A Decision Support Demonstrator for Abiotic Damage to Trees, using a WWW Interface

http://bamboo.mluri.sari.ac.uk/aair/demo/

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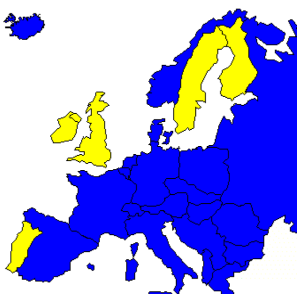
Part of the STORMS project

- Silvicultural
- Techniques
- Offering
- Risk
- Minimizing
- Strategies



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Storm Damage in Europe

- Major constraint on forestry
  - 100 million m³ destroyed by wind in one night
  - 4 million m³ damaged by snow each year
  - 500,000 ha destroyed by fire annually
- Results of damage
  - Increased costs
  - Decreased revenues
  - More dangerous working

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Initial knowledge

- Already much advice available
  - Thinning should be avoided on some sites
  - Alter rotation lengths from financial optimum
  - Use different establishment techniques

  } All have associated costs
- Crude method of assessing wind risk available
  - No account of species, stocking density, stem shape
- Aims of the STORMS project
  - Improve general knowledge of principles involved in forest damage
  - Develop a method for identifying where and what areas are at greatest risk - minimise areas where expensive management practices must be used
  - Develop a method for assessing risks due to alternative management practices

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Aims of Demonstrator

- Provide a single point of access to the spatial and aspatial models
- Indicate levels of error and uncertainty that can be expected
- Illustrate the use of the models for assessing alternative management options
- Facilitate dissemination of project results

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Why use the World Wide Web?

- Allows integration of diverse models into a single interface
- "Instant" accessibility to the outside world
- Ease of updating individual parts of the framework (as models develop) without recompilation
- Easy and effective dissemination of results
- Uses standard low cost equipment and widely available software
- Enables monitoring of user access

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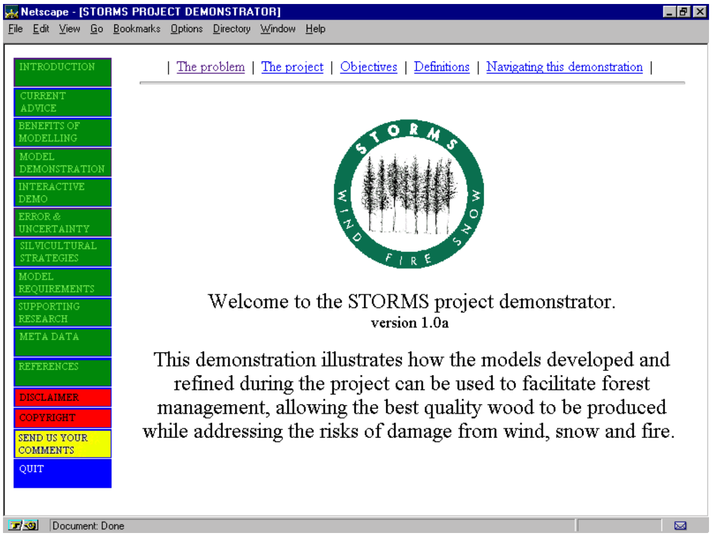
Demonstrator Front Page



Interactive demonstrations

- Provides access to ‘restricted’ versions of the models developed within the project
- Uses ‘javascript’.
- Results are derived from lookup tables, rather than the ‘real model’, to protect the commercially valuable models from being copied

