S1. EEP Model rules and evaluation. The model was trained on 6120 points and tested on 1530 additional points. It consists of 6 rules. The AEP (GSNDVI) served as a dependent variable, while site potential (Sitepot); precipitation (ppt); minimum, maximum and mean temperature (tmin, tmax, tmean) in various seasons served as the explanatory variables.

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Cubist [Release 2.07 GPL Edition]  Fri May 11 13:18:54 2018
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  Options:
    Application `GSNDVI'
    Use 80% of data for training
    Maximum of 6 rules
    Permit extrapolation of 10%

  Target attribute `GSNDVI'

Read 6120 cases (29 attributes) from GSNDVI.data

Model:

 Rule 1: [1379 cases, mean 133.5, range 121 to 143, est err 1.5]

  if
    pptsummersum <= 226
    Sitepot <= 139
  then
    GSNDVI = 100.4 + 0.76 Sitepot + 0.0291 pptsummersum + 0.017 pptspringsum

          - 0.23 tmeansummer + 0.041 pptwintersum - 0.61 tminsummeravg
          + 0.17 tmeanwinter + 0.21 tminspringavg + 0.007 pptprevfallsum
          - 0.08 tmeanspring - 0.09 tmaxsummeravg

 Rule 2: [934 cases, mean 136.6, range 126 to 144, est err 1.4]

  if
    pptsummersum > 226
    Sitepot <= 139
  then
    GSNDVI = -23.6 + 0.92 Sitepot + 0.0622 pptsummersum + 0.053 pptwintersum

          + 0.013 pptspringsum + 0.3 tmaxspringavg - 0.35 tminspringavg
          + 0.16 tmeanwinter

 Rule 3: [1324 cases, mean 138.4, range 126 to 166, est err 2.0]

