WPC QPF MEFP Plugin Configuration Guide

Version: OHD-CORE-16.2.1
Release Date: 7 April 2017

National Weather Service
Office of Hydrologic Development

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1 Overview

The WPC-QPF MEFP forecast source plugin is an implementation of the MEFP plugin framework, described in the *MEFP Plugin Framework User's Manual*. It allows for WPC created QPF forecasts to be used as a forecast source for MEFP ensemble generation. Described herein is the process by which the plugin can be added to the MEFPPE for parameter estimation and to the MEFPEnsembleGeneratorModelAdapter for operational ensemble generation.

The instructions provided herein are applied to an initial set of catchments. If WPC QPF archived forecasts must be prepared for additional locations, see Section 4.2 in the *Tips and Troubleshooting* Section of this document.

GUIDANCE ON WHEN TO USE WPC QPF
When choosing the raw forecasts to use in the MEFP, there are two main considerations: 1) whether there is a sufficiently long and consistent archive of historical forecasts (or reforecasts) from which to estimate the MEFP parameters; and 2) whether the raw forcing source is the best available forcing, particularly in terms of the correlation between the raw forecasts and observations (to which the MEFP parameter estimation is particularly sensitive). In terms of the latter, the MEFP should remove any biases in the raw forcing, but it will typically only preserve the correlations between the raw forecasts and observations and will not improve upon them significantly. The best way to choose between alternative sources of raw forcing (e.g. RFC, WPC and GEFS) is to conduct hindcasting and validation for a consistent period of record; that is, to calibrate the MEFP with the alternative sources of forcing and to compare the results for a consistent historical period. In practice, this is time consuming, but it should be considered for a selection of representative locations. In addition, providing the archive of raw forecasts is sufficiently long (say 6+ years), the MEFPPE parameter diagnostics (particularly the correlation block plots) should provide some indication of the inherent quality of the different sources of raw forcing. When using archived forecasts (as opposed to reforecasts), the quality of the forcing may have improved over time. Thus, for the WPC and RFC forecasts, some judgment is required about the consistency of the archive. In practice, the MEFP parameters may be "diluted" by older forecasts in the WPC or RFC archive for which the quality is significantly worse or the bias characteristics have changed. Likewise, when validating archived forecasts, the verification results may not adequately represent the current forecast quality from these forcing sources. Providing the archive of RFC forecasts is sufficiently long (say 6+ years), the RFC forcing may be preferred over the WPC forcing, and both may be preferred over the GEFS forcing. However, based on the limited validation conducted by HEFS developers, the WPC forcing does not always improve upon the GEFS and may be significantly worse in complex terrain (e.g. high elevation basins) where the forecasting models have changed substantially over time and the corresponding operational adjustments may vary significantly over the archive period.

The WPC QPF forecast is available for a 12Z forecast time and provides forecasts out to three days at a 6-hour time step. If the WPC source is used, **the number of forecast days of WPC QPF can be at most three** and is further limited by the number of days defined in the estimation options during parameter estimation (see Section 2.4). However, when hindcasting, the WPC archive contains **only two days of QPF for many past T0s** (the missing data is mainly during the summer months between 2000-2002). For this reason, we recommend that you only include up to two days of WPC QPF in your hindcast runs. If you elect to include more than two days, be mindful of the missing data when interpreting the validation results (which may be completely missing or replaced with the GEFS source, depending on your configuration). Also, see Section 3.2 Step 4.

1.1 *Notation*

Within this document, the following notation is used:

- All graphical interface components are **Capitalized and in Bold**.
- All XML snippets are in this font or this font.
- All command line entries are in this font.
- All important terms defined in Section 1.2, Terminology, are *italicized*.

1.2 *Terminology*

- *parameter estimation standalone (PE SA)*: The standalone in which the MEFPPE is configured to execute. See the *MEFPPE Configuration Guide*.
- *installation standalone (install SA)*: The standalone in which changes will be made to the MEFP ensemble generation workflow. It is recommended that changes be made to a standalone for testing purposes prior to synchronizing those changes to the operational system.
- *adapter configuration file*: A module configuration file for executing the MEFPEnsembleGeneratorModelAdapter that will be modified to include the WPC QPF forecast source plugin.

1.3 *Directories of Note*

The following directories will be referred to in the instructions provided below:

- <*PE SA region_dir*>: The *PE SA* region home directory, typically "##rfc_sa".
- <*PE SA configuration_dir*>: The *PE SA* Config directory, typically <*PE SA region_dir*>/Config.
- <*MEFPPE run area*>: The MEFPPE run area directory; see the *MEFPPE Configuration Guide*. Typically <*PE SA region_dir*>/Models/hefs/mefppeRunArea.

- <*install SA region dir*>: The *install SA* region home directory, typically "##rfc_sa".
- <*install SA configuration_dir*>: The *install SA* Config directory, typically <*install SA region_dir*>/Config.
- <*tar_root_dir*>: The directory containing the unpackaged contents of the CHPS release package.

1.4 *Pre-installation Steps*

1. Identify the <*tar_root_dir*>, which is where the contents of the CHPS release were unpackaged. Within this configuration process, only the contents of the subdirectory wpcPlugin are used. Those contents are as follows:
   <*tar_root_dir*>/wpcPlugin/…
   - installArguments.txt – User defined arguments. This file must be modified by the user prior to running the install script.
   - install_wpc_plugin.sh – The wpcPlugin install script.
   - files – Directory containing files used by the install script.

2. Identify the *PE SA*. Adapter Changes described herein to add, create, or remove a new forecast source can be made directly in the *PE SA*. The changes are easy to back-out, meaning there is little risk and no need to create a backup.

3. Create an *install SA*. Changes made to operational MEFP module configuration files should be made in an SA for testing purposes. They can then be synchronized with the operational configuration once testing is complete.

4. Identify the initial set of MEFP catchments for which parameters will be estimated for the WPC QPF source and used in generating ensembles. This set of catchments will be used to test the WPC QPF installation and can be added to as needed after installation is complete (see Section 4.2). **The selected catchments must already have parameters estimated for them (i.e., with historical data and parameters already in the MEFPPE run area) and be configured as part of MEFP ensemble generation**.

5. Identify all adapter configuration files that must be modified to include the WPC QPF forecast source plugin for the initial set of MEFP catchments; see Section 1.2.

1.5 *Affected Configuration Files*

The following files within the *PE SA* are created or edited during the installation process described in Section 0:

<PE SA region dir>/…

sa_global.properties
*Config/WorkflowFiles/hefs/ImportMEFP-WPCGrids.xml
*Config/ModuleConfigFiles/hefs/wpcReforecasts/MEFP_WPCQPF_Location_Export.xml
*Config/ModuleConfigFiles/hefs/wpcReforecasts/MEFP_WPCQPF_Interpolate_Location_FMAP.xml
*Config/ModuleConfigFiles/hefs/wpcReforecasts/ImportWPCQPF.xml
*Config/IdMapFiles/IdImportMEFPWPC.xml
Config/RegionConfigFiles/Grids.xml
Config/RegionConfigFiles/Locations.xml
Config/RegionConfigFiles/ModuleInstanceDescriptors.xml
Config/RegionConfigFiles/WorkflowDescriptors.xml
Config/RegionConfigFiles/LocationSets.xml
*[1]Models/hefs/mefppeRunArea/.systemFiles/forecastSourcesDefinition.xml

* Files that are created during the installation process.
[1] File associated with the MEFPPE that is not part of the CHPS configuration directory.

