Putting the "I" in the IAM: Computation and Data Management

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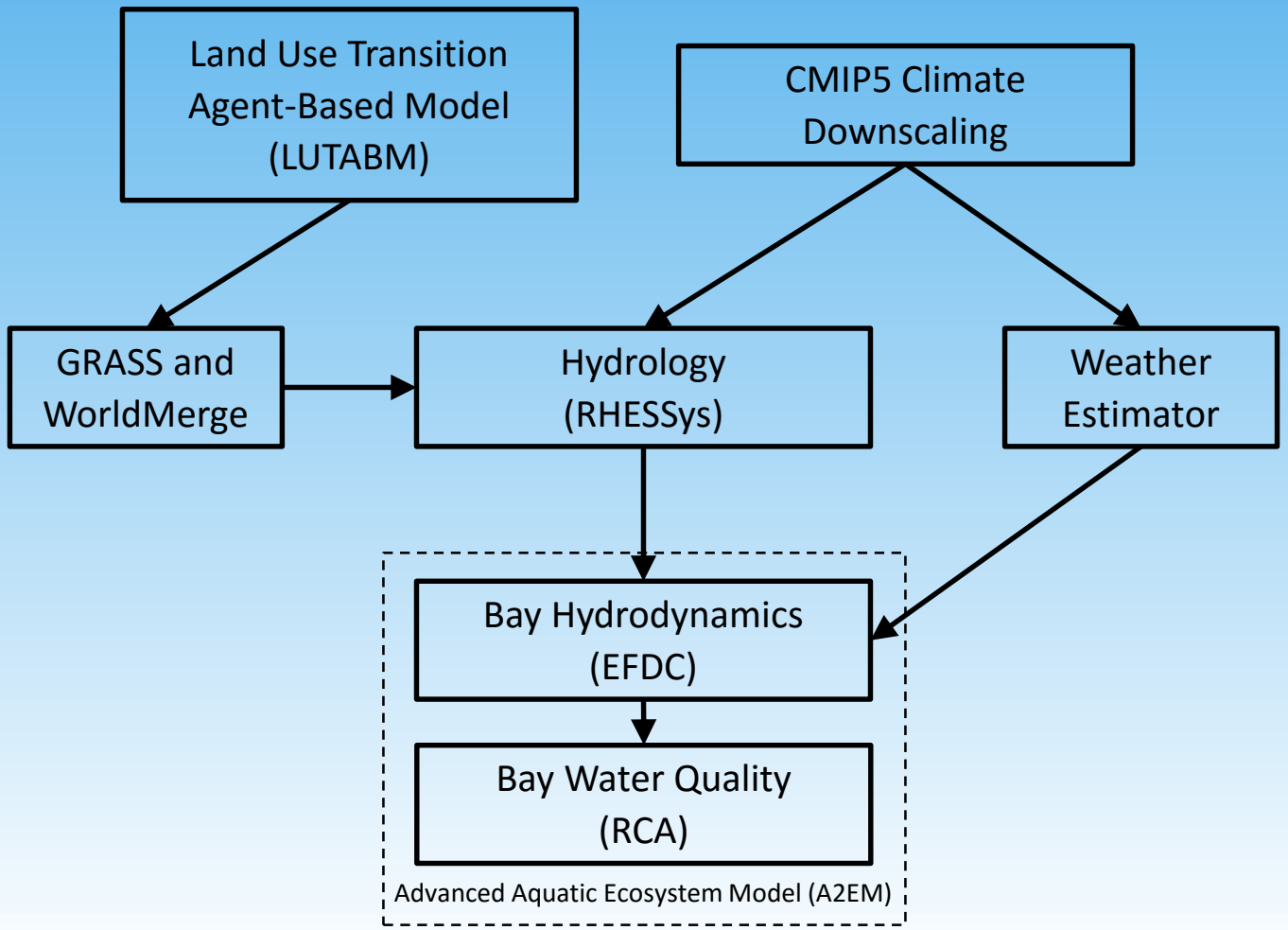
The Integrated Assessment Model

