Developments in SURFEX from CEN

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Developments provided in V9

- One of the first contribution to V9 (July 2018)
  - **Multiphysics** version of Crocus (ESCROC, Lafaysse et al. 2017)
  - Light Absorbing **Impurities** (Tuzet et al., 2017, 2020)
  - **Ski slopes** management (Crocus-RESORT, Spandre et al., 2016 ; Hanzer et al., 2020)
  - SYTRON massif scale **blowing snow** module (Vionnet et al., 2018)
  - MEPRA : **avalanche hazard** diagnostic
  - **MEB-Crocus** coupling

Developments ready in cen branch

- Implementation in SODA of **particle filter** + localisation for **assimilation** of **snow depths** and **optical reflectance** of snow surface. (3 published papers : Cluzet et al., 2021, 2022 ; Deschamps-Berger et al., 2022) (from B. Cluzet 2017-2020)

- **Externalization** of Crocus for coupling with **other surface schemes**. (solution based on partial git clone, dedicated Makefile, and complementary interfaces (from R. Nheili 2018-2021)
  - Already operated in SVS2 (coll. V. Vionnet ECCC)
  - Coupling in progress for FSM2 (coll. G. Mazzotti SLF)
  - Coupling planned for MAR (coll. C. Agosta, LSCE)

  → Currently reviewing possible Crocus adaptations for **Arctic snow** → should lead to a future contribution

- Various **numerical optimizations** of Crocus (from R. Nheili 2018-2021)
  + **cleaning** of snow3L_isba (ski slopes management)

- Optional netcdf4 **compression** (compression level in namelist)

- Change **Crocus tests** in **STRATO** for more realistic configurations and reduced number of tests. (from M. Fructus)

- Our branch is **merged with Meso-NH contribution to V9** (from M. Fructus)
  (explicit blowing snow though Méso-NH Crocus coupling)

Developments in progress in cen_dev branch

- All current developments designed to fill the Météo-France objective of a new snow modelling system at 250 m over all French mountains **before 2026** (with appropriate processes and assimilation)

- SnowPappus : new **blowing snow module** for **hectometric scale 2D simulations**.
  (PhDs Ange Haddjeri and Matthieu Baron ; 2020-2023)
  - Parameterizations of snow particles concentration profiles in the first meters of atmosphere
    - horizontal snow transport flux
      - Upwards divergence scheme to compute erosion / deposition
        → **MPI communications in snow routines**

- Corrections in Crocus **metamorphism** and grain type diagnostics
  (errors in Carmagnola et al. 2014 corrected by M. Baron)

- Ice formation when **freezing rain** (Quéno et al., 2018)

- Reduction of spectral resolution in **Tartes** optical scheme (M. Fructus)

- Planned in 2022 : use of **XIOS** for Crocus outputs (M. Fructus)

- Planned in 2022 : **new assimilation variables** in SODA Particle Filter
  (Snow Cover Fraction, Wet Snow binary product) (E. Cap, A. Haddjeri)

- Planned in 2022 : improvements of MEB-Crocus ? (G. Mazzotti, A. Bouchet)

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