Multi-century perspectives on current and future streamflow in the Missouri River Basin

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science for a changing world

MSU, Strand-Union Building, Ballroom C

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GOALS

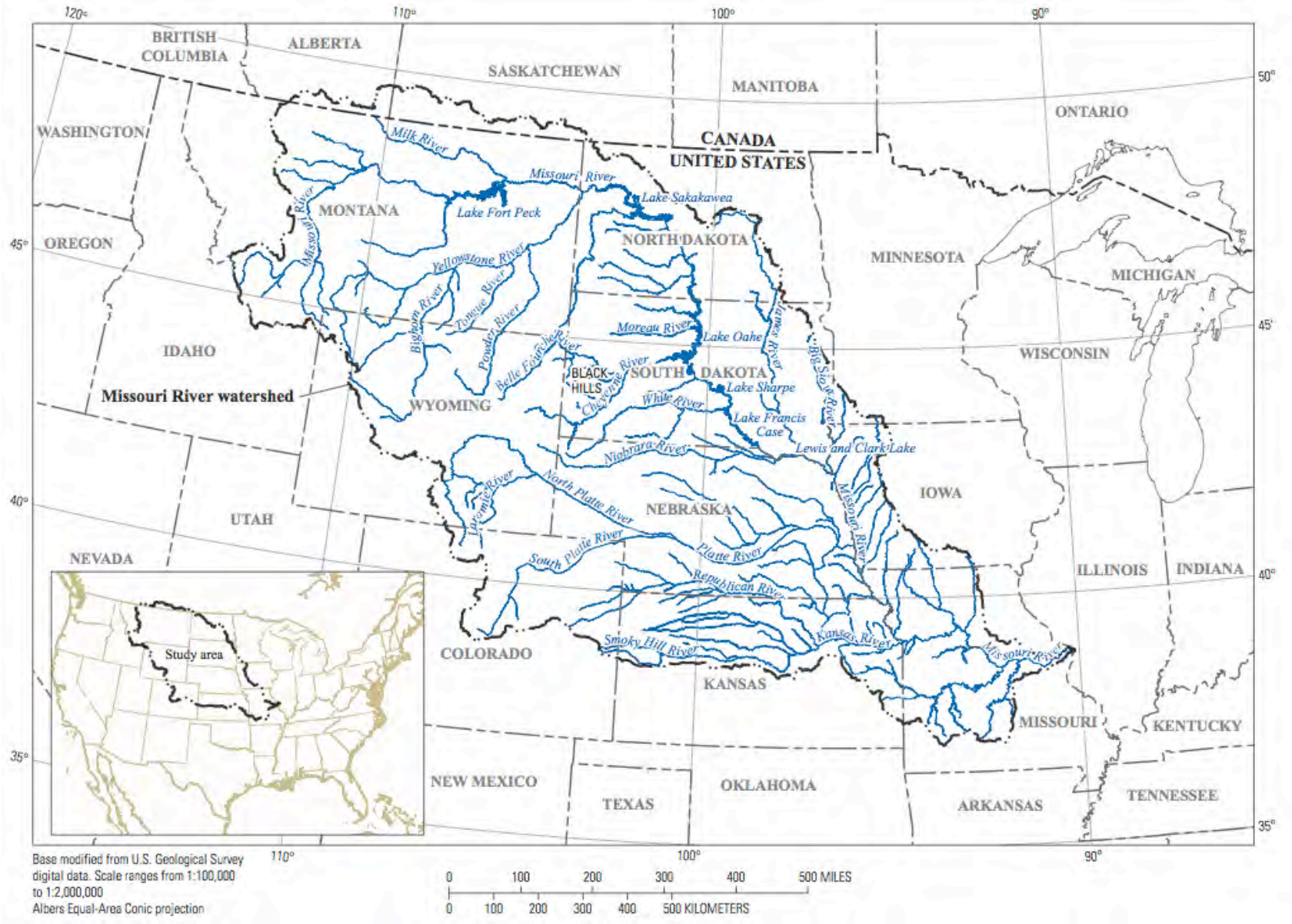
Develop long records (500+yrs) of total water year flows at collaborator/manager selected stream gage locations

Use the records to test and optimize current flow management operations with State and Federal Water Managers

Contextualize projections of future streamflow and snowpack change with paleohydrologic records

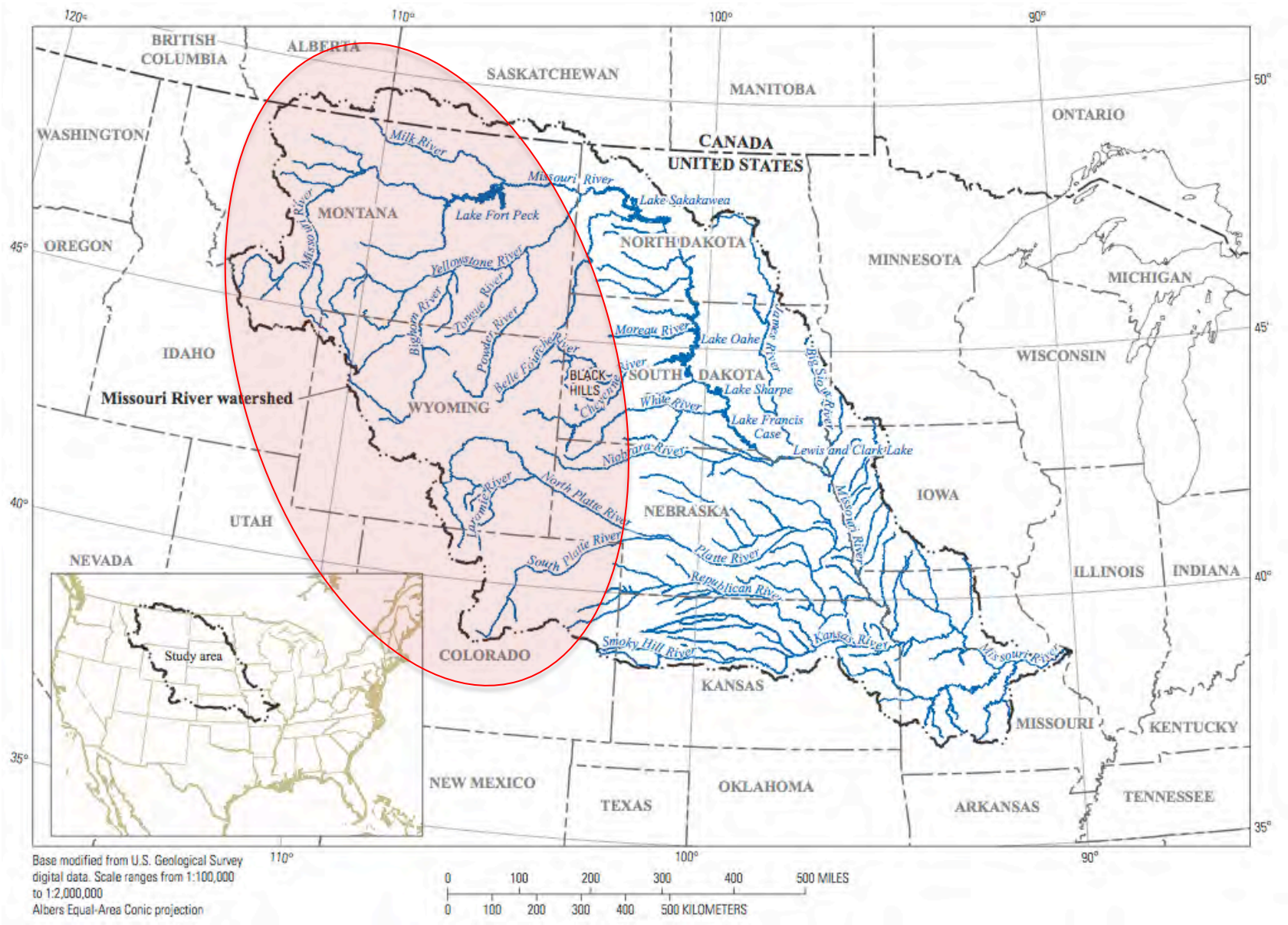
Project Website: Missouri River Paleohydrology Project

