SIMULCABLE:
A new software to optimise the line implantation for cable yarding

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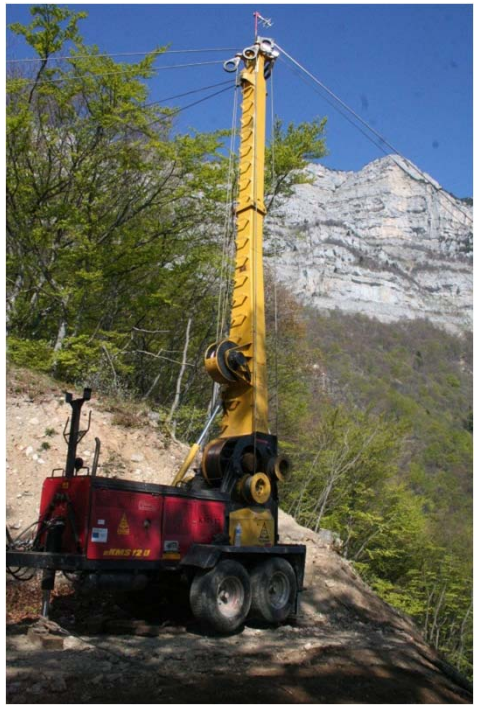
French Context

- Cable yarding is sometimes used to cross river or swamp areas, but most of the time in mountains areas, where building a road is to expensive or not compatible with nature protection goals
- Less than 15 enterprises in France

- Focus on the French Alps,
  - ✓7 enterprises, and only 3 with cable crane (tower yarder)
  - ✓less than 40.000 m3 per year are extracted by cable yarding
  - ✓Difficulties to install new teams, while demand is increasing ⇨foreigner contractors for logging operations

The cable cranes

On a truck:
1100m, 3 to 6 tons



On a trailer:
800m, 3 tons

On a tractor:
400m, 3 tons

In the French alps, all enterprises are equipped with a trailer

The operating conditions

• The crane on the road offer the possibility of harvesting downhill or uphill

• Whole tree are extracted and cut at road side with a harvester or processor:

- ✓Production of wood chips
- ✓Safety conditions for the loggers
- ✓High productivity

Programmation of the line implantation

•Generally done by the forest manager (owner's delegate, expert,….)

•Necessary to establish the business plan of the harvesting operation

<u>The needs, before cutting the corridor:</u>

•Position of the crane and terminal support (tree)

•Number of intermediate pylons and their position for:

✓Determine the time for line implantation (1 to 2 days)

