RFC Short-Term Ensemble Workshop

Ensemble verification session, part 1: introduction to the Ensemble Verification System (EVS)

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   - Plans for EVS (…depend on your feedback!)

Purpose of EVS

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Transition to ensemble forecasts

- Forecasts increasingly allow for uncertainty
- This adds another layer of complexity….
- ….so the benefits must be demonstrated….

Need for verification

- Understanding model strengths/weaknesses
- Identifying systematic errors and causes
- Communicating quality (confidence building)

Purpose of EVS

Verification by operational forecasters

- Purpose built tool that guides users
- Statistics and plots that make sense
- Transparency about how they are computed
- Clarity on limitations and need for judgement

Components of EVS

Components of EVS

Three components

1) Graphical User Interface (GUI) in Java
2) Statistics engine in FORTRAN
3) Plotting engine, based on R scripts

User control

- User interactions controlled by GUI
- Statistics and plotting engines called by GUI
- But ‘control files’ (e.g. R scripts) are available

Graphical User Interface

Staged working environment

- Tabs (high level), windows, panels (low level)
- Navigate using tabs and Next/Back
- Administrative functions always visible

Three stages of verification (as 'tabs')

1. Verification of one variable on one segment
2. Aggregation of statistics across segments
3. Display of original/aggregated statistics

Stage 1: 'verification'

A. Defining a Verification Unit (VU)

- **Identifiers: one variable on one river segment**
- **Input data: path to forecasts/observations**

  Pairing process (observed vs. forecast)
- **Temporal parameters**
- **Output data: directory to store statistics**

B. Selecting verification statistics

- **Tests for mean and ensemble members**

Stage 2: ‘aggregation’

Defining an Aggregation Unit (AU)

- Assumes that verification stats. available
- Requires VUs with ‘common’ properties:
  - Common environmental variable
  - Common temporal parameter values
  - Common statistics (and their parameter values)
- Candidates added automatically to window
- Requires selection of VUs and output path

Stage 2: ‘aggregation’

Behaviour on editing VUs

- VUs may belong to one or many AUs
- If a VU changes, it is removed from all AUs

Calculation of statistics

- Weighted average of input VUs
- Weighted by number of observed events

Stage 3: ‘display’

Plots of verification statistics (using R)

- Various plots depending on stats. computed
- Some plots display composite information
- Plots organised by analysis units (VUs, AUs)
- Allows sub-selection of month or season

Examples of plots

- Reliability diagram
- Scatter plot

Other components of EVS

Statistics engine (FORTRAN)

- Verification statistics (verif*.exe)
- Aggregation of statistics (agg_verif*.exe)
- Driven by command files (written by GUI)
- Example of verif*.exe command file

Plotting engine (R)

- R statistics and graphics (www.r-project.org)
- R plotting scripts written by GUI

Other components of EVS

Documentation!

- User's manual for the GUI
- Appendices with data formats, statistics etc.
- Few examples at present
- Will expand (inc. basic verification concepts)
- Also, code is documented in html

Detailed examples

Example I

Verification of precipitation forecasts

- ABRFC region precipitation (CHTM7)
- 6-hr observed and forecast values
- 01/01/2004 to 31/12/2004
- Lead days 1-14

Example verification

- Verify to lead day 14 at ‘annual scale’

……..

Example II

Verification of streamflow forecasts

- ABRFC region streamflow (CHTM7/JOPM7)
- 6-hr observed and forecast values
- 01/01/2004 to 31/12/2004
- Lead days 1-14

Verification and aggregation

- Verify to lead day 14 at ‘monthly scale’
- Aggregate the two segments……

Plans for the future

Plans for the future

Short/medium term

- Improved verification measures (stats/graph)
- Support for long-term forecasts (> lead 14)
- Confidence intervals for measures
- Improved display in EVS
- Streamflow verification by river stage

Long-term

- One tool for determ./probabilistic forecasts

Plans for the future

Long-term (cont.)

- One tool for all space-time scales
- One tool for all forecast variables (including joint verification of multiple variables)

….your input required!

