BestWay – Optimized logging trail planning under implementation in Swedish forestry

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Outline

- Harvesting in Swedish forestry - forwarders
- Problem and solution approach
- BestWay - data
- BestWay - application
- Results
- Further work

HARVESTING IN SWEDISH FORESTRY - FORWARDERS

- today’s harvest operations and needs

M1

Logging conditions

- Cut to length
- Clear cut ~1-40 hectars
- Harvester – forwarder
- Moderate or no slopes but rough structure
- Snow and darkness

Slide 4

M1 Varfor 2 bilder???

Mari, 2011/04/03

NoGo areas

Water protection

Cultural heritage

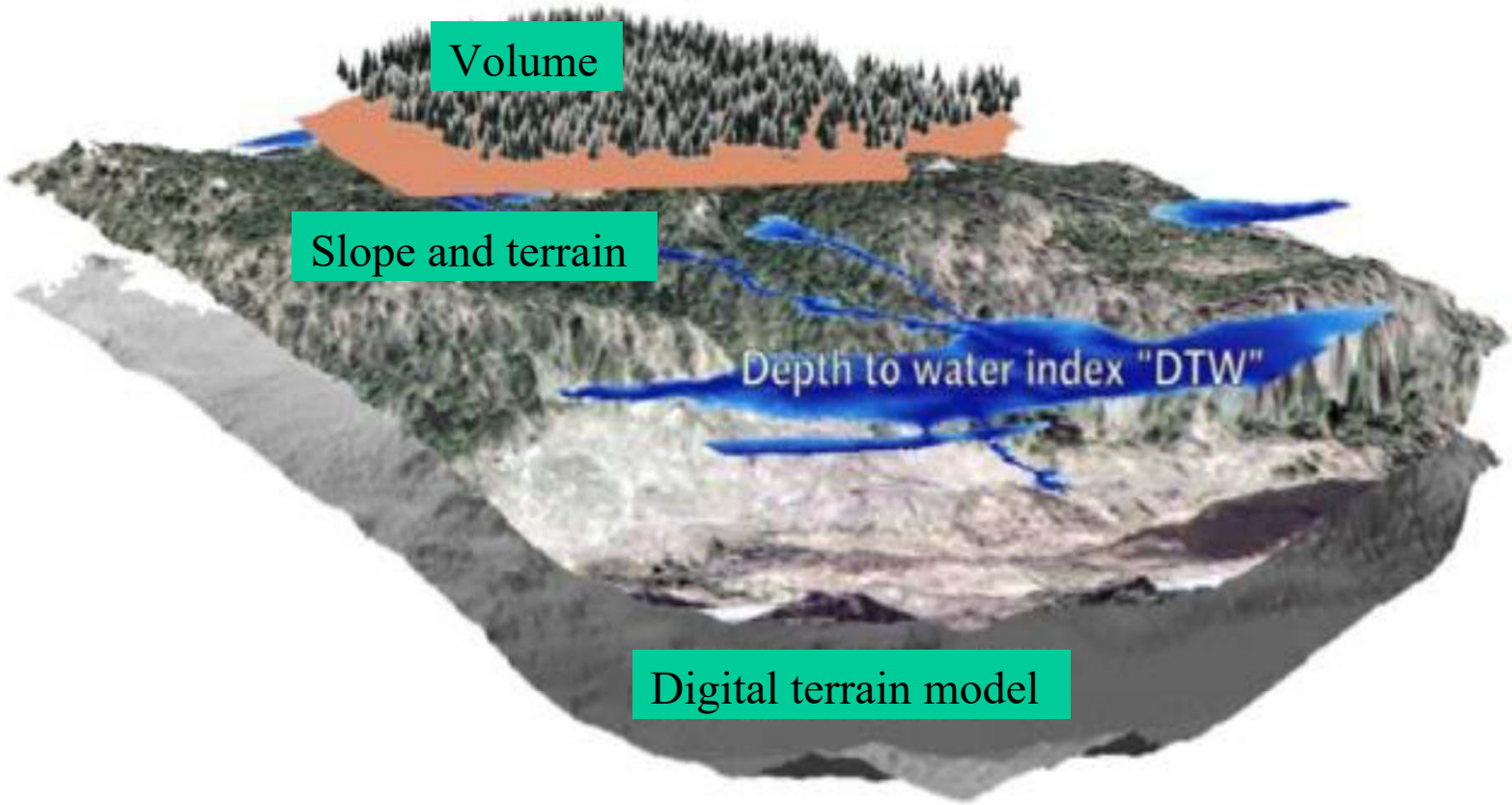
Detour or device for non-destructive passing?

Cost-effective logging while avoiding land damage

Problem and solution approach

- Construct primary logging trails
  - Forwarder routing: cost-effective while avoiding land damage
- Grid of harvest area (2x2 meter)
  - Arcs between adjacent squares
  - Arc cost: higher on wet and/or hillier (slope) areas
  - No arcs to NoGo areas
- Collect all harvested loggs within a harvest area
- Network design problem
- Solved with a subgradient optimization approach

BestWay - data



BestWay - data

- Preloaded DTM, DTW, tree volumes and general NoGo areas

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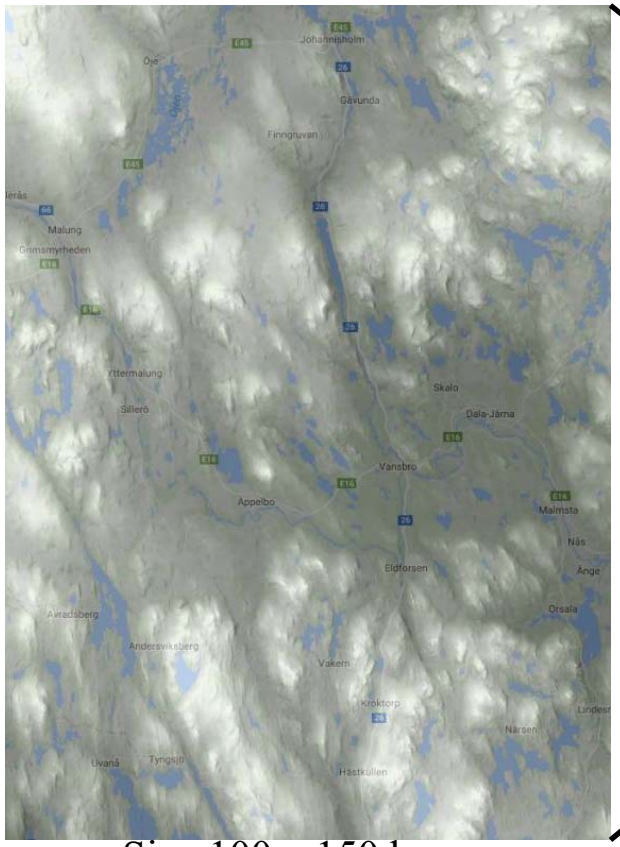
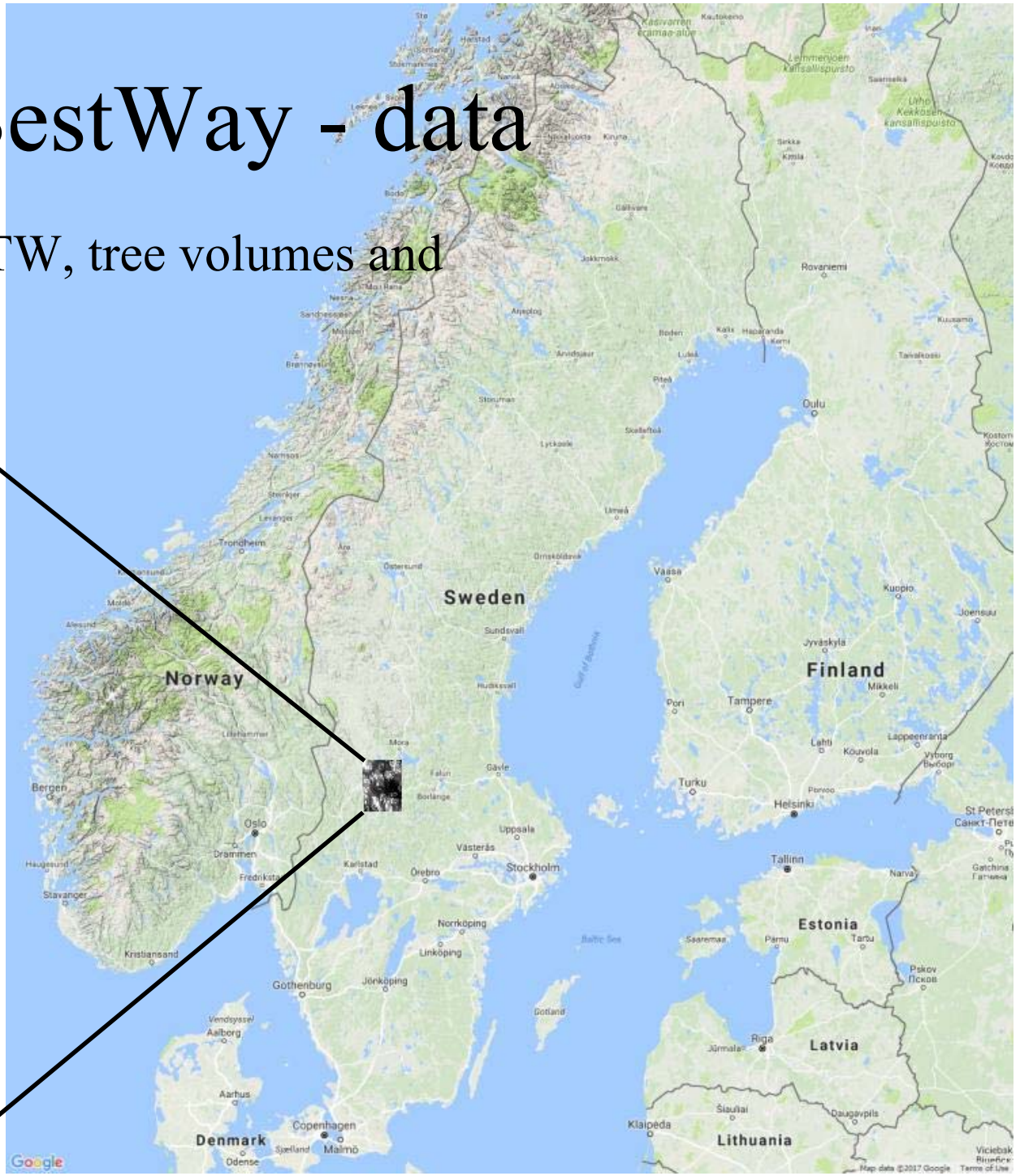
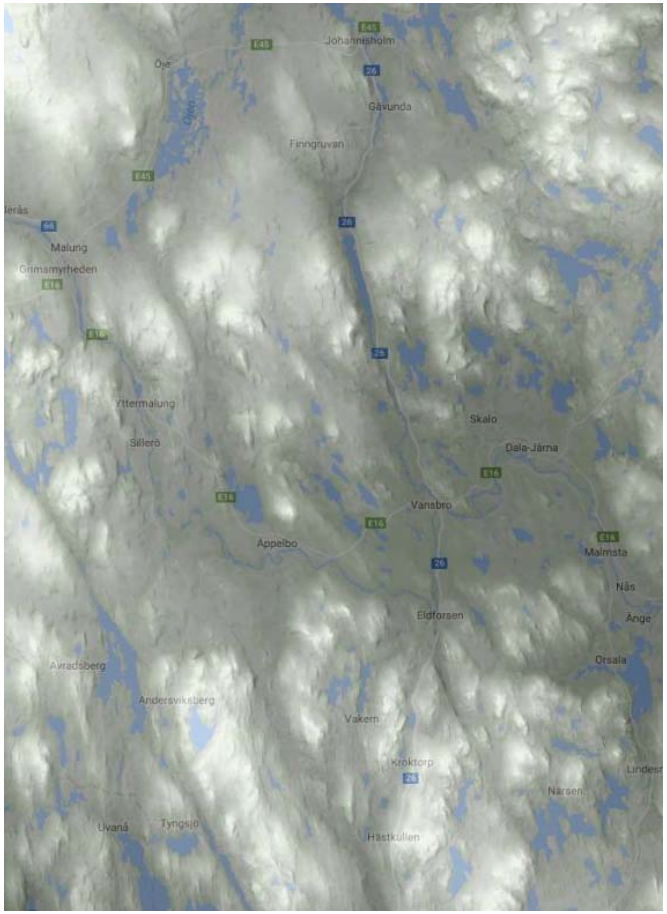


