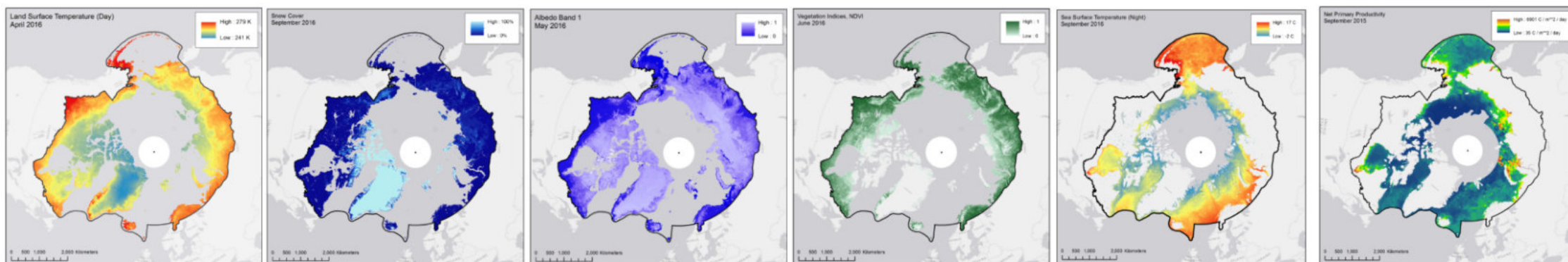


Satellite-based decadal assessments of marine and terrestrial pan-arctic environments

October 2018

Tom Barry, Sara Longan, Liza Jenkins, Karl Bosse



CAFF's Land Cover Change Program

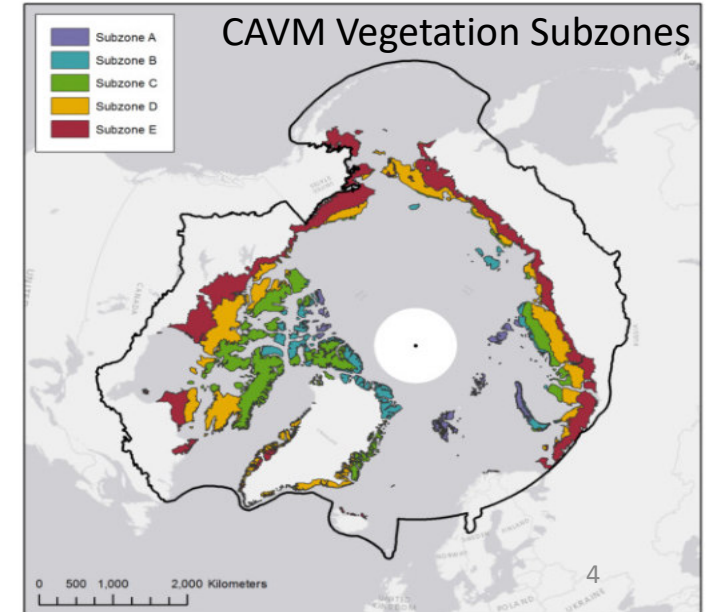
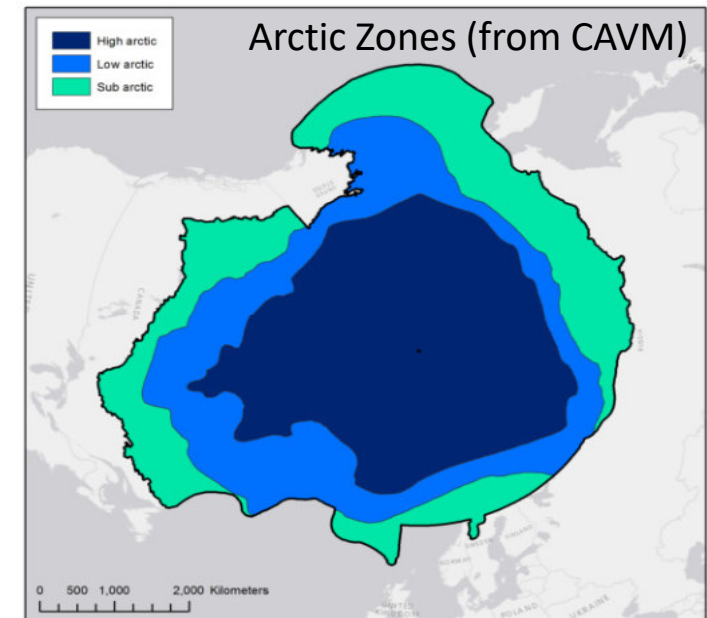
- The overall goal of the program is to harness the power of satellite remote sensing to conduct decadal assessments of the marine and terrestrial environments
- Conduct hindcast assessments
- Develop a simple monitoring program for future change detection
- Have a suite of physical and ecological parameters, and the associated trends, to support biodiversity assessments at various spatial and temporal scales