???

Forecast data file format

```
PRINTING OUT TS HEADER INFORMATION
    THE TIME SERIES ID IS: CHTM7
    THE DATA TYPE IS: QINE
    THE START DATE IS:  1/ 1/1961
    THE TIME STEP IS:  6
    THE CARRYOVER JUL DAY (ijdlst): 37985
    THE CARRYOVER HOUR (ihlst): 24
    THE FORECAST ENDING JUL DAY (ljdlst): 37999
    THE FORECAST ENDING HOUR (lhlst): 24
    THE START JUL DAY (idarun): 22280
    THE START HOUR (ihlst): 24
    THE END JUL DAY (ldarun): 35808
    THE END HOUR (lhlst): 24
    THE NUMBER OF CONDITIONAL MONTHS: 1

 1/ 1/1961 -->    1.531410    1.513815    1.497304    1.482101
 1/ 2/1961 -->    1.467420    1.453291    1.439104    1.424852
 1/ 3/1961 -->    1.410546    1.396229    1.381996    1.367885
 1/ 4/1961 -->    1.353983    1.340290    1.326800    1.313492
 1/ 5/1961 -->    1.300399    1.287488    1.274744    1.262134
 1/ 6/1961 -->    1.249955    1.238373    1.227442    1.217304
 1/ 7/1961 -->    1.207189    1.197028    1.186769    1.176373
