

# 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 and converted internally to lb/ac.in or kg/ha.in

## Methods of Specifying Deposition

### Monthly-varying

- User gives value for first day of each month in MONTH-DATA block
- 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

Dry Flux: ADDR = **ADFX**

Wet Flux: ADWT = PREC \* **ADCN**

PQUAL	Overland flow-associated constituents
PEST	Pesticides-crystalline, adsorbed, solution
NITR	NO <sub>3</sub> -N, NH <sub>3</sub> -N, and Organic N in surface and upper zones
PHOS	PO <sub>4</sub> -P and Organic P in surface and upper zones
TRACER	Tracer in surface and upper zones

IQUAL Overland flow-associated constituents

## RCHRES

Total fluxes added to dissolved storage

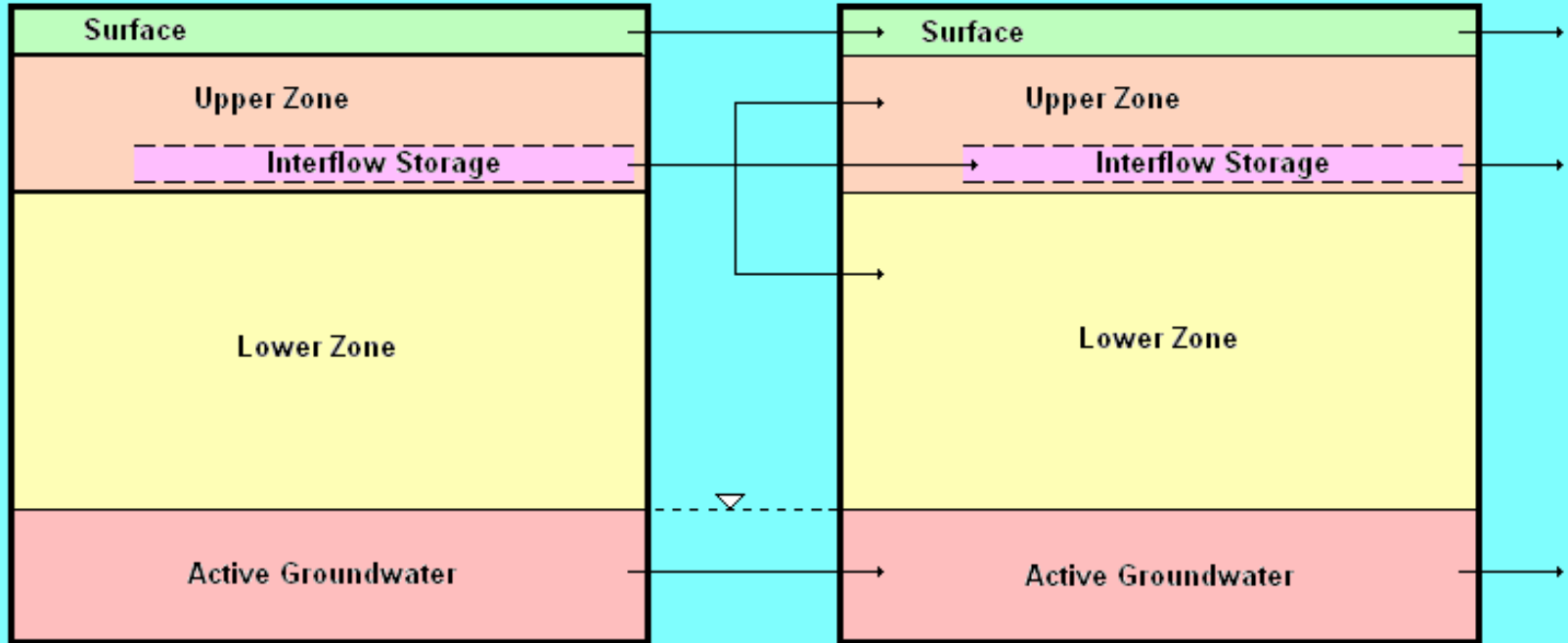
Dry Flux: ADDR = **ADFX** \* SAREA

Wet Flux: ADWT = PREC \* **ADCN** \* SAREA

CONS	Conservative constituents
GQUAL	General constituents
NUTRX	NO <sub>3</sub> -N, NH <sub>3</sub> -N, and PO <sub>4</sub> -P
PLANK	Organic N, P, and C

# LATERAL INFLOW OVERVIEW

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, QUALOF).

Lateral inflow is simply a direct transfer of mass of material to the storages in the downslope 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, QUALSD)

Lateral inflow is handled by altering the existing outflow concentration as a function of the inflow concentration. This change may affect sediment-associated outflow, surface runoff, interflow, and baseflow. There is no effect on the upper or lower zones 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.

# SPECIAL ACTIONS TYPES

<u>TYPE</u>	<u>EXAMPLE OF USAGE</u>
<b>Basic</b>	One-time alteration of a parameter or storage
<b>Repeated</b>	Annual fertilizer applications on same date
<b>Conditional</b>	Avoid applying chemicals during a rain event by using a logical condition
<b>Deferred</b>	Re-attempting a failed conditional action after a specified delay
<b>Undated</b>	Reservoir operation rule applied every interval of the run
<b>Distributed</b>	Spread out fertilizer application over several days/weeks to simulate variability in local farming practices
<b>User-defined Variable Name</b>	Create a single name for a compound fertilizer type such as manure, or represent gross operations such as moldboard plowing or harvesting
<b>User-defined Variable Quantity</b>	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



# 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					Land Segments	
Plowing	PERLND 11 (OPEN)					
Planting	PERLND 12 (FOREST)					
Row Cultivation	PERLND 14 (RESIDENTIAL)					
Harvest	PERLND 15 (COMM/INDUS/TRANS)					
Pesticide Application	PERLND 21 (OPEN)					
Manure Application	PERLND 22 (FOREST)					
Nitrogen Fertilizer Application	PERLND 23 (AG/OTHER)					
Phosphorus Fertilizer Application	PERLND 24 (RESIDENTIAL)					
	PERLND 25 (COMM/INDUS/TRANS)					

Year: 1996    Mo: 6    Day: 15    Hr: 0    Min: 0    Repeat Interval: YR    Parameter Value: DETS 2

Defer if Raining

OK    Cancel

**Edit Special Actions Block**

Records			Actions							Distributes		User Define Names		User Define Quans			Conditions			
OpTyp	OpFst	OpLst	Dc	Ds	Yr	Mo	Dy	Hr	Mn	DsInd	Typ	Vname/Addr	Sub1	Sub2	Sub3	ActCod	Value/Uvquan	Tc	Ts	Num
PERLND	23	0		0	1996	6	15	0	0	0	3	DETS				1	2.5	YR	1	4

Records: 1, Actions: 0, Distributes: 0, User Define Names: 0, User Define Quans: 0, Conditions: 0

Pre-defined Practices

OK    Cancel    Apply    Help    Add    Remove

# IRRIGATION OVERVIEW

**IRRIGATION DEMAND** - Choose one of three methods:

- Input timeseries
- Scheduled applications and rates
- Root zone soil moisture algorithm – adapted from AFSIRS (SFWMD)

**WATER SOURCES** - Choose up to 3 prioritized sources:

- External to basin, such as canals, pipes, and deep (inactive) 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**.