

Stream Temperature Databases for the Lower Snake Hydrologic Region in the Northwest US

Compiled for use with spatial statistical stream models as part of an NCEAS Workshop, April 4-8, 2011

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U.S. Forest Service

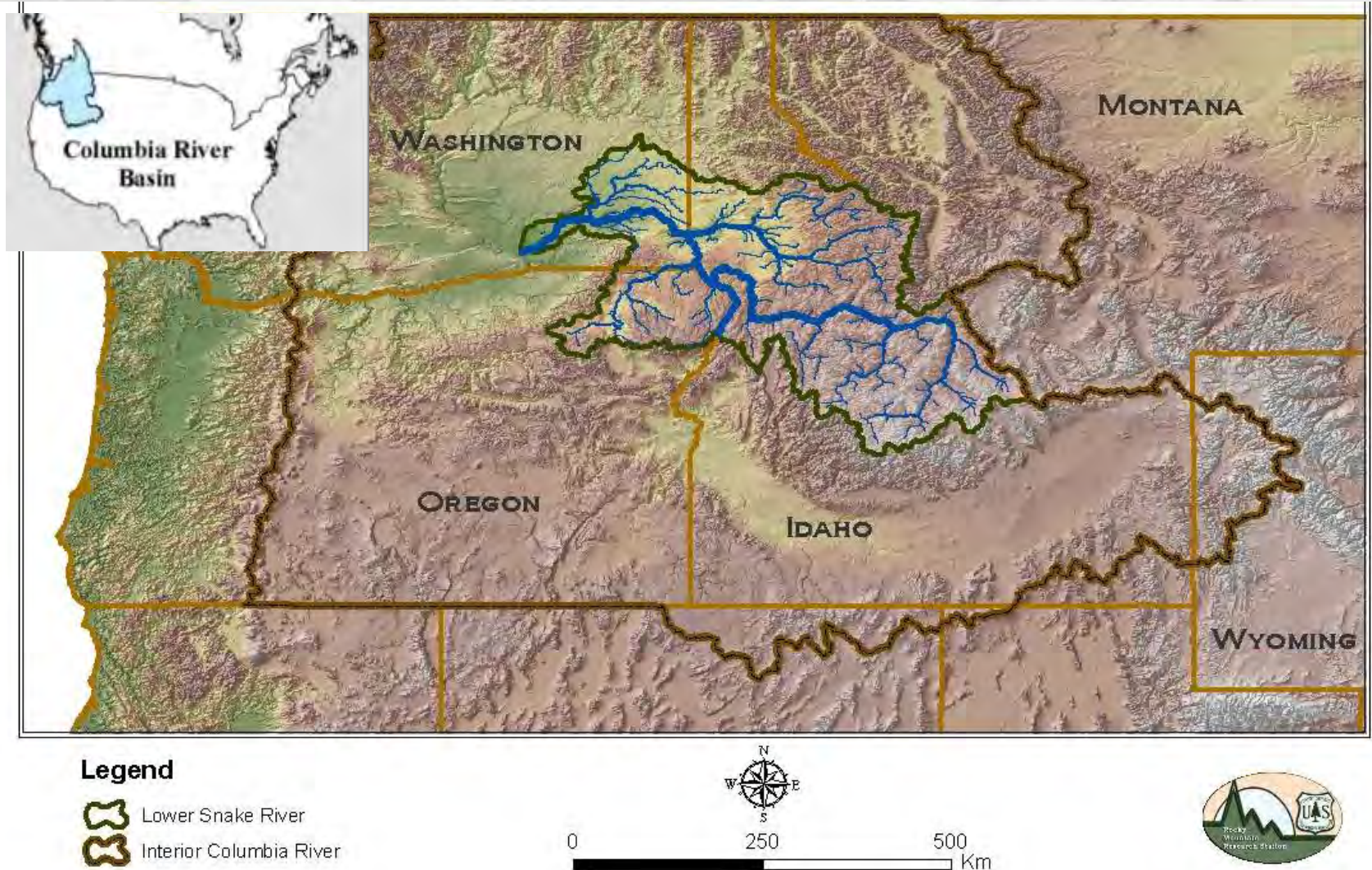
¹CSIRO

²UAF

Our heroines...



Columbia River Basin & Lower Snake Hydrologic Region



Lower Snake Hydrologic Region

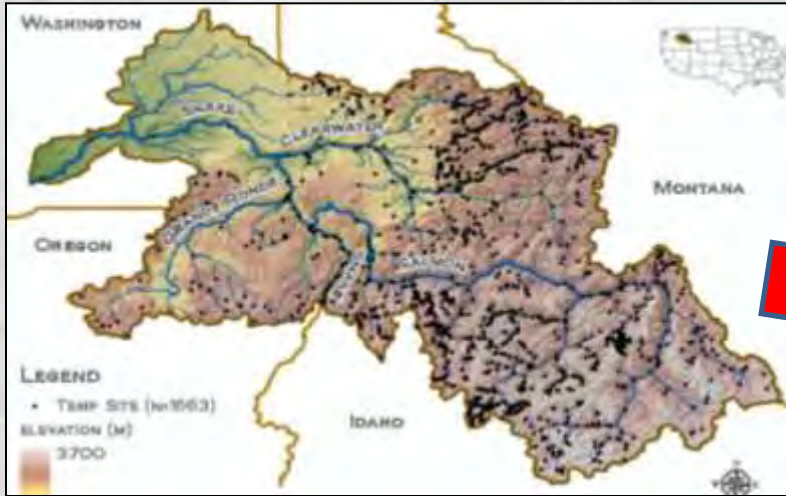
Physical Environment

- 90,000 km² in three states
- Diverse, complex topography (150 - 4,000 m)
- Forested wilderness to lowland desert
- Precipitation (20 - 200 cm/yr)
- Snowmelt hydrologies
- Three primary river basins (Salmon R = 660 km)
- Sparse human populations
- Public land ownership - USFS (~67%), BLM (~13%), private (~20%)



Creating the Stream Temperature Database

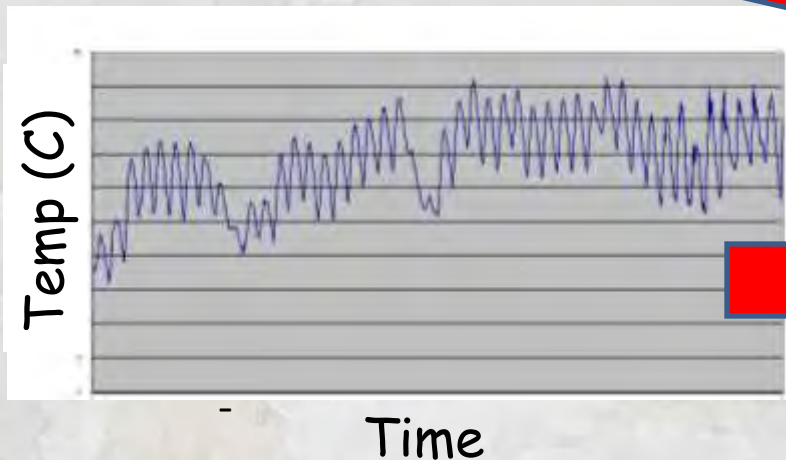
Interagency Data Request



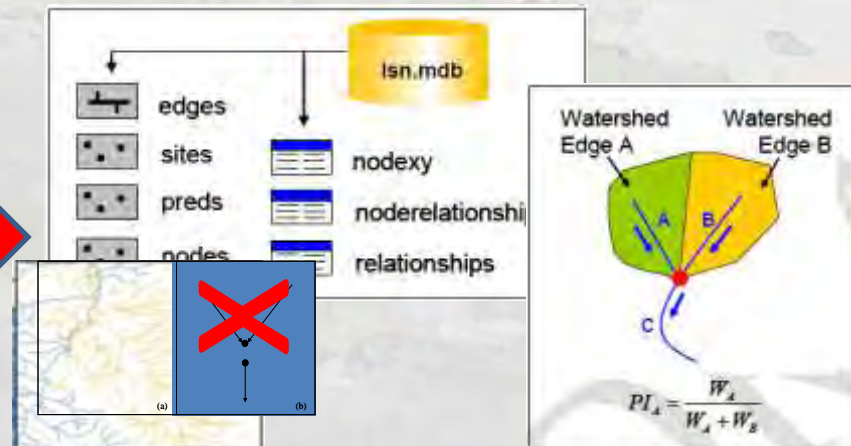
Access/SAS Database

	A	B	C
1			
2	Stream: Elk Creek		
3	Georeference: 610234 E, 4402546 W		
4			
5	Date	Time	Temp (*C)
6	7/15/2005	21:23	15.59
7	7/15/2005	21:53	15.11
8	7/15/2005	22:23	14.64
9	7/15/2005	22:53	14.32
10	7/15/2005	23:23	13.86
11	7/15/2005	23:53	13.55
12	7/16/2005	0:23	13.24

