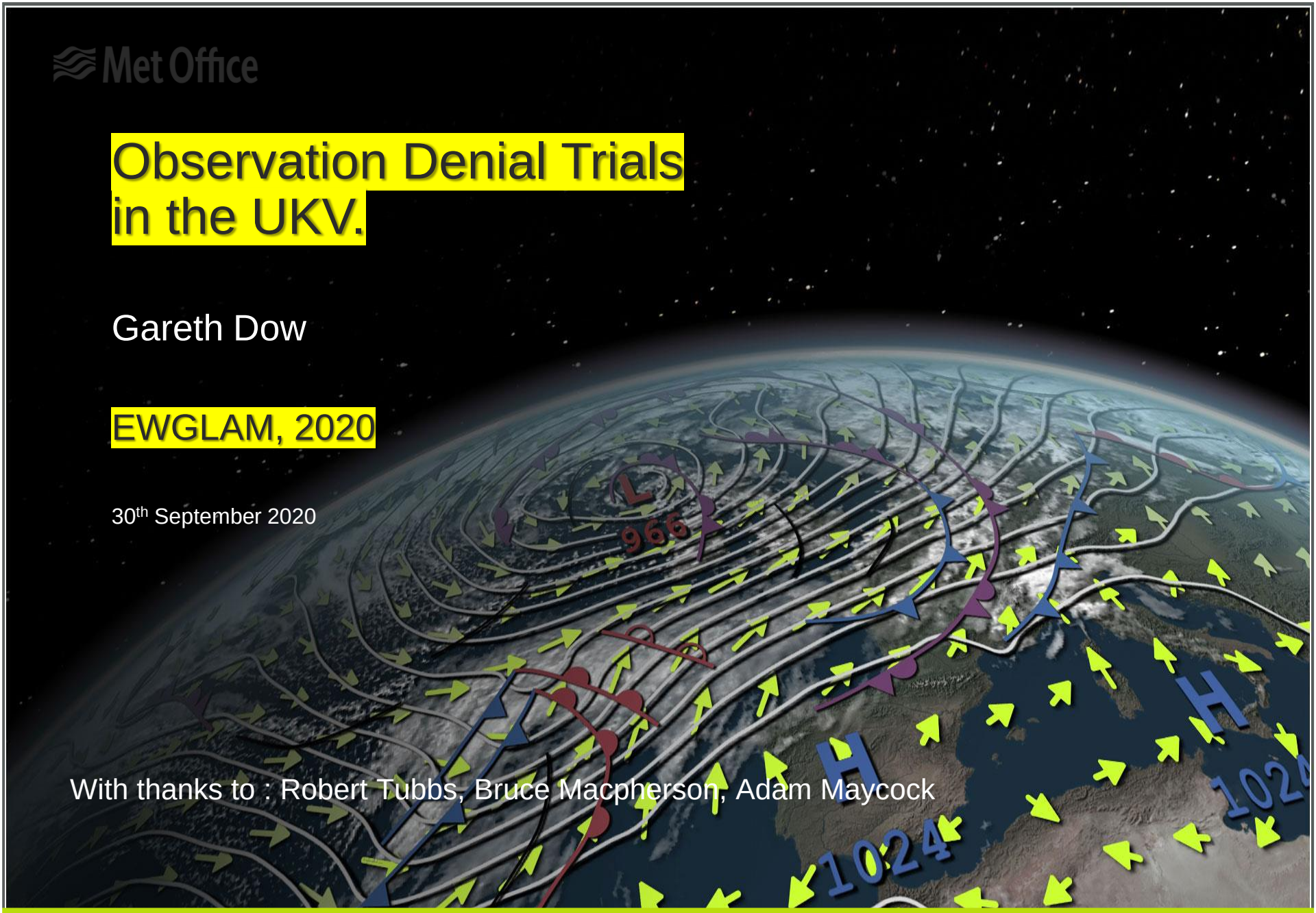
Observation Denial Trials in the UKV.

Gareth Dow

EWGLAM, 2020

30th September 2020



With thanks to : Robert Tubbs, Bruce Macpherson, Adam Maycock

Motivation

- Impact from Observation Network components
- Work in Progress

UKV model configuration – key features

- Variable Grid with 1.5km interior resolution
- Hourly 4D-Var on 4.5km grid
- ‘OS43’ Science (=current Operational)
- Observation Cutoff = 45 minutes (=80 on 11 & 23Z cycles to capture sondes)
- Latent Heat Nudging
- Adaptive Variable Grid
- Climatological covariances – lagged NMC method

Observational Denial Trials

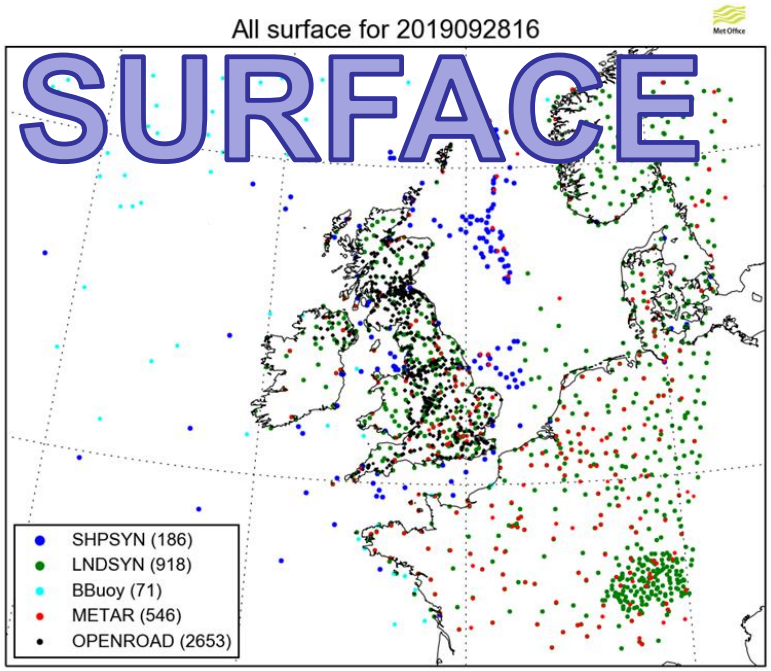
- **Control** = OS43 (current) Science Configuration
- 2 Seasons (Summer and Winter)
- Approximately 2 months in each season

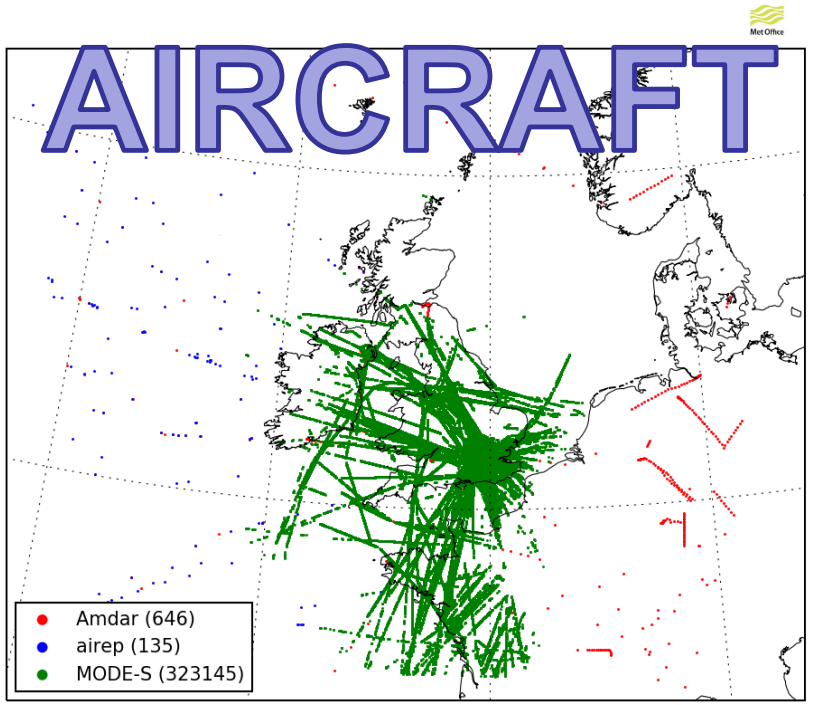
Denial Observation Sets

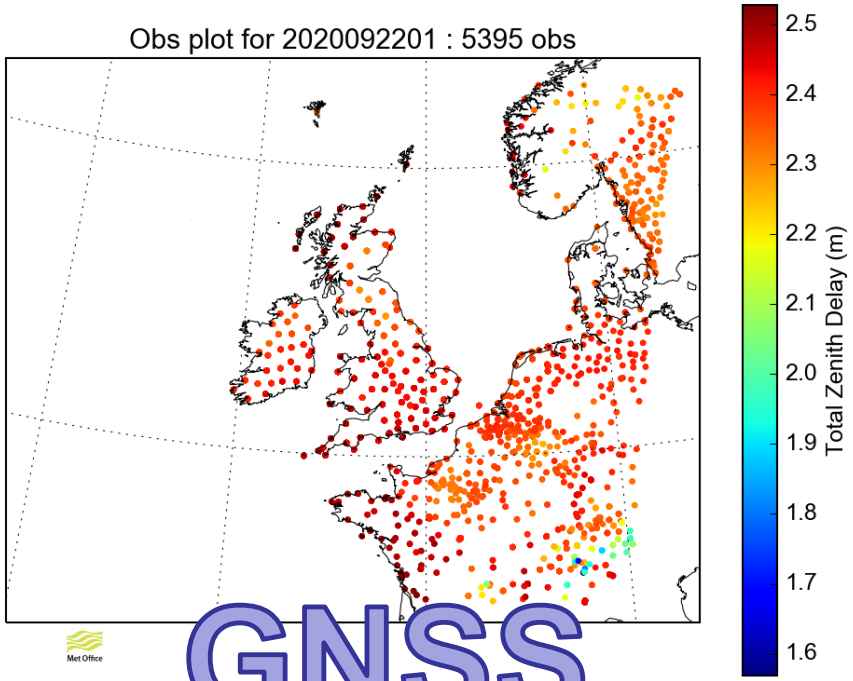
	Near-surface Sets	Abbvn		Obs Denied
1	All land-surface	LAND		= SYNOP + METAR + Roadside
2	All land-surface except roadside	LANDxROAD		= SYNOP + METAR
3	Roadside Only	ROAD		=Roadside
4	All land T/RH	T/RH		=SYNOP + METAR + Roadside T/RH
5	All land MSLP	MSLP		=SYNOP + METAR MSLP

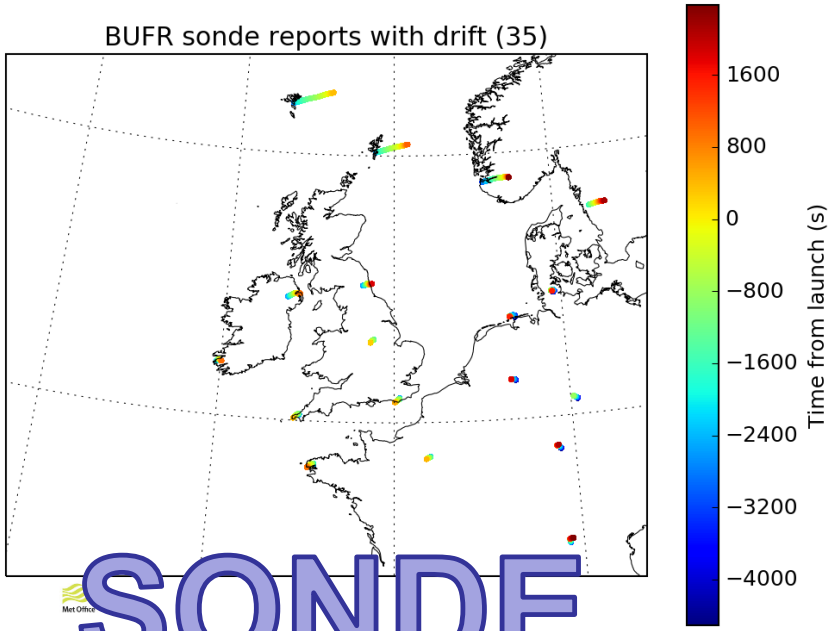
SYNOP: T_{2m}, RH_{2m}, $Wind_{10m}$, Vis_{2m}, MSLP, Cloud
METAR: T_{2m}, RH_{2m}, $Wind_{10m}$, Vis_{2m}, MSLP
ROADSIDE: T_{2m}, RH_{2m}, Vis_{2m}

	Upper-Air Sets	Abbvn		Obs Denied
6	All Upper-Air Conventional	UPAIR	*	=Sondes, Profilers & Aircraft (AIRREP, AMDAR & Mode-S)
7	All AMDAR & AIREP	AMDAR		=AMDAR & AIREP T,RH & Wind
8	All Mode-S	MODES		=MODES Wind
9	Radar	RADAR		=LHN + Doppler Winds
10	GroundGPS	GNSS		=GroundGPS
11	GeoCloud	GEOCLOUD		=Satellite cloud fraction profile
12	All Satellite Radiances	SATRAD	*	=All Satellite Radiances


All surface for 2019092816
SURFACE
SHPSYN (186)
LNDSYN (918)
BBuoy (71)
METAR (546)
OPENROAD (2653)


2020092112 : Aircraft datacoverage : reports =323926
AIRCRAFT
Amdar (646)
airep (135)
MODE-S (323145)


Obs plot for 2020092201 : 5395 obs
GNSS
Total Zenith Delay (m)
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6


BUFR sonde reports with drift (35)
SONDE
Time from launch (s)
1600
800
0
−800
−1600
−2400
−3200
−4000

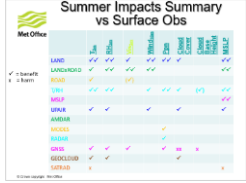
Verification vs Observations

- **'Sensible Weather'** – mainly vs SYNOP (03) observations
- T_{2m}, RH_{2m}, Vis_{2m}, $Wind_{10m}$, Ppn, Cloud Cover, Cloud Base Height, MSLP

- **Upper-Air** – vs SONDE profile observations
- Temperature, RH, Wind
- **Important Note**

……as we also assimilate SYNOP & SONDE obs, impacts from these obs types likely to be exaggerated relative to other obs types

