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Facilitated Panel Discussion

Review HPM Basics

&

Goal 7:

Tests for verification of HPM approach

Recommendations for HPM Improvements

Eric G. Flaig

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Key HPM Concepts

- (PseudoCells → Hydrologic Process Modules)
- Simplify regional solution
- Variable surface hydrology
- Vertical solution
- Local Water management
- Consumptive water use
- Simple HPMs
- Complex HPMs → Hubs

HPM Architecture

- Flexible code development
- Flexible implementation
- Incorporate simple to complex
- Legacy code
- Alternative descriptions of hydrology
  - Quality of data
  - Model implementation objectives
  - Landscape/land use
  - Local hydrology is not hard-coded

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Interaction of HPMs with Regional Solution

Governing Equation

$$S_t = S_{t-1} + P_t - ET_t + CellDelta_{t-1} + hpmInflow_t - \sum_{j=1}^{n} WS_{jt} - \sum_{j=1}^{n} RO_{jt} - Rec_{jt}$$

$\Sigma\ WS_{jt} = Q_{irr} + Q_{cu}$

$\Sigma\ RO_{jt} = Q_{sur} + Q_{int} + Q_{det} + Q_{base} + Q_{sew}$

$Rec_{jt} = Q_{rchg} + Q_{septic} + Q_{seep} + Q_{imp}$

$\Delta S_{jt} = S_{soil} + S_{det} + S_{imp}$

- Explicit solution of HPMs

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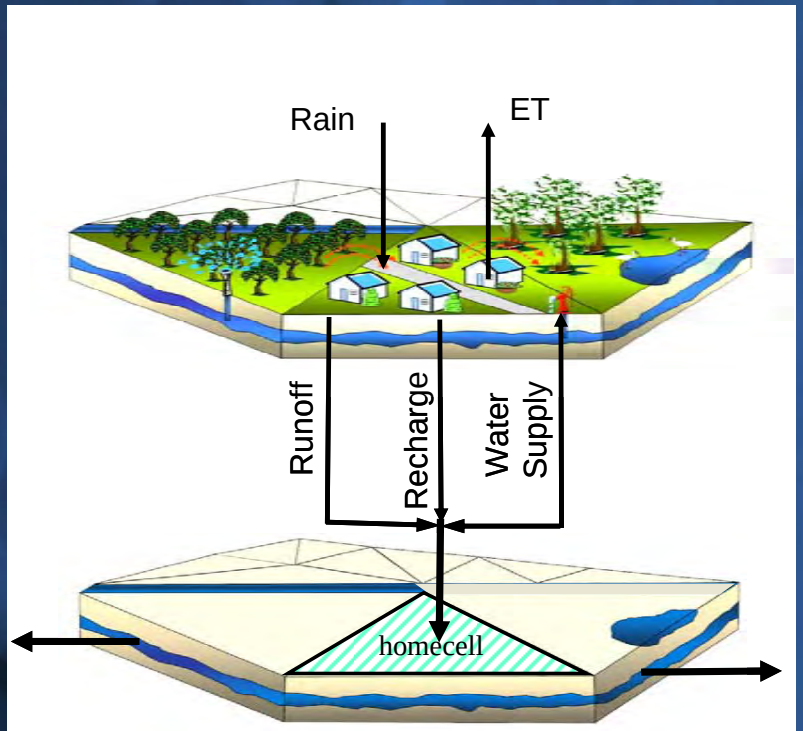
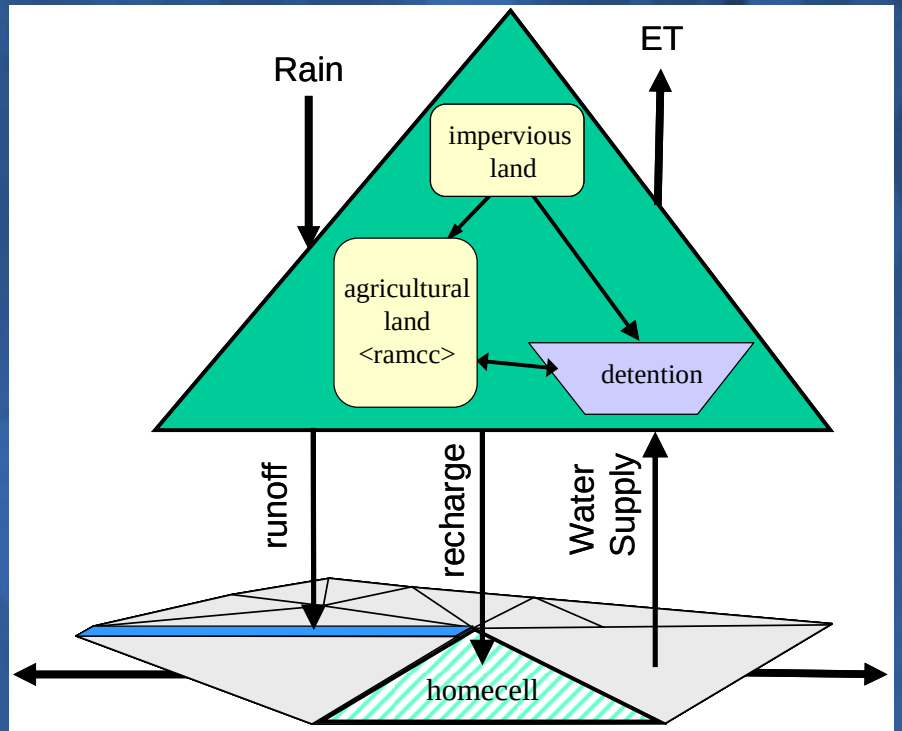
HPM-Regional Solution coupling



