

# Automated Testing in MPAS and WRF Models

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In collaboration with the JEDI (Joint Effort for Data assimilation Integration) team

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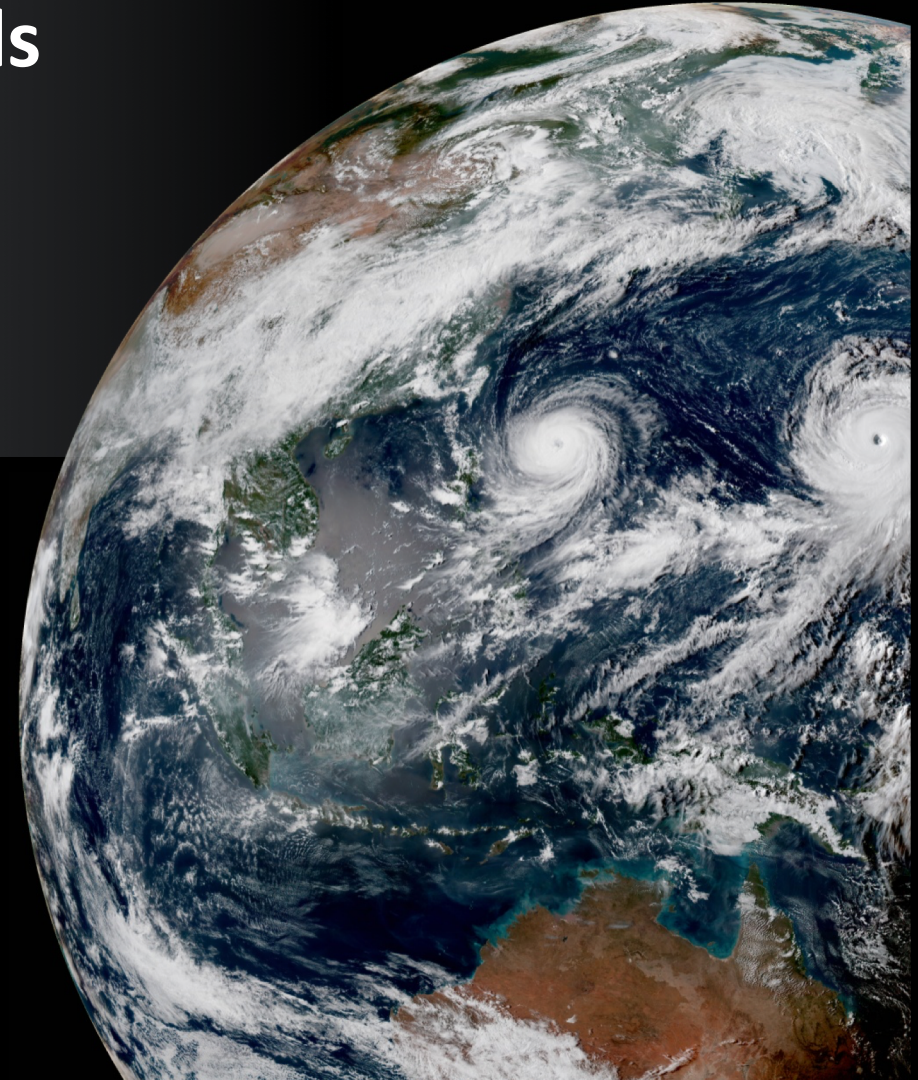


mer-a-o



@maryamabdi7

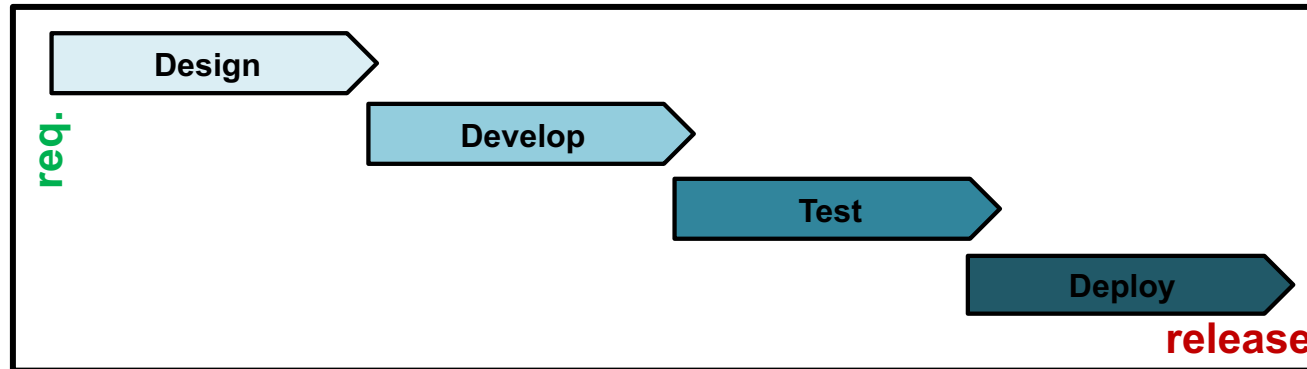
WRF/MPAS Workshop, June 11<sup>th</sup>, 2019



