Modeling Flow Regimes for a cyclical wetland using Groundwater Temperatures in McLean County, IL

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Illinois' first public university

OUTLINE

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  - Factors influencing groundwater temperatures
- STUDY AREA
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INTRODUCTION

- Using groundwater temperatures has increased in the last decade (Musgrave and Binley, 2010).

- Temperature has the highest potential to explain the complex groundwater characteristics and model groundwater flow (Anderson, 2005; Conant, 2004).

- Heat is transported in the subsurface by conduction and convection via groundwater flow.

INTRODUCTION

- When considering the use of groundwater temperatures:
  - Influences on heat (Constantz, 1998)
    - Air Temperature

www.hardwarestore.com

- Solar Radiation

Common.wikimedia.org

- Precipitation

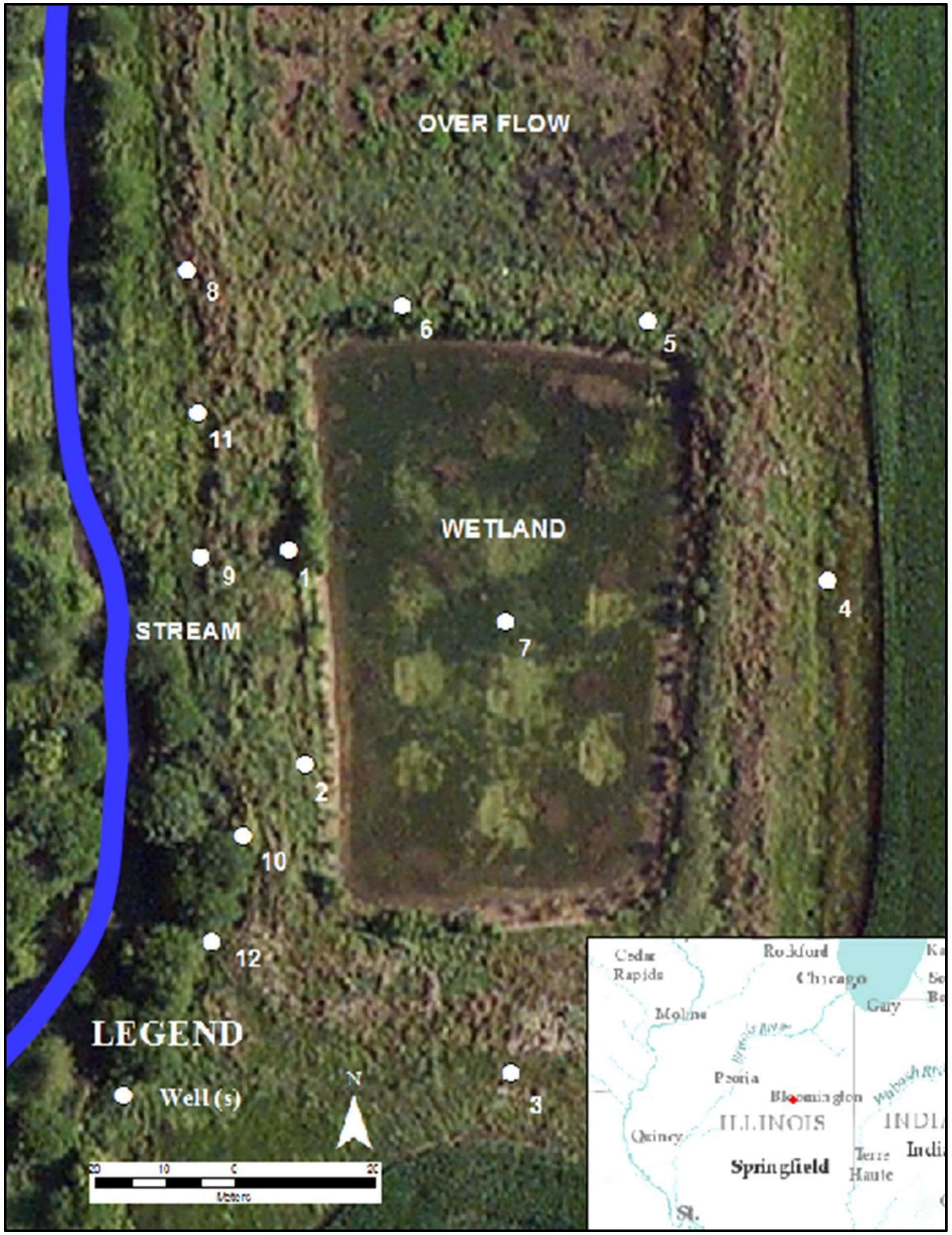
www.intellicast.com

- Water Inflow

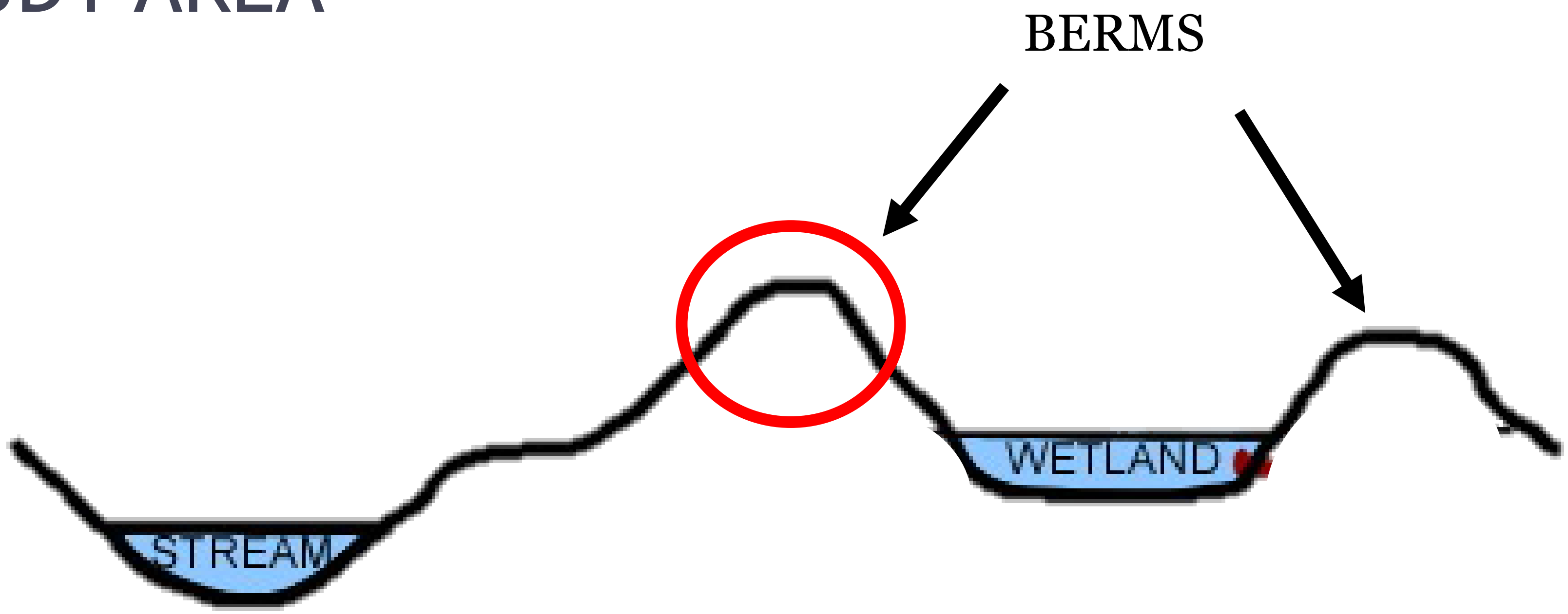
Mavensphotoblog.com

STUDY AREA

- 12 observation wells
- Stream along the west
- Overflow to north
- Dimensions of Durbin wetland are:
    - ~250 feet by 150 feet with depth of 6.64 feet
    - Volume: 249,ooo cubic feet.