T_{2m} Summer



Bias

Diff from Control

RMS

Diff from Control

Note Different Scales

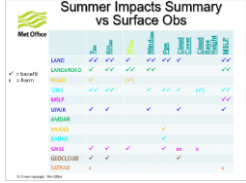
0.6

0.06

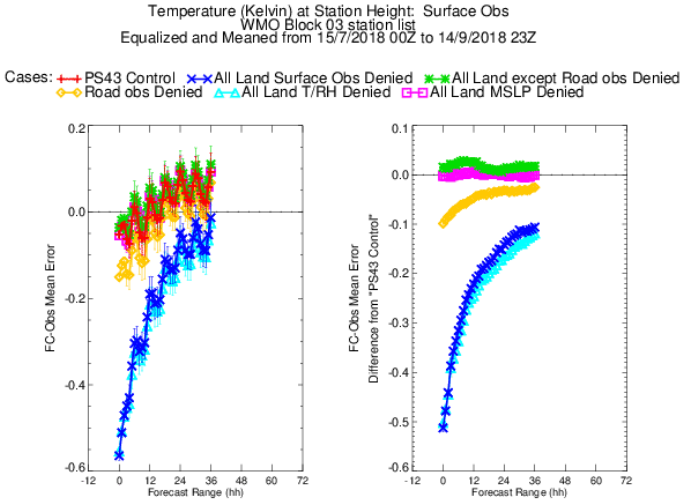
Surface

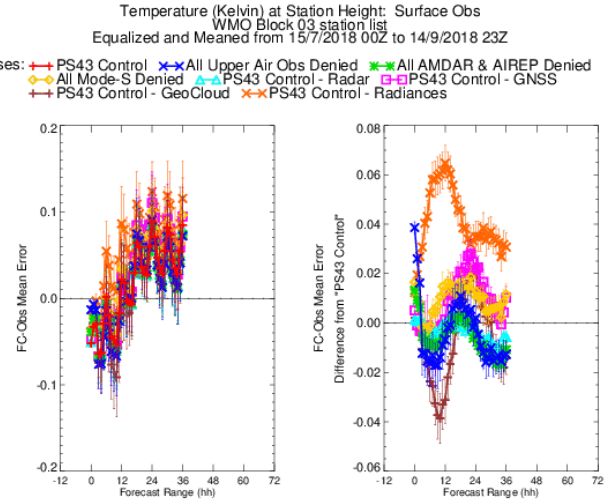
'Upper-Air'

T_{2m} Summer



	T_{2m}
LAND	✓✓
LANDxROAD	✓
ROAD	✓
T/RH	✓✓
MSLP	
UPAIR	✓
AMDAR	
MODES	
RADAR	
GNSS	✓
GEOCLOUD	✓
SATRAD	x

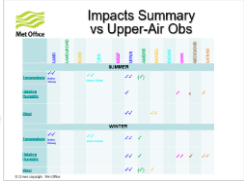




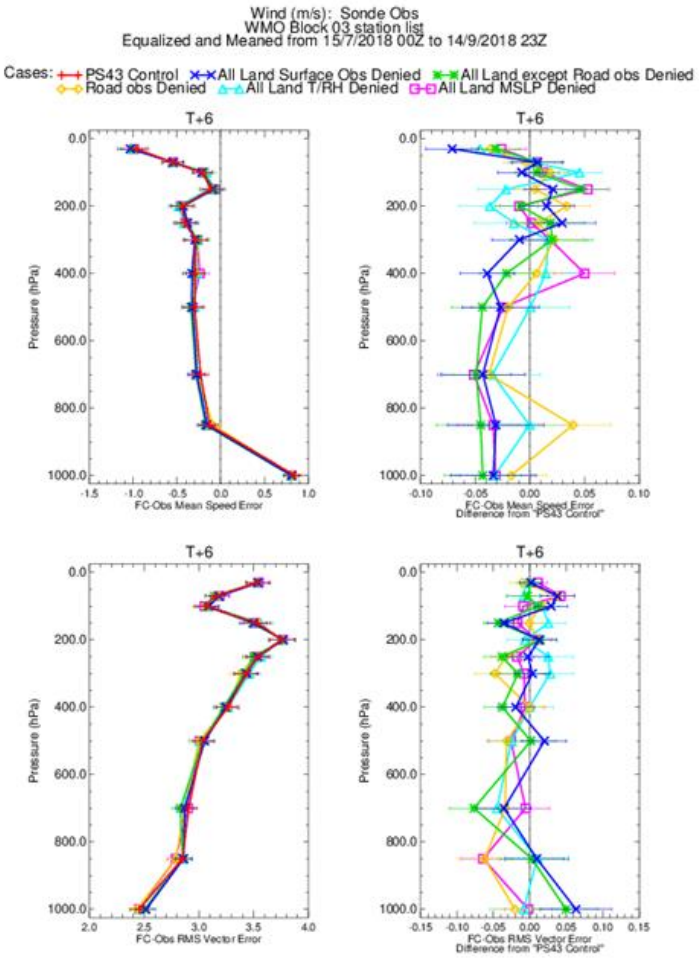
Surface

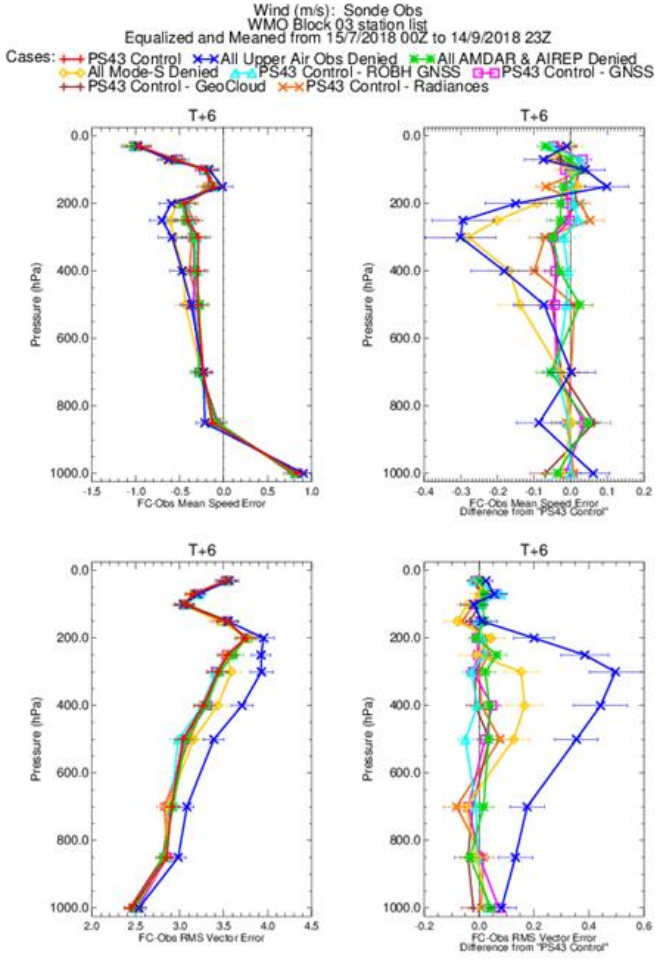
'Upper-Air'

Upper-air Wind Summer



	Wind
LAND	
LANDxROAD	
ROAD	
T/RH	
MSLP	
UPAIR	✓✓
AMDAR	
MODES	✓✓
RADAR	
GNSS	
GEOCLOUD	
SATRAD	





Surface

'Upper-Air'

Summer Impacts Summary vs Surface Obs

✓ = benefit
x = harm

	T_{2m}	RH_{2m}	Vis_{2m}	$Wind_{10m}$	Ppn	Cloud Cover	Cloud Base Height	MSLP
LAND	✓✓	✓✓	✓	✓✓	✓✓	✓		✓✓
LANDxROAD	✓	✓✓	✓✓	✓✓				✓✓
ROAD	✓		(✓)					
T/RH	✓✓	✓✓		✓	✓✓	✓	(✓)	✓✓
MSLP								✓✓
UPAIR	✓	✓		✓		✓		✓
AMDAR								
MODES					✓			
RADAR					✓			
GNSS	✓	✓	✓		✓	xx	x	
GEOCLOUD	✓	✓				✓		
SATRAD	x							x

Winter Impacts Summary vs Surface Obs

✓ = benefit
x = harm

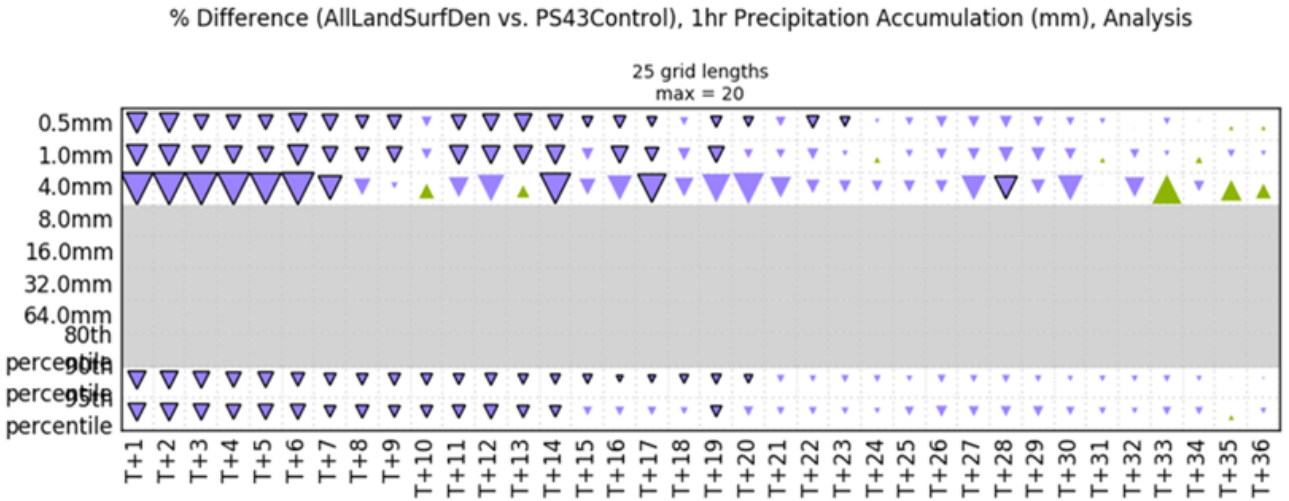
	T_{2m}	RH_{2m}	Vis_{2m}	$Wind_{10m}$	Ppn	Cloud Cover	Cloud Base Height	MSLP
LAND	✓✓	✓✓	✓✓	✓✓	✓✓	✓	(✓)	✓✓
LANDxROAD	✓	✓	✓✓	✓✓	✓			✓✓
ROAD	✓							
T/RH	✓✓	✓✓	✓	✓	✓✓	✓	✓	✓
MSLP					✓			✓✓
UPAIR	(✓)	✓		✓	✓✓		(✓)	✓
AMDAR								
MODES				(✓)				
RADAR	(x)				✓✓			x
GNSS	x	x			✓✓	xx	xx	
GEOCLOUD		(✓)				(✓)		
SATRAD						(✓)		

Impacts Summary vs Upper-Air Obs

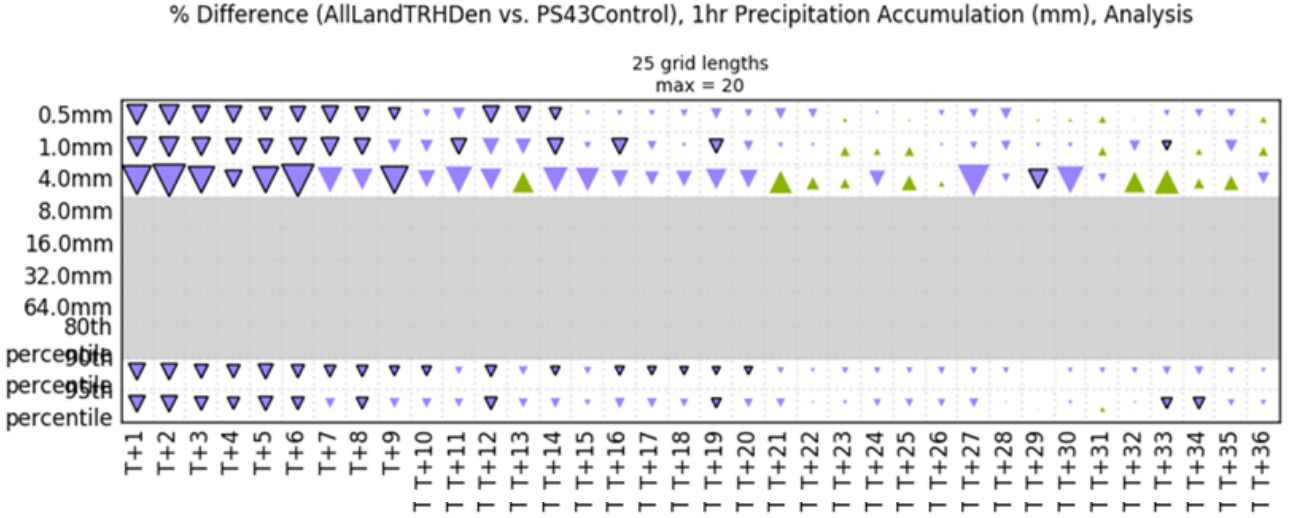
	LAND	LANDxROAD	ROAD	T/RH	MSLP	UPAIR	AMDAR	MODES	RADAR	GNSS	GEOCLOUD	SATRAD
SUMMER												
Temperature	✓✓ (below 700mb)			✓✓ (below 700mb)		✓✓	(✓)					
Relative Humidity						✓				✓	x	✓
Wind						✓✓		✓✓				
WINTER												
Temperature	✓✓ (below 850mb)			✓✓ (below 850mb)		✓✓	✓					
Relative Humidity						✓✓	✓			✓✓	✓	✓✓
Wind						✓✓	(✓)	✓				

Impacts on Ppn from Land Surface Obs (FSS)

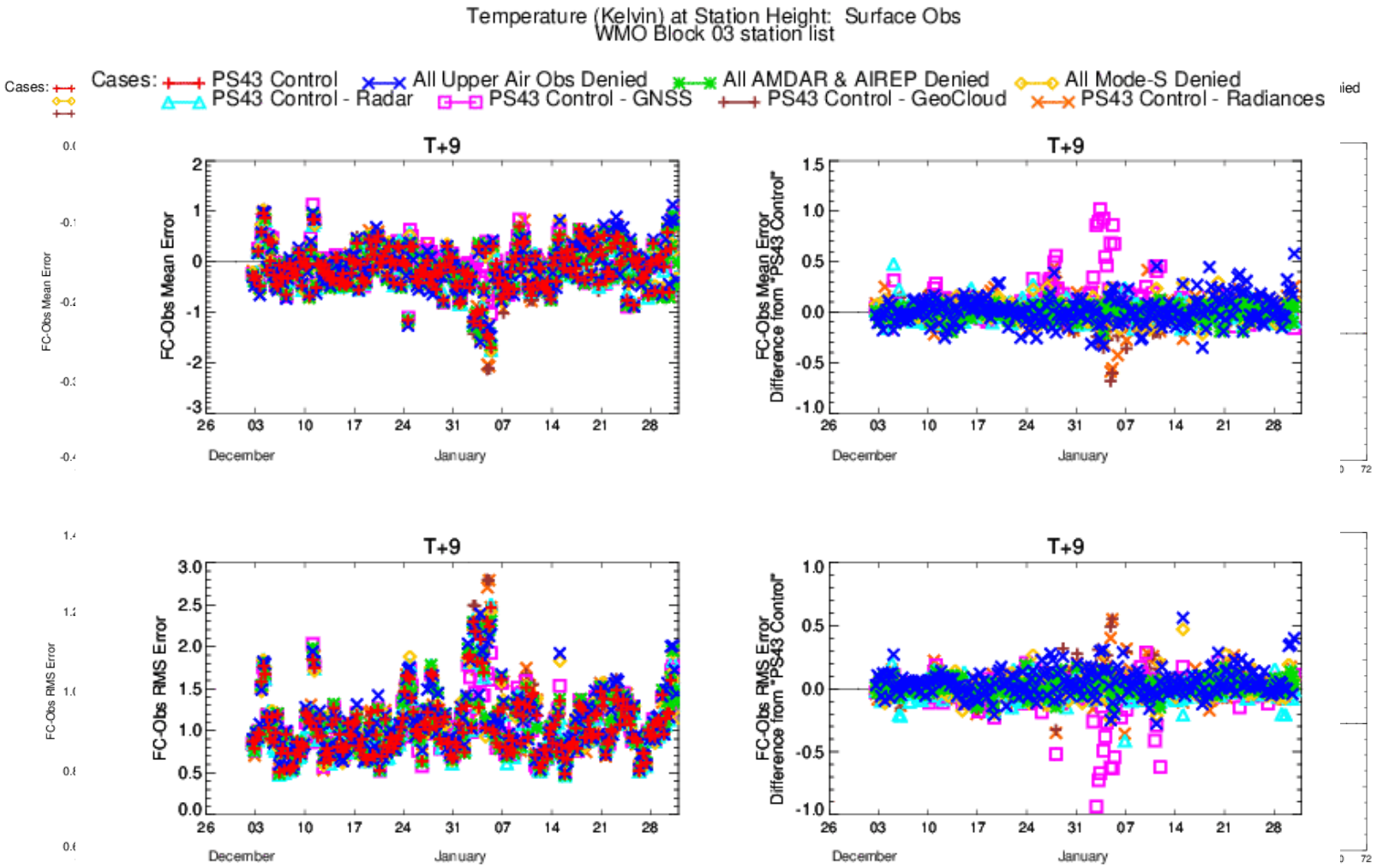
LAND Denial



T/RH RADA Denial



GNSS QC ?



