PICO #1.10 – EGU, 21 Apr. 2016

Integration of snow management into a detailed snowpack model

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Why integrating snow management?

Snow on ski slopes highly differ from natural snow
(Fahey et al.,1999; Rixen et al., 2001; Fauve et al., 2002)

Scientists

Impact of current methods
(Howard and Stull, 2014; Hanzer et al., 2014)

Interaction with climate change
(Marke, 2014; Scott, 2003; Steiger, 2010)

Resorts stakeholders

(policy makers, operators)

Investments decision
(Tawöger, 2014; Hopkins, 2013)

Optimization

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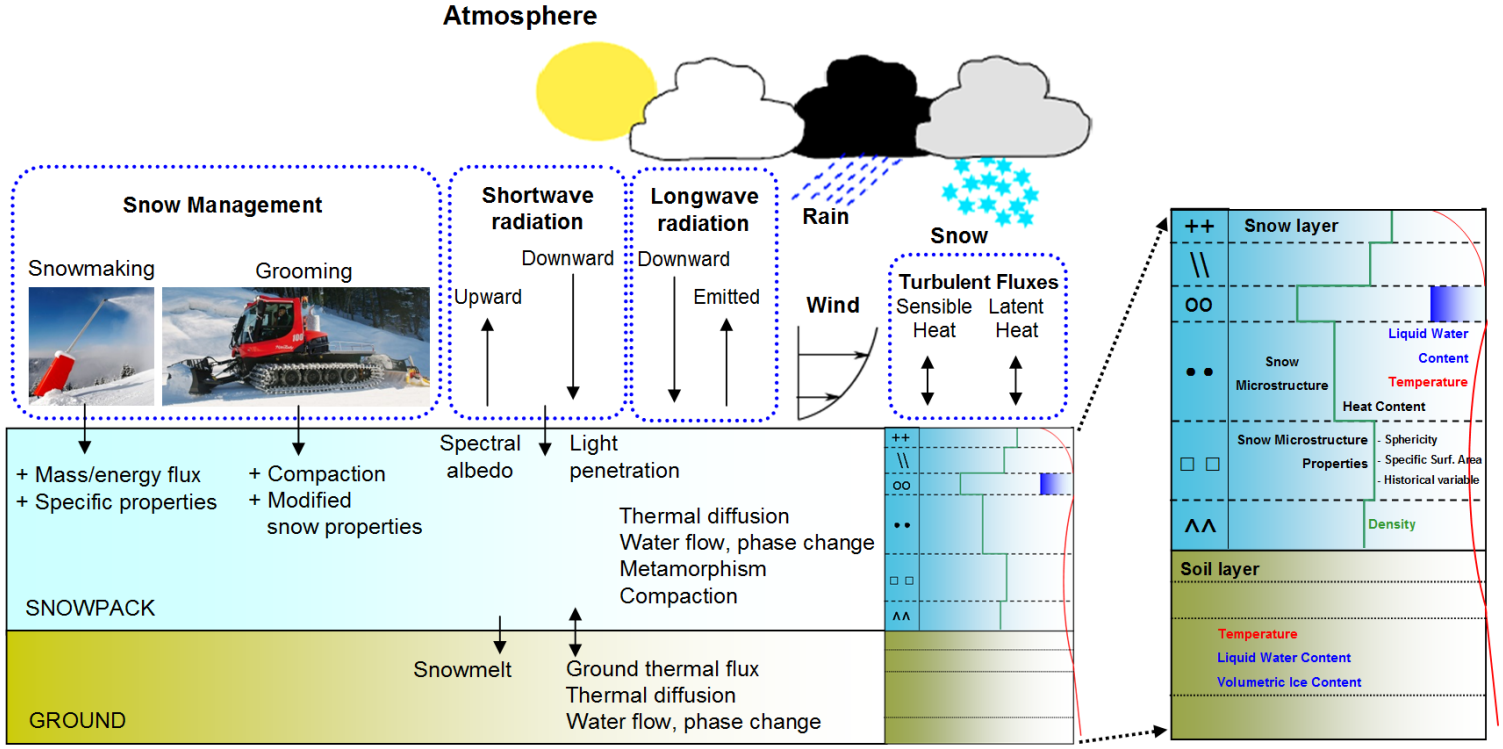
Scheme of the new model « Crocus-Resort »