STUDY AREA



On the west bank of wetland there is a significantly pronounced berm where well 1 and well 2 reside.

Illinois non-point source (NPS)

www.uiaa.org

www.nass.usda.gov

- The reservoir was built to sub-irrigate during drought and treat nutrient contamination into surrounding surface water.
- Groundwater flow controls the amount of nitrate that moves into a system (Denver et. al, 2014).

09/22/2013
DRY CONDITIONS

04/01/2014
WET CONDITIONS

QUESTION

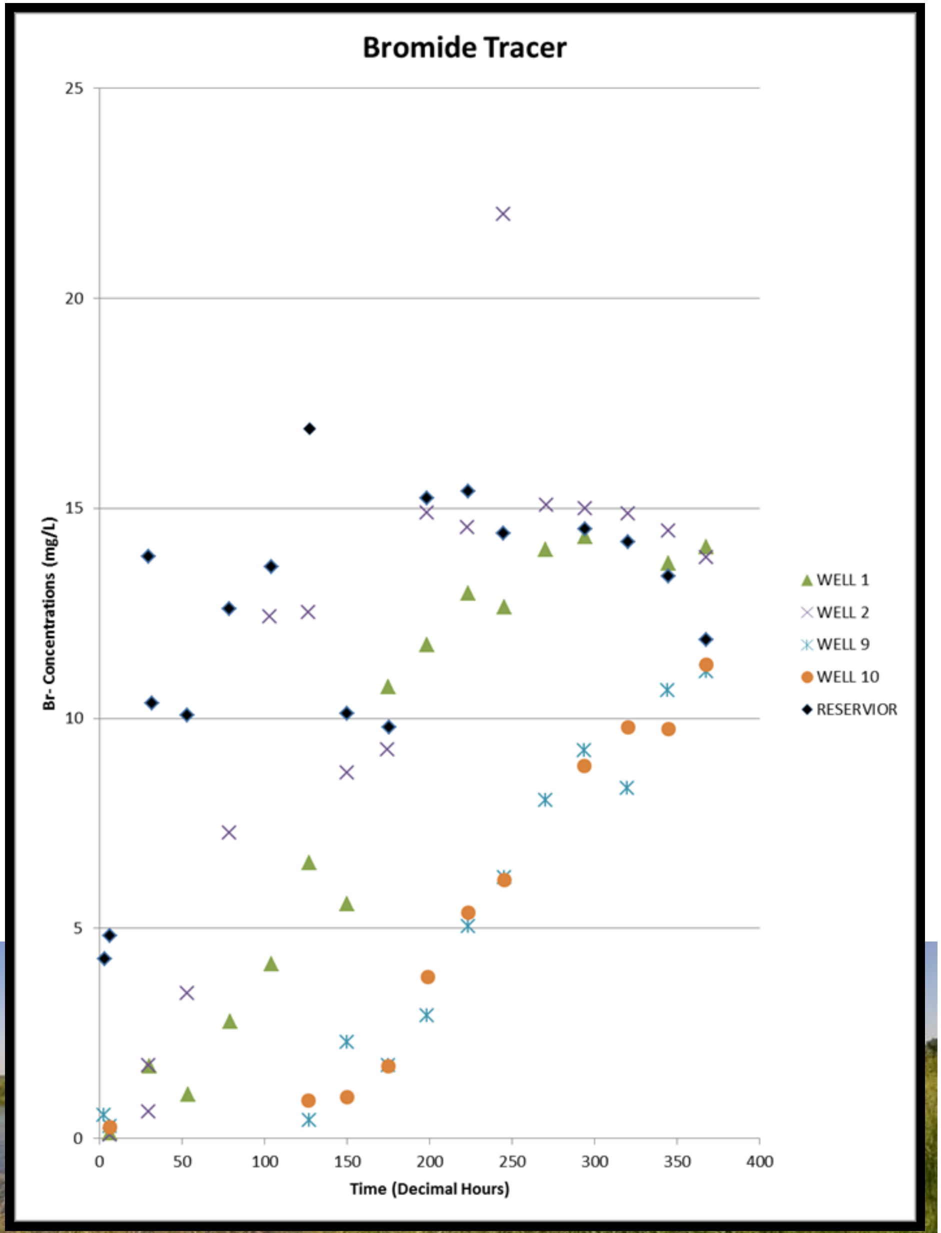
- How do dry conditions and wet conditions for a wetland influence the thermal regime of a local groundwater system?

