

IASI L2
temperature and humidity monitoring
against in situ sonde measurements

Monthly report for September 2023,
Platform: M03,
GroundSegment: GS1

Issue : V1
Date : 03/10/2023

EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
www.eumetsat.int

CONTENTS

1	Introduction	5
1.1	Purpose and scope	5
1.2	Collocation criteria and data selection	5
1.3	Reference Documents	5
1.4	Terminology	6
1.5	MONALISA	6
2	Global Monthly statistics in clear-sky pixel	7
2.1	Matchups	7
2.2	Vertical profile statistics	9
2.2.1	Temperature	9
2.2.2	Specific Humidity	10
2.2.3	Relative Humidity	11
2.3	Quality Indicator profile statistics	13
2.3.1	Temperature	13
2.3.2	Specific Humidity	14
2.3.3	Relative Humidity	15
2.4	Monthly time series	16
2.4.1	Temperature / Humidity	17
2.4.1.1	Level: 10 hPa	17
2.4.1.2	Level: 100 hPa	18
2.4.1.3	Level: 200 hPa	19
2.4.1.4	Level: 300 hPa	20
2.4.1.5	Level: 500 hPa	21
2.4.1.6	Level: 600 hPa	22
2.4.1.7	Level: 800 hPa	23
2.4.1.8	Level: 1000 hPa	24
2.4.2	Precipitable Water	25
2.5	Long-term time series	26
2.5.1	Temperature / Humidity	27
2.5.1.1	Level: 10 hPa	27
2.5.1.2	Level: 100 hPa	28
2.5.1.3	Level: 200 hPa	29
2.5.1.4	Level: 300 hPa	30
2.5.1.5	Level: 500 hPa	31
2.5.1.6	Level: 600 hPa	32
2.5.1.7	Level: 800 hPa	33
2.5.1.8	Level: 1000 hPa	34
2.5.2	Precipitable Water	35
2.6	Histograms	36
2.6.1	Moist adiabatic lapse rate	36
2.6.1.1	Layer: 1500m above Surface	36
2.6.1.2	Layer: 850 - 500 hPa	38
2.6.2	Precipitable Water	40
2.6.2.1	Total Column	40
2.6.2.2	Layer: 1500m above Surface	42
2.6.2.3	Layer: 850 - 500 hPa	44
2.6.2.4	Collocational dependencies	46
2.6.2.5	Angular dependencies	51
3	Regional Europe Monthly statistics in clear-sky pixel	53
3.1	Matchups	53

3.2	Vertical profile statistics	55
3.2.1	Temperature	55
3.2.2	Specific Humidity	56
3.2.3	Relative Humidity	57
3.3	Monthly time series	58
3.3.1	Temperature / Humidity	59
3.3.1.1	Level: 10 hPa	59
3.3.1.2	Level: 100 hPa	60
3.3.1.3	Level: 200 hPa	61
3.3.1.4	Level: 300 hPa	62
3.3.1.5	Level: 500 hPa	63
3.3.1.6	Level: 600 hPa	64
3.3.1.7	Level: 800 hPa	65
3.3.1.8	Level: 1000 hPa	66
3.3.2	Precipitable Water	67
3.4	Long-term time series	68
3.4.1	Temperature / Humidity	69
3.4.1.1	Level: 10 hPa	69
3.4.1.2	Level: 100 hPa	70
3.4.1.3	Level: 200 hPa	71
3.4.1.4	Level: 300 hPa	72
3.4.1.5	Level: 500 hPa	73
3.4.1.6	Level: 600 hPa	74
3.4.1.7	Level: 800 hPa	75
3.4.1.8	Level: 1000 hPa	76
3.4.2	Precipitable Water	77
3.5	Histograms	78
3.5.1	Moist adiabatic lapse rate	78
3.5.1.1	Layer: 1500m above Surface	78
3.5.1.2	Layer: 850 - 500 hPa	80
3.5.2	Precipitable Water	82
3.5.2.1	Total Column	82
3.5.2.2	Layer: 1500m above Surface	84
3.5.2.3	Layer: 850 - 500 hPa	86
3.5.2.4	Collocational dependencies	88
3.5.2.5	Angular dependencies	93
4	Global Monthly statistics per station	95
4.1	Humidity difference maps	95
4.1.1	Layer: 100 - 10 hPa	95
4.1.2	Layer: 200 - 100 hPa	96
4.1.3	Layer: 400 - 200 hPa	97
4.1.4	Layer: 600 - 400 hPa	98
4.1.5	Layer: 800 - 600 hPa	99
4.1.6	Layer:1000 - 800 hPa	100
4.2	Temperature difference maps	101
4.2.1	Layer: 100 - 10 hPa	101
4.2.2	Layer: 200 - 100 hPa	102
4.2.3	Layer: 400 - 200 hPa	103
4.2.4	Layer: 600 - 400 hPa	104
4.2.5	Layer: 800 - 600 hPa	105
4.2.6	Layer:1000 - 800 hPa	106
4.3	Precipitable Water Maps	107
4.3.1	Absolute difference	107
4.3.2	Relative difference	108

1 INTRODUCTION

1.1 Purpose and scope

This report compiles Monthly statistics from the routine monitoring of the IASI L2 temperature and humidity [RD 1] products with *in situ* sonde measurements.

The IASI L2 products come from the operational ground segment GS1. The reference measurements are retrieved from the NOAA Integrated Global Radiosonde Archive (IGRA) [RD 3]. The collocation and statistics are computed with the MONALiSA monitoring facility [RD 4].

This document is intended for internal monitoring purposes, to characterise and detect possible changes or trends in performances. It is also a public report to Users interested in IASI L2 temperature and humidity products uncertainties. In this respect, it is important to note that differences with sondes also include uncertainties of the sonde measurements themselves as well as collocation uncertainties. These come from the representativeness of a point measurements (sonde) *vs* the 12-40 km footprint of IASI and from the spatial and temporal lags between sonde and satellite acquisitions.

1.2 Collocation criteria and data selection

All IASI pixel within 3 h and 50 km from the sonde sites are collocated to the radiosonde measurement and stored in a match-up database.

The statistics are then computed globally and for Europe separately with clear-sky pixel (FLG_CLDNES = 1 or 2 [RD 2]) successfully processed with the statistical (in blue) and optimal estimation (in red) retrieval methods. The quality control on the IASI L2 products retains profiles with quality indicators (uncertainty estimates) better than 1.5 K for tropospheric temperature and 3.5 K in dew point for tropospheric humidity. This selection usually represent more than 95% of the pixel flagged free of clouds (20% of the overall measurements).

1.3 Reference Documents

ID	Title	Reference
[RD 1]	"IASI Level 2 Product Generation Specifications"	EPS.SYS.SPE.990013
[RD 2]	"IASI Level 2 Product Guide"	EUM/OPS-EPS/MAN/04/0033
[RD 3]	"Integrated Global Radiosonde Archive (IGRA)"	https://www.ncdc.noaa.gov/data-access/weather-balloon/integrated-global-radiosonde-archive
[RD 4]	"MONALiSA Software Release Note"	EUM/RSP/TEN/17/930189

1.4 Terminology

- M01 : Metop B
- M02 : Metop A
- M03 : Metop C
- Ground Segment 1 (GS1) : operational
- Ground Segment 2 (GS2) : validation
- Ground Segment 3 (GS3) : experiment

1.5 MONALiSA

- Version : v3.6-32-g90f9e98
- GitHash : 90f9e98a060f1bd1624999a5bf4a2dc6be031c69

2 GLOBAL MONTHLY STATISTICS IN CLEAR-SKY PIXEL

2.1 Matchups

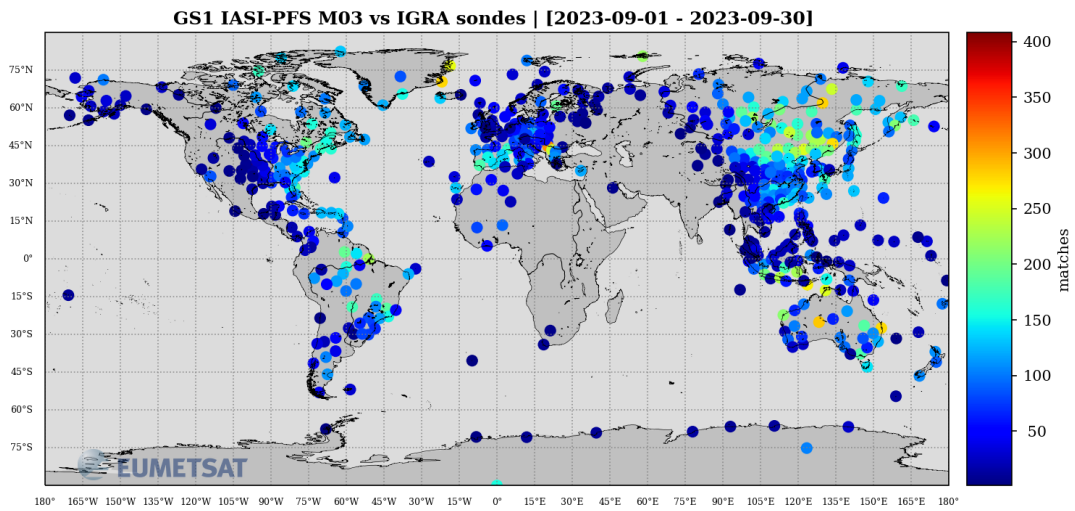


Figure 2.1: Number of match-ups per station with M03 IASI L2 from GS1 for 01-30/09/2023

2.2 Vertical profile statistics

2.2.1 Temperature

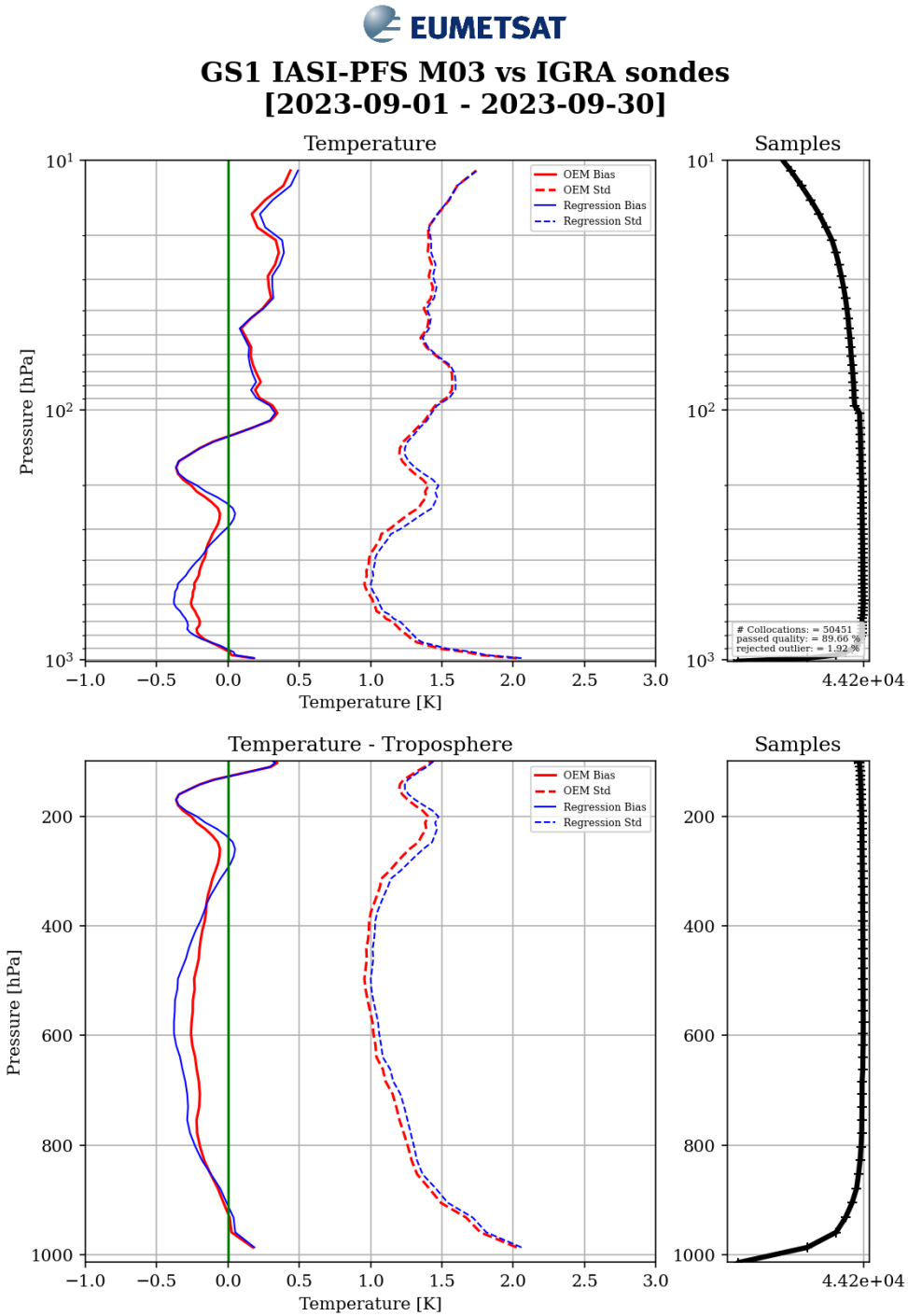


Figure 2.2: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in temperature with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.2.2 Specific Humidity

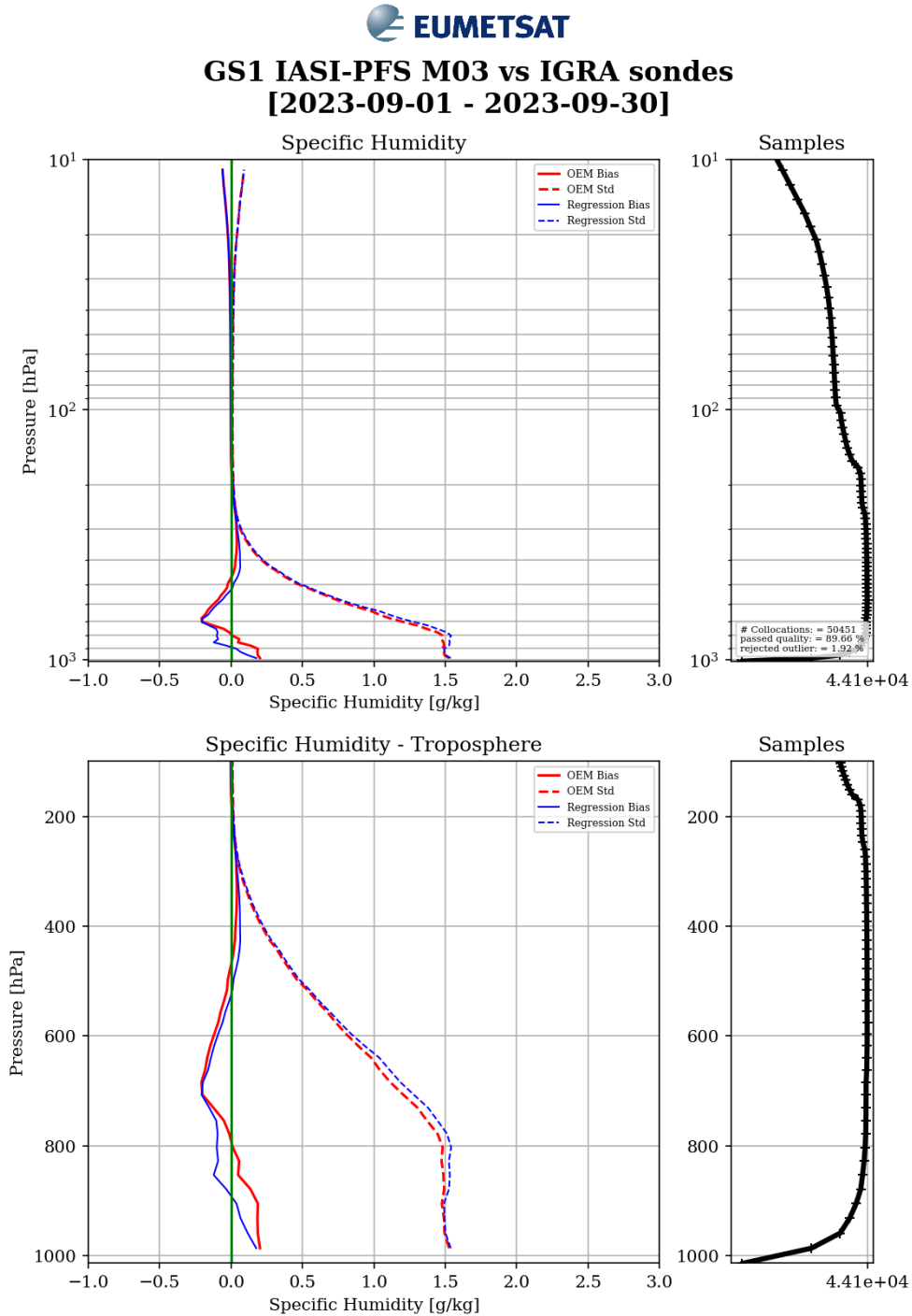


Figure 2.3: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in specific humidity with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for for 01-30/09/2023

2.2.3 Relative Humidity

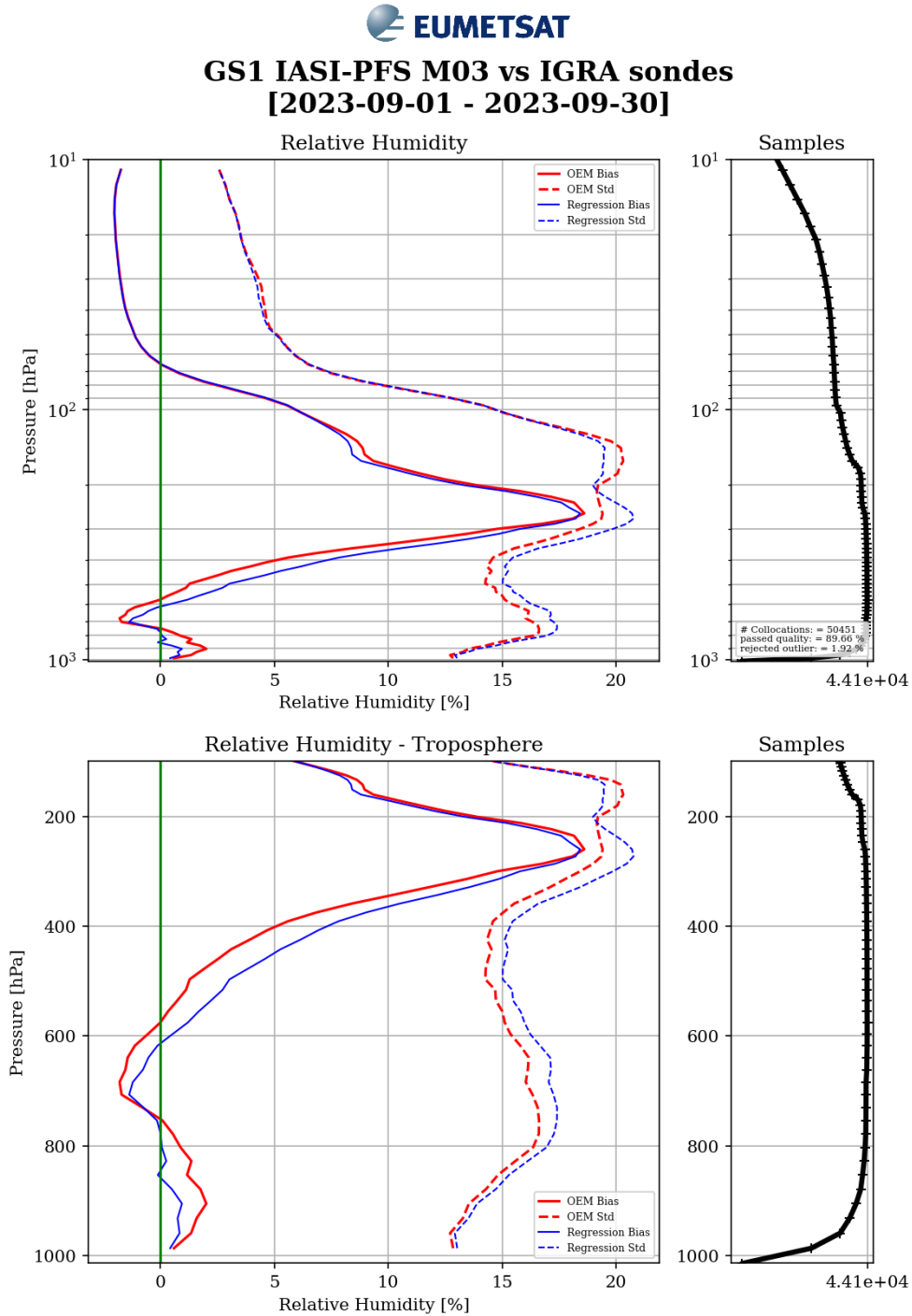


Figure 2.4: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in relative humidity with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for for 01-30/09/2023

2.3 Quality Indicator profile statistics

2.3.1 Temperature

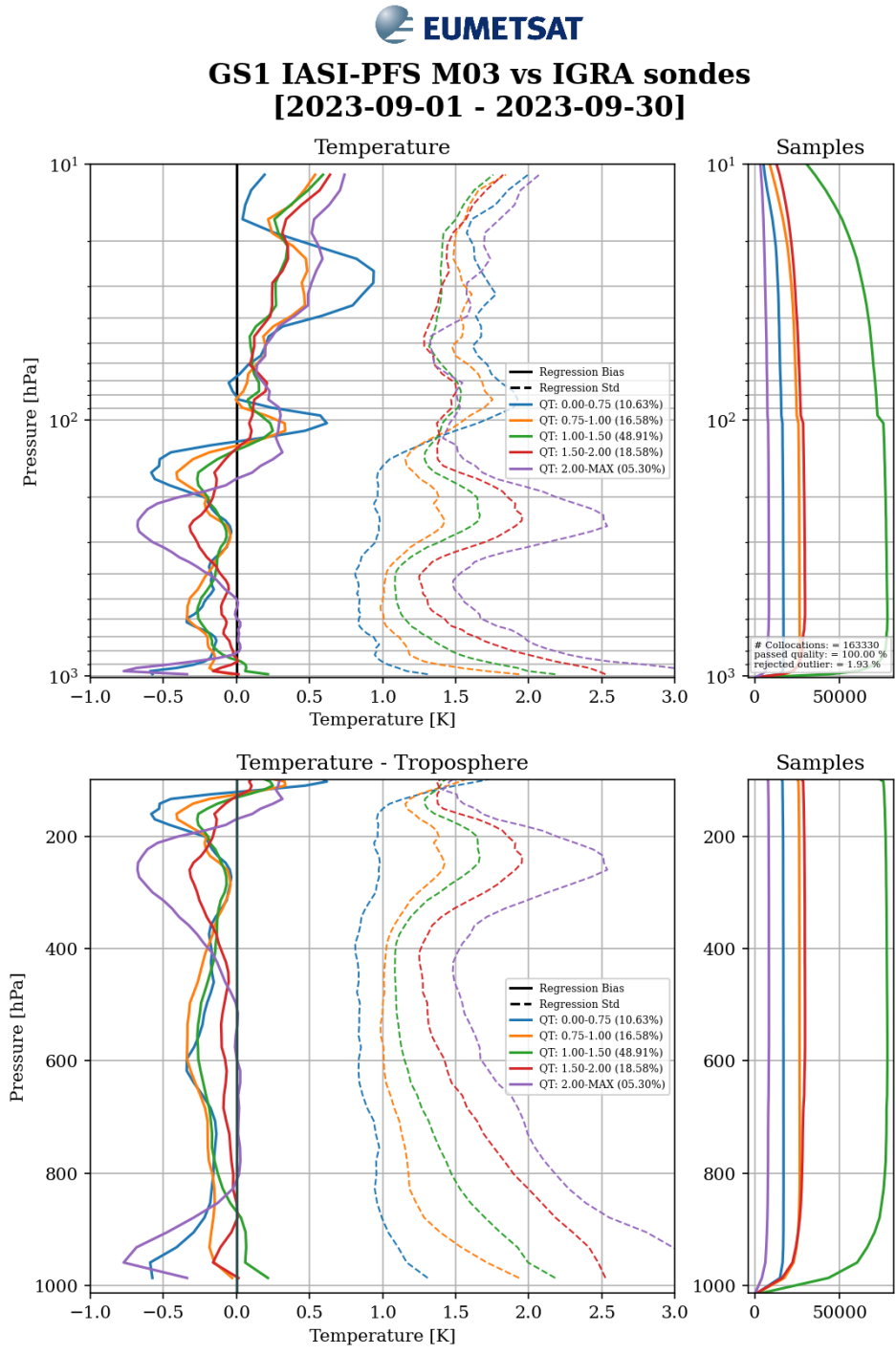


Figure 2.5: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in temperature for different quality indicator ranges (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.3.2 Specific Humidity

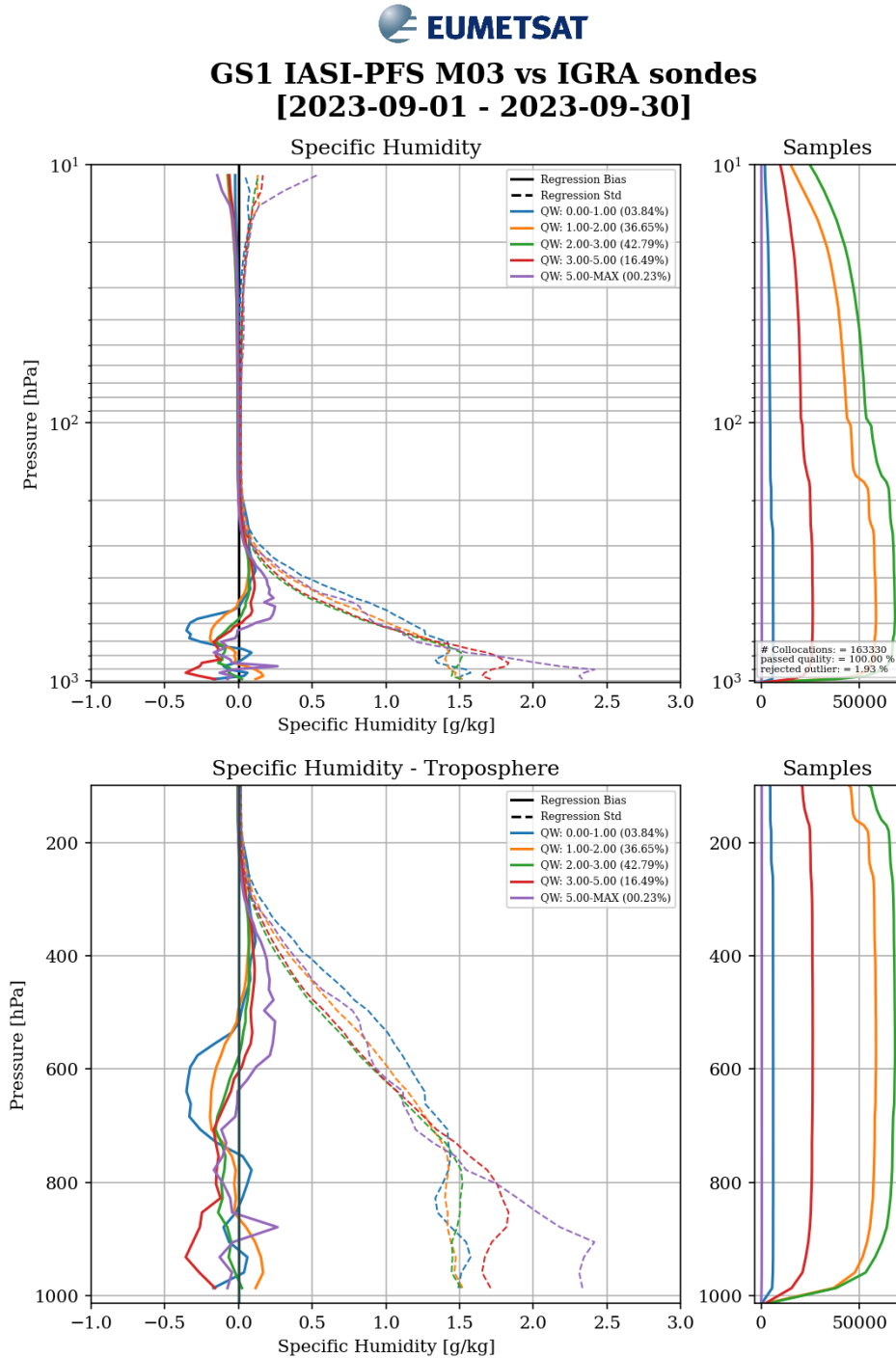


Figure 2.6: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in specific humidity for different quality indicator ranges (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for for 01-30/09/2023

2.3.3 Relative Humidity

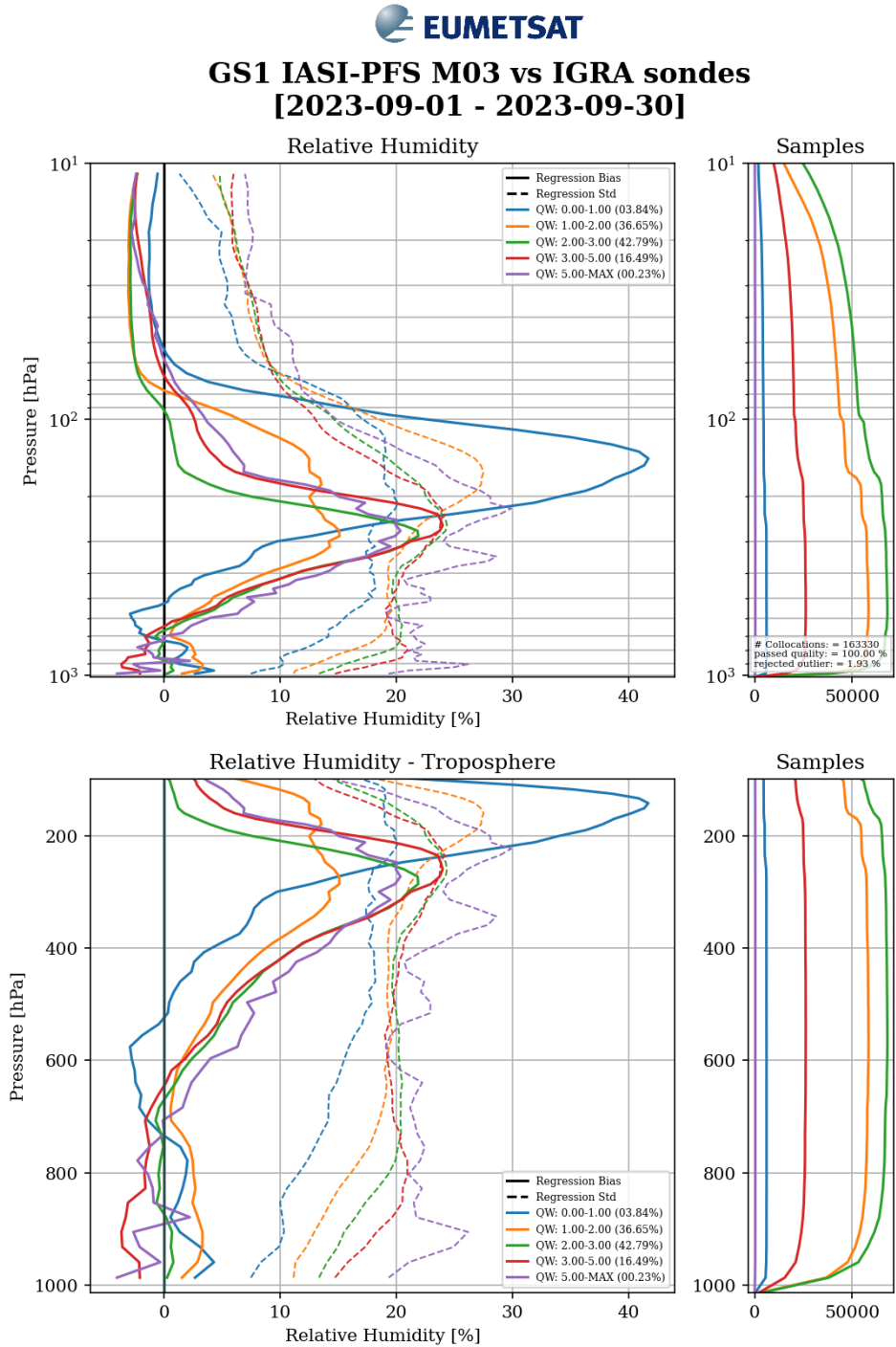


Figure 2.7: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in relative humidity for different quality indicator ranges (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for for 01-30/09/2023

2.4 Monthly time series

2.4.1 Temperature / Humidity

2.4.1.1 Level: 10 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [10.0 hPa]
[2023-09-01 - 2023-09-30]**

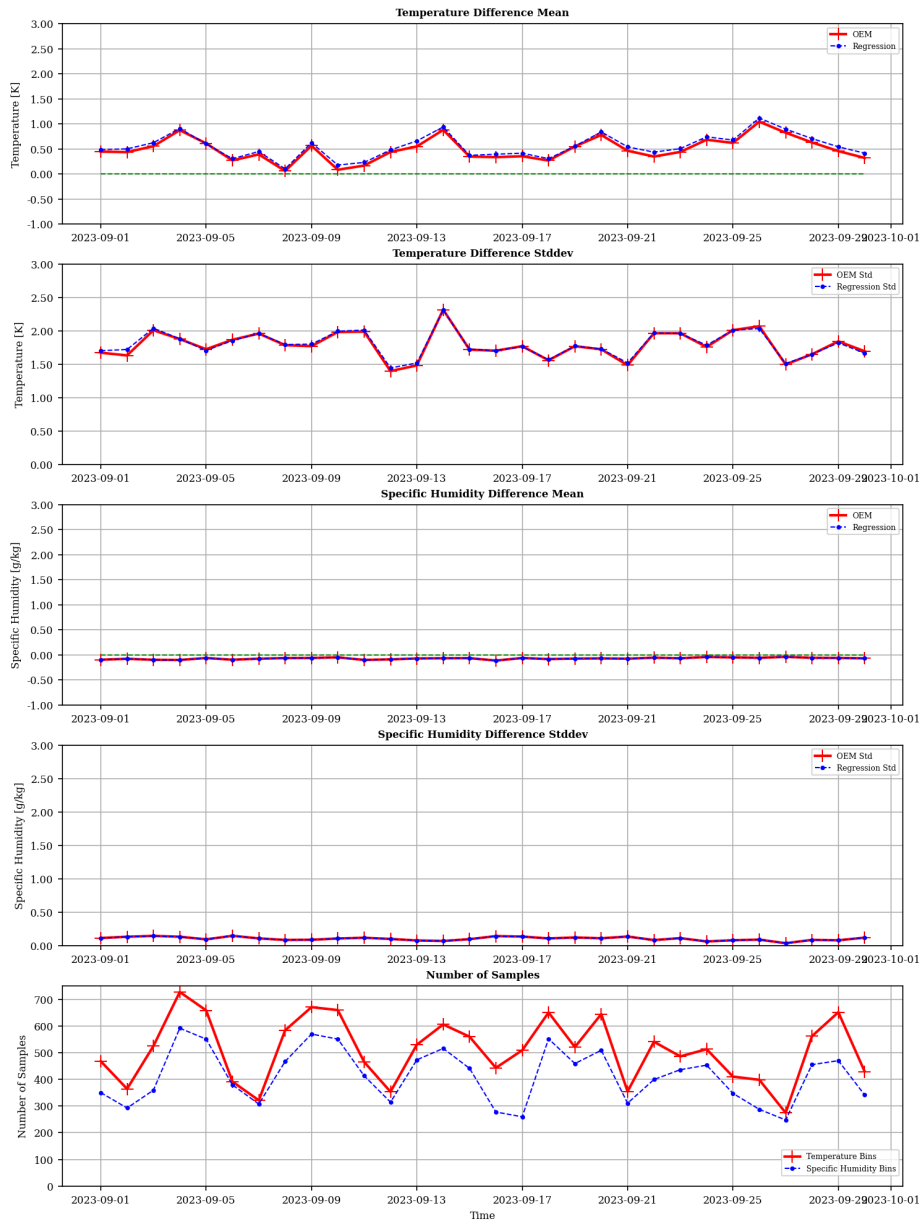


Figure 2.8: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 10 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.2 Level: 100 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [100.0 hPa]
 [2023-09-01 - 2023-09-30]**

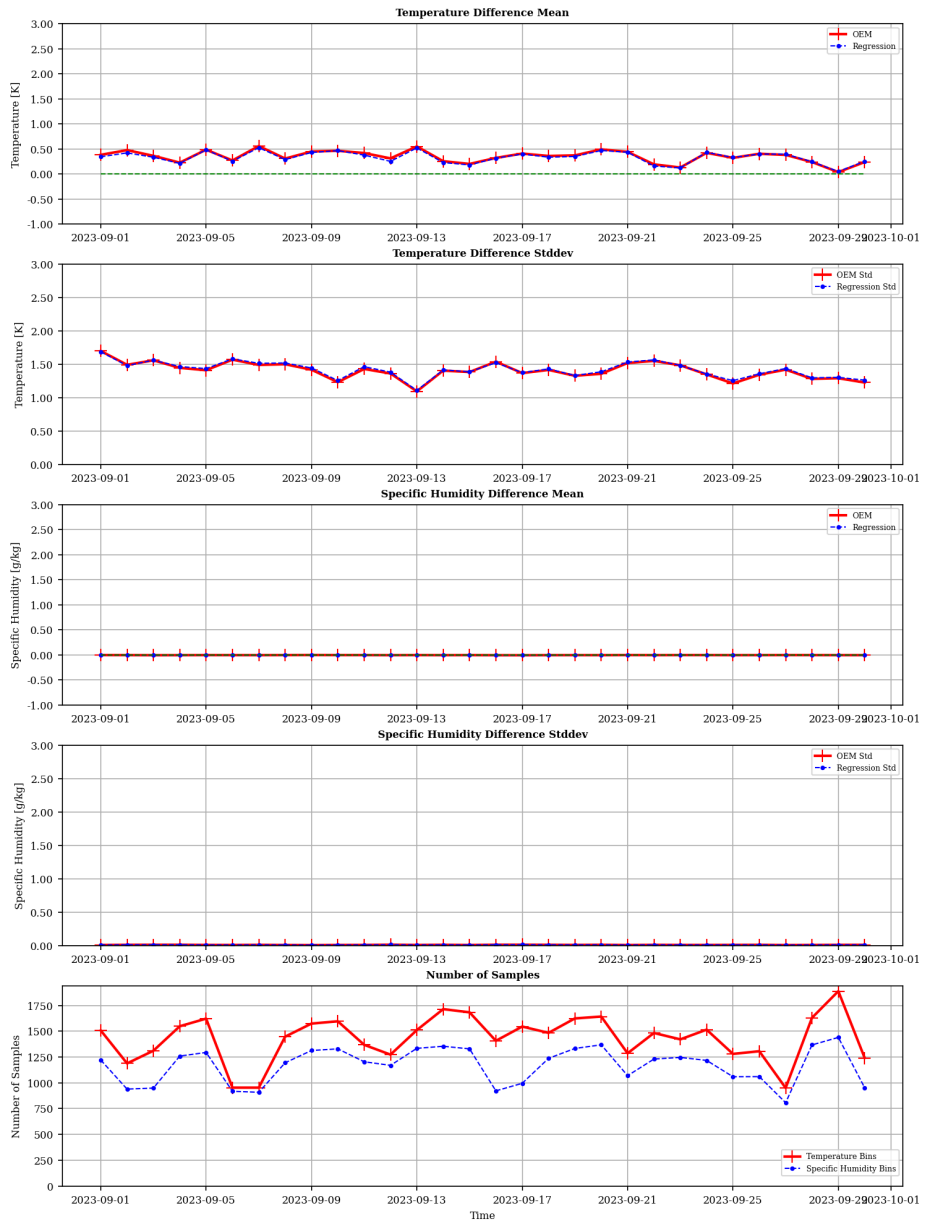


Figure 2.9: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 100 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.3 Level: 200 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [200.0 hPa]
 [2023-09-01 - 2023-09-30]**

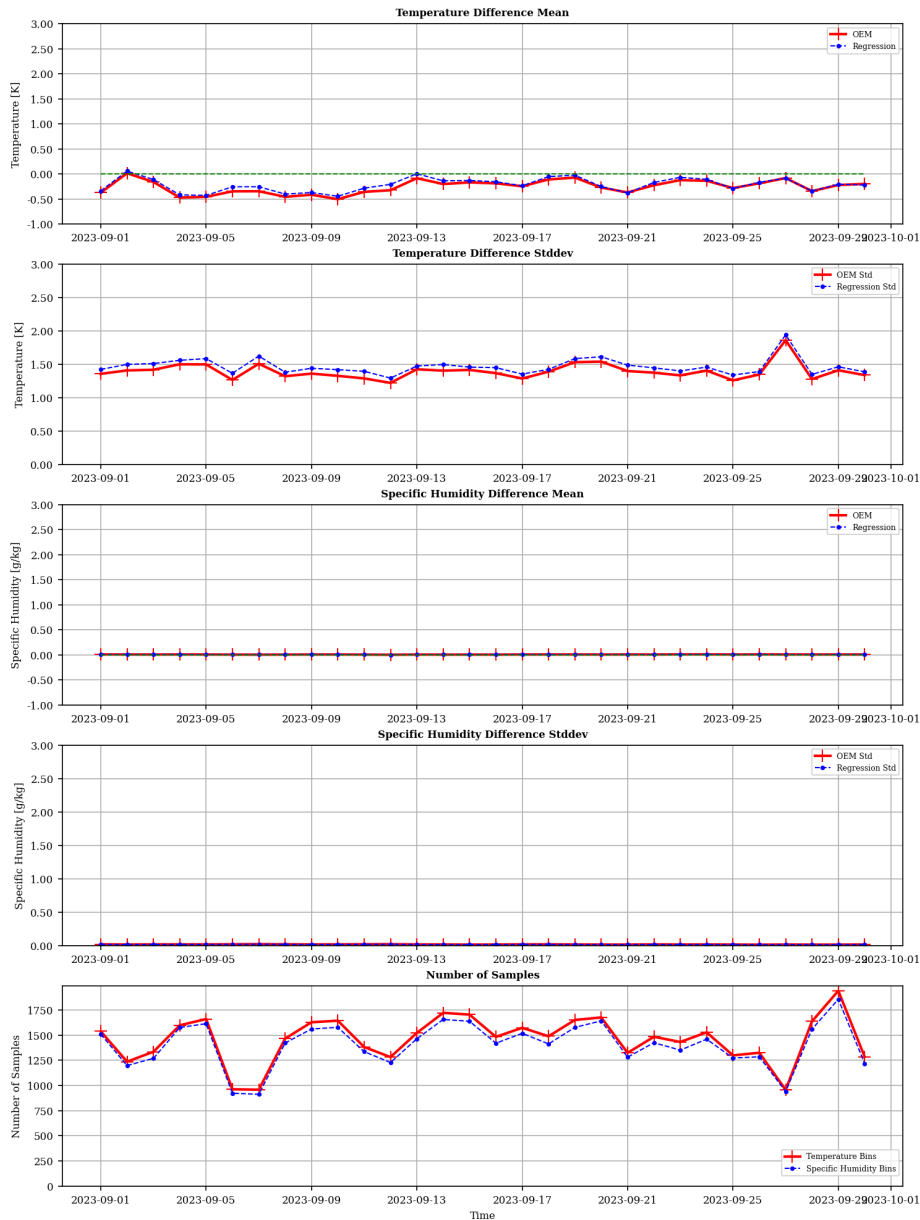


Figure 2.10: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 200 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.4 Level: 300 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [300.0 hPa]
 [2023-09-01 - 2023-09-30]**

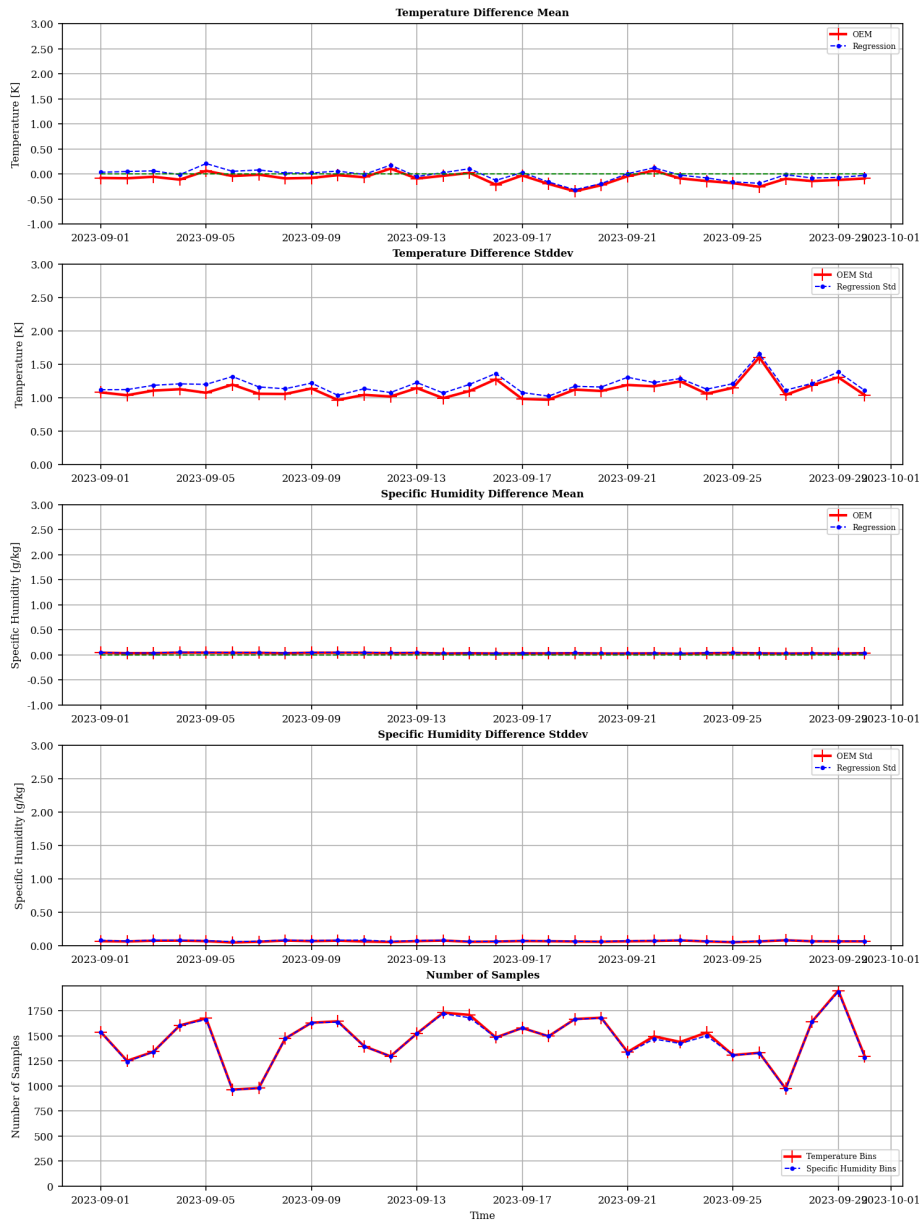


Figure 2.11: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 300 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.5 Level: 500 hPa



