

IASI L2
Precipitable Water monitoring
against GNSS measurements

Monthly report for August 2023,
Platform: M01,
GroundSegment: GS1,
Reference: E-GVAP

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1 INTRODUCTION

1.1 Purpose and scope

This report compiles Monthly statistics from the routine monitoring of the IASI L2 Precipitable Water [RD 1] products with Global Navigation Satellite System (GNSS) measurements.

The IASI L2 products come from the operational ground segment GS1. The reference measurements are retrieved from the EUMETNET [RD 3] GNSS Water Vapour Programm (E-GVAP) [RD 4]. The collocation and statistics are computed with the MONALiSA monitoring facility [RD 5].

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 products uncertainties. In this respect, it is important to note that differences of IASI-L2 with GNSS measurements also include uncertainties of the GNSS measurements themselves as well as collocation uncertainties. These come from the representativeness of a point measurements (EumetNet sites) vs the 12-40 km footprint of IASI and from the spatial and temporal lags between GNSS measurements and satellite acquisitions.

1.2 Collocation criteria and data selection

All IASI pixels within 1h and 20km from the EumetNet sites are considered valid collocations and stored in a match-up database.

The statistics are then computed globally and for the Europe region separately with clear-sky pixels (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 pixels 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]	"EumetNet: European Meteorological Services Network"	https://www.eumetnet.eu
[RD 4]	"E-GVAP: EUMETNET GNSS Water Vapour Programme"	https://www.eumetnet.eu/activities/observations-programme/current-activities/e-gvap/
[RD 5]	"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
- Global Navigation Satellite System (GNSS) : GPS, GLONASS, Galileo (or others TBD)

1.5 MONALiSA

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

2 GLOBAL MONTHLY STATISTICS IN CLEAR-SKY CONDITIONS

2.1 Matchups

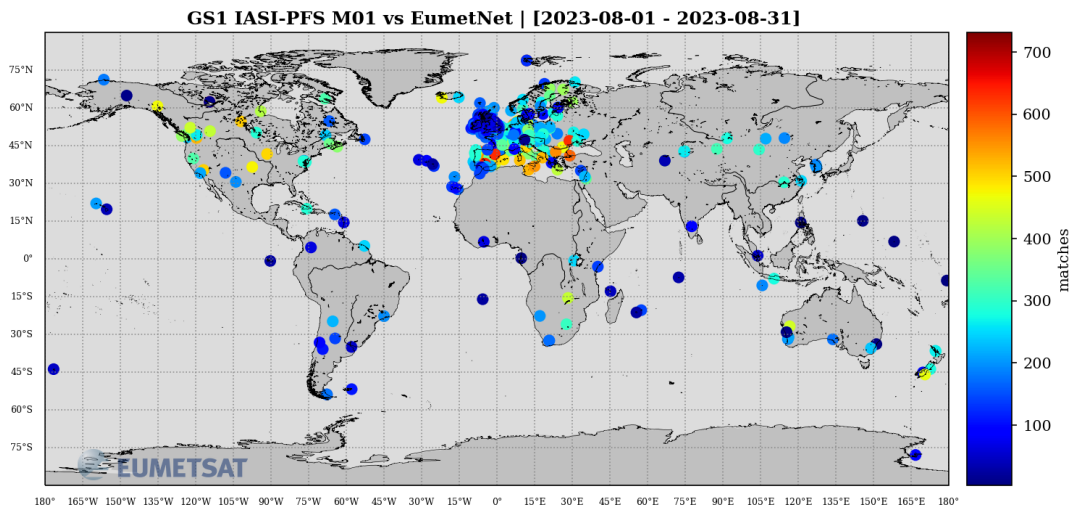


Figure 2.1: Number of match-ups per stations with M01 IASI L2 from GS1 for 01-31/08/2023

2.2 Monthly time series



**GS1 IASI-PFS M01 vs EumetNet Precipitable Water
 [2023-08-01 - 2023-08-31]**

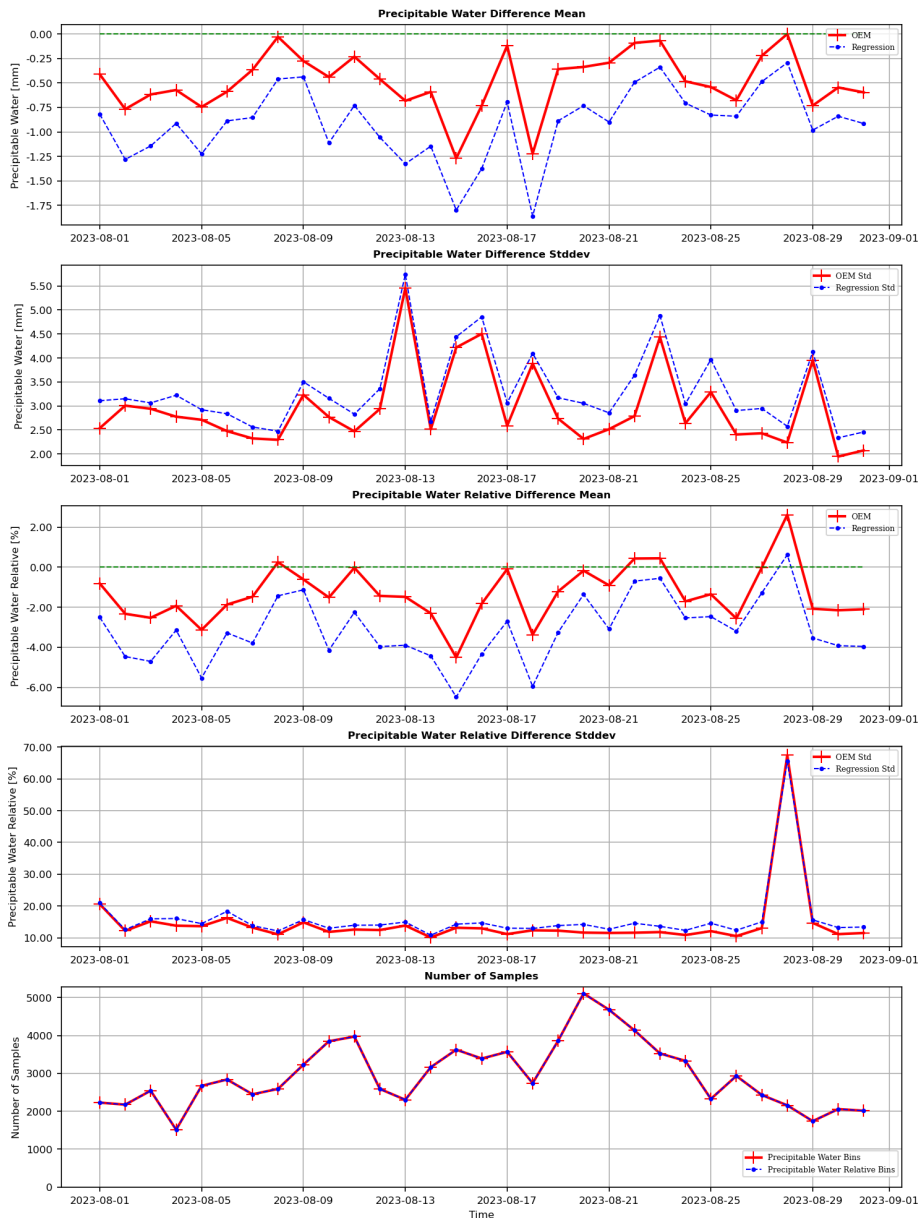


Figure 2.2: Monthly time series of mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and EumetNet. The bottom panel shows the number of Monthly match-ups. Global statistics with M01 IASI L2 from GS1 for 01-31/08/2023

2.3 Long-term time series



**GS1 IASI-PFS M01 vs EumetNet Precipitable Water
 [2021-03-25 - 2023-08-31]**

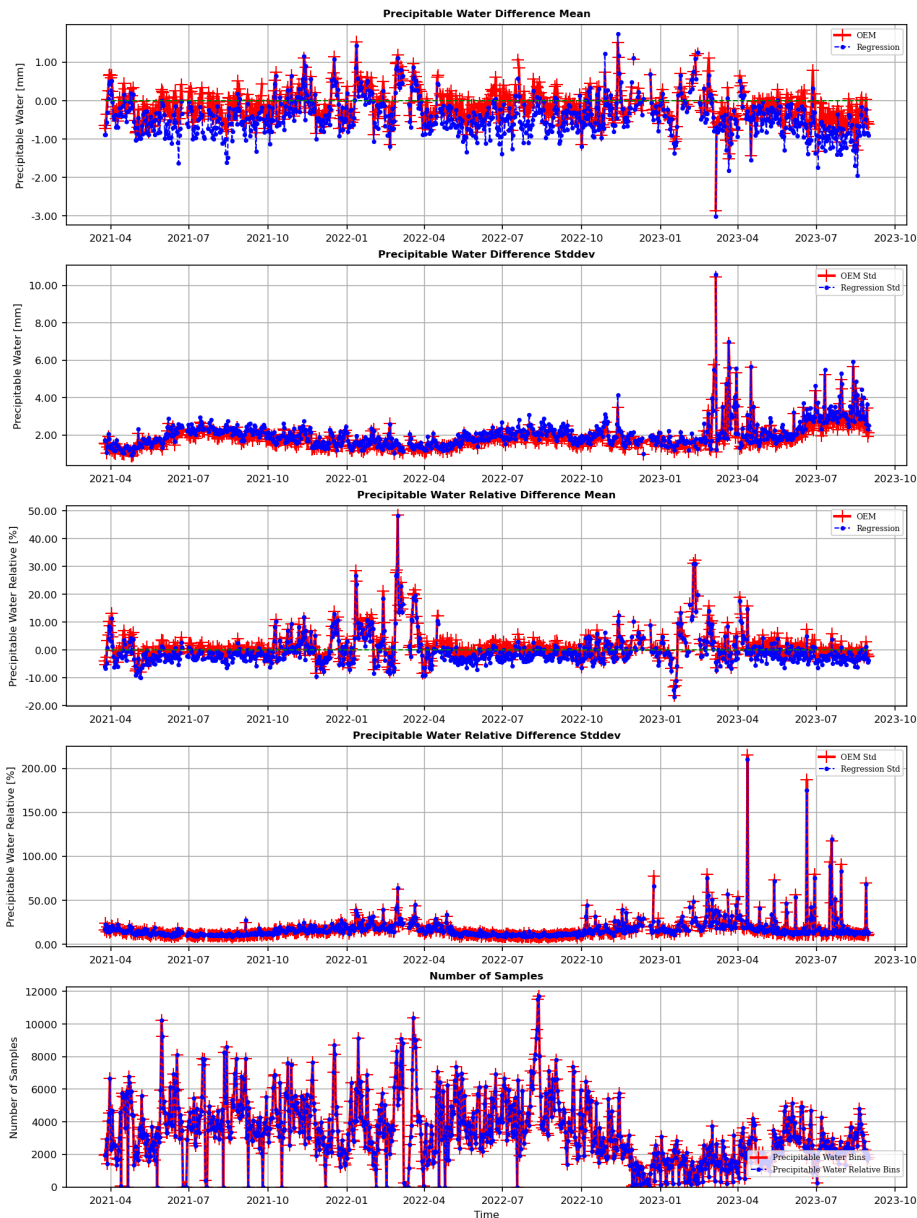


Figure 2.3: Long-term time series of mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and EumetNet. The bottom panel shows the number of Monthly match-ups. Global long-term statistics with M01 IASI L2 from GS1.

