OHD – PQPF and PQTF Project Status

Mary Mullusky & Julie Demargne

PQPF/PQTF Currently Available

- **Raw Climatology – Regular ESP**

  - *Data is sparse and noisy*

  - *No skill*

- **Climate Adjustments – ENS_PRE**

  - *Shifts the ensembles in the long term*

  - *Adds skill*

- **Blending – FCINIT segment definition BLEND-TS**

  - *Shifts the ensembles in the short term*

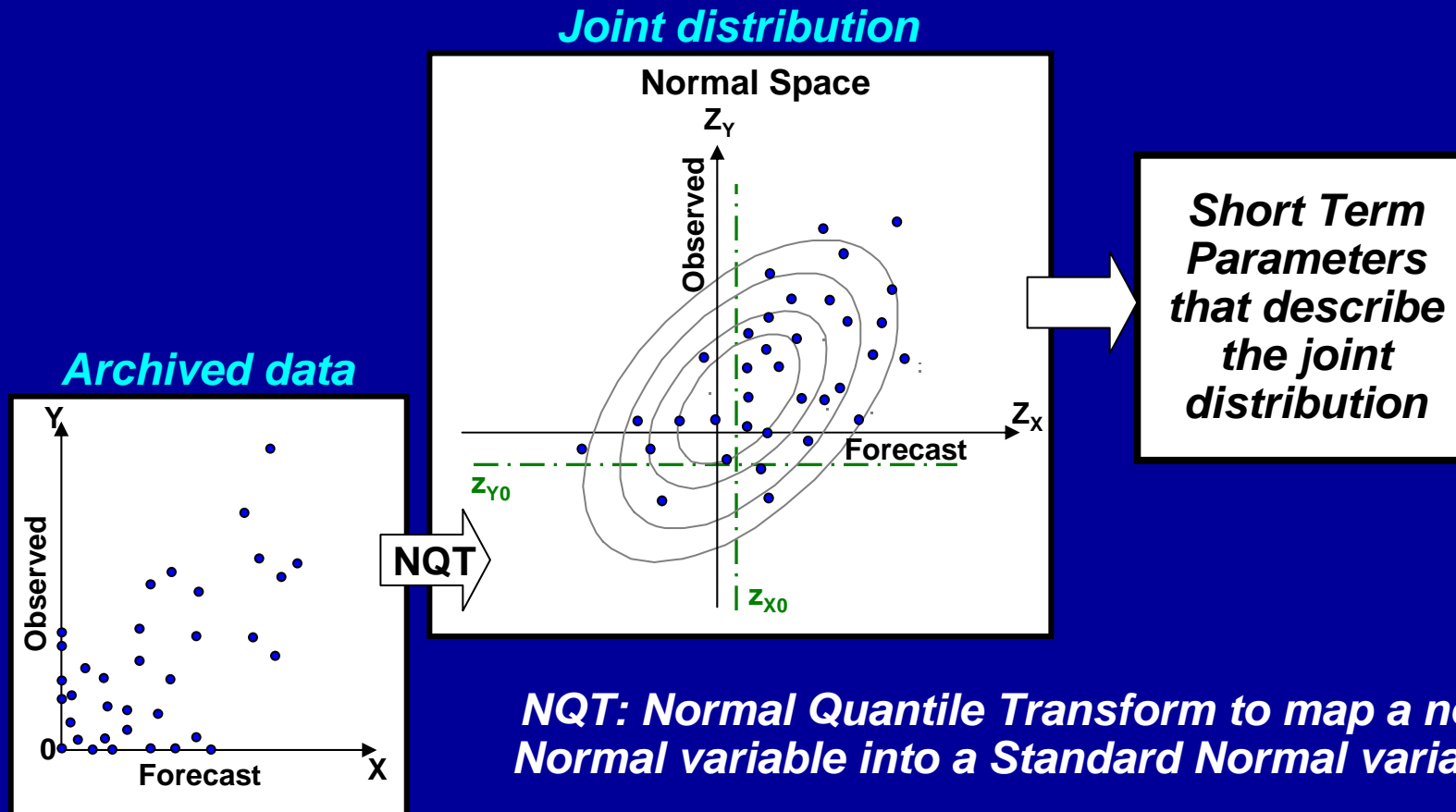 - *Decrease the spread but does not quantify the uncertainty in the QPF/QTF*