The following files within the *install SA* are created or edited during the installation process described in Section 3 and must be added to the operational CHPS configuration for the WPC QPF plugin to be employed operationally:

<*install SA region dir*>/…
*Config/ModuleDataSetFiles/<*adapter configuration file* without .xml extension>.zip
<*adapter configuration file*> - all of them

2 Install the WPC QPF Plugin in the MEFPPE

This section provides instructions for the following:

- **Making needed changes to configuration of the *PE SA*.**
- **Confirming the configuration.**
- **Estimating parameters for WPC QPF for the initial set of catchments.**

By the end of this section, the WPC QPF plugin will be configured for use in the *parameter estimation standalone* and parameters will be estimated for use in ensemble generation.

The process below, including the installation script, is an implementation of what is described in the *MEFP Plugin Framework User's Manual*. See that guide for more information.

2.1 *Modify the installArguments.txt file (Required)*

Action: The installArguments.txt file must be modified before running the install script. The following arguments must be set by the user:

Argument	Description
catchmentLocationSet	Location set (locationSetId) specifying the initial set of catchments for which to estimate parameters. For example: catchmentLocationSet=WPC_SET This may require creating a new, appropriate location set.
writableOutputDirectoryOnLocalDisk	Directory on the local disk relative to the PE SA that will be used to store acquired reforecast files. Around 25 MB per location in the initial set of catchments is required. For example: writeableOutputDirectoryOnLocalDisk=/awips/chps/wpc The MEFPPE will create, read, and remove thousands of files as part of the preparation process for the WPC QPF archived forecasts. Using a local disk for this directory is important for saving processing time.

EXAMPLE: installArguments.txt

The following is a general example of the installArguments.txt file and assumes the location set with locationSetId WPC_SET has been defined.

```
# The following arguments must be specified in this file:
#
# catchmentLocationSet - Location set (locationSetId) specifying the catchments/basins for which to prepare reforecasts.
# writableOutputDirectoryOnLocalDisk - Directory on the local disk relative to the PE SA that will be used to store acquired reforecast files.
#                                      Disk space required: ~25MB per location.
#
catchmentLocationSet=WPC_SET
writableOutputDirectoryOnLocalDisk=/awips/chps/wpc
```

Description: This file specifies the arguments used by the installation script, which is executed in the next step.

2.2 *Run the Installation Script (Required)*

Once the installArguments.txt file has been updated, the install script is ready to run. The install script requires one command line argument: the absolute (full) path to the *PE SA* region directory. It will modify the configuration of the *PE SA* so that the WPC QPF forecast source is available within the MEFPPE.

The actions to perform are as follows:

It is recommended the <*PE SA configuration dir*> be backed up (perhaps as a .tgz file) before performing this step, since the script will modify those configuration files.

#	Action	Expected Results
0	cd to the wpcPlugin script directory. Note the absolute path to the target SA.	The user should be in the following directory: <*tar_root_dir*>/wpcPlugin
1	Run the install script via the following command: install_wpc_plugin.sh <*PE SA region dir*>	The script will process the install files and make the appropriate insertions/copies into the *PE SA*'s region directory, including configuration file changes. Example screen output is provided below.

EXAMPLE: Screen Output of the Installation Script

```
> ./install_wpc_plugin.sh /awips/chpshome/dsa/wpcPlugin_testing/a>
Setting catchmentLocationSet to WPC_SET
Setting writableOutputDirectoryOnLocalDisk to /tmp/dir
Found append file! ./append.sa_global.properties
  Backing up sa_global.properties as sa_global.properties.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./sa_global.properties

Found an insert Or Copy file! ./Models/hefs/mefppeRunArea/.systemFiles/insOrCopy.forecastSourcesDefinition.xml
   Target file exists
  Backing up forecastSourcesDefinition.xml as forecastSourcesDefinition.xml.backup
  Modifying
/awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Models/hefs/mefppeRunArea/.systemFiles/forecastSourcesDefinition.xml
Looking for IdImportMEFPWPC.xml in /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa
  File not found in region directory.  Copying ./Config/IdMapFiles/IdImportMEFPWPC.xml
Looking for ImportMEFP-WPCGrids.xml in /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa
  File not found in region directory.  Copying ./Config/WorkflowFiles/hefs/ImportMEFP-WPCGrids.xml
Looking for ImportWPCQPF.xml in /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa
  File not found in region directory.  Copying ./Config/ModuleConfigFiles/hefs/wpcReforecasts/ImportWPCQPF.xml
Looking for MEFP_WPCQPF_Location_Export.xml in /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa
  File not found in region directory.  Copying
```

```
./Config/ModuleConfigFiles/hefs/wpcReforecasts/MEFP_WPCQPF_Location_Export.xml
Looking for MEFP_WPCQPF_Interpolate_Location_FMAP.xml in /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa
  File not found in region directory.  Copying
./Config/ModuleConfigFiles/hefs/wpcReforecasts/MEFP_WPCQPF_Interpolate_Location_FMAP.xml
Found insert file! ./Config/RegionConfigFiles/insert.Locations.xml
  Backing up Locations.xml as Locations.xml.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Config/RegionConfigFiles/Locations.xml
Found insert file! ./Config/RegionConfigFiles/insert.WorkflowDescriptors.xml
  Backing up WorkflowDescriptors.xml as WorkflowDescriptors.xml.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Config/RegionConfigFiles/WorkflowDescriptors.xml
Found insert file! ./Config/RegionConfigFiles/insert.ModuleInstanceDescriptors.xml
  Backing up ModuleInstanceDescriptors.xml as ModuleInstanceDescriptors.xml.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Config/RegionConfigFiles/ModuleInstanceDescriptors.xml
Found insert file! ./Config/RegionConfigFiles/insert.LocationSets.xml
  Backing up LocationSets.xml as LocationSets.xml.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Config/RegionConfigFiles/LocationSets.xml
Found insert file! ./Config/RegionConfigFiles/insert.Grids.xml
  Backing up Grids.xml as Grids.xml.backup
  Modifying /awips/chpshome/dsa/wpcPlugin_testing/abrfc_sa/./Config/RegionConfigFiles/Grids.xml
```

2.3 *Additional Configuration File Changes*

2.3.1 Modify Existing File: MEFP_WPCQPF_Interpolate_Location_FMAP.xml (Optional)

This step must only be performed if the default spatial interpolation specified in the file does not match that used operationally for ingesting/interpolating the WPC QPF.

Action: Modify the file

<*PE SA configuration_dir*>/ModuleConfigFiles/hefs/wpcReforecasts/
MEFP_WPCQPF_Interpolate_Location_FMAP.xml

as needed in order to ensure that the spatial interpolation performed therein matches that used operationally when importing and interpolating WPC QPF. The default spatial interpolation, shown in the example below, is performed using an averaging algorithm relative to the basin centroid specified in the Locations.xml configuration file.