RACC
Research on Adaptation to Climate Change
in the Lake Champlain Basin



Computation v1.0

One Scenario, 20 Years

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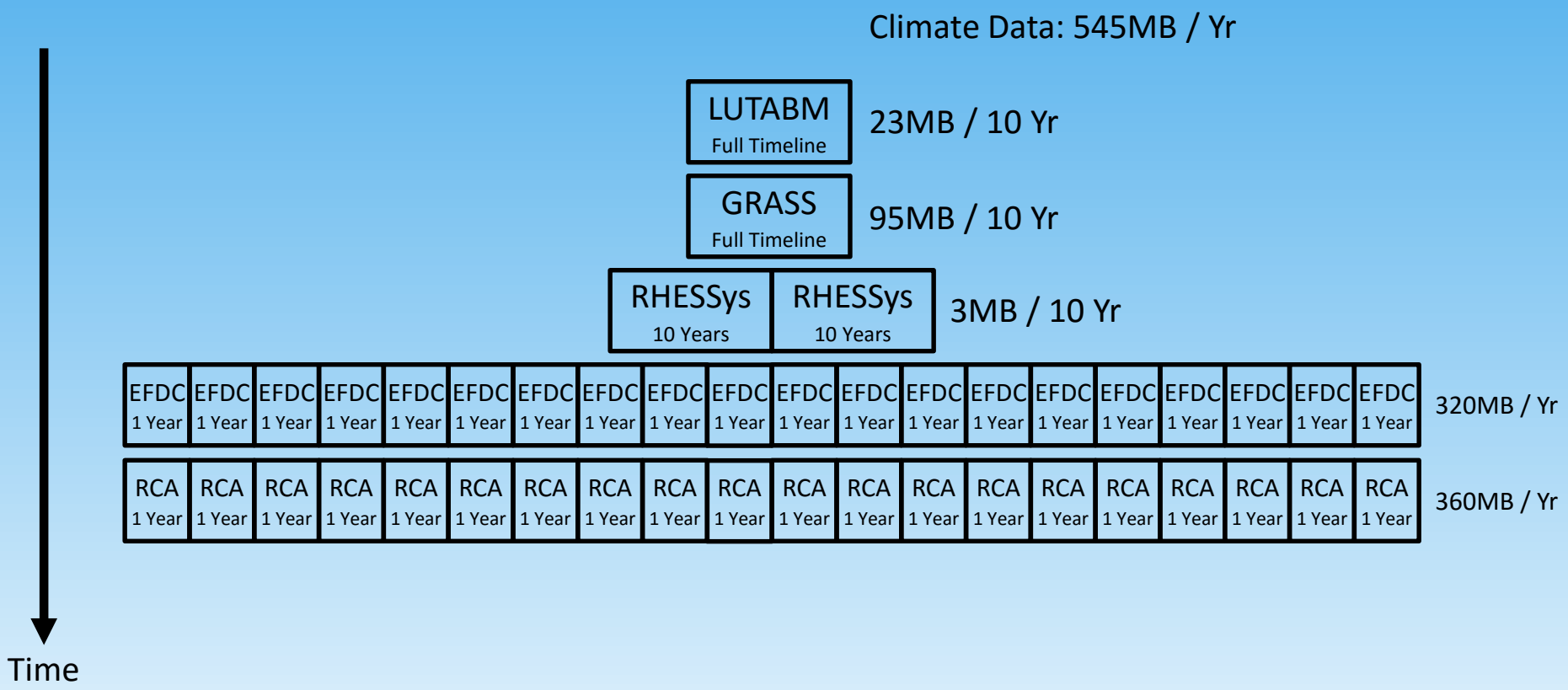

Pegasus

- The Pegasus Workflow Management System manages the data flows and job execution
- Built on HTCondor, a distributed computing platform
- We define the workflow and data files needed for input, and Pegasus monitors the workflow and executes jobs when:
  1) Input data is available
  2) Computational resources are available
- Uses directed acyclic graphs (DAGs) to plan workflow

Past Year's Successes

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- Fully automated the IAM, including some of the post-run analysis and visualization
- Redesigned the IAM to be ready to support feedbacks
- Support continuity between years for the bay biochemical model
- Utilize UCAR's Yellowstone
- Unpacking of the bay water quality model binary output files to ease feedback to other models

Automation

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```
# ============= SCENARIO CONFIGURATION ============= #

    'ABMS': ['IED', 'IDEV', 'LWFP', 'LPFP'],
    'DECADES': [2001, 2011, 2021, 2031],
    'GCMS': ['ipsl-cm5a-mr.1', 'miroc-esm-chem.1', 'mri-cgcm3.1', 'noresm1-m.1'],
    'RCPS': ['rcp85', 'rcp45', 'rcp60'],
    'RANDOM_SEED': 54,

# ============= SETTINGS ============= #

    'RUN': False,
    'DECADES_ARE_DEPENDENT': True,
    'USE_YELLOWSTONE_FOR_LAKE': True,
    'YELLOWSTONE_USER': '******',
    'YELLOWSTONE_ALLOCATION': '******',
    'GLOBUS_USER': '******',
    'DATA_REUSE_DIR': False,