  if
    pptsummersum <= 188
    Sitepot > 139
  then
    GSNDVI = 97.1 + 0.95 Sitepot - 0.71 tmeansummer + 0.0265 pptsummersum
          + 0.02 pptspringsum + 0.026 pptprevfallsum - 0.2 tmaxspringavg
          + 0.3 tminspringavg + 0.016 pptwintersum - 0.22 tminsummeravg
```

Rule 4: [612 cases, mean 141.8, range 129 to 161, est err 1.5]

if
tmaxspringavg > 116
pptwintersum <= 48
pptsummersum > 188
then
GSNDVI = 78 + 0.96 Sitepot - 0.96 tmeansummer + 0.126 pptwintersum
+ 0.0348 pptsummersum - 0.73 tmaxspringavg + 0.37 tmeanspring
+ 0.78 tminsummeravg - 0.46 tminspringavg + 0.27 tmaxsummeravg

Rule 5: [1117 cases, mean 142.4, range 126 to 163, est err 1.5]

if
pptwintersum > 48
pptsummersum > 188
then
GSNDVI = -20.1 + 1.01 Sitepot + 0.0271 pptsummersum + 0.014 pptspringsum

+ 0.4 tminspringavg + 0.26 tmeanwinter - 0.34 tminsummeravg
- 0.07 tmeansummer - 0.07 tmeanspring

Rule 6: [1186 cases, mean 142.6, range 133 to 173, est err 1.6]

if
tmaxspringavg <= 116
pptwintersum <= 48
pptsummersum > 188
Sitepot > 139
then
GSNDVI = -34.1 + 0.92 Sitepot + 0.0323 pptsummersum + 0.081 pptwintersum

+ 0.33 tminspringavg + 0.09 tmeansummer - 0.11 tmaxspringavg
+ 0.03 tmeanspring

Evaluation on training data (6120 cases):

Average |error|	1.6
Relative |error|	0.36
Correlation coefficient	0.93

Attribute usage:

Conds	Model	
100%	100%	pptsummersum
74%	100%	Sitepot
44%	83%	pptwintersum
27%	62%	tmaxspringavg
	100%	tminspringavg
	86%	tmeansummer
	73%	pptspringsum

68% tminsummeravg
66% tmeanspring
52% tmeanwinter
41% pptprevfallsum
30% tmaxsummeravg

Evaluation on test data (1530 cases):

Average |error|	1.5
Relative |error|	0.36
Correlation coefficient	0.93

S2. Predictive model rules and evaluation. The model was trained on 1280 points and tested on 320 additional points. The model was created with 3-member committee models. The BP (Productivity) served as a dependent variable, while site potential (Site_potential), 3-month SPI (SPI3m), USDM percentile index (USDM), 3-month EDDI, and 3-month ESI in various seasons served as the explanatory variables.

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Cubist [Release 2.07 GPL Edition]  Wed Jul 17 14:48:11 2019
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  Options:
    Application `Drought_productivity'
    Use 80% of data for training
    Permit extrapolation of 10%
    3-member committee model

  Target attribute `Productivity'

  Replacing unknown attribute values:
    `ESI_spring' by -0.0013221
    `ESI_summer' by -0.0164259

Read 1280 cases (23 attributes) from Drought_productivity.data

Model 1:

 Rule 1/1: [194 cases, mean 2068.5039, range 852.496 to 3137.27, est err 135.2723]

  if
        SPI3m_spring <= 0.1999029
        USDM_winter <= 550
        USDM_prev_year > 597
        EDDI_spring <= 1.59609
        Site_potential <= 148
  then
        Productivity = -10614.0833 USDM_prev_year - 0.053 USDM_winter
                       + 0.16 USDM_spring + 0.07 SPI3m_winter + 106 SPI3m_spring
                       + 208 EDDI_spring - 12 ESI_spring + 45 Site_potential + 92

 Rule 1/2: [143 cases, mean 2097.0156, range 753.131 to 3037.53, est err 133.0036]

  if
        EDDI_spring > 1.59609
        SPI3m_spring <= 0.199029
        Site_potential <= 148
  then
    Productivity = -9205.5039 - 685 EDDI_spring + 90 Site_potential
                   - 95 EDDI_winter - 0.048 USDM_prev_year + 32 SPI3m_spring
                   + 25 SPI3m_winter + 0.07 USDM_winter + 0.04 USDM_spring
                   + 9 ESI_winter + 9 ESI_spring

 Rule 1/3: [19 cases, mean 2242.9153, range 1171.72 to 3156.42, est err 189.9274]

  if
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    SPI3m_spring > 0.199029
    EDDI_spring > 1.3083
    Site_potential <= 148
  then
    Productivity = -7251.5629 - 1341 EDDI_spring + 84 Site_potential
                + 0.05 USDM_winter - 0.012 USDM_prev_year + 10 ESI_spring
                + 9 SPI3m_winter + 8 SPI3m_spring

Rule 1/4: [113 cases, mean 2296.8665, range 1150.59 to 3145.19, est err 130.9743]

  if
    USDM_winter <= 52
    SPI3m_spring > 0.199029
    Site_potential <= 148
  then
    Productivity = -11123.9837 + 95 Site_potential + 115 SPI3m_winter
                + 58 ESI_spring

Rule 1/5: [163 cases, mean 2397.5527, range 1102.54 to 3269.18, est err 149.1111]

  if
    USDM_winter > 550
    SPI3m_spring <= 0.199029
    EDDI_spring <= 1.59609
    Site_potential <= 148
  then
    Productivity = -12753.9924 + 101 Site_potential + 1.4 USDM_winter
                + 308 SPI3m_spring + 0.33 USDM_spring + 54 EDDI_winter
                + 24 ESI_winter + 25 SPI3m_winter - 0.018 USDM_prev_year
                + 9 ESI_spring

Rule 1/6: [140 cases, mean 2457.7271, range 1448.69 to 4272.75, est err 117.9184]

  if
    USDM_prev_year <= 597
    SPI3m_spring <= 0.199029
  then
    Productivity = -9867.5861 + 87 Site_potential + 106 EDDI_winter

Rule 1/7: [531 cases, mean 2486.3311, range 1349.32 to 3534.35, est err 147.6671]

  if
    USDM_winter > 52
    SPI3m_spring > 0.199029
    EDDI_spring <= 1.3083
    Site_potential <= 148
  then
    Productivity = -11655.8142 + 99 Site_potential + 0.29 USDM_winter
                + 52 SPI3m_winter + 50 EDDI_spring + 33 EDDI_winter
                + 0.04 USDM_spring + 6 ESI_spring

Rule 1/8: [17 cases, mean 3385.1152, range 2829.53 to 4305.53, est err 229.2913]
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if
ESI_spring <= -0.32557
Site_potential > 148
then
Productivity = -3768.1619 + 47 Site_potential + 0.56 USDM_winter
- 0.152 USDM_prev_year + 115 ESI_winter + 92 SPI3m_winter

+ 81 ESI_spring

Rule 1/9: [32 cases, mean 3865.9429, range 3226.99 to 4660.15, est err 139.7003]

if
ESI_spring > -0.32557
Site_potential > 148
then
Productivity = -4124.1562 + 50 Site_potential + 0.34 USDM_winter
- 0.007 USDM_prev_year

Model 2:

Rule 2/1: [98 cases, mean 2138.9900, range 1448.69 to 2660.75, est err 143.5833]

if
USDM_prev_year <= 811
SPI3m_spring <= 0.263186
Site_potential <= 142
then
Productivity = -7766.5643 - 1.157 USDM_prev_year + 75 Site_potential
- 75 EDDI_winter

Rule 2/2: [165 cases, mean 2150.2087, range 753.131 to 4063.96, est err 192.3959]

if
EDDI_spring > 1.55568
then
Productivity = -8087.8481 - 0.473 USDM_prev_year + 74 Site_potential
+ 1 USDM_spring + 22 SPI3m_winter - 19 EDDI_spring
+ 15 SPI3m_spring + 8 ESI_spring

Rule 2/3: [380 cases, mean 2305.0908, range 852.496 to 4305.53, est err 159.2865]

if
USDM_prev_year > 811
SPI3m_spring <= 0.263186
EDDI_spring <= 1.55568
then
Productivity = -8876.3348 + 80 Site_potential + 180 SPI3m_spring
+ 99 SPI3m_winter + 0.34 USDM_spring
- 0.097 USDM_prev_year + 45 ESI_spring

Rule 2/4: [643 cases, mean 2493.9519, range 1150.59 to 4660.15, est err 166.8486]

if

