

Supplementary Materials

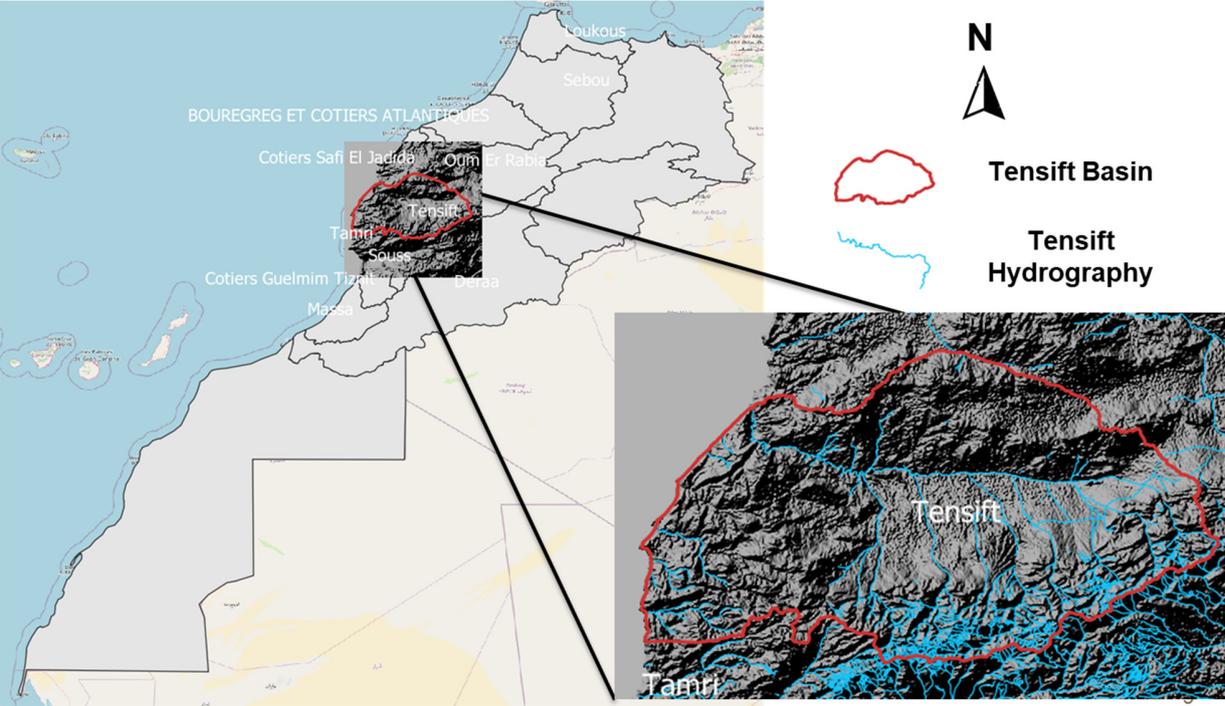
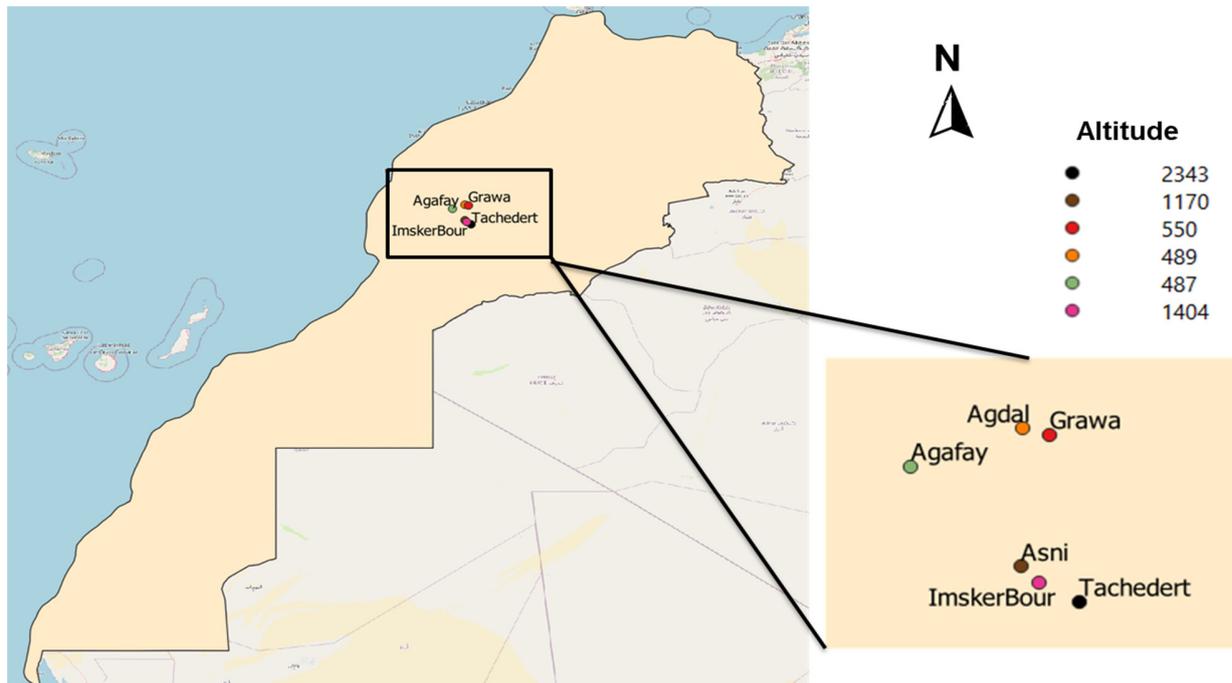
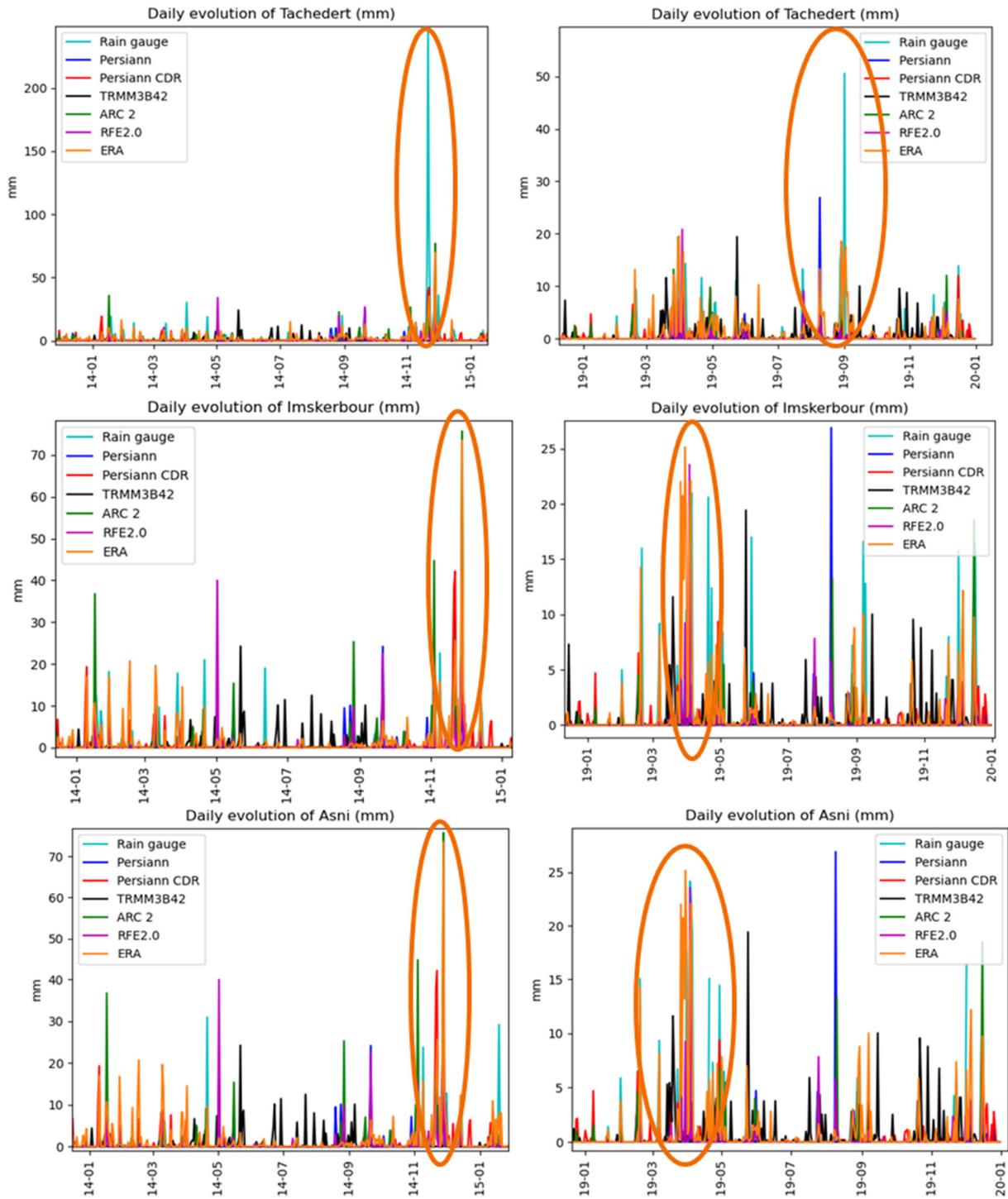


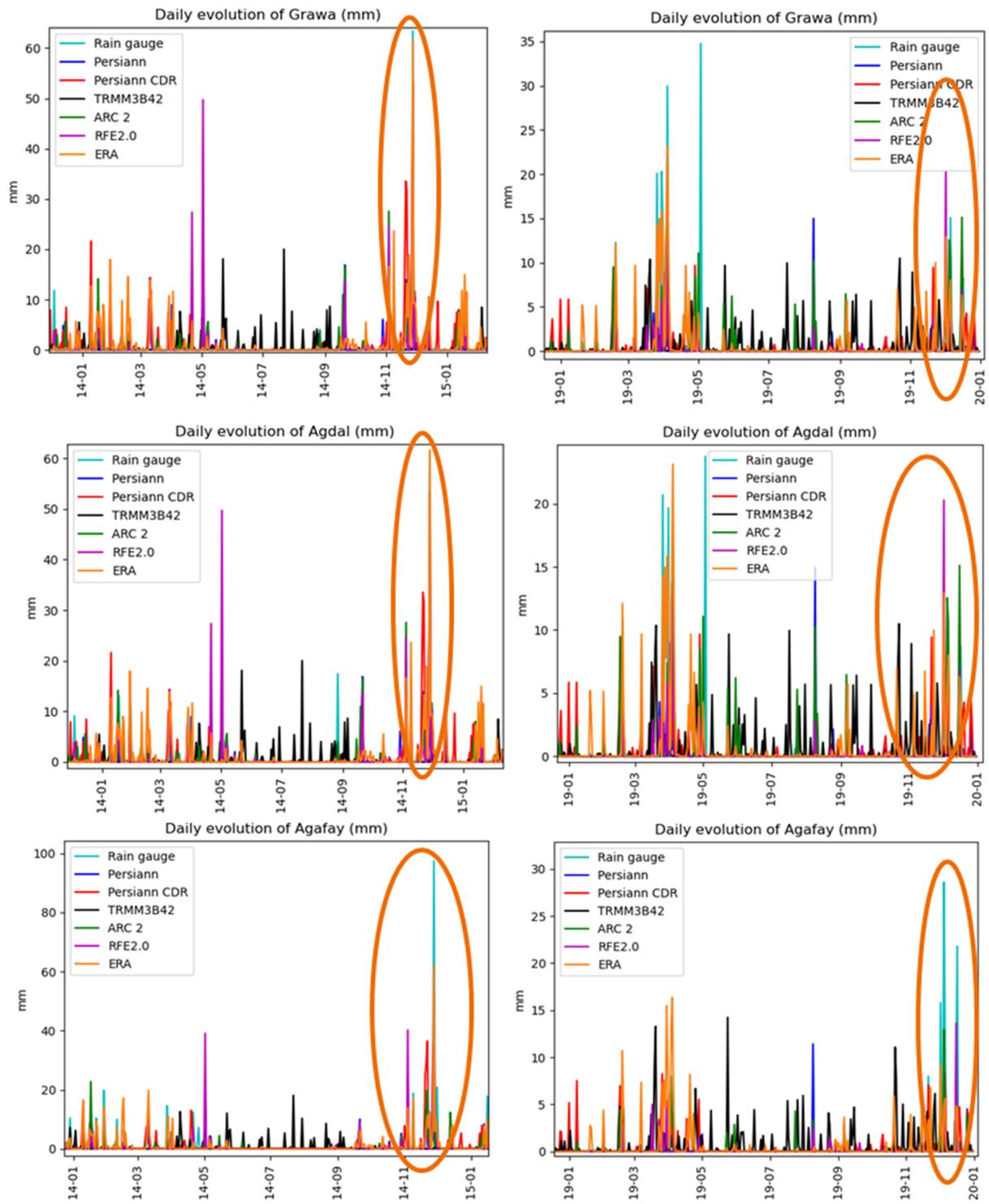
Figure S1: Location of the Tensift Basin of Morocco. Source: Adapted from [36].



