VI.2.3B OPERATIONAL FORECAST SYSTEM FORECAST GENERATION USING PROGRAM FCST

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Introduction

The Operational Forecast Program (FCST) is the program used to generate river forecasts.

Program FCST uses the parametric data defined using programs PPINIT [Hyperlink] and FCINIT [Hyperlink] and the data in the Preprocessor Data Base (PPDB) [Hyperlink] to perform the computations necessary to produce forecast guidance products.

The following Functions are included in program FCST:

- Preprocessing Functions:
  - MAP - computes mean areal precipitation from point precipitation observations and MDR data [Hyperlink]
  - FMAP - generates future MAP time series from user supplied input [Hyperlink]
  - MAPX - computes mean areal precipitation from gridded estimates of precipitation [Hyperlink]
  - MAPE - computes mean areal potential evaporation from point meteorological data [Hyperlink]
  - MAT - computes mean areal temperature from point max/min and instantaneous temperature observations, plus point forecasts of max/min temperature [Hyperlink]

- RRS - generates river, reservoir and snow data time series from available observations [Hyperlink]

- o Forecast Component Execution (FCEXEC) Function [Hyperlink] uses time series produced by the preprocessors and the Operations Table definition for each Segment to produce river forecasts.

- o Extended Streamflow Prediction (ESP) Function [Hyperlink] uses the current conditions plus historical data to represent possible future input sequences in order to generate probabilistic extended outlooks (see Section VI.2.5 [Hyperlink]).

- o Utility Functions that generate various operational summary displays and are used to protect and free carryover dates.

The Flash Flood Guidance (FFG) Operation [Hyperlink] calculates and stores rainfall-runoff curves based on current soil moisture conditions which are used external to compute flash flood guidance and to supply current conditions to event models and local flood warning systems.

The Hydrologic Command Language (HCL) [Hyperlink] is the interface to the FCST program Functions. All run-time input to program FCST is entered through HCL.

Chapter VI.5 [Hyperlink] describes the FCST program. It contains a description of HCL, the HCL syntax rules and commands, examples of HCL input to FCST and a description of each Function and the options available.

The remainder of this Chapter contains some general guidelines for using program FCST. Guidelines that are specific to a particular Function are described for each Function in Section VI.5.3C [Hyperlink].

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HCL Guidelines

Section VI.5.2A [Hyperlink] contains a general description of the HCL including its purpose, terminology used and information about the HCL files.

Section VI.5.2B [Hyperlink] gives the syntax rules to follow when using HCL.

Section VI.5.2C [Hyperlink] describes each of the commands available.

This following are some general recommendations about the use of HCL:

- o Global defaults (i.e., values that apply to all users) are specified for all HCL Techniques. The Global defaults for each Technique are in Section VI.5.3D [Hyperlink]. In many cases the Global default is to not use a specific option or display, thus the user must explicitly specify those options to be used. HCL

allows Local defaults to be set that are specific to each user. It is recommended that the user assign Local defaults for each Technique where the Local default should be different than the global value. Local defaults can be overridden at run-time. The run-time hierarchy for Technique values is:

1. use any values explicitly specified at run-time

2. use Local defaults if defined

3. use Global defaults

Local defaults are set with command SETLDFLT [Hyperlink]. Command DELLDFLT [Hyperlink] is used to delete Local defaults so the Global defaults will be used.

- The user is responsible for all changes to Local defaults and HCL parameters. The OFS system manager will reset the Global default for the daylight savings time switch (Technique NOUTDS [Hyperlink]) but will not reset a Local default for this Technique. Thus it is recommended that a Local default not be set for Technique NOUTDS unless absolutely necessary.

  The user is responsible for keeping the default input time zone code up to date. This parameter is specified when the files are initially created (see Section VI.2.2A [Hyperlink]) and can be changed with command SETUPARM [Hyperlink].

- The HCL input to the FCST program can be greatly reduced through the use of Local defaults and especially through the use of HCL procedures. While it is recommended that Local defaults be set early in the implementation process, it is also recommended that the user attains a reasonable familiarity with the capabilities of the FCST program and how it is to be used before defining HCL procedures. HCL procedures are defined using command DEFINEL [Hyperlink]. Command DELETEL [Hyperlink] is used to delete local procedures, command REPLACE PROCEDURE [Hyperlink] is used to replace an entire procedure and command CHANGE PROCEDURE [Hyperlink] is used to change a portion of an existing local procedure.

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Run-time Guidelines

Some general information that may be helpful at run-time is as follows:

- Which Functions are run and the sequence in which they are computed is totally up to the user. Whether a given Function is included, or whether it is computed once or several times, is determined by the HCL input for each run of FCST. This feature gives the user more flexibility in how the program is used, plus it can be used to make more efficient use of computer resources by eliminating unnecessary computations. Examples of run-time

input to FCST through HCL are shown in Section VI.5.3B.

