

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>

Supplementary data

SUPPLEMENTARY TABLE 1. Table of Acronyms.

| ACRONYM | UOM | DESCRIPTION |
|-----------------------|-------------|--|
| CH_DOY.BBCH07 | Day of year | Beginning of budburst: green shoot tips just visible (Chardonnay) |
| CH_DOY.BBCH15 | Day of year | 5th leaves unfolded (Chardonnay) |
| CH_DOY.BBCH18 | Day of year | 8th leaves unfolded (Chardonnay) |
| CH_DOY.BBCH61 | Day of year | Beginning of flowering: 10% of flowerhoods fallen (Chardonnay) |
| CH_DOY.BBCH65 | Day of year | Full flowering: 50% of flowerhoods fallen (Chardonnay) |
| CH_DOY.BBCH75 | Day of year | Berries pea-sized, bunches hang (Chardonnay) |
| CH_DOY.BBCH81 | Day of year | Beginning of ripening: berries begin to develop variety-specific colour (Chardonnay) |
| CH_DOY.BBCH85 | Day of year | Softening of berries (Chardonnay) |
| CH_DOY.Harvest | Day of year | Harvest (Chardonnay) |
| CH_bud_harvest | Days | Time from budburst to harvest (Chardonnay) |
| CH_bud_veraison | Days | Time from budburst to veraison (Chardonnay) |
| CH_veraison_harvest | Days | Time from veraison to harvest (Chardonnay) |
| CH_flowering_veraison | Days | Time from flowering to veraison (Chardonnay) |
| CH_White.wine.quality | - | White wine quality (Chardonnay) |
| CH_Sparkling_quality | - | Sparkling quality (Chardonnay) |
| TE_DOY.BBCH07 | Day of year | Beginning of budburst: green shoot tips just visible (Teroldego) |
| TE_DOY.BBCH15 | Day of year | 5th leaves unfolded (Teroldego) |
| TE_DOY.BBCH18 | Day of year | 8th leaves unfolded (Teroldego) |
| TE_DOY.BBCH61 | Day of year | Beginning of flowering: 10% of flowerhoods fallen (Teroldego) |
| TE_DOY.BBCH65 | Day of year | Full flowering: 50% of flowerhoods fallen (Teroldego) |
| TE_DOY.BBCH75 | Day of year | Berries pea-sized, bunches hang (Teroldego) |
| TE_DOY.BBCH81 | Day of year | Beginning of ripening: berries begin to develop variety-specific colour (Teroldego) |
| TE_DOY.BBCH85 | Day of year | Softening of berries (Teroldego) |
| TE_DOY.Harvest | Day of year | Harvest (Teroldego) |
| TE_bud_harvest | Days | Time from budburst to harvest (Teroldego) |
| TE_bud_veraison | Days | Time from budburst to veraison (Teroldego) |
| TE_veraison_harvest | Days | Time from veraison to harvest (Teroldego) |
| TE_flowering_veraison | Days | Time from flowering to veraison (Teroldego) |
| TE_Red_quality | - | Red wine quality (Teroldego) |
| TMED | °C | Annual means of daily mean air temperature |
| TMAX | °C | Annual means of daily maximum air temperature |
| TMIN | °C | Annual means of daily minimum air temperature |
| UR | % | Annual means of daily mean relative humidity |
| PREC | mm | Annual means of daily rainfall |
| RAD_glob_tot | MJ/m2 | Annual means of daily solar radiation |
| TMED_soil | °C | Annual means of daily mean soil temperature |

