## 1 Detection of Dry-Down Events

The identification and selection of dry-down events required special attention. To obtain data that could be confidently assumed to be affected by soil-water limitation, I employed a selection procedure consisting of the sequential application of multiple conditions:

1. Periods with at least 15 successive days without precipitation.
2. Both evapotranspiration (ET) and the evaporative fraction (EF) had a significant negative trend over the course of the precipitation-free period.
3. ET had to be be controlled more by the diminishing supply of water rather than atmospheric demand.

The latter condition was implemented by combining two models that individually represented demand and supply limited ET. For the demand limitation, ET was predicted as a linear function of $Rg$

$$\mathrm{ET} = a \cdot Rg + b, \tag{1}$$

where $a$ and $b$ are estimated regression parameters. For the supply limitation, ET was predicted as an exponential decrease with time:

$$\mathrm{ET} = \mathrm{ET}_0 \cdot e^{-k \cdot t}, \tag{2}$$

where $\mathrm{ET}_0$ denotes a parameter for the initial rate of ET at the beginning of the exponential decrease and $k$ denotes the rate of the decay. The variable $t$ denotes the days since the beginning of the selected period.

The demand model was applied to the beginning of any period fulfilling conditions 1. and 2. until a time $t = t_\alpha$, while the supply model was applied to the rest of the period. To find the time step after which supply limitation dominated ET dynamics, I initially set $t_\alpha = 5$ to allow at least 5 observations to be fitted with the demand model and all subsequent ones with the supply model. The residuals of both models were concatenated and the root mean squared error (RMSE) was calculated. I then increased $t_\alpha$ by daily increments until the period fitted with the supply model contained only 5 observations. For each change of $t_\alpha$ the RMSE was noted.

The beginning of supply limitation could then be defined as the $t_\alpha$ for which the RMSE was smallest. As any further increase of $t_\alpha$ would result in a higher RMSE, this indicates that the ET following $t_\alpha$ was best approximated with the exponential decay function which in turn represents supply limitation.

Figure 1 exemplarily shows ET and RMSE for a period fulfilling conditions 1. and 2. The RMSE decreased until $t_\alpha = 12$ and increased gradually thereafter. This means that the ET past $t_\alpha = 12$ could be better predicted with the exponential decrease depending on time rather than the atmospheric demand.

To verify that the selected period did indeed show an approximately exponential decay of ET, we further required that ET had to fit an exponential function with $R^2 > 0.6$.

