Measurements to Metrics to Models

CHaMP Camp 2015

Cove, Oregon – June 1st, 2015

Presenter:
Boyd Bouwes

WATERSHED SOLUTIONS INC

BONNEVILLE POWER ADMINISTRATION

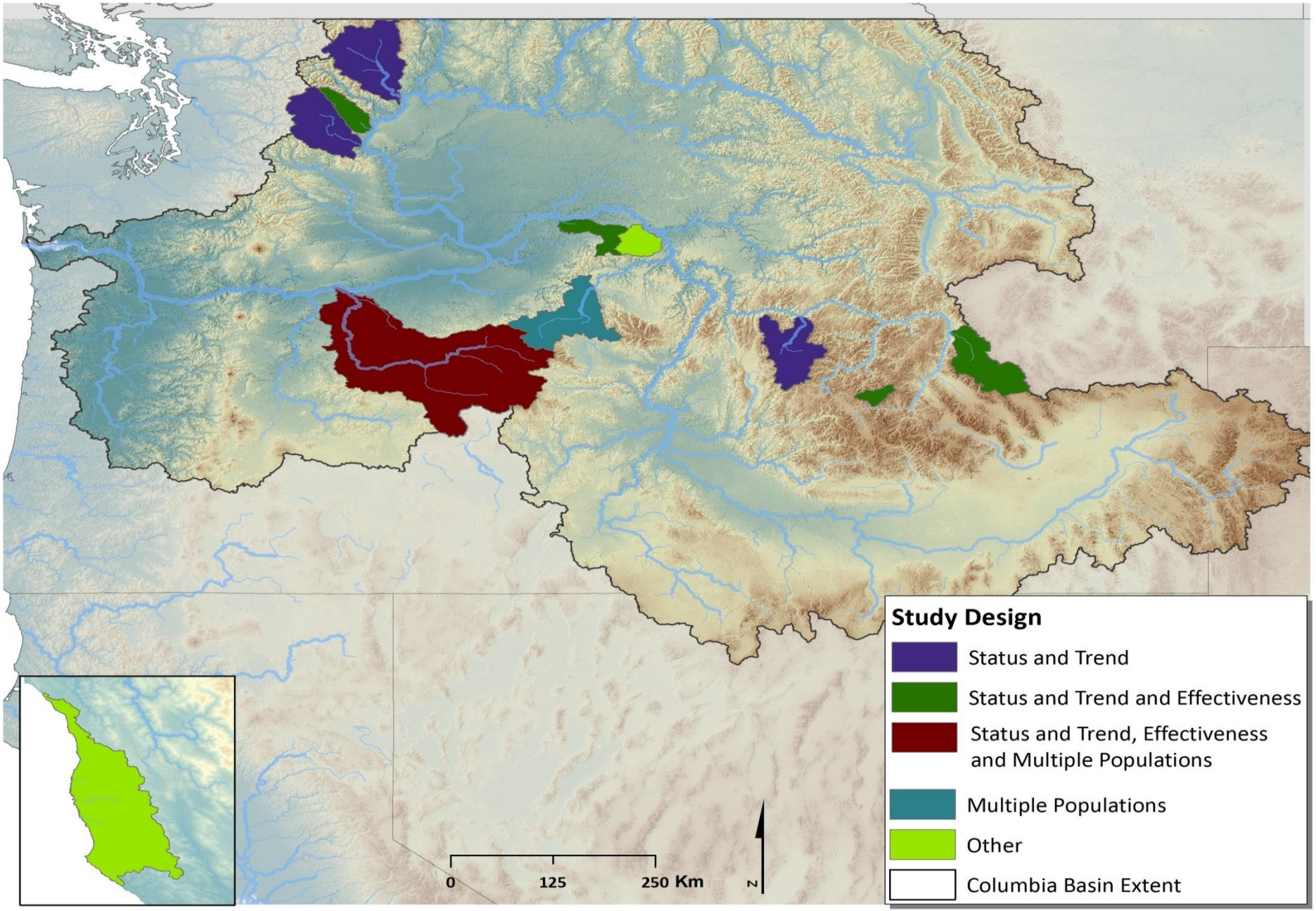
ISEMP

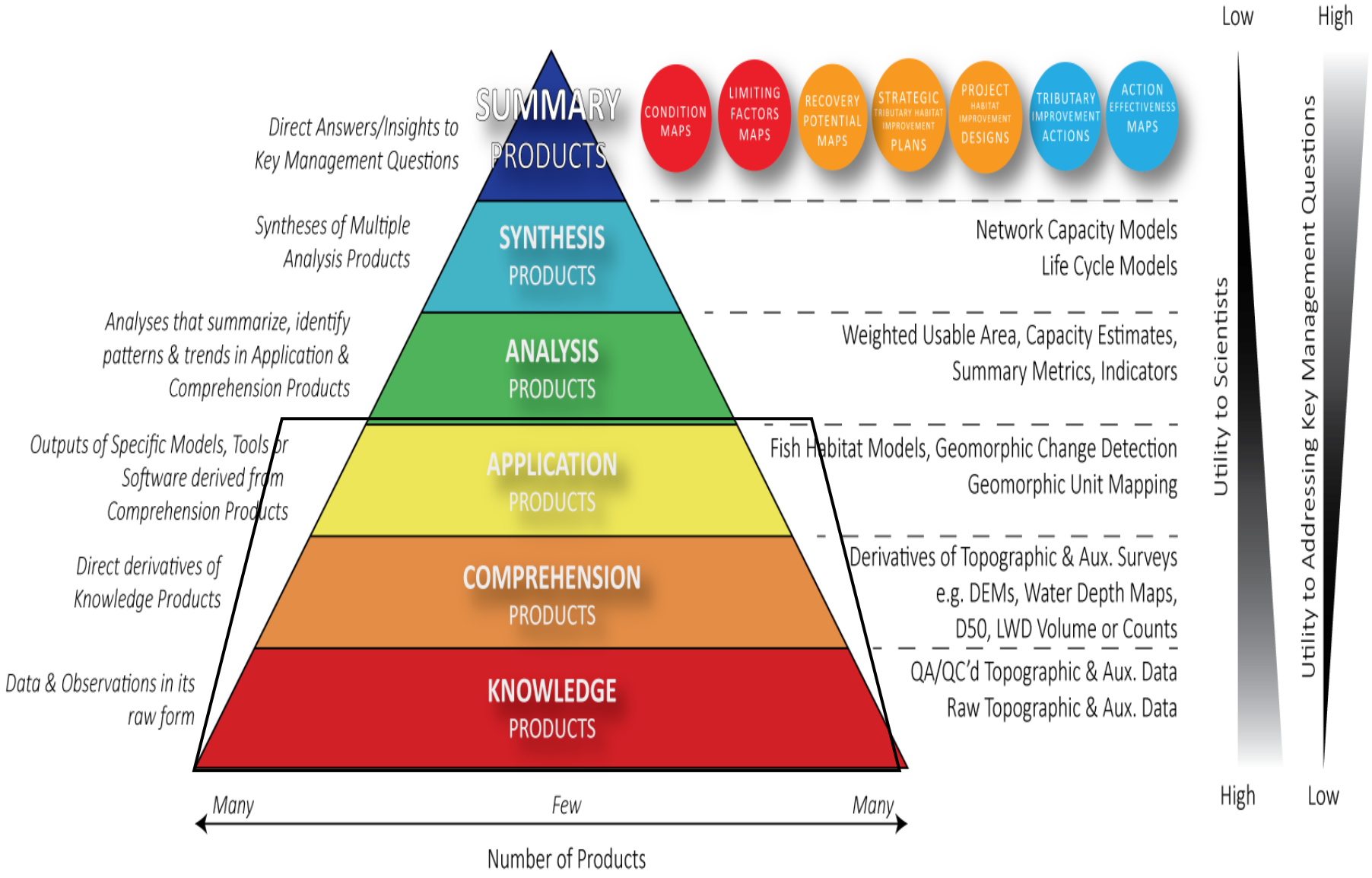
CHaMP

CHaMP Field Season 2014

Lots and lots and lots of data

- 22 Crews
- 124 Hitches
- 503 Surveys
- 393 files per survey
- 197,847 files validated and uploaded


Study Design
Status and Trend
Status and Trend and Effectiveness
Status and Trend, Effectiveness and Multiple Populations
Multiple Populations
Other
Columbia Basin Extent
0
125
250 Km
N


EXAMPLES OF PRODUCTS
Low
High
SUMMARY PRODUCTS
CONDITION MAPS
LIMITING FACTORS MAPS
RECOVERY POTENTIAL MAPS
STRATEGIC TRIBUTARY HABITAT IMPROVEMENT PLANS
PROJECT HABITAT IMPROVEMENT DESIGNS
TRIBUTARY IMPROVEMENT ACTIONS
ACTION EFFECTIVENESS MAPS
Direct Answers/Insights to Key Management Questions
SYNTHESIS PRODUCTS
Syntheses of Multiple Analysis Products
Network Capacity Models
Life Cycle Models
ANALYSIS PRODUCTS
Analyses that summarize, identify patterns & trends in Application & Comprehension Products
Weighted Usable Area, Capacity Estimates, Summary Metrics, Indicators
APPLICATION PRODUCTS
Outputs of Specific Models, Tools or Software derived from Comprehension Products
Fish Habitat Models, Geomorphic Change Detection
Geomorphic Unit Mapping
COMPREHENSION PRODUCTS
Direct derivatives of Knowledge Products
Derivatives of Topographic & Aux. Surveys
e.g. DEMs, Water Depth Maps, D50, LWD Volume or Counts
KNOWLEDGE PRODUCTS
Data & Observations in its raw form
QA/QC'd Topographic & Aux. Data
Raw Topographic & Aux. Data
Utility to Scientists
Utility to Addressing Key Management Questions
High
Low
Many
Few
Many
Number of Products

Measurements are the 'fine scale' descriptions of the physical, chemical, hydrologic, geomorphic, biological characteristics of a stream, usually taken at a reach or habitat unit scale.

