parallel tools platform

http://eclipse.org/ptp

Improving the Eclipse Parallel Tools Platform in Support of Earth Sciences High Performance Computing

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Outline

- Overview of Eclipse and Eclipse Parallel Tools Platform (PTP)
- Motivation for Workbench for High Performance Computing (WHPC)
  - Improvements to Eclipse PTP
- Software Engineering Practices Enabled by Eclipse PTP
  - Code visibility
  - Multi-system build management
  - Performance tuning
  - Source code control
  - Issue Tracking
  - Documentation
  - Earth Science/Weather code example
- Eclipse PTP Resources

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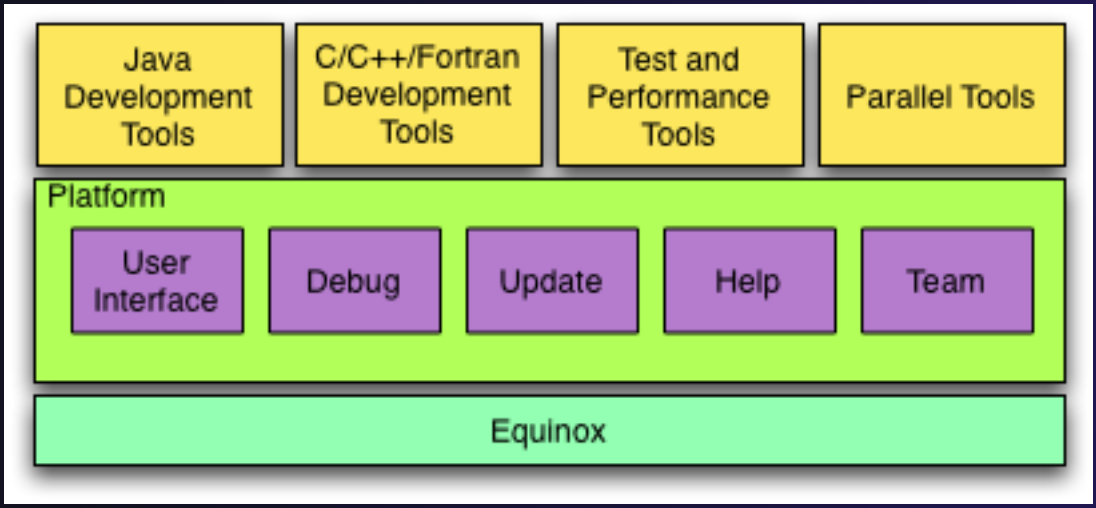
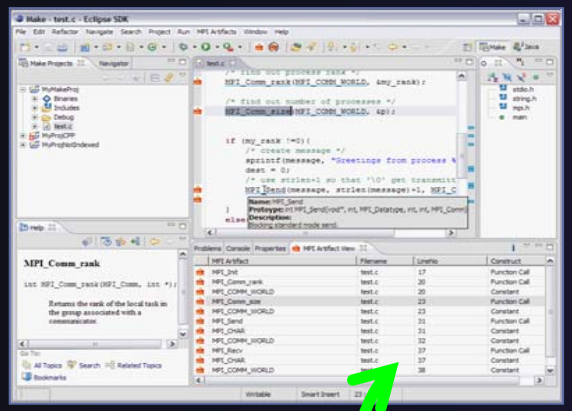
What is Eclipse?

- A vendor-neutral open-source workbench for multi-language development
- A extensible platform for tool integration
- Plug-in based framework to create, integrate and utilize software tools

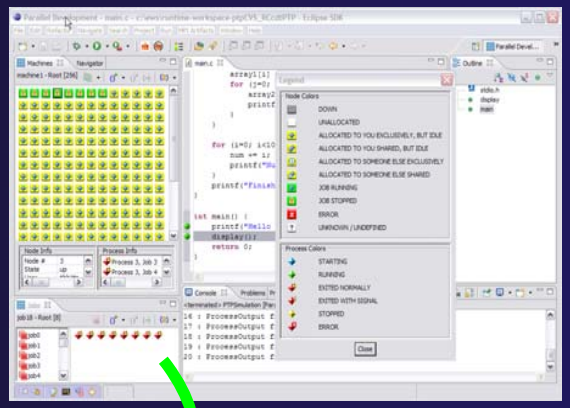


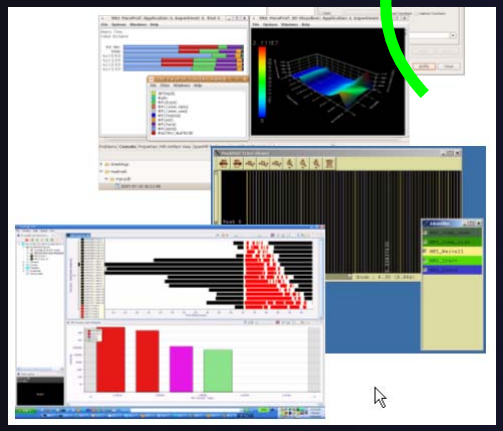
Eclipse Parallel Tools Platform (PTP)

Coding & Analysis

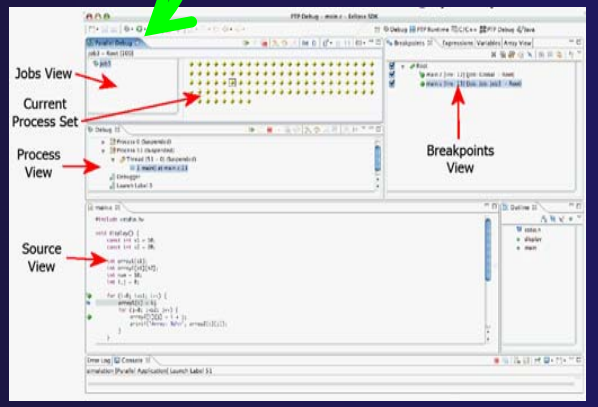


Launching & Monitoring





Performance Tuning



Debugging

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Motivation for Workbench for High Performance Computing (WHPC)

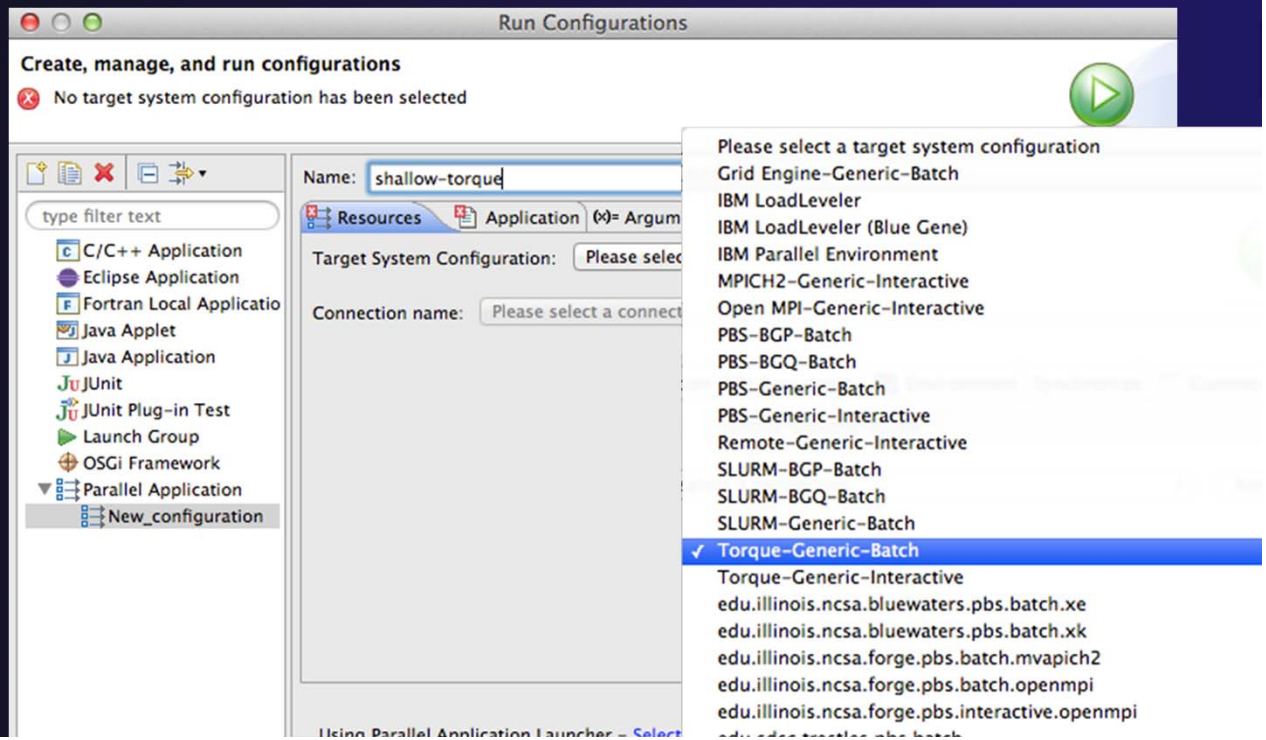
- Stable, portable platform for tool development
  - Focus on tool functionality, manage rapid evolution of HPC platforms
  - Encourage consistent tool look and feel
  - Support for HPC application development practices
- Why Parallel Tools Platform?
  - High potential to meet needs of a WHPC.
  - Target next generation of HPC developers growing up with IDEs (Eclipse, Visual Studio, ...)
  - Need to cultivate community of users!

Improvements

- Work within Eclipse release cycle
  - Major (API-breaking) improvements with coordinated June release
    - Last major release Eclipse 4.2 “Juno” released June 27, 2012
  - Minor enhancements and bug-fixes with two coordinated service releases in September and February
    - Eclipse 4.2 SR2 Released March 1, 2013
- Foci of improvements
  - Improve usability
  - Improve productivity

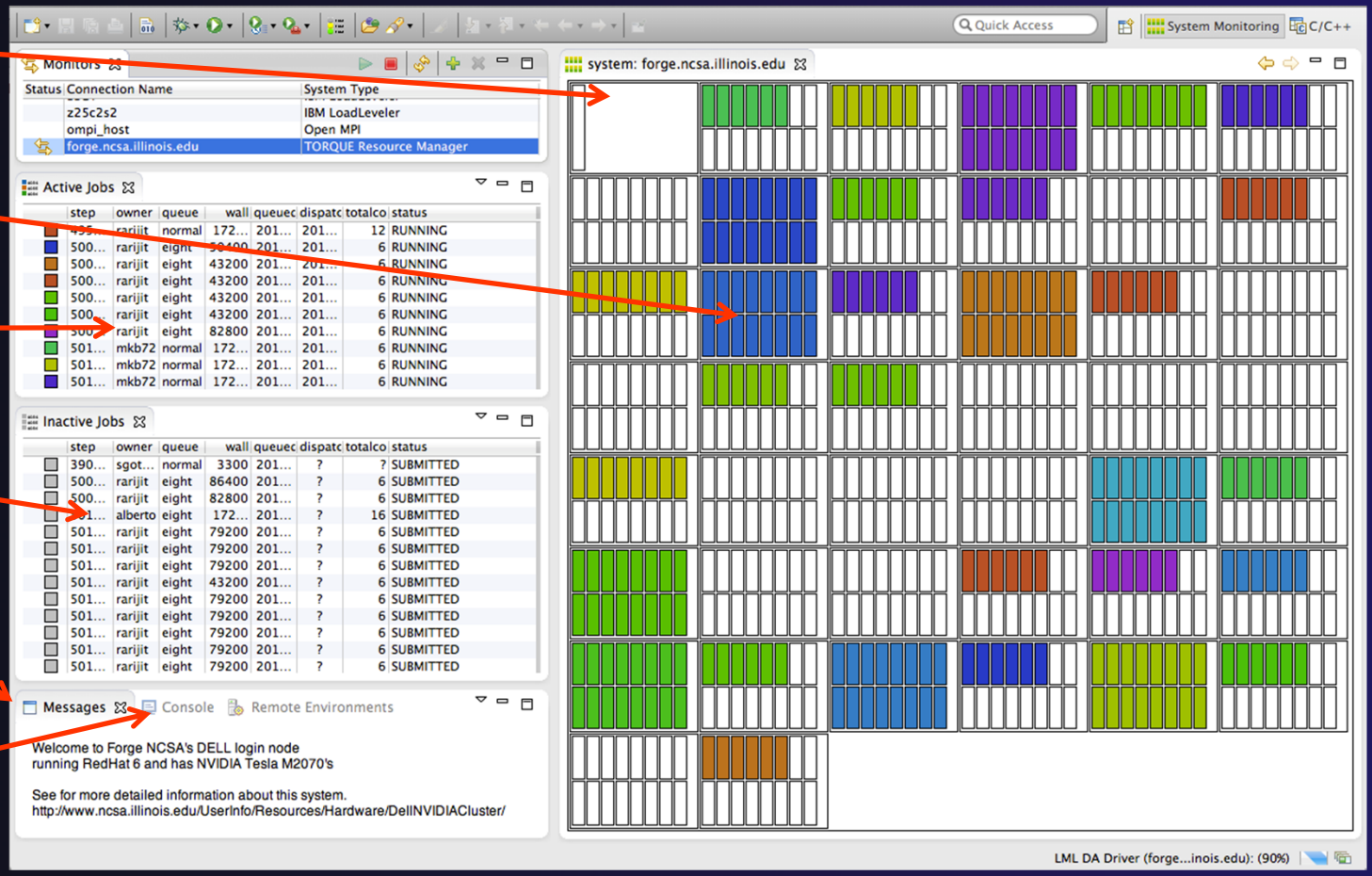
Significant Recent Improvements

- User-configurable machine configuration
  - Wide variety of configurations now available:
  - Documentation, tutorial at
    - http://wiki.eclipse.org/PTP/designs/Resource_Manager_Configuration

