Climate Risk: Thinking through the development and use of climate models for climate risk management at seasonal to decadal timescales

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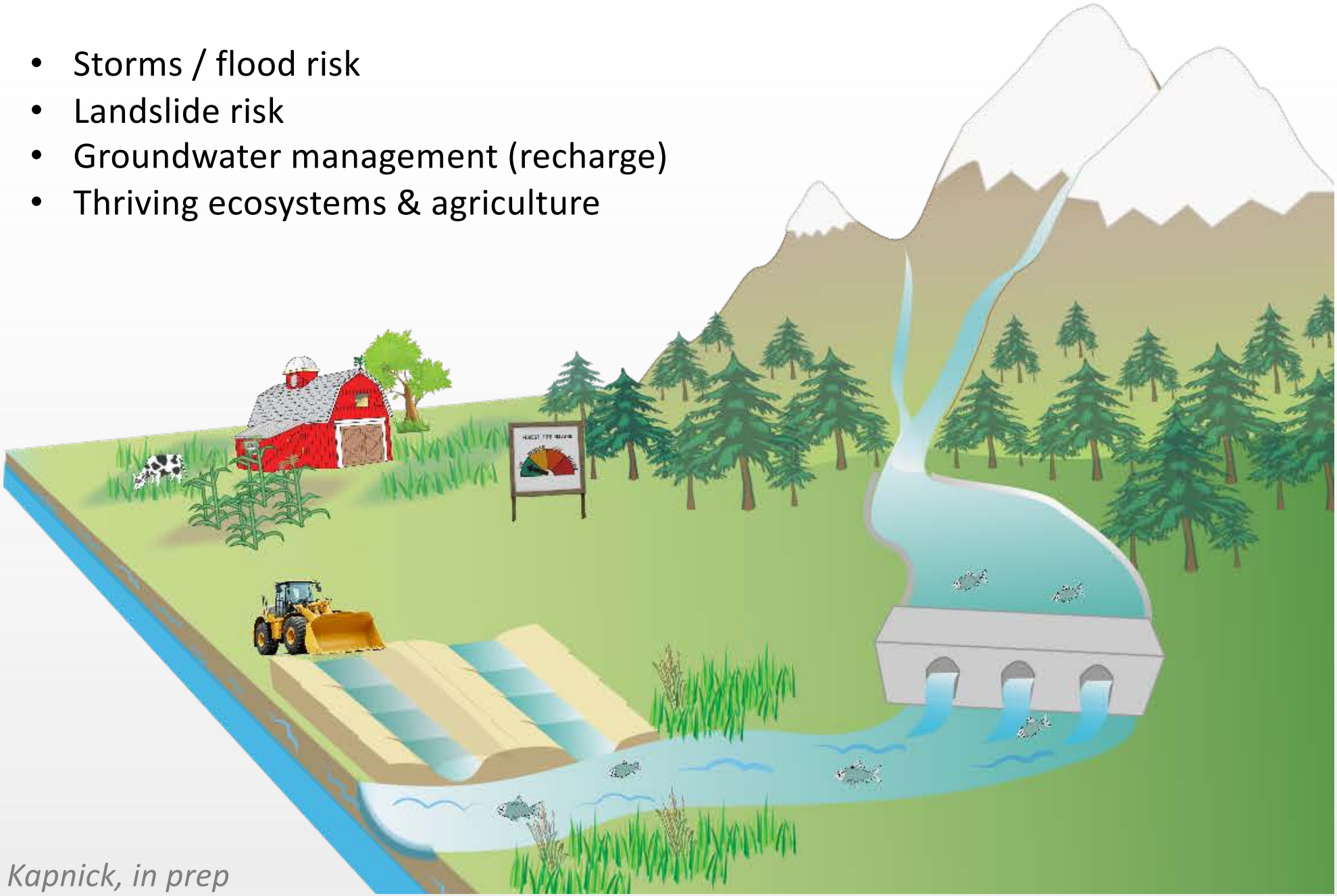
Wet year: risks & management

