The Role of Evaporation in DRI

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OBJECTIVE OF DRI

To better understand the physical characteristics of and processes influencing Canadian Prairie droughts, and to contribute to their better prediction, through a focus on the recent severe drought that began in 1999

DRI THEMES

1. Quantify the physical features,
   - flows of water and energy into and out of the region, and
   - storage and redistribution within the region
2. Improve the understanding of processes and feedbacks governing the
   - formation,
   - evolution,
   - cessation and
   - structure of the drought
3. Assess and reduce uncertainties in the prediction of drought
4. Compare the similarities and differences of current drought to previous droughts and those in other regions
5. Apply our progress to address critical issues of importance to society

Evaporation

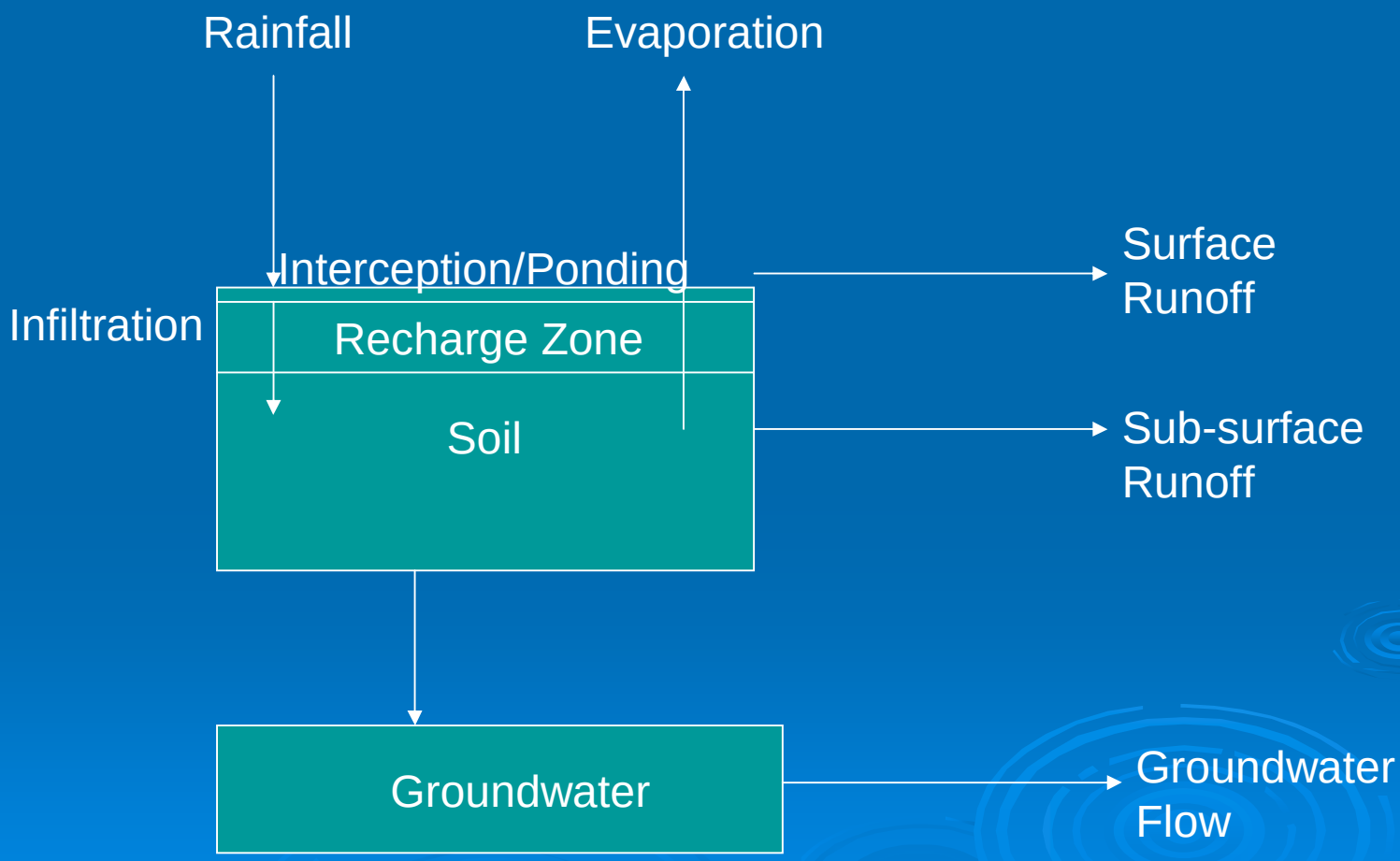
- Water vapour flux to the atmosphere from
  - Soil
  - Open Water
  - Vegetation
    - Interception water/snow
    - Stomatal release
  - Snow/ice
  - Precipitation (? depends on how defined)
- Phase change and transport provides coupling of atmosphere, land surface and sub-surface water and energy balances

