Soil Ice Initialization in SURFEX

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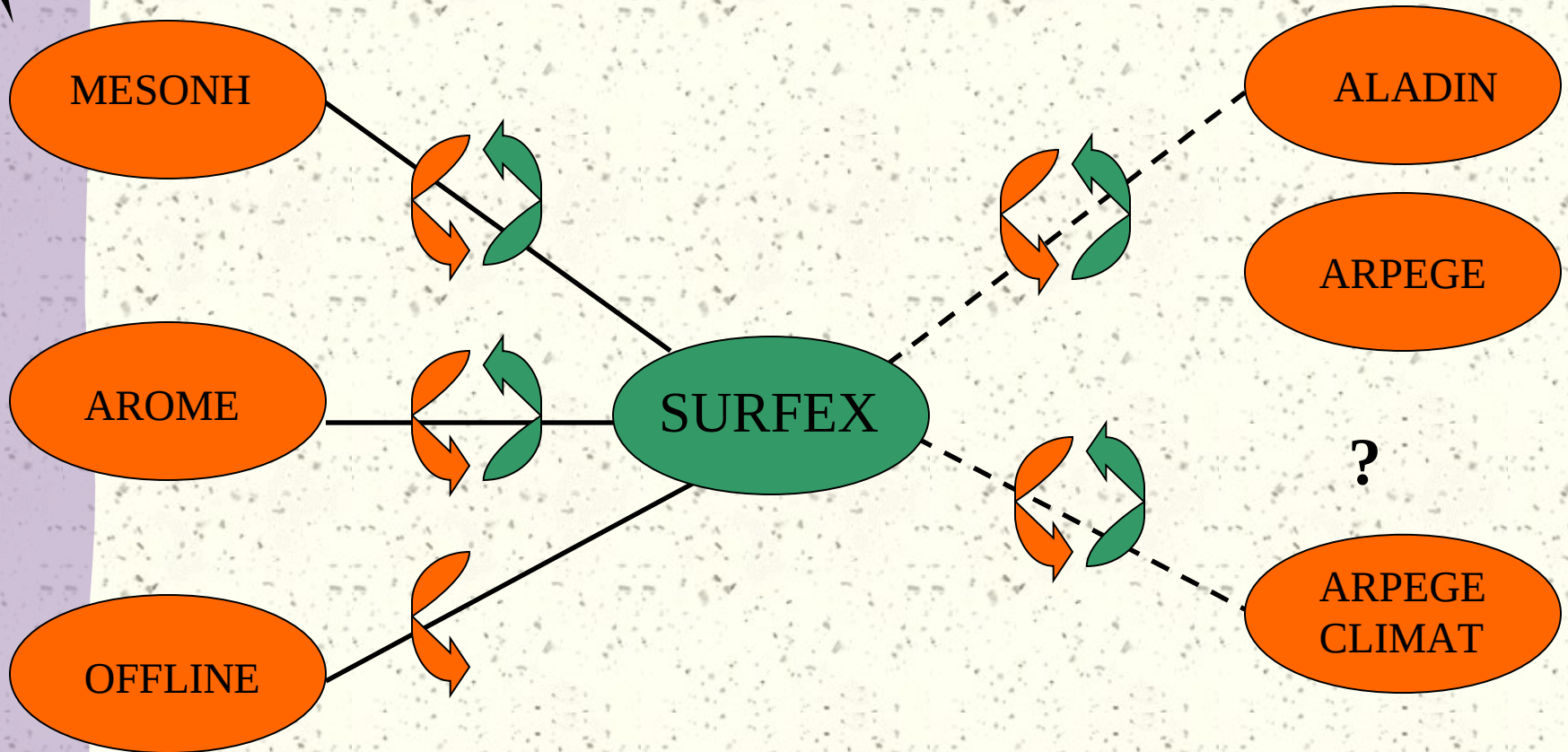
1. SURFEX applications
2. Soil ice initialization

SURFEX applications

MESONH

AROME

OFFLINE

SURFEX

ALADIN

ARPEGE

?