**Figure S2:** Location of weather stations in the Tensift region.



**Figure S3-1:** Zooming on one of the wettest years (2014) and the driest year (2019) (Daily).



**Figure S3-2:** Zooming on one of the wettest years (2014) and the driest year (2019) (Daily).

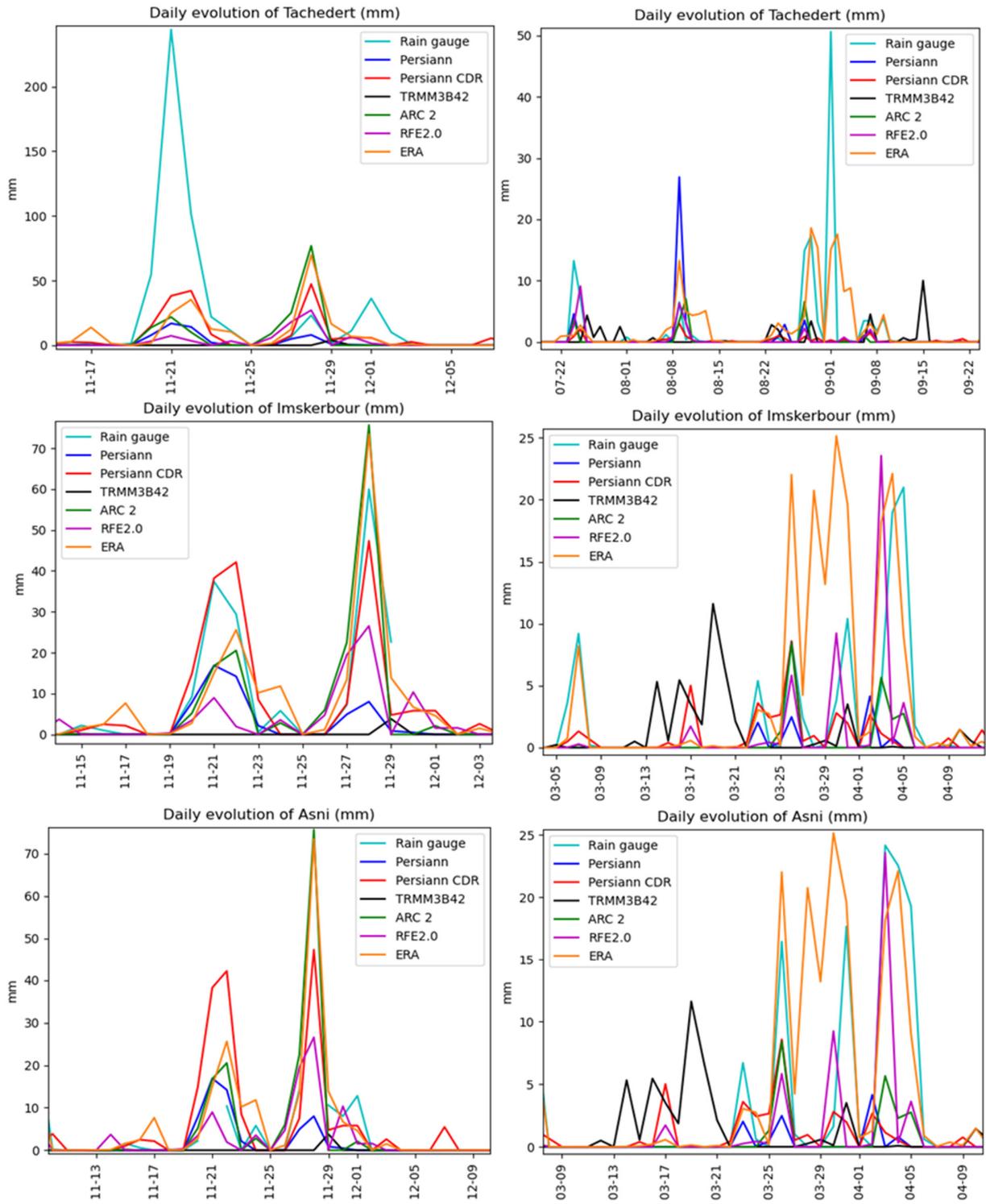


Figure S4-1: Zoom on the spikes of the two study years (Daily).

