

# Appendice H

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## MATERIALI E METODI

I dati utilizzati per le elaborazioni si riferiscono al periodo 2009-2019 e sono relativi alle misure di portata (mq/s) effettuate con cadenza per lo più semestrale e misurate nei periodi di massima ricarica della falda e di minimo livello su tutti i corpi idrici della regione Marche.

Per ogni stazione di monitoraggio che presentava un numero minimo di misurazioni maggiore o uguale a 5 sono state calcolate le statistiche descrittive quali la media, il valore minimo e massimo, il 25° e il 75° percentile e il coefficiente di variazione (%), utile per il confronto del grado di variabilità di ciascun punto.

La tendenza dei livelli di ogni singola stazione è stata stimata attraverso una regressione lineare dei dati della serie storica, con la stima del coefficiente angolare della retta di regressione (espressa in mq/s) e il relativo coefficiente di determinazione  $R^2$ ; l'entità della pendenza della retta (con i rispettivi intervalli di confidenza) è stata rappresentata graficamente per ogni punto di campionamento.

A causa dell'esiguo numero di osservazioni presenti nel Sistema Informativo Arpam la componente tendenziale temporale è stata verificata utilizzando il test non parametrico di Mann-Kendall ad un livello di significatività del 90%; tale test ha il vantaggio di poter essere utilizzato anche in caso di dati mancanti nella serie temporale ed è robusto rispetto alla presenza di eventuali outliers; inoltre, trattandosi di un test non parametrico, non è necessario che l'insieme campionario della serie temporale della variabile di interesse segua una determinata distribuzione statistica.

Le analisi statistiche sono state effettuate utilizzando i software Sas System v.9.3 e ProUCL v.5.0 (2).

## ELENCO STAZIONI DI MISURA DELLA PORTATA

**Tabella 1. Statistiche descrittive, regressione lineare dei dati, Indice di determinazione lineare  $R^2$ , test di Mann-Kendall (livello di significatività: 90%) per stazione di campionamento. Alcune stazioni non presentano trend in quanto non hanno un numero di osservazioni sufficiente ( $\geq 5$ ) per elaborazioni statistiche.**

Stazione	CIS	Periodo di osservazione	N oss	Media	Coeff di variazione	Coeff Angolare retta regressione	R 2	p-value *	Trend significativo
060004_MC	C_CA_CIN	-	3	-	-	-	-	-	-
060054_AN	C_CA_DOM	2012-2019	5	1.9	65.5	-0.0008	0.403	0.592	No
060115_AN	C_CA_DOM	2013-2019	9	5.3	43.6	0.0000	0.000	0.460	No
060137_AN	C_CA_DOM	2013-2019	8	16.5	58.9	0.0038	0.086	0.548	No
060053_AN	C_CA_DOM	-	1	-	-	-	-	-	-
060143_AN	C_CA_DOM	2009-2019	6	2.2	45.4	-0.0008	0.306	0.136	No
060167_AN	C_CA_DOM	2012-2019	10	2.3	58.5	-0.0004	0.089	0.242	No
060129_MC	C_CA_DOM	2012-2015	7	1.2	146.3	-0.0015	0.111	0.191	No
060088_AN	C_CA_DOM	2012-2017	9	1.8	46.9	0.0001	0.004	0.460	No
060162_AN	C_CA_DOM	-	4	-	-	-	-	-	-
060012_MC	C_CA_DOM	-	1	-	-	-	-	-	-
060002_MC	C_CA_DOM	-	3	-	-	-	-	-	-
060243_AN	C_CA_DOM	-	3	-	-	-	-	-	-
070373_MC	C_CA_DOM	-	4	-	-	-	-	-	-
070244_AN	C_CA_DOM	-	1	-	-	-	-	-	-
060098_AN	C_CA_DOM	2013-2019	9	2.2	59.2	0.0011	0.472	0.130	No
060228_PS	CA_CES	2010-2019	18	7.6	53.6	-0.0002	0.003	0.327	No
060133_PS	CA_CES	2014-2019	6	12.5	58.1	-0.0042	0.169	0.235	No

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Stazione	CIS	Periodo di osservazione	N oss	Media	Coeff di variazione	Coeff Angolare retta regressione	R 2	p-value *	Trend significativo
060227_PS	CA_CES	2010-2019	17	8.1	66.4	0.0004	0.005	0.516	No
070010_AN	CA_CON	-	1	-	-	-	-	-	-
060160_PS	CA_CUC_1	2009-2019	13	5.8	97.6	-0.0027	0.274	0.029	Decrescente
060109_AN	CA_CUC_2	2009-2019	10	3.6	53.3	0.0006	0.046	0.300	No
060188_AN	CA_FRA	2013-2019	8	5.6	36.3	-0.0003	0.011	0.274	No
060241_AN	CA_FRA	2013-2017	5	3.4	33.5	0.0005	0.103	0.592	No
060119_AN	CA_MAG	2013-2019	11	3.8	49.3	0.0004	0.021	0.141	No
060123_AN	CA_MAG_1	2013-2019	6	52.0	45.2	0.0085	0.081	0.500	No
060102_MC	CA_MAG_2	2012-2016	7	0.9	4.1	0.0000	0.016	0.119	No
060245_PS	CA_NAR	2011-2019	7	1.2	54.4	-0.0004	0.283	0.119	No
060138_MC	CA_NES_1	2010-2016	8	1.9	77.6	0.0002	0.011	0.452	No
060188_MC	CA_NES_1	2010-2016	8	52.8	39.4	-0.0090	0.118	0.089	Decrescente
060262_MC	CA_NES_1	2012-2016	6	10.3	5.0	0.0004	0.198	0.136	No
060329_MC	CA_NES_1	2012-2016	8	151.2	2.1	-0.0002	0.001	0.548	No
060064_MC	CA_NES_1	-	1	-	-	-	-	-	-
060299_MC	CA_NES_1	-	4	-	-	-	-	-	-
060172_MC	CA_NES_1	-	4	-	-	-	-	-	-
060103_AP	CA_NES_2	-	2	-	-	-	-	-	-
060221_AP	CA_NES_2	-	2	-	-	-	-	-	-
060007_PS	CA_PIE	2010-2019	9	1.0	47.0	-0.0002	0.256	0.179	No
060132_PS	CA_PIE	2010-2019	12	19.3	42.4	0.0007	0.009	0.527	No
060622_PS	CA_PIE	2013-2019	13	15.1	71.0	-0.0087	0.377	0.015	Decrescente
060521_PS	CA_PIE	2013-2019	11	1.2	34.2	-0.0004	0.437	0.082	Decrescente
060303_PS	CA_PIE	-	3	-	-	-	-	-	-
060105_AN	CA_UMM	2009-2019	11	5.9	17.9	0.0004	0.073	0.223	No
060194_AN	CA_UMM	2009-2019	11	3.6	65.6	0.0001	0.000	0.381	No
060102_AN	CA_UMM	2013-2019	8	4.9	42.7	0.0002	0.004	0.548	No
060103_AN	CA_UMM	2013-2019	5	13.7	96.7	-0.0014	0.011	0.408	No
060123_MC	CA_UMM	2012-2016	9	3.2	81.0	0.0002	0.002	0.540	No
060120_MC	CA_UMM_1	2012-2016	7	1.5	0.0	n.c.	n.c.	0.500	No
060050_MC	CA_UMM_1	2012-2016	8	4.9	83.8	-0.0054	0.475	0.031	Decrescente
060150_MC	CA_UMM_1	2010-2016	9	53.1	80.4	-0.0080	0.019	0.460	No
060110_MC	CA_UMM_1	2010-2016	8	4.1	60.1	0.0018	0.259	0.274	No
060113_MC	CA_UMM_1	2010-2016	8	1.2	100.9	-0.0014	0.753	0.119	No
060045_MC	CA_UMM_1	2012-2016	7	7.6	80.2	-0.0039	0.135	0.191	No
060236_MC	CA_UMM_1	2010-2016	9	4.2	30.8	-0.0003	0.029	0.460	No
060103_MC	CA_UMM_1	2010-2016	7	1.1	122.1	-0.0015	0.698	0.191	No
060241_MC	CA_UMM_1	2010-2016	9	12.3	35.3	-0.0026	0.167	0.238	No
060167_MC	CA_UMM_1	-	4	-	-	-	-	-	-
060057_MC	CA_UMM_1	-	1	-	-	-	-	-	-
060028_PS	CA_UMS	2011-2019	5	2.4	69.7	0.0003	0.050	0.592	No
060083_PS	CA_UMS	2009-2019	16	3.5	56.2	0.0002	0.014	0.175	No
060082_PS	CA_UMS	2010-2019	12	6.8	100.6	0.0020	0.097	0.420	No
060239_PS	CA_UMS	2009-2019	14	2.4	77.0	0.0004	0.043	0.165	No
070347_PS	CA_UMS	2009-2019	14	30.5	41.9	0.0047	0.141	0.079	Crescente
060038_AN	CA_UMS	2013-2017	6	1.2	35.0	0.0003	0.229	0.235	No
060161_PS	CA_UMS	2009-2019	16	5.5	94.8	-0.0001	0.001	0.282	No

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Stazione	CIS	Periodo di osservazione	N oss	Media	Coeff di variazione	Coeff Angolare retta regressione	R 2	p-value *	Trend significativo
060222_PS	CA_UMS	2010-2019	6	0.8	47.0	-0.0002	0.361	0.068	Decrescente
060014_AN	CA_UMS	2013-2019	9	2.3	47.4	0.0002	0.013	0.238	No
060233_PS	CA_UMS	2009-2019	12	1.7	78.2	0.0002	0.029	0.420	No
060242_AN	CA_UMS	2009-2019	9	5.1	64.5	0.0011	0.067	0.460	No
060242_PS	CA_UMS	2010-2019	8	13.0	69.8	0.0012	0.024	0.452	No
060017_PS	CA_UMS	2009-2019	12	2.9	47.3	0.0004	0.069	0.473	No
060015_AN	CA_UMS	2009-2019	9	7.1	33.1	-0.0006	0.038	0.238	No
060336_MC	E_CA_DOM	2013-2015	6	2.1	44.0	-0.0007	0.064	0.360	No
060133_AP	E_CA_DOM	-	2	-	-	-	-	-	-
060132_AP	E_CA_DOM	-	1	-	-	-	-	-	-
060333_MC	E_CA_DOM	2012-2016	9	21.6	35.7	-0.0013	0.008	0.540	No
060046_AP	E_CA_DOM	-	1	-	-	-	-	-	-
060230_MC	E_CA_DOM	2011-2016	9	59.7	36.7	0.0020	0.003	0.460	No
060040_MC	E_CA_DOM	2011-2016	9	4.0	62.7	-0.0007	0.035	0.381	No
060027_MC	E_CA_DOM	2012-2016	9	34.0	16.0	0.0014	0.016	0.381	No
070185_MC	E_CA_DOM	2013-2016	5	14.2	45.2	0.0079	0.353	0.408	No
060096_MC	E_CA_DOM	2012-2016	9	7.1	72.3	-0.0044	0.186	0.238	No
060215_MC	E_CA_DOM	2010-2015	7	17.6	63.4	-0.0034	0.048	0.281	No
060159_MC	E_CA_DOM	2010-2016	7	14.7	108.3	-0.0087	0.093	0.500	No
060400_MC	E_CA_DOM	2013-2015	5	6.8	45.8	0.0082	0.556	0.242	No
060100_PS	LOC_BMU	-	1	-	-	-	-	-	-
060263_PS	LOC_BMU	2011-2019	6	1.0	63.7	-0.0002	0.122	0.136	No
070161_PS	LOC_BMU	-	1	-	-	-	-	-	-
060124_PS	LOC_CMC	-	1	-	-	-	-	-	-
060349_PS	LOC_CMC	2010-2019	15	2.6	95.7	-0.0010	0.140	0.008	Decrescente
060367_PS	LOC_CMC	2013-2019	11	3.1	62.2	-0.0007	0.095	0.141	No
060080_PS	LOC_CMC	2010-2019	16	2.1	84.6	0.0003	0.034	0.378	No
060621_PS	LOC_DVP	2013-2019	12	2.3	51.3	-0.0011	0.496	0.010	Decrescente
060083_AP	LOC_LAG	-	3	-	-	-	-	-	-
060137_AP	LOC_LAG	-	2	-	-	-	-	-	-
060077_AP	LOC_LAG	2014-2017	5	1.1	16.6	-0.0003	0.484	0.242	No
060086_AP	LOC_LAG	-	2	-	-	-	-	-	-
060134_AP	LOC_LAG	-	2	-	-	-	-	-	-
060131_AP	LOC_LAG	-	2	-	-	-	-	-	-
060128_AP	LOC_LAG	-	2	-	-	-	-	-	-
060104_AP	LOC_LAG	2014-2017	5	7.9	22.1	-0.0001	0.000	0.408	No
060109_AP	LOC_LAG	-	3	-	-	-	-	-	-
060135_AP	LOC_LAG	-	3	-	-	-	-	-	-
060100_AP	LOC_LAG	-	3	-	-	-	-	-	-
060136_AP	LOC_LAG	2014-2017	5	1.1	12.9	-0.0003	0.807	0.242	No
060237_PS	LOC_MAM	2009-2019	8	1.4	37.6	0.0002	0.450	0.138	No
060220_PS	LOC_MAM	2010-2019	16	2.6	94.2	0.0001	0.001	0.345	No
060250_PS	LOC_MAM	2009-2019	14	28.1	32.7	0.0028	0.109	0.415	No
060458_PS	LOC_MAM	2010-2019	7	0.8	47.9	-0.0002	0.660	0.068	Decrescente
060503_PS	LOC_MAM	2009-2019	8	1.3	53.6	-0.0002	0.028	0.548	No
060241_PS	LOC_MAM	2010-2019	10	1.6	44.2	0.0000	0.000	0.500	No
060063_PS	LOC_MAM	2015-2019	5	1.4	63.9	0.0000	0.000	0.592	No

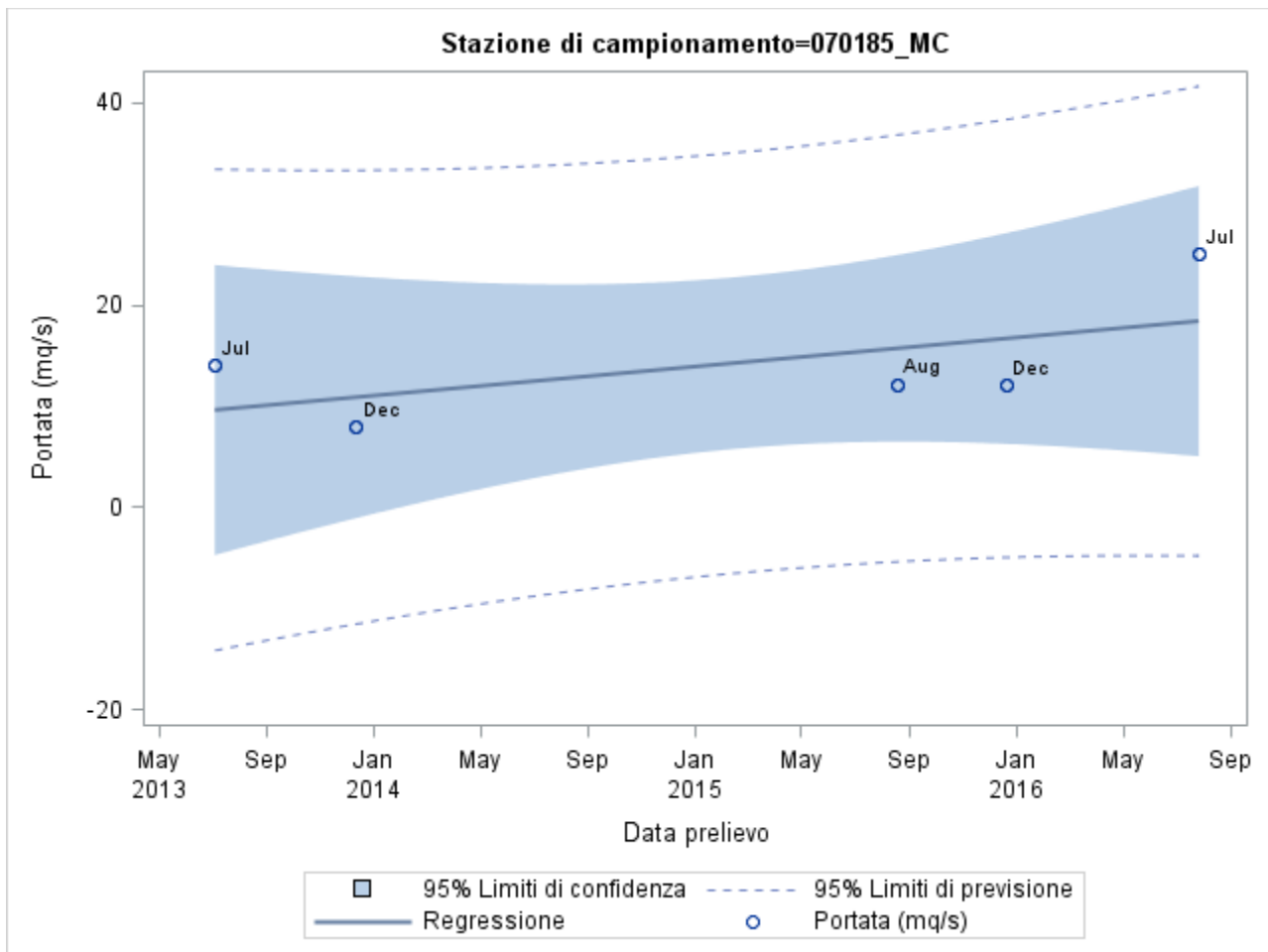
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Stazione	CIS	Periodo di osservazione	N oss	Media	Coeff di variazione	Coeff Angolare retta regressione	R 2	p-value *	Trend significativo
060061_PS	LOC_MAM	-	2	-	-	-	-	-	-

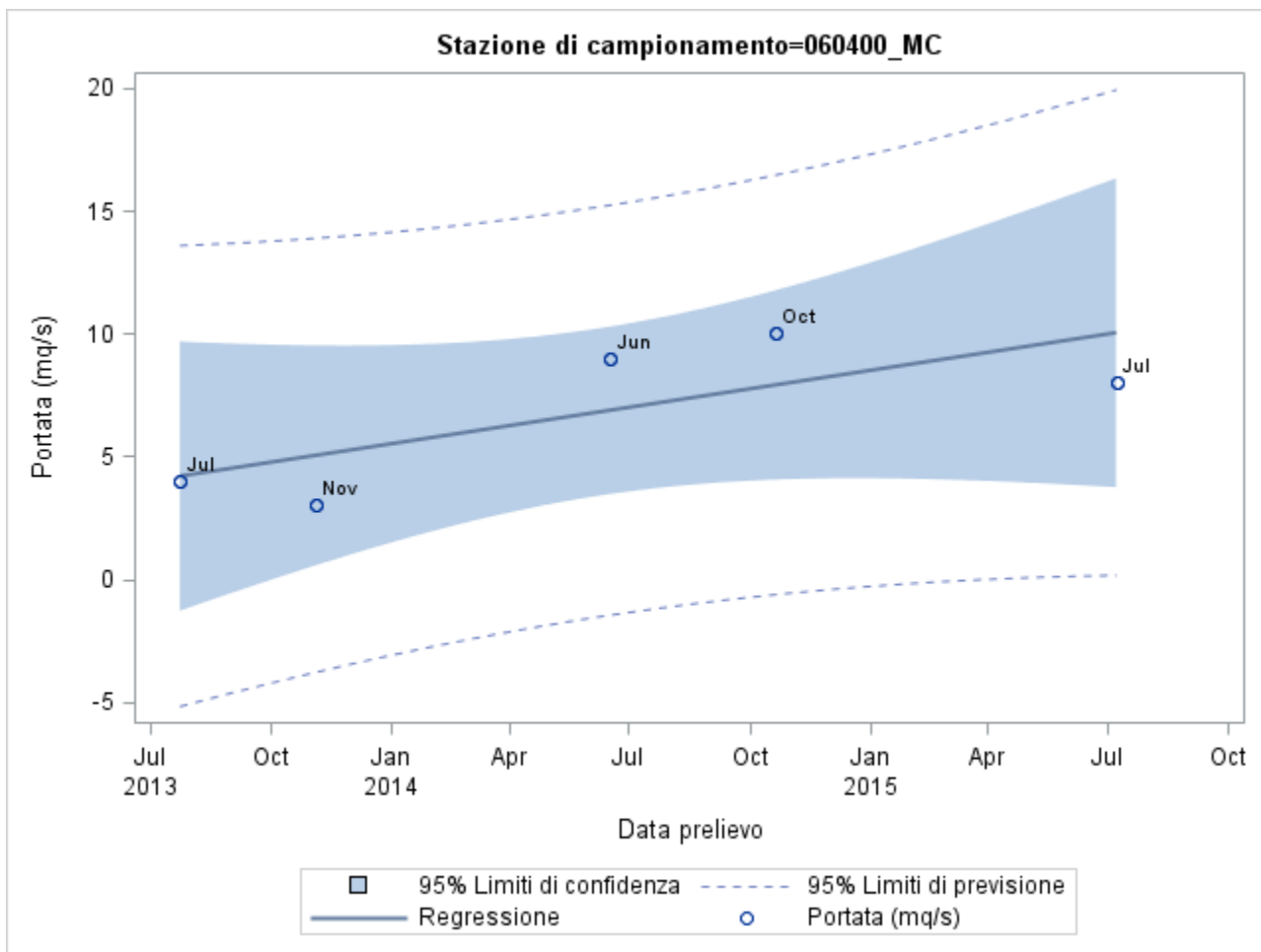
\* Test di Mann-Kendall per il calcolo delle tendenze significative, livello di confidenza 90%

## UNITÀ DI BILANCIO/ACQUIFERO CALCARI

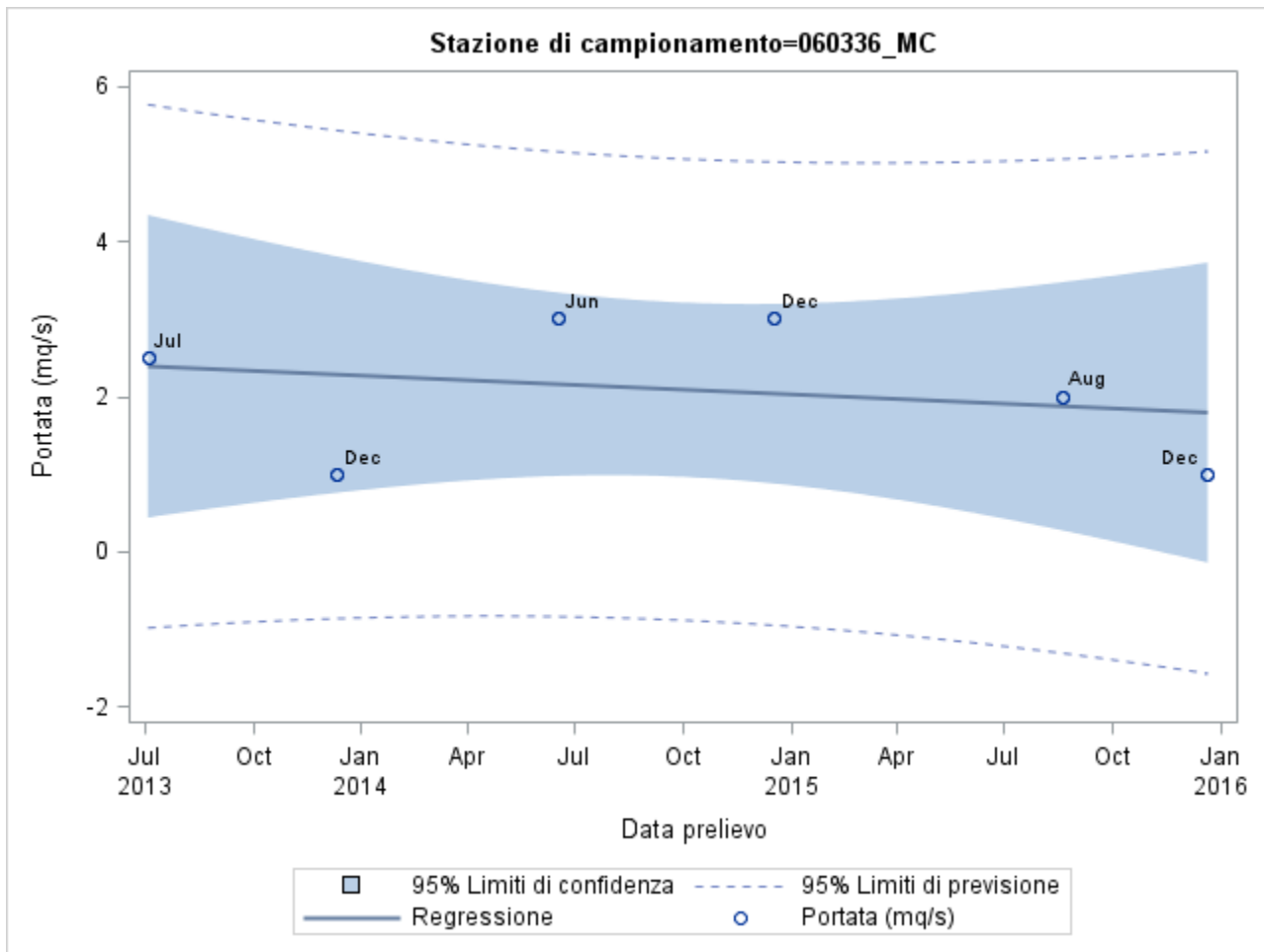
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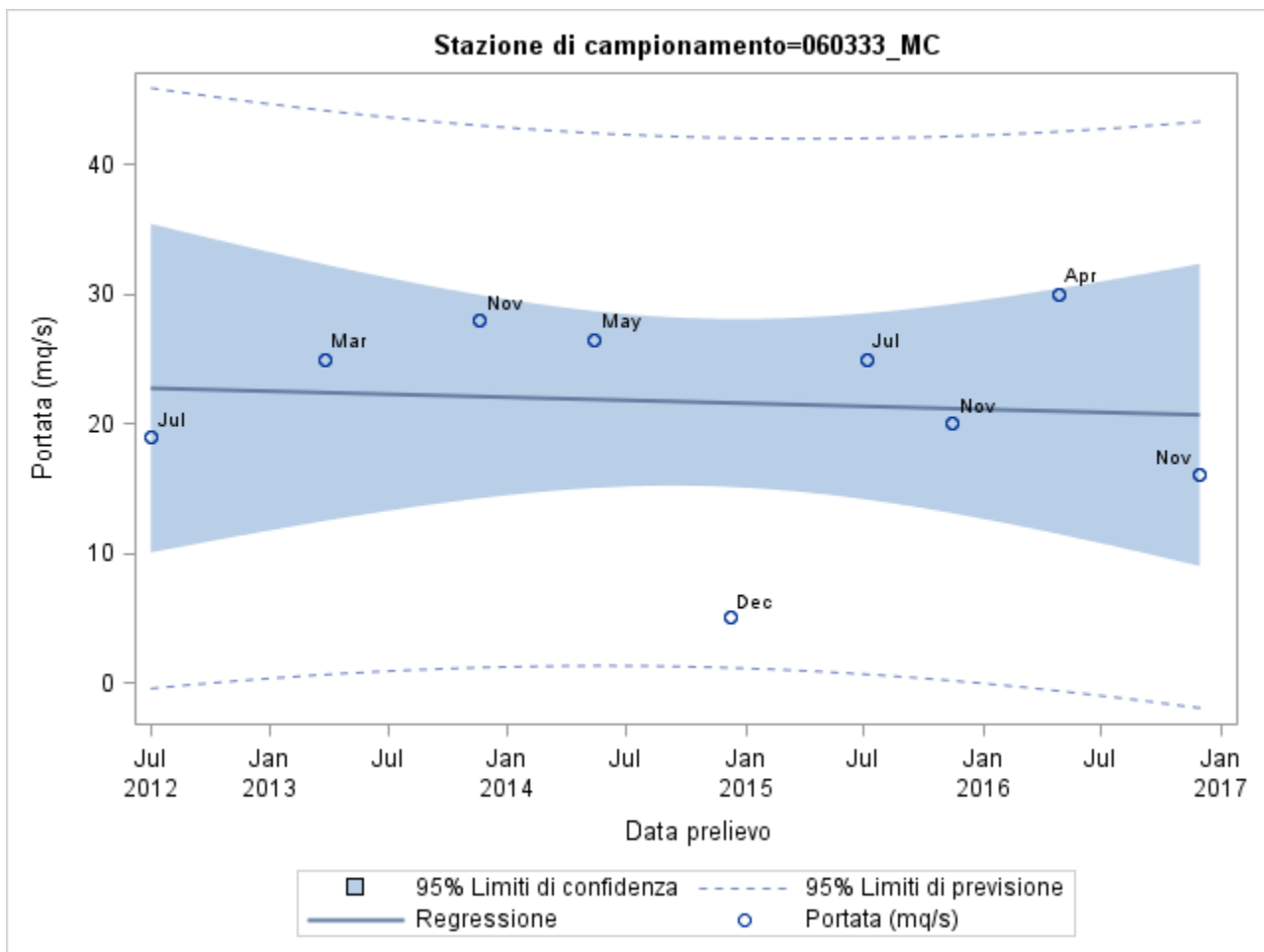
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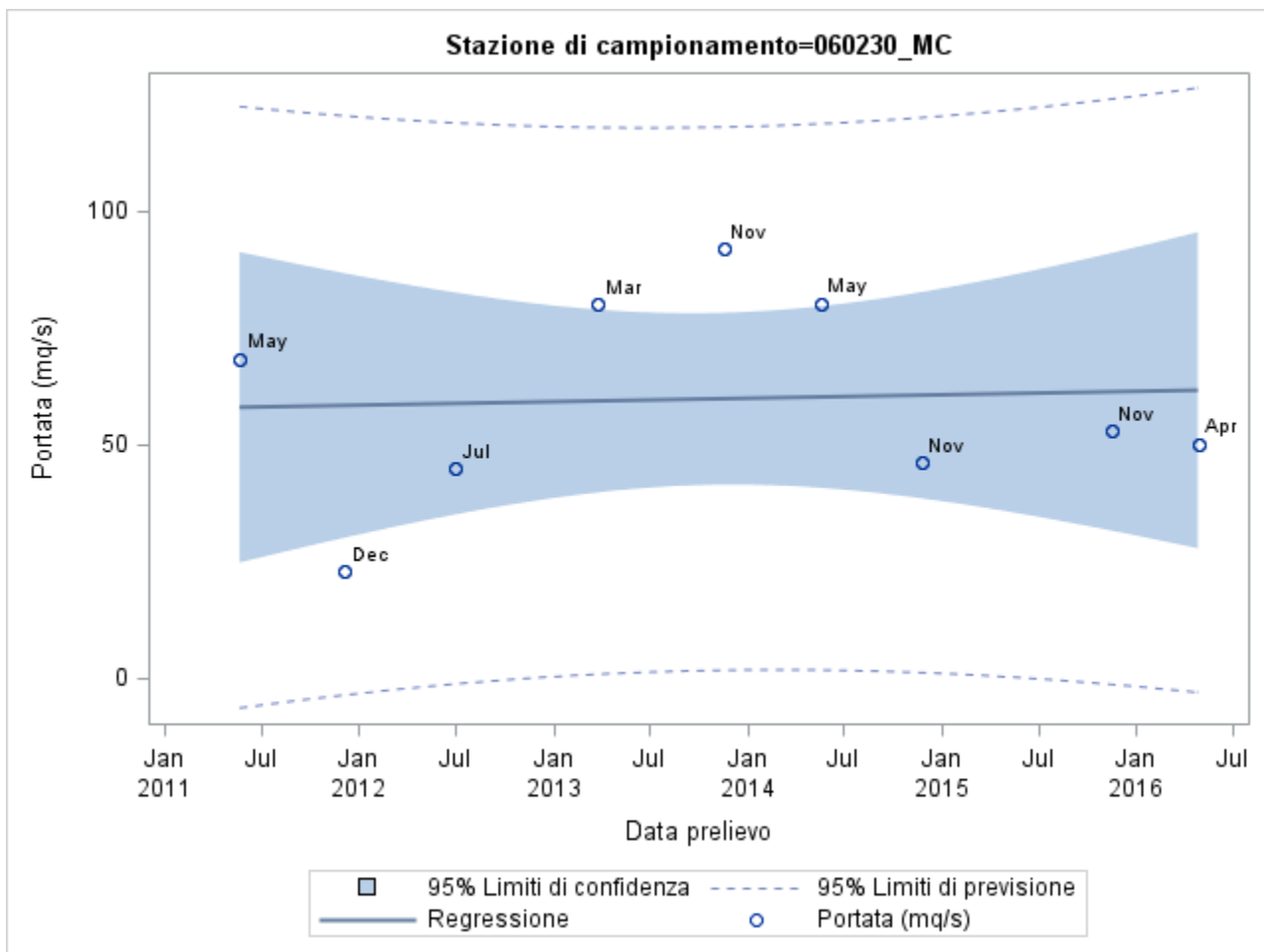


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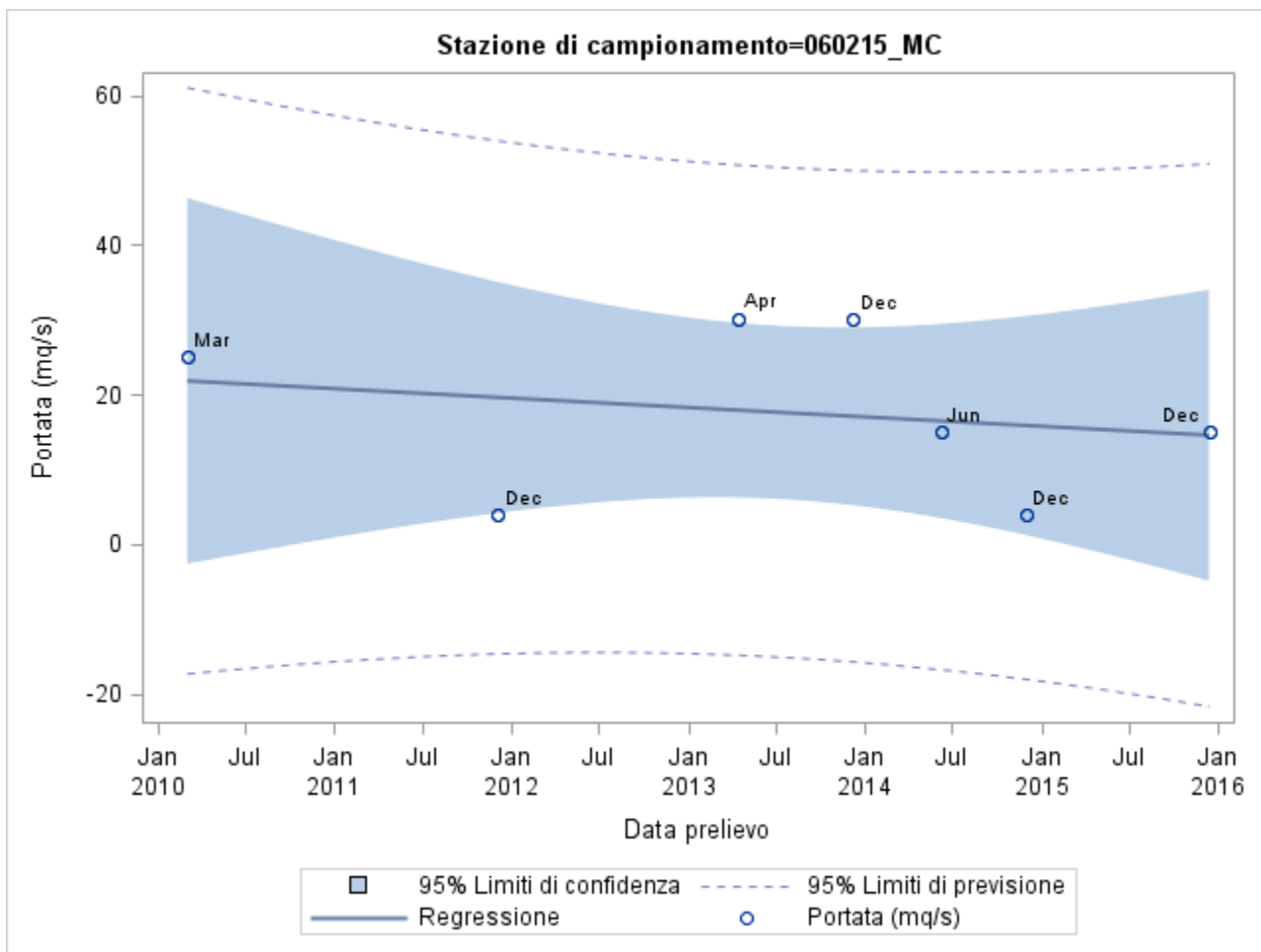