QA/QC

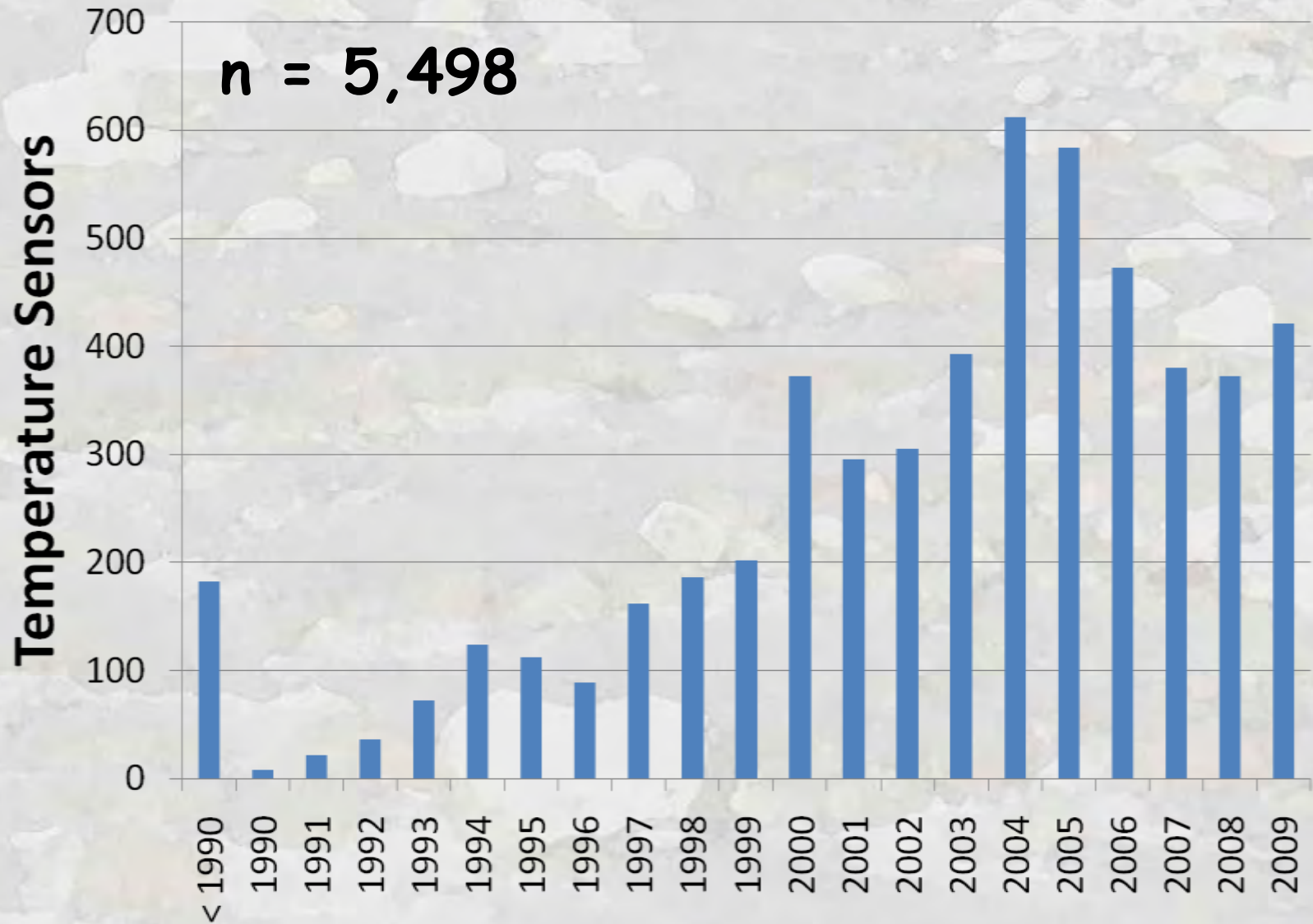


Processing in NHD+, STARS & FLoWS

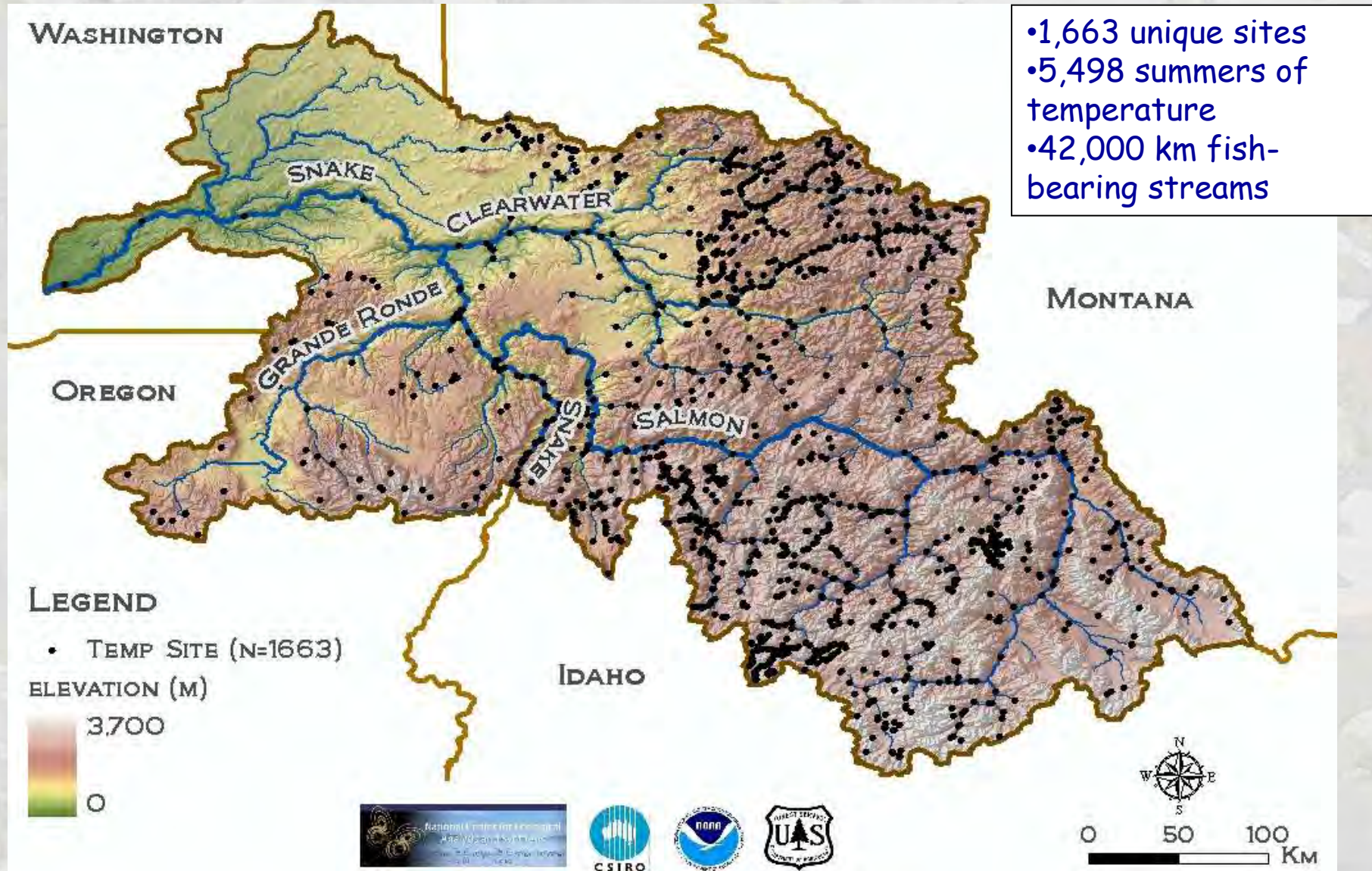


Lower Snake Stream

Temperature Database Sequence

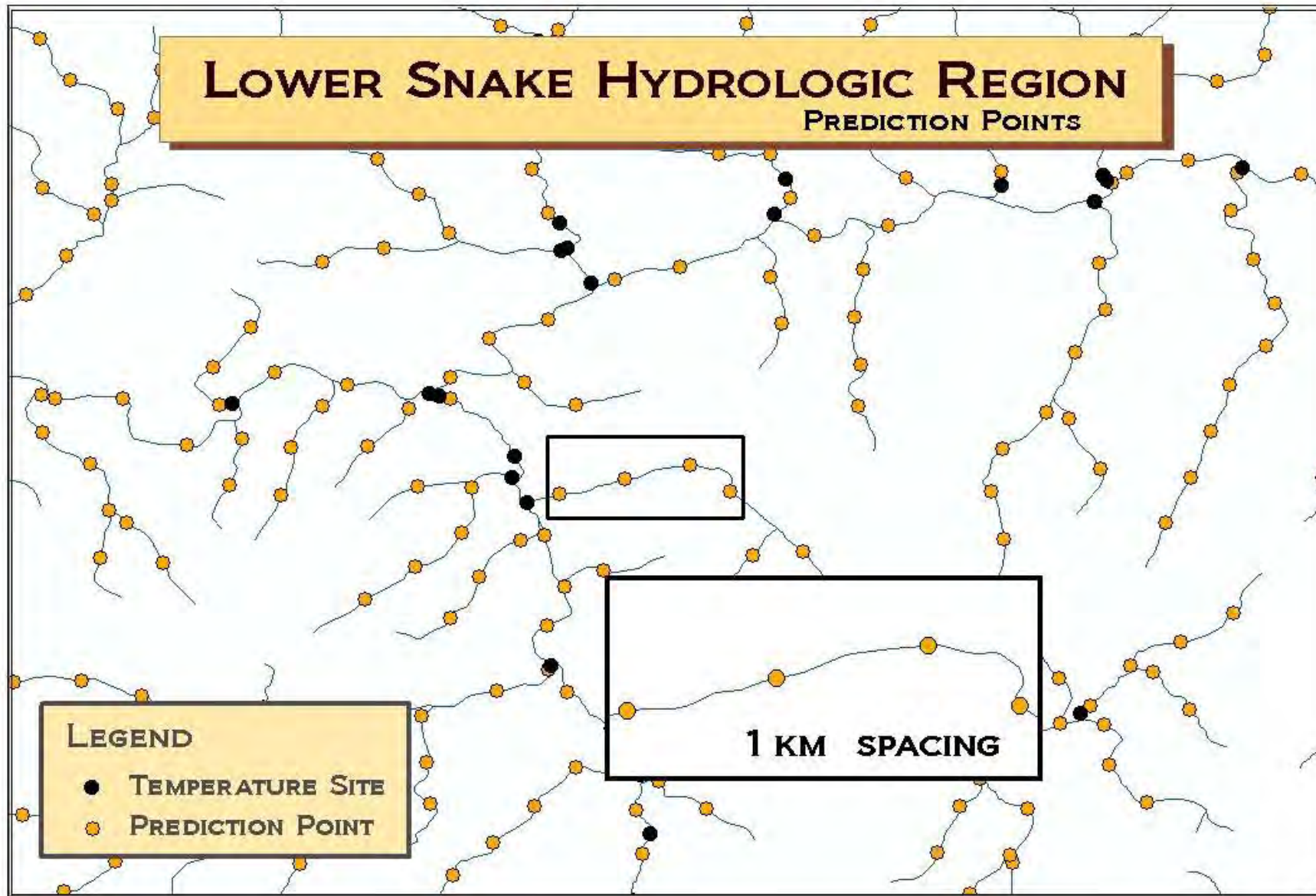


Database 1: Lower Snake Stream Temperature



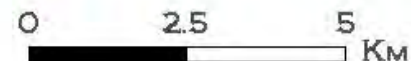
LOWER SNAKE HYDROLOGIC REGION

PREDICTION POINTS

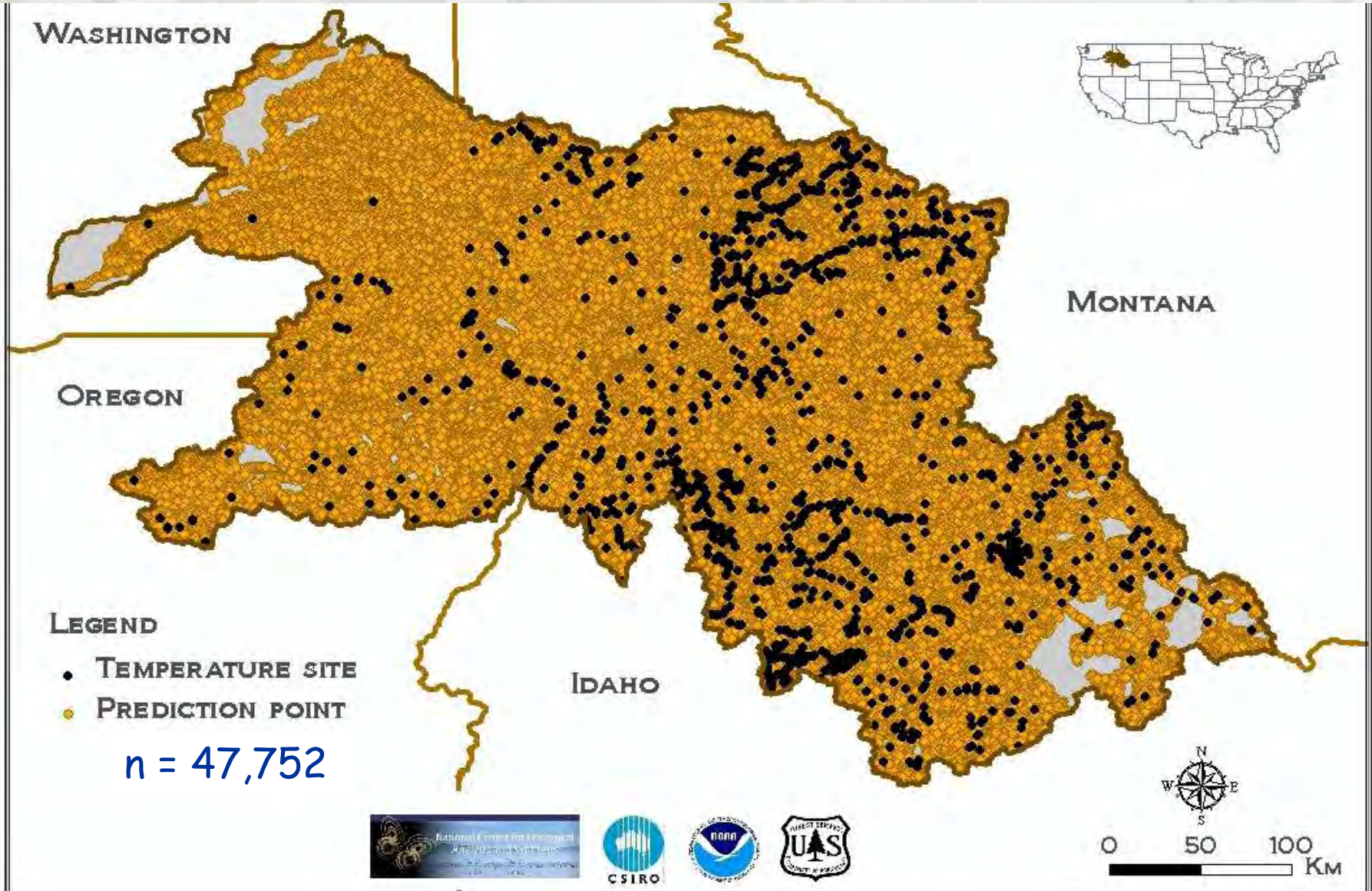


LEGEND

- TEMPERATURE SITE
- PREDICTION POINT

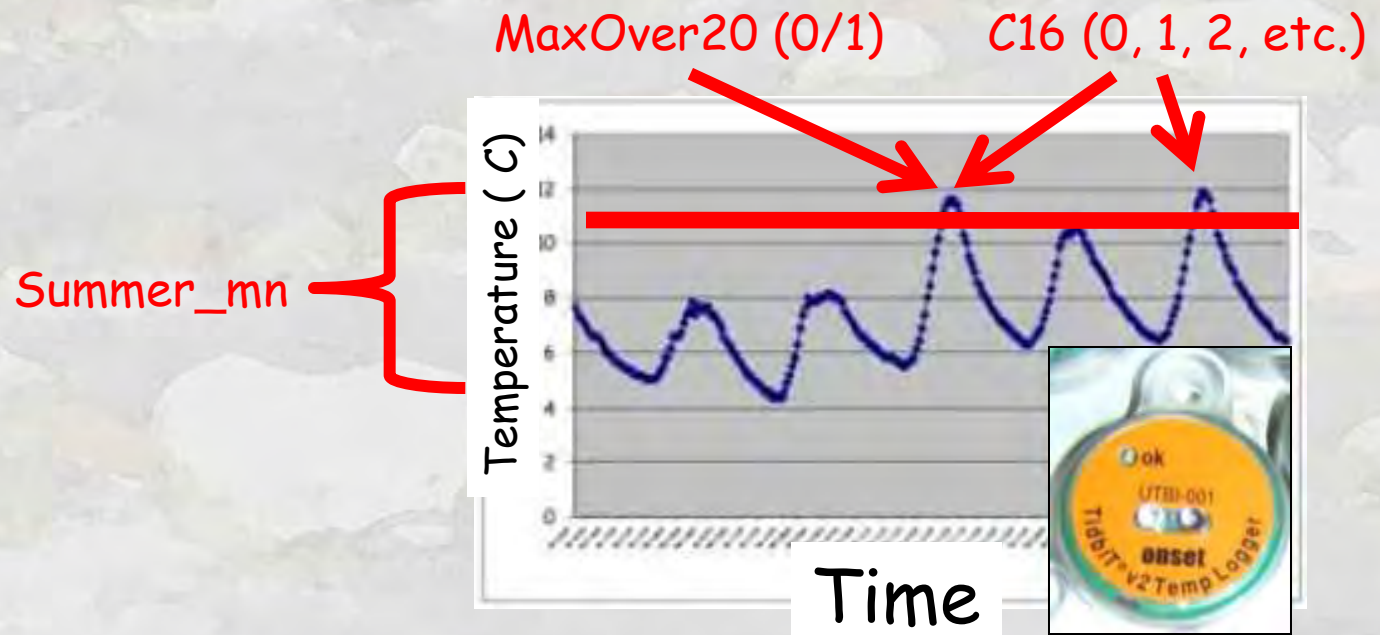


Stream Temperature Model Prediction Points



Stream Temperature Response Metrics

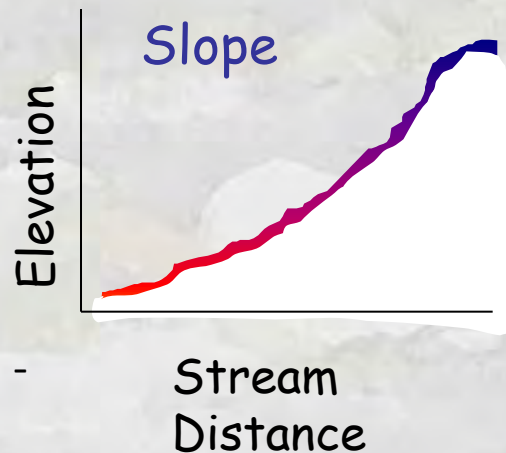
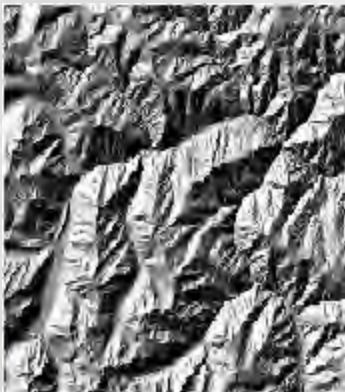
Metric	Variable Type	Definition
1. Summer_mn	Continuous	Mean temperature for a 45 day summer period (July 15 - Aug 31)
2. MaxOver20	Binary	Whether the 20 °C threshold is exceeded at a site during a 45 day summer period
3. C16	Count	Number of days during a 45 day summer period when the daily maximum temperature exceeds > 16 °C
4. C20	Count	Number of days during a 45 day summer period when the daily maximum temperature exceeds > 20 °C
5. C24	Count	Number of days during a 45 day summer period when the daily maximum temperature exceeds > 24 °C



NHD+/Geomorphic Predictor Variables

<i>Predictor</i>	<i>Source</i>	<i>Definition</i>
MAXELEVSMO (m)	NDH+	Elevation of the upper stream segment node (1:100,000-scale) on which a temperature sensor was located
ELEV_DEM (m)		Elevation at stream sensor site derived from a 30-m DEM. Redundant with MAXELEVSMO (m) but provides unique elevations for sensors located on the same segment or far downstream of upper segment node
SLOPE (m / m)	NHD+	Slope of the 1:100,000-scale stream segment on which a temperature sensor was located
CUMDRAINAG (km ²)	NHD+	Cumulative drainage area of the watershed upstream from the stream segment on which a temperature sensor was located
AREAWTMAP	NHD+	Area weighted mean annual precipitation for the watershed upstream from the stream segment on which a temperature sensor was located

