

The BOUSSOLE project technical reports; report #7-21, issue 1.

BOUSSOLE buoy deployment & maintenance log.

June 7, 2016 - June 1, 2017

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Foreword

This report is part of the technical report series that is being established by the BOUSSOLE project.

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1 SCOPE OF DOCUMENT

The BOUSSOLE buoy deployment and maintenance log is a record of all events that occur from the deployment to the recovery of one of the two upper sections of the buoy.

The aim is to keep track of all maintenance operations, such as instruments cleaning or rotations, instruments malfunctions, incidents with the buoy structure, if any, biofouling development and so on.

This information is crucial to a subsequent correct interpretation of the data.

Keeping track of these events also allows their analysis in view of the permanent improvement of protocols.

The present report concerns "buoy deployment XVIII", from June 6 of 2016 to June 1 of 2017.

2 DESCRIPTION OF OPERATIONS

2.1 UPPER SECTION PREPARATION (2016-01)

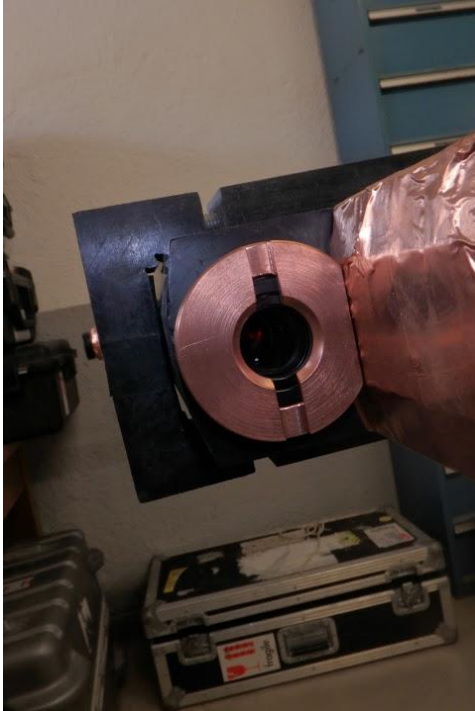
The buoy System (called system #2) was delivered from Satlantic on mid-January 2016, the installation operations started soon after. The system was ready to go at sea by early February and the deployment took place on 7th June 2016, after an unusually long period of bad weather.

The Buoy was equipped with sensors used for the deployment of the buoy XVI recovered on May 2015. The system was prepared in the renovated CCI local in Villefranche-Sur-Mer. Copper sheets and pieces were again fixed wherever possible to avoid biofouling arising. The CISCO antenna was not installed on the buoy (not repaired after being flood).

The system was tested for several days running both with solar panel and battery. No anomalies were observed.

An "in air" data collection was also performed on February 3th to verify the consistency among similar radiometers before deployment (see appendix).







2.2 MOORING DEPLOYMENT

2.2.1 Monday-Tuesday 6-7th June 2016

The upper superstructure to be deployed was brought to La Darse port in Villefranche-sur-Mer at local 13:40 pm with the help of 6 people from LOV.

Once unloaded the old structure, the buoy was loaded on board the GGIX with the help of the CCI crane. The 4 arms were not assembled and were loaded on the ship with the annexe. The GGIX stayed in the Villefranche bay for the night and the day after went to the BOUSSOLE site to complete the installation of the upper superstructure. At about 11h30 the ARGOS messages started being dispatched regularly.

At this date, buoy is equipped with

- DACNet #11
- CLC #004
- Junction Box #002
- Rads set: OCI #048_Eu4m, #050_Ed4m, #163_Eu9m, #164_Ed9m
#030_Es, OCR #036_Lu4m and #037_Lu9m, MVDS #062, OCP#040 (4m)
and OCP#041 (9m)
- Hyper spectral units HOCR-RW #276_Lu4m, #277_Lu9m, HOCR-IW
#327_Es, HOCR-IW #421_Ed4, #422_Ed9, STOR-X #.
- HS4 #H4080705

- Strain-100 #001
- Transmissometers C-Star #626-PR (4m) and #847-PR(9m)
- ECOFLNTUs #608 (4m) and #609 (9m)
- ARGOS beacon #003 (prog id#26021)
- CTD #37SI 30260-2404
- Strain gauge OML CSSPE00356 (not operational)
- PAR #061

The lower part of the buoy is still equipped with the two emergency ARGOS beacons.

2.2.2 Tuesday 7th June 2016

This day is part of the B#172 cruise, and occurred on the same day of the buoy upper superstructure deployment. After the GGIX left the site, divers from OOV performed dark IOPs measurements and recovered the emergency ARGON beacon #5433 for battery replacement before being mounted on the new mooring scheduled in August 2016. Divers also recovered the O₂ optode at 10 m and mounted recently calibrated optodes at 3 and 10 m (the optode at 3 m was dismantled directly from the recovered buoy the day before). Finally the mounted the F3 fluorometer with new batteries at 9 m.

2.2.3 Wednesday 29th June 2016

This day is part of the B#173 cruise on board the *Sagitta III*. Buoy data were downloaded on the top of the buoy and surface sensors and solar panels cleaned. The protection cap was present on the Es Hyperspectral unit and removed (it was mistakenly not removed after buoy installation).

2.2.4 Thursday 30th June 2016

This day two divers from LOV went to the BOUSSOLE site on board the *Papetee* ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. Divers cleaned the underwater optical sensors and performed dark IOPs measurements. Then they retrieved data from the FR sensor at 9 m and re-installed it on the buoy.

2.2.5 Tuesday 19th July 2016

This day the private boat *DOLCEFARNIENTE* from Darkpelican Company in Villefranche-sur-Mer was rent to go to the BOUSSOLE site. When on site divers went at sea to clean the optical sensors, and perform

dark IOPs measurements. In the meantime buoy data were downloaded with a direct connection and surface sensors, ARGOS connector and solar panels cleaned. Then divers dismantled and successively remounted the Triplet fluorimeter for data download. Finally pCO₂ sensors at 4 and 9 m were brought to surface for data download but not re-installed since both were not communicating. The cable of the pCO₂ sensor at 10 m was damaged.

2.2.6 Friday 12th August 2016

This day is part of the B#174 cruise. Divers cleaned optical sensors and performed dark IOPs measurements. The F3 fluorimeter was recovered for data download and mounted again at 9 m. Two recalibrated pCO₂ sensors were mounted on the buoy at 3 m and 10 m depth. Buoy data were downloaded on the top of the buoy and surface sensors and solar panels cleaned.

2.2.7 Saturday-Sunday 27-28th August 2016

These days are part of the mooring rotation cruise on board the CASTOR II ship. The first day buoy system is switched off and the upper superstructure dismantled and stored on board during the mooring rotation operations. The antifouling paint suffered strong degradation. The ARGOS emergency beacon #74605 is dismantled from the old buoy lower superstructure for battery replacement, it will be redeployed on the new lower superstructure later along with pCO₂ sensor and O₂ optode at 10 m. Data from the 2 pCO₂ sensors F3 fluorimeter and CTD at 3 m were downloaded. The second day the buoy upper superstructure is mounted and switched on.

At this date the buoy is equipped with:

- **Strain Gauge OML CSCB40K**

2.2.8 Wednesday 14th September 2016

This day is part of the B#175 cruise. Divers installed the second emergency ARGOS beacon (#5433) on the lower buoy superstructure at 20 m depth. The F3 fluorimeter was recovered for data download and mounted again at 9 m. Underwater optical sensors were cleaned and dark IOPs measurements performed. The light beacon on the top of the buoy, not working, was replaced with a new one. Finally buoy data were retrieved on the top of the buoy after an AK reboot.

2.2.9 Saturday-Sunday 29th September 2016

This day the private ship *PAPETEE* was rent from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. Three divers from LOV were

on board. Underwater and surface optical sensor were cleaned and dark IOPs measurements performed.

2.2.10 Wednesday 12th October 2016

This day is part of the B#176 cruise. Divers cleaned the optical sensors and performed dark IOPs measurements. The F3 fluorimeter was recovered for data download and modification of the schedule: data will be acquire ad 1 hour frequency instead of 15 minutes from now on. The new configuration will allow decreasing the frequency of maintenance operations. Then the F3 was reinstalled on the buoy at 9 m. In the meantime surface sensors and solar panels were cleaned and buoy data downloaded.

2.2.11 Friday 4th November 2016

This day the private ship *PAPETEE* was rent from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. Three divers from LOV were on board. Underwater and surface optical sensor were cleaned and dark IOPs measurements performed. One of the solar panels was broken and need to be replaced. Divers also went on the Cote d'Azur buoy to dismount the ISUS sensor which was unfortunately no more on the buoy.

2.2.12 Wednesday-Thursday 16th-17th November 2016

This day is part of the B#177 cruise. The broken solar panel was removed from the buoy head. The new one could not be installed in place of the broken one because its structure was not adapted to the structure of the buoy: the holes were not in front of the screws and needs to be modified. The surface sensors and the ARGOS connector were cleaned. The second divers cleaned the optical sensors and performed dark IOPs measurements. Buoy data were downloaded and the new solar panel mounted after modification.

2.2.13 Friday 9th December 2016

This day is part of the B#178 cruise. Divers cleaned the optical sensors and performed dark IOPs measurements. The F3 fluorometer was recovered for data download and remounted on the buoy at 9 m. Buoy data were downloaded too. Optical sensors, solar panels and ARGOS connector were cleaned on the top of the buoy.

2.2.14 Wednesday 4th January 2017

This day two divers from LOV went to the BOUSSOLE site on board the *Papetee* ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-

sur-mer. Divers cleaned the underwater optical sensors and performed dark IOPs measurements. The ARGOS messages dispatch had stopped during the night before the mission, however instruments were seen working by divers.

2.2.15 Tuesday 7th February 2017

This day is part of the B#180 cruise. One of the solar panel was broken. When at sea, divers dismantled the F3 fluorometer for data download and install new batteries. Then they cleaned instruments and performed dark IOPs measurements. In the meantime surface instruments, solar panels and ARGOS connector cleaned. The buoy system was on stand-by for low voltage of the battery thus an AK reboot was needed for connection and data download. Finally the F3 was remounted on the buoy at 9 m.

2.2.16 Tuesday 21th February 2017

This day two divers from OOV went to the BOUSSOLE site on board the PAPETEE ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. In water sensors were cleaned and dark IOPs measurements performed.

2.2.17 Wednesday 8th March 2017

This day is part of the B#181 cruise. Divers cleaned the buoy underwater sensors and performed dark IOPs measurements. A connection with the buoy was obtained via an AK reboot for data download. Surface sensors, solar panels and ARGOS connector were cleaned too.

2.2.18 Tuesday 21th March 2017

This day two divers from OOV went to the BOUSSOLE site on board the PAPETEE ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer after recovering a PROVAL float. In water sensors were cleaned and dark IOPs measurements performed.

2.2.19 Friday 7th April 2017

This day is part of the B#182 cruise. When on site divers dismantled the two pCO₂ sensors at 3 m and 10 m depth and the O₂ optode at 3 m. Recalibrated pCO₂ sensor and O₂ optode were installed on the buoy at 3 m depth. Optical sensor were cleaned and dark IOPs measurements performed. Buoy data were downloaded and surface sensors, solar panels and ARGOS connector cleaned.

2.2.20 Tuesday 25th April 2017

This day two divers from OOV went to the BOUSSOLE site on board the PAPETEE ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. In water sensors were cleaned and dark IOPs measurements performed. Data from F3 fluorimeter were also downloaded.

2.2.21 Friday 5th May 2017

This day is part of the B#183 cruise. Divers cleaned the optical sensors and performed dark IOPs measurements. Surface sensors, solar panels and ARGOS connector were cleaned too. Buoy data were downloaded after an AK reboot.

2.2.22 Monday 22th May 2017

This day two divers (from OOV and a private one) went to the BOUSSOLE site on board the PAPETEE ship from MEDITERRANEE PECHE DECOUVERTE Company in Beaulieu-sur-mer. In water sensors were cleaned and dark IOPs measurements performed. The ARGOS beacon was cleaned and the message dispatch restarted.

2.2.23 Monday 25th May 2017

This day the buoy stopped working. The next rotation is scheduled on June 1-2 so no troubleshooting intervention is scheduled.

2.2.24 Thursday 1th June 2017

This day the buoy system was switched off from divers in the early morning. Then the buoy mast dismounted and loaded on-board the GGIX for transport to the Villefranche port. Here the mast was unloaded with the help of the CCI crane at 16h00. The structure was in good conditions. The buoy was cleaned with the Karcher before being transported into the CCI local where it was dismounted in the following days. Data stored in the DACNet could not be downloaded with a regular connection, so they had to be retrieved by removing the Microdrive from DACNet. Instruments were shipped for calibration at the end of July, whereas the aluminium structure was sent to the BSS Company in December.

3 QUANTITATIVE SUMMARY

The deployment lasted 361 days with two interruptions in data acquisition due to hard disk crash, for a total of 39 days.

4 INSTRUMENT SCHEDULE

1 minute acquisition every 15 minutes.

5 ANY PROBLEMS ENCOUNTERED ?

- 1- Biofouling paint started to detach from the upper structure soon after the deployment.
- 2- The cover on the Hyperspectral Es was not removed after installation of the buoy.

6 LESSONS LEARNED

- 1- Specify the total number of covers to remove to divers before deployment.

7 APPENDIX

The following pages contain:

- a summary of the test made with the radiometers before the deployment;
- the time series of dark radiometric measurements (analogic instruments only);
- the schema of the buoy;
- the list of the calibration files;
- servicing reports from third part companies (including cosine scan for radiometers).

Radiometer Test

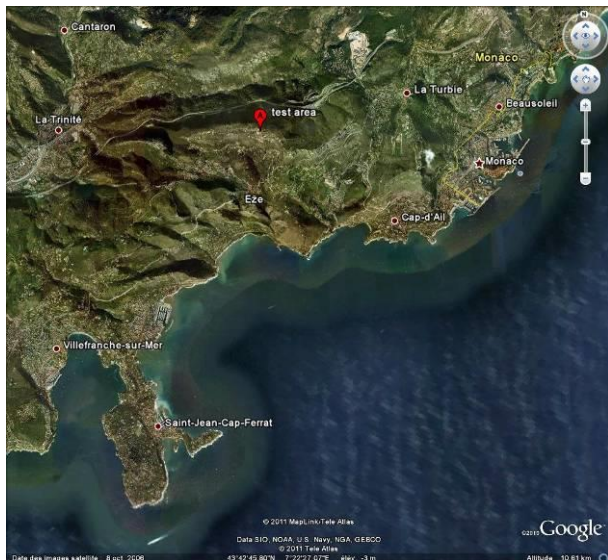
On February 3th 2013 a field campaign to test the buoy radiometers relative performances was organized at the Fort de la Revere. The fort is located at north of the Eze village at about 700m on the sea level (see images below), and near the fort there's a plane field free of obstacles that could cause shadow or glint above radiometers.

All the radiometers used for the buoy were fixed upon a table facing the zenith. The Lu and Eu sensors were covered with teflon caps produced at LOV.

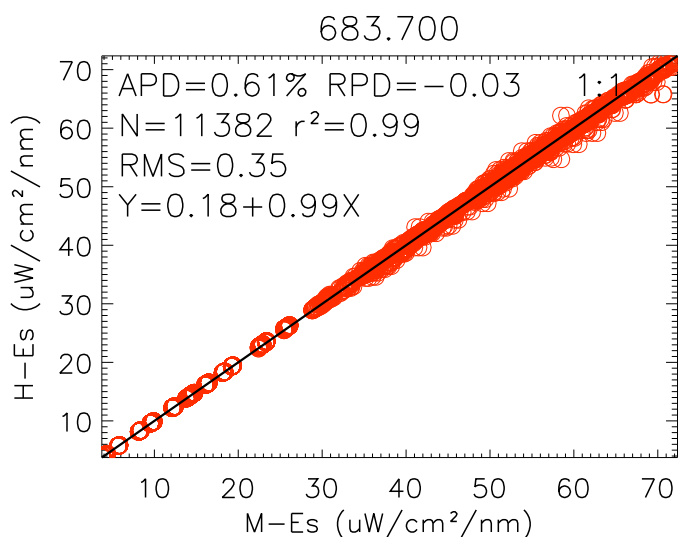
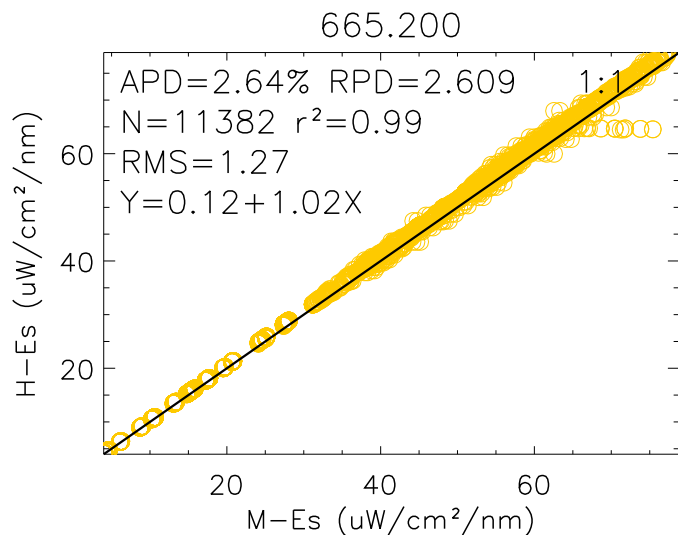
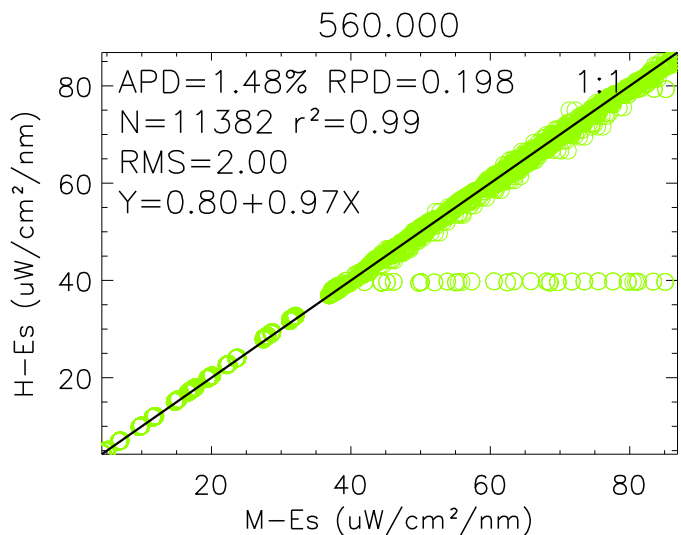
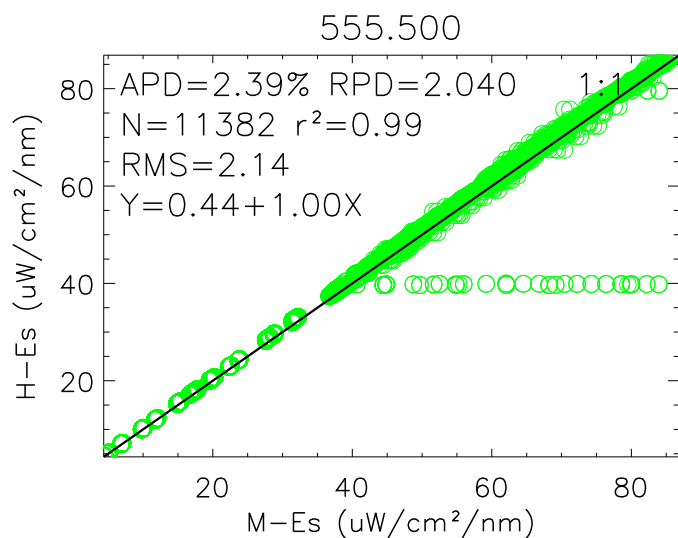
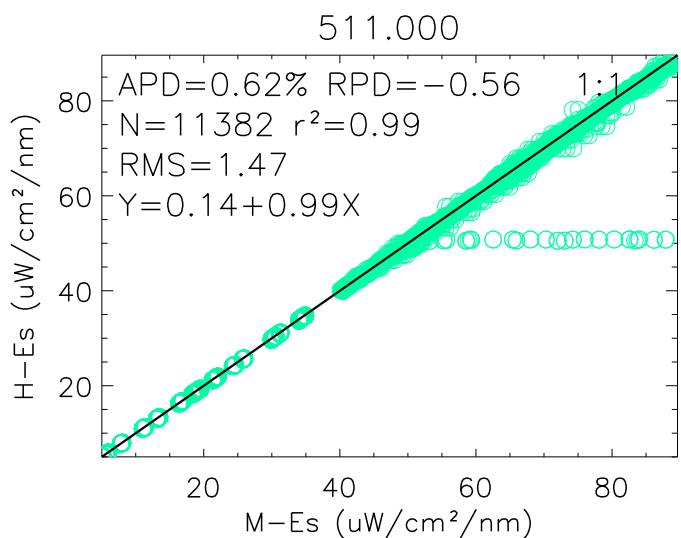
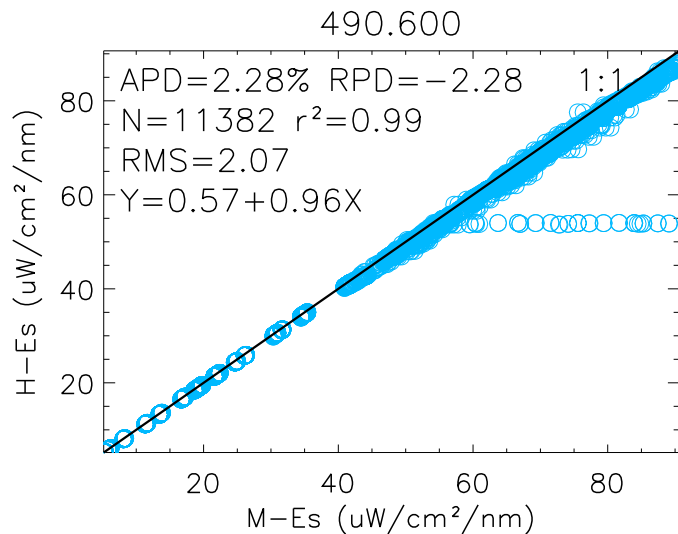
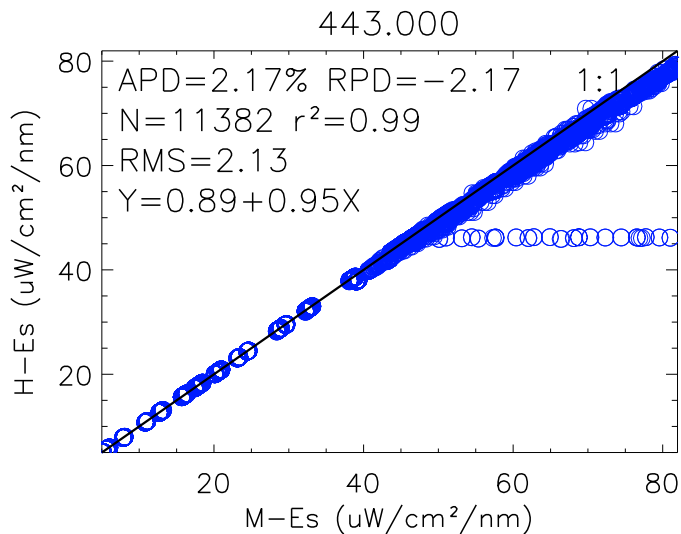
The instruments were all connected as for the buoy deployment (OCPs, DACNet, cables etc.) and powered with a battery. The system schedule was modified to acquire data every 10 minutes instead of 15.

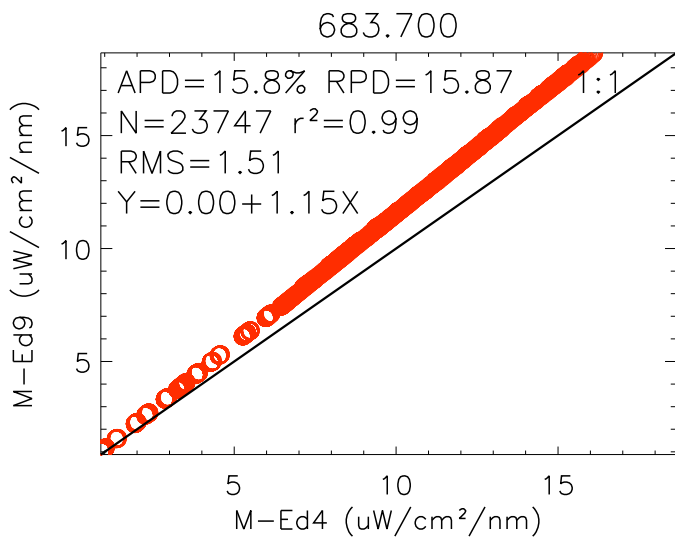
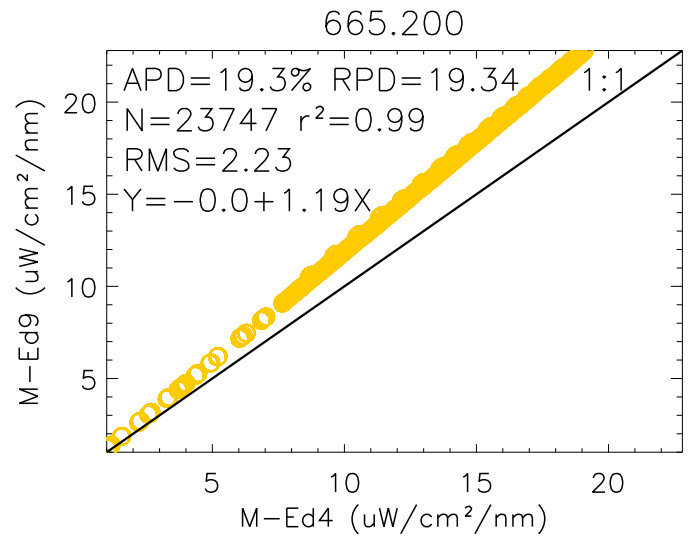
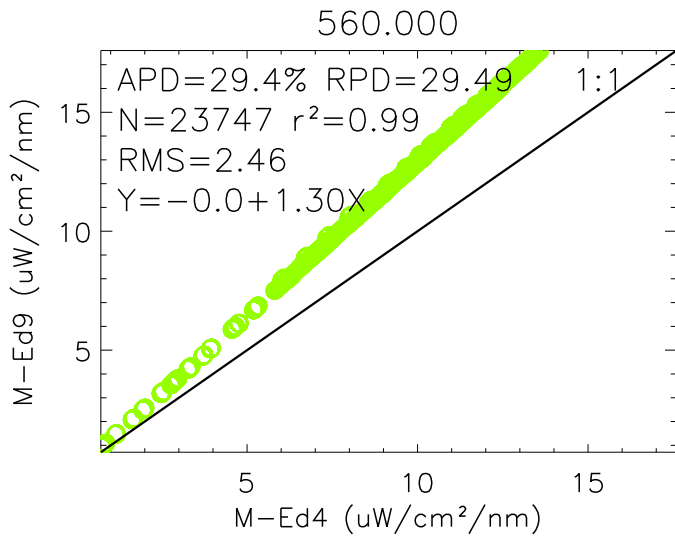
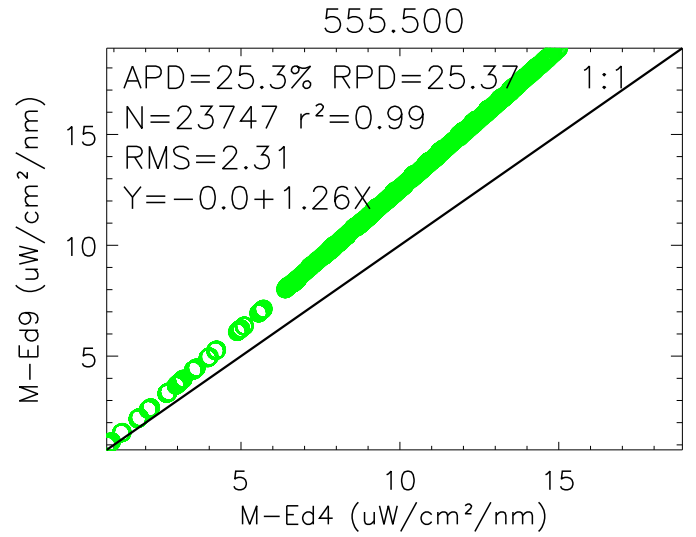
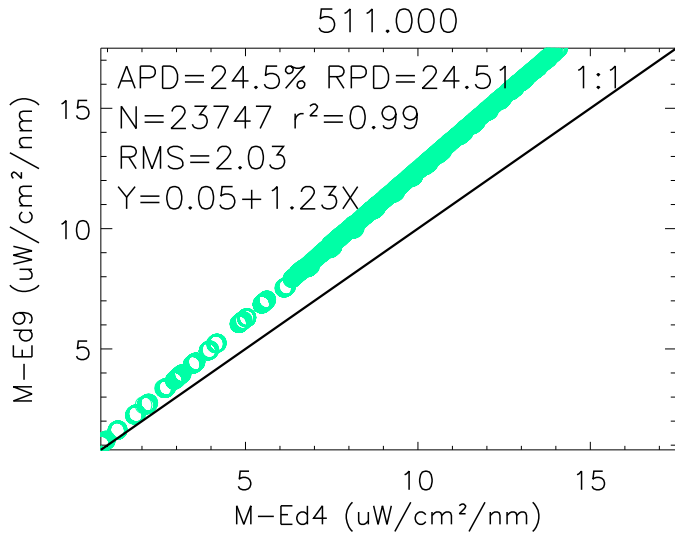
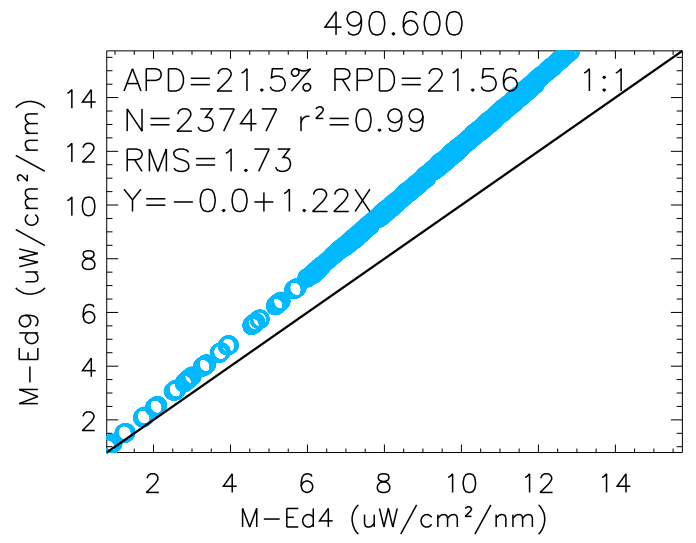
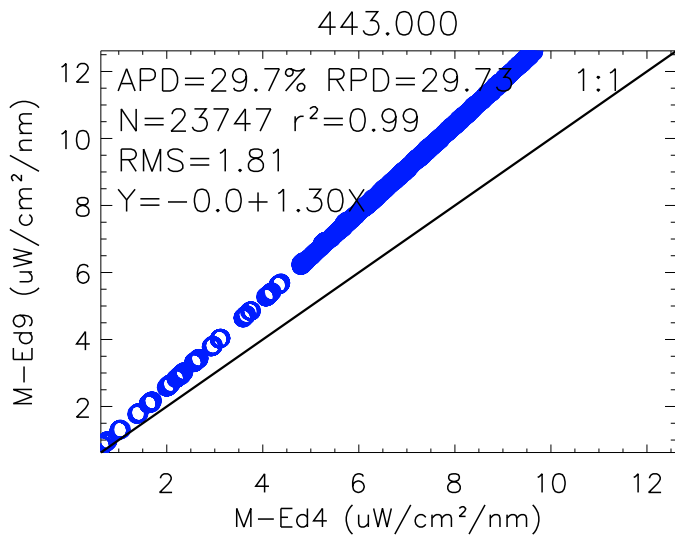
Data were acquired for about 8 hours.

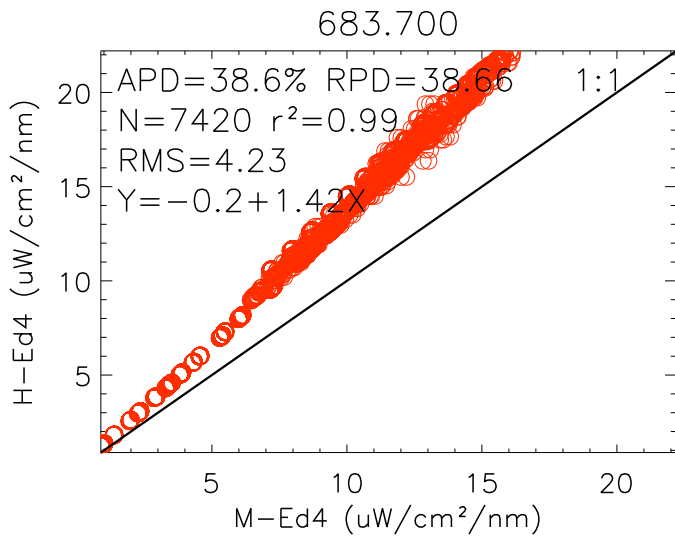
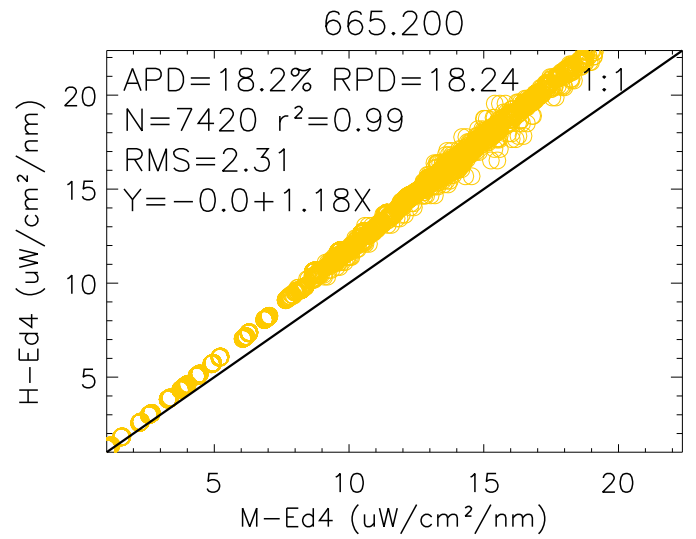
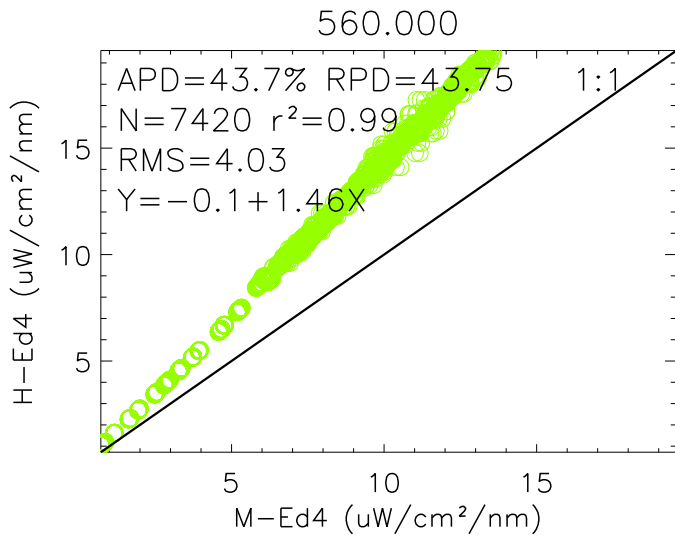
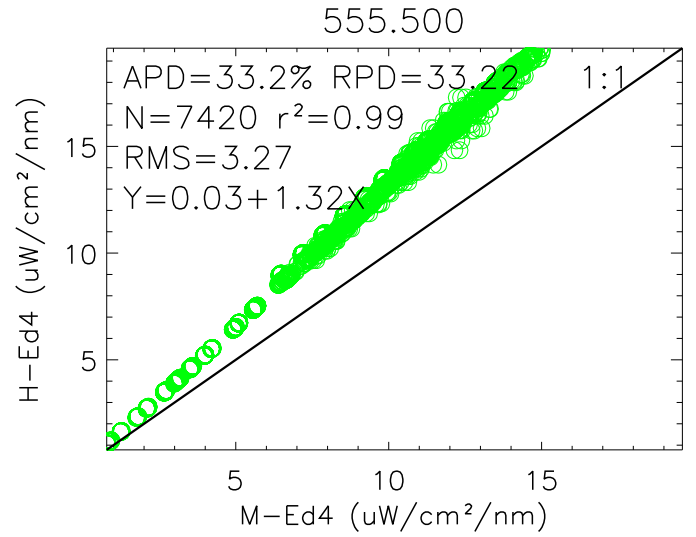
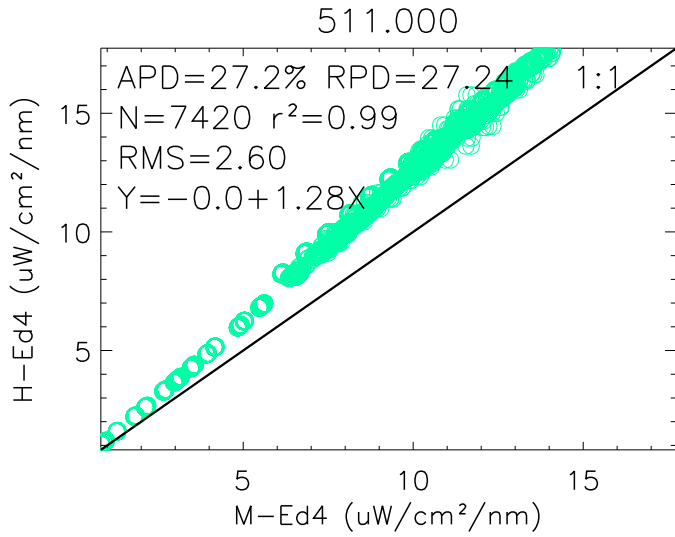
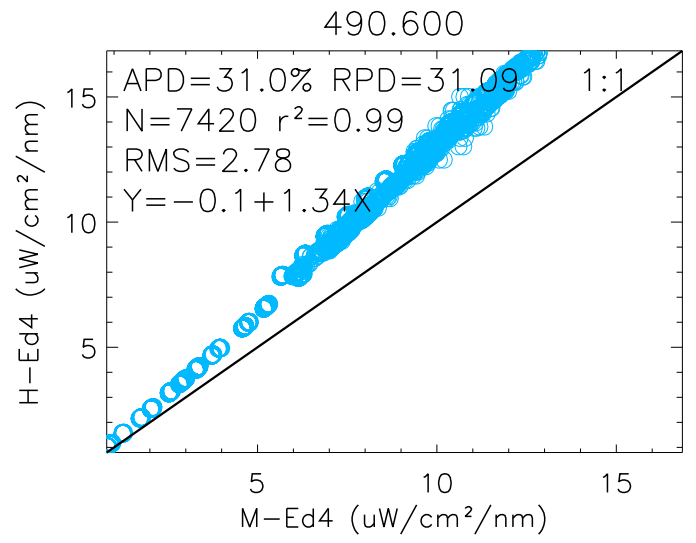
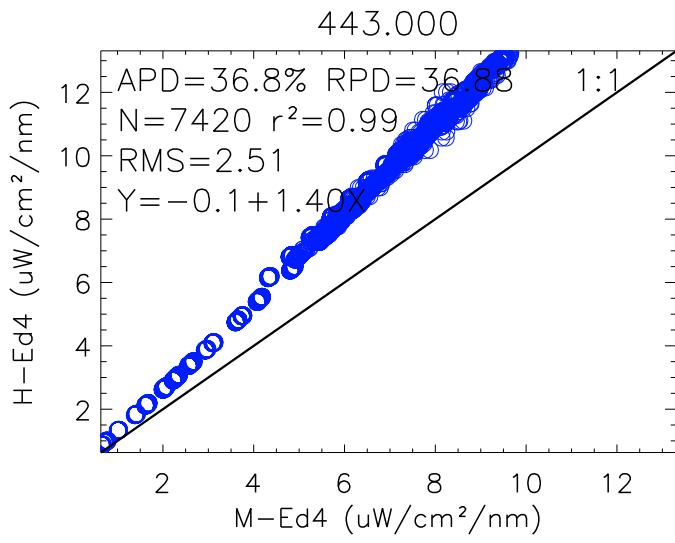
Sky conditions were good. The choice to compare single data by using the TIMETAG variable recorded in data files was maintained.

