Perspectives on surface assimilation at Météo-France

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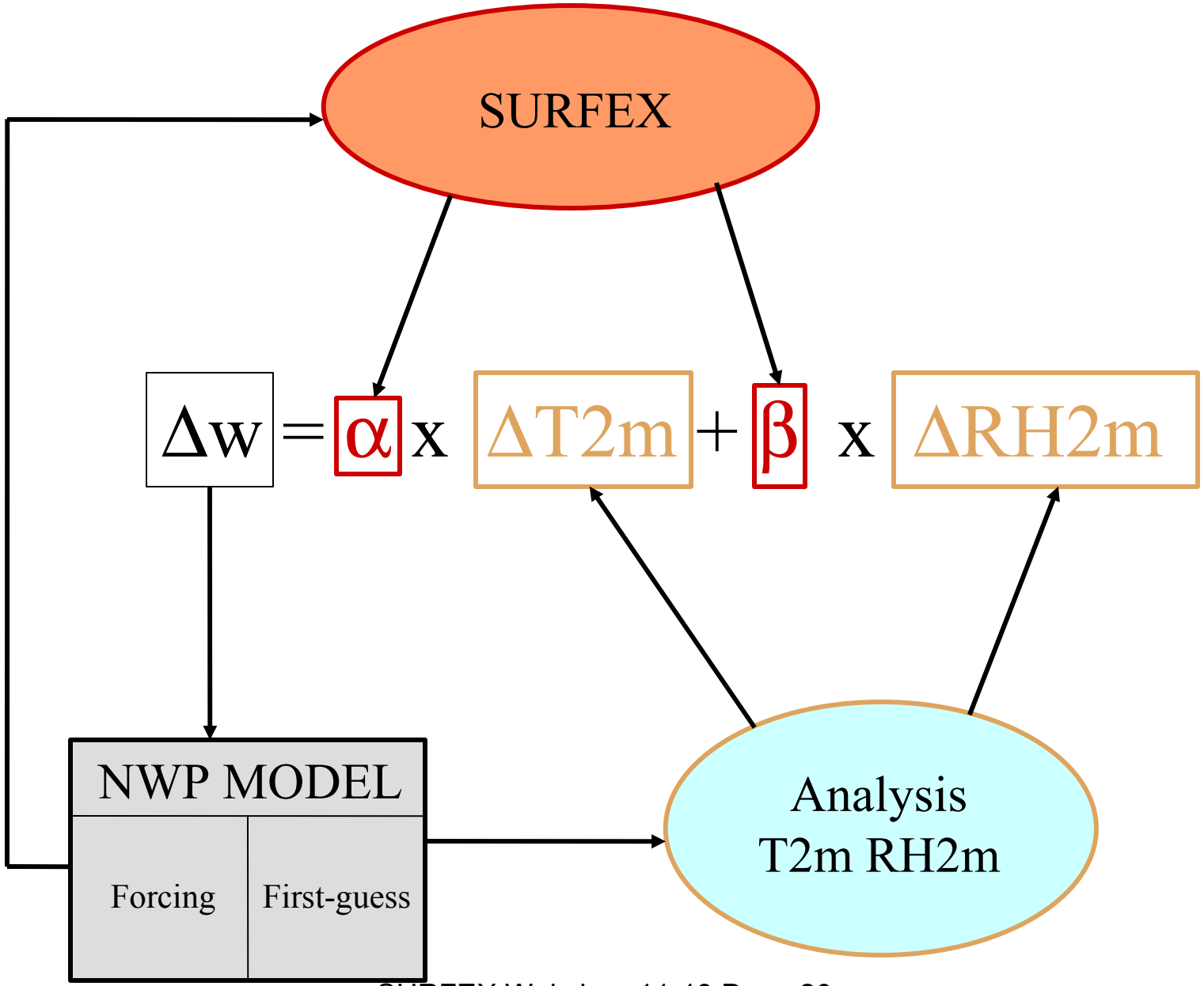
Soil analysis (1)

- Develop an analysis of soil prognostic variables suitable for the various Météo-France NWP models (ARPEGE, ALADIN, AROME), that can assimilate various observation types (conventional obs., satellite data, precipitation, surface radiative fluxes)

