Soil moisture assimilation

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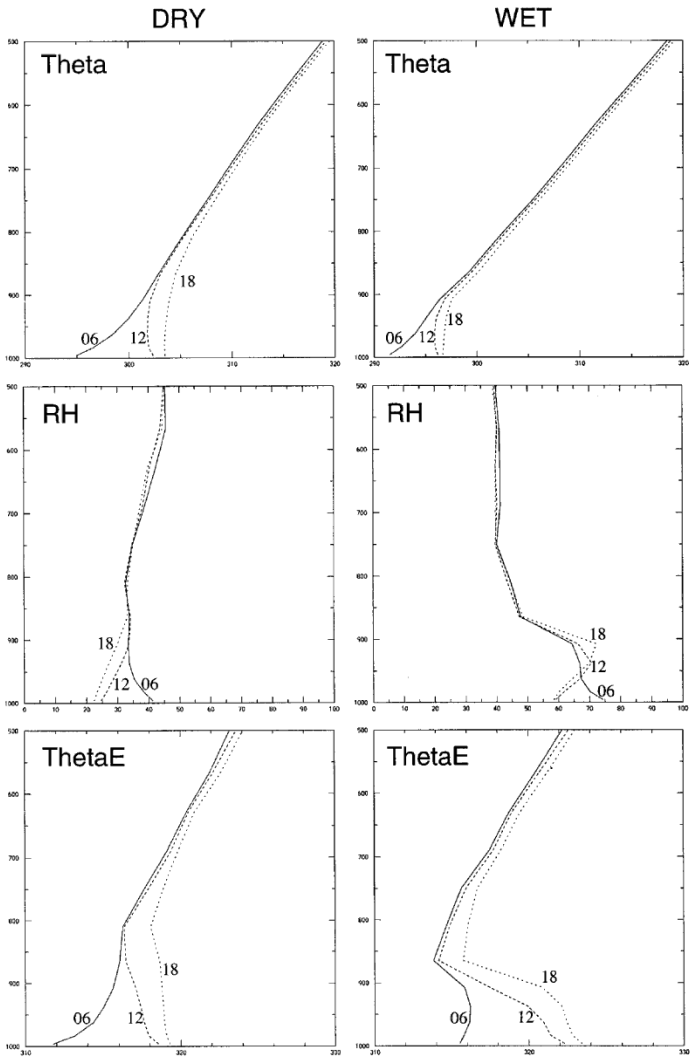
LACE data assimilation working days | Vienna, September 18-20, 2013

Theory on the influence of soil moisture



Schär et al., 1999

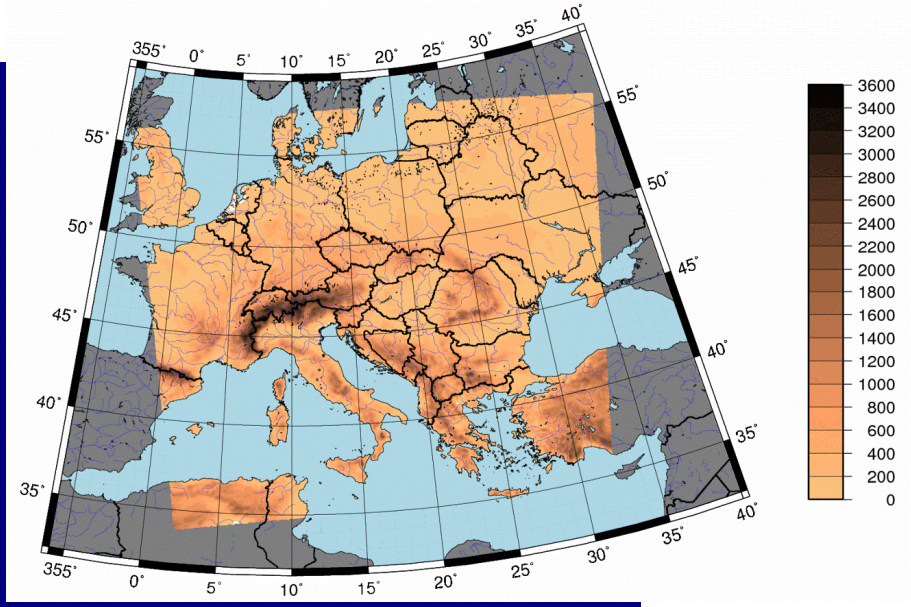
DRY (0.5): solar radiation -> sensible heat
-> pronounced mixing layer
WET (2.0): solar radiation -> latent heat
-> thin mixing layer

WET: moisture is transported into a
thin & cool mixing layer
-> relative humidity increases
(absolute humidity ~ equal, so the additional water, which is raining out, is mainly advected)

WET: well pronounced mixing layer
warmer near the ground, colder above than DRY
-> higher potential for convective instability

Forecasting model

ALADIN



Model version: CY35T1
Horizontal resolution: 9.6km
Vertical resolution: 60 layers
Time step: 415.385 seconds
Forecast range: 72h
Coupling: ARPÈGE
runs per day: 4 (00, 06, 12, 18UTC)

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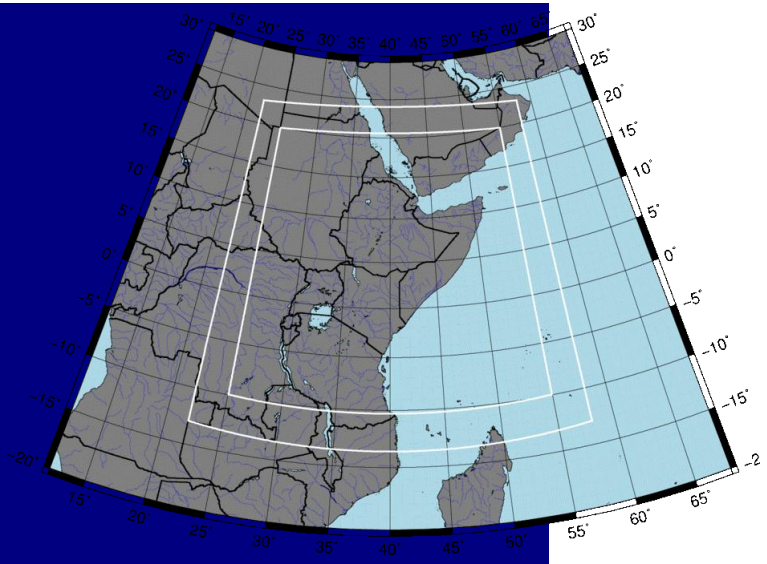
Forecasting model

ALARO



Model version: CY36T1
Horizontal resolution: 8.8km
Vertical resolution: 60 layers
Time step: 180 seconds
Forecast range: 72h
Coupling: IFS
runs per day: 1 (00UTC)

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Assimilation tool

SURFEX (SURFace EXternalisée)

- assimilation based on the Simplified*) Extended Kalman Filter (sEKF)
- version: 4.8
- prognostic variables: wg, w2, Ts, T2
- soil layers: 2
- data to assimilate: soil moisture, (T2M, RH2M)
- data screening: CDF matching, quality flags
- coupling: offline

) simplified: static background error covariance matrix B is defined by the model error standard deviation 0.36(wfcap-wwilt)

