CSHS Workshop: R for hydrologists - building packages

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CSHS SCSH
Canadian Society for Hydrological Sciences
Société Canadienne des Sciences Hydrologiques
Canadian Water Resources Association
Association Canadienne des Ressources Hydriques

Why create a package?

- The best way to distribute **R** code
- Makes your code reproducible
  - makes code reusable
  - improves code quality
  - takes care of dependencies
  - self-documenting
  - should work for anyone, on any computer

Building a package

- All components are text files
  - You could build them manually
- **DON'T!**
- Use the package **devtools**
  - makes it *much* easier
- Also, install packages **roxygen2, rmarkdown**
- Need LaTex installed to create manuals
- Also, make sure to have **git** installed on your system

Mandatory package components

- 2 Files
  - DESCRIPTION
  - NAMESPACE
- 2 directories are mandatory
  - /R – contains code .R files
  - /man – contains documentation .Rd files
- may have other directories

DESCRIPTION

- Contains package description
- Has to have a specific format
- Has to indicate the packages required by your package

DESCRIPTION example from CSHShydRology

```
Type: Package
Package: CSHShydRology
Title: Canadian Hydrological Analyses
Version: 1.2.1
Date: 2022-04-17
Authors:...
Author:...
Maintainer: Kevin Shook <kevin.shook@usask.ca>
Description: A collection of user submitted functions to aid in the analysi
License: AGPL-3
URL: https://github.com/CSHS-hydRology/CSHShydRology
Depends:
    R (>= 4.0.0)
Imports:
   ...
VignetteBuilder: knitr
```

NAMESPACE

- Contains detailed information about imports and exports of each function
- Do NOT create or edit this file
  - **roxygen2** will automatically create and maintain it

R directory

- Contains the **R** code
- Code must be written as functions
- Each function must be in a separate file
  - file name is same as function name
  - file extension must be **.R**

man directory

- Contains the documentation files
- Creates the help system for the package
- Also creates the manual
- Each .R file has a .Rd file in **man**
  - Don't create these files manually

roxygen2

- Used by **devtools**, installed by it
- Automatically creates the .Rd files
  - uses comments at the beginning of each **.R** file

Example

- All lines begin with #'
- First line contains a 1 line description of the file
- Should not end with a period!
- Example:

Tags

Formatting

- Documentation can include formatting codes

Example

Package function

- You should create a function that has the name of your package
- Example: WISKIr-package.R
- Contains information to create NAMESPACE

Example

Other folders

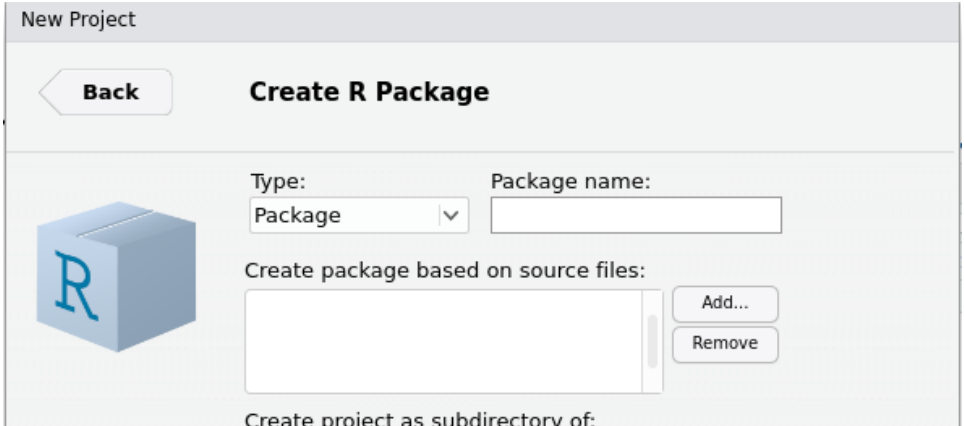
- You may see these folders in packages:
  - /data, data files used by the package
  - /vignettes, documentation written in Markdown
  - /inst, contains the file CITATION showing how to cite the package
  - /src, source code written in C, C++ or Fortran

Workflow

1. Create the package
2. Add code
3. Build package
4. Check package
5. Create package file

1. Creating the package

- Create a new project in a new directory
  - **File|New Project**
  - select **R Package**
  - then give your package a name and a location
- Make sure to use git!