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Sources of development

- Literature review (Howard and Stull, 2014; Hanzer, 2014; Guily, 1991; Fauve, 2002)
  - ⇒ Modelling approach
  - ⇒ Snow management practices
- Interviews with profesionnals
  - ⇒ Snow management practices
  - ⇒ Observation-based expertise
- Field observations
  - ⇒ Evaluation

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« Integrating snow management processes into a detailed snowpack model »

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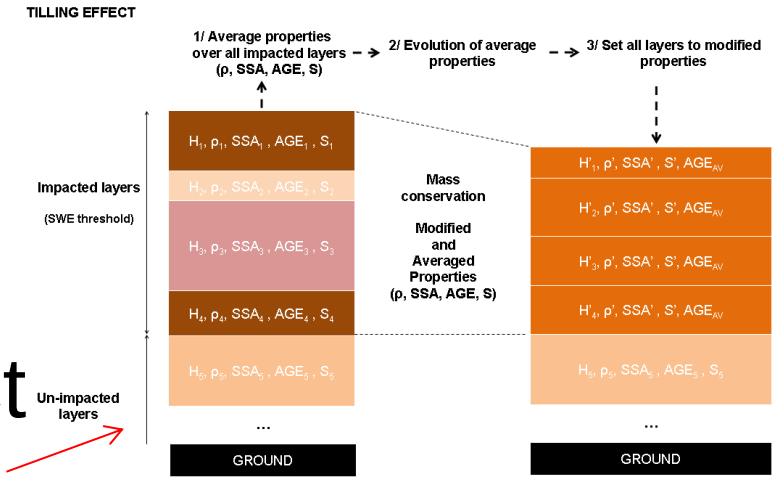
Grooming: physical approach

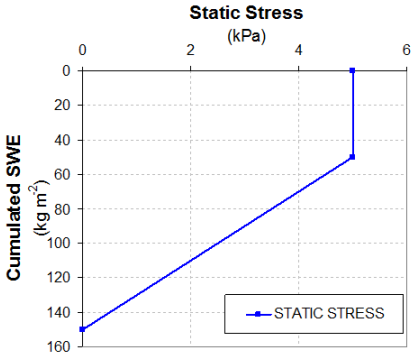
Tiller effect



⇒ **Mixing effect**
⇒ **Densification**
⇒ **Modification of snow microstructure**

Static weight

=> Densification



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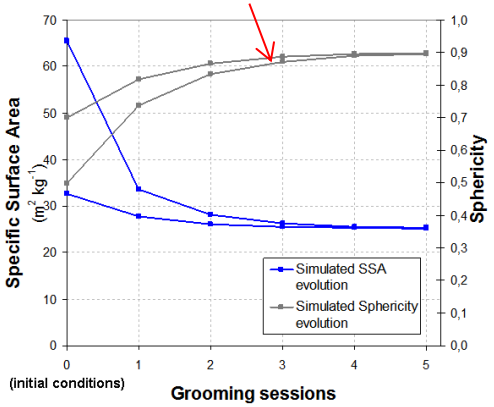

