

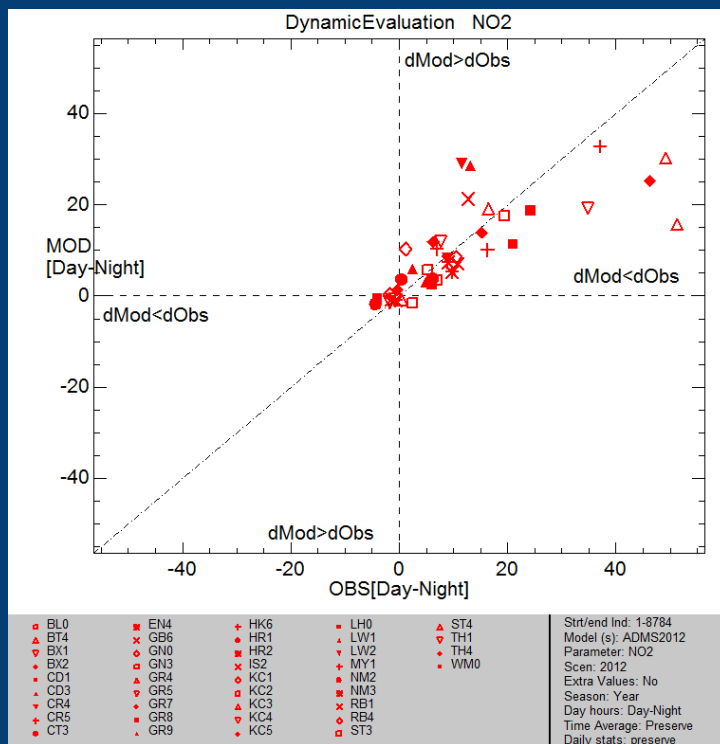
# Comparing QA/QC metrics of two street-scale model configurations

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FAIRMODE

8<sup>th</sup> October 2021

Online

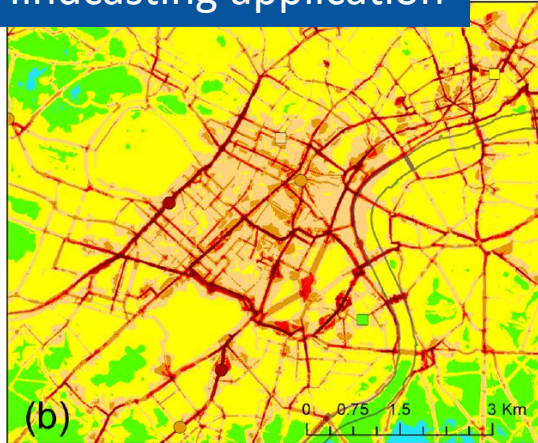
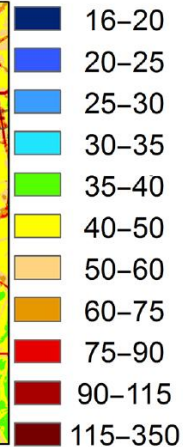




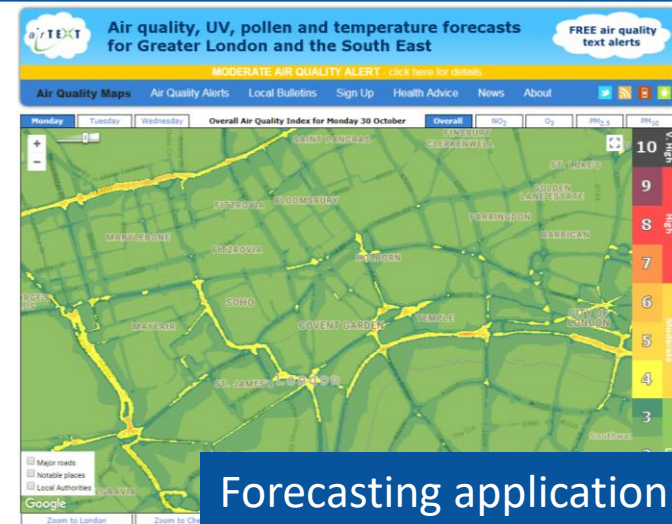
# Model descriptions

## Hindcasting application

NO<sub>2</sub> annual mean (µg m<sup>-3</sup>)

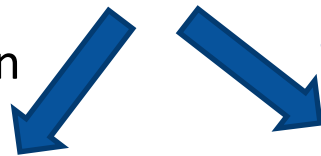


- Hourly modelled concentrations from CERC's quasi-Gaussian ADMS-Urban model
- Street-scale resolution allows evaluation at a range of site types
- **2 applications**



## Forecasting application

- **Research project** involving modelling AQ in London (2012)
- 45 sites (17 background, 28 traffic)
- Measured meteorology and long-range pollutant concentration data used as input, so **good model performance expected**



- **Air quality forecast results** from the airTEXT ([www.airtext.info](http://www.airtext.info)) system for London (2018)
- 84 sites (13 background, 52 traffic, 4 industrial)
- Forecast meteorology and forecast long-range pollutant concentration data (CAMS) used as input, so **model performance likely to be less good**

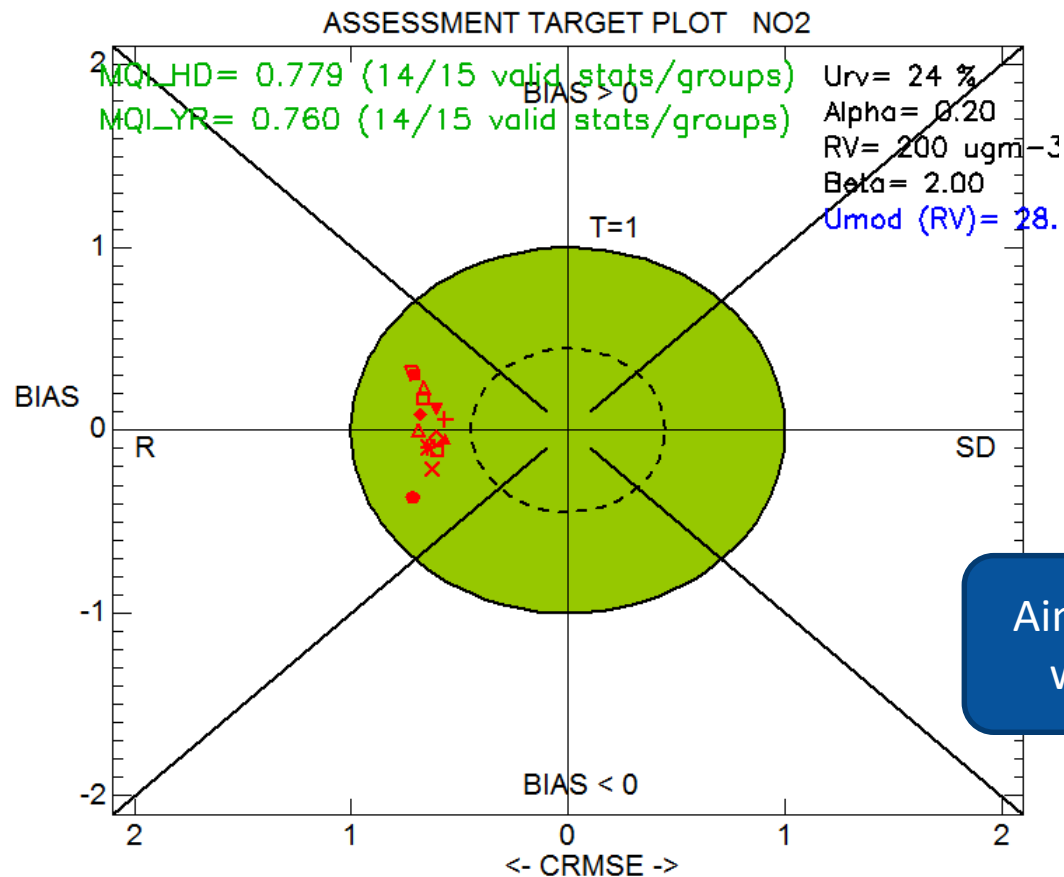
Hood, C., MacKenzie, I., Stocker, J., Johnson, K., Carruthers, D., Vieno, M. and Doherty, R., 2018. Air quality simulations for London using a coupled regional-to-local modelling system. Atmospheric Chemistry and Physics, 18(15), pp.11221-11245.

Stidworthy, A., Jackson, M., Johnson, K., Carruthers, D. and Stocker, J., 2018. Evaluation of local and regional air quality forecasts for London. International Journal of Environment and Pollution, 64(1-3), pp.178-191.