    'EMAIL_ON_START': True,
    'EMAIL_ON_FAILURE': True,
    'EMAIL_ON_SUCCESS': True,
```

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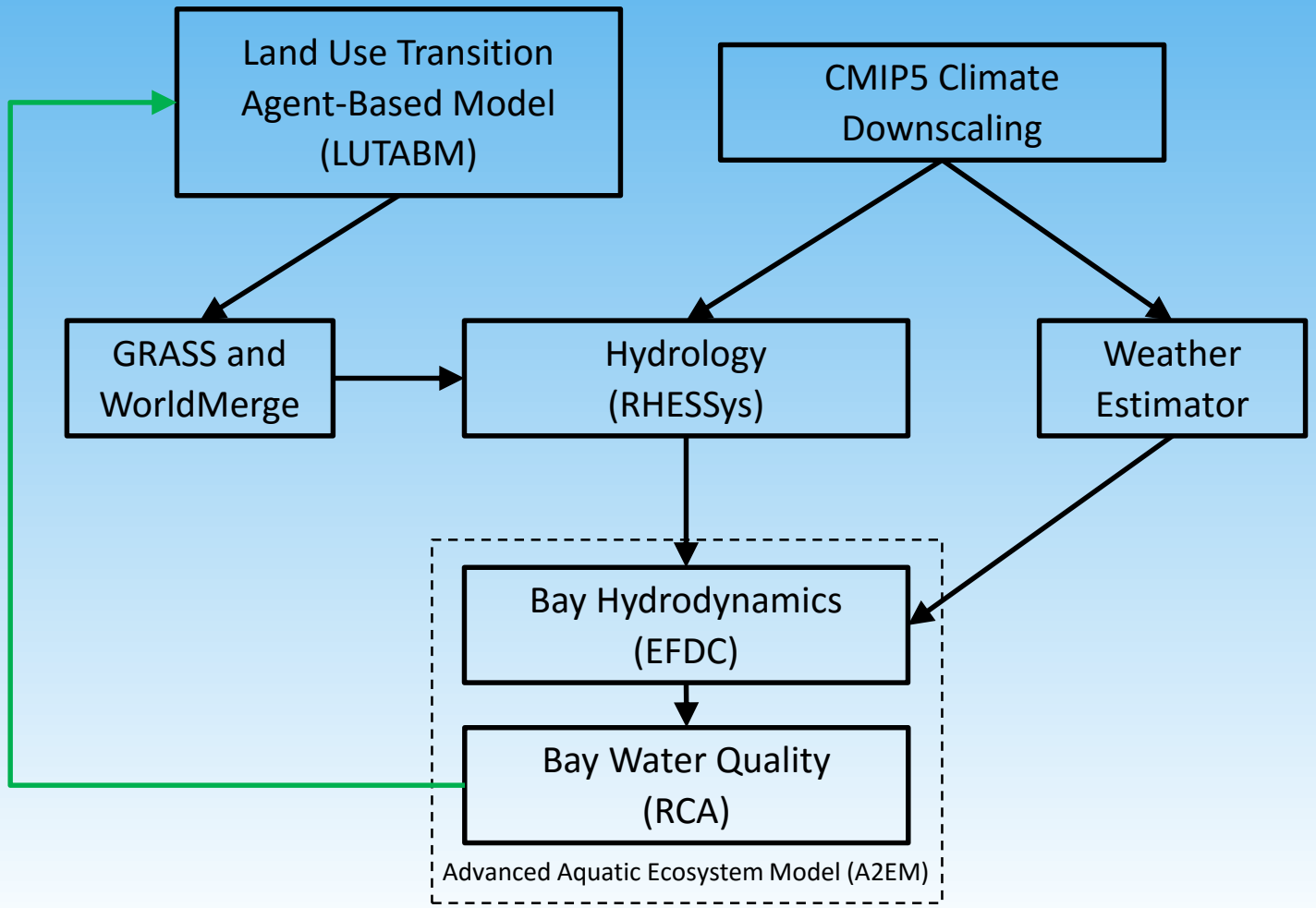

Computation v1.0

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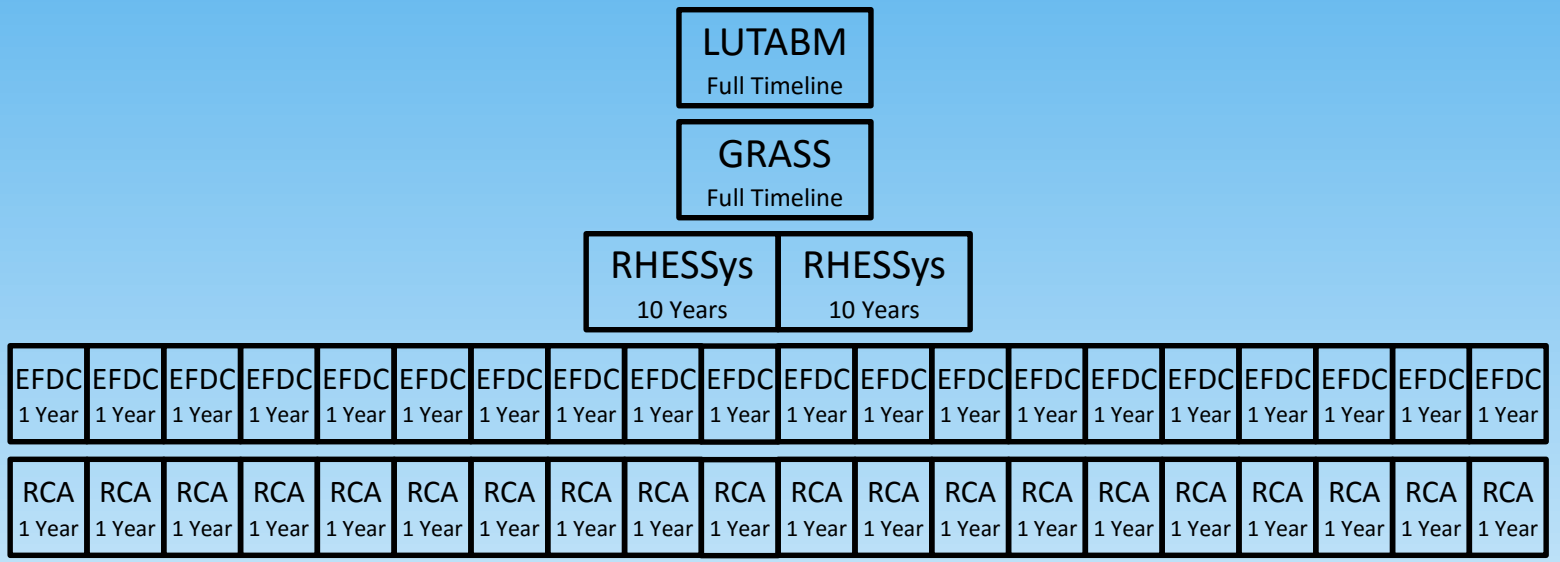

