Hydrology Exercises

Part 1:

Conceptual Hydrological Model Exercise on RTC

a) Basic understanding and implementation by sequential filtering techniques

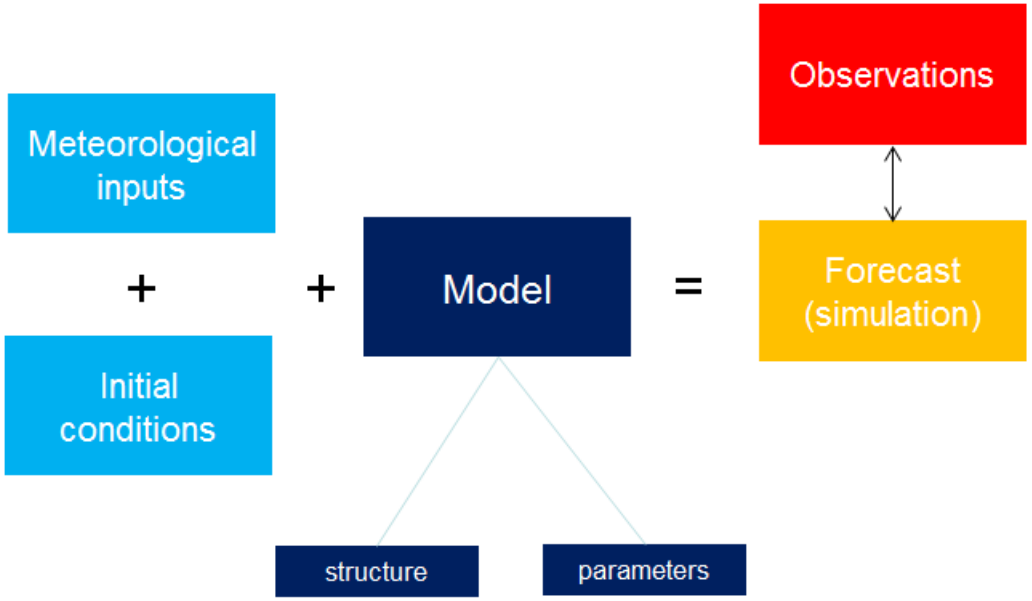
b) Basic understanding and implementation by variational assimilation techniques

Part2:

HyS 2.0 Model Exercise

How to produce a forecast

Aim of DA is not to compensate for biases, but to improve initial conditions for forecasting!



Uncertainties EVERYWHERE!!!

Part 1:

Conceptual Hydrological Model Exercise on RTC

a) Basic understanding and implementation by sequential filtering techniques

Preliminary tasks: MINIMIZE COST FUNCTION

SnowSim = 10cm

SnowObs = 14cm

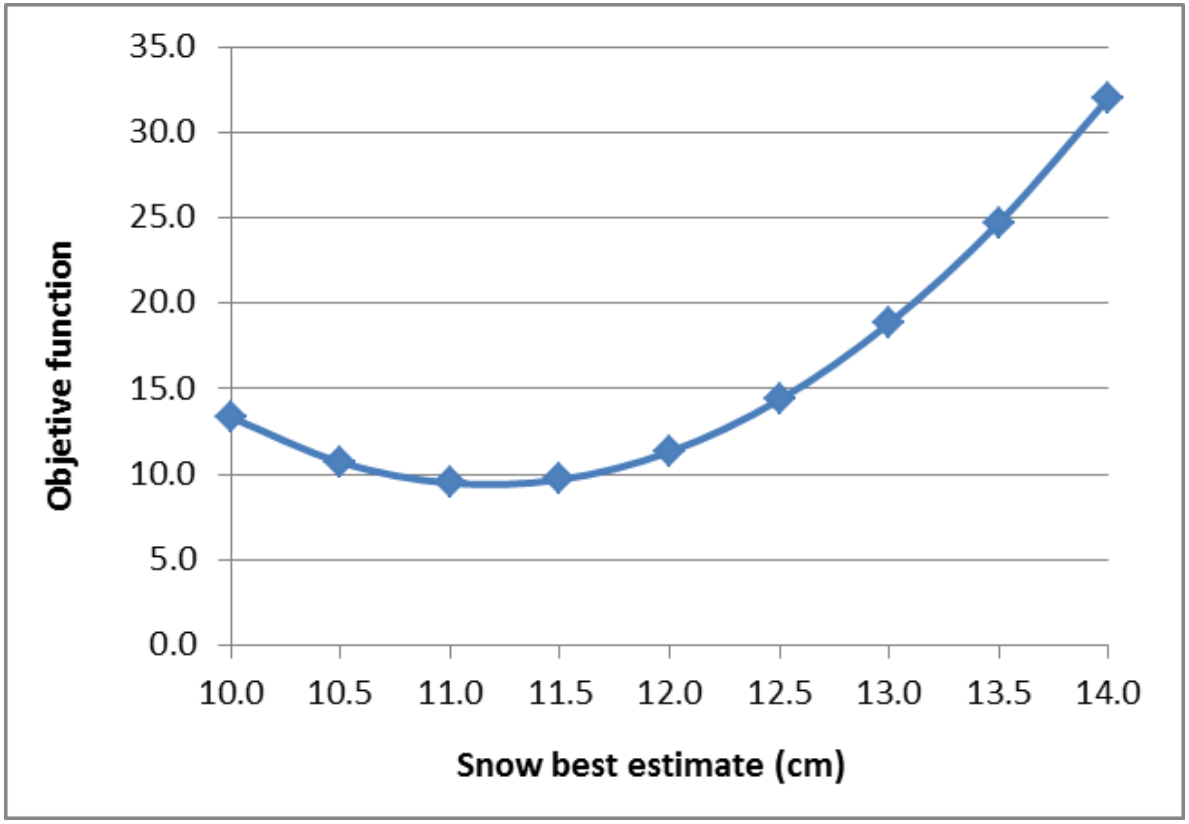
SnowSim variance = 1.2 cm2

SnowObs variance= 0.5 cm2.

$$J = \frac{(\text{Obs} - \text{True})^2}{\sigma_{\text{Obs}}^2} + \frac{(\text{Sim} - \text{True})^2}{\sigma_{\text{Sim}}^2}$$

Least-squares approach

Find “True” that minimizes J

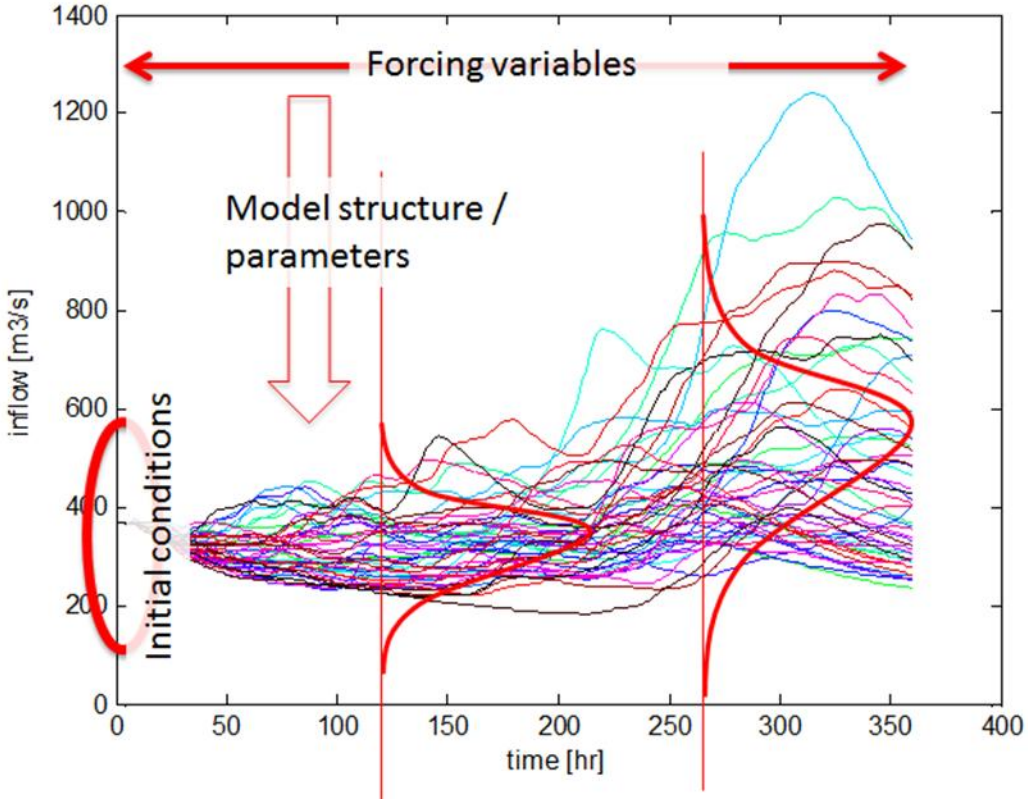


Part 1:

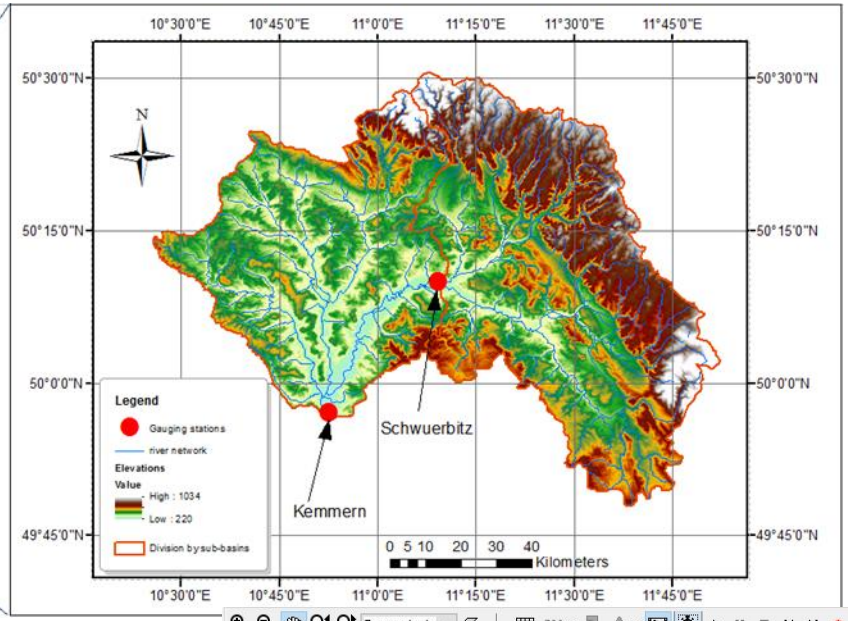
Conceptual Hydrological Model Exercise on RTC

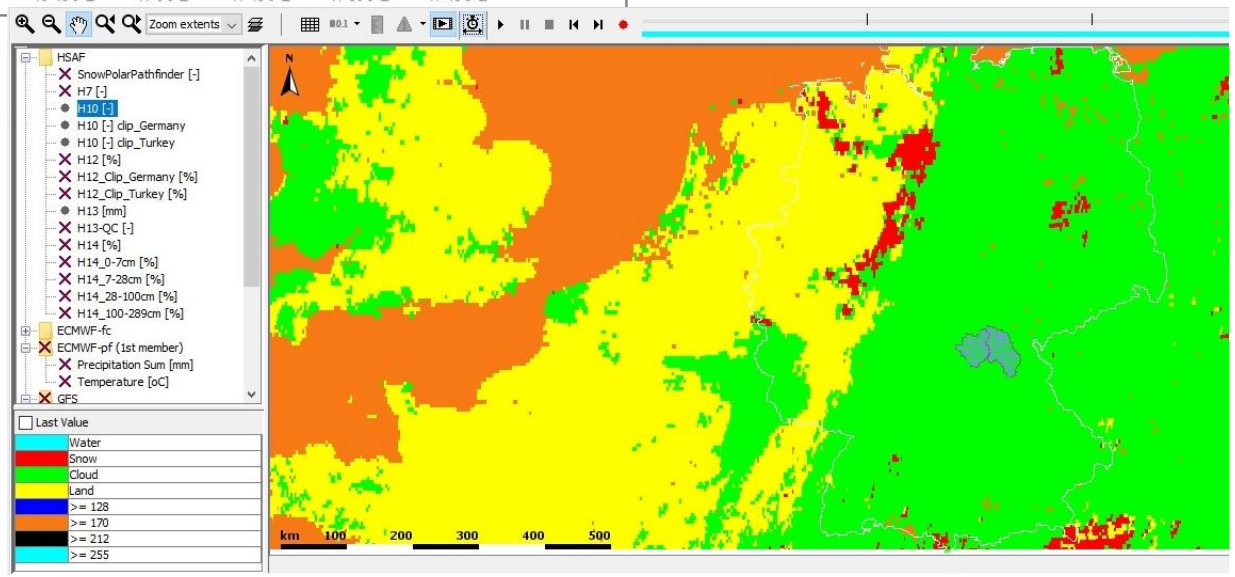
a) Basic understanding and implementation by sequential filtering techniques

Ensemble Kalman Filter (EnKF) formulations



Practical Exercise in FEWS





Result of Comparison between variational and sequential approach

4DVar:

+ simultaneous technique over several time steps
+ suitable for reanalysis
- requires first-order sensitivities, i.e. adjoint code, and preferably a smooth model
- deterministic approach

Ensemble KF:

+ applicable on black-box models, simple to implement
+ probabilistic approach
- sequential technique, has issues with time lags

Part 2 – Cal/Val Exercise in HyS

Reminder: The HyS equations

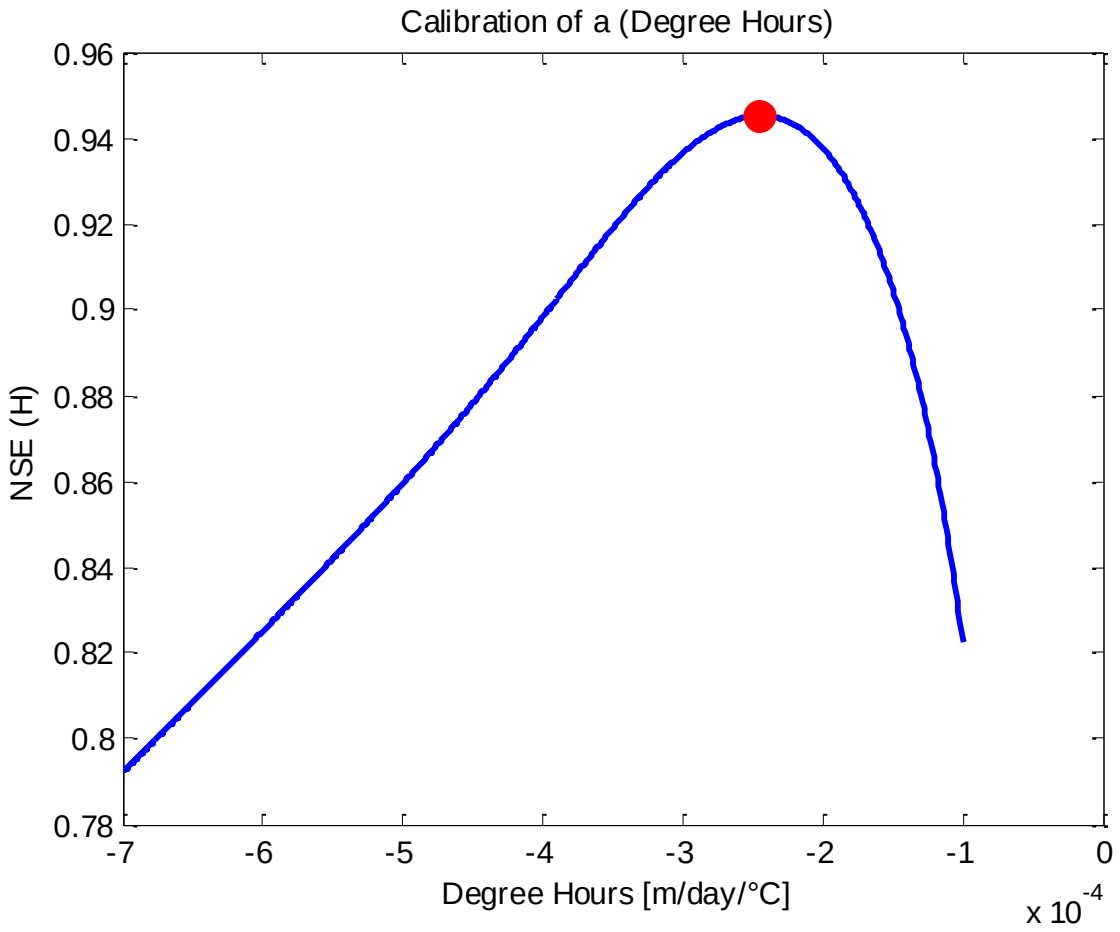
$$\begin{cases} \dfrac{\mathrm{d}h_\mathrm{S}}{\mathrm{d}t} = -\dfrac{h_\mathrm{S}}{\rho_\mathrm{D}}\dfrac{\mathrm{d}\rho_\mathrm{D}}{\mathrm{d}t} + \dfrac{\rho_\mathrm{F}}{\rho_\mathrm{D}}s - I\left[a\,(T - T_\tau)\right] \\ \dfrac{dh_W}{dt} = p + \dfrac{\rho_D}{\rho_W} I\left[a\,(T - T_\tau)\right] - \alpha \cdot K_W \\ \dfrac{\mathrm{d}\rho_\mathrm{D}}{\mathrm{d}t} = c_1 h_\mathrm{S} \rho_\mathrm{D}^2 e^{(0.08(T_\mathrm{S} - T_\tau) - 0.021\rho_\mathrm{D})} + \dfrac{(\rho_F - \rho_\mathrm{D})}{h_\mathrm{S}} s. \end{cases}$$

Only one parameter ”a”, calibrated using the Least Square Method.