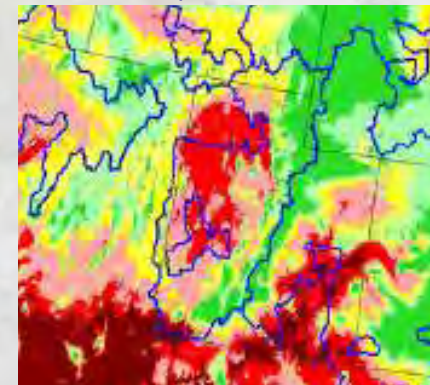
Elevation



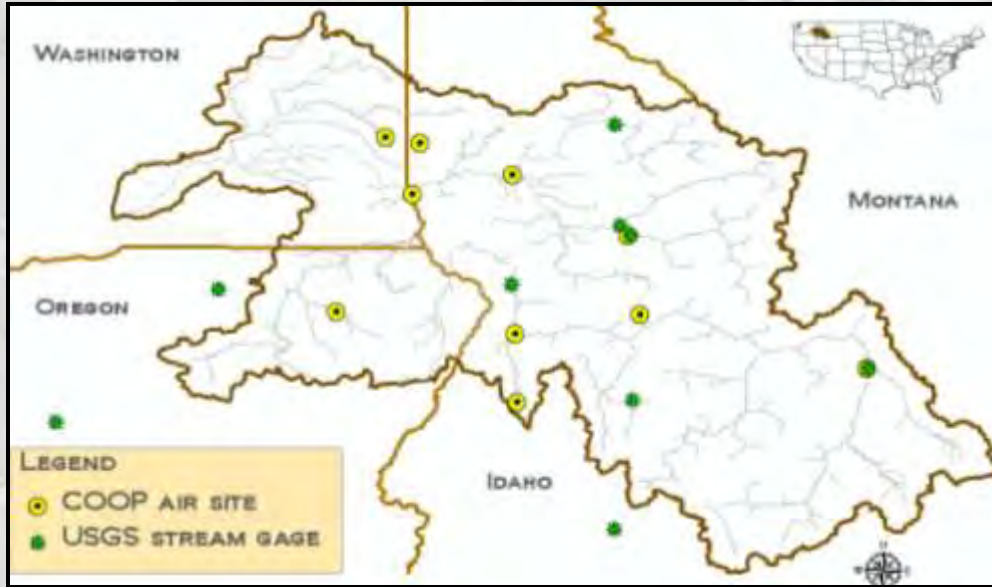
Drainage Area



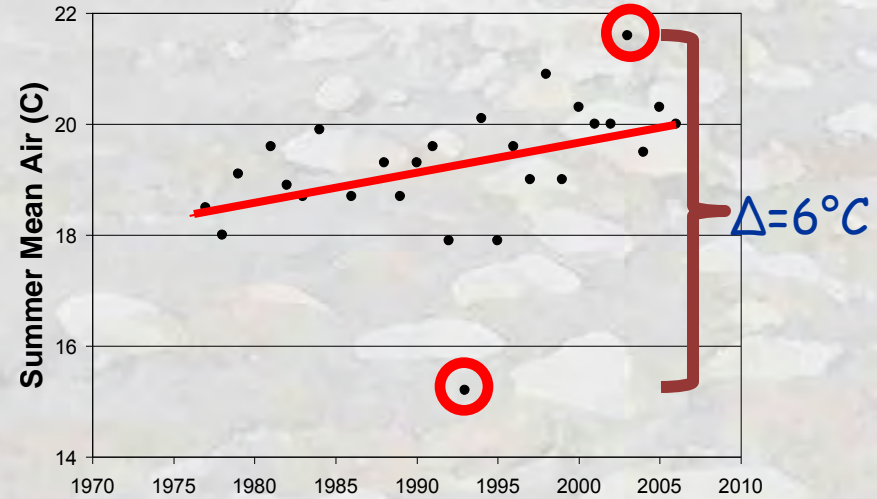
Precipitation



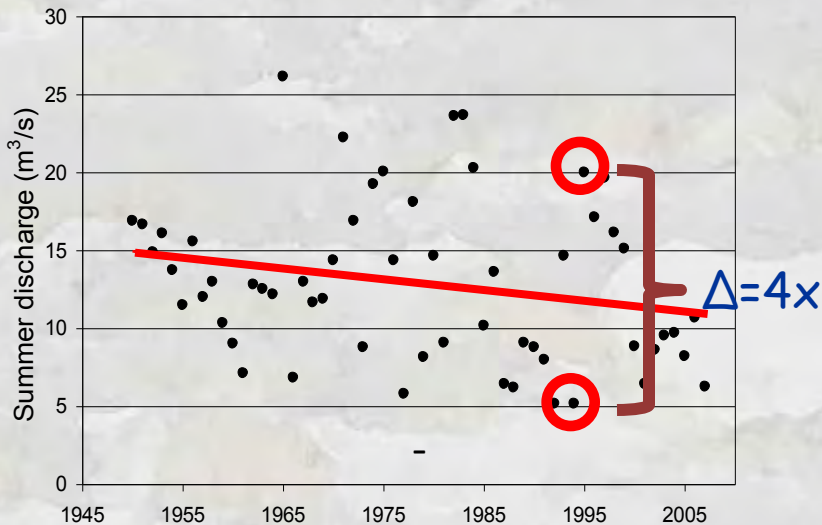
Climate Variable Predictor Summaries



Summer Air Temps = NOAA COOP

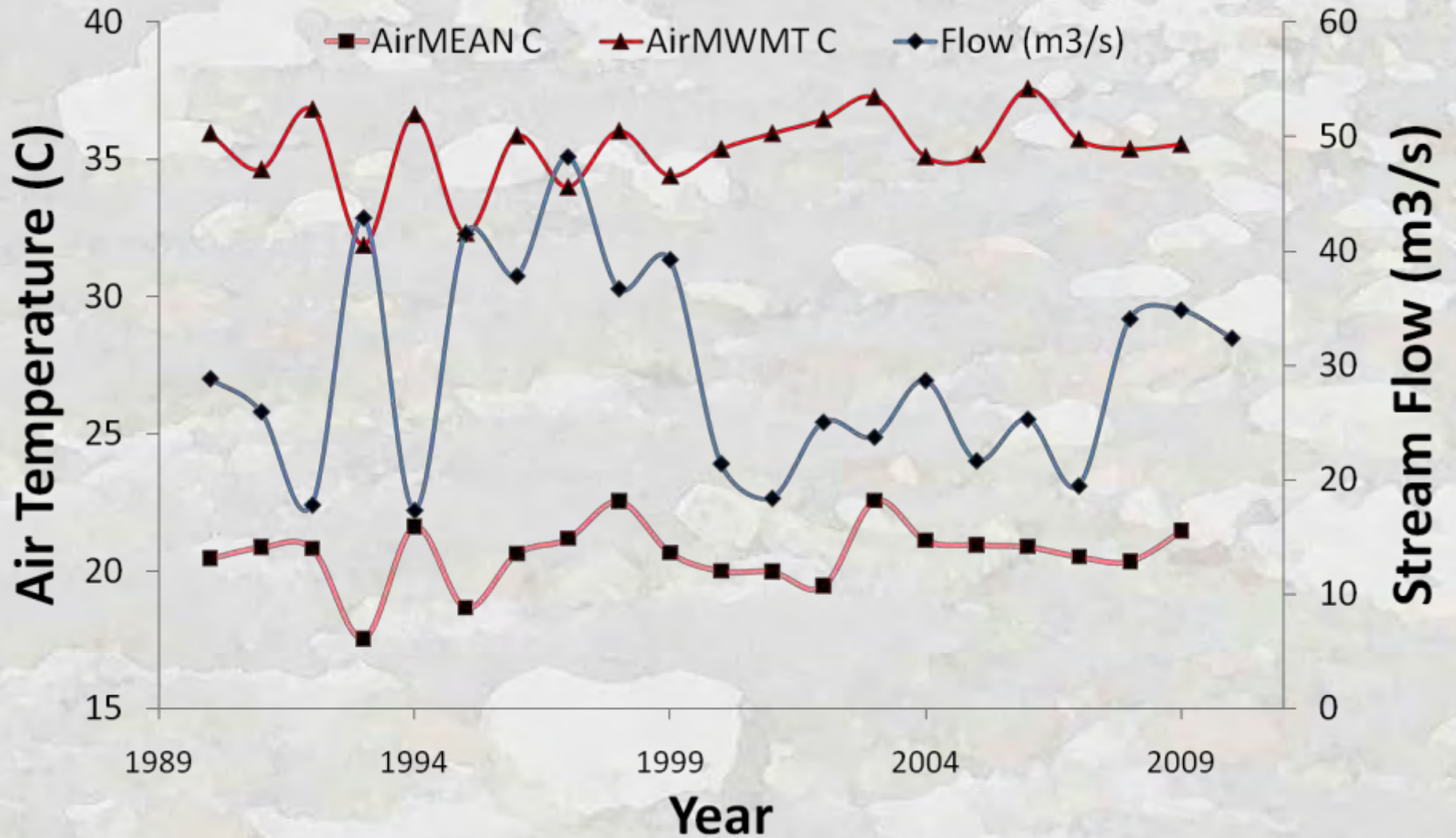


Summer Stream Flow = USGS gages



Regional Climate Composites (1990-2010)

Summer Period (July 16 - Aug 31)