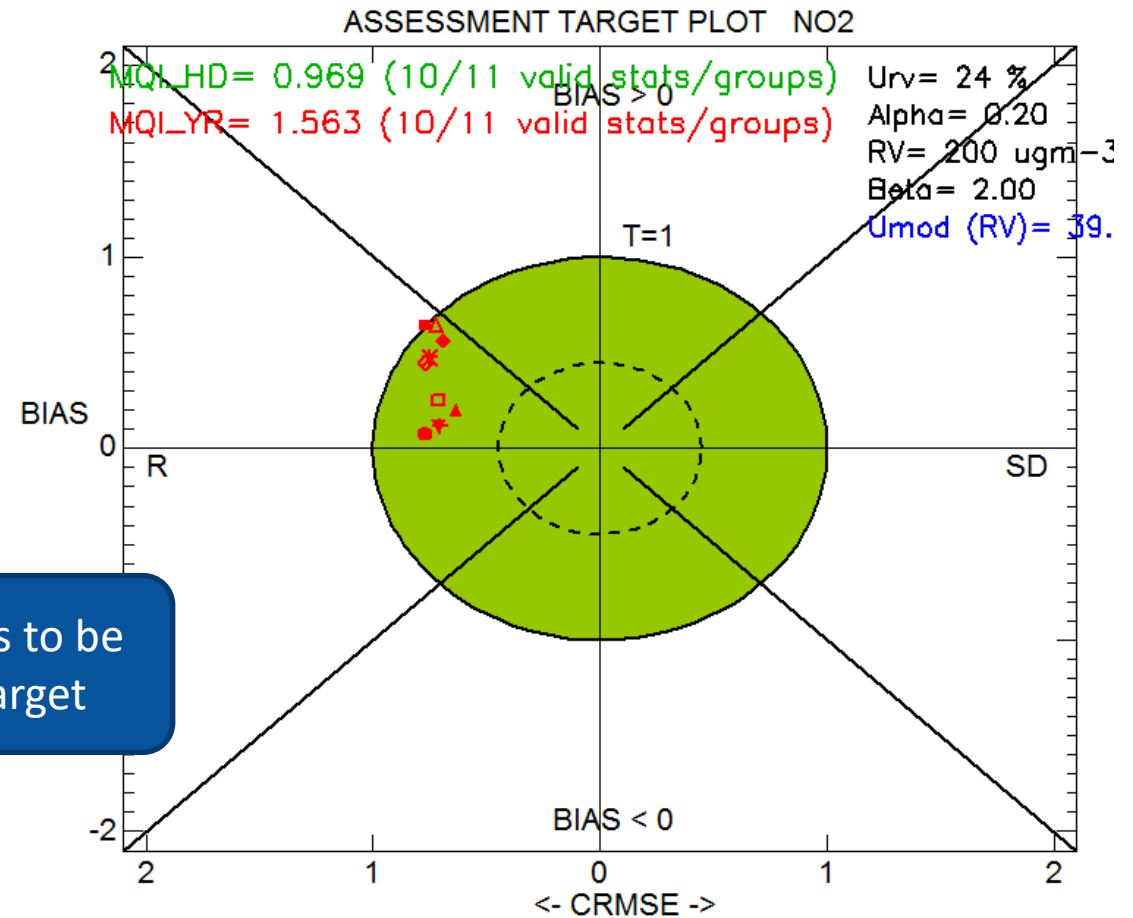


# Compare performance: Background site target plot NO2

## • Hindcast



## • Forecast



Aiming for points to be within green target

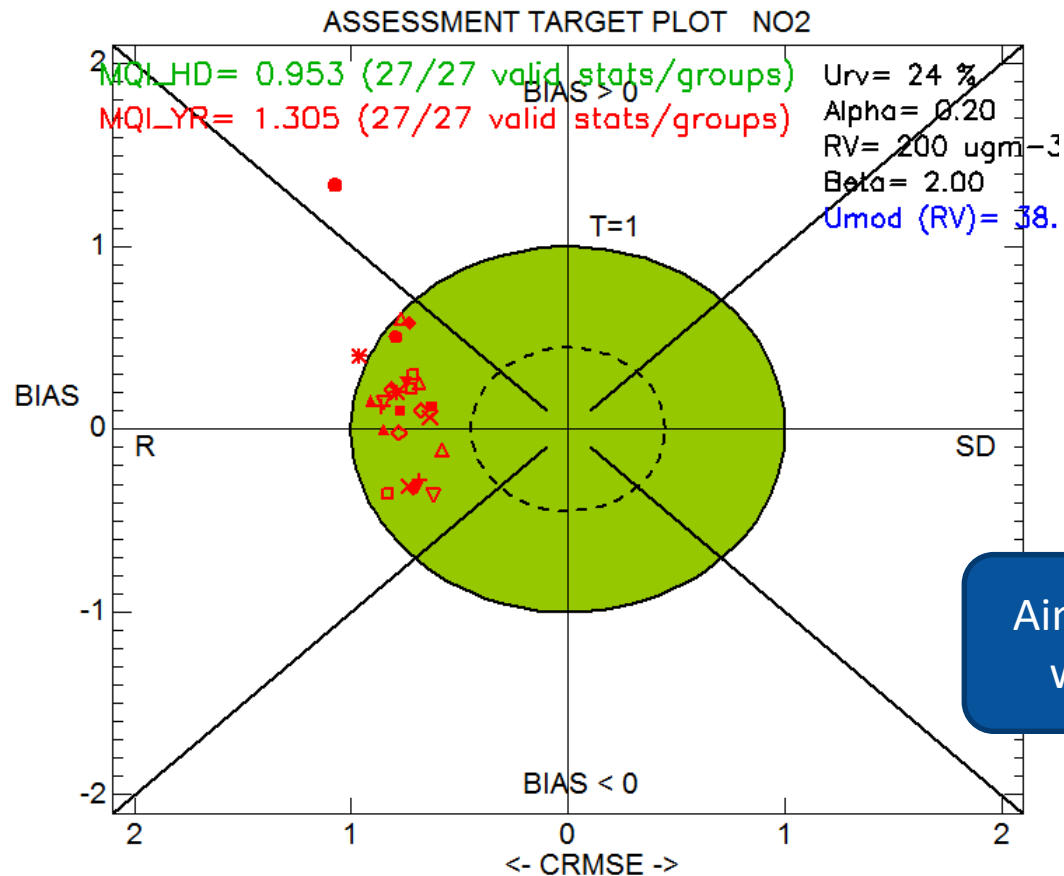
□ BL0	■ NM3	Strt/end Ind: 1-8784
□ BX1	× RB1	Model (s): ADMS2012
□ BX2	× ST3	Parameter: NO2
□ CT3	□ TH1	Scen: 2012
□ GR4	▲ WM0	Extra Values: No
□ HR1		Season: Year
□ KC1		Day hours: All 24h
□ LH0		Time Average: Preserve
□ LW1		Daily stats: preserve

□ BL0	■ WM0	Strt/end Ind: 1-8760
□ BQ7		Model (s): Day0
□ CT3		Parameter: NO2
□ IS6		Scen: 2018
□ KC1		Extra Values: No
□ LB6		Season: Year
□ LW1		Day hours: All 24h
□ WA2		Time Average: Preserve
□ WA9		Daily stats: preserve

