Status of Atmospheric Motion Vectors use in NOAA NCEP weather prediction model

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Outline

Meteosat transitions:

- From Meteosat 7 to Meteosat 8 winds
- From Meteosat 10 to Meteosat 11 winds

Preliminary evaluation of Himawary 9 winds

Quick peek at INSAT winds

Evaluating and Assimilating GOES-16 winds

What's next?

Outline

Meteosat transitions:

- **From Meteosat 7 to Meteosat 8 winds –** early 2017

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Hourly AMVs counts & counts by spectral type

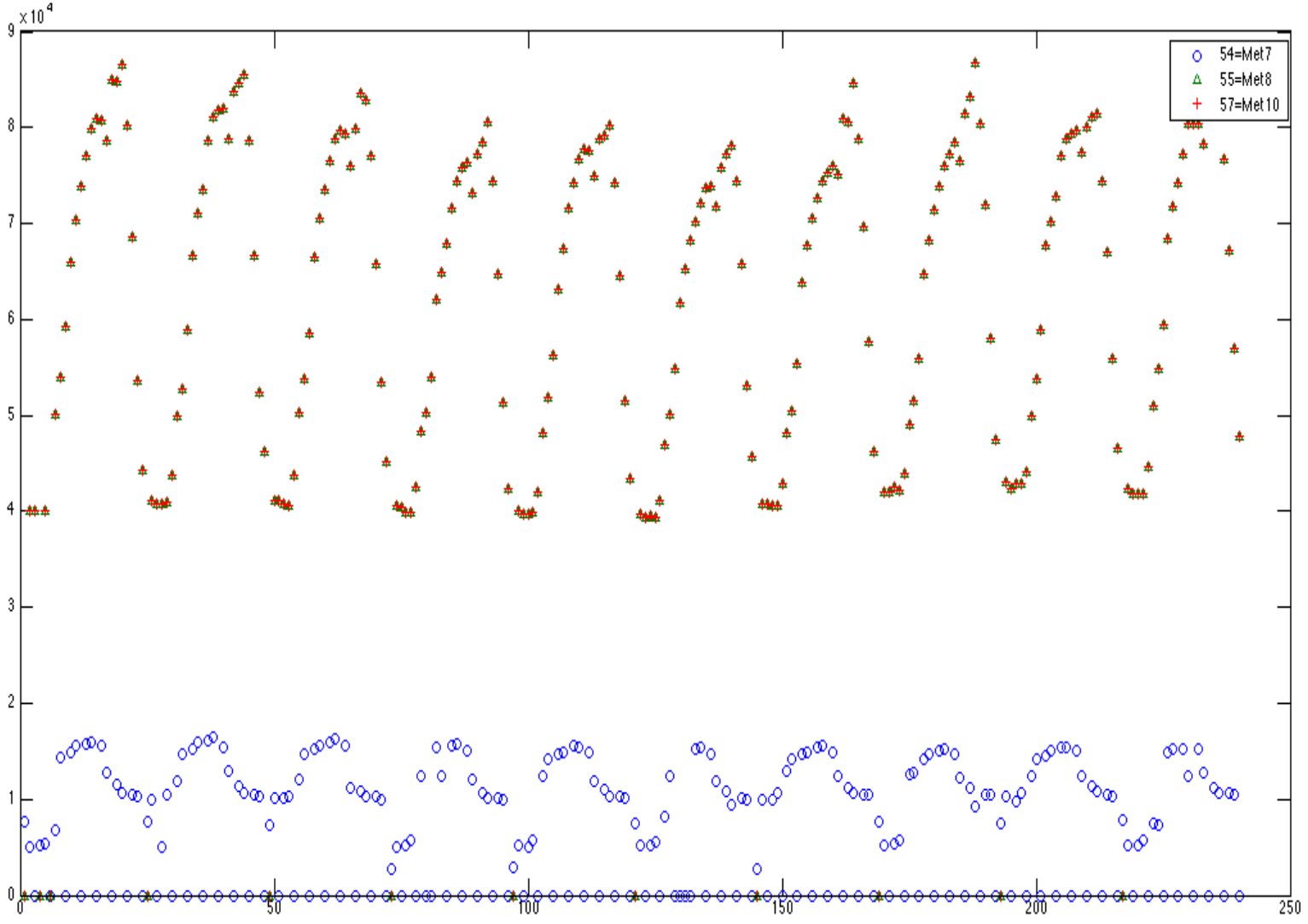
2016-12-12 0Z AMV counts per retrieval time

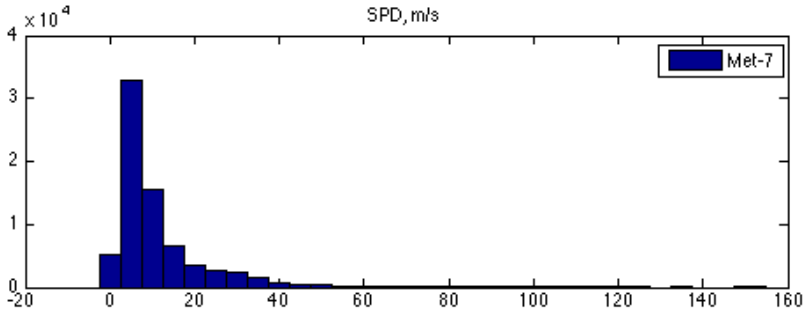
	21Z	22Z	23Z	00Z	01Z	02Z	03Z	All 6h
Met-7	3000	2558	0	3025	3251	0	4125	**15959**
Met-8	29331	29056	30336	33861	38530	44746	0	**205860**
Met-10	32005	32052	30995	30771	31032	33081	0	**188936**

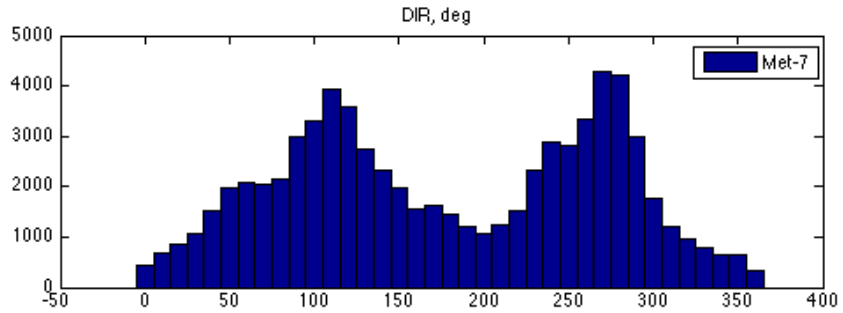
2016-12-12 0Z AMV counts per spectral type

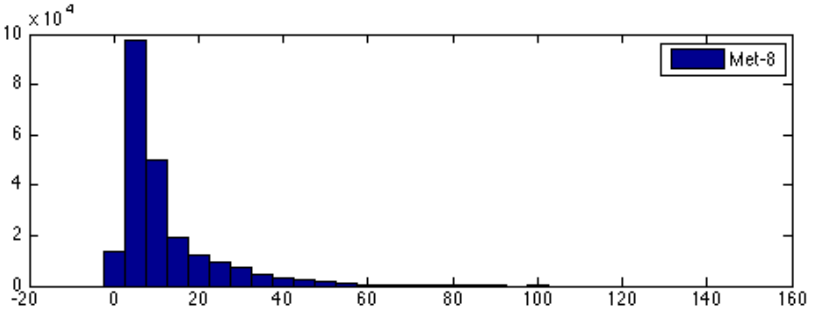
All 6h	VIS	IR	WV (cloud top)	Clear Air WV
Met-7	1327	11548	0	3084
Met-8	32239	62979	67113	43529
Met-10	3590	67237	74250	43859

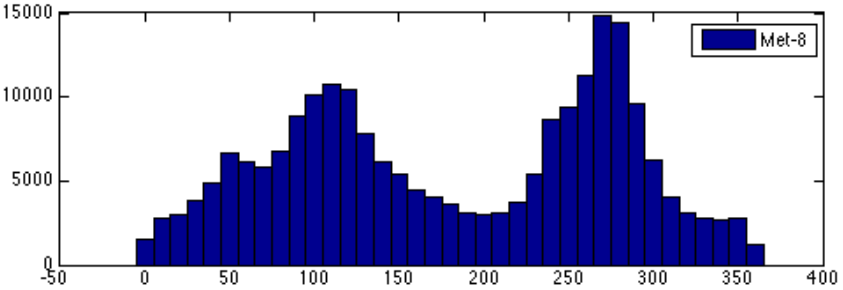
Time series of hourly AMVs counts, 1-10 Jan 2017

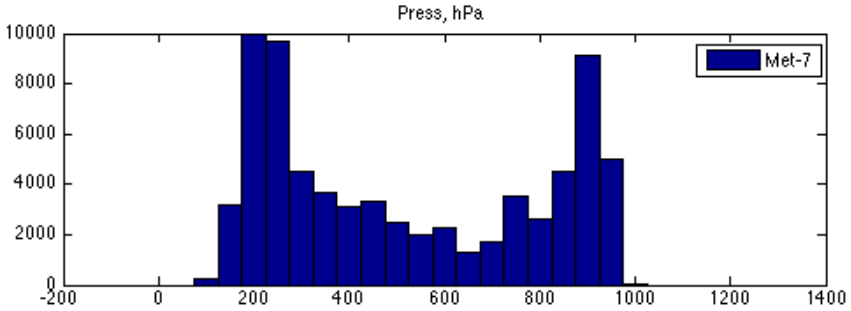


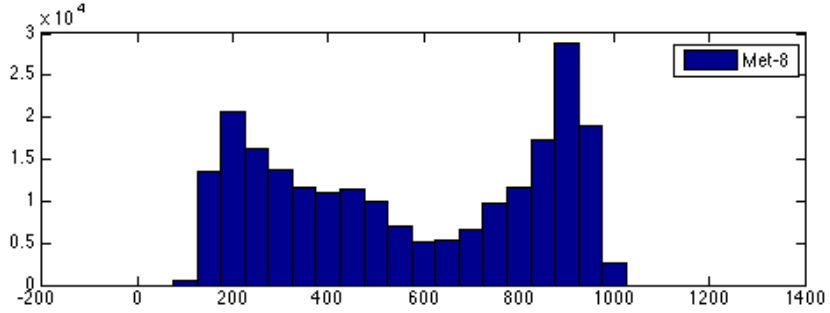








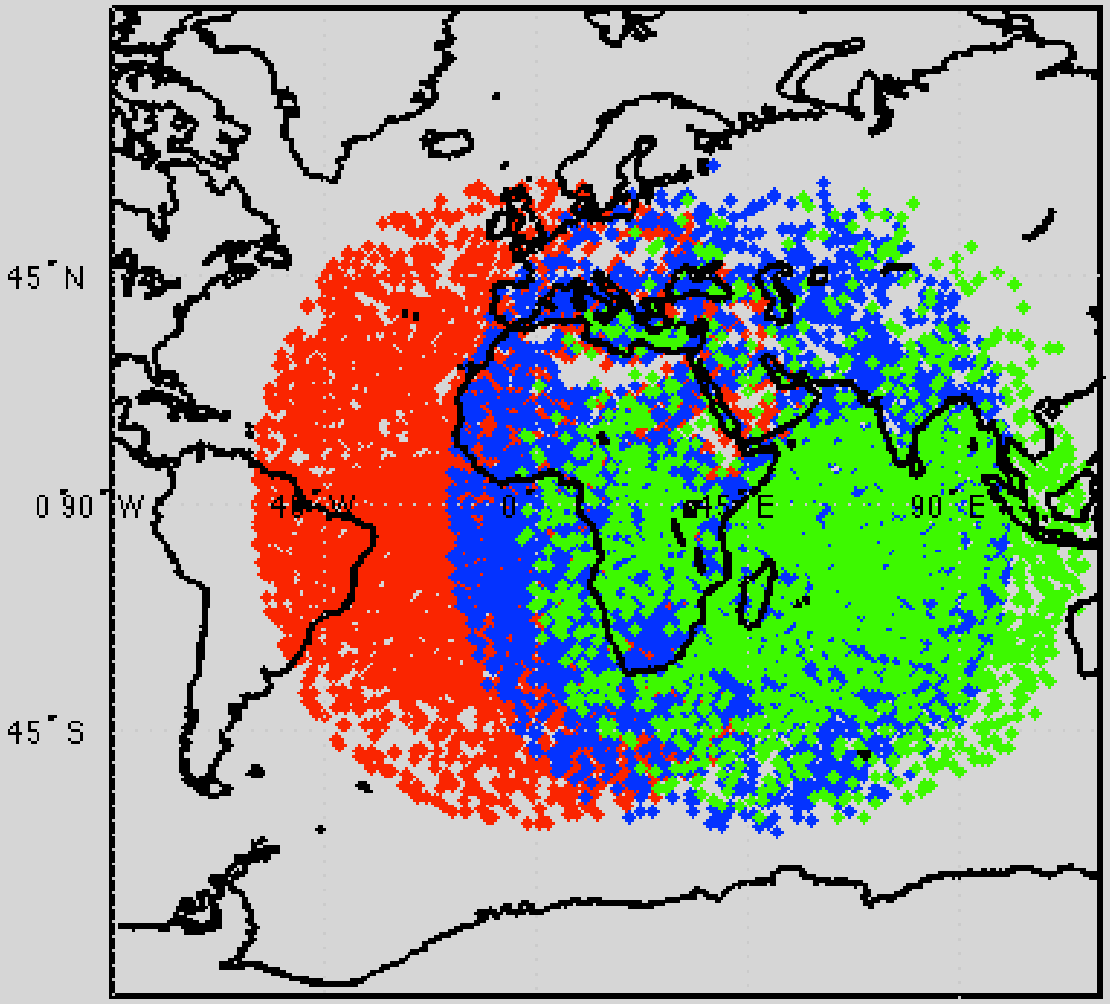




Speed, Direction and Pressure histograms
Met-7 & Met-8
2017-01-01 (24h worth of data)

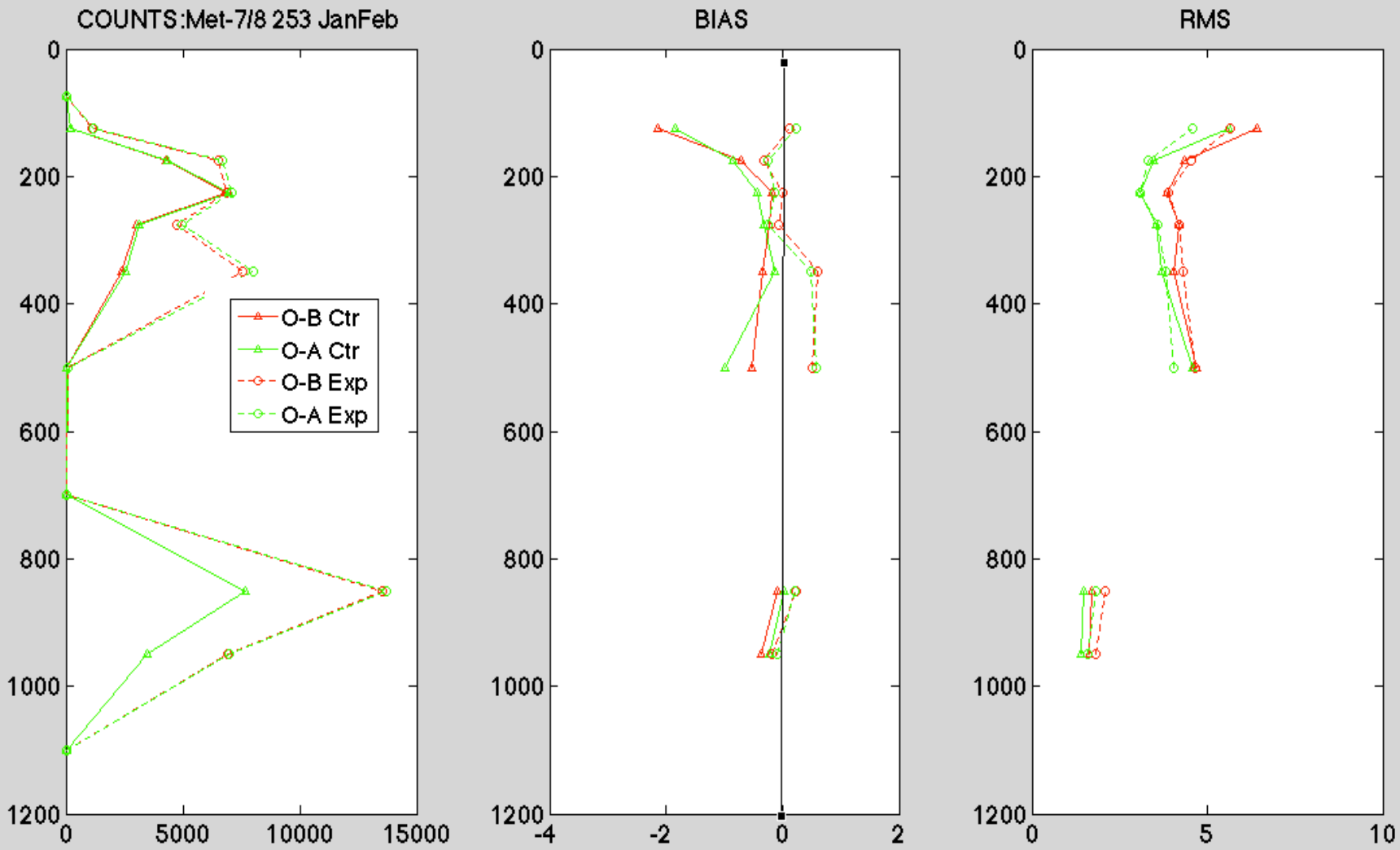
Example:
SPD, DIR and Pressure
Met-7 vs Met-8 histogram comparison

AMVs Full Disk Coverage: Met-10 (red), Met-8 (blue) and Met-7 (green)

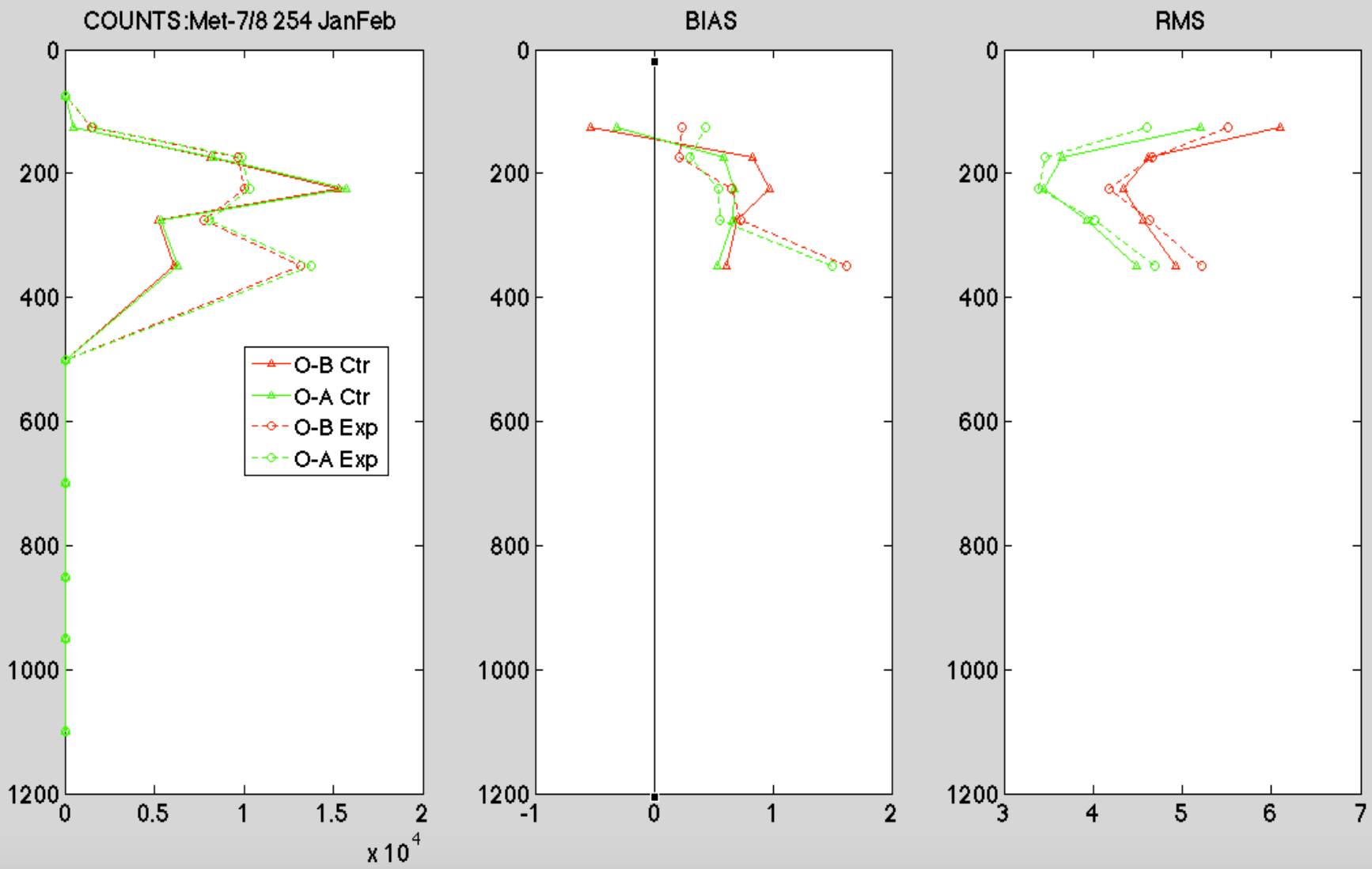


2017-01-01 , 18Z (6h worth of data)

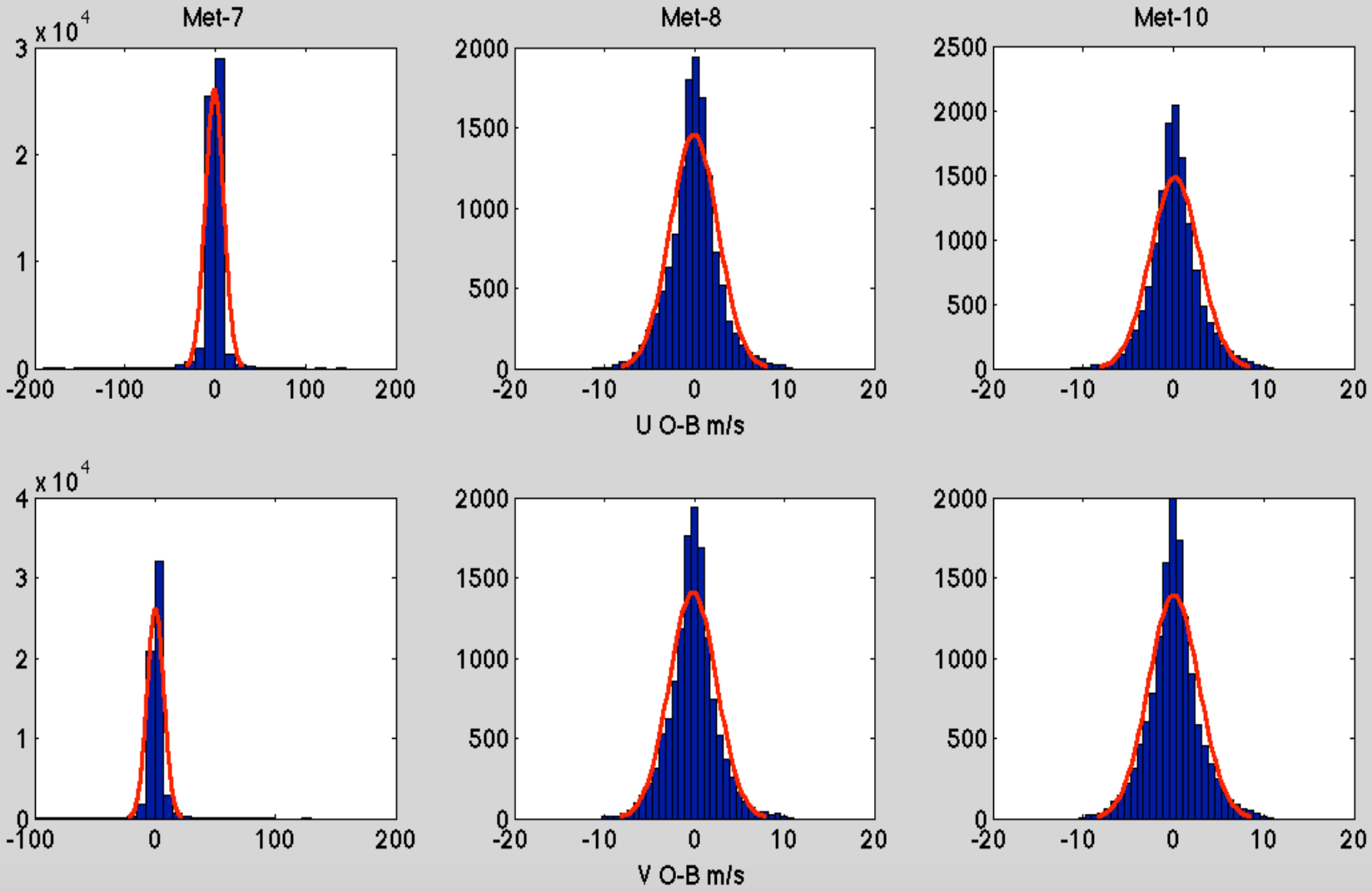
O-B and O-A profiles for Control (Meteosat 7) and Experiment (Meteosat 8) **IR** AMVs



