Thank you for signing in early

The webinar will begin promptly at
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SERDP and ESTCP Webinar Series

The webinar will begin promptly at 12:00 pm ET, 9:00 am PT

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     Required conference ID: 6102000
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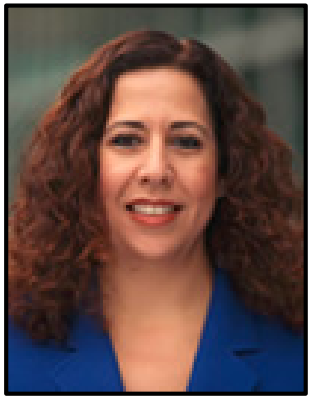
New Resource Conservation Insights to Desert Environments

October 5, 2017

SERDP DOD • EPA • DOE | ESTCP

Welcome and Introductions

Rula A. Deeb, Ph.D.
Webinar Coordinator



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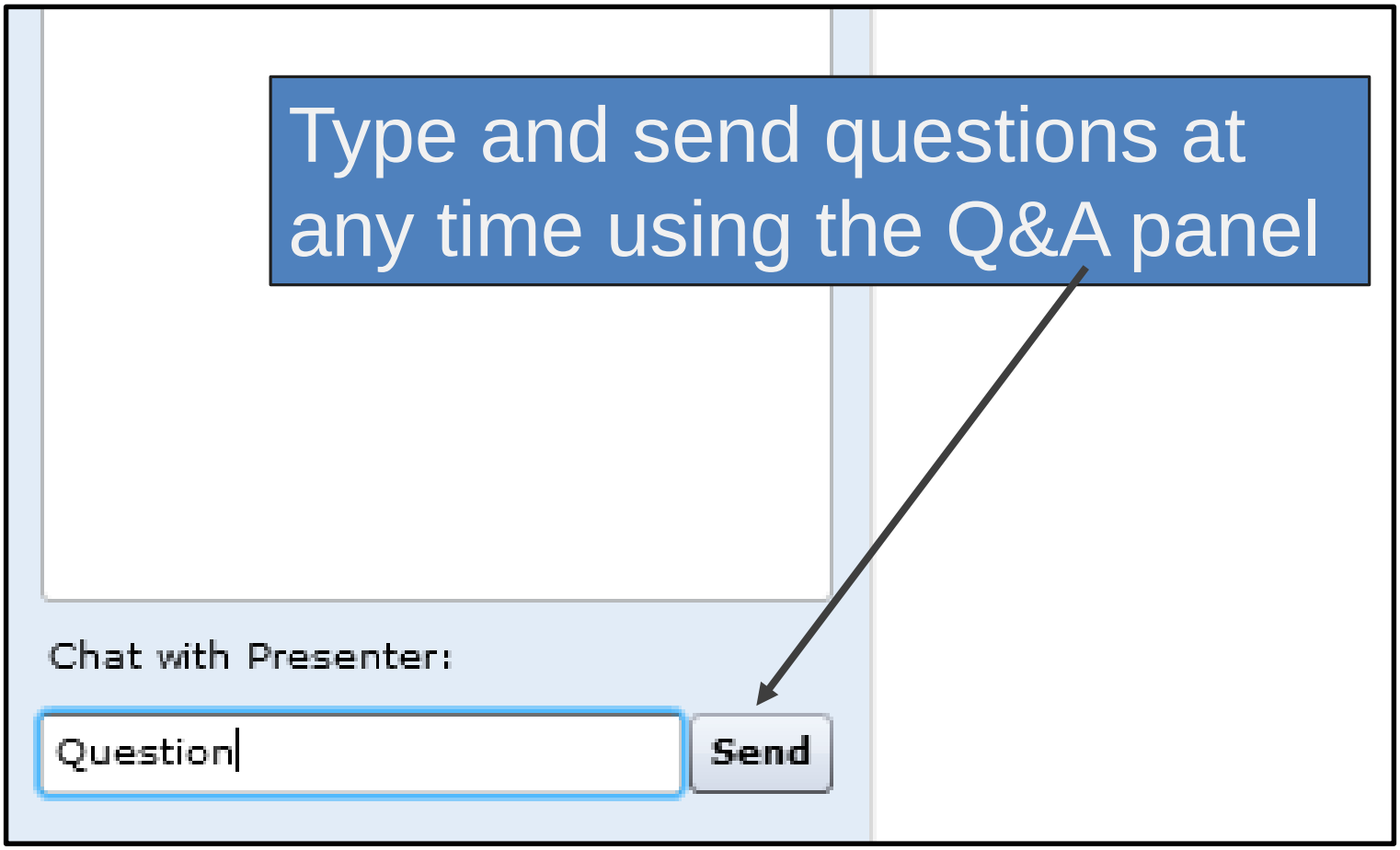
Webinar Agenda

- **Webinar Logistics** (5 minutes)
  Dr. Rula Deeb, Geosyntec Consultants
- **Overview of SERDP and ESTCP** (5 minutes)
  Dr. Kurt Preston, SERDP and ESTCP
- **Predicting, Measuring and Monitoring Aquatic Invertebrate Biodiversity on Dryland Military Bases** (25 minutes + Q&A)
  Dr. David Lytle, Oregon State University
- **More Extreme Monsoon Precipitation in the Southwestern United States and the Potential Implications for DoD Facilities** (25 minutes + Q&A)
  Dr. Christopher Castro, University of Arizona
- **Final Q&A session**

How to Ask Questions



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SERDP and ESTCP Overview

Kurt Preston, Ph.D.
Resource Conservation and Resiliency Program Manager

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SERDP

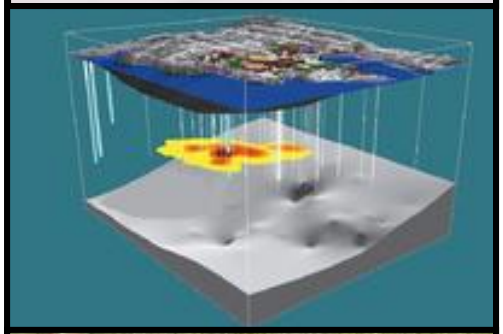
- Strategic Environmental Research and Development Program
- Established by Congress in FY 1991
  - DoD, DOE and EPA partnership
- SERDP is a requirements driven program which identifies high-priority environmental science and technology investment opportunities that address DoD requirements
  - Advanced technology development to address near term needs
  - Fundamental research to impact real world environmental management

ESTCP

- Environmental Security Technology Certification Program
- Demonstrate innovative cost-effective environmental and energy technologies
  - Capitalize on past investments
  - Transition technology out of the lab
- Promote implementation
  - Facilitate regulatory acceptance

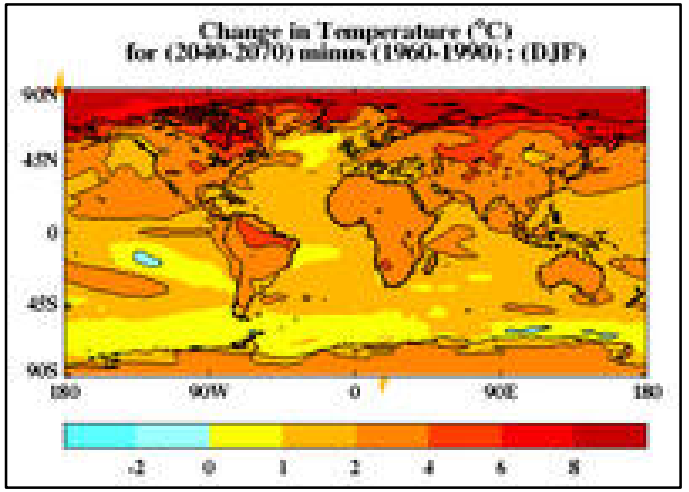
Program Areas

1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Resiliency
5. Weapons Systems and Platforms


Resource Conservation and Resiliency

- Natural resources
  - Ecological forestry
  - Arid lands ecology and management
  - Cold regions ecology and management
  - Pacific island ecology and management
  - Coastal and estuarine ecology and management
  - Living marine resources ecology and management
  - Species ecology and management
  - Watershed processes and management
- Climate change
  - Vulnerability and impact assessment
  - Adaptation science
  - Land use and carbon management
- Air quality
  - Fugitive dust
  - Fire emissions



SERDP and ESTCP Webinar Series

Date	Topic
October 19, 2017	Laser De-Paint and Surface Preparation Mechanism and Technologies
November 2, 2017	Platforms for Underwater and Near-Shore Munitions Surveys
November 16, 2017	Building Envelop Technologies
December 7, 2017	Management of Novel Hawaiian Ecosystems

For upcoming webinars, please visit

http://serdp-estcp.org/Tools-and-Training/Webinar-Series

SERDP • ESTCP SYMPOSIUM

2017 | Enhancing DoD's Mission Effectiveness

A three-day symposium showcasing the latest technologies that enhance DoD's mission through improved environmental and energy performance

- November 28 - November 30, 2017
- Washington Hilton Hotel
  1919 Connecticut Avenue, NW
  Washington, DC 20009
- ***Registration is open***

Predicting, Measuring and Monitoring Aquatic Invertebrate Biodiversity on Dryland Military Bases

David A. Lytle, Ph.D.
Oregon State University

SERDP
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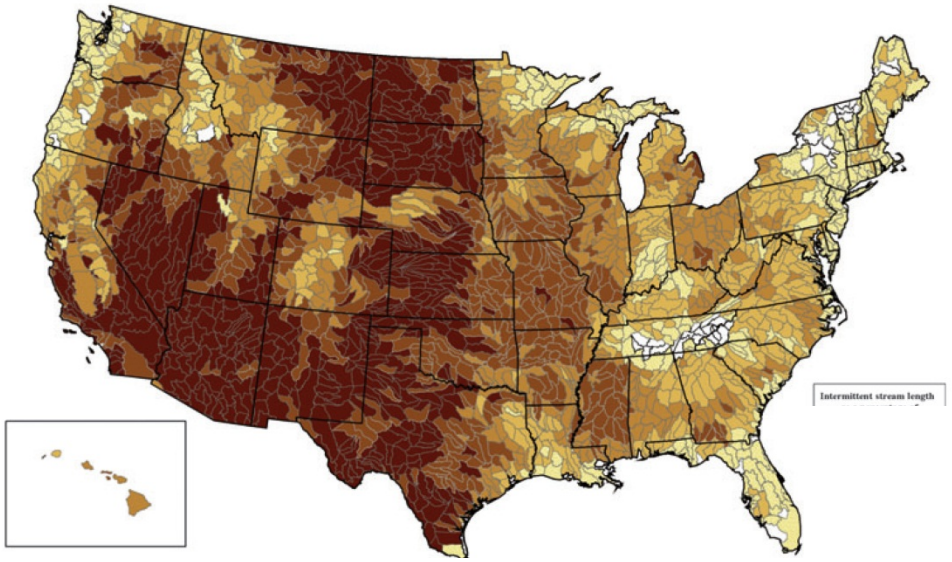
Agenda

- Importance of dynamic hydrology for dryland streams
- Aquatic invertebrate dataset for southwestern military lands
- Niche and neutral models for estimating biodiversity and functional diversity
- Web-based tools for managing invertebrate biodiversity on military lands

Motivation

- Military bases in the southwestern United States harbor both intermittent and perennial streams: how do these stream networks maintain biological and functional diversity?



Nadeau and Rains (2007)

% Intermittent streams

0 50 100

Stream Hydrology is Dynamic

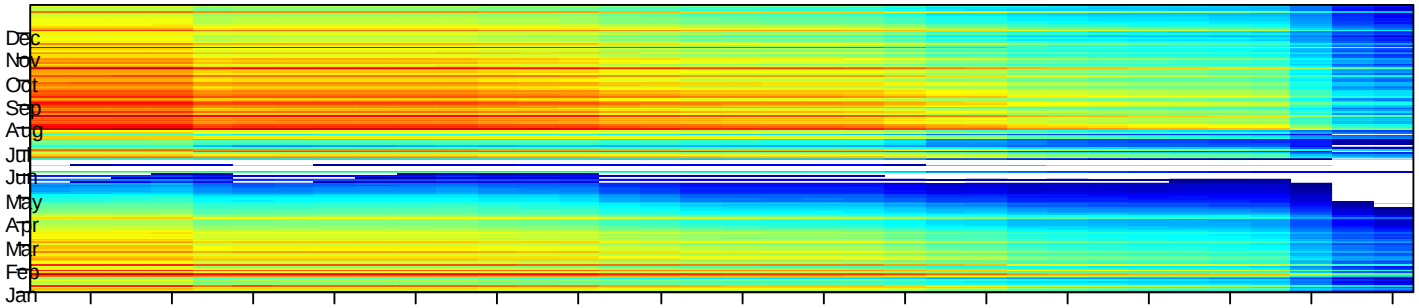
- Stream drying occurs at multiple spatiotemporal scales
- The prevalence of dryland rivers may increase in response to altered land-use, greater human water use and climate change
- Stream drying causes the loss of longitudinal connectivity for aquatic biota

