

Collaborative Tools 1



▶ **Agile Project Management and Collaborative Workflow**

- ◆ **git/GitHub**
- ◆ **git-flow**
- ◆ **ZenHub**

▶ **Documentation**

- ◆ **Sphinx/ReadTheDocs** (*high-level manuals, how-to's, etc*)
- ◆ **Doxygen** (*low-level code details*)

▶ **Computing Environment**

- ◆ **Software containers**
- ◆ **Cloud Computing (AWS)**

Mark Miesch (JCSDA)

JEDI Academy - 13-16 Nov, 2018

College Park, MD



<http://wookiepedia.com>

Academy website



<http://academy.jcsda.org/nov2018>

Already has

- ▶ Instructions for accessing AWS
- ▶ Doxygen documentation for fv3-bundle

We will add further content throughout the week, including slides from presentations

The Way of a JEDI



▶ Collaborative

◆ A Joint Center (**JCSDA**)

- **Partners, collaborators, stakeholders, community**

◆ A Joint Effort (**JEDI**)

- **Distributed team of software developers, with varying objectives and time commitments**

▶ Agile

◆ Innovative

◆ Flexible (*future-proof*)

◆ Responsive to users and developers

◆ Continuous delivery of functional software

Outline



▶ **git/GitHub**

- ◆ **Version control**
- ◆ **Enhancements and bug fixes immediately available to distributed community of developers**
- ◆ **Code review, issue tracking**
- ◆ **Community exports (Code distribution)
...and imports (ecbuild, eckit, fckit)**

▶ **Git-Flow**

- ◆ **Innovation**
- ◆ **Continuous Delivery**

▶ **ZenHub**

- ◆ **Agile project management**
- ◆ **Enhances GitHub's issue tracking and code review functionality**



Dashboard

GitHub, Inc. [US] | <https://github.com/orgs/JCSDA/dashboard>

Apps | JEDI | Software Engineering | Mac | Meetings | Outdoors | Garden | Transition | Colleges | Travel

Search or jump to... Pull requests Issues Marketplace Explore

JCSDA

Repositories [New repository](#)

Find a repository...

- JCSDA/ufo
- JCSDA/fv3-jedi
- JCSDA/ioda
- JCSDA/mpas
- JCSDA/jedi-docs
- JCSDA/lfric
- JCSDA/lfric-bundle
- JCSDA/soca
- JCSDA/ufo-bundle
- JCSDA/fv3-bundle
- JCSDA/oops
- JCSDA/crtm
- JCSDA/mpas-bundle
- JCSDA/docker
- JCSDA/docker_base
- JCSDA/bufr2nc
- JCSDA/fms
- JCSDA/fv3
- JCSDA/wrf-jedi
- JCSDA/singularity

Show more

Browse activity [View organization](#)

Recent activity

- Eliminated reference to UCAR repos and clarified FC environment varia...
JCSDA/jedi-docs · You opened this pull request
- Feature/refac obs opr
JCSDA/ufo · Your review was requested (14)
- Feature/interp test bump
JCSDA/fv3-jedi · You opened this pull request

All activity

- xinzhang8noaa pushed to JCSDA/ufo 7 hours ago
 - 1 commit to `feature/refac_obs0pr`
 - eb35604 one can't override a nonaccessible deferred binding per F08...
- danholiday pushed to JCSDA/fv3-jedi 7 hours ago
 - 2 commits to `feature/radiancread`
 - 0ed7934 working hofx for radiances
 - df854f5 towards bilin for crtm
 - 14 more commits »
- danholiday created a branch `feature/radian...` in JCSDA/ufo
 - JCSDA/ufo
 - Updated Apr 9
- xinzhang8noaa left 2 comments on pull request JCSDA/ufo#63 7 hours ago
 - xinzhang8noaa commented 7 hours ago
 - Googled following things: one can't override a nonaccessible deferred binding F08/0052. (Intel Fortran doesn't yet recognize that.) Therefore, ...
- victordottir left 3 comments on pull request JCSDA/ufo#63 8 hours ago

**git - command line tool
(version control)**

**GitHub - Web-based
repository management
(branches, releases,
code reviews)**



Browser address bar: <https://github.com/JCSDA/ufo>

Repository: **JCSDA / ufo** Private

Unwatch 28 Star 0 Fork 1

Code Issues 33 Pull requests 1 ZenHub Wiki Insights Settings

JEDI Unified Forward Operator

Manage topics

454 commits 44 branches 0 releases 18 contributors Apache-2.0

Branch: **develop** New pull request

Create new file Upload files Find file Clone or download

victordottir and **ytremolet** Bugfix for interpolation: set weights to 0/1 if the obs is outside of... Latest commit ac66a76 an hour ago

cmake	cmake clean-up	a year ago
docs	Adding in files for creating the "Building UFO in OS X" documentation. (9 months ago
src	Bugfix for interpolation: set weights to 0/1 if the obs is outside of...	an hour ago
test	Bugfix for interpolation: set weights to 0/1 if the obs is outside of...	an hour ago
tools	Feature/script fornewobs (#79)	17 hours ago
.gitattributes	Use git lfs	5 months ago
.gitignore	Feature/replace ad alloc (#77)	5 months ago
CMakeLists.txt	Feature/gnssro ropp1d forward (#67)	20 days ago
COPYING	First commit	a year ago
CPPI INT cfg	Feature/style check (#51)	2 months ago



Browser address bar: <https://github.com/JCSDA/ufo>

Repository: **JCSDA / ufo** Private

Unwatch 28 Star 0 Fork 1

Code Issues 33 Pull requests 1 **ZenHub** Wiki Insights Settings

JEDI Unified Forward Operator

Manage topics

454 commits 44 branches 0 releases 18 contributors Apache-2.0

Branch: develop New pull request Create new file Upload files Find file Clone or download

