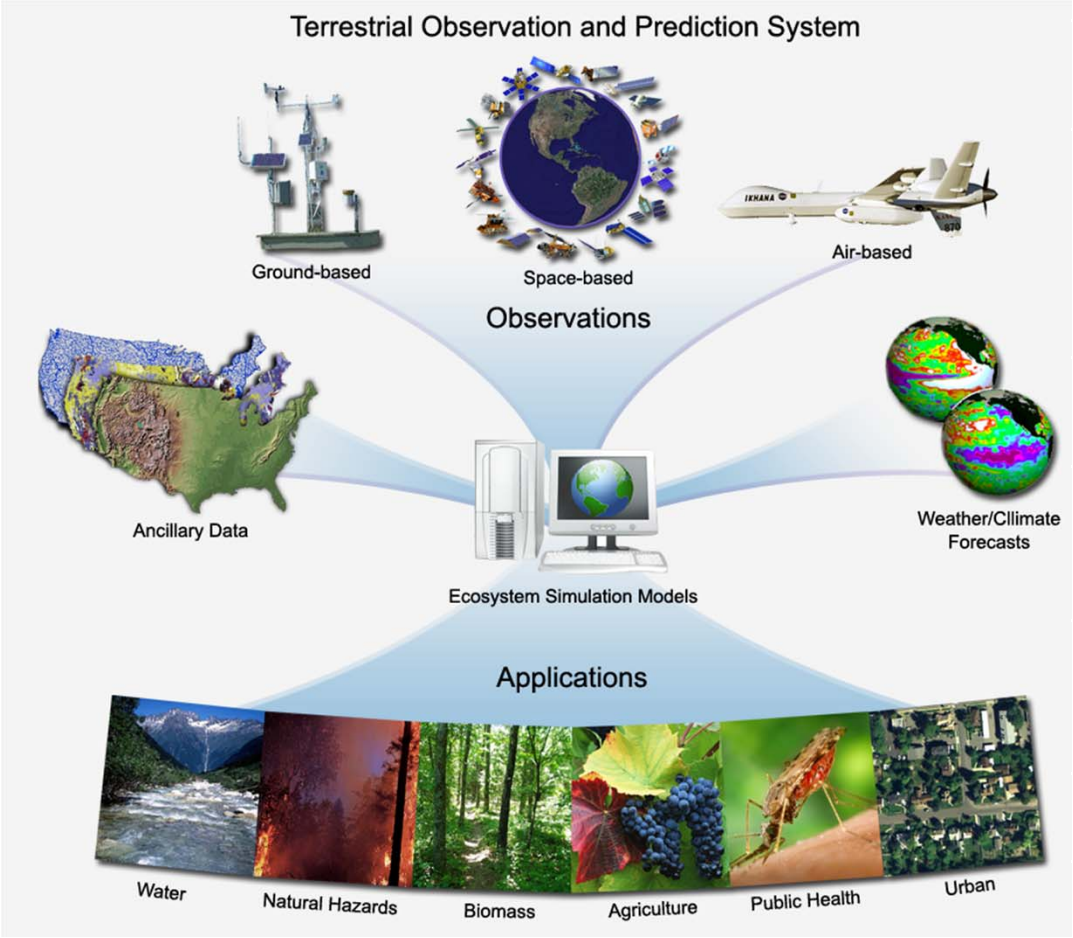