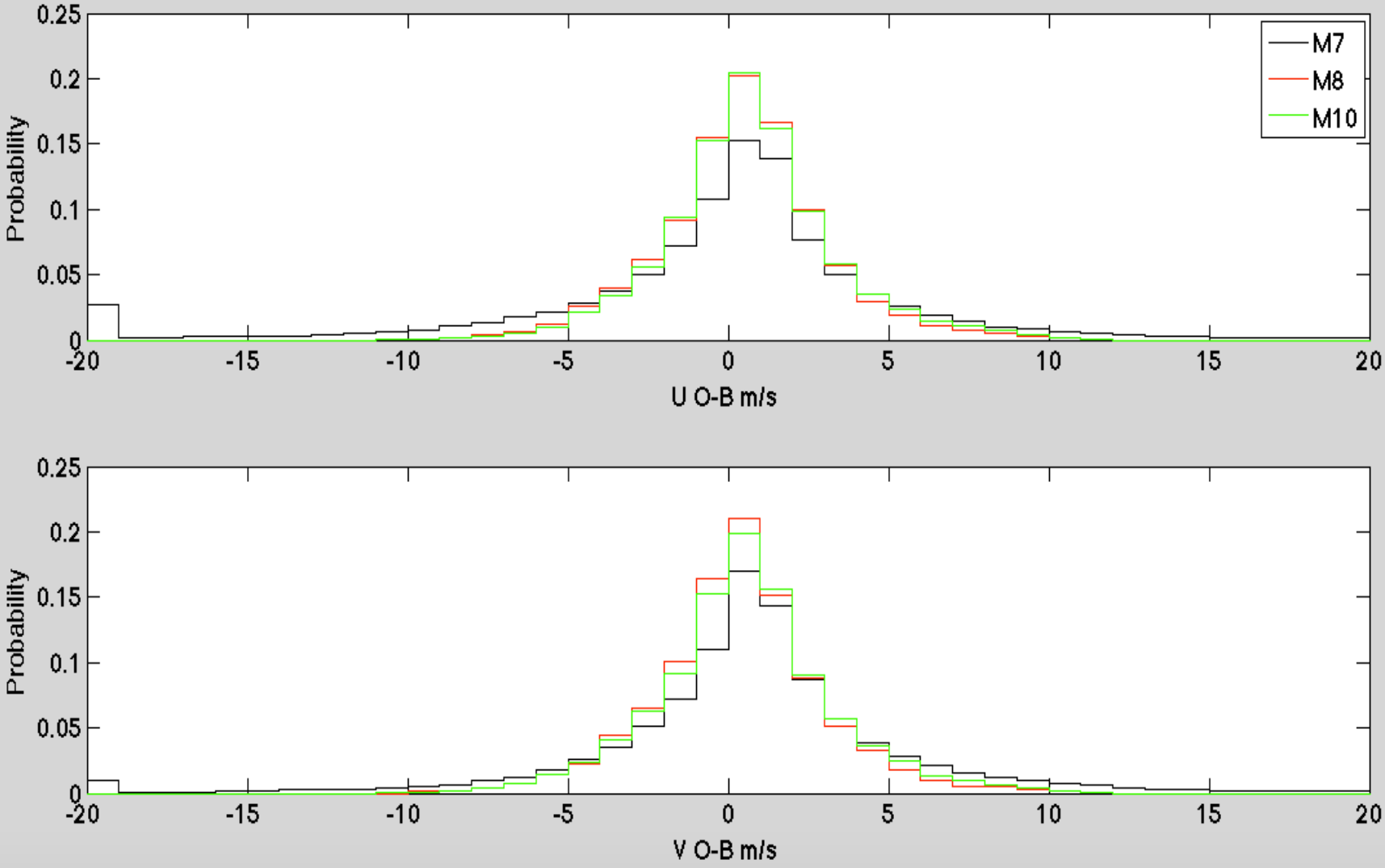
O-B and O-A profiles for Control (Meteosat 7) and Experiment (Meteosat 8) **WV** AMVs



O-B fit to Normal Distribution



O-B PDF: shows strong similarity between M-8 and M-10



Final thoughts

Met-8 AMVs were thinned in the experiment, to match the current operational counts from Met-7

Met-7 and Met-8 are of comparable quality, and depending on the altitude and the counts, one or the other is slightly superior (~0.5m/s)

Both, Met-7 and Met-8's O-B profiles are similar to Met-10, Bias <= 1.5m/s and RMS <= 6m/s

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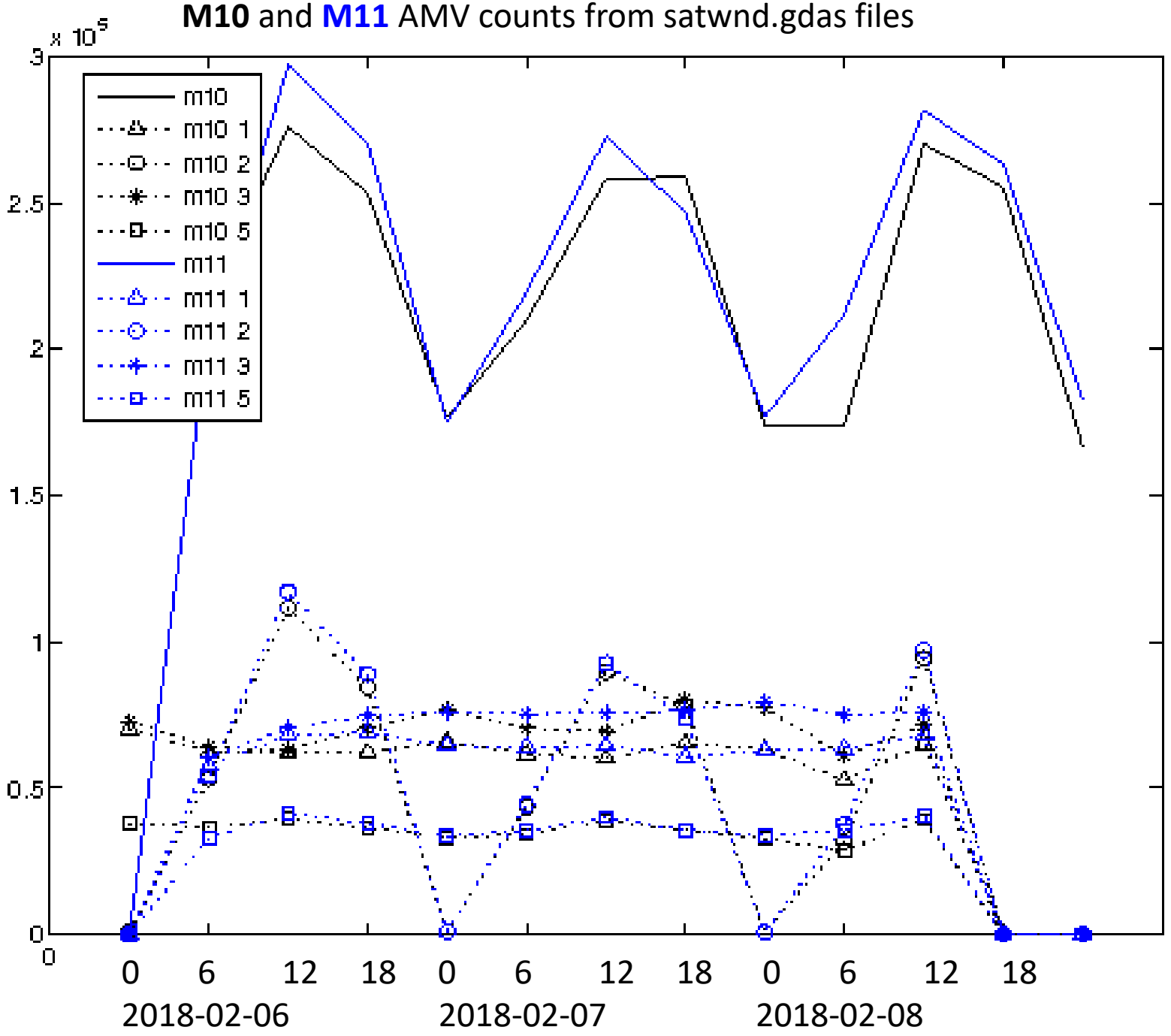
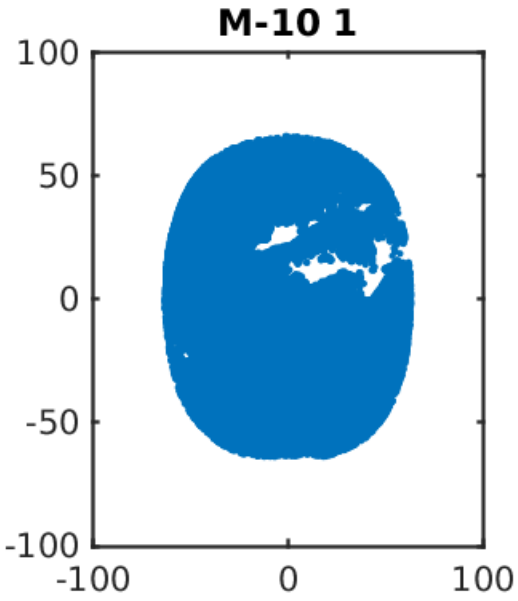
What's next?

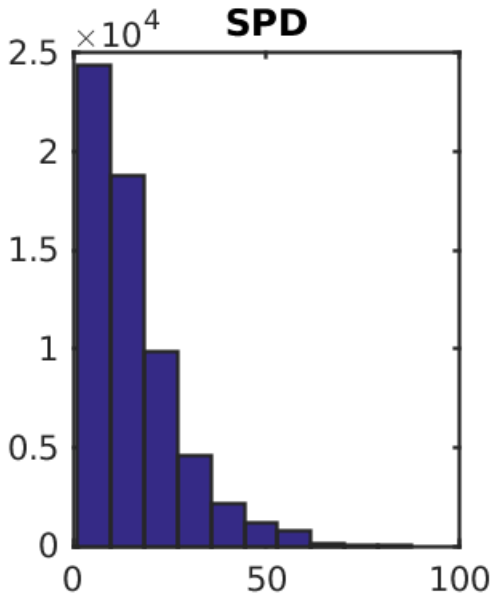
M10 and **M11** AMV counts from satwnd.gdas files