GS1 IASI-PFS M03 vs IGRA sondes [500.0 hPa]
[2023-09-01 - 2023-09-30]

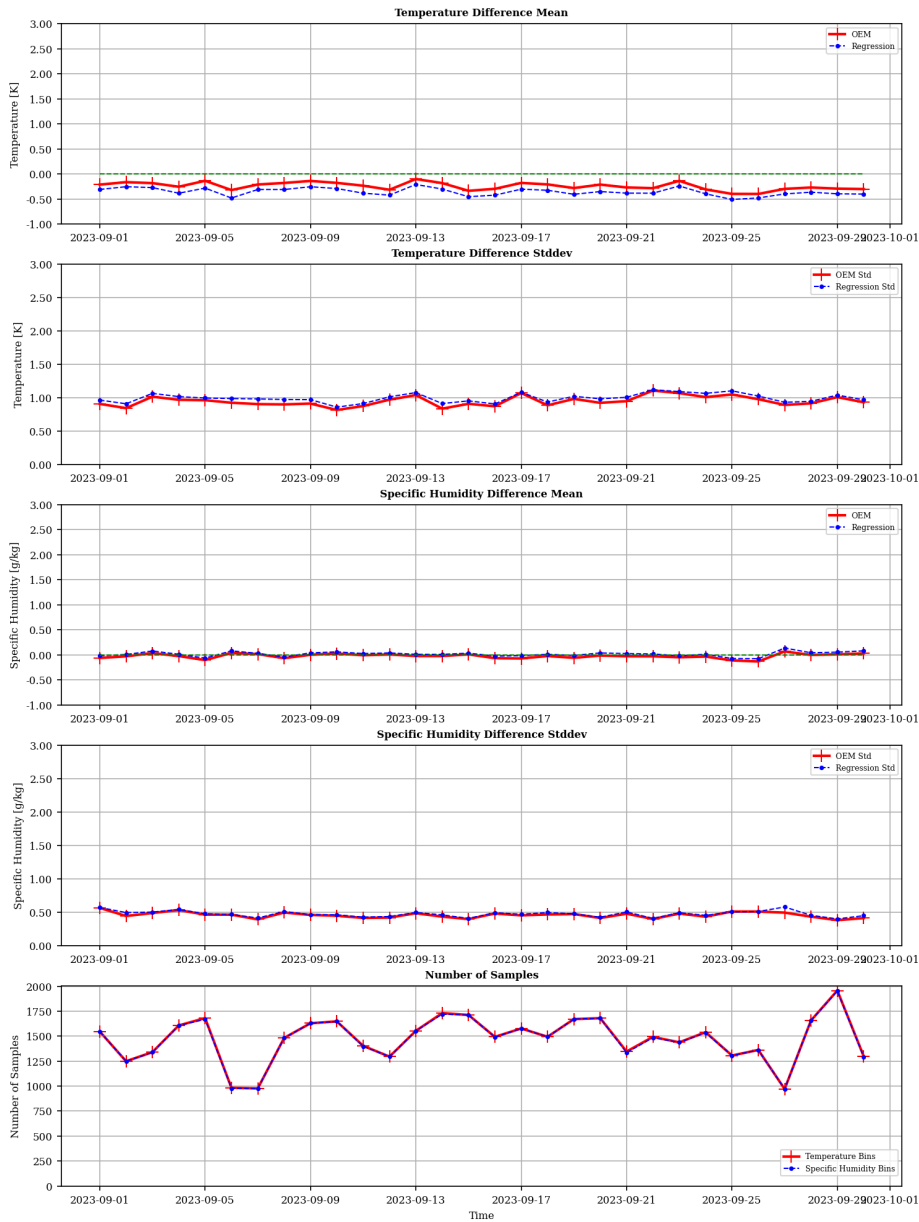


Figure 2.12: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 500 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.6 Level: 600 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [600.0 hPa]
[2023-09-01 - 2023-09-30]**

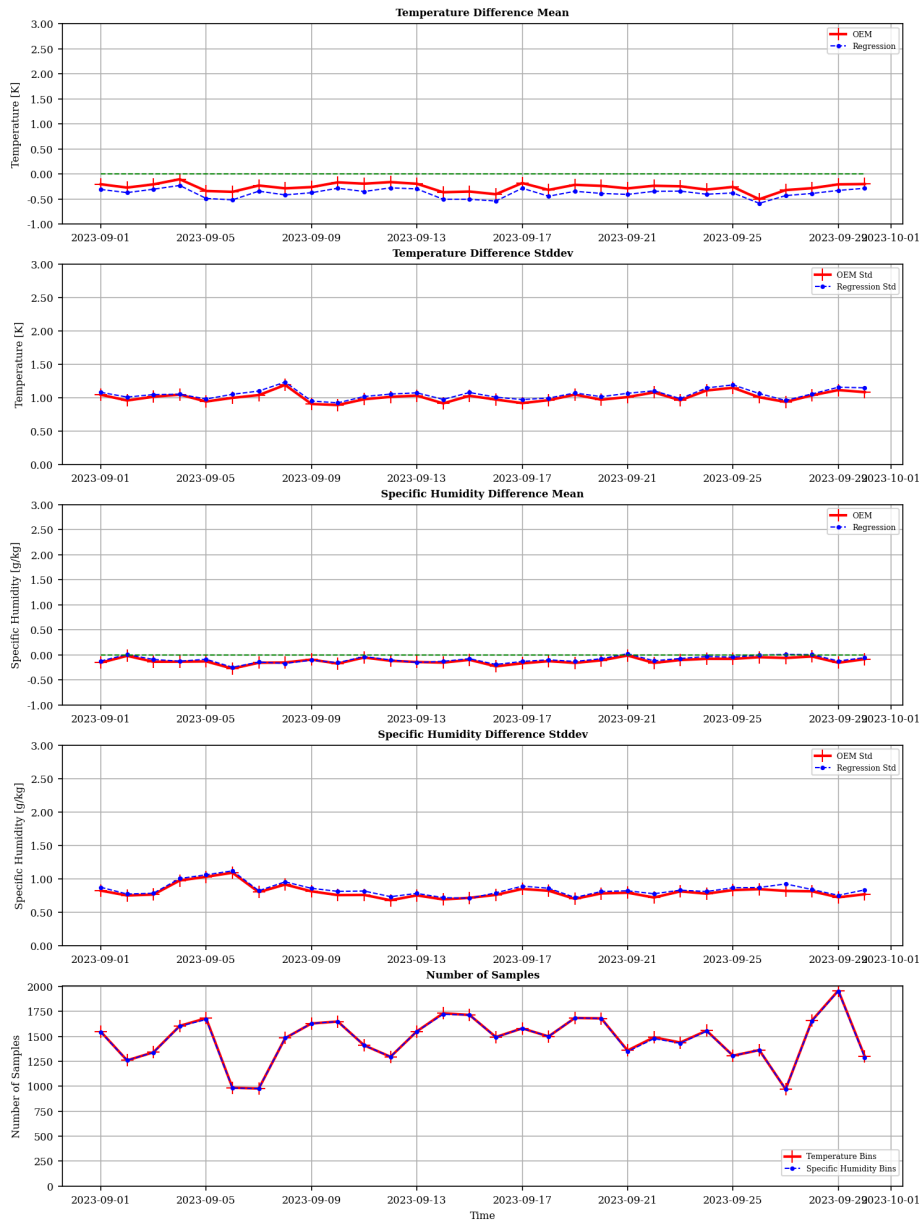


Figure 2.13: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 600 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.7 Level: 800 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [800.0 hPa]
 [2023-09-01 - 2023-09-30]**

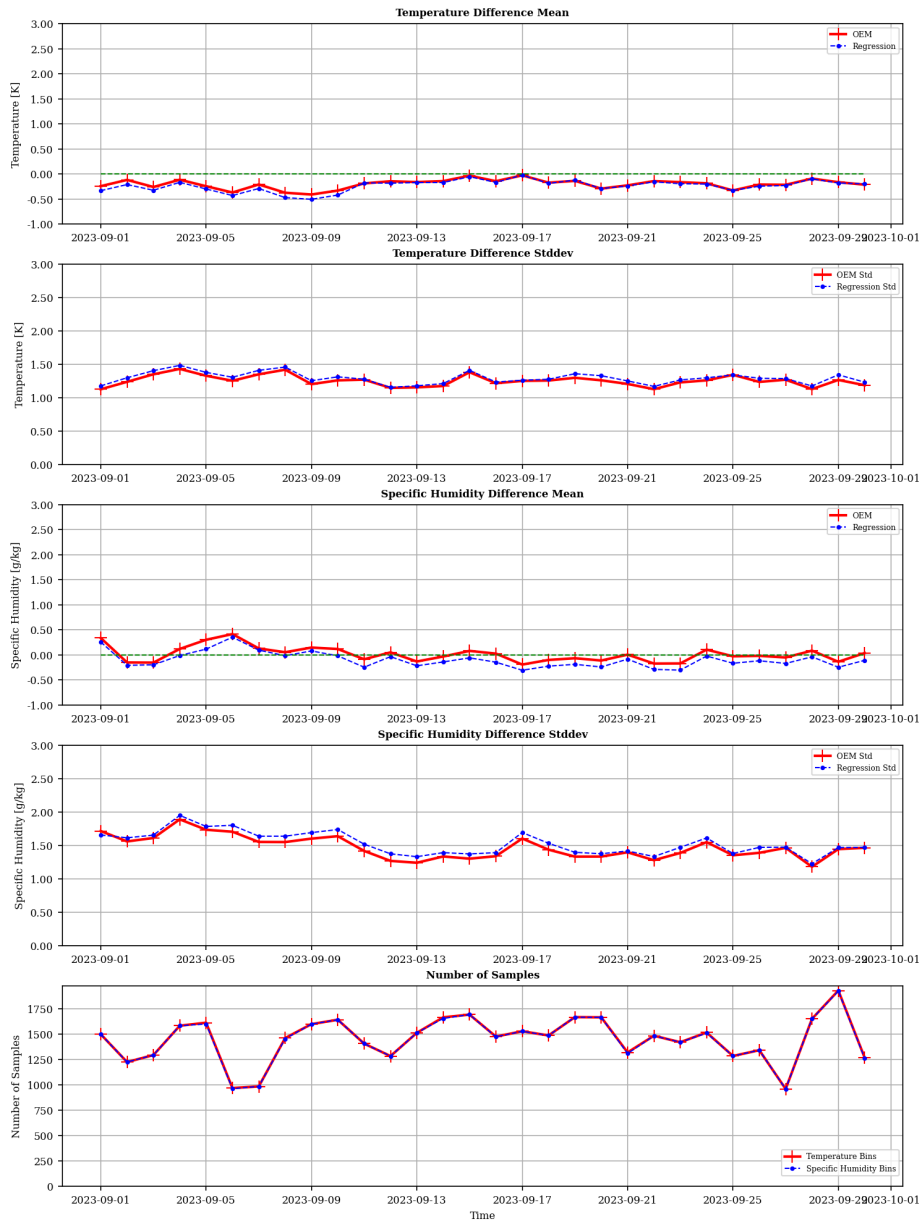


Figure 2.14: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 800 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.1.8 Level: 1000 hPa



GS1 IASI-PFS M03 vs IGRA sondes [1000.0 hPa]
[2023-09-01 - 2023-09-30]

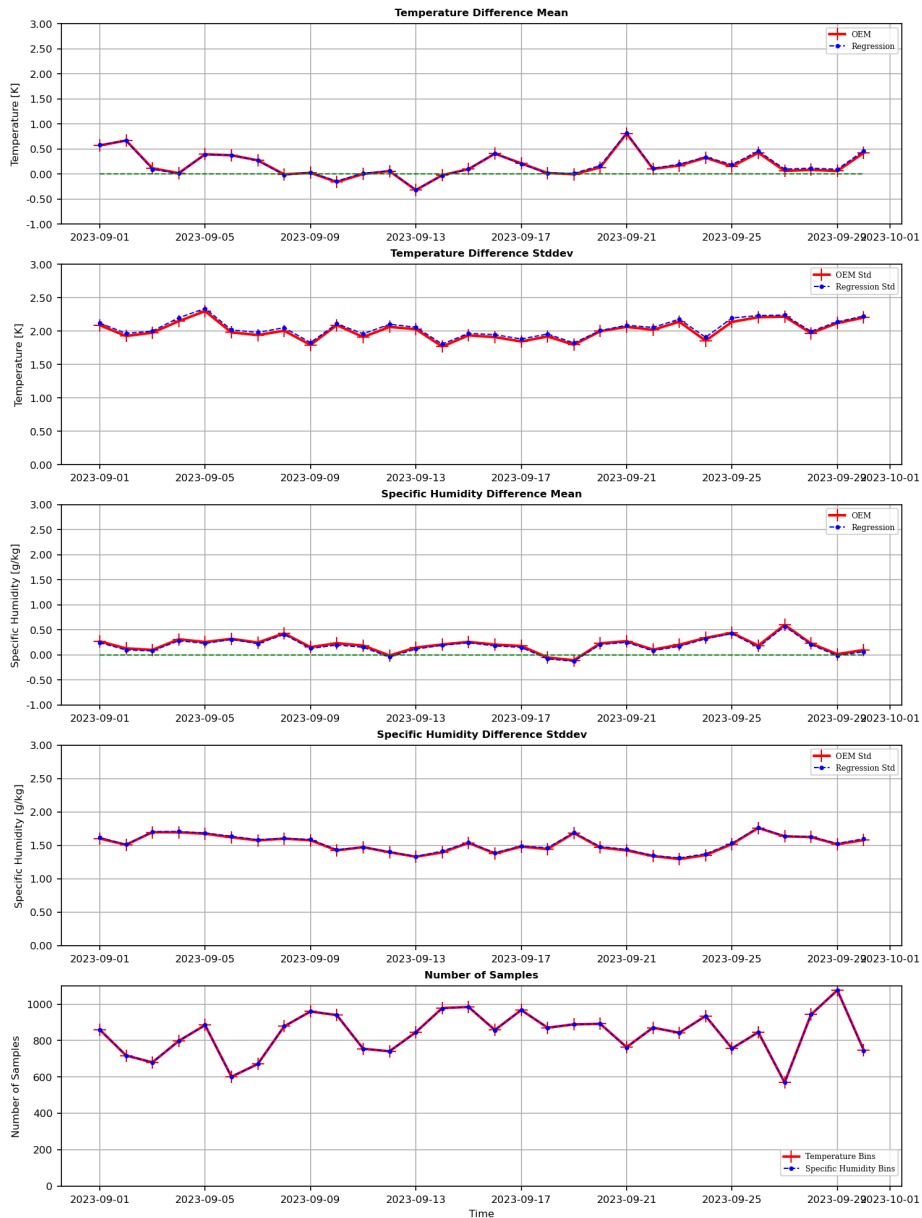


Figure 2.15: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 1000 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.4.2 Precipitable Water



GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water [2023-09-01 - 2023-09-30]

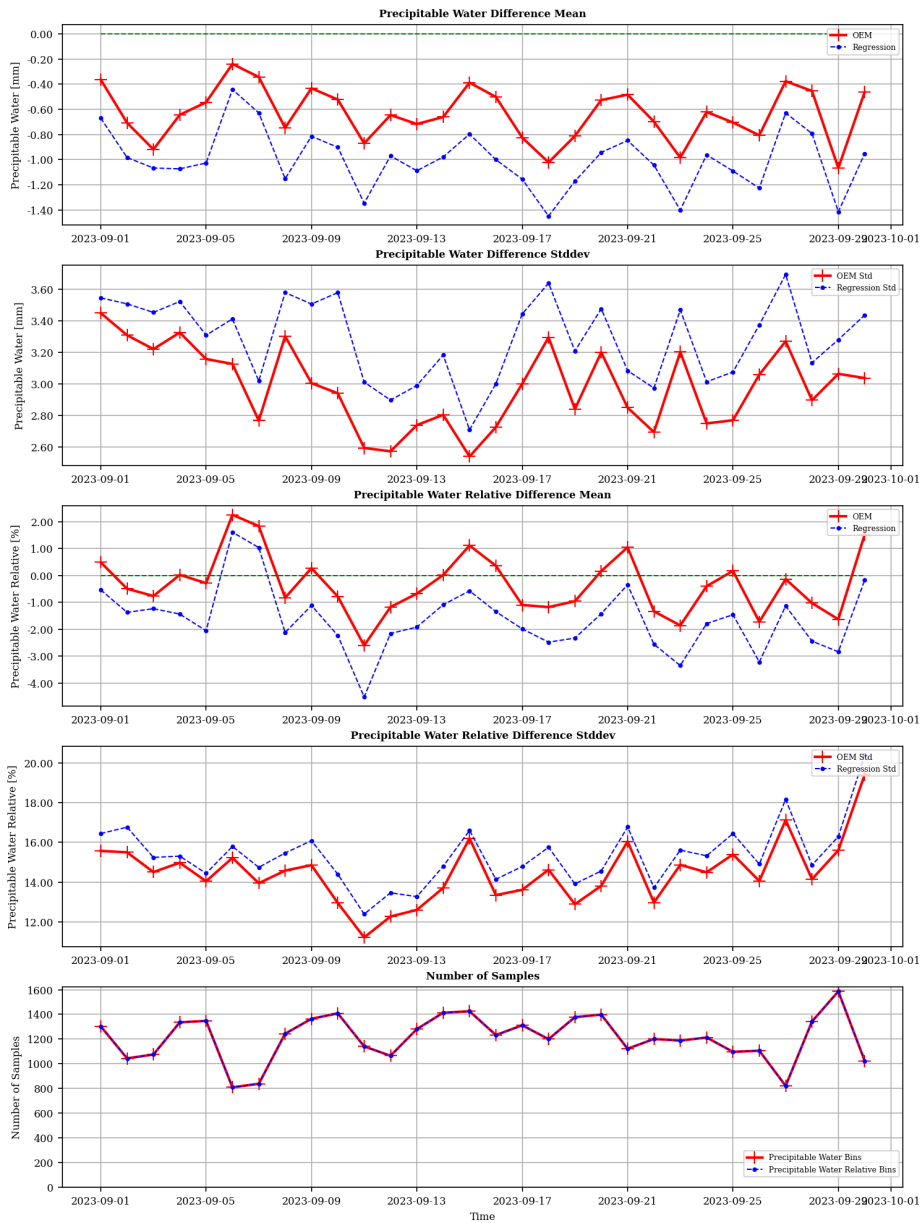


Figure 2.16: Monthly time series of Precipitable Water mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and IGRA. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.5 Long-term time series

2.5.1 Temperature / Humidity

2.5.1.1 Level: 10 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [10.0 hPa]
 [2018-12-12 - 2023-09-30]**

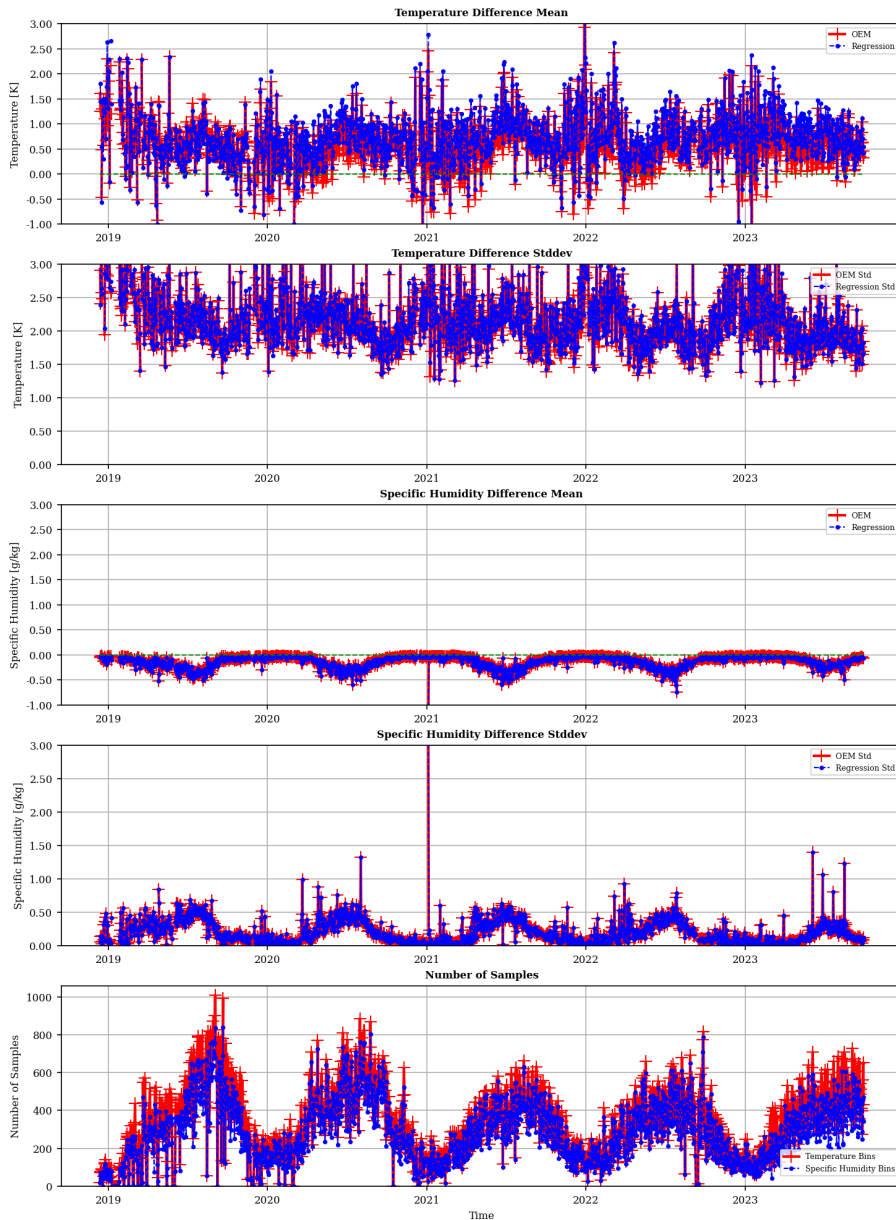


Figure 2.17: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 10 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.2 Level: 100 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [100.0 hPa]
 [2018-12-12 - 2023-09-30]**

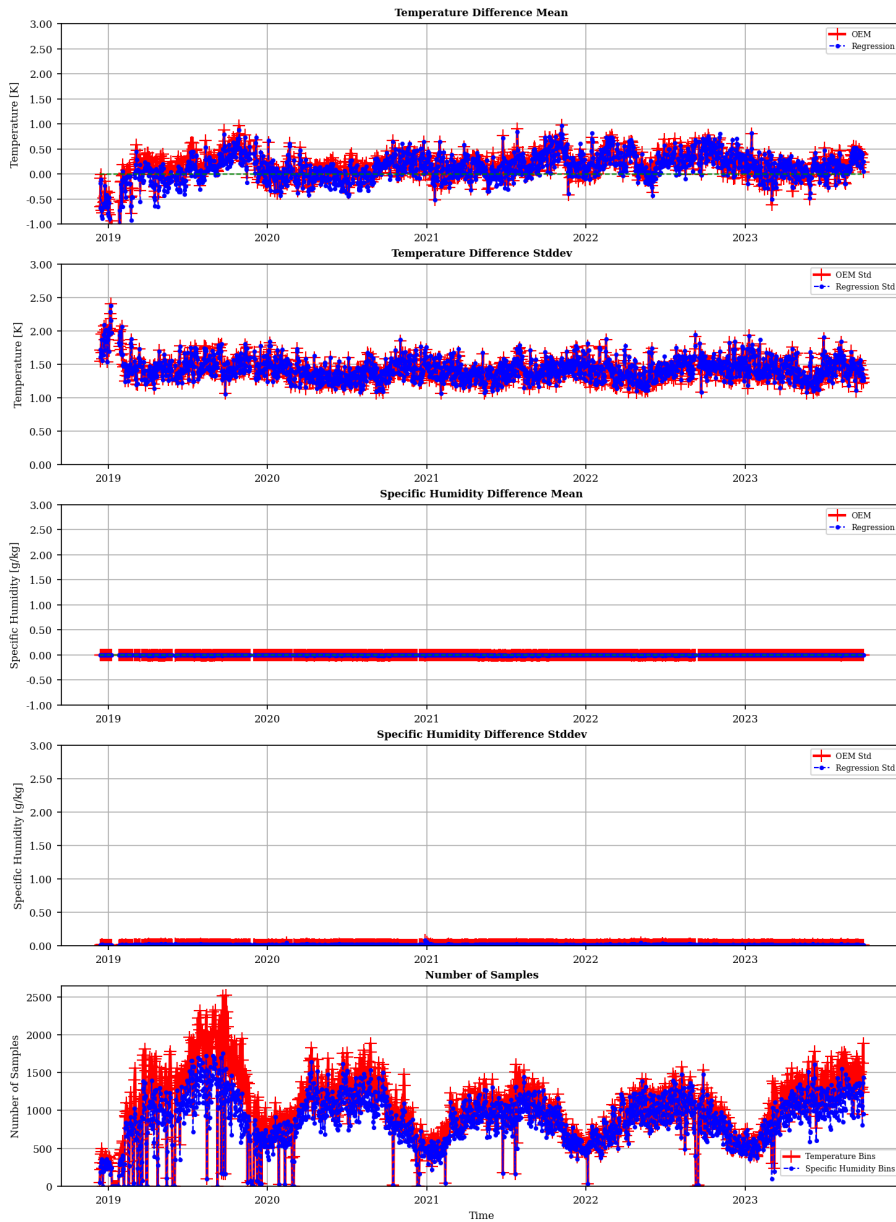


Figure 2.18: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 100 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.3 Level: 200 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [200.0 hPa]
 [2018-12-12 - 2023-09-30]**

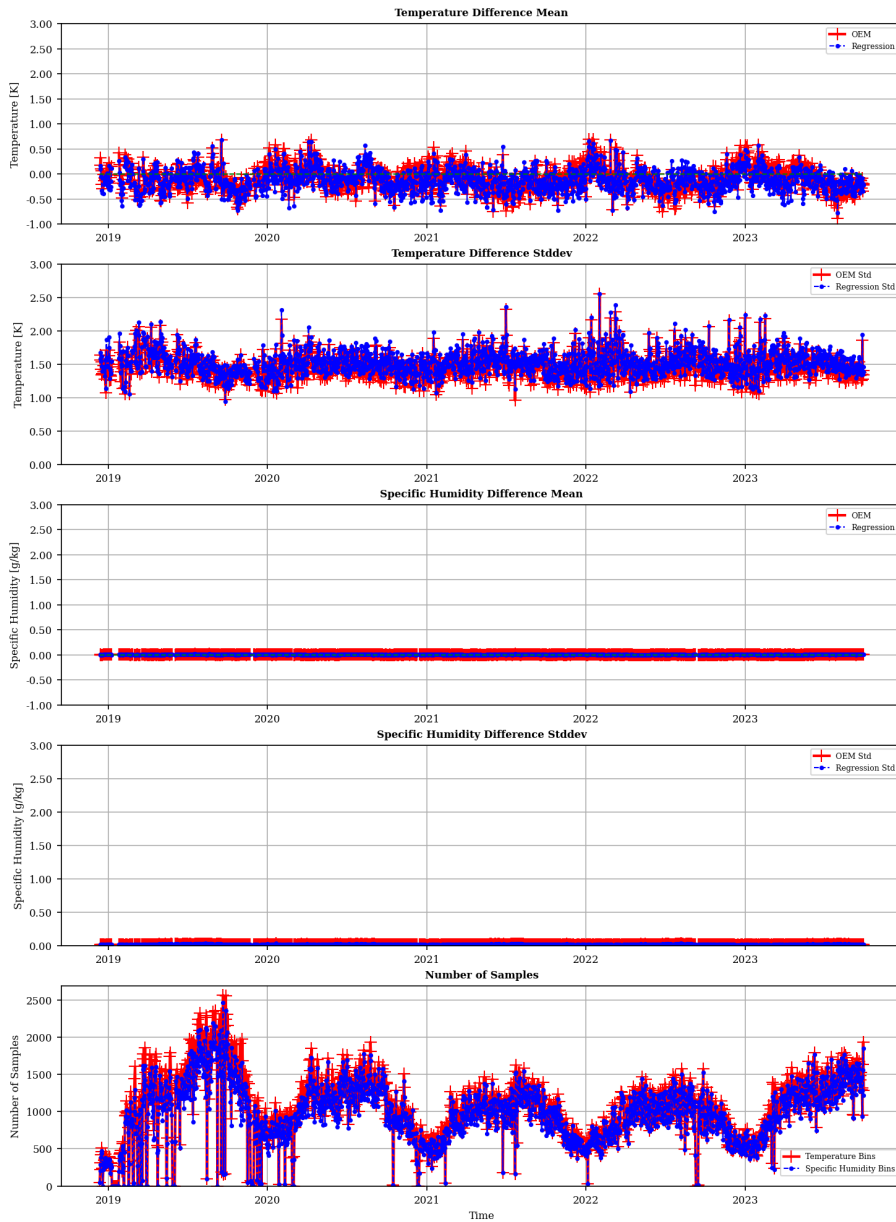


Figure 2.19: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 200 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.4 Level: 300 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [300.0 hPa]
 [2018-12-12 - 2023-09-30]**

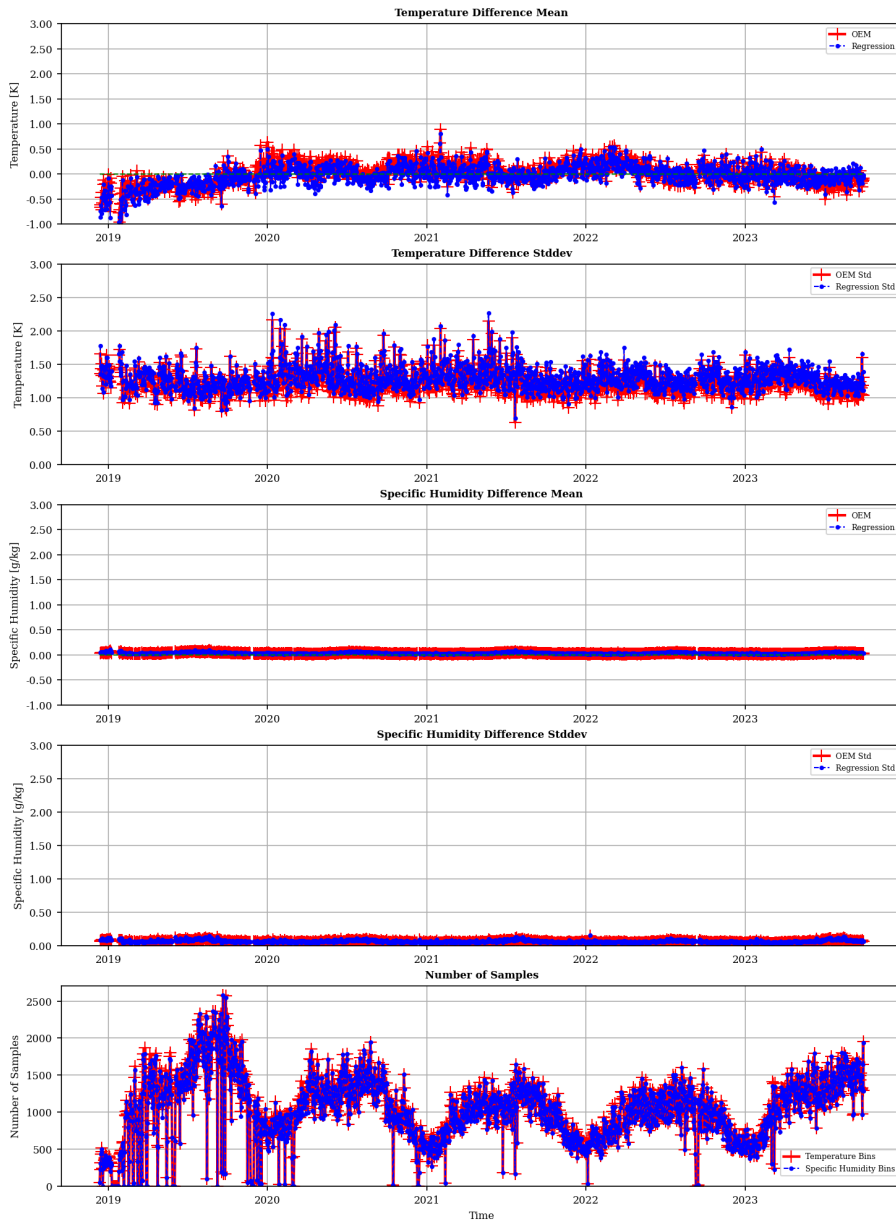


Figure 2.20: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 300 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.5 Level: 500 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [500.0 hPa]
 [2018-12-12 - 2023-09-30]**

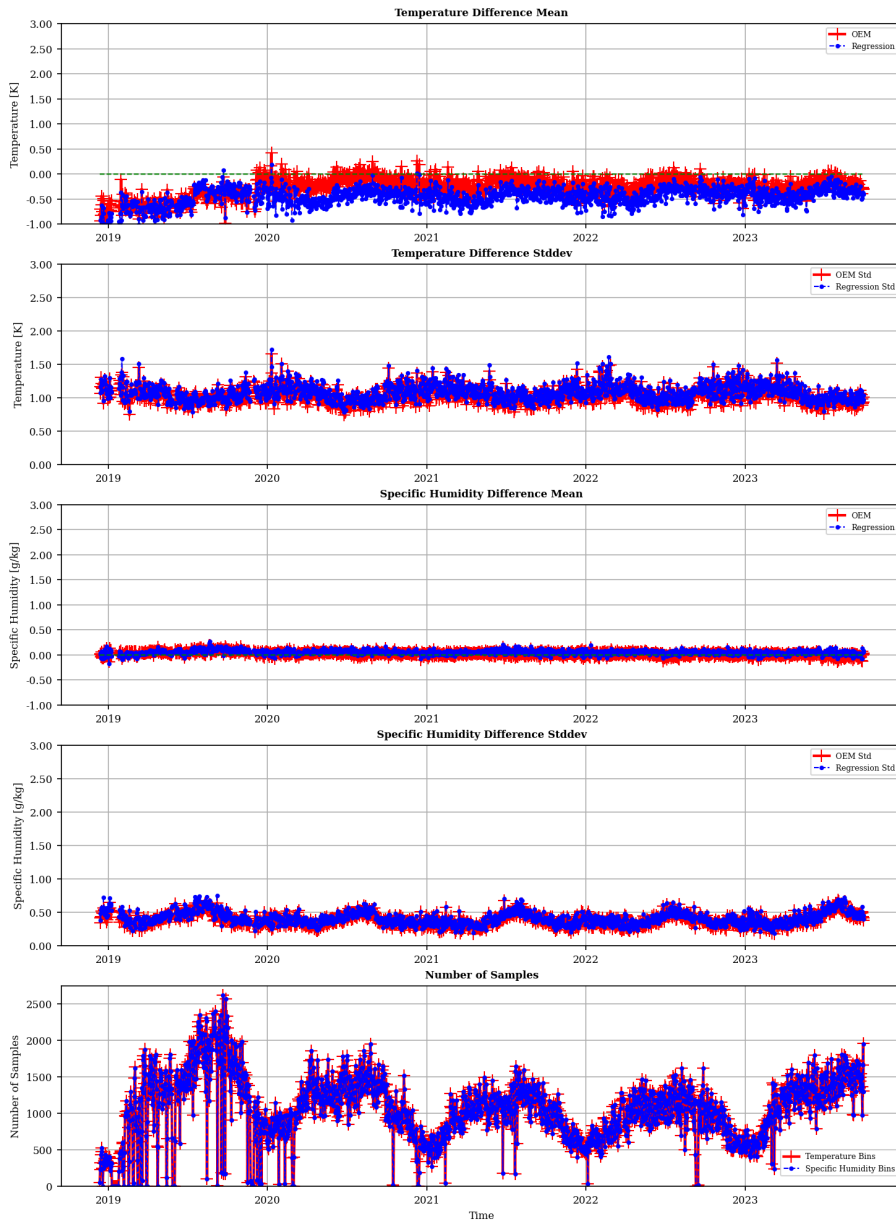


Figure 2.21: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 500 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.6 Level: 600 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [600.0 hPa]
 [2018-12-12 - 2023-09-30]**

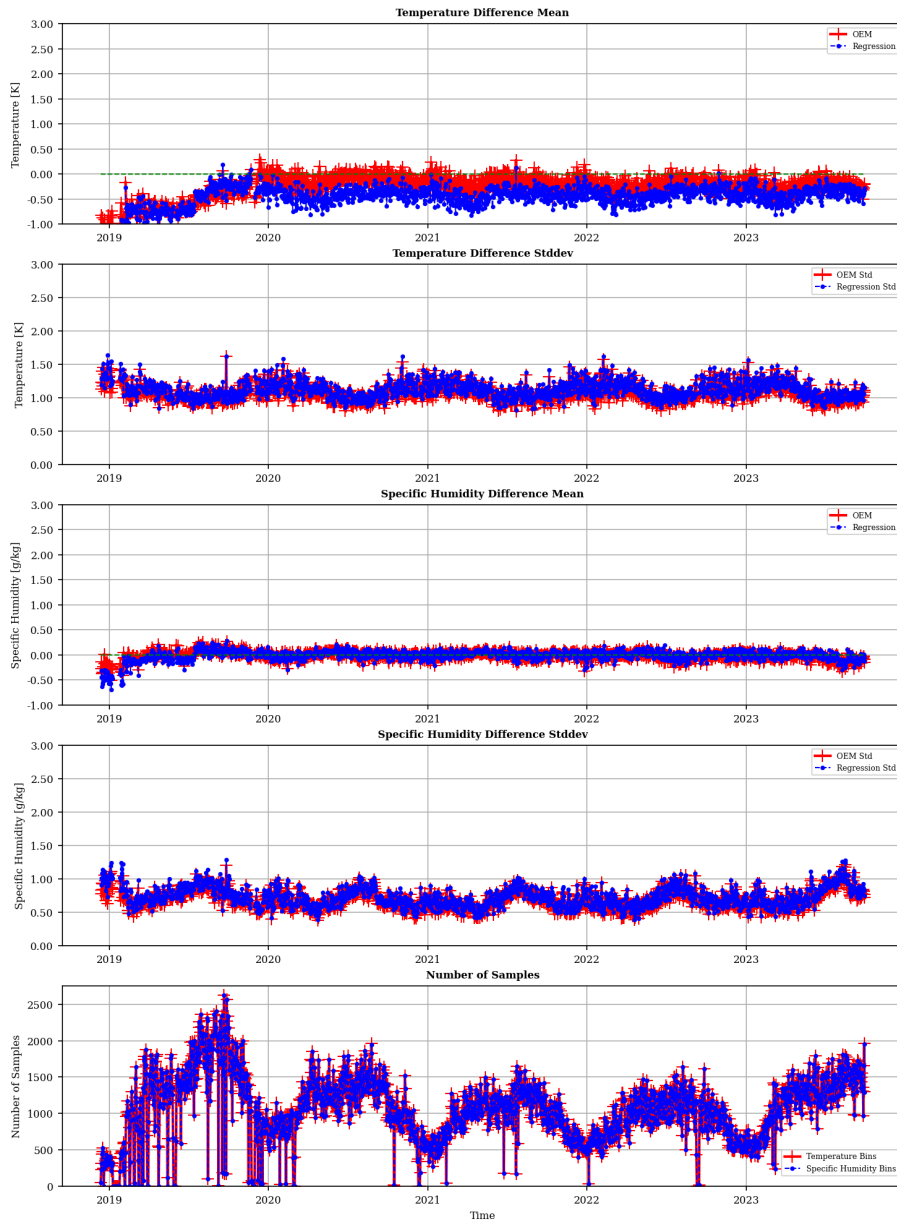


Figure 2.22: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 600 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.7 Level: 800 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [800.0 hPa]
 [2018-12-12 - 2023-09-30]**

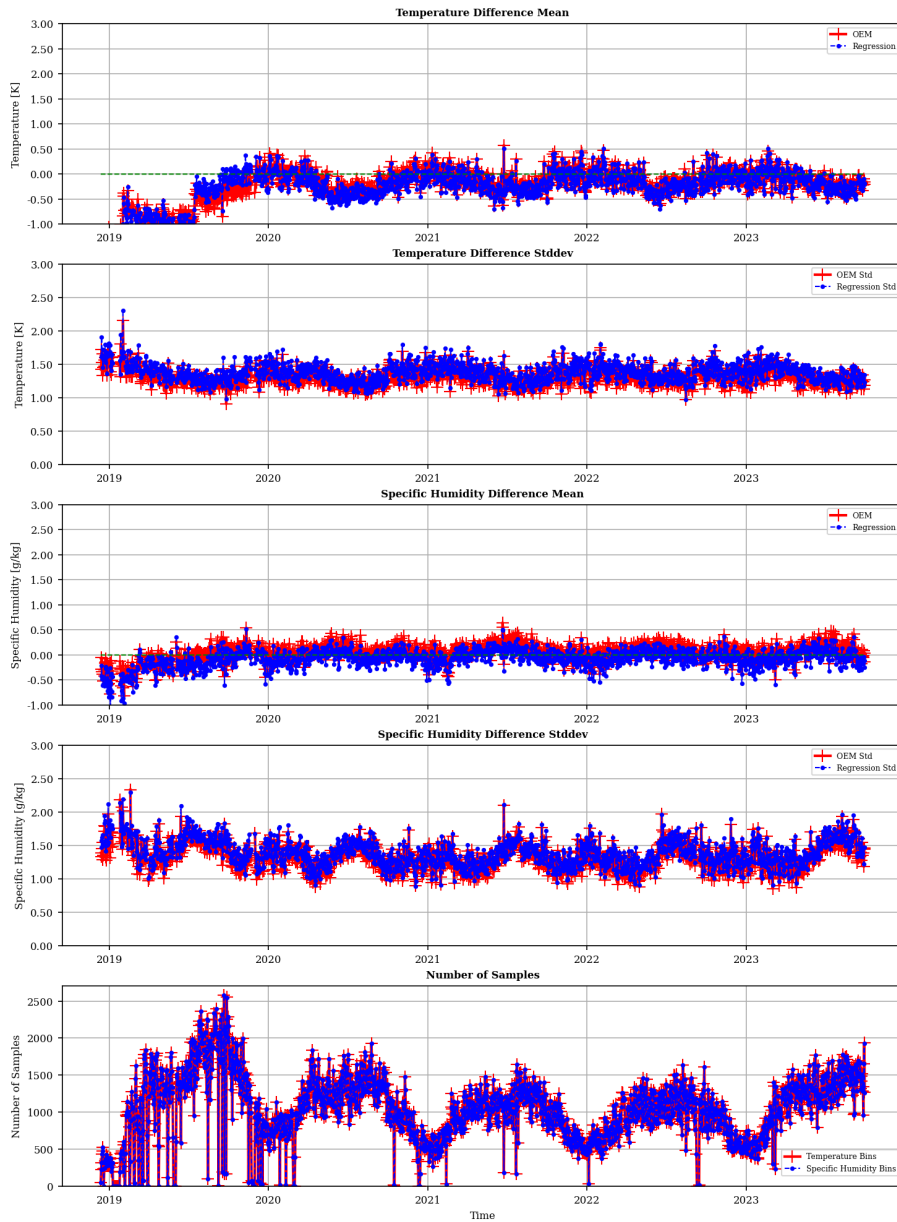


Figure 2.23: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 800 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.1.8 Level: 1000 hPa



**GS1 IASI-PFS M03 vs IGRA sondes [1000.0 hPa]
 [2018-12-12 - 2023-09-30]**

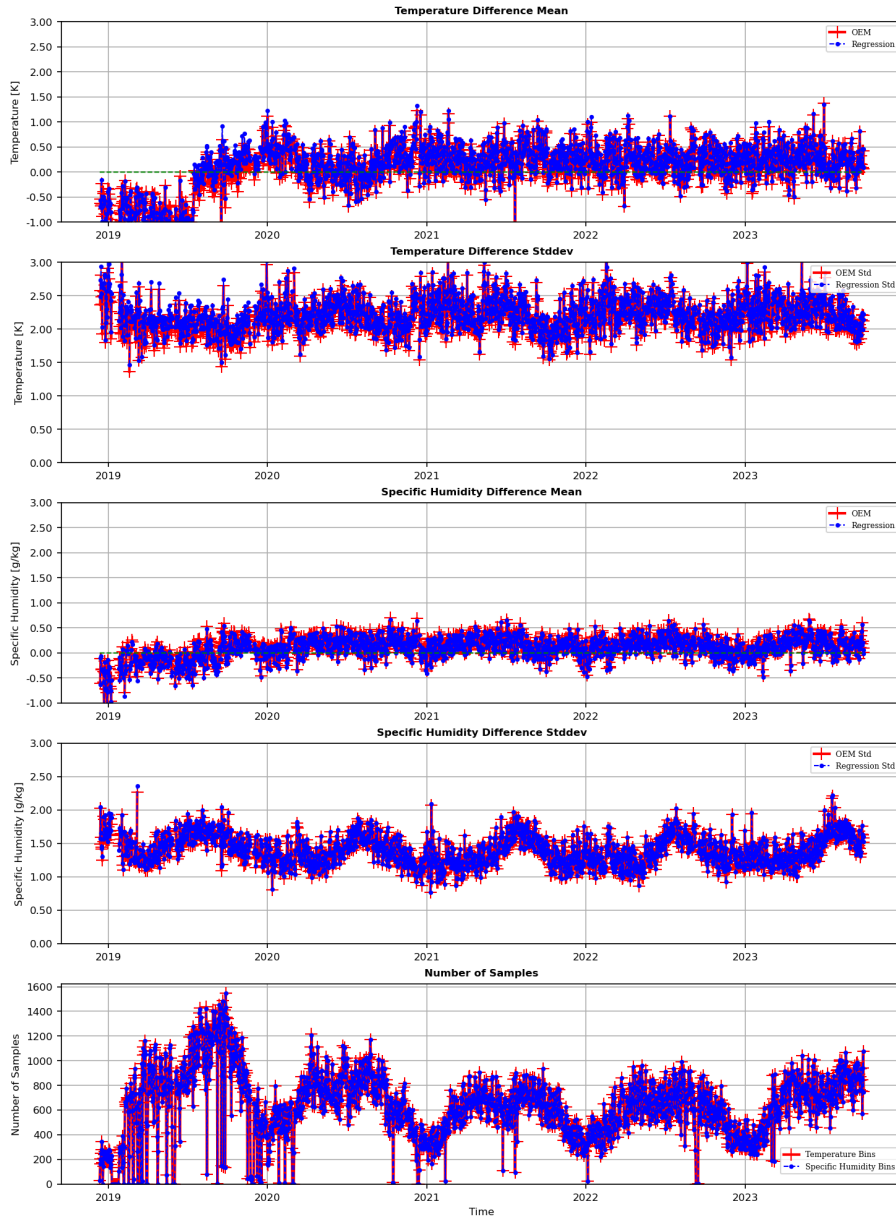


Figure 2.24: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 1000 hPa. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 updated on 30/09/2023