System of integrated waterbodies



Regional system of integrated waterbodies

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HPM simple types & instances

- **Natural System**
  - Natural Wetland System <layer1nsm>
  - Unsaturated Soil <unsat>
  - Five Layer <layer5>
  - Precipitation Runoff Routing <prr>
  - No Action <layerpc>
- **Agricultural**
  - Agricultural Irrigation Requirements <ramcc>
  - Drainage Collector Ditch <pumpedditch>
  - Agricultural Impoundment <agimp>
- **Urban**
  - Impervious Area <imperv>
  - Multi-Basin Routing <mbrcell>
  - Consumptive Use <cu>
  - Urban/Stormwater Retention/Detention <urbandet>

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HPM simple types & instances

	Category	HPM Type	Instance		Category	HPM Type	Instance
1	Natural	Layer1nsm	Upland Forest	9	Agricultural	Afsirs.f	Sugarcane
2		Layer1nsm	Cypress Swamp	10		Afsirs.f	Improved Pasture
3		Layer1nsm	Scrub	11		Afsirs.f	Veggies
4		Layer1nsm	Grass	12		Afsirs.f	Citrus
5		Layer1nsm	Water	13		Afsirs.f	Nursery
6		Layer1nsm	Mangrove	14	Hub-Urban	Imperv/afsirs	High Density(HD)
7		Layer1nsm	Cattail marsh	15		Imperv/afsirs	Low Density(LD)
8		Layer1nsm	Saltwater marsh	16		Imperv/afsirs	Golf courses

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HPM simple types & instances

Category	HPM Type	Instance
	layerpc	does nothing
Natural	Layer1nsm	Wetlands (marsh, swamp, wet prairies)
	Layer5	Uplands with complex soil
	Unsat	Uplands
	PRR	Urban uplands
Agricultural	Afsirs.f	Sugarcane
	Ramcc (afsirscc)	*(Sugar cane, citrus, nurseries, pasture)*
	pumpedDitch	Collector ditches
	agImp	Agricultural impoundments
Urban	Mbrcell	Developed land
	Imperv	Impervious land
	urbanDet	Stormwater detention ponds
	CU	Household Consumptive use

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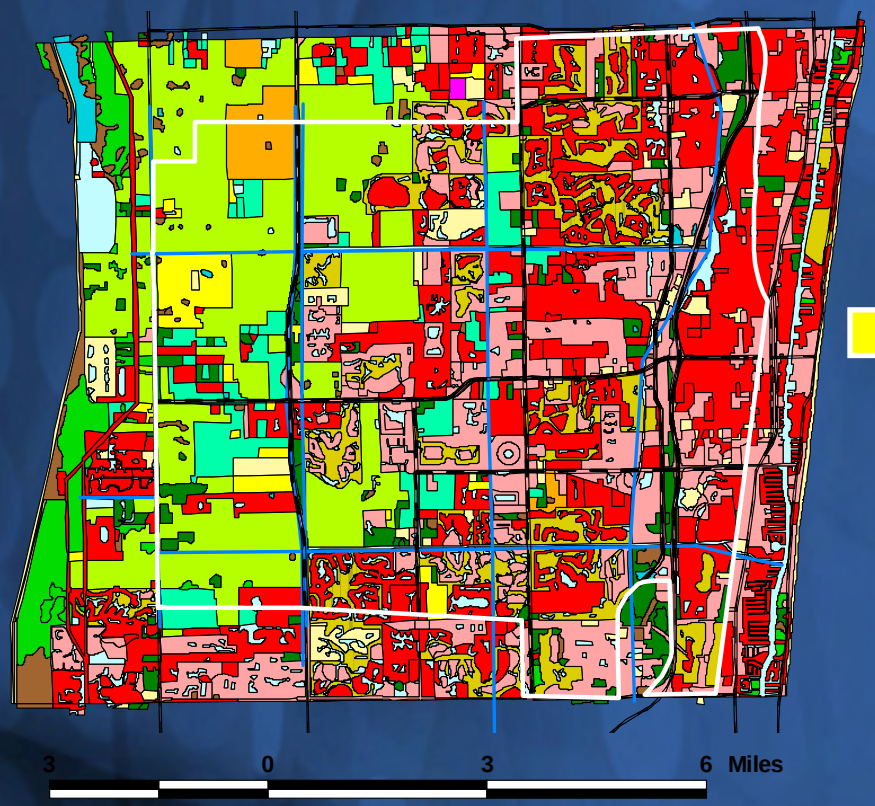
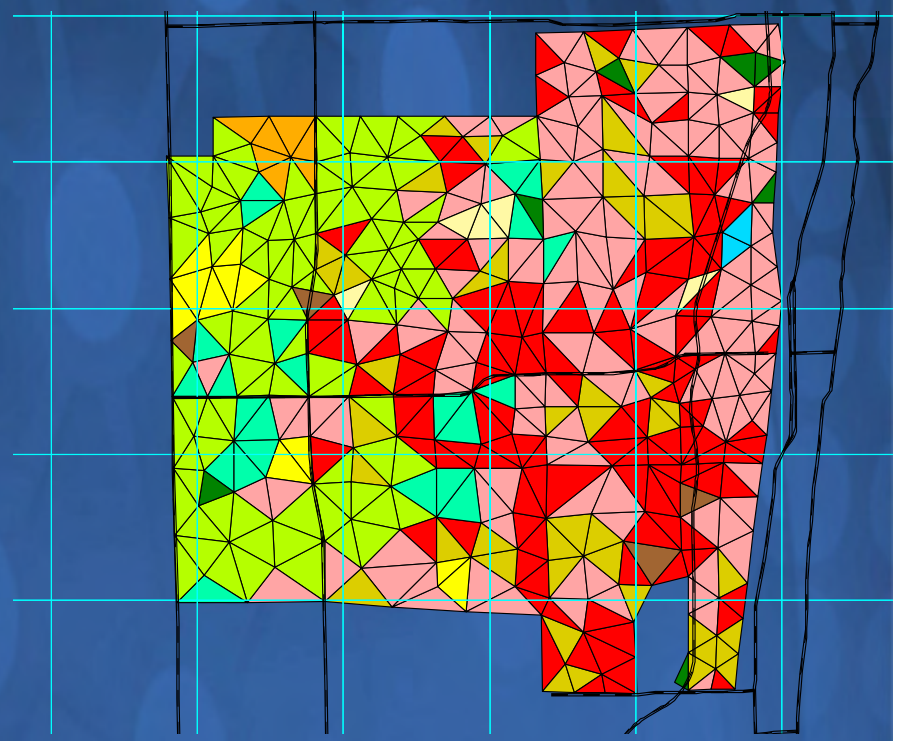
Implementation of simple HPMs