✓Determine the cost for logging

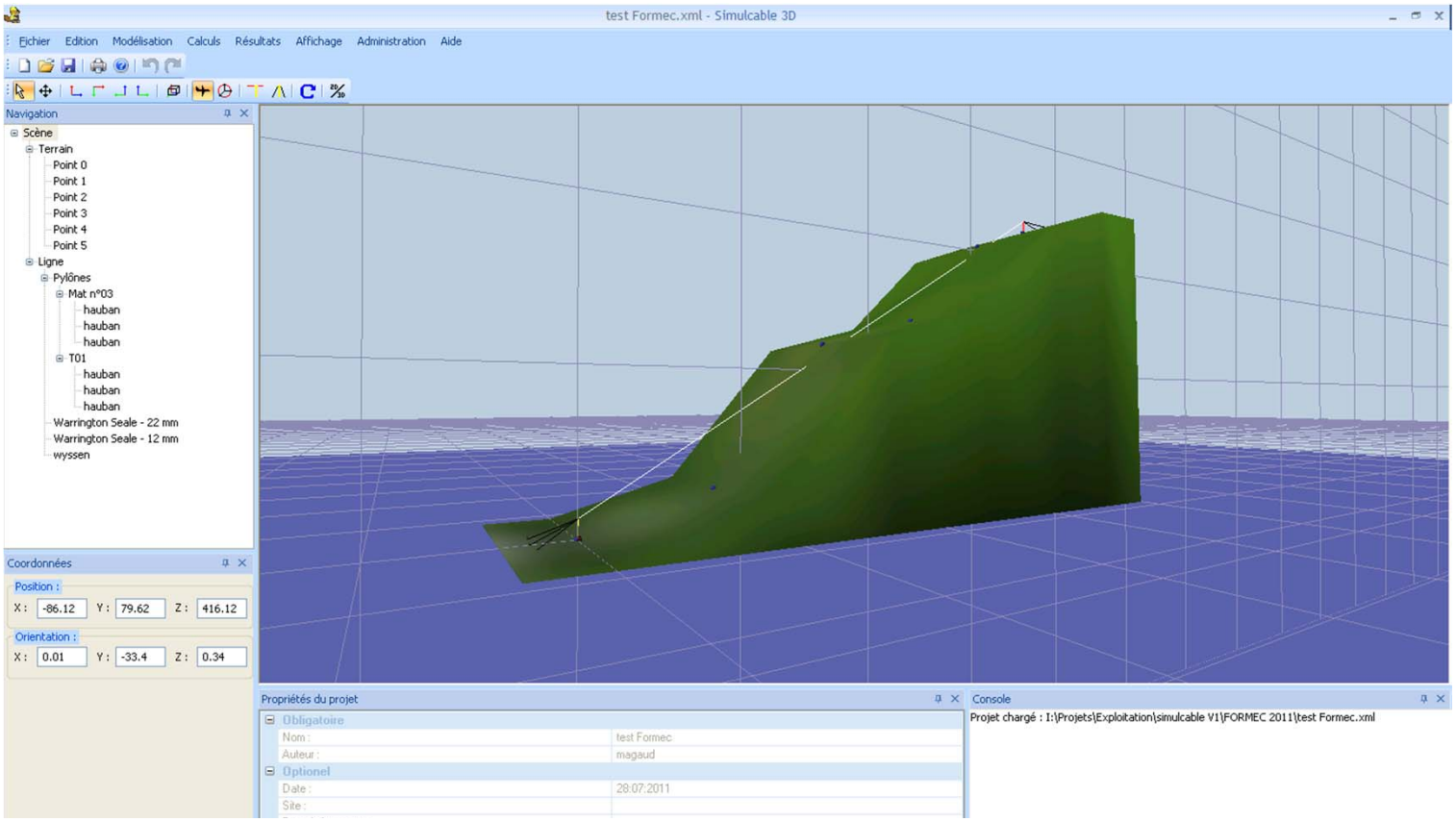
For memory, install 1 pylon takes 0.5 to 1 day, for a cost estimated between 1 to 3 €/ m^3)

⇨**How many pylons are needed?**

Actually, the loggers leave some trees instinctively, in case of additional support should be needed

The objectifs of Simulcable:

•Create the line implantation with a 3D visualisation, with the localisation of the pylons and the critical places.

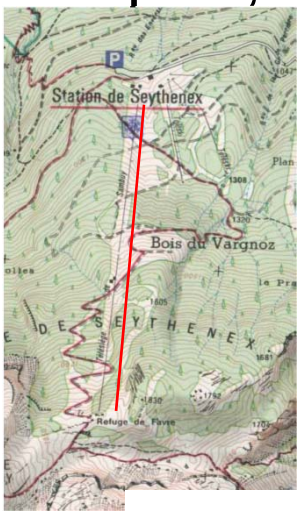


•The Principe: calculation of the forces in the cable

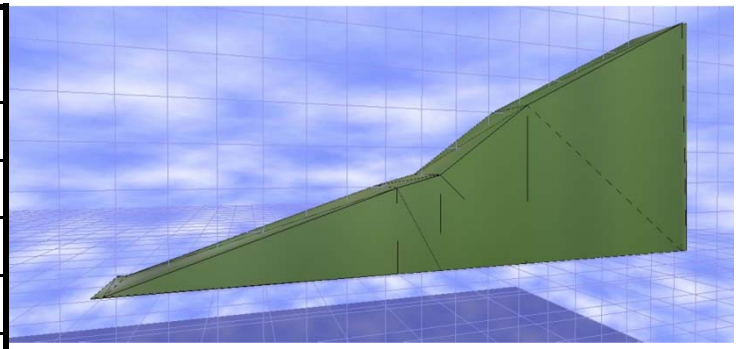
Parameters: topographic profile

The operator needs to know where the crane and the terminal support will be installed. Then the profile can be obtained from:

- **Digital elevation models** (max 50.000 points): good precision but rarely used in France because of his high price
- **Paper maps** (generally 1/25000): quickly realised, but insufficient precision
- **Raise of ground measure**, with compass,clinometer and topofil, which have the best precision



point	Distance on the map (mm)	Altitude (m)	Difference of height (m)
0	0	1250	
1	24	1450	200
2	28.5	1480	30
3	38.5	1560	180
4	60.5	1830	270

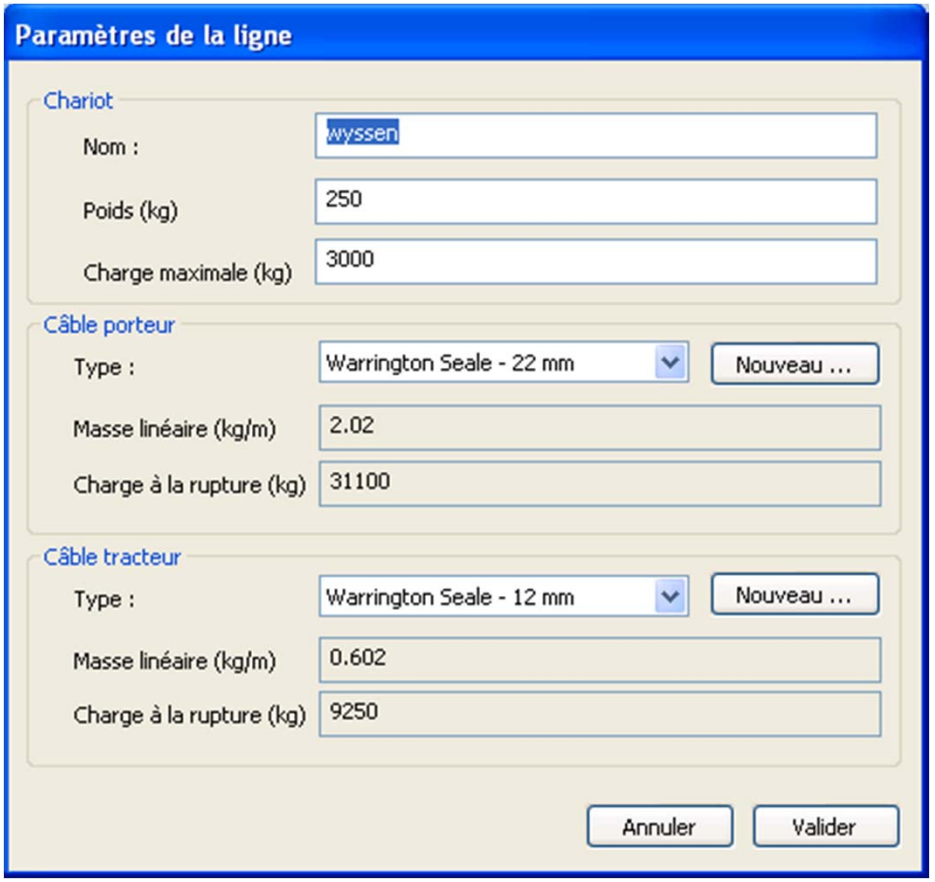


Creation of a profile from paper map 1/25000

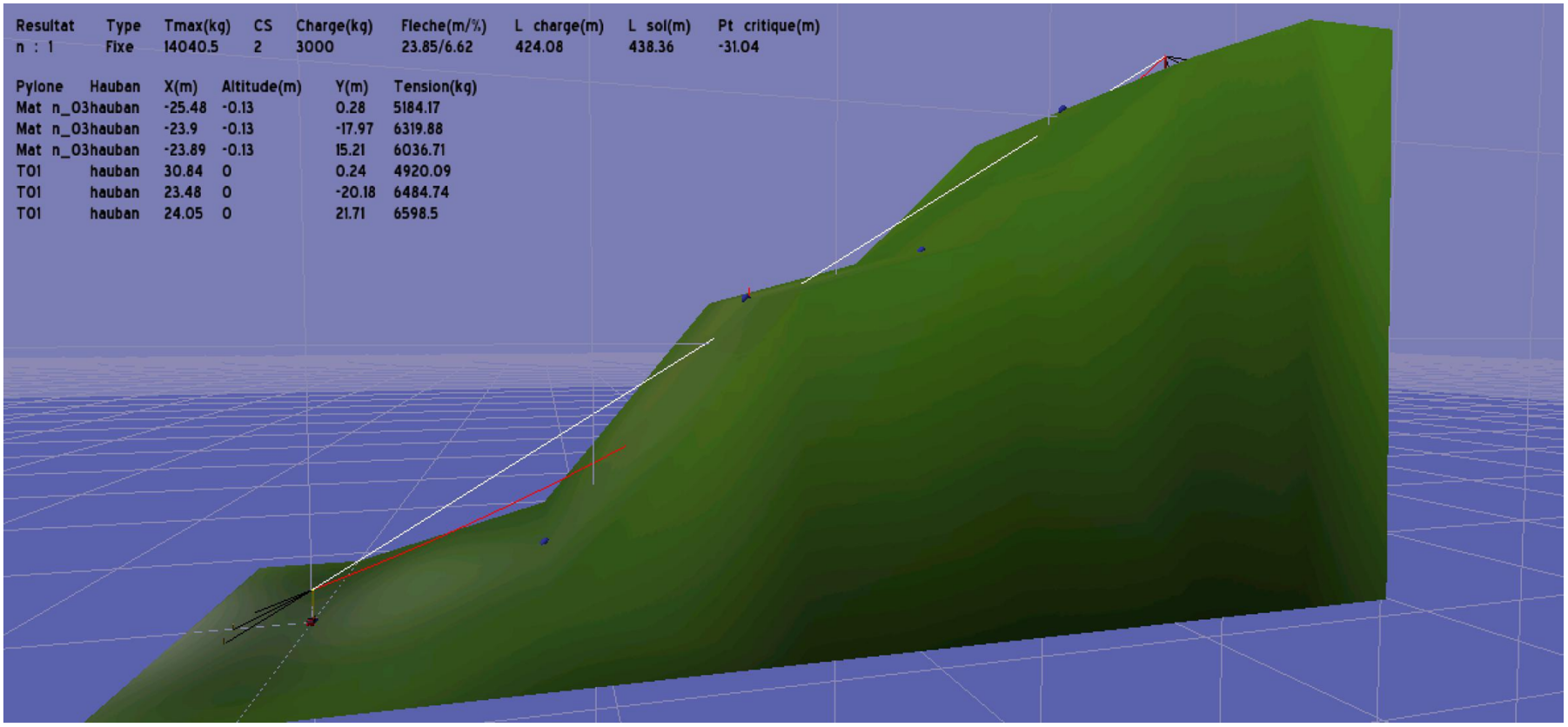
Parameters: cable yarder

- Diameter (mm) of the cable for skyline and mainline
- The rupture resistance
- The carriage: weight and the maximum charge
- Safety factor: minus 1, generally 2
- Height of pylons

The software makes proposition, but the operator can save his own values.