ARPEGE CLIMAT

Soil ice initialization

- Problem :
  - AROME initialization crashed (based on SURFEX PREP tool) on the 17/02/2006 due to soil ice reservoir

- ISBA prognostic variables :
  - Soil temperatures
  - Soil water contents
    - Liquid
    - Ice
  - Interception reservoir
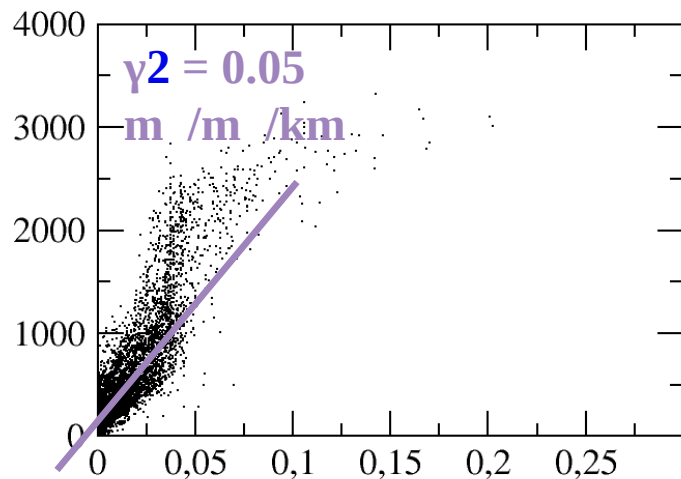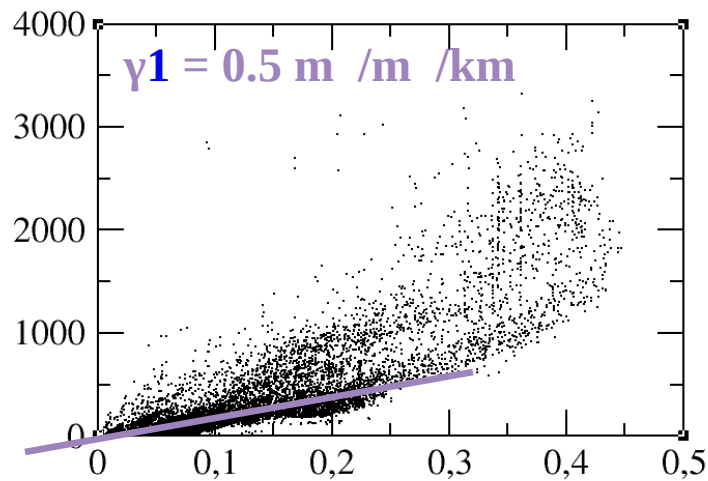 - Snow properties (albedo, density, SWE)

Soil ice initialization

- Proposed solution :
  - Fix the bug !
  - Propose a more physical solution in order to interpolate vertically the soil ice reservoirs from ALADIN (previous method was too empirical)
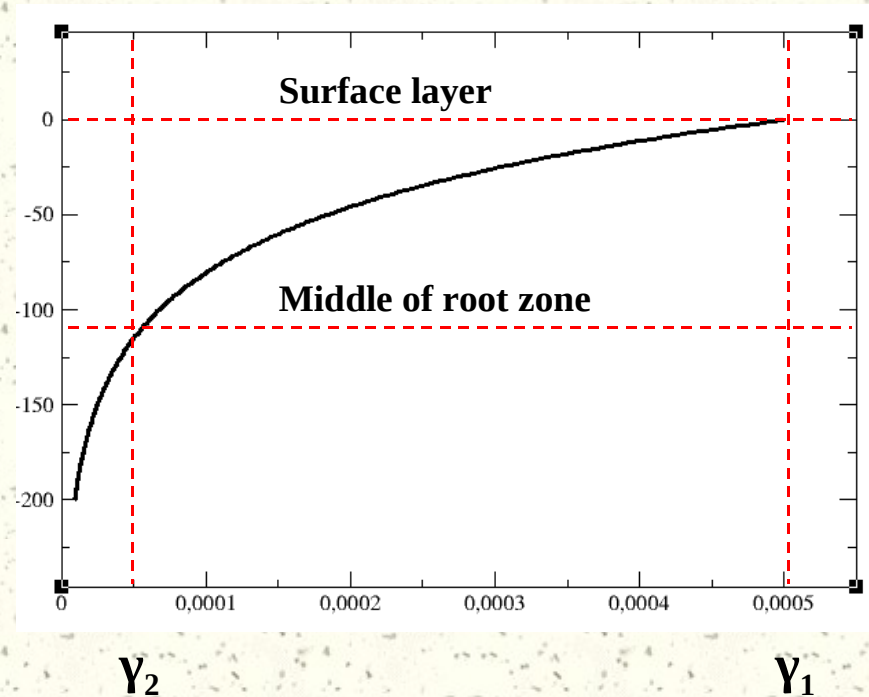
  Introduction of a climatological vertical gradient of the ice water contents.