2.5.2 Precipitable Water



**GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water
 [2018-12-12 - 2023-09-30]**

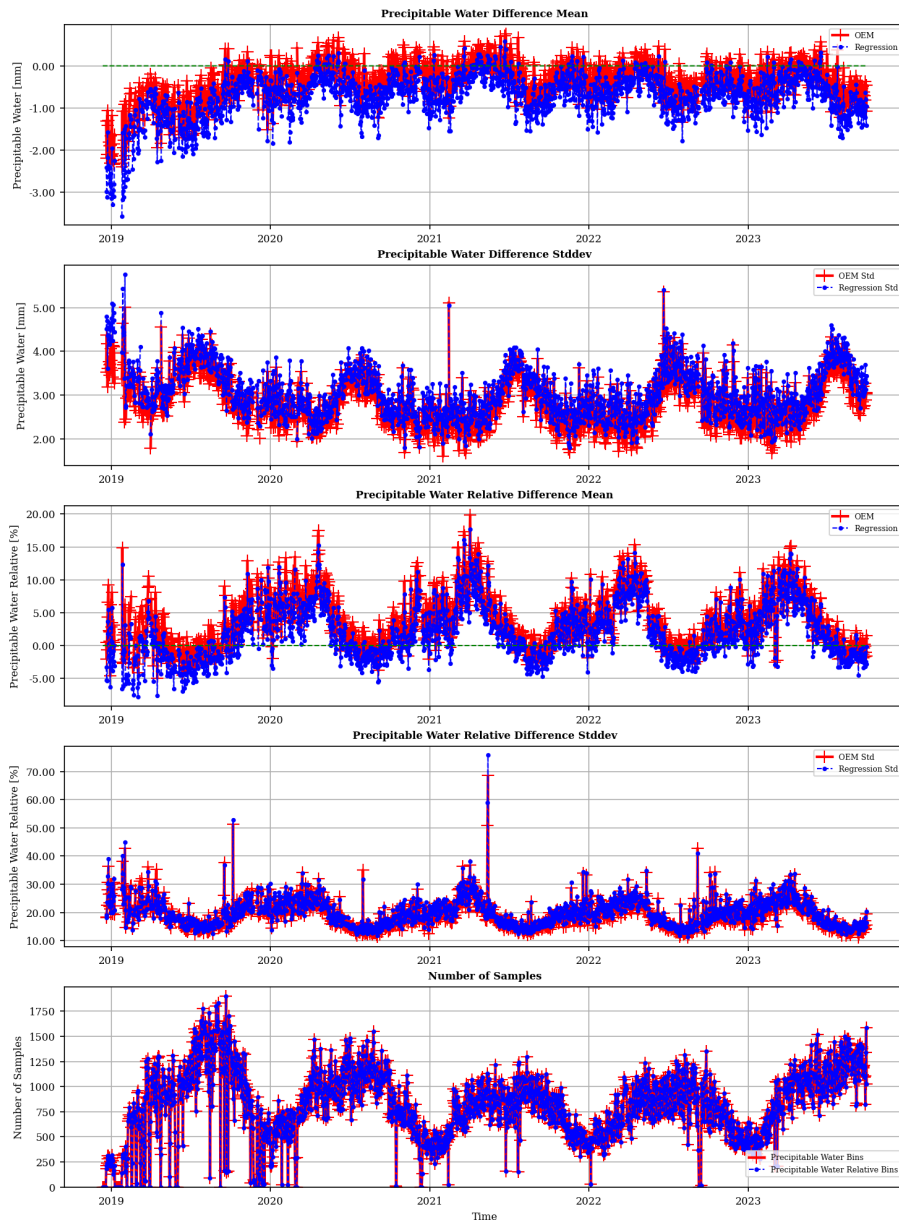


Figure 2.25: Long-term time series of Precipitable Water mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and IGRA. The bottom panel shows the number of Monthly match-ups. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023

2.6 Histograms

2.6.1 Moist adiabatic lapse rate

2.6.1.1 Layer: 1500m above Surface

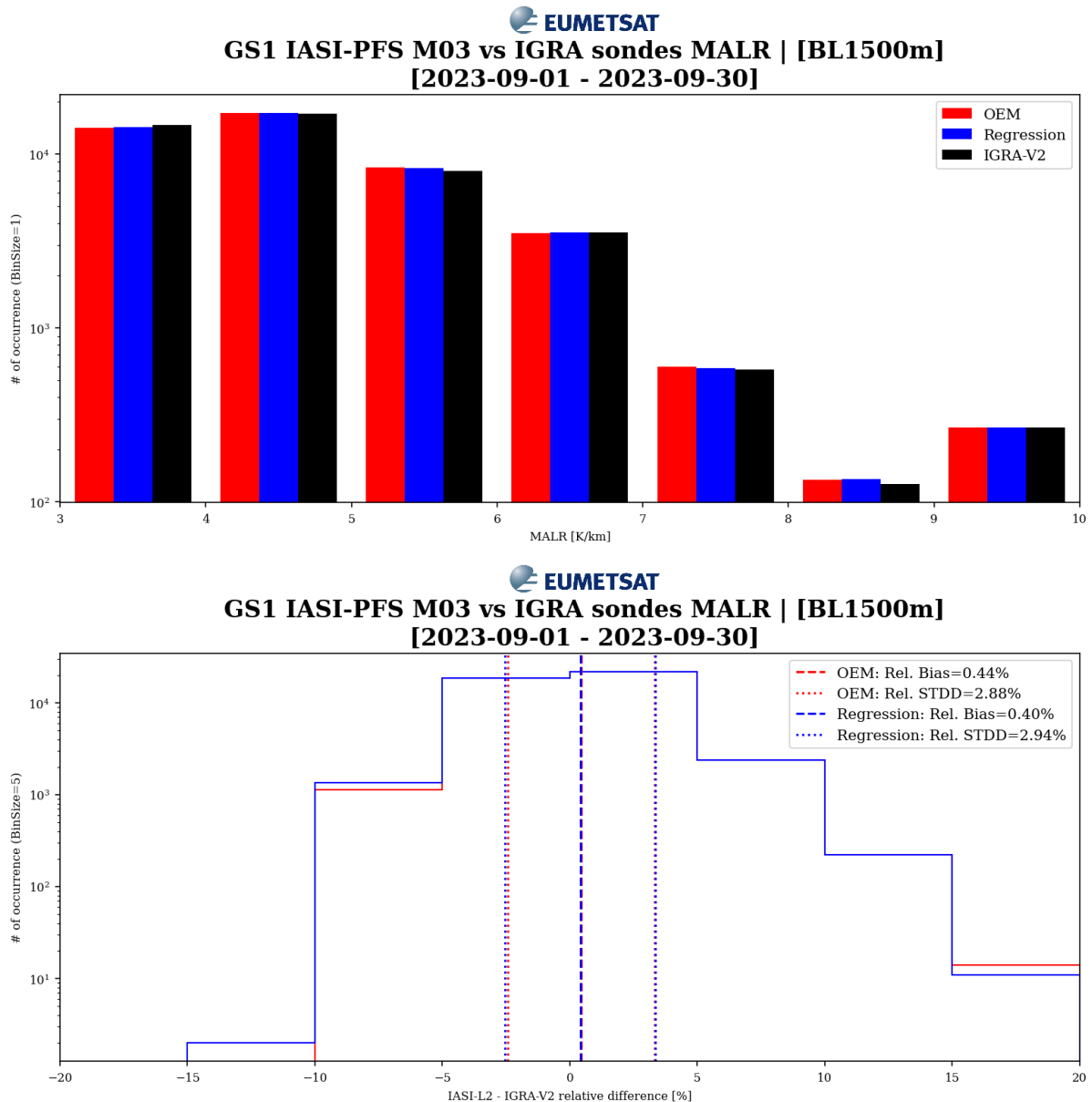


Figure 2.26: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) Histograms as barcharts in absolute units (top) and relative differences (bottom) between IASI L2 and IGRA (ylog). Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

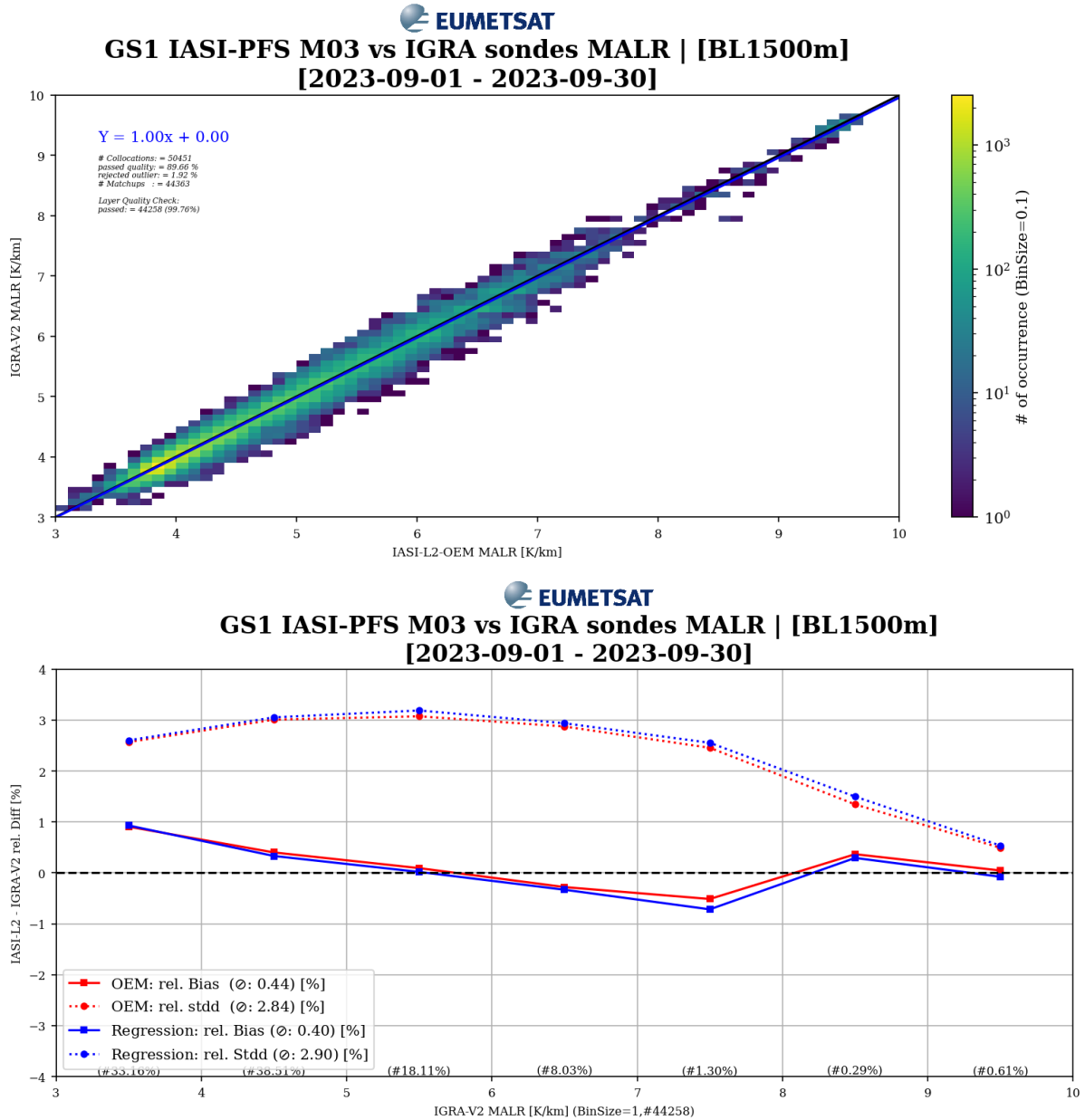


Figure 2.27: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) 2D-Histogram (top) and bias and standard deviation as per pre-defined bins of the IGRA reference (bottom) between IASI L2 and IGRA measurements. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

2.6.1.2 Layer: 850 - 500 hPa

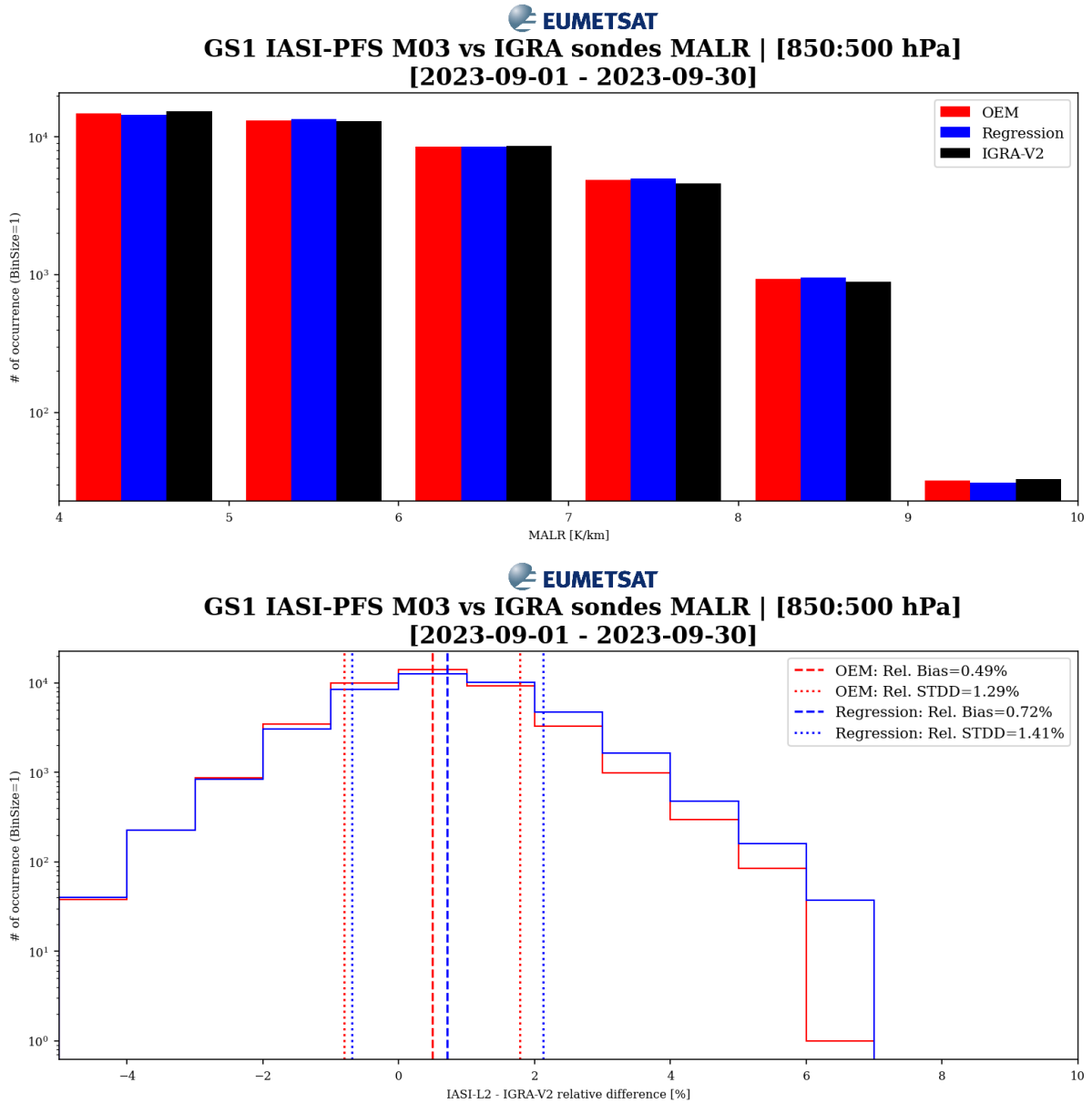


Figure 2.28: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) Histograms as barcharts in absolute units (top) and relative differences (bottom) between IASI L2 and IGRA (ylog). Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

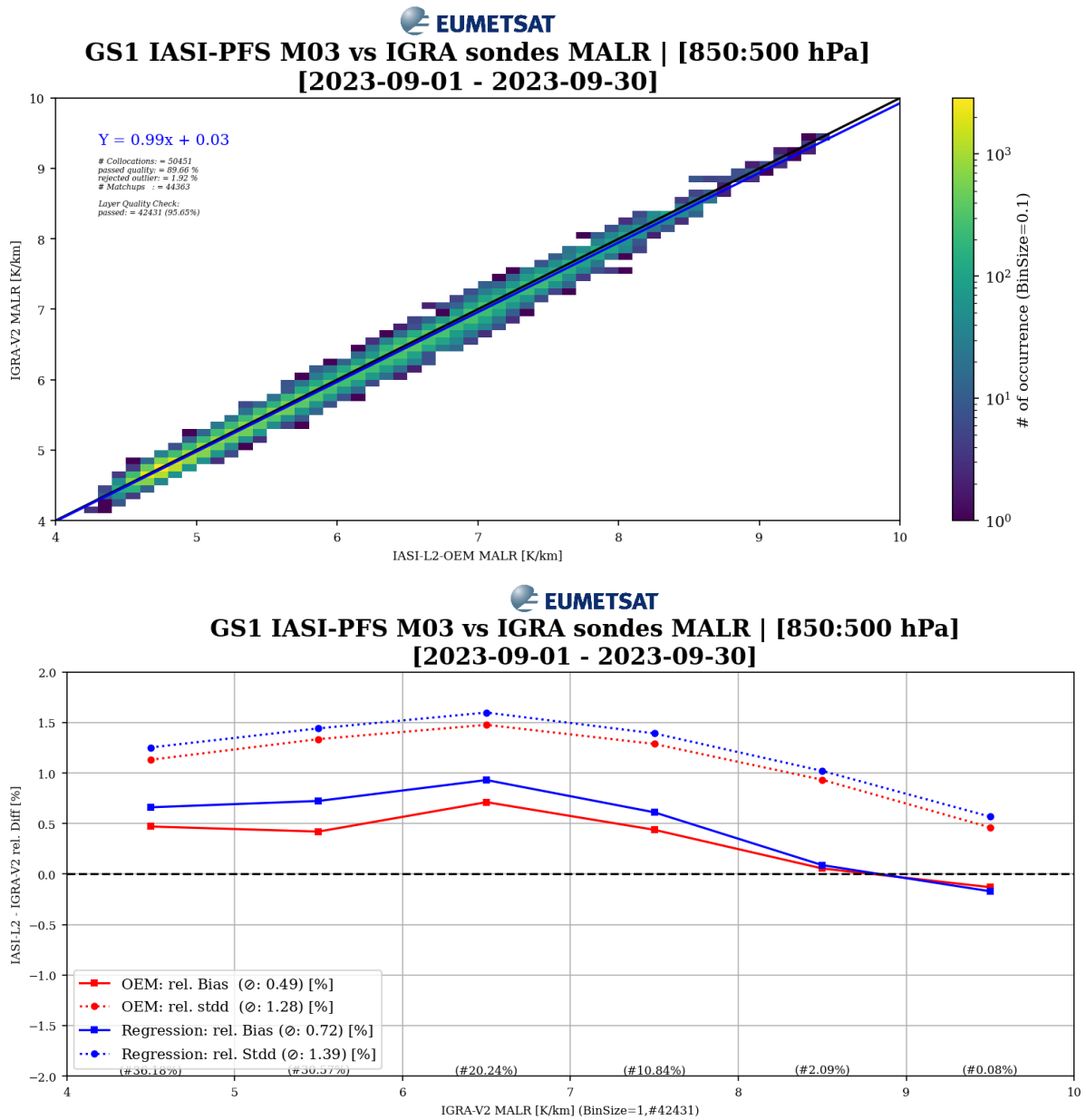


Figure 2.29: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) 2D-Histogram (top) and bias and standard deviation as per pre-defined bins of the IGRA reference (bottom) between IASI L2 and IGRA measurements. Global statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

2.6.2 Precipitable Water

2.6.2.1 Total Column

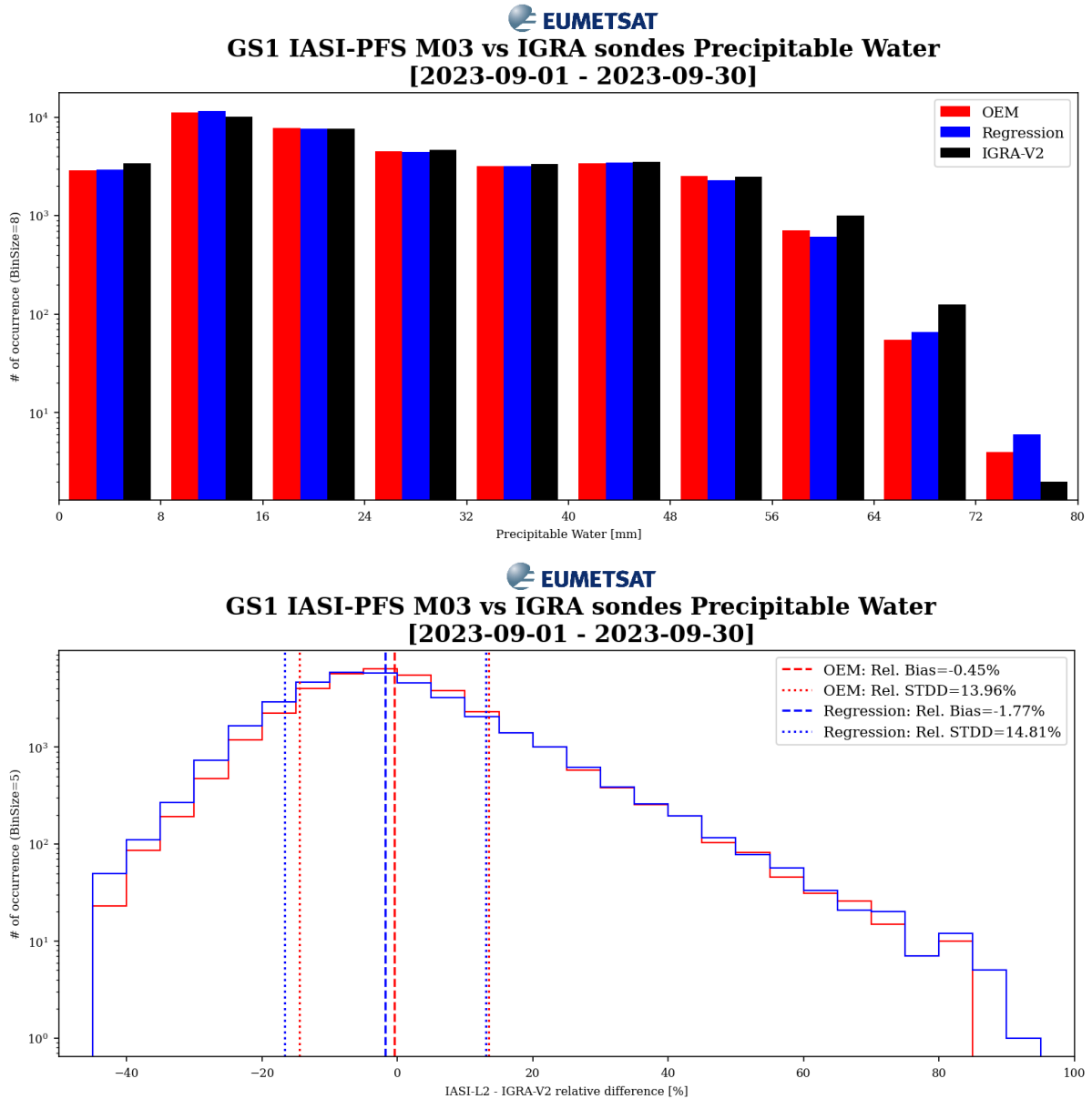


Figure 2.30: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023

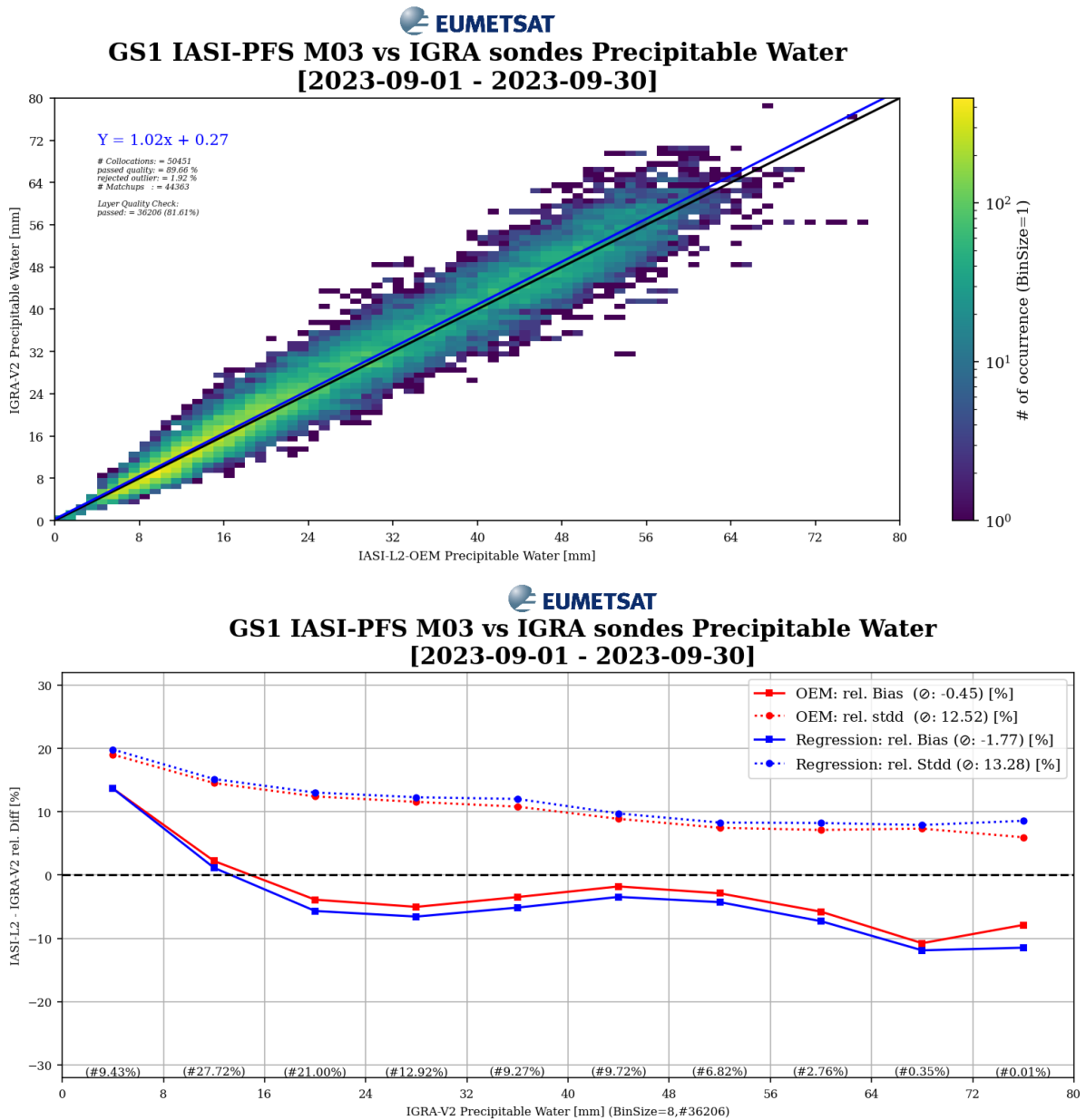


Figure 2.31: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023

2.6.2.2 Layer: 1500m above Surface

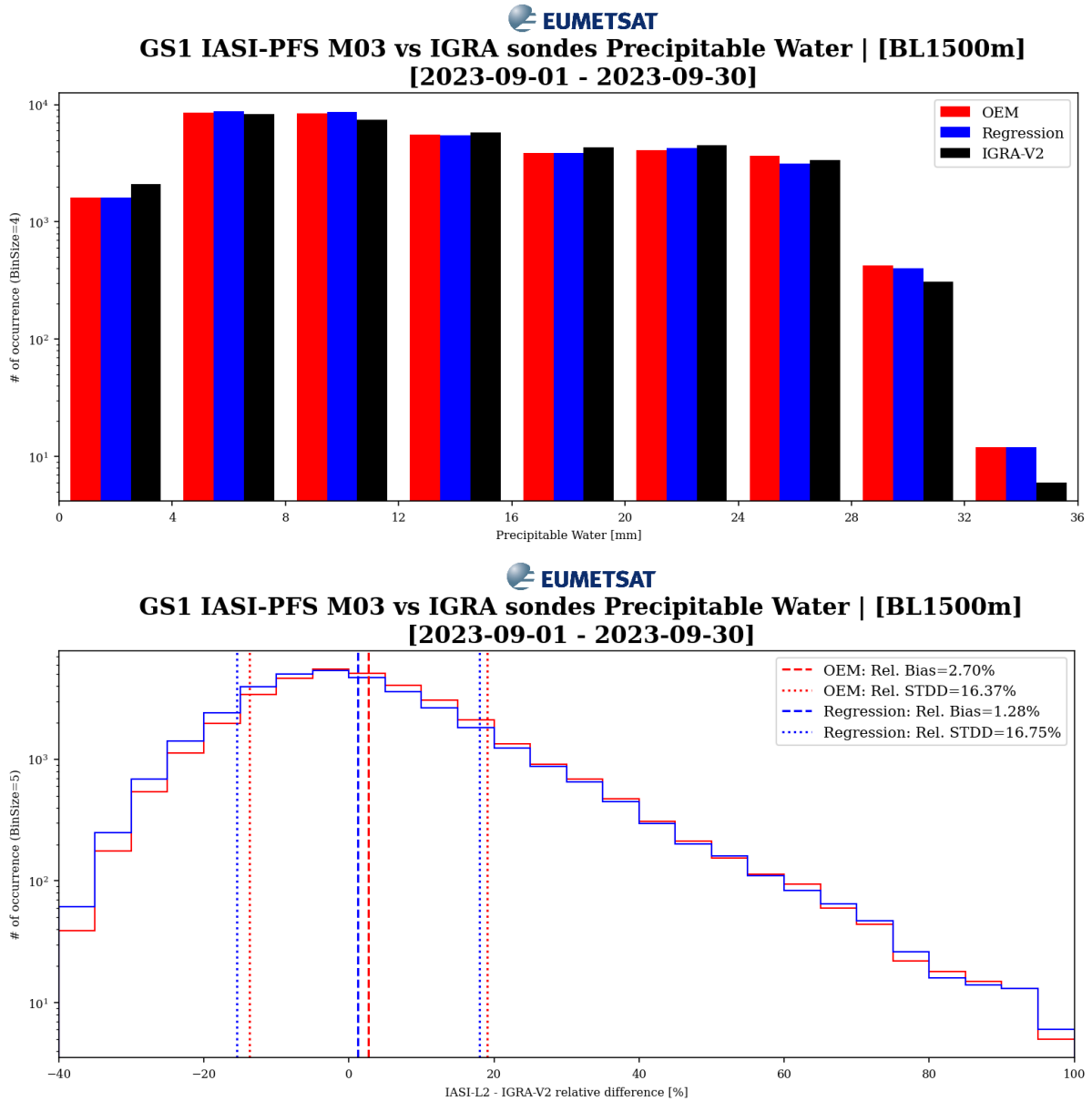
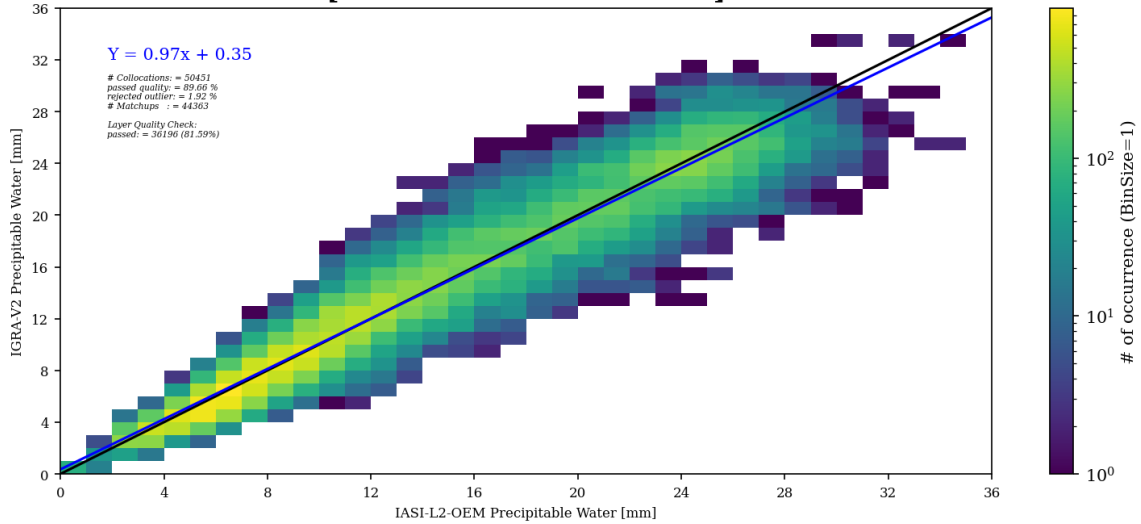


Figure 2.32: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water | [BL1500m]
[2023-09-01 - 2023-09-30]



EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water | [BL1500m]
[2023-09-01 - 2023-09-30]

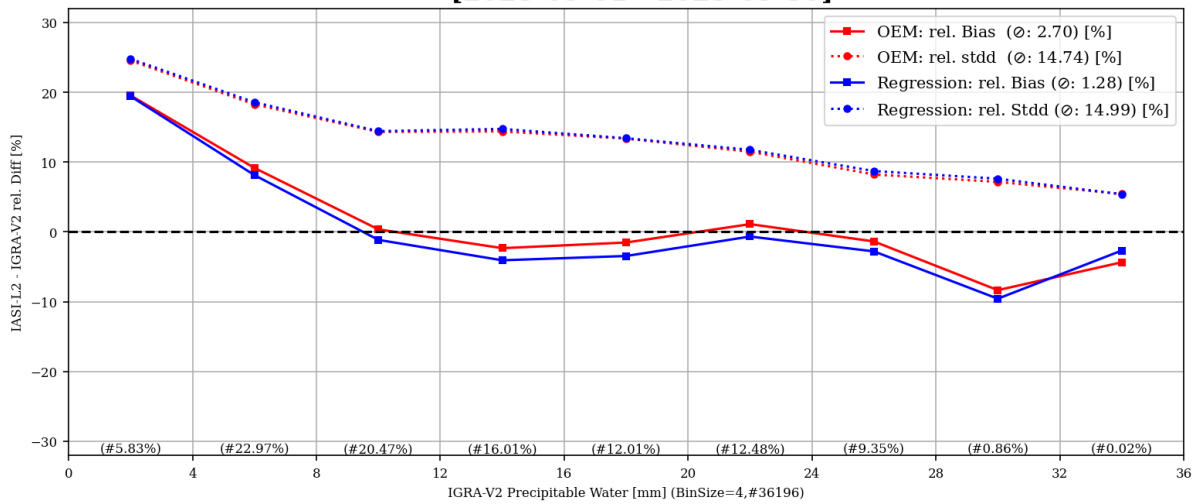


Figure 2.33: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

2.6.2.3 Layer: 850 - 500 hPa

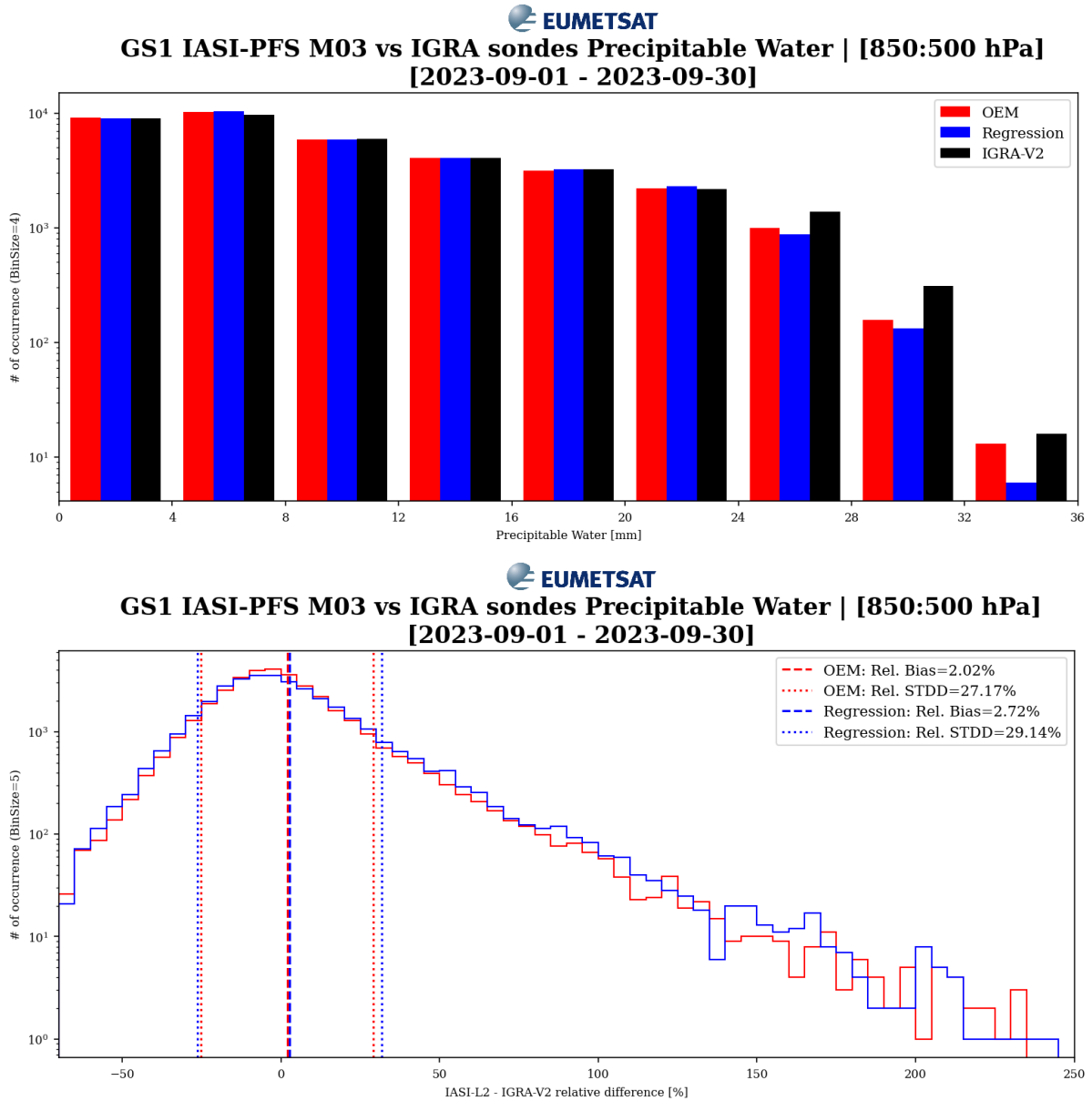
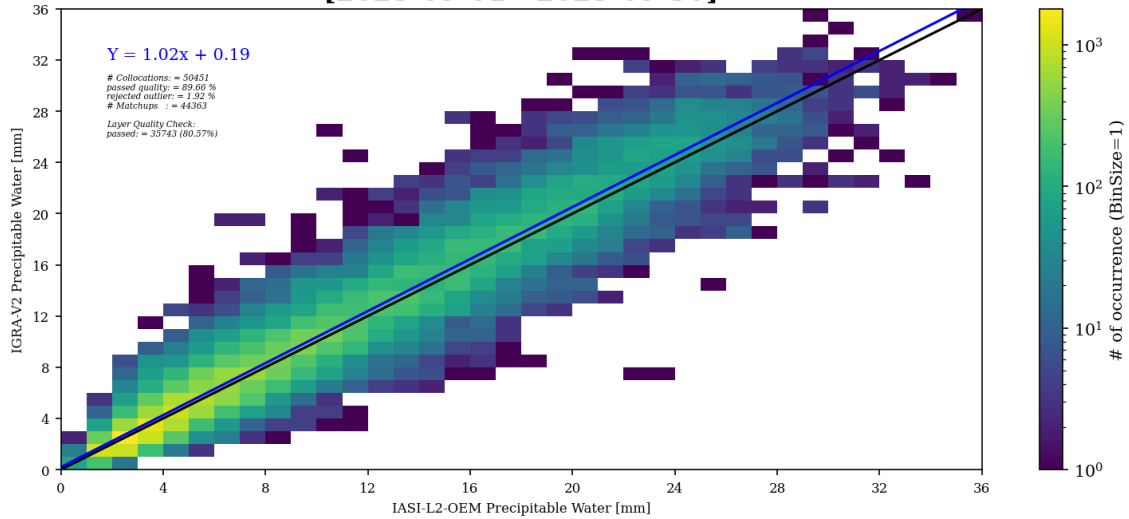


Figure 2.34: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water | [850:500 hPa]
[2023-09-01 - 2023-09-30]



EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Precipitable Water | [850:500 hPa]
[2023-09-01 - 2023-09-30]

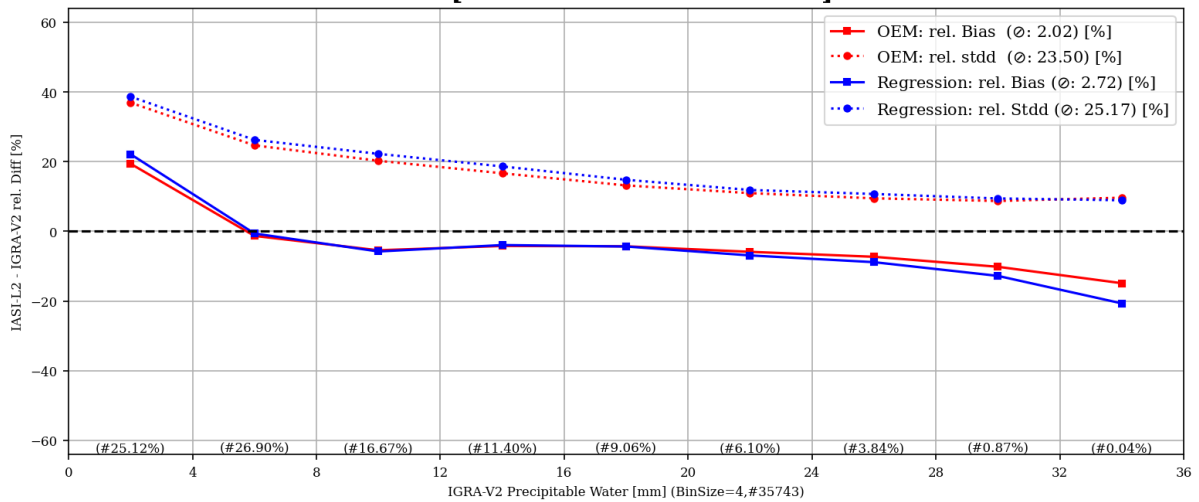


Figure 2.35: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

2.6.2.4 Collocational dependencies

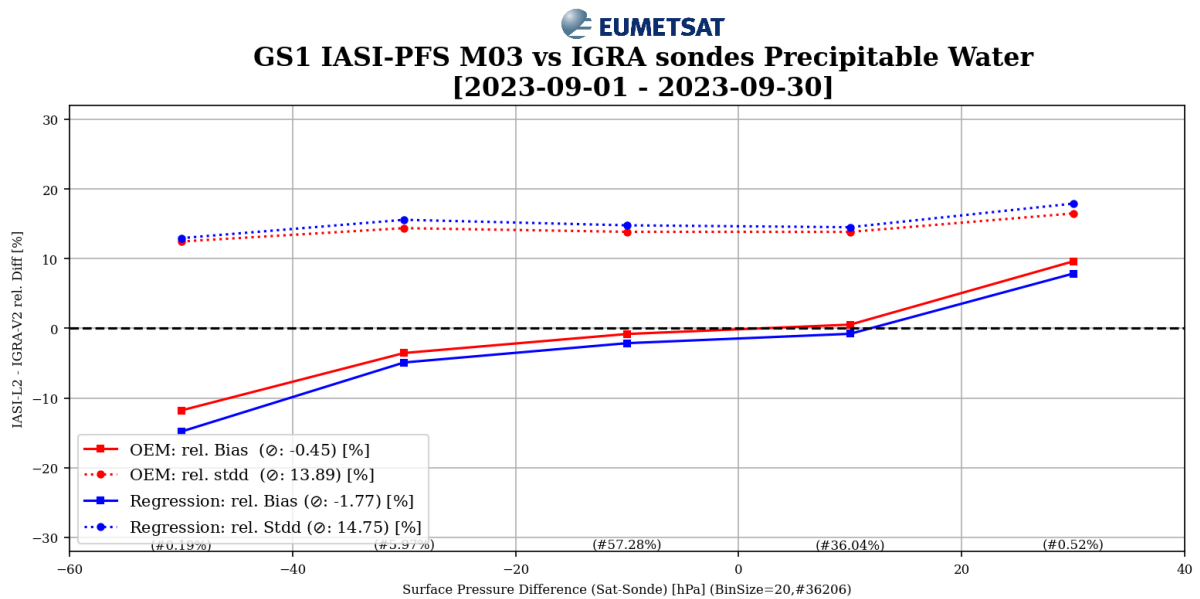
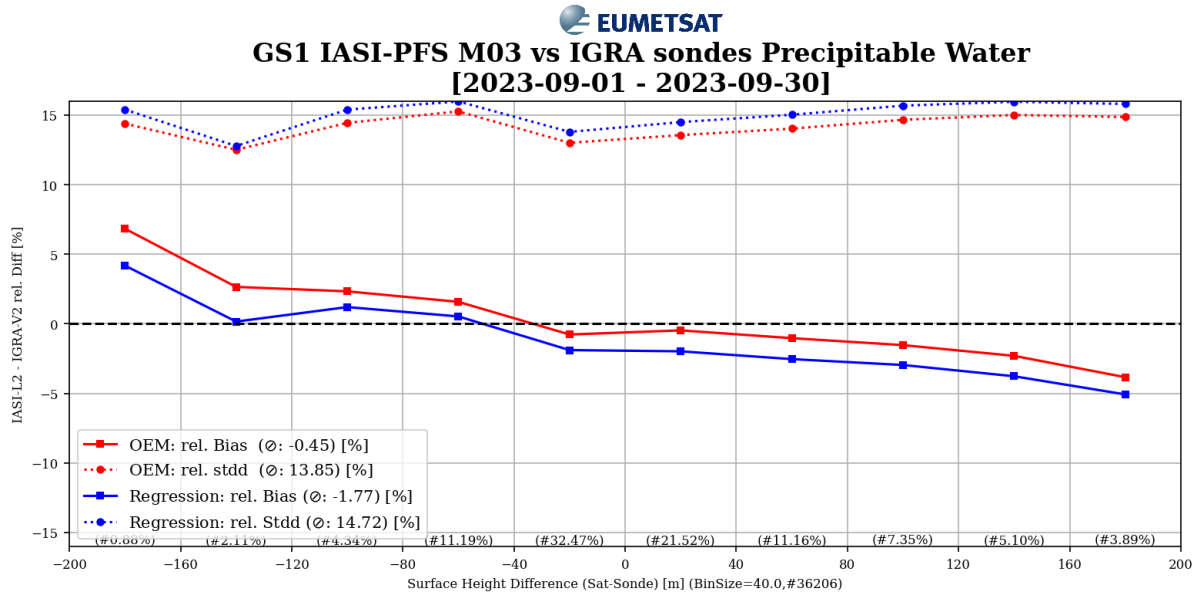


Figure 2.36: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for different surface height (top) and surface pressure differences (bottom).

