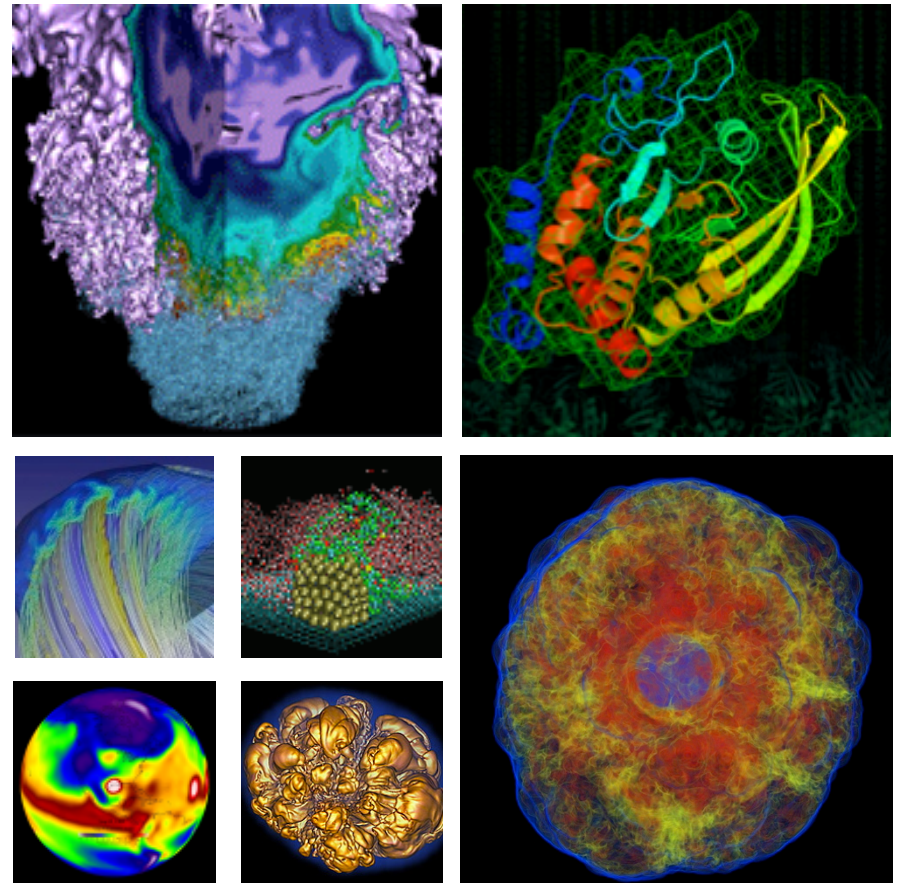# CCE/8.4.0 Beta Feedback from NERSC Users

Helen He, NERSC

Oct 20, 2015, Cray Quarterly Meeting

CCE/8.4.0 Beta Program

- **NERSC participated the beta program to help improving the quality of the Cray's official CCE release.**

- **Beta program duration: July 20 – Aug 14 (later extended to Sept 24, when CCE/8.4.0 was officially released)**

- **CCE/8.4.0.215 installed on Edison on July 22. However license was not available until July 30.**

- **Notified 90 users who have used CCE this year. Collected feedback.**

- **CCE/8.4.0.219 installed on Aug 11.**

- **NERSC provided user feedback to Cray on Aug 13.**

CCE 8.4 Major Features

- **Support for the C++11 language standard.**

- **Support for the OpenMP 4.0 specification.**

- **Support for the inline assembly ASM construct for x86 processor targets.**

- **Support for GNU extensions by default (-h gnu option).**

- **Performance improvements for Cray XE, Cray XK, Cray XC, and Cray CS series systems.**

- **Bug fixes.**

NERSC User #1 (Valery Weber)

- **INC0070995, provided 7 codes with either Internal Compiler Error, or wrong runtime results.**
  - Submitted cases in CrayPort on Aug 13. Turned into 7 bugs. 3 resolved so far
  - Bug 830848, Internal compiler error (allocatable). Confirmed
  - Bug 830850, Internal compiler error (simd). Resolved on Sept 11
  - Bug 830851, Internal compiler error (udr). Confirmed
  - Bug 830844, run time error (allocatable). Confirmed
  - Bug 830849, compile error (atomic). Resolved on Sept 16
  - Bug 830847, compile error (alloc-comp). In progress.
  - Bug 830842, compile error (associate). Resolved on Sept 11.
- **Question: Is it possible to use 8.4 to do offloading on GPU or MIC somewhere at NERSC?**
  - We do not have GNU system at NERSC
  - CCE is not supported on MIC (will support KNL on Cori)
- **NERSC ticket INC0067318 reported May 19 with CCE/8.3.9.**
  - Bug 826470: CCE OpenMP firstprivate error with default initialized components and -g
  - User reported on July 31 that bug still not fixed under CCE/8.4.0.215.
  - Bug resolved on Aug 5

