Integration of Decision-Making with Predictive Capacity for Decadal Climate Impacts

Oct 1, 2014 – Sept 30 2019

NCAR: Cindy Bruyère, James Done, Ming Ge, Greg Holland, Heather Lazrus, Rebecca Morss, Debasish PaiMazumder, Erin Towler and Mari Tye

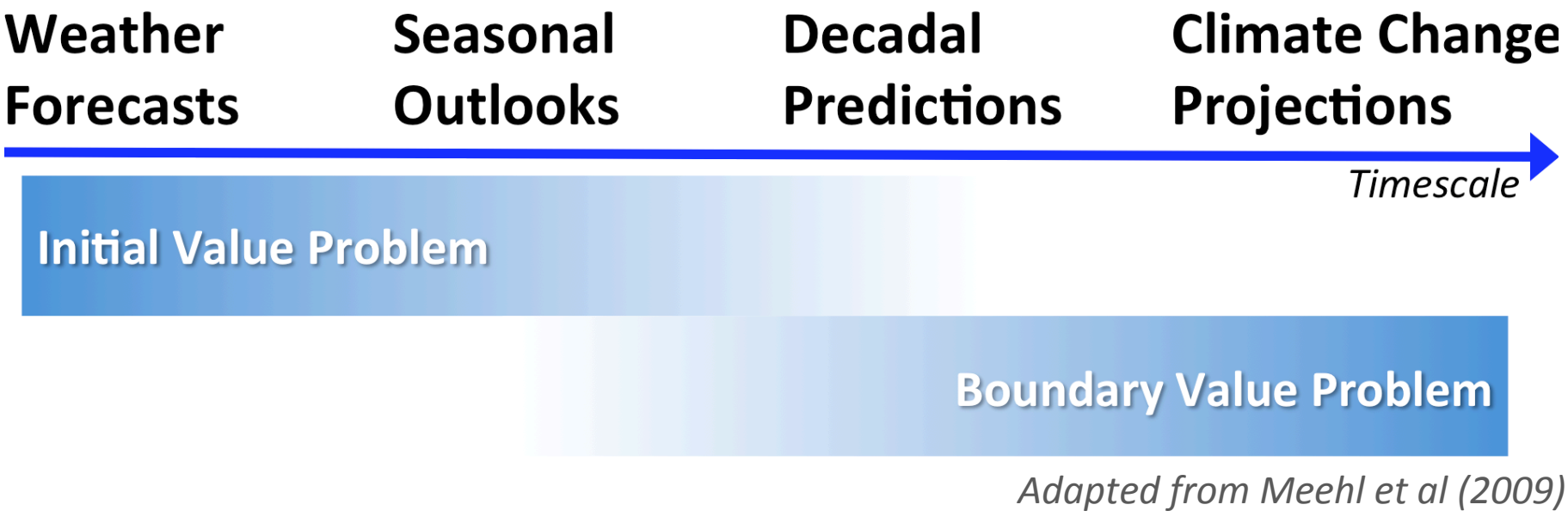
Wharton: Jeffrey Czajkowski

CSU: Jennifer Hoeting and Joshua Hewitt

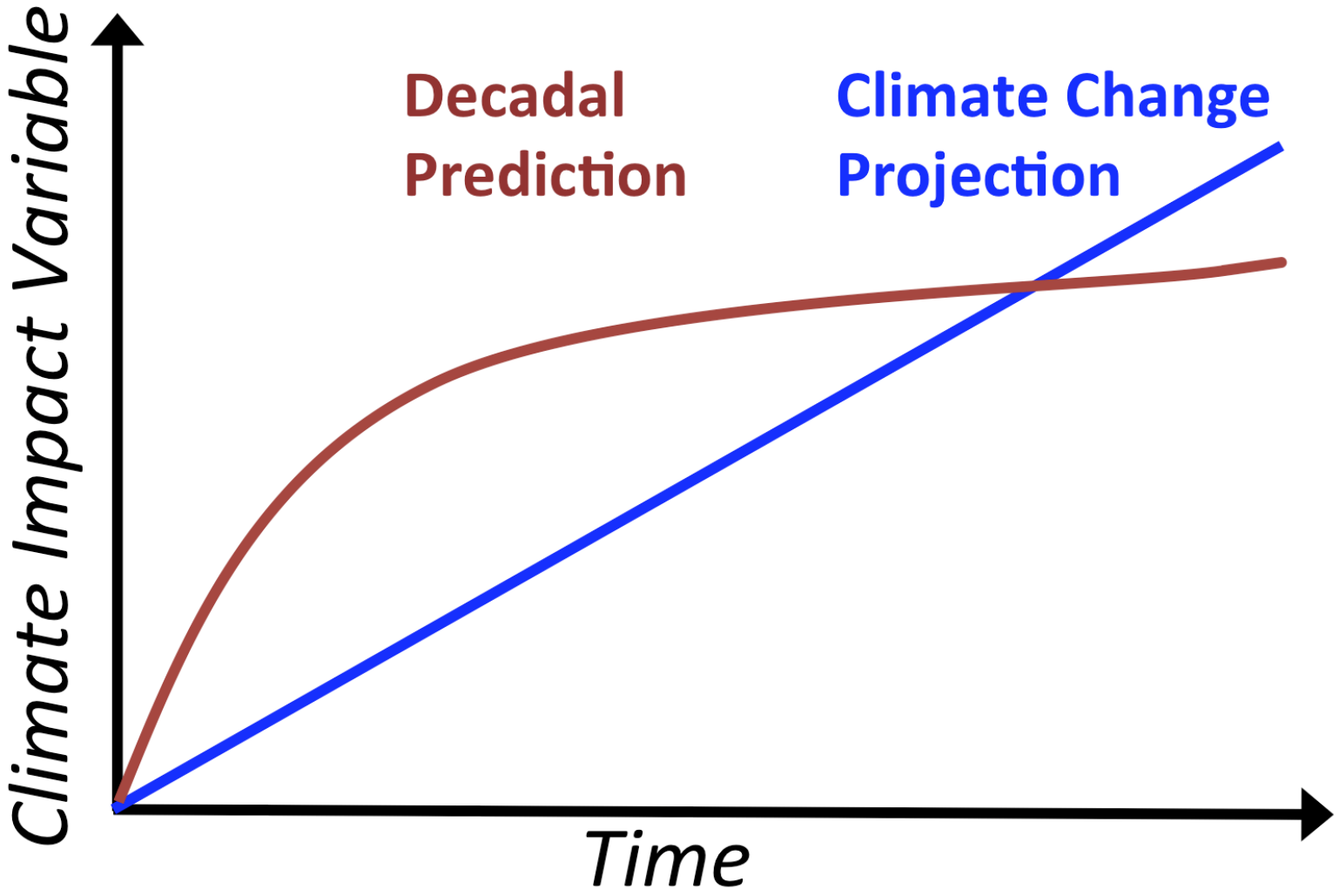
CH2M HILL: Armin Munévar

Meeting Goals

1) Review Project Goals and Scope
2) Review Progress
3) Review Case Studies
4) Research Directions
5) Upcoming Events



Adapted from Meehl et al (2009)


Climate Impact Variable
Decadal
Prediction
Climate Change
Projection
Time

Part I: Understand current information needs and use

In-depth understanding for a single stakeholder;

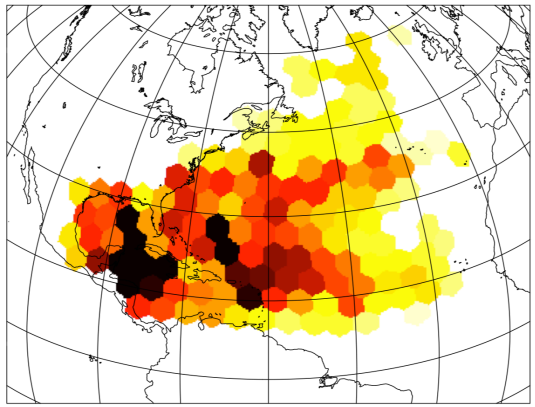
- collect data on interaction with climate information.