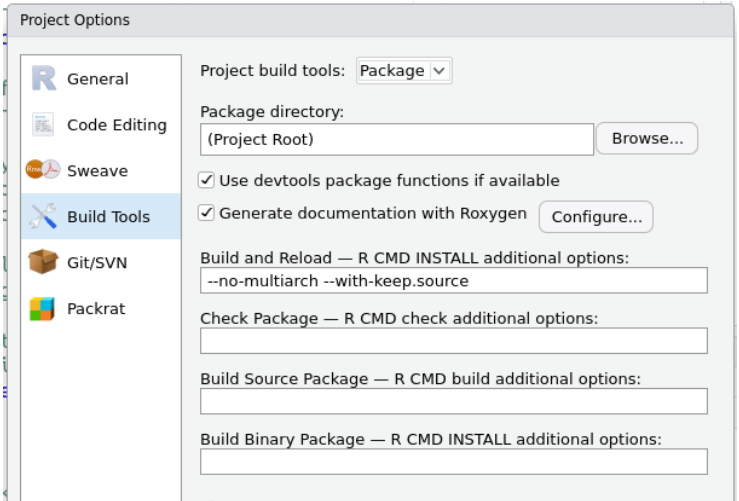


New package

- R studio will create all of the files and directories
  - /R
  - /man
  - DESCRIPTION
  - NAMESPACE
- Also creates a sample file **hello.R** in /R
- Adds folders and files for git

Setting up roxygen

- Not enabled by default
- Set it up using **Tools|Project Options**



2. Adding R code

- Put your R code files in /R
- Must be functions
  - one function per file
- Add the roxygen skeleton to your code for each file
  - **Code|Insert Roxygen Skeleton**
- Fill in skeleton

Example

Converting your R code

- You will ned to make some changes to your code
- Don't use the **library()** function to load packages
  - package importation handled by `NAMESPACE`
- Specify the name of the package in every function (outside of your package and Base R) call
  - syntax is **package::function**

3. Building package

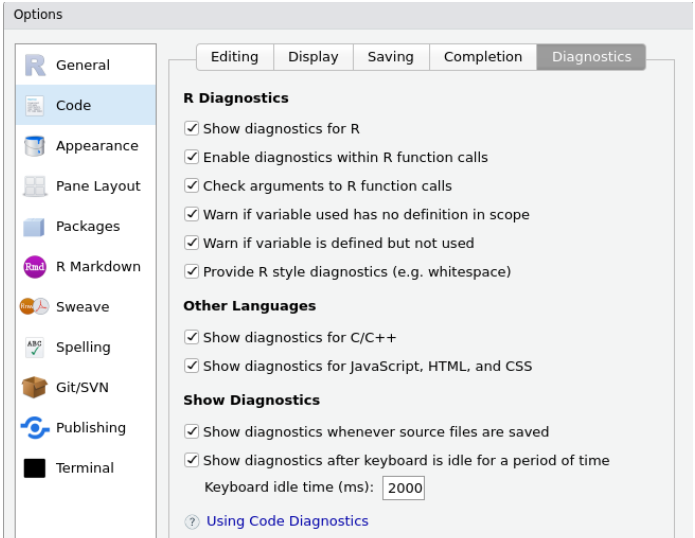
- Use command **Build | Clean and Rebuild**
- Expect to get error messages!
- Fix until package builds
- If the package builds, it will be added to your list of packages

4. Checking the package

- Just because a package can build, doesn't mean that it is good!
- Use command **Build|Check**
  - does a detailed check of entire package
  - tries to run your examples
  - *very* picky
  - you will get many, many errors and warnings

