1. ABOUT THE DATASET

Title: GIS dataset locating suitable sites in England for high-quality Chardonnay viticulture: climate, topography, and soils (2010–2019, 2040–2059 RCP4.5)

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Description: This dataset provides GIS files from an assessment of site suitability for Chardonnay viticulture in England, aimed at identifying locations capable of producing premium single-varietal still wines. The modelling framework uses the Chablis region (France) as an analogue for climate and topography, with additional consideration of soil suitability. Climate conditions are presented for two periods: 2010–2019 (representing current conditions) and 2040–2059 (RCP 4.5, median and upper projections). For each scenario, mean vintage scores were calculated using the Weather Model of Biss and Ellis (2021, 2022). Land suitability is further classified into four categories – Unclassified, Village, Premier Cru, and Grand Cru – based on the combined effects of topography and soils.

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Related publication: Biss, A. J. (2025). Mapping the impact of climate change on the quality potential of UK still Chardonnay wine production: using the Chablis region as an analogous model. Submitted PhD Thesis.

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2. TERMS OF USE

3. PROJECT AND FUNDING INFORMATION

This dataset was not created in the course of a funded project.

4. CONTENTS

If using a QGIS Geographical Information System (QGIS Association, http://www.qgis.org): download all files to the same directory and use the LandSuitability_Chardonnay.qgz to open the project.

For other GIS software: there is no need to download the LandSuitability_Chardonnay.qgs file (and Legend files) as these will not work outside of QGIS. Load files separately into your GIS.

File listing:

LandClassification_TopogSoils.tif
This is a raster image that classifies land in England into one of four categories based on topography and soils, for production of high-quality Chardonnay still wine. In ascending order of quality, the categories are:

Unclassified	Value = 0
Village (a.k.a. Basic)	Value = 1
Premier Cru	Value = 2
Grand Cru	Value = 3

Note that climate is not considered in this layer.
Resolution 10 x 10m.
See LandClassificationLegend_qml below for suggested display.

VintageScore_2010-19.tif
This raster file provides vintage scores for the recent climate (2010-19). It is also similar to the lower projection for mid-Century (RCP 4.5, 5th percentile, 2040-59).
Resolution 5 x 5km.
See VintageScoresLegend.qml below for suggested display.

VintageScore_2040-59_Median.tif
This raster file provides vintage scores for mid-Century under the median projection for climate change (RCP 4.5, 50th percentile).
Resolution 5 x 5km.
See VintageScoresLegend.qml below for suggested display.

VintageScore_2040-59_Upper.tif
This raster file provides vintage scores for mid-Century under the upper projection for climate change (RCP 4.5, 95th percentile, using an alternative projection for the Cool Night Index (CNI2 – see Biss & Ellis, 2022)).
Resolution 5 x 5km.
See VintageScoresLegend.qml below for suggested display.

ElevationLIDAR10m_less_MeanElevationHadUK5km.tif
This is a raster image that displays the difference in elevation (m) between the LIDAR 10 x 10m cell and the mean elevation of the 5 x 5km HadUK-Grid cell that the LIDAR cell is located within (see Elevation Complication, Section 5. Guide to Interpretation).

NUTS_Level1_England.shp and NUTS_Level1_England.shx (OPTIONAL)
Download these 2 vector files to view the regions of England drawn for reference purposes, i.e. London, South-East, South-West, East of England, etc.

LandClassificationLegend.qml (ONLY WORKS IN QGIS)
This file provides the legend for the LandClassification_TopogSoils.tif file:

Unclassified	white
Village (aka Basic)	grey
Premier Cru	dark grey
Grand Cru	black

VintageScoresLegend.qml (ONLY WORKS IN QGIS)
This file provides a legend for the above VintageScore files, categorising vintage ratings into:

≤ 0	white (unsuitable land)
0 – 4.0	red (poor)
4.0 – 6.0	orange
6.0 – 8.0	pale green (good)
6.5 – 7.0	light green
7.0 - 7.5	green
7.5 – 8.0	dark green (very good)
8.0 - 10.0	pink (excellent)

Note:
QGIS version used to generate files: 3.28.13-Firenze
Coordinate Reference System: EPSG:27700 - OSGB36 / British National Grid

5. GUIDE TO INTERPRETATION

Suitable land for Chardonnay viticulture for the purposes of producing still white wine by mid-Century will:

- ✓ have a vintage score ≥ 6 (green or pink); and
- ✓ be classified as at least Village quality land, preferably Premier or Grand Cru