Brown Canyon, Huachuca Mountains, AZ

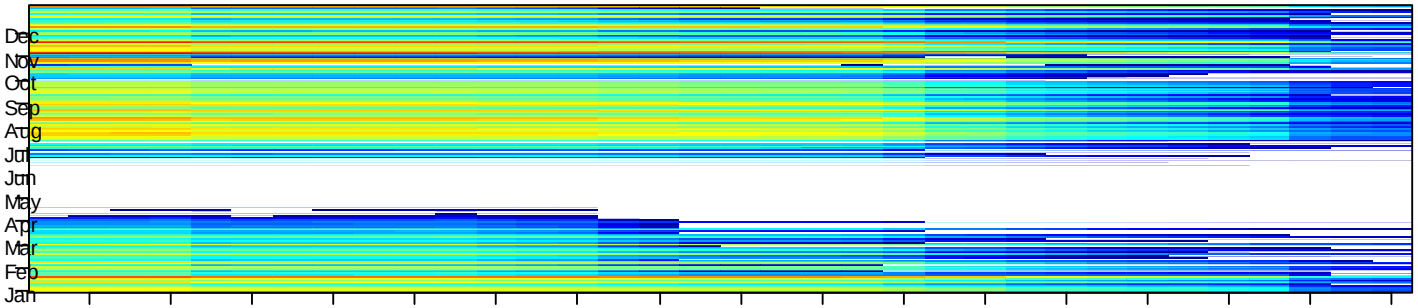
Streams Will Become More Intermittent and Fragmented

Fort Huachuca, AZ

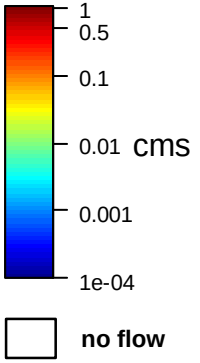
Present Day



Projected Future (2080-2100)



Mean daily flow

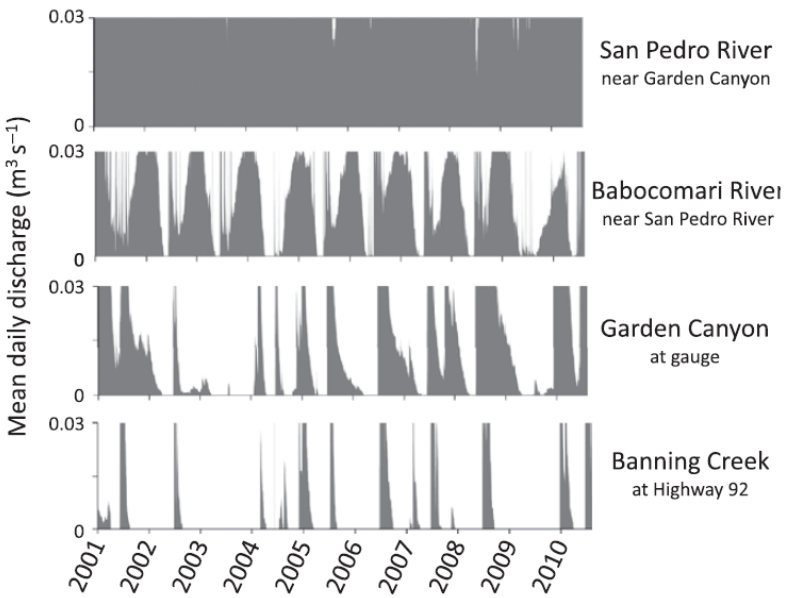


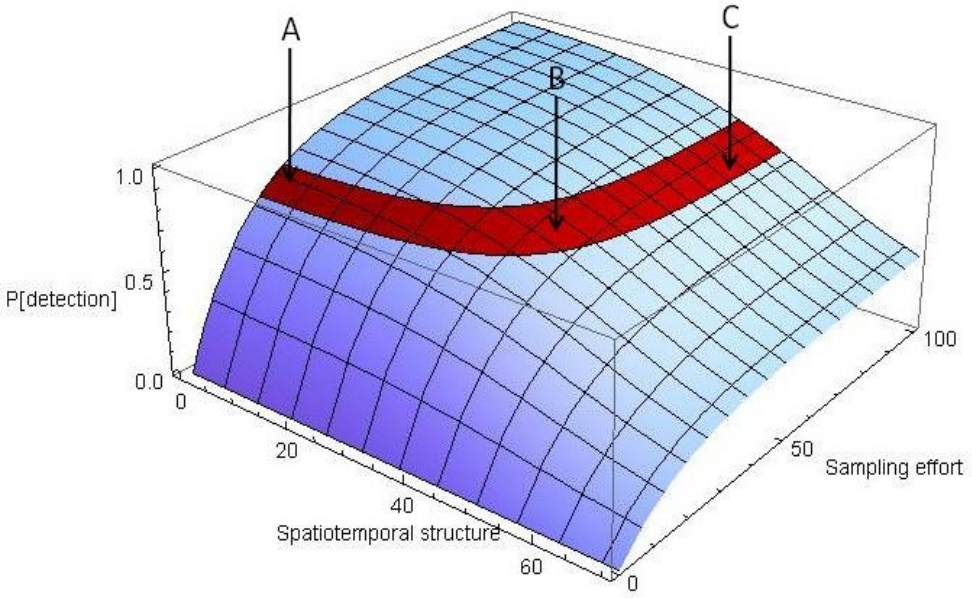
Downstream ***Upstream***

Source: RC-1724

Spatiotemporal Variability

- Spatiotemporal variability (SV) facilitates high landscape-level diversity via niche partitioning and other ecological mechanisms
- However, SV presents measurement challenges because detection probability for a species declines with increasing SV

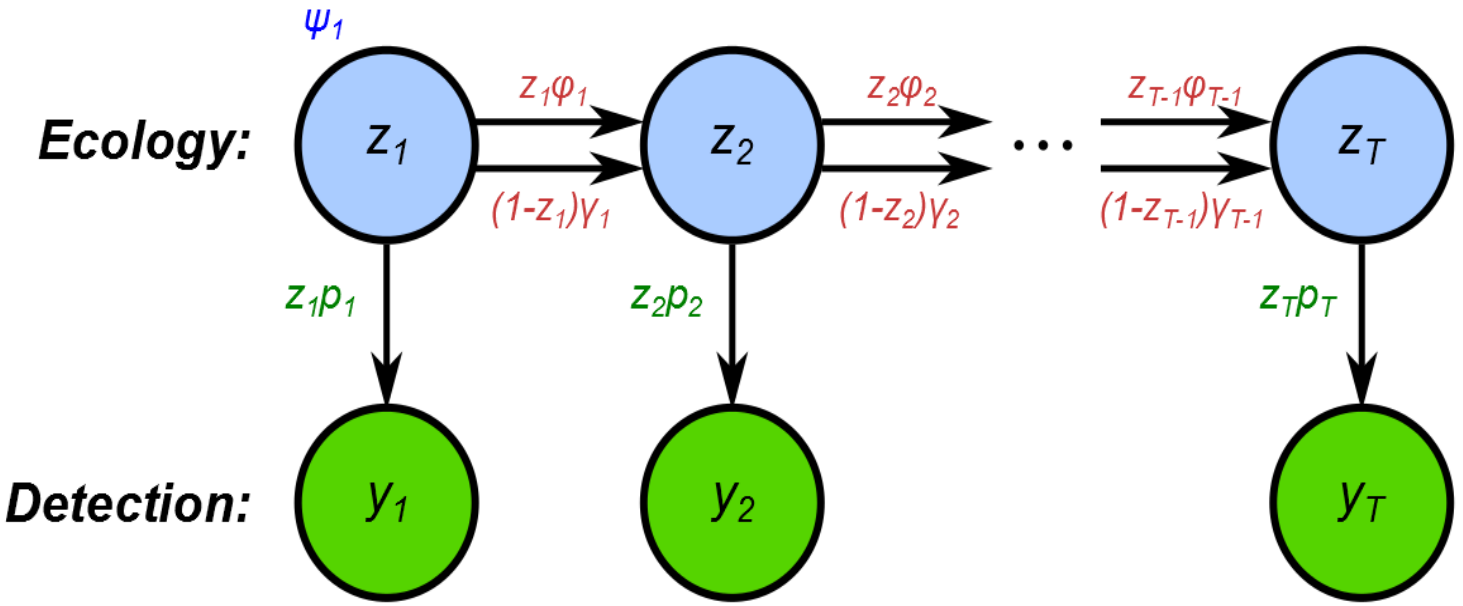




Species A – reliable detection
Species B,C – higher SV requires greater sampling effort

Detecting Species is a Two-fold Process

- Species must be present at time of sampling (ecology)
- Given species presence, surveyors must be able to observe it (detection)

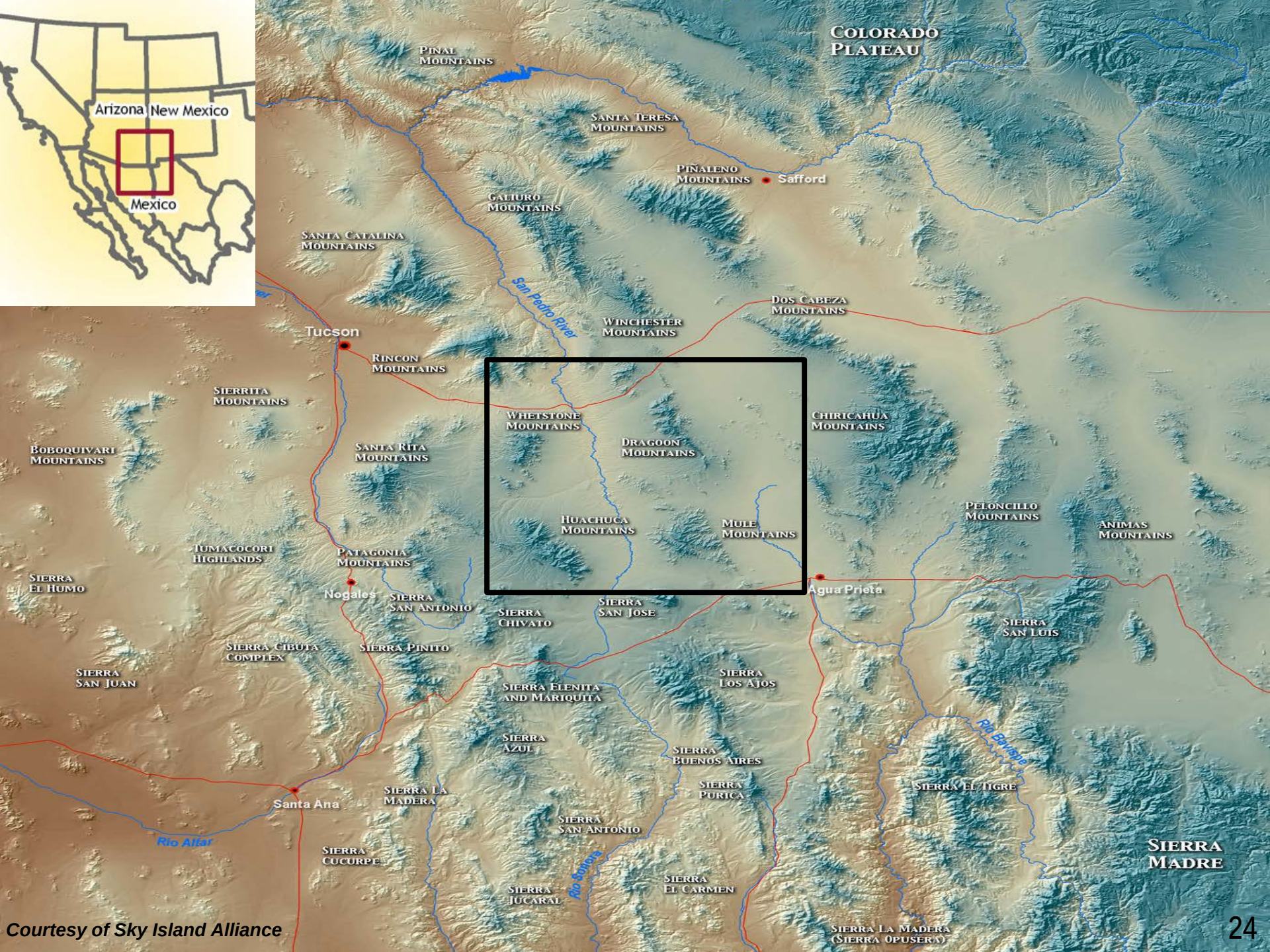


Schematic of a Bayesian occupancy model that incorporates detectability and ecology of species