Goals of PQPF/PQTF Efforts

- **NWS Strategic Plan (1999) calls for provision of weather, water, and climate forecasts in probabilistic terms by 2005**

- **Develop a seamless suite of probabilistic products for lead times ranging from 1 hour to as long as a year**
  - *Remove Noise - Smoothing*
  - *Incorporate skill of QPF/QTF with systematic unbiased uncertainty information*

- **Provide an interim step for short term ensembles until the hydromet community can produce skillful unbiased ensembles**

- **Conduct project under the auspice of HOSIP**

Ensemble Pre-Processor Methodology

1. Short-Term Calibration: at each time step for the whole year, compute the parameters of the joint distribution of observed and forecast precipitation/temperature values

Example for PQPF/PQTF

Joint distribution

Archived data

NQT

Short Term Parameters that describe the joint distribution

NQT: Normal Quantile Transform to map a non-Normal variable into a Standard Normal variable

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Ensemble Pre-Processor Methodology

2. Generate Short-Term PQPF/PQTF Distribution: at each time step for the forecast period, compute the parameters of the conditional distribution of future precipitation/temperature values

Example for PQPF/PQTF

Joint distribution

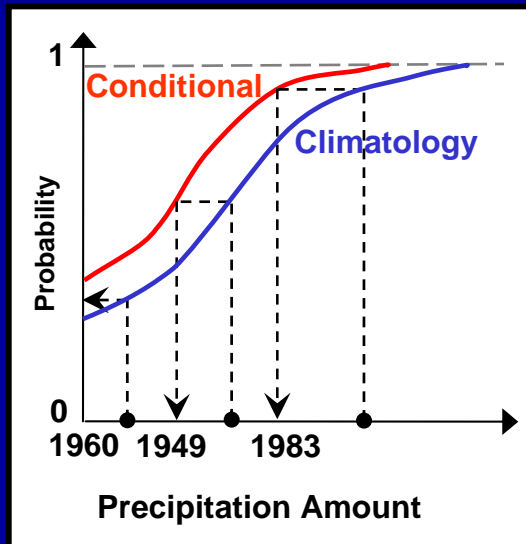*Conditional distribution*

PQPF (PQTF) given a QPF (QTF)
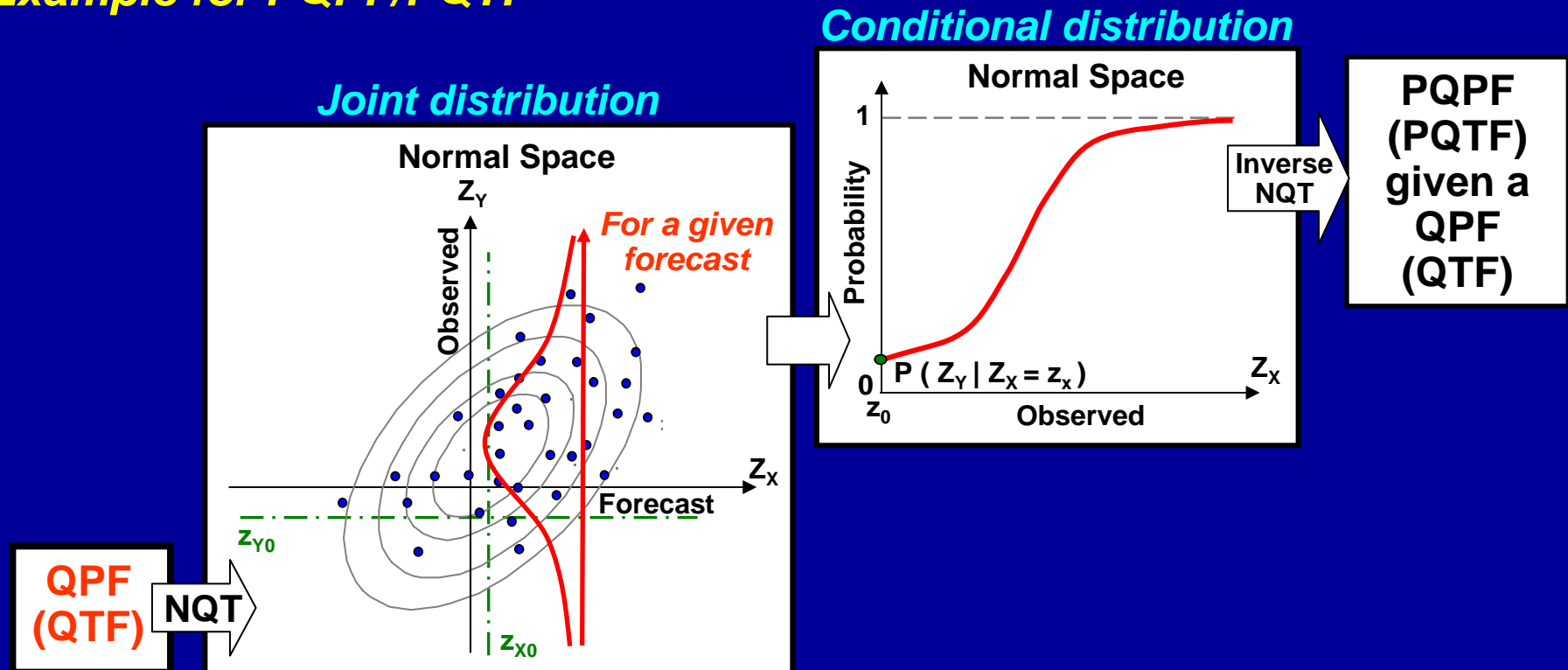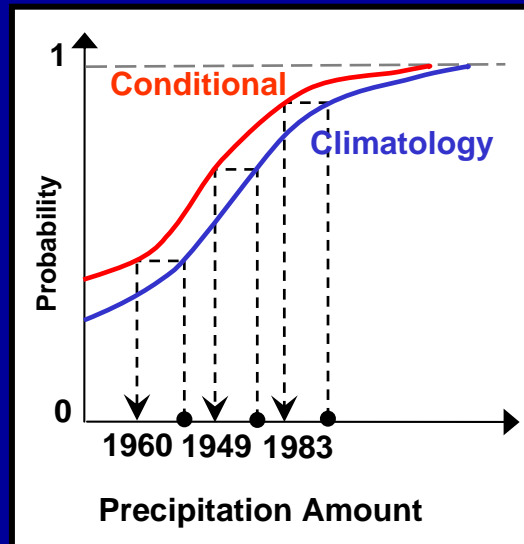
Ensemble Pre-Processor Methodology

3. Short-Term Distribution Mapping: at each time step of the forecast period, generate ensemble points given the conditional distribution of future precipitation/temperature from climatology time series
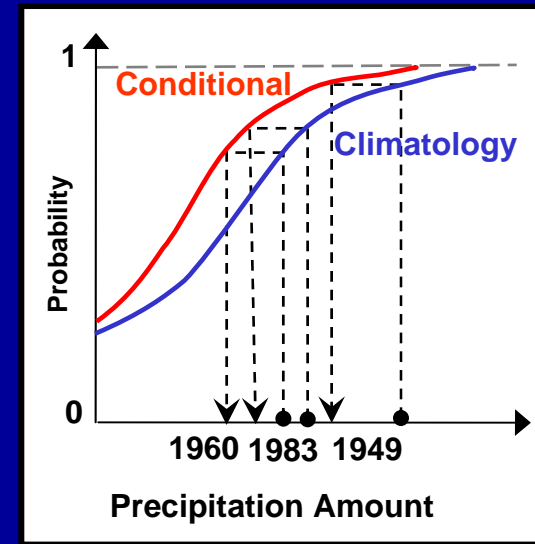
Schaake Shuffle Method

T1

T2

T3

...