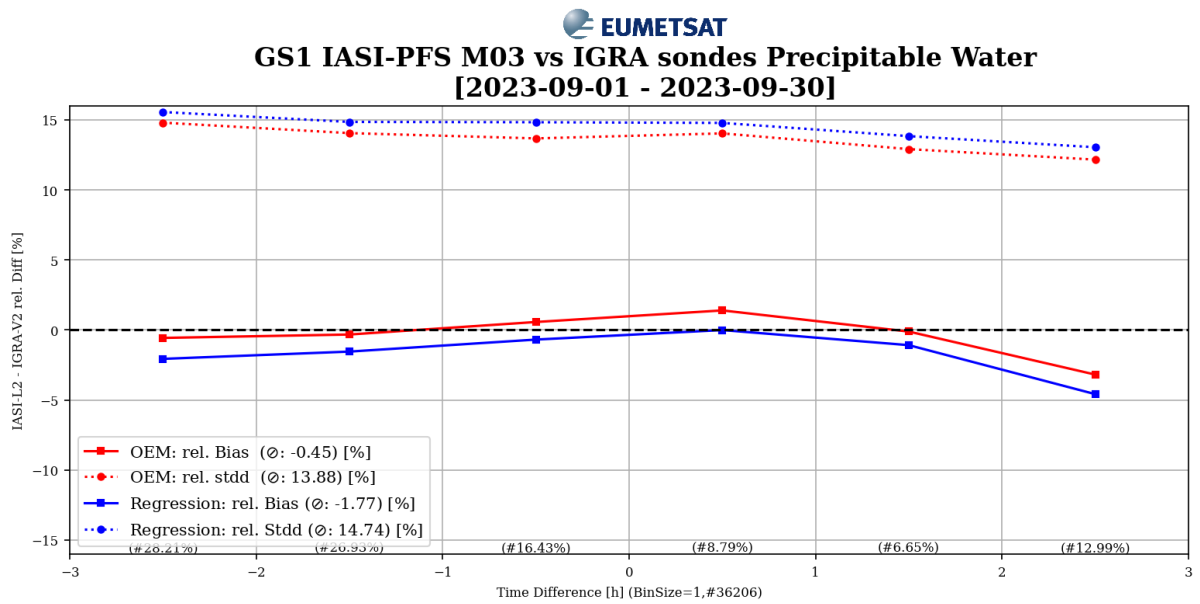
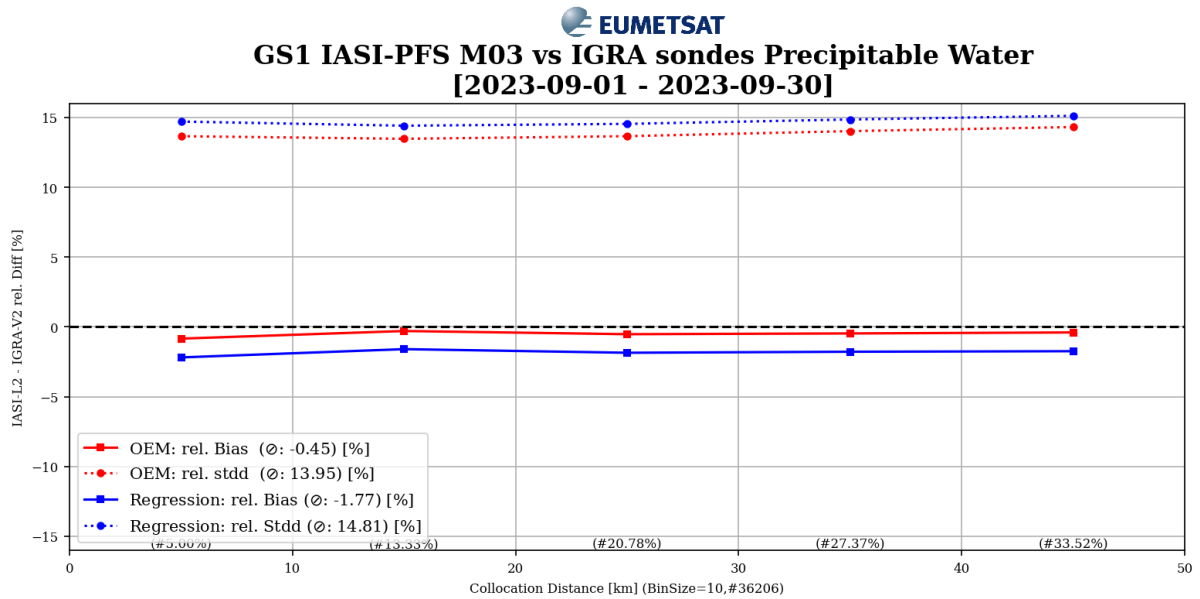


Figure 2.37: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for different collocation spatial distances (top) and temporal differences (bottom).

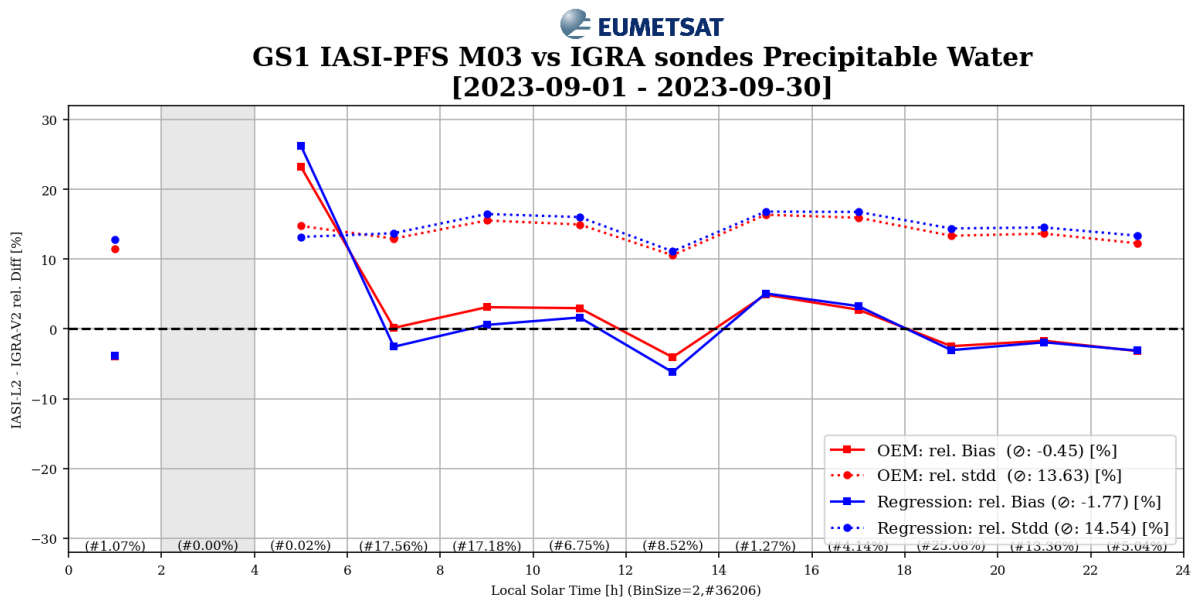
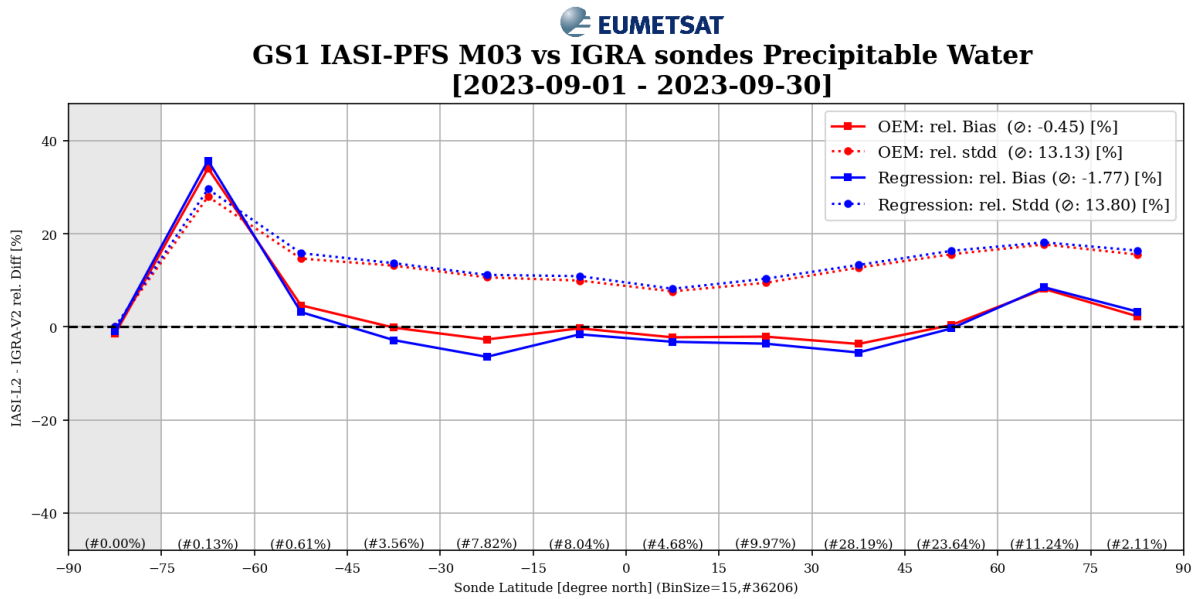


Figure 2.38: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for different latitudes (top) and local solar times (bottom).

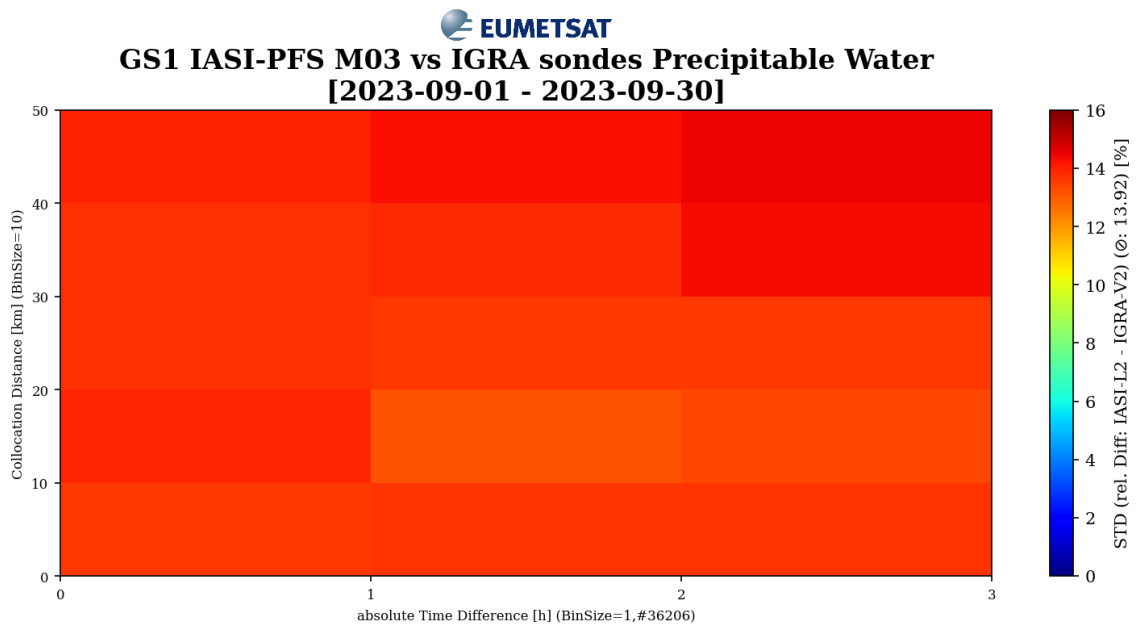
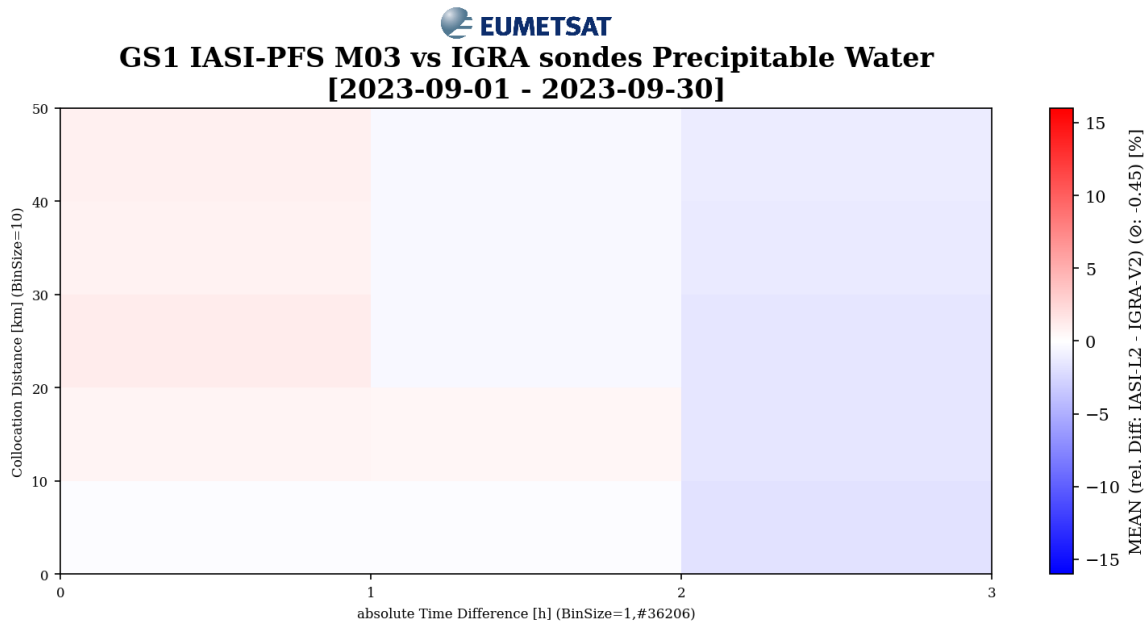


Figure 2.39: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of collocation temporal difference and spatial distances.

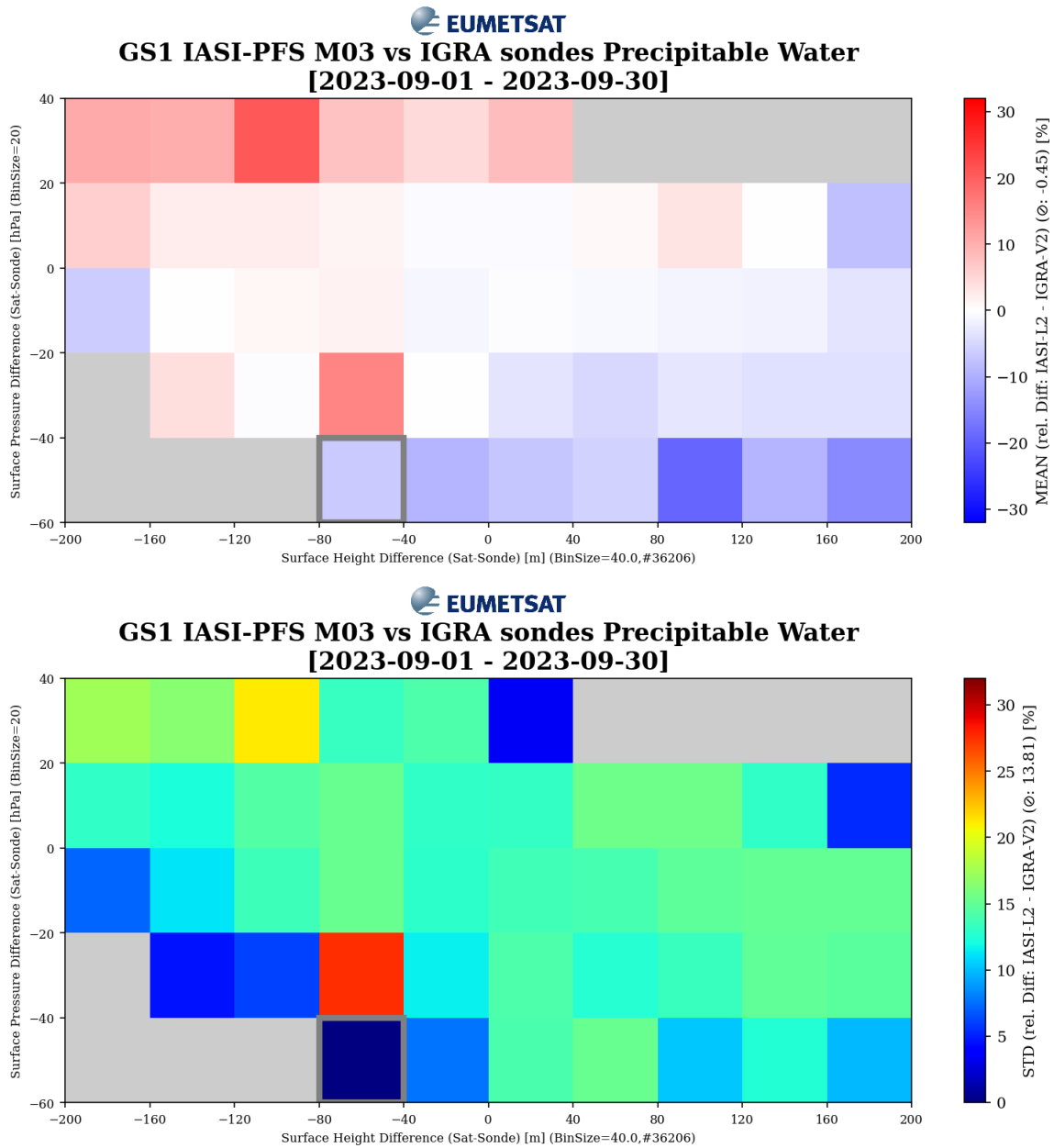


Figure 2.40: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of Surface Pressure Difference and Surface Pressure Difference.

2.6.2.5 Angular dependencies

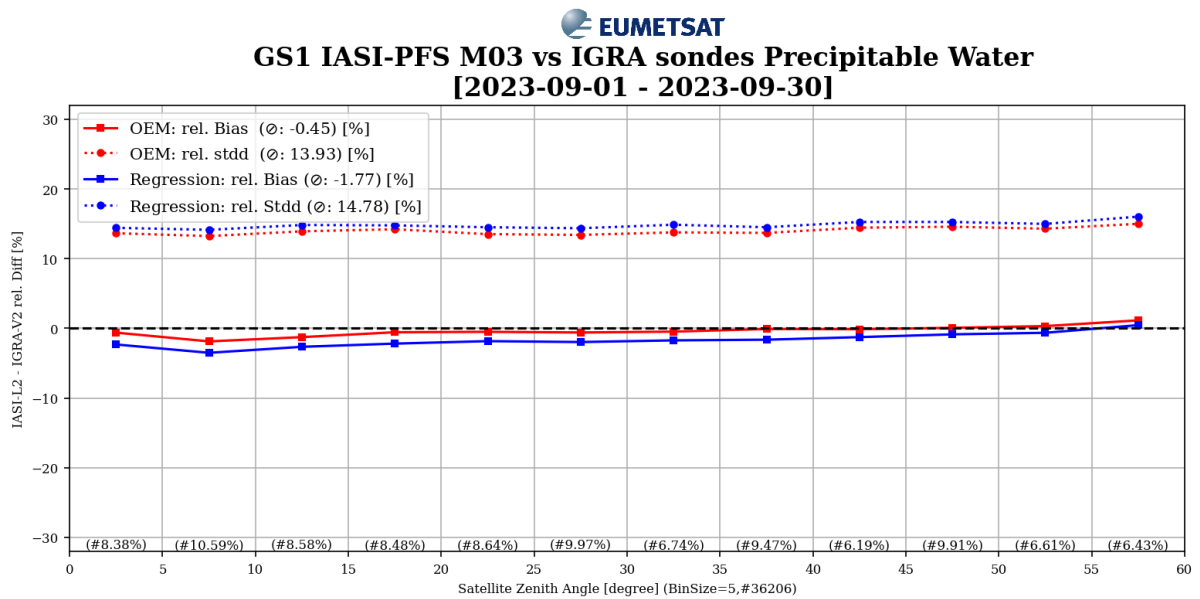
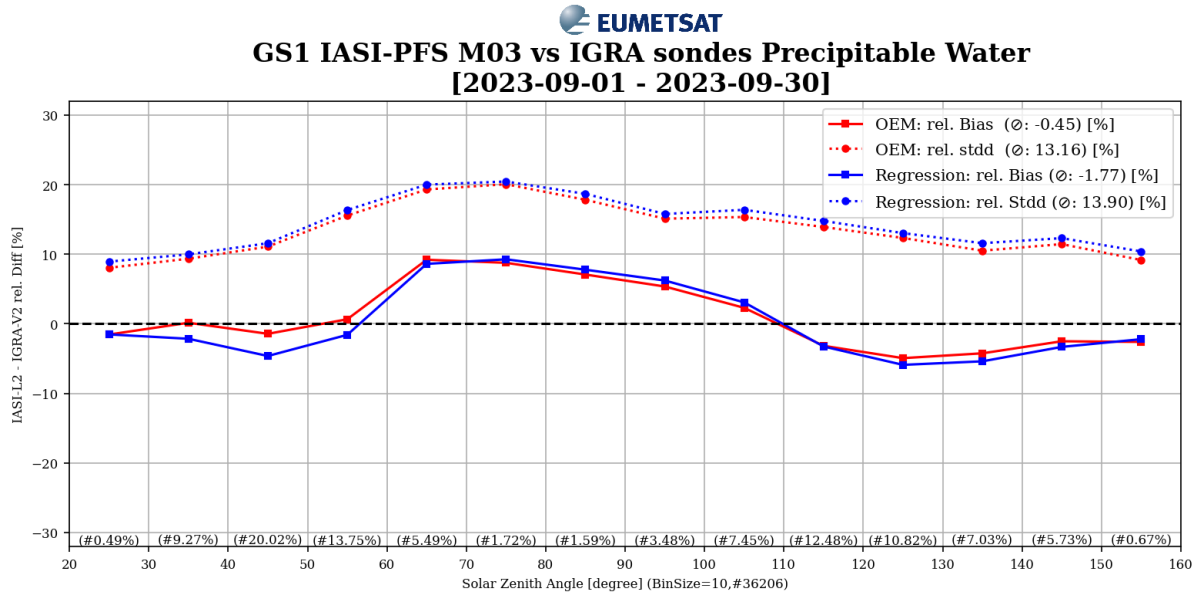


Figure 2.41: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for different sun zenith angles (top) and satellite zenith angles (bottom).

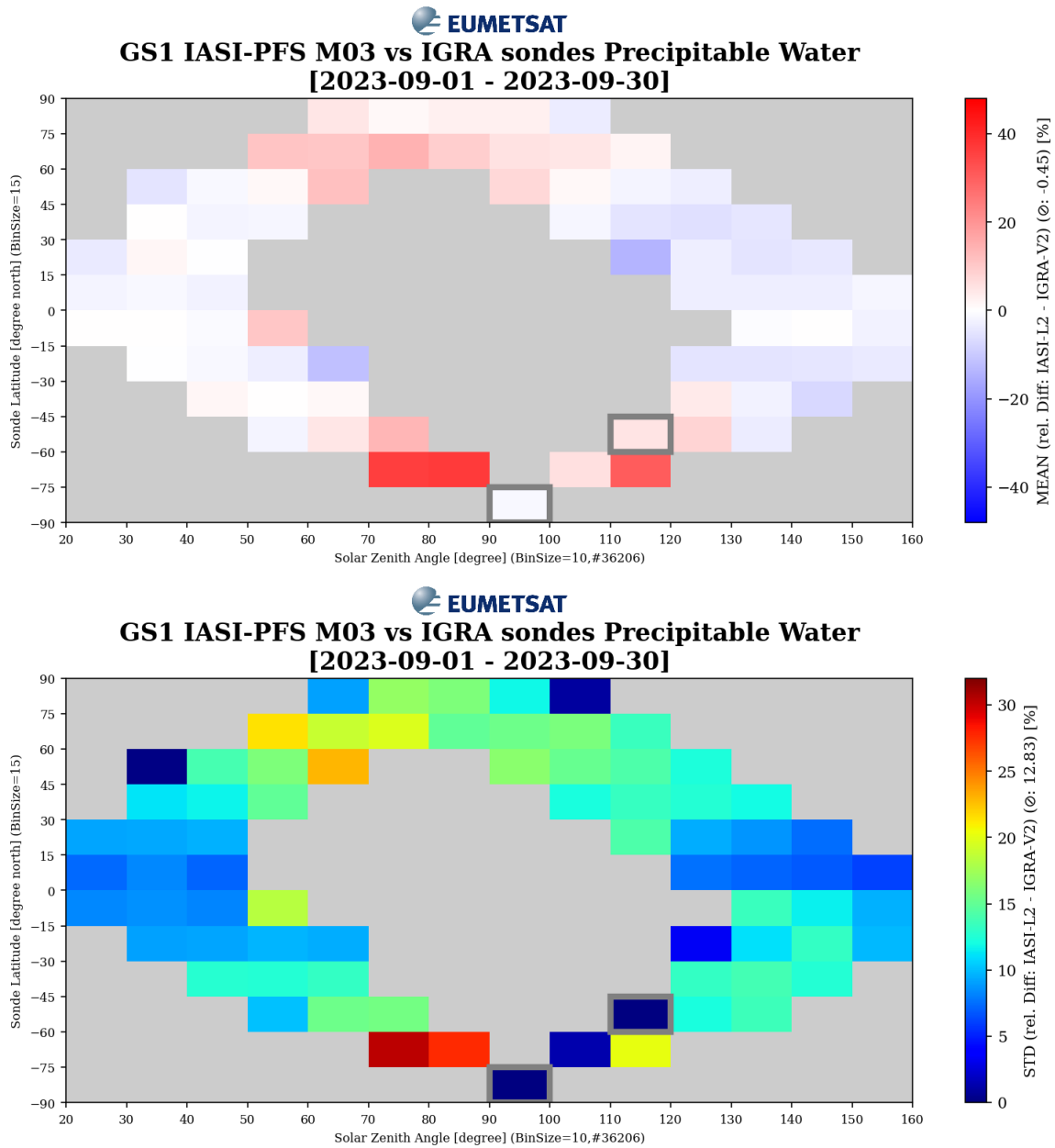


Figure 2.42: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of sun zenith angles and latitude.

3 REGIONAL EUROPE MONTHLY STATISTICS IN CLEAR-SKY PIXEL

3.1 Matchups

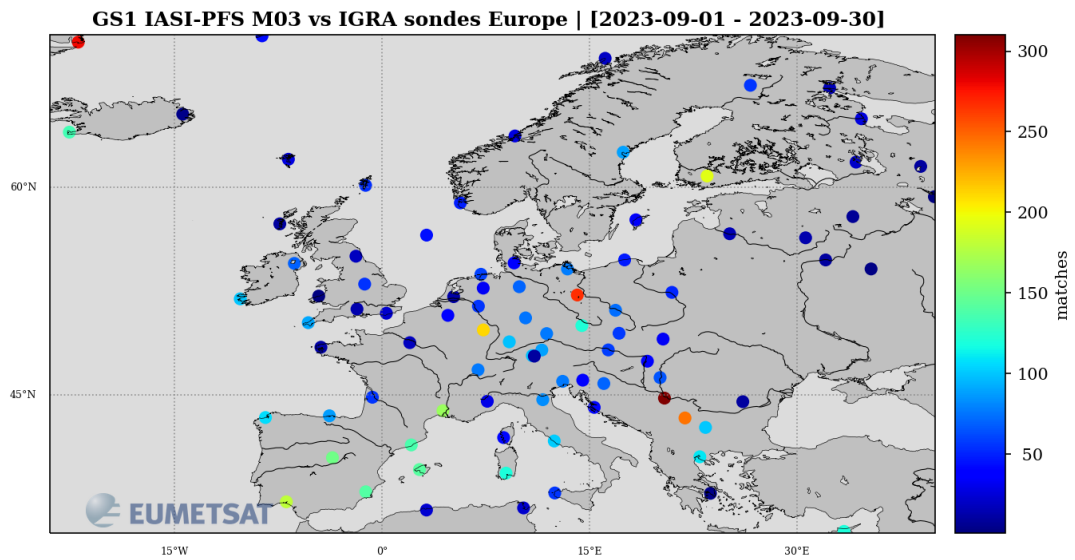


Figure 3.1: Number of match-ups per station with M03 IASI L2 from GS1 for 01-30/09/2023

3.2 Vertical profile statistics

3.2.1 Temperature

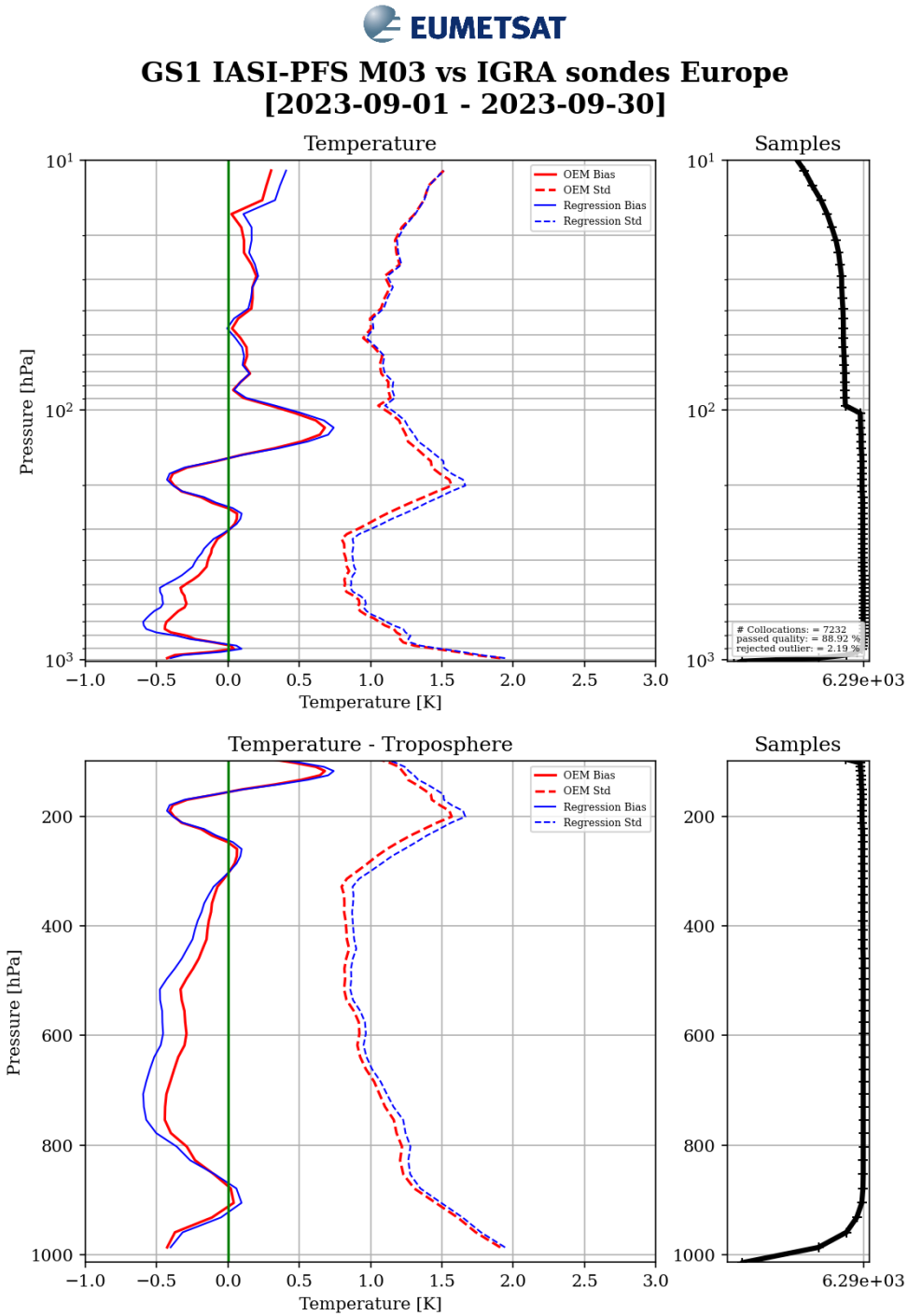


Figure 3.2: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in temperature with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.2.2 Specific Humidity

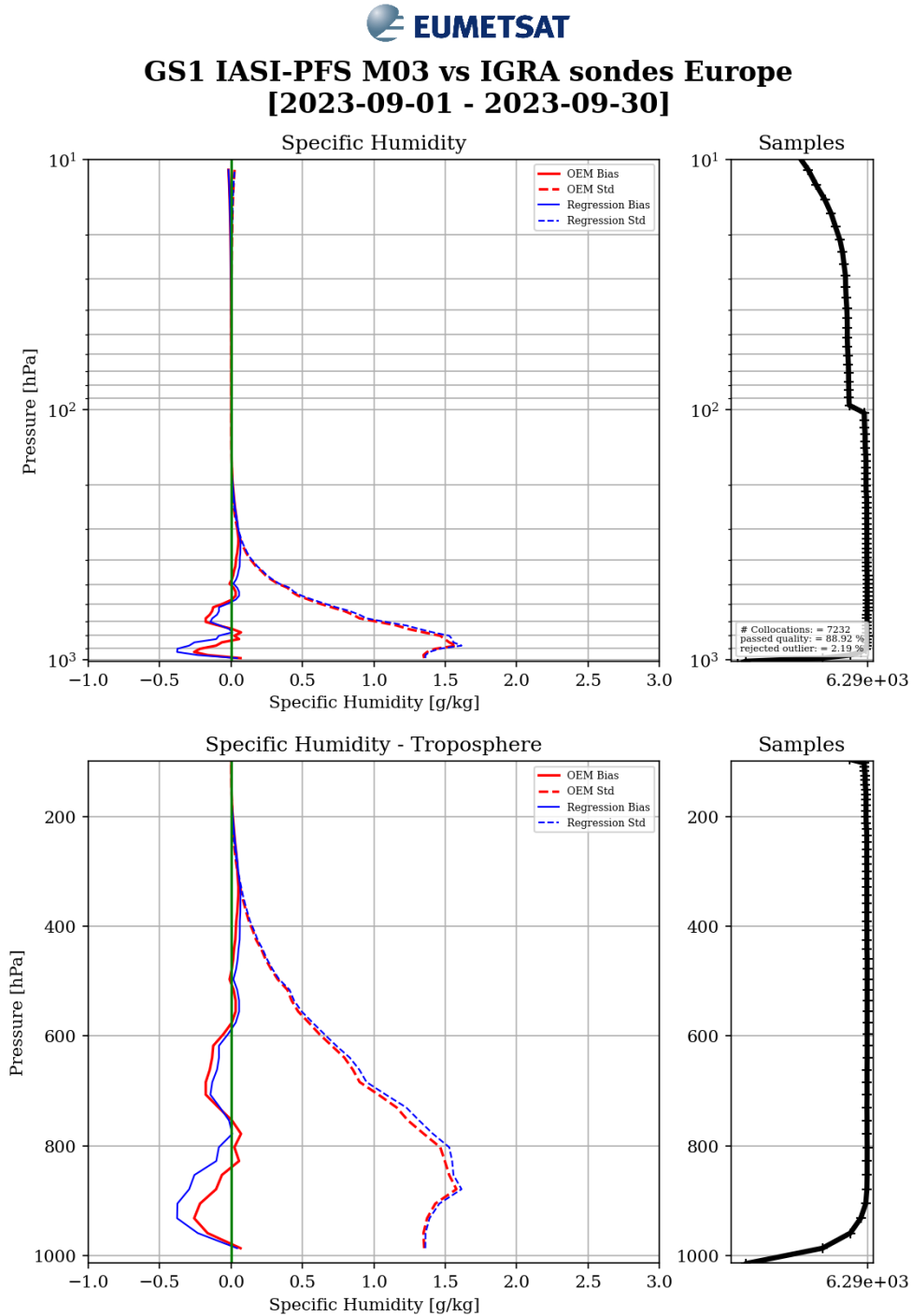


Figure 3.3: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in specific humidity with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.2.3 Relative Humidity

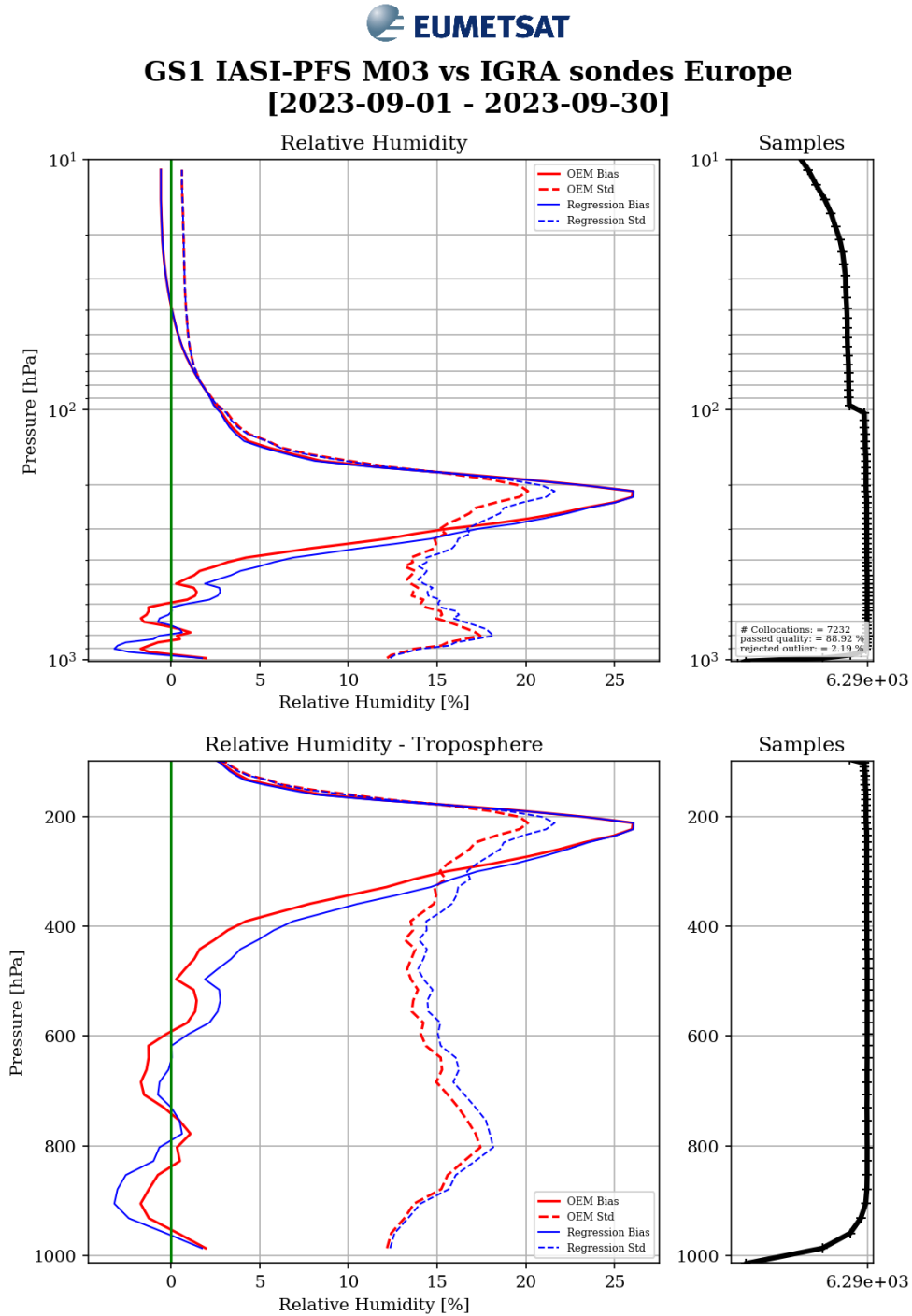


Figure 3.4: IASI vs sonde mean (solid line) difference and standard deviation (dash line) in relative humidity with the statistical (blue) and optimal estimation (red) retrieval methods (top: pressure log scale, bottom: linear scale). Global statistics with M03 IASI L2 from GS1 for for 01-30/09/2023

3.3 Monthly time series

3.3.1 Temperature / Humidity

3.3.1.1 Level: 10 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [10.0 hPa]
 [2023-09-01 - 2023-09-30]**

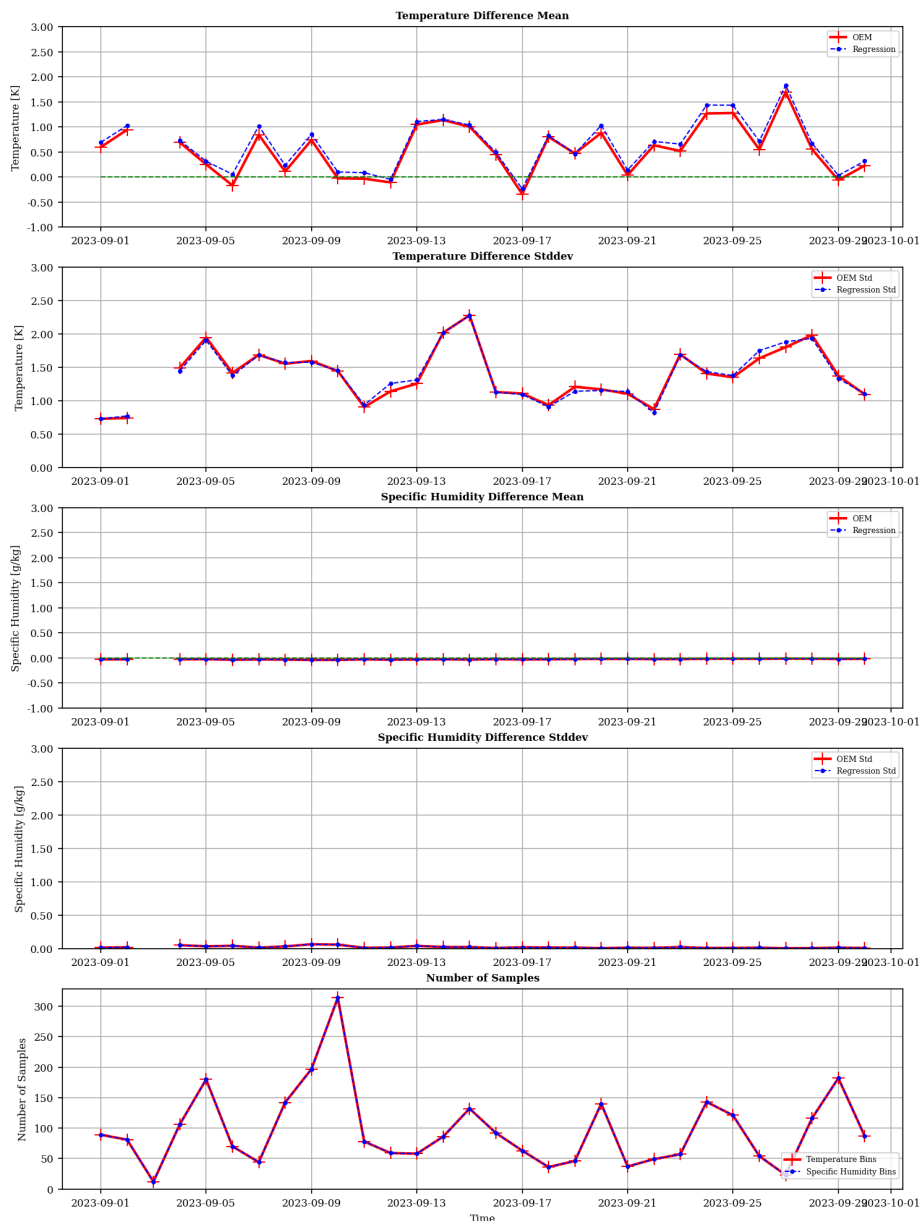


Figure 3.5: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 10 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.2 Level: 100 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [100.0 hPa]
 [2023-09-01 - 2023-09-30]**

