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Assimilation of snow in Hirlam and other models

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General

Snow variable in numerical models

- **Snow water equivalent (SWE)**
- **Density etc**

Snow variable in Synop observation

- **Snow depth (SD)**

In climate models

- **Snow amount increases by snow fall and snow melts**

In weather forecast models (initial value problem)

- **Snow amount increases by snow fall and melts**
- **Snow is analysed**



Snow analysis in NWP models

- **$SWE(an) = SWE(fg) + \Delta SWE(obs)$**
 - Fg normally is short forecast
- **$SWE(fg) \implies SN(fg)$**
 - Density of snow modelled in some way
- **Analysis in SN**
 - Optimal interpolation or Cressman correction method
 - In Hirlam only Synop observations
- **$SN(an) \implies SWE(an)$**



Features of snow analysis

- **Density of snow**
 - Depends only on time (month), Hirlam reference
 - Depends on the age of the snow, Hirlam new surface scheme
- **Orography effect**
- **Analysing of snow edge**
 - Problematic because the Synop observations do not report 0 cm snow
 - ECMWF uses satellite information (snow/not snow)
 - IMS NOAA/NESDIS real-time snow cover



Development of snow analysis in Hirlam

- **Adding more observations**
 - **IMS NOAA/NESDIS real-time snow cover**
 - **GlobSnow and (hydro)SAF**
- **To be considered**
 - **snow/no-snow data: pseudo observations to be able to detect the snow edge**
 - **GlobSnow**
 - **SWE or SD?**
 - **Analysis or interpolation (double penalty)**