Post-processing of model output made easy

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NWP forecasts not perfect

- Systematic errors
- Uncertainty in the initial conditions
- Influence of the resolution of the model
- Global model to Regional domain



Model Output Statistics

- Determining a statistical relationship between forecast and observation
- Sufficient historical archive
- Quantify the systematic forecast errors (bias) for each observation point
- Error at each point is then used to correct future forecasts at the respective point
- MOS requires separate calculations of statistics based on forecast-observation pairs for each lead-time, for each observation location and for each variable

Warner, 2011



Model Output Statistics

- Short-training periods are possible for MOS-based methods
- HOWEVER:
 - Longer lead-time forecasts
 - Rare-events
 - Surface variables with significant bias

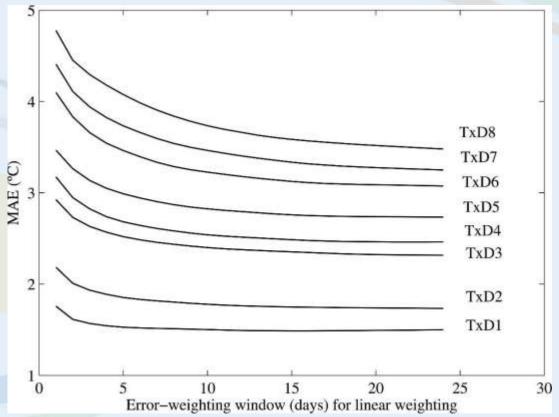
ALL need longer training periods



Model Output Statistics

Short-training periods are possible for MOS-based

methods



Warner, 2011

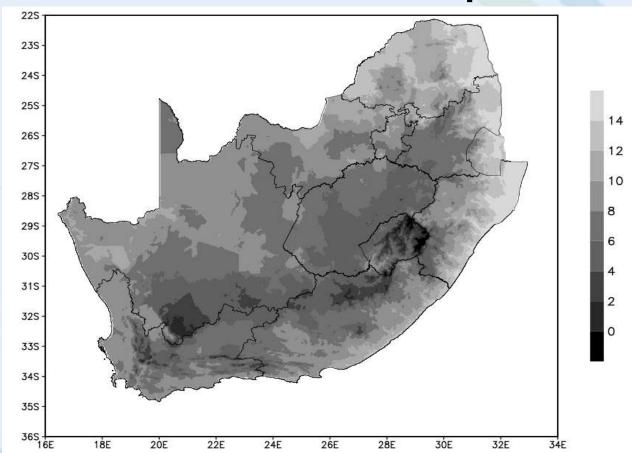


Model Output Statistics: Bias Correction Methods

- Very-short-update-period dynamic MOS
- Bias-calculation approach:
 - Seasonal-mean-error: average mean forecast error is calculated for 6-month period of previous "warm season". Error then is used to correct forecast of "warm season".
 - Moving average with uniform weighting: mean forecast error is calculated using an unweighted average of the bias error from the previous n days.
 - Moving average with linear weighting: Same, but linearly average, with recent errors weighing more responsive to regime changes but have long averaging period in order to provide statistical stability
 - Moving average with non-linear weighting: Same, but using a nonlinearly weighted average.