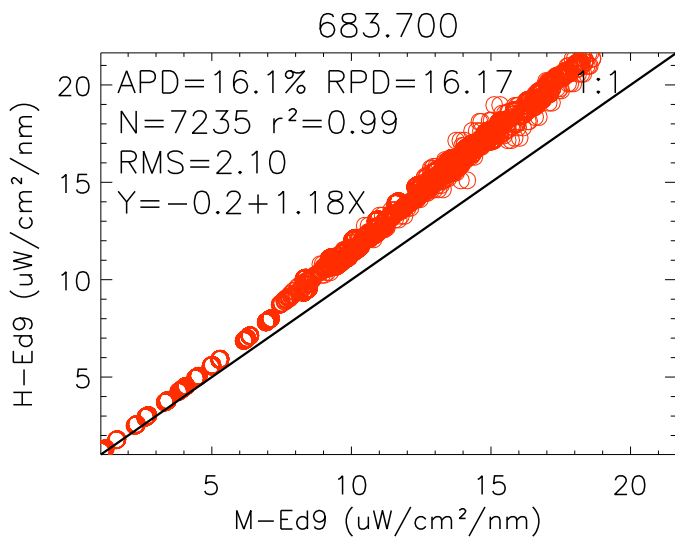
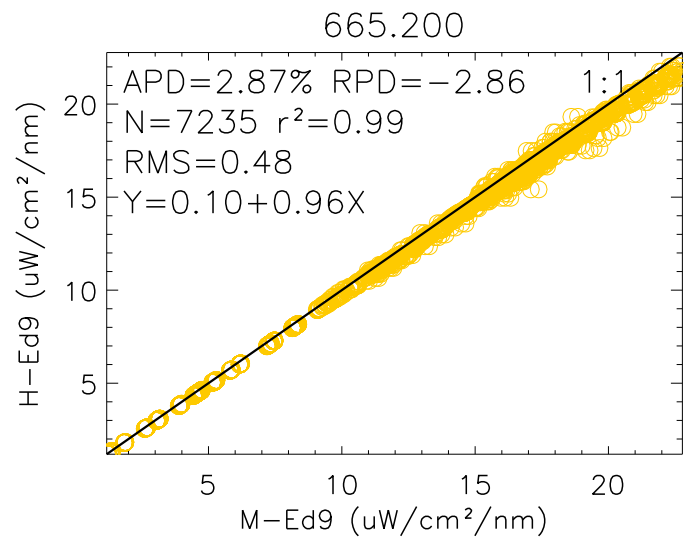
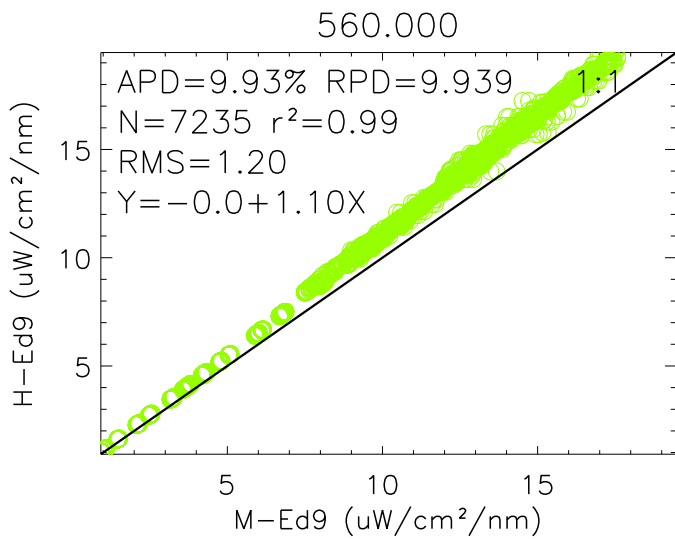
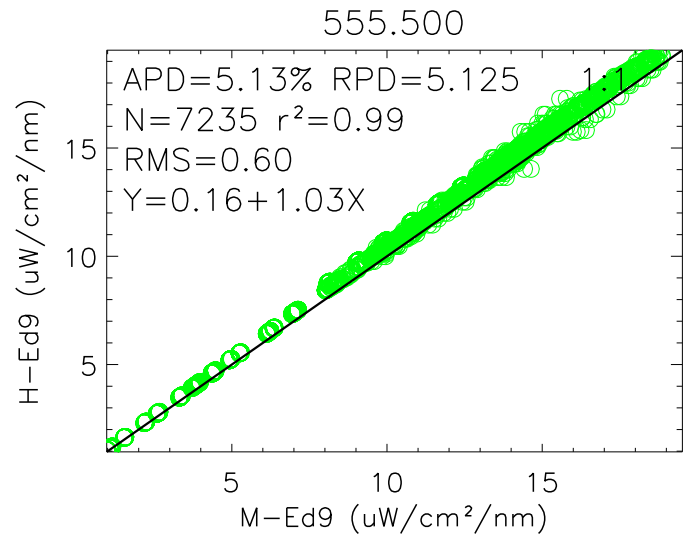
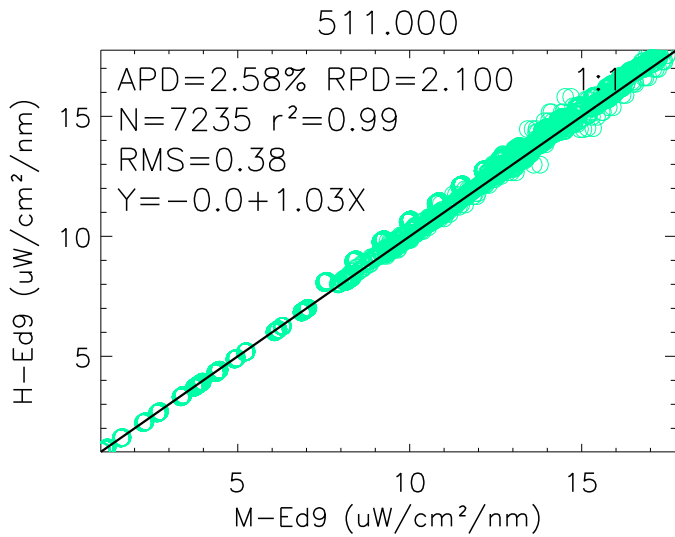
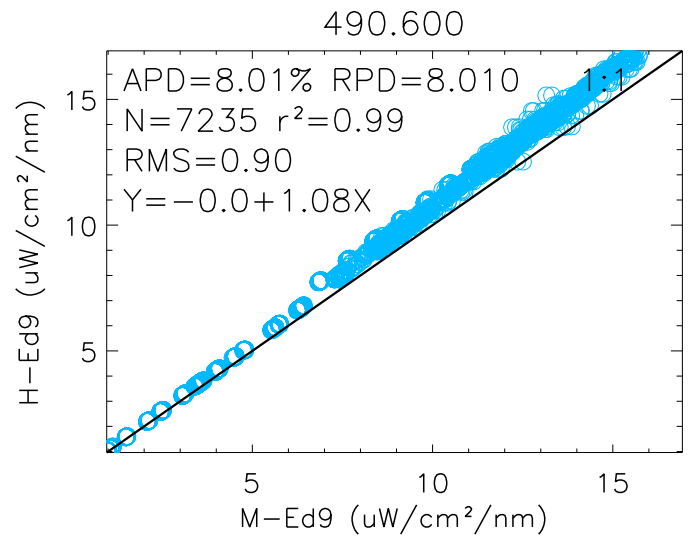
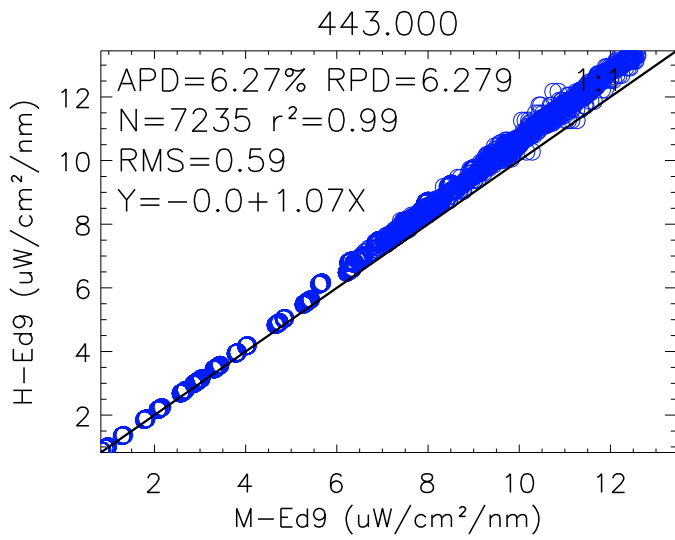


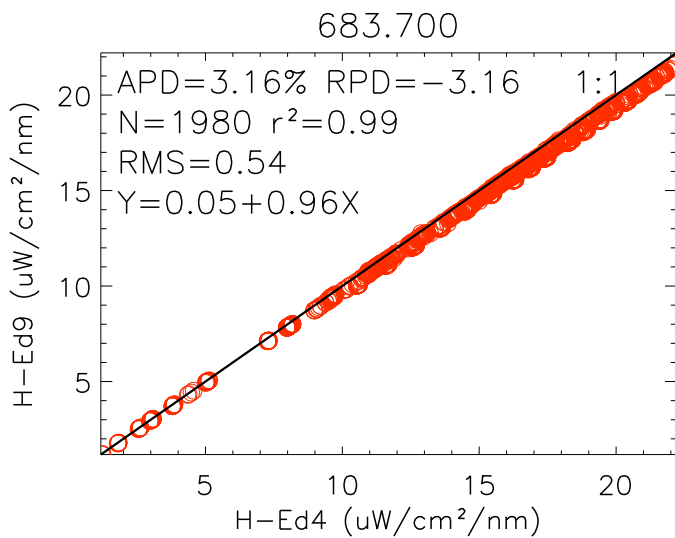
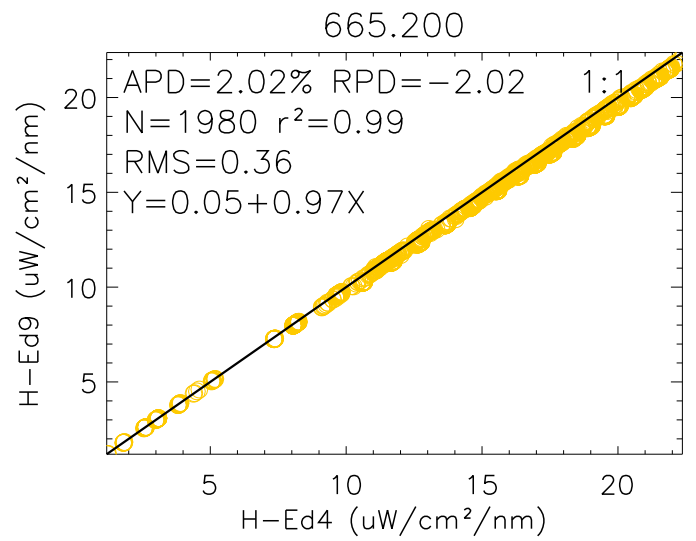
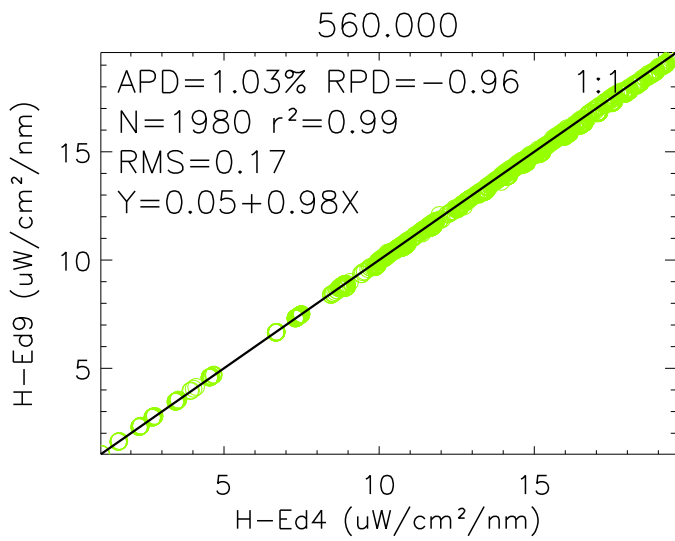
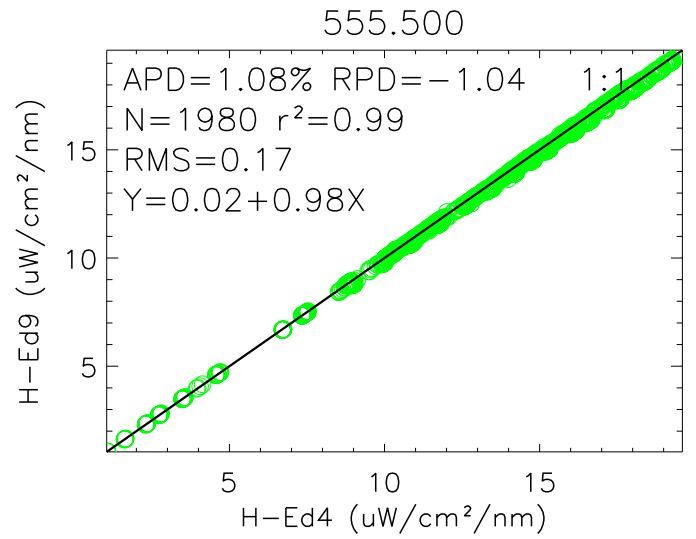
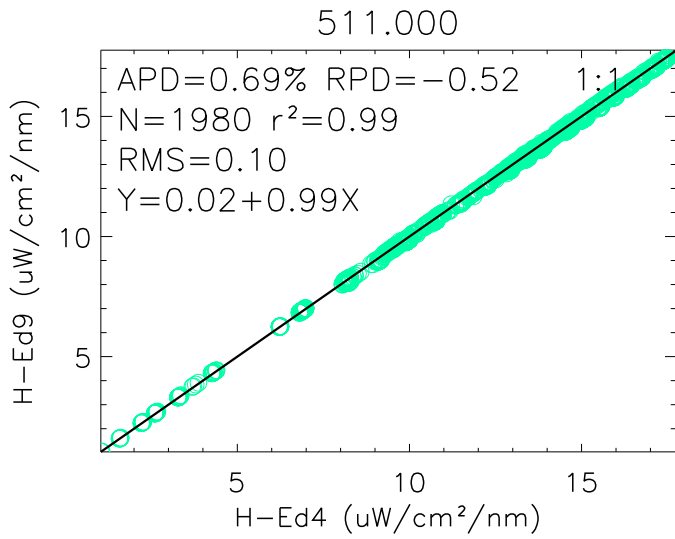
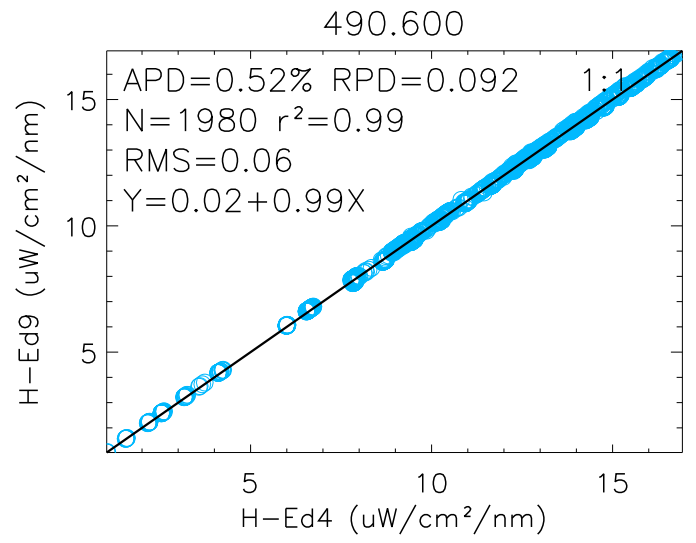
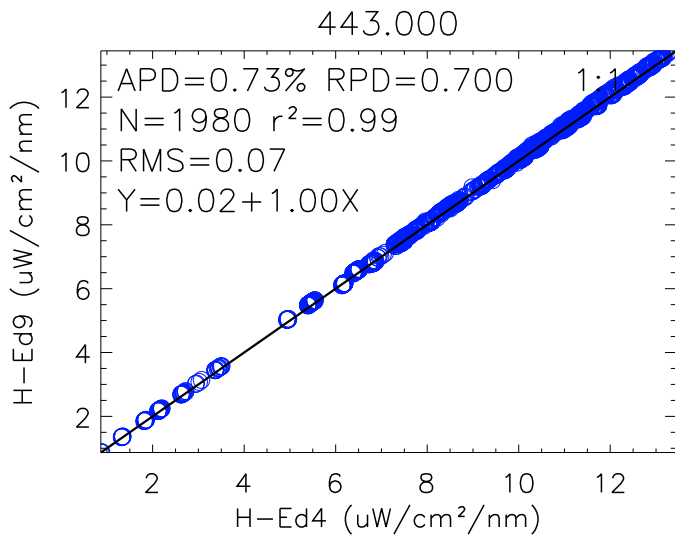
Results of the tests are displayed in the figures below.



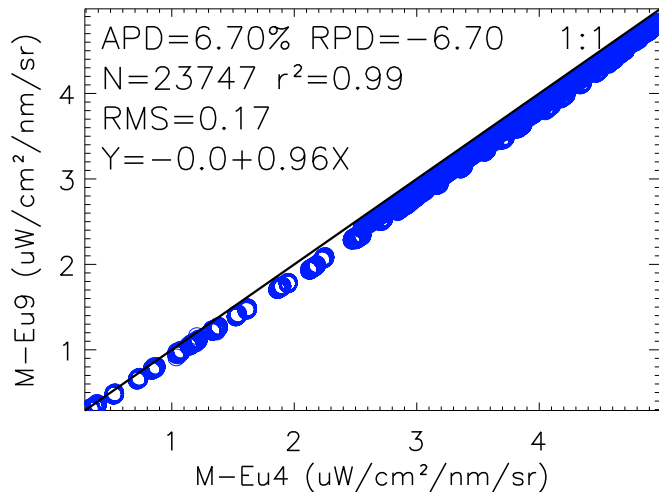




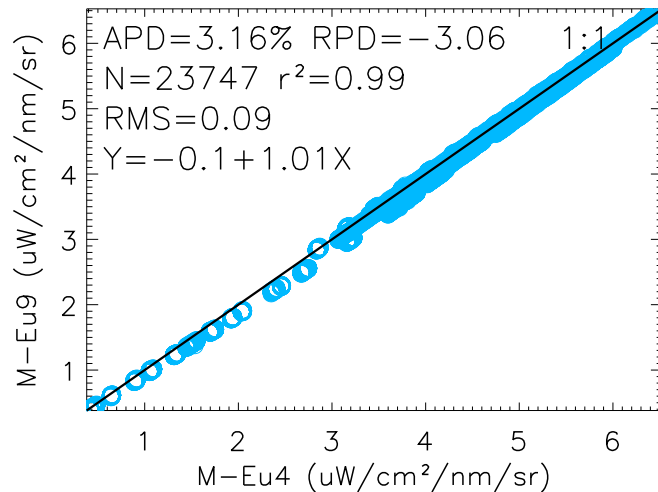




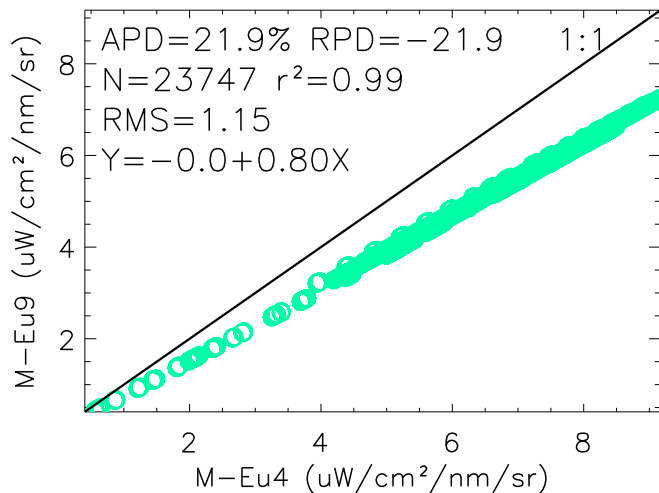
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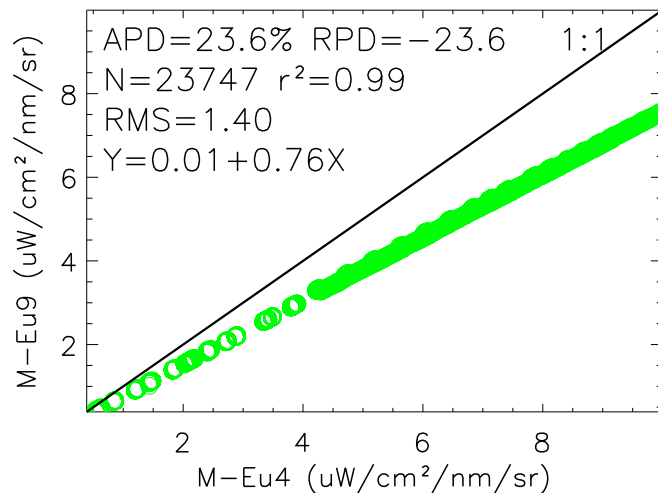
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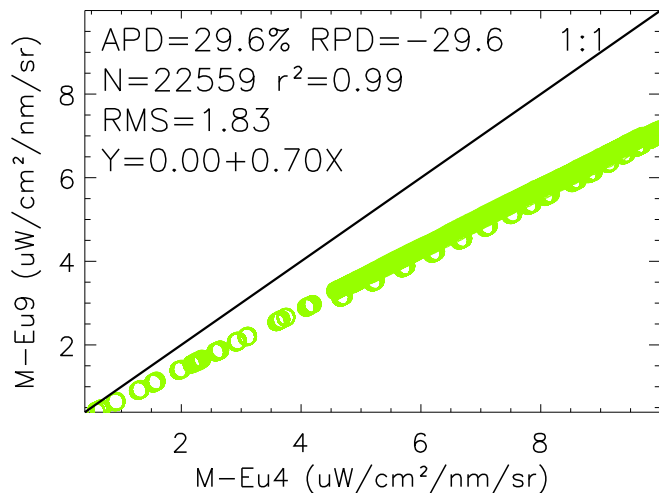
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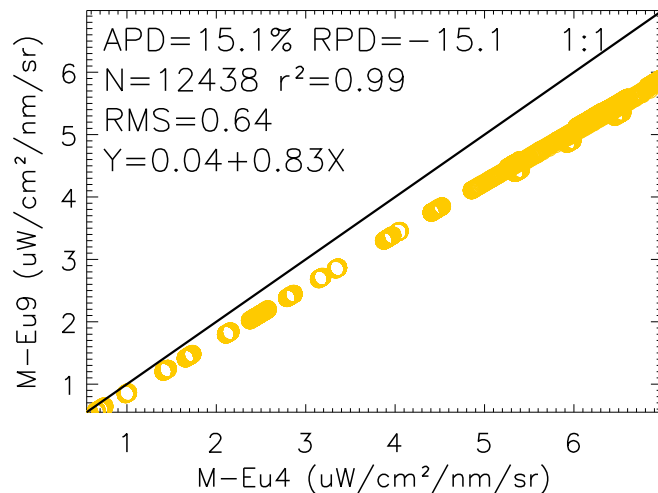
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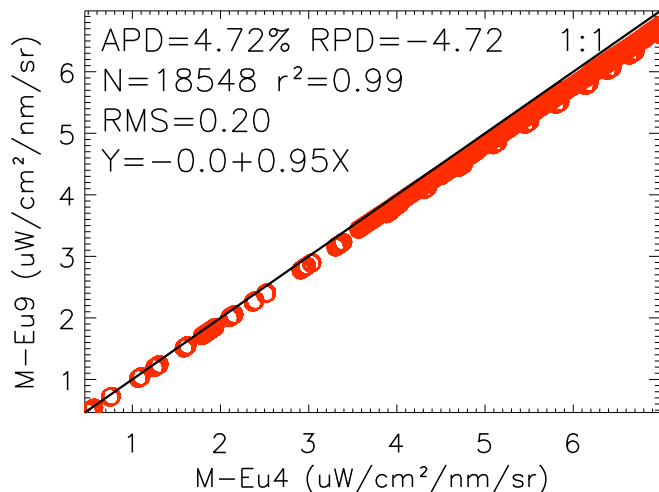
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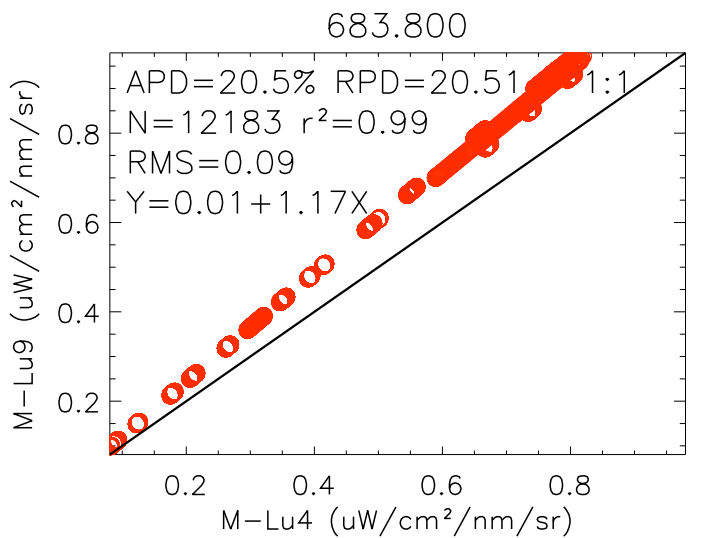
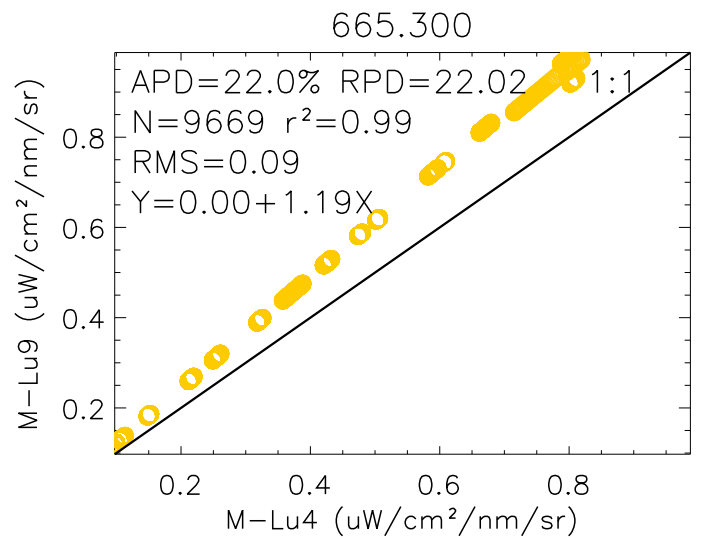
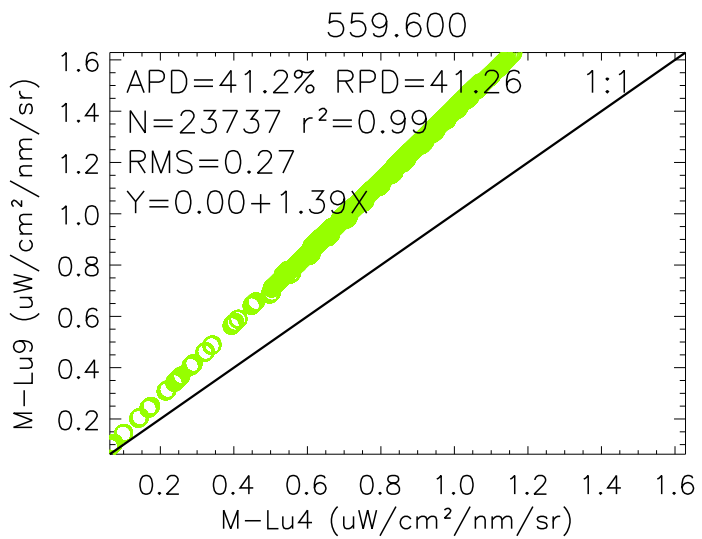
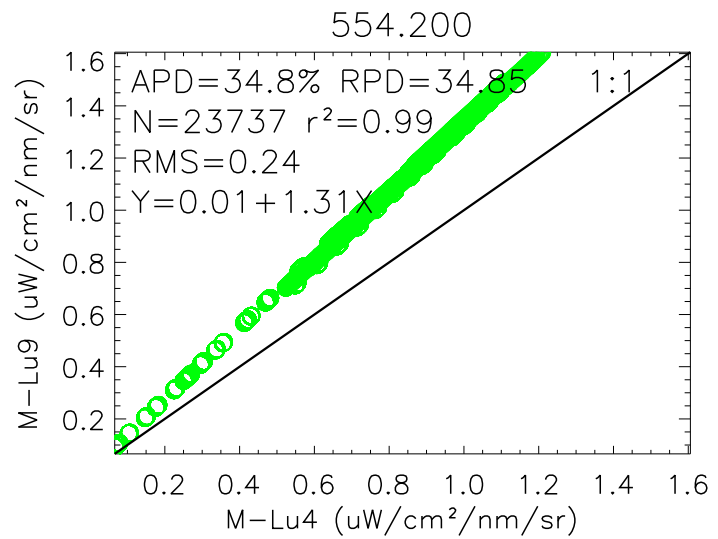
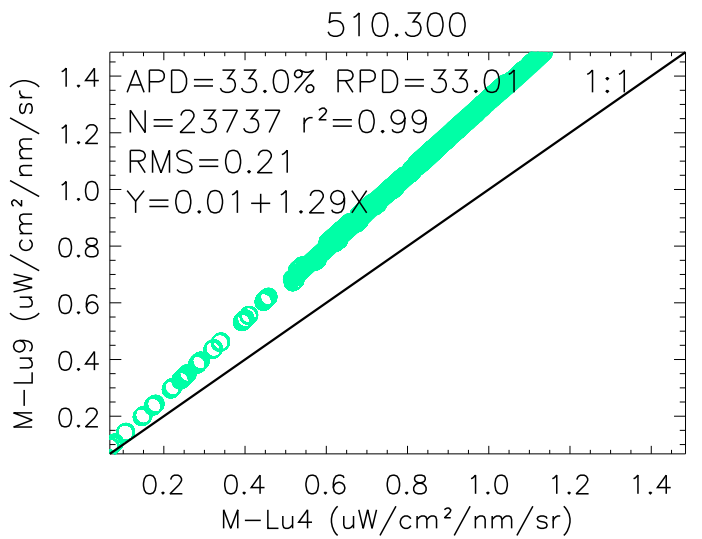
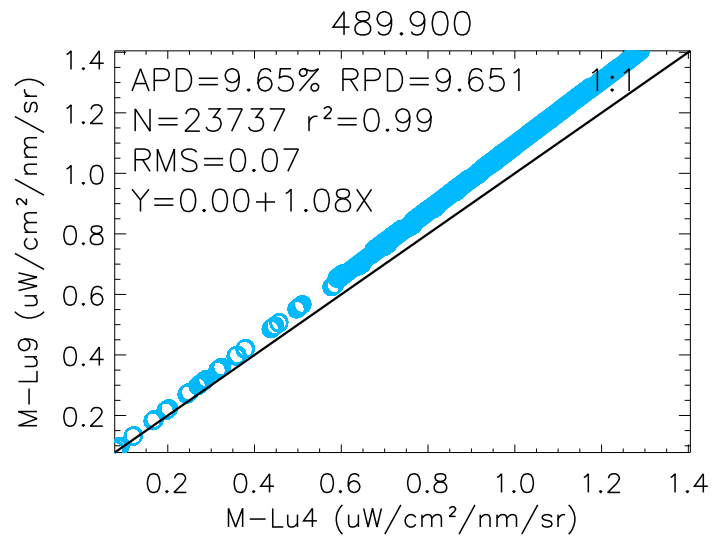
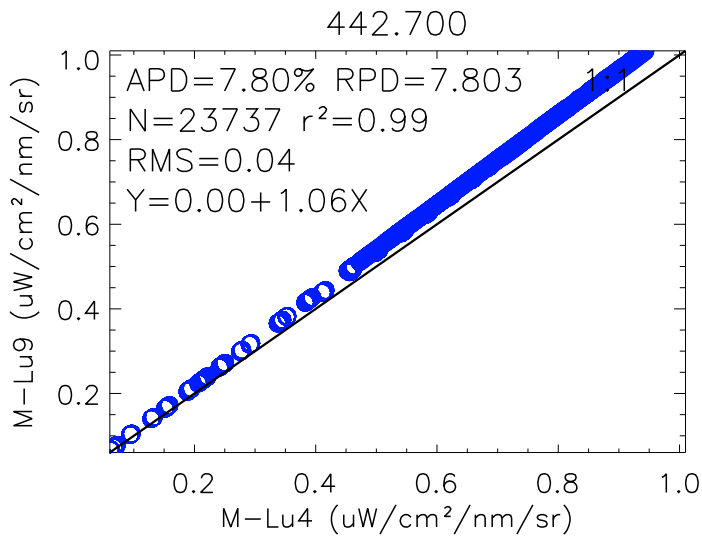


