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PIFSC/ESD/ARP

# Codespaces for Open science

Everything you  
Need to Know to  
Get Started  
Today!

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2024-05-28



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# What are Codespaces?

# What are Codespaces?

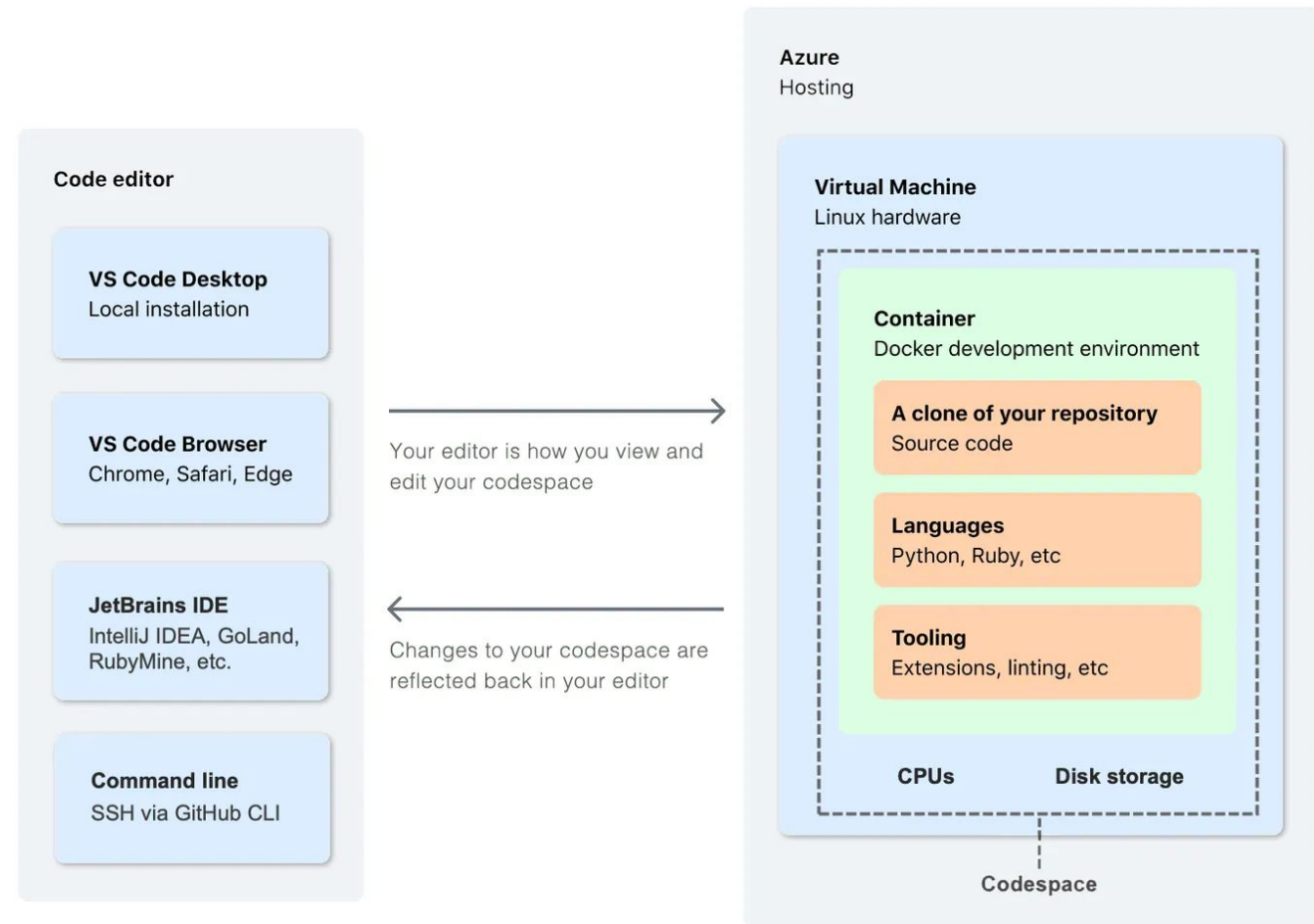
**Your Code**  + **Your Favorite Tools** 

**Your Code**  + **Your Favorite Tools**   
**In the Cloud** 

# The Details: Github Codespaces

## Cloud based environment

- Service by Github
- Connects to your Github Code Repository
- Runs on Virtual Machine in a containerized setup(using Docker)
- Fully customizable
  - from machine resources,
  - container setup,
  - access
  - & more



Link: <https://github.com/features/codespaces>

# The Details: Cost & Options

## Free & Paid Options Available

### Monthly included storage and core hours for personal accounts

The following storage and core hours of usage are included, free of charge, for personal accounts:

| Account plan                      | Storage per month | Core hours per month |
|-----------------------------------|-------------------|----------------------|
| GitHub Free for personal accounts | 15 GB-month       | 120                  |
| GitHub Pro                        | 20 GB-month       | 180                  |



Link: [About billing for GitHub Codespaces](#)



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# Why Codespaces?