2.4 Histograms

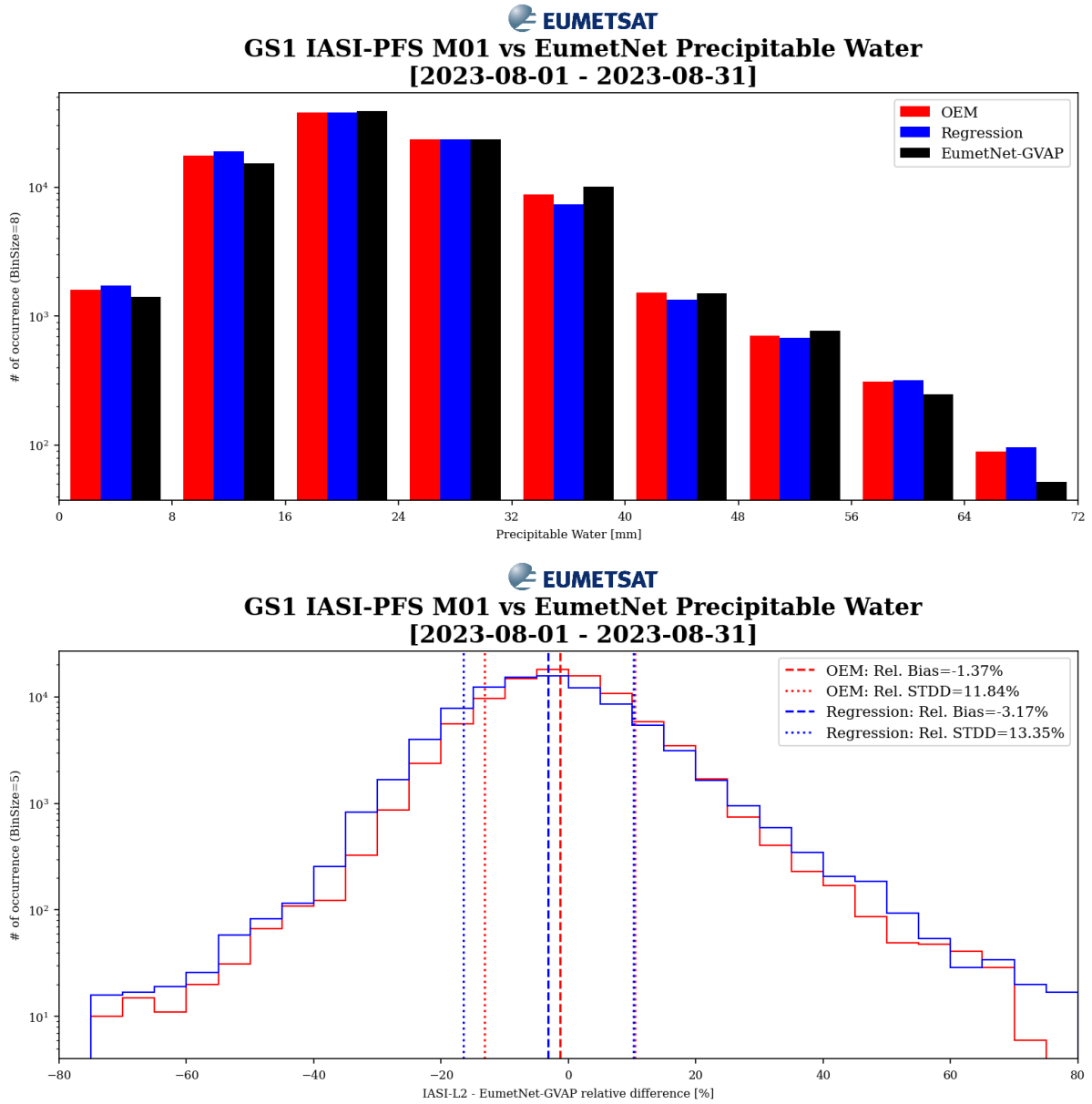


Figure 2.4: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023

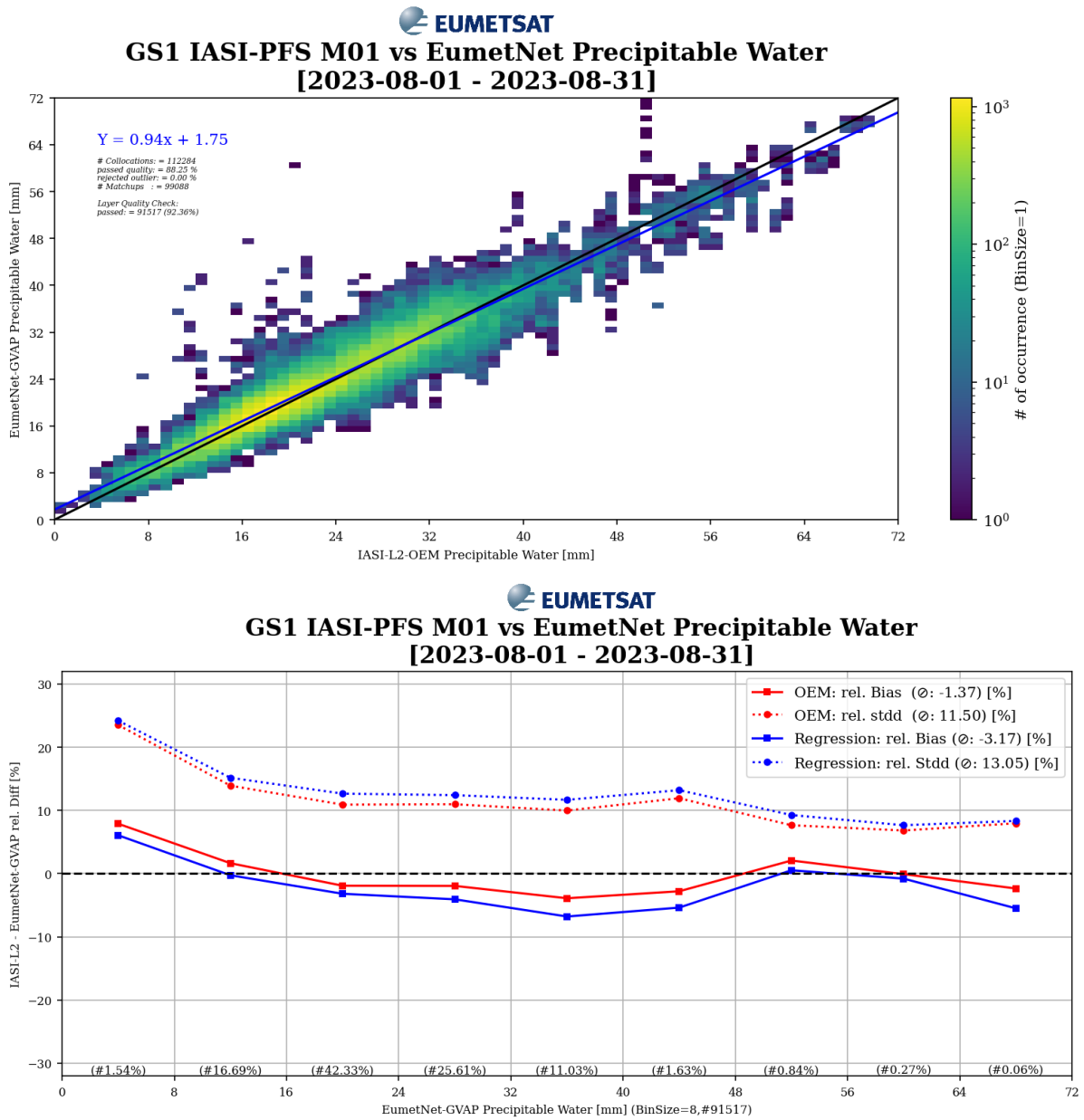


Figure 2.5: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the EumetNet reference (bottom) between IASI L2 Precipitable Water and EumetNet measurements, with M01 IASI L2 from GS1 for 01-31/08/2023

2.4.1 Collocational dependencies

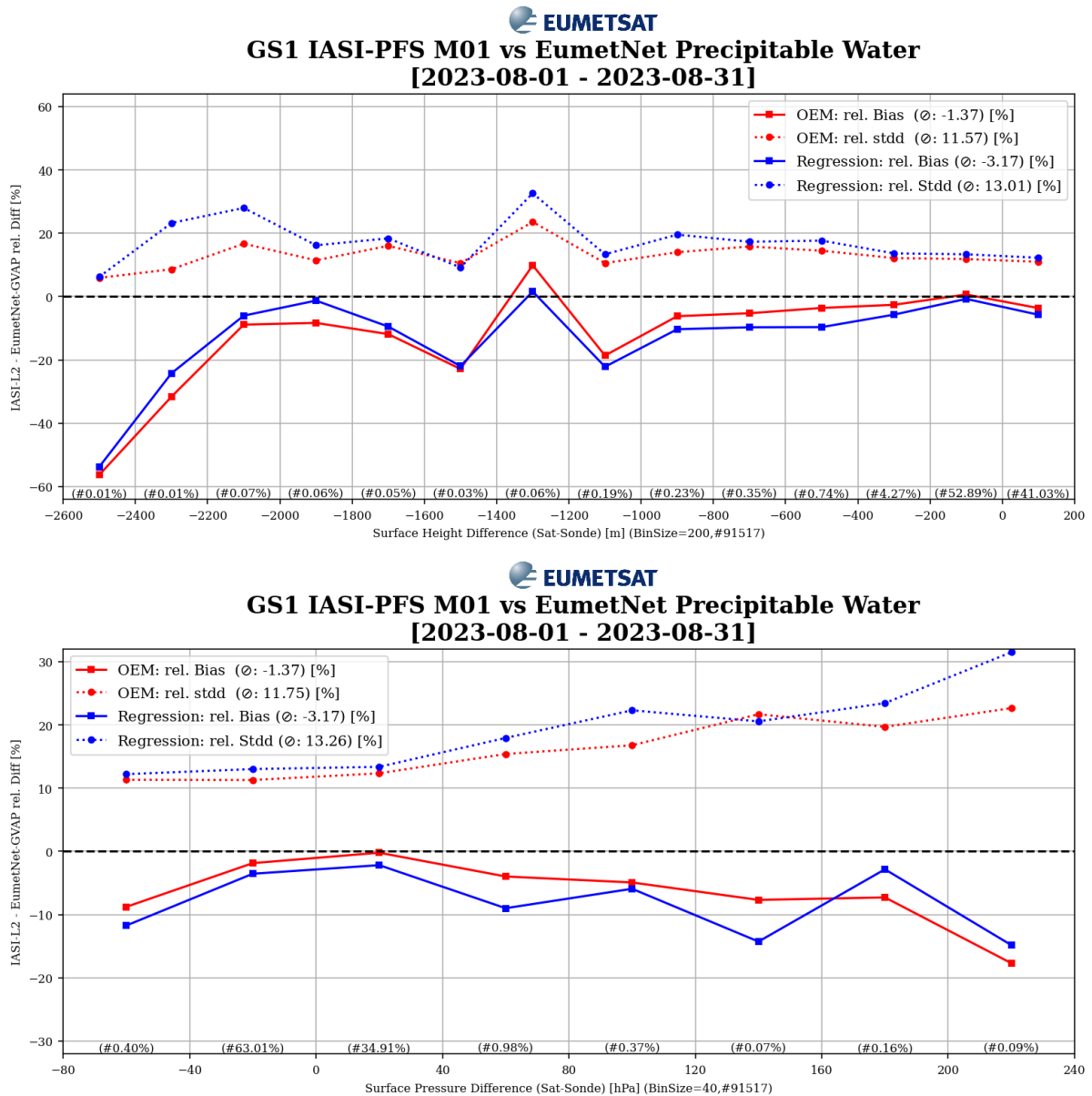


Figure 2.6: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different surface height (top) and surface pressure differences (bottom).

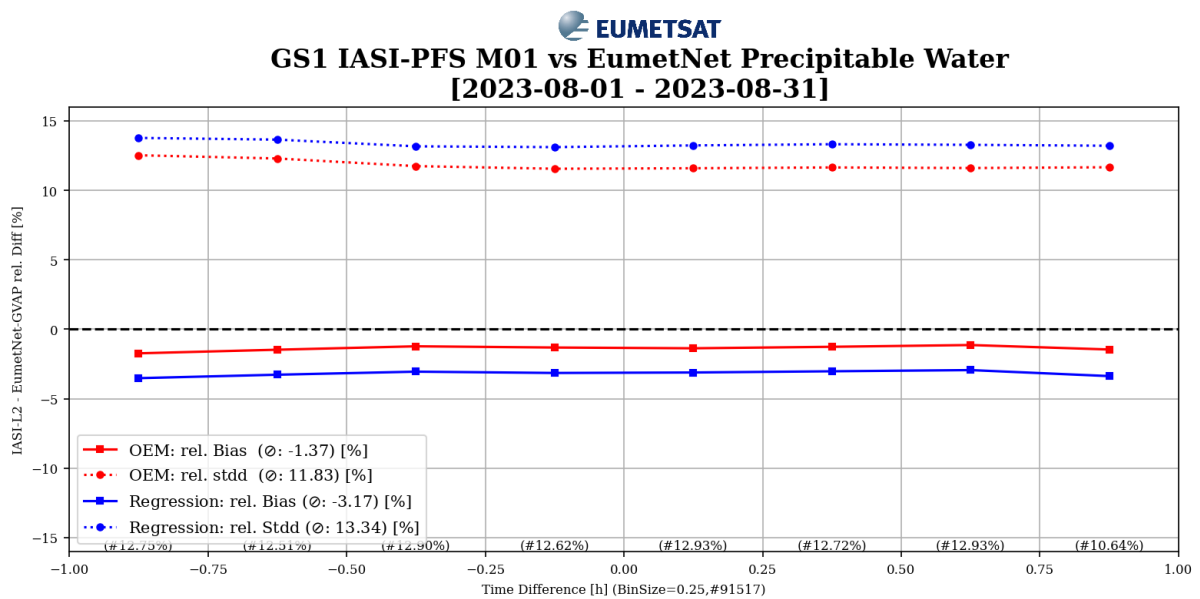
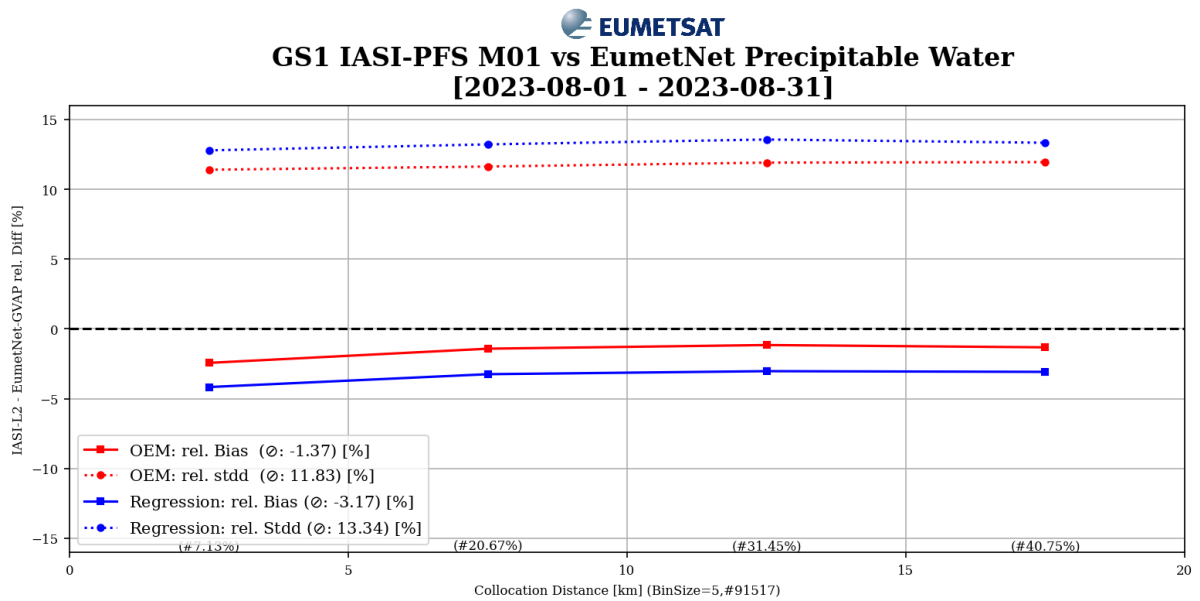


Figure 2.7: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different collocation spatial distances (top) and temporal differences (bottom).