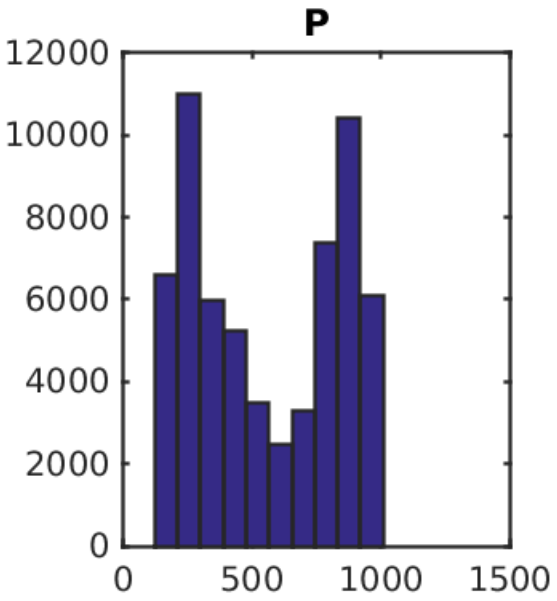
1=IR
2=VIS
3=WVCT
5=WVCA

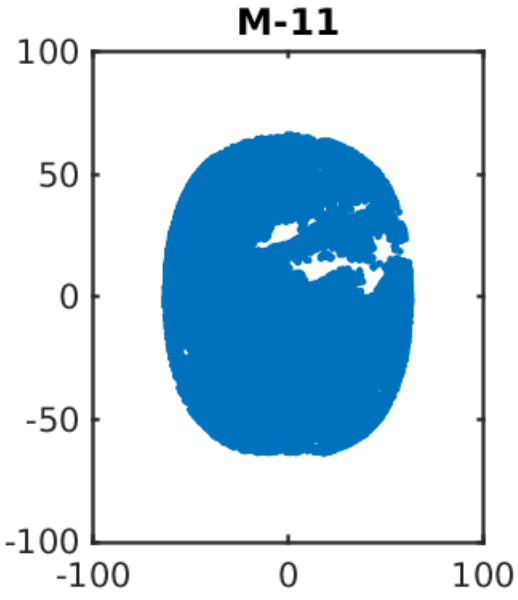


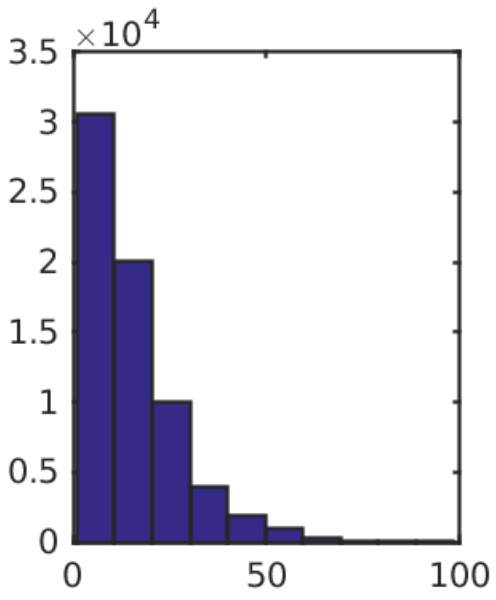
IR

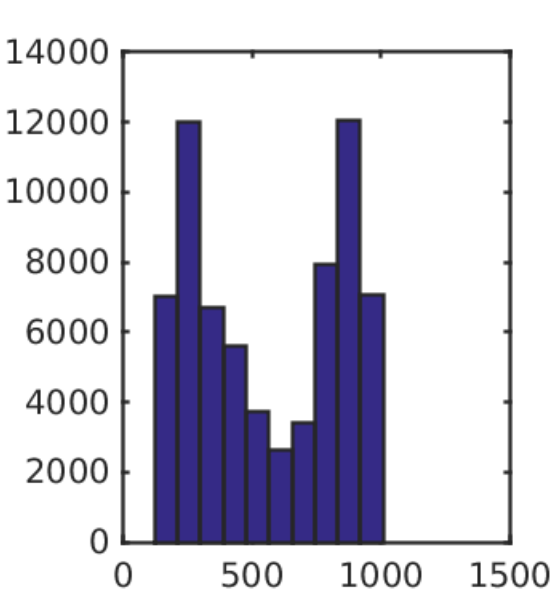

M-10 1
100
50
0
-50
-100
-100
0
100


SPD
×10^4
2.5
2
1.5
1
0.5
0
0
50
100

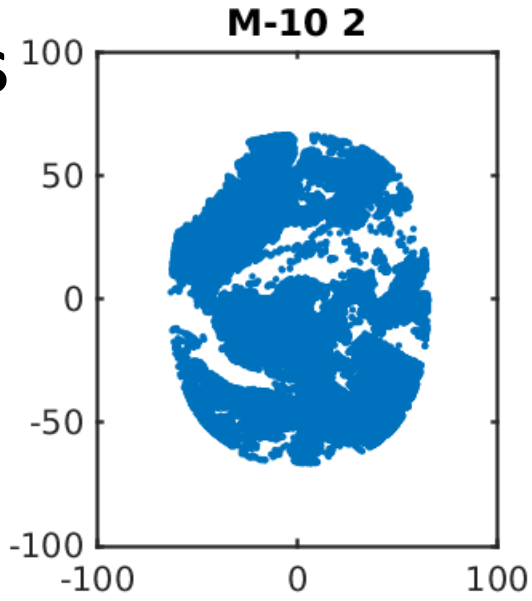

P
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500

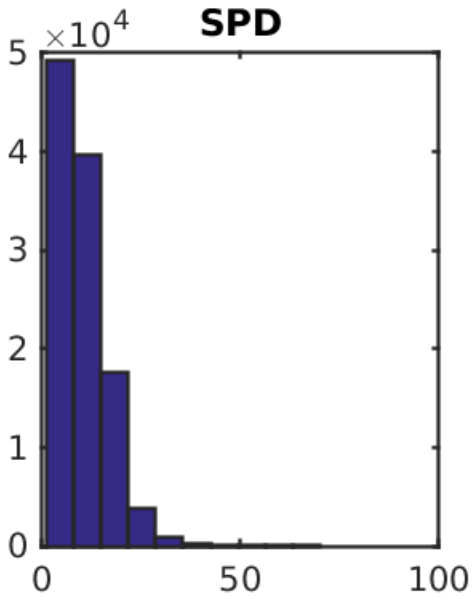

M-11
100
50
0
-50
-100
-100
0
100

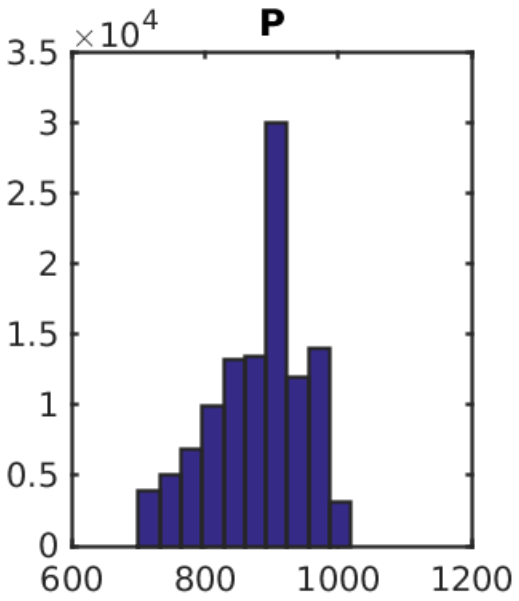

×10^4
3.5
3
2.5
2
1.5
1
0.5
0
0
50
100

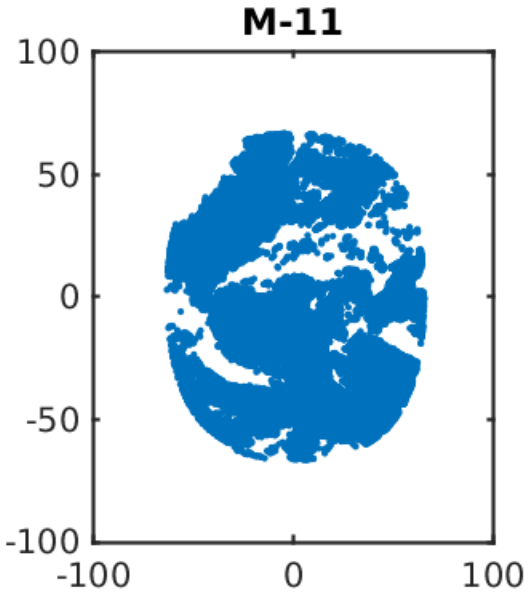

14000
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500

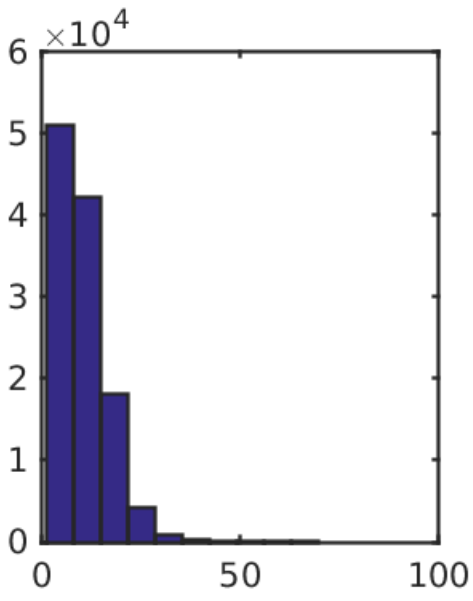
VIS

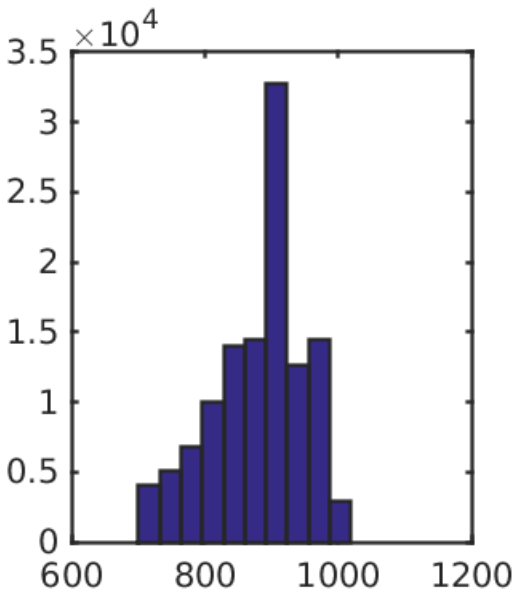

M-10 2
100
50
0
-50
-100
-100
0
100


SPD
×10^4
5
4
3
2
1
0
0
50
100

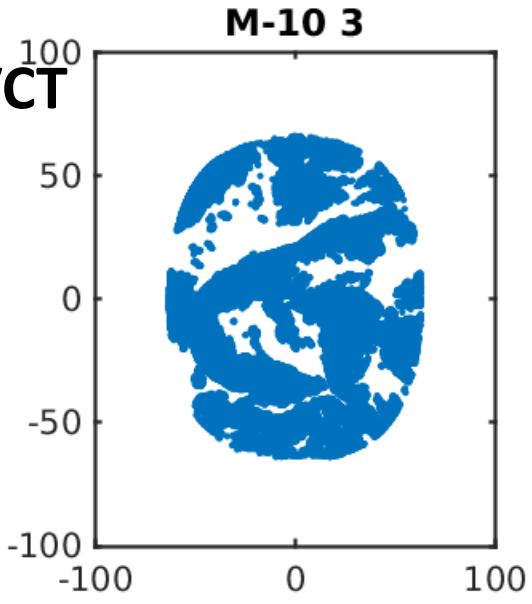

P
×10^4
3.5
3
2.5
2
1.5
1
0.5
0
600
800
1000
1200

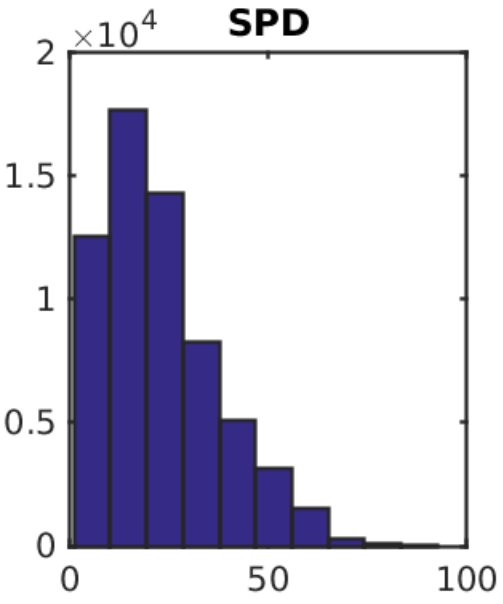

M-11
100
50
0
-50
-100
-100
0
100

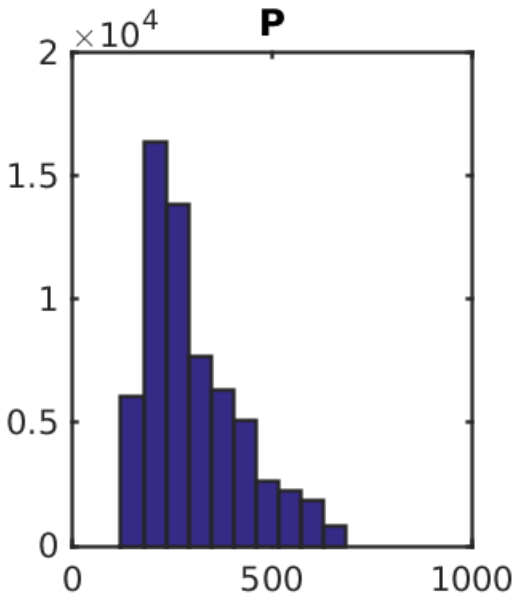

×10^4
6
5
4
3
2
1
0
0
50
100

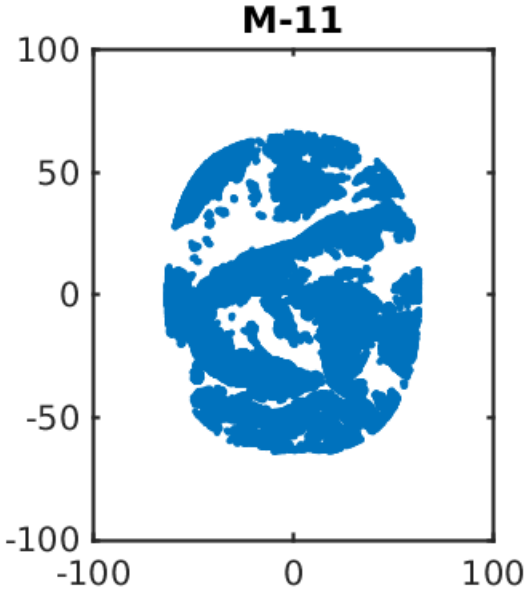

×10^4
3.5
3
2.5
2
1.5
1
0.5
0
600
800
1000
1200

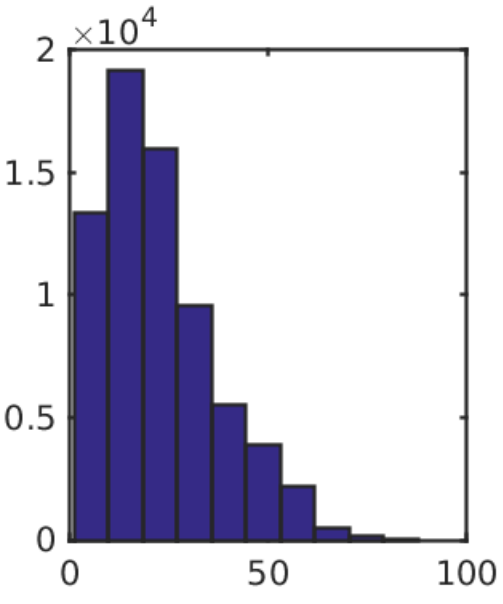
WVCT

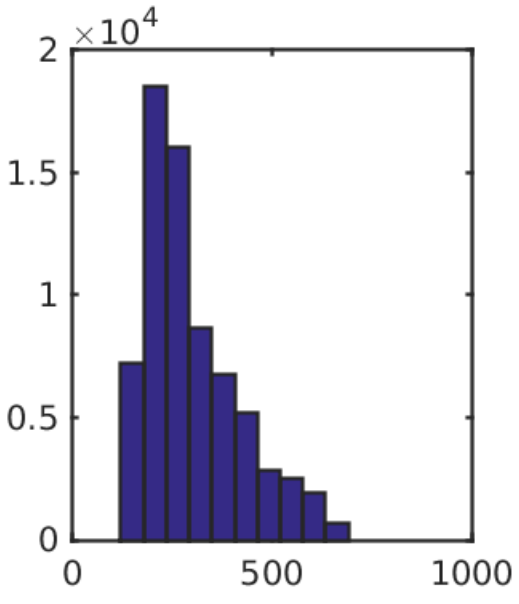

M-10 3
100
50
0
-50
-100
-100
0
100


SPD
×10^4
2
1.5
1
0.5
0
0
50
100

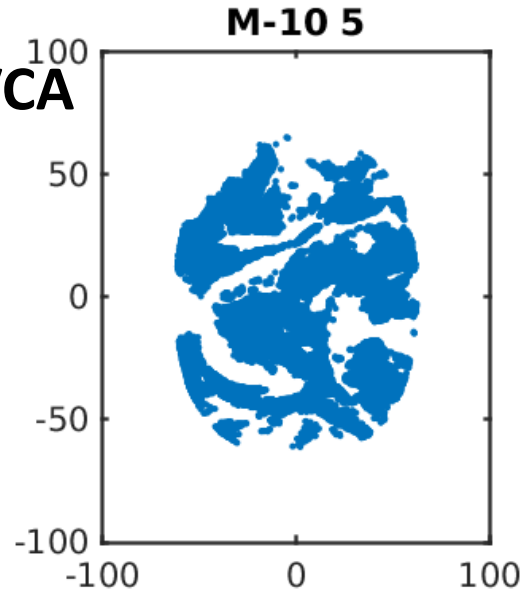

P
×10^4
2
1.5
1
0.5
0
0
500
1000

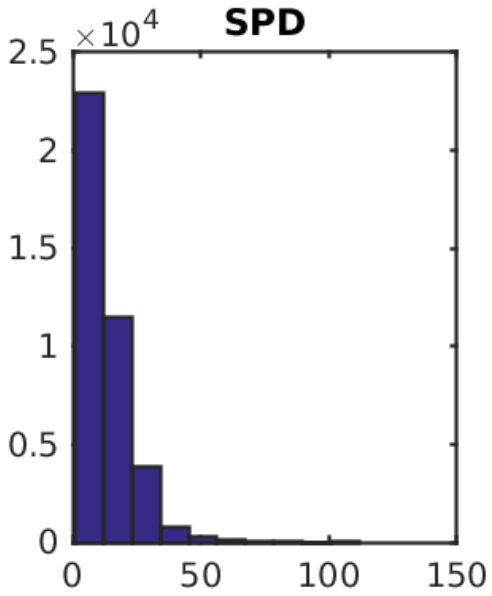

M-11
100
50
0
-50
-100
-100
0
100

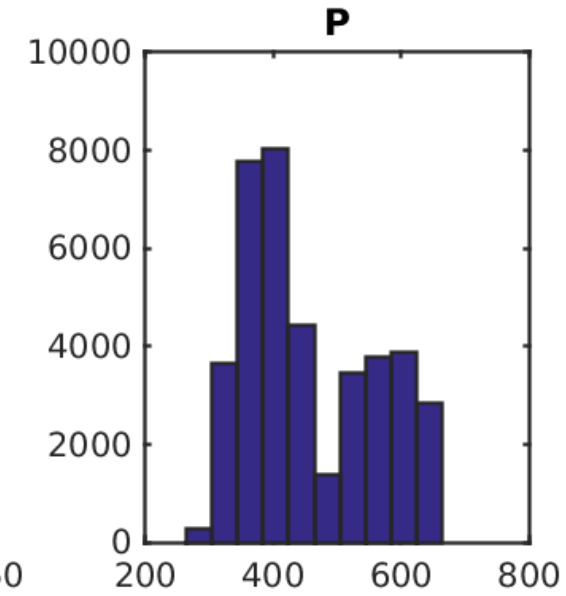

×10^4
2
1.5
1
0.5
0
0
50
100

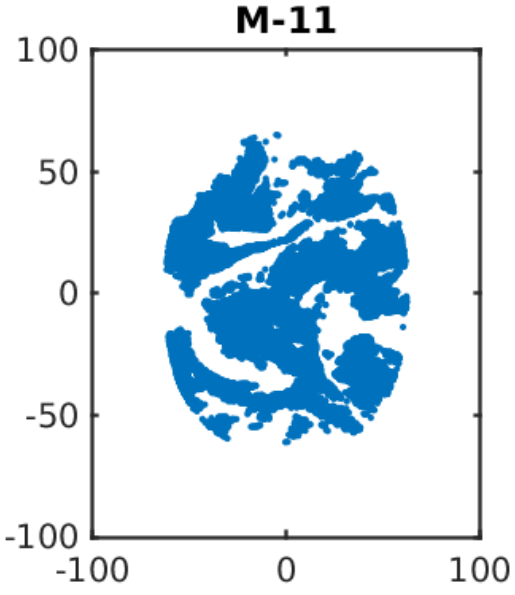

×10^4
2
1.5
1
0.5
0
0
500
1000

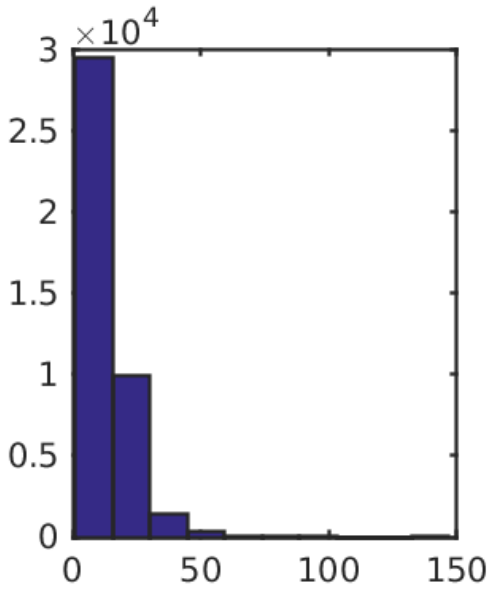
WVCA

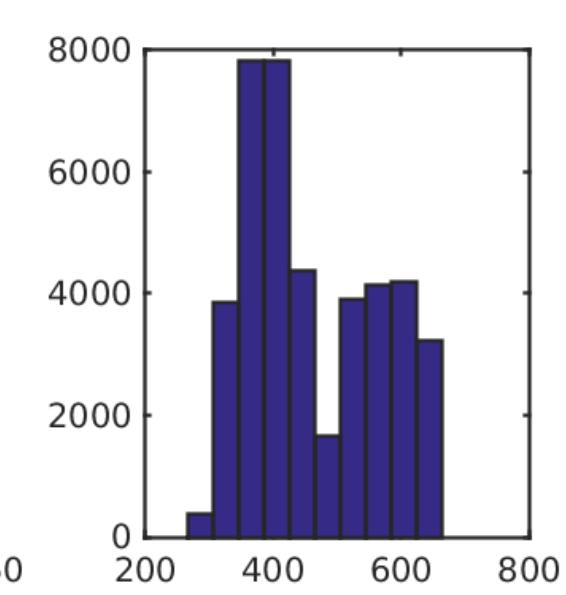

M-10 5
100
50
0
-50
-100
-100
0
100


SPD
×10^4
2.5
2
1.5
1
0.5
0
0
50
100
150


P
10000
8000
6000
4000
2000
0
200
400
600
800


M-11
100
50
0
-50
-100
-100
0
100


×10^4
3
2.5
2
1.5
1
0.5
0
0
50
100
150

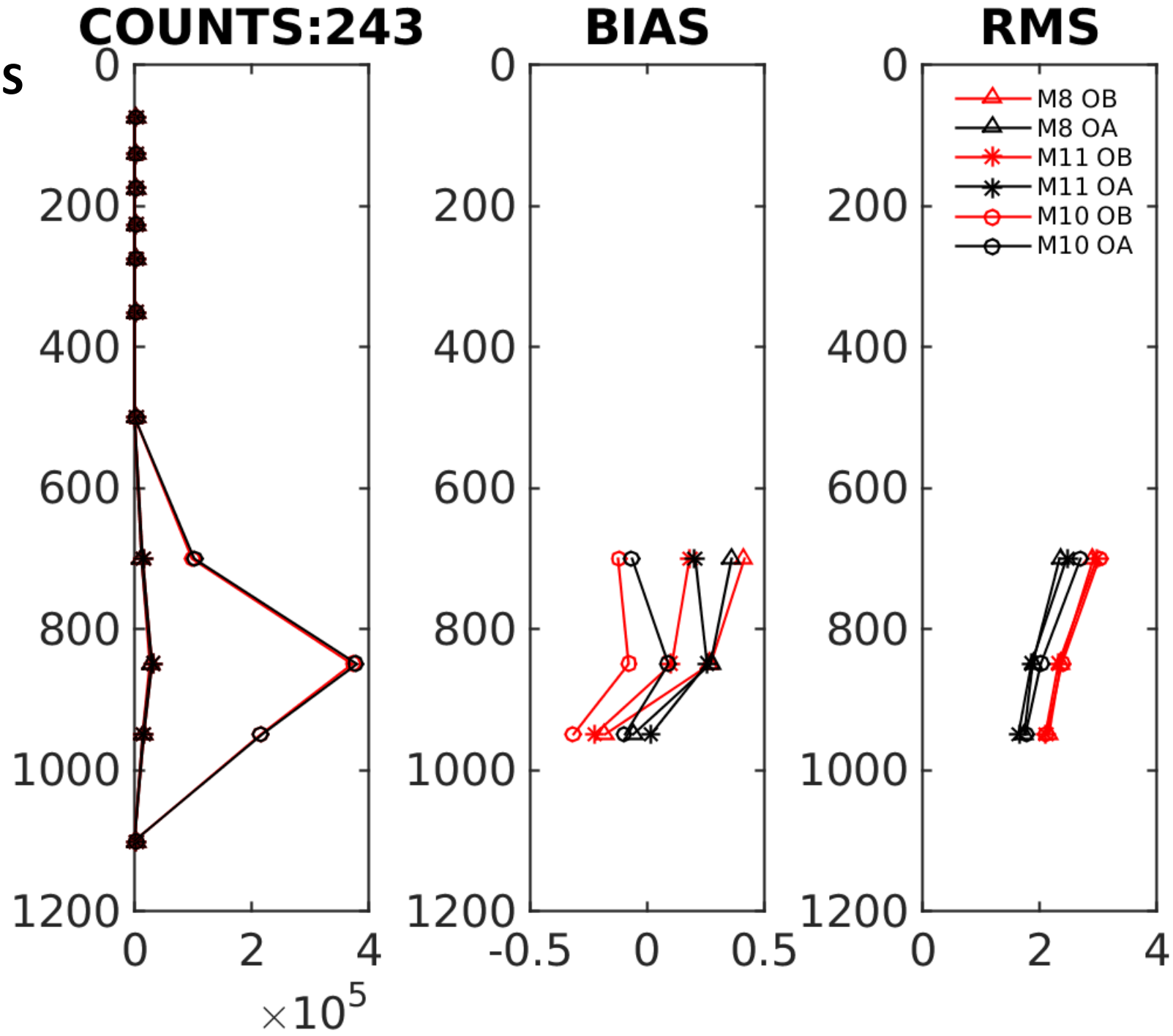

8000
6000
4000
2000
0
200
400
600
800

GSI experiment:

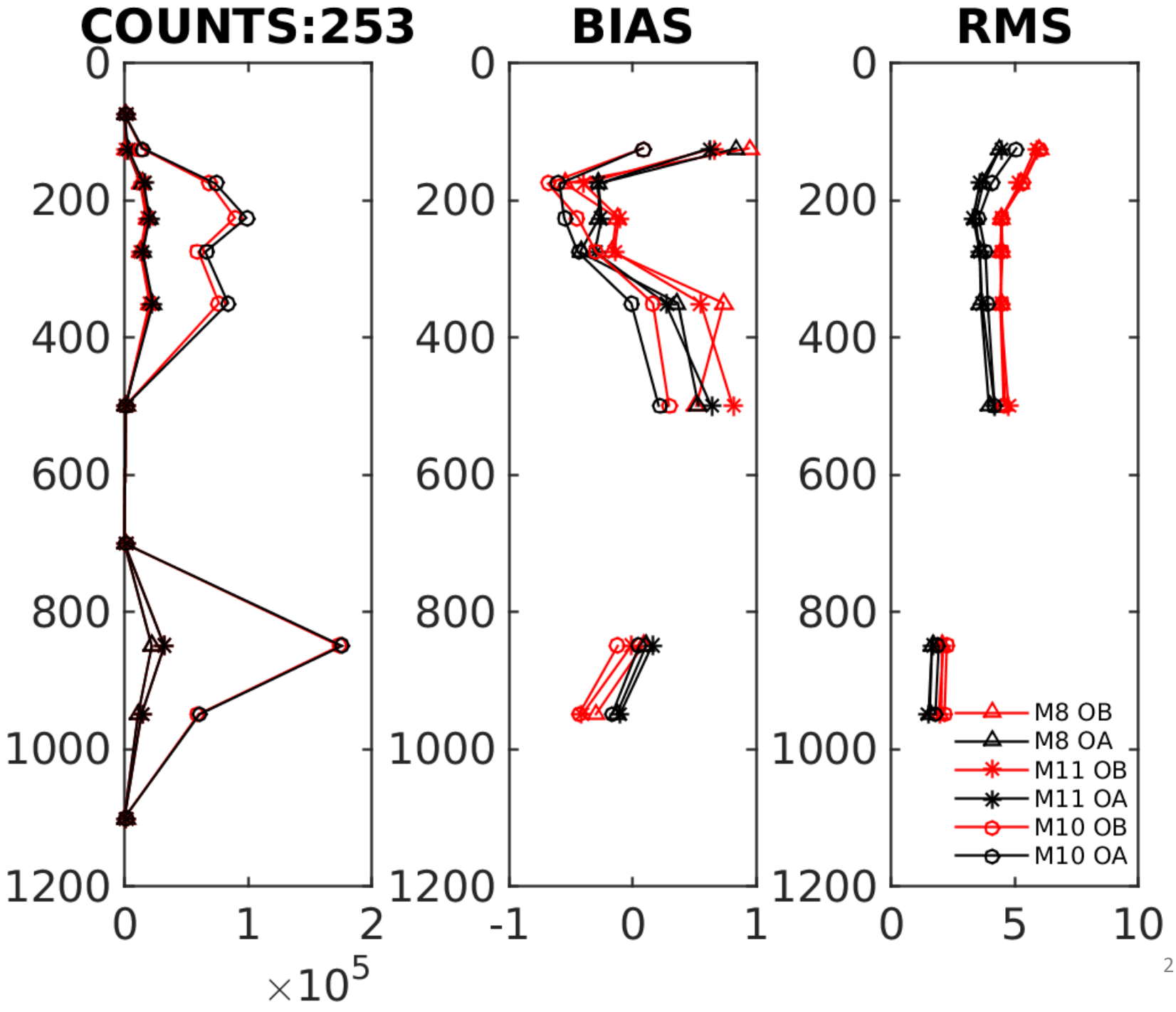
Meteosat 8 – use
Meteosat 11 – use
Meteosat 10 – monitor
Parallel run @ T670

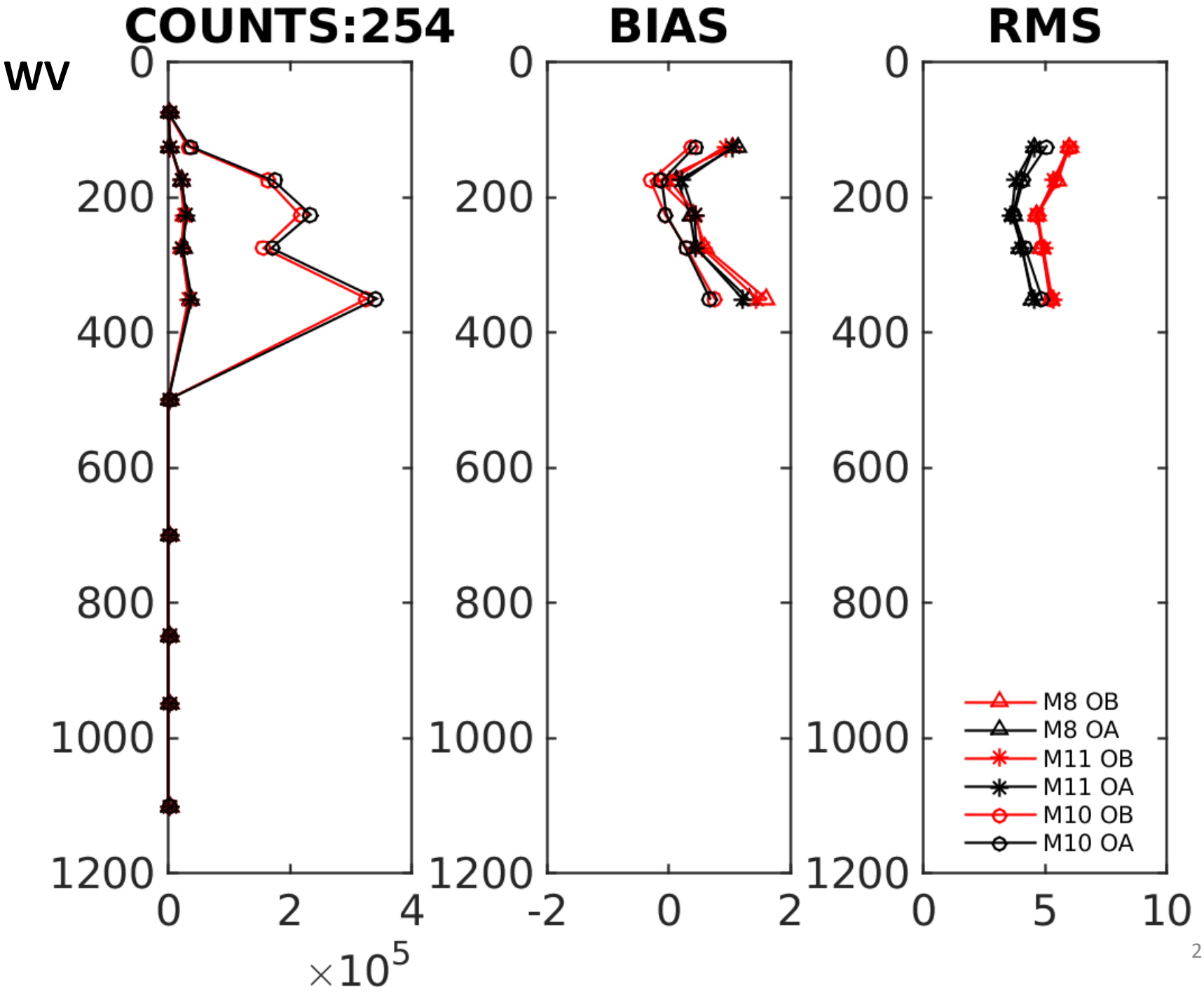
One month long, but plots only from
2018-02-06 06z – 2018-02-10-12z

VIS


COUNTS:243
BIAS
RMS
0
200
400
600
800
1000
1200
0
2
4
×10^5
-0.5
0
0.5
M8 OB
M8 OA
M11 OB
M11 OA
M10 OB
M10 OA

IR


COUNTS:253
BIAS
RMS
0
200
400
600
800
1000
1200
0
1
2
$\times 10^5$
-1
0
1
0
5
10
M8 OB
M8 OA
M11 OB
M11 OA
M10 OB
M10 OA


WV
COUNTS:254
BIAS
RMS
0
200
400
600
800
1000
1200
0
2
4
$\times 10^5$
-2
0
2
0
5
10
M8 OB
M8 OA
M11 OB
M11 OA
M10 OB
M10 OA

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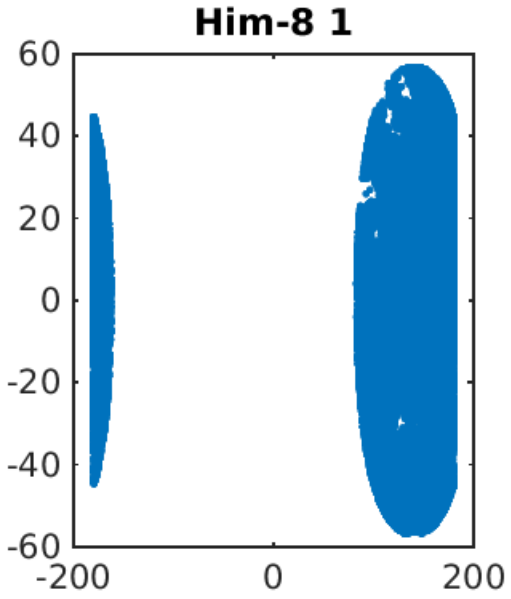
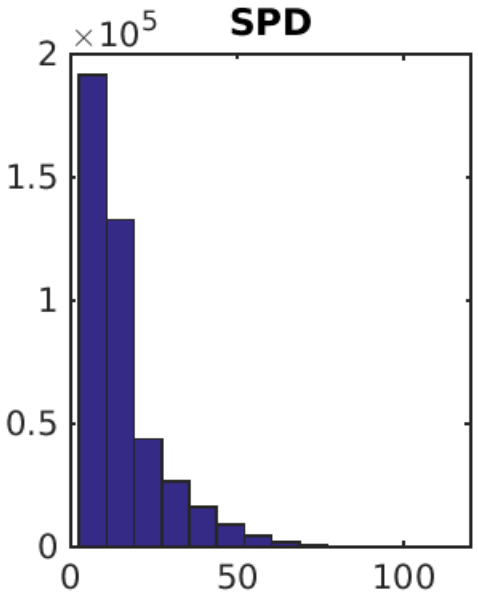
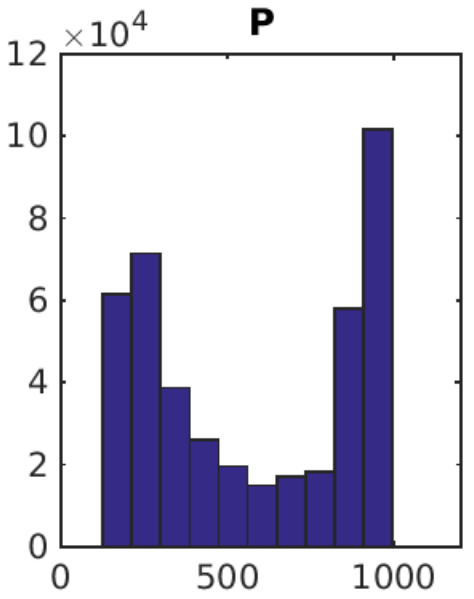
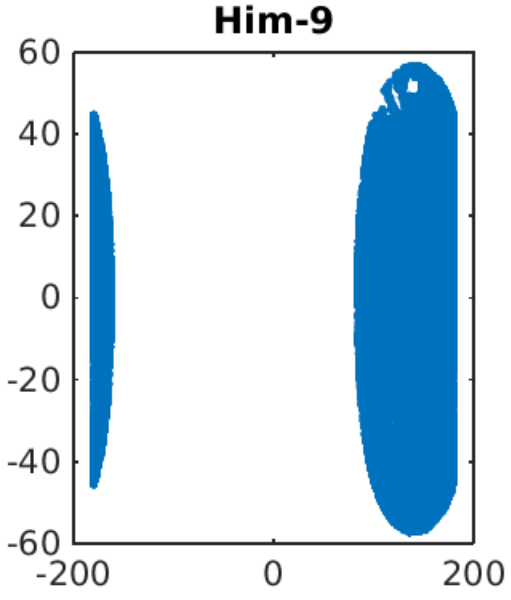
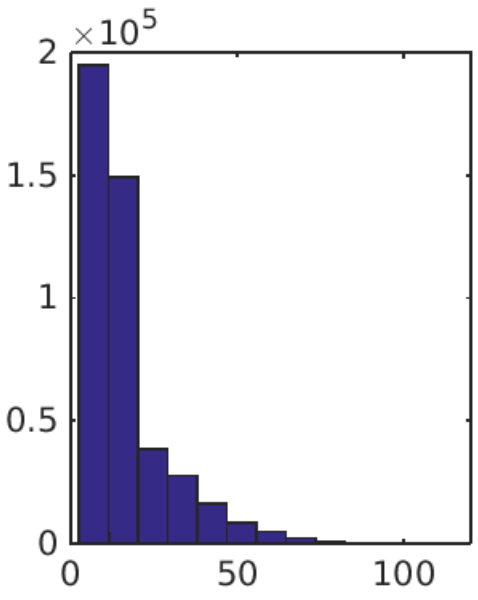
IR