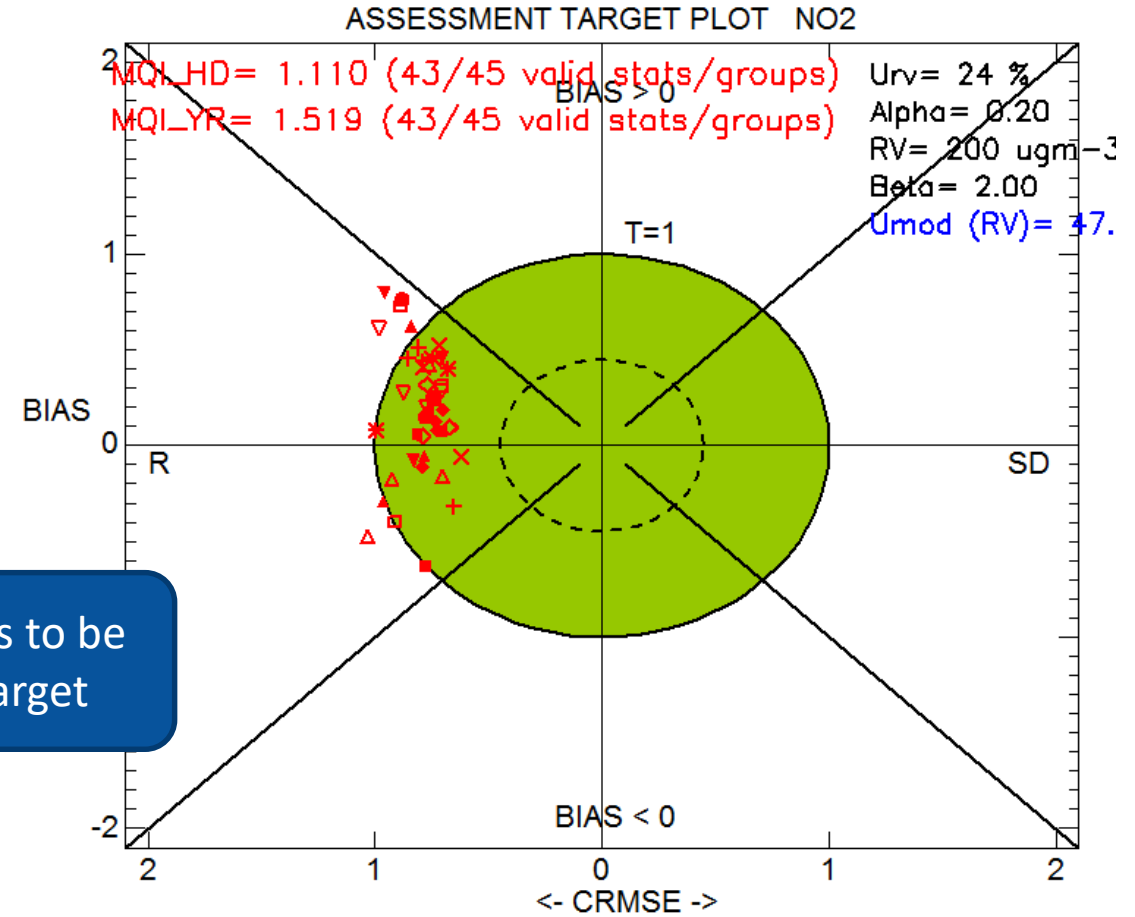


# Compare performance: Traffic site target plot NO2

## • Hindcast



## • Forecast



Aiming for points to be within green target

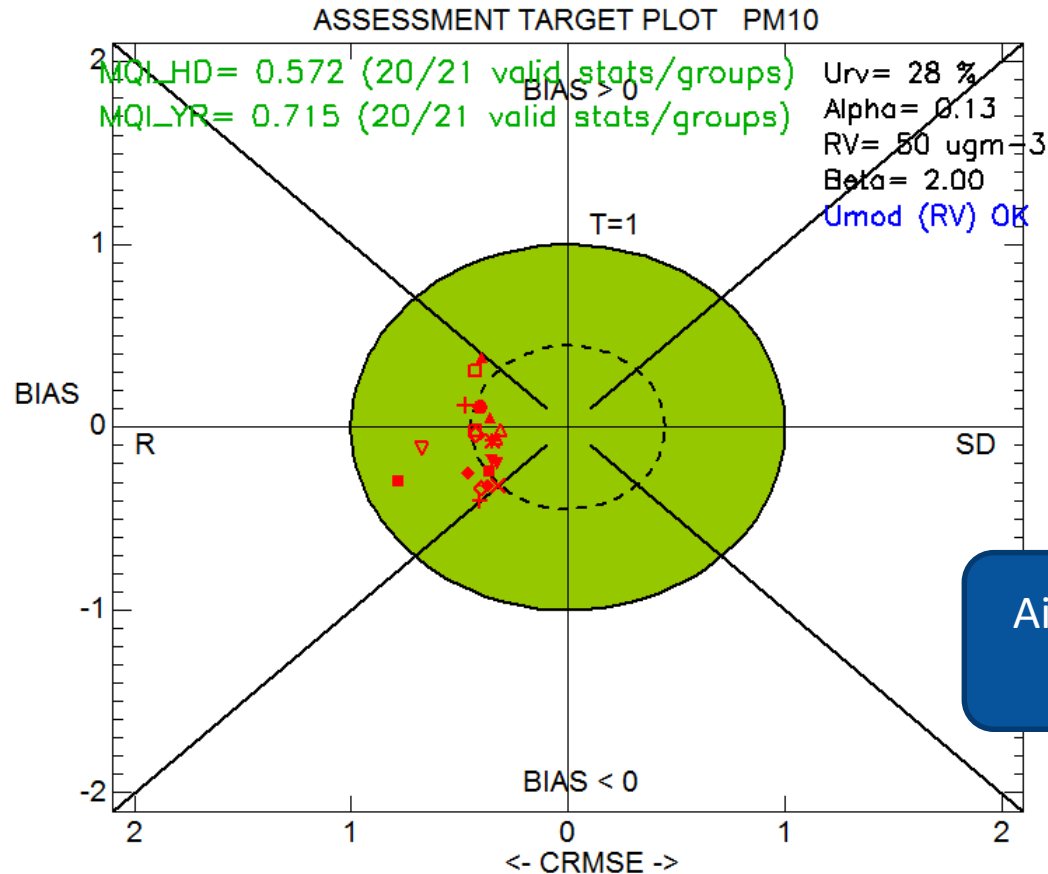
◇ BT4	● GR5	▲ KC3	Strt/end Ind: 1-8784
◇ CD1	● GR7	▲ KC4	Model (s): ADMS2012
◇ CD3	● GR8	▲ KC5	Parameter: NO2
◇ CR4	● GR9	▲ LW2	Scen: 2012
◇ CR5	● HG1	▲ MY1	Extra Values: No
◇ EN4	● HK6	▲ NM2	Season: Year
◇ GB6	● HR2	▲ RB4	Day hours: All 24h
◇ GN0	● IS2	▲ ST4	Time Average: Preserve
◇ GN3	● KC2	▲ TH4	Daily stats: preserve

◇ BG1	● EA6	▲ GR4	◇ HV3	▲ ST6	Strt/end Ind: 1-8760 Model (s): Day0 Parameter: NO2 Scen: 2018 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserve Daily stats: preserve
◇ BG2	● E11	▲ GR7	◇ IS2	▲ TH2	
◇ BT4	● EN1	▲ GR8	◇ LW2	▲ TH4	
◇ BT6	● EN4	▲ GR9	◇ MY1	▲ TK8	
◇ BX1	● EN5	▲ HG1	◇ RB4	▲ WA7	
◇ BX2	● GB6	◇ HI0	◇ RI1	▲ WA8	
◇ CD1	● GN0	◇ HK6	◇ SK5	▲ WM6	
◇ CR5	● GN3	◇ HR2	◇ ST4		
◇ CT6	● GN4	◇ HV1			

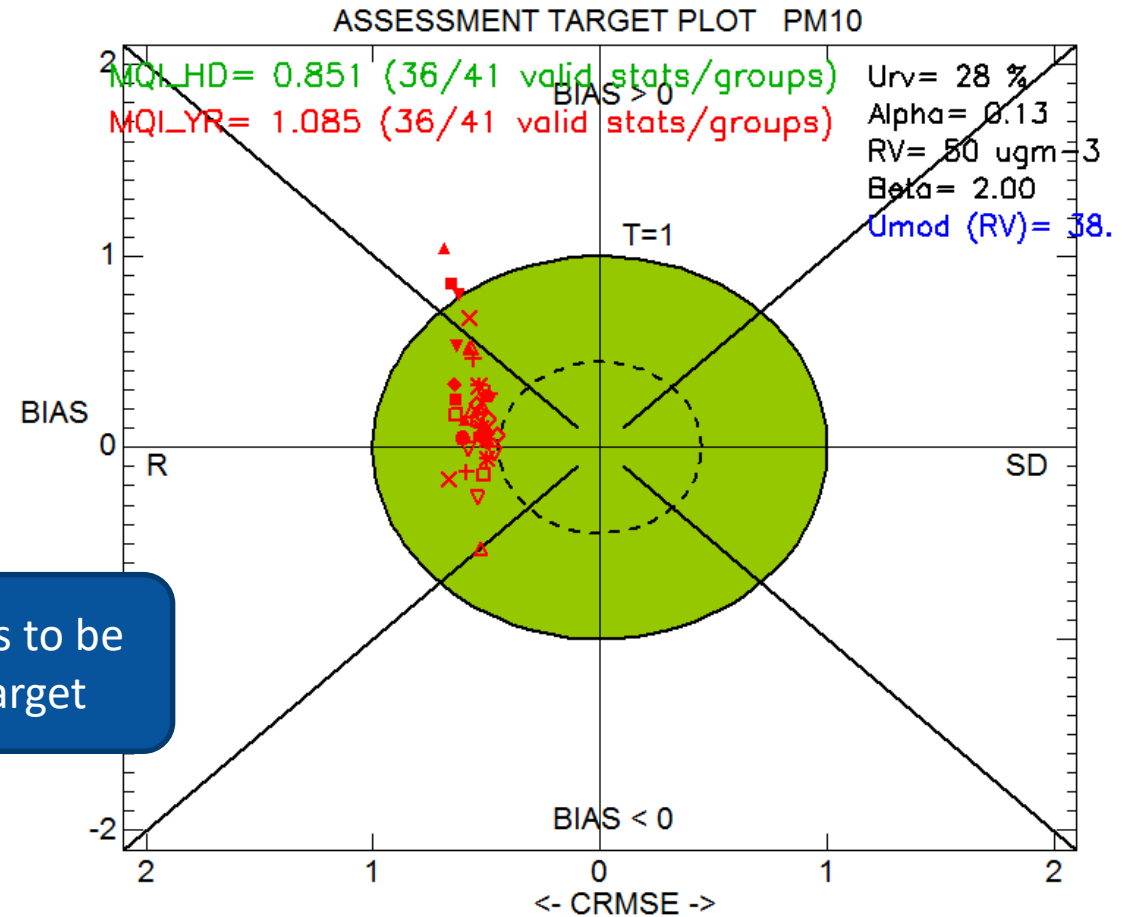


# Compare performance: Traffic site target plot PM10

## • Hindcast



## • Forecast



Aiming for points to be within green target

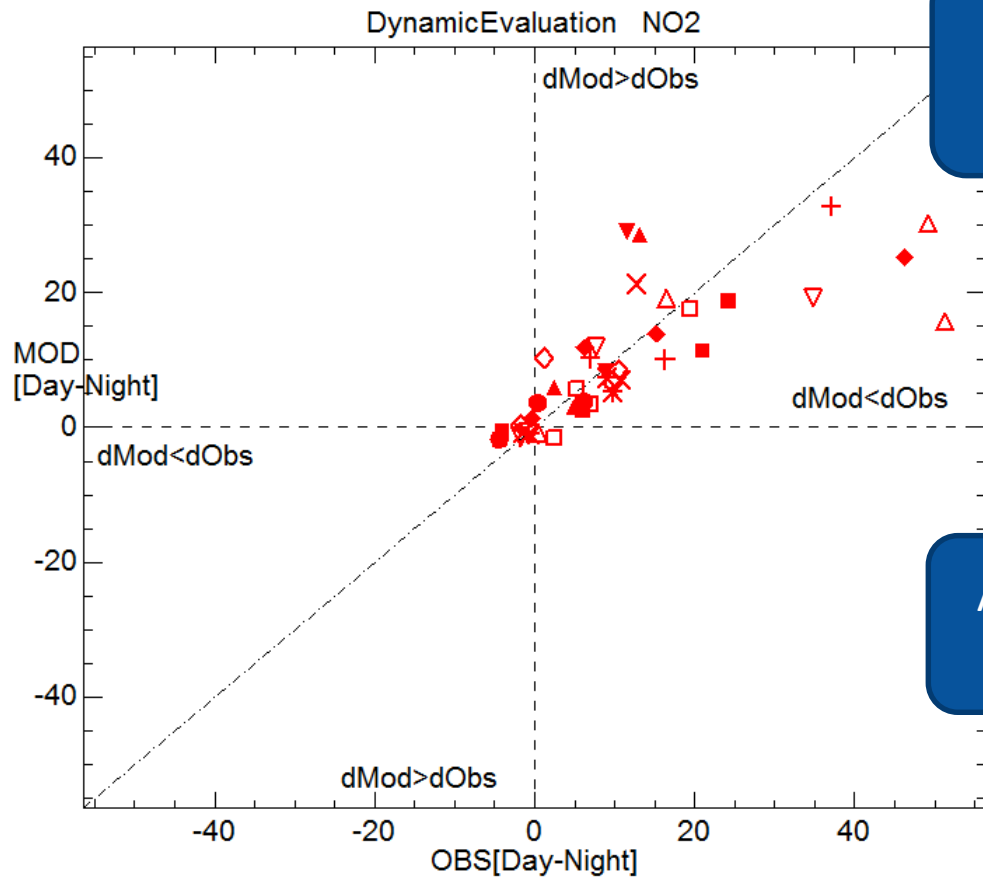
◇ BT4	◇ GR9	▽ ST4	Strt/end Ind: 1-8784 Model (s): ADMS2012 Parameter: PM10 Scen: 2012 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserve Daily stats: Mean
◇ CD1	◇ HG1	◇ TH4	
◇ CD3	◇ HK6		
◇ CR4	◇ HR2		
◇ EN4	◇ HV3		
◇ GN0	◇ IS2		
◇ GR5	◇ KC5		
◇ GR7	◇ MY1		
◇ GR8	◇ RB4		

