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Trainee ship Summer 2013
An overview

Our Trainee: Benjamin Mayr
Advisers: Jakob Messner, Reto Stauffer

Institute of Meteorology and Geophysics Innsbruck

September 2nd, 2013

Introduction to WBET

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Basic goal: **bet better than the wetter**besprechung
Next day, Innsbruck only. What do we forecast?

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- Minimum temperature (18-6UTC; full $^{\circ}C$; 10/50/90)
- Maximum temperature (18-6UTC; full $^{\circ}C$; 10/50/90)

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- Maximum temperature (18-6UTC; full $°C$; 10/50/90)
- Sunshine duration (0-24UTC; full hours; 10/50/90)

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- Maximum temperature (18-6UTC; full $^{\circ}C$; 10/50/90)
- Sunshine duration (0-24UTC; full hours; 10/50/90)
- Amount of precipitation (18-18UTC; mm; 10/50/90)
- Probability of precipitation (18-18UTC; %)

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Furthermore (but not done during the trainee-ship):
Probability of ...

- S-foehn Innsbruck
- N-foehn Innsbruck
- S-foehn in Wippvalley
- thunderstorm
- low stratus deck
- fog

The data

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Observations from Tawes (11121) and Synop (11120).

The data

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Direct model output:

- GEFS reforecast v2, ensemble mean: 1991 - Current

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Observations from Tawes (11121) and Synop (11120).

Direct model output:

- GEFS reforecast v2, ensemble mean: 1991 - Current
- ECMWF deterministic forecast: Jan 2006 - Current
- COSMO7 deterministic forecast: Oct 2012 - Current

The Methods

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For “continuous” variables (tmax, tmin, ssd, pre):

- linear model

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For “continuous” variables (tmax, tmin, ssd, pre):

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- confidence interval $\pm 1.286\ \hat{\sigma}$
- no percentile regression

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- *no* hand selection

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Furthermore used weighting functions:

- season weighting
- wind direction weighting
- combined season/wind weighting

Weighting functions

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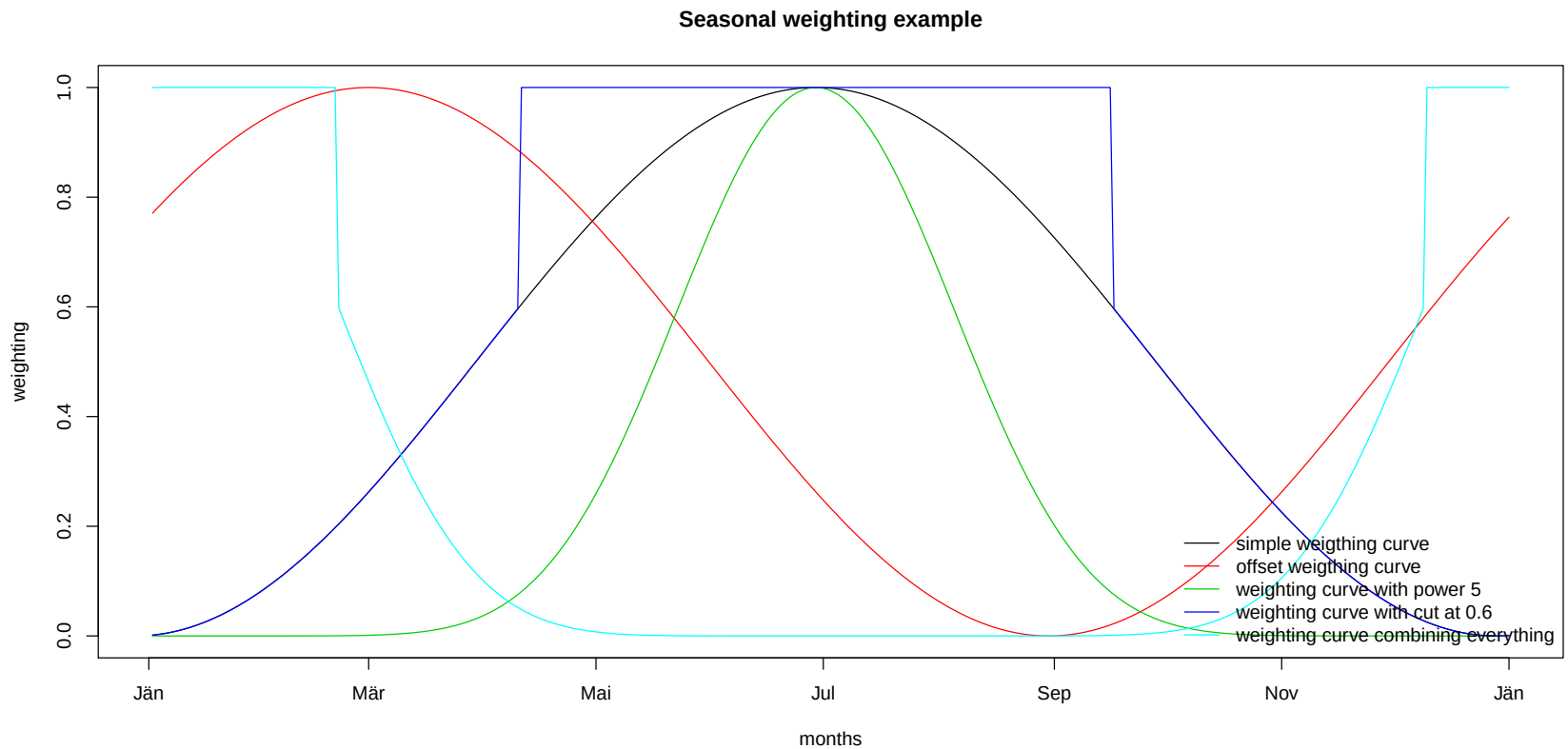

