Advanced Parallel Programming

Overview of MPI-IO Exercises

Dr David Henty
HPC Training and Support
d.henty@epcc.ed.ac.uk
+44 131 650 5960

Stand-Alone Exercise

- We will
  - compile some existing source
  - run it on one and many processors
    - on the front-end and the back-end
  - implement master IO for reading into a block decomposition
    - using global broadcast then copy-back on individual processes
    - by copying appropriate data to a buffer on the master and sending
- Later on
  - extend this to using appropriate datatypes to avoid data copying
  - use above datatypes to achieve same result with MPI-IO
  - extend to do general block-cyclic decompositions with MPI-IO
- Input and output data files can be viewed as pictures
  - to make debugging easier!
- See PDF exercise sheet for full details

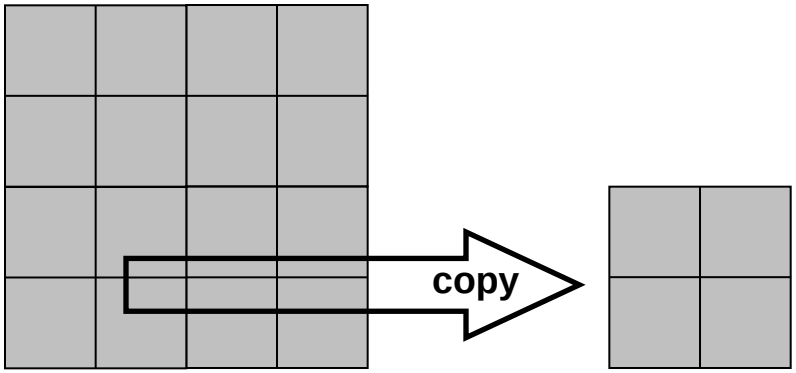
MSc Students: Extending MPP Coursework

- Probably more interesting to put MPI-IO into your own code
  - e.g. your 2D-decomposed MPP coursework exercise

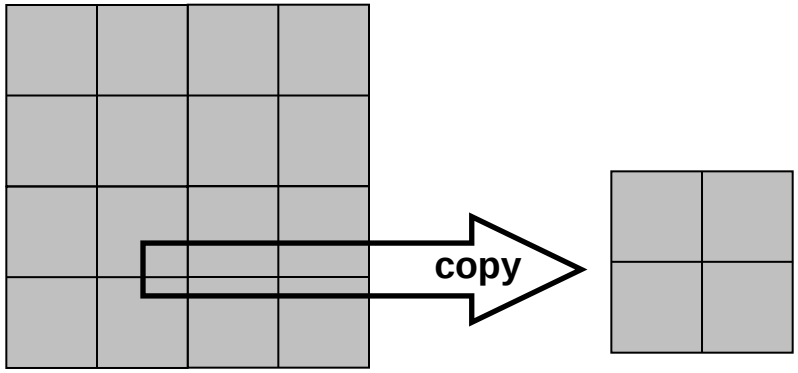
- Issues
  - file formats are different: must replace **`pgmread`** and **`pgmwrite`** with **`ioread`** and **`iowrite`**
  - need special programs to view the files: **`cioview`** or **`fioview`**
  - must have specific names to be visualised: use **`creatfilename`**