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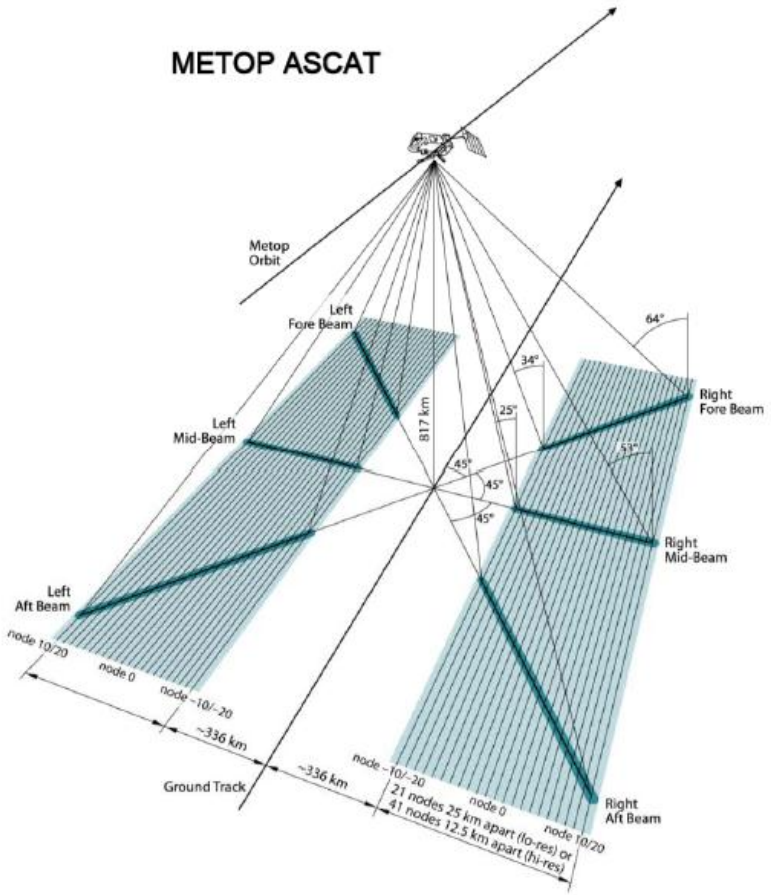
ASCAT



Advanced Scatterometer
on board METOP

polar orbiting satellite
active Scatterometer
microwave spectrum (λ=5.7cm)

spatial resolution: 25km
temporal resolution: ~1.5 days
Data availability: ~2 hours after the measurement

soil moisture value valid for 0-2cm depth

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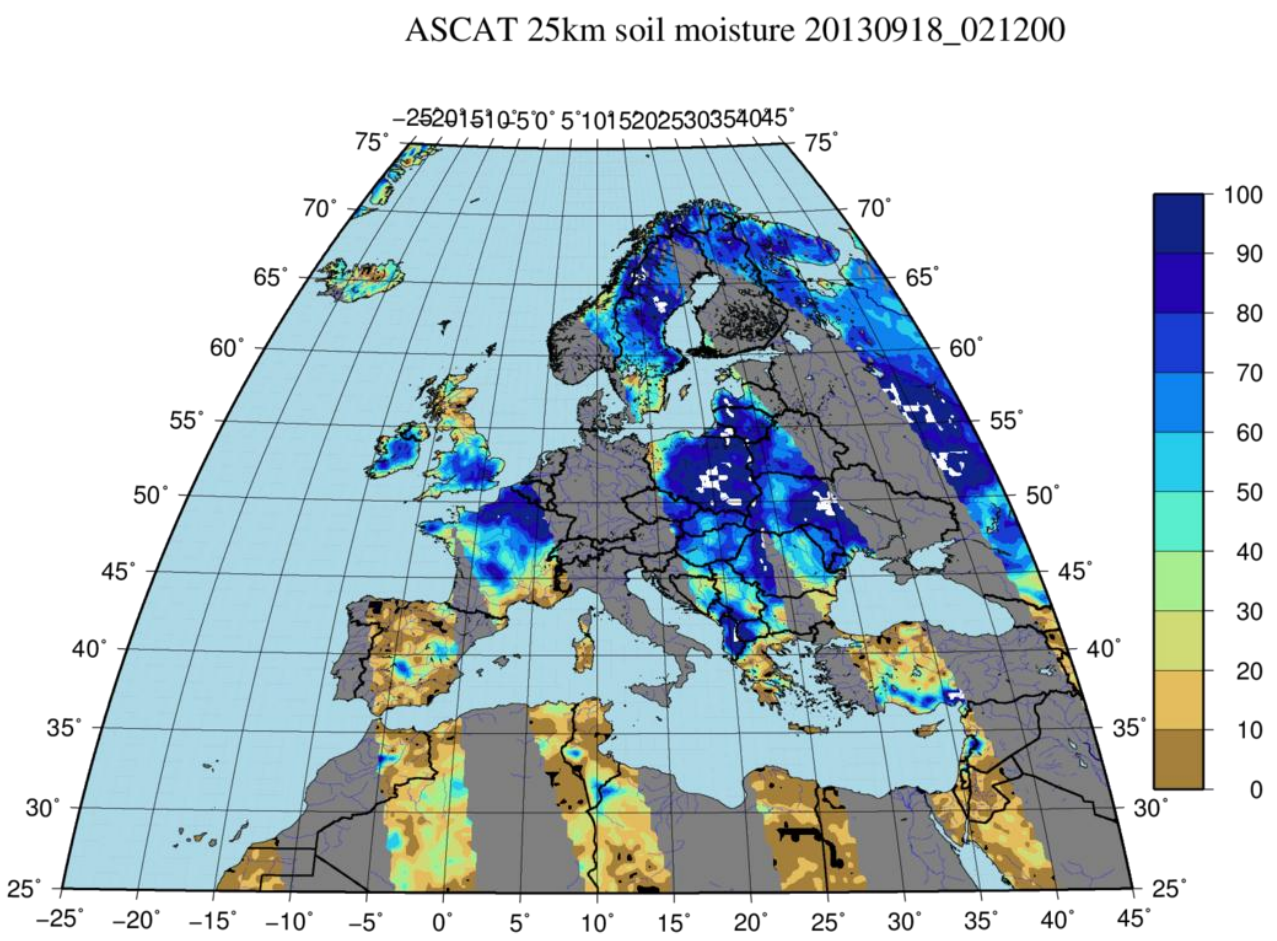
ASCAT