Size:100 x 150 km



BestWay - data

- Preloaded DTM, DTW, tree volumes and general NoGo areas
- Earlier versions - single tree data
- Now - national tree volume information (12.5 m grid)



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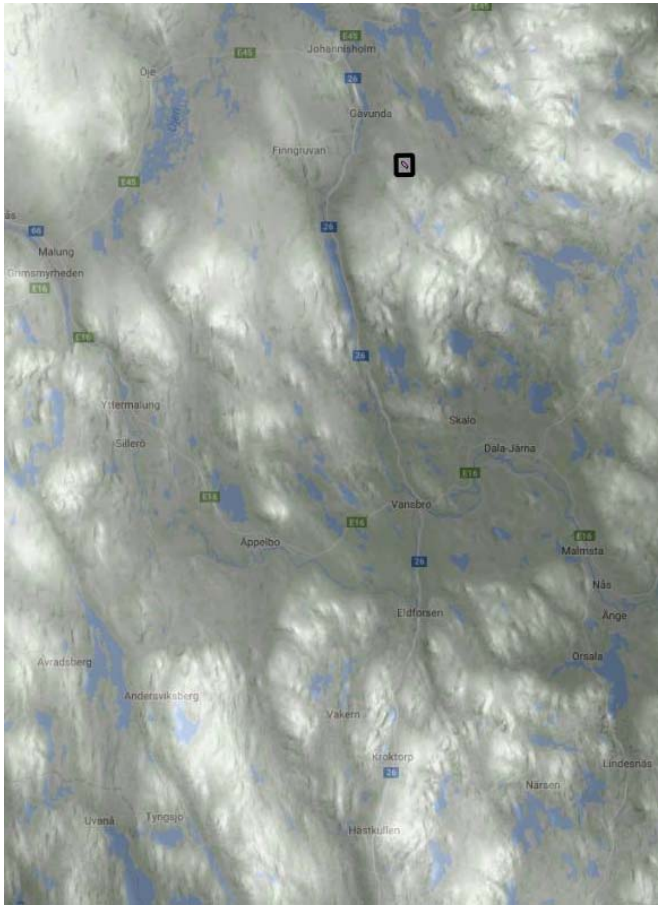
- GUI (shapefiles)
  - Harvest area



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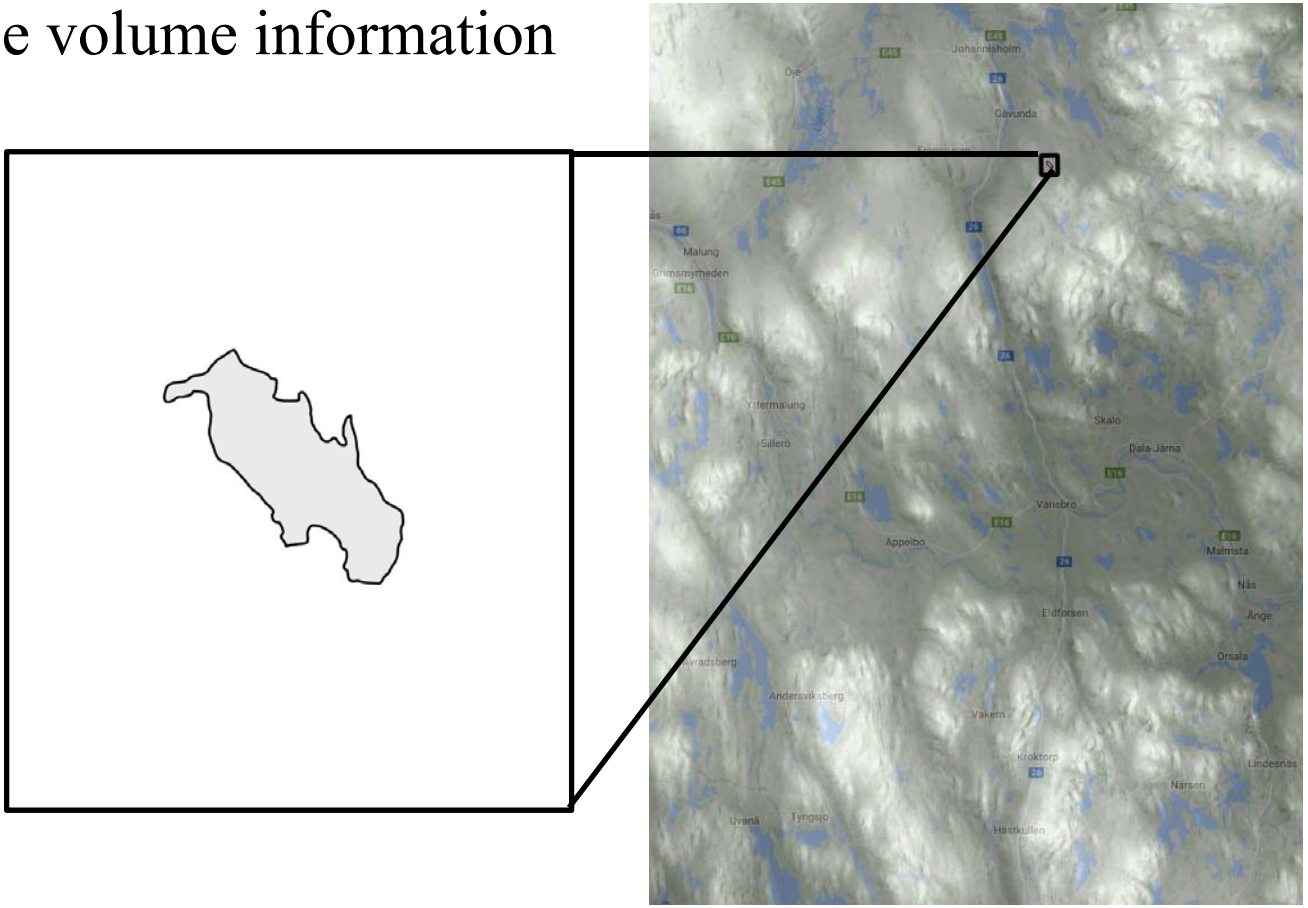