664.800

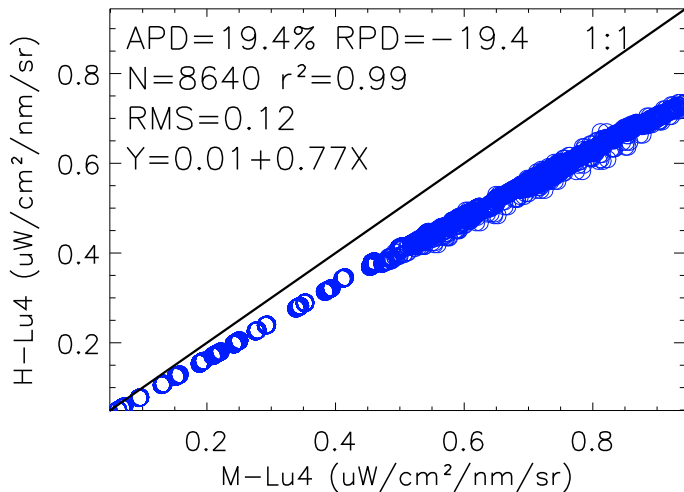


682.400

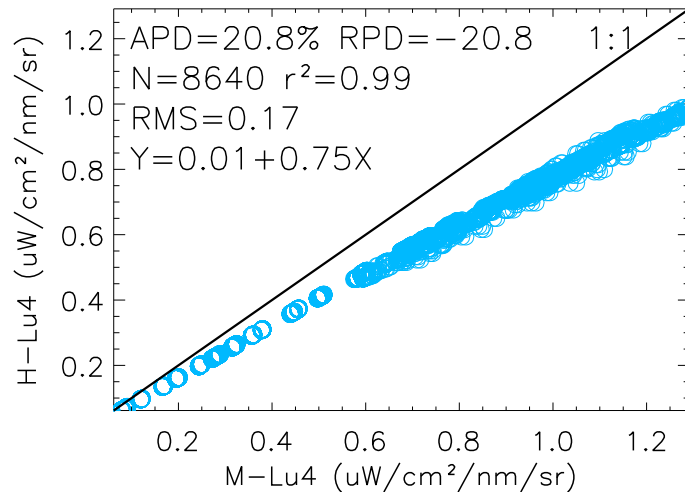




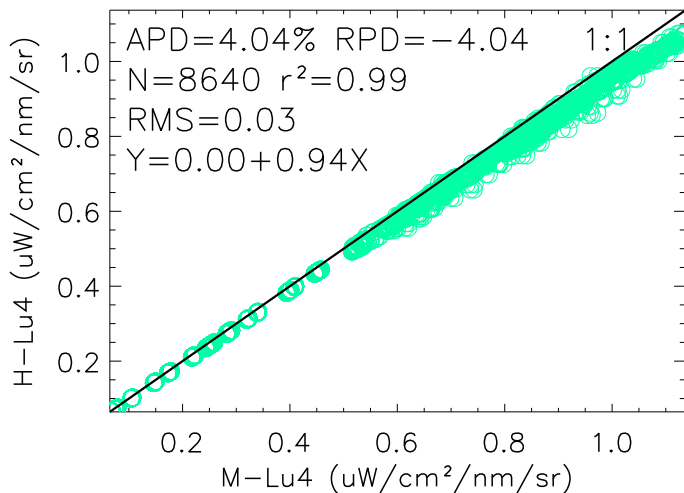
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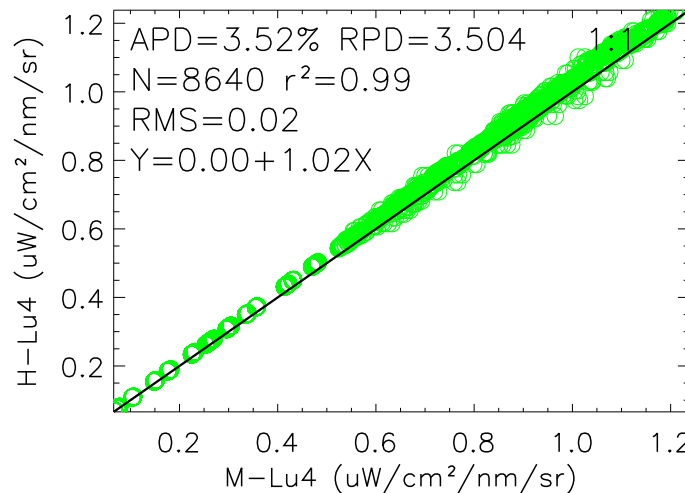
489.900



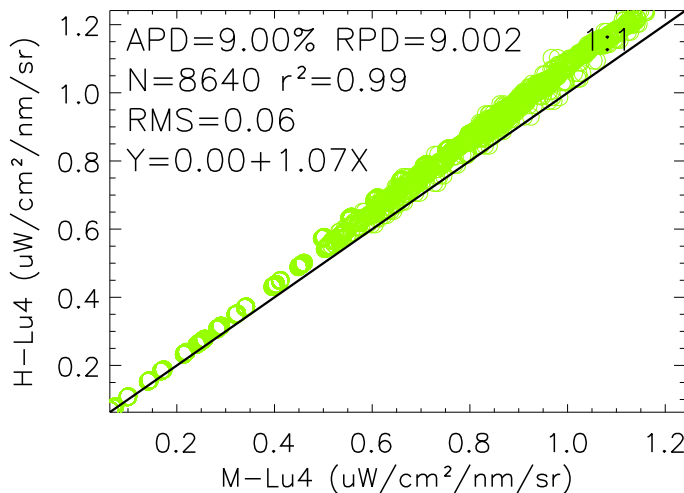
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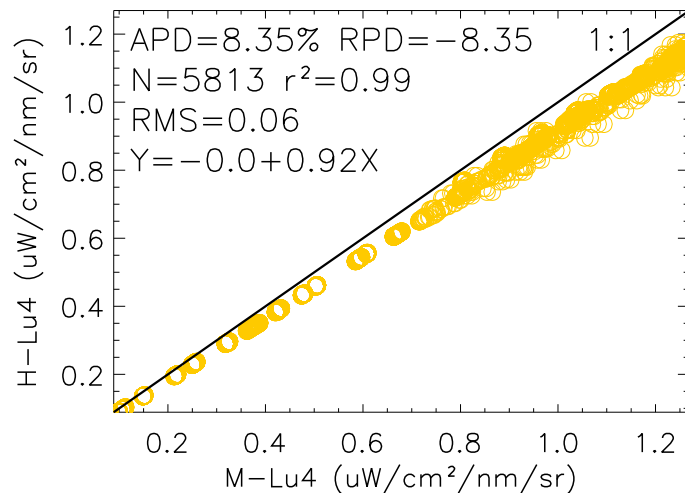
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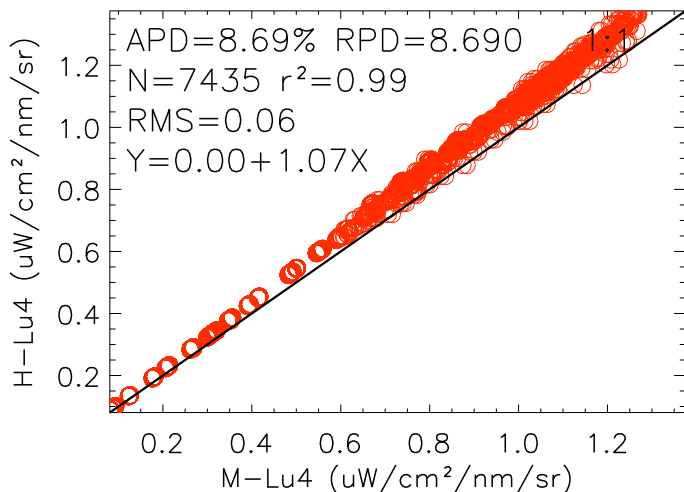
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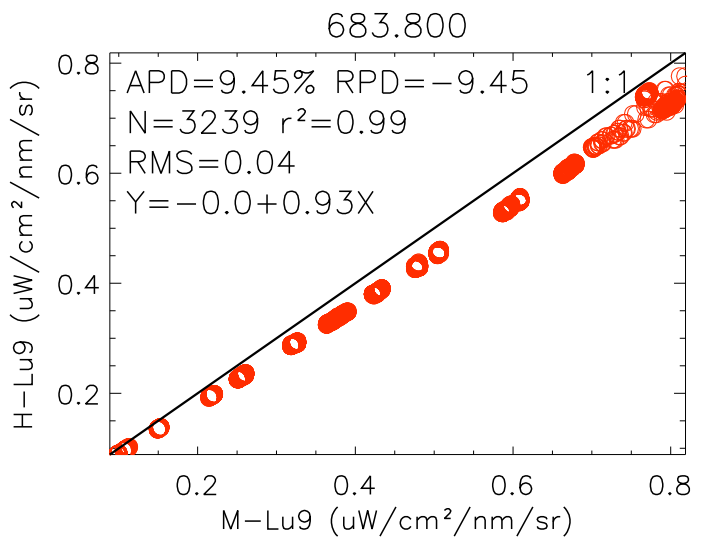
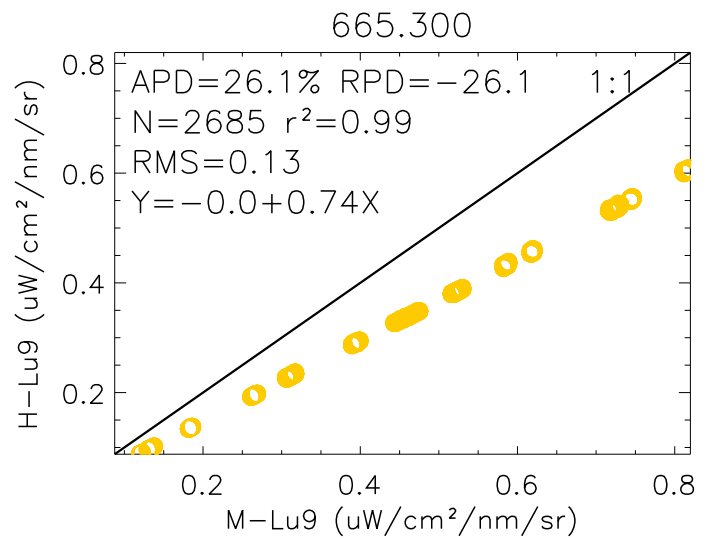
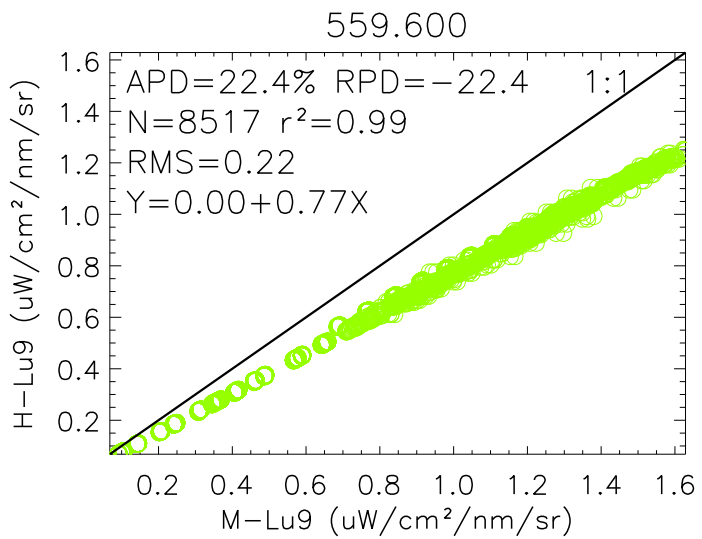
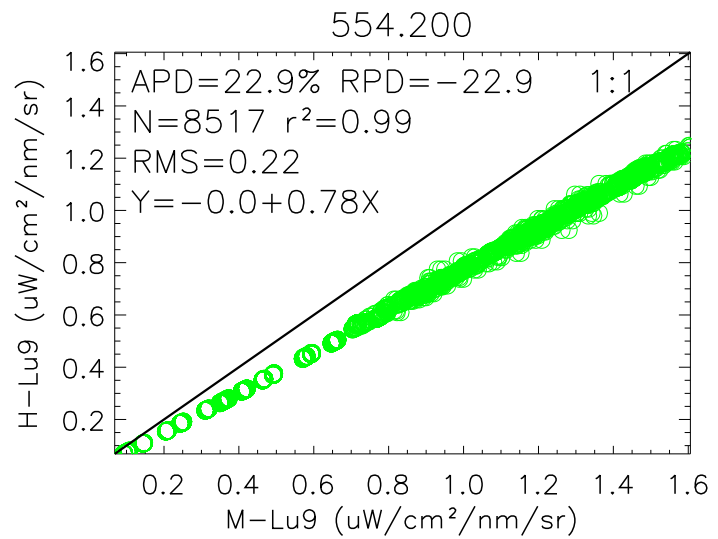
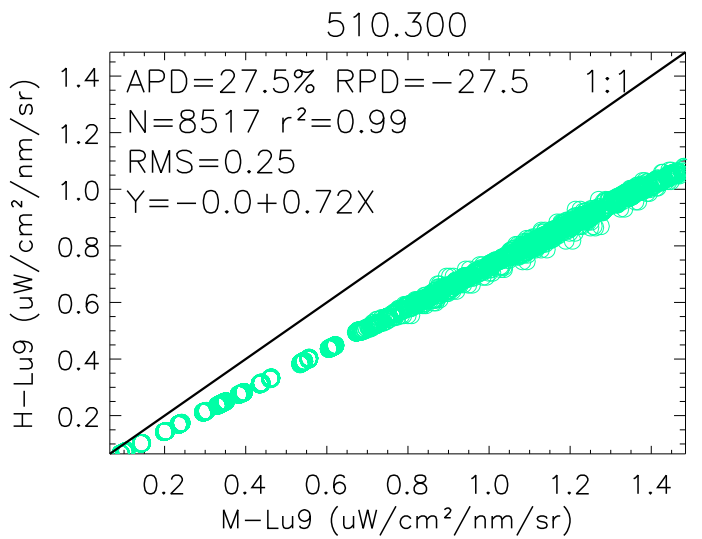
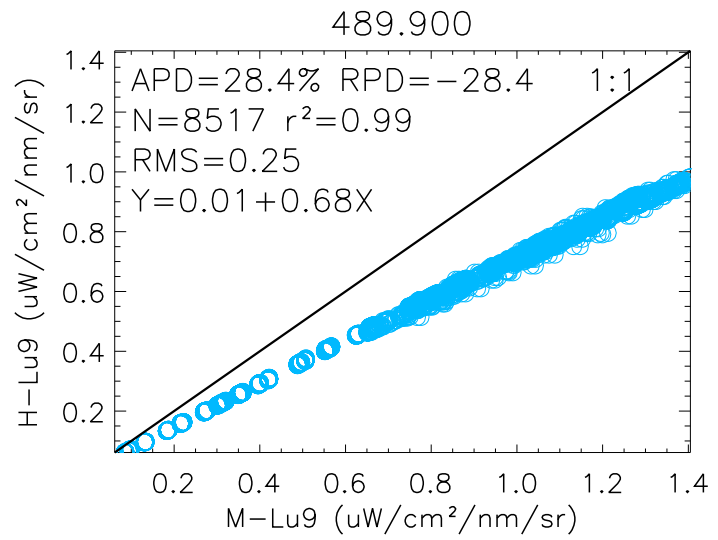
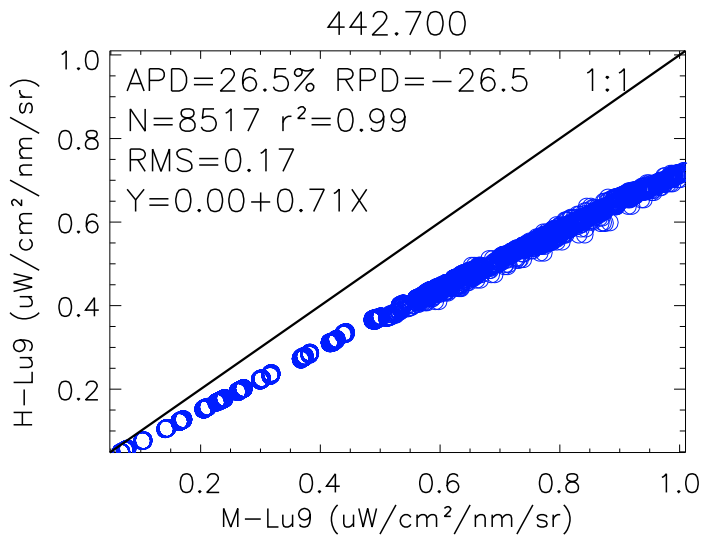


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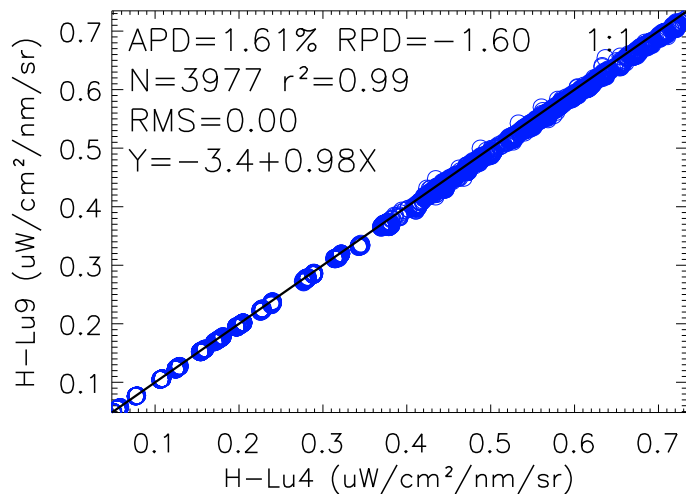


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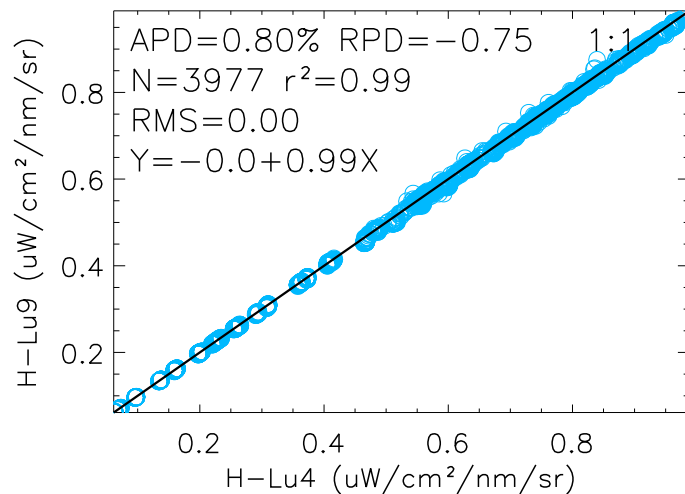




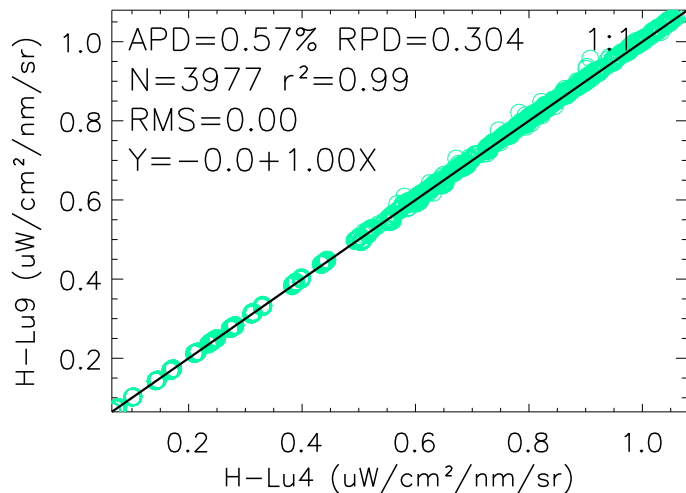
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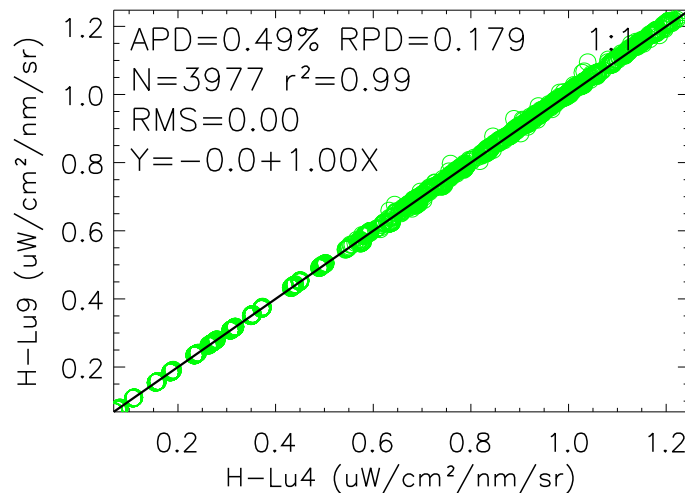
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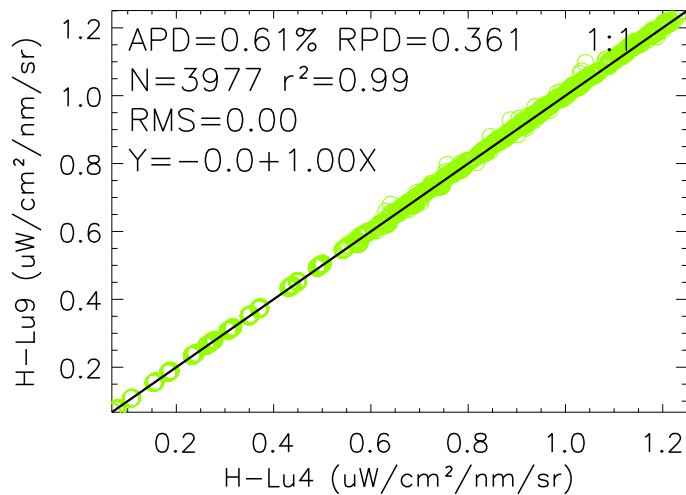
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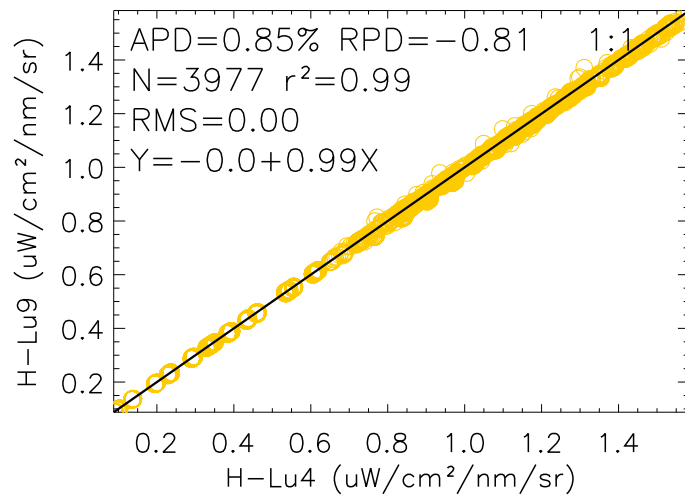
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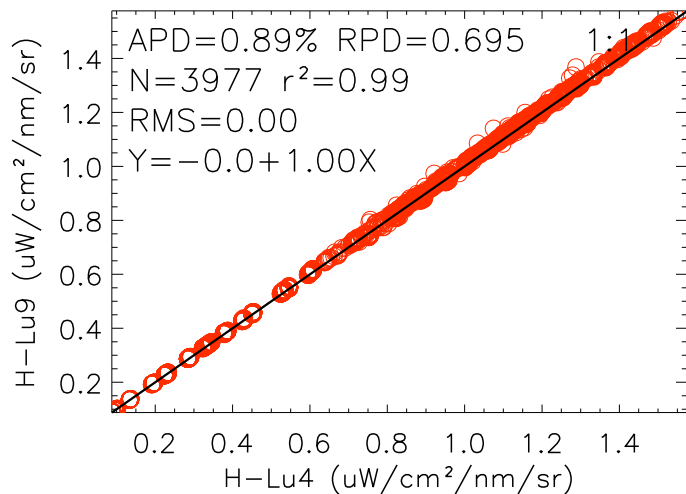
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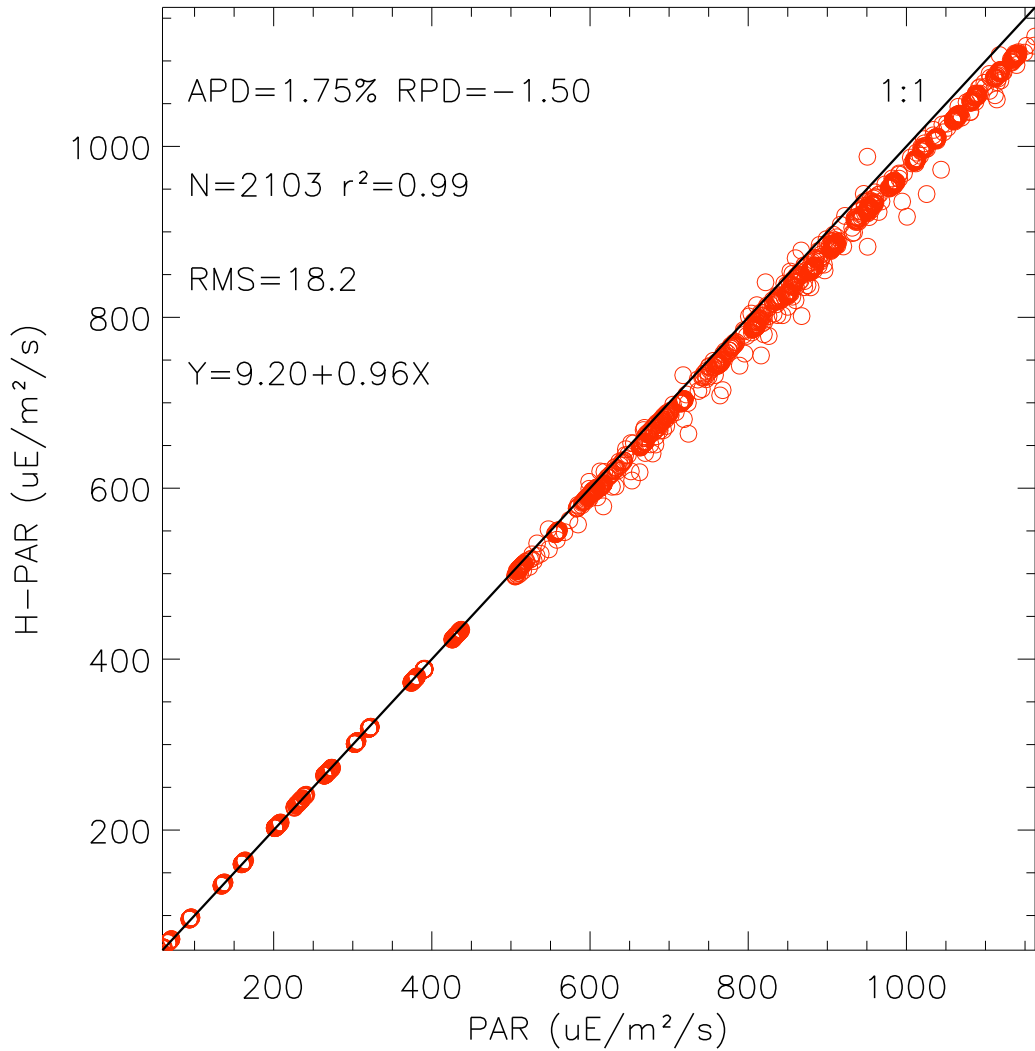


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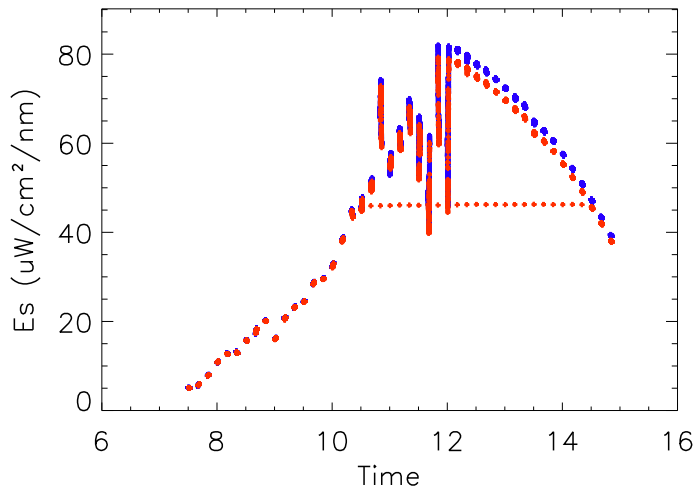


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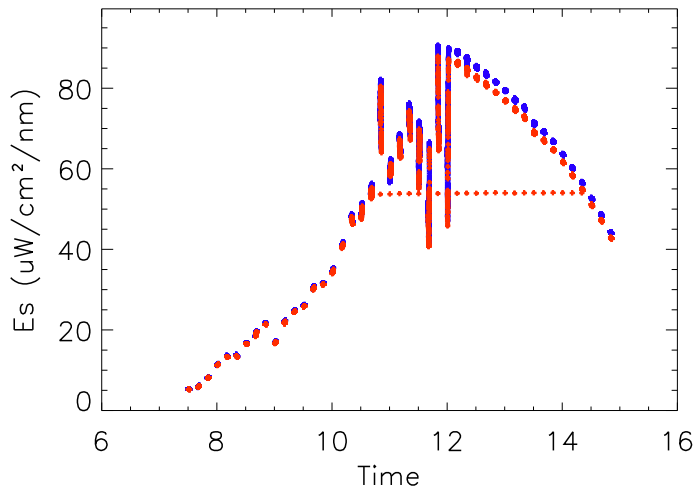




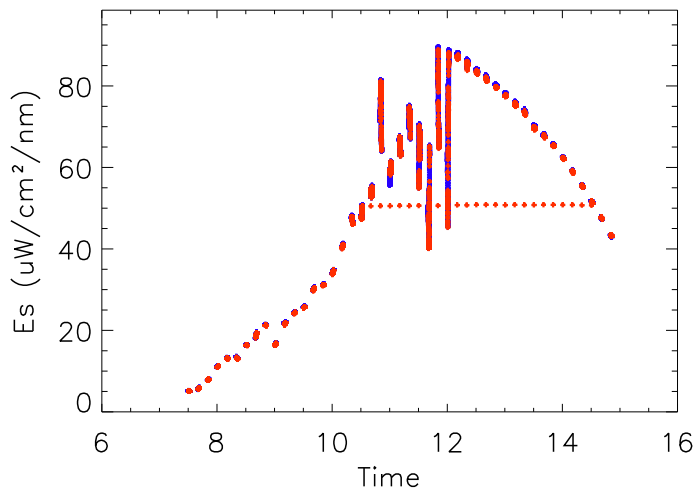
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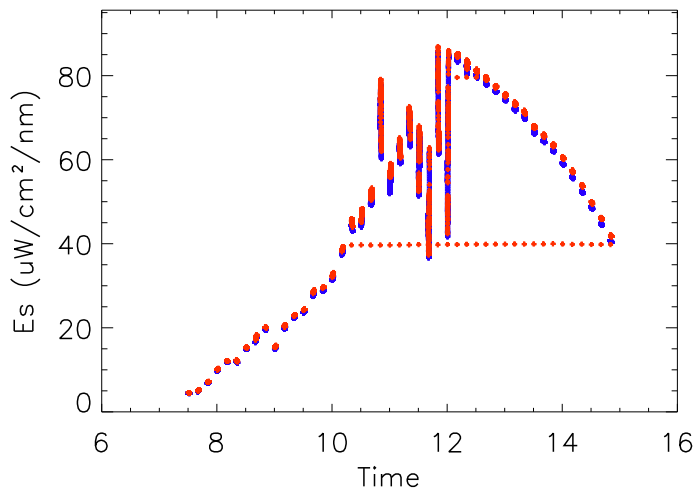
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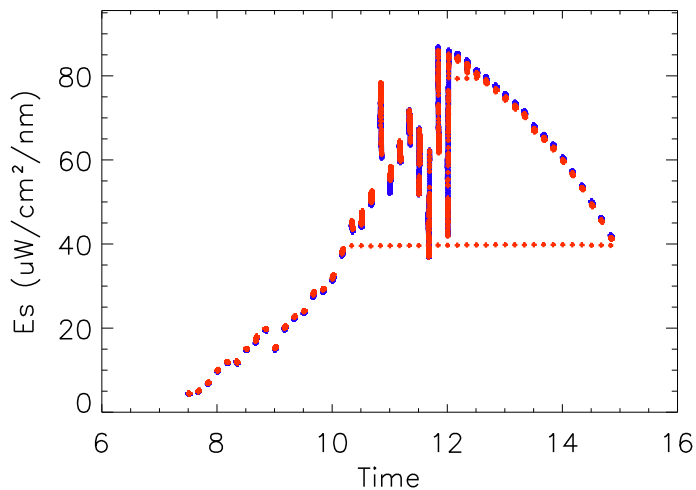
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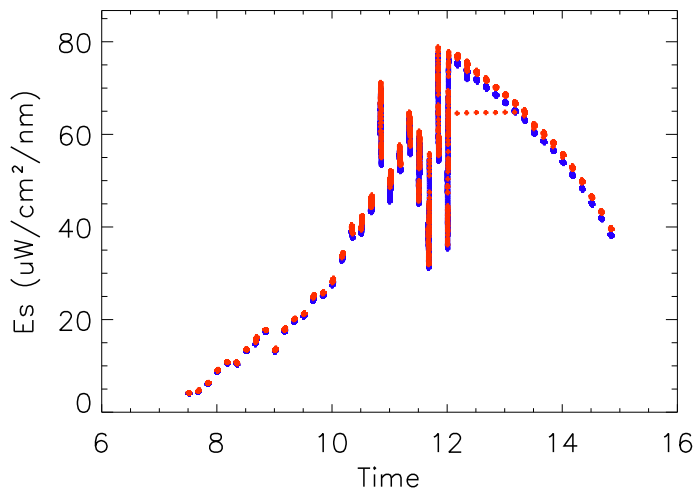
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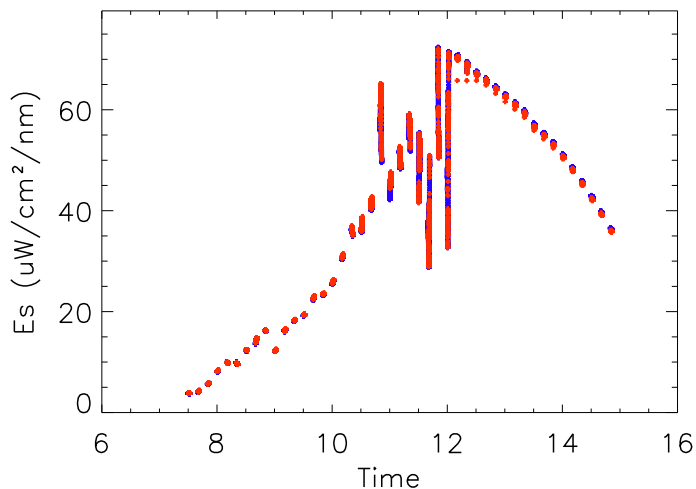
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665.200