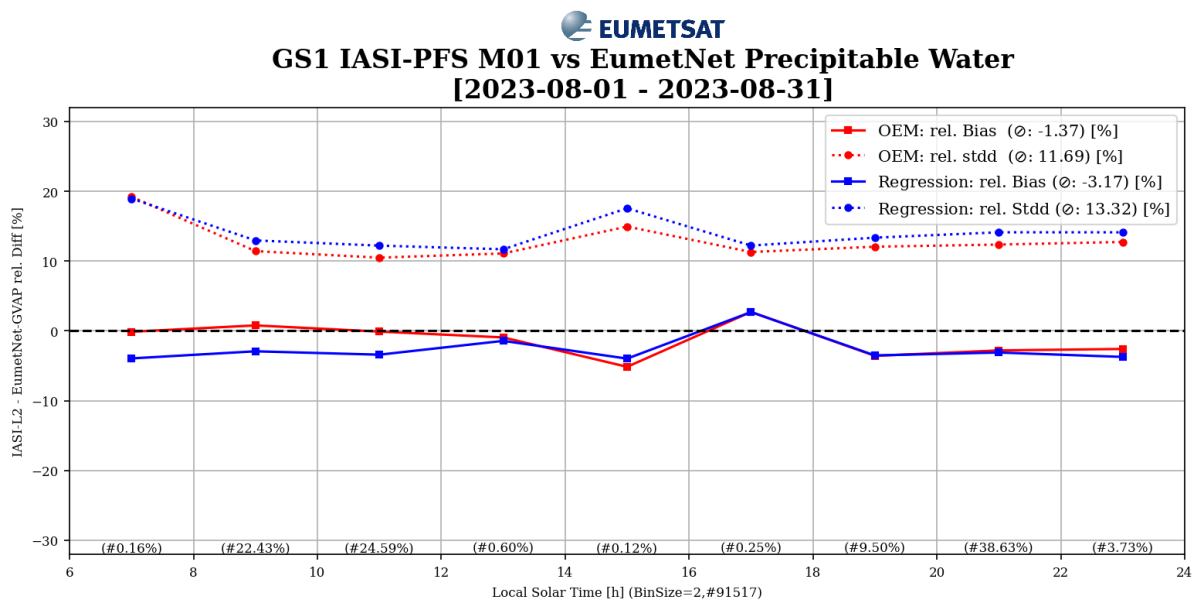
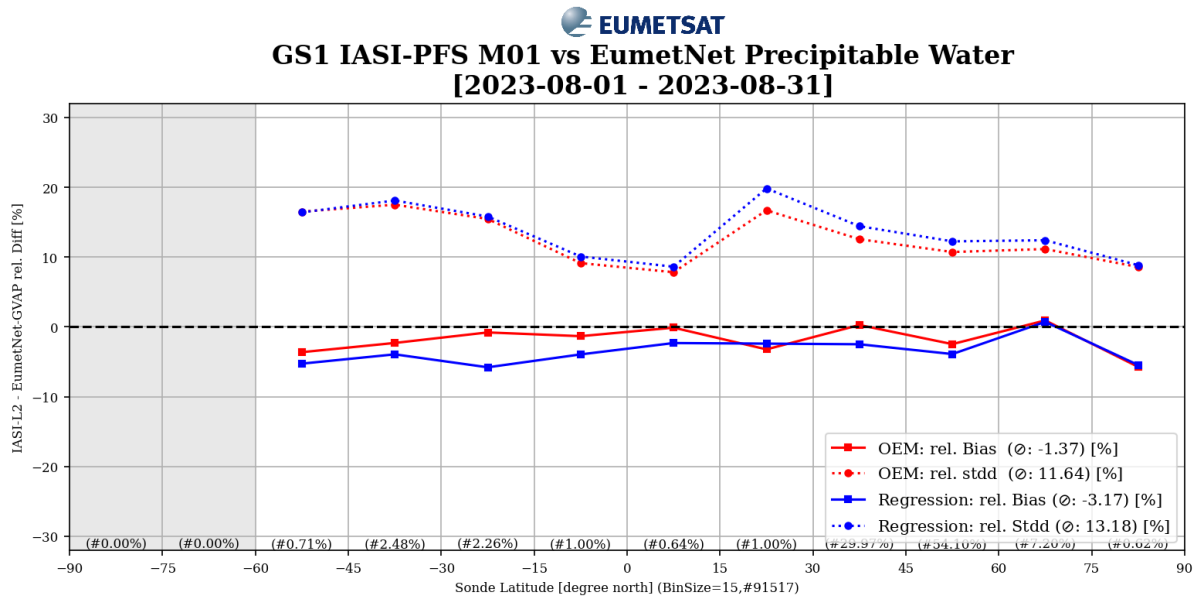


Figure 2.8: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different latitudes (top) and local solar times (bottom).

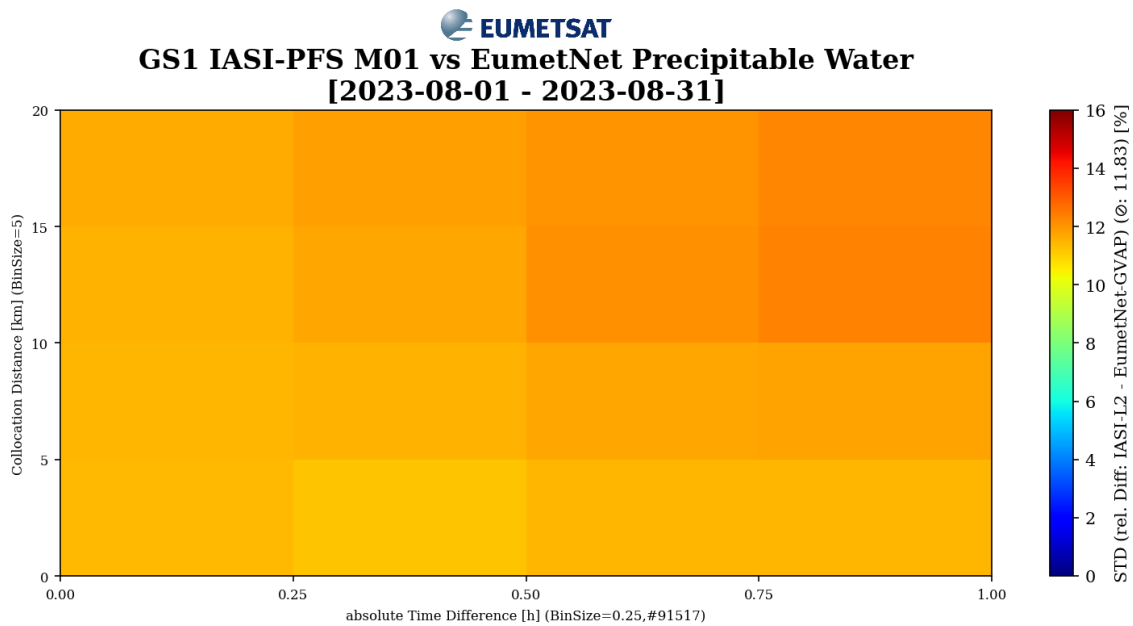
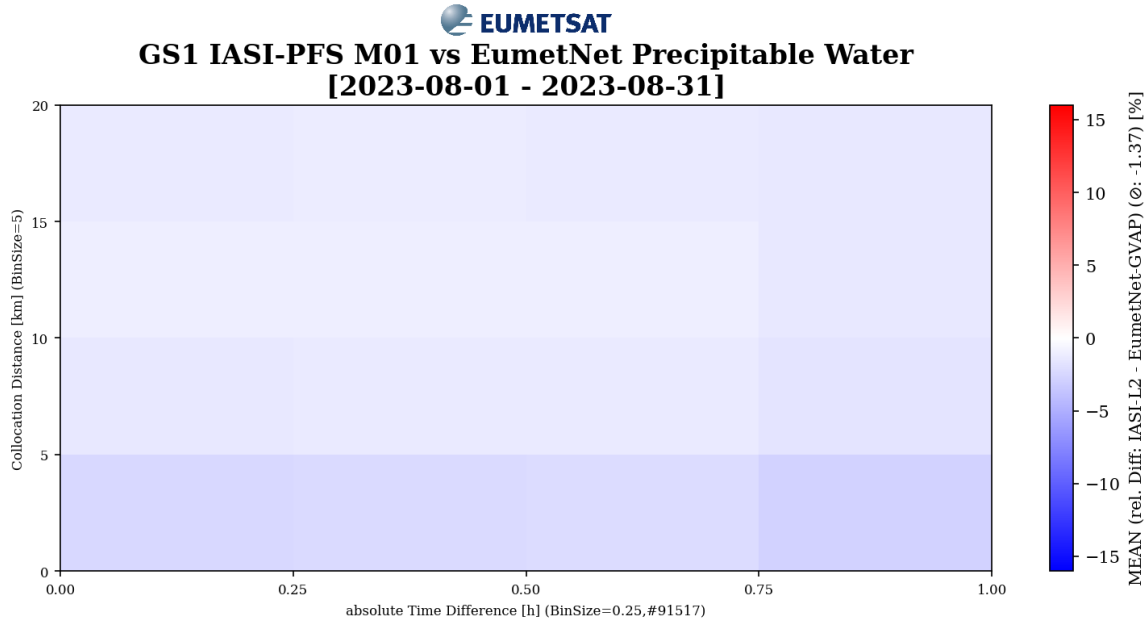


Figure 2.9: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and EumetNet measurements, with M01 IASI L2 from GS1 for 01-31/08/2023 dependent of collocation temporal difference and spatial distances.

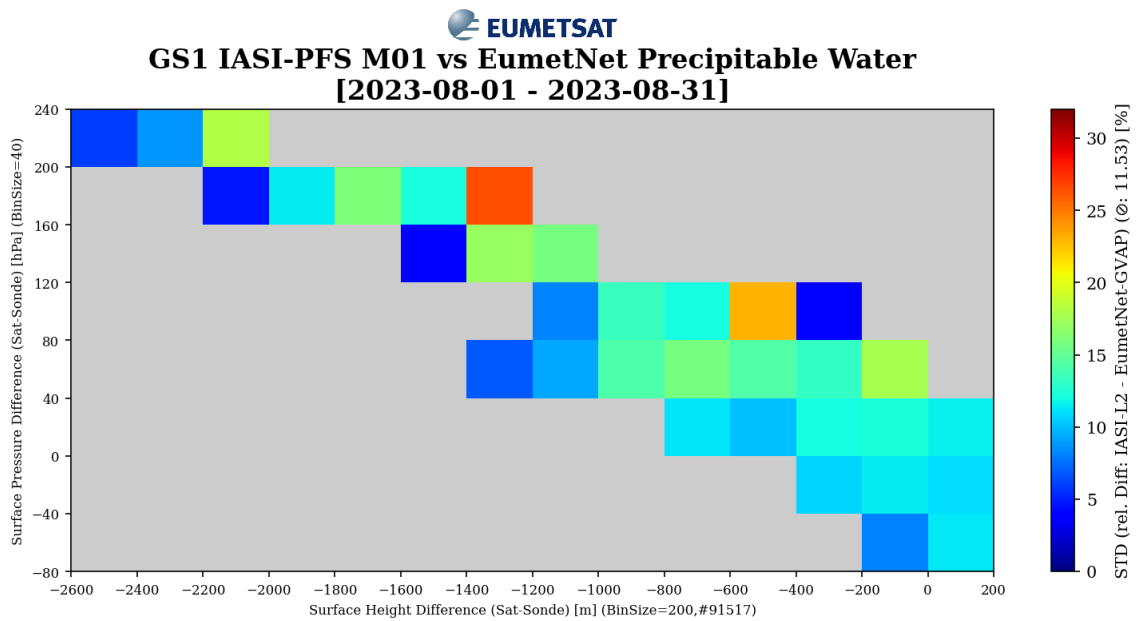
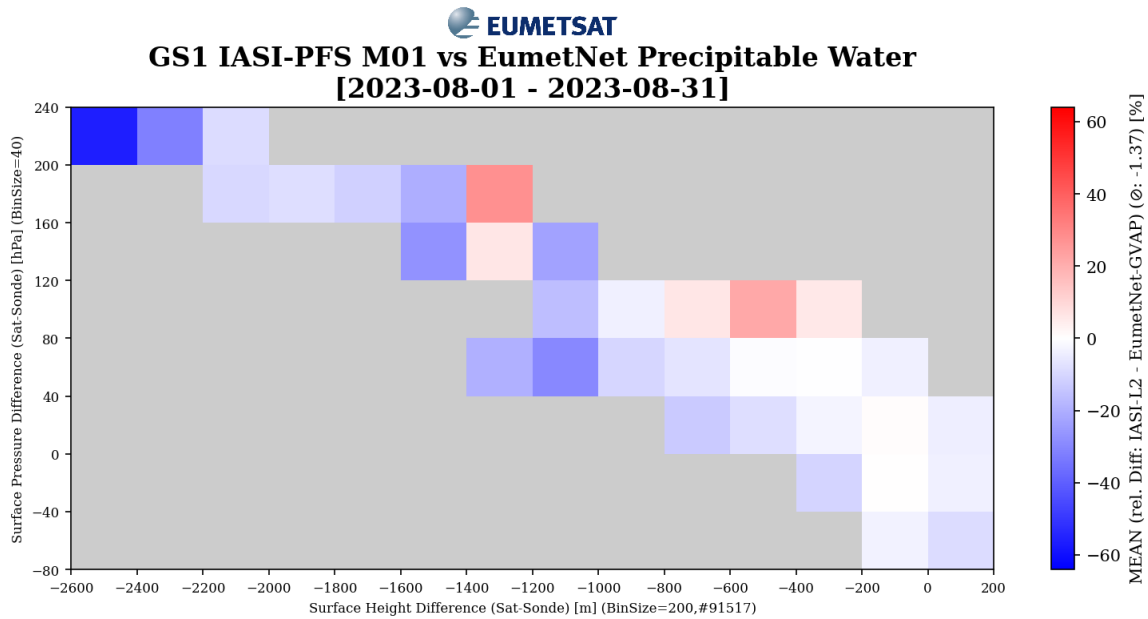


Figure 2.10: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and EumetNet measurements, with M01 IASI L2 from GS1 for 01-31/08/2023 dependent of Surface Pressure Difference and Surface Pressure Difference.

