INCORPORATION OF CLIMATE CHANGE IMPACTS INTO INLAND HYDROLOGIC ANALYSIS

Prepared by Chanel Mueller, PE Hydraulic Engineer/ CRP SME USACE – Saint Paul District September 7, 2017

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."



BULIOHEADS CAN DIS& DAM

ESTRESSED CONCRETE



PRESENTATION OUTLINE

- I. Brief Overview of Guidance
- II. Application
 - i. Appropriate Role in Planning Process
 - ii. Tailor to Project Purpose
 - iii. Need for Exploratory Analysis
 - iv. Requirements
 - v. Addressing Uncertainty
- III. Case Study
- IV. Pathforward





USACE CLIMATE ADAPTATION POLICY: JUNE 2011 UPDATED JUNE 2014 TO REFLECT EO 13653



ADAPTATION POLICY STATEMEN

The primary and overarching policy document for USACE is the USACE Olimate Preparadrases and Resiliance Policy Statement, signed by Assistant Secretary of the Army Jo-Ellen Dary in June 2014.

As the Nation's largest and oldest manager of water resources, the US Army Corps of Engineerin (USACE) has long been successfully adapting its policies, programs, projects, planning, and operations to impacts from import drivers of global change and variability.

It is the policy of USACE to integrate dimetal change properiodnoses and realience pharming and actions in all activities for this purpose of enhancing the realience of ur built and narrail water resource interstructures and it alloctheness of our mitilary support mission; and to take the potential valumabilities of their infrastructure and thos missions to the affects of climate change and variability. USACE that continue undertaining in climate changes

propertications and resultance pairs internal and automal supports and v and Contrains, and shall implement? using the back available – and acts and almetic change information. Using a efforts with other agencies to di actionable basis for adapting to di furthermoon, USACE shall continue dimete change impacts when und planning, astrong priorities, and ma

These actions, which USACE is no has outfined for the future, are fully guiding principles and framowork e Proparadiness and Resilience and Faderal Interagency Climate Chan Force; with Executive Order 13652

 2013 instructions Propering Federal Agency Clim Change Adaptation Plans in Accordance with Execut Order 13653; and with Executive Order 13514 and ti Implementing Instructions for Federal Agency Climate Change Adaptation issued on Natch 4, 2011.

> ISACE understands and is acting to integrate climate displation (managing the unnexidable impacts) with https://opencommune.climate.climate.climate cognitions the very algorithant differences between climate hange adaptation and climate change miligation in terms of physical complexity. fincel and material resources, level if incovedups and technical madmass, and temporal and if incovedups and technical madmass, and temporal and if incovedups and technical madmass, and temporal material madmass.

> > It is the policy of USACE that these and other productive collaborative efforts around climate and global change adaptation shall continue.

This policy establishes the Assistent Secontary of the Ammy for CiV Works as the Agency of Talia supportible to ensuring implementation of all aspacts of this policy. This policy does not fault a splication of the Second and recognizes that USACE has established the USACE Committaion of Cimato Physicandows and Hauliances to adaptation planning and implementation. The Committaion charaled by the USACE Cimat, Englishing and Committaion and particle planning and implementation. The Committaion and applications planning and complexity of the Aem for Civil Works.

This policy statement reaffirms and supersodos the commitment made by USACE in its June 3, 2011 Climate Charge Adaption Policy Statement. This policy shalt be effective beginning June 27, 2014, for all USACE missiones operations, programs and projects and shall remain in effe until it is amended, supersodod, or rovolved.





"It is the policy of USACE to integrate climate change preparedness and **resilience planning** and actions in all activities for the purpose of enhancing the resilience of our built and natural water-resource infrastructure and the effectiveness of our military support mission, and to **reduce the potential vulnerabilities** of that infrastructure and those missions to the effects of climate change and variability"

 Integrate best available and actionable climate science and climate change information at appropriate level of analysis into long-term planning, setting priorities, and making decisions





http://www.corpsclimate.us/adaptationpolicy.cfm

IN THE NEWS...

- Executive Order 13783 Issued in March 2017 "Presidential Executive Order on Promoting Energy Independence and Economic Growth"
- Revocation of EO 13690, "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input"
- Continue to implement climate preparedness and resilience activities until otherwise notified
 - Comply with USACE policy and technical guidance until otherwise notified – all of which comply with other laws and authorities
 - Ensure the reliable performance and costeffectiveness of our missions and operations both today and in the future



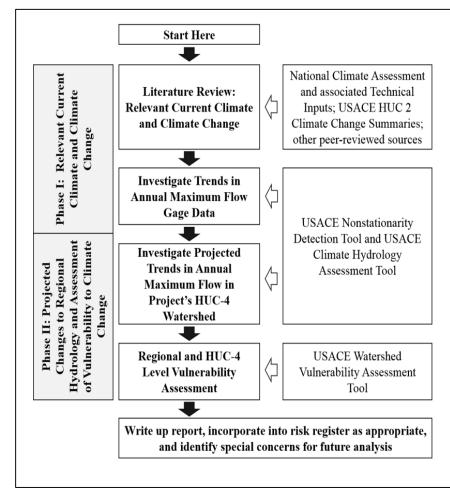






ECB 2016-25: GUIDANCE FOR INCORPORATING CLIMATE CHANGE IMPACTS TO INLAND HYDROLOGY IN CIVIL WORK STUDIES, DESIGNS, AND PROJECTS

- Requires **Qualitative** Analysis
- Resilience & Adaptability in
 Design & Decision making
- Key Components:
 - Literature Review
 - Considers Trends in both past (observed) & projected (future) changes to hydrologic inputs
 - Vulnerability Assessment
 - Nonstationarity Detection







APPROPRIATE EXECUTION AND APPLICATION WITHIN THE PLANNING PROCESS

• When?