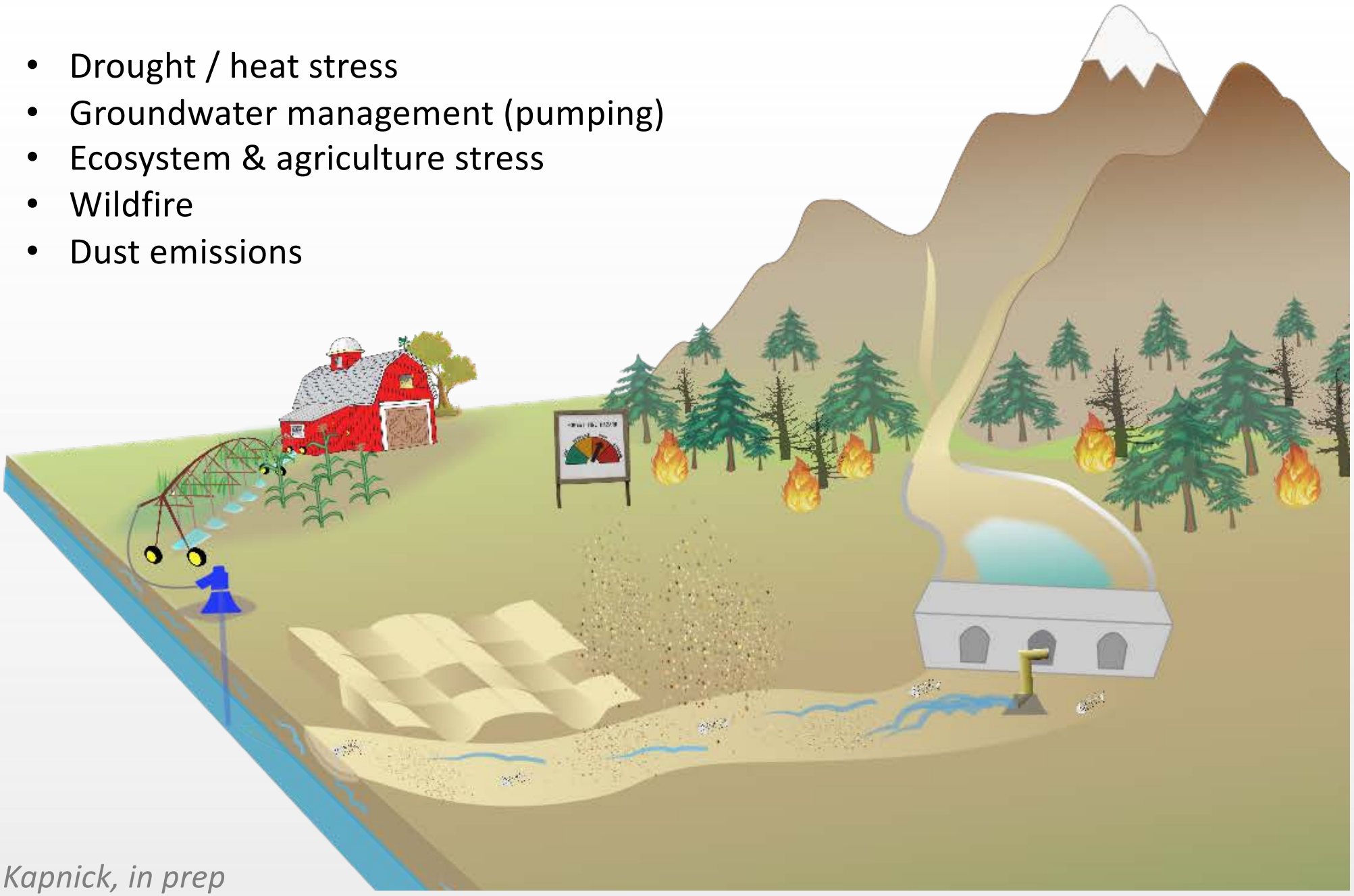
- Storms / flood risk
- Landslide risk
- Groundwater management (recharge)
- Thriving ecosystems & agriculture