„VUT is cautious to promote the ASCAT SM product“
(EUMETSAT ASCAT Soil Moisture Product Evaluation report - 13.7.2009)

therefore:
QC & Bias correction

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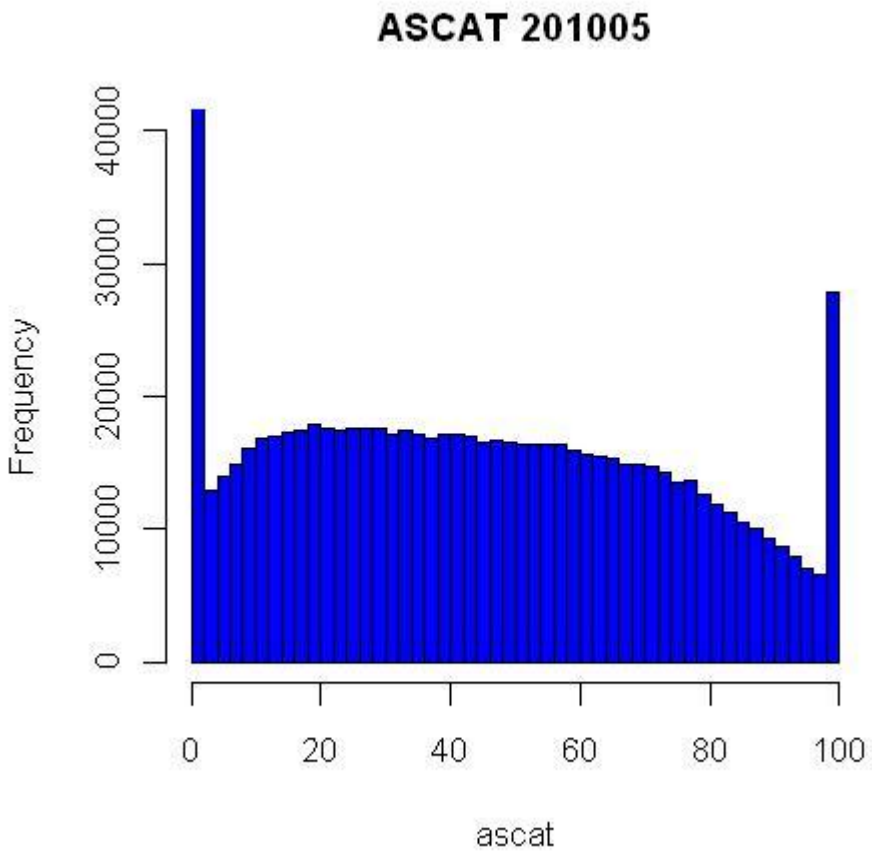
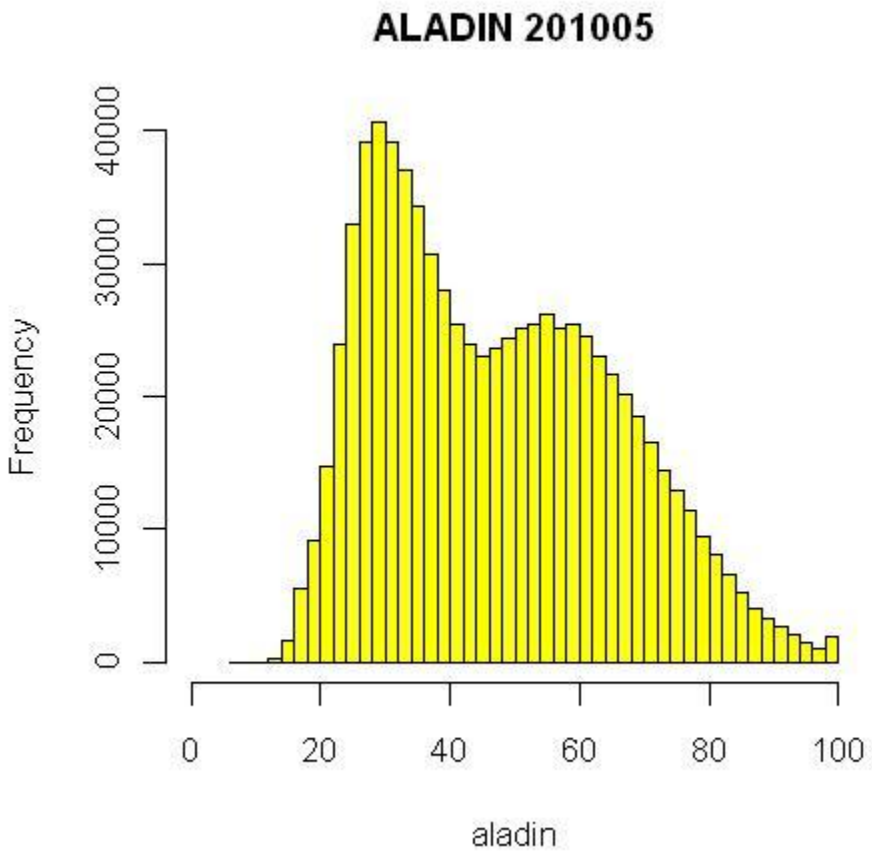
Soil moisture distribution, May 2010





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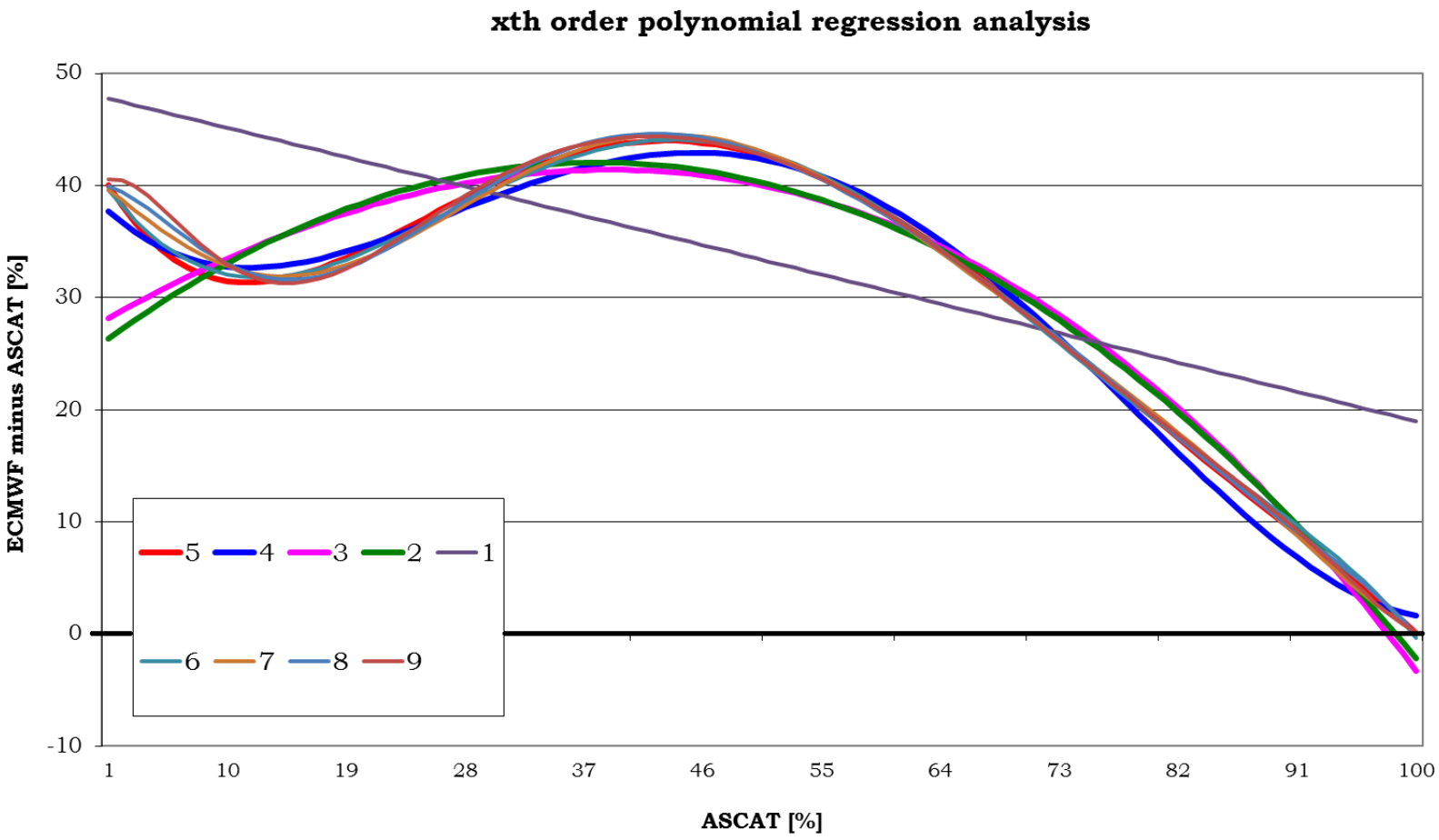
Bias correction with CDF matching