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>



| | | |
|------------------|-------|--|
| PREC_CUM | mm | Cumulative annual precipitation |
| RAD_glob_tot_CUM | MJ/m2 | Total annual solar radiation |
| S_GDD_10 | °C | Growing degree days (T base = 10°C) |
| S_GDD_7_2 | °C | Growing degree days (T base = 7.2°C) |
| S_GDD_6 | °C | Growing degree days (T base = 6°C) |
| TMED_CV | °C | Annual coefficient of variation of daily mean air temperature |
| TMAX_CV | °C | Annual coefficient of variation of daily maximum air temperature |
| TMIN_CV | °C | Annual coefficient of variation of daily minimum air temperature |
| UR_CV | % | Annual coefficient of variation of daily mean relative humidity |
| PREC_CV | mm | Annual coefficient of variation of daily rainfall |
| RAD_glob_tot_CV | MJ/m2 | Annual coefficient of variation of daily solar radiation |
| TMED_soil_CV | °C | Annual coefficient of variation of daily mean soil temperature |
| TMAX_q90 | °C | Quantile 90% of daily maximum air temperature |
| PREC_q90 | mm | Quantile 90% of daily maximum air temperature |
| TMED_Apr1_Sept30 | °C | Daily mean air temperatures averaged in the period April 1st-September 30th |
| TMAX_Apr1_Sept30 | °C | Daily maximum air temperatures averaged in the period April 1st-September 30th |
| TMIN_Apr1_Sept30 | °C | Daily minimum air temperatures averaged in the period April 1st-September 30th |
| TMED_May15_Jun15 | °C | Daily mean air temperatures averaged in the period May 1st-June 31st |
| TMAX_May15_Jun15 | °C | Daily maximum air temperatures averaged in the period May 1st-June 31st |
| TMIN_May15_Jun15 | °C | Daily minimum air temperatures averaged in the period May 1st-June 31st |
| n_T_30 | - | Number of days exceeding 30°C |
| n_T_35 | - | Number of days exceeding 35°C |
| HI_Apr1_Sep30 | - | Huglin index in the period April 1st-September 30th |
| Pcum_Apr1_Sept30 | mm | Cumulative rainfall in the period April 1st-September 30th |
| P_winter | mm | Cumulative rainfall from January to March |
| P_spring | mm | Cumulative rainfall from April to June |
| P_summer | mm | Cumulative rainfall from July to September |
| P_autumn | mm | Cumulative rainfall from October to December |
| TMED_soil_winter | °C | Daily mean soil temperatures averaged from January to March |
| TMED_soil_spring | °C | Daily mean soil temperatures averaged from April to June |
| TMED_soil_summer | °C | Daily mean soil temperatures averaged from July to September |
| TMED_soil_autumn | °C | Daily mean soil temperatures averaged from October to December |
| TMED_winter | °C | Daily mean air temperatures averaged from January to March |
| TMED_spring | °C | Daily mean air temperatures averaged from April to June |
| TMED_summer | °C | Daily mean air temperatures averaged from July to September |
| TMED_autumn | °C | Daily mean air temperatures averaged from October to December |
| DemartonneINDEX | - | De Martonne Index |

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>

| | | |
|-------------------|----|--|
| DemartonneVEGONLY | - | Demartonne index of vegetative period |
| ET_bunch_harv | mm | Evapotranspiration from bunch closing to harvest |
| ETannual | mm | Annual evapotranspiration |

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>



SUPPLEMENTARY TABLE 2. Mann-Kendall trend p-value.