Kapnick, in prep

Dry year: risks & management

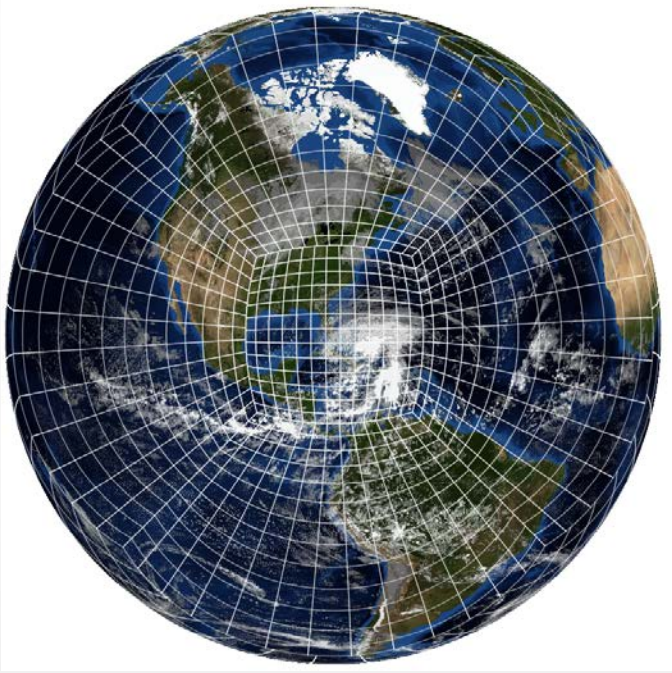
- Drought / heat stress
- Groundwater management (pumping)
- Ecosystem & agriculture stress
- Wildfire
- Dust emissions