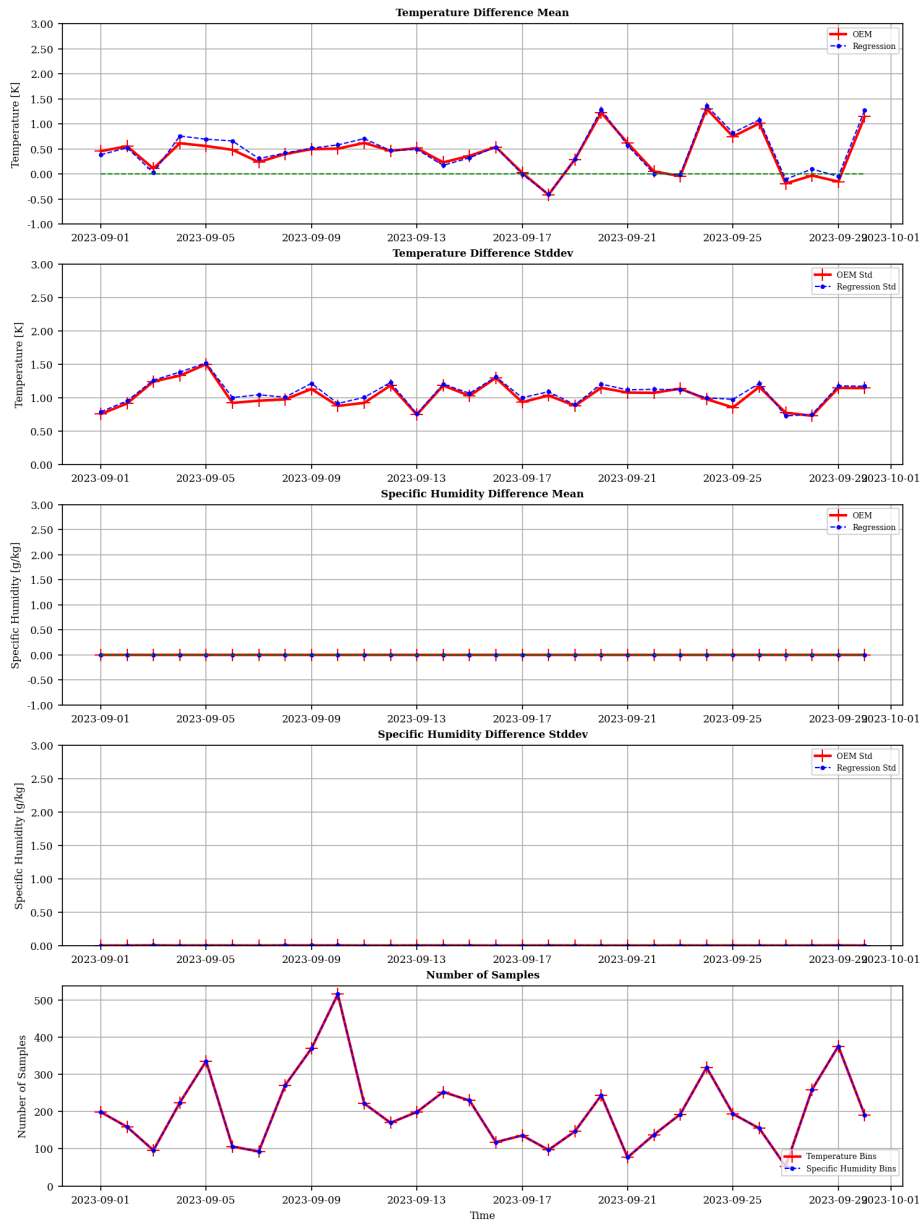


Figure 3.6: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 100 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.3 Level: 200 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [200.0 hPa]
 [2023-09-01 - 2023-09-30]**

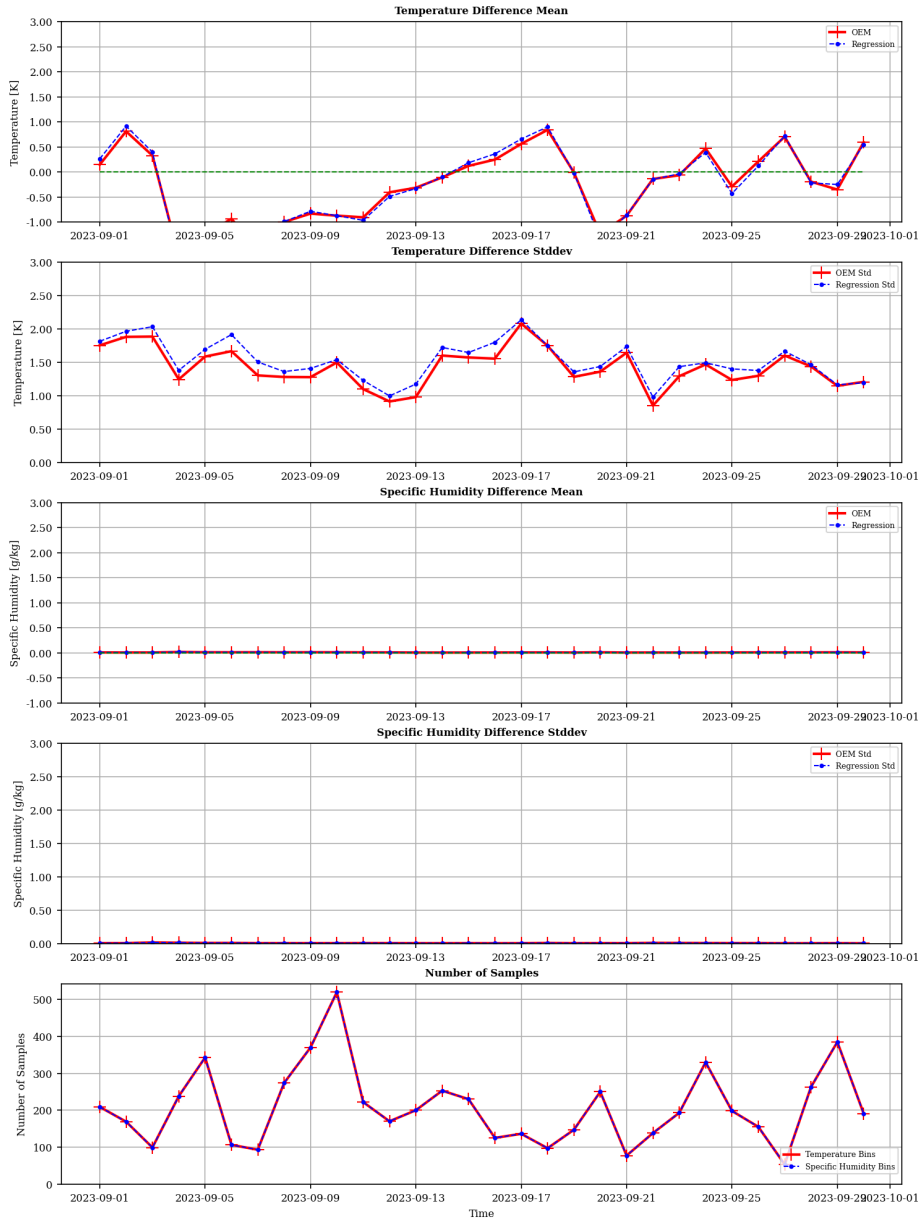


Figure 3.7: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 200 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.4 Level: 300 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [300.0 hPa]
 [2023-09-01 - 2023-09-30]**

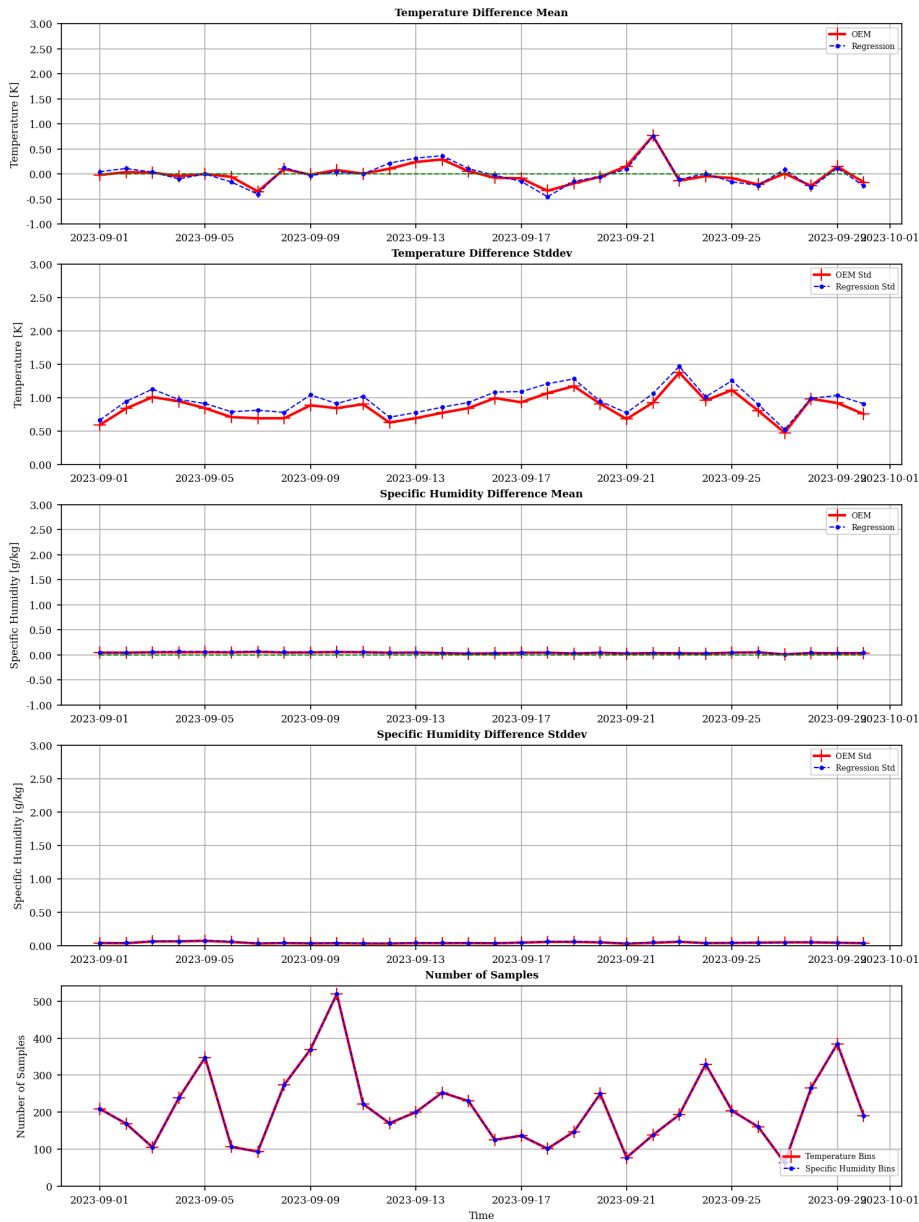


Figure 3.8: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 300 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.5 Level: 500 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [500.0 hPa]
[2023-09-01 - 2023-09-30]**

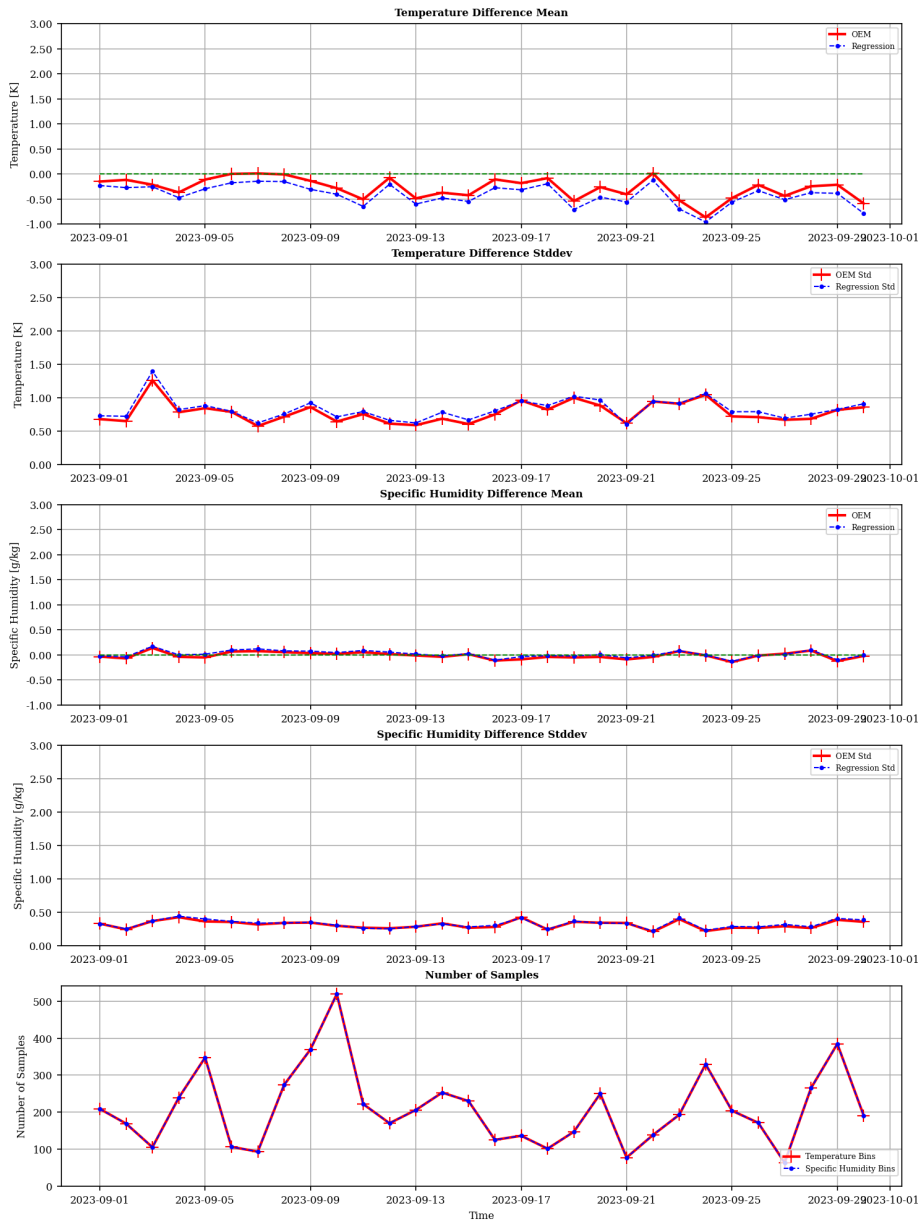


Figure 3.9: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 500 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.6 Level: 600 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [600.0 hPa]
 [2023-09-01 - 2023-09-30]**

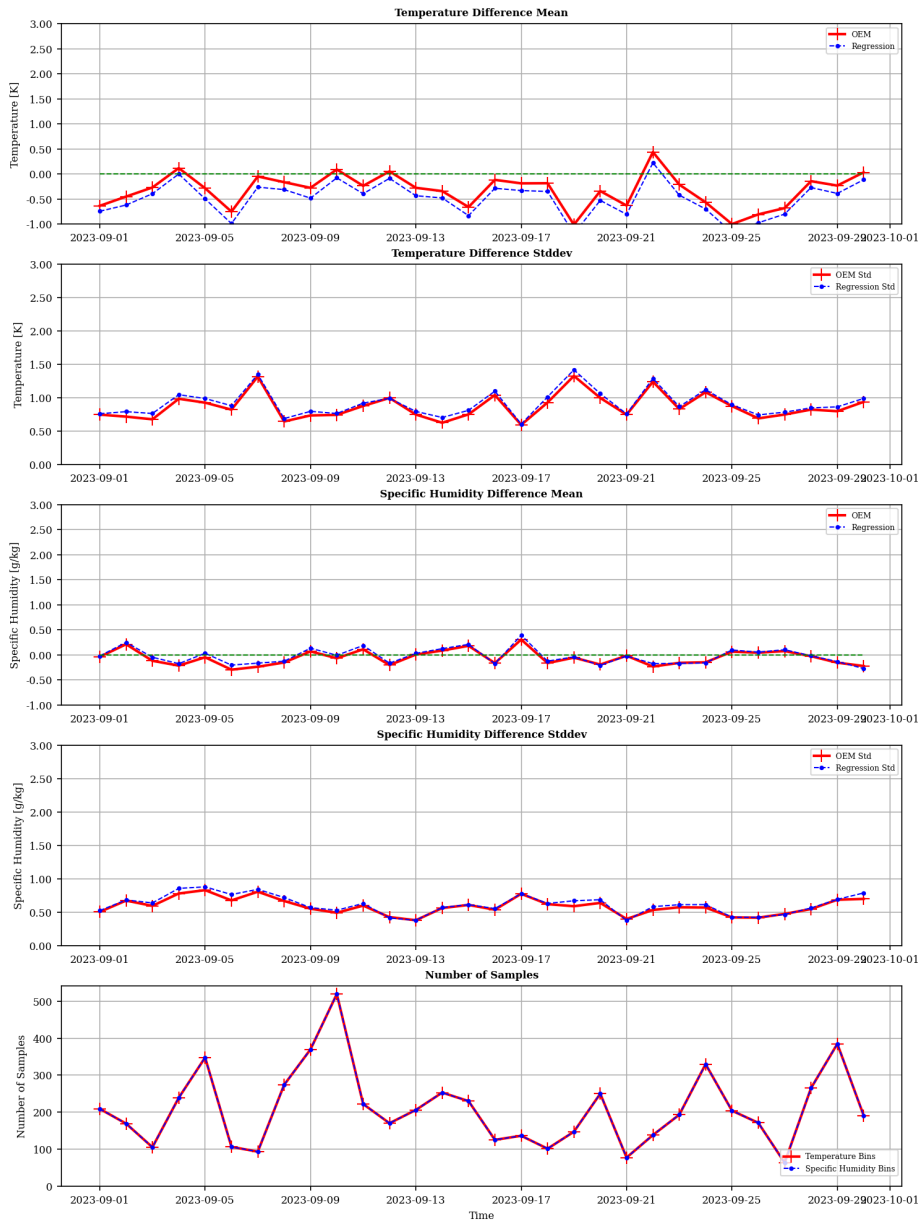


Figure 3.10: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 600 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.7 Level: 800 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [800.0 hPa]
 [2023-09-01 - 2023-09-30]**

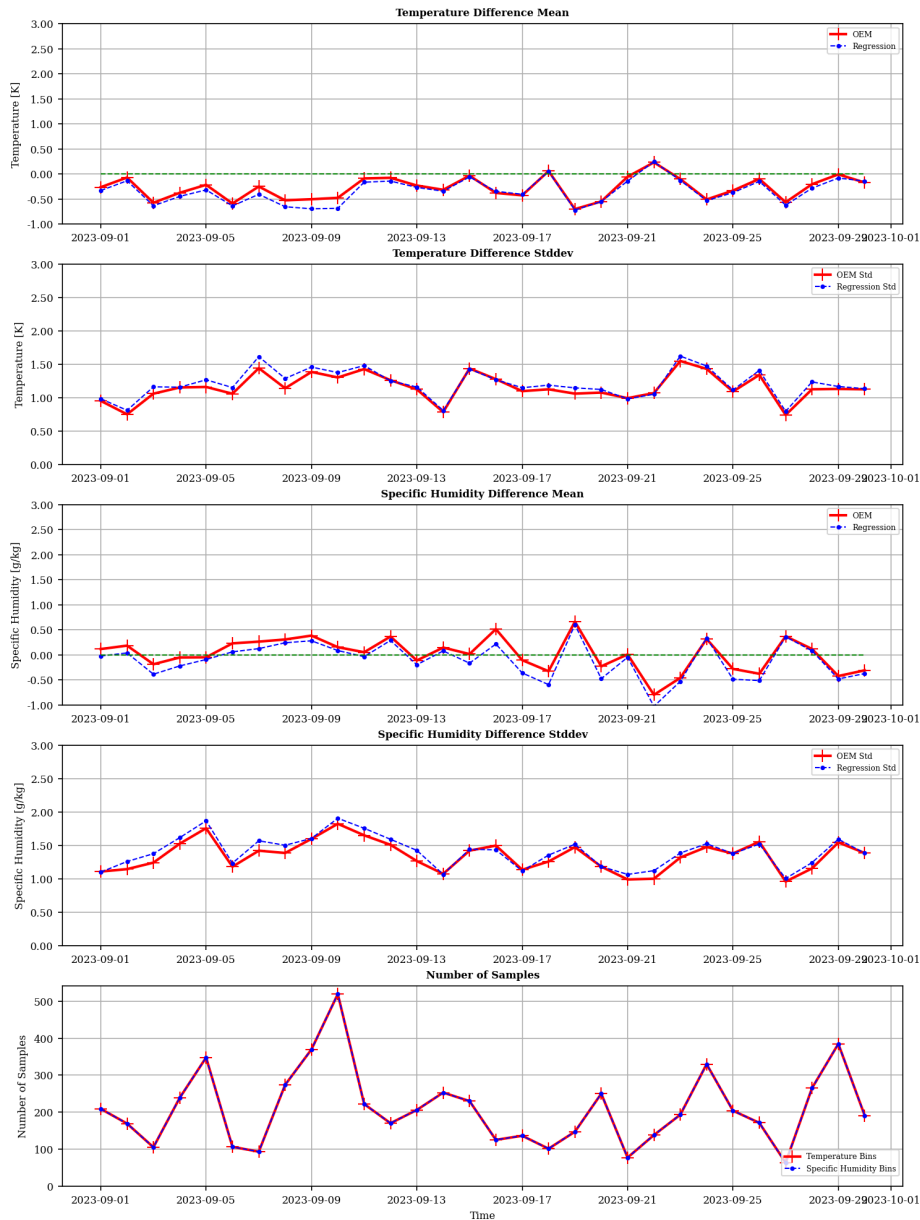


Figure 3.11: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 800 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.1.8 Level: 1000 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [1000.0 hPa]
[2023-09-01 - 2023-09-30]**

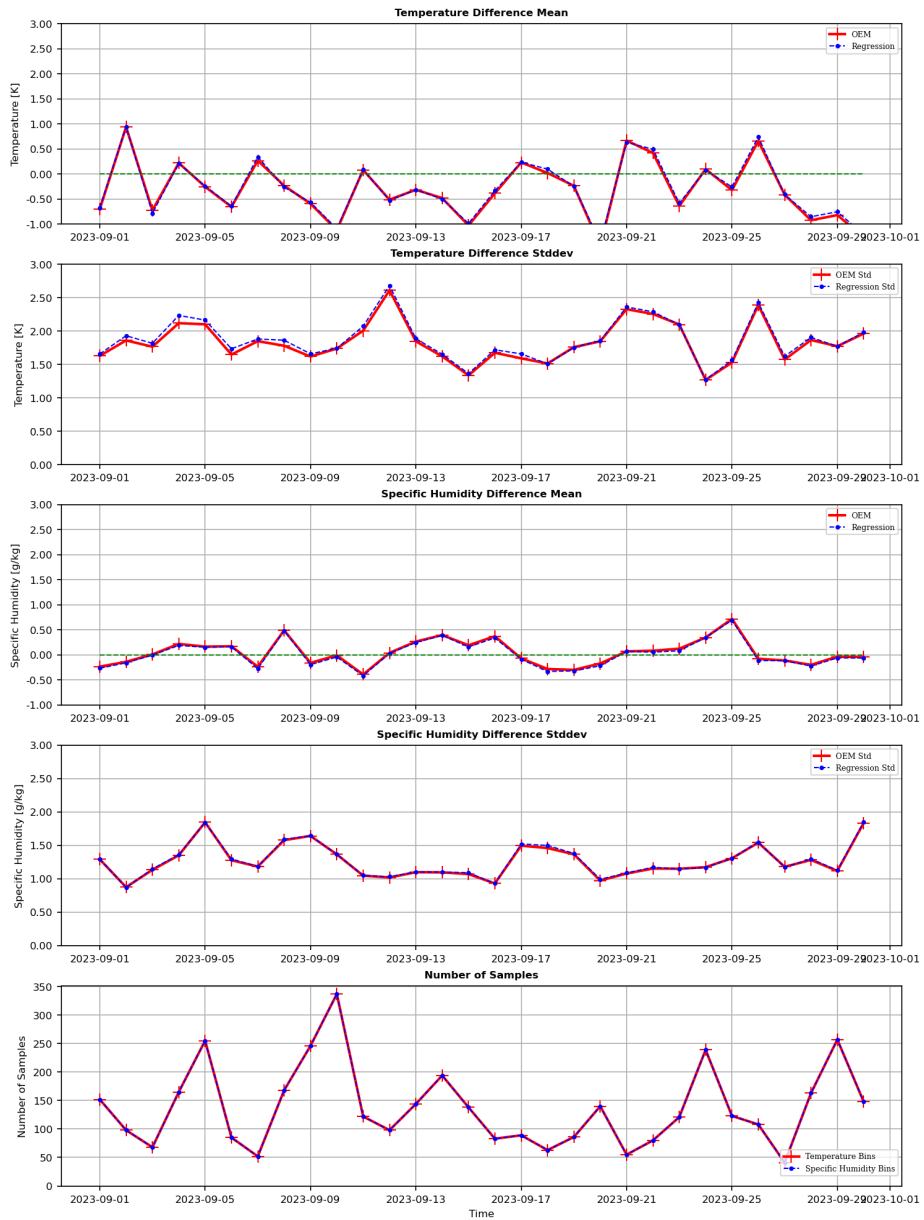


Figure 3.12: Monthly time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 1000 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.3.2 Precipitable Water



GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water [2023-09-01 - 2023-09-30]

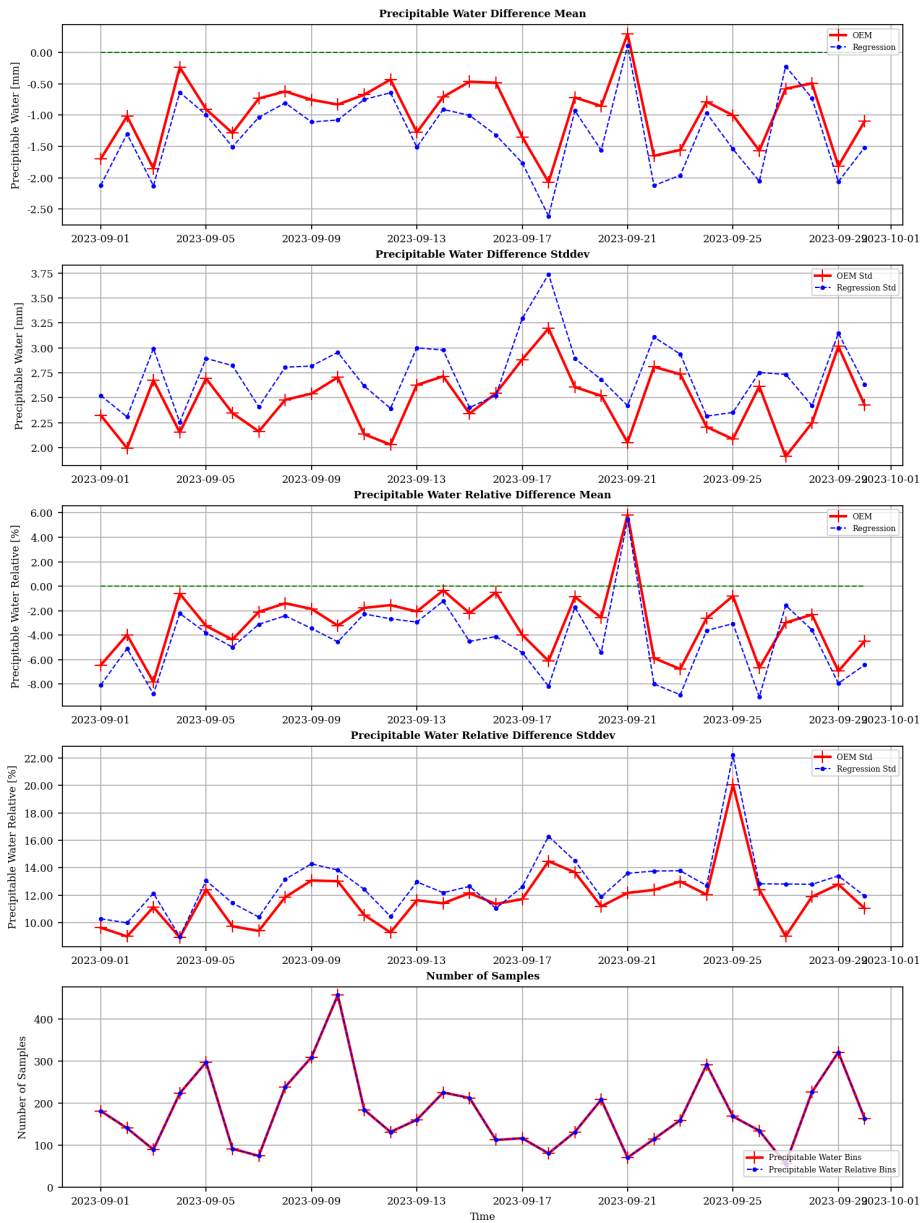


Figure 3.13: Monthly time series of Precipitable Water mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and IGRA. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.4 Long-term time series

3.4.1 Temperature / Humidity

3.4.1.1 Level: 10 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [10.0 hPa]
 [2018-12-12 - 2023-09-30]**

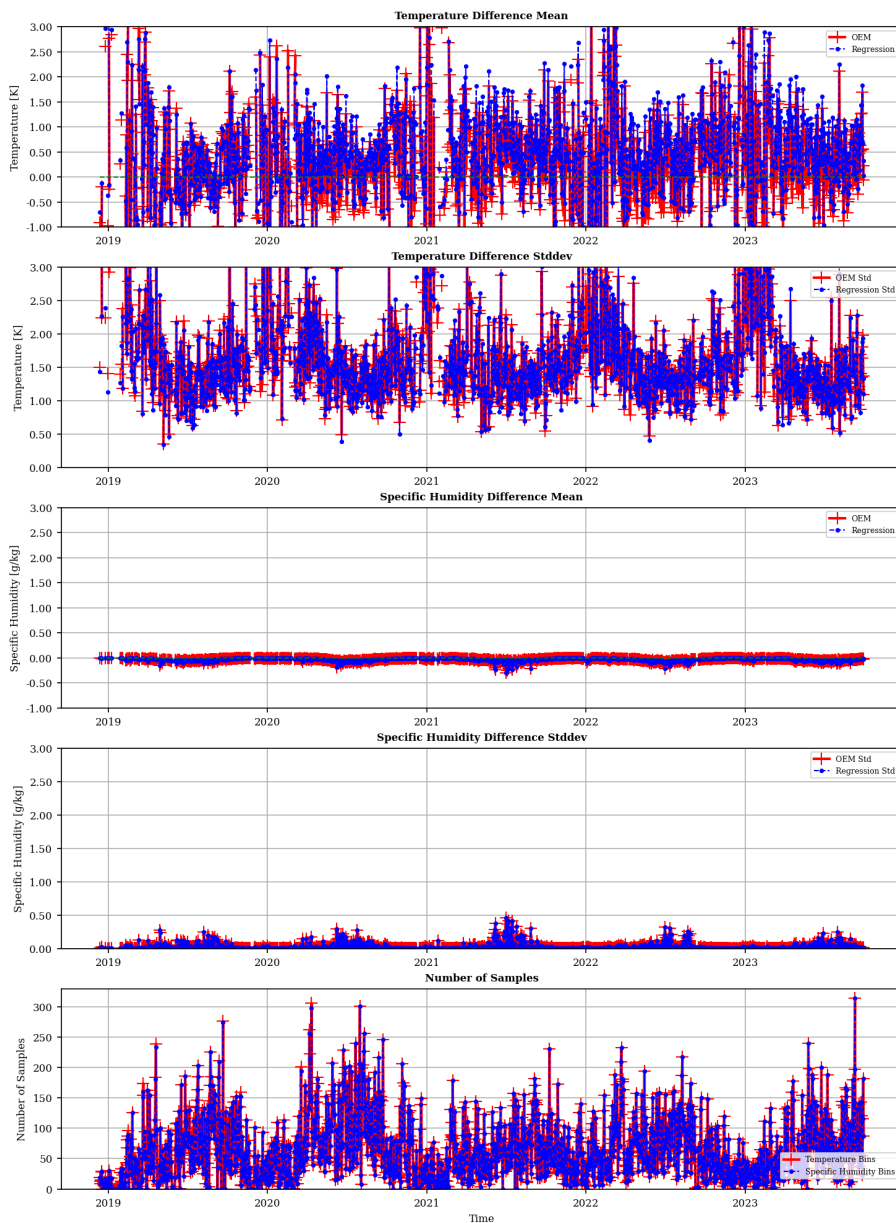


Figure 3.14: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 10 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.2 Level: 100 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [100.0 hPa]
 [2018-12-12 - 2023-09-30]**

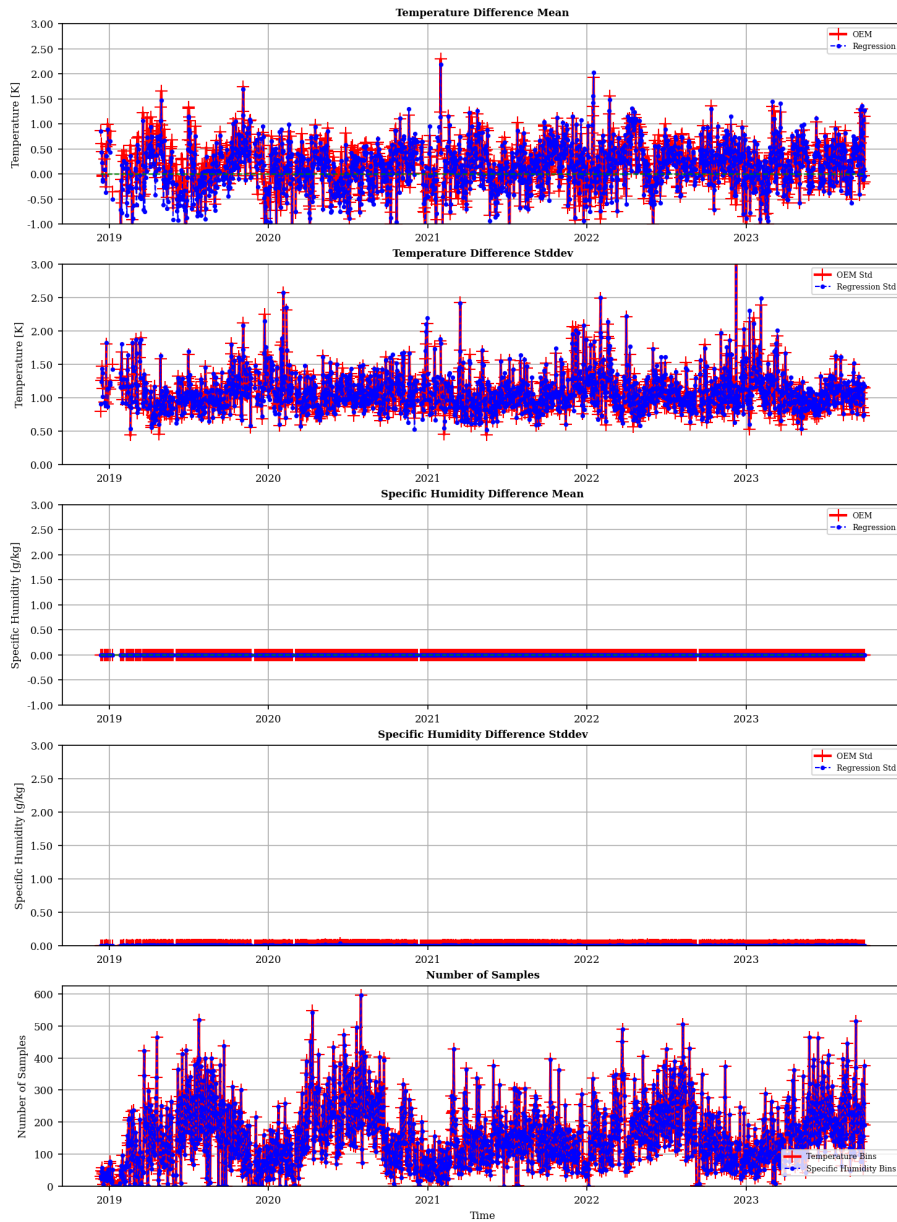


Figure 3.15: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 100 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.3 Level: 200 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [200.0 hPa]
 [2018-12-12 - 2023-09-30]**

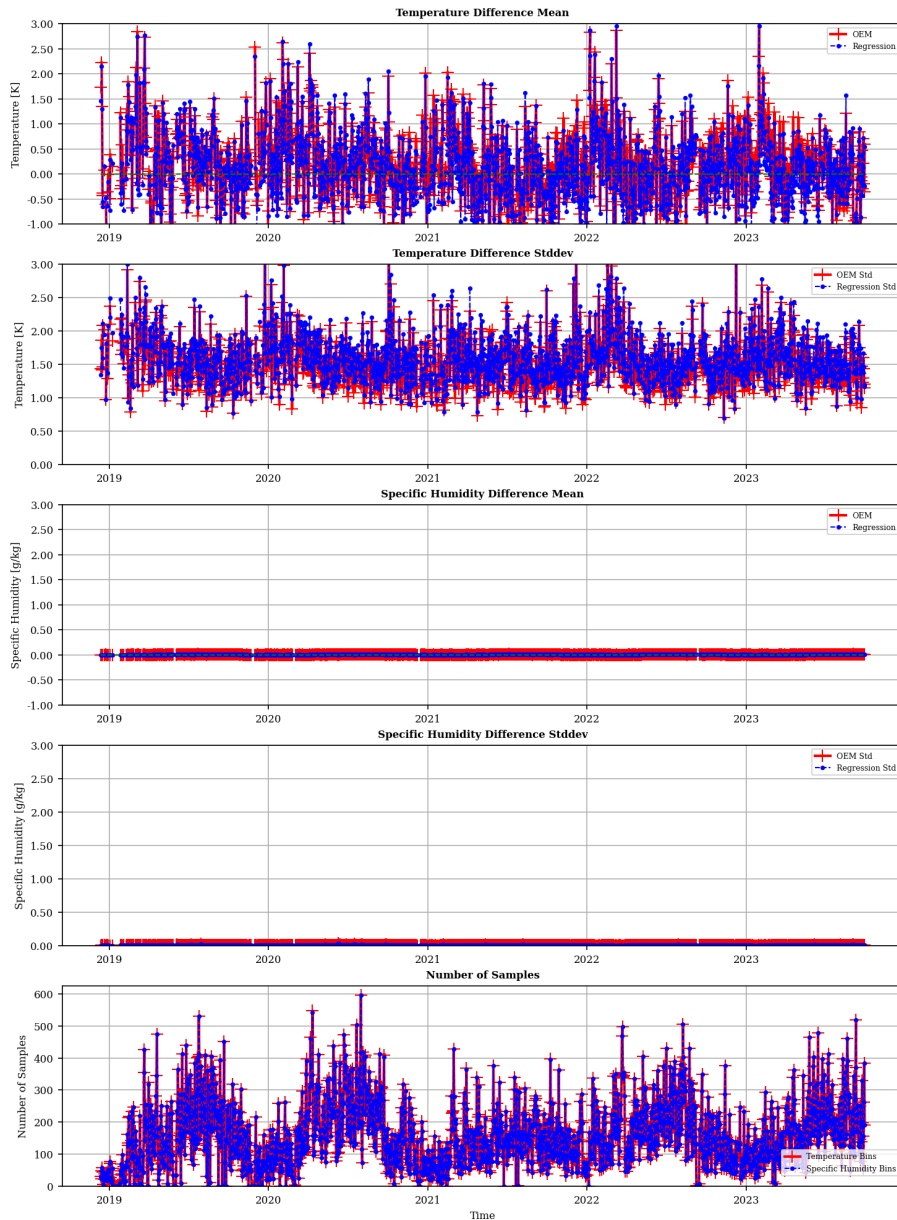


Figure 3.16: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 200 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.4 Level: 300 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [300.0 hPa]
 [2018-12-12 - 2023-09-30]**

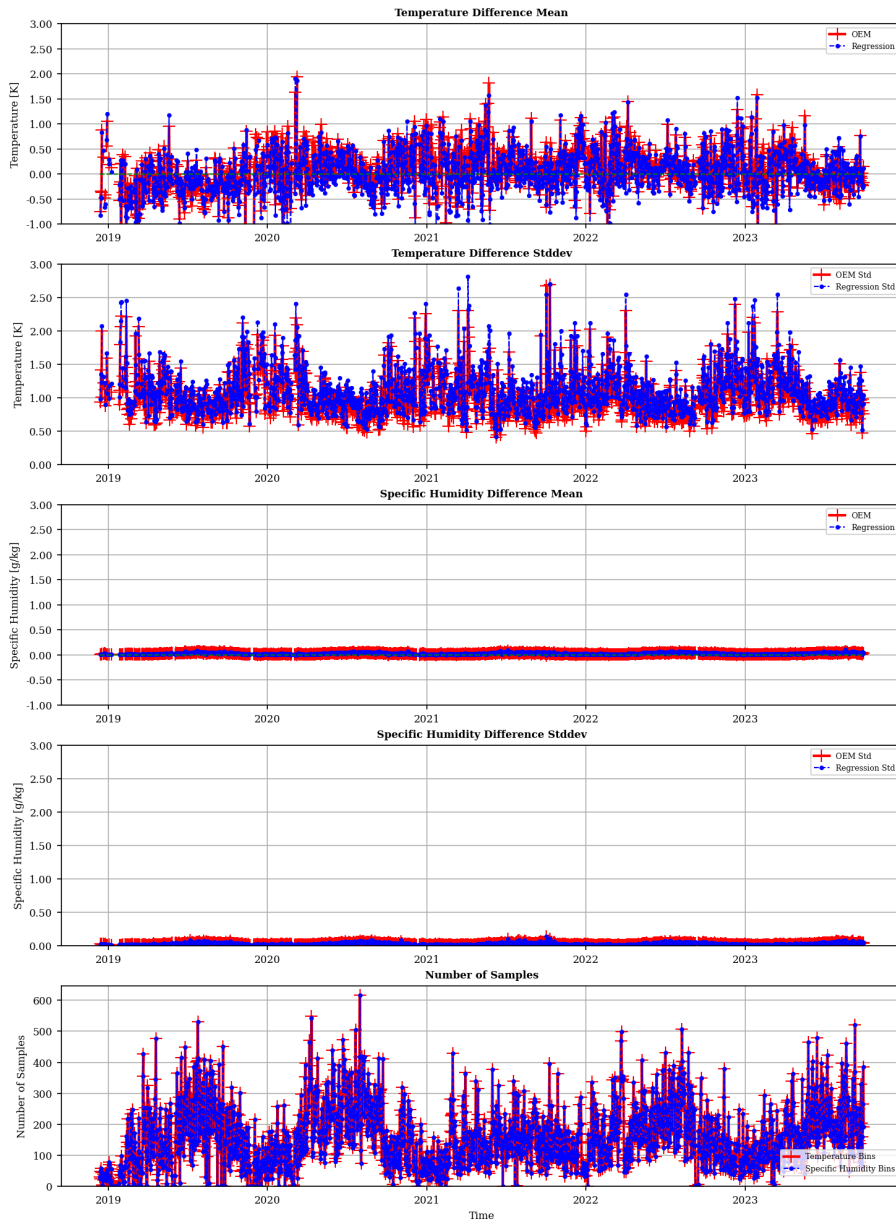


Figure 3.17: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 300 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.5 Level: 500 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [500.0 hPa]
 [2018-12-12 - 2023-09-30]**

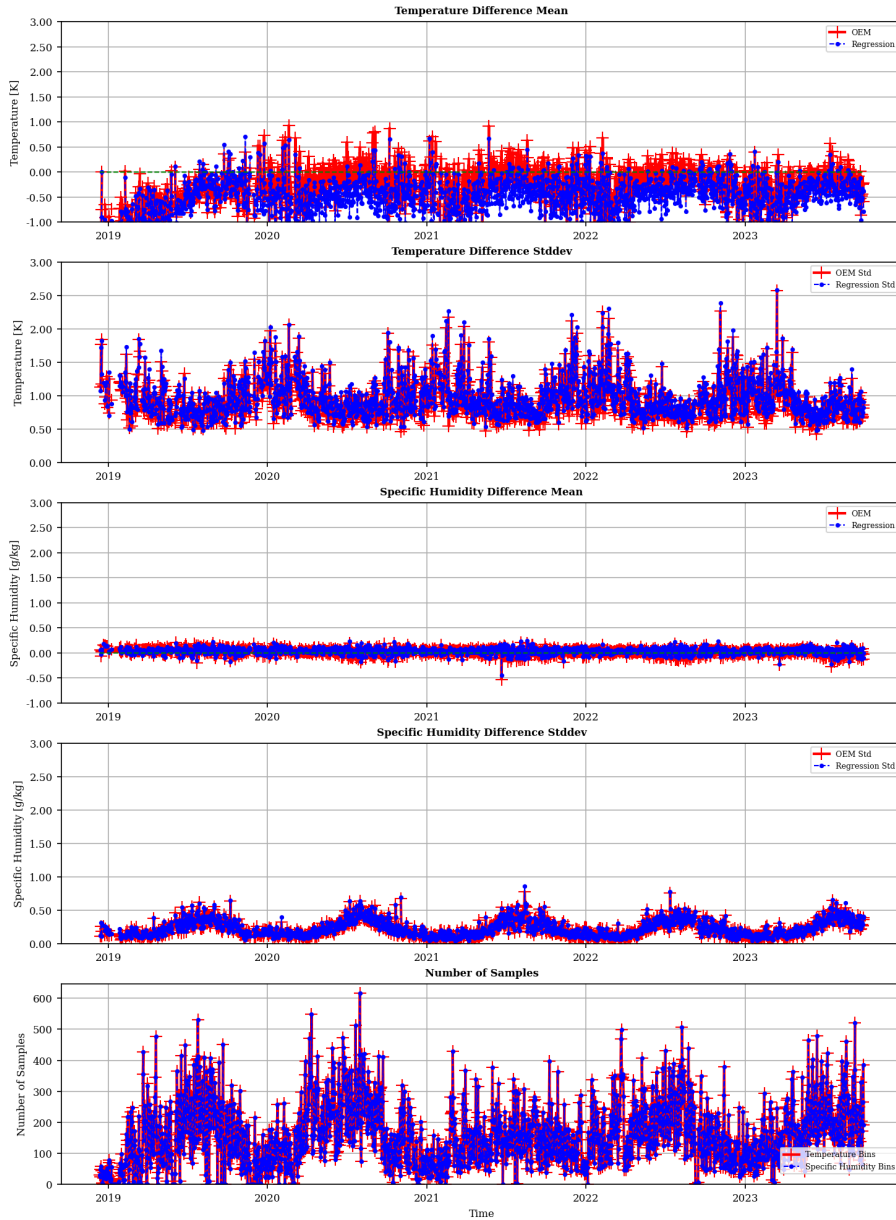


Figure 3.18: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 500 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.6 Level: 600 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [600.0 hPa]
 [2018-12-12 - 2023-09-30]**