The River System



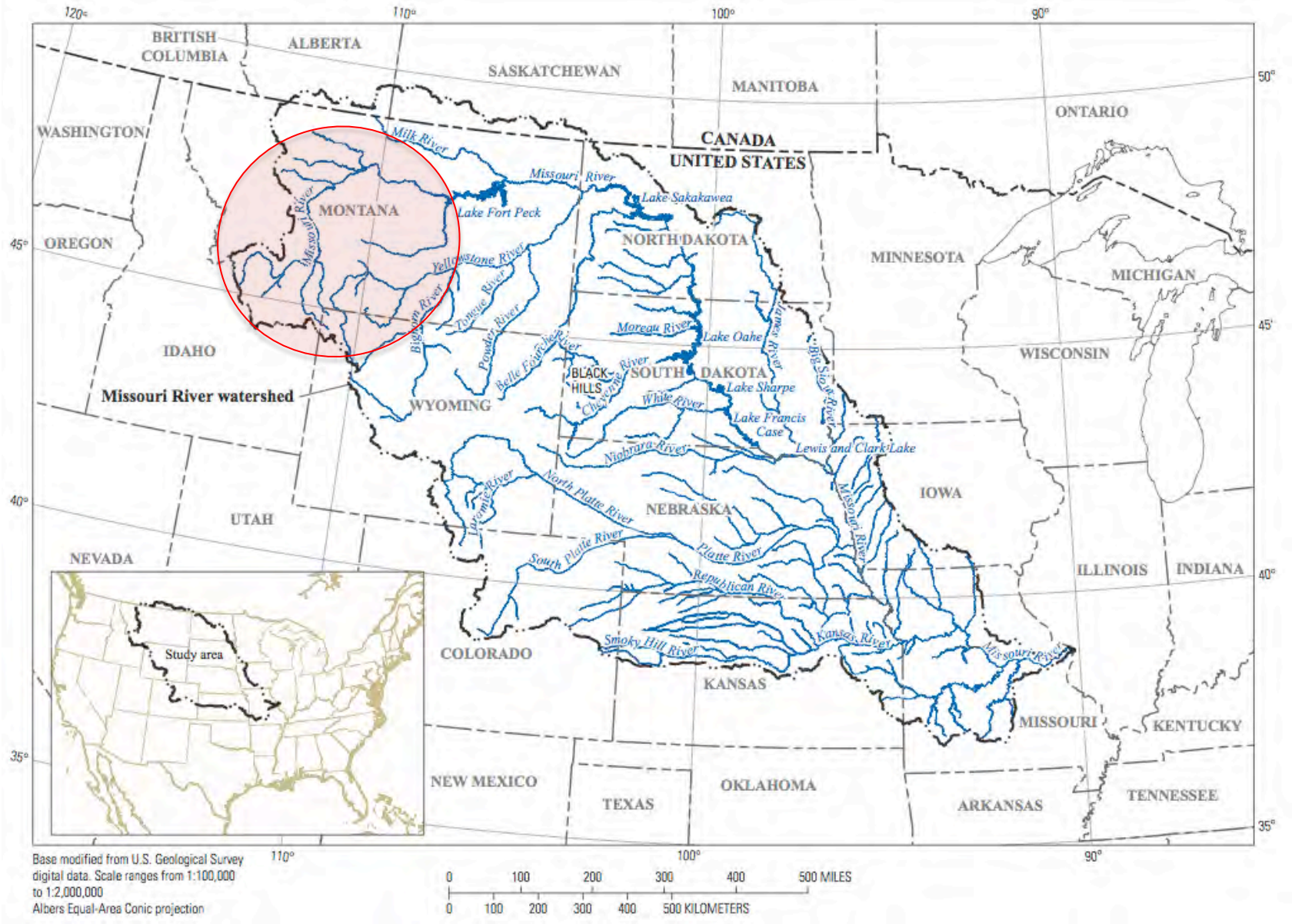
Norton et al., 2014

The Upper Basin



Norton et al., 2014

BOR Basin Study Area



Norton et al., 2014

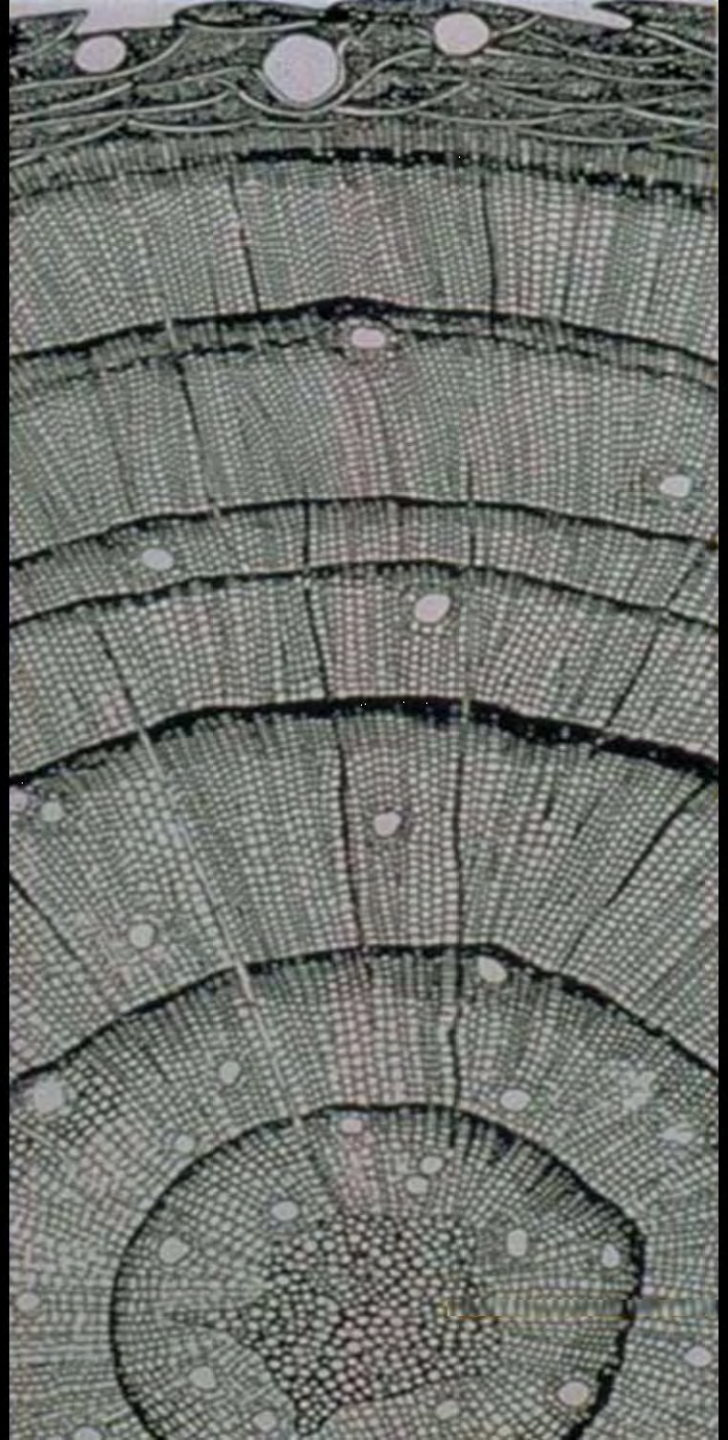
How do we reconstruct streamflow from tree rings?