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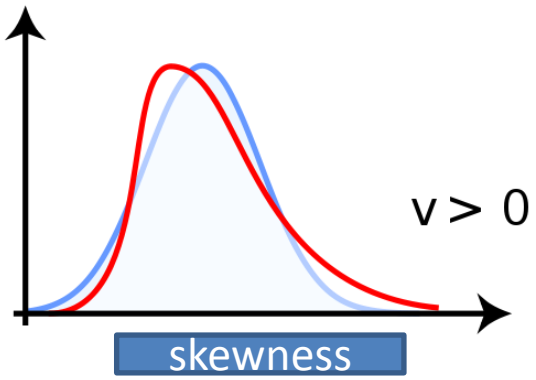
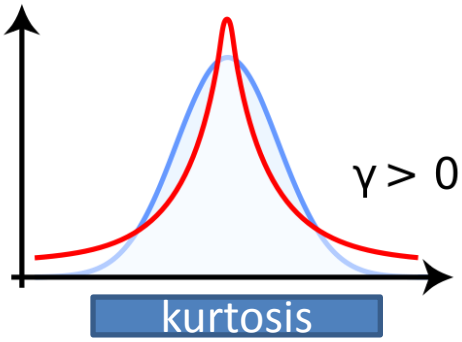
Bias correction with CDF matching

- 4th order polynomial fit:
  - Expectation
  - Variance
  - (positive)Skewness
  - (positive) Kurtosis





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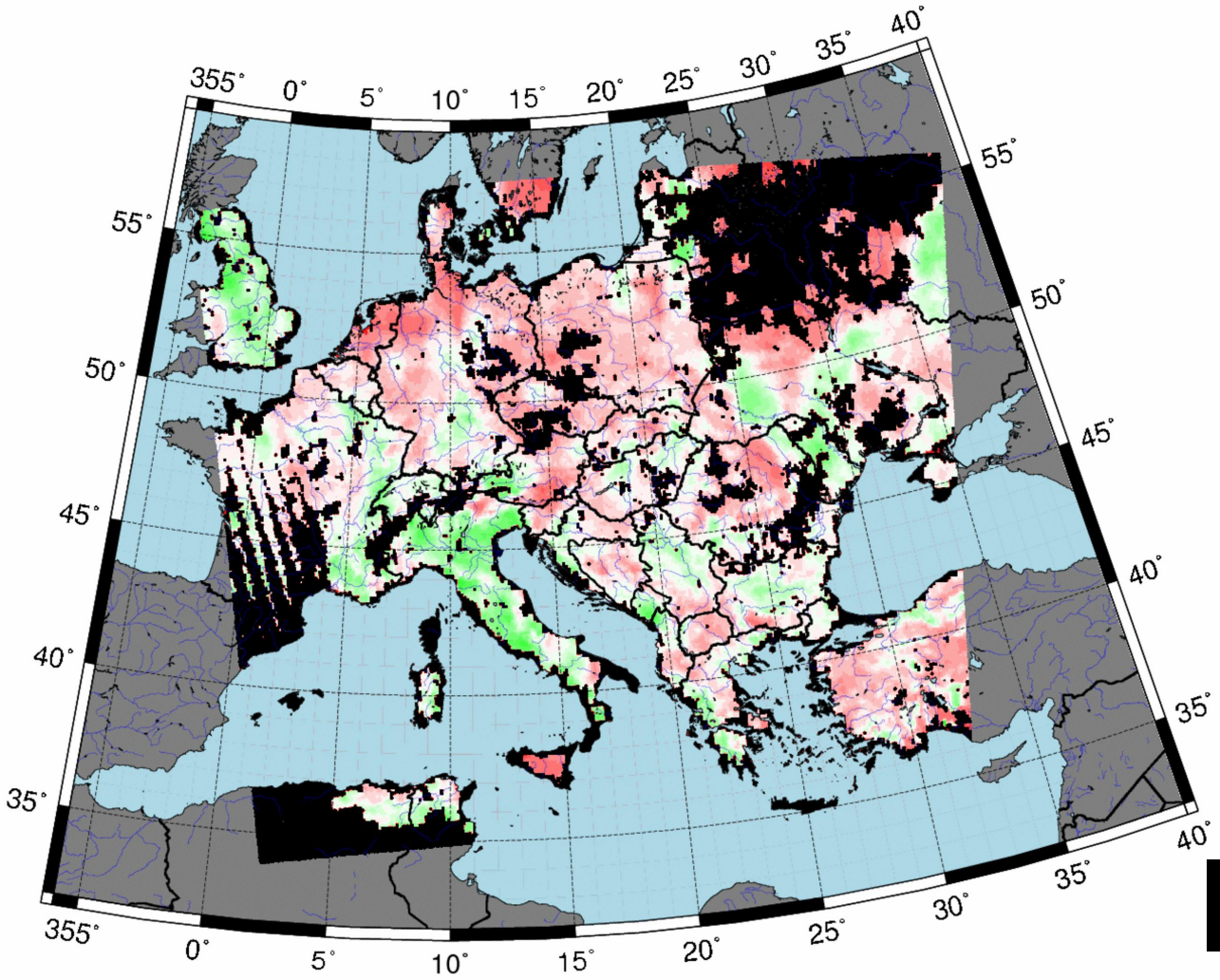
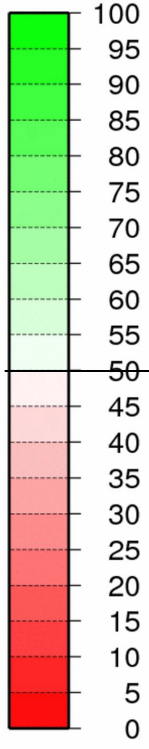
Bias correction with CDF matching





moister

Original "ASCAT measurement"