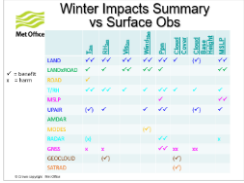
68% error bars calculated using $S/(n-1)^{1/2}$

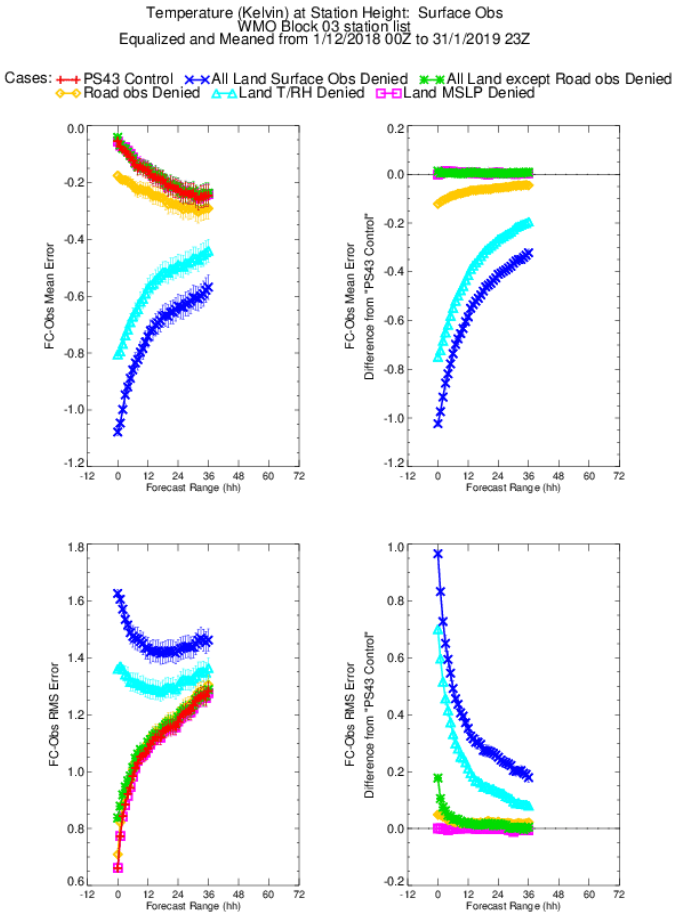
68% error bars calculated using $S/(n-1)^{1/2}$

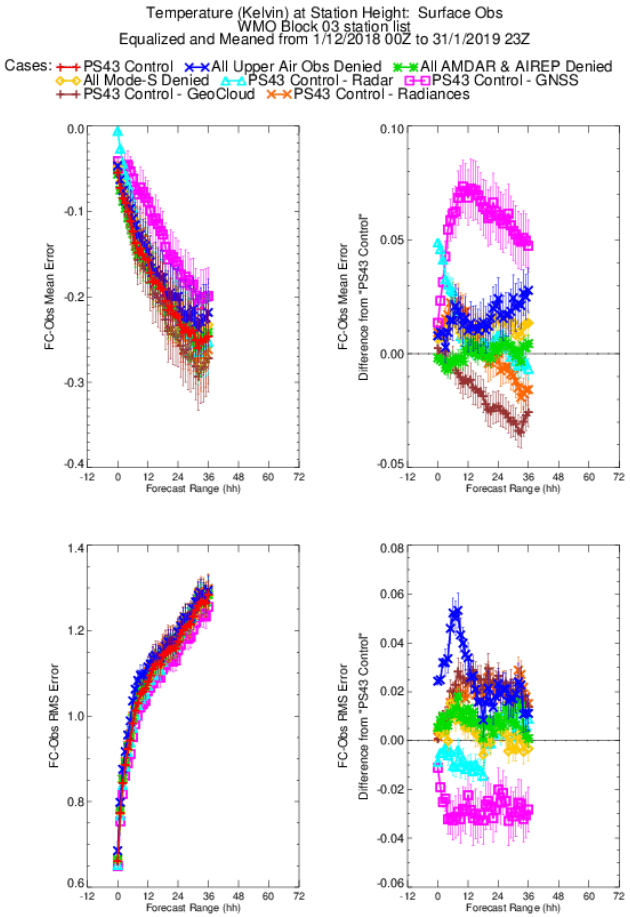
Conclusions

- Redundancy in Surface Network
- ‘All-rounder’ T_{2m}/RH_{2m} observations – benefits also for $Wind_{10m}$ & ppn predictions
- Some episodic negative Impacts from GNSS (QC issues)
- Radar Impacts restricted to ‘Nowcasting’ range
- Mode-S dominating Upper-Air Wind Impacts from Aircraft
- Relatively small impacts from satellite radiances

T_{2m} Winter



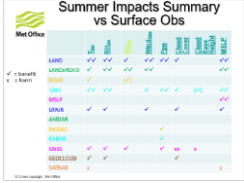


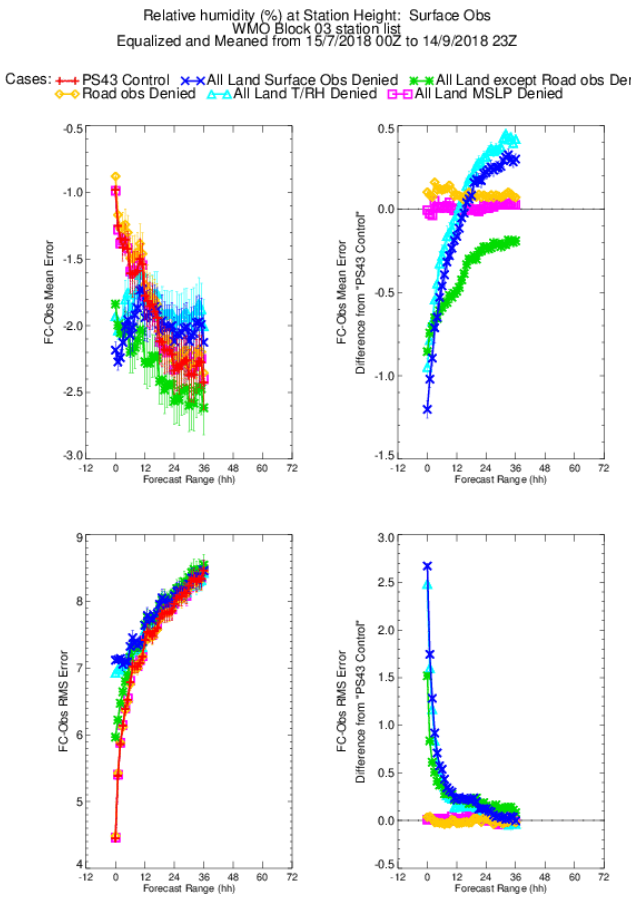


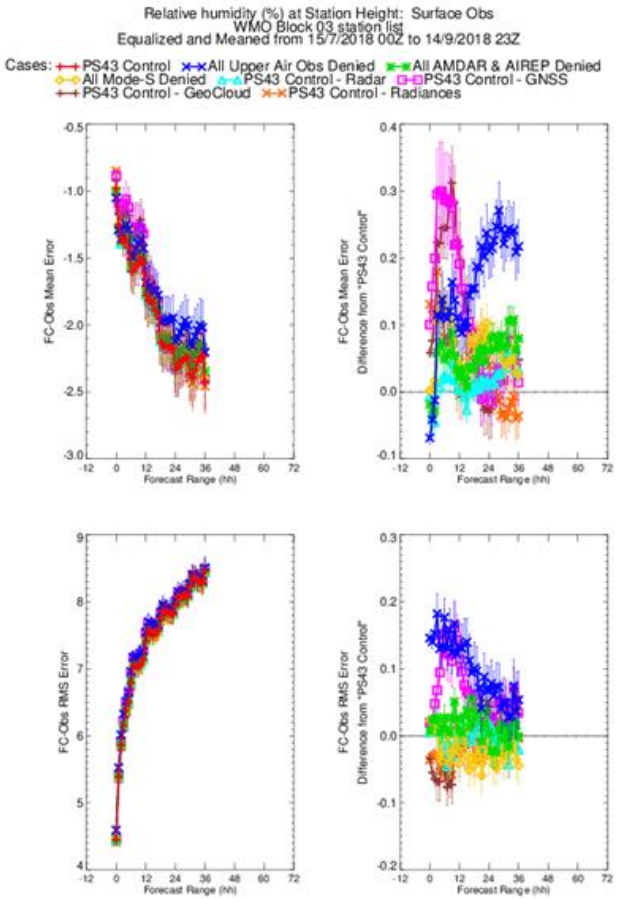
Surface

‘Upper-Air’

RH_{2m} Summer



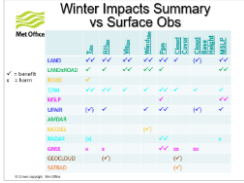


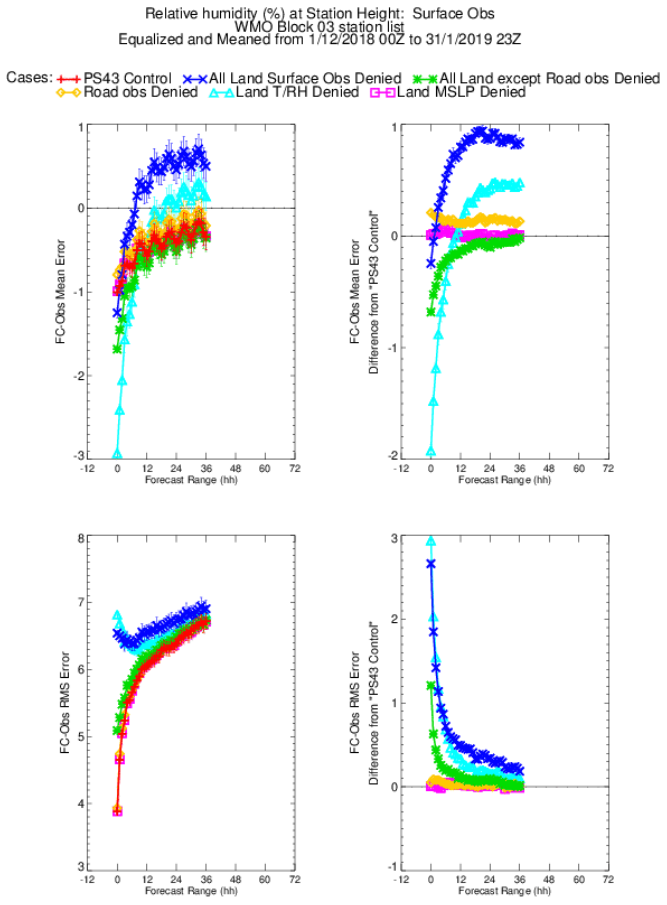


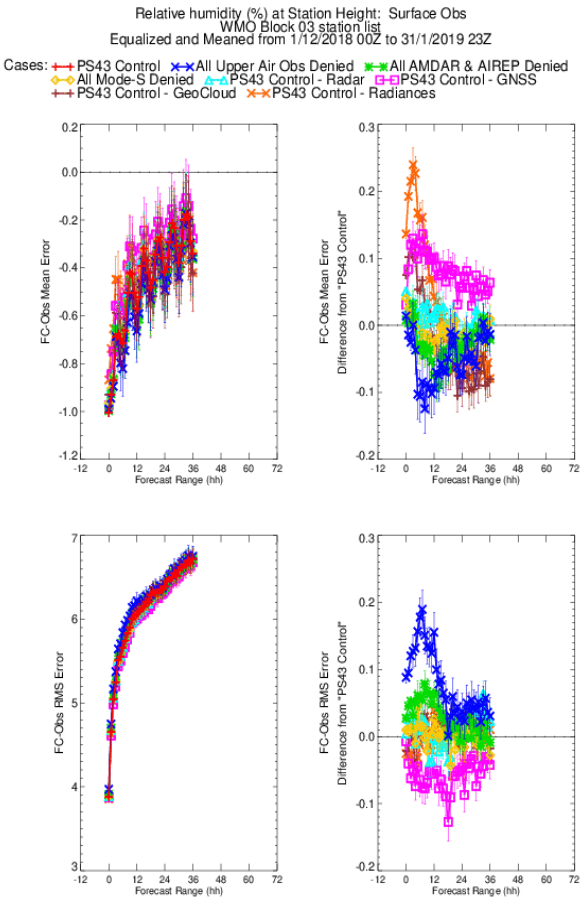
Surface

'Upper-Air'