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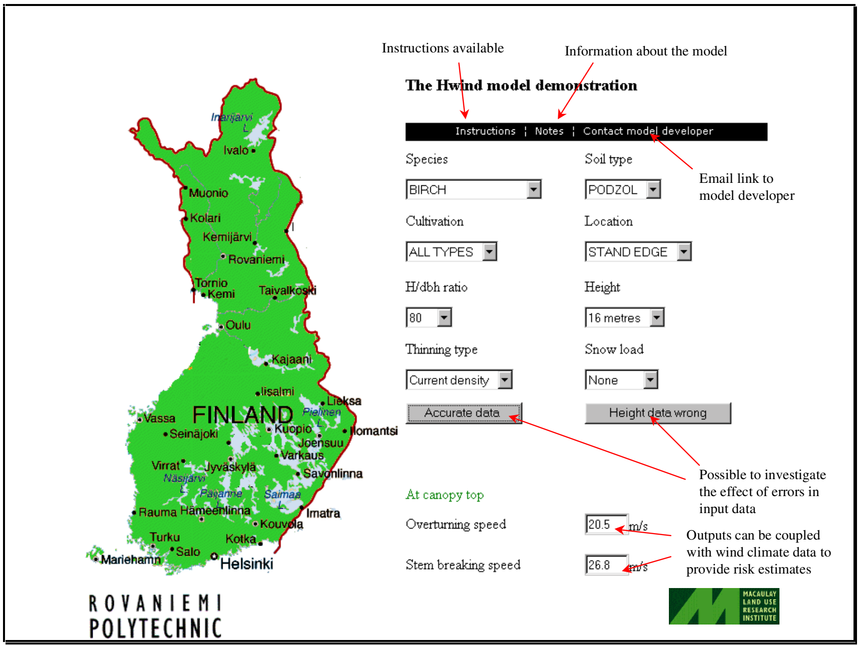
Instructions available
Information about the model
The Hwind model demonstration
Instructions ¦ Notes ¦ Contact model developer
Email link to model developer
Species
BIRCH
Soil type
PODZOL
Cultivation
ALL TYPES
Location
STAND EDGE
H/dbh ratio
80
Height
16 metres
Thinning type
Current density
Snow load
None
Accurate data
Height data wrong
Possible to investigate the effect of errors in input data
At canopy top
Overturning speed
20.5 m/s
Stem breaking speed
26.8 m/s
Outputs can be coupled with wind climate data to provide risk estimates
FINLAND
Inarijarvi L.
Ivalo
Muonio
Kolari
Kemijärvi
Rovaniemi
Tornio
Kemi
Taivalkoski
Oulu
Kajaani
Iisalmi
Lieksa
Vassa
Seinäjoki
Kuopio
Pielinen
Ilomantsi
Joensuu
Varkaus
Virrat
Jyväskylä
Näsijärvi
Savonlinna
Päijänne
Saimaa L.
Rauma
Hämeenlinna
Imatra
Kouvola
Turku
Kotka
Salo
Mariehamn
Helsinki
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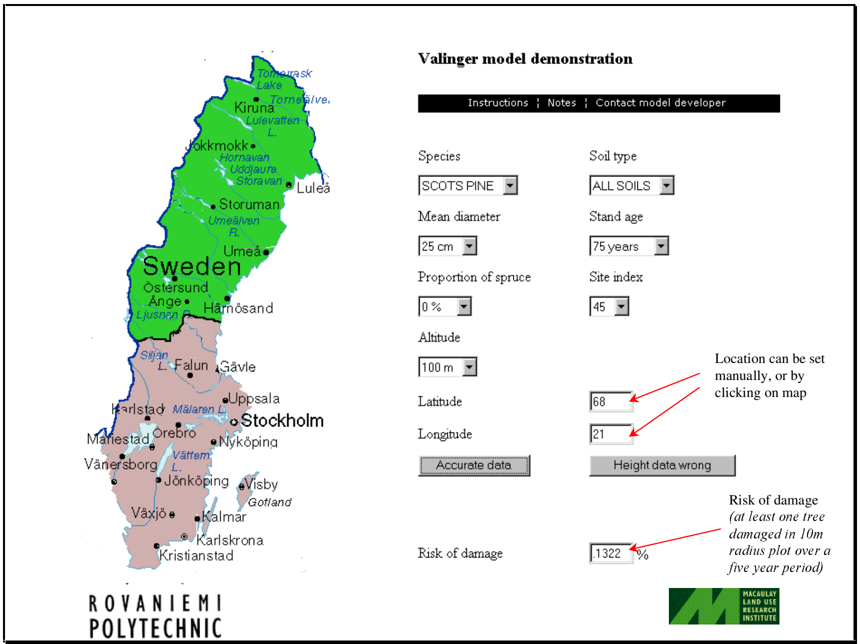
Valinger model demonstration
Instructions ¦ Notes ¦ Contact model developer
Species
SCOTS PINE
Soil type
ALL SOILS
Mean diameter
25 cm
Stand age
75 years
Proportion of spruce
0 %
Site index
45
Altitude
100 m
Latitude
68
Longitude
21
Location can be set manually, or by clicking on map
Accurate data
Height data wrong
Risk of damage
.1322 %
Risk of damage
(at least one tree damaged in 10m radius plot over a five year period)
Sweden
Torneträsk Lake
Kiruna
Torneälve.
Luleälven L.
Jokkmokk
Hornavan
Uddjaure
Storavan
Luleå
Storuman
Umeälven R.
Umeå
Östersund
Ånge
Härnösand
Ljusnan
Siljan L.
Falun
Gävle
Uppsala
Karlstad
Mälaren L.
Stockholm
Mariestad
Örebro
Nyköping
Vänersborg
Vättern L.
Jönköping
Visby
Gotland
Växjö
Kalmar
Karlskrona
Kristianstad
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Using the models for assessing risk on a forest scale