Soil analysis (2)

- First proposal :
  - Method : Simplified 2D-Var/EKF (Jacobians of observation operators obtained in finite differences) within SURFEX (off-line mode)
  - Control variables : T_p and W_p
  - Observations : T_{2m}, RH_{2m} (first stage)
  - Assimilation window : 6-h (ARPEGE, ALADIN), 3-h (AROME)
  - Forcing : short-range forecasts from the atmospheric model that will use the soil analyses as initial conditions


SURFEX
Δw = α x ΔT2m + β x ΔRH2m
NWP MODEL
Forcing
First-guess
Analysis
T2m RH2m

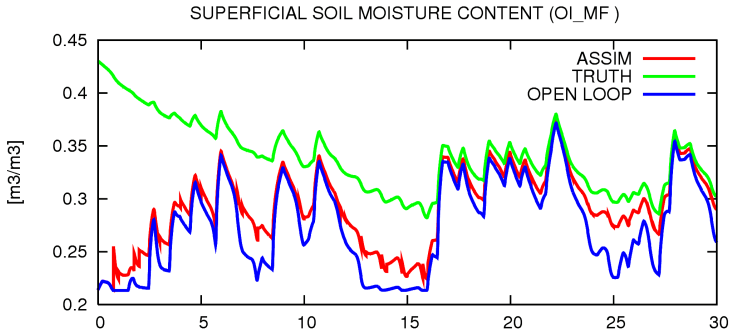
Feasibility study (1)

- Framework : off-line mode at local scale
- Land surface scheme : ISBA-2L
- Forcing : ERA40 (July 02) Prairie central US
- Assimilation techniques :
  - OI_MF with coefficients from Giard & Bazile (2000)
  - OI_EC with coefficients from Douville et al. (2000)
  - EKF : dynamical OI coefficients (Balsamo et al., 2004)
  - EnKF : 100 members - perturbed observations - inflation factor (1.02)

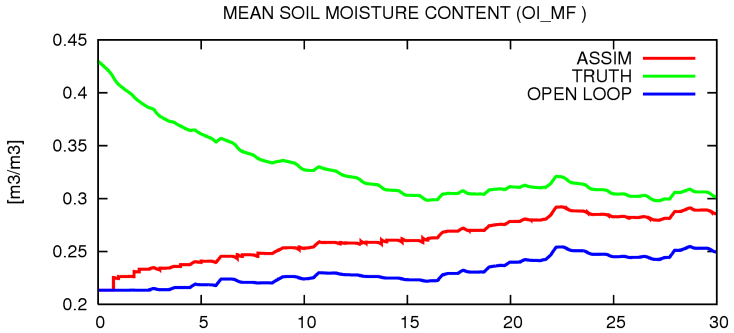
Feasibility study (2)

- Runs :
  - Reference : starting from saturation (w_{sat})
  - Open loop : starting from wilting point (w_{wilt})
  - Assimilation run : starting from wilting point (w_{wilt})
- Control variables : w_g, w_2, T_s, T_2
- Simulated observations : T2m, RH2m every 6-h from reference run
- Background errors : σ_{SWI}=10%, σ_T=1 K
- Observation errors : σ_{RH2m}=10%, σ_{T2m}=1K