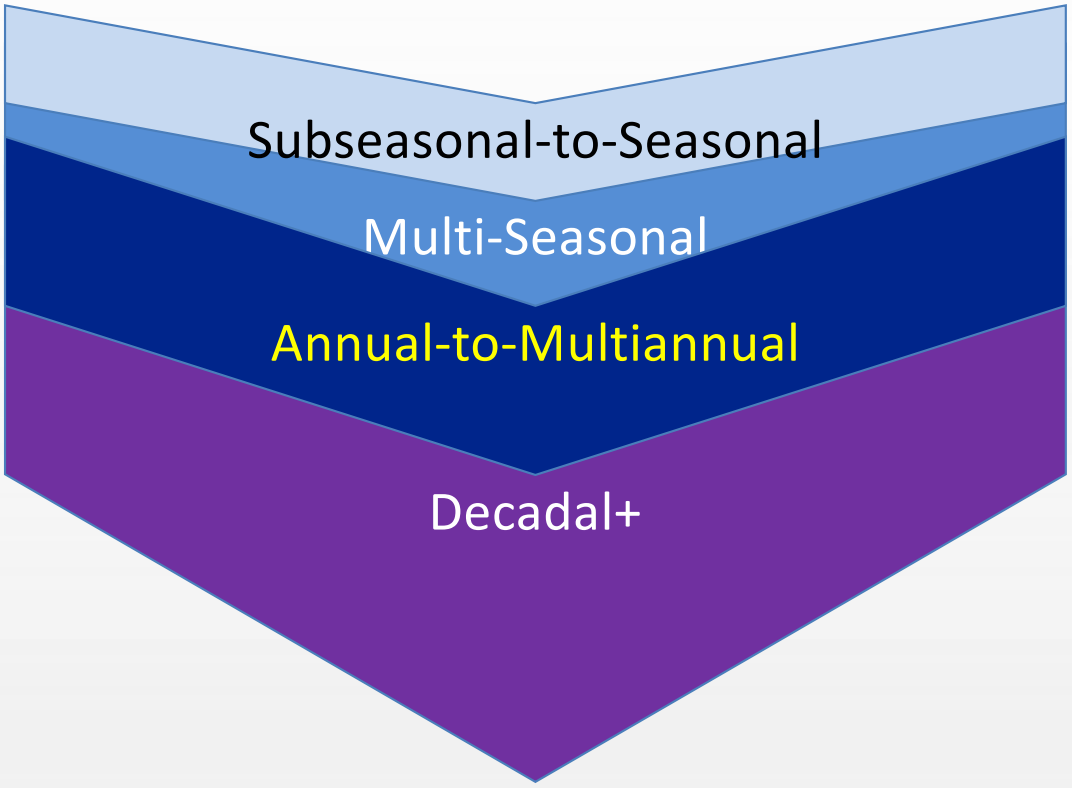


Kapnick, in prep

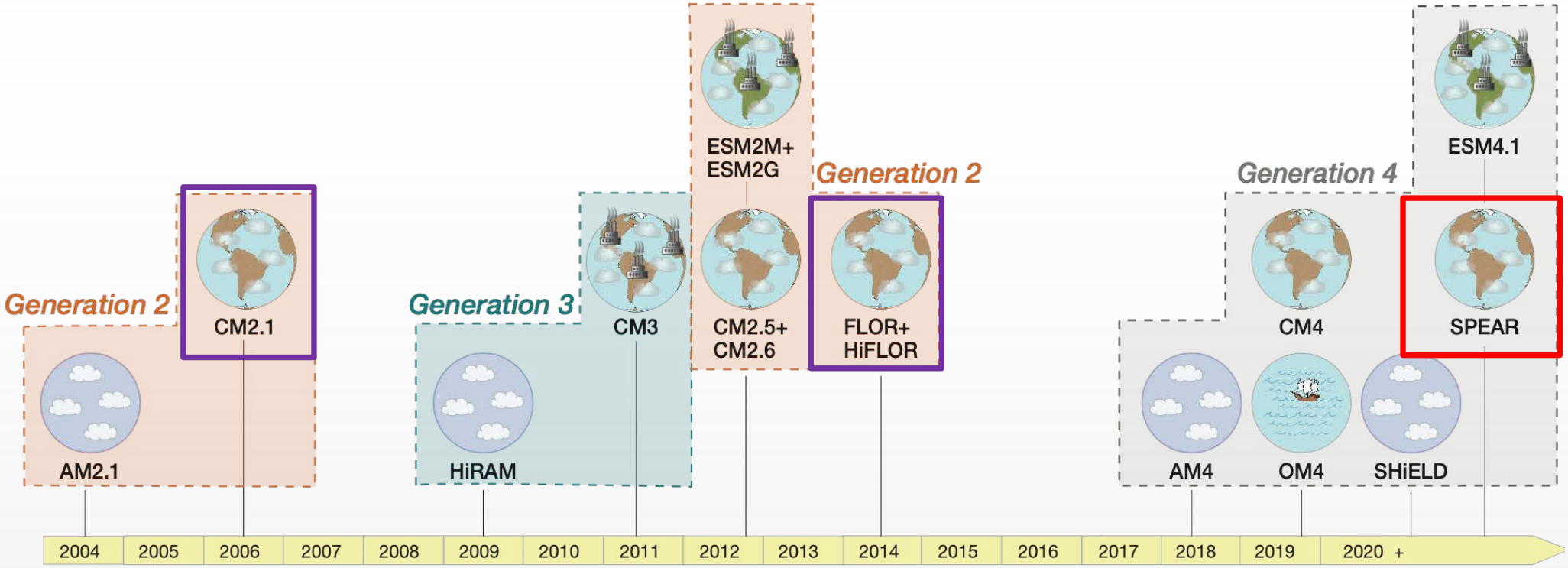
Prediction System R&D

Build prediction systems to predict and project the Earth System across timescales (e.g. seamlessly in **SPEAR**, Delworth et al., In Press at *JAMES*, 2020)





Seamless system for Prediction & EArth system Research
SPEAR: A new model for prediction, projection, & risk analysis



	Atmosphere resolution	Ocean resolution	
SPEAR_LO	100 km	1°	*Global scale climate, decadal prediction*
SPEAR_MED	50 km	1°	*Regional hydroclimate & extremes, seasonal prediction*
SPEAR_HI	25 km	1°	*" " + major hurricanes, better mountains*

The Seamless Prediction Approach

① Create a climate prediction system and validate it over the historical record. [prove it works]