Prairie Drought & Evaporation

- Should be Easy! If R = 0, then P = E
- Not that easy…..
  - E = P - ΔS This is when sub-surface coupling becomes critical to the atmosphere
  - Storage is dynamic during drought. Decreasing surface area of open water, increased root depths, increased depth to water table
  - Seasonality –
    - most runoff is from snowmelt (snowfall),
    - most evaporation is from rainfall
    - Precipitation at times of low energy goes into storage or runoff
  - Episodic Events – runoff removes water before it can infiltrate and form storage for evaporation.
    - Snowmelt over frozen soil
    - Intense rainfall rates (convective storms) which may be atypical of the general drought condition.

Drought Simulation

CRHM: Cold Regions Hydrological Model



The Cold Regions Hydrological Model Platform 2006

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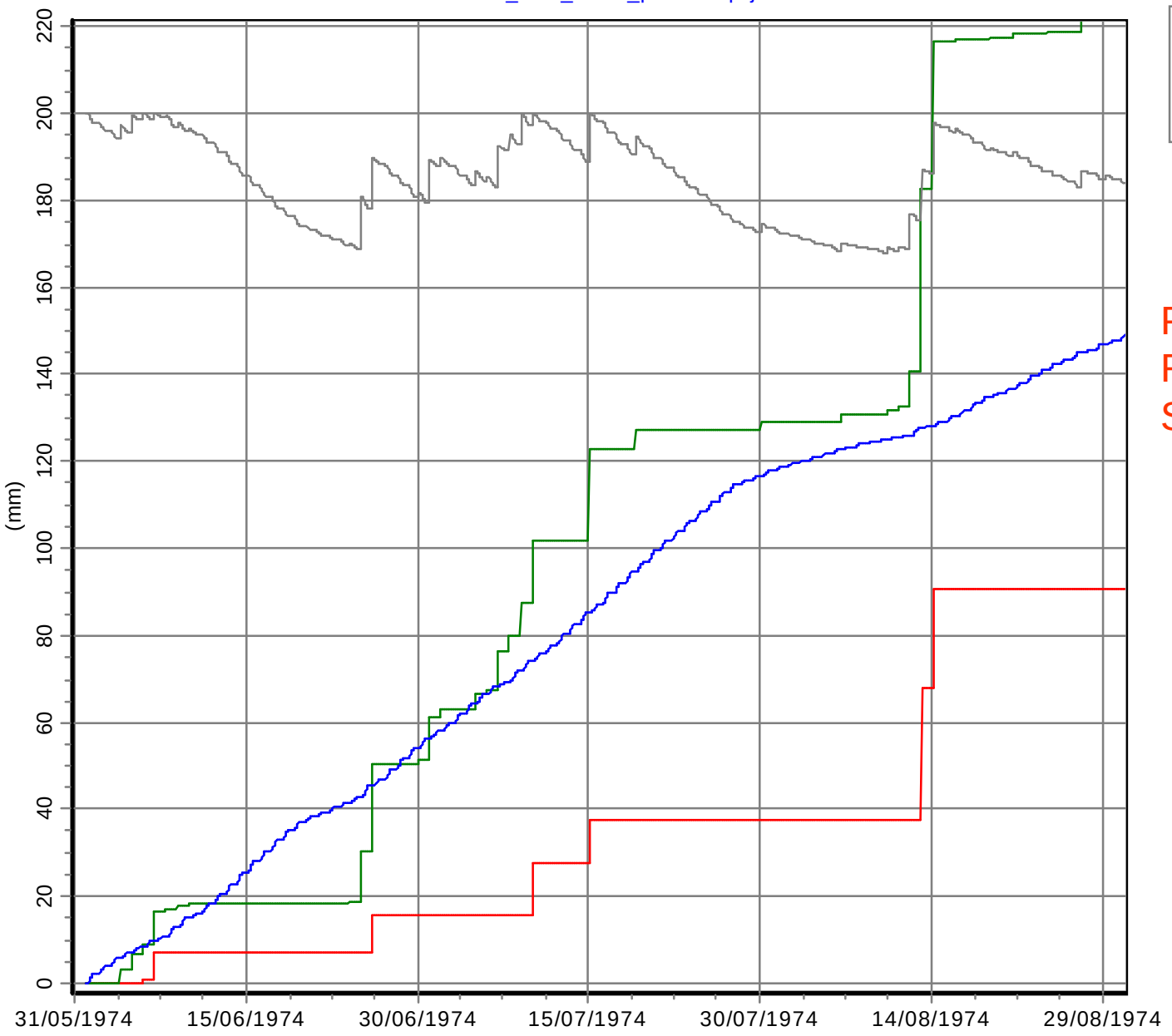

