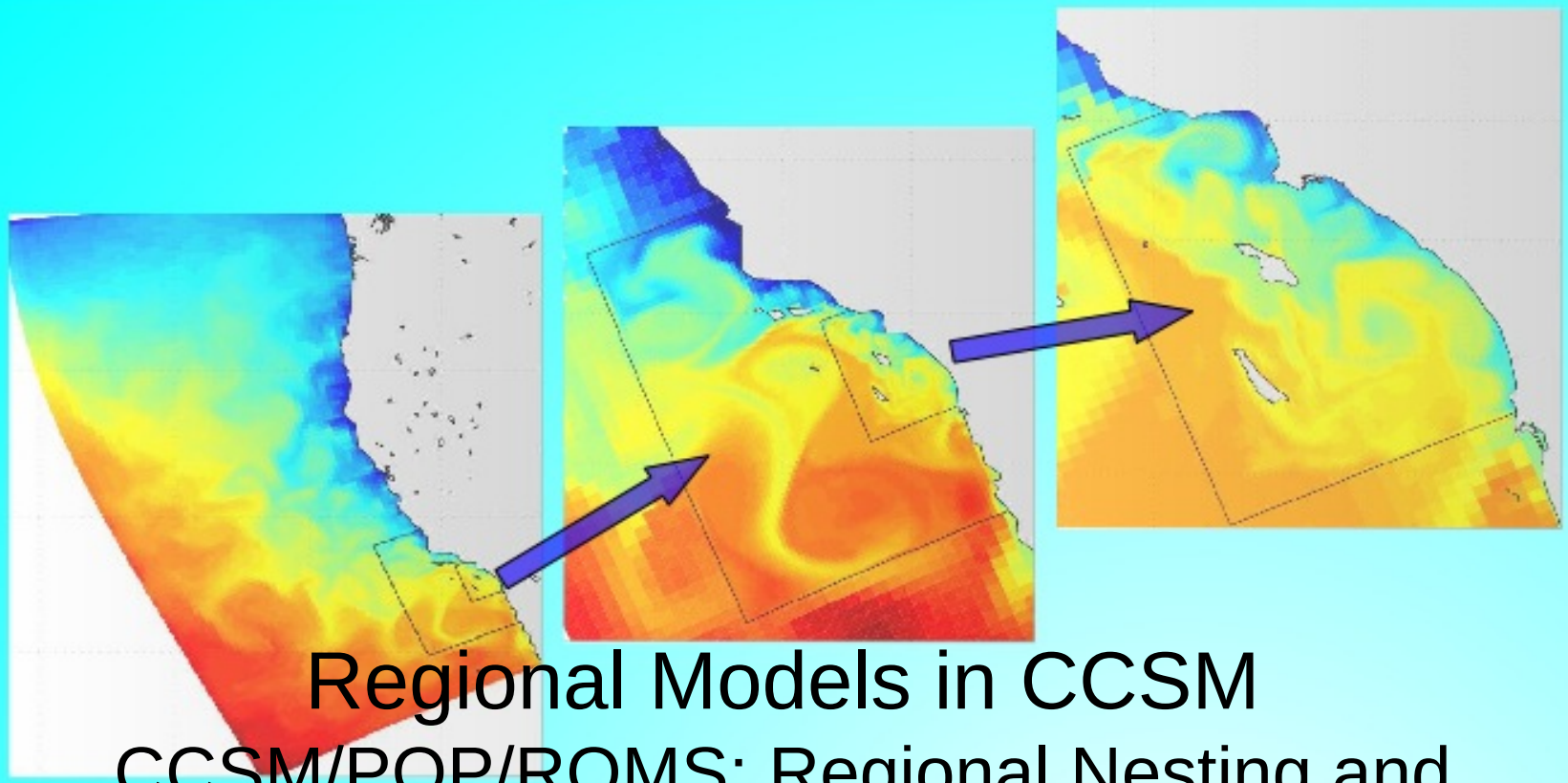

Regional Models in CCSM

CCSM/POP/ROMS: Regional Nesting and Coupling

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What is NRCM?