Ice water contents (superficial and root-zone) obtained from the operational SIM suite from December 2005 to February 2006.
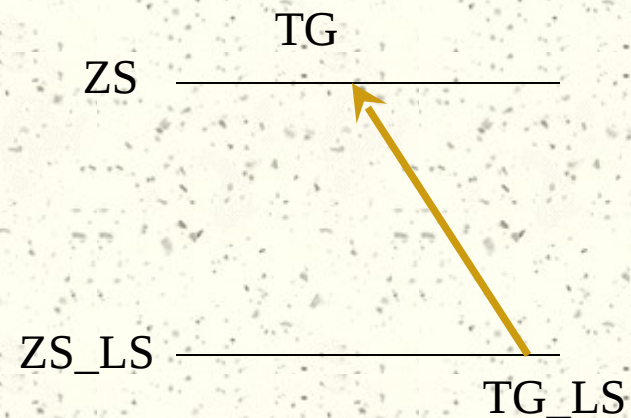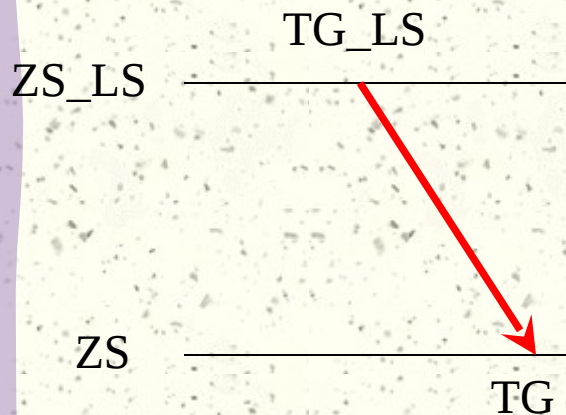
$$\gamma(h) = \gamma_0 \exp(-h/H_0)$$

$\gamma_0 = \gamma_1$ and $H_0 = 0.5\text{m}$

γ1 = 0.5 m /m /km

γ2 = 0.05 m /m /km

Surface layer

Middle of root zone

γ_2 γ_1

Vertical interpolation algorithm for ice water reservoirs

A. Estimation of the temperature profile on target grid for each soil layer and each patch :

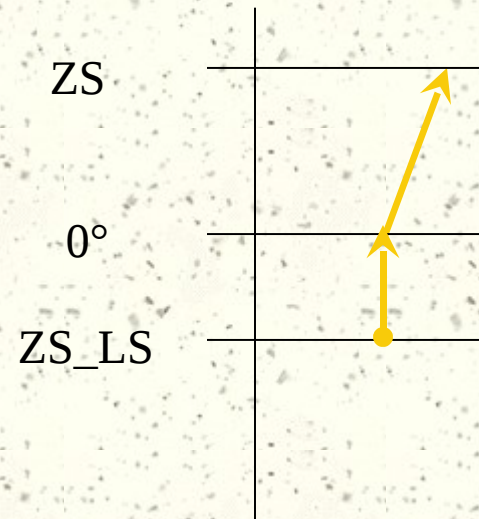$$TG = TG\_LS + \Gamma_T * (ZS - ZS\_LS)$$