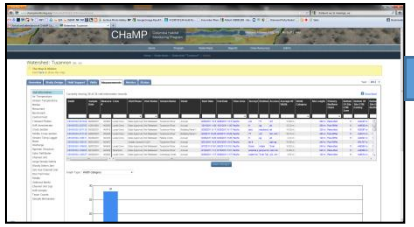
How Does CHaMP Measure Sticks and Stones?

Auxiliary Data Workflow

iPad

Total Station

Data Broker/QC
GIS



Website Upload/QC

Logger Data Transferred Through Broker

Channel Units
Side Channels
Fish Cover
Ocular
Substrate
Pool Tail Fines
LWD
Pebbles
Embeddedness

Riparian
Discharge
Water Chemistry
Drift
Air Temperature
Stream Temperature

QA/QC

Sources of Crew Variability
We can control

=

?

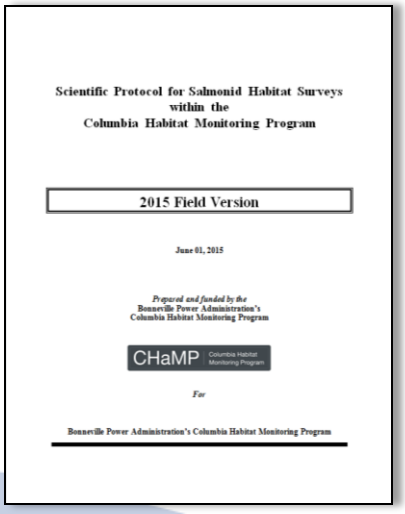
- Protocol?
- Training?
- Protocol Implementation Drift?
- Equipment ?

Data Quality

Clean, Repeatable, and Efficient Data Capture

Training

Field Protocol



Scientific Protocol for Salmonid Habitat Surveys within the Columbia Habitat Monitoring Program

2015 Field Version

June 01, 2015

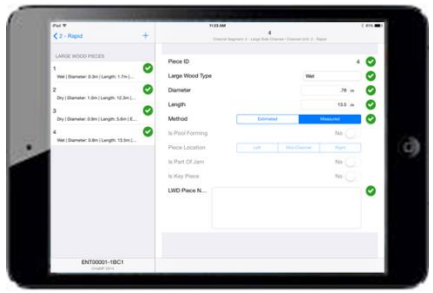
Prepared and funded by the
Bonneville Power Administration's
Columbia Habitat Monitoring Program

CHaMP Columbia Habitat Monitoring Program

For

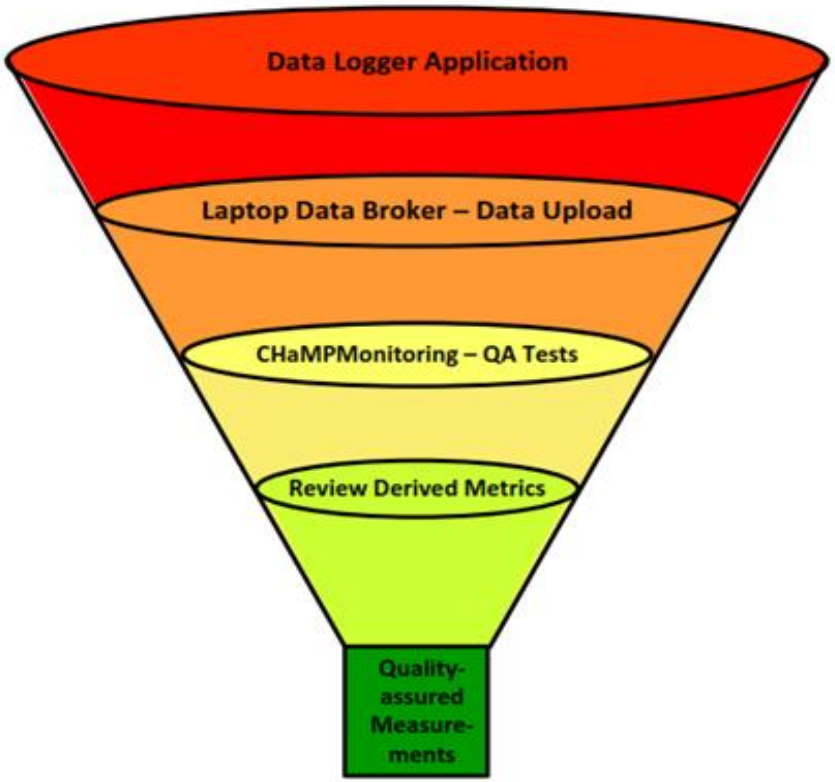
Bonneville Power Administration's Columbia Habitat Monitoring Program

Data Capture



Data Quality Checks

CHaMP Data Quality



Data Logger Application (quality control)
- Required values are non-null
- Numeric values are within range

Data Broker Application (quality control)
- Format and schema of files
- Completeness of all components

CHaMPMonitoring.org (quality assurance)
- Review number of records
- Review outliers (graphical)
- Sanity check (graphical)

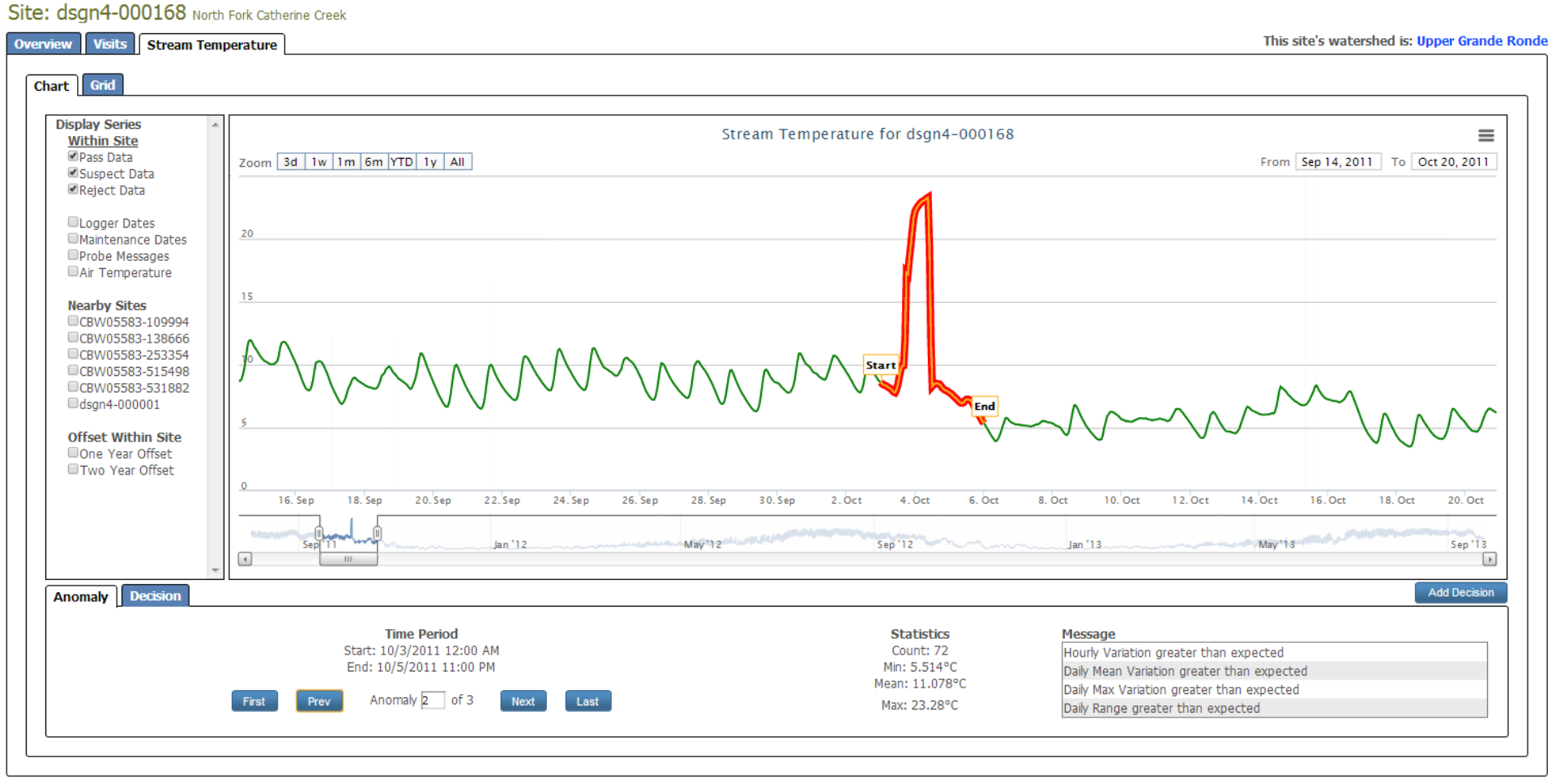
CHaMPMonitoring.org (quality assurance)
- Review of derived metrics (graphical)