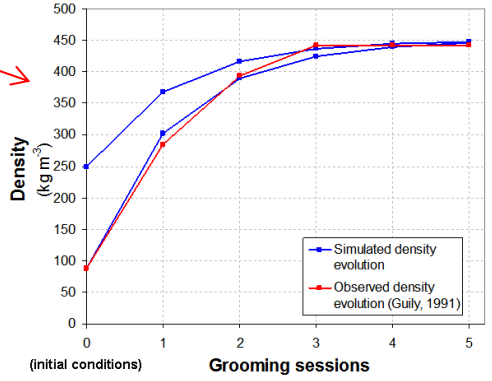

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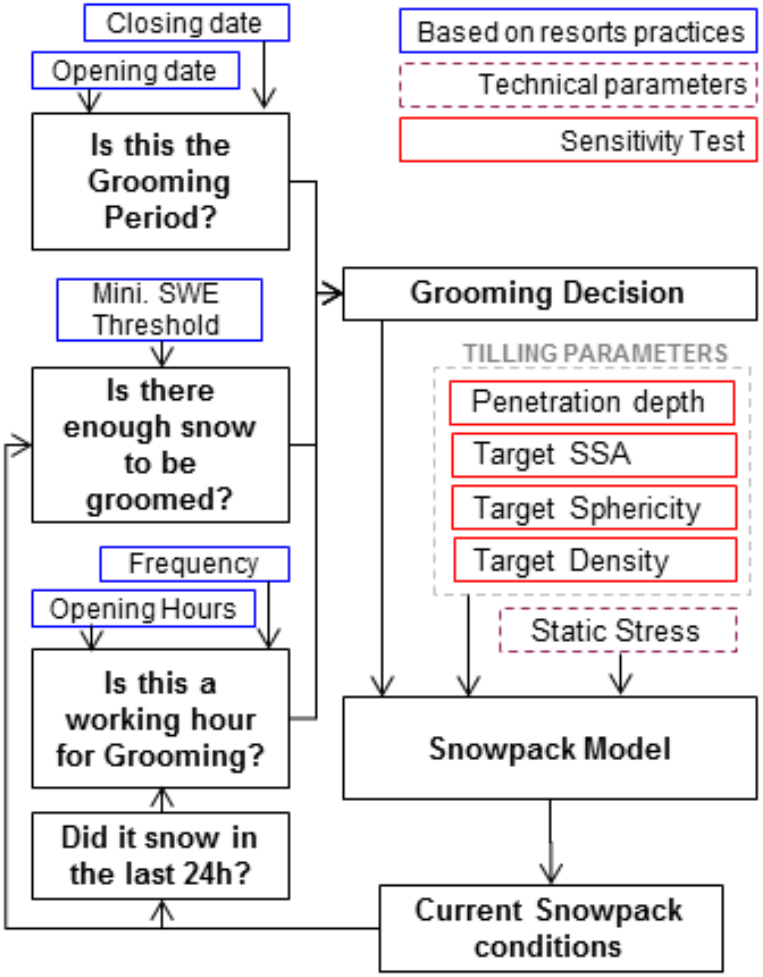
Grooming: practices approach



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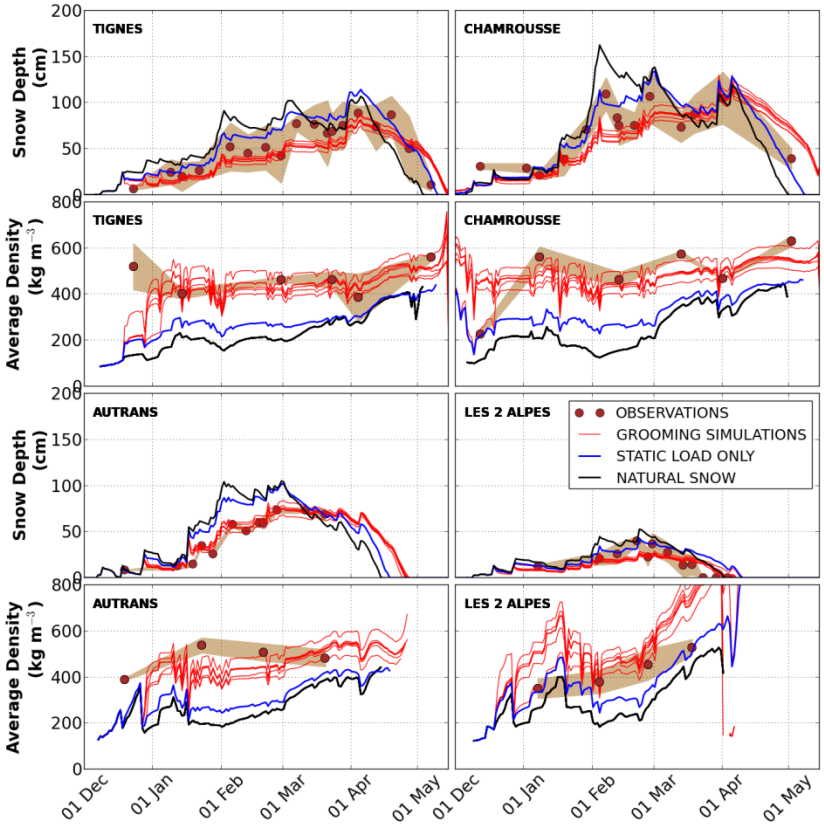
Grooming: evaluation