## 2 List of Detected Dry-Down Events

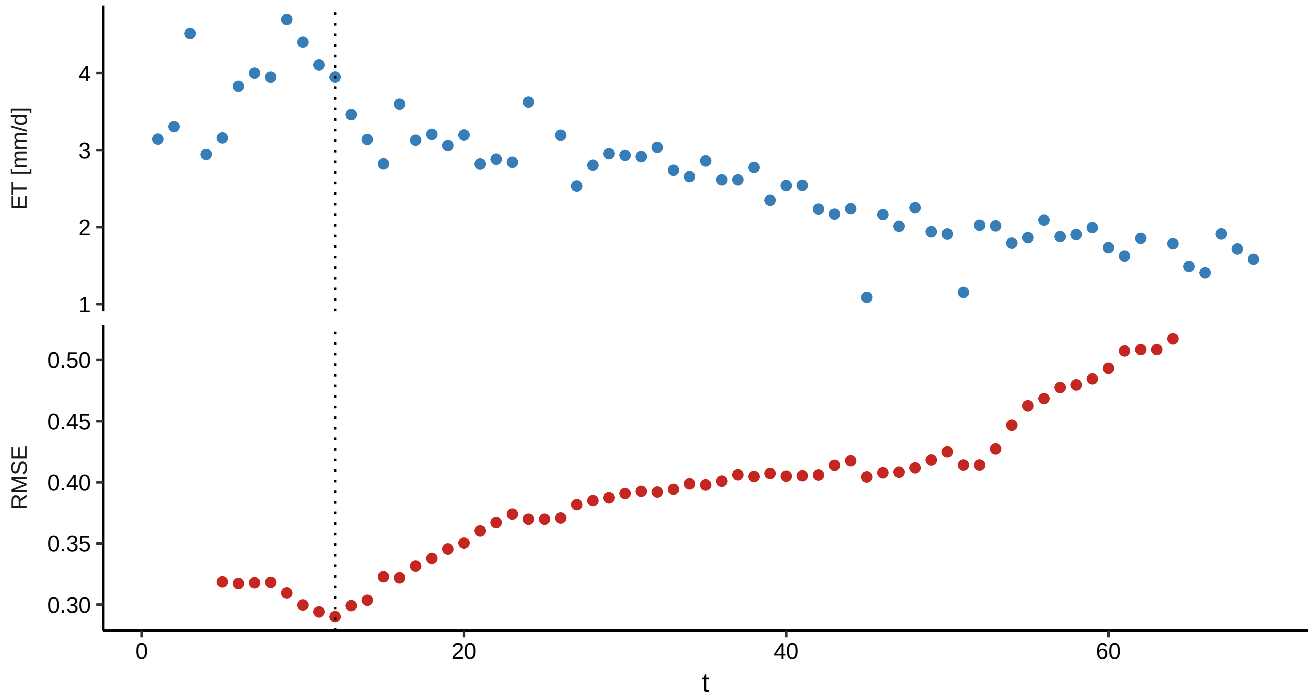


**Figure 1.** RMSE sequence used to identify supply limited ET at the FLUXNET site AU-Dry. The dotted line denotes the day with the smallest RMSE of the combined models, thus indicating the beginning of supply limited ET.

**Table 1.** List of all detected dry-down events used in this study.

| | Site | Start date | End date |
|---|---|---|---|
| 1 | AU-DaP | 2009-4-8 | 2009-6-17 |
| 2 | AU-DaS | 2011-4-28 | 2011-6-30 |
| 3 | AU-Dry | 2013-4-13 | 2013-6-9 |
| 4 | AU-Dry | 2014-5-23 | 2014-10-31 |
| 5 | AU-Gin | 2012-3-4 | 2012-3-28 |
| 6 | AU-How | 2014-6-7 | 2014-10-13 |
| 7 | AU-Stp | 2012-5-24 | 2012-8-3 |
| 8 | IT-Ro2 | 2011-8-8 | 2011-9-13 |
| 9 | IT-Ro2 | 2011-10-14 | 2011-12-19 |
| 10 | SD-Dem | 2007-10-6 | 2008-4-17 |
| 11 | US-Blo | 2004-7-19 | 2004-9-18 |
| 12 | US-SRG | 2008-9-21 | 2008-10-9 |
| 13 | US-SRG | 2012-9-23 | 2012-11-7 |
| 14 | US-SRG | 2014-3-16 | 2014-4-17 |
| 15 | US-SRM | 2008-9-21 | 2008-11-25 |
| 16 | US-SRM | 2011-10-2 | 2011-11-4 |
| 17 | US-Ton | 2002-6-6 | 2002-10-22 |
| 18 | US-Ton | 2005-6-26 | 2005-9-22 |
| 19 | US-Ton | 2006-5-27 | 2006-10-1 |
| 20 | US-Whs | 2014-10-26 | 2014-12-2 |
| 21 | US-Wkg | 2004-10-3 | 2004-10-20 |
| 22 | US-Wkg | 2011-9-22 | 2011-11-4 |
| 23 | BW-Ghg | 2003-3-16 | 2003-4-7 |
| 24 | BW-Ghm | 2003-3-15 | 2003-4-7 |
| 25 | BW-Ma1 | 2000-6-12 | 2000-9-14 |
| 26 | BW-Ma1 | 2000-12-31 | 2001-1-31 |
| 27 | DE-Meh | 2006-7-18 | 2006-7-29 |
| 28 | ES-ES1 | 2003-7-2 | 2003-8-9 |
| 29 | ES-ES1 | 2004-8-9 | 2004-8-29 |
| 30 | ES-ES1 | 2005-12-5 | 2005-12-17 |
| 31 | IL-Yat | 2001-5-6 | 2001-11-12 |
| 32 | IT-Amp | 2003-7-18 | 2003-7-30 |
| 33 | IT-LMa | 2004-9-21 | 2004-10-3 |
| 34 | ML-Kem | 2007-12-2 | 2008-4-28 |
| 35 | ML-Kem | 2008-11-17 | 2008-12-29 |
| 36 | PT-Esp | 2003-7-23 | 2003-8-26 |
| 37 | PT-Mi2 | 2006-7-31 | 2006-8-15 |
| 38 | US-Arb | 2006-7-20 | 2006-8-2 |
| 39 | US-Arc | 2006-7-16 | 2006-8-2 |
| 40 | US-Aud | 2003-10-15 | 2003-11-7 |
| 41 | US-Aud | 2004-4-21 | 2004-5-13 |
| 42 | US-Bo1 | 1998-9-2 | 1998-9-11 |
| 43 | US-Bo1 | 1999-9-3 | 1999-9-11 |
| 44 | US-Bo1 | 2000-8-30 | 2000-9-9 |
| 45 | US-Bo1 | 2005-9-2 | 2005-9-13 |
| 46 | US-FR2 | 2005-9-17 | 2005-10-2 |
| 47 | US-Fuf | 2005-10-18 | 2006-1-17 |