Tools for ephemeral gully erosion research

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Background

- Ephemeral gully erosion, dominant source of erosion from farmland
- Research historically focused on reducing rill and interrill erosion
- Ephemeral gully erosion process poorly understood
- Lack of adequate tools to address ephemeral gully erosion research

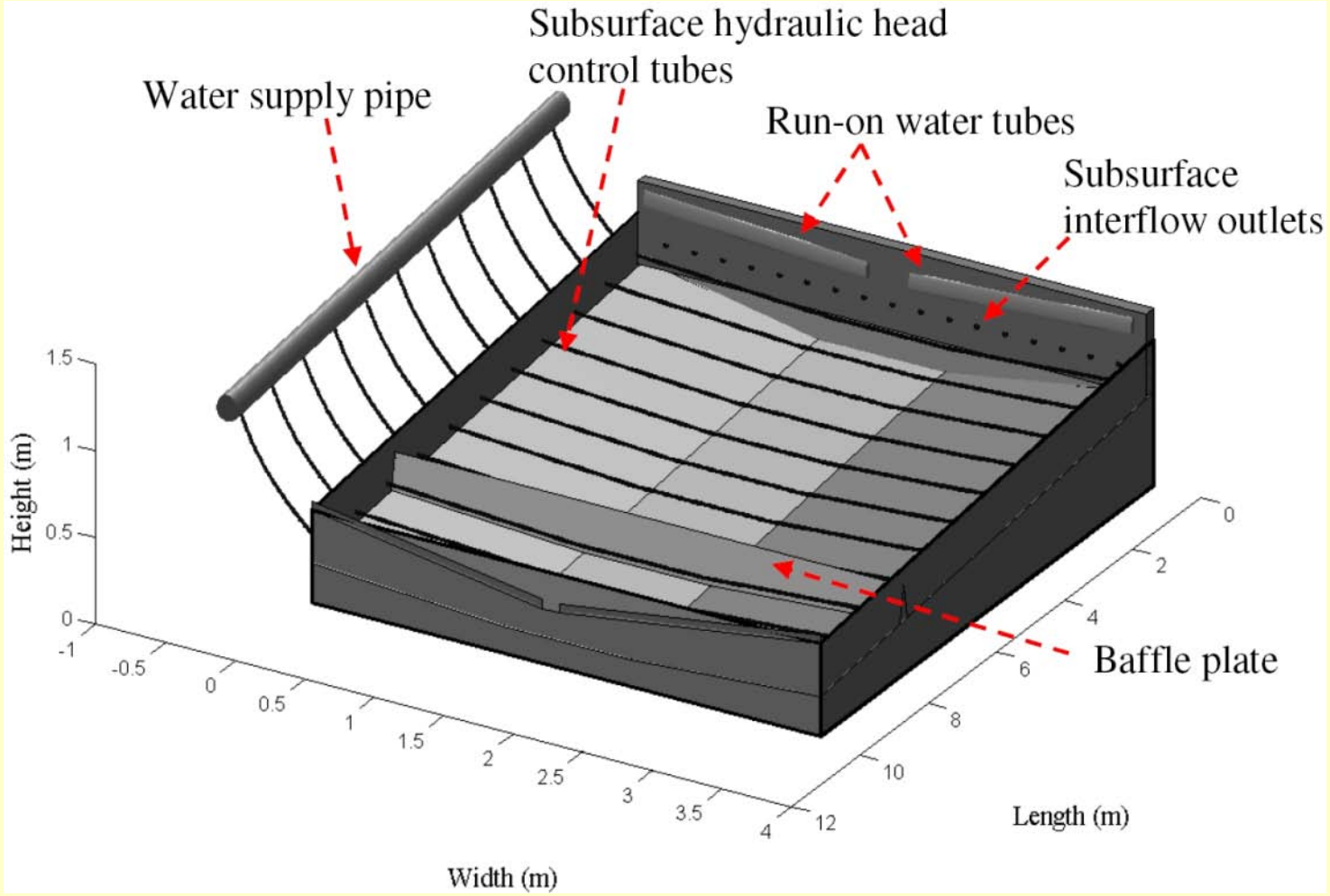
Knowledge gap

- Relative contribution of surface and subsurface hydrology in ephemeral gully initiation and development
- Temporal variations in gully morphology / geometry
- Ephemeral gullies at no-till fields

Objectives

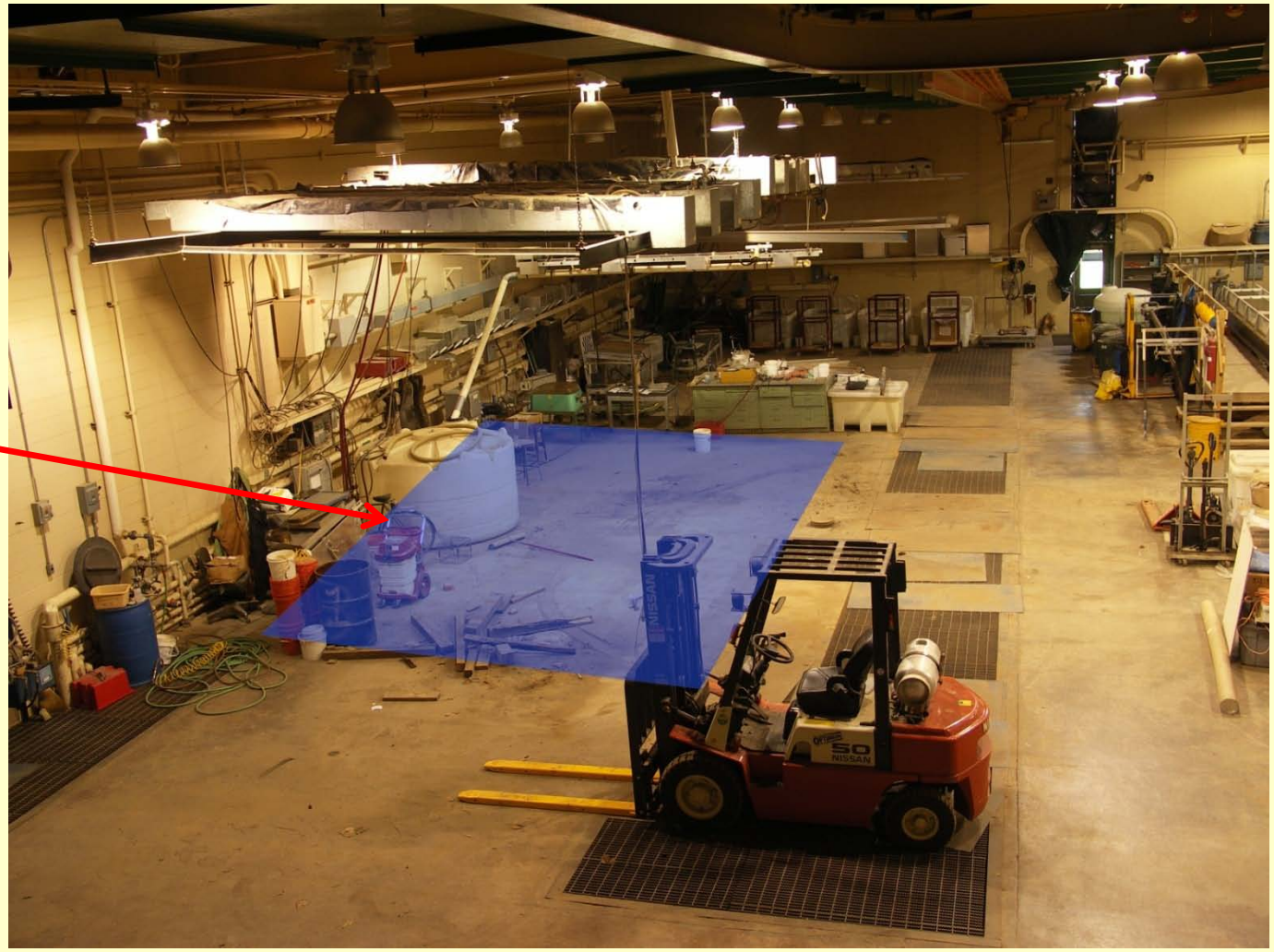
- Develop research tools to specifically address ephemeral gully erosion
- Indoor 9.75-m x 3.66-m hillslope section with fully controlled surface and subsurface hydrology
- Digital photogrammetry for erosion / geometry assessment