| Pvalue_[Mann_Kendall] | y (dependent variable) | x (independent variable) |
|-----------------------|------------------------|--------------------------|
| 1.40E-03 | TMED | time |
| 8.90E-01 | TMAX | time |
| 2.70E-02 | TMIN | time |
| 8.50E+00 | UR | time |
| 8.50E-01 | TMED_soil | time |
| 7.50E-01 | PREC_CUM | time |
| 7.00E-06 | RAD_glob_tot_CUM | time |
| 9.10E-03 | S_GDD_10 | time |
| 2.10E-04 | S_GDD_7_2 | time |
| 3.80E-04 | S_GDD_6 | time |
| 4.00E-03 | TMED_CV | time |
| 5.50E-01 | TMAX_CV | time |
| 1.00E-02 | TMIN_CV | time |
| 7.10E+00 | UR_CV | time |
| 1.00E+00 | PREC_CV | time |
| 5.80E-02 | RAD_glob_tot_CV | time |
| 4.50E-02 | TMED_soil_CV | time |
| 3.30E+00 | TMAX_q90 | time |
| 5.00E-01 | PREC_q90 | time |
| 3.60E-03 | TMED_Apr1_Sep30 | time |
| 9.50E+00 | TMAX_Apr1_Sep30 | time |
| 9.90E-02 | TMIN_Apr1_Sep30 | time |
| 1.10E+00 | TMED_May15_Jun15 | time |
| 6.70E+00 | TMAX_May15_Jun15 | time |
| 7.00E+00 | TMIN_May15_Jun15 | time |
| 8.40E-01 | n_T_30 | time |
| 6.70E+00 | n_T_35 | time |
| 8.00E-02 | HI | time |
| 5.50E+00 | Pcum_Apr1_Sep30 | time |
| 5.60E+00 | P_winter | time |
| 9.00E+00 | P_spring | time |
| 5.40E+00 | P_summer | time |
| 5.40E+00 | P_autumn | time |
| 5.70E-02 | TMED_soil_winter | time |
| 9.20E+00 | TMED_soil_spring | time |
| 6.10E+00 | TMED_soil_summer | time |
| 5.00E-03 | TMED_soil_autumn | time |
| 7.90E-01 | TMED_winter | time |
| 6.20E-02 | TMED_spring | time |
| 1.60E-01 | TMED_summer | time |
| 7.90E-01 | TMED_autumn | time |
| 5.00E-01 | DemartonneINDEX | time |
| 3.30E+00 | DemartonneVEGONLY | time |
| 7.00E-04 | ET_bunch_harv | time |

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>

| | | |
|----------|-----------------------|------------------|
| 9.60E-07 | ETannual | time |
| 5.30E-02 | n_T_0 | time |
| 9.50E+00 | last_freeze | time |
| 1.20E-01 | BBCH07_last_freeze | time |
| 1.20E-02 | GDD_10_TE_BBCH07 | time |
| 0.00E+00 | GDD_10_TE_BBCH61 | time |
| 8.60E+00 | GDD_10_TE_BBCH81 | time |
| 8.30E-01 | GDD_10_TE_Harvest | time |
| 9.70E-02 | GDD_10_CH_BBCH07 | time |
| 1.70E-01 | GDD_10_CH_BBCH61 | time |
| 5.00E-01 | GDD_10_CH_BBCH81 | time |
| 4.70E+00 | GDD_10_CH_Harvest | time |
| 7.90E-03 | TE_DOY.BBCH07 | time |
| 9.00E-02 | TE_DOY.BBCH15 | time |
| 8.80E-01 | TE_DOY.BBCH18 | time |
| 1.60E-03 | TE_DOY.BBCH61 | time |
| 3.30E-03 | TE_DOY.BBCH65 | time |
| 8.00E-03 | TE_DOY.BBCH75 | time |
| 1.20E-04 | TE_DOY.BBCH81 | time |
| 2.90E-04 | TE_DOY.BBCH85 | time |
| 6.00E-05 | TE_DOY.Harvest | time |
| 4.00E+00 | TE_bud_harvest | time |
| 6.00E-01 | TE_bud_veraison | time |
| 9.20E-01 | TE_veraison_harvest | time |
| 3.30E+00 | TE_flowering_veraison | time |
| 8.60E-02 | CH_DOY.BBCH07 | time |
| 8.60E-02 | CH_DOY.BBCH15 | time |
| 2.00E-03 | CH_DOY.BBCH18 | time |
| 3.40E-02 | CH_DOY.BBCH61 | time |
| 3.10E-03 | CH_DOY.BBCH65 | time |
| 6.60E-03 | CH_DOY.BBCH75 | time |
| 9.20E-02 | CH_DOY.BBCH81 | time |
| 2.00E-03 | CH_DOY.BBCH85 | time |
| 9.00E-05 | CH_DOY.Harvest | time |
| 1.00E-01 | CH_bud_harvest | time |
| 5.60E+00 | CH_bud_veraison | time |
| 6.90E-01 | CH_veraison_harvest | time |
| 2.20E+00 | CH_flowering_veraison | time |
| 7.90E-03 | TE_DOY.BBCH07 | TMED_soil_winter |
| 9.00E-02 | TE_DOY.BBCH15 | TMED_soil_winter |
| 8.80E-01 | TE_DOY.BBCH18 | TMED_soil_winter |
| 1.60E-03 | TE_DOY.BBCH61 | TMED_soil_winter |
| 3.30E-03 | TE_DOY.BBCH65 | TMED_soil_winter |
| 8.00E-03 | TE_DOY.BBCH75 | TMED_soil_winter |
| 1.20E-04 | TE_DOY.BBCH81 | TMED_soil_winter |
| 2.90E-04 | TE_DOY.BBCH85 | TMED_soil_winter |