C15 Basin



Simple HPMs



Scrub
Urban-High density
Urban-Low density
Vegies
Water
Citrus
Forest
Golf courses
Nursery
Pasture-improved
Pasture-unimproved

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HPM Hubs Concepts

- A Hub is:
  - Collection of HPMs
  - Usually connected to a single water supply and discharge
- Scaling:
  - Aggregate multiple smaller scale cells into a larger cell to match large-scale regional operations
- Multiple HPMs across several cells
- Multiple HPMs within a cell

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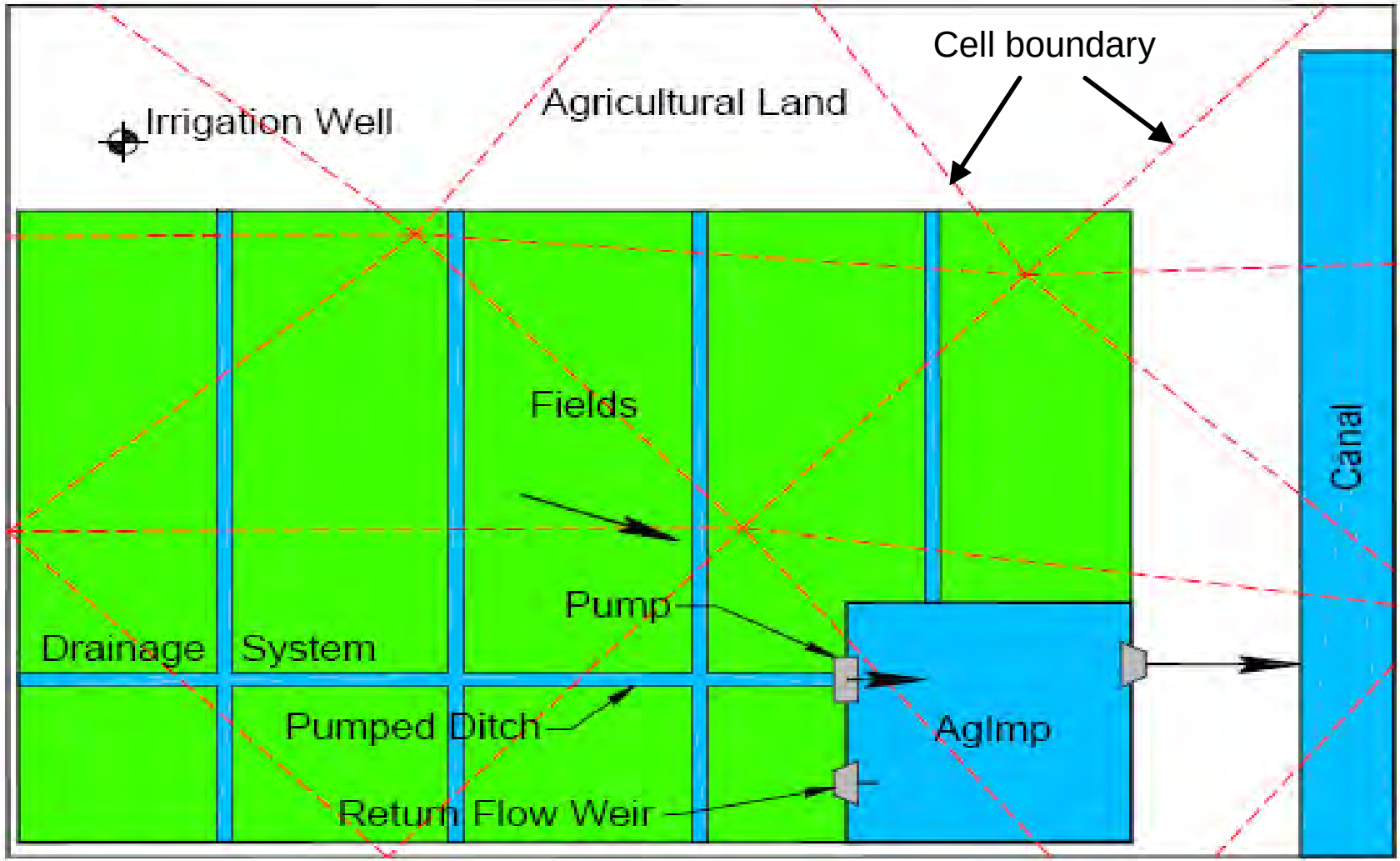
Agricultural Hub