EXAMPLE: Default Configuration File

```
<?xml version="1.0" encoding="UTF-8"?>
<transformationModule xmlns="http://www.wldelft.nl/fews"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.wldelft.nl/fews http://chps1/schemas/transformationModule.xsd"
version="1.0">

    <variable>
        <variableId>wpc_grid</variableId>
        <timeSeriesSet>
            <moduleInstanceId>ImportWPCQPF</moduleInstanceId>
            <valueType>grid</valueType>
            <parameterId>FMAP</parameterId>
            <locationId>HEFS_WPC</locationId>
            <timeSeriesType>temporary</timeSeriesType>
            <timeStep unit="hour" multiplier="6" />
            <readWriteMode>read complete forecast</readWriteMode>
        </timeSeriesSet>
    </variable>
    <variable>
        <variableId>wpc_scalar</variableId>
        <timeSeriesSet>
            <moduleInstanceId>MEFP_WPCQPF_Interpolate_Location_FMAP</moduleInstanceId>
            <valueType>scalar</valueType>
            <parameterId>FMAP</parameterId>
            <locationSetId>Catchments_WPC</locationSetId>
            <timeSeriesType>temporary</timeSeriesType>
            <timeStep unit="hour" multiplier="6"/>
            <readWriteMode>add originals</readWriteMode>
            <ensembleId>main</ensembleId>
        </timeSeriesSet>
    </variable>
    <transformation id="SpatiallyInterpolatedHEFS-WPCQPF">
        <interpolationSpatial>
            <average>
                <inputVariable>
                    <variableId>wpc_grid</variableId>
                </inputVariable>
                <outputVariable>
```

```
                    <variableId>wpc_scalar</variableId>
                </outputVariable>
            </average>
        </interpolationSpatial>
    </transformation>
</transformationModule>
```

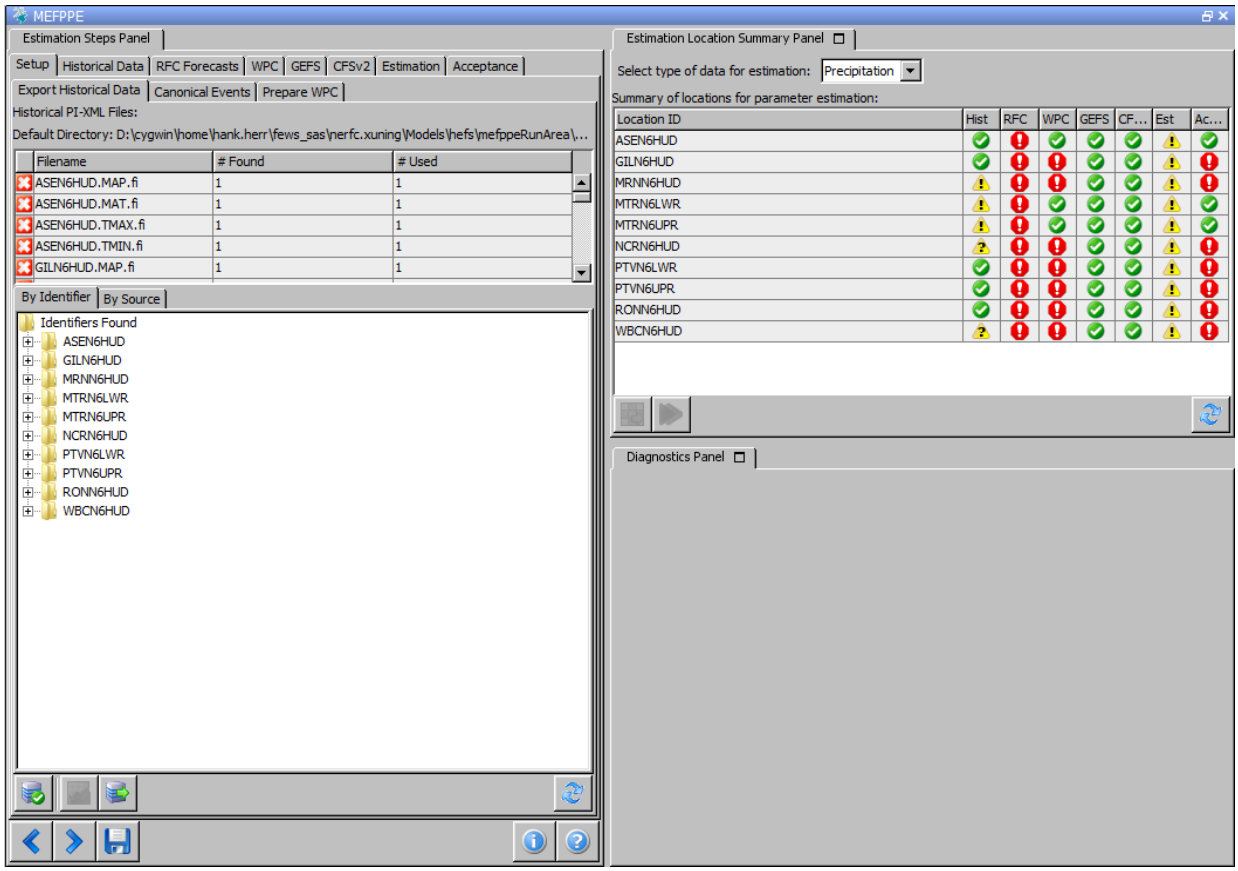
2.4 *Prepare Reforecasts and Estimate Parameters for Initial Catchments (Required)*

Estimating parameters for the WPC QPF requires preparing reforecasts (archived forecasts, in this case) and then estimating parameters using appropriately specified estimation options. The following provides instructions for completing that process and assumes the following:

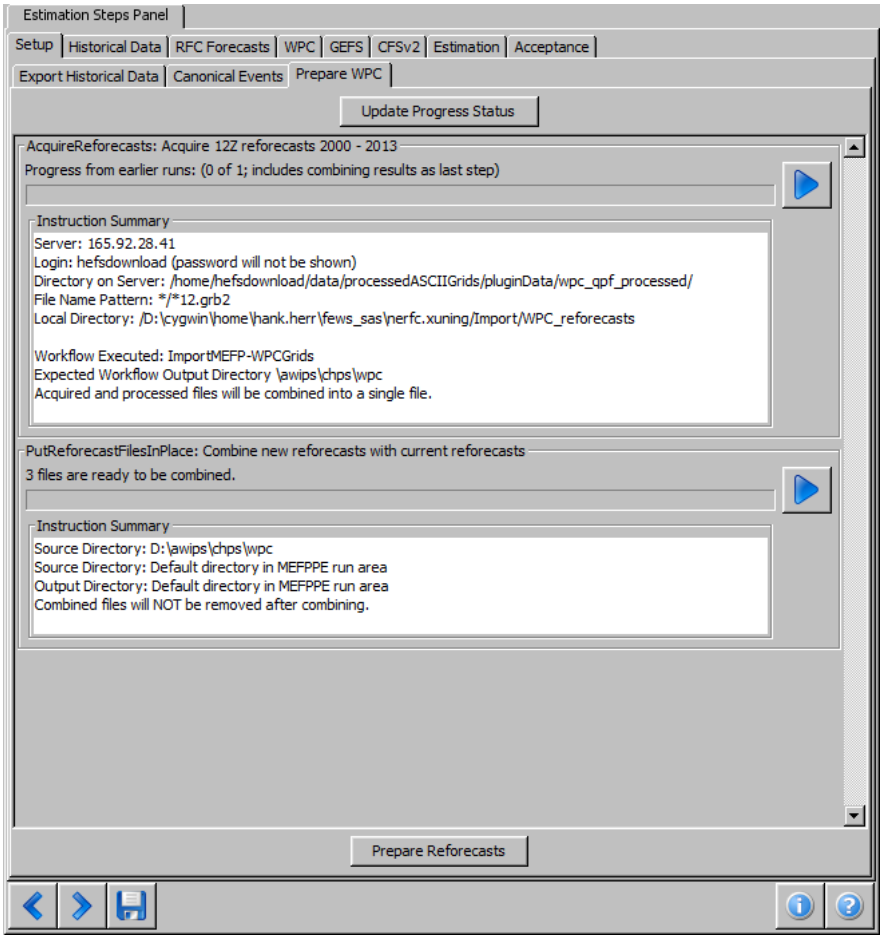
- **The MEFPPE is already setup to estimate parameters for the initial catchments (i.e., the historical data has already been acquired via the Setup Panel).**
- **Parameter files already exist for the initial catchments and will only be updated by estimating parameters for this one forecast source**.

