Growing Societal Partnerships for Climate Resilience through Collaborative Storytelling

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With thanks for Linda Shenk (Dept. of English) & Brandon Fisel (Dept. of Geol. & Atmos. Sci.)
Informing Concerns of Community Partners

- How to use the large volume of data?
- How to produce information that is relevant, credible and actionable?
Co-creating Knowledge: A New Paradigm

Emphasis:
- relationships
- equity
- creativity
- values

Users
- Governments / IGOs
- Civic organizations / NGOs
- Concerned industries
- ...

Scientists
- Research institutes
- Universities
- Research consultancies
- ...

Regional climate information

Producers
- Met. services
- Climate services
- Operational private sector
- ...

(IPCC AR6 WG1, Ch. 10)
A Co-Creation Pathway: Storytelling

- Allows for diverse ways of knowing
- Connects personal experience and local knowledge with scientific systems
- Fosters creativity, connection, and relationship-building

(adapted from Irwin et al., 2018)
A Storytelling Lesson from Shakespeare!

Why are the families feuding so intensely in *Romeo and Juliet*?
A Storytelling Assistant: Community Environment Model

Contrast with leading-edge climate models: How can something so simple help??
A Storytelling Assistant: Community Environment Model

Model’s gaps = space for partner’s stories
~ An Accessible, Evocative Tool ~

Gaps of
- Nonspecificity
- Multiplicity
- Revision
Goals:

❖ Fostering relationships, equity, creativity and recognition of values
❖ Listening to partners’ stories: what was impactful, memorable weather and climate?
❖ Recognizing the authority of all participants
❖ Going beyond individual narratives to collective understanding among all
❖ Filling understanding gaps by “layering diverse knowledges” (Hulme, 2018)
❖ Creating a “cognitive ecosystem” among all partners

Outcome: Meaningful climate information
Climate Model Stories: Storylines

- “Tales of Future Weather” (Hazeleger et al. 2015)
- “... a physically self-consistent unfolding of past events, or of plausible future events or pathways.” (Shepherd et al., 2018)

Motivations:

1) Societal engagement: **What are memorable/impactful weather or climate events?**

2) How well do models represent these events?

(Adapted from Shepherd, 2019)
Approach: Object-oriented analysis

**Tempest Extremes:** Software tracking 3-D space-time objects (Ullrich & Zarzycki, 2017)

Here - objects of daily precipitation:
- Interpreted as events
- Yields event storylines
Approach: Objects from Tempest Extremes

Example: Objects of erosion-producing Feb-Mar-Apr precip. events

OTE: “Event” = Daily precip ≥ 32 mm (1.25 inches) at locations in a space-time volume

Storyline: Erosion events will occur ~2 weeks earlier, promoting more erosion unless land management changes
Concluding Thoughts

- Object-oriented analysis: a natural focus on events, especially community-defined, high-impact events
- The events ➔ decision-relevant storylines motivated by interactions with community partners
- Can combine events of different types ➔ compound events
- Flexible: can build on experiences, concerns, perspectives, values of all involved
- Promotes co-exploration of climate simulations and, thus, co-production of climate knowledge that is relevant, credible and actionable ...
- ... which, in turn promotes appropriate responses.
Shenk and Gutowski, 2022: Mind the gaps! Co-producing storylines with stakeholders, using lessons in collaborative storytelling from William Shakespeare. *WIREs Climate Change* [DOI: 10.1002/wcc.783].

Extra Slides
Storylines from Tracking Events

Approach: Object-oriented analysis

Tempest Extremes: Software tracking 3-D space-time objects (Ullrich & Zarzycki, 2017)

Here - objects of drought and heat stress

Interpreted as events
Yields event storylines

Analysis Region: North Central US

(Modified IPCC SREX analysis regions for contiguous U.S.)
Event Objects: Short-Term Drought

Ag. Motivation: Undermines pollination, promotes high T?

40-Day low-precip events: Cumulative precipitation ≤ 25 mm

“Season”: April-May-June-July

Observations:

► PRISM: Parameter elevation Regression on Independent Slopes Model (4-km aggregated to 25-km grid)

► Time period: 1981-2000

Model Simulations:

► RegCM4 (25-km grid spacing)

► Boundary conditions: GFDL & MPI (Contemporary & RCP8.5)

► Time periods: 1981-2000 and 2041-2060
Short-Term Drought: Object Areas

Number = 828

Durations: Similar among all
Event Objects: Heat Stress

**Ag. Motivation:** Temperatures exceeding optimum

**5-D heat-stress events:** Average $T_{max} \geq 30^\circ C$

**“Season”:** April-May-June-July

**Same Observations & Simulations**

When heat-stress and drought objects overlap, which comes first?

- Heat
- Drought
- Tie

**PRISM**
Events: Crop Heat Stress & Short-Term Drought

Ag. Motivations: Inhibited crop development

5-D heat-stress events: Average Tmax $\geq 30^\circ$C

40-Day low-precip events: Cumulative precipitation $\leq 25$ mm

“Season”: April-May-June-July

Number of heat-stress events

For both types:
1. Frequency is biggest change.
2. Area & duration change little.
3. Heat stress usually leads drought.
4. Compound events much more extreme
What could be a decision-relevant storyline?

Qualitatively:

☞ Short-term drought and heat-stress events will become more frequent, but area and duration will not change.

☞ Watch for heat stress as a potential precursor, especially …

☞ … because when drought and stress are simultaneous, they will both tend to be more intense.

Can quantify as needed.
Compound Events:  
Short-Term Drought & Heat Stress

- Climate change: Drought freq. & Heat-stress area

- Drought & heat stress: heat stress precedes drought

- Drought + heat stress (compound) events tend to be more extreme than individual events.

What could be a decision-relevant storyline?

Qualitatively:
- Short-term drought events will become more frequent, though area and duration will not change.

- Watch for heat stress as a potential precursor, especially …

- … because when drought and stress are simultaneous, they will both tend to be more intense.