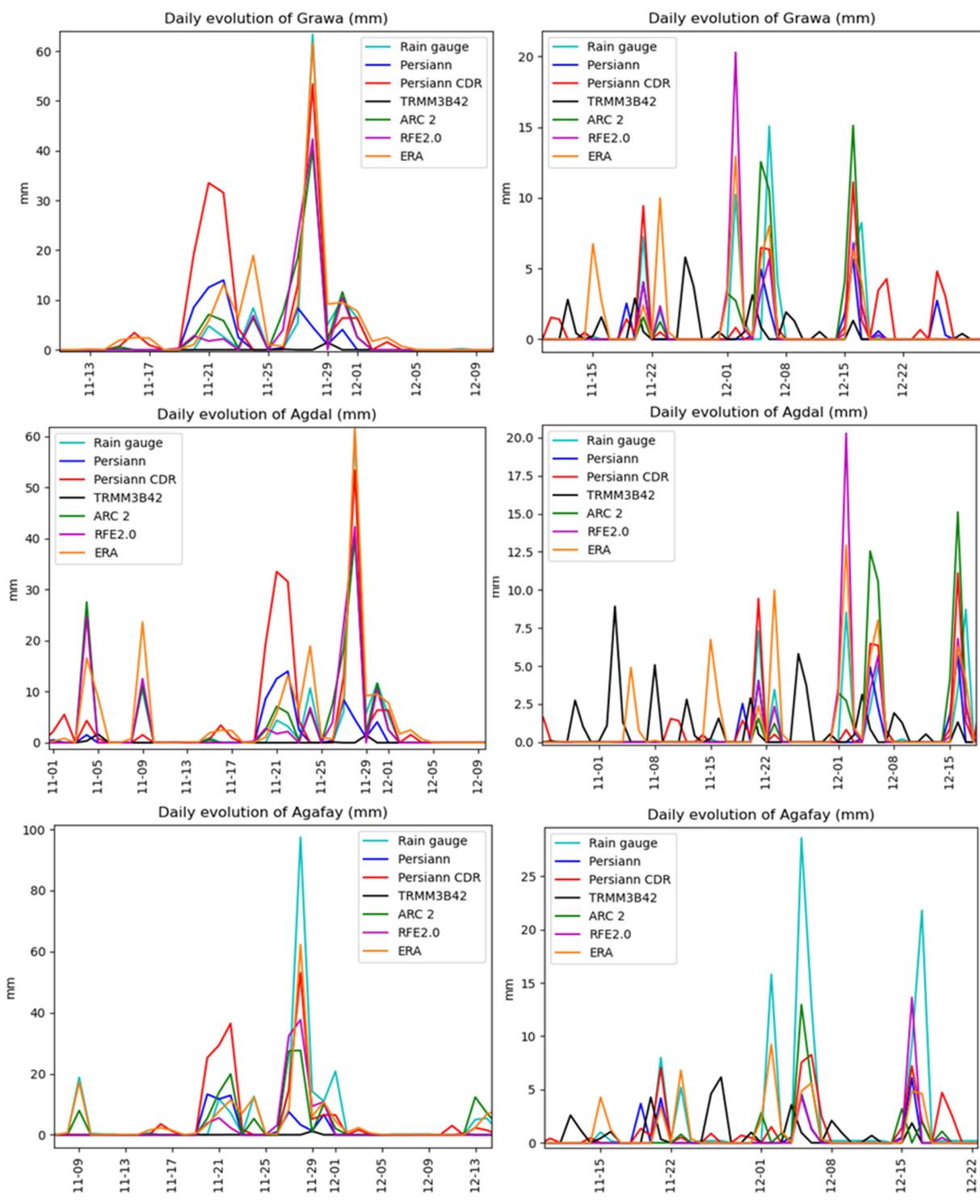
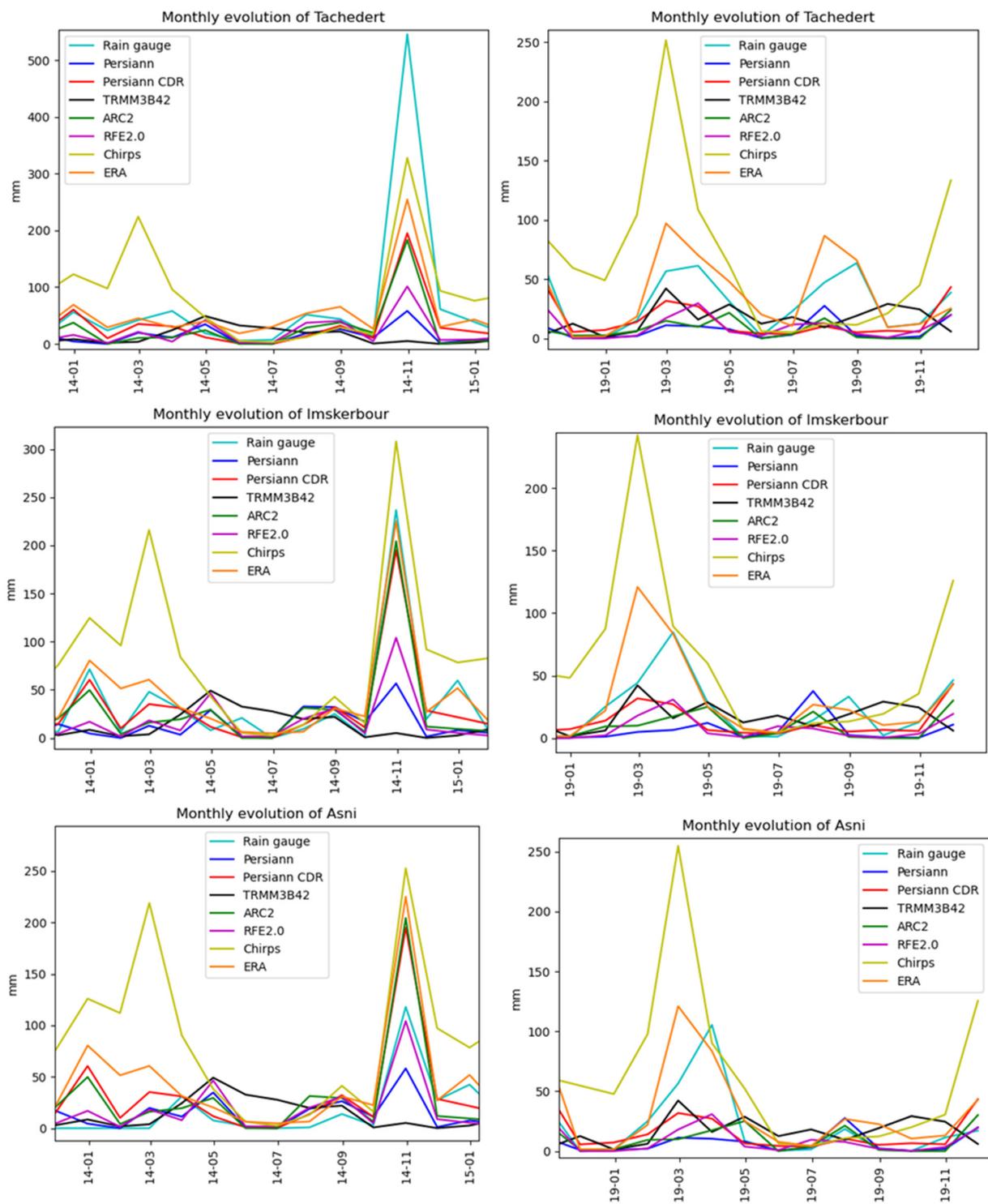
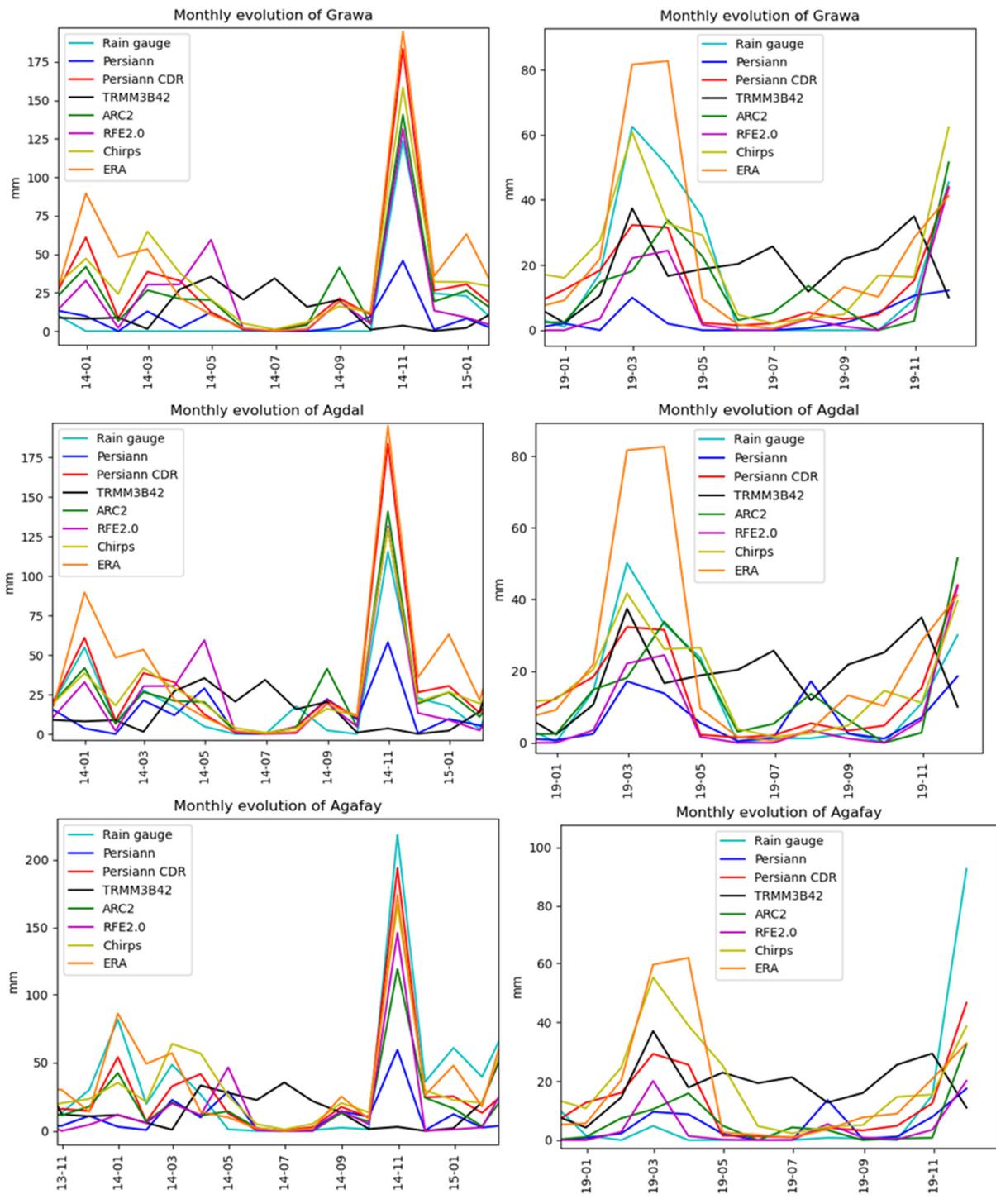


Figure S4-2: Zoom on the spikes of the two study years (Daily).



**Figure S5-1:** Zooming on one of the wettest years (2014) and the driest year (2019) (Monthly).



**Figure S5-2:** Zooming on one of the wettest years (2014) and the driest year (2019) (Monthly).

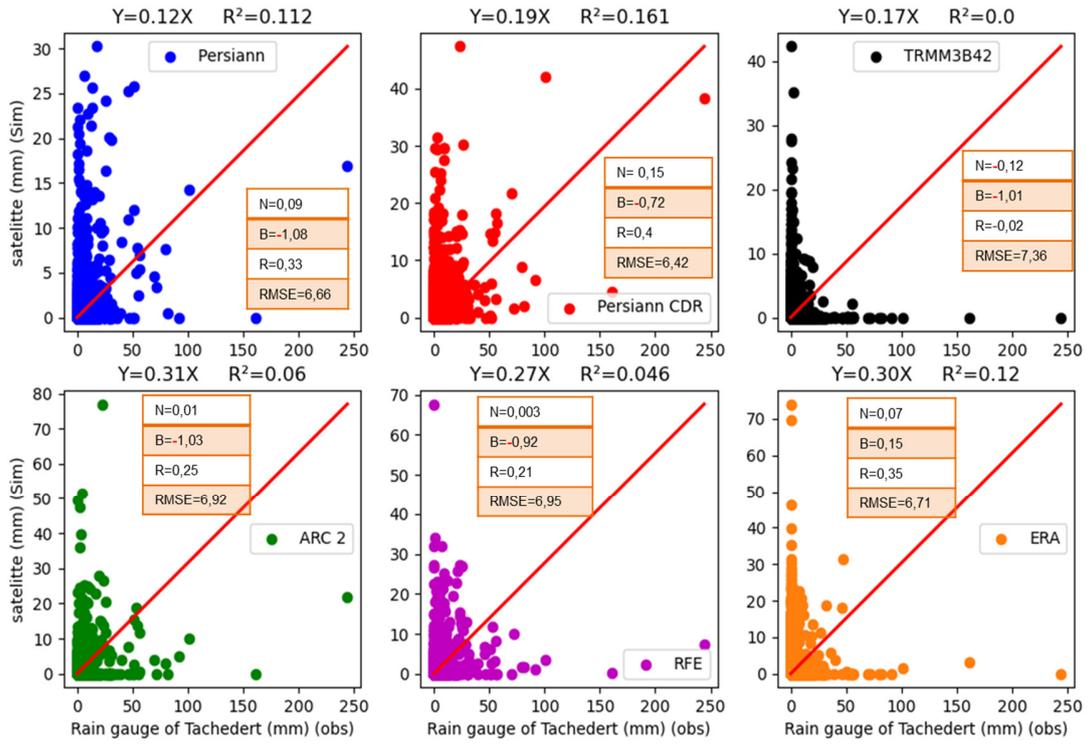


Figure S6: Scatterplot of the daily satellite products and the Tachedert weather station data.

