

**Precipitation in Modeling**

---

---

---

---

---

---

---

---

**Rainfall as Model Input**

- Form and detail largely determined by model output desired
  - runoff volume requires daily rain
  - peak rates require short duration amounts (min., hr.)
  - erosion, sediment and chemical transport require storm rainfall
- Amounts usually are from point records
  - must be averaged over watershed area

---

---

---

---

---

---

---

---

**Rainfall as Model Input**

- Types of rainfall data required
  - space
    - one gage averaged to represent watershed
    - multiple gages each assigned to a part of watershed
  - time
    - daily
    - hourly
    - equal time increment
    - breakpoint

---

---

---

---

---

---

---

---

### Rainfall as Model Input

- Types of rainfall data required
    - erosivity
      - rainfall energy (E) x intensity (I)
      - E is summed using shortest reasonable durations and corresponding intensities
- total energy (E) x  $\frac{I}{100}$  = R factor
- for good results gage must be on or very near watershed

---

---

---

---

---

---

---

---

### Rainfall Energy vs. Intensity

TABLE 3.1 KINETIC ENERGY OF NATURAL RAINFALL (METRIC TON-METERS PER HECTARE PER CM) (MODIFIED FROM WISCHMEIER AND SMITH, 1989)

Intensity cm/h	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0	121	148	163	175	184	191	197	202	208
1.	219	234	247	259	269	276	282	287	291	295
2.	297	309	321	332	344	346	347	349	350	351
3.	353	354	355	356	358	359	360	361	362	363
4.	364	365	366	367	368	368	369	370	371	372
5.	373	373	374	375	375	376	377	378	378	379
6.	380	380	381	381	382	383	383	384	384	385
7.	385	385	387	387	388	388	389	389	390	390
8.	391	391	392	392	393	393	394			

---

---

---

---

---

---

---

---

### Rainfall as Model Input

- Types of rainfall data required
  - intensity for given duration (=T<sub>c</sub>)
    - Rational formula
  - amount for certain duration and frequency of occurrence (design storm)
    - not actual data; be careful!! -- runoff frequency resulting may not be same as for rainfall

---

---

---

---

---

---

---

---

### Snowfall Models

- Significant part of hydrology in many areas
- Important properties in modeling
  - water equivalent
  - density (increases with time)
  - depth
  - optical properties
  - areal extent

---

---

---

---

---

---

---

---

### Snowfall Models

- Methods of division between rain and snow
  - base on temperature of 0°C (NRCS method uses 1.7°C at ground level since snow forms at heights)
  - combination of dry bulb and dewpoint temperature
  - if only daily mean temperature is available assume fraction of precipitation is rain and rest snow

---

---

---

---

---

---

---

---

### Snowmelt Models

- Energy balance approach
  - heat sources
    - net radiation
    - convection of sensible heat from air
    - latent heat by condensation of moist air on pack
    - heat from rain (sensible and latent from rain freezing on pack)
    - conduction of heat from ground

---

---

---

---

---

---

---

---

### Snowmelt Models

- Energy balance approach
  - any heat raising pack temperature above 32°F is used to melt pack
  - account for changing albedo of pack with new snow
    - affects net radiation
    - decreases over time

---

---

---

---

---

---

---

---

### Snowmelt Models

- Simplified approach
  - degree-day accumulation because air temperature is easily measured
$$M = K(T_a - T_b)$$
- Spatial variability comments regarding rainfall also apply to snowmelt
  - varying cover depth as well as melt rates (topo and slope orientation effects)

---

---

---

---

---

---

---

---