Broad understanding across multiple stakeholders;

- collect data through focus groups/detailed interviews.

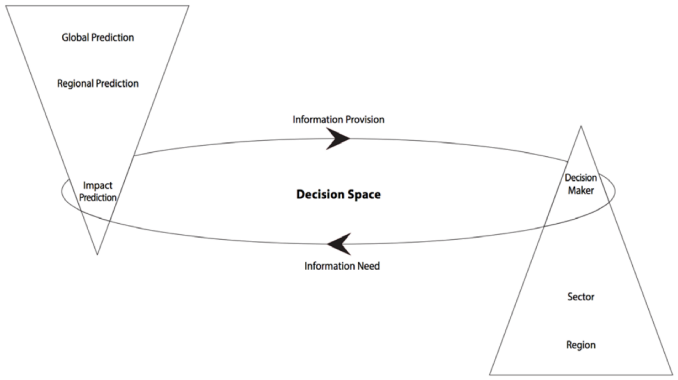
Part II: Build predictive capacity for the needed information:

- developing new statistical-dynamical modeling techniques that combine climate and impact data and incorporate uncertainty;



- test prototypes with stakeholders;

- iterate between the information needs and predictive capacity.



Overall Project Outcome

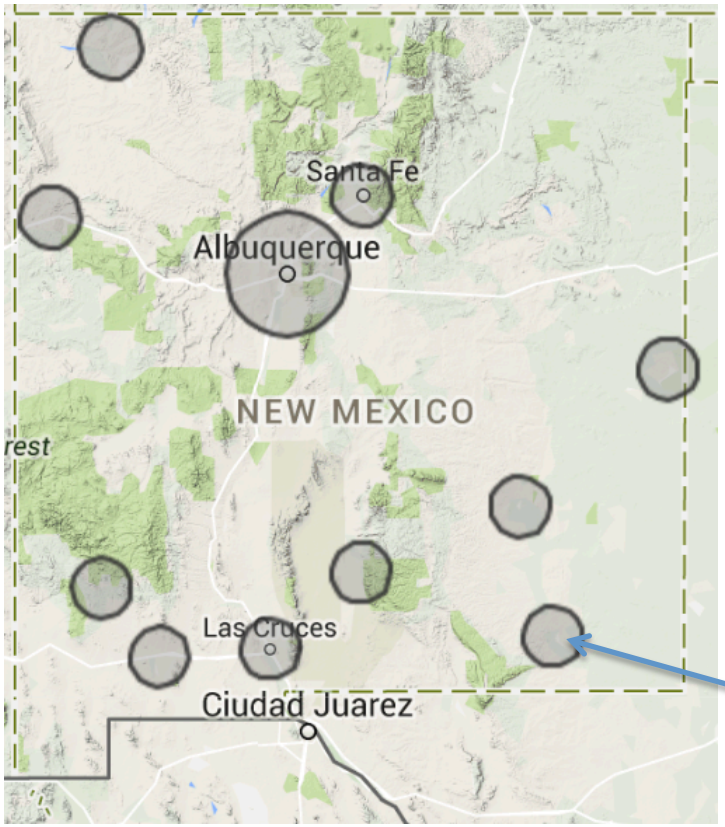
A generalized interdisciplinary research framework to integrate predictive capacity with decision-making.

Progress

- Josh Hewitt joins the project.
- Literature review of decadal climate science.
- Project webpage, a space for interaction engage with prototypes.
- Combined single and multi-practitioner approaches.
- Explored proof of concept for rainfall at Carlsbad, NM.

Leverage predictions in places where initialization increases skill (E.g. North Atlantic).

Carlsbad, NM rainfall is correlated with the Atlantic Multi-decadal Oscillation (AMO).