drier

No bias correction

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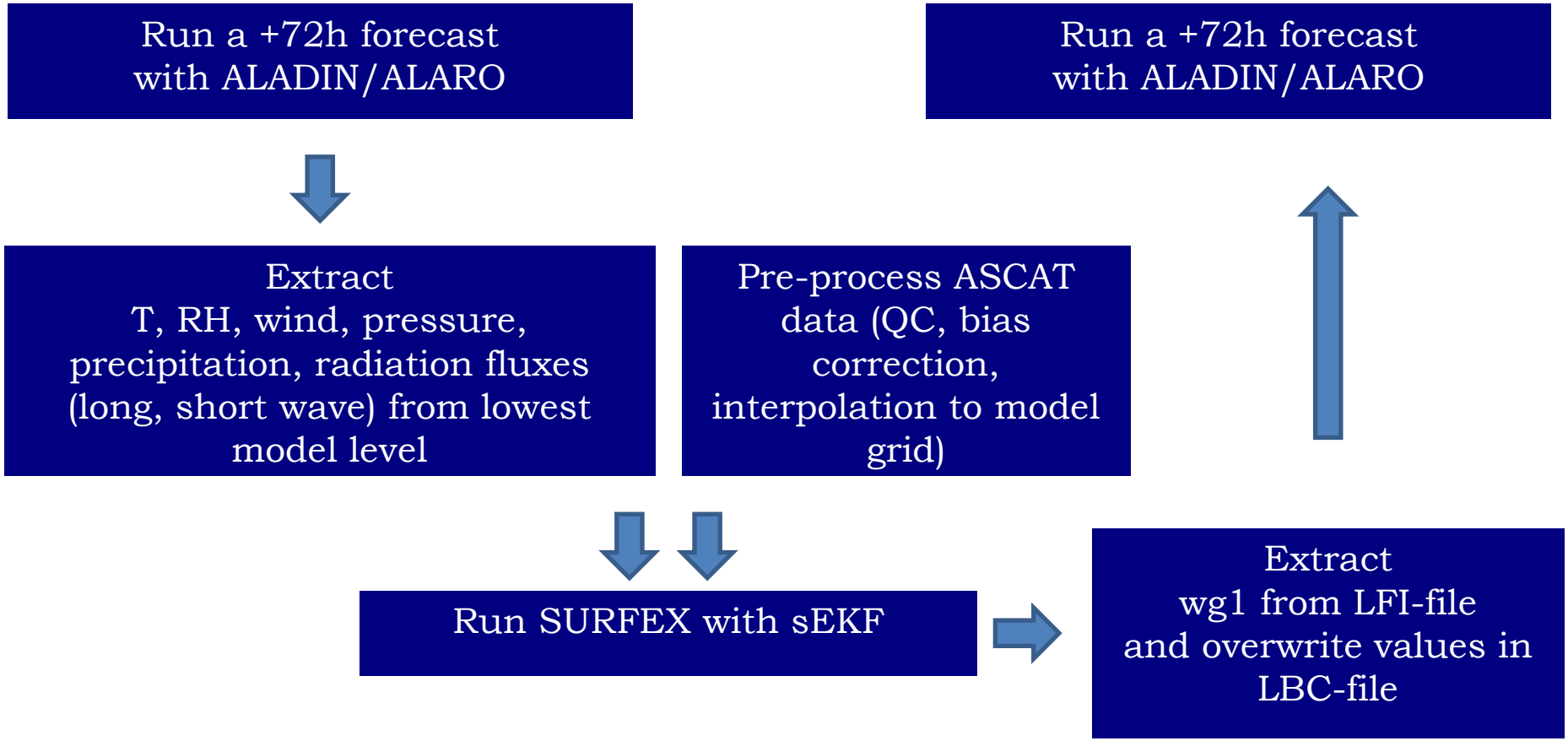
Technical implementation



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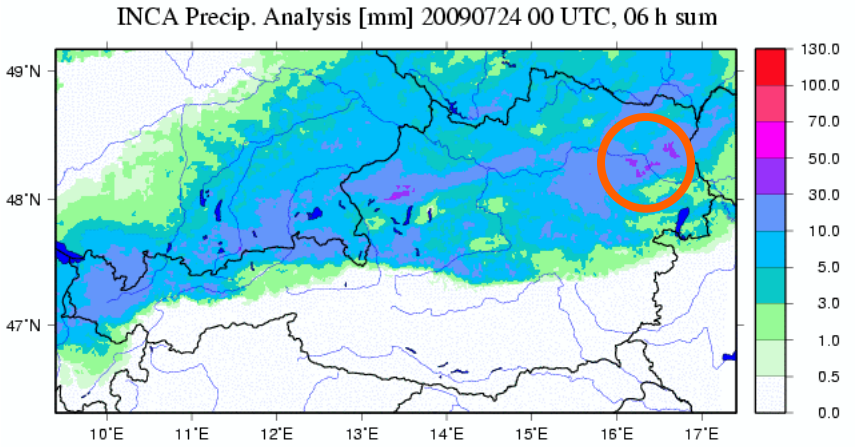
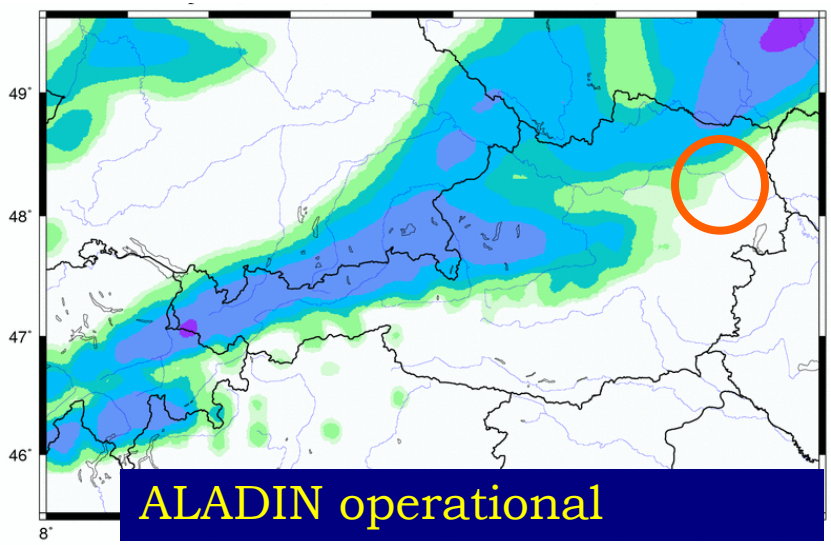
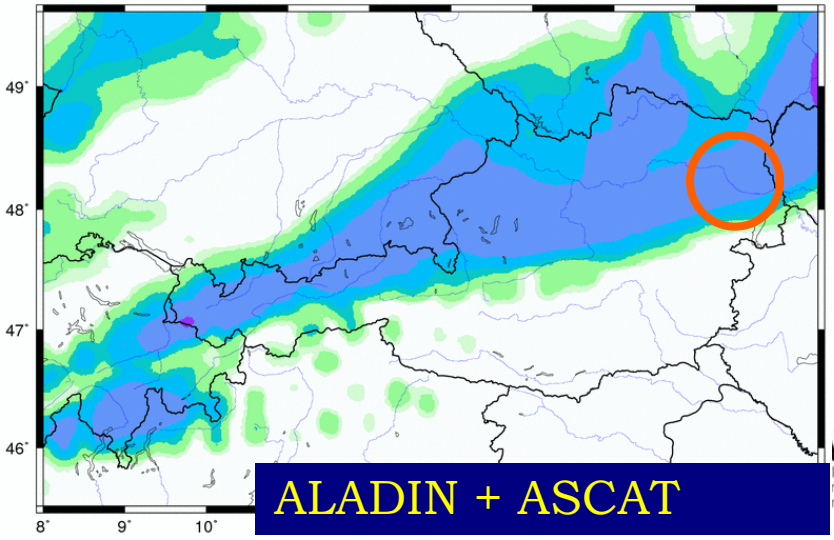
Verification of precipitation (case study in Austria, July 23rd, 2009)