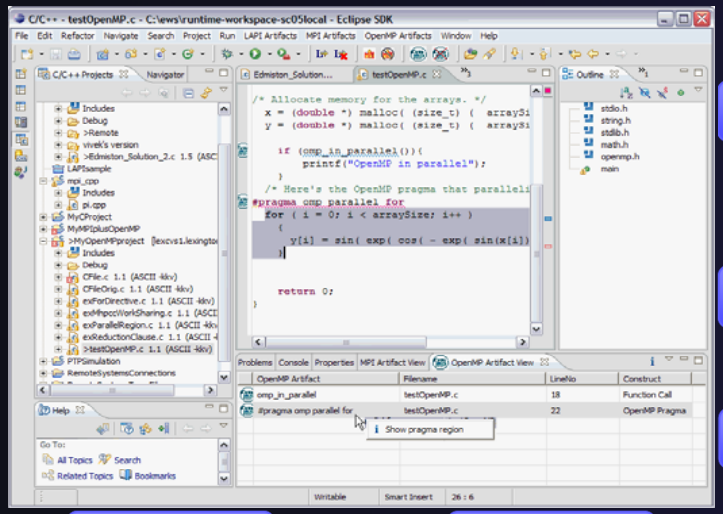


Scalable System Monitoring

- System view
- Jobs running on system
- Active jobs
- Inactive jobs
- Messages
- Console



Synchronized Projects

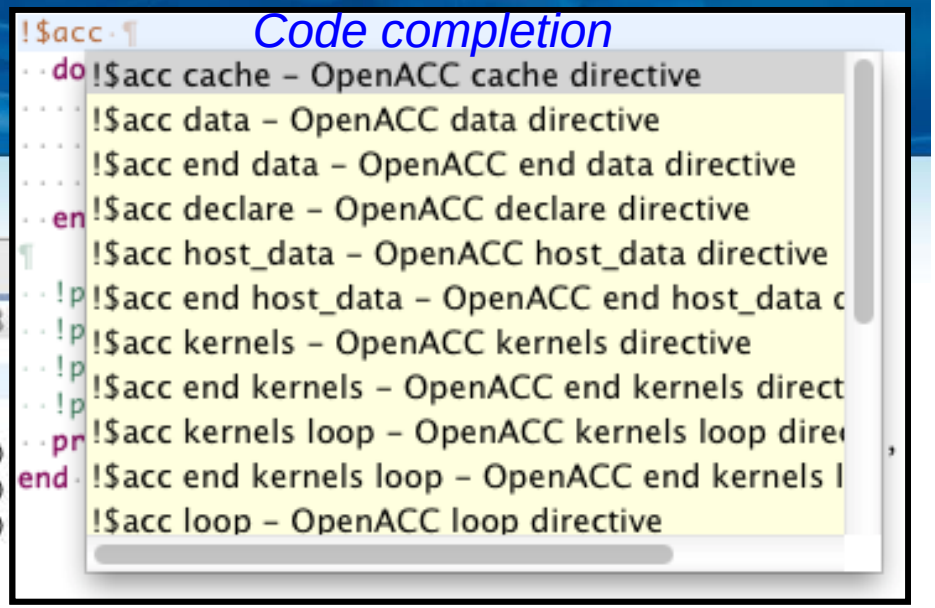


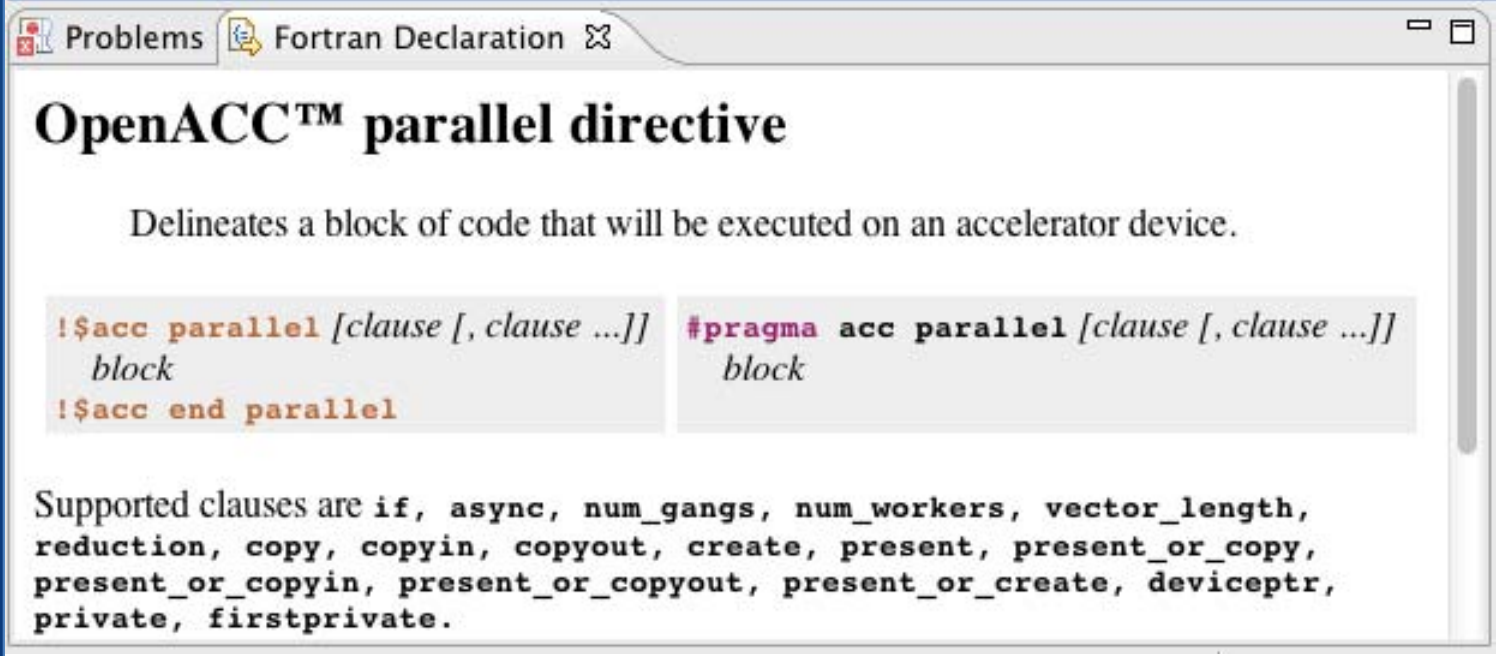
BLUE WATERS
SUSTAINED PETASCALE COMPUTING

Integrated OpenACC documentation and PLDT support

(added for BW)

Documentation also available for MPI, OpenMP





```
5   double precision :: a(SIZE, SIZE), b(SIZE, SIZE), c(SIZE, SIZE)
6
7   a(:) = 0. ! This will raise a warning
8
9   do i = 1, SIZE
10    do j = 1, SIZE
11      a(i,j) = i*10.d0+j
12      b(i,j) = j*10.d0+i
13    end do
14  end do
15
16 !$acc parallel loop
17  do i = 1, 1000
18    c(:,:) = (a(:,:) + b(:,:)) / 2.d0
19    a(:,:) = (a(:,:) + c(:,:)) / 2.d0
20    b(:,:) = (b(:,:) + c(:,:)) / 2.d0
21  end do
22 !$acc end parallel loop
23
24  !print *, "Averages:"
25  !print *, sum(a(:,:)/(SIZE*SIZE))
26  !print *, sum(b(:,:)/(SIZE*SIZE))
27  !print *, sum(c(:,:)/(SIZE*SIZE))
28  print *, "Minimums:", minval(a(:,:)), minval(b(:,:)), minval(c(:,:))
```

Problems | Console | Fortran Declaration | Fortran Analysis/Refactoring Problems

1 error, 1 warning, 17 others

Description	Resource
▼ Warnings (1 item)	
The number of subscripts is smaller than the number of declared dimensions.	test1.f90
▼ Infos (17 items)	
A divide was turned into a multiply by a reciprocal	test1.f90
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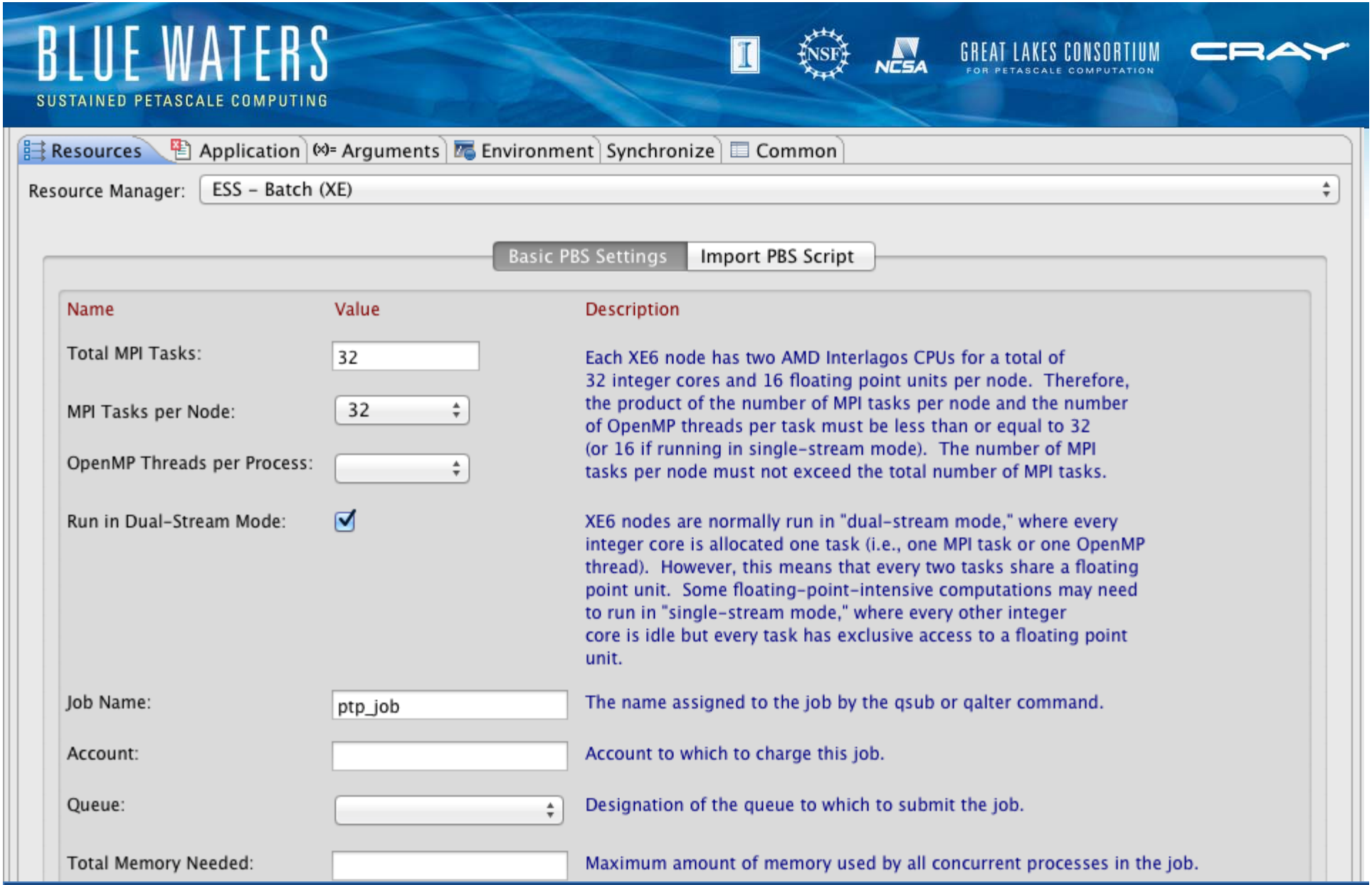
A floating point expression involving an induction variable was strength reduced b...	test1.f90
A loop nest at line 18 collapsed to a single loop.	test1.f90
A loop starting at line 10 was not vectorized because a better candidate was found...	test1.f90
A loop starting at line 17 was blocked with block size 512	test1.f90