RH_{2m} Winter



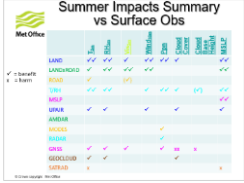


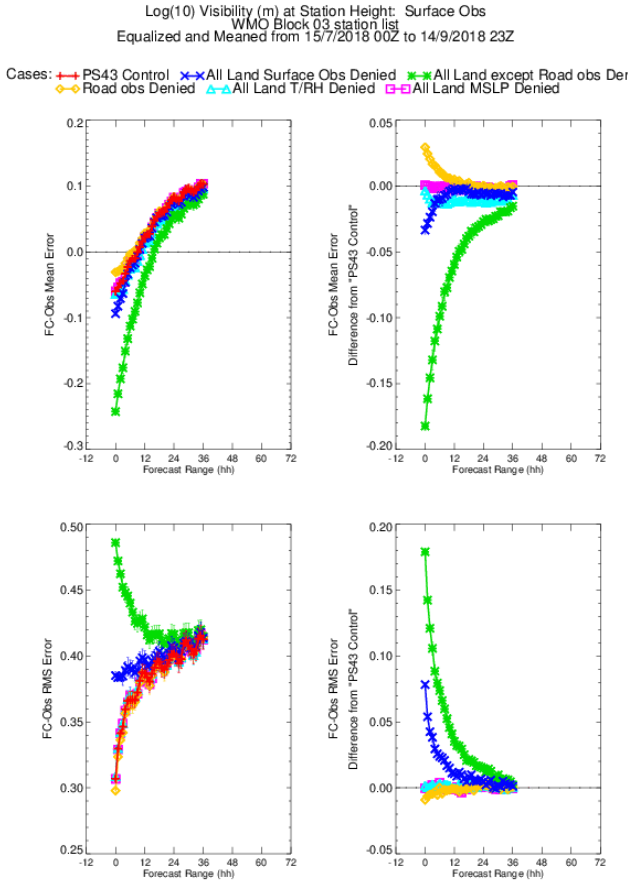


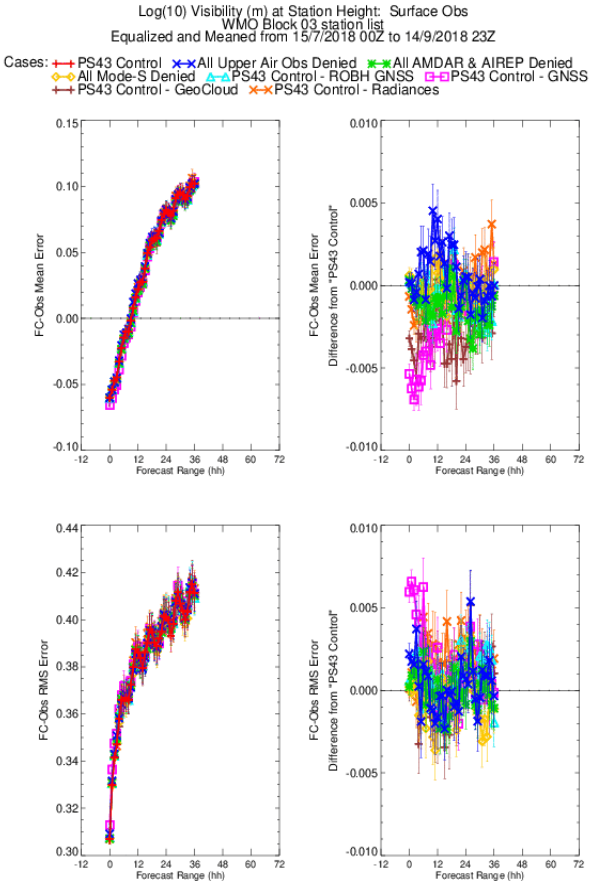
Surface

'Upper-Air'

Vis_{2m} Summer



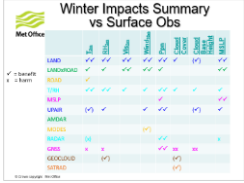


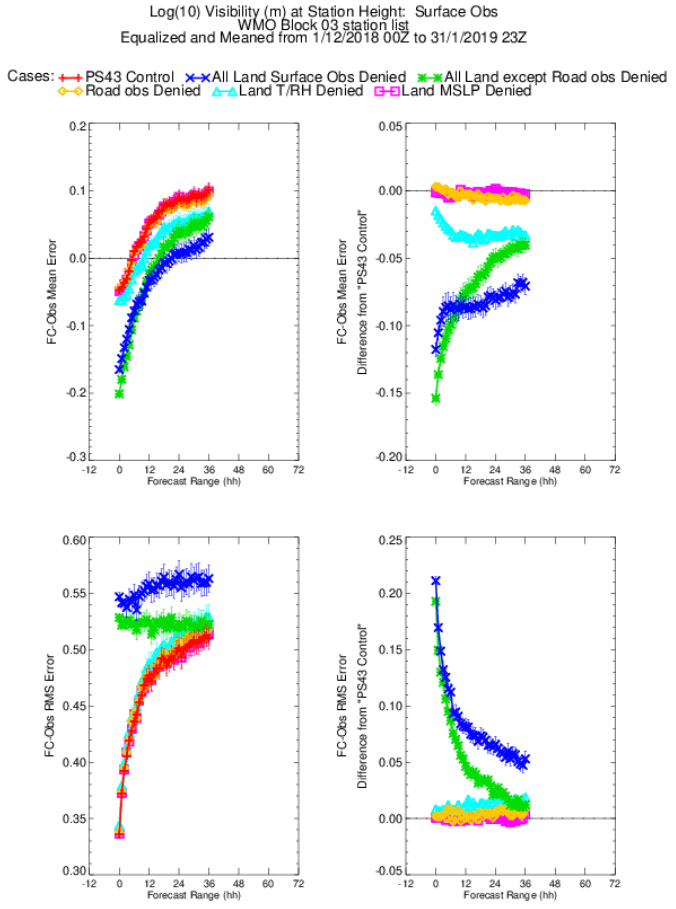


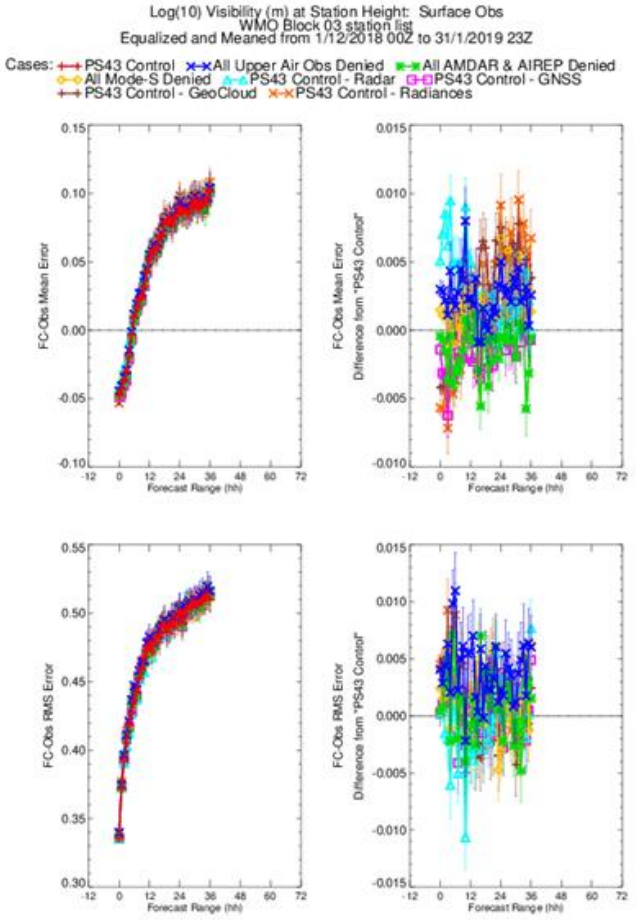
Surface

'Upper-Air'

Vis_{2m} Winter



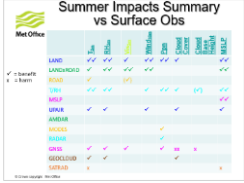


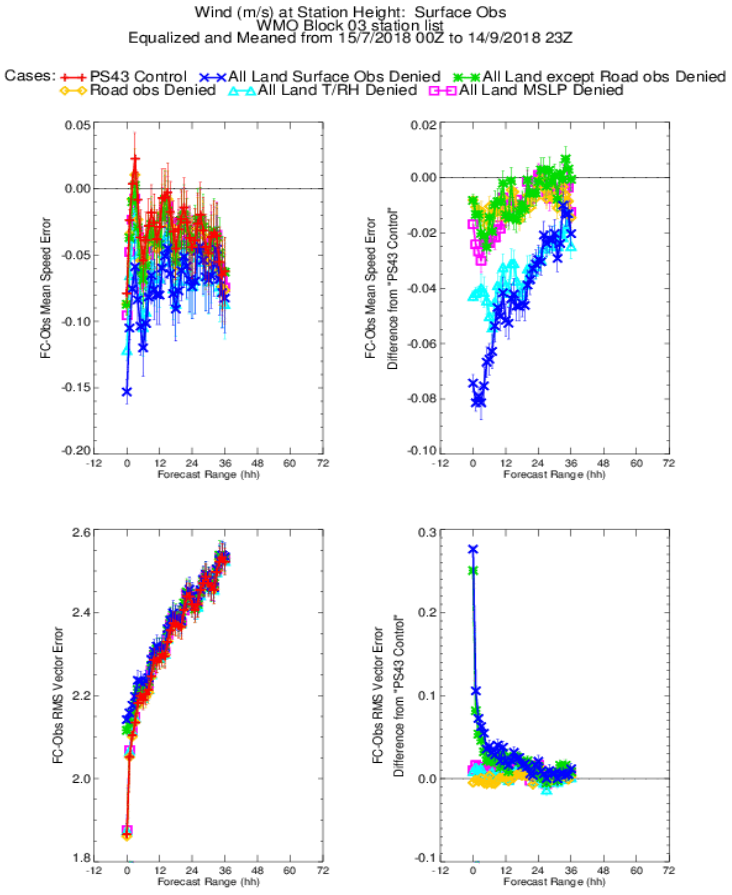


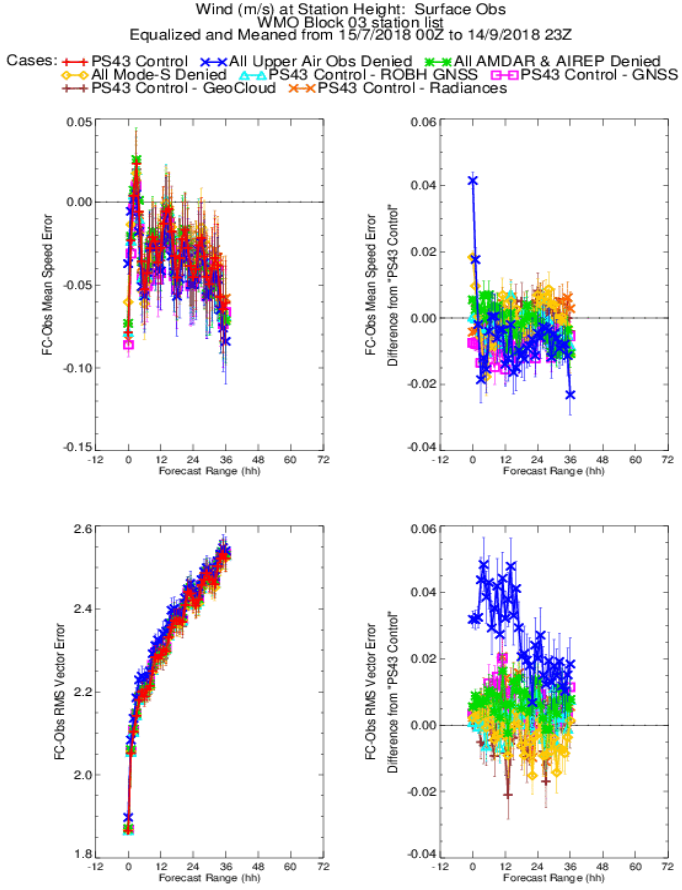
Surface

'Upper-Air'

$Wind_{10m}$ Summer



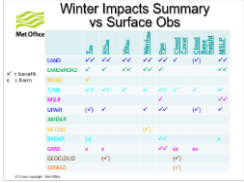


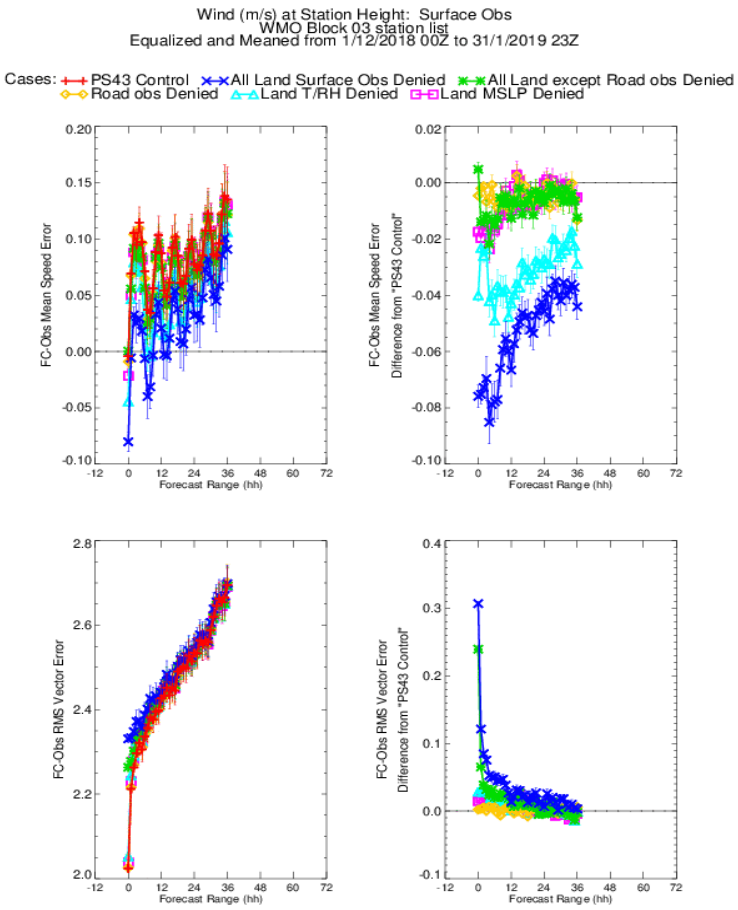


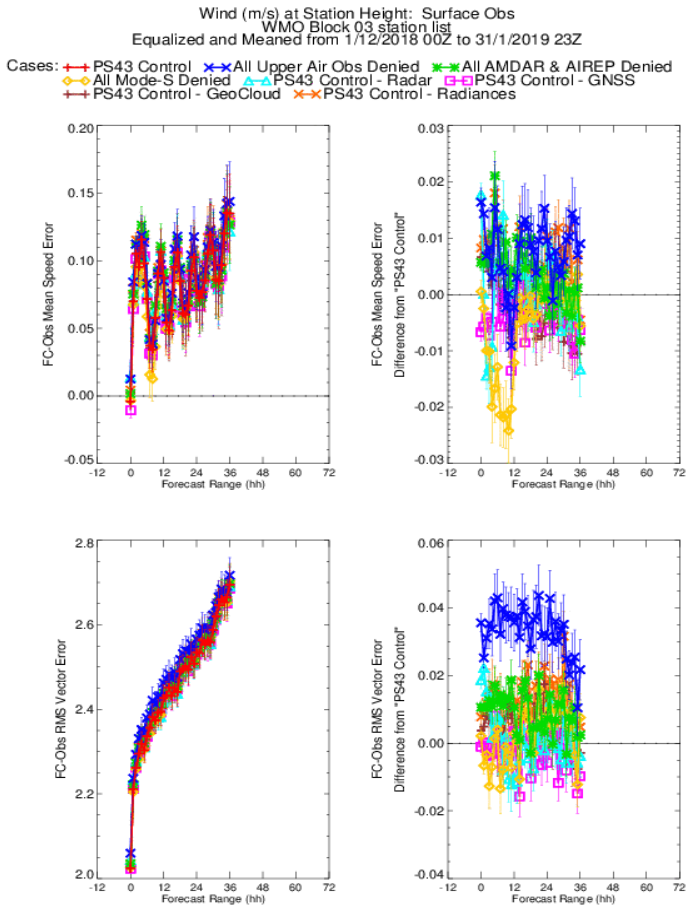
Surface

‘Upper-Air’