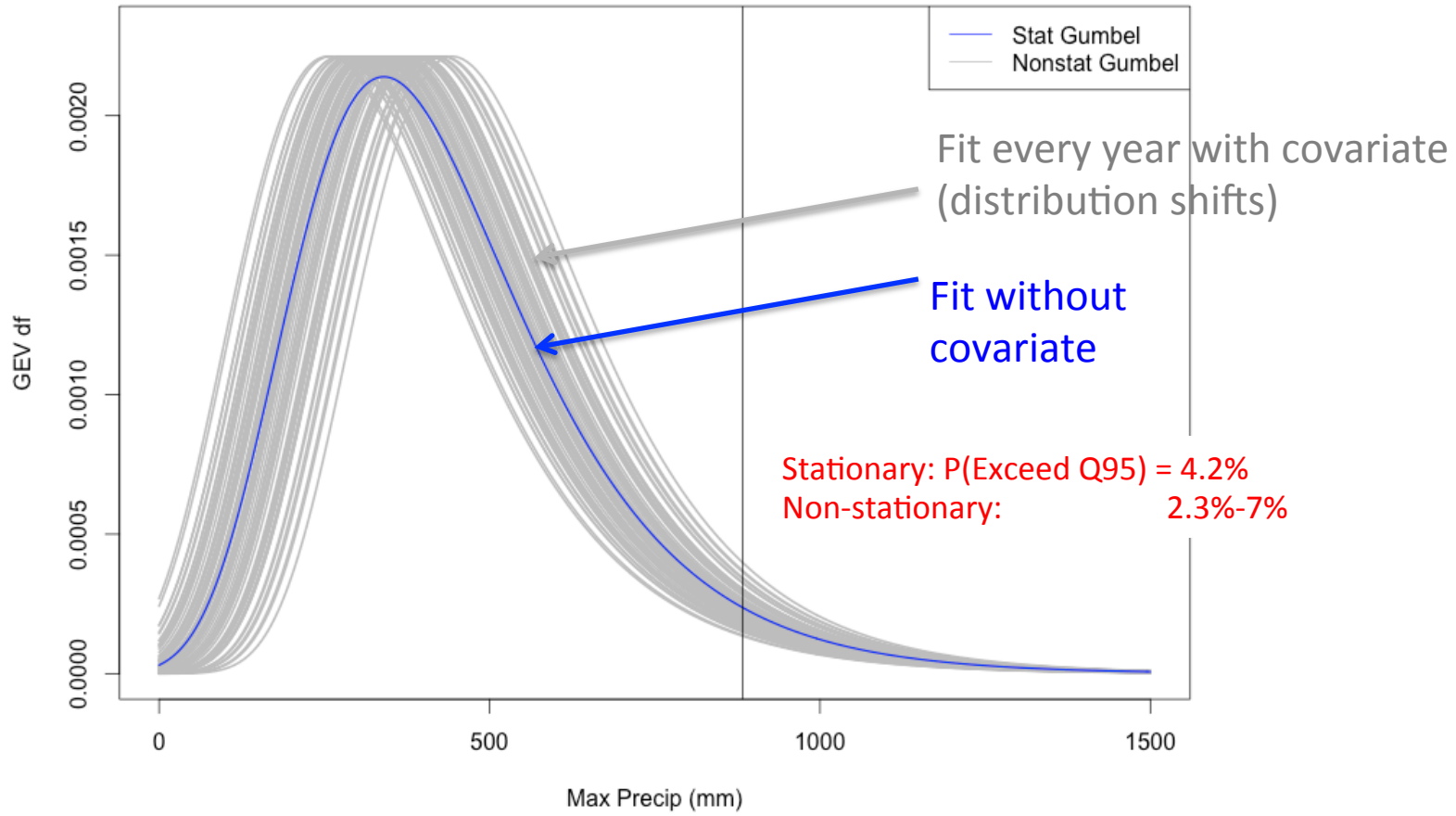


Carlsbad has high quality, long records.

Erin Towler

Develop statistical prediction model to derive decision-relevant variable conditioned on the AMO.

GEV: Annual average AMO is significant (p = 0.024) as a covariate to predict maximum summer precipitation at Carlsbad.



Erin Towler

Diverse Interests

- Graceful failure embedded in design.

- Perception of time in weather risk

- daily, seasonal, decadal, centennial.