◇ BG2	◇ E11	▽ GR9	▽ RB4	Strt/end Ind: 1-8760 Model (s): Day0 Parameter: PM10 Scen: 2018 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserve Daily stats: Mean
◇ BT4	◇ EN5	◇ HK6	◇ RI1	
◇ BT6	◇ GB6	◇ HR2	◇ RI2	
◇ BX0	◇ GN0	◇ HV1	◇ SK5	
◇ BX1	◇ GN3	◇ HV3	◇ ST4	
◇ BX2	◇ GN4	◇ IS2	◇ ST6	
◇ CD1	◇ GR4	◇ LW2	◇ TH4	
◇ CT8	◇ GR7	◇ MY1	◇ TK8	
◇ EA6	◇ GR8	◇ MY7	◇ WA7	

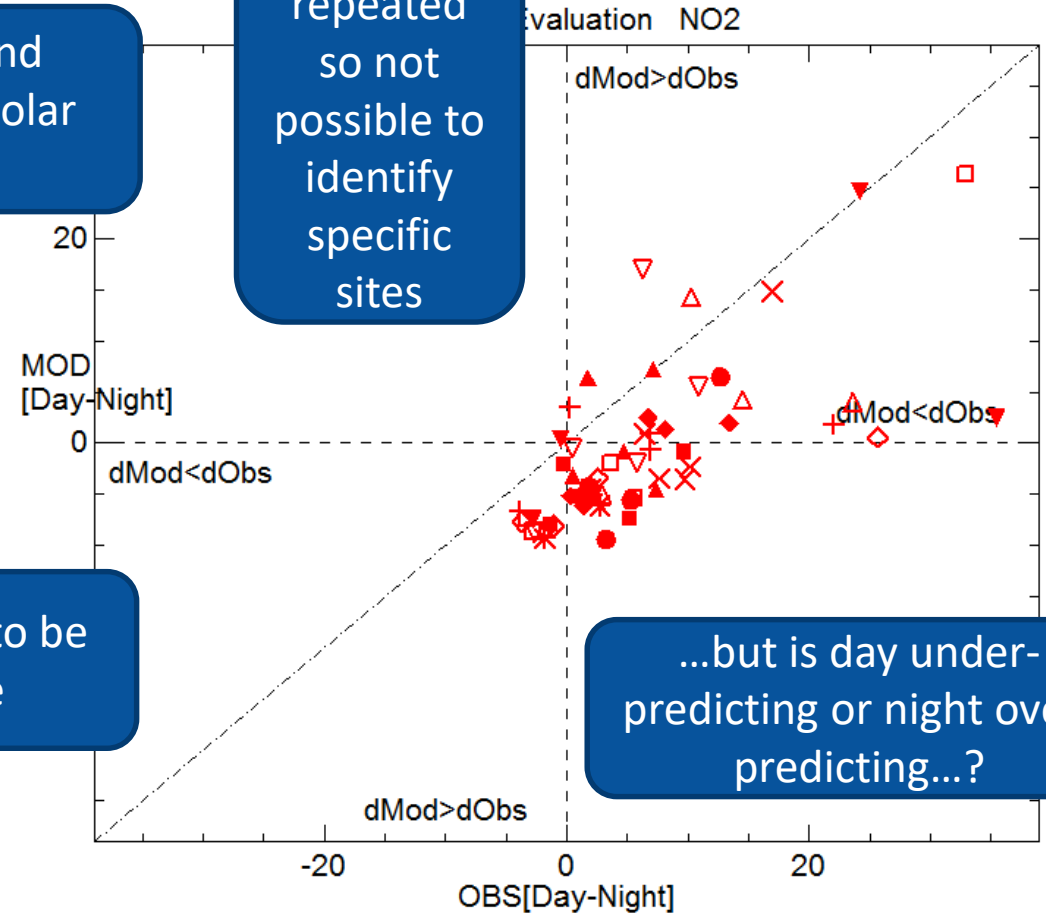


# Compare performance: Day – Night NO2

## • Hindcast



## • Forecast



How are 'day' and 'night' defined? Solar elevation?

Symbols repeated so not possible to identify specific sites

Aiming for points to be on the 1:1 line

...but is day under-predicting or night over-predicting...?

BL0	EN4	HK6	LH0	ST4
BT4	GB6	HR1	LW1	TH1
BX1	GN0	HR2	LW2	TH4
BX2	GN3	IS2	MY1	TH4
CD1	GR4	KC1	NM2	WM0
CD3	GR5	KC2	NM3	
CR4	GR7	KC3	RB1	
CR5	GR8	KC4	RB4	
CT3	GR9	KC5	ST3	

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: NO2  
 Scen: 2012  
 Extra Values: No  
 Season: Year  
 Day hours: Day-Night  
 Time Average: Preserve  
 Daily stats: preserve

BG2	CR5	GB6	HI0	LB6
BL0	CT3	GN0	HK6	LW1
BQ7	CT6	GN3	HR2	LW2
BT4	EA6	GN4	HV1	MY1
BT5	EA8	GR4	HV3	RB4
BT6	EI1	GR7	IS2	RI1
BX1	EN1	GR8	IS6	RI2
BX2	EN4	GR9	KC1	SK5
CD1	EN5	HG1	LB5	ST4

Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: NO2  
 Scen: 2018  
 Extra Values: No  
 Season: Year  
 Day hours: Day-Night  
 Time Average: Preserve  
 Daily stats: preserve