- Upfront
- Fully Integrated

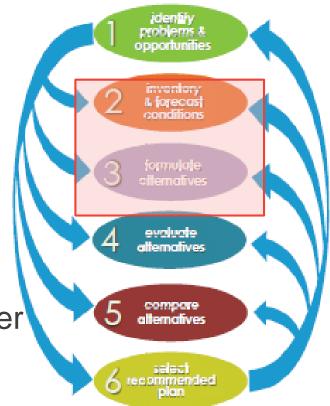
• Who?

- PDT Member
- Appropriate Expertise
- Collaboration
- Certified CPR ATR Reviewer

• Expected Impact?

- Risk Informed Decision Making
- ➢ Build Resilience → Reduce Vulnerabilities

FIGURE 1: THE CORPS' ITERATIVE SIX STEP PLANNING PROCESS







TIE BACK TO PROJECT PURPOSE

• What USACE business lines are impacted by the project?

How will **Proposed Alternatives** Impact the Hydrology of the Study Area?

How will Climate Change Impact the Hydrology of the Study Area?

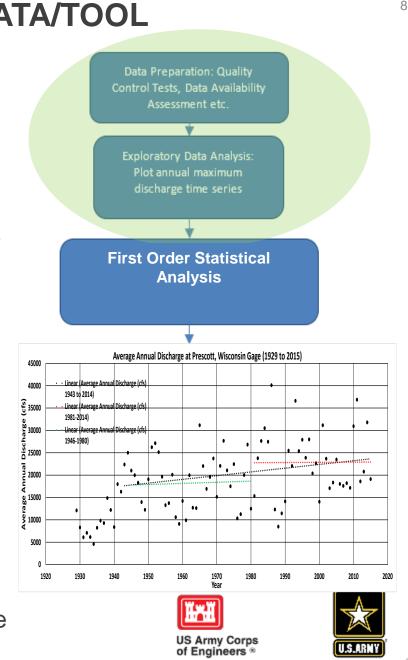
Look for Positive and Negative Feedback Loops





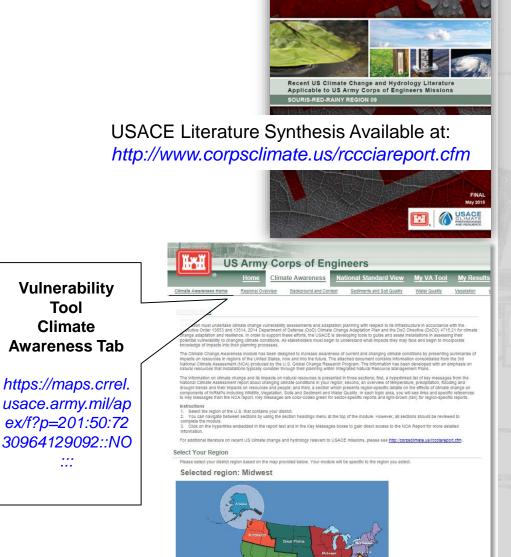
KNOW YOUR STUDY AREA & DATA/TOOL AVAILABILITY

- History of Regulation, Land Use Changes, Data Quality
- What variables are critical to assessing the impact of your project on the hydrology of the basin?
- What data is available in your basin?
- Many resources have been developed for studies primarily affecting high flows
- For other flow regimes:
 - Literature Review
 - Vulnerability Tool
 - Reach out to CPR POCS for guidance



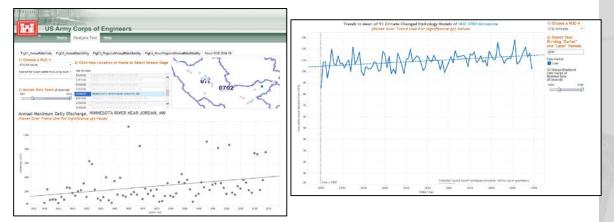
LITERATURE REVIEW

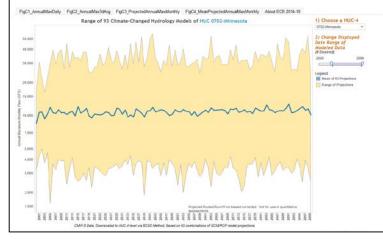
- Outline of broad trends in observed and projected changes to climate that might impact watershed hydrology
- Trends in Observed & Future Projections of:
 - Precipitation
 - Seasonality
 - Temperature
 - Streamflow
- Resources for Literature Review
 - USACE HUC02 Literature Synthesis
 - 3rd National Climate Assessment – Vulnerability Tool



CLIMATE HYDROLOGY ASSESSMENT TOOL: TREND ANALYSIS

- Significant Linear Trends in Observed Annual Maximum Flows
- Significant Trends in Projected Annual Maximum Monthly Flow Data
 - Projected, Future Monthly Precipitation & Temperature Data
 - Based on 93 combinations of different global climate model outputs run for different greenhouse gas trajectories
 - Spatially Downscaled using a statistical method
 - Translated to an Unregulated Streamflow Response using a Hydrologic Model





Climate Hydrology Assessment Tool Available at: http://corpsmapu.usace.army.mil/cm_apex/f?p=313:2:0::NO





US Army Corps of Engineers *

NONSTATIONARITY DETECTION GUIDANCE & WEB APPLICATION

- In April of 2017, USACE released technical guidance related to the detection of hydrologic non-stationarities in annual peak streamflow records
 - ETL 1100-2-3, Guidance for Detection of Non-stationarities in Annual Maximum Discharges
- Supported by a Web-based Tool

Nonstationarity Detection Tool Available at: http://corpsmapu.usace.army.mil/cm_apex/f?p=257:2:0: :NO:::