CHaMP | Columbia Habitat Monitoring Program

Log In | Help

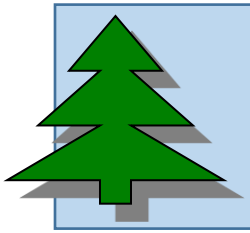
CHaMPMonitoring.org

Quality Assurance Review



CHaMP 2014
Data Quality Assurance Process

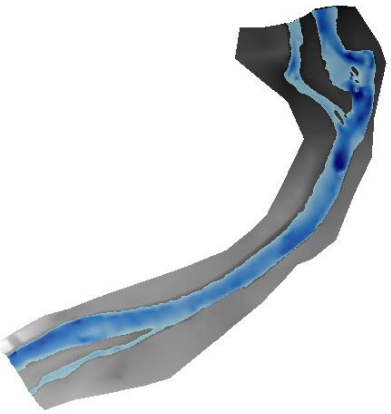
July **October** **November** **December** **March 2015**

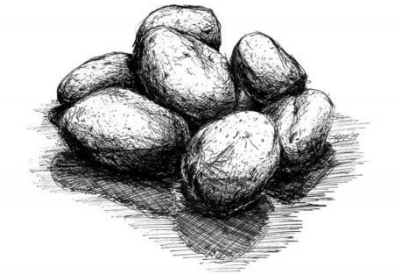


FIELD OFFICE: Champmonitoring.org and GIS

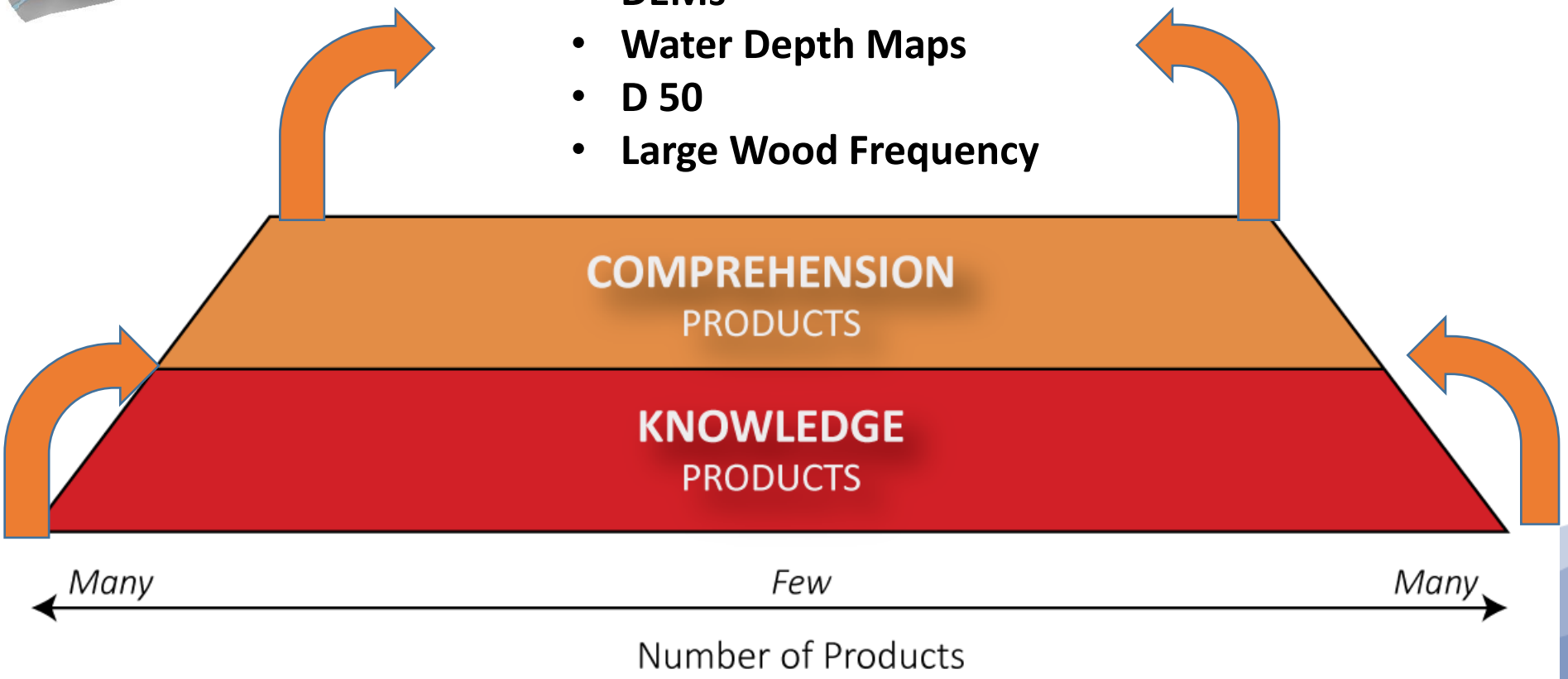
Data logger Checks Total Station checks CHaMP Toolbar Topo checks	Data upload to cm.org	Measurement data review -aux -temperature Topo data review and repair	Metric review and visit promotion	Central cm.org QA review	Metric Release