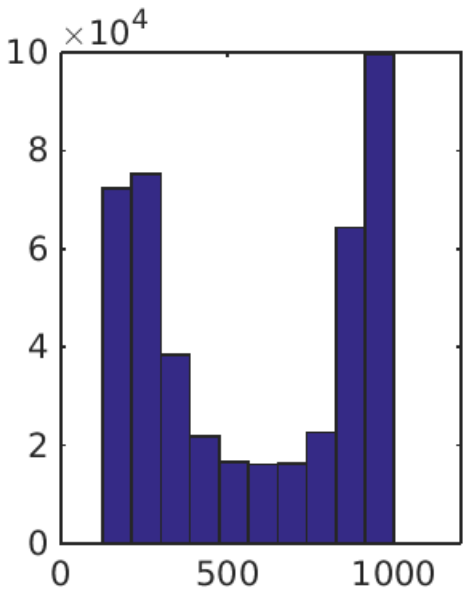

Him-8 1
60
40
20
0
-20
-40
-60
-200
0
200


SPD
×10^5
2
1.5
1
0.5
0
0
50
100

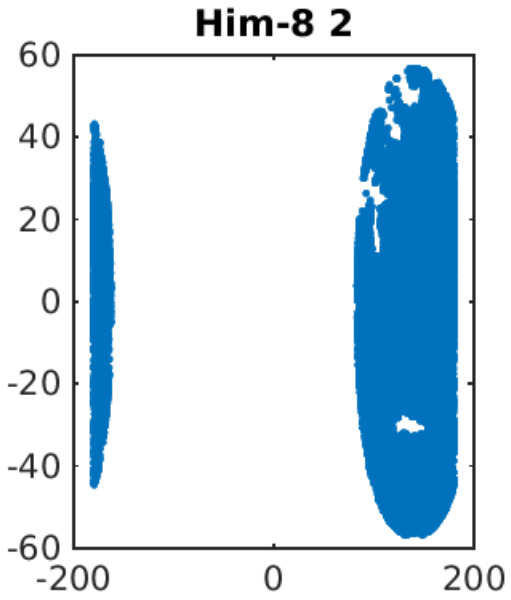

P
×10^4
12
10
8
6
4
2
0
0
500
1000

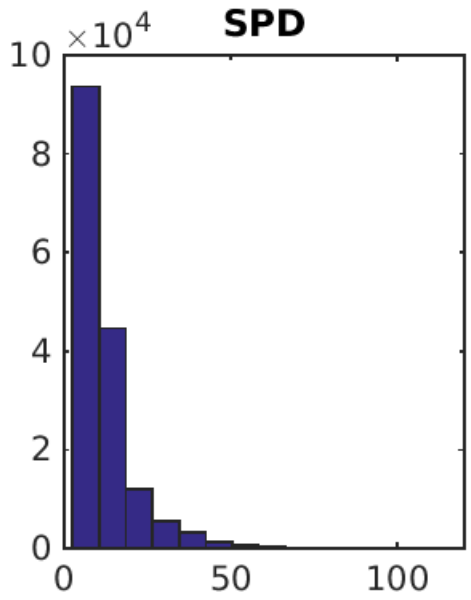

Him-9
60
40
20
0
-20
-40
-60
-200
0
200

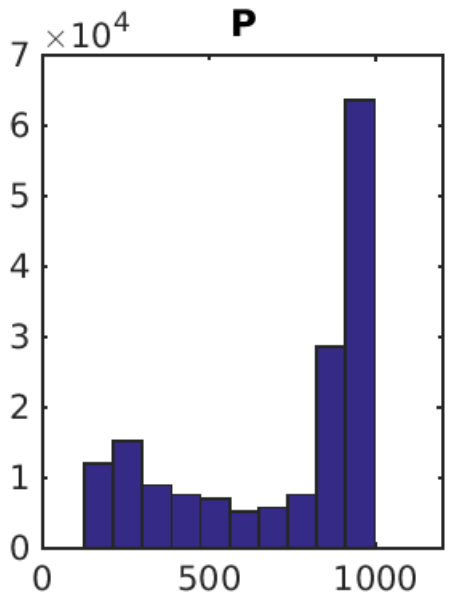

×10^5
2
1.5
1
0.5
0
0
50
100

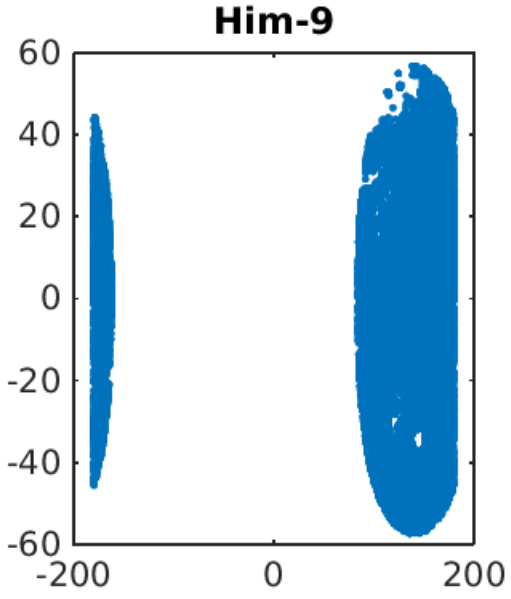

×10^4
10
8
6
4
2
0
0
500
1000

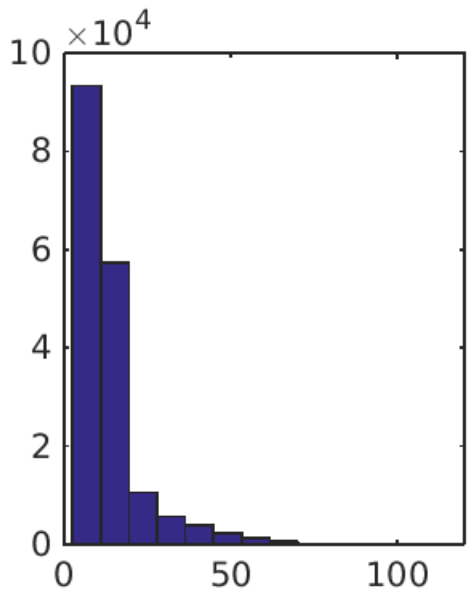
VIS

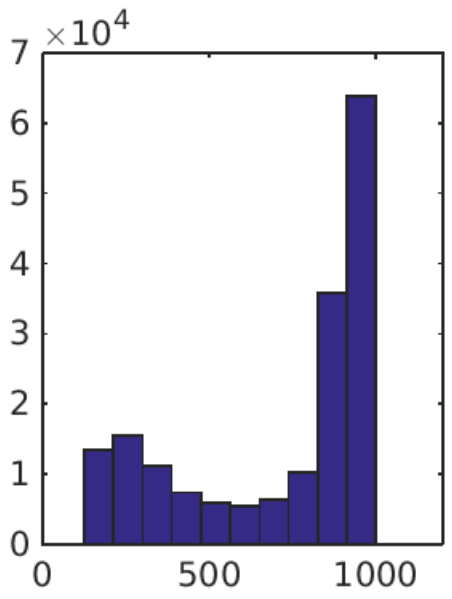

Him-8 2
60
40
20
0
-20
-40
-60
-200
0
200


SPD
×10^4
10
8
6
4
2
0
0
50
100

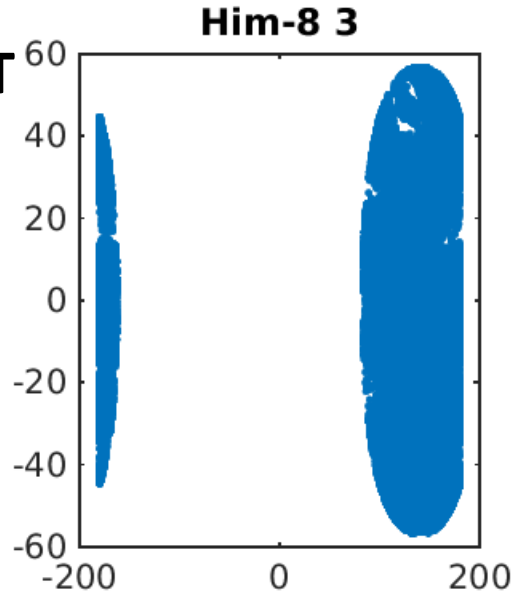

P
×10^4
7
6
5
4
3
2
1
0
0
500
1000

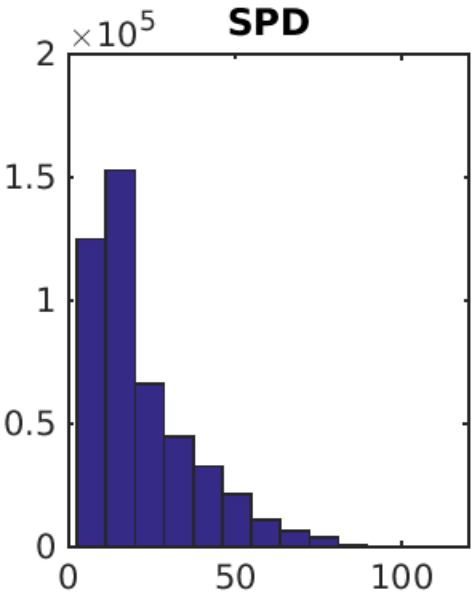

Him-9
60
40
20
0
-20
-40
-60
-200
0
200

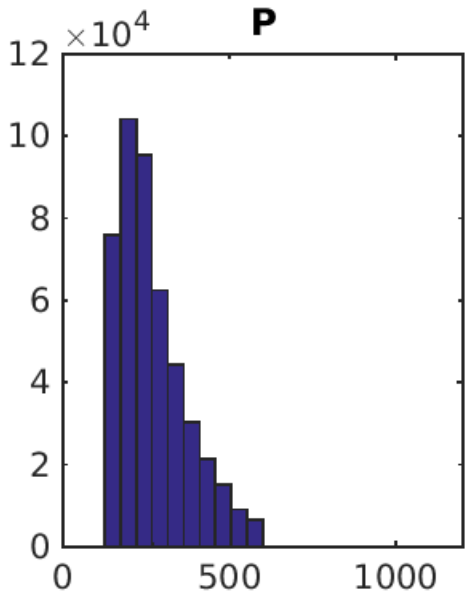

×10^4
10
8
6
4
2
0
0
50
100

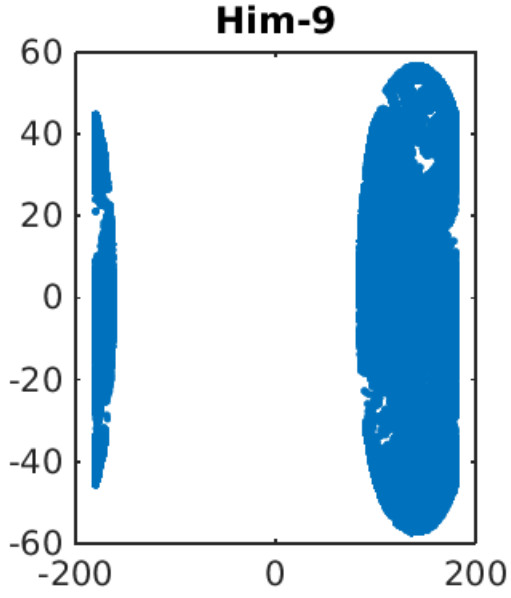

×10^4
7
6
5
4
3
2
1
0
0
500
1000

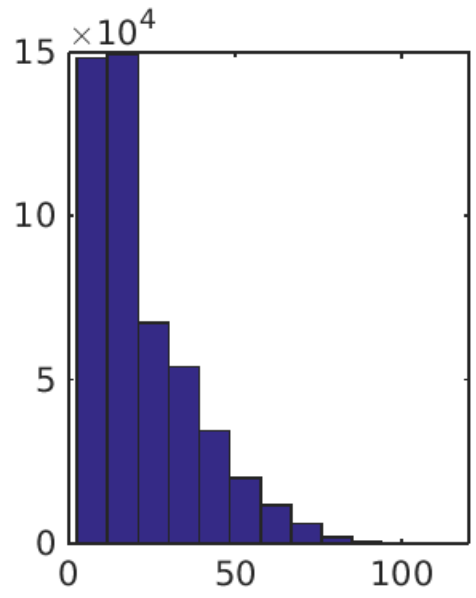
WVCT

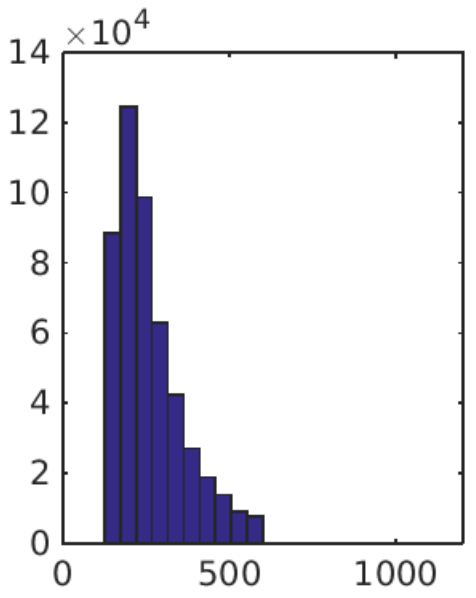

Him-8 3
60
40
20
0
-20
-40
-60
-200
0
200


SPD
×10^5
2
1.5
1
0.5
0
0
50
100

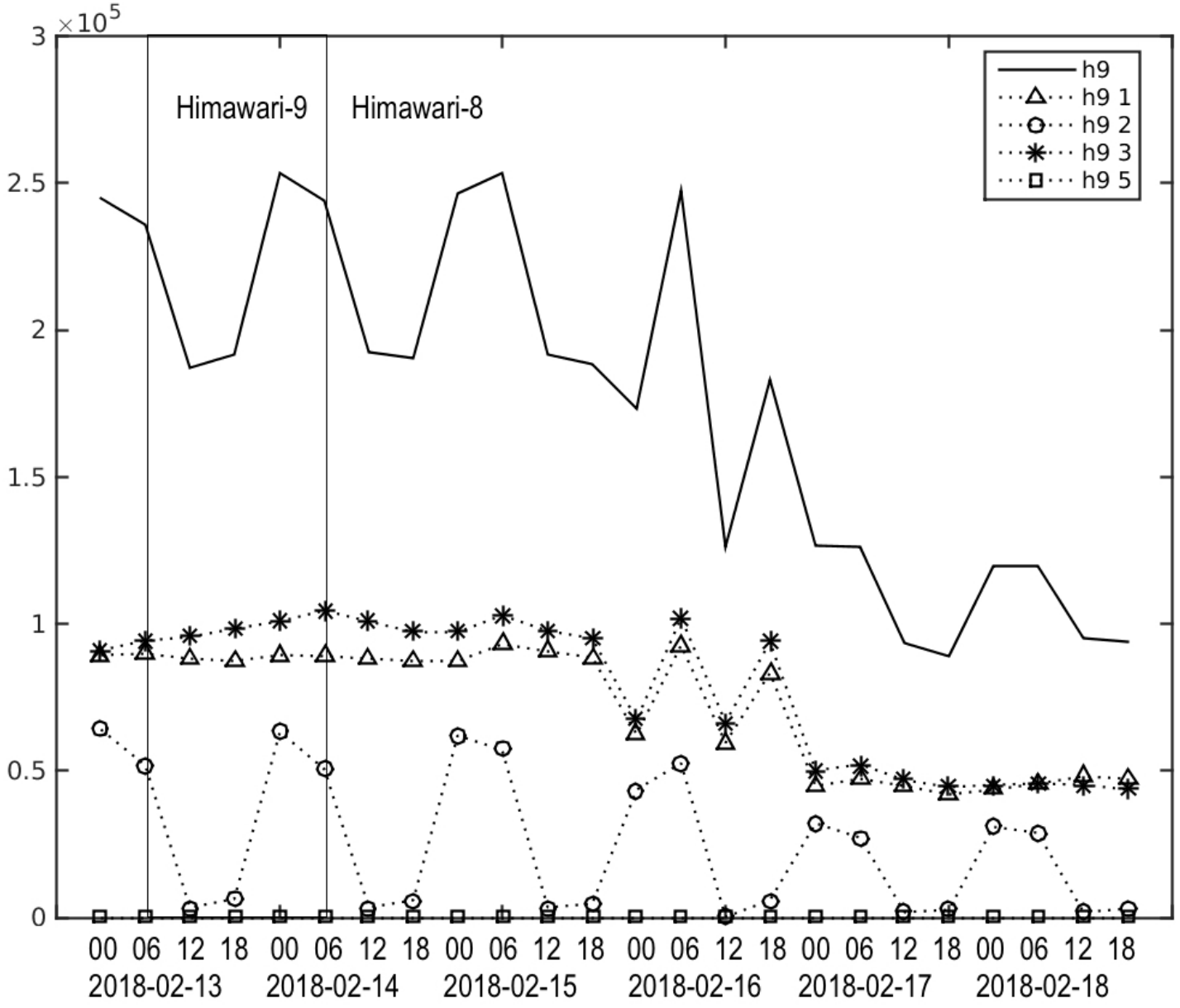

P
×10^4
12
10
8
6
4
2
0
0
500
1000


Him-9
60
40
20
0
-20
-40
-60
-200
0
200

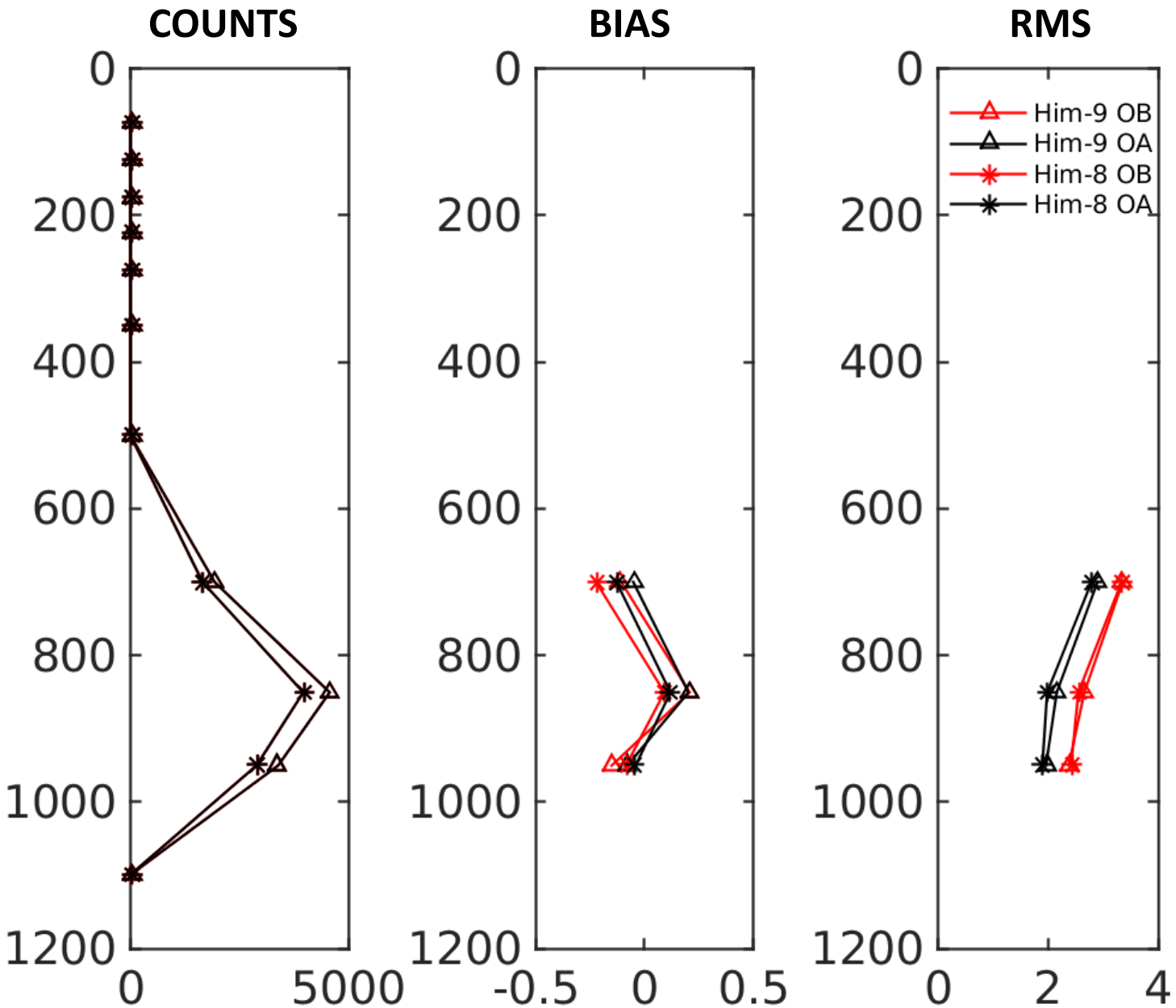

×10^4
15
10
5
0
0
50
100


×10^4
14
12
10
8
6
4
2
0
0
500
1000

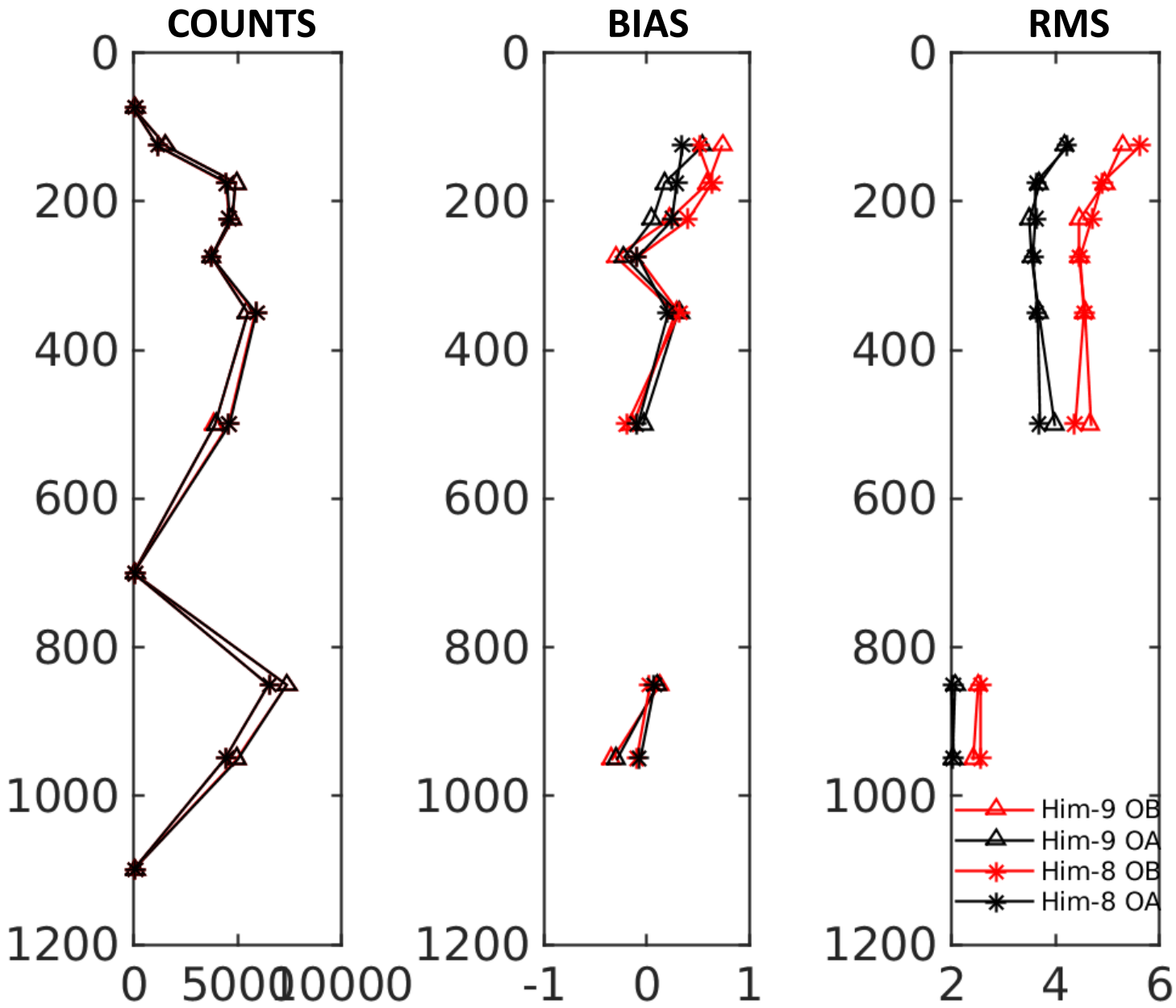
Himawari counts series



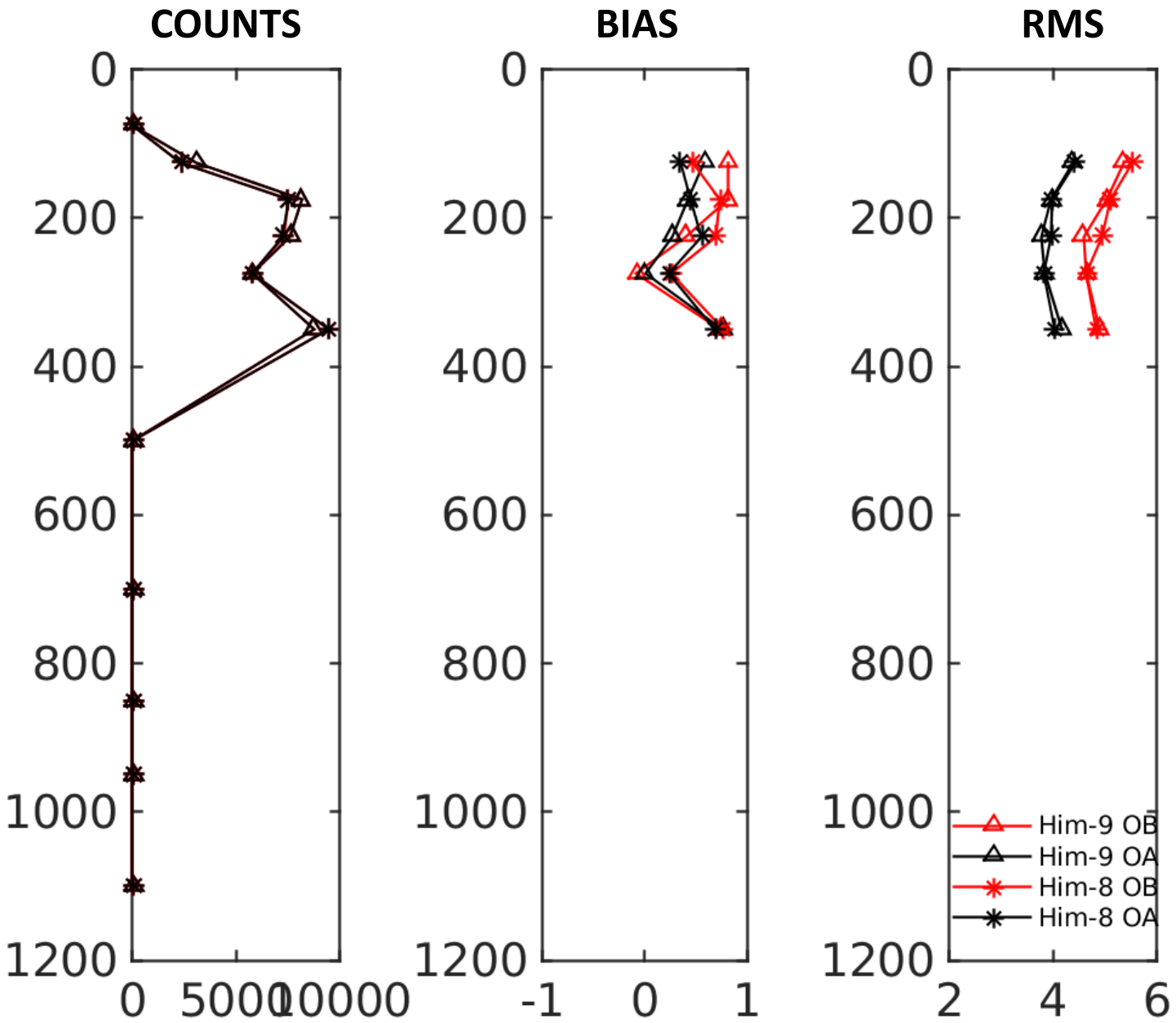
VIS


COUNTS
BIAS
RMS
0
200
400
600
800
1000
1200
0
5000
-0.5
0
0.5
2
4
Him-9 OB
Him-9 OA
Him-8 OB
Him-8 OA

