MET Verifying Probabilities

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METplus Tutorial
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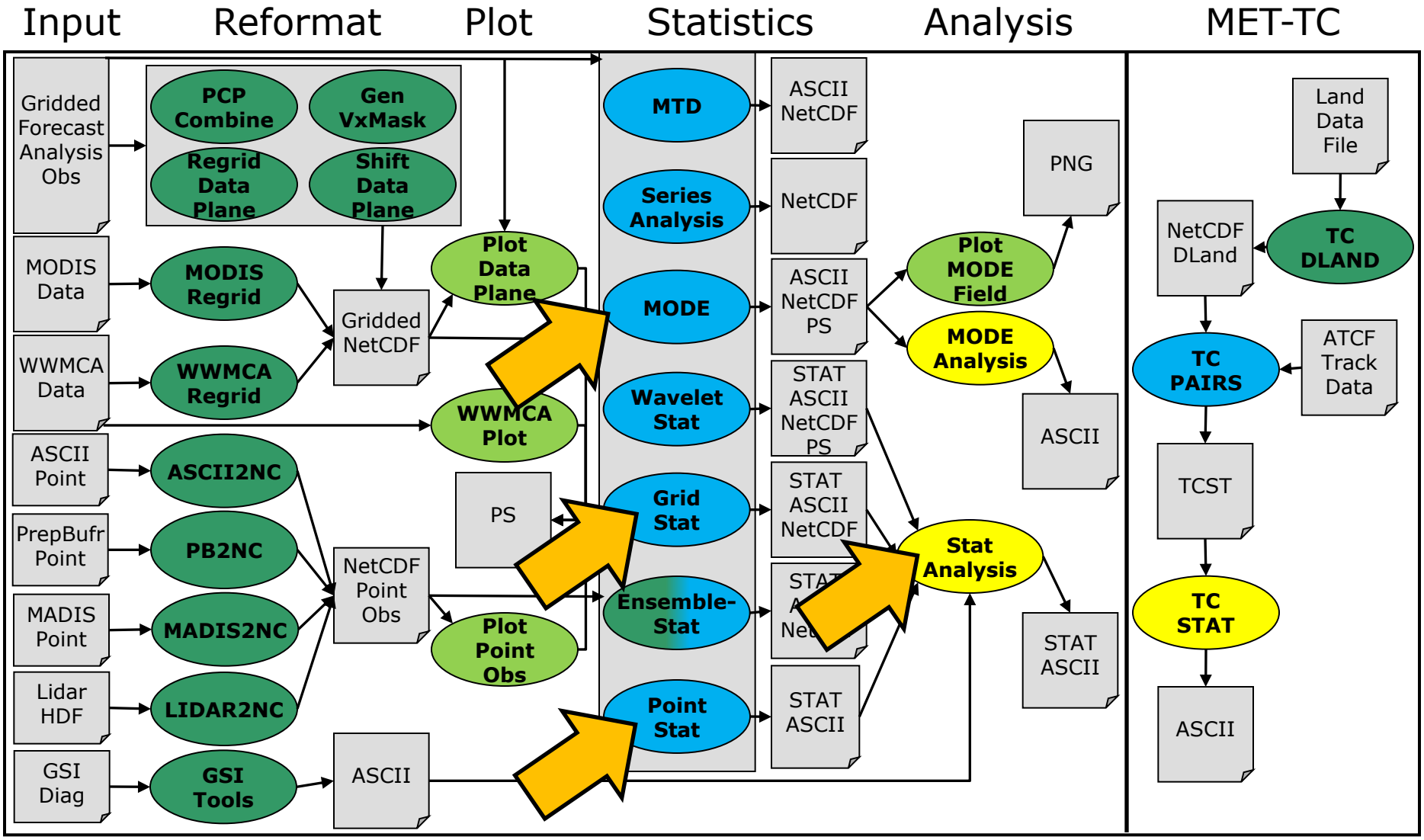
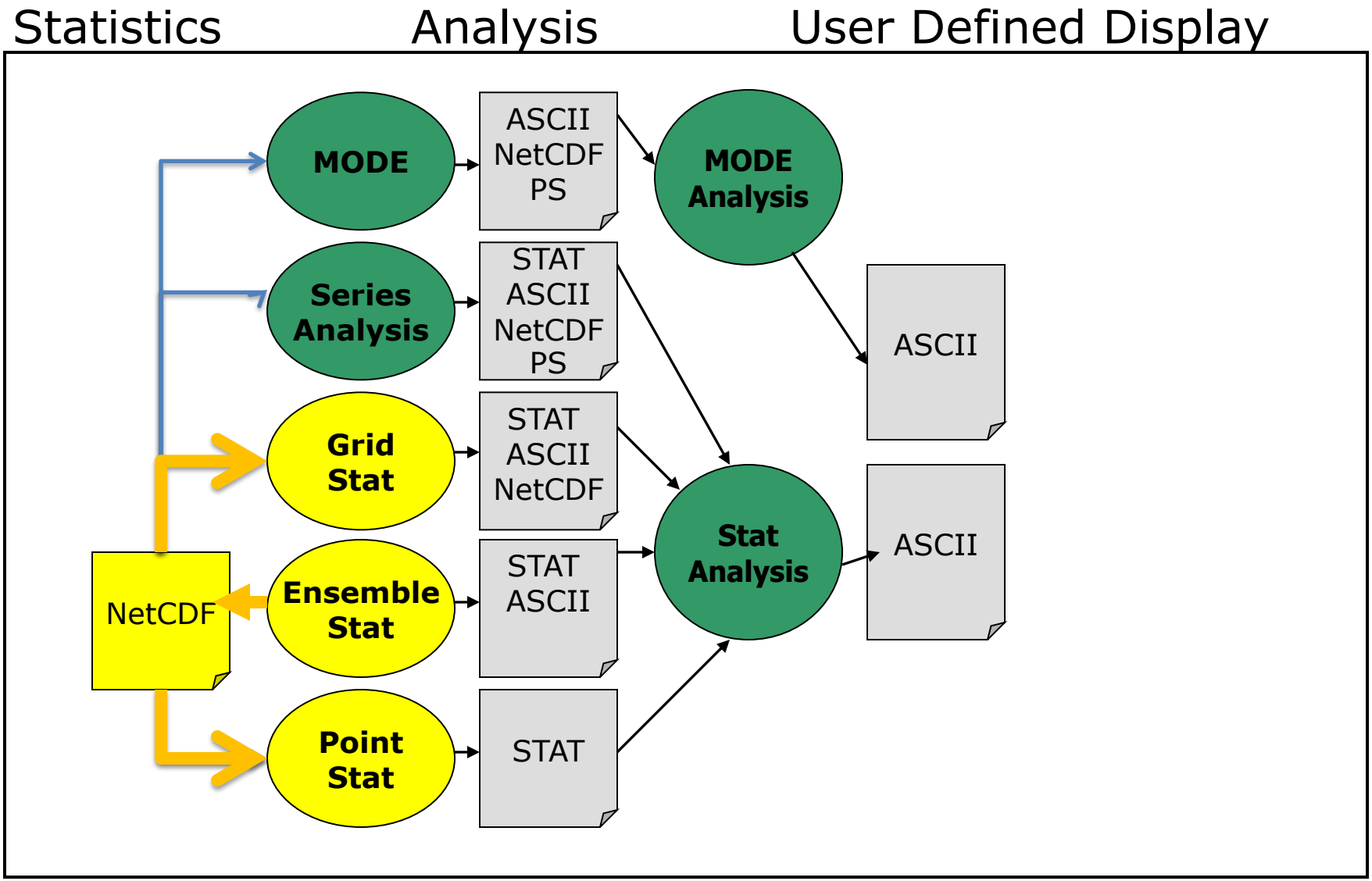
Tools for Evaluating Probabilities