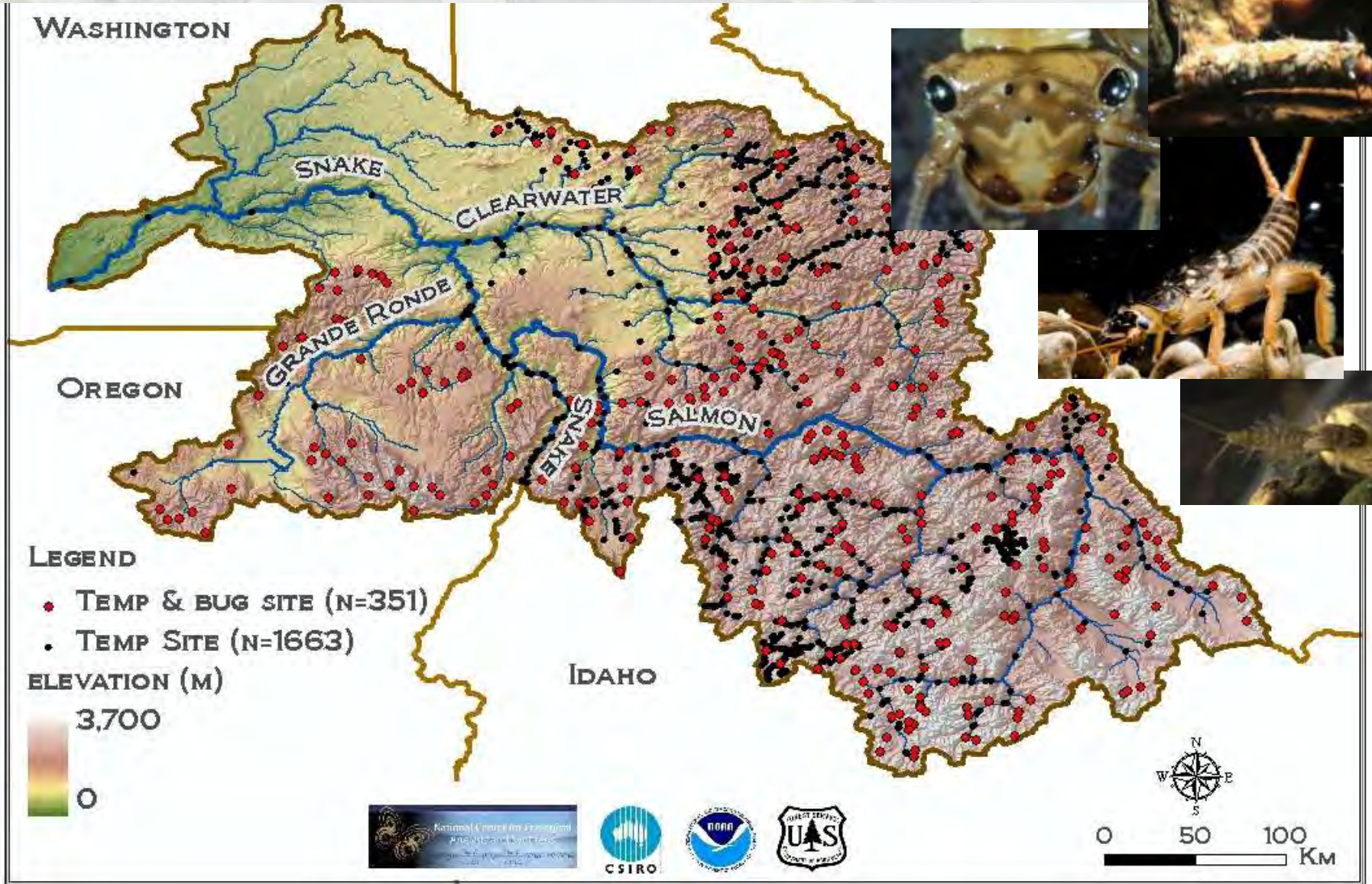


Variable Summary Metrics

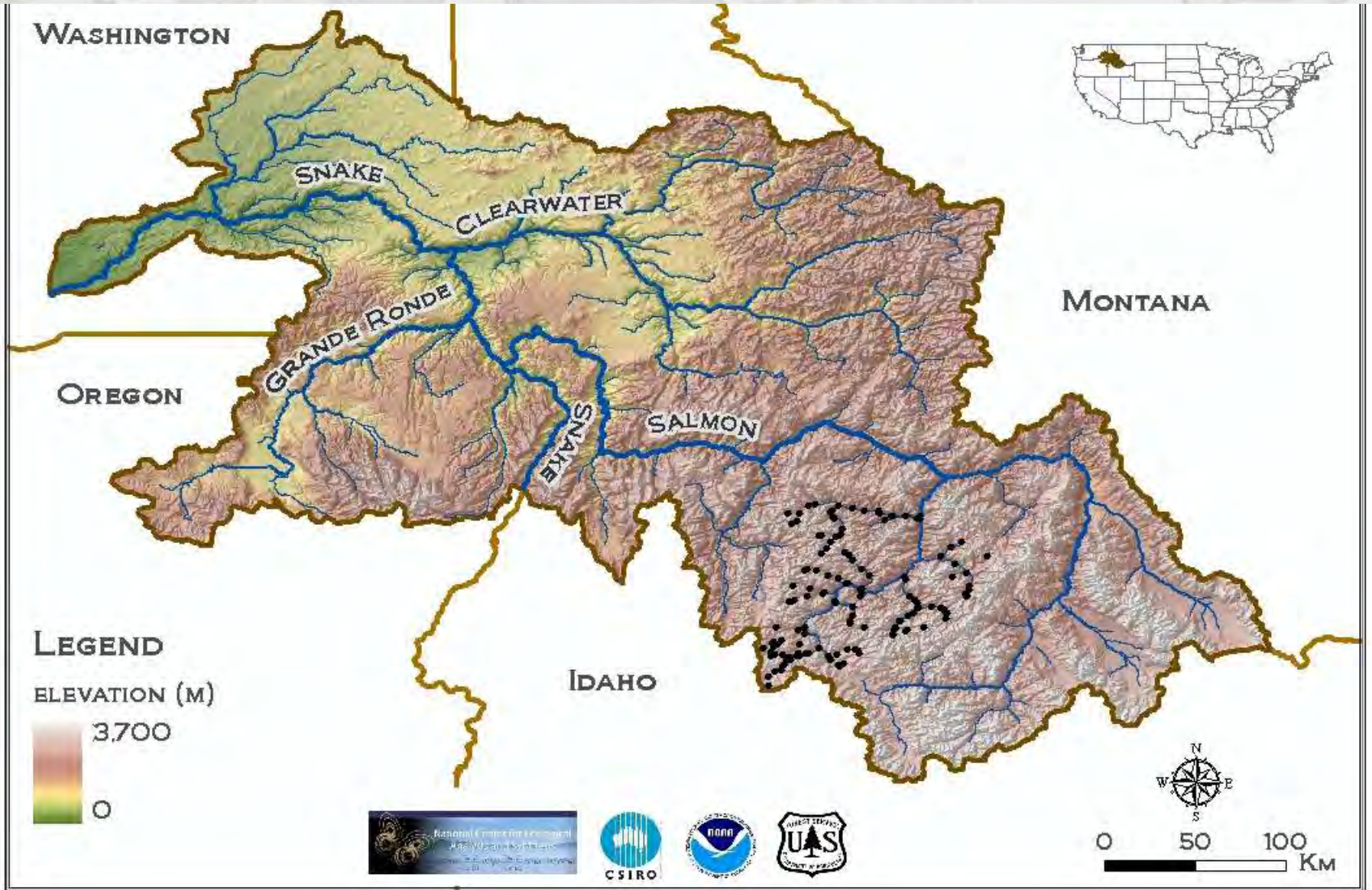
<i>Variable</i>	<i>n</i>	<i>Mean</i>	<i>Median</i>	<i>SD</i>	<i>Minimum</i>	<i>Maximum</i>
MAXELEVSMO (m)	1,663	1,314	1,291	505	134	2,714
ELEV_DEM (m)	1,663	1,156	1,076	496	105	2,441
SLOPE (m/m)	1,663	0.057	0.038	0.060	0.000	0.400
CUMDRAINAG (km ²)	1,663	6,208	26	32,516	1	247,722
AREAWTMAP	1,663	1,203	1,205	330	333	2,124