Derivative Metrics from Topographic Surveys and Aux. Data





- **DEMs**
- **Water Depth Maps**
- **D 50**
- **Large Wood Frequency**



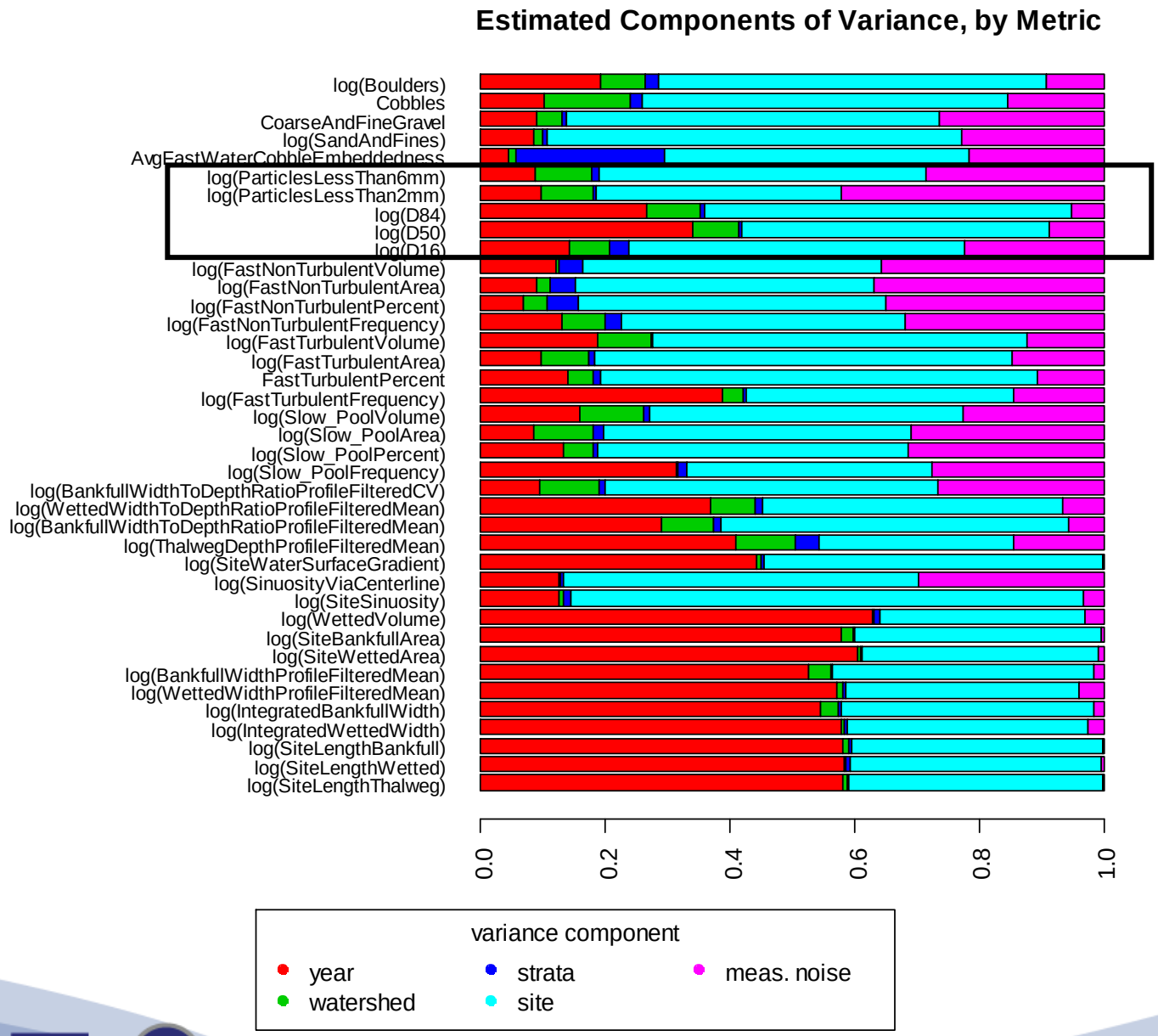
CHaMP Metric Assessment

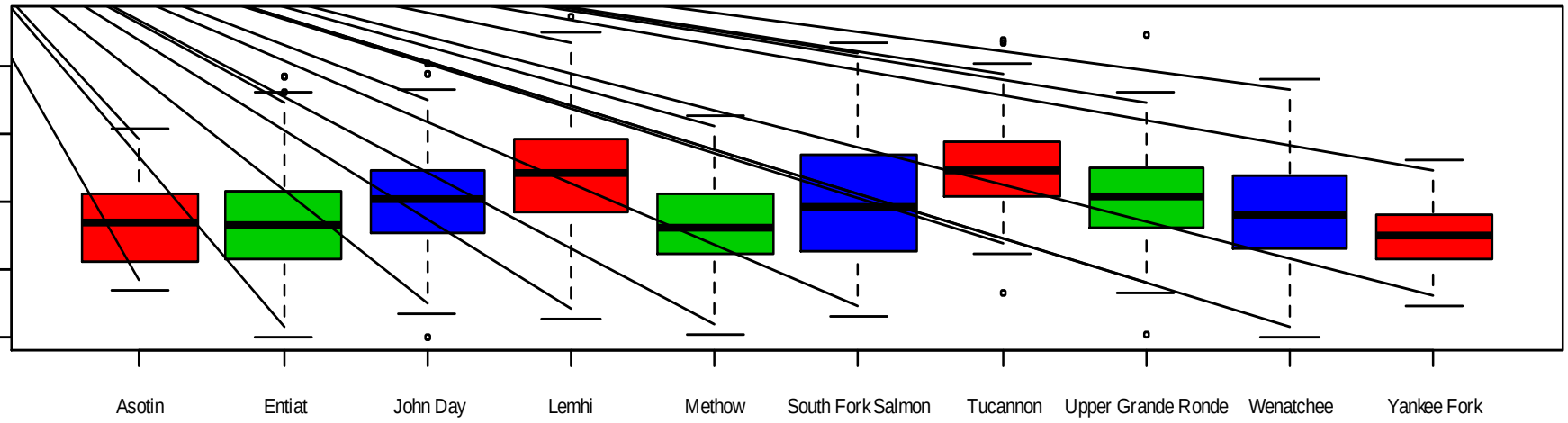
Ensure CHaMP Metrics are Capable:

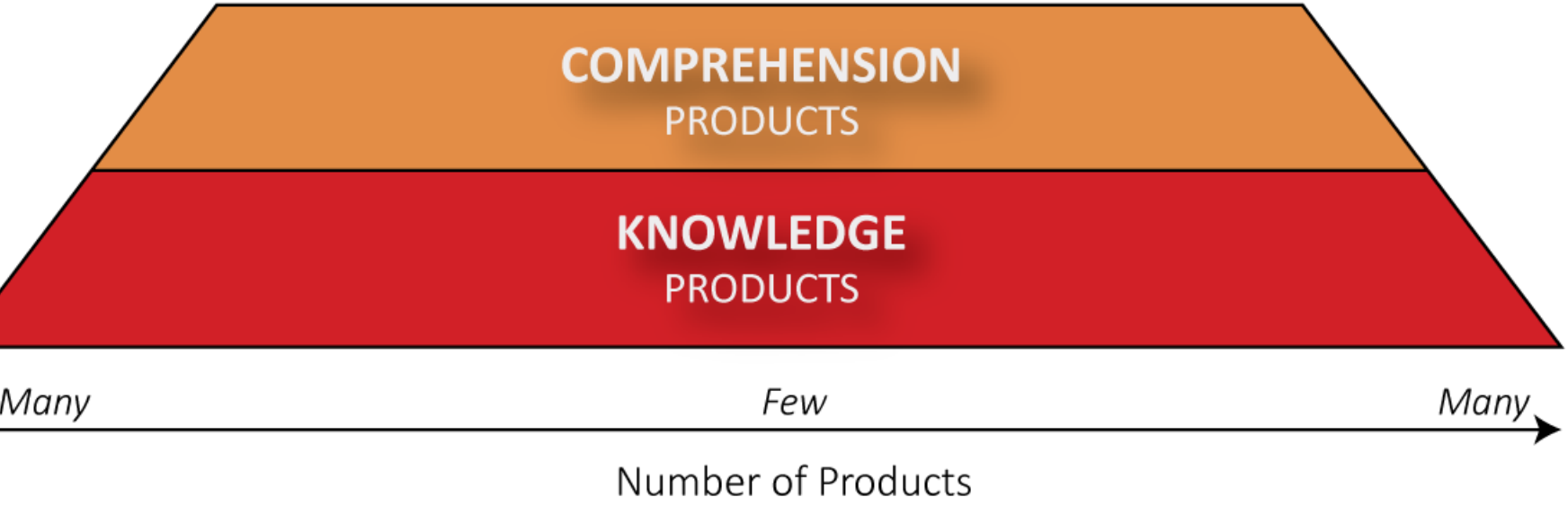
- Metric Capability is a Function of:
  - Measurement Accuracy and Precision ("Bias" and "Noise")
  - Spatial and Temporal Variance Patterns
  - Sampling Design
  - Models from which Analyses, and Summary Products are Built

- Steps to Assessing Metric Capability:
  - Create Graphical Tools to Visualize Elements of Metric Capability
    - Patterns of Measurement Noise and Spatial/Temporal Variance
    - Identify Problems, Outliers, Data Transformation Needs, etc.