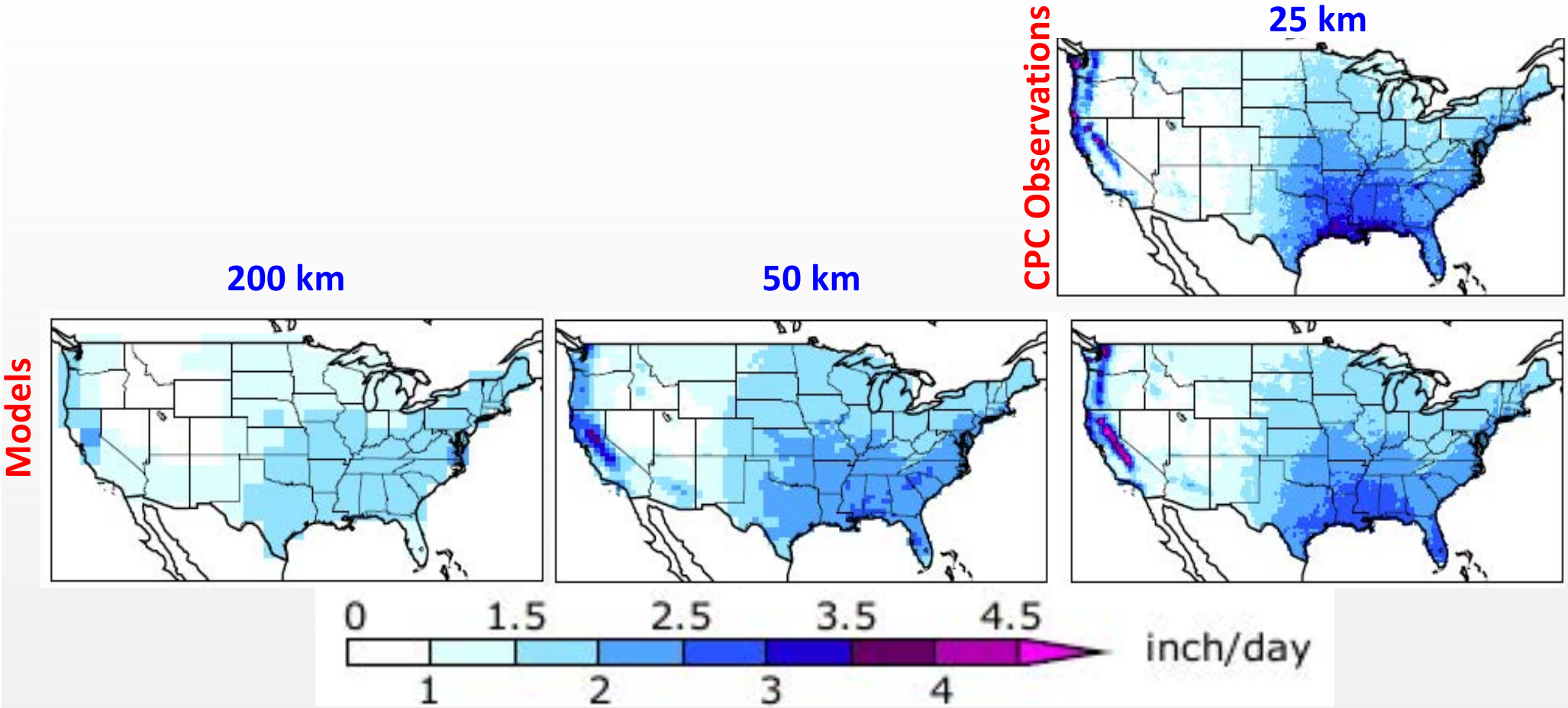
② Provide seasonal and decadal predictions. Explore the skill of phenomena with increasing complexity. [operational products, research new skill]

③ Create "transient climate simulations" to understand climate over time (ex. 1850-2100). Conduct risk assessments. [climate variability, change, risk]

④ Due to time it takes from R&D phase to operations and desire for resiliency, develop prediction products accounting for climate variability & change. [Integrate prediction with expected risk]