Laboratory hillslope section



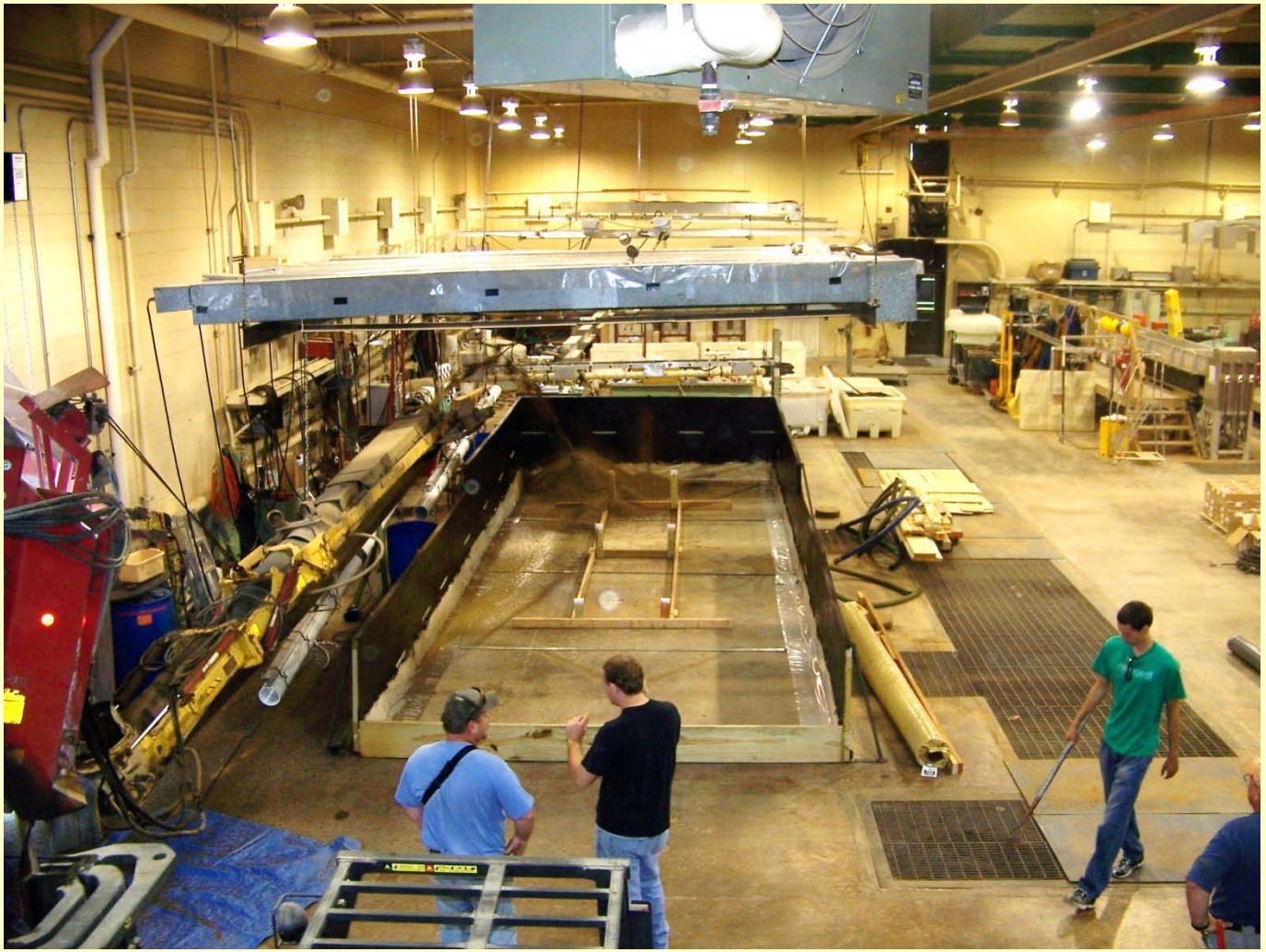
Laboratory hillslope section

30-ft x 12-ft



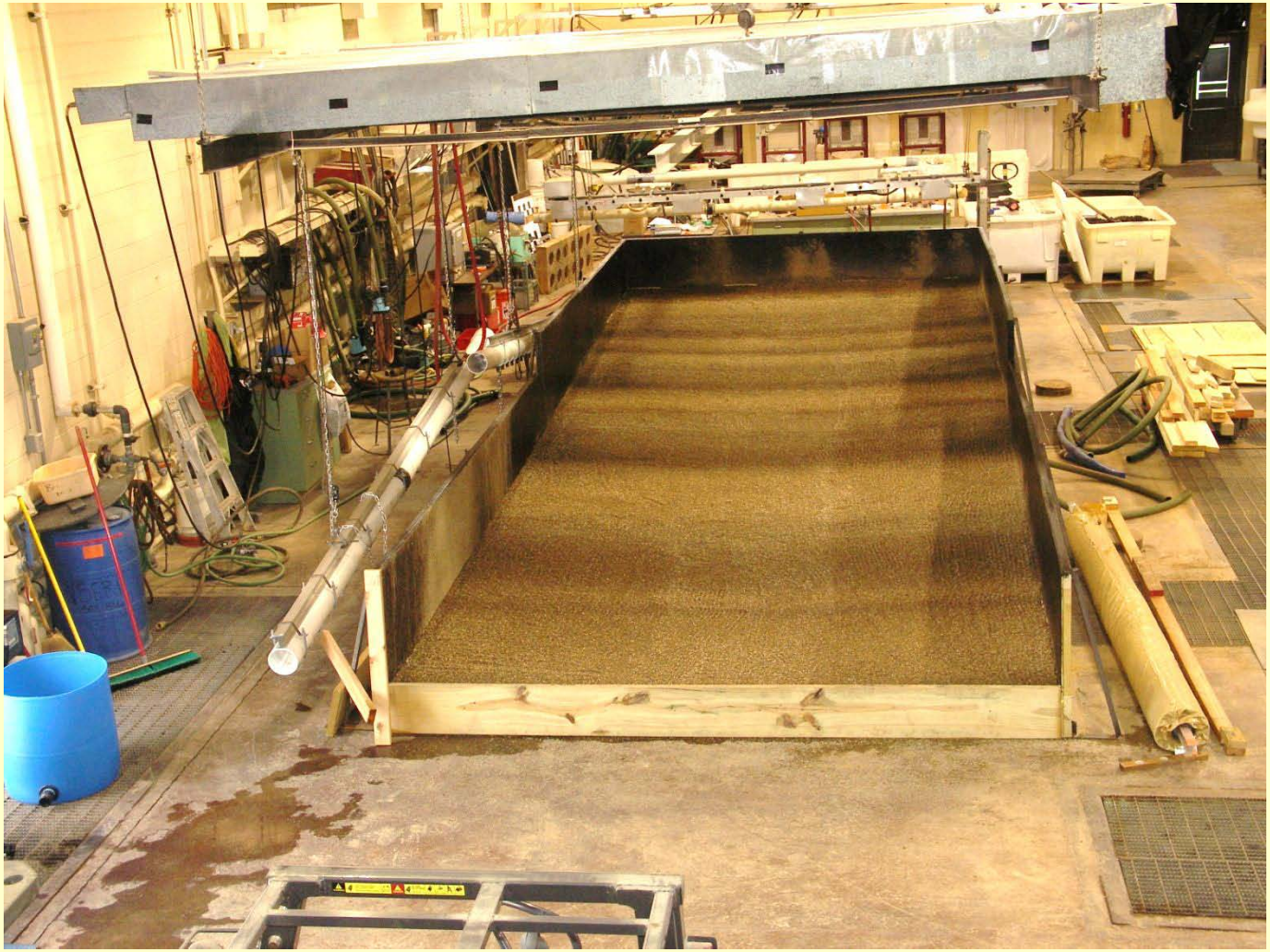
Laboratory hillslope section

Frame +
Pea gravel



Laboratory hillslope section

Frame + base