Computation v2.0

Four Scenarios, 40 Years

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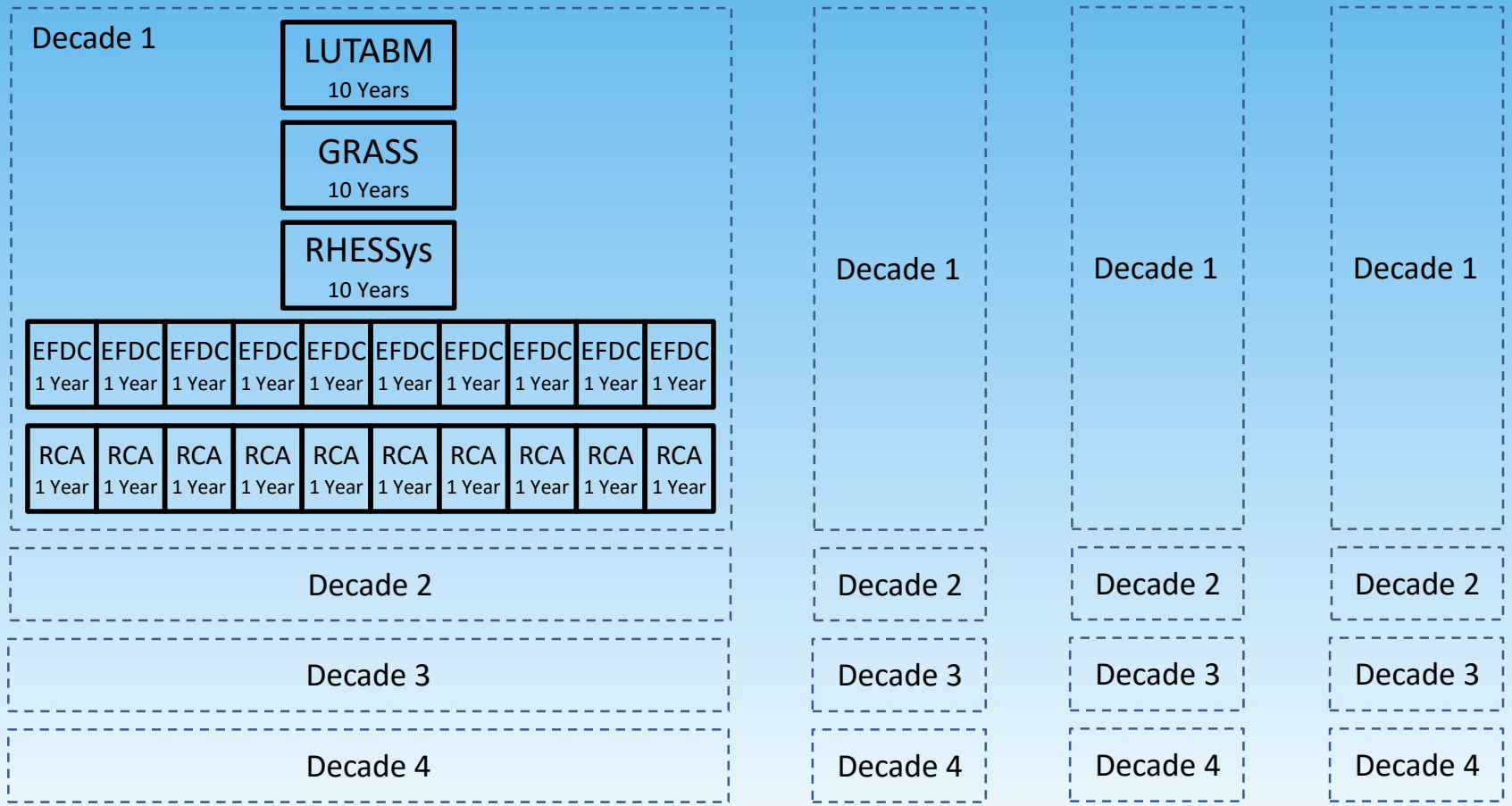

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Computation v2.0

One Scenario, 10 Years

