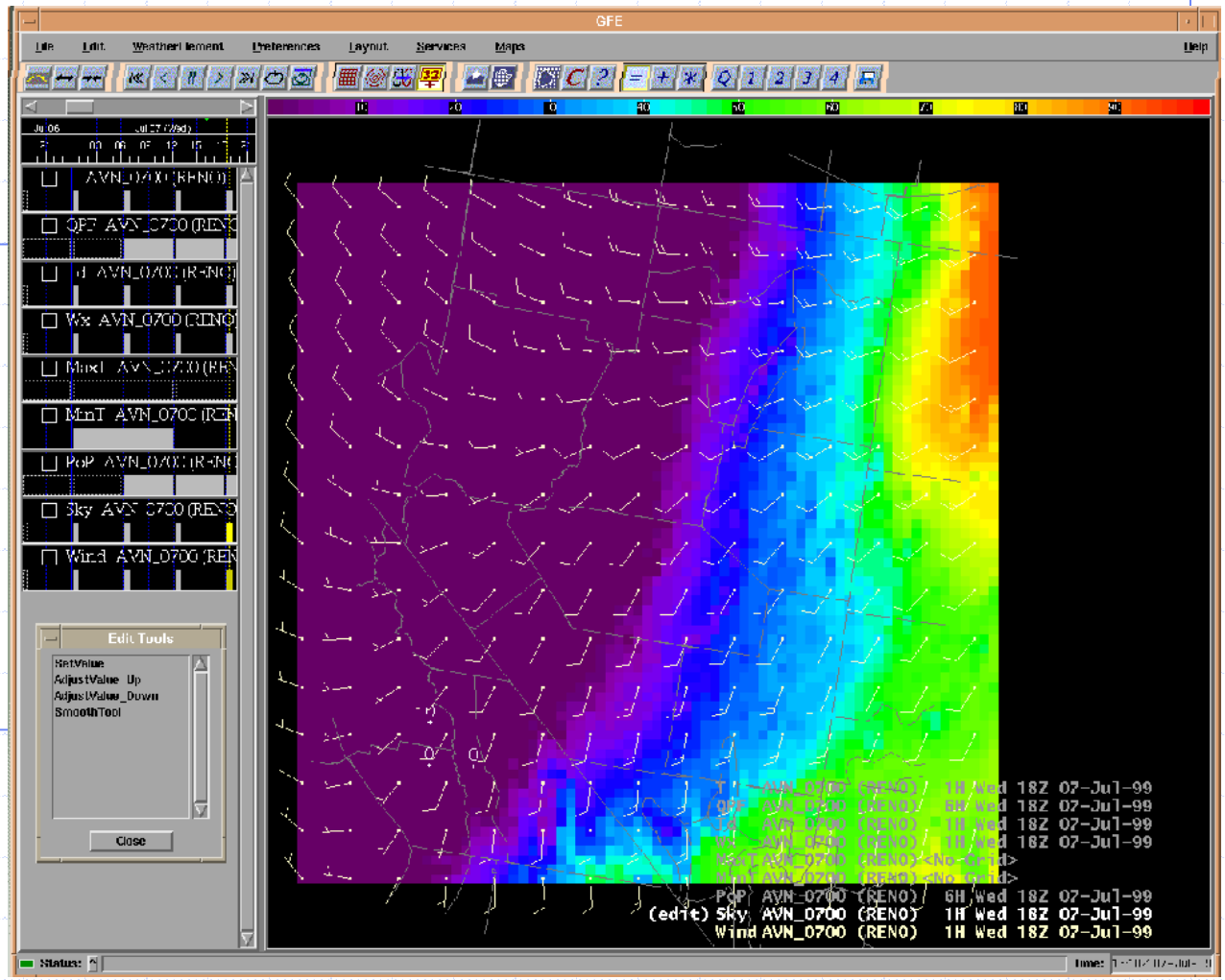
IFPS and GFESuite Tech Review –

an Interactive Forecast Preparation Technique

Sept. 9 2003



"I decided enough is enough! I'll take a couple of months off and if I have an urge to come back part time, it is possible. The lack of science being put into operations is disturbing, i.e., GFE and IFPS. MOS is doing better than the forecasters!"

-38-year NWS Veteran

National Weather Service Modernization Components

- Office Reorganization into WFOs
- Improved Satellites (GOES-NEXT)
- Doppler Radar (NEXRAD)
- New Forecaster Workstations (D2D)
- **New Forecast Paradigm (IFPS/GFESuite)**
- **New Forecast Products (National Digital Forecast Database - NDFD)**

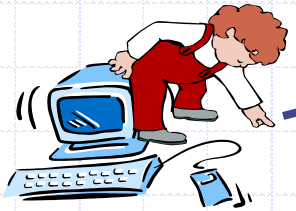
What is IFPS/GFESuite?

- An interactive graphical forecast preparation system for producing routine forecast products in various formats.
- Currently in operational use by all NWS WFOs.
- Data source for the National Digital Forecast Database (NDFD)

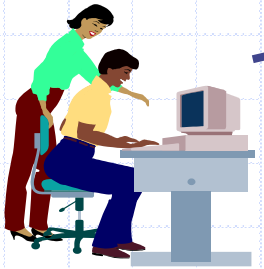
Paradigm Shift: From Typing Text to Interacting with Grids

Pre-IFP Technique

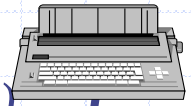
1. Examine Guidance using AWIPS



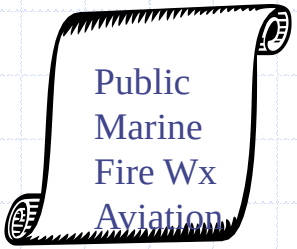
2. Coordinate for consistency



3. Then, type (fast)...

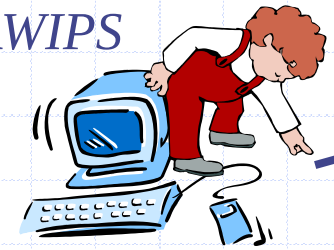


TEXT

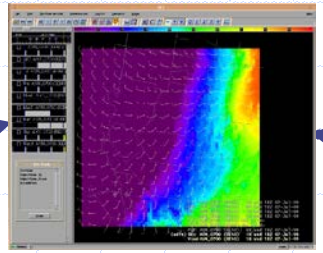


IFP Technique

1. Examine Guidance using AWIPS

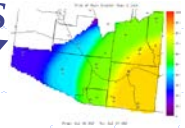


2. Edit Guidance Digitally

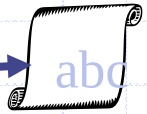


3. Then, press a button to generate products

Graphical

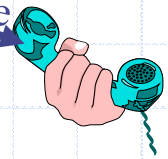


Text



Radio

Phone



Web

How does IFPS/GFESuite work?

- A 7-day digital forecast database is established at each WFO
- Forecasters interactively modify the contents of the database according to the latest observations and model guidance.
- NWS text, tabular, voice, and graphical products are generated from the database.
- The database itself is provided as an NWS product to customers and partners.

Differences between IFPS and GFESuite

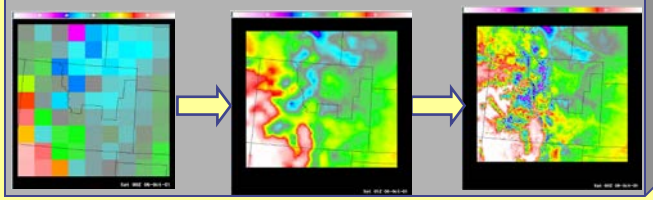
- IFPS: operational system in NWS, consisting of components from FSL and MDL
- GFESuite: major component of IFPS, developed by FSL, provided to NWS.

Components of GFESuite

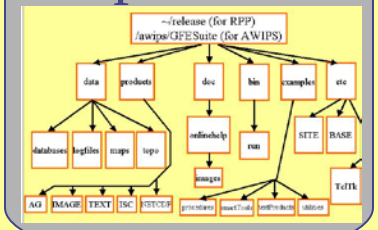
Strictly uses grid approach

Ingest/DB

Smart Initialization

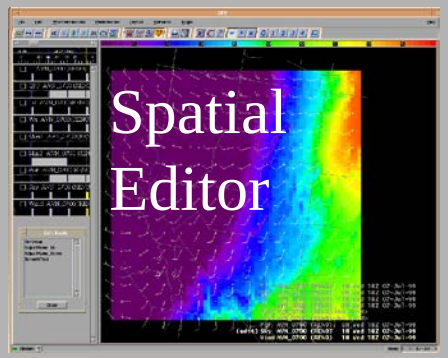


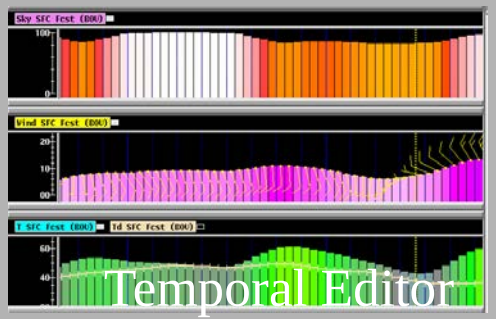
ifpServer



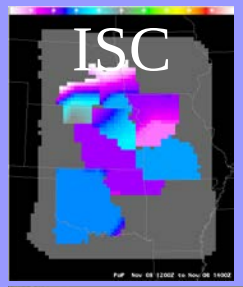
D2D AWIPS Model Data

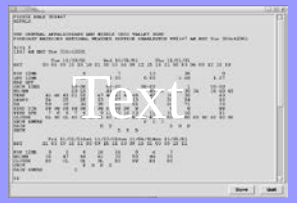
GFE Editors

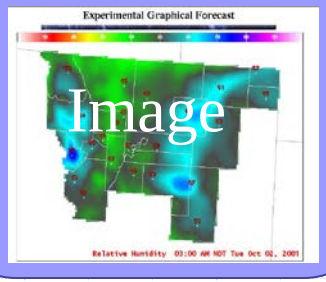




Products







GFESuite Development Approach

GFESuite Development Approach (Rapid Prototyping Project)

- Quick turnaround of software
  - 6-8 week cycle typical
- Frequent interaction with forecasters
  - Workshops
  - Listservers
  - Software evaluations
- Mature software delivered to NWS for nationwide IFPS deployment

GFESuite Architecture

- Languages and Systems
  - Python / C++
  - Linux / PCs
- Very flexible and tailorable
  - Smart Tools, Initialization, Database
  - Incorporation of local models
  - Product Generation
- FSL provides infrastructure, field extends system capabilities to meet their needs