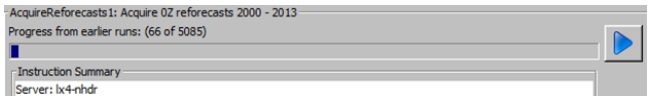
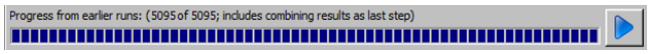
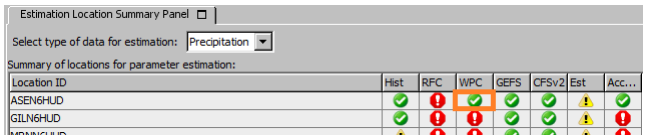
The actions to perform are as follows:

#	Action	Expected Results
0	Start the *PE SA* as usual (be sure to use a run script under ohdPlugins) and open the MEFPPE. If necessary, set the port number by clicking on the **Connect to CHPS PI-service Button**, as per usual (see Sections 3.2.4.4 and 3.5.1.1 of the *MEFP User's Manual* for more information).	The CHPS SA should show the initial screen for the MEFPPE and the **Connect to CHPS PI-service Button** will show a green checkmark:



#	Action	Expected Results
1	Select the **Prepare WPC** tab of the **Setup Panel**. If you do not see that tab, then the installation process failed.	The preparation steps as a scrollable list of panels, one panel per step. For the WPC QPF, the following should be displayed:



#	Action	Expected Results
2	Click on the **Prepare Reforecasts Button**. When the **Continue or Rerun Dialog** opens, click **Rerun**.	The steps displayed in the panel will be performed, top to bottom, with the progress bars updating as the step proceeds:  As each step is performed, the corresponding **Perform Step Button**, to the right of the progress bar, will change to display a stop icon, , and can be clicked to stop the preparation process. The **Perform Step Buttons** for other steps will change to the wait icon, . When complete, the status bar for each step should indicate all steps have been performed and all **Perform Step Buttons** will display the run icon:  Furthermore, in the **Location Summary Table** (upper right of the MEFPPE), a green checkmark will be displayed in the WPC column for each catchment for which reforecasts were prepared:  If you do not see a row corresponding to the catchment, then you have not yet added that location to MEFPPE and estimated parameters for it. See the *MEFPPE Configuration Guide* for instructions on how to do so. If you see a row, but the WPC icon is not a green checkmark, then that catchment did not have any reforecasts prepared for it. Check to make sure the locationId in the initial catchment location set is properly specified and matches that for the MEFPPE row. For more information, see Section 3.5.3 of the *MEPF User's Manual*.

Whenever the preparation process is re-run from scratch, by clicking on the **Rerun Button** in the **Continue or Rerun? Dialog**, <u>all</u> previously prepared reforecast files are removed from the <*MEFPPE run area*>. Only click on the **Rerun Button** the first time reforecasts are prepared or if previously existing reforecast files were updated for some reason, forcing a re-preparation.

#	Action	Expected Results

Description of Reforecast Preparation

Reforecasts are prepared in two steps:

1. AcquireReforecasts: Acquire 12Z reforecasts 2000 - 2013

SFTP to a webserver to acquire reforecast files one at a time. For each file, process them through an import/interpolate/export workflow. Files exported are placed in the directory specified by the writableOutputDirectoryOnLocalDisk argument defined in Section 2.1.

2. PutReforecastFilesInPlace: Combine new reforecasts with current reforecasts

Moves the files from that directory to their final location in the MEFPPE run area,

<*MEFPPE run area* >/pluginData/WPC,

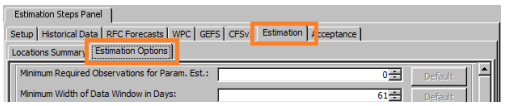
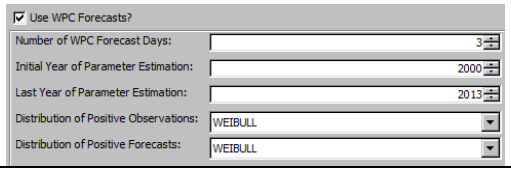
combining the reforecasts with any already prepared and placed in that directory. This allows for incremental updates to the list of reforecasts in the future.

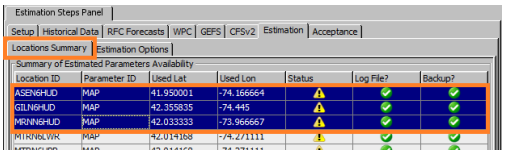
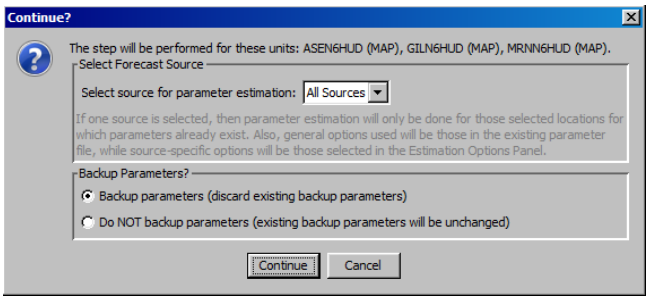
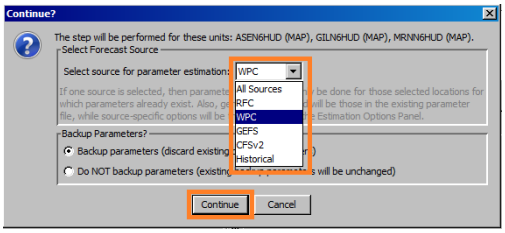
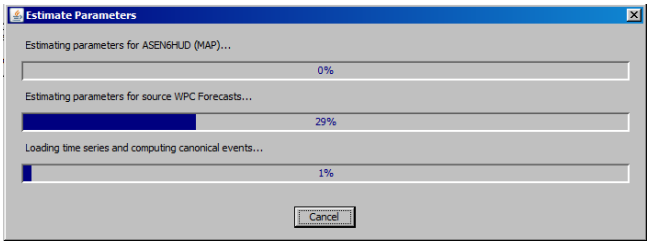
The entire process should take 4 – 8 hours to complete, depending on the network connection speed and the number of catchments in the initial set. However, it may be much slower if the directory mentioned in Step 1 above is not on the local disk.

If the process stops for any reason, an error message will be displayed. Shut down the *PE SA* and repeat the steps above to restart the SA and perform the preparation process again. The process will pick up from where it left off when it stopped.