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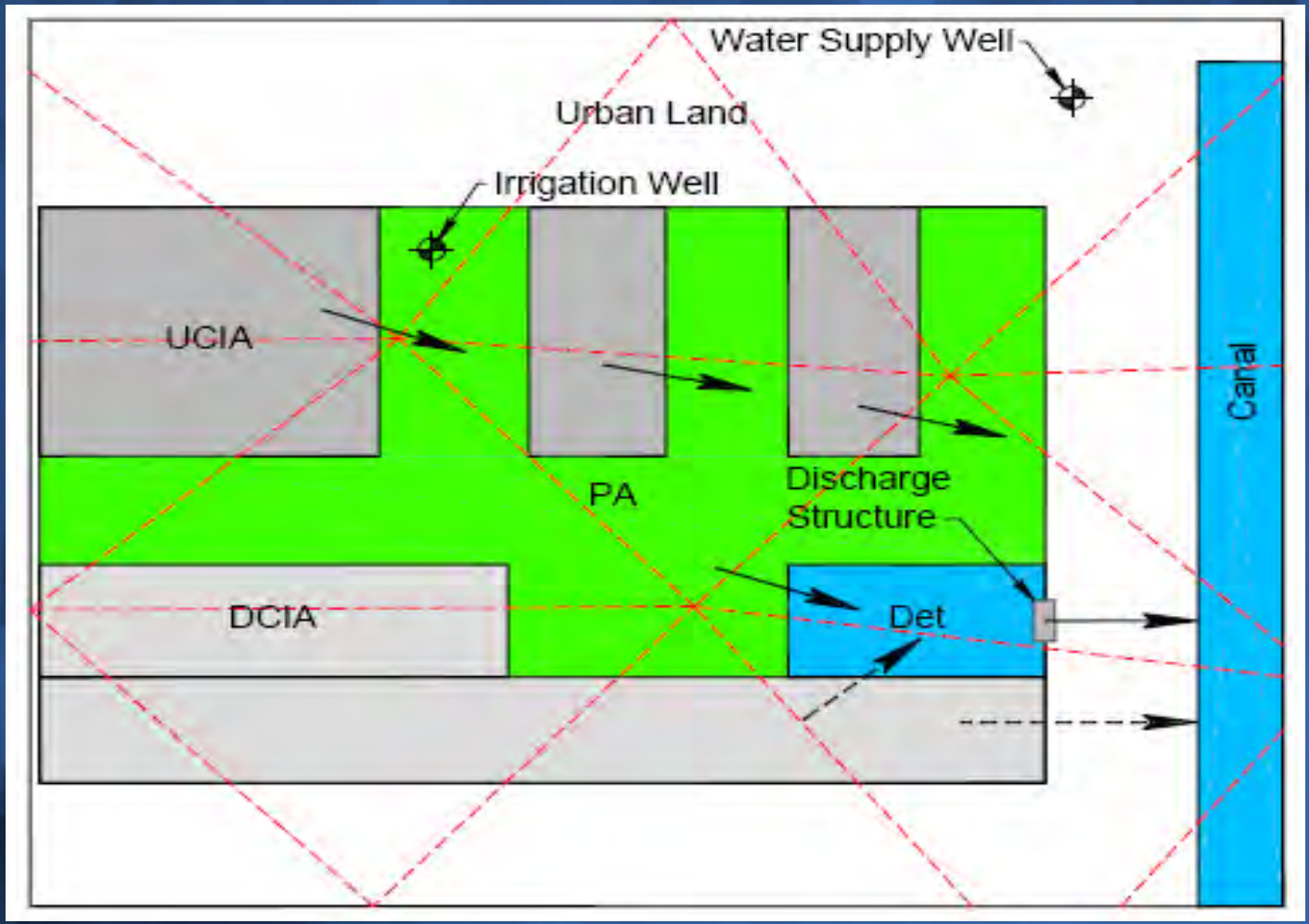
Urban Hub



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HPM Hubs

- **Agricultural**
  - Agricultural Irrigation Requirements
  - Drainage Collector Ditch
  - Agricultural Impoundment
- **Urban**
  - Impervious Area
  - Consumptive Use
  - Urban Stormwater Retention/Detention

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Hub Types

Hub-Urban	Imperv/ afsirs	High density urban & low density urban
	Imperv/ ramcc/ urbandet	
	Imperv/ ramcc/ pumpedDitch	Developments w/detention
	Imperv/ multi-ramcc/ pumpedDitch	Water control districts
Hub-Ag	afsirs	Simple EAA
	ramcc/ agimp	Citrus
	ramcc/pumpedDitch	Veggies, nurseries
	ramcc/pumpedDitch/agimp	Citrus