FlowCMS (m ³ /s)	21	27.7	25.3	7.8	17.3	50.0
AirMEAN (C)	21	20.8	20.9	0.9	17.5	22.6
AirMWMT (C)	21	35.7	35.5	1.1	31.9	37.6
Summer_mn (C)	5,498	12.7	12.2	3.1	3.0	26.1
MaxOver20 (0/1)	5,498	0	0	0	0	1
C16 (#)	5,498	17	10	19	0	48
C20 (#)	5,498	5	0	12	0	48
C24 (#)	5,498	1	0	4	0	48

Database 2: Aquatic Macro-Invertebrates

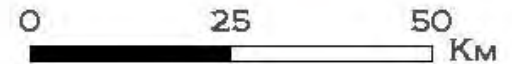
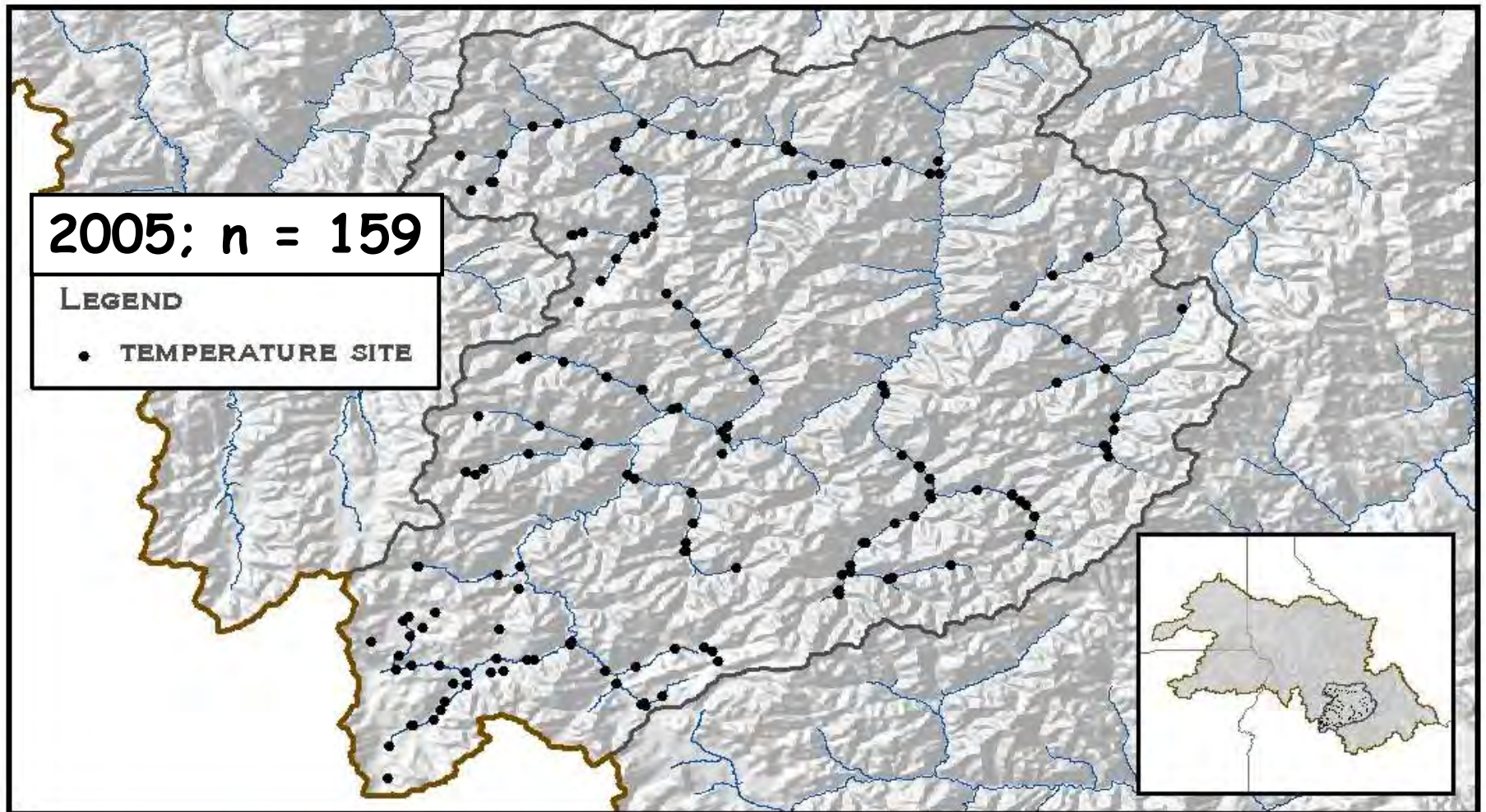
Most Sites Sampled Twice (5-year intervals starting in 2001)