After the build, compiler errors, warnings, and loopmark information are shown in the Problems view and source code editor

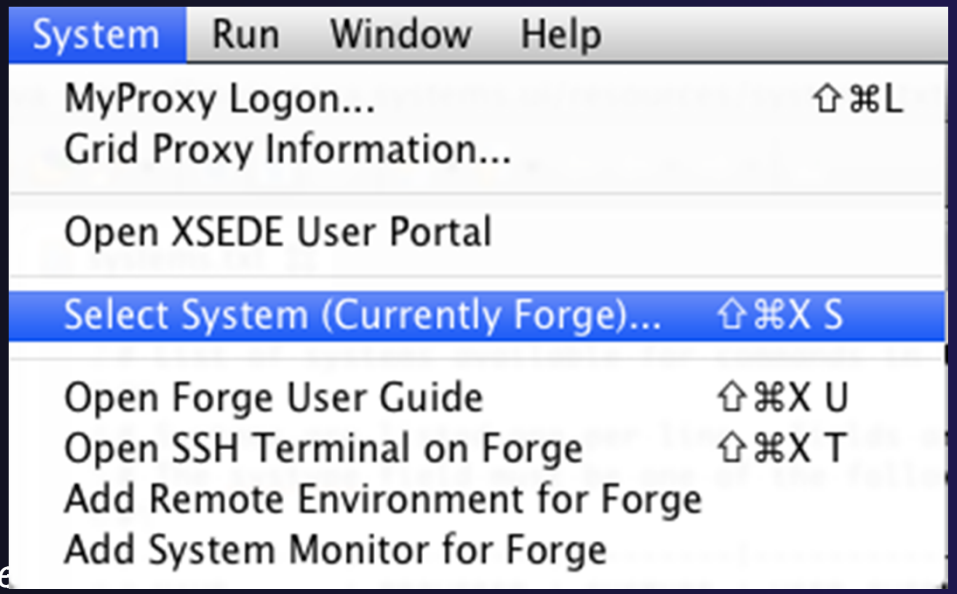
(Cray, PGI support added for BW)



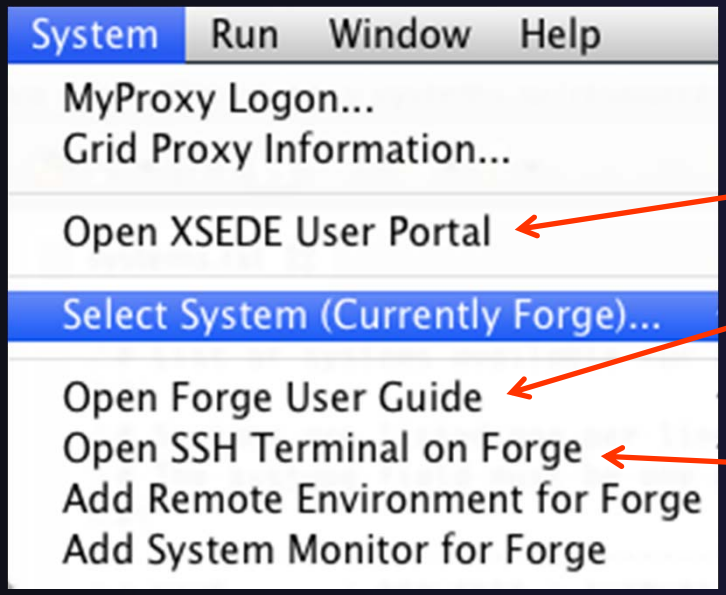
Graphical interface for launching a job (customized for BW)

Additional Plug-ins from NCSA

- NCSA publishes additional plug-ins can be added onto an existing PTP installation
  - http://forecaster.ncsa.uiuc.edu/help/index.jsp
- Contribute a **System** menu to the menu bar with XSEDE- and NCSA-specific commands



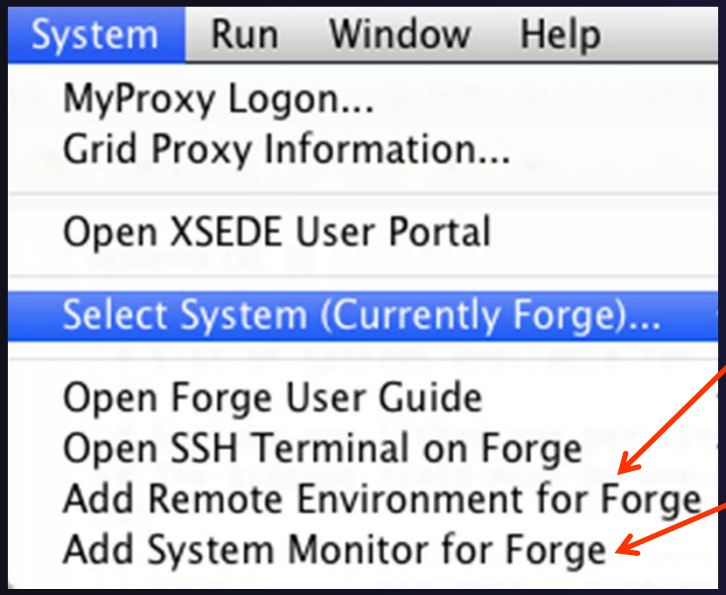
System Menu



- Open Web content in Eclipse:
  - **Open XSEDE User Portal**
  - **Open User Guide** for a machine
- Open an SSH terminal (as an Eclipse view)

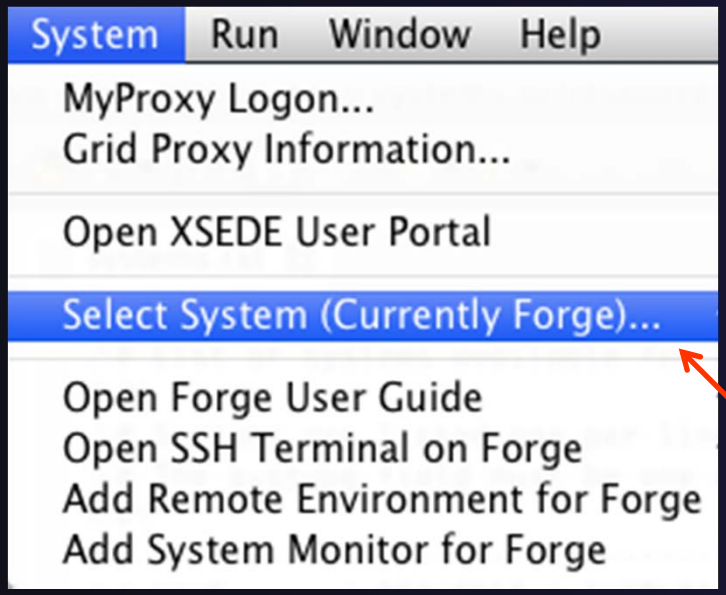
Eclipse-integrated SSH terminals are provided by the Remote System Explorer (RSE), one of the features that is included in the Eclipse for Parallel Application Developers package.

System Menu



- Shortcuts for common PTP tasks:
  - **Add Remote Environment** adds a Remote Tools connection for a particular machine
  - **Add System Monitor** opens the System Monitoring perspective and begins monitoring a particular machine

System Menu



- The plug-in is preconfigured with information about XSEDE and NCSA resources
- The bottom four commands generally prompt for a system
- **Select System** can be used to eliminate this prompt, so these commands always act on a particular system

MyProxy Logon

- **MyProxy Logon** allows you to authenticate with a MyProxy server
  - Often **myproxy.teragrid.org**
- It stores a "credential," which is usually valid for 12 hours
- During these 12 hours, SSH connections to XSEDE resources will not require a password; they can use the stored credential
  - However, you **must** enter the correct username for that machine!

Improvements in the works...

- External Tools Framework (ETFW) being transitioned to use the resource manager "JAXB" XML descriptions.
  - Enhanced flexibility for tool integration
- Environment Management enhancements
  - Ordering of modules (important for some machines)
  - Connect environment management and scanner-discovery
- Separate Build system from CDT build
  - Cleaner multi-system build management
  - Builds in any language