GFESuite Staff

- Current staff level: 3.8 + 1
- Responsible for:
  - Software development
  - User and System Documentation
  - Training
  - Testing, Quality Assurance
  - Software Packaging
  - Field Support

Methodology of Forecasting on Grids

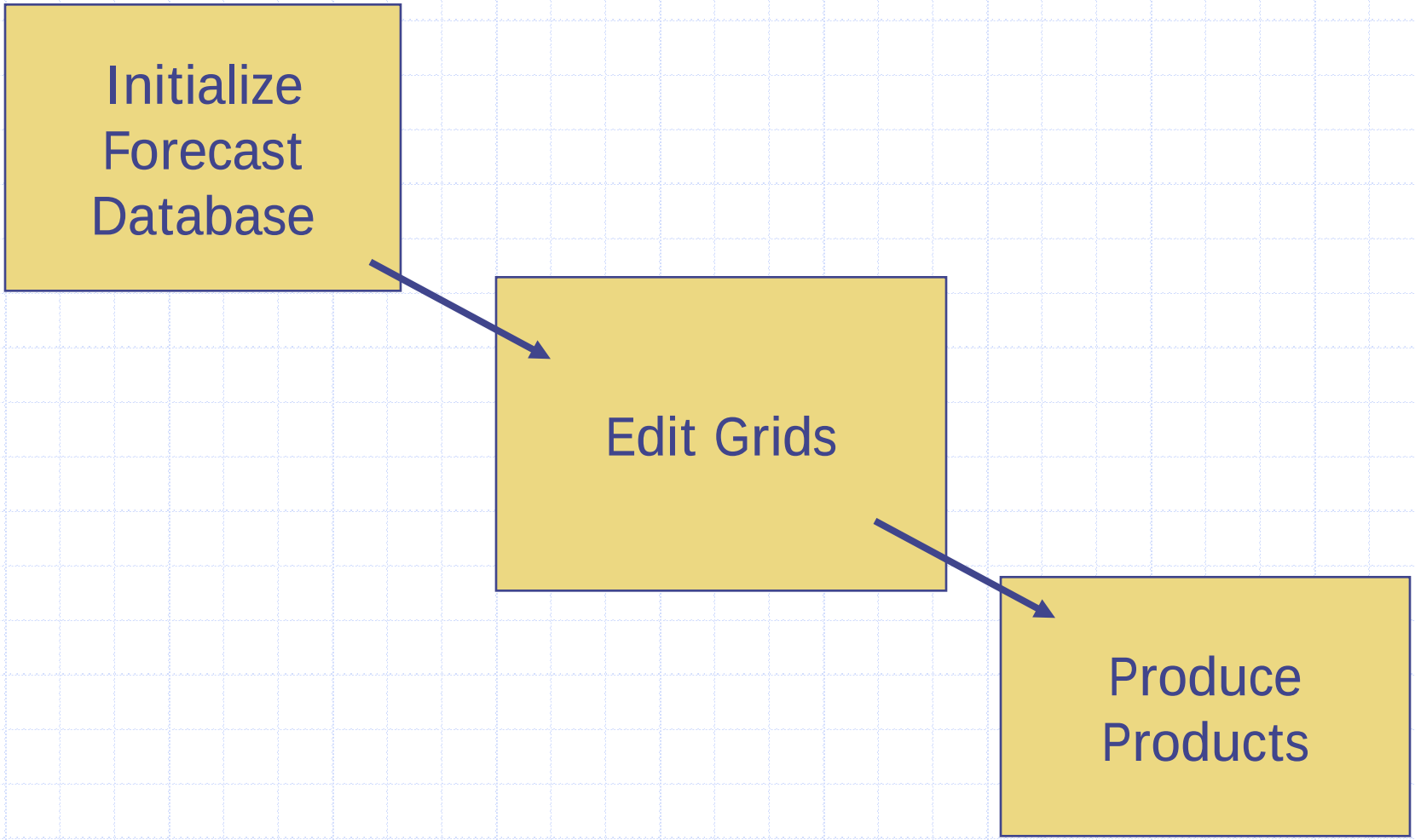
What is being Forecast?

- Temporal resolution: 1-3 hours
- Public weather elements:
  - T, Td, RH, Sky, PoP, Wx, QPF, Wind, MaxT, MinT, WindGust, SnowAmt, ...
- Fire Weather elements:
  - LAL, Haines Index, Transport Wind, Mixing Height, Stability, CWR, InvBurnOffTemp
- Marine weather elements:
  - Icing, Wave Height, Swell Height/Direction/Period
- Local Custom weather elements

What is being Produced?

- Text Products
  - Marine, Fire Weather, Public, Custom
  - Narratives, Tables, Custom
- Graphical Products
  - Available on local web pages
- Gridded Products
  - Available through the National Digital Forecast Database (NDFD) in GRIB2 format

Three-Step Forecast Process



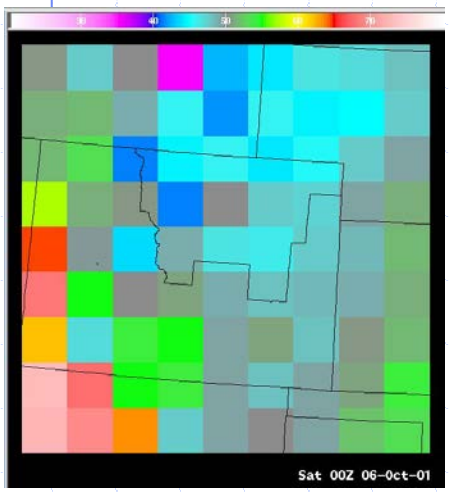
Forecast Methodology

Derivation of Surface Fields from Models

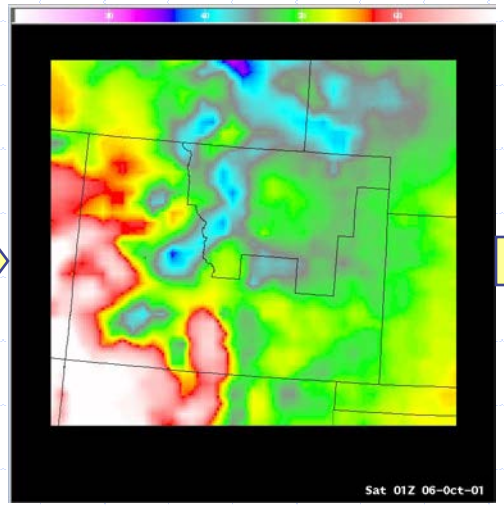
Overview

- What
  - Provides a first guess for the forecast
  - Derives surface weather conditions from model fields
- Why
  - Forecasts require surface elements not available in model
  - Forecasts require higher spatial/temporal resolution than available from model