Figure: Example of used season weighting functions.

Weighting functions

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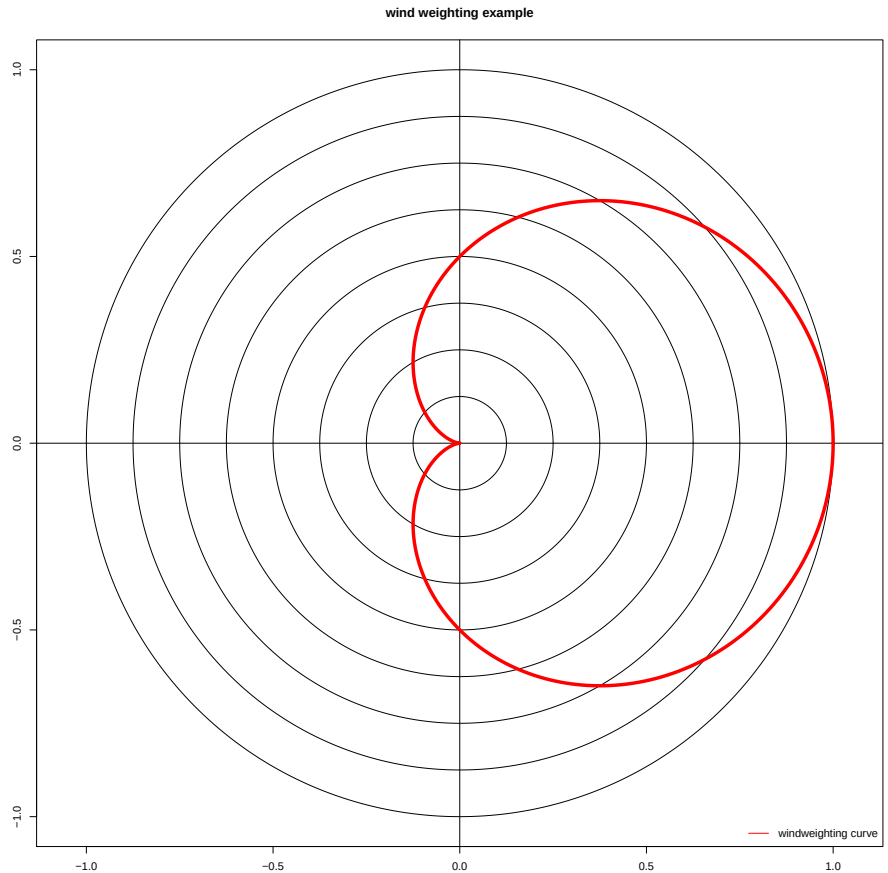

Figure: Example of used wind weighting functions.