	DEPARTMENT OF THE ARMY	
	U.S. Army Corps of Engineers	ETL 1100-2-3
CECW-CE	Washington, DC 20314-1000	
Technical Letter No. 1100-2-3		28 April 2017
	EXPIRES 27 April 2021 Global Changes	
GUID.	ANCE FOR DETECTION OF NONSTATIONA IN ANNUAL MAXIMUM DISCHARGES	RITIES
(USACE) with guidance	neer Technical Letter (ETL) provides U.S. Army e for detection of abrupt and slowly varying chan imum discharge supporting USACE project plant s and maintenance.	ges (nonstationarities) in
	ETL is effective immediately and applies to all H Il USACE elements having responsibility for civi	
3. Distribution Statem	ent. Approved for public release; distribution is u	mlimited.
4. <u>References</u> . Requir	ed and related references are listed in Appendix A	ŧ.
reduce vulnerabilities a effects of climate chang proven to be robust eno operational life. But in climate change and mo assumption of stationar constant through time). in water resources plan provides technical guid	CE policies requires consideration of climate char nd enhance the resilience of our water resource in e. USACE projects, programs, missions and ope ugh to accommodate the range of natural climate some places and for some impacts relevant to US thifications to watersheds are undermining the flu ity (the statistical characteristics of hydrologic in This assumption has enabled the use of well-acc ming and design that rely primarily on the observe rance on detecting nonstationarities in the flow rec future and should be considered in the future with	frastructure to the rations have generally variability over their ACE operations, damental design ne series data are epted statistical methods d record. This ETL ord which may continue
gradually depending on physical processes. Sta change. However, due detection of the potentia that are related to oscill	tionarities. Changes in hydrologic processes can the characteristics of the nonstationarity factors is tistical methods have been developed to detect be to limitations in current understanding, this ETL al presence of Long-Term Persistence (LTP) in th ations in climate regime over a wide range of tem	affecting relevant oth abrupt and gradual does not apply to e discharge time series poral scales.
	rides detailed guidance on how to detect non-LTF al maximum discharge supporting USACE planni	





THE STATIONARITY ASSUMPTION

Stationarity: The assumption that the statistical characteristics of hydrologic time series data are constant through time. The concept of stationarity is a fundamental assumption underlying hydrologic analysis and design.

Application of the Stationarity Assumptions

- Enables the use of well-accepted statistical methods in water resources planning and design (example: Bulletin 17b/c)
- Relies primarily on the observed record
- What happens if the data collected in the past no longer resembles what lies ahead?

Potential Drivers of Non-Stationarity in hydrometrological records:

- Climate Change
- Watershed Modification

Guidelines For Determining

Flood Flow Frequency

Bulletin # 17B of the Hydrology Subcommittee

A. <u>Climatic Trends</u>

There is much speculation about climatic changes. Available evidence indicates that major changes occur in time scales involving thousands of years. In hydrologic analysis it is conventional to assume flood flows are not affected by climatic trends or cycles. Climatic time invariance was assumed when developing this guide.



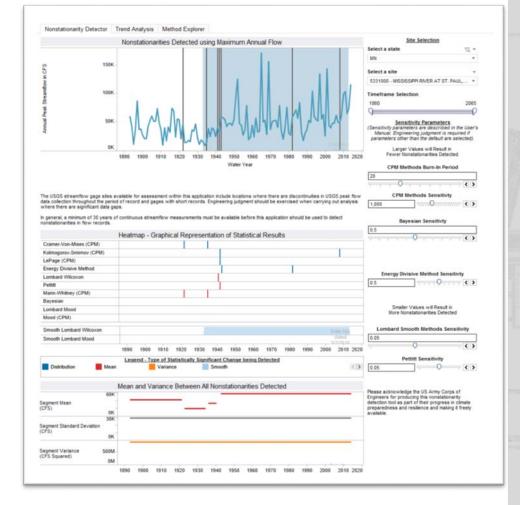


12

US Army Corps of Engineers *

APPLICATION OF NONSTATIONARITY DETECTOR TESTS

- Apply a Variety of Statistical Tests
- Target Changepoints in Mean, Variance, and Overall Distribution
- Web-Accessible Tool 12 Statistical Tests
 - A detailed description of the statistical methods and their applications to hydrologic engineering can be found here -<u>http://corpsmapu.usace.army.mil/rc</u> <u>c/nsd/docs/Nonstationarity_Detecti</u> <u>on_Tool_User_Guide.pdf</u>.

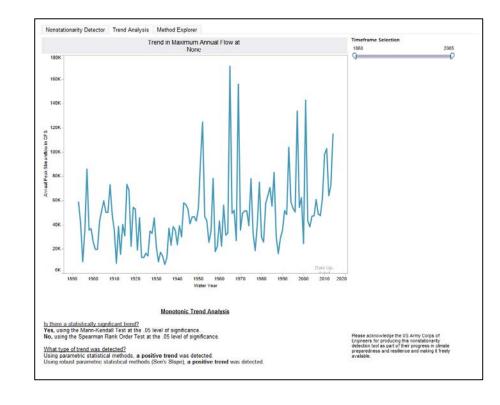






DETECTION OF MONOTONIC CHANGES

- Further evidence of Nonstationarity: Is there an increasing or decreasing trend in the data and/or subsets of the data?
- The detection of monotonic patterns is generally performed using either the Mann-Kendall test or the Spearman test
- Tests do not provide quantitative information related to magnitude of change observed