```
    SPI3m_spring > 0.263186
  then
    Productivity = -10346.8617 + 89 Site_potential + 0.43 USDM_spring
                + 67 EDDI_winter + 0.08 USDM_winter
                - 0.021 USDM_prev_year + 14 ESI_spring + 12 SPI3m_spring
                + 8 SPI3m_winter

 Rule 2/5: [532 cases, mean 2795.2405, range 1670.23 to 4660.15, est err 166.9139]

  if
    Site_potential > 142
  then
    Productivity = -7873.809 + 73 Site_potential + 0.61 USDM_winter
                + 140 SPI3m_winter + 112 ESI_spring
                - 0.108 USDM_prev_year + 84 SPI3m_spring - 46 EDDI_winter

                - 0.18 USDM_spring

Model 3:

 Rule 3/1: [119 cases, mean 1936.8162, range 852.496 to 3567.14, est err 135.2686]

  if
    SPI3m_spring <= -1.18148
    EDDI_spring <= 1.64678
  then
    Productivity = -10905.0495 + 88 Site_potential + 186 EDDI_winter
                - 126 ESI_winter - 53 ESI_spring + 0.2 USDM_winter
                + 40 SPI3m_spring + 0.12 USDM_spring
                - 0.033 USDM_prev_year + 10 SPI3m_winter

 Rule 3/2: [12 cases, mean 2060.9275, range 1171.72 to 3110.11, est err 349.3818]

  if
    SPI3m_spring > 0.199029
    EDDI_spring > 1.49562
  then
    Productivity = -4434.6249 - 2575 EDDI_spring + 80 Site_potential
                + 0.04 USDM_winter + 6 ESI_spring