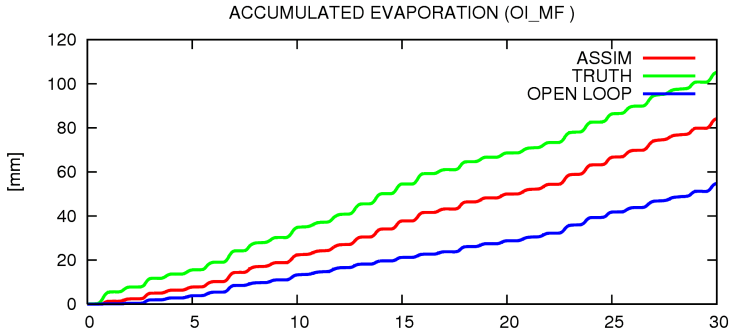
OI_MF


SUPERFICIAL SOIL MOISTURE CONTENT (OI_MF)
ASSIM
TRUTH
OPEN LOOP
[m3/m3]
0.45
0.4
0.35
0.3
0.25
0.2
0
5
10
15
20
25
30

w_g


MEAN SOIL MOISTURE CONTENT (OI_MF)
ASSIM
TRUTH
OPEN LOOP
[m3/m3]
0.45
0.4
0.35
0.3
0.25
0.2
0
5
10
15