IR


COUNTS
BIAS
RMS
0
200
400
600
800
1000
1200
0 5000 10000
-1 0 1
2 4 6
Him-9 OB
Him-9 OA
Him-8 OB
Him-8 OA

WV


COUNTS
BIAS
RMS
0
200
400
600
800
1000
1200
0
5000
10000
-1
0
1
2
4
6
Him-9 OB
Him-9 OA
Him-8 OB
Him-8 OA

Outline

Meteosat transitions:

- From Meteosat 7 to Meteosat 8 winds

- From Meteosat 10 to Meteosat 11 winds

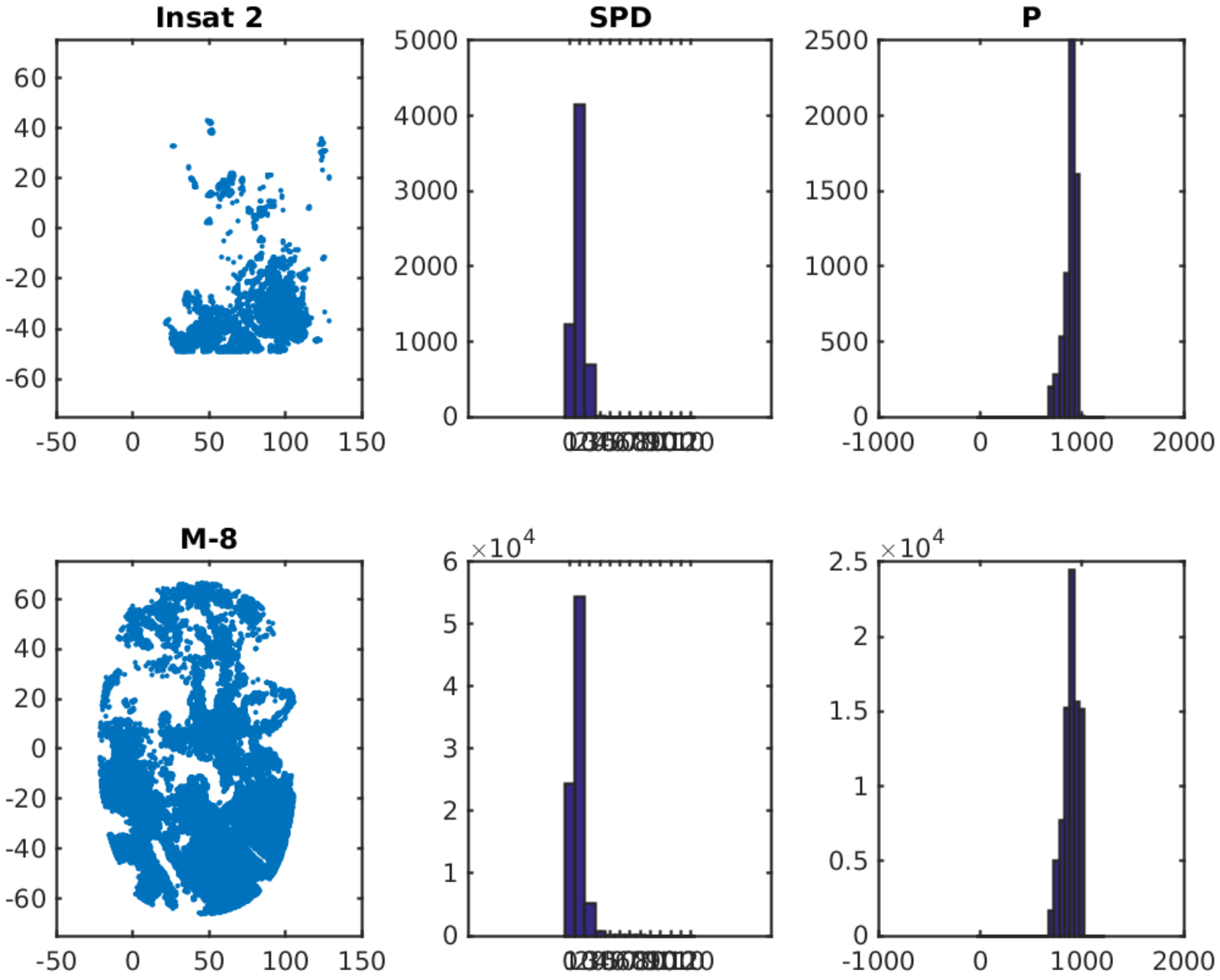
Preliminary evaluation of Himawary 9 winds

Quick peek at INSAT winds

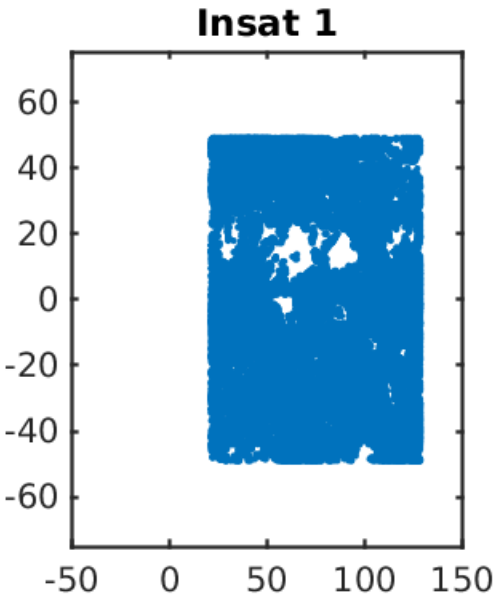
Evaluating and Assimilating GOES-16 winds

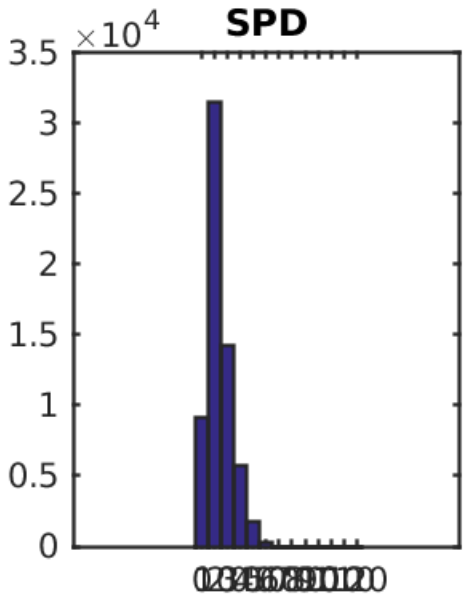
What's next?

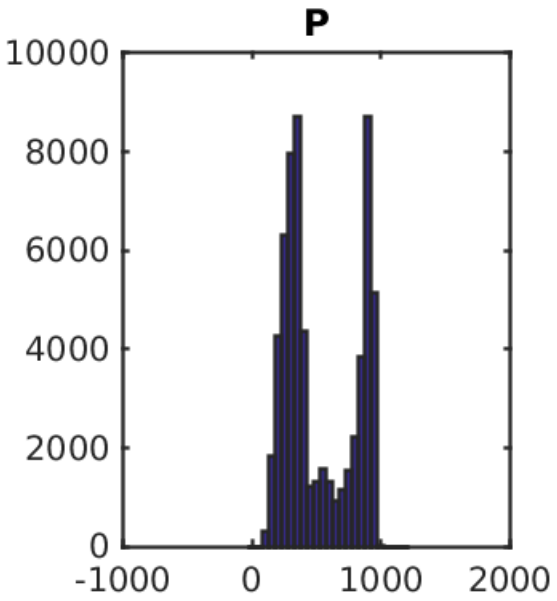
VIS

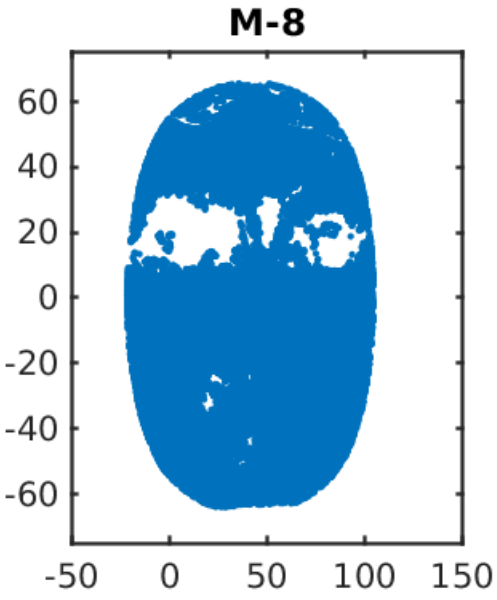


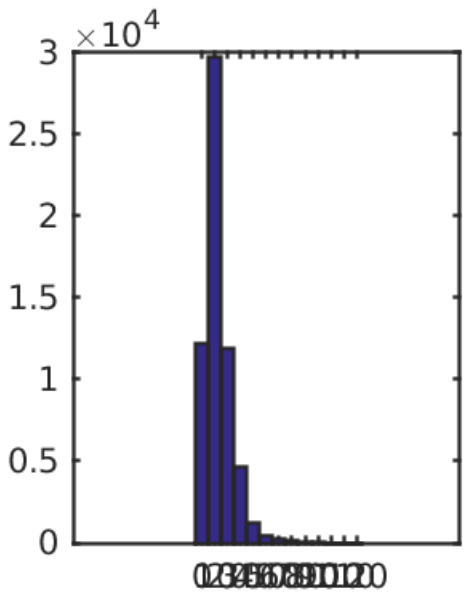
IR

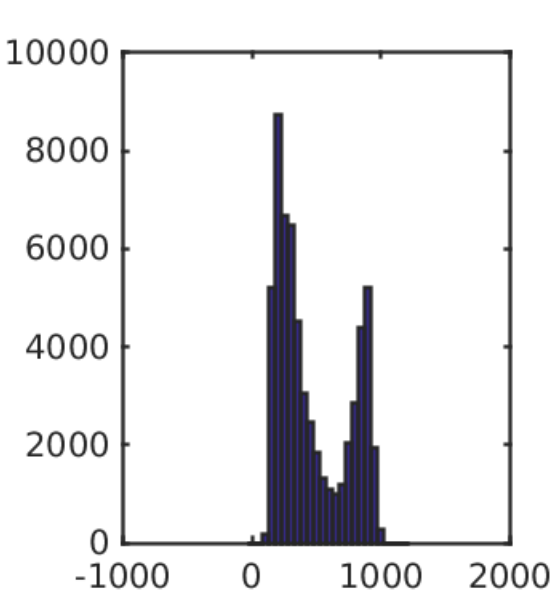

Insat 1
60
40
20
0
-20
-40
-60
-50
0
50
100
150


SPD
×10^4
3.5
3
2.5
2
1.5
1
0.5
0

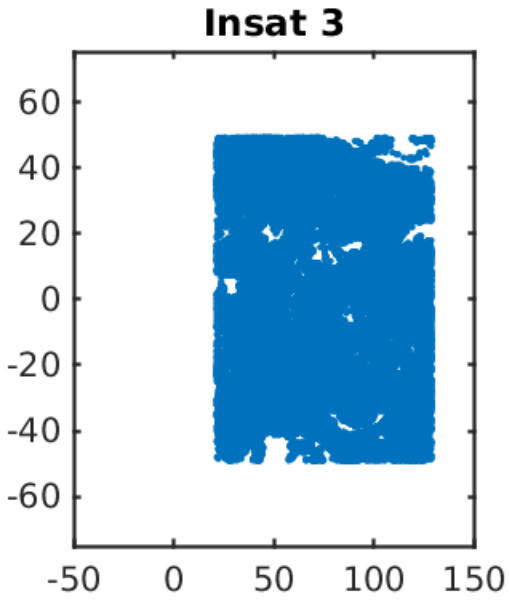

P
10000
8000
6000
4000
2000
0
-1000
0
1000
2000

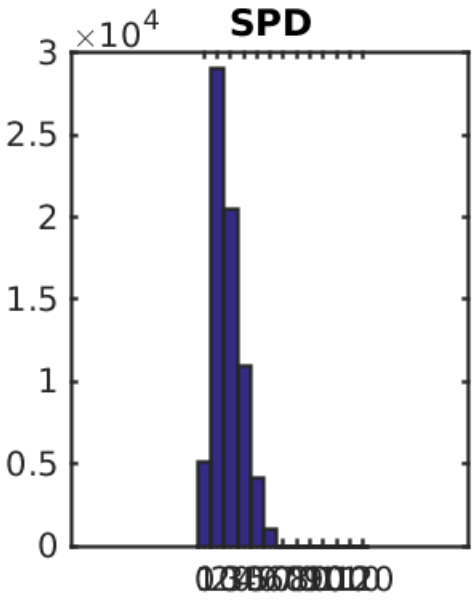

M-8
60
40
20
0
-20
-40
-60
-50
0
50
100
150

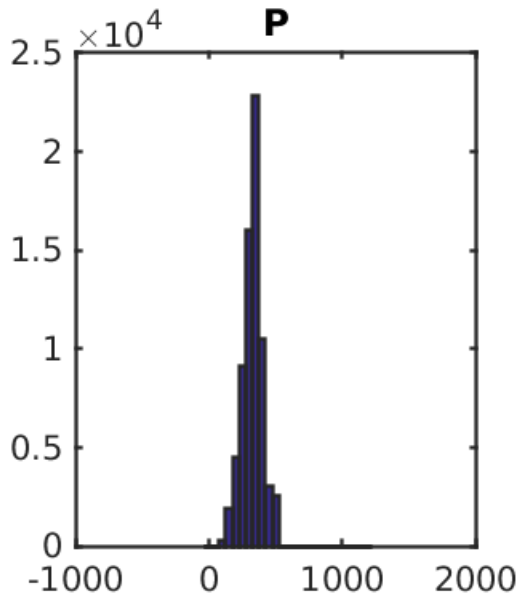

×10^4
3
2.5
2
1.5
1
0.5
0

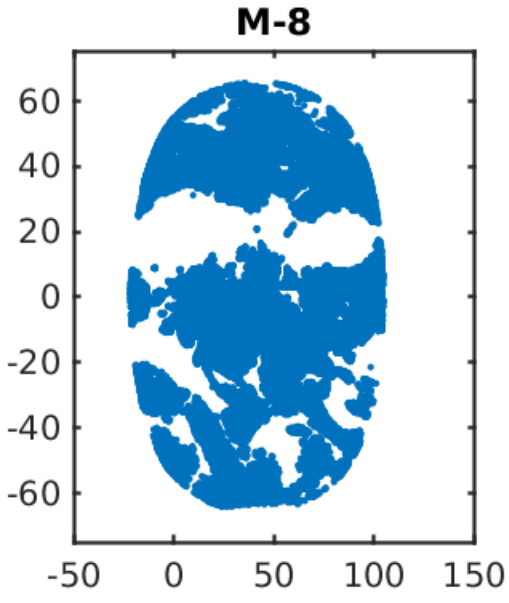

10000
8000
6000
4000
2000
0
-1000
0
1000
2000

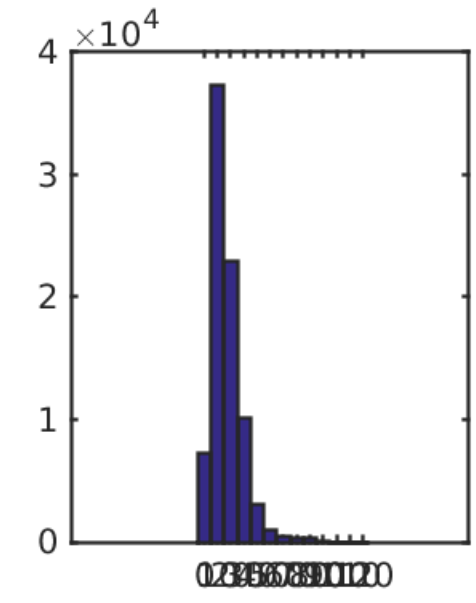
WV

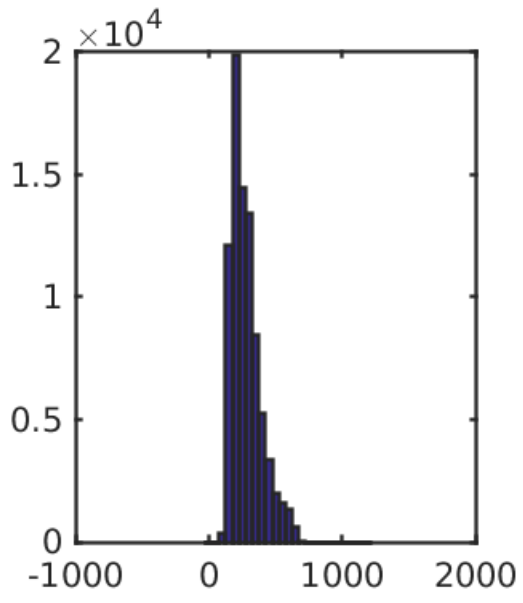

Insat 3
60
40
20
0
-20
-40
-60
-50
0
50
100
150


SPD
×10^4
3
2.5
2
1.5
1
0.5
0


P
×10^4
2.5
2
1.5
1
0.5
0
-1000
0
1000
2000


M-8
60
40
20
0
-20
-40
-60
-50
0
50
100
150


×10^4
4
3
2
1
0


×10^4
2
1.5
1
0.5
0
-1000
0
1000
2000

Outline

Meteosat transitions:

- From Meteosat 7 to Meteosat 8 winds

- From Meteosat 10 to Meteosat 11 winds

Preliminary evaluation of Himawary 9 winds

Quick peek at INSAT winds

Evaluating and Assimilating GOES-16 winds

What's next?

Preliminary GOES-R-like winds evaluation in GSI (from IWW13)

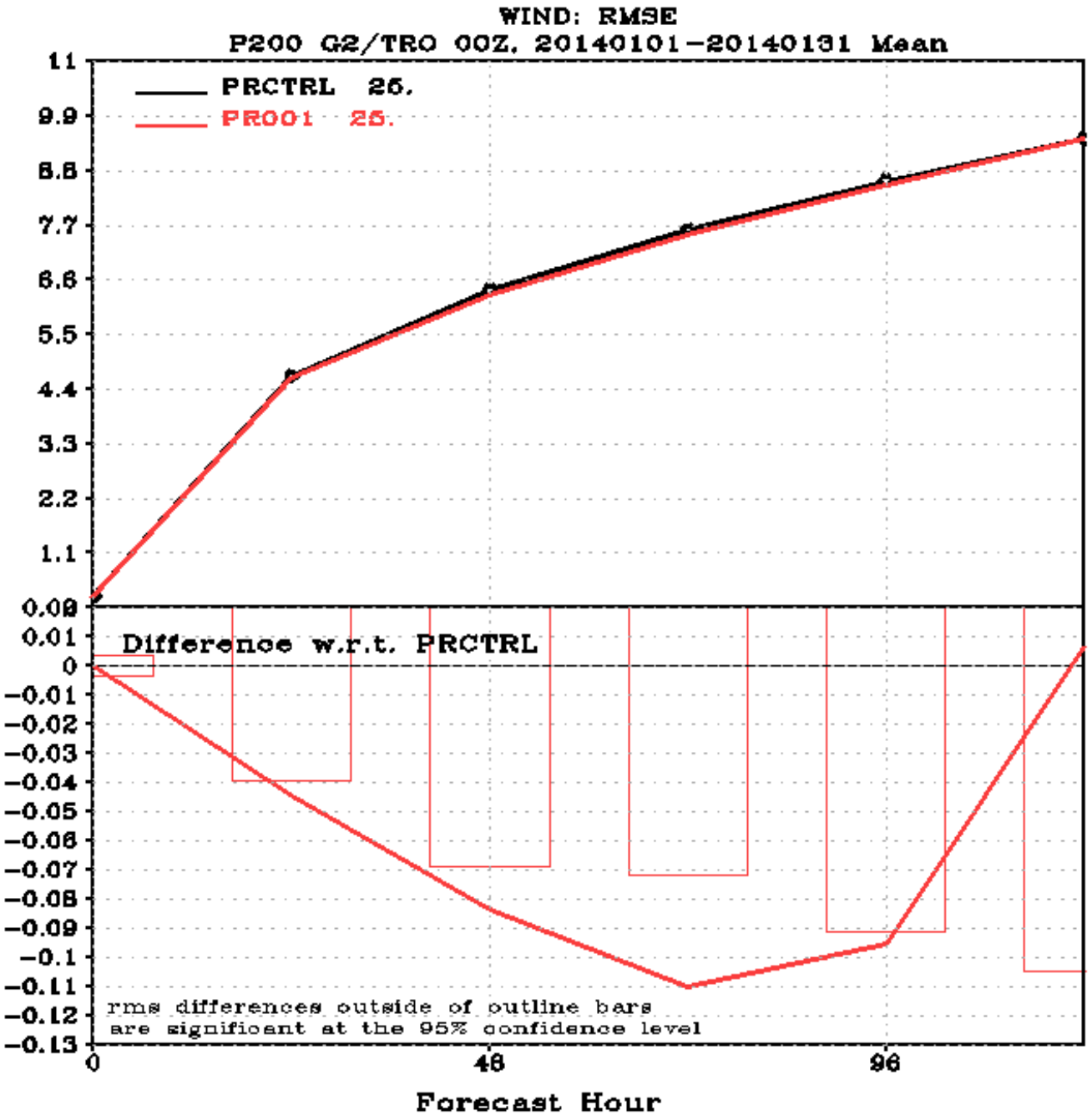
GOES-R-like winds – retrieved with Nested Tracking algorithm (developed for GOES-R) from GOES-13/15 imagery
– observations from NESDIS STAR

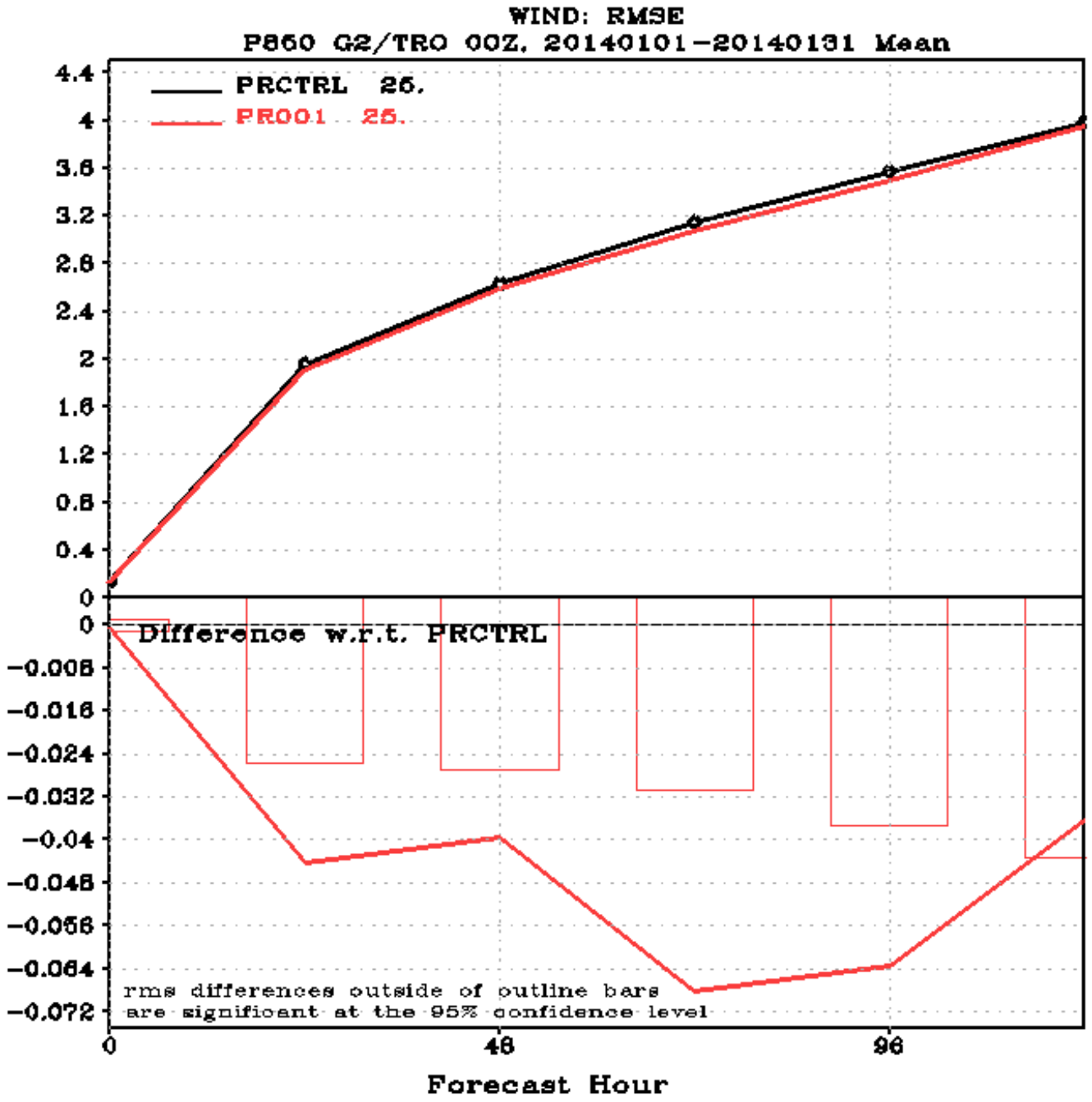
Setup:
3D-Hybrid run, GFS at T670, GSI at T254, EnKF at T254
64 Pressure levels
20140101- 20140201
Verification against operational analysis