METHODS- Field Collection

- Hydraulic head and temperature were measured in the field from 9/12/2013 to 10/8/2014.
- Water temperature (°C) was measured using a YSI-85 salinity-conductivity meter.
- Head values were measured with a water level meter and adjusted to surveyed elevations.
- Bromide tracer test was conducted by mixing 48 kg of sodium bromide into the wetland.
- Samples from the wetland, wells, and stream, were collected over 16 days.

RESULTS- Tracer Test

- Tracer tests indicates wetland waters infiltrate into subsurface and travel towards the stream.
- Concentrations of bromide were seen in the down gradient wells after three days of the initial start of test.
- Conducted on 5/13/2013 to 5/29/2013

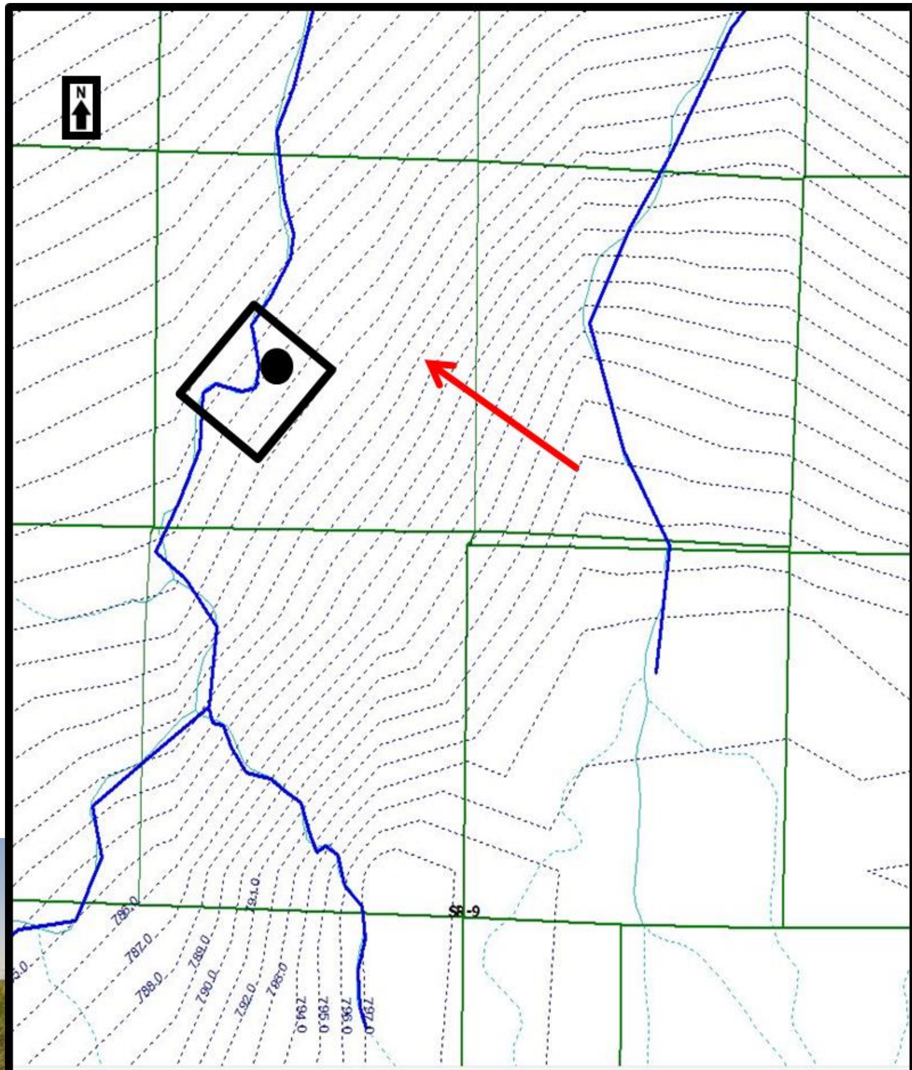


MEHTODS- Modeling

- GFLOW was used to verify the regional groundwater flow.