**Ensemble points incorporate the skill of the single value forecast**

Historical space-time properties are preserved
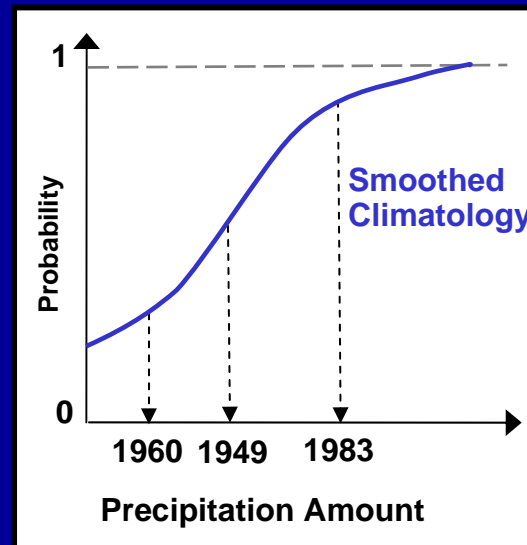
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Ensemble Pre-Processor Methodology

4. Distribution Mapping if no QPF/QTF Forecast: at each time step of the forecast period, use the smoothed climatology distribution of historical precipitation/temperature and distribution mapping to generate ensembles

Schaake Shuffle Method
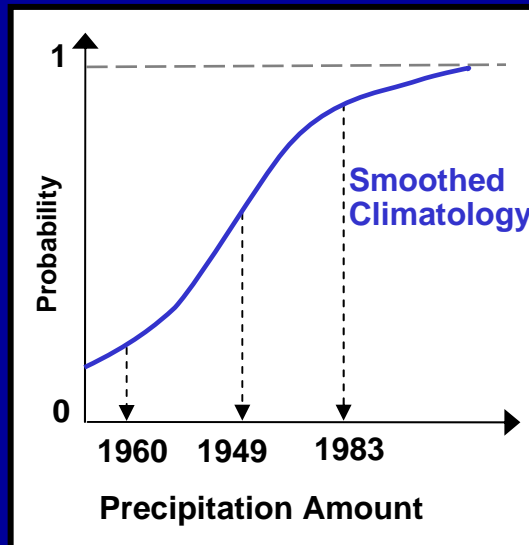
Space-time properties are similar to the historical events properties

Ensemble Pre-Processor Methodology

5. Climate adjustments: integrates days 1-365 meteorological forecasts/climate outlooks from NCEP/CPC. The pre-processor adjusts smoothed historical mean areal precipitation (MAP) and temperature (MAT) time series with respect to the current meteorological forecasts/climate outlooks.
***Pre-processor will only do climate adjustments if no QPF/QTF forecast**