Ensemble-Stat Probability Fields



Verifying Probabilities

- Probabilistic verification method tools:
  - Grid-Stat, Point-Stat, and Stat-Analysis
- Define Nx2 contingency table using:
  - Multiple forecast probability thresholds
  - One observation threshold

Forecast	Observation		Total
	$o = 1$ (e.g., "Yes")	$o = 0$ (e.g., "No")	
p_1 = midpoint of (0 and threshold1)	n_{11}	n_{10}	$n_{1\cdot} = n_{11} + n_{10}$
p_2 = midpoint of (threshold1 and threshold2)	n_{21}	n_{20}	$n_{2\cdot} = n_{21} + n_{20}$
⋮	⋮	⋮	⋮
p_j = midpoint of (threshold$i$ and 1)	n_{i1}	n_{i0}	$n_{j} = n_{j1} + n_{j0}$
Total	$n_{\cdot 1} = \Sigma n_{i1}$	$n_{\cdot 0} = \Sigma n_{i0}$	$T = \Sigma n_i$

Example:

- FCST: Probability of precip

[0.00, 0.25, 0.50, 0.75, 1.00]

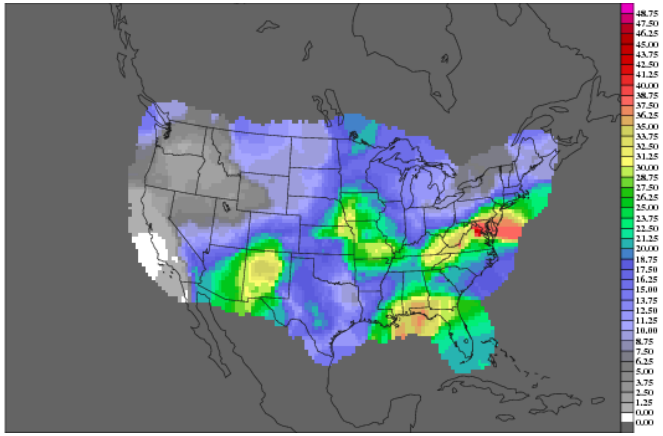
==0.25

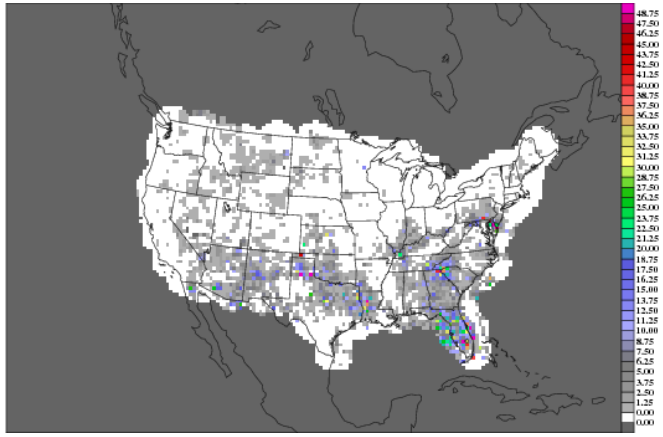
- OBS: Accumulated precip

> 0.00

Verifying Probabilities: Example

- Verify probability of precip with total precip:





- Configuration file settings:

```
fcst = {
 field = [
  {
   name          = "POP";
   level         = [ "Z0" ];
   //cat_thresh = [ >=0.0, >=0.25, >=0.50, >=0.75,
    >=1.00 ];
   cat_thresh    = [ ==0.25 ];
   prob          = TRUE;
  }
 ];
};
```

```
obs = {
 field = [
  {
   name        = "APCP";
   level       = [ "A12" ];
   cat_thresh = [ >0.0 ];
  }
 ];
};
```

Grid-Stat for Probability: Configure

- Many configurable parameters – only set a few:
  - APCP_24… is name of ens mean in netcdf file
  - prob = True important
  - cat_thresh used for reliability and roc curves
  - Use 24hr Accumulation in grib file threshold at >10 mm
  - Generate probabilistic statistics

