

Hurricane Forecast Improvement Project's
"Stream 1.5" Concept of Operations
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1. Introduction

The Hurricane Forecast Improvement Project (HFIP) uses the term "Stream 1" for the yearly upgrades made to operational numerical weather prediction capabilities, and the developmental and test activities supporting them. HFIP terms efforts taking multiple years to enhance operations as "Stream 2". In 2009, HFIP and the National Hurricane Center (NHC) agreed to establish a new, intermediate pathway to operations known as "Stream 1.5". This document provides a Concept of Operations (CO) for Stream 1.5 pertaining to NHC operations.

Stream 1.5 covers improved models and/or techniques (all, henceforth, "projects") that the NHC, based on prior assessments, wants to access in real-time during a particular hurricane season, but which cannot be made available to NHC by the operational modeling centers in conventional "production" mode. Insufficient computing capability and/or programmer time constitute the primary operational limitations delaying implementations into operations. HFIP's Stream 1.5 supports activities that intend to bypass these current operational deficiencies by using non-operational resources to move forward the delivery of guidance to NHC by one or more hurricane seasons. Stream 1.5 projects are run as part of HFIP's annual summertime "Demo Project".

August 1- October 20 is chosen as the period for real-time Stream 1.5 activities. This period is selected because it corresponds to the climatological peak in Atlantic tropical cyclone frequency and because the two month offset from the June 1 start of hurricane season provides additional time for preparation by researchers, HFIP and the NHC.

2. Candidate projects

HFIP's focus on computer model guidance opens the opportunity for a variety of numerical weather prediction projects to be part of Stream 1.5. To qualify, however, participation by a candidate project must be approved by HFIP management, the developer or developer's home institution, and the NHC.

Experience indicates that schemes that are not thoroughly vetted in advance can be a distraction and time-sink for forecasters or, worse yet, detrimental when introduced to the operational environment. In addition, the resources required by an operational center to accommodate such schemes can be substantial. For these reasons, the NHC will have veto authority on which candidate projects qualify for Stream 1.5 real-time activity. NHC's process will usually consider some of the following criteria for intended

forecast model enhancements. In addition, they may apply standards for display format and content, communications methods, and other run-time considerations.

a. Tropical cyclone track forecasts

Recognizing that NHC's track forecast errors decrease by about 3-4% per year on average, and tend to parallel gains made in Stream 1 numerical guidance, the following will be viewed in a relatively positive light:

- Projected improvement is more than 3-4% over an operational scheme's previous year's performance; or, for a new technique, 3-4% better than the average error of the previous year's top-flight models
- Techniques that improve the conventional model consensus track error by at least 3-4%
- Schemes that otherwise enhance the operational forecast by providing better "guidance on guidance"
- An especially high "frequency of superiority"
- High run-to-run consistency in combination with acceptable performance

b. Tropical cyclone intensity forecasts

Little to no improvement in NHC tropical cyclone intensity forecast accuracy has occurred in at least 20 years. Model guidance has improved but on average is no better than the NHC forecast. Techniques that improve upon existing guidance for tropical cyclone intensity and rapid intensification will receive special consideration in the selection process.

3. Demonstration sample size requirements and model configurations

To qualify for Stream 1.5 real-time activities the merits of a project must be determined over a large enough number of test cases to indicate robust results. The standard employed by the NWS's Environmental Modeling Center (EMC) and NHC for a new model is three years of cases. This period was established to ensure a sufficient number of cases across a representative number of environmental regimes. Upgrades to an existing model requires a smaller test (or retrospective) period of cases, usually two years, to determine whether it will be implemented into operations.

The nominal benchmark for Stream 1.5 is two years of cases. A shorter test period is strongly discouraged; in such cases, the statistical significance of the forecast improvements and breadth of the sample will be considered. Fewer cases will usually necessitate larger increases in capability. Retrospective testing must be conducted with

the model configuration being proposed for the real time runs. Additional guidance for retrospective testing will be provided on an annual basis.

4. Verification and assessment

The HFIP Verification Team, in collaboration with NHC, will be responsible for conducting forecast model verification.

HFIP Teams and the NHC will assess the Stream 1.5 products.

5. Run-time considerations

Projects in the evaluation stage and, if accepted, for real-time use will run typically using computing resources (systems and people) supported by arrangements reached between HFIP leadership and the developer(s) and/or their home institutions.

Output content and format will be established by the HFIP in consultation with HFIP teams (e.g., the Applications Development and Diagnostics Team) and/or the NHC, as appropriate. For example, track and intensity forecast information was to be provided in 2010 to the HFIP Verification Team and to the NHC in the Automated Tropical Cyclone Forecast "ATCF" format then employed by NHC. The generation, transmission and display of other data, including model fields, will need to be carefully determined and established before the real-time activities begin. Options for data and field displays include NHC systems (e.g., ATCF, NAWIPS and AWIPS), the web, or other systems that NHC can access. Setting up this capability can be a lengthy process. Early communication with NHC on this aspect is strongly recommended. Information Technology (IT) security requirements must be met.

Utility and forecaster confidence is enhanced when output is available for every 6-hourly forecast cycle. A 12-hourly cycle will generally be the minimum frequency considered for acceptance.

The manner in which Stream 1.5 output is employed in operations is at the discretion of the NHC.

6. Transition to routine operations

The decision authority for transfer of a Stream 1.5 project into conventional Stream 1 operations rests with the relevant operational organizations (e.g., EMC).

7. Endorsement and modification

This CO is approved by, and future modifications are the responsibility of, the HFIP Project Manager or Development Manager, and the NHC.