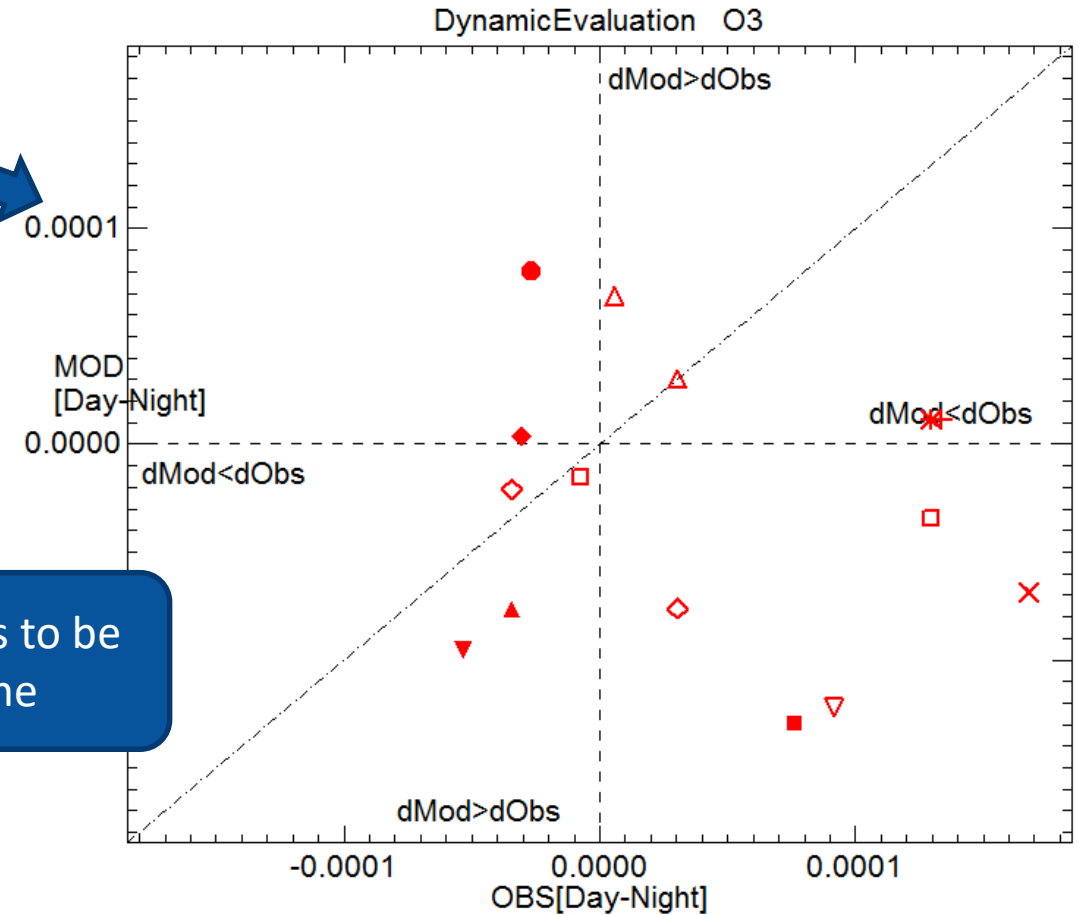
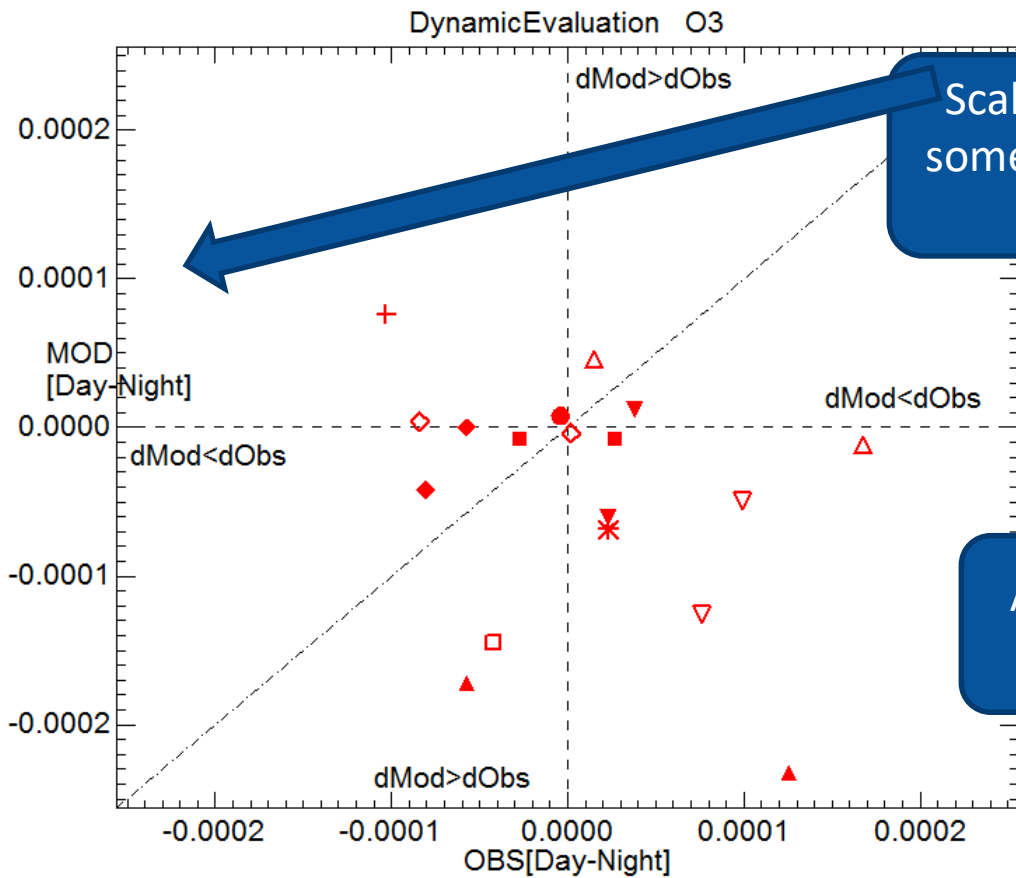




# Compare performance: Day – Night O3

## • Hindcast

## • Forecast



- ◇ BL0
- △ BX1
- ▽ GB6
- ◆ GN3
- GR4
- ▲ GR8
- ▼ GR9
- ✦ HK6
- KC1
- ✦ LH0
- ◇ MY1
- △ NM2
- ▽ NM3
- ◆ RB1
- ▲ ST3
- ▼ TH1
- ✦ TH4
- ▼ WMO

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: O3  
 Scen: 2012  
 Extra Values: No  
 Season: Year  
 Day hours: Day-Night  
 Time Average: 8h  
 Daily stats: Max

- ◇ BL0
- △ BQ7
- ▽ BT4
- ◆ BX1
- GB6
- ▲ GN3
- ▼ GR4
- ▲ GR8
- ▼ GR9
- HI0
- HK6
- ✦ KC1
- ◇ MY1
- RI2
- ▲ TH4

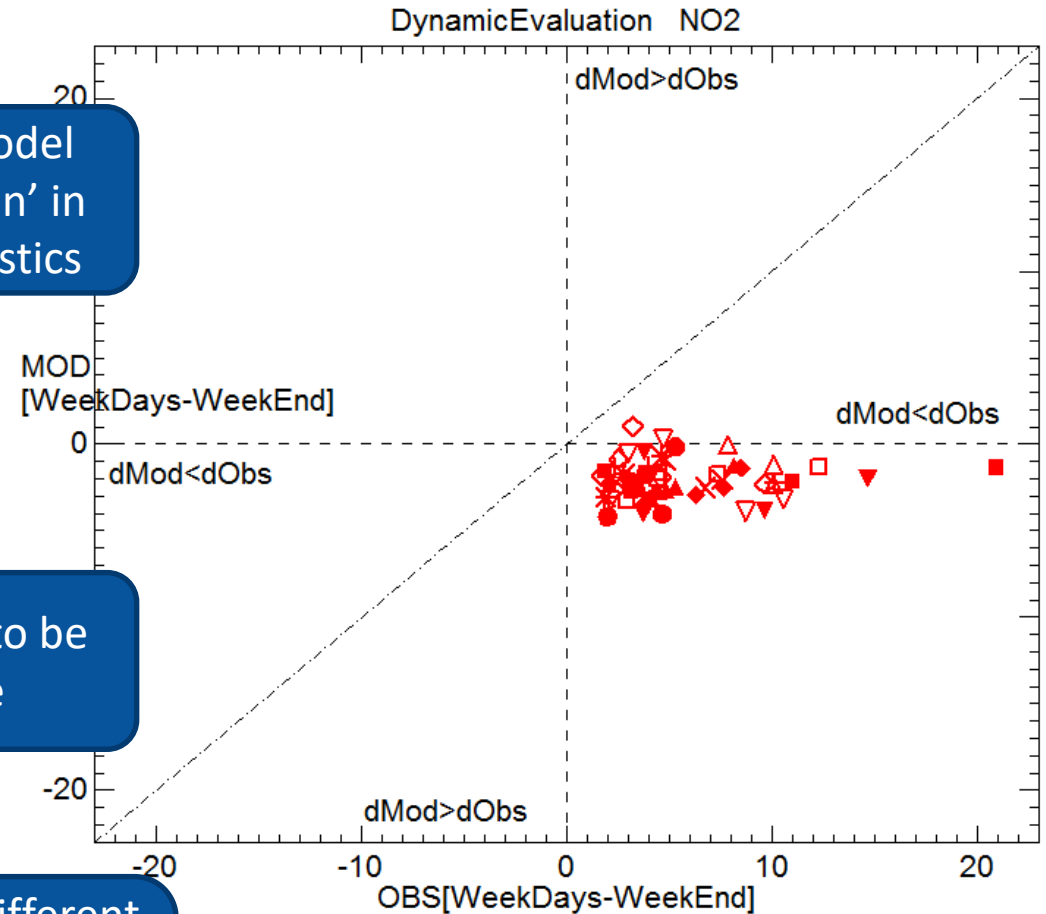
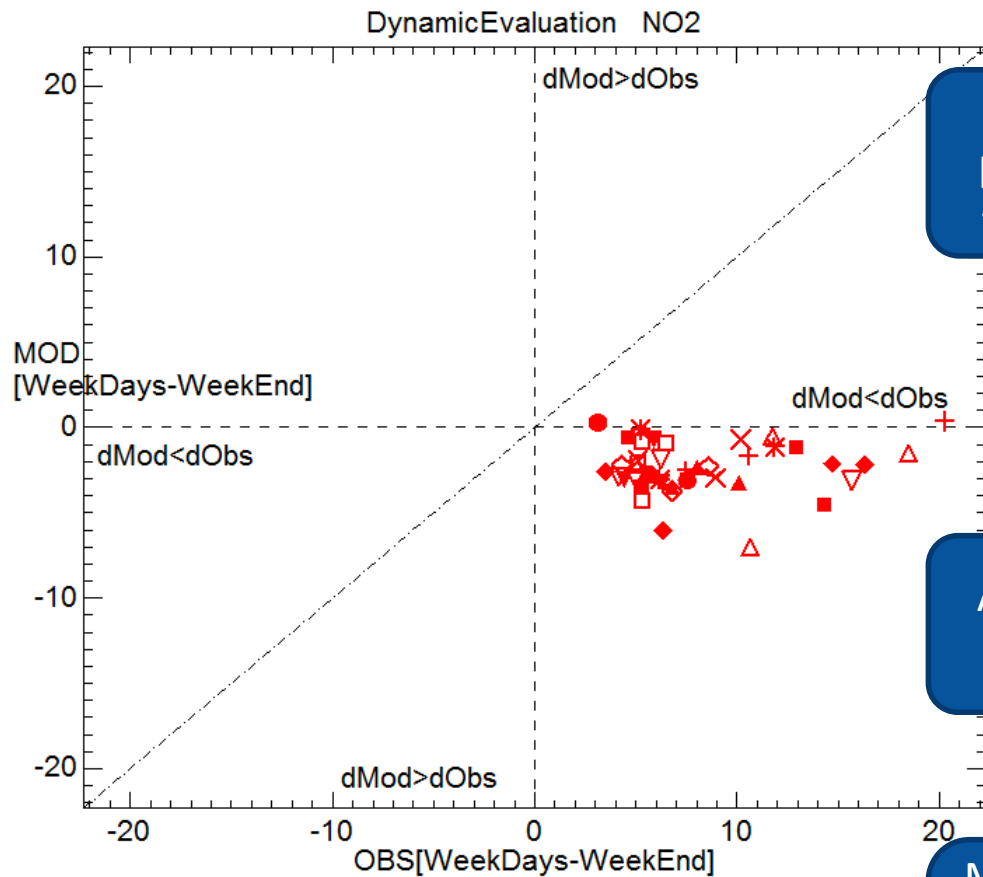
Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: O3  
 Scen: 2018  
 Extra Values: No  
 Season: Year  
 Day hours: Day-Night  
 Time Average: 8h  
 Daily stats: Max