Stratigraphies

Seasonal evolution



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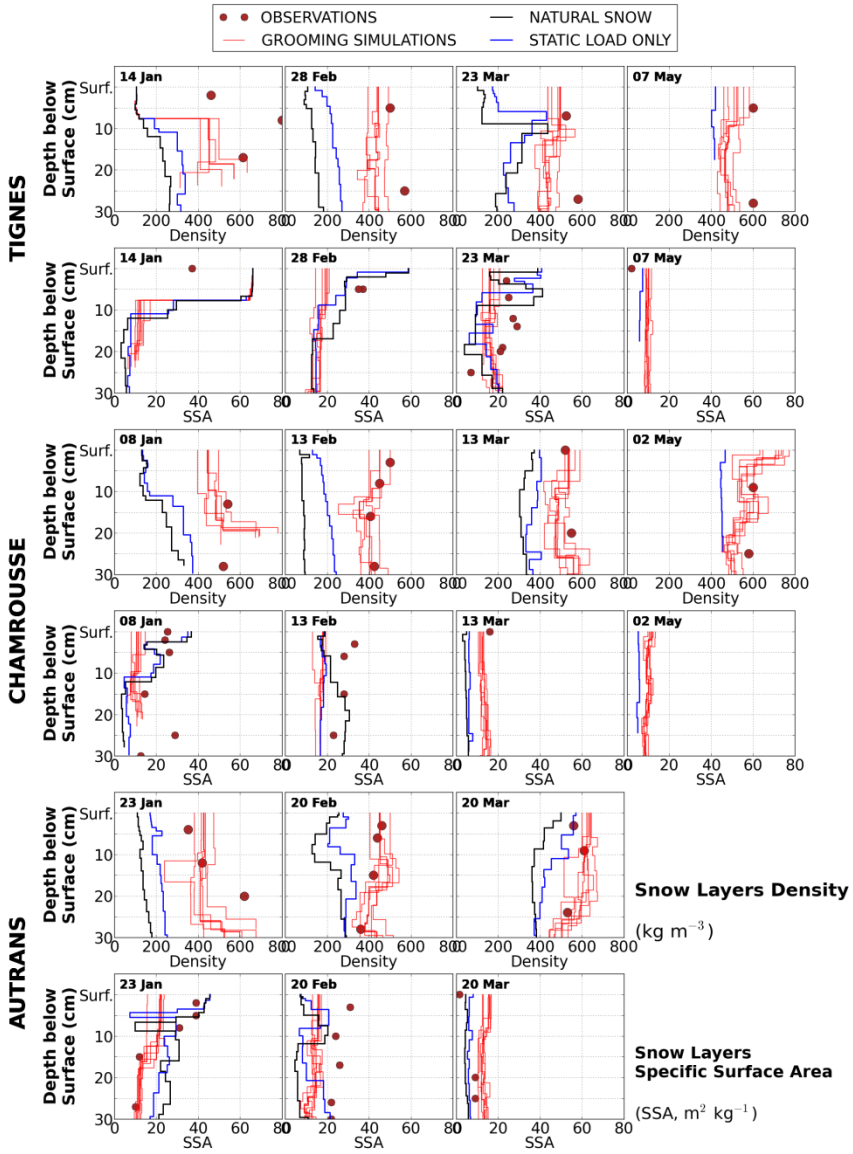