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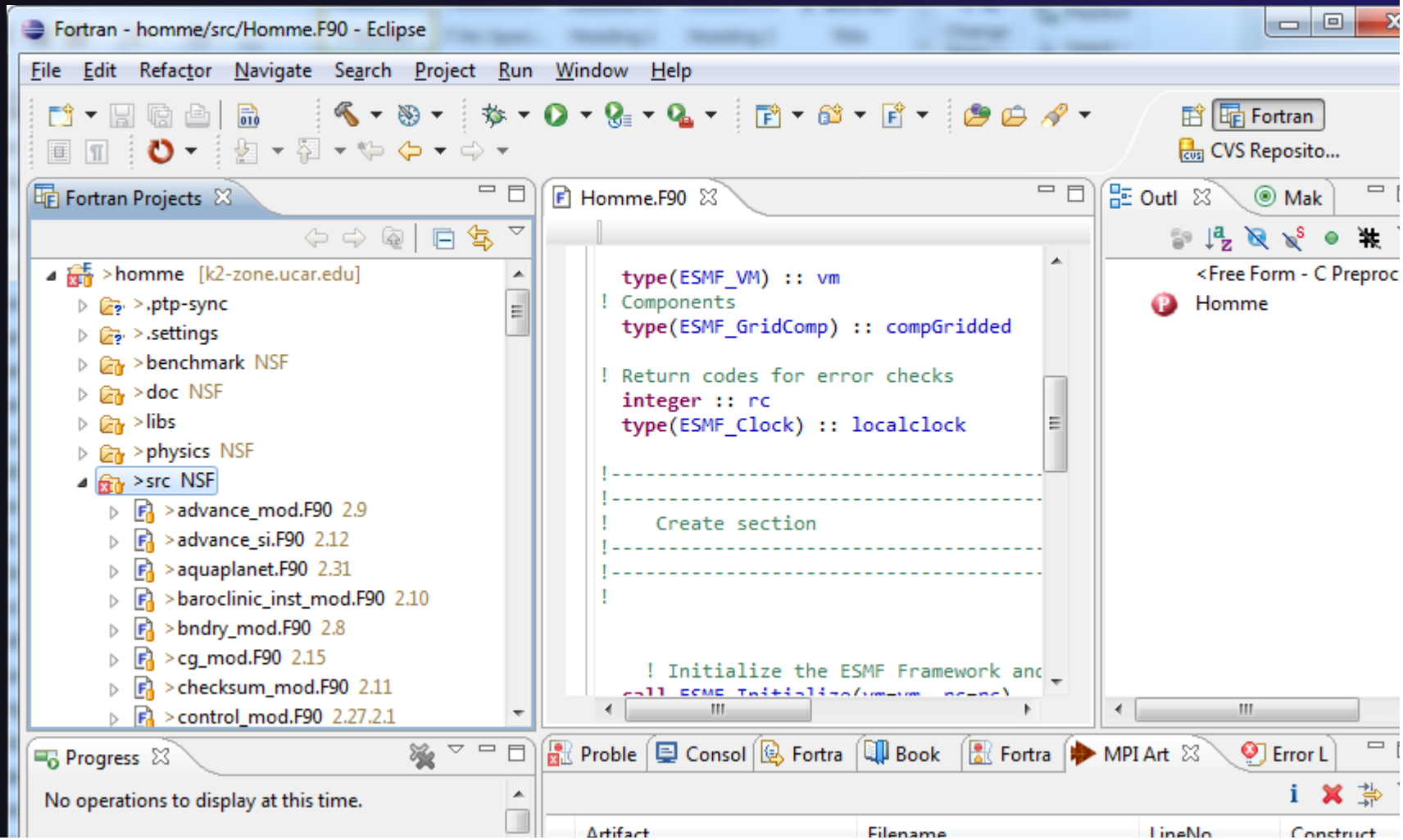
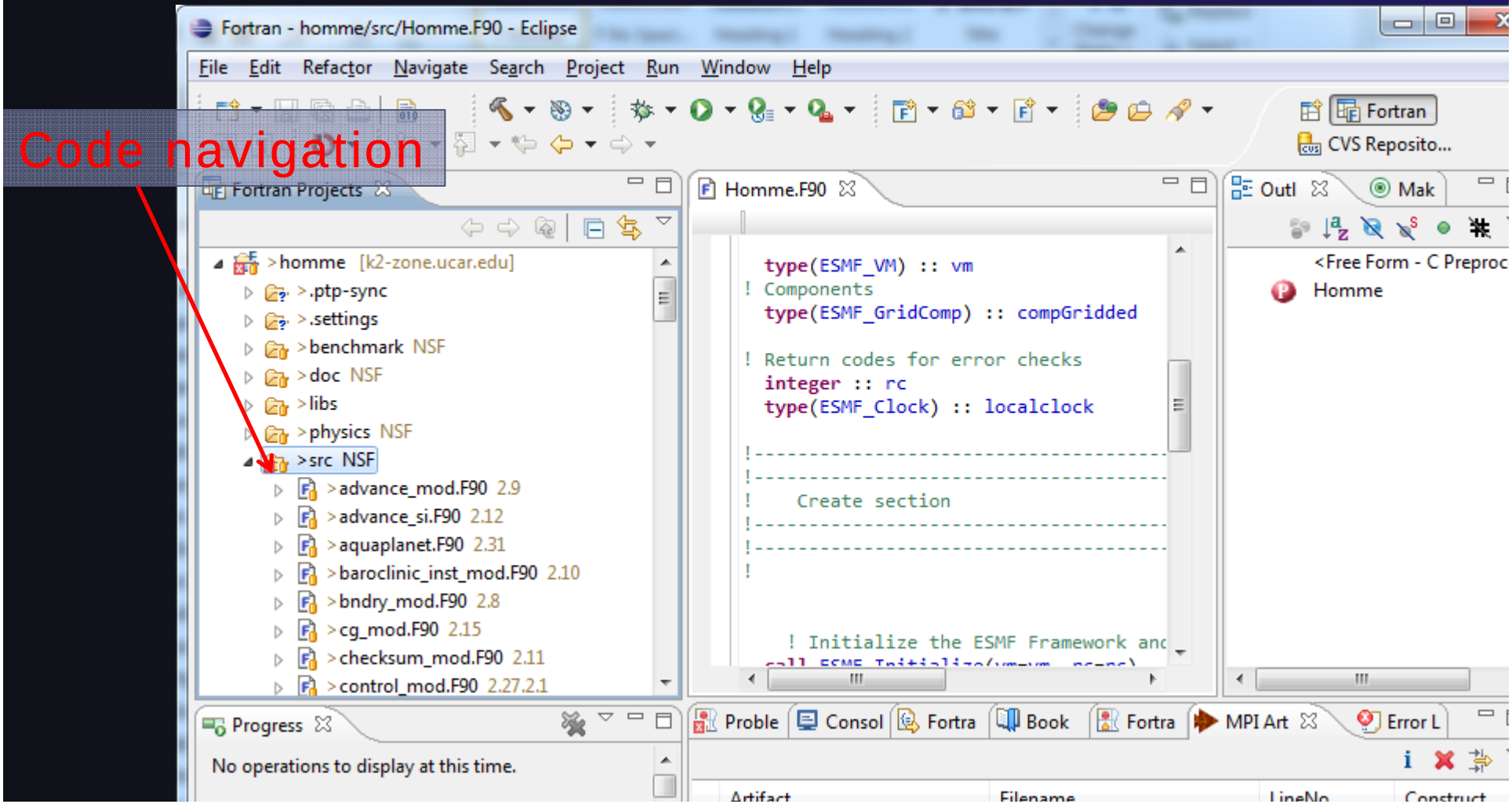
Software Engineering

- Code Visibility



Software Engineering

- Code Visibility



Software Engineering

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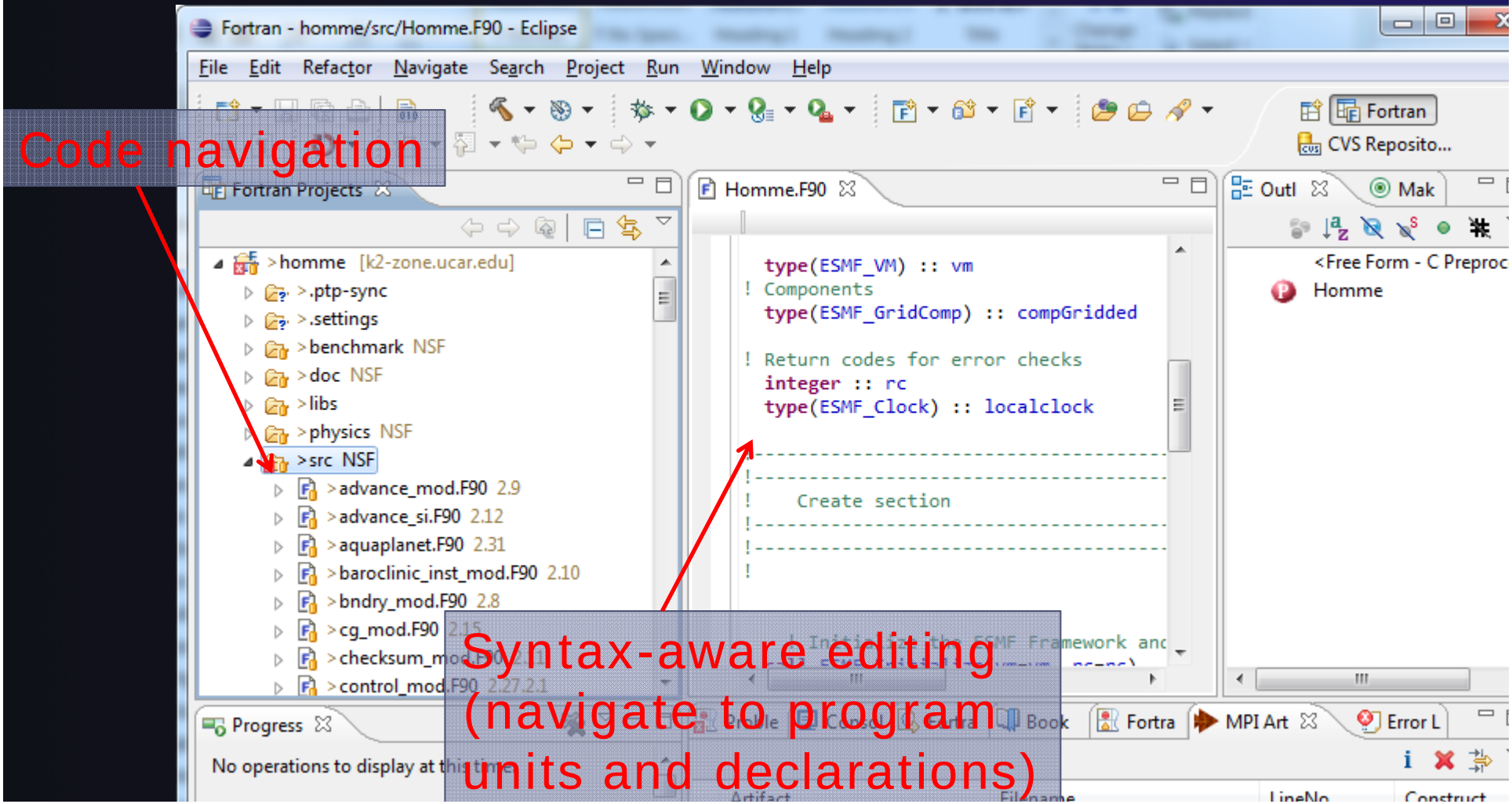
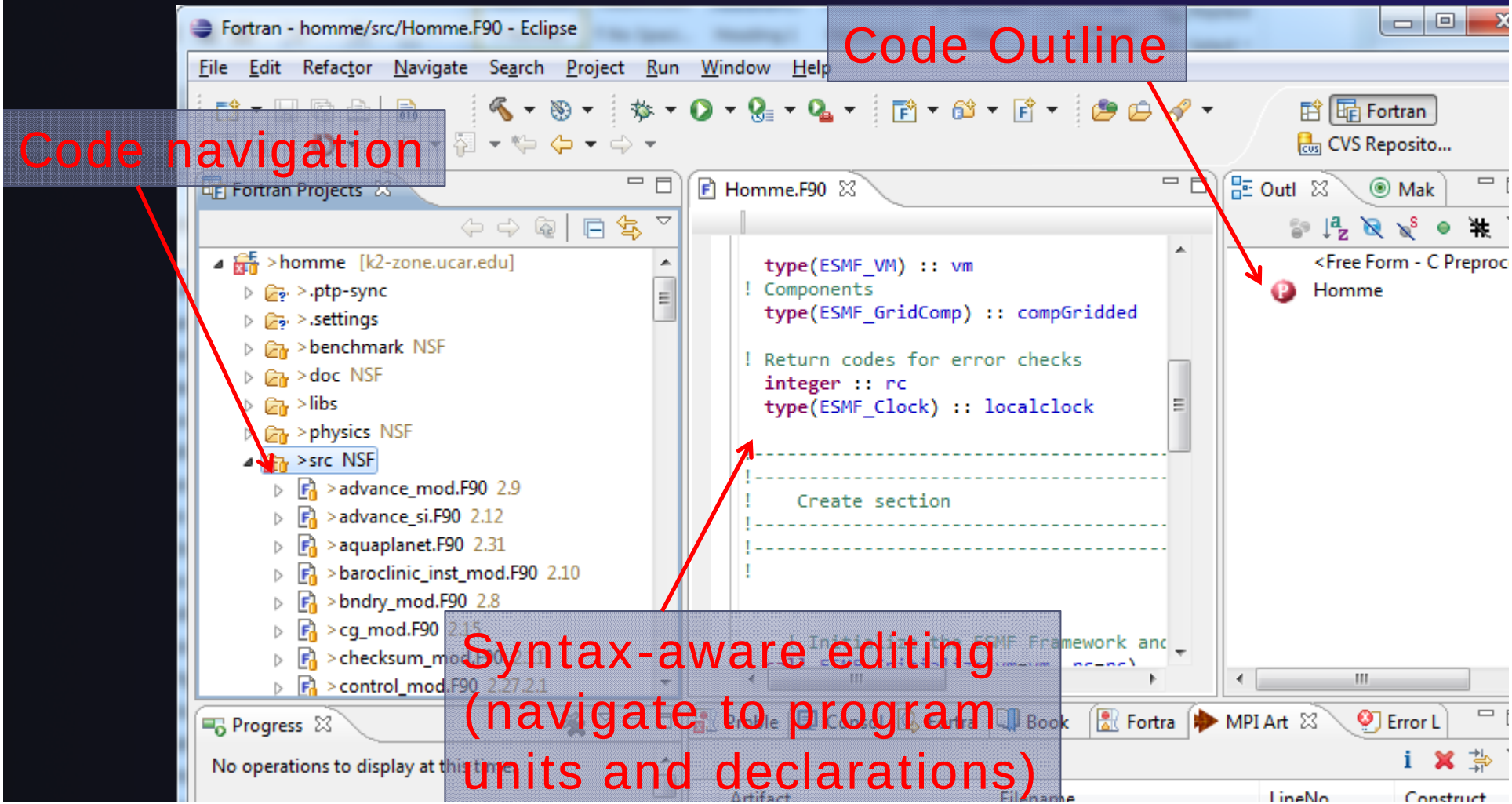