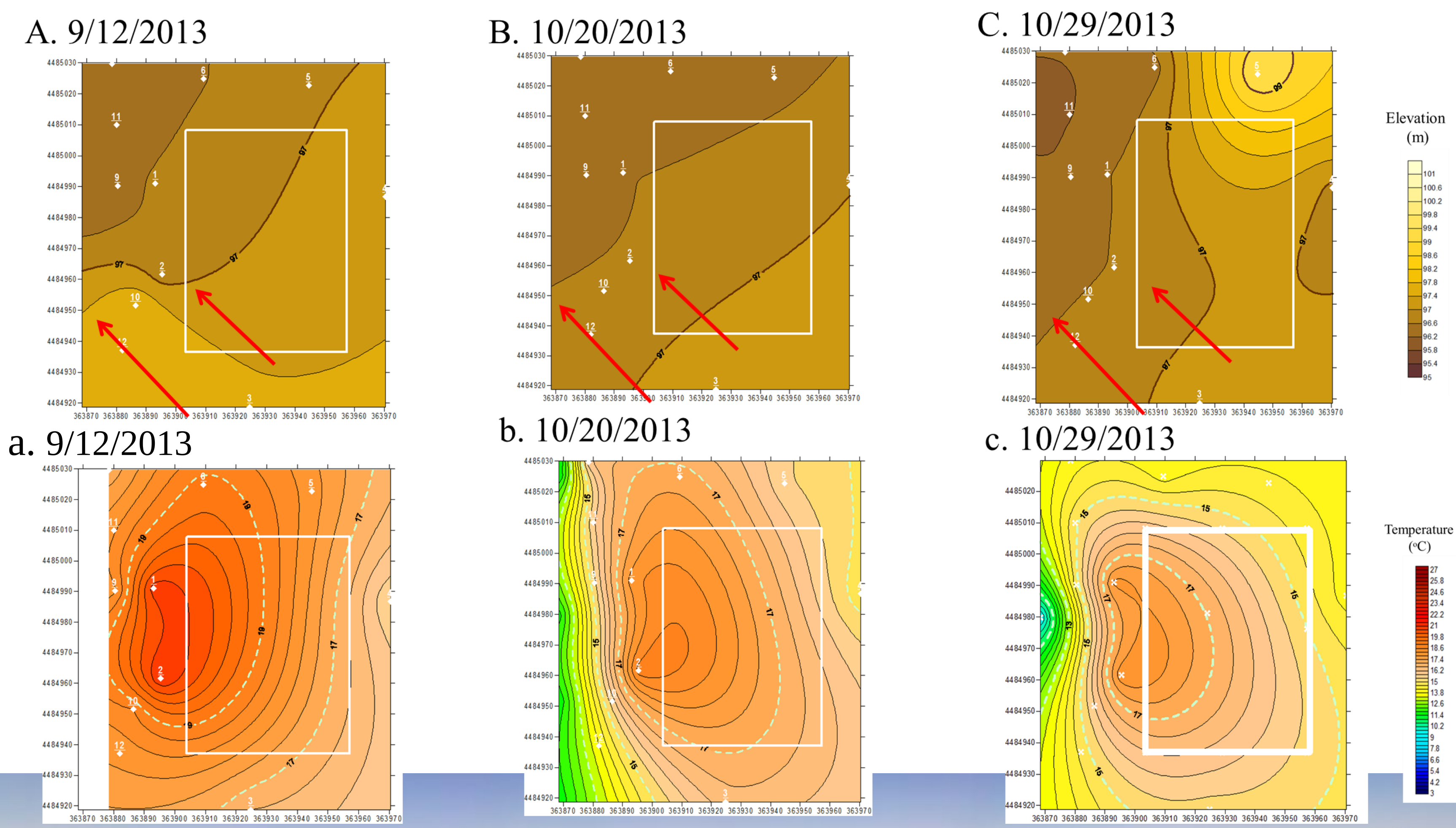
- Kriging method was used to interpolate the water table (hydraulic head) and the thermal gradient within the study area.