A*brief* overview:*

Tree*rings* as*proxies* for*past* climate*

How*is*tree*growth*related*to*climate?*

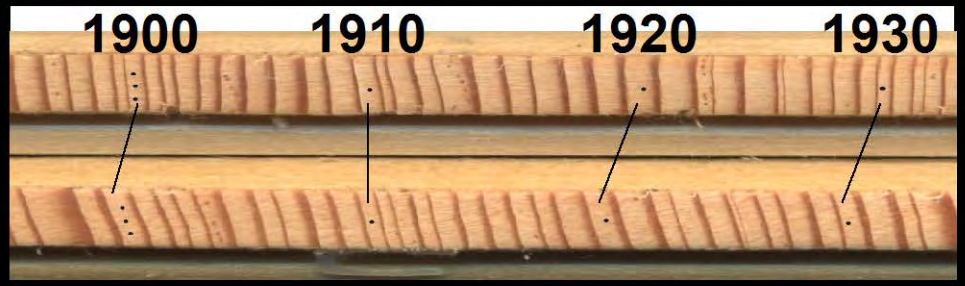
*



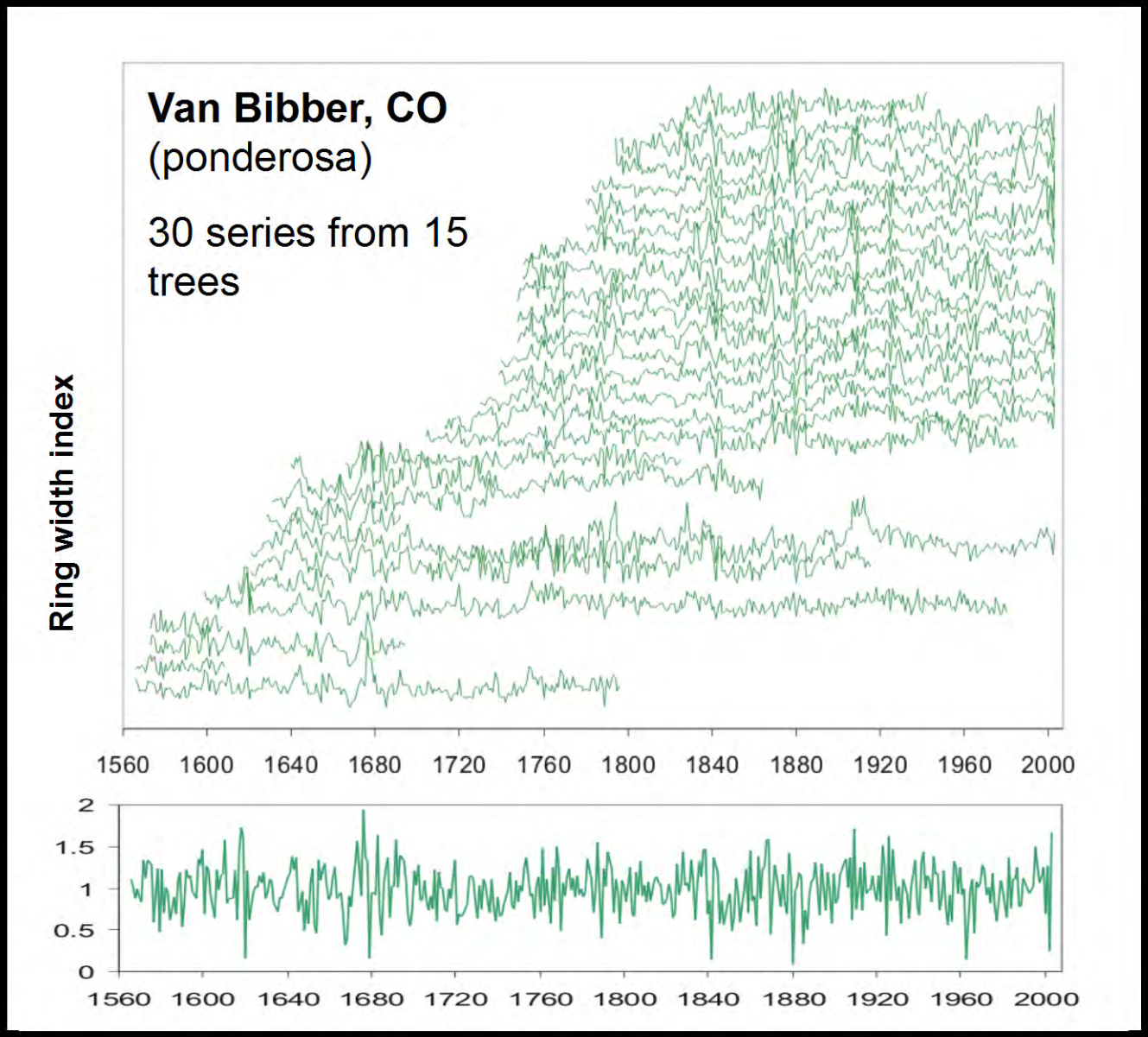
Trees*that*record*variability*in*moisture*

Field*collec$ons*

Sample*prepara$on*



Compiling the tree%ing chronology



Chronology = basic unit of tree%ing data, "building block" for the climate reconstruc$on

Progress to date

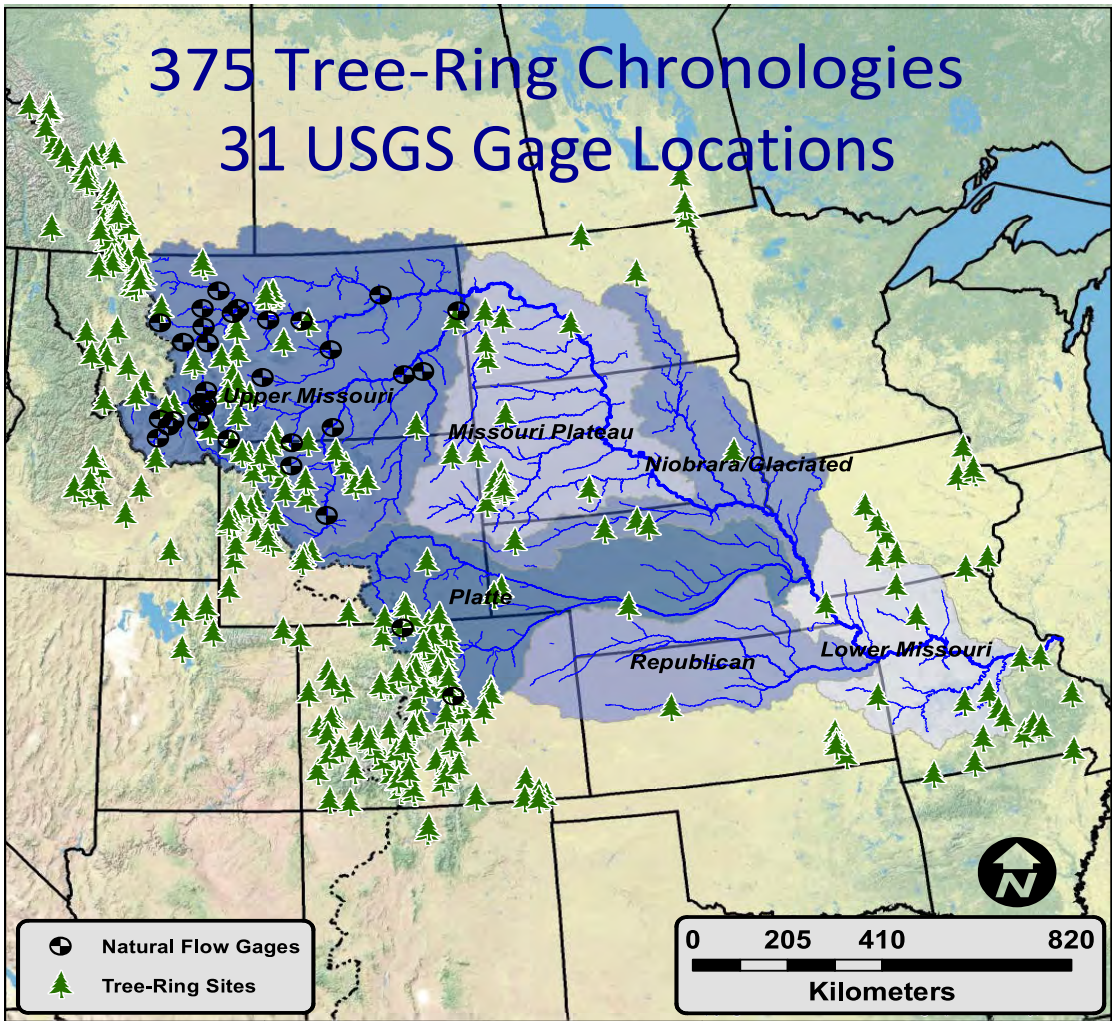
- Tree-ring data set generated
  - Over 100 records added to the ITRDB
- Streamflow data set compiled
  - 49 naturalized records basin-wide (31 headwaters , 18 main stem)
- Reconstructions at 31 headwaters gages, averaging 1163 years in length.