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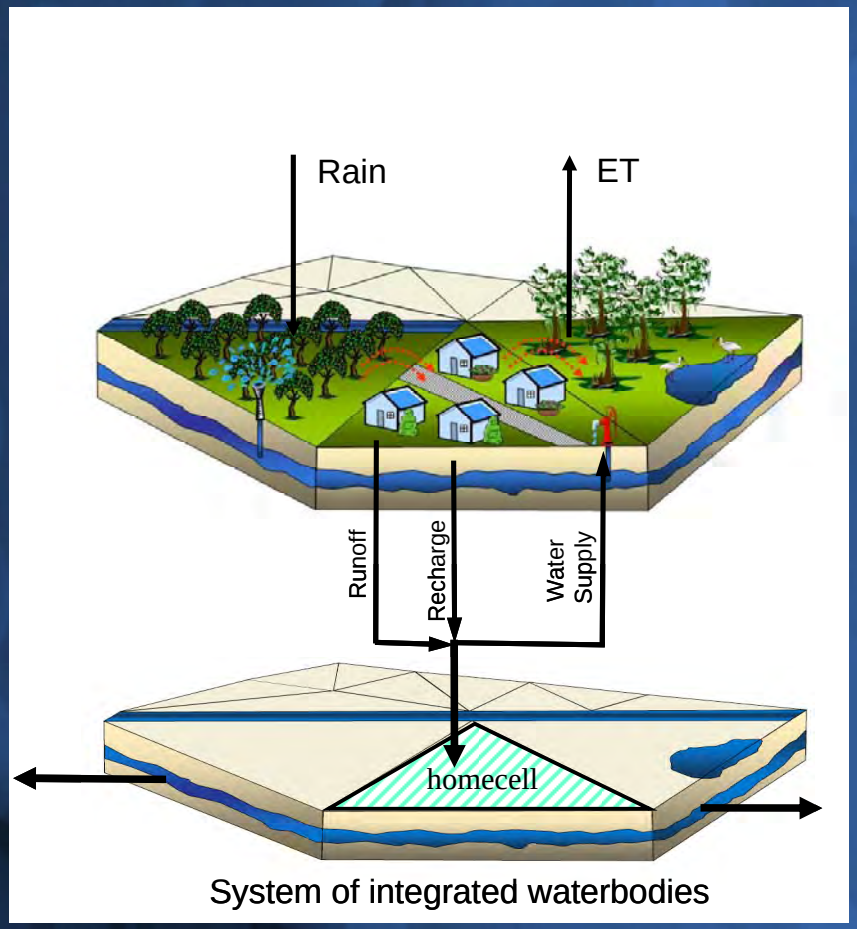
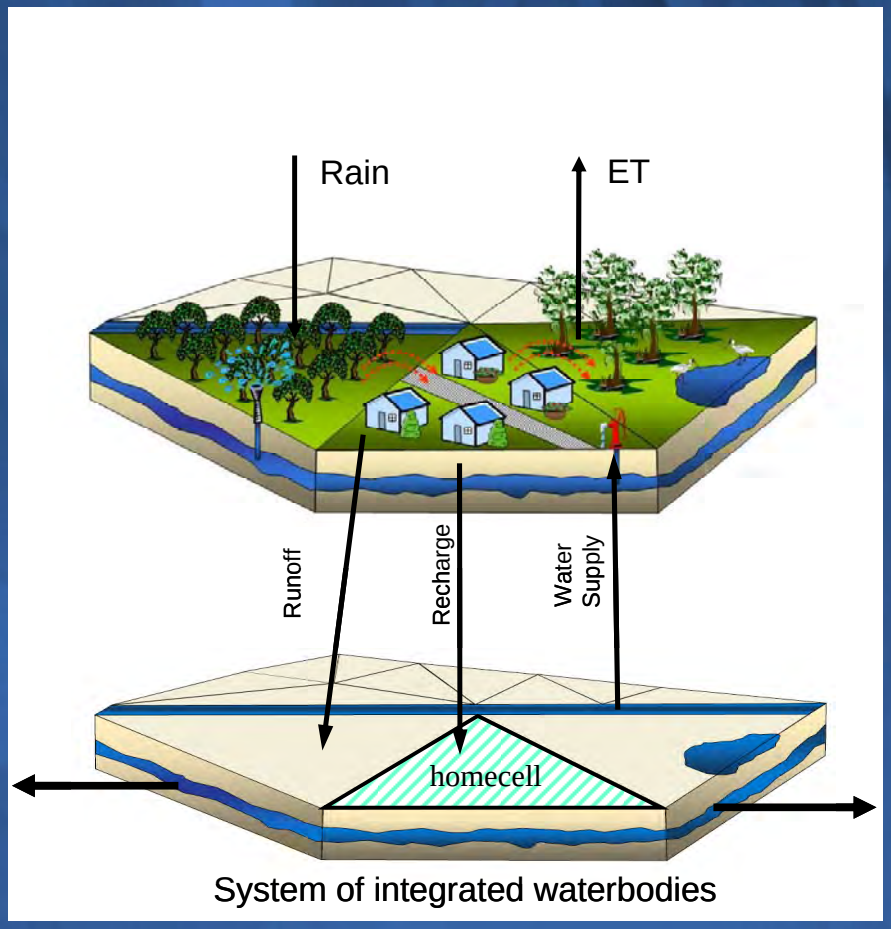
Hub HPM-Regional Solution coupling