$Wind_{10m}$ Winter



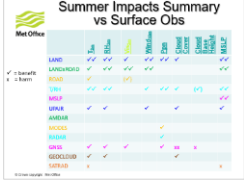


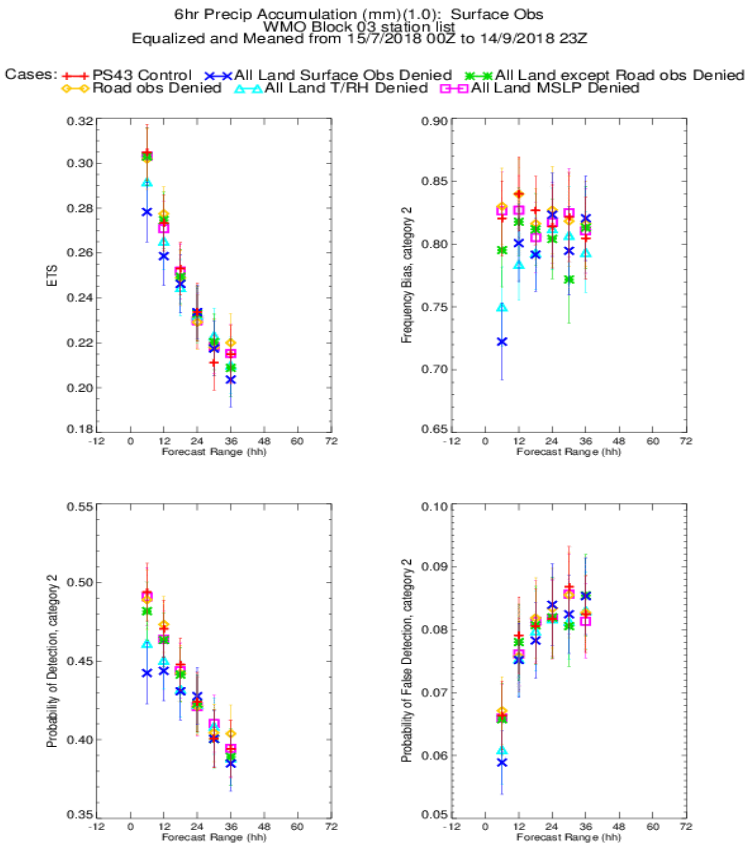


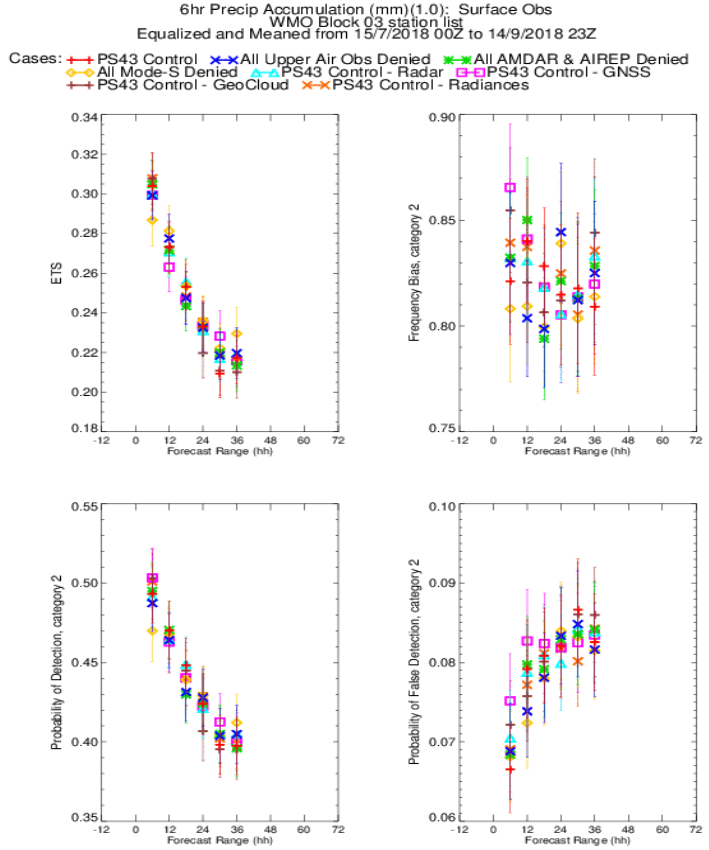
Surface

‘Upper-Air’

Ppn (1mm/6 hour) Summer



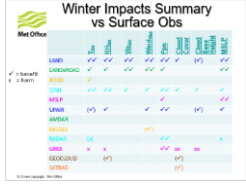


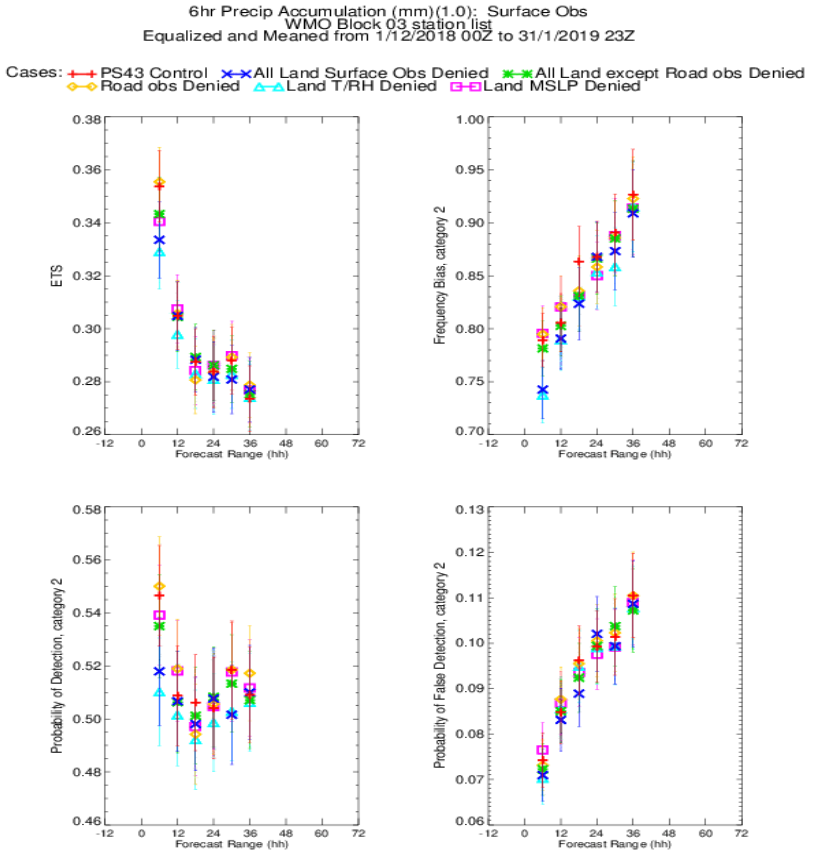


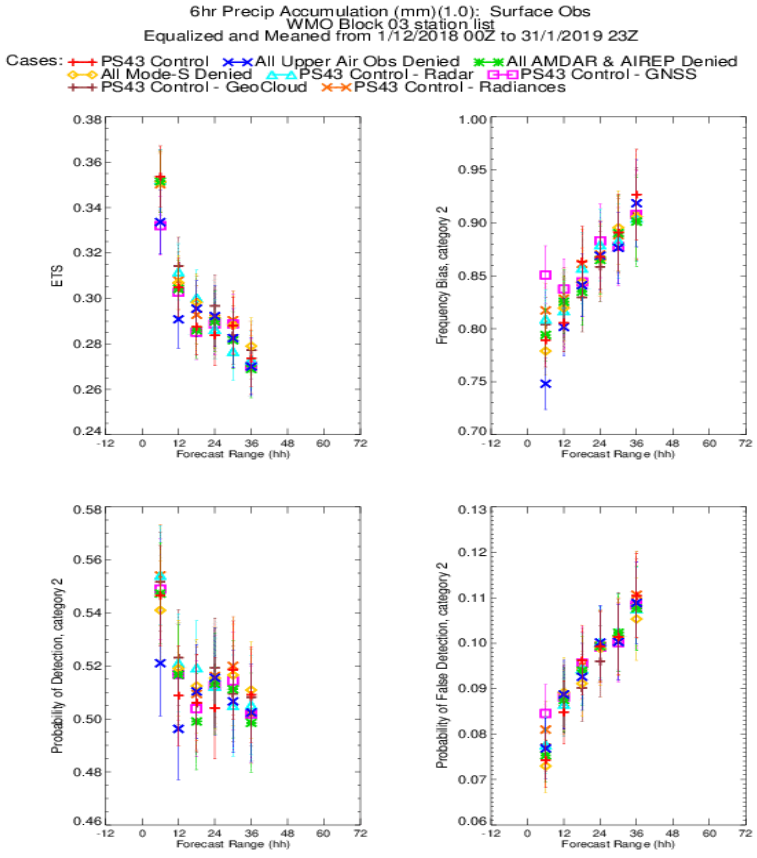
Surface

‘Upper-Air’

Ppn (1mm/6 hour) Winter



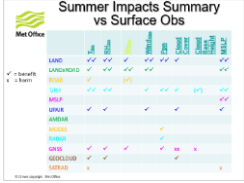


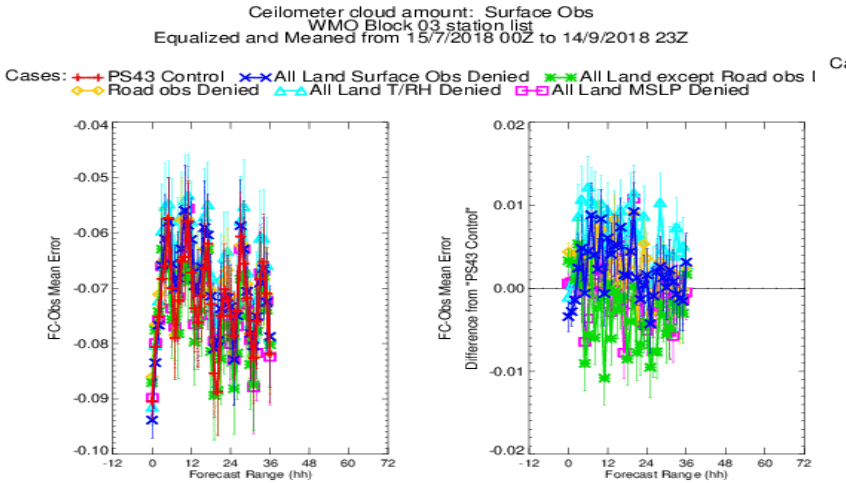


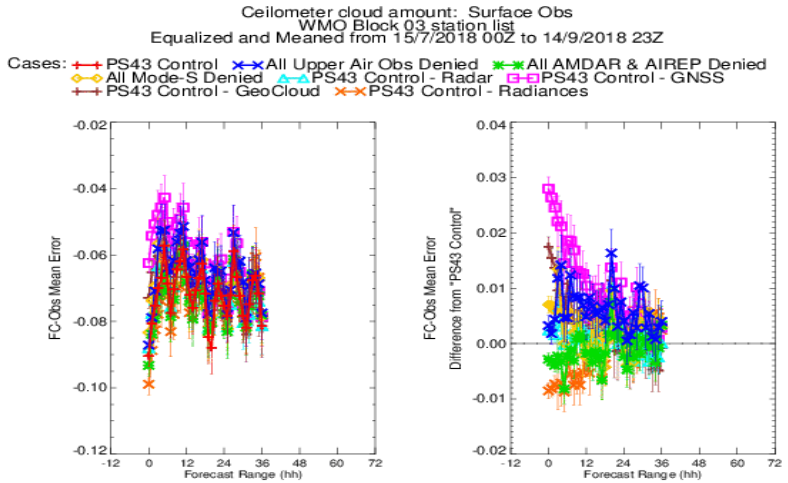
Surface

‘Upper-Air’

Cloud Cover Summer



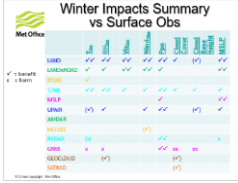


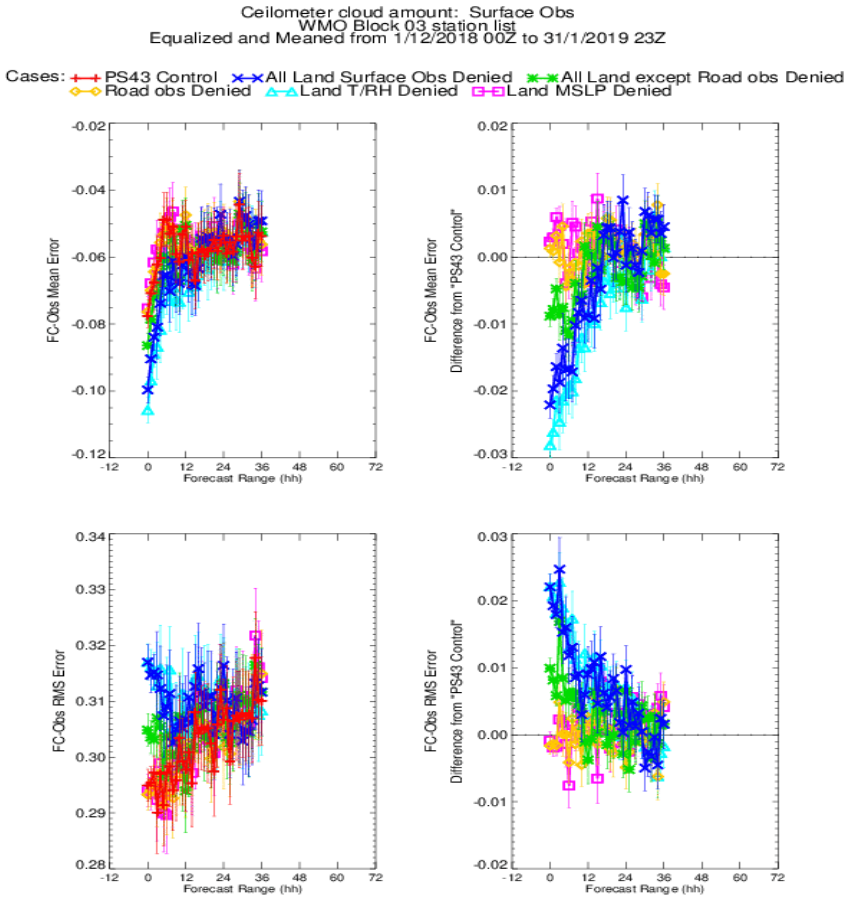


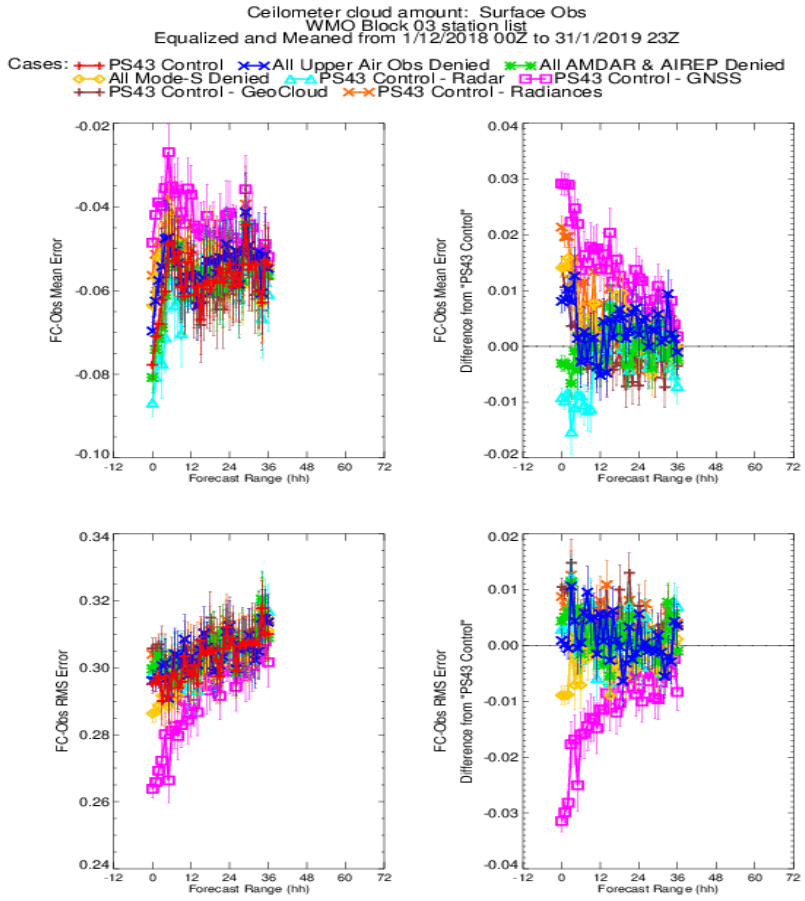
Surface

‘Upper-Air’