20
25
30

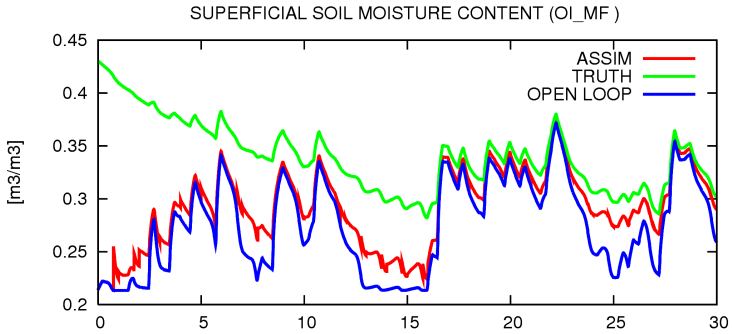
w_2


ACCUMULATED EVAPORATION (OI_MF)
ASSIM
TRUTH
OPEN LOOP
[mm]
120
100
80
60
40
20
0
0
5
10
15
20
25
30

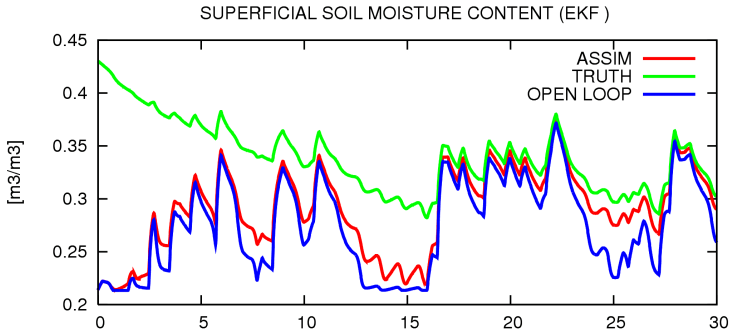
E

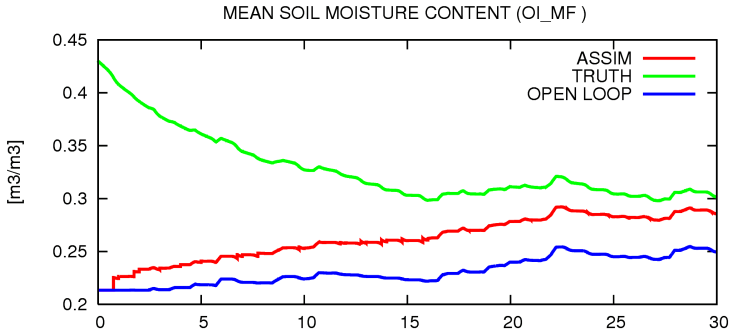
OI_MF

EKF