Results 1/4: first visualisation

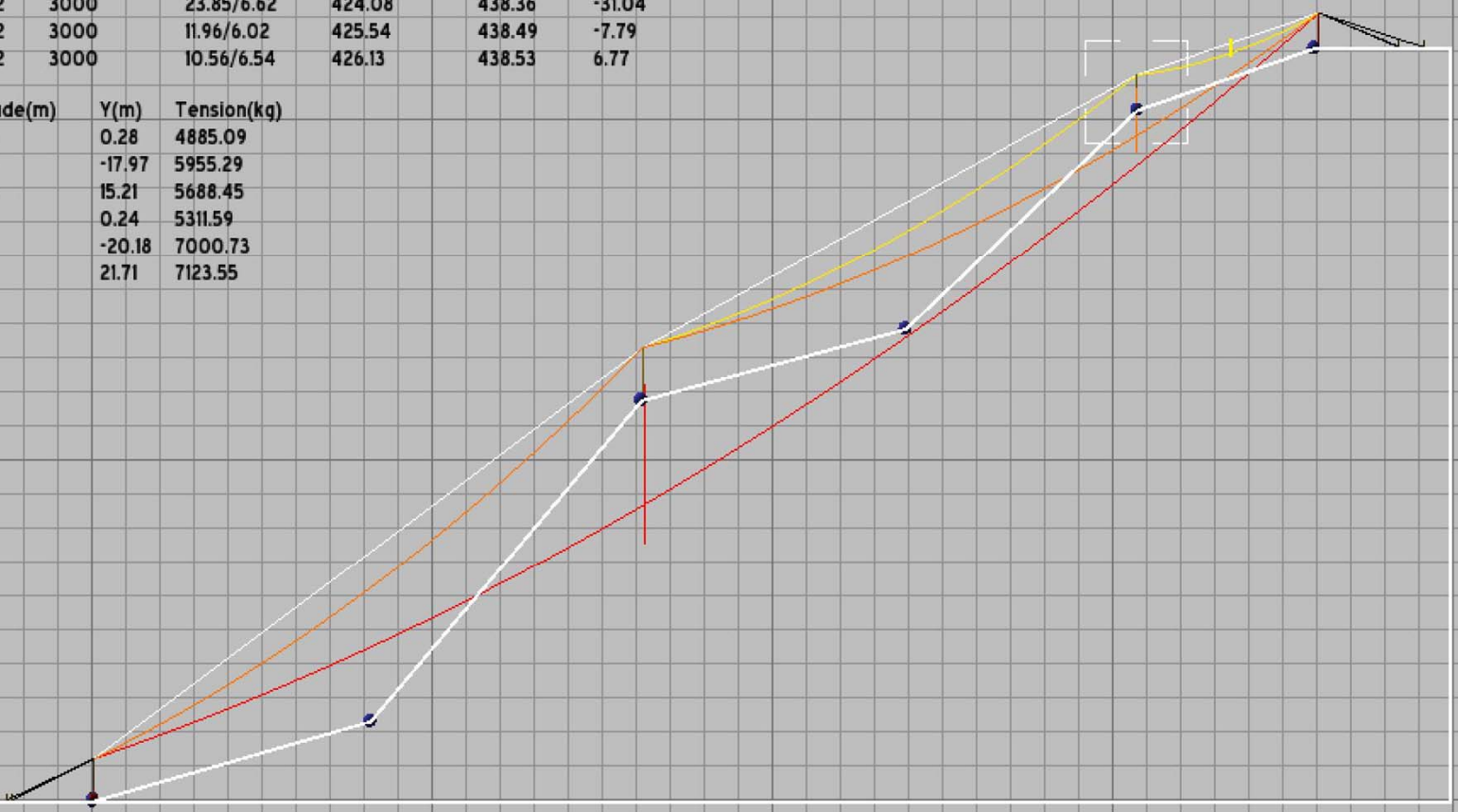


First visualisation (3D) after calculation without pylons

Results 2/4: final visualisation

Resultat	Type	Tmax(kg)	CS	Charge(kg)	Fleche(m/%)	L charge(m)	L sol(m)	Pt critique(m)
n : 1	Fixe	14040.5	2	3000	23.85/6.62	424.08	438.36	-31.04
n : 2	Fixe	14563.5	2	3000	11.96/6.02	425.54	438.49	-7.79
n : 3	Fixe	15157.8	2	3000	10.56/6.54	426.13	438.53	6.77