- See additional exercise sheet **`mpiio-mpp.pdf`** for details

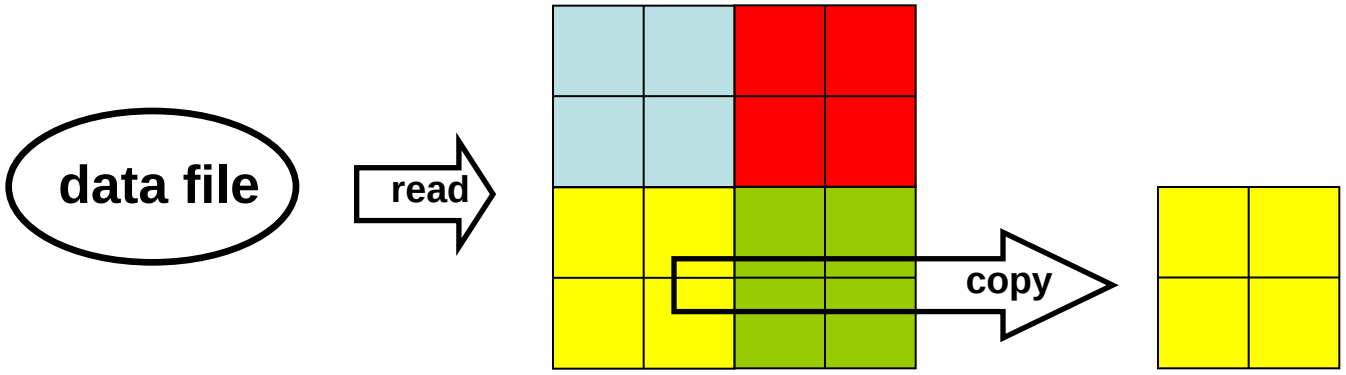