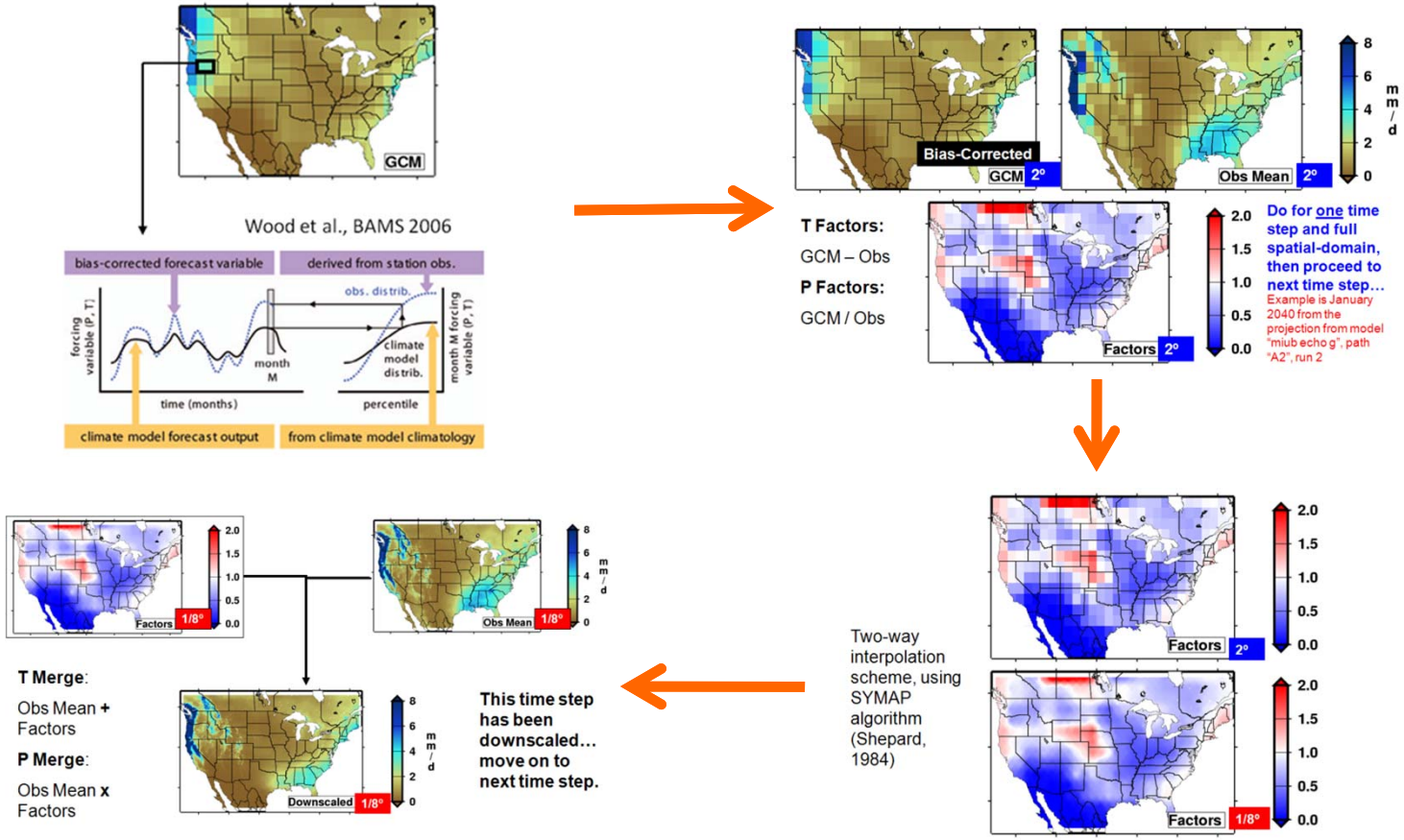
Methods: TOPS



