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► **To cite this version:**

S. Dupire, F. Berger. Automatic mapping of possible forest operations: a decision support tool for forest planning. XXIV IUFRO World Congress, Oct 2014, Salt Lake City, United States. pp.1, 2014. hal-02600330

HAL Id: hal-02600330

<https://hal.inrae.fr/hal-02600330>

Submitted on 16 May 2020

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Automatic mapping of forest operation possibilities: a spatial decision support tool for forest planning

S. Dupire^{1,2}, F. Berger^{1,2}

A need for identifying forest accessibility according to forest operation systems



Skidder operation

In France, in mountainous regions, most of the harvested wood is extracted using a skidder. For 50 years, forest road network and silviculture have been thought to facilitate this specific system. Today, despite these efforts, only 50% of the mountain forests are accessible with skidder. Objective methods are needed to identify the different forest operation possibilities and assist forest managers when planning operations.



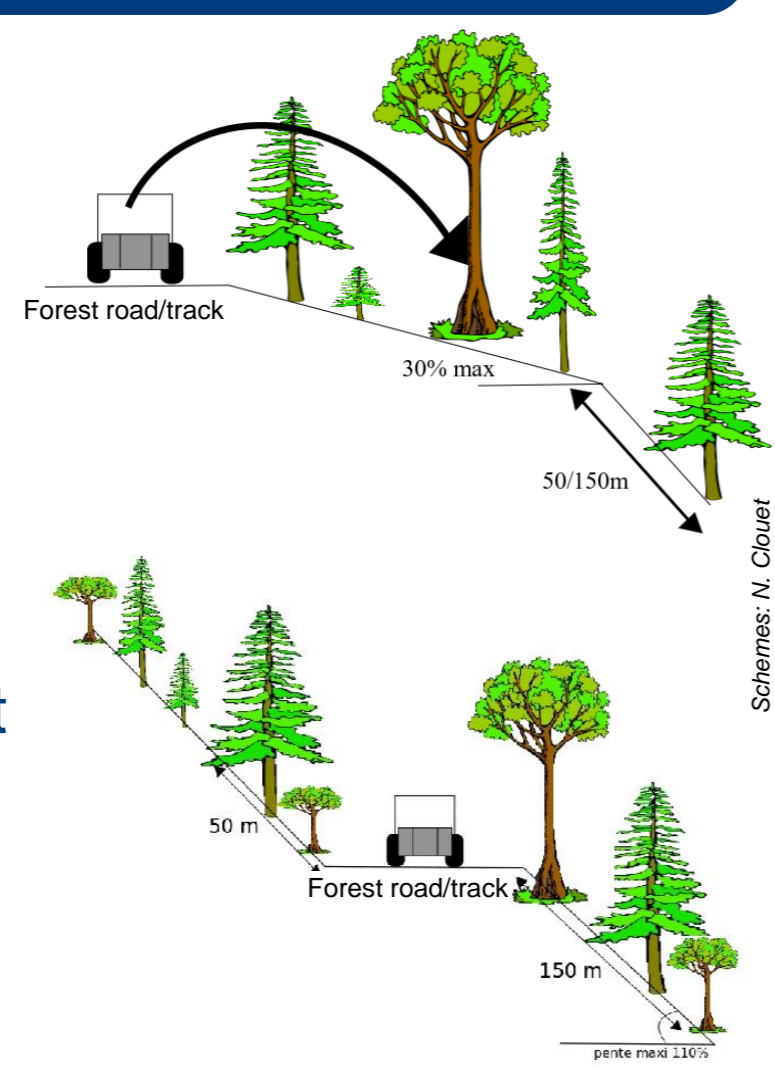
Cable yarding operation

A spatial decision support tool named Sylvaccess has been developed in order to identify the accessible areas according to two forest operation systems: skidder and cable yarding.