Model and Variable info's

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Naming on the next few slides:

Hash	description
ECMWF	based on ECMWF DMO
GEFS	based on GEFS reforecast data set
COSMO7	based on COSMO DMO
METEO SERVICE	MOS of the Meteo Service
glmnet	using lasso for predictor selection (glmnet package)
lm	simple linear model with no weighting
wlm	linear model with seasonal weighting
wwlm	linear model with wind weighting
swwlm	linear model using both seasonal and wind weighting

Model and Variable info's

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Model description:

hash	description
intercept	direct model variable (e.g. tmax 2m) + intercept + sin/cos of the Julian day
lagged	using the same variables as "intercept" model but adding "lagged obs"
1glmnet	set of prescreened "important" variables (selection made with lasso but coefficients estimated with lm or glm) including derived variables
glmnet	variables (including derived variables) selected for each day separately using the glmnet package

Model and Variable info's

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Variable description:

- always used 24-h lagged observation

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- here and there other lagged variables

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- some derived vars: over-spanning 12 to 24-h period

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Variable description:

- always used 24-h lagged observation
- here and there other lagged variables
- DMO centred at *ONE SINGLE* lead time
- some derived vars: over-spanning 12 to 24-h period

E.g.: *lagged-obs, allt2max, allt2min, sund_sum, ssrd_sum, ssrd_max, ssrd_min, tcc_sum, hcc_sum, mcc_sum, lcc_sum, tcc_max, hcc_max, mcc_max, lcc_max, tcc_min, hcc_min, mcc_min, lcc_min, td14, tddiff14, LCK_td14, LCK_tddiff14*

Results: Maximum Temperature

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	RMSE	MAE	BIAS	better	equal	worse	points
WB	2.23	1.75	-0.94	0.00	72.00	0.00	0.00
GEFS.tmax.intercept_wlm	2.11	1.71	0.04	28.00	17.00	26.00	2.00
WB corrected	2.11	1.64	-0.83	5.00	65.00	2.00	3.00
COSMO7.tmax.glmnet_wlm	1.98	1.60	-0.38	23.00	22.00	19.00	4.00
GEFS.tmax.1glmnet_wlm	1.45	1.17	-0.12	35.00	16.00	20.00	15.00
ECMWF.tmax.glmnet_wlm	1.50	1.20	0.19	35.00	17.00	19.00	16.00
GEFS.tmax.glmnet_wwlm	1.44	1.15	-0.10	33.00	22.00	16.00	17.00
GEFS.tmax.glmnet_wlm	1.36	1.08	-0.05	36.00	17.00	18.00	18.00
METEO SERVICE	1.47	1.16	0.13	34.00	23.00	15.00	19.00
GEFS.tmax.glmnet_swwlm	1.38	1.08	-0.04	35.00	20.00	16.00	19.00