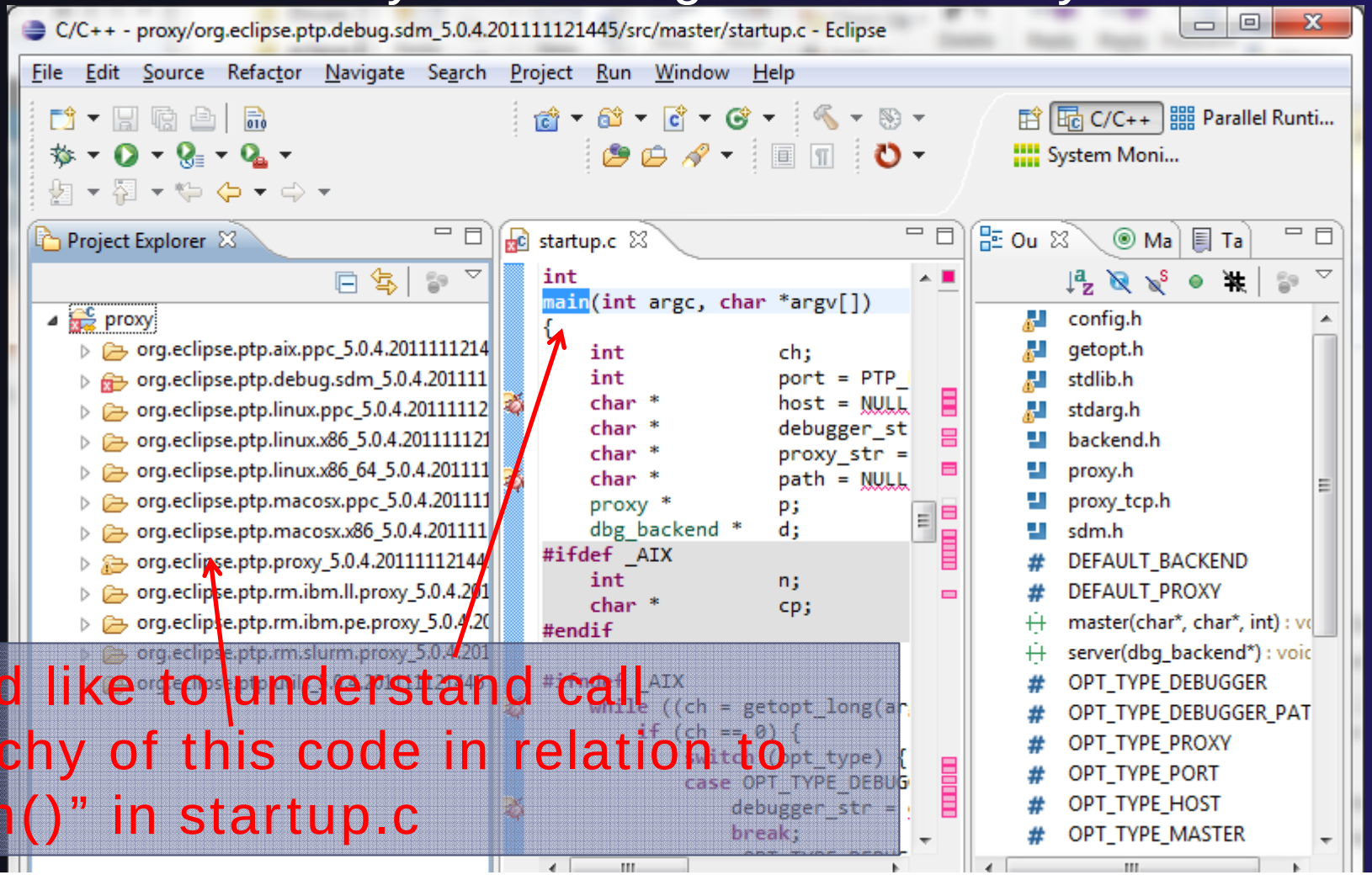
Software Engineering

- Code Visibility



Software Engineering

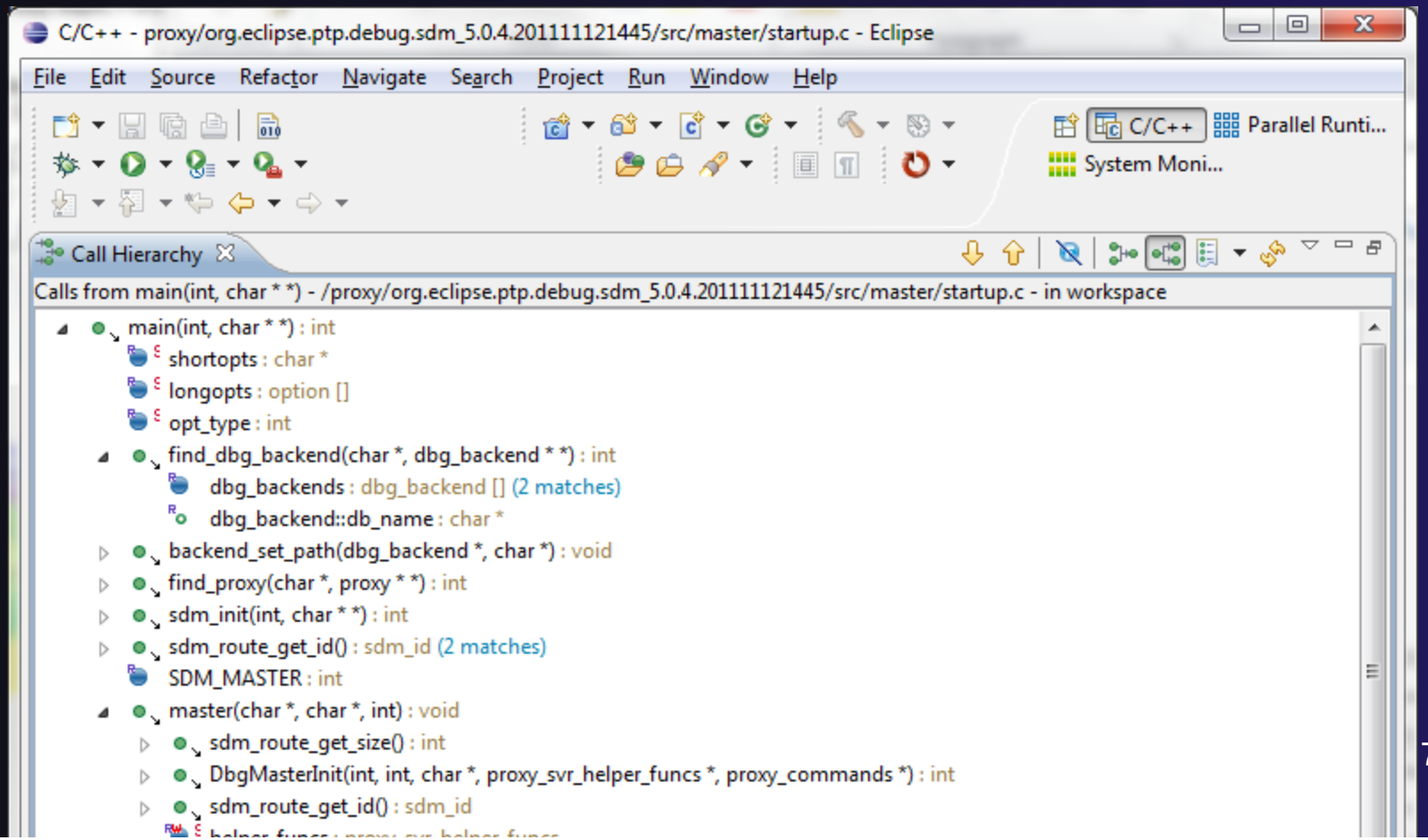
- Code visibility: deducing call hierarchy



Would like to understand call hierachy of this code in relation to "main()" in startup.c

Software Engineering: Call Hierarchy (C/C++)

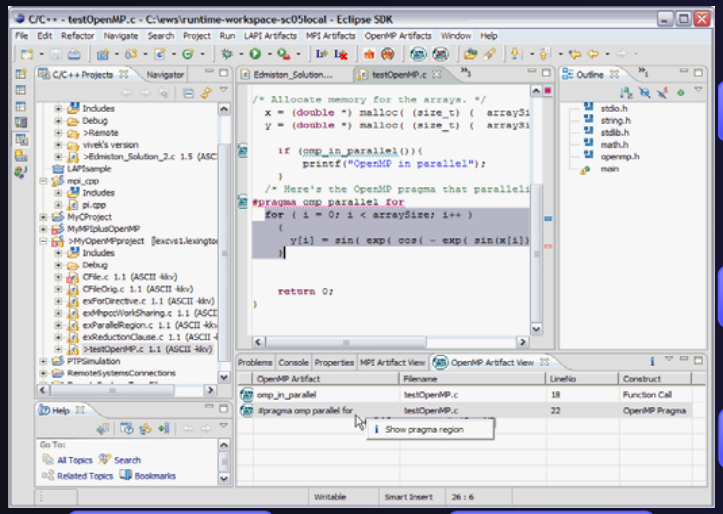
- After selecting main, right click and select <Open Call Hierarchy>



Multi-machine build management

- Local
  - Source is located on local machine, builds happen locally
- Synchronized
  - Source is local, then synchronized with remote machine(s)
  - Building and launching happens remotely (can also happen locally)
- Remote
  - Source is located on remote machine(s), build and launch takes place on remote machine(s)

Synchronized Projects

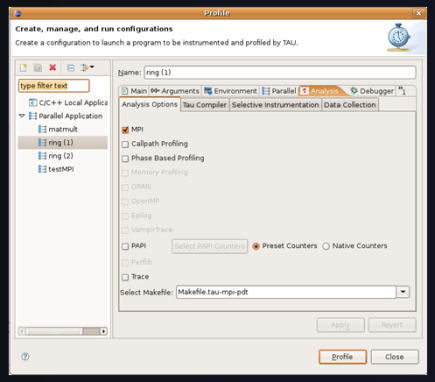


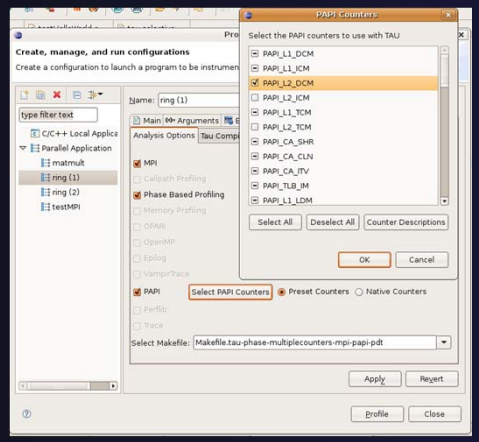
Launch Service
Run
Compute
Debug
Debug Service
Build Service
Executable
File Service
Index Service
Build
Edit
Search/Index
Navigation
Synchronize
Local source code
Source code copy
Local
Remote

