parallel tools platform

http://eclipse.org/ptp

Development Environments for HPC: The View from NCSA

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DEHPC '15
San Francisco, CA
18 October 2015

Acknowledgements

- Portions of this material are supported by or based upon work supported by the Defense Advanced Research Projects Agency (DARPA) under its Agreement No. HR0011-07-9-0002, the United States Department of Energy under Contract No. DE-FG02-06ER25752, the Blue Waters sustained petascale computing project, which is supported by the National Science Foundation under award number OCI 07-25070, and the SI2-SSI Productive and Accessible Development Workbench for HPC Applications, which is supported by the National Science Foundation under award number OCI 1047956

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- Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

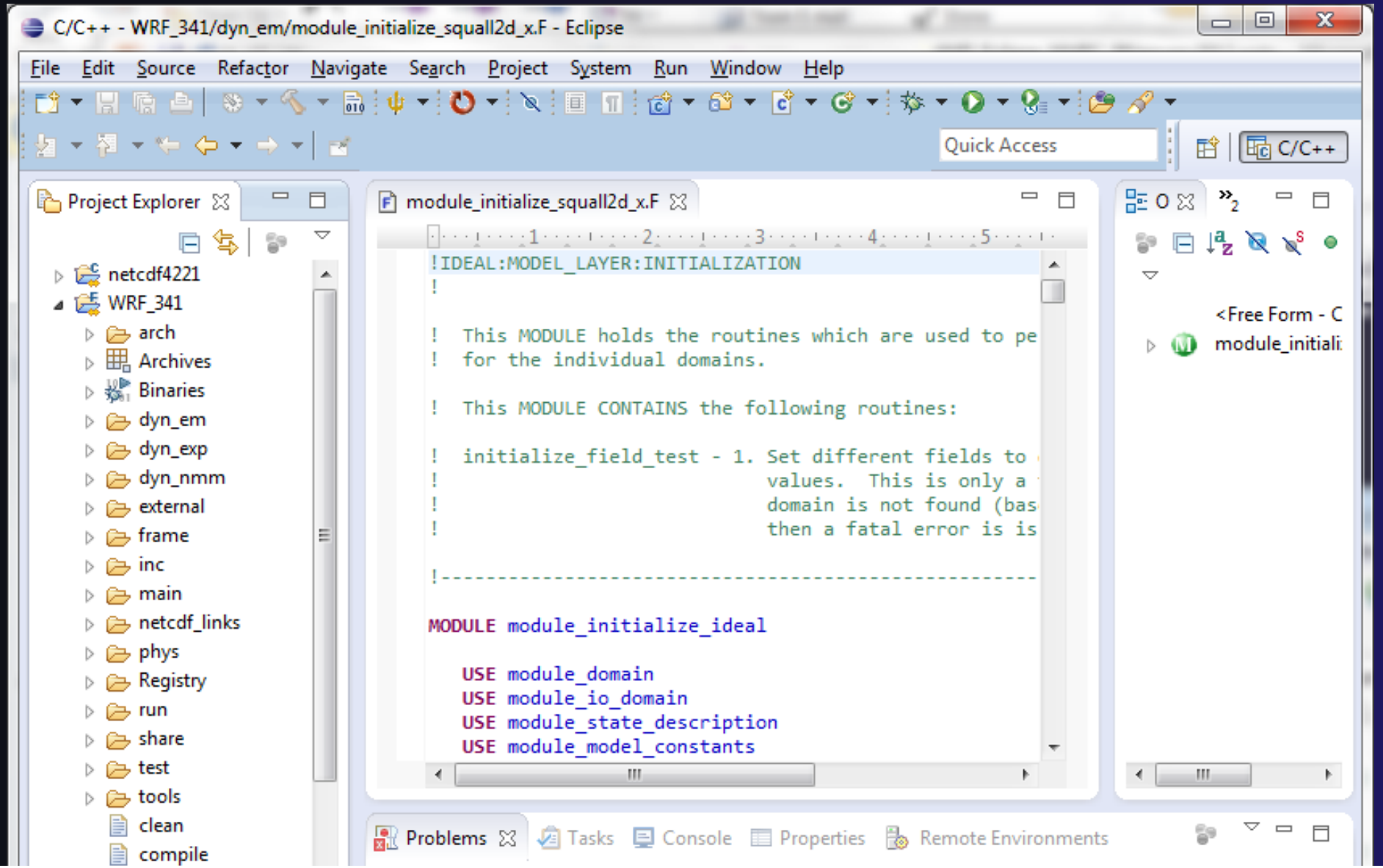
Outline

- Overview of Eclipse and the Parallel Tools Platform (PTP)
- Motivation for Workbench for High Performance Computing (WHPC)
- Advantages of Eclipse for HPC Software Developers
- Sustainability, Investment, Collaboration: Building Community
- Challenges with DEHPC
- Opportunities (for discussion)

Eclipse

- Integrated development environment (IDE)
  - Edit code, compile, run, debug without leaving Eclipse
  - Graphical user interface

Eclipse


C/C++ - WRF_341/dyn_em/module_initialize_squall2d_x.F - Eclipse
File Edit Source Refactor Navigate Search Project System Run Window Help
Quick Access
C/C++
Project Explorer
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WRF_341
arch
Archives
Binaries
dyn_em
dyn_exp
dyn_nmm
external
frame
inc
main
netcdf_links
phys
Registry
run
share
test
tools
clean
compile
module_initialize_squall2d_x.F
!IDEAL:MODEL_LAYER:INITIALIZATION
!
! This MODULE holds the routines which are used to pe
! for the individual domains.
! This MODULE CONTAINS the following routines:
! initialize_field_test - 1. Set different fields to
! values. This is only a
! domain is not found (bas
! then a fatal error is is
!---
MODULE module_initialize_ideal
USE module_domain
USE module_io_domain
USE module_state_description
USE module_model_constants
<Free Form - C
module_initiali
Problems
Tasks
Console
Properties
Remote Environments