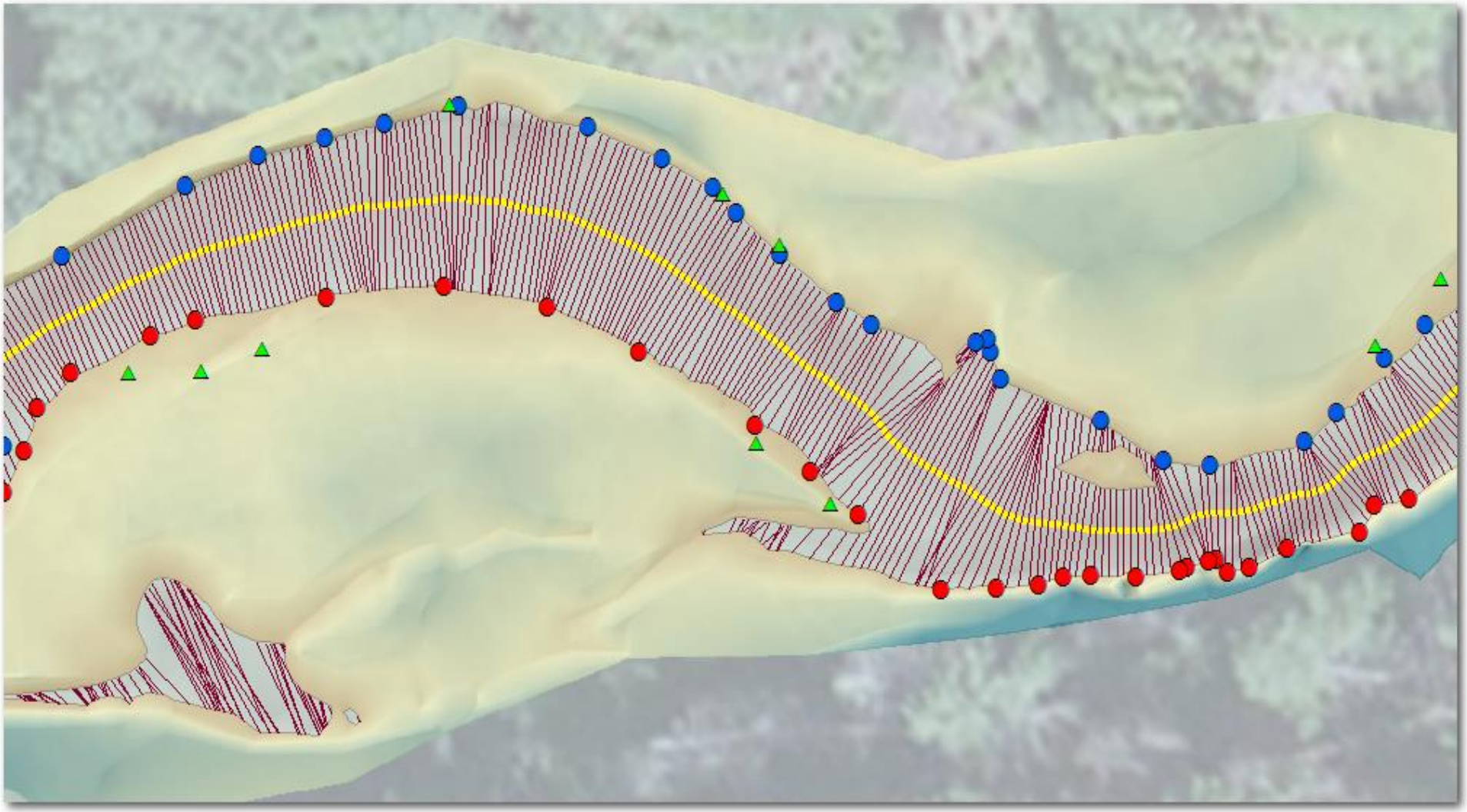
Variance Decomposition for Key CHaMP Metrics




CoarseAndFineGravel by Watershed
Asotin
Entiat
John Day
Lemhi
Methow
South Fork Salmon
Tucannon
Upper Grande Ronde
Wenatchee
Yankee Fork


COMPREHENSION
PRODUCTS
KNOWLEDGE
PRODUCTS
Many
Few
Many
Number of Products

RBT- Cross Sections from Topographic Data



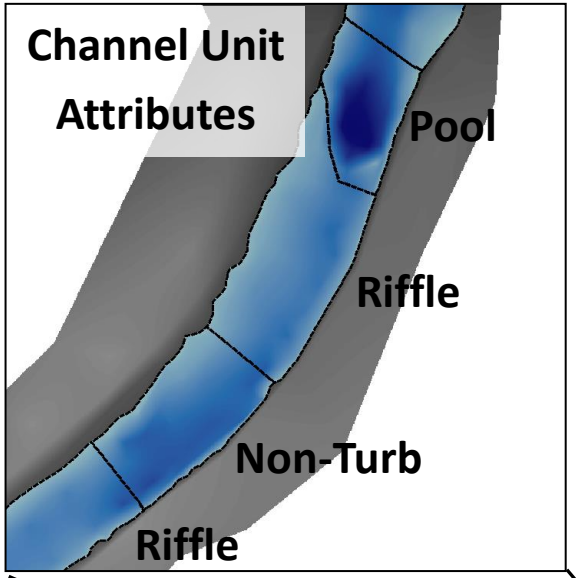
RBT and GCD Measurements and Metrics

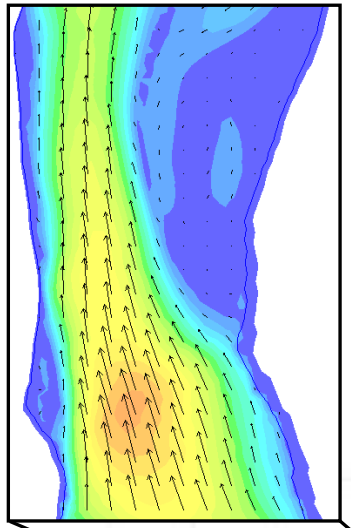
- Site Length (centerline)
- Site Length (Thalweg)
- Sinuosity
- Wetted width
- Bankfull width
- Bankfull Channel Capacity
- Area Sum
- RP100
- Pool tail crest depth average
- Pool max depth average
- Average Bankfull elevation
- Average channel capacity
- Average cross section area
- Average rectangular cross section area
- Site topographic gradient
- Site water surface gradient
- Site area wetted
- Site area bankfull
- Wetted volume
- Bankfull volume
- Detrended DEM standard deviation
- Water depth standard deviation

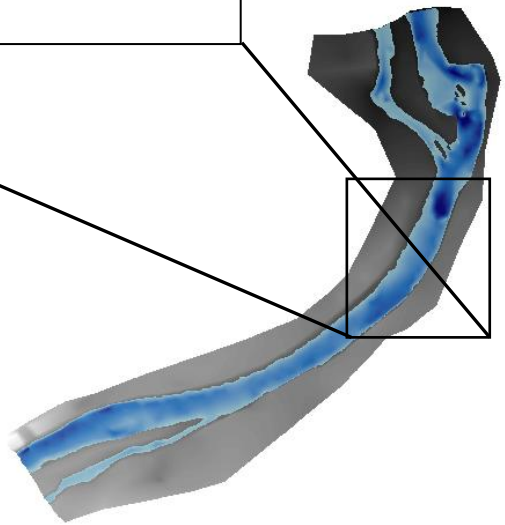
- For Each Channel Unit
  - Area
  - Volume
  - Count
  - Frequency
  - Spacing
  - Percent of site
  - Average Max Depth
  - Average Depth at Thalweg Exit
  - Average Residual Depth
- For Each Tier 1 and Tier 2 Channel Unit Type
  - Area
  - Volume
  - Count
  - Frequency
  - Spacing
  - Percent of site
  - Average Max Depth
  - Average Depth at Thalweg Exit
  - Average Residual Depth

- GCD results for the entire site, for each tier 1 and 2 channel unit type, and also for the common bankfull area between two visits:
  - Raw area of erosion
  - Thresholded area of erosion
  - Percent of area of interest with detectable change
  - Total net volume of difference
  - Total net volume of difference +/- error
  - Average net thickness of difference
  - Average net thickness of difference +/- error
  - Average net thickness of difference with detectable change
  - Average net thickness of difference with detectable change +/- error

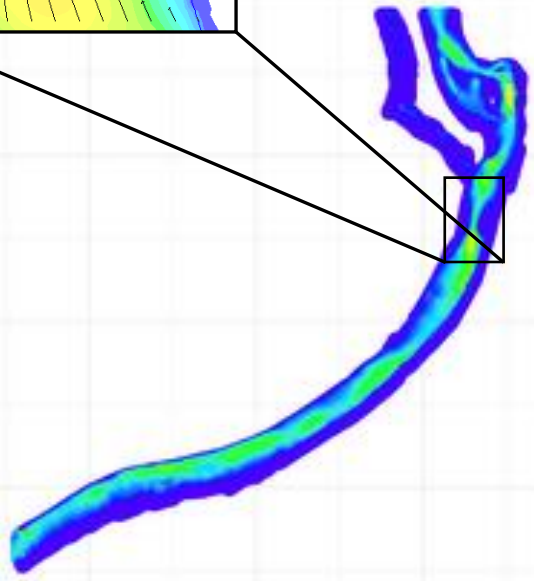
Metrics Derived from Topographic Data Integrated with Auxiliary Data