Data Contributions

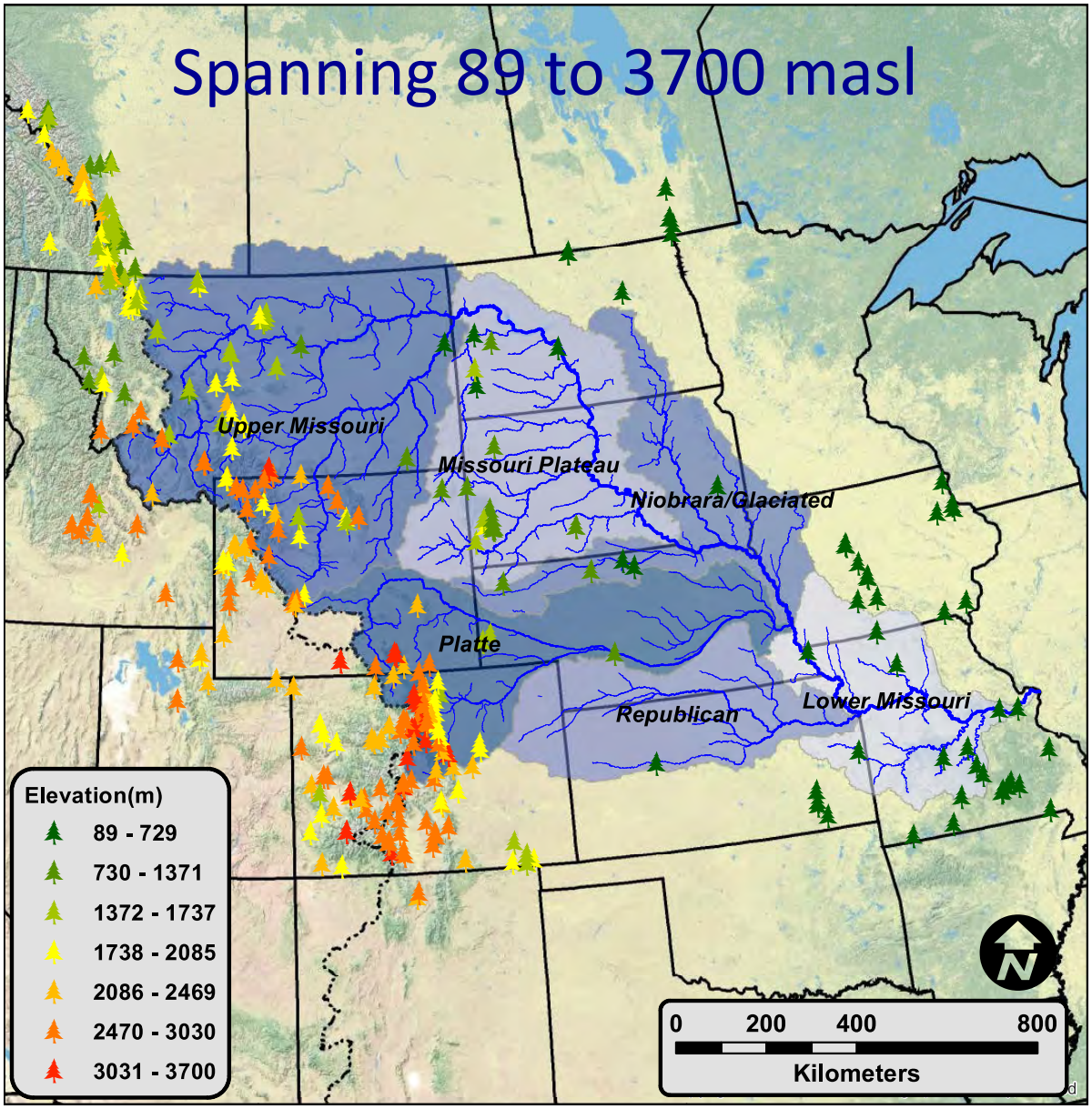
- Tree Ring Data
  - Over 50 different collectors
  - Over 30 years of collection effort
- Naturalized Streamflow Data
  - 10 contributors
  - Over 100 years of streamflow gaging

What data did we use to Reconstruct Flows?

- Tree-ring chronologies - 375
- Naturalized streamflow records - 31



Tree Ring Database



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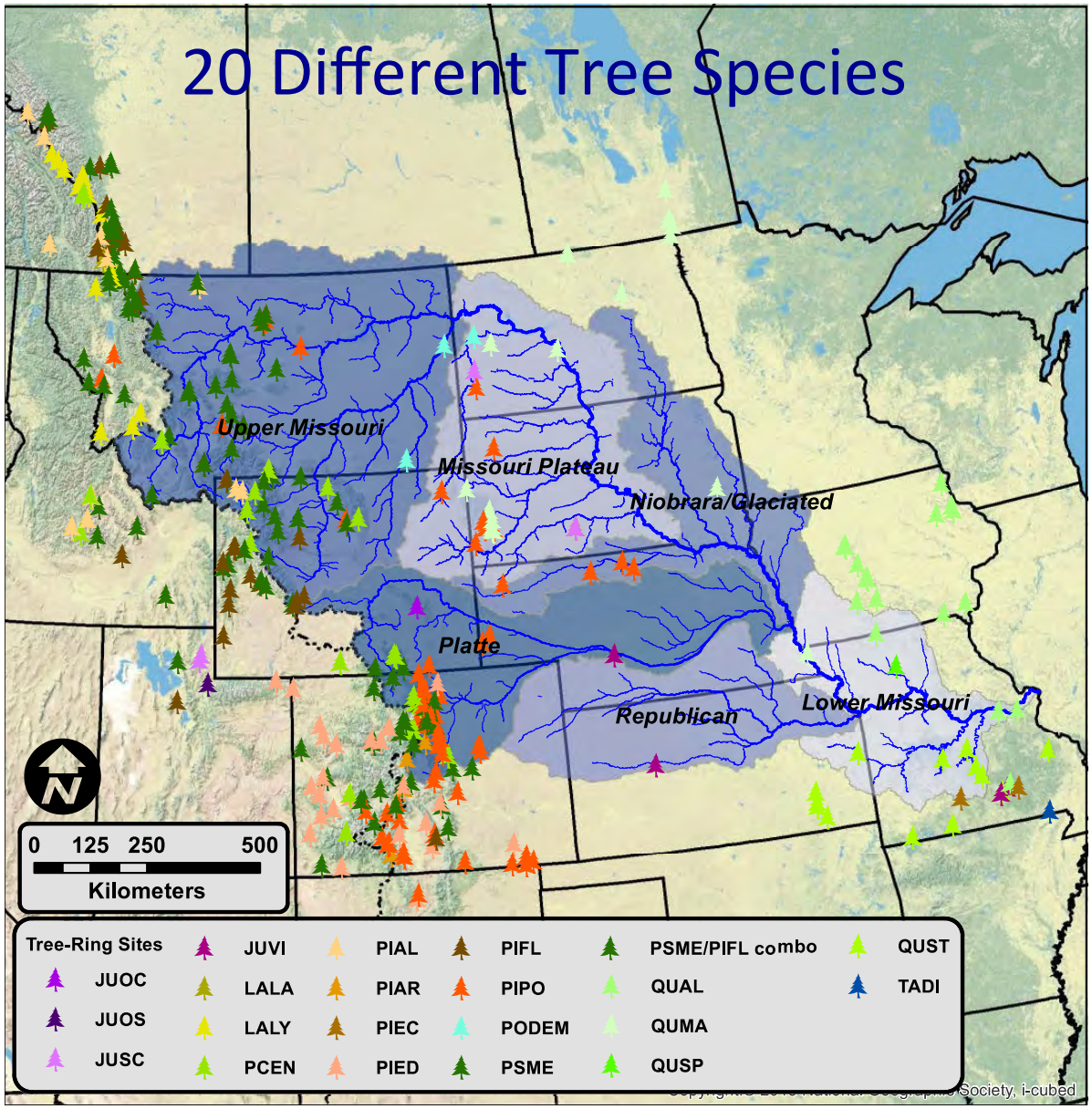