RESULTS- GFLOW

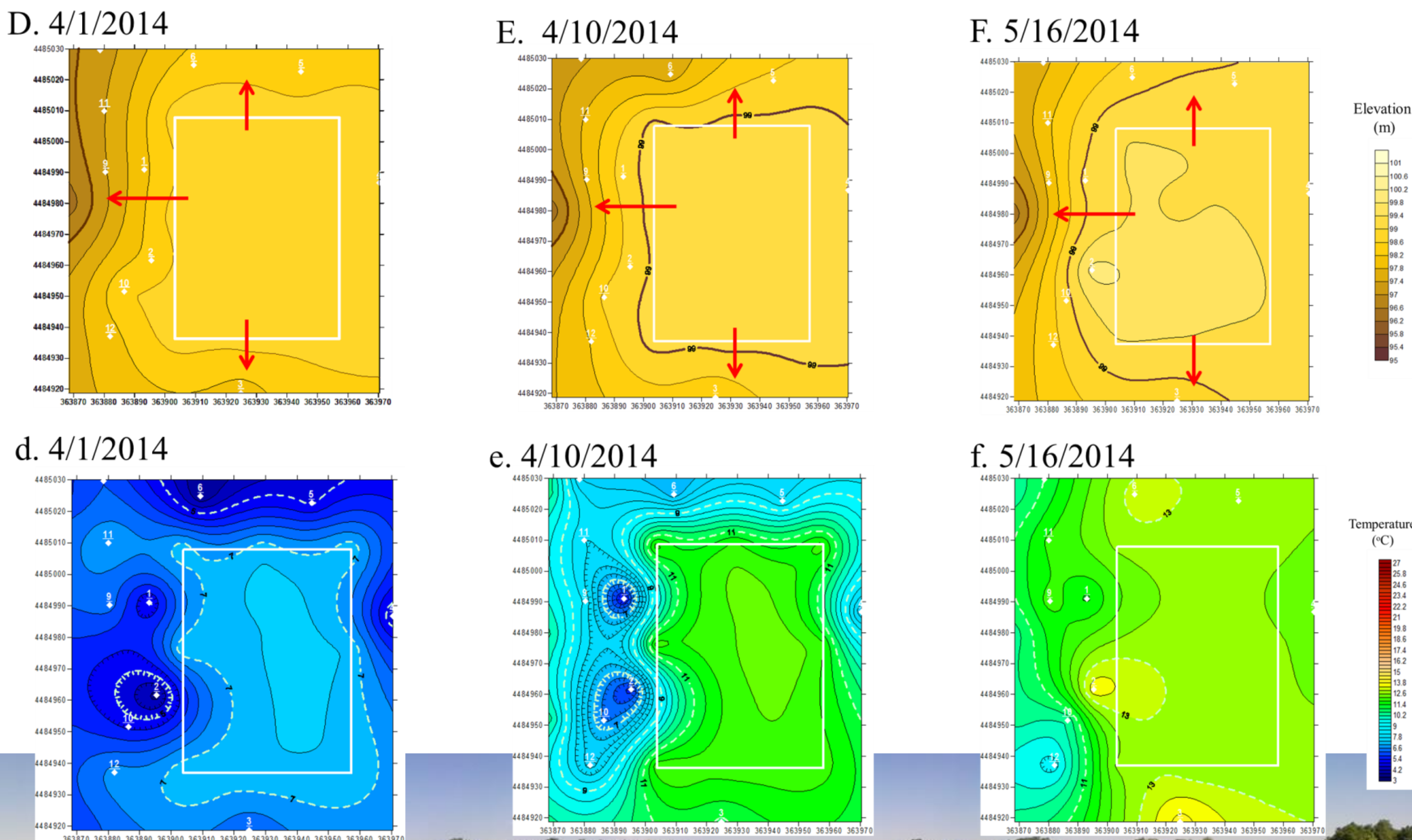


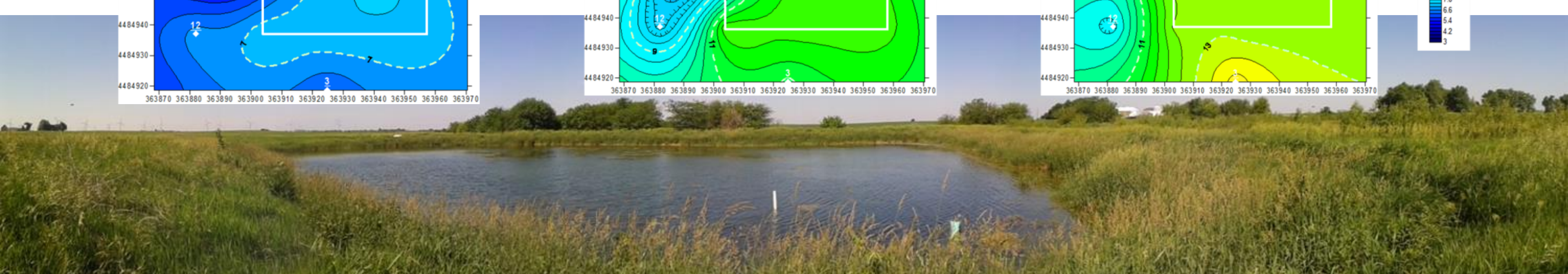
- Regional groundwater model using GFLOW.
- Regional groundwater flow is from southeast to northwest.
- Site location is a black dot.
- Red arrow represents flow direction.
- Open square is the boundary for model.

Water table and temperature during **dry conditions**



