On-Farm Water Budget

ESHMC Meeting January 2009

B. Contor

Are we gonna fish, or cut bait?

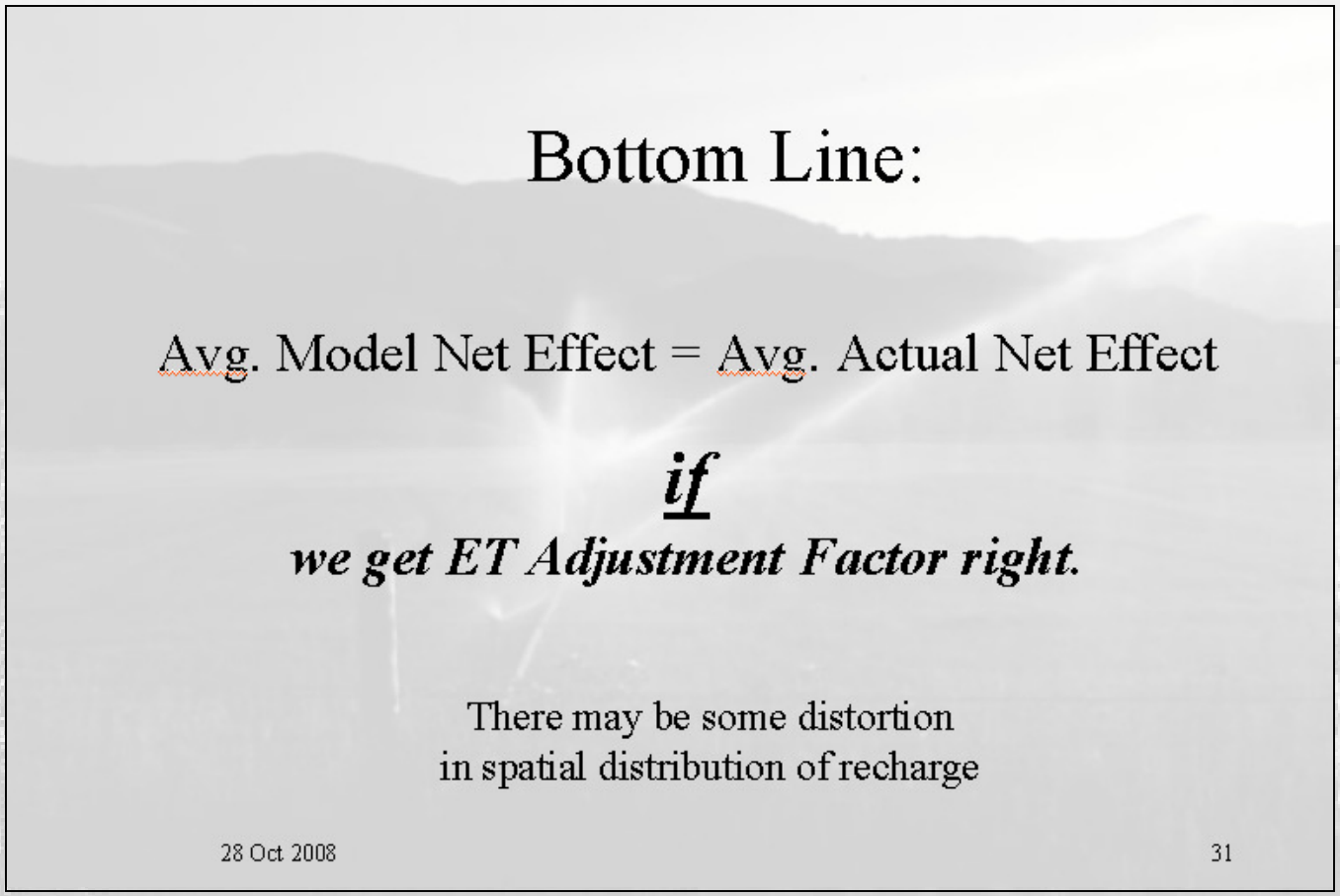
Issues

- If GW irrigators under-irrigate, does the ESPAM1.1 practice over-estimate net withdrawals?
- If SW irrigators are supply constrained, does the ESPAM1.1 practice under-estimate incidental recharge?