P>E

R > 0

S little change

No Drought

The Cold Regions Hydrological Model Platform 2006

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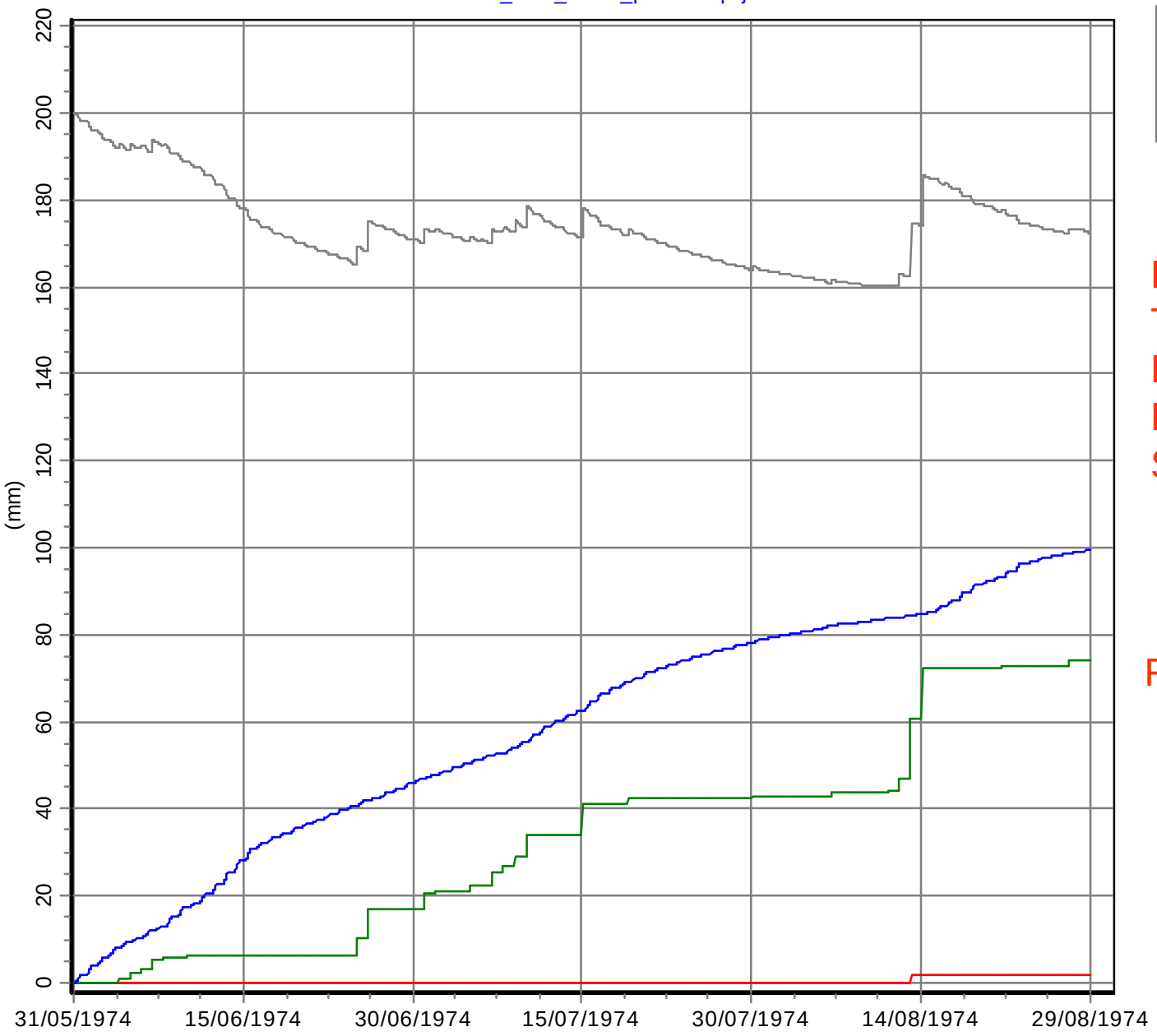