Sylvaccess Skidder

PARAMETERS

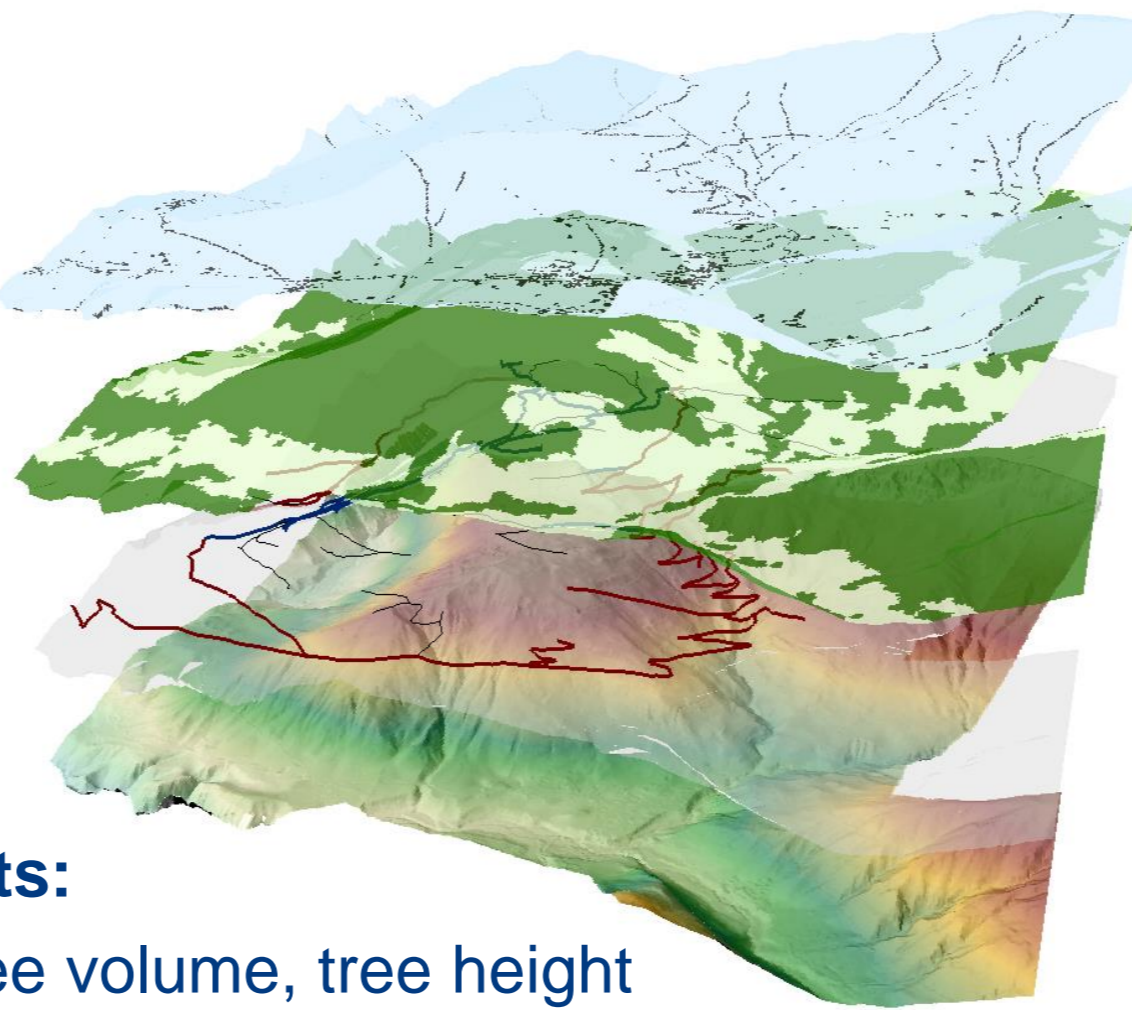
- If slope $\leq 30\%$**
 - “Free” movement of the skidder
 - Winching possible from the contour of the area
- If slope $> 30\%$**
 - Timber is winched from forest roads or forest tracks:
 - 50 m uphill
 - 150 m downhill