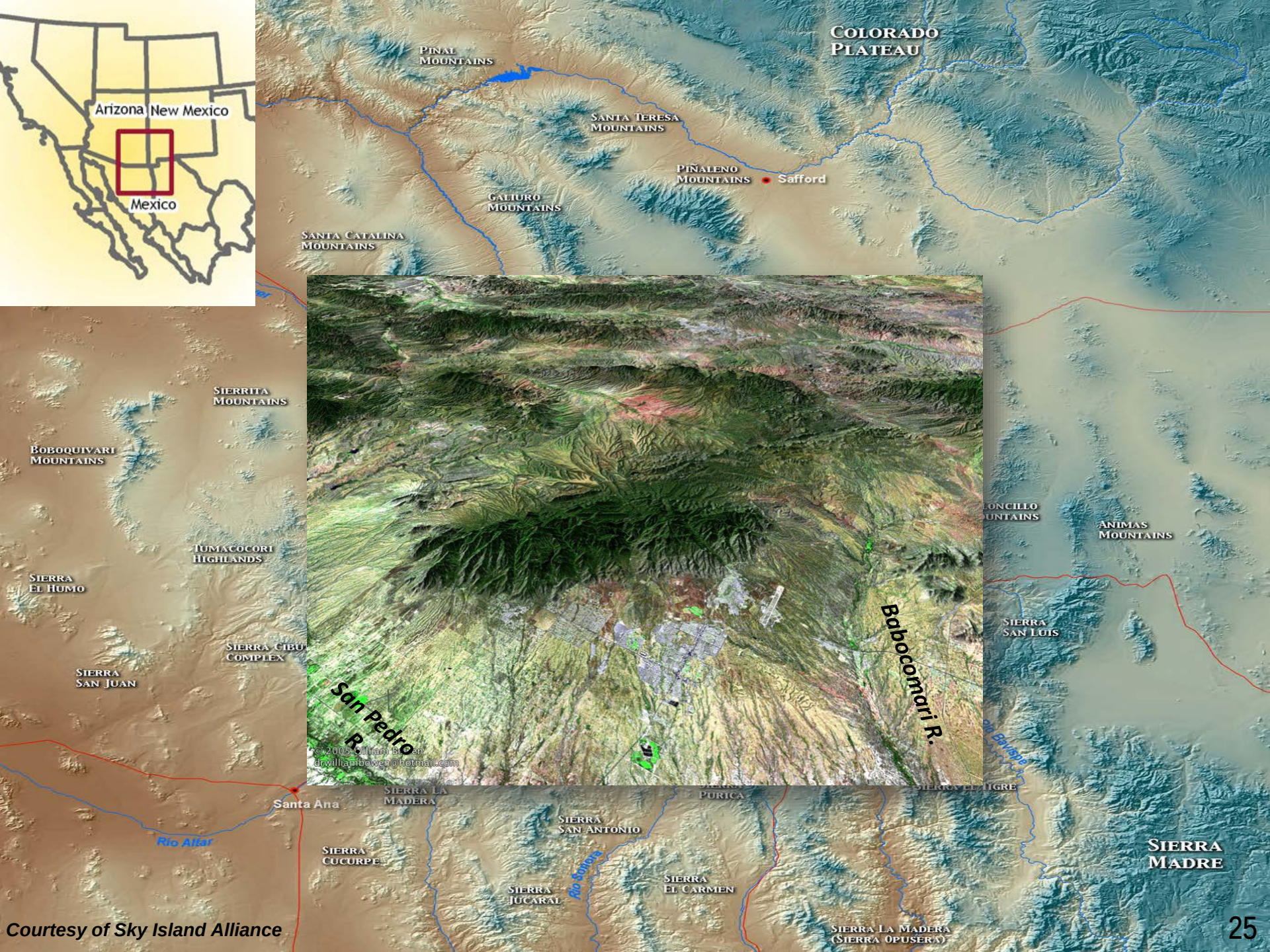
Aquatic Invertebrate Biodiversity

- OCH fauna (Odonata – dragonflies; Coleoptera – aquatic beetles; Hemiptera – aquatic bugs) at Fort Huachuca (AZ), White Sands Missile Range (NM) and NAWS China Lake (CA)
- Physico-chemical habitat measurement and landscape-level data
- Estimates of sampling effort, power and efficiency by resampling a subset of sites





Courtesy of Sky Island Alliance



Courtesy of Sky Island Alliance

Aquatic Invertebrate Biodiversity

- Sampling on all three bases (2012 - 2016 inclusive)
  - 731 samples collected
  - Over 339,692 specimens identified
- Raw species diversity (OCH plus other taxa)
  - Fort Huachuca, AZ: 313
  - China Lake, CA: 89
  - White Sands, NM: 131
- Baseline dataset for future management efforts
- Powerful dataset for exploring dryland river networks

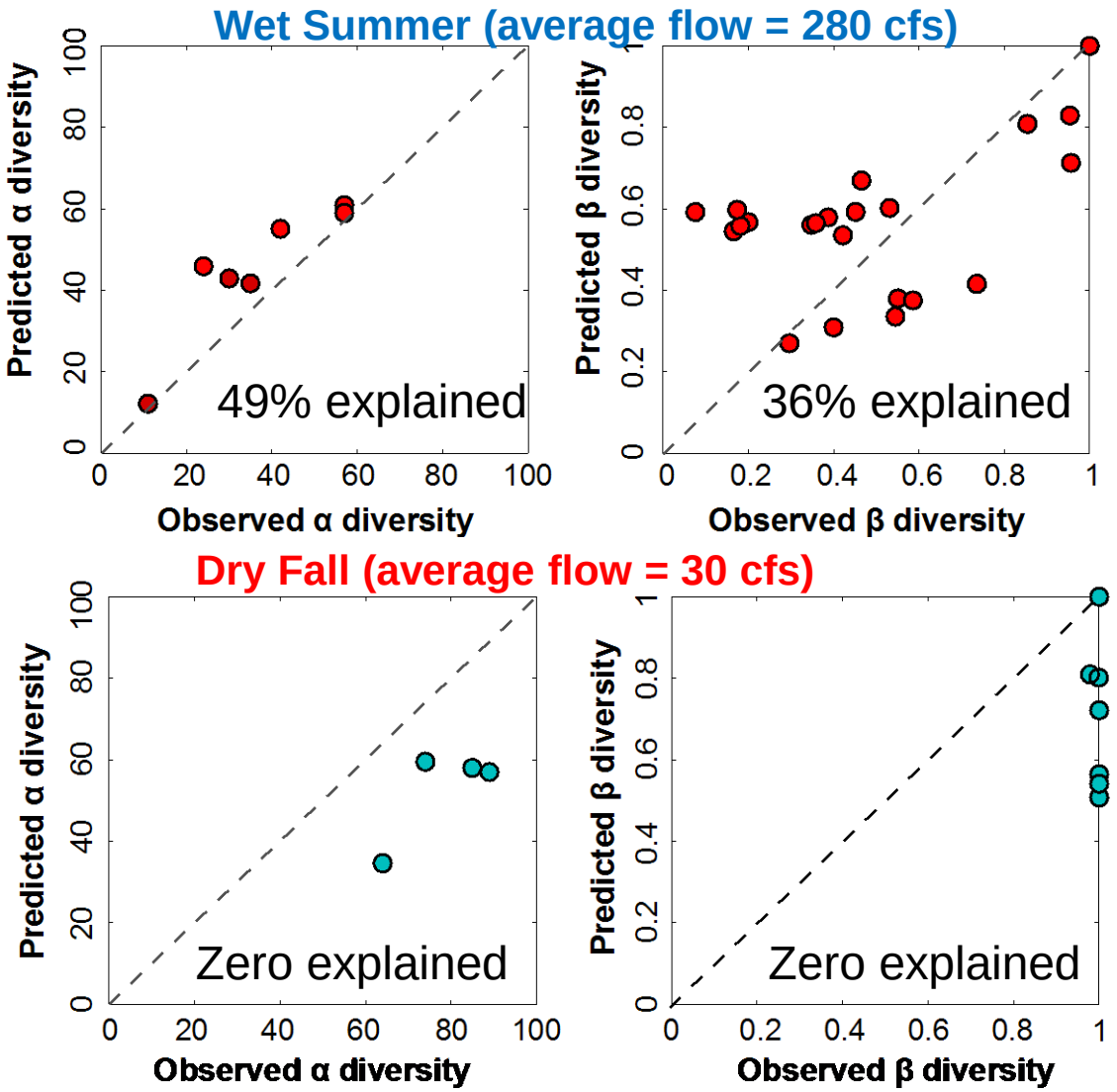
Niche vs. Neutral Models

- Niche-based models
  - Mechanistic. The species niche (intrinsic characteristics of the species) interacts with the environment (extrinsic drivers) to determine patterns of occurrence
  - Implemented with machine-learning methods; robust to nonlinearities and interactions in data
- Neutral metacommunity models
  - Require almost no information about the biology of organisms (hence “neutral”)
  - Good at predicting biodiversity magnitudes in aquatic and terrestrial ecosystems
  - Useful **null model** for isolating the importance of other factors (habitat degradation, invasive species, management decisions, etc.)

Neutral Models: Just Add Water

- Neutral metacommunity models perform better in wet periods (i.e., wet years or wet seasons) than dry periods)

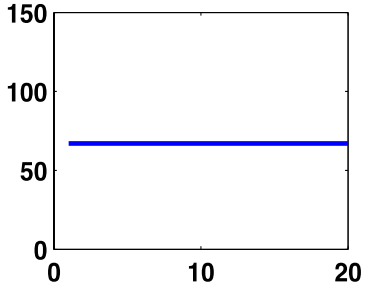
Predicted α and β diversity during wet and dry seasons

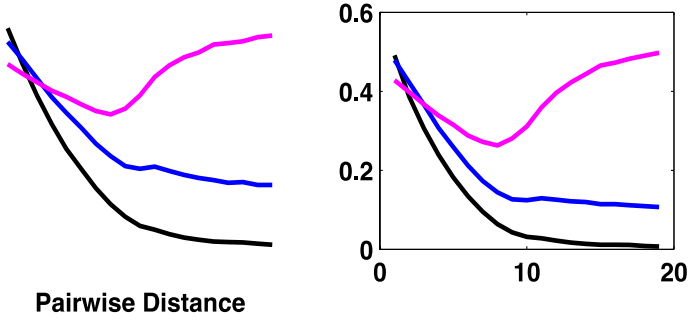


Neutral Models

Useful for Avoiding Bias

- Traditional biodiversity estimators can be biased when sites differ in size (Ecosphere, 2016)
- This is a problem when comparing pools vs. ponds, streams vs. rivers
- A simple solution: **Always use the Chao biodiversity estimator**





Dispersal level

local dispersal

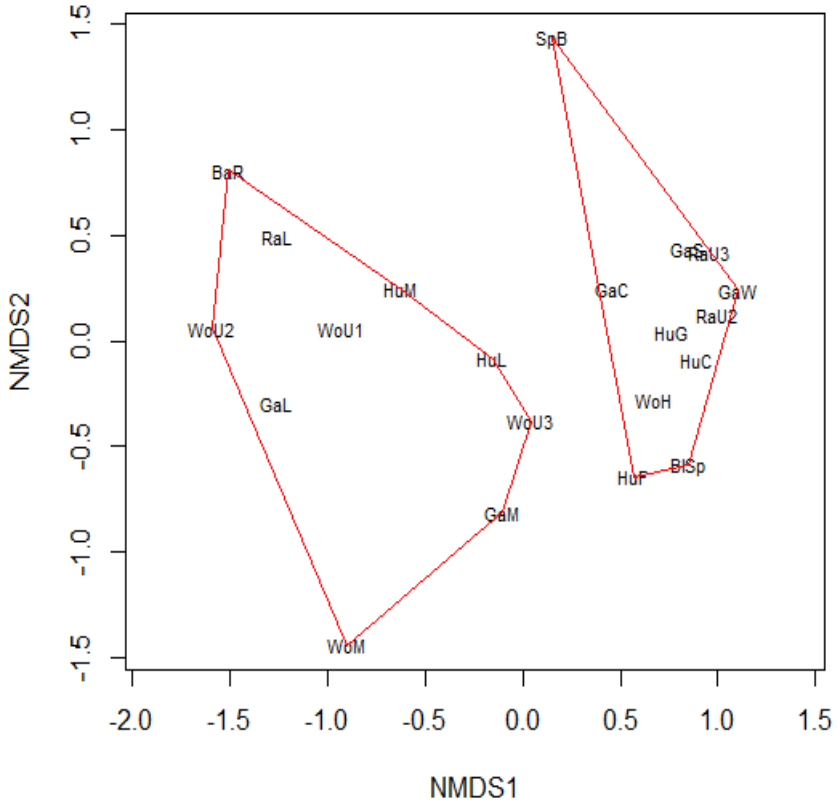
Intermediate

widespread

Niche-Based Models

Hydrology Matters

- Hydrology (perennial vs. intermittent and ephemeral flows) has a strong influence on species distribution patterns
- Emphasizes need to manage intermittent sites, as well as prized perennial sites

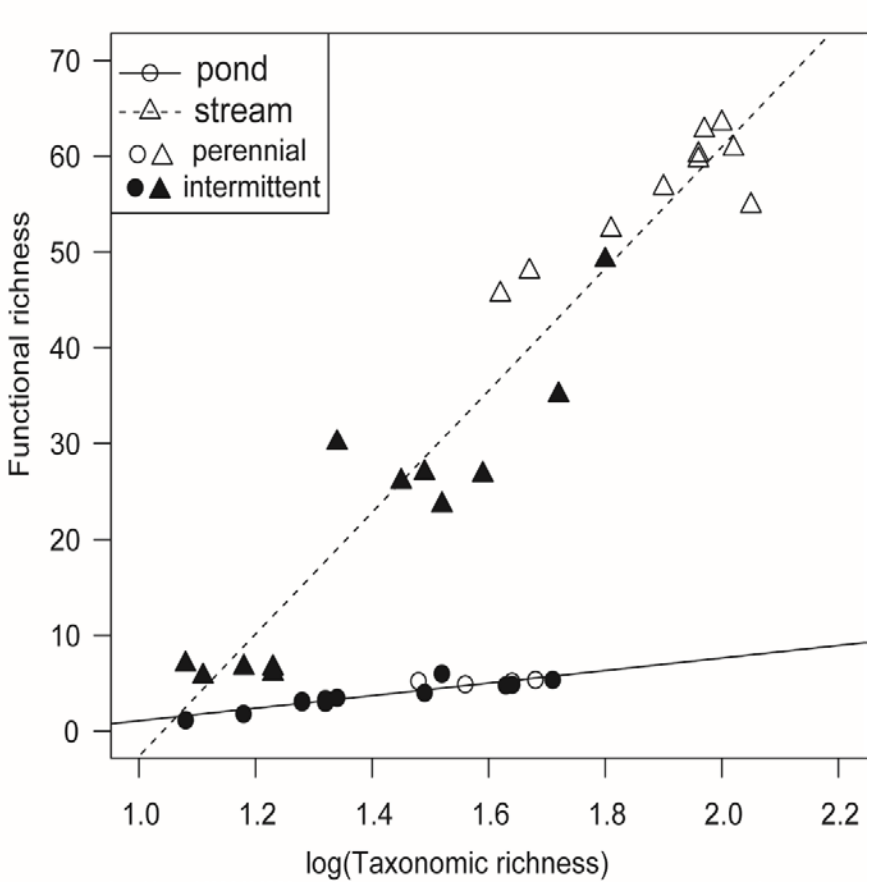


NMDS (non-metric multidimensional scaling) plot of samples. Sites closer to each other are more similar in terms of species composition