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OHD PQPF/PQTF Project

- **5 Components to implementation**

  - *Calibration*

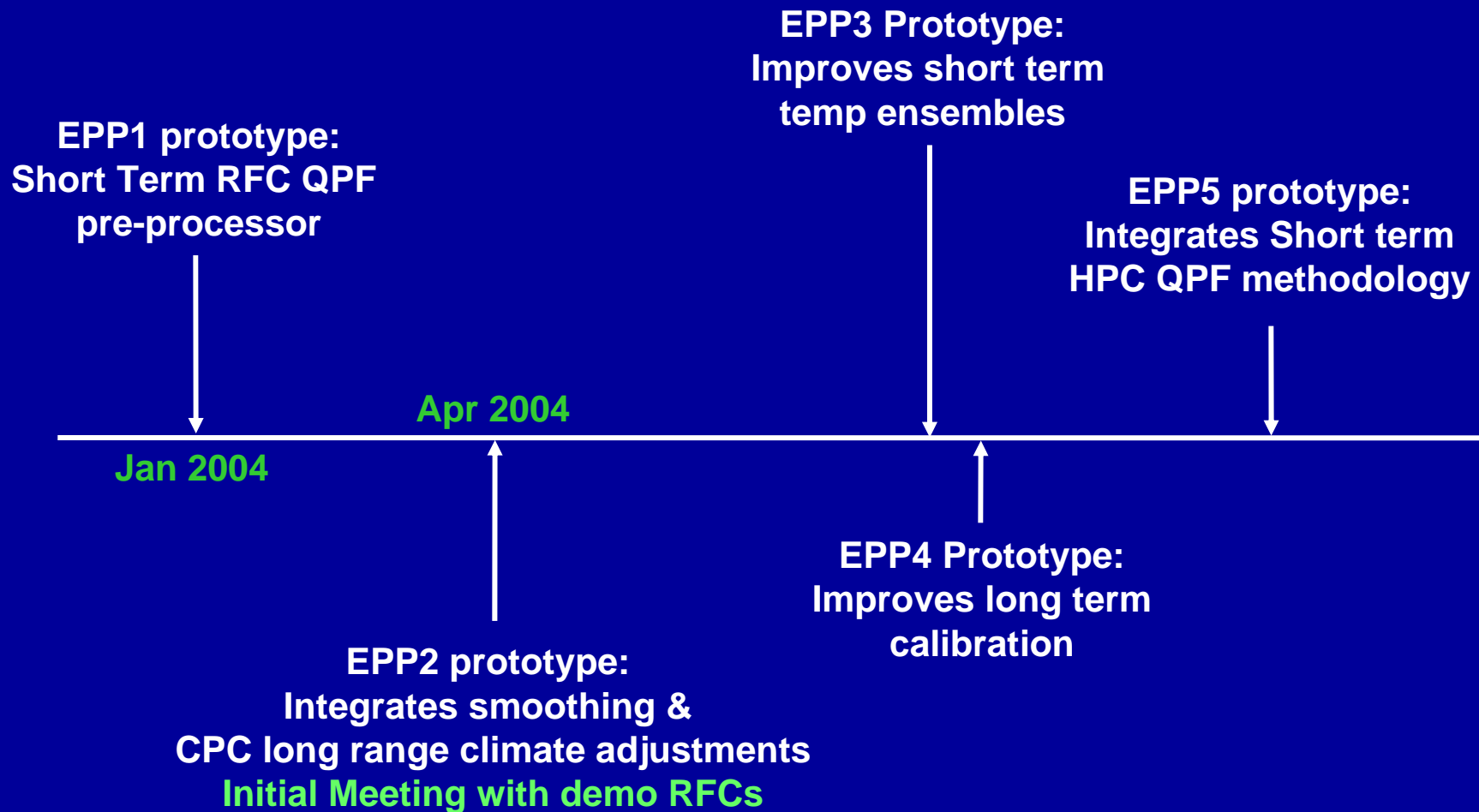 - *Ensemble Generation*

  - *Verification*

  - *Product Generation/ Visualizations*

  - *Papers*

- **3 Time Horizons**

  - *Short 1-5 day*

    - **RFC QPF/QTF**

    - **HPC QPF**

  - *Medium 6-14 day*

  - *Long range 15 days – 1 year*

OHD PQPF/PQTF Project

- **3 RFCs testing prototype of short term methodology**

  – *MARFC, CNRFC, ABRFC*

- **Learning others experience with short term**

  – *NERFC and CBRFC*

- **April Meeting with 5 RFCs and OHD**

  – *OBJECTIVE: Status of Field and HQ ensemble projects*

  – *HIGHLIGHTS*

    ➤ **Verification**

    ➤ **Pre-Processor Enhancements**

    ➤ **Hydrologic Uncertainty**

    ➤ **Archiving**

    ➤ **Training and Documentation**

  – *Presentations and Meeting Report*
    www.nws.noaa.gov/ohd/hrl/presentations/ensemblewkshp0404/index.htm

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PQPF/PQTF Project Sequence

EPP3 Prototype:
Improves short term
temp ensembles

EPP1 prototype:
Short Term RFC QPF
pre-processor

EPP5 prototype:
Integrates Short term
HPC QPF methodology

Apr 2004

Jan 2004

EPP4 Prototype:
Improves long term
calibration

EPP2 prototype:
Integrates smoothing &
CPC long range climate adjustments
Initial Meeting with demo RFCs