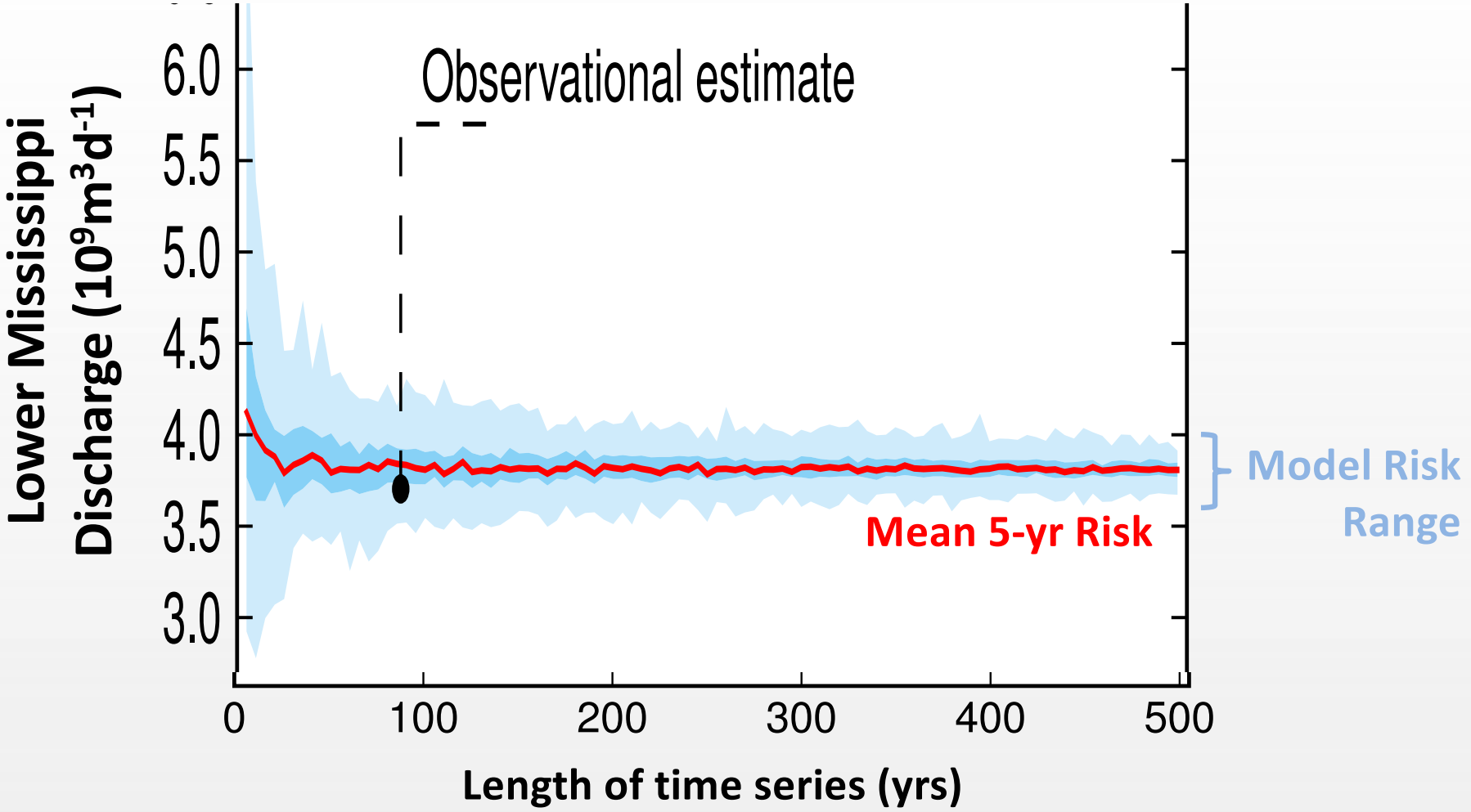
Example: develop models for precipitation extremes

- Models need to be designed for regional & local risk assessment
- Example: US precipitation extremes (van der Wiel et al. *J Clim,* 2016)