Table: Scores of different MOS for tmax

Results: Maximum Temperature

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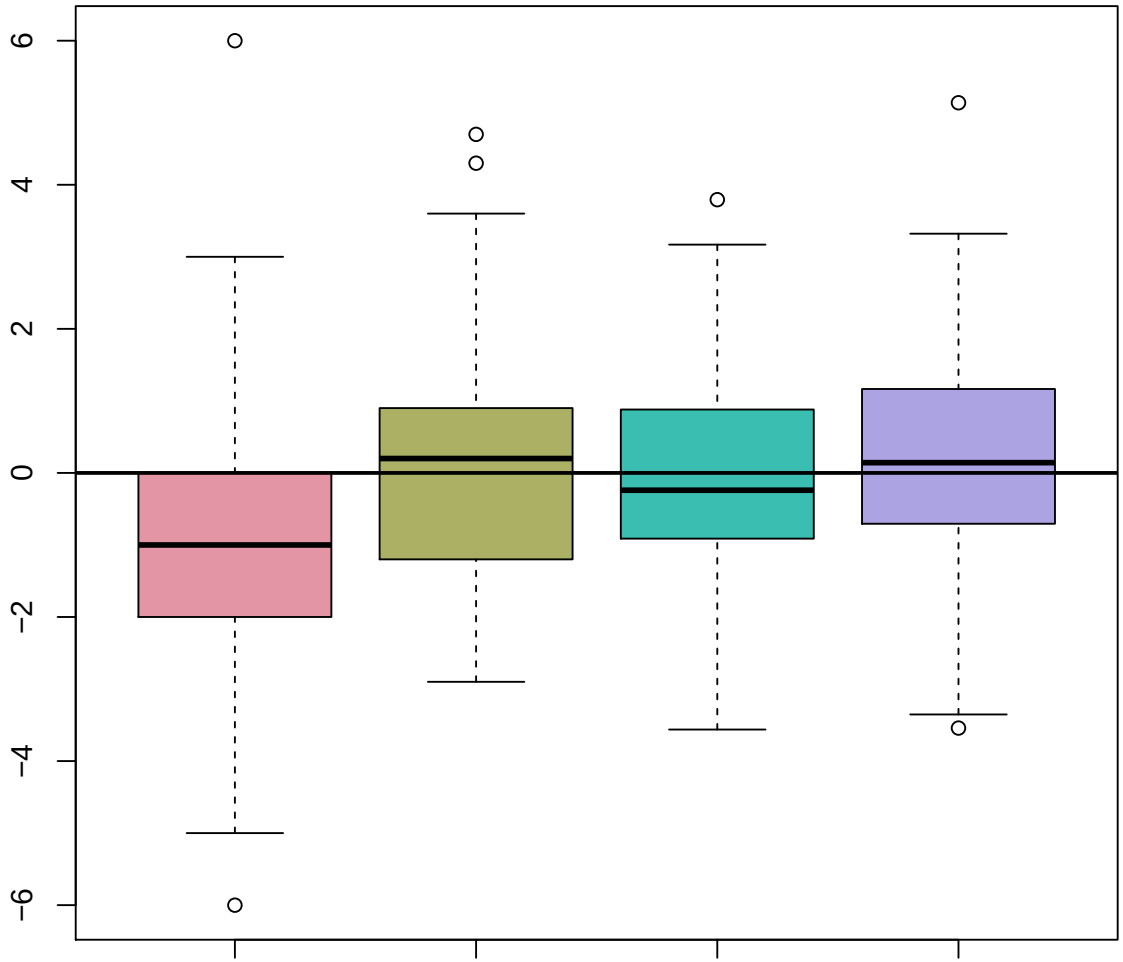
Residuals boxplot plus paired t−test results tmax [sample: 70]



Results: Minimum Temperature

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	RMSE	MAE	BIAS	better	equal	worse	points
COSMO7.tmin.glmnet_wlm	2.13	1.52	-0.43	21.00	13.00	30.00	-9.00
GEFS.tmin.1glmnet_wlm	1.78	1.40	-0.03	23.00	21.00	28.00	-5.00
WB	2.38	1.69	0.16	0.00	73.00	0.00	0.00
ECMWF.tmin.lagged_wlm	1.92	1.44	0.14	25.00	23.00	24.00	1.00
GEFS.tmin.glmnet_wlm	1.81	1.39	-0.02	26.00	21.00	25.00	1.00
ECMWF.tmin.1glmnet_wlm	1.72	1.30	-0.13	27.00	20.00	25.00	2.00
WB corrected	2.26	1.61	0.27	9.00	59.00	5.00	4.00
ECMWF.tmin.glmnet_wlm	1.51	1.10	-0.12	27.00	24.00	21.00	6.00
METEO SERVICE	1.61	1.13	-0.39	32.00	20.00	21.00	11.00

