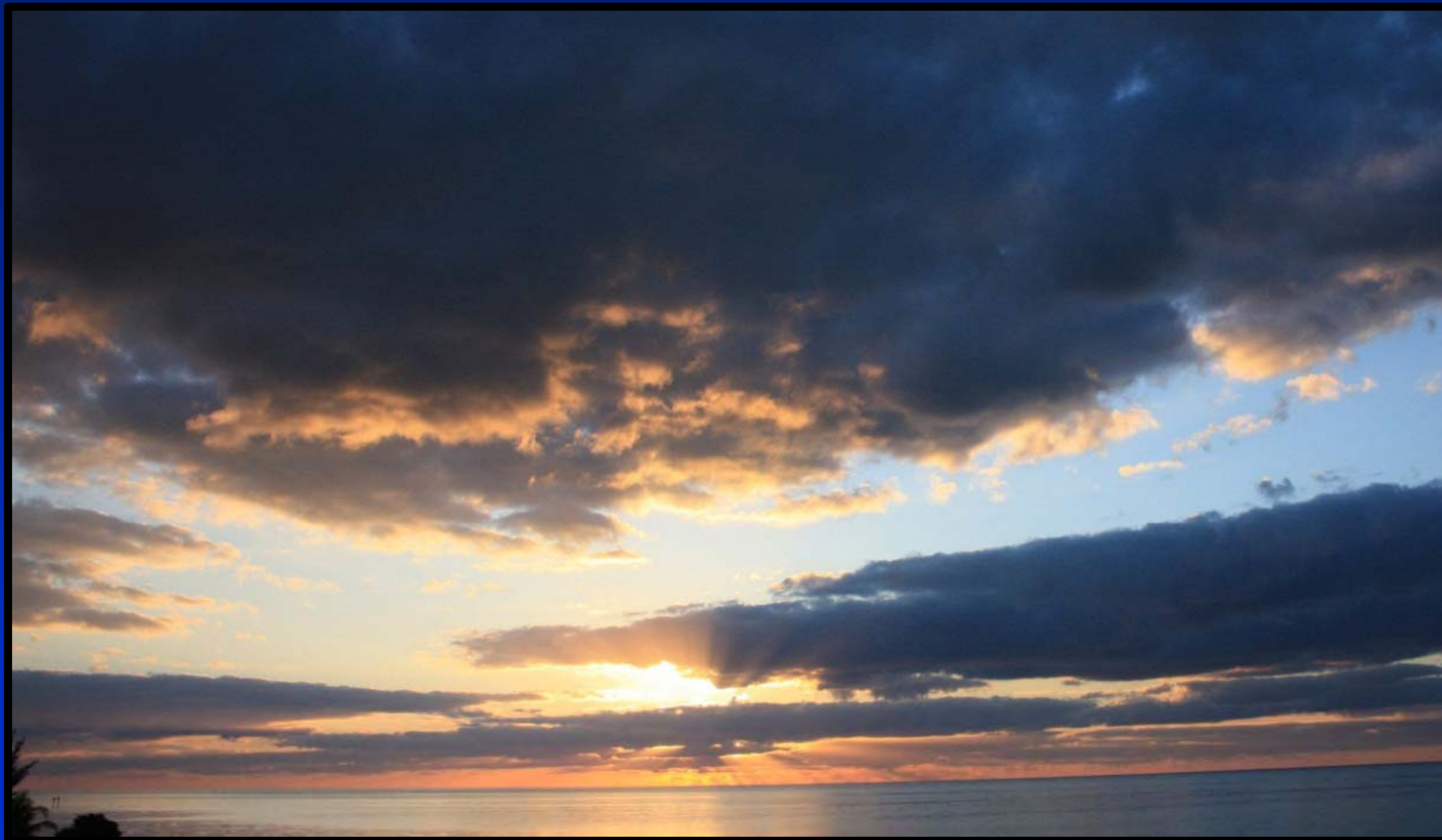


Precipitation Parameters Of Stochastic Climate Models For A Changing Climate

Bruce Wilson, U of MN and Aleksey Sheshukov, KSU

International Symposium on Erosion and Landscape Evolution

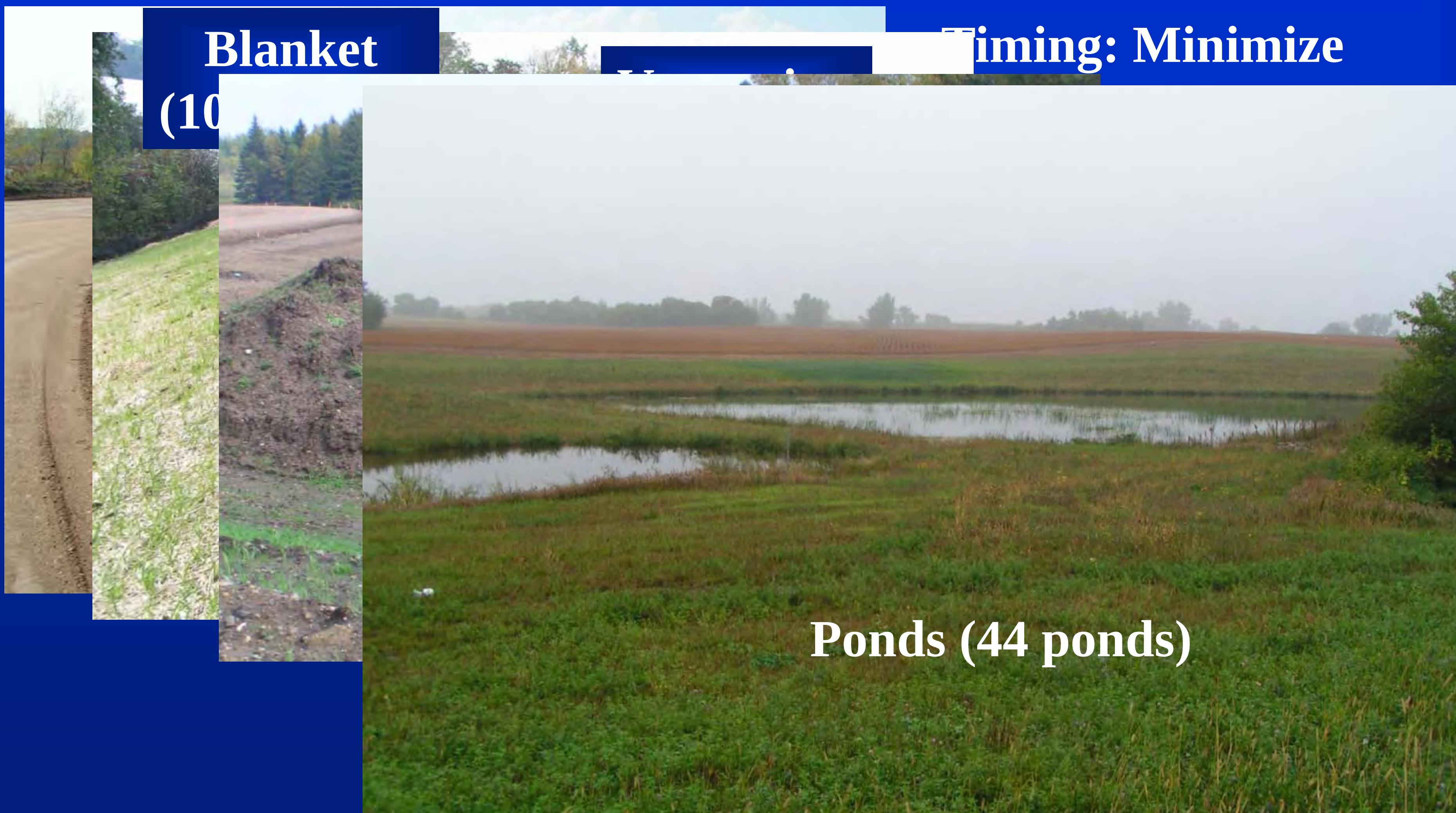
ASABE, Anchorage, AK **(9-21-2011)**

Outline

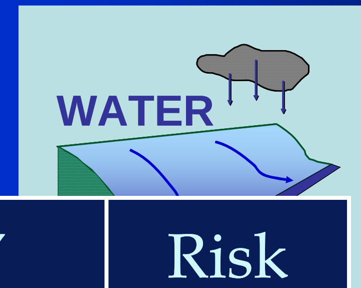
- Background
- Relationships for precipitation
- Example application