The Benefits of Codespaces



# Github Codespaces: Benefits

## Benefits of GitHub Codespaces [↗](#)

Reasons for choosing to work in a codespace include:

- **Use a preconfigured development environment** - You can work in a development environment that has been specifically configured for the repository. It will have all of the tools, languages, and configurations you need to work on that project. Everyone who works on that repository in a codespace will have the same environment. This reduces the likelihood of environment-related problems occurring and being difficult to debug. Each repository can have settings that will give contributors a ready-to-use, fit-for-purpose environment, and the environment on your local machine will be unchanged.
- **Access the resources you need** - Your local computer may not have the processing power, or storage space, you need to work on a project. GitHub Codespaces allows you to work remotely on a machine with adequate resources.
- **Work anywhere** - All you need is a web browser. You can work in a codespace on your own computer, on a friend's laptop, or on a tablet. Open your codespace and pick up from where you left off on a different device.
- **Choose your editor** - Work in the browser in the VS Code web client, or choose from a selection of desktop-based applications.
- **Work on multiple projects** - You can use multiple codespaces to work on separate projects, or on different branches of the same repository, compartmentalizing your work to avoid changes made for one piece of work accidentally affecting something else you're working on.
- **Pair program with a teammate** - If you work on a codespace in VS Code, you can use Live Share to work collaboratively with other people on your team. For more information, see "[Working collaboratively in a codespace](#)."
- **Publish your web app from a codespace** - Forward a port from your codespace and then share the URL, to allow teammates to try out the changes you've made to the application before you submit those changes in a pull request.
- **Try out a framework** - GitHub Codespaces reduces the setup time when you want to learn a new framework. Just create a codespace from one of the [quickstart templates](#).

- Free
- Fast
- Quick to set up
- Simple to use
- Easy to collaborate
- Consistent
- Isolated (containerized)
- Full control of VM:
  - start, stop, restart, suspend-resume, delete, and so on
- And Great for Reproducibility
  - For Science/Research
  - Workshops
  - Dev/test environments
  - and more



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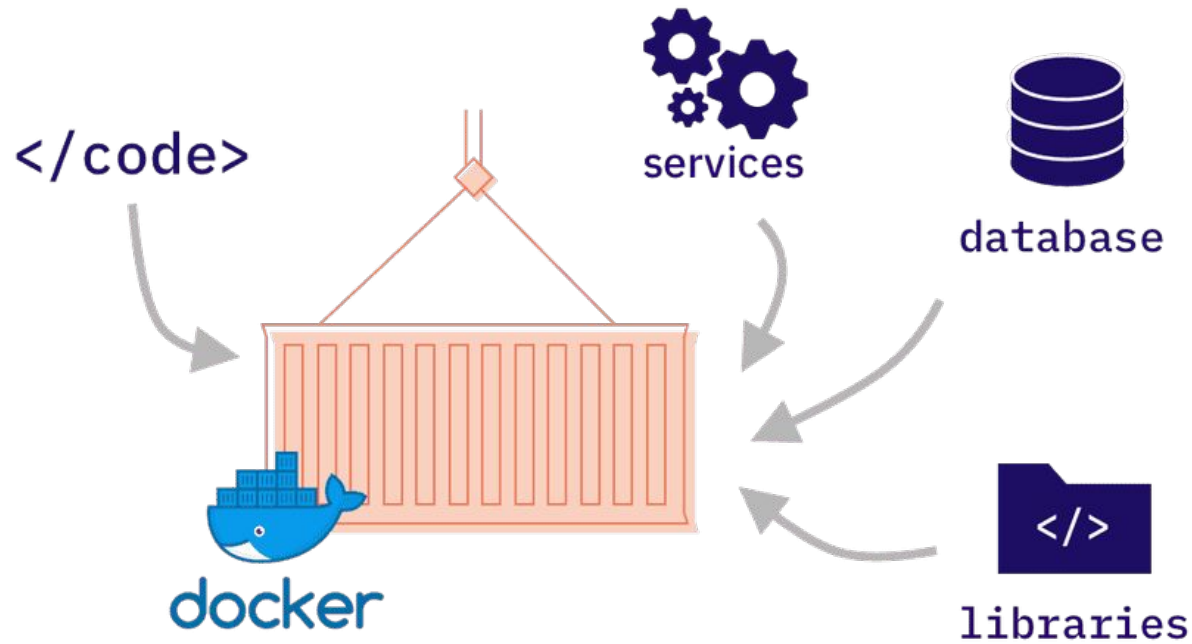
# How do Codespaces work?