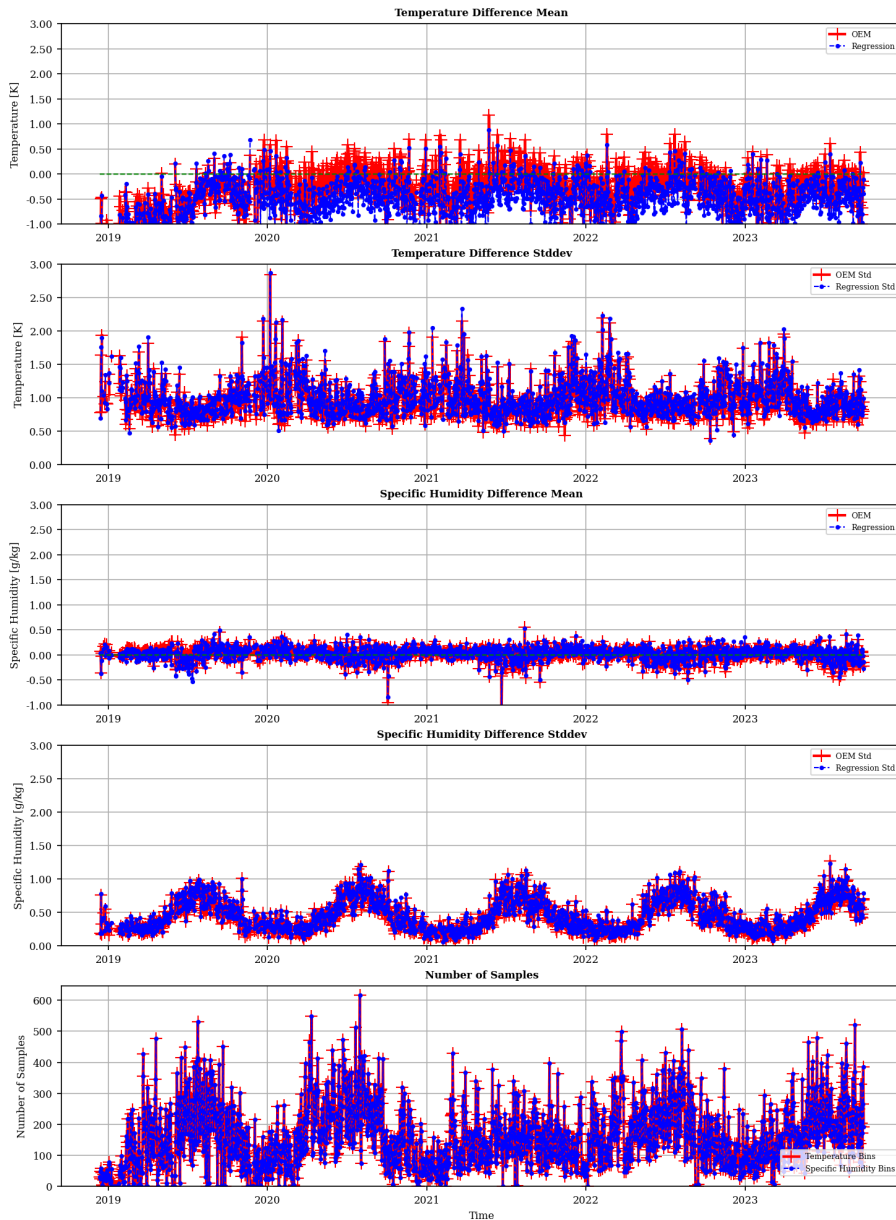


Figure 3.19: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 600 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.7 Level: 800 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [800.0 hPa]
 [2018-12-12 - 2023-09-30]**

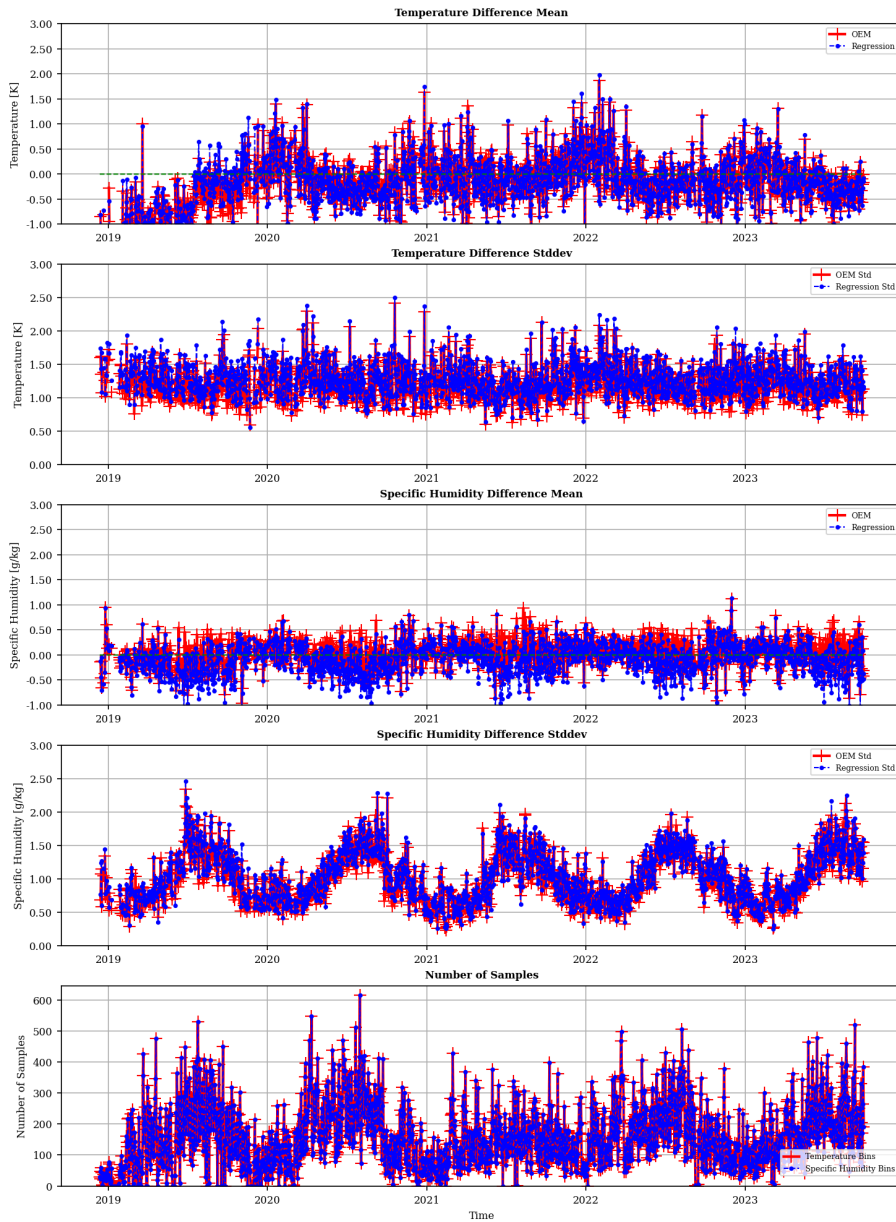


Figure 3.20: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 800 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.1.8 Level: 1000 hPa



**GS1 IASI-PFS M03 vs IGRA sondes Europe [1000.0 hPa]
 [2018-12-12 - 2023-09-30]**

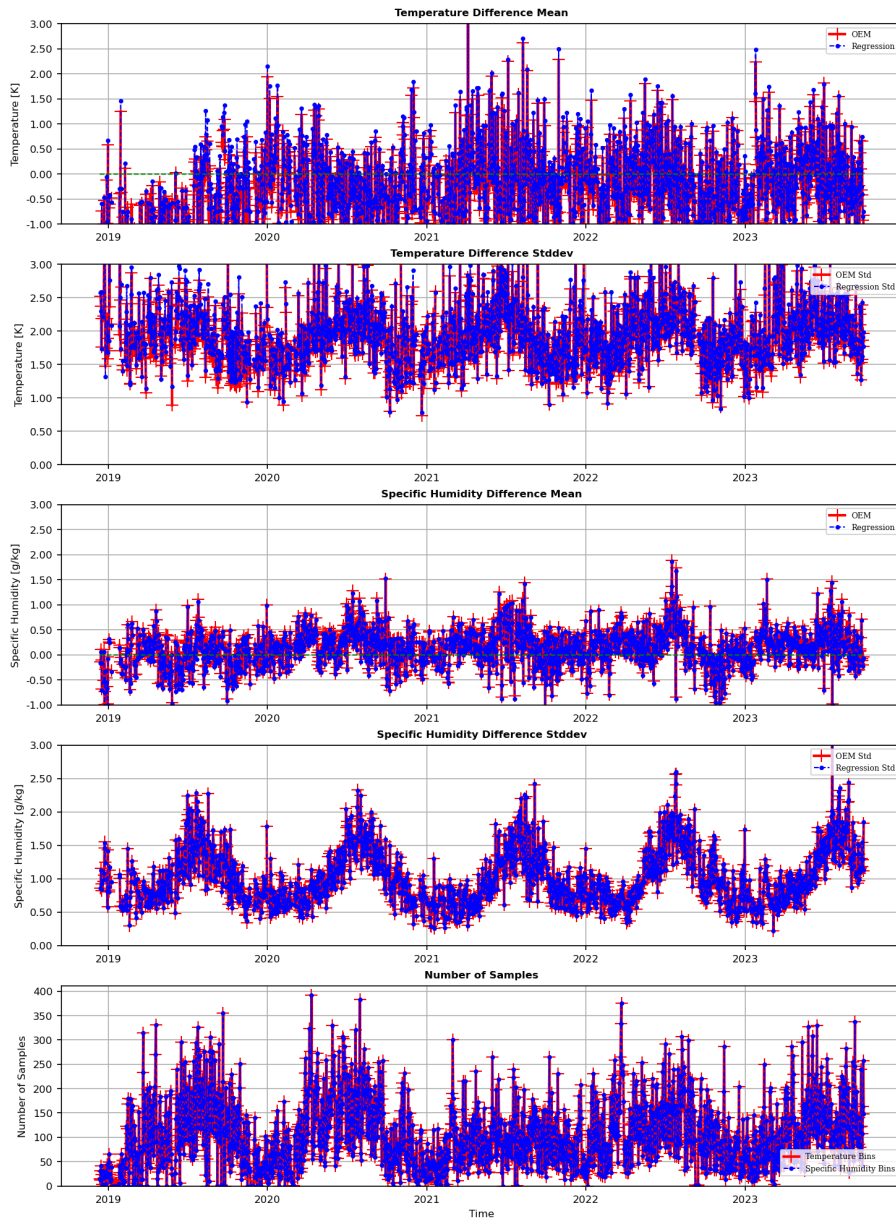


Figure 3.21: Long-term time series of mean difference and standard deviation in temperature (top 2 panels) and humidity (middle 2 panels) between IASI L2 and sondes at 1000 hPa. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 updated on 30/09/2023

3.4.2 Precipitable Water



GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water [2018-12-12 - 2023-09-30]

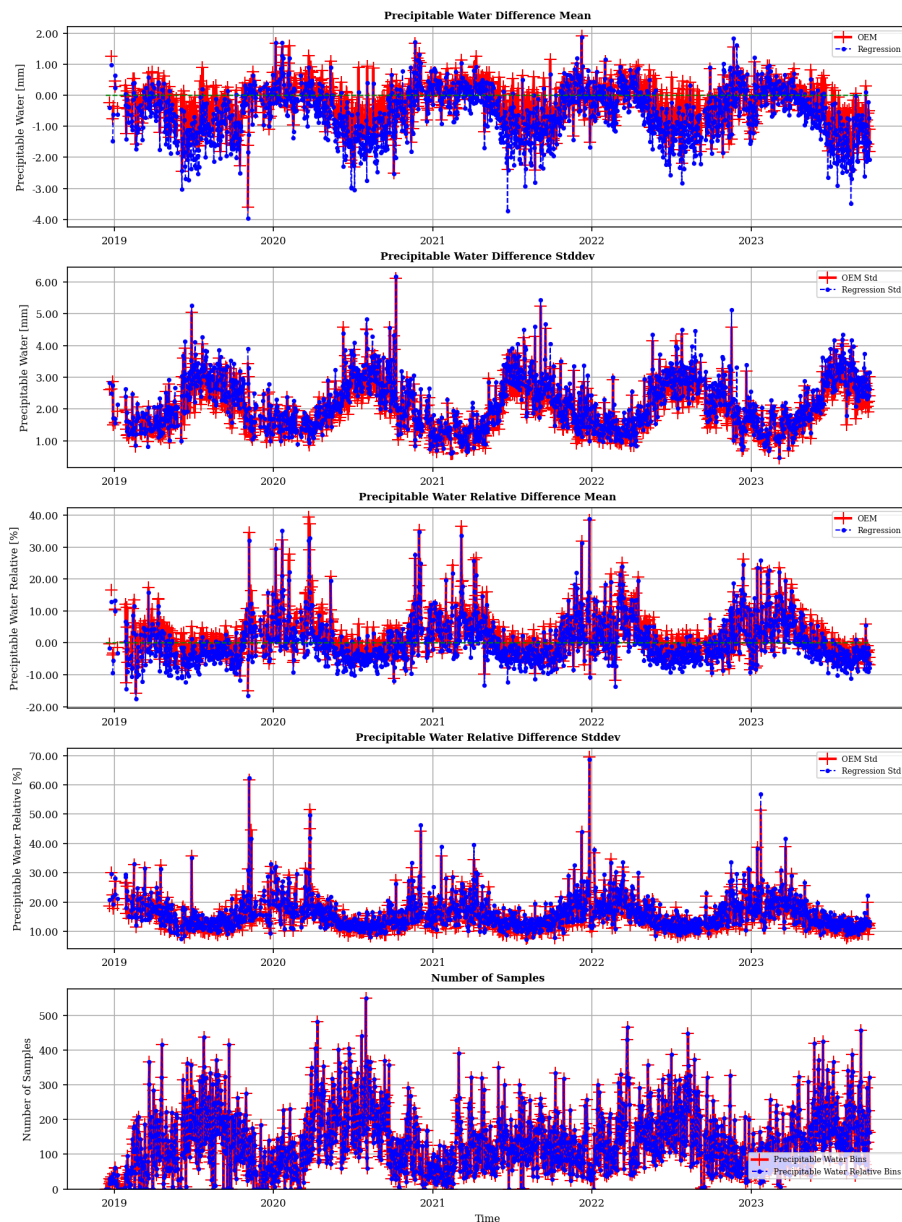


Figure 3.22: Long-term time series of Precipitable Water mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and IGRA. The bottom panel shows the number of Monthly match-ups. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023

3.5 Histograms

3.5.1 Moist adiabatic lapse rate

3.5.1.1 Layer: 1500m above Surface

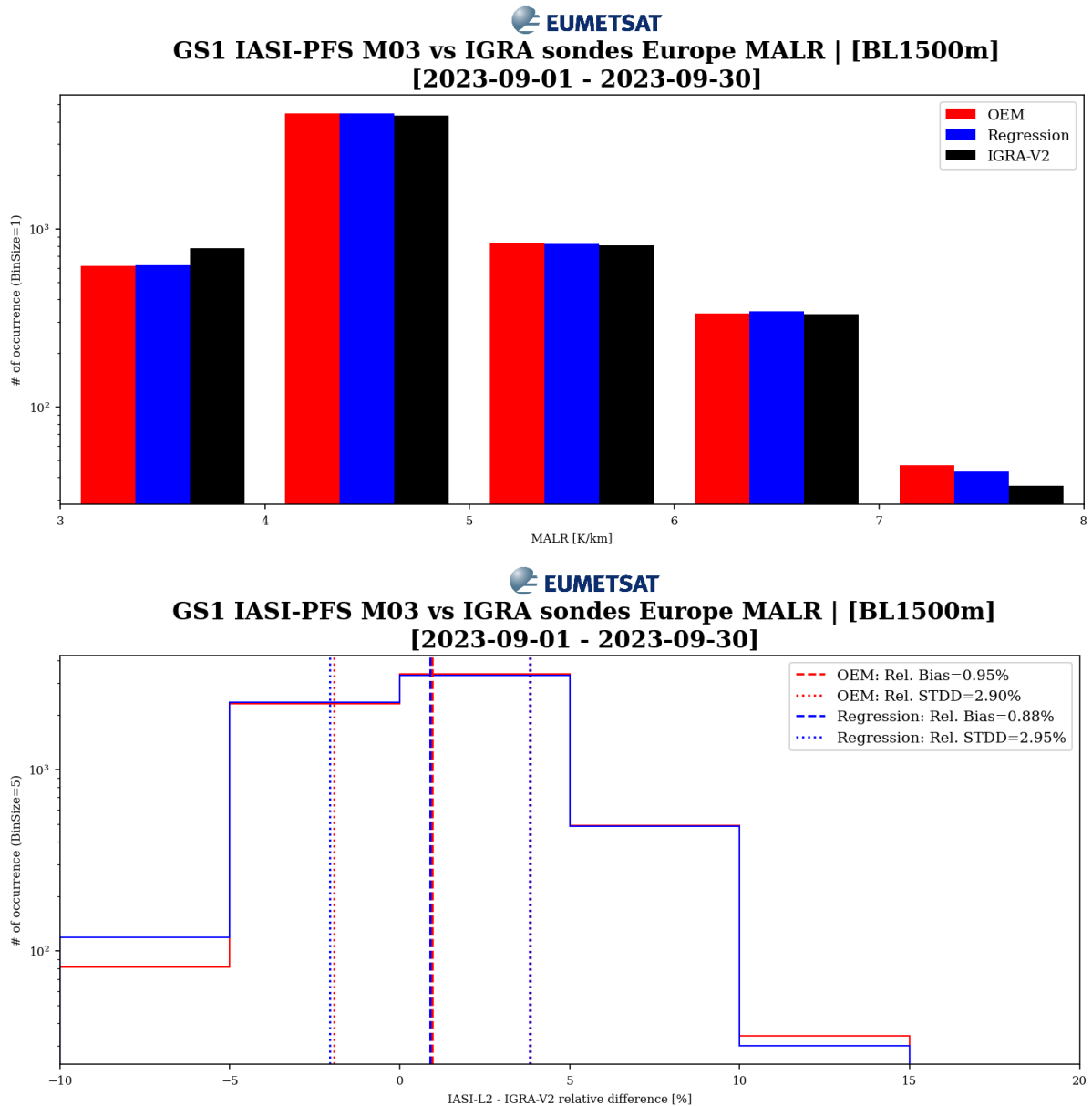


Figure 3.23: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) Histograms as barcharts in absolute units (top) and relative differences (bottom) between IASI L2 and IGRA (ylog). Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

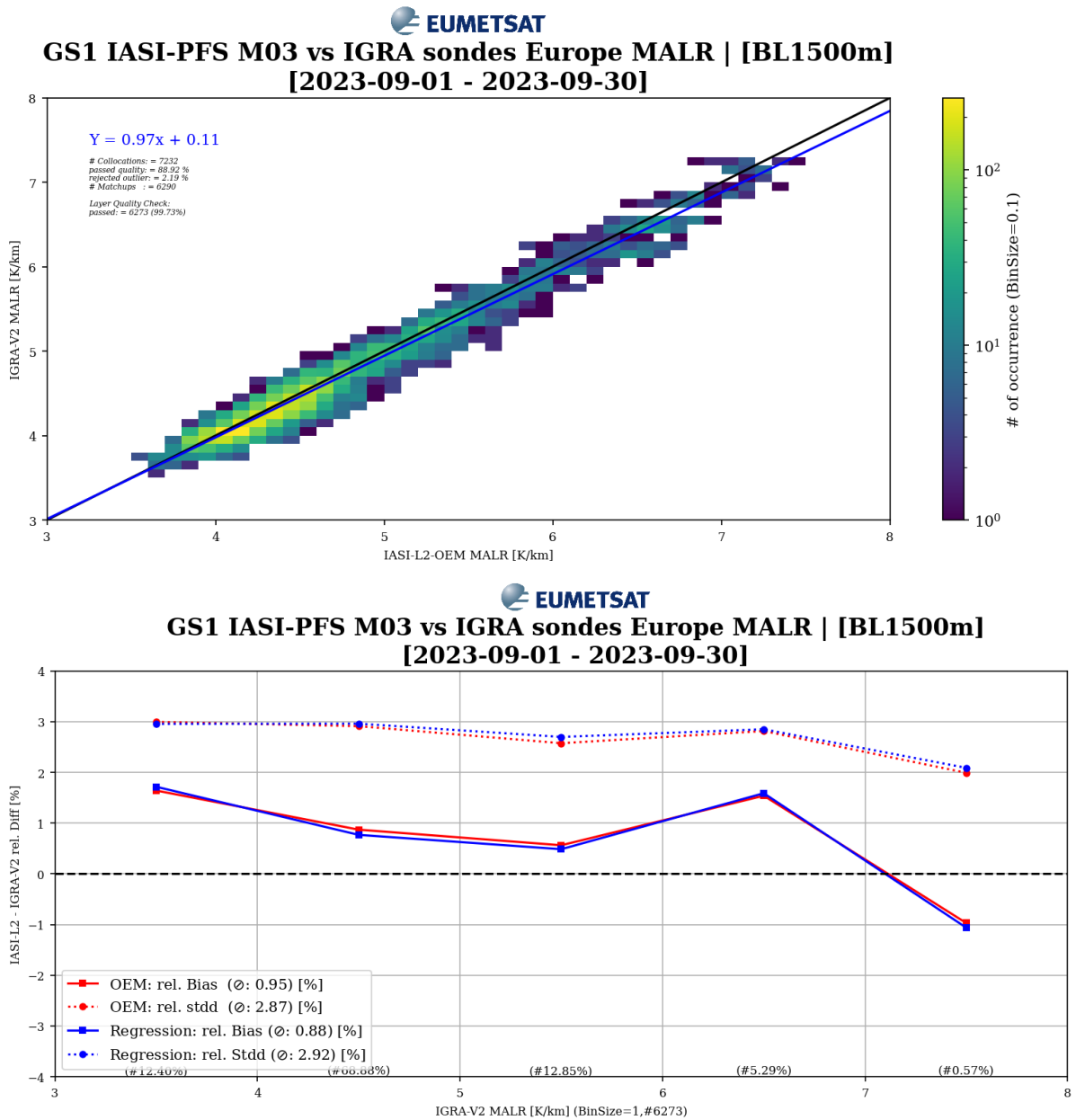


Figure 3.24: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) 2D-Histogram (top) and bias and standard deviation as per pre-defined bins of the IGRA reference (bottom) between IASI L2 and IGRA measurements. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

3.5.1.2 Layer: 850 - 500 hPa

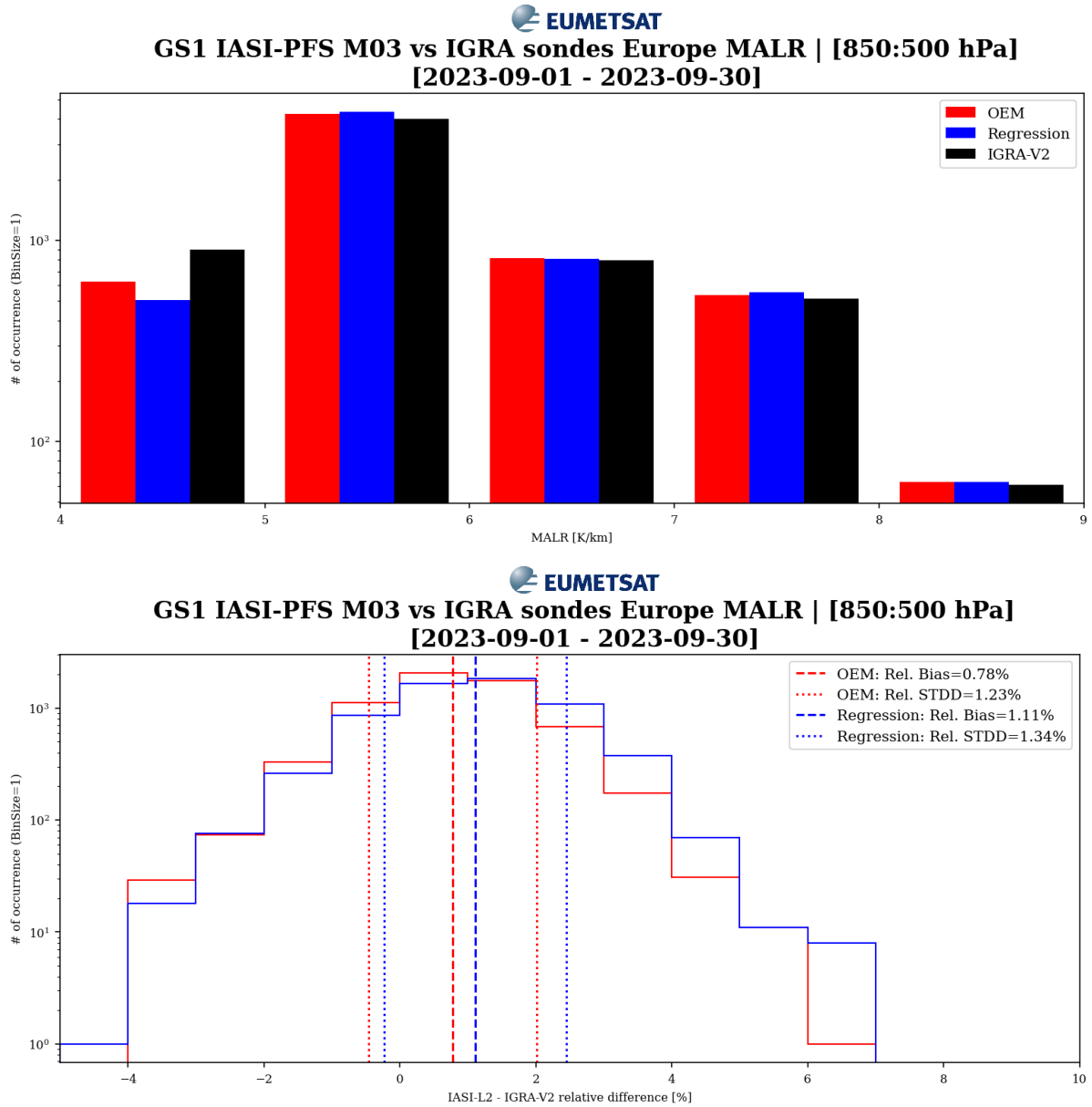


Figure 3.25: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) Histograms as barcharts in absolute units (top) and relative differences (bottom) between IASI L2 and IGRA (ylog). Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

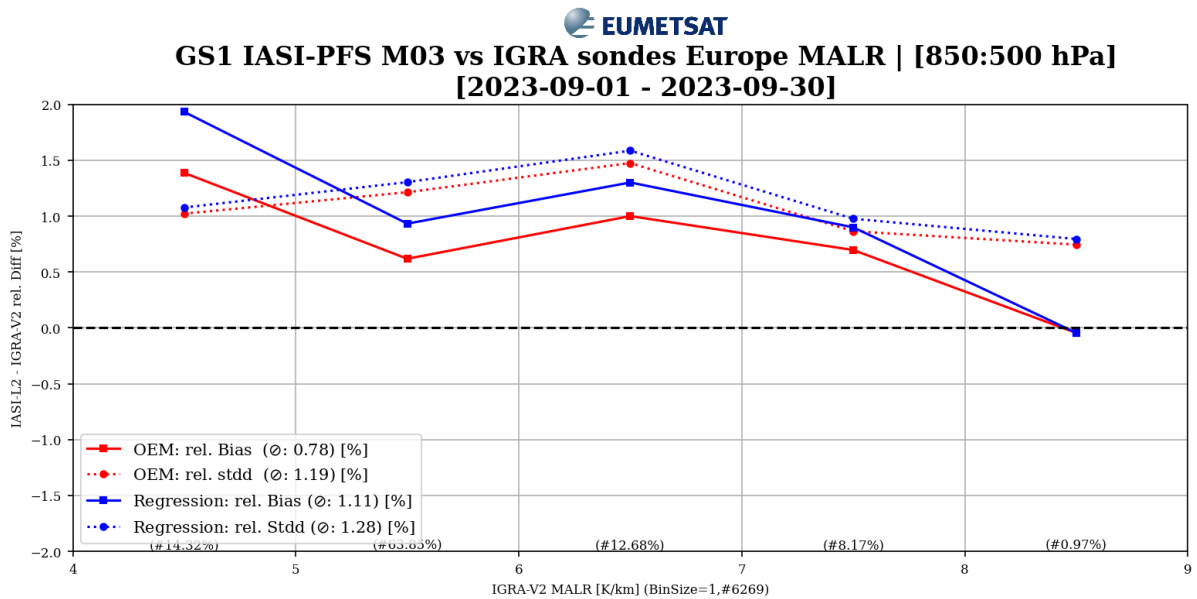
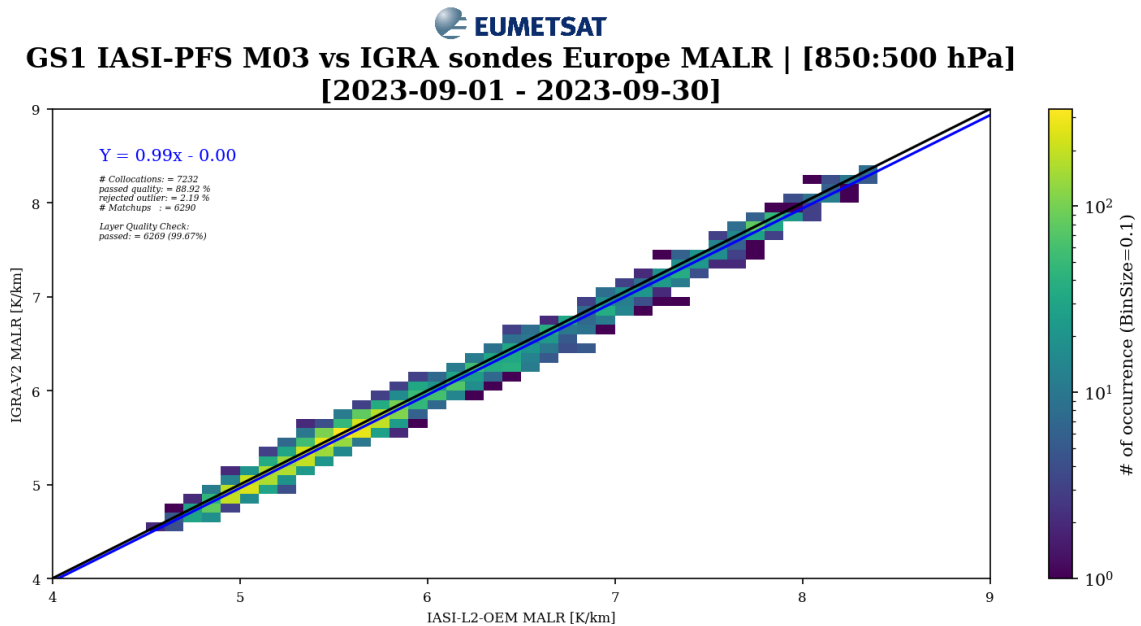


Figure 3.26: Mean Moist Adiabatic Lapse Rate (MA-Lapse Rate) 2D-Histogram (top) and bias and standard deviation as per pre-defined bins of the IGRA reference (bottom) between IASI L2 and IGRA measurements. Regional Europe statistics with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa.

3.5.2 Precipitable Water

3.5.2.1 Total Column

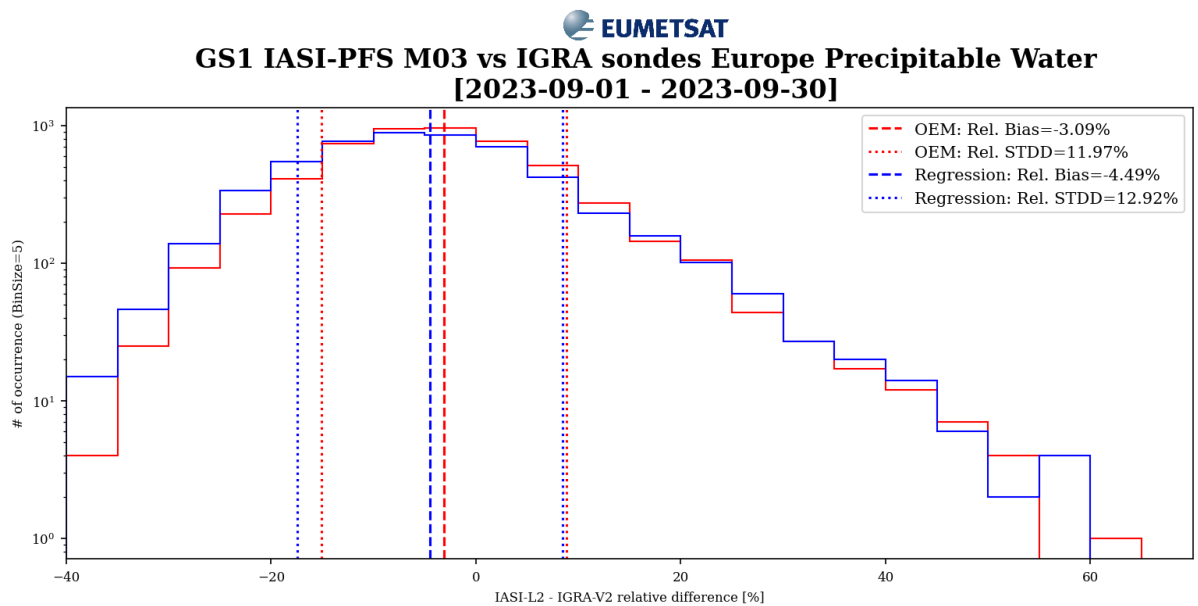
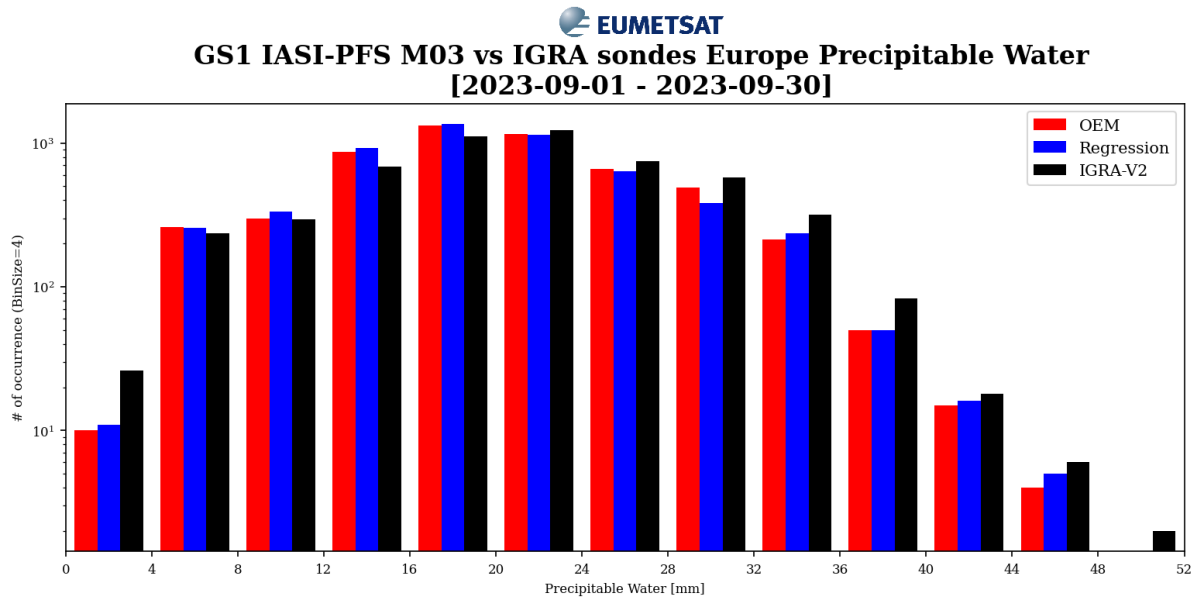


Figure 3.27: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023

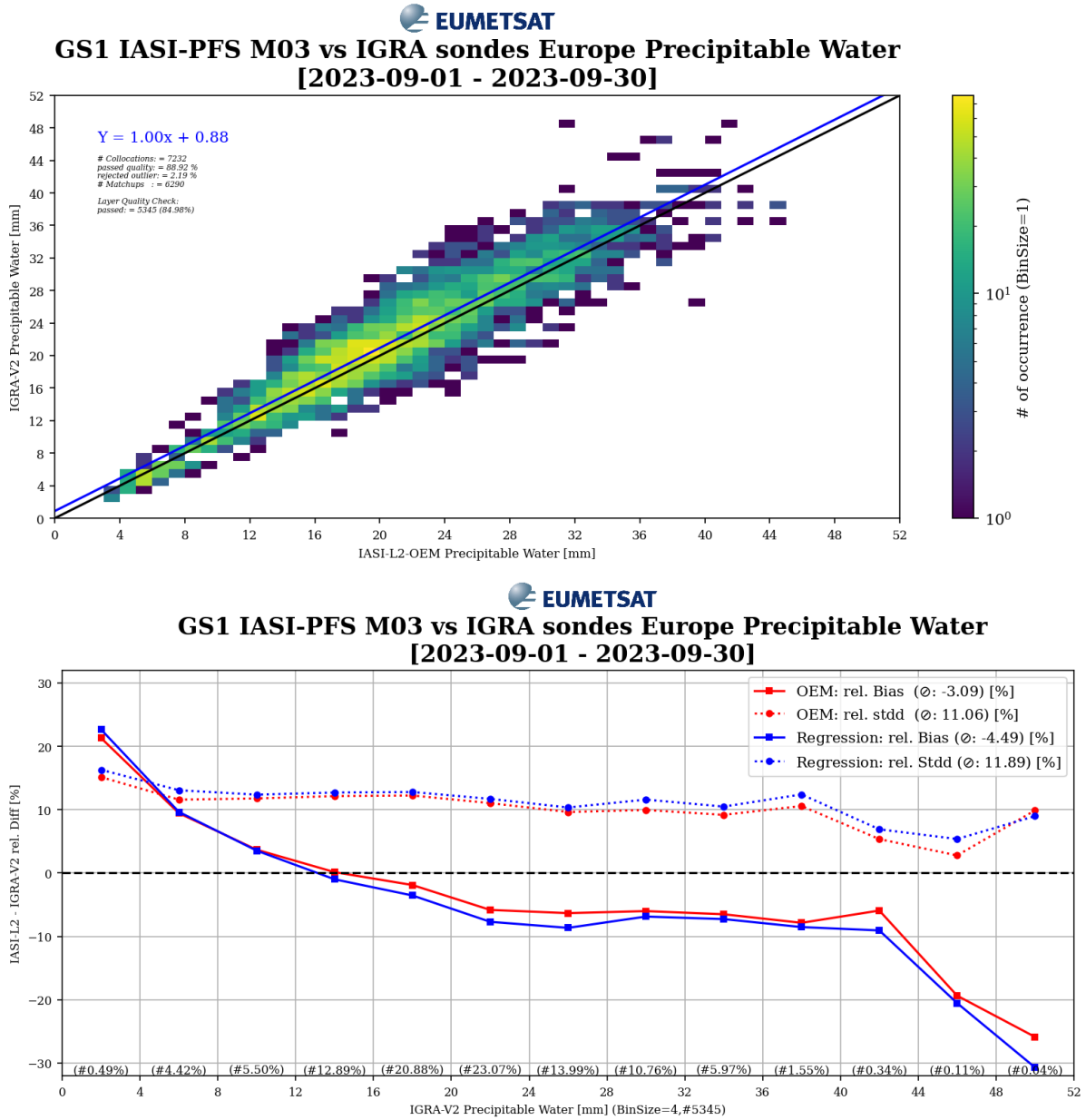


Figure 3.28: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023

3.5.2.2 Layer: 1500m above Surface

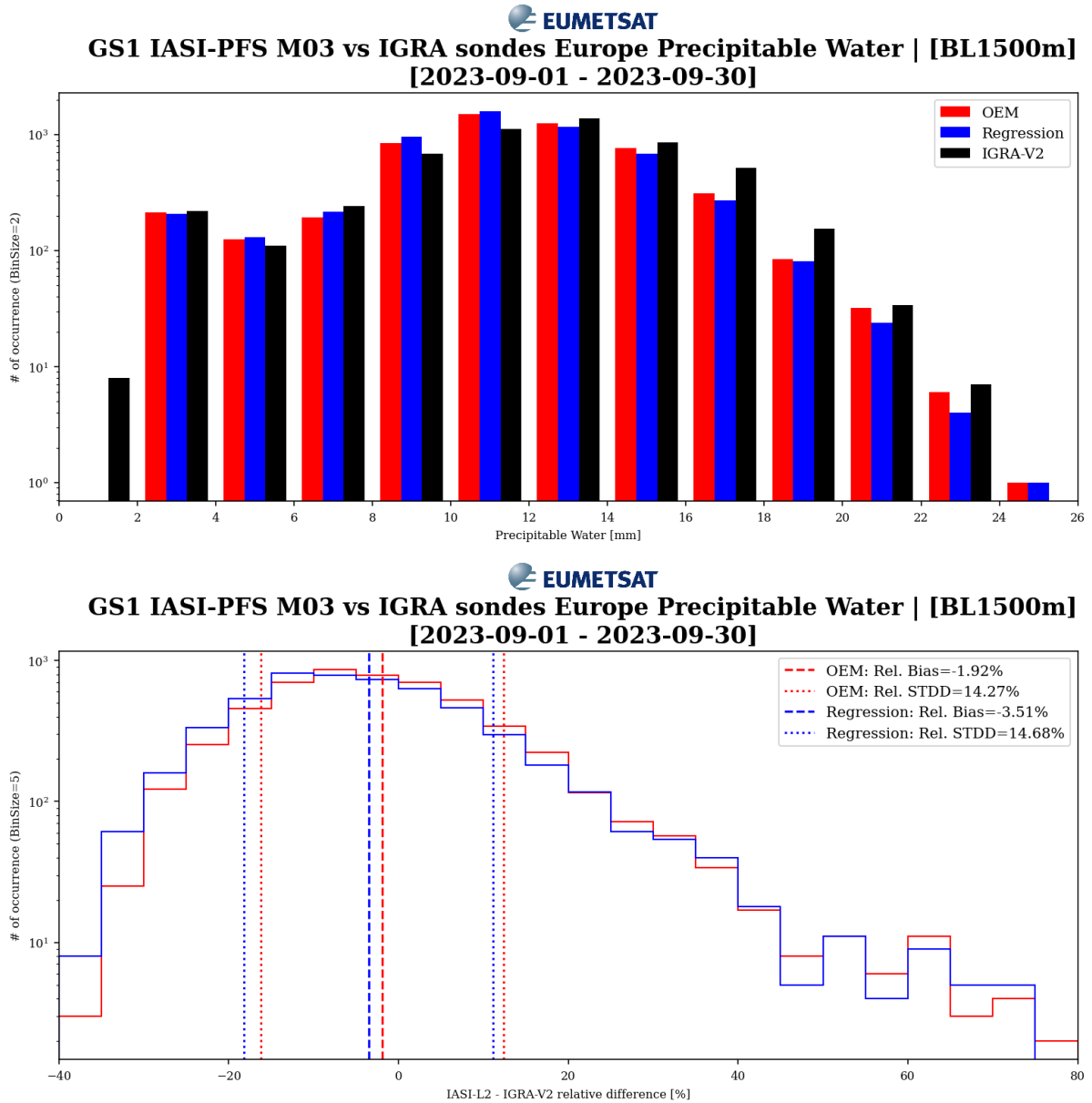
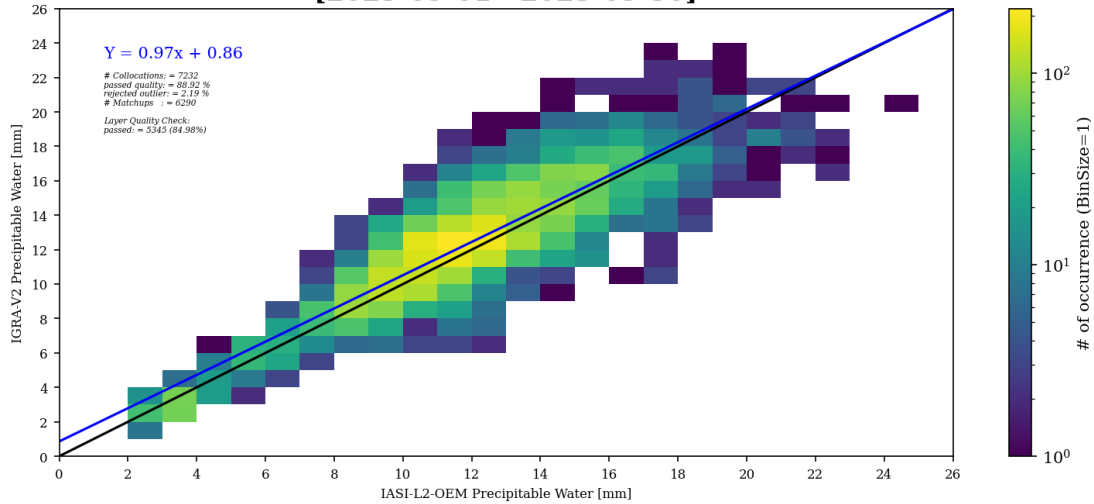


Figure 3.29: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water | [BL1500m]
[2023-09-01 - 2023-09-30]



GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water | [BL1500m]
[2023-09-01 - 2023-09-30]

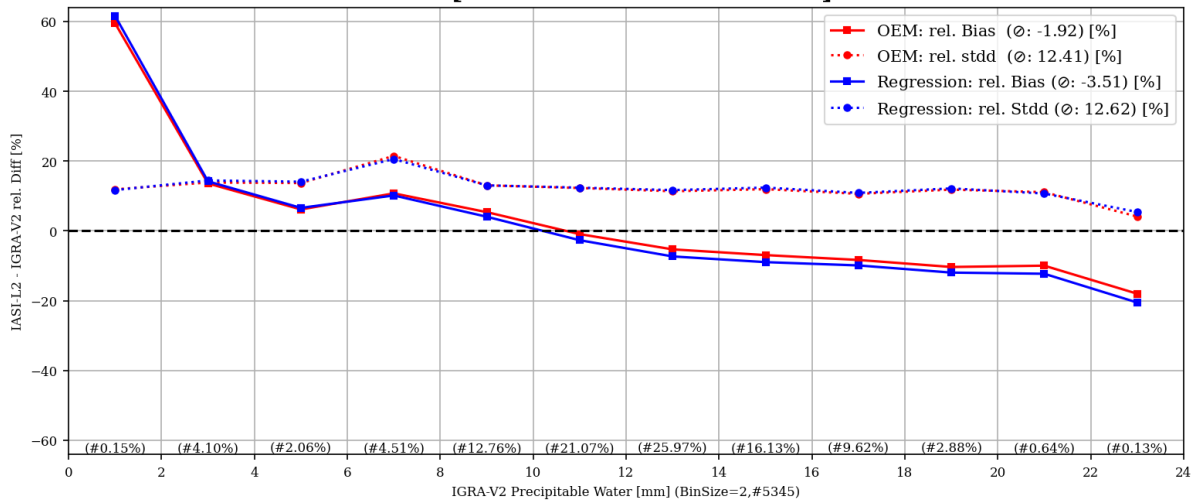


Figure 3.30: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer 1.5 km above the surface.