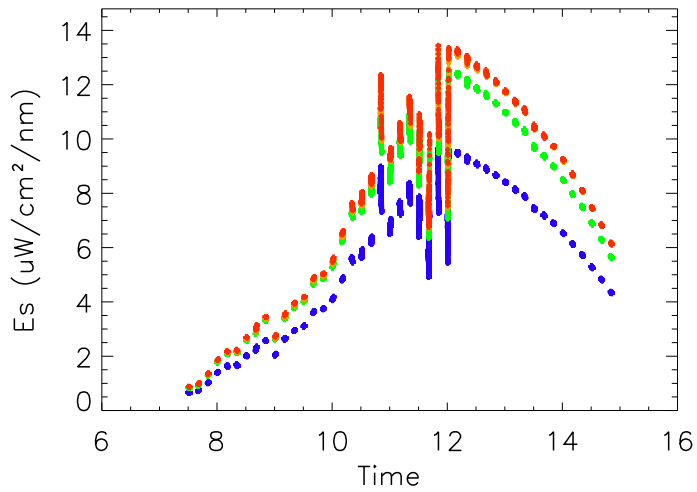
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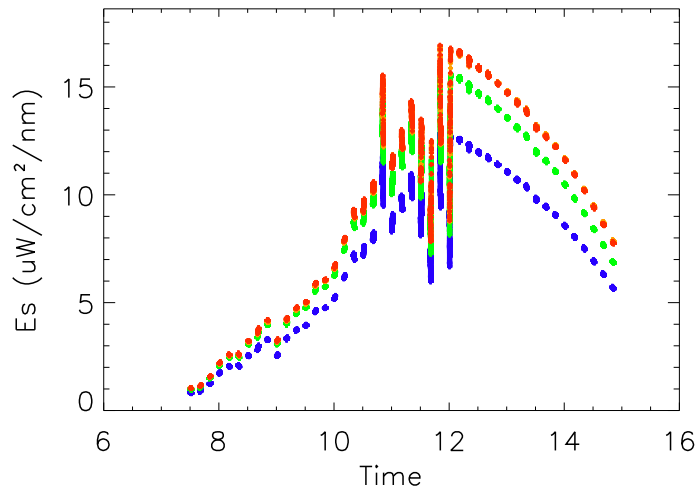
Multi-Es

Hyper-Es

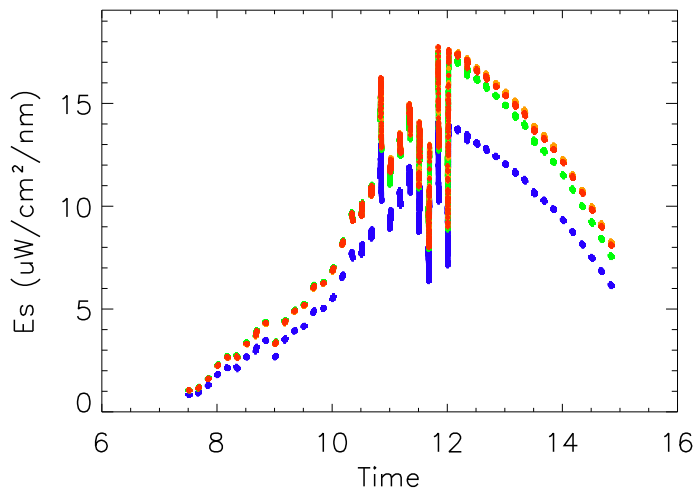
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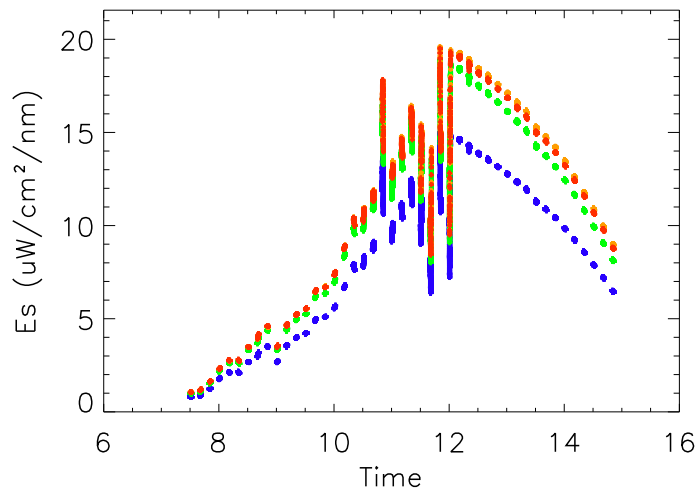
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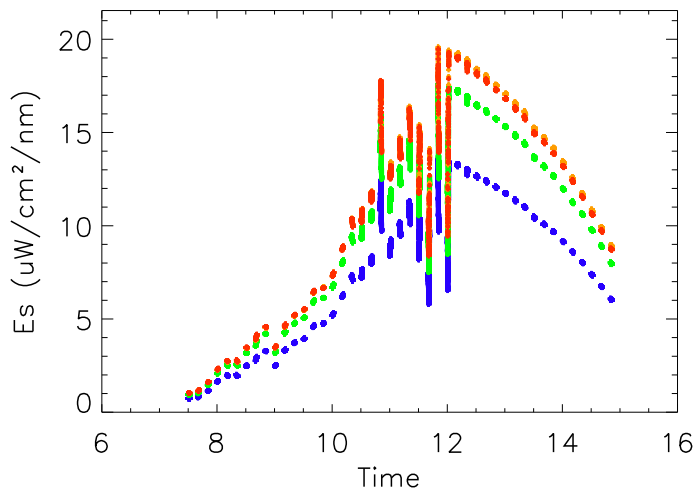
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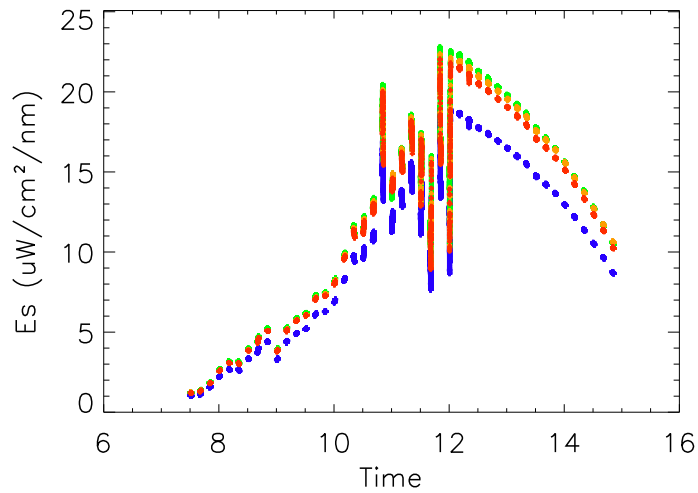
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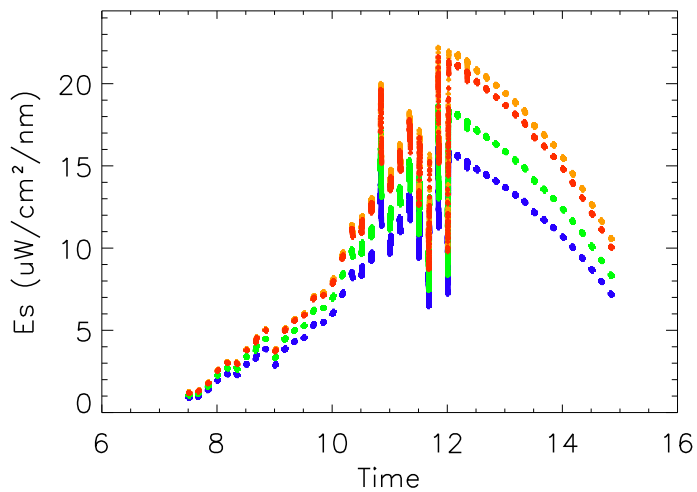
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665.200



683.700



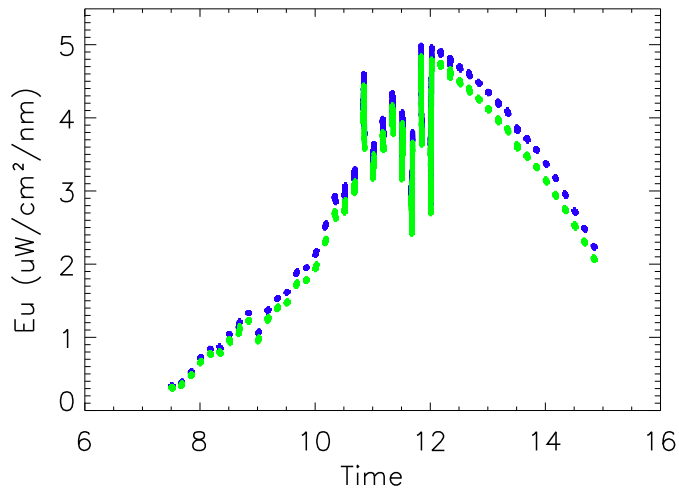
Multi-Ed4

Multi-Ed9

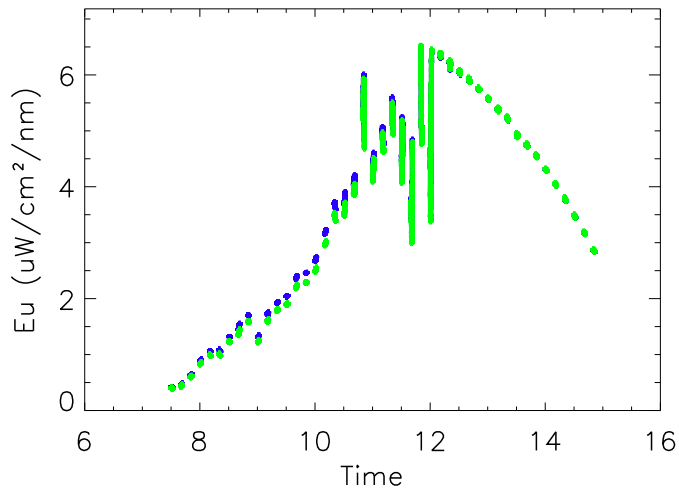
Hyper-Ed4

Hyper-Ed9

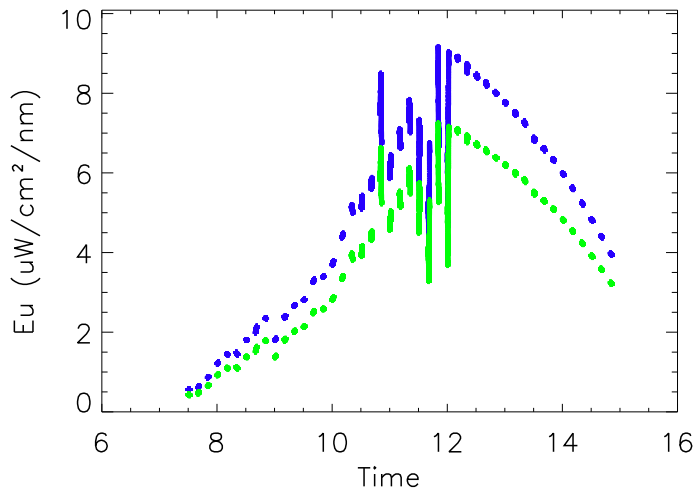
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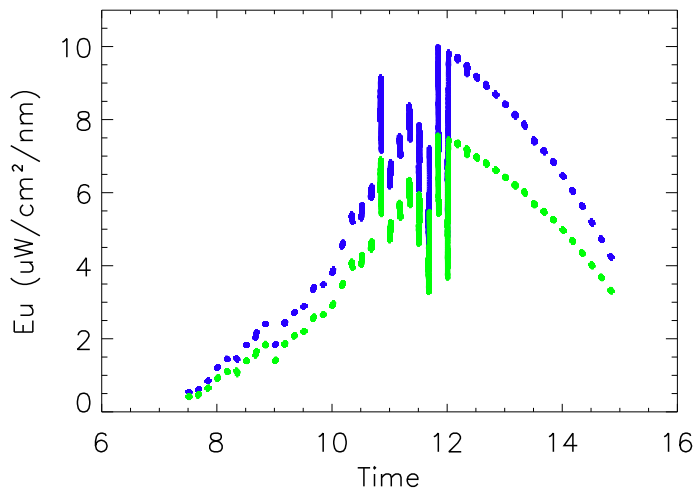
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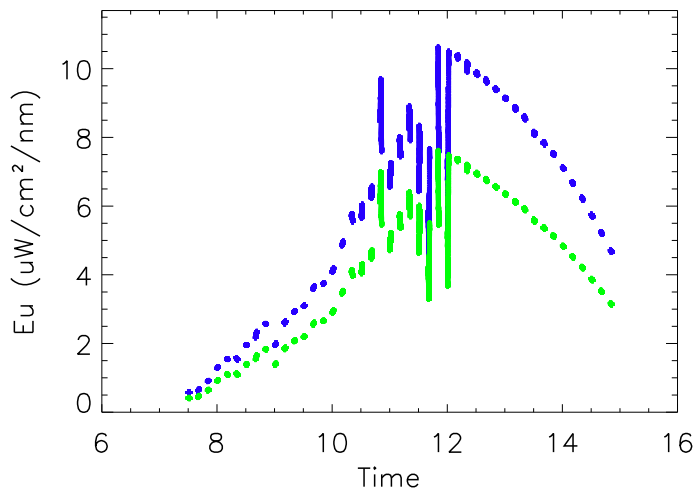
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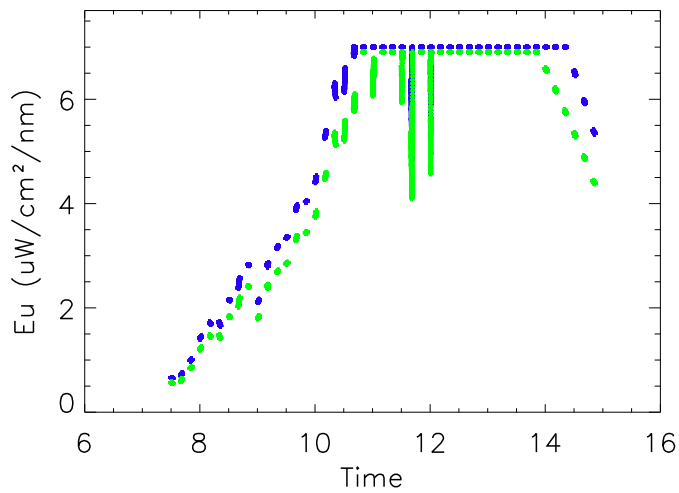
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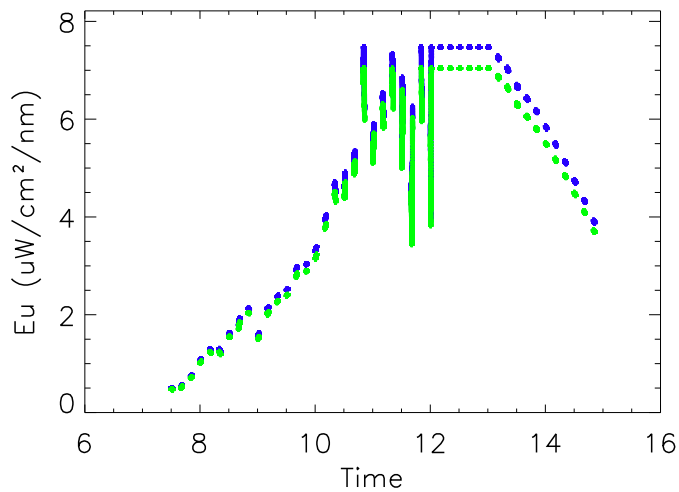
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665.300



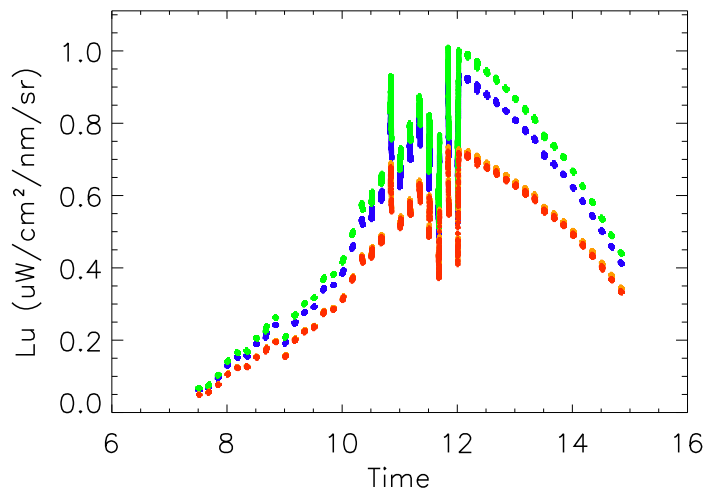
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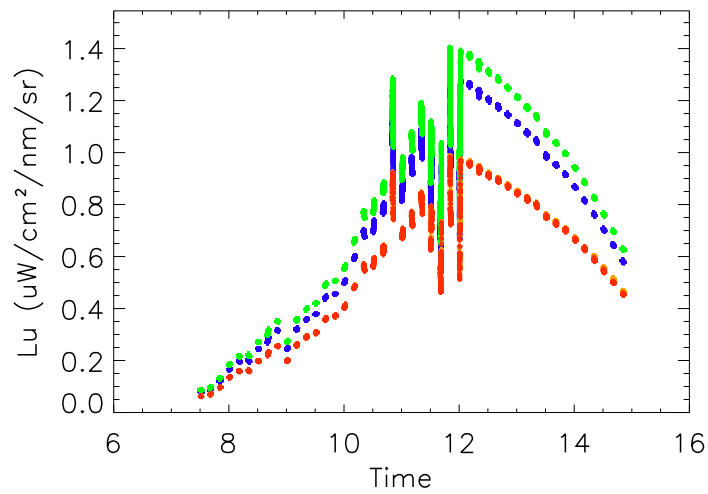
Multi-Eu4

Multi-Eu9

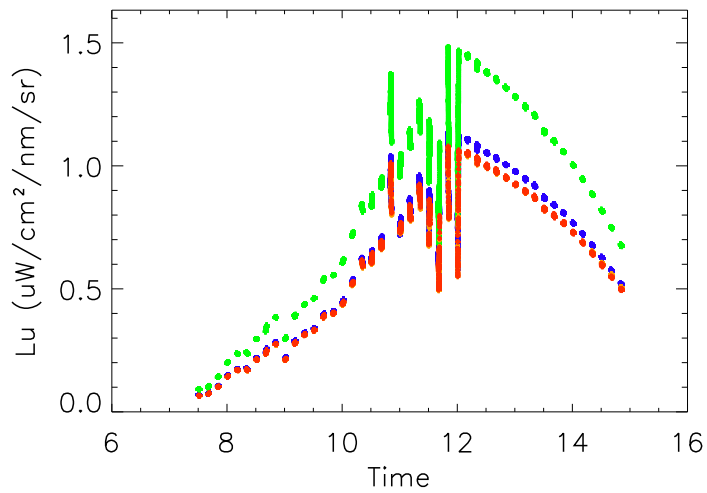
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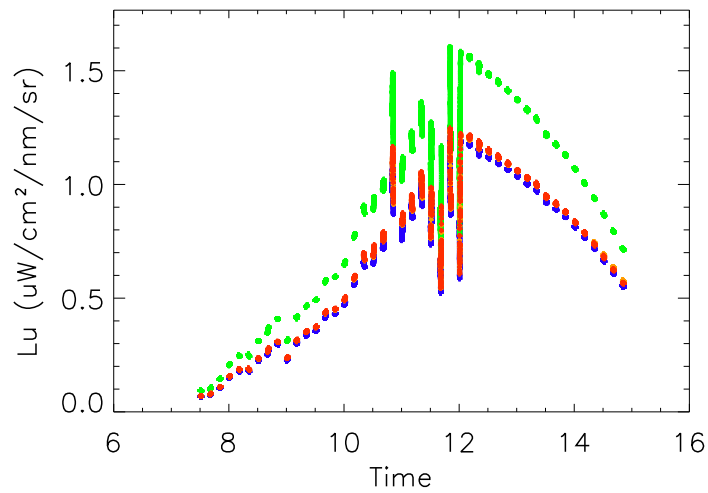
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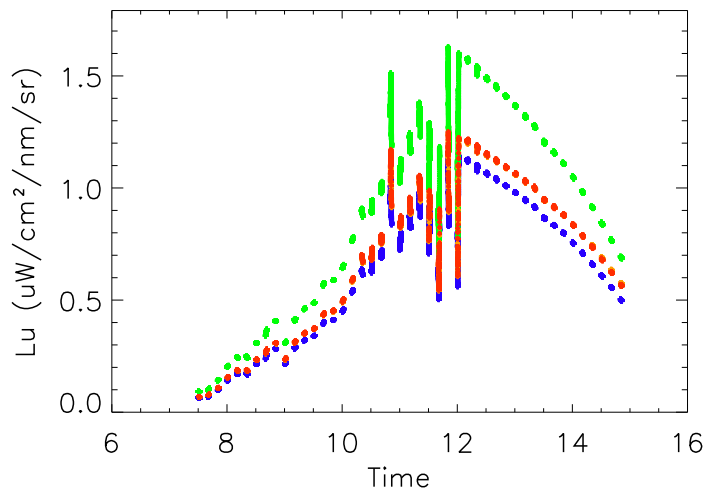
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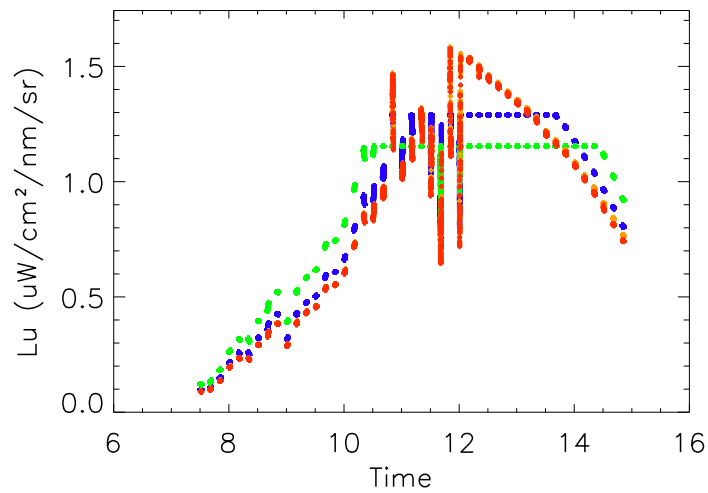
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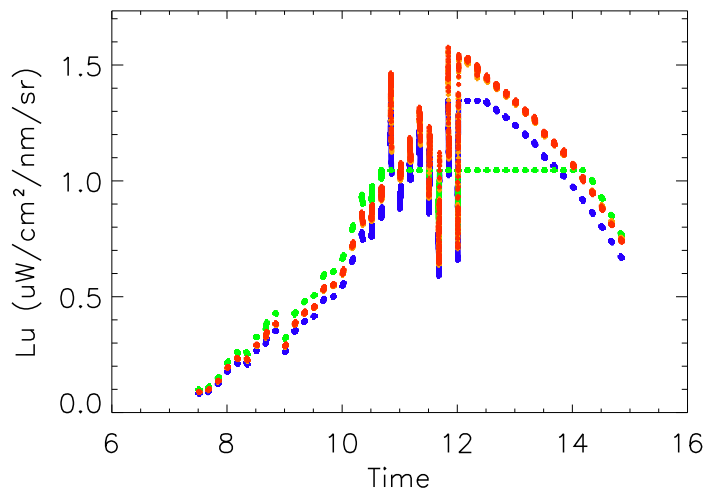
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665.300



683.800

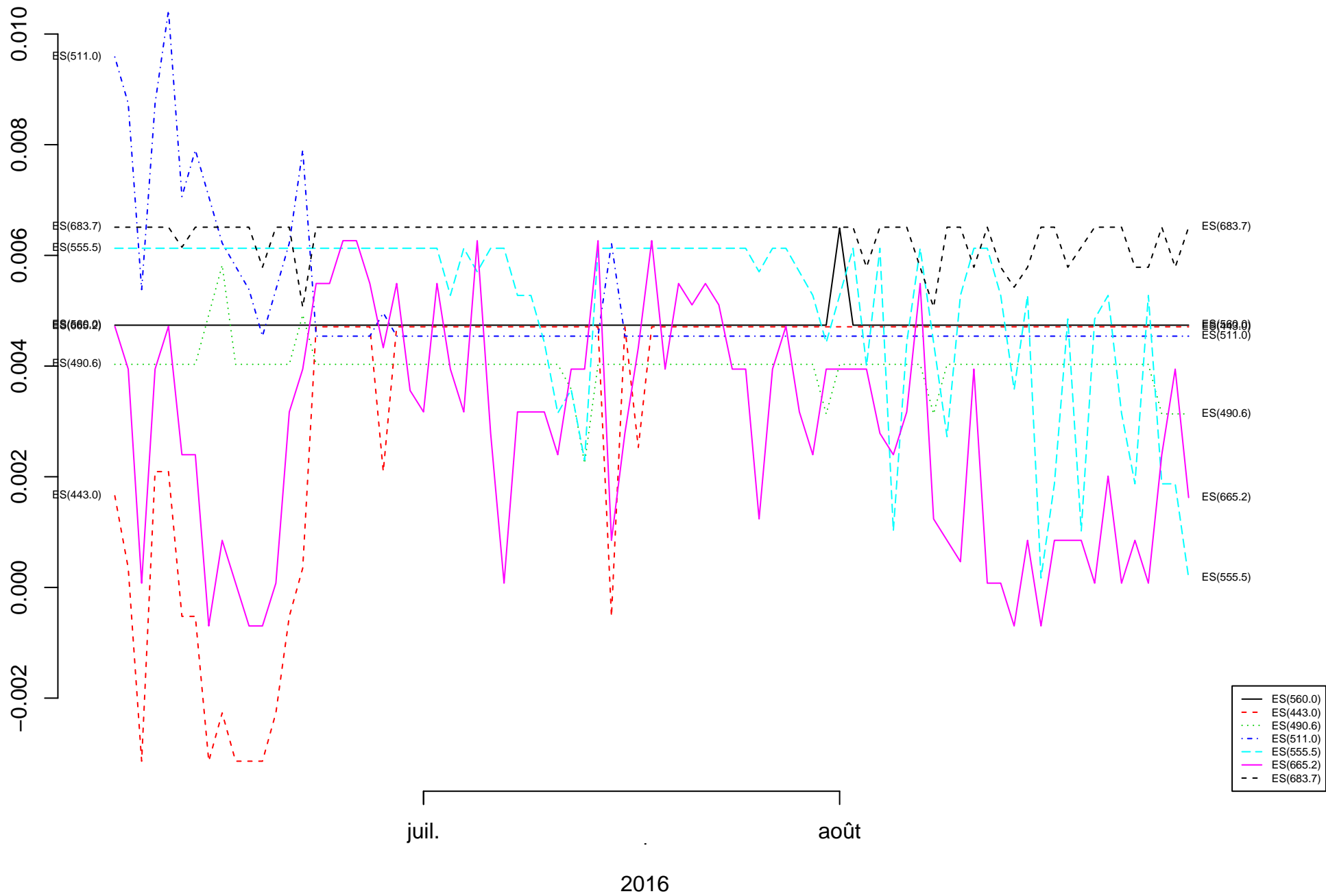


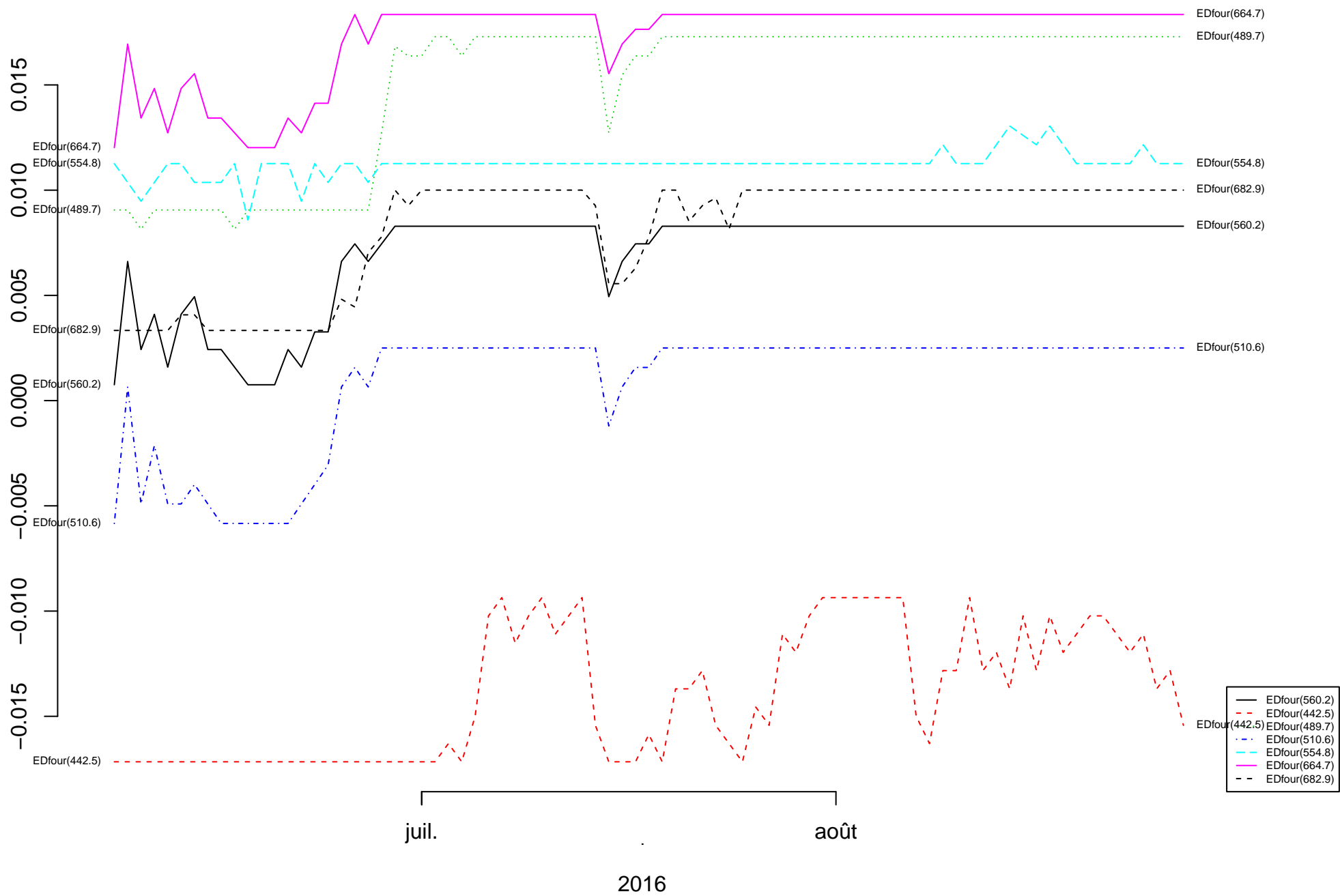
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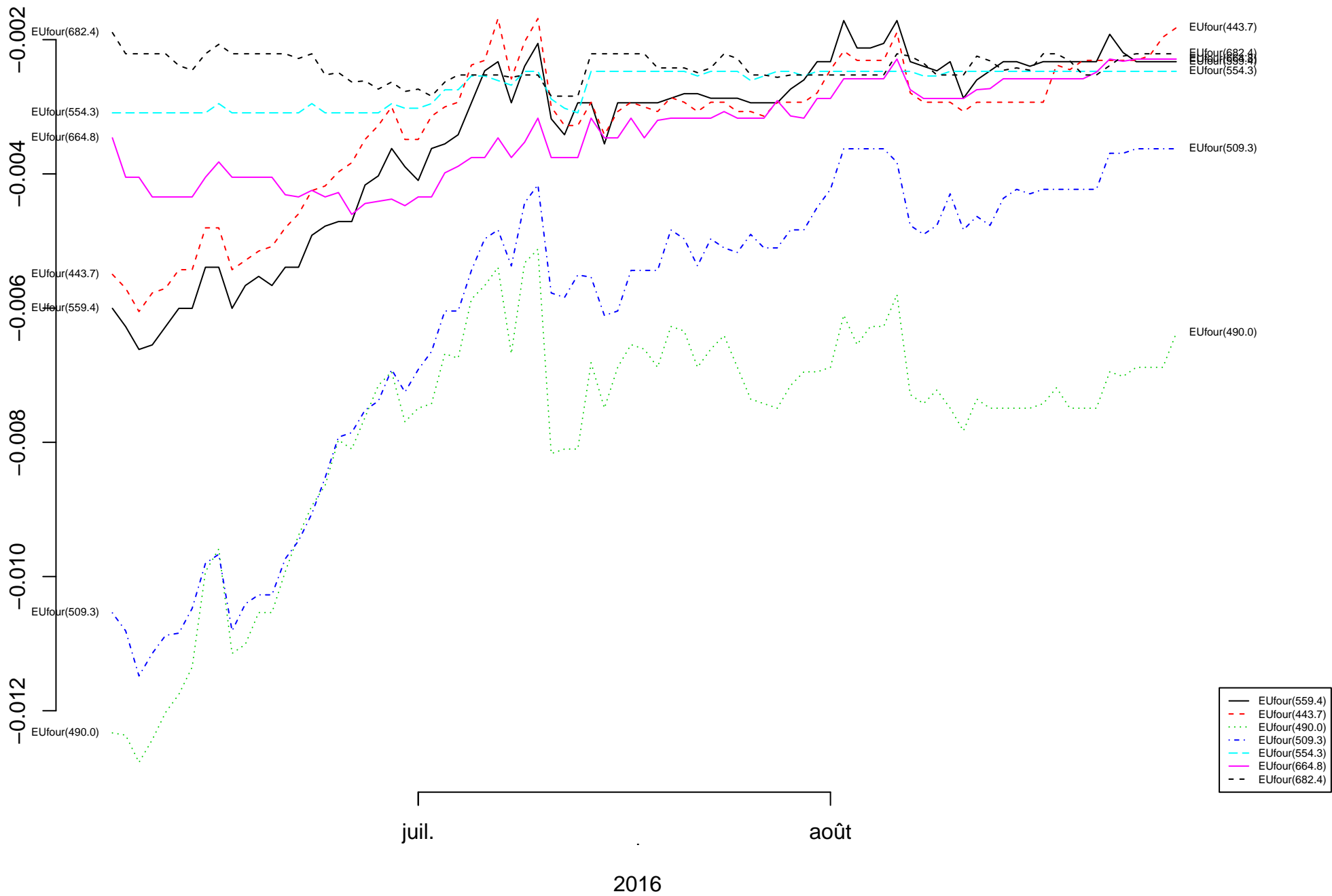
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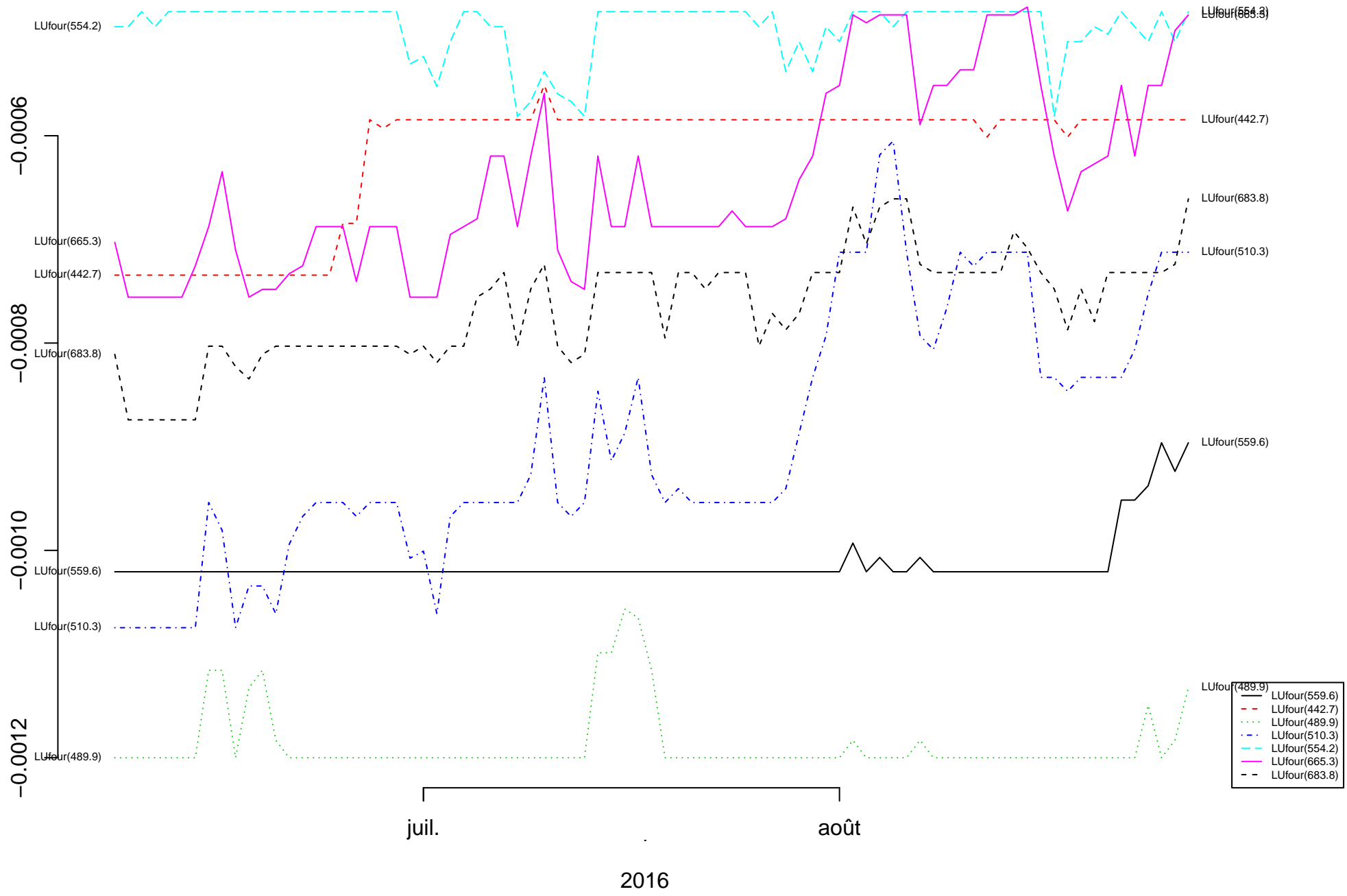
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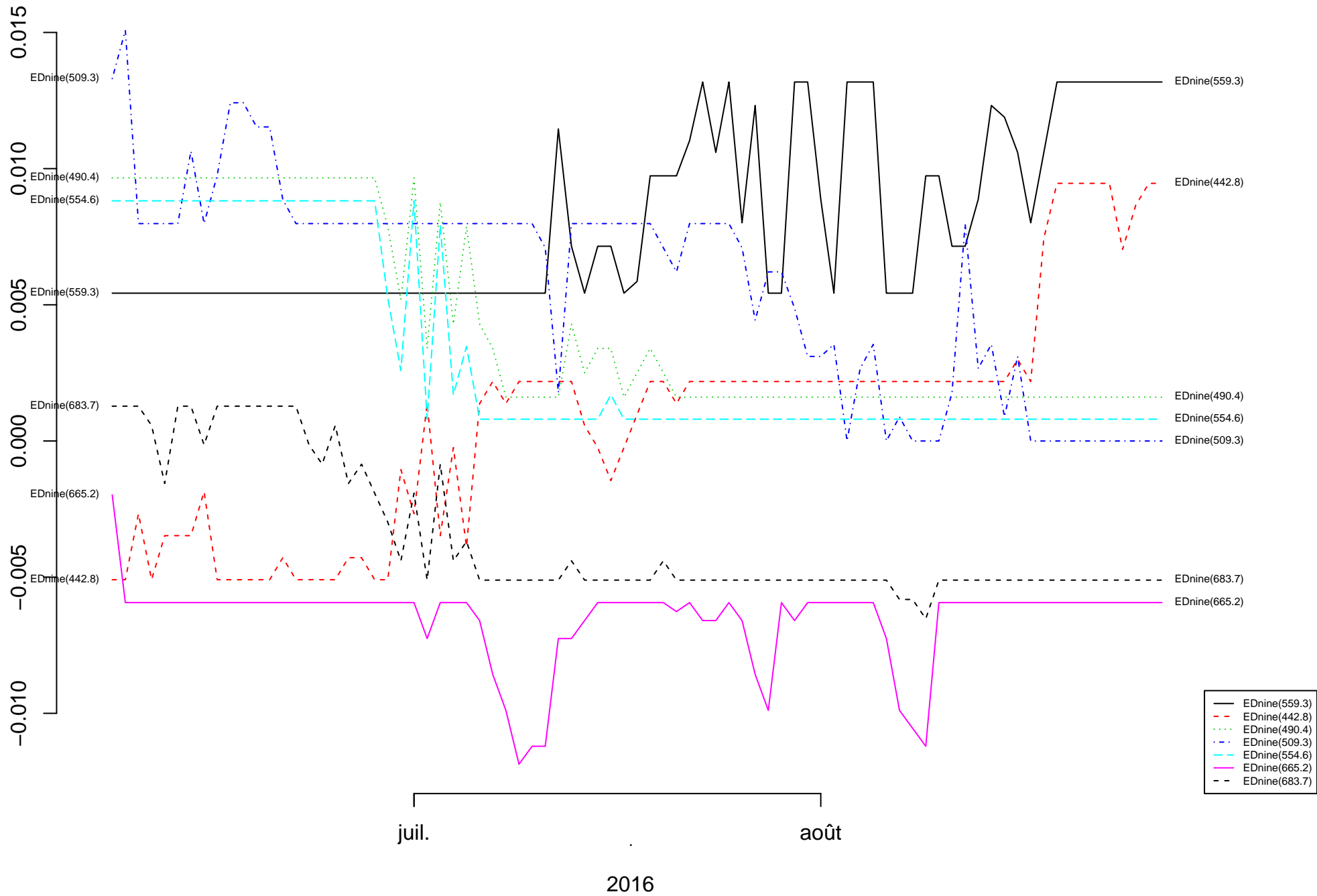
Hyper-Lu9