Satellite Data

- Rich dataset of satellite data have been developed specific to the pan-arctic and are currently available on the Arctic Biodiversity Data Service (ABDS) portal <https://www.abds.is/>
- In addition to raw satellite data, many derived products are available
- Satellite sensors include:
 - MODIS standard products (electro-optical data) from 2000-2017
 - Passive microwave derived sea ice extent from 1978-2017
- Data are available for both marine and terrestrial parameters

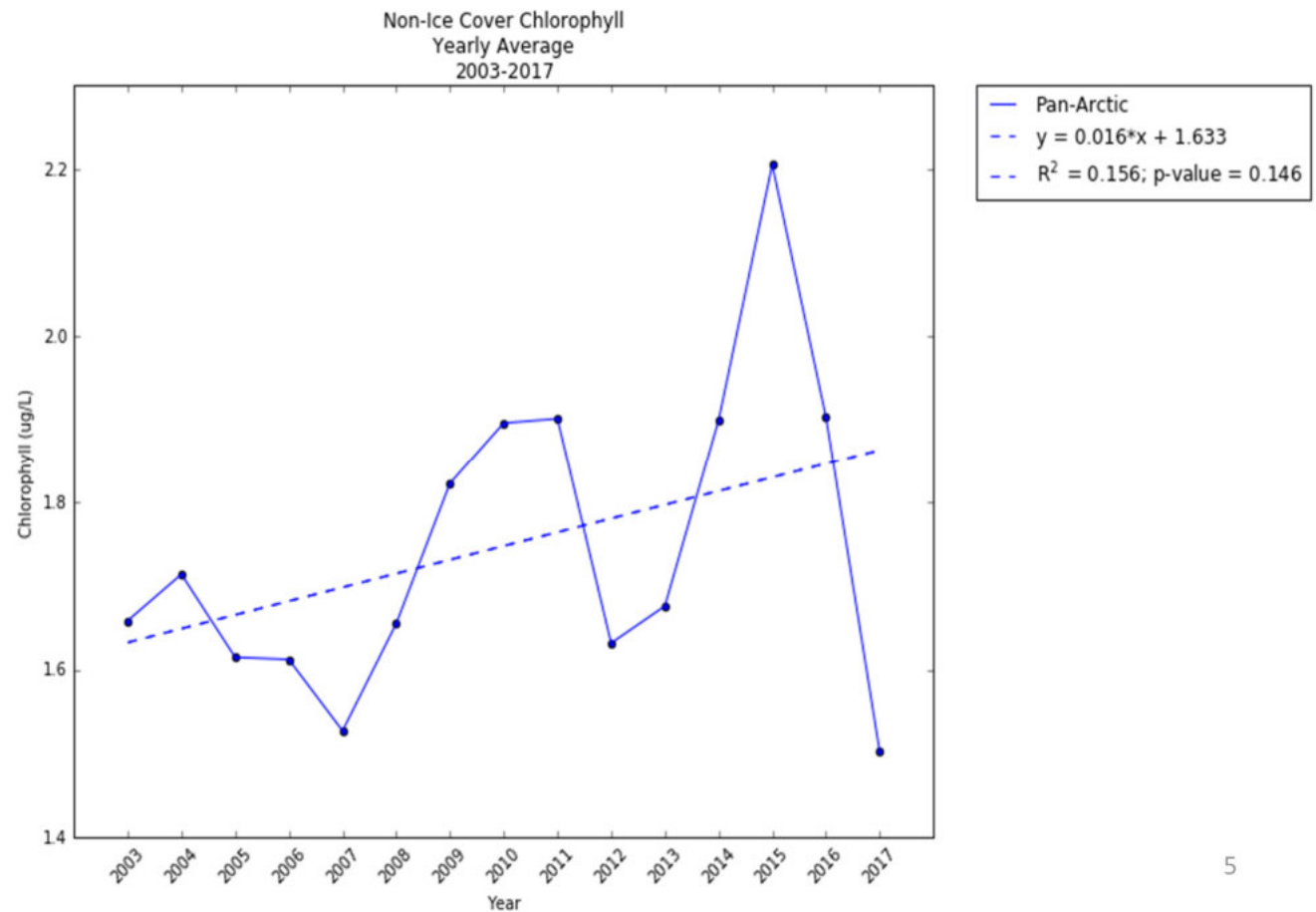
Methods

- Analysis areas
 - CAFF's Pan-Arctic boundary
 - Arctic Zones (high, low, sub)
 - CAVM (Circumpolar Arctic Vegetation Map) Vegetation Subzones A through E
- Satellite-derived marine parameters
 - Chlorophyll
 - CDOM
 - Sea surface temperature (SST)
 - Primary productivity (PP)
 - Sea ice
- Satellite-derived terrestrial parameters
 - Land surface temperature (LST)
 - Snow covered area
 - NDVI/EVI
 - Growing season length
 - Green up
 - Senescence