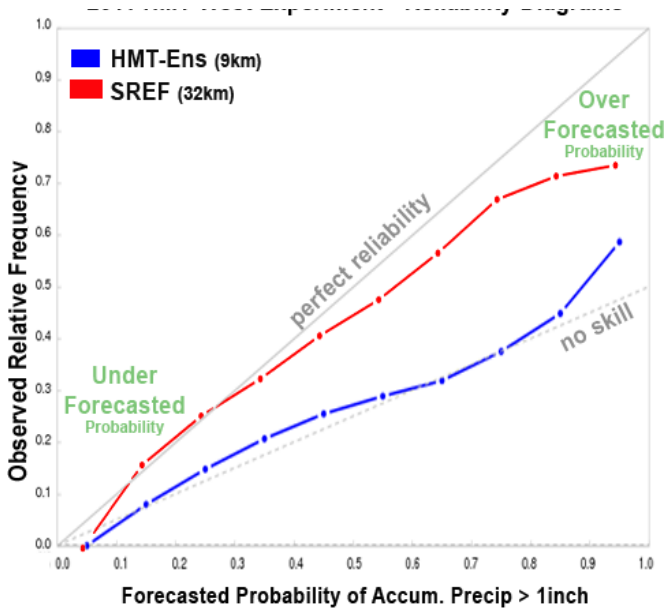
```
fcst = {
  wind_thresh = [ NA ];

  field = [
    {
     name       = "APCP_24_A24_ENS_FREQ_ge10.000";
     level      = [ "(*,*)" ];
     prob       = TRUE;
     cat_thresh = [ >=0.0, >=0.1, >=0.2,
                    >=0.3, >=0.4, >=0.5,
                    >=0.6, >=0.8, >=1.0 ];
     //cat_thresh = [ ==0.1 ];
     }
  ];

};
obs = {

  wind_thresh = [ NA ];

  field = [
    {
     name       = "APCP";
     level      = [ "A24" ];
     cat_thresh = [ >10.000 ];
    }
  ];

};
```

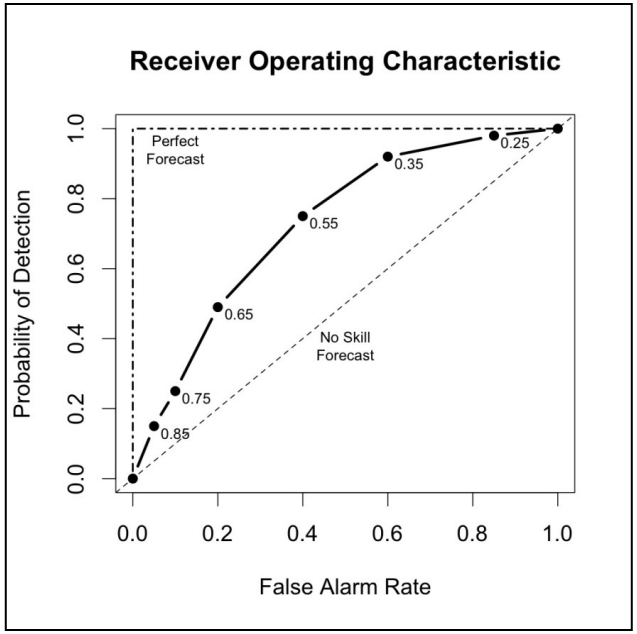
```
output_flag = {
. . .
   cnt    = NONE;
   sl1l2  = NONE;
   vl1l2  = NONE;
   pct    = BOTH;
   pstd   = BOTH;
   pjc    = BOTH;
   prc    = BOTH;
   eclv   = BOTH;
   nbrctc = NONE;
   nbrcts = NONE;
   nbrcnt = NONE;
. . .
};
```

Grid-Stat for Probability: Output

- Output written to .stat file and, if desired, to individual text files:
  - PCT – Probability Contingency Table Counts
  - PSTD – Probability Contingency Table Scores
    - Brier Score, Reliability, Resolution, Uncertainty, Area Under ROC
  - PJC – Joint/Continuous Statistics of Probabilistic Variables
    - Calibration, Refinement, Likelihood, Base Rate, Reliability points
  - PRC – ROC Curve Points for Probabilistic Variables
  - ECLV – Economic Cost Loss Value