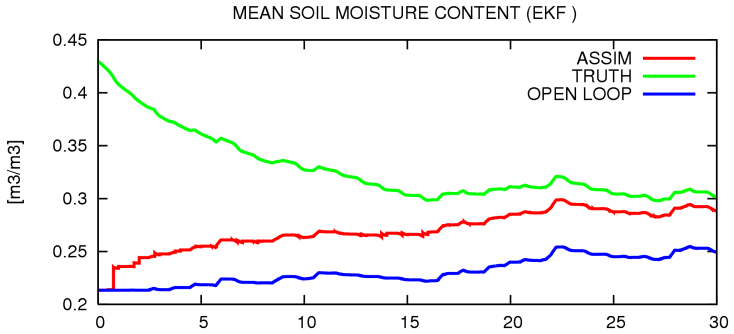


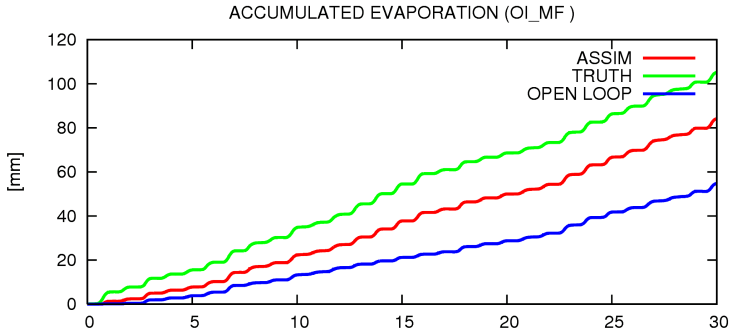
w_g



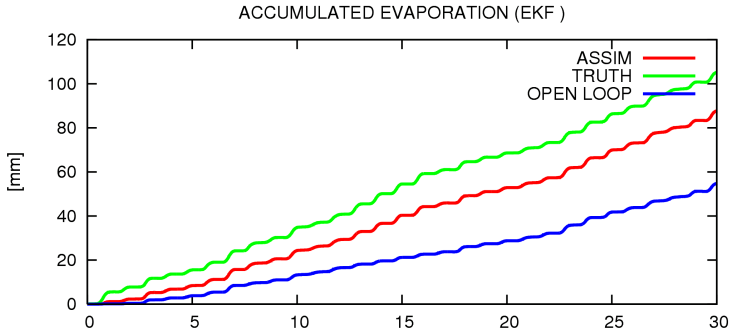


w_2



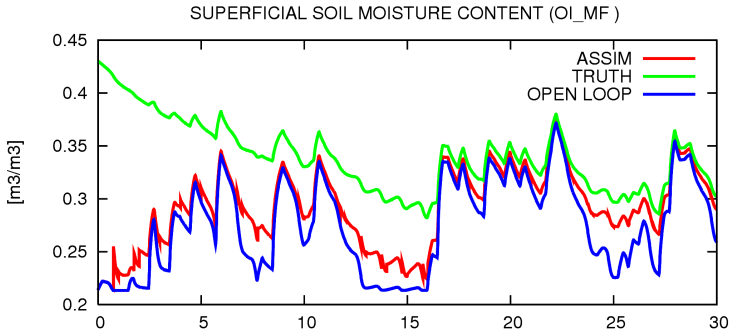


E

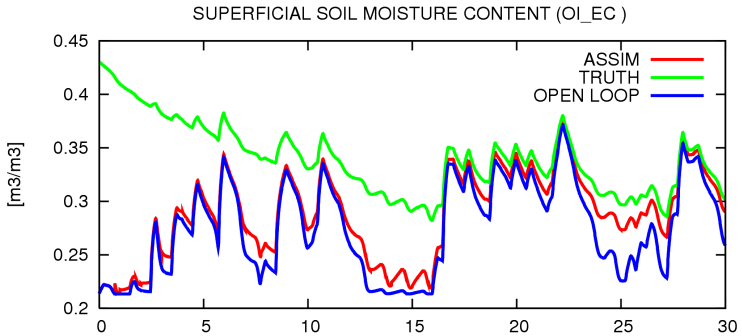


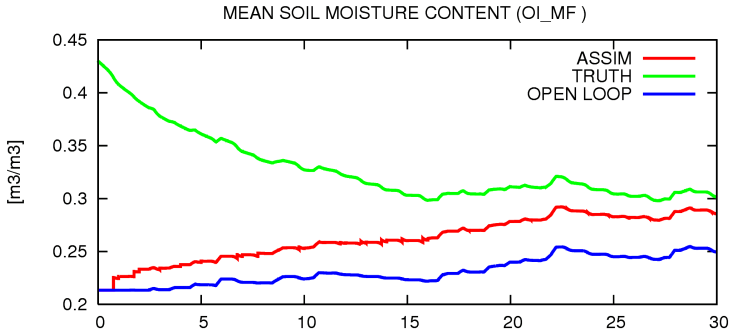
OI_MF

OI_EC