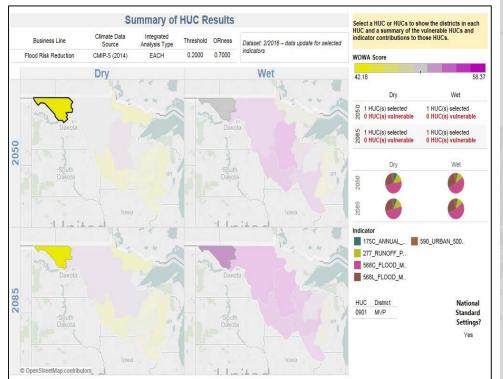






USACE WATERSHED VULNERABILITY ASSESSMENT TOOL

- Screening Level Tool
- Relative Vulnerability to Climate Change
- Comparative Analysis: 202 HUC4 watersheds
- Business Line Specific
- Global Climate Model + Different Greenhouse Gas Emission Scenarios + Hydrologic Model = 100 realizations of future flows/ precipitation/ temperature
 - Top 50% of traces "wet" bottom 50% "dry" by annual cumulative flow
 - Vulnerability Score Overtime (2050 & 2085)
- Weighted Order Weighted Average (WOWA) Vulnerability Score
- 27 predefined indicator Variables
- Top 20% are deemed Vulnerable
- Ex: Flood Risk
 - Acreage in the Floodplain
 - Variation in Annual Runoff
 - Runoff Elasticity
 - Indicators of Flood Magnification



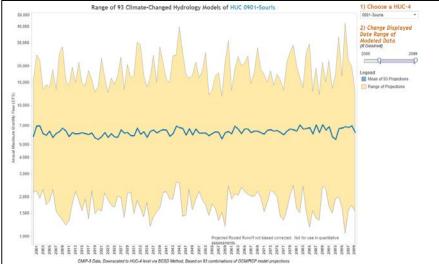
Watershed Vulnerability Assessment Tool Available at (CAC Card Accessible): https://maps.crrel.usace.army.mil/projects/rcc/portal.html

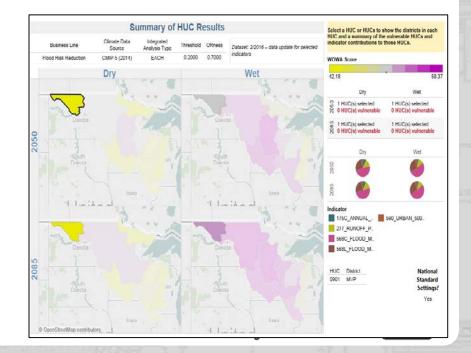




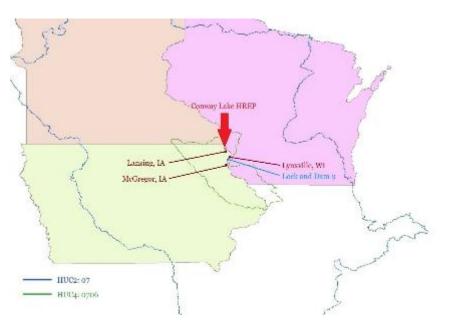
ADDRESSING UNCERTAINTY

- Acknowledge Uncertainty Associated with Climate Model Output for Future
- Interpreting Global Climate Model Output
- Hydrologic Model Uncertainty





- Part of the Upper Mississippi River Restoration Program
- HUC-04: 0706 Upper Mississippi-Maquoketa-Plum
- Located in Pool 9 (upstream of Lock & Dam 9) -Lansing, Iowa
- Includes Protecting or restoring 321 acres of aquatic and floodplain forest habitat
- Key Objectives
 - Overwintering habitat for fish
 - Establishment of floodplain forest
- 1,170 acre project area including Shore Slough and Phillipi Lake
- Long-term stream gage: USGS gage 05389500, Mississippi river at McGregor, Iowa







- Literature Review written with an ecosystem restoration focus
 - "In Water Resources Region HUC 07, the Upper Mississippi Region, the report concludes that "increased air temperatures and increased frequencies of drought, particularly in the summer months, will result in **increased water temperatures**. This may lead to **water quality concerns**, particularly for the dissolved oxygen levels, which are an important water quality parameter **for aquatic life**.
 - **Increased air temperatures** are associated with the growth of nuisance **algal blooms** and influence wildlife and supporting food supplies.
 - Increased mean annual precipitation in the region may pose complication to planning for ecosystem needs due to more variation in flows (Civil Works Technical Report CWTS-2015-13, USACE (2015))."



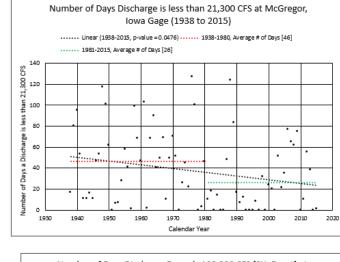


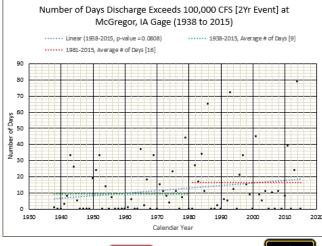
First Order Statistical Analysis

- Looked at trends in annual peak data (readily available in climate assessment tool)
- Looked at trends in datasets particularly relevant to the project purpose – ecosystem restoration

Not Done, but Recommended in future..

 Apply nonstationarity detection tool to variable specific to study purpose









EXAMPLE: CONWAY LAKE HABITAT REHABILITATION & ENHANCEMENT PROJECT FEASIBILITY REPORT & INTEGRATED ENVIRONMENTAL ASSESSMENT: VULNERABILITY ASSESSMENT

