LECTURE #17

ADDITIONAL HSPF FEATURES
ATMOSPHERIC DEPOSITION OVERVIEW

Types of Deposition

Dry Deposition
• Input as areal flux rate – ADFX
• Specified as lb/ac or kg/ha per interval

Wet Deposition
• Input as concentration in rainfall – ADCN
• Specified as mg/l

Methods of Specifying Deposition

Monthly-varying
• Input values for first day of each month in MONTH-DATA table
• Daily values interpolated from these values

Time Series
• User supplies an input time series in WDM file
## HSPF Module Sections and Constituents Receiving Atmospheric Deposition

### PERLND and IMPLND
Unit area fluxes added to surface or upper zone storages only

- **Dry Flux** = \( \text{ADFX} \)
- **Wet Flux** = \( \text{PRECIP} \times \text{ADCN} \)

### PQUAL
Overland flow-associated constituents

### PEST
All pesticides (crystalline, adsorbed, & solution forms)

### NITR
NO\textsubscript{3}-N, NH\textsubscript{3}-N, and Organic N

### PHOS
PO\textsubscript{4}-P and Organic P

### TRACER
Tracer

### IQUAL
Overland flow-associated constituents

### RCHRES
Total fluxes added to dissolved storage

- **Dry Flux** = \( \text{ADFX} \times \text{Surface area} \)
- **Wet Flux** = \( \text{PRECIP} \times \text{ADCN} \times \text{Surface area} \)

### CONS
All conservative constituents

### GQUAL
All general constituents

### NUTRX
NO\textsubscript{3}-N, NH\textsubscript{3}-N, and PO\textsubscript{4}-P

### PLANK
Refractory organic N, P, and C
The existing outflow of any constituent for any PERLND or IMPLND may be routed as inflow to a downslope PERLND or IMPLND.
LATERAL INFLOW METHODS

MASS BALANCE CONSTITUENTS
These constituents are modeled by tracking a storage and all input and output fluxes (e.g., flow, sediment, overland-flow-associated general constituent).

Lateral inflow is a direct transfer of mass to the storages in the downslope land segment. Permissible storages are surface, upper zone, interflow, lower zone, and active groundwater.

CONCENTRATION CONSTITUENTS
These constituents are modeled by assigning a concentration to the outflow of water or sediment (e.g., temperature, DO, sediment-associated general constituent)

Lateral inflow is handled by altering the outflow concentration as a function of the lateral inflow concentration. This can affect sediment-associated outflow, surface runoff, interflow, and baseflow. There is no effect on the upper zone or lower zone since these have no storages or direct outflows.
LATERAL INFLOW PARAMETER INPUT

MASS BALANCE CONSTITUENTS - None

CONCENTRATION CONSTITUENTS
Weighting factors are used to specify the effect of lateral inflows on the effective outflow concentration. Separate factors are specified for each relevant soil layer (surface, baseflow, etc.) The PERLND table appears below.

LAT-FACTOR

< PLS> Sediment Surface Interflow Baseflow ***
# # SDLFAC SLIFAC ILIFAC ALIFAC ***
1 5 0.3 0.5 0.5 0.4
END LAT-FACTOR

Effective outflow concentration is computed each timestep as the weighted average of the original computed concentration and the lateral inflow concentration.

Refer to Time Series Catalog for details of the lateral inflow time series.
SPECIAL ACTIONS OVERVIEW

Special Actions are used to represent the effects of processes that are not addressed by the model algorithms - particularly human intervention in the natural system.

They are commonly used to:

1. Alter miscellaneous parameters for natural processes not explicitly modeled.

2. Modify soil storages of agricultural chemicals to represent fertilizer and pesticide applications.

3. Alter soil characteristics to represent effects of agricultural operations.

4. Perform reservoir operations that are too complex to represent with existing options.
<table>
<thead>
<tr>
<th>TYPE</th>
<th>EXAMPLE OF USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>One-time alteration of a parameter or storage</td>
</tr>
<tr>
<td>Repeated</td>
<td>Annual fertilizer applications on same date</td>
</tr>
<tr>
<td>Conditional</td>
<td>Avoid applying chemicals during a rain event by using a logical condition</td>
</tr>
<tr>
<td>Deferred</td>
<td>Re-attempting a failed conditional action after a specified delay</td>
</tr>
<tr>
<td>Undated</td>
<td>Reservoir operation rule applied every interval of the run</td>
</tr>
<tr>
<td>Distributed</td>
<td>Spread out fertilizer application over several days/weeks to simulate variability in local farming practices</td>
</tr>
<tr>
<td>User-defined Variable Name</td>
<td>Create a single name for a compound fertilizer type such as manure, or represent gross operations such as moldboard plowing or harvesting</td>
</tr>
<tr>
<td>User-defined Variable Quantity</td>
<td>Gain access to the value of an internal variable for use in a logical condition (e.g., the rainfall in the current timestep) or as an action value</td>
</tr>
</tbody>
</table>
SPECIAL ACTION DETAILS

**Basic Action line**
A Special Action modifies a single Target variable at a given point in time. It can be reset to, or incremented by, a given Action Quantity.