Sediment Control

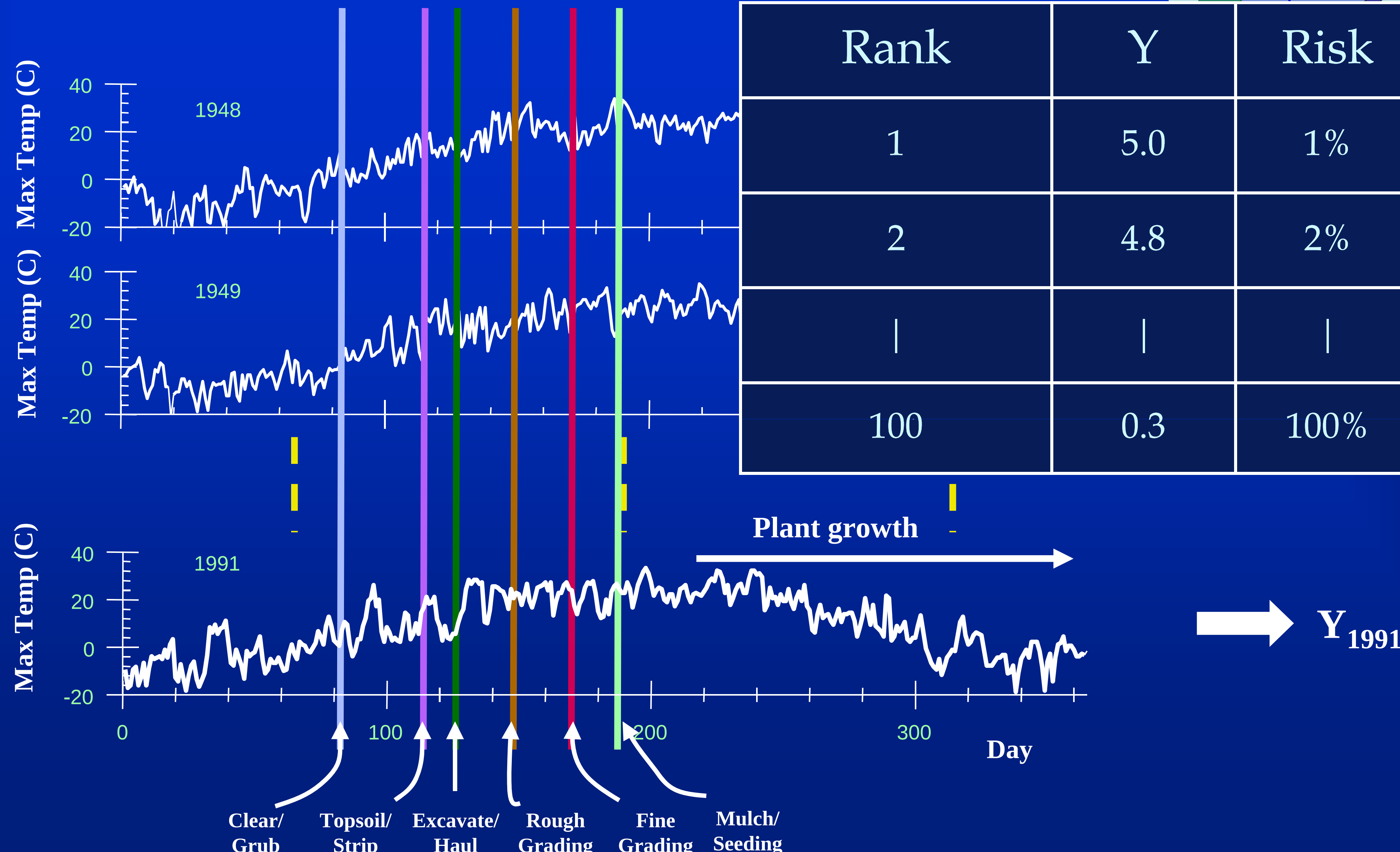
Timing: Minimize



Computational Framework



Rank	Y	Risk
1	5.0	1%
2	4.8	2%
|	|	|
100	0.3	100%



WINDS Model

Weather

Inputs for

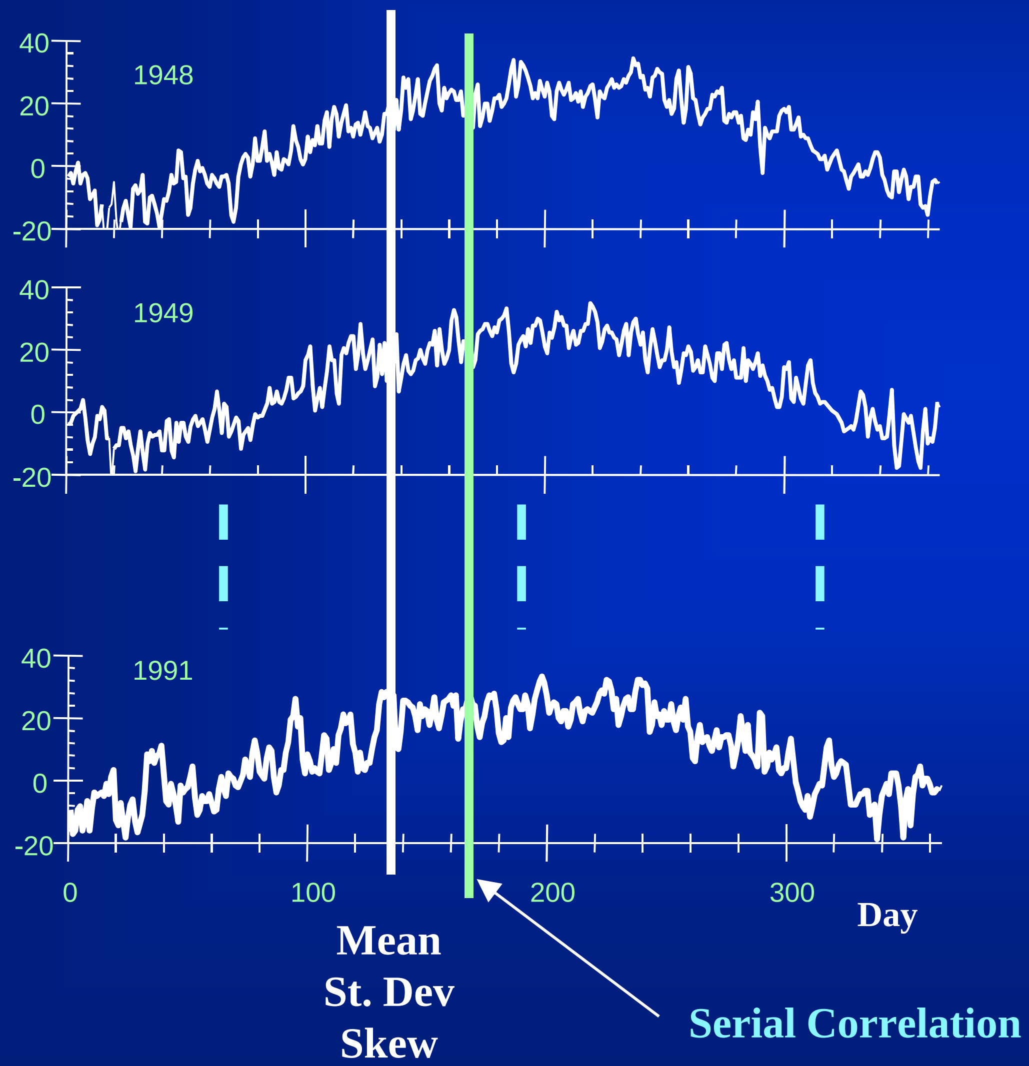
Nonpoint

Data