Input Parameter	United States (1km)
Impervious surface area	SERGoM (Theobald et al., 2009)
Climate (baseline run)	TOPOMET Weather Surfaces
Climate (forecast)	WCRP CMIP3 (Maurer et al., 2007) Ensemble average for scenarios A1B, A2, B1
Elevation	National Elevation Dataset (resampled to 1km)
Leaf Area Index (baseline run)	MODIS MOD15A2 LAI (Myneni et al., 2000)
Leaf Area Index (forecast)	Simulated by BIOME-BGC
Soils	U.S. STATSGO2 database
Land Cover	MODIS MOD12Q1 Land cover (Friedl et al., 2002) LPJ?

Methods: Climate Downscaling

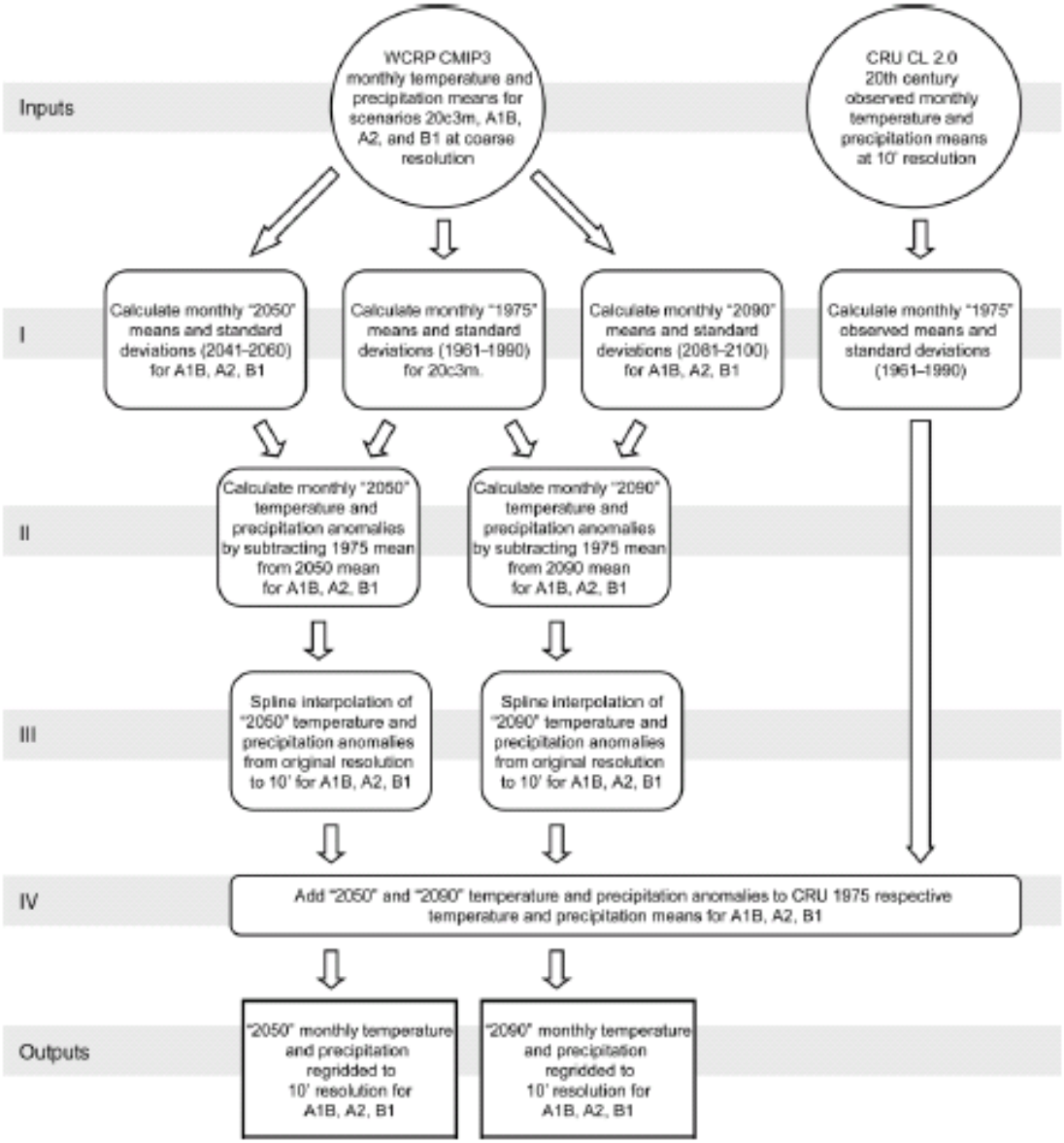
Statistical downscaling: Bias-Correction Spatial Downscaling



More info at: http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections

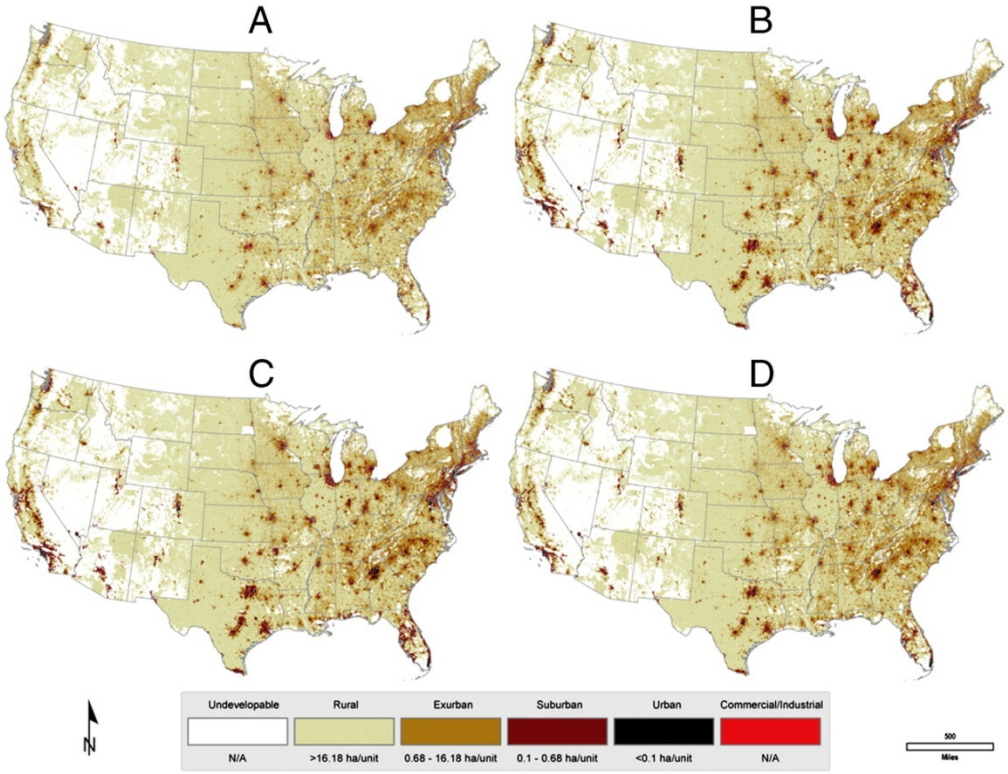
Alternate Method for NPS Park-level scenarios?