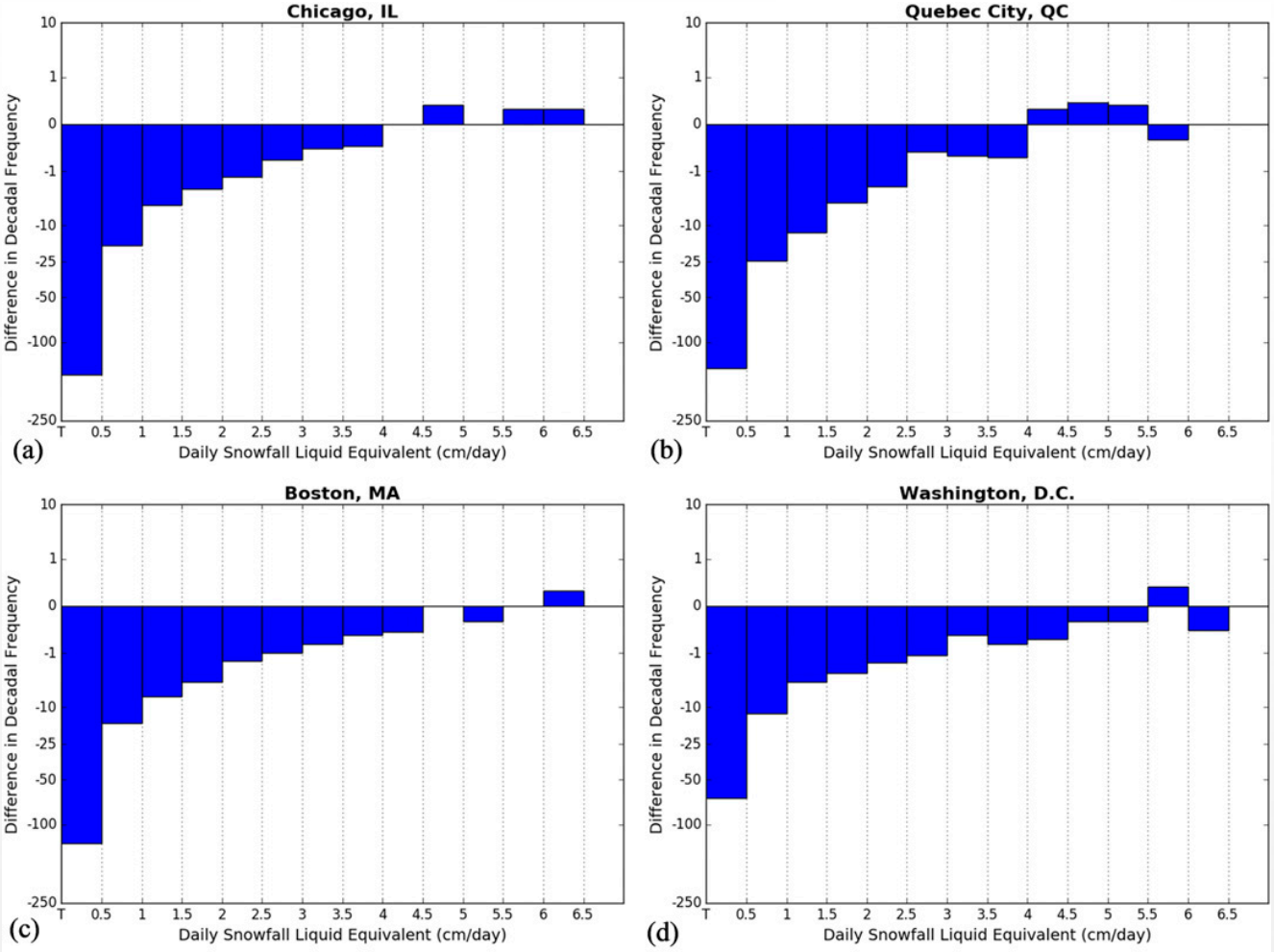
Quantify risk with models & observations

Example: Lower Mississippi 5-yr Monthly Flood Risk



Sources: Van der Wiel et al. J. Hydrometeo, 2018;

Changes in snow distributions in cities



** In this study we only used 300 years in the future, we need more to explore statistical significance in the extremes

Source: Janoski et al, J Climate, 2018

Understanding Risk Across Timescales to Reduce Impacts

- **Risk Assessment** (before or after an event happens):
  - What is the likelihood of an event today?
  - What causes an event?
  - How are risks changing? Is the risk today different than the past? What do we expect in the future?
- **Risk Management** (reducing negative impacts):
  - Is an event predictable? How far in advance?
  - How can we apply our knowledge of changing risks and prediction skill to inform risk management solutions via operations or data?

Snow Example

- **Problem:** Snow impacts winter activities/tourism, summer water supply, water quality, & ecology
- **Short time scale:** seasonal predictions provide advance knowledge of snow availability
- **Long climate simulations:** explore risk today and in the future
  - Changes in average conditions
  - Changes in risk of extreme high / low years
  - New emerging risks? Examples: increased wildfire, bark beetles, extreme blizzards
- **Combining timescales:** develop shorter predictions with longer term changes in mind. Predictions or risk management plans need to account for changing risks.

Summary

- The same climate prediction system can be used for prediction, projection, and risk assessment
- We need to build our prediction systems accounting for climate risks
- Next steps:
  - SPEAR seasonal predictions will be released to the North American MultiModel Ensemble later in 2020
  - We are running our transient climate simulations through 2100, writing scientific papers showing how to use the data / assess risk. We are exploring how to release it
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