- Demonstration contains examples for the UK, Finland and Portugal

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Use of model in Finland

- Mechanistic model applied to all the stands of Scots pine in a forest compartment in Finland to calculate wind speed to cause damage

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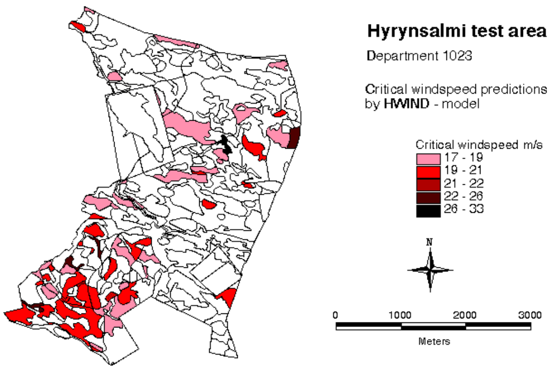

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Use of model in Finland

- Mechanistic model applied to all the stands of Scots pine in a forest compartment in Finland to calculate wind speed to cause damage
- Risk of damaging wind speed occurring calculated

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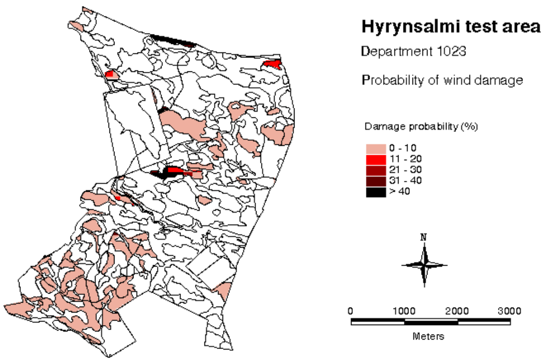

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Use of model in Finland

- Mechanistic model applied to all the stands of Scots pine in a forest compartment in Finland to calculate wind speed to cause damage
- Risk of damaging wind speed occurring calculated
- Stands of trees which actually suffered damage had been identified as being at high risk - model validation!

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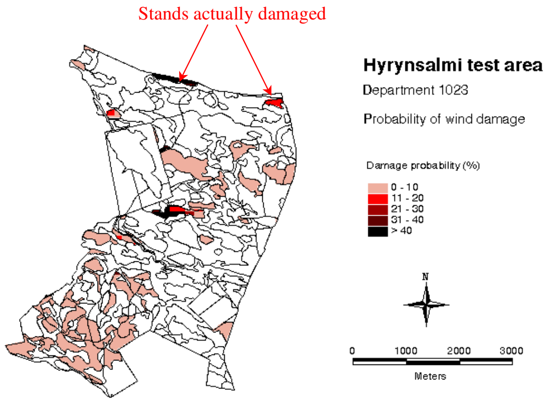

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Use of model in Finland

- Mechanistic model applied to all the stands of Scots pine in a forest compartment in Finland to calculate wind speed to cause damage
- Risk of damaging wind speed occurring calculated
- Stands of trees which actually suffered damage had been identified as being at high risk.
- Use of logistic model developed in Sweden also identified the stands which were damaged

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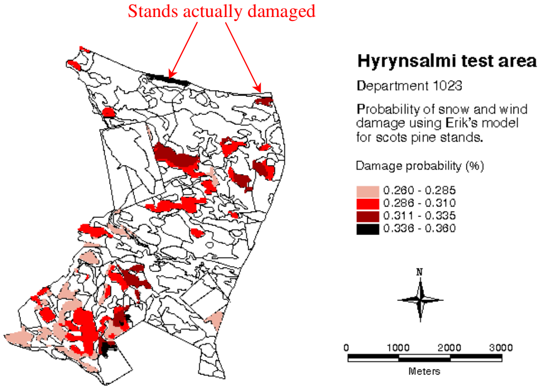

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Use of model in Finland

- Mechanistic model applied to all the stands of Scots pine in a forest compartment in Finland to calculate wind speed to cause damage
- Risk of damaging wind speed occurring calculated
- Stands of trees which actually suffered damage had been identified as being at high risk.
- Use of logistic model developed in Sweden also identified the stands which were damaged
- Models appear to exaggerate the risk of damage - but damage occurs every year, and 'actual damage' data relate to just a single year.