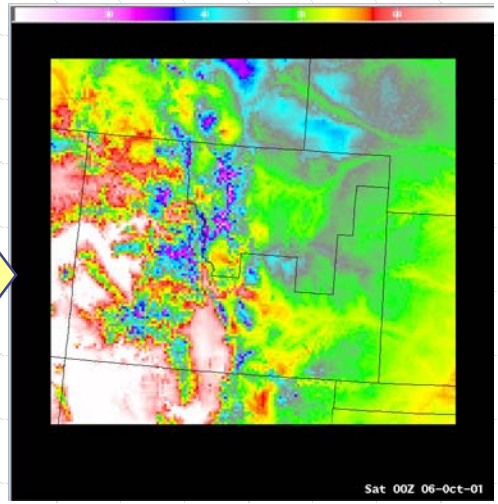
Derived Surface Temperature



Raw model
Data at 80km



Sampled to 5km
resolution



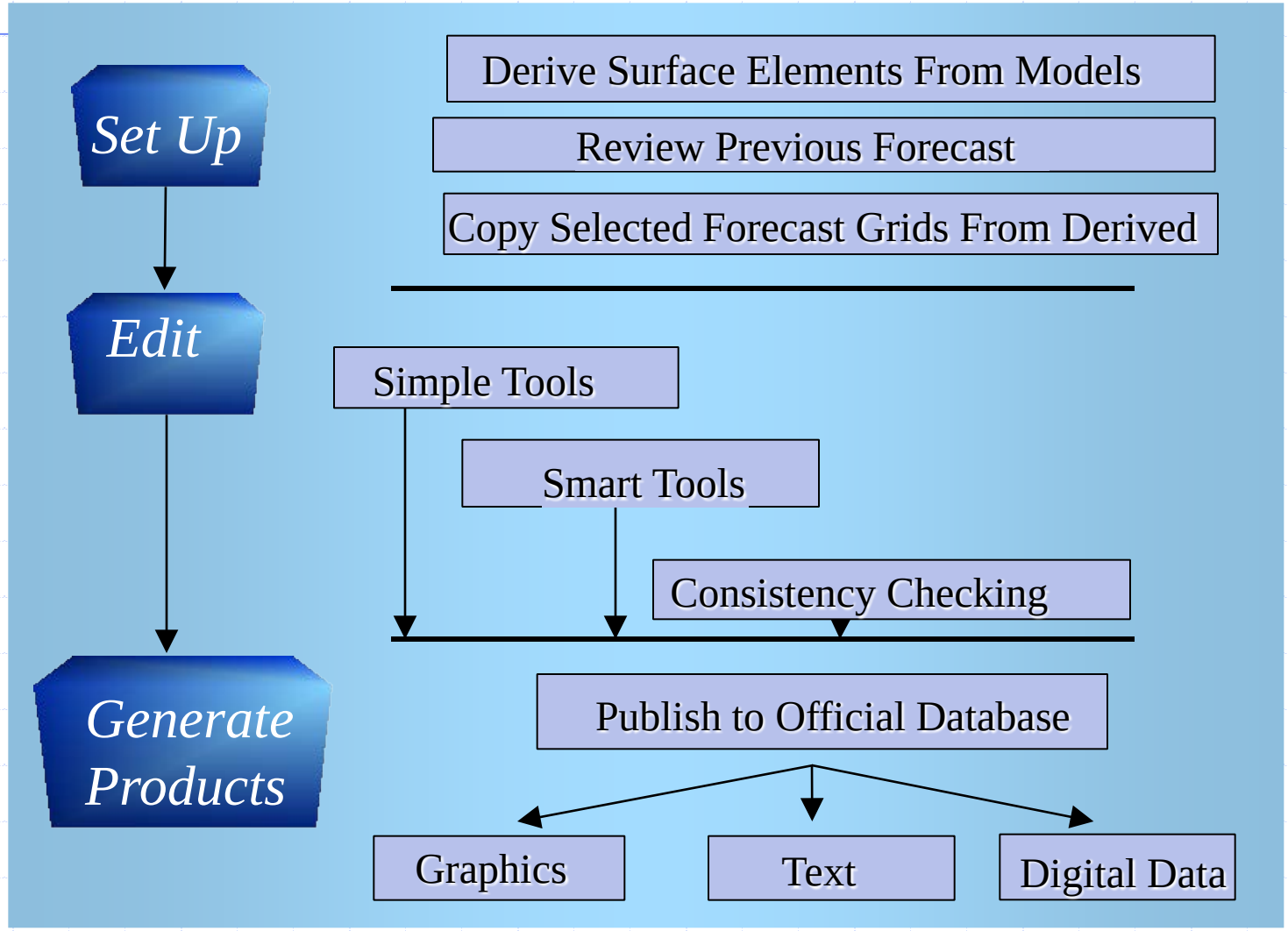
Topography
adjustments made

2 meter Temperature → Surface Temperature

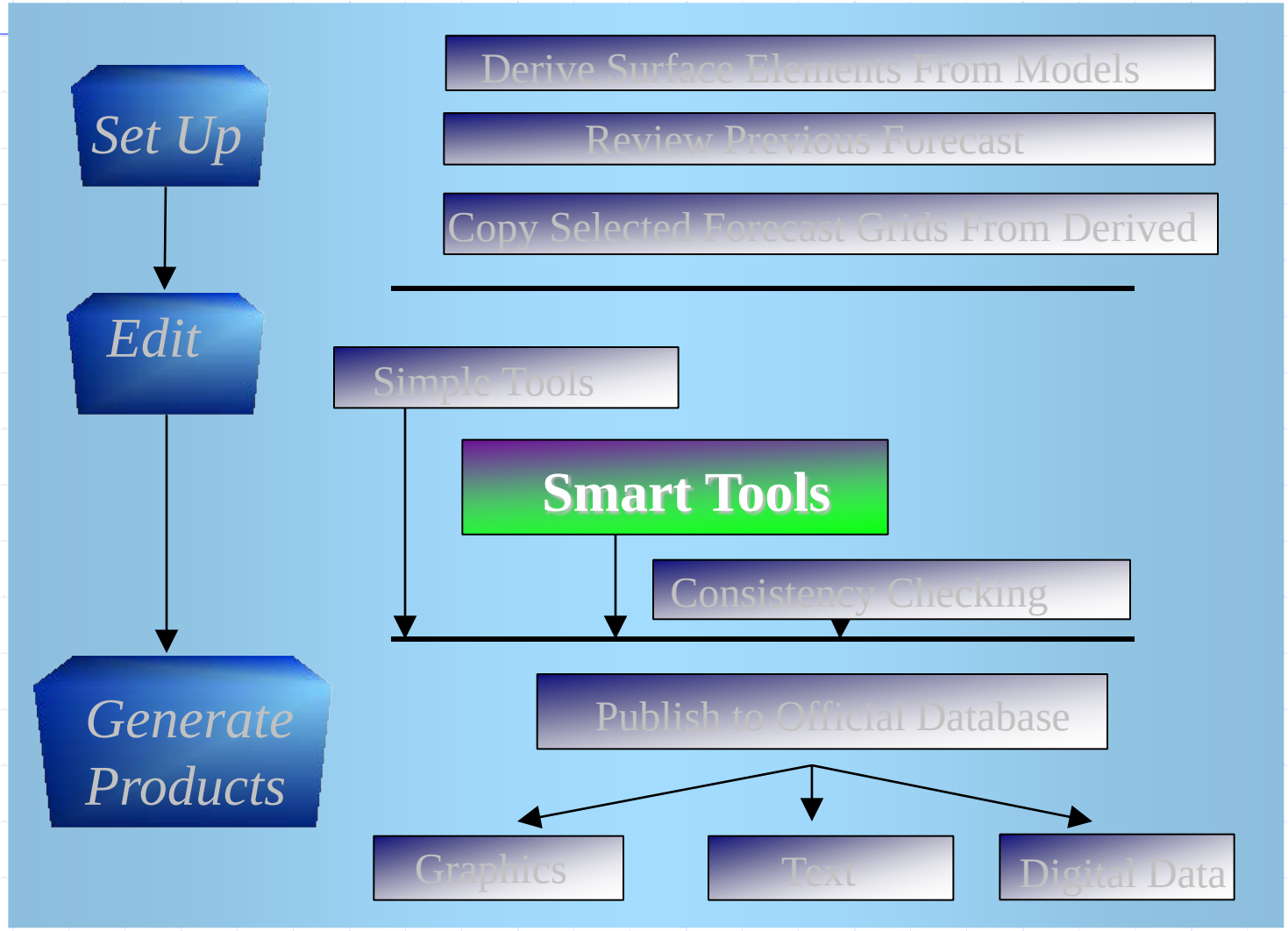
Forecast Methodology

Preparing and Editing the Forecast

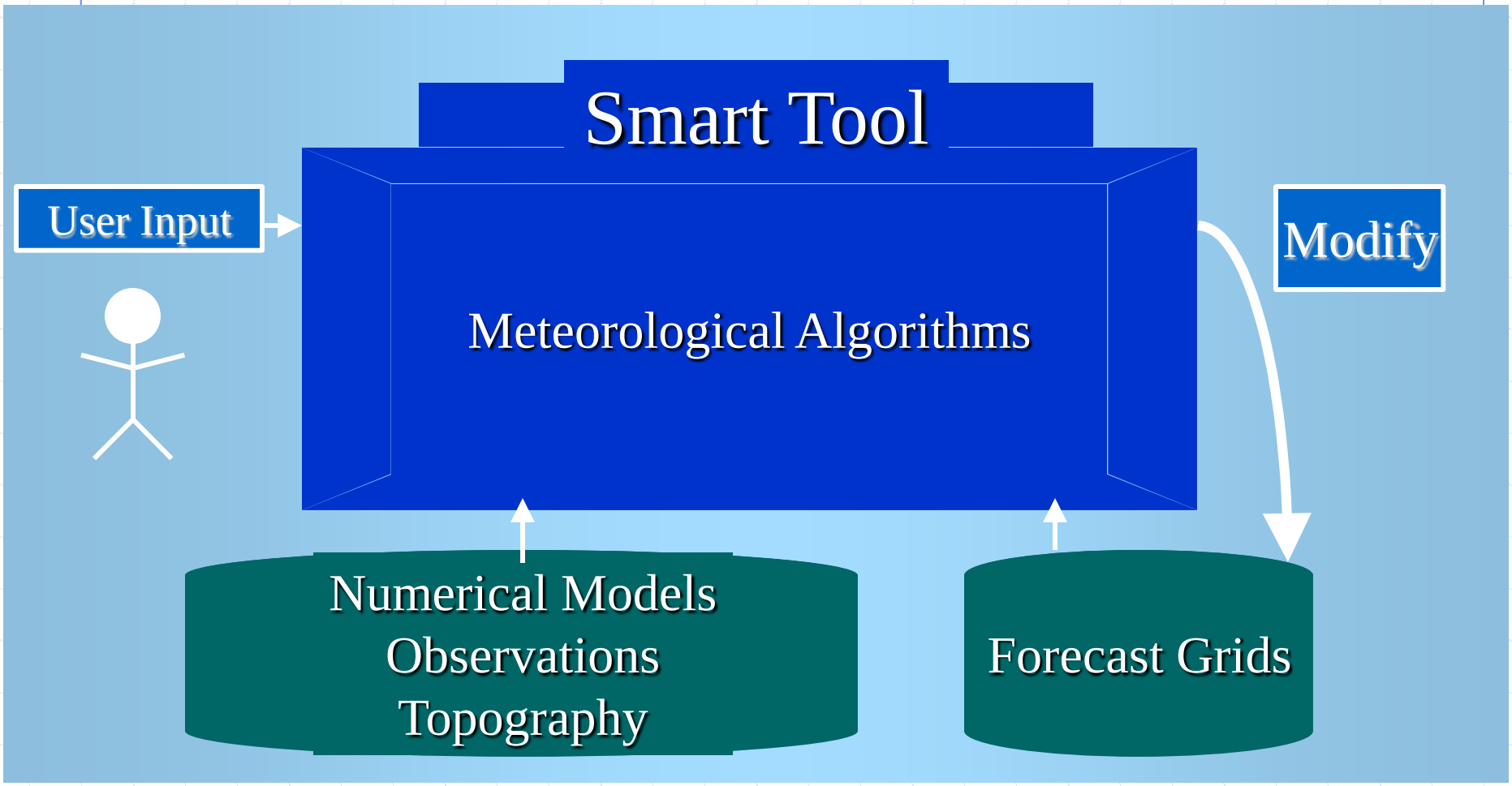
Forecast Process



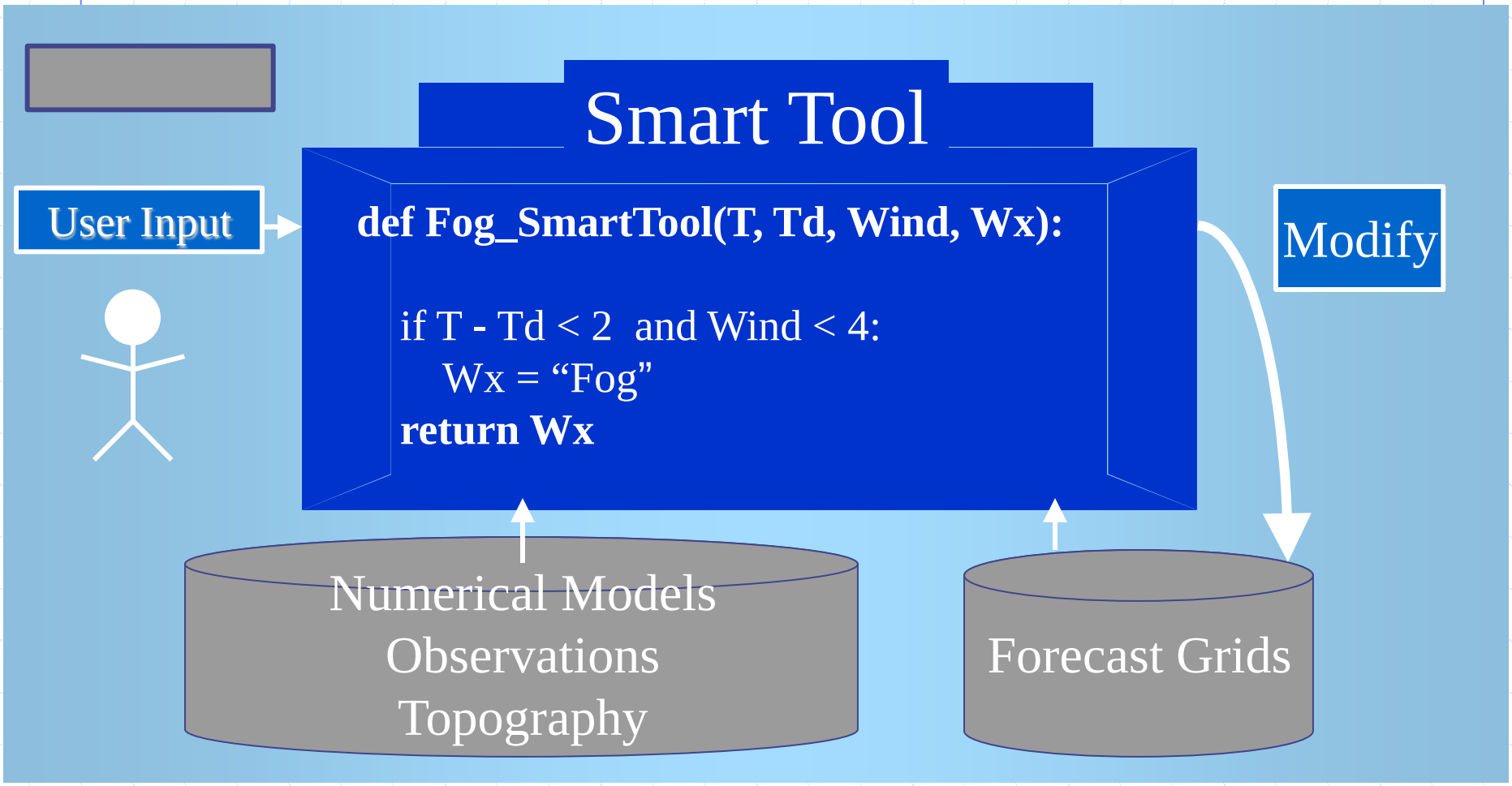
Forecast Process



Smart Tools


Smart Tool
User Input
Meteorological Algorithms
Modify
Numerical Models
Observations
Topography
Forecast Grids

Smart Tools


Smart Tool
User Input
def Fog_SmartTool(T, Td, Wind, Wx):
if T - Td < 2 and Wind < 4:
Wx = "Fog"
return Wx
Modify
Numerical Models
Observations
Topography
Forecast Grids

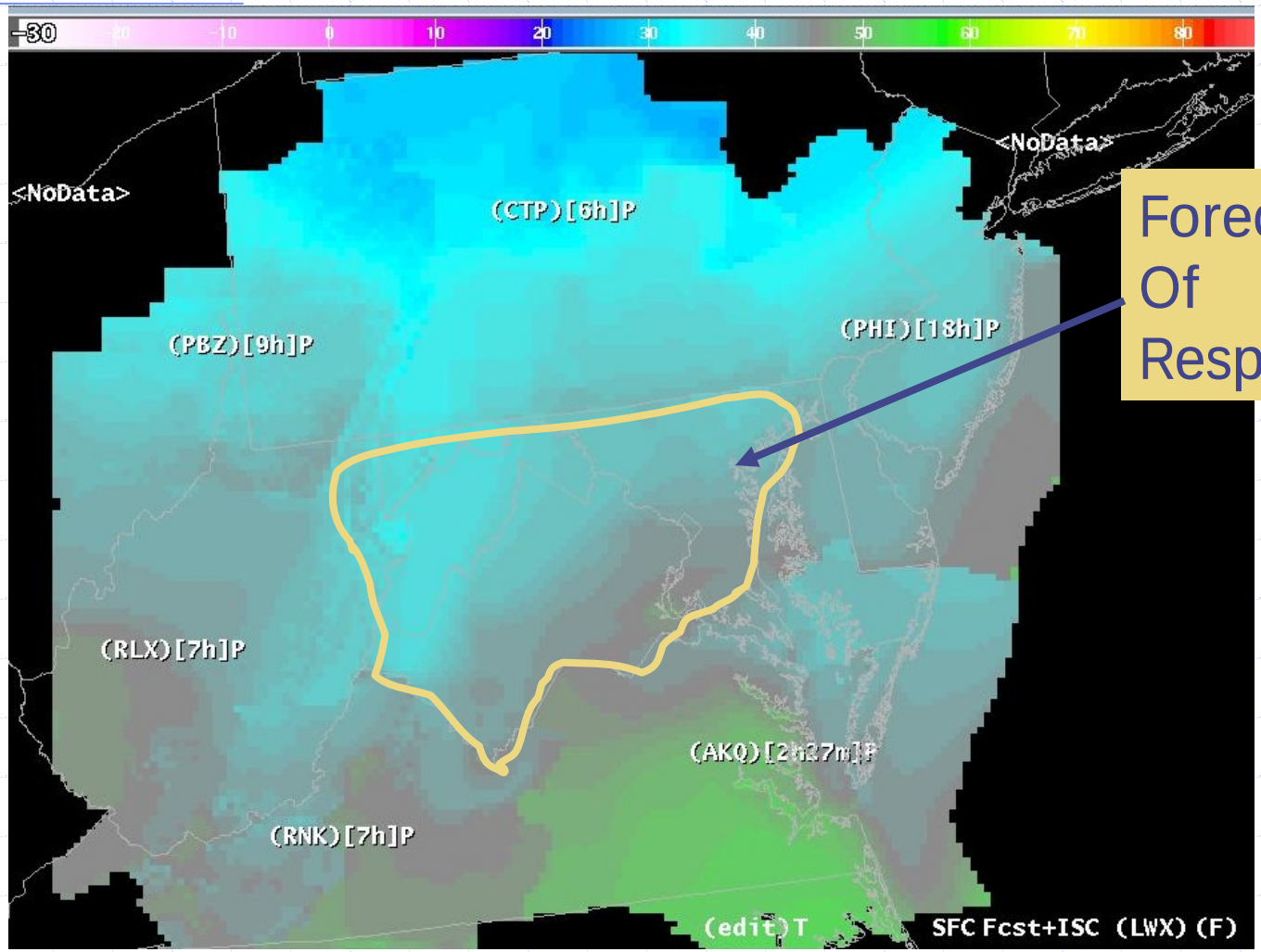
Forecast Methodology

Coordination/Collaboration

Coordination between WFOs

- Coordination between WFOs is more complicated when forecasting on grids.
- GFESuite provides Intersite Coordination techniques to view proposed forecasts from adjacent sites.
- Chat Software is used to communicate intent between offices. (commercial s/w)

Intersite Coordination on GFE



Forecast Area Of Responsibility

Chat Room Sample (12Planet)

Discussion

File Options

Participants:

Name
HPC NDFD
HPC Day1-2 QPF
HPC Mdl Diag
eax-4
ICT (Update)
WFO SGF (LX2)
oaxisc
WFO SGF (LX1)
tsa_longTerm
Topeka Short Term
Topeka Long Term
EAX short term
ICT (Routine)

Contribute:

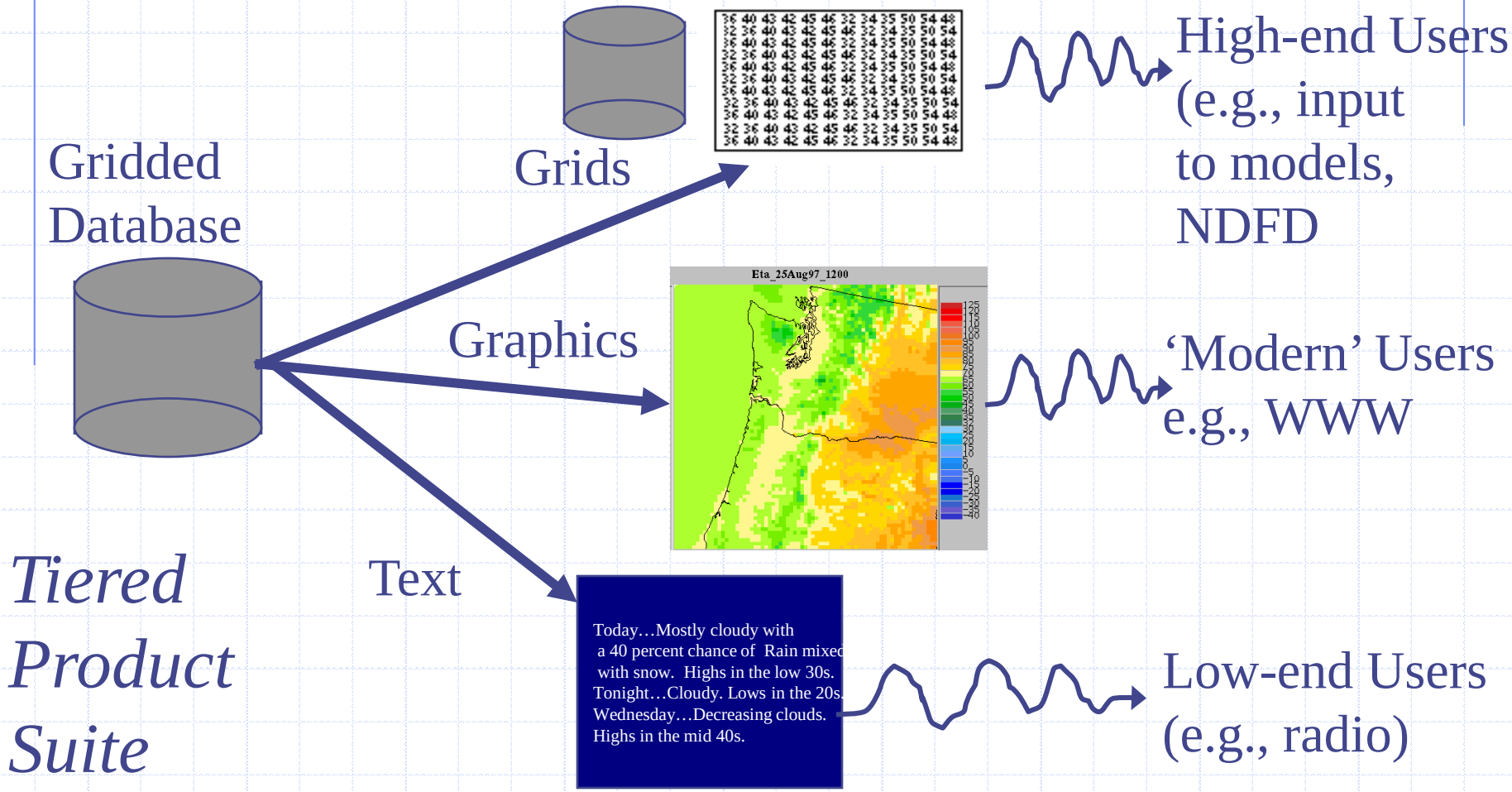
Conversation Record:

```
(WFO SGF (LX1) disconnected at 09-05 10:23)
(Topeka Long Term disconnected at 09-05 11:15)
(oaxisc disconnected at 09-05 12:32)
(oaxisc connected at 09-05 12:35)
(Topeka Short Term disconnected at 09-05 13:01)
(oaxisc disconnected at 09-05 13:09)
(oaxisc connected at 09-05 13:10)