 1/ 8/1961 -->    1.165979    1.155536    1.145074    1.134520
```

Observed data file format

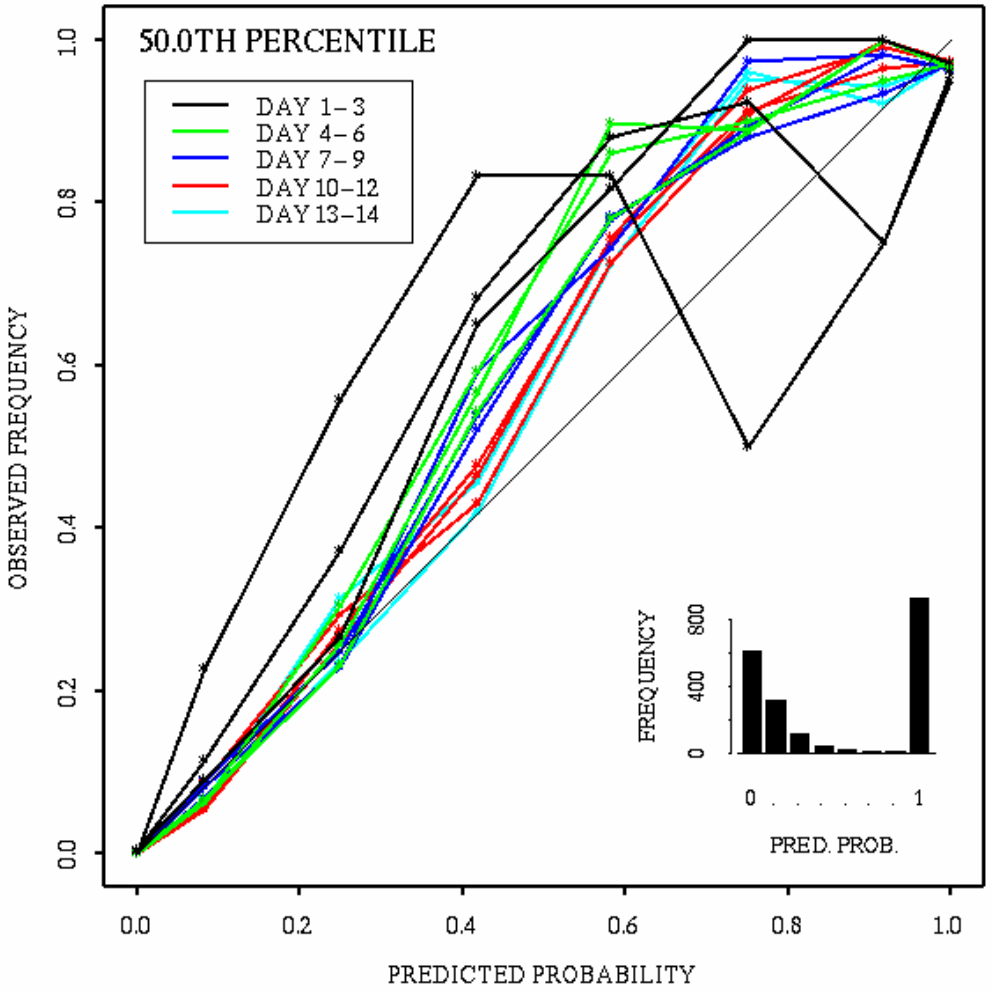
```
$OH datacard format:
$FromFile      Type Dim  Unit  Stp StationID  StationDesc (header card 1)
$m  yyyy mm    yyyy  col format (header card 2)
$StationID  mmyy day datavalue (values n cards)
ts296.2005090 QINE L3    CMS    6   CHTM7X             CARTHAGE (DCP)
01  2003 01    2005  1    F9.3
               1 3    1    3.450
               1 3    1    3.510
               1 3    1    3.540
               1 3    1    3.550
               1 3    2    3.570
               1 3    2    3.610
               1 3    2    3.640
               1 3    2    3.590
               1 3    3    3.540
               1 3    3    3.490
               1 3    3    3.490
               1 3    3    3.440
               1 3    4    3.390
               1 3    4    3.340
               1 3    4    3.340
               1 3    4    3.340
               1 3    5    3.290
```