*With the Magic of Containers!*



# What is a Container?

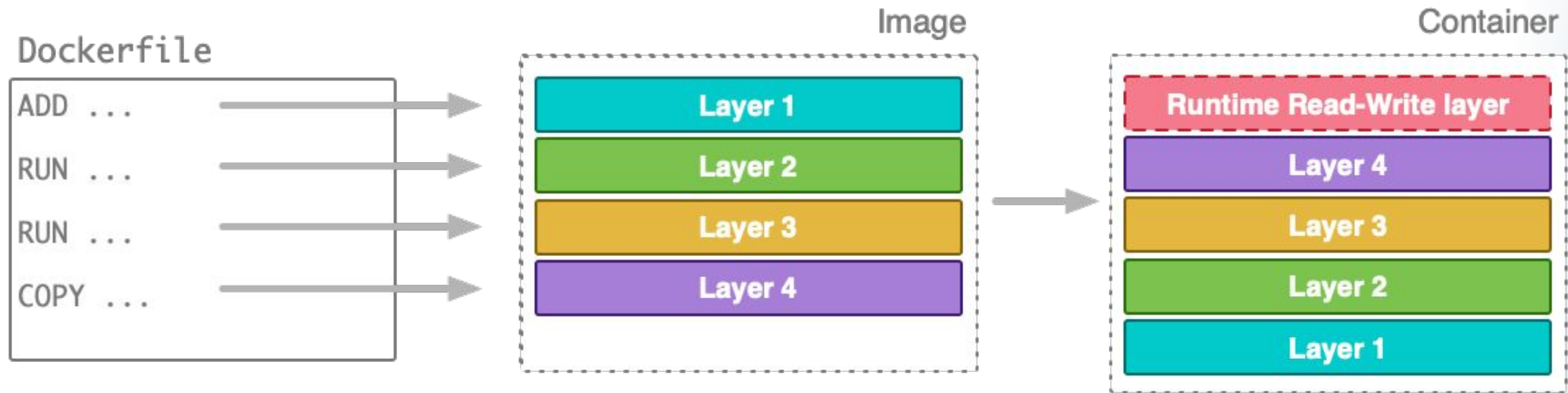
“lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings”



With Containers we have:

- Consistency
- Portability
- Scalability
- Resource efficiency
- Version control
- Collaboration
- Security