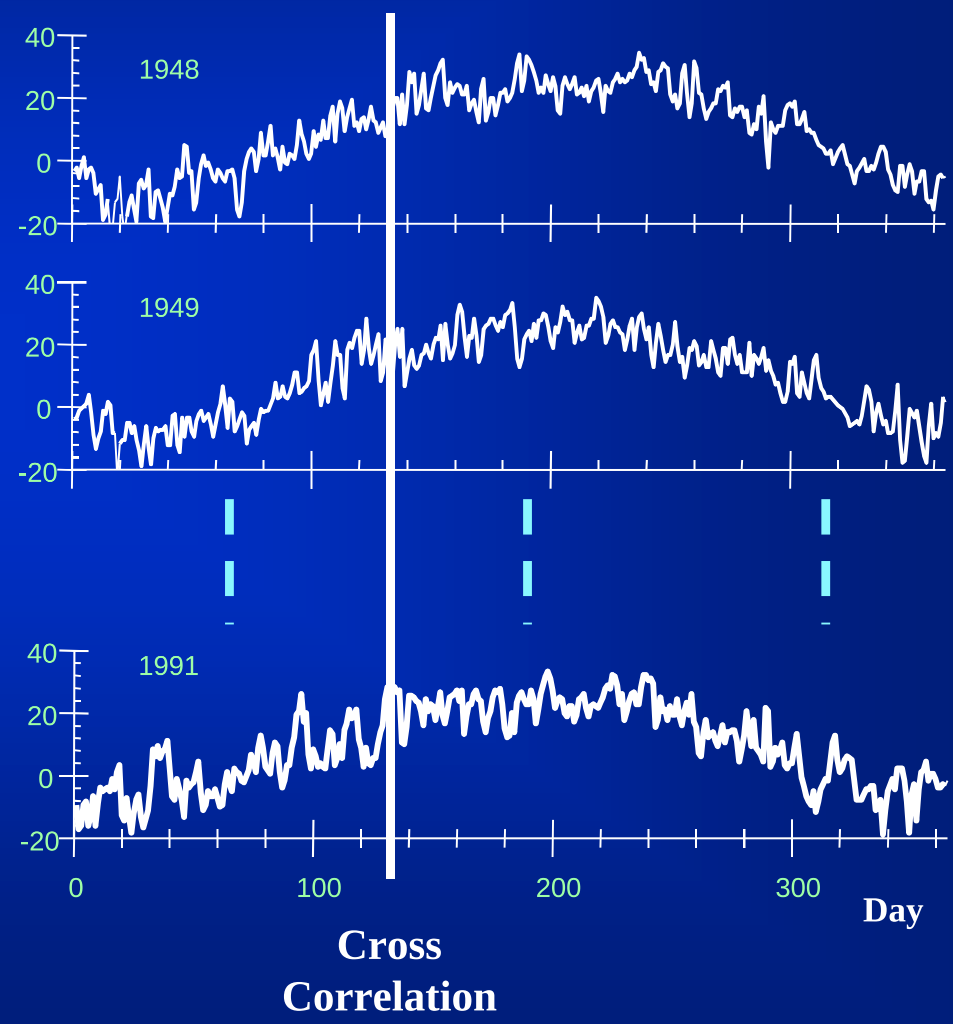
Simulations

Part 1: Compute statistics

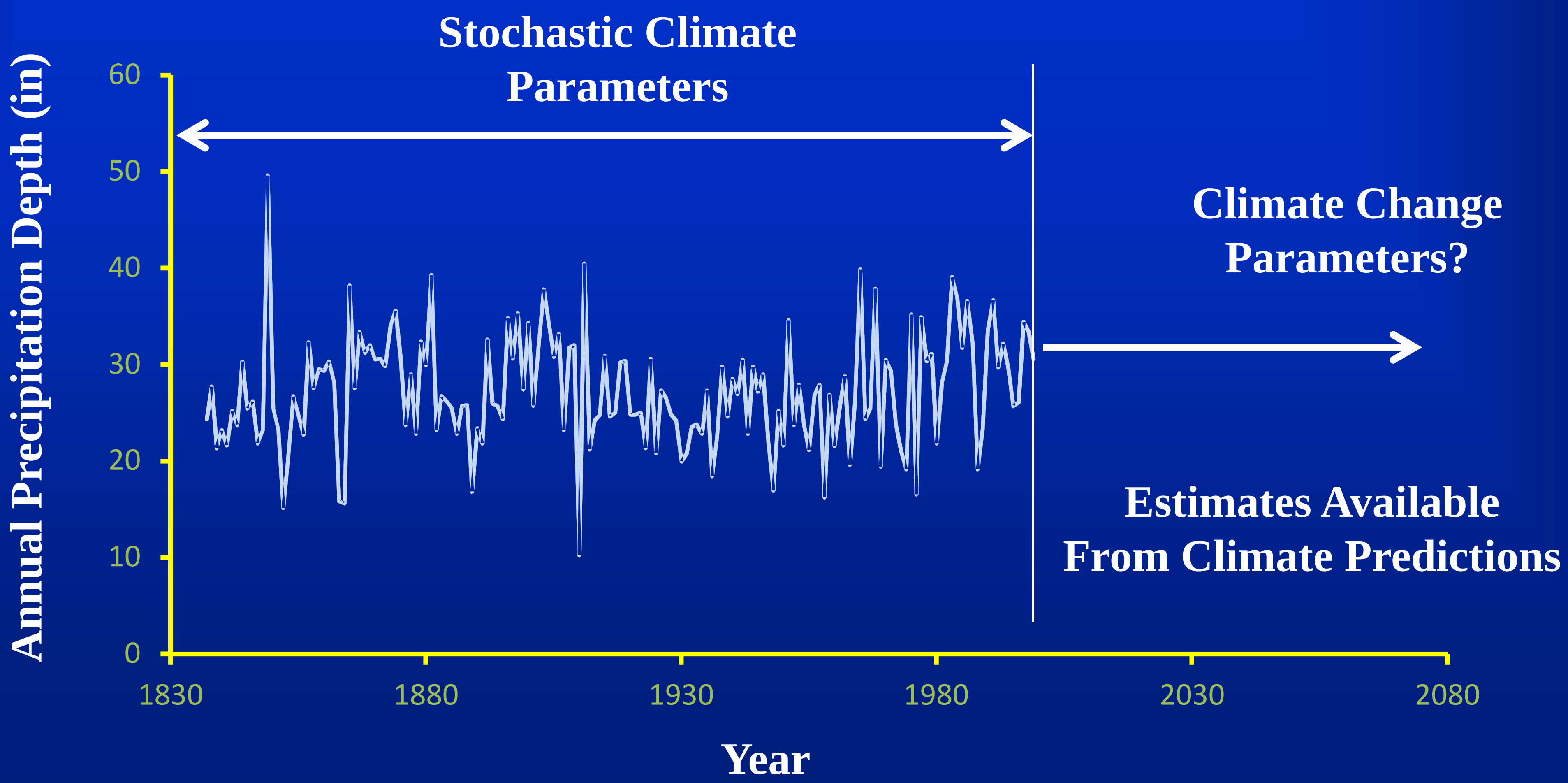
Max Temperature



Min Temperature



Climate Change



Climate Change: Non-Precipitation

Multiplicative:

$$X_n = \lambda\, X_o$$

Addictive:

$$X_n = X_o + \beta$$

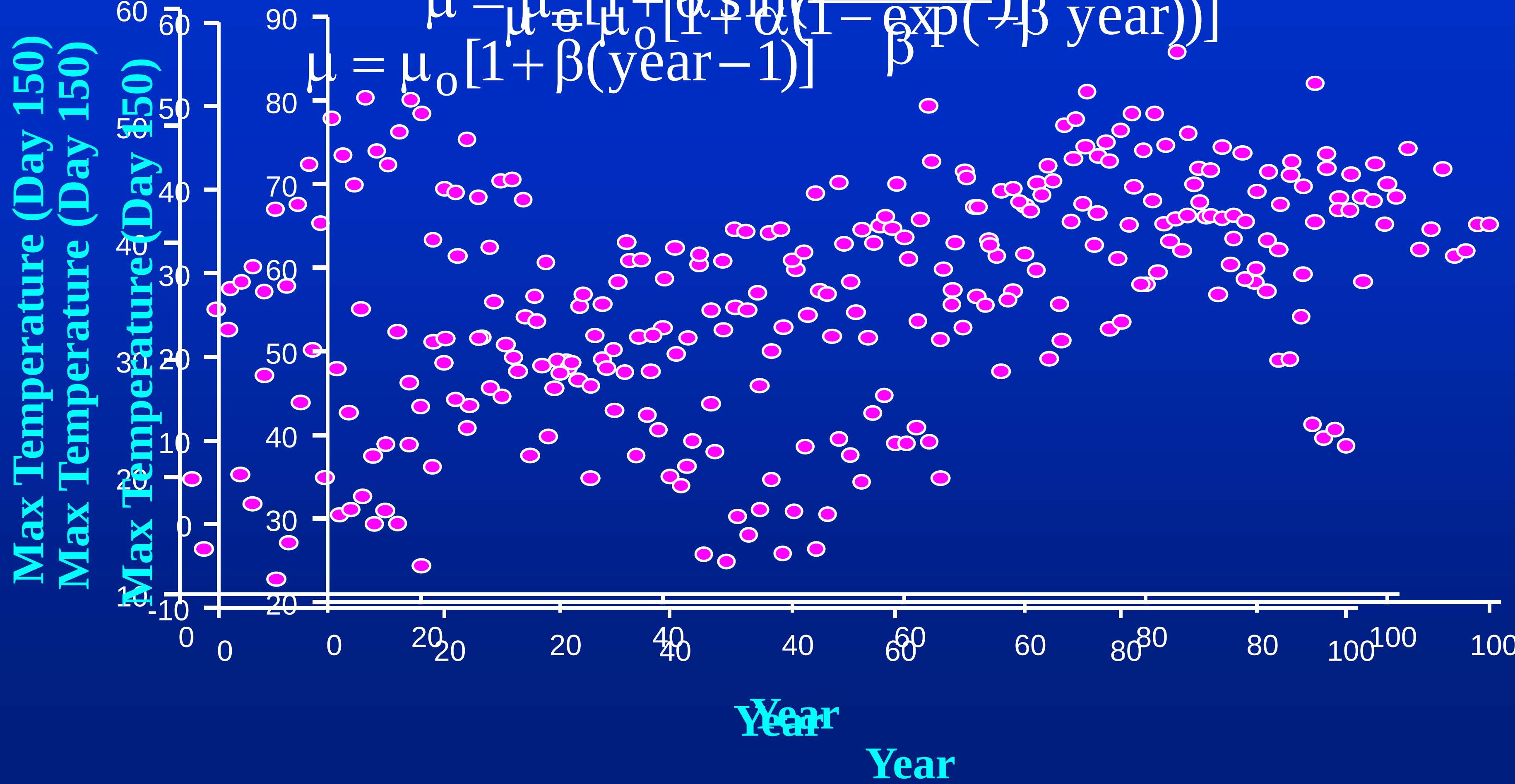
Straightforward if only interested in changing to new mean

Continued ...

$$\mu = \mu_o[1 + \alpha \sin(\frac{year - 1}{\beta})]$$

$$\mu = \mu_o[1 + \alpha(1 - \exp(-\beta\ year))]$$

$$\mu = \mu_o[1 + \beta(year - 1)]$$



Richardson's Precipitation Approach

$$E(P_T) = E(r)E(n_w)$$

Total Depth

$$E(P_{Tn}) = \lambda_T E(P_{To})$$

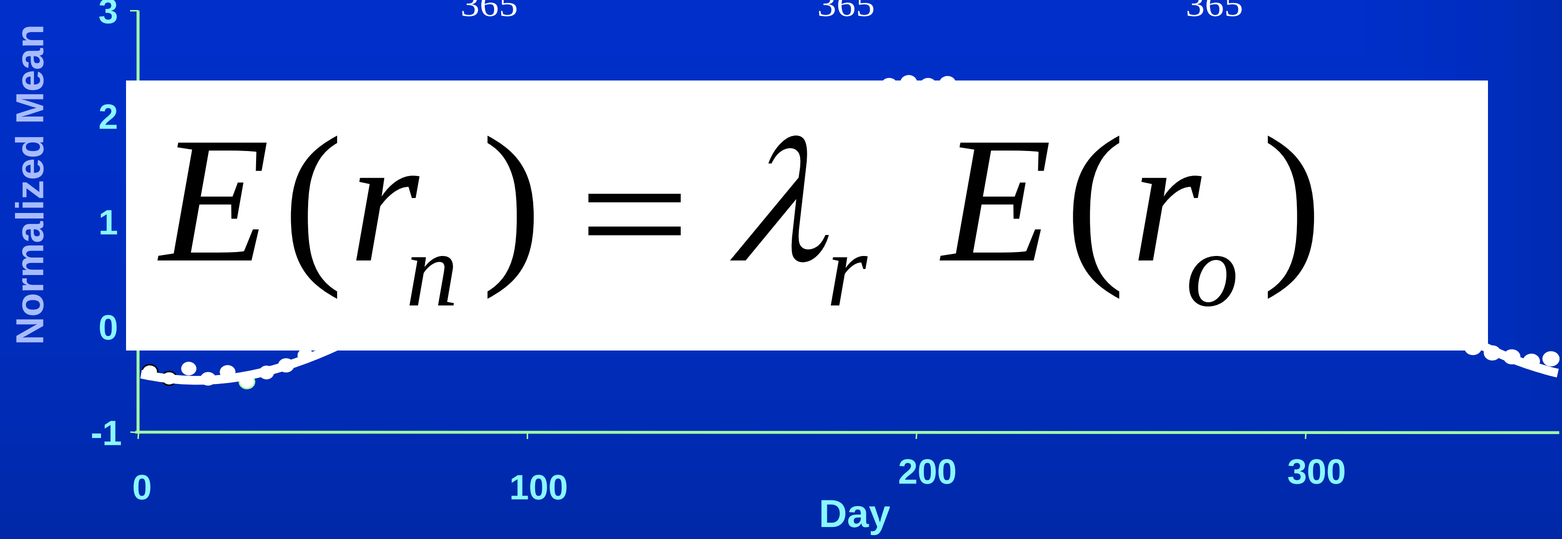
Number of Wet Events

New depth = f(# events, depth per event)