Eclipse

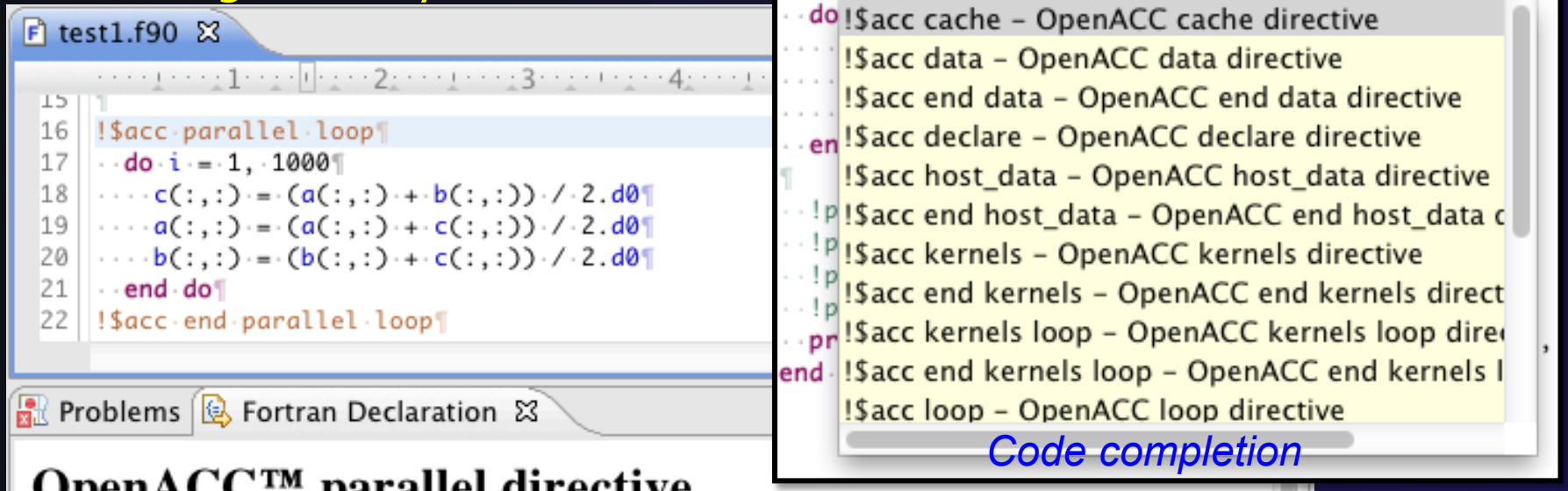
- Integrated development environment (IDE)
  - Edit code, compile, run, debug without leaving Eclipse
  - Graphical user interface
- **Plug-ins** add new functionality to Eclipse
  - Support languages: C/C++, Fortran, Python, …
  - Support version control systems: Git, Subversion, …
  - Support issue tracking systems: Bugzilla, Jira, …
  - Support HPC development (?!)

Parallel Tools Platform (PTP)

- **PTP:** a set of plug-ins that extend Eclipse to support HPC development
  - Write code on your laptop
  - Build it on a remote HPC system using its compilers
  - Run it on the remote HPC system (qsub)
  - Debug it on the remote system (MPI debugger)
  - Tune it for performance on the remote system
  - …all inside Eclipse!

Eclipse Parallel Tools Platform (PTP)