2.4.2 Angular dependencies

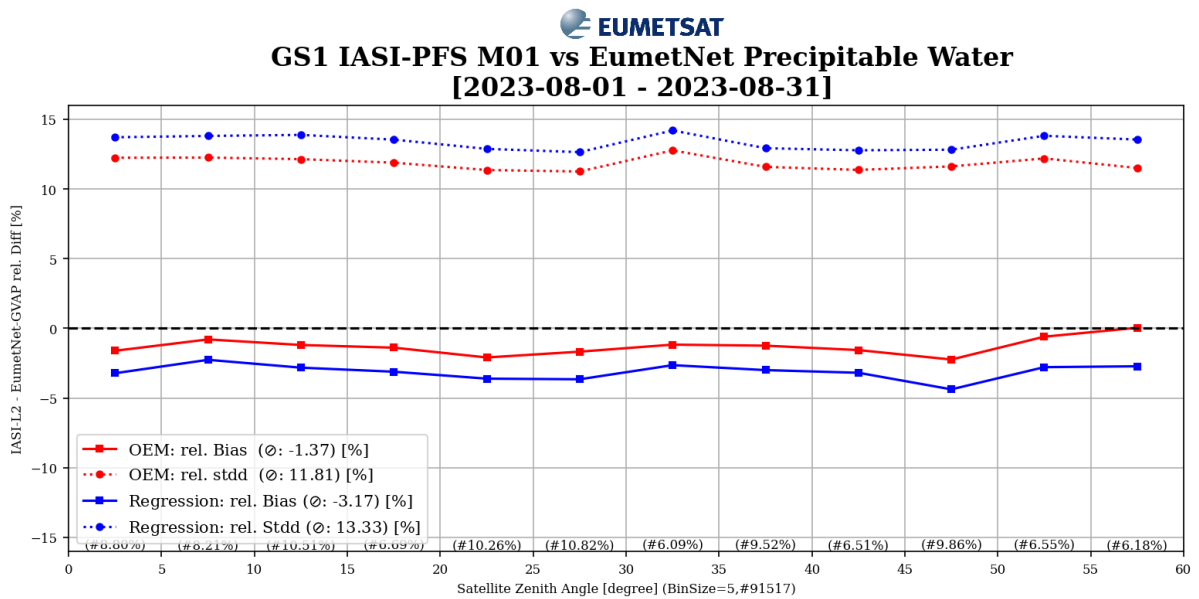
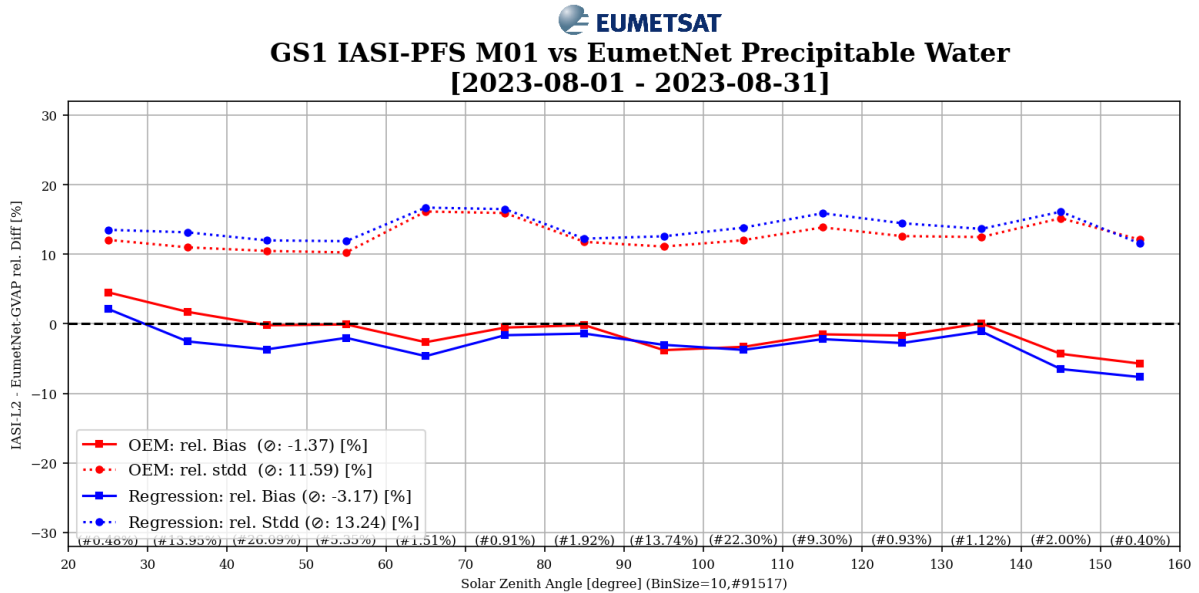


Figure 2.11: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different sun zenith angles (top) and satellite zenith angles (bottom).

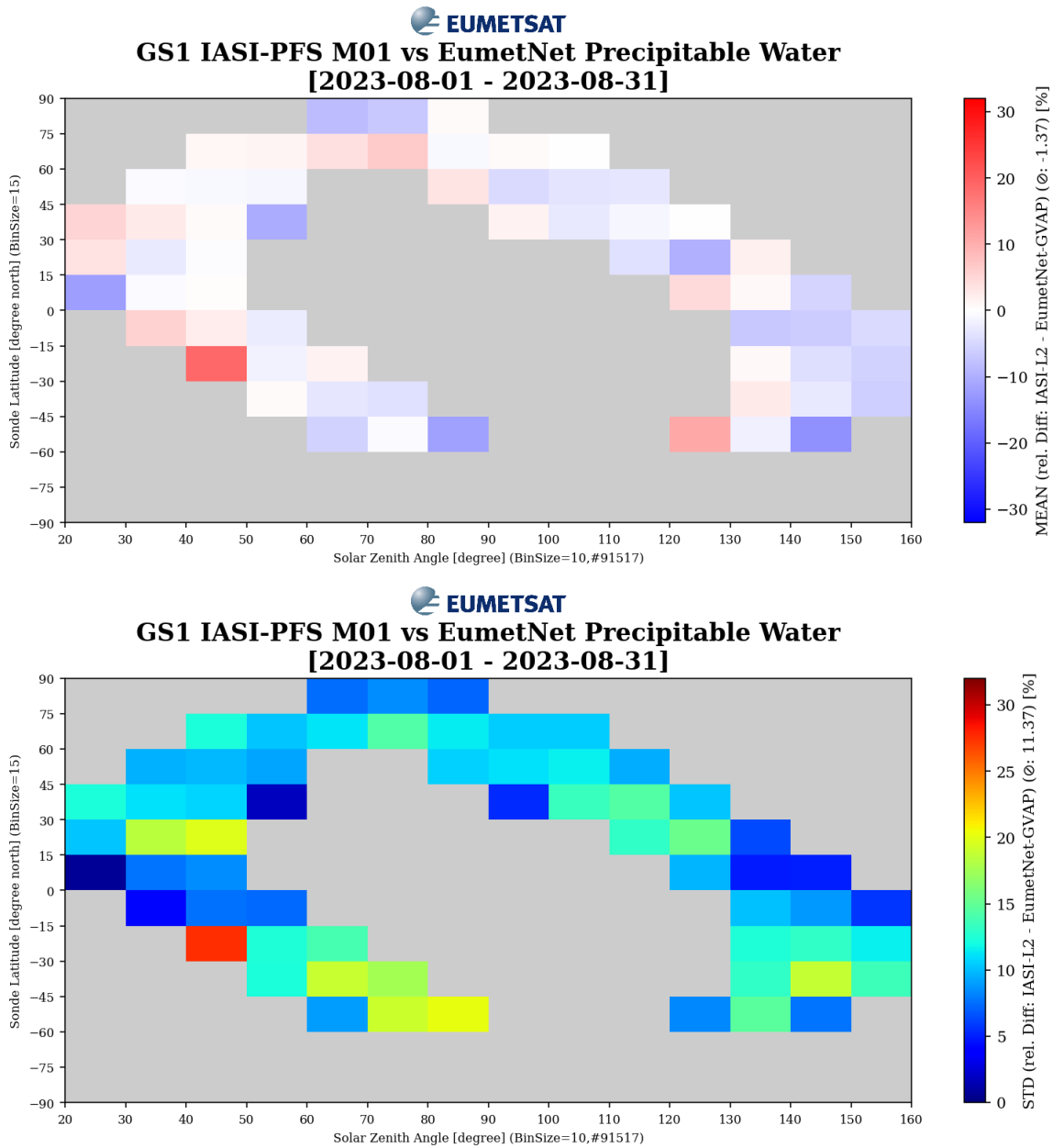


Figure 2.12: 2D Histograms bias (top) and standard deviation (bottom) for IASI L2 Precipitable Water and EumetNet measurements, with M01 IASI L2 from GS1 for 01-31/08/2023 dependent of sun zenith angles and latitude.

3 REGIONAL EUROPE MONTHLY STATISTICS IN CLEAR-SKY CONDITIONS

3.1 Matchups

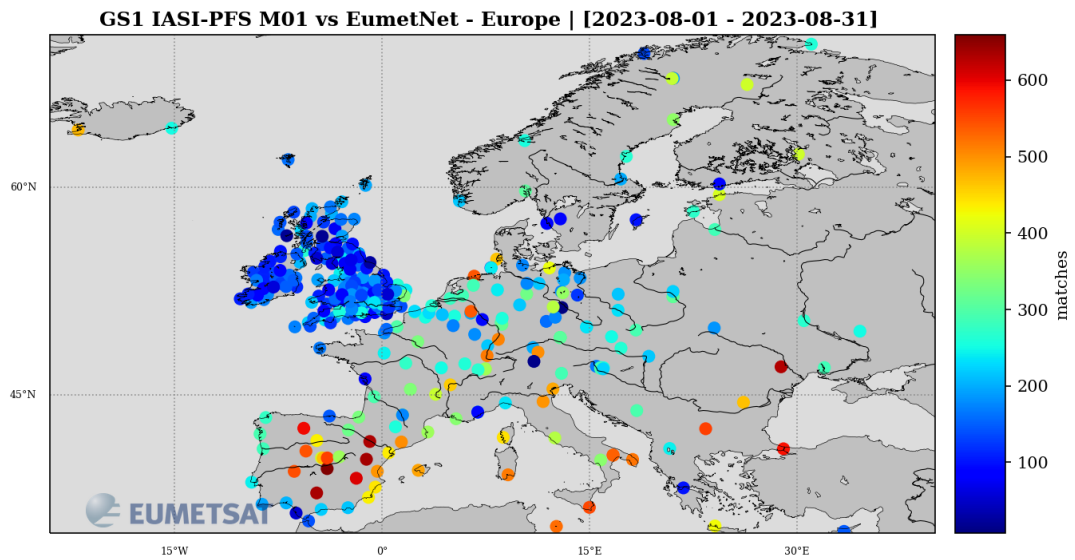


Figure 3.1: Number of match-ups per stations with M01 IASI L2 from GS1 for 01-31/08/2023

3.2 Monthly time series



**GS1 IASI-PFS M01 vs EumetNet - Europe Precipitable Water
 [2023-08-01 - 2023-08-31]**

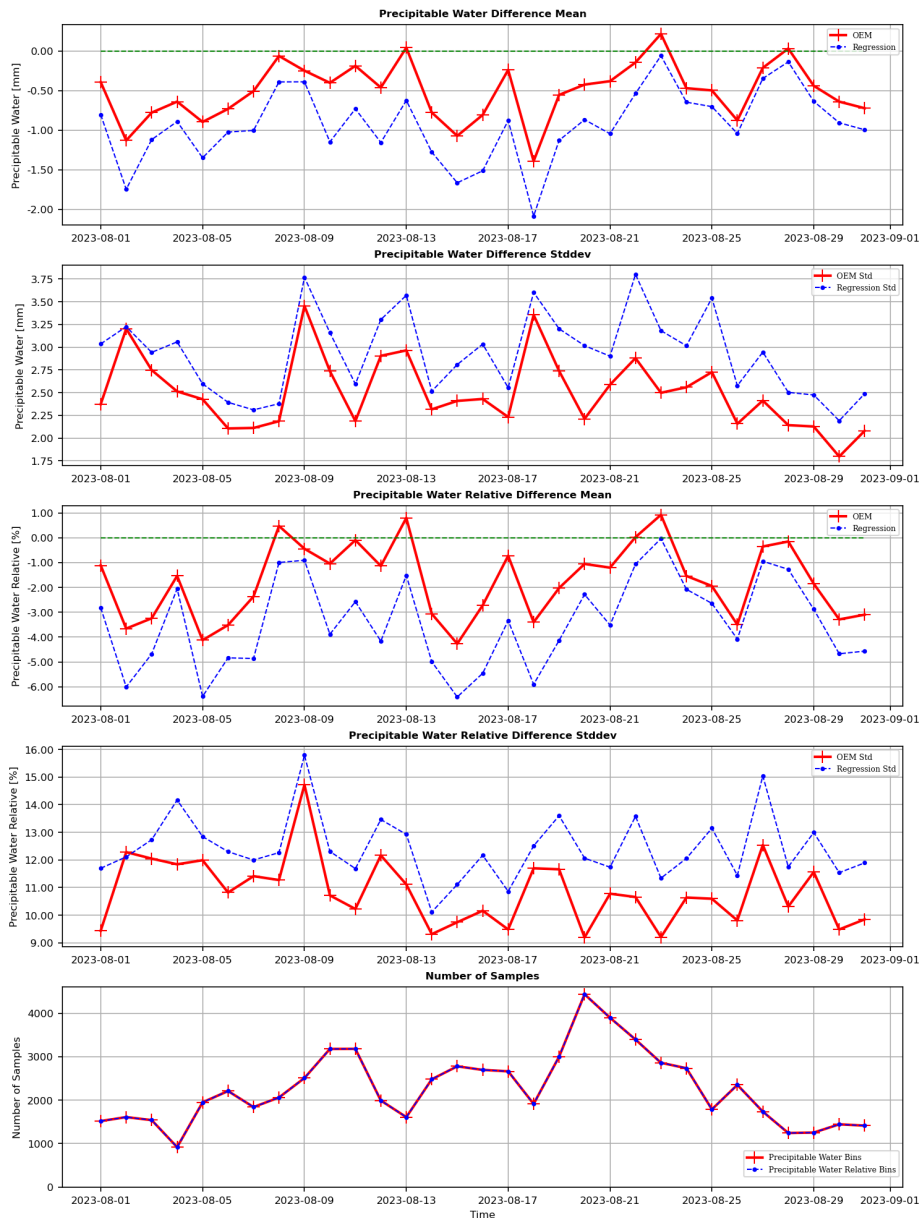


Figure 3.2: Monthly time series of mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and EumetNet. The bottom panel shows the number of Monthly match-ups. Europe statistics with M01 IASI L2 from GS1 for 01-31/08/2023

3.3 Long-term time series



**GS1 IASI-PFS M01 vs EumetNet - Europe Precipitable Water
 [2021-03-25 - 2023-08-31]**

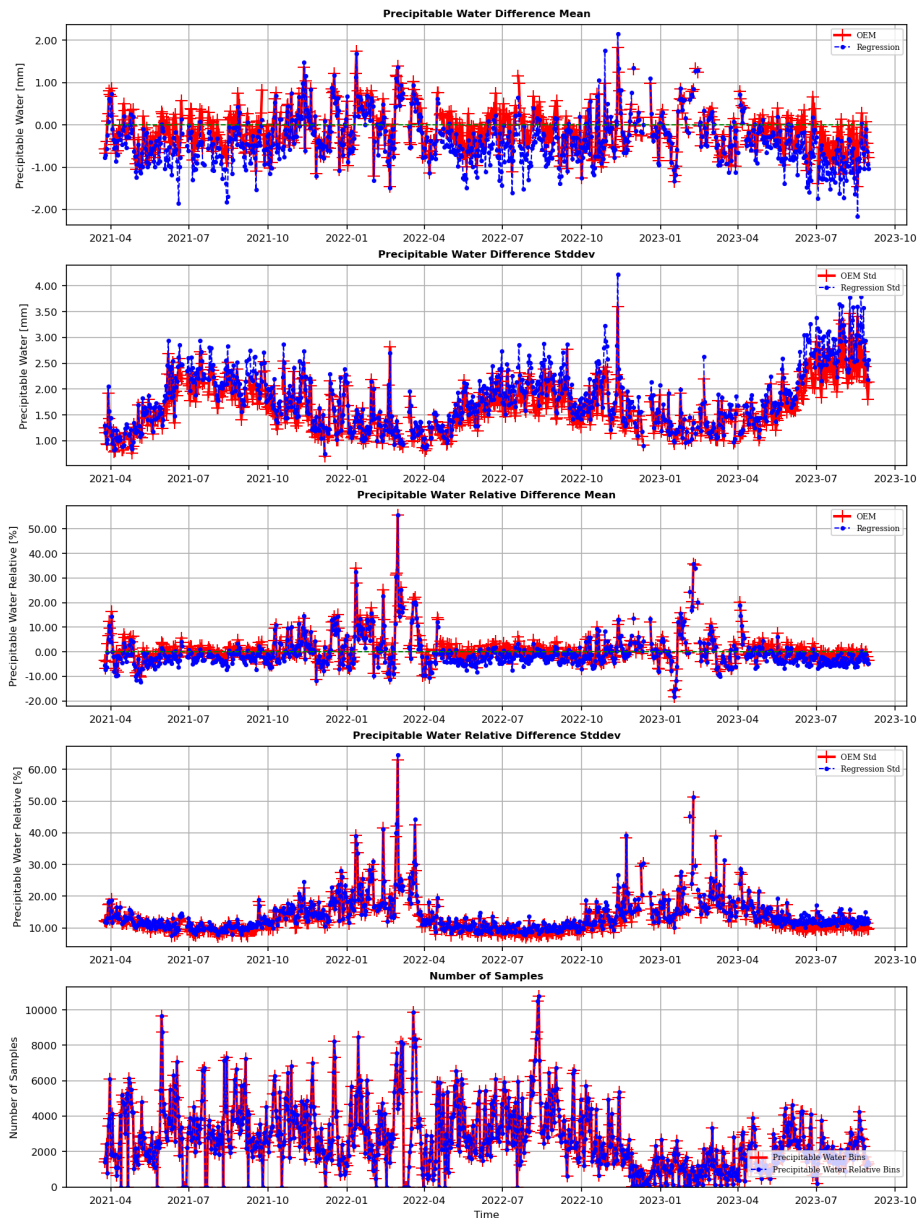


Figure 3.3: Long-term time series of mean difference and standard deviation in absolute (top 2 panels) and relative Difference (middle 2 panels) between IASI L2 and EumetNet. The bottom panel shows the number of Monthly match-ups. Europe long-term statistics with M01 IASI L2 from GS1.