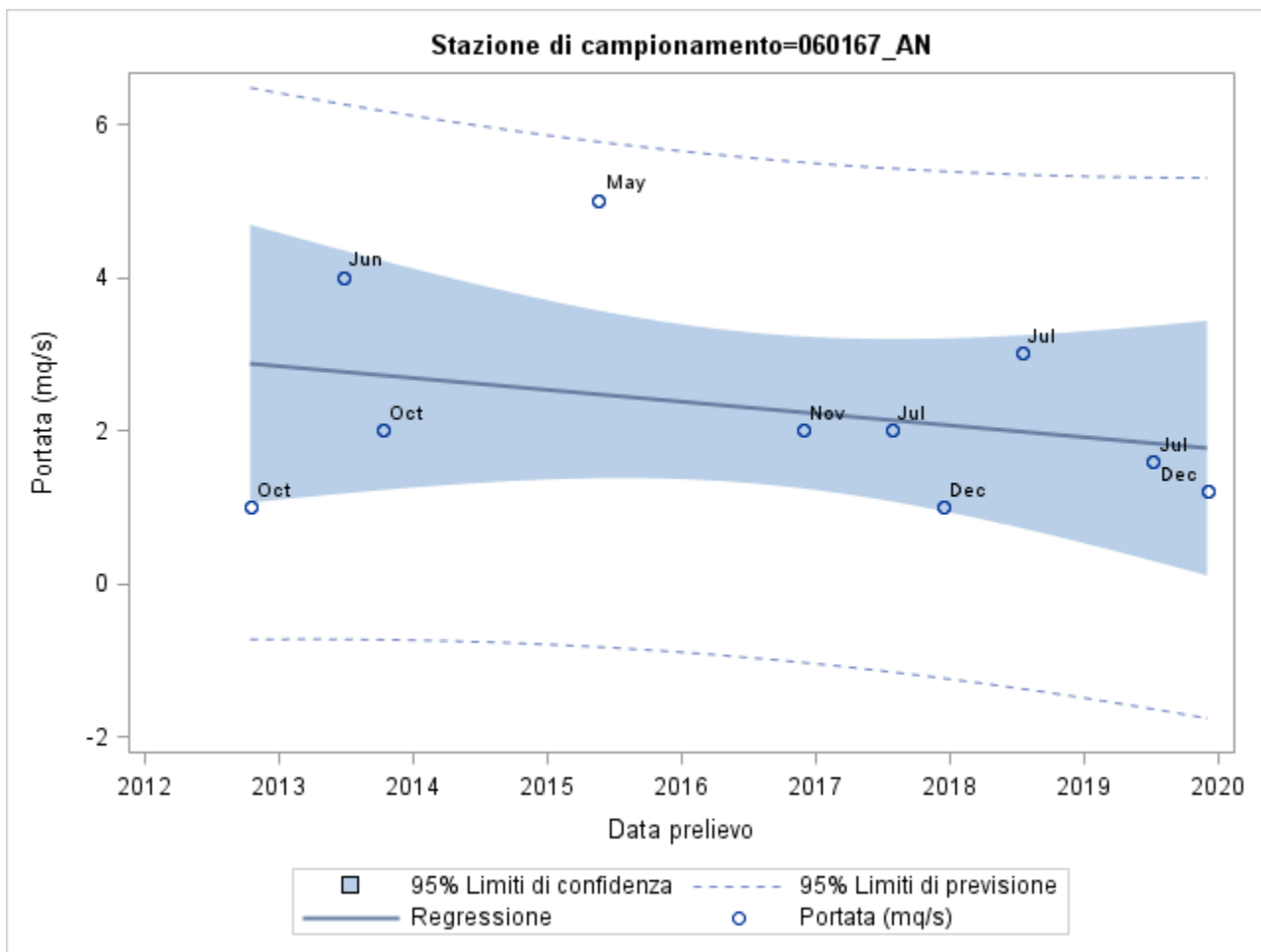
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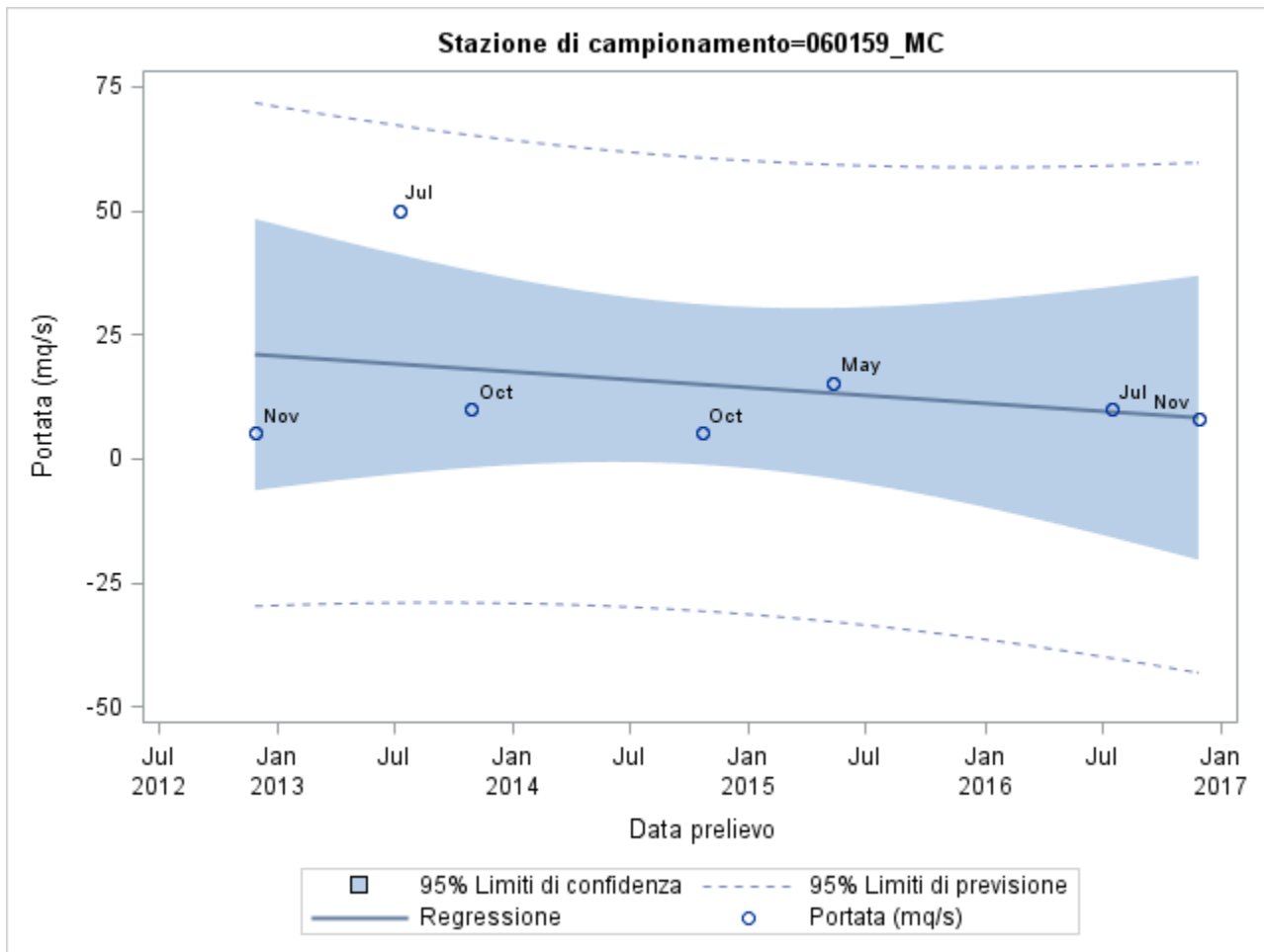
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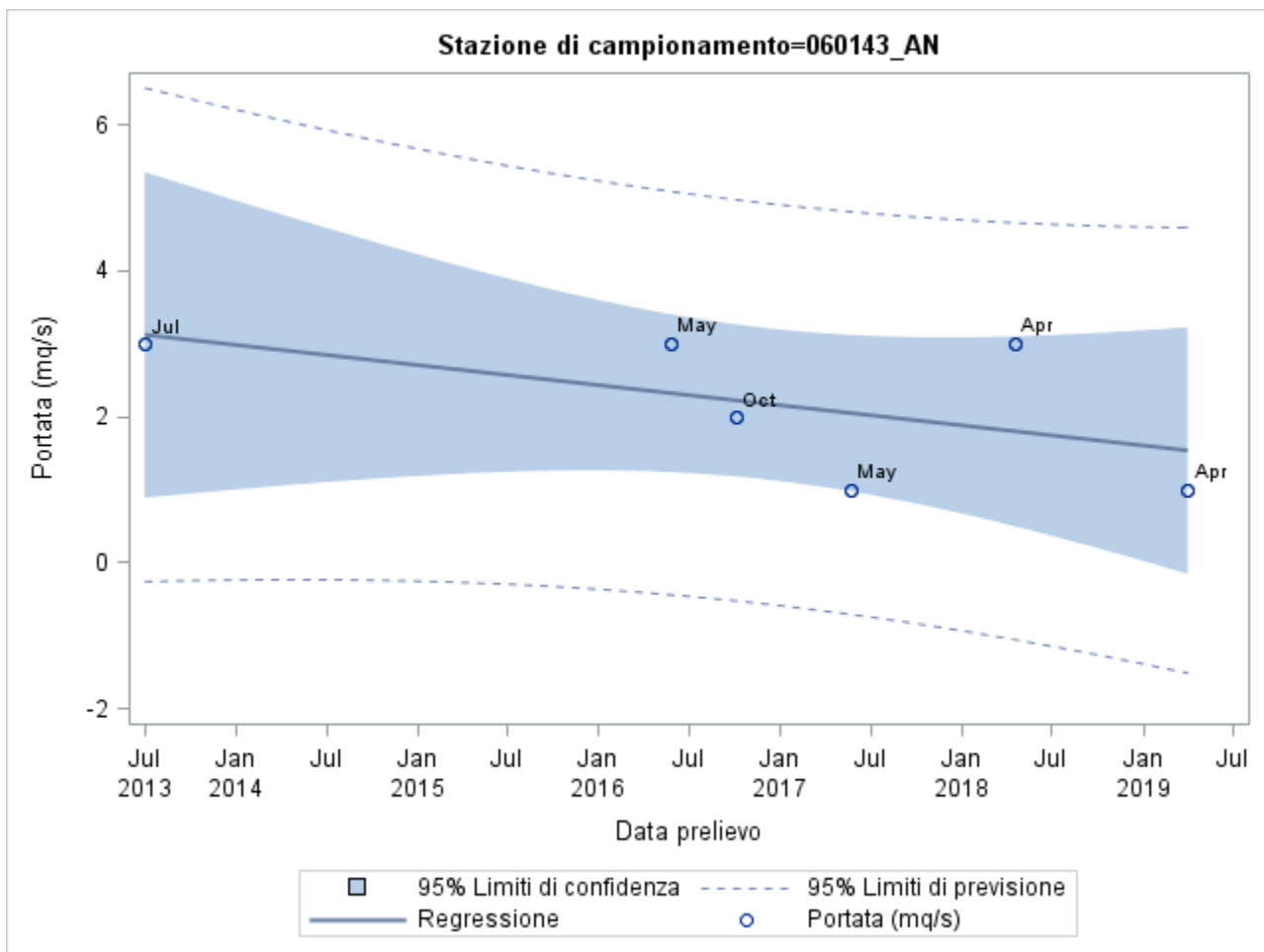
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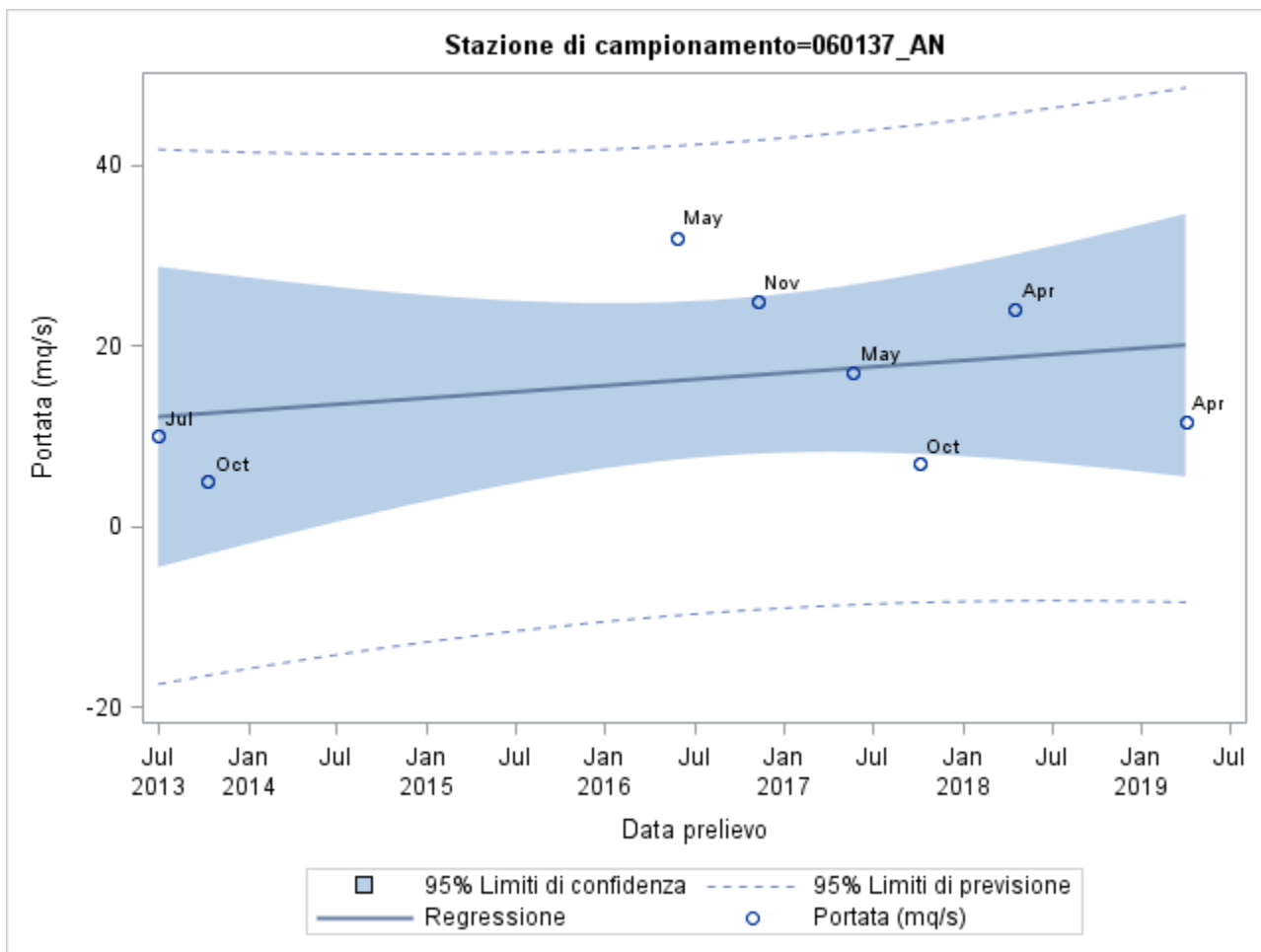
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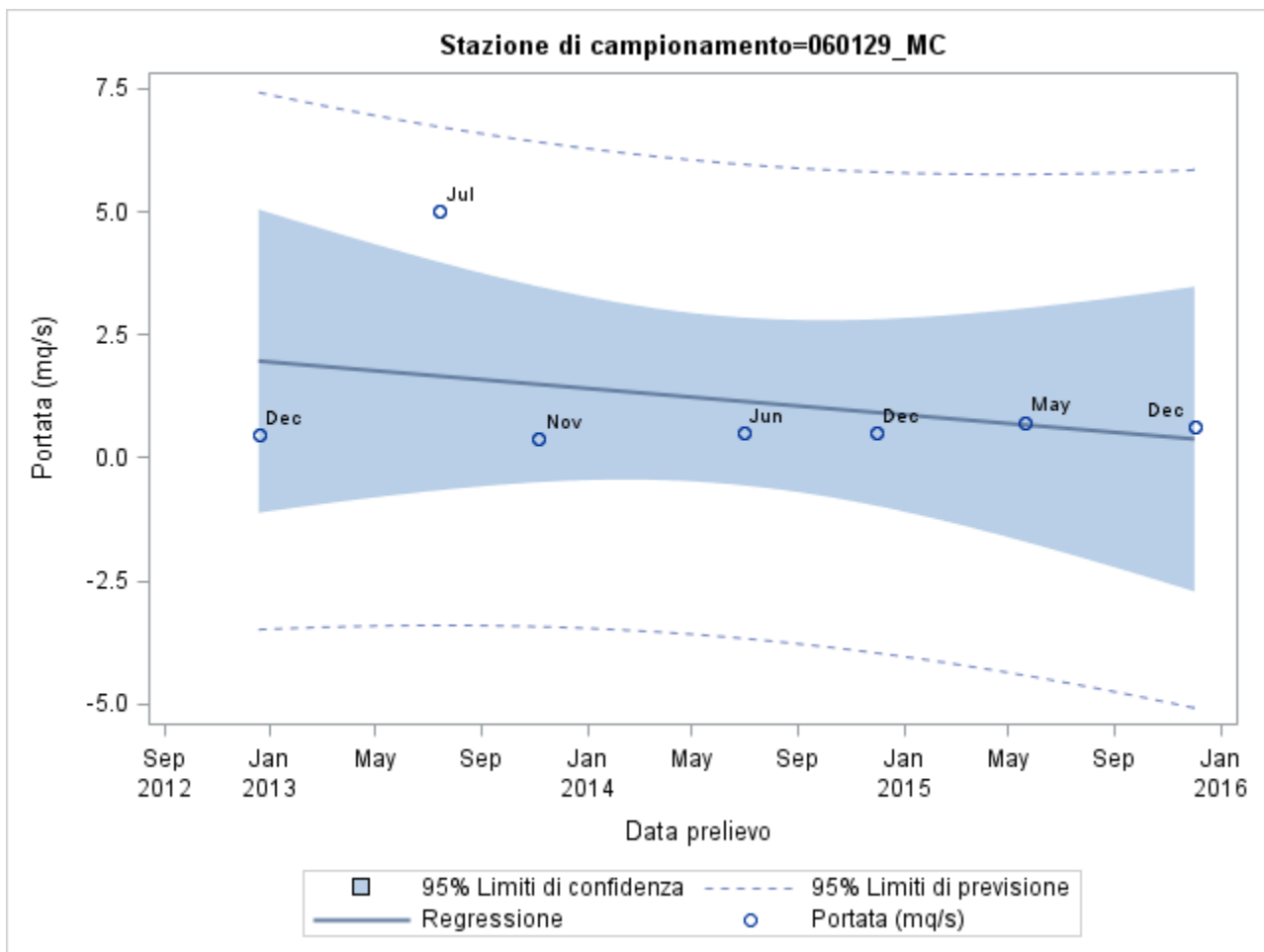
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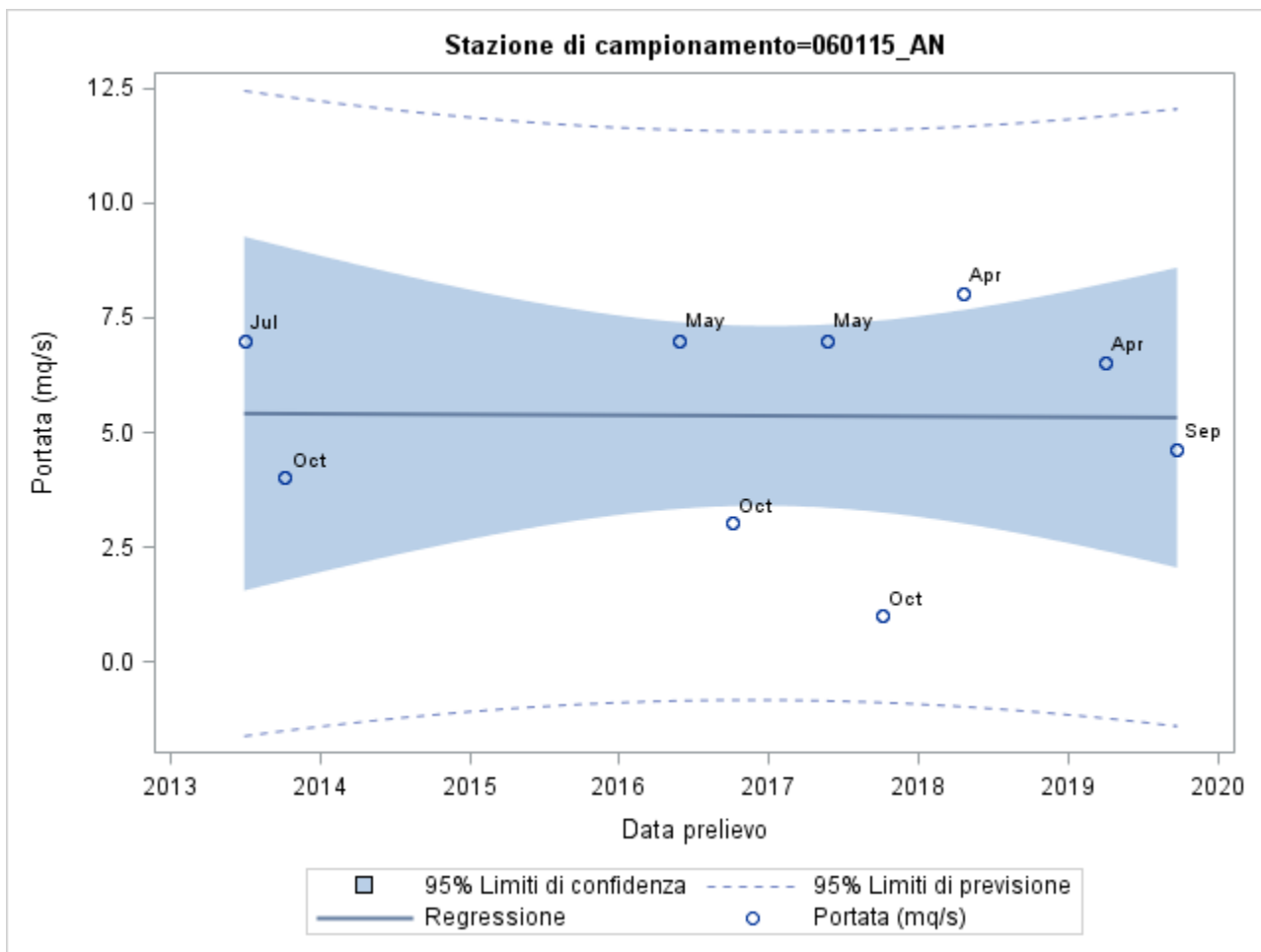
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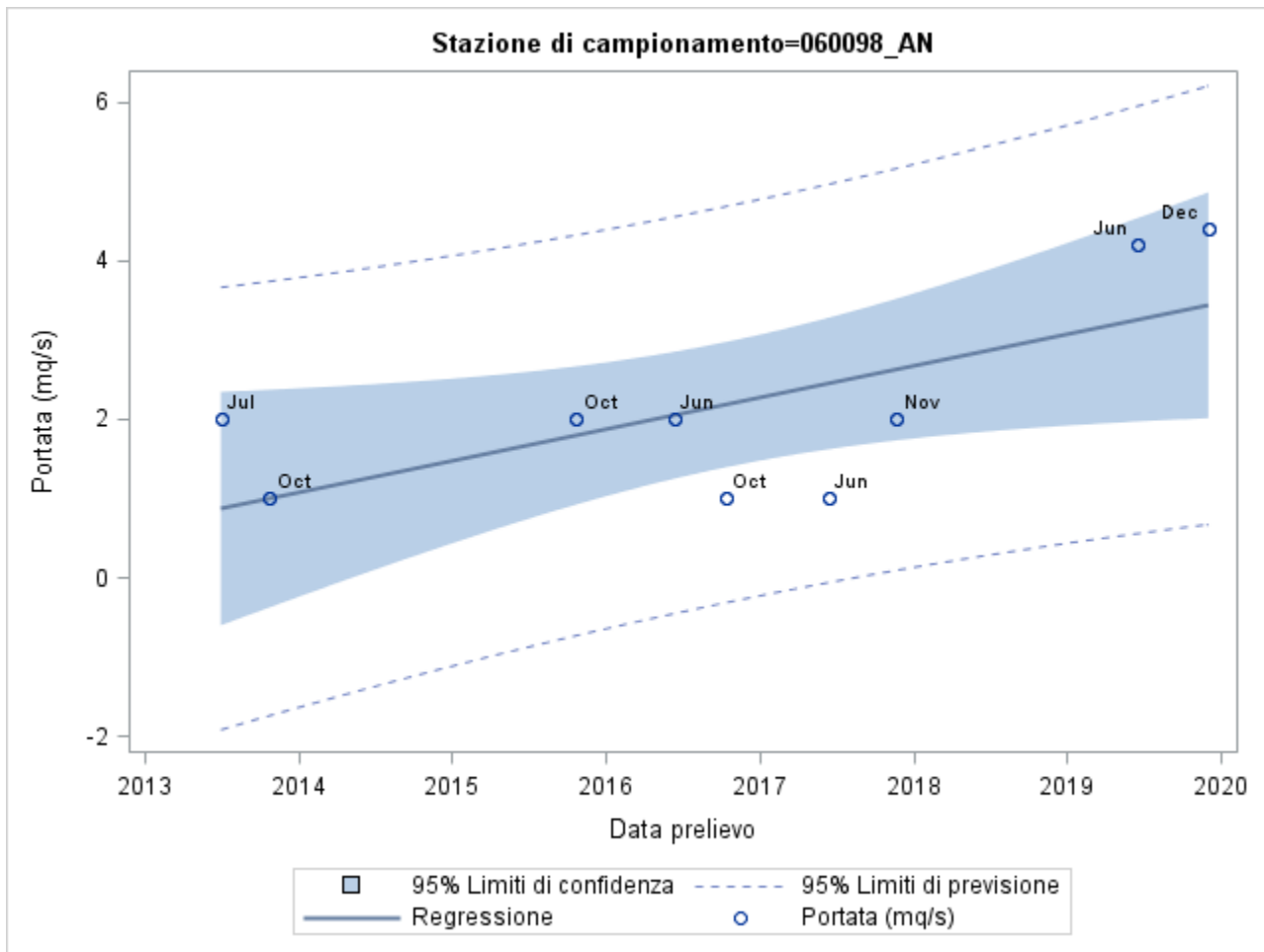


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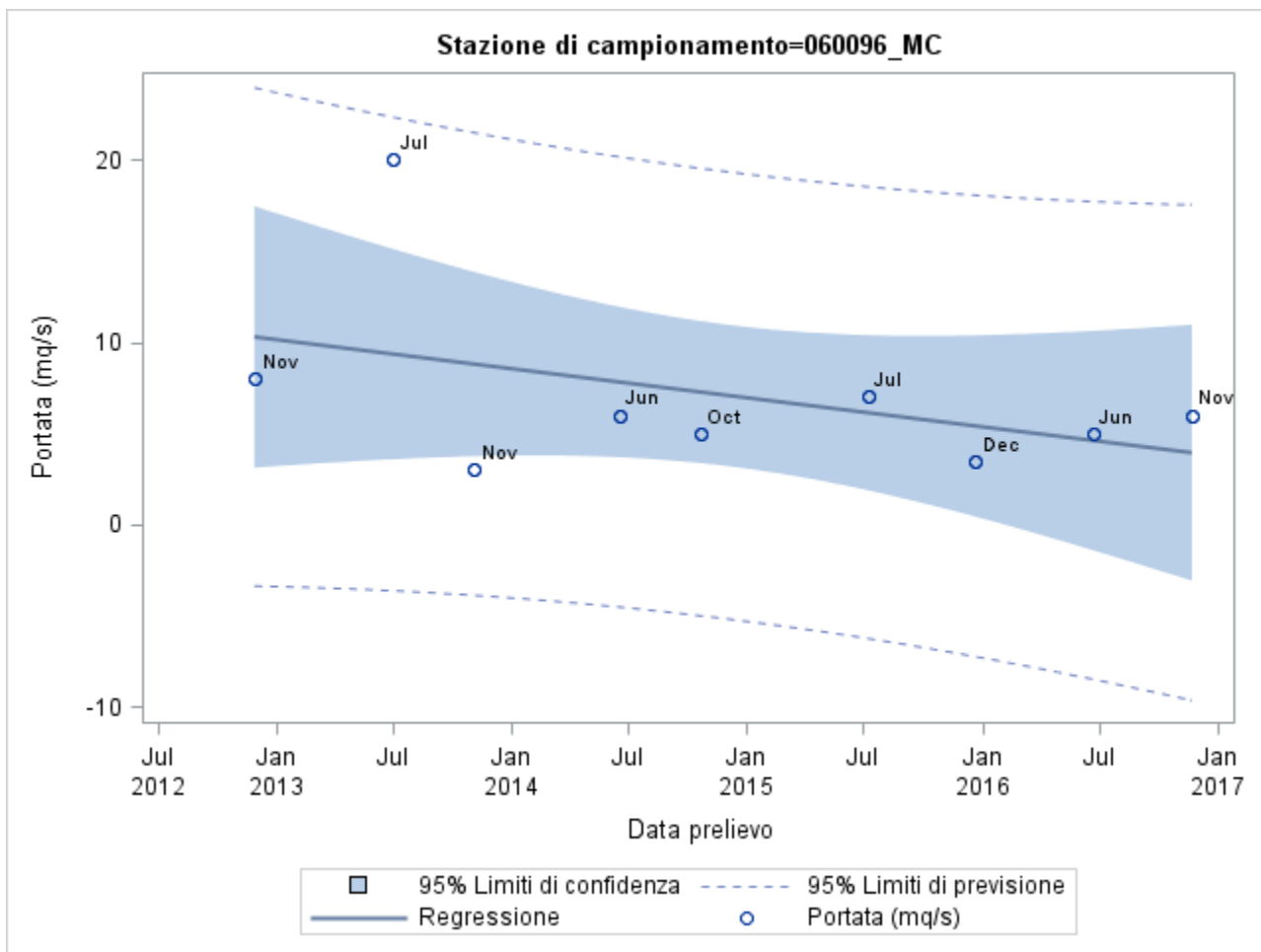




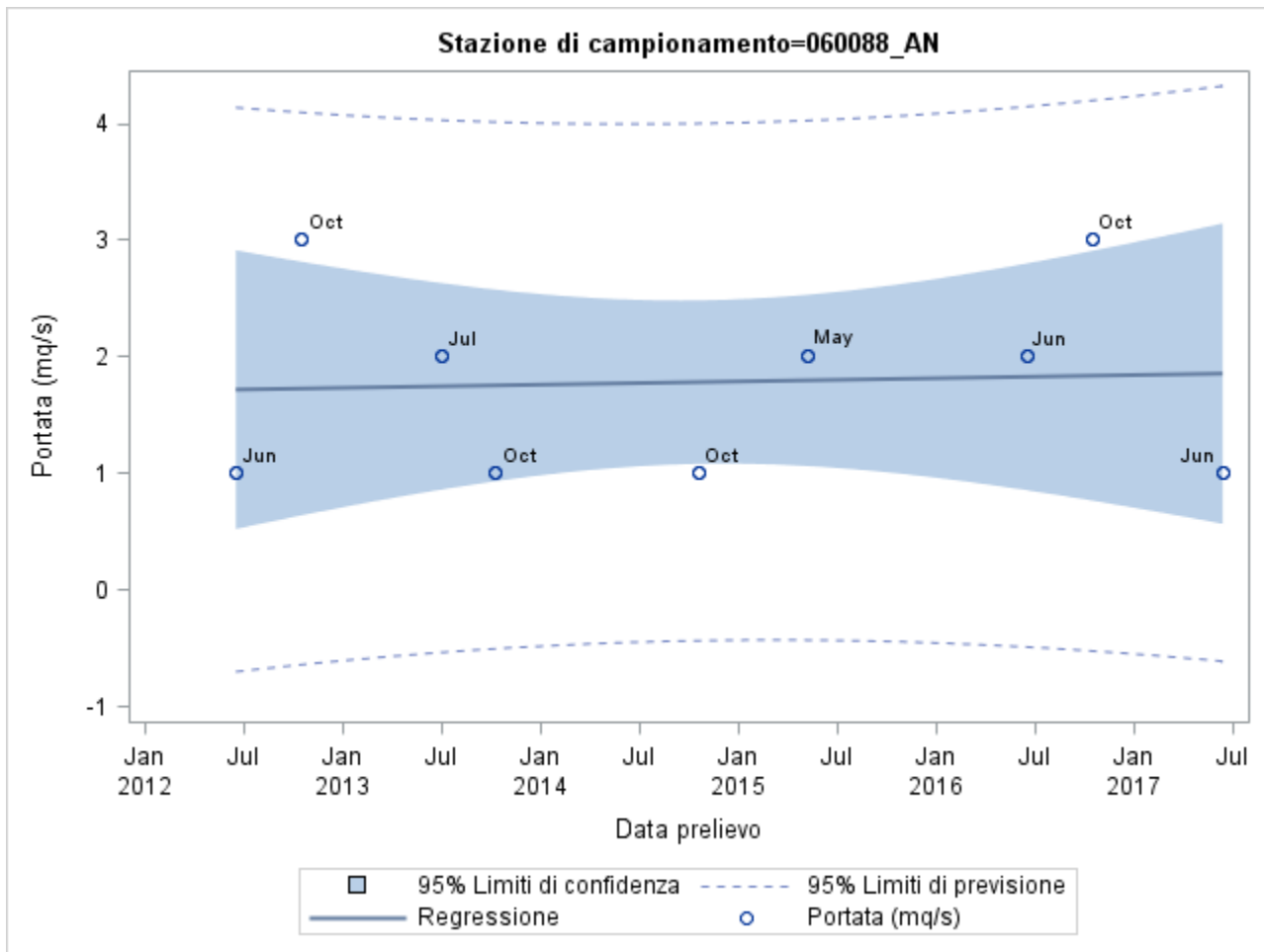
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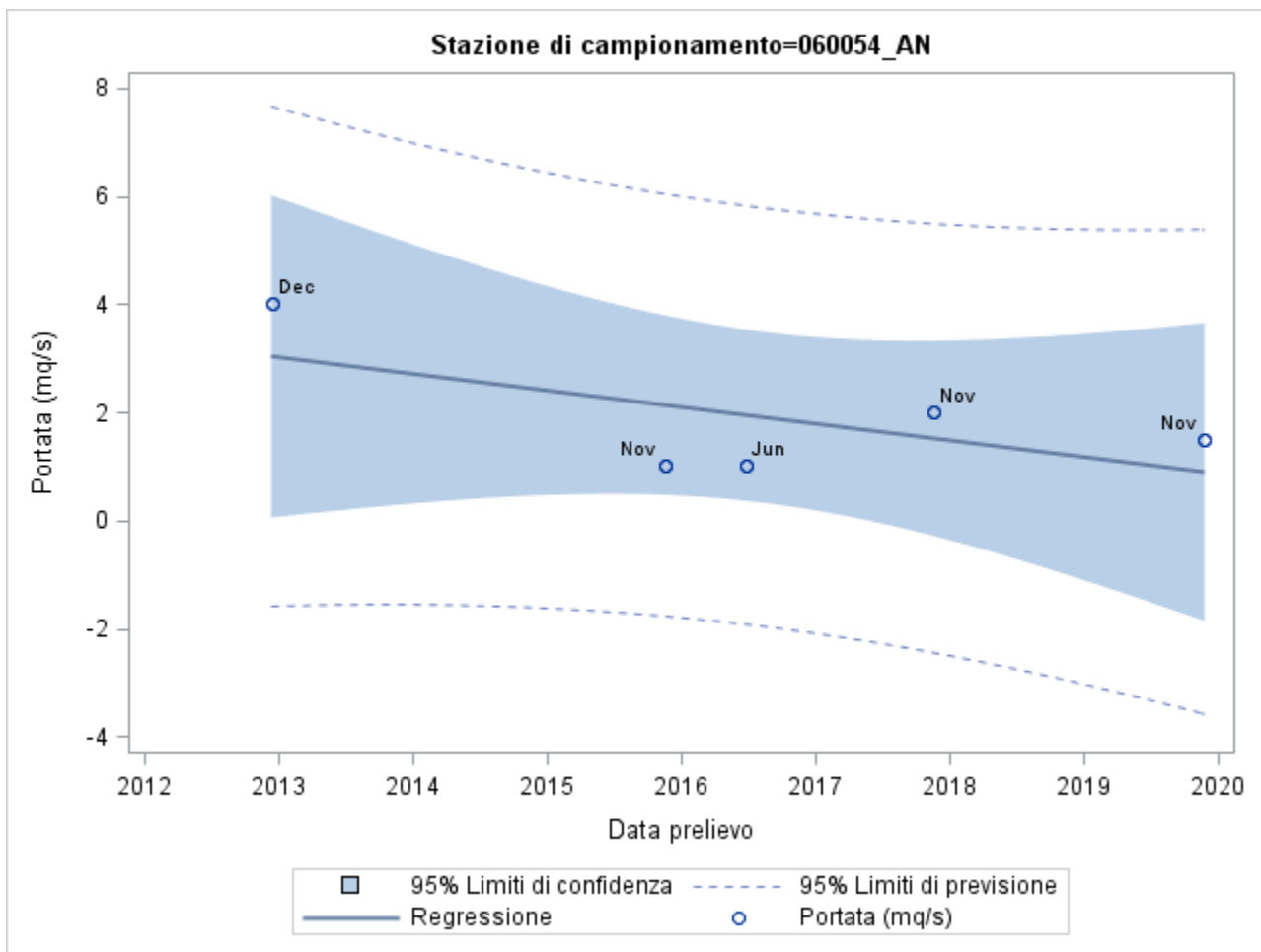
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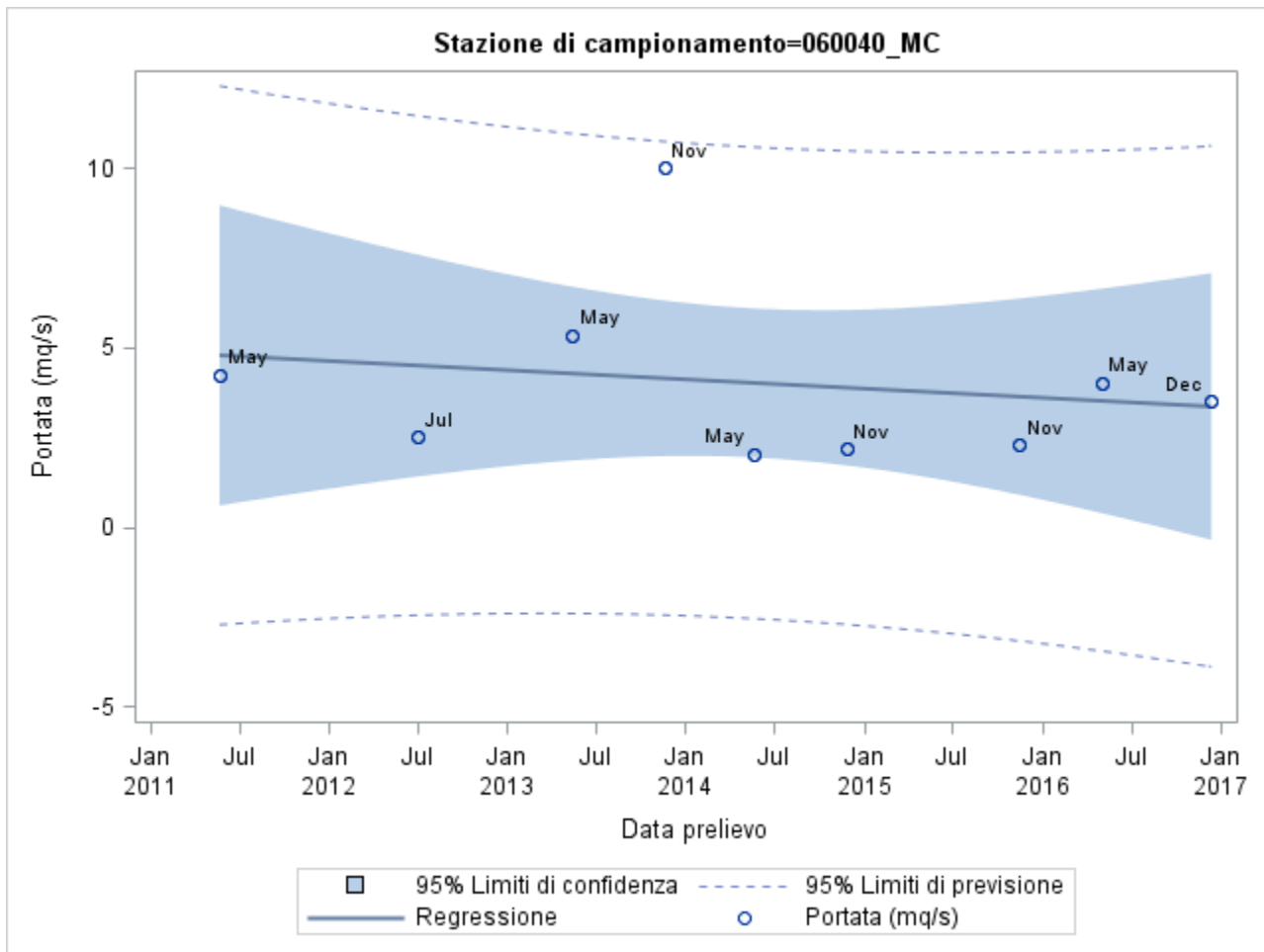
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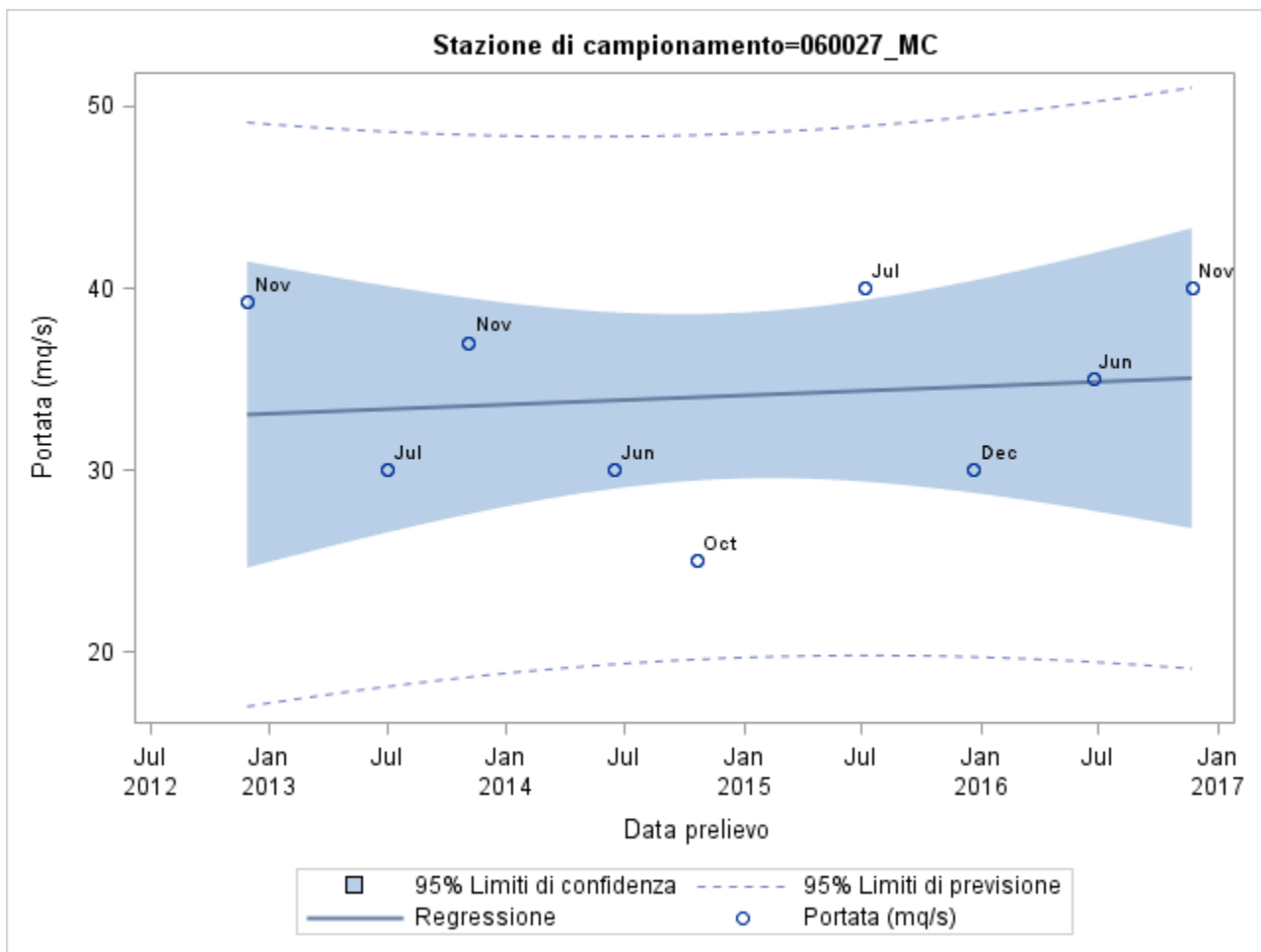
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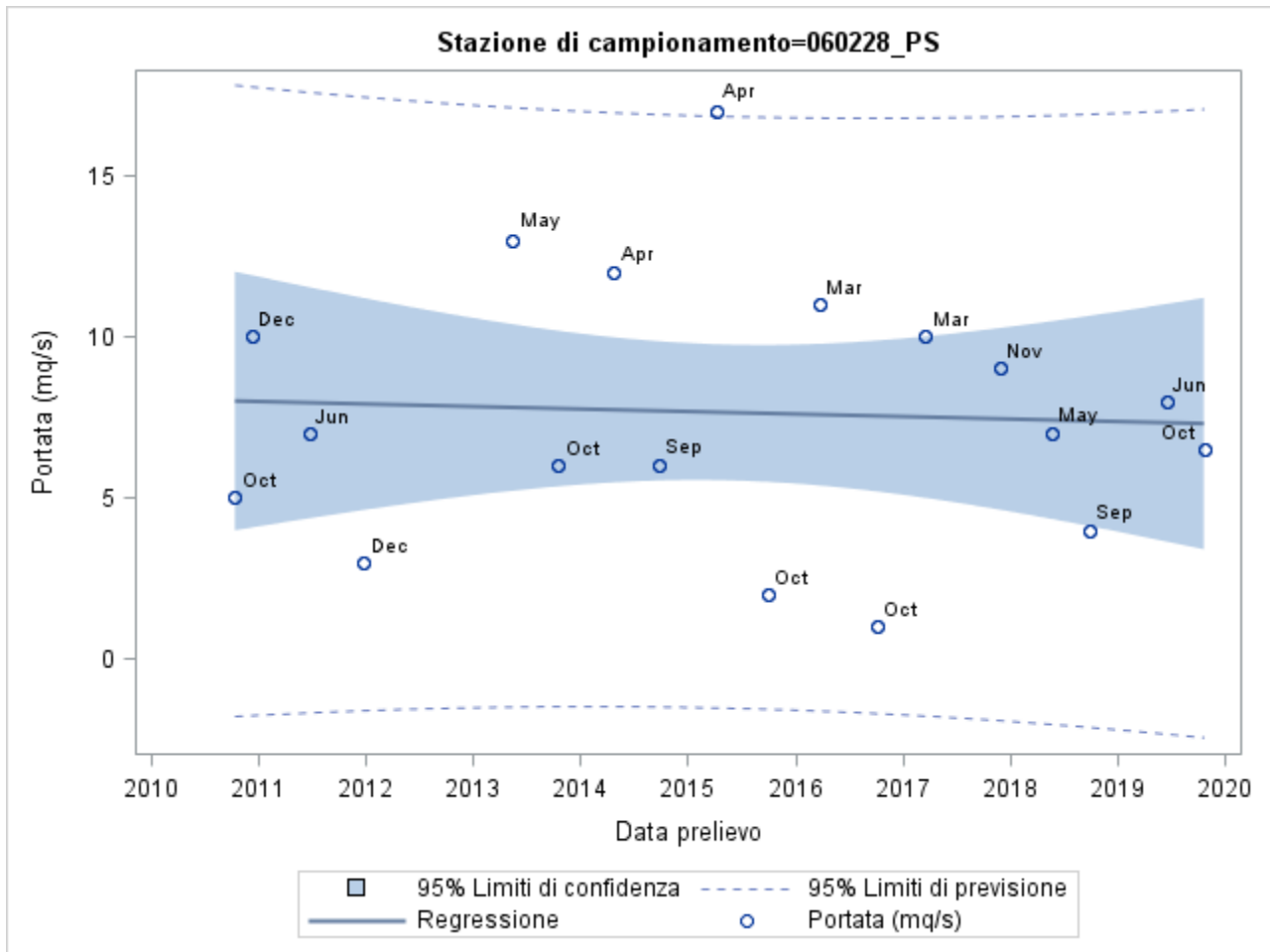