- Climate change factor technique
- Tabor and Williams (2010)
- Methods proposed for use to generate 4km output that would serve as the basis for NPS park-level scenarios
- Similar overall approach, though the BCSD method makes corrections in relationships between predicted and observed climate for each GCM grid cell



Methods: Integration of SERGoM Data

- SERGoM ISA scenarios are used to adjust the soil depth in TOPS on a decadal time step
- **Assumption:** Decreases in soil water holding capacity are linearly proportional to increasing fractional ISA
- Approach worked well in Chesapeake and Delaware watersheds



Scenarios, 1950-2100

	A1B (avg + high + low)	**A2** (avg + high + low)	**B1** (avg + high + low)
No LUC	3 runs	3 runs	3 runs
SERGoM LUC	3 runs	3 runs	3 runs
SERGoM + biome shifts?	3 runs	3 runs	3 runs
SERGoM + BMPs + biome shifts?	3 runs	3 runs	3 runs

High / low scenarios defined by 80th and 20th percentile for each monthly timestep

27-36 runs, each producing ~2 TB of data

Plus 9 1km monthly climate scenarios, and daily baseline runs for 2001-2010

TOPS Parameters

Climate
Maximum Temperature
Minimum Temperature
Average Temperature
Precipitation
Vapor Pressure Deficit
Shortwave Radiation

Vegetation
Water stress factor
Gross primary productivity
Net primary productivity
Respiration (Maintenance, Heterotrophic)

Hydrology
Outflow
Evapotranspiration
Soil water potential (another indicator of vegetation water stress)
Snow water equivalent
Soil moisture (VWC)

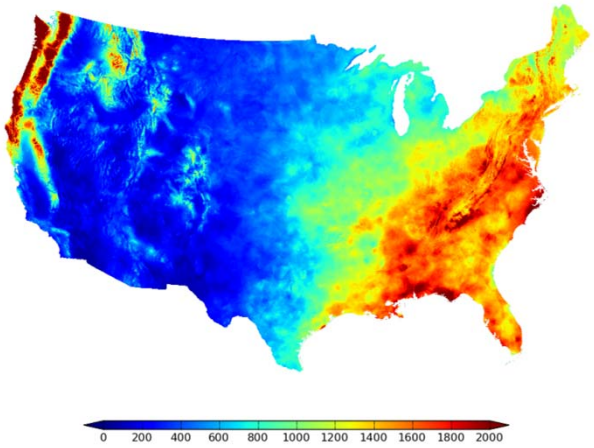
BGC Biome Types
Grasses
Shrubs
Savannah
Broadleaf evergreen forest
Broadleaf deciduous forest
Needleleaf evergreen forest
Needleleaf deciduous forest
Unvegetated
Urban (masked)

Data Formats & Delivery

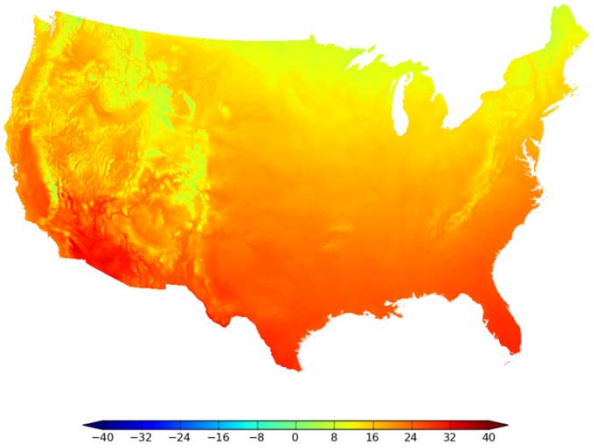
- Data is natively produced as 32-bit floating point binary grids (flt32)
- Anticipate production of 25-75 TB of data
- Objective: Transfer all data and metadata to NPS for archiving and distribution
- Options:
  - Deliver as floats
  - Convert to GeoTIFF
  - Convert to NetCDF
- Data storage limitations? Data storage costs? Back-up and redundancy?
- Extract subsets for selectLCCs only?