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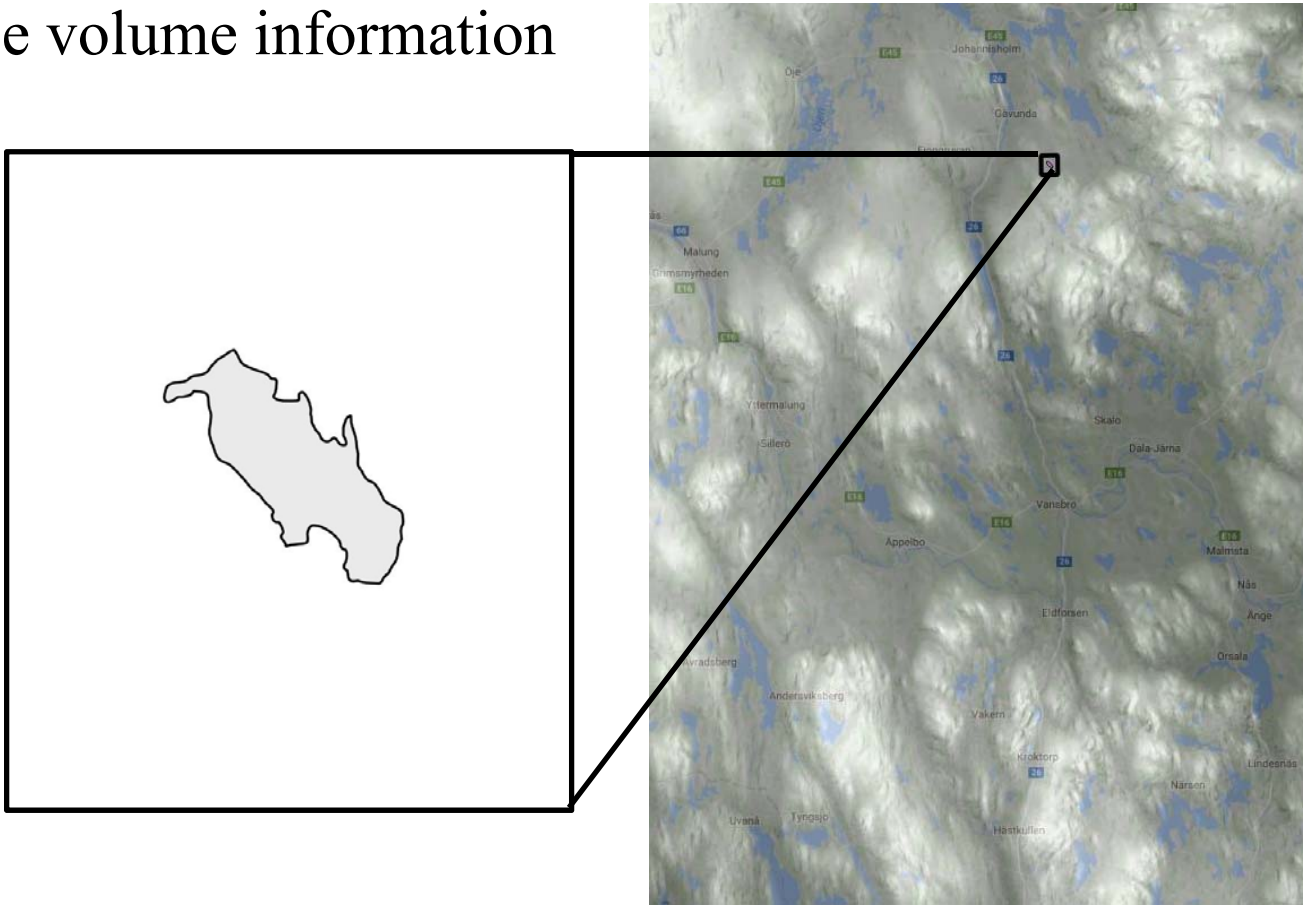
  - Landings



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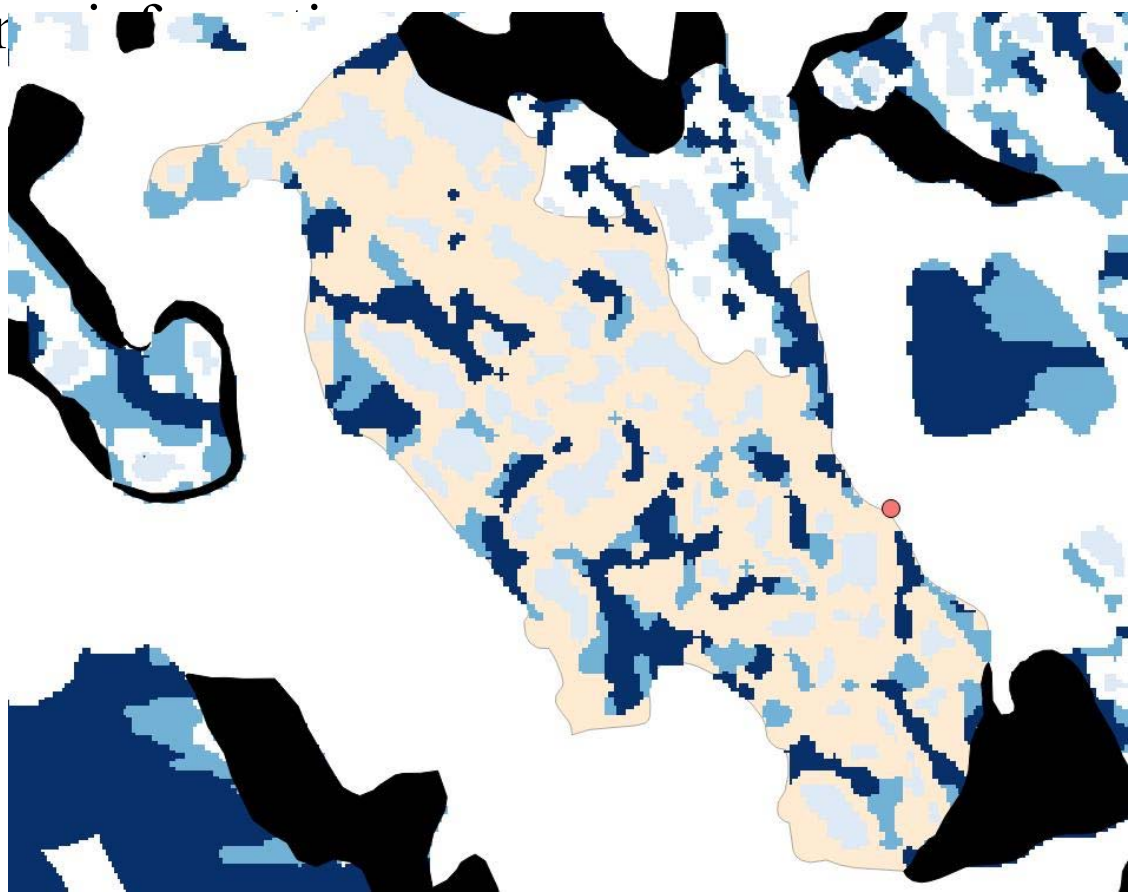