# Agile methodology enables the key stakeholders and developers to collaborate more closely to accelerate delivery

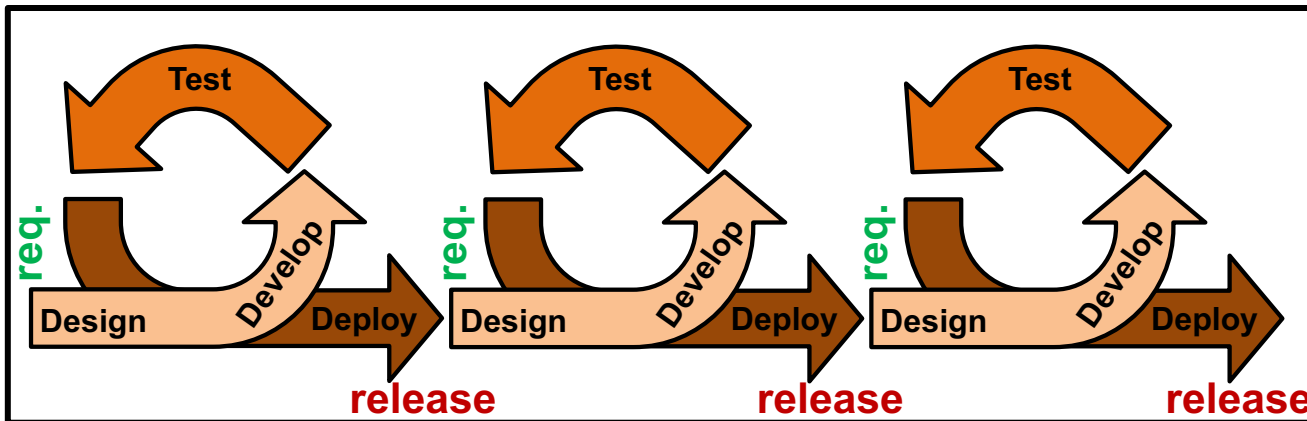


## Waterfall



- Not ideal for large size projects
- Requirements and goals may become irrelevant
- Bug fix can be expensive

## Agile

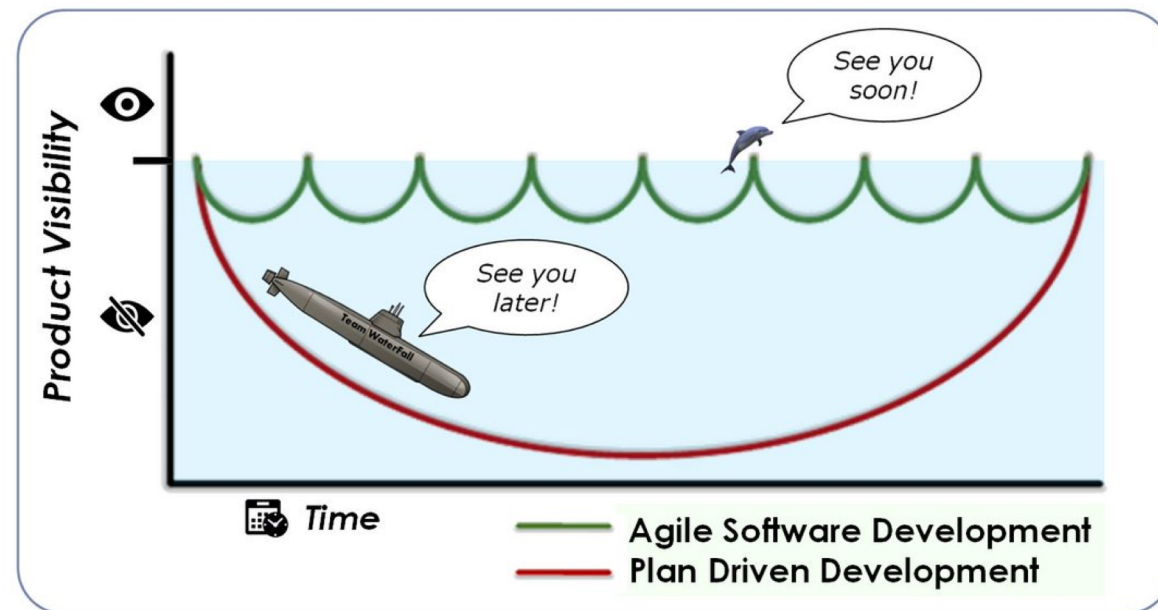


- Iterative development
- Requirements and solutions evolve through collaboration between teams
- Always have a system that works



# Agile in scientific programming: Make incremental changes

- In scientific programming the requirements can change based on the results from the previous increment :  
*“Scientists can’t know what their programs should do next until the current version has produced some results.”\**
- **Separation of concerns:** Developing code in small increments with frequent feedback and course correction
- Increase efficiency, reusability, and reproducibility



## Useful tools:

- Version Control Systems (VCS) – GitHub, GitLab, ...
- Testing framework – Travis-CI, Jenkins, Bamboo
- Containers - Docker, Charliecloud, Singularity