Niche-Based Models

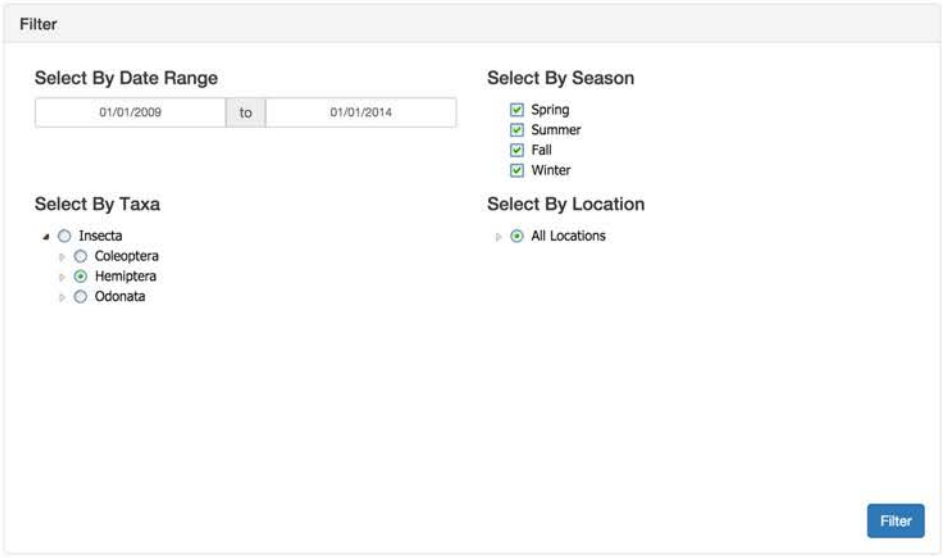
Species Don't (Always) Matter

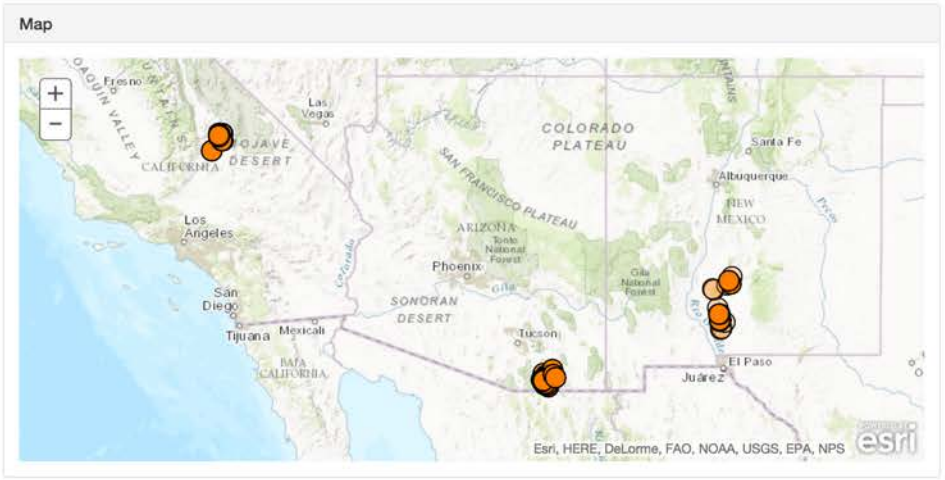
- Functional (trait) richness of pond and stream invertebrates converges, despite almost no overlap in species pools (Ecosphere, 2016)
- Potential for shared management tools and objectives across military bases

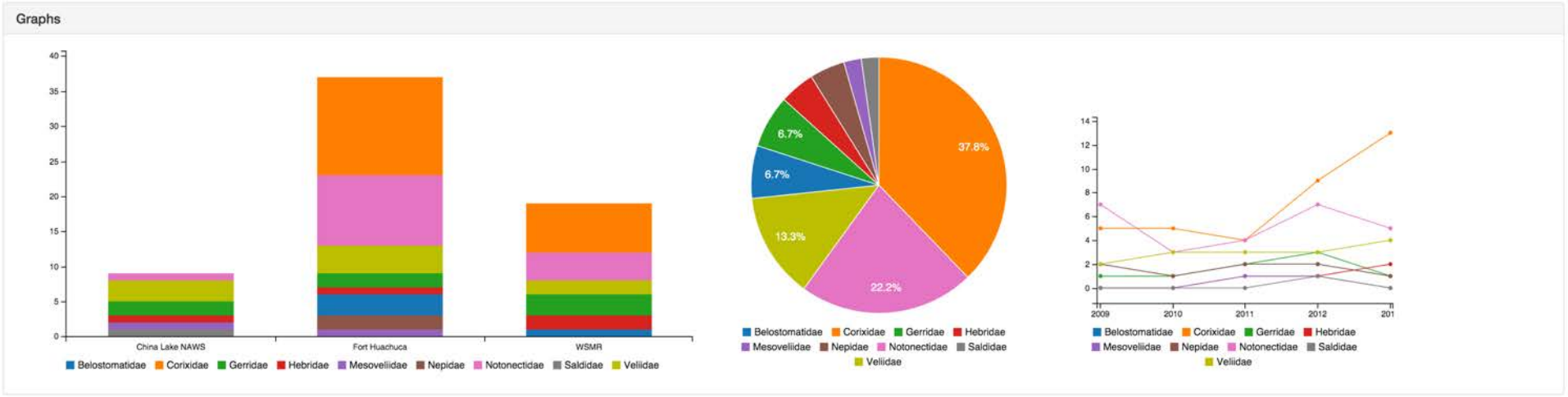


Functional richness of stream (Arizona) and pond (Ontario, Canada) invertebrates from perennial and intermittent sites

Web-Based GUI

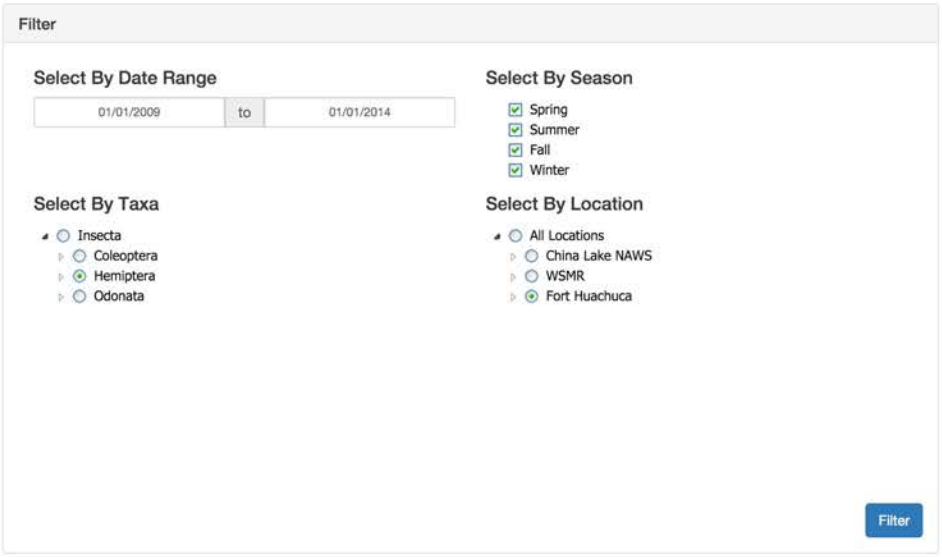


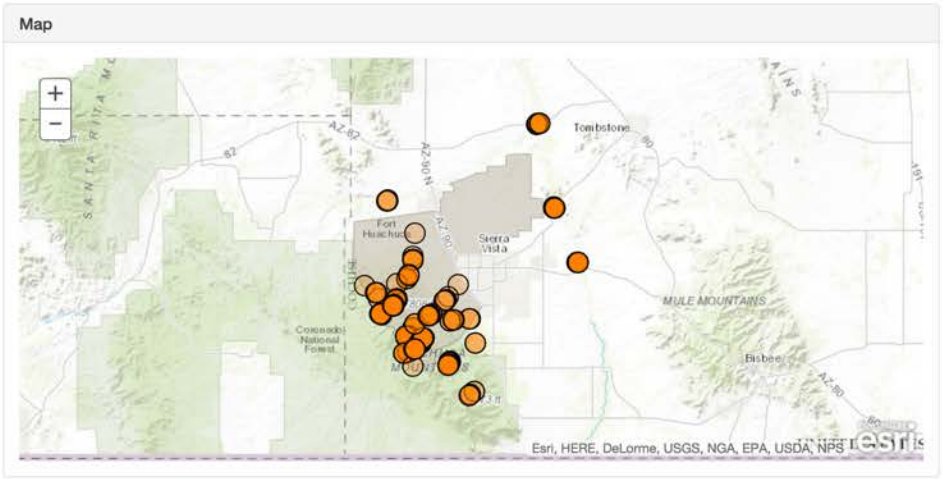


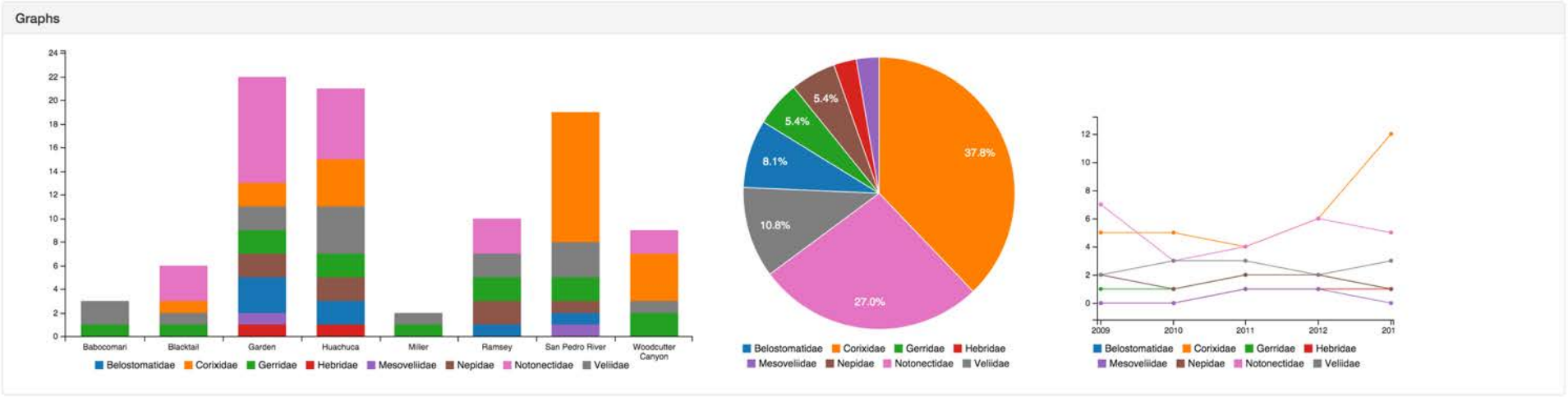


http://lytle-capstone.science.oregonstate.edu/app/

Web-Based GUI







http://lytle-capstone.science.oregonstate.edu/app/

Conclusions

Management and Conservation

- Consider the hydrology of sites in management plans; hydrology affects biodiversity, ecosystem processes and sample design
- The functional diversity of sites can be similar, despite different species pools; this makes cross-ecosystem management possible
- Intermittent habitats contribute to landscape-level biodiversity; manage for networks of sites rather than sole focus on perennial sites

Publications

- 2017. Tonkin, J.D., M.T. Bogan, N. Bonada, B. Rios-Touma, D.A. Lytle. Seasonality and predictability shape temporal species diversity. Ecology.
- 2017. Giam, X., W. Chen, T.A. Schriever, R. Van Driesche, R. Muneepeerakul, D.A. Lytle, J.D. Olden. Hydrology drives seasonal variation in dryland stream macroinvertebrate communities. Aquatic Sciences
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- 2016. Schriever, T.A., and D.A. Lytle. Convergent diversity and trait composition in temporary streams and ponds. Ecosphere.
- 2015. Dong, X., R. Muneepeerakul, J.D. Olden, & D.A. Lytle. Effect of spatial configuration of habitat capacity on beta diversity. Ecosphere DOI: 10.1890/ES14-00497.1
- 2015. Schriever, T.A., M.T. Bogan, K.S. Boersma, M. Cañedo-Argüelles, K.L. Jaeger, J.D. Olden, & D.A. Lytle. Hydrology shapes taxonomic and functional structure of desert stream invertebrate communities. Freshwater Science.
- 2015. Boersma, K.S., L.E. Dee, S.J. Miller, M.T. Bogan, & D.A. Lytle. Quantitative methods for examining trait-based hypotheses across communities. Ecology.
- 2015. Bogan, M.T., K.S. Boersma, & D.A. Lytle. Resistance and resilience of invertebrate communities to seasonal and supraseasonal drought in arid-land headwater streams. Freshwater Biology.
- 2015. Cañedo-Argüelles, M., K.S. Boersma, M.T. Bogan, J.D. Olden, I.C. Phillipsen, T.A. Schriever, D.A. Lytle. Dispersal strength determines metacommunity structure in a dendritic riverine network. Journal of Biogeography 42(4): 778-790.
- 2014. Boersma, K.S., M.T. Bogan, B.A. Henrichs, & D.A. Lytle. Top predator removals have consistent effects on large species despite high environmental variability. Oikos. DOI: 10.1111/oik.00925
- 2014. Boersma, K.S., M.T. Bogan, B.A. Henrichs, & D.A. Lytle. Invertebrate assemblages of pools in arid-land streams have high functional redundancy and are resistant to severe drying. Freshwater Biology 59: 491-501.
- 2013. Bogan, M.T., K.S. Boersma & D.A. Lytle. Flow intermittency alters longitudinal patterns of invertebrate diversity and assemblage composition in an arid-land stream network. Freshwater Biology 58(5): 1016-1028.