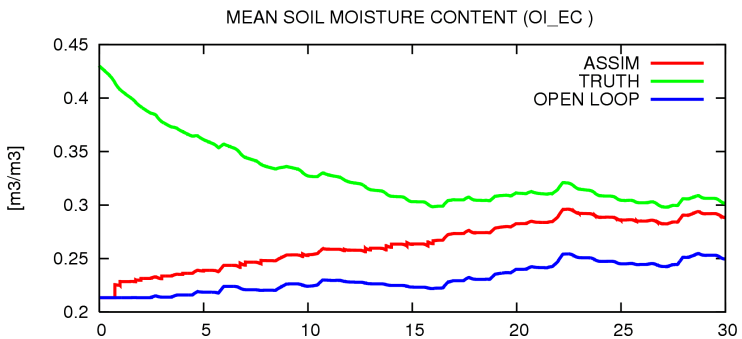


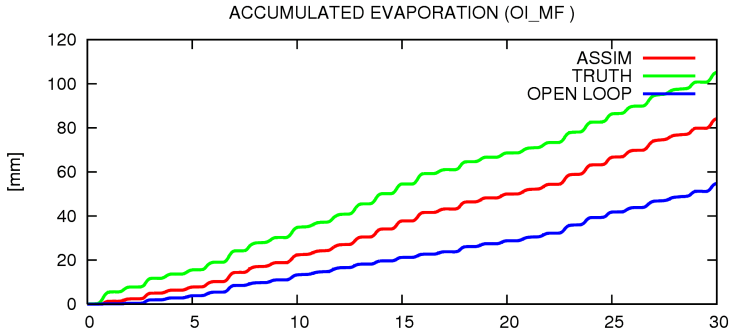
w_g



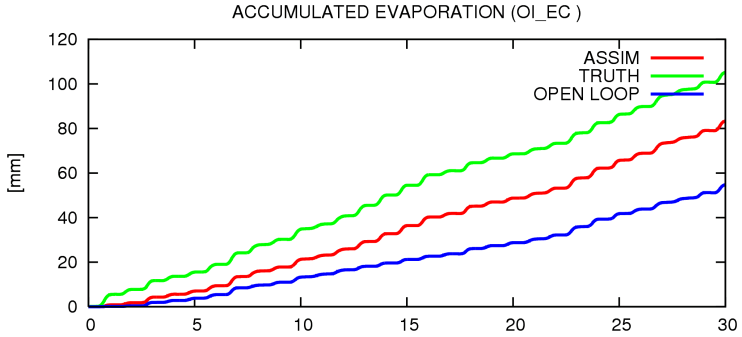


w_2



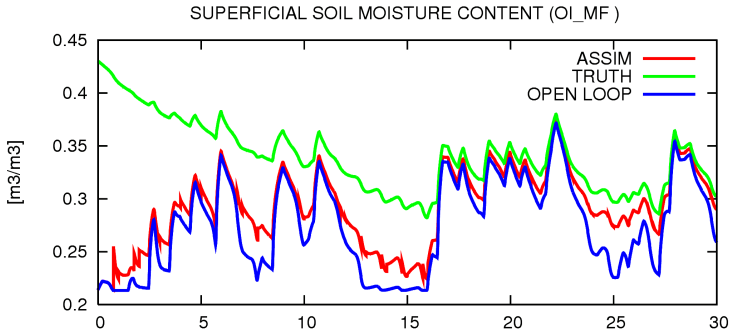


E

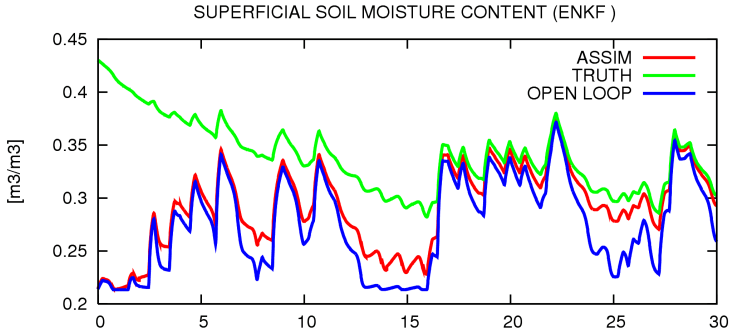


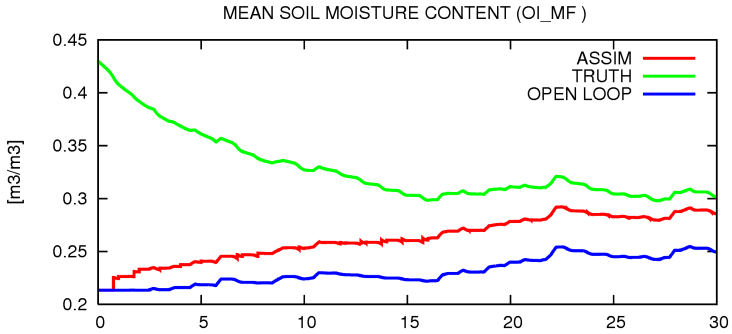
OI_MF

EnKF