If the process continues to fail, this may be indicative of a configuration or software error.

For more information, see Section 3.5.3 of the *MEFP User's Manual*

3	Switch to the **Estimation Panel** and click on the **Estimation Options Tab**:  Specify the estimation options you wish to use; the defaults are:  	If any option is changed, the **Default Button** to the right of that option will become enabled:

#	Action	Expected Results
4	Switch back to the **Locations Summary Tab** and select the catchments for which to estimate parameters for the WPC QPF forecast source from the **Summary of Estimated Parameters Availability Table**:  Click on the **Perform Step Button**: 	A **Continue Dialog** will open: 
5	Select the source WPC from the **Select Source Choice Box** and click **Continue:** 	The parameters will be estimated for the WPC QPF forecast source <u>only</u> and for all those locations for which an estimated parameters file already exists. A standard parameter estimation progress dialog will be displayed:  Note that the options used to estimate parameters are those selected in the previous step combined with the general options loaded from the parameter file. See Section 3.9.5.1 of the *MEFP User's Manual* for more information.
6	Backup the existing MEFP parameters used in ensemble generation. Those files are located here: *<mefp_root_dir>*/mefpParameters	See the *MEFPPE Configuration Guide* for the definition of *<mefp_root_dir>*. The backup can be removed once it is confirmed ensembles can be generated successfully (see Section 3.3.
7	Accept the parameter files for the initial set of catchments as usual via the **Acceptance Panel** as done before so that the new parameters are put in place for testing ensemble generation.	

3 Installing the WPC Plugin in the MEFP Forecast Components

This section provides instructions for the following:

- **Configuring the MEFPEnsembleGeneratorModelAdapter to generate ensembles that include the WPC QPF forecast source plugin.**

By the end of this section, the WPC QPF plugin will be configured for use in the *installation standalone* with appropriate changes made to all impacted *adapter configuration files*.

This section is written under the assumption that WPC QPF is already imported as part of your operational CHPS configuration and spatially interpolated for catchments. If that is not the case, then your operational CHPS configuration must be modified so that WPC QPF is imported and interpolated. Talk to your CHPS configuration focal point, HSD, or another RFCs as needed to make that happen.

The process below follows closely Section 2.2 of the *MEFP Plugin Framework User's Manual*, using the MEFPPE run area forecastSourcesDefinition.xml file as a basis from which to create the module data set.

3.1 *Create and Modify forecastSourcesDefinition.xml (Required)*

Action: For each affected *adapter configuration file*, do the following:

cd <*install SA configuration_dir*>/ModuleDataSetFiles/.
cp <*MEFPPE run area*>/.systemFiles/forecastSourcesDefinition.xml .

Edit the file forecastSourcesDefinition.xml removing the reforecastPreparationSteps XML element from within the source XML element defined for the WPC forecast source. Then do the following:

zip <*adapter configuration file* name without .xml extension>.zip forecastSourcesDefinition.xml
rm forecastSourcesDefinition.xml

EXAMPLE: Using MEFPPE forecastSourcesDefinition.xml File

This example is specific to ABRFC. The *adapter configuration file* is KEYINF_MEFP_FMAP_Forecast.xml and all of the default forecast sources are to be used with the WPC plug-in forecast source being added.

The content of the forecastSourcesDefinition.xml file will be as follows:

```
<forecastSources>
  <source class="ohd.hseb.hefs.mefp.sources.rfcfcst.RFCForecastSource" id="RFC"/>
  <source class="ohd.hseb.hefs.mefp.sources.plugin.PluginForecastSource" id="WPC"/>
  <source class="ohd.hseb.hefs.mefp.sources.gefs.GEFSForecastSource" id="GEFS"/>
  <source class="ohd.hseb.hefs.mefp.sources.cfsv2.CFSv2ForecastSource" id="CFSv2"/>
  <source class="ohd.hseb.hefs.mefp.sources.historical.HistoricalForecastSource" id="Historical"/>
</forecastSources>
```

The name of the module data set file created containing the forecastSourcesDefinition.xml file will be KEYINF_MEFP_FMAP_Forecast.zip.

Description: The module data set file will provide to the MEFPEnsembleGeneratorModelAdapter a list of the forecast sources available for ensemble generation. An exportDataSetActivity XML element will be added to each impacted *adapter configuration file* in the next step.

3.2 *Modify all Adapter Configuration Files (Required)*

Action: For each affected *adapter configuration file*, the following modifications must be made:

1. Set the exportDataSetDir XML element of the general section to be the work directory.

EXAMPLE: Modified general XML element of Adapter Configuration File

Note the highlighted XML element:

```
...
  <general>
     <description>MEFP Ensemble Generator</description>
     <piVersion>1.8</piVersion>
     <rootDir>%TEMP_DIR%</rootDir>
     <workDir>%ROOT_DIR%/work</workDir>
     <exportDir>%ROOT_DIR%/input</exportDir>
     <exportDataSetDir>%ROOT_DIR%/work</exportDataSetDir>
     <exportIdMap>IdExportMEFPMAP</exportIdMap>
     <importDir>%ROOT_DIR%/output</importDir>
     <dumpFileDir>$GA_DUMPFILEDIR$</dumpFileDir>
     <dumpDir>%ROOT_DIR%</dumpDir>
     <diagnosticFile>%ROOT_DIR%/output/diag.xml</diagnosticFile>
  </general>
...
```

2. If not already included, add a makeDir XML element to the startUpActivities XML element that will create the work directory. If no startUpActivities XML element exists, add it.

EXAMPLE: Added exportDataSetActivity XML element

This example is specific to ABRFC:

```
...
<startUpActivities>
  <makeDir>
     <dir>%ROOT_DIR%/work</dir>
  </makeDir>
</startUpActivities>
...
```

3. Add exportDataSetActivity XML element, so that the moduleInstanceId matches the name of the *adapter configuration file* being modified. The element must be placed immediately after the exportTimeSeriesActivity and before the exportRunFileActivity XML element.

EXAMPLE: Added exportDataSetActivity XML element

This example is specific to ABRFC:

```
...
<exportDataSetActivity>
    <moduleInstanceId>KEYINF_MEFP_FMAP_Forecast</moduleInstanceId>
</exportDataSetActivity>
...
```

4. Specify appropriate run file properties. At a minimum, the wpcNumberOfForecastDays property must be set to a value between 1 and 3 in order for the WPC QPF to be included in the run as a forecast source. Other options should be set as appropriate.

- The number of forecast days used must not be greater than the number of days for which parameters were estimated, based on the estimation options set in Section 2.4.
- When hindcasting, for some archive forecast T0s, only two days of WPC QPF are available. Thus, depending on the setting of the behaviorIfEventIsMissing run file property (see Section 4.4.3 of the *MEFP User's Manual*), the adapter may error out for some hindcast T0s if the number of forecast days is set to three.

