The Drought Early Warning System (DEWS)

Phil Harder
Rick Lawford
Elaine Wheaton

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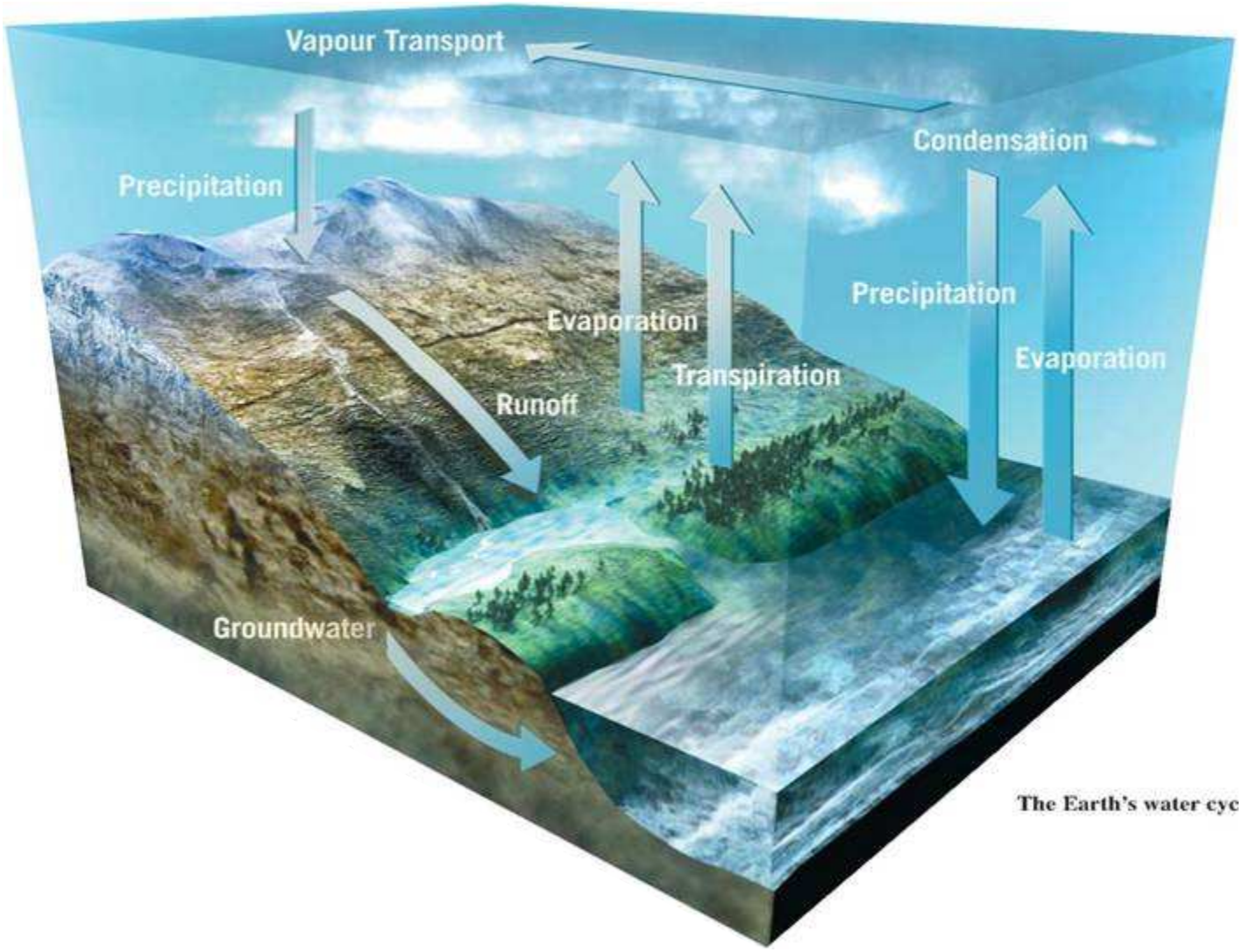
Important fluxes in the Water Cycle



PRECIPITATION

Precipitation falls either as rain or snow depending on the air temperature (or season)
Precipitation drives the hydrologic cycle by supplying moisture to the land surface where it is partitioned into soil moisture, runoff, or ground water infiltration.
Precipitation arises from processes on many scales including the planetary scale, the synoptic scale and the convective or local scale.
Intense precipitation can be a hazard in terms of flooding and erosion when it comes too quickly for a prolonged period.

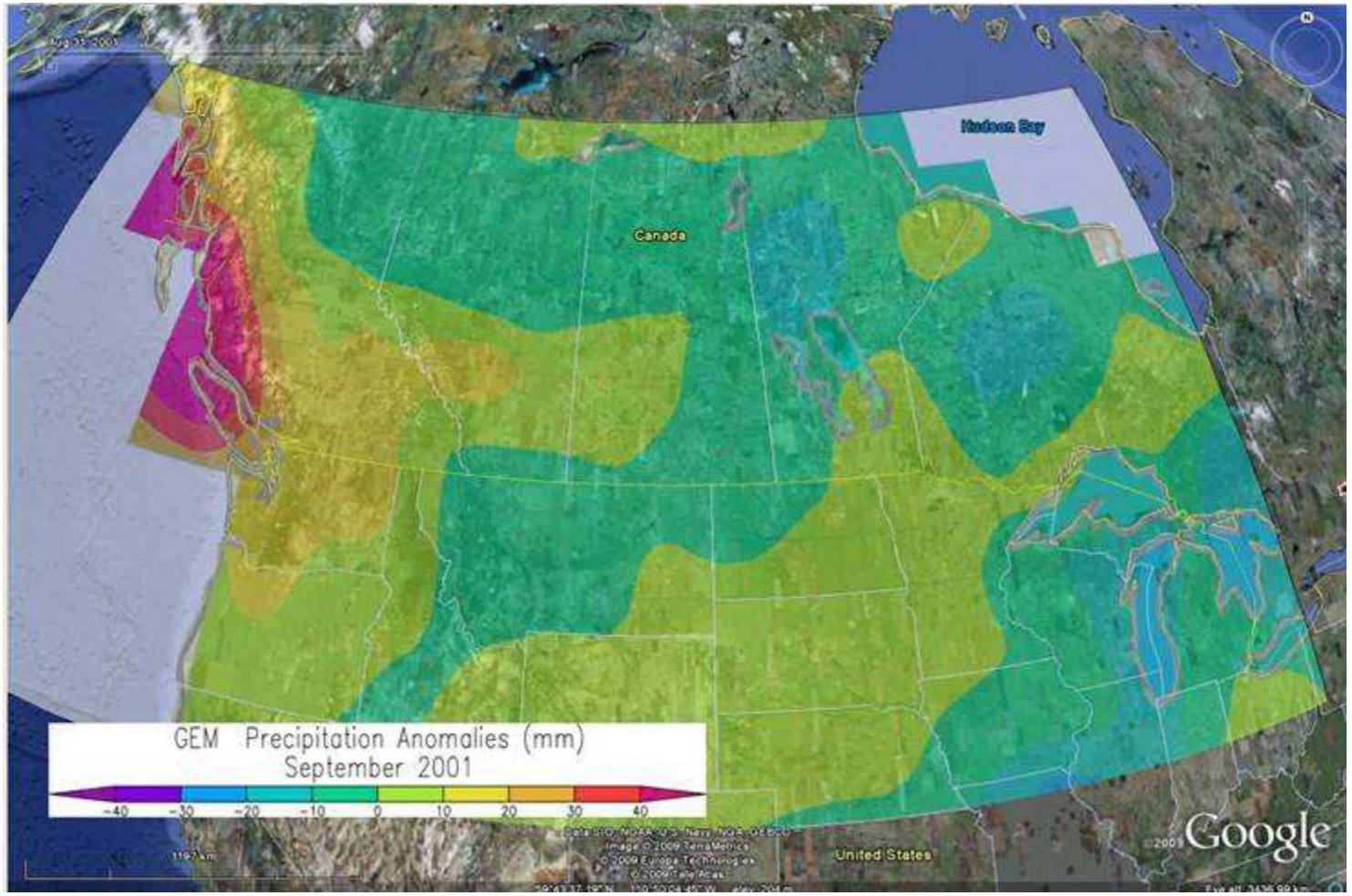
Questions:
How important is the scale of the information provided about precipitation?
How does the use of precipitation information vary according to season?
How much lead time is desirable for precipitation forecasts (3 days?, 1 month?, 3 months?)