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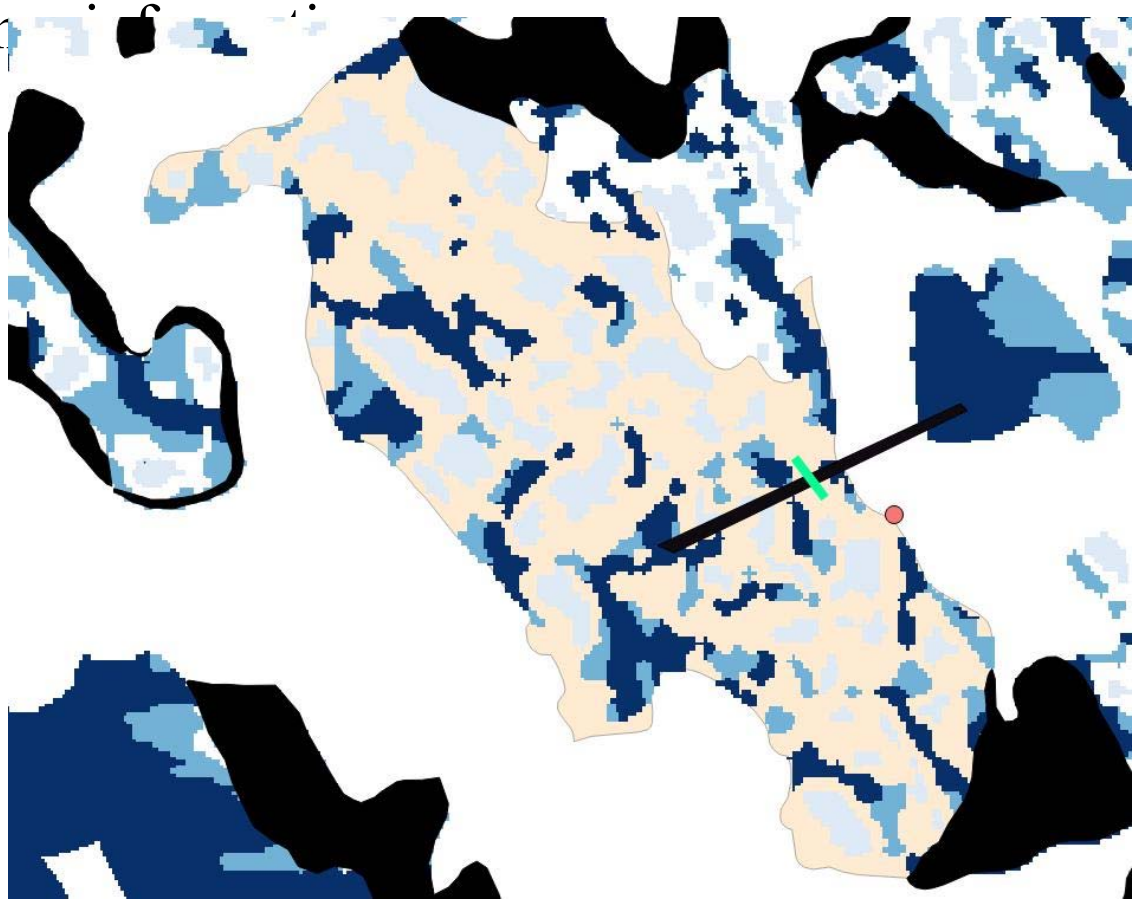
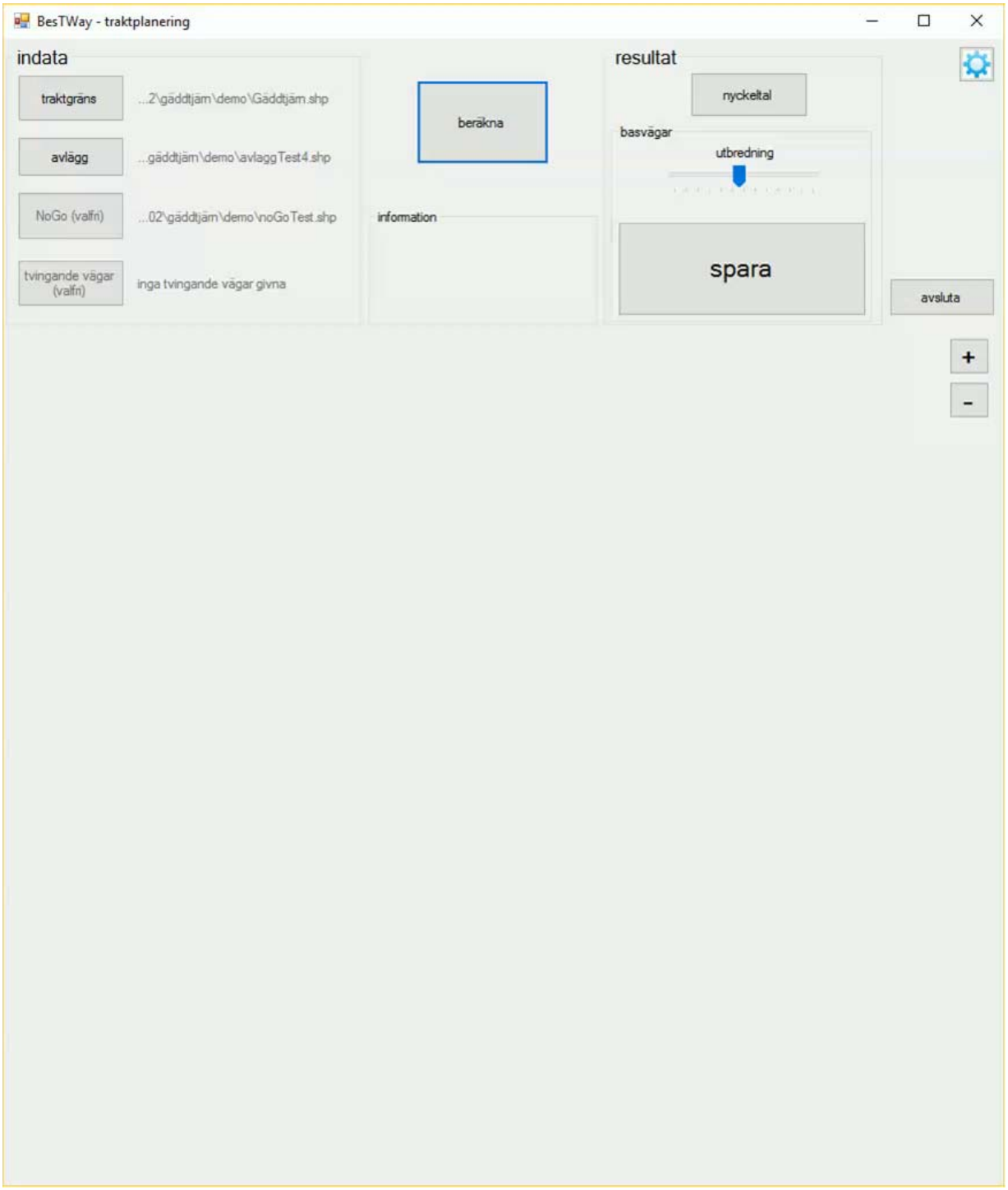
  - Extra NoGo areas
  - Non-destructive passings ('bridges')