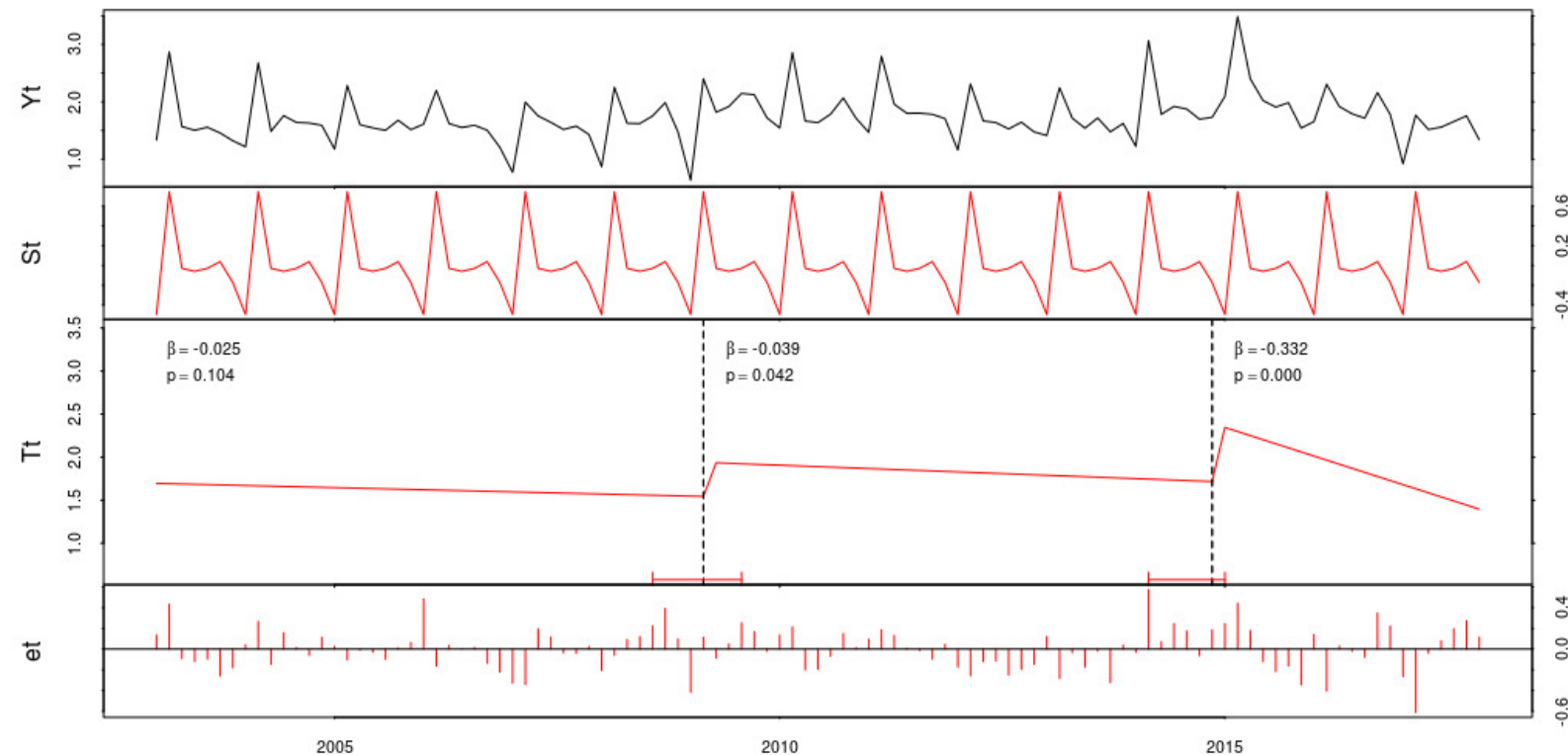
Example Data: Marine Chlorophyll

- Annual chlorophyll data shows no statistically significant trend

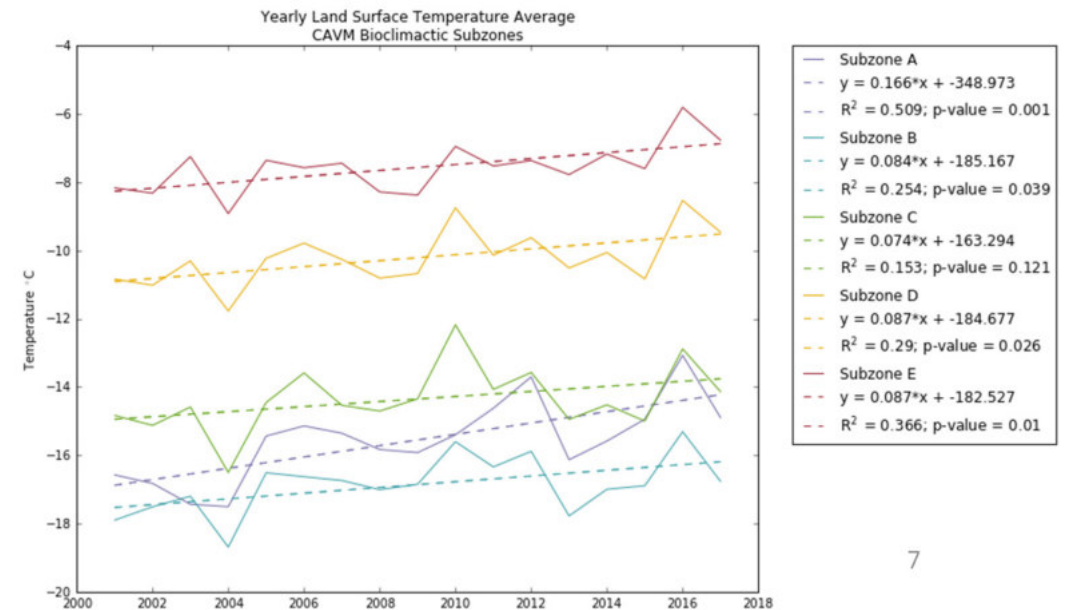
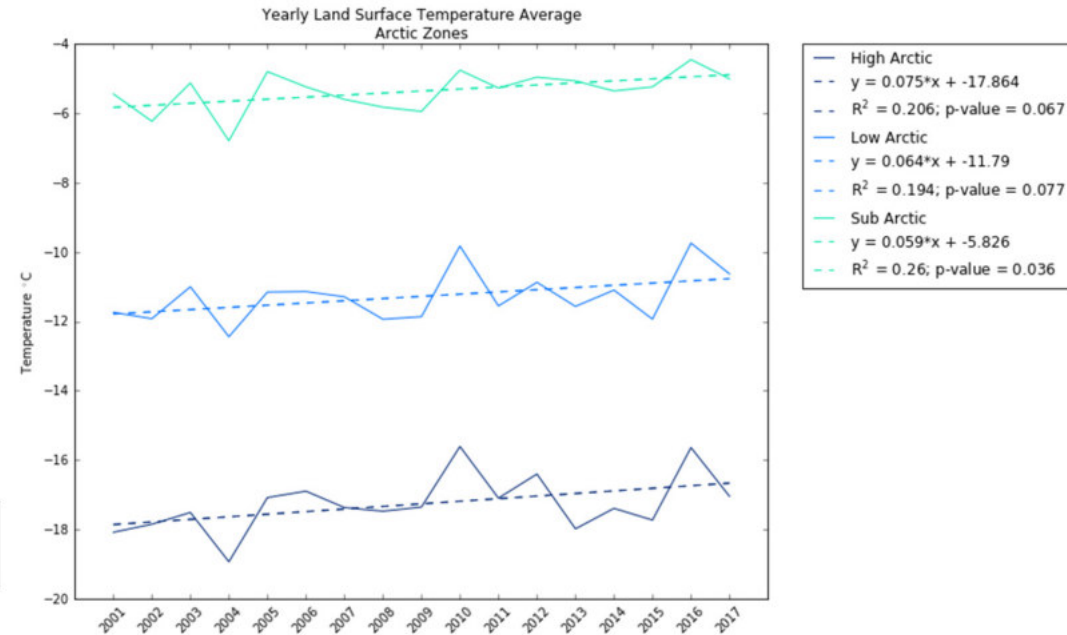