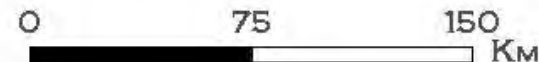
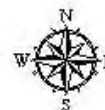
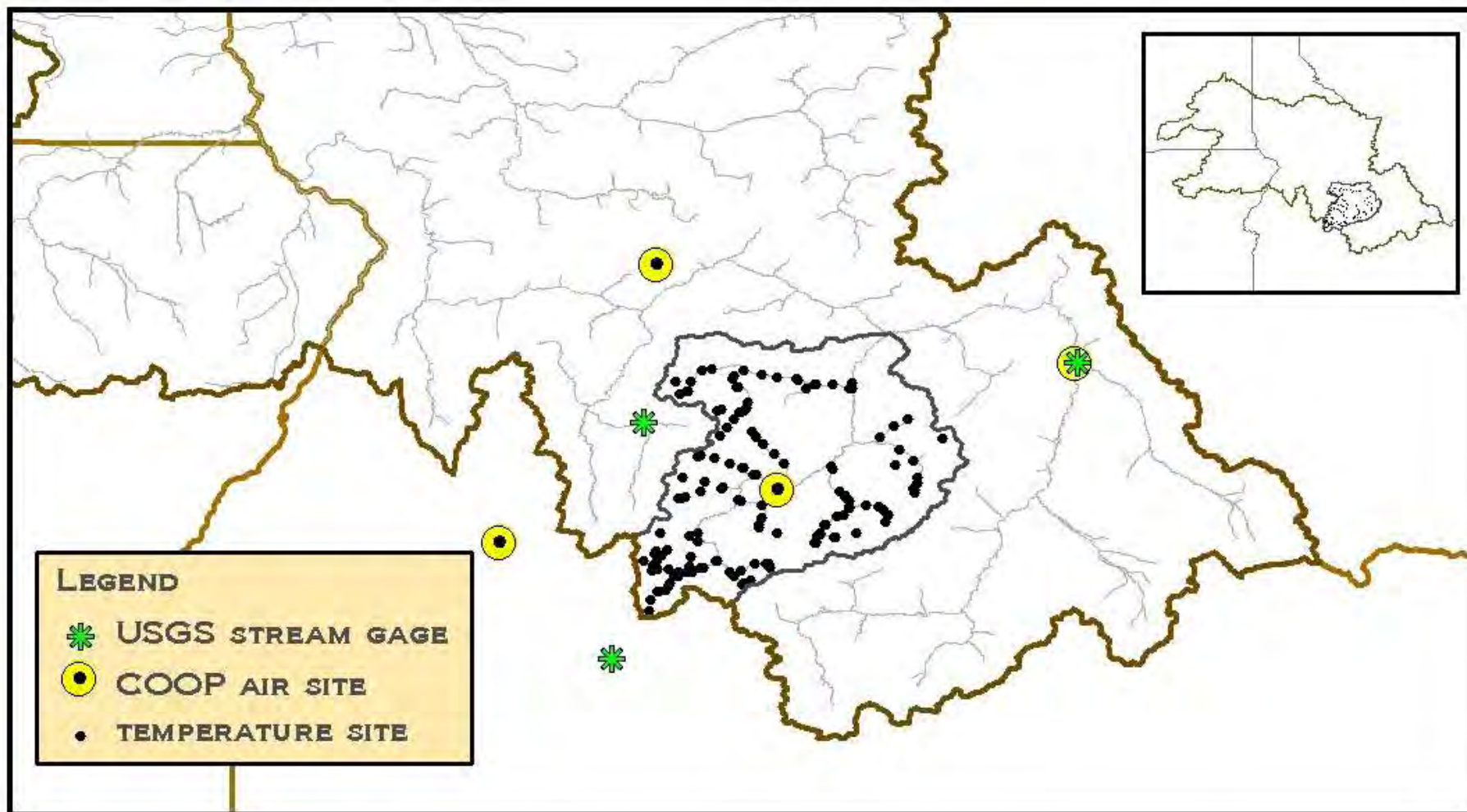
Database 3: Middle Fork Salmon R. Space-Time



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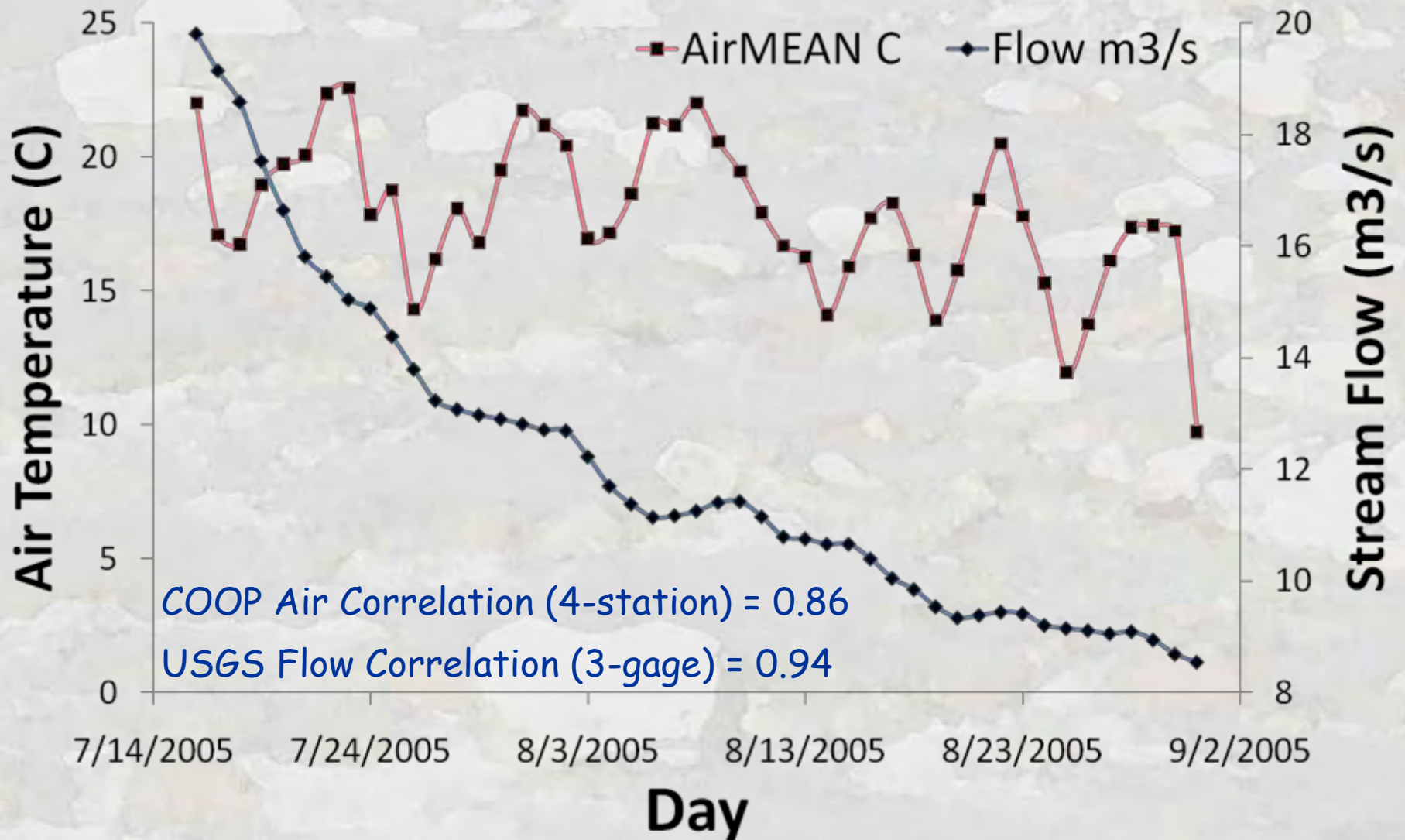


Database 3: Stations for Daily Climate Data



MFK Salmon Climate Composites

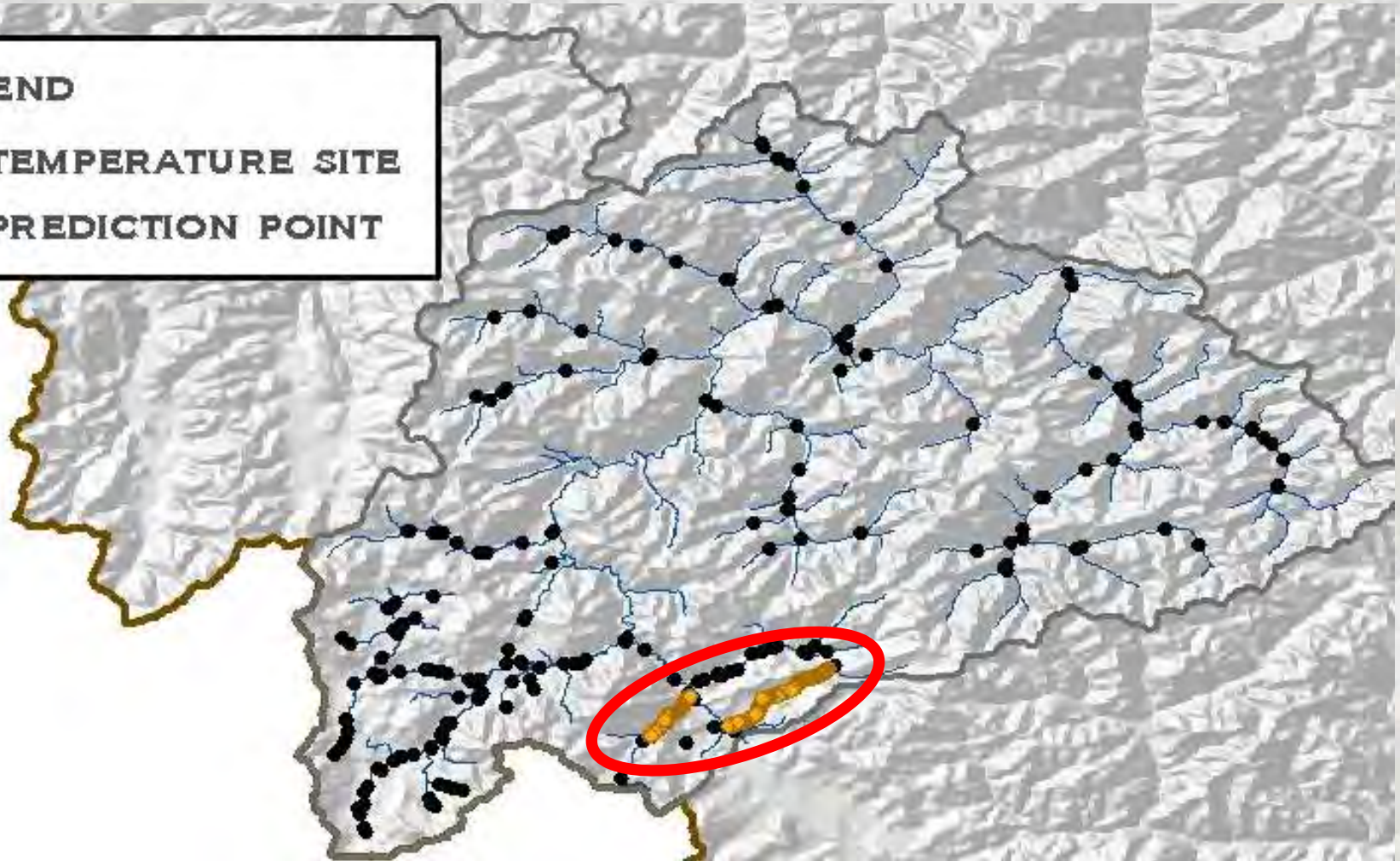
2005 Daily Averages (July 16 - Aug 31)