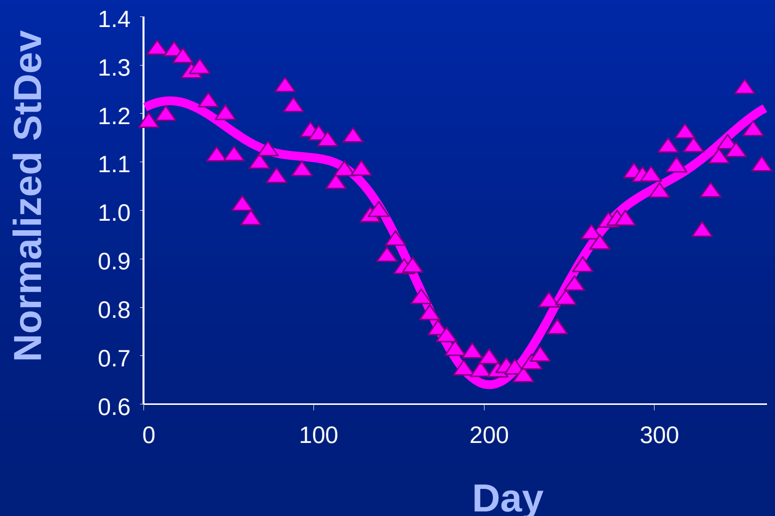
λ_T from climate model

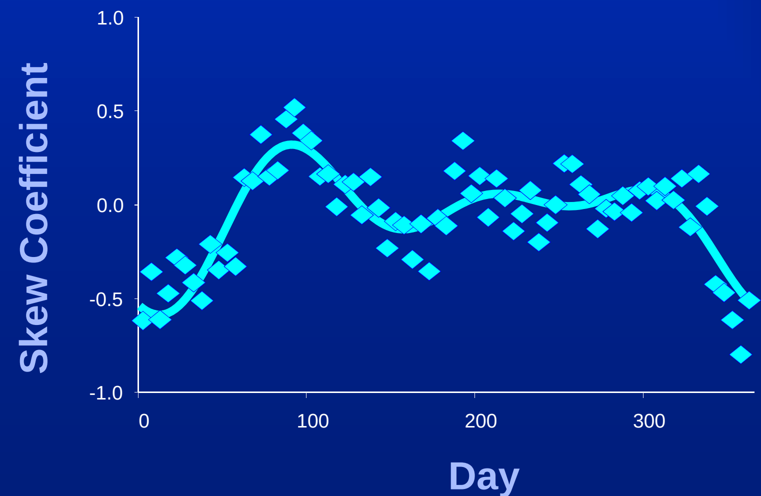
Precipitation Depth

$$b_o + b_1 \cos\left(\frac{day(2\pi)}{365} + \phi_1\right) + b_2 \cos\left(\frac{2day(2\pi)}{365} + \phi_2\right) + b_3 \cos\left(\frac{3day(2\pi)}{365} + \phi_3\right)$$