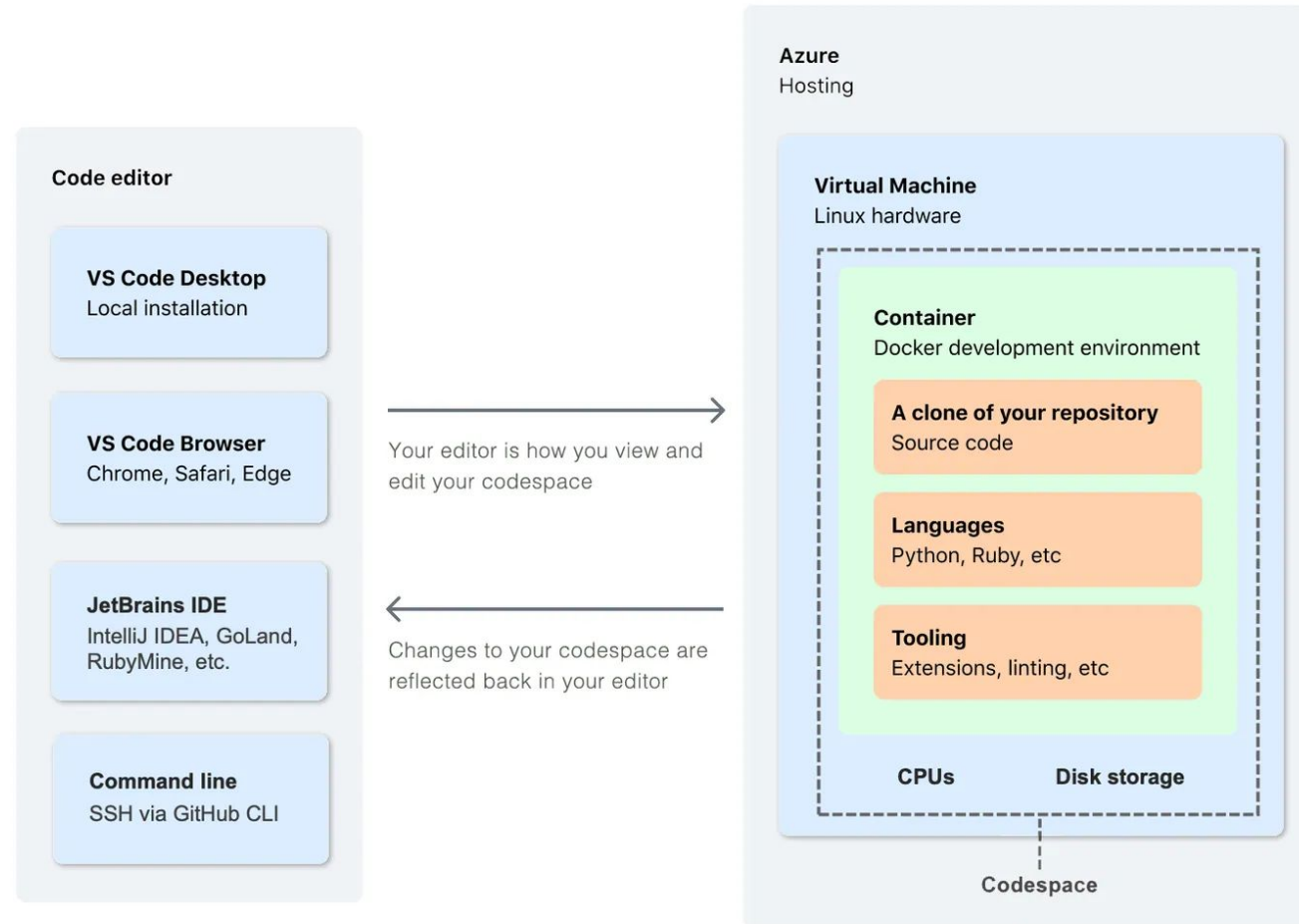
# Containers



# Github Codespaces: DevContainer

```
1  {
2    "name": "Kaleidocode",
3    "image": "ghcr.io/kaleideocode/dev_image:latest"
4
5    // Automatically forward ports for Express and MySQL
6    "forwardPorts": [3000, 3306],
7
8    "settings": {
9      "terminal.integrated.shell.linux": "/bin/bash"
10   },
11
12   // After setup, install deps from package.json
13   "postCreateCommand": npm install,
14
15
16   // Install and enable VS Code extensions
17   "extensions": [
18     "dbaeumer.vscode-eslint",
19     "mutantdino.resourcemonitor",
20     "GitHub.copilot"
21   ],
22
23 }
```

# Github Codespaces: The Details







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# Github Codespaces: Quickstart



# Codespaces Templates



## Choose a template



Start a codespace from a template and get to developing with the power of a virtual machine in the cloud.



**Blank**  
By github   
Start with a blank canvas or import any packages you need.  
[Use this template](#)



**React**  
By github   
A popular JavaScript library for building user interfaces based on UI components.  
[Use this template](#)



**.NET**  
By github   
A full-stack web application template written in C# leveraging the power of .NET 8.  
[Use this template](#)



**Ruby on Rails**  
By github   
A full-stack web framework for building dynamic websites that deliver a rich user experience.  
[Use this template](#)



**Jupyter Notebook**  
By github   
JupyterLab is the latest web-based interactive development environment for notebooks, code, and data.  
[Use this template](#)

**Express**  
By github   
Express is a minimal and flexible Node.js web application framework.  
[Use this template](#)

**Next.js**  
By github   
Next.js is a React framework that gives you building blocks to create web applications.  
[Use this template](#)

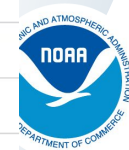
**Django**  
By github   
Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design.  
[Use this template](#)

**Flask**  
By github   
Flask is a lightweight web application framework.  
[Use this template](#)

**Preact**  
By github   
A fast 3kB alternative to React with the same modern API.  
[Use this template](#)

- docker-existing-docker-compose
- docker-existing-dockerfile
- docker-in-docker
- docker-outside-of-docker-compose
- docker-outside-of-docker
- dotnet-fsharp
- dotnet-mssql
- dotnet-postgres
- dotnet
- go-postgres
- go
- java-postgres
- java
- javascript-node-mongo
- javascript-node-postgres
- javascript-node
- jekyll
- kubernetes-helm-minikube
- kubernetes-helm
- markdown
- miniconda-postgres
- miniconda
- php-mariadb
- php
- postgres
- python-shell

Links: <https://github.com/codespaces>  
<https://github.com/codespaces/templates>



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# Open Science Codespaces: Templates



## Open Science Codespaces

Quick & Easy Cloud Working Environments(Codespaces).  
This repo setups Github Codespaces for R/RStudio,  
python and more. These can be used for

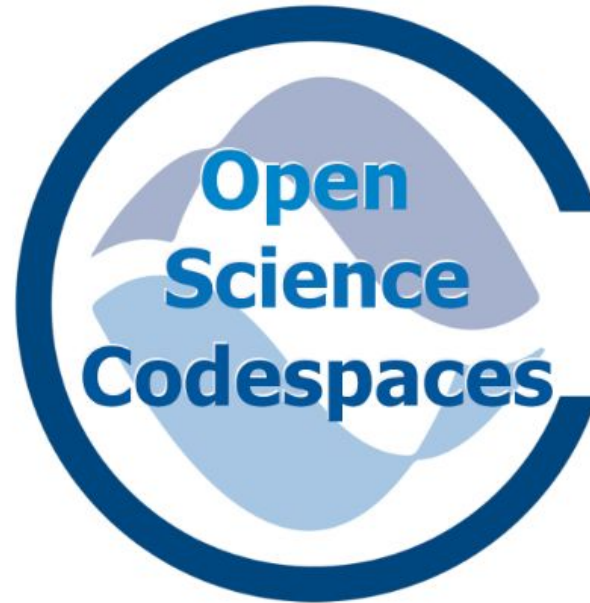
- Reproducible Science Setups
- Workshops
- Portable Development
- and more!