Latest commit: **victordottir** and **ytremolet** Bugfix for interpolation: set weights to 0/1 if the obs is outside of... ac66a76 an hour ago

cmake	cmake clean-up	a year ago
docs	Adding in files for creating the "Building UFO in OS X" documentation. (9 months ago
src	Bugfix for interpolation: set weights to 0/1 if the obs is outside of...	an hour ago
test	Bugfix for interpolation: set weights to 0/1 if the obs is outside of...	an hour ago
tools	Feature/script fornewobs (#79)	17 hours ago
.gitattributes	Use git lfs	5 months ago
.gitignore	Feature/replace ad alloc (#77)	5 months ago
CMakeLists.txt	Feature/gnssro ropp1d forward (#67)	20 days ago
COPYING	First commit	a year ago
CPPI INT.cfg	Feature/style check (#51)	2 months ago

git/GitHub (JEDI tips)



▶ **Work with JEDI bundles**

- ◆ **Clone bundle repo**
- ◆ **Let ebuild do the rest**
- ◆ **If that doesn't work, read the README file**
- ◆ **Get in the habit of running *make update* after ebuild**
- ◆ **Edit the CMakeLists.txt file to use your local version**

```
#ebuild_bundle( PROJECT ufo GIT "https://github.com/JCSDA/ufo.git" BRANCH develop UPDATE )  
ebuild_bundle( PROJECT ufo SOURCE "~/jedi/src/ufo-bundle/ufo" )
```

▶ **Cache your GitHub credentials**

```
git config --global credential.helper 'cache --timeout=3600'
```




▶ **LFS = Large File service**

- ◆ **Increases GitHub size limits for individual files from 100 MB to 2GB**
- ◆ **Cumulative storage purchased in 50 GB data packs**
- ◆ **Used for anything that isn't code (*data files, restart files, etc*)**

▶ **Transparent to the user**

- ◆ **When you push to GitHub, any files that are tracked by LFS will go to a remote server (the LFS Store)**
- ◆ **The GitHub repo will only contain a pointer to that file**
- ◆ **When you fetch/pull/clone an LFS-enabled repo from GitHub, LFS will check to see if you have the large files on your computer (local LFS cache). If not, it will retrieve them from the LFS Store as needed.**

Git-Flow



Git Flow is:

▶ **A Philosophy**

- ◆ **Optimal for Agile Software Development**
 - **Innovation**
 - **Continuous Delivery**

▶ **A Working Principle**

- ◆ **Enforcement of branch naming conventions soon to come**

▶ **An Application (*extension to git*)**

- ◆ **Already installed in AMI and Singularity Container**
- ◆ **brew install git-flow-avh # (Mac)**
- ◆ **sudo apt-get install git-flow # (linux)**
- ◆ **<https://github.com/petervanderdoes/gitflow-avh>**

A state of mind,
git-flow is



The Git-Flow Manifesto

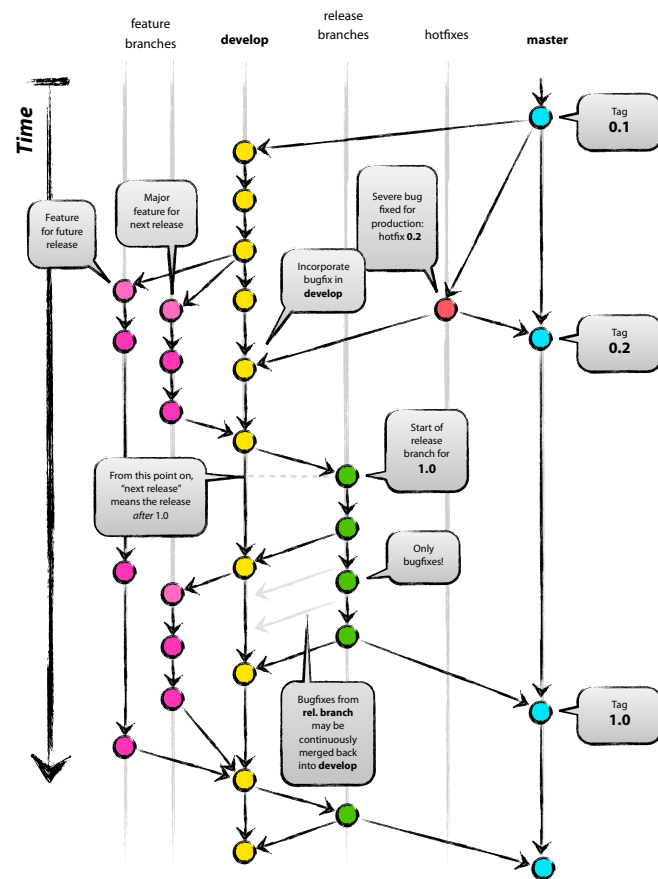


<http://nvie.com/posts/a-successful-git-branching-model/>

Vincent Driessen (2010)

git branching model

Highly Recommended!