# Compare performance: Weekday / weekend NO2

## • Hindcast

## • Forecast



Corresponding model performance 'green' in the summary statistics

Aiming for points to be on the 1:1 line

Models include a different traffic profile at the weekend but the factors don't vary spatially

BL0	EN4	HG1	KC5	ST3
BT4	GB6	HK6	LH0	ST4
BX1	GN0	HR1	LW1	TH1
BX2	GN3	HR2	LW2	TH4
CD1	GR4	IS2	MY1	WM0
CD3	GR5	KC1	NM2	
CR4	GR7	KC2	NM3	
CR5	GR8	KC3	RB1	
CT3	GR9	KC4	RB4	

Strt/end Ind: 1-878  
 Model (s): ADMS2  
 Parameter: NO2  
 Scen: 2012  
 Extra Values: No  
 Season: Year  
 Day hours: WeekD  
 Time Average: Pres  
 Daily stats: preserve

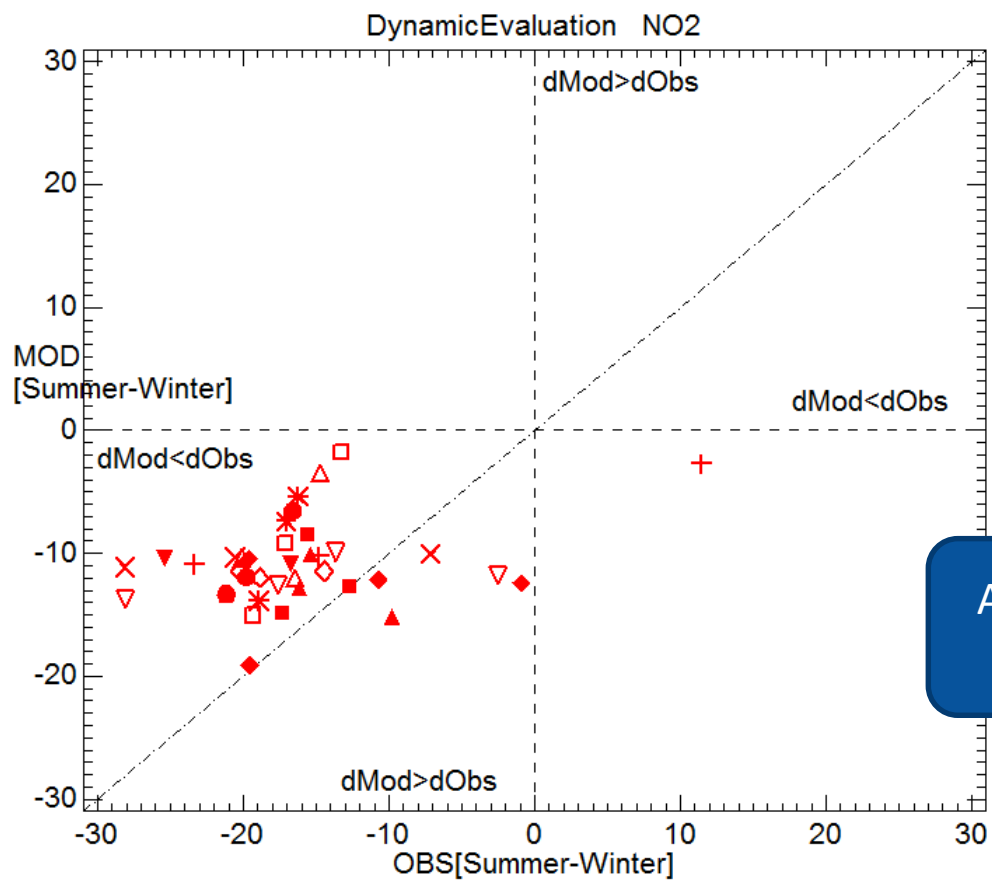
CD1	EN5	HG1	LB5	Strt/end Ind: 1-8760
CR5	GB6	HI0	LB6	Model (s): Day0
CT3	GN0	HK6	LW1	Parameter: NO2
CT6	GN3	HR2	LW2	Scen: 2018
EA6	GN4	HV1	MY1	Extra Values: No
EA8	GR4	HV3	RB4	Season: Year
EI1	GR7	IS2	RI1	Day hours: WeekDays-WeekE
EN1	GR8	IS6	RI2	Time Average: Preserve
EN4	GR9	KC1	SK5	Daily stats: preserve





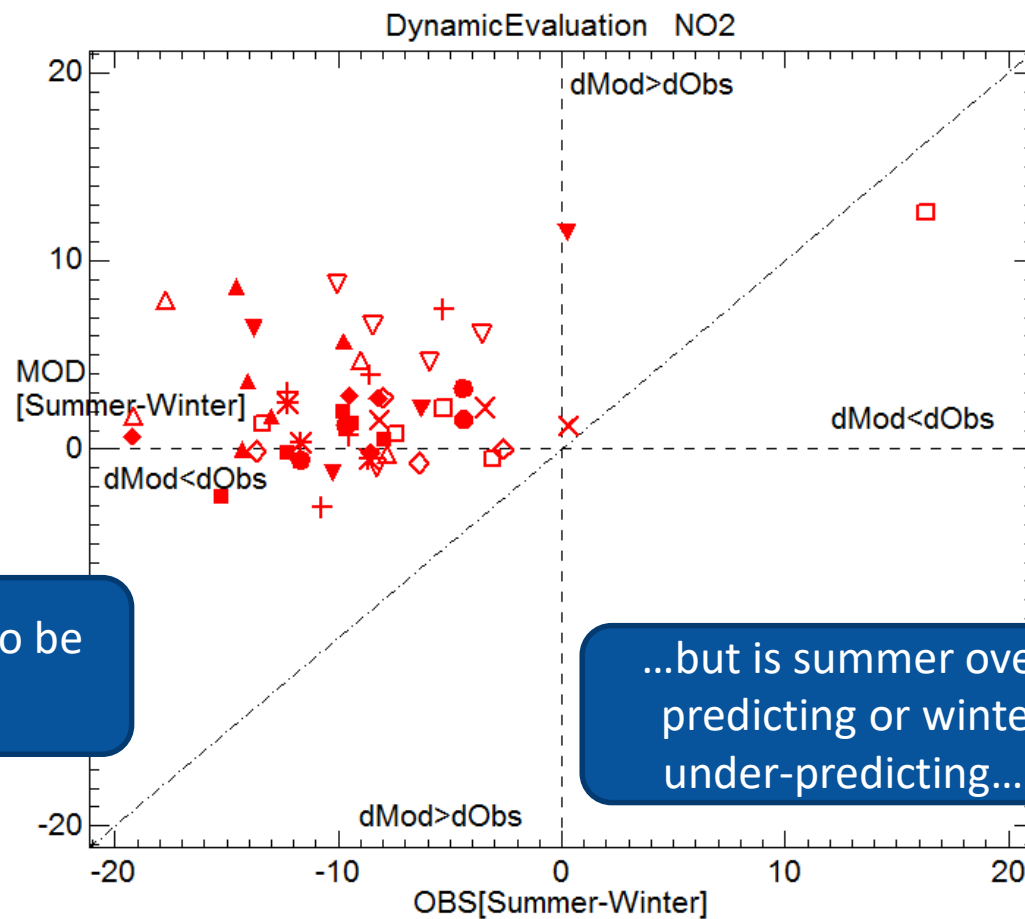
# Compare performance: Summer – Winter NO2

## • Hindcast



Aiming for points to be on the 1:1 line

## • Forecast



...but is summer over-predicting or winter under-predicting...?

- ▽ BX1
- ◇ BX2
- △ CD1
- △ CD3
- ▽ CR4
- ▽ CR5
- △ CT3
- △ EN4
- × GB6
- ◇ GN0
- ◇ GN3
- △ GR4
- ▽ GR5
- △ GR7
- △ GR9
- △ HK6
- △ HR1
- × HR2
- × IS2
- △ KC1
- △ KC2
- △ KC3
- ▽ KC4
- ◇ KC5
- △ LH0
- △ LW1
- ▽ LW2
- △ MY1
- △ NM2
- × NM3
- × RB1
- △ RB4
- △ ST3
- △ ST4
- ▽ TH1
- △ TH4
- WMO

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: NO2  
 Scen: 2012  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: preserve

- ◇ BG2
- △ BL0
- ▽ BQ7
- △ BT5
- △ BT6
- ▽ BX1
- ▽ BX2
- △ CD1
- × CR5
- ◇ CT3
- ◇ CT6
- △ EA6
- ▽ EA8
- ▽ EI1
- △ EN1
- △ EN4
- ▽ EN5
- △ GB6
- △ GN0
- × GN3
- × GN4
- △ GR4
- ◇ GR7
- △ GR8
- △ GR9
- ▽ HG1
- △ HI0
- △ HK6
- △ HR2
- △ HV1
- × IS2
- × IS6
- △ KC1
- ◇ LB5
- ▽ LB6
- △ LW1
- △ LW2
- ▽ MY1
- △ RB4
- △ RI1
- × RI2
- ◇ ST4
- ◇ ST5
- △ ST6
- ▽ TH2