Table: Scores of different MOS for tmin

Results: Minimum Temperature

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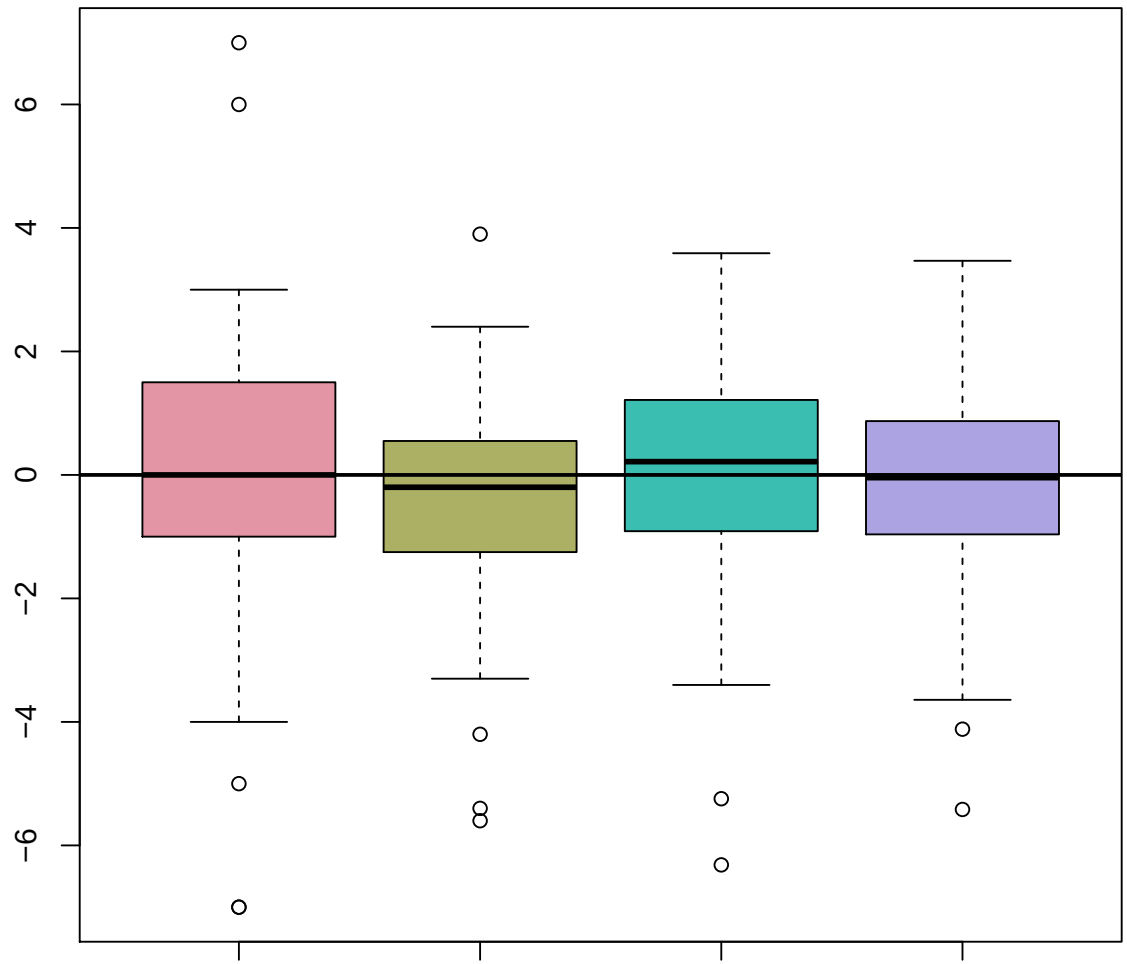
Residual boxplot plus paired t−test results tmin [sample: 71]



Results: Sunshine Duration

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	RMSE	MAE	BIAS	better	equal	worse	points
GEFS.sun.glmnet_wlm	2.70	2.09	-0.39	22.00	17.00	33.00	-11.00
WB	2.42	1.80	-0.47	0.00	73.00	0.00	0.00
METEO SERVICE	2.07	1.64	-0.20	26.00	23.00	24.00	2.00
WBcorrected	2.26	1.66	-0.23	7.00	63.00	3.00	4.00
ECMWF.sun.glmnet_wlm	1.63	1.32	-0.01	32.00	22.00	18.00	14.00

Table: Scores of different MOS for sunshine duration.