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PQPF/PQTF Project Sequence

EPP6 prototype:
Integrates medium
range methodology

EPP7 prototype:
Calibration prototype
for all lead times

EPP5 prototype:
Integrates Short term
HPC QPF
methodology

Probabilistic Verification Research
Prototype Days 1-5

Probabilistic Verification Research
Prototype: Integrates Days 6-14

Possible Move from Research and Analysis to Operational Development for EPP4

Calibration

Fcst/Obs pairs → **Short term calibration** → *Short Term Smoothed Parameters*

Raw Climatology → **ens_pre_cp** → CPC Adjustment Parameters Long Term Smoothed Rank Parameters
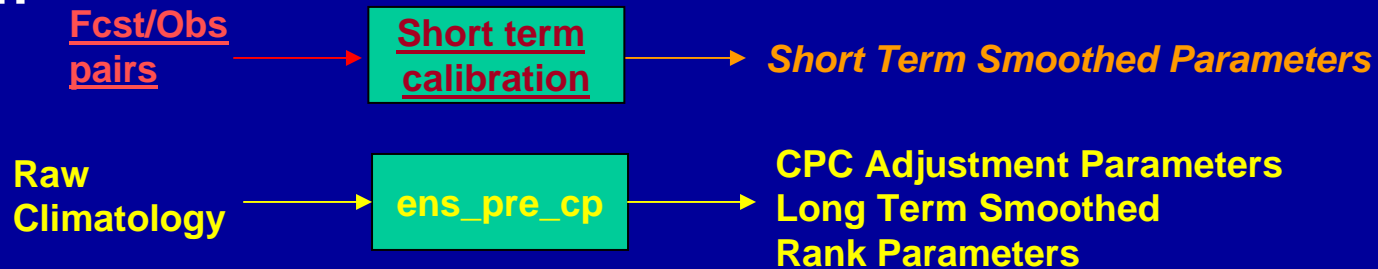
Meteorological Ensemble Generation

Smoothed ensembles with CPC adjustment *and short term enhancements*

CPC Adjustment Parameters Long Term Smoothed Rank Parameters

QPF

CPC Forecasts → **ens_pre_s** → 1, 2, ... 40

Short Term Smoothed Parameters
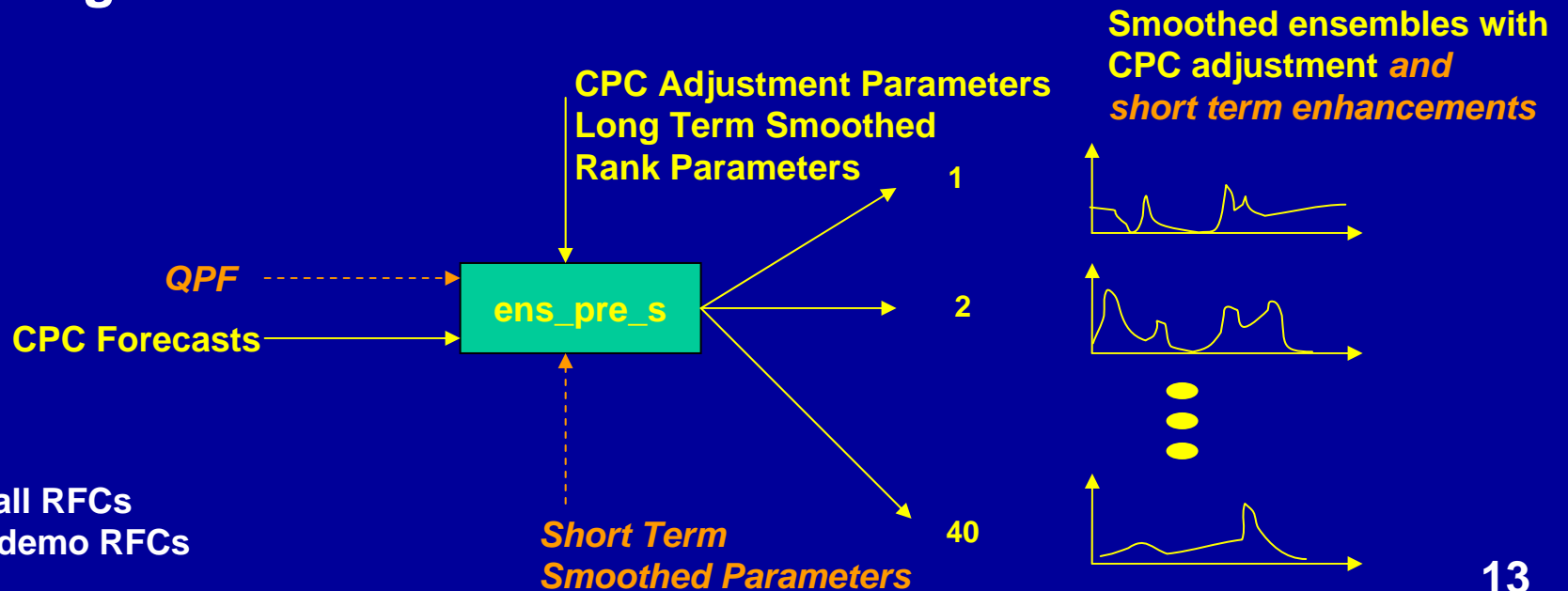
YELLOW: all RFCs
ORANGE: demo RFCs
RED: OHD