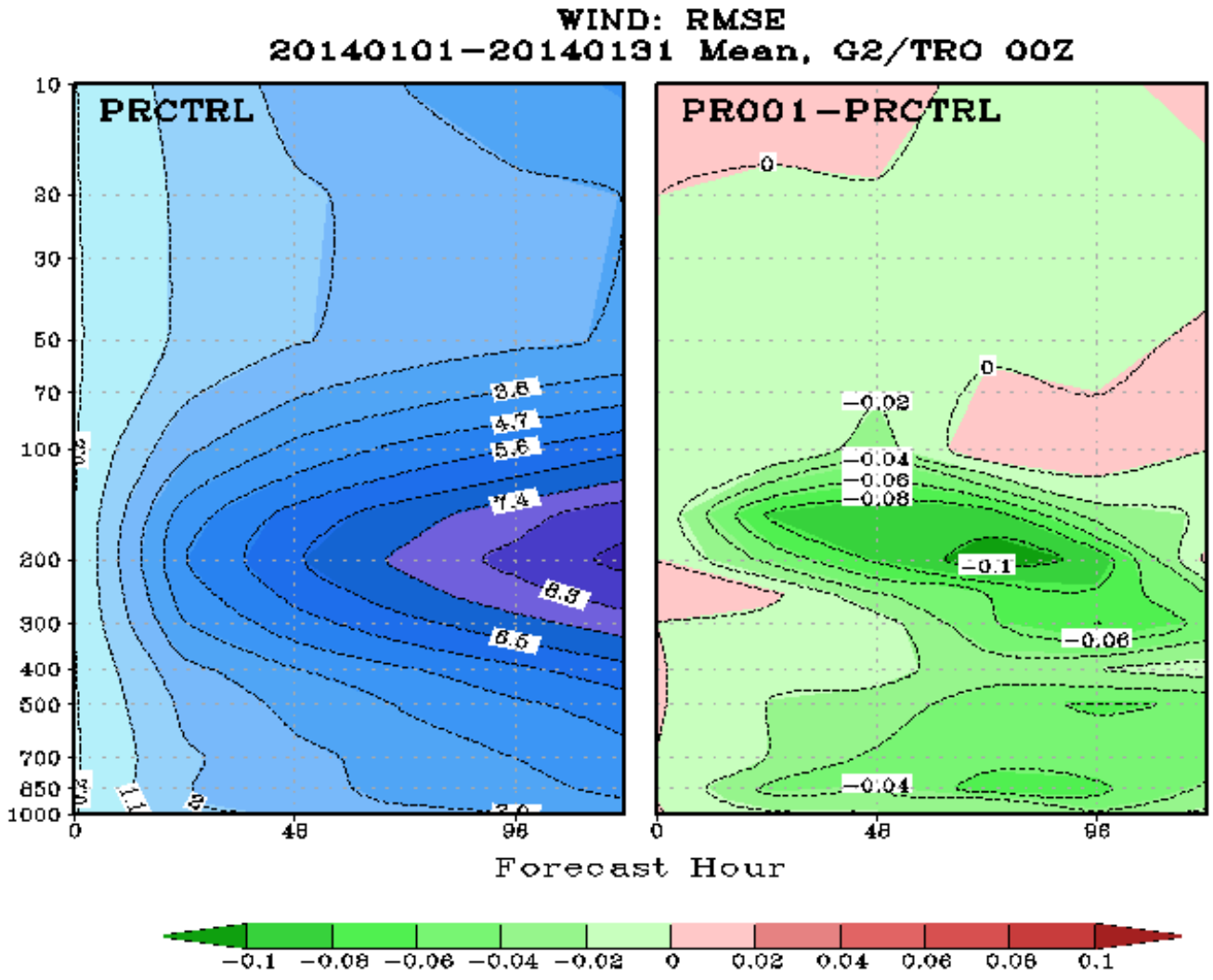
Used AMVs:
Meteosat, MTSAT-2 and MODIS

***New**:*
***** GOES-R-like winds replace GOES-13/15 winds for synoptic times 0, 6, 12, 18 Z
***** ObsError_GOES-R = ObsError * 0.5
***** PCT1 ∈ [0.04 0.5] , nested tracking parameter, a measure of the cluster standard deviation (BT) divided by the distance the cluster traveled between images

All winds subject to quality control and thinning as in operations
(read_satwnd.f90, setupw.f90, prepobs_errtable.global, global_convinfo.txt)


WIND: RMSE
P200 G2/TRO 00Z. 20140101-20140131 Mean
PRCTRL 25.
PR001 25.
11
9.9
8.8
7.7
6.6
5.5
4.4
3.3
2.2
1.1
0.00
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
-0.1
-0.11
-0.12
-0.13
Difference w.r.t. PRCTRL
rms differences outside of outline bars
are significant at the 95% confidence level
0
48
96
Forecast Hour


WIND: RMSE
P850 G2/TRO 00Z, 20140101-20140131 Mean
PRCTRL 25.
PR001 25.
4.4
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
Difference w.r.t. PRCTRL
0
-0.008
-0.016
-0.024
-0.032
-0.04
-0.048
-0.056
-0.064
-0.072
rms differences outside of outline bars
are significant at the 95% confidence level
0
48
96
Forecast Hour


WIND: RMSE
20140101-20140131 Mean, G2/TRO 00Z
PRCTRL
PR001-PRCTRL
10
20
30
50
70
100
200
300
400
500
700
850
1000
3.8
4.7
5.6
7.4
8.3
6.6
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.06
-0.04
0
48
96
Forecast Hour
-0.1 -0.08 -0.06 -0.04 -0.02 0 0.02 0.04 0.06 0.08 0.1

Operational GOES-16 (post launch GOES-R) winds status

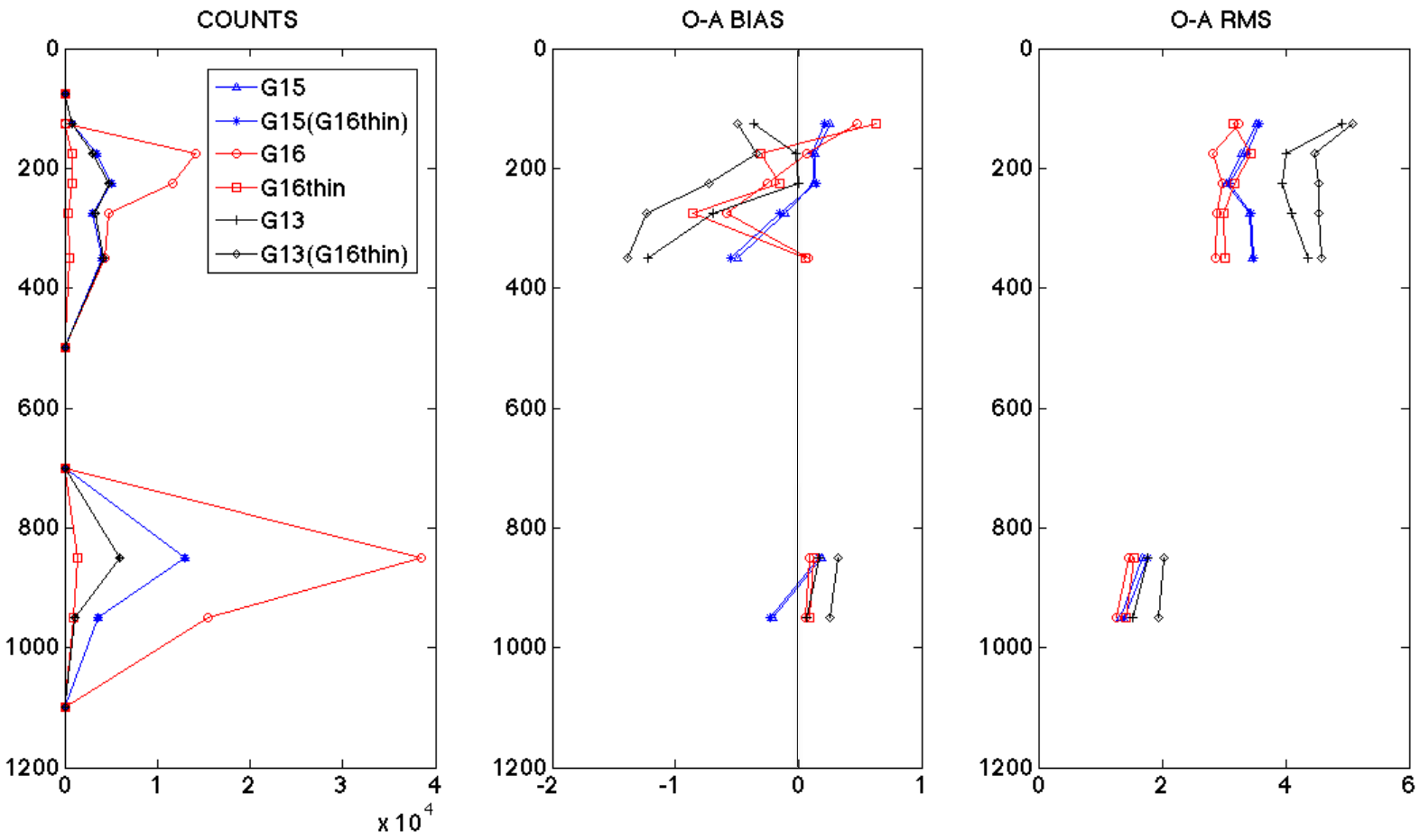
- July 2017 – WMO approved new BUFR format table
- August – October 2017 – final BUFR adjustments and tests; height assignment updates implemented; operational feed finalized;
- November 2017 – real data for comprehensive GOES-R AMVs evaluation
- December 2017 – GOES-16 moved to permanent location; AMV product not impacted
- 21 Dec 2017 - monitoring GOES-16 in operation
- 5 Jan 2018 – started assimilating GOES-16 AMVs

An accelerated implementation schedule was necessary to ensure continuity of GOES-E winds after GOES-13 winds were switched off. At the moment IR cloud-top, WV cloud-top and WV clear-sky winds are actively assimilated.

- Data quality is similar/better that seen from previous GOES satellites. Work continues to understand data better, to ensure positive FC impact and to include VIS and SWIR

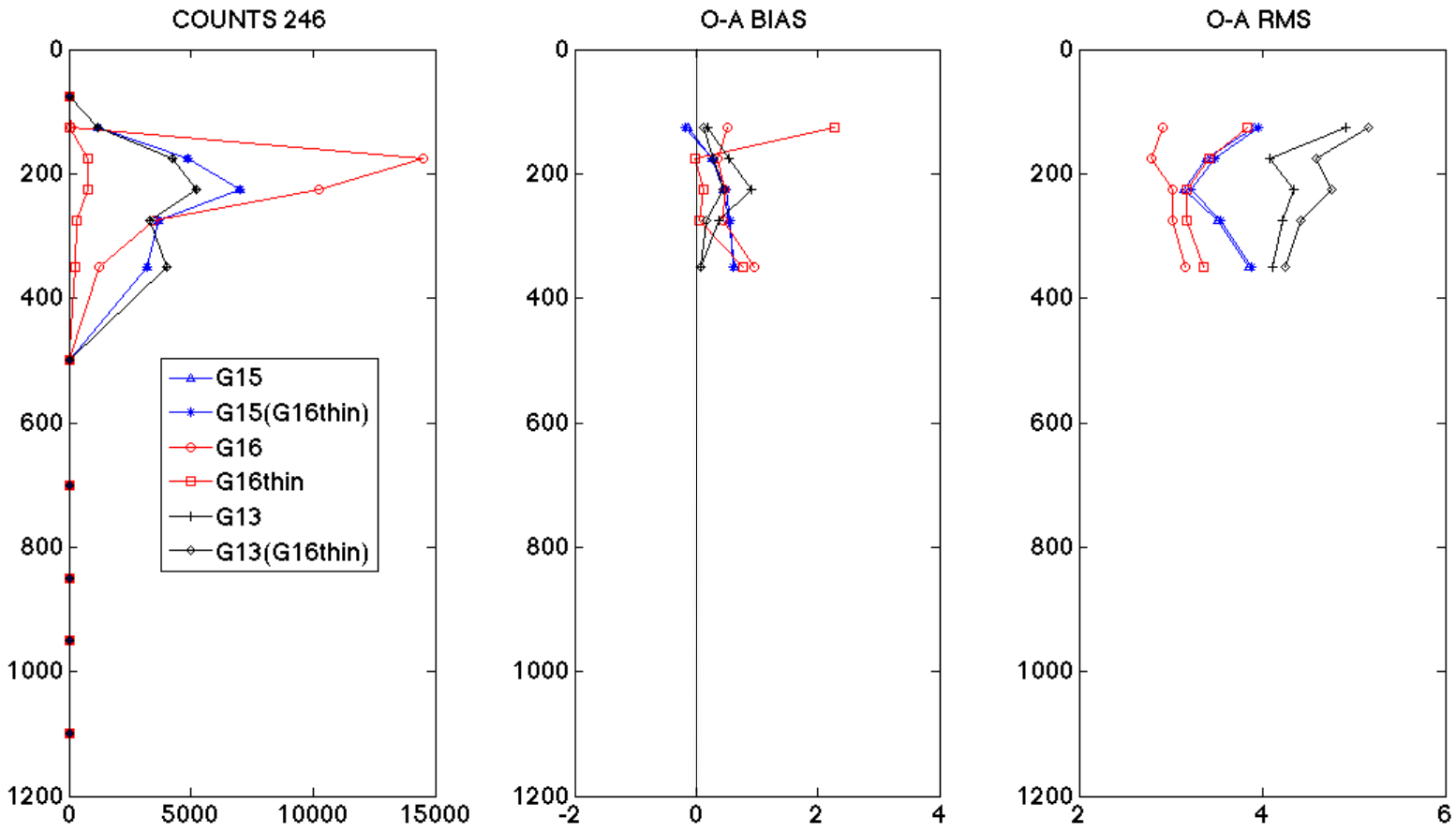
Thinning test

IR



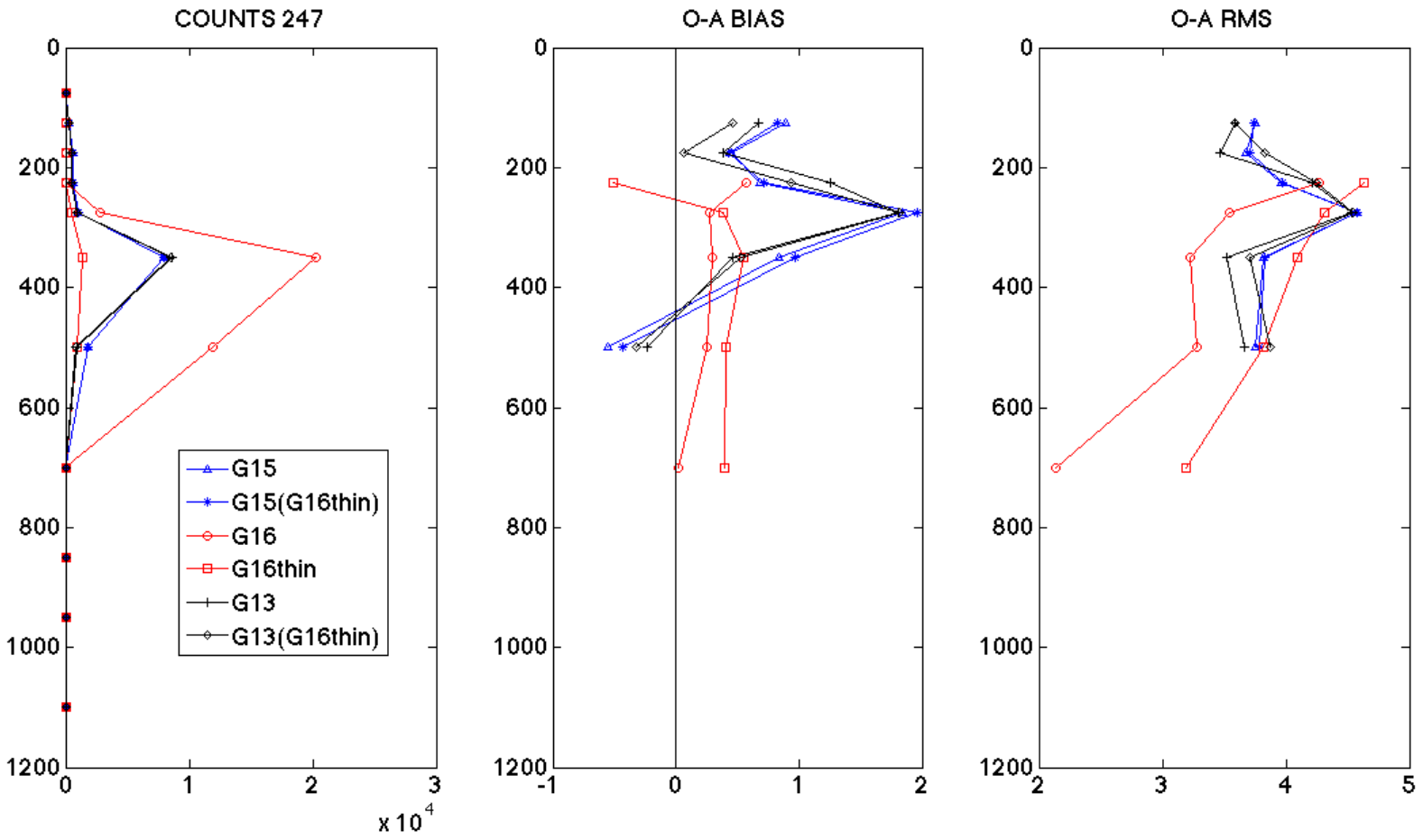
Thinning test

WV CT



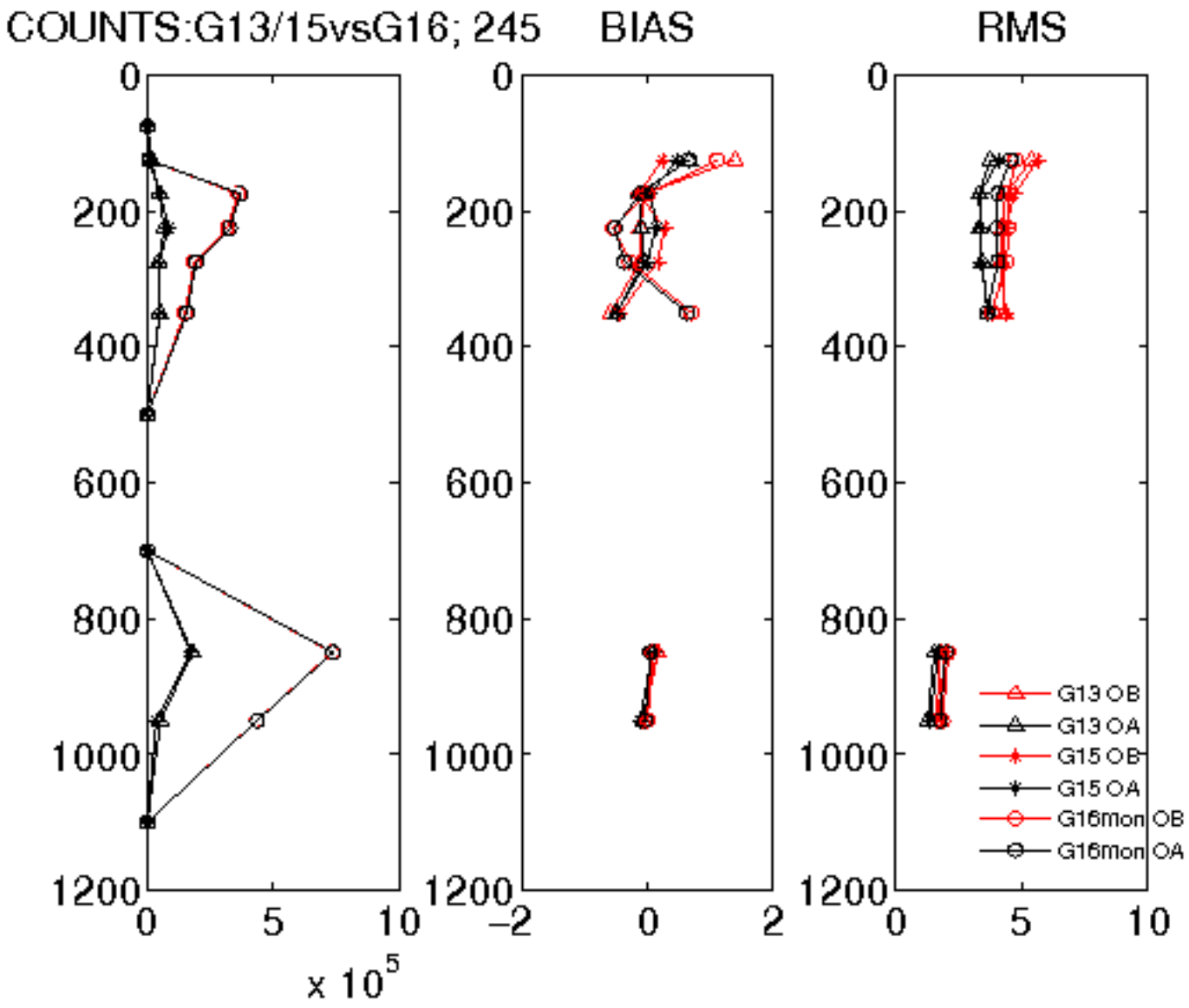
Thinning test

WV CA



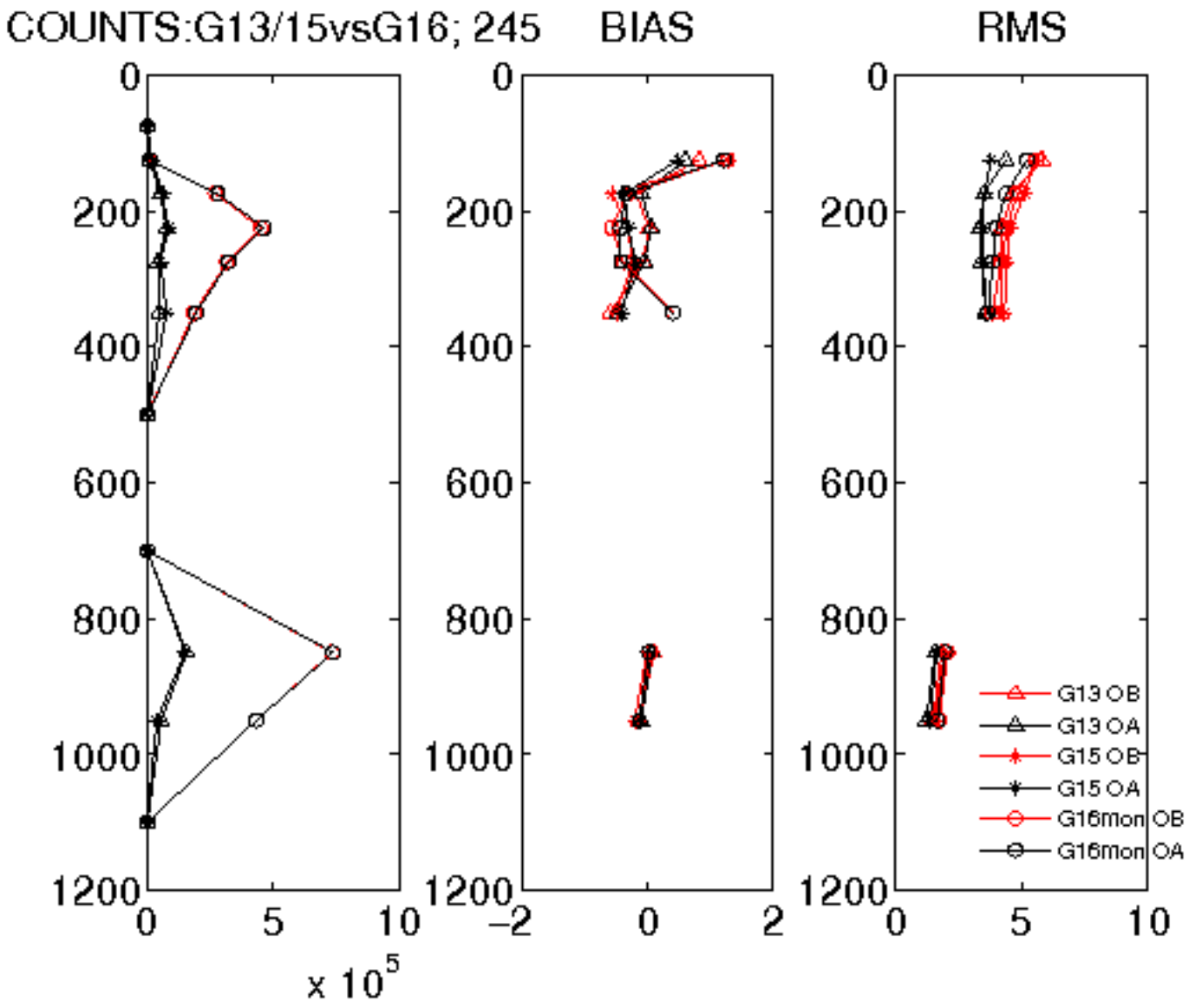
Monitoring experiment: 2 weeks of **before** / after the positioning move