Depth (m)
1.00
0.75
0.50
0.25



Velocity (m/s)
1.5
1.0
0.5
0.0

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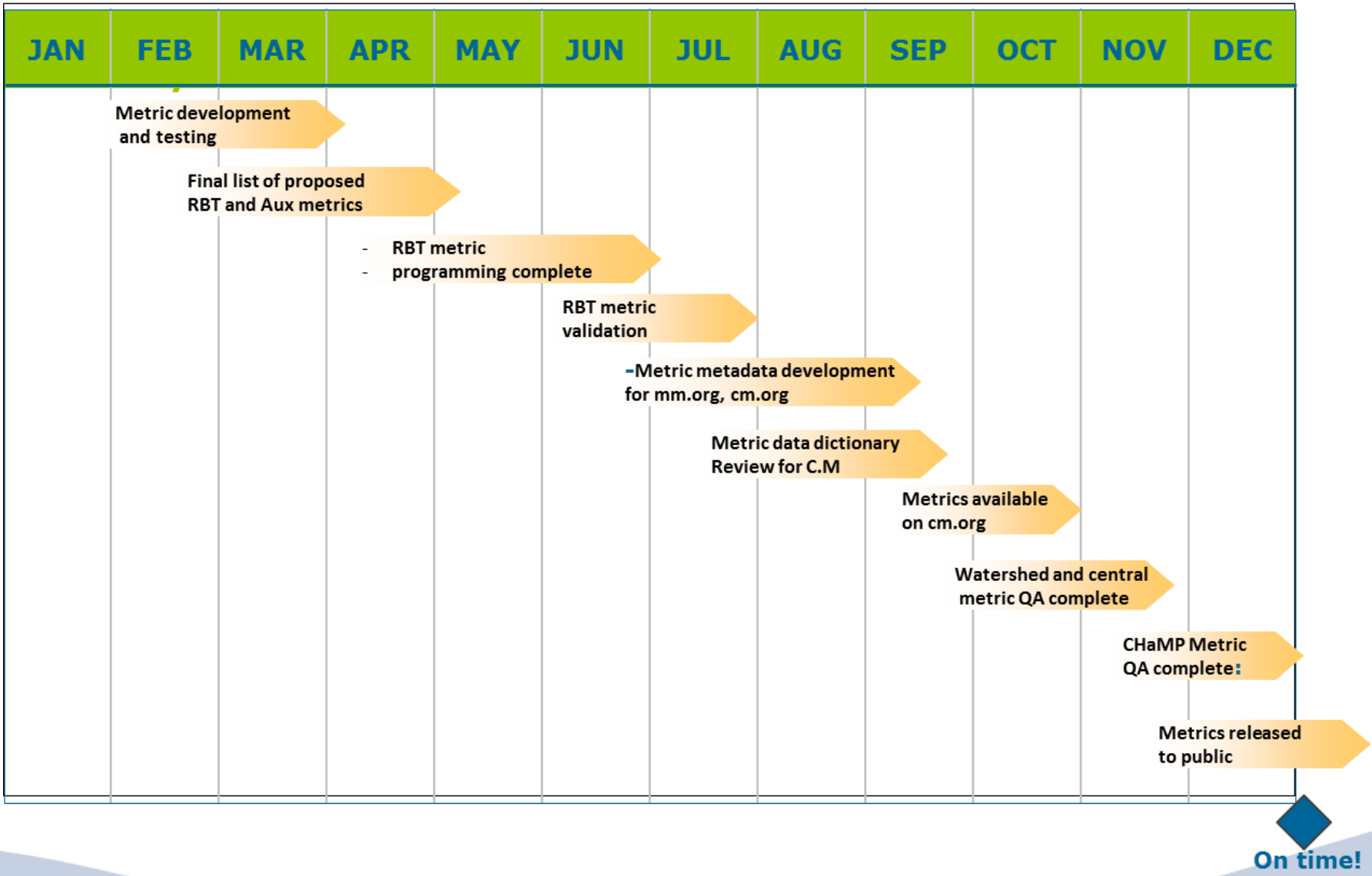
CHaMP Metric Annual QA



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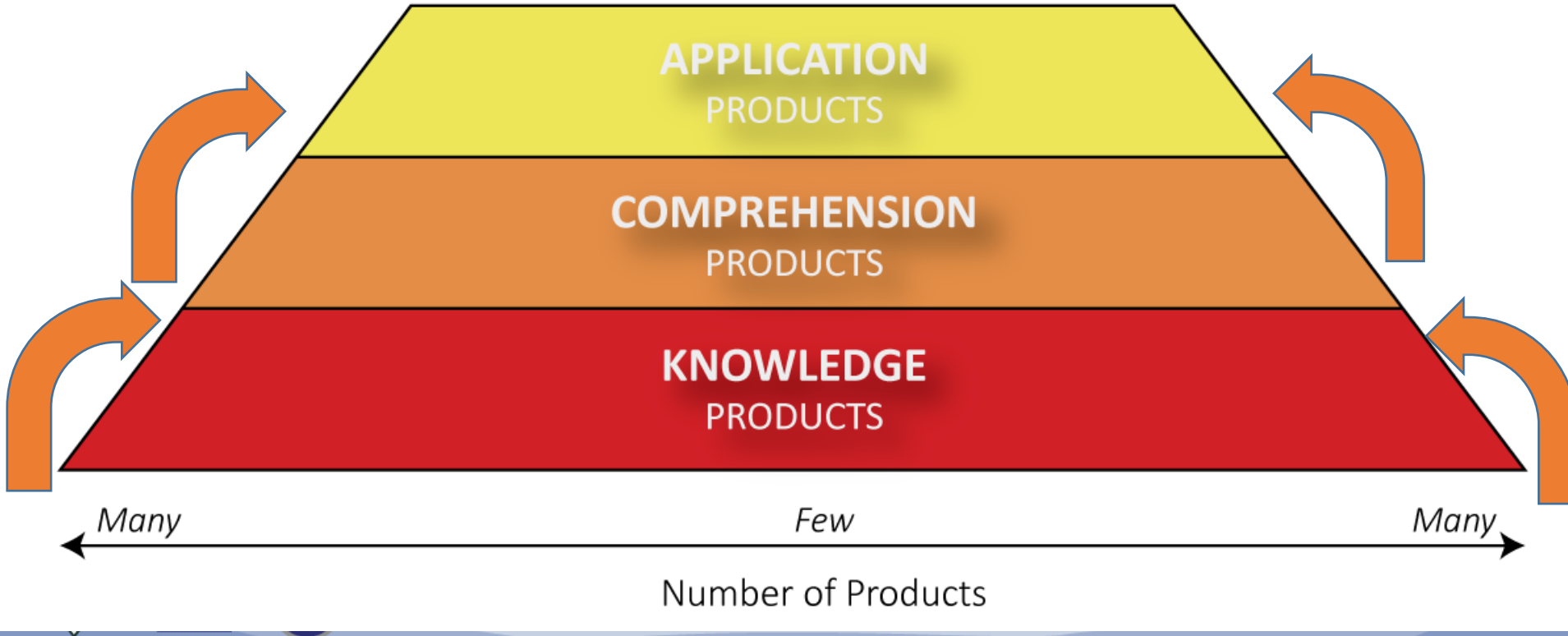
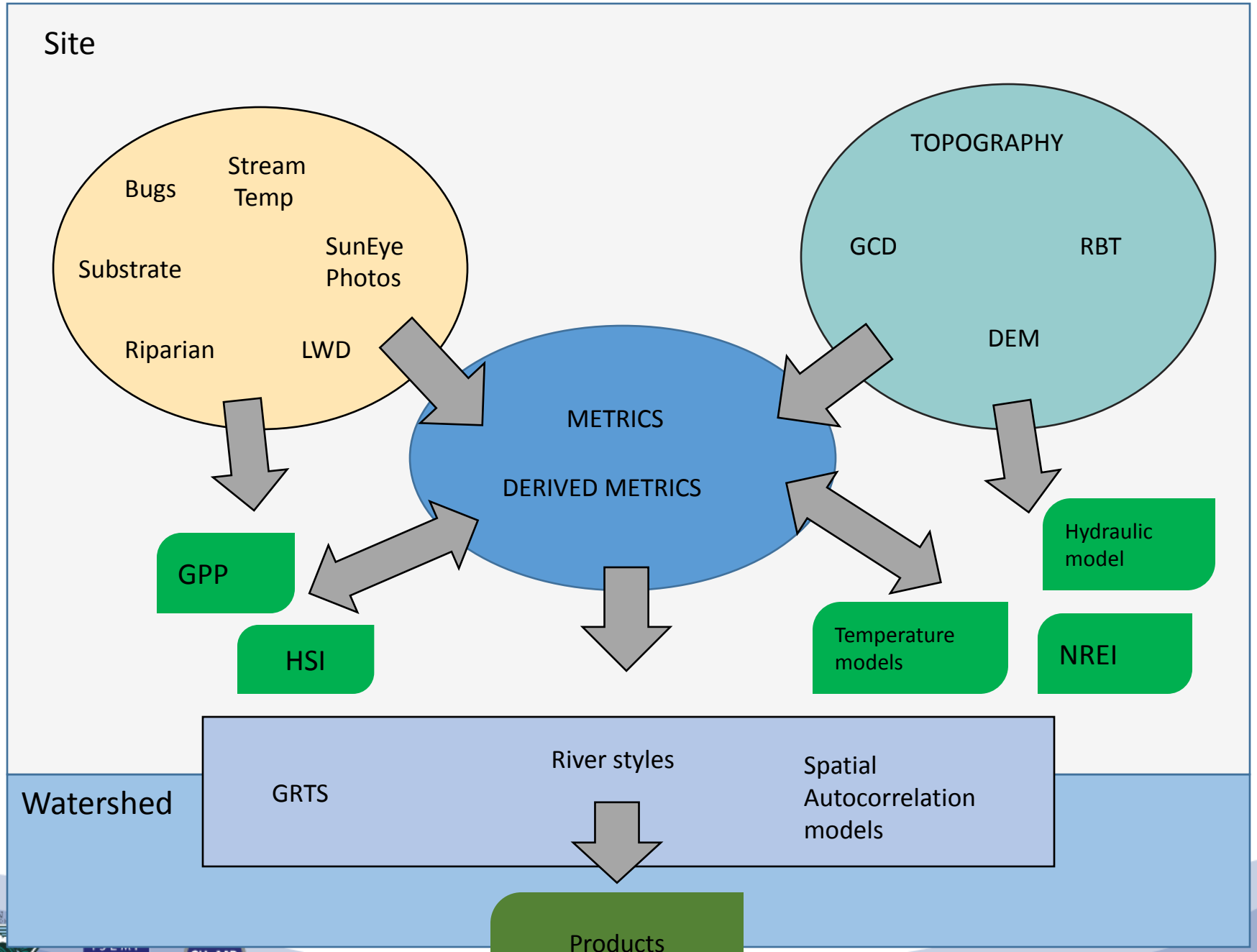
ISEMP
CHaMP