Last Meeting

- Illustrations of conceptual relationships & ESPAM1.1 practice
- Discussion of effects of simplifications & their ramifications
- Discussion of operation & calculation of ET adjustment factors

Last Meeting (cont)



(we also discussed other spatial-distribution effects)

Last Meeting (cont)

- Tacit acceptance that ET adjustment factors reasonably accommodate GW-only irrigation issues?
- Long discussion about what to do for SW irrigation.

Last Meeting (cont)

- IWRRI commitments:
  - Incorporate explicit irrigation efficiency report into summary tool
  - Consider and report on possible ways to treat effects of deficit irrigation from SW:
    - Increase in irrigation efficiency
    - Decline in evapotranspiration (ET)
    - Impact upon in-field percolation

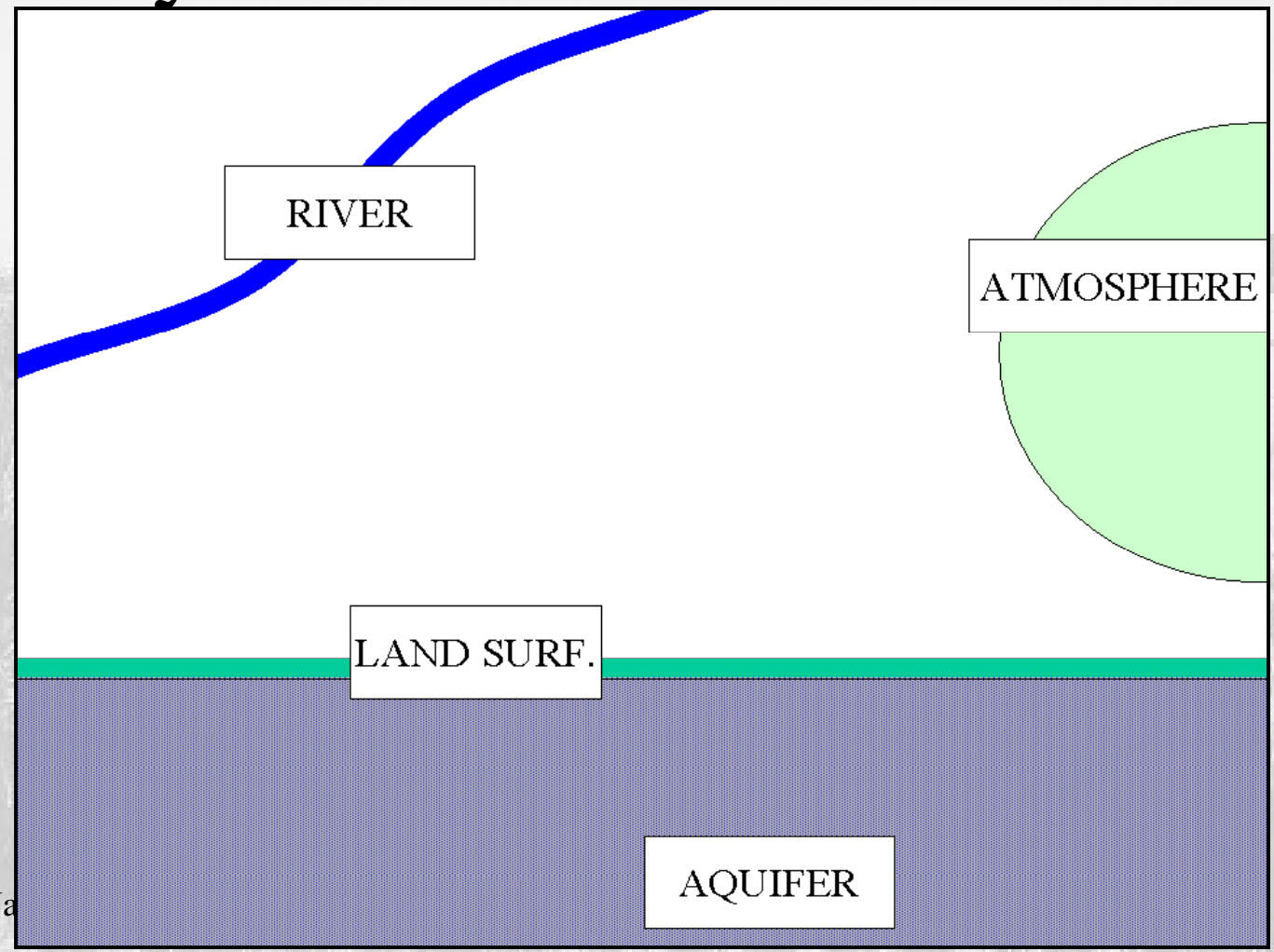
IWRRI Commitments

- Summary Tool efficiency report:
  - The best we may get is *by model cell* (not by irrigation entity)
  - Results will always be unsatisfying on mixed-source parcels.

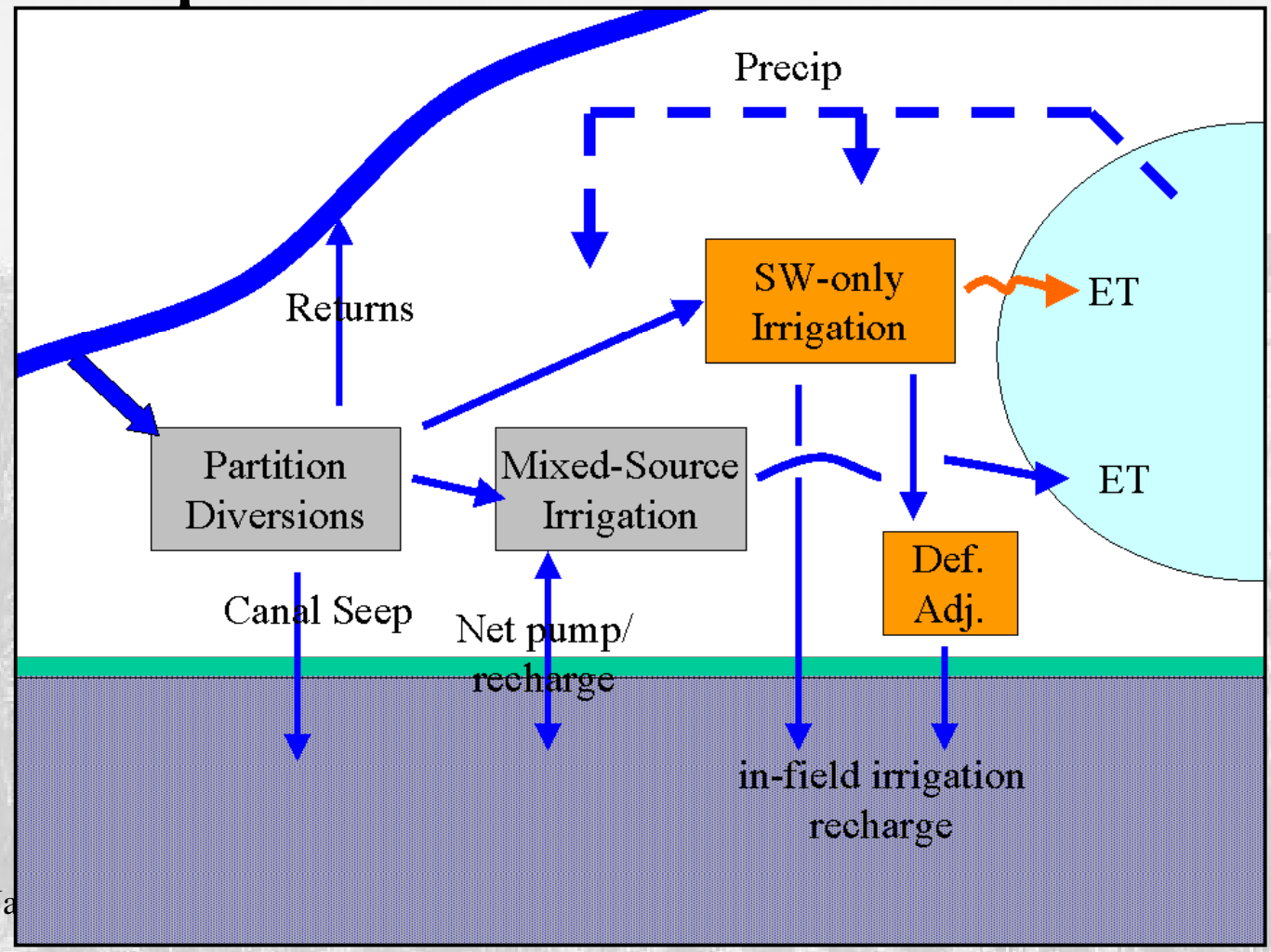
IWRRI Commitments (cont)