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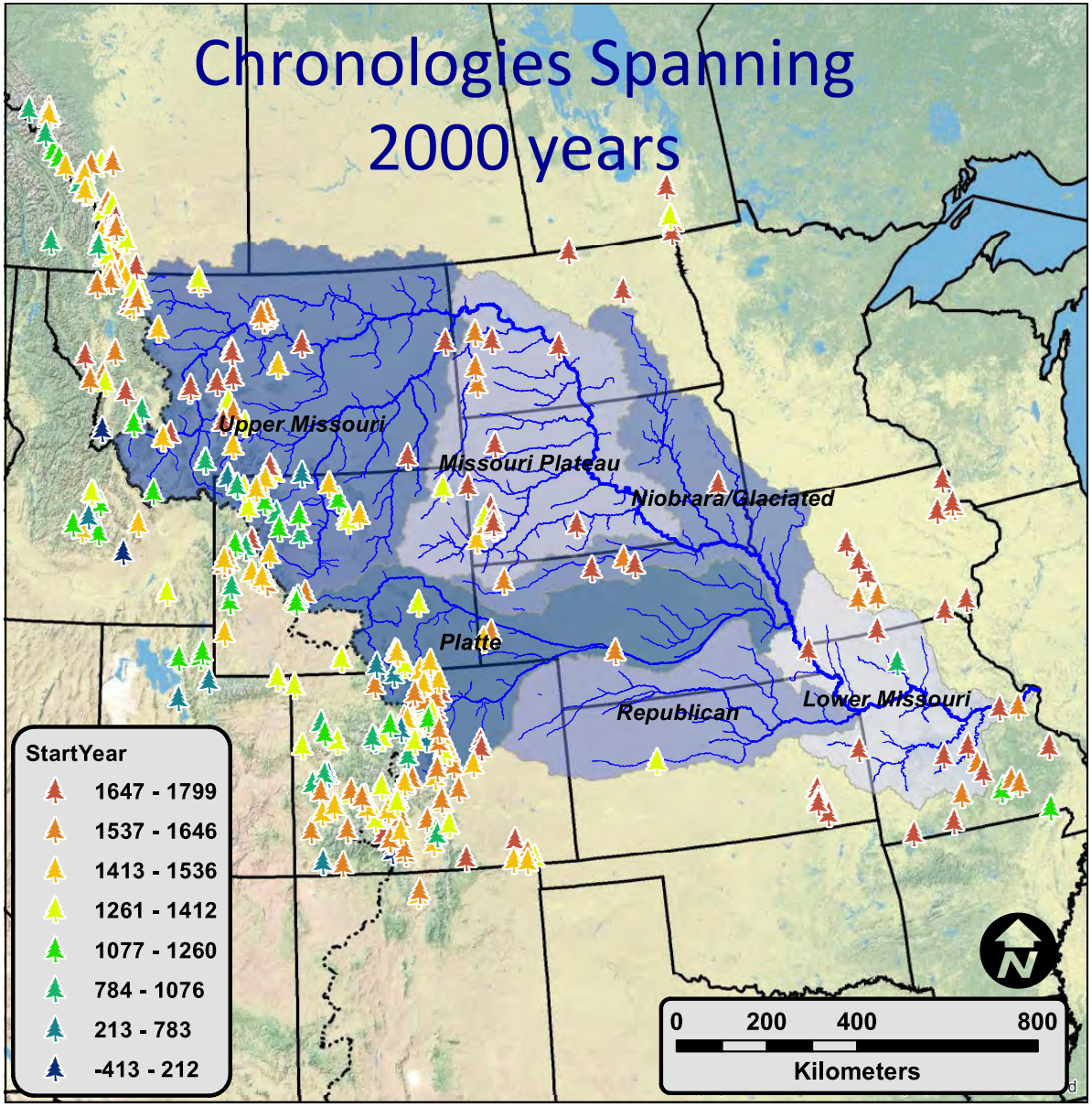
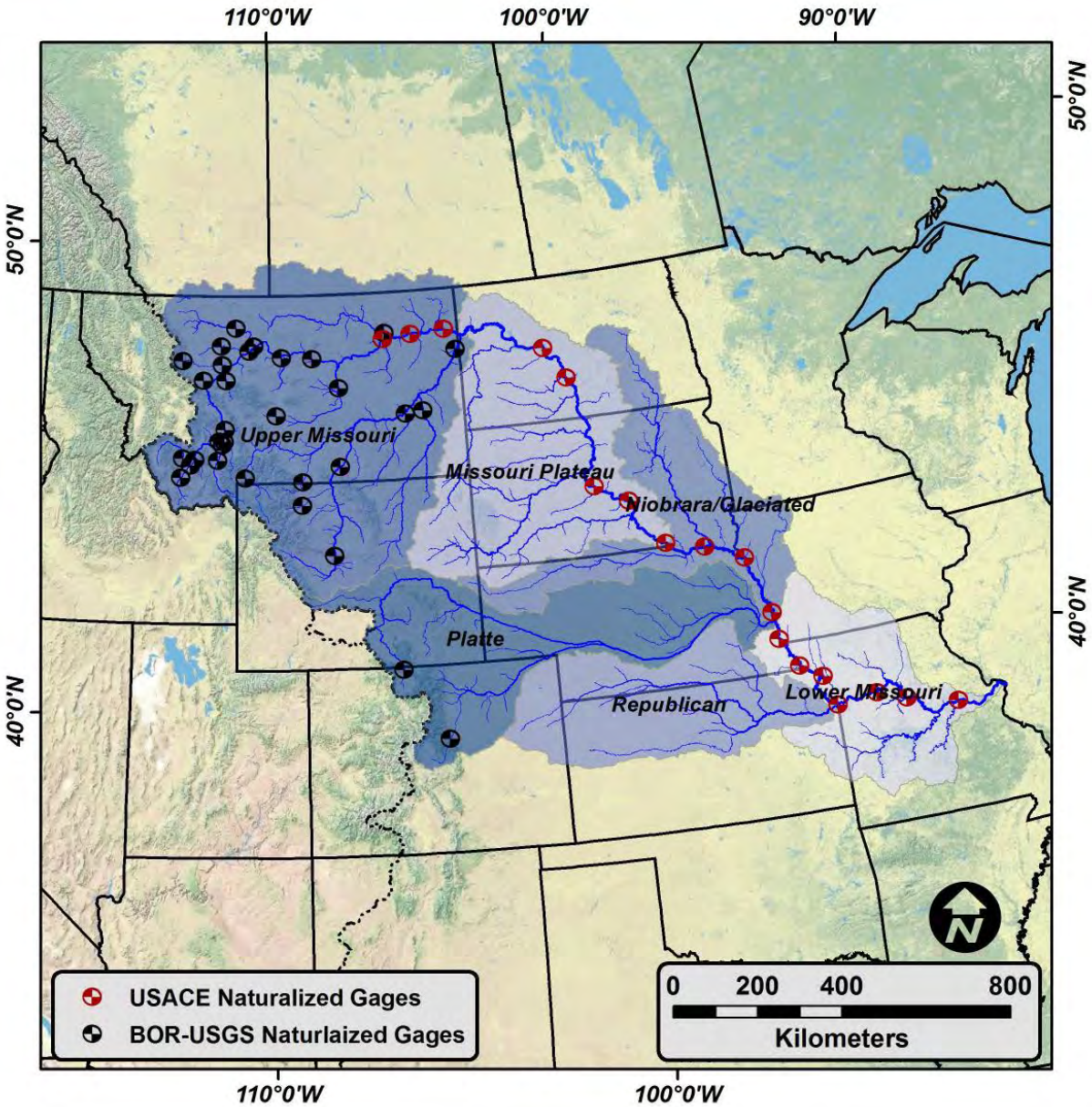