Watersheds	Sites sampled	Data uploaded	Topo To Do	Topo unknown	Topo special cases	Temp data QA	Metrics promoted	Metrics released
Asotin	20	20	0	1	0	Y	0	0
Entiat	75	75	8	1	0	Y	0	0
Grande Ronde	75	75	1	0	0	Y	0	0
John Day	95	30	7	3	3	Y	0	0
Lemhi	43	43	2	0	0	Y	0	0
Methow	26	26	4	0	0	Y	0	0
Minam	10	10	0	0	0	Na	0	0
South Fork Salmon	25	25	1	0	0	Y	0	0
Tucannon	33	33	2	3	0	N	0	0
Wenatchee	33	33	3	0	0	Y	0	0
Yankee Fork	25	25	1	3	2	Na	0	0
Big Creek (CA)	25	14	11	0	0	N	0	0
Umatilla	3	2	2	0	0	N	0	0
Deschutes, Walla Walla	14	12	3	0	0	Na	0	0

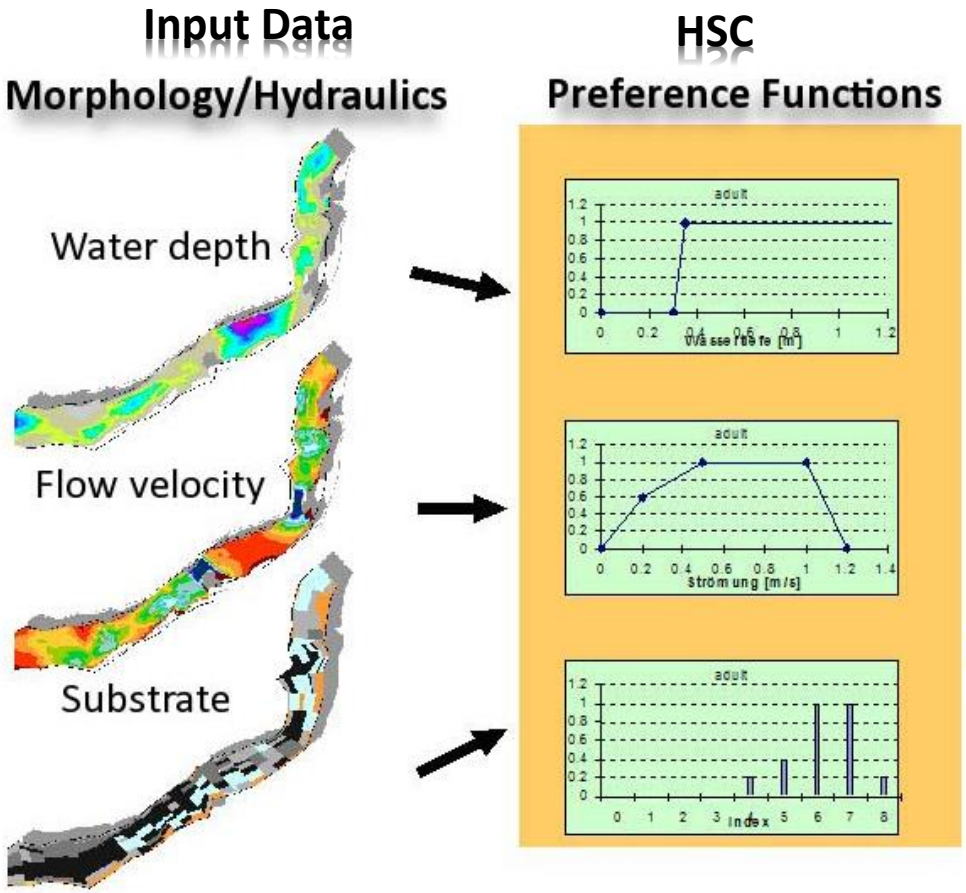
APPLICATION PRODUCTS

are the outputs of a specific model, tool or software application, and are produced using combinations of different metrics. Examples of application products include hydraulic models, habitat models, bio-energetic models, geomorphic change detection, etc.




Site
Bugs
Stream Temp
Substrate
SunEye Photos
Riparian
LWD
TOPOGRAPHY
GCD
RBT
DEM
METRICS
DERIVED METRICS
GPP
HSI
Hydraulic model
Temperature models
NREI
Watershed
GRTS
River styles
Spatial Autocorrelation models
Products

Habitat Suitability Index

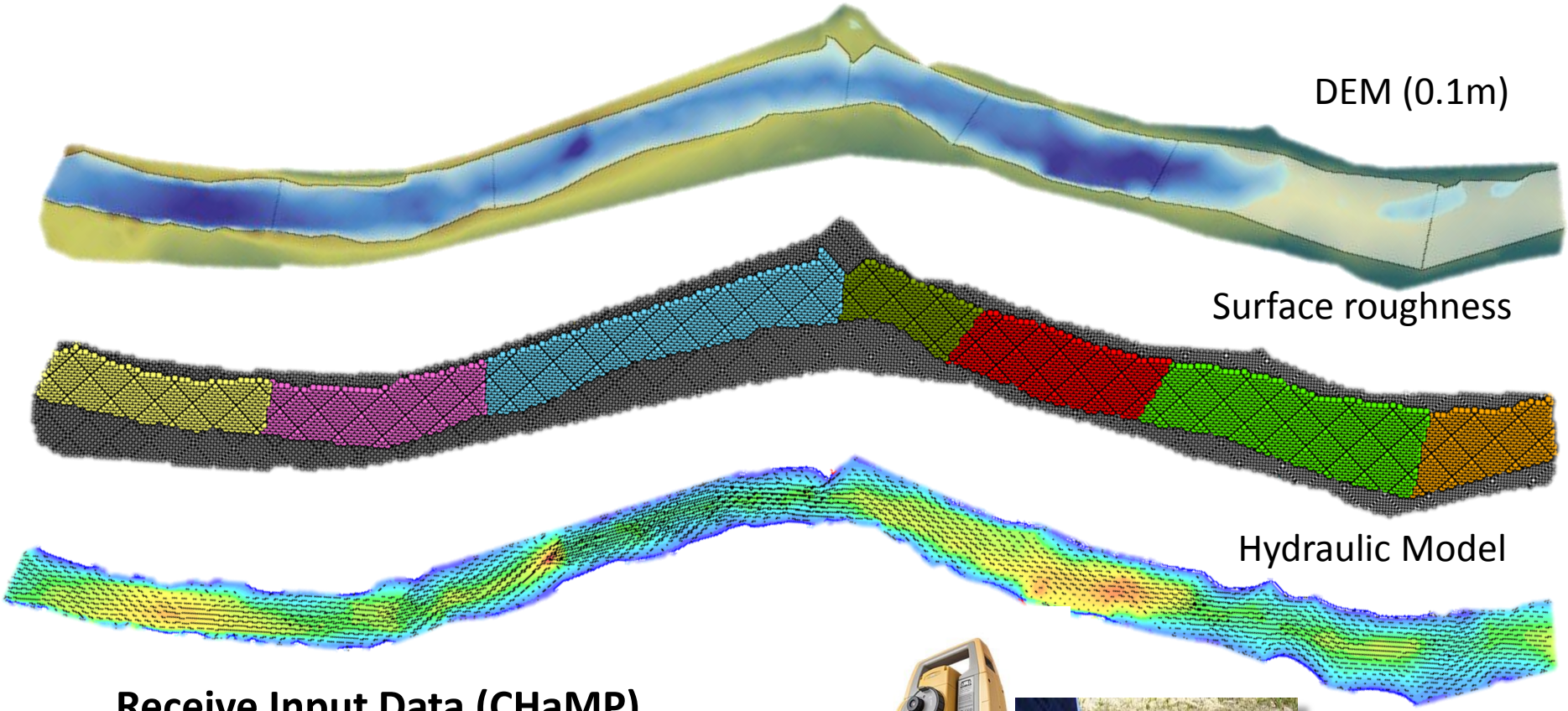


*can weight individual variables

http://www.casimir-software.de/data/CASiMiR_Fish_Handb_EN_pdf

CHaMP HSI Data Inputs

Habitat Variable	Spatial Resolution	Spatial Data Source	Primary CHaMP Survey Data	Life Stage
Velocity, Depth	10-cm cell	Delft3D hydraulic model	Topographic data, substrate/roughness, flow data	All
Substrate	**Channel Unit**	**Derived**	**Areal % substrate categories**	**Spawner-Embryo**
Cover	Channel Unit	Derived	Cover, Undercut Banks, Areal % Substrate	Juvenile Rearing
Water Temperature	Site	Derived	Mean, Min., Max at daily, 8-day, or monthly scales	All
Fines	**Channel Unit**	**Derived**	**Areal % substrate, pebble counts**	**Spawner - Embryo**