3.4 Histograms

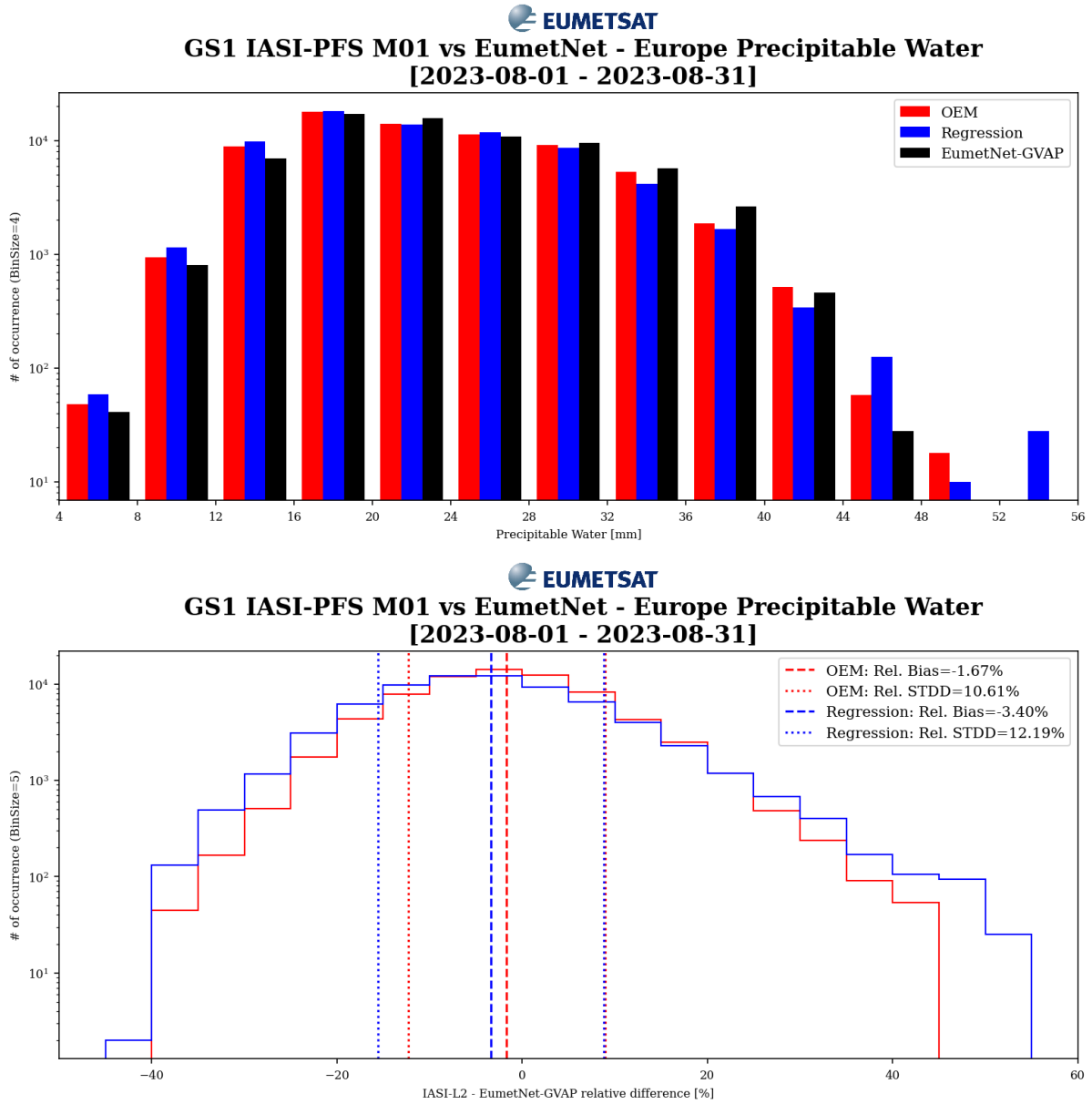


Figure 3.4: Histograms as barcharts in mm (top) and relative differences (bottom) between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023

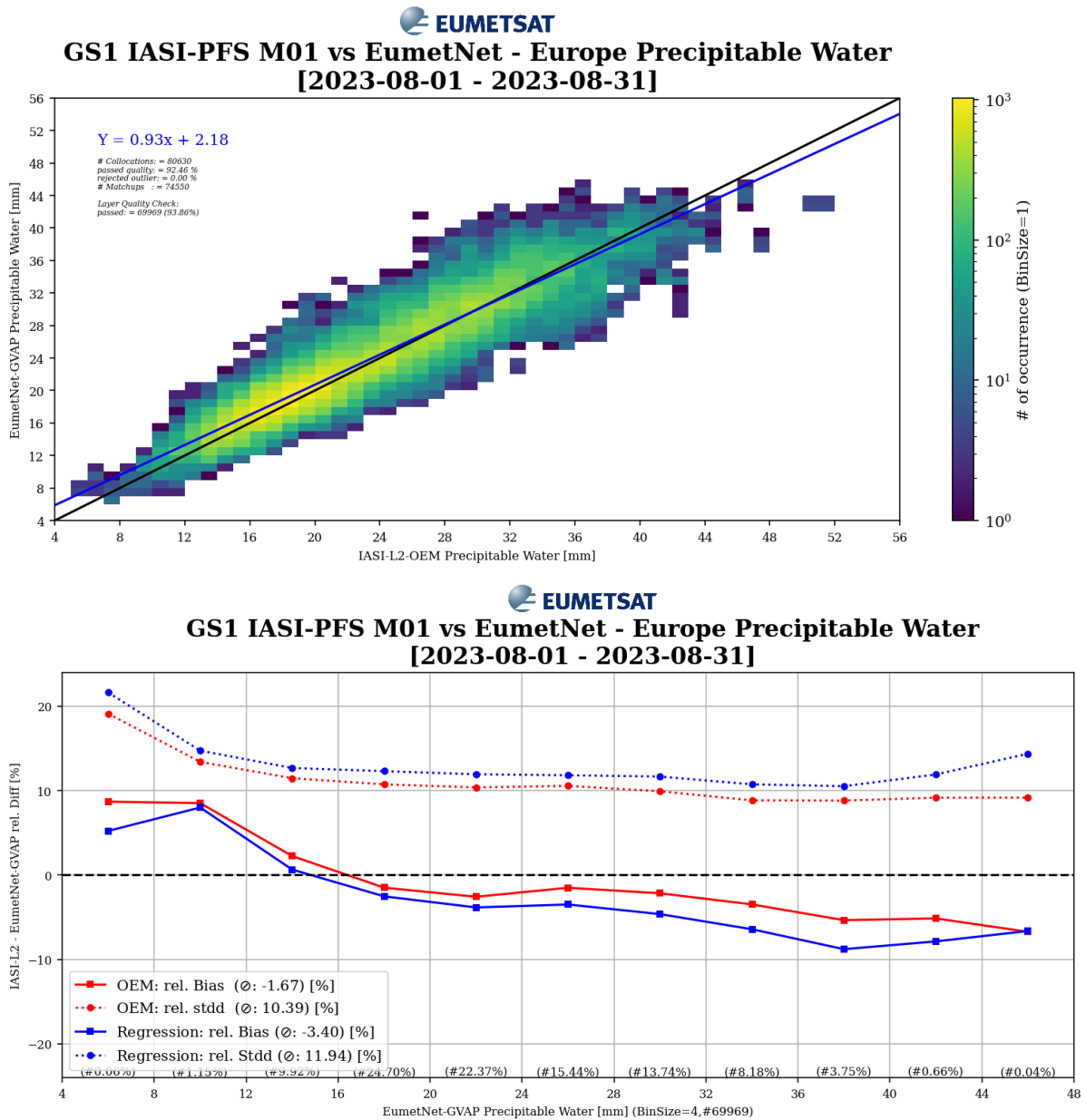


Figure 3.5: 2D Histogram (top) and bias and standard deviation as per 5-mm-sized-bin of the EumetNet reference (bottom) between IASI L2 Precipitable Water and EumetNet measurements, with M01 IASI L2 from GS1 for 01-31/08/2023

3.4.1 Collocational dependencies

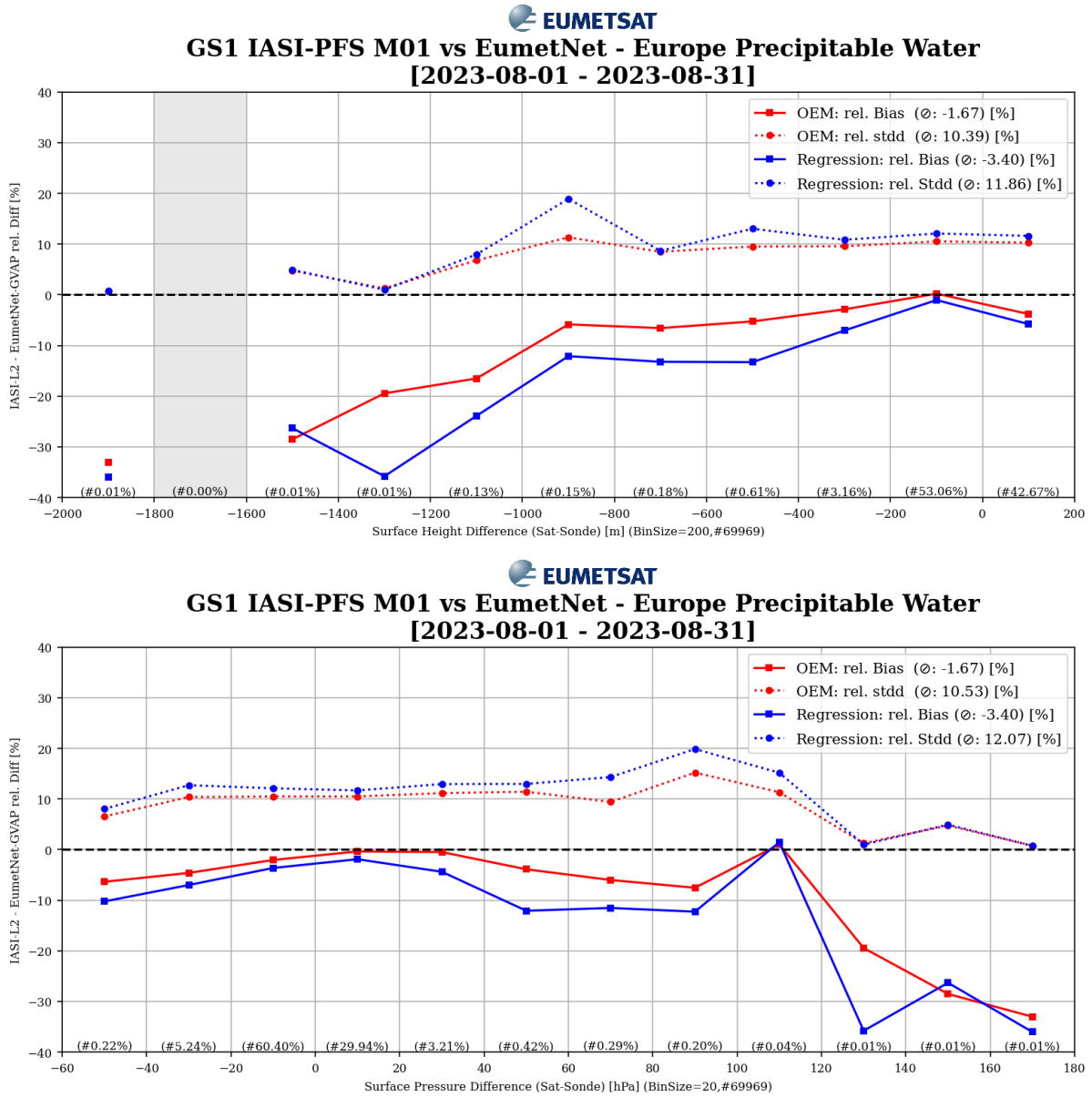


Figure 3.6: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different surface height (top) and surface pressure differences (bottom).

