Getting Started with MPI

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1. Obtain MPI for your operating system.

   - Linux/Mac: MPI is available on most math department computers. If you are using a personal machine, there are instructions available here. (Note, since all math department computers come with MPI already installed, these instructions have not been tested.)
   - Windows: Follow the instructions provided here, with the follow amendments: (1) To obtain MSMPI and MSMPI SDK, you want to download v9.0.1. On this page, the Download button gives the option to download the files *msmpisdk.msi* and *msmpisetup.exe*. Download both of these files and run them. (2) In step 3., the website asks that you execute the command

     COPY "%MSMPI_INC%" INCLUDE

     When executing this commend, make sure that the subdirectories, named *x64* and *x86*, are copied as well. If they are not, you can navigate to MPI include directory and copy them to the temporary directory manually. The MPI include directory is typically found in the path *C:\Program Files (x86)\MicrosoftSDKs\MPI\Include*. Further, to execute the GENDEF command, you must have installed gendef via MinGW. The gendef package is listed under "mingw32-gendef", or equivalent. If MinGW refuses to download this package, the website that MinGW pulls from may be temporarily down for maintenance, and should be running by the next day.

     Note, you can open *.f90*, *.F90*, and *.h* files with Notepad or equivalent to edit them.

2. Open your task manager to figure out how many cores your machine has. This will be important when running MPI programs, as you should not use more cores than your machine has.

   The website that has installation directions for MPI on Windows includes a an example program which utilizes MPI. To ensure that you have properly installed MPI on your machine, compile and run this program. We include the code typed out below, to be saved in a file called "my_mpi_program.F90":

```
PROGRAM HELLO

USE MPI

IMPLICIT NONE

INTEGER :: rank, num_procs, ierror

CALL MPI_INIT(ierror)
CALL MPI_COMM_SIZE(MPI_COMM_WORLD, num_procs, ierror)
CALL MPI_COMM_RANK(MPI_COMM_WORLD, rank, ierror)
PRINT*, 'Process ', rank, ': Hello world'
CALL MPI_FINALIZE(ierror)

END PROGRAM HELLO
```

The instructions used for downloading and installing MPI should also include instructions on how to compile and run simple programs like these. Try running this program with different number of cores (e.g., one core, two cores, four cores [if your computer has that many!]).

Modify this program to also return the amount of time it takes to run by using the CPU_TIME subroutine.

Use the MATLAB script MERGE_SUBGRIDS.M included with EZ_PARALLEL to combine the subgrid output files