Acknowledgments

- Project co-PIs
  - Julian D. Olden, University of Washington
  - Rachata Muneepeerakul, University of Florida
- Fort Huachuca, White Sands Missile Range, and NAWS China Lake resource conservation managers and staff

For additional information, please visit
http://serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Natural-Resources/Arid-Lands-Ecology-and-Management/RC-2203

Speaker Contact Information

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SERDP DOD • EPA • DOE | ESTCP

Q&A Session 1

More Extreme Monsoon Precipitation in the Southwestern U.S. and the Potential Implications for DoD Facilities

Christopher L. Castro, Ph.D.
University of Arizona

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Seminar Outline

- Monsoon weather hazards and DoD concerns
- Convective-permitting modeling and monsoon meteorology
- High resolution modeling approach, performance
- Changes in atmospheric environment, extreme weather
- Translation of information to DoD facility scale
- Concluding points

Monsoon Severe Weather Hazards

Effects of Anthropogenic Climate Change?

Video

https://www.youtube.com/watch?v=RLGCmnX_yH4

Thunderstorm Impacts of DoD Interest

- Precipitation amount
- Precipitation intensity
- Wind gusts (outflow boundaries)
- Spatial location
- Timing

Weather Watch and Warning Criteria

25th Operational Weather Squadron (OWS)

Terminal Aerodrome Forecast (TAF)

Weather Watches

Watch Type	Criteria	Area Affected	Desired Lead Time	Mission Impact (other than those stated in AFMAN 15-129)	Issued By
Tornado	Tornado or Funnel Cloud	Aerodrome (5NM)	As potential warrants		OWS
Damaging Winds	Winds >= 50 kts	Aerodrome (5NM)	As potential warrants		OWS
Hail	>= ¾ inch	Aerodrome (5NM)	As potential warrants		OWS
Freezing Precipitation	Any	Aerodrome (5NM)	As potential warrants		OWS
Heavy Snow	>= 2" in 12 hrs	Aerodrome (5NM)	As potential warrants		OWS
Heavy Rain	>= 2" in 12 hrs	Aerodrome (5NM)	As potential warrants		OWS
Lightning	Potential Within 5 nm	Aerodrome (5NM)	30 minutes		OWS
Lightning	Within 5 nm of Aerospace Maintenance and Regeneration Group (AMARG)	Aerodrome (5NM)	30 minutes		OWS

Weather Warnings

Warning Type	Criteria	Area Affected	Desired Lead Time	Mission Impact (other than those stated in AFMAN 15-129)	Issued By
**Tornado	Tornado or Funnel Cloud	Aerodrome (5NM)	30 minutes		OWS
**Damaging Winds	Winds >= 50 kts	Aerodrome (5NM)	60 minutes		OWS
**Strong Winds	Winds 35-49 kts	Aerodrome (5NM)	60 minutes		OWS
**Hail	>= ¾ inch	Aerodrome (5NM)	60 minutes		OWS
**Freezing Precipitation	Any	Aerodrome (5NM)	90 minutes		OWS
**Heavy Snow	>= 2" in 12 hrs	Aerodrome (5NM)	90 minutes		OWS
Heavy Rain	>= 2" in 12 hrs	Aerodrome (5NM)	90 minutes		OWS
Lightning	Within 5 nm of Runway Complex	Aerodrome (5NM)	Observed		WF
Lightning	Within 5 nm of AMARG	Aerodrome (5NM)	Observed		WF

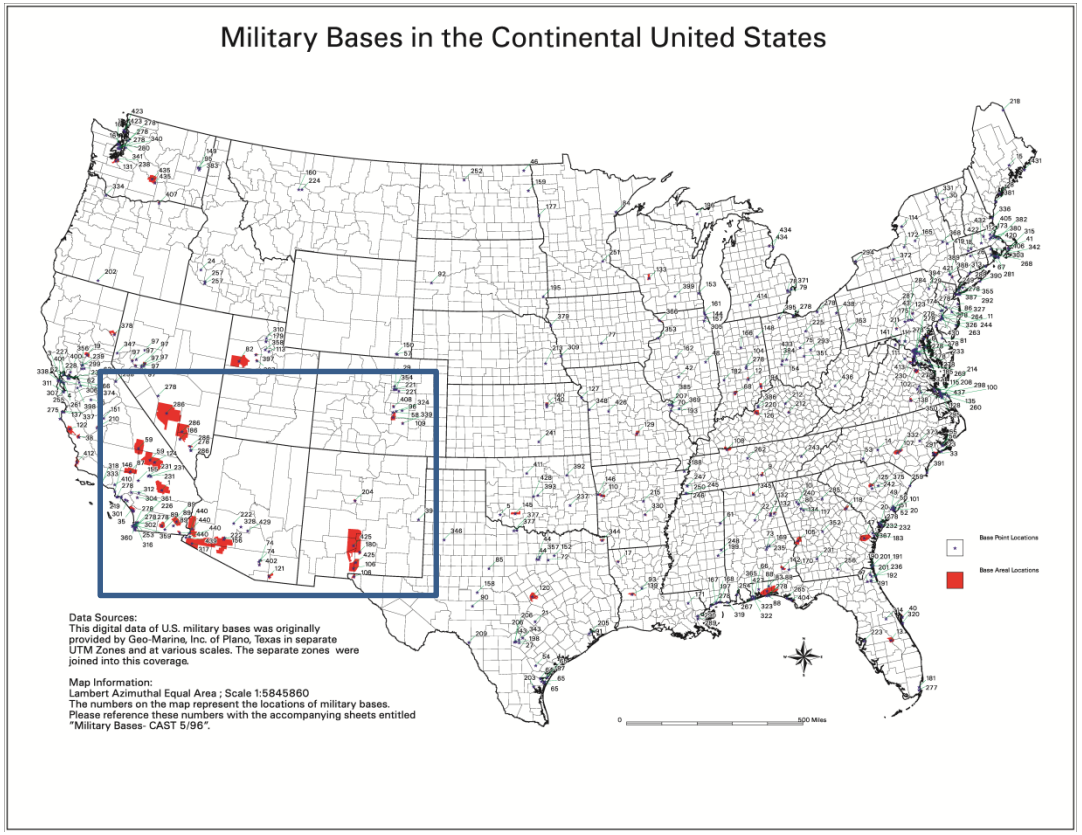
** NOTE: 355 OSS/OSW and/or DMAFB CP will ensure these WWA criteria are sent to the NAOC POC.

NOTES:

*ALL OBSERVED WEATHER WARNINGS AND ADVISORIES WILL BE ISSUED BY THE WEATHER FLIGHT DURING REGULAR DUTY HOURS. OWS WILL ISSUE OBSERVED WARNINGS/ADVISORIES WHEN THE WF IS NOT ON DUTY

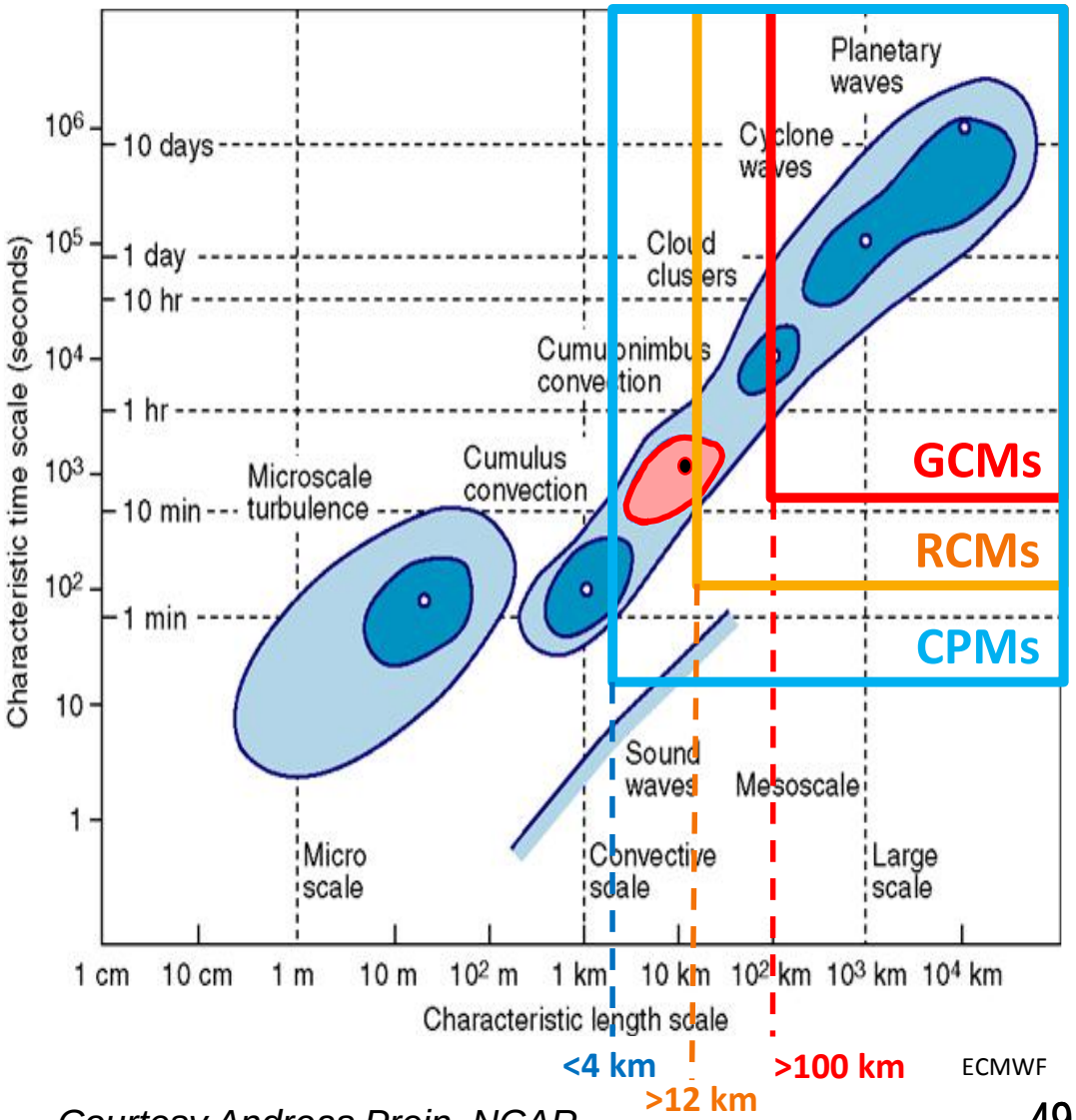
Technical Objectives

- Simulate extreme monsoon weather and evaluate changes
- Weather forecasting-based approach to climate change projection



Convection Permitting Models (CPMs)

- Grid spacing ≤ 4 km
- Weather forecasting
  - Weisman et al., 1997
  - Done et al., 2004
- Climate
  - Langhans et al., 2012



Courtesy Andreas Prein, NCAR

Monsoon Thunderstorms in Arizona

- Forced by the diurnal mountain valley circulation
- Form over the mountains during late morning to early afternoon
- Reach mature stage by about mid-afternoon

Monsoon thunderstorms at Kitt Peak at mature stage with gust fronts (Photo taken around 3 pm)