Author: Vincent Driessen
Original blog post: <http://nvie.com/posts/a-successful-git-branching-model/>
License: Creative Commons BY-SA

The Git-Flow Manifesto: Takaways




- ▶ **master is for releases only**
- ▶ **develop**
 - **Not ready for public consumption but compiles and passes all tests**
- ▶ **Feature branches**
 - **Where most development happens**
 - **Branch off of develop**
 - **Merge into develop**
- ▶ **Release branches**
 - **Branch off of develop**
 - **Merge into master and develop**
- ▶ **Hotfix**
 - **Branch off of master**
 - **Merge into master and develop**
- ▶ **Bugfix**
 - **Branch off of develop**
 - **Merge into develop**

Agile Software Development



► 12 Agile Principles


 <p>Early and continuous delivery of valuable software</p> <p>1</p>	 <p>Welcome changing requirements even late in development</p> <p>2</p>	 <p>Deliver working software frequently</p> <p>3</p>	 <p>Business people and developers working together daily</p> <p>4</p>	 <p>Build projects around motivated individuals and trust them to get the job done</p> <p>5</p>	 <p>The most effective method of conveying information is face-to-face conversation</p> <p>6</p>
 <p>Working software is the primary measure of progress</p> <p>7</p>	 <p>Sustainable development: maintain a constant pace indefinitely</p> <p>8</p>	 <p>Continuous attention to technical excellence</p> <p>9</p>	 <p>Simplicity: maximize the amount of work not done</p> <p>10</p>	 <p>Teams self-organize</p> <p>11</p>	 <p>Teams regularly reflect and adjust behaviour</p> <p>12</p>

Agile Software Development



► 12 Agile Principles

**Git-Flow helps with many of these
For the rest, we have ZenHub**




Early and continuous delivery of valuable software

1 ✓




Welcome changing requirements even late in development

2 ✓




Deliver working software frequently

3 ✓




Business people and developers working together daily

4



Build projects around motivated individuals and trust them to get the job done

5 ✓



The most effective method of conveying information is face-to-face conversation

6




Working software is the primary measure of progress

7 ✓



Sustainable development: maintain a constant pace indefinitely

8




Continuous attention to technical excellence

9 ✓



Simplicity: maximize the amount of work not done

10 ✓



Teams self-organize

11



Teams regularly reflect and adjust behaviour

12 ✓

Agile workflows: ZenHub



Boards · JCSDA/ufo

GitHub, Inc. [US] <https://github.com/JCSDA/ufo/tree/develop/src/ufo#boards?repos=128851401,138515813>

Apps JEDI AWS Software Mac Meetings Home Colleges Travel EPO

Search or jump to... Pull requests Issues Marketplace Explore

JCSDA / ufo Private Unwatch 16 Star 0 Fork 0

<> Code Issues 5 Pull requests 1 ZenHub Wiki Insights

Boards Reports Create... Invite your team View tutorials Shortcuts Open in web app

Repos (2/2) Labels Milestones Assignees Epics Releases Find Issues (f+i) New Issue +

25 Issues - 21 Story Points
New Issues

- old-ufo #3 dot product in ObsVector and GeoVaLs is not yet distributed. (local pe value only) **bug question**
- old-ufo #5 Add time to marine UFO's. **bug enhancement**
- old-ufo #6 Implement putdb in ObsSpace.cc **question**
- old-ufo #15 Remove hardcoded metadata from ufo_radiance_eqv **enhancement**
- old-ufo #21 Generic FG check **enhancement**

1 Issue - 0 Story Points
Icebox

- old-ufo #16 Read metadata for CRTM through interface **enhancement**

8 Issues - 9 Story Points
Backlog

- old-ufo #14 Access to metadata for CRTM **enhancement**
- old-ufo #17 Pass hooks between c++/Fortran for CRTM K matrix **enhancement**
- old-ufo #18 Use all radiosonde observed variables **enhancement**
- old-ufo #19 Use all observed variables from aircrafts **enhancement**
- old-ufo #28 Check GeoVaLs I/O and files for tests **enhancement**

8 Issues - 7 Story Points
In Progress

- old-ufo #13 Implement git-LFS **enhancement**
- old-ufo #33 Fix UFO test failures when running on Theia using ifort **enhancement**
- old-ufo #20 Check obs times **enhancement**
- old-ufo #32 add time window screening as a filter **enhancement**
- old-ufo #44 Marine UFO - Satellite Temperature (Along track nighttime) **enhancement**
- old-ufo #70 Various naming/interface issues **enhancement**
- old-ufo #31

4 Issues - 0 Story Points
Review/QA

- old-ufo #4 the st hofx i **help wanted**
- old-ufo #4 Featu
- old-ufo #4 Moved atm/m moved
- ufo #9 Featu variab

Mark Miesch mmiesch

ZenHub Features



- ▶ **Customizable Project boards**
 - ◆ **Prioritize and organize tasks**
 - ◆ **Reviews/Feedback**
 - ◆ **Sprints (Milestones) and Epics**
- ▶ **Closely integrated with GitHub**
 - ◆ **Access boards directly from GitHub repos**
 - ◆ **ZenHub tasks are GitHub issues and vice versa**
- ▶ **Tasks/Issues**
 - ◆ **Assign up to 10 individuals**
 - ◆ **Labels, difficulty estimates, etc.**
 - ◆ **Can be linked to pull requests**
 - ◆ **Markdown supported (boldface, checklists...)**
- ▶ **Monitoring progress**
 - ◆ **Burndown charts**
 - ◆ **Velocity tracking**
 - ◆ **Release reports**
 - **Time estimate to deliver a specified set of features**

ZenHub Pipelines



▶ ***New Issues***

- ◆ ***Default landing spot***
- ◆ ***Issues should not stay here long***

▶ ***Backlog***

- ◆ ***Main “To Do” List***
- ◆ ***Arrange in order of priority (reviewed regularly by teams)***

▶ ***IceBox***

- ◆ ***Low-priority items that should be done at some point but do not require immediate attention***

▶ ***In Progress***

- ◆ ***Lets others know what you are doing to promote collaboration and avoid redundancy***