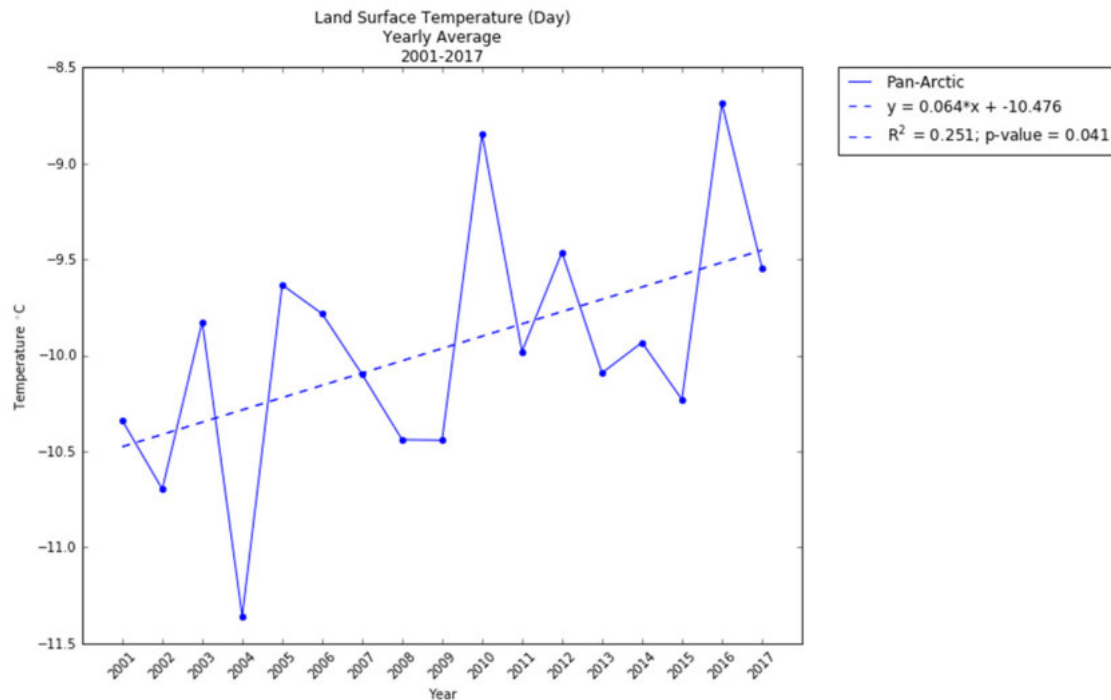


Example Data: Marine Chlorophyll

- No trend identified in annual data, but seasonal data shows 3 distinct trends within the dataset with breakpoints identified at approximately 2009 and 2014
- Only the second and third trends are statistically significant with $p=0.042$ and <0.00 respectively
- Trend summary: 2000-2009 no trend; 2010-2014 decreasing chl; 2015-2017 magnitude shift to more extreme decreasing chl