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So, the models appear to work

BUT a *good* Decision Support tool also

- indicates how certain the results are (error and uncertainty)
- provides background information to the decision

These are also included within the demonstration

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Error and uncertainty

Possible causes

- Absolute error (e.g. measurement)
- Attribute error
- Algorithm derived inputs
- Resolution
- Scale

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One example: scale and soil classification

- Soil has a major influence on tree stability
- It is, however, impractical to map small areas in polygonal datasets resulting in minimum mapable unit and inclusions. (This occurs irrespective of scale used)
- sub-class information is therefore usually included in the key
- This means that various options are available for modelling: dominant, subdominant or "statistical" soil types, and this can give different model outputs

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Forest in west of Scotland
Six scenarios

- 1:10000 - Forestry Commission soil map
- 1:50000 - major soil type
- 1:50000 - inclusion soil type
- 1:50000 - "best" soil type *(major soil type or inclusion soil type which offers the greatest rooting ability)*
- 1:50000 - "worst" soil type *(as above, but which offers the least rooting ability)*
- 1:1000000 - European soils map

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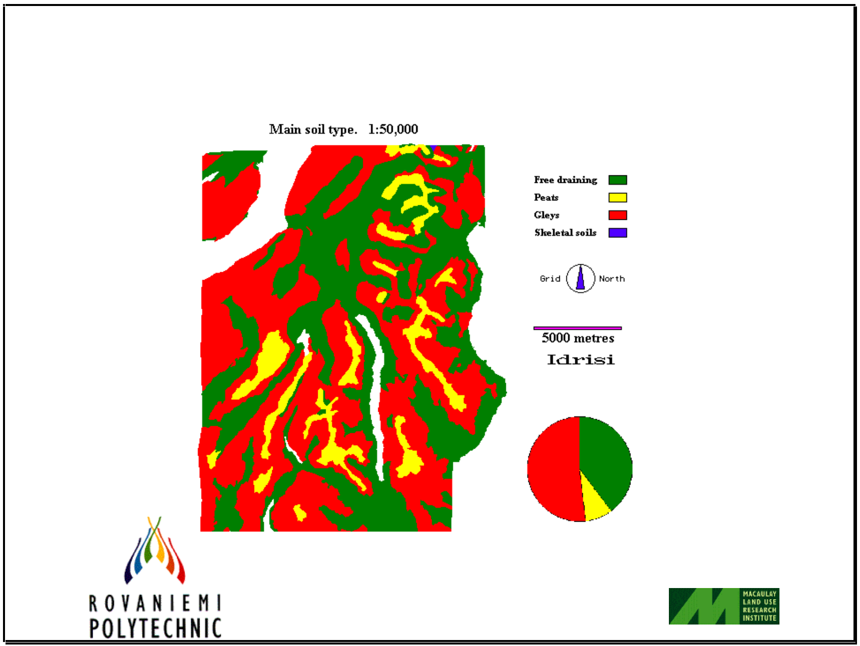
Main soil type. 1:50,000
Free draining
Peats
Gleys
Skeletal soils
Grid North
5000 metres
Idrisi
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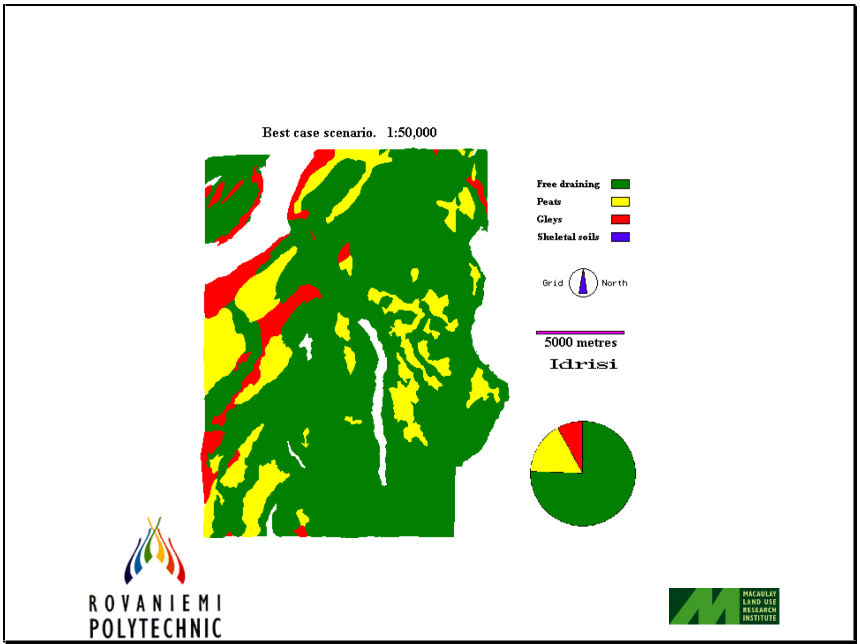
Best case scenario. 1:50,000
Free draining
Peats
Gleys
Skeletal soils
Grid North
5000 metres
Idrisi
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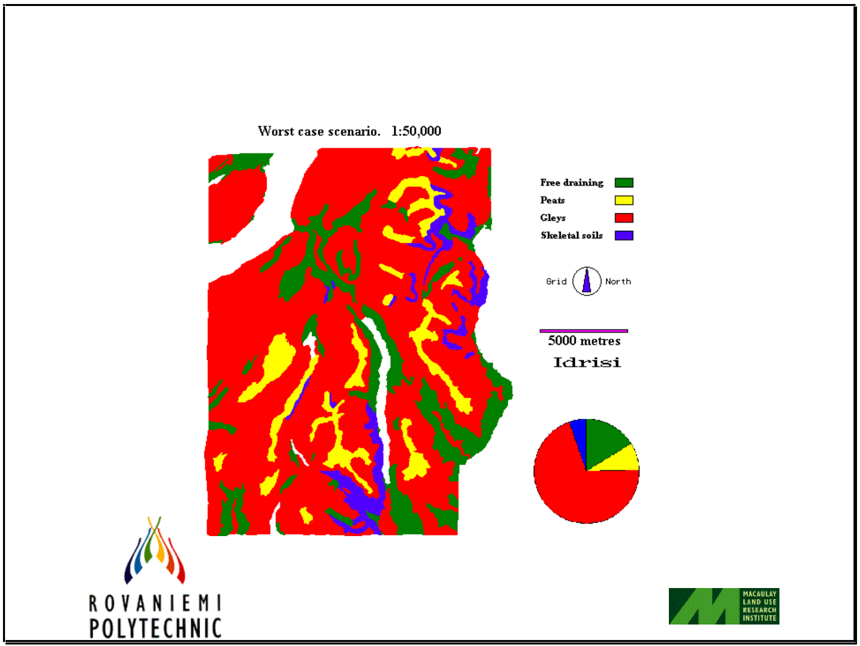
Worst case scenario. 1:50,000
Free draining
Peats
Gleys
Skeletal soils
Grid North
5000 metres
Idrisi
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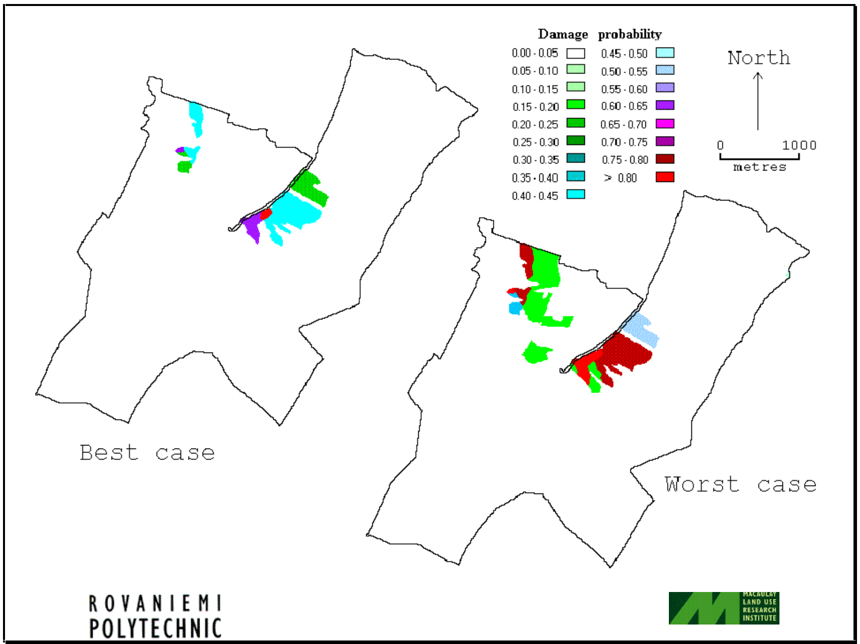
Damage probability
0.00 - 0.05
0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60
0.60 - 0.65
0.65 - 0.70
0.70 - 0.75
0.75 - 0.80
> 0.80
North
0 1000
metres
Best case
Worst case
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The Demonstrator also illustrates scenario testing