(WFO SGF (LX1) connected at 09-05 13:16)
(tsa_longTerm connected at 09-05 13:17)
(Topeka Short Term connected at 09-05 13:34)
HPC NDFD 09-05 13:54
   The HPC Preliminary extended fcst discussion is available in AWIPS,
   along with days 3-7 fronts/pressure centers.
(Topeka Long Term connected at 09-05 14:04)
(Topeka Long Term disconnected at 09-05 14:05)
(Topeka Long Term connected at 09-05 14:05)
eax-4 09-05 14:26
   Using the timing of the 00Z AVN, it looks like the best chance for rain
   at EAX will be Tue afternoon through Wed morning.
eax-4 09-05 14:30
   Temps for early next week are tricky.  Maxes will depend on how much
   tropical moisture streams out of the gulf, but MRF looks way too cool
   Sun through Tue.
HPC NDFD 09-05 14:34
   EAX- The AVN control member has the quarter inch isohyet reaching the
   northwest corner of MO 00z on the 11th, moving 50-75 miles southeast by
   12z on the 11th, then another 50-75 miles southeast by 00z on the 12th.
   The only difference on the ensemble mean is the mean provides a chance
   of showers starting 00 on the 10th (moisture returning fm the south)
   with only light amounts less than a quarter inch (no suprise there,
   considering the averaging that occurs in the ensembles).
(EAX short term connected at 09-05 14:34)
HPC NDFD 09-05 14:39
   EAX- Good comment on the temp situation- as usual, we'll need to resolve
   the rate of return of the Gulf moisture, with a slower return implying
   warm conditions lasting longer.  We're leaning towards raising the
   draft temps on the 11th due to the implied limited coverge of precip. in
   the AVN fcst south/east of northwest MO.
(EAX short term disconnected at 09-05 14:40)
(EAX short term connected at 09-05 14:40)
eax-4 09-05 14:43
   Very dry soil conditions have contributed to very warm temps here this
```

