Assessing the impact of climatic controls on global changes in land-surface phenology  
**Introduction**

**Land Surface Phenology**

-> Why important, timeseries etc.

**Climatic Controls in the LSP context**

- Growing Season Index (Jolly 2005)

- Based on Temperature, Vapour Pressure Defficit (VPD) and photoperiod

- Very simple linear relationships and thresholds

**Idea: Compare them!**

Spark: New Stöckli dataset:

* **Modelled** LAI based on GSI, Plant Functional Type (PFT) and elevation classes
* Prediction assimilated with 10 years of MODIS LAI and FPAR data
* 50 years of global LAI & FPAR data (1 deg resolution)
* 32 years of global LAI & FPAR data (0.5 deg resolution)

**How plausible is LAI-re?**

* Comparison to an established LAI product is needed
* LAI3g is the newest iteration of the AVHRR GIMMS timeseries
* LAI3g computed with remotely sensed NDVI3g and MODIS LAI and FPAR neural network

**Research Questions**

* How does the LAI-re compare to the LAI3g dataset? Do they differ/how? (any obvious over/under estimations?)
* How do climatic controls (temperature, VPD) impact different PFTs/biomes/regions over time?
* (How) do changes in LSP depend on changes in climatic controls?

**Materials and Methods**

**Data & Data preparation 1/2**

*Available data*

* LAI3g: 30 years (1982-2011) of global, 15-day composite LAI data (spatial resolution: 1/12 degree)
* LAI-re: 33 years (1980-2012) of global, daily LAI and climatic control data(spatial resolution ½ degree)*Preparation:*
* Resize LAI3g to fit LAI-re resolution (1/2 degree, bilinear)
* resample temporal frequency of LAI-re (daily) to fit LAI3g (15 day composites)

**Data preparation 2/2: Extracting LSP indices**

* Get Start of Season, End of Season and Growing Season Length
* Harmonic Analysis to get smooth yearly LAI profiles using HANTS
  + Developed for NDVI, but same principle applies for LAI
* Wide range of possible SOS definitions, Midpoint or Max-Increase will be used
* EOS defined as first day after SOS where LAI value is below LAISOS
* Process all LAI-re data, random sample of LAI-3g over all years

**Plausibility analysis of LAI-re**

* Compare raw LAI-re data to LAI3g data for Land surface points (yearly averages, monthly averages)
* Compare extracted LSP indices

**Analyze Changes in Climatic Controls**

* Get monthly statistics over all available years to check for trends within data

**Compare Climatic Controls to LAI**

* Calculate correlation coefficient for climate controls and LSP indices
* Different ways to go about it:
  + Compare SOS to control factors on this day/month
  + Compare SOS to control factors in the preceding month
  + Compare GSL to annual mean or monthly means
  + …

**Challenges**

**LAI Dataset Comparison**

* Both datasets connected to MODIS LAI
* No absolute plausibility test possible within the scope of thesis
* Differences in both datasets could arise for several reasons:
  + LAI3g could be limited by NDVI saturation
  + LAIre could be limited by model assumptions or GSI

**Climatic Controls**

* Based on linear functions and thresholds
  + Oversimplified
* No absolute T/VPD data, constrained by GSI data

**Effect of Climatic Controls on LSP**

* Explorative approach
  + So many Possibilities, very little time
* No prior work to draw on

**Expected Results**

* Slight rise of GSL in temperature-controlled areas
* no expectations for VPD, unclear how it affects LSP

**Introduction**

*LAI3g:* based on GIMMS AVHRR NDVI3g (MODIS LAI used for training neural network)

*LAI-re:* MODIS dataset reanalysis by extending GSI Model (including Plant functional type (PFT) and elevation data; then: forward model FPAR, based on MODIS LAI on FPAR, )

-> both connected to MODIS LAI

-> any other LAI datasets to compare to? Something completely MODIS-independent?

**Methods**

*Resample*all datasets to 0.5 degree resolution? (LAI-re resolution, coarsest dataset) Check for scaling effects..

*Test sites*: For LAI-Comparison: Landcover type (IGBP, like Zhu,2013)?

***LAI Comparison:***

- HANTS for smoothing

- Land Cover (p42. Validation good practices, Garonna) to mask water/other non-vegetation lc

- Extract metrics: Max-inflection and/or Midpoint method for LSP

***Changes in Climatic Controls***

Look at controls independently by creating maps, look at trend in time series by defined regions (same as LAI-regions?)

(mainly amount-of-daylight; or maybe test just to make sure?)

How: yearly averages? Monthly? Don’t know yet.

***Comparison***

Correlate changes in LSP-metric (GSL probably (or all 3)) to measured LAI3g; - Extract by PFT/Land Cover? Biome/Region -> seems more appropriate for global trend study.

**Results**

Expected:

*LAI*: generally GSL lengthening, Depending on location of course

*LAI3g-LAIre:* wouldn’t expect too many differences considering they use the same training data. NDVI limitations (3g) might influence it more than climatic controls (re)

*GSI-LAI*: slight rise in temperature, VPD?! No clue what to expect.

Comparison: generally slight rise of GSL with temperature; no trend with radiation (hours daylight stay the same), maybe something with VPD

**Analysis**

**Discussion**