Default Case



Simple Case

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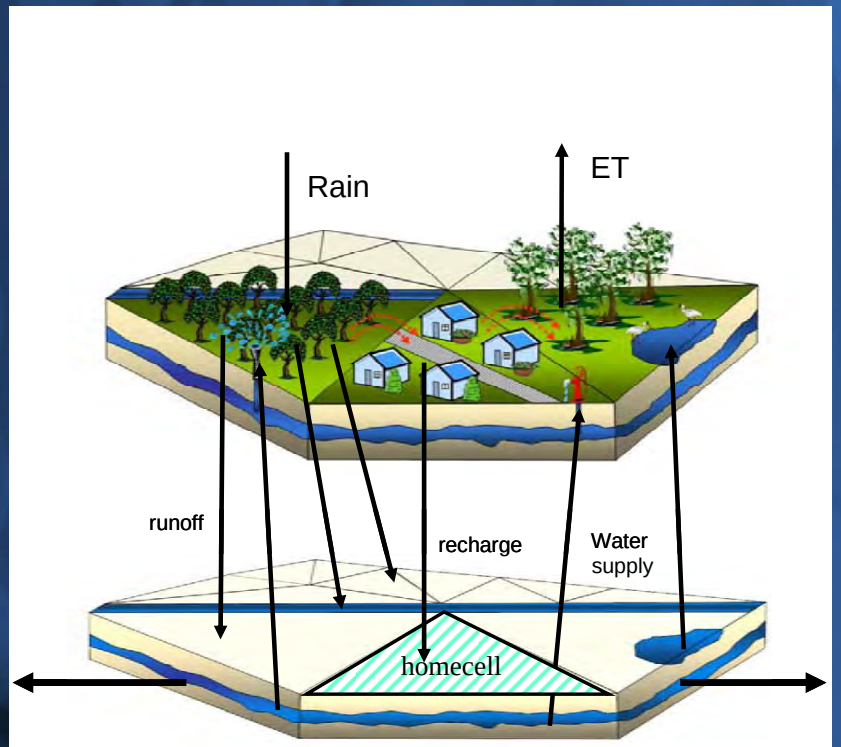
Hub HPM-Regional Solution coupling



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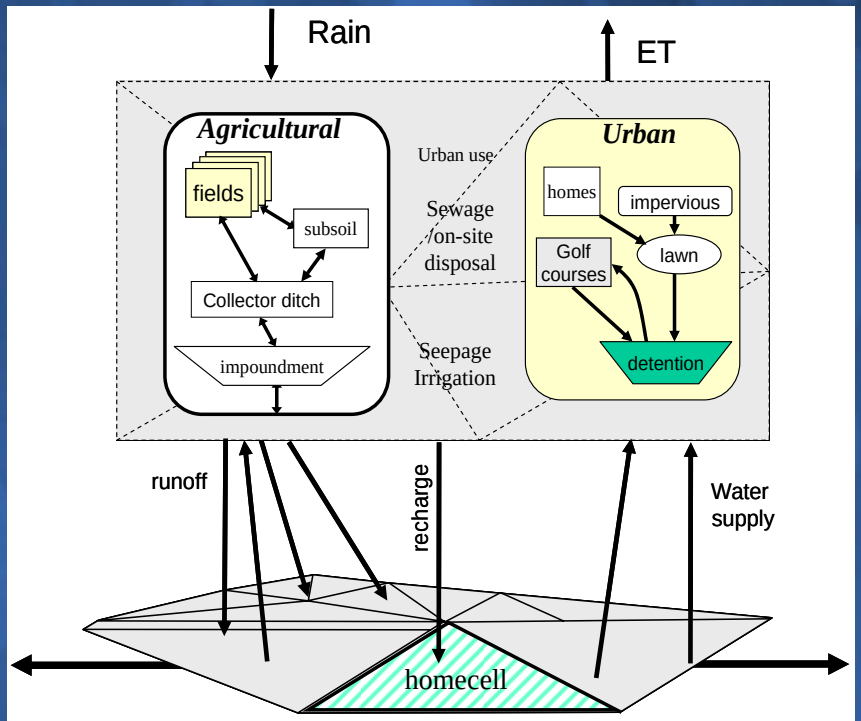

