2D Modeling
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Outline

• Types of Models
  – Steady vs Unsteady
  – 1D vs 2D
  – Software available

• Basics of 2D modeling
  – Inputs
  – Outputs
  – Things to consider

• Case Study
Types of Modeling Available
Steady vs Unsteady
1-dimensional vs 2-dimensional
Steady vs Unsteady

Steady
- Flow is constant
- Storage not a factor
- Only need peak

Unsteady
- Flow changes with Time
- Storage is a factor
- Hydrograph
Unsteady - Hydrograph

Steady State
Unsteady - Storage

![Graph for Reach "R420"

Reach "R420" Results for Run "100 yr"

Legend (Compute Time: 26Mar2012, 12:20:09)

- Run:100 YR Element:R420 Result:Outflow
- Run:100 YR Element:R420 Result:Combined Inflow

Flow (cfs)
1D vs 2D

1-dimensional
- Node & Link Based
  - Cross sections
  - Junctions
  - Storage Ponds
  - Diversions

2-dimensional
- Grid or Spatially Based
  - Flow in multiple directions
  - Storage accounted for in model
1D – Node & Link Based

- **Flow**
  - Follows your network
  - Controlled by downstream feature
2D – Grid Based

- Flow
  - Follows terrain
  - Determined by neighboring water surface elevation
How Do I Decide?

- Don’t be Prejudice
  - One type is not necessarily better than another
  - Let your circumstances dictate which model you use
Steady 1D Models

- Clearly defined channels
- Structures
- Flow direction is clear
- Rural and Urban
- Steep slopes, Fast moving
- Narrow Channels
- Floodways
Unsteady 1D Models

- Storage significant factor
- Diversions occur
- Structures
- Rural and Urban
- Swamp/wetlands
- Wide floodplains
Unsteady 2D Models

- Storage significant, flat, slow moving
- Flow paths are unclear
- Unconfined flooding - structures minimal
- Alluvial Fans
- Swamps
- Size can be a limitation
## Some Products Available

<table>
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<th>Model</th>
<th>Steady</th>
<th>Unsteady</th>
<th>1D</th>
<th>2D</th>
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Basics of 2D Modeling
Flo-2D
Simple model 2D

- Inflow (Point or Rain)
- Topography
- Infiltration
- Manning’s roughness
- Outflow
Extras

- Structures
- Levees
- Area Reduction Factors
- 1D Channels
Outputs

- Water surface elevation grid
- Depth grid
- Velocity grid
- Flow hydrographs at cross sections
- Much more
Things to Consider

- Be willing to invest some effort into the setup
- Choose grid cell size
  - Based on the size of the project
  - Depth change over cell
- Troubleshoot bugs
  - Sticky Elements
  - Velocity adjustments
- Start simple then add detail
Case Study
Coastal Georgia PMRs
Effingham and Chatham Counties
Too Urban

FLO-2D

- Flow is unpredictable
- Flat and Swampy
- Extensive storage

Too Urban
• 68 sq miles
• 100 ft Cell size
Case Study – Inputs

- Inflow - Rain
- Topo – 100 ft cell size from LiDAR
- Infiltration – CN
- Manning’s – Land Use and Roads
- Outflow – encompassing watershed
Terrain
- High 95 ft
- Low - 30 ft
CN
- High 98
- Low 30
Manning’s n
• High 0.2
• Low 0.03
Case Study – So Far So Good

- We have a simple model
- Good enough for Hydrology…Probably
- Easier than coding an unsteady network

Now for the Extras…
Levee elevation must be below grid elevations.
Case Study – Results

- Standard Output
  - Water Surface Elevation
  - Velocity
  - Depth
- Floodplain Cleaned up
- Hydrographs
  - For 1D models
Depth over LiDAR
Greater than 0.5ft
Results
• Floodplains
• Hydrographs

HMS inflow
Was it worth it?

- **Hydrology (Detailed and Limited Detailed)**
  - 68 sqmi watershed
  - Complex drainage patterns, low level of effort

- **Hydraulics (Limited Detailed)**
  - About 20 streams and about 40 to 50 miles
  - 30 Structures

- **Floodplain Mapping**
  - Not straight forward because we had rain on the grid.