## Methods

Run Hector

* Standalone Hector version 2 is run 5,000 times using 5,000 quasirandom combinations of four carbon and temperature parameters: beta, q10, s, and diff.
  + Parameter space sampled
    - Beta (is this Carbon fertilization?? Documentation in Hector ini file says “about +20% @2xCO2”. The parameter space sampled by the quasirandom generator was 0 to 1, units?? Source for this range?
    - Q10 soil respiration response, 0.2 to 5 unit less. Range source?
    - S the equilibrium climate sensitivity “for 2xCO2” 1 to 7 degree C. Range source?
    - Diff the ocean heat diffusivity, 0.5 to 4 cm2/s. Range source?
  + The quasirandom generator uses Sobol’s quasirandom sequence generator. This method generates random samples that are distributed evenly over the parameter space. (Do we want to include some figures of the parameter combinations explored? Could do 2 3D scatter plots…) This method prevents creating a parameter combination that over represents the parameters means.
* Standalone Hector is run with the volcanic forcing turned on and otherwise default settings

Dn metric / Dc metric

* The Dn metric is gamma distributed statics that can used to determine the distance between computed data and observational data while accounting for variability in the model and observational data.
* This is the equation used to calculate the Dn metric where…
  + is the number of points being compared
  + is the squared difference between the observational and model point on the same spatial and temporal grid
  + is the variability of the observational data at point
* This is the equation used to determine the gamma distribution of Dn with respect to specific shape and scale parameters and respectively.
  + is the actual gamma function

Where and

* + is the shape parameter for the gamma distribution and is equal to the number of points being compared, , divided by 2.
  + is the scale parameter
    - is the variability in the observational and model data defined by another equation. Note is really sensitive to the this determines the amount and kind of variability are accounted for between the observational data and the model data.
* variability of the observations
* variability of the model, if there is no variably in the model then this term vanishes
* is the covariance of the model and observation data, if the model and observations are independent of one another then this term will vanish.
* After the gamma distribution is constructed then for some significance level α a cut off value for Dn called Dc can be determined. Dc can be used to reject the null hypothesis that the model data matches the observations data
  + if Dn < Dc then we fail to reject the null hypothesis that Dn < Dc that the model and observation data matche
  + if Dn > Dc then we reject the null hypothesis that the model data matches the observational data
* Urrego-Blanco and Huke used the Dn metric to validate a model and accounted for spatial variably, in we define so that it looks at temporal variability and then use the Dn metric to judge a parameter combination or model calibration.
* We use the Dn metric to judge how well the parameter combinations model four variables, temperature, atmospheric CO2, land flux, and net primary production.

Observation processing

* Global mean temperature anomaly
  + Idk exactly where it came from but we averaged 4 temperature products together
  + Variance = variance across the different observational temp products
  + Sigma 2 = mean 2 \* Rolling sd ^ 2
    - Have to normalize Hector temperature to the same reference period before can calculate the D metric values
* Atm CO2
  + Came from NOAA averaged the interpolated monthly data
  + Sn2 = variance for each annual mean
  + Sigma 2 = mean 2 \* Rolling sd ^ 2
* Land Flux
  + From the global carbon project
  + Variance = their reported sd ^ 2
  + Sigma 2 = mean 2 \* Rolling sd ^ 2
* NPP
  + MODIS… Min processed
  + Global total grid value \* area of grid and then summed
  + Sn2 = 10% of the global value
  + Sigma 2 = 2 sd ^2 where sd was taken over the entire time series because it was short and did not have to balance the variability of the signal and the natural variability of the climate

Observation layering

* Um I think that this is to be determined…

Parameter Selection

* For the … list the observation layers … we selected the 2100 temperature min and maxes
* Used those parameter combinations and ran in Hector 2 – GCAM 5.

May be in a different section

* Unlike Urrego-Blanco and Huke instead of using the Dn metric to validate a model, in our case we use the Dn metric to judge the 5,000 parameter combinations. If the parameter combination yields results that “match” observations based on the Dn metric then the Hector run matches observations and passes the a observational filter/screen?