IR



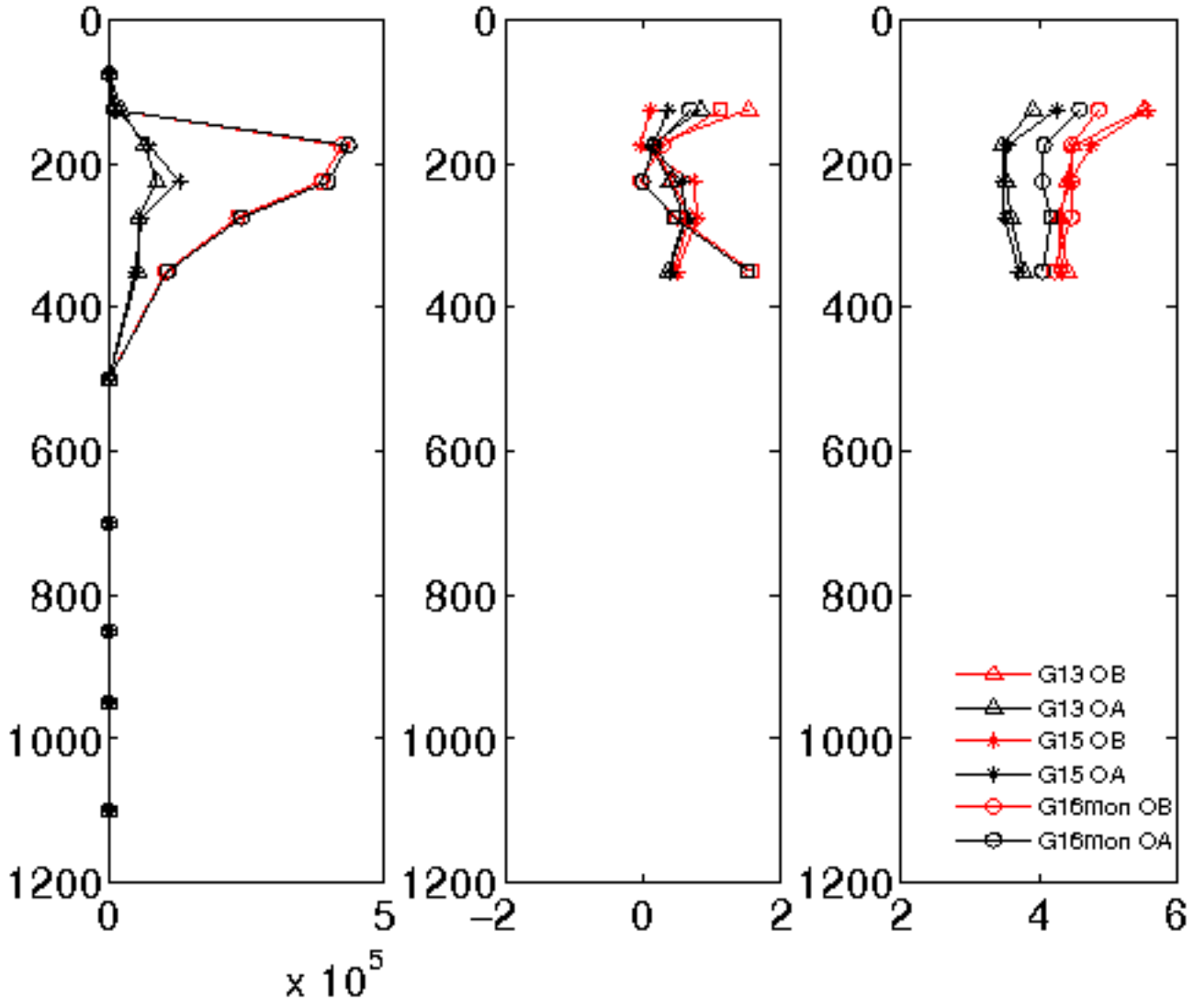
Monitoring experiment: 2 weeks of before / **after** the positioning move

IR

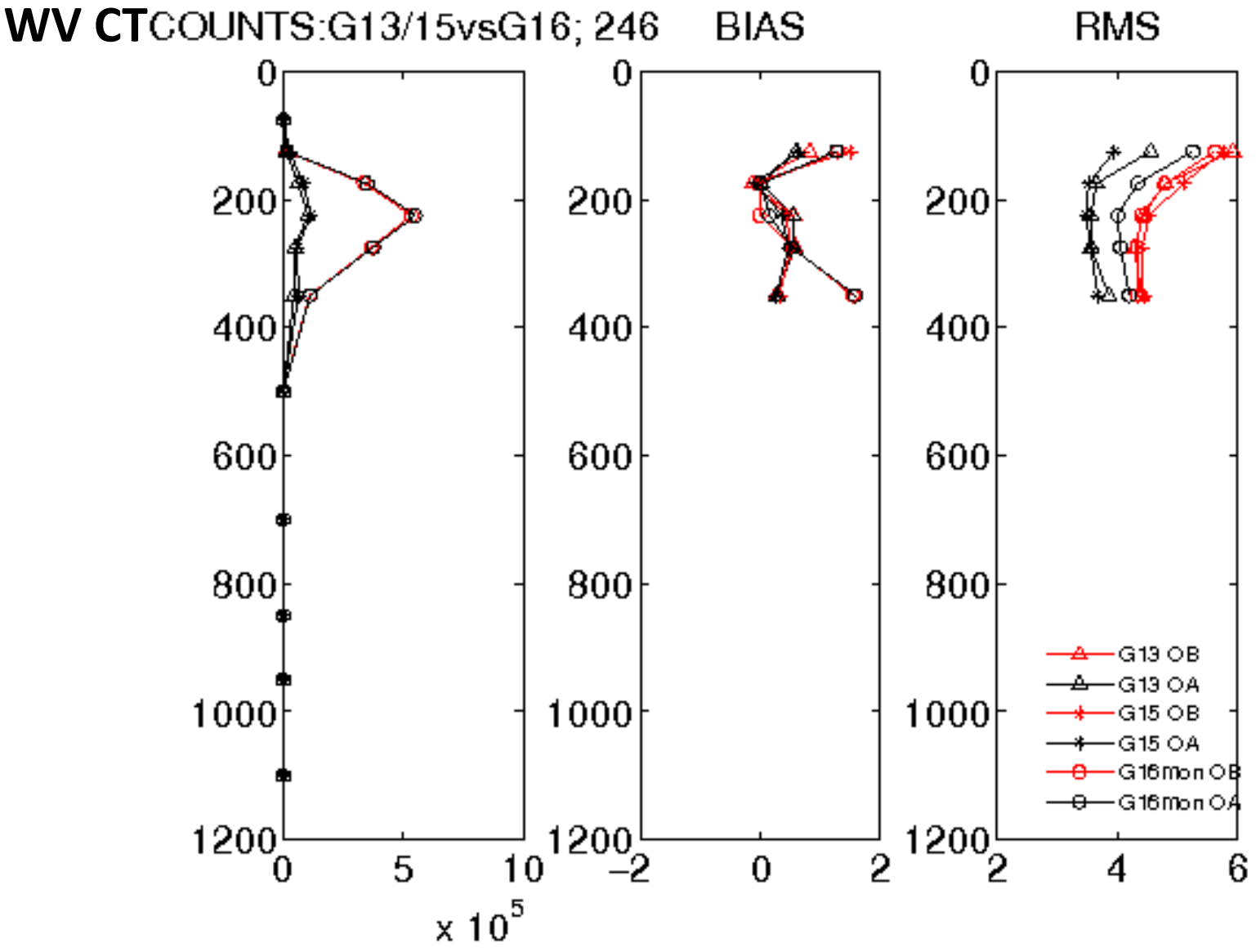


Monitoring experiment: 2 weeks of **before** / after the positioning move

WV CT COUNTS:G13/15vsG16; 246 BIAS RMS

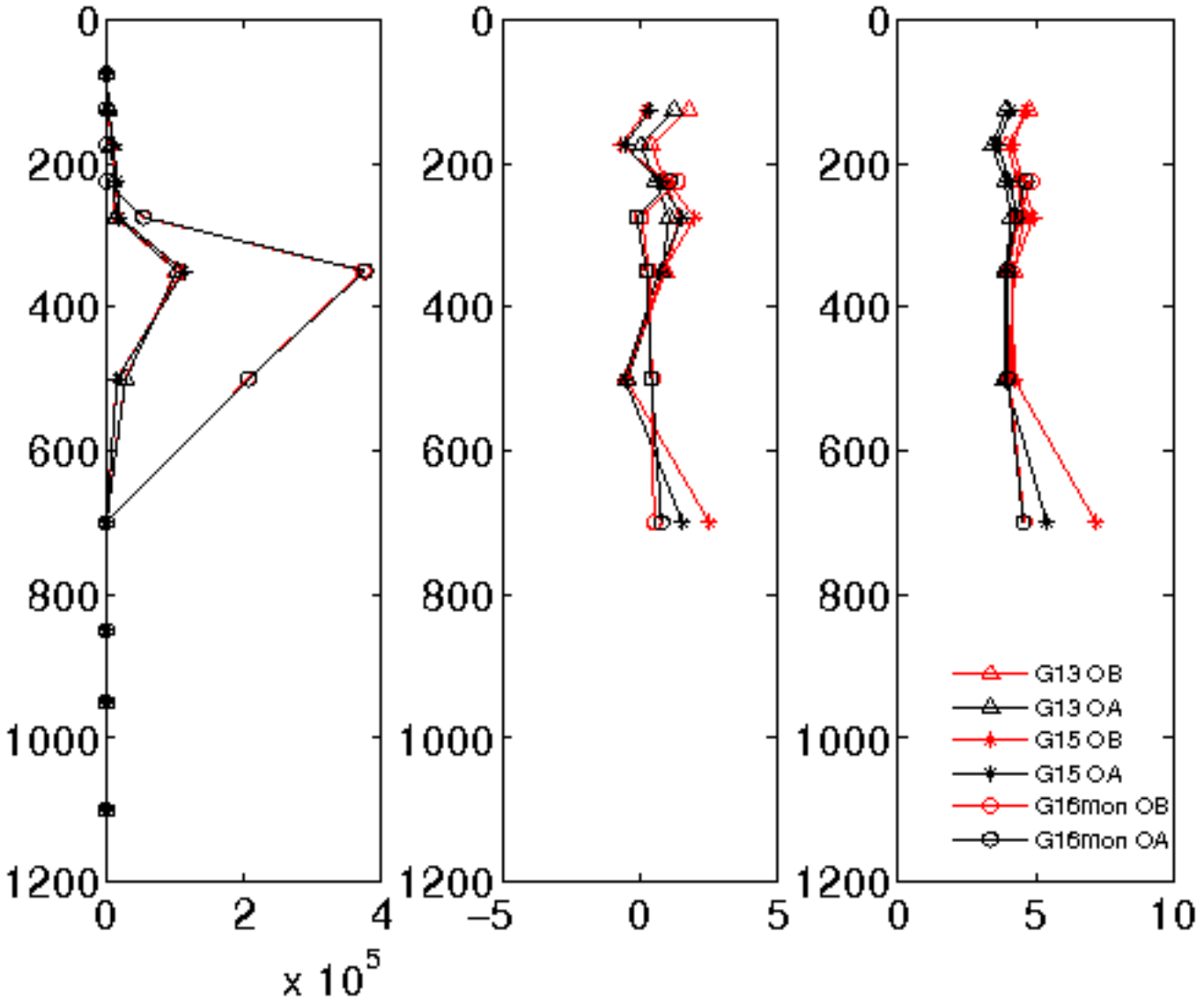


Monitoring experiment: 2 weeks of before / **after** the positioning move



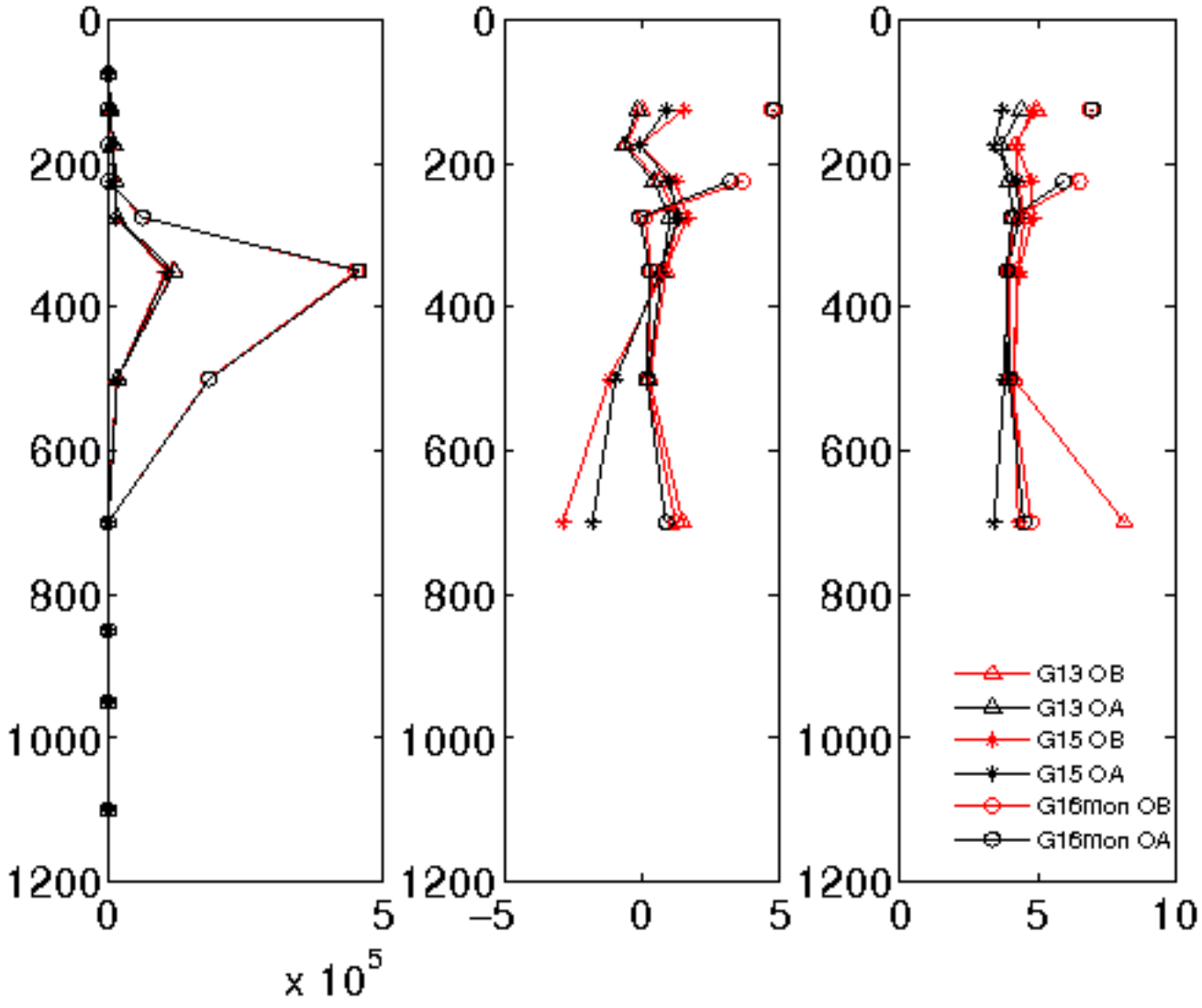
Monitoring experiment: 2 weeks of **before** / after the positioning move