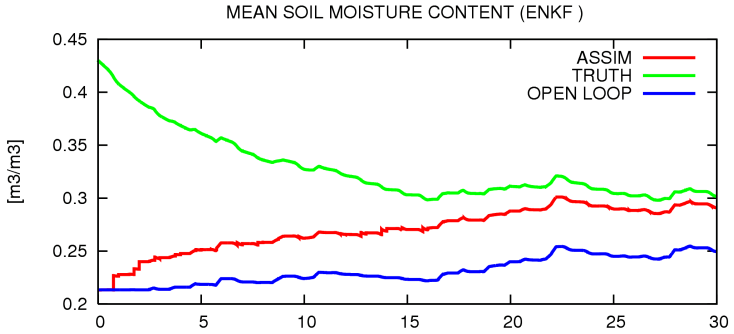


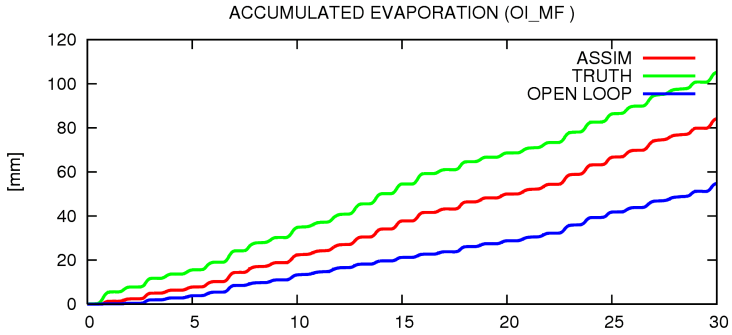
w_g





w_2





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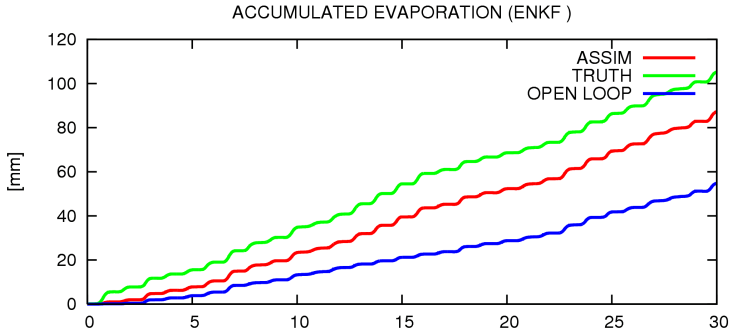
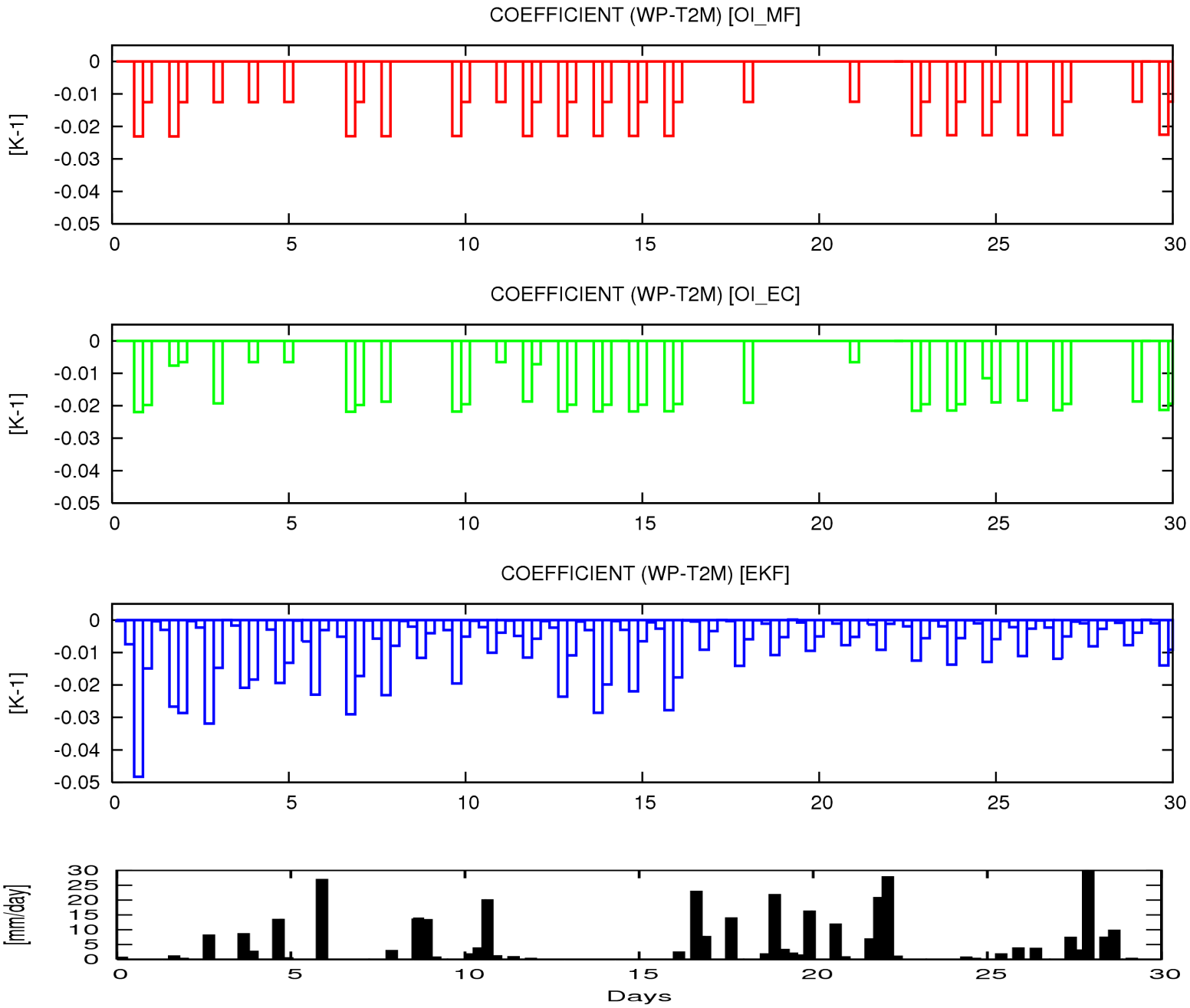
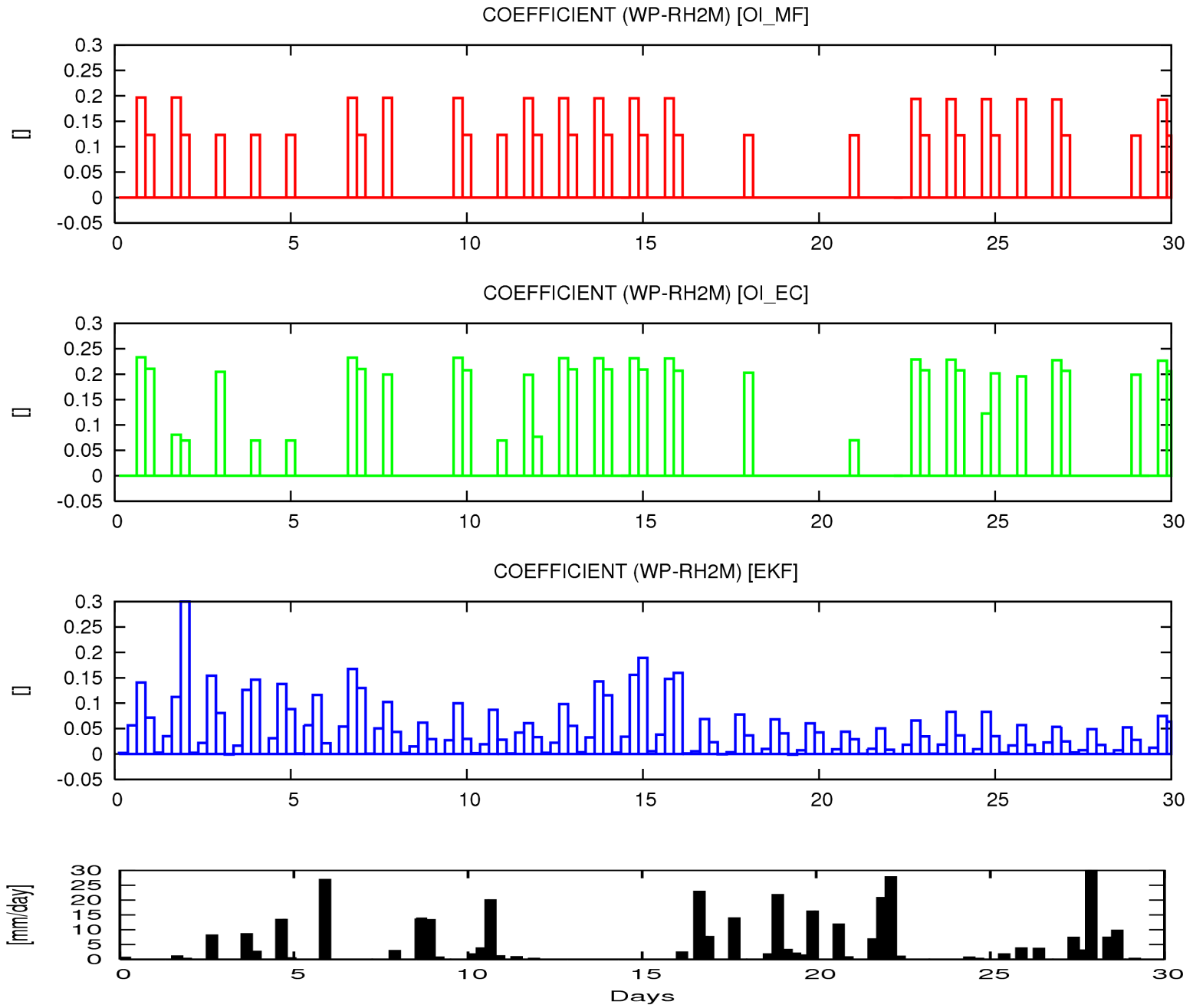



