Acceleration of global cumulative human impacts

Project Planning Document

Broad Objective

Look at the rate of change (acceleration) in cumulative human impacts to global oceans over time.

Stressors

We have 14 stressor layers with time series data available. Some of these layers are almost certainly ready to be used in this project, others, such as commercial fishing layers, have not yet been created. For the majority of these stressors we are using the 99.99th quantile as the reference point. We are also keeping the reference point consistent through time. **We need to make sure this is (a) what we want to do and (b) being applied across all layers.**

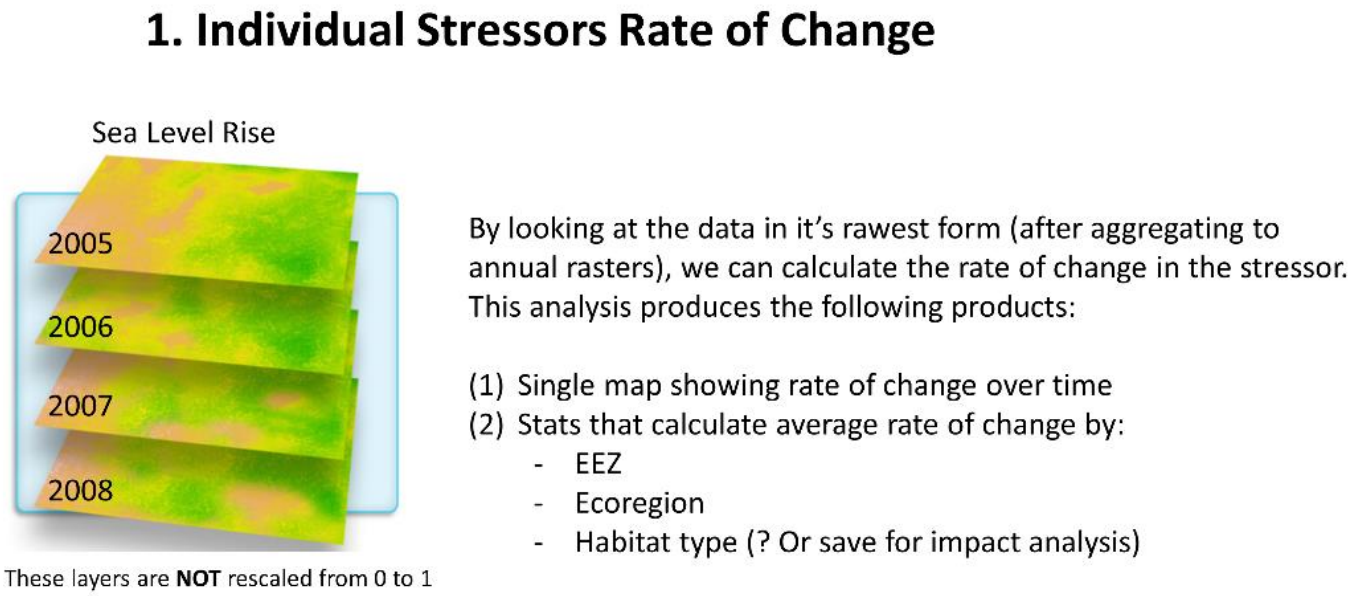
Stressor	Min Year	Max year	Reference Point	Min	Max	Units
Ocean Acidification	2005	2015	<= 1, or change in ASS	NA	NA	Aragonite Saturation State
Sea Surface Temperature	1982	2012	128	-133	164	# Anomalous weeks w/i 5 yr period
Ultraviolet Radiation	2005	2015	41	-43	50	number of anomalous weeks in a year
Sea Level Rise	1993	2015	0.2523	-0.93985	0.51	meters
Fertilizer	2002	2013				
Pesticide	2002	2013				
Artisanal Fishing	2003	2010				tons per km2 standardized by primary productivity (log transformed)
Commercial Fishing (5 layers)	2003	2010				
Night Lights						
Coastal Population	2003	2013				

Methods

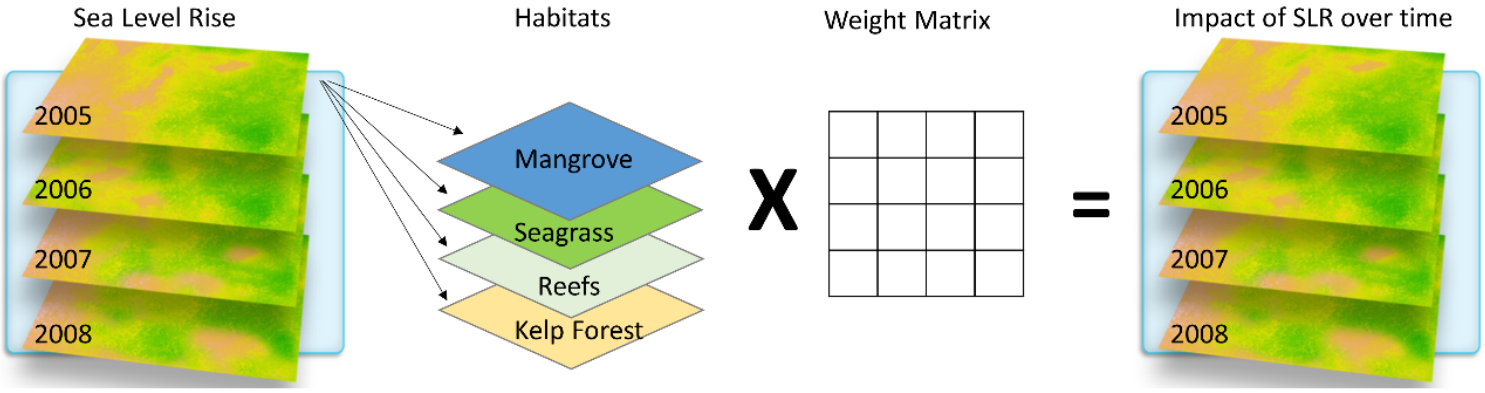
I view this project in three steps, but would like feedback to make sure we are on the same page:

1. Looking at how individual stressors have changed through time
    a. This does not evaluate their impact on habitats
2. How have individual stressors impacts to habitats changed through time?
    a. This takes step 1 a bit further and applies the stressor to the habitat + weight matrix. This will give us a comparison between straight up rate of change in a stressor (e.g. higher temps over x years) and the impact that the calculated rate of change has over time. This would highlight areas where maybe SST is increasing rapidly, but the habitats in that area are less vulnerable compared to an area where SST is rising more slowly but in areas with highly vulnerable habitats…
3. Cumulative Human Impacts across time
    a. For every year in our time series, create a CHI map then look at those maps over time and see how CHI per cell has changed.

Some visuals to help explain these



2. Individual Stressors Impact Maps



These layers are rescaled from 0 to 1

The impact maps are generated by taking the *average impact* per cell.

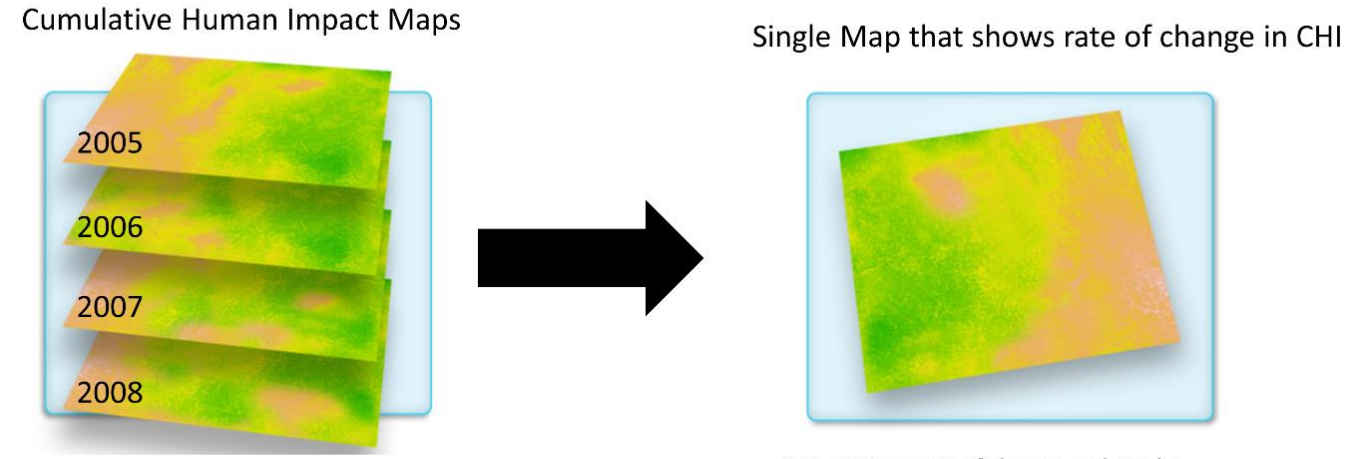
Products from this analysis:

- An Impact map produced for every year in the stressors time series (e.g. 22 for SLR – 1993 to 2015)
- Single map showing rate of change in CHI
- Individual stressor-habitat maps (if we want. I think we should generate these anyway to have on hand for additional explorations)

Get average rate of change and CHI by:

- EEZ
- Ecoregion
- Habitat type
- Bins (lowest 10% CHI, 10-50%, 50-90%, highest 10%)

3. Cumulative Human Impact Maps



Each of these years is the cumulative human impact for that year. Since we will already have individual stressor*habitat*weights maps, these will be easy to generate.

Get average rate of change and CHI by:

- EEZ
- Ecoregion
- Habitat type
- Bins (lowest 10% CHI, 10-50%, 50-90%, highest 10%)

Products from this analysis:

- An Impact map produced for every year in which we have all stressors (2005-2010)
- Single map showing rate of change over time series

Decisions we need to make

Reference Points

We should use a single reference point for each stressor for consistency. In the table above I have listed those reference points we used for OHI. I imagine we would keep the same for this analysis. I have yet to derive fishing stressors for each gear type that is why they are blank.

Are we ok with commercial fishing being derived from only the "Industrial" catch from SAUP. Catch defined as "Subsistence", "Recreational" and "Artisanal" can then be integrated in the Artisanal Fishing pressure. **This is what we did for OHI 2016**.

Rescaling

For nearly all of these stressors we rescale using the 99.99th quantile. In a few cases, mainly fishing, we first log transform the data as it is heavily skewed to very high values in very few cells globally. **Are we ok with continuing with this methodology?**

Questions

- Dan have you processed the 2013 fert and pest data? In the google sheet you have a note that you have the data but haven't yet processed it.
- Where is the Coastal Population data and script? We should move these onto Mazu/GitHub. Mel is also interested in the data and how you processed it as it may be useful in OHI (right Mel?).
- Dan, have you derived raw and transformed yearly rasters for fertilizer, pesticide, night lights? What reference point did you use?
- Sea Surface Temperature layers are aggregates across 5 years since we use a 5 year rolling window. This is also done when we calculate fishing and uv for OHI. Do we want to keep this for this analysis? Or should we be creating individual yearly comparisons.
- Should we keep SLR clipped to the coast?
- What impact weight matrix do we use?
- Do we have updated habitats through time?