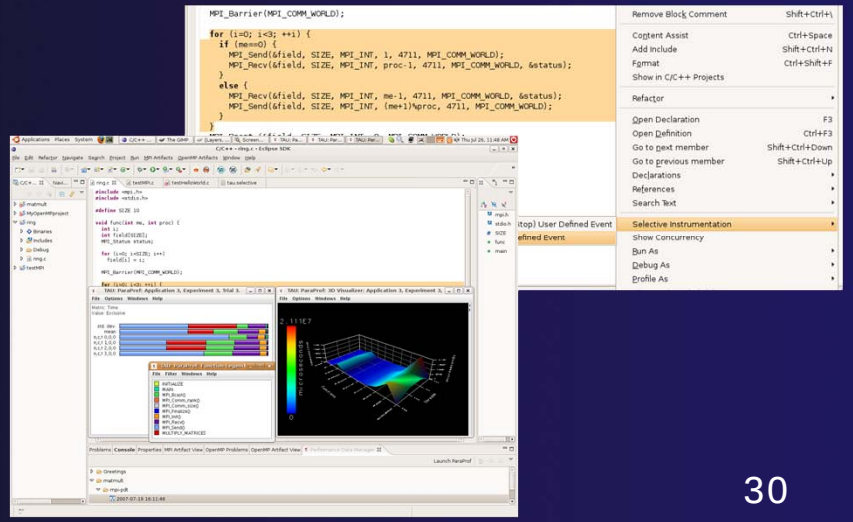
Performance Tuning: PTP TAU plug-ins

http://www.cs.uoregon.edu/research/tau

- TAU (Tuning and Analysis Utilities)
- First implementation of External Tools Framework (ETFw)
  - Support for additional command-line tools can be added with XML tool definitions
- Eclipse plug-ins wrap TAU functions, make them available from Eclipse
- Full GUI support for the TAU command line interface
- Performance analysis integrated with development environment





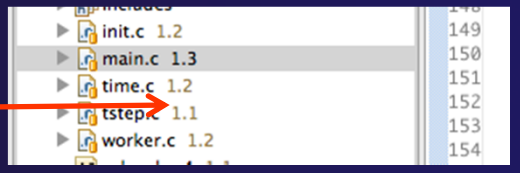


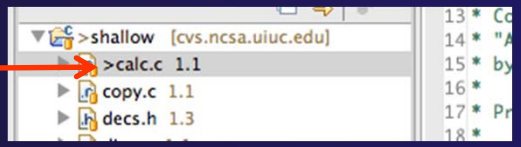
Source Code Control: “Team” Features

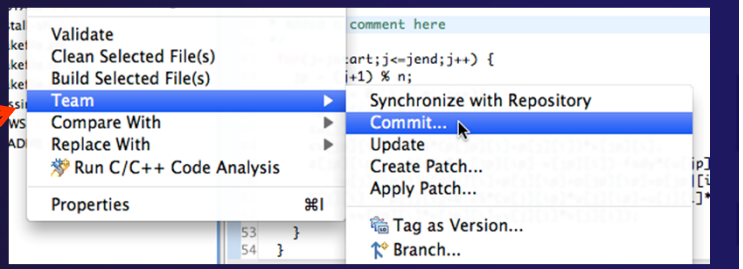
- Eclipse supports integration with multiple version control systems (VCS)
  - CVS, SVN, Git, and others
  - Collectively known as “Team” services
- Many features are common across VCS
  - Compare/merge
  - History
  - Check-in/check-out
- Some differences
  - Version numbers
  - Branching

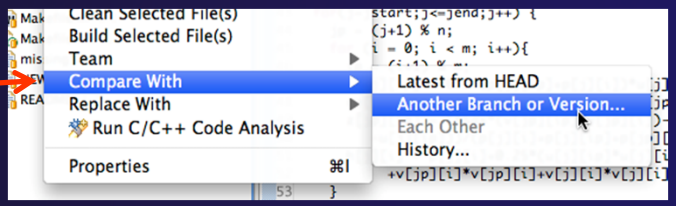
CVS Features

- Shows version numbers next to each resource
- Marks resources that have changed
  - Can also change color (preference option)
- Context menu for Team operations
- Compare to latest, another branch, or history
- Synchronize whole project (or any selected resources)
- Similar support for SVN, Git, ...