INCA precipitation analysis
23.7.2009, 18-00UTC



ALADIN operational



ALADIN + ASCAT

Verification of precipitation with SAL (Austria, July 2009)

SAL verification
period: 20090720 - 20090730
domain 00: 10KM_OESTERREICH_GESAMT
lon: 09.50 - 17.30
lat: 46.10 - 49.20
gridpoints: 1972 (58 x 34)
dx,dy= 10km

FORECAST RANGE: 0 - 48, DT: 06 h

OPER EX42

event type:	OPER	EX42
total:	088	088
A (obs=yes, mod=yes):	076	076
B (obs= no, mod=yes):	011	011
C (obs=yes, mod= no):	000	000
D (obs= no, mod= no):	001	001

AMPLITUDE SCORE A [-2:+2]:
0: perfect QPF forecast
-2: QPF underestimated
+2: QPF overestimated

STATISTICS for A:

	OPER	EX42
mean :	0.46	0.54
stdev:	1.21	1.17
var :	1.47	1.38
max :	2.00	2.00
min :	-1.88	-1.84

STRUCTURE SCORE S [-2:+2]:
0: perfect structure forecast
-2: objects too small/peaked
+2: objects too large/flat

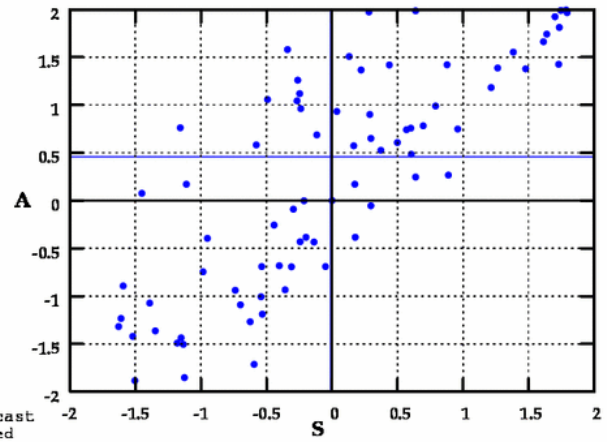
STATISTICS for S:

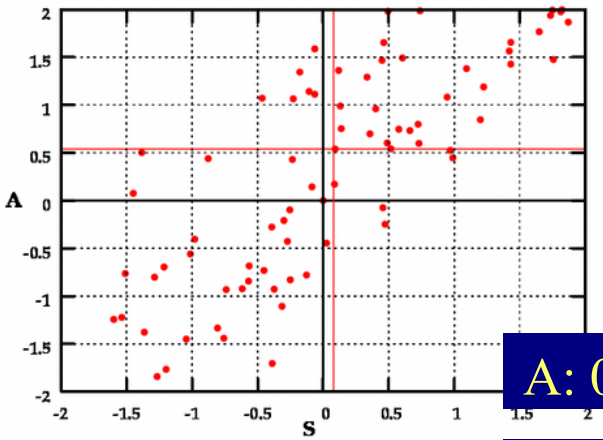
	OPER	EX42
mean :	-0.01	0.08
stdev:	0.96	0.94
var :	0.92	0.88
max :	1.79	1.87
min :	-1.63	-1.60

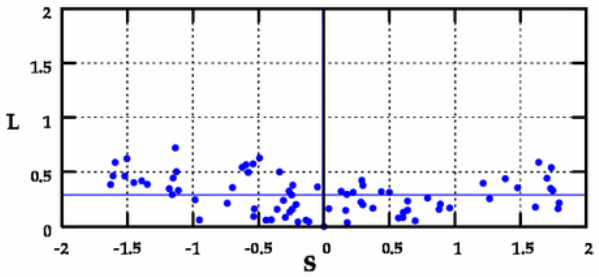
LOCATION SCORE L [0:+2]:
0: perfect location forecast
+2: wrong center of Total Mass and/ or Center (TCM) of objects relative to TCM

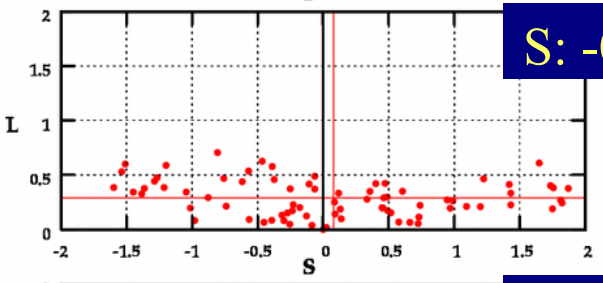
STATISTICS for L:

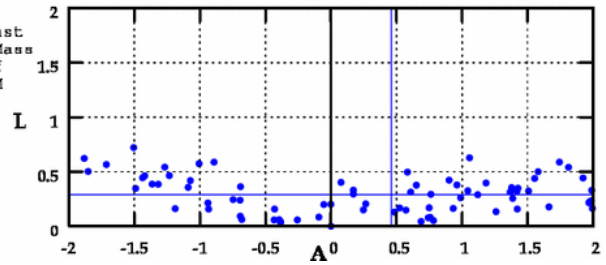
	OPER	EX42
mean :	0.29	0.29
stdev:	0.17	0.17
var :	0.03	0.03
max :	0.72	0.70
min :	0.00	0.00