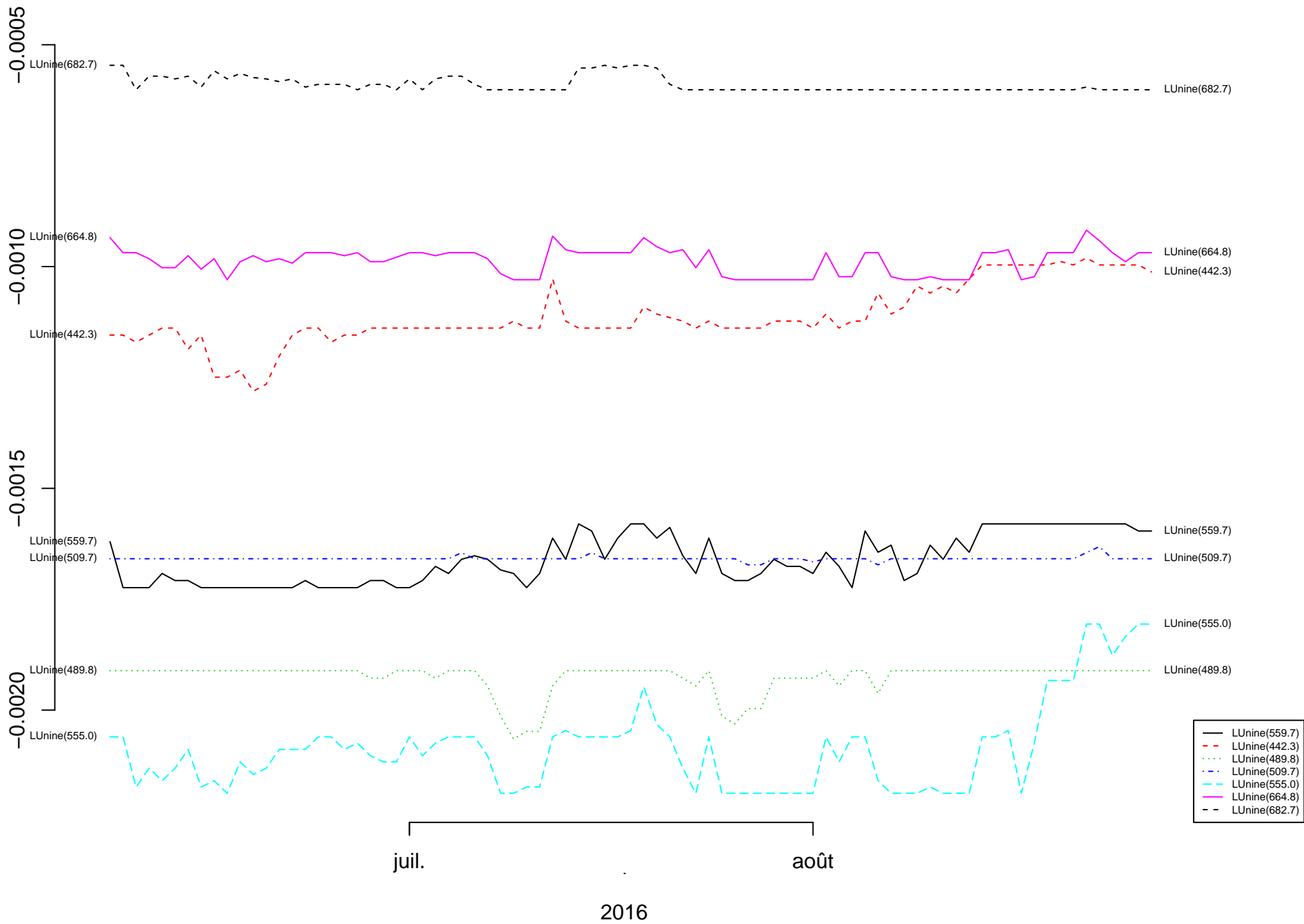


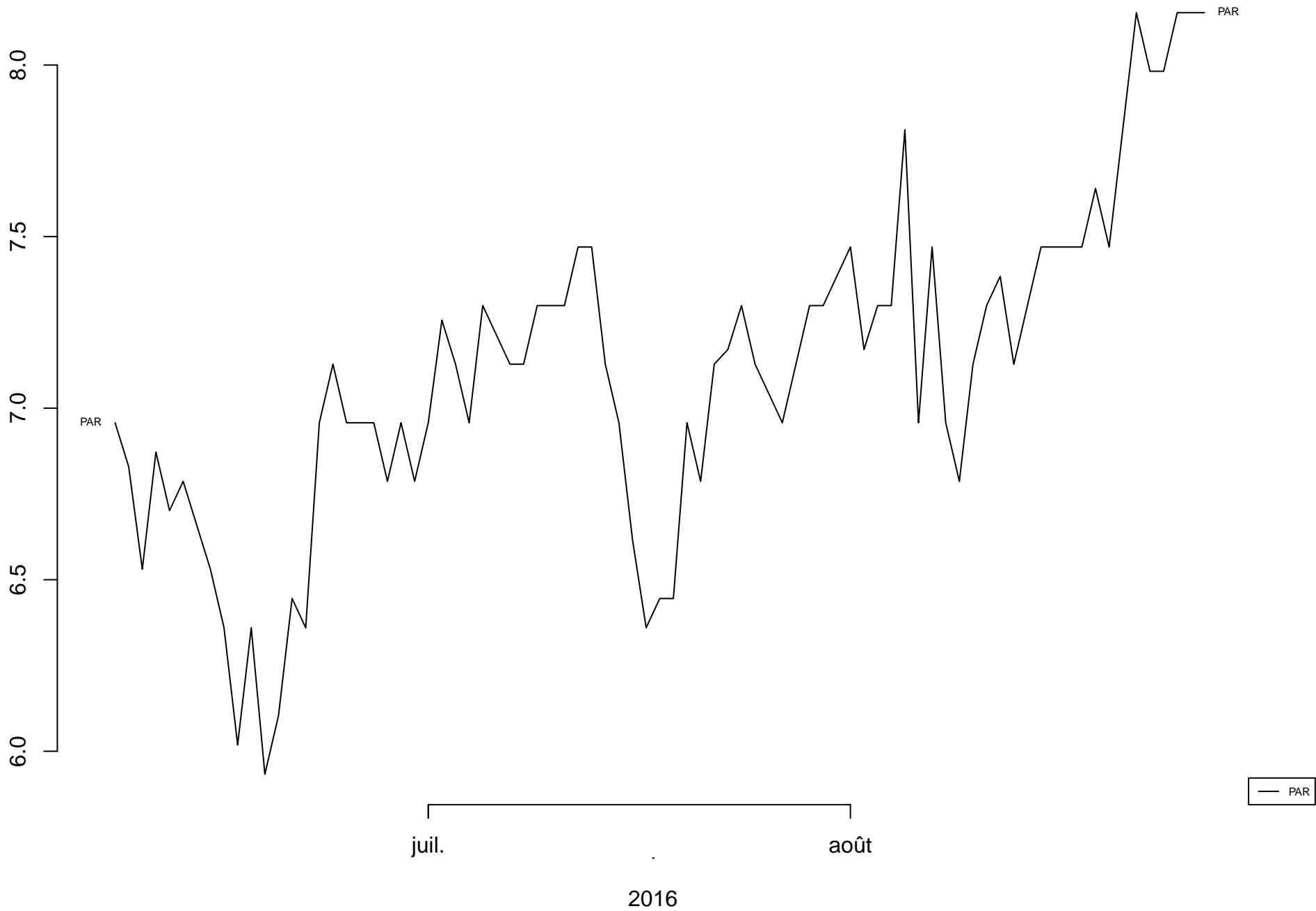


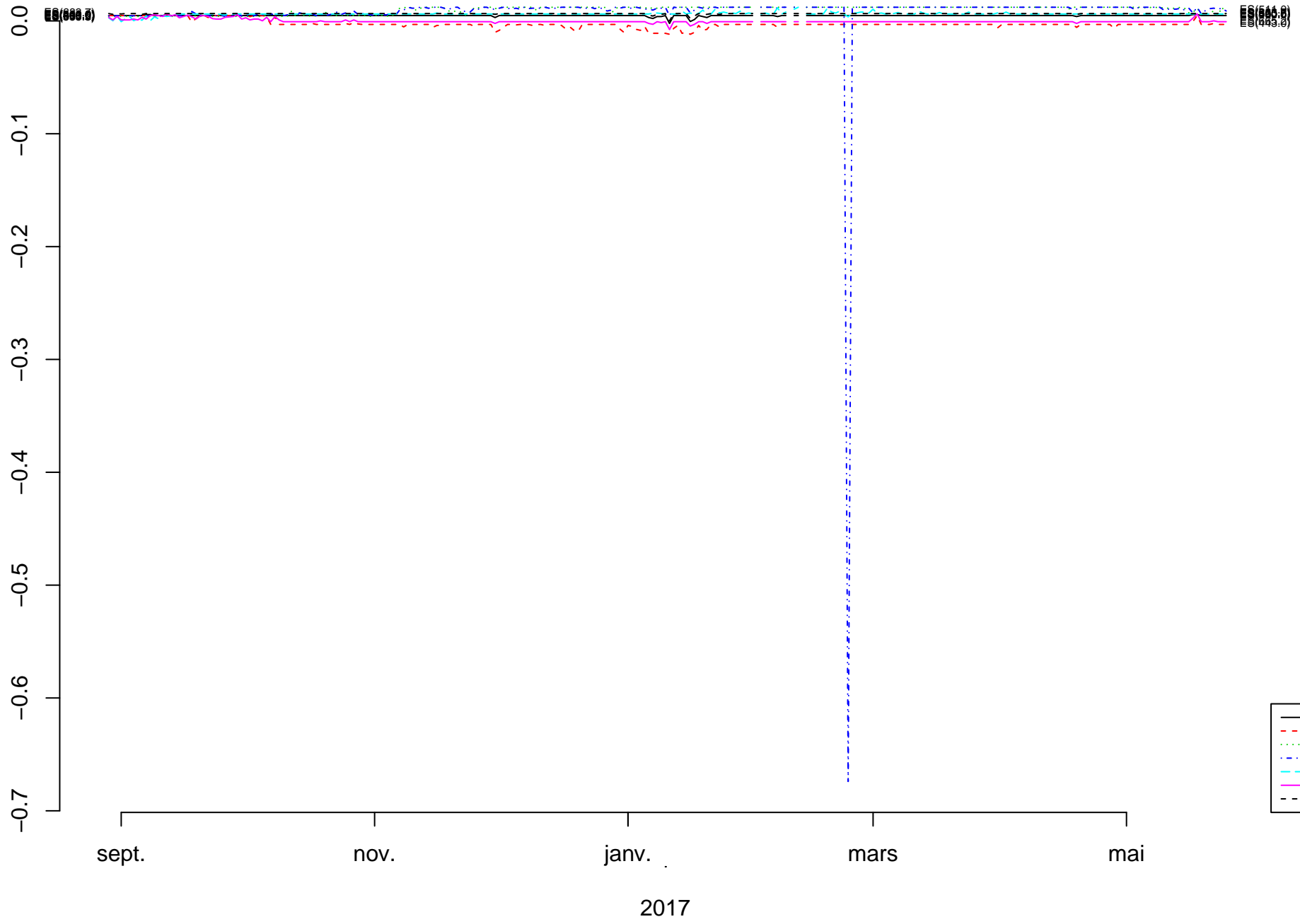


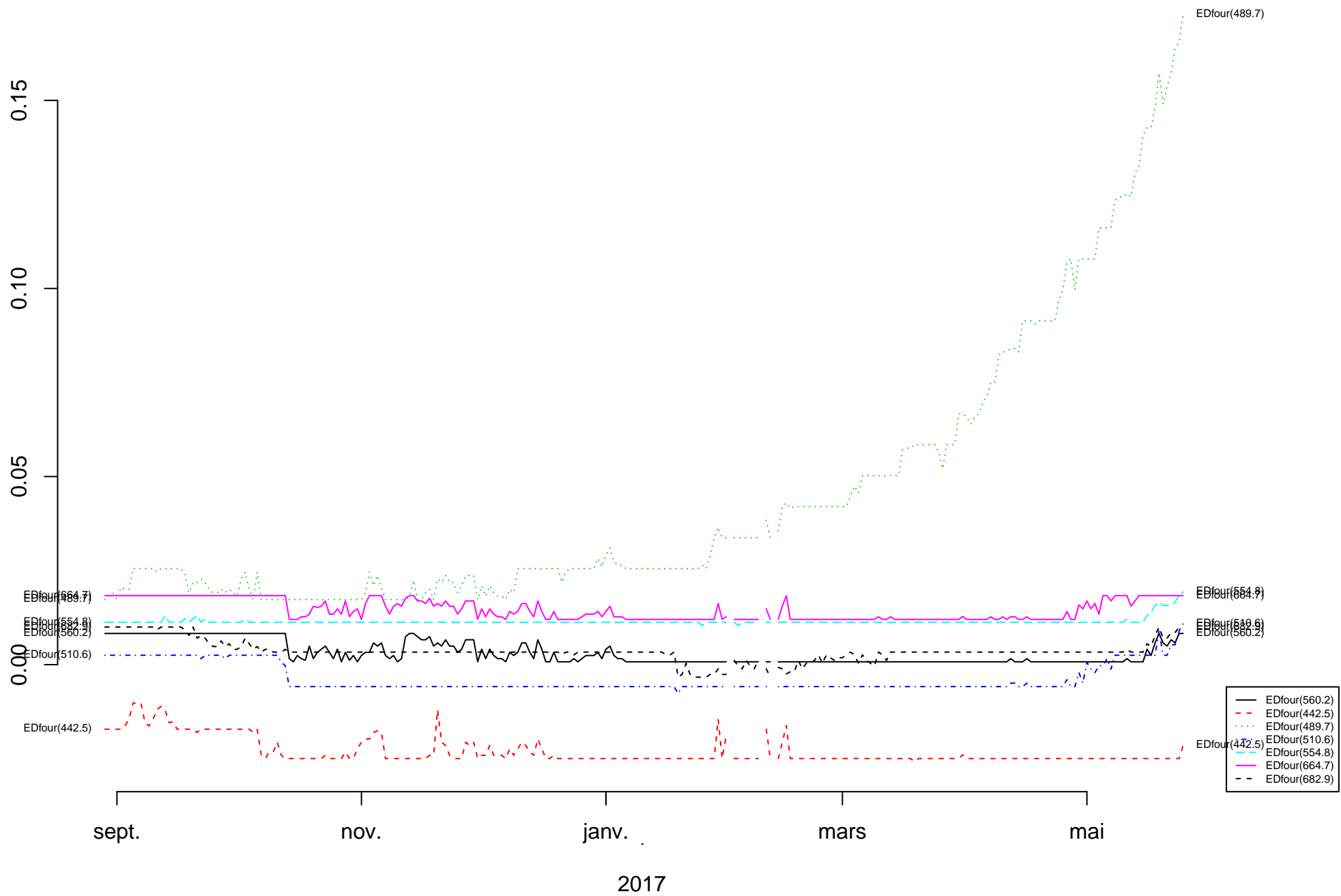


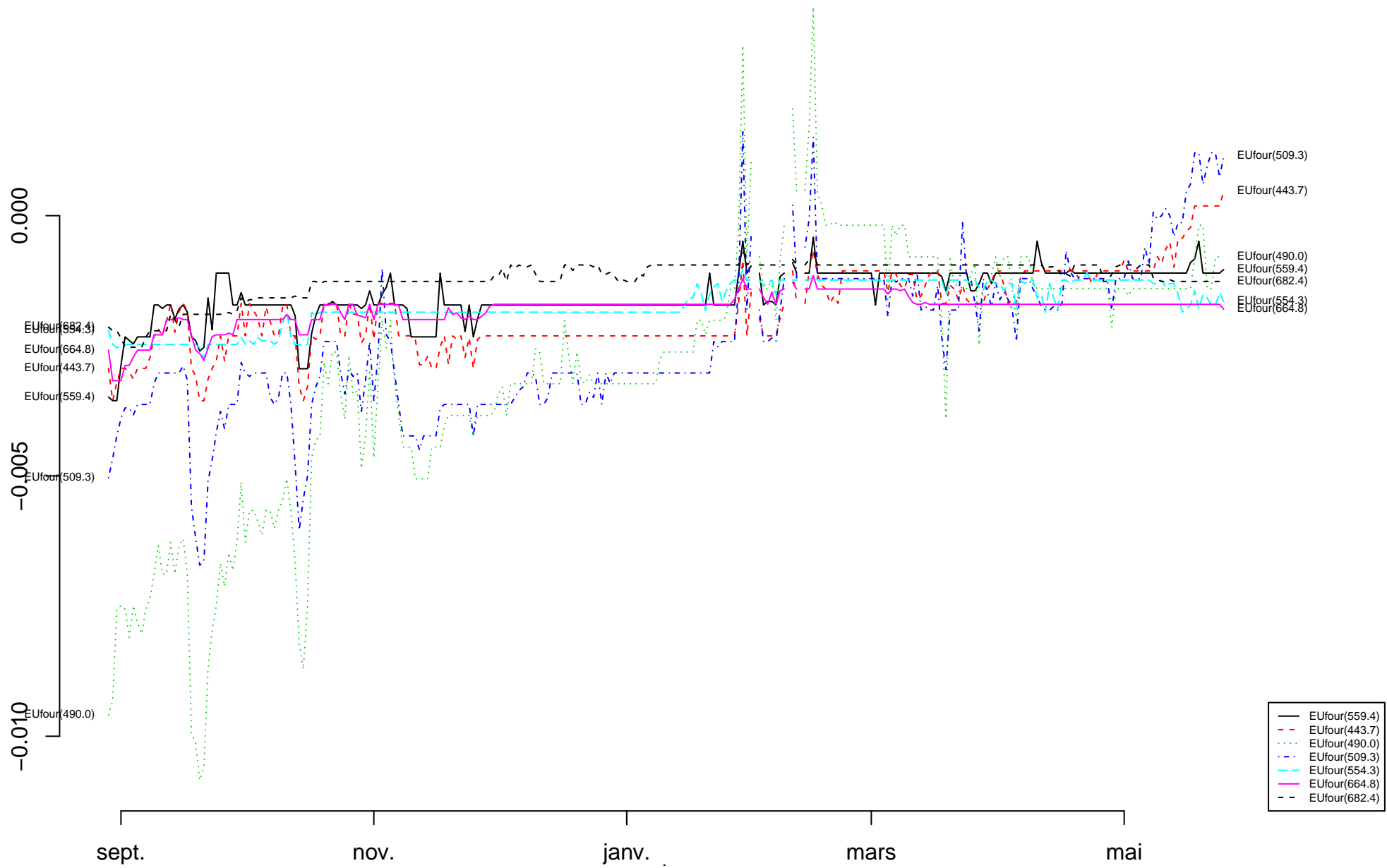


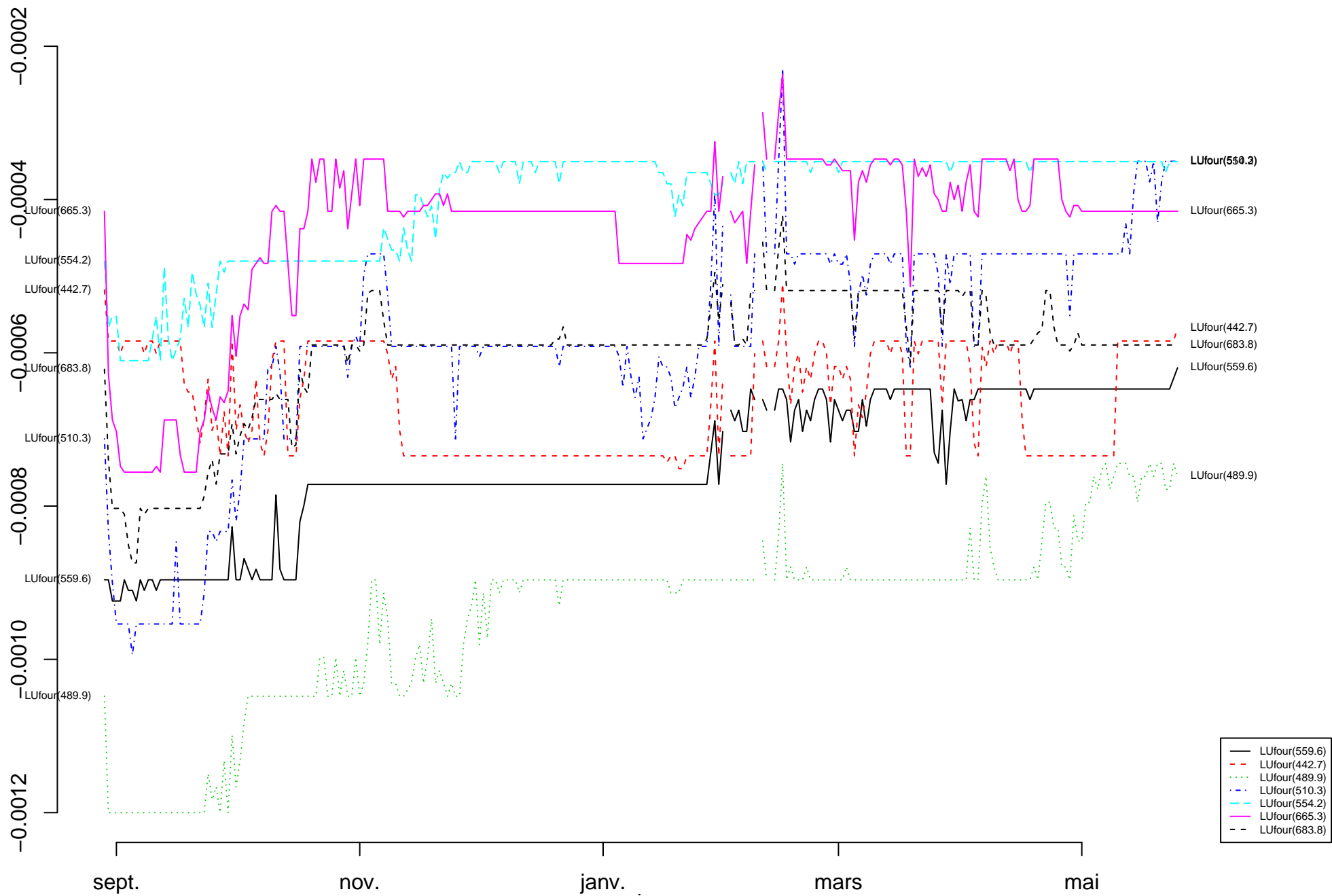




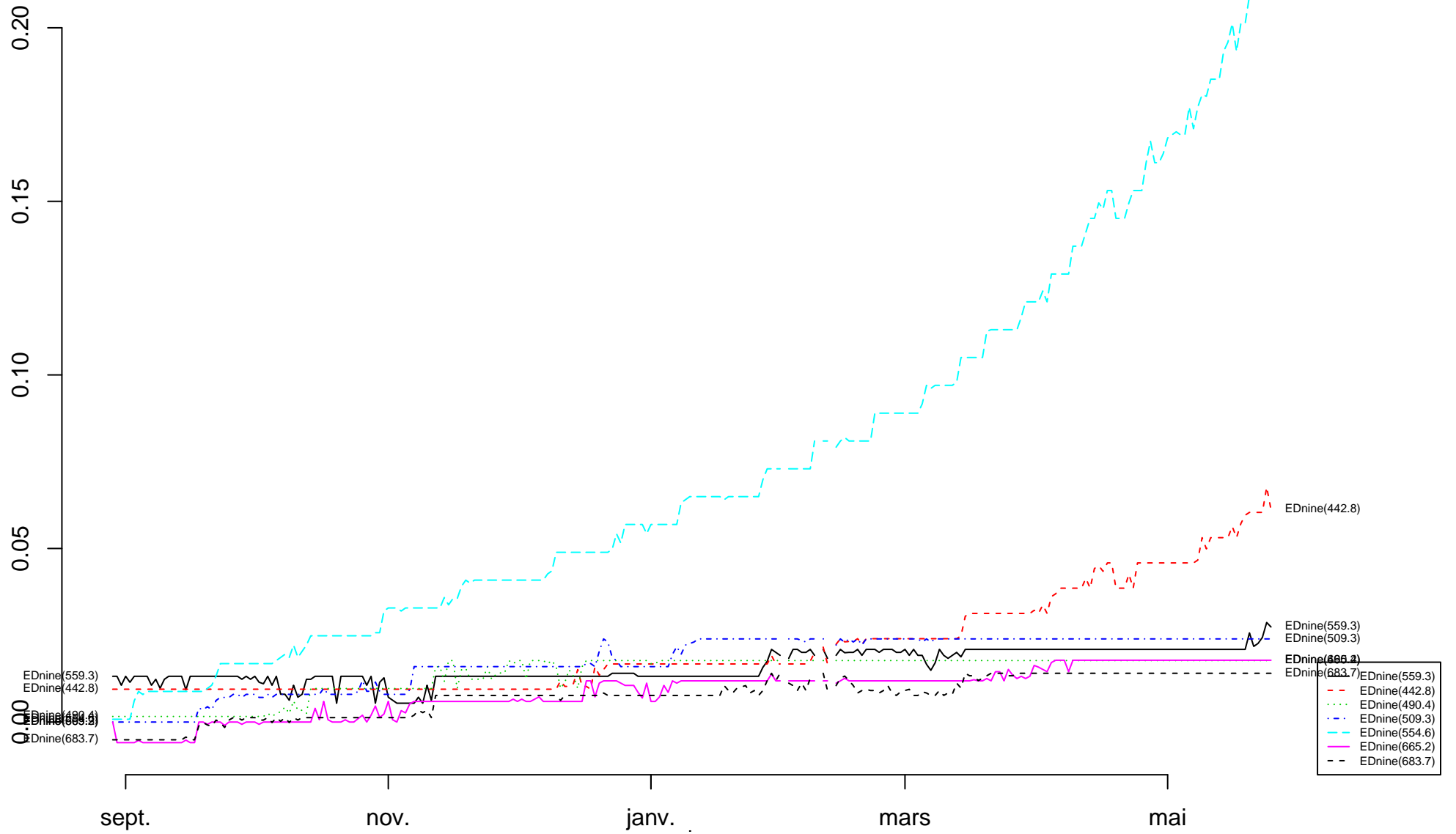




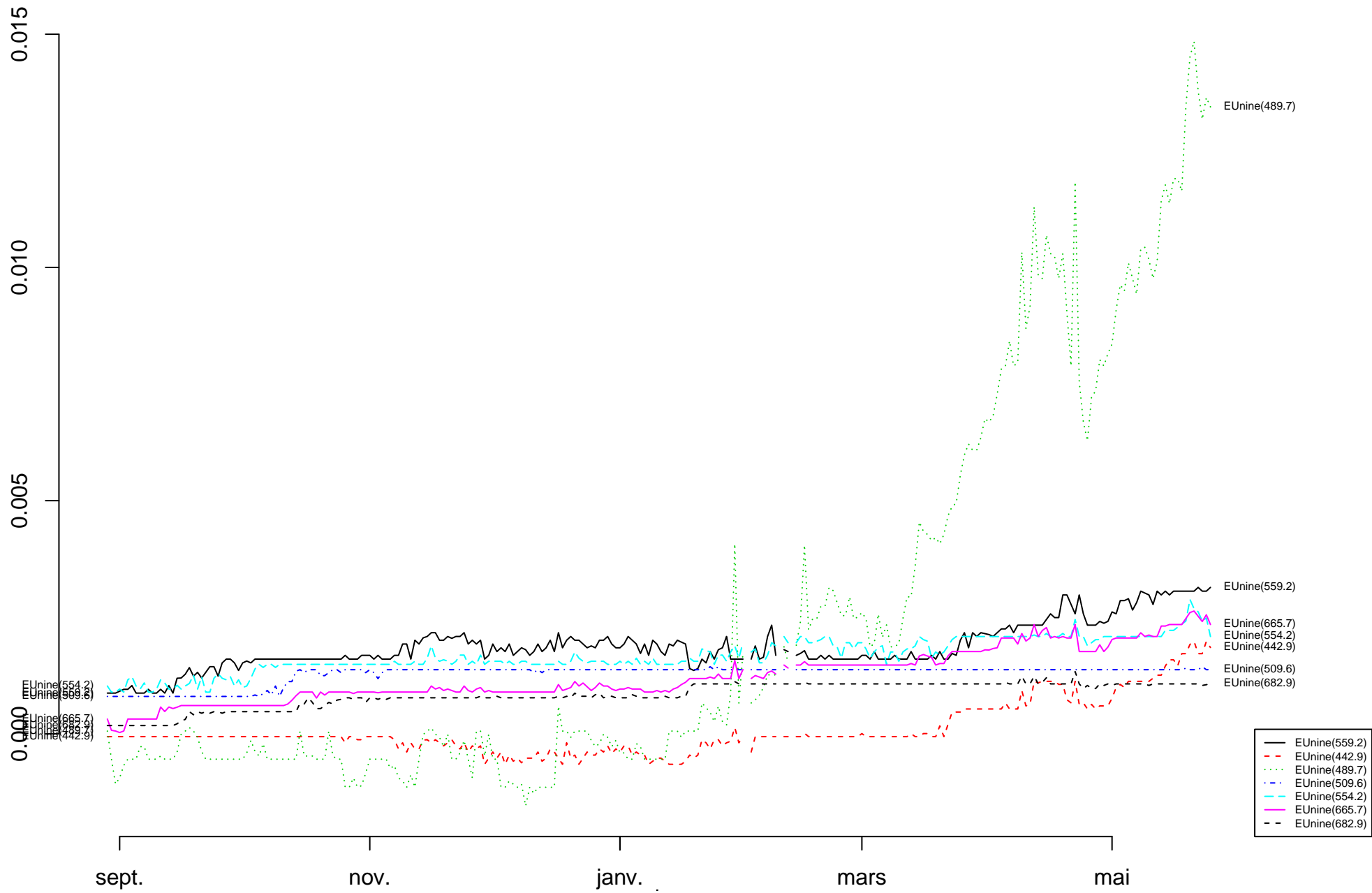




2017



2017



0.015
0.010
0.005
0.000

EUnine(489.7)

EUnine(559.2)