- Consider and report on possible ways to treat effects of deficit irrigation from SW:
  - The topic of the rest of this presentation

Conceptual SW-Irrigation Physical Model ESPAM1.1

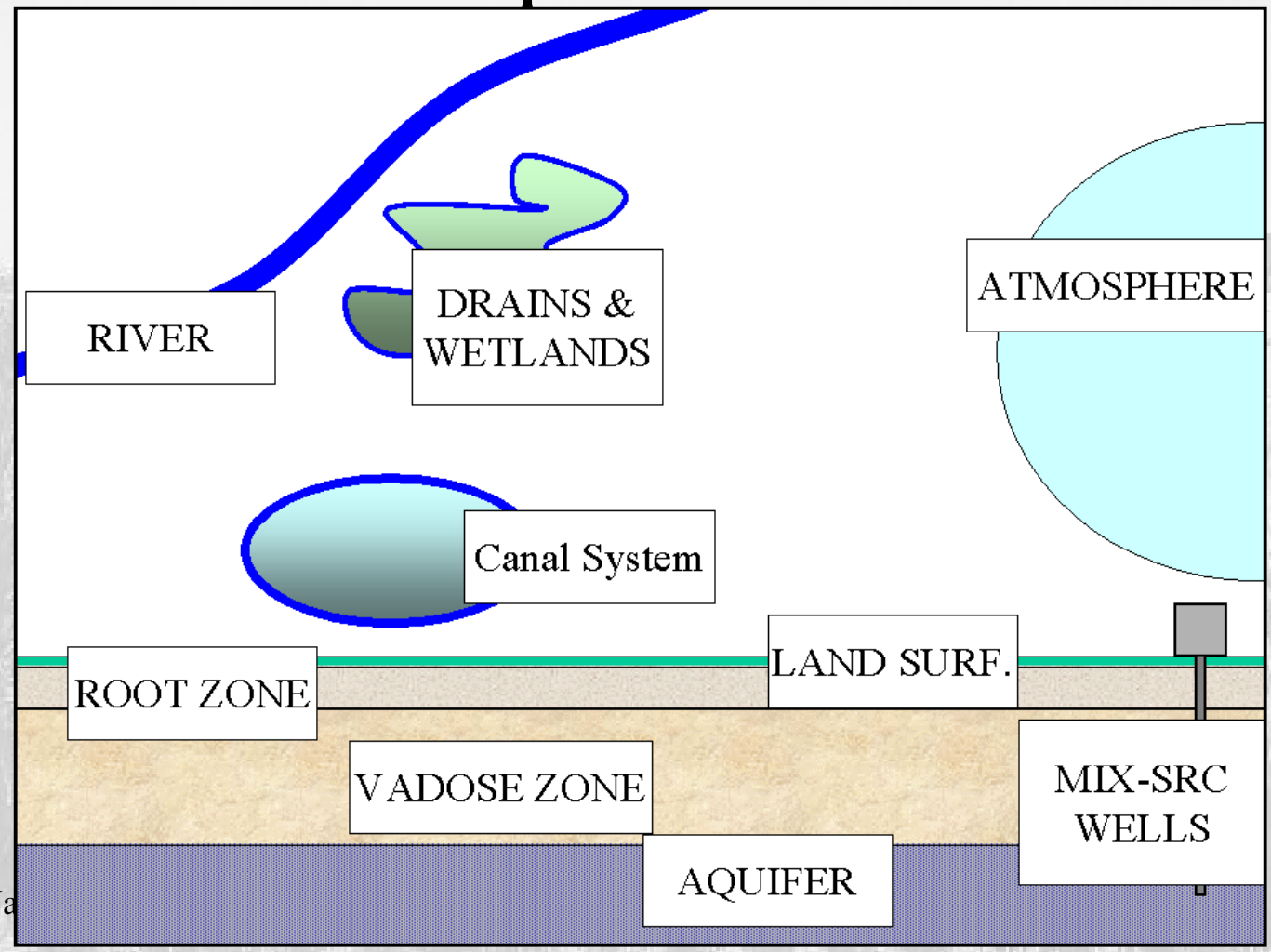


SW Irrigation Processes Represented in ESPAM1.1

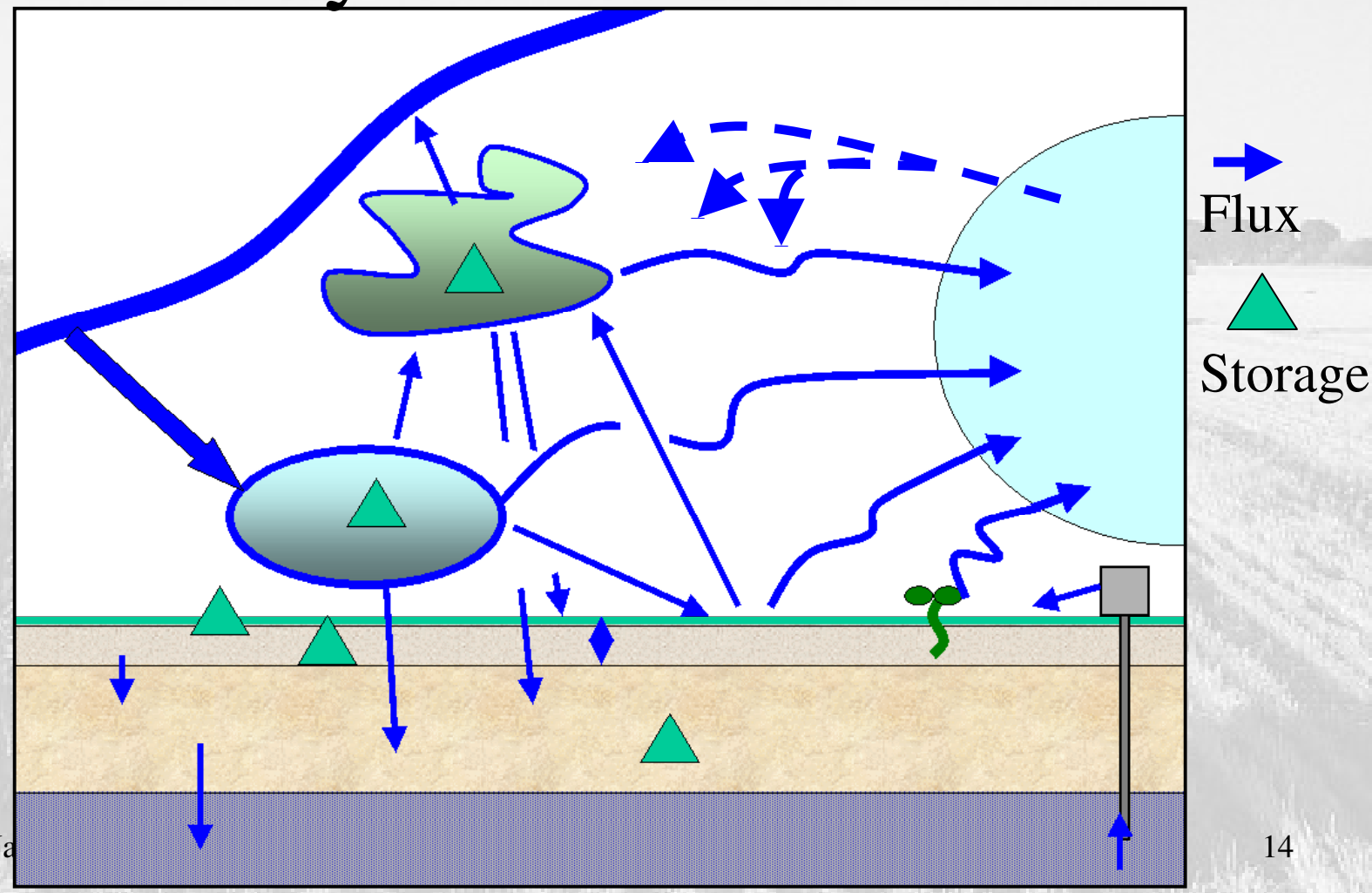



This is a simplification
of reality

Alternate SW Irrigation Conceptual Model



Alternate SW Irrigation Physical Processes



This is a simplification of reality

"The best maps are at a scale of 1:1 but they are hard to fold"

(Mark Twain?)

Personal bias: antagonism = f(clients' needs, complexity...)

Three Basic Options

- Modify tool to enforce reasonable irrigation efficiency
- Reverse IWRRI/IDWR decision and undertake wholesale revision of Recharge Tool
- Follow ESPAM1.1 practice and perform manual adjustment for deficit irrigation

Modify tool to enforce reasonable in-field irrigation efficiency

- Martin-Supalla equation (Journal of Irrigation and Drainage Engineering 110 (1984):148-165) provides a basis:

$$Y = Y_d - (Y_m - Y_d)\,[1 - (1 - I/I_m)^{(1/B)}]$$

Y = crop yield
Y_d = dryland (rain-fed) crop yield
Y_m = yield at full irrigation
I = irrigation depth
I_m = irrigation depth at full irrigation
B = $(ET_m - ET_d)/I_m$
ET_m = evapotranspiration at full irrigation
ET_d = dryland (rain-fed) evapotranspiration

Modify tool (cont)

- Neglects important components:
  - partition of diversions to headgate delivery, mixed-source lands, canal loss and return flows.
  - storage in canals, drains, wetlands, root zone, vadose zone
- One-time use
  - (new Recharge Tool required for ESPAM3)

Modify tool (cont)

- Alternate viewpoints on effort entailed
  - a) "Just a few lines of code"
  - b) "A process is required"
    - define algorithm
    - code
    - test and verify
    - apply
    - document and defend

Reverse IWRRI/IDWR decision and undertake wholesale revision of Recharge Tool

- Are we gonna fish, or cut bait?

Follow ESPAM1.1 practice and perform manual adjustment for deficit irrigation

- Balanced look at components
  - Returns are reasonable?
  - Canal leakage reasonable?
  - Partition to mixed-source lands reasonable?
  - Field-headgate delivery reasonable?
  - Implied in-field irrigation efficiency is reasonable?

Follow ESPAM1.1 (cont)

- Reasonability of Returns
  - this one is **MOST IMPORTANT**
    - other decisions only affect spatial distribution, this one affects **actual quantity of recharge**
  - rule of thumb X% to Y% (first cut)
    - X & Y negotiable, propose X = 0%, Y = 50%
  - consider available data (including other entities)

Follow ESPAM1.1 (cont)

- Reasonability of Canal Leakage
  - rule of thumb X% to Y% (first cut)
    - X & Y negotiable, propose X = 10%, Y = 50%
  - consider available data
  - remember our prior decisions to use a non-linear algorithm

Follow ESPAM1.1 (cont)

- Reasonability of Mixed-source partition
  - What is implied depth delivered to mixed-source parcels?
  - How does this compare with distance-determined mixed-source fractions?