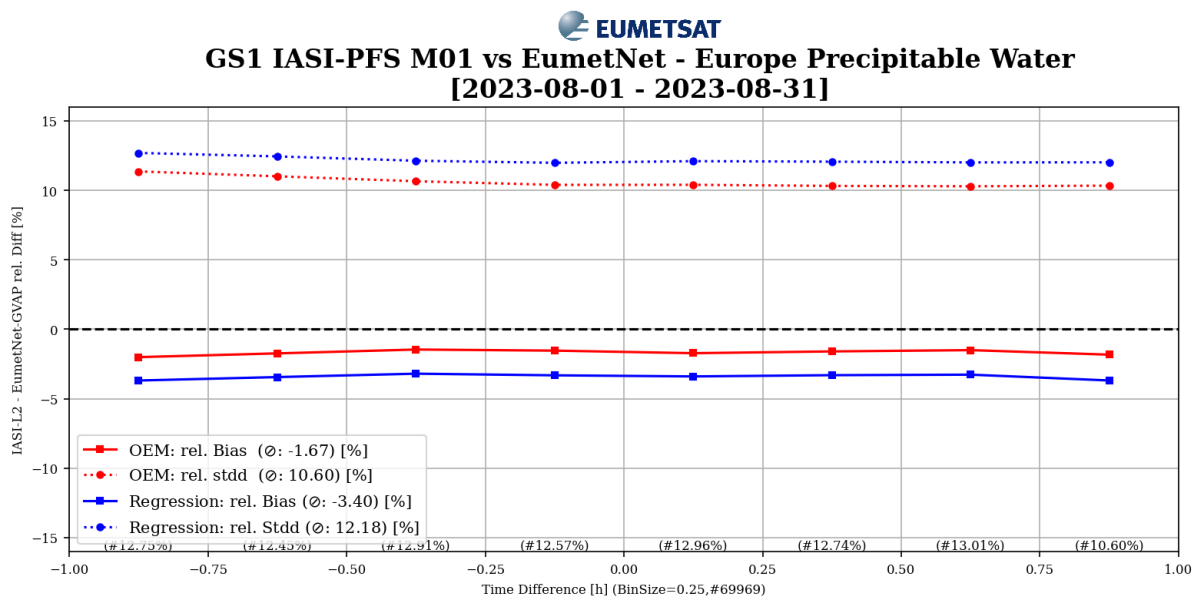
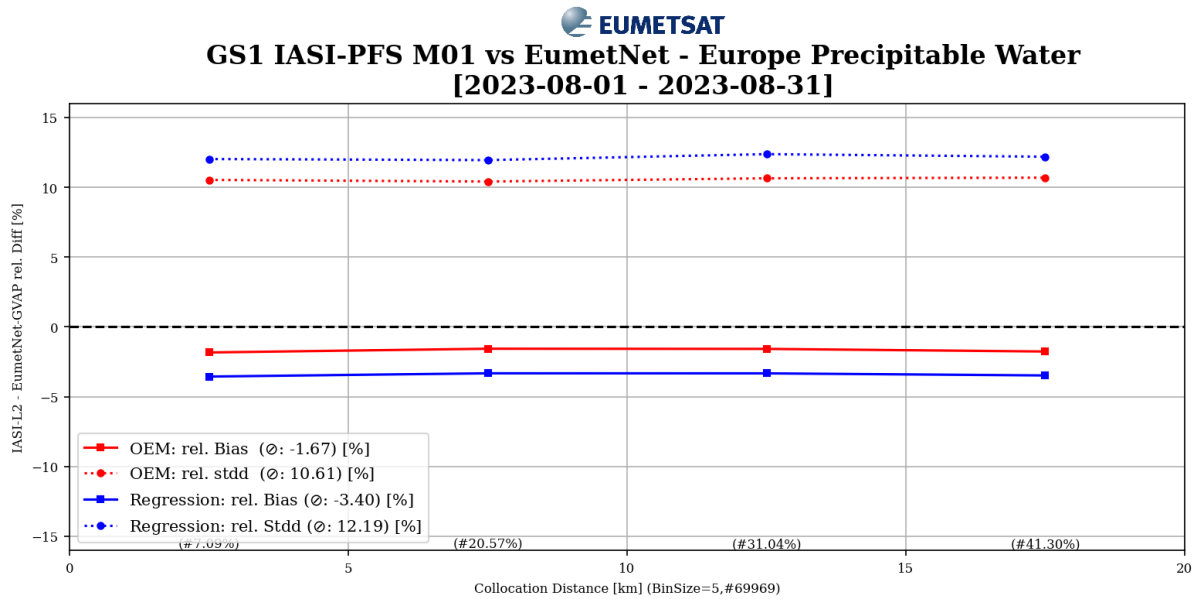


Figure 3.7: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different collocation spatial distances (top) and temporal differences (bottom).

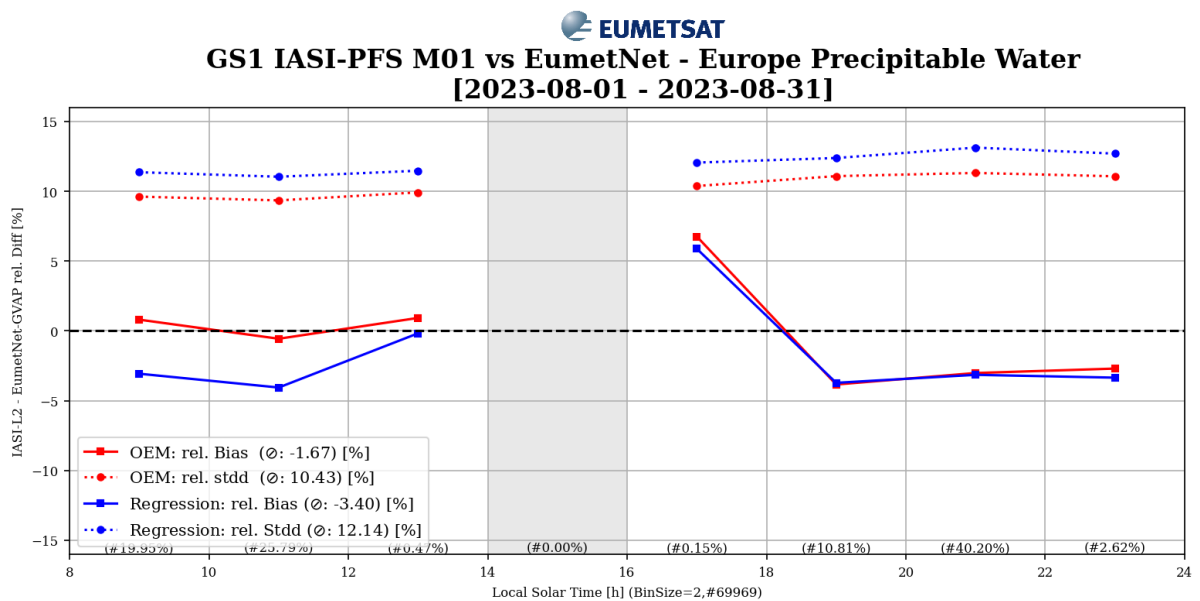
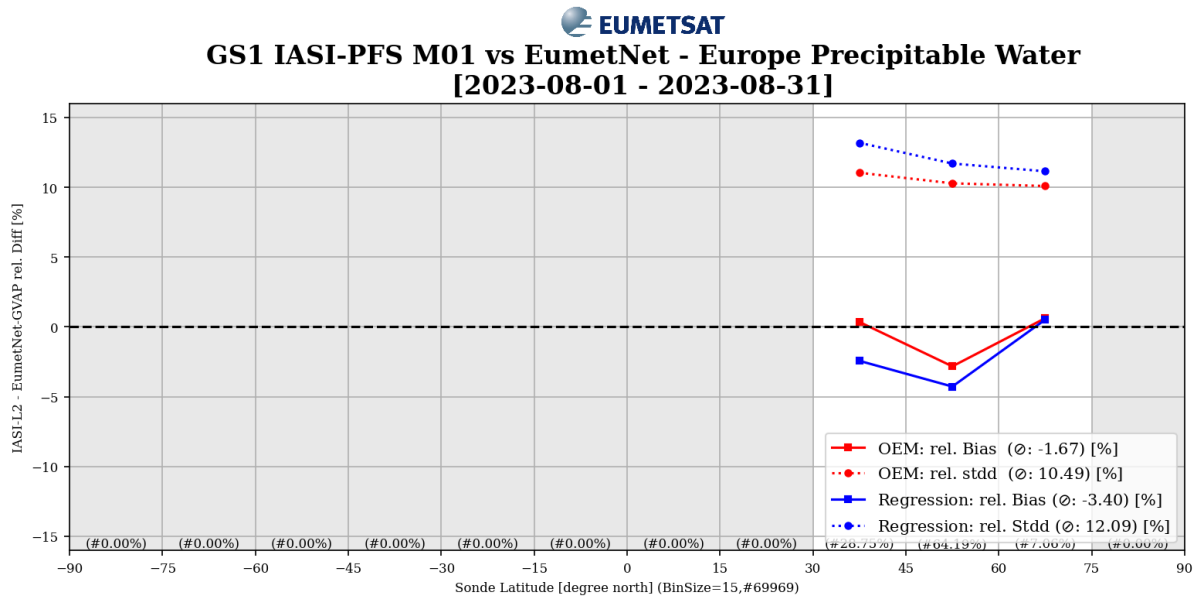


Figure 3.8: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different latitudes (top) and local solar times (bottom).

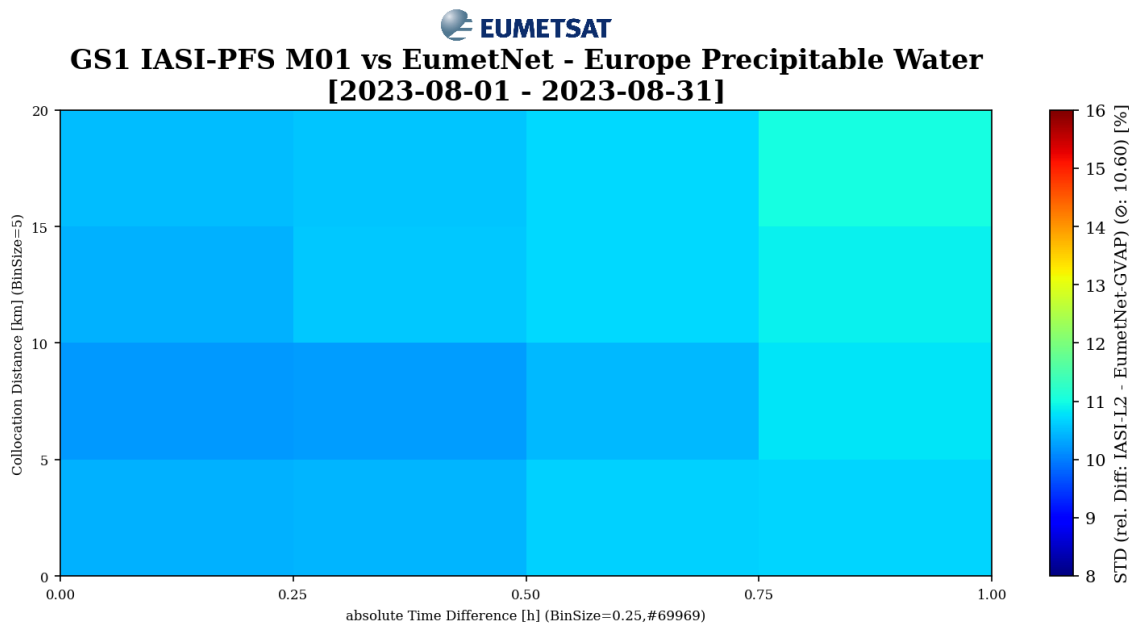
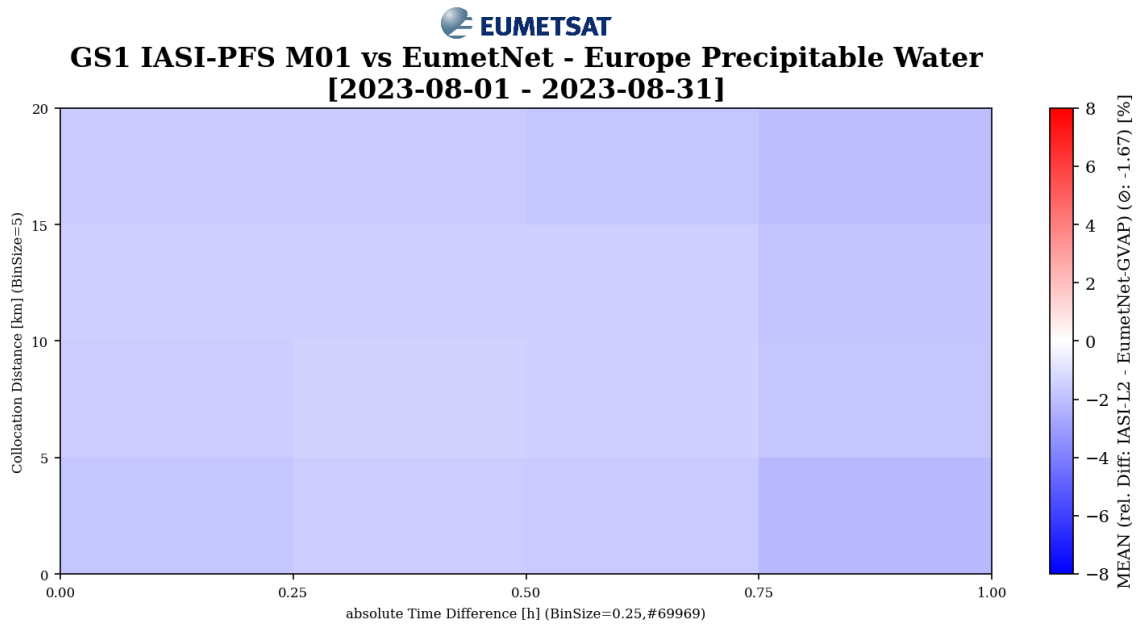


Figure 3.9: 2D Histograms: bias (top) and standard deviation (bottom). Dependencies of IASI-L2 Precipitable Water and EumetNet measurements differences on absolute collocational time difference (x-axis) and collocational distance (y-axis), with M01 IASI L2 from GS1 for 01-31/08/2023.