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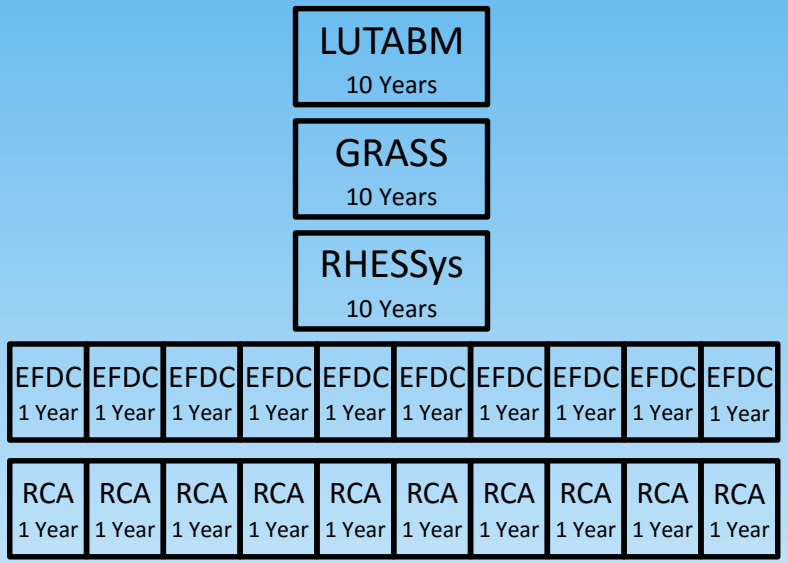

Computation v2.1

One Scenario, 10 Years

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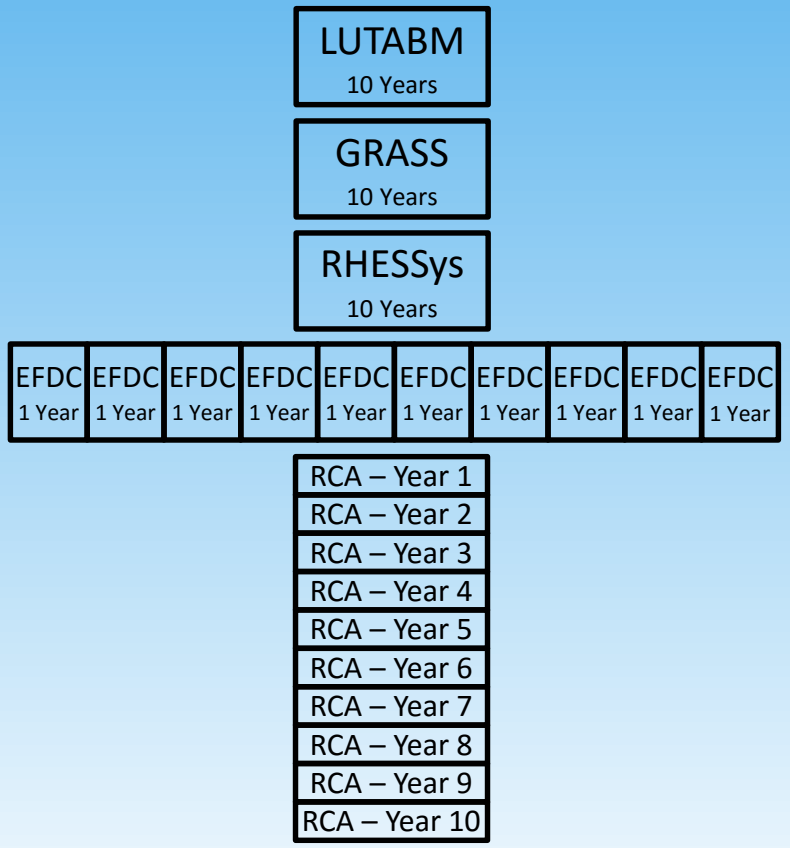