Follow ESPAM1.1 (cont)

- Reasonability of Field Headgate Deliveries
  - rule of thumb X ft to Y ft (first cut)
    - X ~ 2 feet (based on GW pumping depths from Water Measurement District experience)
    - Y ~ 4 feet (based on IDWR water-right standard)
  - Apply decision rules if delivery < X or delivery > Y
  - Use Fixed-Point data set to make adjustment if needed

Follow ESPAM1.1 devilish details

- If delivery > Y then look carefully at returns, mixed-source & canal leakage
  - only adjust returns if other data confirm adjustment
  - make mixed-source deliveries reasonable
  - put rest of adjustment into canal leakage
  - if things still don't make sense, revisit diversion & land-cover data

Follow ESPAM1.1 devilish details (cont)

- If delivery < X then look again at returns, mixed-source & canal leakage
  - if these still seem reasonable consider in-field efficiency

Follow ESPAM1.1 devilish details (cont)

- Is implied irrigation efficiency reasonable?
  - Use published ranges of values for application method types
  - don't forget contribution of precipitation & moisture stored in root zone
    - winter precip
    - carry-over from prior crop
  - Calculate implied efficiency of delivered water

Follow ESPAM1.1 devilish details (cont)

- Is implied irrigation efficiency reasonable (cont)?
  - Use Martin-Supalla equation to calculate expected irr. efficiency under deficit irr.
  - Use new efficiency to calculate new ET
  - if new ET < model ET, calculate adjustment

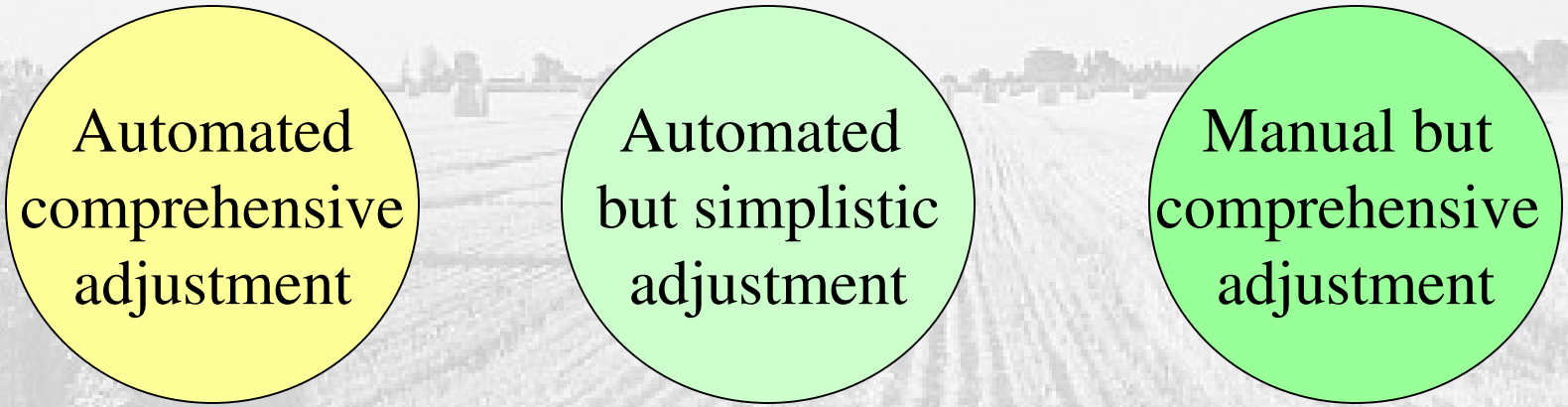
Follow ESPAM1.1 devilish details (cont)