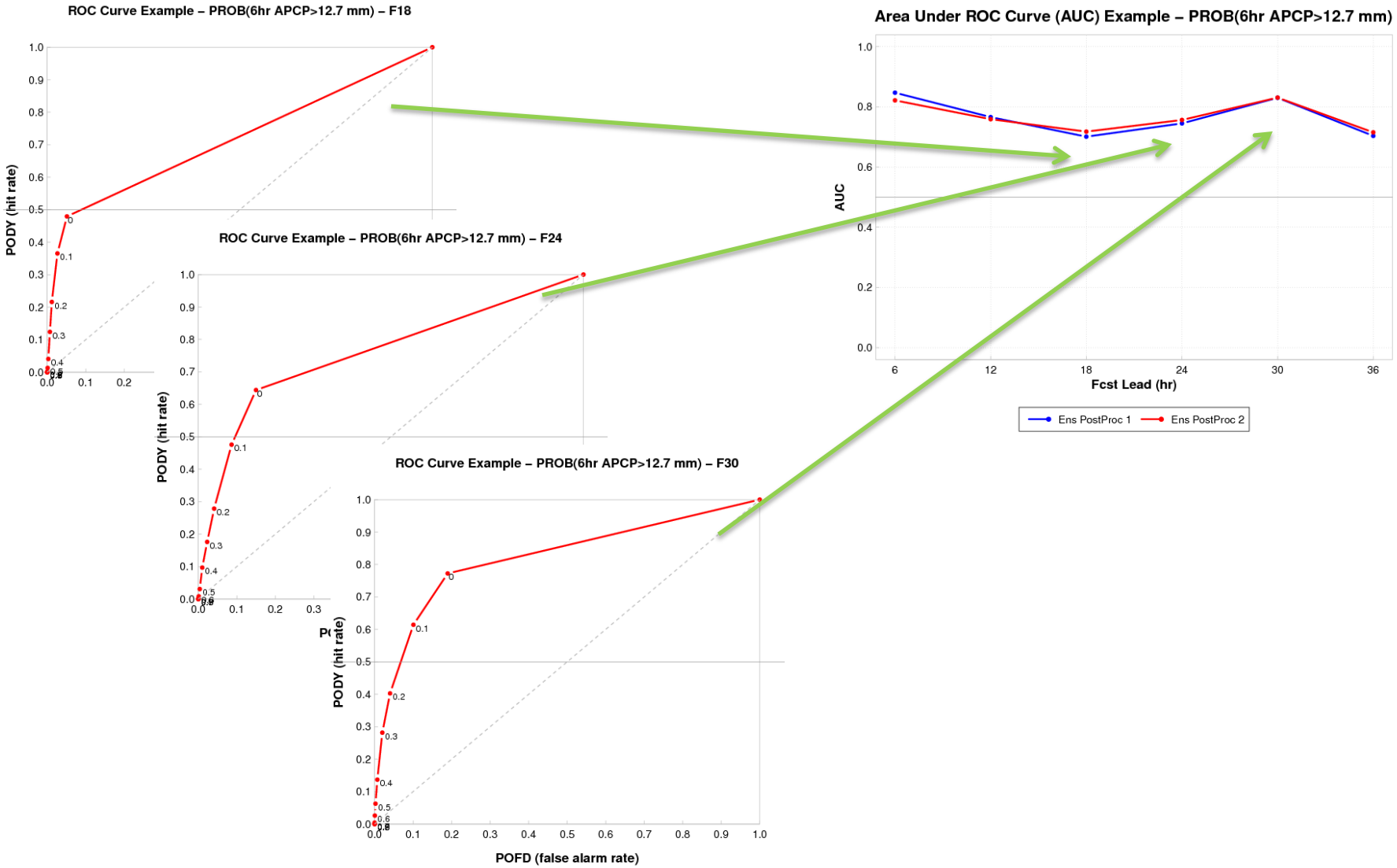
PJC





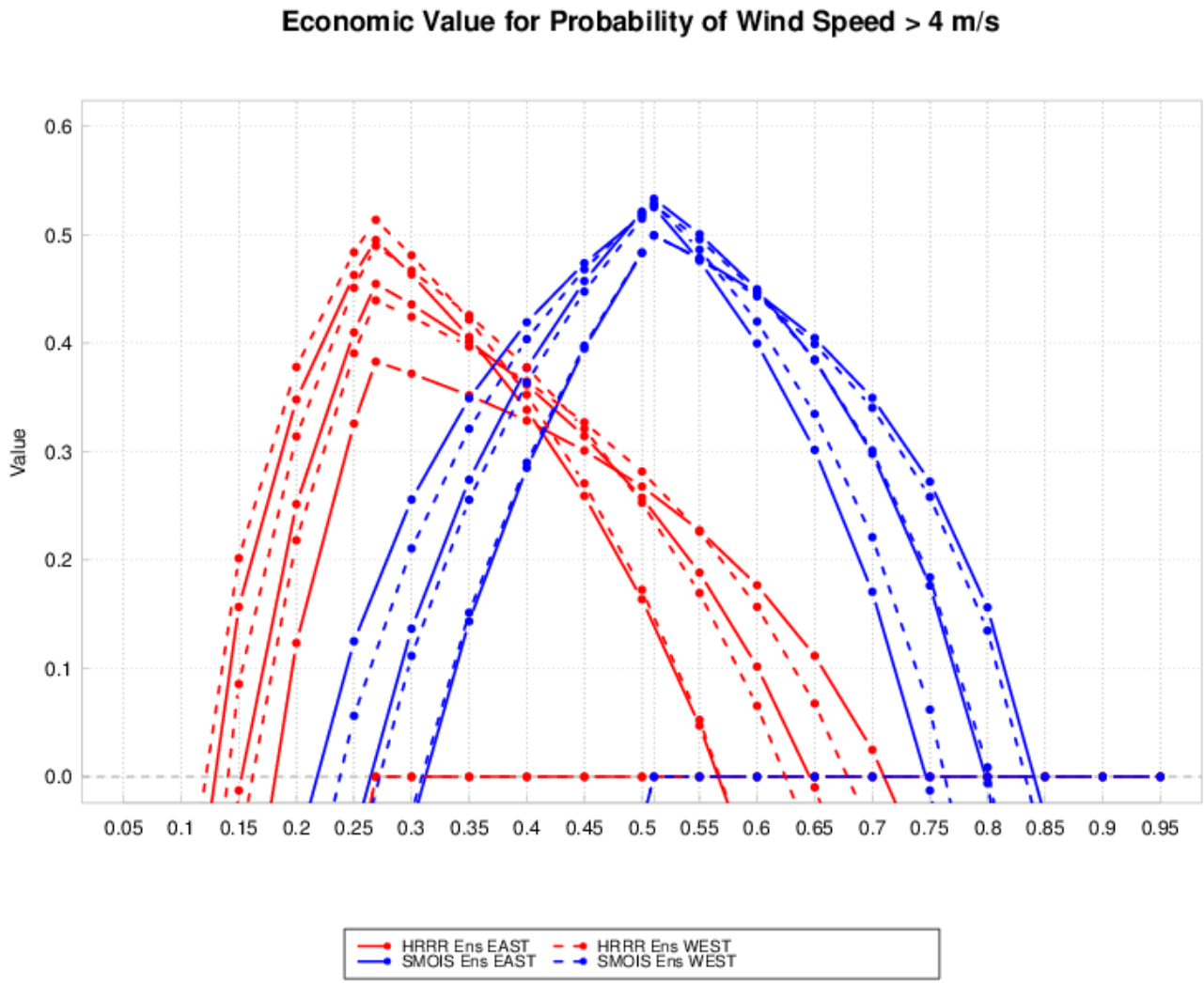
PRC

Grid-Stat for Probability: ROC



Grid-Stat for Probability: ECLV

- Computed from 2x2 CTC contingency tables or Nx2 PCT tables



Stat-Analysis: Overview

- **Aggregation**
  - **aggregate -** aggregates stat data across multiple time steps or masking regions. ***Output line type is the same as input line type*** (i.e. SSVAR → SSVAR)
    - FHO, CTC, MCTC, SL1L2, SAL1L2, VL1L2, VAL1L2, **PCT**, NBRCNT, NBRCTC, GRAD, ISC, RHIST, PHIST, RELP, SSVAR
  - **aggregate_stat –** aggregates across multiple times/regions then calculates statistics. Output line is different from input line types.