Interpolated vs. Point Data

- Point data from observation stations provides information valid at a single location
- Interpolated/gridded data captures the areal distribution of data over a region in a systematic manner
  - Common output of models and reanalysed datasets from DRI
  - Different levels of sophistication
    - From simple areal means to taking into account elevation differences
  - Useful in approximating data in areas with no/little data

Monthly Precipitation Anomaly Forecast
May 2002

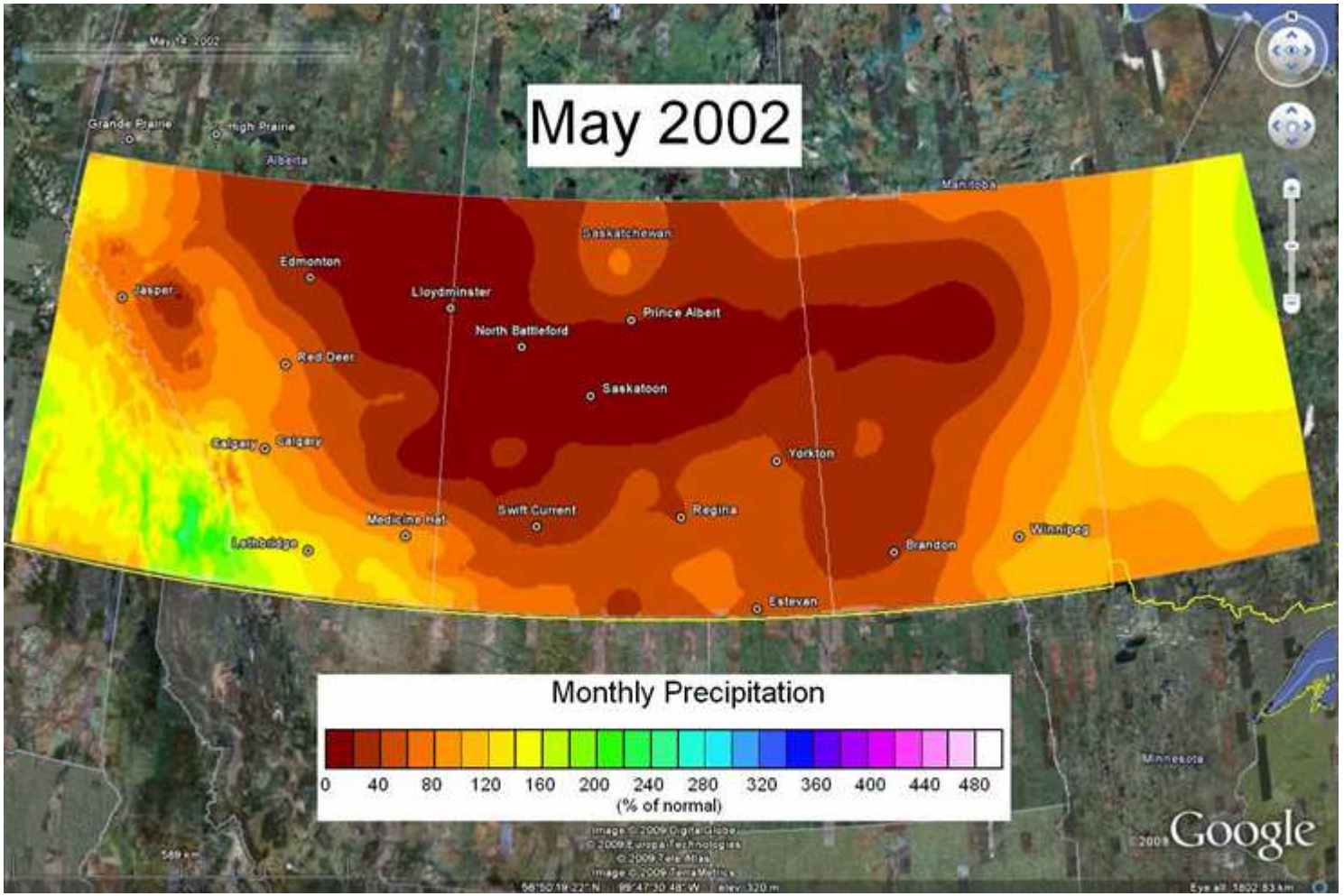
Source: Rabah Aider



- Monthly forecasted precipitation amount represented as an anomaly with units of mm

Monthly Precipitation Anomaly
May 2002

Source: CFS



- Gridded precipitation, from a quality controlled dataset that interpolates with a spline technique (ANUSPLIN)