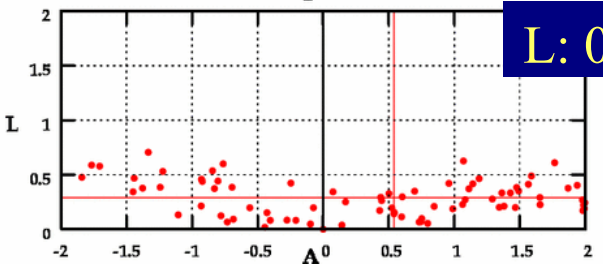












A: 0.46 vs 0.54

S: -0.01 vs 0.08

L: 0.29 vs 0.29

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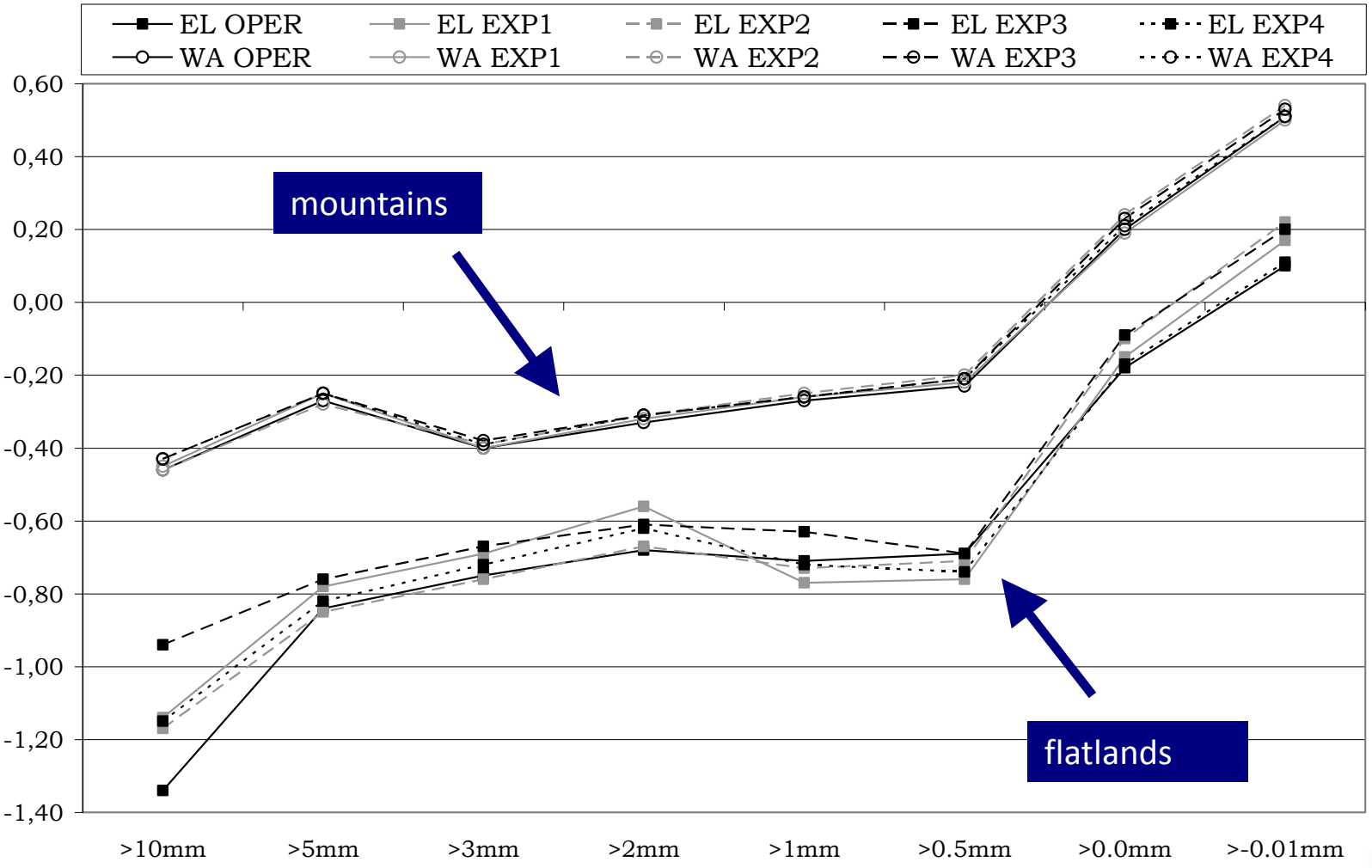
Verification of precipitation with SAL (Austria, July 2009)



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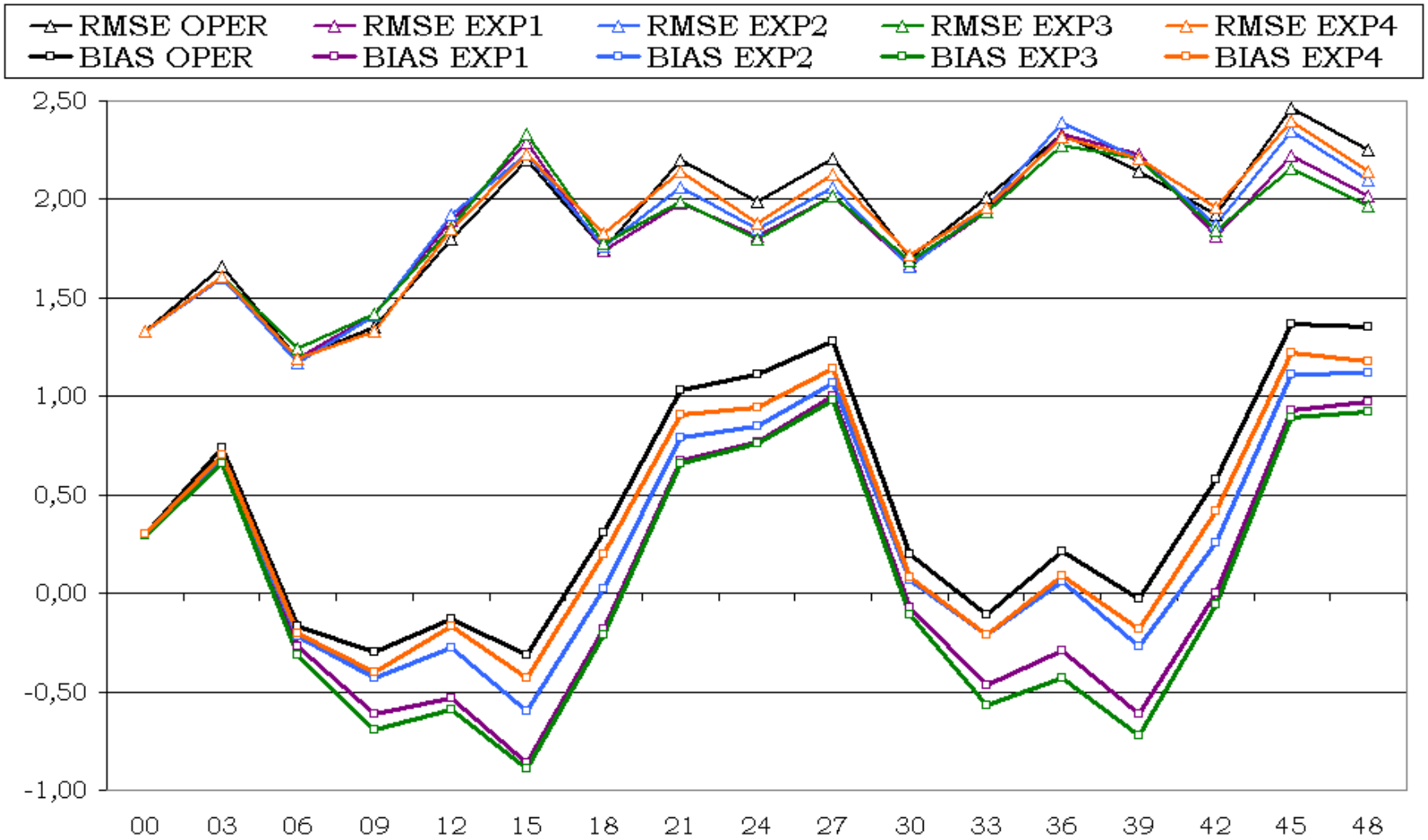
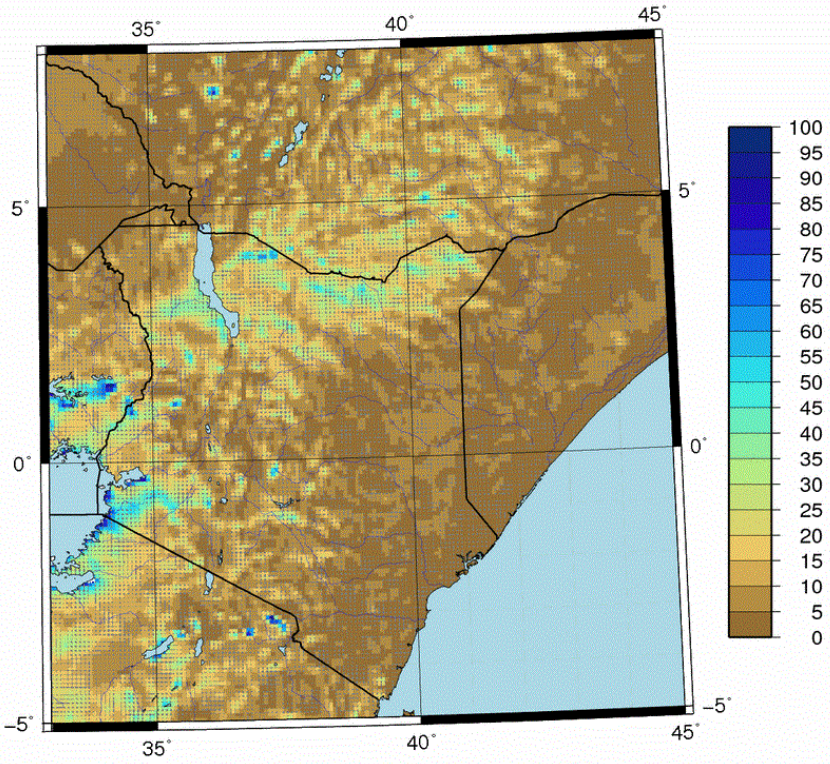
Verification of T2m (Austria, July 2009)