### Contact

- [Michael.Akridge@noaa.gov](mailto:Michael.Akridge@noaa.gov)

### List of Codespaces

1. [R Codespaces](#)
  - RStudio
  - Tidyverse
  - Verse
  - Geospatial
  - Shiny Server
  - [Environmental Data Summary \(EDS\) Codespace](#)
2. [Python Codespaces](#)
  - [Python Streamlit App Example | Data Explorer & Viz Tool](#)
  - [Other Python Codespaces](#)
3. [Resources, Links & More Info](#)



Link: <https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces>








# Open Science Codespace Templates



## R Codespaces

Just click the button below to quickly start a codespace:

| Codespace            | QuickStart Link   | Description  |
|----------------------|---|--|
| RStudio              |  <a href="#">Open in GitHub Codespaces</a>   | Adds RStudio Server. Install R from source and set RSPM as default CRAN mirror |
| RStudio Tidyverse    |  <a href="#">Open in GitHub Codespaces</a>   | Adds tidyverse packages & devtools. R packages for data science                |
| RStudio Verse        |  <a href="#">Open in GitHub Codespaces</a>   | Adds tex & publishing-related package to tidyverse                             |
| RStudio Geospatial   |  <a href="#">Open in GitHub Codespaces</a>   | Adds geospatial packages   |
| RStudio Shiny Server |  <a href="#">Open in GitHub Codespaces</a> | Adds shiny server  |

Link: <https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces>



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# Github Codespaces Walkthrough & Demo

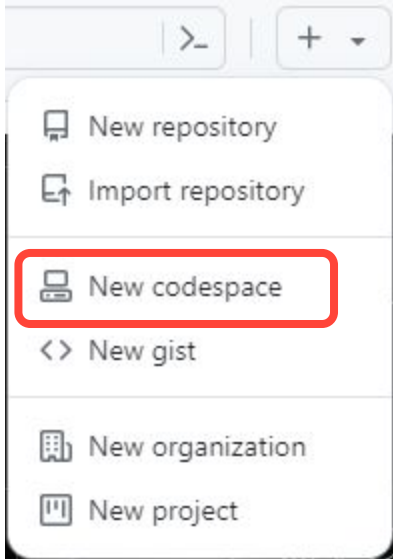
# Github Codespaces Walkthrough: How to Demo

- How to create a codespace
- How to start/stop a codespace
- How to check your codespace usage
- How to add/install packages to your R Codespaces
- How to add a codespace to an existing project
- and more!

Link: <https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces>




# How to Create a Codespace




## Create a new codespace

**Repository**  
To be cloned into your codespace

MichaelAkridge-N... ▼

 Codespace usage for this repository is paid for by MichaelAkridge-NOAA.

**Branch**  
This branch will be checked out on creation

 main ▼

**Dev container configuration**  
Your codespace will use this configuration

RStudio Codespace  
.devcontainer/rstudio/devcontainer.json ▼

**Region**  
Your codespace will run in the selected region

US West ▼

**Machine type**  
Resources for your codespace

2-core ▼

**Create codespace**



Setting up your codespace



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# How to Stop/Start/Delete Codespace