Cloud Cover Winter



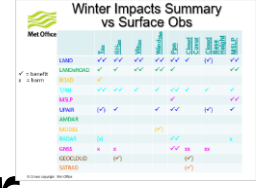


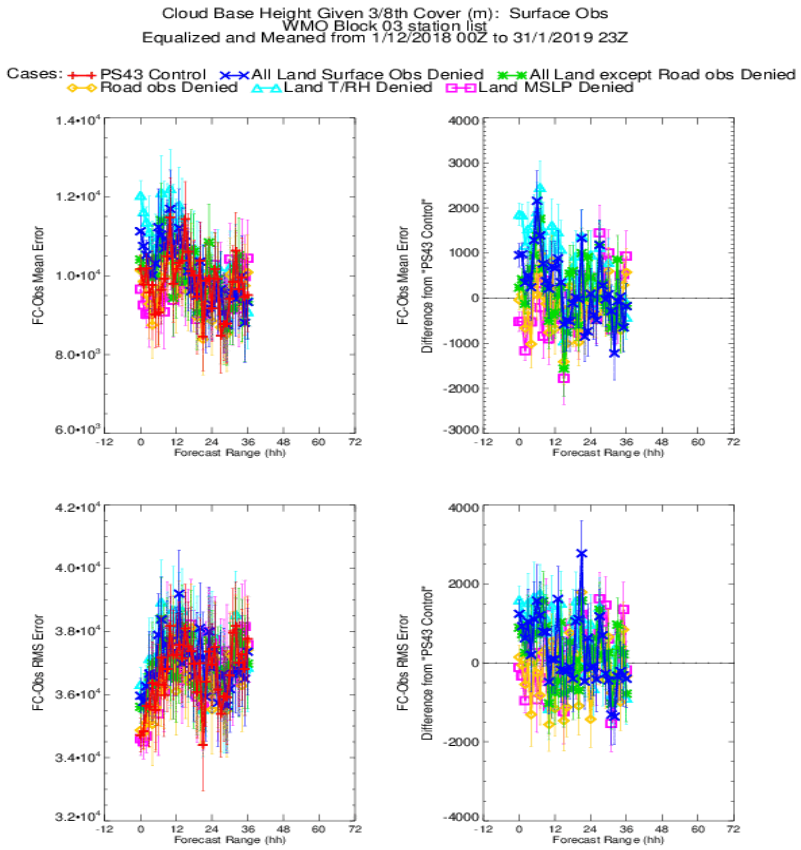


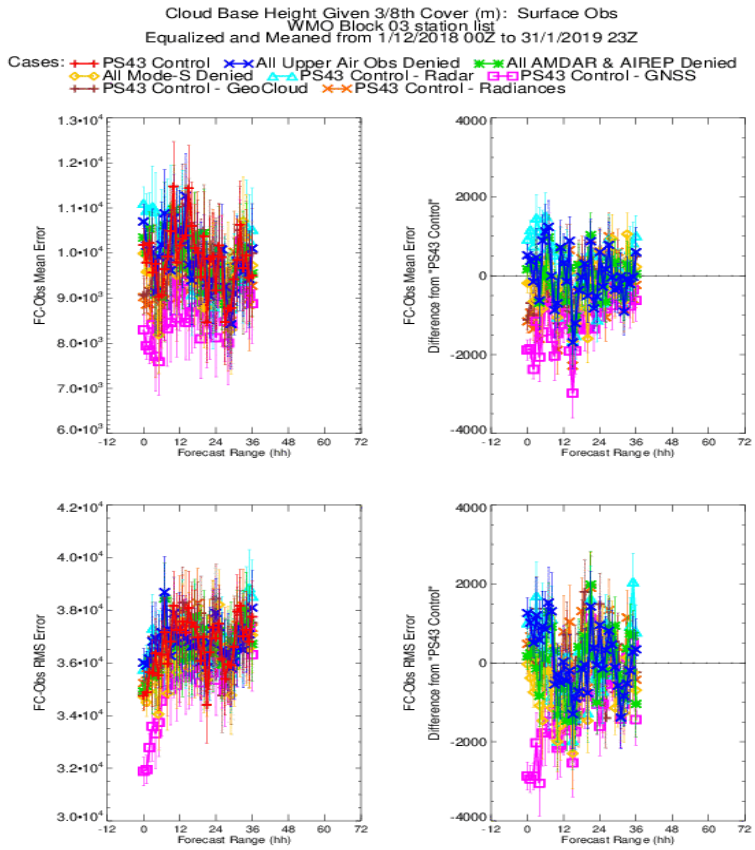
Surface

‘Upper-Air’

Cloud Base Height Winter

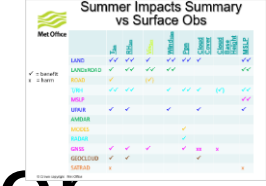




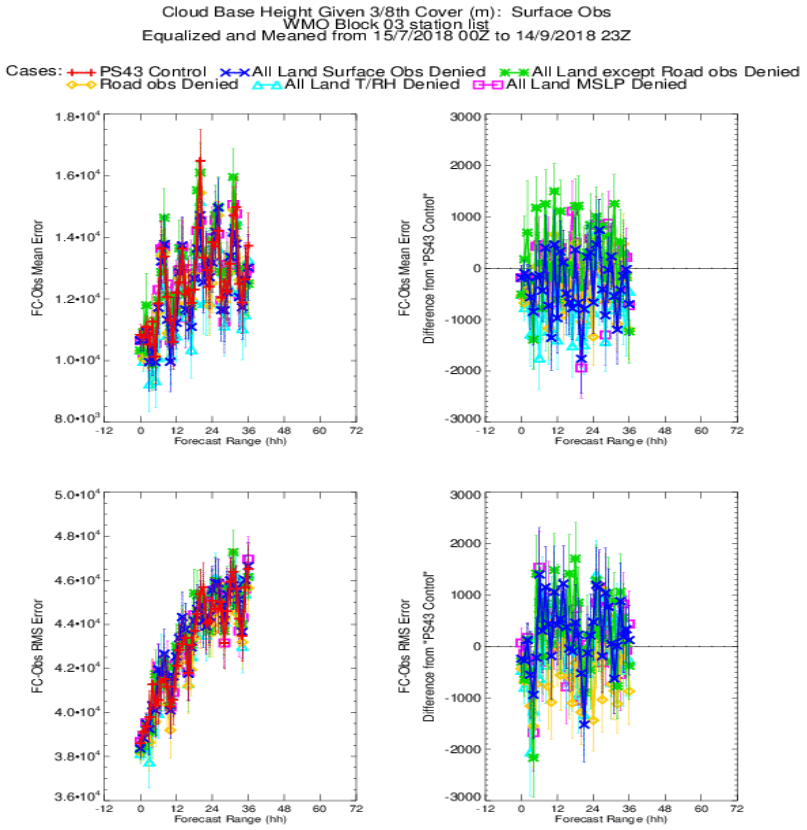


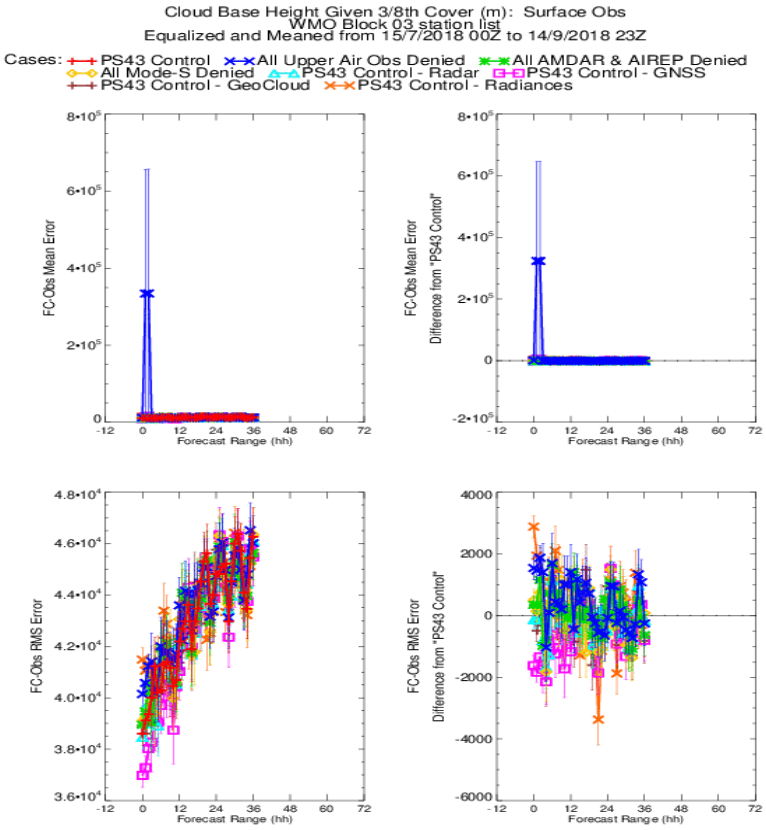
Surface

'Upper-Air'



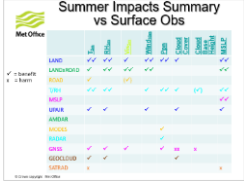
Cloud Base Height Summer



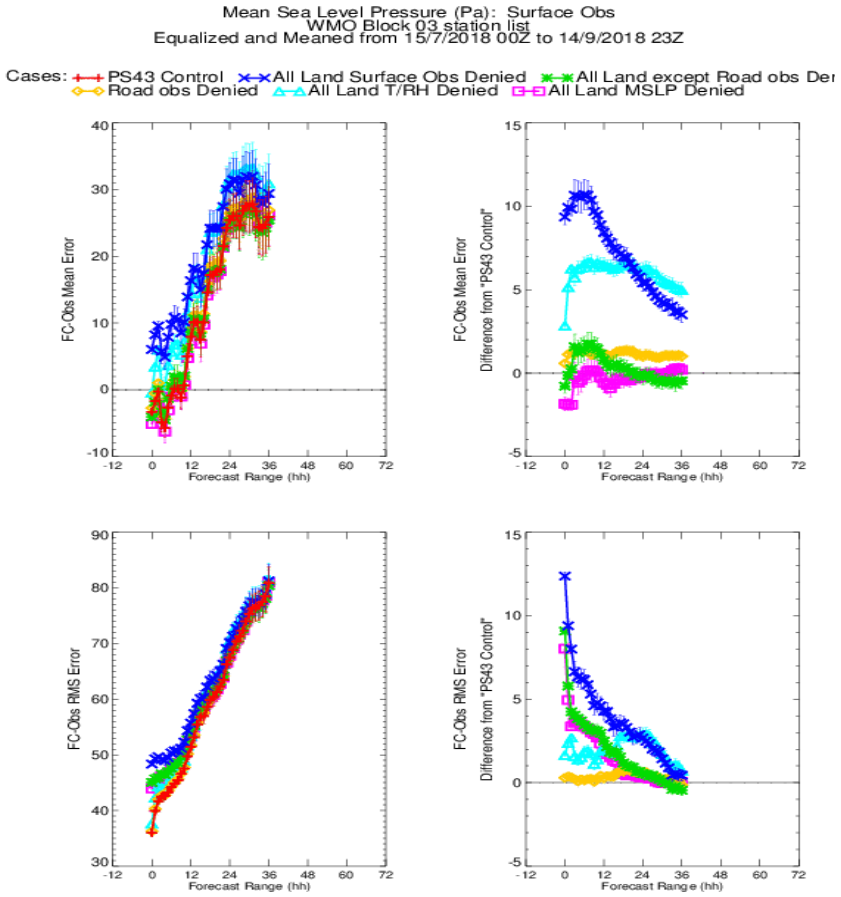


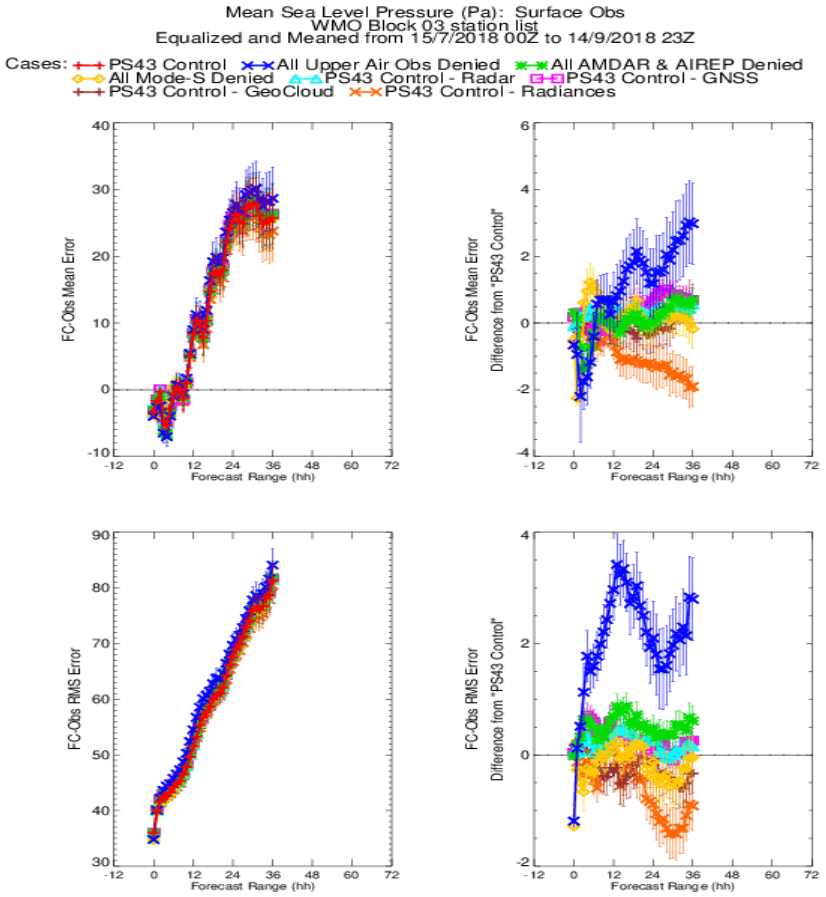
Surface

‘Upper-Air’