Forecast Methodology

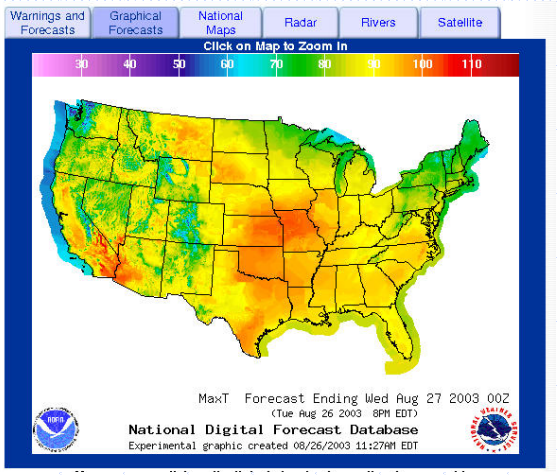
GFESuite Product Production

GFESuite Product Suite

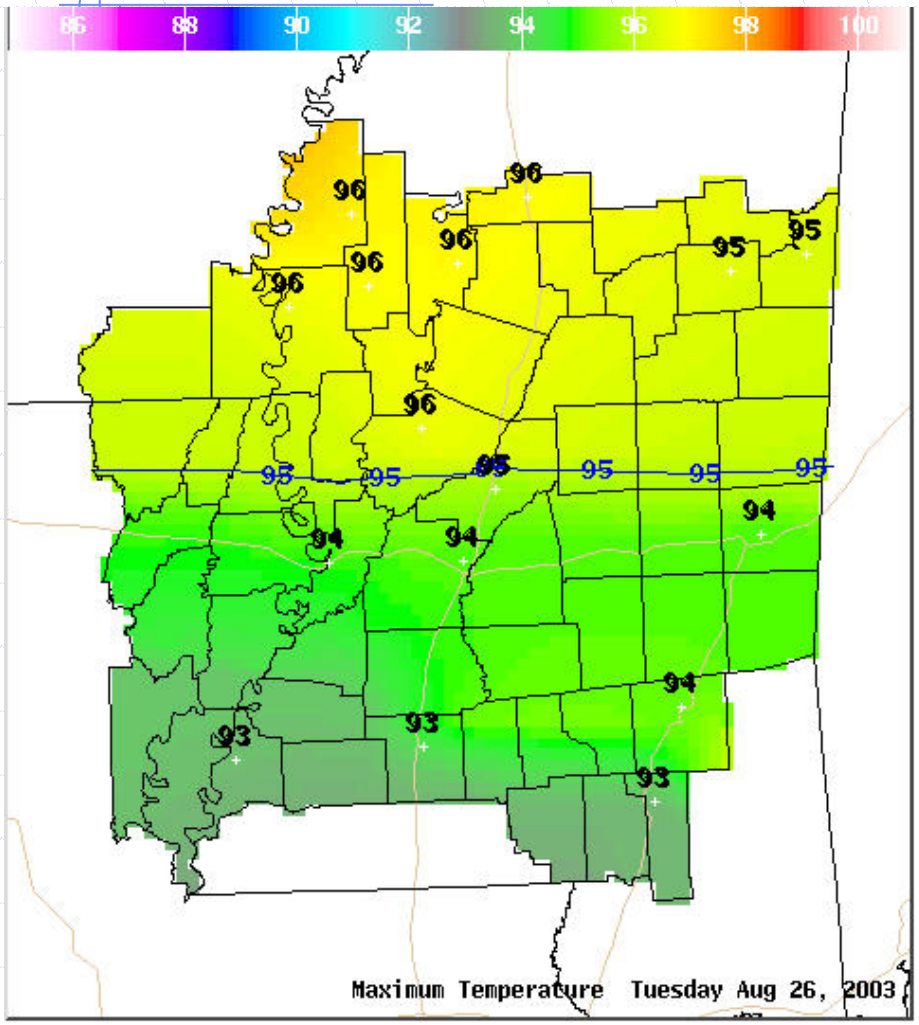


High-end users: Grids

- National Digital Forecast Database (NDFD)
- Data into local models, e.g., fire suppression models
- Detailed data for advanced users, e.g., power companies

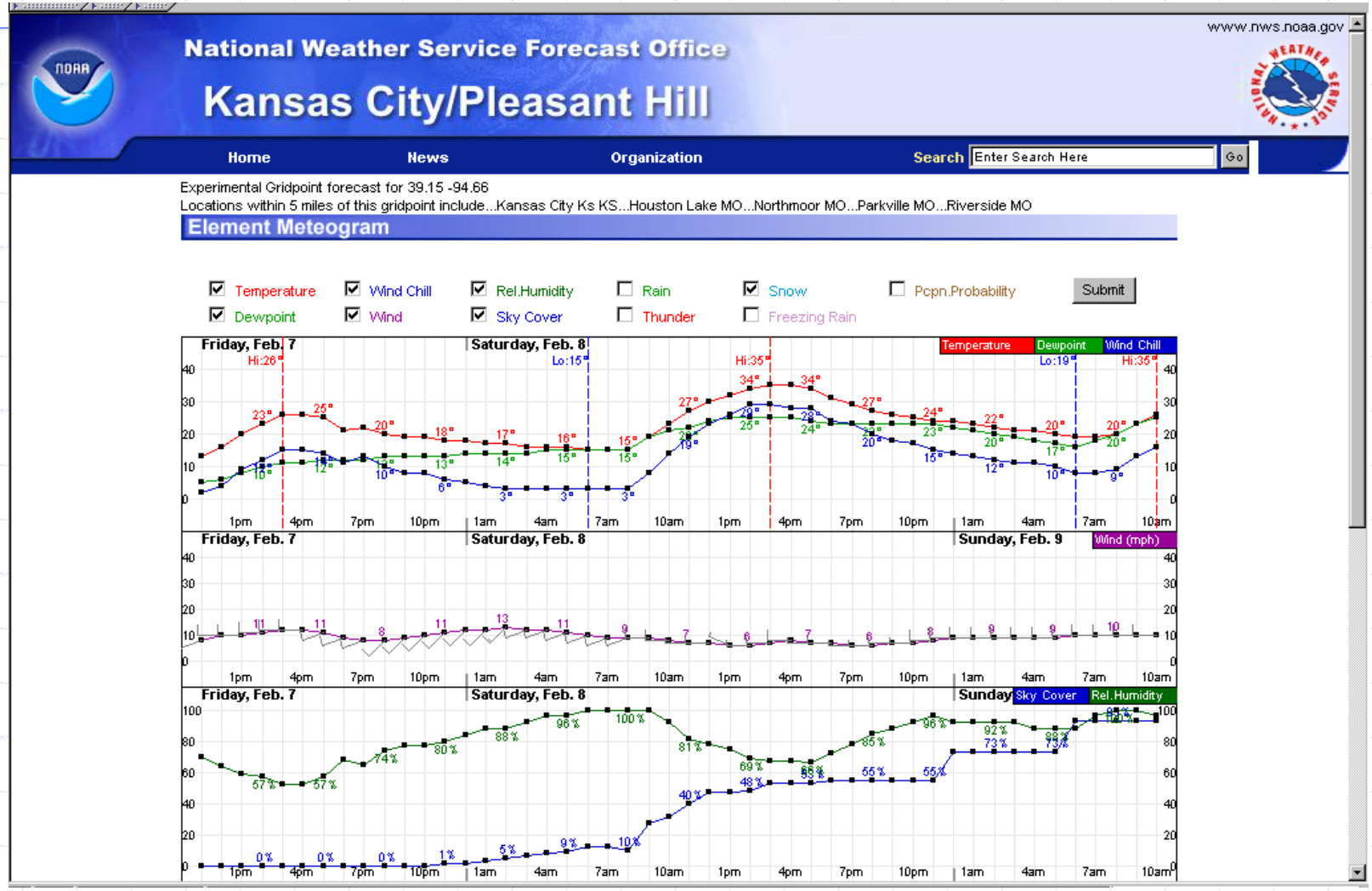


Graphical images for the local WFO



- Graphics and images can be overlaid
- For local office web pages.
- Generated directly from the grids.
- Configurable.