NERSC User #2 (Nathan Weeks)

- **INC0070627: Reported problem on Aug 1**
  - Internal compiler error, using a 50-line sample test code
  - Works with CCE/8.3.11, but not with CCE/8.4.0
- **Bug 829300: "Bug in ftn beta CCE 8.4 release" created on Aug 3**
- **Bug resolved on Aug 6, fix is in the official release**

NERSC User #3 (Linh Nguyen)

- **Requested pre-release CCE documentation**
  - Received.

- **Reported cmake could not detect C++ features**

- **Case #114730 created on Aug 3: "CCE/8.4.0.215: missing include file for c++11 standard "**

```
 % CC -h std=c++11 -openmp xthi.c

CC-5 craycc: ERROR File = /opt/cray/mpt/7.2.1/gni/mpich2-cray/83/include/mpi.h, Line = 42

The source file "cstdint" is unavailable.

# include <cstdint>

^
```

- **Fix for bug 830846 is in official CCE/8.4.0 release.**

Cray Staff (Marcus Wagner)

- **Marcus has been working with NCAR CESM team on using CCE/8.4.0 internal releases to compile and run CESM**
- **Opened many private bugs on CCE/8.4.0.xxx**
  - General compiler bugs
  - Bugs related to OpenMP
  - Bugs on performance issues (degradation, or slower than Intel compiler)
- **Status as of Aug 13: CESM runs with pure MPI. And it runs faster than Intel compiler.**
  - A sample case run time:
  - CCE/8.4.0.215:   TOT Run Time: 145 seconds
  - Intel/15.0.3.187: TOT Run Time: 160 seconds
- **Status as of Aug 13: CESM has run time error with hybrid MPI/OpenMP**
  - Two bugs filed related to deep_copy and deep_privatize run time errors
- **Status as of Aug 19**
  - The above 2 bugs were fixed. CESM with hybrid MPI/OpenMP runs successfully with CCE/8.4.0 internal version, and slightly faster than Intel compiler.
  - CCE/8.4.0: # simulated years / cmp-day =   27.522
  - Intel/15.0.3: # simulated years / cmp-day =   26.987
  - However, CCE compile time is much slower than Intel compile time. Bug filed.

Cray Staff (Marcus Wagner)

- **The OpenMP-4.0 Specification states**
  - The type of list items appearing in the aligned clause must be C_PTR or Cray Fortran pointer, or the list item must have the POINTER or ALLOCATABLE attribute.

- **CCE/8.4.0.211 does not compile *.F90 sources containing "!$OMP SIMD ALIGNED (...)" clauses that does not comply with this restriction**
  - Should OpenMP standard relax this requirement?
  - Should CCE relax this requirement?

- **The Intel compiler compiles "!$OMP SIMD ALIGNED (...)" anyway and achieves speedup**

- **Helen raised it with OpenMP Committee in Sept.**
  - The requirement is going to be relaxed in OpenMP 4.1 standard.

NERSC User #4 (Jim Edwards), NCAR CESM

- **Working on testing CESM with the CCE compiler.**

- **Reported a compiler bug.**

- **Thinks that the compiler is working well enough that it can be added to the CESM test suite to assure new problems going forward being introduced.**

- **This is a big step for the CESM team to be able to use Cray compilers.**

NERSC User #5 (Chris Kerr), NCAR CESM

- **Optimizing CESM kernels using Intel and CCE compilers.**
- **CCE outperforms Intel compiler consistently.**
- **CCE/8.4.0.219 can vectorize loops having dependency as below:**

```
do k=1,nlayers
    urad(k) = urad(k-1) …    <- recursion in k
enddo
```

  - Intel/15.0.1: major computational loop did not vectorize
    - Not able to restructure code to vectorize loops
  - cce/8.4.0.219: major computational loop did vectorize
    - What trick did CCE use ☺ ? Reverse loop ordering?

- **In one case: Doubly nested conditionals in loops prevent vectorization; So precomputed conditionals outside loop**
  - Intel compiler vectorized major computational loops
  - CCE does not vectorize major computational loops
  - Marcus filed a performance bug on CCE

Summary

- **Sent slides presented today to Cray on Aug 13**

- **Cray acknowledged our feedback was very helpful**

- **With cases and bugs opened, the turnaround time for resolution was very quick (thank you!)**

- **Fixes are included in official 8.4.0 release**

- **The beta program directly benefits users at NERSC and other sites**

Thank you.