- Nested Regional Climate Model
- Initiative to use regional models inside a global climate model to enhance resolution in geographic areas of scientific interest without resolving the entire domain
- Adds different physical parameterizations on different scales
- Upscale results? Plenty of scientific issues
- Plenty of software engineering issues as well

NRCM: Ocean Stages

- Goal: to utilize upscaling from regional ocean processes to improve global climate simulations
- Process: start with current CCSM3 and create a composite OCN component containing POP and multiple nested ROMS. Proceed in three stages:
  - Stage A) 1-way nesting of ROMS in POP and coupling to single atmosphere.
    - Phase 1) No merging of POP/ROMS SSTs (offline NEP)
    - Phase 2) OCN merges POP/ROMS SSTs to send back to CPL
  - Stage B) 2-way nesting of ROMS in POP and coupling to single atmosphere.
  - Stage C) nested ROMS coupled to nested WRF (in CAM)
- Will only focus on Stage A for now

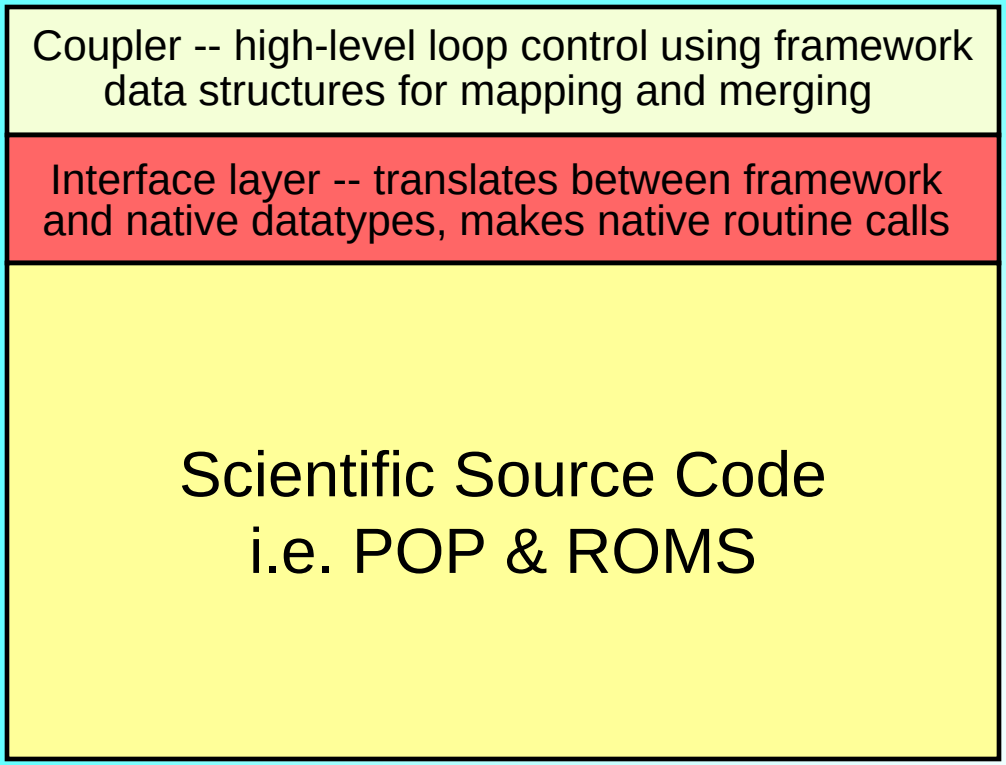
Changes To CCSM for Stage A-1

- Replace POP with a composite ocean model that sequentially couples POP with a number of ROMS nests
- CPL6 modifications to send extra data needed by ROMS from the atmosphere and on the atmosphere timestep -- including the ability to store and average that data
- Modify POP by moving its coupling routines and major timestep loop up into the composite model (while making as few changes as possible, of course)
- Output from POP to the composite model has to include 3D fields for ROMS boundary conditions

Requirements for CCSM POP/OCN

- Coupling of POP to OCN occurs via subroutine calls
  - Containing only framework data structures
  - Containing all the input and output data
- Coupling of POP to CPL replaced by coupling of OCN to CPL
  - All current POP coupling brought to the top level driver
- OCN must be able to run as a special case with only POP (without the feedback of ROMS).
  - bit-for-bit answers must be achieved when compared to current POP/CPL results