System of integrated waterbodies

Comprehensive Case

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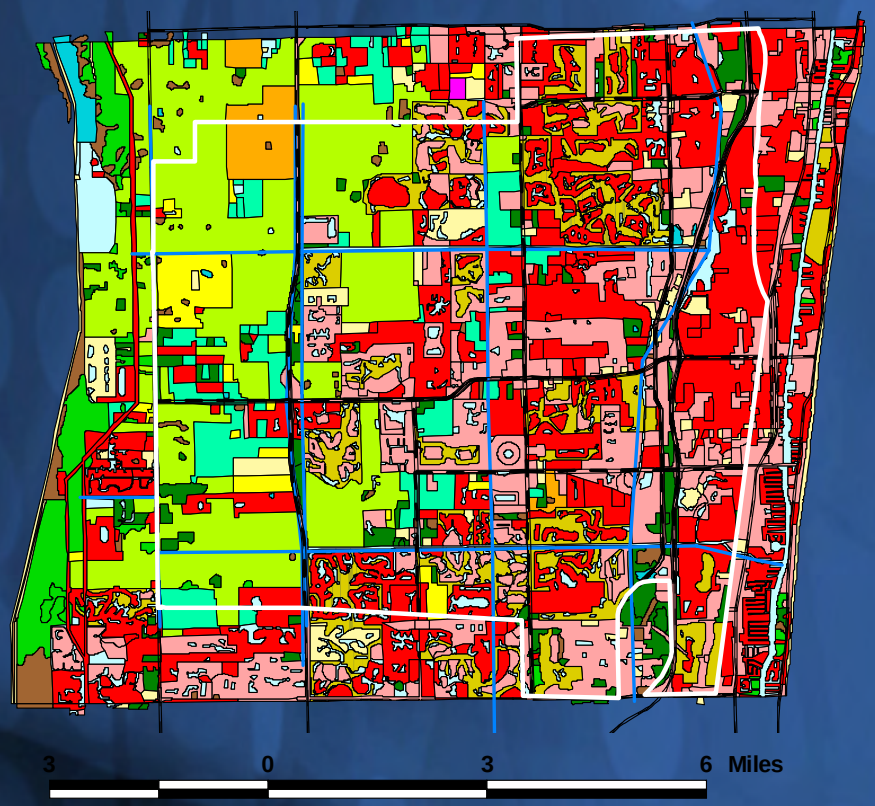
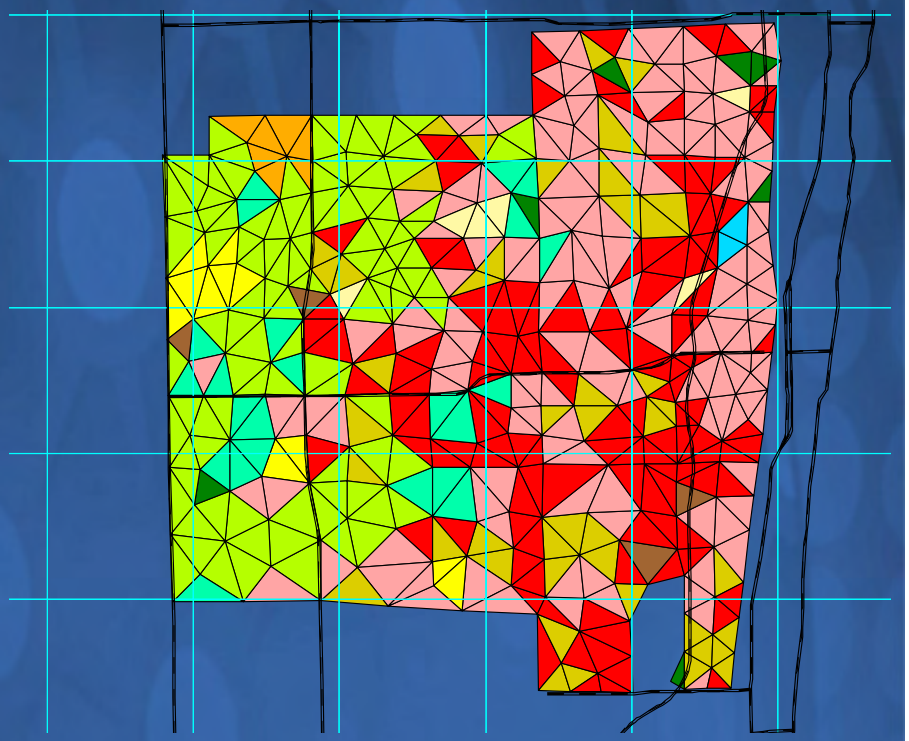
Hub Implementation