- The length of the run period is also a user option that can vary from one Function to another, again avoiding unnecessary computations. For example, if only precipitation observations for the current day have been reported since the last time MAP was run, there is no need to run MAP for more than the latest day even though Function FCEXEC might be run for several observed data days. Previous days MAP values are available for FCEXEC on the PDB.

  The maximum period that a Function can be run during a given compute varies:

Function	Maximum Value
MAP	10 days
MAPX	depends on number of MAPX areas
FMAP	maximum future days allowed on the PDB
MAT and MAPE	number of observed days on the PPDB plus maximum future days allowed on the PDB
RRS	maximum days allowed on the PDB
FCEXEC	31 days but no more than the maximum future days allowed on the PDB can be included

- Some Functions can be executed for a portion of the user area while others must be run for the entire area. MAPX, MAT, RRS, MAPE and FMAP must be run for the entire area. MAP and FCEXEC can be run for individual Carryover Groups, Forecast Groups, areas or Segments.

- Additional computer resources are required when saving carryover in Function FCEXEC, primarily an increase in disk accesses plus some extra computation time. Thus it is recommended that carryover only be saved when needed (i.e., perhaps only in the final run of the day).

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Use of the Processed Data Base (PDB)

The PDB is used to store all time series that are labeled as INPUT for any Segment. INPUT time series for Segments include all time series produced by the Preprocessor Functions and all time series that need to be passed from one Segment to another (e.g., the downstream discharge time series from one Segment needs to be stored on the PDB so it can be used as an upstream inflow to the next Segment).

Some items to be aware of when using the PDB include:

- The writing of time series to the PDB cannot be turned on or off. All output time series produced by a FCST run are written to the PDB. The time series values generated by the current run either replace or are added on to the values for the time series stored on the PDB. Thus the time series stored in the PDB always reflect the most recent FCST run.

- Each time series accessed by Function FCEXEC contains values based on observed data and values based on future (forecast) data. Each time series contains an indicator to when future data begins. Technique LSTCMPDY [Hyperlink] used by FCEXEC indicates the end of the observed data. Checks are made between these two values and a warning is printed when they differ. These warnings can be suppressed with Technique RWWARN [Hyperlink].

- Many of the time series stored on the PDB are not allowed to contain missing data when used by Function FCEXEC. Chapter I.5-DATATYPE-TS [Hyperlink] contains a table that indicates which data types cannot contain missing values. When missing values are encountered by Function FCEXEC for any of these data types, an error is printed, the run period is altered so as not to include missing data periods and other actions, such as turning off the saving of carryover, are taken if necessary.

- The PDB utility program (PRDUTIL [Hyperlink]) can be used to list and edit time series. Run-time modifications can be used to change input time series values for a single run of Function FCEXEC, but permanent changes can only be made by rerunning the Function that generated the time series with different data or by using program PRDUTIL command TSEDIT [Hyperlink]. Run-time modifications that alter output time series will result in a permanent change since the data are changed before being written.

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Use of Run-Time Modifications (MODs)

MODs give the user a means of making adjustments to the computations so that simulated conditions will more closely correspond to observed conditions.

Run-time options (HCL Techniques) give the user control over general run-time features of Function FCEXEC and some limited control on a Segment basis (e.g., nonuniversal Techniques can turn certain options 'on' or 'off' on a Segment basis). However only the MODs give the user a means of changing individual numbers used in the computations. MODs can be used to change input or output time series values or to alter time series between Operations; adjust carryover values for individual Operations; input data such as snow water-equivalent, areal snow cover, or form of precipitation to alter internal computations; and make temporary changes to more variable parameters such as the unit hydrograph and permanent changes to a few highly variable parameters, such as the AI correction factor in the API Operation.

The available MODs for Function FCEXEC are described in VI.5.3C-FCEXEC-MOD [Hyperlink].

MODs can be misused by over-adjusting quantities to make computed and observed values match. This is analogous to over-fitting of parameter values during model calibration (so called curve-fitting). Also it is difficult sometimes to decide what adjustment to make, especially on the rising leg of the hydrograph. However until adequate automatic

updating procedures are available in the OFS, it is highly recommended that MODs be used to keep computed conditions in line with the observed conditions. The blend procedures available in the OFS are only applicable to cases when there is a relatively small deviation between simulated and observed values.

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File Backup

Backup copies of all OFS files should be maintained on a regular basis so that files can be restored when system or job failures occur while writing to the files. Restoration of the files will be needed most frequently when writing parametric or carryover data. Abnormal terminations while writing station or time series data seldom require any files to be restored.

It is recommended that all of the user's OFS files are backed up daily.

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