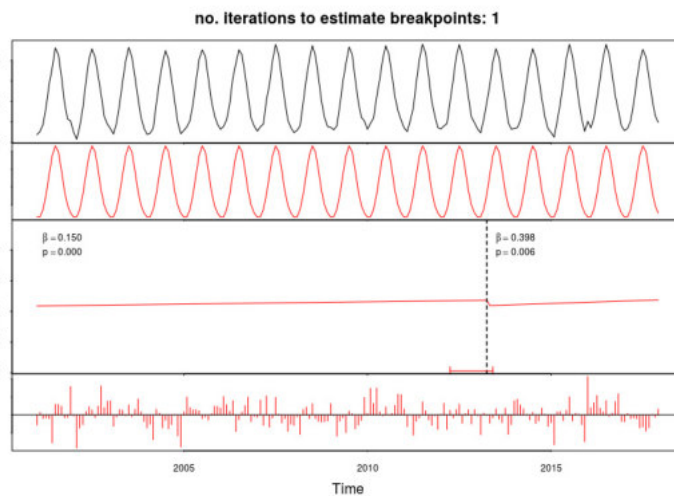
Example Data: Land Surface Temperature, Annual Average



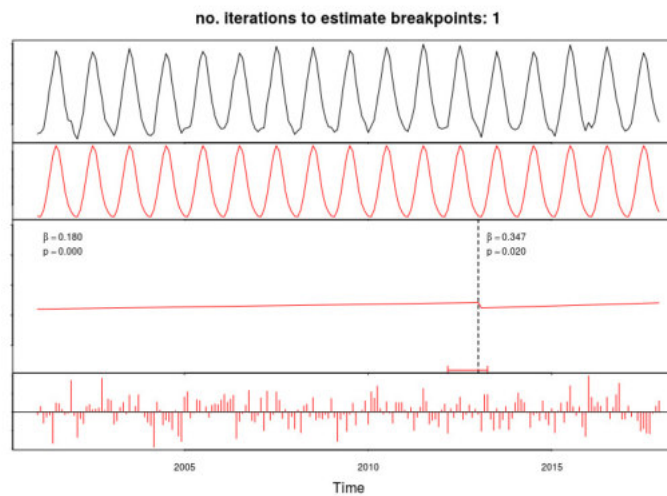
Example Data: Land Surface Temperature, Seasonal Data

- All analysis areas show a statistically significant, increasing trend
- Trend breakpoints identified in High Arctic (April 2013), CAVM Zone B (Jan 2013), & CAVM Zone C (April 2013)