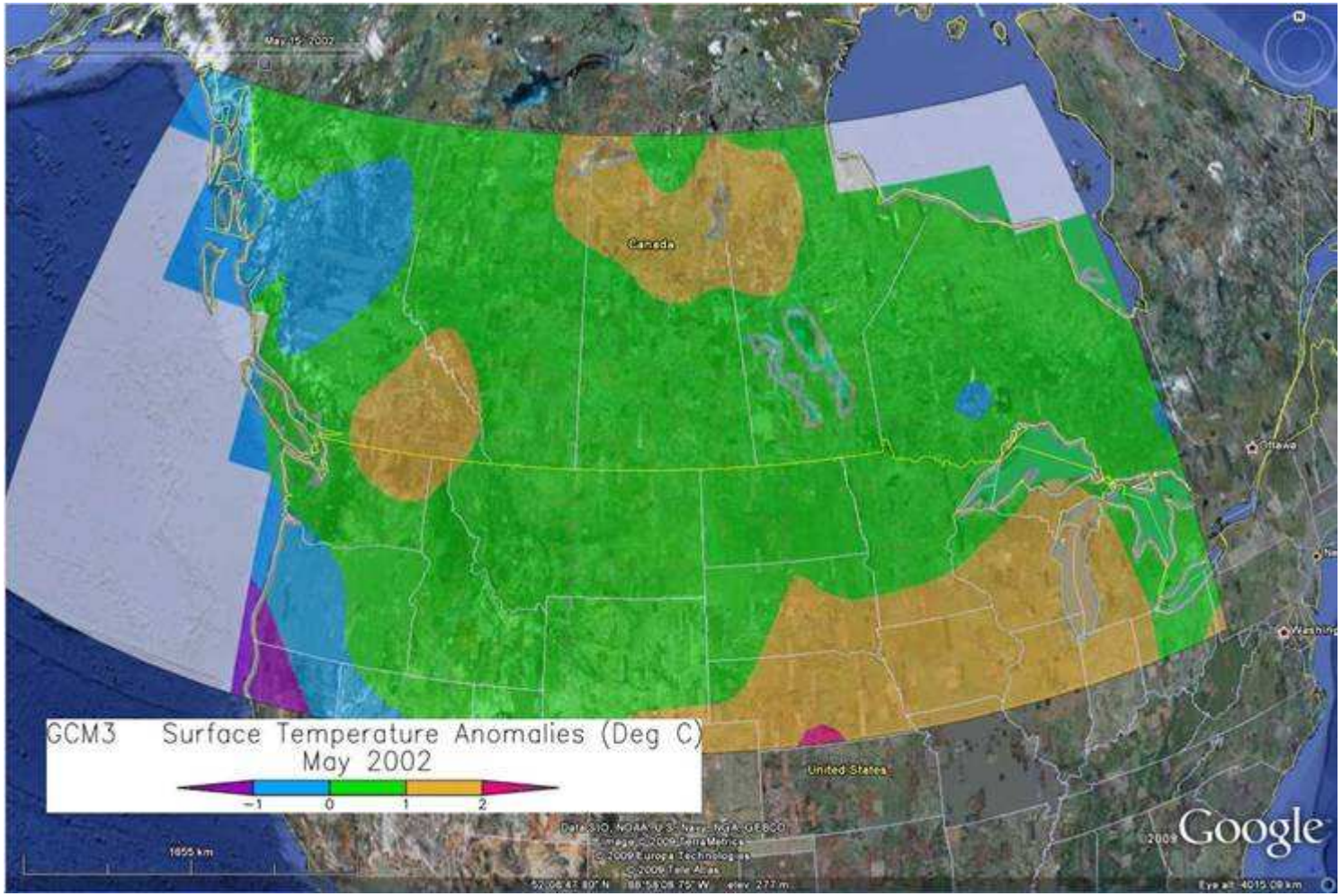
TEMPERATURE

Temperature is determined by the energy balance and is controlled by the planetary and synoptic scale processes and the local energy budget. Temperature is an important control on plant growth (especially at the lower end). Temperature affects evapotranspiration and on evaporation (rate of drying) processes.

Questions:
How important is the scale of the information provided about temperature?
How does the use of temperature information vary with season?
How much lead time is desirable for temperature forecasts (3 days?, 1 month?, 3 months?)

Monthly Temperature Anomaly Forecast
May 2002

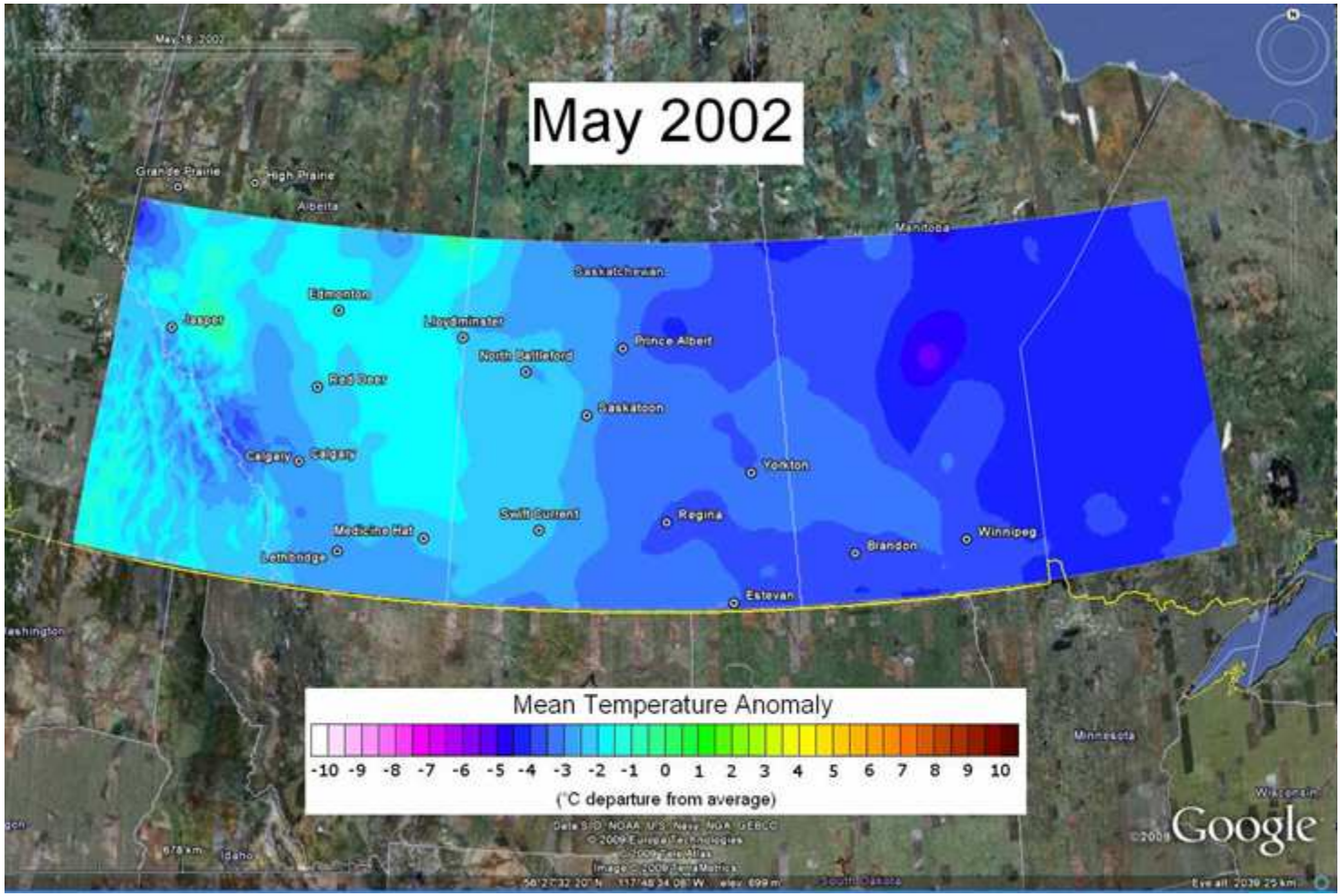
Source: Rabah Aider



- Predicted surface temperature represented as an anomaly with units of degrees Celsius

Monthly Temperature Anomaly
May 2002

Source: CFS



- Gridded surface temperature, from a quality controlled dataset that interpolates with a spline technique (ANUSPLIN)

SURFACE WATER STORAGE

Surface water storage gives an indication of the water that is currently available on the surface to buffer the effects of drought. In consists of a cold season component, the snow pack, and a warm season component – the water stored in reservoirs, ponds and lakes.

QUESTION:
What kind of information on Snow Cover would be useful for managing on-farm spring water reserves during the spring?