Writing better code

- Turn on Code Diagnostics using **Tools|Global Options**



5. Creating the package file

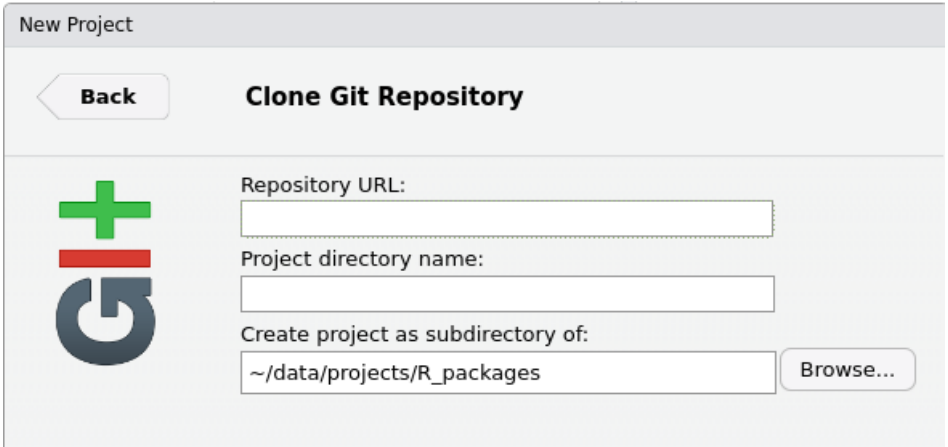
- 2 options:
  - **Build** | **Build Source Package** - contains source code (all languages)
  - **Build** | **Build Binary Package** - contains compiled Fortran, C, C++ code
- Reason is that Windows computers usually don't have compilers
- If just using **R** code, make it a source package
- If you are using Fortran, C, C++, create both types

Building the manual .pdf

- When the package is built, should also create the .pdf
- Must have LaTex installed
- For some reason, this doesn't work for me
  - have to do it manually
  - type in this command in the **R** console:

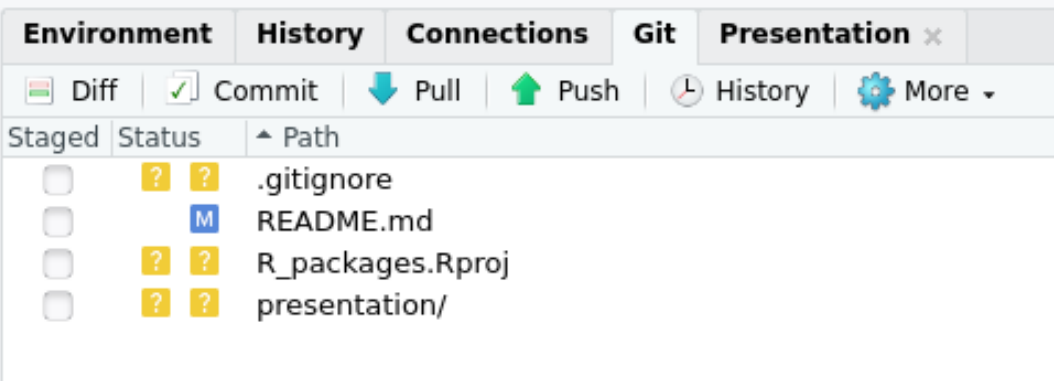
Copying an existing repository

- You can create a package by cloning an existing git repository
- **File|New Project** and select **Version Control**
- Works with GitHub - just enter the url
- Try this one: https://github.com/CentreForHydrology/WISKIr



Using git

- Every time you change your code, commit the changes to your git repository
- If you make a mistake, you can go back to an older version



Misc.

- Make sure you specify a licence for your code
  https://choosealicense.com/
- Don't forget to update the version number in DESCRIPTION
  - version $< 1.0.0$ – not ready for outside use
  - use major.minor.patch numbers
    https://semver.org/
- Remember to update the date in DESCRIPTION

Unit tests

- New feature, part of **devtools**
  - tests the results of functions
  - compares function outputs to known values
  - allows automated testing of functions