A. Additional frozen water Δw when going up

Soil ice : WGI = WGI + Δw   soil liquid : WG = WG - Δw

ZS

ZS_LS

0°

ZS

0°
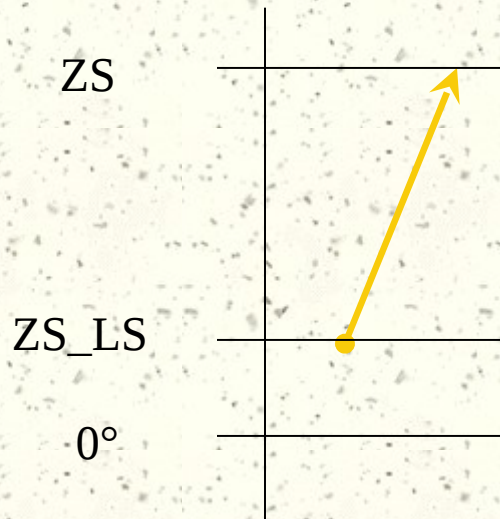
ZS_LS

$\Delta w = \gamma(h) * (ZS - ZS\_LS)$

Continous freezing process

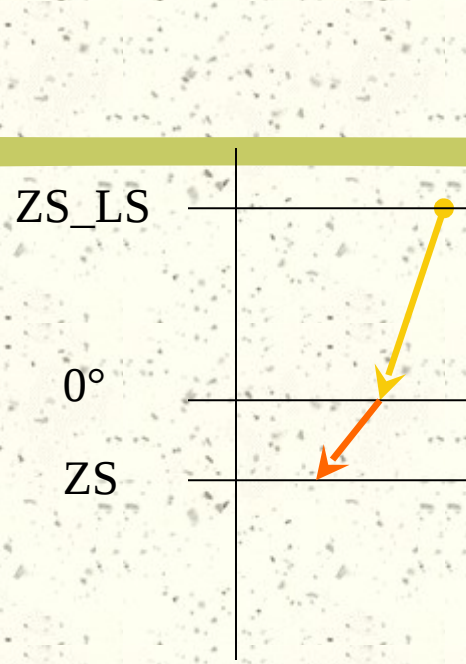$\Delta w = \gamma(h) * (ZS - ZSF)$

Freezing starts at ZSF

Freezing level for soil water : $ZSF = ZS + (XTT - TG) / \Gamma_T$
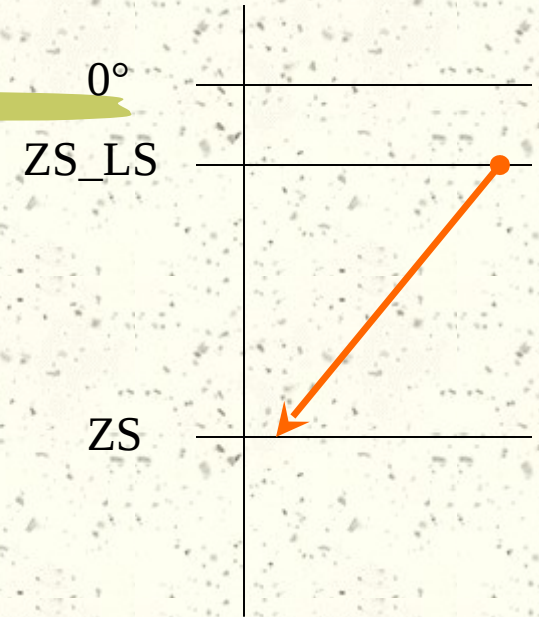
A. Additional liquid water Δw when going down

ZS_LS

ZS

0°

ZS_LS

0°

ZS

0°

ZS_LS

ZS
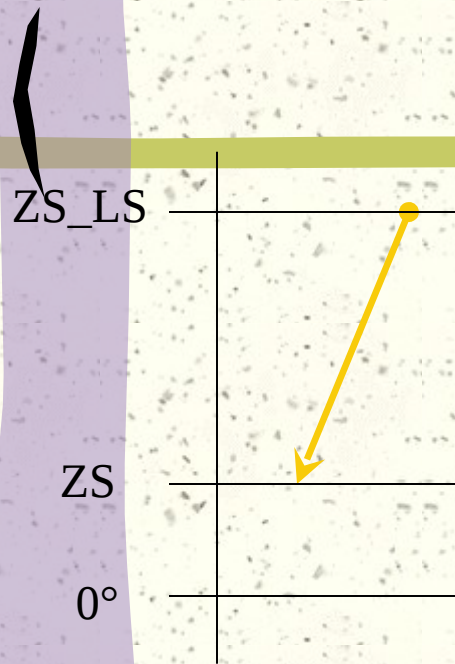
$\Delta w = \gamma(h) * (ZS - ZS\_LS)$

Partial melting of soil ice

$\Delta w = \gamma(h) * (ZSF - ZS\_LS)$

$+ \gamma(0) * (ZS - ZSF)$

Soil ice melting down to ZSF and then rapid melting of the remaining on all layers