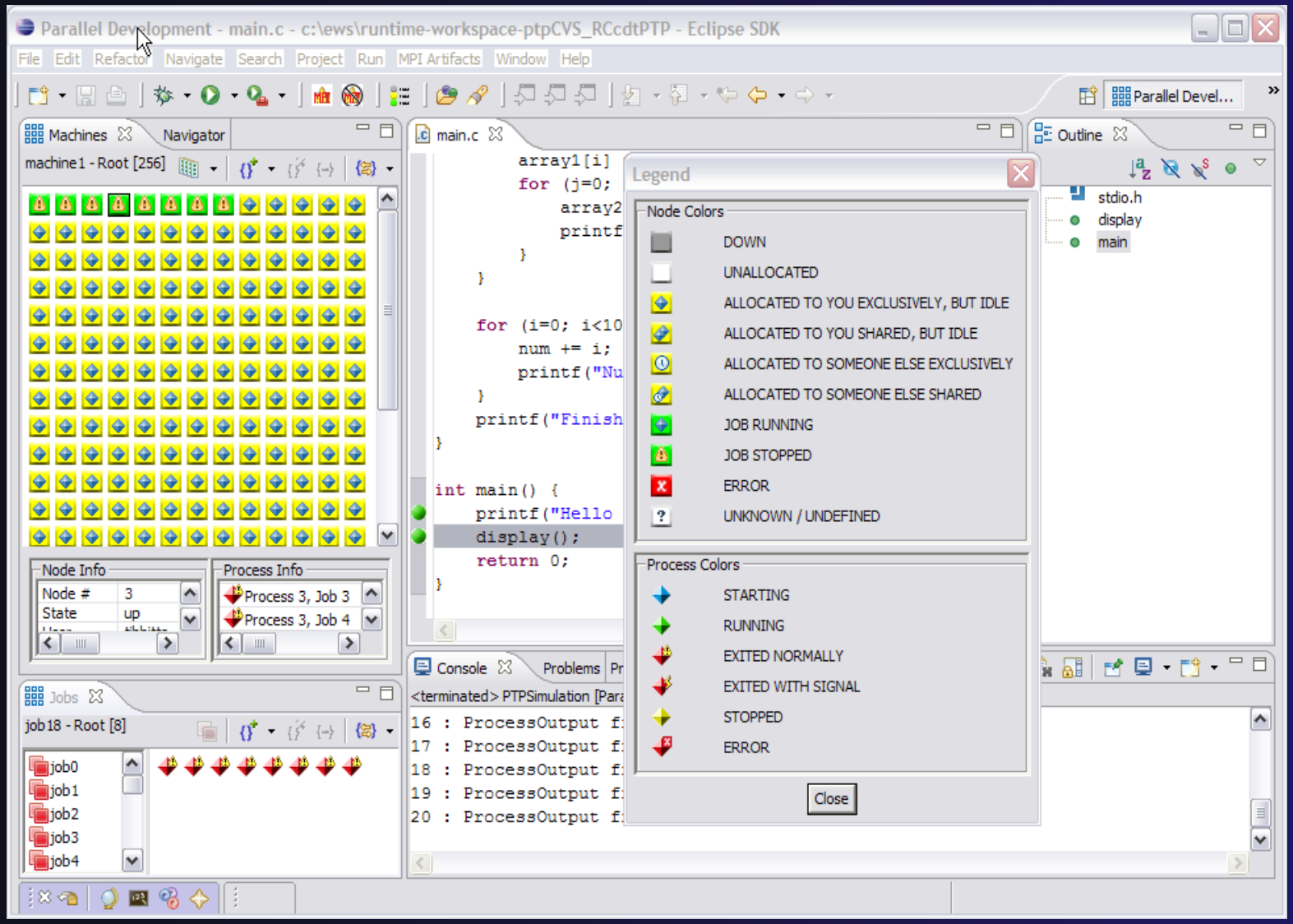
Coding & Analysis



Eclipse Parallel Tools Platform (PTP)

Coding & Analysis

Launching & Monitoring



Eclipse Parallel Tools Platform (PTP)