SPATIAL INPUTS

Compulsory inputs:

- Obstacles
- Forest area
- Road network
- DTM



Additional optional inputs:

Stand volume, average tree volume, tree height

Sylvaccess Cable

PARAMETERS

Geometric layout:

- Span horizontal distance
- Span vertical distance

Skyline properties :

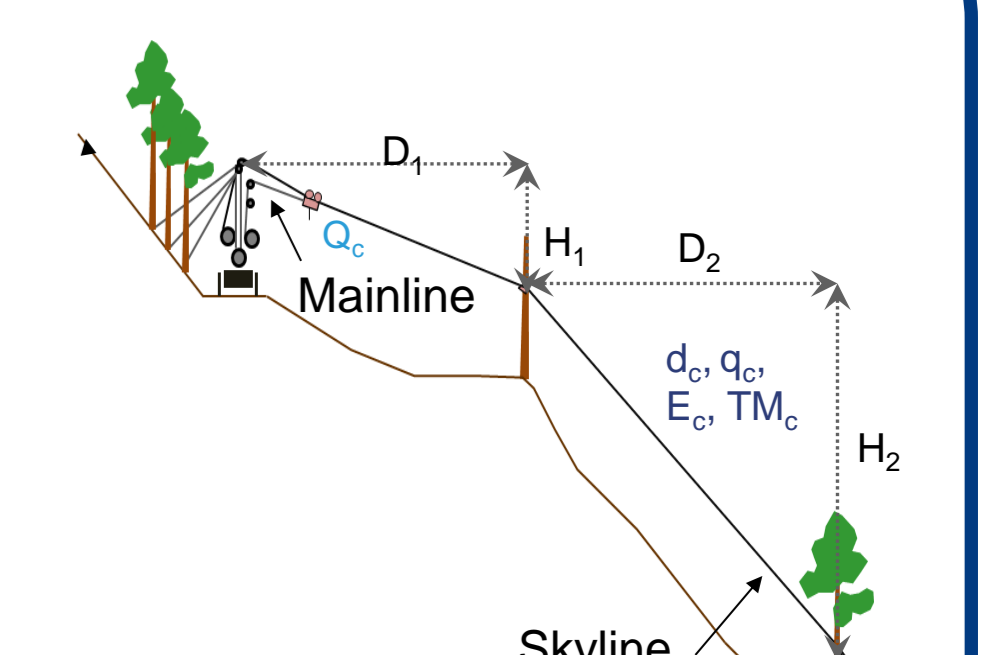
- Diameter
- Self-weight
- Elasticity – Young Modulus
- Maximum tension

Carriage properties:

- Empty weight

Load properties:

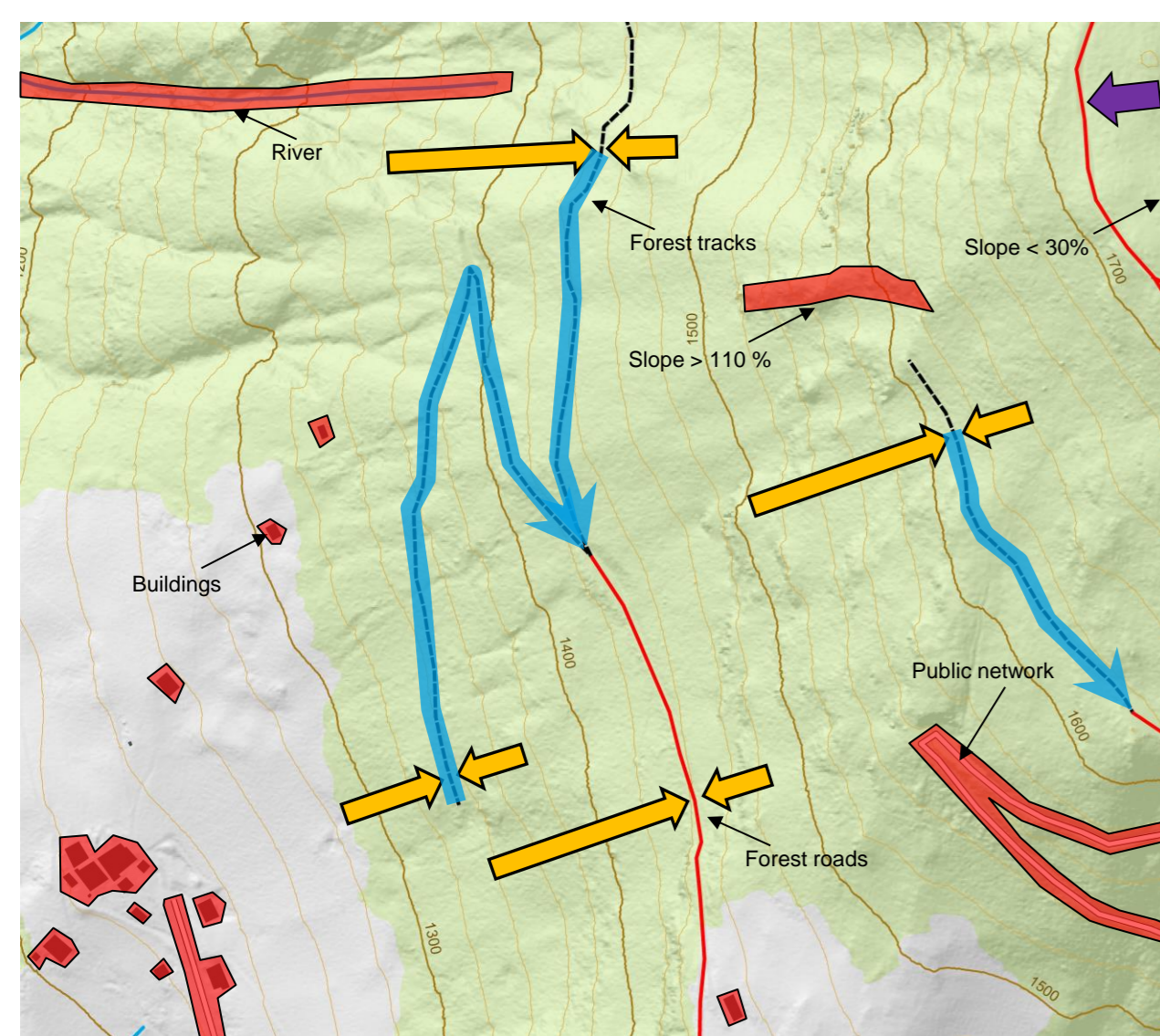
- Suspended load



Configuration:

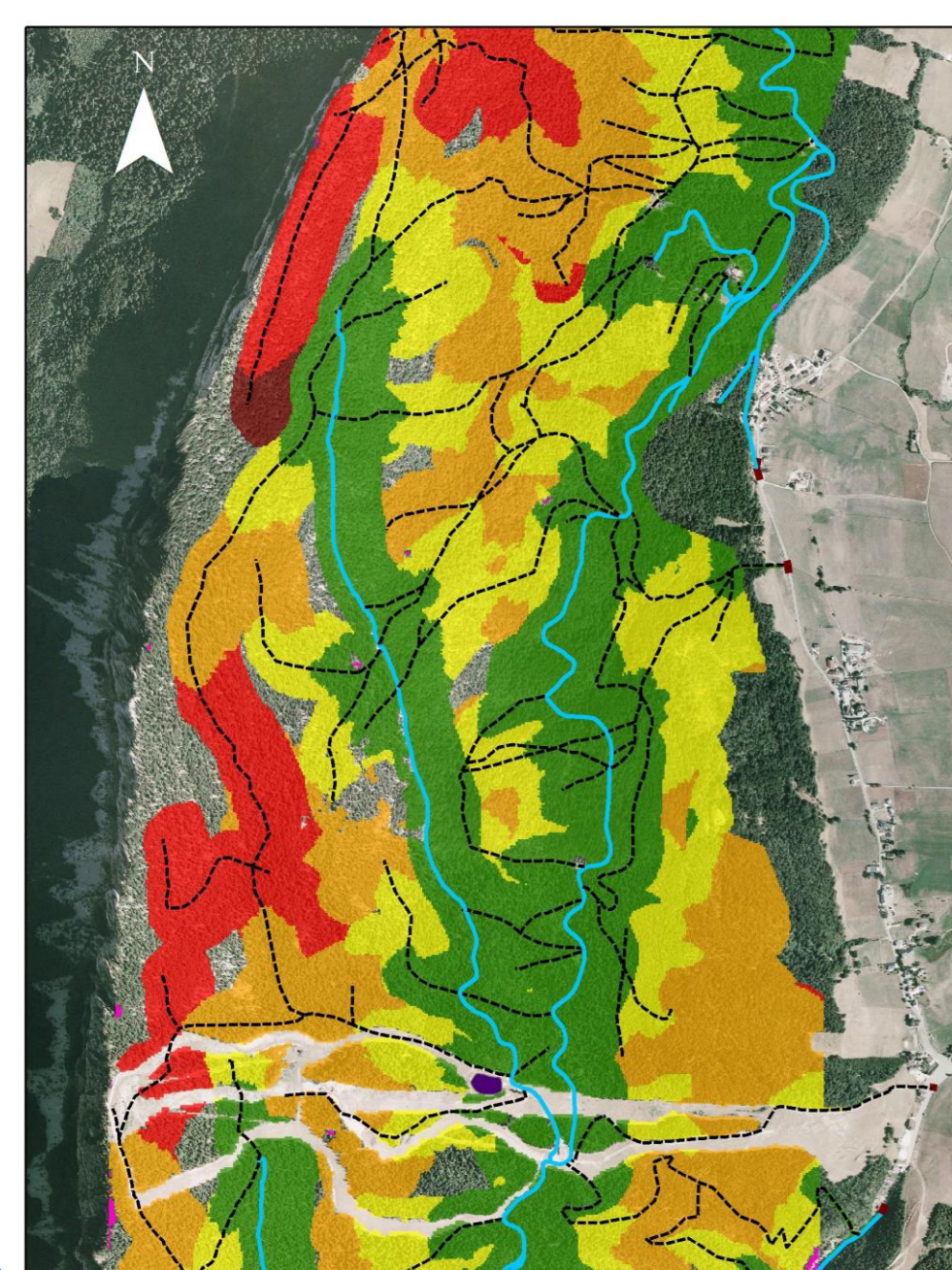
- Maximum number of int. sup.
- Minimum clearance

PROCESS



- Remove obstacles and area where slope is too high for manual felling
- Calculate winching distance
- Calculate skidding distance on forest tracks
- Calculate skidding distance inside forest

RESULTS



Sylvaccess – Skidder
Total distance from felling place to forest roads

Vercors

- Network**
- Forest tracks
 - Forest roads
 - Public network
- Total distance by class**
- < 250 m
 - 250 - 500 m
 - 500 - 1 000 m
 - 1 000 - 2 000 m
 - > 2 000 m

Available outputs:

- Accessible forests
- Non accessible forests
- Winching distance
- Skidding distance on tracks
- Skidding distance in forest
- Total harvesting distance
- Area directly accessible
- Optimal yarding area
- Summary table
- Simulation parameters