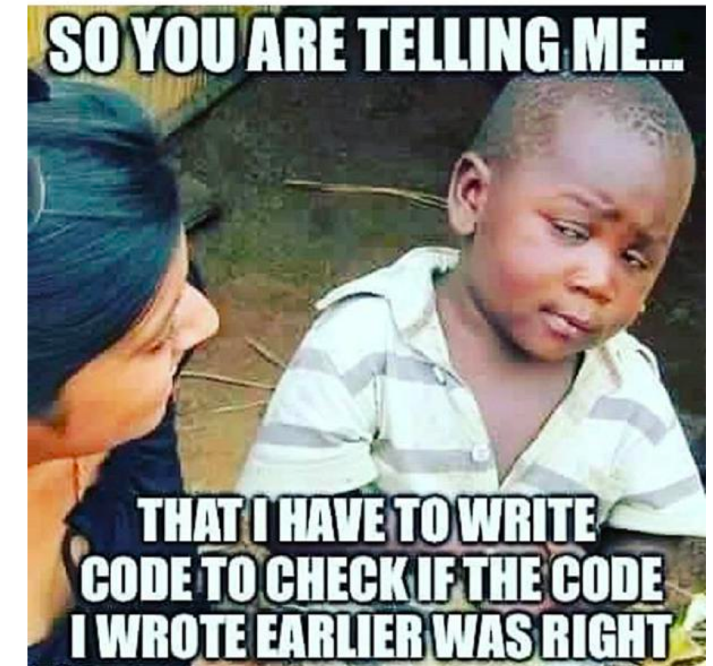
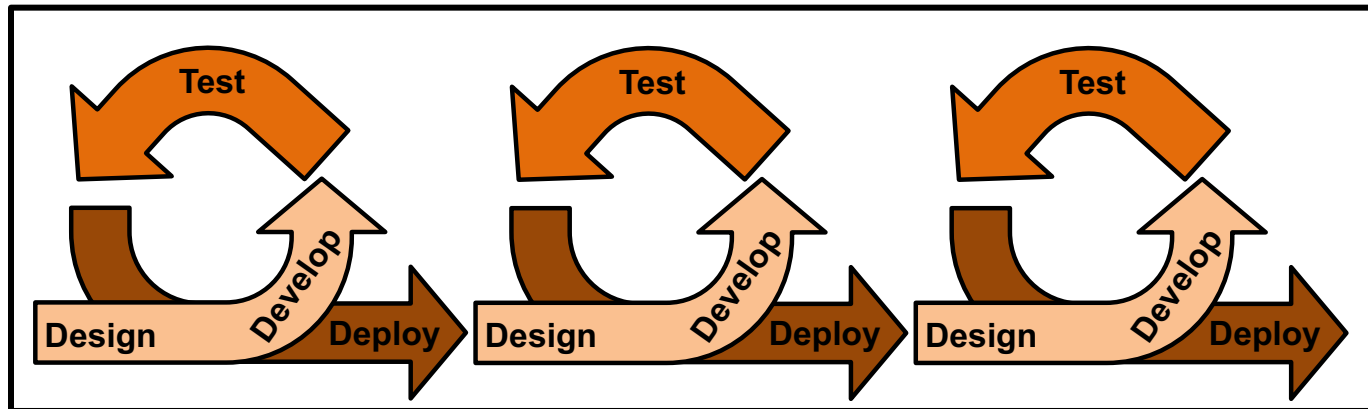
\* Wilson G, et al. Best practices for scientific computing. PLoS Biol. ;12(1):e1001745. doi:10.1371/journal.pbio.1001745

# Testing is one of the key components of Agile methodology



Agile testing:

- Continuous process and receive feedback in each iteration
- Easier to review
- Issues are fixed within the same iteration