Coding & Analysis

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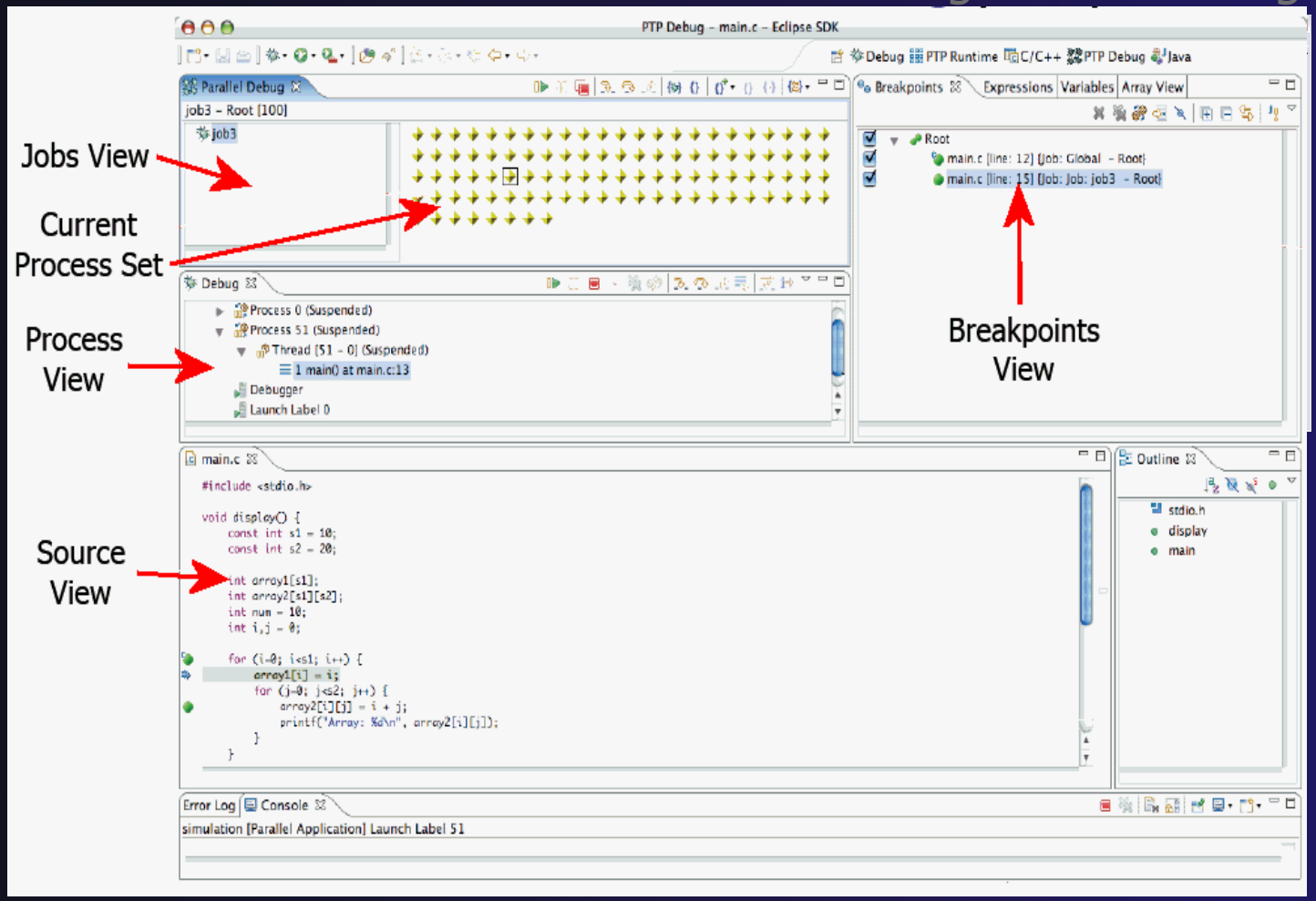
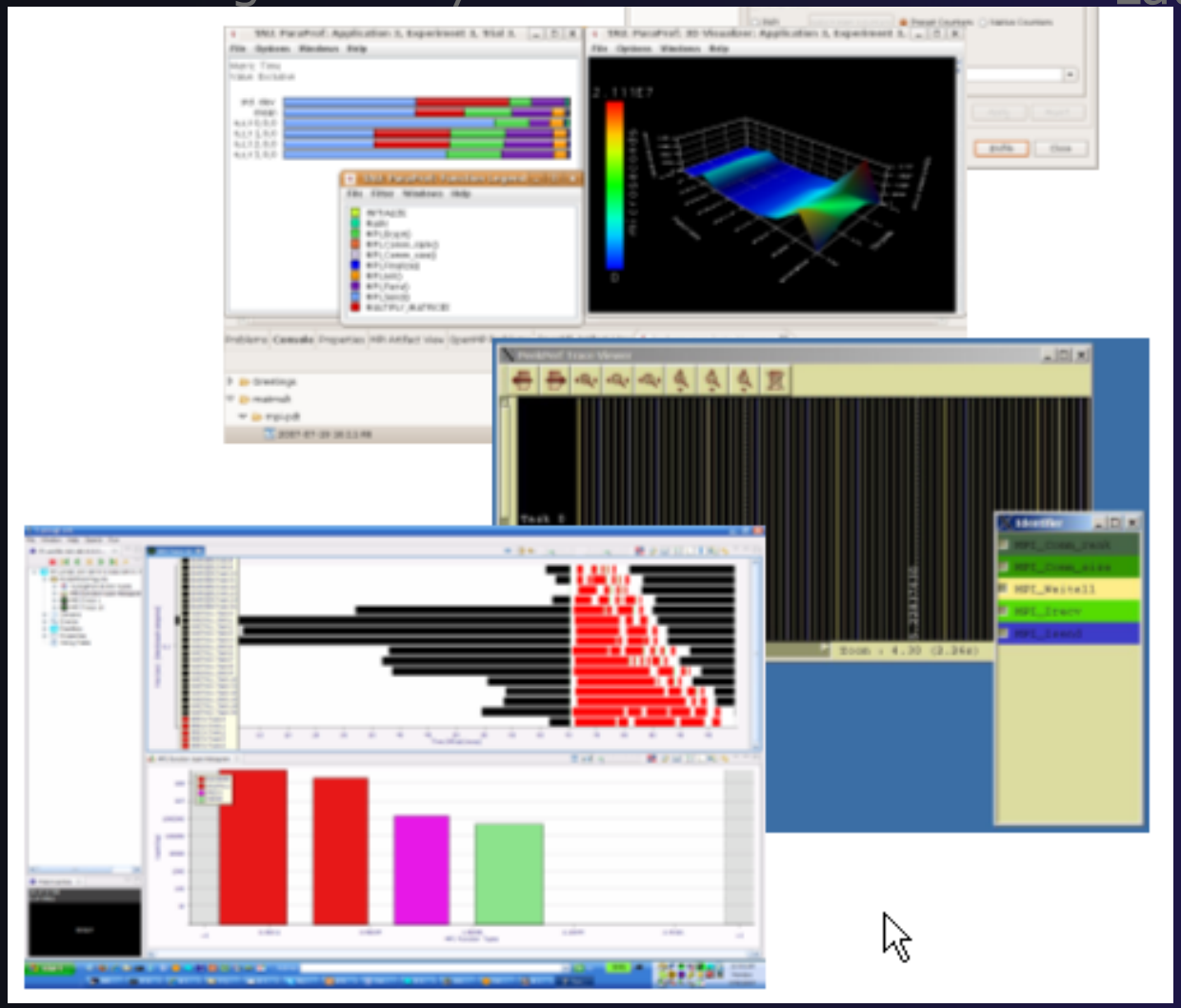


Debugging

Eclipse Parallel Tools Platform (PTP)

