Implementation Techniques for Numerical Methods in Atmospheric Models

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Asynchronous communication with MPI in HOMME (CAM-SE)

### Pack and Send

```plaintext
MPI_Waitall( \( L^s_p \) ) ; wait for previously posted Isend
for \( q \in L^s_p \) do
  for \( e \in E_q \) do
    packData( e, q ) ;
  end
  MPI_Isend( q ) ;
end
```

Pack data to MPI message buffer

Send data in message buffer to rank \( q \)

### Computation

Might require algorithm restructuring

### Receive and Unpack

```plaintext
n_r ← 0
while \( n_r < |L^r_p| \) do
  ; check if msg is available, if yes then \( q \) contains the corresponding rank
  if MPI_Testany( \( L^r_p, q \) ) then
    for \( e \in E_q \) do
      unpackData( e, q ) ; unpack data from MPI msg buffer
    end
    reset MPI_Request for \( q \) to MPI_REQUEST_NULL  \( n_r ← n_r + 1 \) ; increase received counter
  end
end
```
Jablonowski-Williamson test case: surface pressure

(a) SE (day 7)  
(b) DG (day 7)  
(c) SE (day 9)  
(d) DG (day 9)
SE strong scaling \( n_e = 120, \ n_p = 4 \)

![Graph](image)
DG strong scaling $n_e = 120, np = 6$