Experimental Meteograms



Zone Forecast Product (ZFP)

```
FPUS56 KLOX 261044
ZFPLOX
SOUTHWESTERN CALIFORNIA ZONE FORECAST
NATIONAL WEATHER SERVICE LOS ANGELES/OXNARD CA
330 AM PDT TUE AUG 26 2003

CAZ041-262130-
LOS ANGELES COUNTY COAST INCLUDING DOWNTOWN LOS ANGELES-
330 AM PDT TUE AUG 26 2003

.TODAY...MOSTLY CLOUDY THIS MORNING WITH AREAS OF FOG. PARTLY CLOUDY
THIS AFTERNOON. ISOLATED SHOWERS...MAINLY THIS MORNING. HIGHS FROM THE
70S AT THE BEACHES TO THE LOWER TO MID 80S INLAND. CHANCE OF RAIN 20
PERCENT.
.TONIGHT...PARTLY CLOUDY THIS EVENING THEN CLEARING. LOWS IN THE 60S.
.WEDNESDAY...MOSTLY SUNNY. HIGHS FROM THE 70S AT THE BEACHES TO THE
LOWER TO MID 80S INLAND.
.WEDNESDAY NIGHT THROUGH THURSDAY...MOSTLY CLEAR...EXCEPT FOR PATCHY
LATE NIGHT THROUGH MORNING LOW CLOUDS AND FOG. LOWS IN THE 60S.
HIGHS FROM THE 70S AT THE BEACHES TO THE 80S INLAND.
.THURSDAY NIGHT THROUGH SUNDAY...AREAS OF NIGHT THROUGH MORNING LOW
CLOUDS AND FOG...OTHERWISE MOSTLY CLEAR. LOWS IN THE 60S.
HIGHS FROM THE 70S AT THE BEACHES TO THE 80S INLAND.
.SUNDAY NIGHT...MOSTLY CLEAR IN THE EVENING...THEN AREAS OF LOW
CLOUDS AND FOG LATE. LOWS IN THE 60S.
.LABOR DAY...AREAS OF LOW CLOUDS AND FOG IN THE MORNING...OTHERWISE
PARTLY CLOUDY. HIGHS FROM THE LOWER 70S AT THE BEACHES TO THE LOWER 80S
INLAND.
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Area Forecast Matrix (AFM)

```
Eastern Hampden-Eastern Hampshire-Hartford-Tolland-
Including the cities of...Hartford...Northampton...Springfield...
Stafford
1128 AM EDT Tue Aug 26 2003

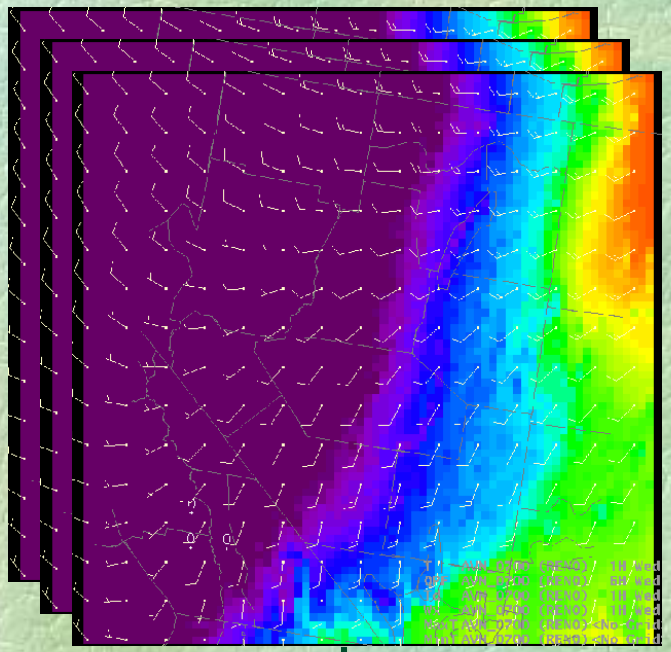
              Tue  08/26/03     \     Wed  08/27/03     \     Thu  08/28/03
EDT         03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18

Pop 12hr                 30          50          10          10          10
Qpf 12hr                  0     .25-.49           0           0           0
Max qpf                   0     .25-.49           0           0
Mx/MN                    83          64          90          55          80
Temp            62 70 76 81 74 75 71 67 68 76 83 89 83 75 68 60
Heat index               82                      83 88 83
Dewpt           59 61 63 65 67 65 63 63 65 64 62 60 59 56 53 51
Rh              90 74 65 59 79 72 76 87 91 67 50 38 45 52 59 73
Wind dir        NW NW NW  S  S SE SE SW  W  W  W  W NW NW NW NW
Wind spd         2  5  2  5 10  5  5 10 15 20 20 20 20 20 15 15 15 15 10 10
Clouds          SC SC B1 B2 B2 B1 B1 B1 B1 B1 SC SC SC SC SC SC SC SC SC SC
Rain shwrs          S  C  C  C  C  C  C
Tstms                        C  C  C
Obvis                             pf pf

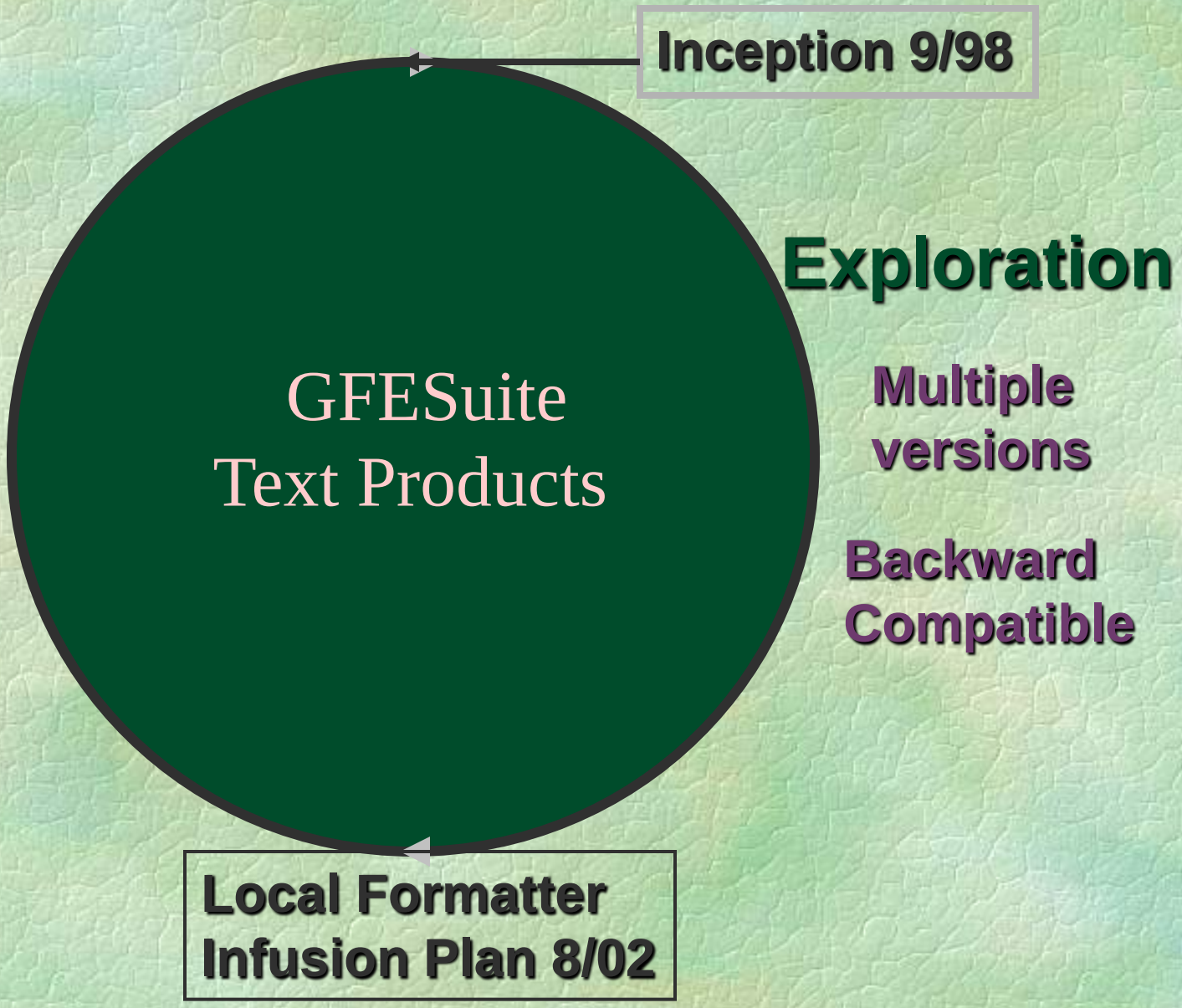
            \Fri 08/29/03\Sat 08/30/03\Sun 08/31/03\Mon 09/01/03
EDT         00 06 12 18 00  06 12 18 00  06 12 18 00  06 12 18 00