Coding & Analysis

Launching & Monitoring

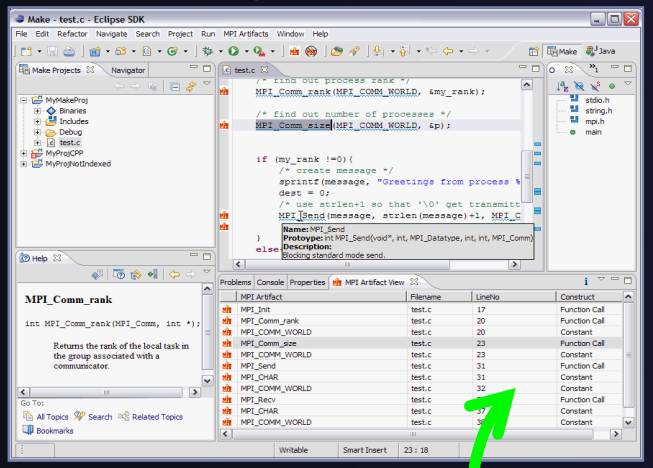


Debugging

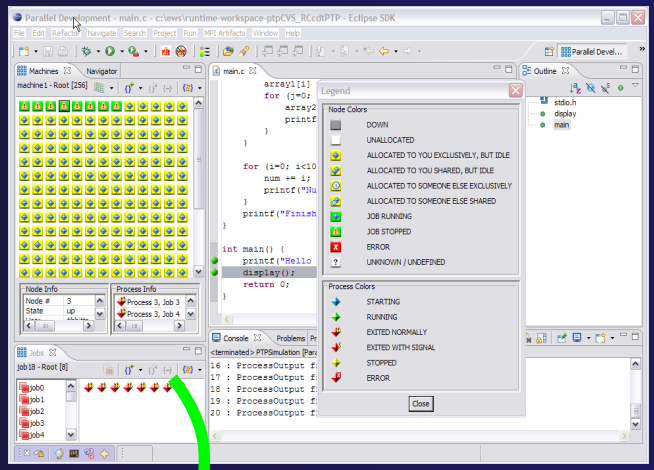
Performance Tuning

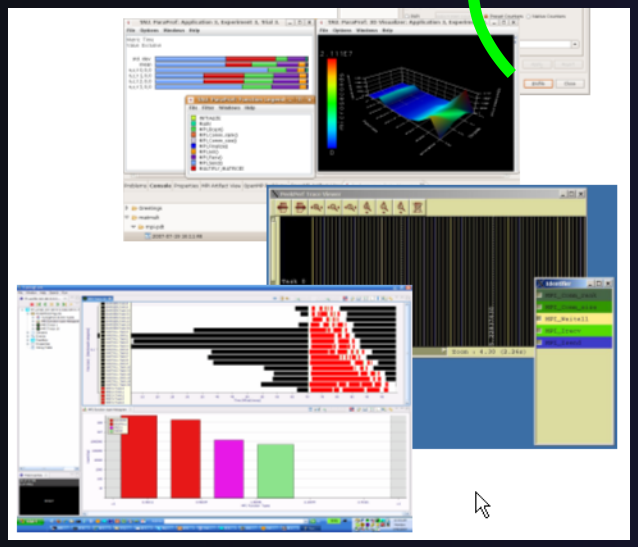
Eclipse Parallel Tools Platform (PTP)

Coding & Analysis

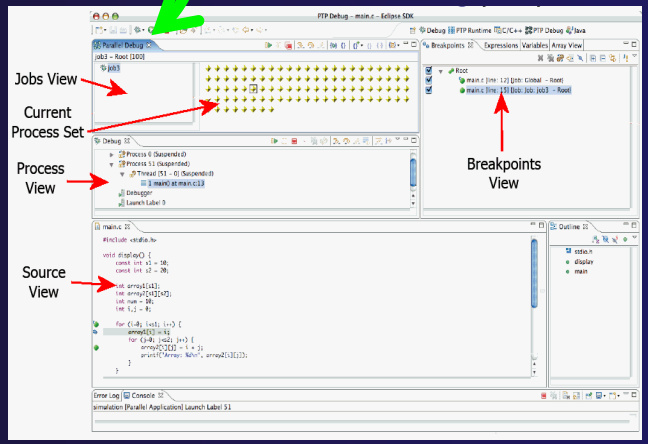


Launching & Monitoring





Performance Tuning



Debugging

Motivation for Workbench for High Performance Computing (WHPC)

- Context
  - NSF 1047956: SI2-SSI: A Productive and Accessible Development Workbench for HPC Applications Using the Eclipse Parallel Tools Platform
- 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

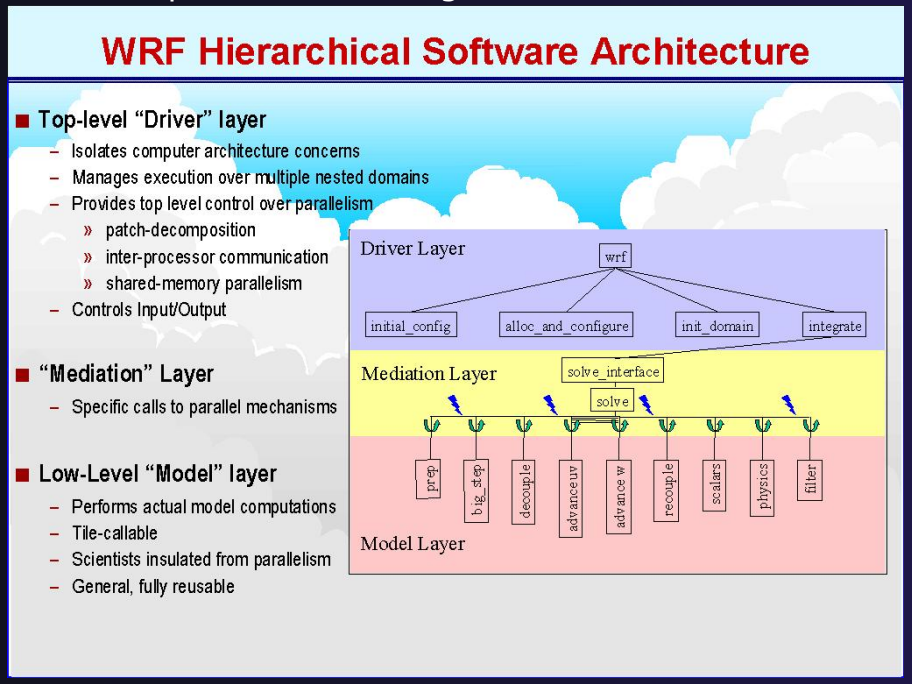
- Work within Eclipse release cycle
  - Major (API-breaking) improvements with coordinated June release
    - Last major release Eclipse 4.5 “Mars” released June 2015
  - Minor enhancements and bug-fixes with two coordinated service releases in September and February
    - Eclipse 4.5 SR1 Released September, 2015.
- Foci of improvements
  - Improve usability
  - Improve productivity