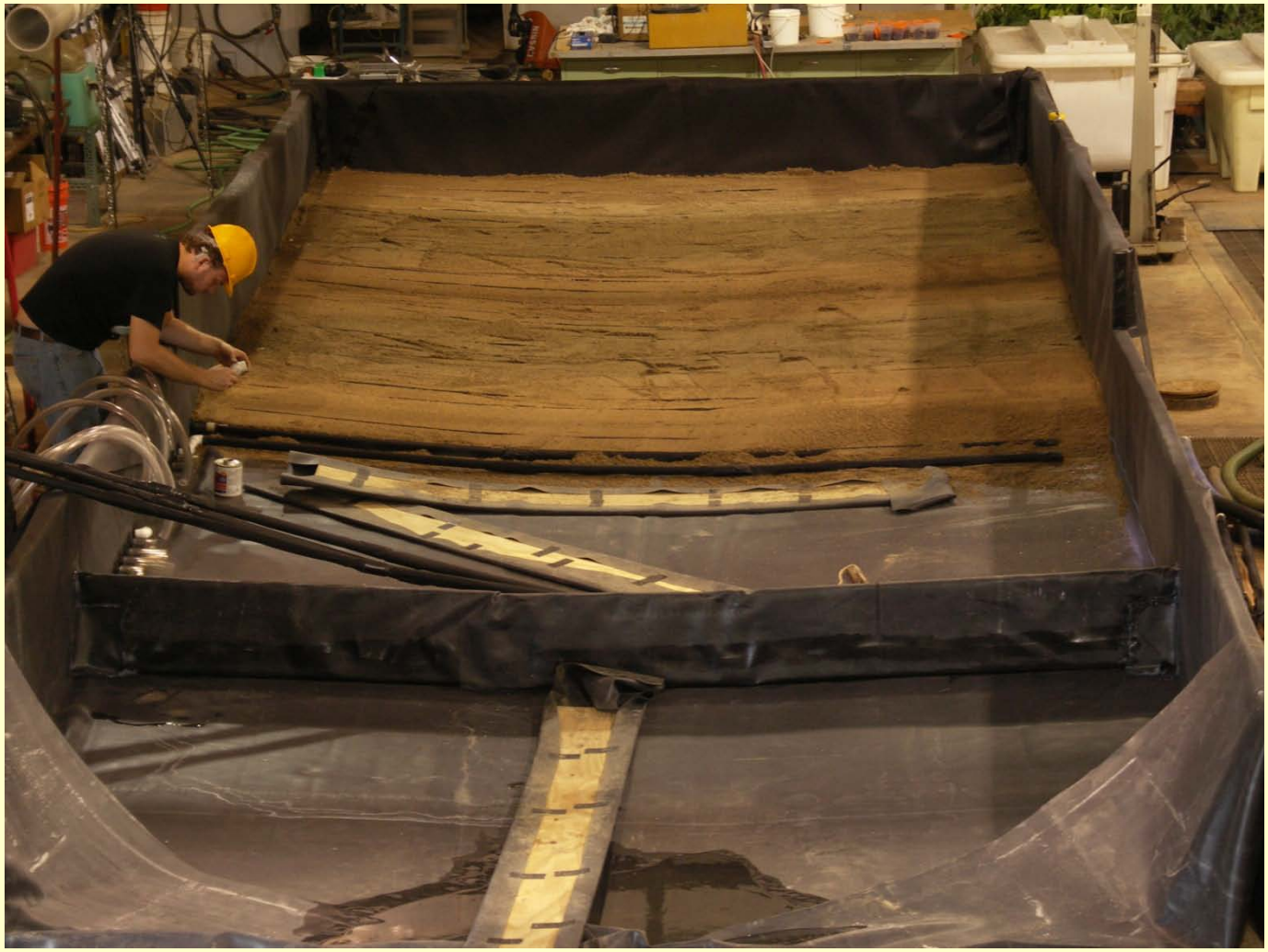


Laboratory hillslope section

Rubber liner

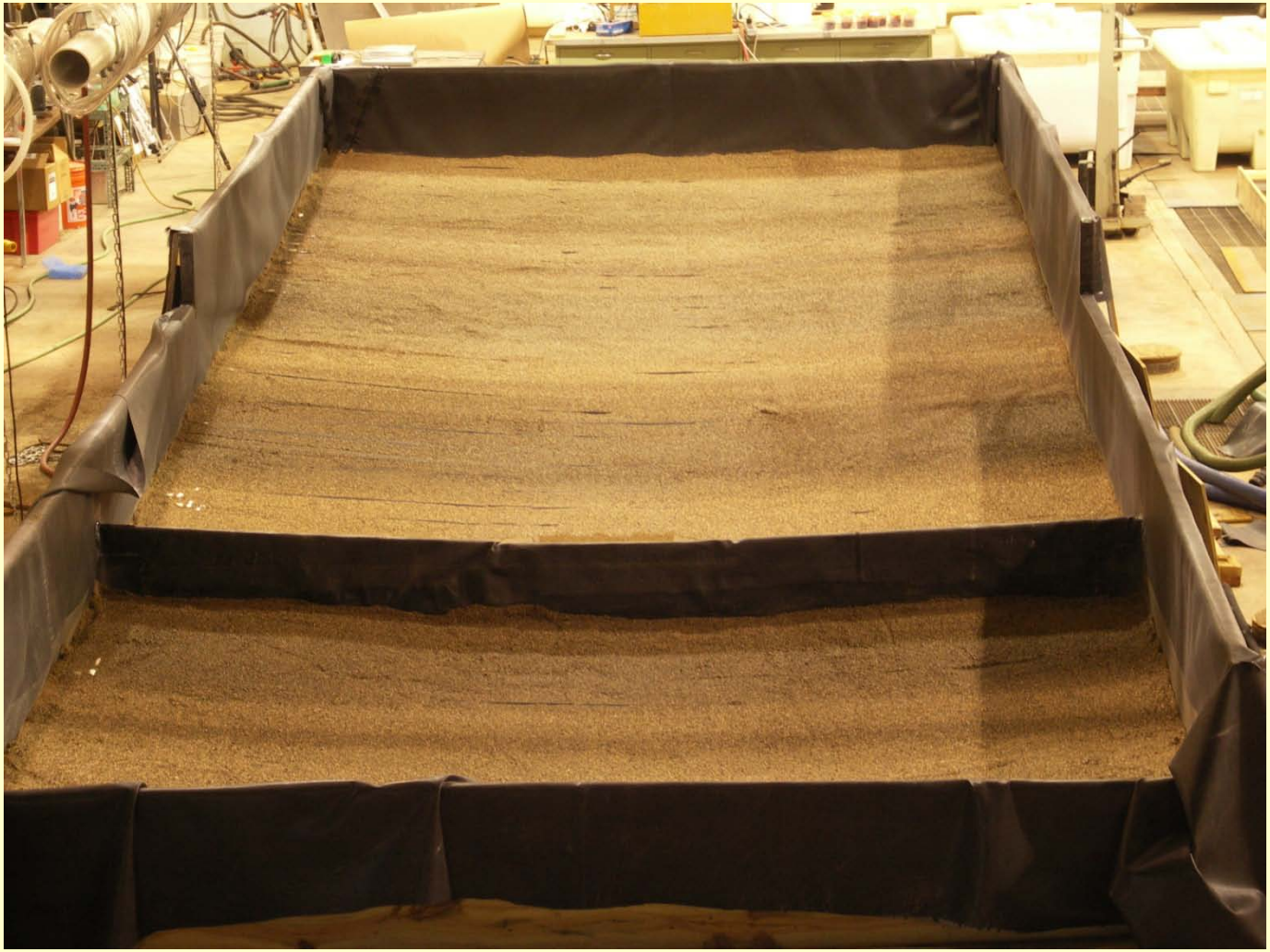
Laboratory hillslope section

Water table control pipes in sand layer



Laboratory hillslope section

Water table control pipes in sand layer