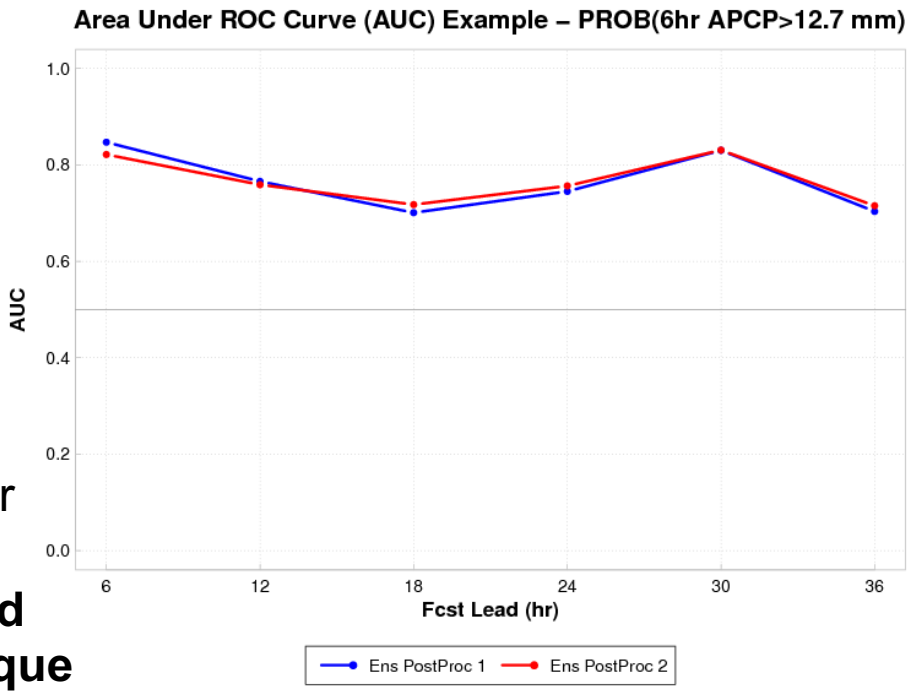
Valid line type combinations include:

-line_type FHO, CTC	yields -out_line_type CTS, ECLV
-line_type MCTC	yields -out_line_type MCTS
-line_type SL1L2, SAL1L2	yields -out_line_type CNT
-line_type VL1L2	yields -out_line_type VCNT
-line_type VL1L2, VAL1L2	yields -out_line_type WDIR
-line_type **PCT**	yields -out_line_type **PSTD, PJC, PRC, ECLV**
-line_type NBRCTC	yields -out_line_type NBRCTS
-line_type ORANK	yields -out_line_type RHIST, PHIST, RELP, SSVAR
-line_type **MPR**	yields -out_line_type FHO, CTC, CTS, MCTC, MCTS, CNT, SL1L2, SAL1L2, VL1L2, VCNT, **PCT, PSTD, PJC, PRC**, ECLV, WDIR

Stat-Analysis: MPR to PSTD

```
stat_analysis \
-lookin point_stat_model2_120000L_20160501_120000V.stat \
-job aggregate_stat -line_type MPR -out_line_type PSTD \
-out_fcst_thresh ge0,ge0.1,ge0.2,ge0.3,ge0.4,ge0.5,ge0.6,ge0.7,ge0.8,ge0.9,ge1.0 \
-out_obs_thresh eq1.0 \
-by FCST_VAR \
-out_stat out_pstd.txt
```