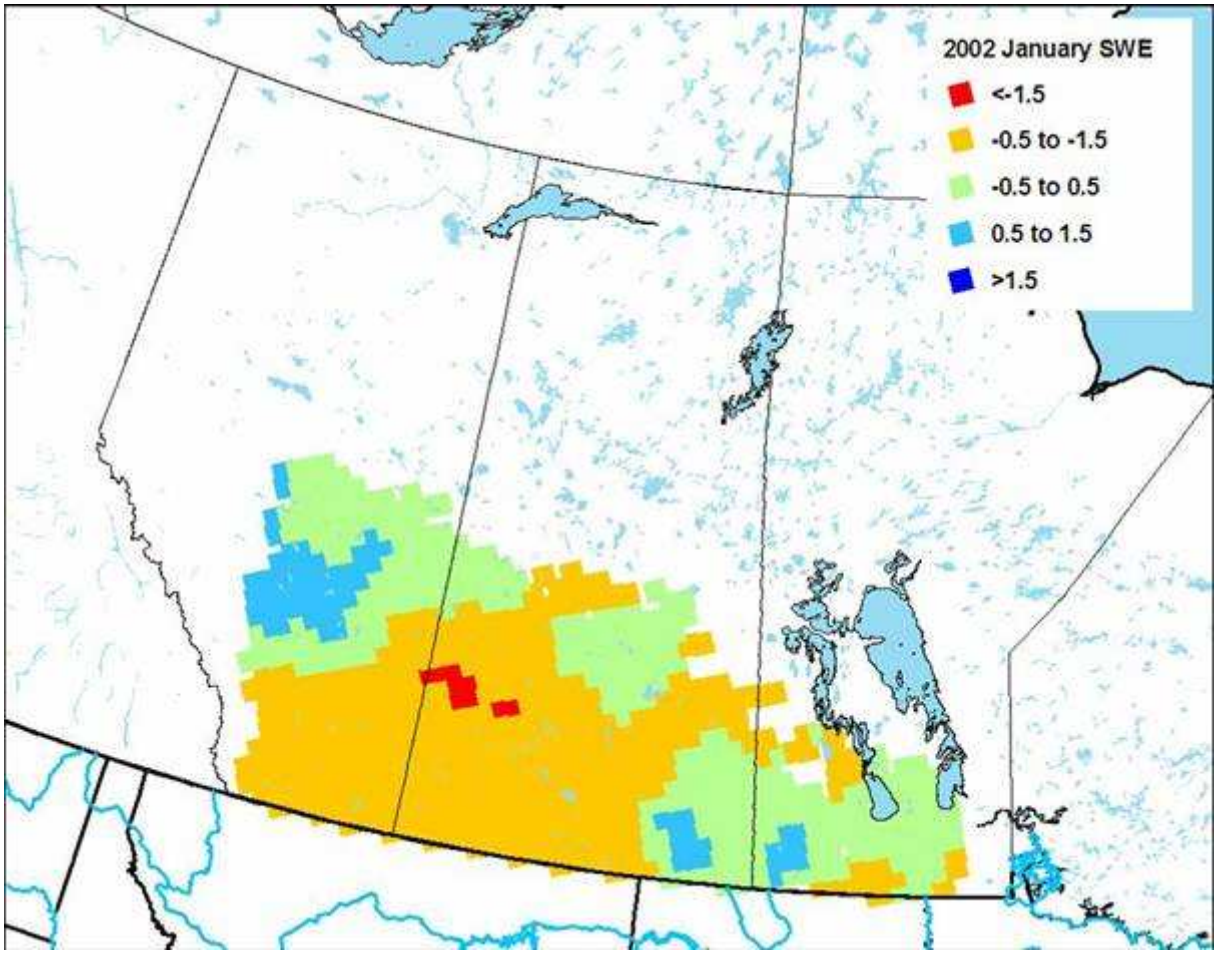
What types of information on surface water storage would be useful in

Assessing the state of on-farm water reserves?

What types of water storage information are needed for managing waterfowl and ecosystems?

Snow Water Equivalent
Jan 2002

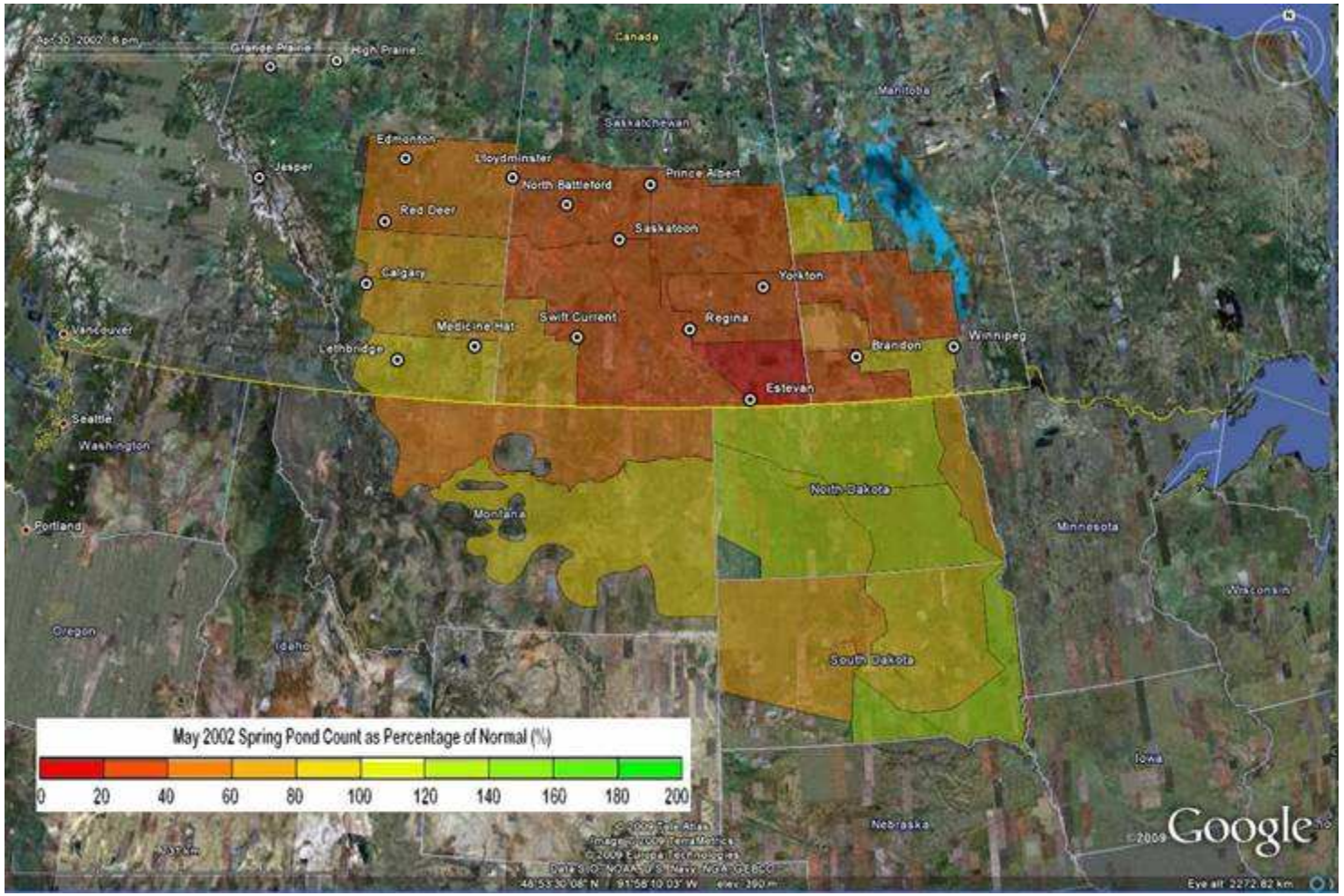
Source: Derksen



- SWE is a measurement that represents the liquid equivalent of snow
- The SWE is represented as an anomaly in terms of standard deviation
- <-1.5 is extremely dry, -1.5 to -0.5 is below normal, -0.5 to 0.5 is near normal, 0.5 to 1.5 is above normal, >1,5 is extremely wet.