IO strategy 1: no data on workers



Process 2

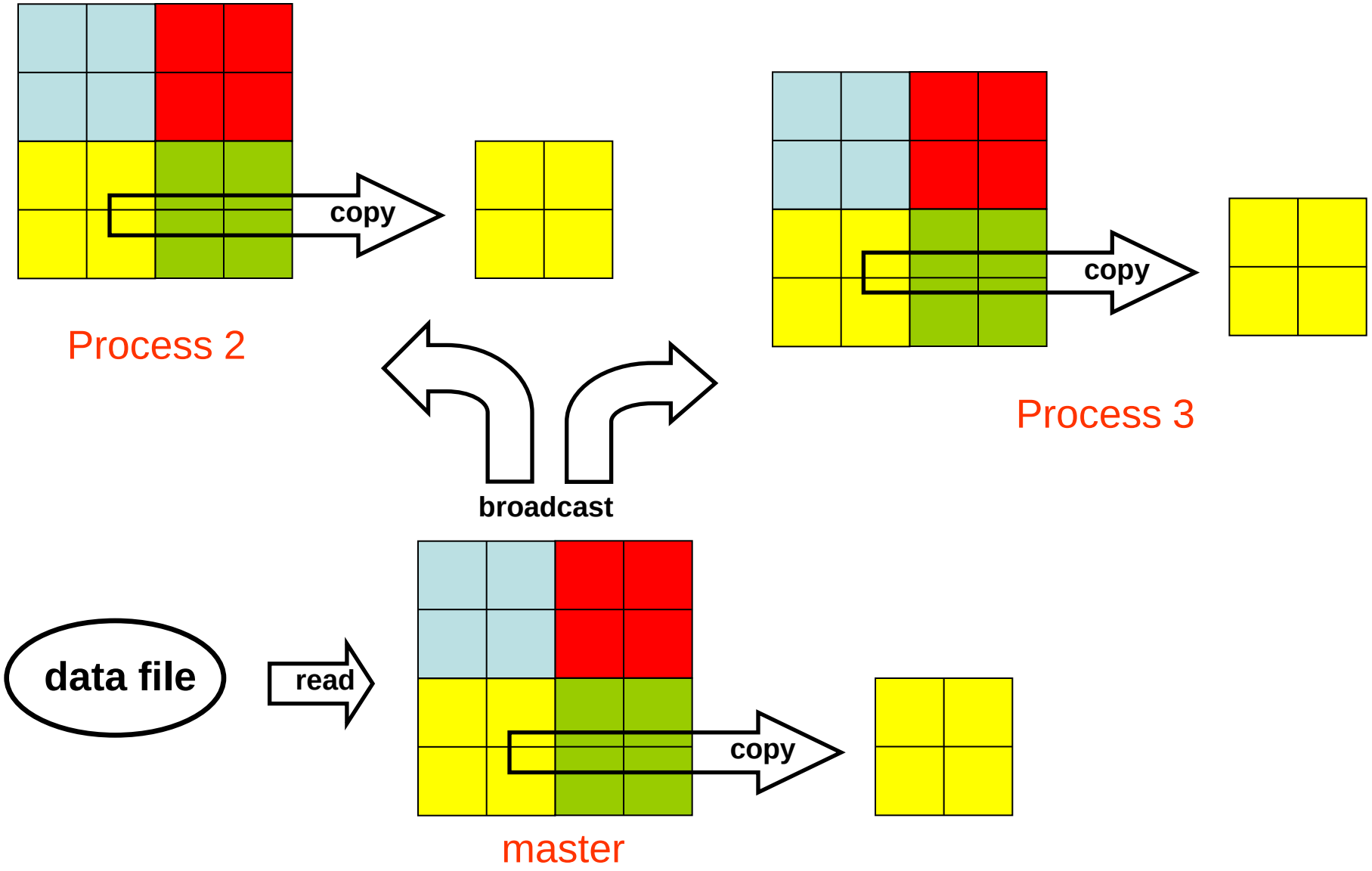


Process 3

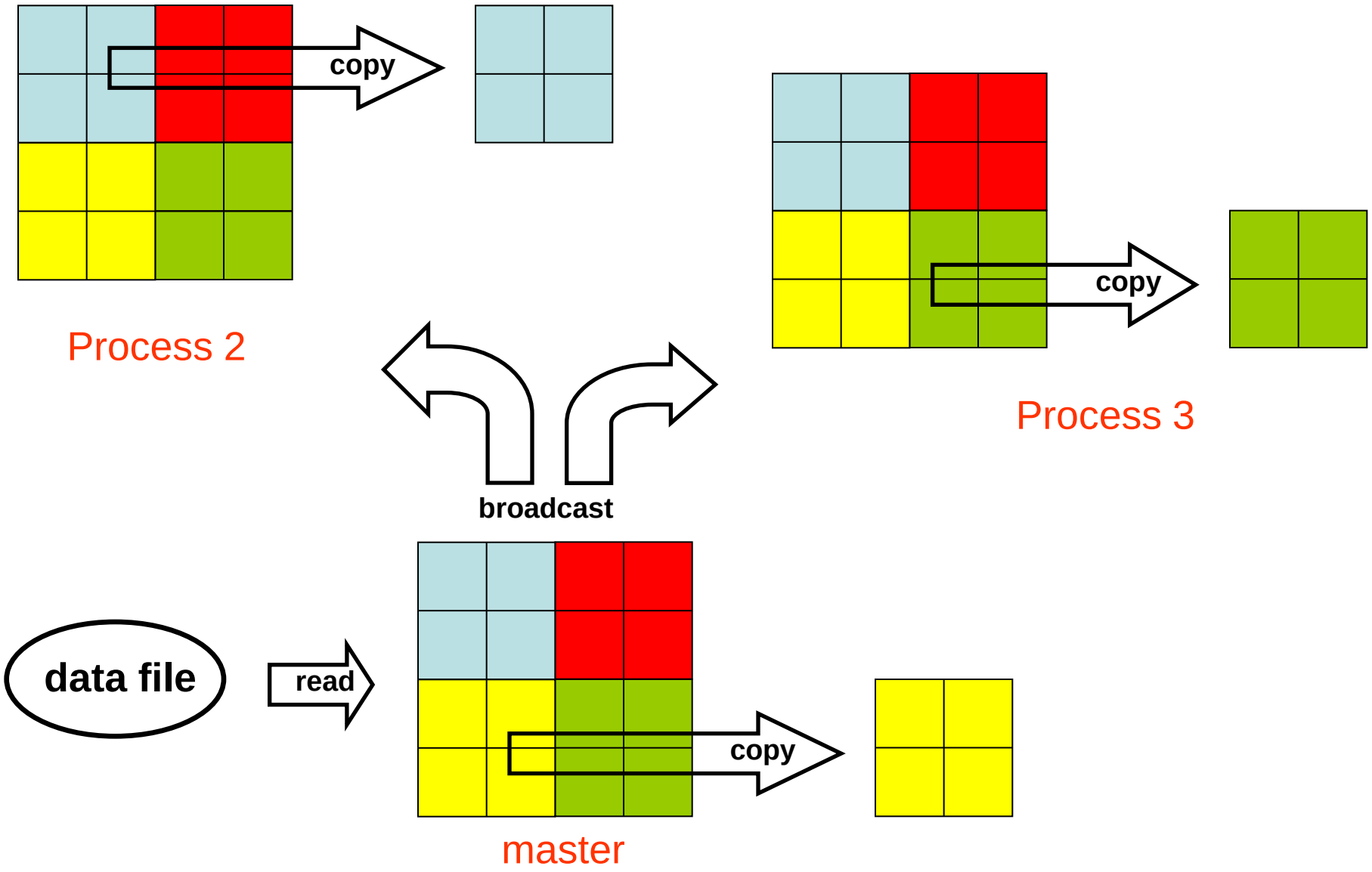