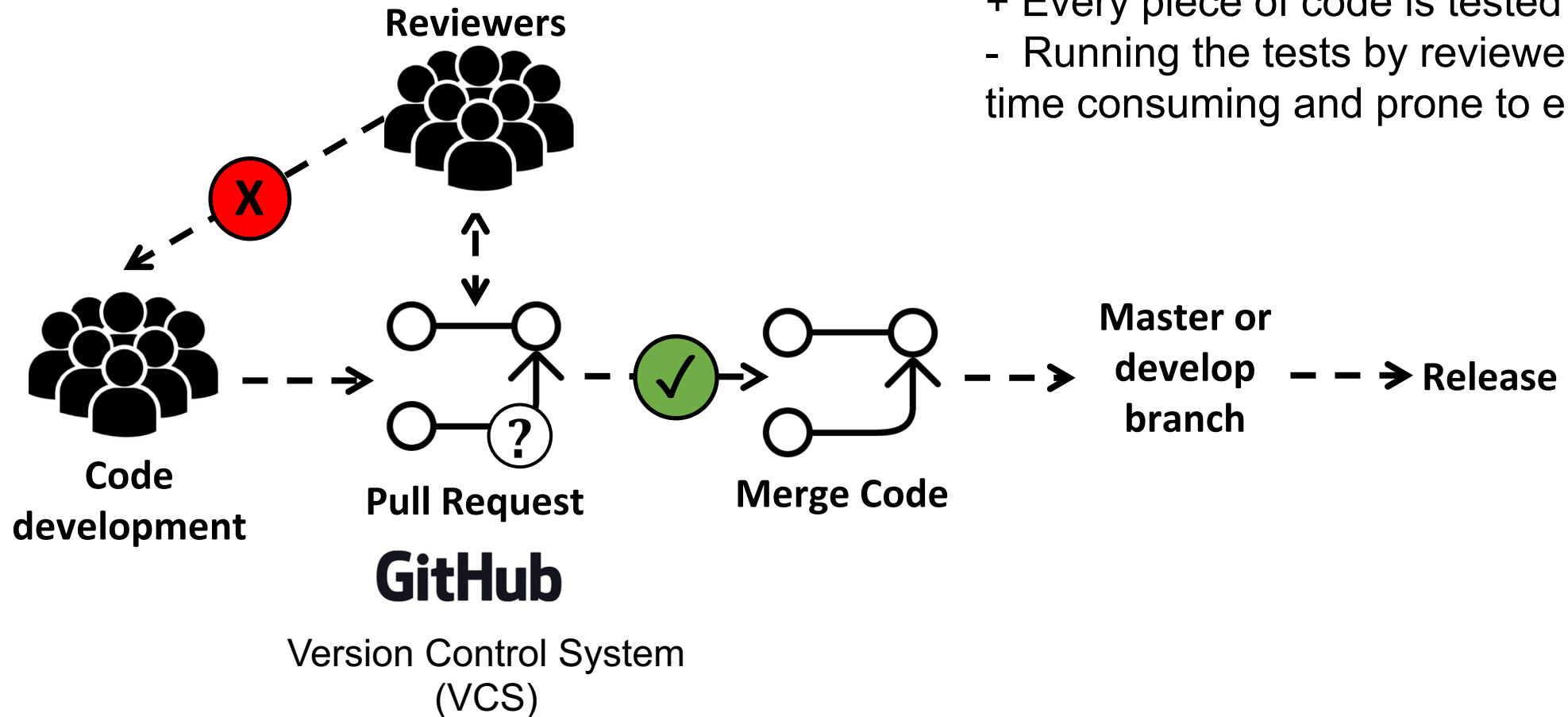


Types of tests:

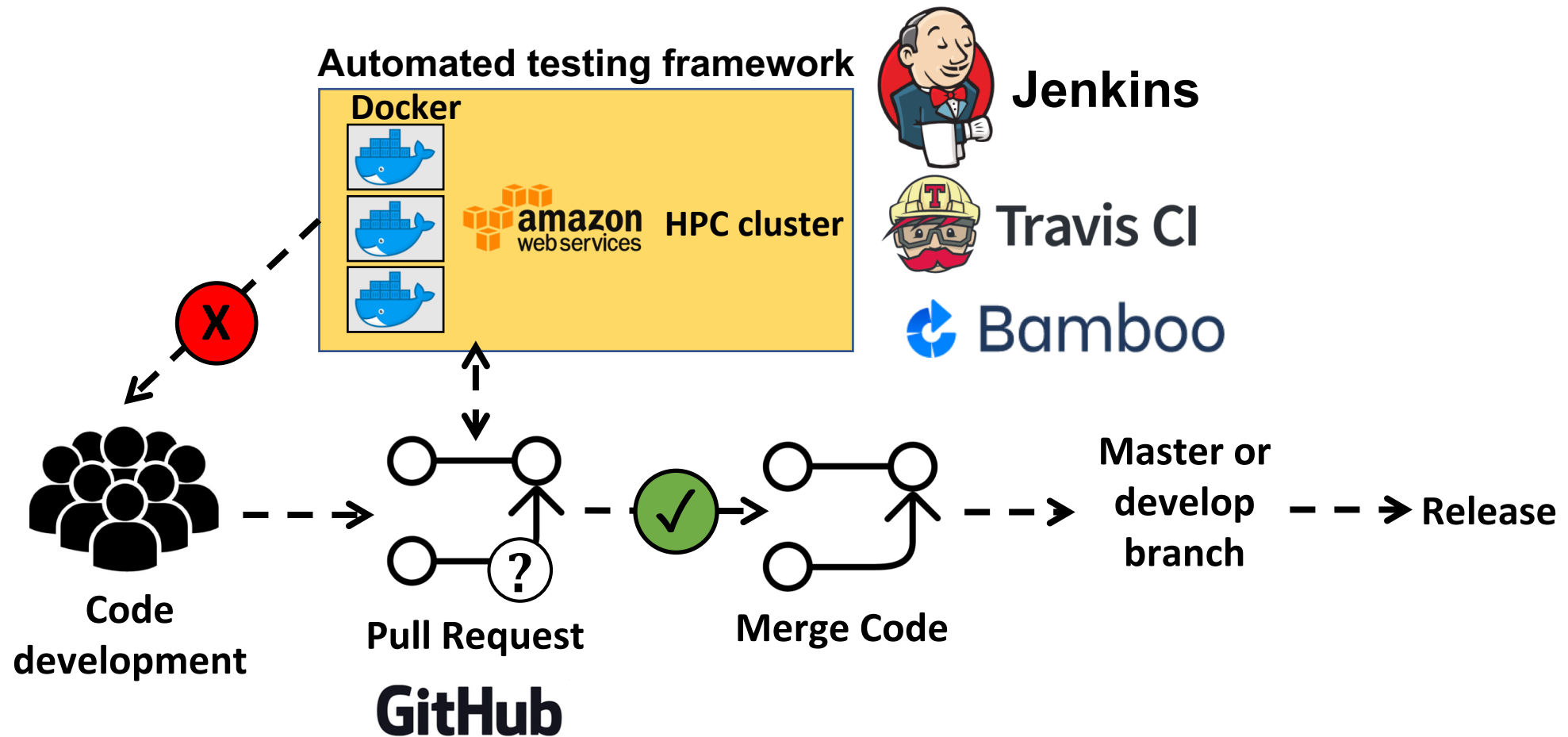
1. Unit tests (test each component) : is input correct? is the answer close to a known answer?, ...
2. Application tests (test the whole system)