3.5.2.3 Layer: 850 - 500 hPa

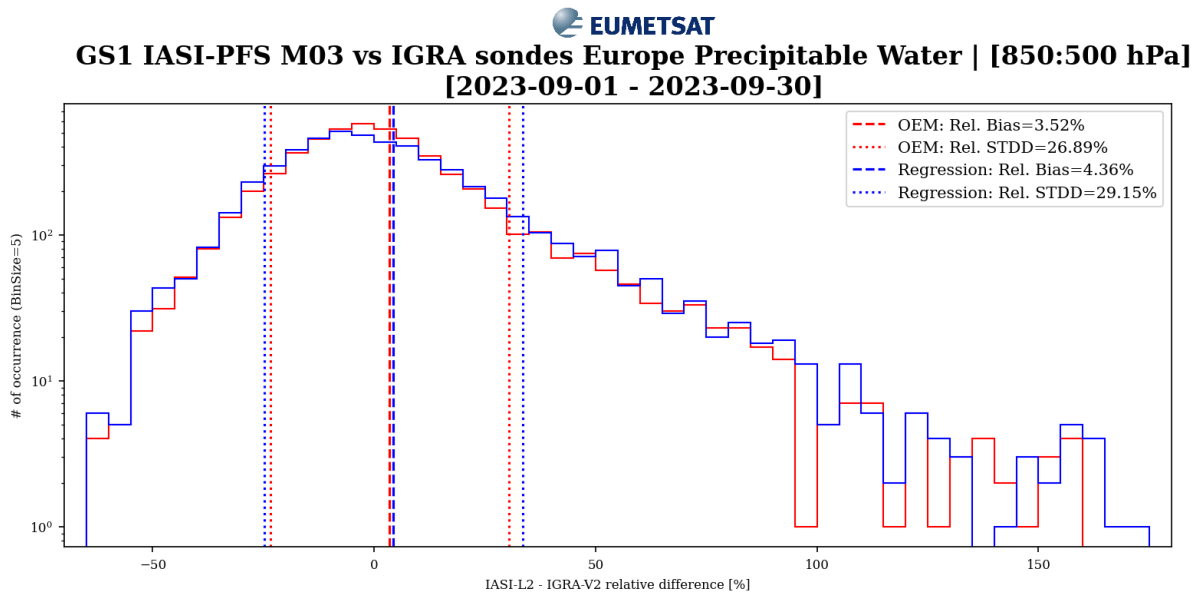
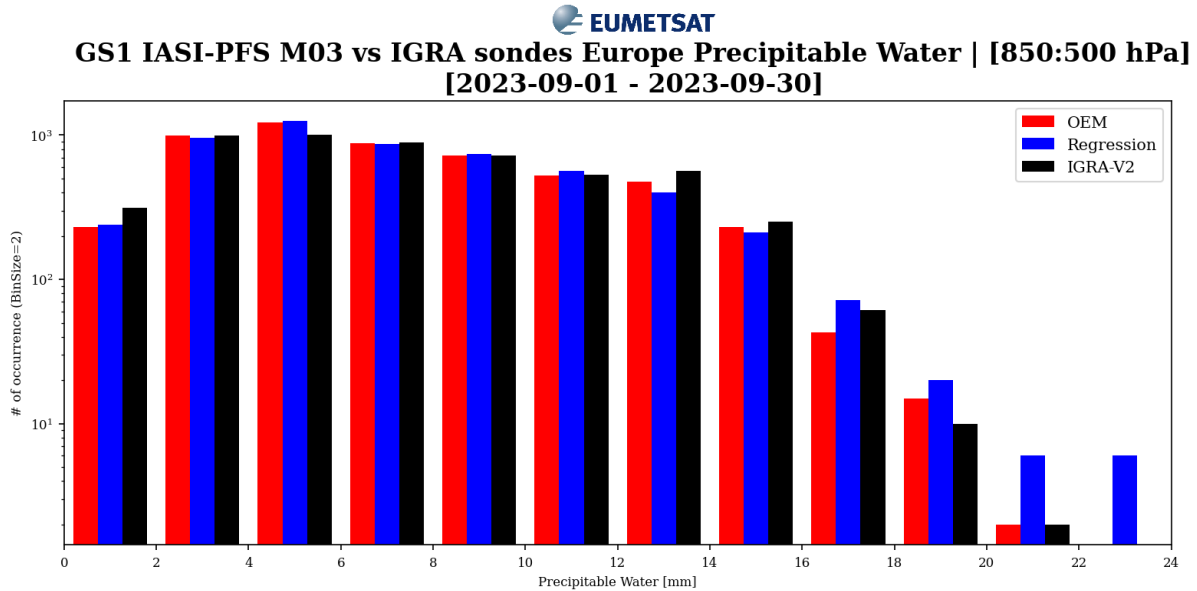
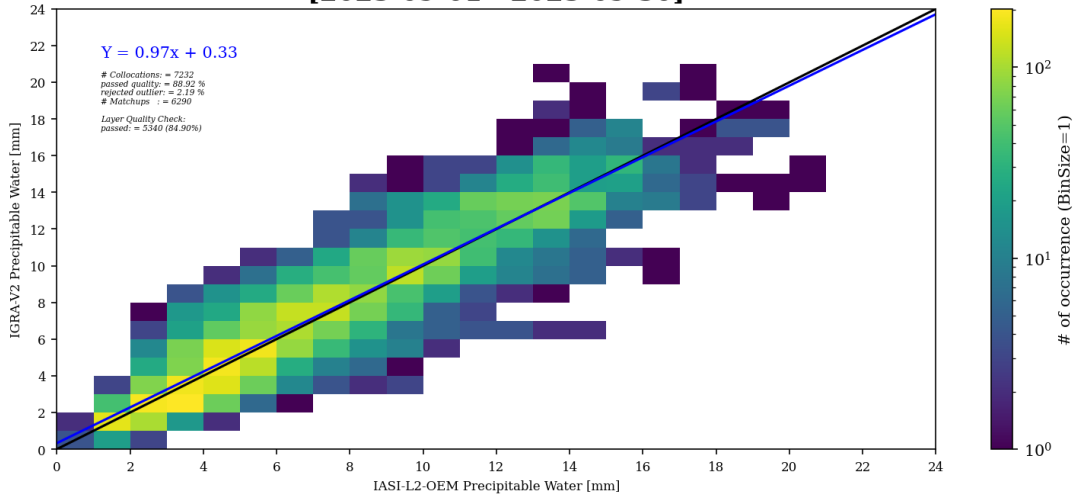


Figure 3.31: Histograms as barcharts mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and IGRA (ylog), with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa

EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water | [850:500 hPa]
[2023-09-01 - 2023-09-30]



EUMETSAT
GS1 IASI-PFS M03 vs IGRA sondes Europe Precipitable Water | [850:500 hPa]
[2023-09-01 - 2023-09-30]

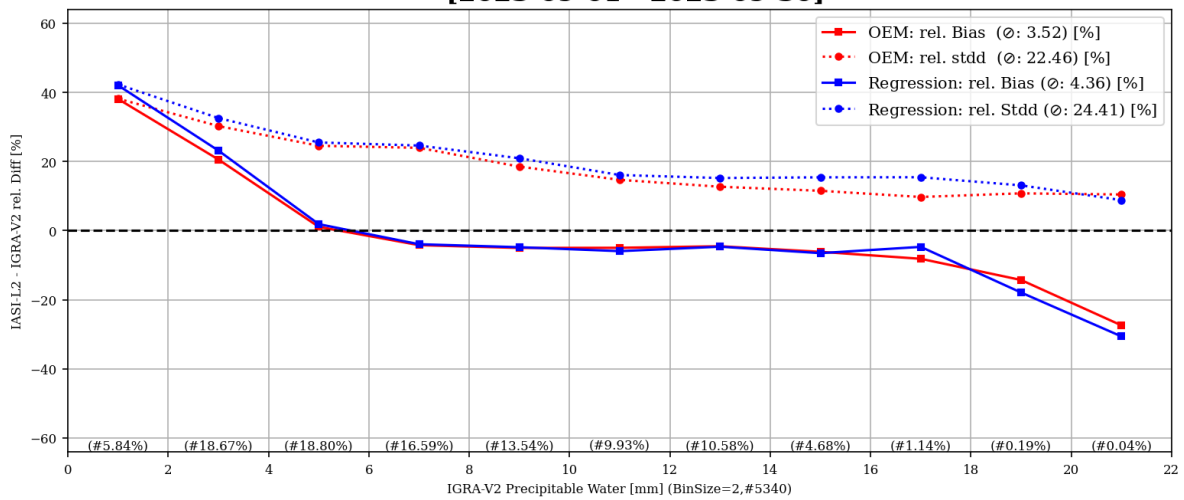


Figure 3.32: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the IGRA reference (bottom) between IASI L2 Precipitable Water and IGRA measurements, with M03 IASI L2 from GS1 for 01-30/09/2023 for the layer from 850 to 500 hPa

3.5.2.4 Collocational dependencies

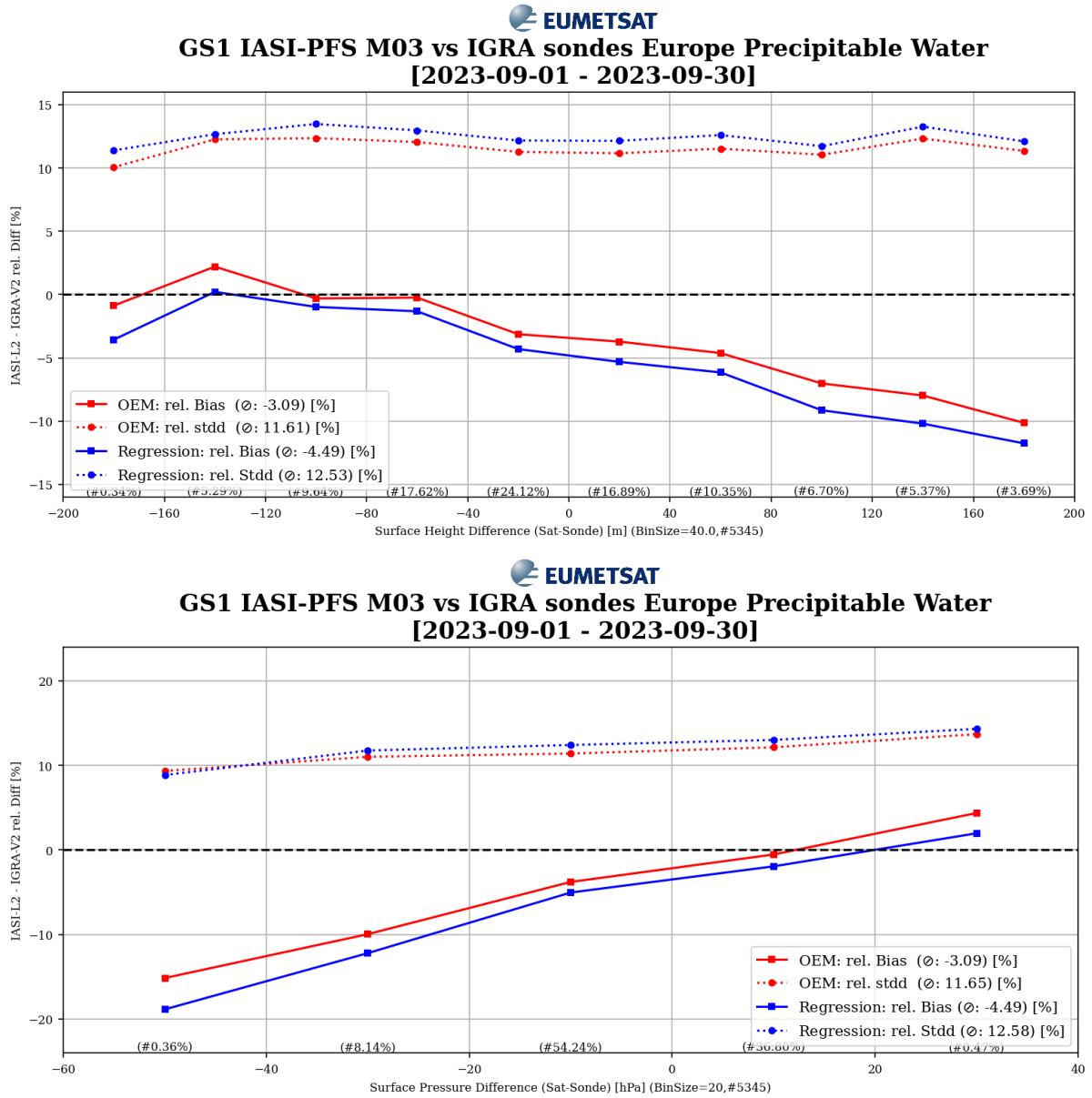


Figure 3.33: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 for different surface height (top) and surface pressure differences (bottom).

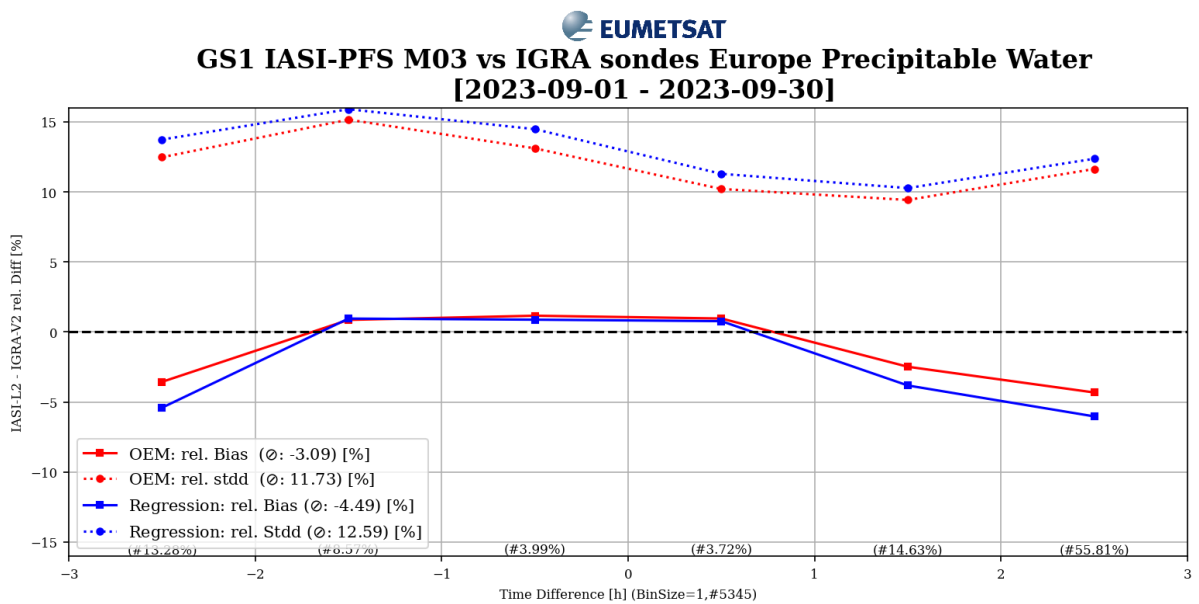
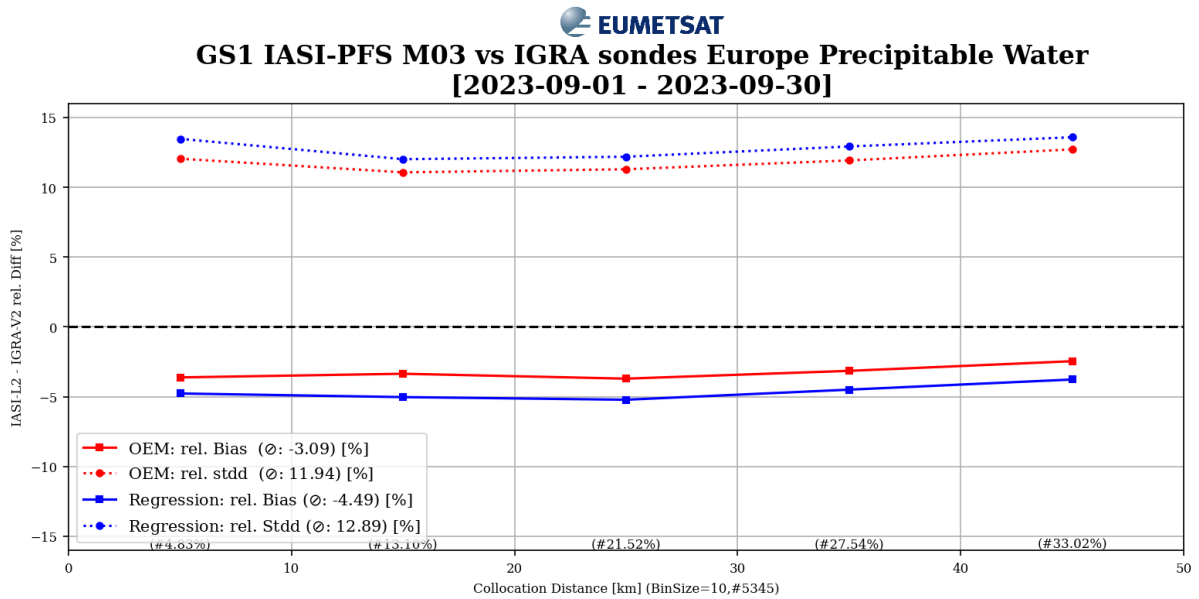


Figure 3.34: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 for different collocation spatial distances (top) and temporal differences (bottom).

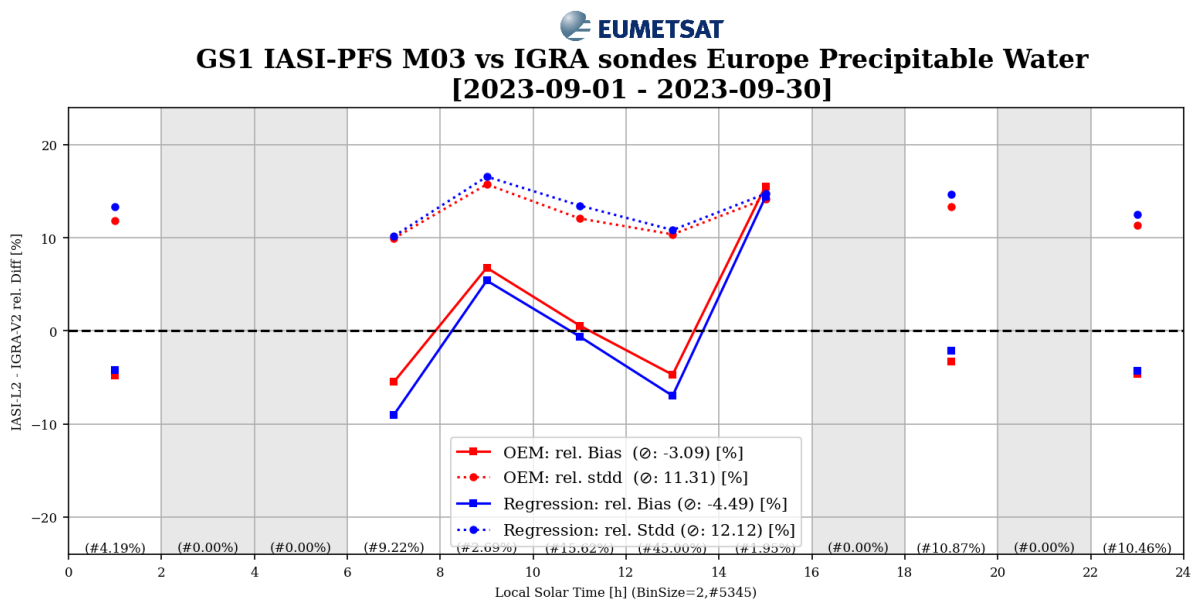
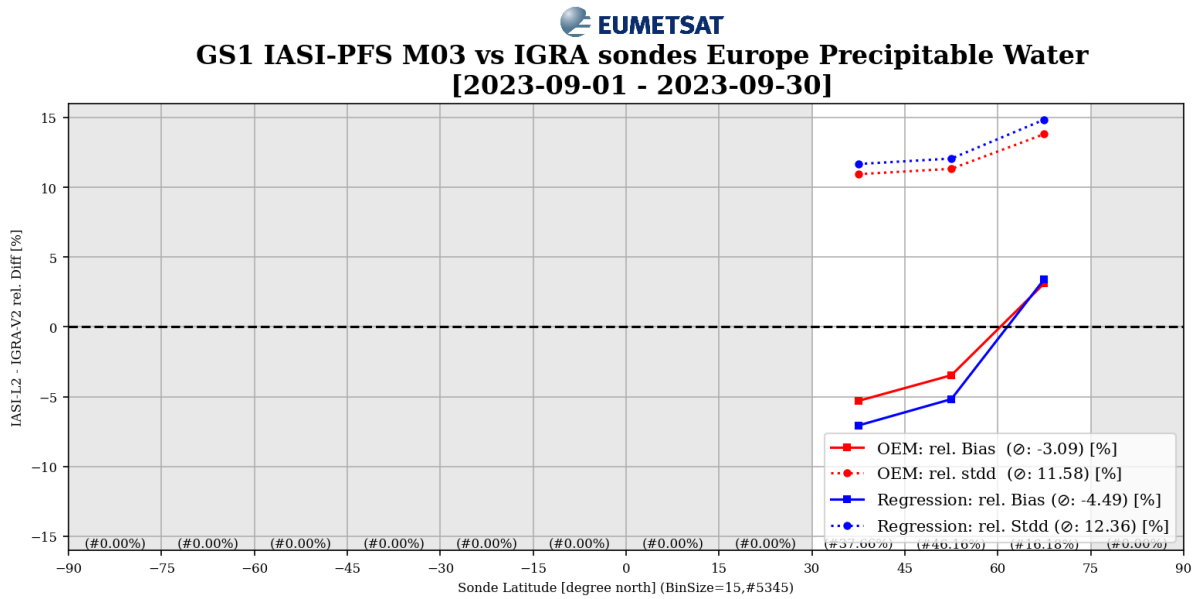


Figure 3.35: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 for different latitudes (top) and local solar times (bottom).

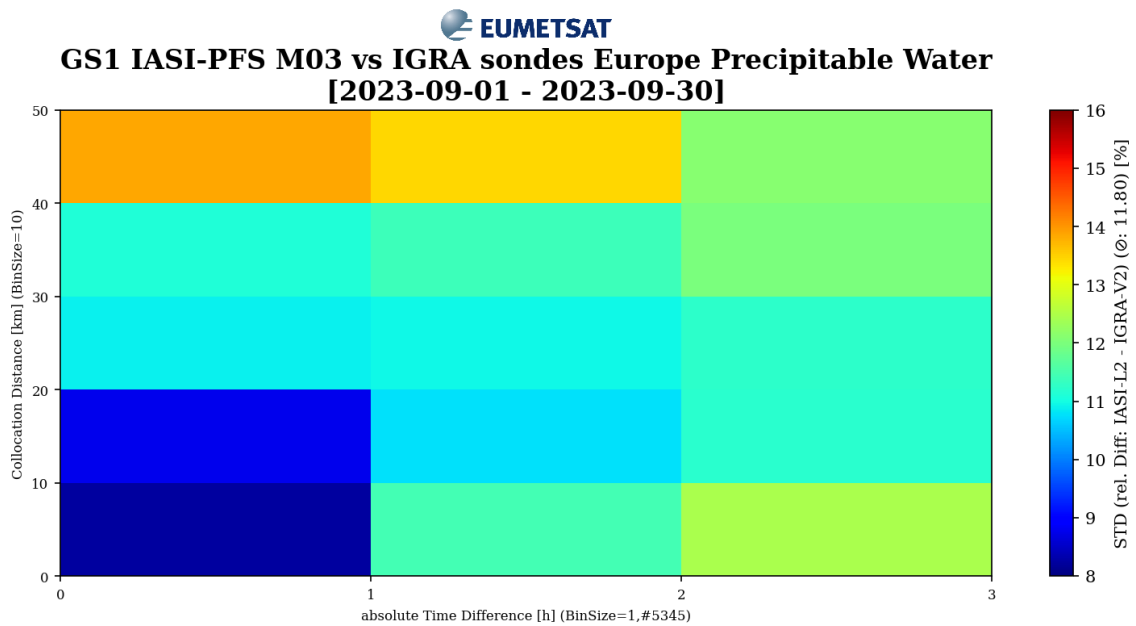
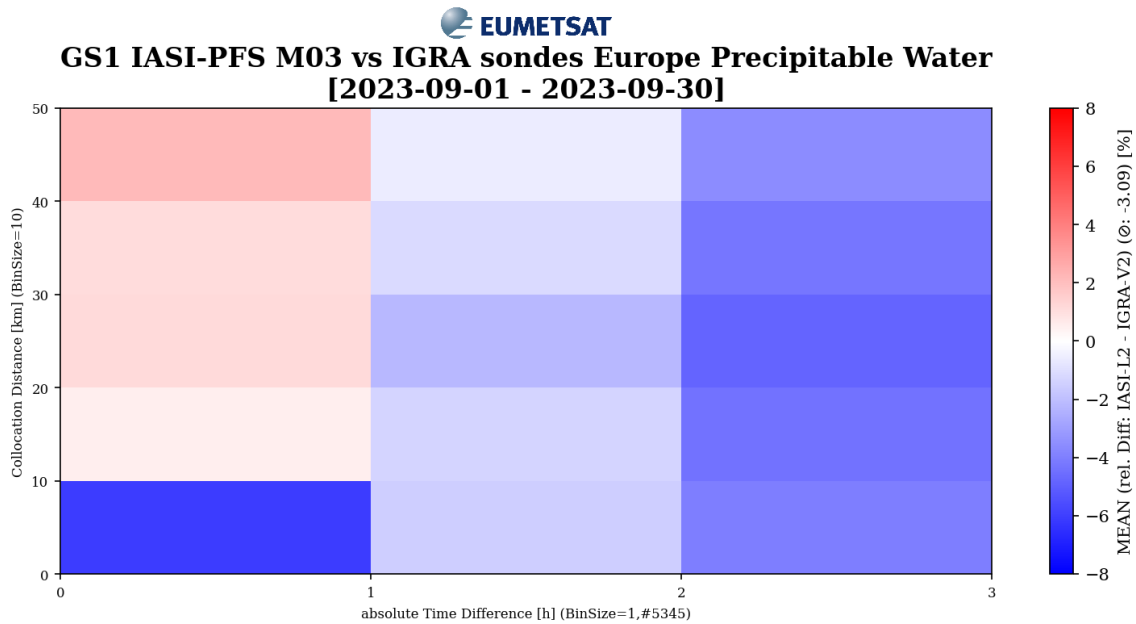


Figure 3.36: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of collocation temporal difference and spatial distances.

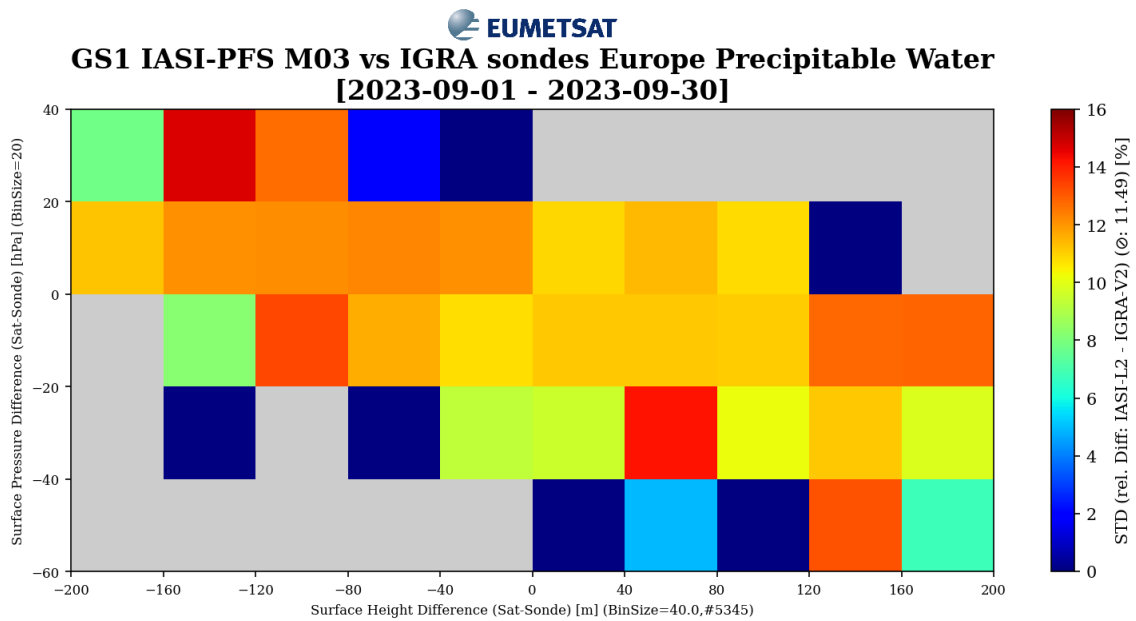
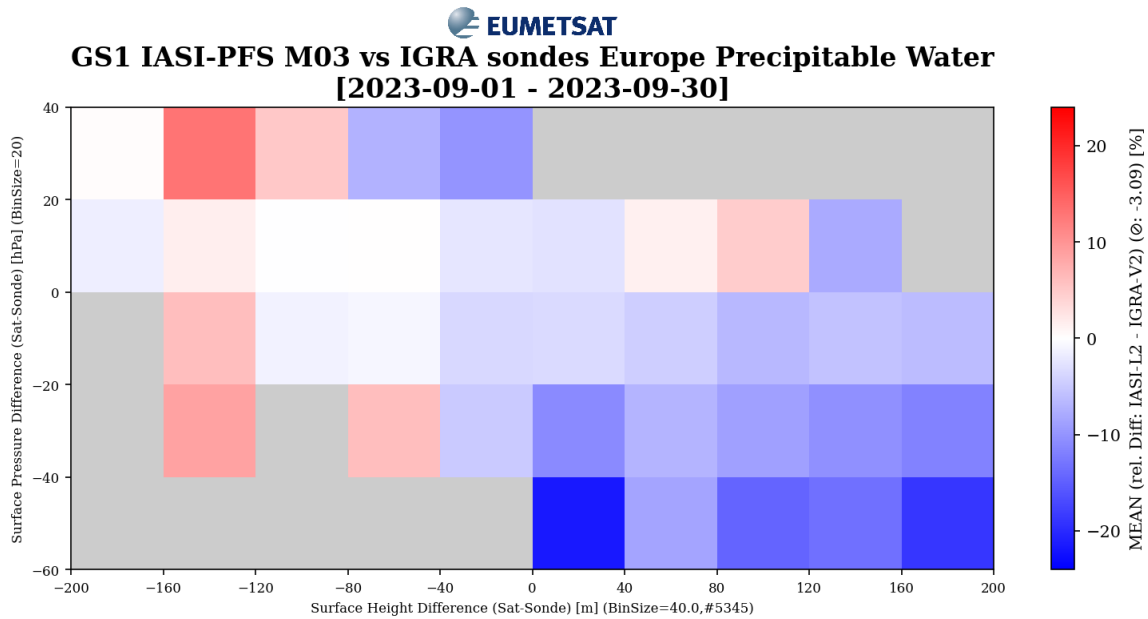


Figure 3.37: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of Surface Pressure Difference and Surface Pressure Difference.

3.5.2.5 Angular dependencies

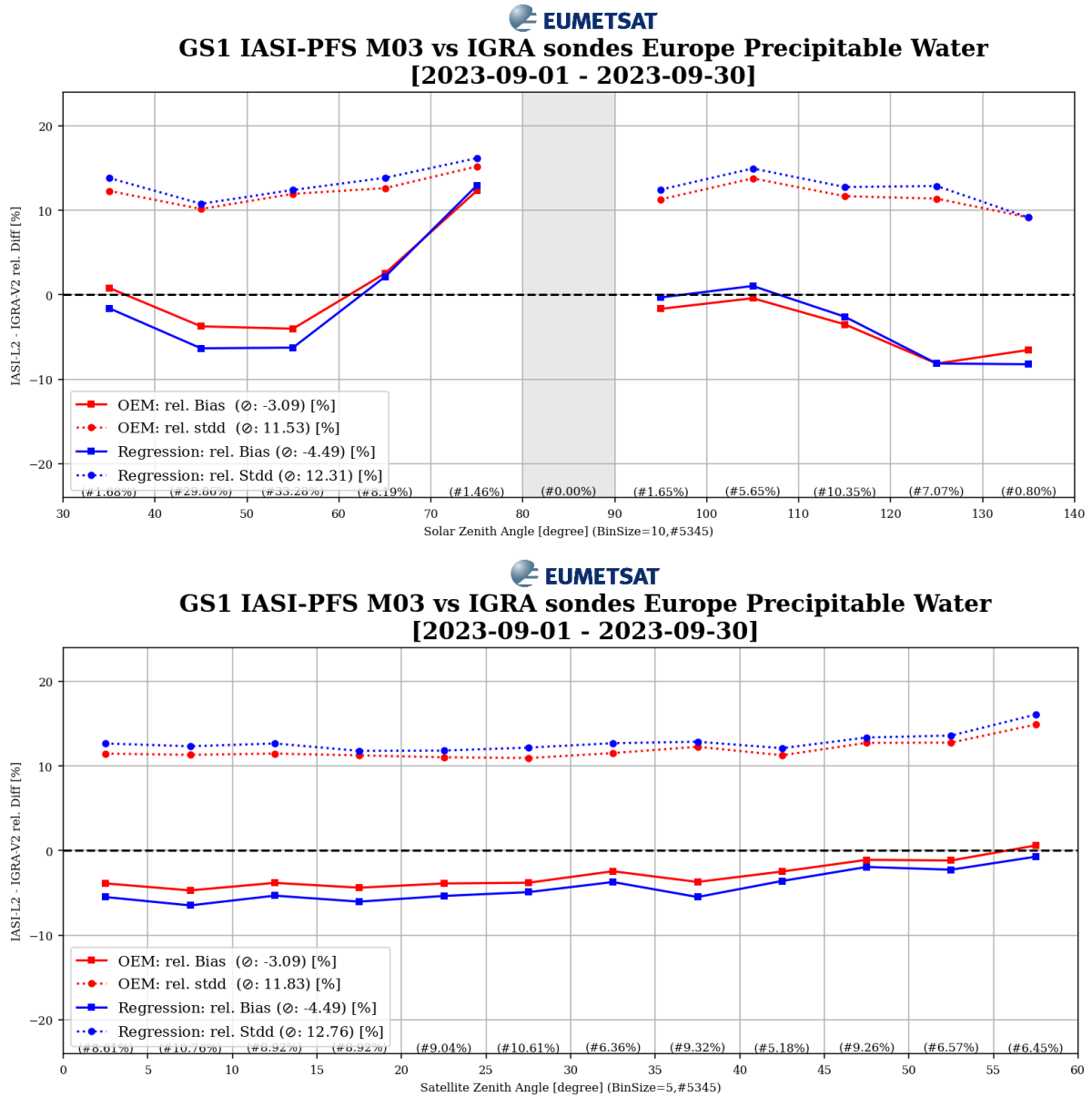


Figure 3.38: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and IGRA (ylog), for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 for different sun zenith angles (top) and satellite zenith angles (bottom).

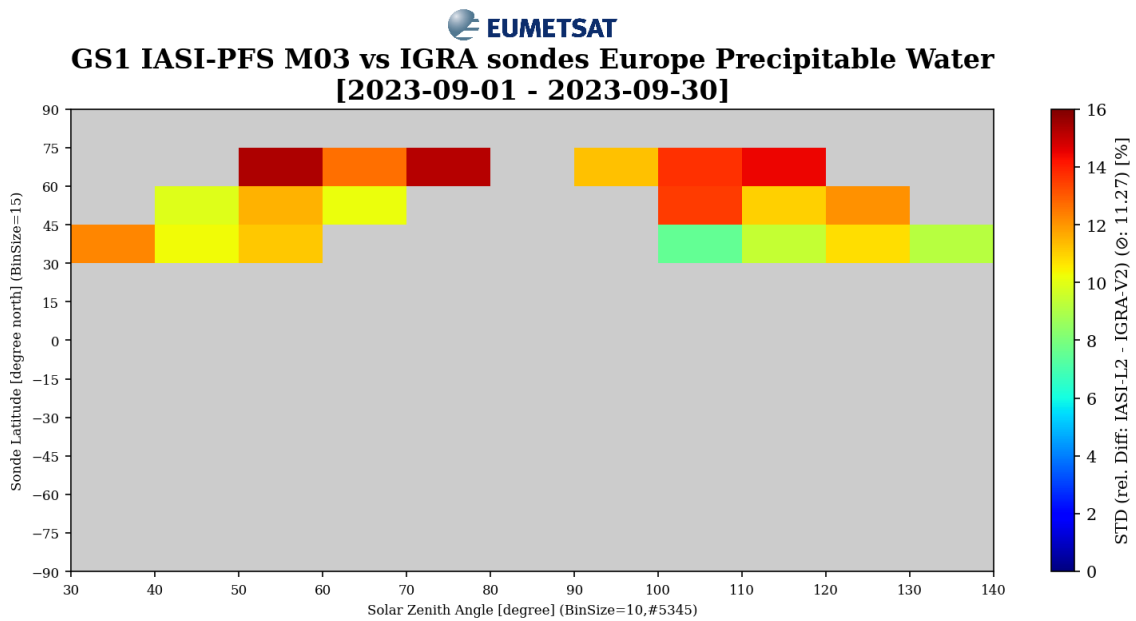
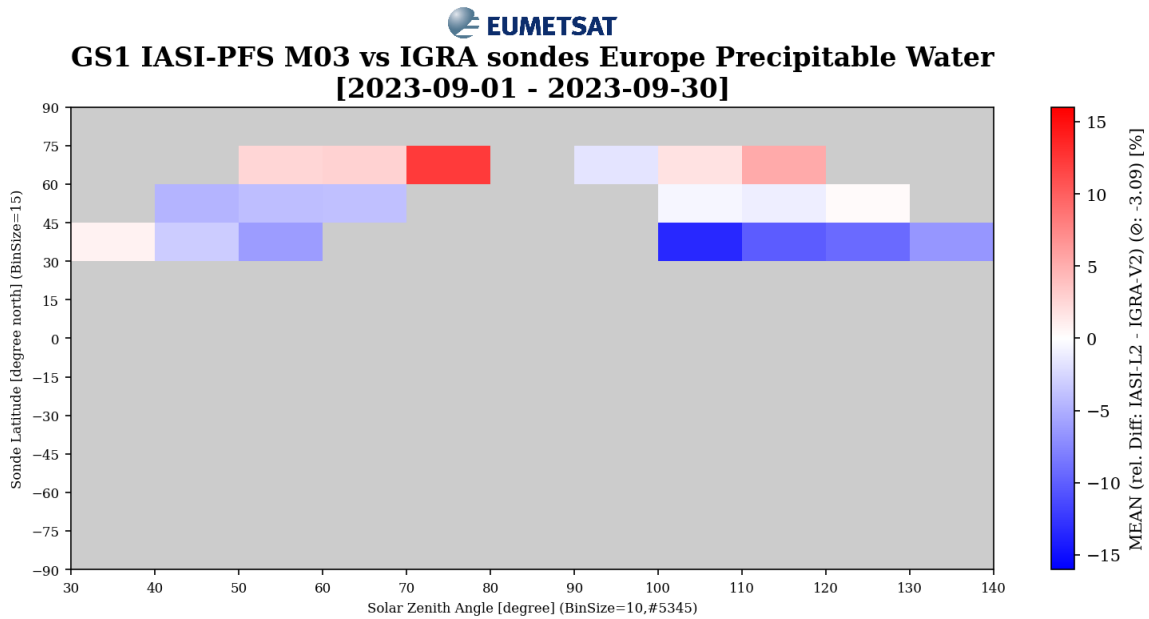


Figure 3.39: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and IGRA measurements, for Europe with M03 IASI L2 from GS1 for 01-30/09/2023 dependent of sun zenith angles and latitude.

4 GLOBAL MONTHLY STATISTICS PER STATION

4.1 Humidity difference maps

4.1.1 Layer: 100 - 10 hPa

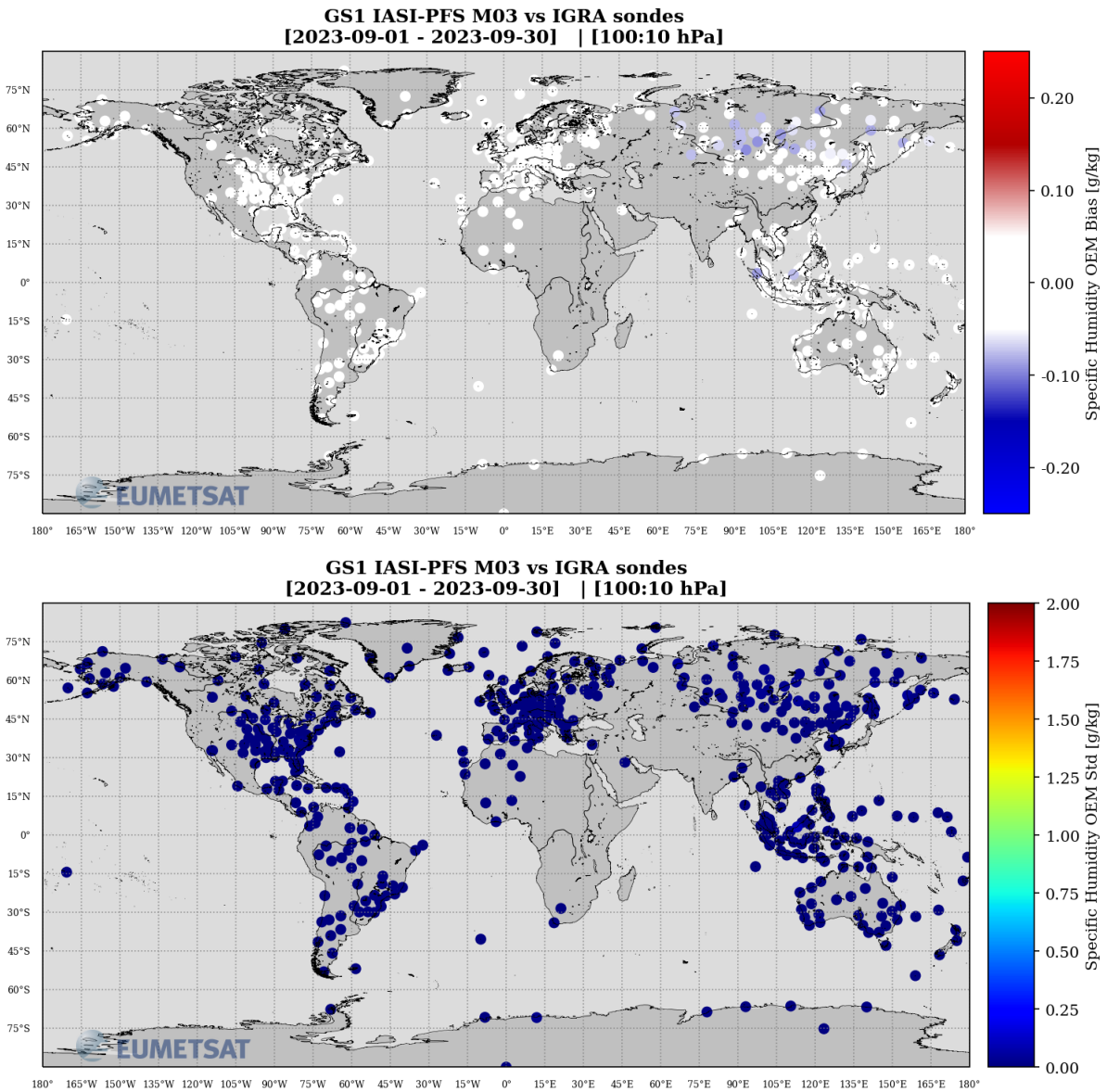


Figure 4.1: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [10-100hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.1.2 Layer: 200 - 100 hPa

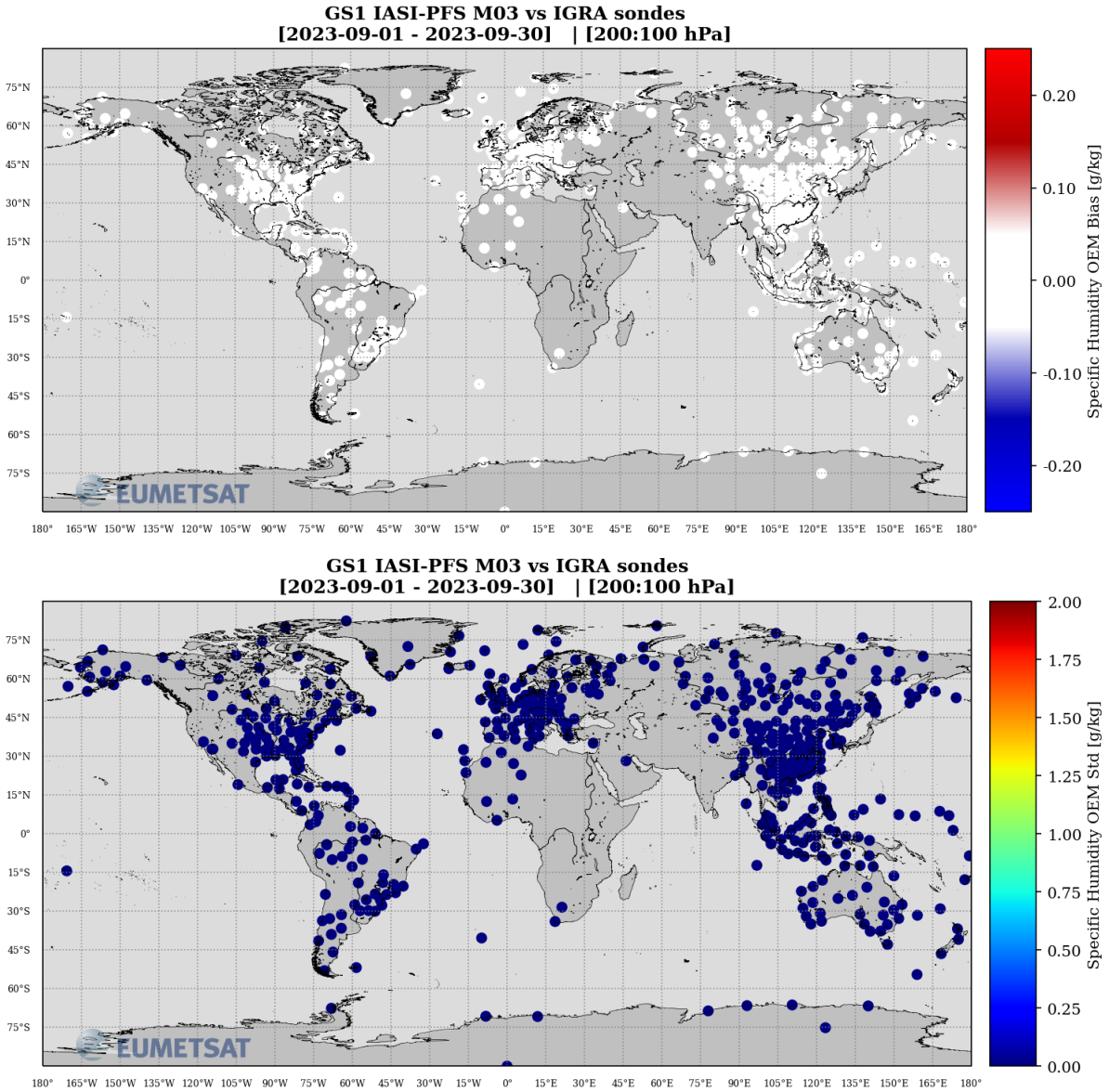


Figure 4.2: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [100-200hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.1.3 Layer: 400 - 200 hPa