$\Delta w = \gamma(0) * (ZS - ZS\_LS)$

If soil ice present with T>0, uniform rapid melting down to ZS

D. Impact of the new vertical interpolation on the superficial soil ice water content
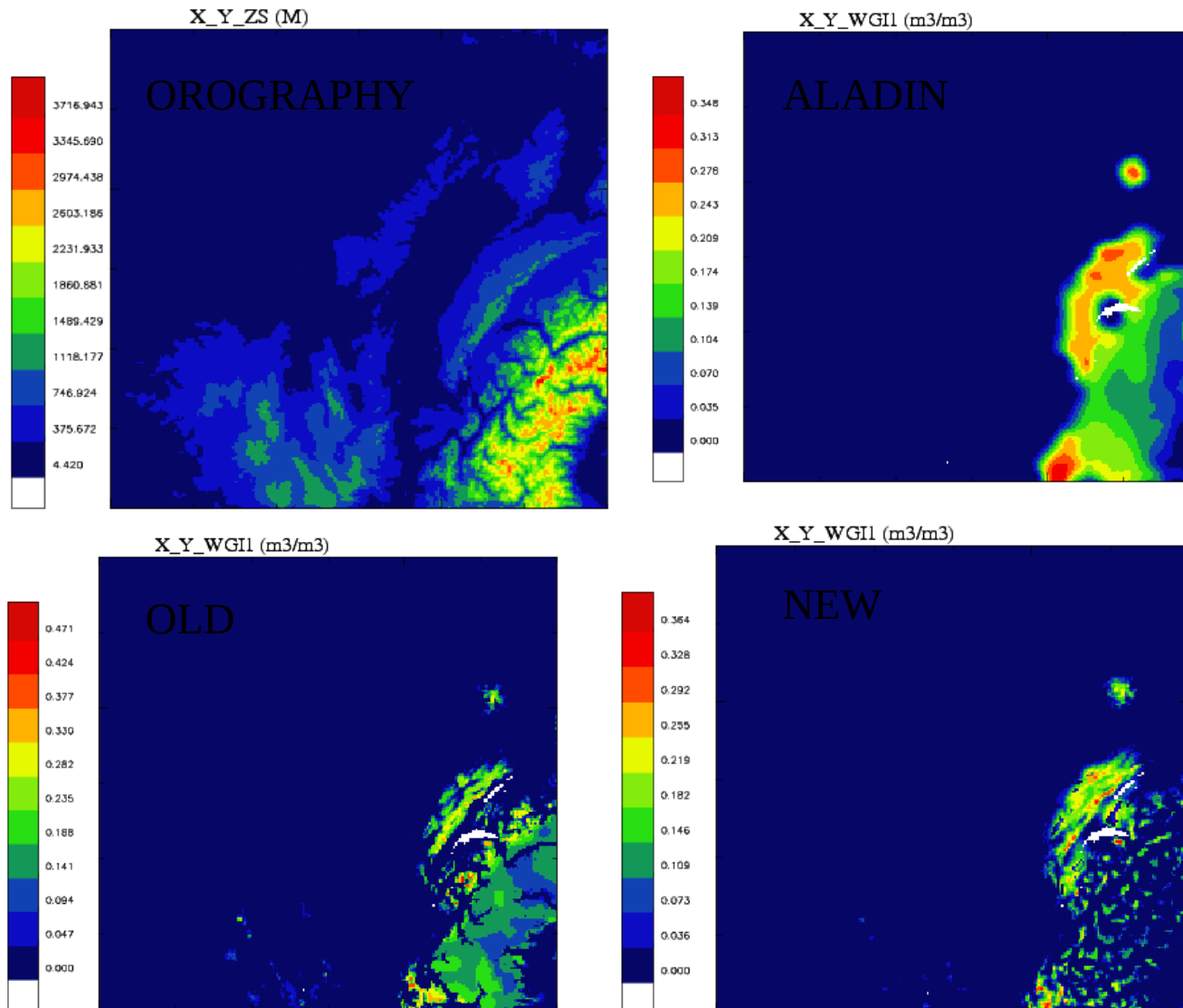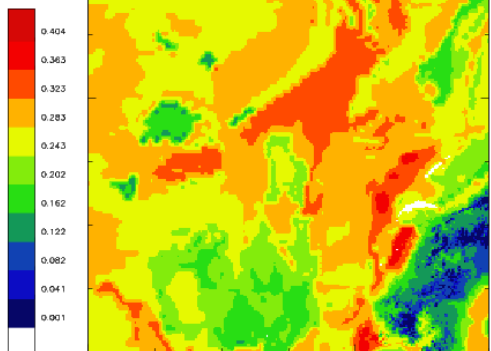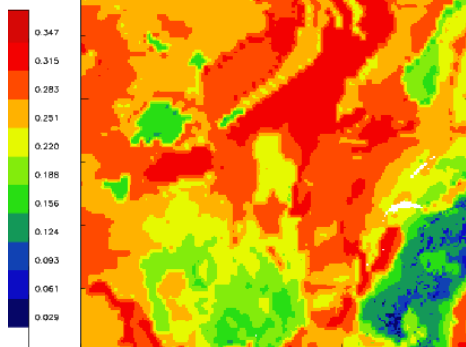