Spring Pond Count
May 2002

Source: CWS & USFWS



- The estimated number of spring ponds (sloughs, wetlands, filled ditches) represented as a percentage of ponds normally counted

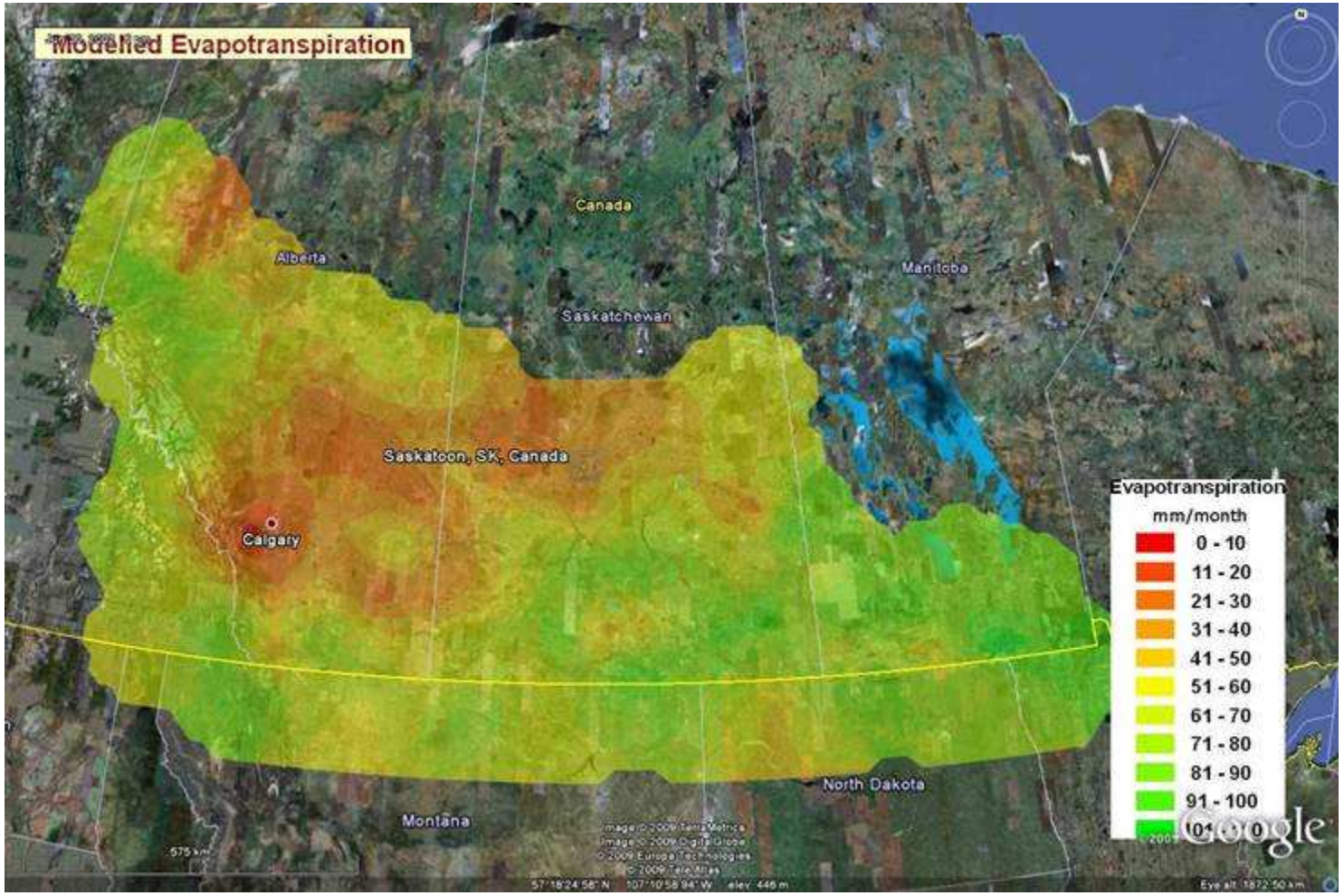
EVAPOTRANSPIRATION (ET)

Evapotranspiration is an estimate of the water that leaves the surface from plants (transpiration) and from the soil and water surfaces (Evaporation)
Potential ET is correlated with temperature.
Actual ET which is the amount that actually occurs is correlated with plant Growth and usually is only correlated with Potential ET when the plant is not affected by water stress.

QUESTIONS:
On what time scales would ET be helpful for planning?
What is the relationship between ET and irrigation and how can ET information be used to increase irrigation efficiency.

Evapotranspiration
July 2002

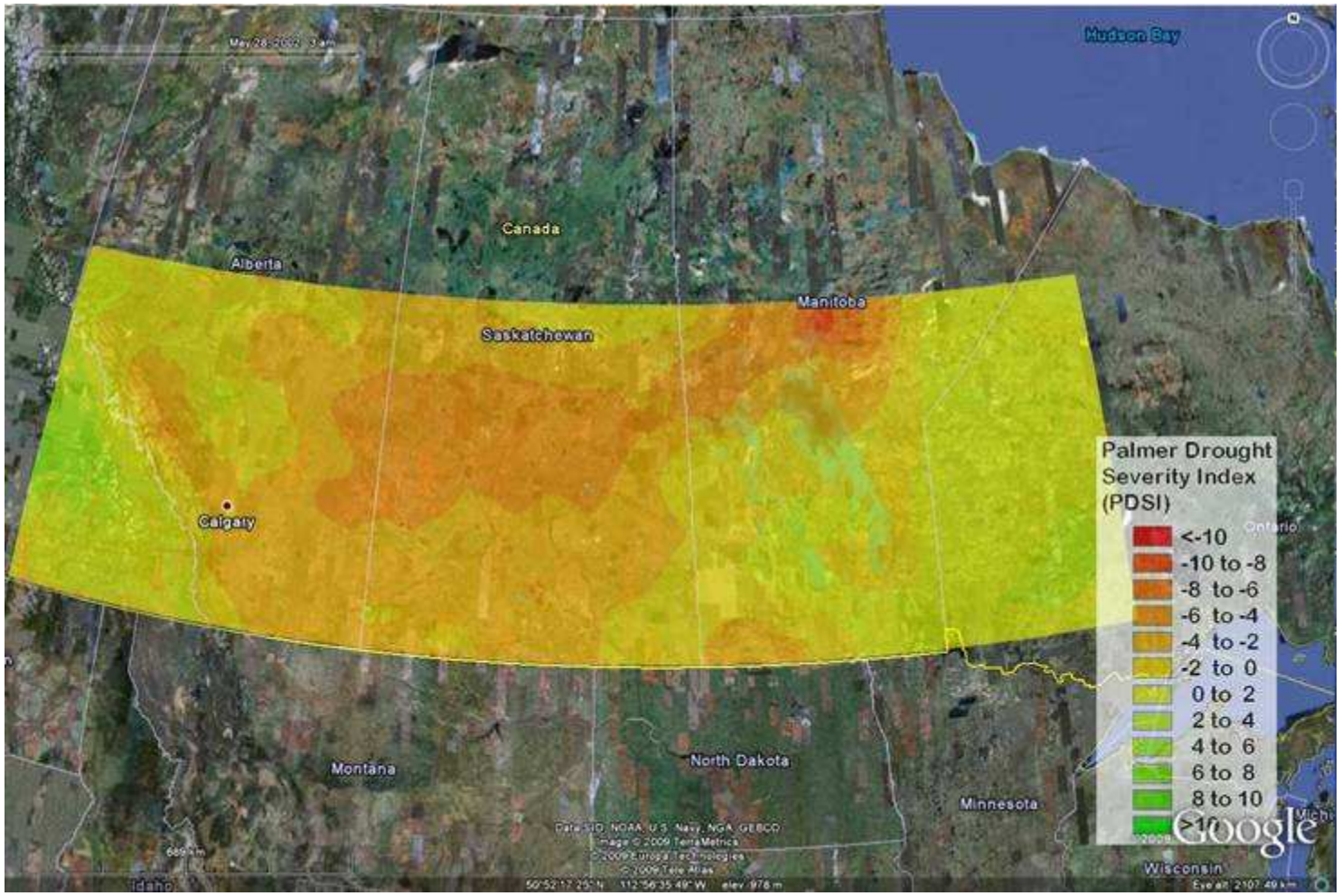
Source: Hanesiak & Brimelow



- ET is the flux of moisture from the surface to the atmosphere through plant transpiration and evaporation
- ET is restricted by available moisture so areas with low ET values represent dry areas and vice versa