C15 Basin



Simple HPMs



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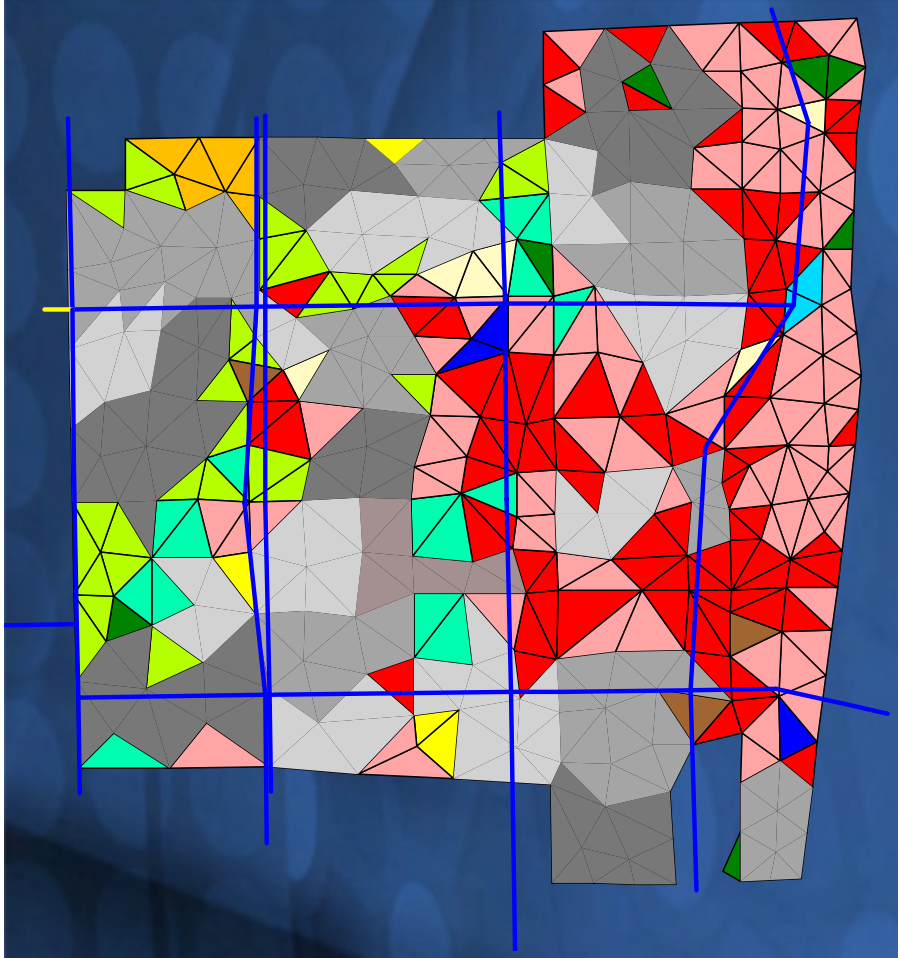
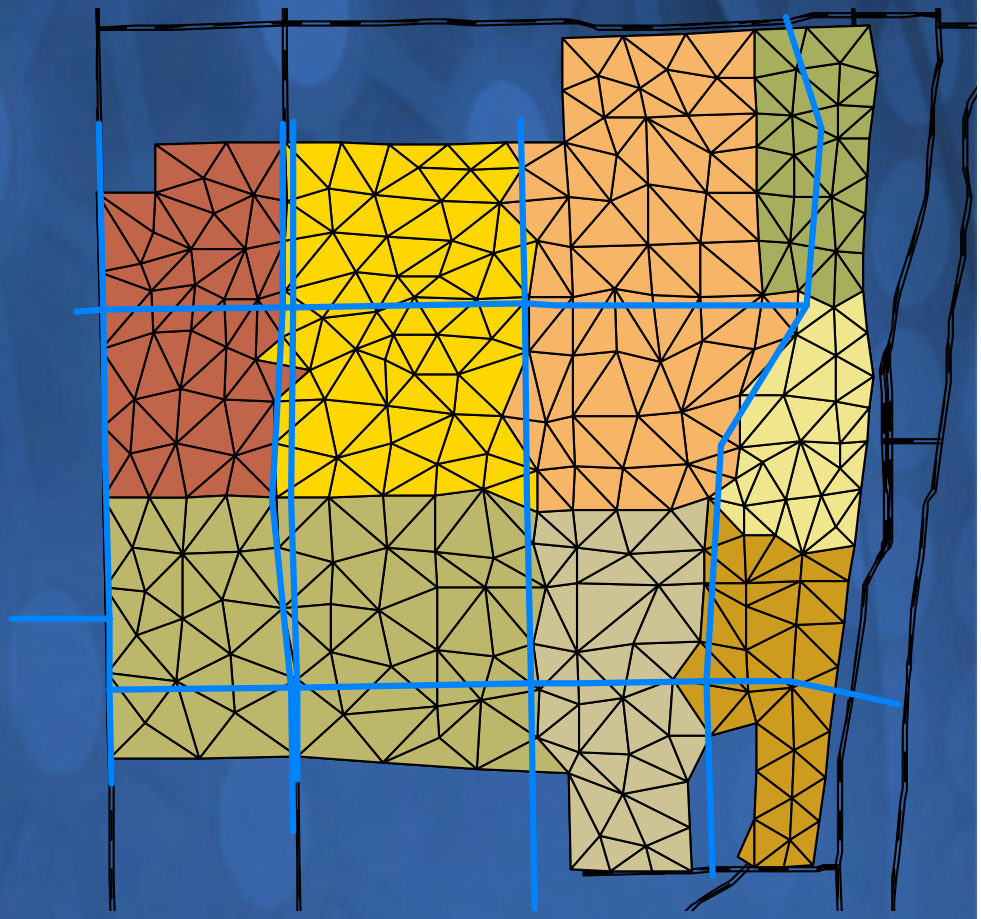
Hub Implementation



Small Hubs – Water use



Large Hubs – subwatersheds

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Panel Comments

- Editorial
- Consistency among HPMs
  - terminology, control volumes, references
- Specific comments with PRR and mbrcell HPMs
  - we need to address issues with the equations
  - improve discussion
- Add implementation section to HPM paper.

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HPM Implementation

Implementation of HPMs

- Pre-processing landscape features → HPMs
- GIS feature classes
- HPM parameter look-up tables
- Create HPM XML input files

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Potential Testing and Verification

Options

- Conduct reasonableness tests on each HPM and vary the parameter values.
- Compare results among HPMs.
- Compare HPM output for single HPMs and Hubs to other models.
- Compare HPMs to field data where possible.
- Sensitivity of HPMs on the regional solution.

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Open Discussion

- Test and Verify HPMs
- Improve HPMs