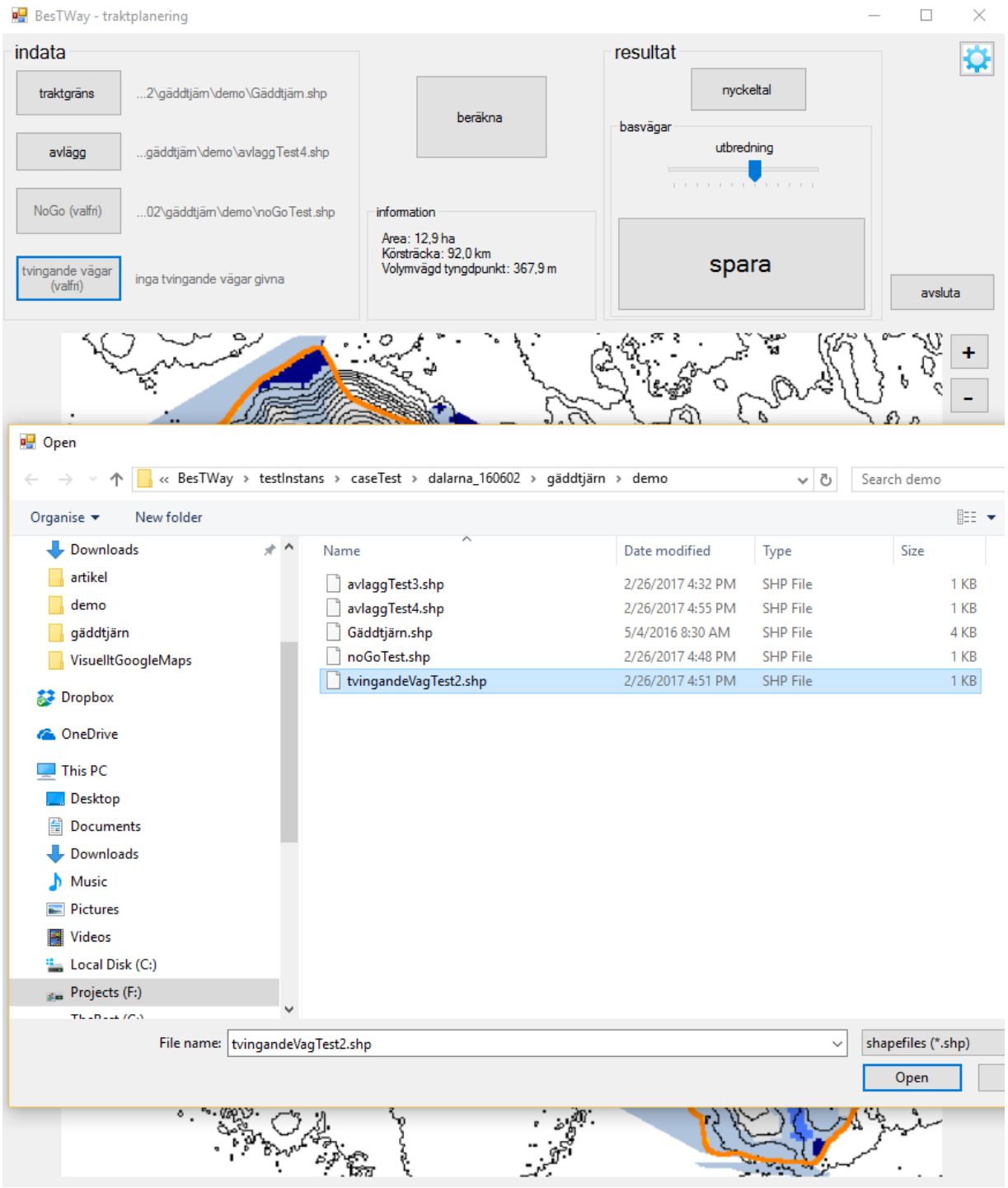


BestWay - application



BestWay - run

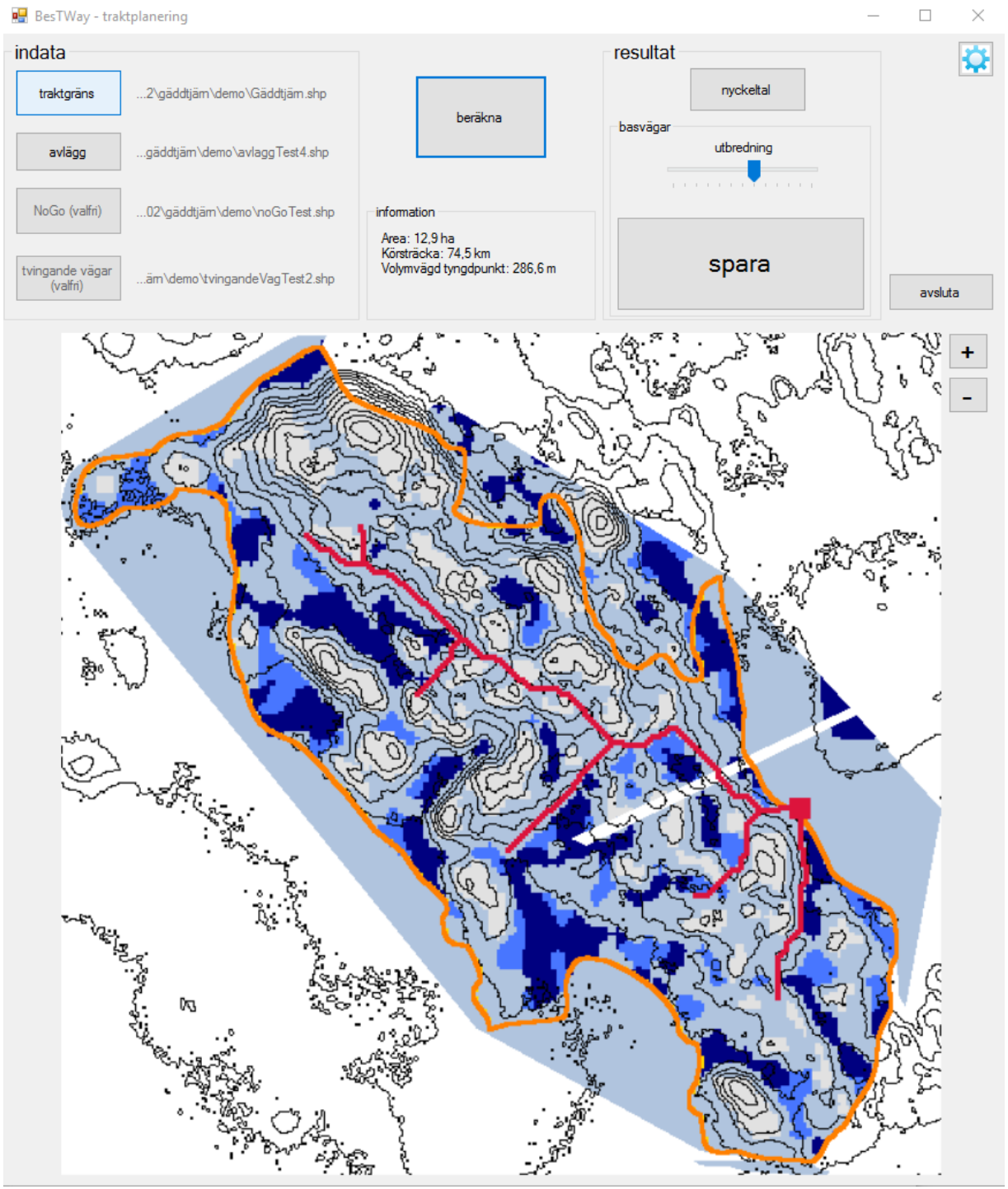
Picture version



Demo – run example with bridge

forwarding distance:

No bridge: 92 km

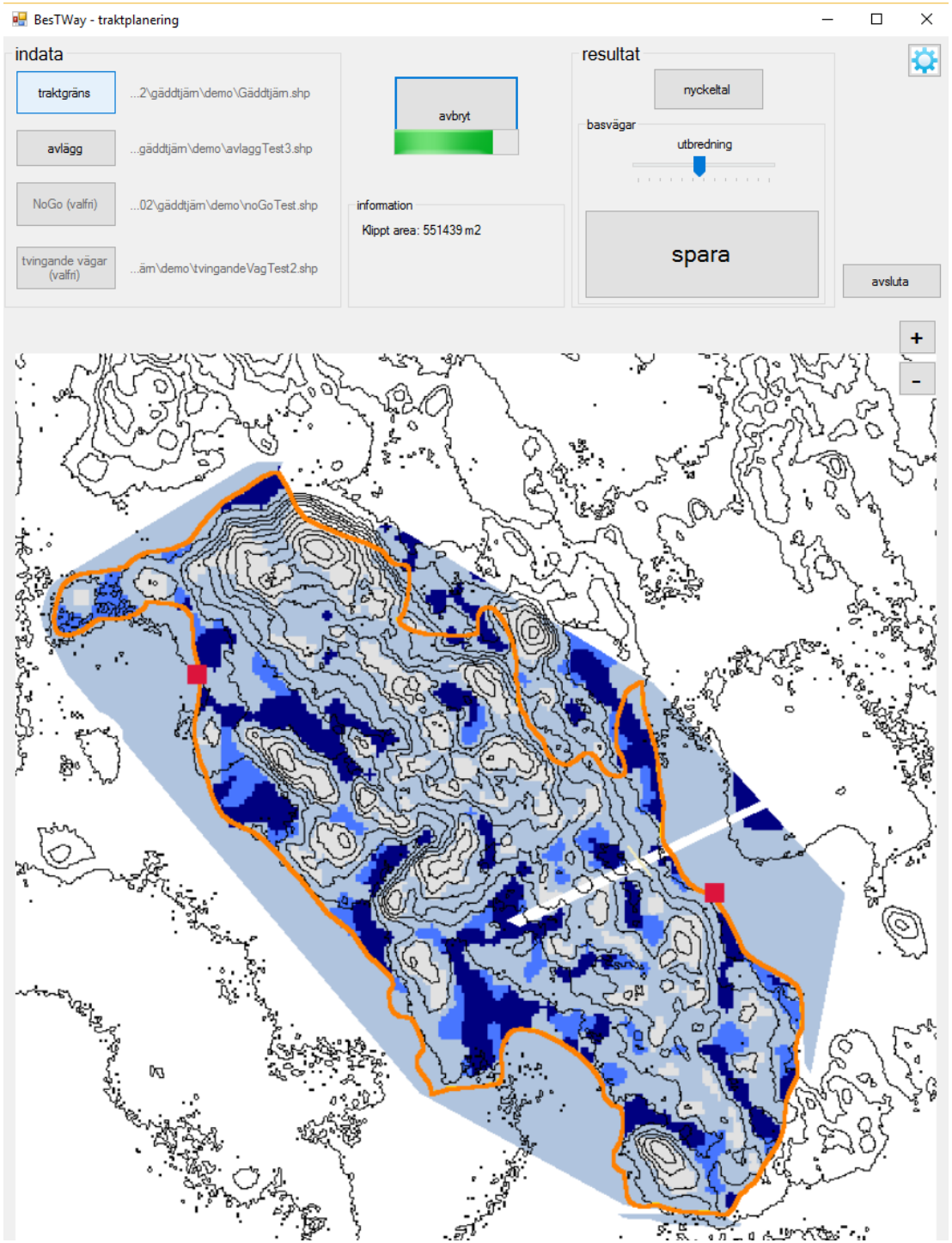


Demo – run example with bridge

forwarding distance:

No bridge: 92 km

With bridge: 74.5 km

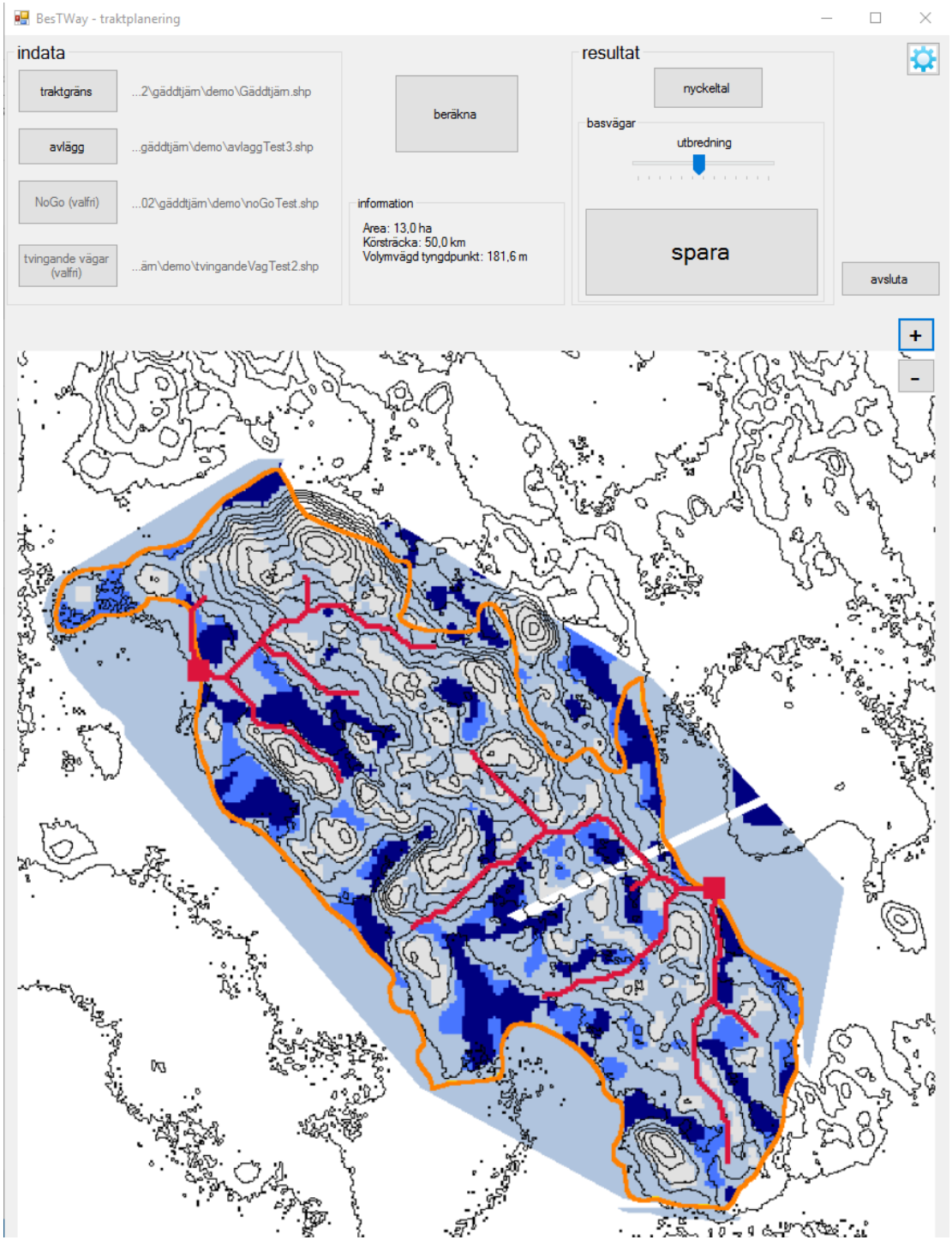


Demo – run example with two landings

forwarding distance:

No bridge: 92 km

With bridge: 74.5 km



Demo – run example with two landings

forwarding distance:

No bridge: 92 km

With bridge: 74.5 km

Two landings: 50 km

Results

- Two companies in Sweden tested BestWay 2016.
  - Company 1: 4 planners, about 45 objects
  - Company 2: 6 planners, still busy testing
  - Planning was done before visiting the harvest areas and then compared to manual suggestion
- User opinions
  - BestWay easy to use
  - Good results on smaller objects
  - Landing location crucial
  - Extra NoGo areas are often identified when visiting the object
  - Varying results on bigger objects with multiple separated harvest areas
  - Important to integrate with the system used by each company
  - Possible for BestWay to suggest landing locations?

Further work

- More companies to test BestWay
- Develop GUI for a tablet/ipad/touchscreen laptop
  - Change data by drawing on screen
    - Add, remove, and/or move landings
    - Add, remove, and/or move NoGo areas
    - Add, remove, and/or move bridges
    - Change or move wet areas
- Suggest landing locations
- Improve quality of secondary logging trails


Thank you for listening!
Questions?
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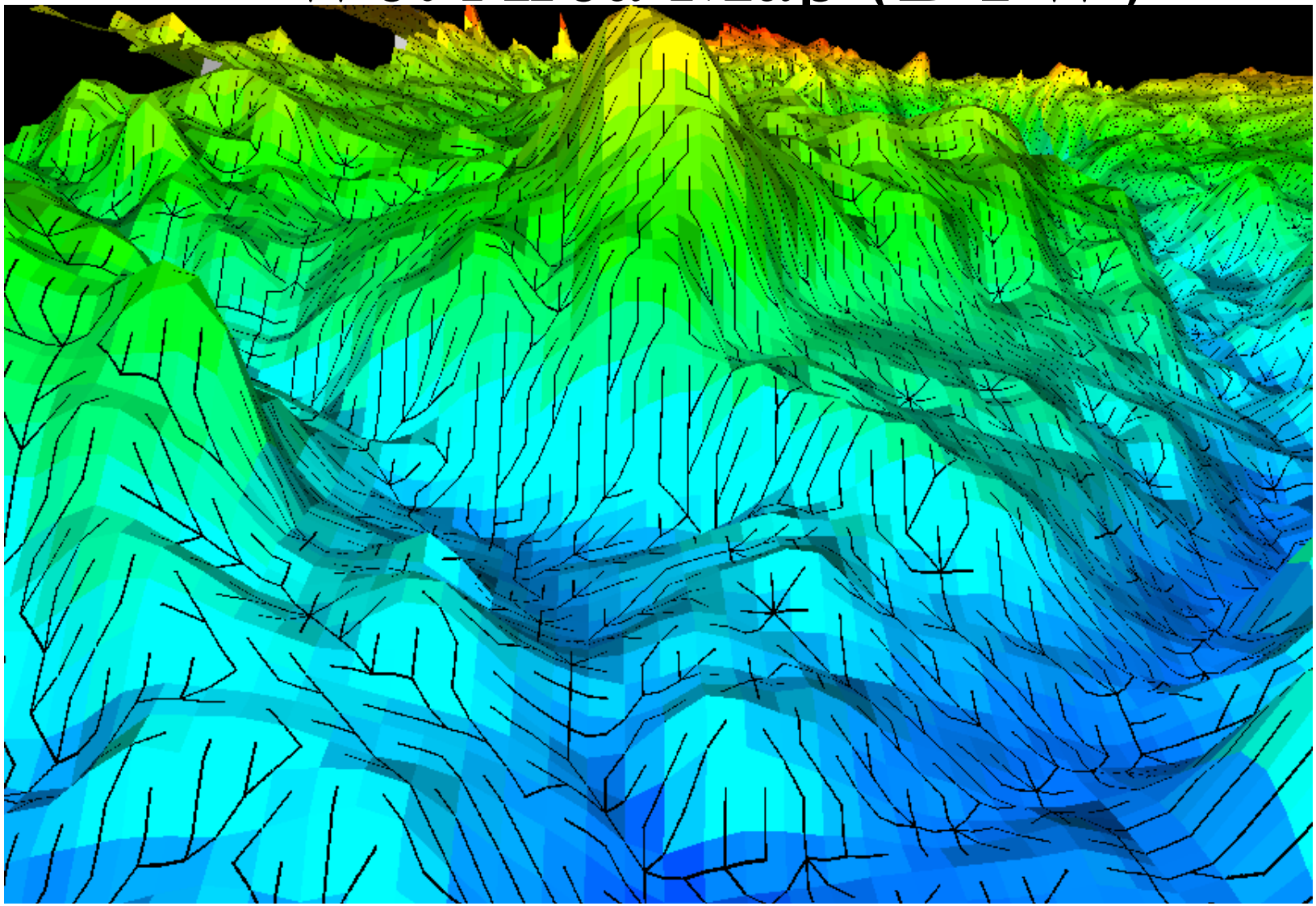
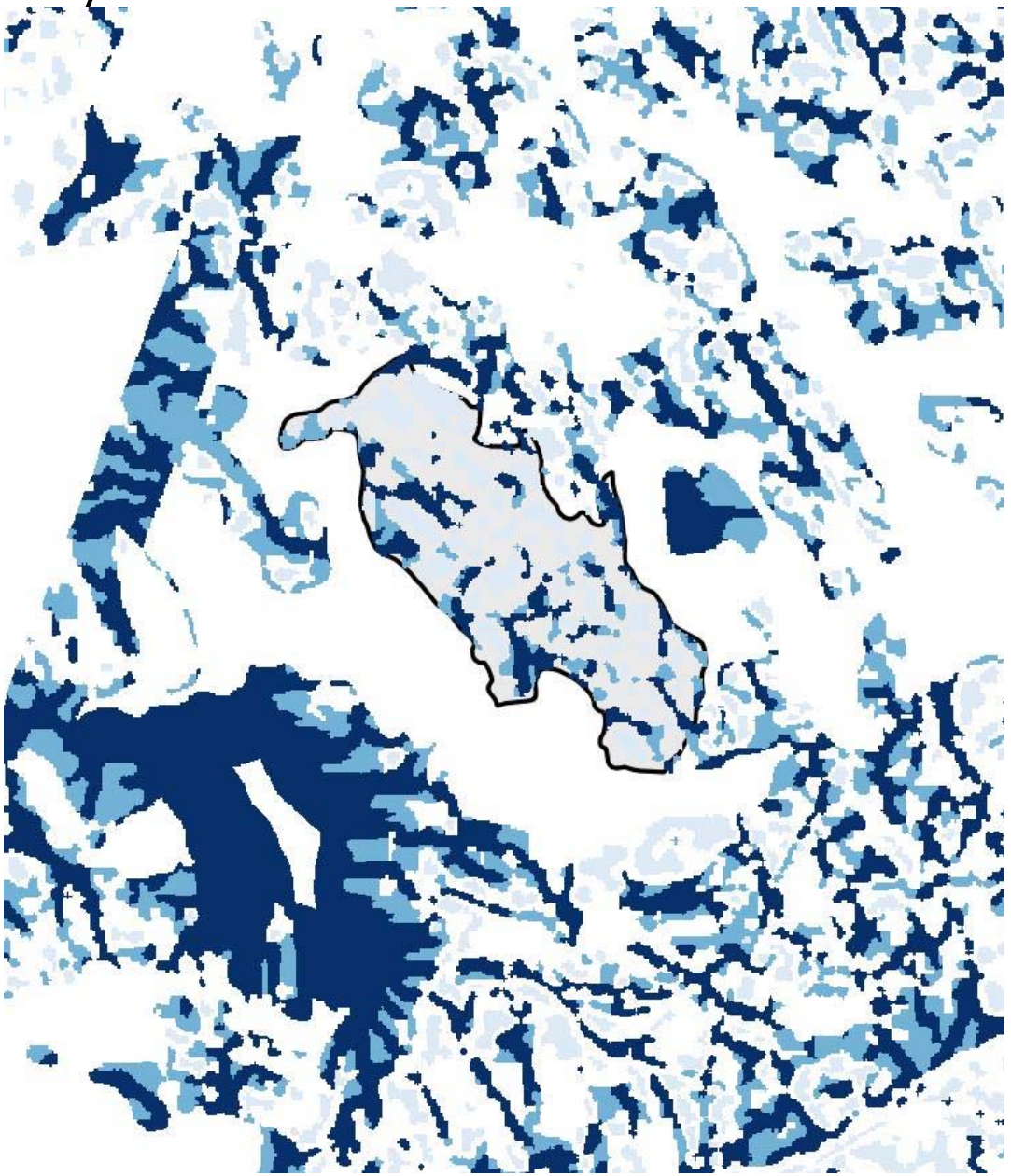
Digital Terrain Model (DTM)
-> Wet Area Map (DTW)