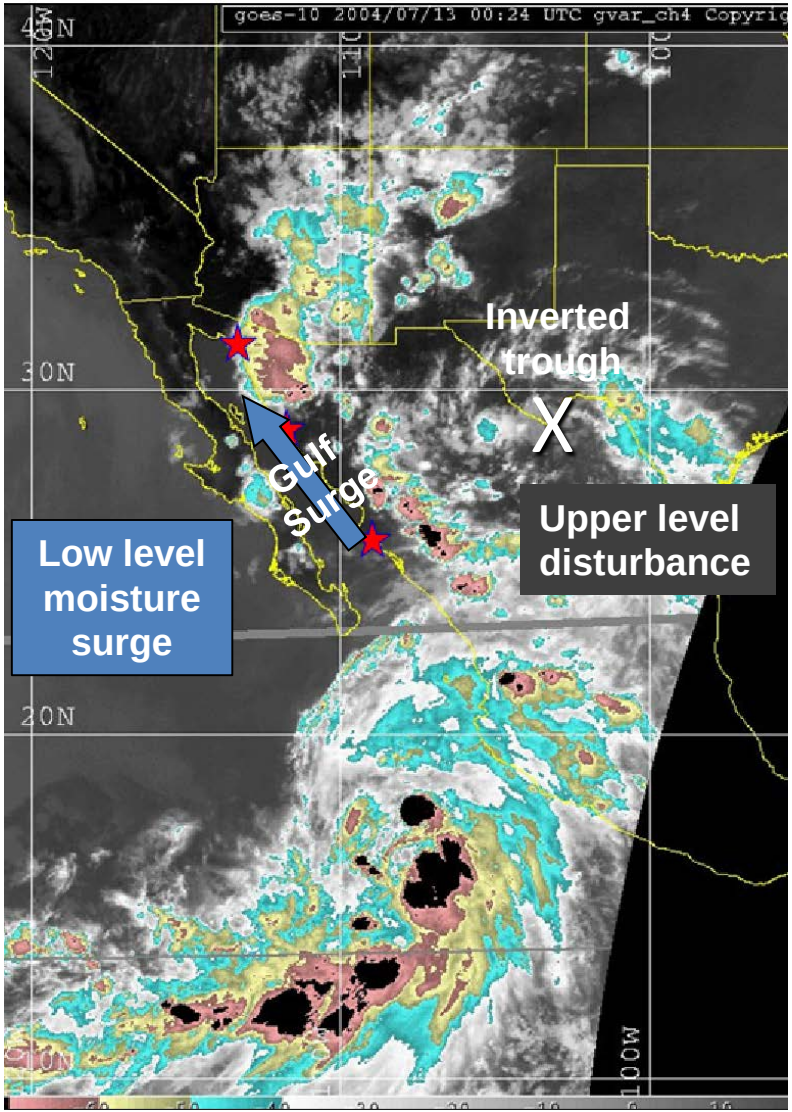
Conditions in Atmosphere for Strong Monsoon Thunderstorms

- Thermodynamic
  - Instability
  - Moisture
- Dynamic
  - Lifting
  - Wind shear

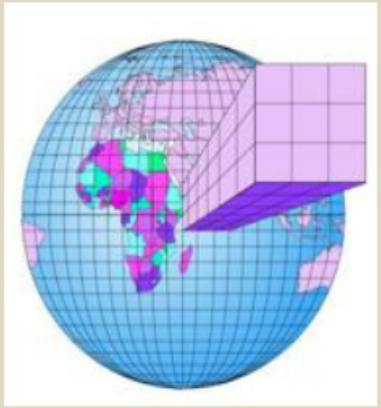
Monsoon Severe Weather Event

Example Day

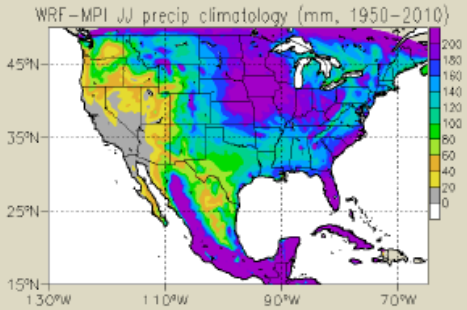
- Thunderstorms originate on the Mogollon Rim
- Intensify and move westward toward low deserts and the Colorado River Valley



Methodological Approach Using a Regional Climate Model (RCM)

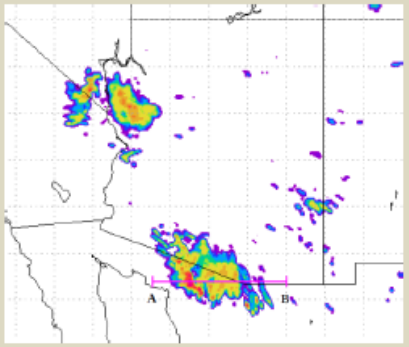


Long-term dynamical downscaling as RCM



Simulate identified severe weather events in RCM simulation

Radar reflectivity of simulated organized convection in Arizona



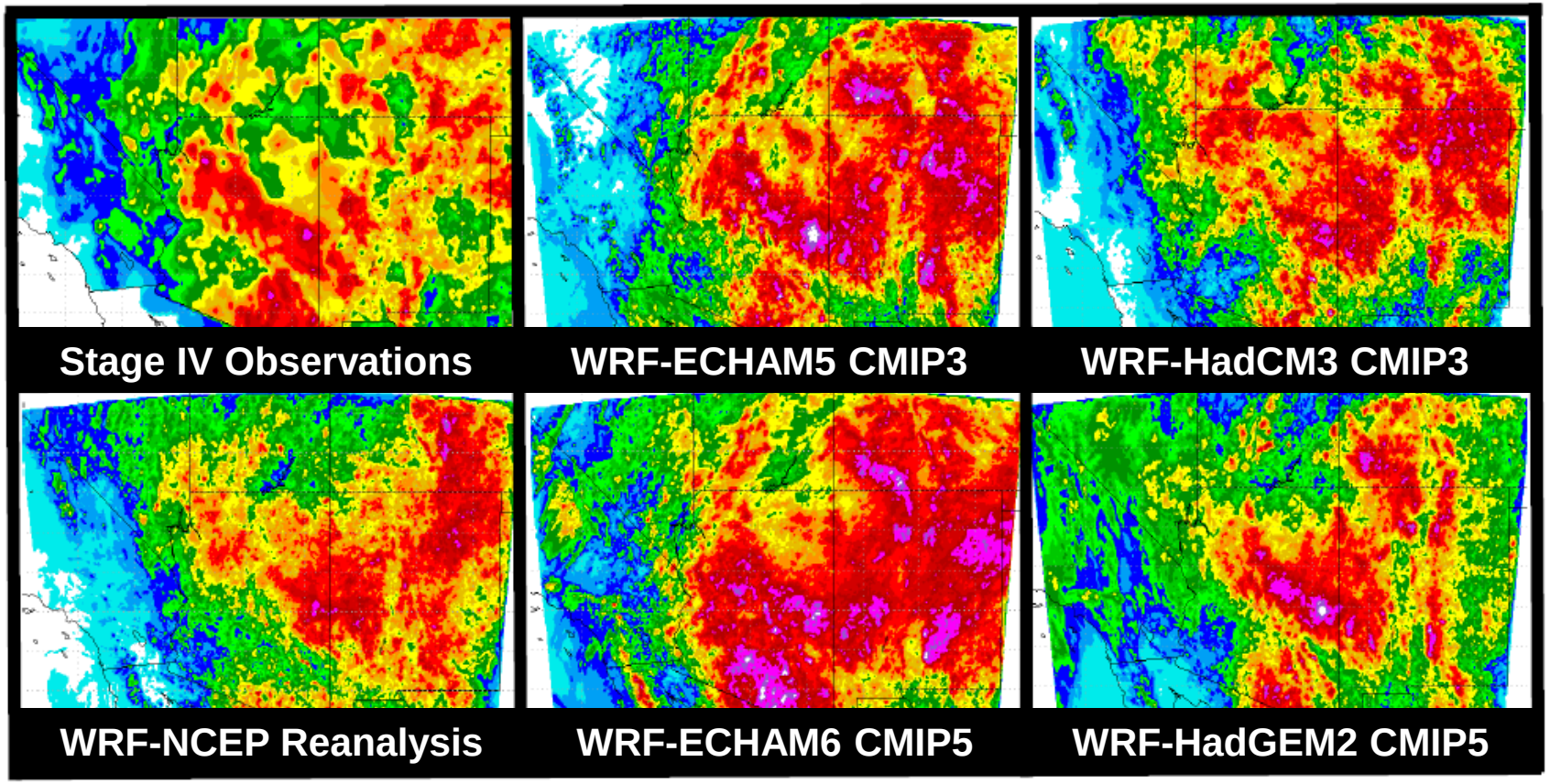
Select global climate change projection models and reanalysis (1-2.5^{o} resolution)

Baseline long term regional climate model simulations for historical and future periods (35-50 km resolution)

High resolution numerical weather prediction type simulations (2.5 km resolution)

Daily Average Precipitation

Modeled versus Observations

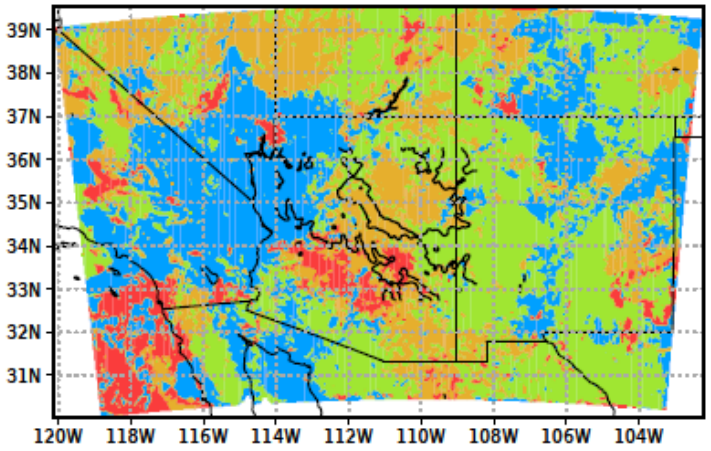


Luong et al. (2017, J. Appl. Meteor. Climatol.)

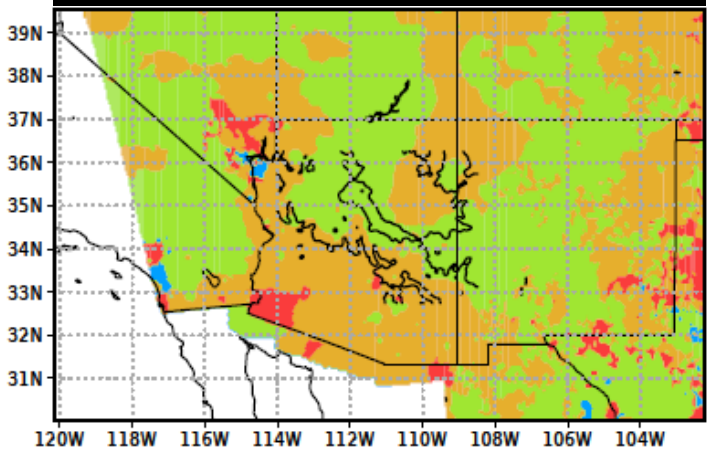
Timing of Peak Convective Rainfall

Modeled versus Observations

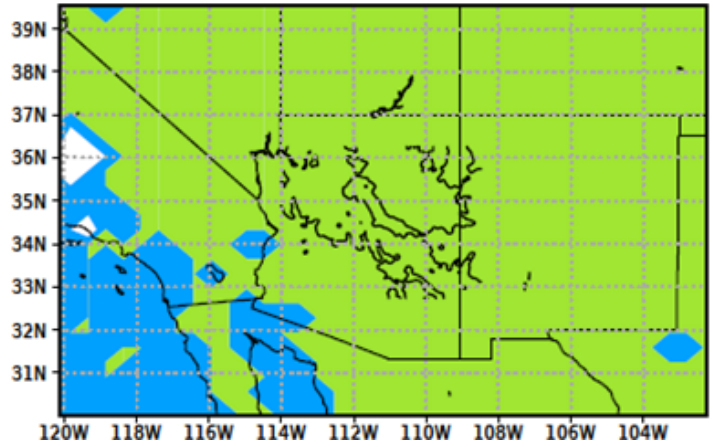
High resolution model (2.5 km)



Observations



Coarse resolution model (35 km)



Peak Rainfall (LT)

5 am – 11 am

11 am – 5 pm

5 pm – 11 pm

11 pm – 5 am

Luong et al. (2017, J. Appl. Meteor. Climatol.)