Elevation complication (from Biss, 2025): A complication arose because the topography model was built on LIDAR cells with a resolution of 10m, whereas the climate data came from HadUK-Grid cells with a resolution of 5km (that already account for elevation) (Met Office et al., 2020). In other words, the elevation of an identified land parcel may be higher or lower than the mean elevation of its HadUK-Grid cell and can therefore be expected to be cooler or warmer, respectively, than the climate data upon which the vintage ratings were calculated; by approximately 0.65 °C per 100 metres based on the mean adiabatic lapse rate (Royal Meteorological Society, 2024). This discrepancy is mapped in the file below. As such, for any areas where the elevation discrepancy is greater than 25 to 50m, greater caution is required in the interpretation of the expected vintage score and some adjustment to the calculation may be needed. For example, if the land parcel in question is considerably higher (positive number) than the mean elevation of the HadUK-Grid cell, this would likely signify it is cooler in temperature than modelled, resulting in generally lower vintage scores than expected. This tends not to be an issue in most areas currently suitable (or expected to be suitable by mid-Century) for viticulture in England, although is more of an issue for suitability assessments in the British uplands. See ElevationLIDAR10m_less_MeanElevationHadUK5km.tif file.

Caveats and model limitations: See Biss (2025).

6. METHODS

Data used for the Chablis analogue:

Weather (from Biss & Ellis, 2021): Monthly weather data for Chablis were taken from the French meteorological service, Météo-France. The Chablis weather station (number 89068001) lies on the outskirts of the town of Chablis at latitude 47°49'19" N, longitude 3°47'26" E and elevation 141 m. It does not record sunshine duration, however. For this variable, the records from two weather stations in Auxerre, both approximately 19 km west of Chablis, were merged: Auxerre (latitude 47°48'05" N, longitude 3°32'43" E, elevation 207 m, from October 1962 to April 2013) and Auxerre-Perrigny (latitude 47°49'28" N, longitude 3°32'58" E, elevation 152 m, from April 2013 to October 2020).

This weather dataset comprised monthly readings from October 1962 (the earliest date available for key temperature measurements) to October 2020. The data were also used to generate climatic indices that are typically used for viticulture, including indices for growing season temperature and precipitation for the phenological phases important for wine quality.
Chablis vintage score was modelled as a function of mean temperature from April to September (curvilinear relation, maximum score at 16–17 °C), mean minimum temperature in September (an index of cool nights; negative relation), and total rainfall from June to September (negative relation). This simple three-factor model distinguished between *Poor* and higher-quality Chablis vintages well, but less so between *Good* and *Excellent* vintages.

Topography (from Biss, 2020): Four topographical variables (elevation, aspect, gradient, and relative elevation) were derived from a digital elevation model (DEM). The Chablis vineyards were then digitised as a layer over the DEM, and zonal statistics and histograms were produced in ArcGIS 10.4.1 (ArcGIS) (Esri, Woodlands, CA, USA) to provide topographical summaries for those vineyard areas. The DEM was derived from elevation data taken from the Shuttle Radar Topography Mission (SRTM), which was obtained through the USGS Earth Explorer website (https://earthexplorer.usgs.gov/). The SRTM data were acquired on 11 February 2000 and published on 23 September 2014 (Entity ID SRTM1N47E003V3) and have a resolution of 1 arc-s (approximately 30m, although this is closer to 25.6 m for the Chablis study area).

Soils (from Biss, 2020): an electronic image of a soil map was extracted from the website of the Chambre d'Agriculture de Bourgogne (n.d.) 'Sols de Bourgogne' and georeferenced and digitised in ArcGIS. The map showed that the Chablis vineyards are distributed over eight cartographic soil units [Unités Cartographique de Sol (UCS)], each of which comprise between 3 and 10 different soil types (Unités Typologique de Sols). The unit of most importance is UCS n°30 (UCS30), the soil unit associated with the Kimmeridgian slopes.

Data used for the UK/England target:

Weather (from Biss & Ellis, 2022):

UK weather data was obtained from the UK meteorological service's (Met Office) gridded dataset of climate variables, the HadUK-Grid (Met Office *et al.*, 2018). This data is interpolated from in situ land-based meteorological station data for the whole of the UK adjusted for the Urban Heat Island effect, proximity to the coast, topography, and elevation to provide a realistic picture of climate at a location (see Met Office *et*

al. (2018) and Hollis *et al.* (2019) for details of the gridding methodology and data accuracy).

The HadUK-Grid data were obtained at a resolution of 5 km × 5 km (Met Office *et al.*, 2020) for i) the 20-year period from 1981 to 2000, which is the reference period for climate change projections in the UK, and ii) annually from 2010 to 2019, and loaded into QGIS. It comprised monthly measurements for mean temperature (°C), mean minimum temperature (°C), mean maximum temperature (°C), and total precipitation (mm). These values were used to calculate, in QGIS, the three climate indices needed for the Model and then to map UK climate suitability for 1981 to 2000 (the base period) and 2010 to 2019 (recent decade).