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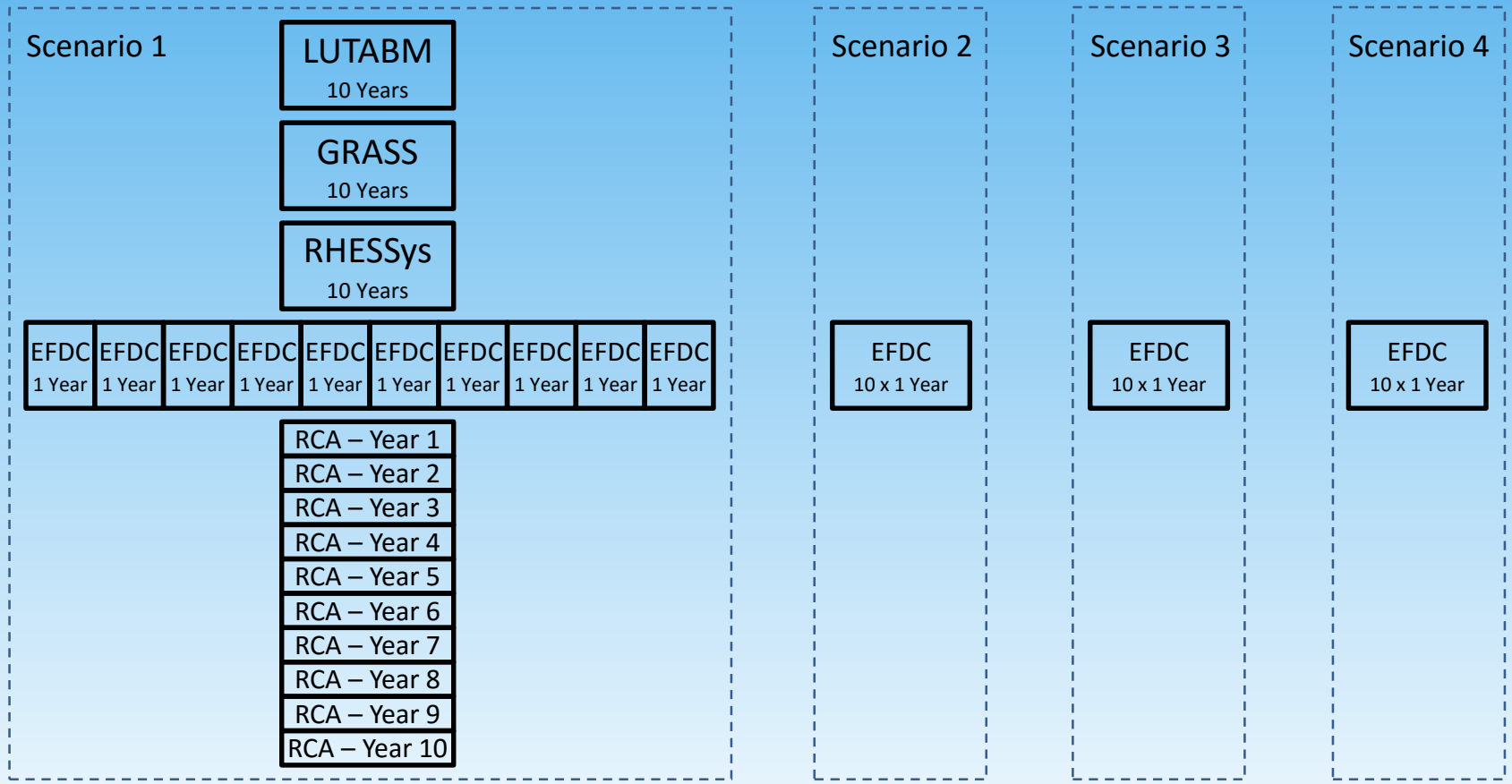
Computation v2.2

Four Scenarios, 10 Years



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Binary → CSV

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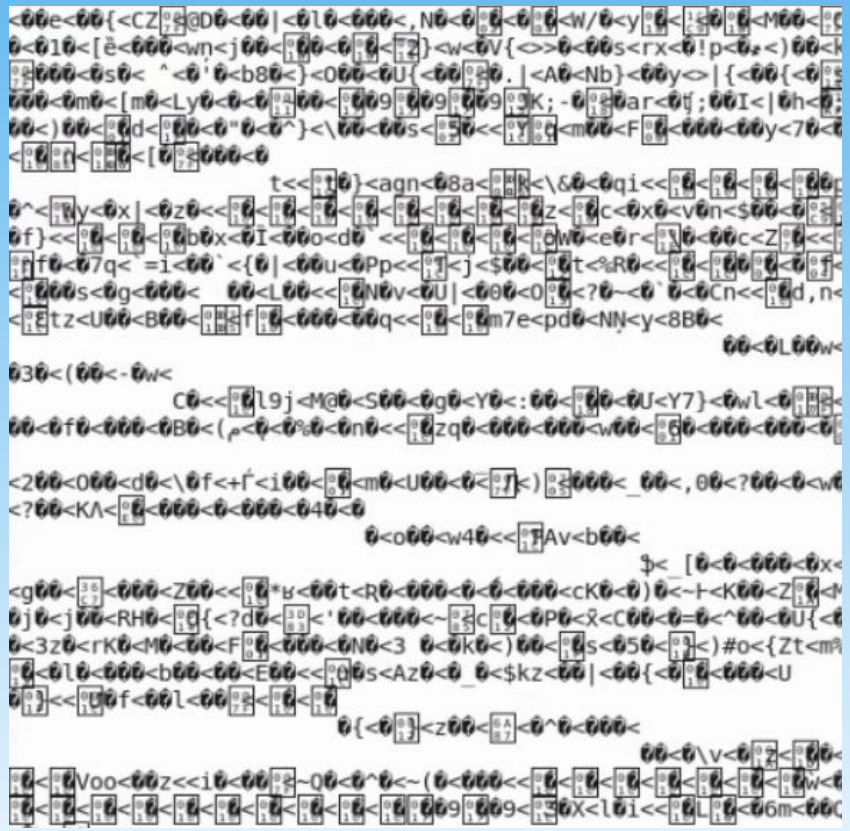

