**Book Notes**

Anthropocene - the time period in which humans have had a substantial impact on the Earth.

Each time a new component is added to the model a new set of feedbacks is introduced.  
  
The first models which coupled the ocean (slow dynamics) and the atmosphere (fast dynamics) we're unstable - something to look out for.  
  
Testing:  
A key test is their ability to reproduce already observed climate change  
Models tend to struggle in capturing past abrupt climate changes.  
  
Sophisticated models - short timescales (exclude longer term processes e.g. Earth crust stuff), high spatial resolution.  
  
Intermediate models - Longer timescales (thousands to millions of years), low spatial resolution, often decrease dimensionality.  
  
Simple models - capture aggregate variables e.g. surface temperature, very limited spatial resolution, can include more parts of the Earth system.  
Look more into 'integrated assessment models'.  
  
Ed Lorenz 3 equations model of the atmosphere:

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https://en.wikipedia.org/wiki/Lorenz\_system  
  
Weather is more of an 'initial conditions problem', while climate is more of a 'boundary conditions problem'.  
  
Climate models are projections rather than predictions because we cannot reasonably predict some of the dependent variables e.g. greenhouse gas emissions over lig timescales. So we run models with a range of inputs.  
  
Projections of global temperature change depends fairly linearly with cumulative co2 emissions up to a given time.  
500 billion tonnes --> 1 degree C  
  
On short timescales (next few decades), temperature pathways are not very dependent on the emissions pathway because the climate system is still responding to the energy imbalance caused by past greenhouse gas emissions.  
  
Temperature depends of the natural log of atmospheric carbon.  
  
Climate change is not spatially uniform, the arctic is warwing twice as fast as the global average.  
  
Clausius-Clapeyron equation:

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https://scienceinfo.com/the-clausius-clapeyron-equation-derivation-with-applications/  
  
Tipping points:  
can be caused by strong positive feedback loops in climate system (Venus climate change?)  
After a tipping point occurs the system transitions into a new stable state.  
It is difficult to pass tipping points on a planetary scale but it is easier for subsystems if the Earth.