EXAMPLE: Modified exportRunFileActivity Properties

See the highlighted properties. The wpcNumberOfForecastDays is set to 3 days, so that MEFP uses 3 days of the WPC QPF forecast when generating ensembles. The wpcUseEPT is set to true, ensuring the EPT model is used for precipitation intermittency modeling. However, true is its default value, so it is included here only for illustration purposes.

```
...
<properties>
   <string key="hindcasting" value="$MEFP_HINDCASTING$"/>
   <string key="parameterDir" value="$MEFP_ROOT_DIR$/mefpParameters"/>
   <int key="wpcNumberOfForecastDays" value="3"/>
   <int key="rfcNumberOfForecastDays" value="0"/>
   <int key="gefsNumberOfForecastDays" value="15"/>
   <int key="cfsv2NumberOfForecastDays" value="270"/>
   <int key="climatologyNumberOfForecastDays" value="330"/>
   <string key="wpcUseEPT" value="true"/>
   <int key="initialEnsembleYear" value="1952"/>
   <int key="lastEnsembleYear" value="2013"/>
</properties>
...
```

5. Modify the exportTimeSeriesActivity so that operational forecast time series are exported for use by the MEFPEnsembleGeneratorModelAdapter. The length of the time series must meet or exceed the value of wpcNumberOfForecastDays. Furthermore, the qualifierId of the exported time series must be "WPC". Id-mapping may be used to assign an appropriate qualifierId.

EXAMPLE

The following is an example of a timeSeriesSet added to the exportTimeSeriesActivity XML element in the configuration file for the MEFPEnsembleGeneratorModelAdapter. The example is specific for NERFC:

```
...
<timeSeriesSet>
  <moduleInstanceId>FMAP_PreProcessing_HPC</moduleInstanceId>
  <valueType>scalar</valueType>
  <parameterId>FMAP</parameterId>
  <locationSetId>Catchments_HEFS_Hudson</locationSetId>
  <timeSeriesType>external forecasting</timeSeriesType>
  <timeStep unit="hour" multiplier="6"/>
  <relativeViewPeriod unit="day" start="0" startOverrulable="true" end="2" endOverrulable="false"/>
  <readWriteMode>read only</readWriteMode>
</timeSeriesSet>
...
```

In order to associate a qualifierId of WPC with this time series, lines similar to the following were added to the id-mapping file referred to by the exportIdMap XML sub-element of the general element:

```
...
<map internalLocation="HOPR1SNE" externalParameter="FMAP" internalParameter="FMAP"
      externalLocation="HOPR1SNE" externalQualifier="WPC"/>
...
```

One line is needed per locationId for which WPC QPF forecasts will be exported.

For more information on id-mapping, speak with your CHPS configuration focal point.

Description: With the changes made above, the MEFPEnsembleGeneratorModelAdapter will now be configured to generate ensembles that include the WPC QPF plugin forecast source.

3.3 *Confirm Configuration*

Action: Execute the adapter configuration files in debug mode. To do so, setup the adapter configuration file for debug messaging (set the printDebugInfo property to be "1") and execute it in debug mode through the **Manual Forecast Dialog**.

Examine the diag.xml file that is generated. Lines such as the following confirm source parameters were found and read in from the parameter file:

```
<line level="4" description="The current tar entry file WPCSourceModelParameters.meta.xml matches that expected for source WPC Forecasts; reading source parameters..."/>
<line level="4" description="Done reading tarred parameter files for source WPC Forecasts."/>
```

Lines such as the following indicate that forecast ensembles were generated for the specific T0 and for specific canonical events:

```
<line level="3" description="Generating forecast ensemble for T0 2013-05-20 12:00:00 GMT for the source WPC Forecasts which has a number of forecast days set to 3..."/>
...
<line level="4" description="Generating and applying forecast ensemble for source WPC Forecasts and event CanonicalEvent(number = &lt;xml number:20&gt;, start = &lt;xml startPeriod:12&gt;, end = &lt;xml endPeriod:12&gt;, numens = &lt;xml numberOfLaggedEnsembleMembers:5&gt;) which has value 0.0 and correlation parameter -0.04905(-99 is always used for resampled climatology)."/>
<line level="4" description="Generating and applying forecast ensemble for source WPC Forecasts and event CanonicalEvent(number = &lt;xml number:4&gt;, start = &lt;xml startPeriod:4&gt;, end = &lt;xml endPeriod:4&gt;, numens = &lt;xml numberOfLaggedEnsembleMembers:5&gt;) which has value 33.391605377197266 and correlation parameter -0.00214(-99 is always used for resampled climatology)."/>
...
```

3.4 *Synchronize Changes to the Central Database (Required)*

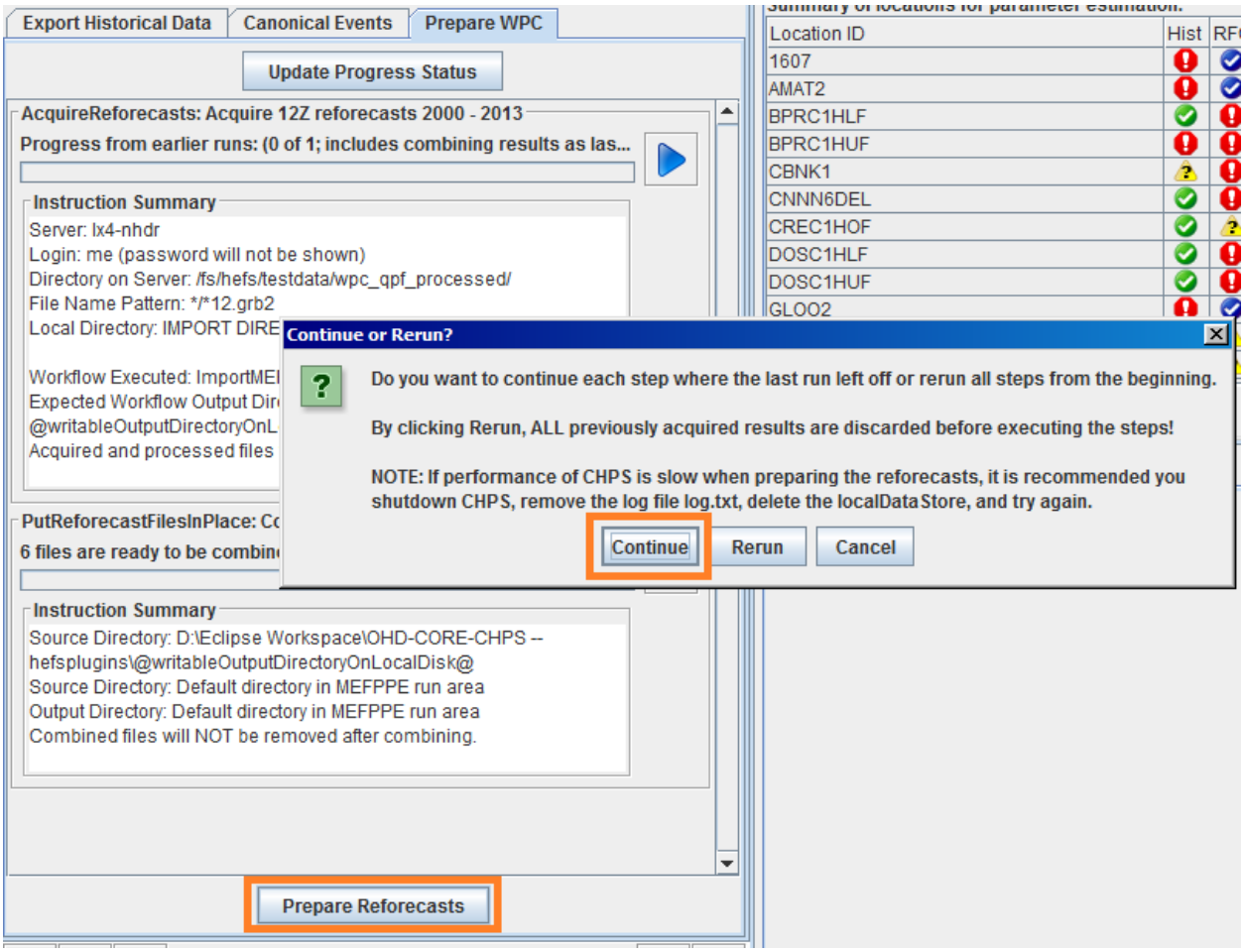
Once the installation steps above are complete, including confirmation, port all of the configuration changes to the central database. This should include the module data set files created in Section 3.1 and the adapter configuration files modified in Section 3.2.