▶ ***Review/QA***

- ◆ ***Solicit feedback before you mark something as...***

▶ ***Closed***

Documentation



▶ **Agile Project Management and Collaborative Workflow**

- ◆ **git/GitHub**
- ◆ **git-flow**
- ◆ **ZenHub**

▶ **Documentation**

- ◆ **Sphinx/ReadTheDocs** (*high-level manuals, how-to's, etc*)
- ◆ **Doxygen** (*low-level code details*)

▶ **Computing Environment**

- ◆ **Software containers**
- ◆ **Cloud Computing (AWS)**

Sphinx/ReadtheDocs



JEDI Documentation — JEDI D. x

Secure | <https://jointcenterforsatellitedataassimilation-jedi-docs.readthedocs-hosted.com/en/latest/>

Apps JEDI Software Engineering Mac Meetings Outdoors Garden Transition Colleges Travel Cooking Self EPO

JEDI Documentation
latest

Search docs

Background
Working Practices
Developer Tools and Practices
JEDI Environment
Building, Testing, and Running JEDI

Docs » JEDI Documentation [Edit on GitHub](#)

JEDI Documentation

Welcome to JEDI!

This documentation will help you get started with JEDI whether you are a user or a developer.

Table of Contents

- [Background](#)
 - [JEDI High Level Requirements](#)
 - [JEDI General Methodology](#)
- [Working Practices](#)
 - [Branching and merging code](#)
 - [Forking and cloning repositories](#)
 - [Reviewing code](#)
 - [Testing](#)
 - [Creating documentation](#)
- [Developer Tools and Practices](#)
 - [Homebrew \(Mac only\)](#)
 - [Git flow](#)
 - [Git-LFS](#)
 - [Sphinx](#)
 - [Doxgen](#)

Read the Docs v: latest

Publicly available
Targeted at users as well as developers

Sphinx/ReadtheDocs



<https://jointcenterforsatellitedataassimilation-jedi-docs.readthedocs-hosted.com/en/latest/>

JEDI Documentation — JEDI D... x

Secure | <https://jointcenterforsatellitedataassimilation-jedi-docs.readthedocs-hosted.com/en/latest/>

Apps JEDI Software Engineering Mac Me

JEDI Documentation
latest

Search docs

Background
Working Practices
Developer Tools and Practices
JEDI Environment
Building, Testing, and Running JEDI

JEDI Documentation

Welcome to JEDI!

This documentation will help you get started with JEDI whether you are a user or a developer.

Table of Contents

- Background
 - JEDI High Level Requirements
 - JEDI General Methodology
- Working Practices
 - Branching and merging code
 - Forking and cloning repositories
 - Reviewing code
 - Testing
 - Creating documentation
- Developer Tools and Practices
 - Homebrew (Mac only)
 - Git flow
 - Git-LFS
 - Sphinx
 - Docker

Read the Docs v: latest

Publicly available
Targeted at users as well as developers

Sphinx/ReadtheDocs



The screenshot shows a Google search for "jedi working practices". The search results include:

- JEDI Documentation – JEDI Documentation 1 documentation**
<https://jointcenterforsatellitedataassimilation-jedi-docs.readthedocs-hosted.com/en/latest/>
See the following links for more details on the **JEDI working practices**. Branching and merging code · Forking and cloning repositories · Reviewing code · Testing ...
- [PDF] JEDI Documentation Documentation - ReadTheDocs**
<https://readthedocs.com/projects/jointcenterforsatellitedataassimilation-jedi-docs/>
May 25, 2018 - See the following links for more details on the **JEDI working practices**. Branching and merging code · Forking and cloning repositories.
- Comparative Analysis | CommunityGovernance**
<https://www.earthsystemcog.org/projects/.../Comparative-Analysis-CommunityGovernance>
Apr 18, 2017 - **JEDI: Working Practices** and Governance for Collaborative Code Development. Developmental Testbed Center (DTC). Developmental Testbed ...

Or, get there from
<http://academy.jcsda.org>

Sphinx/ReadtheDocs



Building, Testing, and Running x

Secure | https://jointcenterforsatellitedataassimilation-jedi-docs.readthedocs-hosted.com/en/latest/developer/building_and_testing/in...

Apps JEDI Software Engineering Mac Meetings Outdoors Garden Transition Colleges Travel Cooking Self EPO

JEDI Documentation
latest

Search docs

Background
Working Practices
Developer Tools and Practices
JEDI Environment

Building, Testing, and Running JEDI

- Building and compiling JEDI
 - Precursor: Git Configuration
 - Step 1: Clone the Desired JEDI Bundle
 - Step 2: Choose your Repos
 - Step 3: Run ecbuild (from the build directory)
 - Step 4: Run make (from the build directory)
- JEDI Testing
 - Running ctest
 - Manual Execution
 - The JEDI test suite
 - Tests as Applications
 - Initialization and Execution of Unit Tests
 - Anatomy of a Unit Test
 - Integration and System (Application) Testing
 - JEDI Testing Framework
- Adding a New Test
 - Step 1: Create a File for your Test Application
 - Step 2: Define A Test Fixture
 - Step 3: Define Your Unit Tests
 - Step 4: Register your Unit Tests with Boost
 - Step 6: Create an Executable
 - Step 7: Create a Configuration File
 - Step 8: Register all files with CMake and CTest
 - Adding an Application Test
- JEDI Configuration Files

Previous Next

Read the Docs v: latest

Sphinx



▶ **Sphinx**

- ◆ **The real workhorse behind the documents**
- ◆ **Python package**
- ◆ **Source code written with Restructured text**

▶ **Distribution plan**

- ◆ **ReadtheDocs for now to publish**
- ◆ **Sphinx Source code on GitHub (jedi-docs)**
- ◆ **Tagged versions of the doc repos will be linked to JEDI releases**