# Testing Workflow



# Automated Testing Workflow

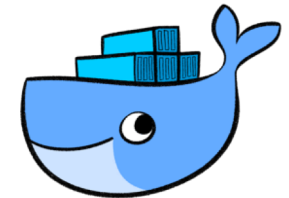
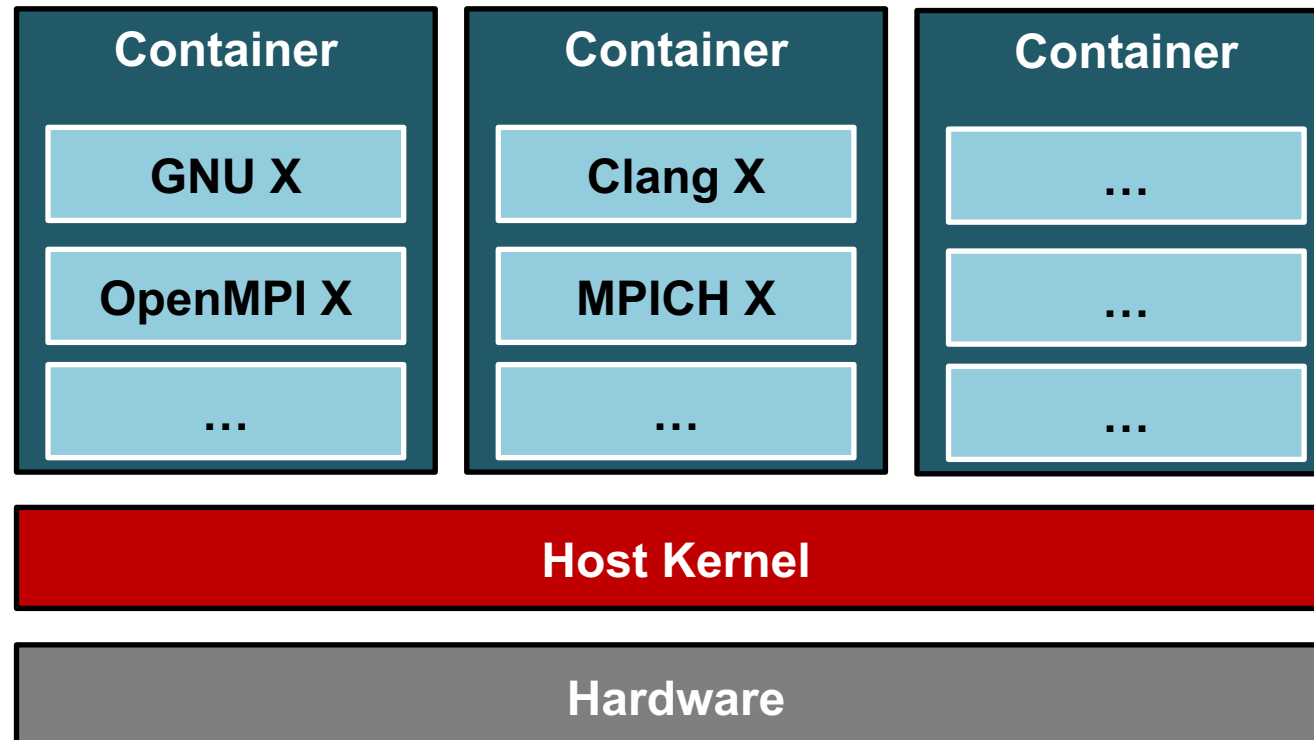




# Containers: A packaged user environment that can be “uppacked” and used across different systems, from laptops to cloud to HPC



- Standardized packaging for software and dependencies
- Build and test across multiple platforms
- Increase portability and reusability of the code



