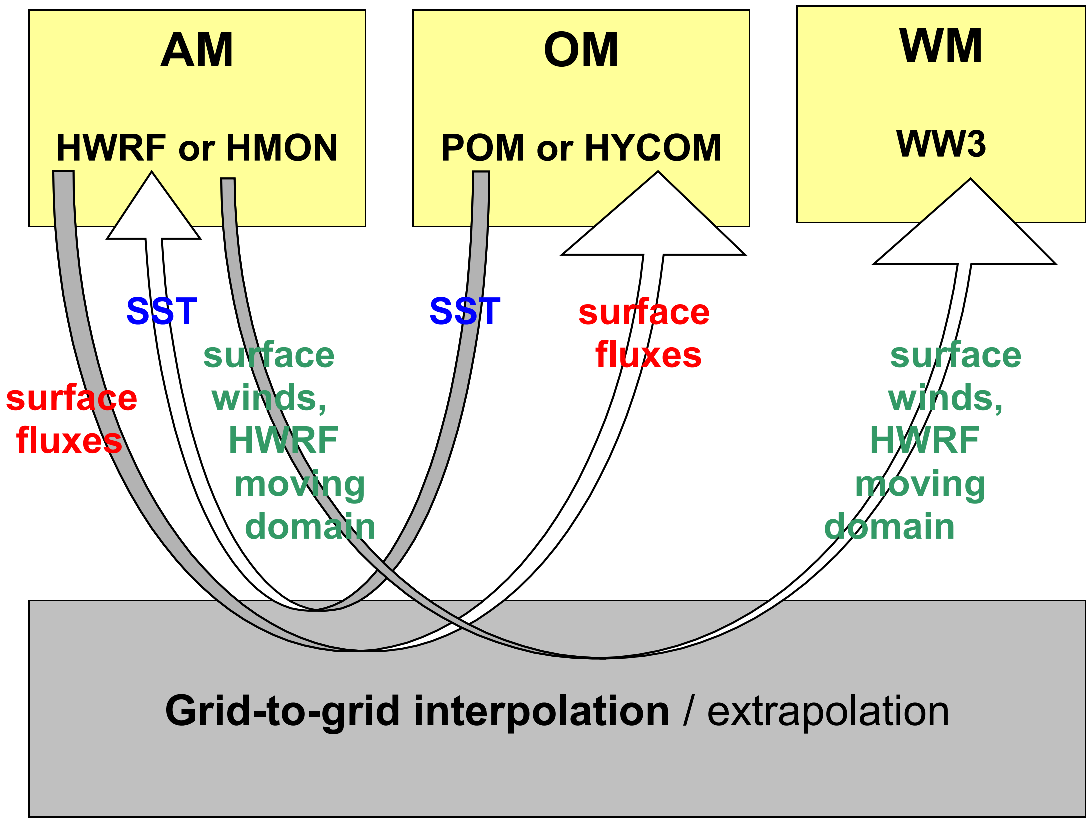
HWRF / HMON COUPLING

- **AM = HWRF or HMON**
- **OM = POM or HYCOM**
- **WM = WW3**
- **C = Coupler:** sea surface to sea surface grid-to-grid interpolation; controls; diagnostics

(all separate executables)

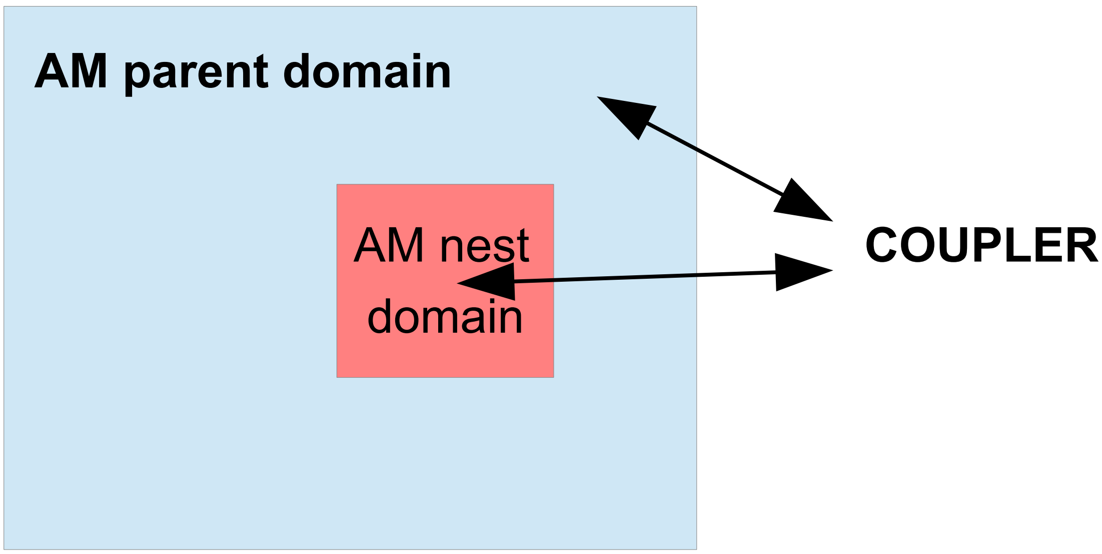
- each Component (AM, OM, WM) executable can be run either in the coupled system or standalone