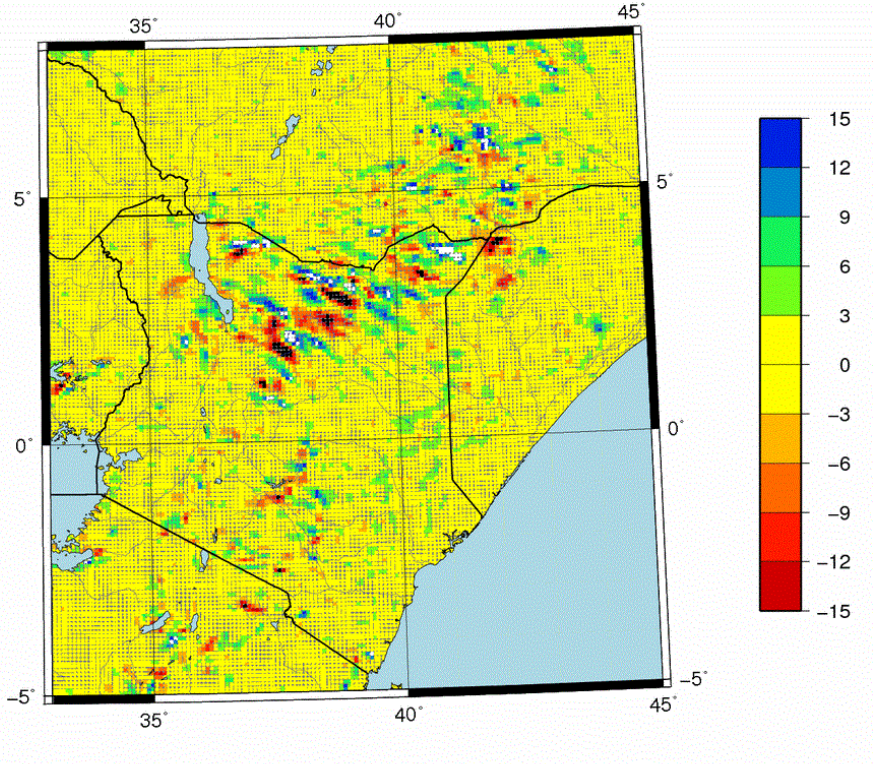


Verification of precipitation (Africa, April 2009)

01.04.2009 00UTC +24h precipitation sum



ASCAT run [mm/24h]



difference ASCAT minus REF [mm/24h]

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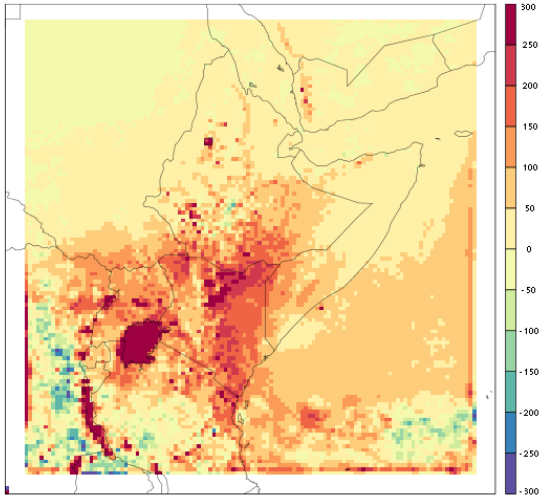
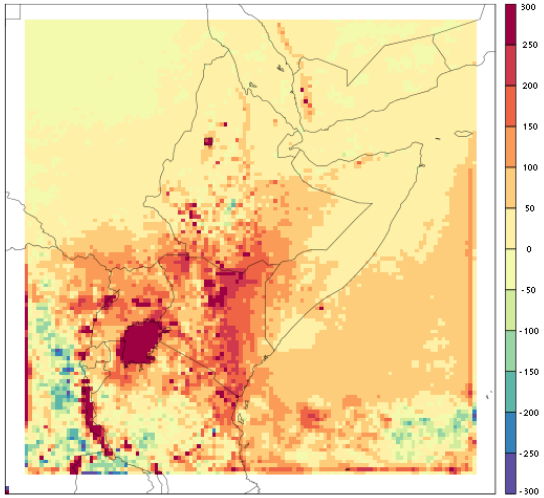
Verification of precipitation (Africa, March 2009)

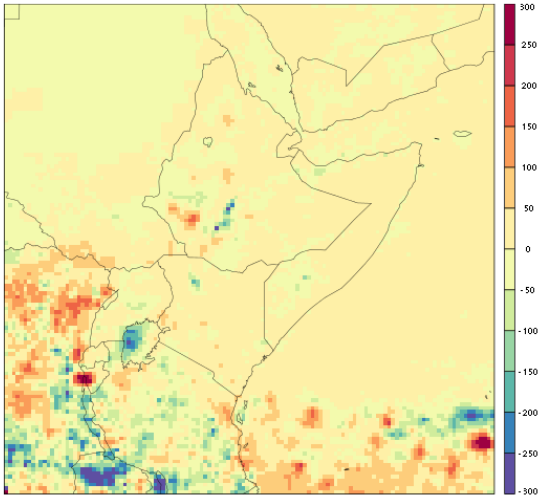
01.03.-31.03. 2009 precipitation sum vs TRMM



ALARO



ALARO+sEKF



IFS

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Thank you for your attention!

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