4 Tips and Troubleshooting

This section covers tips and troubleshooting topics related to the WPC QPF plugin forecast source and will be expanded as additional topics are identified.

4.1 *Incorporating Newly Available WPC QPF Archived Forecast Files*

If WPC QPF archived forecast GRIB2 files are added to the SFTP server accessed by this WPC QPF forecast source plugin, then those new archived forecasts can be incorporated by clicking on the **Prepare Reforecasts Button** as usual and clicking **Continue** when the **Continue or Rerun? Dialog** opens:



After the preparation process is complete, re-estimate the parameters for the WPC forecast source only, as per Section 2.4, Steps 4 and 5.

After clicking **Continue**, above, the MEFPPE will run without removing any already made progress. First, it will update the progress status of the first "AcquireReforecasts" step and identify which archived GRIB2 files have not been processed yet, adjusting the progress bar appropriately. It will then process each of those new files (only) as usual: SFTP to acquire each

file one at a time and execute the appropriate workflow. When done, the "PutReforecastFilesInPlace" step will be performed which will combine those new results with the existing results already placed within the directory, <MEFPPE run area >/pluginData/WPC.

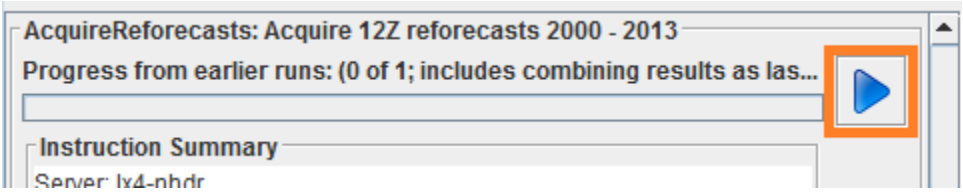
4.2 *Preparing Reforecasts for Additional Locations*

If reforecasts must be prepared and parameters estimated for additional catchments (i.e., after the initial set of catchments has already been prepared), then perform parameter estimation by clicking on the individual **Run Step Buttons**.

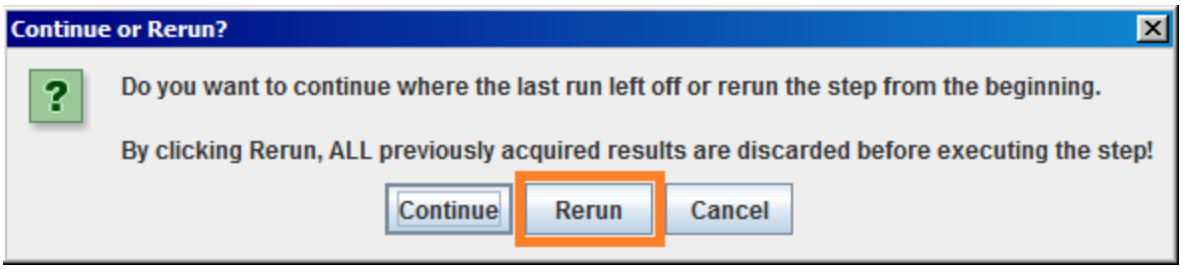
Perform the following steps:

1. Modify the location set "Catchments_WPC" within the file *<PE SA configuration_dir>*/RegionConfigFiles/LocationSets.xml to include only those locations which are newly added. Restart the PE SA and open MEFPPE.

2. In the **Prepare WPC Panel**, click on the **Run Step Button** for the "AcquireReforecasts" preparation step:

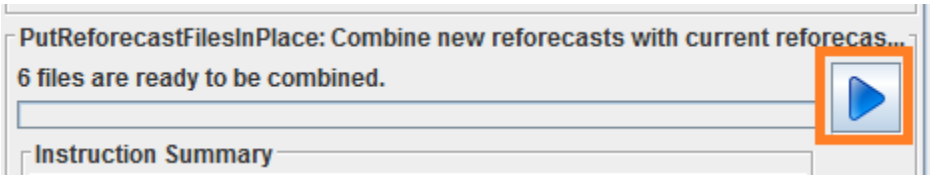


3. When the **Continue or Rerun Dialog** opens, click **Rerun**:

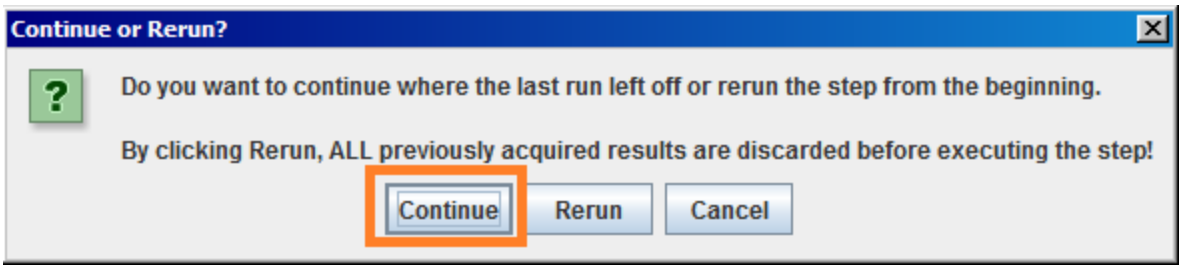


The first step of the reforecast preparation process will execute, from scratch, for the newly added locations. This may take several hours to complete.

