Expose Master Thesis Lepke

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knitr::write_bib(c("knitr", "stringr"), file = "packages.bib")
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Short summary: Improve Climate Model future projections by using obersvational data and Machine Learning With future climate change, droughts in the Amazon forest may become more frequent and/or severe. Droughts can turn Amazon regions from rain forest into savanna, leading to high amounts of carbon released into the atmosphere. Past research has shown that there is a relatioship between Sea Surface Temperatures (SSTs) in the Tropical Atlantic/Pacific and precipation in the Amazon.(Schneider, 2018) Step one in my thesis will be to quantify this relationship further, using different approaches and compare them to each other. So I am trying to find a predictive (interpretable) model that can predict precipation from SST time series and possibly other variables. If such a mechanism is found it can be used as a so called "emergent constraint". Since different climate models give different answers about future climate change, there is a need to narrow the so called "spread". Here we try to constrain this spread by using information from observations. We can evaluate a climate models realism by comparing it's simulated variable to actual observed variables. And assume that models that simulate present climate well, simulate future climate variables well, too. The models future projections then get rescaled according to how well they fit the present climate variable. (Much simplified) We rescale a models future projection (i.e rain) by how well it fits the current observable data. Then we can use a ML approach to learn function: f(model data of present climate variable) = rescaled model projection and predict: f(observed data of present climate variable) = projection of validate with CV etc. This can be learned f.e by Gradient Boosting Regression Trees

Longer explanation: Motivation: Related Work SST amazonas: Emergent Constraint: Related Work GBRT: The data: Next steps

written 31.01: Tropical rainforests constitute large global carbon sinks, making them an important factor for assessing future climate change. Droughts can have a major impact on these ecosystems and their function as carbon sinks, as was seen in the Amazon drought of 2010, which had a total biomass carbon impact of 2.2 PgC. Therefore drought forecasting poses an important challenge to solve. Earlier work has studied the connection between sea surface temperatures (SST) and precipation in the Amazon basin. The authors created an early-warning indicator for Amazon droughts based on tropical Atlantic SSTs. While this approach worked reasonably well, they focused solely on the tropical Atlantic, to predict droughts indicated by a drought threshold. Another interesting challenge is to predict precipation in the Amazonas in general, based on SSTs. Hence the first task in my Master Thesis is to fit a predictive model, that can forecast the precipation in the Amazonas. The connection of SST and precipation might be linked to certain areas in the ocean or a specific mechanism. The authors named earlier, for example identified a dipol between the northern and southern transatlantic ocean (NTAO, STAO respectively), as indicator for future droughts.

partly from draft, partly from alex hall and ucla: With future climate change, droughts in the Amazon forest may become more frequent and/or severe. Droughts can turn Amazon regions from rain forest into savanna, leading to high amounts of carbon released into the atmosphere. Past research has shown that there is a relationship between Sea Surface Temperatures (SSTs) in the Tropical Atlantic/Pacific and precipation in the Amazon. Step one in this thesis will be to quantify this relationship further using different approaches and compare them to each other. So I am trying to find a predictive (interpretable) model that can forecast precipation from SSTs and possibly other variables. If such a mechanism is found it can be used as a so called "emergent constraint". Since different climate models give different answers about future climate change, there is a need to narrow this so called "spread". When analyzing global climate models, we might find a relationship between an observable variable A of the current climate and B of future climate projections. Because the observed measurements of the predictor A can be used to constrina the models' responses B, relationship between A and B is called emergent constraint. Variable A may be a characteristic of the climate system (humidity, winds, etc) or characterize natural variations (in he seasonal cycle, or from year to year). Once A is estimated observationally, we can use the emergent constraint to judge a model's realism and narrow down the spread of future climate projections.

So we need a variable, that we can measure in the real world and have historical data of (i.e. X) and a variable that is of importance for the future climate (Y).

A classic example for an emergent constraint is the Arctic sea-ice albedo feedback. Ice

Different climate models have different values for the

reflectivity of sea-ice areas. This has a direct influence on each climate model's projection of future global warming, measured in climate sensitivity. Climate sensitivity defined as follows, how much does global average temperatures rise when the amount of CO_2 in the atmosphere is doubled, compared to the preindustrial age.

OG snow albedo feedback explained This is an example of an early 'emergent constraint', a technique seeking strong statistical relationships between parameters describing aspects of current and future climate across a GCM ensemble, which can be both observed and physically explained

a relationship may emerge between a models' simulated variable X of the current climate and Y of the models' projections of future climate.

Here we try to constrain the spread by using information from observations. If there exists a relationship between an observable variable X and a future

First the variable

We rescale a models future projection of by how well it represents historical observations or quantities.

Insert example of emerging constraint?

(Much simplified) We rescale a models future projection (i.e rain) by how well it fits the current observable data. Then we can use a ML approach to learn: f(model data) = rescaled model projection and predict: f(observed data) = projection validate with CV etc.

droughts means no rain rain prediction is important master thesis 2-fold 1st create predictive model based on sst to predict precipation 2nd use emergent constraint

References

Schneider, T. (2018). Statistical inference with emergent constraints.