WV CA COUNTS:G13/15vsG16; 247 BIAS RMS

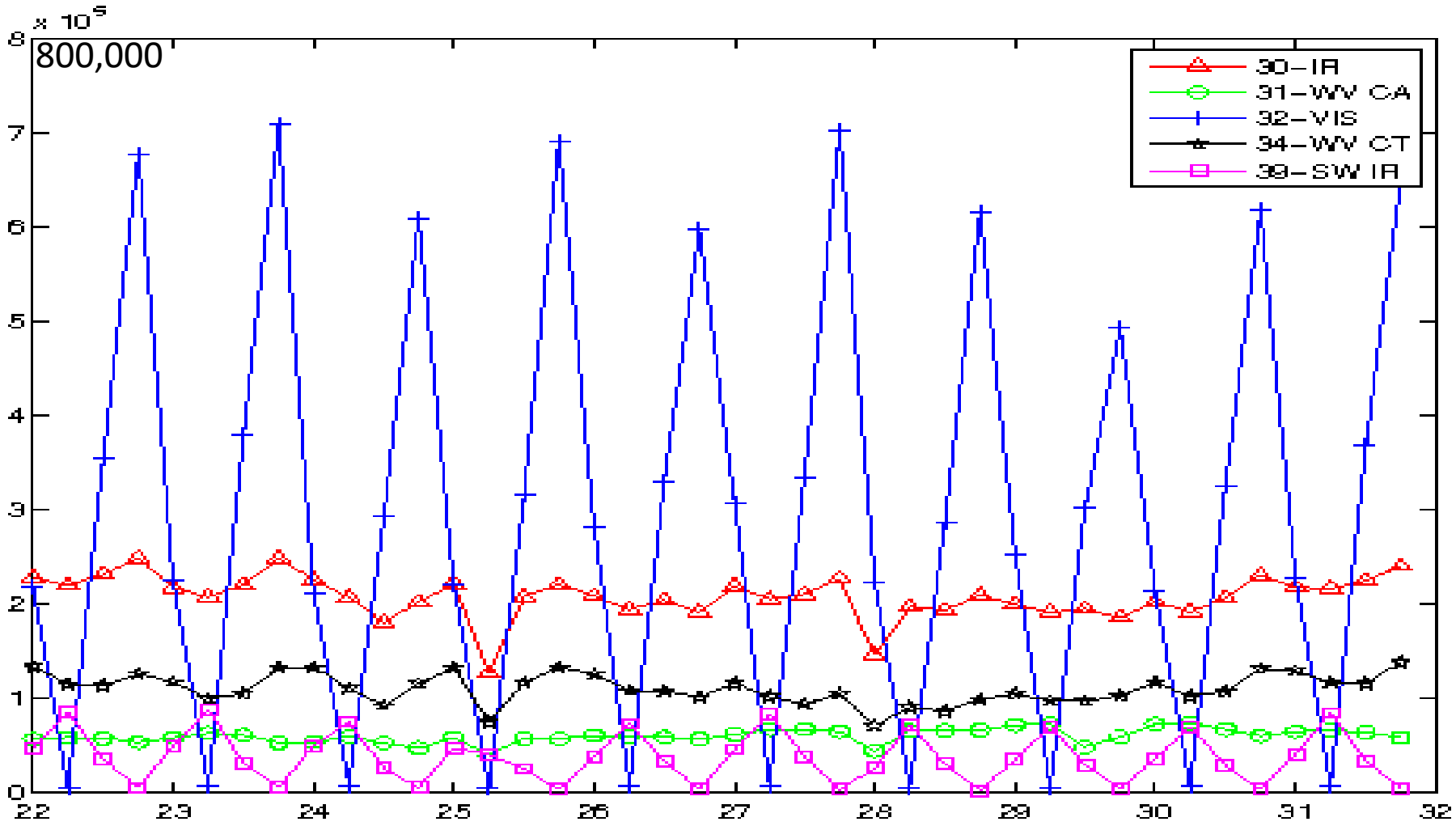


Monitoring experiment: 2 weeks of before / **after** the positioning move

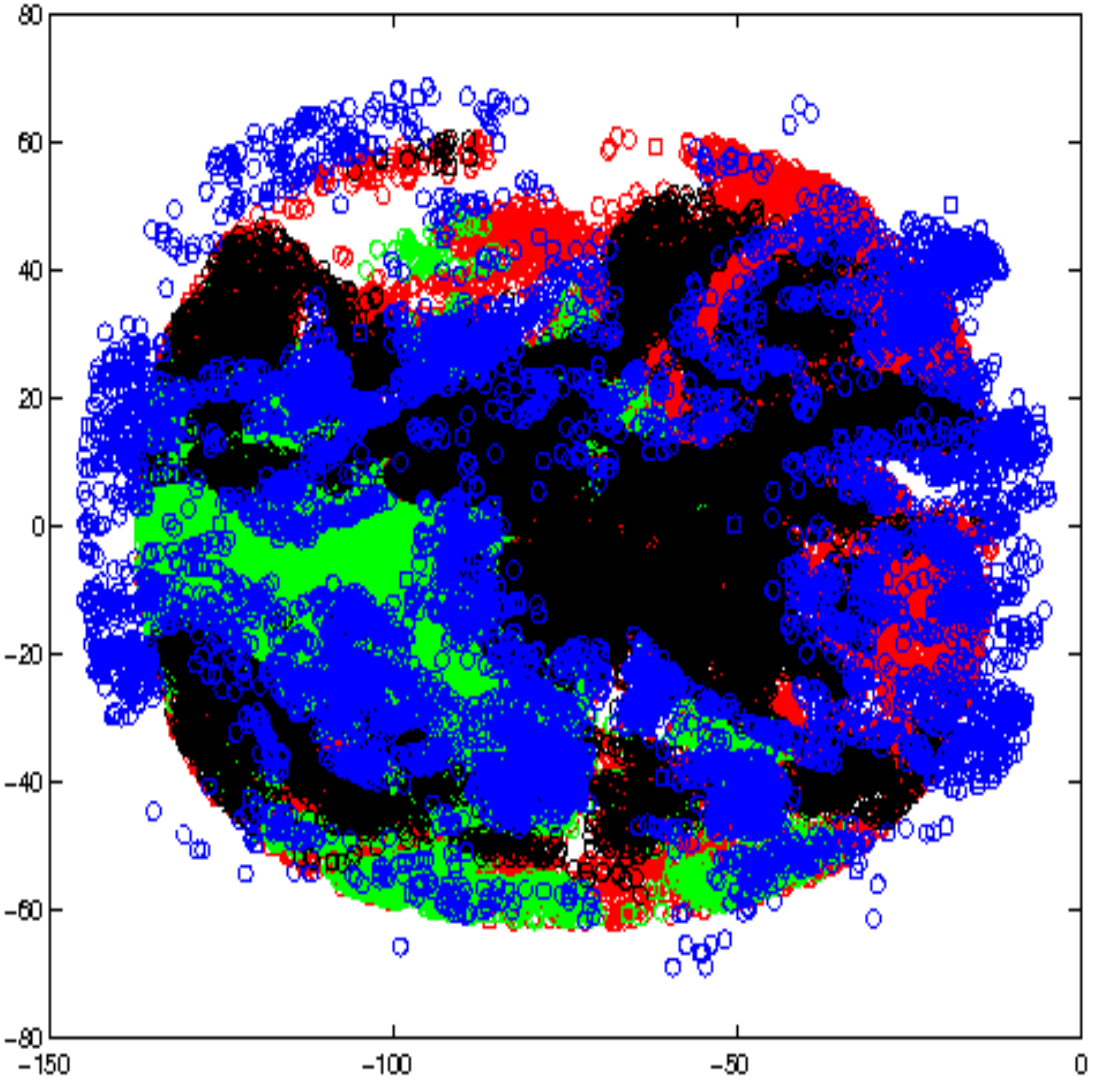
WV CA COUNTS:G13/15vsG16; 247 BIAS RMS



GOES-16 counts , Dec 2017



2018-Jan-16 00z GOES-16 AMVs spectral coverage

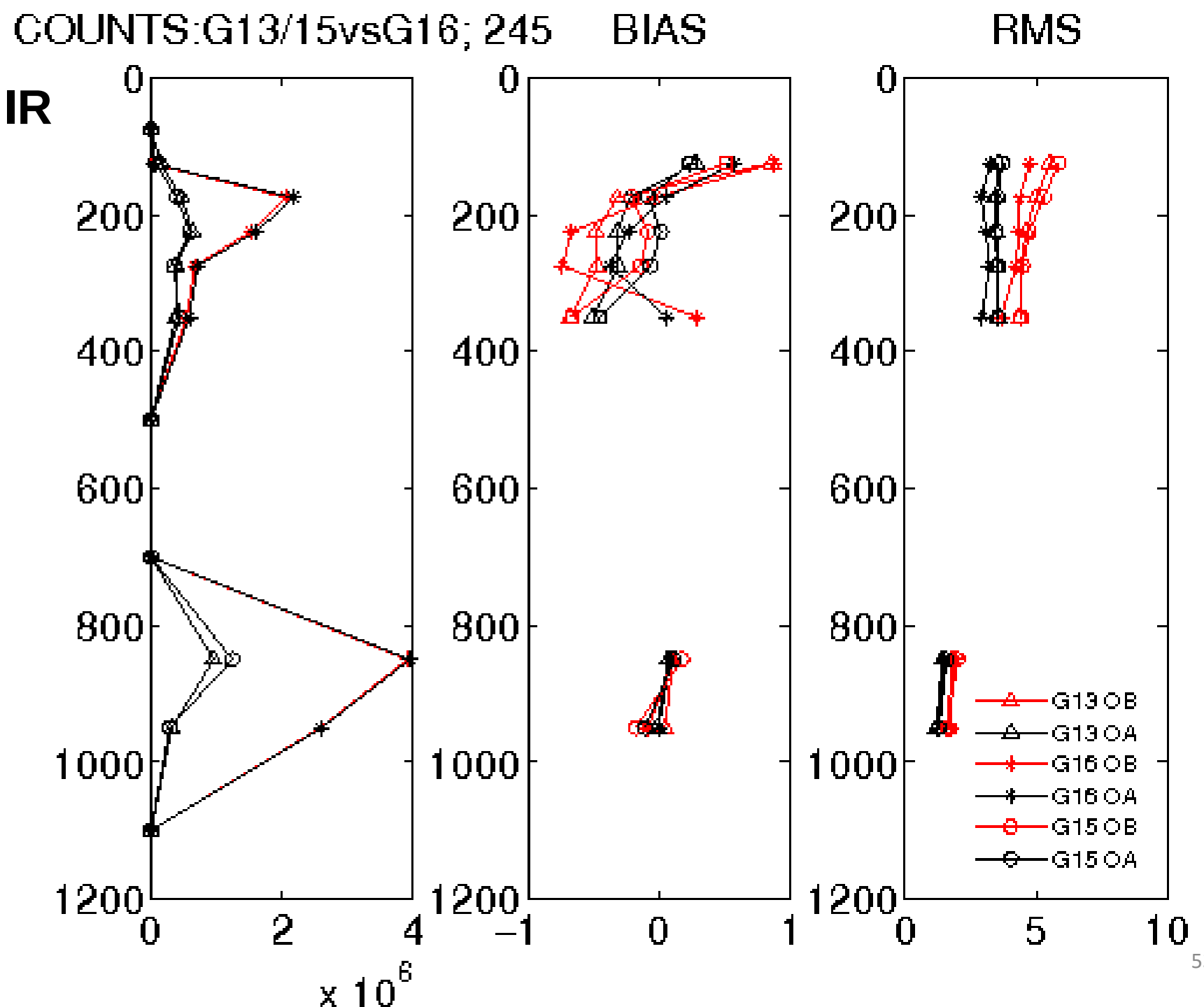


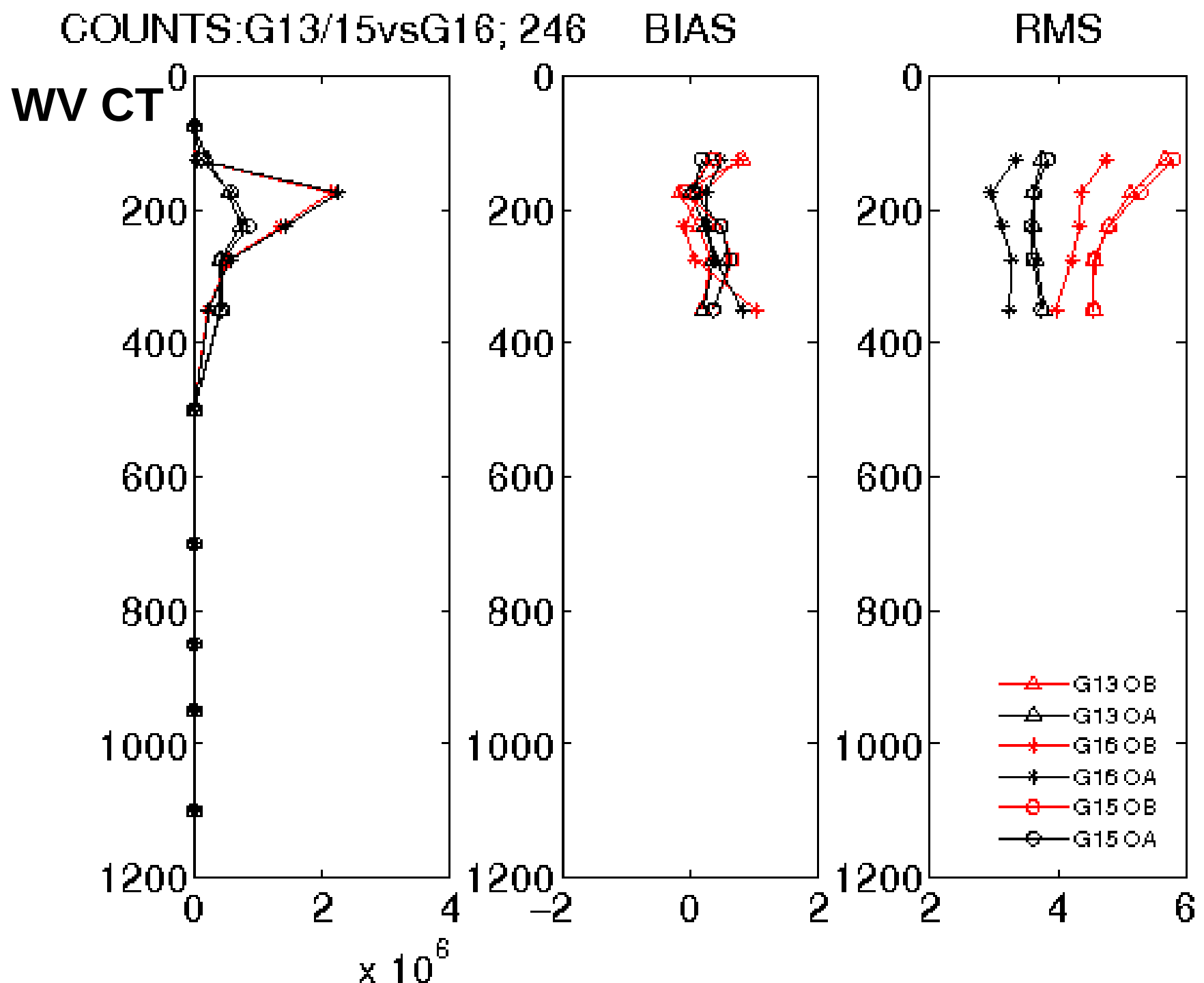
VIS - green
IR - red
WVCT - black
WVCA - blue

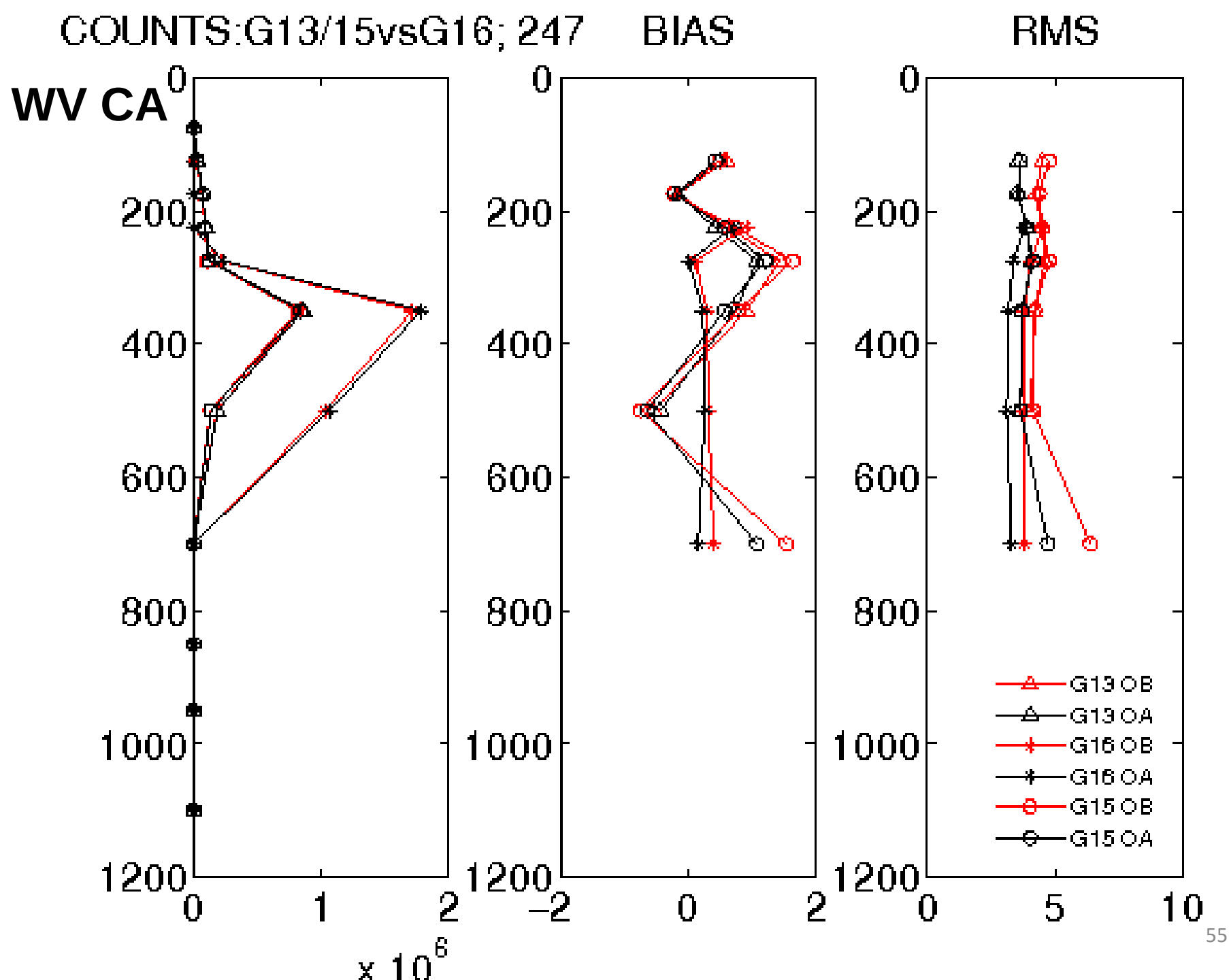
GOES-16 experiment

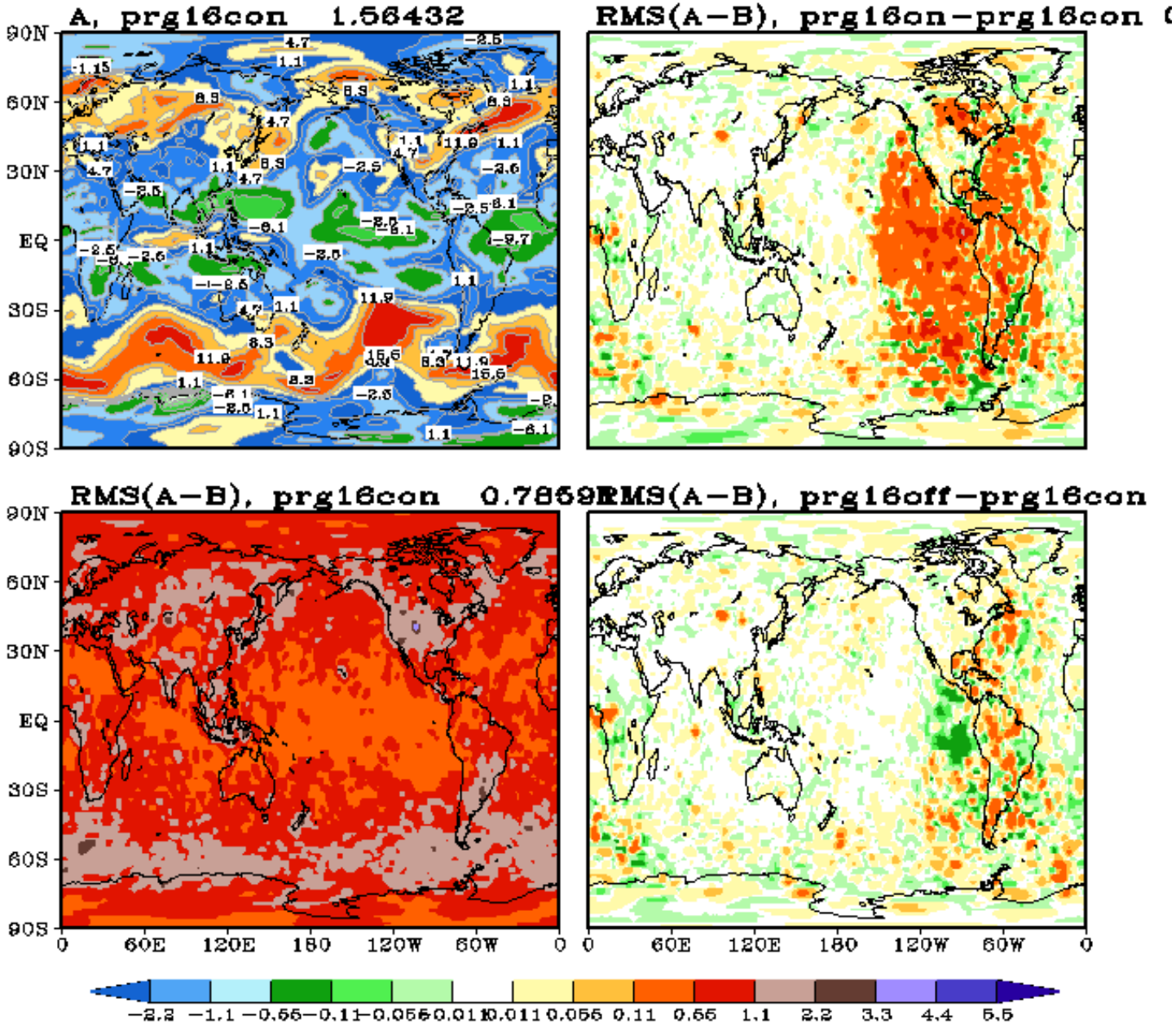
Control and Experiment @T670
Conrol : Goes **13** + Goes 15
Experiment : Goes **16** + Goes 15

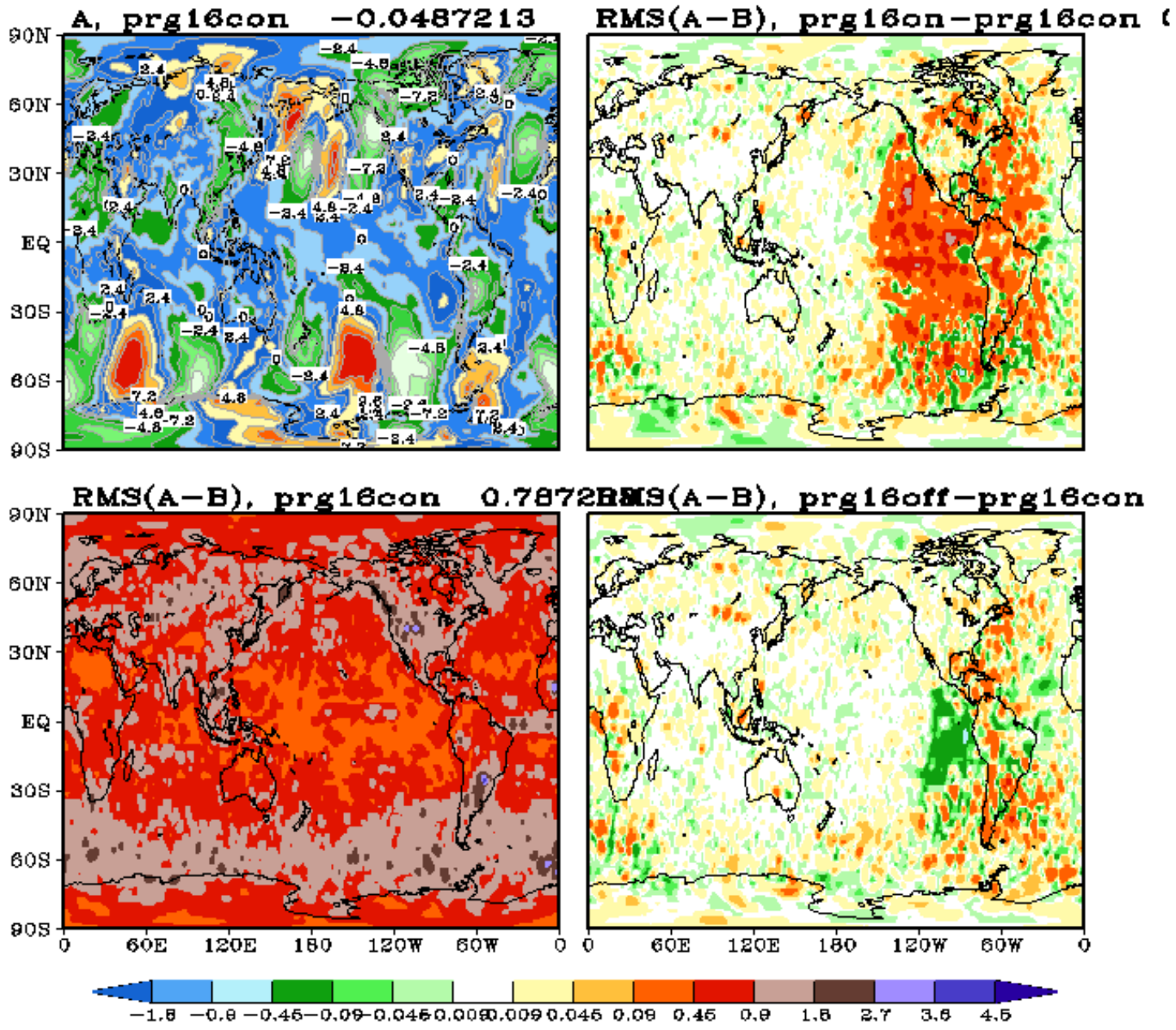
No thinning, OE for Goes-16 is half of that for Goes-13/15

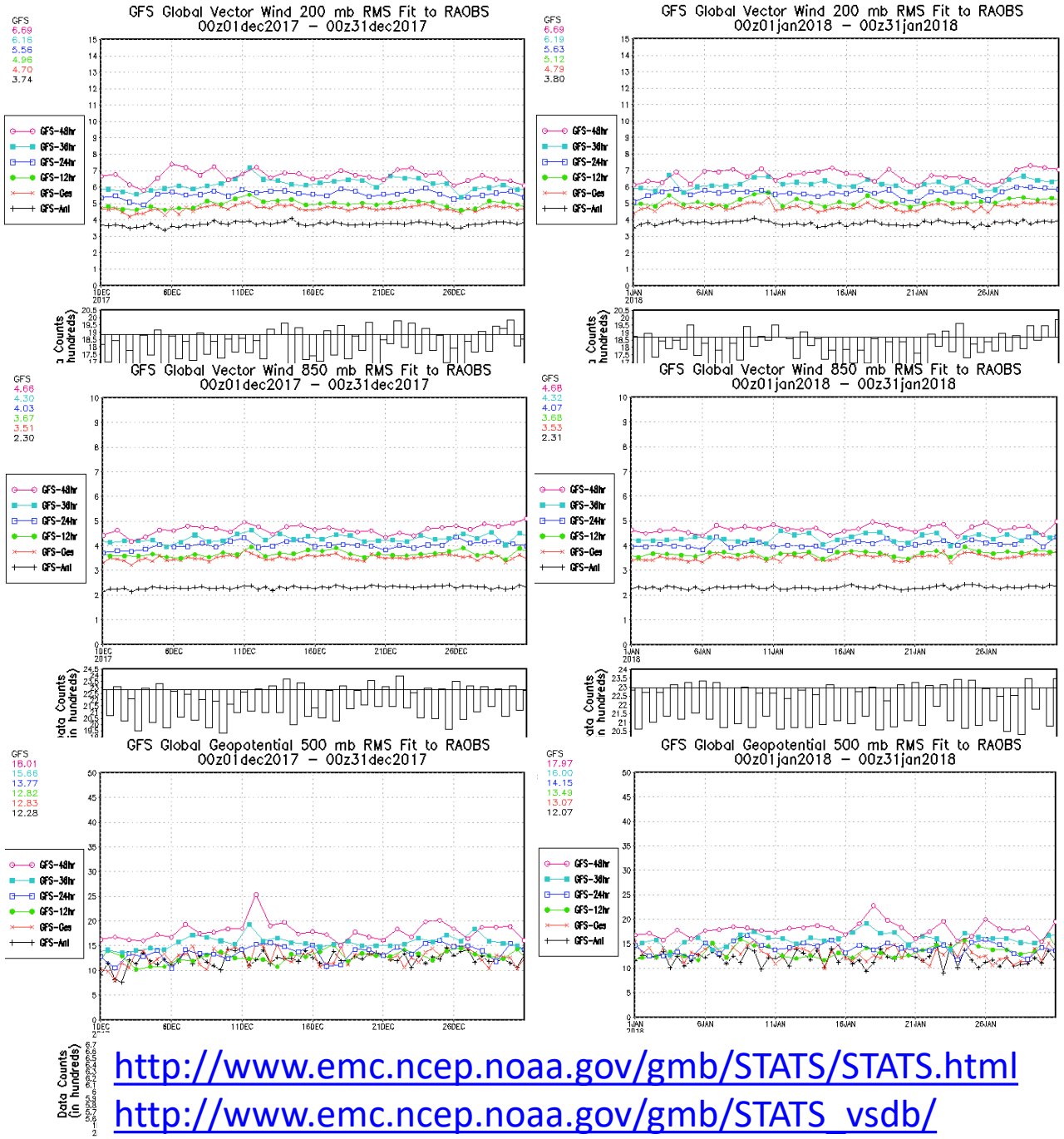

COUNTS:G13/15vsG16; 245
BIAS
RMS
IR
0
200
400
600
800
1000
1200
0
2
4
x 10^6
−1
0
1
0
5
10
G13 OB
G13 OA
G16 OB
G16 OA
G15 OB
G15 OA


WV CT
COUNTS:G13/15vsG16; 246
BIAS
RMS
0
200
400
600
800
1000
1200
0
2
4
x 10^6
−2
0
2
2
4
6
G13 OB
G13 OA
G16 OB
G16 OA
G15 OB
G15 OA


COUNTS:G13/15vsG16; 247
BIAS
RMS
WV CA
0
200
400
600
800
1000
1200
0
1
2
x 10^6
−2
0
2
0
5
10
G13 OB
G13 OA
G16 OB
G16 OA
G15 OB
G15 OA


RMS of GDAS Analysis Increments, U (m/s)
800 hPa, [00 06 12 18] Cyc, 00Z02Nov2017 ~ 18Z04Nov2017
A, prg16con 1.56432
RMS(A−B), prg16con−prg16con
RMS(A−B), prg16con 0.7869
RMS(A−B), prg16off−prg16con
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
−2.2 −1.1 −0.55 −0.11 −0.055 0.011 0.011 0.055 0.11 0.55 1.1 2.2 3.3 4.4 5.5


RMS of GDAS Analysis Increments, V (m/s)
800 hPa, [00 06 12 18] Cyc, 00Z02Nov2017 ~ 18Z04Nov2017
A, prg16con −0.0487213
RMS(A−B), prg16on−prg16con
RMS(A−B), prg16con 0.7872
RMS(A−B), prg16off−prg16con
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
−1.8 −0.9 −0.45 −0.09 −0.045 0.009 0.045 0.09 0.45 0.9 1.8 2.7 3.6 4.5



http://www.emc.ncep.noaa.gov/gmb/STATS/STATS.html

http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/

Still investigating:

- High AMVs altitudes

- Normality of O-B distributions

- Observation Error

- PCT1's skill in predicting AMV departure from the GFS background

- Test new 'gross error check' reprocessed data (J.Daniel's talk)

- EFSOI

Lesson learned:

Longer in time overlap between satellites is needed!

Outline

Meteosat transitions:

- From Meteosat 7 to Meteosat 8 winds

- From Meteosat 10 to Meteosat 11 winds

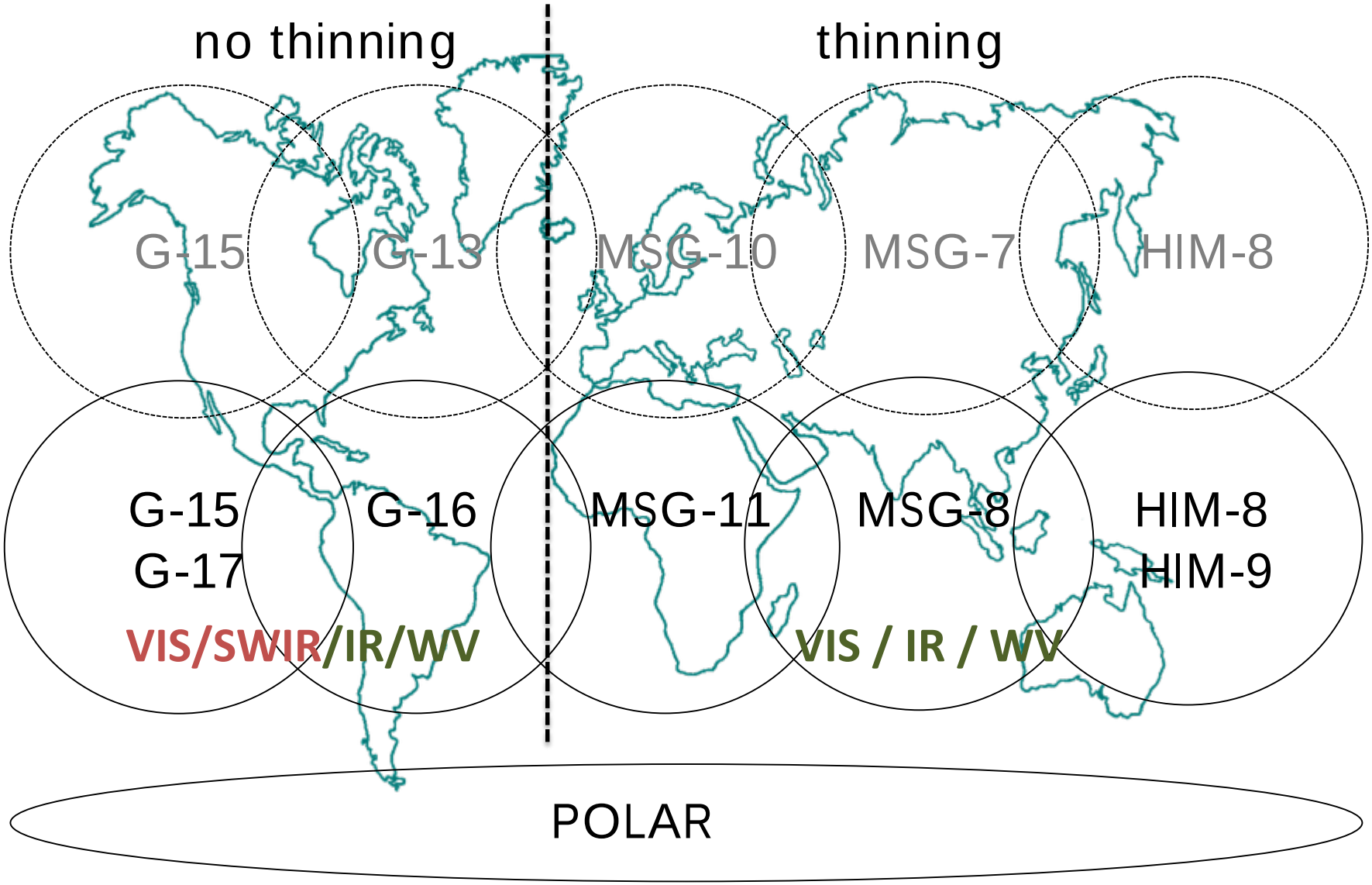
Preliminary evaluation of Himawary 9 winds

Quick peek at INSAT winds

Evaluating and Assimilating GOES-16 winds

What's next?

What's next?


no thinning
thinning
G-15
G-13
MSG-10
MSG-7
HIM-8
G-15
G-17
G-16
MSG-11
MSG-8
HIM-8
HIM-9
VIS/SWIR/IR/WV
VIS / IR / WV
POLAR