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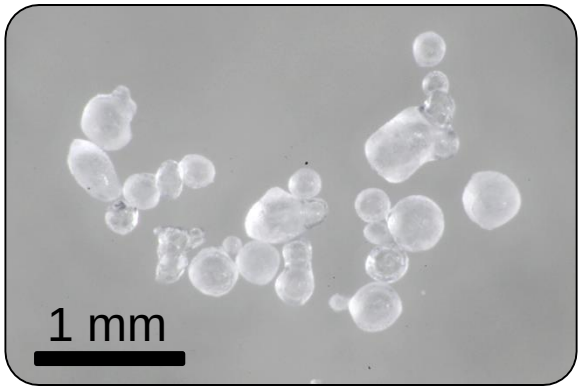
Snowmaking: physical approach

- Initial properties specified
  - ⇒ Density (600 kg/m^3)
  - ⇒ Specific Surface Area (25 m^2 kg^{-1})
  - ⇒ Sphericity (90%)



- Production flow rate specified
- Wet-bulb temperature threshold specified
- Maximum wind speed (4.2 m s^{-1})

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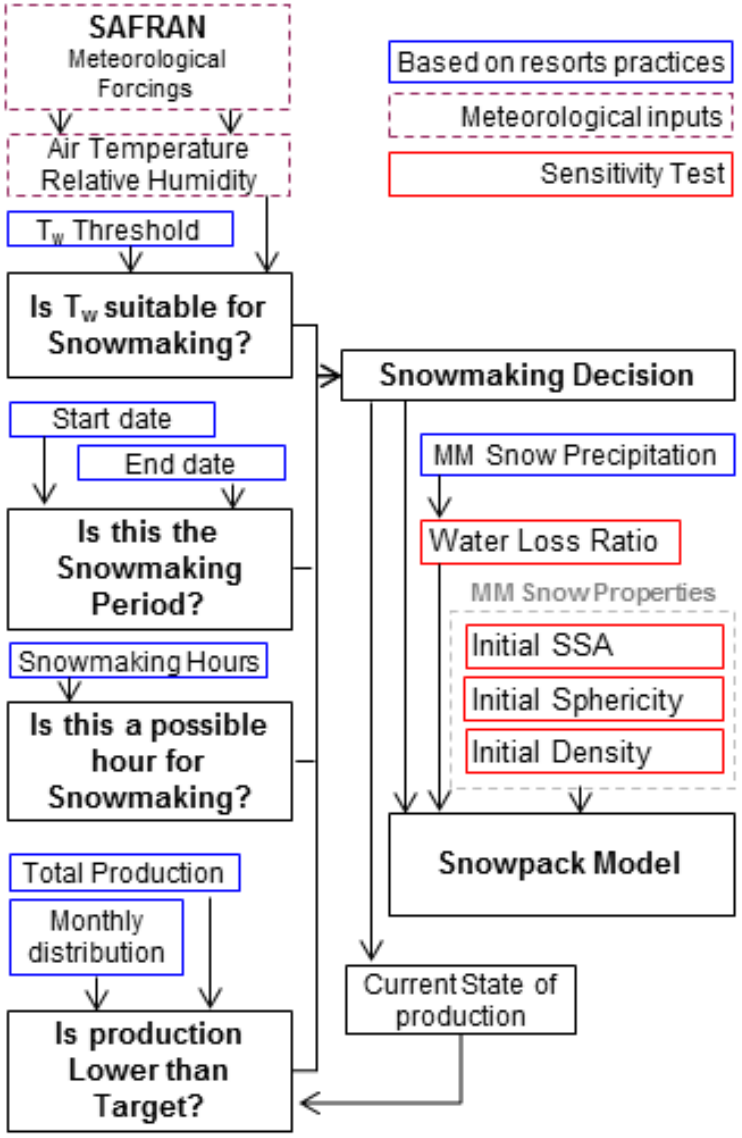
Snowmaking: practices approach