Laboratory hillslope section

+ Soil

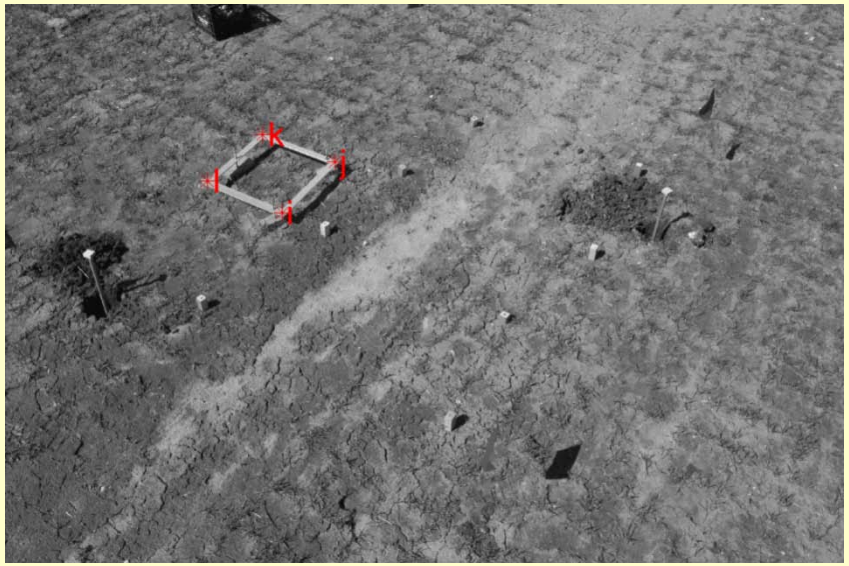
Laboratory hillslope section

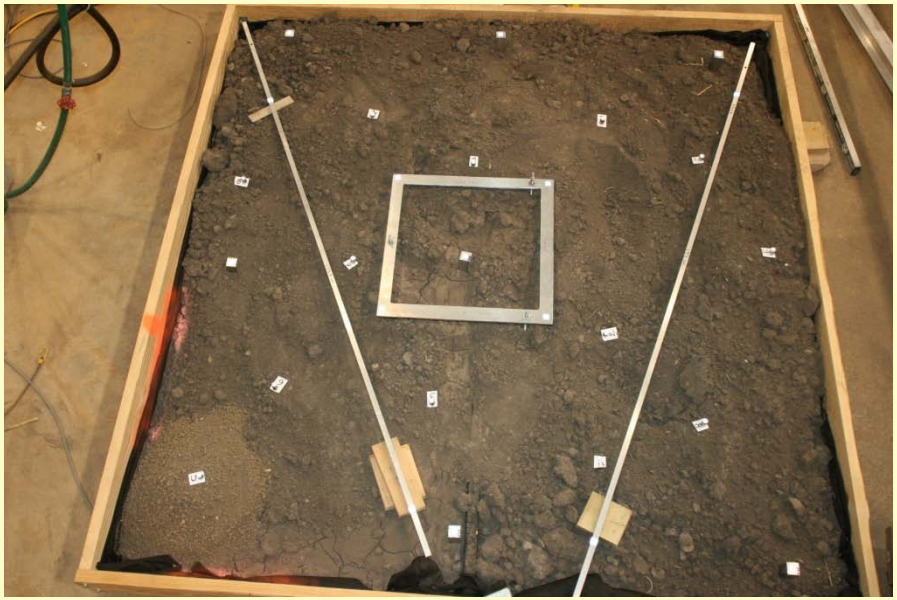
Ready for a run

Photogrammetry technique

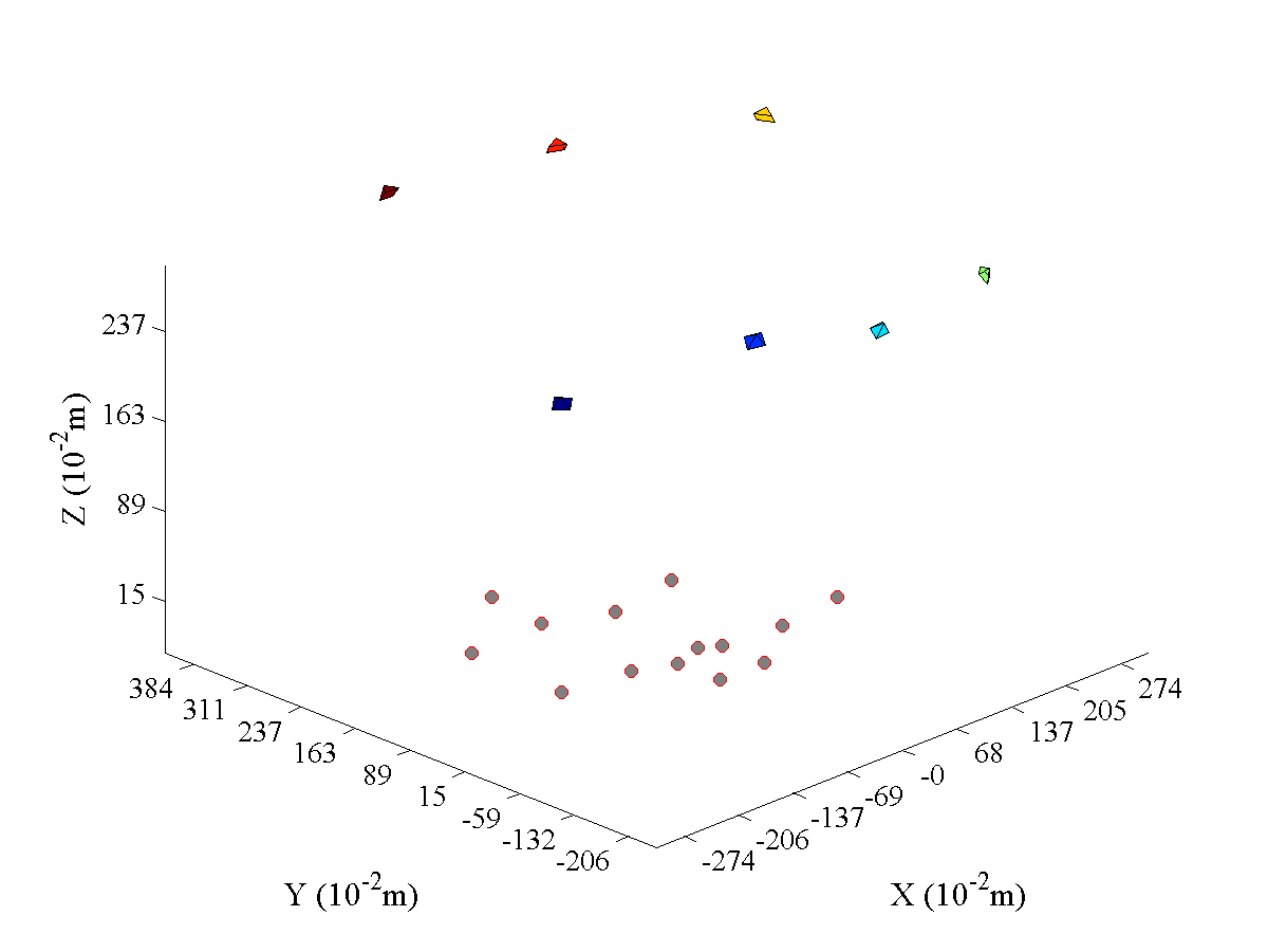
- Simplified photogrammetric technique channel geometry / erosion measurement
- Use a rectangular calibration frame and photogrammetric survey procedure to obtain control points
- 2 steps method:
  - Determine XYZ of control points
  - Use control points in conventional photogrammetric DEM generation