Consider 2 possible types of users of Eclipse Parallel Tools …

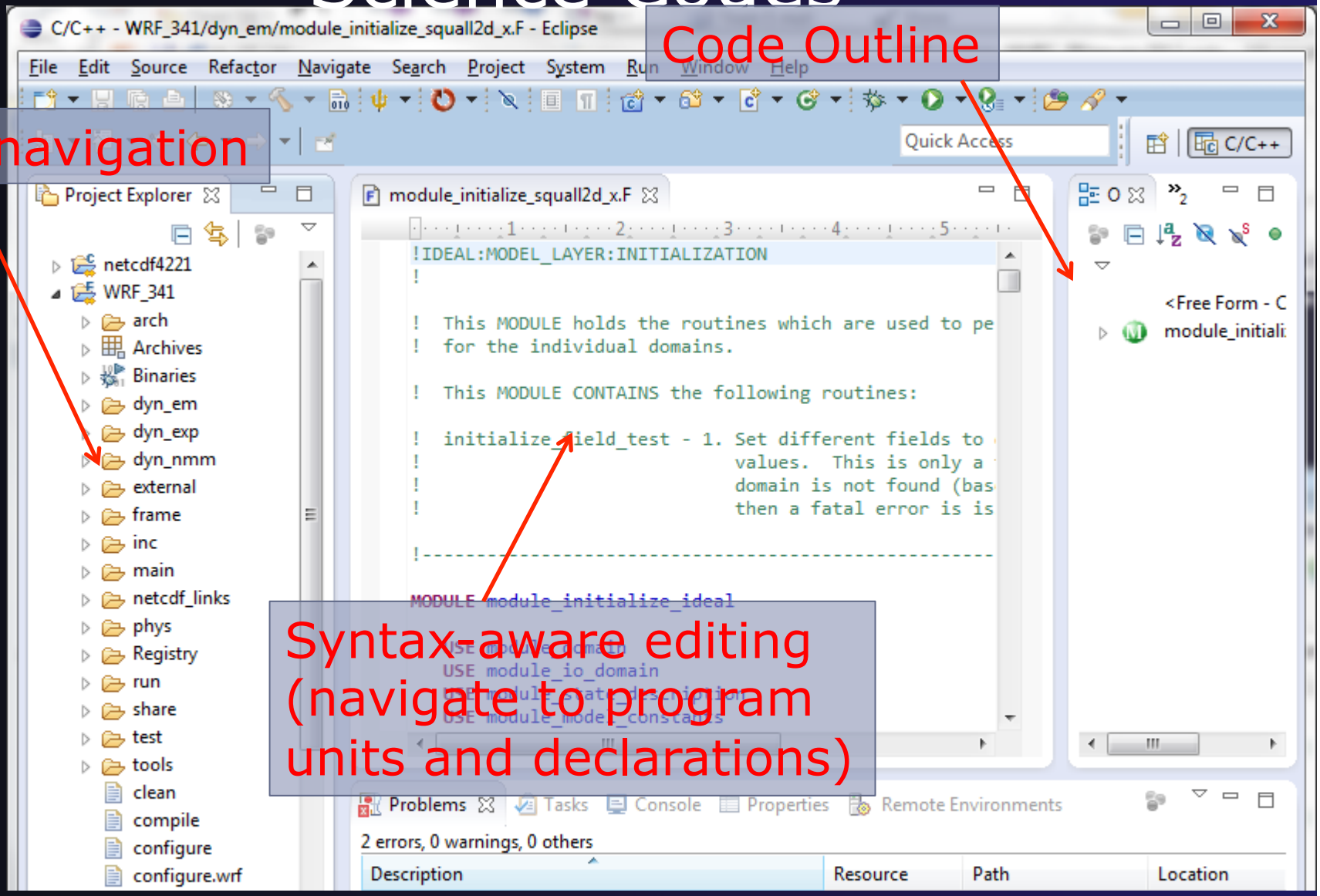
- Science code users/modelers
  - Need to build science code
  - May need to modify science code (and rebuild)
- Software specialists enabling modeling projects
  - Lots of software engineering concerns
- Next set of slides address some of those concerns.

Science 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 Computational Science Codes



Eclipse aiding in a typical code workflow…

- May want to add a model output variable
- Eclipse PTP makes it easy to navigate source, make changes
- Drive remote builds on HPC resources
  - Make, autotools…
- Run – can generate a run configuration for particular system, batch environment