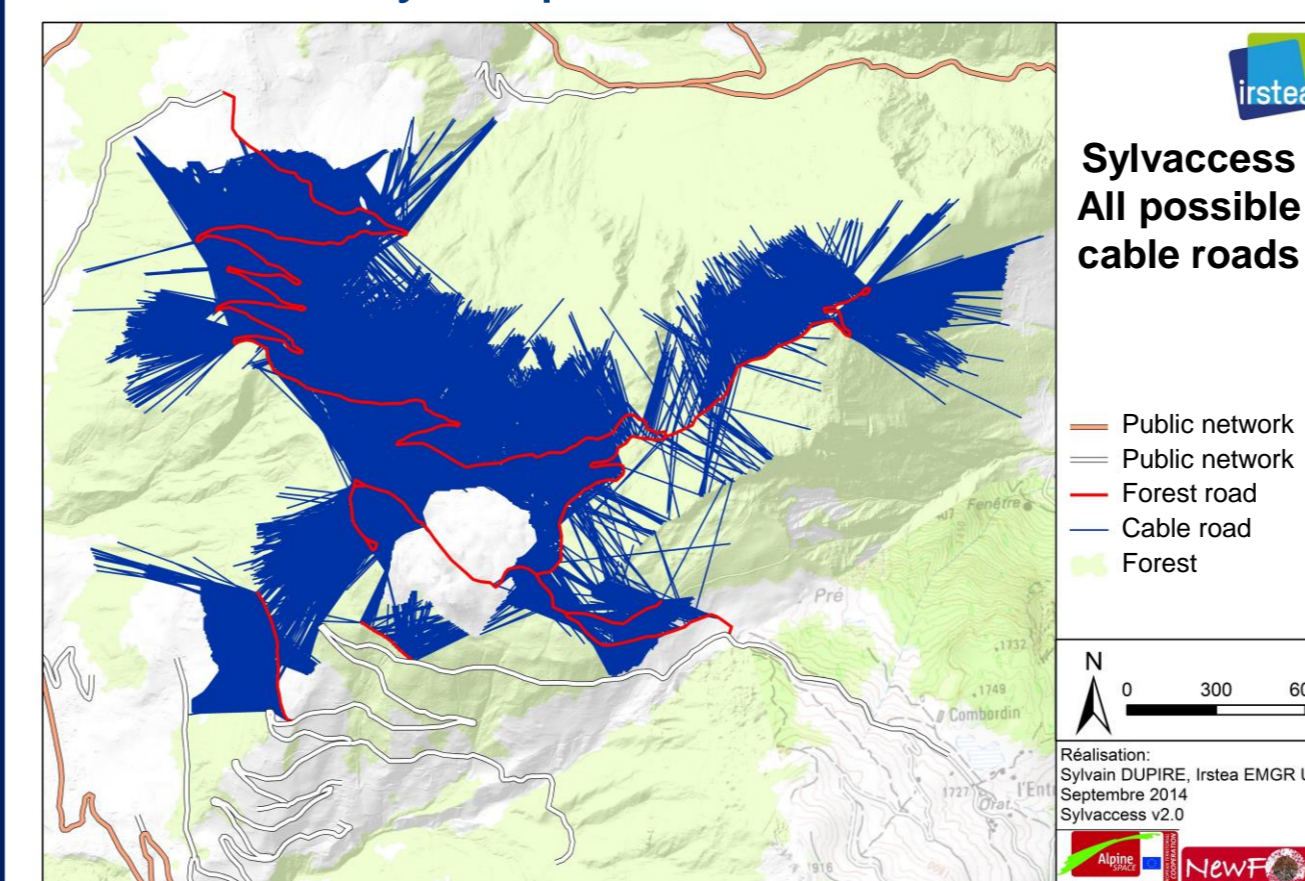
PROCESS

- Select road pixel to analyze
- Create all possible cable roads
- Keep only correct cable roads
- Run mechanical analysis on all cable road. Example with cable road with azimuth 30°
- Select the cable road and extract the profile
- Optimize the layout save profile in a database
- Process next road pixel

RESULTS

Raw outputs:

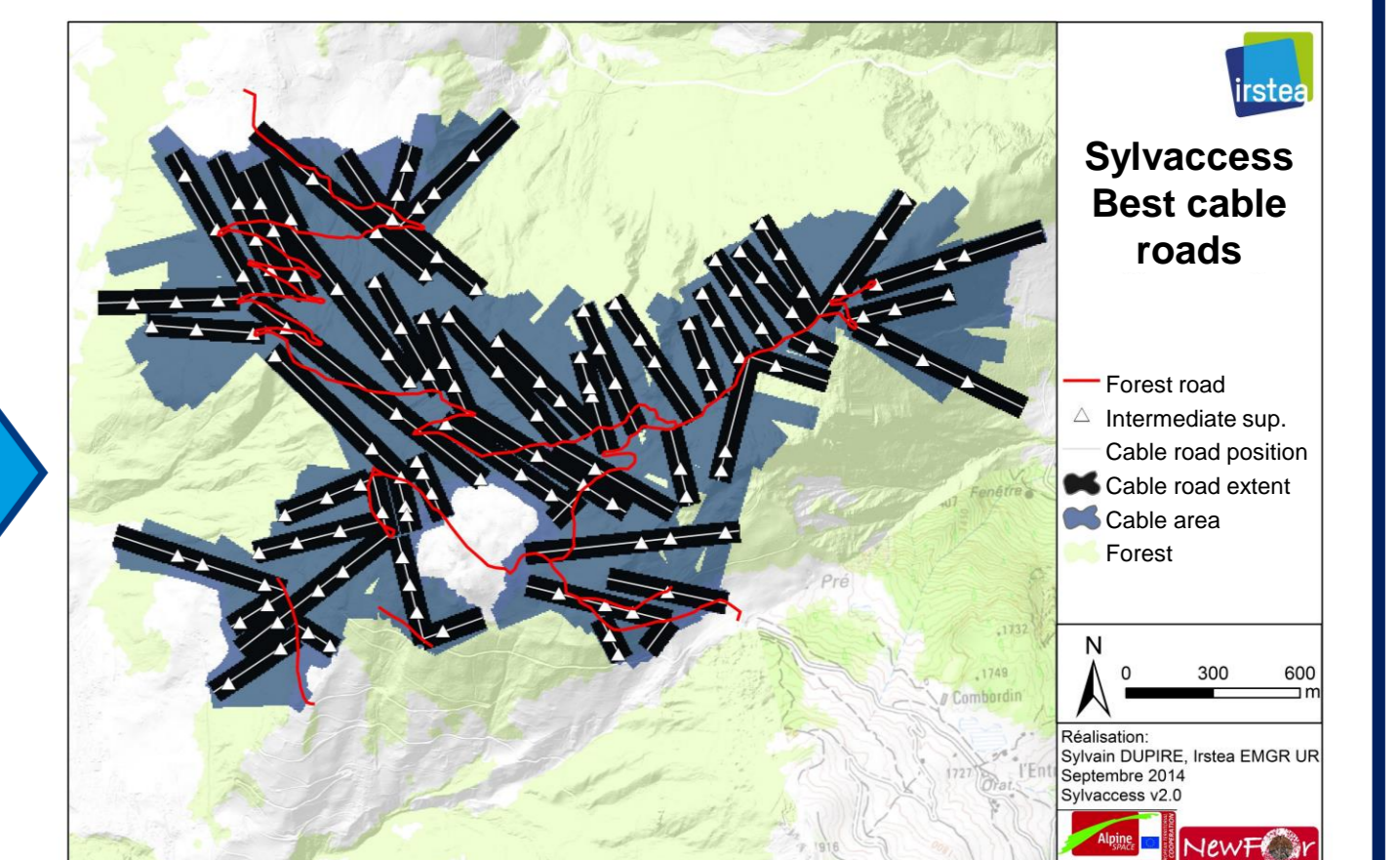
Geospatial database of all possible cable roads with layout parameters



250 000 cable roads tested on 700 ha
Only 25 000 possible roads kept

Handled outputs:

Selection of the best cable roads according to 1 to 4 criteria



55 cable roads selected according to the criteria, covering 55% of the forest area

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