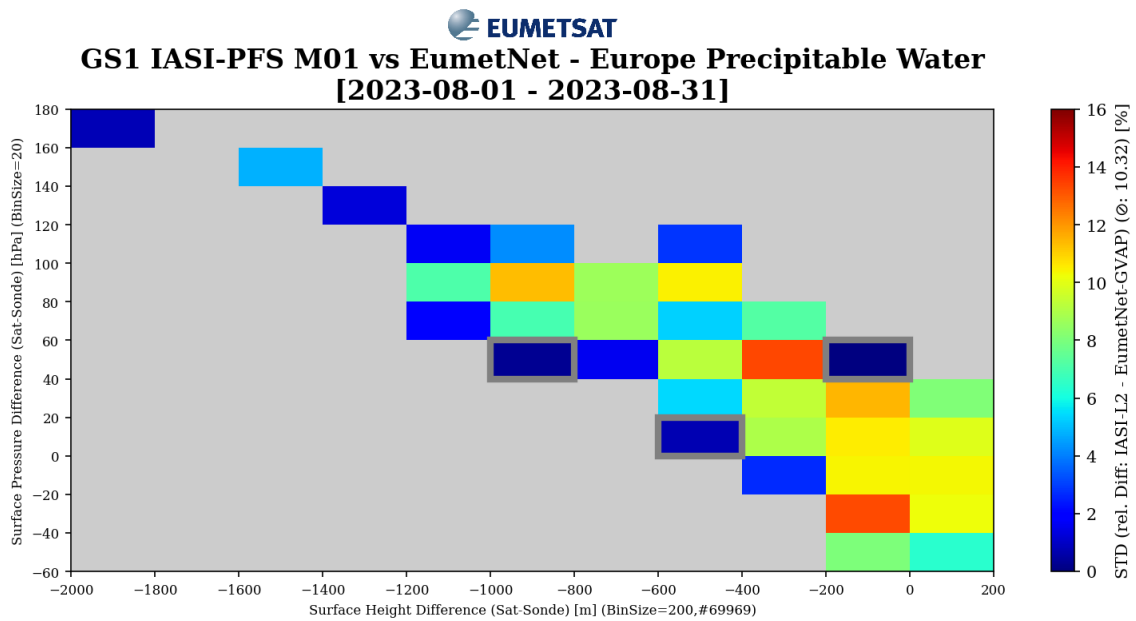
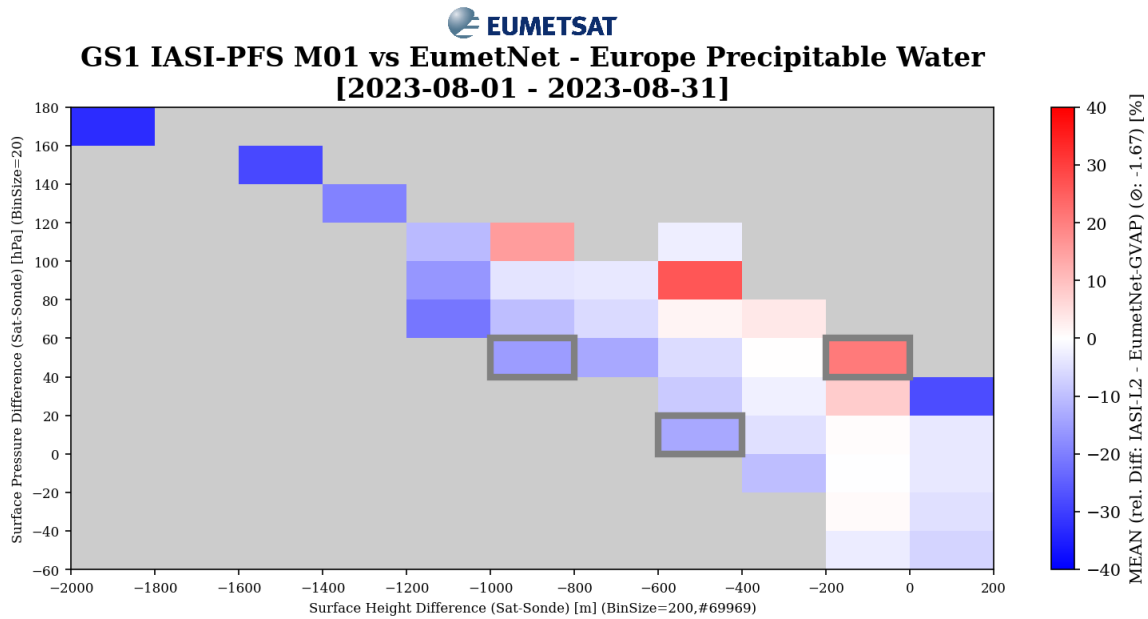


Figure 3.10: 2D Histograms: bias (top) and standard deviation (bottom). Dependencies of IASI-L2 Precipitable Water and EumetNet measurements differences on Surface Height Differences (x-axis) and Surface Pressure Differences (y-axis), with M01 IASI L2 from GS1 for 01-31/08/2023.

3.4.2 Angular dependencies

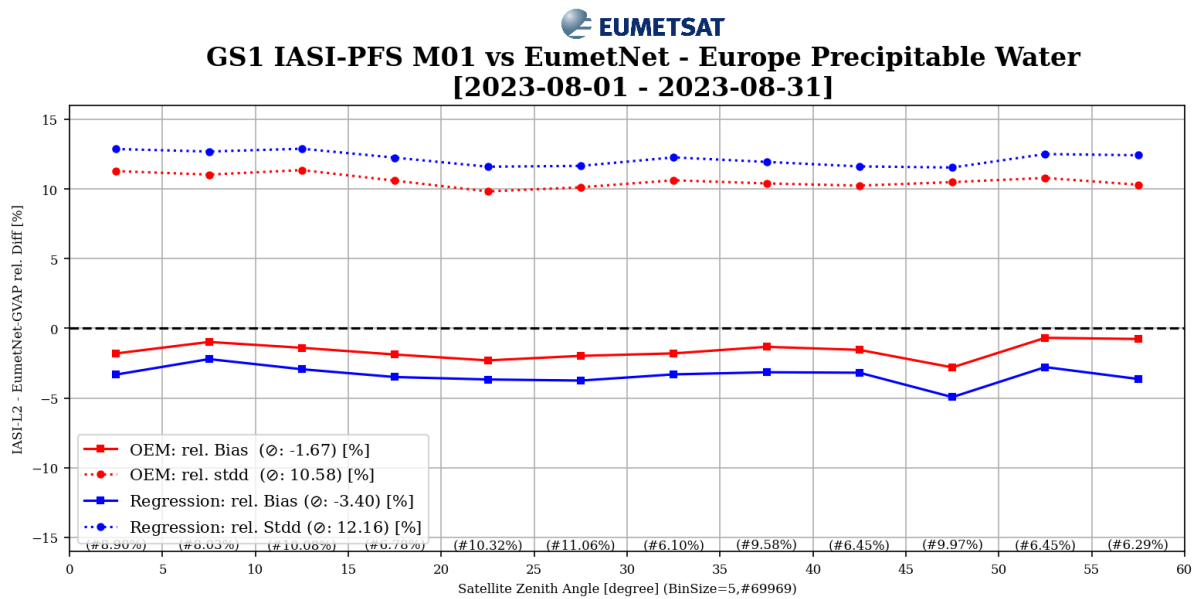
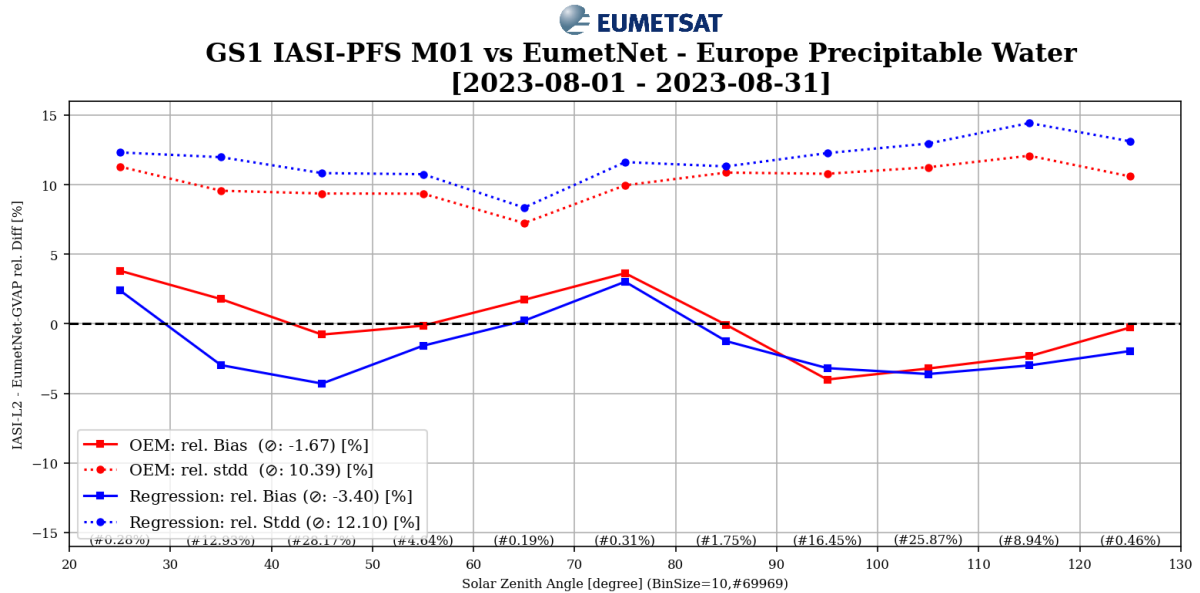


Figure 3.11: Relative bias and standard deviation histograms between IASI L2 Precipitable Water and EumetNet (ylog), with M01 IASI L2 from GS1 for 01-31/08/2023 for different sun zenith angles (top) and satellite zenith angles (bottom).

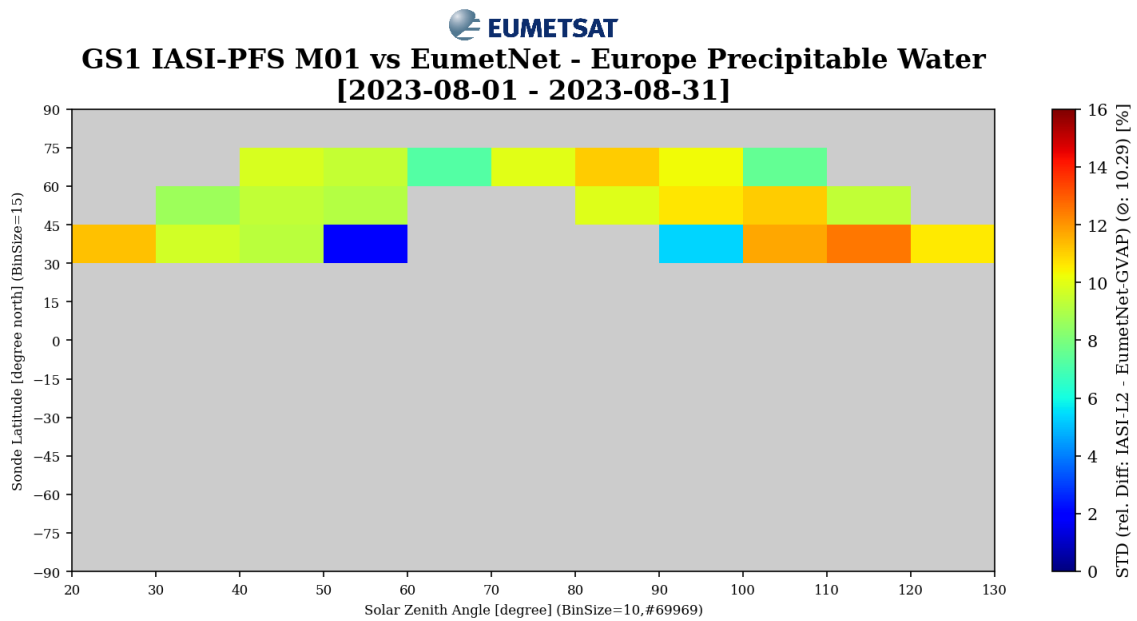
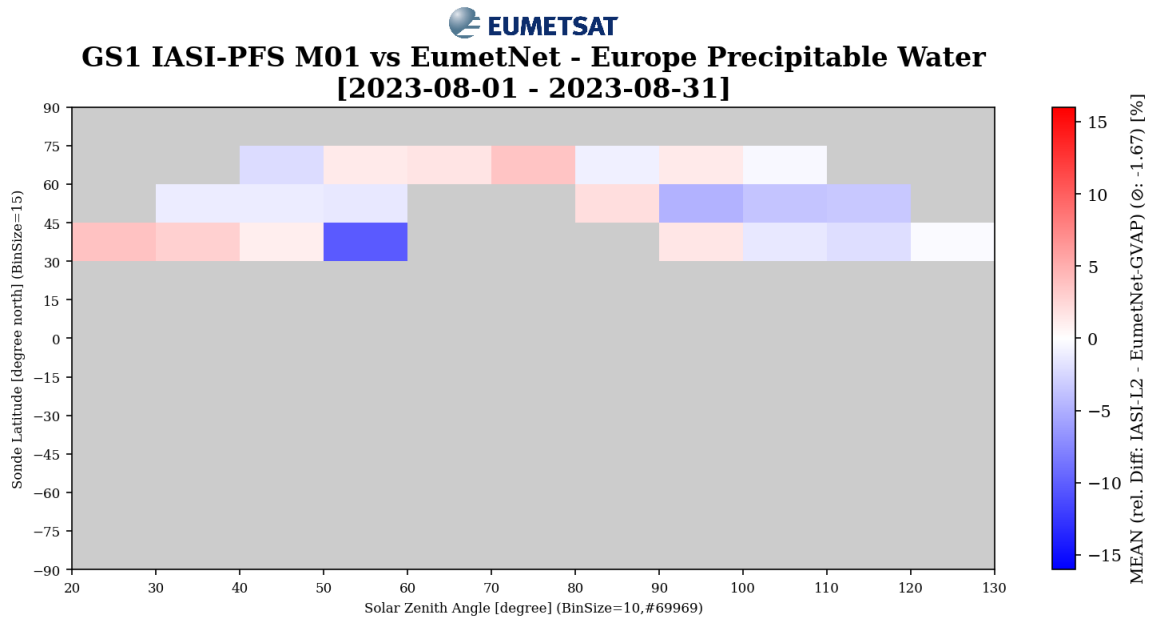


Figure 3.12: 2D Histograms: bias (top) and standard deviation (bottom). Dependencies of IASI-L2 Precipitable Water and EumetNet measurements differences on Solar Zenith Angles (x-axis) and Latitude (y-axis), with M01 IASI L2 from GS1 for 01-31/08/2023.