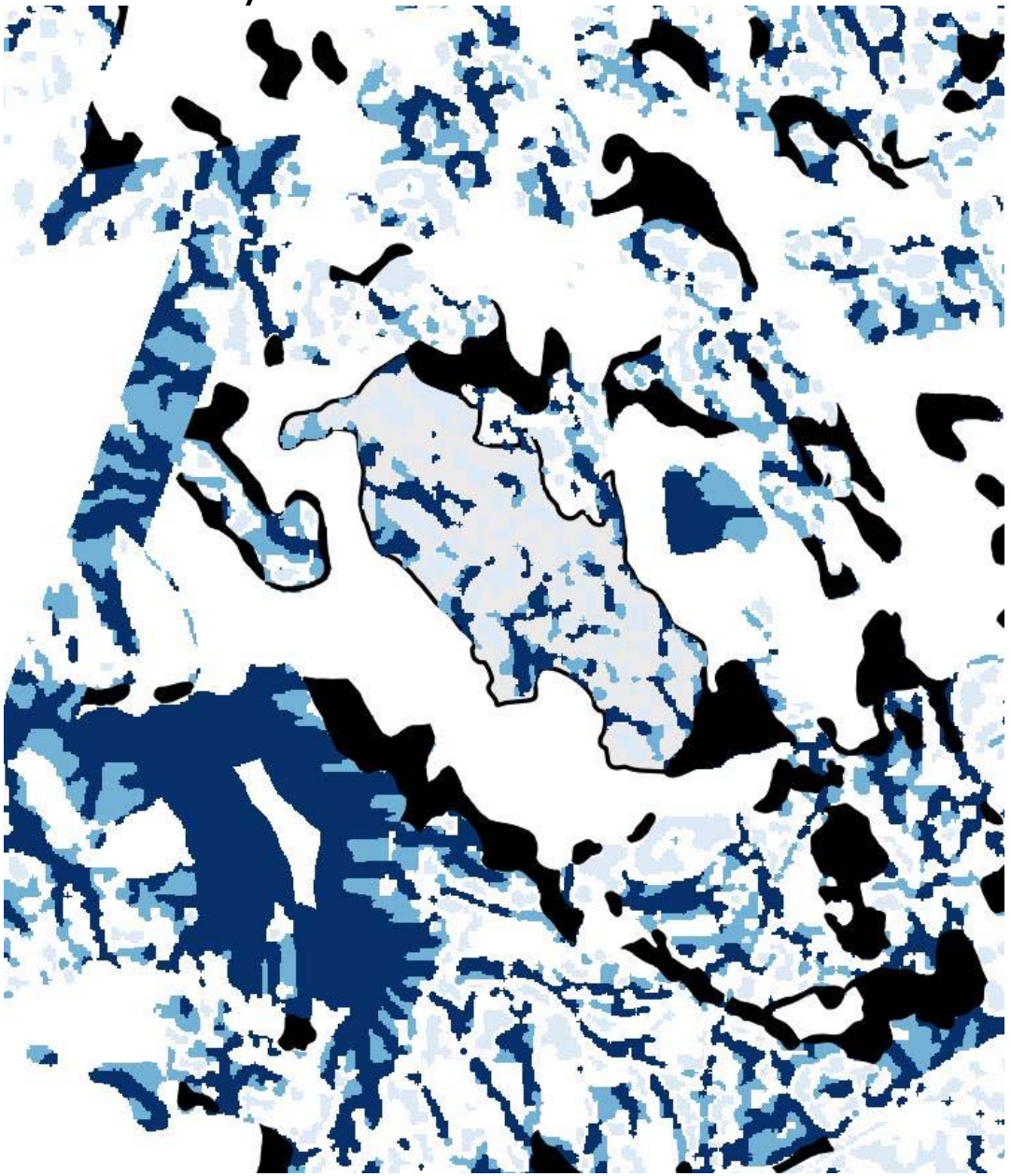


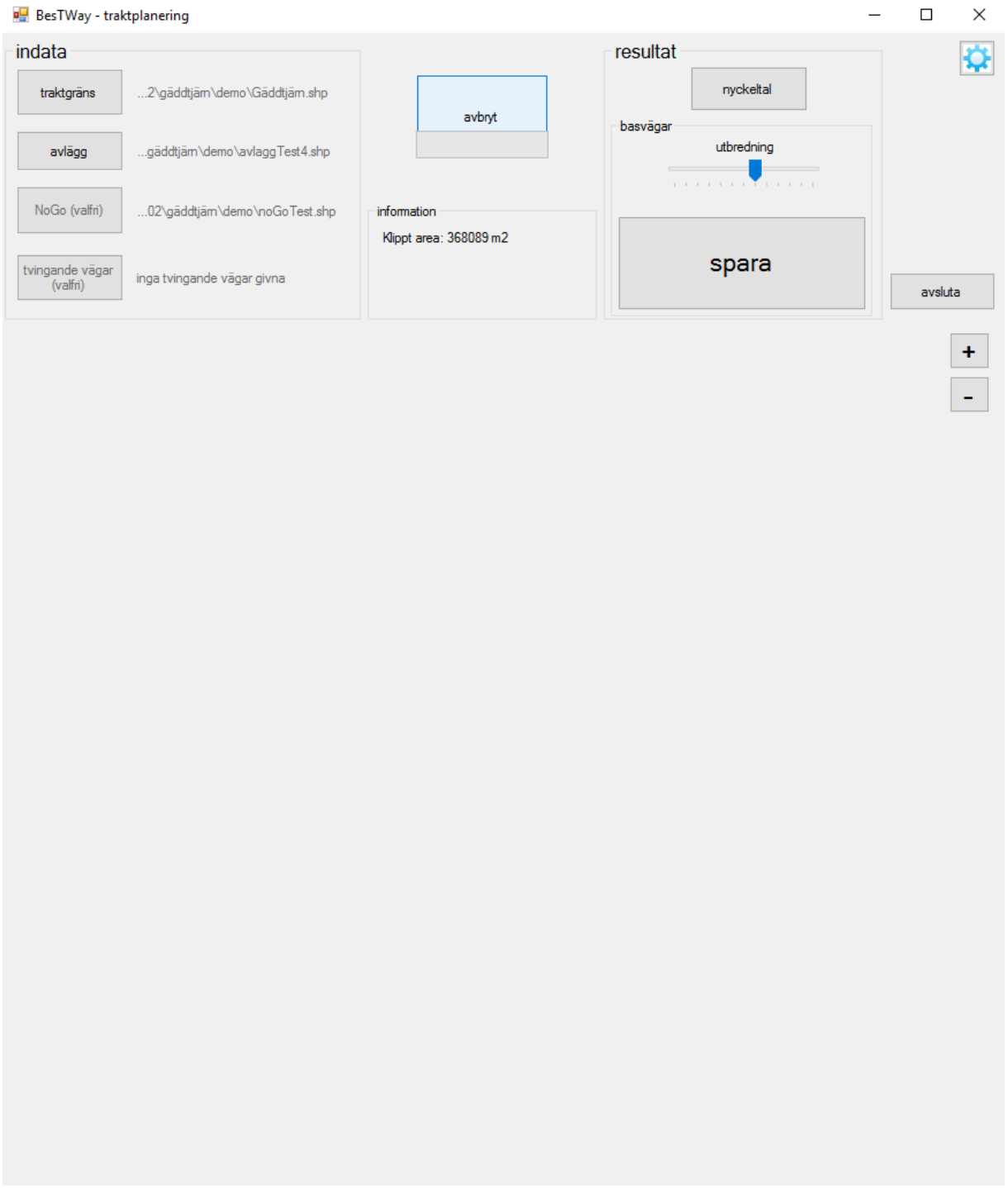
BestWay – harvest area

BestWay – harvest area with DTW

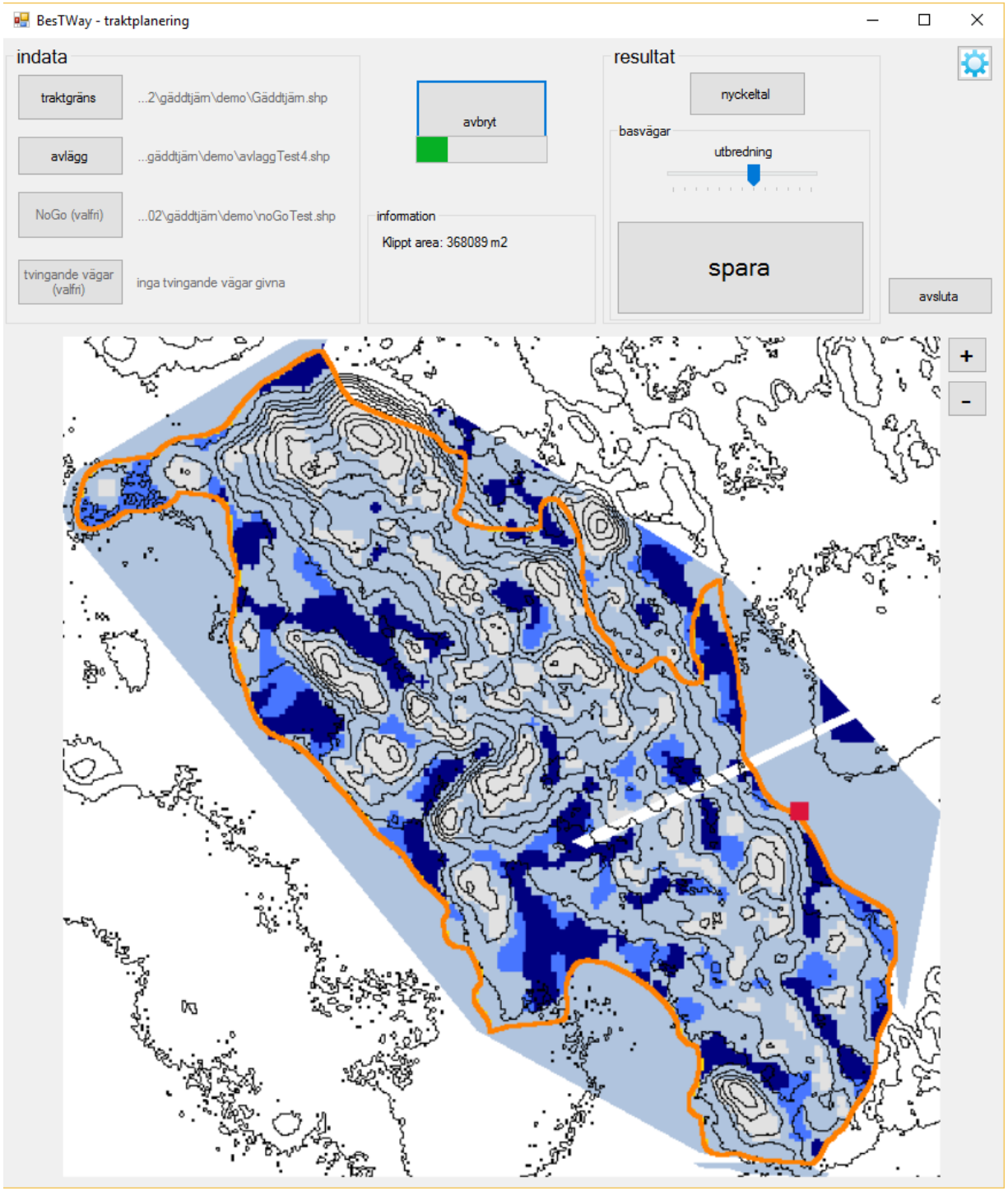


BestWay – and NoGo areas