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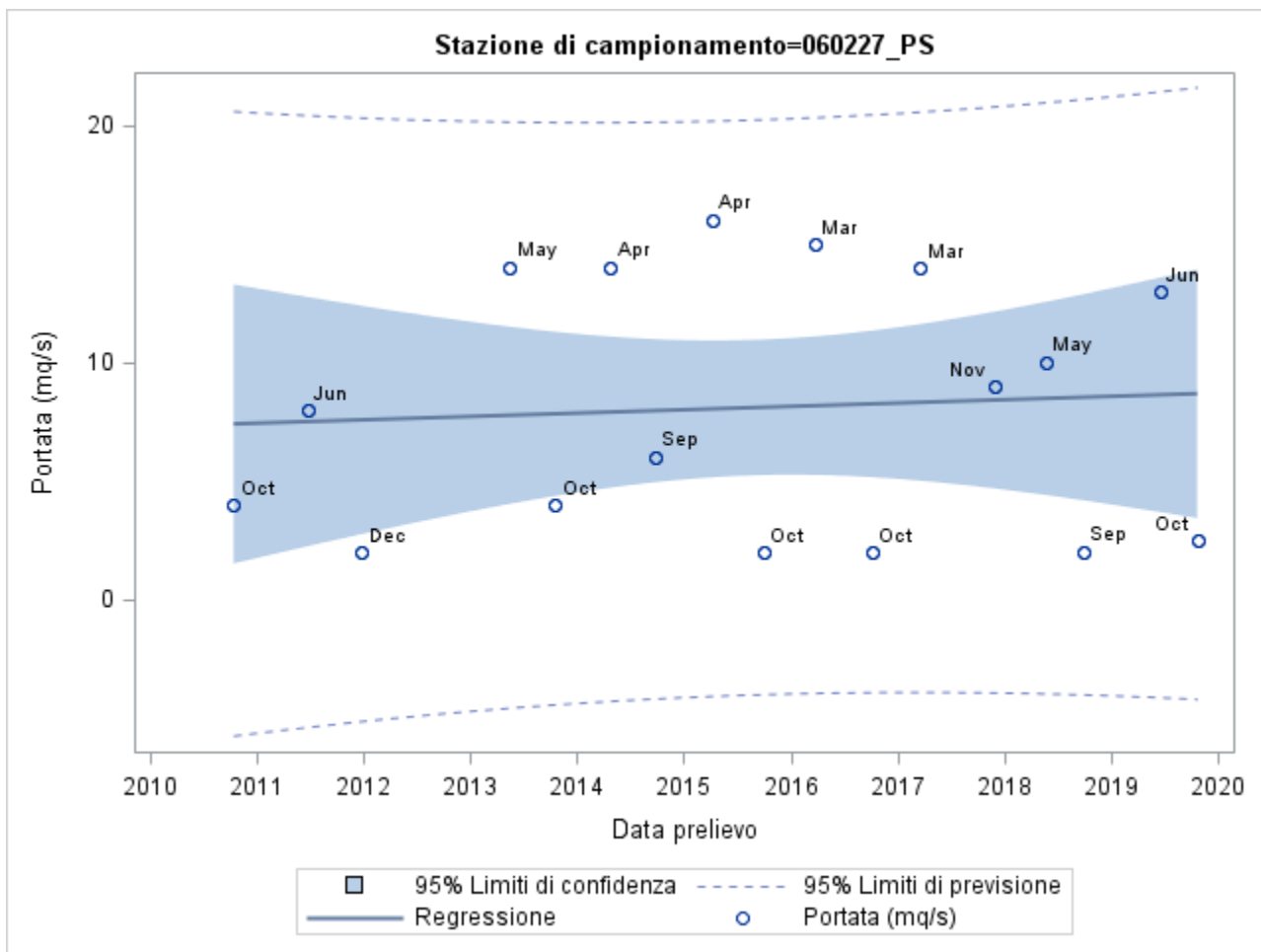


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## CA\_CES - UNITÀ DI MONTI DELLA CESANA

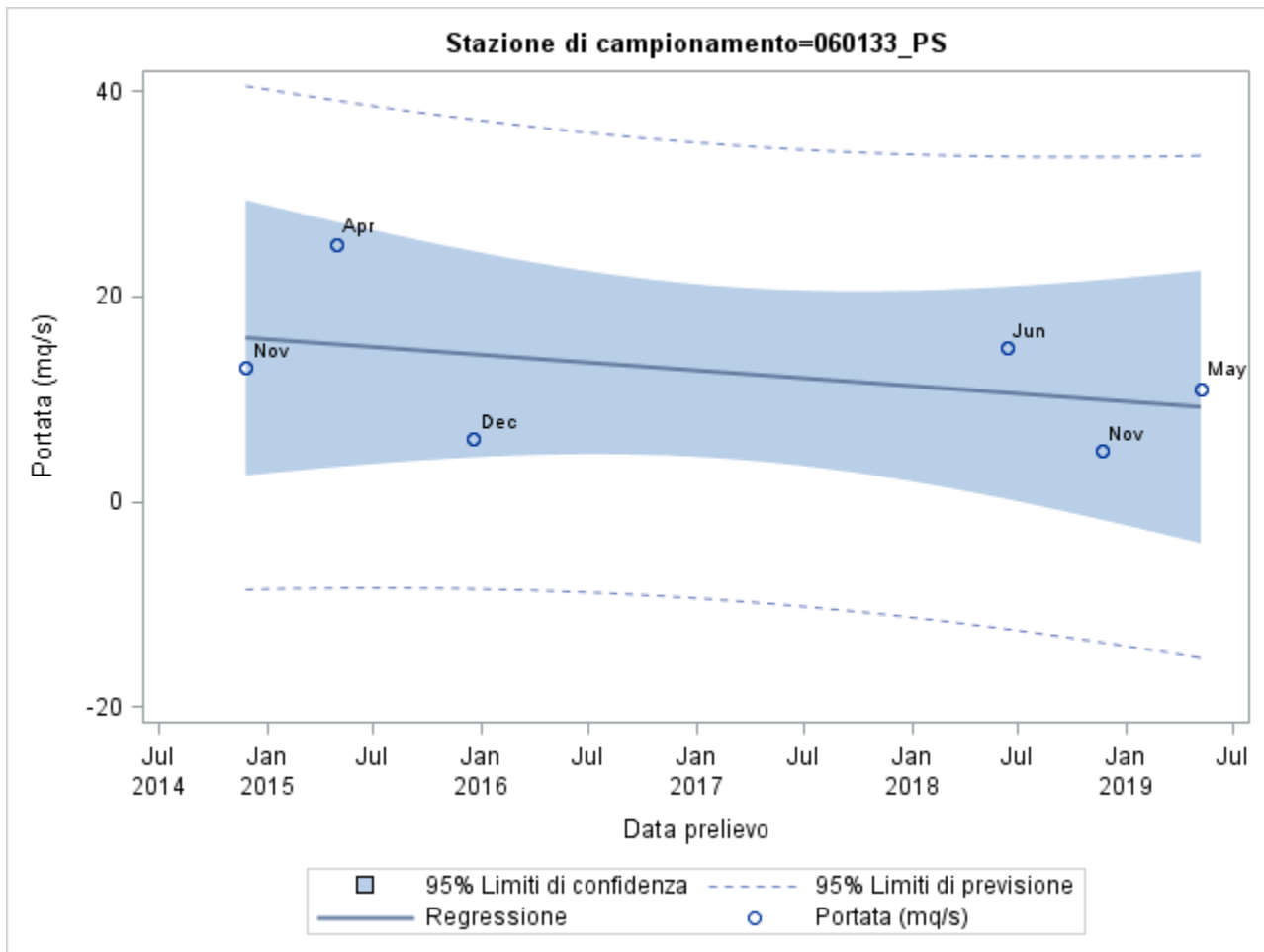


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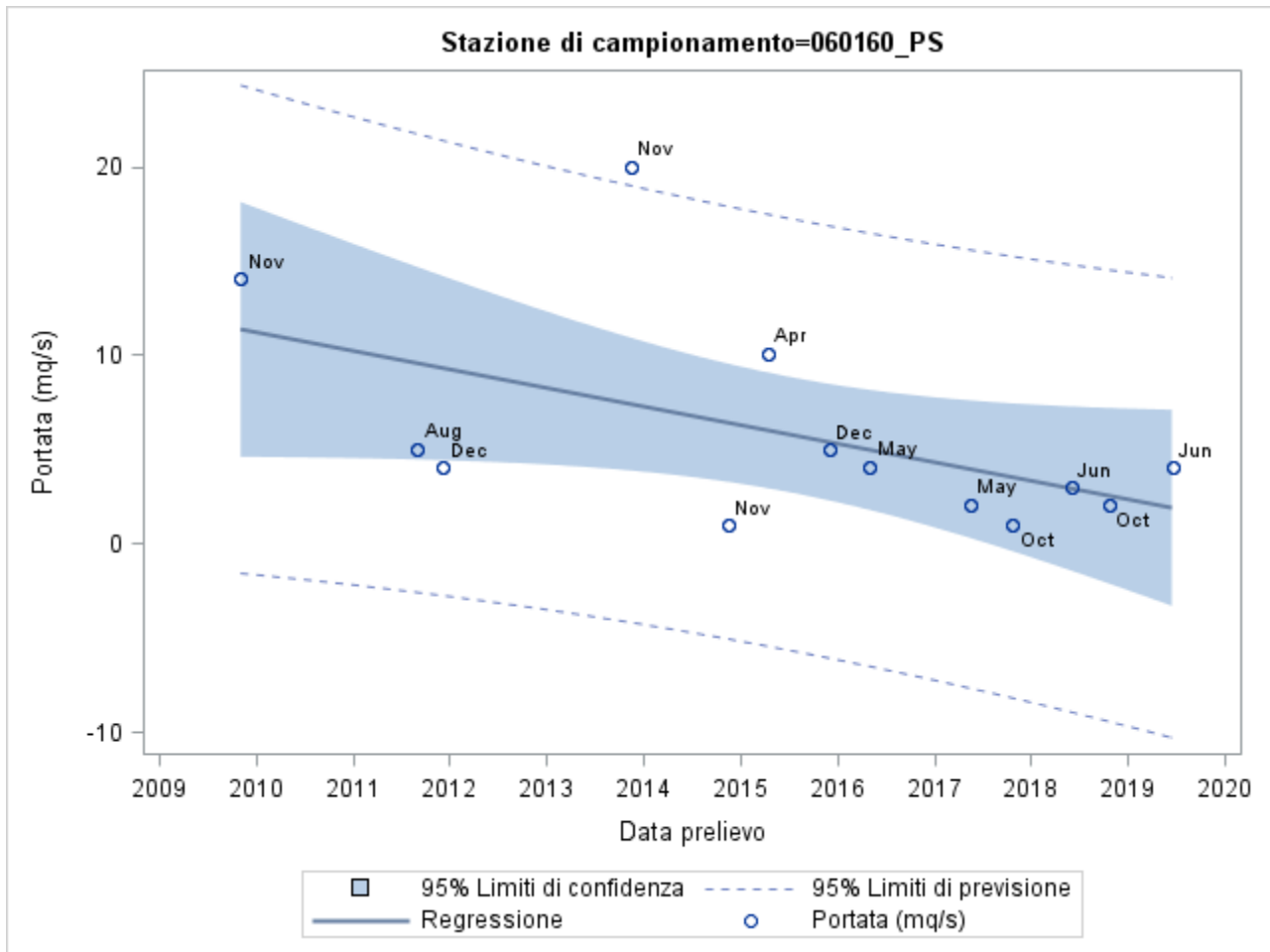


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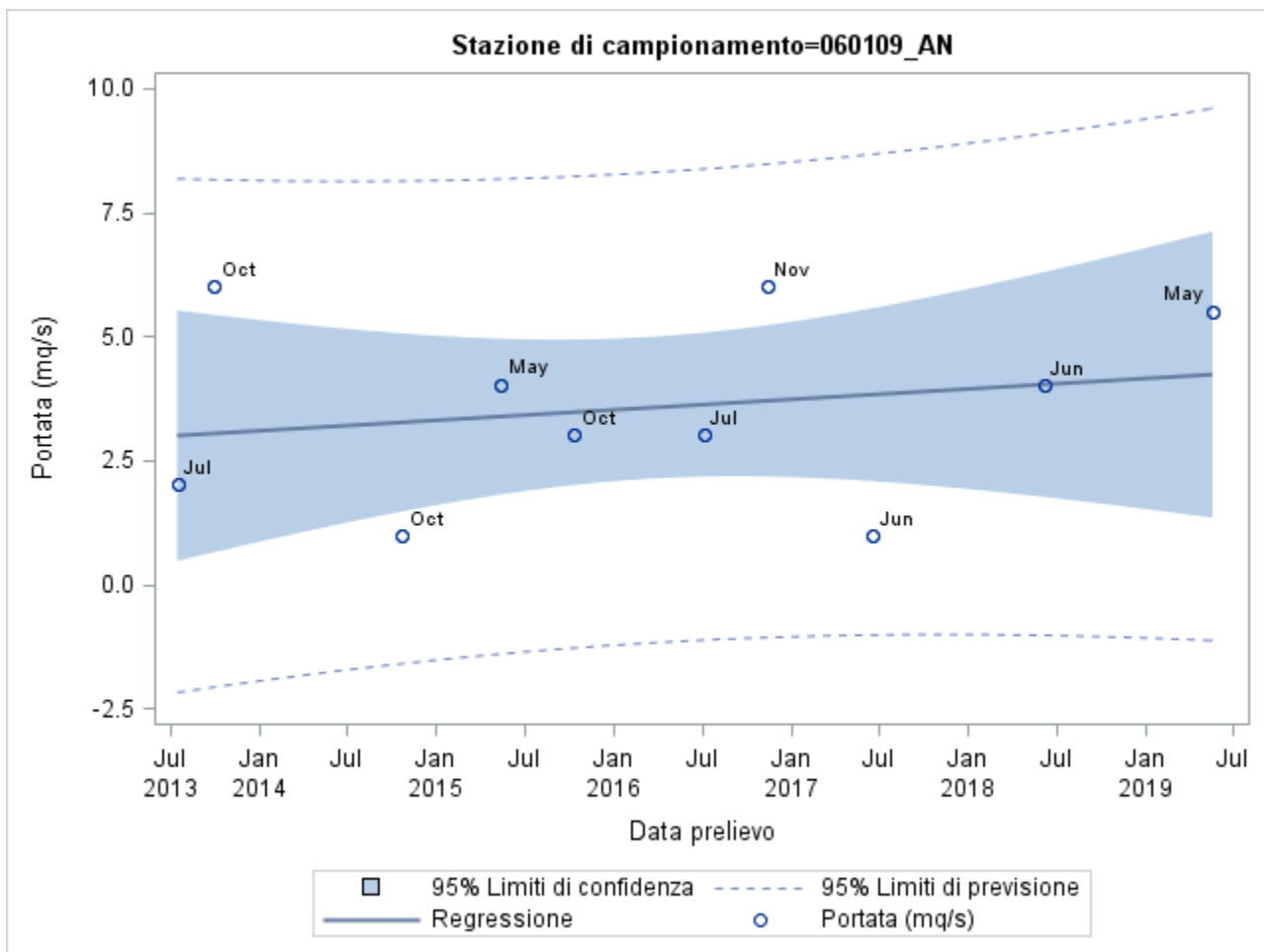


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## CA\_CUC - UNITÀ DI MONTE CUCCO (CA\_CUC\_1, CA\_CUC\_2)

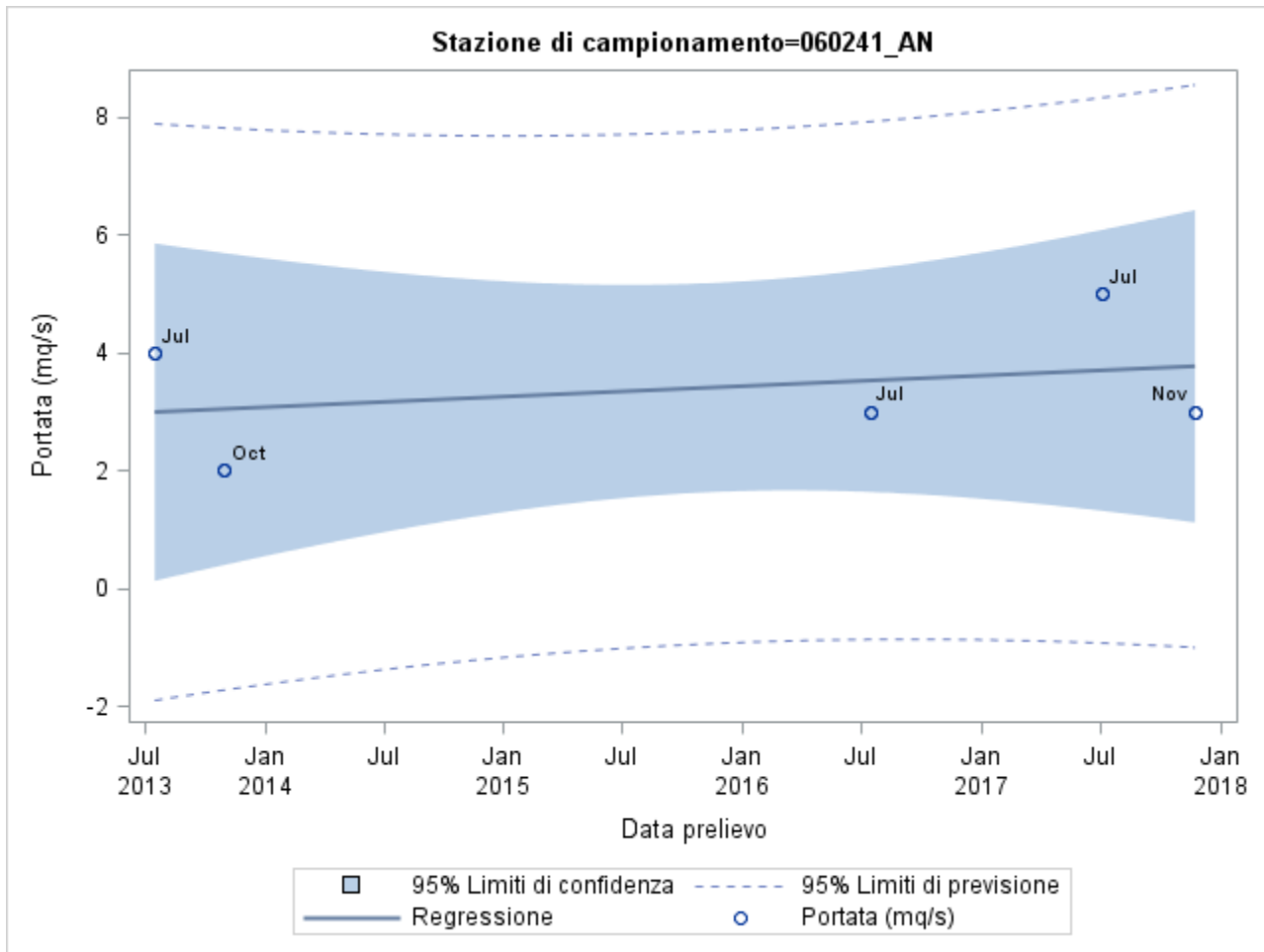


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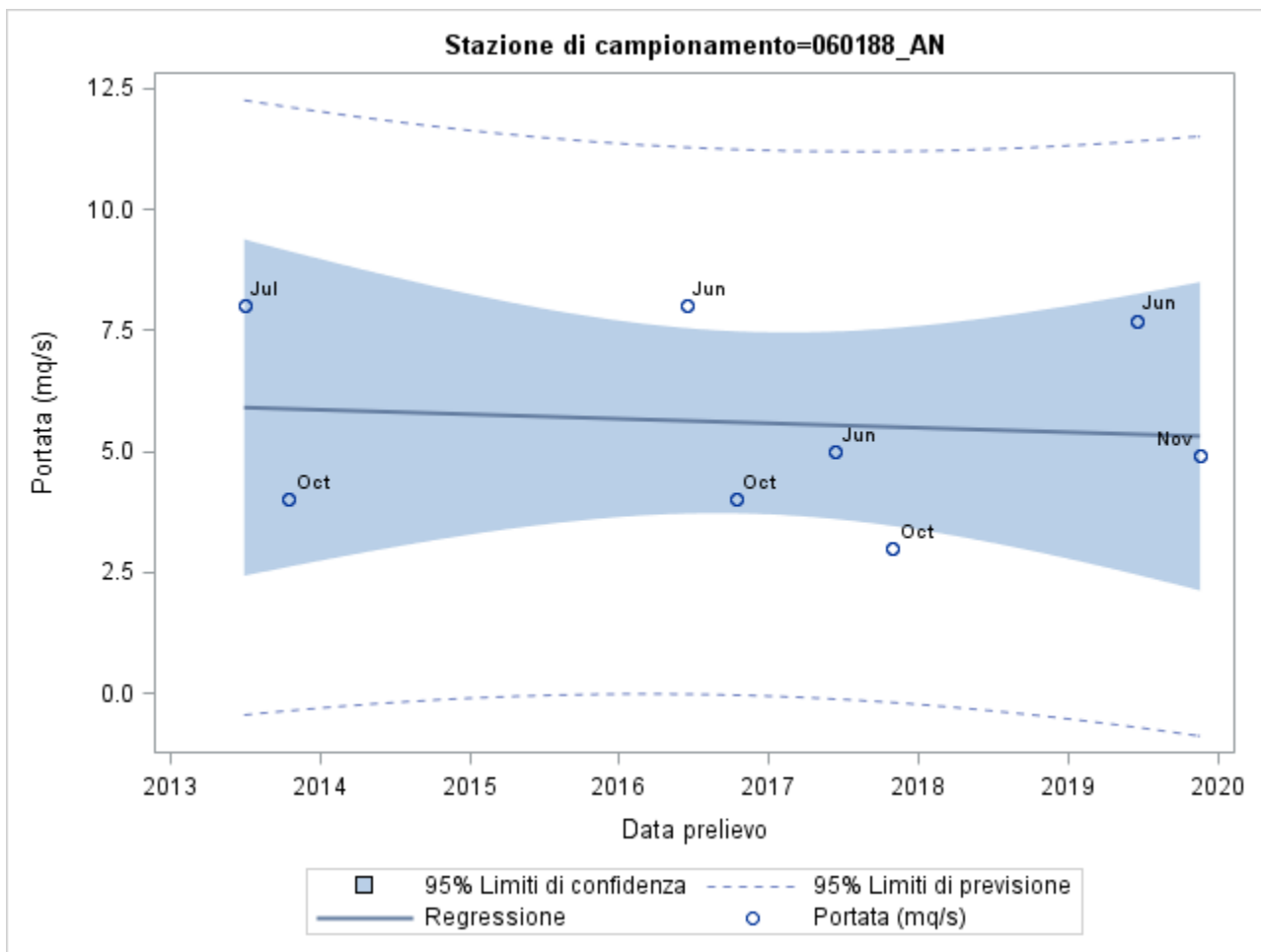


# Appendice H

## CA\_FRA - UNITÀ DI FRASASSI

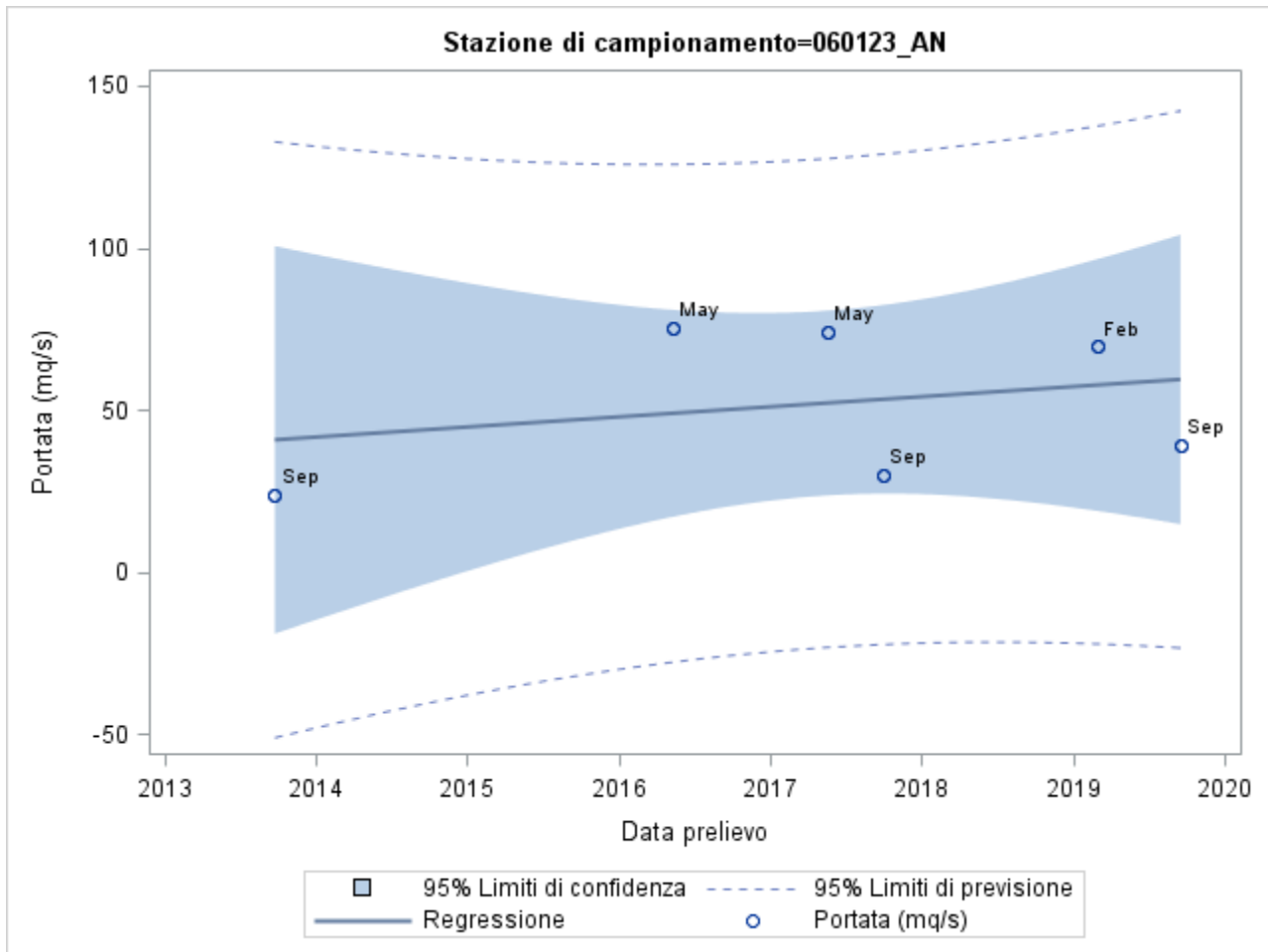


# Appendice H

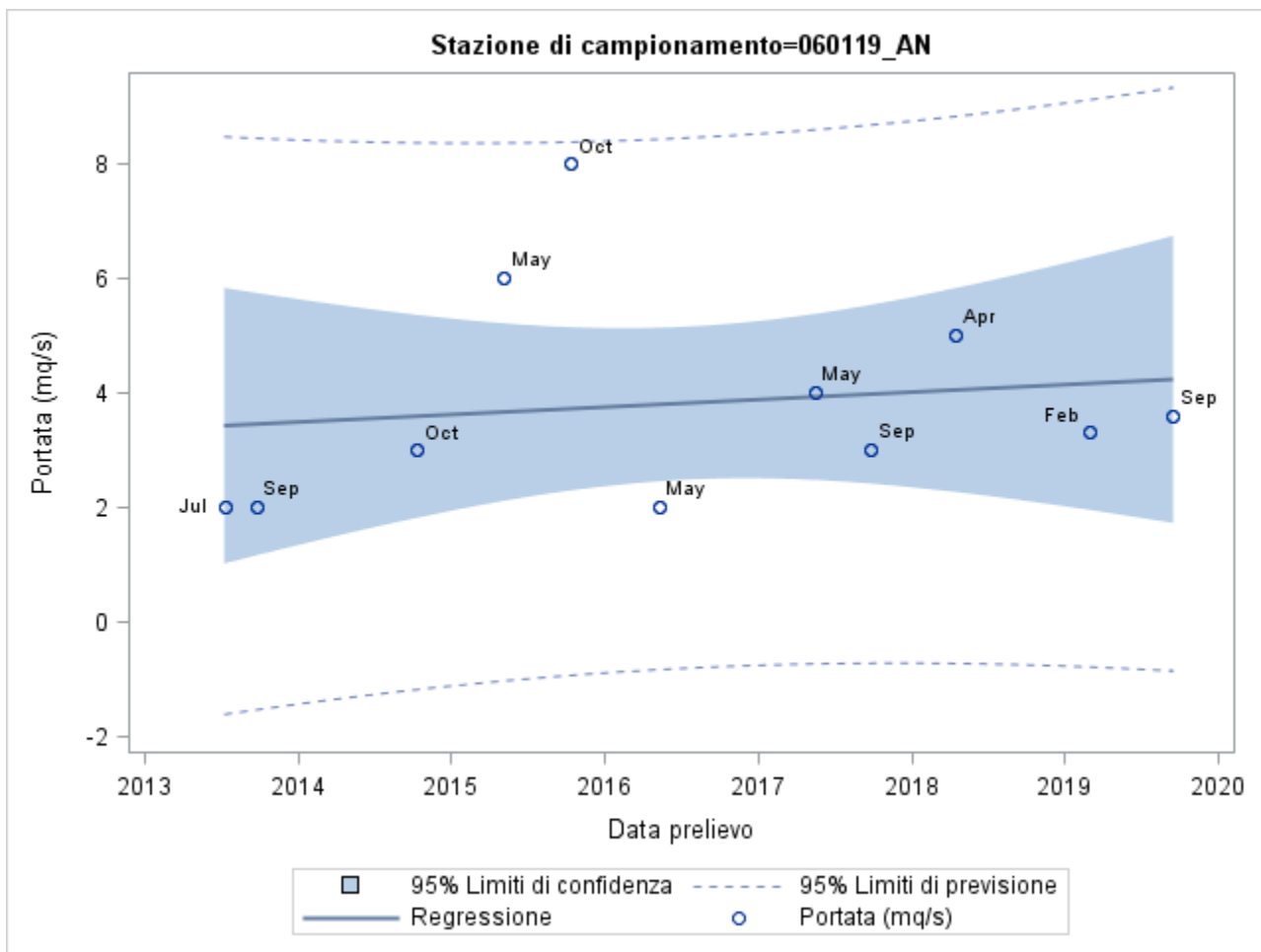


# Appendice H

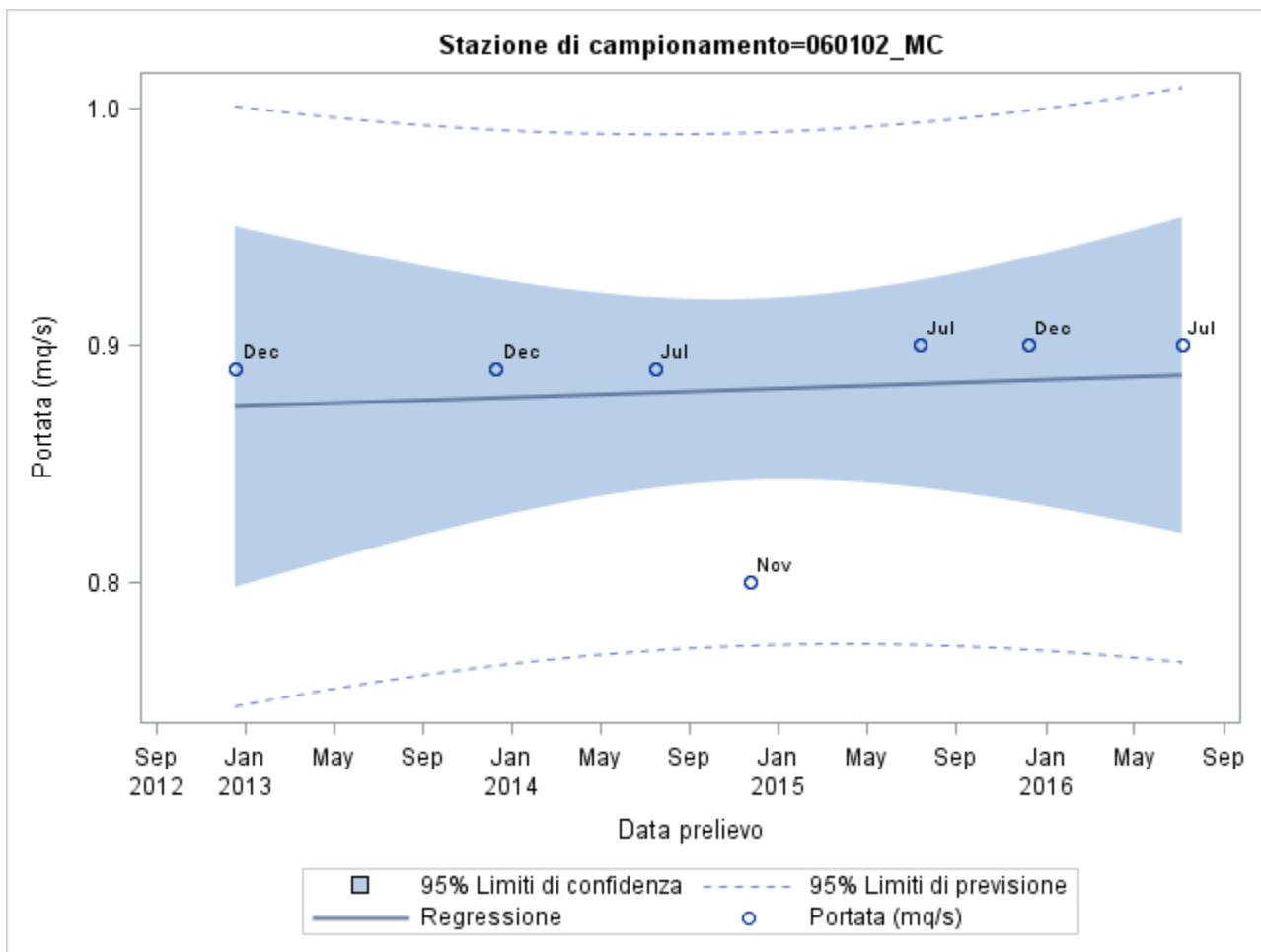
## CA\_MAG - UNITÀ DI MONTE MAGGIO (CA\_MAG, CA\_MAG\_1, CA\_MAG\_2)