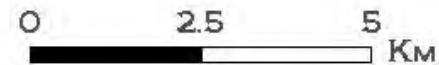
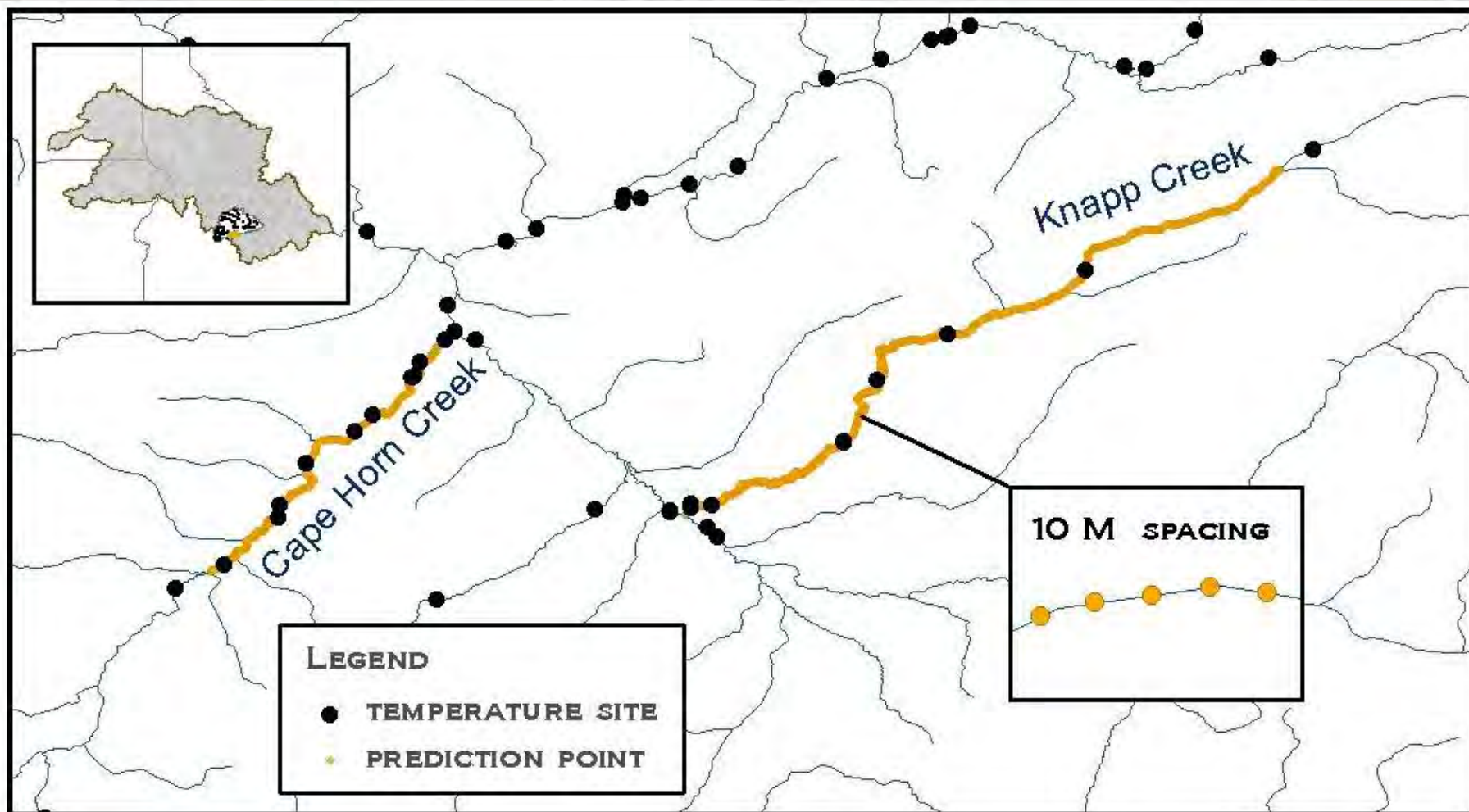
Database 4: Block Krigge Streams

LEGEND

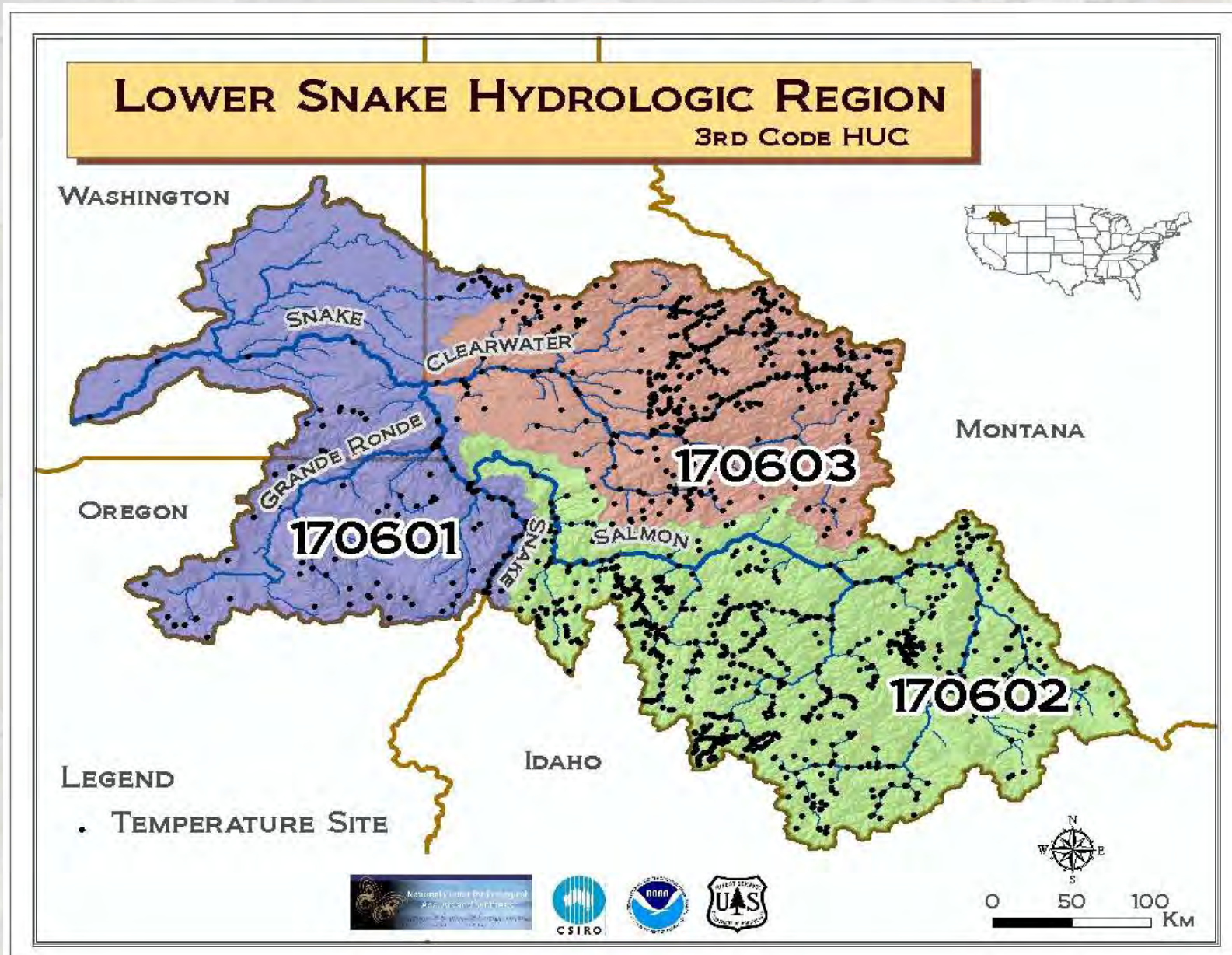
- TEMPERATURE SITE
- PREDICTION POINT



Database 4: Block Krigge Streams



Database can be subset by hydrologic codes



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