BestWay – run example



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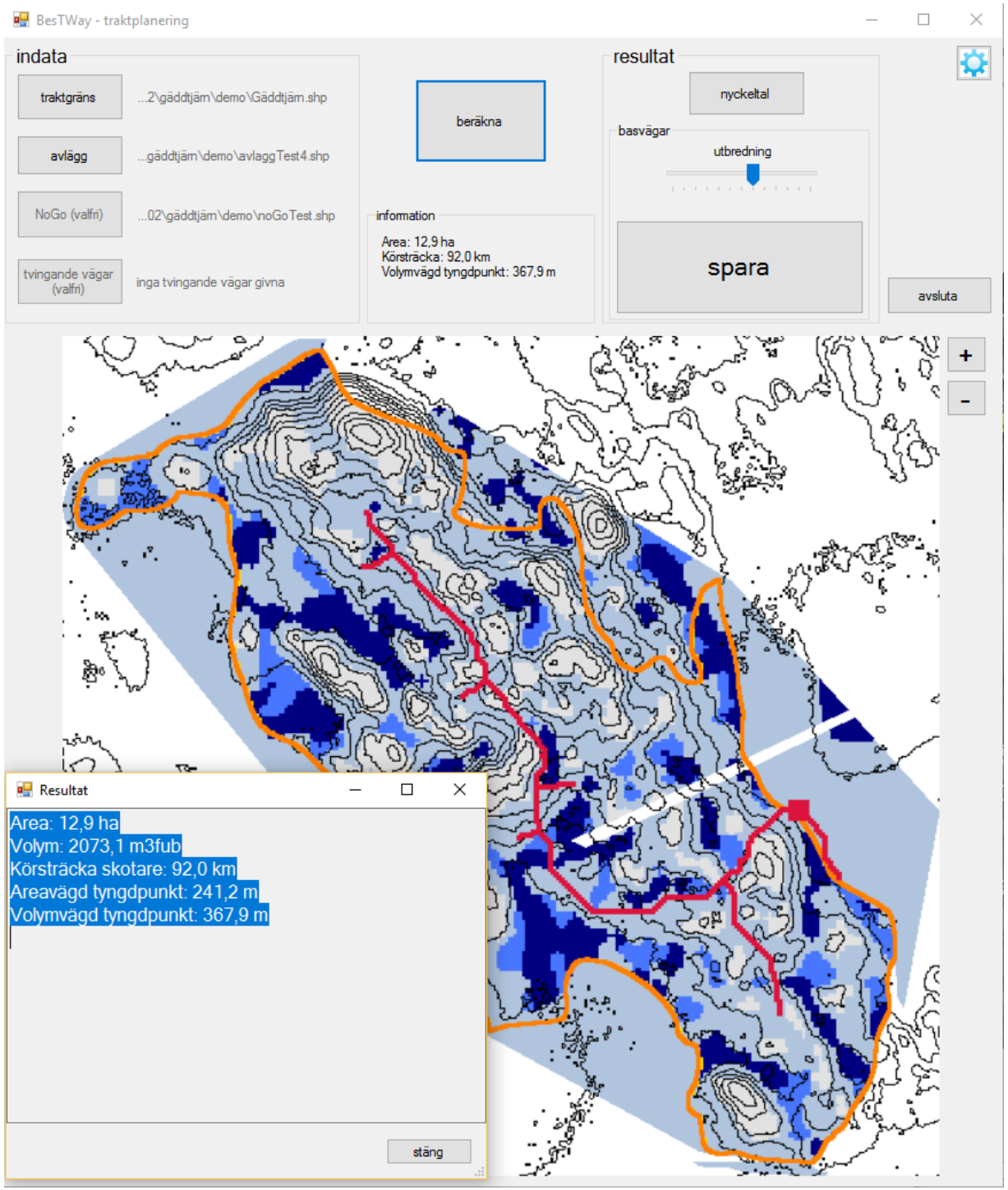

Demo – run example without bridge

forwarding distance:

No bridge: 92 km

Picture version