Palmer Drought Severity Index
May 2002

Source: Wheaton & Bonsal



- An index based on temperature and precipitation that reflects dryness. It is a good indicator of meteorological drought
- >4 is extremely wet, 4 to 2 is moderately wet, 0 is normal, -2 to -4 moderately drought, <-4 severe drought

Soil Moisture

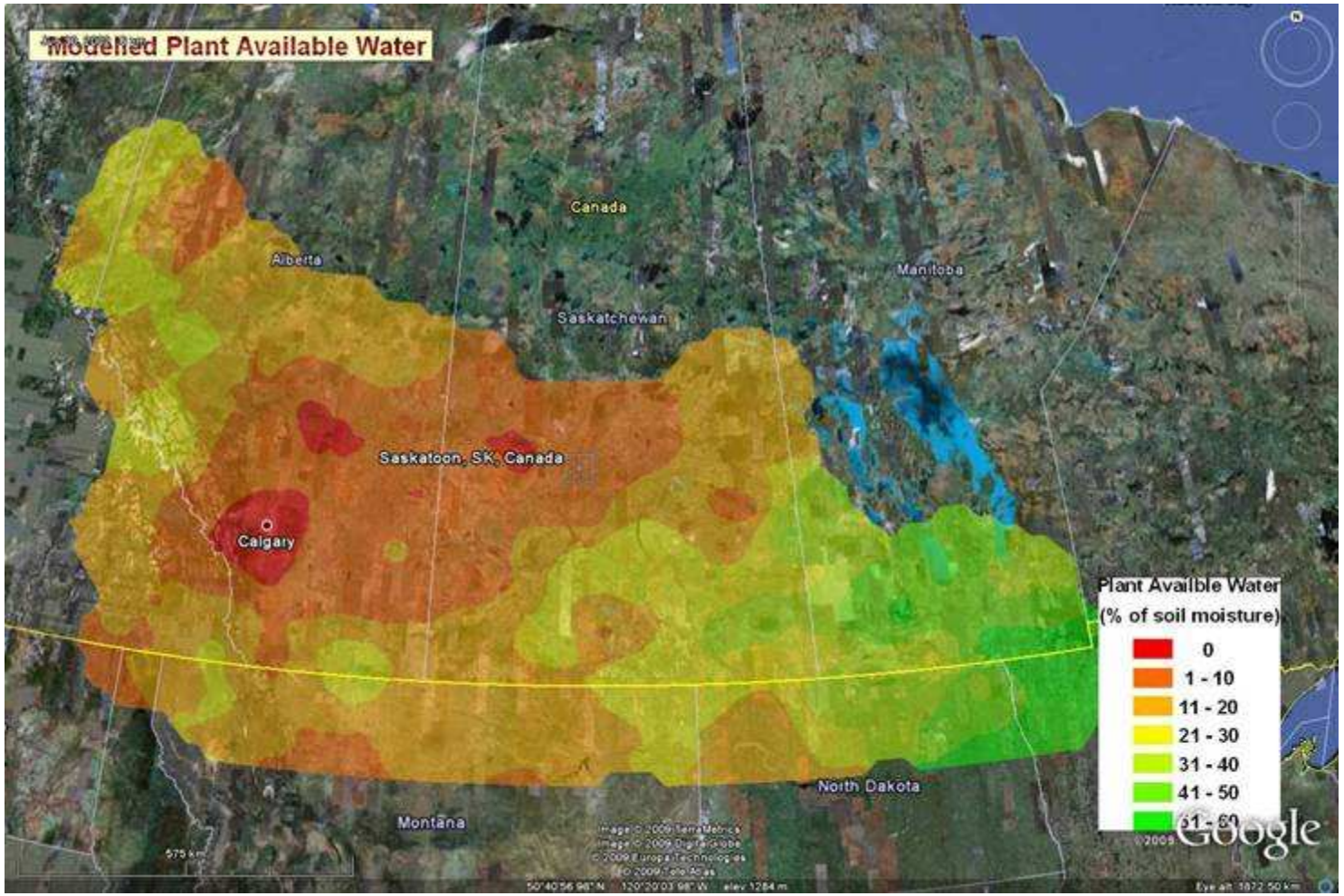
Water in the soil supports the growth of plants that rely on the soil water to support their transpiration and nutrient needs.

Moisture near the surface controls the partitioning of solar radiation between sensible heat (thermal), latent heat (evaporation) and ground heating.

Questions:
What depth of soil moisture measurement is most useful?
How frequently are soil moisture needed?
What is the most appropriate spatial resolution?