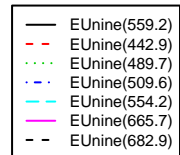
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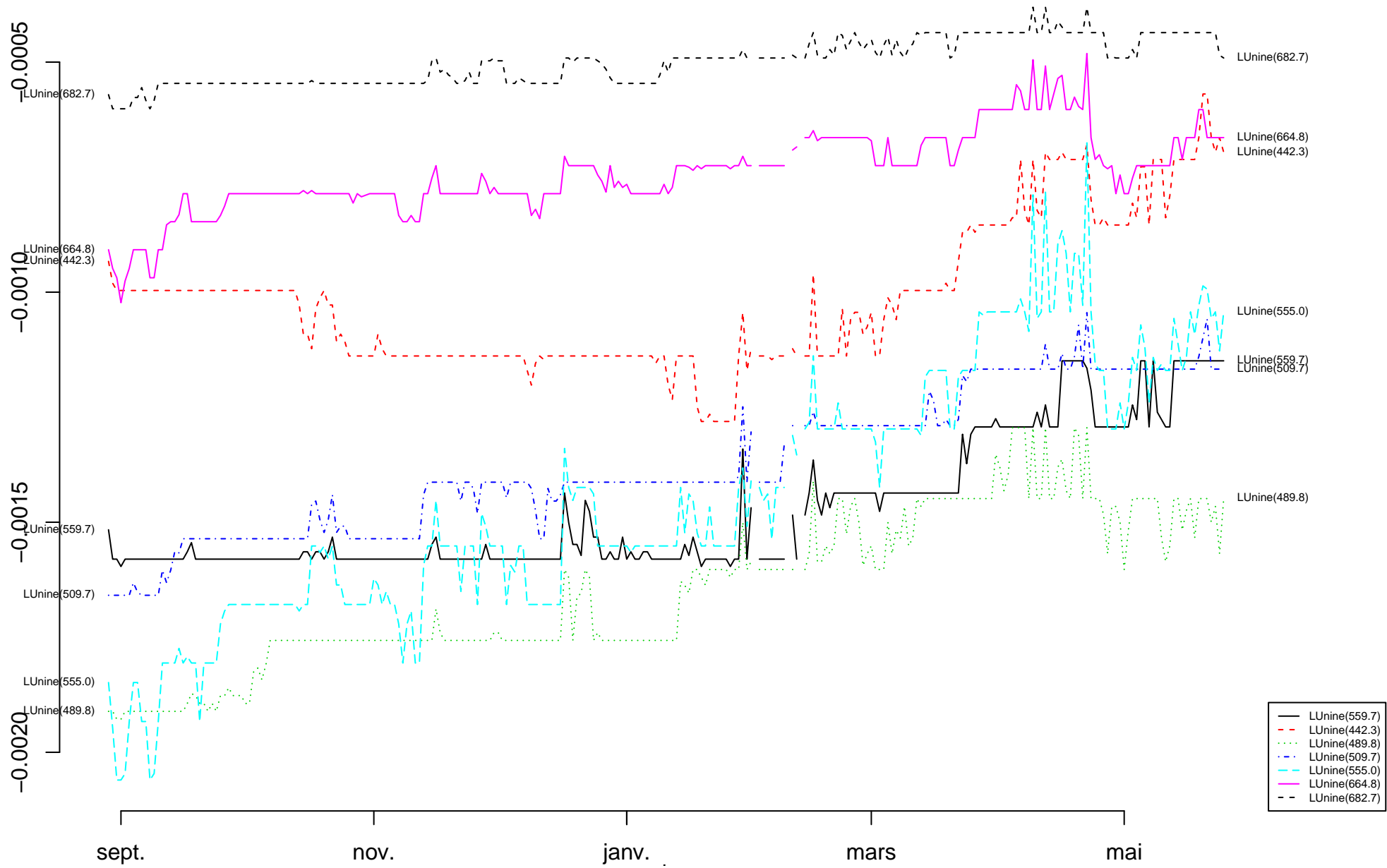
EUnine(554.2)

EUnine(442.9)

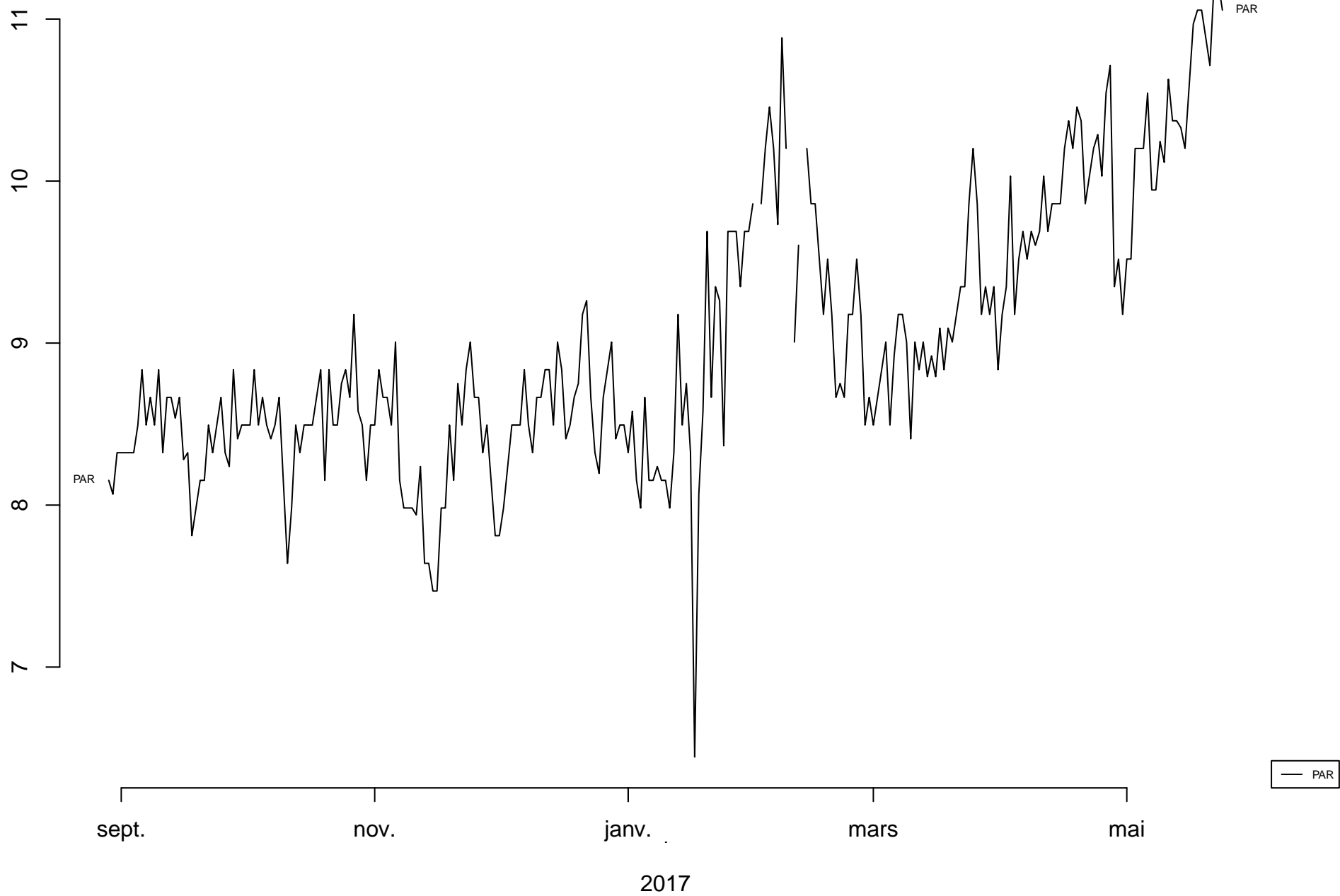
EUnine(509.6)

EUnine(682.9)



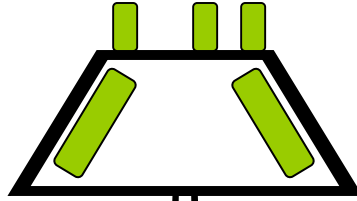


2017



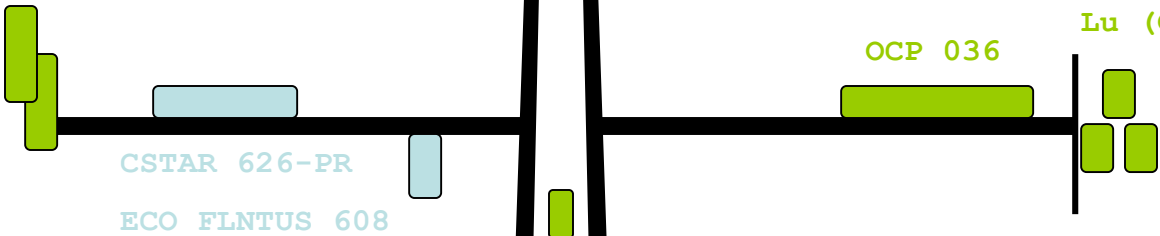
- SATLANTIC
- HOBILABS
- WETLABS
- SEABIRD
- GARROS

MVD (OCI) 030
 ARGOS 003
 Es (HOI) 327
 Junction Box SJB 002
 MVDS 0062
 PAR 0061
 Feux:
 Solar Panels:



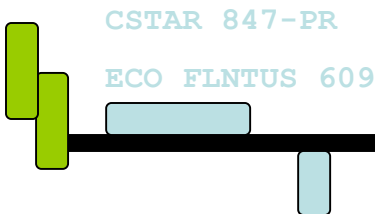
Lu (HOCR) 276
 Ed (HOCRI) 421

Ed (OCI) 050
 Eu (OCI) 048
 Lu (OCR) 036



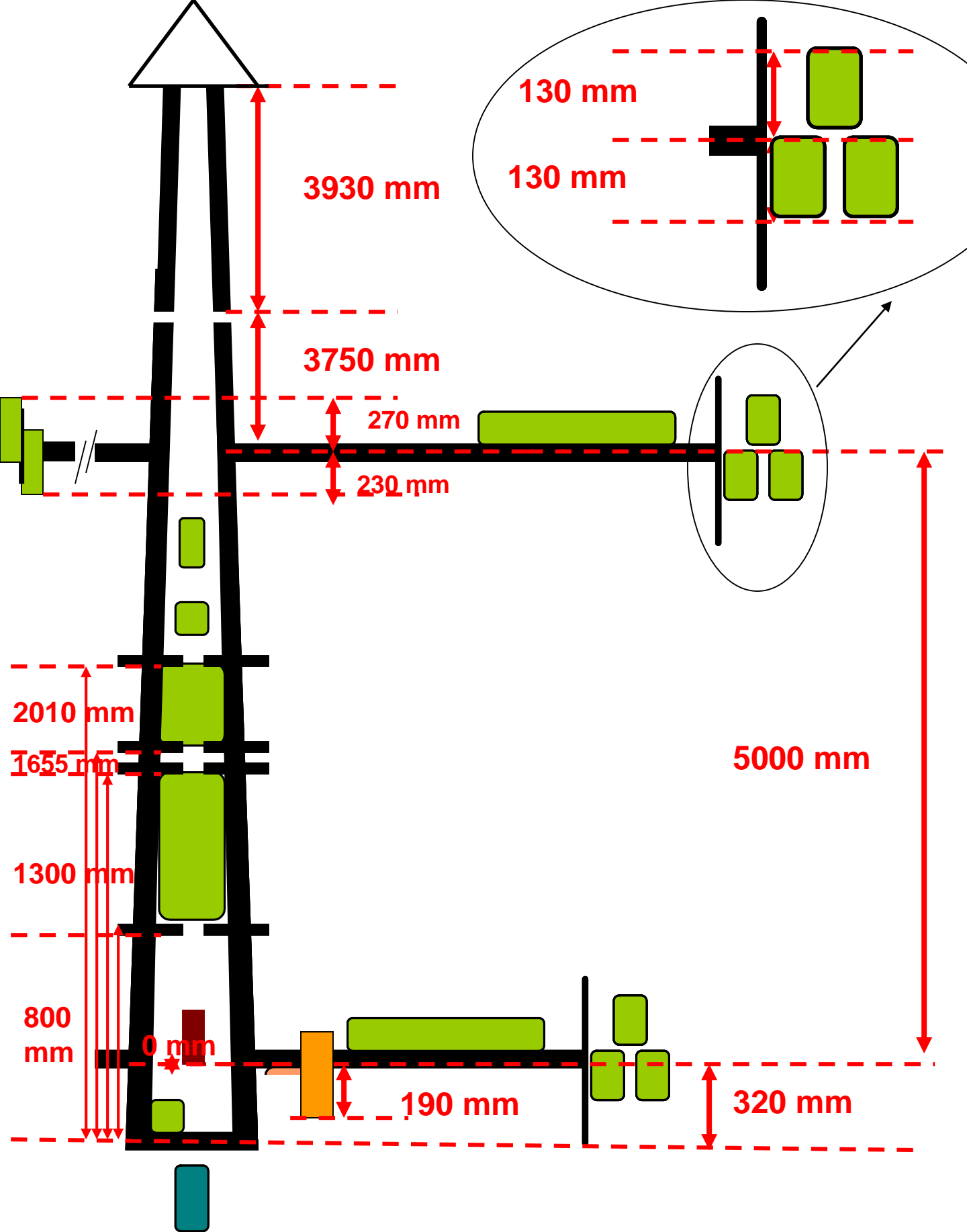
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 Ed (HOCRI) 422

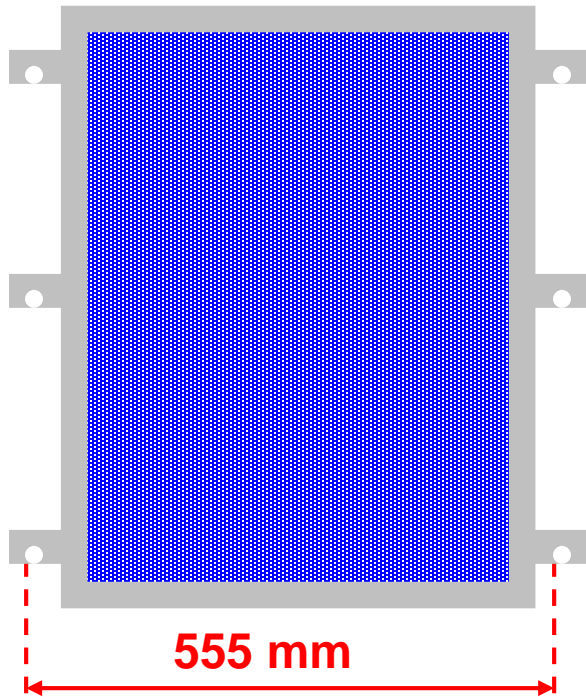
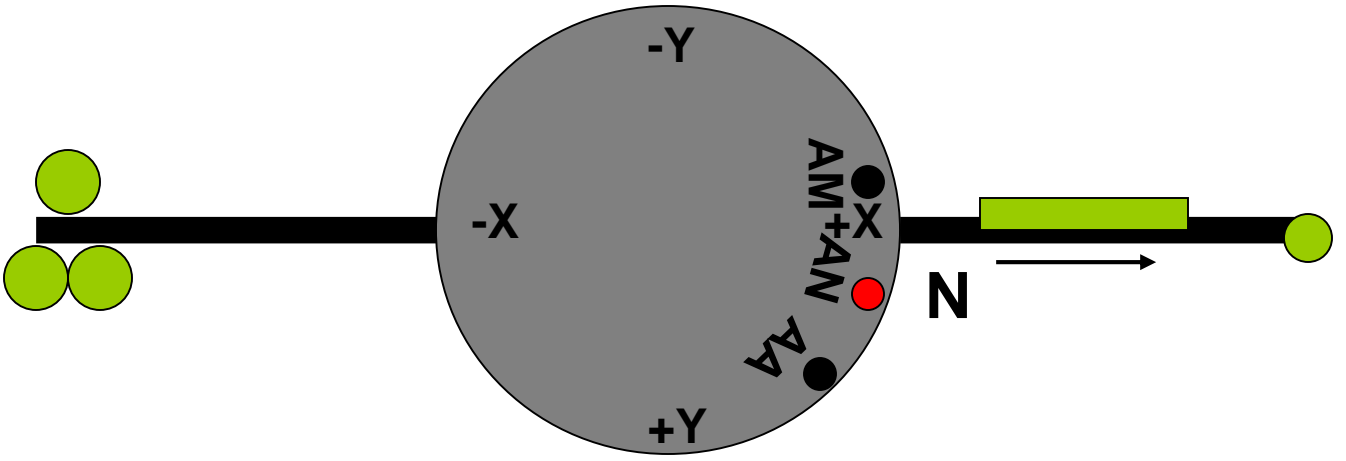
STOR-X 068
 CLC 004
 DACNet (mSM) 011
 Battery 002
 Strain-100 001

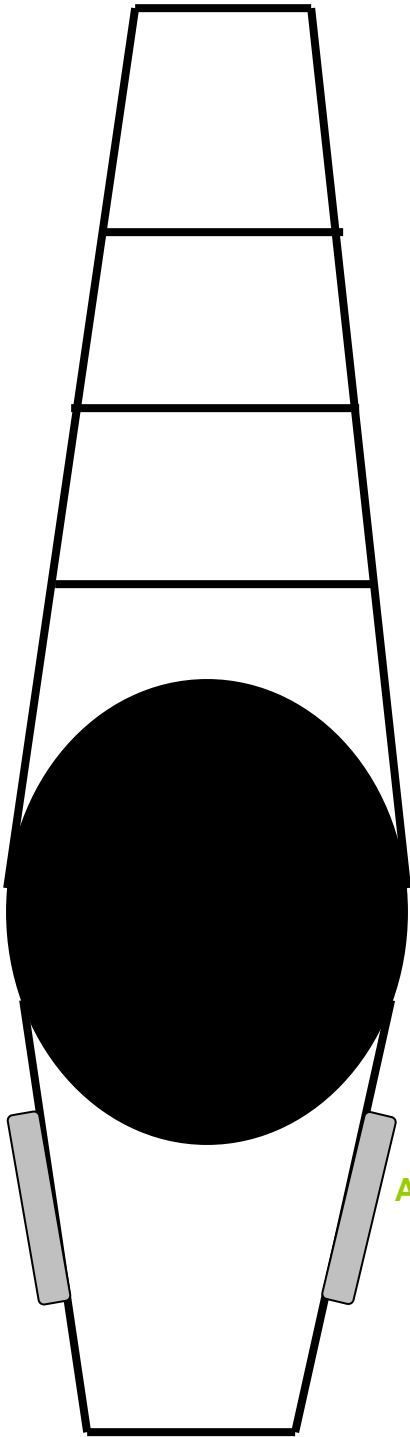


CTD 37SI30260-2404
 OCP 037
 Ed (OCI) 164
 Eu (OCI) 163
 Lu (OCR) 037

HS4 H4080705
 GAROS OML CSCB40K







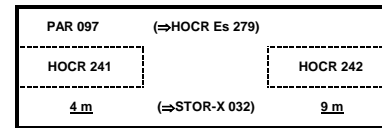
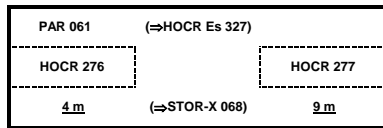
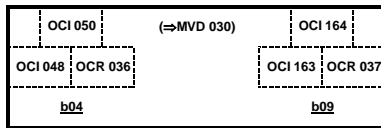
ARGOS 5433

ARGOS 74605

2017

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
	4-Jan	7-Feb 21-Feb	8-Mar 21-Mar	7-Apr 25-Apr	5-May 22-May							
	(only rads cleaning)											
4 m			ocp036t.cal							ocp040q.cal		
		CST-626PR 608_2015-07-28	HPL276J.cal/PLD276J.cal HPE421E.cal/PED421E.cal						CST-1057PR 726_2016-08-15	HPL241M.cal/PLD241M.cal HPE399I.cal/PED399I.cal		
9 m			ocp037q.cal							ocp041p.cal		
		CST-847PR 609_2015-07-28	HPL277I.cal/PLD277I.cal HPE422E.cal/PED422E.cal						CST-1058PR 727_2016-08-15	HPL242m.cal & PLD242m.cal HPE405H.cal & PED405H.cal		
MVD			mvd062o_bis.cal									
			HED327O.cal & HSE327O.cal							HED279N.cal & HSE279N.cal		
			H4080705 2015-9-13.cal							H4070403 2016-09-15.cal		
			Strain100_001b.cal							Strain100_001b.cal		
			SATSTX0068f.cal							SATSTX0032j.cal		

buoy XIX deployment (2017-06-02, vf1)



Customer Service Report

SATLANTIC

RMA 2015-120

Instrument (S/N) OCP-100 (036)
Reason for return In Field Failure
Arrived Jul.9/2015

Vincenzo Vellucci
CNRS

Calibration Details

Head	S/N	Digital NID	Comments	Post Cal File	Final Cal File
OCI-200	048			OCP036R.cal	OCP036T.cal
OCI-200	050			OCP036R.cal	OCP036T.cal
OCR-200	036			OCP036R.cal	OCP036T.cal

Customer Observations

Yearly servicing and calibrations

Service Observations

As received, instrument telemetry was not possible. It was discovered that the Ed module had suffered electrical damage and subsequently was disabling the P/T module.

Physical check

Fluorometer 4 pin female bulkhead connector was found to be severely corroded and will require replacement.

Final cal results

Final calibrations performed on OCI-200 048 & 050.

Post cal summary

For OCI-200 s/n 048, all of the filters are within spec, except for 443. Further testing is required.

For OCI-200 s/n 050, all of the filters are within spec, except for 560. Further testing is required.

For OCR-200 s/n 036, all of the filters are within spec.

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.24/2015	Post calibrations have been completed on OCI200 s/n 048 and 050.	JS
Sep.30/2015	Post calibrations have been completed on OCR200 s/n 036	JS
Oct.1/2015	Inspection completed.	CB
Oct.7/2015	Internal inspection completed.	CB
Oct.8/2015	OCP0036: Replaced main power filter capacitors within Ed module filter board. OCP0036: Replaced fluorometer 4 pin female bulkhead connector.	CB
Nov.9/2015	OCI200 s/n 050: Detectors changed in CH1, 560nm & CH3, 490nm. OCI200 s/n 048: Detectors changed in CH2, 443nm.	CB
Dec.15/2015	C-Star 626 integrated.	CB

Customer Service Report



RMA 2015-120

Instrument (S/N)

OCP-100 (037)

Vincenzo Vellucci

Reason for return

In Field Failure

CNRS

Arrived

Jun.5/2015

Calibration Details

Head	S/N	Digital NID	Comments	Post Cal File	Final Cal File
OCI-200	163			OCP037P.cal	OCP037Q.cal
OCI-200	164			OCP037P.cal	OCP037Q.cal
OCR-200	037			OCP037Q.cal	

Customer Observations

Yearly servicing and calibrations

Physical check

C-Star bulkhead conductors required cleaning.

Post cal summary

For OCI200 s/n 163, all of the filters are within spec.

For OCI200 s/n 164, all of the filters are within spec.

For OCI200 s/n 037, all of the filters are within spec.

Service Observations

As received, instrument was operational.

Final cal results

Final calibrations were completed on OCR200 s/n 163 and 164.

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.24/2015	Post calibrations have been completed on OCI200 s/n 163 and 164.	JS
Sep.30/2015	Post calibrations have been completed on OCR200 s/n 037.	JS
Oct.1/2015	Inspection completed. C-Star port bulkhead conductors cleaned.	CB
Dec.14/2015	OCI-200 s/n 164: Fixed high dark on CH4, 555nm. All 200 series heads passed final cosine scanning.	CB
Dec.15/2015	C-Star 847 integrated.	CB
Dec.15/2015	Final calibrations were completed on OCR200 s/n 163 and 164.	JS
Dec.21/2015	Optics sensors intercompared & reality-checked - PASSED.	KD
Dec.22/2015	OCP037 with accompanying heads passed reality check.	CB
Dec.23/2015	Integrated for full system testing.	CB

Customer Service Report



RMA 2015-120

Vincenzo Vellucci
CNRS

Instrument (S/N) MVD (62)
Reason for return In Field Failure
Arrived Jun.5/2015

Calibration Details

Head	S/N	Digital NID	Comments	Post Cal File	Final Cal File
OCI-200	030			MVD062N.cal	MVD062O.cal

Customer Observations

Yearly servicing and calibrations

Service Observations

none

Physical check

none

Final cal results

Final calibration was completed.

Post cal summary

For OCI200 s/n 030, all of the filters are not within spec. no
Further testing is required.

Under warranty

Description of Work Performed

Date	Work Done	Tech
Sep.24/2015	Post calibration was completed on OCI200 s/n 030.	JS
Nov.13/2015	OCI200 s/n 030 diffusers were replaced.	CB
Dec.1/2015	Passed final cosine scanning.	KD
Dec.15/2015	Final calibration was completed.	JS
Dec.22/2015	Sensor intercompared & reality-checked - PASSED.	KD
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test
Intercomparison Test
Post Cal

Quality Assurance

Signed Duell Adam
Date 28 Dec 2015

Customer Service Report

SATLANTIC

RMA 2015-120

Instrument (S/N)

Solar Panels ()

Reason for return

In Field Failure

Arrived

Jun.5/2015

Vincenzo Vellucci

CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

As received all panels were operational.

Physical check

Solar Panel # D31109159D72FAC requires replacement of 1 outer bracket.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.24/2015	Inspections completed. 1 outer bracket replaced for Solar Panel # D31109159D72FAC. Under full sunlight: Solar Panel # D31109159D72FAC = 22.50VDC Solar Panel # JWW00591201012020204 = 24.10VDC Solar Panel # JWW00591201012020181 = 24.15VDC	CB

Work/Quality Verification Results

Boat Test []

Intercomparison Test []

Post Cal []

Quality Assurance

Signed

Daniel Adan

Date

Dec 28, 2015

SAT-QR-87001
 Verification Checklist
 CNRS Mooring System (Page 1 of 3)



This document is the final inspection, verification checklist for Satlantic's CNRS Mooring System. The inspection is performed after all other work has been completed, before it is shipped to a customer. The inspection is conducted and QA counter signed by qualified Satlantic Technicians.



DACNet with enclosure removed

RMA Number: 2015-120
 Date: Dec 28, 2015
 Primary Technician: DARRALL ADAMS / CHRIS BEASLEY

Satlantic Mooring System Manager:

- DA Final internal inspection (wiring, loctite, silicone, etc)
- DA Verify fuses
- CB Install new 9 Volt Lithium Battery 09/30/2015
- DA Verify operation of ports:
 Serial: CISCO: Manual Override: Console:
- DA Current draw at 12 Volts 1040 mA
- SA Archive Microdrive Incoming
- SA Archive Microdrive Outgoing B4Y86P34, B4R2E X94 (BACK UP)

Satlantic MORS 4 Meter:

- CB Reality Check document complete:
 OCP SN 36 OCI-200 SN 48 OCI-200 SN 50 OCR-200 SN 36
- DA Verify Port Link operation
- DA Verify logged data set

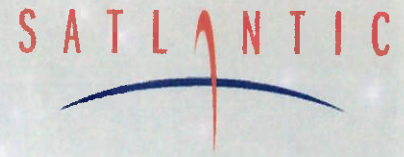
Satlantic MORS 9 Meter:

- CB Reality Check document complete:
 OCP SN 37 OCI-200 SN 163 OCI-200 SN 164 OCR-200 SN 37
- DA Verify Port Link operation
- DA Verify logged data set

Satlantic Stor-X System:

- CB Reality Check document complete:
 Stor-X SN 68
 HyperOCR I SN 327
 HyperOCR R SN 276 with HPE SN 421
 HyperOCR R SN 277 with HPE SN 422
 PAR SN 61
- CB In water test
- DA Verify Port Link operation
- DA Verify logged data set

SAT-QR-87001
Verification Checklist
CNRS Mooring System (Page 2 of 3)



Satlantic MVDS:

- Reality Check document complete:
MVD SN 62 OCI-200 SN 30
- Verify Port Link operation
- Verify logged data set

Satlantic Strain Gauge:

- Verify correct operation:
Strain-100 SN 1
- Verify Port Link operation
- Verify logged data set

CISCO Wireless Hub:

- Internal inspection
- Verify correct operation - unit was water damaged DA

WildCat PTT:

- Verify correct operation

HobiLabs HydroScat:

- Verify correct operation:
HydroScat SN H4080705
- Verify Port Link operation
- Verify logged data set

SeaBird MicroCat:

- Verify correct operation:
MicroCat SN 2904
- Verify Port Link operation
- Verify logged data set

WetLabs ECOFLNTUS:

- Verify correct operation:
ECOFLNTUS 4 Meter SN 608
ECOFLNTUS 9 Meter SN 609
- Verify Port Link operation
- Verify logged data set

Satlantic Cables:

- Visual inspection
- Connect components with RMA cables
- Notes: _____

Customer Service Report



RMA 2015-120

Instrument (S/N)

Reason for return

Arrived

Stor-X (68)

In Field Failure

Jun.5/2015

Vincenzo Vellucci

CNRS

Calibration Details

Head	S/N	Digital NID	Comments	Post Cal File	Final Cal File
HSE	327			HSE327M.cal, HED327M.cal	HSE327O.cal HED327O.cal, STX0068_15Dec2 2.sip
PAR	061			SATSTX0068F.ca l, STX0068_15Dec2 2.sip	
HPE	421			none	HPE421E.cal, PED421E.cal, STX0068_15Dec2 2.sip
HPL	276			HPL276J.cal, PLD276J.cal, STX0068_15Dec2 2.sip	
HPE	422			none	HPE422E.cal, PED422E.cal, STX0068_15Dec2 2.sip
HPL	277			HPE277I.cal, PLD277I.cal, STX0068_15Dec2 2.sip	

Customer Observations

Yearly servicing and calibrations

Physical check

Female conductors require cleaning.

Post cal summary

Service Observations

HPE 421 spectrometer temperature static at 99 degrees.

HPE 422 spectrometer digital circuit board requires replacement.

HSE 327 spectrometer digital circuit board requires replacement.

No issues observed with HPL 276, 277.

Final cal results

Final calibrations were completed for HPE 412, 422, & HSE 327.

Under warranty

SAT-QR-87001
Verification Checklist
CNRS Mooring System (Page 3 of 3)



Power System - Solar Panels:

- Voltage under full sun:
Panel #1 22.50V Panel #2 24.10V Panel #3 24.15V
- Visual inspection

Power System - Solar Panel Junction Box:

- Internal inspection and diode check
- Verify operation of each port
- Verify switch function in both directions (20 cycles)

Power System - Charge Load Controller:

- Internal inspection
- Verify correct operation
- Float voltage 14.25 V
- Low voltage cutoff 9.51 V
- Check fuses

Power System - Battery Pack:

- Check battery condition if applicable
- Internal inspection
- Test temperature sensor with CLC
- Verify switch function in both directions (20 cycles)
- Check vent valve

Operation:

- System operating within parameters of data collection schedule
- Wireless telemetry system and software operating correctly connected directly via RS45 ethernet cable
- Mooring System manager software version 2008.2
- Inspect node manager files
- Delete test data from disk

Additional Notes:

Tested with Basestation software running Windows 7. Data path
is as follows:
C:\users\username\AppData\Local\VirtualStore\Program Files (x86)\Satlantic\
BaseClient\node\telemetry

Cisco unit was not used for final testing as it was damaged. Established
direct connection via Ethernet patch port and RS45 connector. Computer
set as 10.1.1.4 IP.

Quality Assurance: Dave Dore

Date: Dec 28, 2015

Dec.22/2015

PAR sensor intercompared - PASSED.

KD

Work/Quality Verification Results

Boat Test
Intercomparison Test
Post Cal

Quality Assurance

Signed Donell Adams

Date Dec 28, 2015

Customer Service Report



RMA 2015-120

Instrument (S/N) Ass't Cables ()
Reason for return In Field Failure
Arrived Jun.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

Cables on replacement order:

7 OCI/OCR cables: Customer requested . .
1 DACNet-ARGOS cable: Customer requested
1 DACNet-CISCO cable: Customer requested
DACNet-CLC cable: Highly weakened female
conductors

Cables built:

DACNet-CTD cable: Failed insulation testing (205VDC)
DACNet-HS4 cable: Failed insulation testing (205VDC)

Cables repaired:

CLC-J/Box: Repairs given due to jacket damage
STOR-X-HyperEs: Repairs given due to jacket damage
OCP-C-Star 9m: Repairs given due to jacket damage

Cables to retire soon due to routine wear & ageing:

DACNet-OCP 4m, DACNet-Strain-100,
DACNet-ECO-FLNTU 9m, OCP-C-Star 4m,
OCP-C-Star 9m.

Physical check

Repairs and replacements will be required.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.21/2015	Assessment completed.	CB
Sep.22/2015	Continuity checks and 250VDC insulation testing completed. Minor repairs to cabling jackets completed. Cabling female conductors cleaned as required.	CB

Customer Service Report



RMA 2015-120

Instrument (S/N) Strain-100 (001)
Reason for return In Field Failure
Arrived Jun.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Physical check

Female bulkhead conductors require cleaning.

Post cal summary

none

Service Observations

As received, instrument was operational.

Final cal results

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.25/2015	Inspection completed. Female bulkhead conductors cleaned. Instrument voltage/current response confirmed.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []
Intercomparison Test []
Post Cal []

Quality Assurance

Signed

Date

28 Dec 2015

Customer Service Report



RMA 2015-120

Instrument (S/N) Junction Box (002)
Reason for return In Field Failure
Arrived Jun.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Physical check

Switch is exhibiting rust deposits.

Post cal summary

none

Service Observations

As received, instrument was operational.

Final cal results

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.30/2015	Inspection completed. Port switching checks completed. Diode check completed. All fuses replaced.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []

Intercomparison Test []

Post Cal []

Quality Assurance

Signed

Danell A. ...

Date

Dec 28, 2015

Customer Service Report



RMA 2015-120

Instrument (S/N) CLC (004)
Reason for return In Field Failure
Arrived Jun.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Physical check

Conductors required cleaning.

Post cal summary

none

Service Observations

As received, instrument was operational.

Final cal results

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.30/2015	Inspection completed. Bulkhead conductors cleaned. All fuses replaced. Low voltage disconnect (LVD) measured 9.31VDC; PASS. Battery return voltage (post LVD) measured 10.50VDC; PASS. Battery float voltage measured 14.25VDC; PASS.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []

Intercomparison Test []

Post Cal []

Quality Assurance

Signed *D. Vellucci*

Date Dec 28, 2015

Customer Service Report

SATLANTIC

RMA 2015-120

Instrument (S/N)

Battery Case (02)

Reason for return

In Field Failure

Arrived

Jun.5/2015

Vincenzo Vellucci

CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Physical check

Minor damage found along o-ring seal.

Post cal summary

none

Service Observations

As received, instrument was operational.

Final cal results

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Oct.1/2015	Inspection completed. Minor o-ring surface damage repaired. All fuses replaced.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []

Intercomparison Test []

Post Cal []

Quality Assurance

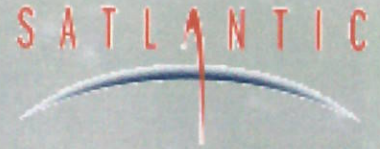
Signed

Paul Adu

Date

Dec 28, 2015

Customer Service Report



RMA 2015-120

Instrument (S/N) CISCO (002)
Reason for return In Field Failure
Arrived Jun.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

As received instrument was found to be flooded and subsequently not operational.

Physical check

Mechanicals/Antenna/Vicor Salvageable.
Modem and antenna housing will require replacement.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.24/2015	Assessment completed. Internal inspection completed.	CB

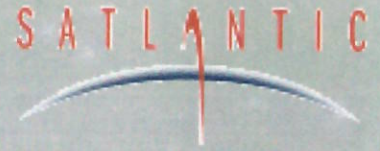
Work/Quality Verification Results

Boat Test []
Intercomparison Test []
Post Cal []

Quality Assurance

Signed Daell Adu
Date Dec 28, 2015

Customer Service Report



RMA 2015-120

Instrument (S/N) SBE (2404)
Reason for return In Field Failure
Arrived Jun.30/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

As received from manufacturer, instrument was operational.

Physical check

Good physical condition.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.25/2015	Assessment completed.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []
Intercomparison Test []
Post Cal []

Quality Assurance

Signed *Daniel Adam*
Date 28 Dec 2015

Customer Service Report

SATLANTIC

RMA 2015-120

Instrument (S/N) HydroScat-4 (H4080705)
Reason for return In Field Failure
Arrived Oct.8/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Physical check

Nothing to report.

Post cal summary

none

Service Observations

As received, instrument was operational.

Final cal results

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Oct.8/2015	Assessment completed.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []

Intercomparison Test []

Post Cal []

Quality Assurance

Signed 

Date 28 Dec 2015

Customer Service Report

SATLANTIC



RMA 2015-120

Instrument (S/N) FLNTUS (608)
Reason for return In Field Failure
Arrived Aug.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

As received from manufacturer, instrument was operational.