```
RCA Simulation Results - Scenario: ipsl-cm5a-mr.1 rcp60
Exported: 2016-01-26 14:09:22.645967
Grid ID,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,
I Grid,5,6,7,5,6,7,5,6,7,5,6,7,8,9,5,6,7,8,9,5,6,7,8,9,4
J Grid,7,7,7,8,8,8,9,9,9,10,10,10,10,10,11,11,11,11,11,1

2001-01-01 01:00:00,0.000210,0.000210,0.000210,0.016500,
2001-01-01 13:00:00,0.000457,0.000457,0.000457,0.002805,
2001-01-02 13:00:00,0.000952,0.000952,0.000952,0.000851,
2001-01-03 13:00:00,0.001447,0.001447,0.001447,0.001292,
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2001-01-08 13:00:00,0.003922,0.003922,0.003922,0.011549,
2001-01-09 13:00:00,0.004417,0.004417,0.004417,0.005647,
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2001-01-18 13:00:00,0.008877,0.008877,0.008877,0.008838,
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2001-01-22 13:00:00,0.010862,0.010862,0.010862,0.010856,
```

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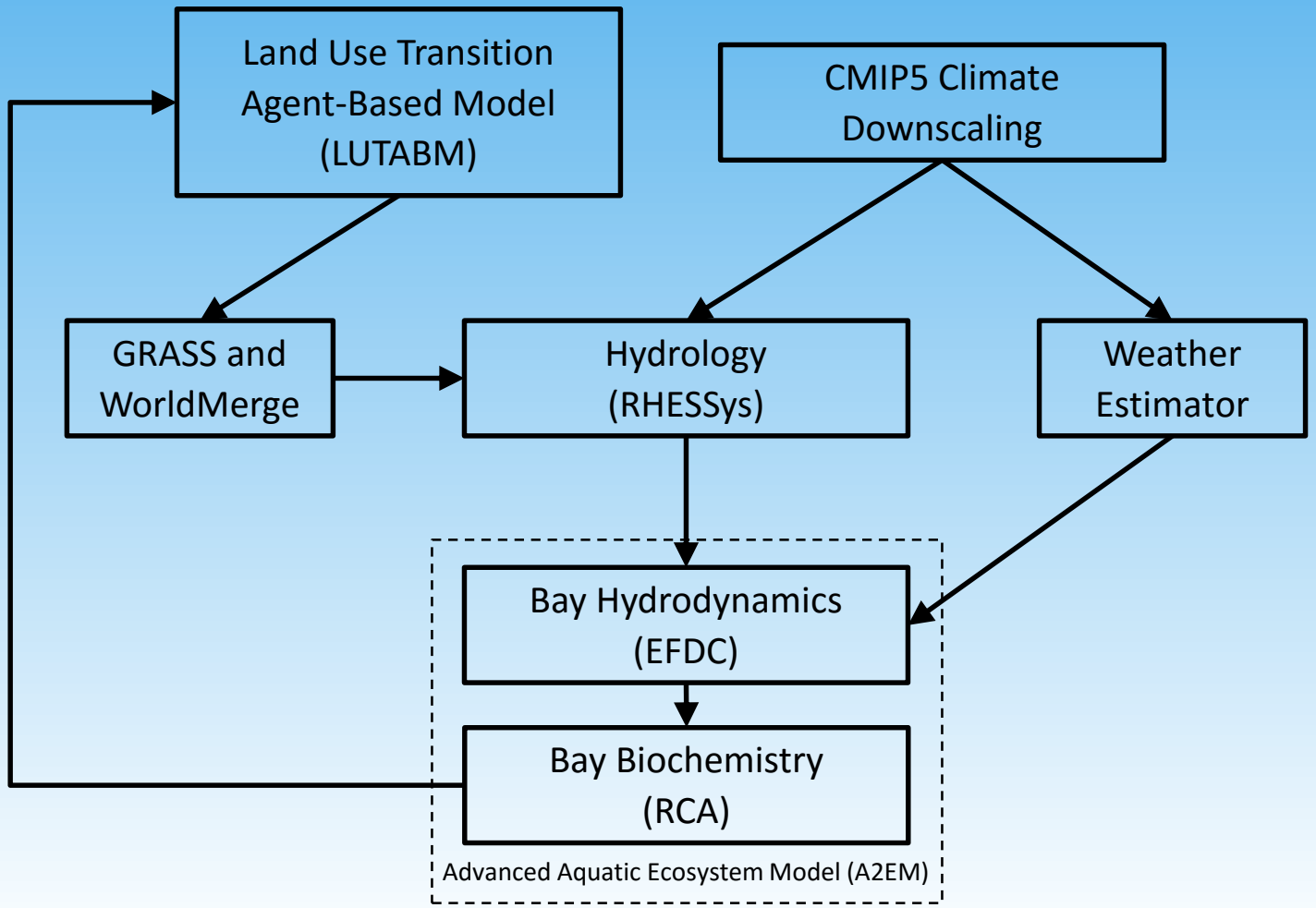

Future Work

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- Coming Soon
  - LUTABM will supply BMP adoption percentages for RHESSys