UK climate projections for the period 2040 to 2059, using the RCP 4.5 emissions scenario, were obtained from the Met Office UKCP18 dataset (Met Office, n.d.[a]) for each administrative region; see Fung et al. (2018) for a discussion of the data caveats and limitations. UKCP18 is the most recent set of climate projections offered by the UK Met Office, providing probabilistic projections using a perturbed parameter ensemble (PPE) of many different variants of the HadCM3 climate model. The data comprised projected absolute changes, by month, in mean air temperature (for calculation of $Tmean_{Apr-Sep}$), minimum air temperature (for calculation of CNI), and percentage change in precipitation (for calculation of $P_{Jun-Sep}$), from the base reference period of 1981 to 2000. For each of these variables, three thousand samples were extracted, and the 5th, 50th (median) and 95th percentile probability changes were calculated.

These three variables are not consistent with each other (Met Office, 2018). For example, a 95th percentile increase in TmeanApr-Sep does not occur during the same sample run as a 95th percentile change in CNI and/or PJun-Sep. Pearson correlation coefficients between changes in each of the three climate indices for England and Wales for the 3,000 samples were: TmeanApr-Sep vs CNI 0.59; TmeanApr-Sep vs PJun-Sep −0.34; CNI vs PJun-Sep −0.22.

In keeping with the direction of these correlations, the 5th percentile probability projection for the vintage score was made using the 5th percentile projections for each of $Tmean_{Apr-Sep}$ and CNI but the 95th percentile projection for P_{JunSep} and vice versa (95th, 95th, but 5th, respectively). The median projection for vintage score used the 50th percentile projections for all three variables.

The RCP 4.5 pathway was selected because it is an intermediate greenhouse gas emissions scenario and also because the range in projected values for an increase in mean summer temperature to 2040–2059 for England and Wales (+0.3 °C and +3.2 °C at the 5th and 95th percentiles, respectively) exceed those of RCP 2.6 (+0.5 °C and + 3.1 °C) and the other intermediate UK scenario RCP 6.0 (+0.3 °C and + 3.0 °C) (Met Office, n.d.[b]). Thus RCP 4.5 covers a greater range of possible climate scenarios. The period 2040 to 2059 was chosen to reflect the investment horizon of a new vineyard planted over the current decade, given it takes approximately 4 years for a new vineyard to achieve full cropping production and the expected productive life of a vine is around 30 years (Skelton, 2020).

Absolute RCP 4.5 projections for the 2040 to 2059 period were then calculated in QGIS by applying the UKCP18 projections to 1981 to 2000 HadUK-Grid data.

Two estimates of CNI: We questioned the extent to which CNI will rise as projected. As such, for each of the three percentile probability projections (5 %, 50 %, 95 %), two estimates of CNI were applied to

calculate the vintage score. The first assumed CNI would change according to UKCP18 projections. An alternative value (CNI2) was calculated in proportion to that for the change in CNI and the change in $Tmean_{Apr-Sep}$ that occurred between 1981–2000 and 2010–2019. Hence CNI2 assumed the recent historical relationship between the two indices would continue, and we used the UKCP18 projection for $Tmean_{Apr-Sep}$ for its calculation.

Topography & Soils:

Topography (from Biss, 2025): Topographic data for England was obtained from the LIDAR Composite Digital Terrain Model (DTM) provided by the Environment Agency (2023a), comprising elevation data at 10-metre resolution. QGIS 3.28.13 was then used to generate two topography derivatives: slope gradient and aspect.

The topography (and soils) study is focused on England, as comparable LIDAR data of similar resolution was unavailable for both England and Wales.

Soils (from Biss, 2025): Soil classification followed the methods of Nesbitt et al. (2018) and Vinescapes (2019), using Cranfield University's LandIS Soilscapes data (Farewell et al., 2024a and 2024b). The dataset contains 27 soil classes, of which eight were identified as suitable for viticulture, based on agricultural potential and drainage characteristics. Additionally, four soil types were deemed suitable but with impeded drainage, necessitating further inspection (Nesbitt et al., 2018; Vinescapes, 2019). For mapping purposes in this study, these four soil types were only considered suitable on slopes exceeding 5% gradient, allowing for overland flow and drainage.

Soil variability, however, is considerably greater than that represented by the Soilscapes data and this may impact vineyard suitability. Thorough on-site soil analysis would be required before making any investment decisions.

Land exclusions: Several datasets were employed to delineate areas unsuitable for viticulture due to existing land-use, flood risk or legal protections. These include datasets from the UK Centre for Ecology & Hydrology (2023) for land-use, the Environment Agency (2023b, 2023c) for flood risk, and protection status from Historic England (n.d.) and Natural England (n.d.). This approach follows that of Nesbitt et al. (2018), with minor adjustments in the Historic England and Natural England data.