Sample Climate (TopoMet)

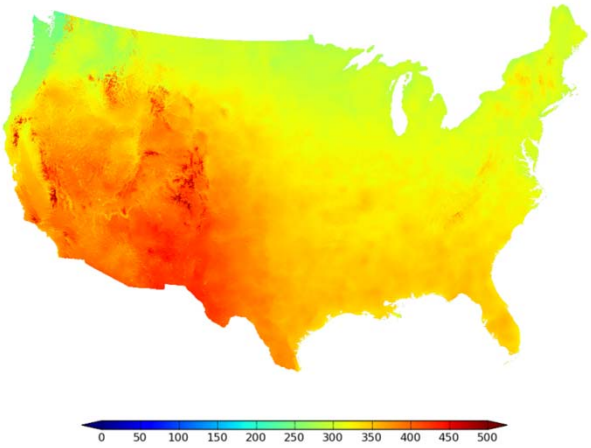
Precipitation



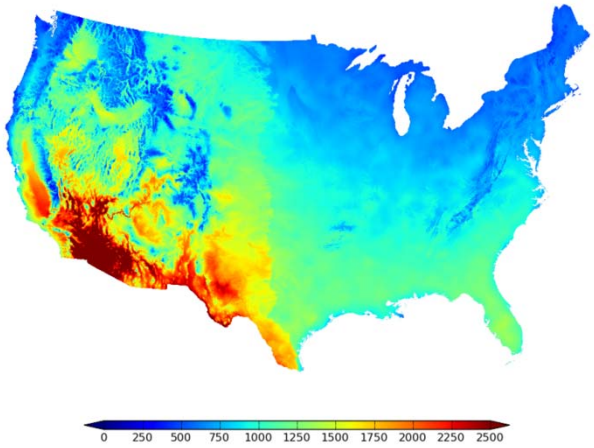
Tmax/Tmin



Srad

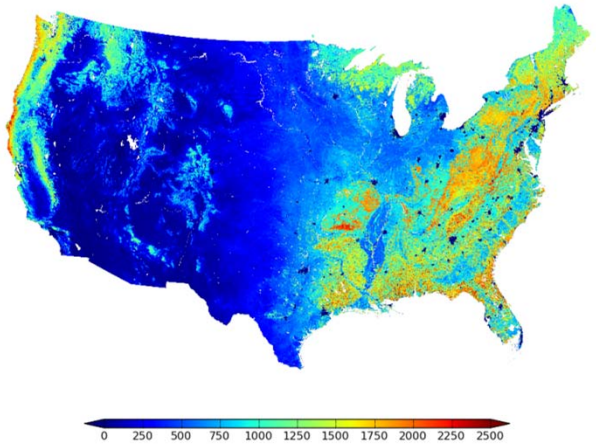


VPD

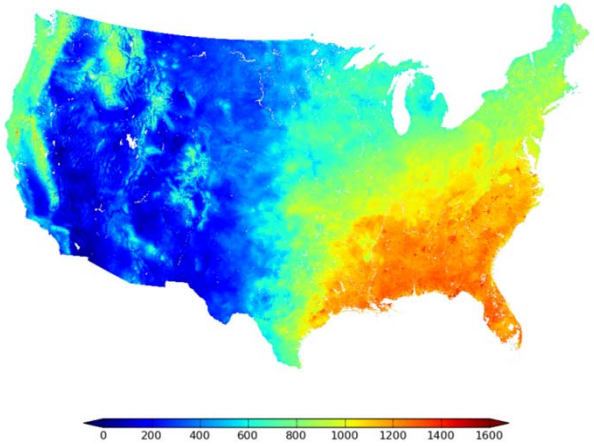


Sample TOPS Results

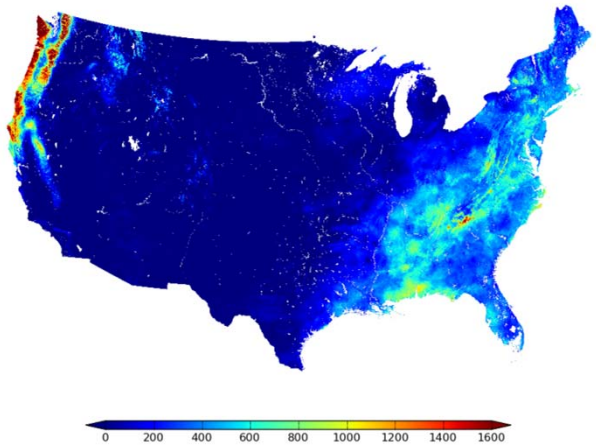
GPP

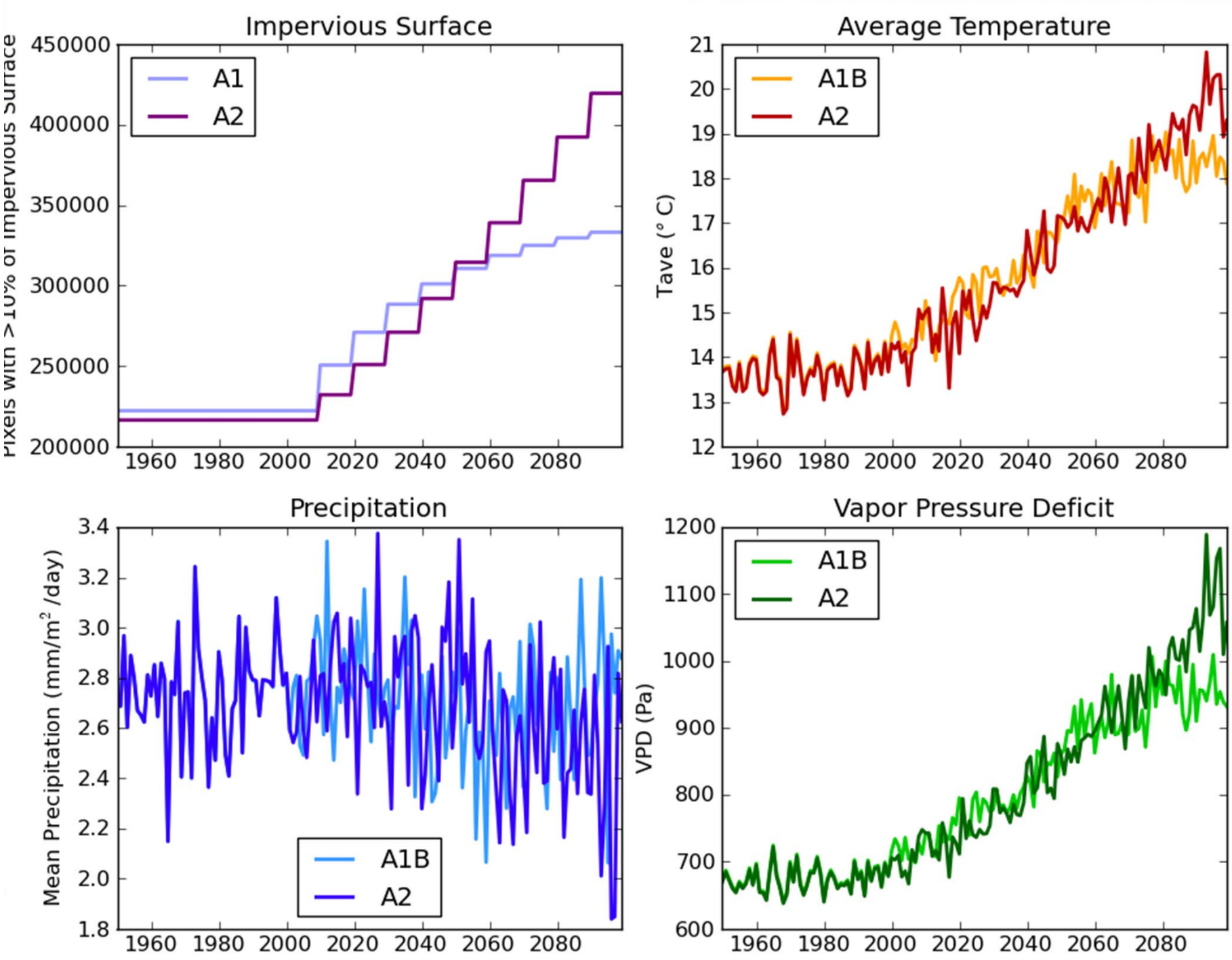


EvapoTranspiration



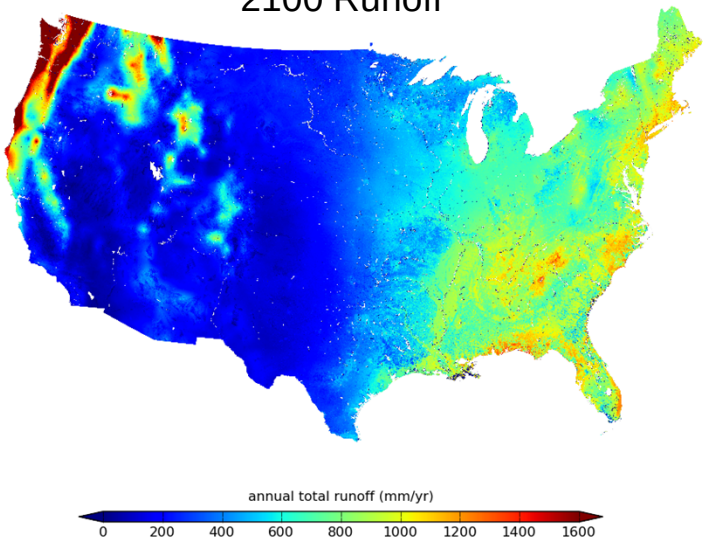
Runoff



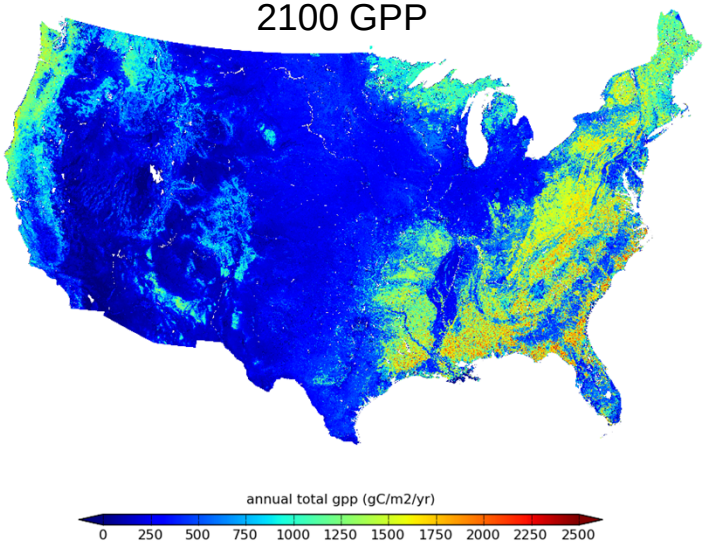

Impervious Surface
Pixels with >10% of Impervious Surface
450000
400000
350000
300000
250000
200000
A1
A2
1960 1980 2000 2020 2040 2060 2080
Average Temperature
Tave (° C)
21
20
19
18
17
16
15
14
13
12
A1B
A2
1960 1980 2000 2020 2040 2060 2080
Precipitation
Mean Precipitation (mm/m^2 /day)
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
A1B
A2
1960 1980 2000 2020 2040 2060 2080
Vapor Pressure Deficit
VPD (Pa)
1200
1100
1000
900
800
700
600
A1B
A2
1960 1980 2000 2020 2040 2060 2080