Physical check

Bulkhead base showing signs of corrosion.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.25/2015	Assessment completed.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

Boat Test []
Intercomparison Test []
Post Cal []

Quality Assurance

Signed *Dall'An*
Date *Dec 28, 2015*

Customer Service Report

SATLANTIC

RMA 2015-120

Instrument (S/N) FLNTUS (609)
Reason for return In Field Failure
Arrived Aug.5/2015

Vincenzo Vellucci
CNRS

Calibration Details

None

Customer Observations

Yearly servicing and calibrations

Service Observations

As received from manufacturer, instrument was operational.

Physical check

Bulkhead base showing signs of corrosion to a lesser degree than s/n 609.

Final cal results

none

Post cal summary

none

Under warranty

no

Description of Work Performed

Date	Work Done	Tech
Sep.25/2015	Assessment completed.	CB
Dec.22/2015	Integrated for full system testing.	CB

Work/Quality Verification Results

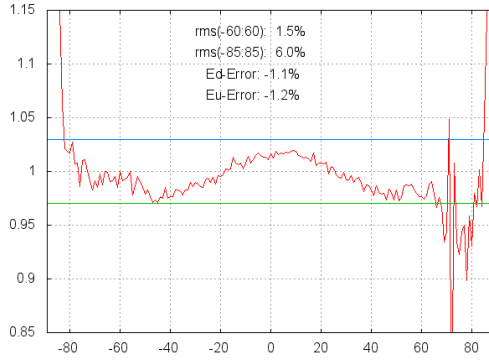
Boat Test []
Intercomparison Test []
Post Cal []

Quality Assurance

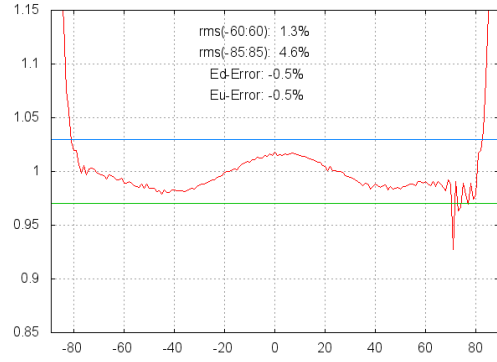
Signed *Daell Aden*
Date 28 Dec 2015

Scan 716, OCI-200, sn 129

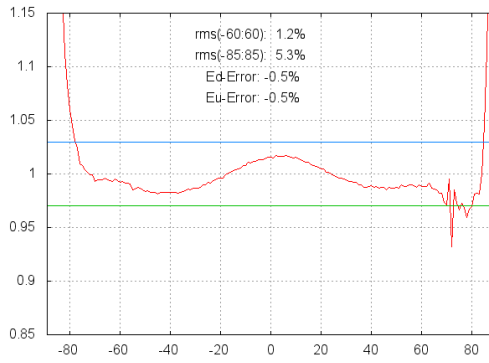
MVD0000 Cosine scan - Difference from ideal cosine, channel 1, 412 nm



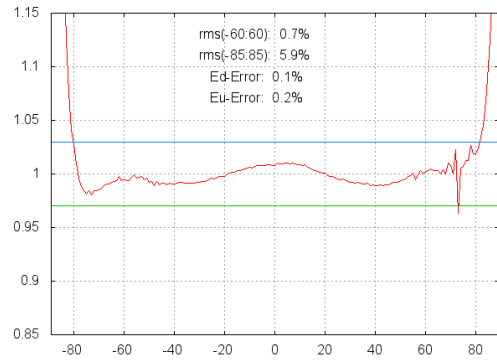
MVD0000 Cosine scan - Difference from ideal cosine, channel 2, 442 nm



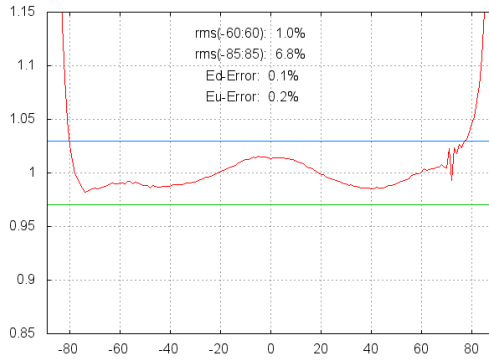
MVD0000 Cosine scan - Difference from ideal cosine, channel 3, 490 nm



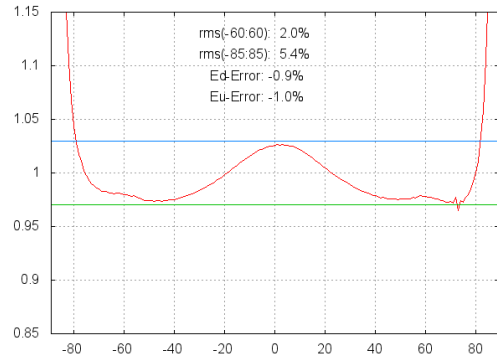
MVD0000 Cosine scan - Difference from ideal cosine, channel 4, 510 nm



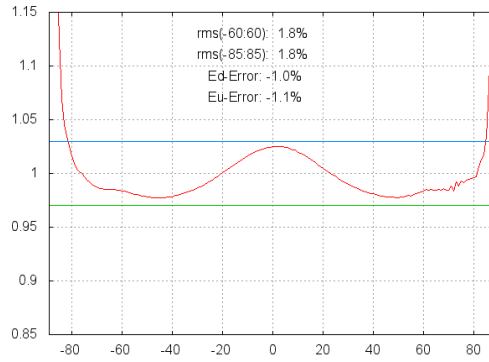
MVD0000 Cosine scan - Difference from ideal cosine, channel 5, 555 nm



MVD0000 Cosine scan - Difference from ideal cosine, channel 6, 665 nm

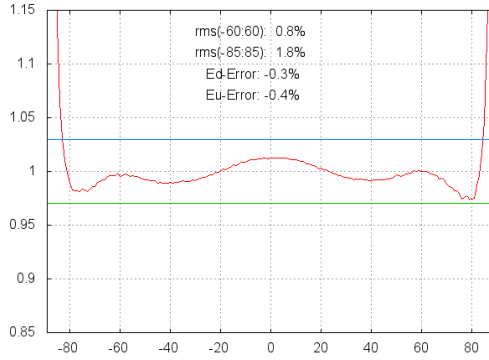


MVD0000 Cosine scan - Difference from ideal cosine, channel 7, 683 nm

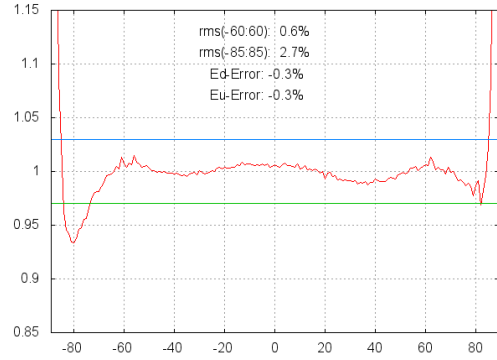


Scan 719, OCI-200, sn 30

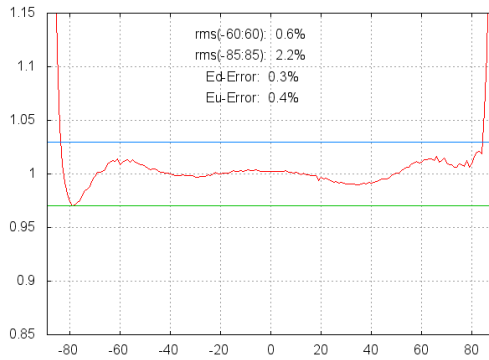
MVD0000 Cosine scan - Difference from ideal cosine, channel 1, 412 nm



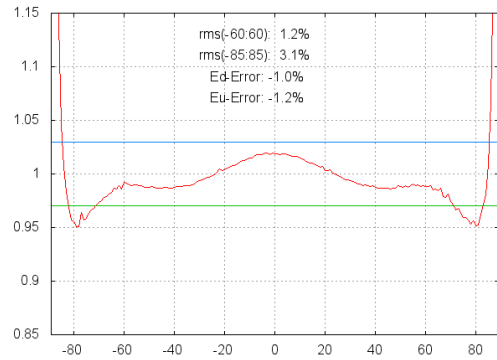
MVD0000 Cosine scan - Difference from ideal cosine, channel 2, 442 nm



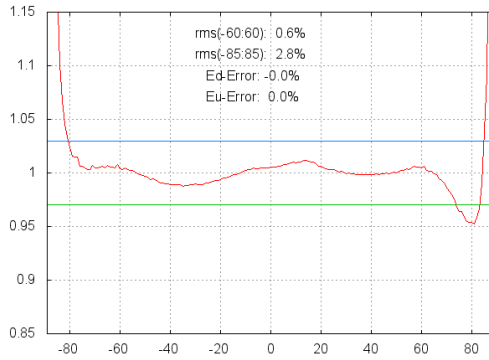
MVD0000 Cosine scan - Difference from ideal cosine, channel 3, 490 nm



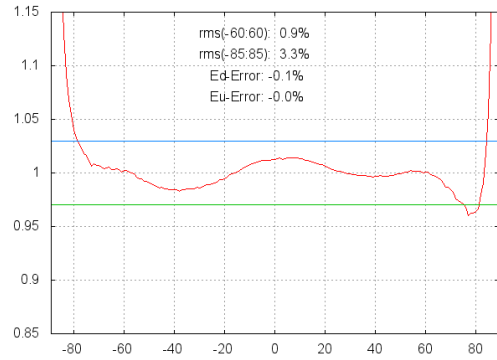
MVD0000 Cosine scan - Difference from ideal cosine, channel 4, 510 nm



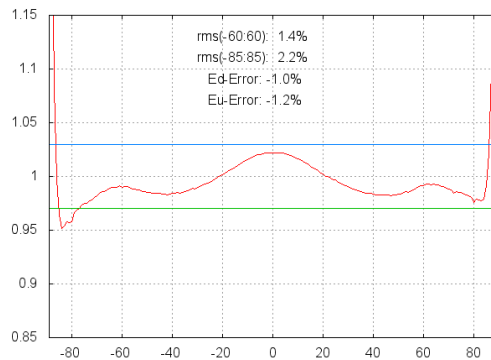
MVD0000 Cosine scan - Difference from ideal cosine, channel 5, 555 nm



MVD0000 Cosine scan - Difference from ideal cosine, channel 6, 665 nm

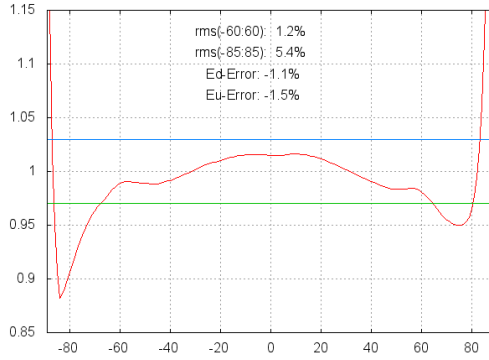


MVD0000 Cosine scan - Difference from ideal cosine, channel 7, 683 nm

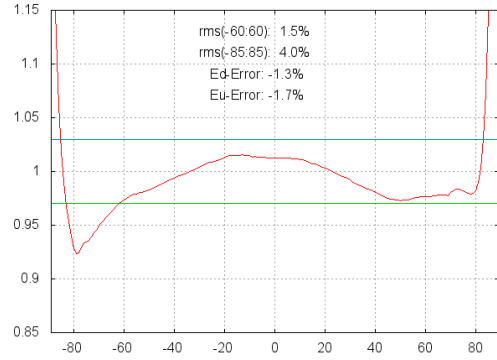


Scan 721, OCI-200, sn 163

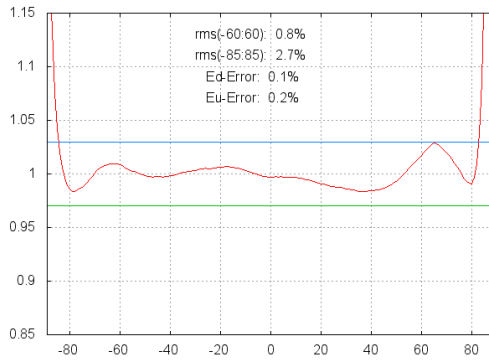
MVD0000 Cosine scan - Difference from ideal cosine, channel 1, 412 nm



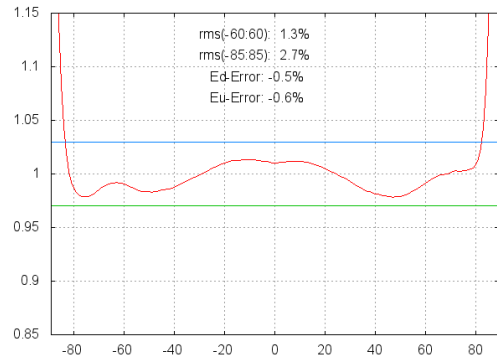
MVD0000 Cosine scan - Difference from ideal cosine, channel 2, 442 nm



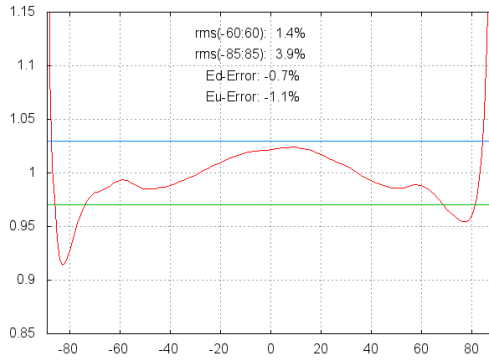
MVD0000 Cosine scan - Difference from ideal cosine, channel 3, 490 nm



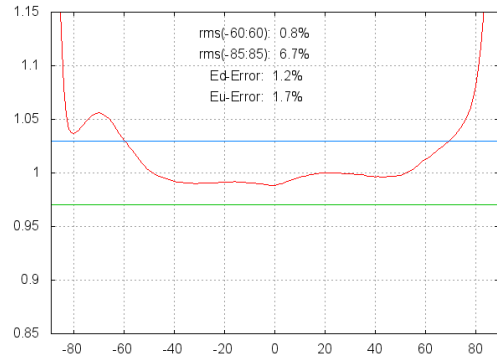
MVD0000 Cosine scan - Difference from ideal cosine, channel 4, 510 nm



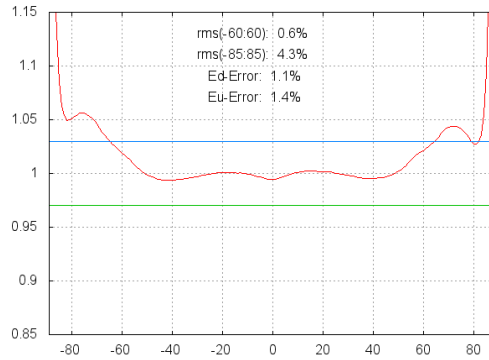
MVD0000 Cosine scan - Difference from ideal cosine, channel 5, 555 nm



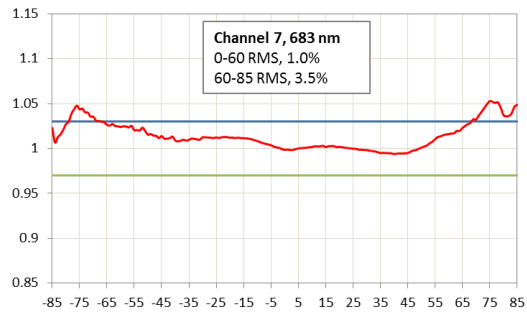
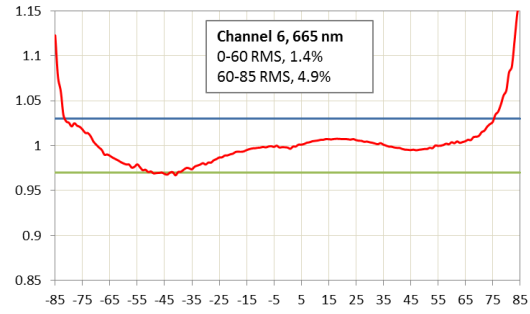
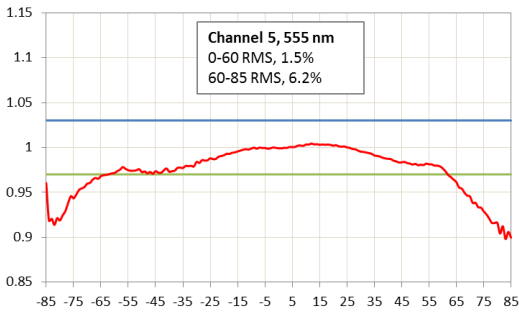
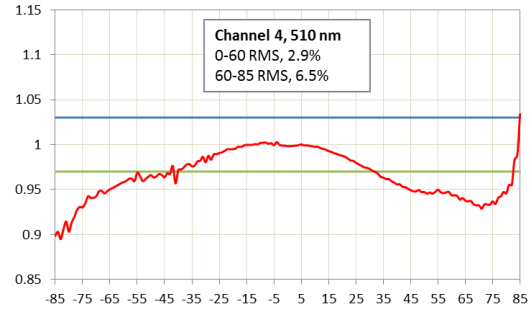
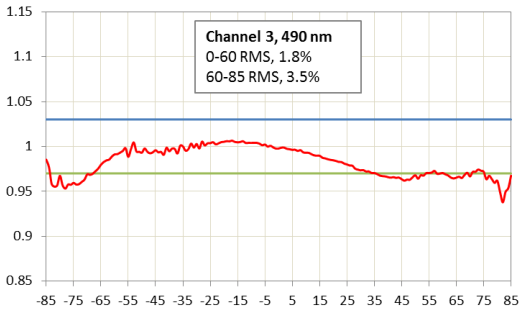
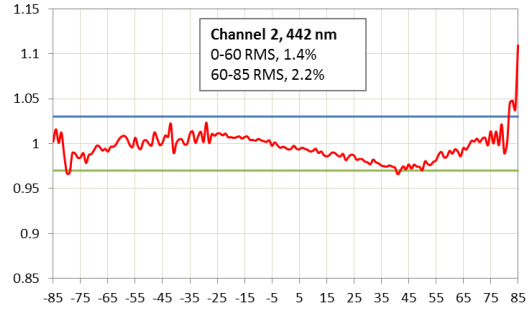
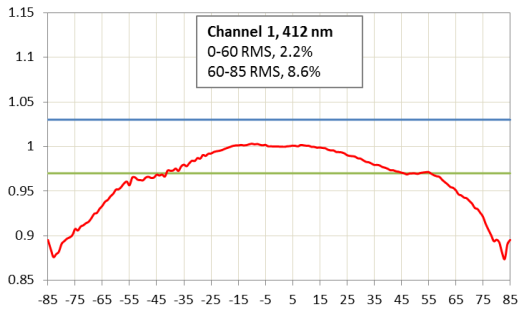
MVD0000 Cosine scan - Difference from ideal cosine, channel 6, 665 nm



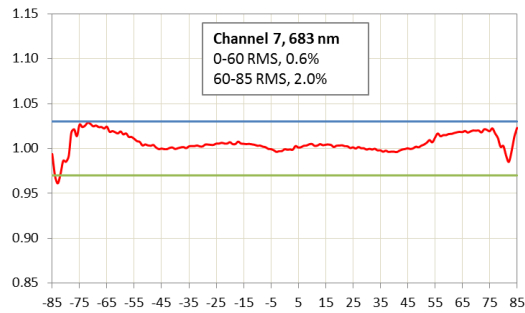
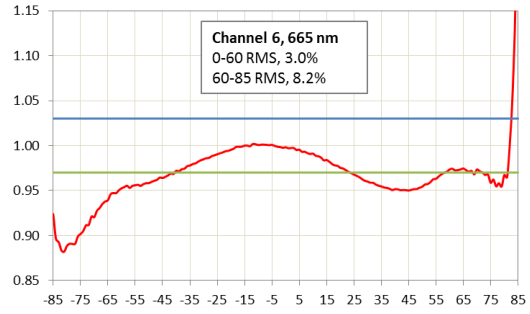
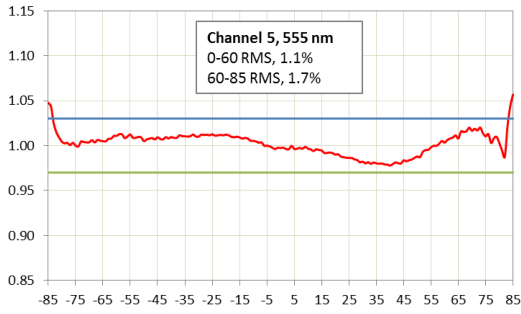
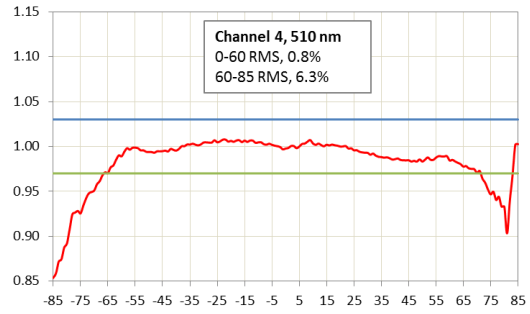
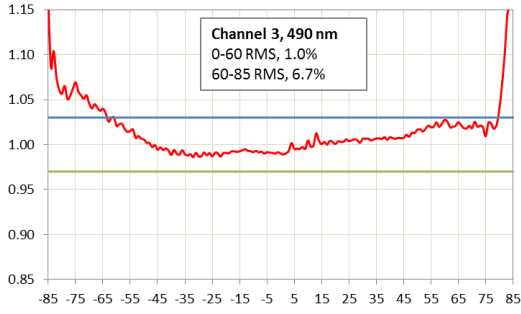
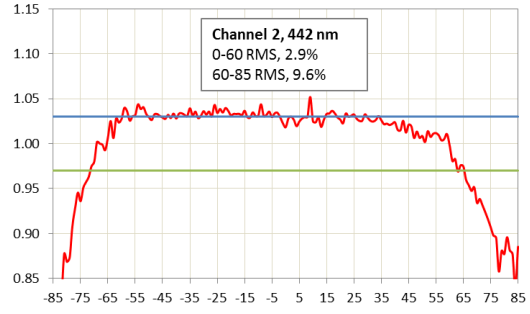
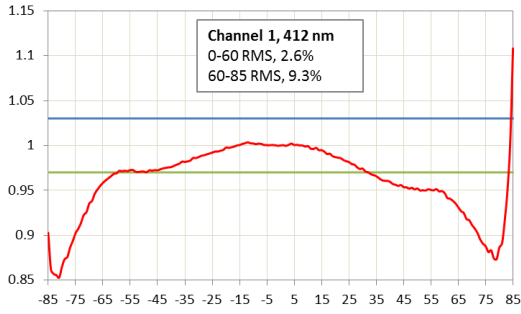
MVD0000 Cosine scan - Difference from ideal cosine, channel 7, 683 nm



Scan 724, OCI-200, sn 164

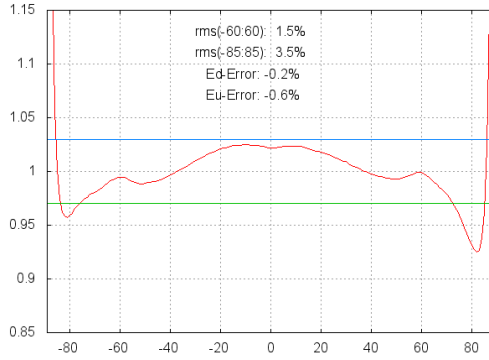


Scan 726, OCI-200, sn 50

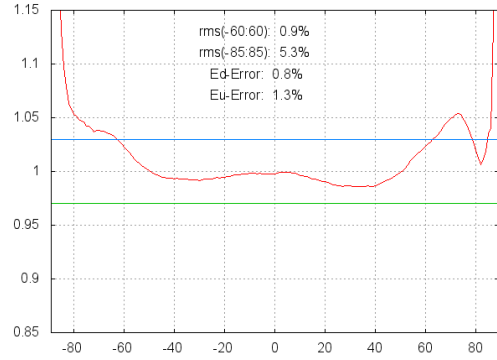


Scan 740, OCI-200, sn 48

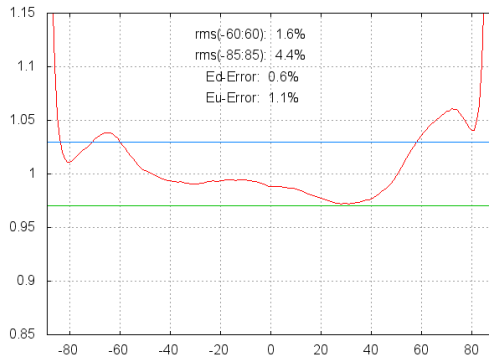
MVD0000 Cosine scan - Difference from ideal cosine, channel 1, 412 nm



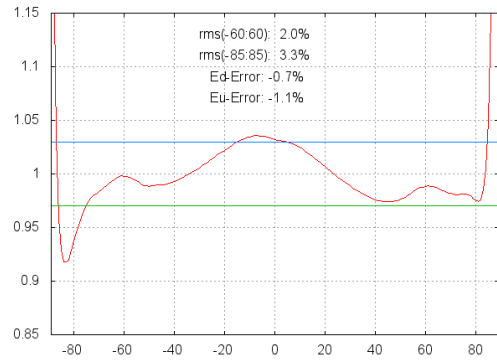
MVD0000 Cosine scan - Difference from ideal cosine, channel 2, 442 nm



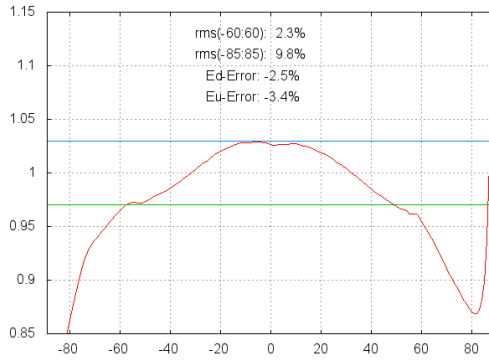
MVD0000 Cosine scan - Difference from ideal cosine, channel 3, 490 nm



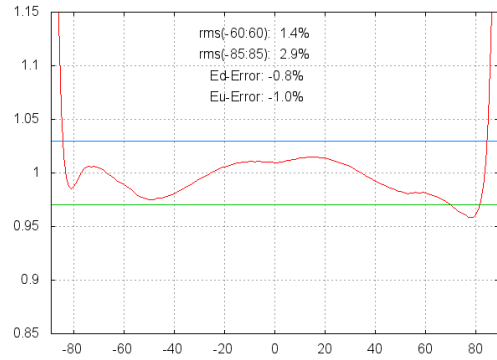
MVD0000 Cosine scan - Difference from ideal cosine, channel 4, 510 nm



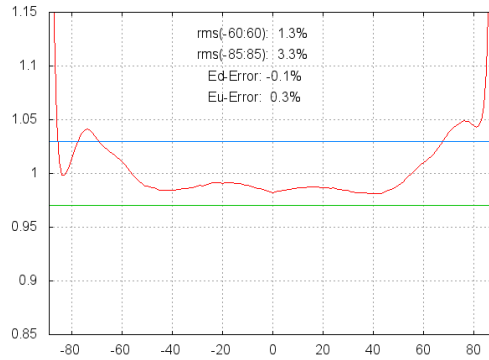
MVD0000 Cosine scan - Difference from ideal cosine, channel 5, 555 nm



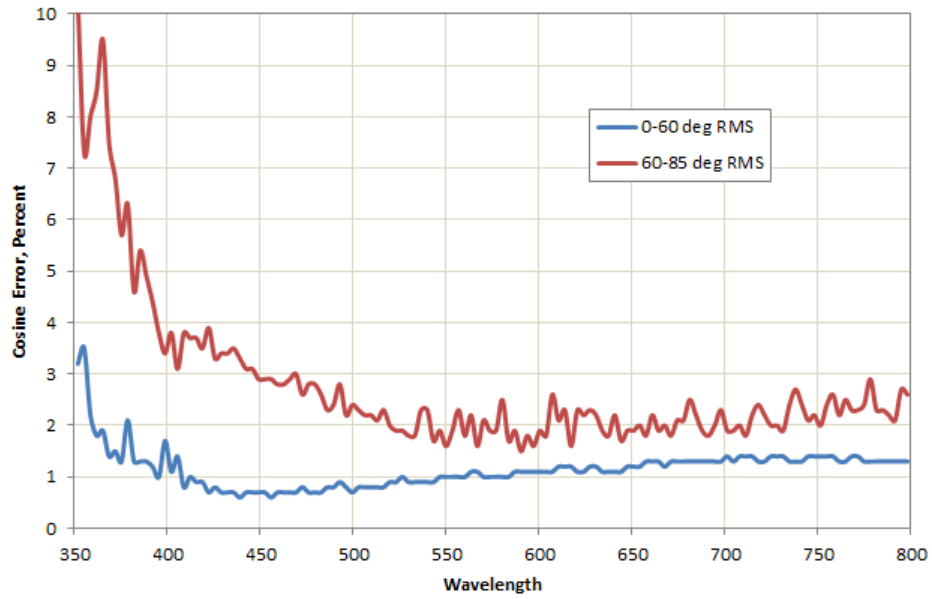
MVD0000 Cosine scan - Difference from ideal cosine, channel 6, 665 nm



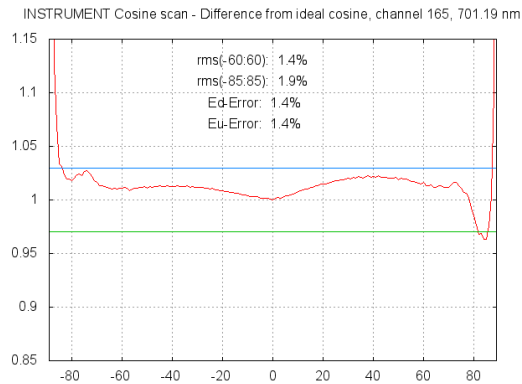
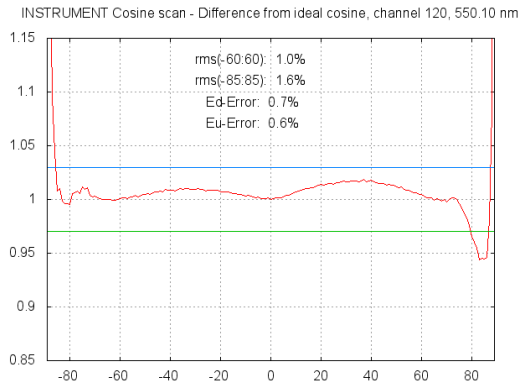
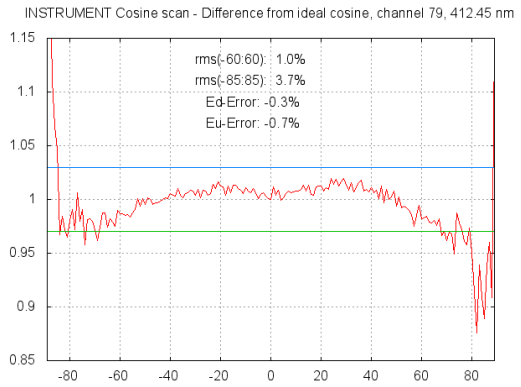
MVD0000 Cosine scan - Difference from ideal cosine, channel 7, 683 nm



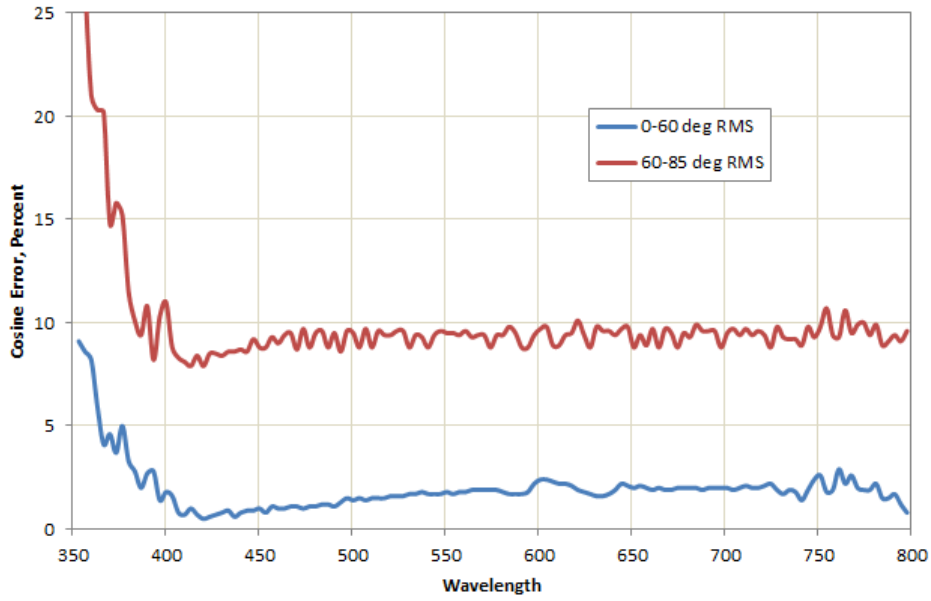
Scan 741, HOCR, HSE, sn 327



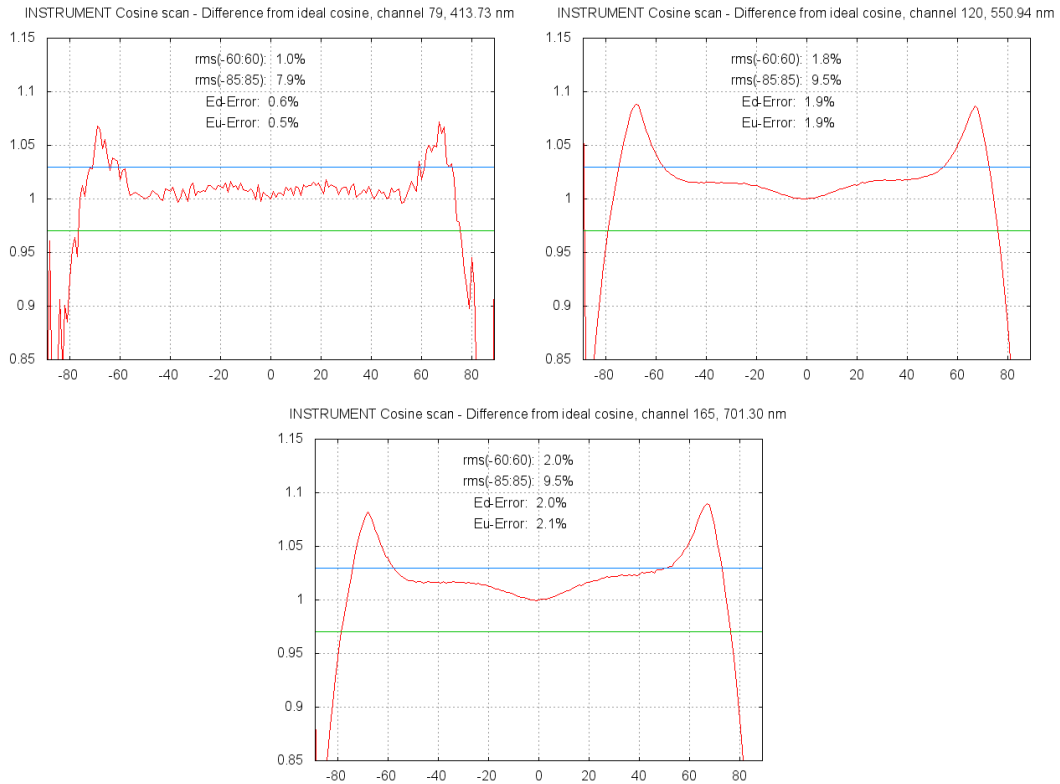
The increased error at the short wavelengths is primarily a result of noise due to low lamp UV output.