Receive Input Data (CHaMP)

DEM,

WSE-DEM

Thalweg

Particle Size Distribution (D84)

Discharge

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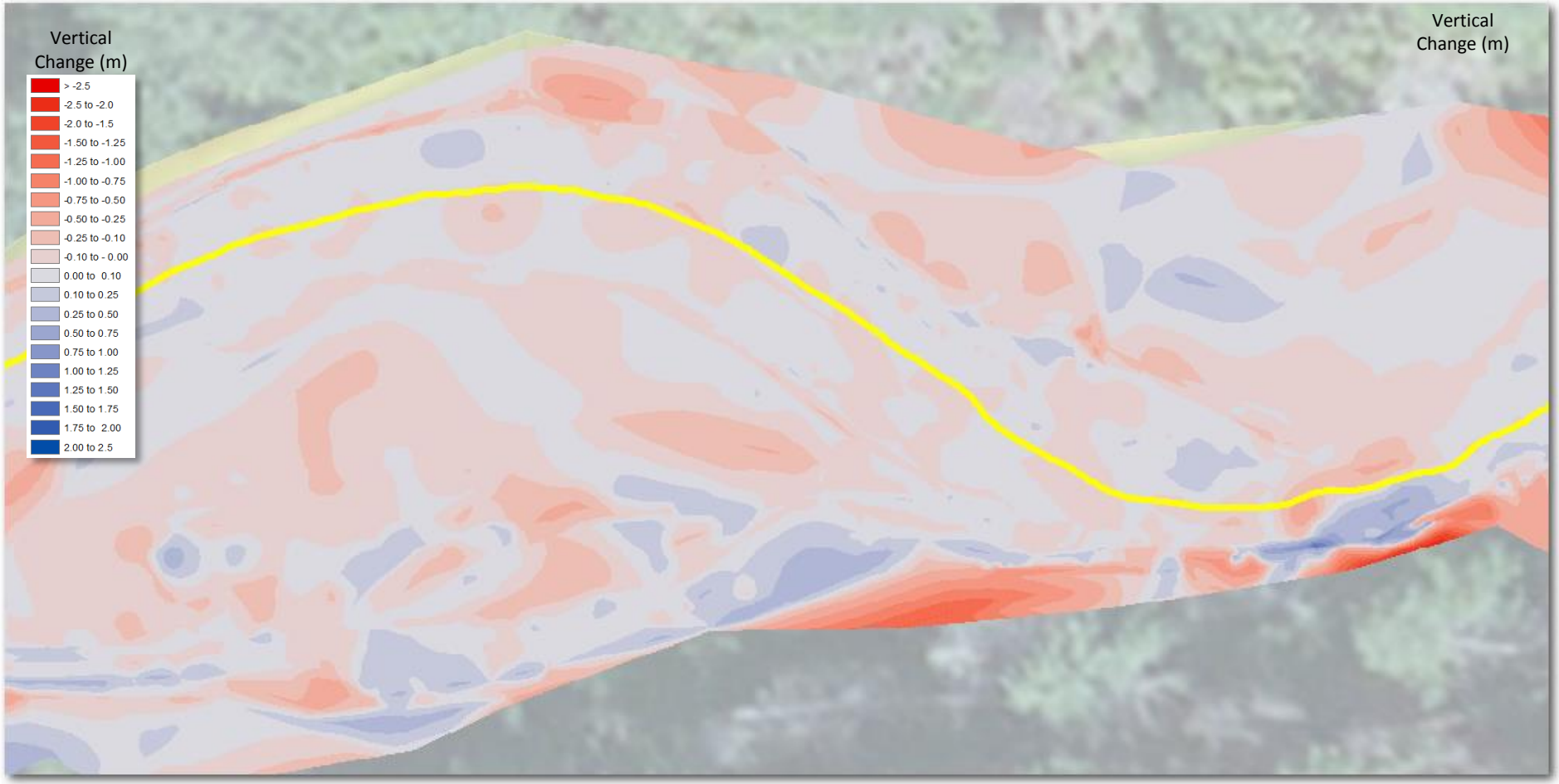
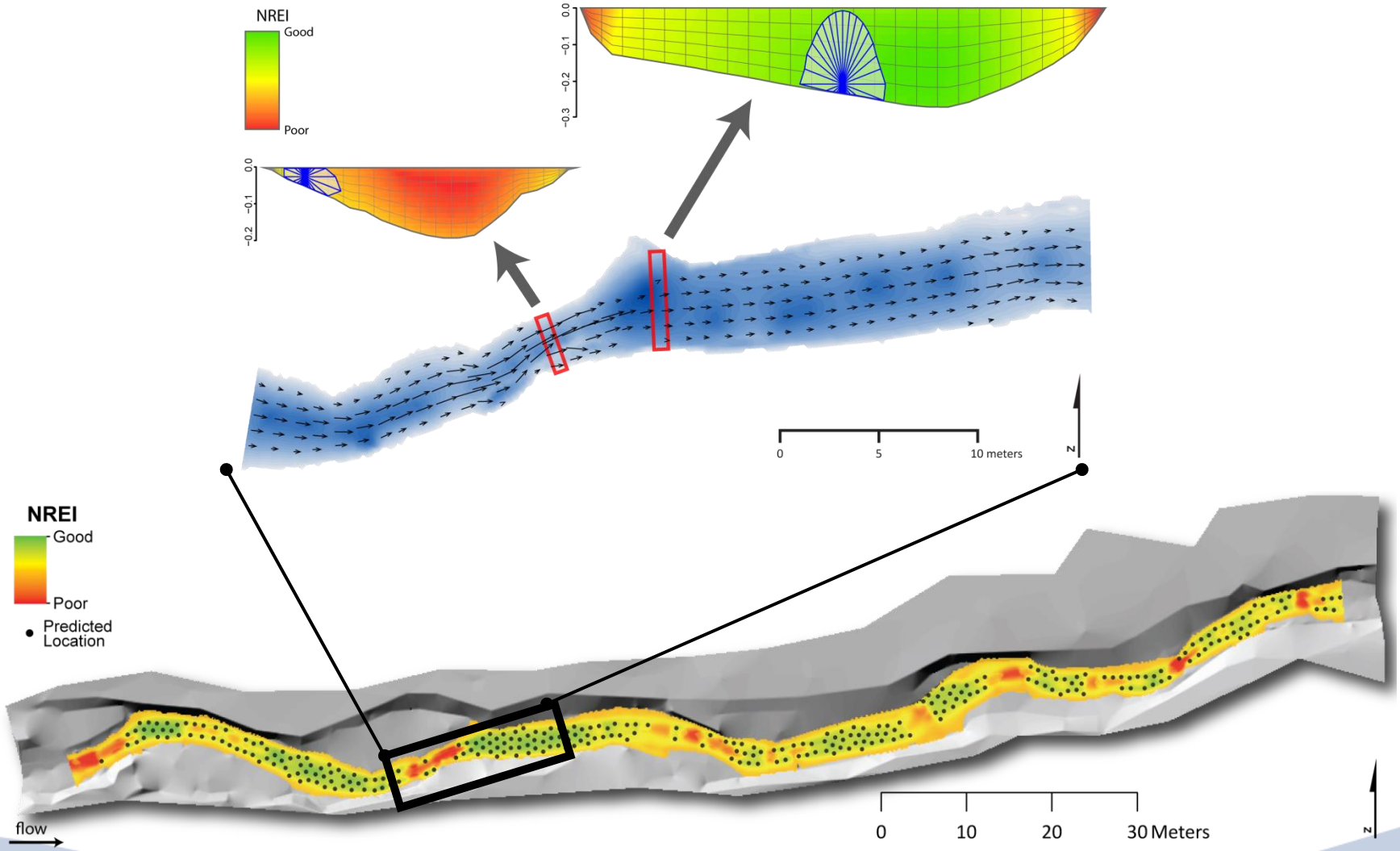
Geomorphic Change Detection



Carrying Capacity



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