Results: Sunshine Duration

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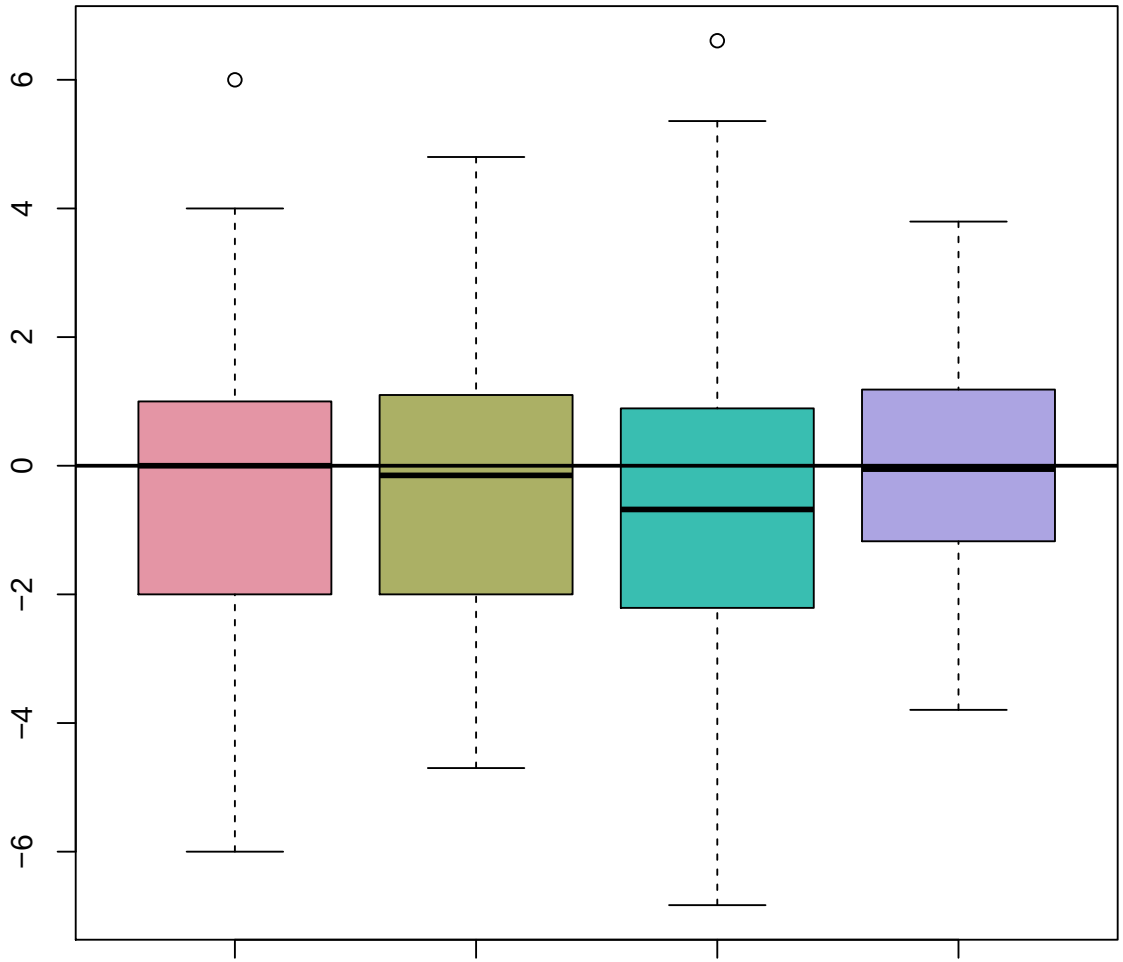
Residual boxplot plus paired t−test results sun [sample: 70]



	WB	METEOSERVICE	bestGFS	bestECMWF
t.test mean		0.299	0.127	0.483
t.test p.val		0.257	0.709	0.0704

Results: Precipitation Amount

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	RMSE	MAE	BIAS	better	equal	worse	points
COSMO7.rrr.glmnet_lmX	6.13	2.32	-1.22	17.00	8.00	38.00	-21.00
METEO SERVICE	4.67	2.50	1.11	14.00	34.00	24.00	-10.00
WB	4.85	2.17	0.47	0.00	72.00	0.00	0.00
GEFS.rrr.glmnet_wlm	5.25	1.94	-0.51	21.00	28.00	21.00	0.00
WB corrected	4.93	2.11	0.30	8.00	58.00	6.00	2.00
GEFS.rrr.glmnet_wwlm	5.37	1.74	-1.07	20.00	38.00	12.00	8.00
Climatology	5.95	1.92	-1.92	22.00	39.00	11.00	11.00
ECMWF.rrr.glmnet_wlm	4.77	1.75	-0.55	23.00	36.00	12.00	11.00
GEFS.rrr.glmnet_swwlm	5.41	1.72	-1.16	21.00	39.00	10.00	11.00

Table: scores for precipitation amount.