Docker

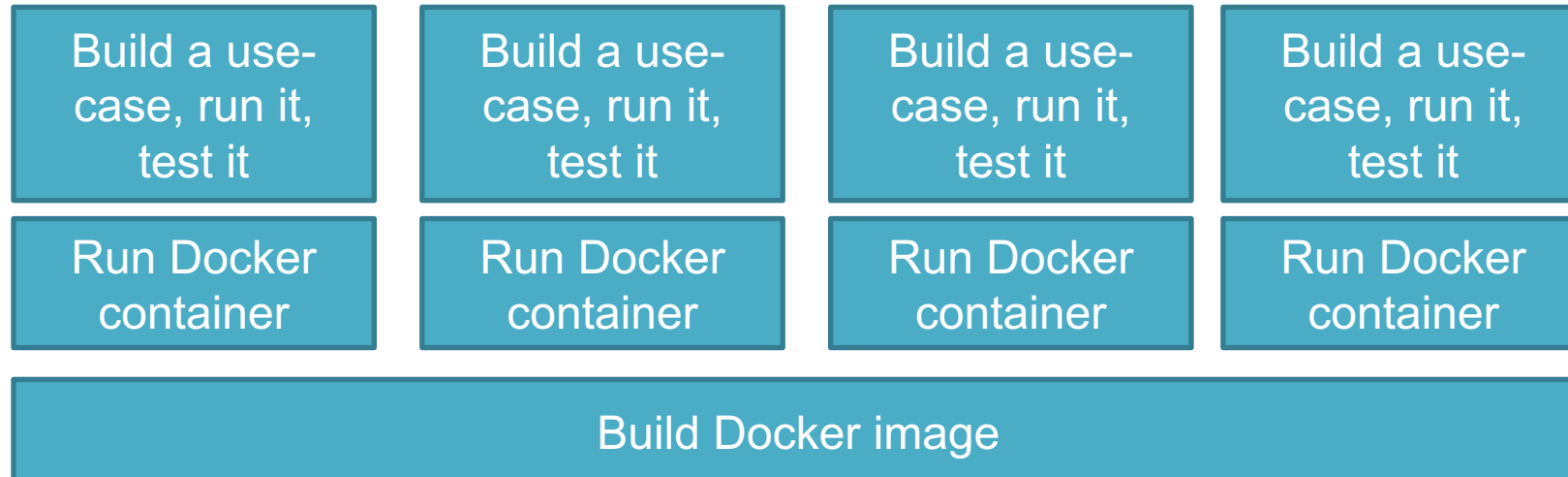


Charliecloud

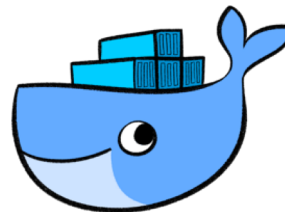


Singularity

# With Docker containers we can test different use-cases in parallel

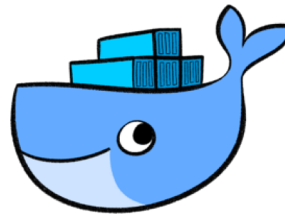
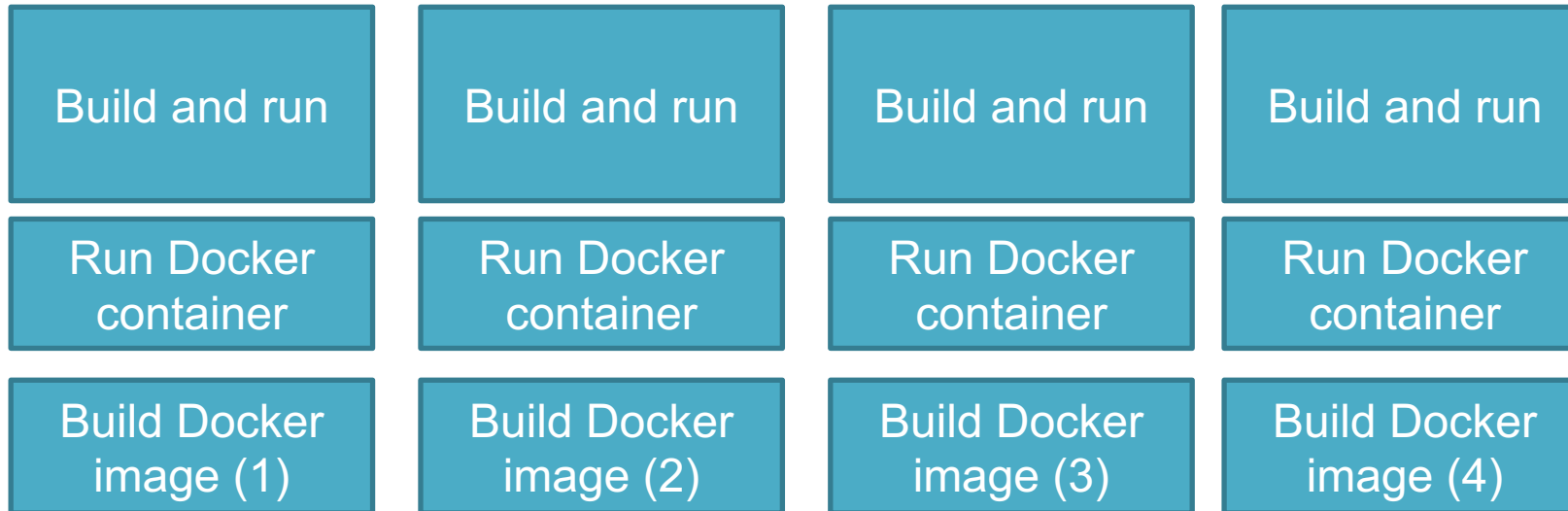


Examples of use-cases:  
NMM  
Chem  
Ideal: QSS  
Ideal: B Wave  
EM real  
Moving Nest