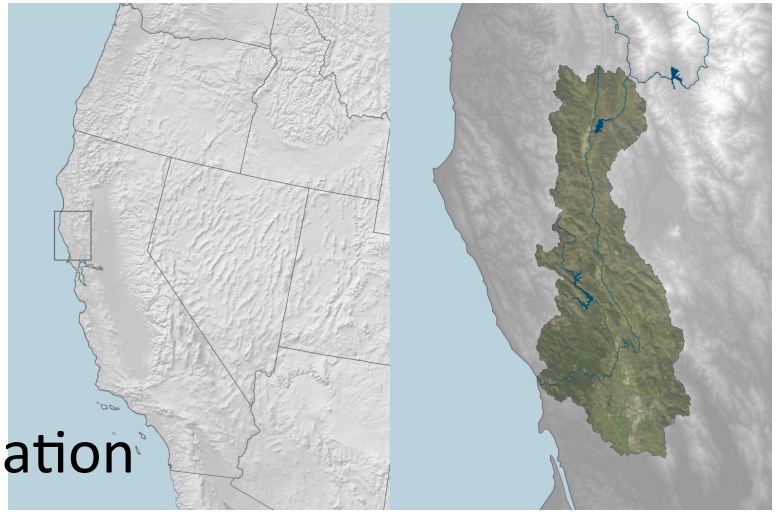
- Economic impact modeling incorporating human behavioral factors.

- Development of new statistical methods related to threshold behavior.

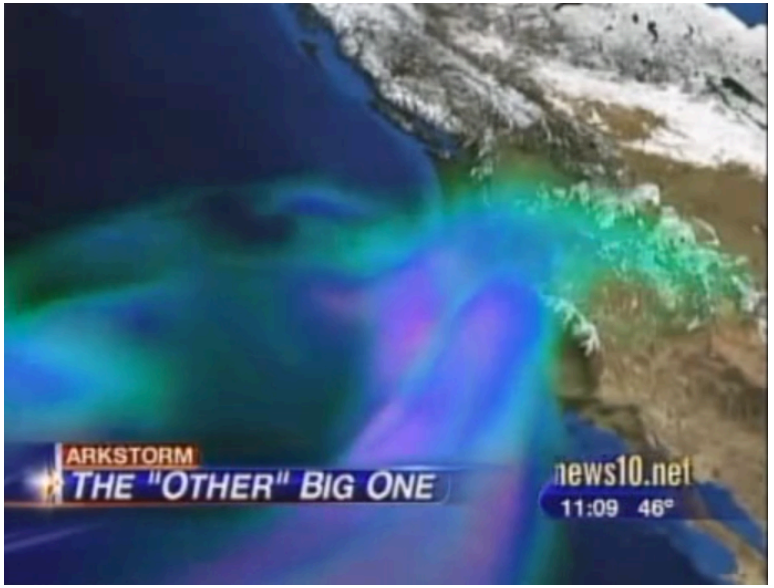
- Is the impact more predictable than the atmosphere?

- explore the range of possible *events* in different climates/design/ management scenarios.

Russian River, CA



- 80% annual rainfall from winter storms.
- Water supply <-> flood control
- Agriculture/sanitation/ecosystem/recreation
- System (physical infrastructure and management) based on historical risk (return periods of 3-day rainfall).
- Highly constrained management system – insurance etc.
- CH2M Hill conducting vulnerability assessments



Further reading: http://www.usclivar.org/sites/default/files/documents/2014/Variations2014Fall.pdf

Historical Data

Flood Risk	Data Source	Resolution	Period
3-day rainfall return values	Livneh	Daily, 1/16°	1915->2015

Flood Impact	Data source	Resolution	Period
Cresting	USACE	Daily, peak	1939->2015
NFIP	Wharton	Zip Code, annual?	1979->

Drought Risk	Data Source	Resolution	Period
Consecutive Dry Days	Livneh	Daily, 1/16°	1915->2015

Drought Impact	Data Source	Resolution	Period
Mendocino Inflow	USACE	Daily discharge (ft^3s^{-1})	1941->2015
Others, crop yield?			

Approach:

1. Understand current use of climate data by CH2M Hill

- meeting in late Sept.