Results: Precipitation Amount

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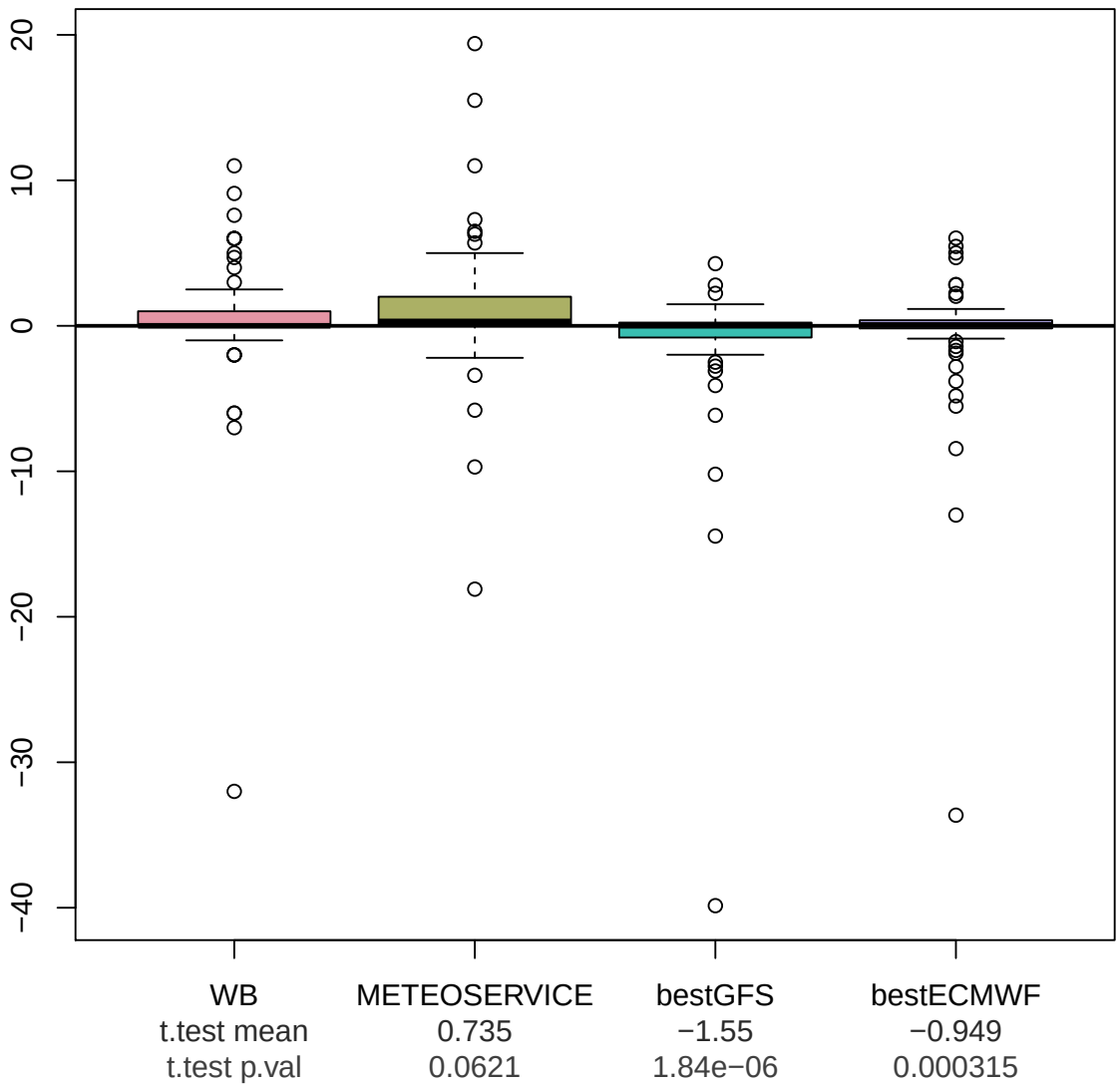

Results: Probability of Precipitation

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ECMWF.1glmnet

forecast \ observations	FALSE	TRUE
FALSE	27	16
TRUE	13	15
HR	0.483871	
FAR	0.4642857	

ECMWF.glmnet

forecast \ observations	FALSE	TRUE
FALSE	37	14
TRUE	3	17
HR	0.5483871	
FAR	0.15	

GEFS.1glmnet

forecast \ observations	FALSE	TRUE
FALSE	28	7
TRUE	10	24
HR	0.7741935	
FAR	0.2941176	

GEFS.glmnet

forecast \ observations	FALSE	TRUE
FALSE	30	7
TRUE	8	24
HR	0.7741935	
FAR	0.25	

WB

forecast \ observations	FALSE	TRUE
FALSE	29	5
TRUE	11	26
HR	0.8387097	
FAR	0.2972973	