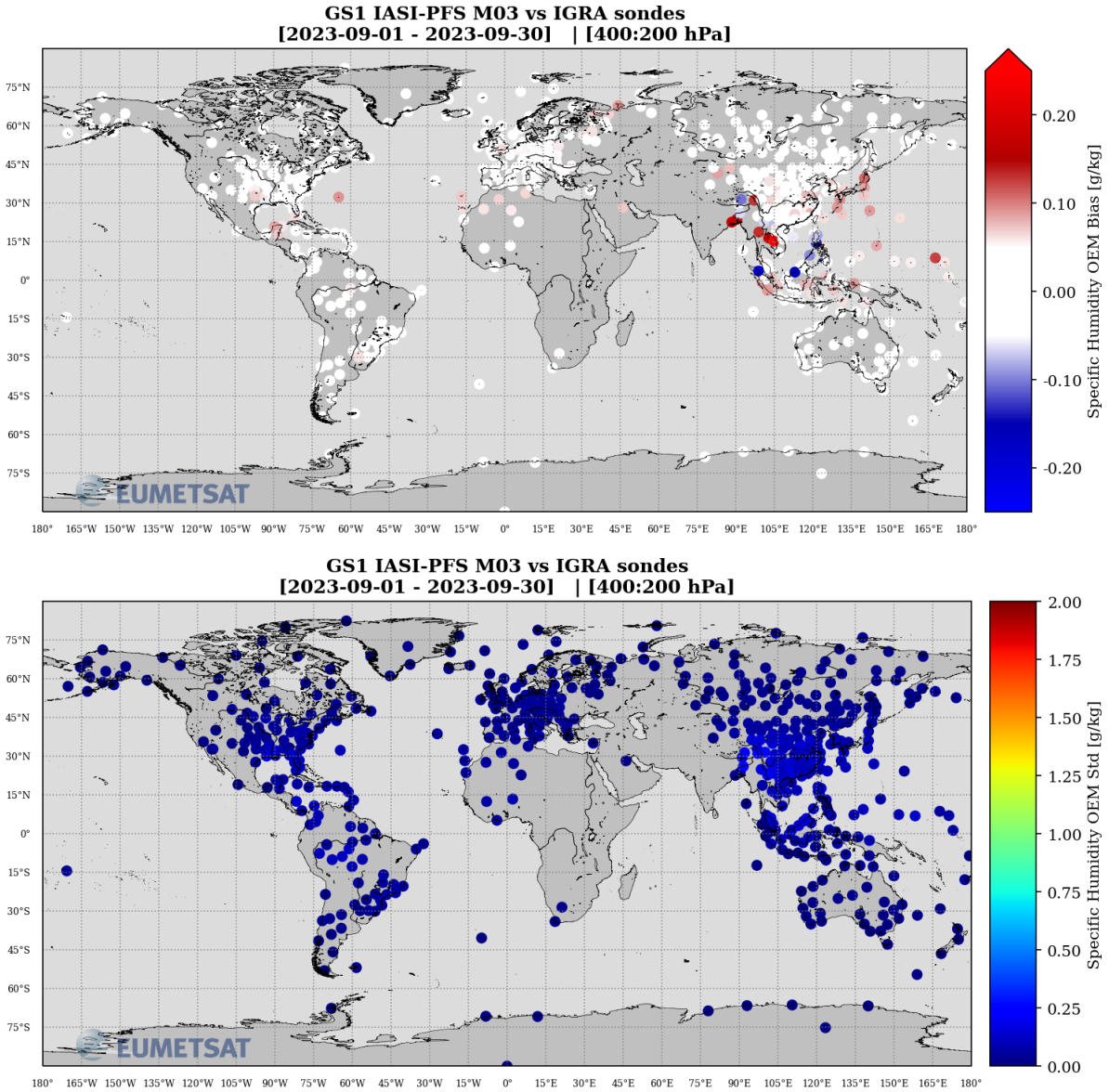


Figure 4.3: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [200-400hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.1.4 Layer: 600 - 400 hPa

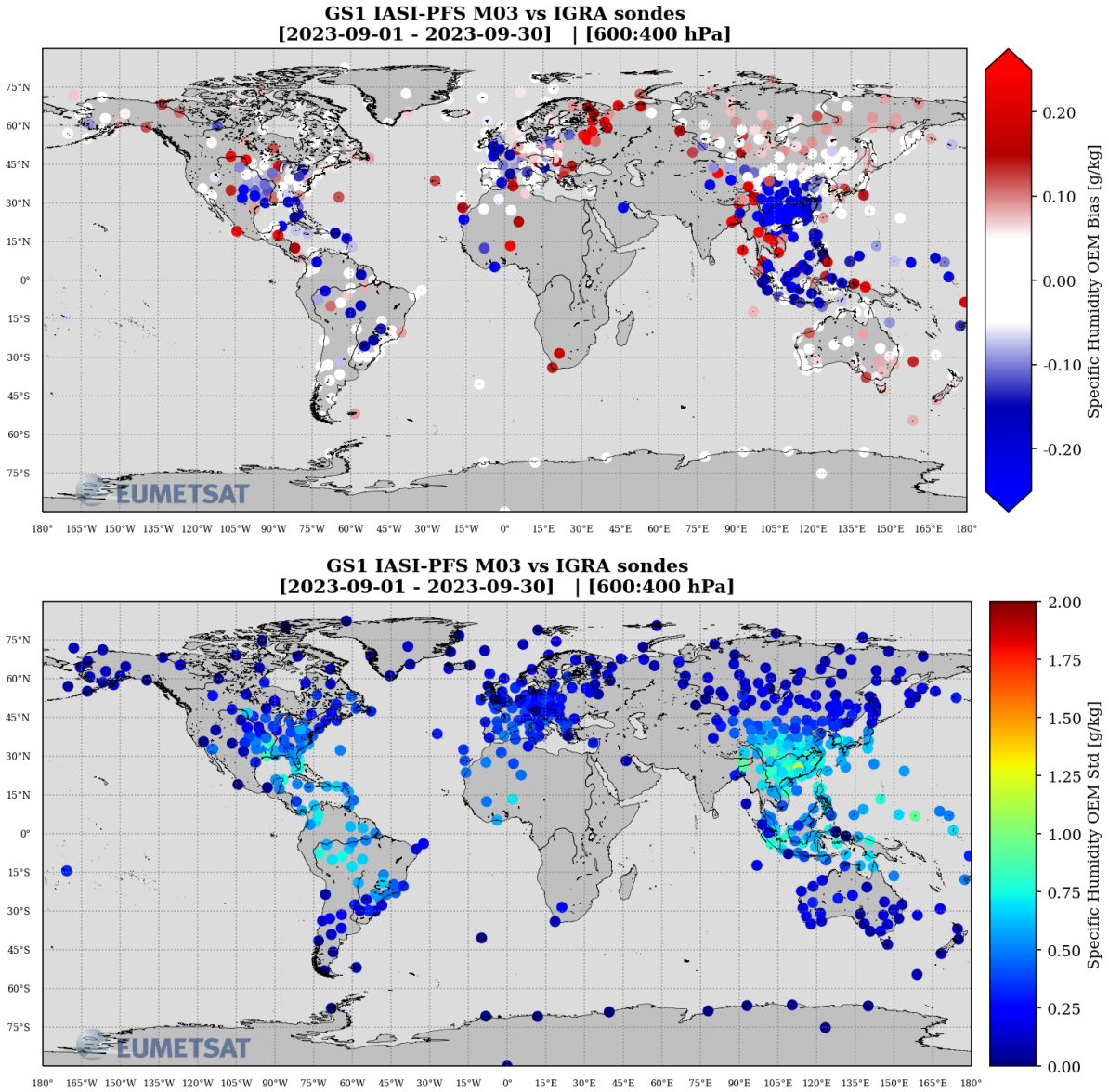


Figure 4.4: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [400-600hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.1.5 Layer: 800 - 600 hPa

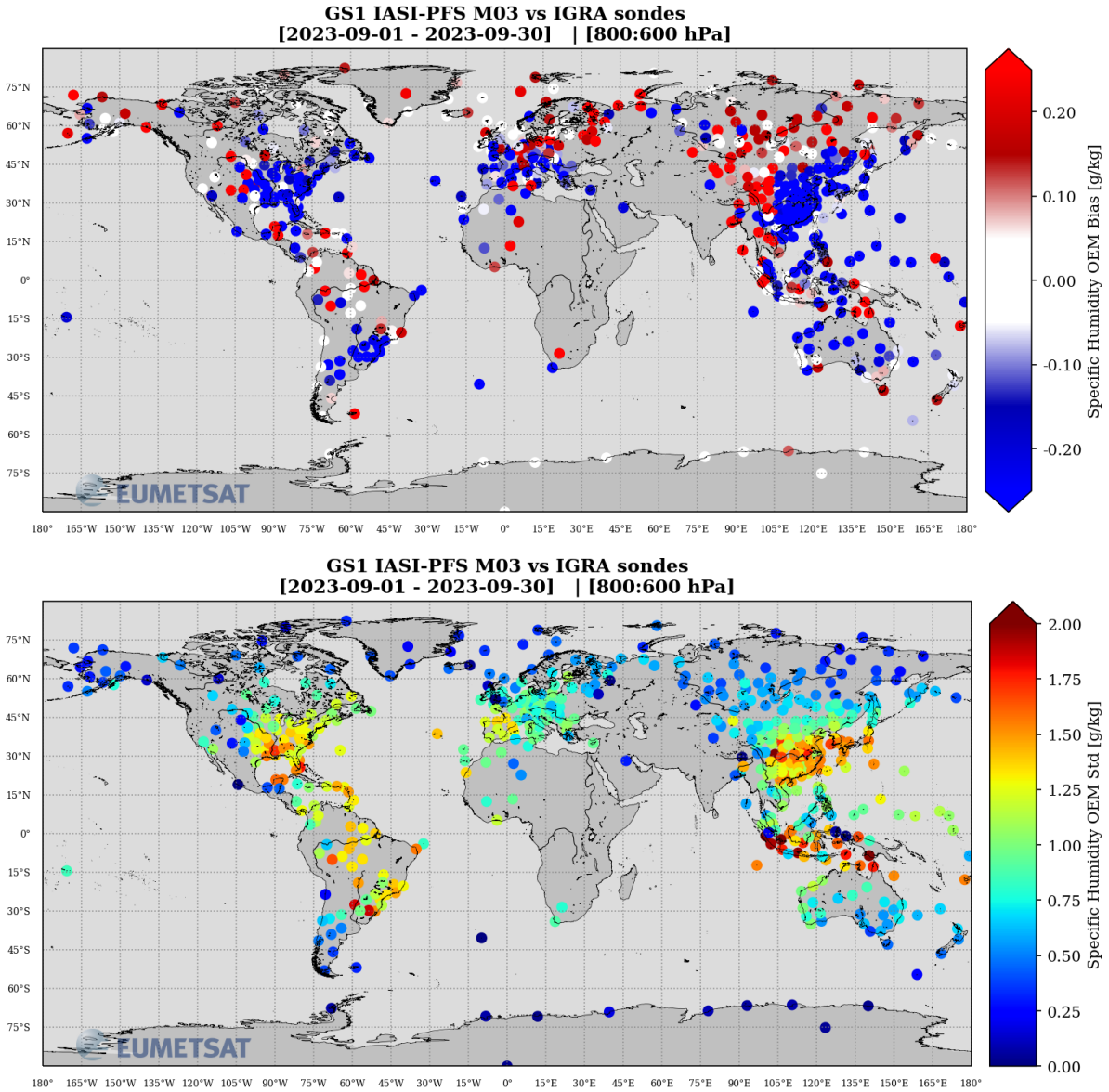


Figure 4.5: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [600-800hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.1.6 Layer:1000 - 800 hPa

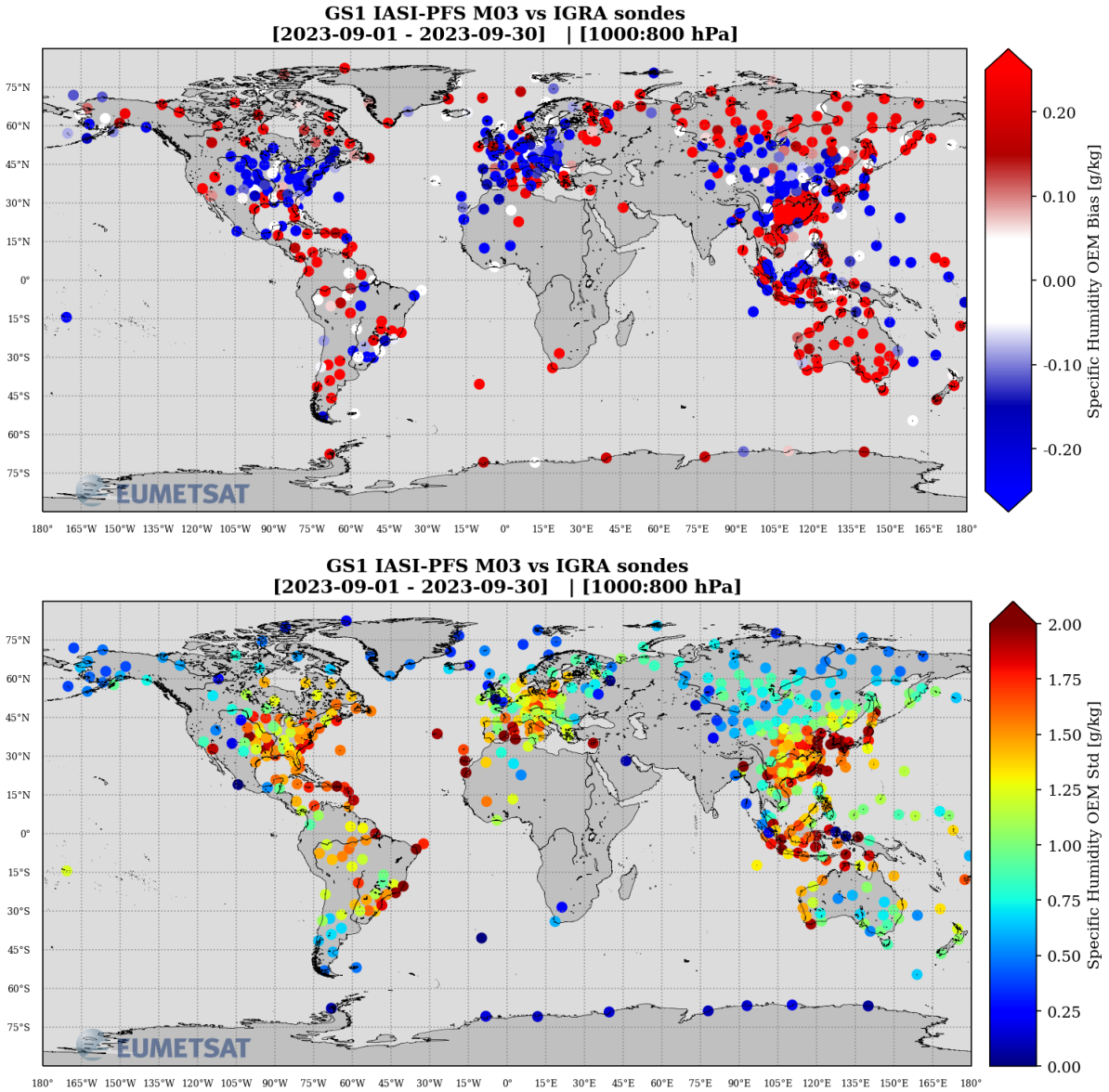


Figure 4.6: Maps of humidity mean (top) differences and standard deviation (bottom) between IASI L2 humidity and sondes in the layer [800-1000hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2 Temperature difference maps

4.2.1 Layer: 100 - 10 hPa

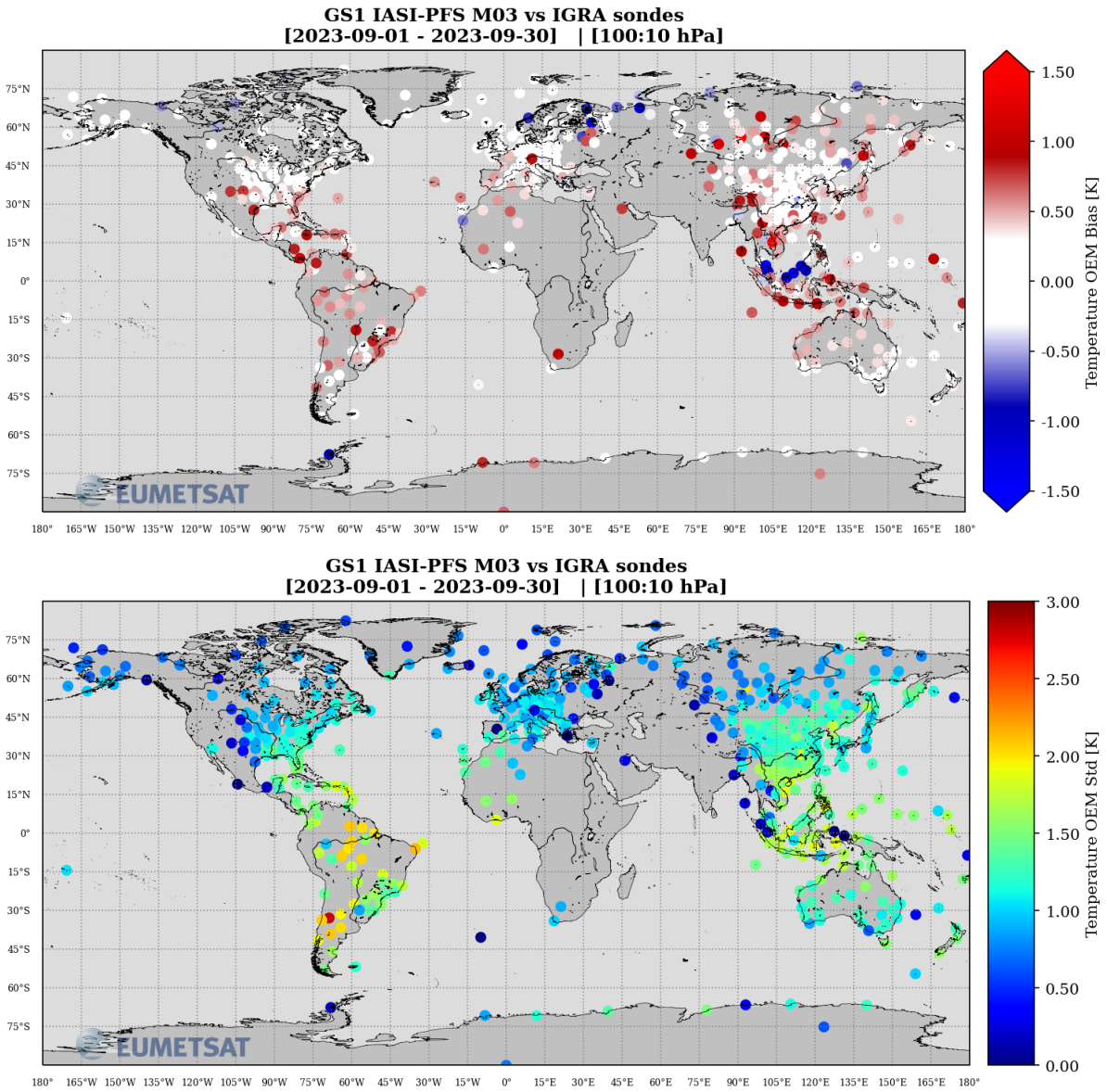


Figure 4.7: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [10-100hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2.2 Layer: 200 - 100 hPa

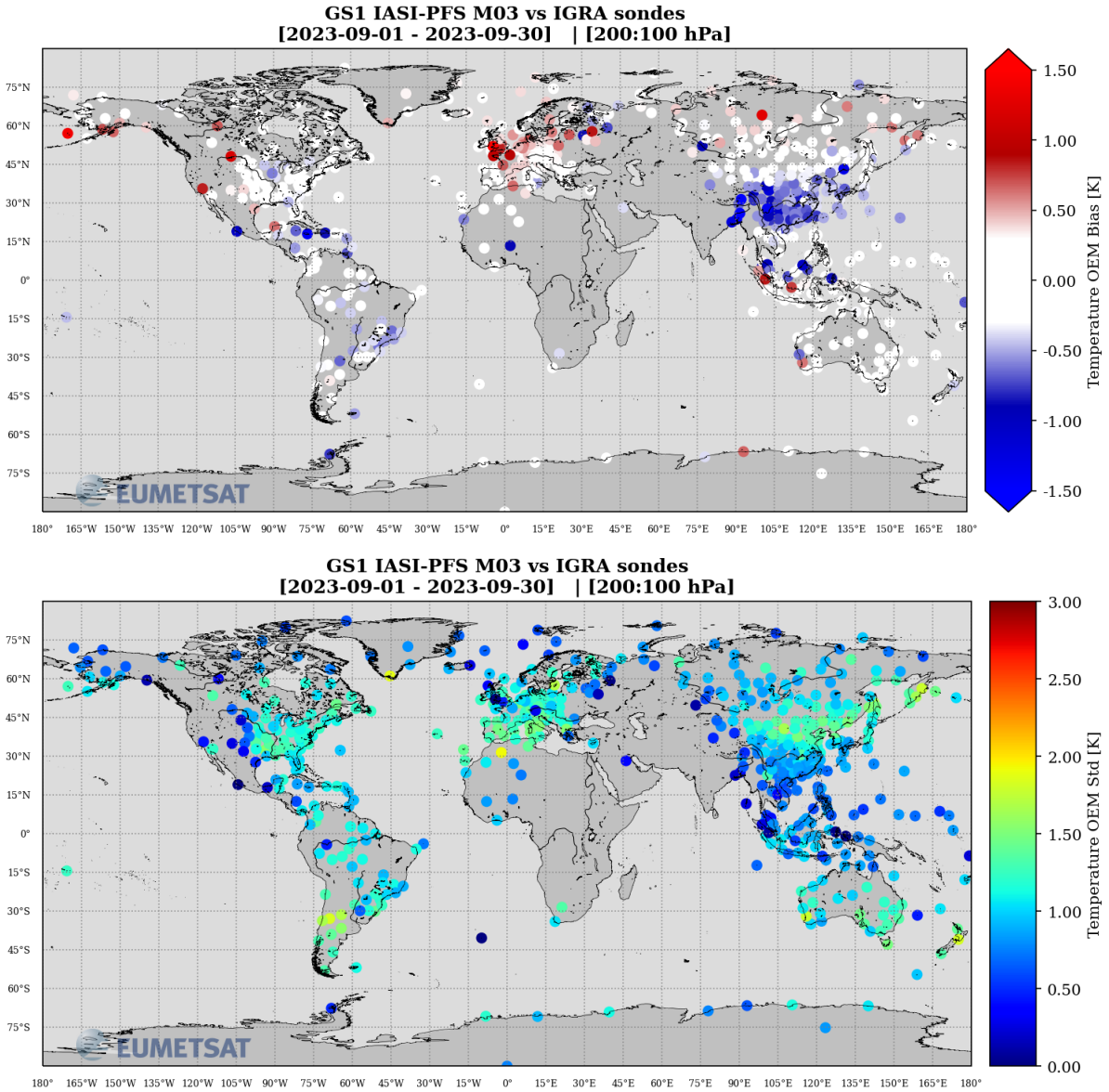


Figure 4.8: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [100-200hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2.3 Layer: 400 - 200 hPa

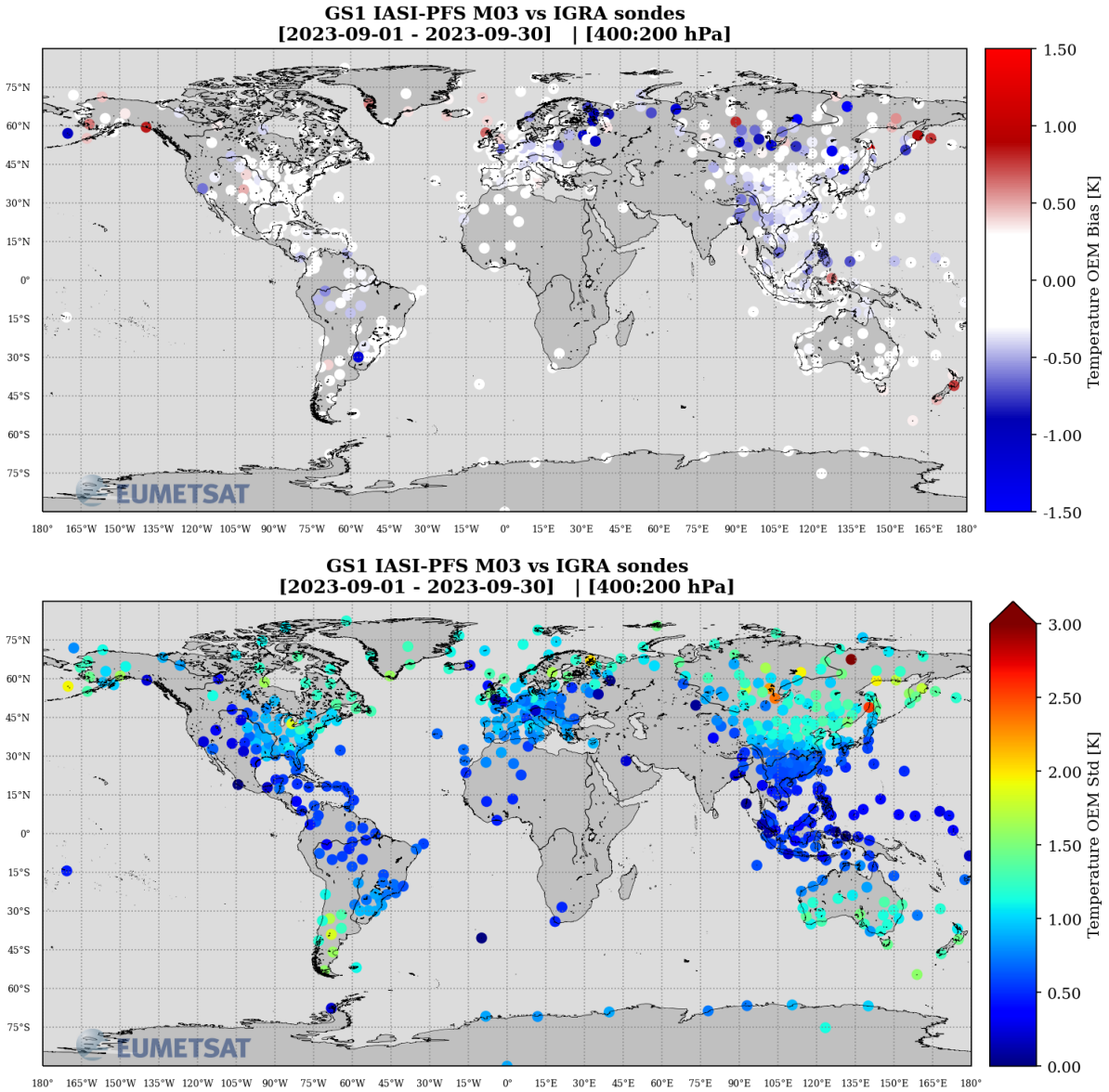


Figure 4.9: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [200-400hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2.4 Layer: 600 - 400 hPa

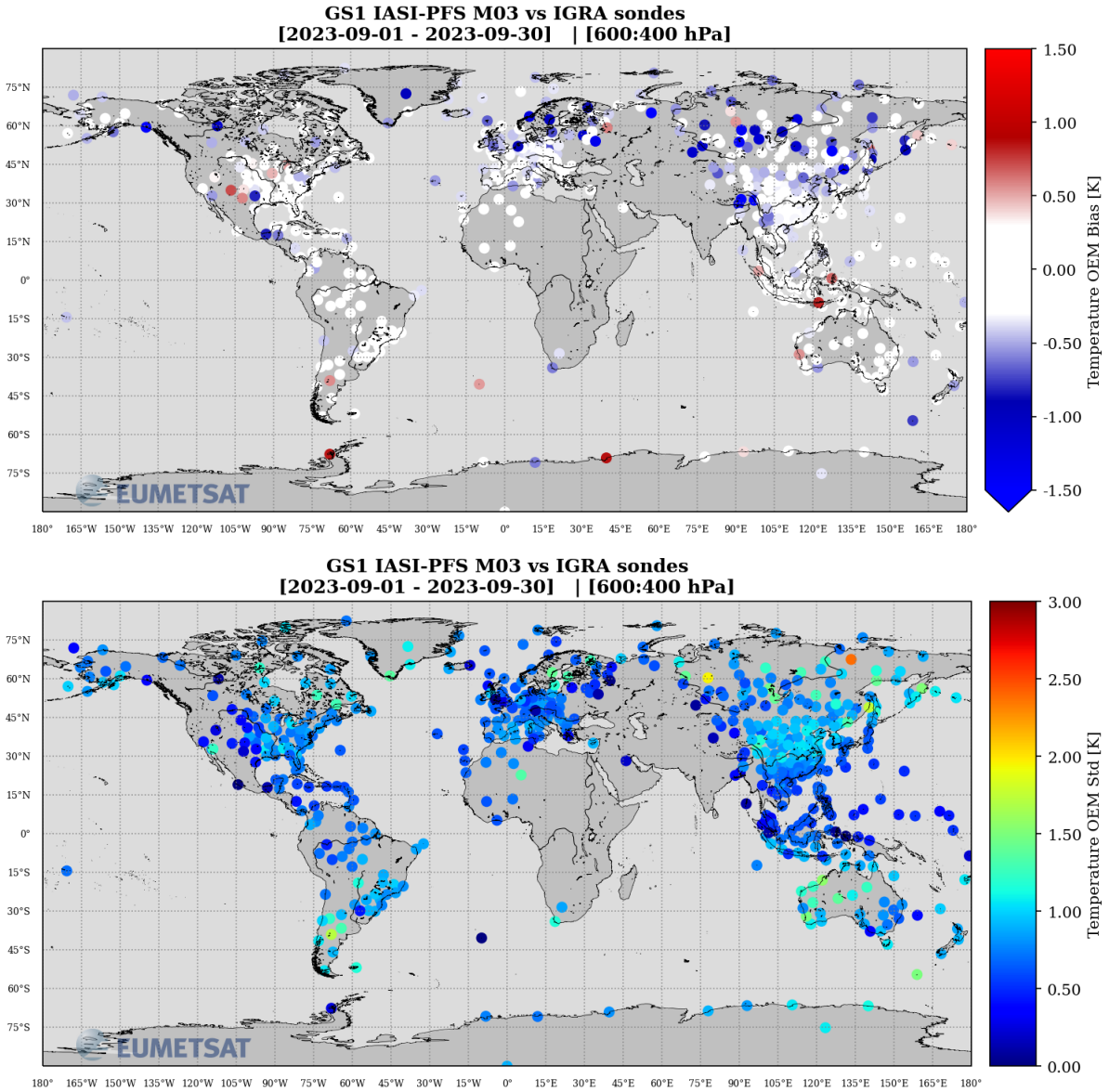


Figure 4.10: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [400-600hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2.5 Layer: 800 - 600 hPa

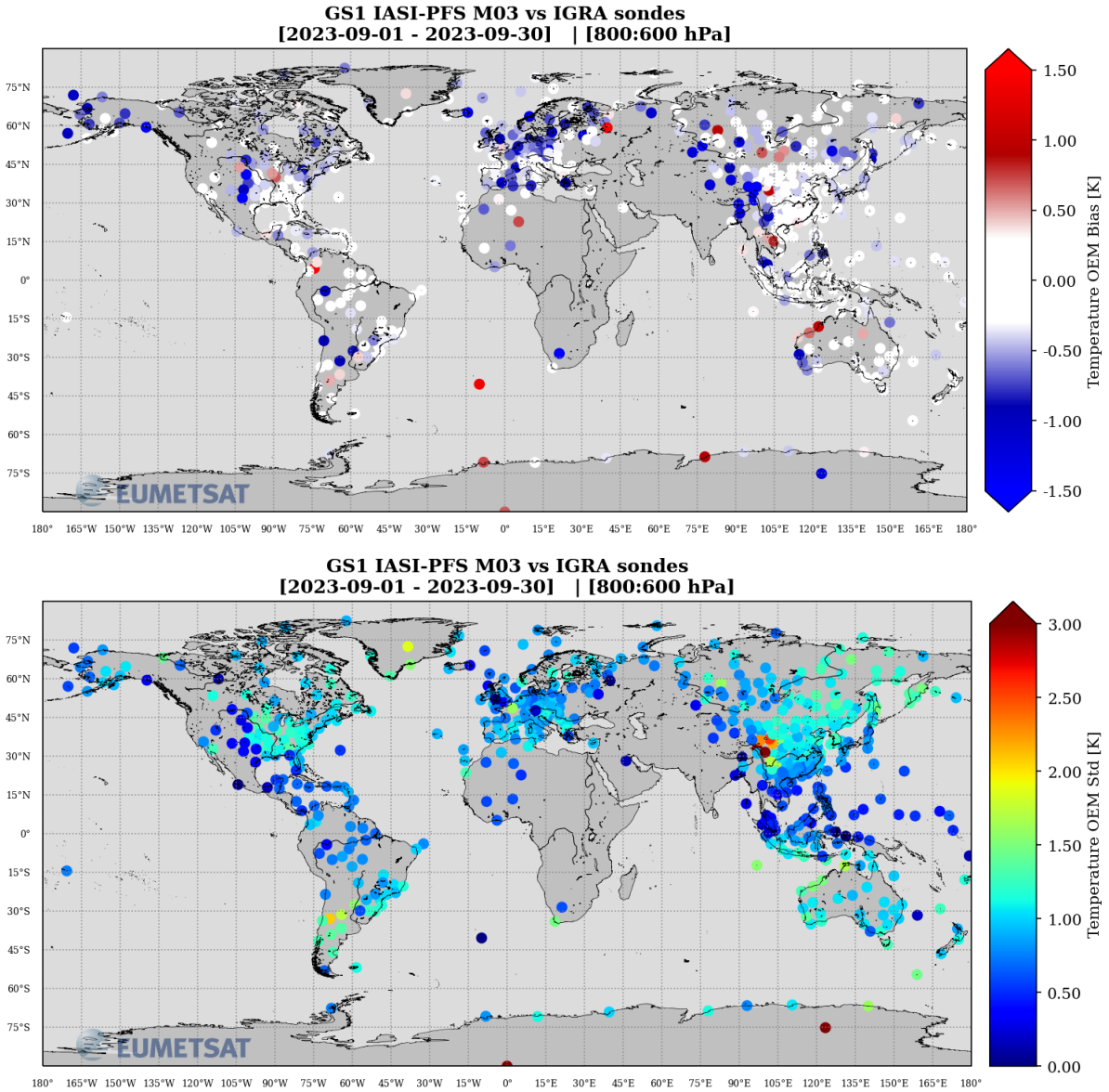


Figure 4.11: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [600-800hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.2.6 Layer:1000 - 800 hPa

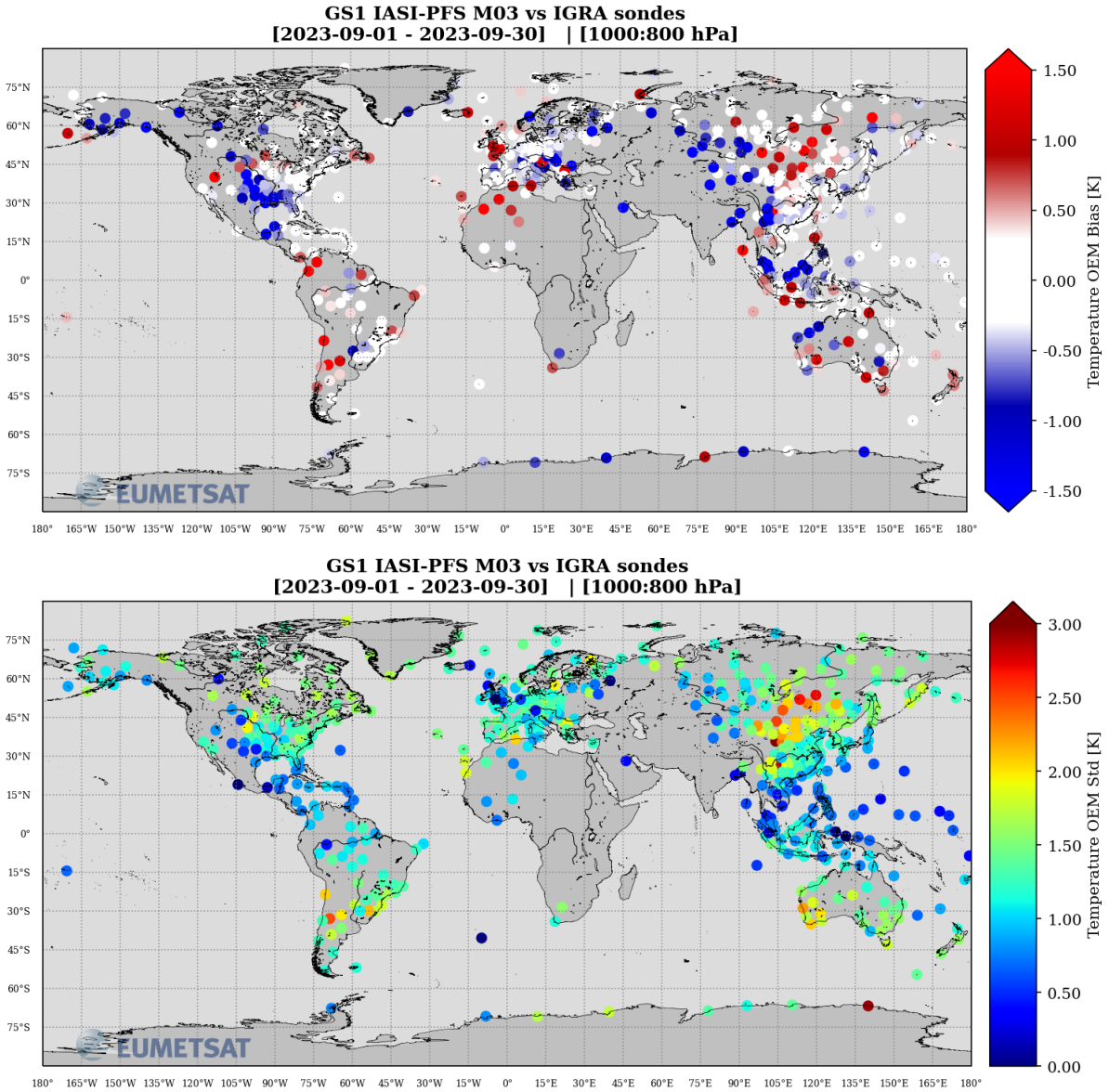


Figure 4.12: Maps of temperature mean (top) differences and standard deviation (bottom) between IASI L2 temperature and sondes in the layer [800-1000hPa], with M03 IASI L2 from GS1 for 01-30/09/2023

4.3 Precipitable Water Maps

4.3.1 Absolute difference

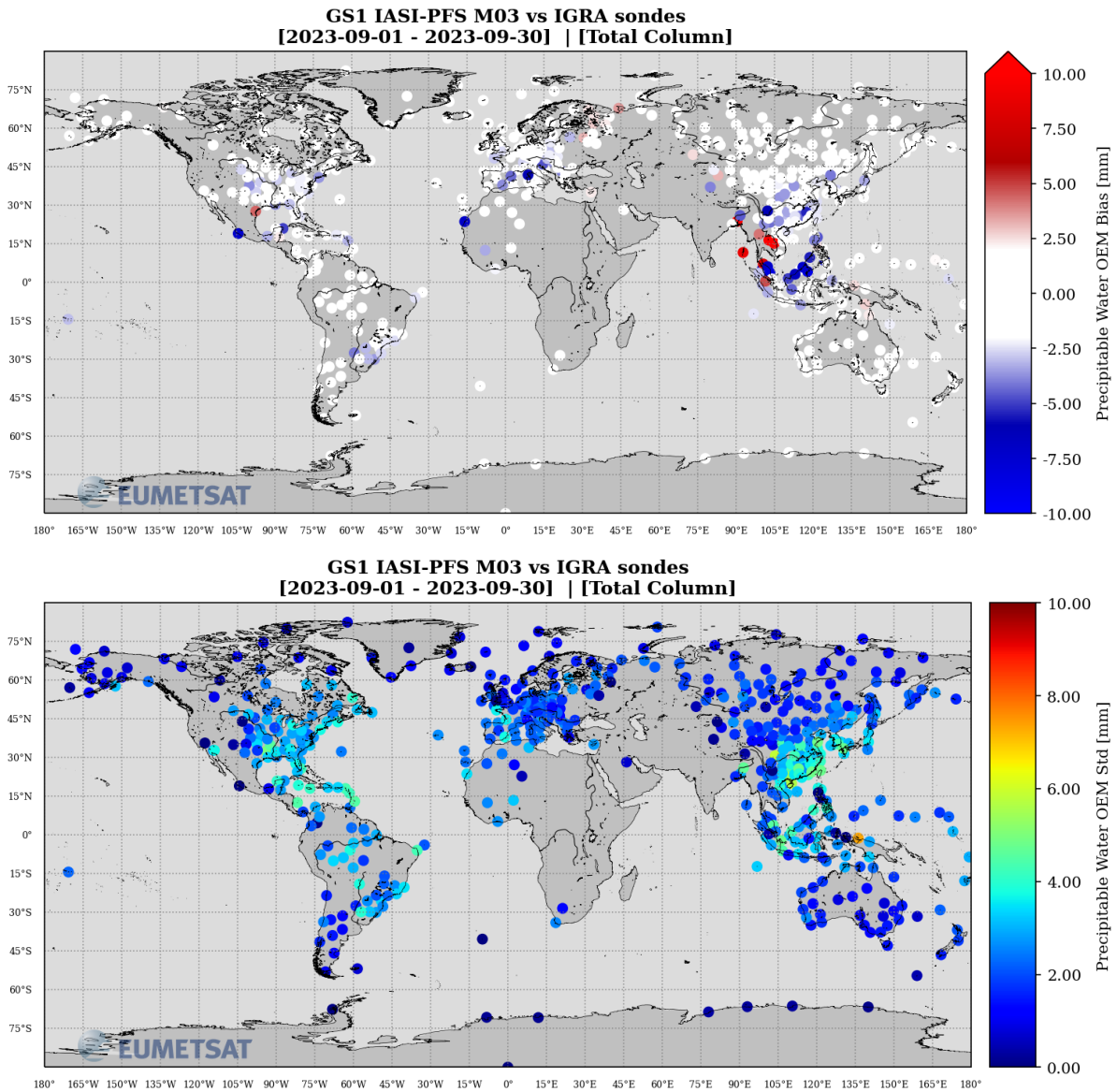


Figure 4.13: Maps of absolute Precipitable Water mean (top) absolute differences and standard deviation (bottom) between IASI L2 and IGRA, with M03 IASI L2 from GS1 for 01-30/09/2023

4.3.2 Relative difference

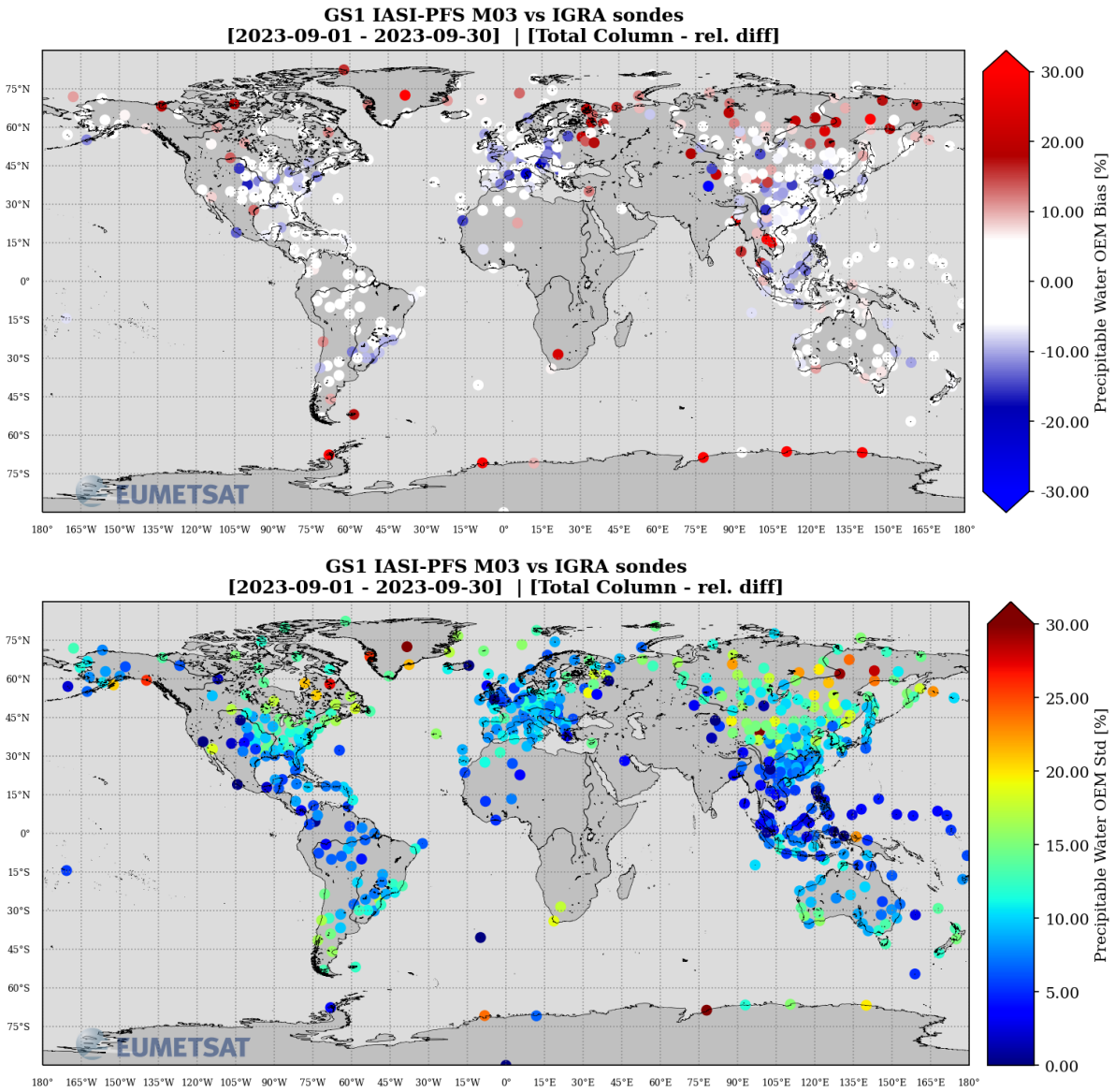


Figure 4.14: Maps of relative Precipitable Water mean (top) relative differences and standard deviation (bottom) between IASI L2 and IGRA, with M03 IASI L2 from GS1 for 01-30/09/2023