Pylone	Hauban	X(m)	Altitude(m)	Y(m)	Tension(kg)
Mat n_03	hauban	-25.48	-0.13	0.28	4885.09
Mat n_03	hauban	-23.9	-0.13	-17.97	5955.29
Mat n_03	hauban	-23.89	-0.13	15.21	5688.45
T01	hauban	30.84	0	0.24	5311.59
T01	hauban	23.48	0	-20.18	7000.73
T01	hauban	24.05	0	21.71	7123.55



Final visualisation (2D) after adding 2 pylons

Results 3/4: calculation

- The results of the successive calculations determine:
  - ✓tensions in the skyline
  - ✓Highest and lowest point
  - ✓Length of the line

Results	Type	Tension max (kg)	Safety factor	Charge (kg)	Fleche (m/%)	Length in charge (m)	Length on ground (m)	Critic point (m)	High point (m)
n : 1	Fixe	14040.5	2	3000	23.85/6.62	424.08	438.36	-31.04	21.03
n : 2	Fixe	14563.5	2	3000	11.96/6.02	425.54	438.49	-7.79	38.64
n : 3	Fixe	15157.8	2	3000	10.56/6.54	426.13	438.53	6.77	38.64

The results provide information on how many pylons to preserve and their proper position

Results 4/4: the anchors

- The operator has the possibility of positioning the anchors of the crane and the terminal support
- Not necessary, it can validate the positioning of the anchors in steep terrain

Pylon	Anchors	X (m)	Altitude (m)	Y (m)	Tension (kg)
Mat n°03	Anchors	-25.48	-0.13	0.28	4885.09
Mat n°03	Anchors	-23.9	-0.13	-17.97	5955.29
Mat n°03	Anchors	-23.89	-0.13	15.21	5688.45
T01	Anchors	30.84	0	0.24	5311.59
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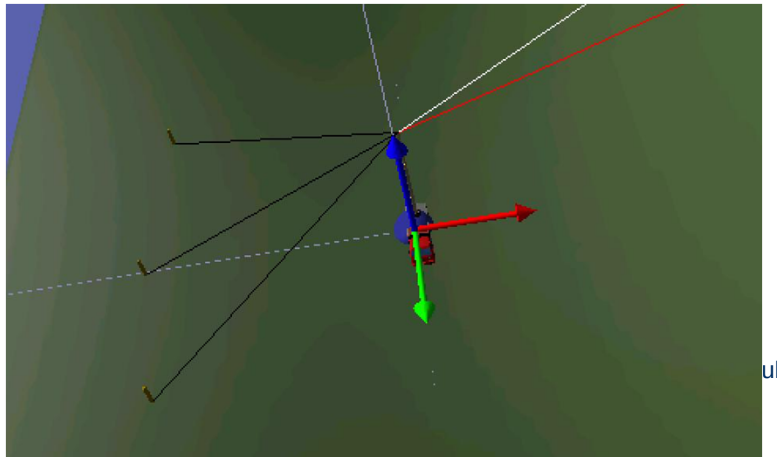

Results and visualisation in the anchors

Conclusion and perspectives

- Helpful for determine the number of necessary pylons and their position
- The cable operator can plan the time for the line implantation, as well as its cost

- Future development or link with research project:
  - Development of a module for running skyline
  - Optimisation of cable line position as near as possible to the intended felling, with the best “yield index” (m^3/linear meter of line)
  - Adaptation to a software for the cost calculation like HEPROMO (WSL, Switzerland)

Conclusion and perspectives

Thank you for your attention