$$E(r_n) = \lambda_r \; E(r_o)$$





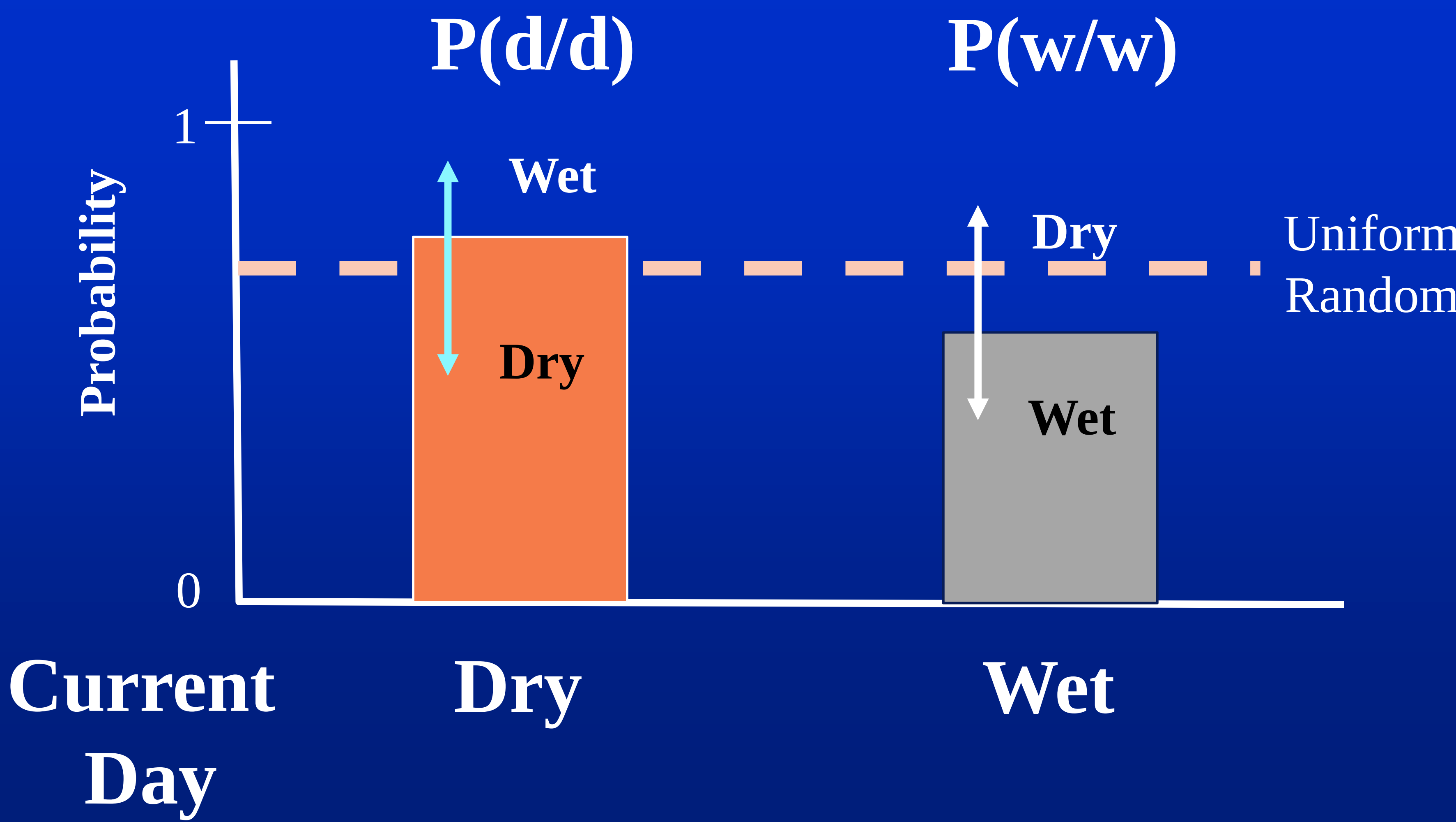
Number of Wet Events

$$E(n_{w,n}) = \lambda_w \; E(n_{w,o})$$

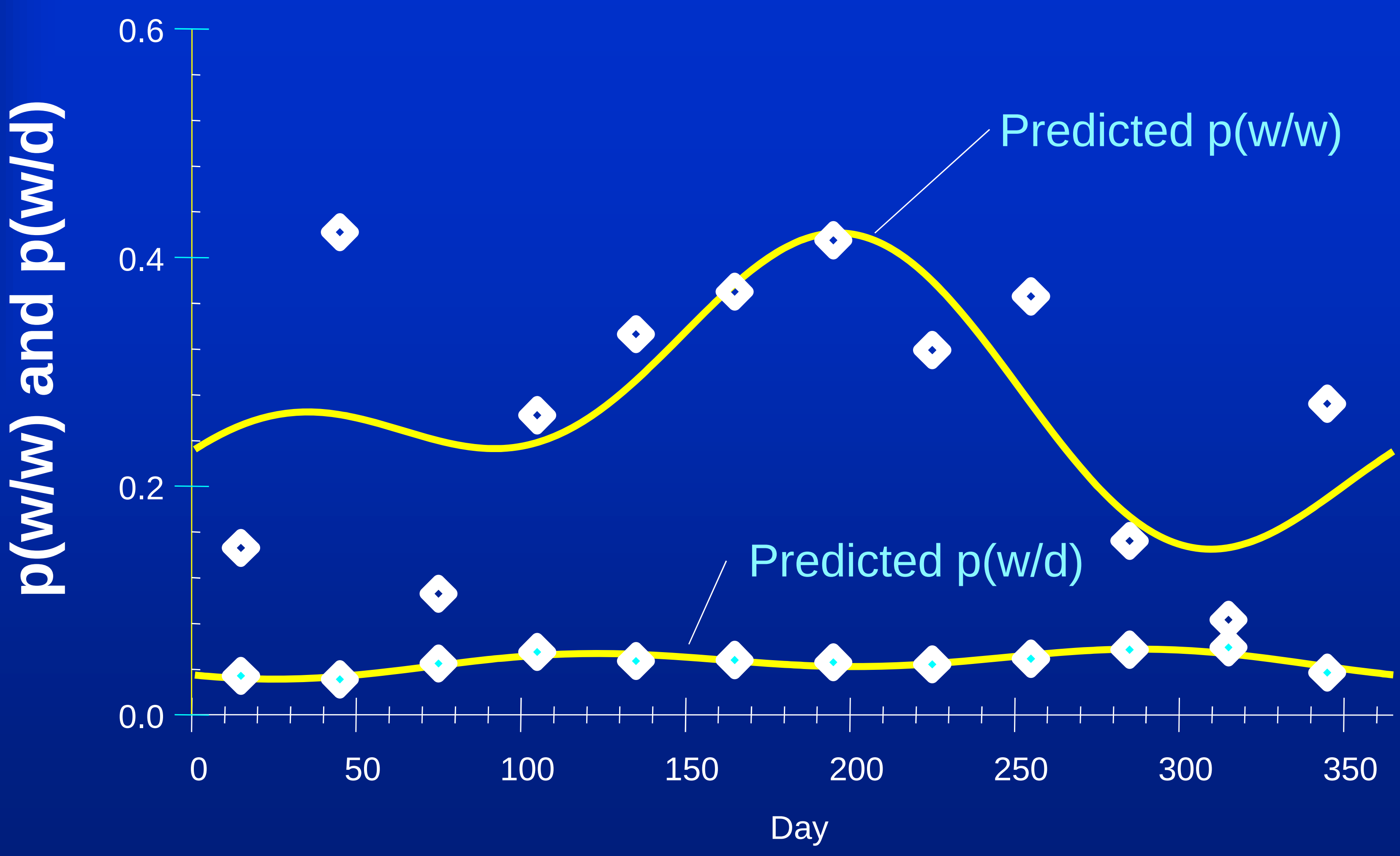
Climate model λ_T and specified λ_r:

$$\lambda_w = \frac{\lambda_T}{\lambda_r}$$

Number of Wet Days: Markov Chain



Transitional Probabilities



Derivations

User-specified parameter:

$$\gamma = \frac{n_{ww,o}}{n_{ww,n}}$$

Proper Transitional Probabilities

$$P_n(d/d) = 1 - \frac{\lambda_w P_o(w) - \gamma\,[P_o(d)\,P_o(d/d) + P_o(w) - P_o(d)]}{(1-\lambda_w)\,P_o(w) + P_o(d)}$$

$$P_n(w/w) = \left(\frac{\gamma}{\lambda_w}\right) P_o(w/w)$$

where

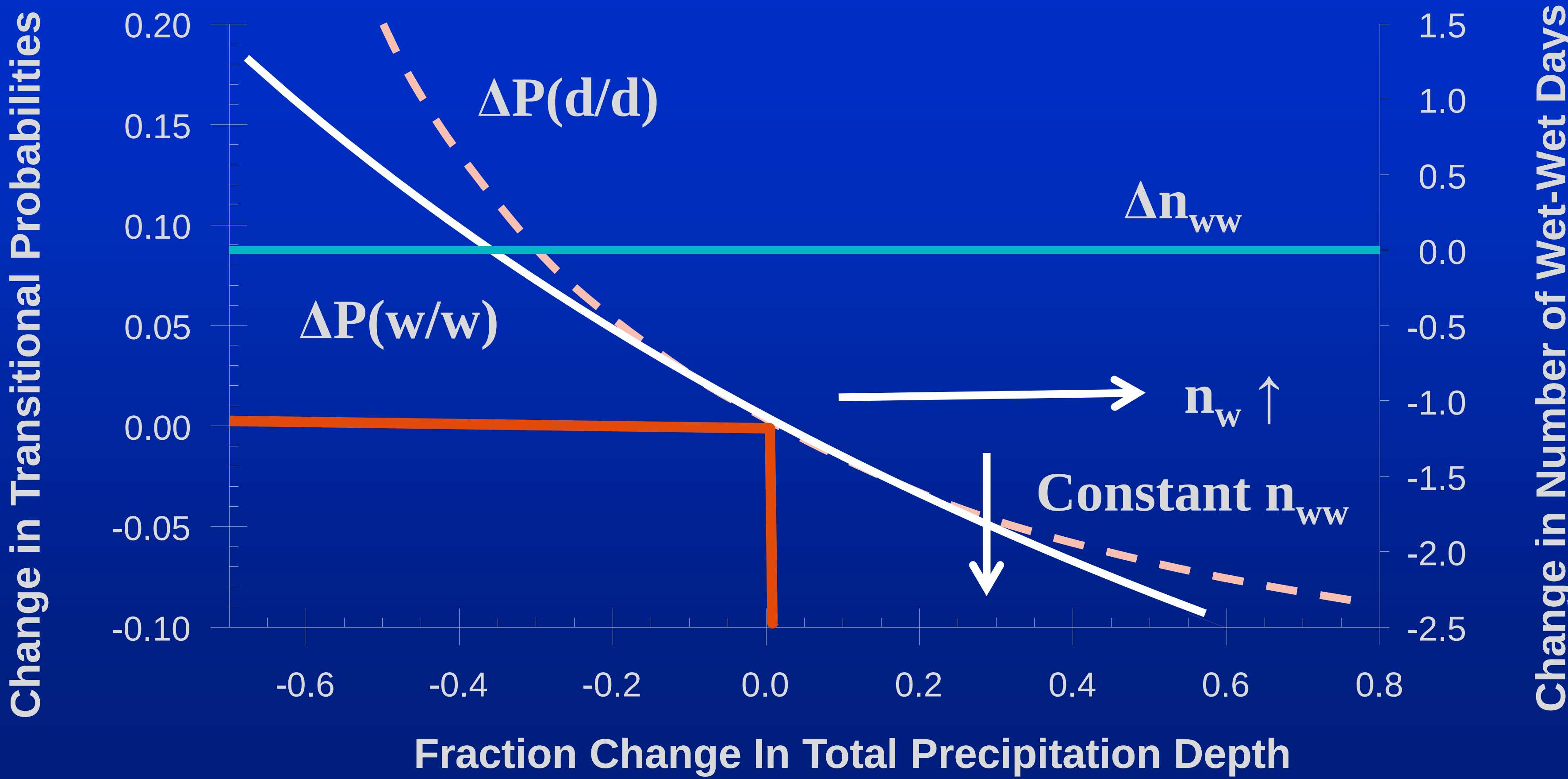
$$P_o(d) = \frac{P_o(d/w)}{1 + P_o(d/w) - P_o(d/d)}$$