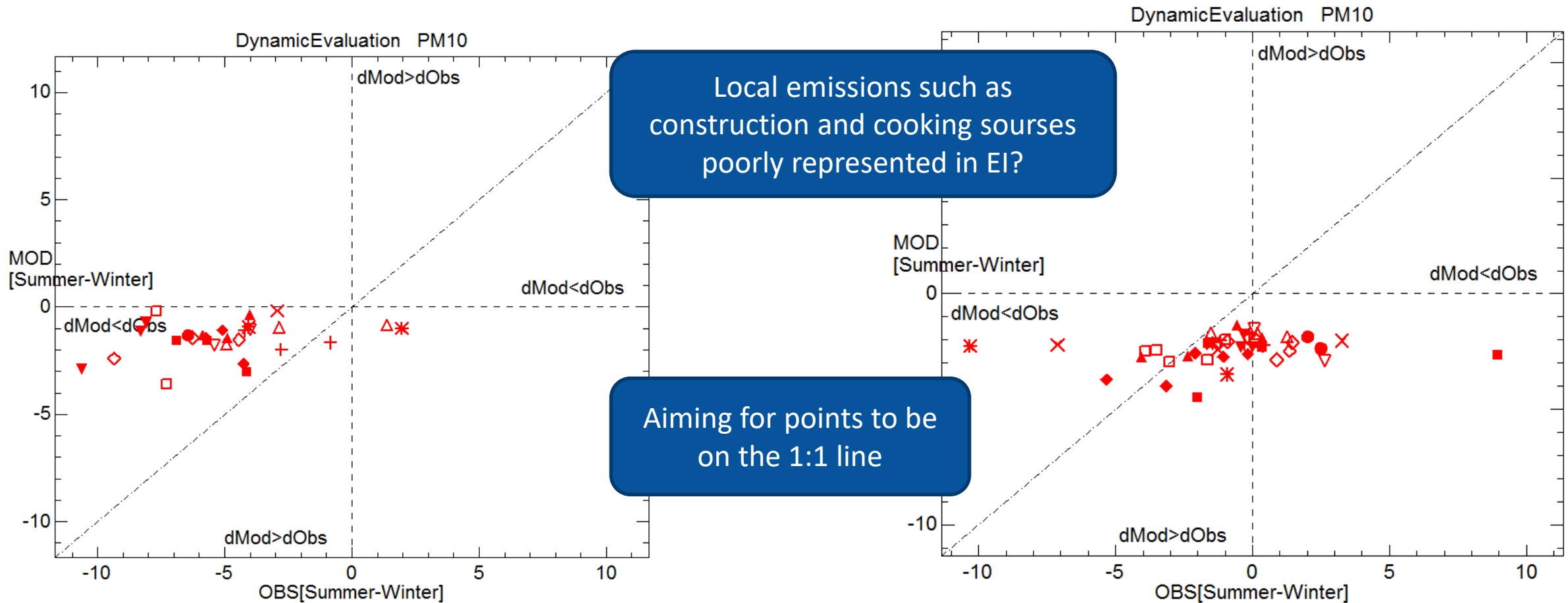
Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: NO2  
 Scen: 2018  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: preserve



# Compare performance: Summer – Winter PM10

- Hindcast

- Forecast



- ◇ BL0
- ◇ BX1
- ▽ BX2
- ◇ CD1
- ◇ CD3
- ▽ CR3
- ▽ CR4
- ◇ CT3
- ✕ GN0
- ✕ GR4
- ◇ GR5
- ◇ GR7
- ◇ GR8
- ▽ GR9
- ◇ HG1
- ◇ HK6
- △ HR1
- ▽ HR2
- ◇ HV3
- ◇ IS2
- ◇ KC1
- ◇ KC5
- ◇ LH0
- ◇ MY1
- ◇ RB4
- ◇ ST4
- △ TH1
- ▽ TH4
- ◇ WM0

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: PM10  
 Scen: 2012  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: Mean

- ◇ BG2
- ◇ BL0
- ▽ BQ7
- ▽ BQ8
- ◇ BT4
- ◇ BT5
- ◇ BT6
- ◇ BX1
- ◇ BX2
- ✕ CD1
- ◇ CT3
- ◇ CT8
- ◇ EA6
- △ EA8
- ◇ EI1
- ◇ GB6
- ▽ GN0
- ◇ GN3
- ◇ GN4
- ◇ GR4
- ✕ GR7
- ◇ GR8
- ◇ GR9
- ◇ HR2
- ◇ HV1
- △ HV3
- ▽ IS2
- ✕ IS6
- ◇ LB5
- ◇ LB6
- ◇ LW2
- ◇ MY1
- ◇ MY7
- ▽ RB4
- ▽ RI1
- ◇ RI2
- ✕ ST4
- ✕ ST5
- ◇ ST6
- △ TH4
- △ TK8
- ▽ WA7
- ◇ WA9
- ◇ WM0

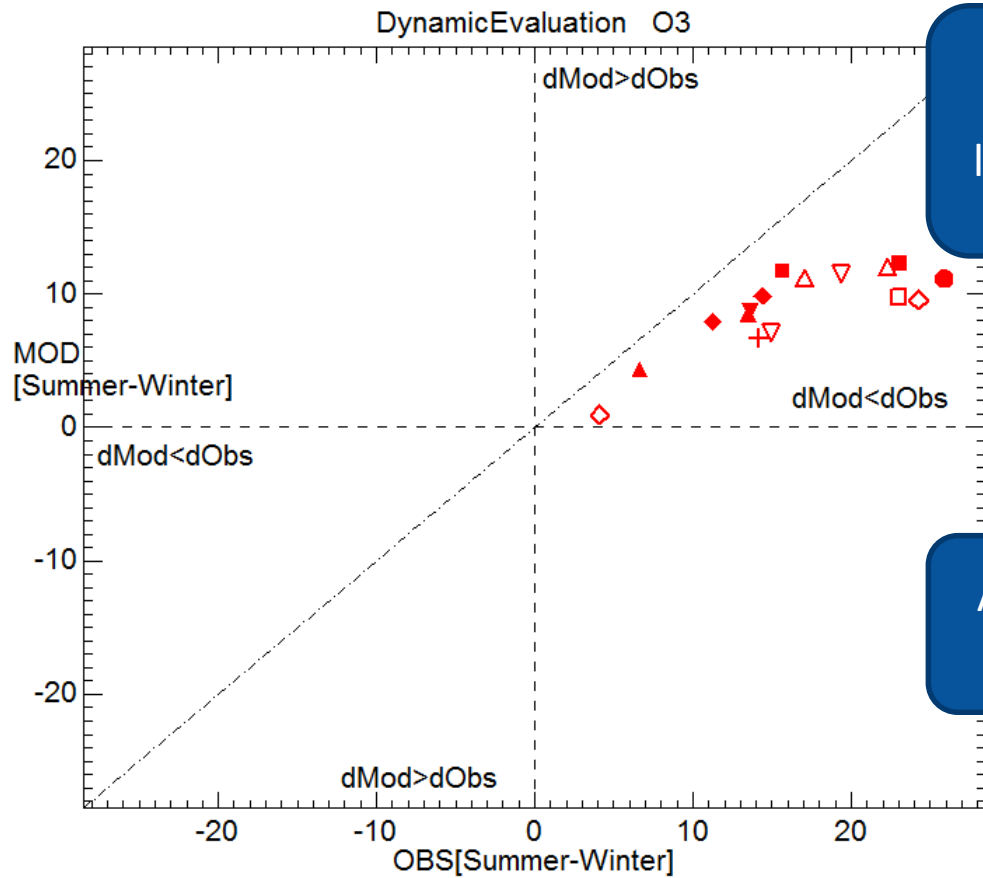
Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: PM10  
 Scen: 2018  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: Mean



# Compare performance: Summer – Winter O3

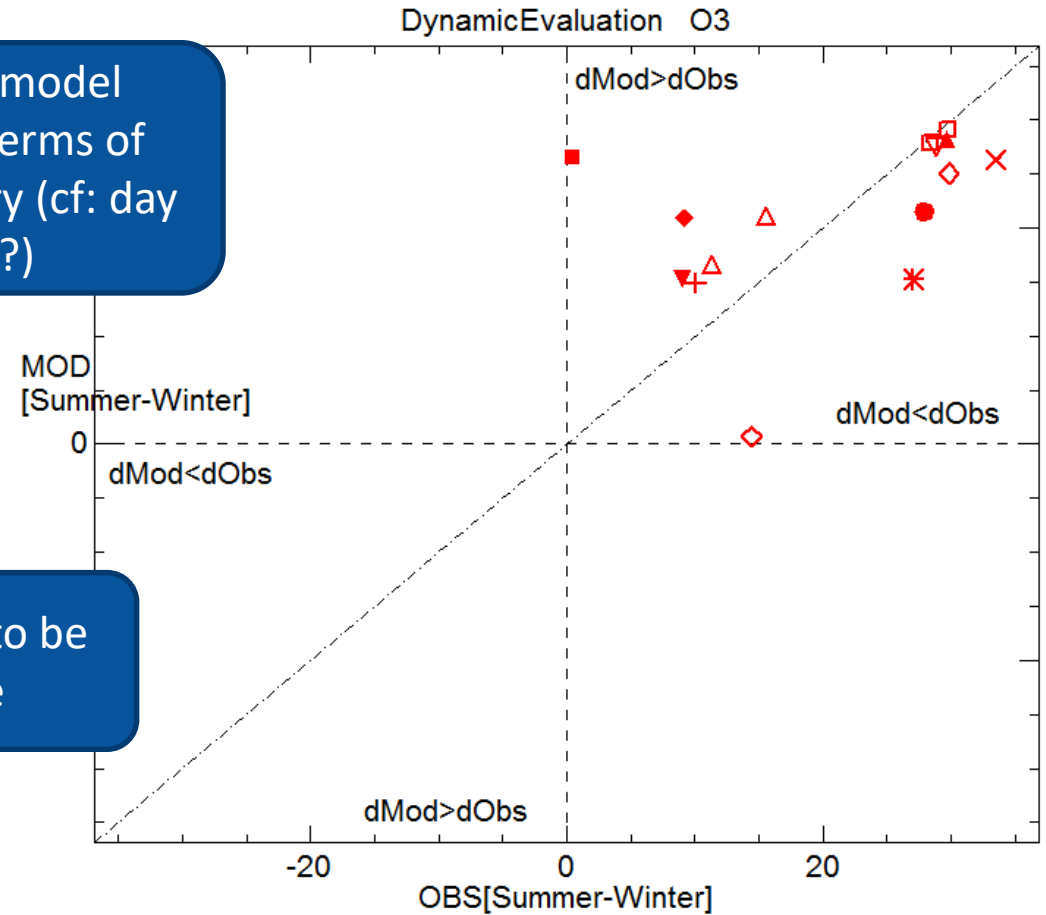
## • Hindcast

## • Forecast



Generally good model performance in terms of local NOx chemistry (cf: day / night plot?)