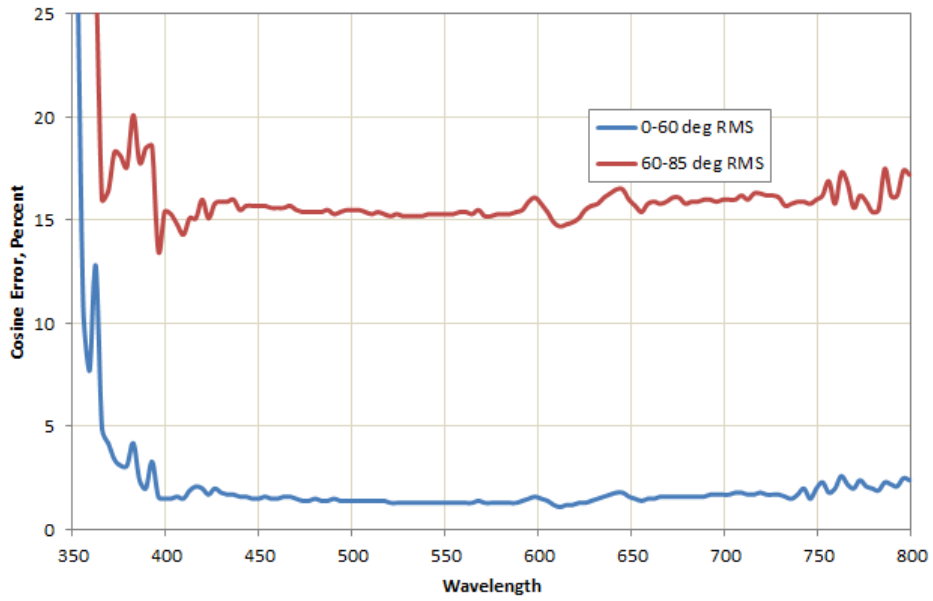
Scan 742, HOCR, HPE, sn 421



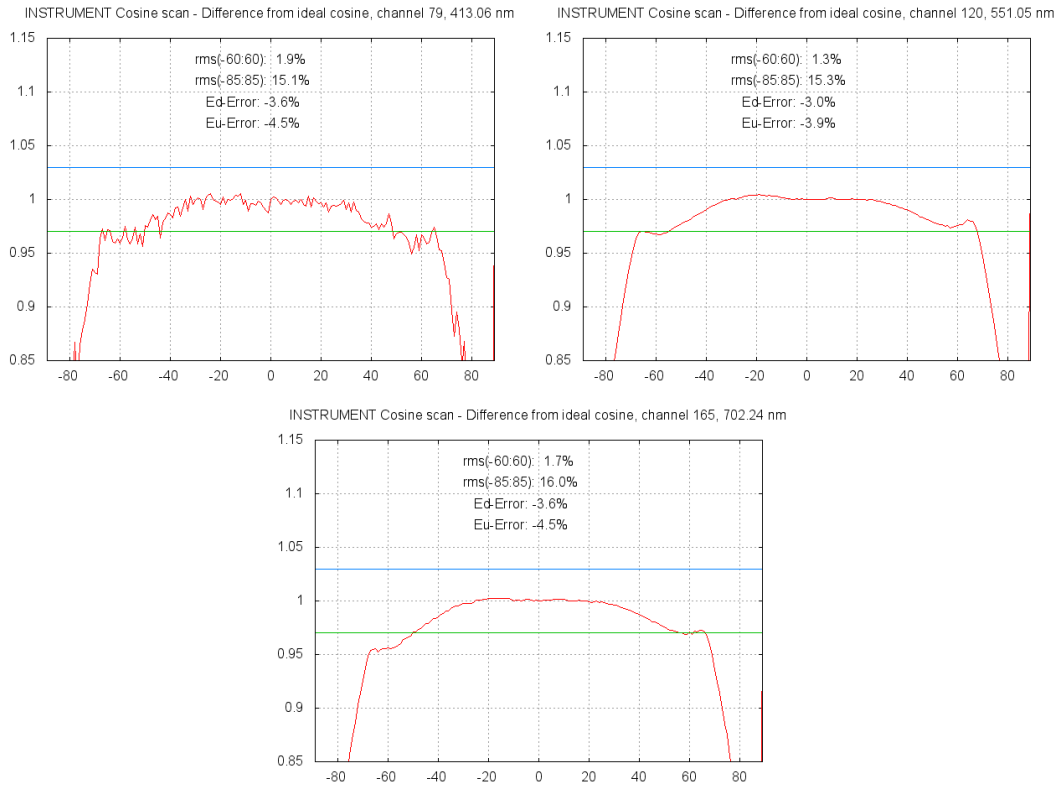
The increased error at the short wavelengths is primarily a result of noise due to low lamp UV output.

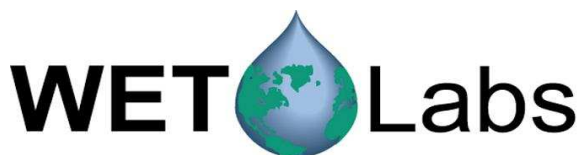


Scan 743, HOCR, HPE, sn 422



The increased error at the short wavelengths is primarily a result of noise due to low lamp UV output.





C-Star Calibration

Date **7.28.15** S/N# **CST-626PR** Pathlength **25cm**

Analog output

V_d **0.058 V**
V_{air} **4.752 V**
V_{ref} **4.661 V**

Temperature of calibration water **23.0 °C**
Ambient temperature during calibration **22.9 °C**

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x, in meters): **$Tr = e^{-cx}$**

To determine beam transmittance: **$Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$**

To determine beam attenuation coefficient: **$c = -1/x * \ln(Tr)$**

V_d Meter output with the beam blocked. This is the offset.

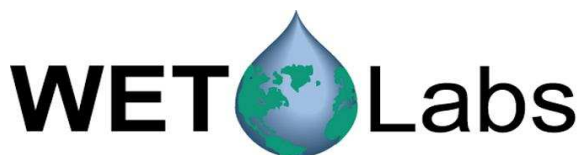
V_{air} Meter output in air with a clear beam path.

V_{ref} Meter output with clean water in the path.

Temperature of calibration water: temperature of clean water used to obtain **V_{ref}**.

Ambient temperature: meter temperature in air during the calibration.

V_{sig} Measured signal output of meter.



C-Star Calibration

Date **7.28.15** S/N# **CST-847PR** Pathlength **25cm**

Analog output

V_d **0.054 V**
 V_{air} **4.766 V**
 V_{ref} **4.663 V**

Temperature of calibration water **23.5 °C**
Ambient temperature during calibration **23.0 °C**

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x , in meters): $Tr = e^{-cx}$

To determine beam transmittance: $Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$

To determine beam attenuation coefficient: $c = -1/x * \ln(Tr)$

V_d Meter output with the beam blocked. This is the offset.

V_{air} Meter output in air with a clear beam path.

V_{ref} Meter output with clean water in the path.

Temperature of calibration water: temperature of clean water used to obtain V_{ref} .

Ambient temperature: meter temperature in air during the calibration.

V_{sig} Measured signal output of meter.

FLNTU Characterization Sheet

Date: July 28, 2015

S/N: FLNTUS-608

Chlorophyll Scale Factor

Chlorophyll concentration expressed in $\mu\text{g/l}$ can be derived using the equation:

$$\text{CHL } (\mu\text{g/l}) = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

	Analog		Digital	
Dark Counts	0.106	V	64	counts
Scale Factor (SF)	6	$\mu\text{g/l/V}$	0.0074	$\mu\text{g/l/count}$
Maximum Output	4.98	V	4119	counts
Resolution	0.8	mV	1.0	counts
Ambient temperature during calibration	23.0	$^{\circ}\text{C}$		

Nephelometric Turbidity Unit (NTU) Scale Factor

Turbidity units expressed in NTU can be derived using the equation:

$$\text{NTU} = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

	Analog		Digital	
Dark Counts	0.180	V	127	counts
NTU Solution Value	2.83	V	2327	counts
Scale Factor (SF)	2	NTU/V	0.0030	NTU/count
Maximum Output	4.98	V	4119	counts
Resolution	0.5	mV	1.0	counts
Ambient temperature during calibration	23.0	$^{\circ}\text{C}$		

Definition of terms:

Dark Counts: Signal output of the meter in clean water with black tape over detector.

NTU Solution Value: Signal output of the turbidity sensor when measuring a sample of interest.

SF (CHL): Determined using the following equation: $\text{SF} = x \div (\text{output} - \text{dark counts})$, where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

SF (NTU): Scale factor is determined using the following equation: $\text{SF} = \text{xx} \div (\text{Output} - \text{Dark counts})$, where xx is the value of a Formazin concentration. For example: $12.2 \div (2011 - 50) = 0.0062$.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: standard deviation of 1 minute of collected data.

FLNTU Characterization Sheet

Date: July 28, 2015

S/N: FLNTUS-609

Chlorophyll Scale Factor

Chlorophyll concentration expressed in $\mu\text{g/l}$ can be derived using the equation:

$$\text{CHL } (\mu\text{g/l}) = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

	Analog		Digital	
Dark Counts	0.113	V	60	counts
Scale Factor (SF)	7	$\mu\text{g/l/V}$	0.0085	$\mu\text{g/l/count}$
Maximum Output	4.97	V	4121	counts
Resolution	0.5	mV	1.0	counts
Ambient temperature during calibration	23.0	$^{\circ}\text{C}$		

Nephelometric Turbidity Unit (NTU) Scale Factor

Turbidity units expressed in NTU can be derived using the equation:

$$\text{NTU} = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

	Analog		Digital	
Dark Counts	0.157	V	109	counts
NTU Solution Value	3.22	V	2643	counts
Scale Factor (SF)	2	NTU/V	0.0026	NTU/count
Maximum Output	4.97	V	4070	counts
Resolution	0.6	mV	1.0	counts
Ambient temperature during calibration	23.0	$^{\circ}\text{C}$		

Definition of terms:

Dark Counts: Signal output of the meter in clean water with black tape over detector.

NTU Solution Value: Signal output of the turbidity sensor when measuring a sample of interest.

SF (CHL): Determined using the following equation: $\text{SF} = x \div (\text{output} - \text{dark counts})$, where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

SF (NTU): Scale factor is determined using the following equation: $\text{SF} = \text{xx} \div (\text{Output} - \text{Dark counts})$, where xx is the value of a Formazin concentration. For example: $12.2 \div (2011 - 50) = 0.0062$.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: standard deviation of 1 minute of collected data.



SEA-BIRD ELECTRONICS, INC.

13431 NE 20th Street Bellevue, Washington 98005 USA

Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	CNRS/LOV		
Job Number:	84284	Date of Report:	6/18/2015
Model Number	SBE 37SI	Serial Number:	37SI30260-2404

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' Performed Not Performed

Date: Drift since last cal: PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' Performed Not Performed

Date: Drift since Last cal: PSU/month*

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.



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Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	CNRS/LOV		
Job Number:	84284	Date of Report:	6/18/2015
Model Number	SBE 37SI	Serial Number:	37SI30260-2404

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION'

Performed Not Performed

Date:

Drift since last cal: Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR'

Performed Not Performed

Date:

Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 2404
CALIBRATION DATE: 18-Jun-15

SBE 37 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.063945e+000
h = 1.460937e-001
i = -1.115086e-004
j = 3.033822e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 2.7782e-007

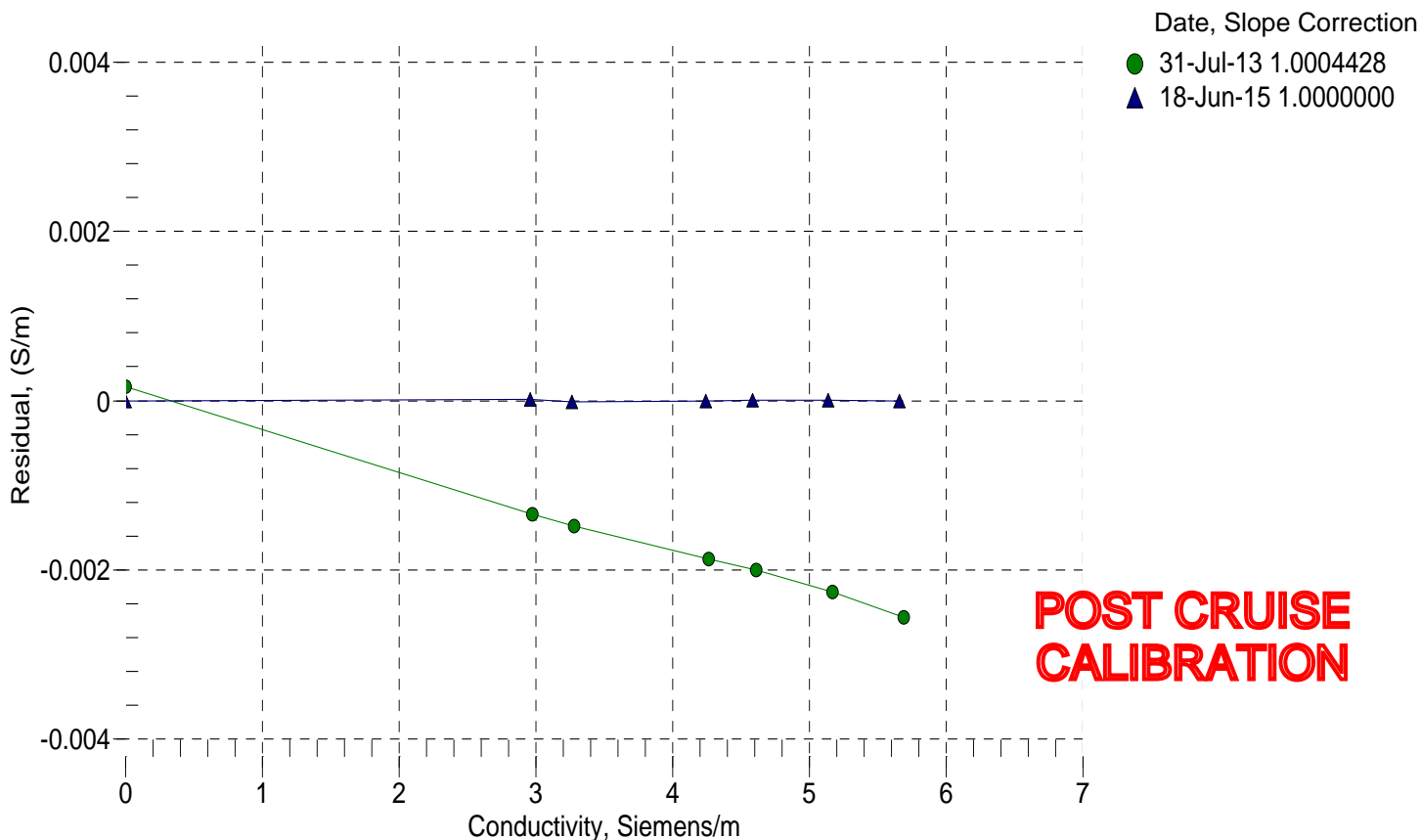
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2699.36	0.00000	0.00000
1.0000	34.6130	2.96024	5243.89	2.96025	0.00001
4.4999	34.5935	3.26576	5438.55	3.26575	-0.00001
15.0000	34.5505	4.24244	6018.06	4.24244	-0.00001
18.5000	34.5406	4.58572	6208.65	4.58573	0.00001
24.0000	34.5294	5.14064	6504.67	5.14065	0.00000
29.0000	34.5225	5.65959	6769.49	5.65958	-0.00000
32.5001	34.5182	6.02987	6952.08	6.02980	-0.00007

$$f = \text{INST FREQ} * \text{sqrt}(1.0 + \text{WBOTC} * t) / 1000.0$$

$$\text{Conductivity} = (g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \epsilon * p) \text{ Siemens / meter}$$

$$t = \text{temperature} [^{\circ}\text{C}]; p = \text{pressure} [\text{decibars}]; \delta = \text{CTcor}; \epsilon = \text{CPcor};$$

$$\text{Residual} = \text{instrument conductivity} - \text{bath conductivity}$$



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Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 2404
CALIBRATION DATE: 16-Jun-15

SBE 37 PRESSURE CALIBRATION DATA
FSR: 44 psia S/N 1097

COEFFICIENTS:

PA0 = 4.683072e-003
PA1 = 2.081233e-003
PA2 = -2.008896e-010

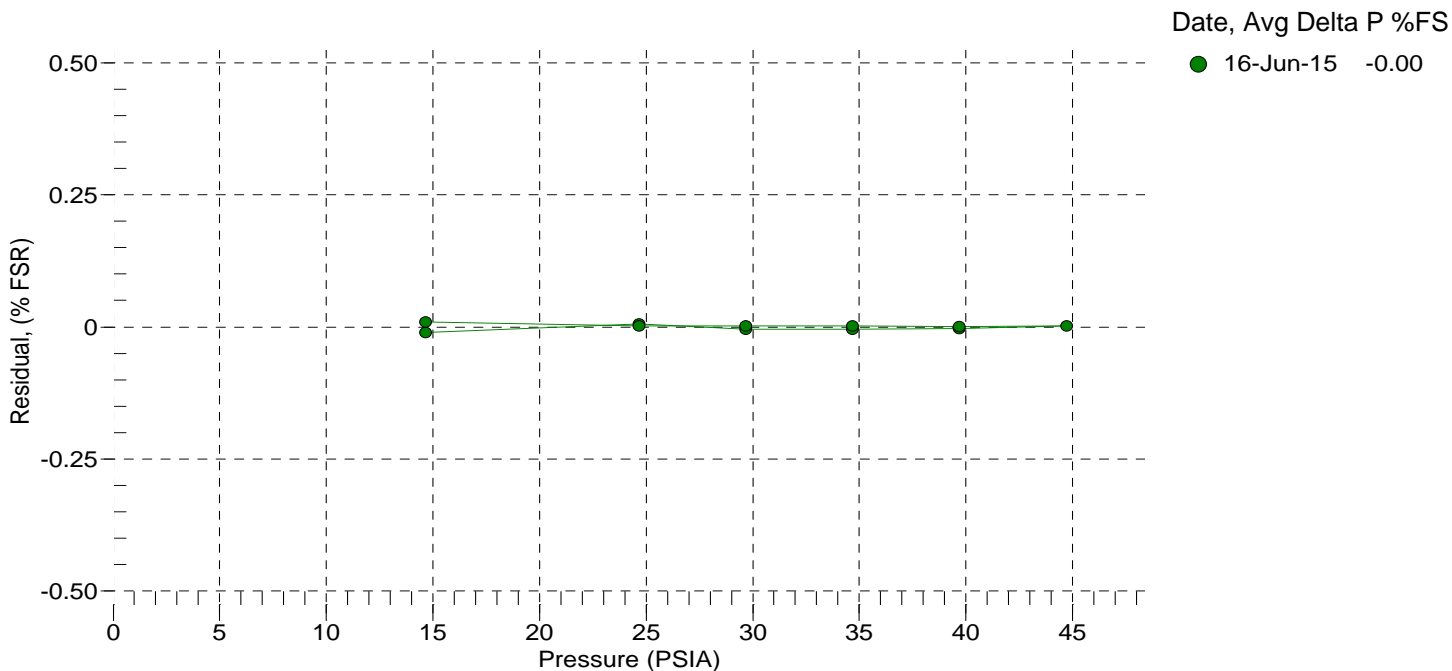
PTCA0 = 6.911580e+001
PTCA1 = -2.357601e-001
PTCA2 = 1.418358e-002
PTCB0 = 2.493275e+001
PTCB1 = -2.500000e-004
PTCB2 = 0.000000e+000

PRESSURE SPAN CALIBRATION					THERMAL CORRECTION	
PRESSURE PSIA	INST OUTPUT	TEMP ITS90	COMPUTED PRESSURE	ERROR %FS	TEMP ITS90	INST OUTPUT
14.66	7113.6	23.4	14.65	-0.01	32.50	7383.65
24.66	11930.6	23.6	24.66	0.01	29.00	7384.90
29.68	14346.3	23.6	29.68	-0.00	24.00	7385.59
34.68	16754.6	23.6	34.68	-0.00	18.50	7373.18
39.69	19169.9	23.6	39.69	-0.00	15.00	7379.11
44.71	21593.2	23.6	44.71	0.00	4.50	7378.51
39.69	19169.6	23.6	39.69	0.00	1.00	7377.92
34.69	16759.4	23.6	34.69	0.00		
29.68	14345.3	23.7	29.68	0.00	TEMP (ITS90)	SPAN (mV)
24.68	11939.4	23.8	24.68	0.00	-5.00	24.93
14.66	7117.9	23.8	14.66	0.01	35.00	24.92

$$x = \text{pressure output} - \text{PTCA0} - \text{PTCA1} * t - \text{PTCA2} * t^2$$

$$n = x * \text{PTCB0} / (\text{PTCB0} + \text{PTCB1} * t + \text{PTCB2} * t^2)$$

$$\text{pressure (psia)} = \text{PA0} + \text{PA1} * n + \text{PA2} * n^2$$



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SENSOR SERIAL NUMBER: 2404
CALIBRATION DATE: 18-Jun-15

SBE 37 RTC CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

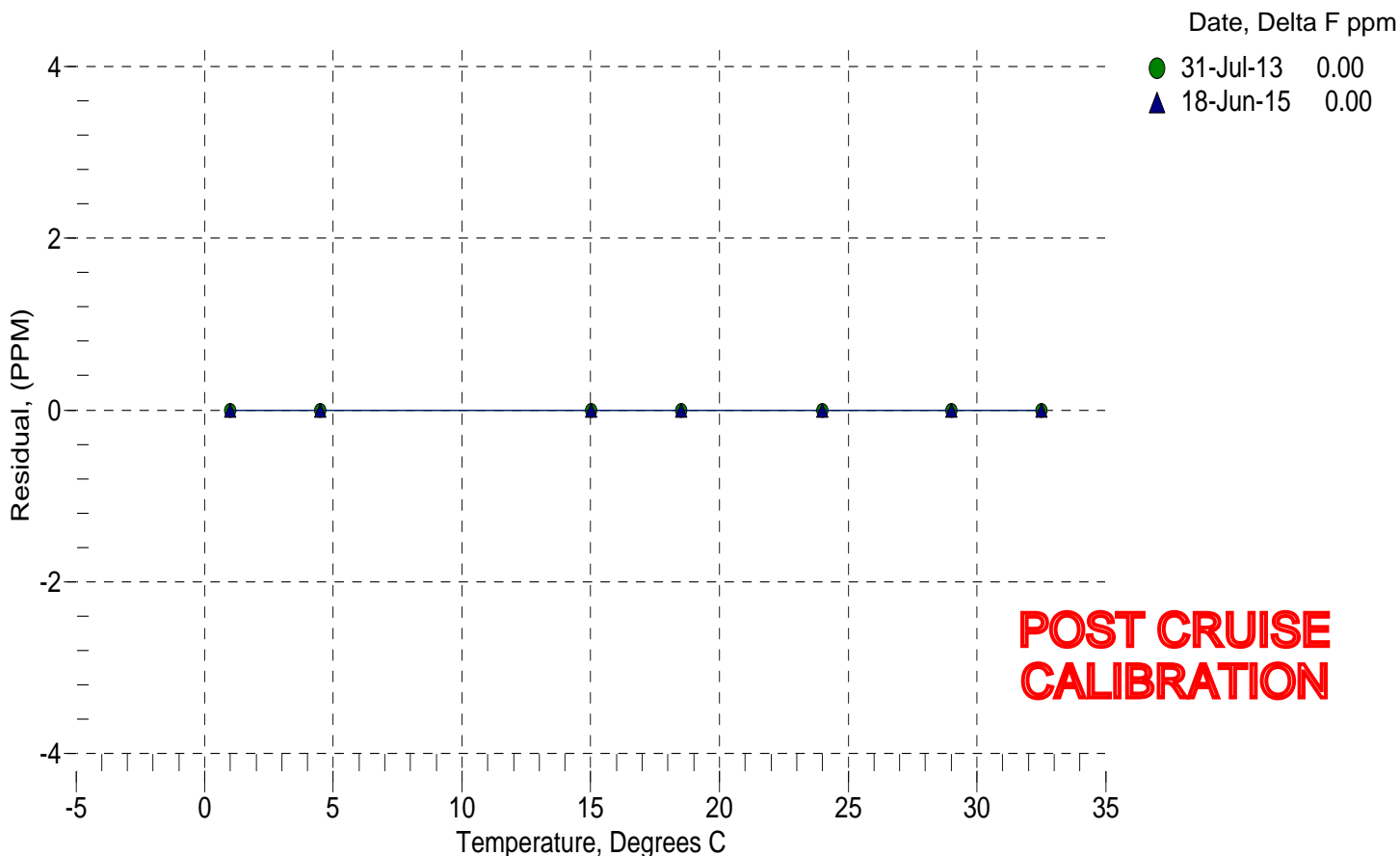
COEFFICIENTS:

rtca0 = 1.000000e+000
rtca1 = 0.000000e+000
rtca2 = -0.000000e+000

BATH TEMP (ITS-90)	RTC FREQ (Hz)	COMPUTED FREQ (Hz)	RESIDUAL (PPM)
1.0000	1.0000000	1.0000000	0.0
4.4999	1.0000000	1.0000000	0.0
15.0000	1.0000000	1.0000000	0.0
18.5000	1.0000000	1.0000000	0.0
24.0000	1.0000000	1.0000000	0.0
29.0000	1.0000000	1.0000000	0.0
32.5001	1.0000000	1.0000000	0.0

$$\text{RTC frequency} = \text{rtca0} + \text{rtca1} * t + \text{rtca2} * t^2$$

$$\text{Residual} = (\text{Computed RTC frequency} - \text{Measured RTC frequency}) * 1e6$$



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SENSOR SERIAL NUMBER: 2404
CALIBRATION DATE: 18-Jun-15

SBE 37 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

COEFFICIENTS:

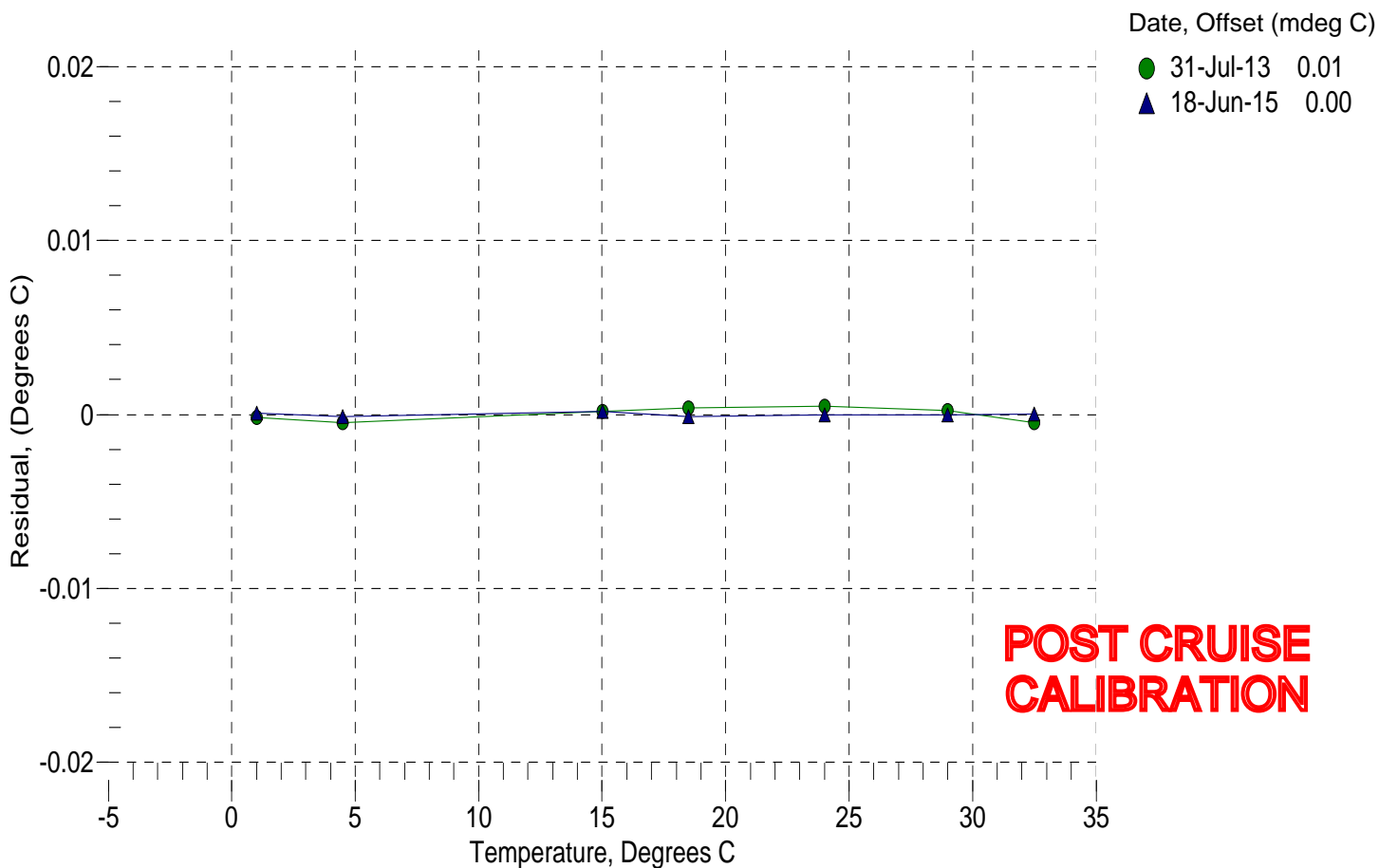
a0 = 1.973898e-005
a1 = 2.617870e-004
a2 = -1.399482e-006
a3 = 1.272681e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	823583.5	1.0001	0.0001
4.4999	704317.7	4.4998	-0.0001
15.0000	449096.3	15.0002	0.0002
18.5000	388930.3	18.4999	-0.0001
24.0000	312068.7	24.0000	-0.0000
29.0000	256997.1	29.0000	-0.0000
32.5001	225071.7	32.5001	0.0000

Temperature ITS-90 = $1 / \{ a_0 + a_1[\ln(n)] + a_2[\ln^2(n)] + a_3[\ln^3(n)] \} - 273.15$ (°C)

Residual = instrument temperature - bath temperature

n = instrument output





Hobi Instrument Services

HydroScat-4 Calibration Certificate

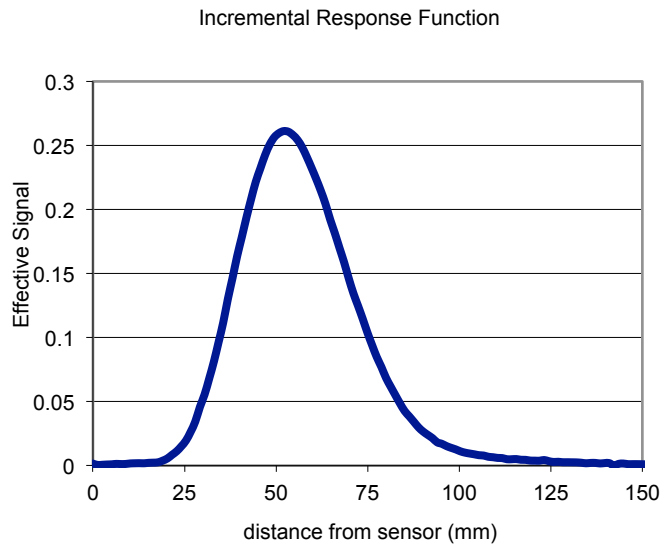
Cert Date: **September 13, 2015**

Serial Number: **H4080705**

Configuration: **B0**

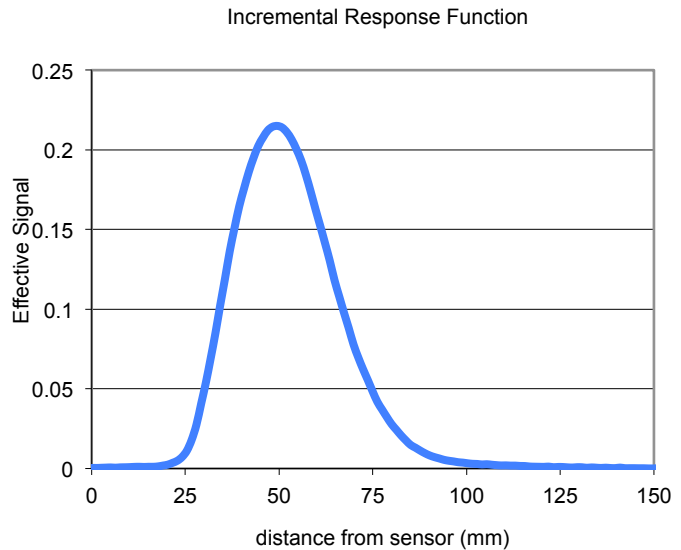
Channel 1: bb442

mu:	33.96	
mu Rho:	1.1	
SigmaExp:	0.116	
Temp Coeff:	0.00173	
	Gain Factor Dark Offset	
Gain 1:	1.000	11
Gain 2:	9.616	9
Gain 3:	94.473	10
Gain 4:	847.13	14
Gain 5:	9538.9	15



Channel 2: bb488

mu:	45.78	
mu Rho:	1.1	
SigmaExp:	0.109	
Temp Coeff:	-0.0006	
	Gain Factor Dark Offset	
Gain 1:	1.000	22
Gain 2:	9.660	23
Gain 3:	95.789	23
Gain 4:	869.51	8
Gain 5:	9794.3	-123





Hobi Instrument Services

HydroScat-4 Calibration Certificate

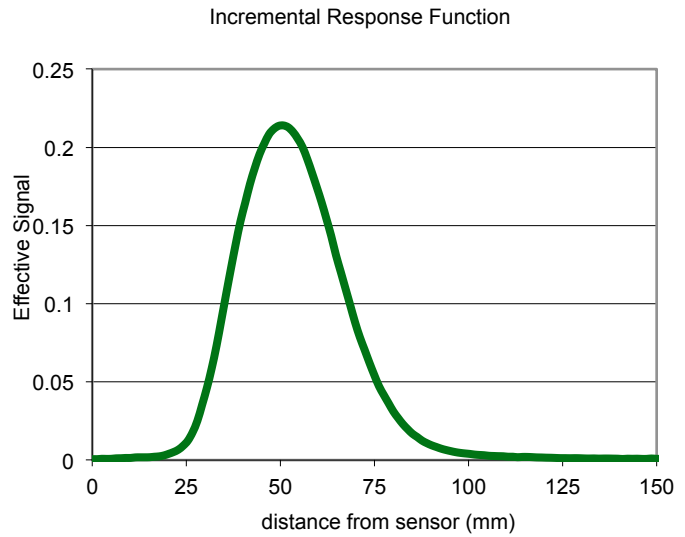
Cert Date: **September 13, 2015**

Serial Number: **H4080705**

Configuration: **B0**

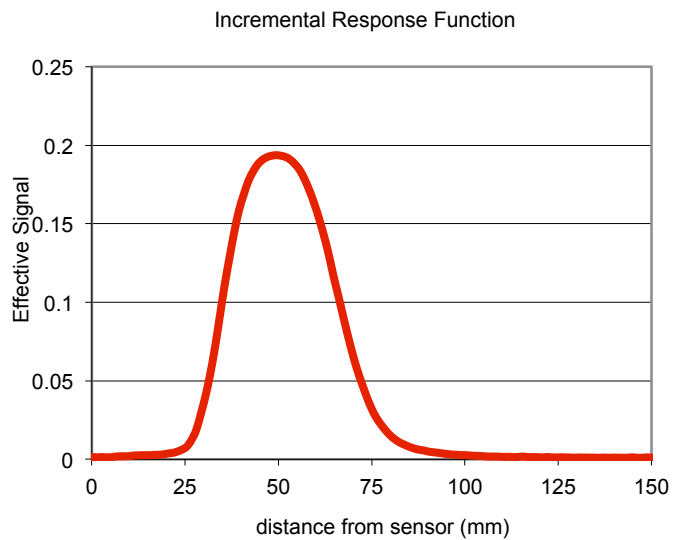
Channel 4: bb550

mu:	45.73	
mu Rho:	1.1	
SigmaExp:	0.111	
Temp Coeff:	0.00048	
	Gain Factor Dark Offset	
Gain 1:	1.000	5
Gain 2:	9.530	6
Gain 3:	93.399	5
Gain 4:	842.27	2
Gain 5:	9073.8	-241



Channel 5: bb620

mu:	51.39	
mu Rho:	1.1	
SigmaExp:	0.107	
Temp Coeff:	-0.0107	
	Gain Factor Dark Offset	
Gain 1:	1.000	30
Gain 2:	9.649	30
Gain 3:	95.370	30
Gain 4:	875.36	24
Gain 5:	9724.1	-57





Hobi Instrument Services

Cert Date: **September 13, 2015**

Serial Number: **H4080705**

Configuration: **B0**

Depth Cal Date **9/13/15**

Depth Calibration

Coefficient:

0.0129

meter (sea water)/count

Offset:

29.0

meters (sea water)

$R^2 = 1.000$

Pressure Transducer Response