Final Streamflow Database Entire Basin



Reconstruc$on*process*in*a*nutshell*

Tree*Rings**

Observed*Streamflow**

Sta$s$cal*Calibra$on*

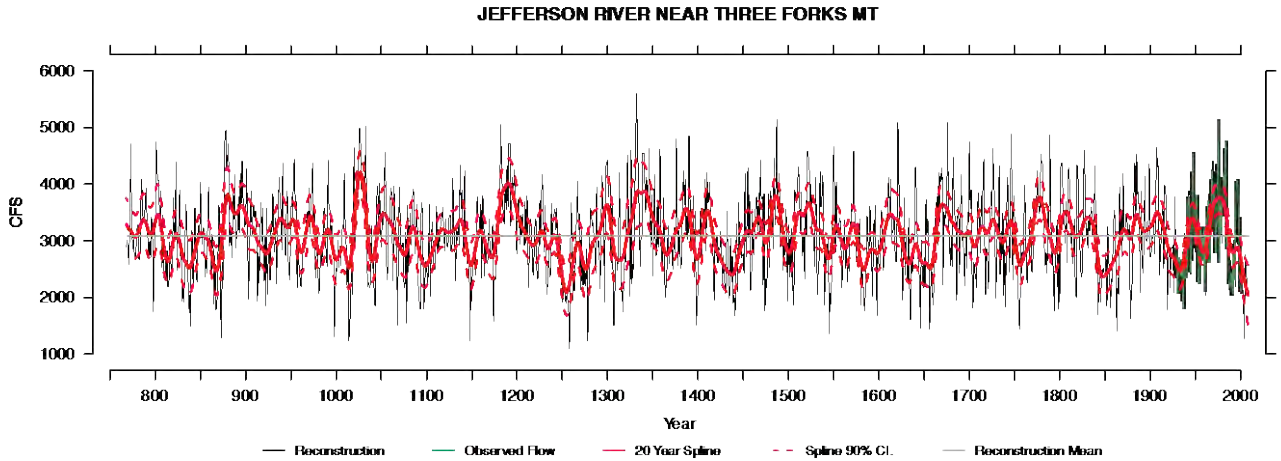
Reconstruc$on*Model*

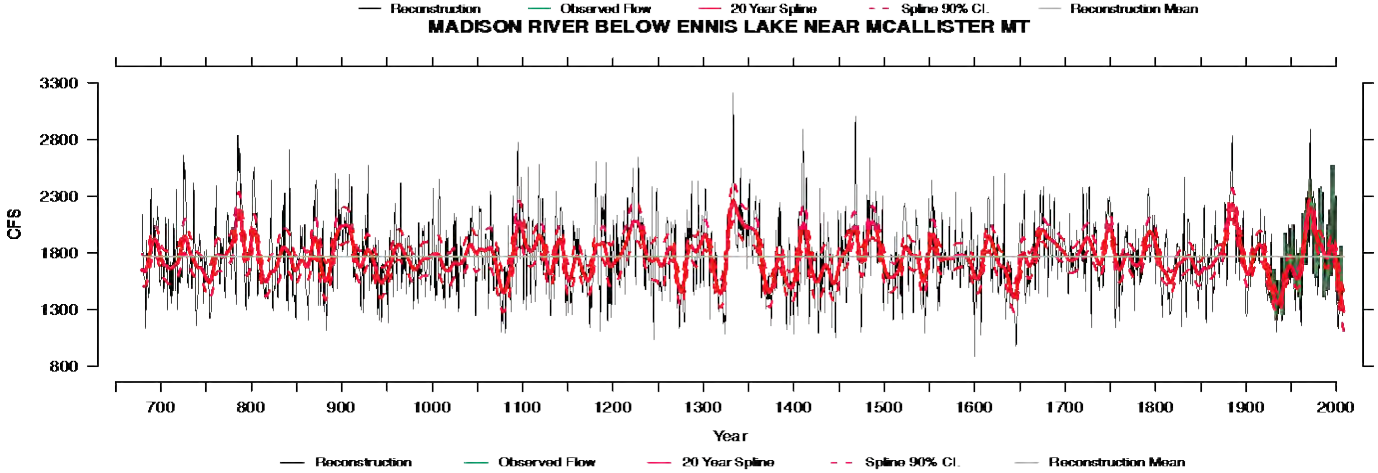
Time*Series*of*Reconstructed*Streamflow*

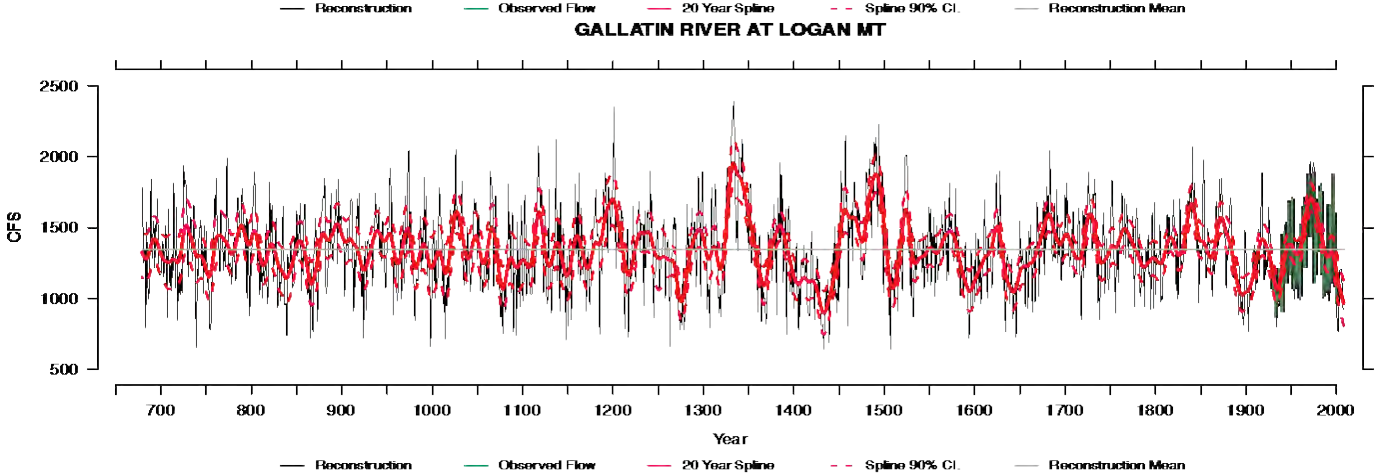
Preliminary Results

Gage	CV_R.Squared	CV_Prediction_Error	Start_Year
BIGHORN RIVER NEAR ST. XAVIER, MT	0.84	254.31	722
WIND RIVER BELOW BOYSEN RESERVOIR, WY	0.81	162.86	722
MISSOURI RIVER NEAR LANDUSKY MT	0.81	982.39	769
NORTH PLATTE RIVER NEAR NORTHGATE CO	0.79	69.75	380
MADISON RIVER BELOW ENNIS LAKE NEAR MCALLISTER MT	0.78	115.27	680
SMITH RIVER NEAR EDEN MT	0.76	59.98	986
MILK RIVER AT NASHUA MT	0.76	157.06	1104
JUDITH RIVER NEAR MOUTH, NEAR WINIFRED MT	0.76	29.04	769
MISSOURI RIVER AT FORT BENTON MT	0.74	796.50	769
GALLATIN RIVER AT LOGAN MT	0.73	106.52	680
MISSOURI RIVER AT TOSTON MT	0.73	441.34	680
MADISON RIVER NEAR THREE FORKS MT	0.73	124.36	1014
SUN AT GIBSON RESERVOIR NEAR AUGUSTA, MT	0.71	78.73	1062
MUSSELSHELL RIVER AT MOSBY MT	0.71	107.03	1027
MARIAS RIVER NEAR CHESTER MT	0.71	124.63	1154
YELLOWSTONE RIVER NEAR SIDNEY MT	0.71	1287.93	882
SOUTH PLATTE RIVER AT SOUTH PLATTE CO	0.70	62.40	379
SHOSHONE RIVER BELOW BUFFALO BILL RESERVOIR, WY	0.69	110.00	680
MUSSELSHELL RIVER AT HARLOWTON MT	0.68	41.86	986
SUN RIVER NEAR VAUGHN MT	0.66	132.27	882
YELLOWSTONE RIVER AT CORWIN SPRINGS MT	0.65	319.27	769
TETON RIVER NEAR DUTTON MT	0.64	34.72	1154
RUBY RIVER NEAR TWIN BRIDGES MT	0.64	38.28	769
TETON RIVER AT LOMA MT	0.64	41.64	987
JEFFERSON RIVER NEAR THREE FORKS MT	0.64	333.58	769
BIG HOLE RIVER NEAR MELROSE MT	0.64	161.17	818
BEAVERHEAD RIVER AT BARRETTS MT	0.63	55.88	1062
TONGUE RIVER AT MILES CITY MT	0.61	91.83	875
DEARBORN RIVER NEAR CRAIG MT	0.60	41.21	882
CLARKS FORK YELLOWSTONE RIVER NEAR BELFRY MT	0.58	109.23	722
POWDER RIVER NEAR LOCATE MT	0.45	162.37	1307
Average	0.69	213.98	853