Summary of HUC Results

Business Line Climate Data Antispared Diverse Threshold ORness Indicators Dataset: 2/2/16 - data update for sets Indicators Change in Low Runoff 3.15 3.15 Ecosystem Restoration CMIP-5 (2014) EACH 20% 0.70 Dry Wet 0 1HUC(s) valuerable 0 0 Diacota 0 HUC(s) valuerable 0 HUC(s) valuerable 0 HUC(s) valuerable Signifi 0 0 0 0 HUC(s) valuerable 0 HUC(s) valuerable Signifi 0 0 0 0 HUC(s) valuerable 0 1HUC(s) valuerable Signifi 0 0 0 HUC(s) valuerable 0 1HUC(s) valuerable 0 Signifi 0 0 0 0 0 0 0 0 Diaota 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 <td< th=""><th></th><th>2</th><th>ummary or</th><th>HUC R</th><th>esuits</th><th></th><th>Flood Magnification - L</th><th>ocal</th><th>0.81</th><th>1.00</th></td<>		2	ummary or	HUC R	esuits		Flood Magnification - L	ocal	0.81	1.00
Dublicity Line Source Analysis Type Intestino 3u.0 2.3 Ecosystem Restoration CMIPS (2014) EACH 20% 0.70 Dry Wet 0.02 7.3.3 Dry Wet 0.02 0.02 Dry Wet 0.02		Climate Data	Interneted				Mean Annual Runoff		6.39	6.18
Ecosystem Restoration CMIP-5 (2014) EACH 20% 0.70 indicators Indicators <thindicators< th=""> Indicators Indicators</thindicators<>	Business Line		Analysis Type	Threshold	ORness	Dataset: 2/2016 – data update for select				1.57
WVM Score Dry Wet 0.02 73.33 Dy Wet 0.02 73.33 Dy Wet 0.02 010(2) sylinerable 0.02 010(2) sylinerable 0.01(2) sylinerable 0.01	Econuctor Postaration			20%	0.70		At Risk Freshwater Plan	its	26.11	25.89
Out 13.33 Directa Directa Direct	Ecosystem Restoration	CMIP-5 (2014)	EACH	2076	0.70		WOWA Score			
Bacita 0002 13.33 Dy Wet 9 1HUC(s) velocited 0HUC(s) velocited 0HUC(s) velocited 0HUC(s) velocited		Dry				Wet				
I HUC(s) selected I HUC(s) selected Storth I HUC(s) selected Daota I HUC(s) selected I HUC(s) selected I HUC(se) selected <		Diy				WCL	60.82	73.33		
Darota Darota Darota I HUC(s) selected I HUC(s) selected Sight h Darota Darota Diversity I HUC(s) vulnerable Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity Diversity							Dry	Wet		
Davota Storth Davota Storth Davota Dova				5			ନ୍ତି 1 HUC(s) selected ର 0 HUC(s) vulneral	1 HUC(s) selected 0 HUC(s) vulnerable		
South Dakota Iowa Iowa Iowa Iowa Iowa Iowa Iowa Iow			est.		Dakot		ର 1 HUC(s) selected ର 0 HUC(s) vulneral	1 HUC(s) selected 0 HUC(s) vulnerable		
Dakota Dakota III Dakota Iowa Iowa Iowa Iowa Iowa	South							Wet		
Indicator B_AT_RISK_FRE. 277_RUNOFF_PR. 70 B_AT_RISK_FRE. 207_MACROINVE 156_SEDIMENT 5680_FLOOD_MA B_Atota 2210_MONTHLY 5681_FLOOD_MA 2210_MONTHLY 5681_FLOOD_MA South Dakota 1000 1000 1000 1000 1000	Dakota						5050			
South Ecosystem Reduction Vulnerability score 2050 Dry 2085 Dry 2085 Iowa Iowa Iowa Iowa Iowa Iowa Iowa Iowa	1	lowa	5	3		lowa	5085			
South South Dakota South Dakota In Dakota <		1						277_RUNOFF_PR 70		
South South Dakota South Dakota In Dakota <		100					65L_MEAN_ANN	297_MACROINVE		
Daxota Daxota Daxota 221C_MONTHLY 568L_FLOOD_MA South Dakota South Dakota South Dakota South Dakota Image: Comparison of the com	5		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	5	Δ \leq	~~	156 SEDIMENT	568C FLOOD MA		
South Dakota in South Dakota in South Dakota in Dokota i				181.16	Dakot					
South Dakota in Dakota in Dakota if HUC 4 Watershed Ecosystem Reduction Vulnerability Score 2050 Dry 2050 Wet 2085 Dry 2085 Mississippi River (0706) 71.78 71.28 71.38 71.38 71.5			66C		T					
South Dakota in Dakota in Dakota if HUC 4 Watershed Ecosystem Reduction Vulnerability Score 2050 Dry 2050 Wet 2085 Dry 2085 Mississippi River (0706) 71.78 71.28 71.38 71.38 71.5	1.1.3			1 1 1 1 1	3			Projected Vulnerability with	1 Respect to Ecosyst	em Restora
Dākota Dākota 2050 Dry 2050 Wet 2085 Dry 2085 Jokota Iowa Iowa </td <td>South</td> <td></td> <td></td> <td>-</td> <td>South</td> <td></td> <td></td> <td></td> <td></td> <td></td>	South			-	South					
lowa	Dakota		sin	1.200	Dakota	i i i				2085 V
			- A.M.				Mississippi River (0706)	71.78 71.28	71.38	71.8
			5	1		Iowa				

Mississippi River (0706) 2050 Epoch Drv Wet Contribution to WOWA 20 Indicator Ecosystem Restoration Vulnerability Score Sediment (Change in Sediment Load / Current Load) 1.49 2.23 Short-term Variability in Hydrology (75th Percentile of Annual Ratios of <u>StDey</u> of Monthly Runoff) 4.78 4.57 Runoff Elasticity (% Change in Runoff / % Change in 15.69 15.24 Precipitation) Macroinvertebrate (Score of Six Metrics) 11.33 11.24 Flood Magnification - Cumulative 2.03 3.37 Flood Magnification - Local 0.81 1.00



CONCLUSIONS

- Increased cold water inflow events
- Increased inter-annual variability in flow & precipitation
- Overall Flow increases
- Decreasing number of growing season low flow days

RESULTING RESILIENT FEATURES BUILT INTO PROJECT

- The elevation of floodplain forest project features was increased to account for the possibility of future increases in flows.
- Adaptive management options will be available for some project features:
 - Notching the rock closure built to form overwintering habitat to accommodate increased summer flows if the overwintering habitat performs well
 - Monitoring and maintaining riprap groins if they are damaged by high flow conditions.