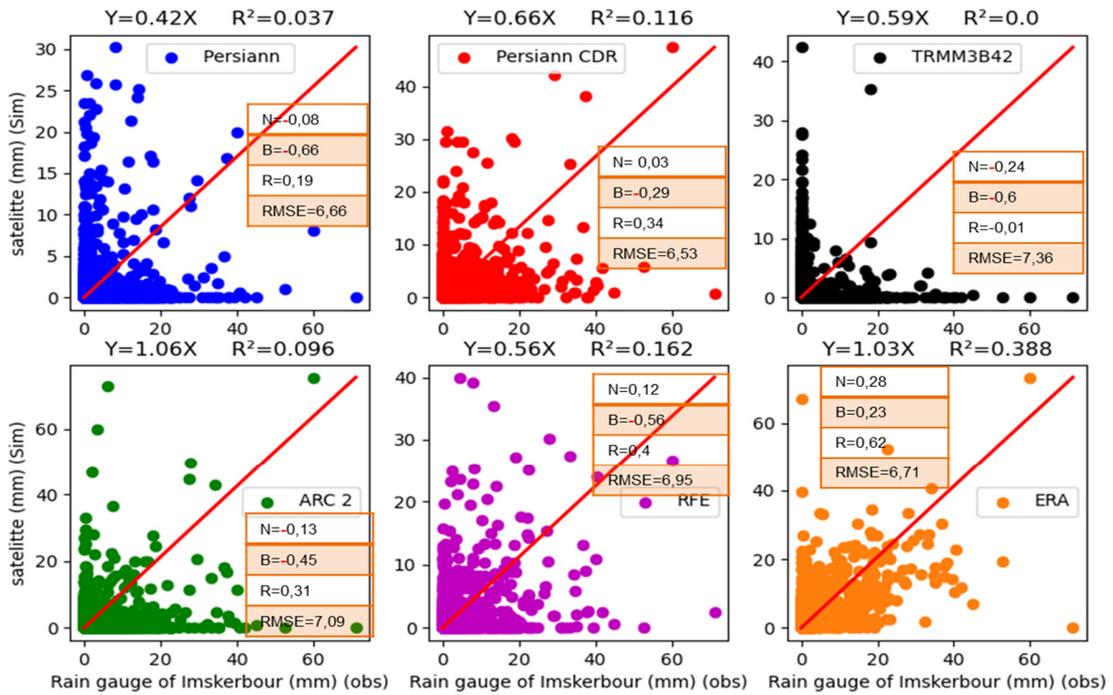
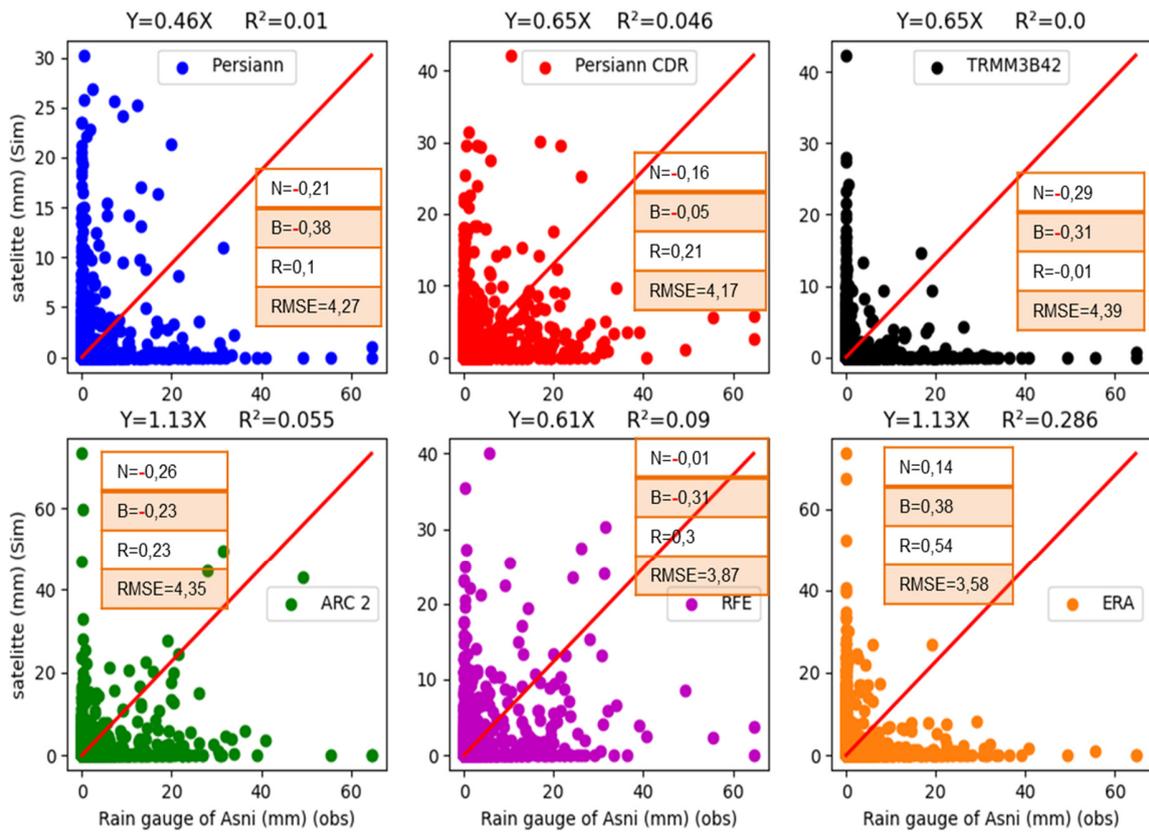
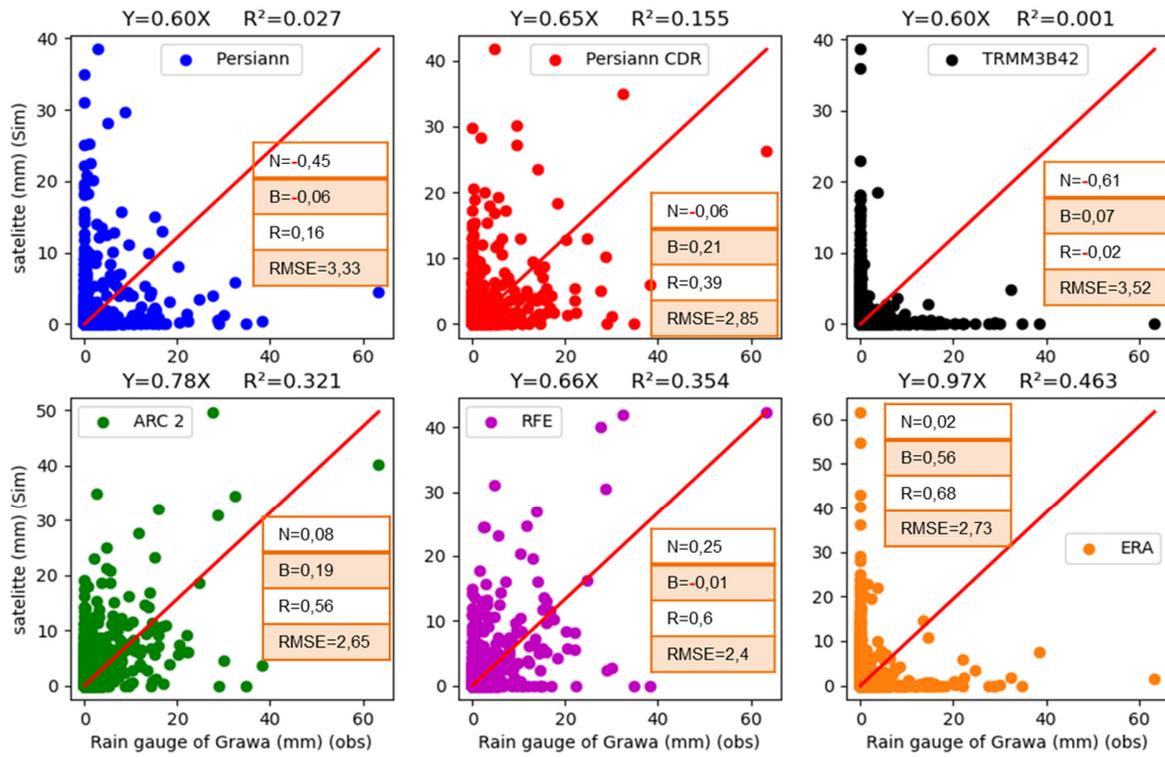


Figure S7: Scatterplot of the daily satellite products and the Imskerbour weather station data.



**Figure S8:** Scatterplots of the daily satellite products and Asni weather station.



**Figure S9:** Scatterplots of the daily satellite products and Grawa weather station data.

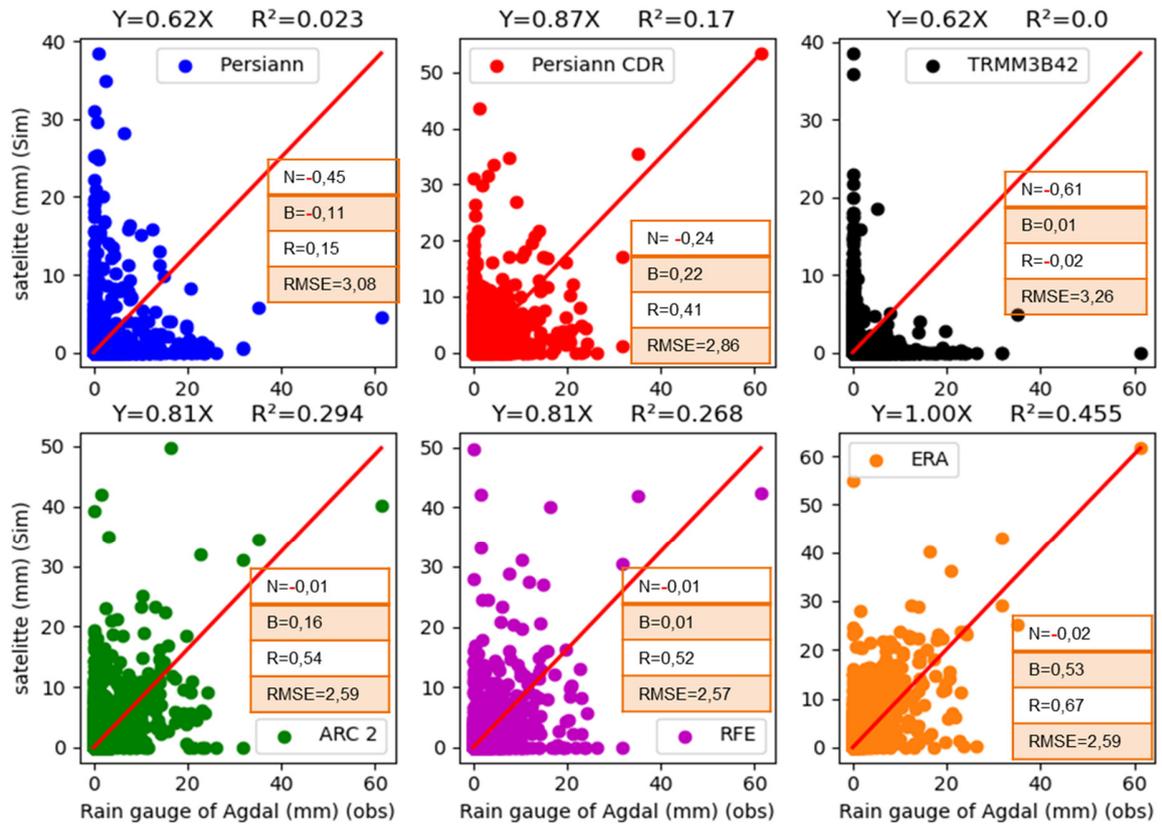
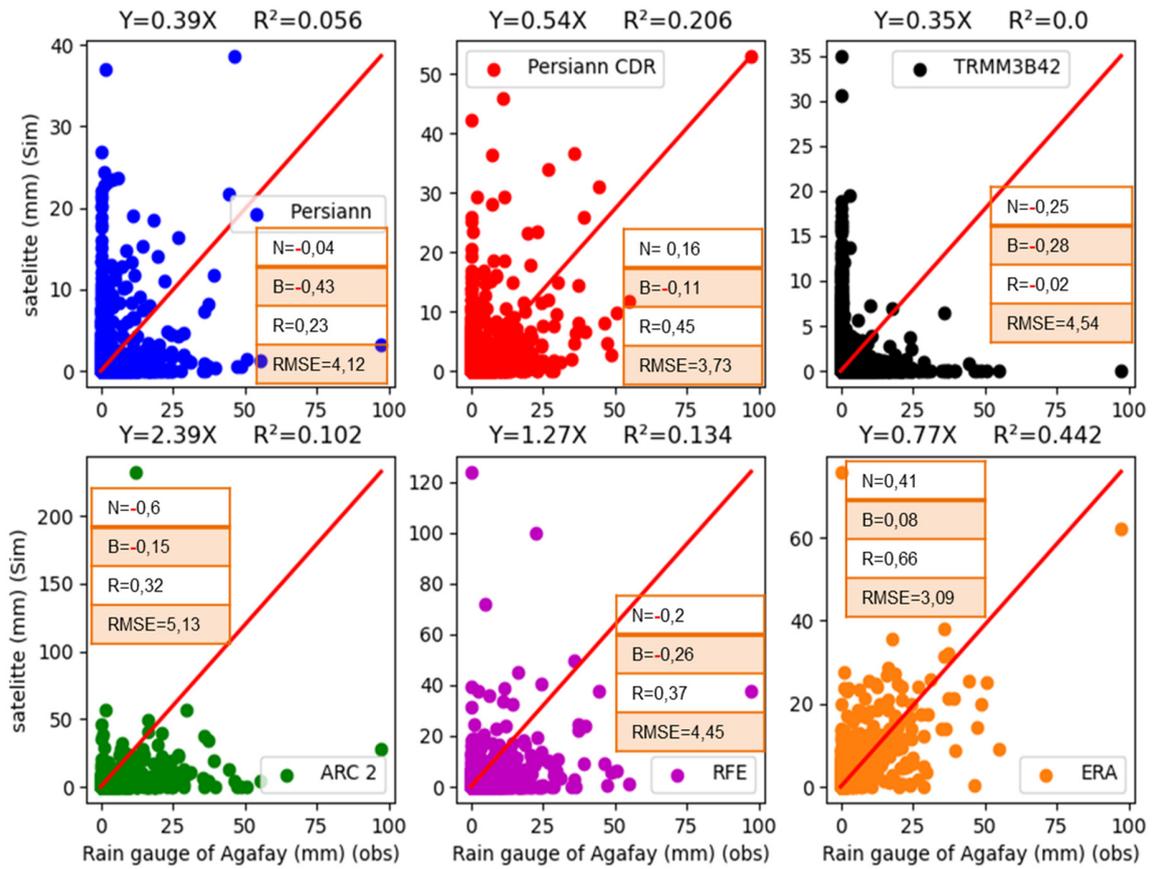


Figure S10: Scatterplots of the daily satellite products and Agdal weather station data.