Preliminary Results







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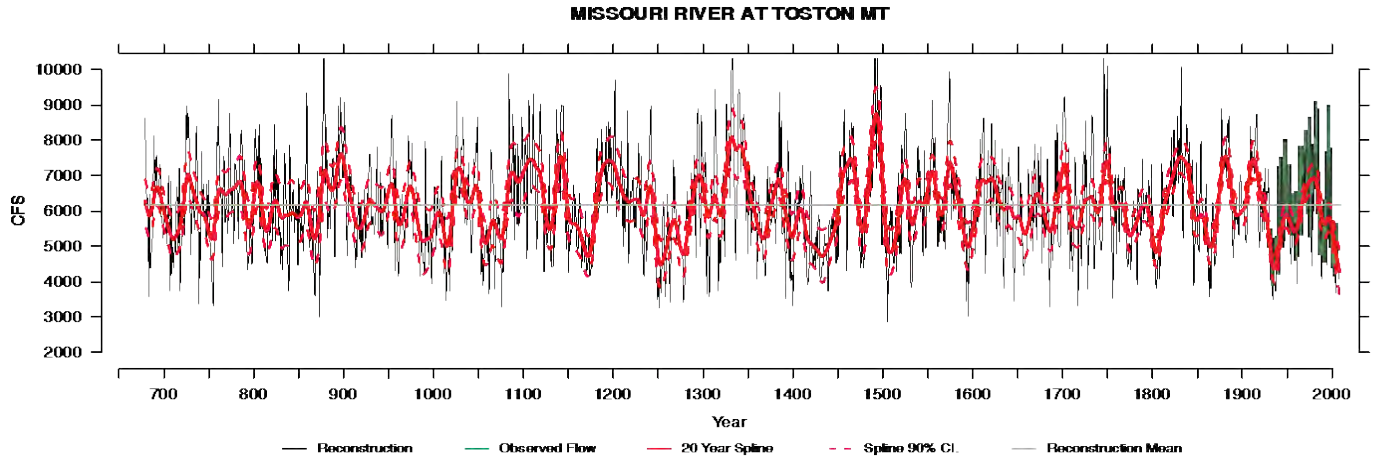
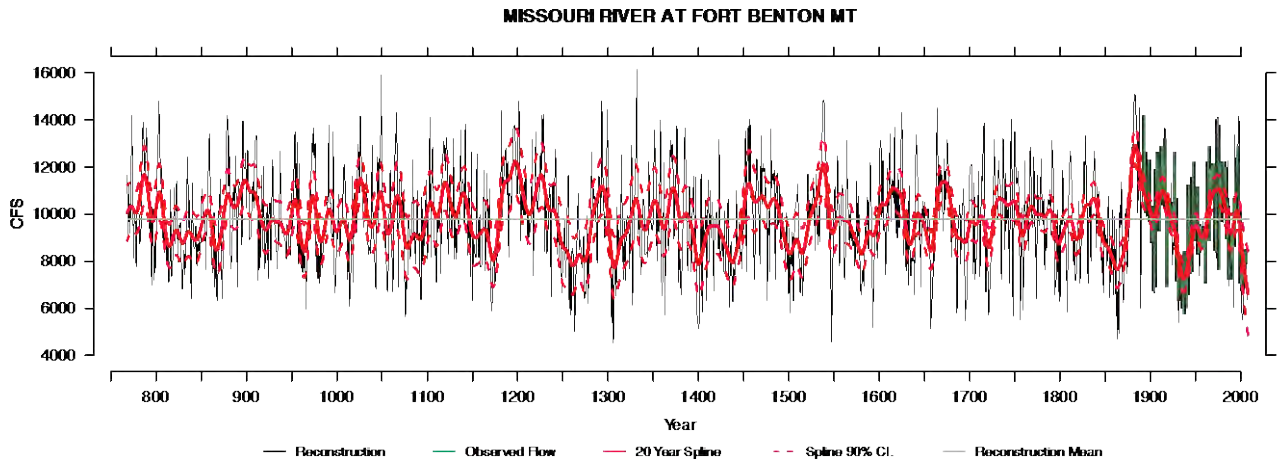
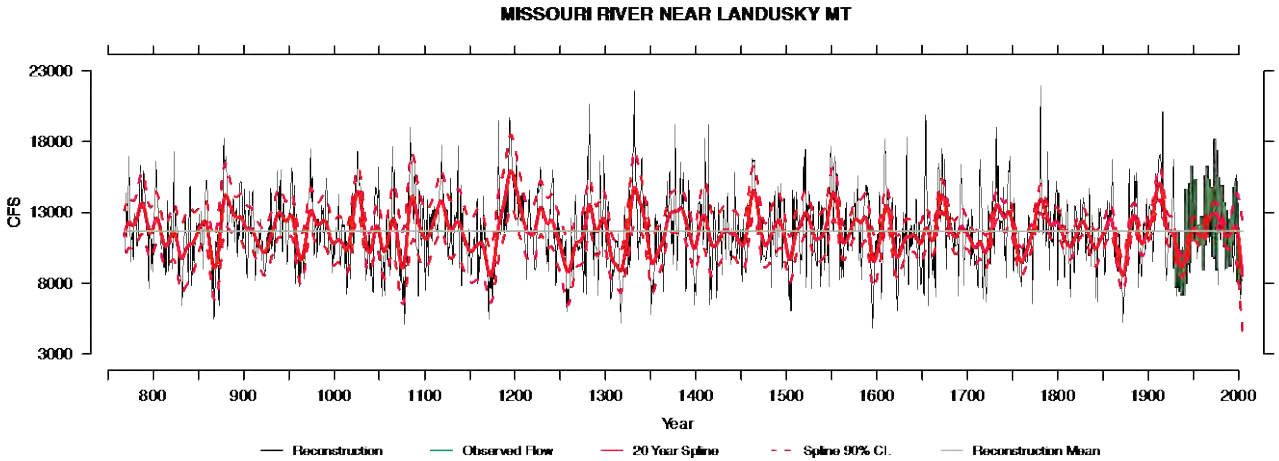
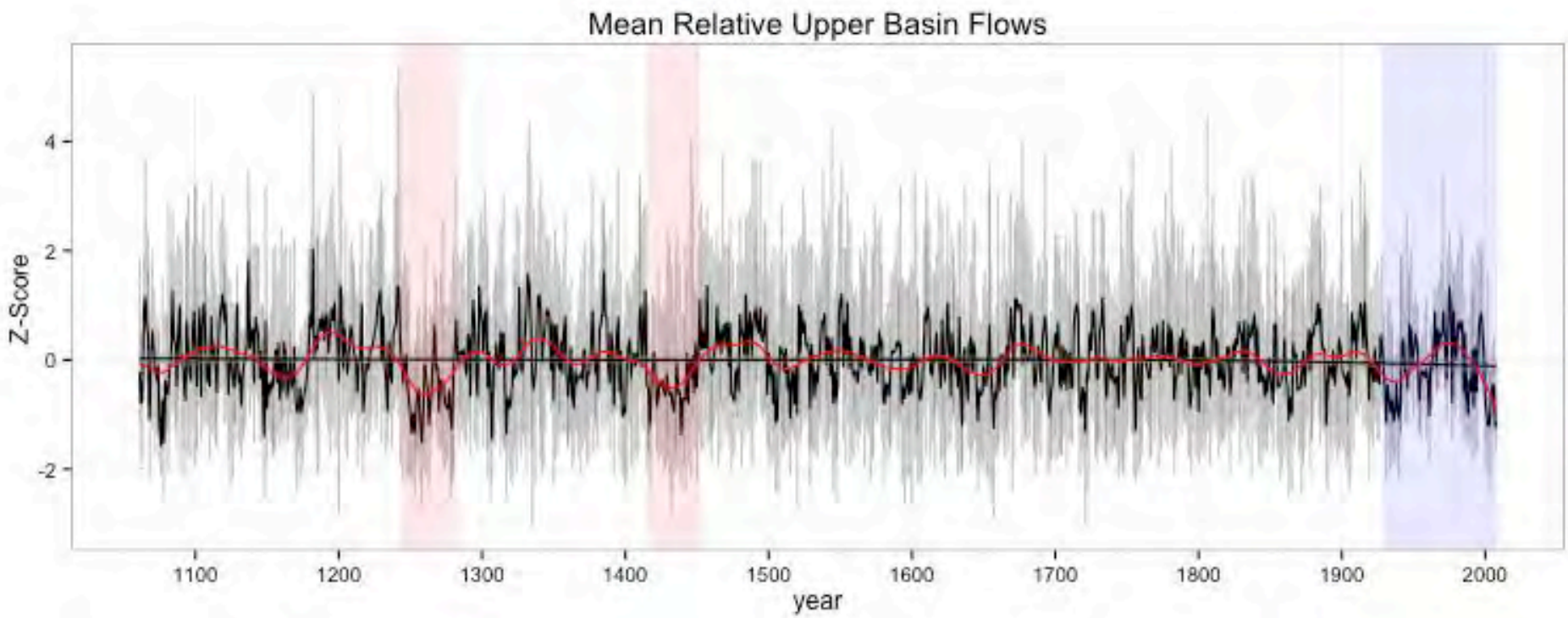