master

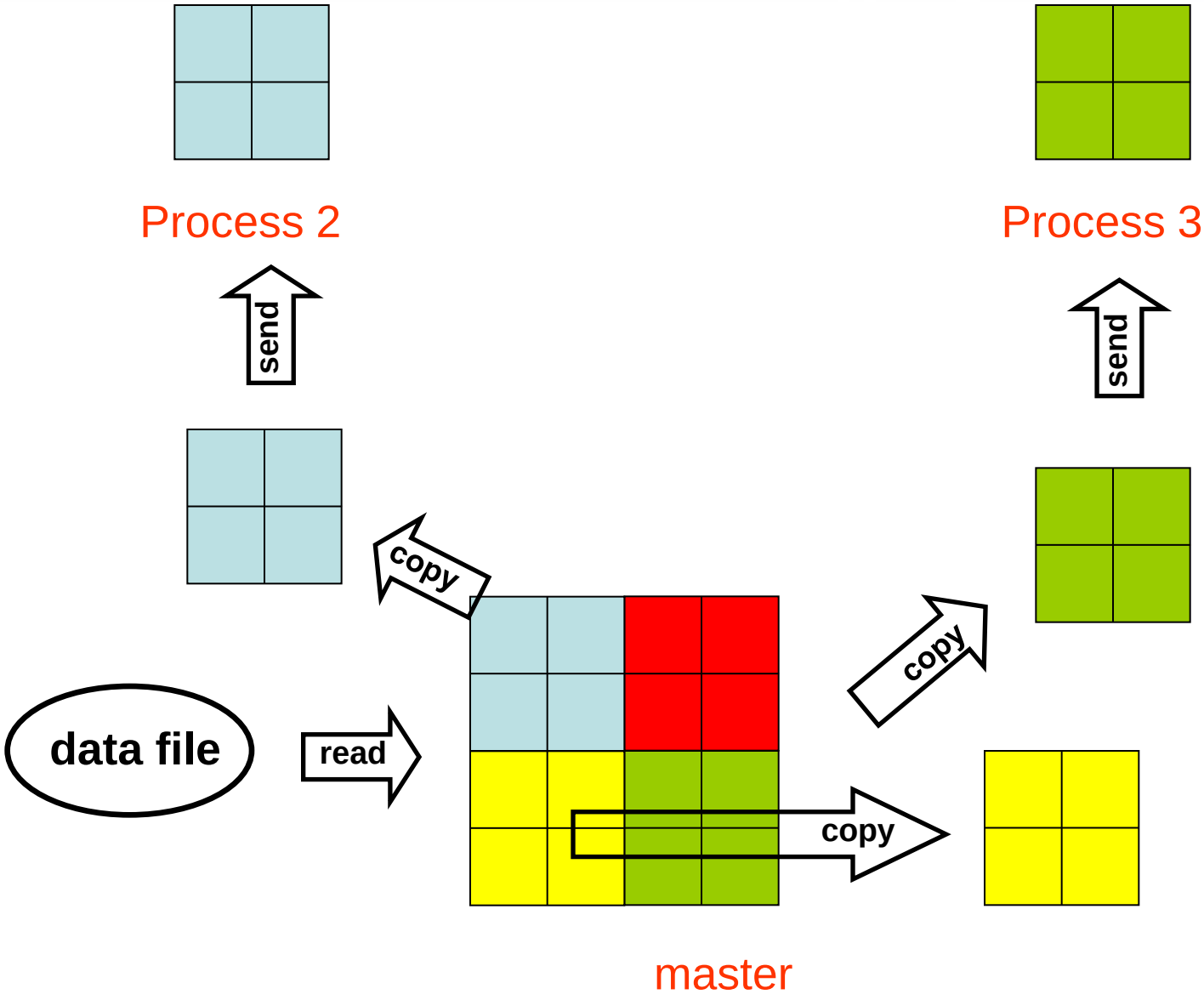
IO strategy 2: incorrect data on workers