The topography & soils model: topographic data for the Chablis vineyards in Burgundy, France, was obtained from Biss (2020) for the three main Chablis appellations: Village Chablis, Premier Cru and Grand Cru. Solar irradiation charts were also generated to investigate the interaction between slope aspect and gradient for Chablis. This analysis was then used alongside the abovementioned Chablis topographic data to define slope aspect / gradient categories for the three wine quality levels, such that as the category of slope steepness increases, the acceptable range of aspect narrows. The categories identified were i) Unclassified, ii) Village quality (very gentle slopes with good drainage), iii) Premier Cru quality (gentle, moderate or strong slopes facing East to South-East) and iv) Grand Cru quality (gentle, moderate or strong slopes facing South to West) (Figure 1).

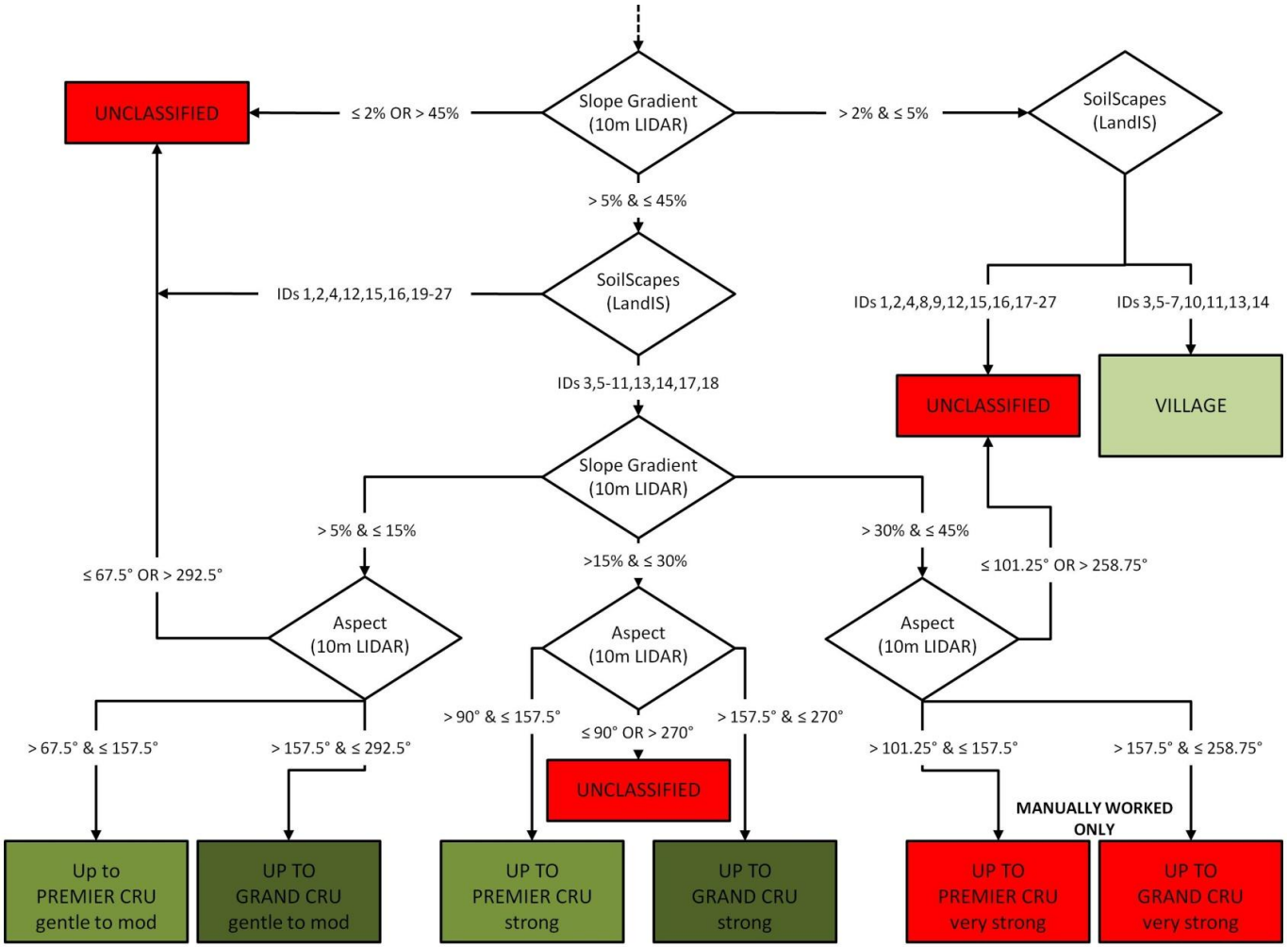

Figure 1 Generalised model to identify suitable land in England for Chardonnay viticulture for still wine, based on topography and soils. Note the topmost arrow represents the input of LIDAR 10 m data for England less areas excluded because of existing land use, flood risk and protected designation. From Biss (2025)

7. REFERENCES

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