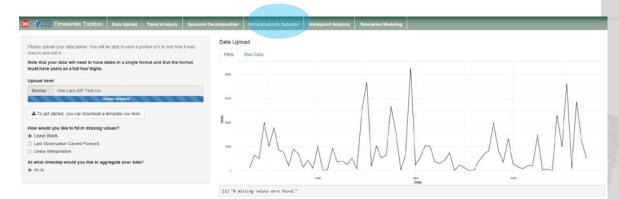


UPCOMING SUPPORT

Timeseries Toolbox: User Input
 Timeseries – Nonstationarity

Detection Tool

- Example Library for ECB 2016-25
- Web Based & In-Person Training



	A COLUMN OF THE OWNER								Libr	ary of Climate C	Change Assessment (CAL) - DEMO
Ľ,		os of Er	naine	ers							Lapper in an Chairet Munier - Annumations 6]1
-	Statement of the local division of the local	Add Ex	STREET, STREET	Administra	ator He	dip.					
		No.									and the state of the
help ee	chier is like valays or view bilders coherens area	or clob here.									
serge	on Roctoration new Management sk Raduction (Plood Risk Management) net in on on on on	Countil Batterioria Batfale Chadeetoni Chicago Delesti BIRDC Banga For East For East For Worth	A Ada Adap Exp Res Class Dro Exp	nth active Manapplication to Pro- panded Literal sitiset Project with Softing rought trans Climatic rought Protect	ement Stial equarcy Ar ture Review Features	egies salytis r	Auto Char Str	6			og 1-2
		Galveston	Shi	the in Season:		ine irreves	~				
least Box	ibman a man	Oher Dobins	Clean	Kapamirin							
٩v		Go How 5	•	Adipti V							
etala	Study Tille			Dominat	Sales.	Publicly Available	Storly Completion Data	Turnopmin	Primary Danman Line	Primary USACE Distance	Prisary Keywords
etala :	Study Tills A Mediscolings for Estimating Present-Day Free a Trend II Annual peak form	aeras Plane By As	coarding for	Downhart 2	Slates Final	Publicly Available No	Shorty Completion Data 07/02/2018	Byropein Annual prek Rove reme analyzed fullowing CGB 2014	Printery Desires Une Proof Risk Reductor: (Freed Risk Nanopenetic)	Primary USACE Distaict Defato	Pressry Reported New Frequency, Land Use Effects. User Inputted Time Series- Norstationarily Tool
etsis F	A Methodology for Editorialing Present-Day Trend							Arread proli Roos were analyzed			Place Pressence , Land Use Effects, User legislied Time Series- Norability Text
etala F	A Methodology for Estimating Present-Day Free a Trend if Asnaal peak Torn A Methodology for Estimating Present Day Free	sercy Flows By Jo	counting for	2	Final	Pre	97102/2918	Armani proti Rovo rene analyzeni futbosing ECB 2014	Plood Risk Reduction (Plood Risk Management)	Bufala	Power Pressence - Land Une Effects. User legisled Time Series- Norstationarily Tool Application to Pressance Analysis. High Pow. User reputed Time Series. Resetationarily Tool
etala e e	A Methodology for Edinating Present-Day Treat a Tread if Annual peak town A Methodology for Edinating Present Day Frec a Tread if Annual peak Treat Comme Lake Hashile Perfaultiston and Elinanc	serry Flam By A present Proved Pea et	counting for additiv	2	Final Final	Pe Pe	9752/0918 3652/0918	Averaal prest flows nerve analyzed bibaning ECB 2014 Annual prest flows nerve analyzed informing ECB 2014 The Connect Lake Habitat	Front Flat Fectucion: (Flood Flat Nanagement) Flood Flat Factorier: (Flood Flat Nanagement)	Bufala Bufala	Power Pressence - Land Une Effects. User legisled Time Series- Norstationarily Tool Application to Pressance Analysis. High Pow. User reputed Time Series. Resetationarily Tool
etala e e e e	A Methodology for Extension Present-Day Treas a Tread of Annual prack Town A Methodology for Extension Environment Day Treas a Tread All Annual prack Town Connect Later Habitat Refutations and Extrains Report and Integrated Technicarisms and Extrains Report and Integrated Technicarisms and Extrains Report and Integrated Technicarisms and Extrains	serry Flam By A present Proved Pea et	counting for additiv	2 2	Tead Find Beckey	Pe Pa Pe	9762/2919 8662/2919 96/29/2917	Annual press Rever analyzed bitaning ECB 2014. Annual press Room wave analyzed bitaning ECB 2014. The Connece Lake Habian Restantization and Exhanic Assolitation similar through analyze	Pipol Rat Retactor: (Flood Rat Management) Flood Rat Detector: (Flood Rat Management) Ecosystems Restarates	Defato Defato DL Paul	Place Departury Land Use Effects User Inputted Time Semi- honditionarity Tool Oppiciation for Separation Analysis, regis Tool, User styrated Time Semi-Distributionarity Teol Lan Four Maderale Than, Recovers Restriction Management PL Lang Teon Prevalend Chinda Timeta Management Place
etals e e e e e e e	A Methodology for Editorialing Present-Darp Trend a Time of Annual park Nons A Methodology for Editorial present Day Freco a Time of Annual park Time Comma Late Method The Additions are Donor Report are in High-ded Trendentiation are Donor Report are in High-ded Trendentiation are Donor Report are in High-ded Trendentiation are Donor Report are independent Advancement Assessment Denors Carefy Careford Presidentiation and Donor Nancard Gardo, Hier Galch, are the South Path	serry Flam By A present Proved Pea et	counting for additiv	2 2	Find Find Feeders Find	Pe No No No	97020998 88020998 96250998 96250987 11092098	Annual prof. Roos new analyzed bitwing CCB 2014. Innual part them same analyzed bitwing CCB 2014. This Consult Lake Holdia Personatistation and Extension A qualitative simular sharips analysis sum consulta.	Piped Risk Restuction (Piped Risk Management) Rised East Restuction (Piped East Management) Ecompilees Restuction (Piped East Management) Piped Risk Restuction (Piped East Management)	Terfalu Bufalo 31. Ped Oradu	Prov Frequency Land Use Effects User Injusted Two Sees- honditionals from pageszen in Preparent Anapesa, reijn Floo, User repeted Two Series, Franklinnend Treil Lan Port Maderia Frankenski Reinstenden Vareugeneret P Lang Two Frequencia Colorde Treinis, Mare Annet Ruest Hallwall