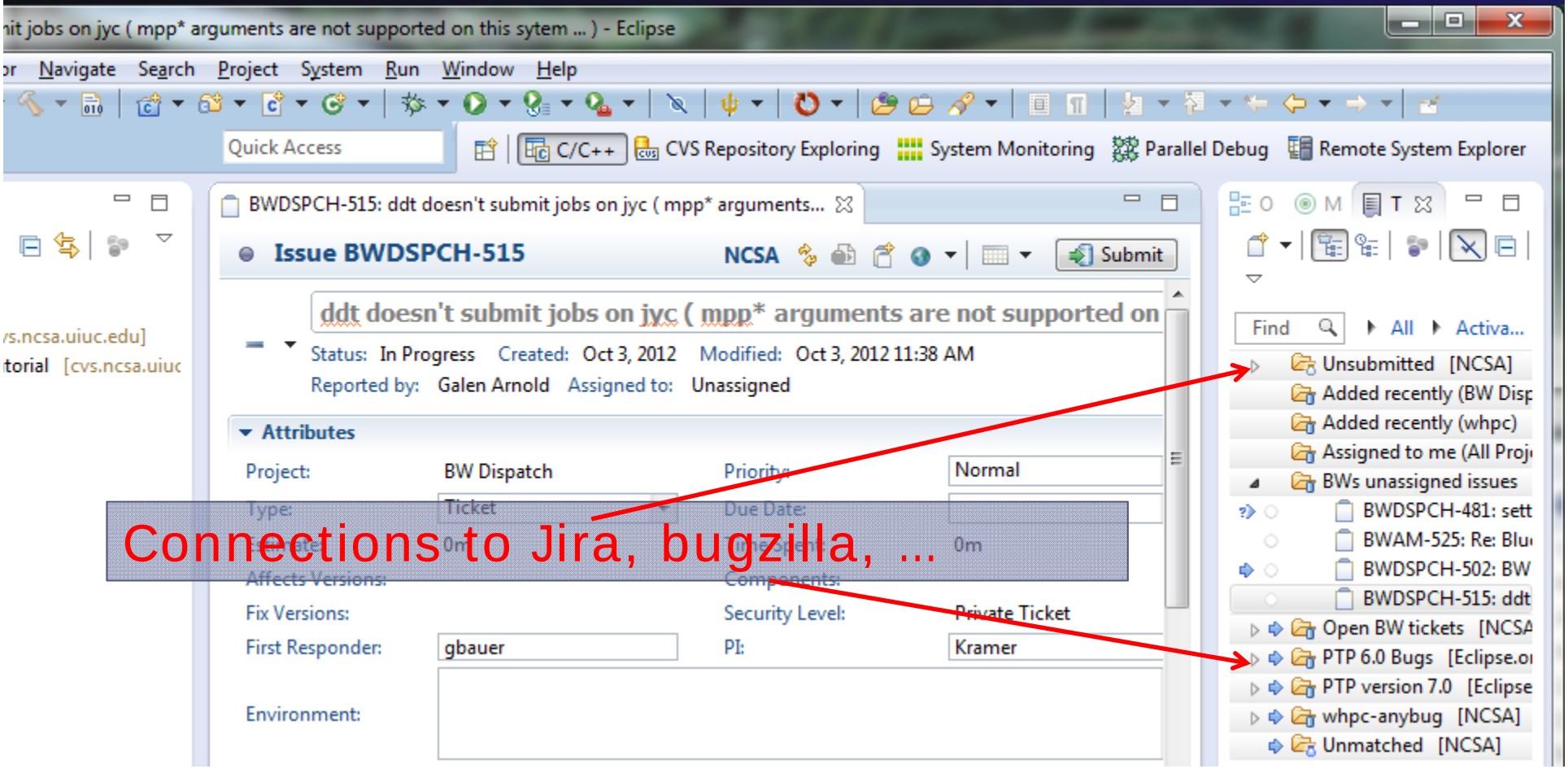






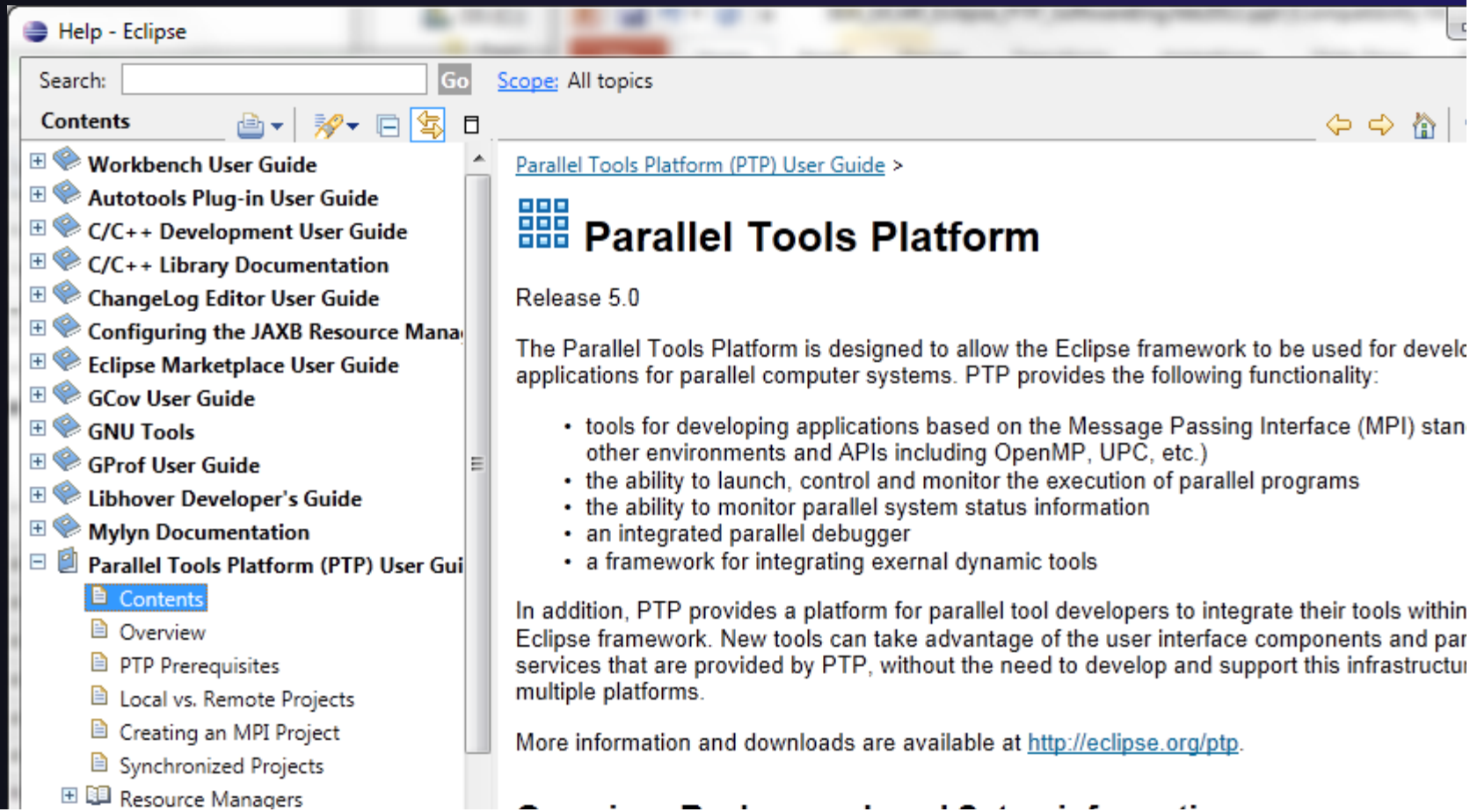
Issue Tracking

- Mylyn Bridge
  - Tracks tasks, links to source and bug repositories



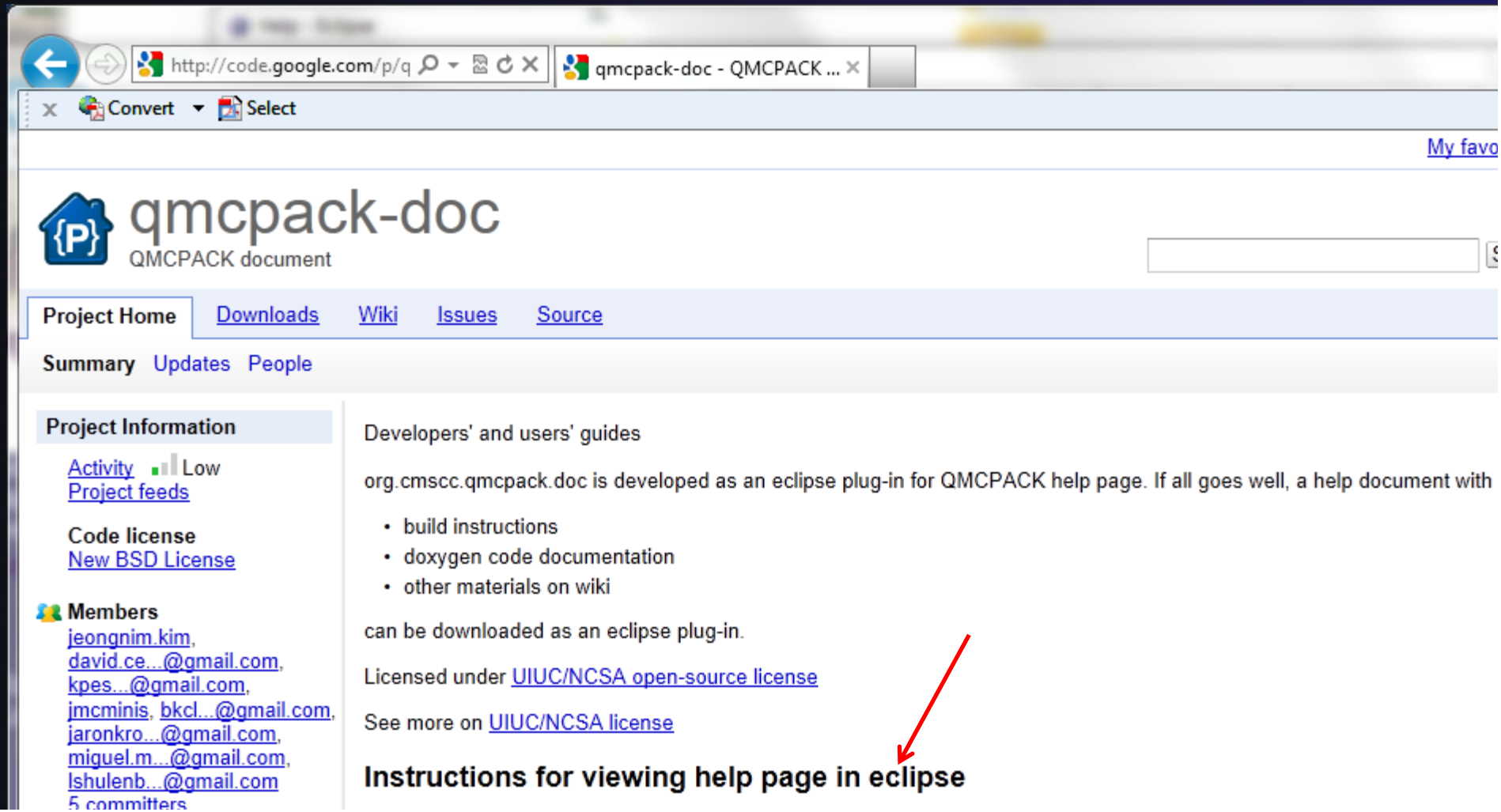
Eclipse Documentation

- Eclipse Help System – built in and standalone (http://help.eclipse.org)



Adapting Eclipse Documentation to Other Projects: QMCPack

- See http://code.google.com/p/qmcpack-doc/

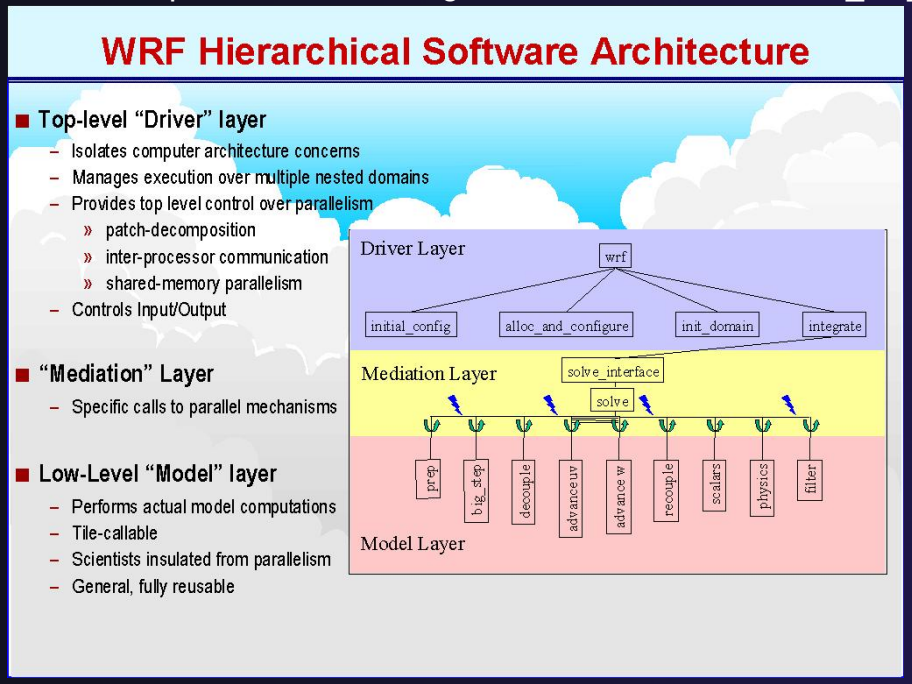


Consider 2 possible types of users of Eclipse Parallel Tools ...

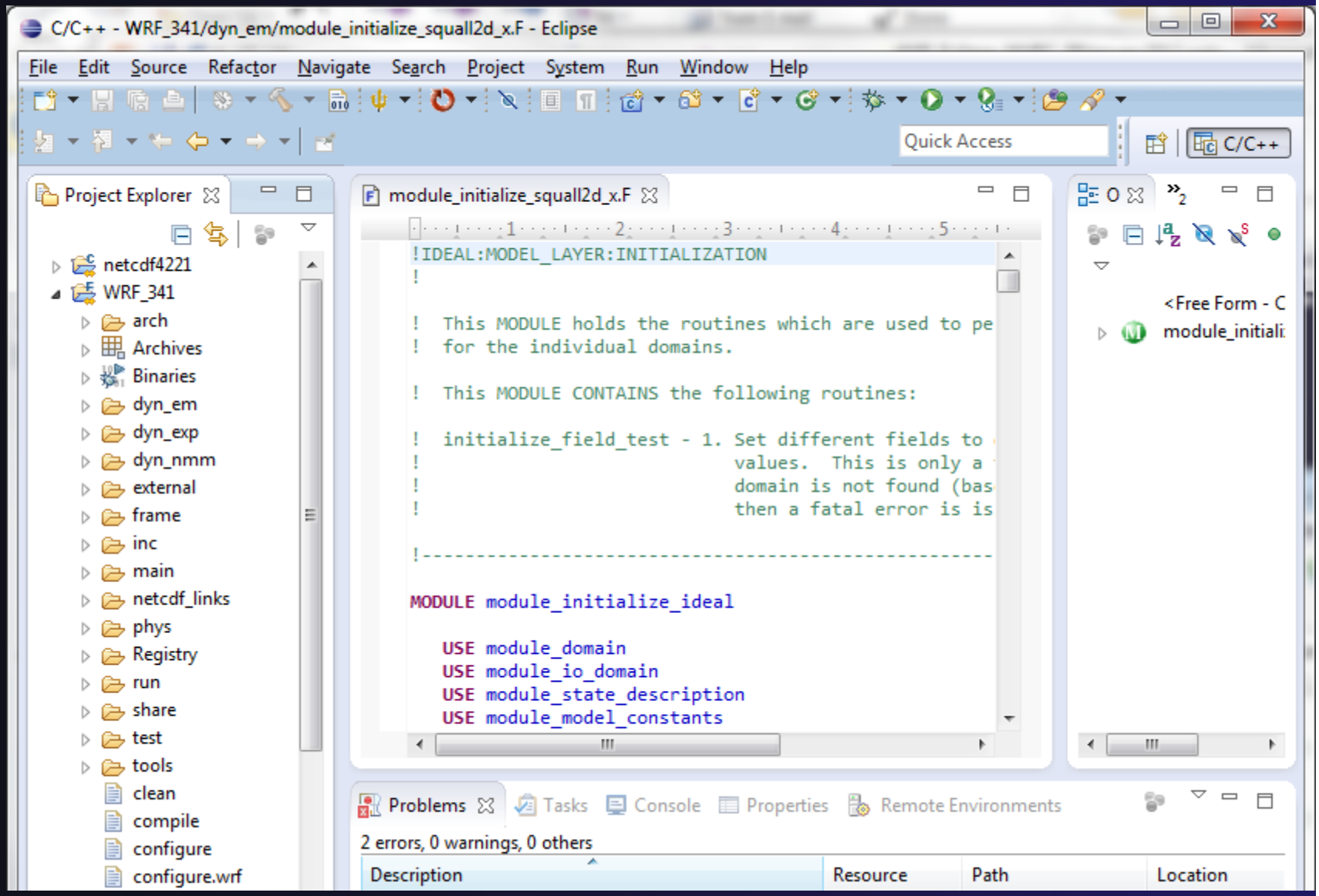
- Weather code users/modelers
  - Need to build weather code
  - May need to modify weather code (and rebuild)
- Software specialists enabling modeling projects
  - Lots of software engineering concerns
- Next set of slides address some of those concerns.

Weather code users/modelers

- Some of the challenges
  - Complex codes (eg WRF)
  - Codes + HPC architectures can be daunting
  - Adding user code not always easy
- WRF: from http://wrf-model.org/PRESENTATIONS/2000_04_18_Klemp/sld007.htm