Actions of PQPF/PQTF Demo RFCs

- **Provide feedback for intermediate prototypes**

- **Archive data for additional calibration**

  – *Forecast/Observation pairs of precipitation and temperature*

- **Archive data for verification**

  – *QPF/QTF*

  – *PQPF/PQTF*

  – *Streamflow ensembles*

  – *Observed precipitation, temperature and streamflow*

Preparations Needed at all RFCs

- **To use smoothed climatology in the long term**

  - *Calibration – ens_pre_cp*

    - ➤ **INPUT: MAP and MAT historical climatological data**

  - *PQPF/PQTF Ensemble Generation – ens_pre_s*

- **To prepare data for short term calibration**

  - *Archive Forecast/Observation pairs of precipitation and temperature*

- **To archive data for verification**

  - *Streamflow ensembles*
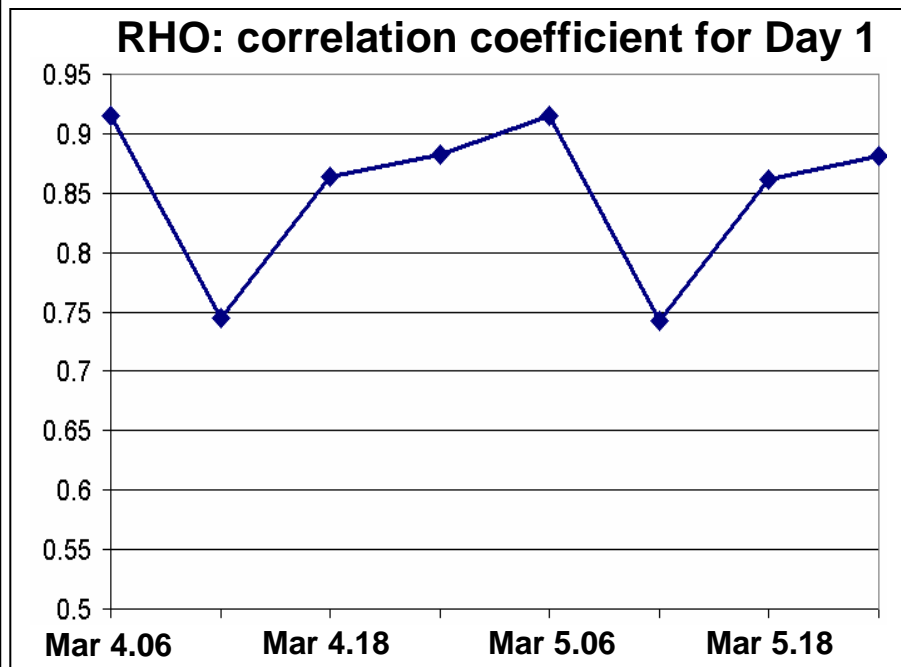
  - *Observed streamflow*

PQPF/PQTF Project Outcomes

- **Methodology for days 1-365 available to demo RFCs**

- **More experience with short term including verification results**

- **Calibration prototype for days 1-365**

- **Requirements document for outstanding issues and future work**

- **In the context of the ensemble strategic plan, define the next project to move ensemble pre-processor components through operational development to deployment**

Example of Day 1 PQPF (ABRFC test site)