Atmospheric Thermodynamic Conditions

Changes During the Last 30 Years

- Long-term modeled and observed increases in instability, precipitable water
- Changes can be attributed to (anthropogenic) climate change

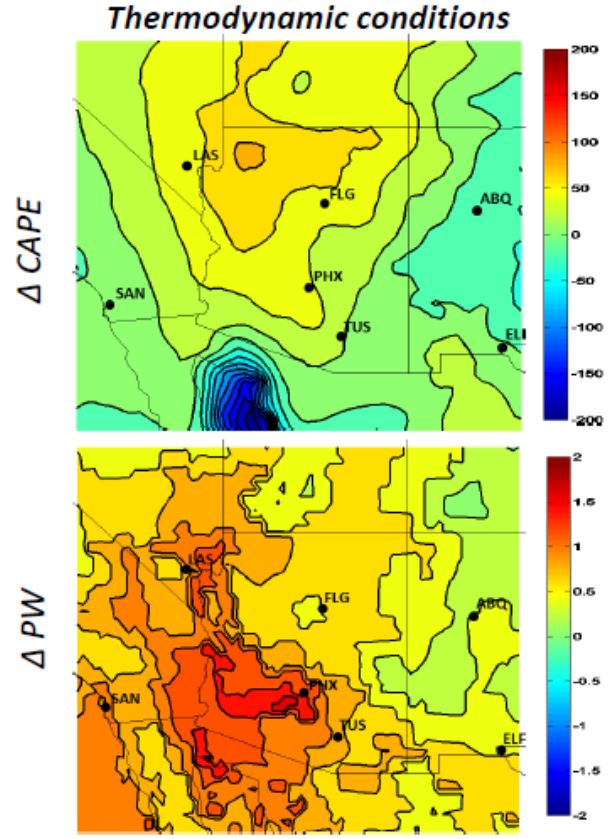
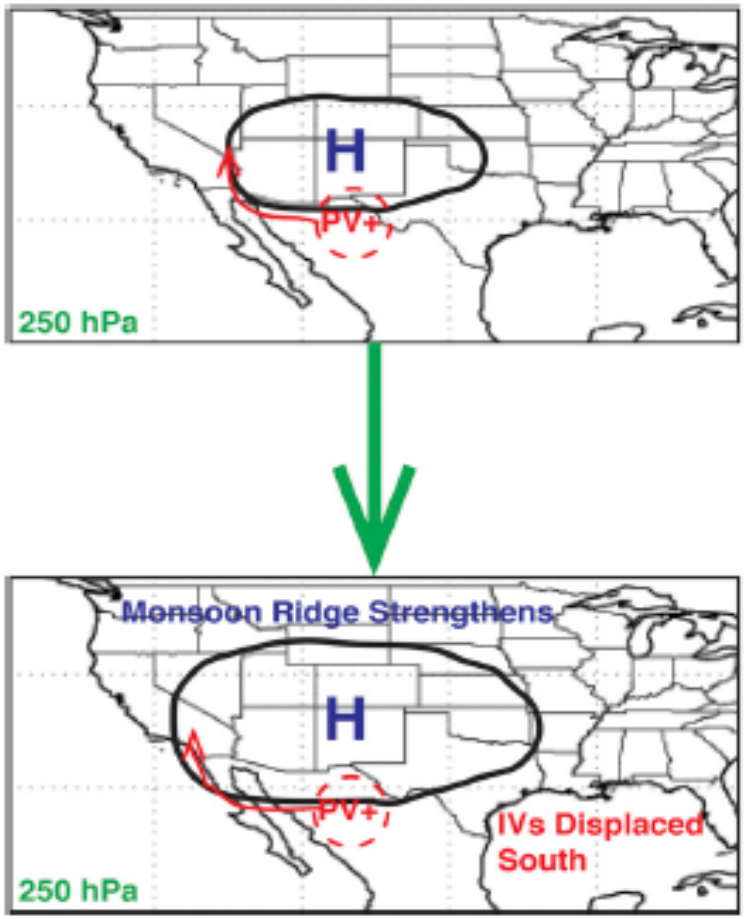


Figure 2: JA differences in downscaled reanalysis (1980-2010 minus 1950-1979) for convective available potential energy (CAPE, J kg^{-1}) and precipitable water (PW, mm). Operational radiosonde sites indicated. (Jares et al., in preparation)

Atmospheric Dynamic Conditions

Changes

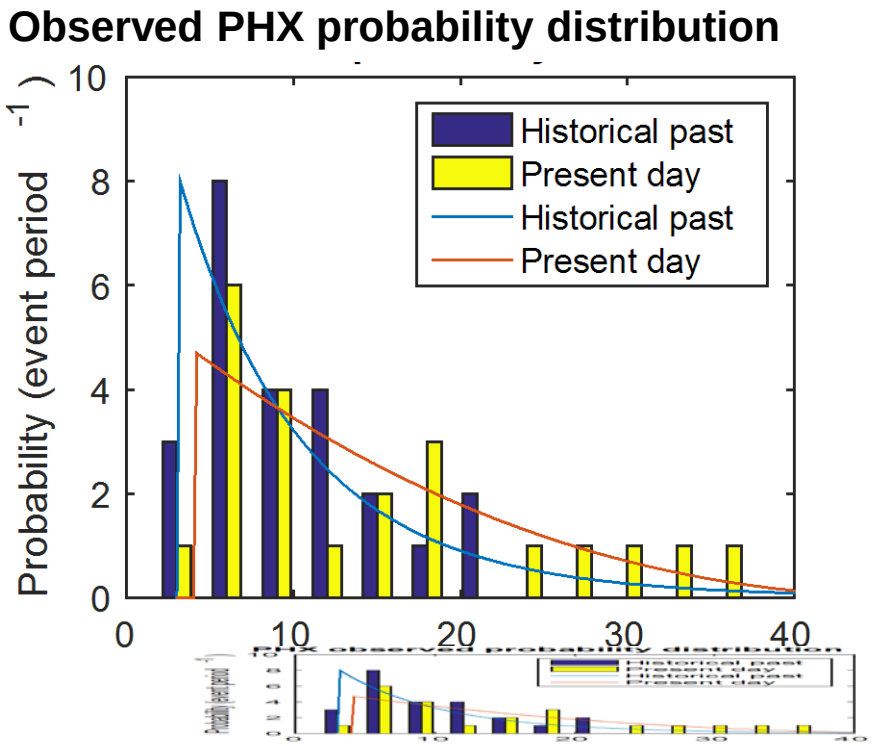


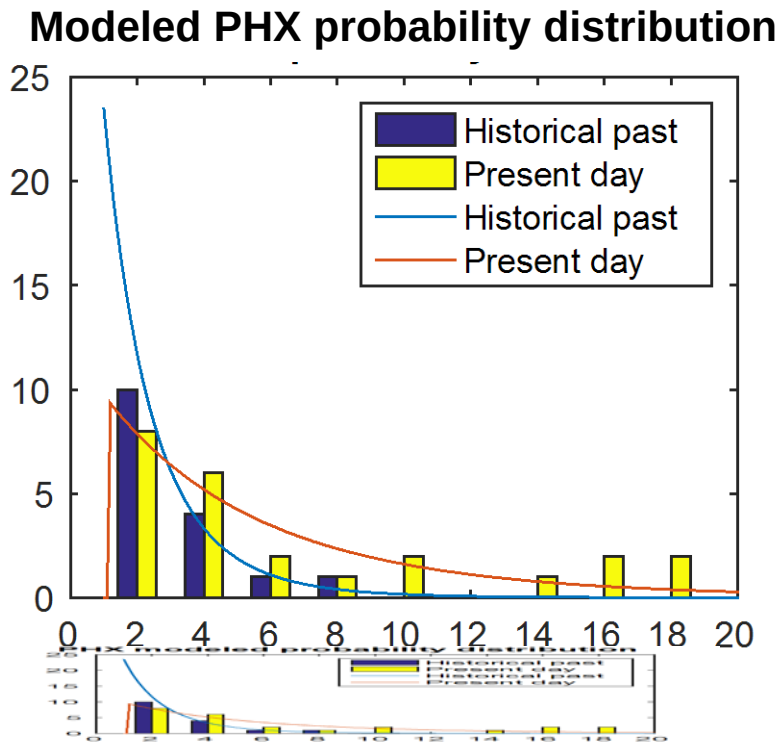
- The monsoon ridge has expanded
- Upper level disturbance displaced further south of the Southwest U.S.
- Less frequency of organized convective events in Arizona, but these events will be more intense

Lahmers et al. (2016, J. Climate)

Distribution of Extreme Daily Precipitation

Lower Frequency, More Intense Events





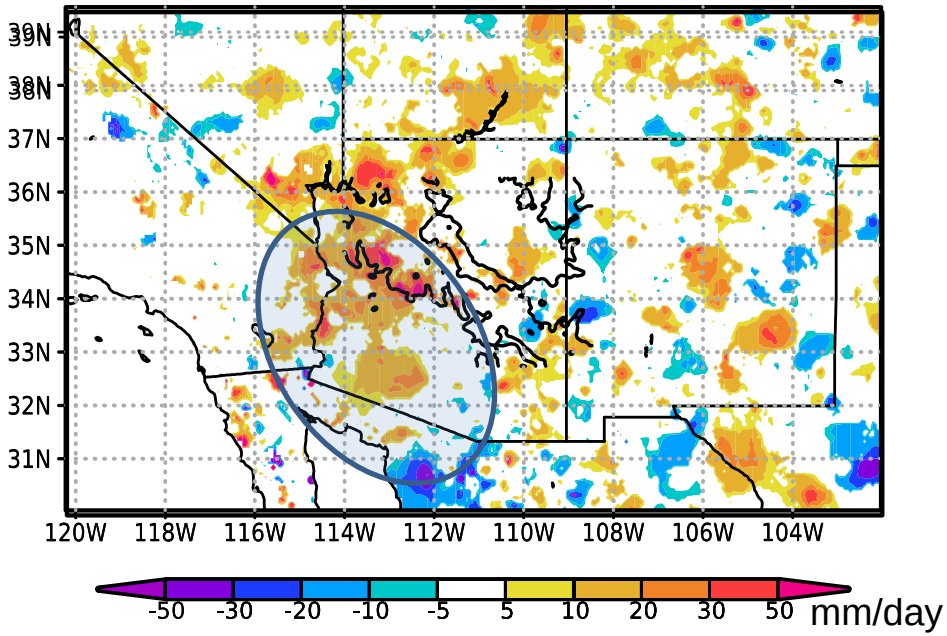
Notes: Historical past = 1950-1970; present day = 1990-2010
Results shown are for Phoenix, Arizona (PHX)

Luong et al. (2017, J. Appl. Meteor. and Climatol.)

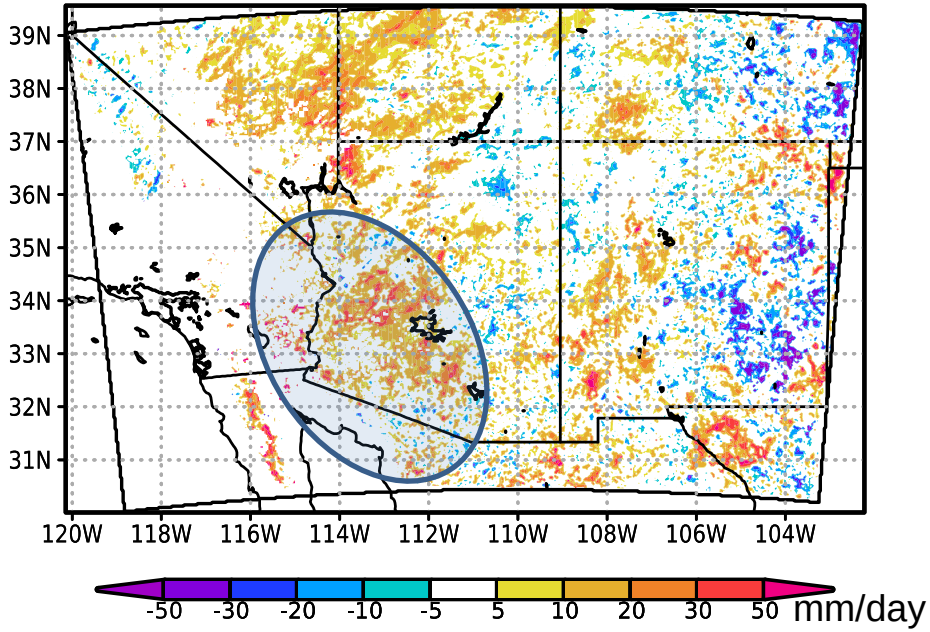
Significant Changes: Extreme Precipitation

Largest Increase in Southwest Arizona, Coincident with Important DoD Installations

Station observations



WRF model: Δx = 2.5 km (CPM)

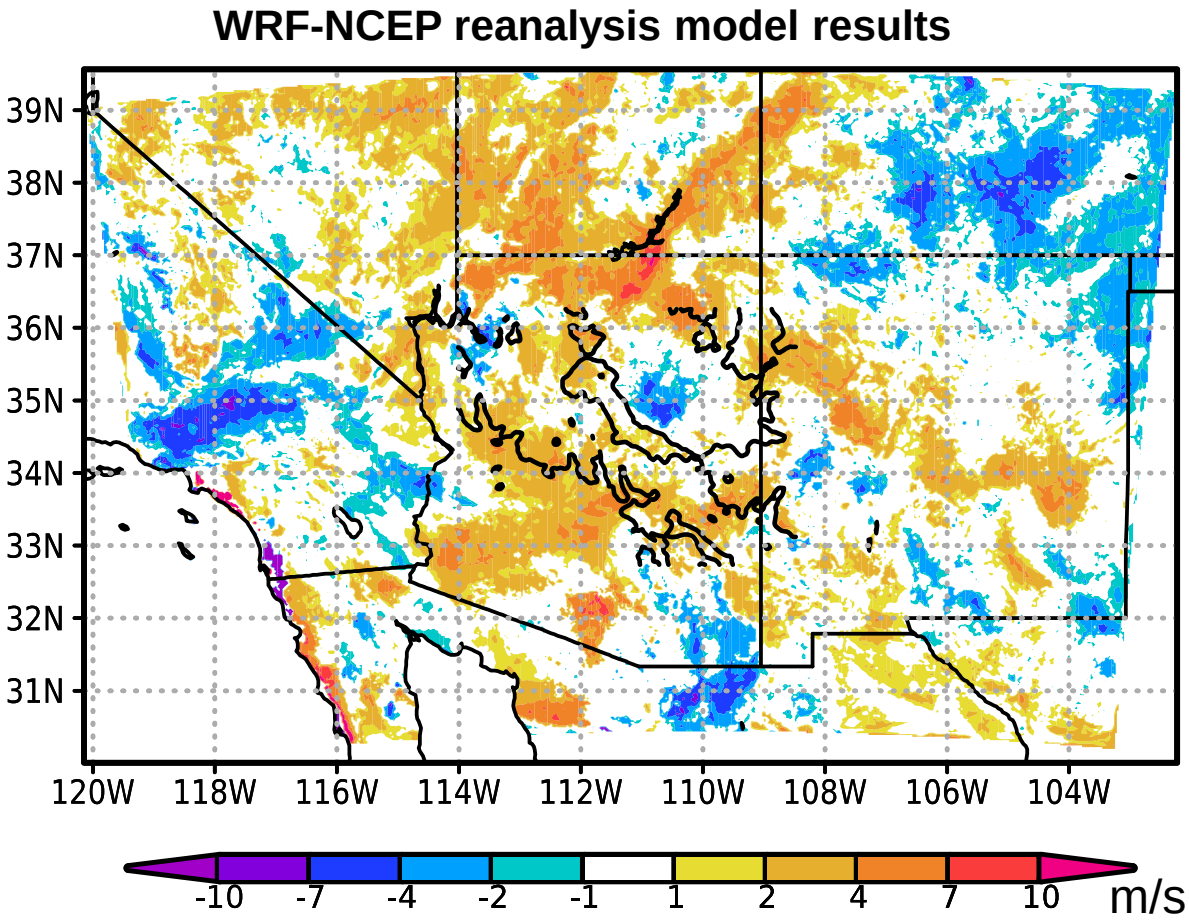


Note: Timeframes 1950-1970 vs. 1990-2010

Luong et al. (2017, J. Appl. Meteor. and Climatol.)