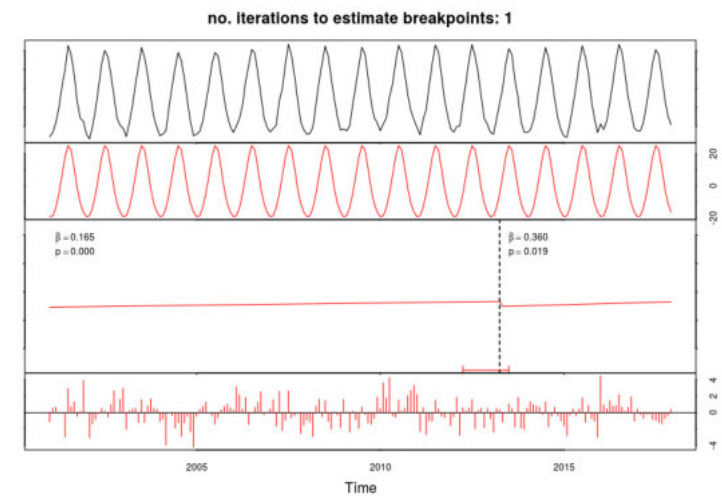
High Arctic



CAVM B



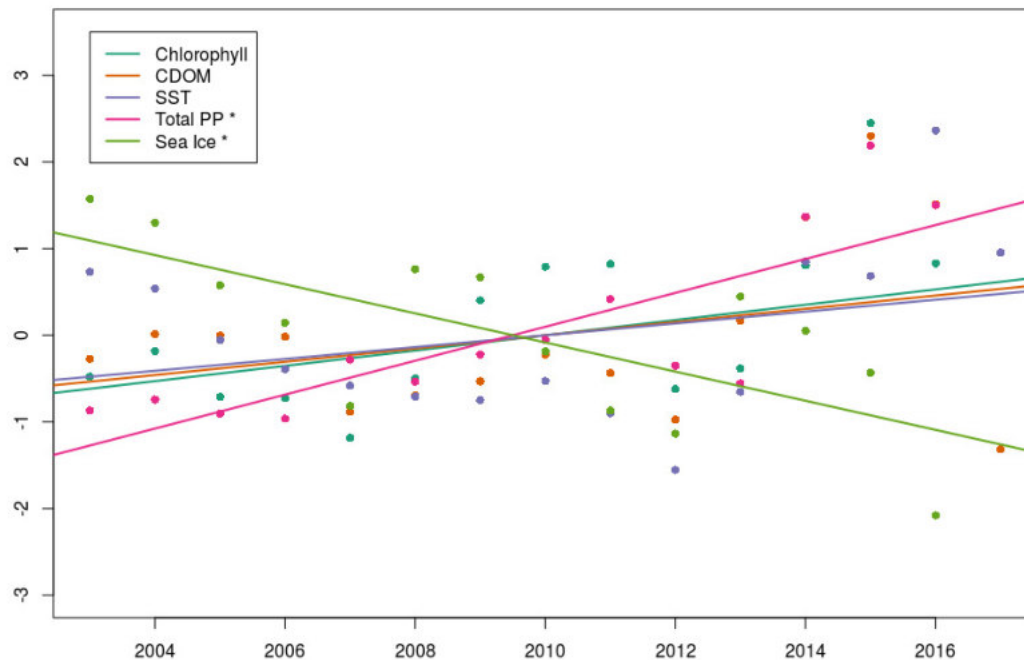
CAVM C



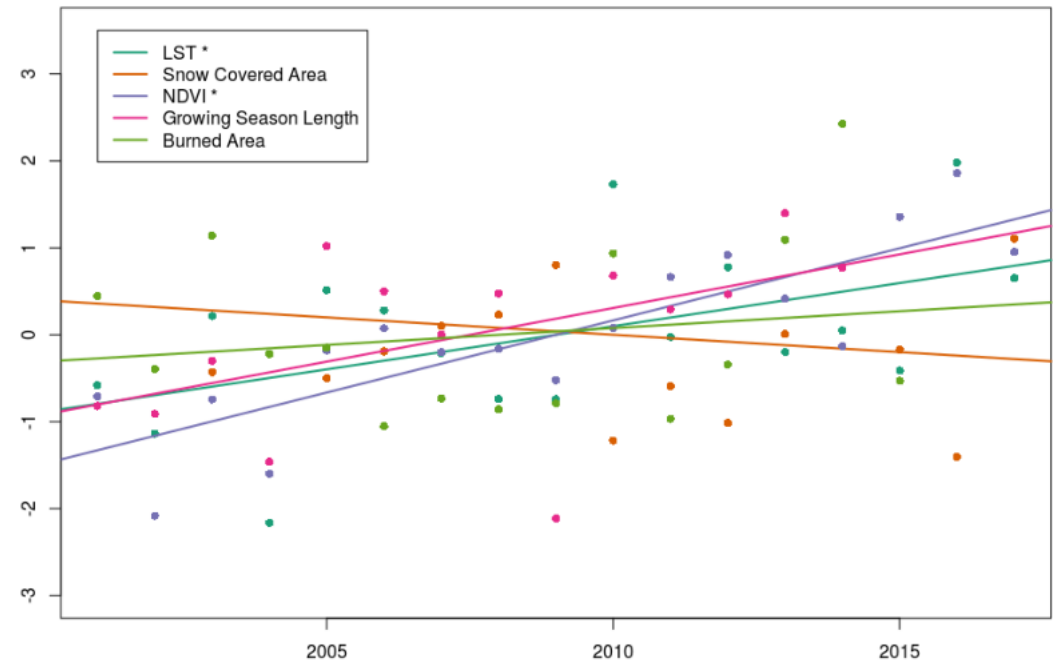
Rate of Change



Marine



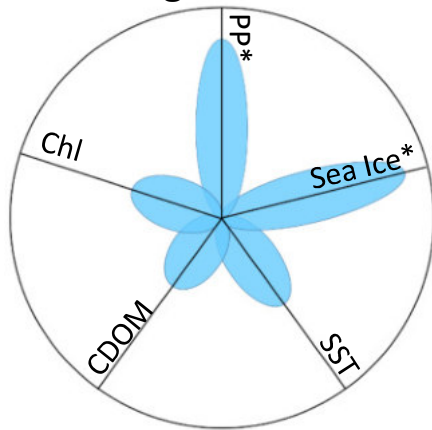
Terrestrial



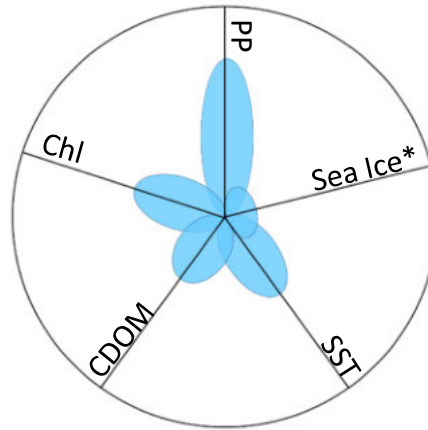
- The average annual normalized data show approximately the same rate of change occurring in both the marine and terrestrial environments