**Figure S11:** Scatterplots of the daily satellite products and Agafay weather station data.

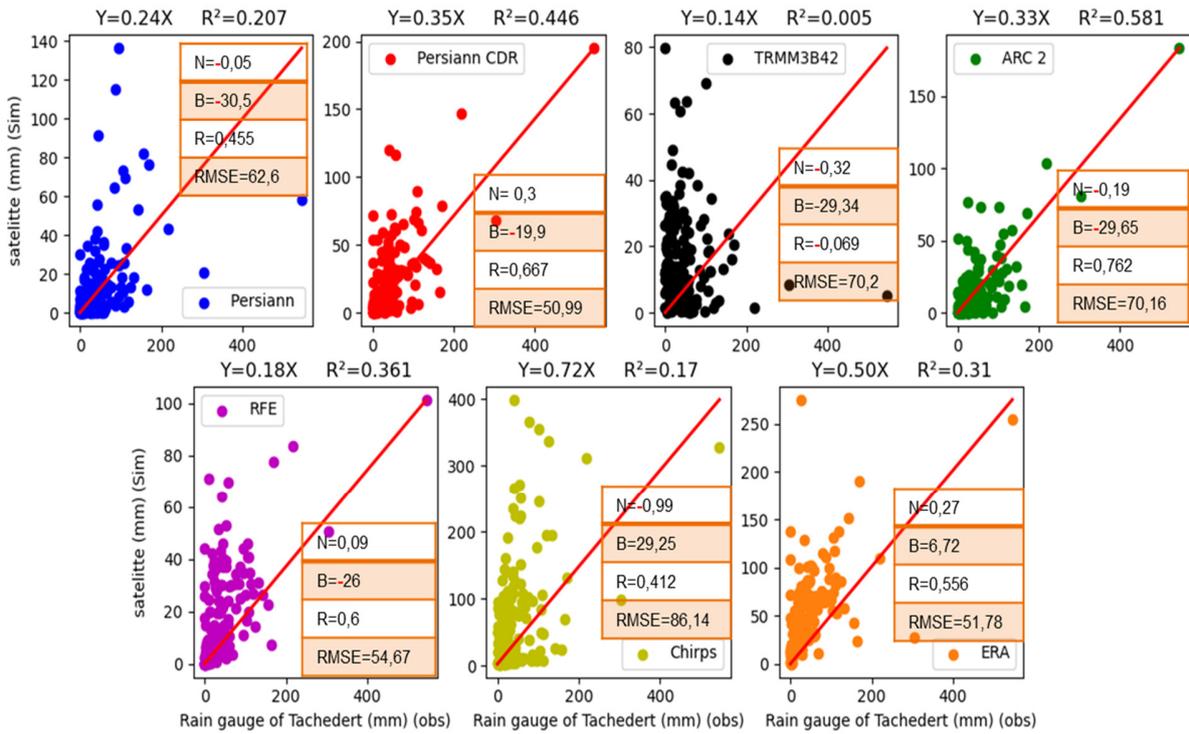


Figure S12: Scatterplots of the monthly satellite products and the Tachedert weather station data.

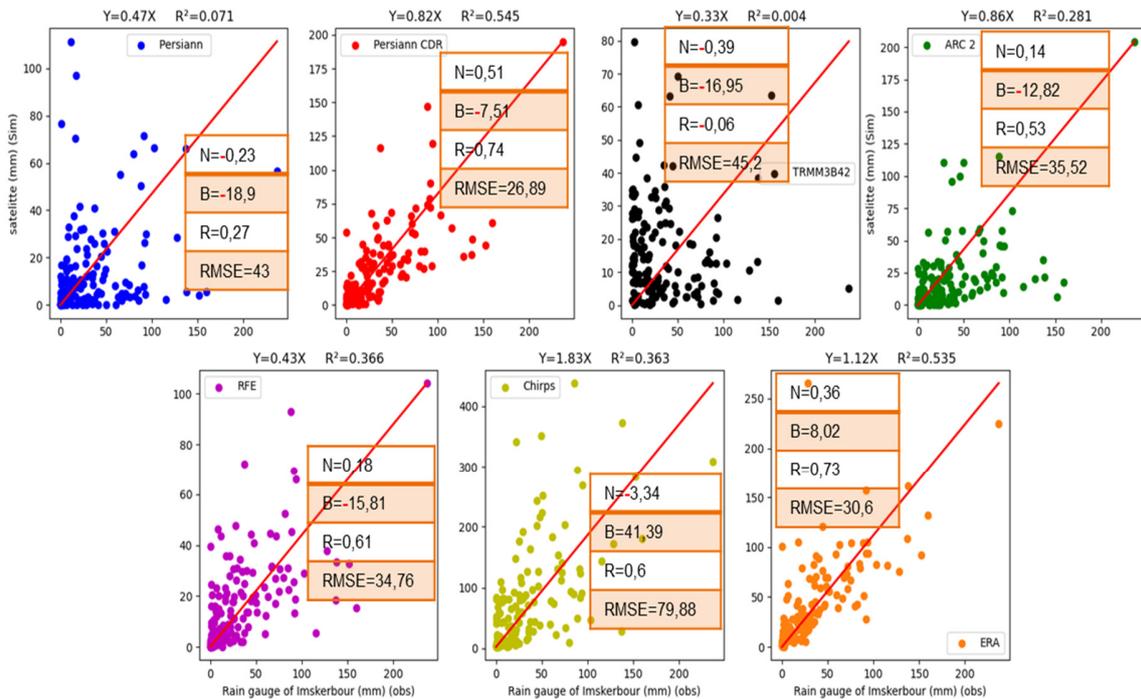


Figure S13: Scatterplots of the monthly satellite products and the Imskerbour weather station data.

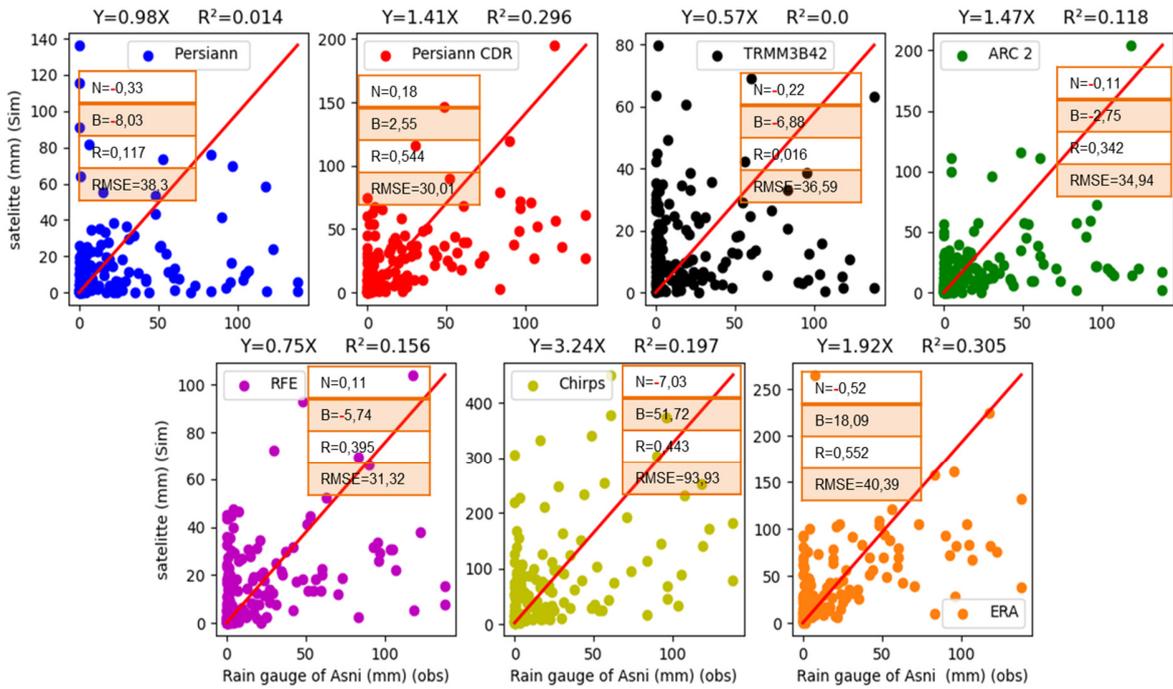


Figure S14: Scatterplots of the monthly satellite products and the Asni weather station data.