Illustration

- Insight into user parameter γ
- Stillwater, OK – April, 1900-1979
- One-half of change in depth
- $\gamma=1$ (constant number wet-wet days)
- $\gamma=\lambda_w$ (ratio new to old wet days)

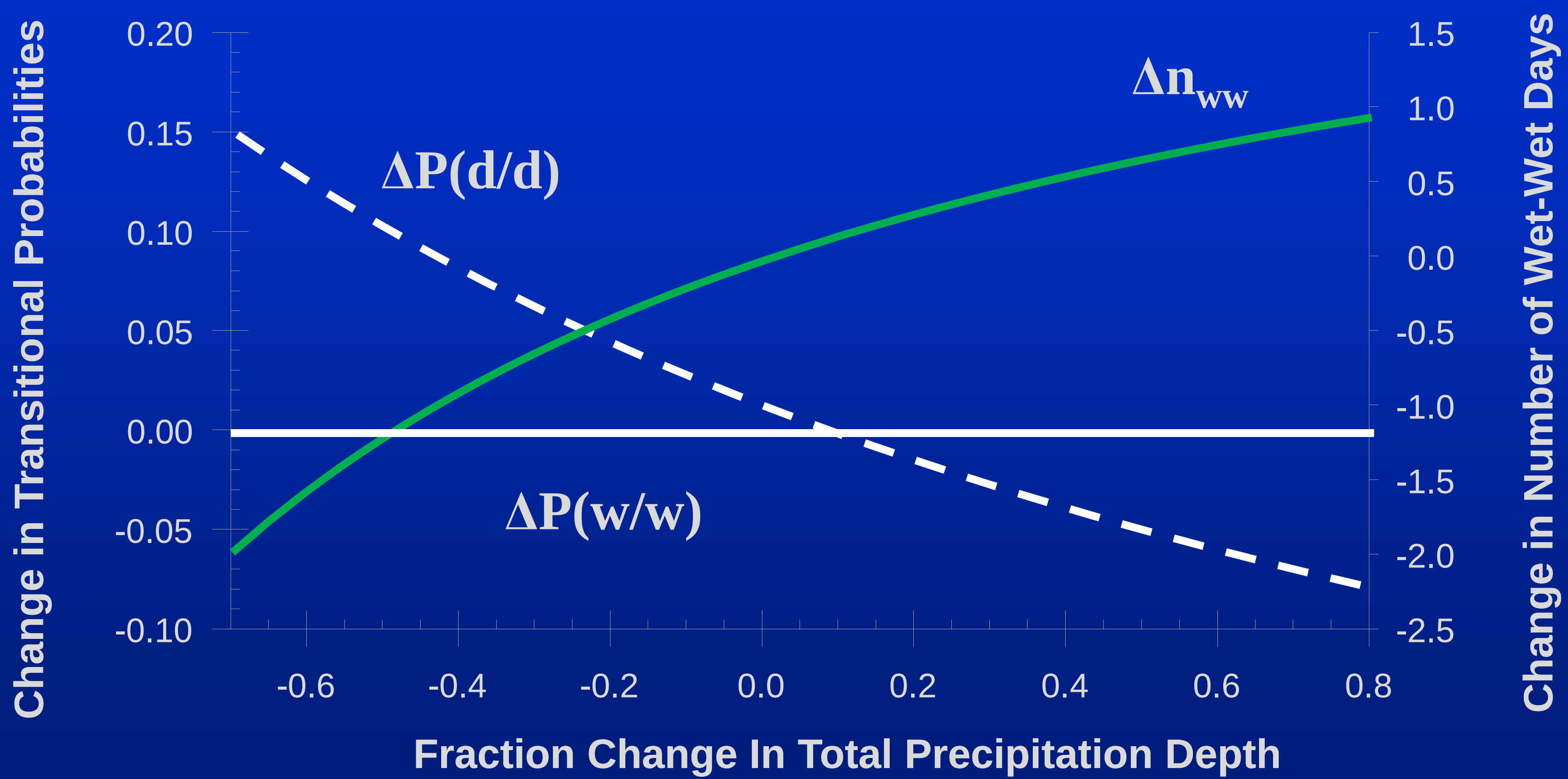
Constant Number of Wet-Wet Days

New storms develop more often on dry days and dissipate more rapidly on wet days



Equal Ratio of New to Old Wet Days

Persistence of storm systems remains constant



Summary

- Framework to adjust parameters in stochastic climate models
- Precipitation more difficult
- Transitional probabilities use additional parameter γ
- Depended on persistence of storms
- Other possible applications

Questions?