Aiming for points to be on the 1:1 line



- ◇ BL0
- △ BX1
- ▽ GB6
- ◆ GN3
- GR4
- ▲ GR8
- ▼ GR9
- + HK6
- KC1
- ◇ MY1
- NM2
- △ NM3
- ▽ RB1
- ◆ ST3
- ▲ TH1
- ▼ TH4

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: O3  
 Scen: 2012  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: 8h  
 Daily stats: Max

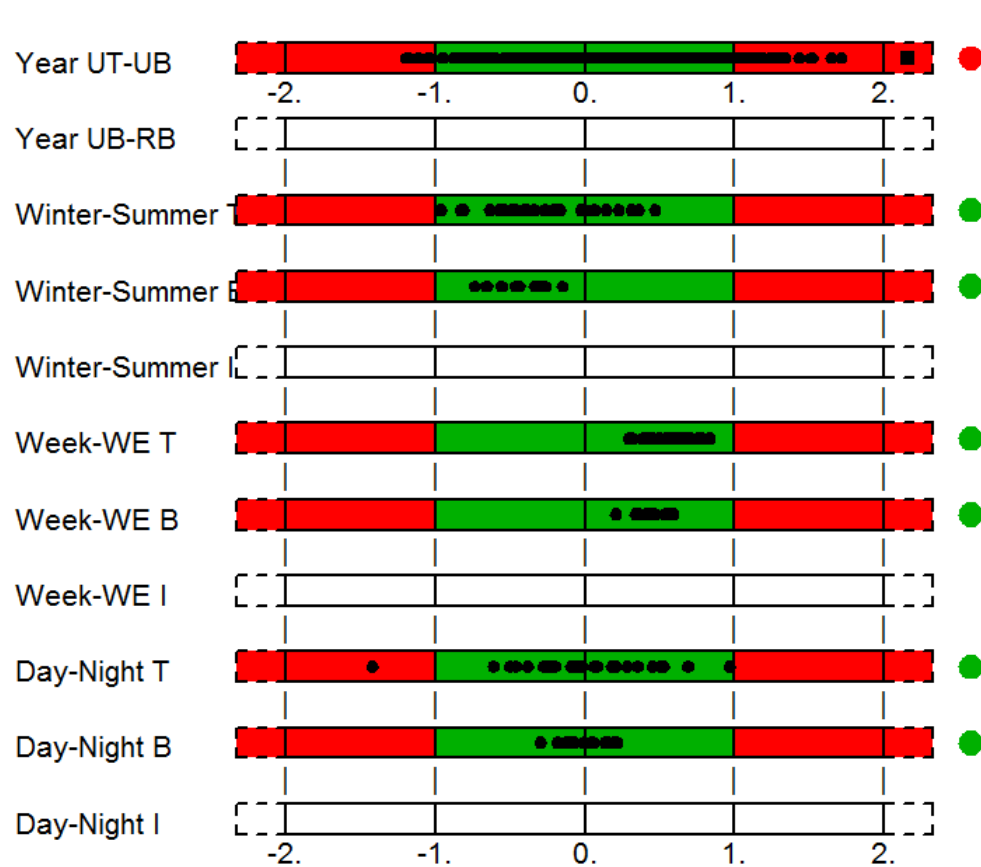
- ◇ BL0
- BQ7
- △ BT4
- ▽ BX1
- ◆ GB6
- GN3
- ▲ GR4
- ▼ GR8
- + GR9
- HI0
- HK6
- × KC1
- ◇ MY1
- RI2
- ▲ TH4

Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: O3  
 Scen: 2018  
 Extra Values: No  
 Season: Summer-Winter  
 Day hours: All 24h  
 Time Average: 8h  
 Daily stats: Max

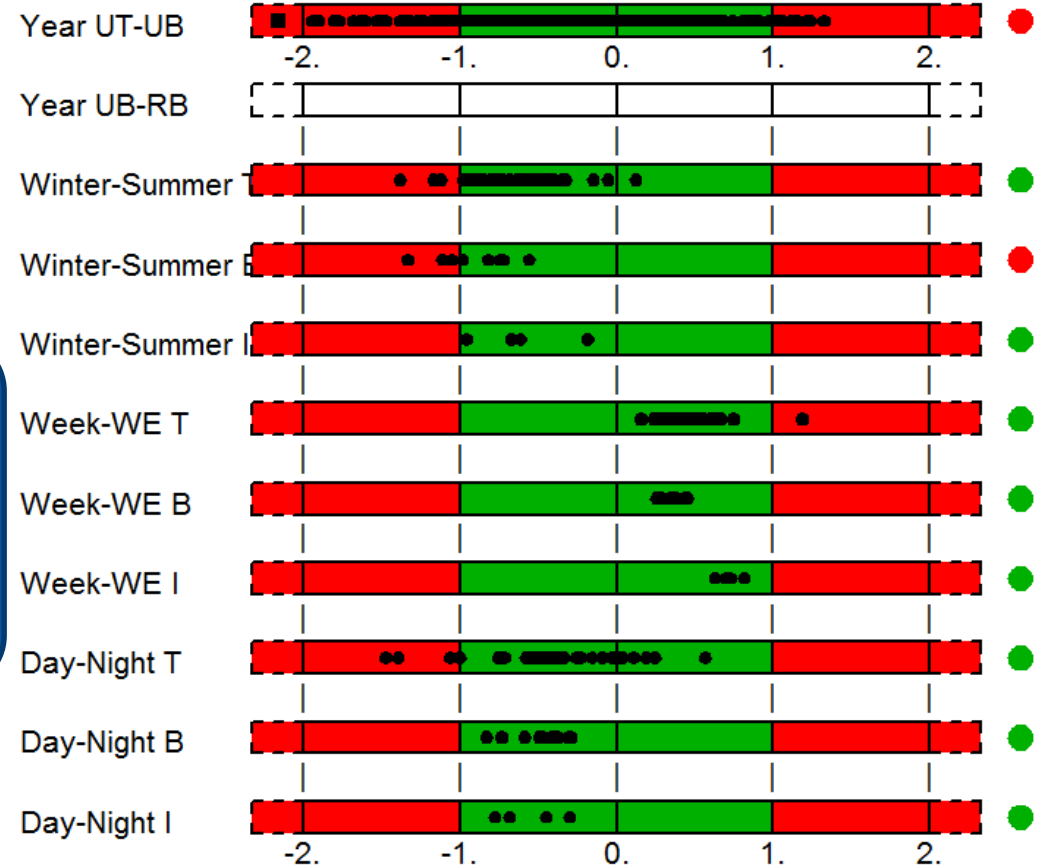


# Compare performance: Dynamic evaluation NO2

## • Hindcast



## • Forecast



Weekend / weekday looks fine according to these metrics

Sites considered in spatial metrics = 12

Strt/end Ind: 1-8784  
 Model (s): ADMS2012  
 Parameter: NO2  
 Scen: 2012  
 Extra Values: 12  
 Season: Year  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: preserve

Strt/end Ind: 1-8760  
 Model (s): Day0  
 Parameter: NO2  
 Scen: 2018  
 Extra Values: 12  
 Season: Year  
 Day hours: All 24h  
 Time Average: Preserve  
 Daily stats: preserve



# Compare performance: Dynamic evaluation NO2

## • Hindcast



Sites = 17  
(13 or 10 used)



Sites = 12



Sites = 8



Sites = 3

## • Forecast



- It would be useful to understand more about how many sites should be used in the evaluation
- QA/QC document says 'if a choice of 3 is made, three urban background (UB) stations will be used to calculate three gradients with each available urban traffic (UT) station' – but Delta appears to use 1 site less than the threshold

# Summary

- Tested the proposed QA/QC protocols for 2 applications, one that we would expect to pass the majority of criteria set, one where we would understand if model performance was not so good due to forecasting inputs
- Target plots behaved as expected: more difficult to satisfy criteria at traffic sites for pollutants strongly influenced by traffic emissions (NO<sub>2</sub>)
- With the day/night, summer/winter, weekend/weekday plots:
  - O<sub>3</sub> day/night values seem very odd
  - Could supplementary results be output to enable users to compare absolute values in addition to differences?
  - It is good practice for model users to be able to explain the results in terms of model formulation and model inputs (e.g. we should look into the weekend / weekday NO<sub>2</sub> results)
  - Repeated symbols not helpful
- Dynamic evaluation: the spatial metric may not be robust for large city evaluations where an urban background site in the city centre records a higher concentration than a roadside site in a suburban location
- Evaluation binning according to wind speed or atmospheric stability would also be helpful, for example because some models perform less well in some meteorological conditions



Thank you for listening  
Any Questions?