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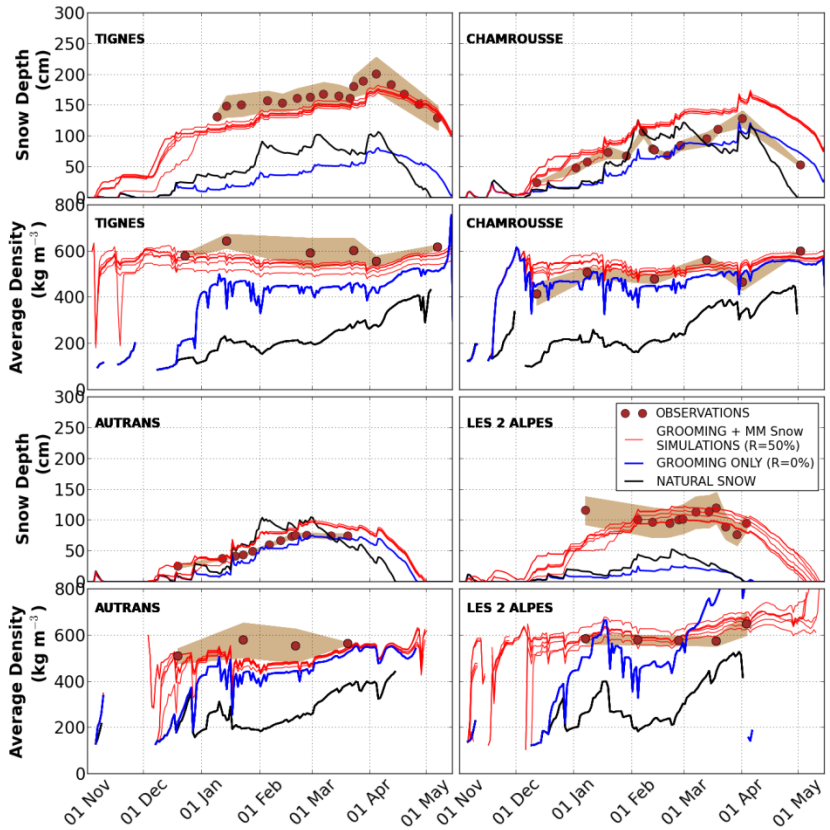
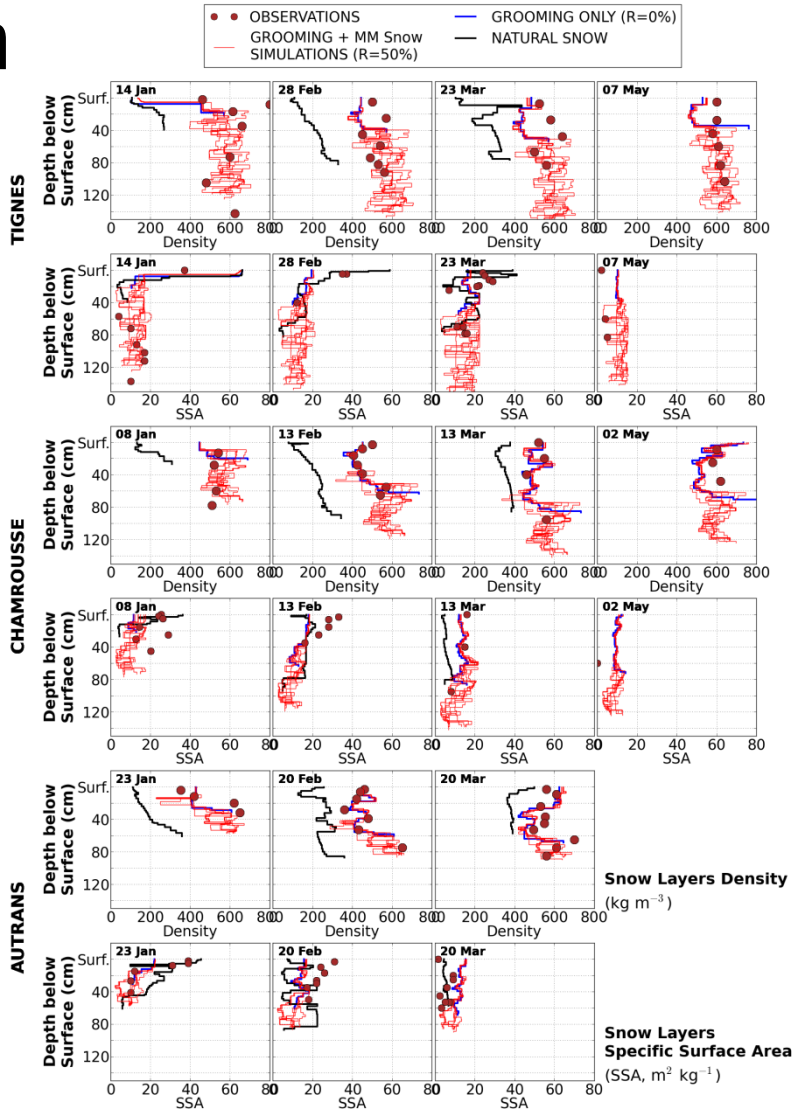
Snowmaking: evaluation