Software Specialists enabling modeling projects

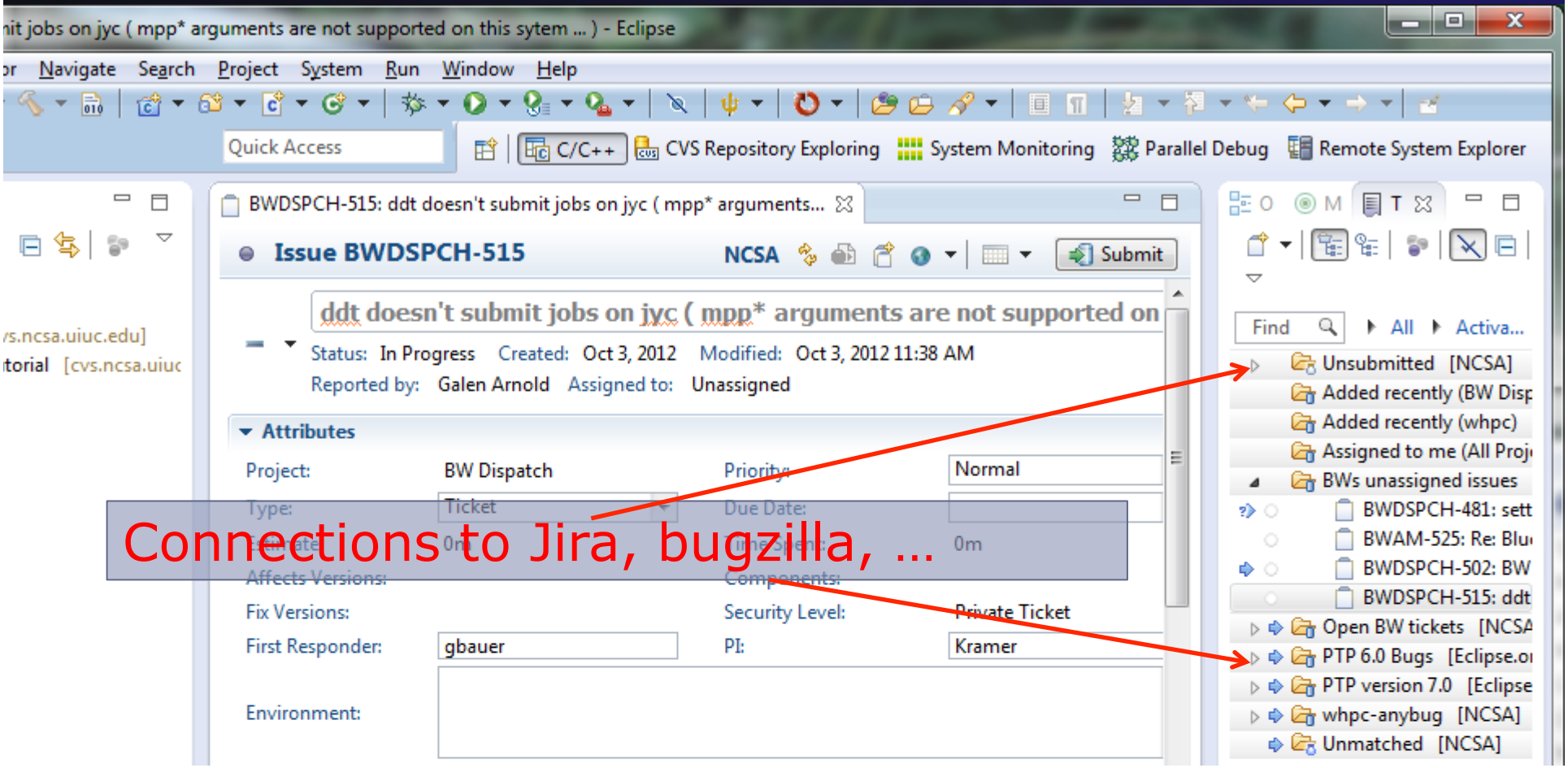
- Need a wider array of software engineering tools
  - Source repository
  - Issue tracking
  - Documentation
  - Performance tuning…
- Eclipse Parallel Tools can help with many of these concerns