  - LUTABM will incorporate data from RCA
- Wish List
  - Automate more analysis / visualizations
  - Use Yellowstone for other IAM components
  - Natively compile EFDC / RCA for Linux
  - Improve error handling and restarting

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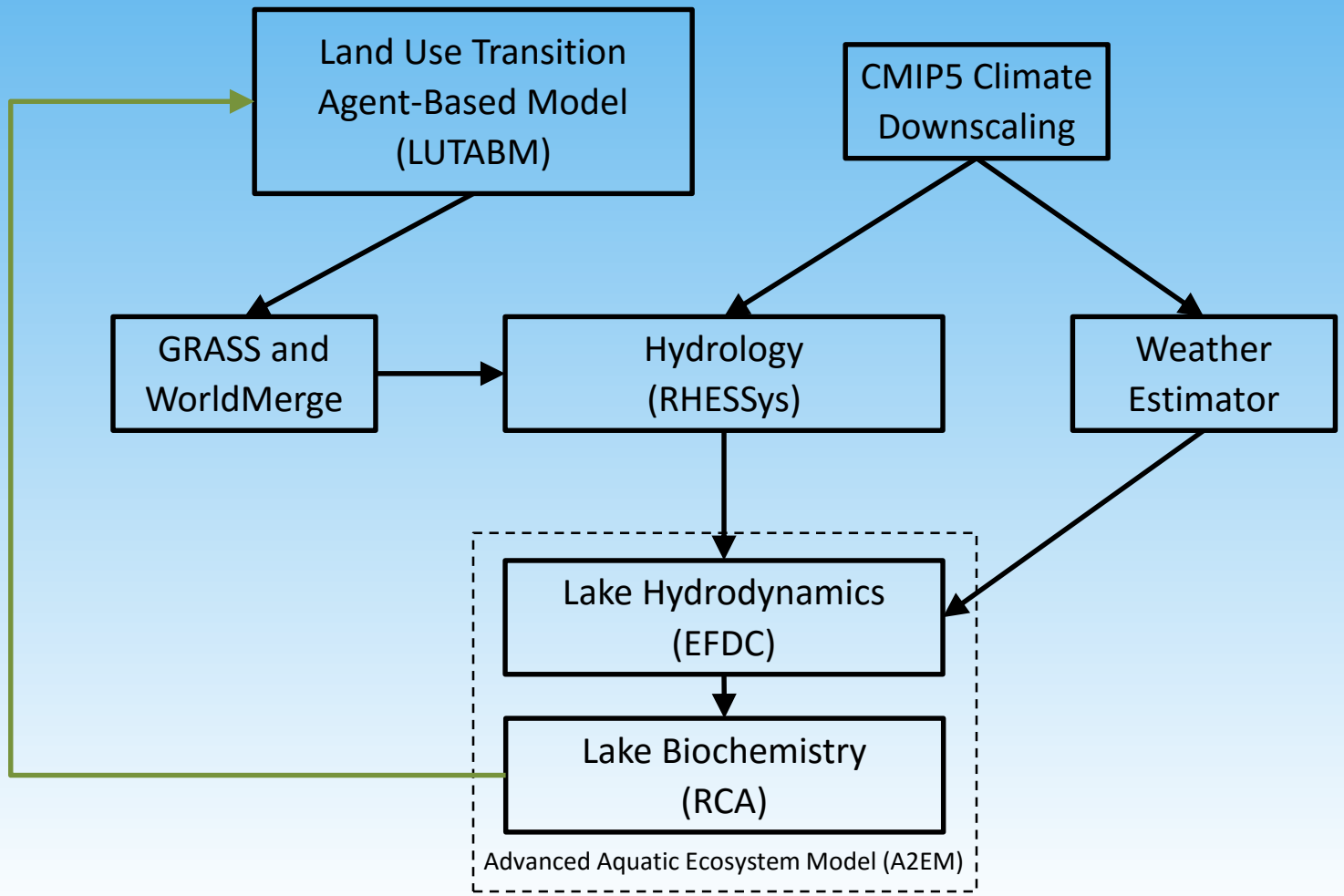

Computation

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16 40-Year Scenarios:

For Each Scenario:

16 Processes		Land Use Transition Agent-Based Model (LUTABM)	
16 Processes		GRASS and WorldMerge	
64 Processes		Hydrology (RHESSys)	x Number of Years / 10 (Parallel)
640 Processes	Executed on Yellowstone	Lake Hydrodynamics (EFDC)	x Number of Years (Parallel)
640 Processes		Lake Biochemistry (RCA)	x Number of Years (Serial)

Computation

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16 40-Year Scenarios:

For Each Scenario and Decade:

64 Processes — Land Use Transition Agent-Based Model (LUTABM)

64 Processes — GRASS and WorldMerge

64 Processes — Hydrology (RHESSys)

640 Processes — Executed on Yellowstone — Lake Hydrodynamics (EFDC) — x 10 (Parallel)

640 Processes — Lake Biochemistry (RCA) — x 10 (Serial)