For more info on Sphinx see the corresponding page in the JEDI documentation, under *Developer Tools and Practices*

Doxygen



Doxygen

Used in JEDI for:

- ▶ **Documenting functions and subroutines (C++ and F90)**
- ▶ **Documenting classes and structures (C++ and F90)**
- ▶ **Viewing namespaces and modules**
- ▶ **Generating Class Hierarchies**
- ▶ **Generating Call diagrams**
- ▶ **Any other documentation that involves specific blocks of code**

For example Doxygen documentation (fv3-bundle)

See

<https://github.com/nov2018>

Sample output: "man page"



◆ testStateInterpolation()

template<typename MODEL >

```
void test::testStateInterpolation ( )
```

Interpolation test.

testStateInterpolation() tests the interpolation for a given model. The conceptual steps are as follows:

1. Initialize the JEDI **State** object based on idealized analytic formulae
2. Interpolate the **State** variables onto selected "observation" locations using the `getValues()` method of the **State** object. The result is placed in a JEDI **GeoVaLs** object
3. Compute the correct solution by applying the analytic formulae directly at the observation locations.
4. Assess the accuracy of the interpolation by comparing the interpolated values from Step 2 with the exact values from Step 3

The interpolated state values are compared to the analytic solution for a series of **locations** which includes values optionally specified by the user in the "StateTest" section of the config file and a randomly-generated list of **Nrandom** random locations. Nrandom is also specified by the user in the "StateTest" section of the config file, as is the (nondimensional) tolerance level (**int**) to be used for the tests.

This is an equation:

$$\zeta = \left(\frac{x - x_0}{\lambda} \right)^{2/3}$$

Relevant parameters in the ****State*** section of the config file include

- **norm-gen** Normalization test for the generated **State**
- **interp_tolerance** tolerance for the interpolation test

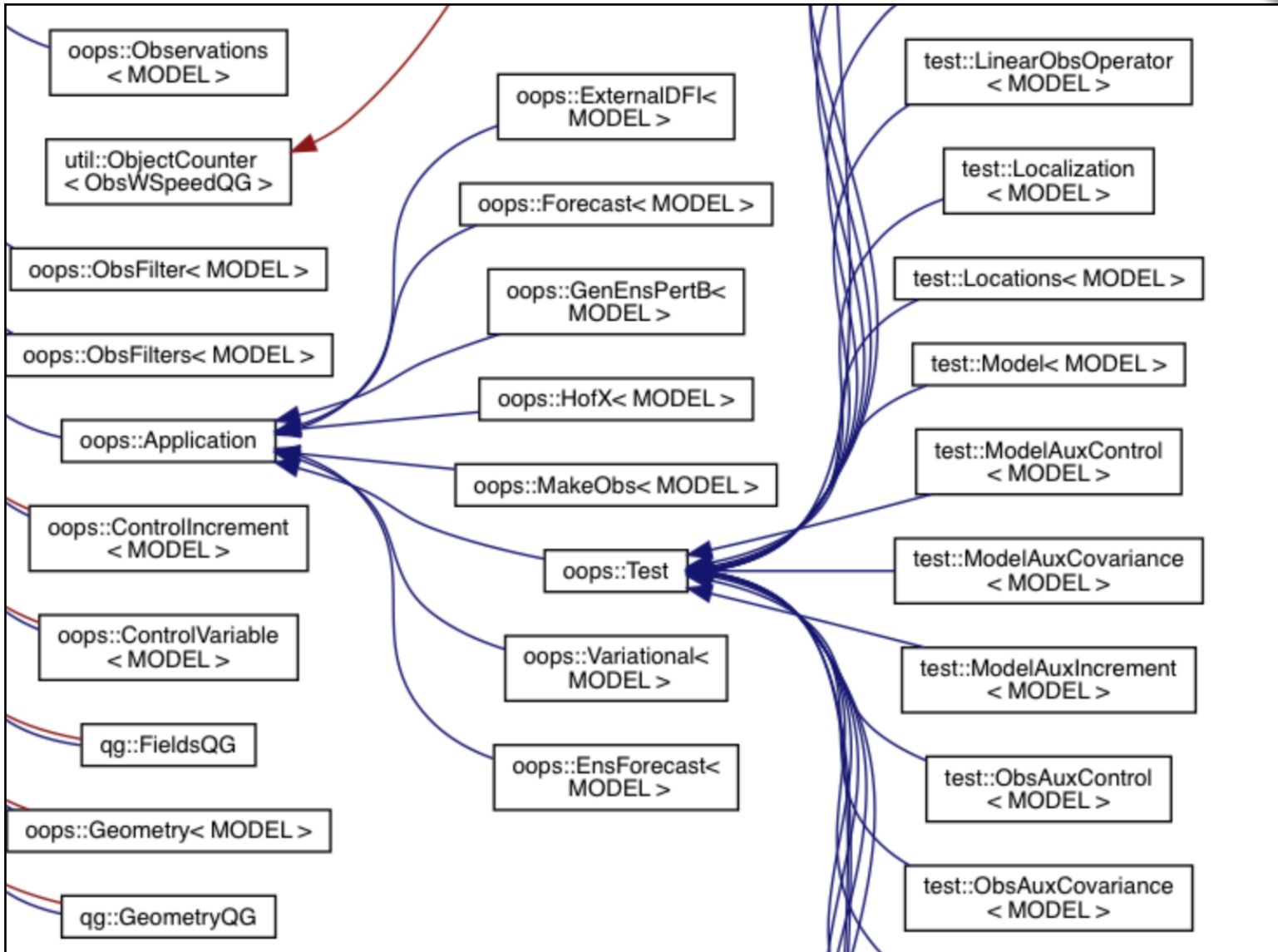
Date

April, 2018: M. Miesch (JCSDA) adapted a preliminary version in the feature/interp branch