COEFFICIENT (WP-T2M) [OI_MF]
[K-1]
0
-0.01
-0.02
-0.03
-0.04
-0.05
0
5
10
15
20
25
30
COEFFICIENT (WP-T2M) [OI_EC]
[K-1]
0
-0.01
-0.02
-0.03
-0.04
-0.05
0
5
10
15
20
25
30
COEFFICIENT (WP-T2M) [EKF]
[K-1]
0
-0.01
-0.02
-0.03
-0.04
-0.05
0
5
10
15
20
25
30
[mm/day]
0
5
10
15
20
25
30
0
5
10
15
20
25
30
Days


COEFFICIENT (WP-RH2M) [OI_MF]
[]
COEFFICIENT (WP-RH2M) [OI_EC]
[]
COEFFICIENT (WP-RH2M) [EKF]
[]
[mm/day]
Days

Possible developments (1)

- Code the EKF within SURFEX
- Examine OI coefficients in « off-line » mode and compare them with operational OI coefficients (global scale)
- Produce a global « off-line » analysis over a summer period using archived 2m analysis increments from CANARI (no feedback of the corrections in the atmospheric model)
- Compare increments and analyses with operational analyses (Météo-France, ECMWF, MSC) and SIM
- Perform a number of atmospheric forecasts with the new soil analyses

Possible developments (2)

- Adapt EKF/SURFEX to ALADIN and AROME
- Use forcing from precipitation and downward radiation analyses (e.g. LANDSAF, ANTILOPE, SAFRAN)
- Use new observations (T_b-L-band,T_b-C-band, W_s, T_{skin} IR)
- Use new control variables : ISBA-DF, W_{sn}, LAI