Step 1: Control points survey

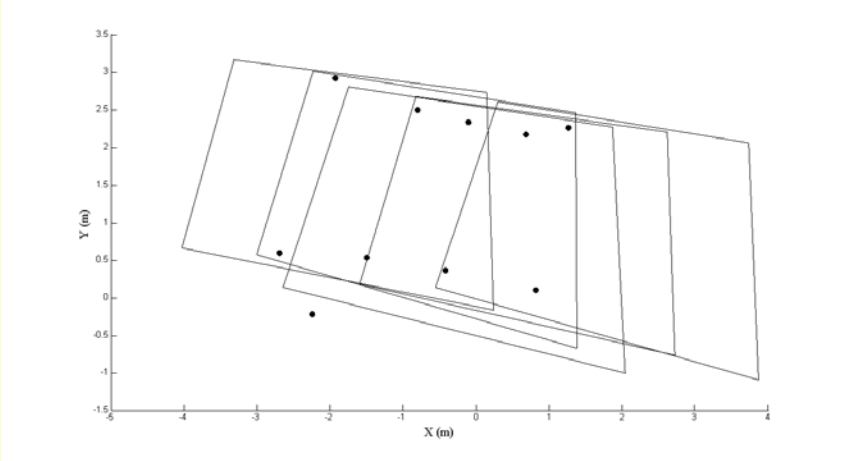


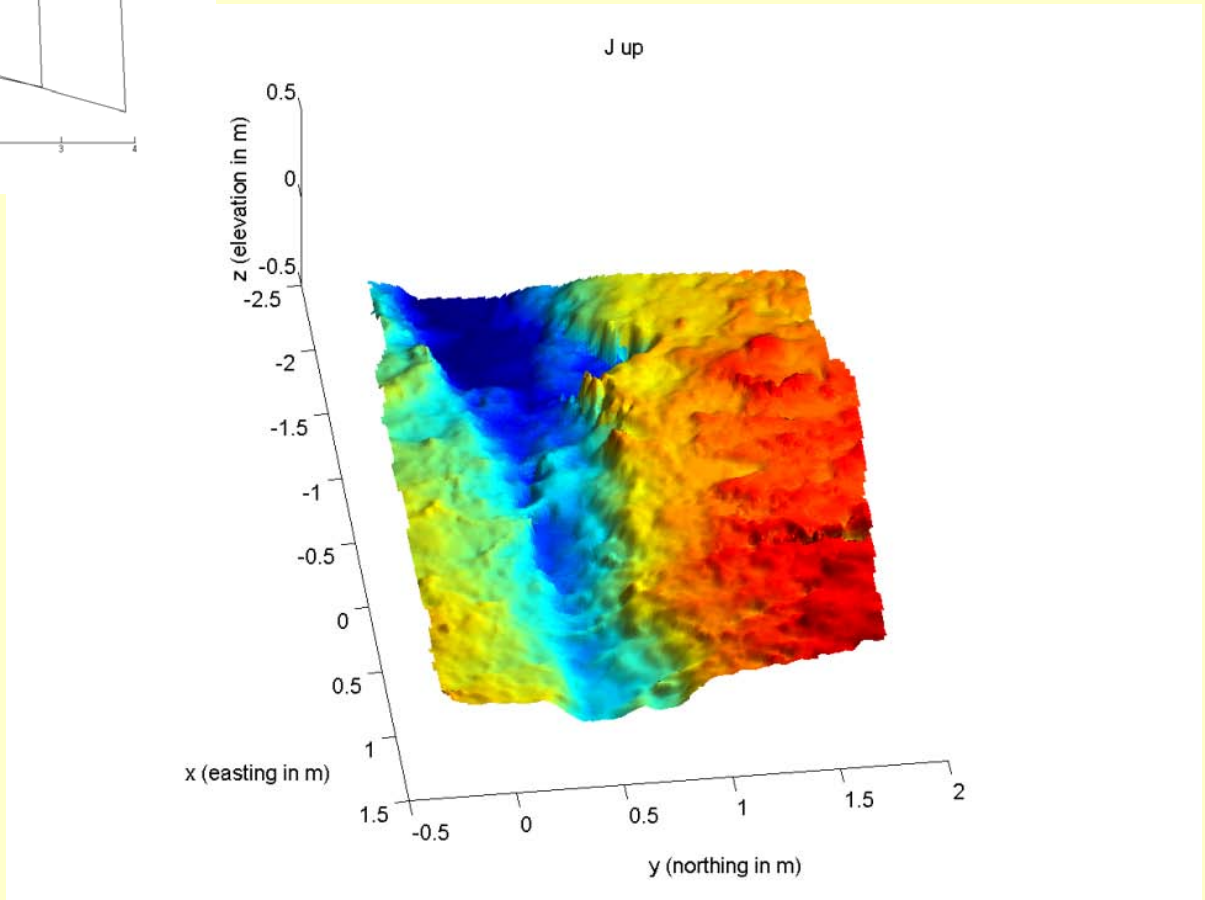


Step 1: Control points survey

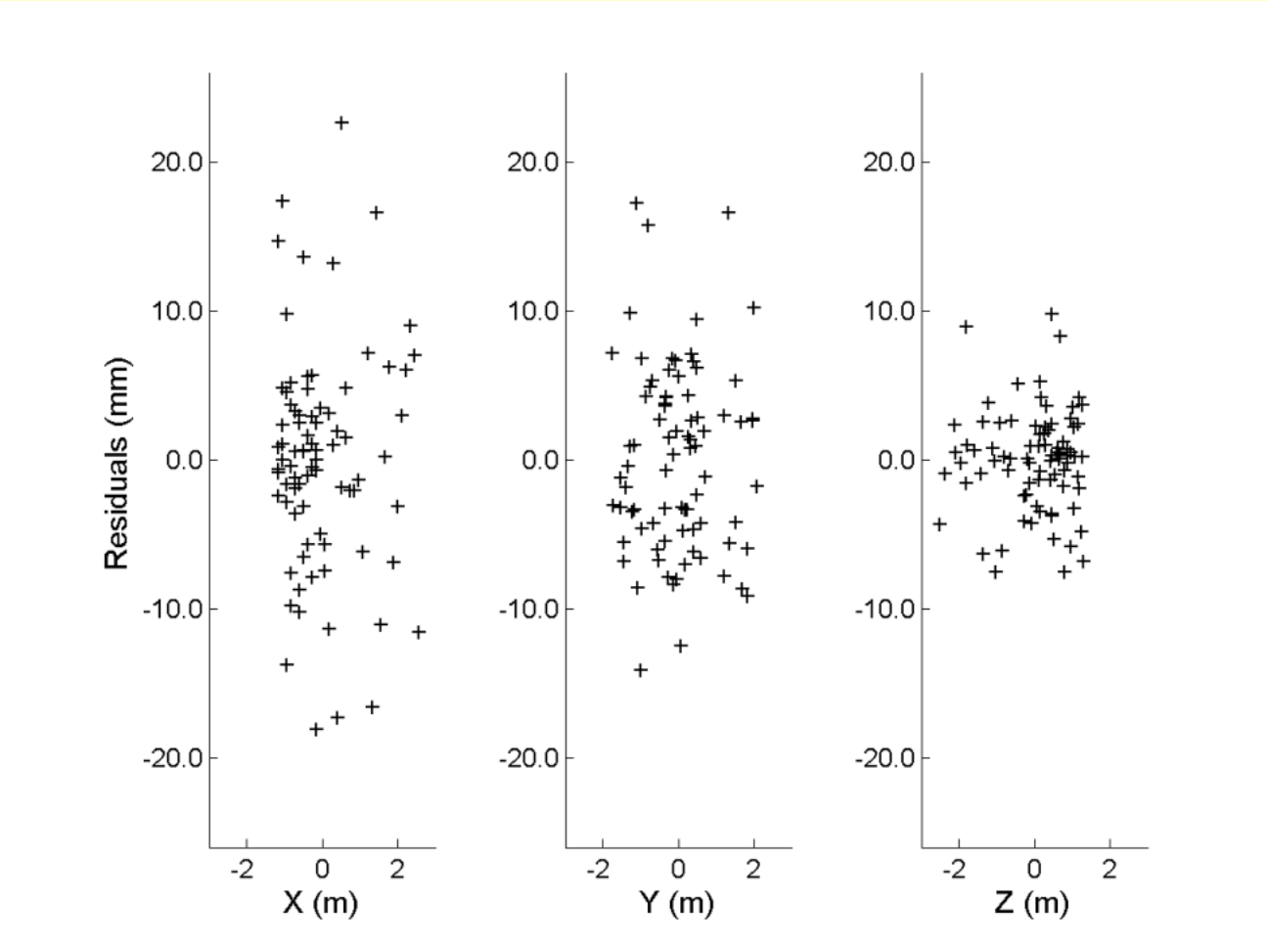


Step2: DEM generation

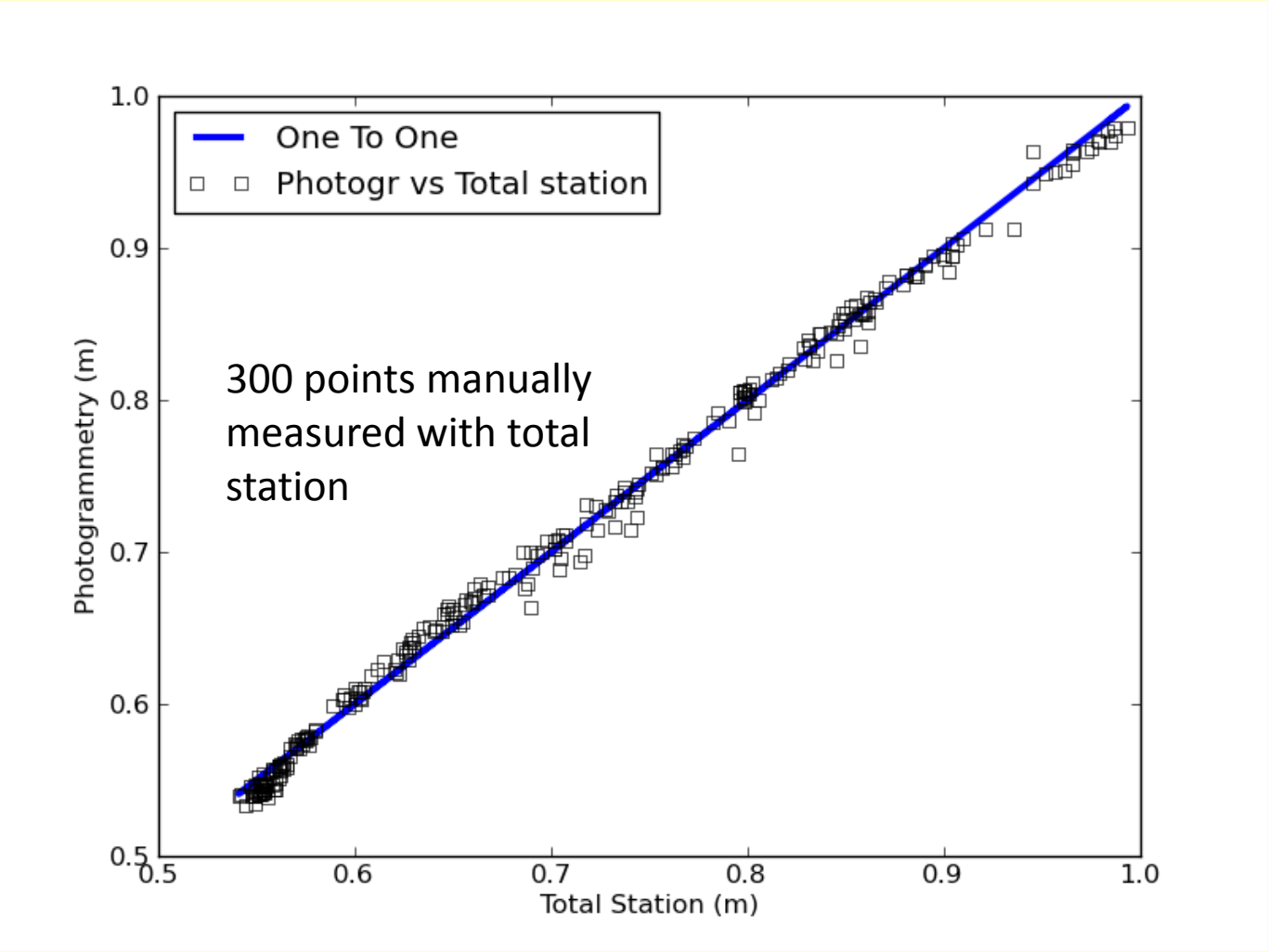




Photogrammetry survey vs. Total station



DEM photogrammetry vs. Total station



Example of lab application

- Monitor channel development during rainfall experiment
- Incrementally digitize the soil surface every volume Q of water applied
- Compare Seepage to drainage