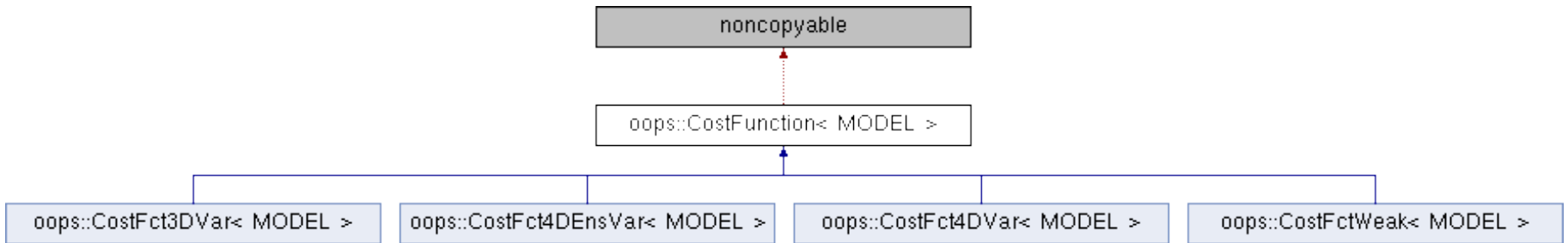
Warning

Since this model compares the interpolated state values to an exact analytic solution, it requires that the "analytic_init" option be implemented in the model and selected in the "State.StateGenerate" section of the config file.