Preliminary Results - Droughts



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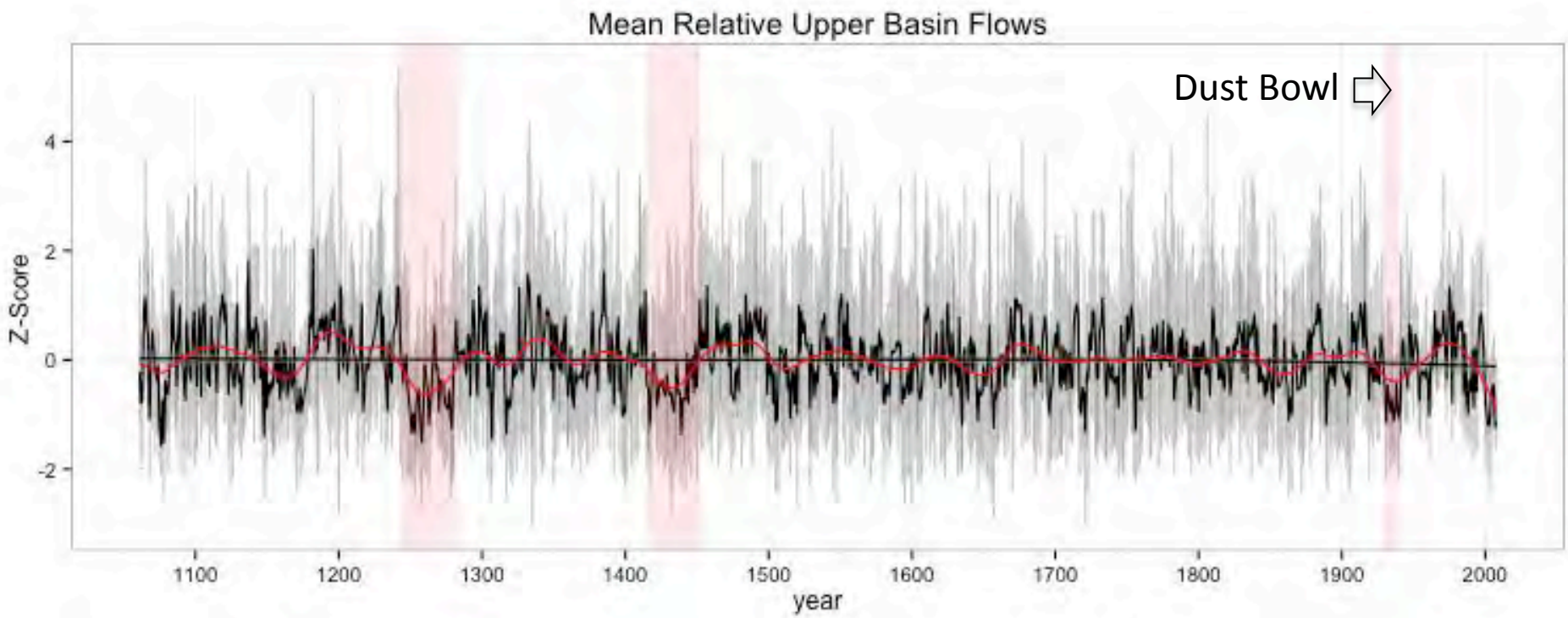
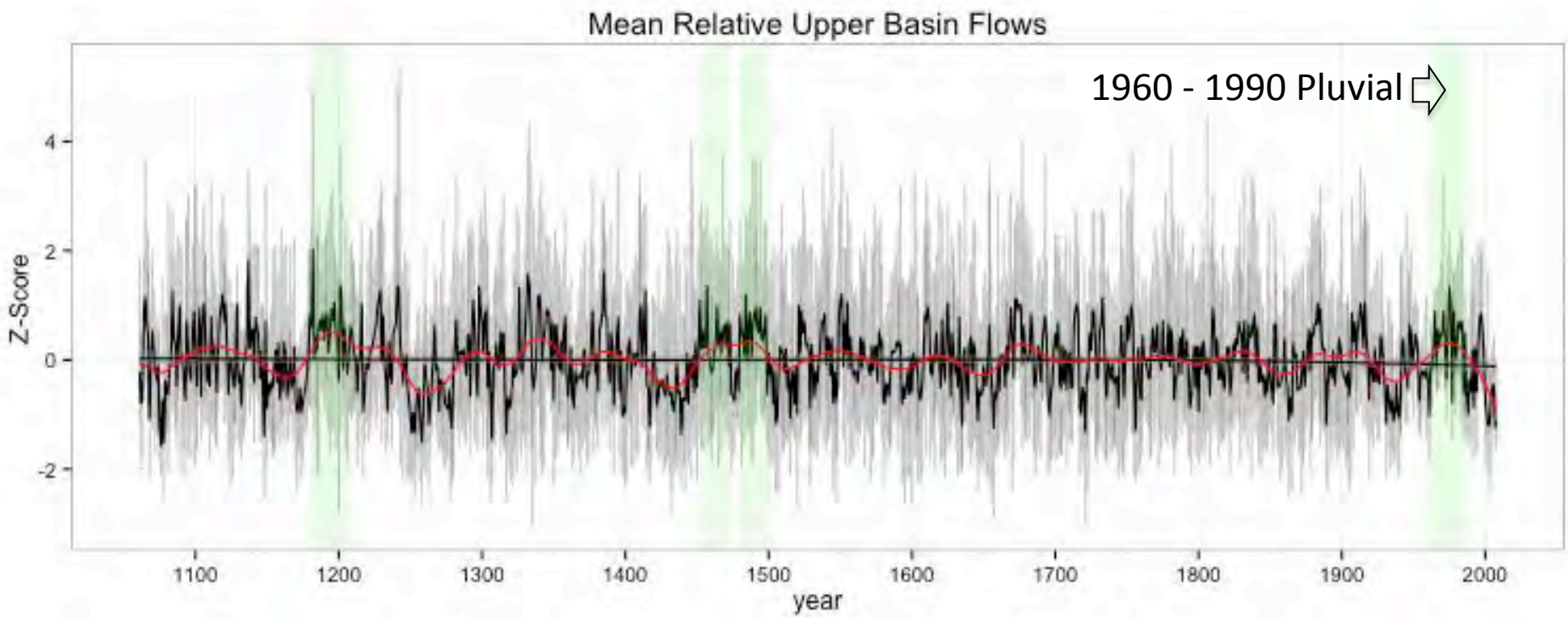
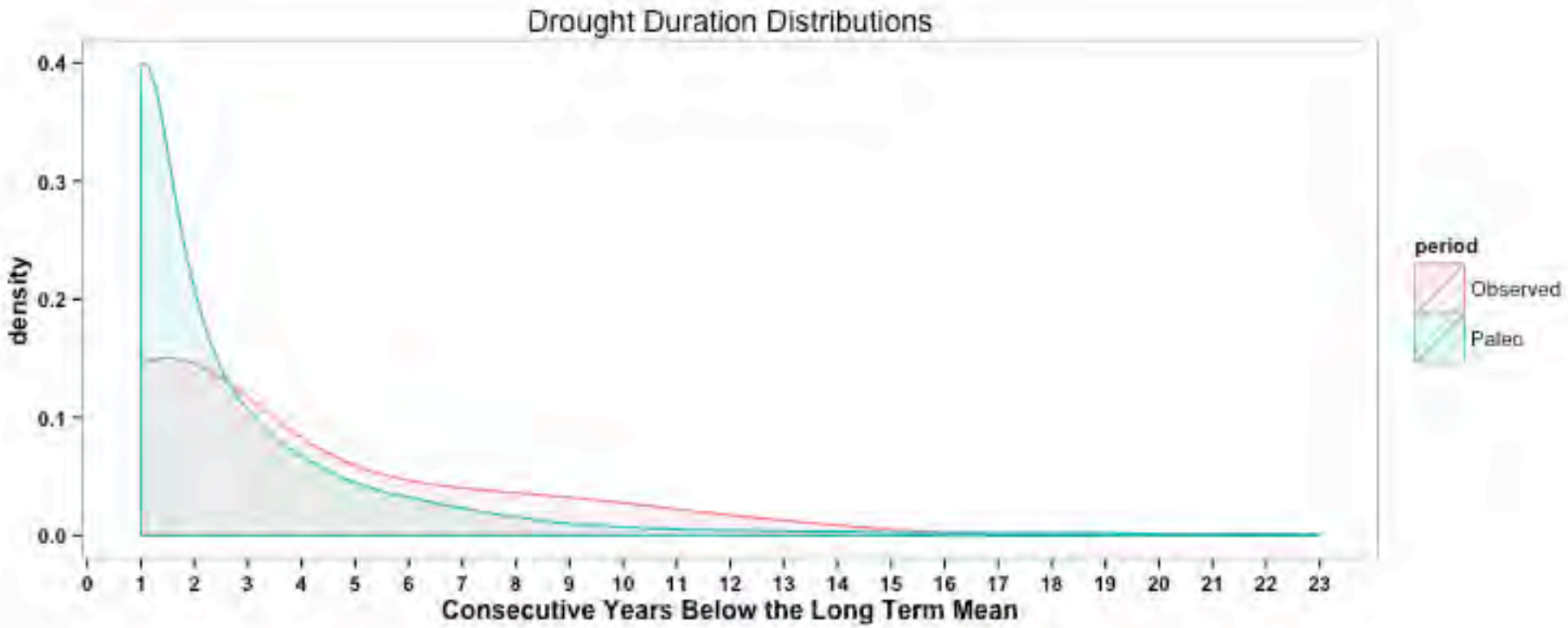


Preliminary Results - Pluvials



Preliminary Results



Integrating paleo-reconstructions into a basin study

- Statistical disaggregation of annual flows to daily flows

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- Routing of paleo flow data through RiverWare model

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- Testing of current flow management operations by State and Federal Water Managers

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- Outcomes used to draft the BOR's upper basin Impacts Assessment (End of year) and Basin Study (Next September).

- Publication of upper Missouri streamflow reconstructions

Thank You