P/3

T + 3 °C

R = 0

E > P

S declines

First Year of Drought

The Cold Regions Hydrological Model Platform 2006

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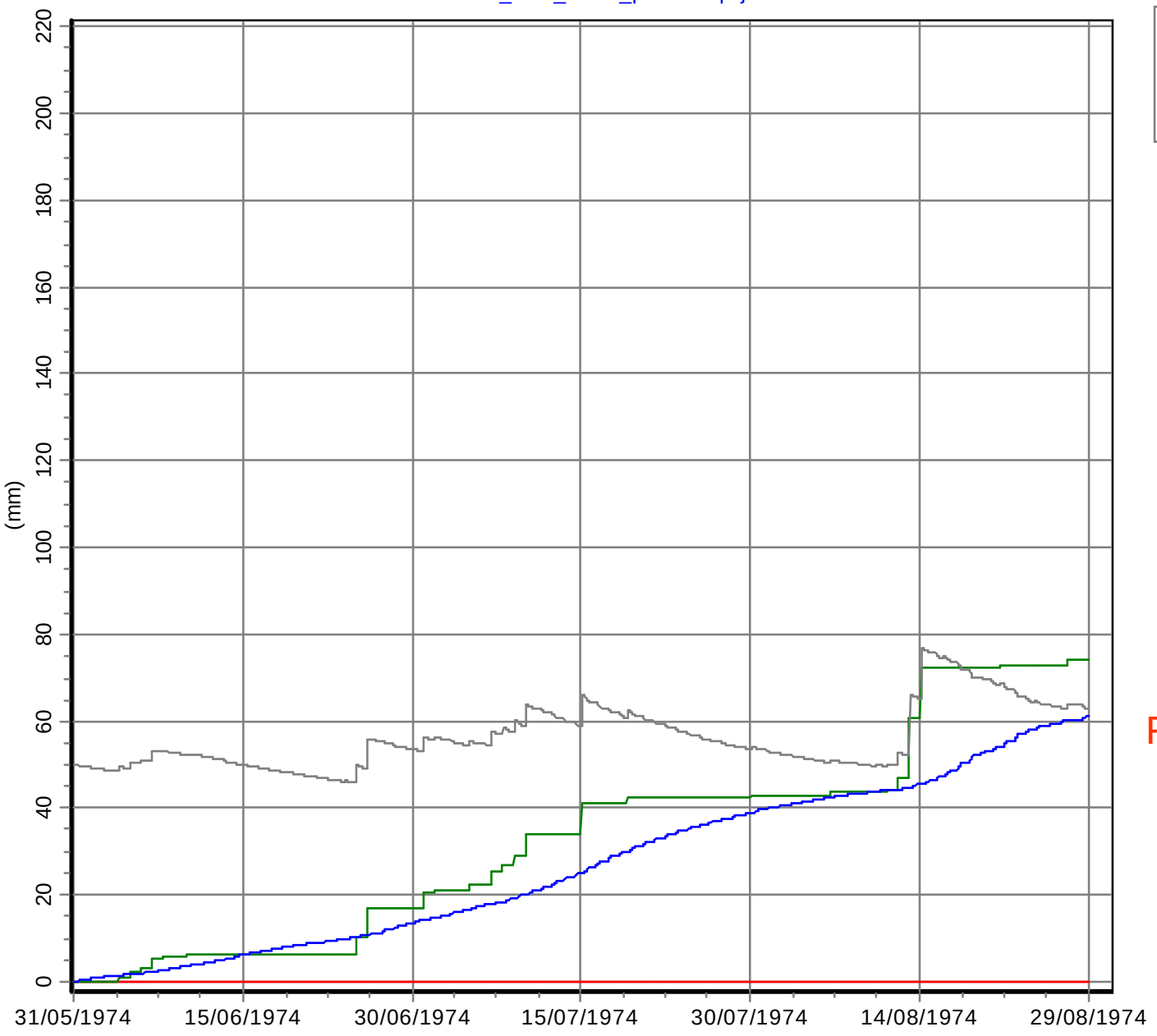

P/3
T + 3 °C
R = 0
E ≈ P
S depleted

Full Drought

Synthetic Drought Progression

mm of water

	No Drought	1st Summer	Full Drought
Rainfall	222	75	75
Evaporation	150	100	61
Storage Change	-18	-28	+14
Runoff	90	3	0

DRI Evaporation Interests

- Need to characterize evaporation spatially and temporally for the recent drought (lack of soil moisture data!!)
- Need to understand how evaporation interacts with drought evolution, including feedbacks
- Need to model evaporation in drought accurately in order to better predict drought, water supply, soil moisture and atmospheric feedbacks

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