etals e e e e e e e e e	A Methodology for Editorialing Present-Day Freed a Transf Annual park from Methodology to its formania Present-Day Freed a Transf Annual park from Contexes Late Health Methodology and Echang Report and Health Methodology and Echang Report and Health Methodology Annual Henroet Gardon, Annuel Caston, and the Ecology Patho Present Carefy Caston Freedom	sericy Plans By Ad oreard Project Pea et anticles Hydrolog a River	counting for additiv	2 2 2 2	Final Final Recieve Final Ferview	Ne Ne Ne Ne	87622918 88622918 99252817 11092918 85392917	Avoid prof. Roos nove analyzed biomap COB 2014. Annua part from two analyzed biomap COB 2014. The Conner Leve Hubbal Retraintations and Estatus. A splitterie similar things or alyze that conner Leve particle floor in Encount Care particle floor in Encounter particle floor in Encounter particle floor in Encounter particle floor in Encounter to the .	Phote Risk Fetercher, Phote Risk Management, Rised East Eastecher, Phote East Management) Essimptions Redorders Rised East Redorder: (Phote Risk Management) Rised Risk Redorder: (Phote Risk Management)	Befali Befali St. Ped Orahu Satramenti	Prior Present, 3 and 1 an Ehrist, tow Insulter Time Sees- trostationant's and the second seco
	A Methodology in a Calendary Press Day Free C Tomord Annowal Adams A Methodology in a Celenange Press Day Into There d Annee Sea and Tomor Sea and Tomor Sea and Sea and Sea and Sea and Sea and Sea and Sea and Sea and Sea and Sea and Sea and Sea and Netword Sea. In Medica, and the Section Patho Press Day Sea and Sea and Sea and Sea and Network Sea and Sea and Sea and Sea and Sea and Network Sea and Sea and Sea and Sea and Sea and Network Sea and Sea and Sea and Sea and Sea and Network Sea and Sea and Sea and Sea and Sea and Network Sea and Sea and Sea and Sea and Sea and Sea and Network Sea and Se	sency Flore By Ac orient Protect Pea et andeler Hydrolog a River	counting for additiv	2 2 2 2	Final Final Recipion Final Final Final Final	Pie Pie Pie Pie Pie	97520944 84520944 94252947 411042945 85240947 942540947	Ansial peel loss nere analyzed bitmus (CD 2014). Ansara peel townee analyzed bitmus (CD 2014). The Compression towards for an analyzed bitmus for	Proof Flait Ferrichion Fried Flait Management, Flood Flait Ferrichion Flood Flait Management, Econyclem Flaid calas Proof Flait Ferrichion Flood Flait Management, Proof Flait Ferrichion Flood Flait Management, Romparies	Pufalo Bafalo 25. Peol Oradra Satzawanto Resk Wand	Proc Pagence J, Land Dan Elholas, Uno Insoland Terra Sanos- montantescuer Terra Terra Page Terra, Univer republic I in Segnational Terra Sanos Page Terra (Sanos Terra Sanos Land Terra Machaedi Franz, Rescensi Restaria Marca Manager Lang "and "Restaria Colombi Terra Marca Manager Langs", "and "Restaria Colombi Terra Marca Manager Langs", "and "Restaria Colombi Terra Marca Manager Sanos Marca Marca Manager High Franc Lang Terra Forsibiat Climata Terra Marca Manager
	A Mathematican La Calenda Barrano Den Free Tendra Canada Santa Barrano Den Free Santa Calenda Santa Santa Santa Santa Mathematican Santa Santa Santa Santa Santa Santa Santa Santa Tahadilatana an Canas Santa Santa Santa Tahadilatana an Canas Patrana Santa Santa Tahadilatana Patrana Dan Yunee Caesta Matsua Hansara Santa Santa Jania Jania Hansara Santa Canada Janiya Hansara Santa Canada Janiya	sency Flore By Ac orient Protect Pea et andeler Hydrolog a River	counting for additiv		Final Final Recipes Final Final Final Final	Ne Ne Ne Ne Ne Ne	97522944 86522944 96252944 41542994 85342997 96232947 86232944 86232944	Annual prof. Box to use a marginal Mathema (2002) that a marginal strategy of the set of the set of the Mathema (2002) set of the set of the set of the set of the set of the marginal set of the set of the set of the Mathema (2014). The set of the set of the Mathema (2014) set of the set of the set of the Mathema (2014) set of the set of the set of the Mathema (2014).	Pool PAA Fencieur Prior Reis Nanagement, Pool Paa Encietur Prior Pais Nanagement, Eusenbein Feduraten Piool Paa Encietur Prior Rais Management, Pool Paa Encietur Prior Rais Management, Reispine Piool Paa Encietur Prior Rais Management,	Esfats Esfats 24 Peel Orada Satoanento Feek utaid Jaddoorvitte	In our dense of the first time tracket from times the advancement of the second secon