The Coupled System



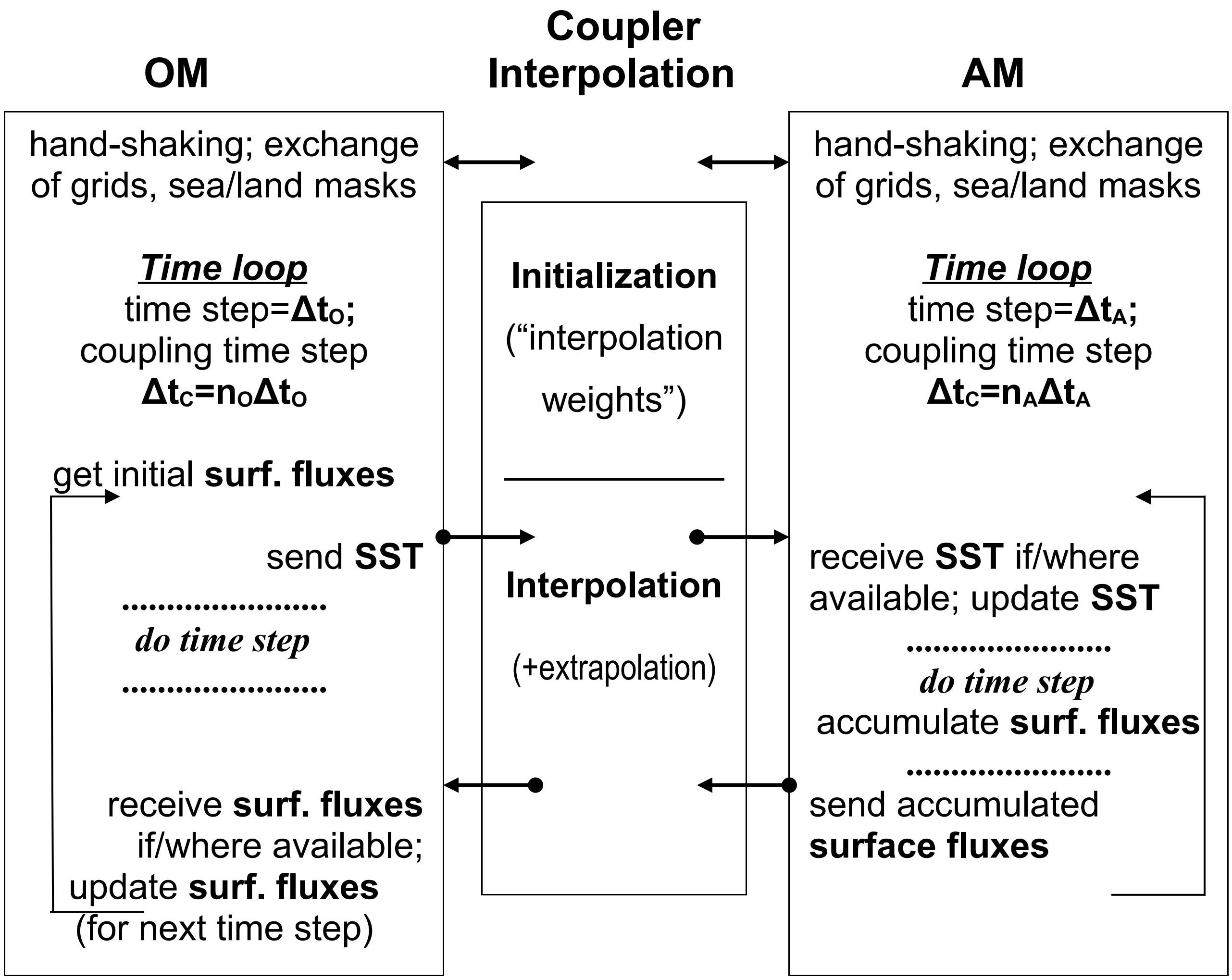
(+ additional WM↔AM and WM↔OM communications)

AM MOVING DOMAIN COUPLING



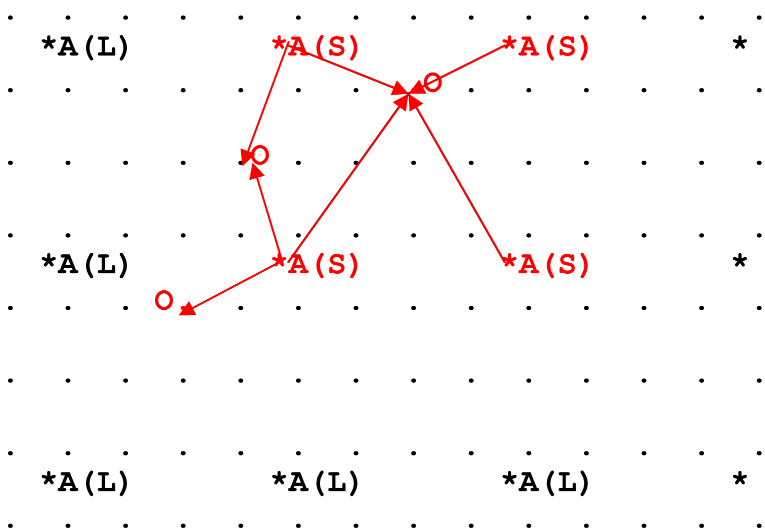
- Fine resolution moving domain grid is considered a section of fine resolution stationary grid in parent domain
- Initialization of interpolation: for course resolution grid and fine resolution grid in parent domain