<https://github.com/codespaces>

Owned by MichaelAkridge-NOAA

Created from [MichaelAkridge-NOAA/Open-Science-Codespaces](#)  
friendly robot

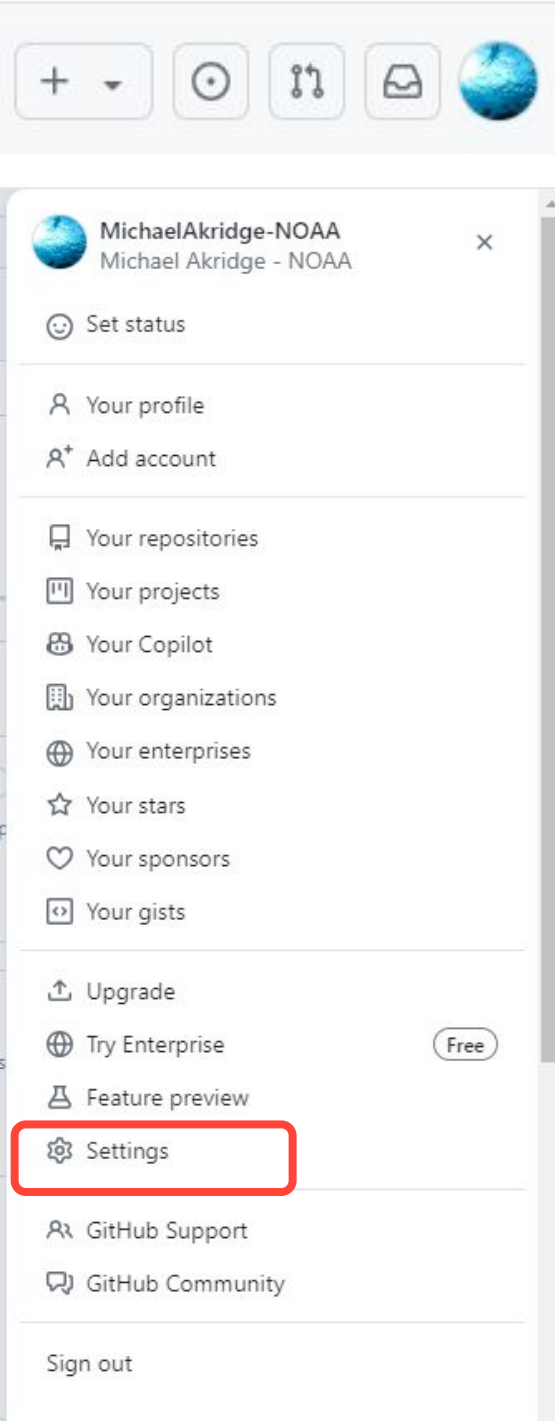
2-core • Retrieving... • Active

- Rename
- Publish to a new repository
- Change machine type
- Stop codespace
- Auto-delete codespace ✓
- Open in Browser
- Open in Visual Studio Code
- Open in JetBrains Gateway Beta
- Open in JupyterLab Beta
- Delete








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# How to Check Your Usage



 **Michael Akridge - NOAA** (  
Your personal account

-  Public profile
-  Account
-  Appearance
-  Accessibility
-  Notifications

Access

 **Billing and plans**

 **Plans and usage**

Spending limits

Payment information



**Codespaces**

Included quotas reset in 7 days. [See billing documentation](#)



**Usage hours**

2.10 of 120.00 included core hours used

\$0.00



**Storage**

0.01 of 15.00 included GB-month used

\$0.00

\$0.00 monthly spending limit | [Set up a spending limit](#)

\$0.00



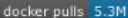

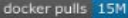
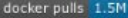
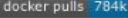
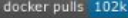





# How to Add/Install Packages to your R Codespace

If possible, Use or Create an Image with Packages Already Installed

<https://rocker-project.org/images/>






## 2 Images

### 2.1 The versioned stack

| image                              | base image                        | description   | pulls   |
|------------------------------------|-----------------------------------|---|---|
| <a href="#">rocker/r-ver</a>       | <a href="#">ubuntu</a>            | Install R from source and set RSPM as default CRAN mirror             |  5.3M   |
| <a href="#">rocker/rstudio</a>     | <a href="#">rocker/r-ver</a>      | Adds RStudio Server   |  26M    |
| <a href="#">rocker/tidyverse</a>   | <a href="#">rocker/rstudio</a>    | Adds tidyverse packages & devtools                                    |  15M    |
| <a href="#">rocker/verse</a>       | <a href="#">rocker/tidyverse</a>  | Adds tex & publishing-related package                                 |  1.5M   |
| <a href="#">rocker/geospatial</a>  | <a href="#">rocker/verse</a>      | Adds geospatial packages  |  784k   |
| <a href="#">rocker/binder</a>      | <a href="#">rocker/geospatial</a> | Adds requirements to run repositories on <a href="#">mybinder.org</a> |  102k |
| <a href="#">rocker/shiny</a>       | <a href="#">rocker/r-ver</a>      | Adds shiny server   |  3M   |
| <a href="#">rocker/shiny-verse</a> | <a href="#">rocker/shiny</a>      | Adds tidyverse packages   |  1.1M |
| <a href="#">rocker/cuda</a>        | <a href="#">rocker/r-ver</a>      | Adds CUDA support to <a href="#">rocker/r-ver</a>                     |  43k  |
| <a href="#">rocker/ml</a>          | <a href="#">rocker/cuda</a>       | Adds CUDA support to <a href="#">rocker/tidyverse</a>                 |  71k  |
| <a href="#">rocker/ml-verse</a>    | <a href="#">rocker/ml</a>         | Adds CUDA support to <a href="#">rocker/geospatial</a>                |  42k  |