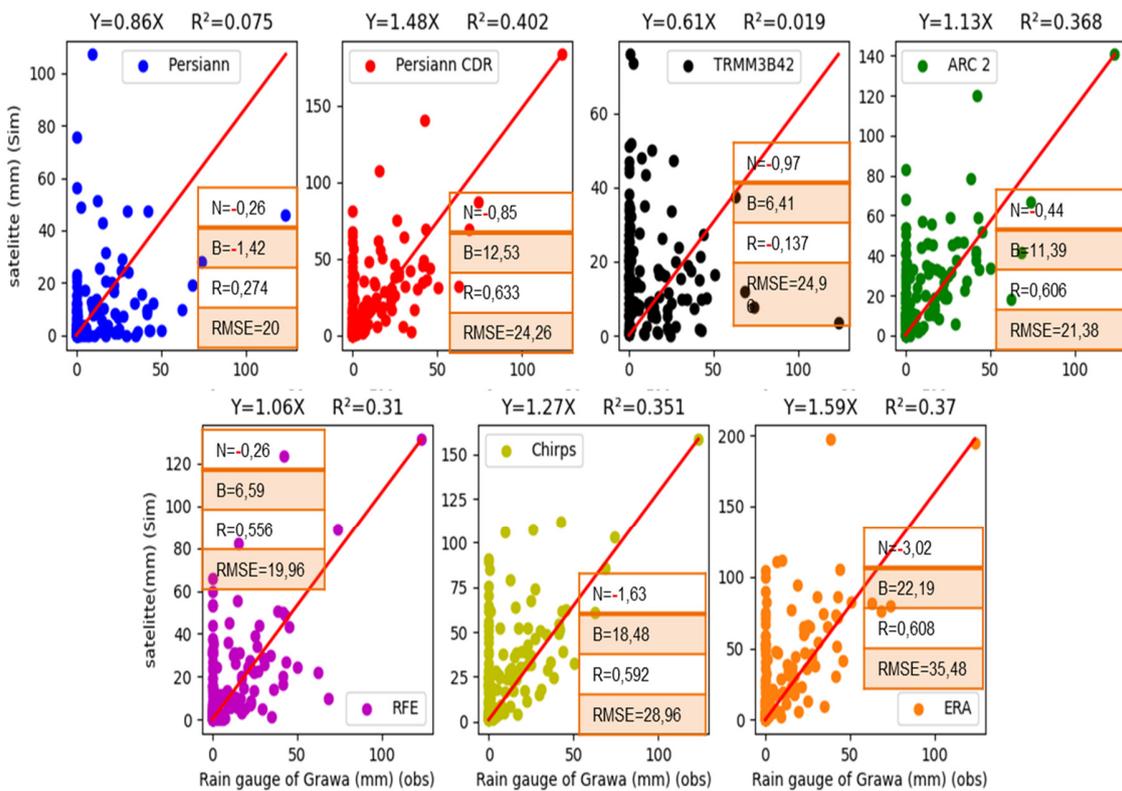


Figure S15: Scatterplots of the monthly satellite products and the Grawa weather station data.

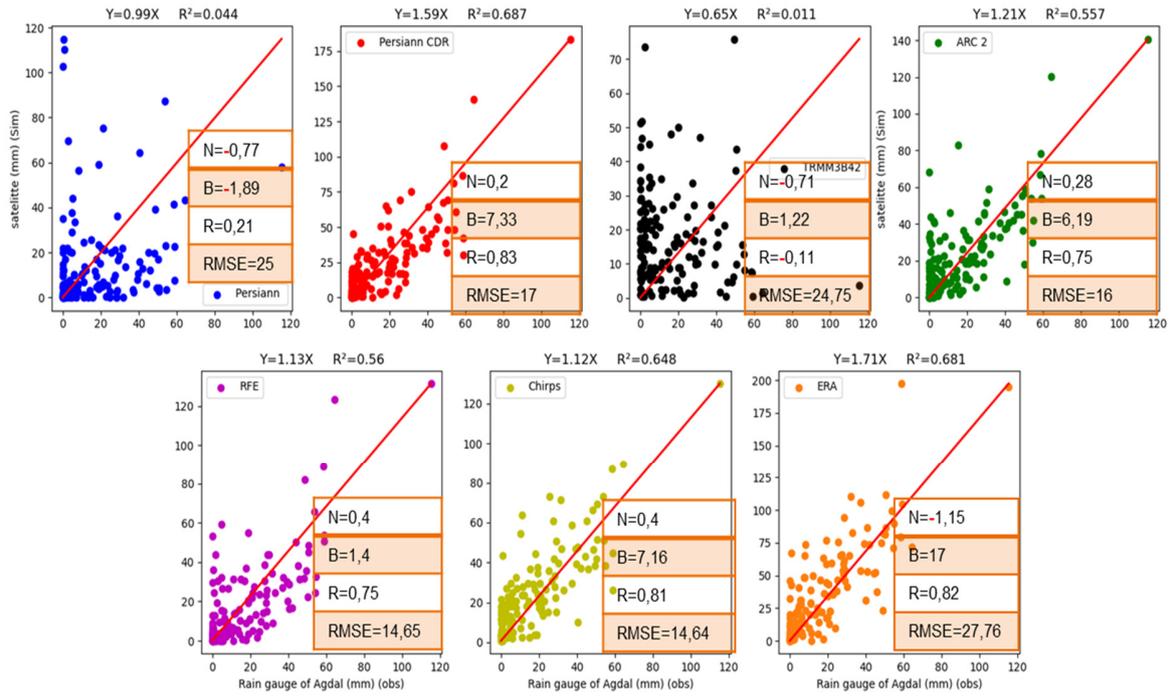


Figure S16: Scatterplots of the monthly satellite products and the Agdal weather station data.

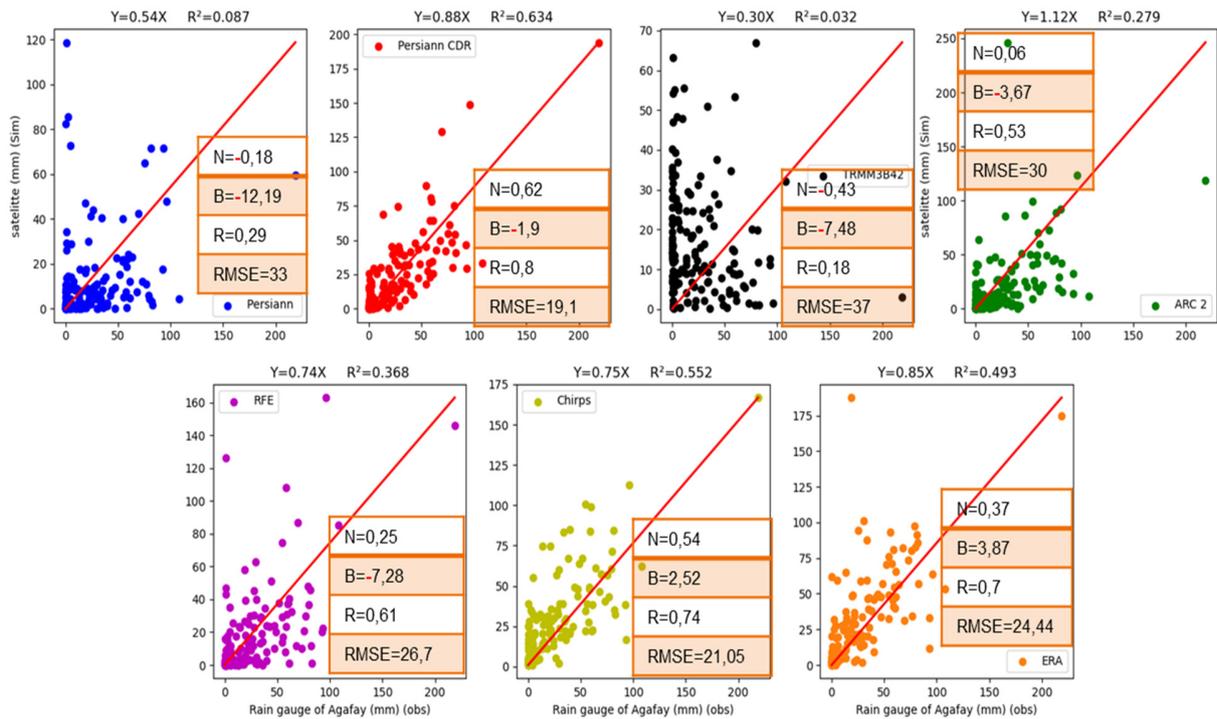


Figure S17: Scatterplots of the monthly satellite products and the Agafay weather station data.

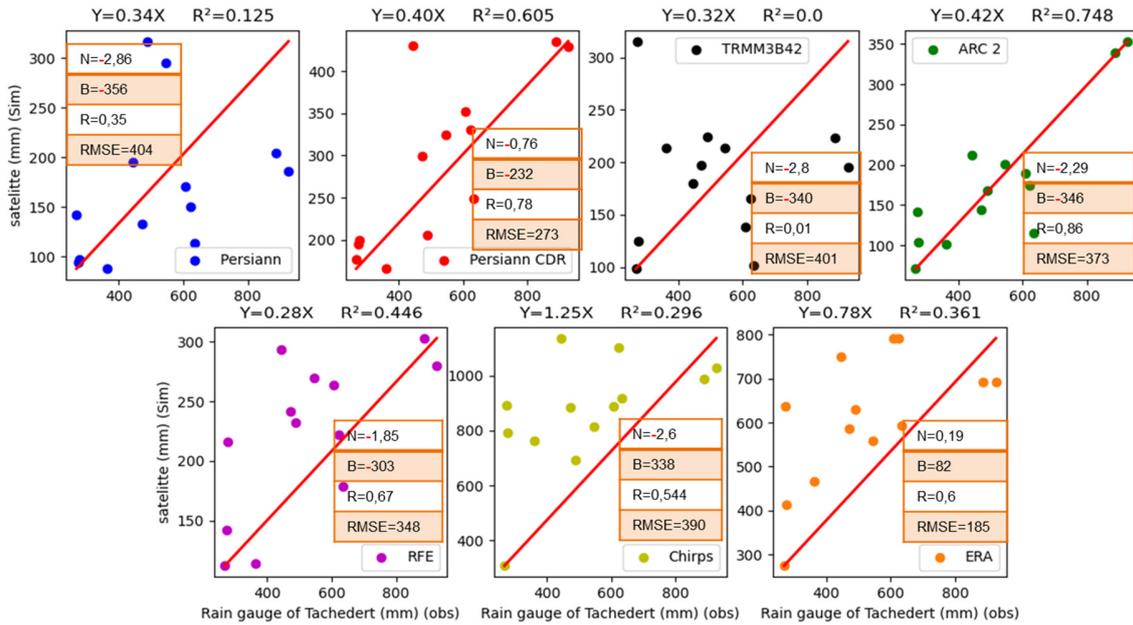


Figure S18: Scatterplots of the annual satellite products and the Tachedert weather station data.

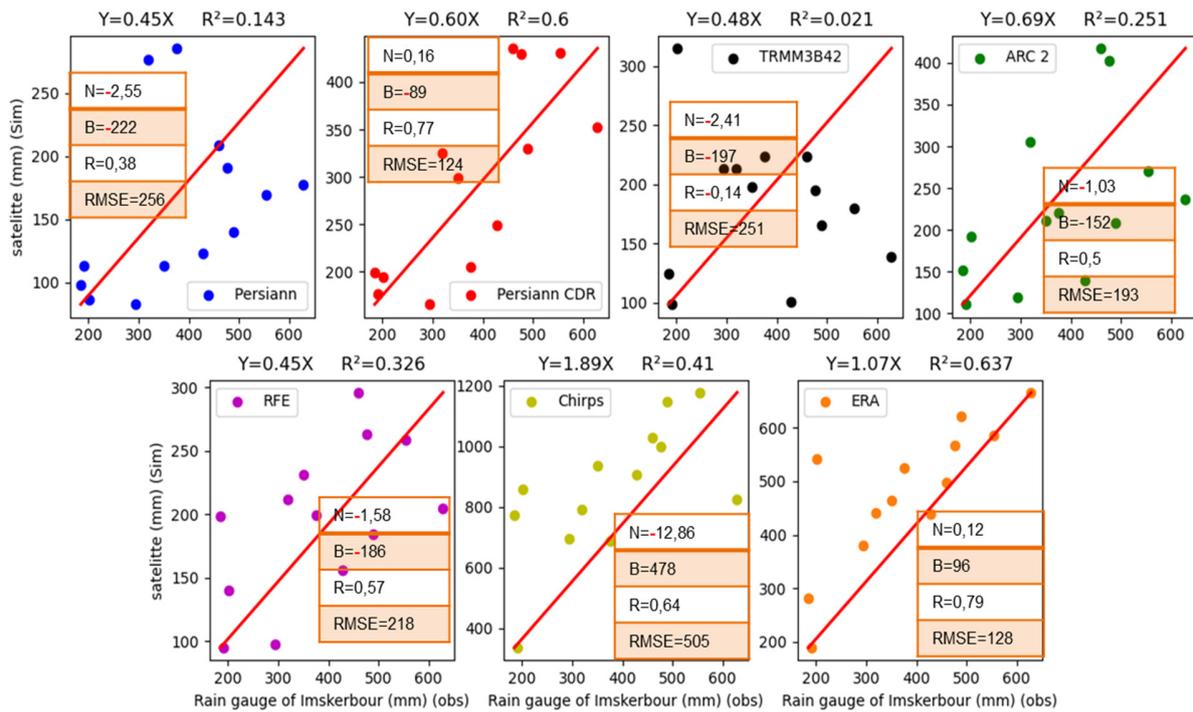


Figure S19: Scatterplots of the annual satellite products and the Imskerbour weather station data.