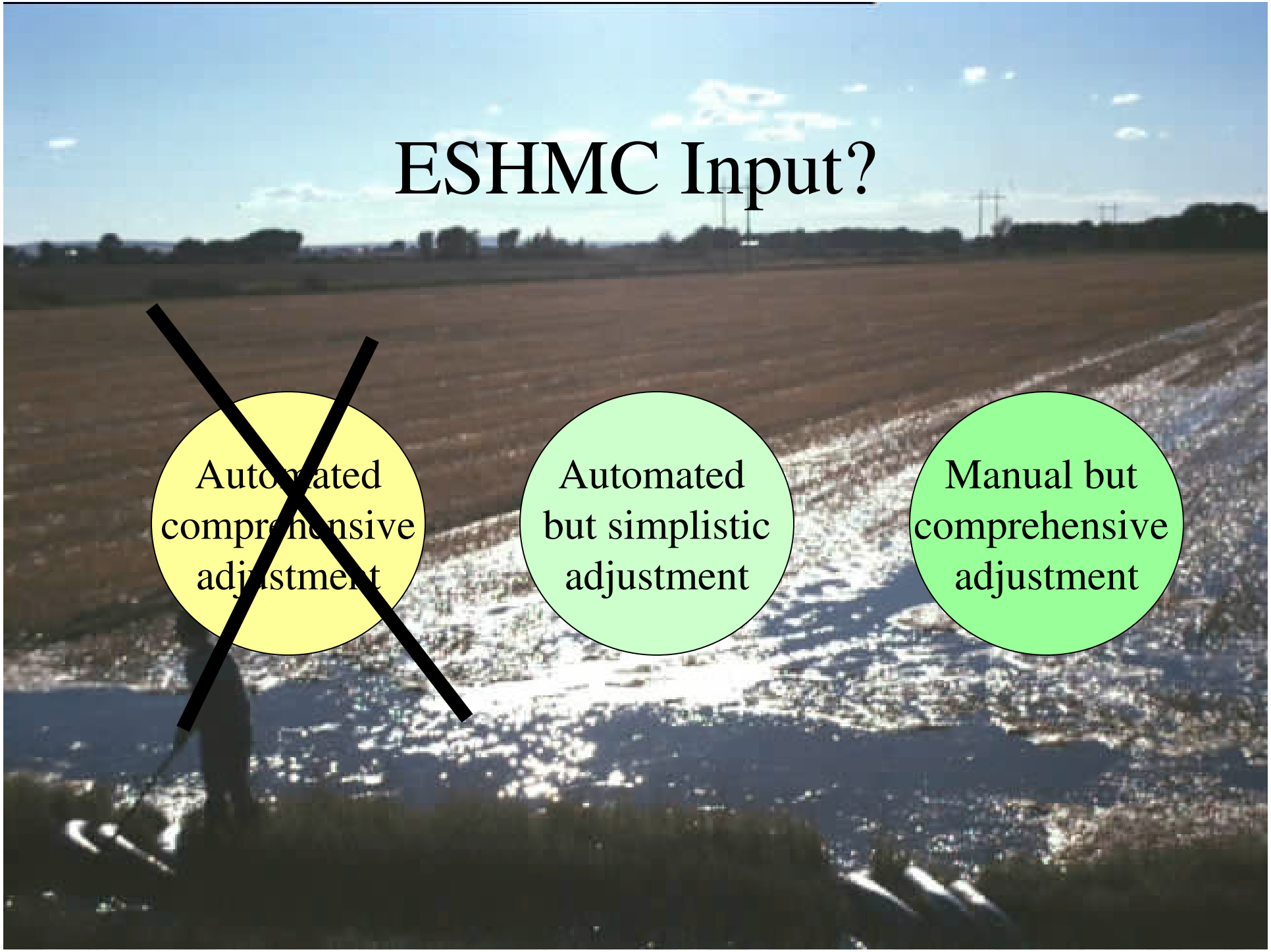
- Use Fixed-Point data set to make adjustment if needed
  - Model ET minus "True" ET = required adjustment
  - If model ET is too high, calculated recharge is too low
  - Therefore, apply adjustment as *positive value* in fixed-point data set.

Follow ESPAM1.1 devilish details (cont)

- Note: Martin-Supalla equation is defined on ***annual*** basis.
  - perform calculations on annual basis
  - if adjustment is required, proportionally apply to irrigation season
    - this assumes irrigators know how to best apply what is available

Summary of Choices




ESHMC Input?
Automated comprehensive adjustment
Automated but simplistic adjustment
Manual but comprehensive adjustment