# Appendice H



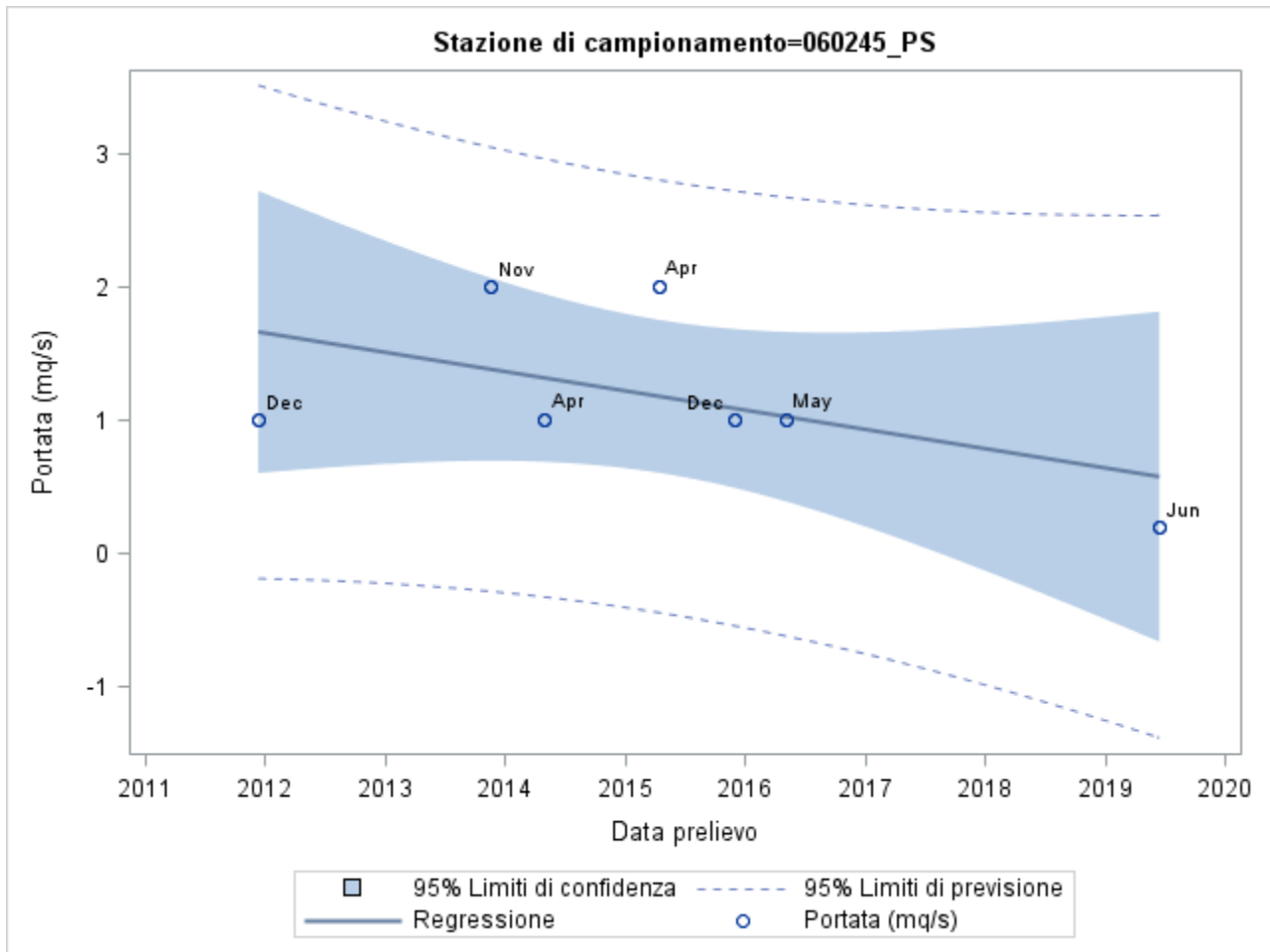
# Appendice H





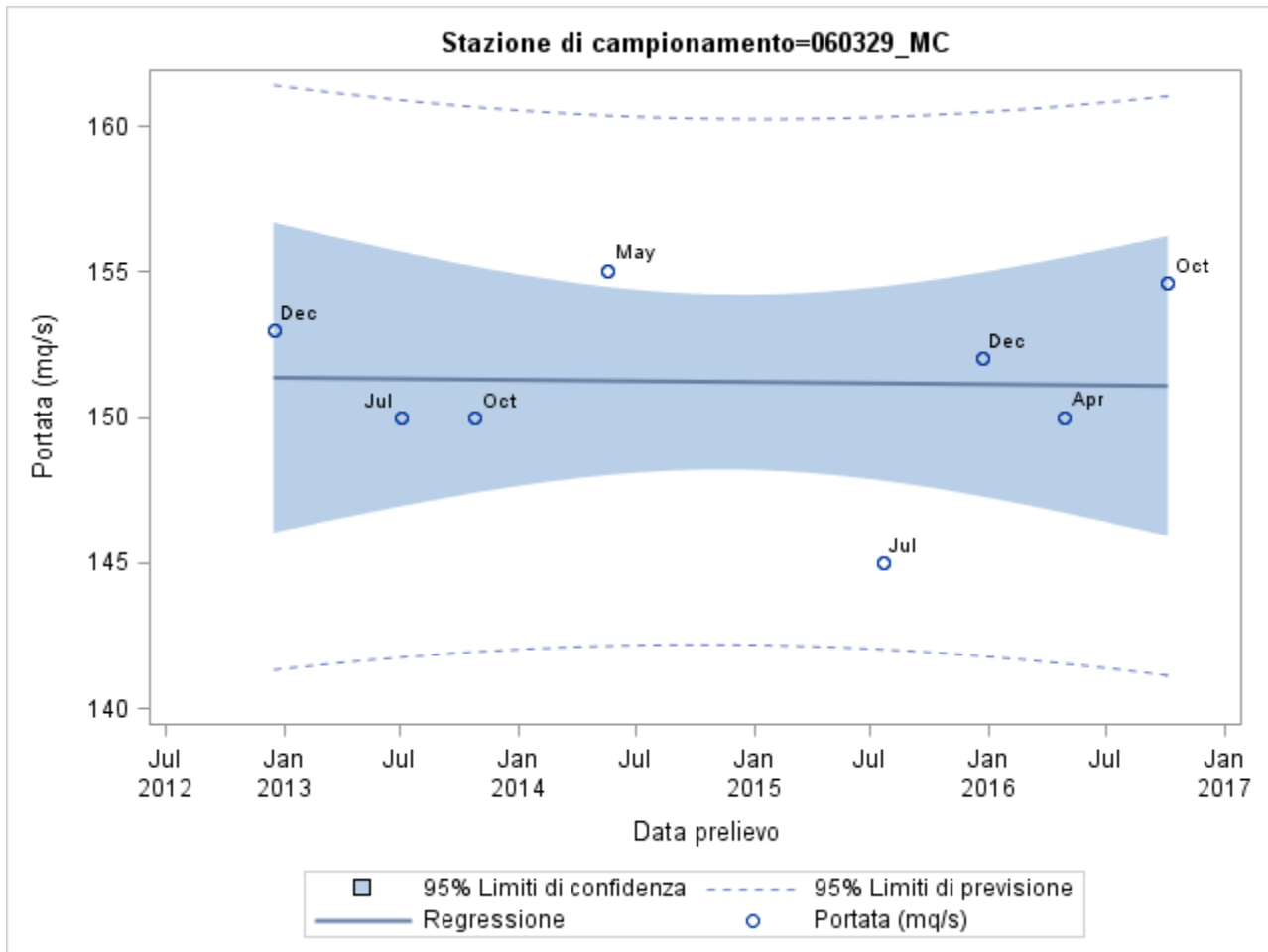
# Appendice H

CA\_NAR - UNITÀ DI NARO

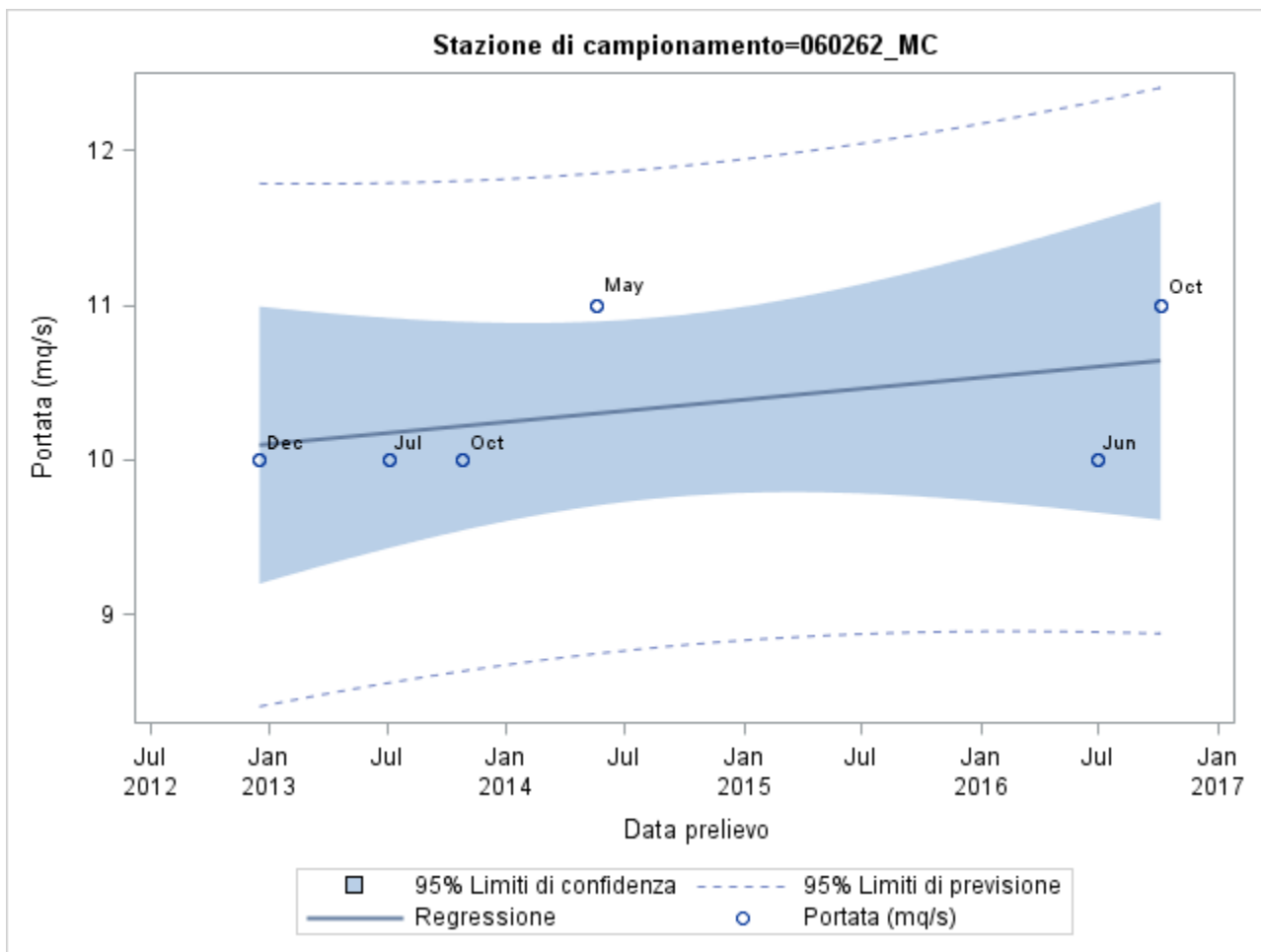


# Appendice H

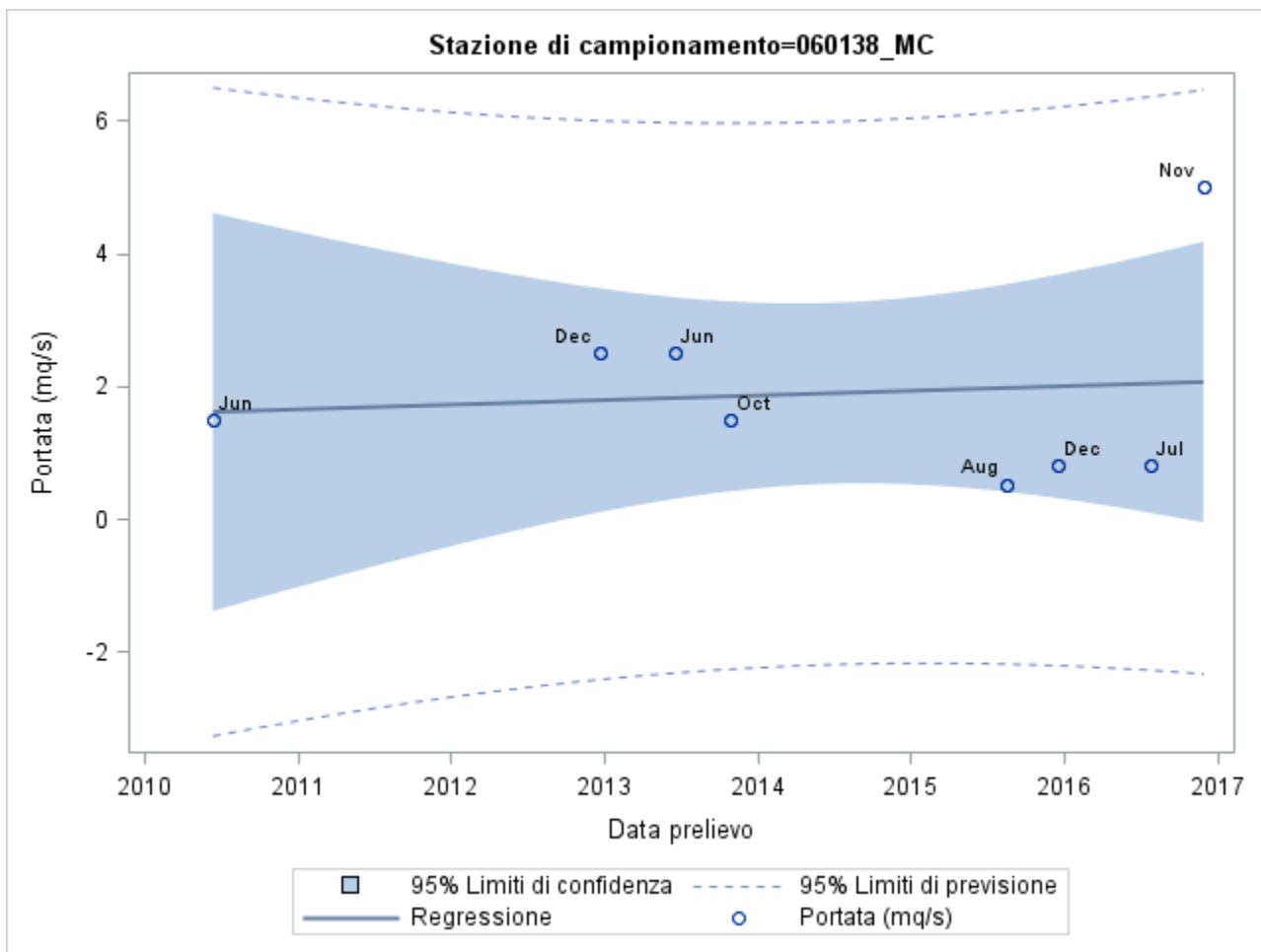
CA\_NES - SISTEMA FIUME NERA - MONTI SIBILLINI (CA\_NES\_1, CA\_NES\_2)



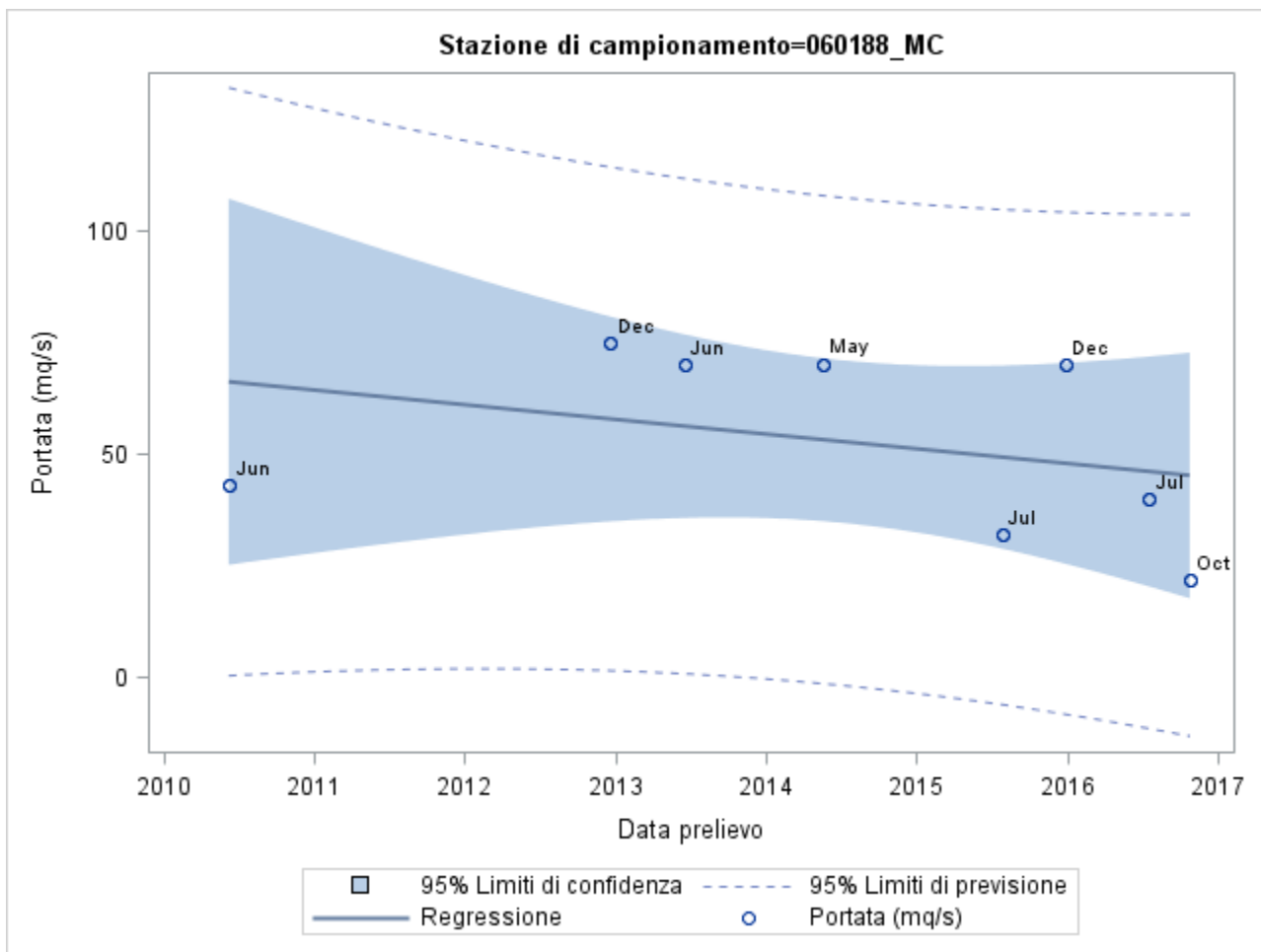
# Appendice H



# Appendice H

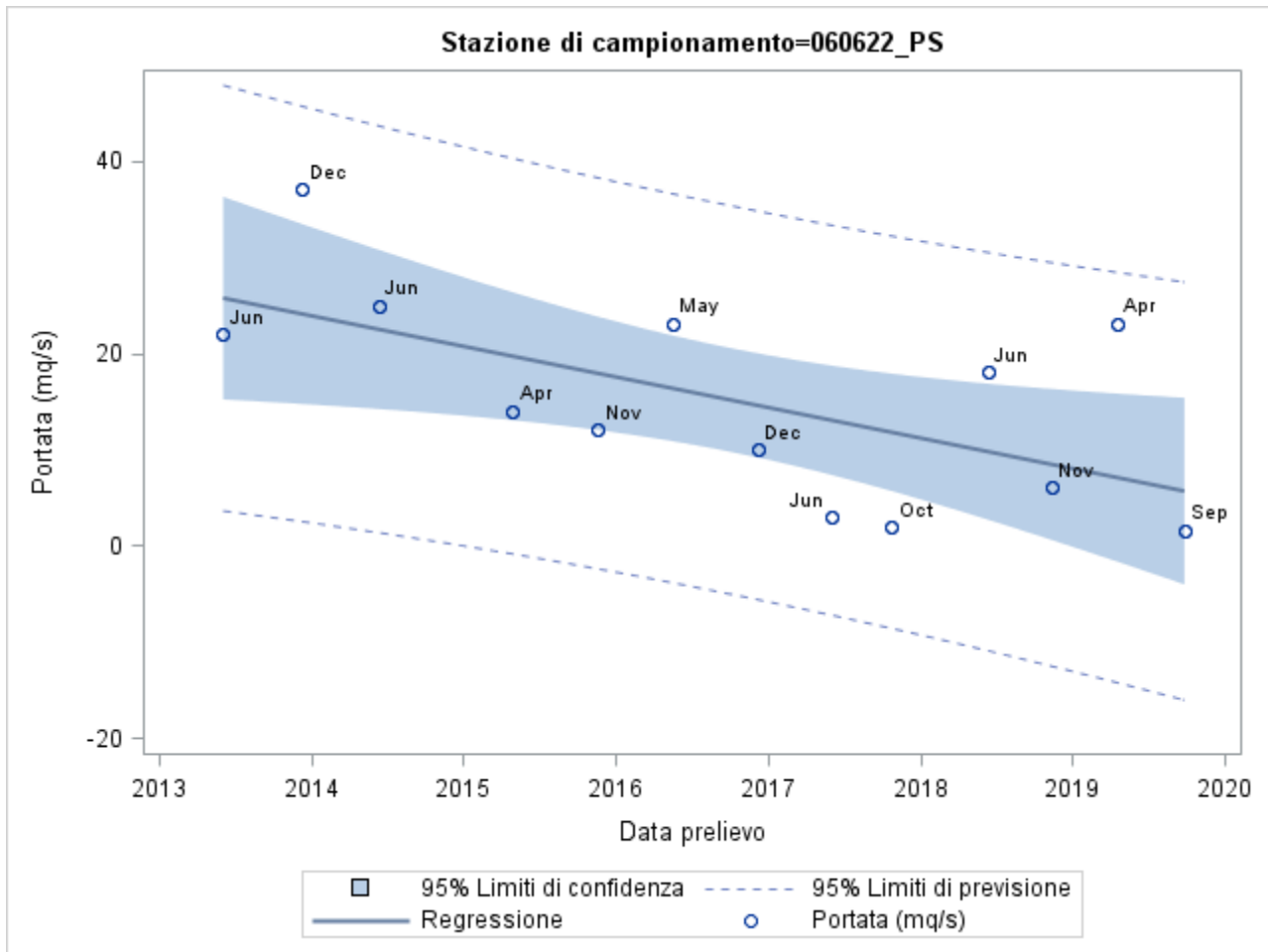


# Appendice H

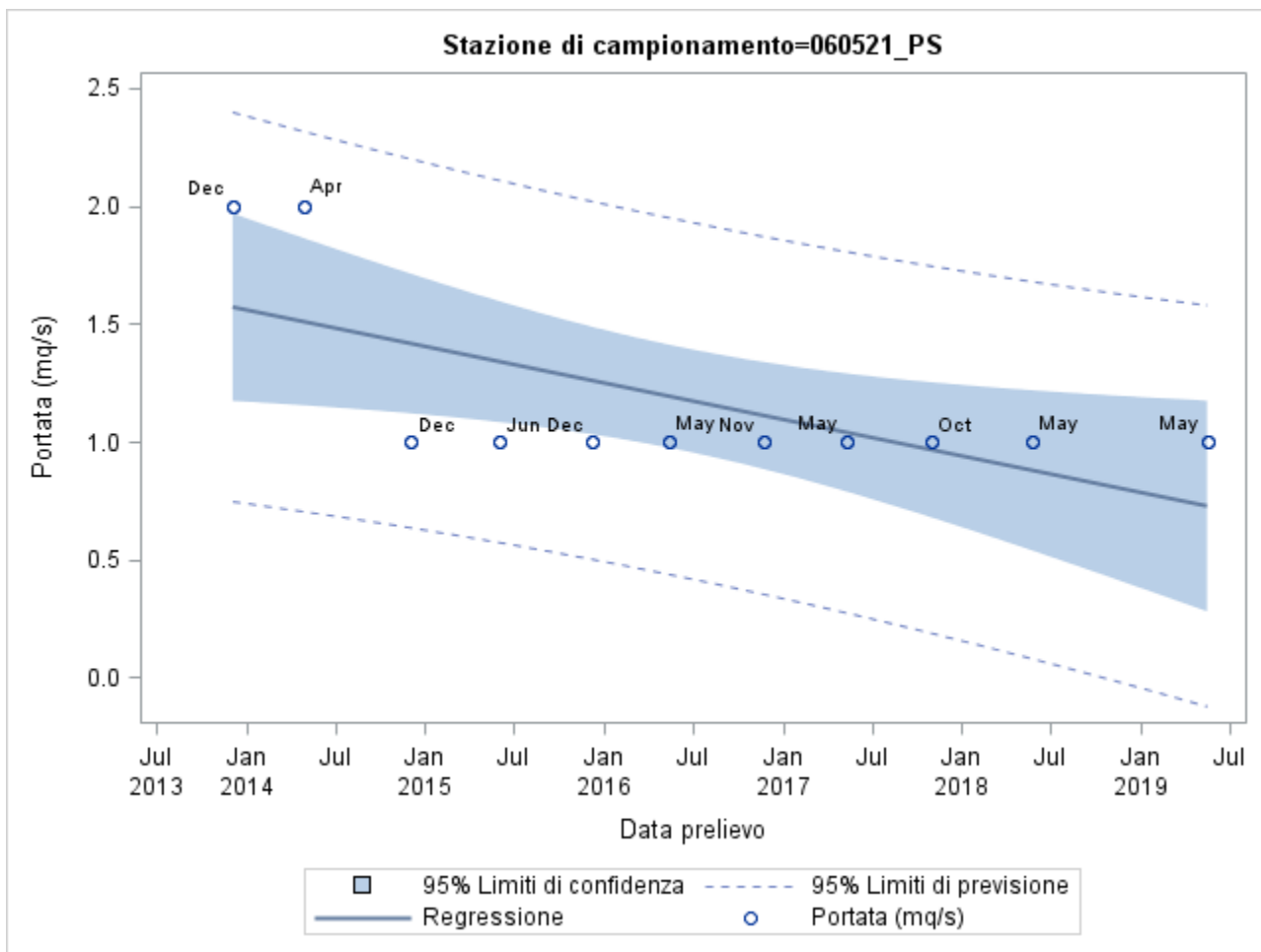


# Appendice H

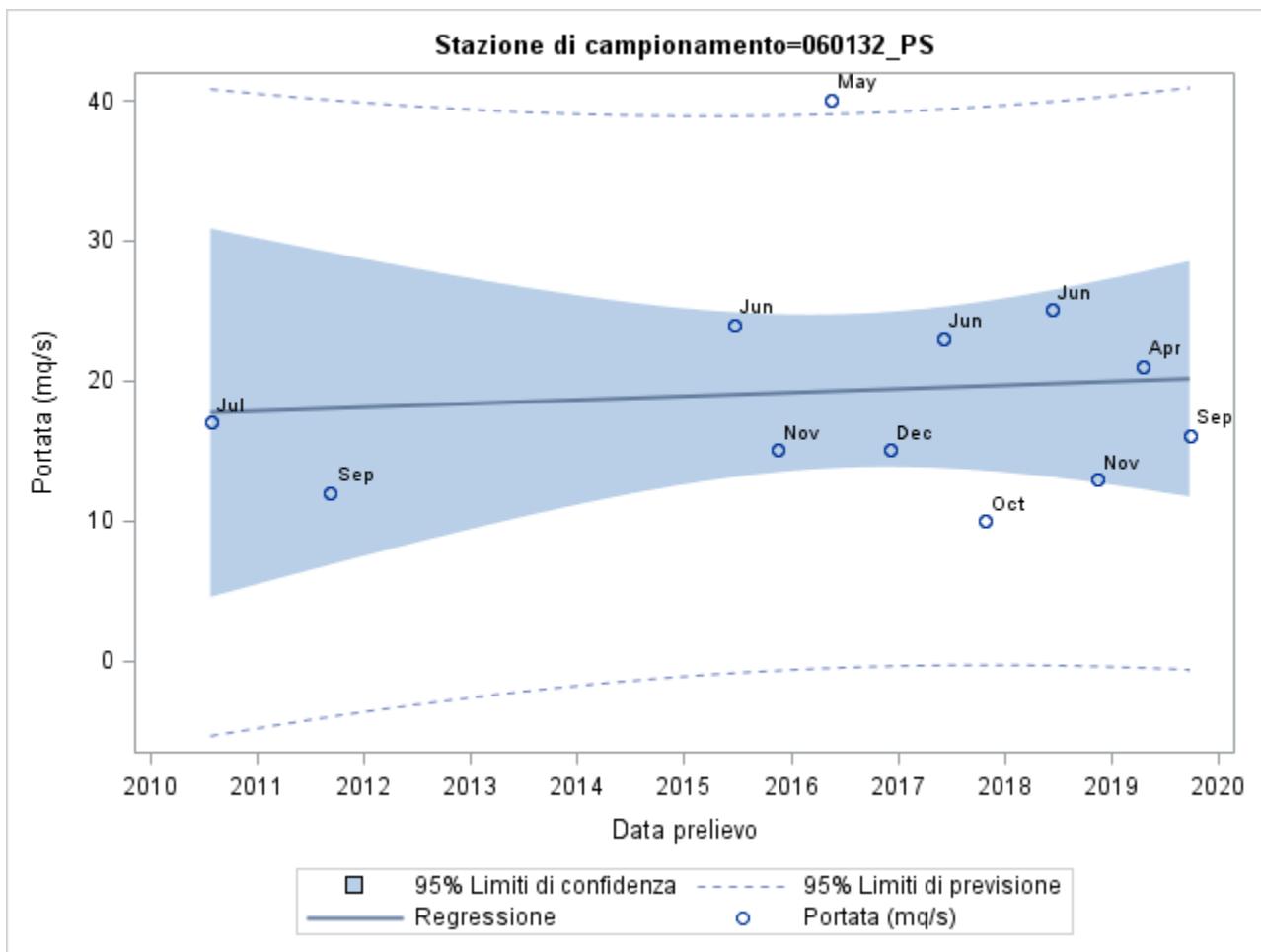
CA\_PIE - UNITÀ DI M. PIETRALATA - M. PAGANUCCIO