MSLP Summer

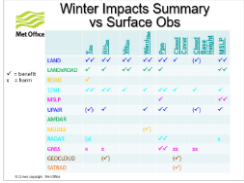


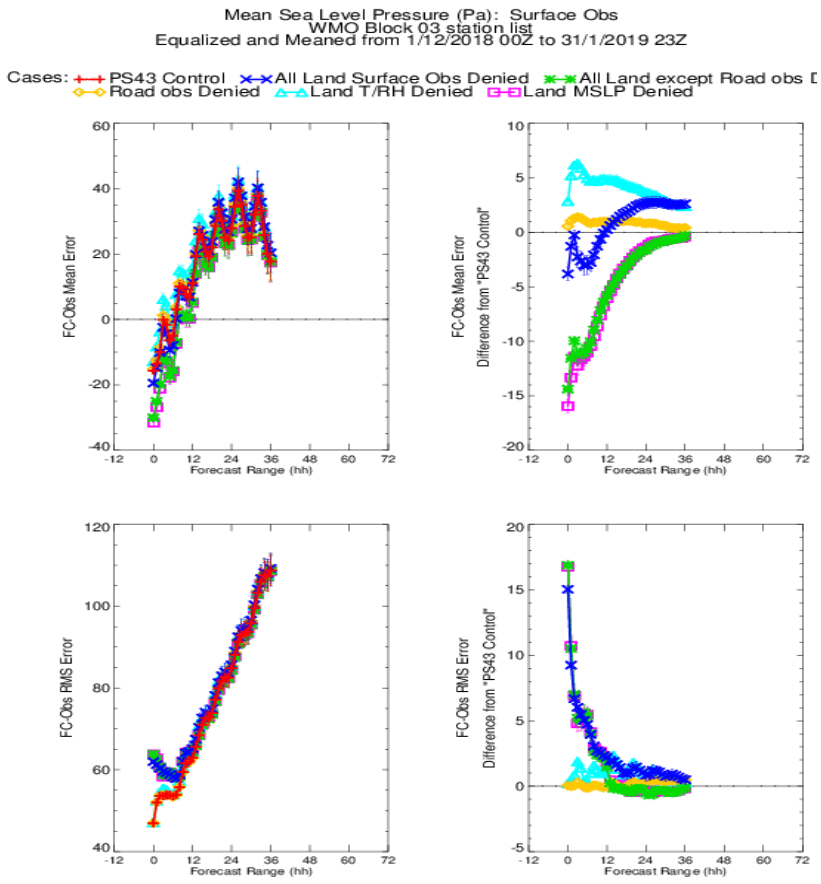


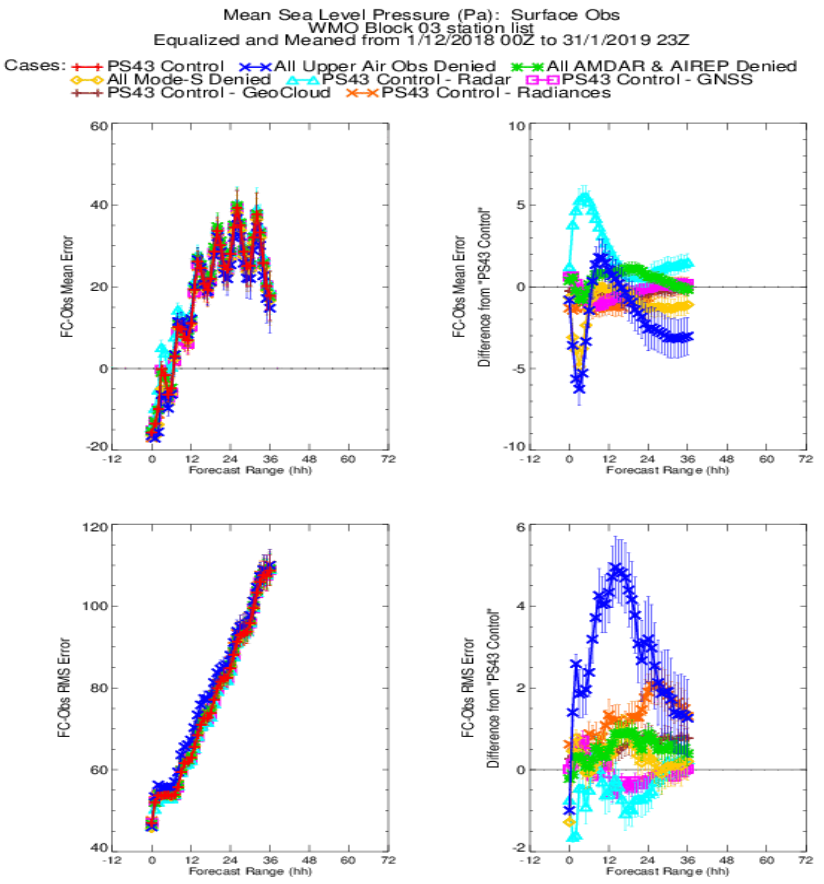
Surface

‘Upper-Air’

MSLP Winter



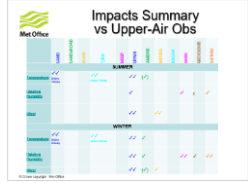


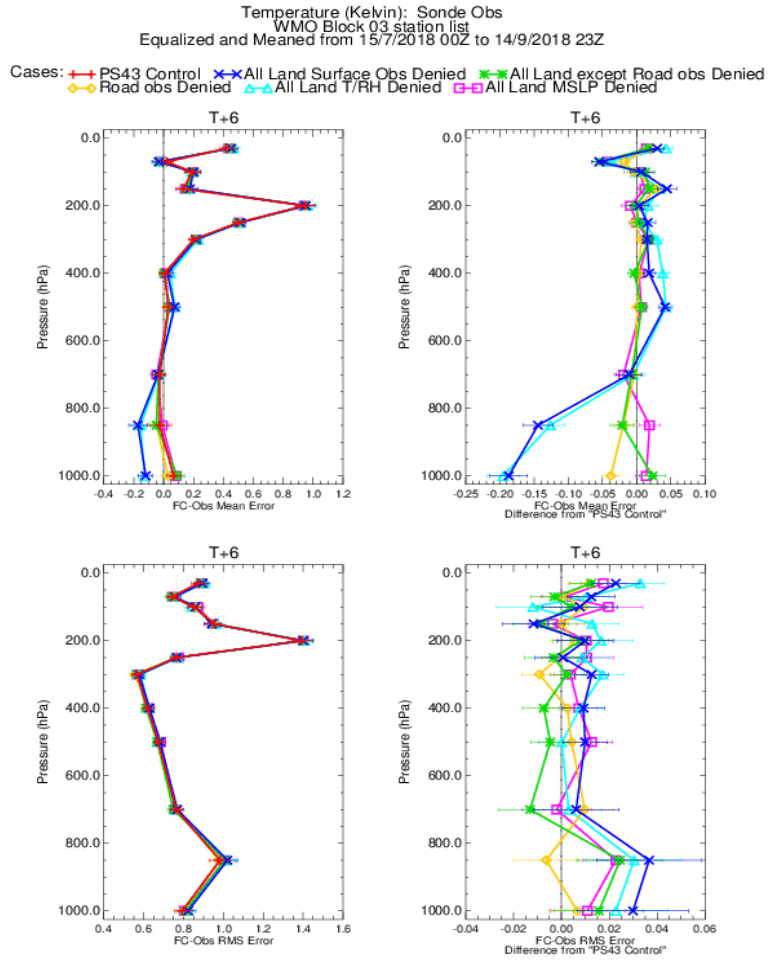


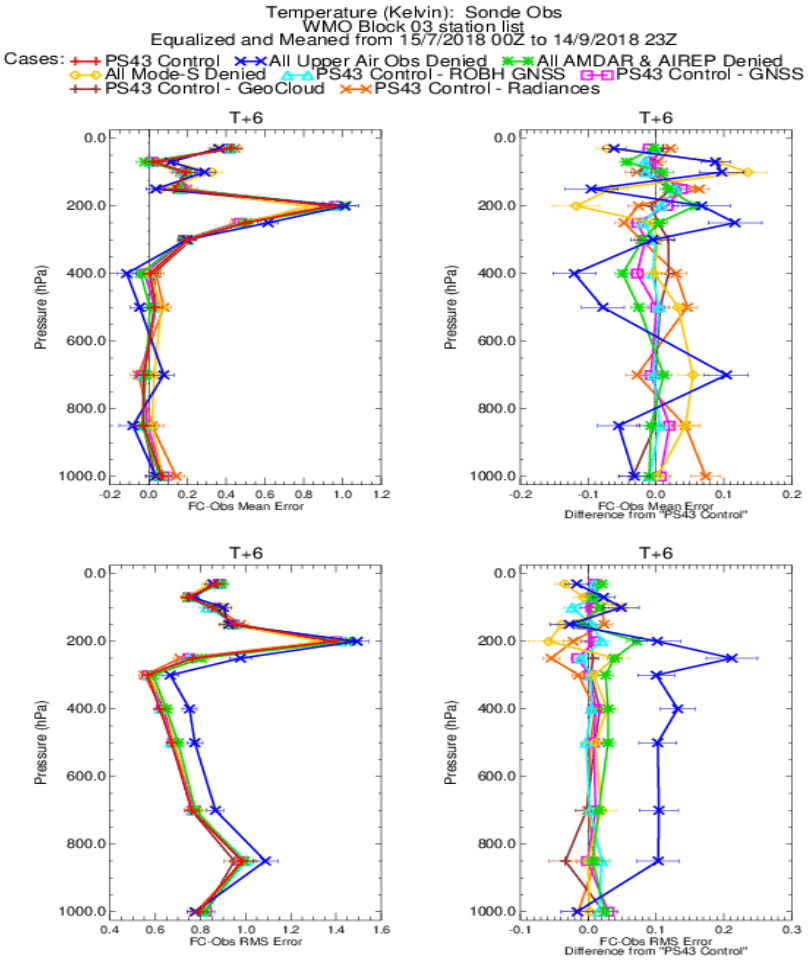
Surface

‘Upper-Air’

Upper-air Temperature Summer

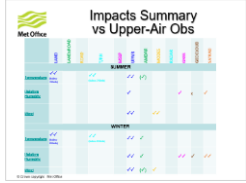




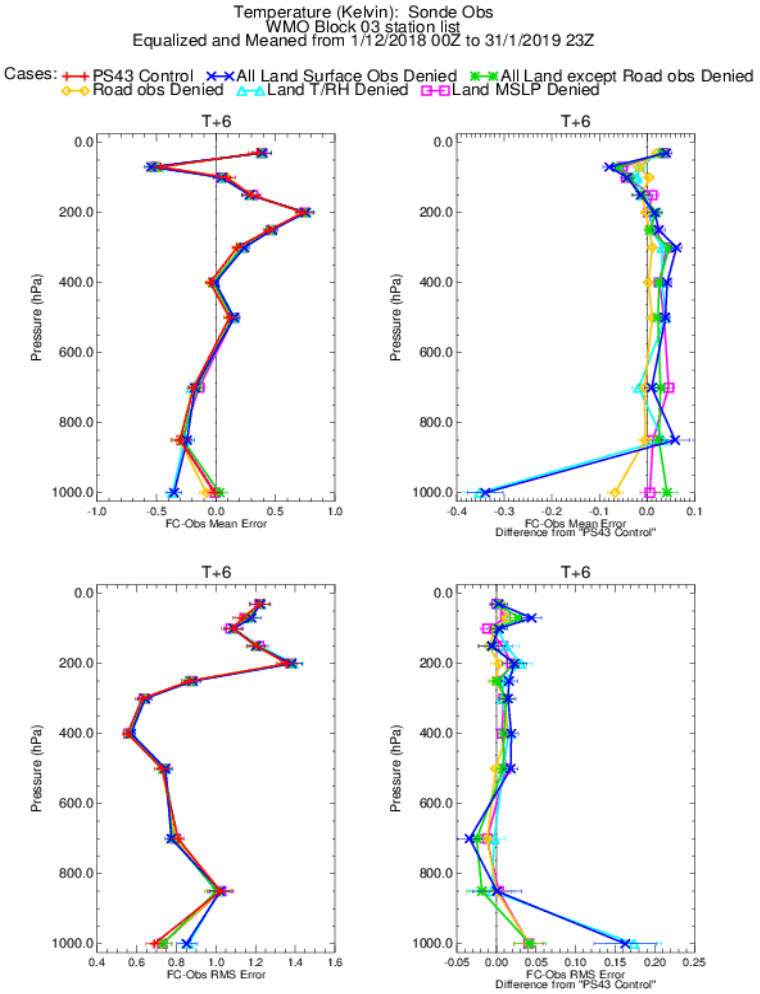


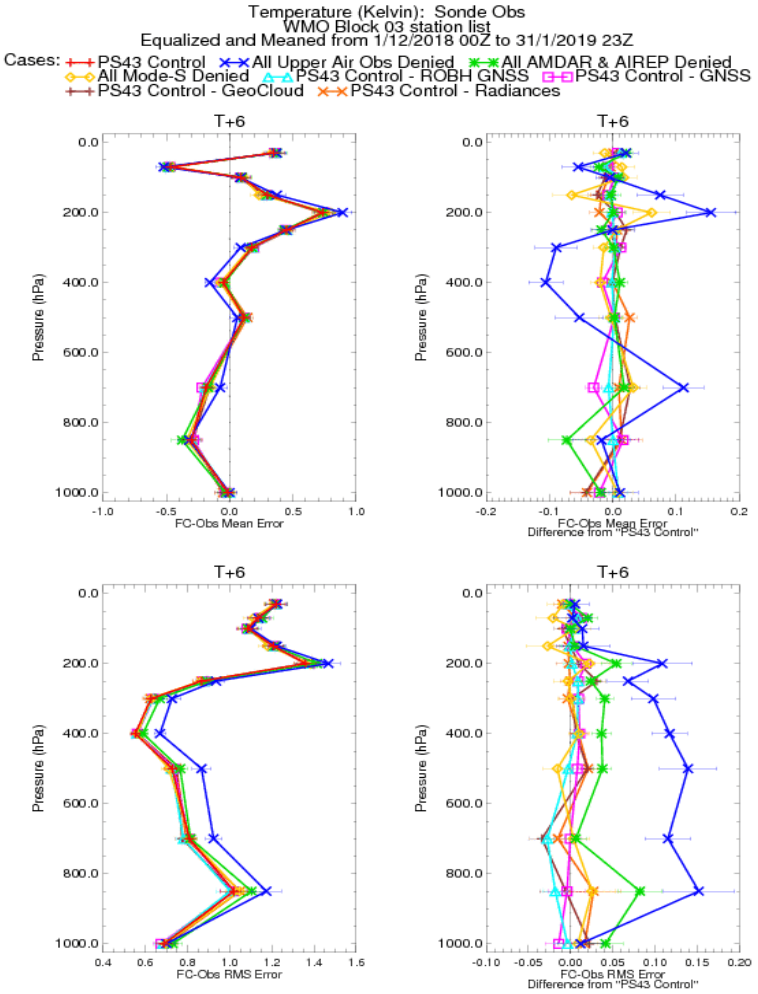
Surface

'Upper-Air'