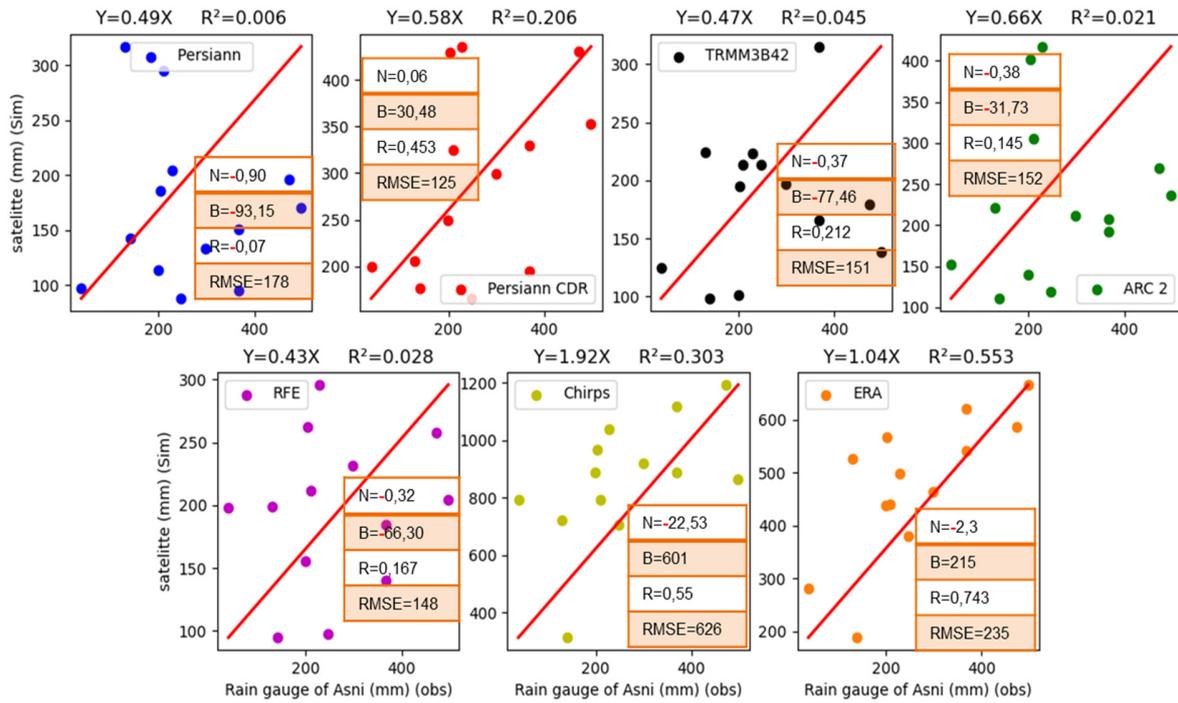


Figure S20: Scatterplots of the annual satellite products with the Asni weather station data.

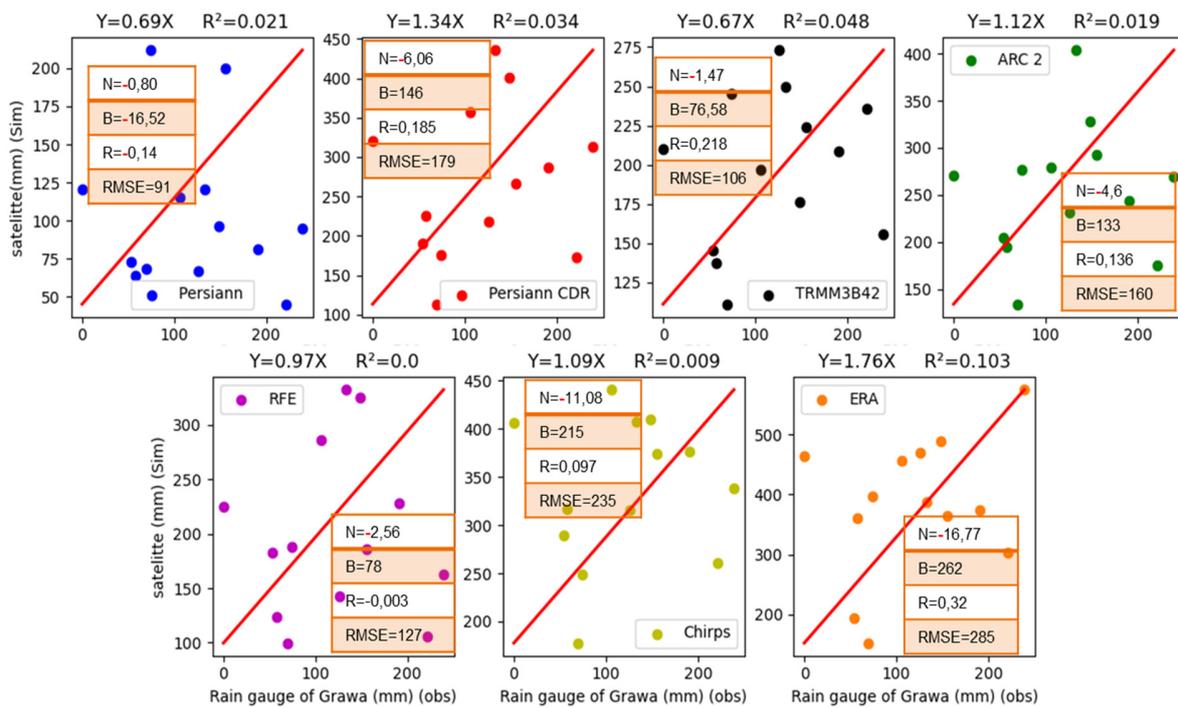


Figure S21: Scatterplots of the annual satellite products and the Grawa weather station

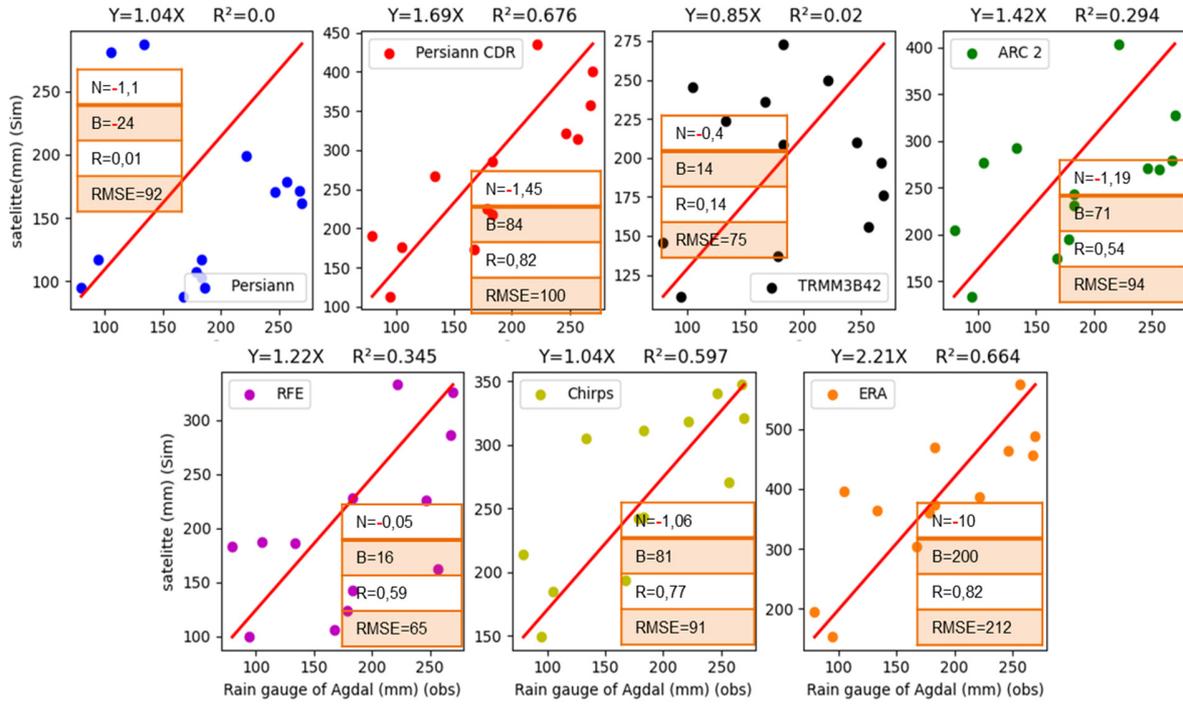


Figure S22: Scatterplots of the annual satellite products and the Agdal weather station