# Appendice H

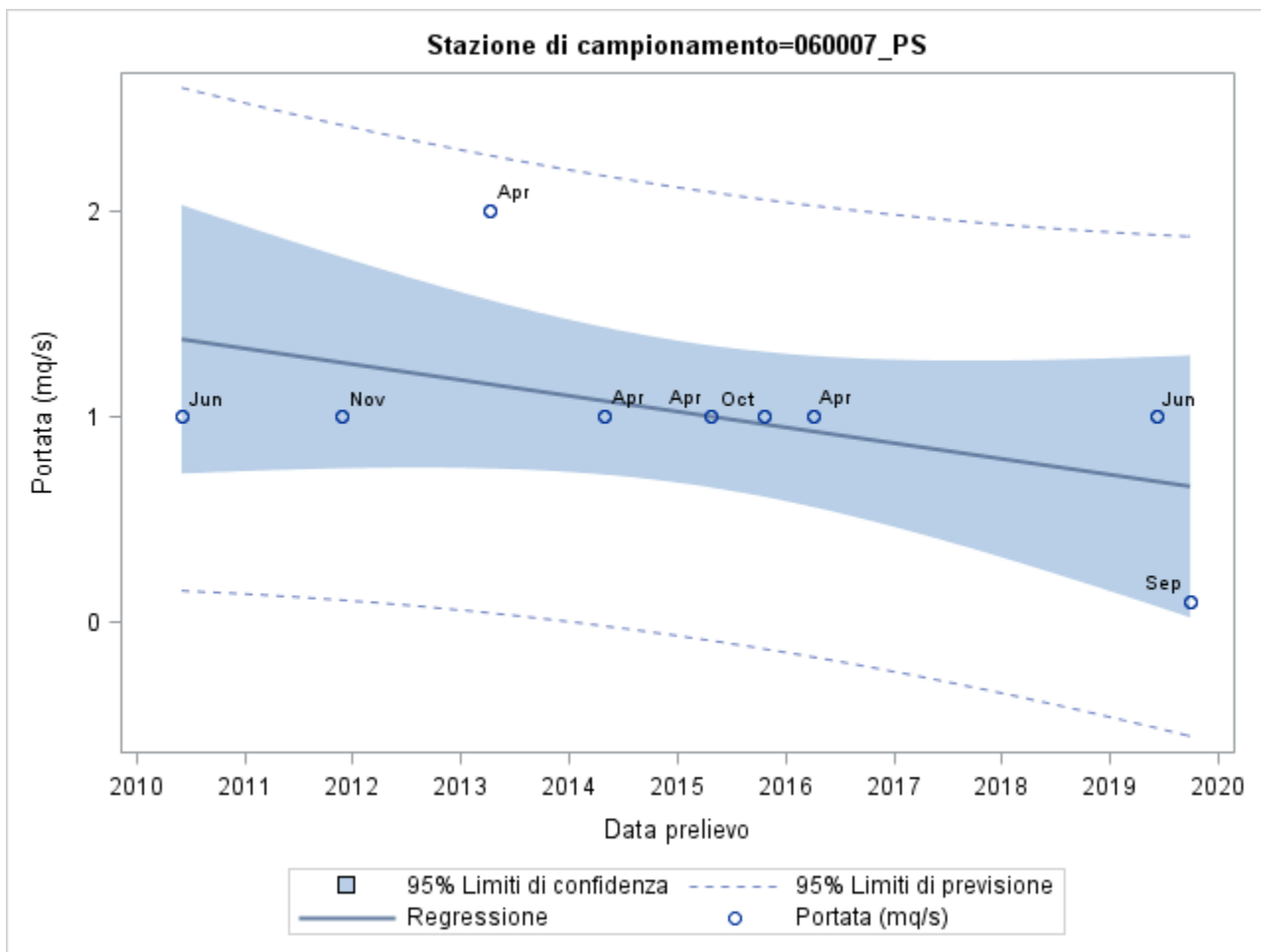


# Appendice H



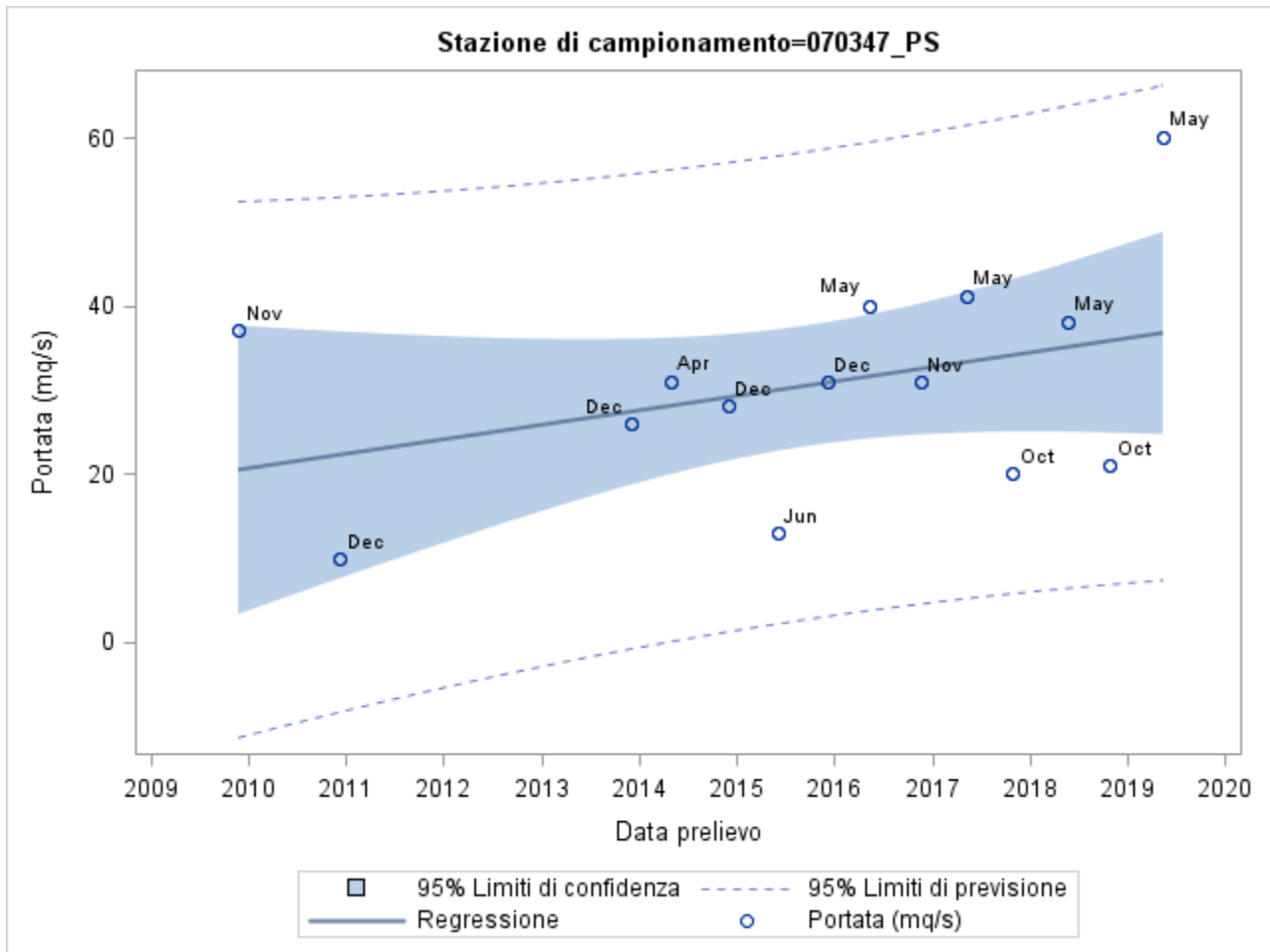


# Appendice H

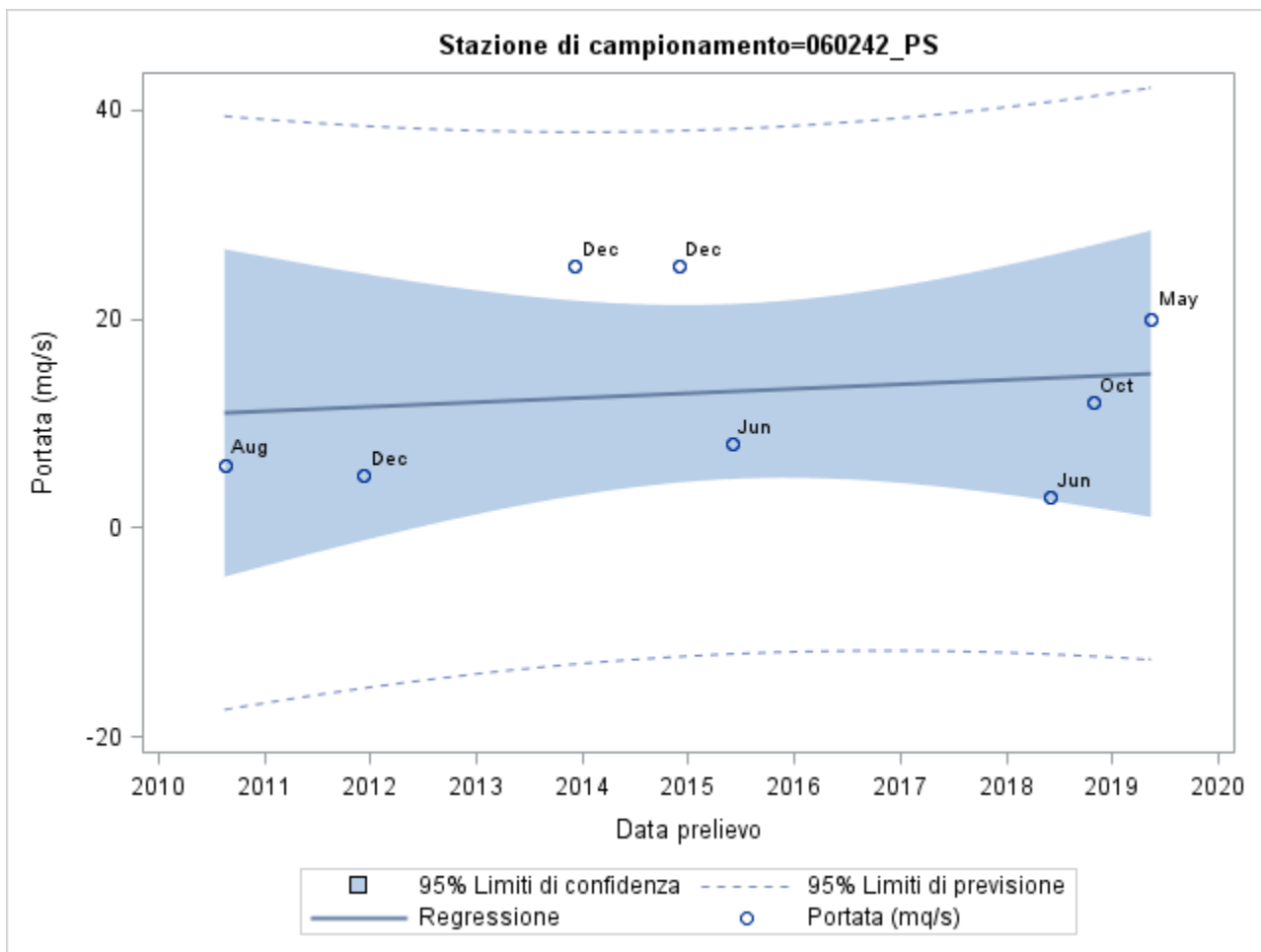


# Appendice H

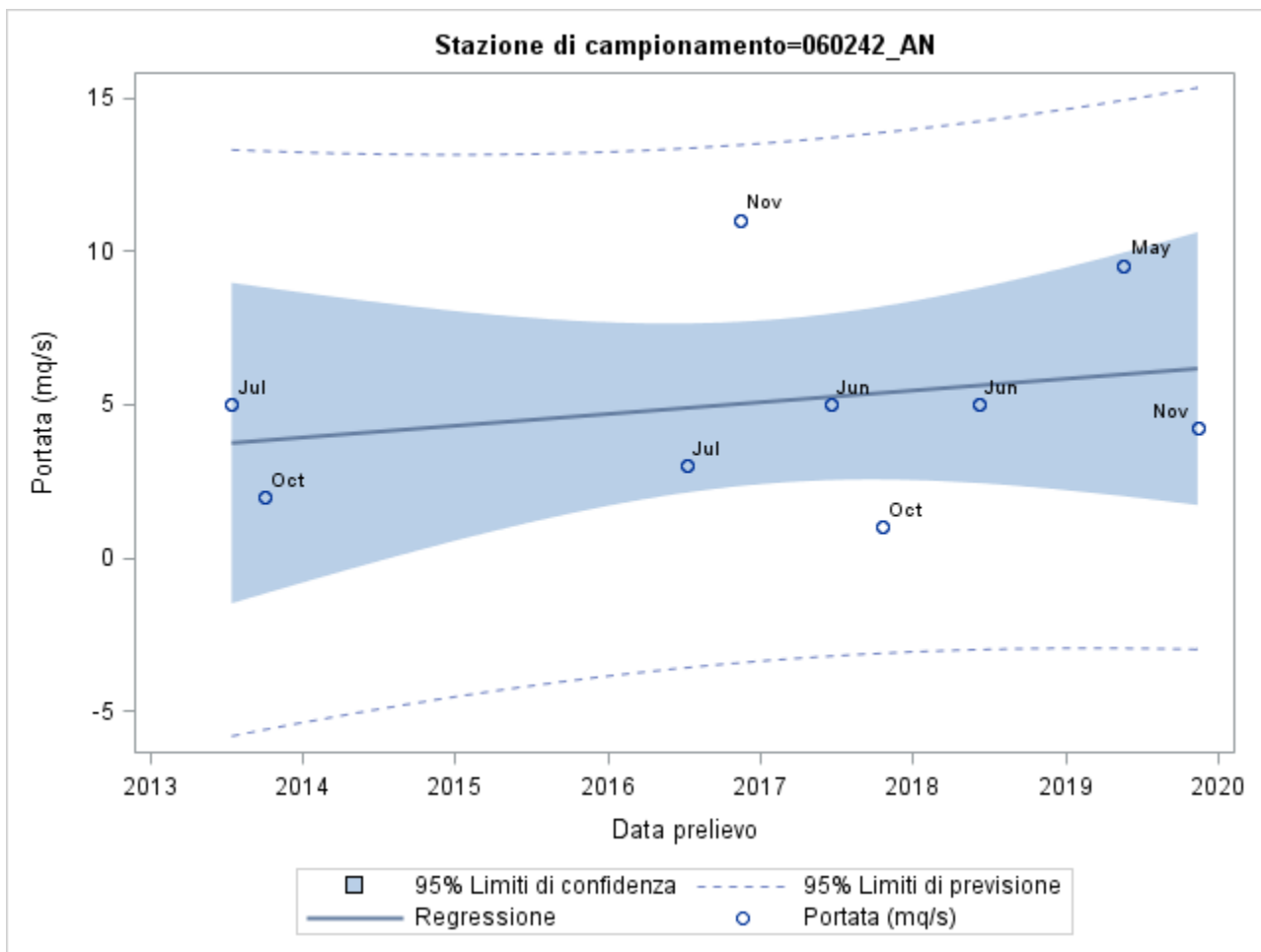
## CA\_UMS - SISTEMA UMBRO – MARCHIGIANO