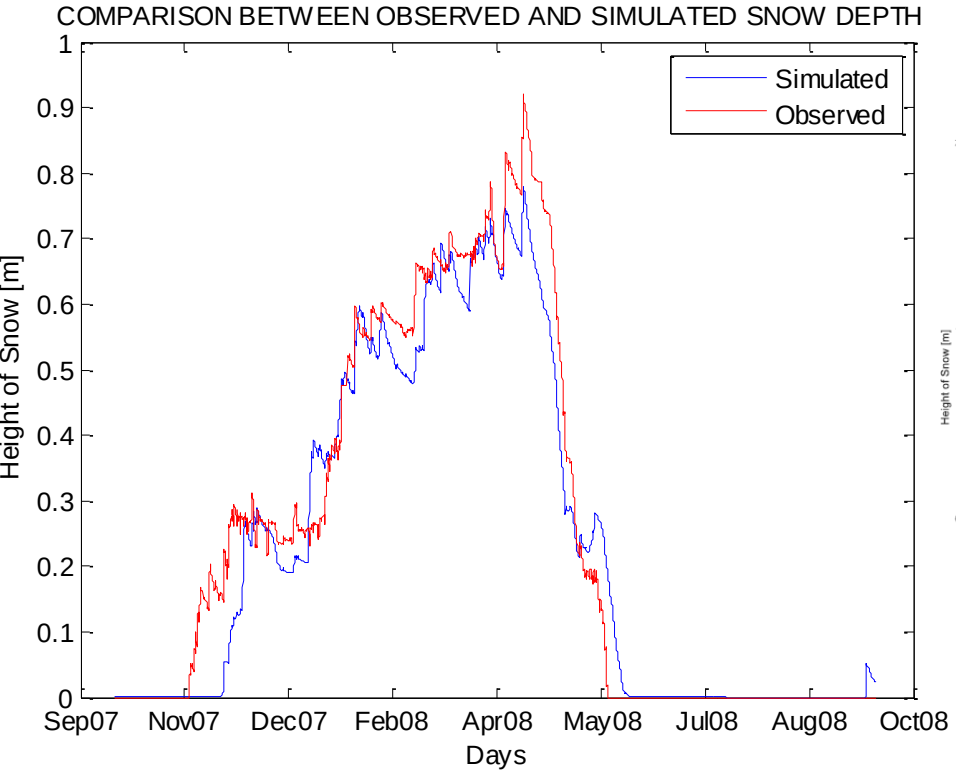
a: (m/(h*K))

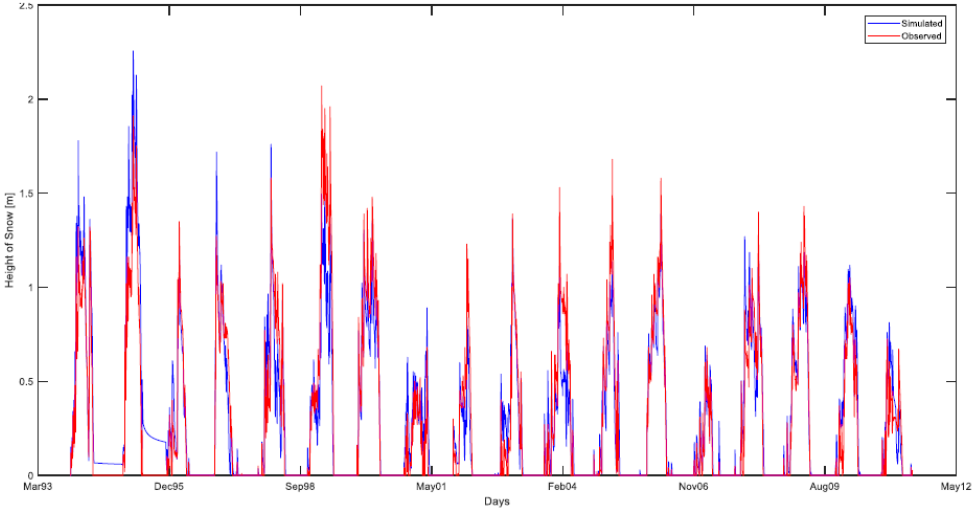
Part 2 – Cal/Val Exercise in HyS

Aim: Maximize the Nash-Suttcliffe Efficiency Coefficient in a calibration period a range of potential melt parameters, then run validation period with optimised melt parameter



Part 2 – Cal/Val Exercise in HyS





Part 2 – Cal/Val Exercise in HyS