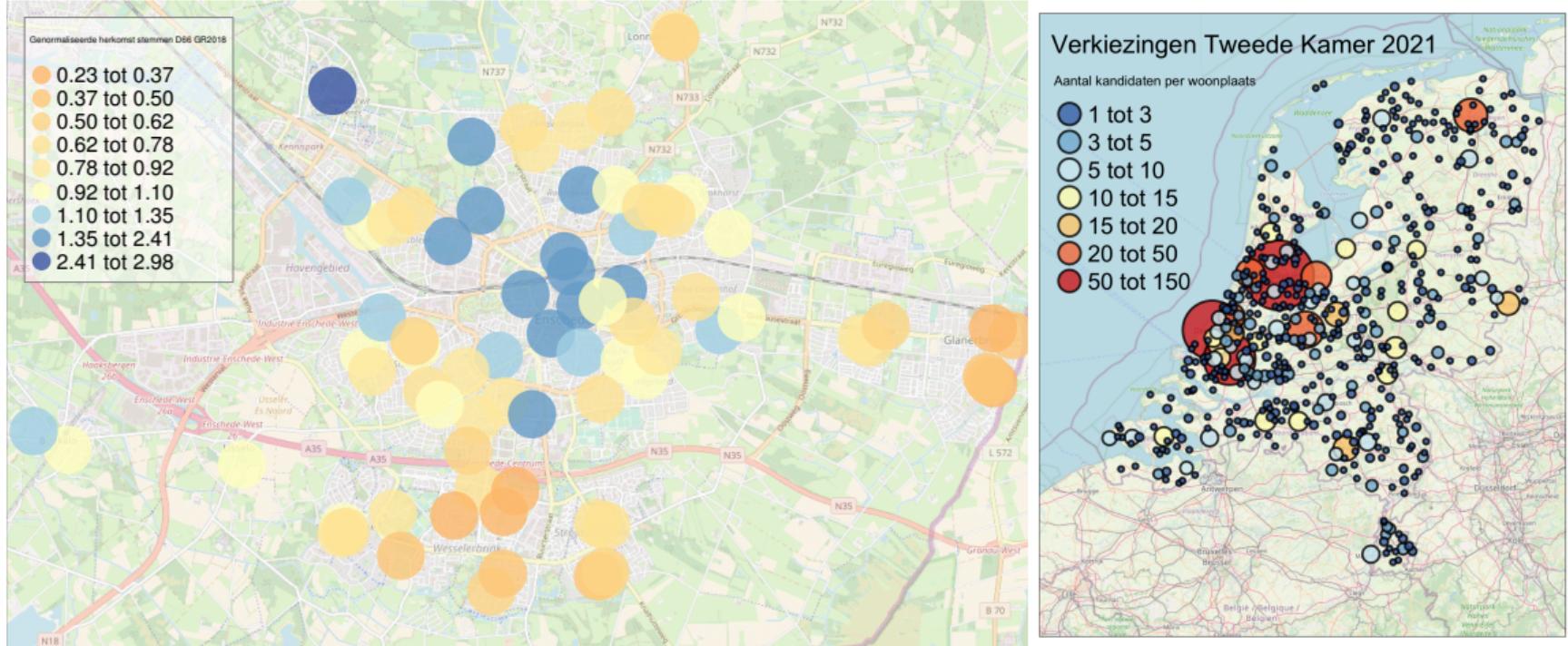
# Data from Eurostat on a map



# Time series from Eurostat

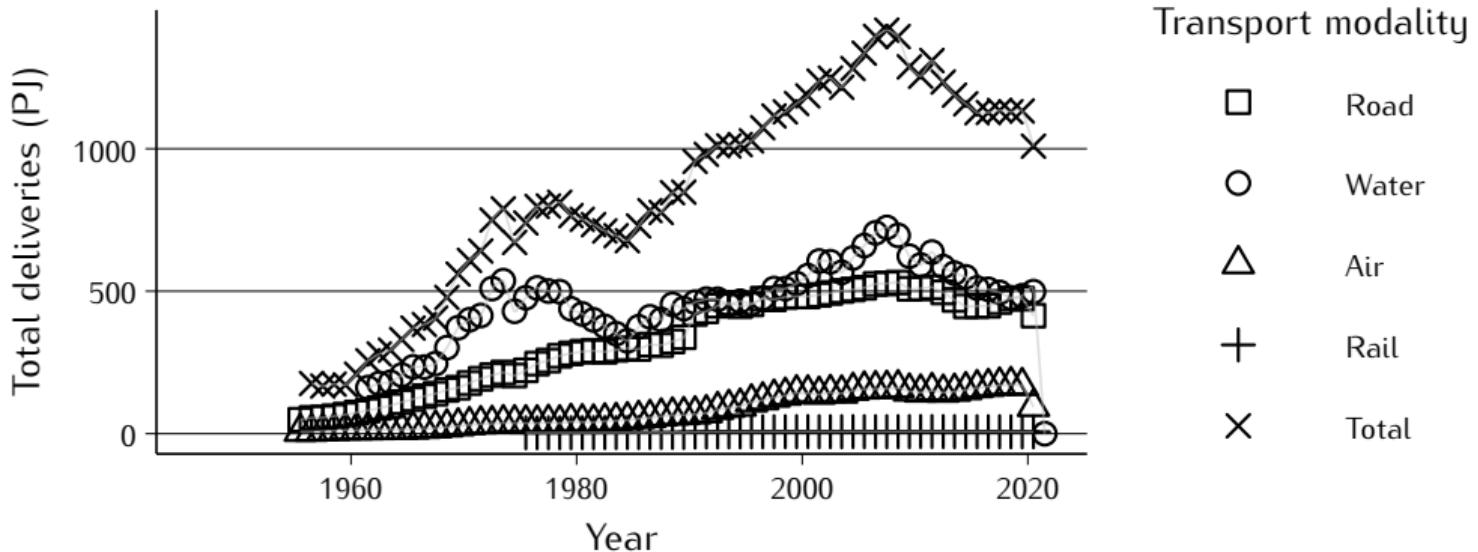


# Data on a map



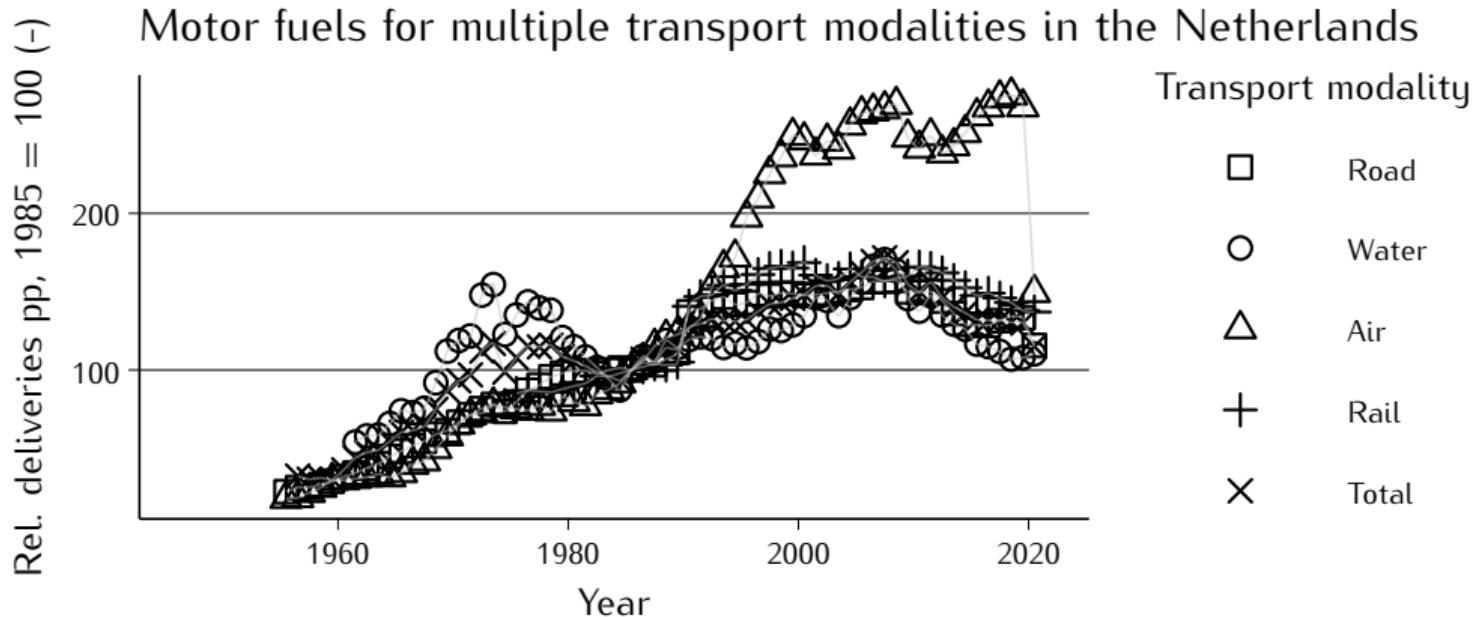
# All dutch transport

Motor fuels for multiple transport modalities in the Netherlands



Source: CBS (NL)

# Per head of population, index 1985



Source: CBS (NL)

# Exif data from photos

- › R-package exifr can read EXIF data from photos.
- › Fun example: automatic photobook generation from a collection of photos.



*Stoofperen uitdelen in de buurt*  
4 november 2020



*Het fruit voor de Christmas cake*  
14 november 2020



*Ingrediënten  
Christmas cake*  
5 november 2020



*Zwaar beslag Christmas  
cake*  
15 november 2020

# Outline

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Examples

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# Reproducible research

With R, knitr and L<sup>A</sup>T<sub>E</sub>X, one can

- › show the reader the true calculations (R-code) performed on data
- › quickly recalculate when needed and regenerate report(s) including graphs
- › change the layout of graphs quickly without the risk of introducing errors

# Better research

- › Less redundancy in calculation methods
- › Measurement error propagation made easy, and many other packages available from CRAN
- › Dynamic connections possible to C++, MatLAB, Python, Fortran, Java, ...
- › Writing and processing measurement data can be done at once, instead of at the end of a research project

# Questions and ideas

- › *Any ideas from the audience?* I am happy to take questions or remarks.
- › After this presentation, feel free to find out more or contact me (Vic van Dijk) via [setyourtext.com](http://setyourtext.com)