Stratigraphies

Seasonal evolution





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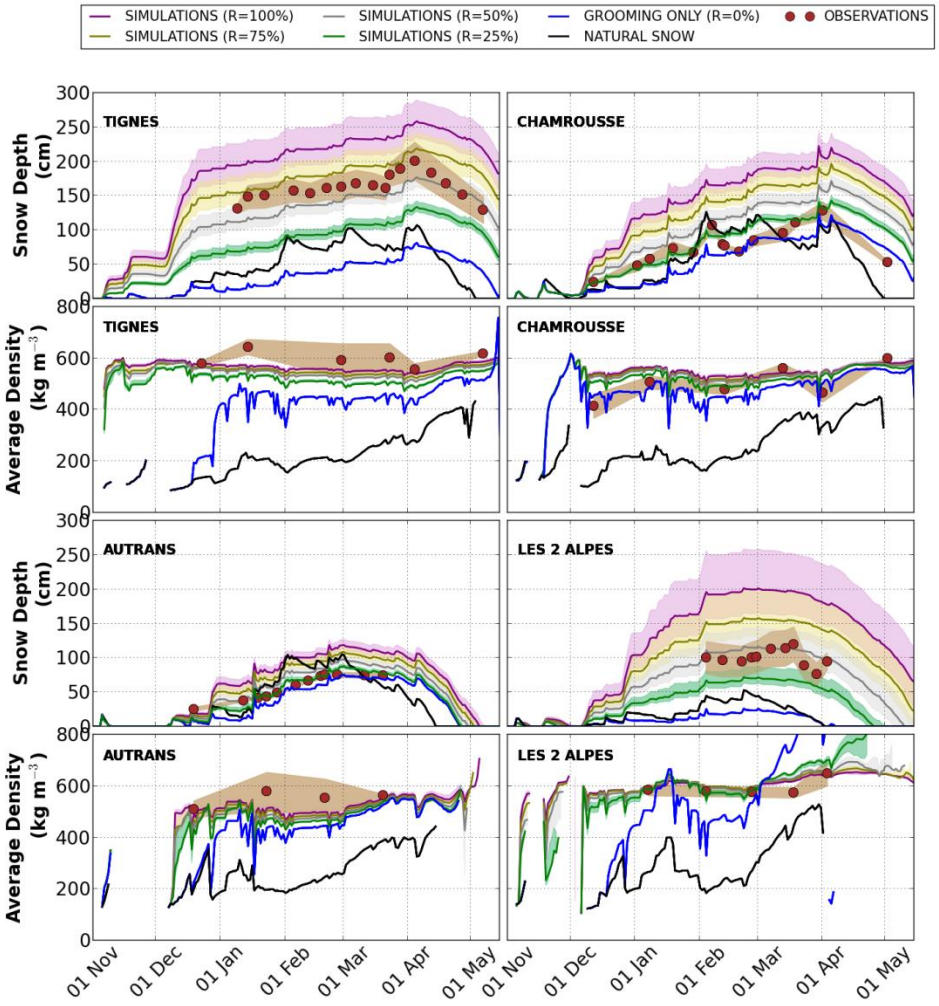
About the uncertainty on water losses…

Seasonal evolution of snowpacks

with R = 100% to 0%
of the total water volume
used by snowmakers



More details on this question
in PICO #1.11

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For more details

Spandre, P., Morin, S., Lafaysse, M., George-Marcelpoil, E., Francois, H., Lejeune, Y., 2016. **Integration of snow management processes into a detailed snowpack model.** Cold Regions Science and Technology doi :10.1016/j.coldregions.2016.01.002

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