- Sea Ice and primary productivity show the same rate of change, albeit in opposite directions

Rate of Change in Geographic Subzones

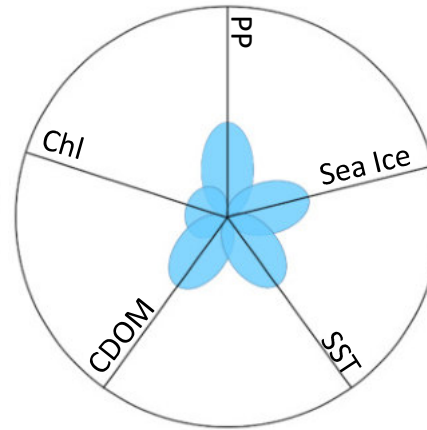
High Arctic



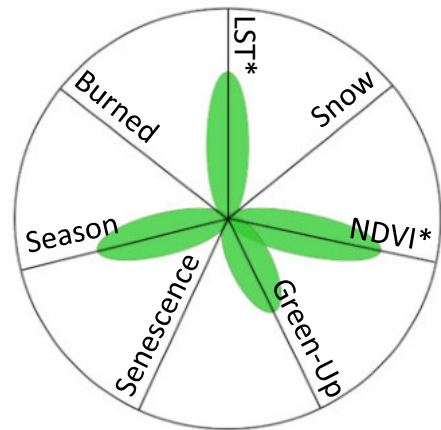
Low Arctic



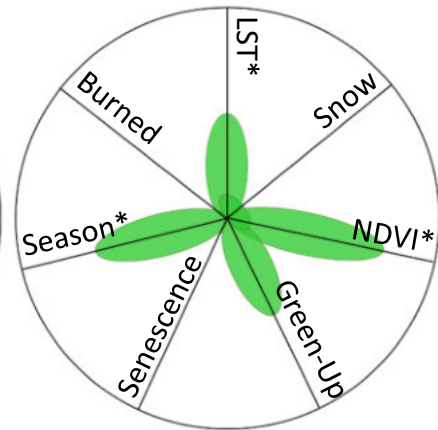
Sub-Arctic



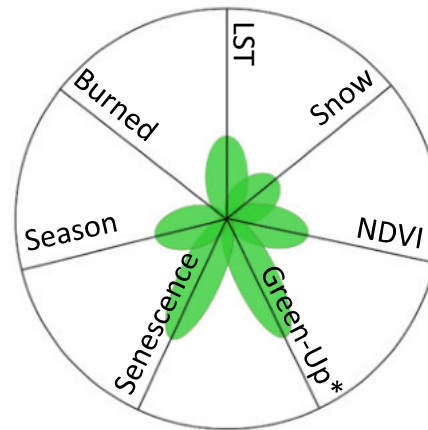
CAVM A



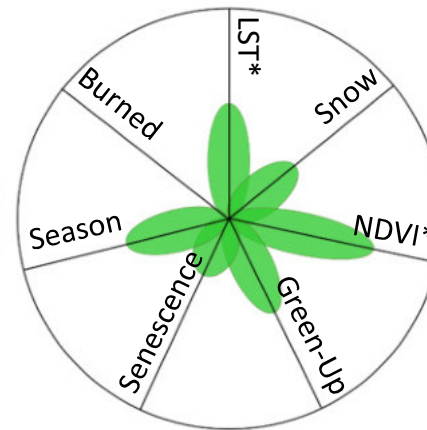
CAVM B



CAVM C



CAVM D



CAVM E