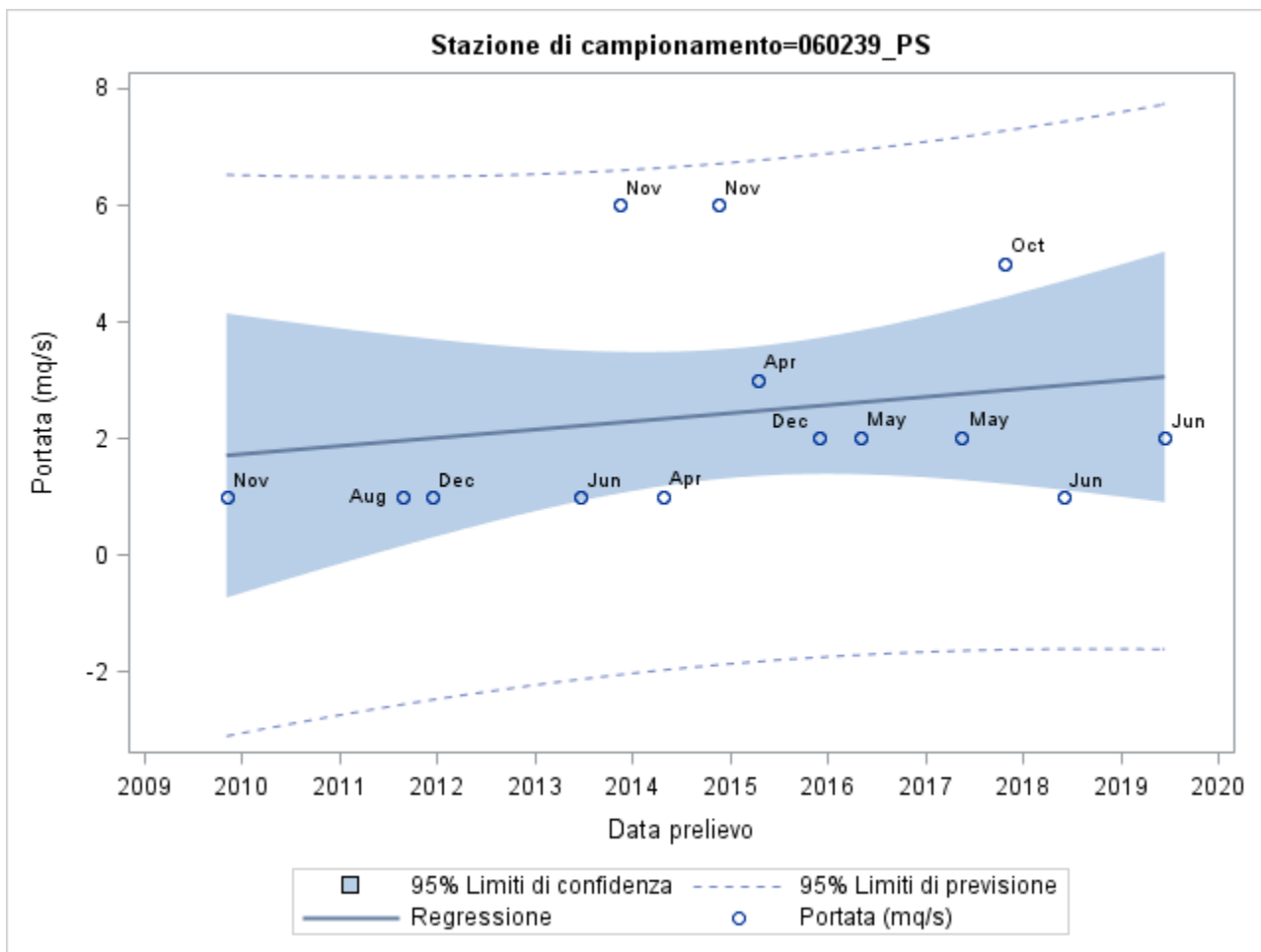
# Appendice H



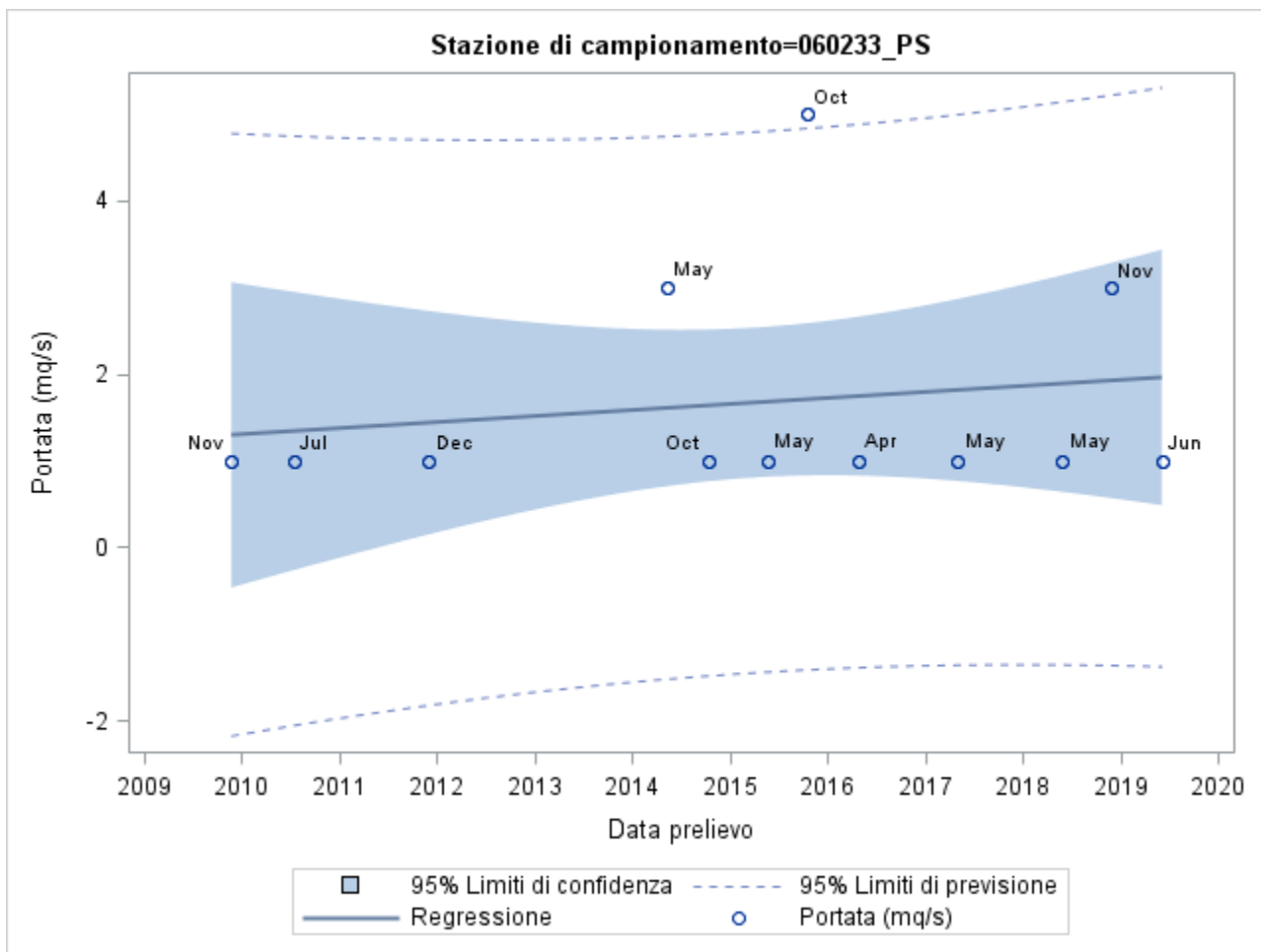
# Appendice H



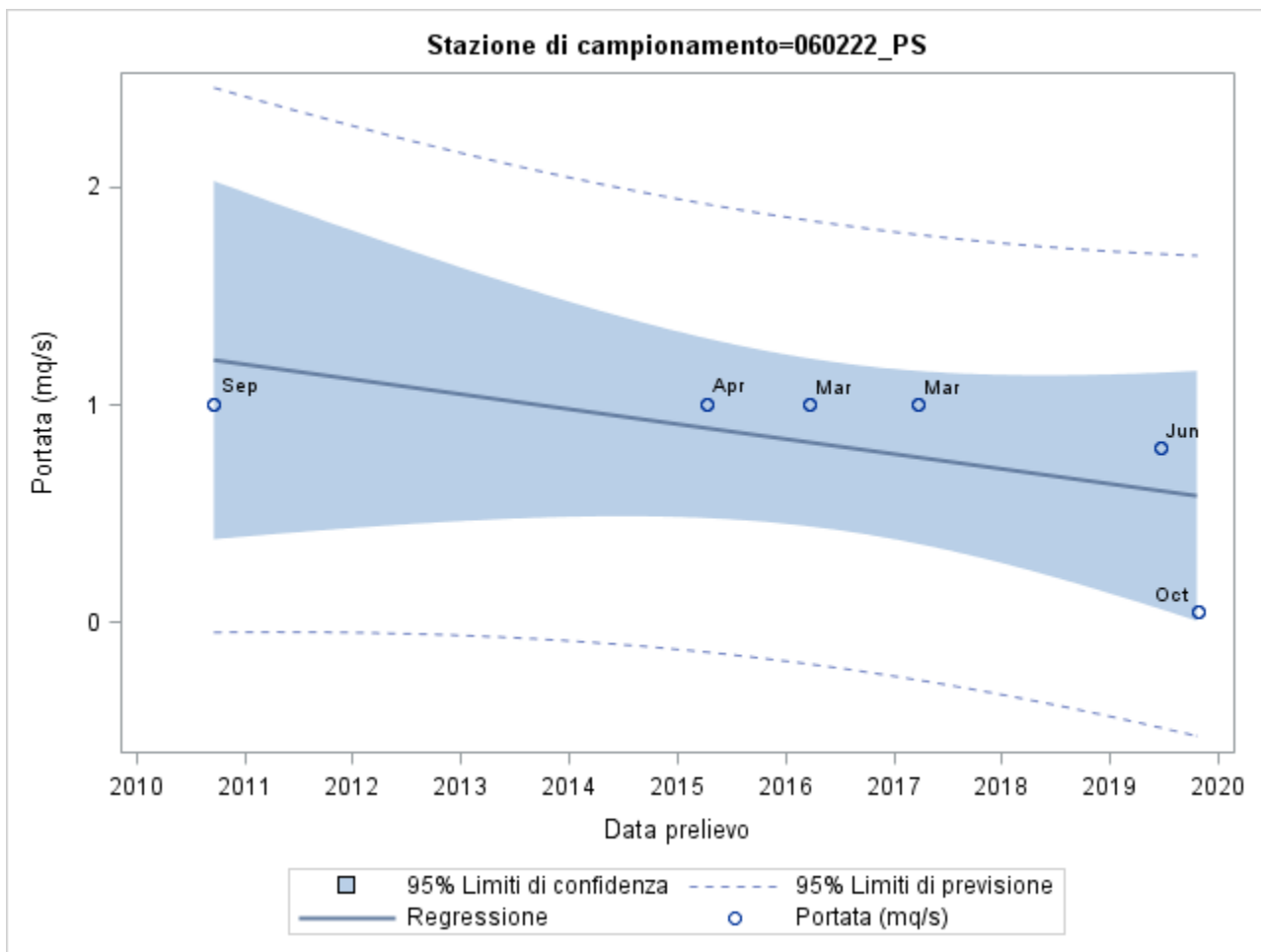
# Appendice H



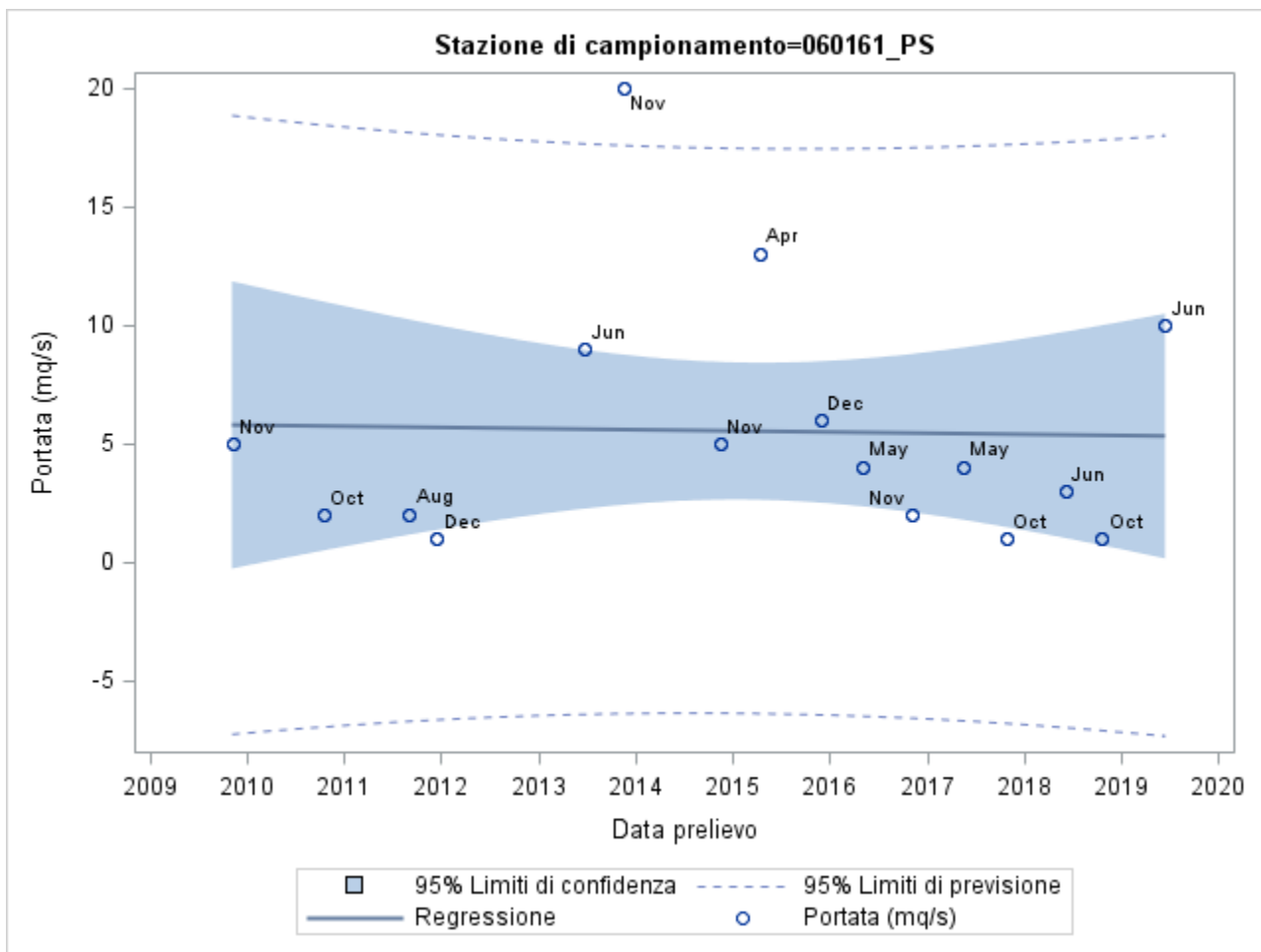
# Appendice H



# Appendice H

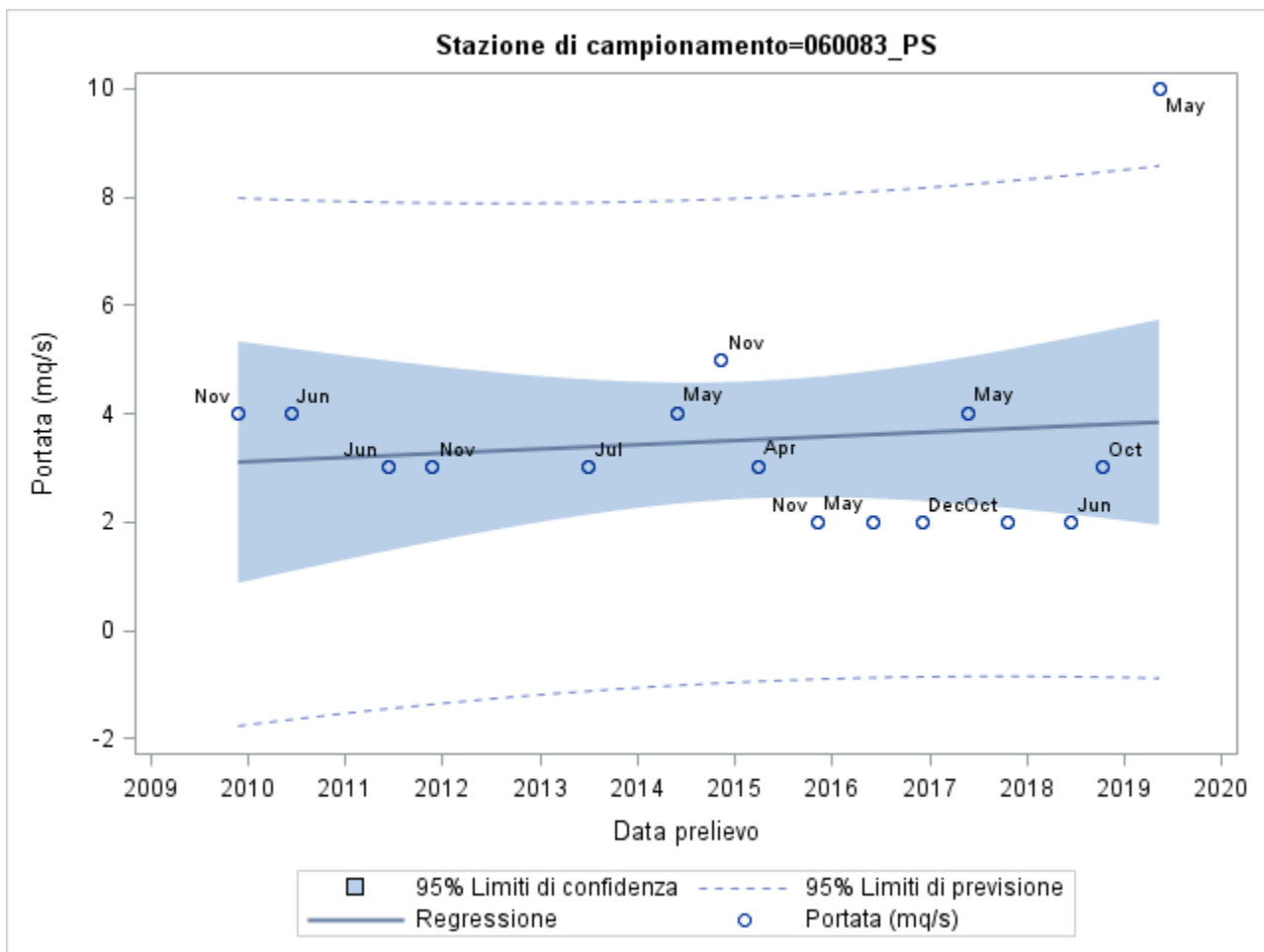


# Appendice H

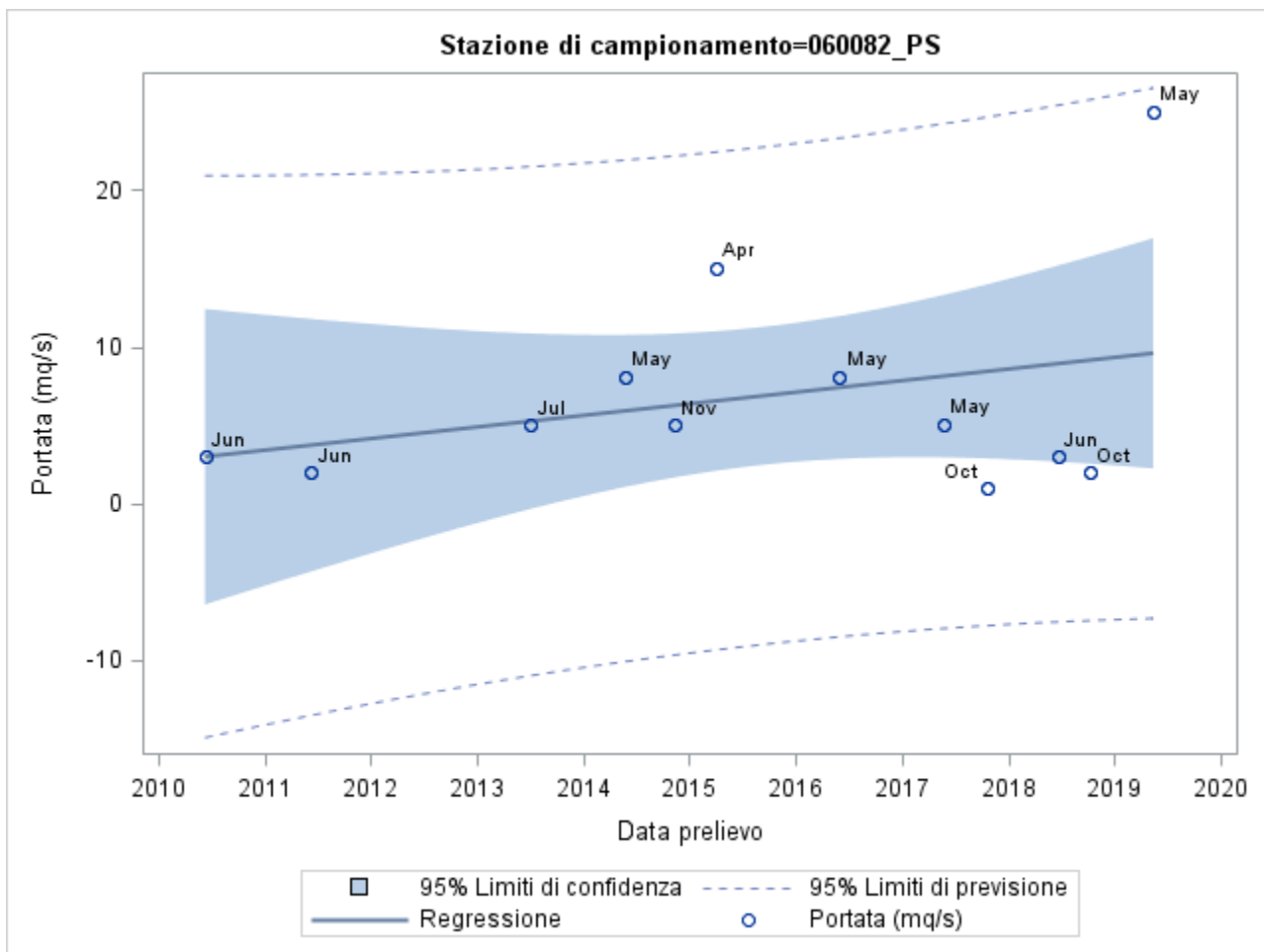




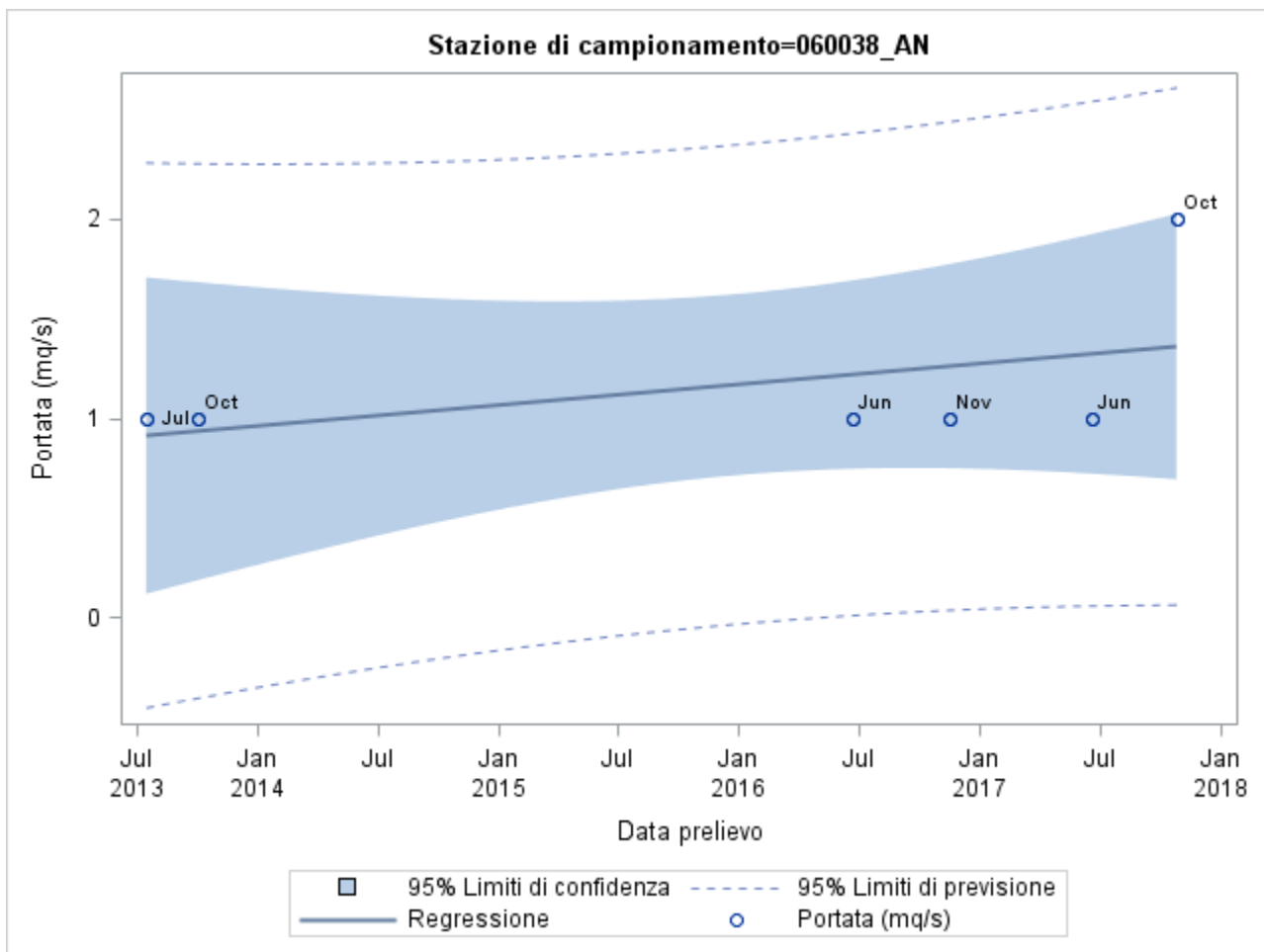
# Appendice H



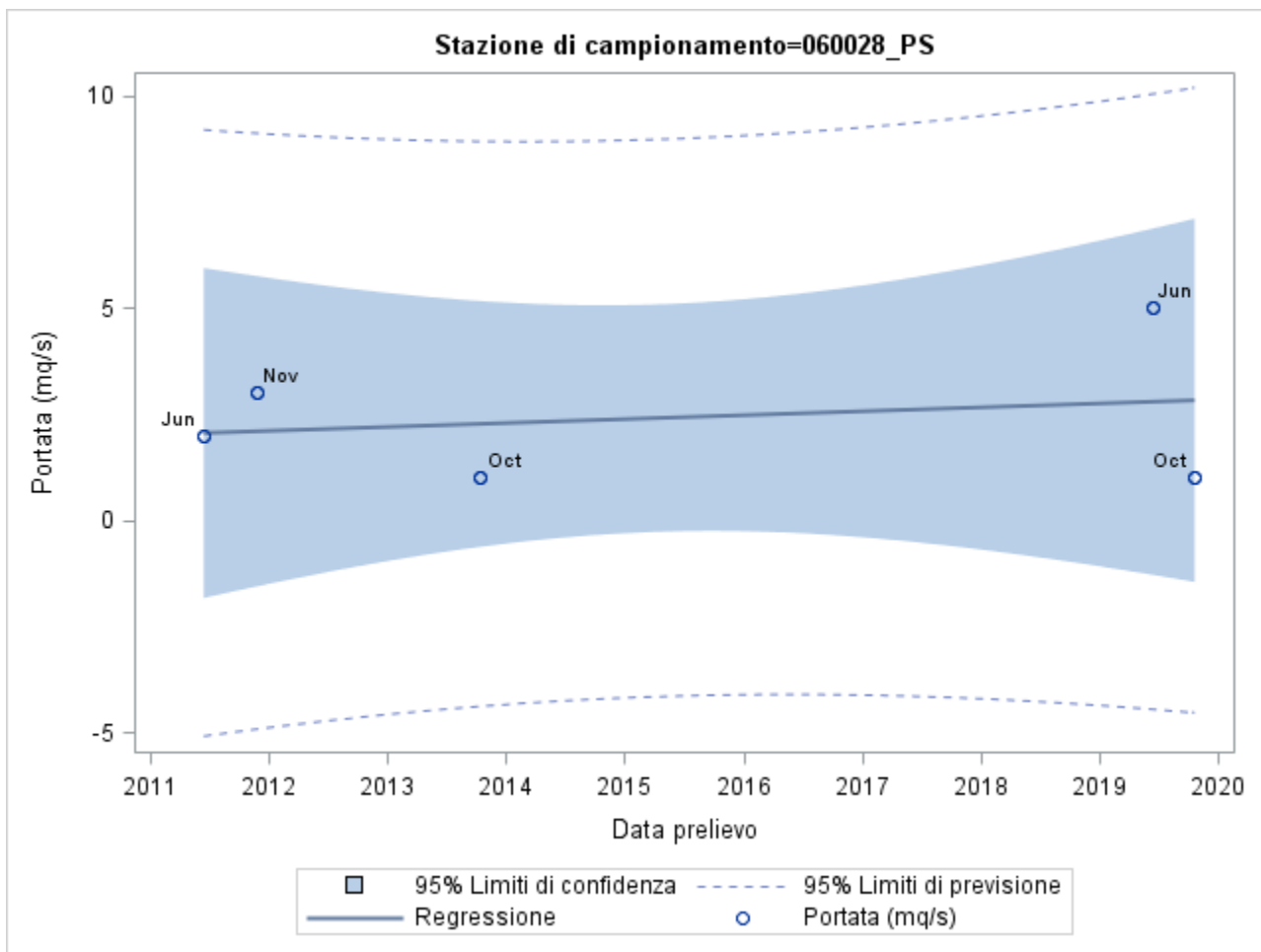
# Appendice H



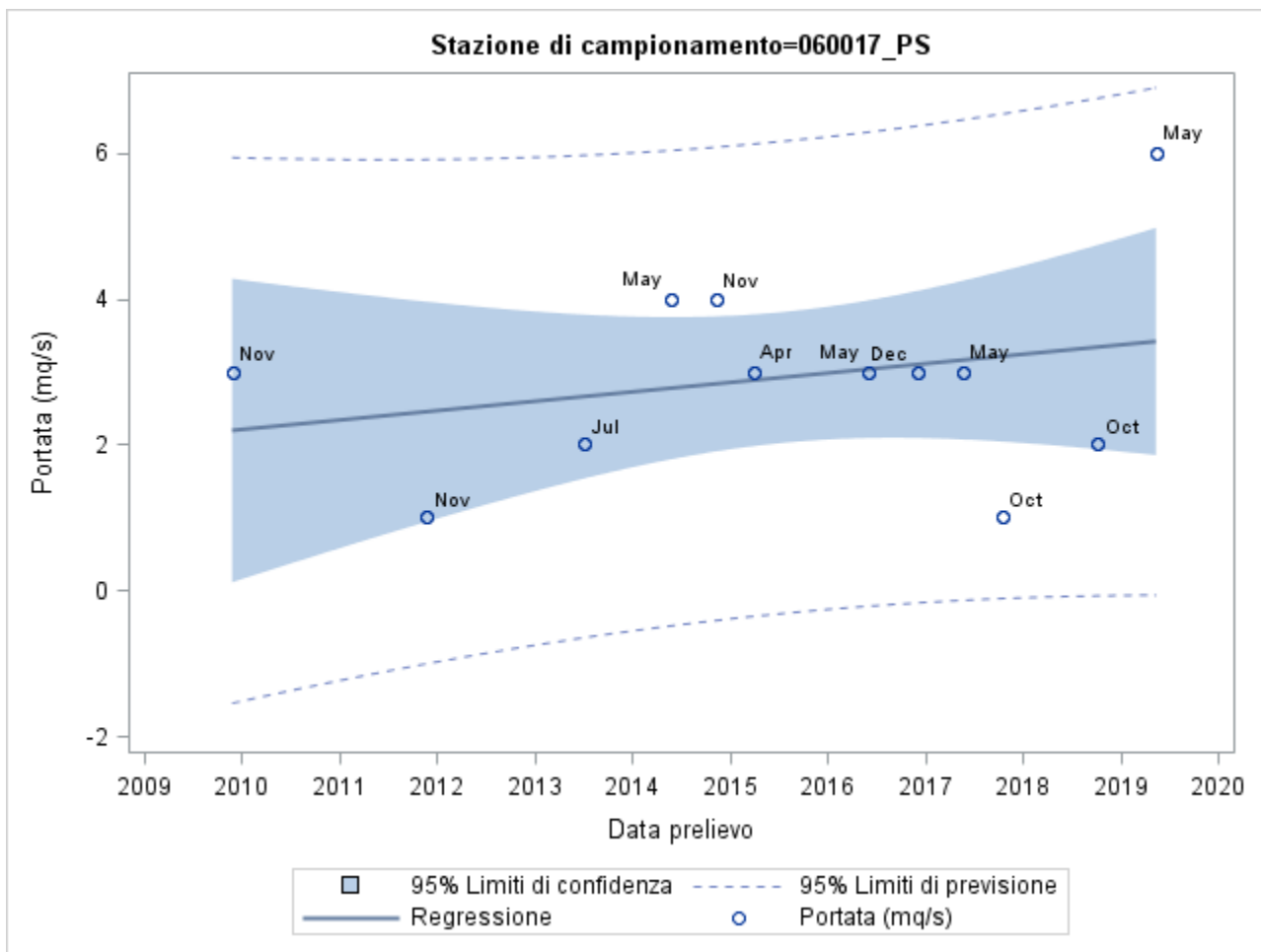
# Appendice H



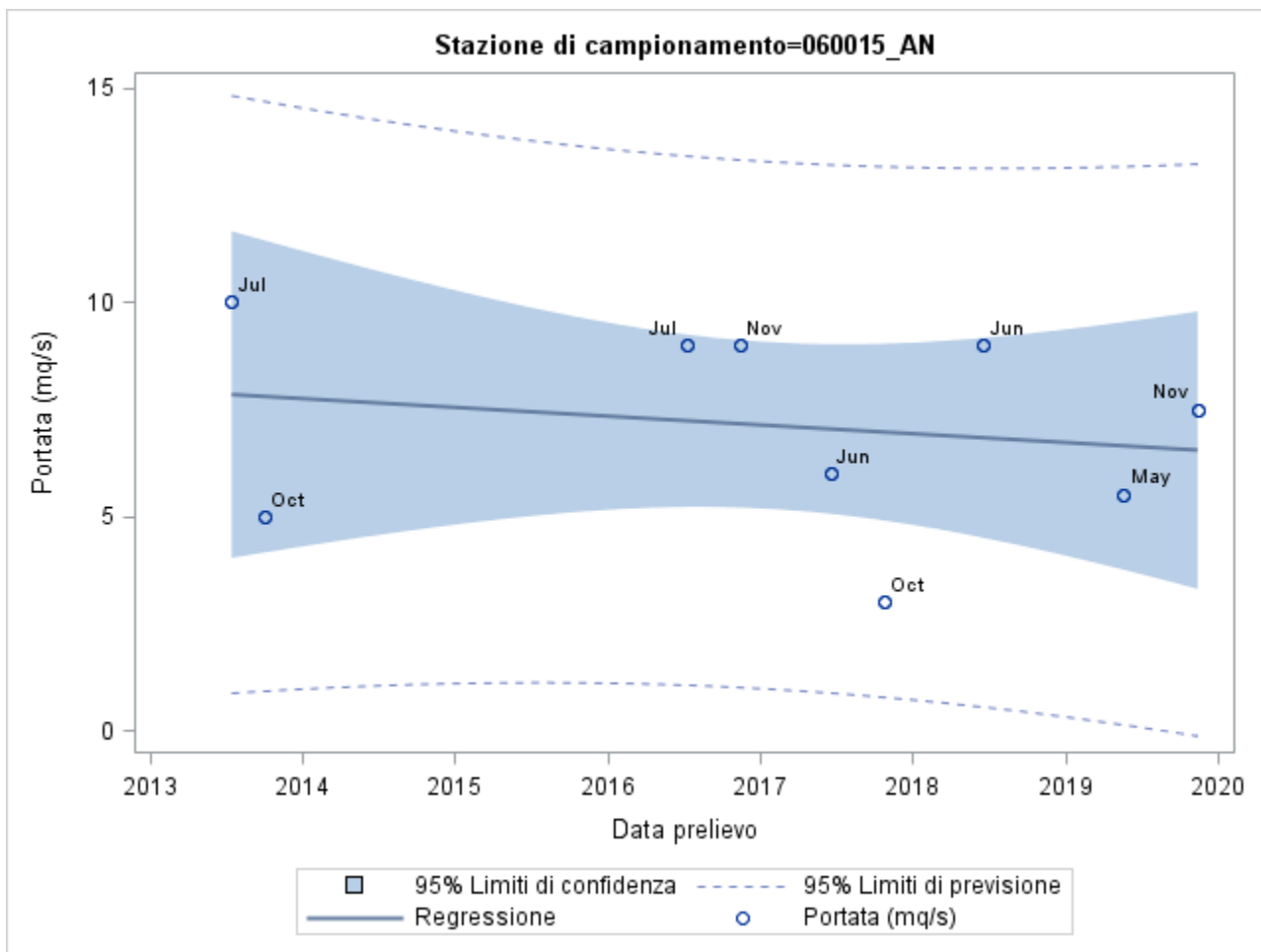
# Appendice H



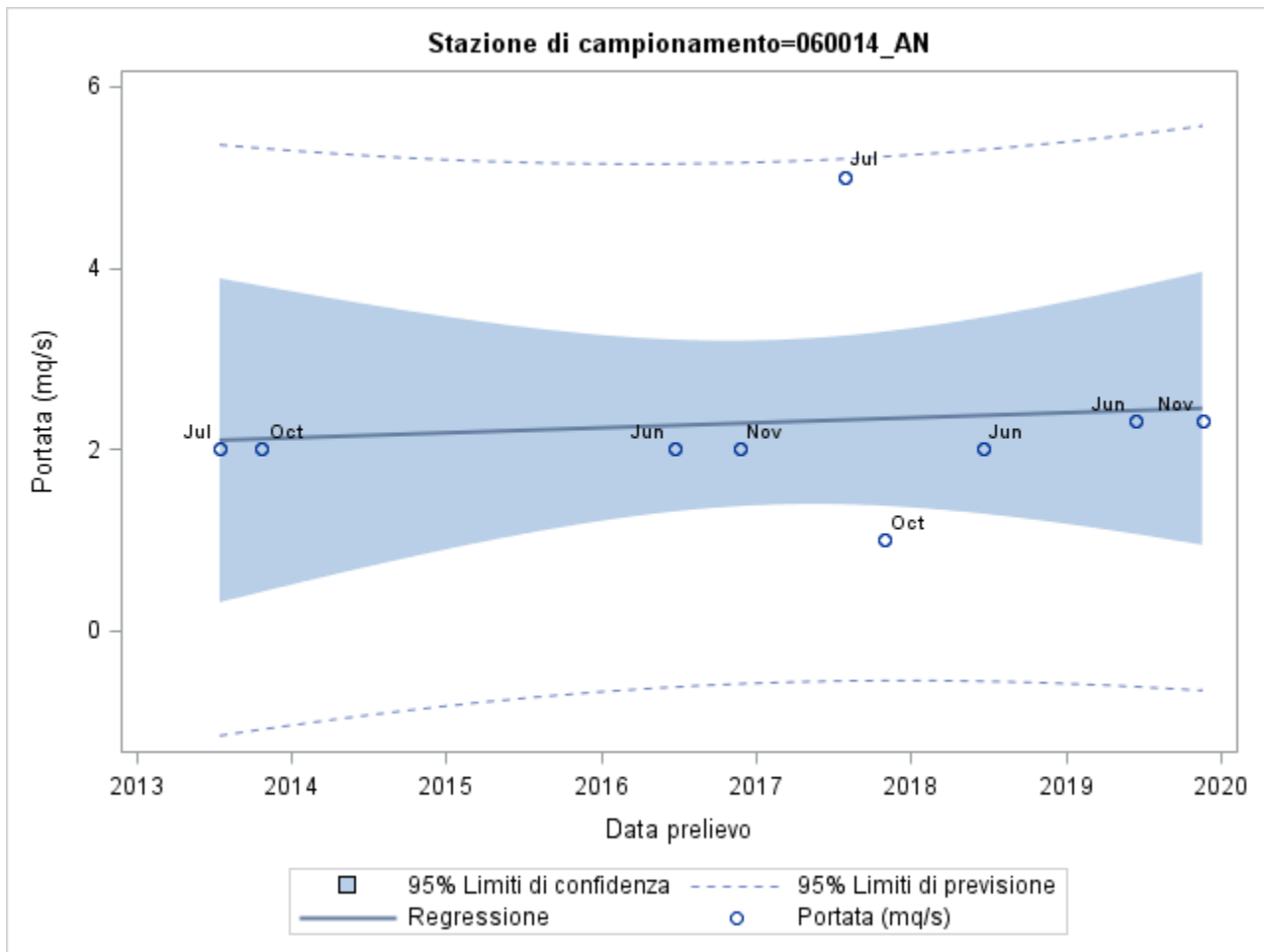
# Appendice H



# Appendice H

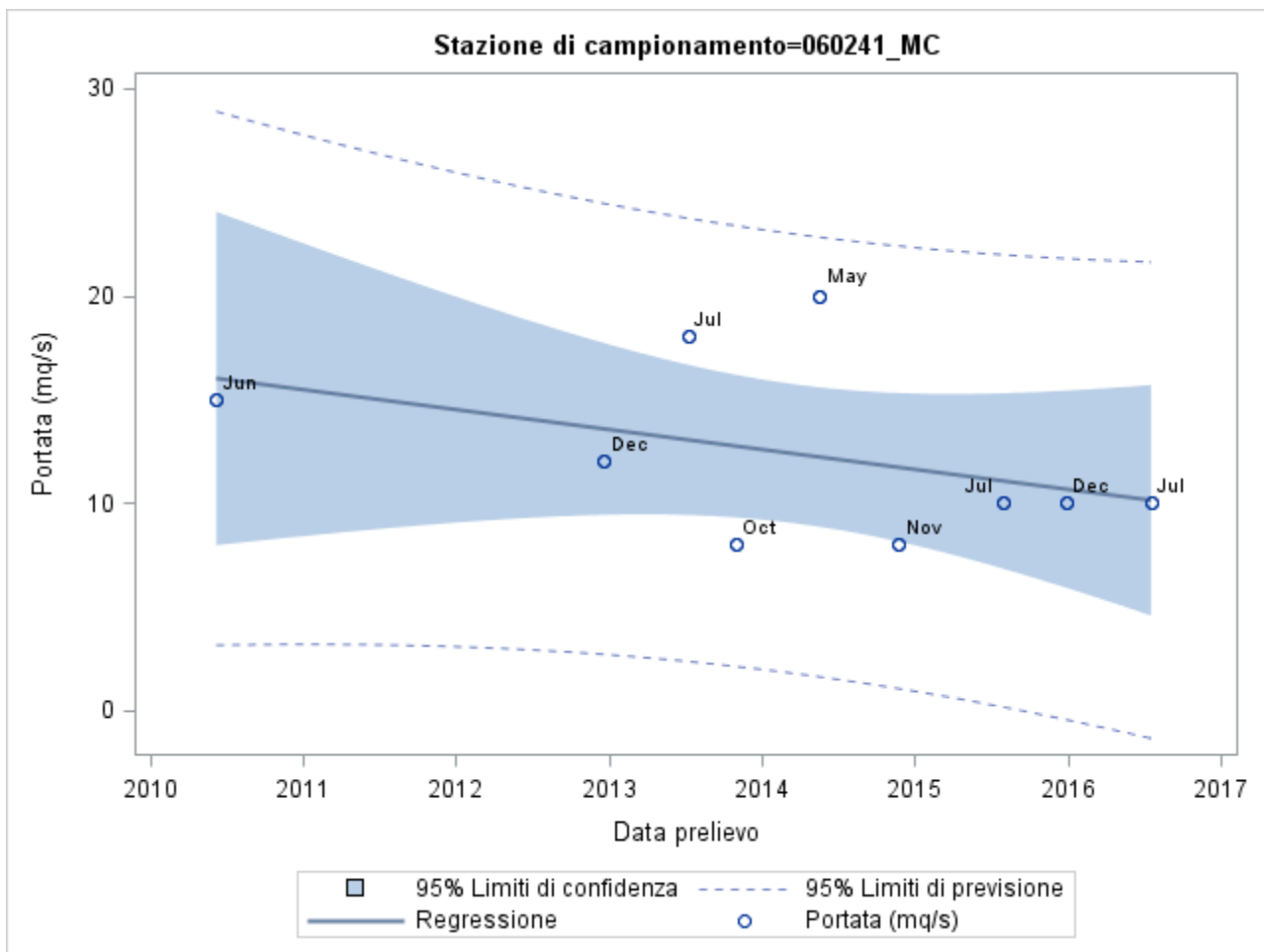


# Appendice H



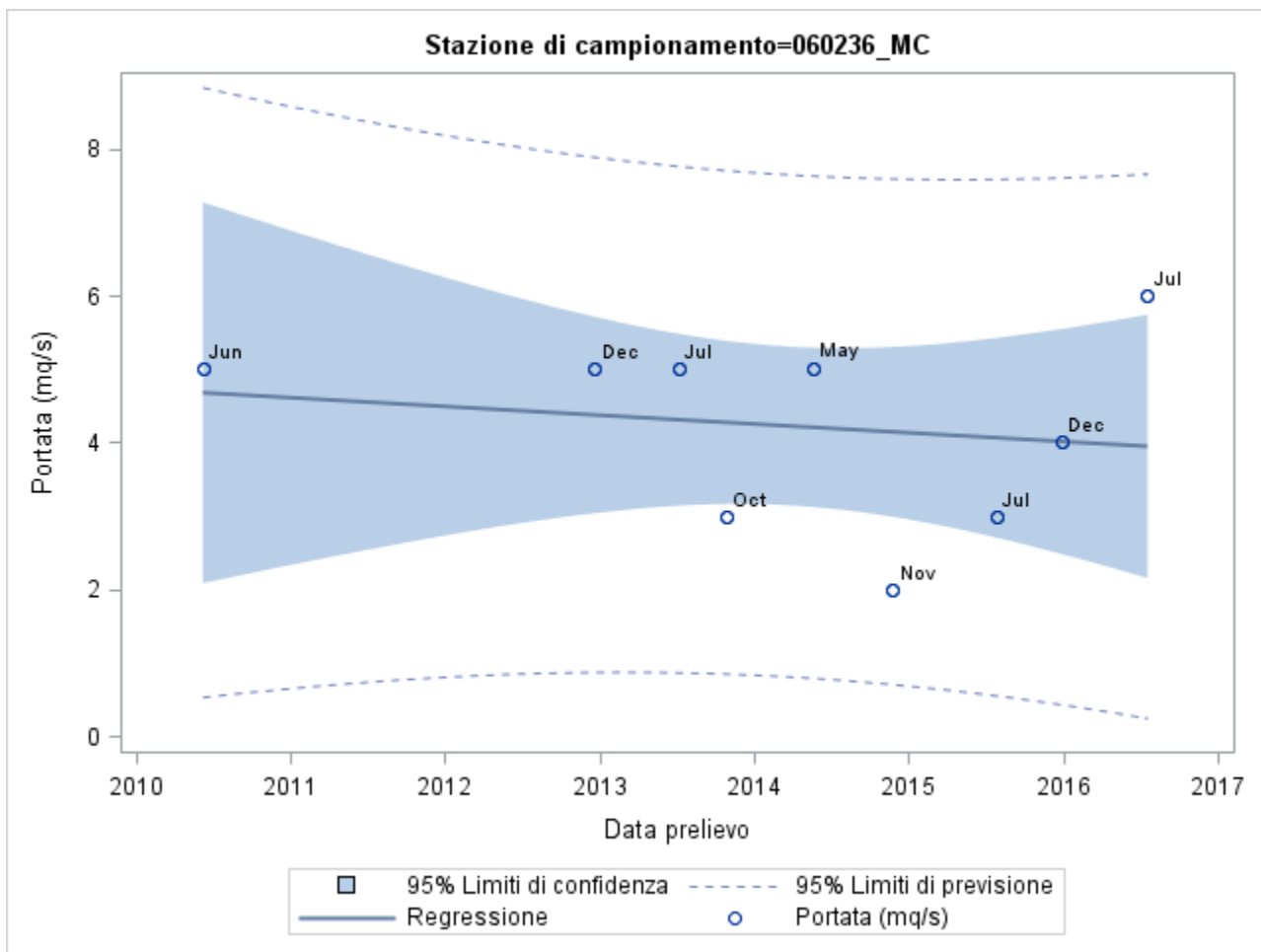
# Appendice H

CA\_UMM - SISTEMA UMBRO - MARCHIGIANO MERIDIONALE (CA\_UMM, CA\_UMM\_1)