paired_ts file format

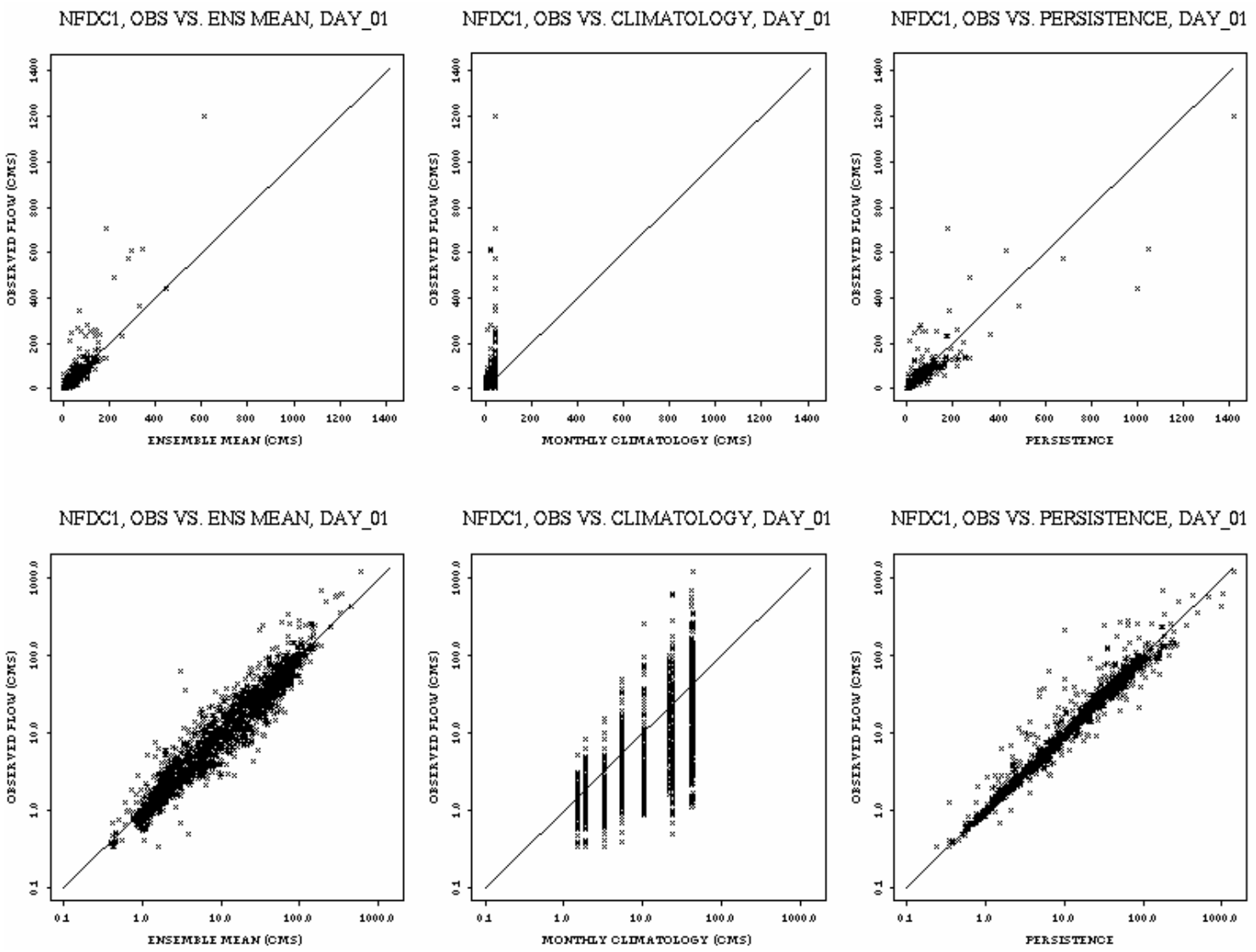
```
CHTM7          2004              1              1              1             10
   11.68000         11.53000         11.39000         11.10000
   12.44000         12.14000         11.98000         11.83000
          1    1.531410         1.513815         1.497304         1.482101
          2    1.531410         1.513829         1.497312         1.482047
          3    1.531410         1.513823         1.497198         1.481656
          4    1.531410         1.513815         1.497185         1.481652
          5    1.531366         1.513768         1.497242         1.482227
          6    1.531498         1.805292         2.872780         4.623281
          7    1.531366         1.513656         1.496913         1.481300
          8    1.531542         1.514317         1.498304         1.483706
          9    1.531410         1.513815         1.497206         1.481731
         10    1.531542         1.514317         1.498304         1.483706
CHTM7          2004              1              2              1             10
   11.10000         10.96000         10.82000         10.68000
   11.68000         11.53000         11.39000         11.10000
          1    1.462469         1.447247         1.433062         1.419696
          2    1.462375         1.446887         1.432238         1.418146
          3    1.462515         1.447426         1.433465         1.420448
          4    1.462140         1.445964         1.430080         1.414002
          5    1.462422         1.447067         1.432653         1.418929
          6    1.462562         1.447603         1.433863         1.421184
          7    1.462562         1.447603         1.433863         1.421184
          8    1.462515         1.447426         1.433465         1.420448
          9    1.462375         1.446887         1.432238         1.418146
         10    1.462562         1.447603         1.433863         1.421184
```

.....