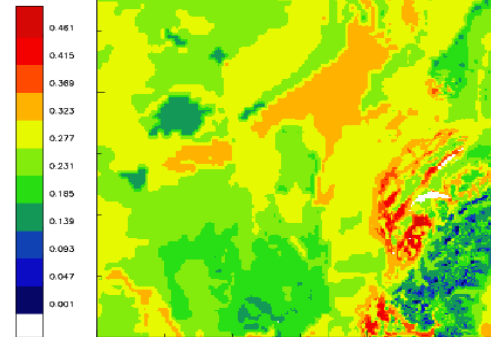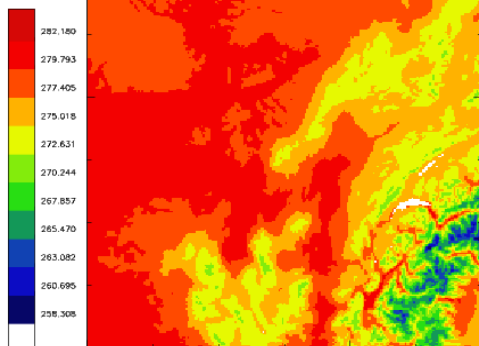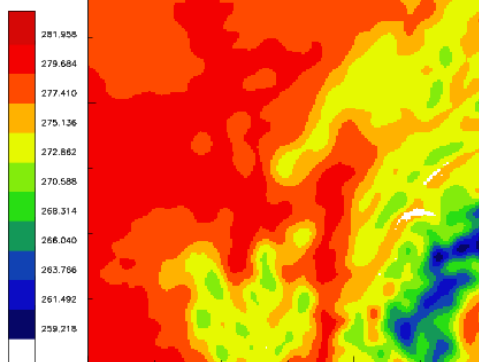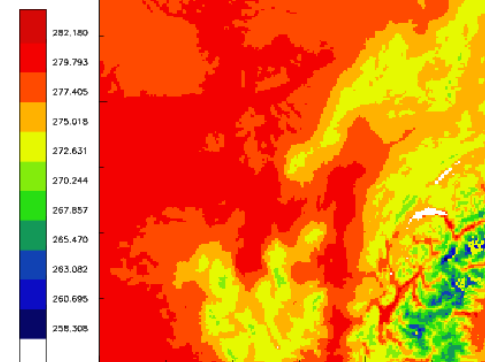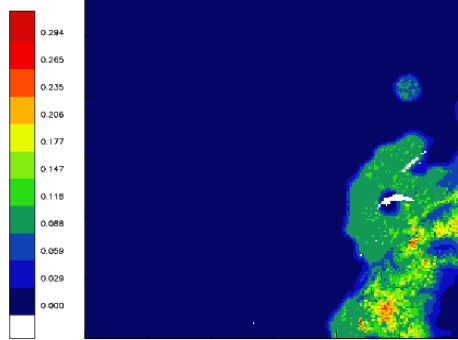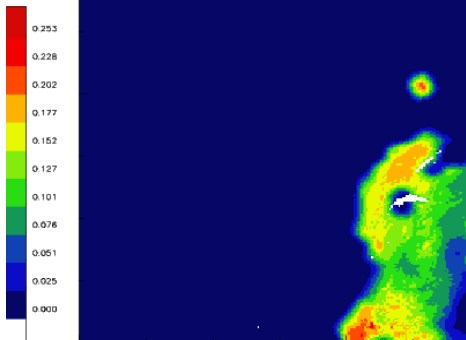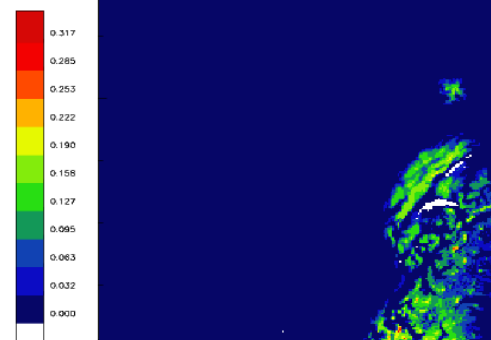
WG