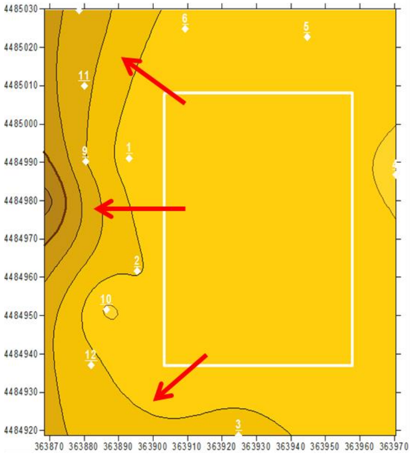
Water table and temperature during **wet conditions**





Water table and temperature during **wet conditions**

G. 6/5/2014



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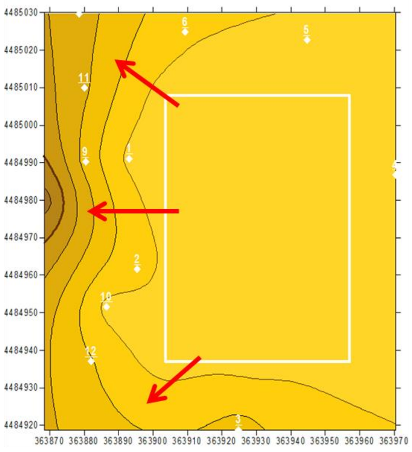

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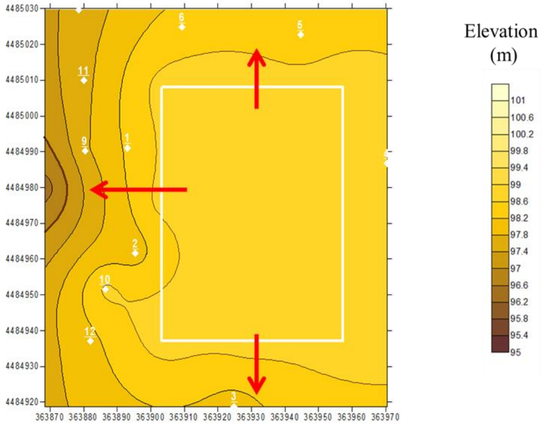