Upper-air Temperature Winter

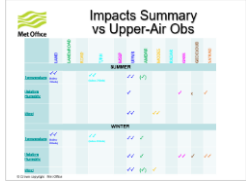


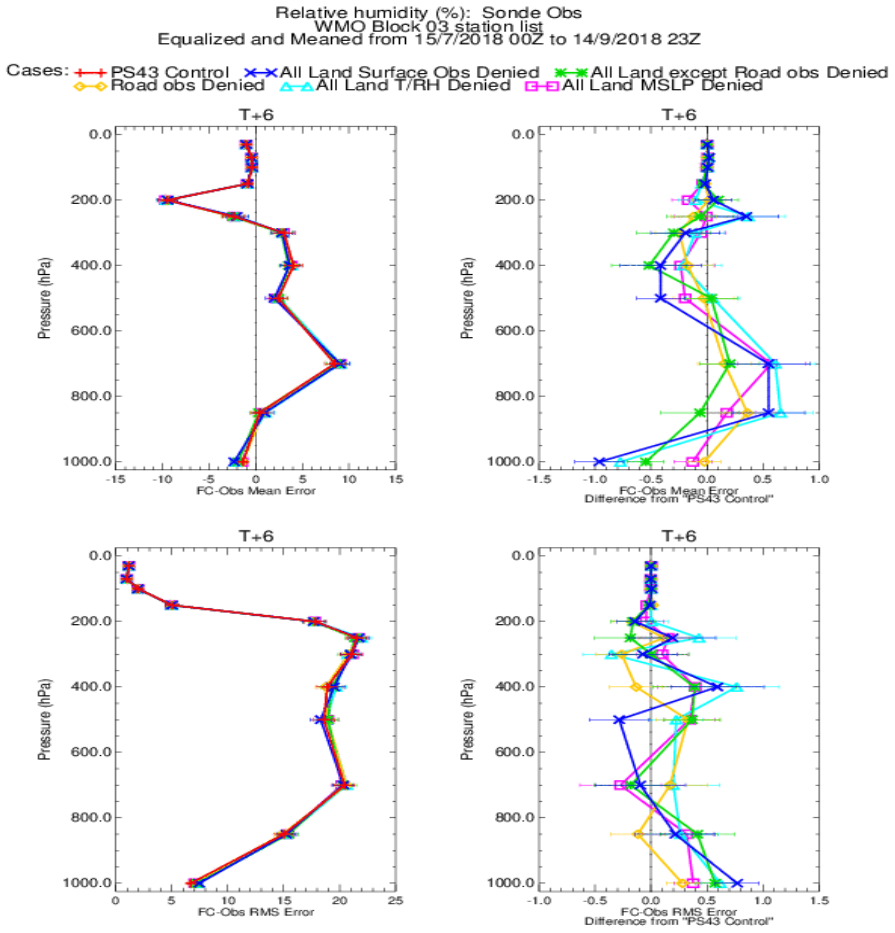


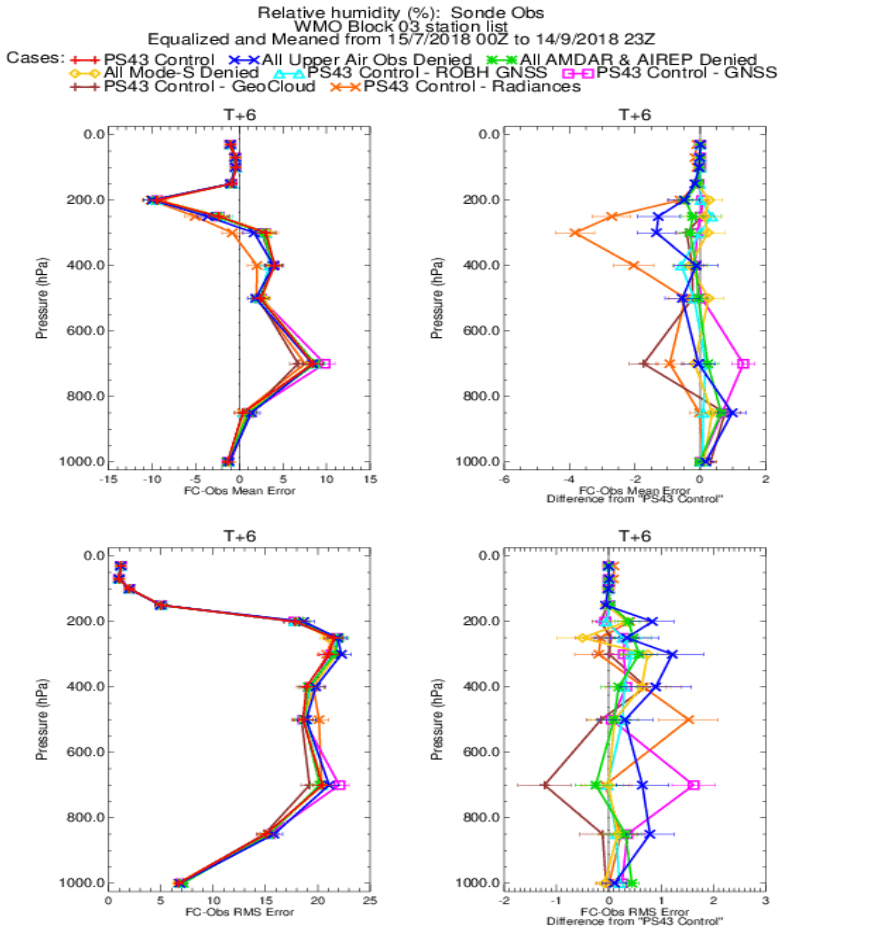
Surface

‘Upper-Air’

Upper-air RH Summer



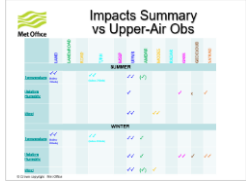


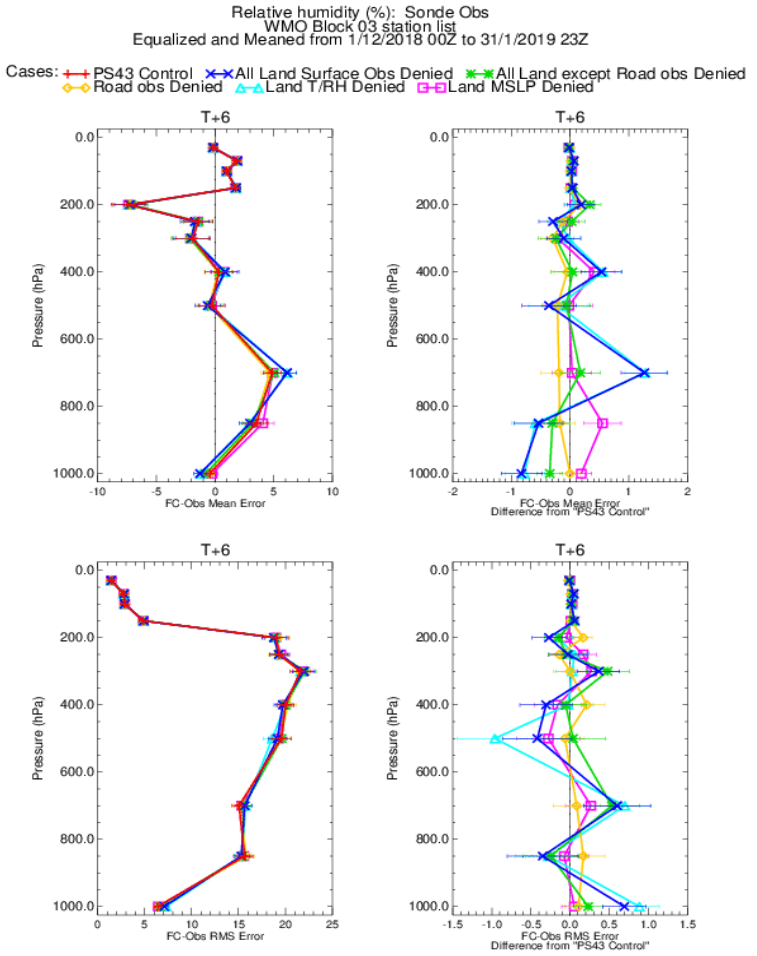


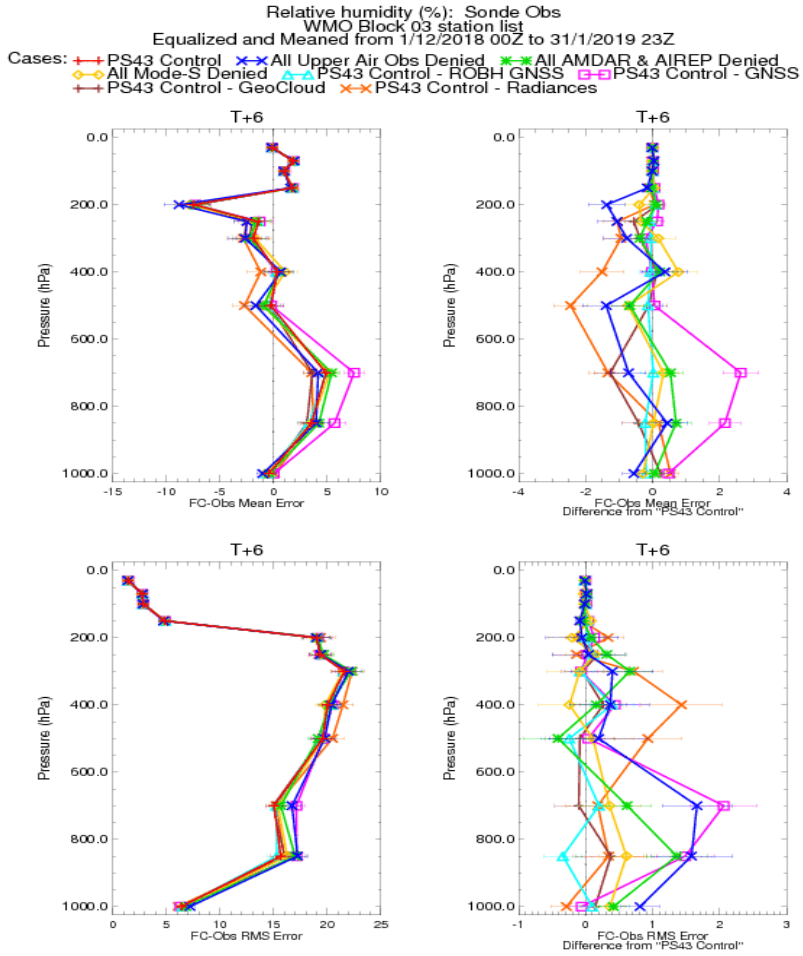
Surface

‘Upper-Air’

Upper-air RH Winter



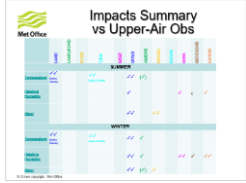


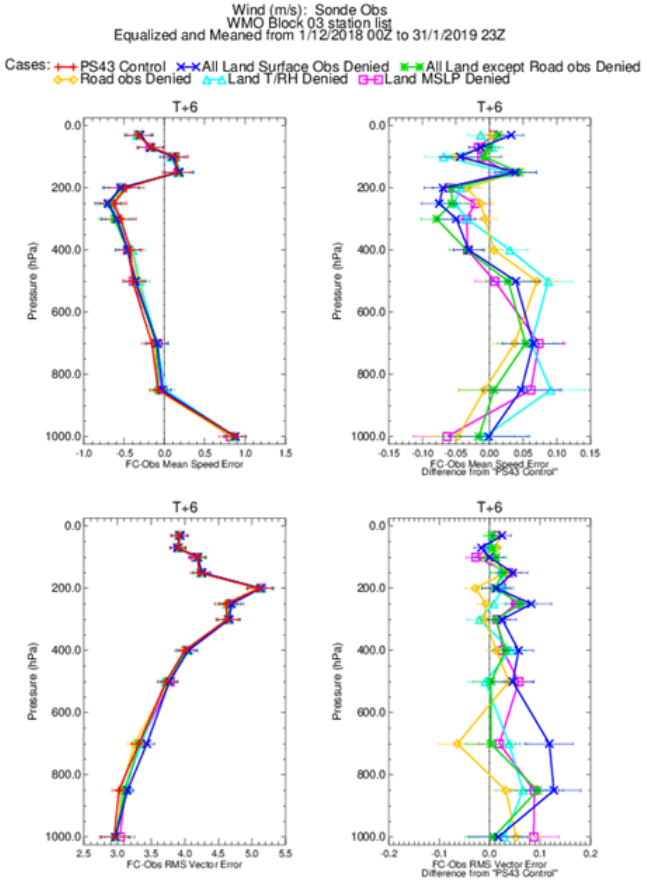


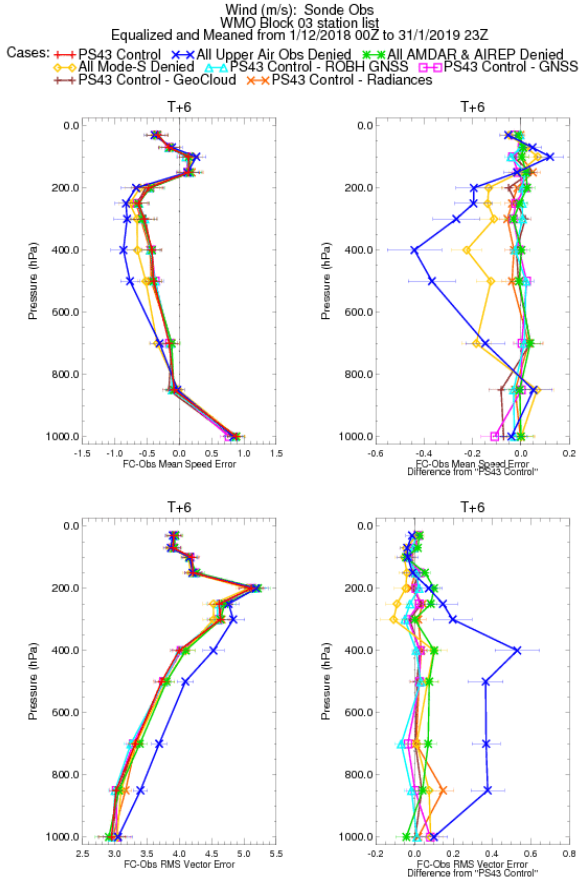
Surface

'Upper-Air'

Upper-air Wind Winter







Surface

'Upper-Air'

Vs OpenRoad Obs