Plant Available Water
July 2002

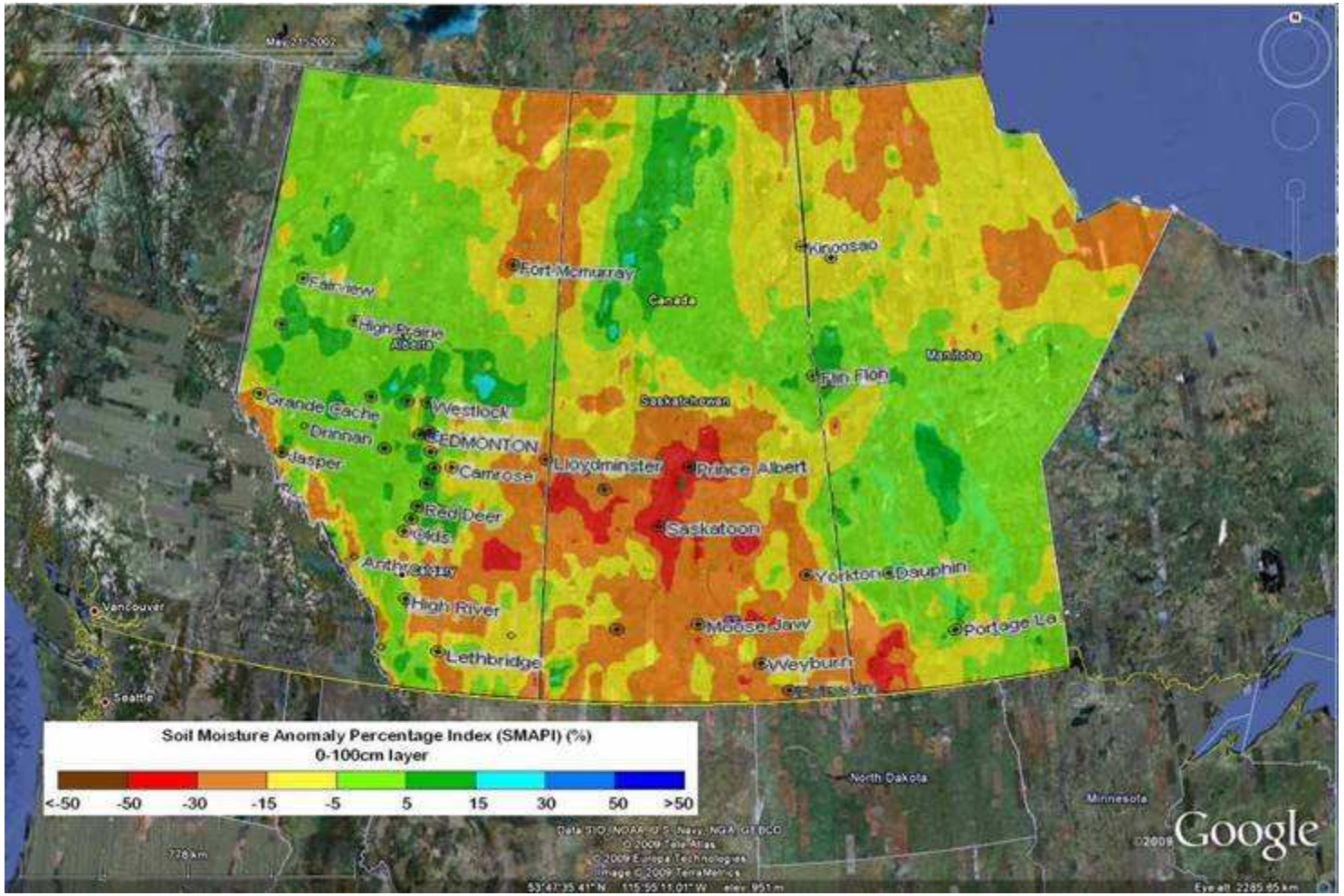
Source: Hanesiak & Brimelow



- PAW is a measure of soil moisture that is available for plants and calculated here by the PAM-II model.
- For wheat a PAW value below 30% indicates that plant is highly stressed and putting little energy into growing/producing grain

Soil Moisture Anomaly Percentage Index
May 2002

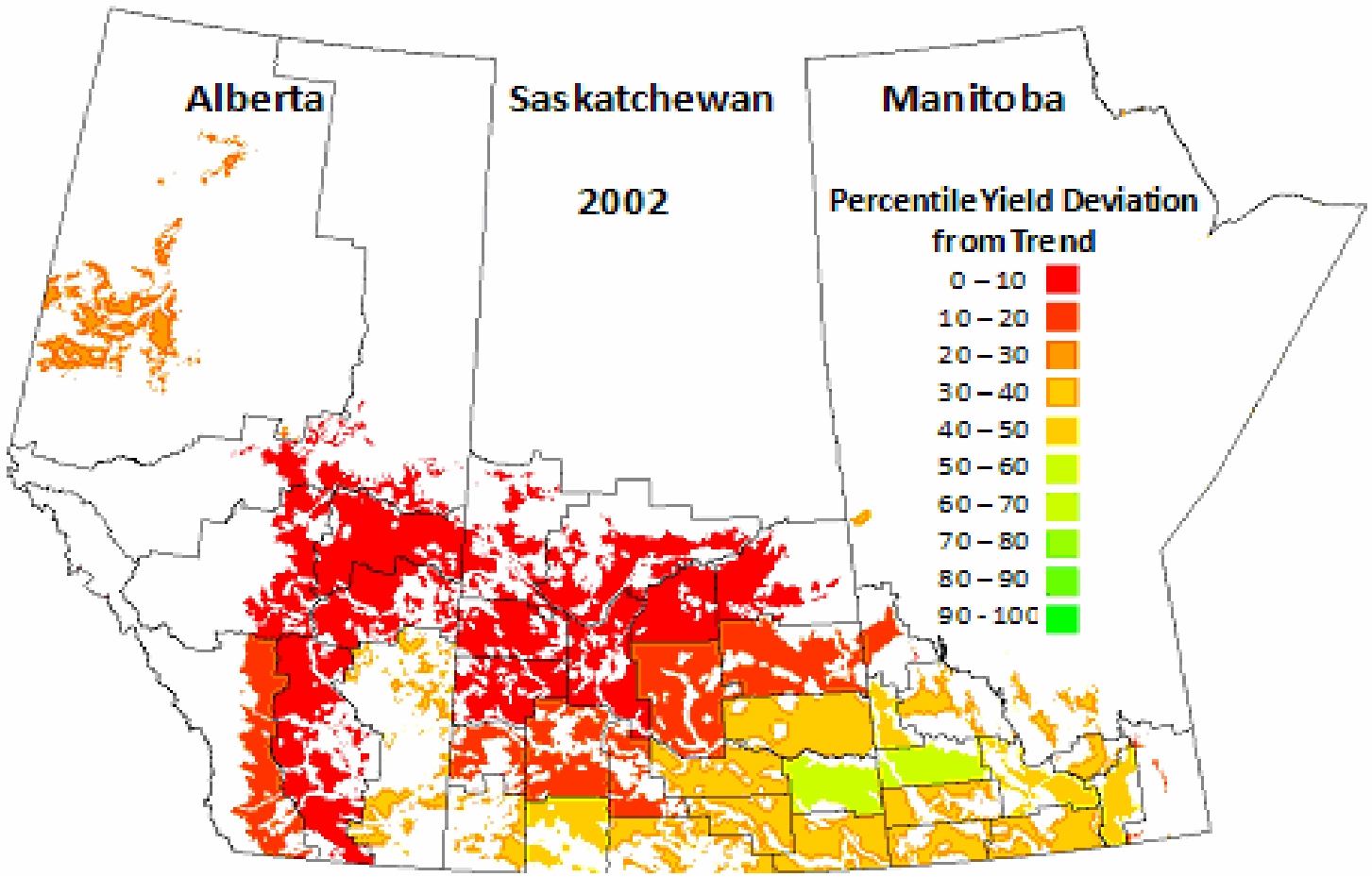
Source: Lei Wen



- Using a hydrological model (VIC) which takes into account non-contributing areas a longer term climatology of soil moisture has been calculated.
- Soil moisture is calculated on a grid and represented as an anomaly in terms of percentage of normal

Yield Deviation
Crop Year 2002

Source: Paul Bullock



- Percentile yield deviation from trend by Census Agricultural Region
- Values for each CAR are the area-weighted means for yield deviation from trend for spring wheat, barley, canola and field peas.

RUNOFF/ RIVER DISCHARGE

River discharge represents the water that runs off laterally on the surface and in shallow subsurface water system sand through the channel drainage network. Runoff is the river discharge generated per unit area.