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

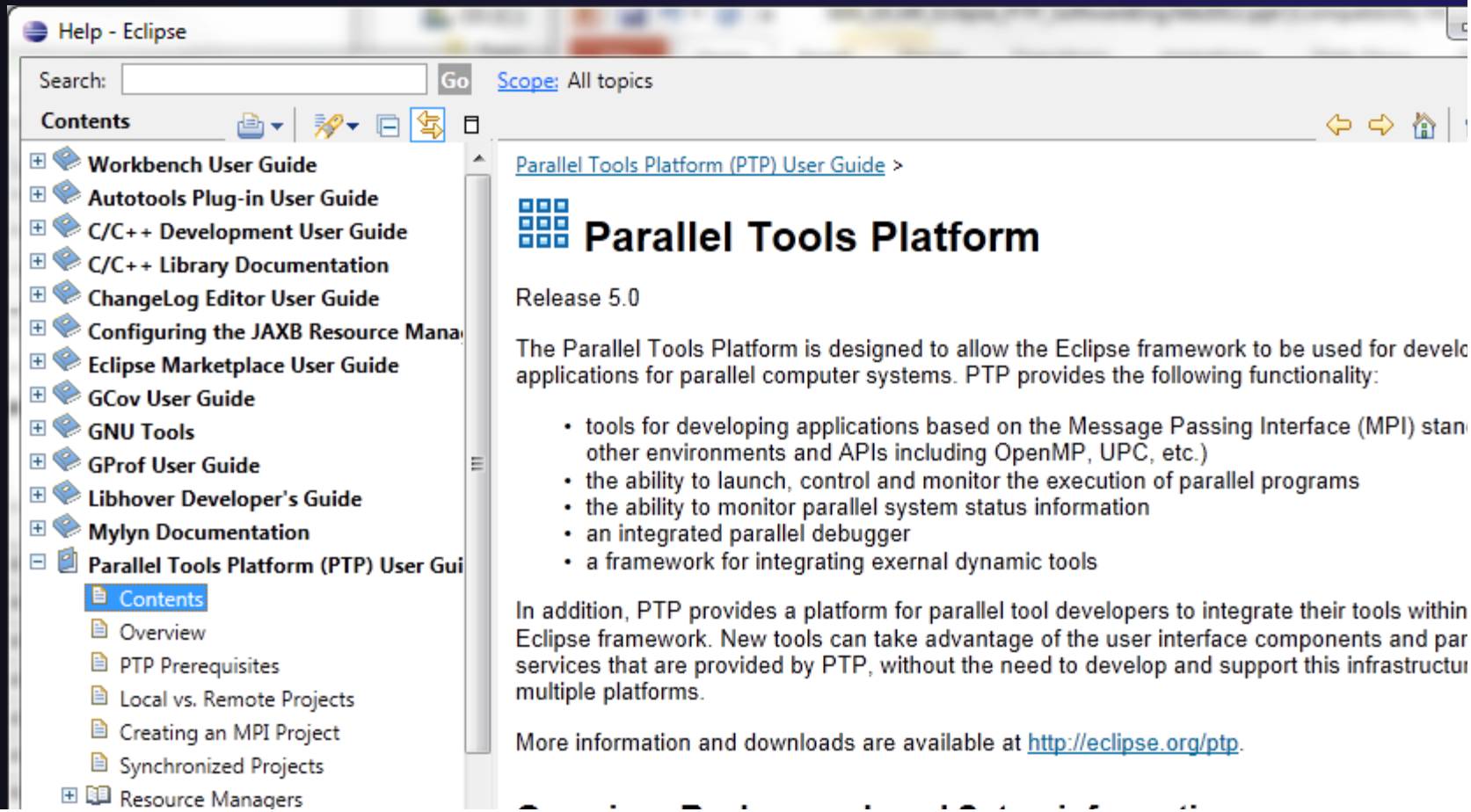
Issue Tracking

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



Eclipse Documentation

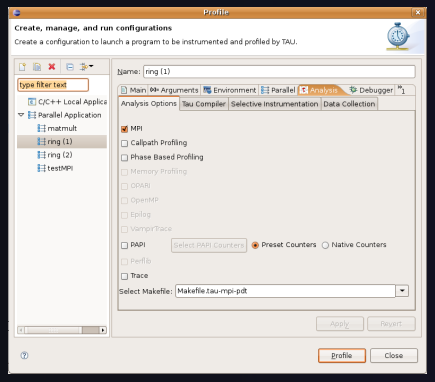
- Eclipse Help System – built in and standalone (http://help.eclipse.org)

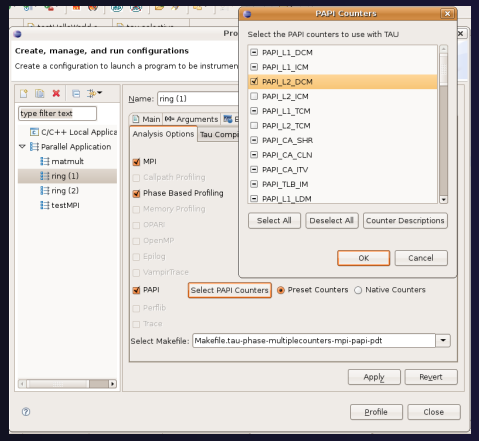


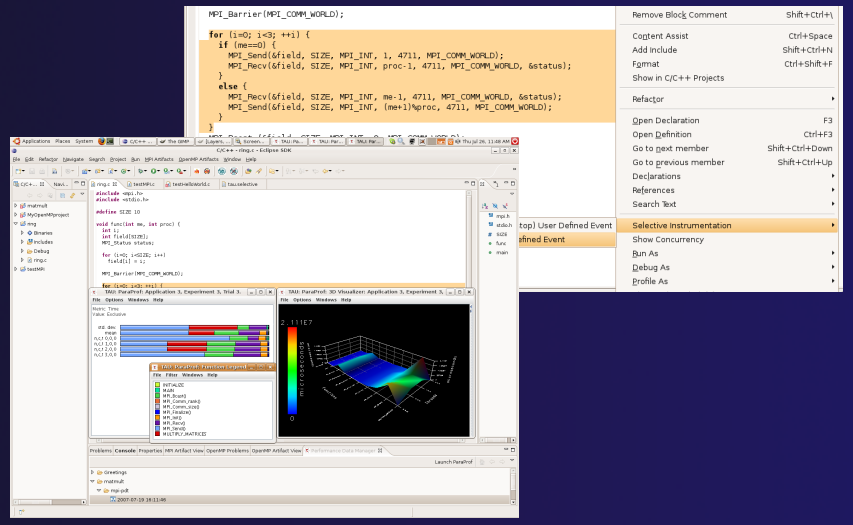
Performance Tuning: PTP TAU plug-ins

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

- TAU (Tuning and Analysis Utilities)
- First implementation of External Tools Framework (ETFw)
- 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







Sustainability, Investment, Collaboration: Building Community

- Stakeholders/investors
  - Funding agencies → innovative capability
  - HPC vendors
    - contribute to open source foundational software
    - basis for proprietary or open-source add-ons
  - Supercomputing centers
    - user support and training
    - xml documents for batch system and local policy integration

Sustainability, Investment, Collaboration: Building Community II

- Stakeholders/investors continued
  - Supercomputing integrating organizations (eg, XSEDE):
    - user support
    - single sign-on support (?)
    - training
    - education support
  - Tool providers
    - xml documents for integration of command line tools
    - extra value-add from tool-specific plugins?
  - Anyone else?

Challenges for DEHPC

- Budgetary pressure on supercomputing centers and integrating organizations
- Challenges successfully competing proposals in open calls (eg, NSF SI2).
  - Innovation, impact are paramount here
- User community is large, disperse (eg lots of downloads of PTP, hard to connect to user community)

Opportunities (for discussion)

- Can we build a community to support a DEHPC?
  - PIs proposing to funding agencies for innovative additions?
  - Vendor contributions to DEHPC?
  - Supercomputing centers and integrating organizations support?
    - Eg, User support, training, configuration (xml) documents

Eclipse Parallel Tools Platform

www.eclipse.org/ptp