 Rule 3/3: [387 cases, mean 2120.4473, range 753.131 to 3185.77, est err 136.2435]

  if
    SPI3m_winter <= -0.26115
    Site_potential <= 148
  then
    Productivity = -10899.6928 + 94 Site_potential - 0.27 USDM_prev_year
                + 0.66 USDM_spring - 98 EDDI_winter

 Rule 3/4: [158 cases, mean 2144.1140, range 753.131 to 4063.96, est err 160.3739]

  if
    EDDI_spring > 1.64678
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then
Productivity = -8780.0565 - 1454 EDDI_spring + 96 Site_potential
- 194 EDDI_winter + 0.161 USDM_prev_year
+ 47 SPI3m_spring + 0.12 USDM_winter + 26 SPI3m_winter
+ 13 ESI_winter

Rule 3/5: [211 cases, mean 2380.5793, range 1249.96 to 3269.18, est err 168.2369]

if
USDM_winter > 195
SPI3m_spring > -1.18148
SPI3m_spring <= 0.199029
EDDI_spring <= 1.64678
Site_potential <= 148
then
Productivity = -12950.6832 + 107 Site_potential + 352 SPI3m_spring
+ 1.07 USDM_winter - 0.19 USDM_prev_year
+ 116 SPI3m_winter + 0.13 USDM_spring

Rule 3/6: [125 cases, mean 2417.6711, range 1029.49 to 4272.75, est err 175.0032]

if
USDM_winter <= 195
SPI3m_spring <= 0.199029
EDDI_spring <= 1.64678
then
Productivity = -11455.3714 + 100 Site_potential - 0.98 USDM_winter
- 156 EDDI_winter + 23 SPI3m_spring
- 0.019 USDM_prev_year + 11 ESI_spring + 12 SPI3m_winter

Rule 3/7: [87 cases, mean 2512.9185, range 1526.31 to 3269.18, est err 182.9935]

if
USDM_prev_year > 2575
SPI3m_spring <= 0.199029
EDDI_spring <= 1.64678
Site_potential <= 148
then
Productivity = -14455.6019 + 122 Site_potential - 216 SPI3m_winter
+ 90 EDDI_winter + 0.1 USDM_winter + 22 SPI3m_spring
+ 0.07 USDM_spring - 0.013 USDM_prev_year

Rule 3/8: [461 cases, mean 2518.8743, range 1150.59 to 3534.35, est err 165.2857]

if
SPI3m_winter > -0.26115
SPI3m_spring > 0.199029
EDDI_spring <= 1.49562
Site_potential <= 148
then
Productivity = -12552.8688 + 106 Site_potential + 172 EDDI_spring
+ 0.08 USDM_prev_year

Rule 3/9: [28 cases, mean 3602.6821, range 2874.71 to 4272.75, est err 256.8739]

if
  USDM_winter <= 565
  Site_potential > 148
then
  Productivity = -366.869 - 0.73 USDM_winter + 27 Site_potential
                 - 35 EDDI_winter

Rule 3/10: [21 cases, mean 3827.7156, range 2829.53 to 4660.15, est err 317.8513]

if
  USDM_winter > 565
  Site_potential > 148
then
  Productivity = -12229.7738 + 14.92 USDM_winter + 710 SPI3m_winter
                 + 41 Site_potential - 143 EDDI_winter

Evaluation on training data (1280 cases):

Average |error|	129.8323
Relative |error|	0.31
Correlation coefficient	0.95

Attribute usage:

Conds	Model	
72%	61%	SPI3m_spring
64%	100%	Site_potential
58%	35%	EDDI_spring
29%	64%	USDM_winter
19%	82%	USDM_prev_year
18%	76%	SPI3m_winter
1%	66%	ESI_spring
	74%	USDM_spring
	66%	EDDI_winter
	13%	ESI_winter

Evaluation on test data (320 cases):

Average |error|	143.6743
Relative |error|	0.32
Correlation coefficient	0.95