

Parameterization of DEMENTpy across the Southern California Climate Gradient

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This document serves to detail how the DEMENTpy inputs were prepared for each of the five sites simulated across the climate gradient (**Figure 1**). In combination with the Jupyter Notebooks(.ipynb) provided, readers or those who are interested are supposed to be able to reproduce the preparation.

In detail, inputs including water potential, soil temperature, and litter chemistry were processed and derived. Water potential was derived from precipitation via an intermediate step of converting the precipitation data. Code underlying all this processing is accessible at a GitHub Repo (<https://github.com/bioatmosphere/microbiome-climate-gradient.git>).



Figure 1: Location of the five sites.

1 Ecosystems across the Southern California climate gradient

All five sites (**Table 1**) are located on granitic parent material and experience Mediterranean precipitation patterns (cool, wet winters; hot, dry summers). This climate gradient covers a temperature range from ... to...

Table 1: Five sites across the climate gradient.

Site	Latitude	Longitude	Elevation
Desert	33.648	-116.38	275
Scrubland	33.610	-116.45	1280
Grassland	33.737	-117.70	470
Pine-Oak	33.683	-116.77	1710
Subalpine	33.823	-116.75	2250

2 Climate Forcing

2.1 Precipitation

Longterm daily precipitation data were accessed from various sources for the five sites:

Desert: daily precipitation data from Boyd Deep Canyon California accessible at <https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?caucde>

Scrubland: daily precipitation data from Burns Pinon Ridge Reserve California accessible at <https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?caucbu>

Grassland:

Pine-Oak: daily precipitation data from James Reserve Station, California available at <https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?caucja>

Subalpine: Since there was no station directly next to the Subalpine site, the precipitation at this site is likely underestimated. In Glassman et al. (2019), precipitation was averaged from three NOAA weather stations with heated gauges accounting for snow (USC00045091; US1CARV0002; and USC00044211): <https://www.ncdc.noaa.gov/cdo-web/datasets#GHCND>. Instead, daily precipitation data from station Mt. San Jacinto California (<https://raws.dri.edu/cgi-bin/rawMAIN.pl?caCMSJ>) was accessed.

2.2 Water Potential (ψ)

As there are no direct measurements of water potential (ψ ; unit: MPa) at different sites across the gradient, an approximate method was applied. This approximation is based on the only available water potential data at the grassland site. With available measurements of water content (θ ; unit: g H₂O g⁻¹ wood), daily water potential was derived by Allison & Goulden (2017) at the grassland site for a record of ??????. This derivation of water potential followed a conversion from water content to water potential as per the equation [Dix 1985, referenced in Allison & Goulden (2017)]:

$$\psi_{grassland} = -10^{0.118 - 0.114 \log_{10} \theta} \quad (1)$$

Water potential of all the other four sites (ψ_{site}) were derived by linearly scaling grassland site water potential ($\psi_{grassland}$) based on the Total Annual Precipitation (**TAP**; unit: mm) at each site following:

$$\psi_{site} = \frac{TAP_{site}}{TAP_{grassland}} \psi_{grassland} \quad (2)$$

One condition that makes this approximate scaling legitimate is the same Mediterranean precipitation patterns across the climate gradient (cool, wet winters and hot, dry summers).

2.3 Temperature (°C)

Soil temperature data at a daily time step was used. These data were available at <https://github.com/stevenallison/UCIClimateExperiment/tree/master/updatednames>.

3 Litter Chemistry and Input

DEMENTpy requires substrate-specific inputs in terms of C, N, and P (**Table xx**). **Phospholipids** (i.e., OrgP1 in the model) are a key component of all cell membranes (<https://en.wikipedia.org/wiki/Phospholipid>). Though compound-specific stoichiometry is clear for determining concentration by element, substrate-specific concentration ((Sub_i) ; unit: mg cm^{-3}) needs to be determined. This derivation followed:

$$Sub_{s,i} = Fraction_{s,i} Total_s \quad (3)$$

where s is one of the five sites, i is one of the 10 substrates, $Fraction_{s,i}$ is the percentage of substrate i in site s , and $Total_s$ is the total concentration of initial substrates (C+N+P) in site s . $Fraction$ was informed by field measurements of litter chemistry at each site as presented in Baker & Allison (2017). $Total$ was approximated by NPP at each site. As per the observation by Baker & Allison (2017), standing litter pools are largest in the grassland and pine-oak site, reduced in the subalpine site, significantly reduced in the scrubland site, and negligible in the desert site.

References

- Allison, Steven D, & Goulden, Michael L. 2017. Consequences of drought tolerance traits for microbial decomposition in the DEMENT model. *Soil Biology and Biochemistry*, **107**, 104–113.
- Baker, Nameer R, & Allison, Steven D. 2017. Extracellular enzyme kinetics and thermodynamics along a climate gradient in southern California. *Soil Biology and Biochemistry*, **114**, 82–92.