Warner, 2011

Bias Correction Methods: A SAWS Eample



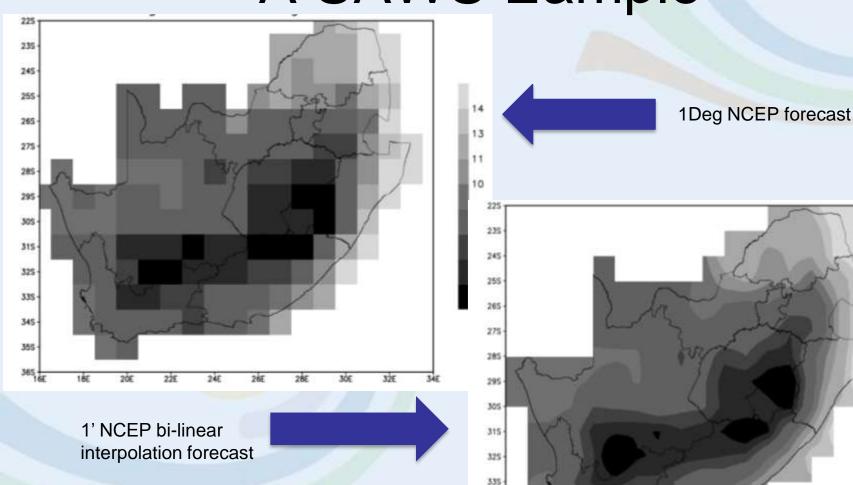
Marx & Landman, 2011



Bias Correction Methods:
A SAWS Eample

345

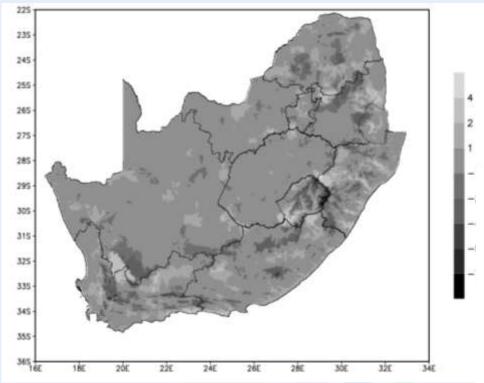
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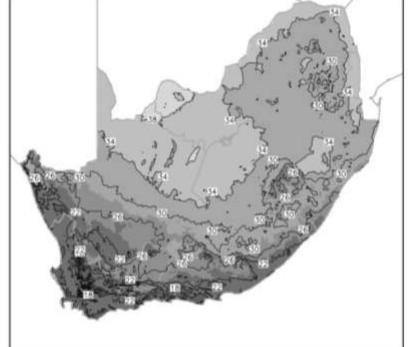
Marx & Landman, 2011

Doc Ref no: RES-PSN-SWFDP_Bias_cor

Bias Correction Methods: A SAWS Eample



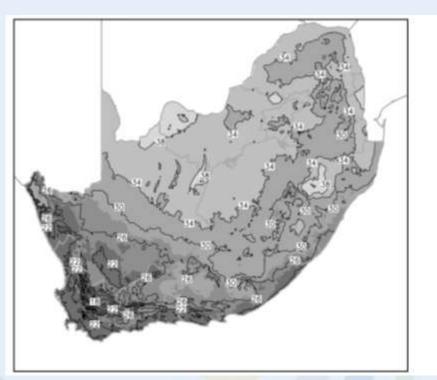
Average monthly map - NCEP
1' interpolated forecast
CLIMATE ERROR



CLIMATE ERROR field applied to 1' interpolated forecast

Marx & Landman, 2011

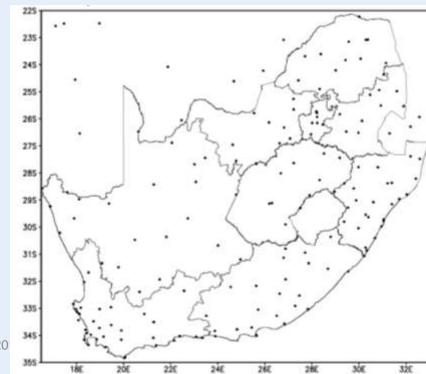
Bias Correction Methods: A SAWS Eample





14-day running unweighted bias corrections on 167 stations – inverse bi-linear interpolation to apply bias to whole domain

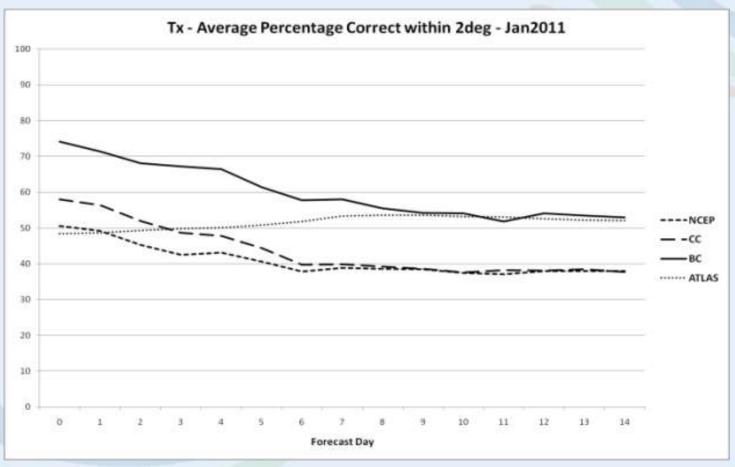
CLIMATE-BIAS CORRECTED FORECAST



Marx & Landman, 2011

Doc Ref no: RES-PSN-SWFDP_Bias_correction-20

Bias Correction Methods: A SAWS Eample





Bias Correction Methods: Made Easy

- 1. Daily minimum and maximum temperature forecast
- 2. Daily minimum and maximum temperature observations
- 3. Calculate daily: Bias = (F O)
- 4. After at least 14-days, calculate:

$$raBias = \frac{1}{n} \mathop{\circ}_{k=1}^{n} (F_k - O_k)$$



Bias Correction Methods: Made Easy

- 5. For new forecast: newFcst = NWPfcst raBias
- 5. New forecast now bias corrected!
- 6. Adjust *raBias* daily for current 14-day average.
- 7. Apply to Tn and Tx.