*** opt foplop dcdts yr mo dy hr mn d t vnam s1 s2 s3 ac quantity tc ts rp
<****><-><--><--<<---><> <> <> <><><> <><<--><--<<--><<<<<<<>>> <> <-><>->
PERLND 1 3 1976/06/05 12 SPS 2 1 += 0.625

**Math functions**
An Action may modify a variable in many different ways (e.g. subtract, multiply, log, exponentiation)

*** opt foplop dcdts yr mo dy hr mn d t vnam s1 s2 s3 ac quantity tc ts rp
<****><-><--><--<<---><> <> <> <><><> <><<--><--<<--><<<<<<<>>> <> <-><>->
PERLND 1 3 1976/06/05 12 SPS 2 1 *= 0.9

**Repeated**
An Action may be repeated, e.g. annually for ten years.

*** opt foplop dcdts yr mo dy hr mn d t vnam s1 s2 s3 ac quantity tc ts rp
<****><-><--><--<<---><> <> <> <><><> <><<--><--<<--><<<<<<<>>> <> <-><>->
PERLND 1 1976/06/05 12 SPS 2 1 += 0.625 YR 1 10

**Conditional ( IF / ELSE IF / ELSE / END IF )**
An Action may depend on simulated conditions in the basin by referring to the current value of any variable in any operation.

*** opt foplop dcdts yr mo dy hr mn d t vnam s1 s2 s3 ac quantity tc ts rp
<****><-><--><--<<---><> <> <> <><><> <><<--><--<<--><<<<<<<>>> <> <-><>->
IF (precip < 0.01) THEN
PERLND 1 1976/06/05 12 SPS 2 1 += 0.625 YR 1 10
END IF
SPECIAL ACTION EDITING IN WINHSPF

Add Pre-defined Agricultural Practice

Agricultural Practices
- Planting
- Fertilizing
- Crop Cultivation
- Harvest
- Pesticide Application
- Nitrogen Fertilizer Application
- Phosphorus Fertilizer Application

Land Segments
- PERLND 11 (OPEN)
- PERLND 12 (FOREST)
- PERLND 14 (RESIDENTIAL)
- PERLND 15 (COMM/INDUS/TRANS)
- PERLND 21 (OPEN)
- PERLND 22 (FOREST)
- PERLND 23 (AG/OTHER)
- PERLND 24 (RESIDENTIAL)
- PERLND 25 (COMM/INDUS/TRANS)

Repeat Interval
- Year
- Dets
- Value

Deferr if Raining

OK  Cancel

Edit Special Actions Block

<table>
<thead>
<tr>
<th>Records</th>
<th>Actions</th>
<th>Distributes</th>
<th>User Define Names</th>
<th>User Define Quans</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpTyp</td>
<td>OpFst</td>
<td>OpLst</td>
<td>Yr</td>
<td>Mo</td>
<td>Dy</td>
</tr>
<tr>
<td>PERLND 23</td>
<td>0</td>
<td>0</td>
<td>1988</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

10 of 12
IRRIGATION OVERVIEW

IRRIGATION DEMAND - Choose one of three methods:
- Input timeseries
- Scheduled applications and rates
- Root zone soil moisture algorithm (AFSIRS)

WATER SOURCES - Choose up to 3 prioritized sources:
- External to basin, such as canals, pipes, and deep groundwater
- A RCHRES
- Local shallow groundwater (AGWS) in a PERLND

APPLICATION TARGETS - Divide among 5 possible storages:
- Interception (sprinkler systems)
- Surface (drip lines)
- Upper zone (shallow buried systems)
- Lower zone (deep buried systems)
- Active groundwater zone (seepage irrigation ditches in field)
ROOT ZONE MOISTURE ALGORITHM

Inputs
- Depth (CRDEP), field capacity (FLDCAP), and wilting point (WILTP) for each soil layer.
- Growing season, root depth (CRDEP), and maximum allowable water depletion (AWD) for each crop (up to 3 crops per year). CRDEP and AWD may be constant or monthly varying, or may be defined by 4 stages of crop growth.
- Irrigation efficiency (IREFF)
- Fraction of land segment receiving irrigation (ARZI)

Method
- The root depth and soil layer parameters are used to compute the available water capacity (AWC) and field capacity of the crop root zone
- AWD is the fraction of AWC that may be depleted before irrigation is needed.
- When AWD is reached, net irrigation demand (NIR) is the amount of water needed to raise the root zone water storage up to field capacity.
- Gross irrigation demand (IRRDEM) = NIR adjusted by IREFF.