# With Docker containers we can test different builds and software versions



# Example of Travis-CI interface in JEDI



JCSDA / **oops** / **oops** Private

Unwatch 29

Star 0

Fork 2

Code

Issues 26

**Pull requests 7**

ZenHub

Security

Insights

Filters

is:pr is:open

Labels 8

Milestones 2

New pull request

7 Open 190 Closed

Author

Labels

Milestones

Reviews

Assignee

Sort

☐ New QG geometry 

#273 opened 2 days ago by benjaminmenetrier • Review required Review/QA

1

☐ More informative error messages for L95 model file I/O errors 

#272 opened 5 days ago by markjolah • Review required Review/QA

1

☐ Feature/remove ens linearize 

#270 opened 6 days ago by shlyaeva • Approved Review/QA

6

☐ Feature/remove obsop observed 

#269 opened 6 days ago by shlyaeva • Draft

3

☐ Updated compare script and toy-model tests 

#264 opened 7 days ago by benjaminmenetrier • Approved Review/QA

7



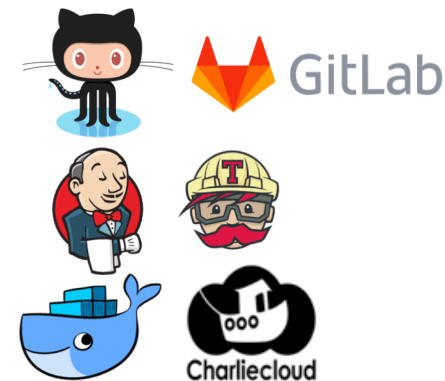
# Summary



- Scientific community can benefit from Agile methodology; increase efficiency, reusability, and reproducibility
- **Separation of concerns:** Developing code in small increments with frequent feedback (testing) and course correction

## Useful tools:

- Version Control Systems (VCS) – GitHub, GitLab, ...
- Testing framework – Travis-CI, Jenkins, Bamboo
- Containers - Docker, Charliecloud, Singularity



# Extra





### Review required

At least 1 approving review is required by reviewers with write access. [Learn more.](#)

[Add your review](#)



### All checks have passed

3 successful checks

[Hide all checks](#)



**Travis CI - Pull Request** Successful in 21m — Build Passed

Required

[Details](#)



**codecov/patch** — 100% of diff hit (target 68.32%)

[Details](#)



**codecov/project** — 68.32% (+0%) compared to 8ffacbe

[Details](#)



# JCSDA / oops



build

passing

Current

Branches

Build History

Pull Requests

✓ PR #273

New QG geometry



benjaminmenetrier

🔗 #154 passed

🔗 7ccc7b9

✓ PR #273

New QG geometry



benjaminmenetrier

🔗 #152 passed

🔗 433168e

✓ PR #272

More informative error messages for L95 model fil



Mark J Olah

🔗 #149 passed

🔗 23a2e5c



Current

Branches

Build History

Pull Requests

Build #154

More options



**Pull Request #273** New QG geometry



#154 passed



Restart build

🔗 Commit 7ccc7b9

🔗 #273: New QG geometry

🔗 Branch develop

🕒 Ran for 20 min 31 sec

📅 2 days ago



Debug build

👤 benjaminmenetrier



Compiler: gcc C++

[Job log](#)

[View config](#)

✕ Remove log

📄 Raw log

```
1 Worker information
6 Build system information
413
414 docker stop/waiting
416 resolvconf stop/waiting
418 Adding APT Sources
590 $ sudo service docker start
592 Installing SSH key from: default repository key
594 Using /home/travis/.netrc to clone repository.
```

worker\_info

system\_info

docker\_mtu

resolvconf

apt

services

ssh\_key

0.02s





JCSDA



JCSDA

Repositories

Insights



APRIL 30, 2019 - MAY 29, 2019

View:

public and private builds

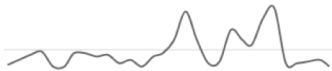


Week

Month

TOTAL BUILDS

266



TOTAL JOB MINUTES

4,294 mins



AVERAGE QUEUE TIME

1.14 mins

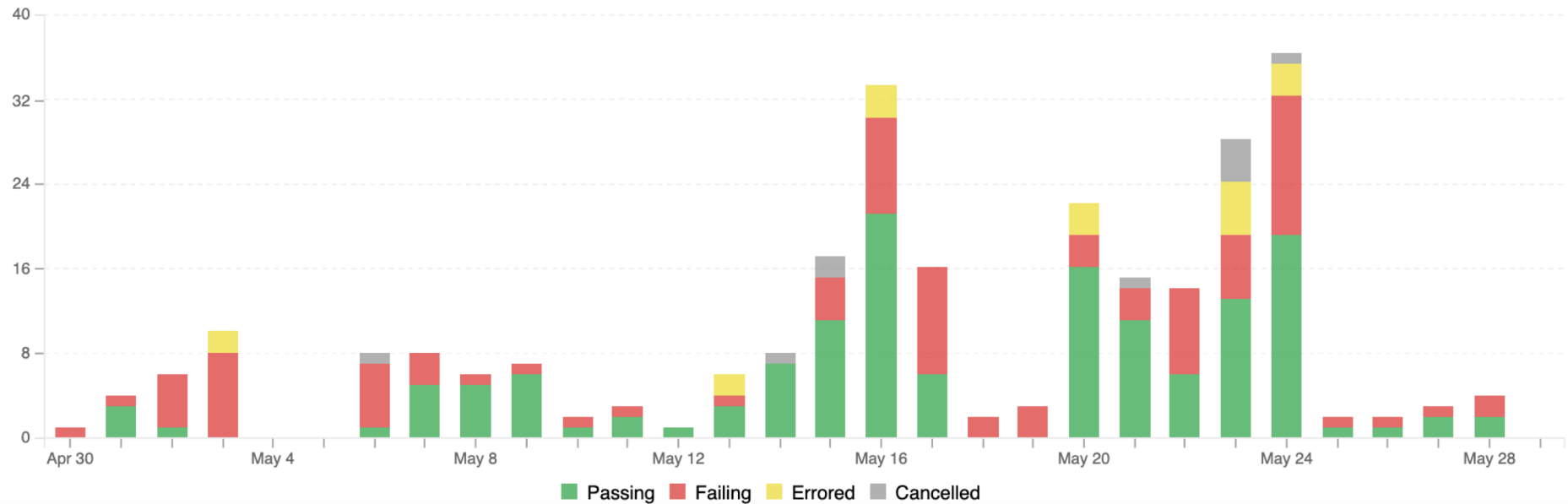


ACTIVE REPOSITORIES

5



### Build Statuses



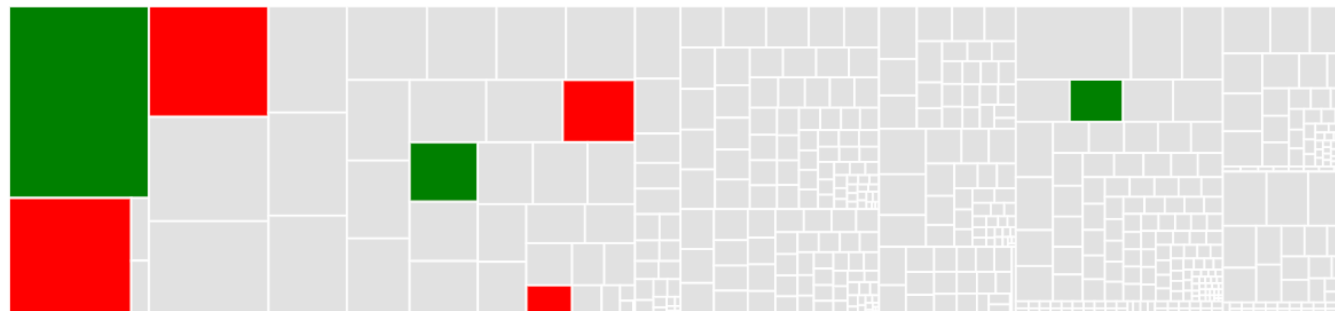


mer-a-o commented 2 days ago • edited ▾

+ 😊 ...

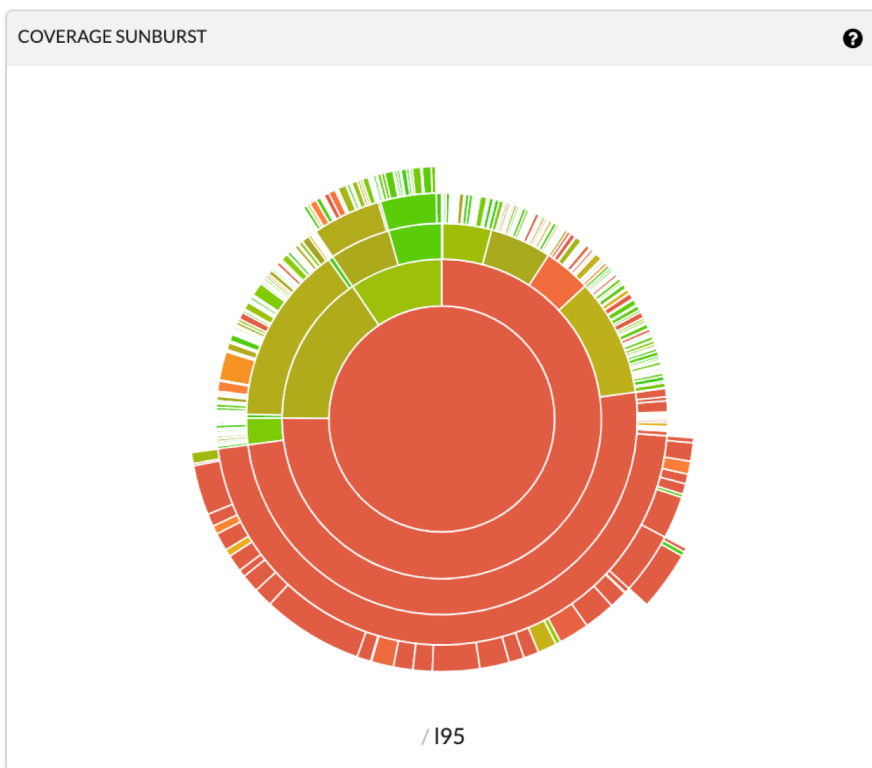
## Codecov Report

Merging [#273](#) into [develop](#) will decrease coverage by `0.01%`.  
The diff coverage is `n/a`.



@@	Coverage Diff			@@
##	develop	#273	+/-	##
=====				
- Coverage	68.32%	68.31%	-0.02%	
=====				
Files	513	513		
Lines	32218	32201	-17	
=====				
- Hits	22014	21999	-15	
+ Misses	10204	10202	-2	

Impacted Files	Coverage Δ	
<a href="#">qq/model/qq_obsdb_mod.F90</a>	95.51% <0> (-0.25%)	⬇
<a href="#">src/oops/generic/bump/tools_fit.F90</a>	67.28% <0> (-0.94%)	⬇
<a href="#">src/oops/generic/bump/external/tools_stripack.F90</a>	45.73% <0> (-0.9%)	⬇



<https://codecov.io/gh/JCSDA/oops>