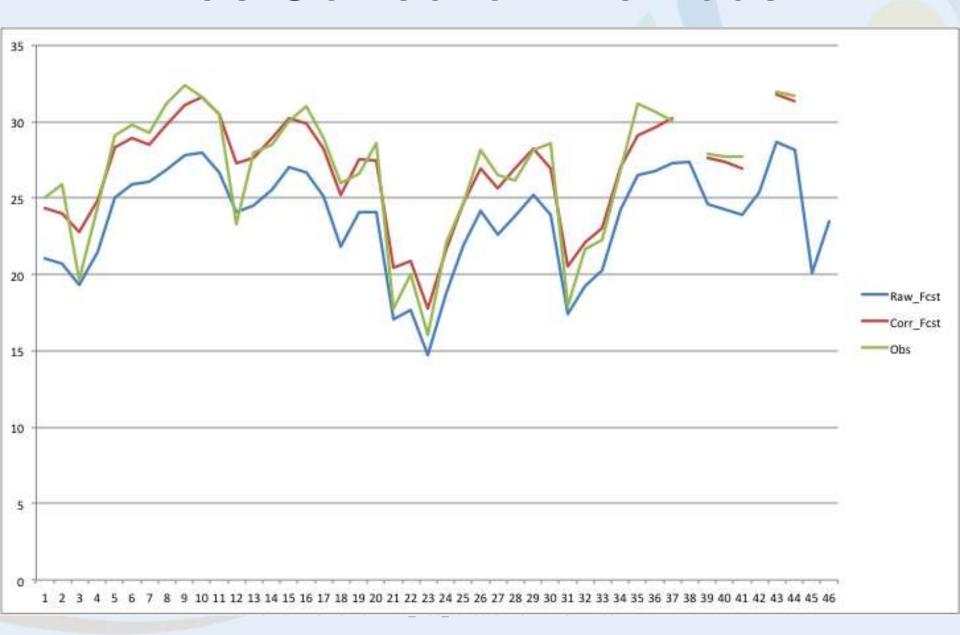
Bias Correction Methods: Made Easy - example

Date	ID		Lat	Lon	Txo	Txf	Bias	14d mean	Tnf bc
2012080	1	68262	-25,74	28,18	222		*		
2012080	2	68262	-25,74	28,18	208	18,1	-2,7	-	
2012080	3	68262	-25,74	28,18	231	20,2	-2,9	-	
2012080	4	68262	-25,74	28,18	248	22,2	-2,6		
2012080	5	68262	-25,74	28,18	260	22,6	-3,4	-	
2012080	6	68262	-25,74	28,18	256	17,9	-7,7	*	
2012080	7	68262	-25,74	28,18	215	8,9	-12,6	-	
2012080	8	68262	-25,74	28,18	89	12,4	3,5	-	
2012080	9	68262	-25,74	28,18	148	15,5	0,7	2	
2012081	0	68262	-25,74	28,18	183	18,3	0	*	
2012081	1	68262	-25,74	28,18	219	21,1	-0,8	-	
2012081	2	68262	-25,74	28,18	251	12,3	-12,8	-	
2012081	3	68262	-25,74	28,18	154	16,6	1,2	-	
2012081	4	68262	-25,74	28,18	206	19,8	-0,8	2	
2012081	5	68262	-25,74	28,18	285	23,9	-4,6	-3,25	
2012081	6	68262	-25,74	28,18	250	21,1	-3,9	-3,33571	24,35
2012081	7	68262	-25,74	28,18	259	20,7	-5,2	-3,5	24,03571
2012081	8	68262	-25,74	28,18	197	19,3	-0,4	-3,34286	22,8
2012081	9	68262	-25,74	28,18	244	21,5	-2,9	-3,30714	24,84286
2012082	0	68262	-25,74	28,18	291	25	-4,1	-3,05	28,30714
2012082	1	68262	-25,74	28,18	298	25,9	-3,9	-2,42857	28,95
2012082	2	68262	-25,74	28,18	293	26,1	-3,2	-2,90714	28,52857
2012082	3	68262	-25,74	28,18	312	26,9	-4,3	-3,26429	29,80714
2012082	4	68262	-25,74	28,18	324	27,8	-4,6	-3,59286	31,06429
2012082	5	68262	-25,74	28,18	316	28	-3,6	-3,79286	31,59286
2012082	6	68262	-25,74	28,18	305	26,7	-3,8	-3,15	30,49286
2012082	7	68262	-25,74	28,18	233	24,1	0,8	-3,17857	27,25