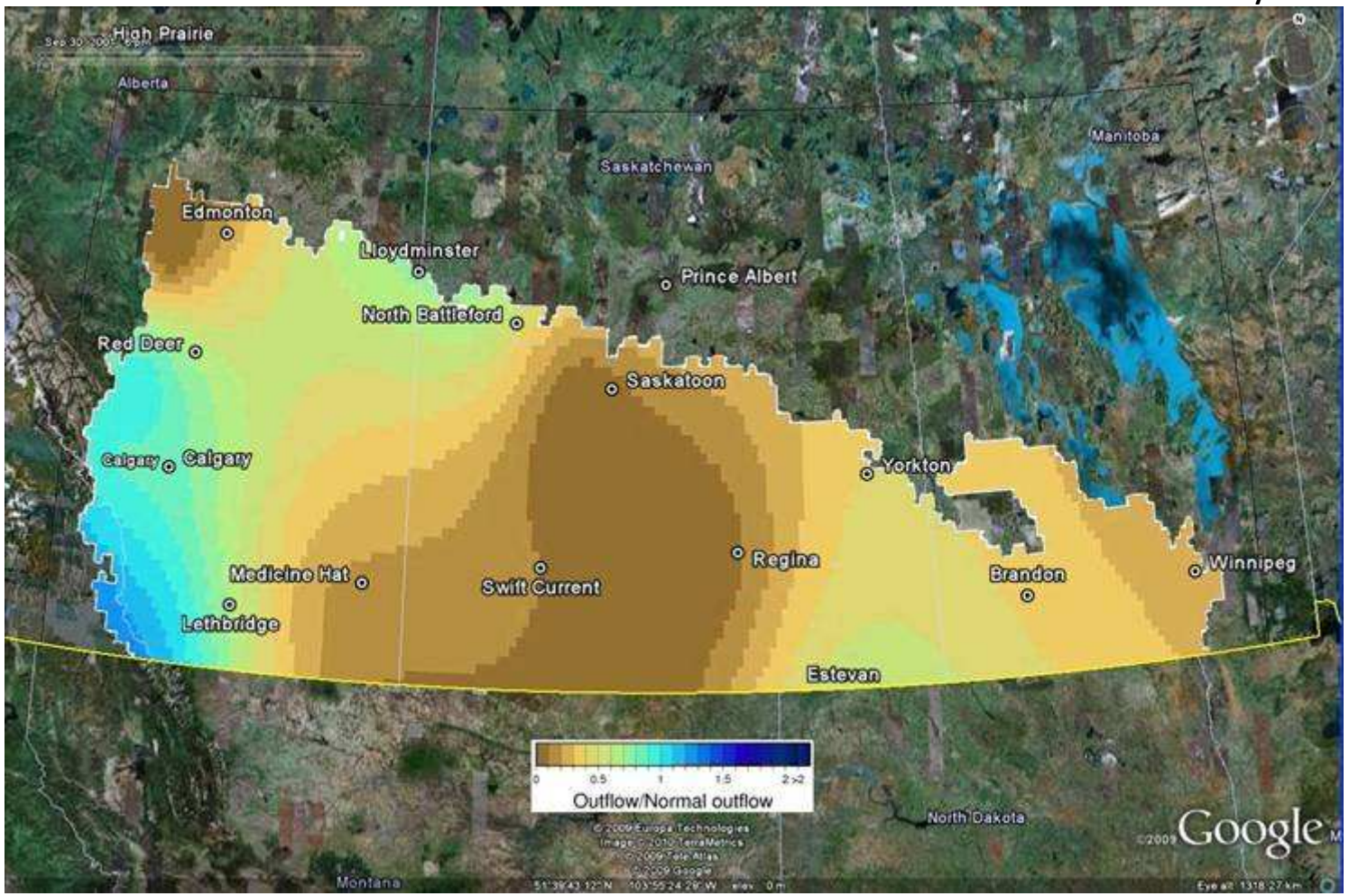
River discharge/ runoff provides information on the water available for replenishing reservoirs and wetlands.

On the Canadian prairies the precipitation-runoff relationship is sensitive to the surface moisture conditions.

QUESTION:
What types of data would be needed to supplement the EC information on runoff when planning the replenishment of small on-farm reservoirs for cattle and irrigation?

Modelled Runoff
Spring 2002

Source: Pomeroy & Shook



- Outflow (spring runoff) from a typical small prairie basin simulated across the prairies.
- The mapped value is standardized as a ratio of calculated outflow/normal outflow.

INFILTRATION AND RECHARGE/DISCHARGE

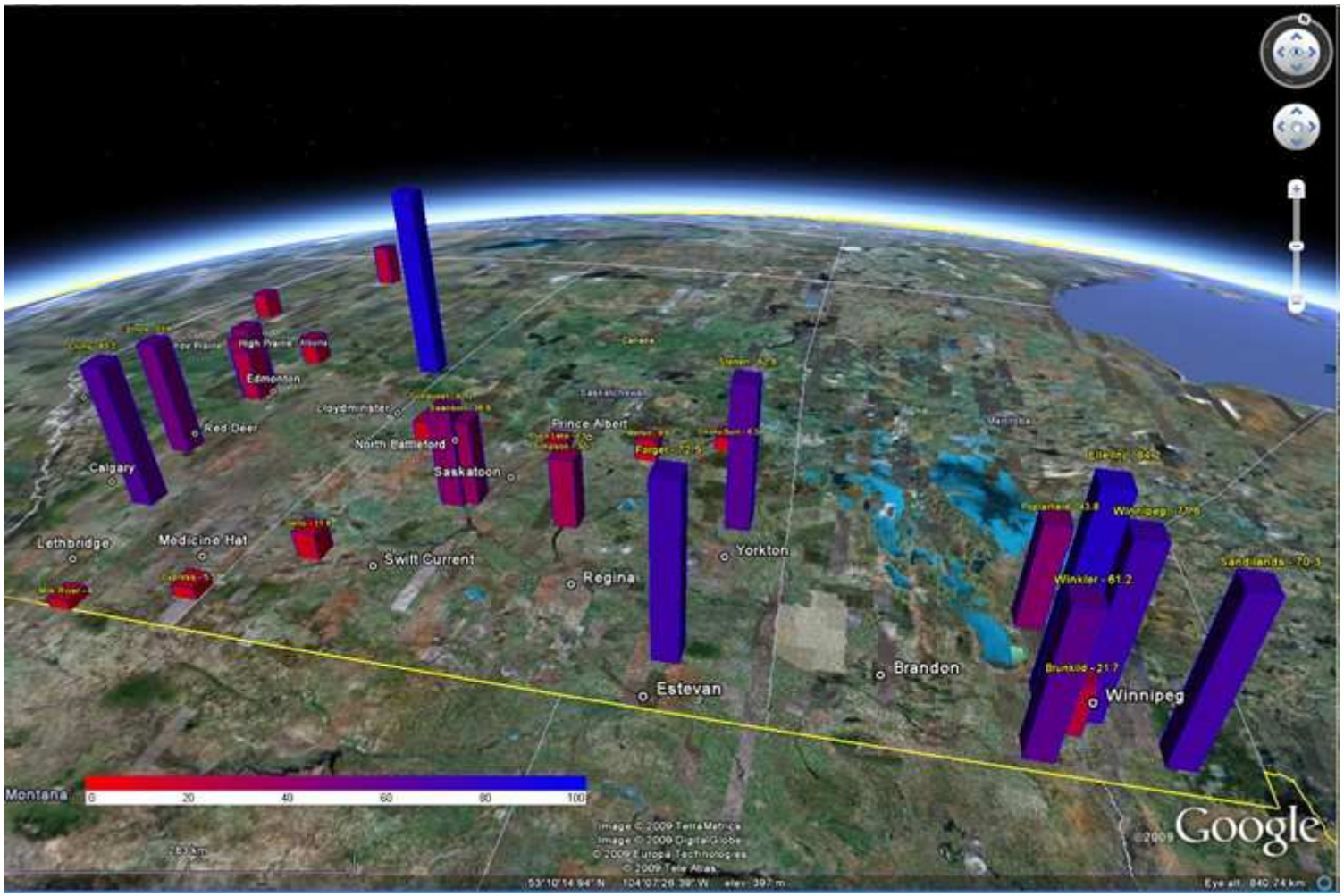
Infiltration or recharge is a representation of the rate at which water leaves the vadoze zone and reaches the groundwater table. It is also reflected in the rate of change of groundwater levels. Rising groundwater levels represent recharge, falling groundwater levels or periods when use and gw discharge exceeds recharge.

Decreasing ground water levels can lead to surface drying, falling ground water levels and drying springs.

QUESTIONS:
What types of information would be useful in determining when ground water and well water was going to become harder to access?

Groundwater levels
May 2002

Source: Garth van der Kamp



- The water table levels of selected wells considered representative of hydro meteorological conditions (unaffected by human activity)
- Represented as the percent rank (<10 would be near record low conditions)