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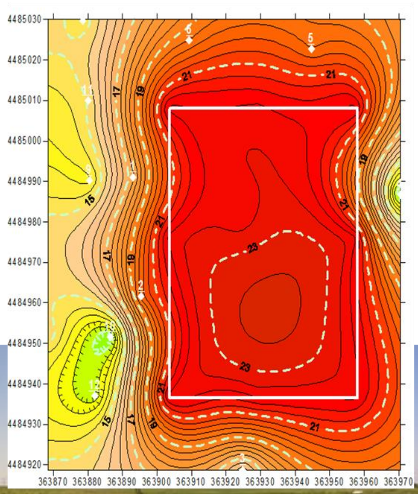

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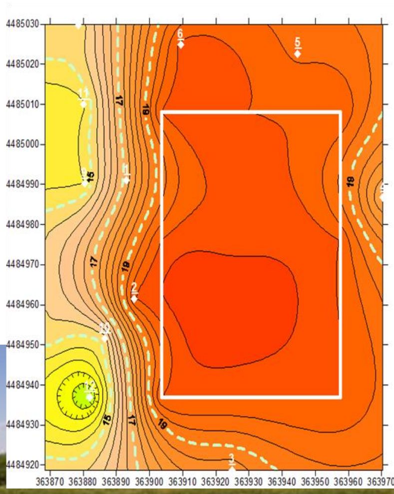

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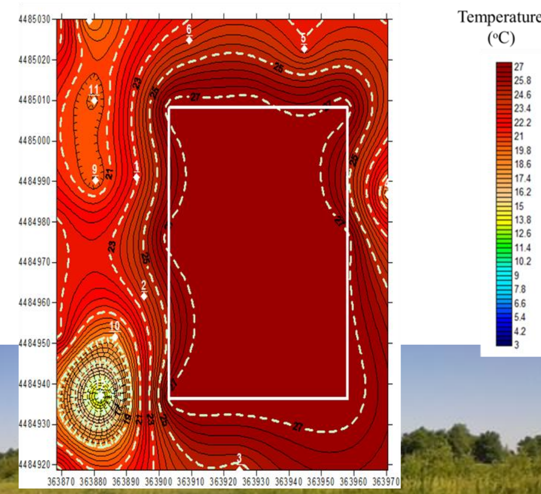

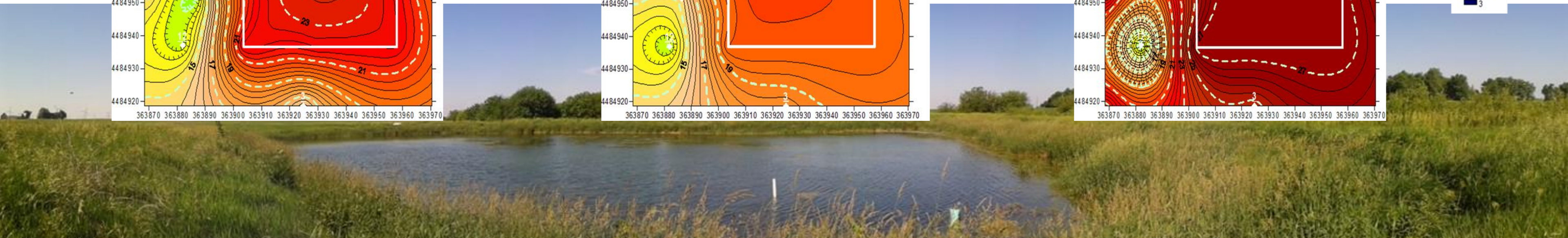

CONCLUSION

- The wetland serves as a groundwater recharge.
- The western berm serves as a source of thermal energy.

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THANK YOU