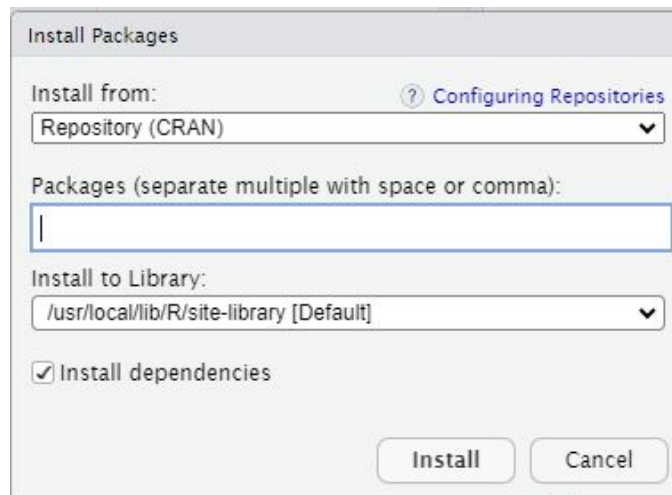
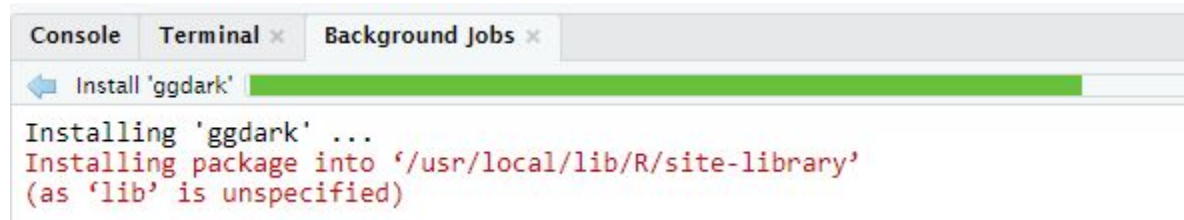
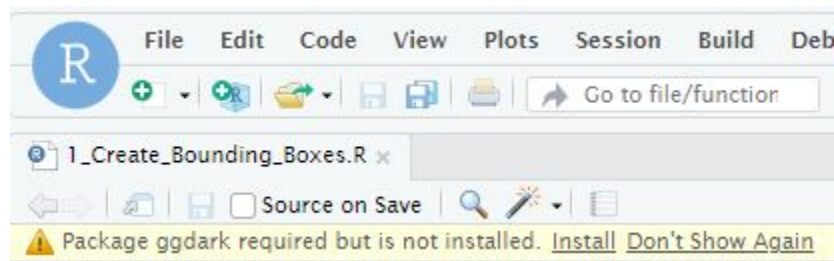
## R Codespaces

Just click the button below to quickly start a codespace:

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| RStudio Verse        |  <a href="#">Open in GitHub Codespaces</a>   | Adds tex & publishing-related package to tidyverse                             |
| RStudio Geospatial   |  <a href="#">Open in GitHub Codespaces</a>   | Adds geospatial packages   |
| RStudio Shiny Server |  <a href="#">Open in GitHub Codespaces</a> | Adds shiny server  |

# How to Add/Install Packages to your R Codespace

## Example 00: Via RStudio in the Codespace as normal



The screenshot shows the RStudio 'Packages' pane. It displays a list of installed and available packages. The 'base' package is checked, indicating it is installed. The 'ggdark' package is not listed, suggesting it is not installed.

| Name                                     | Description   | Version  |
|--|---|----------|
| <b>System Library</b>                    |   |          |
| <input type="checkbox"/> abind           | Combine Multidimensional Arrays                                     | 1.4-5    |
| <input type="checkbox"/> arrow           | Integration to 'Apache' 'Arrow'                                     | 15.0.1   |
| <input type="checkbox"/> askpass         | Password Entry Utilities for R, Git, and SSH                        | 1.2.0    |
| <input type="checkbox"/> assertthat      | Easy Pre and Post Assertions  | 0.2.1    |
| <input type="checkbox"/> backports       | Reimplementations of Functions Introduced Since R-3.0.0             | 1.4.1    |
| <input checked="" type="checkbox"/> base | The R Base Package  | 4.4.0    |
| <input type="checkbox"/> base64enc       | Tools for base64 encoding   | 0.1-3    |
| <input type="checkbox"/> BH              | Boost C++ Header Files  | 1.84.0-0 |
| <input type="checkbox"/> BiocManager     | Access the Bioconductor Project Package Repository                  | 1.30.23  |
| <input type="checkbox"/> BiocVersion     | Set the appropriate version of Bioconductor packages                | 3.19.1   |
| <input type="checkbox"/> bit             | Classes and Methods for Fast Memory-Efficient Boolean Selections    | 4.0.5    |
| <input type="checkbox"/> bit64           | A S3 Class for Vectors of 64bit Integers                            | 4.0.5    |
| <input type="checkbox"/> blob            | A Simple S3 Class for Representing Vectors of Binary Data ('BLOBS') | 1.2.4    |
| <input type="checkbox"/> blogdown        | Create Blogs and Websites with R Markdown                           | 1.19     |
| <input type="checkbox"/> bookdown        | Authoring Books and Technical Documents with R Markdown             | 0.39     |
| <input type="checkbox"/> boot            | Bootstrap Functions (Originally by Angelo Canty for S)              | 1.3-30   |
| <input type="checkbox"/> brew            | Templating Framework for Report Generation                          | 1.0-10   |
| <input type="checkbox"/> brio            | Basic R Input Output  | 1.1.5    |
| <input type="checkbox"/> broom           | Convert Statistical Objects into Tidy Tibbles                       | 1.0.5    |
| <input type="checkbox"/> bslib           | Custom 'Bootstrap' 'Sass' Themes for 'shiny' and 'rmarkdown'        | 0.7.0    |
| <input type="checkbox"/> cachem          | Cache R Objects with Automatic Pruning                              | 1.0.8    |
| <input type="checkbox"/> callr           | Call R from R   | 3.7.6    |
| <input type="checkbox"/> cellranger      | Translate Spreadsheet Cell Ranges to Rows and Columns               | 1.1.0    |