TOPS Results: Coupled Climate and Land Use Change

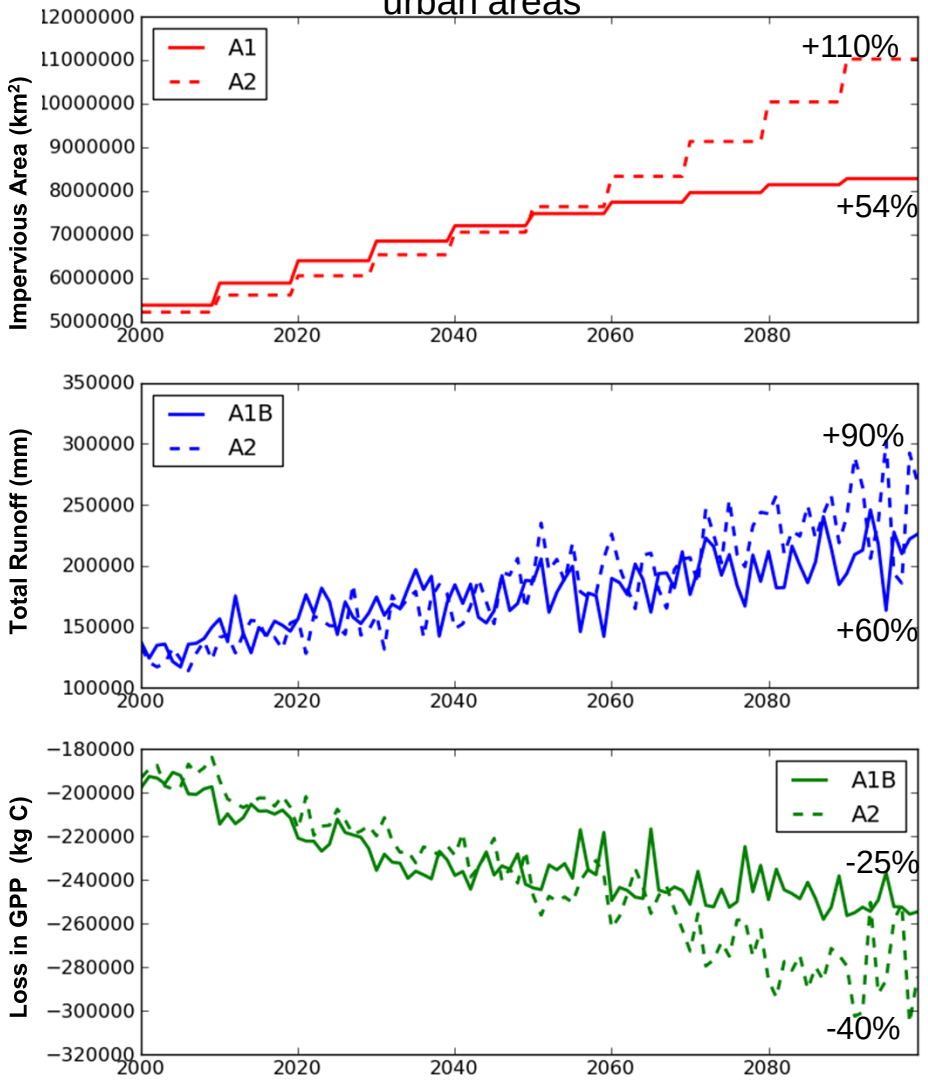
2100 Runoff



2100 GPP



Coupled climate and land use change impacts over urban areas



Schedule

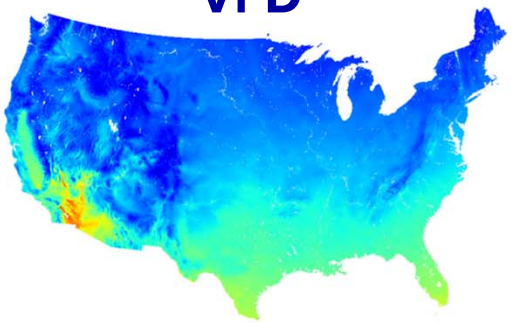
Task	Dates
Port TOPS-BGC to monthly timestep (again)	November to February (complete)
Acquire PRISM data and prepare downscaling	February (complete)
Pre-process new SERGoM scenarios	Feb 21 – March 7 (complete)
Calculation of ensemble averages / downscaling to 1km w/Thrasher & Duffy	March 1-21 (In progress)
First runs (climate only)	March 22-26
Second runs (climate + LUC)	March 27-31
Third runs (climate + LUC + BMP)	April 1-5
Data analysis and initial summaries	April 1-30
Data preparation for transfer	May - June

Projected Climate under IPPCC SRES A1B

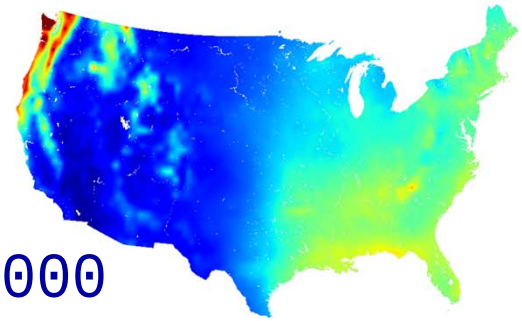
1km Downscaled GFDL CM2.0

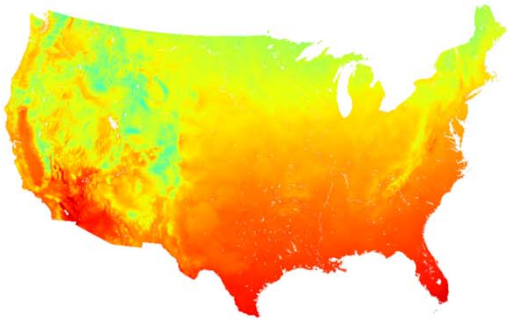
Precipitation | **Tave** | **VPD**

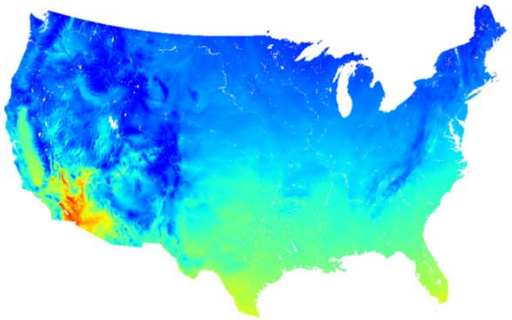
1950



2000







2100