Pop 12hr      10    40     50    40     30    30     30    10
Mx/MN         61    89     66    86     62    73     57    77
Clouds        SC    SC     B1    SC     B1    B1     B1    B1
Rain shwrs           C      C     C      C     C      C
Tstms                             C      C
```

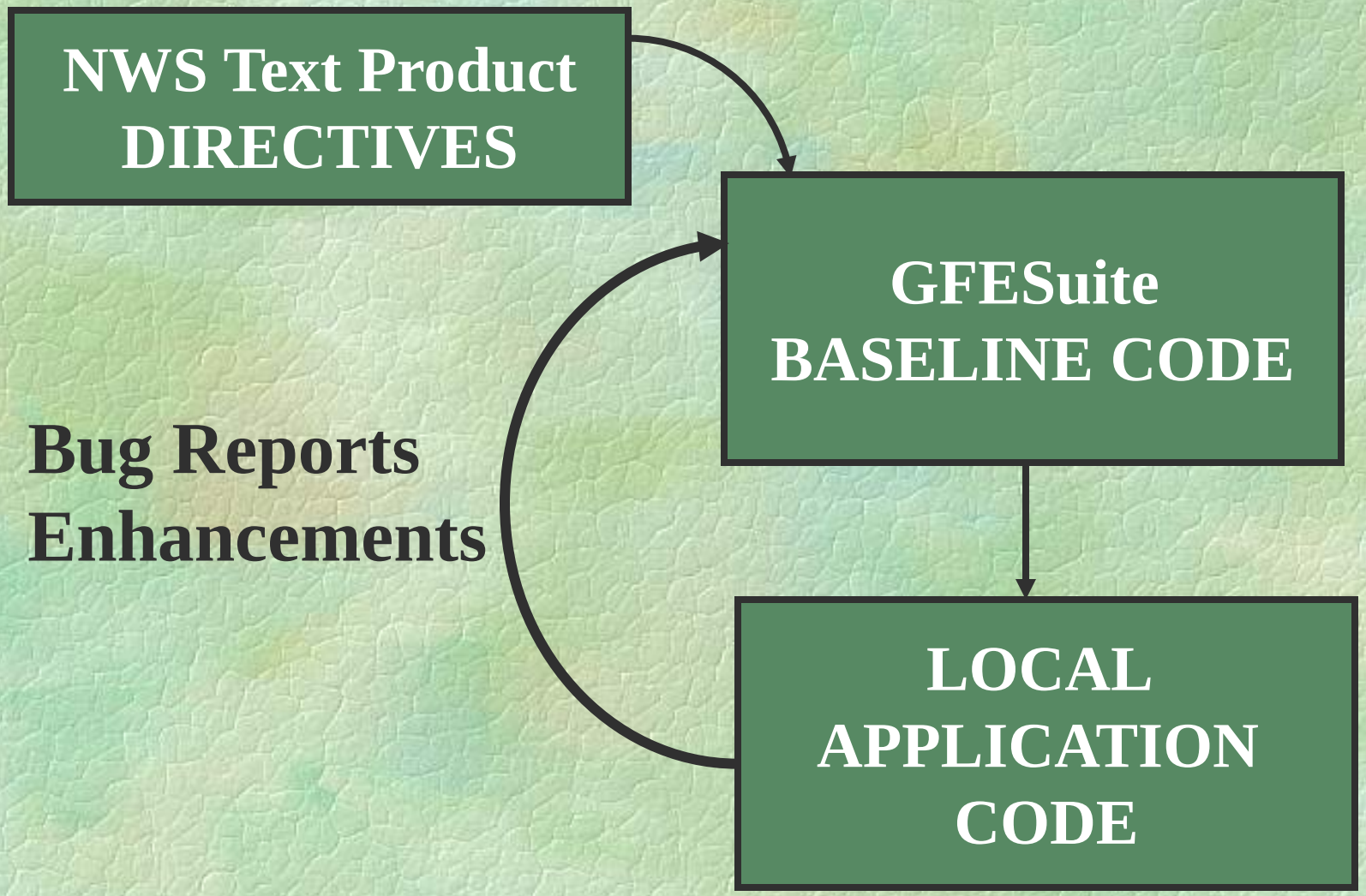
Grids to Text



.TODAY...MOSTLY SUNNY THEN PARTLY CLOUDY IN THE AFTERNOON. WARMER. HIGHS IN THE UPPER 60S TO MID 90S. NORTHWEST WINDS AROUND 15 MPH.
.TONIGHT...PARTLY CLOUDY WITH SCATTERED SHOWERS. LOWS IN THE UPPER 50S TO LOWER 70S. NORTHWEST WINDS AROUND 5 MPH SHIFTING TO THE SOUTH AFTER MIDNIGHT. AREAL COVERAGE OF SHOWERS 50 PERCENT.
.FRIDAY...PARTLY CLOUDY. HIGHS IN THE LOWER 60S TO MID 70S. WEST WINDS AROUND 5 MPH.

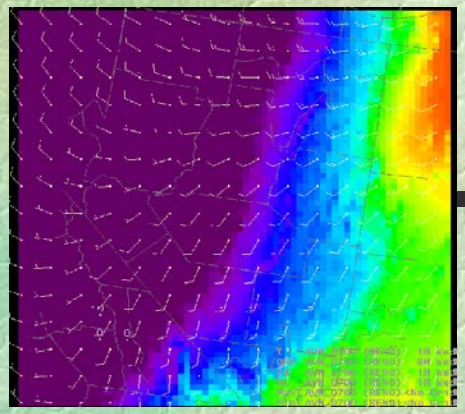

Inception 9/98
Exploration
GFESuite
Text Products
Multiple versions
Backward Compatible
Local Formatter Infusion Plan 8/02

Rapid Prototype Process



Grids to Text

Partly cloudy.