SUPPLEMENTARY DATA

Faralli, M., Mallucci, S., Bignardi, A., Varner, M., & Bertamini, M. (2024). Forty years in the vineyard: climate change may impose additive inter-annual effects on phenology and berry quality. *OENO One*, 58(3).
<https://doi.org/10.20870/oeno-one.2024.58.3.8083>

| | | |
|----------|-----------------------|------------------|
| 6.00E-05 | TE_DOY.Harvest | TMED_soil_winter |
| 8.60E-02 | CH_DOY.BBCH07 | TMED_soil_winter |
| 8.60E-02 | CH_DOY.BBCH15 | TMED_soil_winter |
| 2.00E-03 | CH_DOY.BBCH18 | TMED_soil_winter |
| 3.40E-02 | CH_DOY.BBCH61 | TMED_soil_winter |
| 3.10E-03 | CH_DOY.BBCH65 | TMED_soil_winter |
| 6.60E-03 | CH_DOY.BBCH75 | TMED_soil_winter |
| 9.20E-02 | CH_DOY.BBCH81 | TMED_soil_winter |
| 2.00E-03 | CH_DOY.BBCH85 | TMED_soil_winter |
| 9.00E-05 | CH_DOY.Harvest | TMED_soil_winter |
| 7.90E-03 | TE_DOY.BBCH07 | TMED_spring |
| 9.00E-02 | TE_DOY.BBCH15 | TMED_spring |
| 8.80E-01 | TE_DOY.BBCH18 | TMED_spring |
| 1.60E-03 | TE_DOY.BBCH61 | TMED_spring |
| 3.30E-03 | TE_DOY.BBCH65 | TMED_spring |
| 8.00E-03 | TE_DOY.BBCH75 | TMED_spring |
| 1.20E-04 | TE_DOY.BBCH81 | TMED_spring |
| 2.90E-04 | TE_DOY.BBCH85 | TMED_spring |
| 6.00E-05 | TE_DOY.Harvest | TMED_spring |
| 8.60E-02 | CH_DOY.BBCH07 | TMED_spring |
| 8.60E-02 | CH_DOY.BBCH15 | TMED_spring |
| 2.00E-03 | CH_DOY.BBCH18 | TMED_spring |
| 3.40E-02 | CH_DOY.BBCH61 | TMED_spring |
| 3.10E-03 | CH_DOY.BBCH65 | TMED_spring |
| 6.60E-03 | CH_DOY.BBCH75 | TMED_spring |
| 9.20E-02 | CH_DOY.BBCH81 | TMED_spring |
| 2.00E-03 | CH_DOY.BBCH85 | TMED_spring |
| 9.00E-05 | CH_DOY.Harvest | TMED_spring |
| 1.20E+00 | TE_Red_quality | time |
| 9.40E-01 | CH_White.wine.quality | time |
| 2.40E+00 | CH_Sparkling_quality | time |