RUN-TIME DATA FLOW



Data interpolation

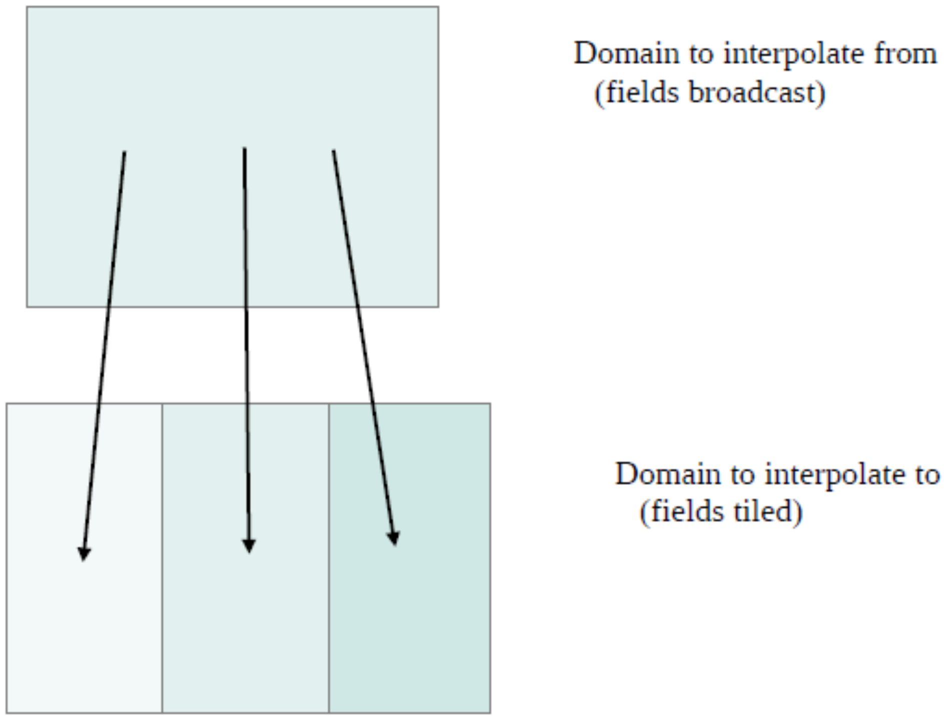
• Interpolation: bilinear in elementary grid cells, sea points to sea points only



• Data not supplied by interpolation, due to domain and sea-land mask inconsistencies, are provided by:

- background (e. g. GFS) data
- extrapolation on domain’s sea-point-connected component, for a specified number of grid steps, with (AM SST) or without (OM surface fluxes) relaxation to background data

Parallelized interpolation



Interpolation initialization: for each domain 2 gridpoint p_{ij} find domain 1 elementary grid cell C_{kl} such that p_{ij} lies inside C_{kl}

Data:

- the domains are not necessarily quadrilateral
- elementary grid cells C_{kl} are quadrilateral but not necessarily the elementary cell **(k,l), (k+1,l), (k+1,l+1), (k,l+1)** in terms of indexing
- gridpoints are represented by their latitudes/longitudes (or other common coordinates); grids are general (not latitudinal/longitudinal)

Methods:

- direct search: **~N^4** operations: inefficient. Cannot be pre-computed once and forever, as each forecast uses its own domains
- **current method**: **~N^3** operations. Algorithm: go along a "continuous" path on grid 2; check if the current segment of the path crosses domain 1 boundary an odd number of times, thus determining if the current domain 2 gridpoint lies inside domain 1; if it does, search for the grid 1 cell using the one found for the previous domain 2 gridpoint as a 1st guess and if necessary continuing the search in expanding rectangles
- Implication for the case of AM moving nested grid: initialization performed for a "total" grid covering the entire static domain and including all possible positions of the moving grid as sub-grids. Alternative: dynamic (run-time) initialization

EFFICIENCY

T – WCT of Coupled System; $\mathbf{T_i}$ – WCT of Component, N – number of components

Optimal communication setup definition: for given T_1, T_2, T_C T is a minimum (neither Component waits for the other Component). If $T_C=0$ (ideal case) then $T=\max(T_1,T_2)$.

For optimal communication setup (exists for N=2):

$$T=\max(\min(T_1,T_2)+T_C,\max(T_1,T_2))$$

I. e. **if $T_1 \geq T_2$ then**

$$\mathbf{T=\max(T_2+T_C,T_1)}$$

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with N > 2 the optimal communication setup may or may not exist