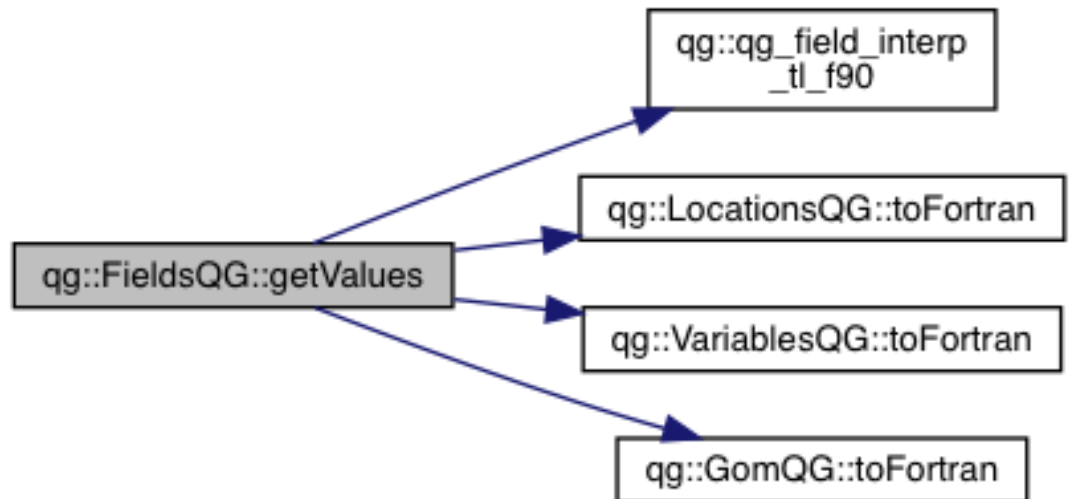
Sample output: class hierarchy



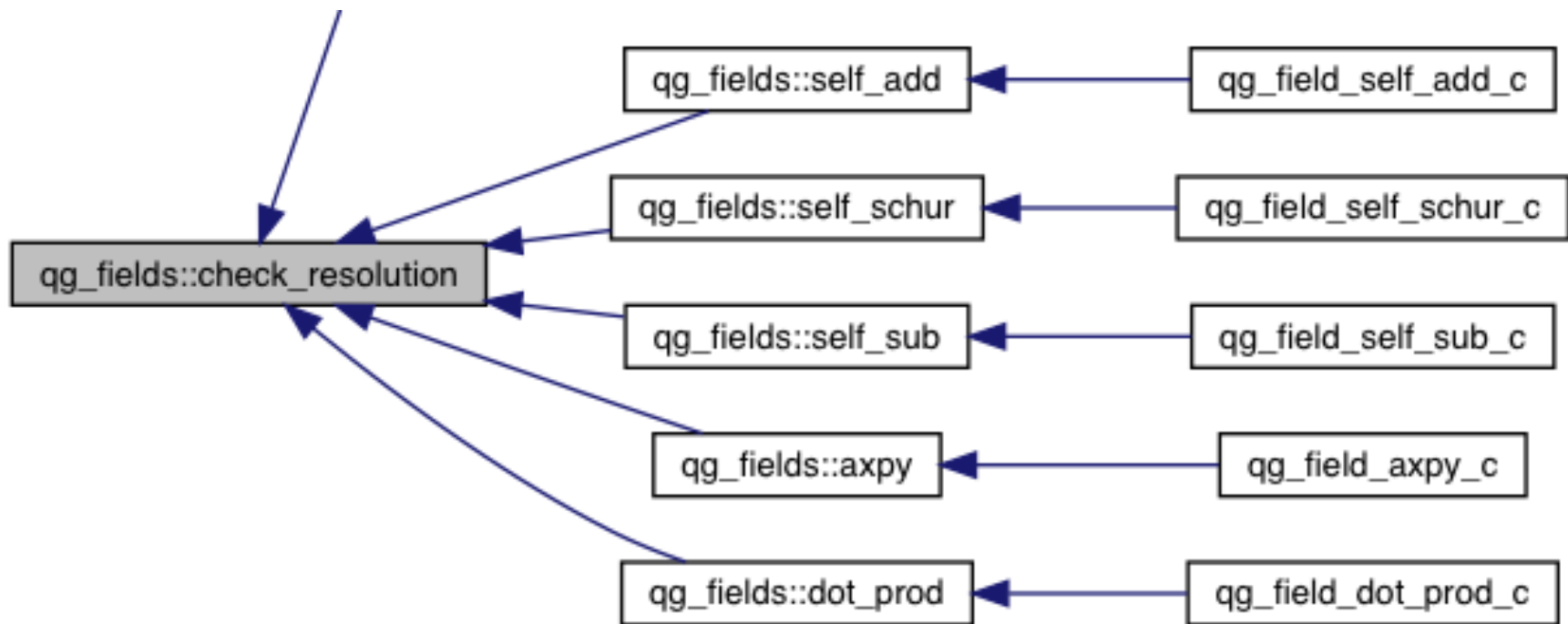
Sample output: inheritance, call graphs



Clickable boxes!

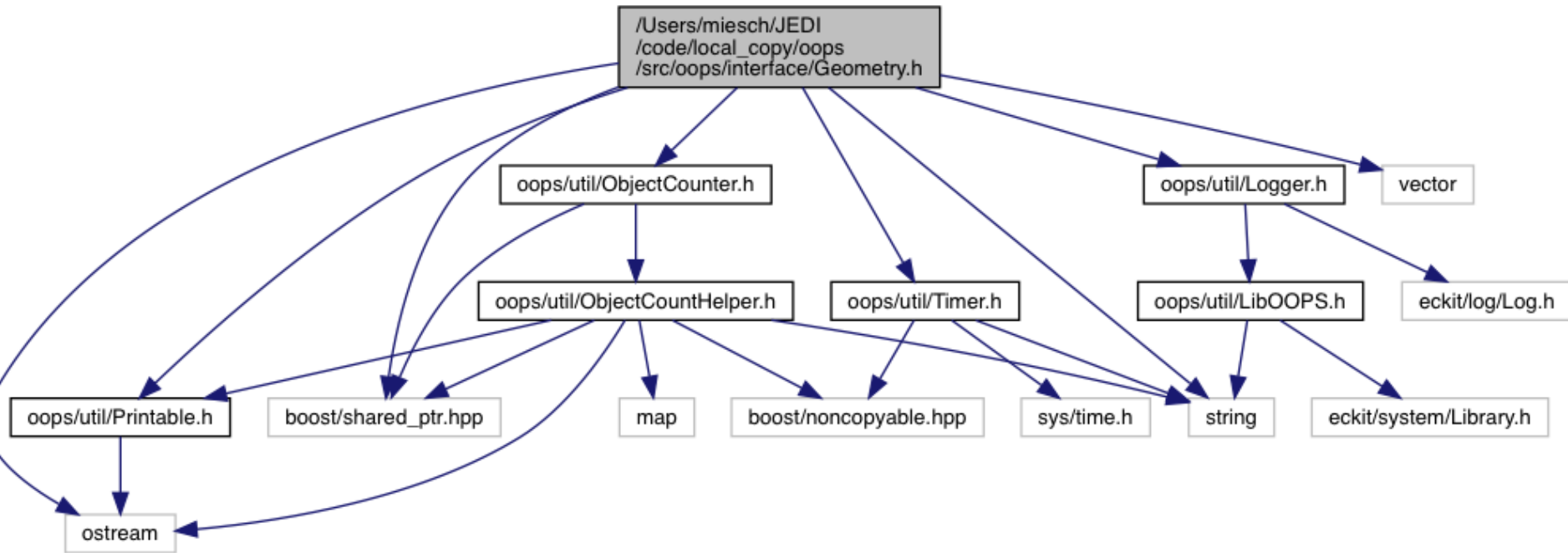


Sample output: caller graphs



Note that these traces end in `_c` (this is a Fortran routine)
Doxygen has trouble with C++ / Fortran binding
Look for corresponding `_f90` routine to follow further

Sample output: include diagrams



Can get complicated!

Computing Environment



▶ **Agile Project Management and Collaborative Workflow**

- ◆ **git/GitHub**
- ◆ **git-flow**
- ◆ **ZenHub**

▶ **Documentation**

- ◆ **Sphinx/ReadTheDocs** (*high-level manuals, how-to's, etc*)
- ◆ **Doxygen** (*low-level code details*)