Navigating Weather Codes



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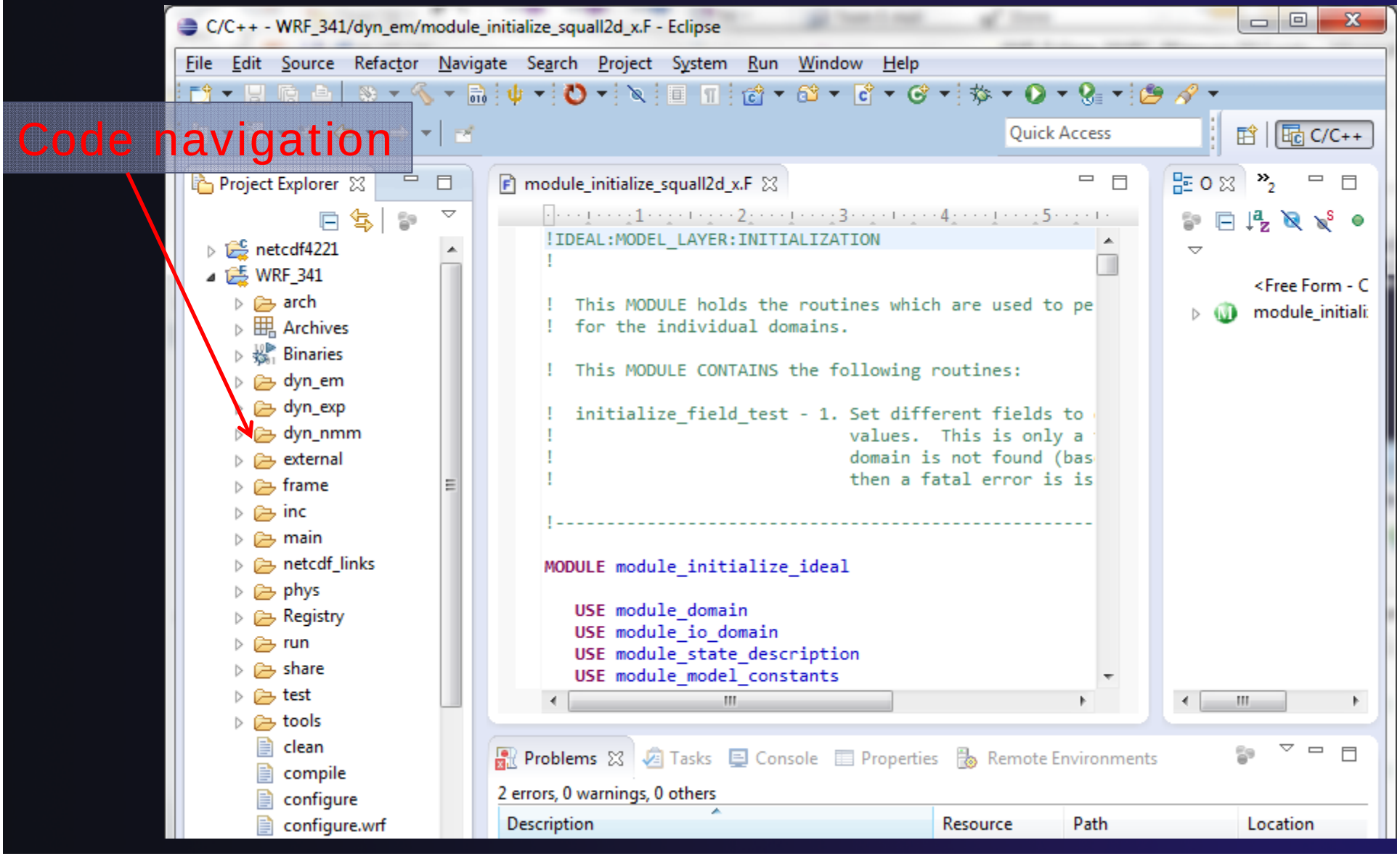

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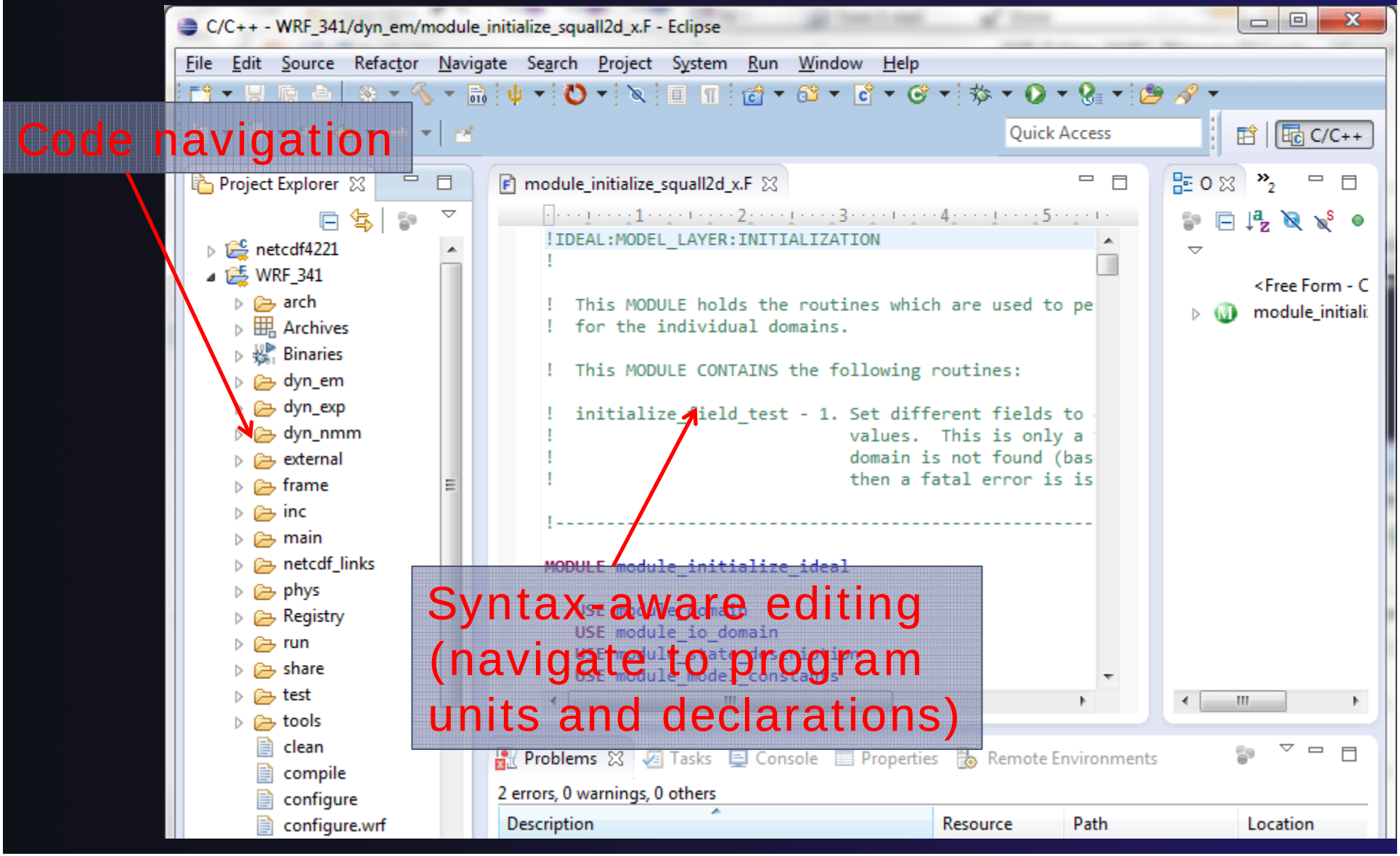

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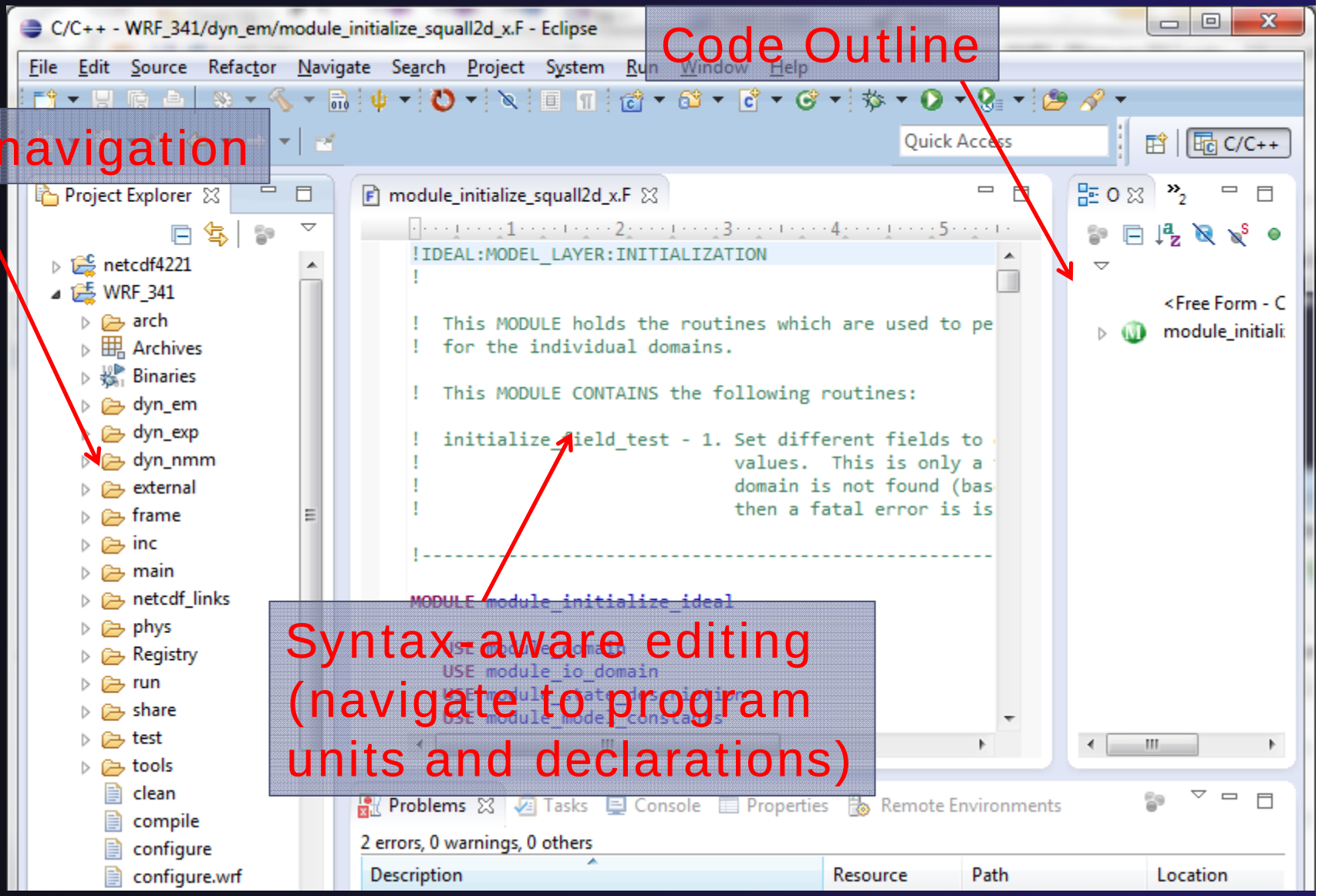

Eclipse aiding in the WRF workflow…

- May want to add a model output variable
- Eclipse PTP makes it easy to navigate source, make changes
- WRF Build
  - Interactive “compile” script – use terminal within Eclipse to complete
  - Configure Eclipse to drive “make” to iteratively build after modifications
- WRF Run – can generate a run configuration for particular system, batch environment

Software Specialists enabling modeling projects

- Need a wider array of software engineering tools
  - Source repository
  - Issue tracking
  - Documentation
  - Performance tuning…
- Eclipse Parallel Tools can help with many of these concerns

Outline

- Overview of Eclipse and Eclipse Parallel Tools Platform (PTP)
- Motivation for Workbench for High Performance Computing (WHPC)
  - Improvements to Eclipse PTP
- Software Engineering Practices Enabled by Eclipse PTP
  - Code visibility
  - Multi-system build management
  - Performance tuning
  - Source code control
  - Issue Tracking
  - Documentation
  - Earth Science/Weather code example
- Eclipse PTP Resources

Online Information

- Information about PTP
  - Main web site for downloads, documentation, etc.
    - http://eclipse.org/ptp
  - **Wiki for designs, planning, meetings, etc.**
    - **http://wiki.eclipse.org/PTP**
  - Articles and other documents
    - http://wiki.eclipse.org/PTP/articles
- Information about Photran
  - Main web site for downloads, documentation, etc.
    - http://eclipse.org/photran
  - User's manuals
    - http://wiki.eclipse.org/PTP/photran/documentation

Mailing Lists

- PTP Mailing lists
  - Major announcements (new releases, etc.) - low volume
    - http://dev.eclipse.org/mailman/listinfo/ptp-announce
  - User discussion and queries - medium volume
    - http://dev.eclipse.org/mailman/listinfo/ptp-user
  - Developer discussions - high volume
    - http://dev.eclipse.org/mailman/listinfo/ptp-dev
- Photran Mailing lists
  - User discussion and queries
    - http://dev.eclipse.org/mailman/listinfo/photran
  - Developer discussions –
    - http://dev.eclipse.org/mailman/listinfo/photran-dev

Getting Involved

- See http://eclipse.org/ptp
- Read the developer documentation on the wiki
- Join the mailing lists
- Attend the monthly developer meetings
  - Conf Call Monthly: Second Tuesday, 1:00 pm ET
  - Details on the PTP wiki
- Attend the monthly user meetings
  - Teleconference Monthly
  - Each 4th Wednesday, 2:00 pm ET
  - Details on the PTP wiki

PTP will only succeed with your participation!