	A biologicality to Edited by French Terrorito for Proc Strand Concernation Research Concernation A biological strategies and the Strange Terrorito Concernation Concernation and Product Concernation Concernation Concernation Concernation Concernation Concernation Concernation Concernation Protoco Concernation Concernation Protoco Concernation Analysis Engenesis of Concernation Analysis Researce Stated Concernation Analysis Researce Stated Concernation Concernation Researce Stated Concernation Concernation Concernation Concernation Concernation Concernation Researce Stated Concernation Concernation Concernation Concernation Researce Stated Concernation C	sency Flore By Ac orient Protect Pea et andeler Hydrolog a River	counting for additiv		Paul Paul Recise Paul Recise Paul Paul Paul Paul	No No No No No No No No	97520999 84500999 945262997 945240997 955340997 955340997 955340997 955340997	Anticipate from two standards Manage 2002/2012 Anticipate 2015 for two standards Manage 2012/2012 The Conversition Standards Association of the Anticipate Association of the Association of the Anticipate Association of the Anticipate Association of the Association of the	Post Plan Frechter Post Fals Nanaperent Post Plan Frechter Post Fals Nanaperent Ecosystem Folken Henrik Post Plan Fals Nanaperent Post Plan Frechter Post Fals Nanaperent Post Plan Frechter Post Fals Nanaperent Post Plan Facultur Post Fals Nanaperent Post Plan Facultur Post Fals Nanaperent	Esfats Esfats 24. Peel Oradia Satisamento Feek utaiet Jacksonville Lesiaville	In our dense of the second sec
	A bit backgroup to Librarian Prevandor Pro- Barrard Analysis Markinson. Day Pro- Barrard Analysis Markinson. Day Pro- tection and Analysis Markinson. Day Pro- Security of Control Control (1997) A sec- ption of Control Control Markinson. Proceeding Control Analysis Proceeding Control Control Control Markinson Control Control Markinson Control Control Control Control Markinson Control Control Control Control Markinson Control Control Control Control Markinson Control Control Control Control Control Markinson Control Control Control Control Control Markinson Control Control Control Control Control Control Control Markinson Control Co	seersy Plant By As one of Protect Protect and share Hydrolog a Down	counting for adulty pi Moeins	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Faul Faul Becker Faul Faul Faul Faul Faul Faul Faul Faul	Ne Ne Ne Ne Ne Ne Ne Ne	87520998 86520998 96280297 91090982 955340997 945550997 861952998 861952998 861952998 861952997	Anatod and Boos new periodical Manage CAD 2023. Annual periodic Section and Section Manage CAD 2023. The Convers Lake Hondral Canada Section and Section and Section and Section And Section And Section And Section And Section And Section And Section And Section And And Section And Section And And Section And And And And And And And And And An	Paral Para Recolor Paral Ras Nanaparenti Para da Bandor Paral Ras Nanaparenti Canapenes Reador Bine Tana Nanaparenti Dana da Bandore Paral Ras Nanaparenti Paral Para Raschare Paral Ras Nanaparenti Dana Da Nashander Paral Ras Nanaparenti Canaparenti Paral Ras Nanaparenti Canaparenti Paral Ras Nanaparenti	Parfato Barfato Sal Paul Omatra Satramento Paula dana Astosovelle Lasavelle Sat Paul	In our Descent, Leak to Ethols, then Inselant Fina Seam- and Seamanna, Territory, San Seamann, S
	A shedrowing the Calculate Province On Pro- teored Province and Pro- Province Province Pro- Province Pro- Pro- Province Pro- Pro- Pro- Pro- Pro- Pro- Pro- Pro-	servy Flast By A control Praid Praid of Praid Praid active Hydrolog Die Des	counting for adulty pi Moeins	2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	Paul Paul Becker Paul Paul Paul Paul Paul Paul Paul Paul	Pie Nie Nie Nie Nie Nie Nie Nie Nie Nie	87520999 88520099 9656099 9650999 9850999 9850999 9850999 88300997 8756097 8756097	Anticid of look rever an enderstand ladering CGO 2012. Annual part from twee stratycell individuals (CGO 2014) The Convers Late Holds Antice Conversion and the Conversion and Conversion and Conversion Antice Conversion and Antice Conversion Antice Conversion and Antice Conversion Antice Conversion and Antice Conversion Antice Conversion and Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conversion Antice Conv	Pose Plan Reschor Pose Flan Nanapereck Pose Clan Reschor Pose Flan Nanapereck Casepose Robot Sell Nano Clan Reschor Pose Flan Nanapereck Nano Sell Nan Reschur Pose Flan Nanapereck Nano Sell Nano Sell Nanapereck Nano Sell Nanapereck Nano Sell Nanapereck Nano Sell Nanapereck Sell Nanapereck Nanapereck Nanapereck	Bufalo Bufalo 20 Pedi Orapia Sociaento Rech stand Jobasovite Louisella 20 Pedi 30 Pedi Abuta	Nov Present, Leet te fabric ter header free term anderstellung von Erstellung von Stellung von Stellung von Stellung von Stellung von Stellun
	A bibliographic process that in the second of the second o	servy Flast By A control Praid Praid of Praid Praid active Hydrolog Die Des	counting for adulty pi Moeins		Final End Bester Final F	Pie Pie Pie Pie Pie Pie Pie Pie Pie Pie	87520999 88520999 9656297 9750995 9750997 9750299 9756297 9756297 9756297	Anator do Buor tens andreads Markano CG 2014 Anator and Buor tens antipado Markano CG 2014 Anator and Buor tens antipado Markano CG 2014 Anator and Anator and Anator antipado Anator and Anator and Anator Anator and Anator A	Parak Pak Pecudiar Parak Pak Nanagamani Peruda Pak Penudiar Parak Pak Nanagamani Data Pak Paka Pak Pak Nanagamani Paka Pak Paka Pak Pak Pak Nanagamani Paka Pak Paka Paka Pak Pak Pak Paka Paka Paka Pak Paka Paka	Bufali Bufali Difali 3: Ped Oraba Sacieneetti Buskineetti addasevite Sacieneetti Sacieneetti Adapameet	In our dense of the sector of





US Army Corps of Engineers ®

QUESTIONS/COMMENTS?