4. When the previous step is complete, click on the **Run Step Button** for the "PutReforecastFilesInPlace" step:

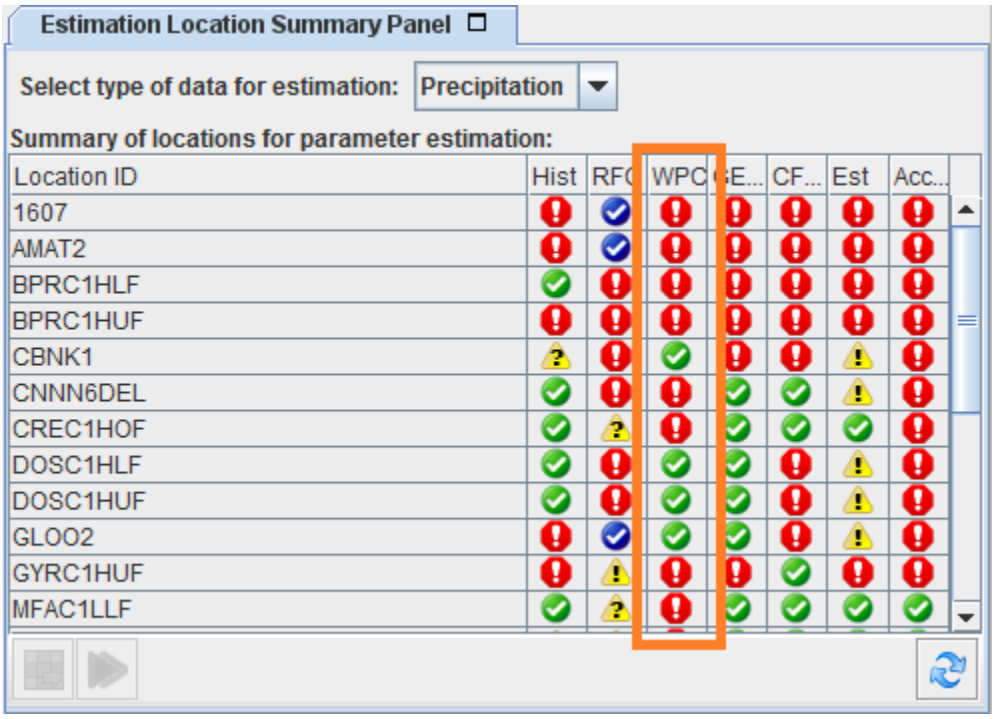


5. When the **Continue or Rerun Dialog** opens, click **Continue** (**Do NOT click Rerun!**):



Again, do NOT click Rerun!!! If you do so, the reforecast files for all locations prepared previously will be removed from the MEFPPE run area and will need to be prepared again; a process that takes hours.

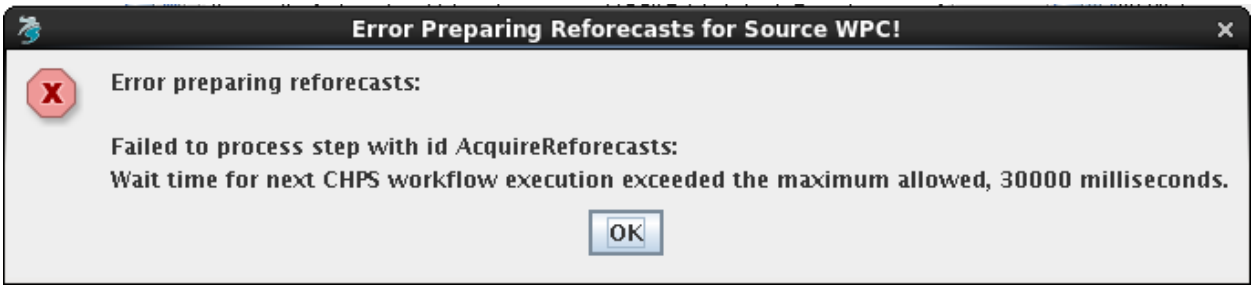
6. Once the "PutReforecastFilesInPlace" step is complete, verify that a green checkbox icon, , is included for all of the newly added locations:



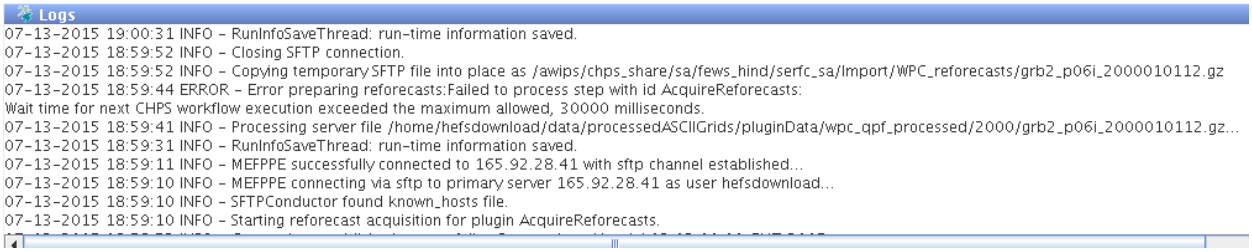
7. Estimate parameters for those locations for the WPC forecast source only, as per Section 2.4, Steps 4 and 5.

4.3 *Time-out Errors During Reforecast Preparation*

The WPC forecast source plug-in includes multiple points at which it is possible for a time-out error to occur. For example,



indicates that MEFPPE waited 30 seconds (30,000 milliseconds) to receive a signal that a file is ready to be imported via executing the CHPS workflow and, when it failed to receive that signal, generated an error and quit. The CHPS **Logs Panel** will often provide an explanation of what happened. In this example, the **Logs Panel** showed the following:



Notice that the MEFPPE successful connects to the server,

```
07-13-2015 18:59:11 INFO - MEFPPE successfully connected to 165.92.28.41 with sftp channel established...
```

Upon connection, MEFPPE will acquire a listing of the files that must be processed, equivalent to a Unix ls command that must return thousands of file names, in this case. No log message is generated when this listing is performed. However, the "Processing server file" log message indicates the time when the file list was acquired and the first file SFTP initiated:

```
07-13-2015 18:59:41 INFO - Processing server file /home/hefsdownload/data/processedASCIIGrids/pluginData/
```

The file listing took 30 seconds, given the time differential between this message and the previous one. While the SFTP processor is acquiring a file to import, the CHPS workflow processor reported this error:

```
07-13-2015 18:59:44 ERROR - Error preparing reforecasts:Failed to process step with id AcquireReforecasts:
Wait time for next CHPS workflow execution exceeded the maximum allowed, 30000 milliseconds.
```

It started waiting to execute the CHPS workflow apparently at 18:59:14 and exceeded the configured maximum wait time of 30 seconds. During that time it was waiting for both the file

listing to complete and the first file to be acquired, but, as stated above, just the file listing alone took 30 seconds. Hence, the workflow processor timed out as the first file was being acquired.

Whenever a time-out error occurs, the first fix to attempt is to increase the appropriate configured maximum wait time in the forecast sourced definition file:

<MEFPPE run area>/.systemFiles/forecastSourcesDefinition.xml

In this case, that wait time is specified by the attribute maxWaitToExecute of the workflowInstructions XML element:

```
<workflowInstructions maxWaitToExecute="30000" maxWaitForExecutionToComplete="30000">
```

In general, the following table lists the XML attributes that control possible time-out errors when preparing reforecasts for the WPC forecast source plug-in. In each case, a snippet of the error message text is provided as well as a description of the possible cause.

In each case, if an error of that type is encountered, increase the wait time attribution and try again. If the problem persists, report it via FogBugz.

Wait-time Attribute	Error Message Snippet	Cause
maxWaitToExecute (workflowInstructions element)	Wait time for next CHPS workflow execution exceeded the maximum allowed…	SFTP file listing and/or acquisition of one file to import took too long. For the first file to process/import, the time required includes that necessary to acquire a listing of the files to process on the SFTP server as well as that needed to acquire the first file via SFTP. For each file thereafter, only the time necessary to acquire a file is included.
maxWaitForExecutionToComplete (workflowInstructions element)	CHPS Workflow FAILED to execute in ##### for the file…	CHPS workflow took too long to complete, based on the number of milliseconds specified for this attribute. The message shown to the left is generated by the MEFPPE; additional error messages generated by CHPS may be displayed as well.
maxWaitForPuttingFileInPlace (sftpInstructions element)	File was acquired but signal to put the file in place for import was never caught…	CHPS workflow took too long to complete. Upon acquiring a file to process/import via SFTP, the SFTP processor will wait for a signal indicating that the file can now be put in place for import. It will only wait as long as this attributes indicates before giving up and timing out.