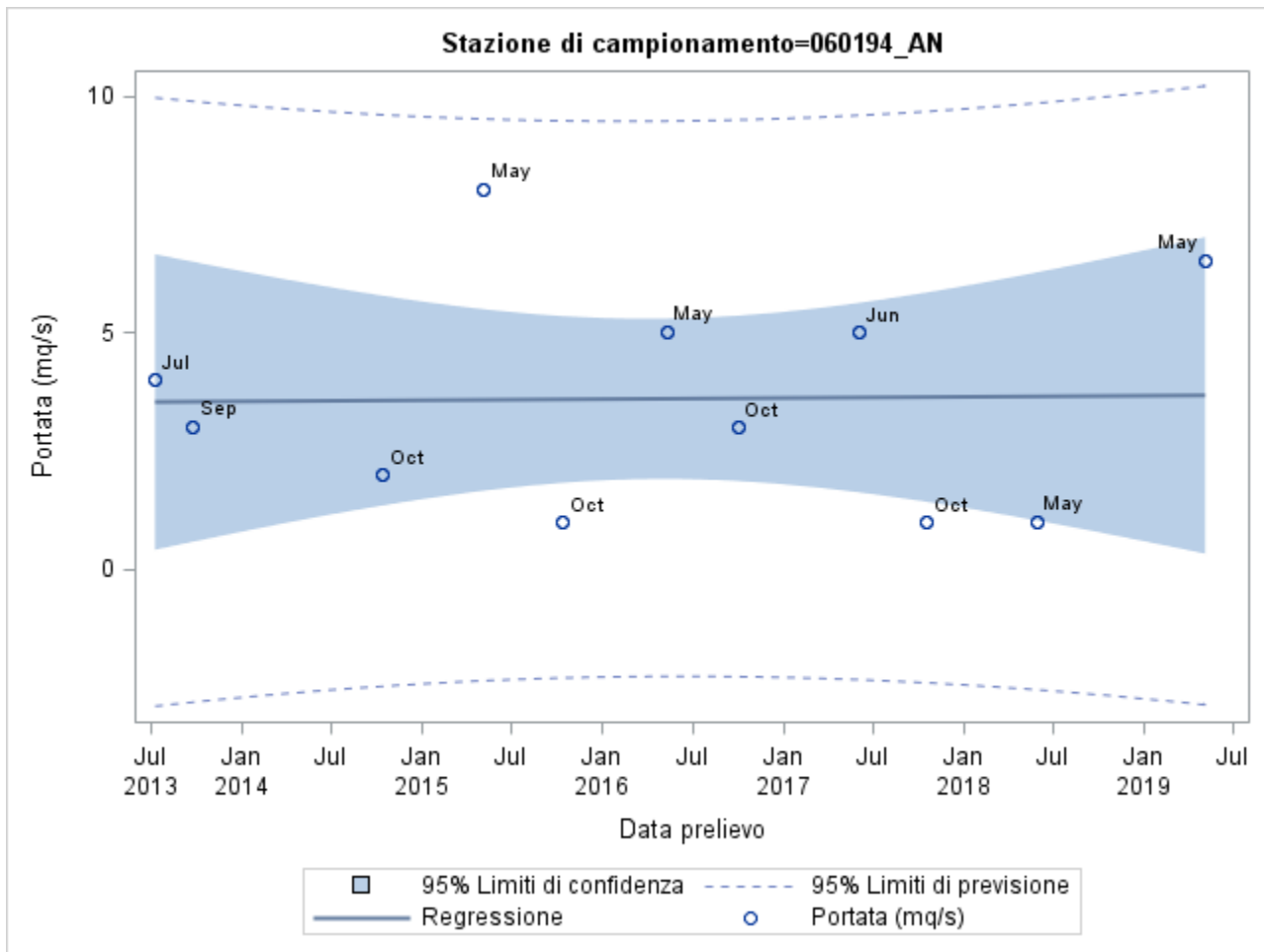




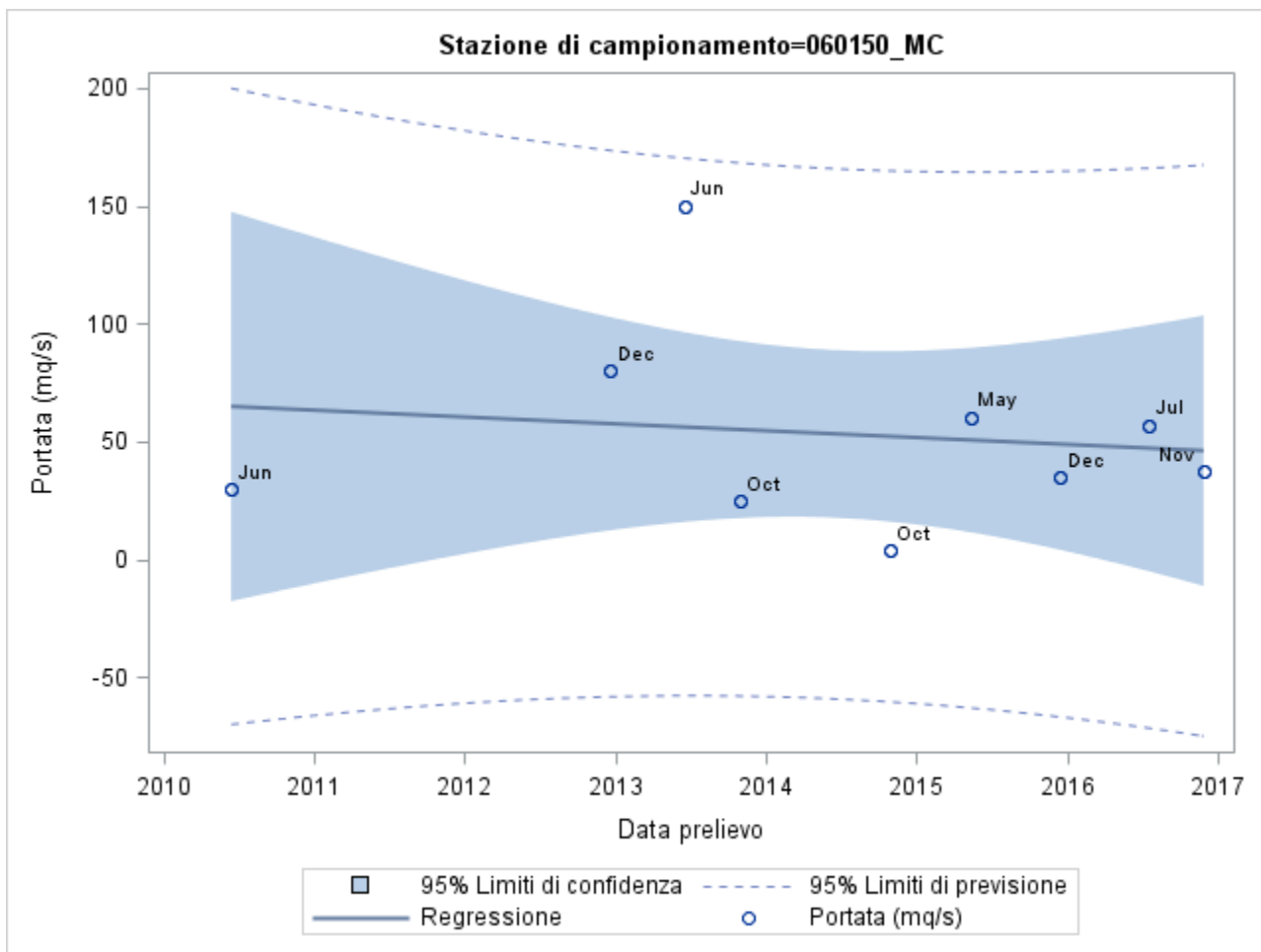
# Appendice H



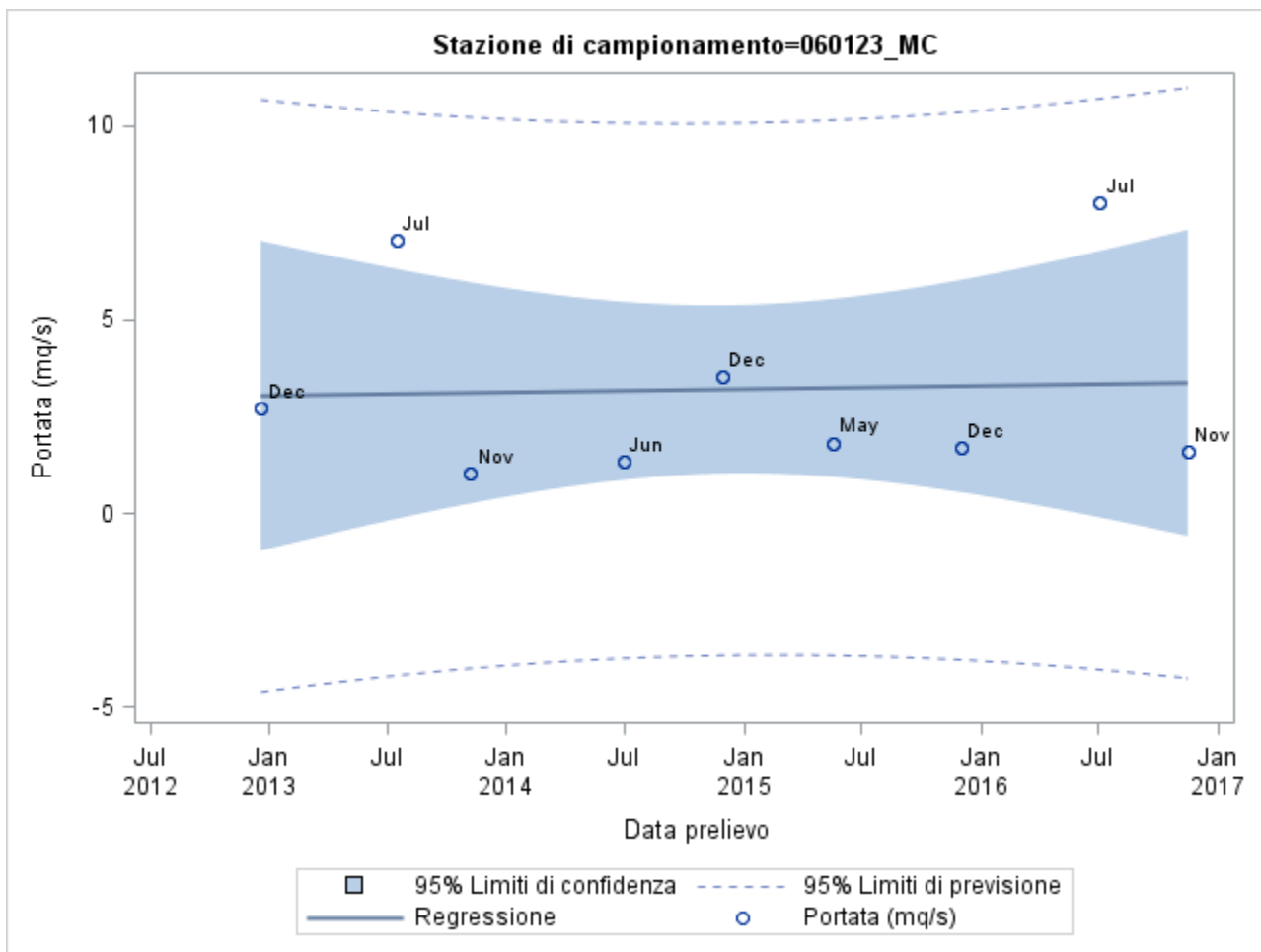
# Appendice H



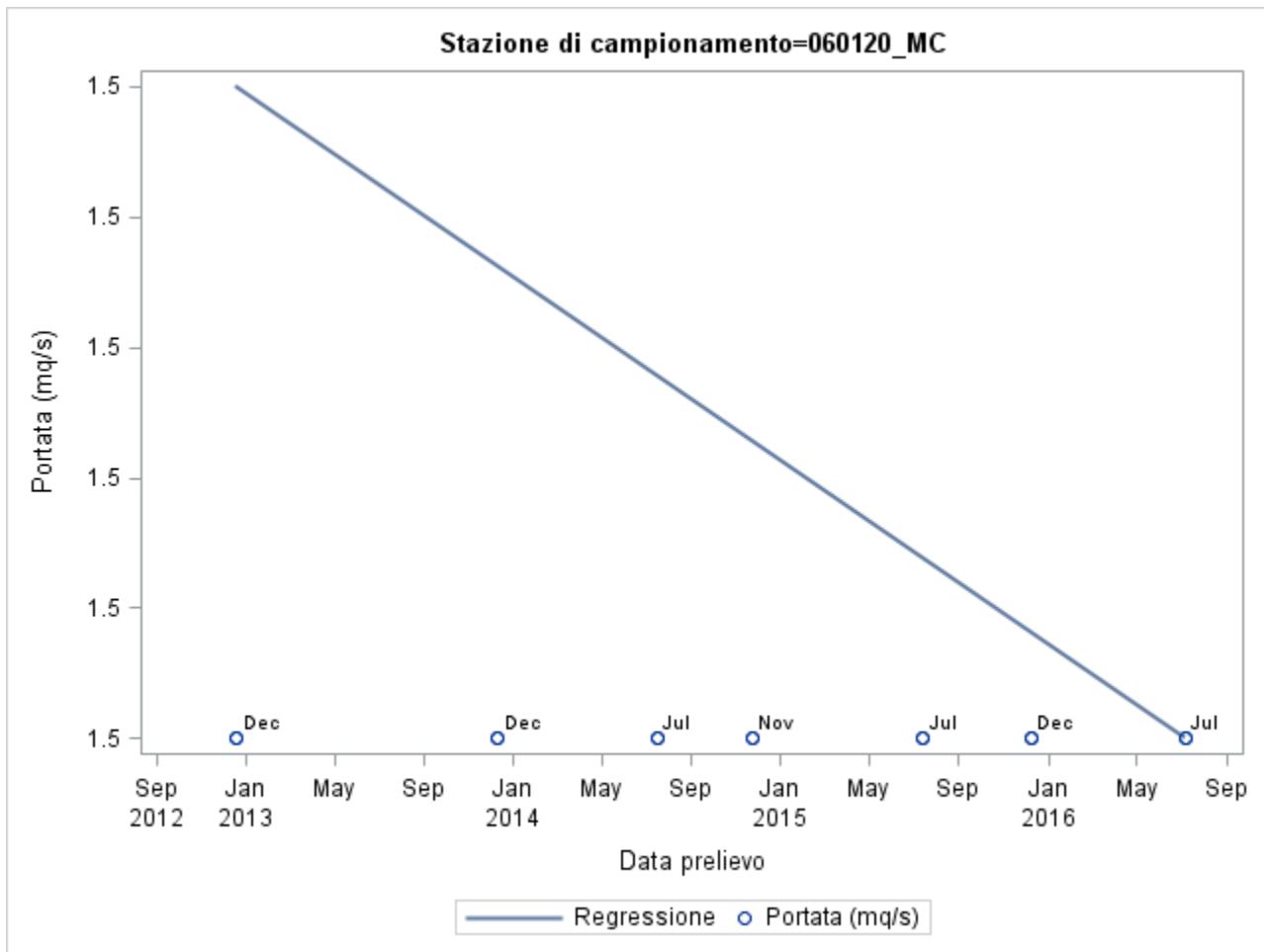
# Appendice H



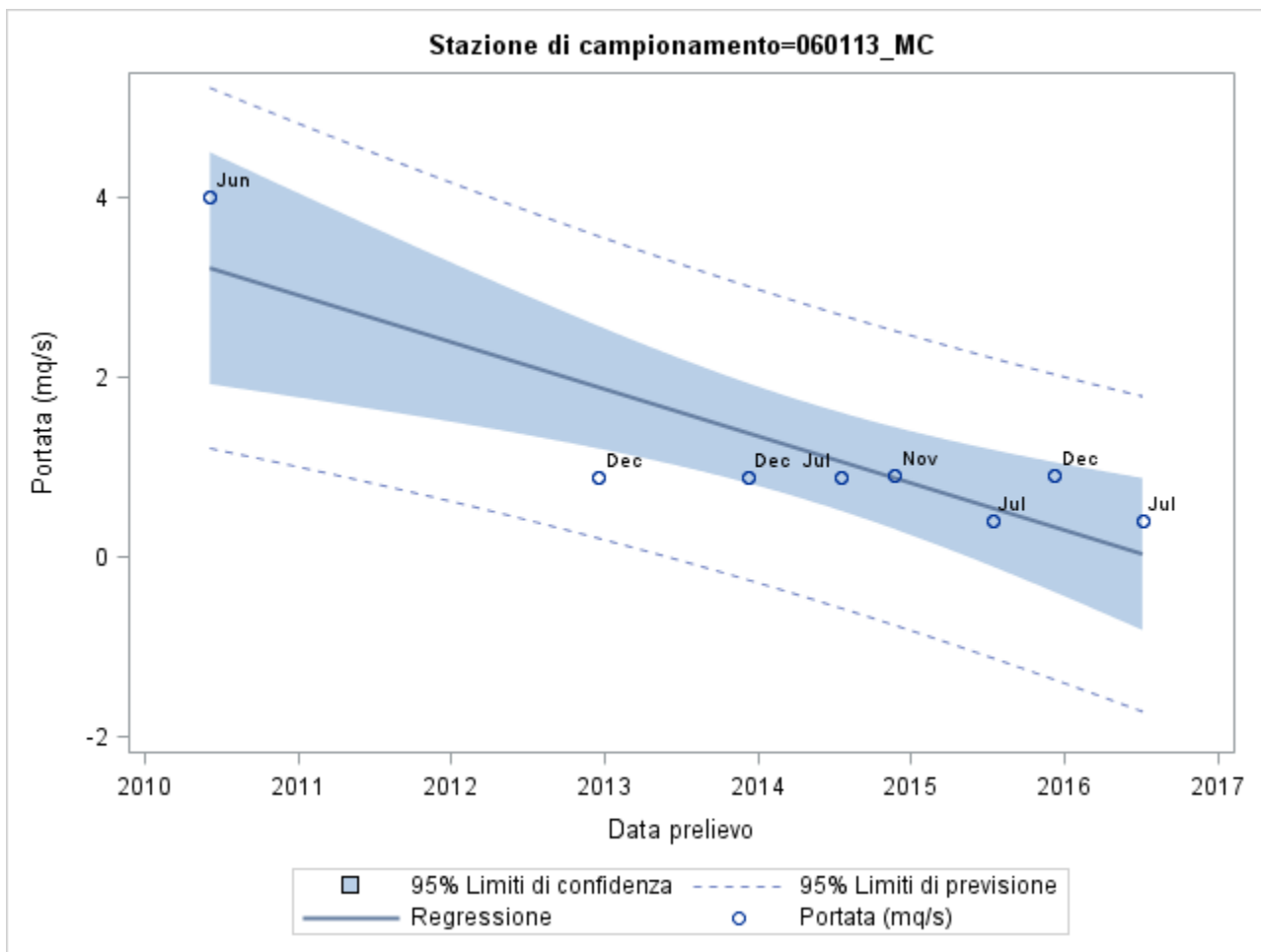
# Appendice H



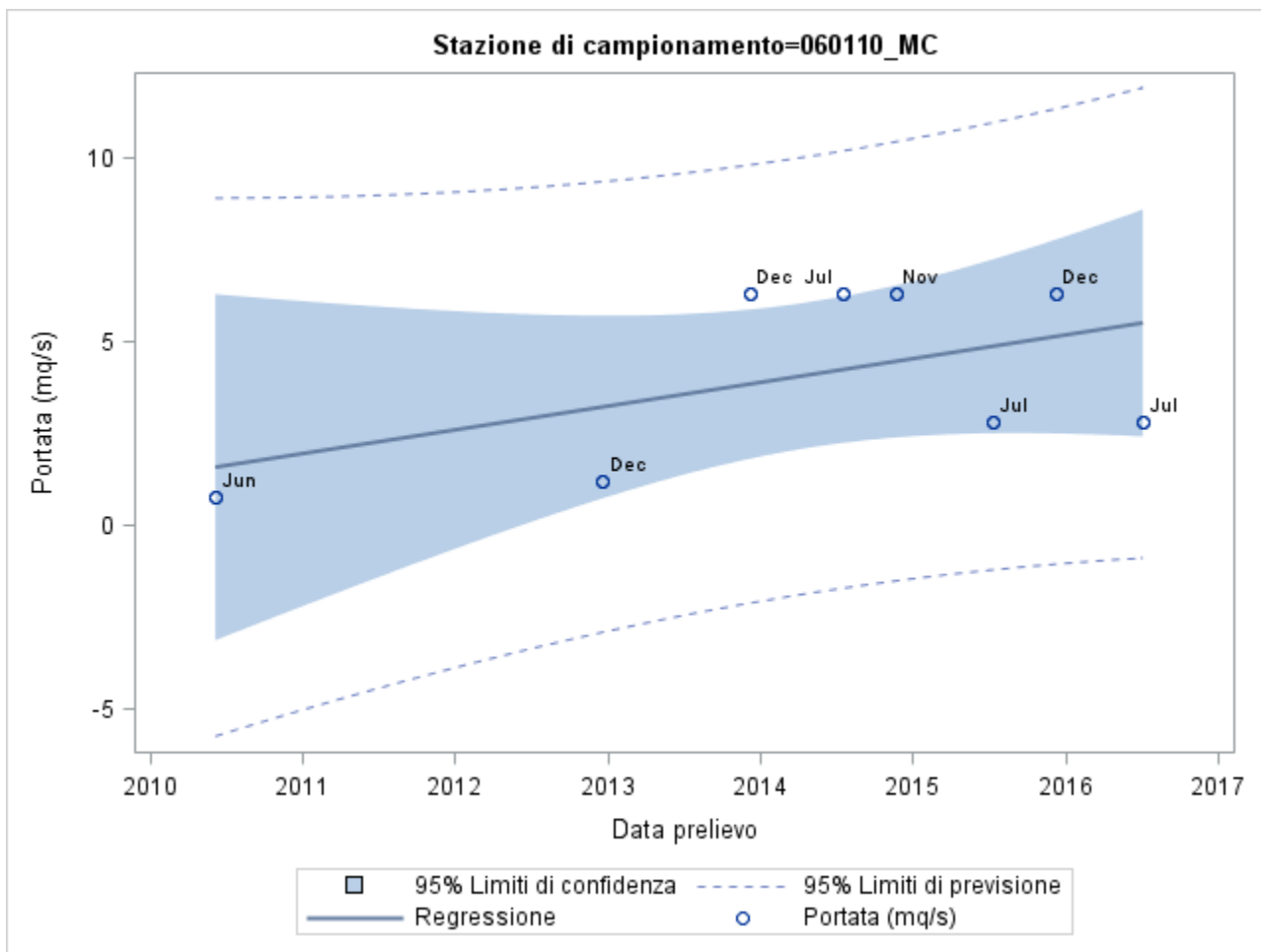
# Appendice H



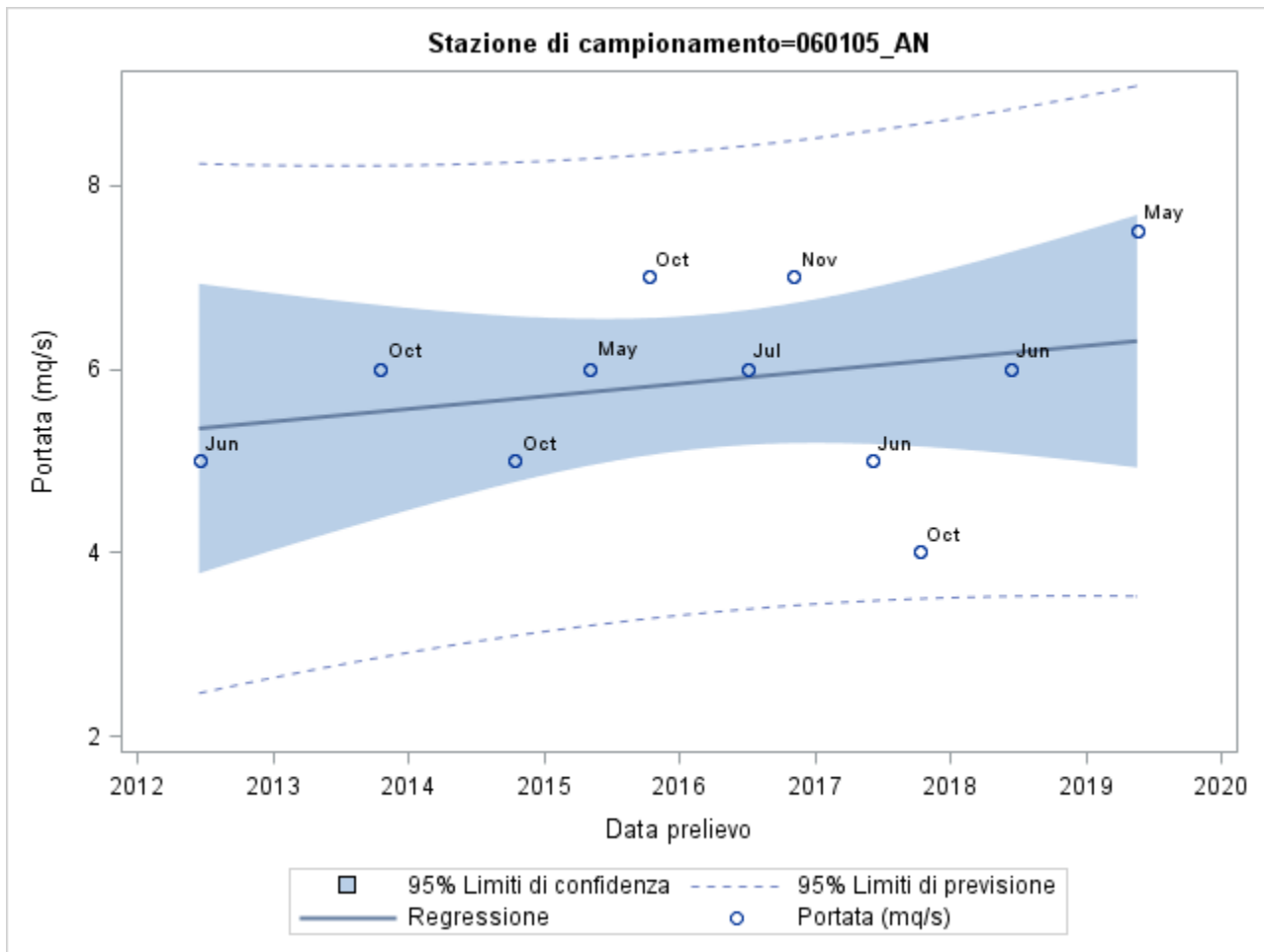
# Appendice H



# Appendice H

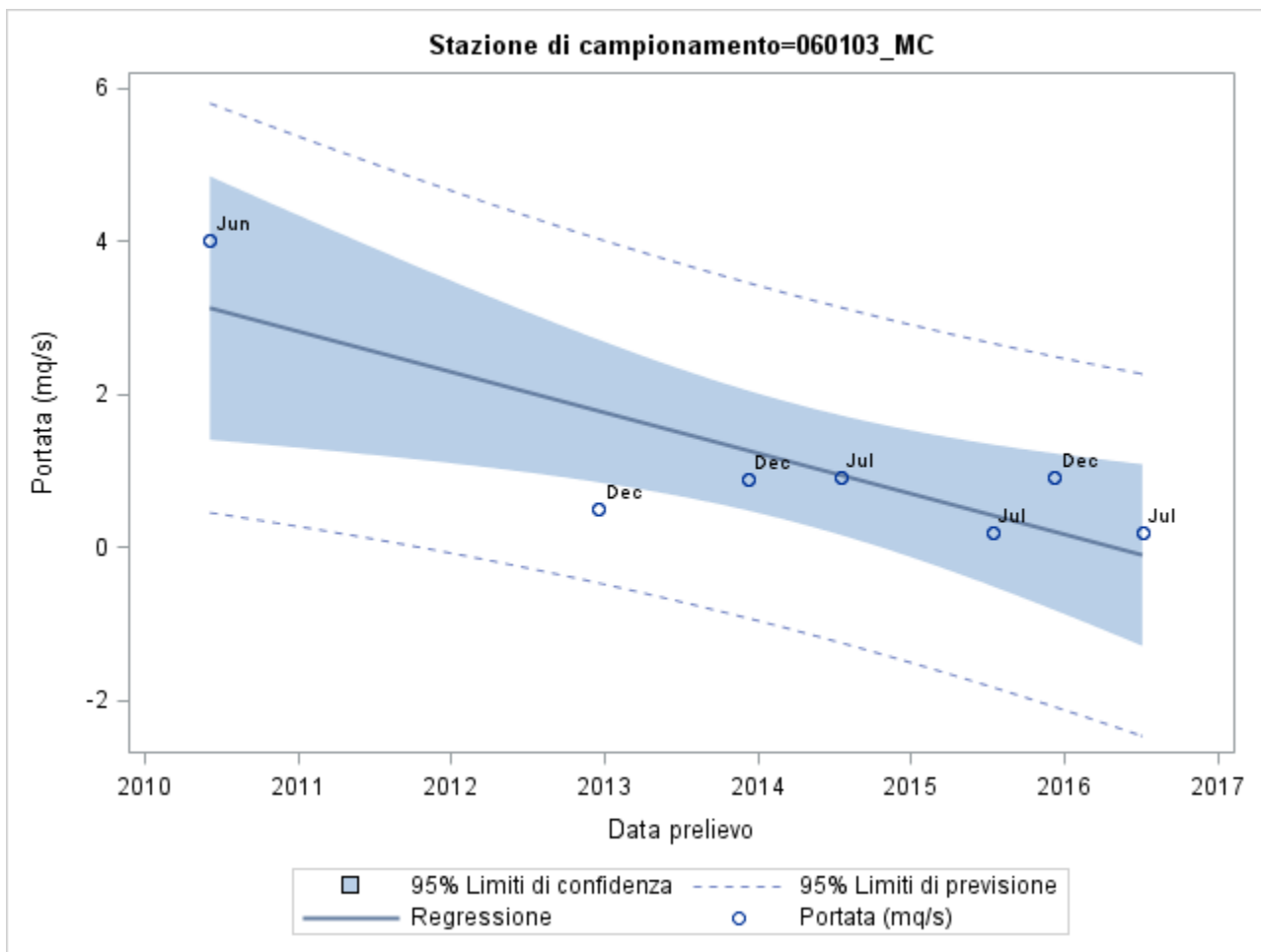


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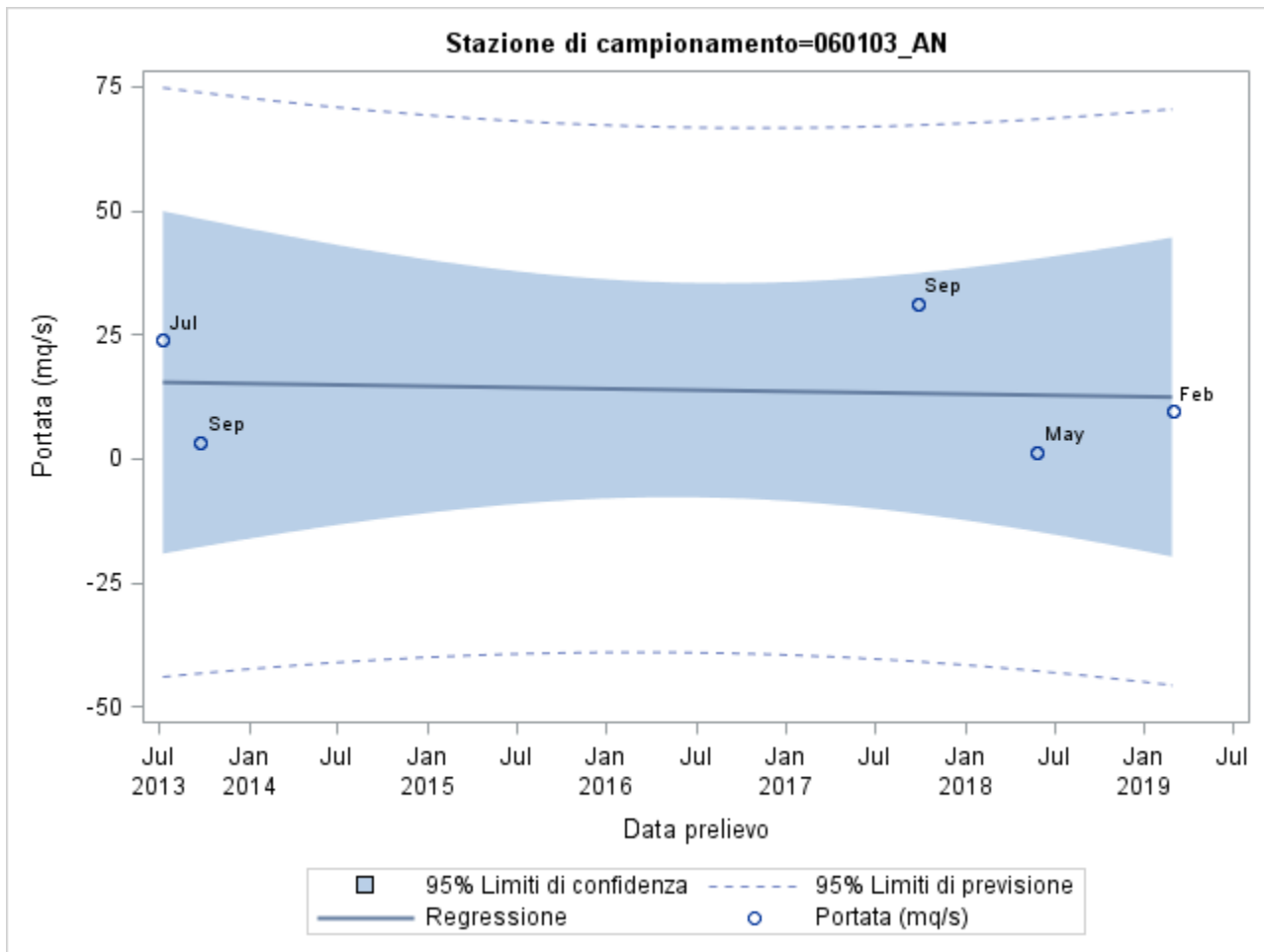