TG2

WGI2

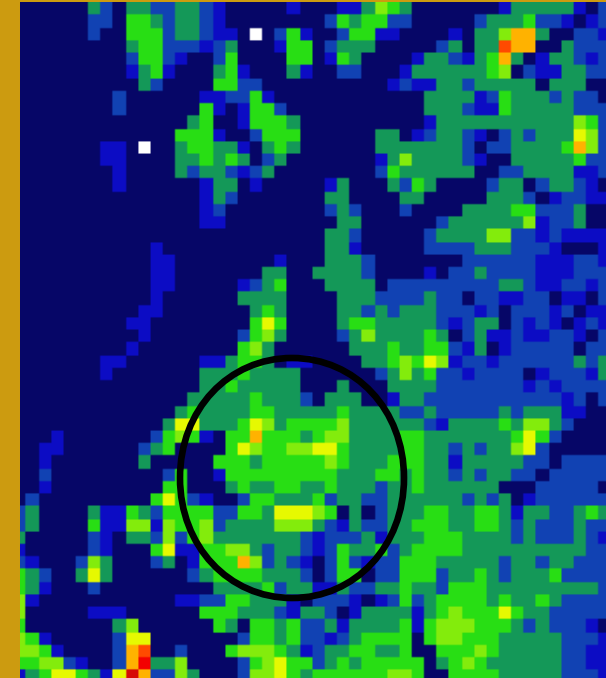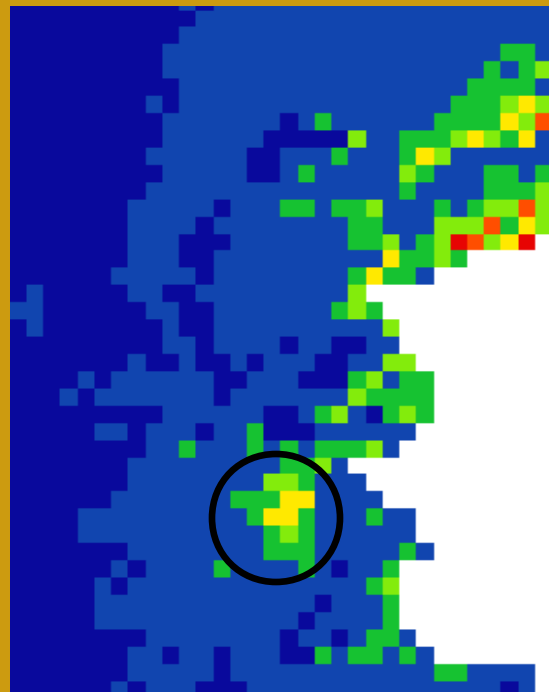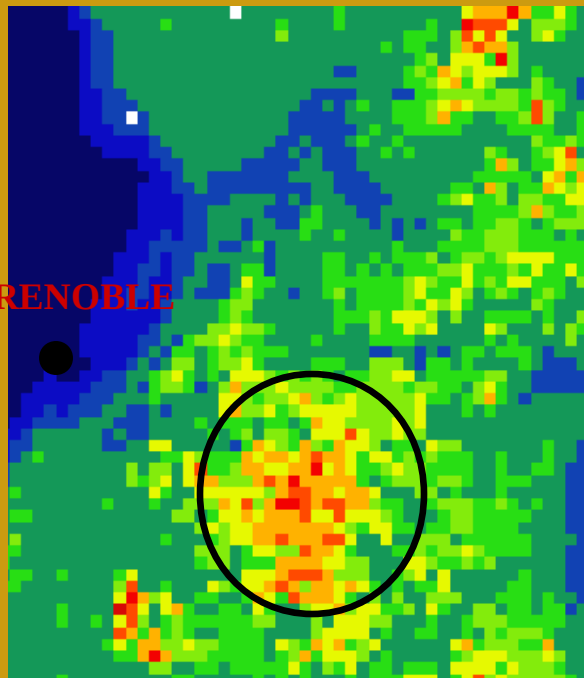E. Impact of the new vertical interpolation on the root zone soil ice reservoir

OLD   SIM - FRANCE   NEW

GRENOBLE

2.5 km   8 km   2.5 km

0.21 m³/m³   0.12 m³/m³   0.13 m³/m³