For a forest in mid-Wales, we can consider two options:

- thin the trees (produces a higher quality final crop of timber)
- don't thin the trees (may reduce the risk of damage, and avoids expensive early thinning)

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Scenario testing -method

- Current stand data can be used to predict what the stand will be like in twenty years time if managed using one or other of the silvicultural options. The data can then be used to assess where wind damage may occur.

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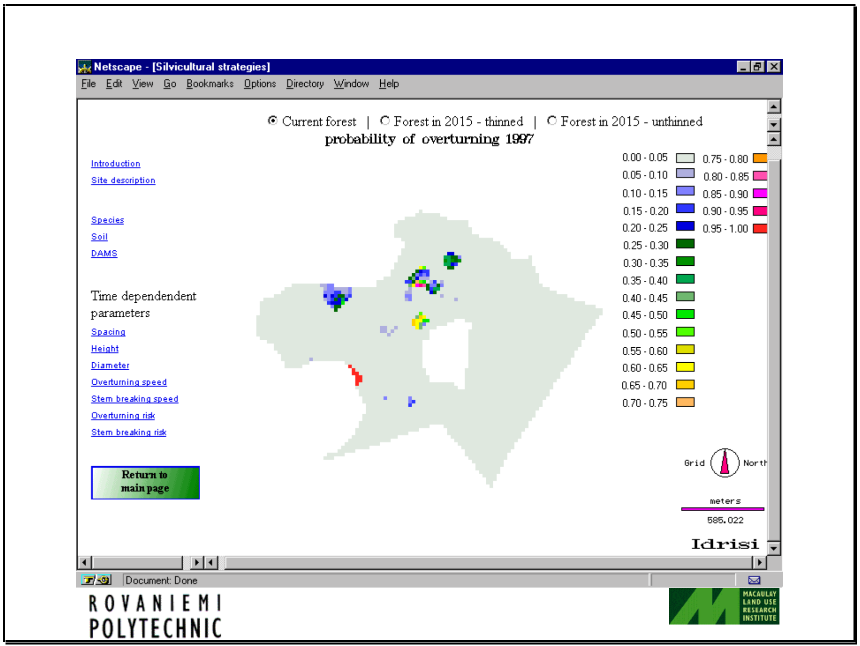
Netscape - [Silvicultural strategies]
File Edit View Go Bookmarks Options Directory Window Help
Current forest | Forest in 2015 - thinned | Forest in 2015 - unthinned
probability of overturning 1997
Introduction
Site description
Species
Soil
DAMS
Time dependendent parameters
Spacing
Height
Diameter
Overturning speed
Stem breaking speed
Overturning risk
Stem breaking risk
Return to main page
0.00 - 0.05
0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60
0.60 - 0.65
0.65 - 0.70
0.70 - 0.75
0.75 - 0.80
0.80 - 0.85
0.85 - 0.90
0.90 - 0.95
0.95 - 1.00
Grid North
meters
585.022
Idrisi
Document: Done
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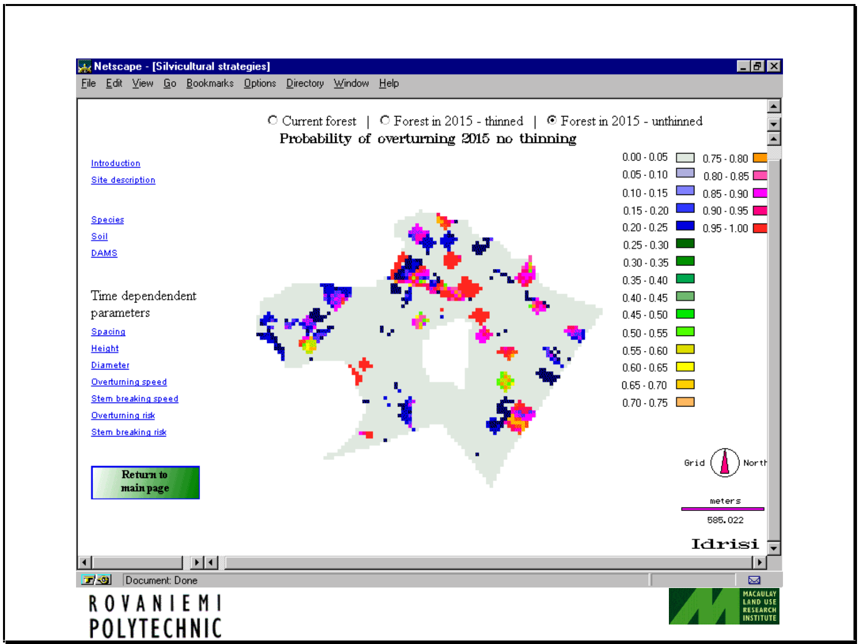
Netscape - [Silvicultural strategies]
File Edit View Go Bookmarks Options Directory Window Help
Current forest | Forest in 2015 - thinned | Forest in 2015 - unthinned
Probability of overturning 2015 no thinning
Introduction