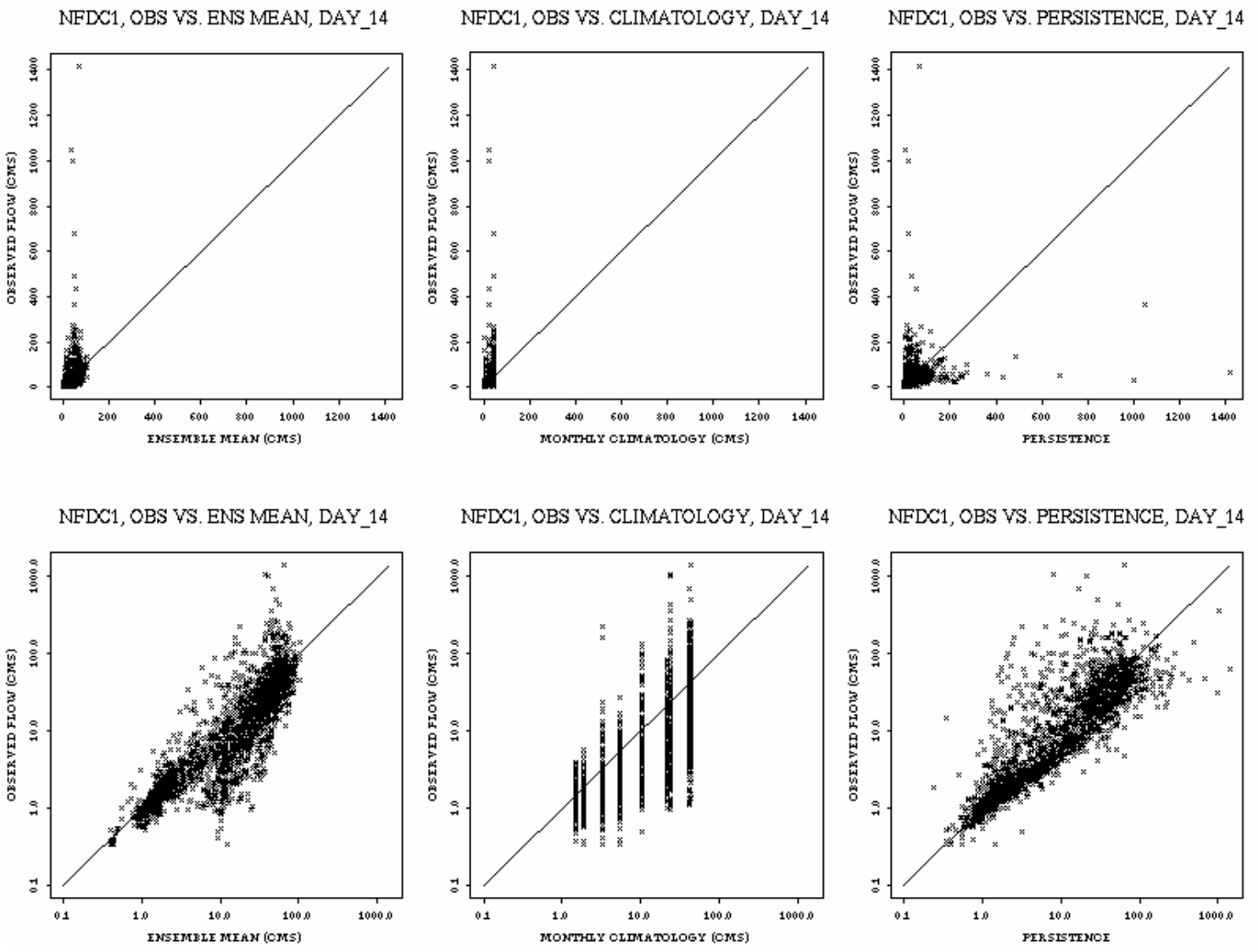
Reliability diagram



Scatter plot



Scatter plot



Verif*.exe command file

```
#Ensemble Verification System (EVS) verification control file.
#This file was prepared automatically by the EVS user interface.
#Consult the user's manual for help on the control arguments or contact
#James Brown (James.D.Brown@noaa.gov) for further details.
#PATH TO OBSERVATIONS:
flow_obs_dir=/fs/ensembles/projects/verif/ensfcst/obs_flow/CHTM7PQ.CHTM7.QINE.06.OBS
#PATH TO ENSEMBLE FORECASTS:
flow_ens_dir=/fs/ensembles/projects/verif/ensfcst/CHTM7PQ/
#PATH TO OUTPUT STATISTICS:
flow_out_dir=/fs/ensembles/projects/verif/results/flow/
#RIVER FORECASTING CENTRE ID:
rfc_id=DEFAULT
#RIVER SEGMENT ID:
segment_id=CHTM7PQ
#TIME-SERIES ID:
timeseries_id=CHTM7
#ENVIRONMENTAL VARIABLE ID:
variable=streamflow
#VERIFICATION START DATE:
beginning date=20040101
#VERIFICATION END DATE:
ending date=20041231
#PAIR OBSERVATIONS AND FORECAST VALUES?
pair_ts=yes

..........
```