Extreme Downdraft Wind Speed

Significant Change



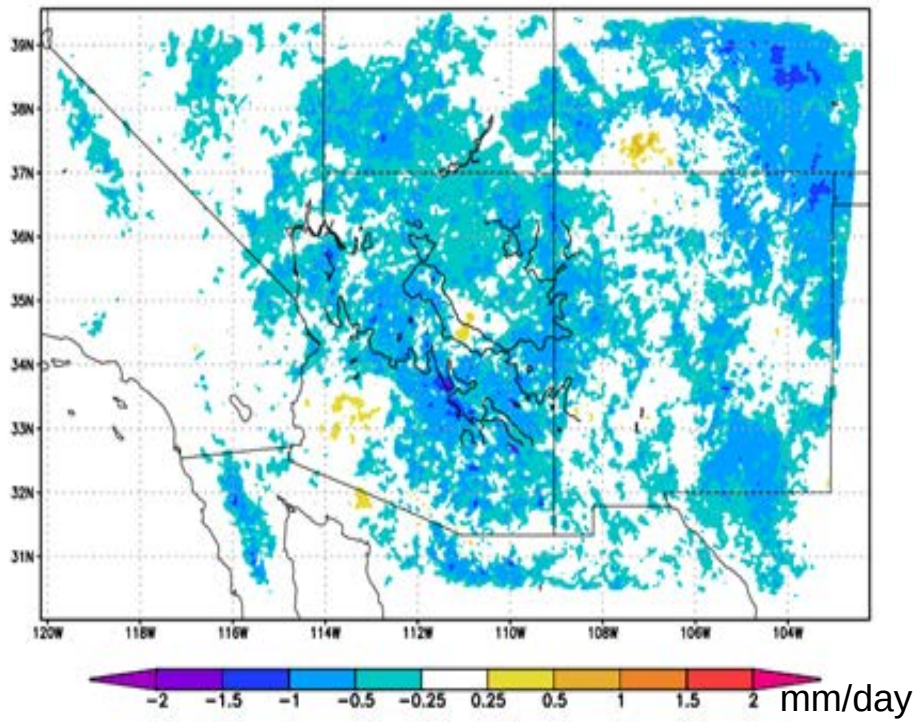
Note: Timeframes 1950-1970 vs. 1990-2010

Luong et al. (2017, J. Appl. Meteor. and Climatol.)

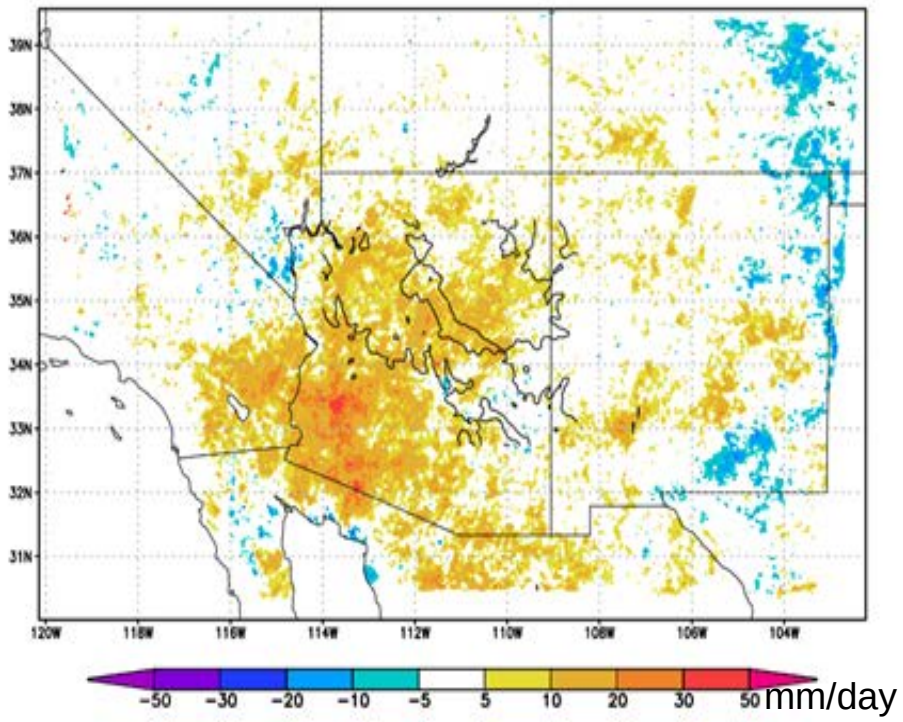
Precipitation

Significant Change, Ensemble of Four CMIP3 and CMIP5 Global Climate Models

Mean trend from model ensemble



Extreme trend from model ensemble



Note: Time period is 2021-2040 minus 1991-2010

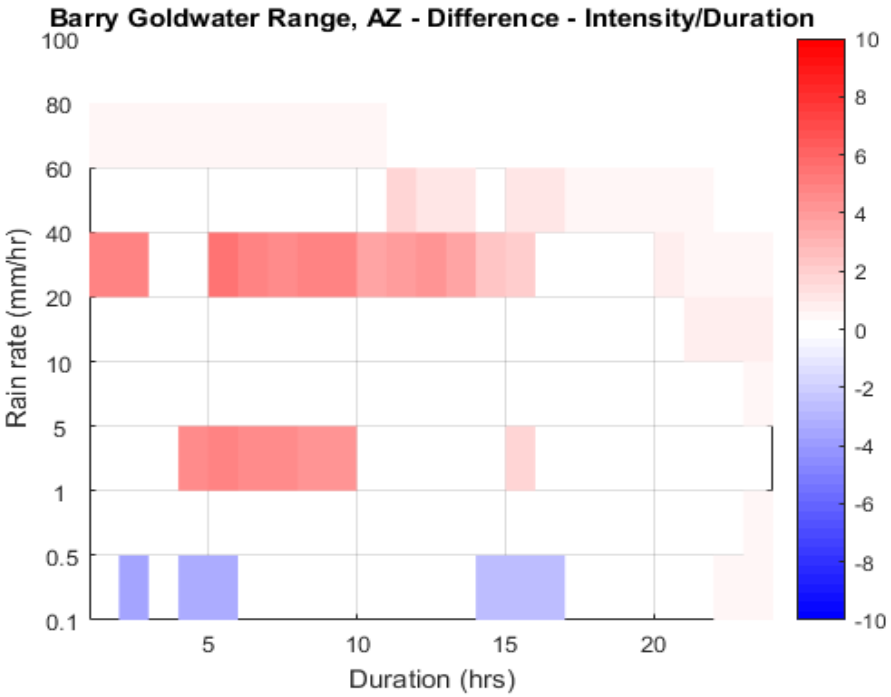
Castro et al. (2016 AMS Meeting)

Precipitation Intensity and Duration

Significant Percentage Changes

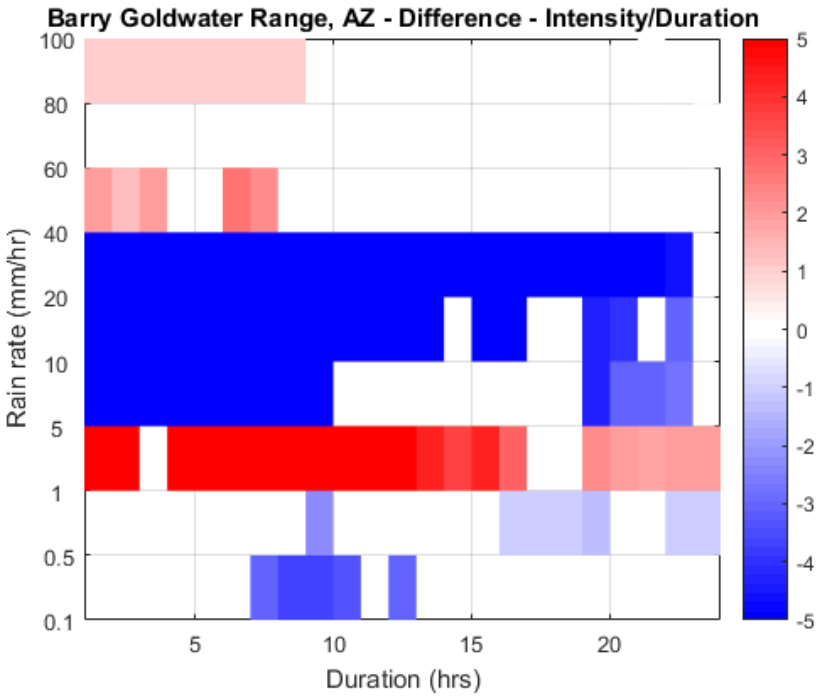
WRF NCEP

1990-2010 minus 1950-1970



WRF CMIP Ensemble Average

2021-2040 minus 1990-2010



Relevance to DoD decision making

- Future operational capability of DoD installations, in relation to OWS weather watch and warning criteria
- Investigate changes over time in model simulation results that are impossible to observationally measure but important (e.g., downdraft wind speed, turbulence)
- A methodological approach to modeling of changing severe weather extremes, potentially transferable to other areas of the U.S. and world

Complete model simulation data available to DoD partners through cloud storage interface

News Headlines

CLIMATE CENTRAL

Researching and reporting the science and impacts of climate change

Global Warming Is Fueling Arizona's Monstrous Monsoons

By Bobby Magill

Published: August 4th, 2017

Summer in Arizona and throughout the Southwest is monsoon season, which means a daily pattern of afternoon thunderstorms, flash floods, dramatic dust clouds and spectacular displays of lightning over the desert.

As the climate changes, Arizona's monsoon rainfall is becoming more intense even as daily average rainfall in parts of the state has decreased, according to a new study. Increasingly, extreme storms threaten the region with more severe floods and giant dust storms called haboobs.

A haboob dust storm rolls over suburban Phoenix in 2012. Credit: Jasper Nance/flickr

Every summer, rivers of moisture in the lower troposphere — the monsoonal flow — stream into the Southwest from the Gulf of Mexico and Gulf of California. Nearly every day in midsummer, the sun heats the mountains and the deserts, creating convection. The rising warm air allows thunderclouds to build during the day before exploding into dramatic electrical storms in the afternoon and evening.

But today's monsoons aren't like the ones travelers on Route 66 would have driven through 60 years ago.

ARIZONA REPUBLIC
TUESDAY, JULY 25, 2017 azcentral.com PART OF THE USA TODAY NETWORK

$371 IN COUPONS

STUDY: MONSOON PACKING BIGGER PUNCH

MICHAEL CHOW/THE REPUBLIC
The driver of this vehicle attempted to cross a flooded street in Apache Junction on Monday. She later had to be rescued.

Much of state is seeing fewer, but stronger, summer storms

WELDON B. JOHNSON
THE REPUBLIC | AZCENTRAL.COM

If you think Phoenix-area monsoon storms are worse now than they were years ago, you might be right.

A team of University of Arizona climate scientists released a study that concludes that central and southwestern Arizona are getting fewer but more intense monsoon storms than 50 years ago.

Christopher Castro, a co-author of the study, said that while rain totals over the course of the monsoon haven't increased significantly, much of that rain has fallen in a few large storms.

He said to picture the storms over the course of a season as a line, with the minor storms represented on the left and the storms gaining intensity as they progress along that line.

See MONSOON, Page 7A

SAM CARAVANA/THE REPUBLIC
A sign marks a closed portion of Citrus Road between Lower Buckeye and Broadway roads in the West Valley. The area saw flooding following recent monsoon storms.

More online: Go to **azcentral.com** to watch a video of a water rescue and to see more photos from Monday's monsoon storms.

Concluding Points

- There has been a long term increase in atmospheric moisture and instability in recent decades, due to anthropogenic climate change
- The more favorable thermodynamic environment is causing monsoon thunderstorms to be more extreme, though they are becoming less frequent
- High resolution atmospheric modeling is able to pinpoint southwestern Arizona as a local ‘hot spot’ where monsoon storms are now more intense, and this trend is projected to continue
- The model information generated by this work is at a spatial scale that is informative for decision making at the DoD facility scale and conforms to weather watch and warning criteria

For additional information, please visit

https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Infrastructure-Resiliency/Vulnerability-and-Impact-Assessment/RC-2205

Speaker Contact Information

castro@atmo.arizona.edu; 520-626-5617

SERDP DOD • EPA • DOE | ESTCP

Q&A Session 2

The next webinar is on October 19, 2017

Laser De-Paint and Surface Preparation Mechanism and Technologies

SERDP DOD • EPA • DOE | ESTCP

Survey Reminder

Please take a moment to complete the survey that will pop up on your screen when the webinar ends