Date	ID		Lat	Lon		Тхо	Txf	Bias		14d mean	Tnf bc	New Bias	OBS	ABS	Bias	ABS Nbias	Event	N	bias <bias< th=""></bias<>
20120801		68262	-25,74		28,18	222		2											
20120802		68262	-25,74		28,18	208		100 100	-2,7										
20120803		68262	-25,74		28,18	231		60	-2,9										
20120804		68262	-25,74		28,18	248		-	-2,6										
20120805		68262	-25,74		28,18	260			-3,4										
20120806		68262	-25,74		28,18	256			-7,7										
20120807		68262	-25,74		28,18	215		l.	-12,6										
20120808		68262	-25,74		28,18	89	12,4	-	3,5										
20120809		68262	-25,74		28,18	148	15,5		0,7										
20120810		68262	-25,74		28,18	183	18,3		0	-									
20120811		68262	-25,74		28,18	219	21,1	8	-0,8										
20120812		68262	-25,74		28,18	251	12,3		-12,8	-									
20120813		68262	-25,74		28,18	154	16,6	8	1,2										
20120814		68262	-25,74		28,18	206	19,8		-0,8	-									
20120815		68262	-25,74		28,18	285	23,9	ij.	-4,6	-3,25									
20120816		68262	-25,74		28,18	250	21,1		-3,9	-3,33571	24,35	-0,65		25	3,9	0,65		1	1
20120817		68262	-25,74		28,18	259	20,7		-5,2	-3,5	24,03571	-1,86429	2	5,9	5,2	1,864286		1	1
20120818		68262	-25,74		28,18	197	19,3		-0,4	-3,34286	22,8	3,1	. 1	9,7	0,4	3,1		1	0
20120819		68262	-25,74		28,18	244	21,5	i	-2,9	-3,30714	24,84286	0,442857	2	1,4	2,9	0,442857		1	1
20120820		68262	-25,74		28,18	291	25		-4,1	-3,05	28,30714	-0,79286	2),1	4,1	0,792857		1	1
20120821		68262	-25,74		28,18	298	25,9		-3,9	-2,42857	28,95	-0,85	2	9,8	3,9	0,85		1	1
20120822		68262	-25,74		28,18	293	26,1		-3,2	-2,90714	28,52857	-0,77143	2	9,3	3,2	0,771429		1	1
20120823		68262	-25,74		28,18	312	26,9		-4,3	-3,26429	29,80714	-1,39286	3	1,2	4,3	1,392857		1	1
20120824		68262	-25,74		28,18	324	27,8		-4,6	-3,59286	31,06429	-1,33571	3	2,4	4,6	1,335714		1	1
20120825		68262	-25,74		28,18	316	28		-3,6	-3,79286	31,59286	-0,00714	3	1,6	3,6	0,007143		1	1
20120826		68262	-25,74		28,18	305	26,7		-3,8	-3,15	30,49286	-0,00714	30),5	3,8	0,007143		1	1
20120827		68262	-25,74		28,18	233	24,1	No.	0,8	-3,17857	27,25	3,95	2	3,3	0,8	3,95		1	0
20120922							27,4			-3,06154		5							0
20120923		68262	-25,74		28,18	279			-3,3	-3,1	27,66154	-0,23846	2	7,9		0,238462		1	
20120924		68262	-25,74		28,18	277		100	-3,4	-3,05385	27,4	-0,3		7,7	3,4			1	1
20120925		68262	-25,74		28,18	277		100	-3,8	-3,04615	26,95385	-0,74615		7,7	3,8			1	1
20120926		OULUL			20,10	***	25,4	95	3,0	-3,1			3.00	,,,	3,0	- 0,7,70137			0
20120927		68262	-25,74		28,18	320		100	-3,3	-3,125	31,8	-0,2		32		0,2		1	
20120928		68262	-25,74		28,18	317	S 0000000	60	-3,5	-3,025	31,325	-0,375		1,7	3,5			1	1
20120929		OULUL	6077.7		20,20	541	20,1	M.	2,3	-3,25455		,,,,,,		.,,	3,3	- 0,575			0
20120929							23,5			-3,23433				-					U
20120930							23,3	_	5714	-3,33		-0,04036		-			1-00	42 🔽	35
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Bias Correction Methods:



Bias Correction Methods: Made Easy

QUESTIONS?