Channel development

Upslope

2Q

3Q

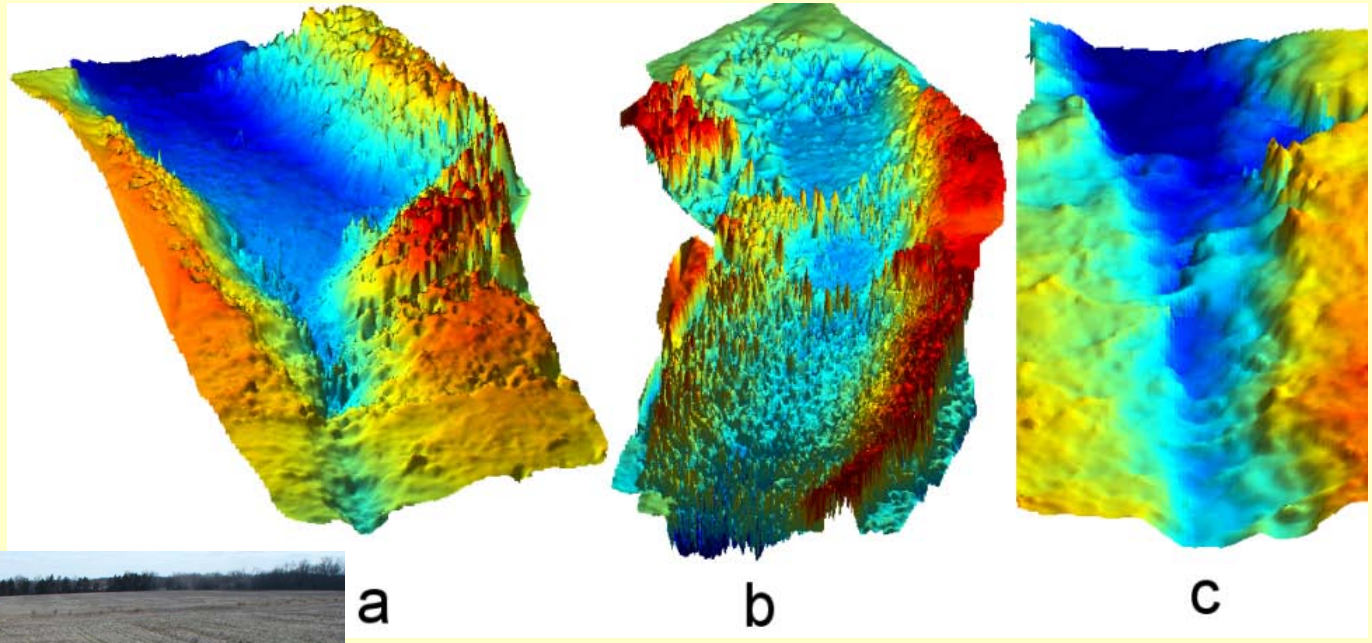
4Q

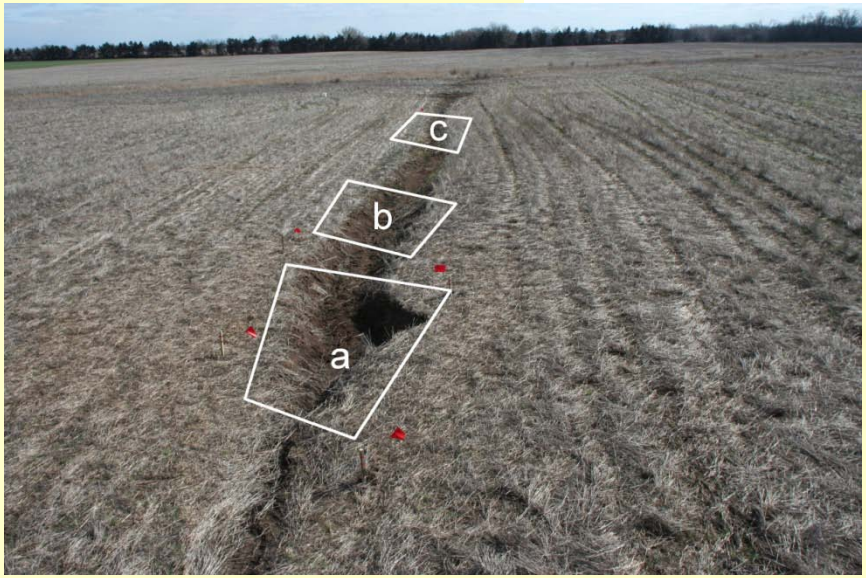
6Q

Downslope

Channel development

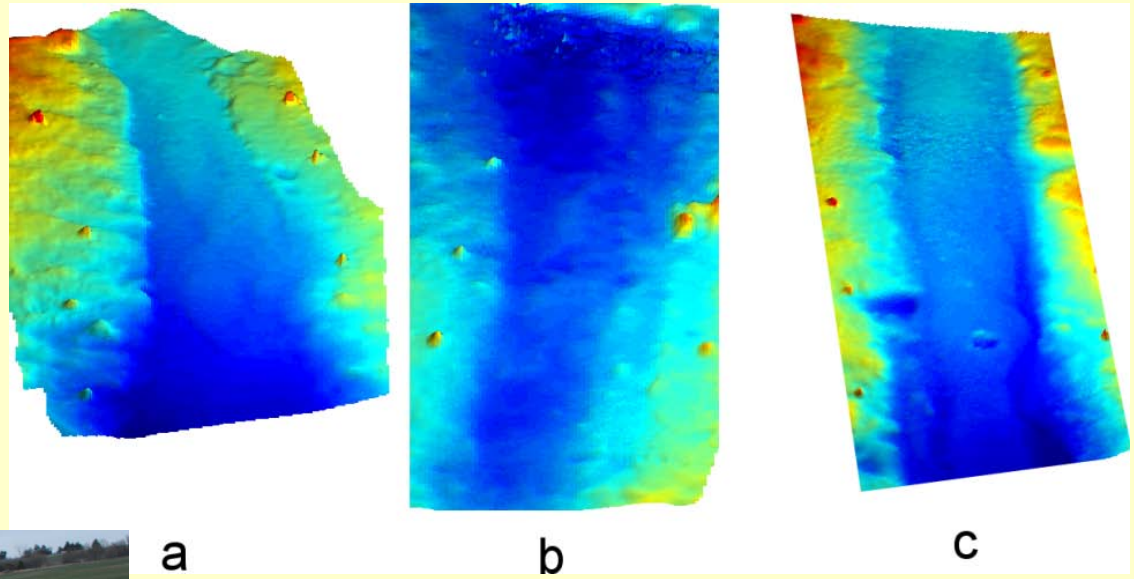
Field gully survey

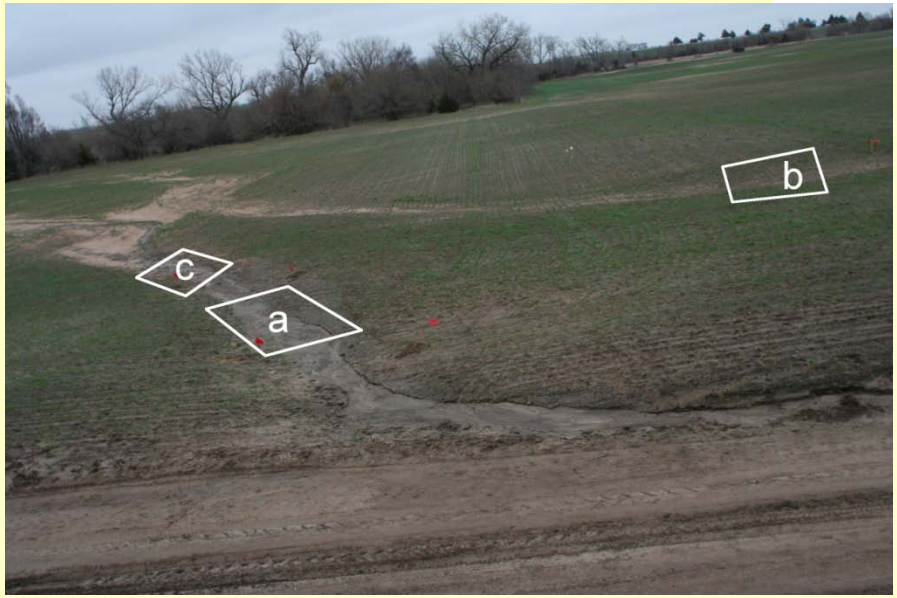




No-till field

Field gully survey





Conventional tillage

Conclusions

- We developed research tools to specifically address ephemeral gully erosion
- Indoor hillslope section will help clarify the relative contribution of surface and subsurface hydrology in ephemeral gully development
- Simplified digital photogrammetry technique makes erosion / geometry data acquisition accessible to scientists around the world