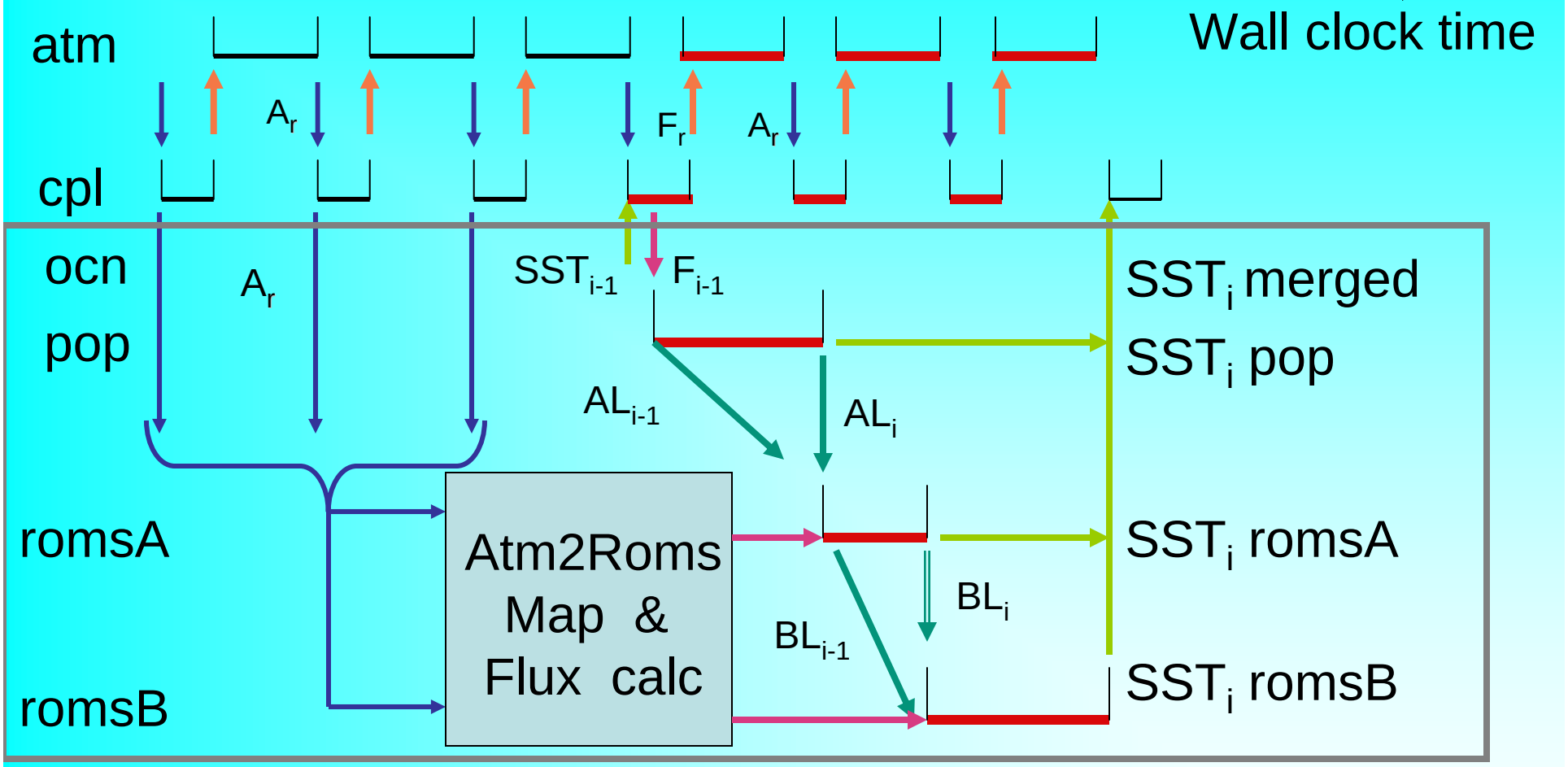
Sequential Coupling Design



POP/ROMS Coupling Steps

POP_Run1
if time to send to coupler then
    map atm data to ROMS grid
    map POP data to ROMS grid
    ROMS_Run
    map ROMS output to POP grid
    merge ROMS and POP results
    send results to the coupler
endif
if time to recv from coupler then
    receive data from the coupler
endif
POP_Run2

Time Flow: (ith ocn-cpl coupling interval)



A_r = atm state at atm radiation time

F_r = atm/ocn flux (A_r , SST_{i-1})

F_{i-1} = <F_r> averaged over interval i-1

$[AB]L_{i-1}$ = pop boundary conditions mapped to romsA and RomsB