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Spacing
Height
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Stem breaking speed
Overturning risk
Stem breaking risk
Return to main page
0.00 - 0.05
0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60
0.60 - 0.65
0.65 - 0.70
0.70 - 0.75
0.75 - 0.80
0.80 - 0.85
0.85 - 0.90
0.90 - 0.95
0.95 - 1.00
Grid North
meters
585.022
Idrisi
Document: Done
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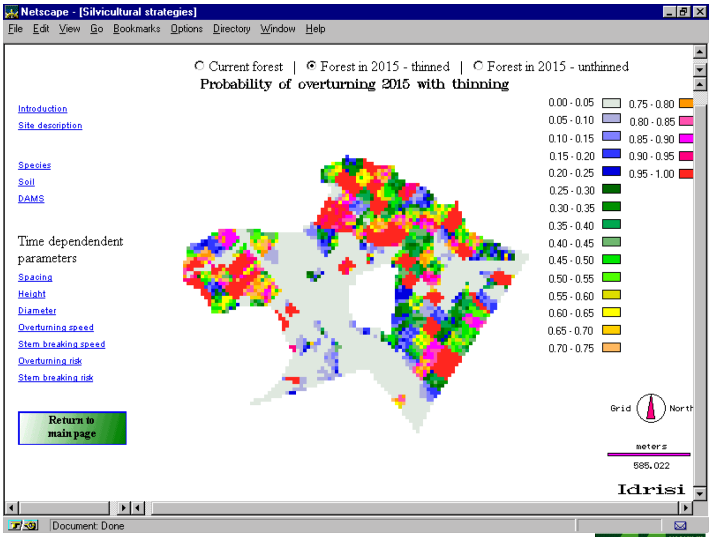

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Scenario testing - results

- Thinning the stand will cause more damage than non-thinning.
- **BUT** before making a final decision on which option is best, a detailed economic evaluation would be required. Although the trees from the unthinned stand may not have been damaged, they may not satisfy market requirements.

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Conclusions from running the Demonstrator on the WWW

- WWW interface offers an excellent medium for integrating models into a single Decision Support framework
- Can be used to run models "live" or "pre-prepared"
- Problem of "security" and copyright. If it's on the WWW it must be free…..!
- It also offers an easy (and updatable) method of dissemination, which uses standard and widely available equipment and software

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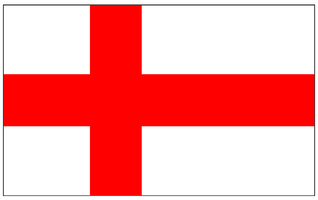
An example of Finnish/Scottish Collaboration!



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