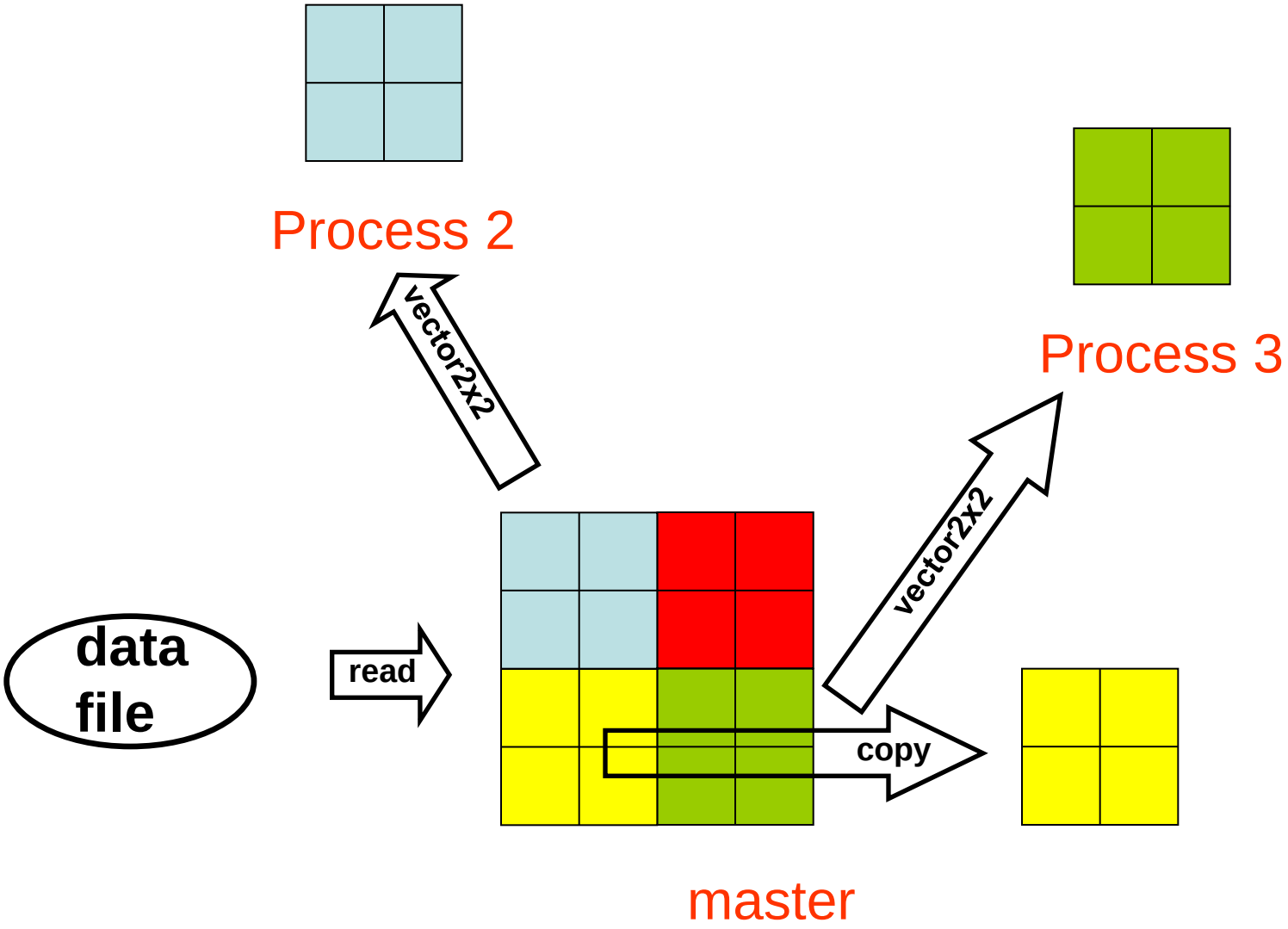
IO strategy 3: correct but inefficient



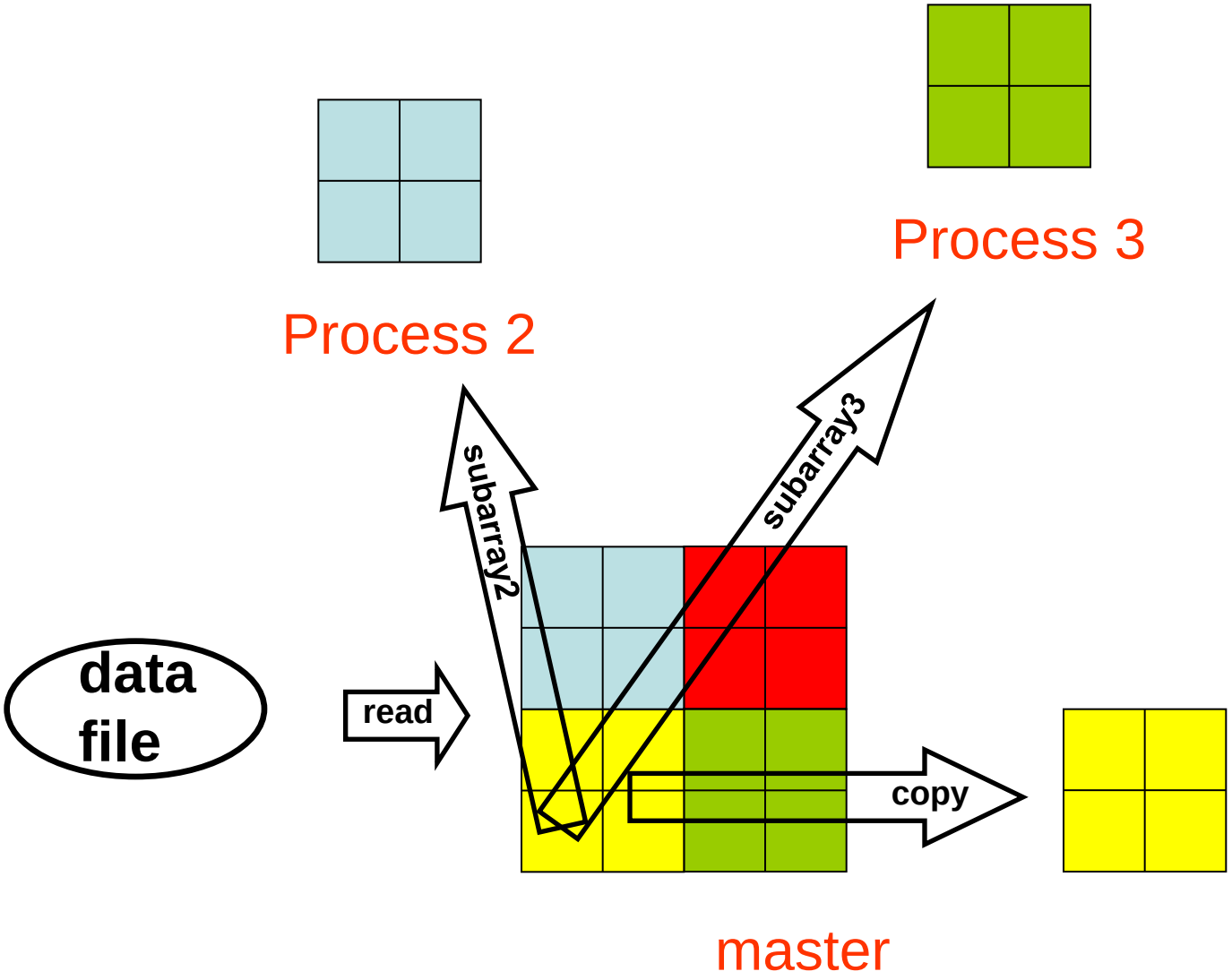
IO strategy 4: standard master IO



IO strategy 5: vector datatype



IO strategy 6: subarray datatypes



Using MPI-IO

- Pass your derived datatypes to appropriate MPI-IO calls
  - use subarrays with **`disp = 0`**
  - or a vector with non-zero values of **`disp`**

Template Code (Fortran)

```
! define subarray datatype for this process
INTEGER(KIND=MPI_OFFSET_KIND) disp
disp = 0
call MPI_File_open(…, fh, ierr)
call MPI_File_set_view(fh, disp, MPI_REAL,
       subarray, 'native', MPI_INFO_NULL, ierr)

call MPI_File_read_all(fh,buf,count,MPI_REAL,…)
call MPI_File_close(fh, ierr)
```

Template Code (C)

```
/* define subarray datatype for this process */
 MPI_File fh;
 MPI_File_open(…, &fh);
 MPI_File_set_view(fh, 0, MPI_FLOAT, subarray,
                   “native”, MPI_INFO_NULL);

  MPI_File_read_all(fh, buf, count, MPI_FLOAT, …)
  MPI_File_close(&fh);
```