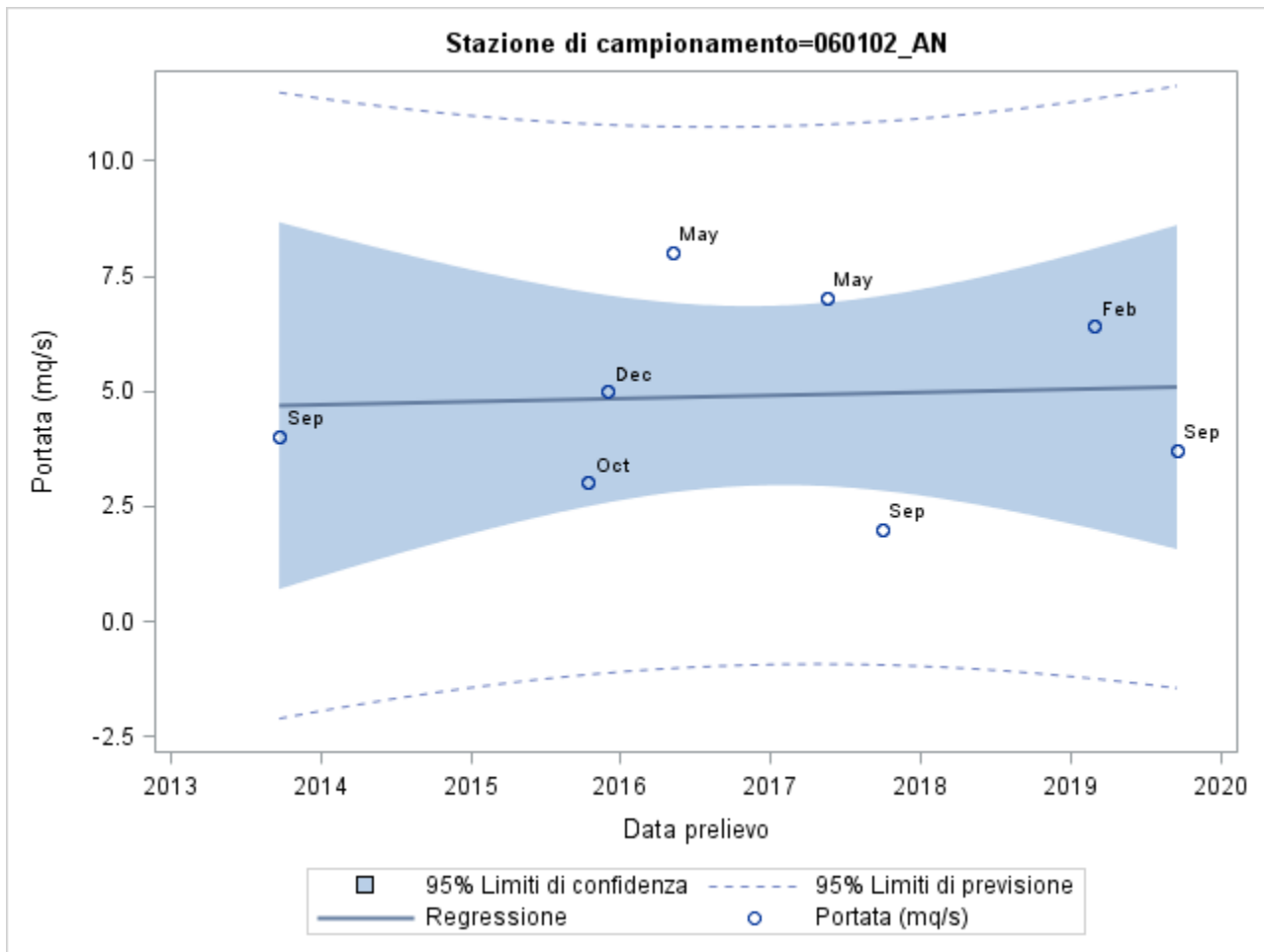
# Appendice H



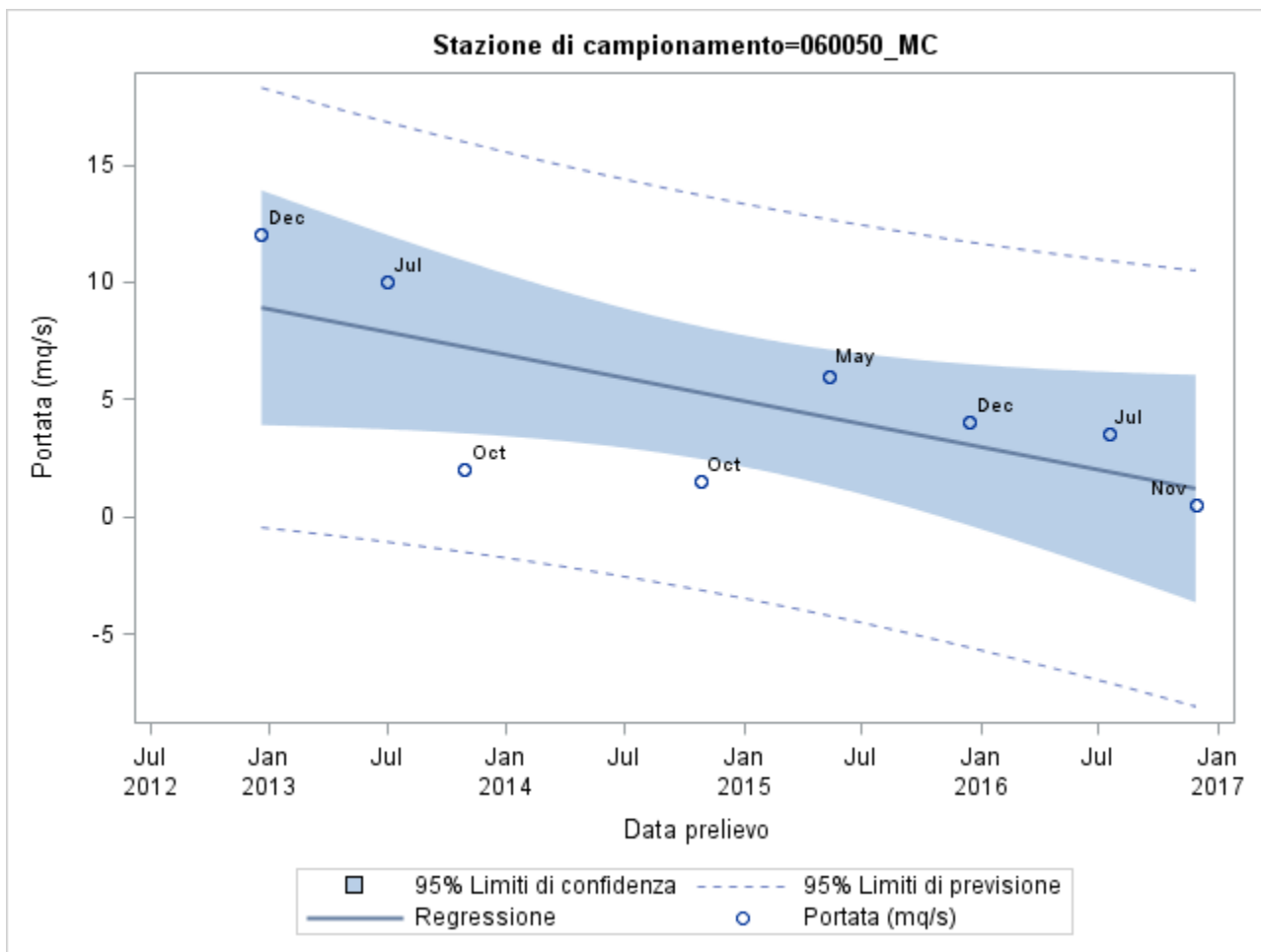
# Appendice H



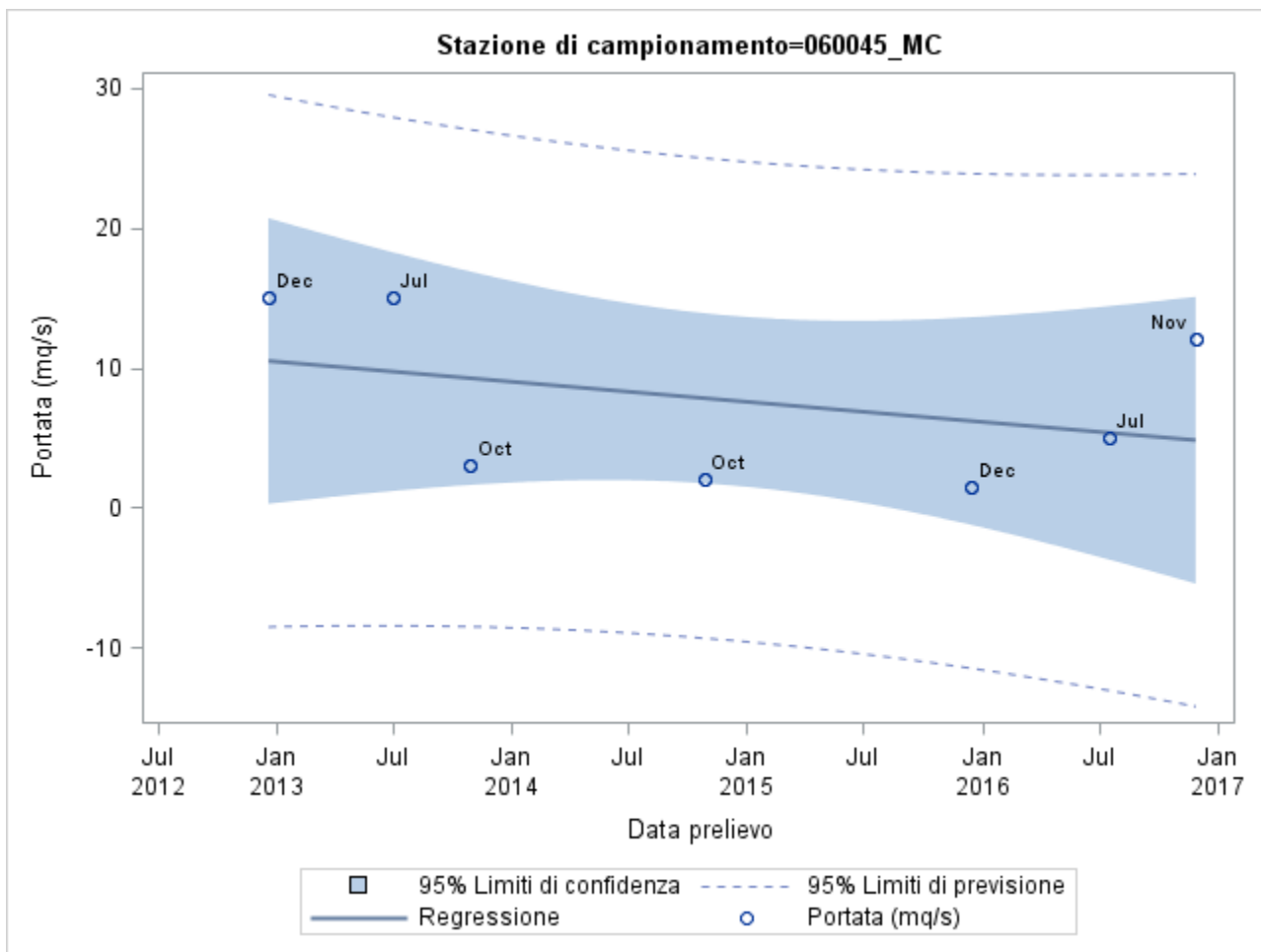
# Appendice H



# Appendice H



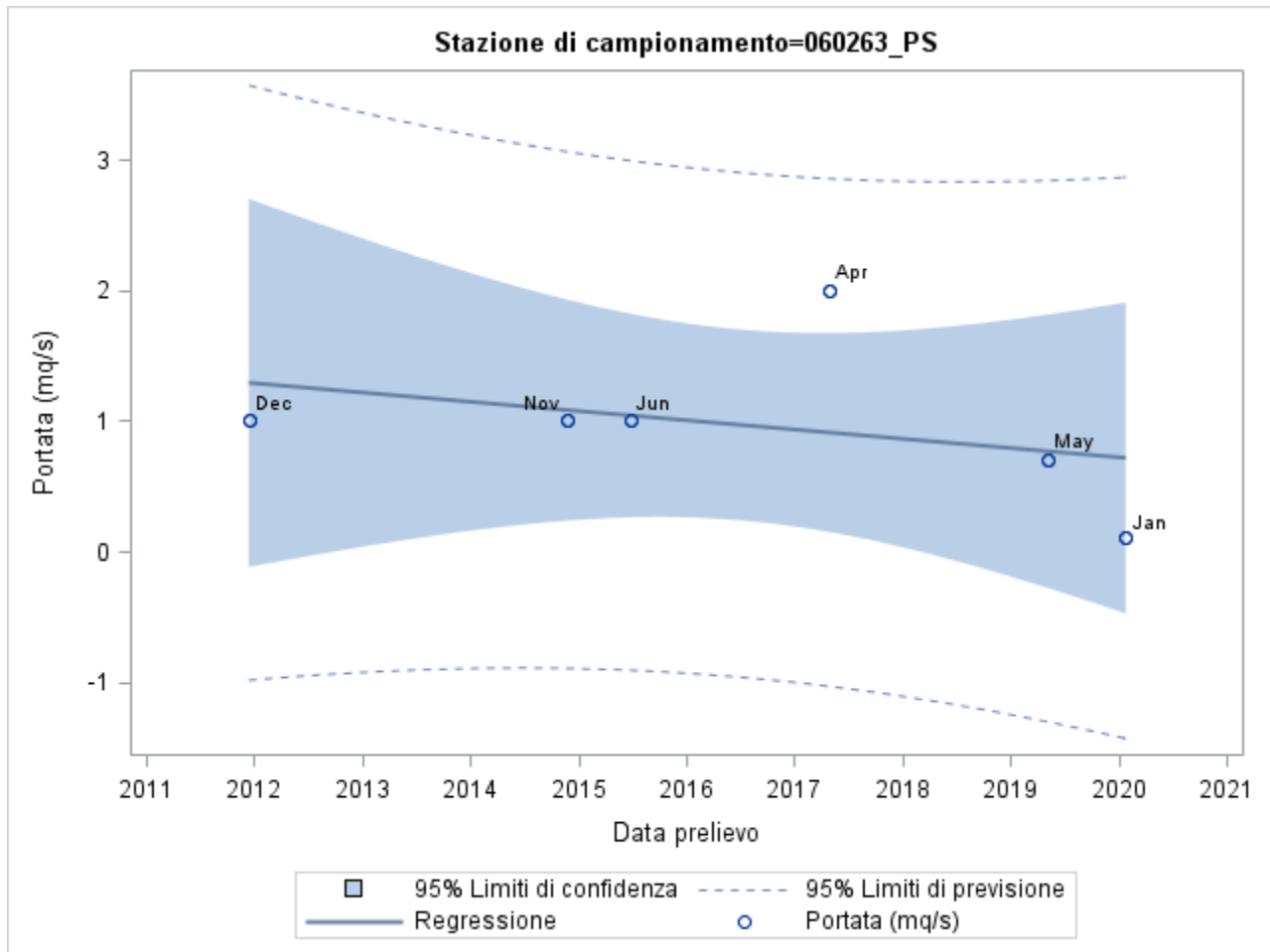
# Appendice H



# Appendice H

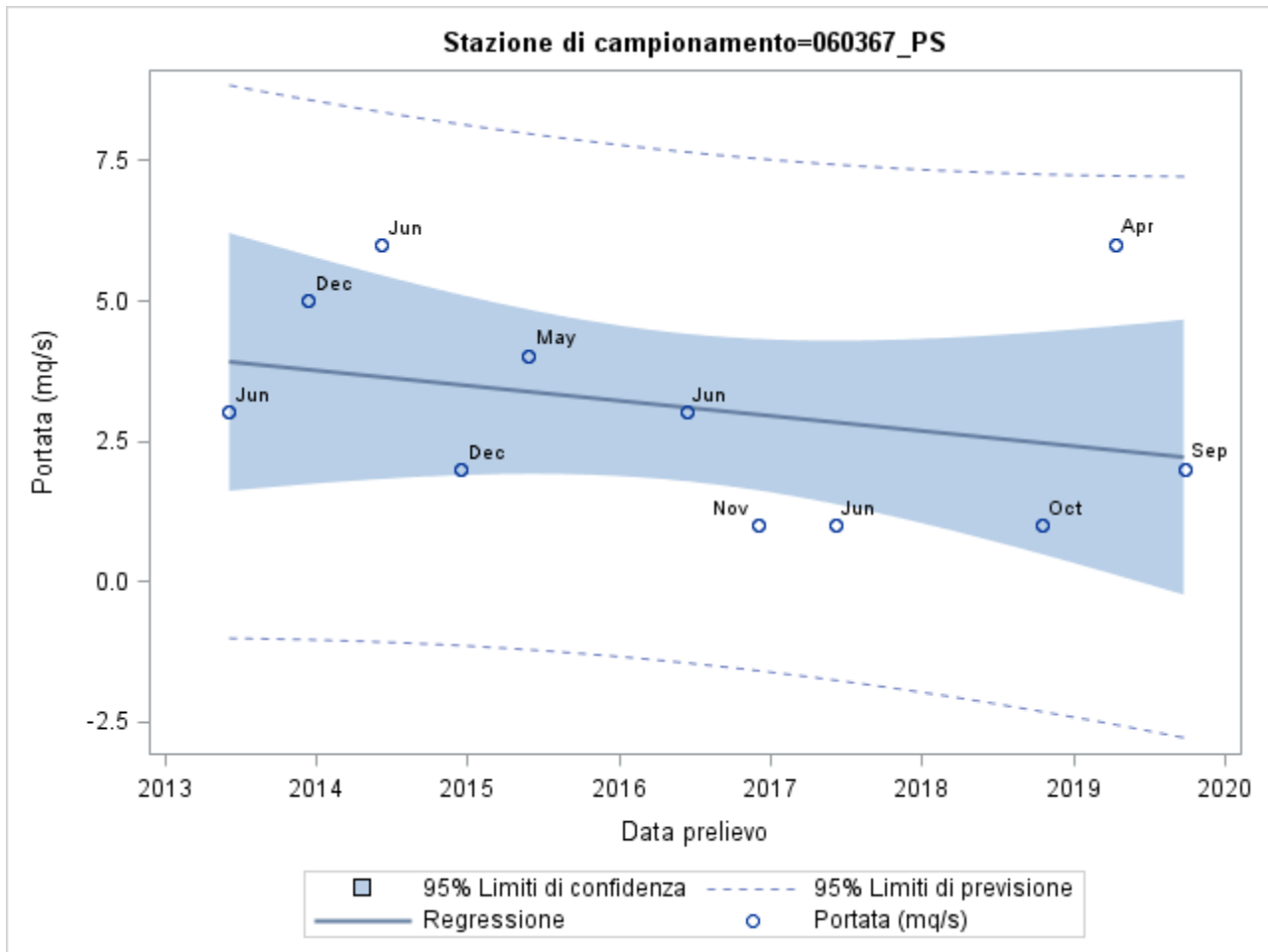
## ACQUIFERI LOCALI

### LOC\_BMU - DEPOSITI ARENACEI E ARENACEO - PELITICI DEI BACINI MINORI (URBINO)

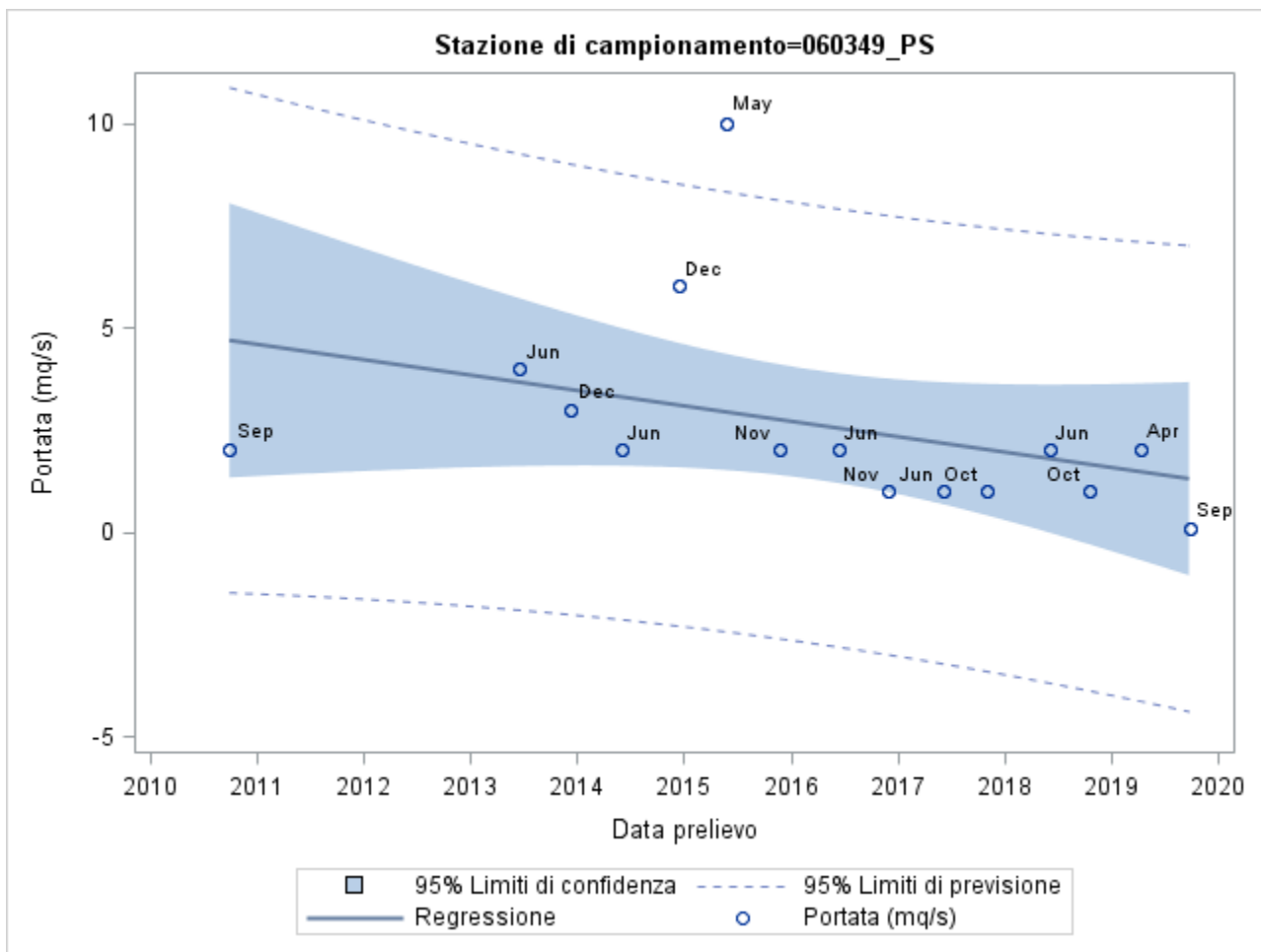


# Appendice H

## LOC\_CMC - ALLOCTONO DELLA COLATA DELLA VAL MARECCHIA (CARPEGNA)

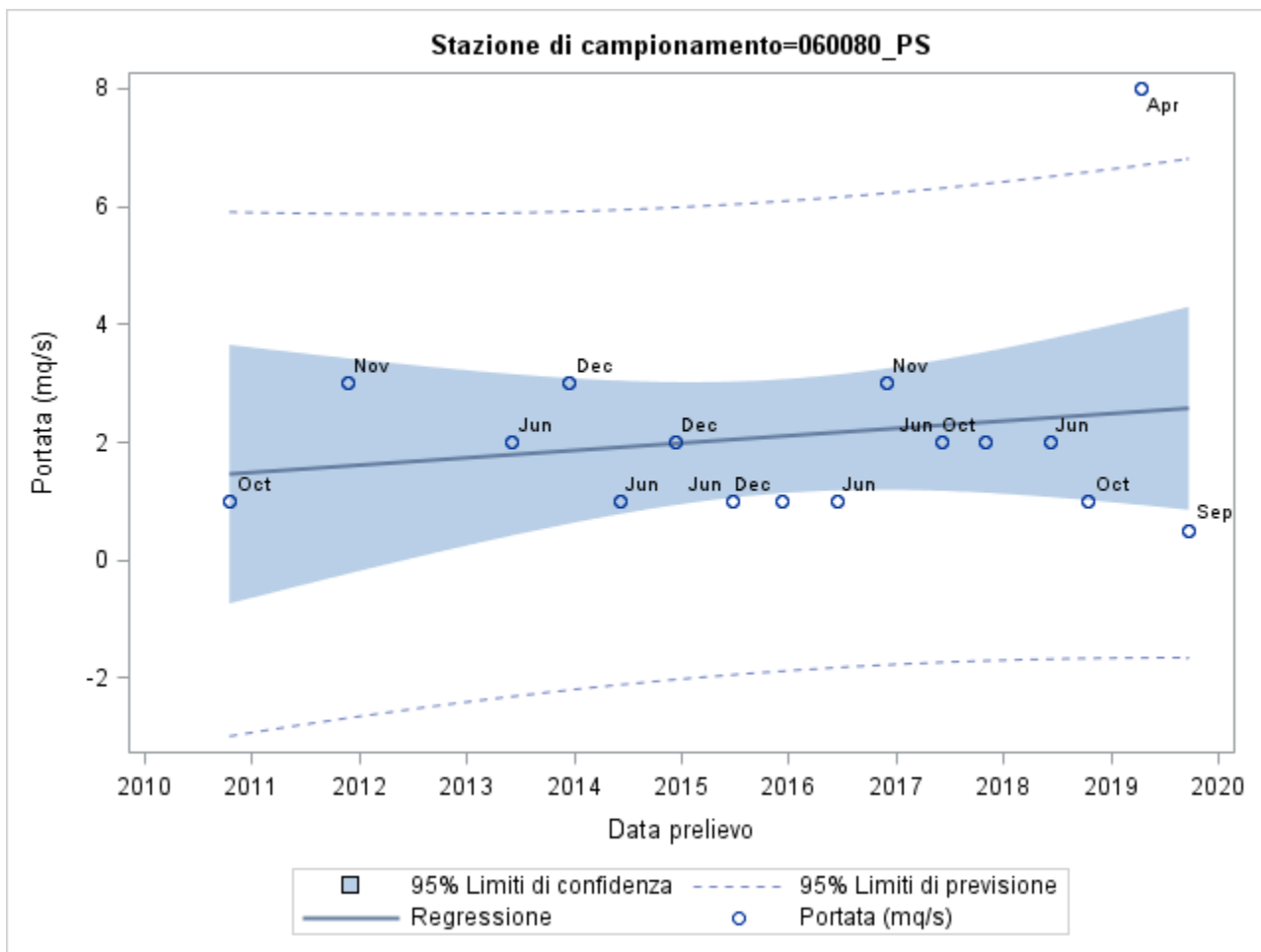


# Appendice H



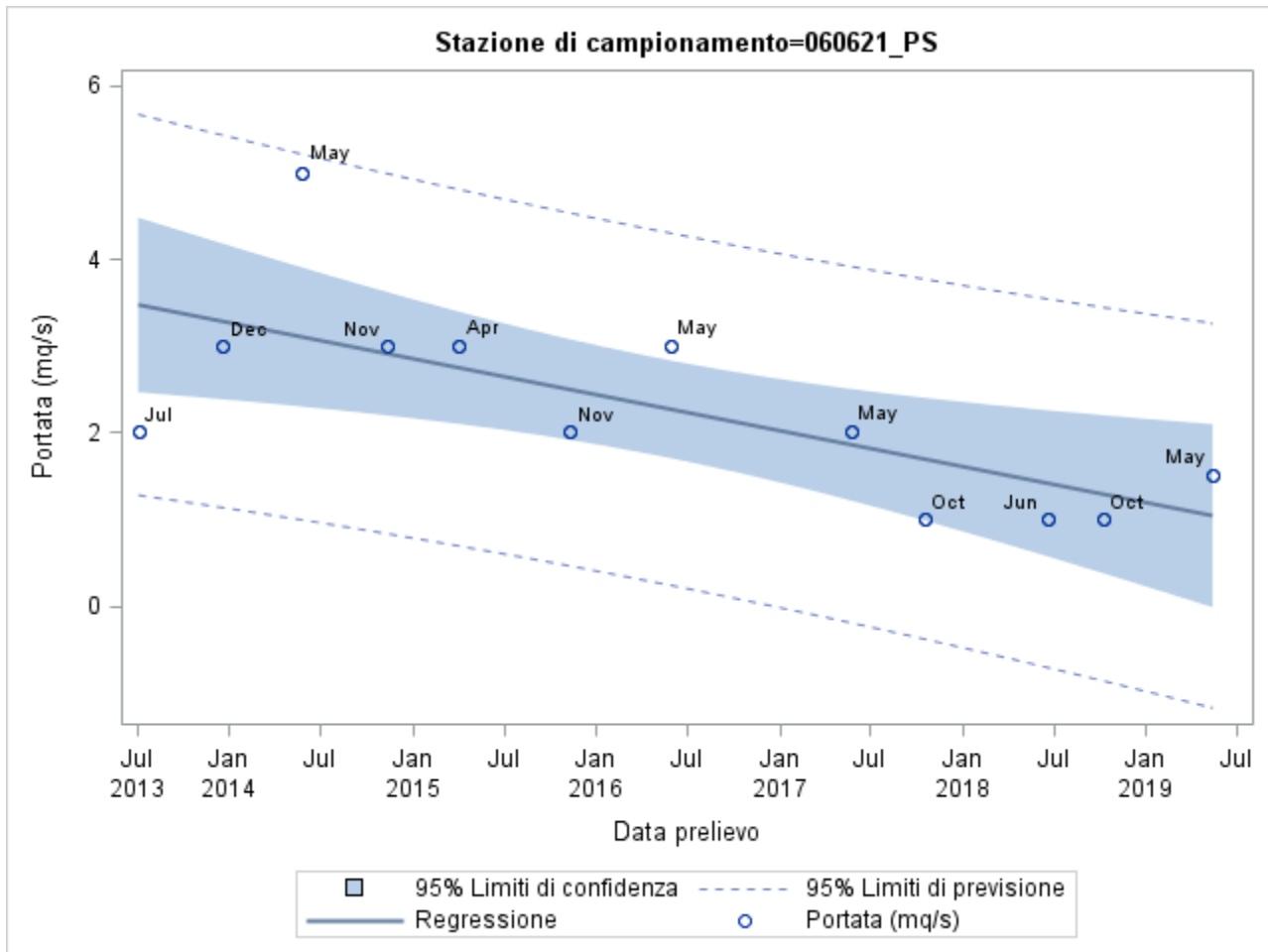


# Appendice H



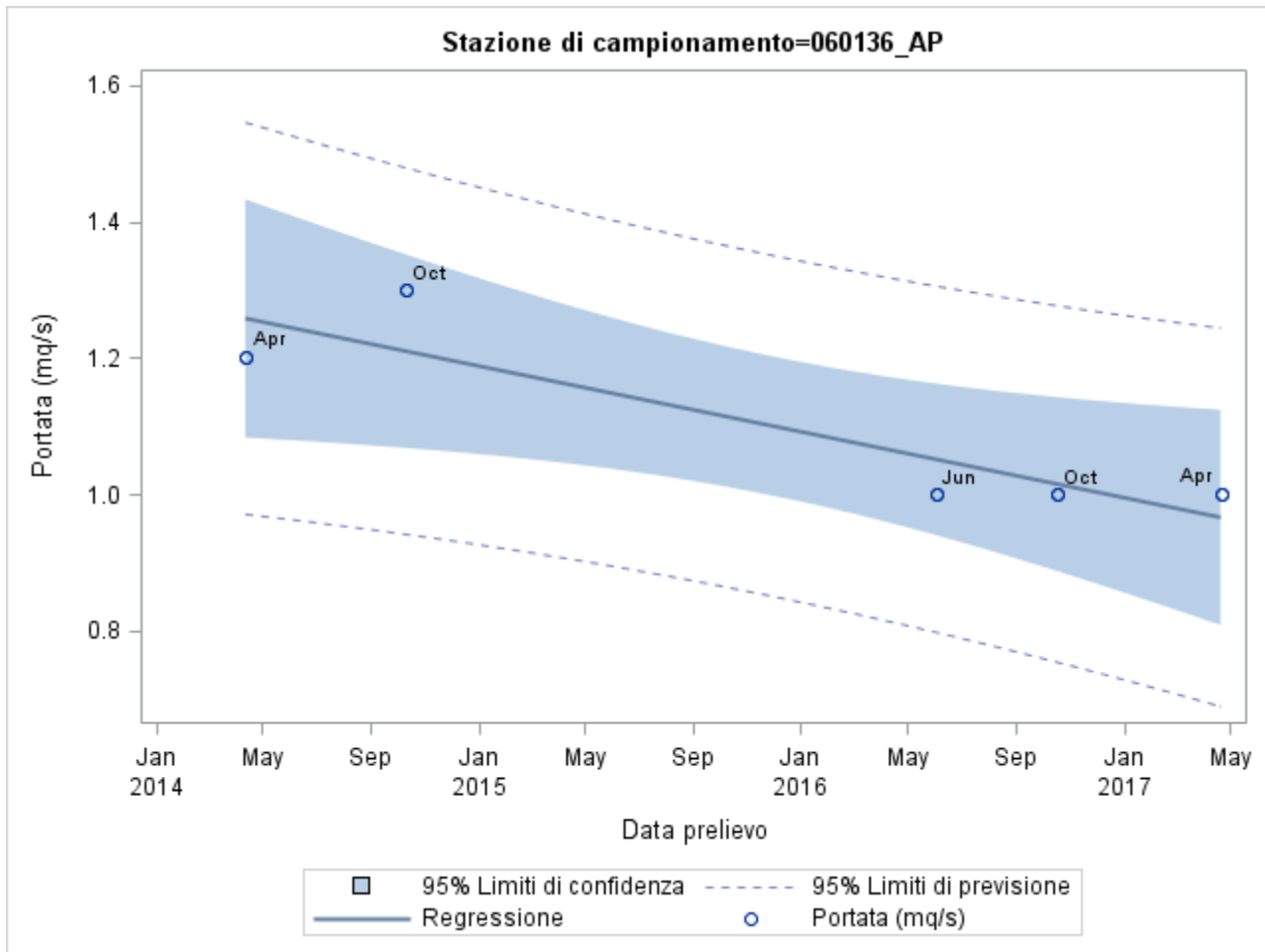
# Appendice H

## LOC\_DVP - DEPOSITI DETRITICI DI VERSANTE (PERGOLA)

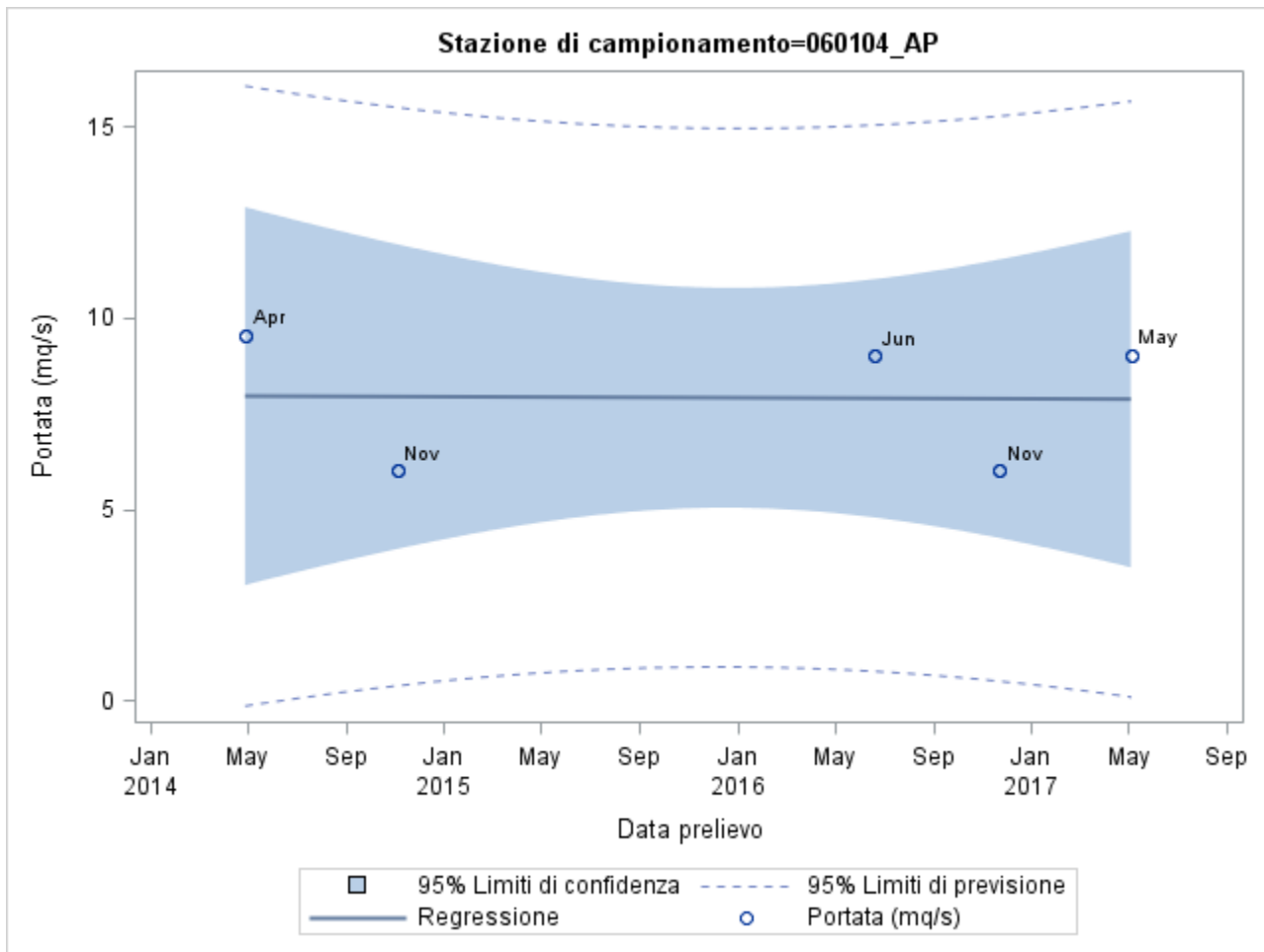


# Appendice H

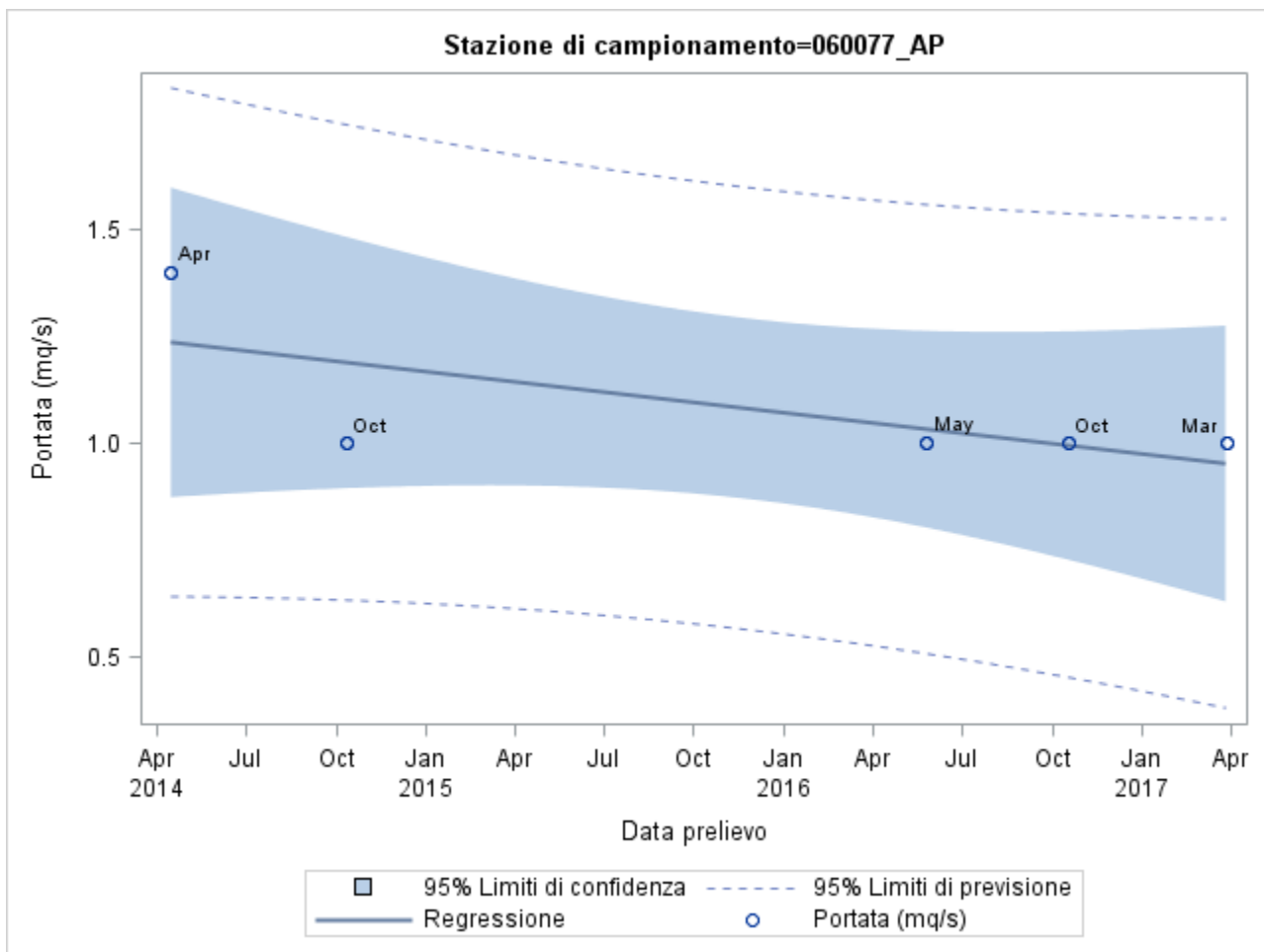
## LOC\_LAG - DEPOSITI TERRIGENI DEL BACINO DELLA LAGA E DELLA MONTAGNA DEI FIORI



# Appendice H

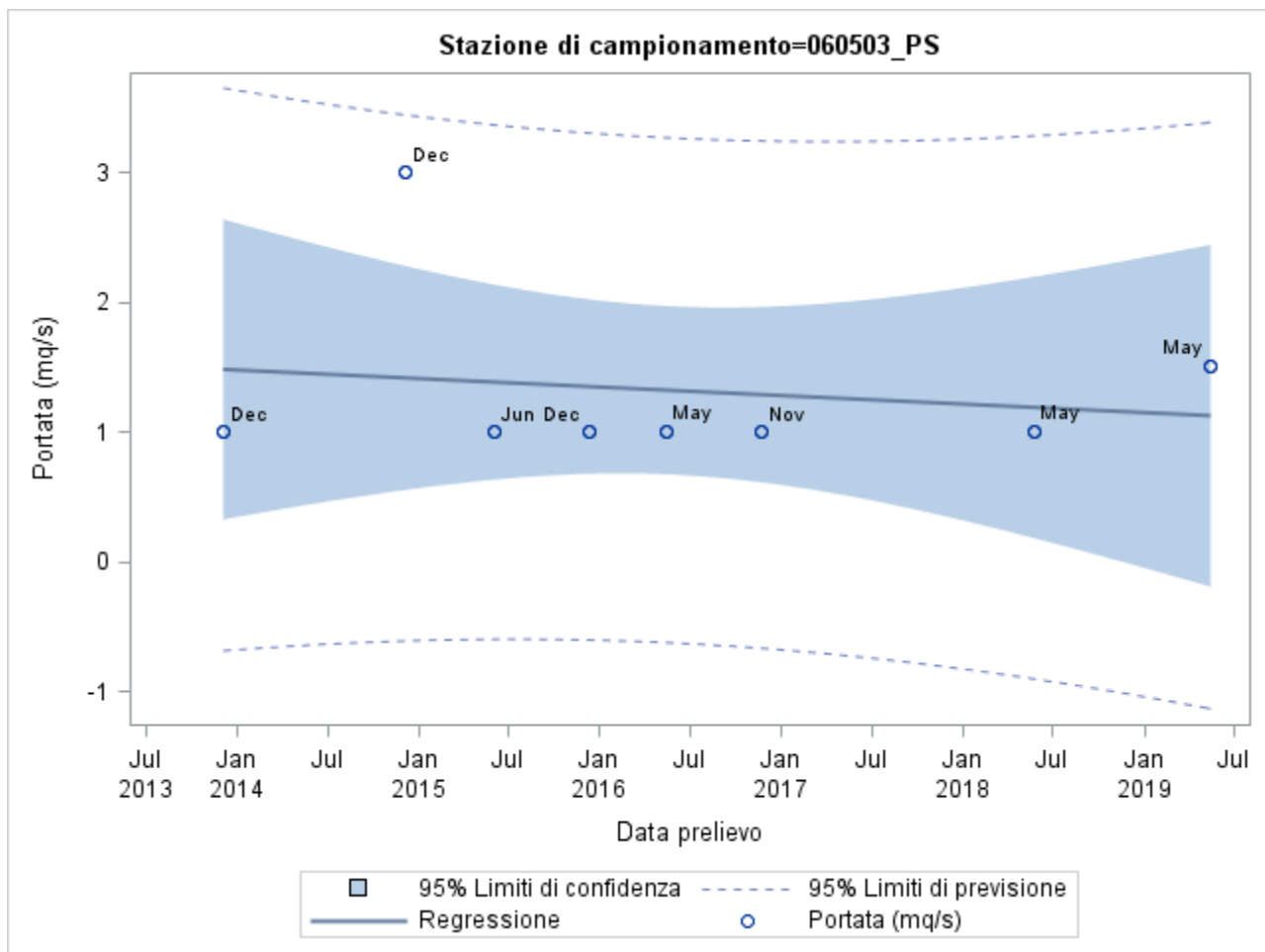


# Appendice H

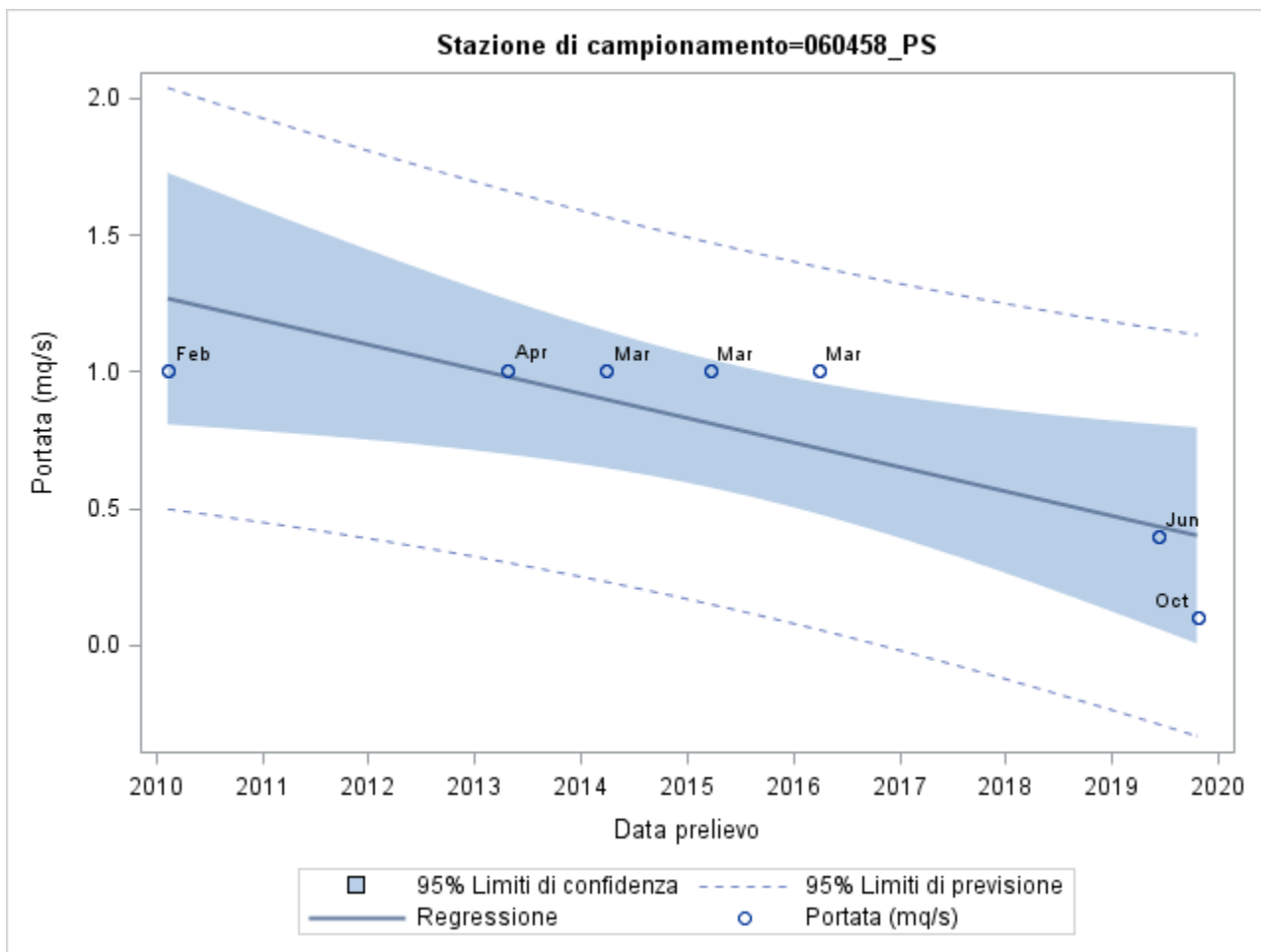


# Appendice H

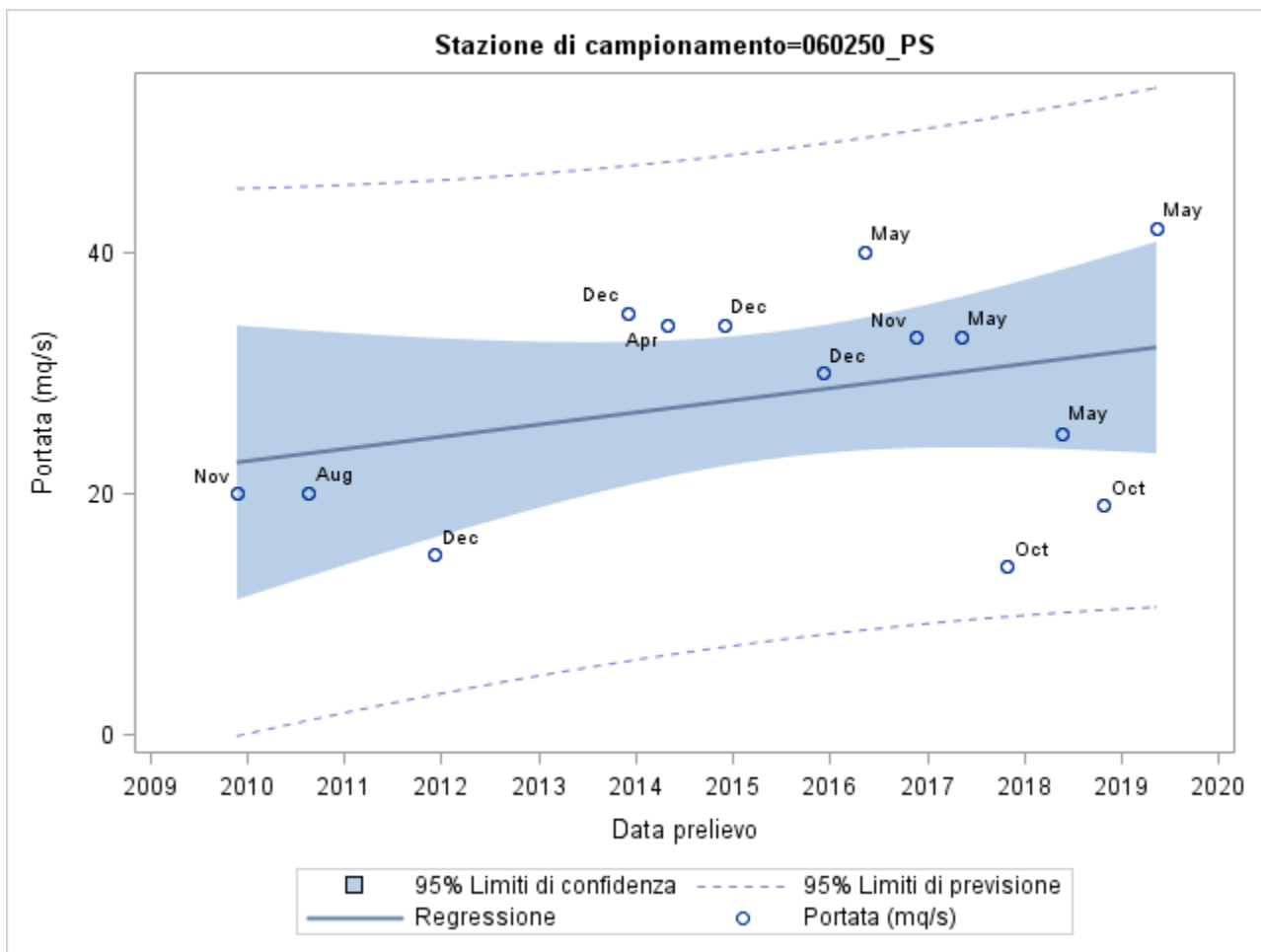
## LOC\_MAM - DEPOSITI TERRIGENI DELLA FORMAZIONE MARNOSO - ARENACEA (MERCATELLO SUL METAURO)



# Appendice H

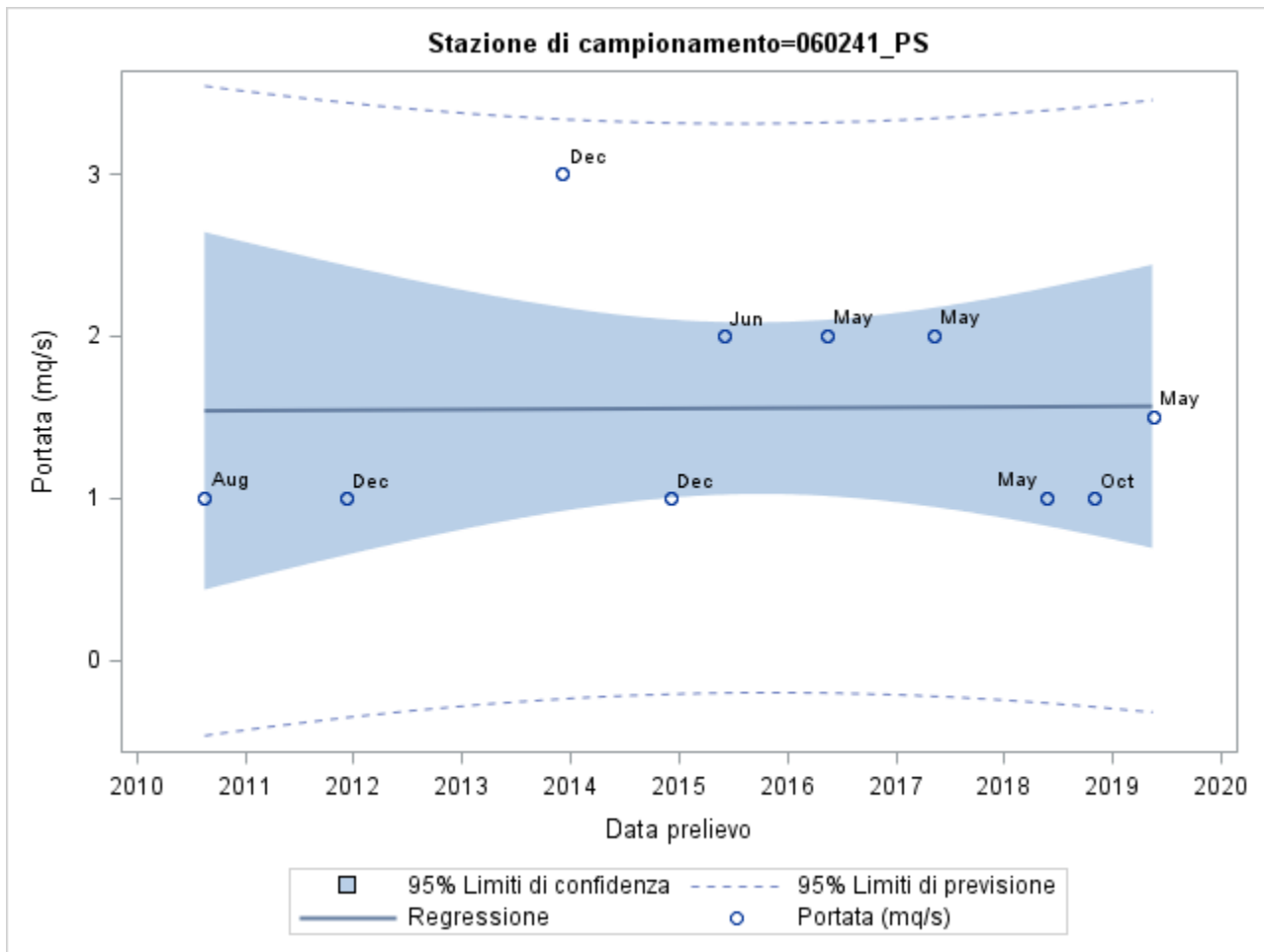


# Appendice H

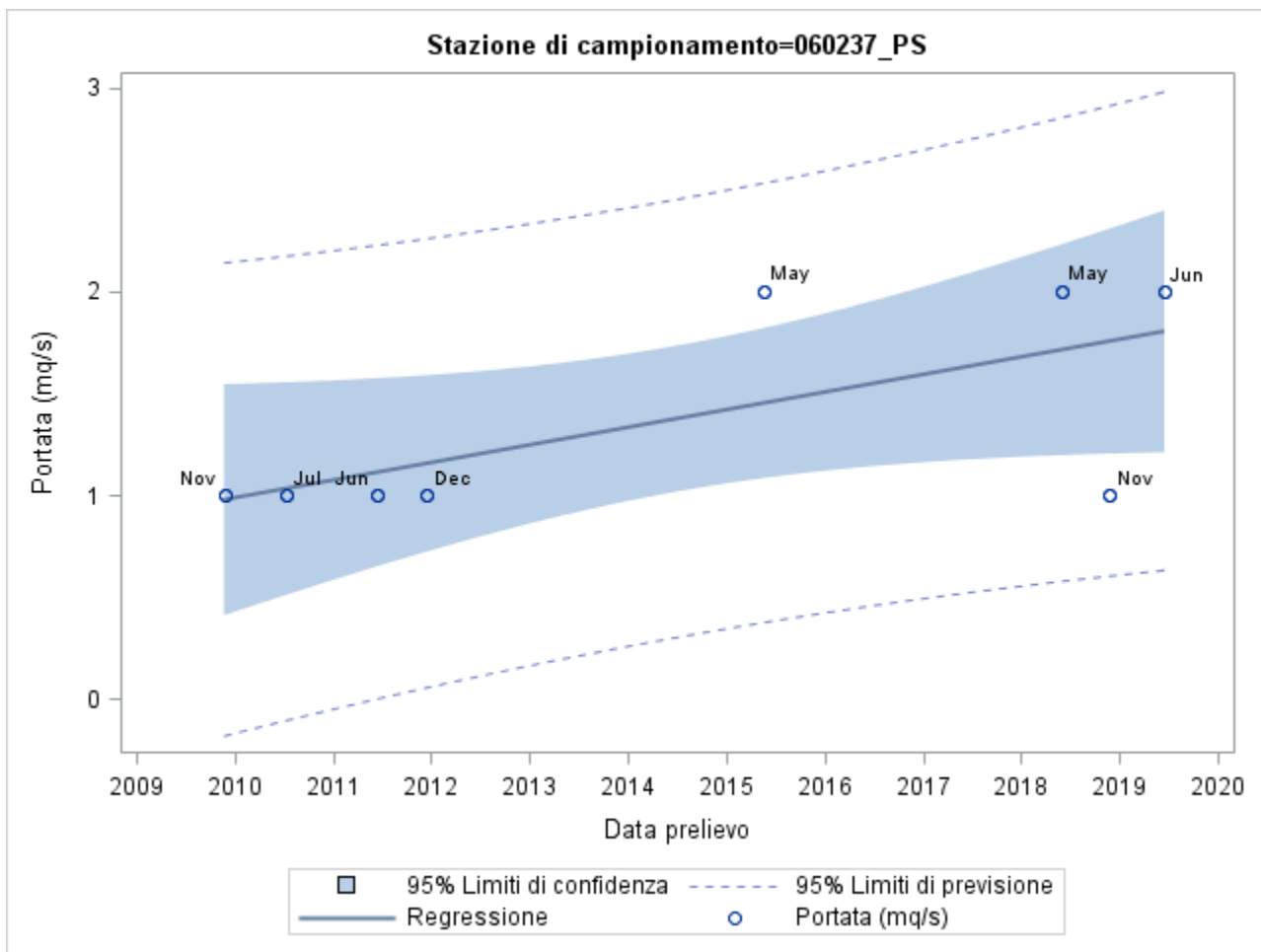




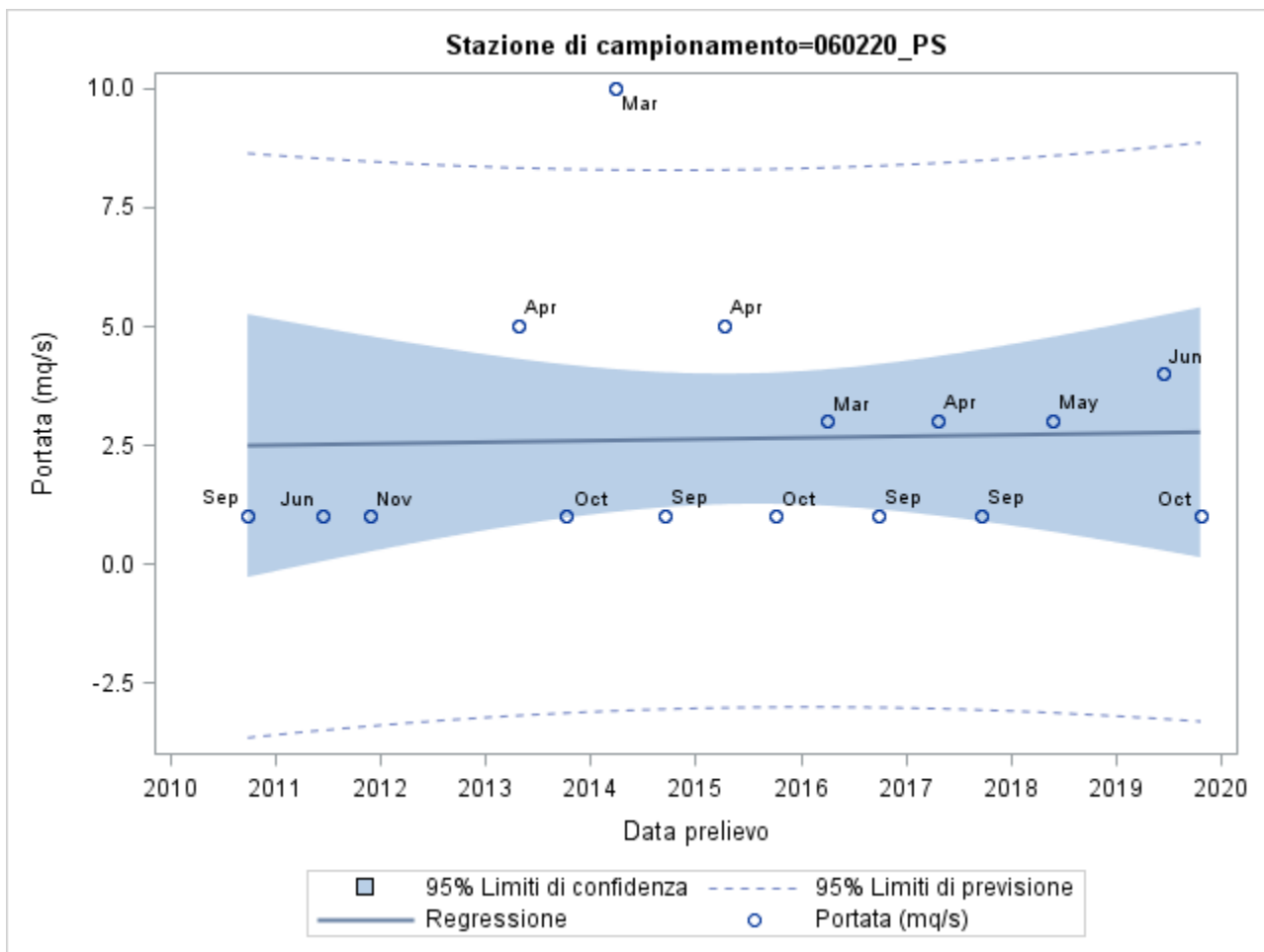
# Appendice H



# Appendice H



# Appendice H



# Appendice H