2. Assess our ability to predict impact variable on decadal timescales:

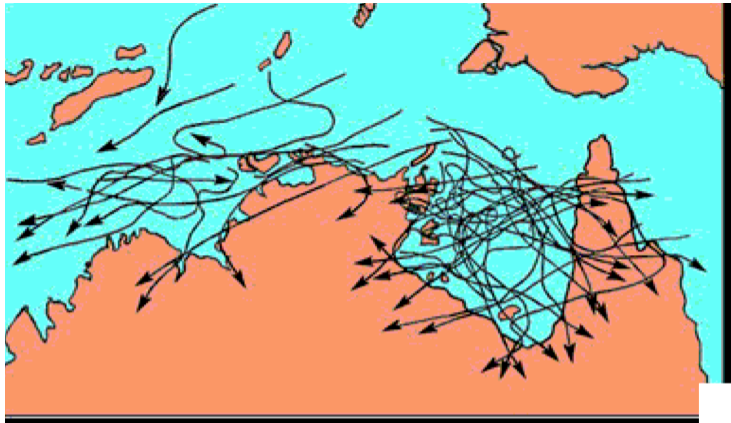
- dynamical downscaling is limiting, so

A) upscale the impact variables to skillful predictions: Impact=f(climate).

B) - generate *O*(10000) synthetic storms conditioned on skillful prediction,

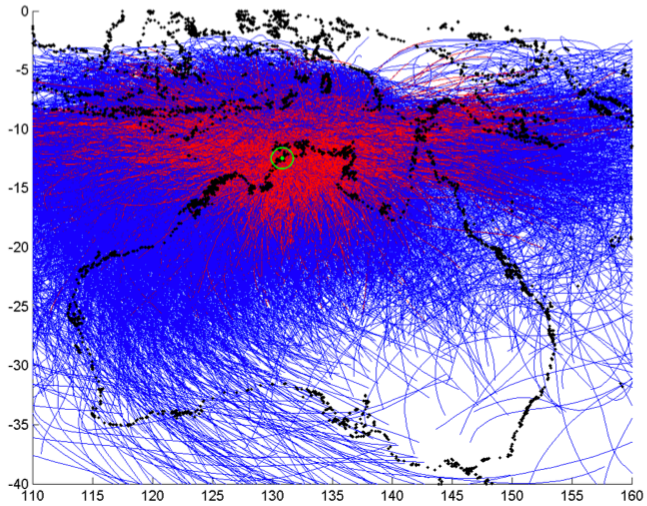
- apply an Atmospheric River Damage Potential (ARDP) index to synthetic storms (lat, lon, angle of incidence, WVT duration and intensity, temperature, soil moisture).

Synthetic cyclone track generation for Darwin



Tracks over a 20 year period
in the Northern Territory.
(Bureau of Meteorology)

6200 Synthetic tracks
under NCAR/NCEP 1981-2000 Climate
Annual Frequency =0.18



Gray Swans

Emanuel and Lin

Approach:

3. Develop presentations of the prediction to inform water management hedging strategy.

- Maps of ARDP threshold exceedences?

4. Iterative towards effective presentations.

City of Denver

CH2M Hill: Urban drainage and flood control.

Snowpack and rain driven.

Sign of future trend is unclear.

impact data:

- permuted National Flood Insurance Program data
- discharge data
- Colorado Urban Hydrograph Procedure (CUHP)

Communication

1) Project meetings every 3 months, one speaker to focus discussion. Next meeting, November 2015, volunteers?
2) The key is to interact across disciplinary components.
3) Project website
4) NSF PI Meeting, Aug 31-Sept 2, Washington DC (James and Ming)
5) Meeting at CH2M Hill Denver, late Sept.
6) Annual Report due Oct 1.
7) We have travel funds (NCAR: approx. 3 domestic trips/year)
8) Elsevier 'Climate Services' Journal.

Global Risk, Resilience and Impacts Toolbox

Community Development Facilitated by NCAR.

- ***Understanding*** *Risk of,*
- *Increasing Resiliency to, and*
- *Reducing Impacts of,*
- ***Weather and Climate Extremes.***

www.ecep.ucar.edu

GRRIT Structure