4 GLOBAL MONTHLY STATISTICS PER STATION

4.1 Maps - absolute difference

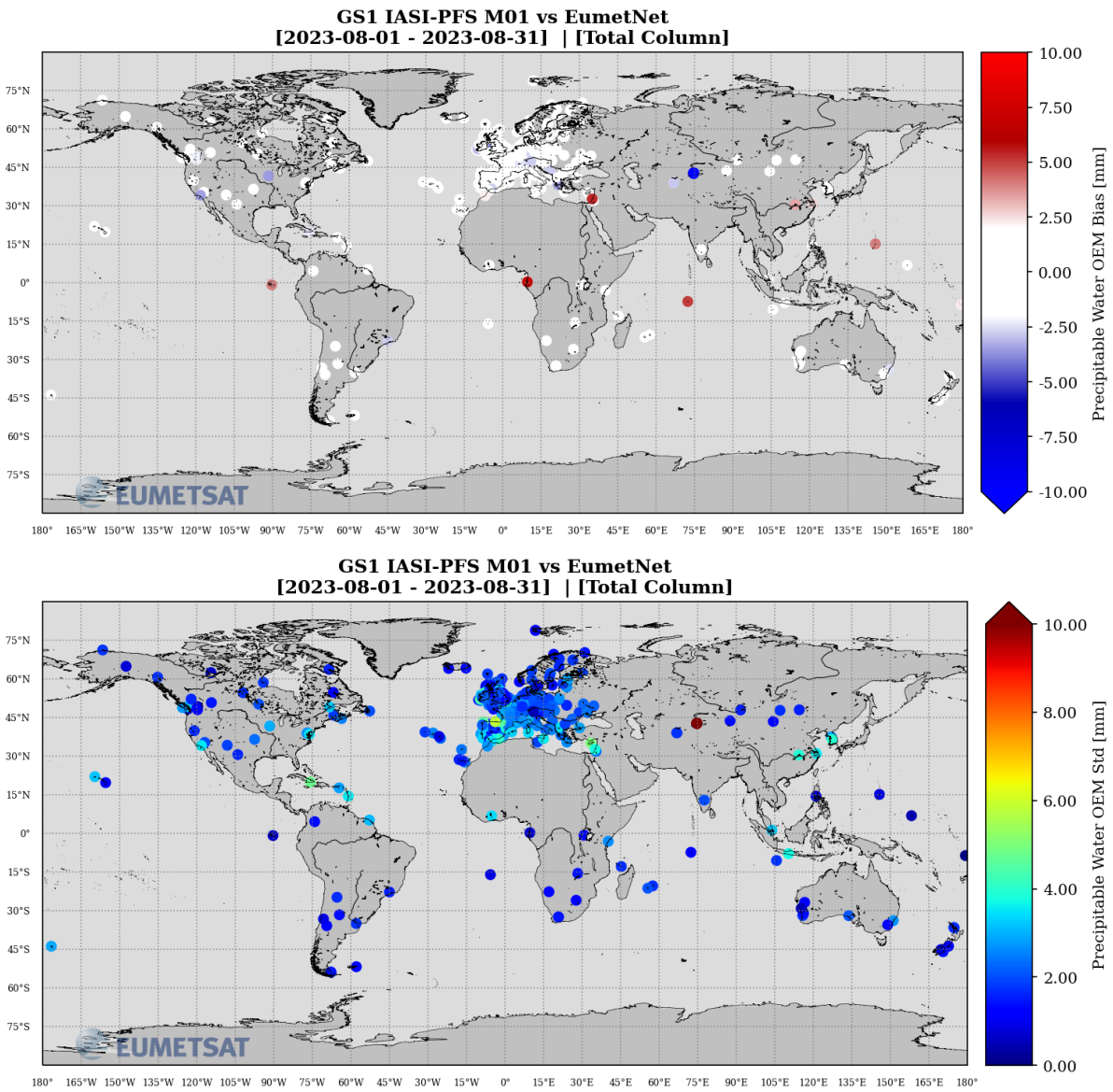


Figure 4.1: Maps of relative Precipitable Water mean (top) absolute differences and standard deviation (bottom) between IASI L2 and EumetNet, with M01 IASI L2 from GS1 for 01-31/08/2023

4.2 Maps - relative difference

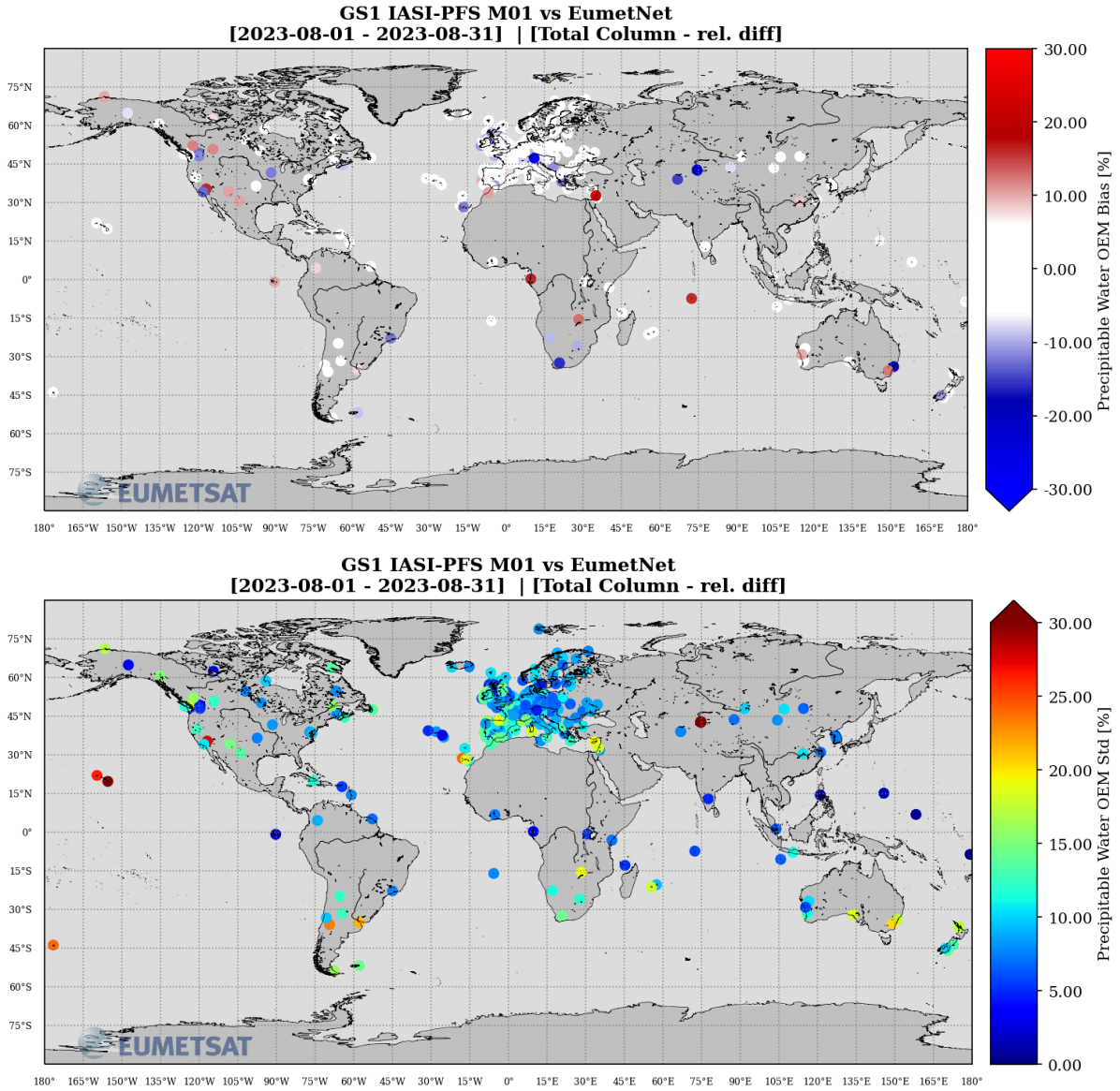


Figure 4.2: Maps of relative Precipitable Water mean (top) relative differences and standard deviation (bottom) between IASI L2 and EumetNet, with M01 IASI L2 from GS1 for 01-31/08/2023

5 REGIONAL EUROPE MONTHLY STATISTICS PER STATION

5.1 Maps - absolute difference

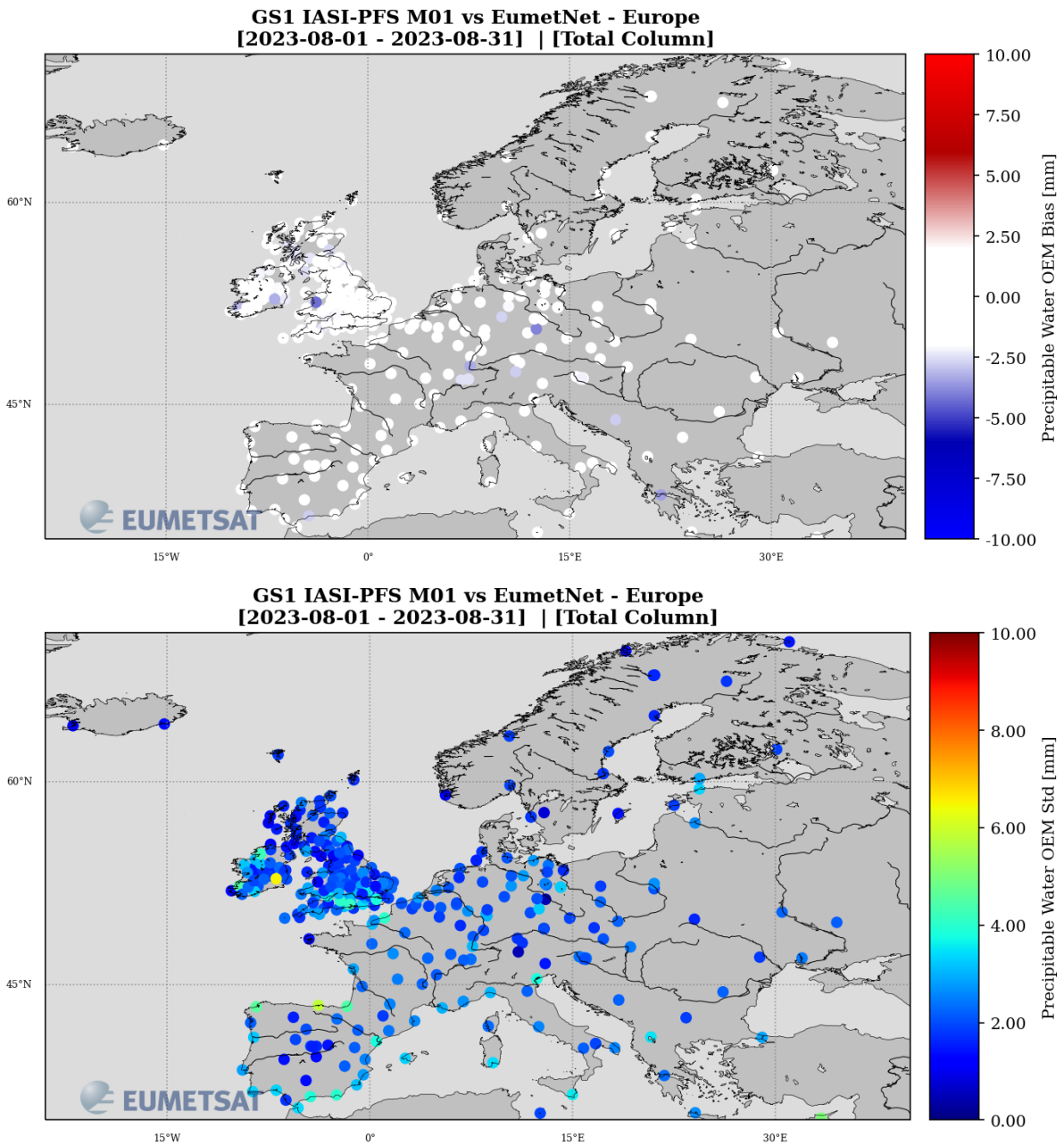


Figure 5.1: Maps of relative Precipitable Water mean (top) absolute differences and standard deviation (bottom) between IASI L2 and EumetNet-Europe, with M01 IASI L2 from GS1 for 01-31/08/2023

5.2 Maps - relative difference

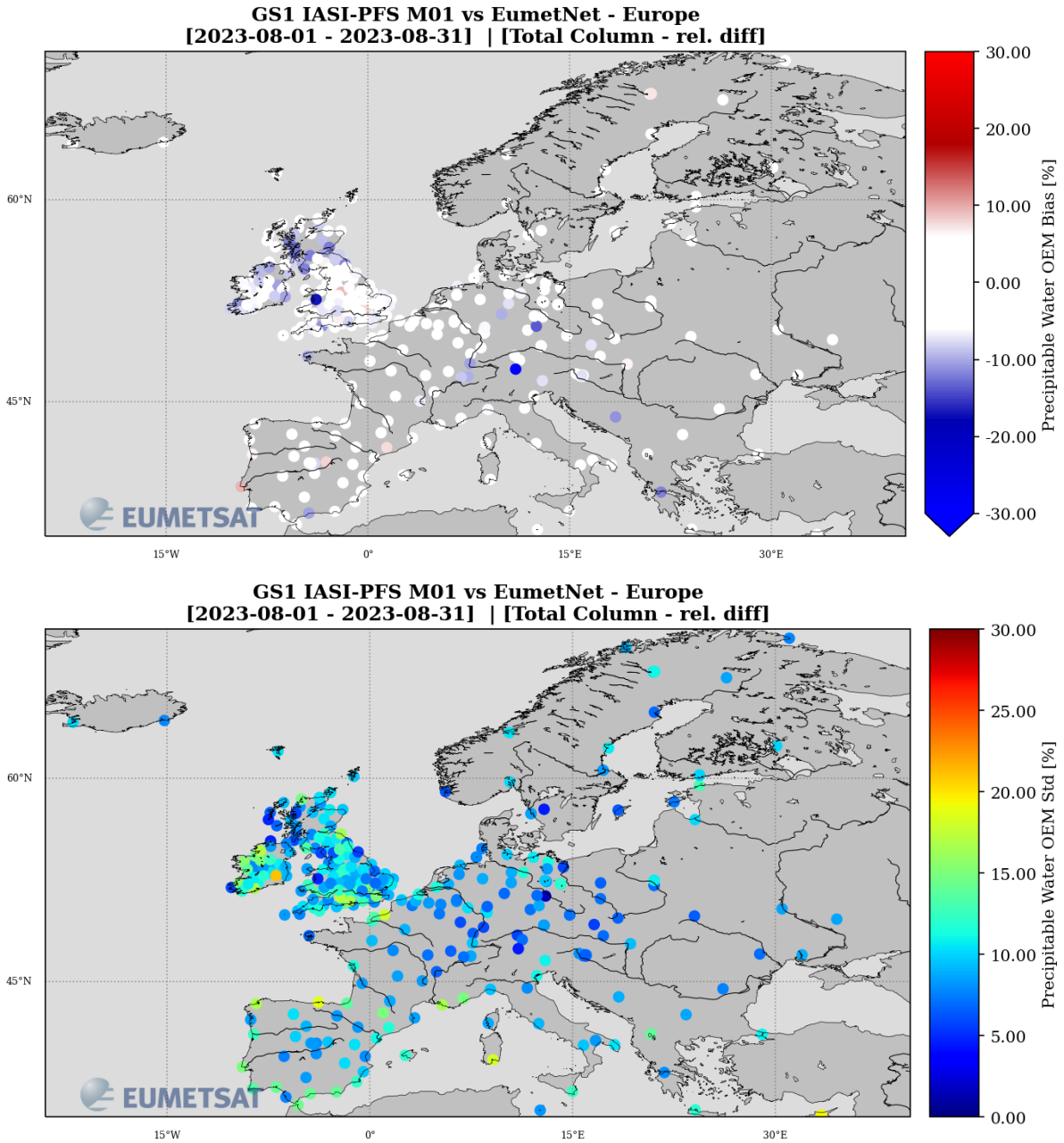


Figure 5.2: Maps of relative Precipitable Water mean (top) relative differences and standard deviation (bottom) between IASI L2 and EumetNet-Europe, with M01 IASI L2 from GS1 for 01-31/08/2023