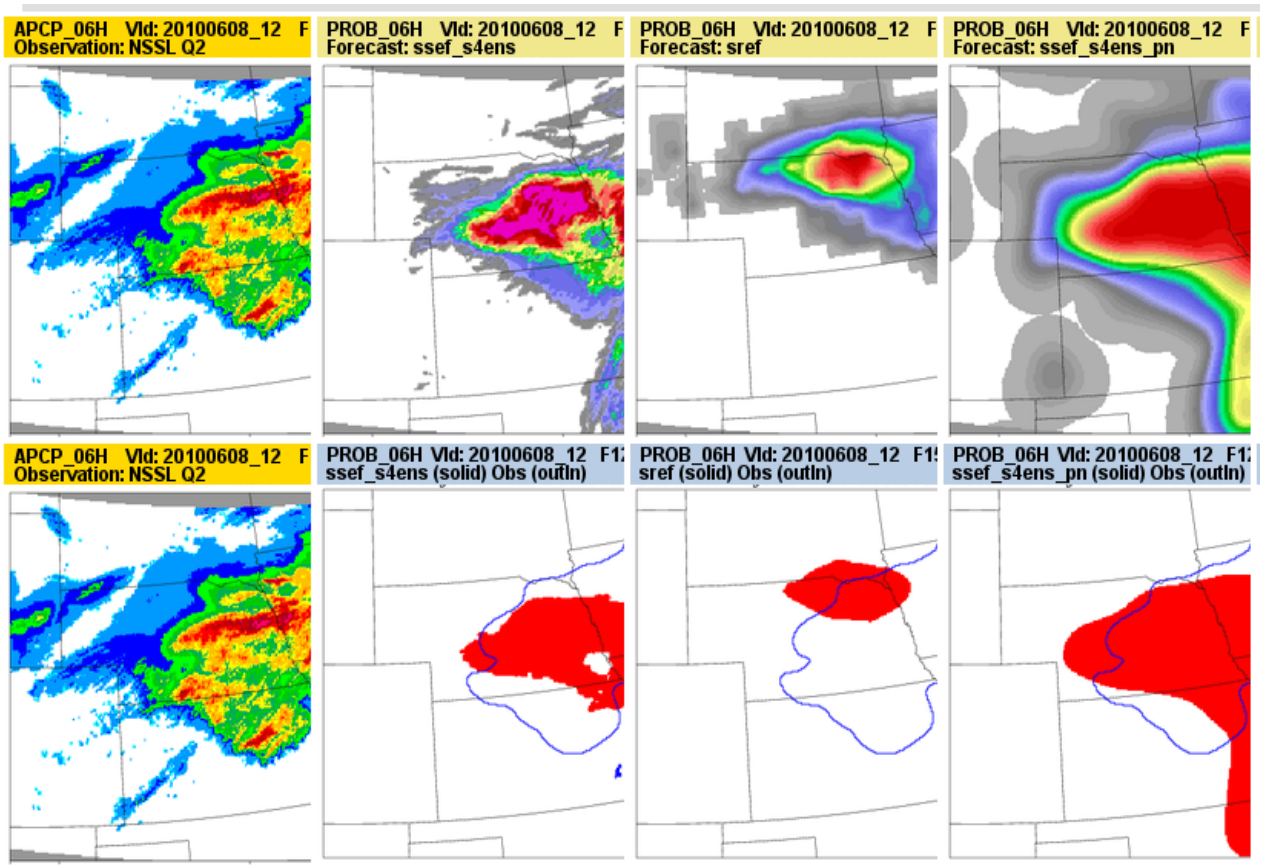
(-out_fcst_thresh eq0.1)



- **Aggregates the MPR line type** (matched pairs)
- **Into the PSTD line type** (probabilistic contingency statistics e.g. Brier Score, AUC)
- **Using bins of 0.1** (10% probability) for the forecast field
- **Using one threshold for the obs field**
- **Run the job separately for each unique forecast variable**
- **Write the data to out_pstd.txt**

MODE Applied to Probabilities

You can use MODE on probability fields also…



In this case: Probability field threshold = 0.5 (50%)
Observed field threshold > 12.7 mm (or 0.5”)