# How to Add/Install Packages to your R Codespace

Example 01: Add to them to your Devcontainer File via Features

```
// Features to be used in the dev container
"features": {
  "ghcr.io/rocker-org/devcontainer-features/r-packages:1": {
    "packages": "cli, rlang, tidyverse, devtools, data.table, ggplot2,
dplyr, shiny, rmarkdown, knitr, testthat, roxygen2, plotly",
    "installSystemRequirements": true
  }
}
```

**'Features'** are self-contained units of installation code and development container configuration. Features are designed to install atop a wide-range of base container images.



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# How to Add/Install Packages to your R Codespace

Example 02: Extend an Image & Add them to your Dockerfile

```
# Install R packages needed for basic setup
```

```
RUN R -e "install.packages(c('plotly', 'reticulate'), dependencies =  
TRUE)"
```

**Dockerfile** is a text document containing all the commands required to assemble an image.



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# How to Add/Install Packages to your R Codespace

Example 02a: Add them to your Dockerfile via an install.R script

## #Add to Docker File

# Copy install.R file to the Docker image

**COPY** `install.R` /usr/local/bin/install.R

# Install R packages using the install.R script

**RUN** `Rscript` /usr/local/bin/install.R

## # Example install.R File

`list.of.packages` <- c("plotly", "reticulate")

`install.packages(list.of.packages)`

**Dockerfile** is a text document containing all the commands required to assemble an image.



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# How to Add/Install Packages to your R Codespace

And more! Use whatever best fits your workflow and project

**Renv:** The renv package helps you create reproducible environments for your R projects.

## # Using 'renv' - install.R File

```
install.packages("renv")
renv::init()
renv::install(c("plotly", "reticulate"))
renv::snapshot()
```

<https://rstudio.github.io/renv/articles/renv.html>


**Pak:** A Fresh Approach to R Package Installation

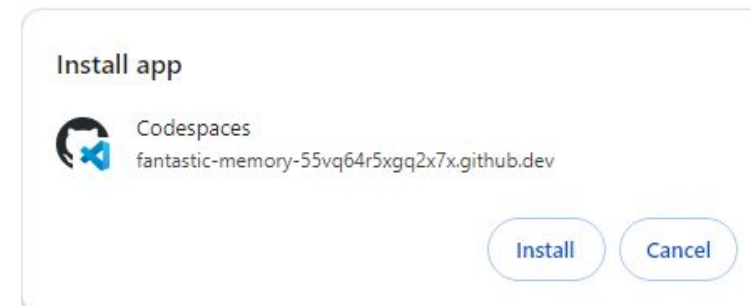
## # Using 'pak' - install.R File

```
install.packages("pak")
pak::pkg_install(c("plotly", "reticulate"))
```

<https://pak.r-lib.org/>

# Github Codespaces: Tips & Tricks

- Starting with a good base image will save start(build) time
- A codespace will automatically stop after 30mins of inactivity to save resources. It can be restarted at any point
- You can pre-build a codespace for faster startup for users (but takes up storage)
- To use a cloud codespace locally there is a VS code extension (<https://marketplace.visualstudio.com/items?itemName=GitHub.codespaces>)
- For shiny & other app testing, you can open up ports to the public to share with testers
- You can install a desktop shortcut to your codespace. click -> 



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# Thanks! Questions?

## More info:

- <https://github.com/features/codespaces>
- [GitHub Codespaces overview](#)

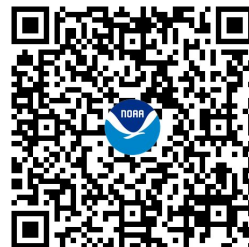
## Helpful Links:

- [GitHub Codespace Templates](#)
- <https://github.com/devcontainers>
- [Awesome-devcontainers](#)
- [rocker-project.org](https://rocker-project.org)

## Get Started Today!



Open in GitHub Codespaces



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