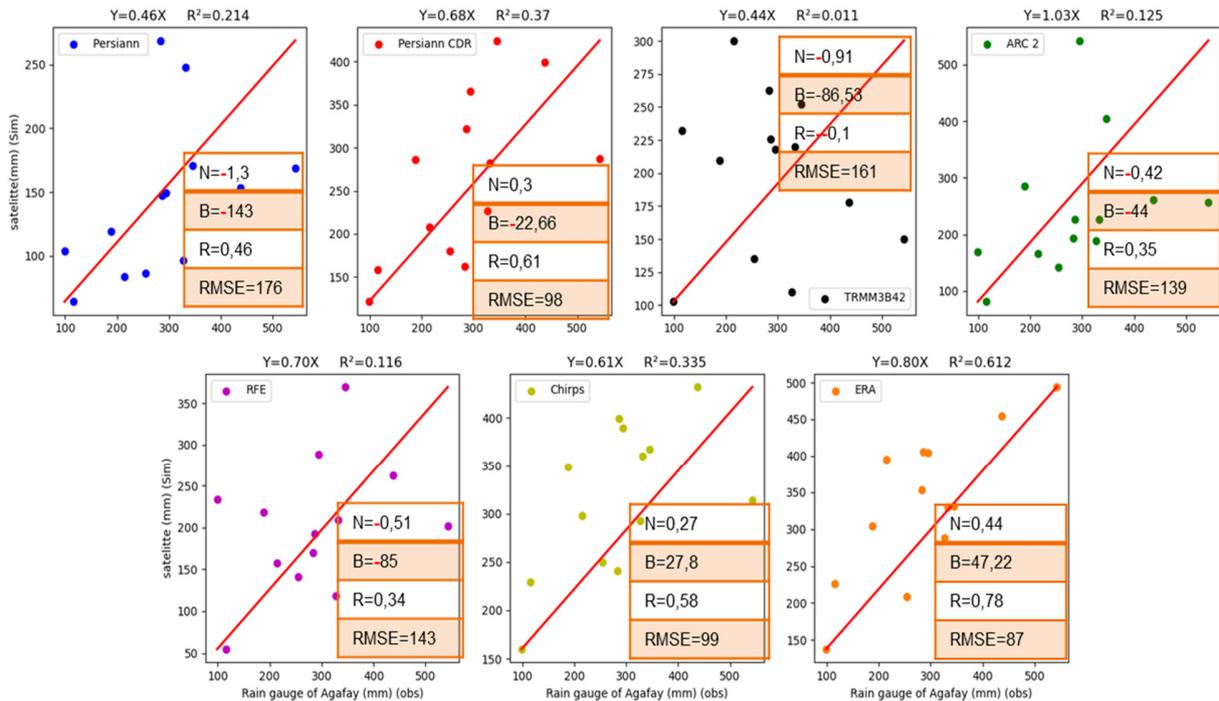
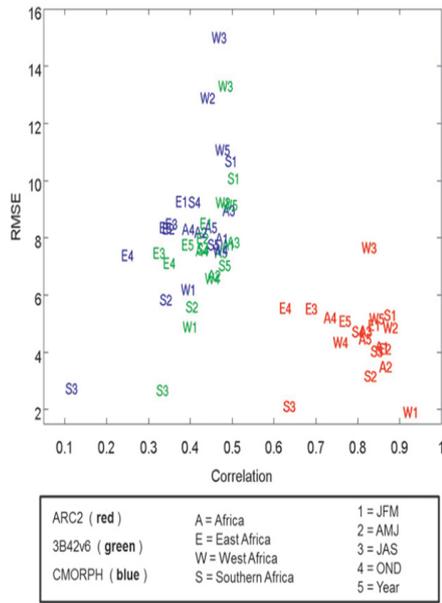
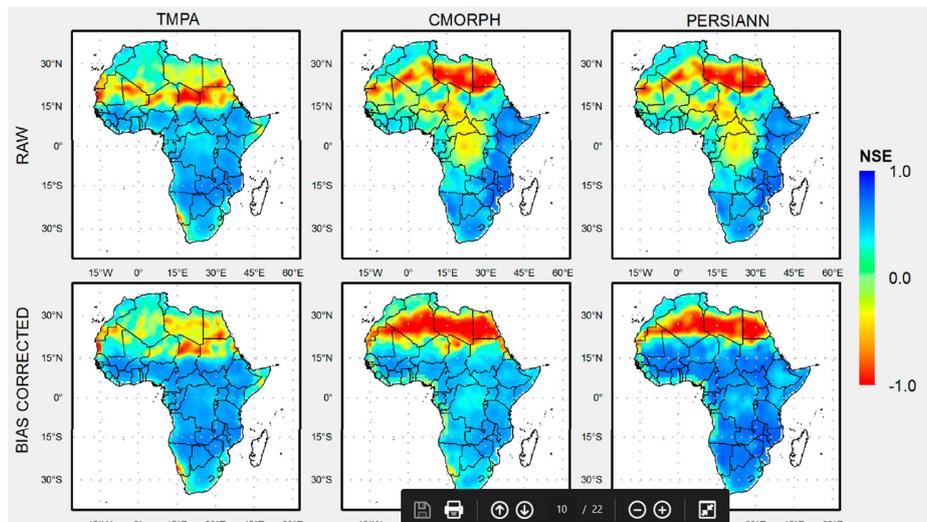


Figure S23: Scatterplots of the annual satellite products and the Agafay weather station



**Figure S24:** Scatterplot of the correlation (x-axis) and RMSE (y-axis) between rain gauge measurements and ARC2 (red), TRMM (green) and CMORPH (blue). [27]



**Figure S25:** Nash efficiency (NSE) of the three satellite precipitation products compared to the GPCP baseline before bias correction (top line), and after (bottom line). [30]

**TableS1:** Availability of rainfall data

| Data                  | Start date | End date   |
|-----------------------|------------|------------|
| Tachedert<br>(2343)   | 13/05/2007 | 24/06/2020 |
| Imeskerbour<br>(1404) | 10/05/2007 | 21/07/2020 |
| Asni (1170)           | 07/01/2004 | 21/07/2020 |
| Grawa (550)           | 10/09/2003 | 13/08/2020 |
| Agdal (489)           | 09/11/2004 | 13/08/2020 |
| Agafay (487)          | 05/02/2003 | 19/08/2020 |

**Table S2:** Availability of satellite and reanalysis data

| Data   | Start date | End date   |
|--|------------|------------|
| Persiann (CHRS/ NASA/NOAA) [12] (24h) (0.25°)<br>IR (GEO: GOES GMS-5, METEOSAT)+ MOP (LEO) | 01/03/2000 | Today      |
| Persiann CDR [14] (24h) (0.25°) : IR+NCEP+GPCP   | 01/01/1983 | Today      |
| TRMM3B42 (NASA) [20] (3h) (0.25°) : MOP+ IR<br>+GPCP                                       | 31/12/1997 | 31/12/2019 |
| ARC2 (CPC) [22] (24h) (0.1°) : IR+ GTS   | 01/01/1983 | Today      |
| CHIRPS (FEWS NET) [24] (1M) (0,05°) : IR+ TMPA+<br>GTS+ GPCC                               | 01/01/1981 | Today      |
| RFE2 (NOAA) [23] (24h) (0,1°) : MO+ IR+ satellite<br>SSM+ GTS                              | 01/01/2002 | Today      |
| ERA5 (ECMWF) [28] (1h) (0,25°)   | 01/01/1980 | 01/06/2020 |

**Table S3:** Classification of SPI values

| SPI classification | SPI values     |
|--------------------|----------------|
| Extremely dry      | < - 2          |
| Severely dry       | -1.99 to -1.50 |
| Moderately dry     | -1.49 to -1.0  |
| Near normal        | -1.0 to 1.0    |
| Moderately wet     | 1.0 to 1.49    |
| Severely wet       | 1.50 to 1.99   |
| Extremely wet      | >2             |

**Table S4:** Drought Periods at Tachedert weather station.

| Tachedert Start date | Drought Duration (DD) | Drought Intensity (DI) | Drought severity (DS) |
|----------------------|-----------------------|------------------------|-----------------------|
| September 2008       | 3 M                   | -1.6                   | 4.4                   |
| Auguste 2013         | 3 M                   | -1.2                   | 1.8                   |
| May 2016             | 4 M                   | -2.25                  | 6.2                   |
| April 2017           | 3 M                   | -1.4                   | 1.5                   |
| July 2018            | 3 M                   | -1.4                   | 1.8                   |
| January 2019         | 3M                    | -1.4                   | 3.1                   |

**Table S5:** Drought Periods at Imskerbour weather station.

| Imskerbour<br>Start date | Drought Duration<br>(DD) | Drought Intensity<br>(DI) | Drought severity<br>(DS) |
|--------------------------|--------------------------|---------------------------|--------------------------|
| January 2008             | 2 M                      | -1.2                      | 1,3                      |
| November 2009            | 2 M                      | -2.1                      | 2,2                      |
| January 2012             | 4 M                      | -1,2                      | 3,4                      |
| June 2013                | 4 M                      | -1.2                      | 2.1                      |
| November 2013            | 3 M                      | -1.1                      | 2.3                      |
| December 2015            | 3 M                      | -1.4                      | 3.3                      |
| May 2016                 | 3 M                      | -1.5                      | 3.9                      |
| August 2017              | 5 M                      | -1.5                      | 4.5                      |
| December 2018            | 5 M                      | -2.66                     | 5.4                      |
| November 2019            | 2 M                      | -1.05                     | 1.7                      |

**Table S6:** Drought Periods at Asni weather station.

| Asni<br>Start date | Drought Duration<br>(DD) | Drought Intensity<br>(DI) | Drought severity<br>(DS) |
|--------------------|--------------------------|---------------------------|--------------------------|
| September 2010     | 3 M                      | -1.02                     | 2.4                      |
| December 2013      | 5 M                      | -1.38                     | 4.8                      |
| March 2015         | 7 M                      | -1.4                      | 5.5                      |
| December 2015      | 3 M                      | -1.66                     | 2.3                      |
| December 2017      | 3 M                      | -1.62                     | 3.9                      |

**Table S7:** Drought Periods at Agdal weather station.

| Agdal<br>Start date | Drought Duration<br>(DD) | Drought Intensity<br>(DI) | Drought severity<br>(DS) |
|---------------------|--------------------------|---------------------------|--------------------------|
| Marsh 2008          | 3 M                      | -2.39                     | 3                        |
| May 2010            | 2 M                      | -1.01                     | 1.8                      |
| January 2012        | 4 M                      | -2.1                      | 4                        |
| October 2014        | 2 M                      | -1.01                     | 1.3                      |
| September 2015      | 2 M                      | -1.1                      | 1.7                      |
| December 2015       | 4 M                      | -2.38                     | 4.2                      |
| April 2017          | 3 M                      | -1.01                     | 2.5                      |
| August 2017         | 7 M                      | -1.62                     | 6.5                      |
| January 2019        | 2 M                      | -2.18                     | 2.9                      |
| September 2019      | 4 M                      | -1.02                     | 2                        |

**Table S8:** Drought Periods at Agafay weather station.

| Agafay<br>Start date | Drought Duration<br>(DD) | Drought Intensity<br>(DI) | Drought severity<br>(DS) |
|----------------------|--------------------------|---------------------------|--------------------------|
| April 2008           | 4 M                      | -2.48                     | 3.5                      |
| February 2011        | 2 M                      | -1.36                     | 1.6                      |
| December 2011        | 2 M                      | -1.75                     | 3                        |
| Marsh 2012           | 2 M                      | -1.35                     | 1.9                      |
| November 2013        | 2 M                      | -1.18                     | 2                        |
| September 2014       | 3 M                      | -1.22                     | 1.9                      |
| December 2015        | 3 M                      | -2.02                     | 2.8                      |
| September 2016       | 3 M                      | -1.02                     | 2.1                      |
| January 2019         | 7 M                      | -2.18                     | 8.2                      |
| September 2019       | 4 M                      | -1.42                     | 3                        |

**Table S9:** Drought Periods over Tensift Basin

| Drought Periods                 | DD | DS   | DI    |
|---------------------------------|----|------|-------|
| January 2008 to November 2008   | 11 | 12,2 | -2,48 |
| November 2009 to December 2009  | 2  | 2,2  | -2,1  |
| May 2010 to November 2010       | 6  | 4,2  | -1,02 |
| February 2011 to Mars 2011      | 2  | 1,6  | -1,36 |
| December 2011 to April 2012     | 5  | 12,3 | -1,75 |
| June 2013 to April 2014         | 11 | 10,7 | -1,8  |
| September 2014 to November 2014 | 3  | 3,2  | -1,2  |
| Marsh 2015 to February 2016     | 12 | 19,4 | -2,38 |
| May 2016 to November 2016       | 7  | 12,2 | -2,25 |
| April 2017 to February 2018     | 11 | 16,4 | -1,62 |
| July 2018 to September 2018     | 3  | 1,5  | -1,4  |
| December 2018 to July 2019      | 8  | 19,6 | -2,66 |
| September 2019 to December 2019 | 3  | 5    | -1,42 |