METEO SERVICE

forecast \ observations	FALSE	TRUE
FALSE	18	22
TRUE	2	29
HR	0.5686275	
FAR	0.06451613	

Results: Probability of Precipitation ECMWF

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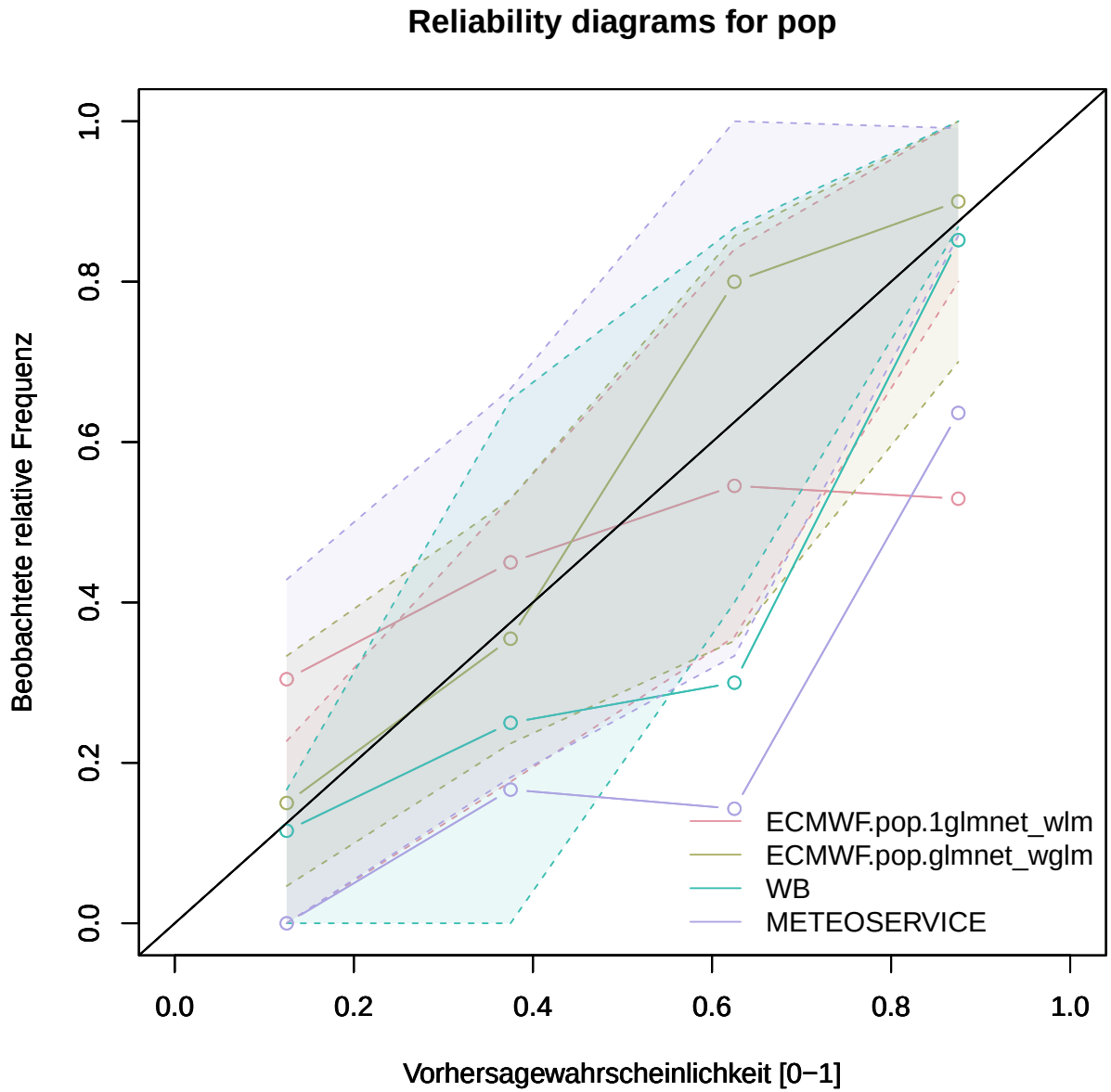

Results: Probability of Precipitation GEFS

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