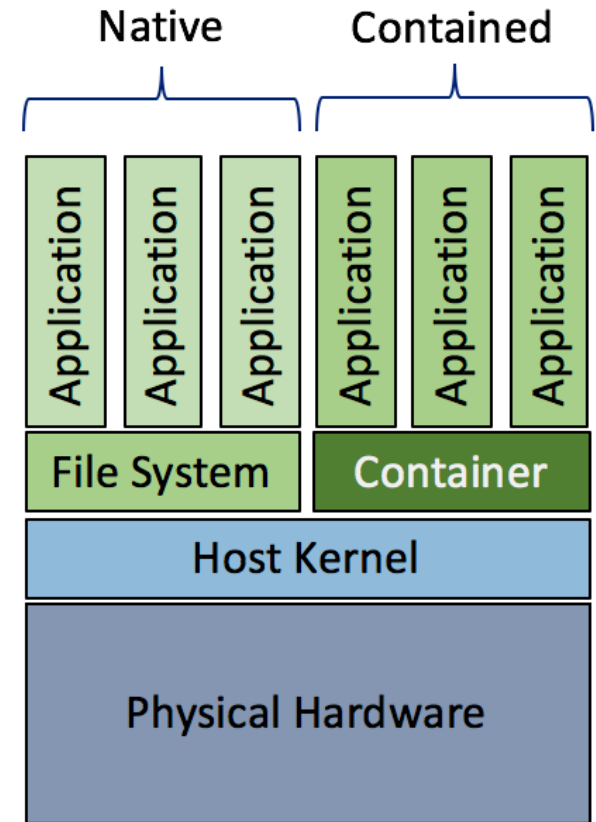
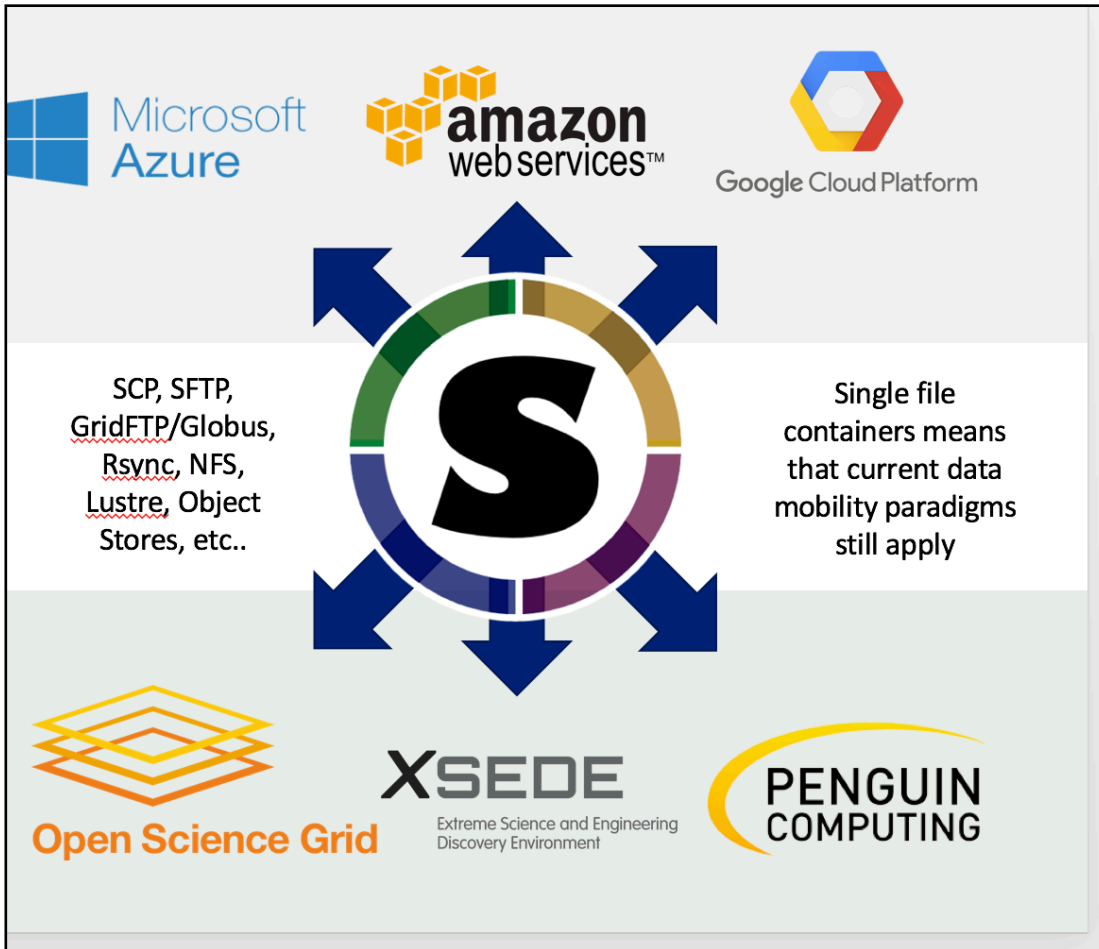
▶ **Computing Environment**

- ◆ **Software containers (Singularity)**
- ◆ **Cloud Computing (AWS)**

Containers for Portability



Singularity, Docker



Container Architecture

JEDI Singularity Container



- ▶ **Pre-installed software**

- ◆ **Compilers (C++, Fortran)**

- ◆ **open-mpi**

- ◆ **LAPACK**

- ◆ **Eigen3**

- ◆ **HDF5**

- ◆ **NetCDF4**

- ◆ **Boost**

- ◆ **python**

- ◆ **...**

- ▶ **Self-contained in a single image file**

- ◆ **singularity pull shub://JCSDA/singularity**

- ◆ **singularity shell -e <image-file>**

Caveat: Singularity must be installed!

Amazon Web Services (AWS)



▶ **Computing Resources**

- ◆ **Variety of optimized compute instances**
- ◆ **State-of-the-art hardware (Intel Xeon)**
- ◆ **Available on-demand or queued (spot instances)**
- ◆ **Pay only for what you use**
- ◆ **Community Applications (e.g. sagemaker, lambda)**

▶ **AWS in JCSDA**

- ◆ **Training (e.g. *this week!*)**
- ◆ **Sharing Data, applications**
- ◆ **Continuous Integration (JEDI)**
- ◆ **Applications**
 - **NWP**
 - **Machine Learning**
 - **FSOI**
 - **Web hooks**
 - ...



Resources



JEDI Documentation - access link from
<https://academy.jcsda.org>

Extensive GitHub documentation & tutorials
<https://help.github.com>

Lots of Great Github Cheat Sheets

<https://education.github.com/git-cheat-sheet-education.pdf>

<https://jan-krueger.net/git-cheat-sheet-extended-edition>

<https://patrickzahnd.ch/uploads/git-transport-v1.png>

Doxygen

<http://www.stack.nl/~dimitri/doxygen/manual/index.html>

AWS

<http://aws.com>