Highs in the 50's.

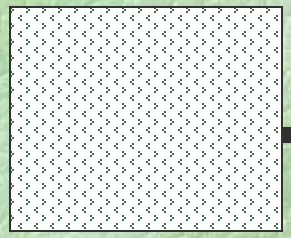
Grids to Text

Chance of rain and patchy fog in the morning.

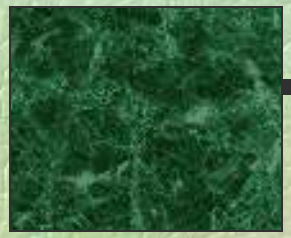
Chance of rain in the afternoon.

Chance of rain. Patchy fog in the morning.

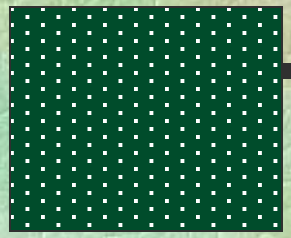
Grids to Text



Chance of rain and drizzle in the early evening.



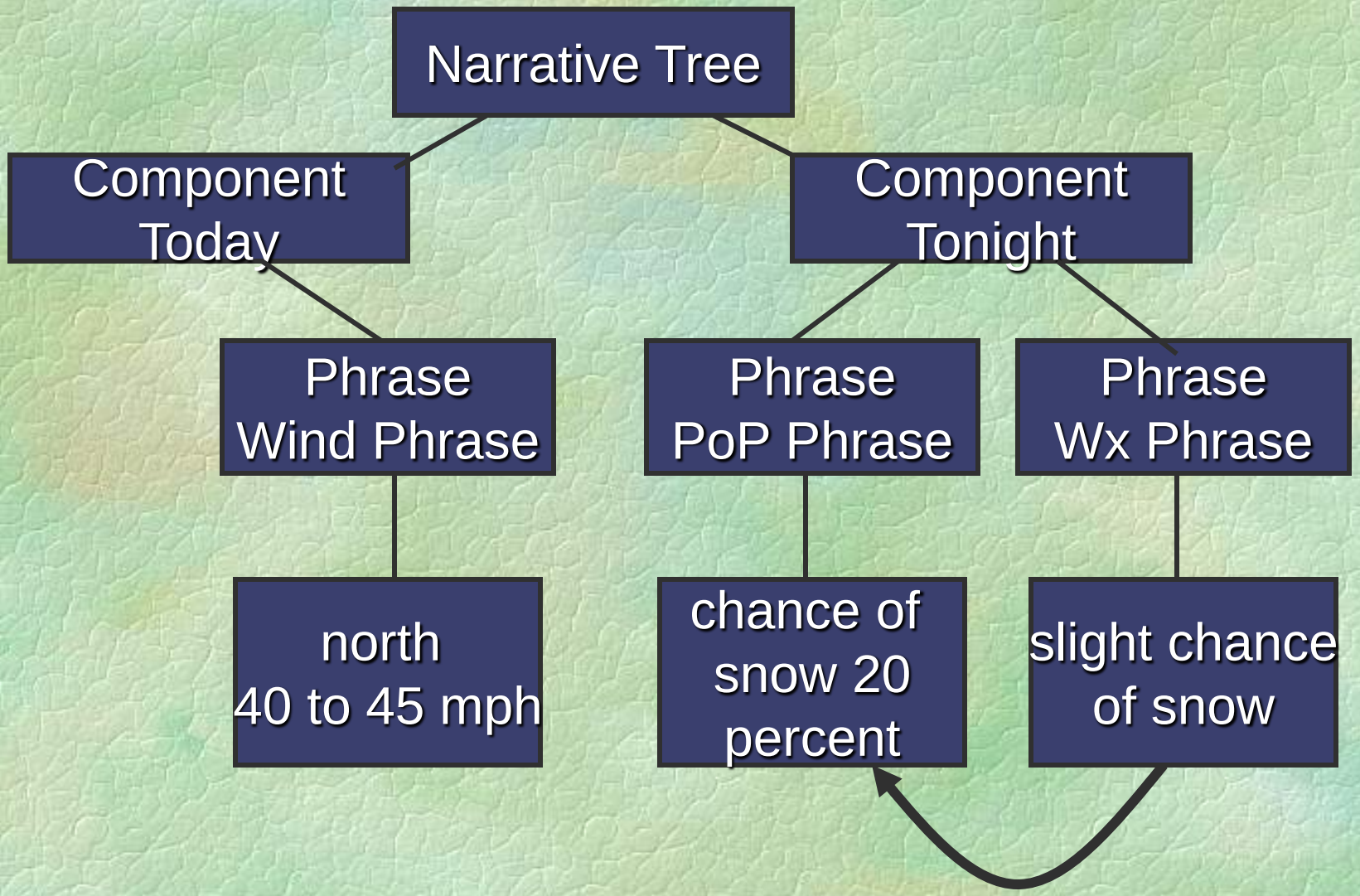
Chance of rain and drizzle mixed with patchy fog in the late evening.



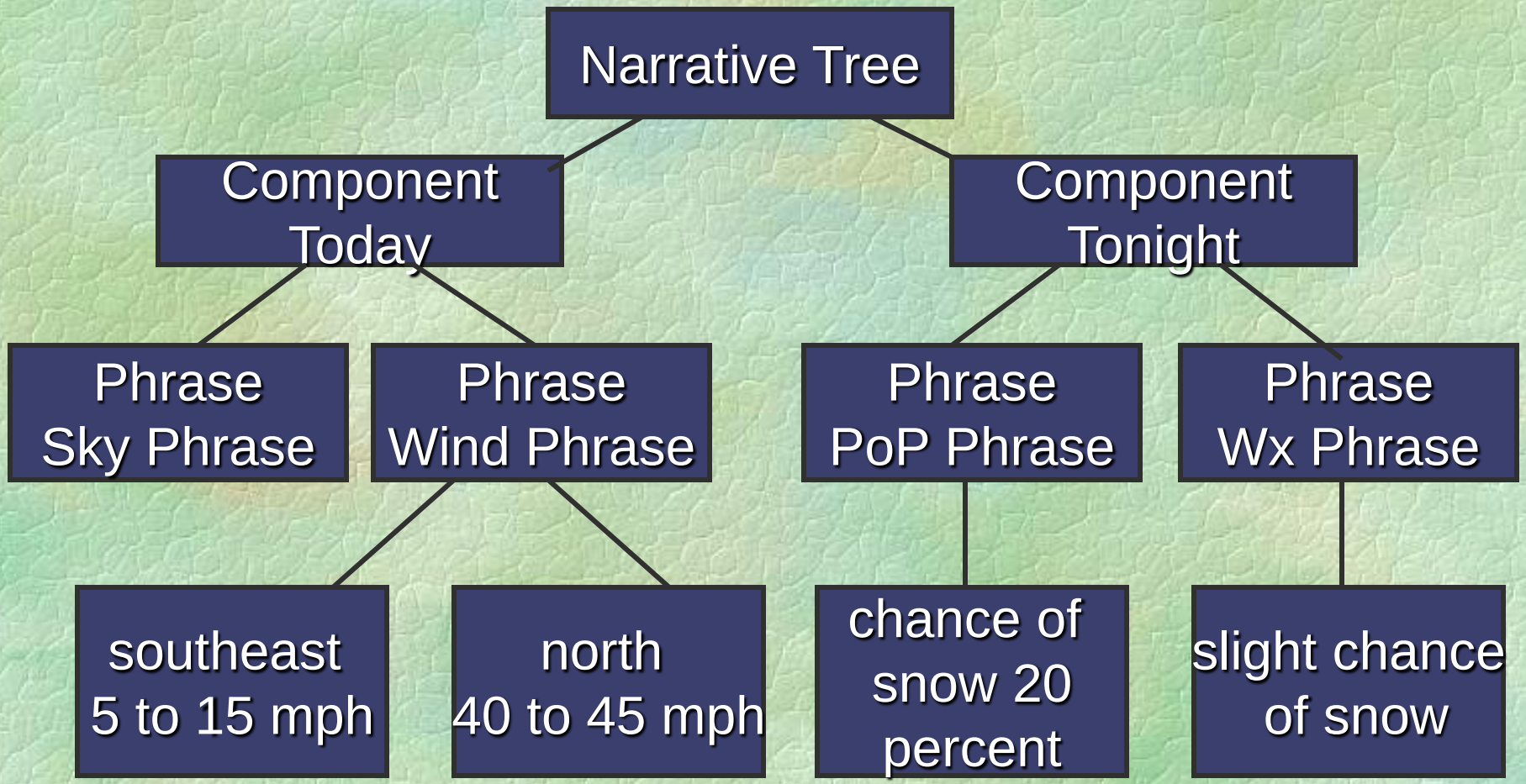
Chance of rain and drizzle mixed with blowing snow after midnight.

Chance of rain and drizzle. Patchy fog in the evening then blowing snow after midnight.

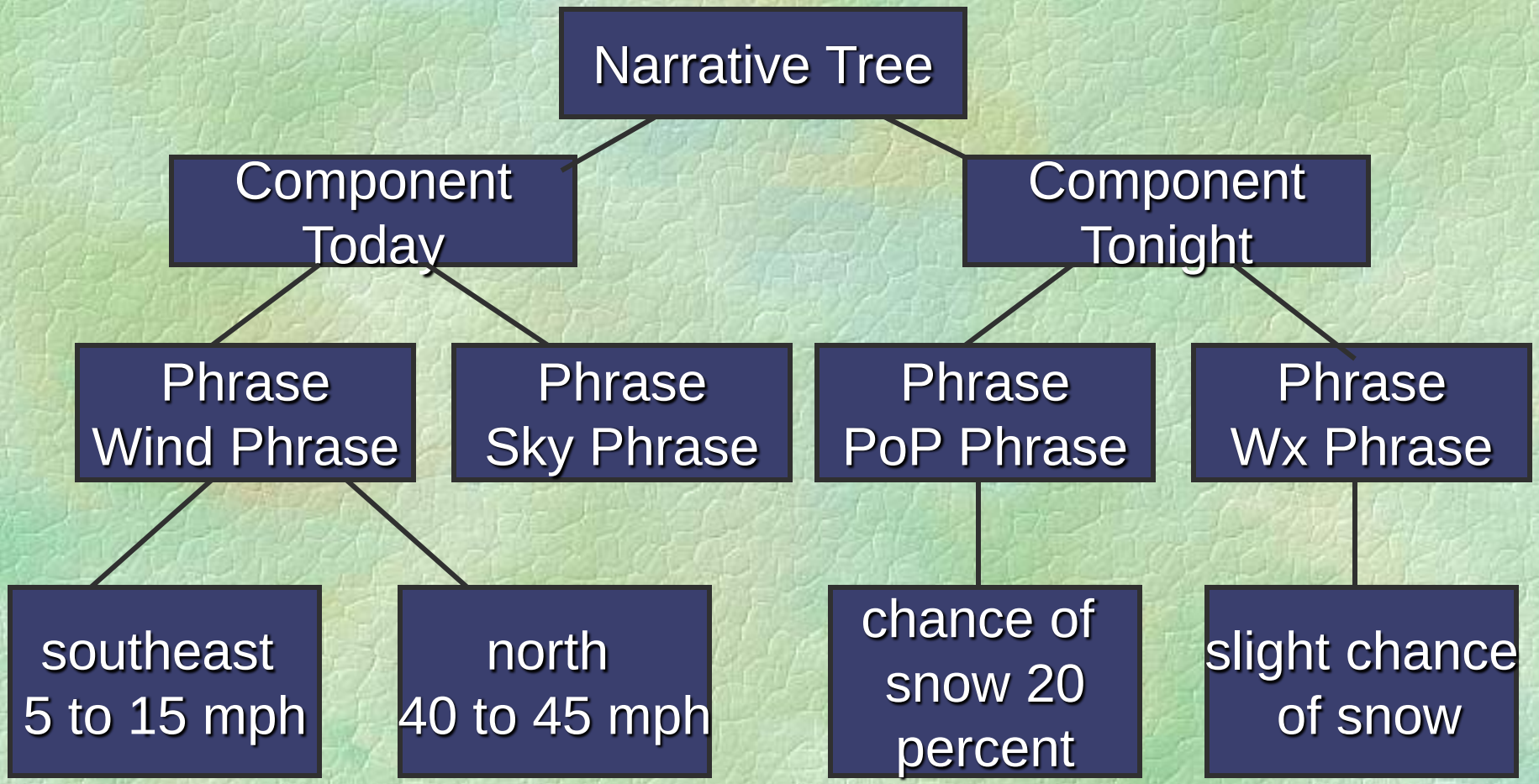
“Holographic” Processing



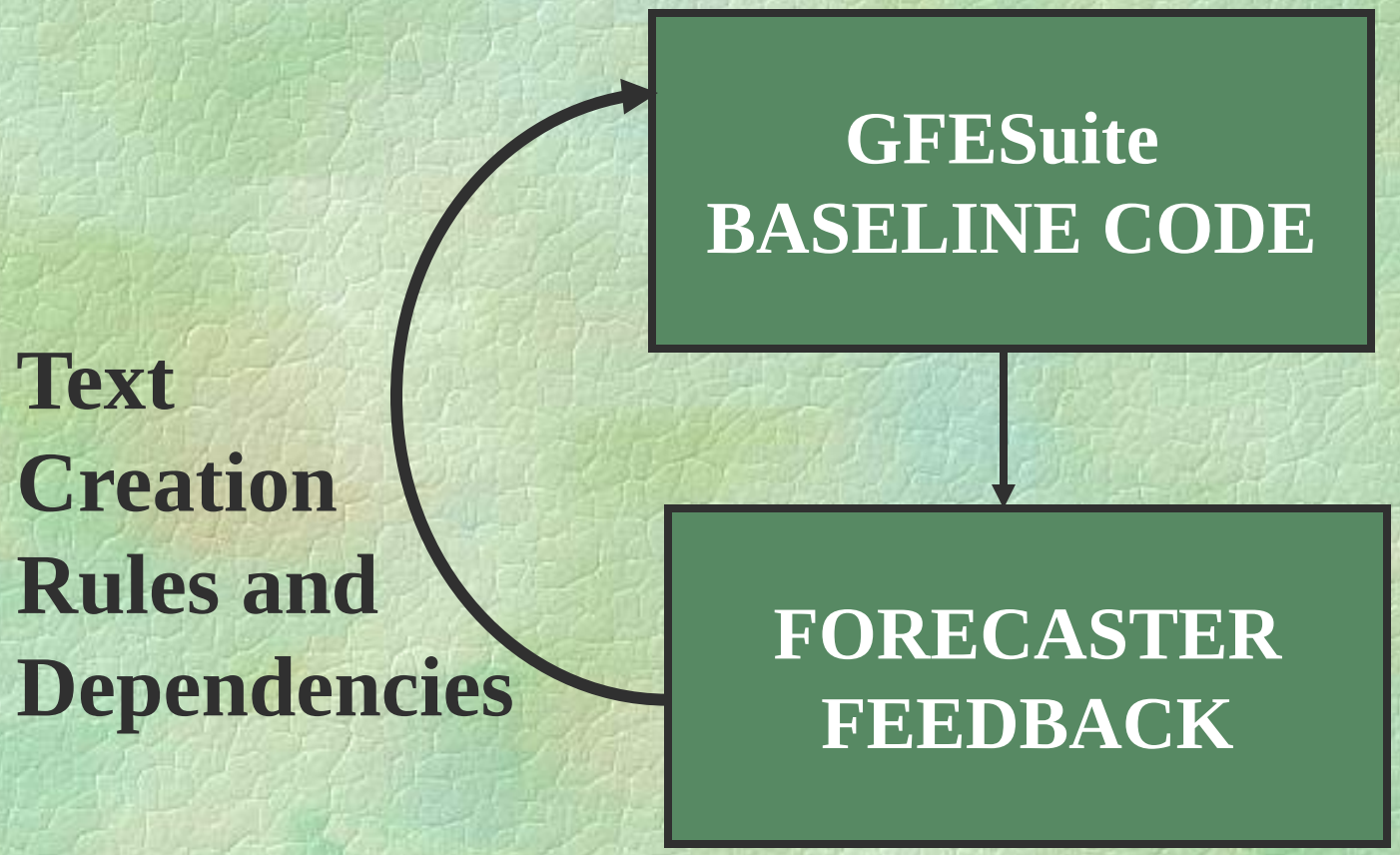
Holographic" Processing



Holographic" Processing



Rapid Prototype Process



Standardized Local Products 6/03

Inception 9/98

Consolidation

Integrating Versions

Changing Infrastructure

GFESuite
Text Products

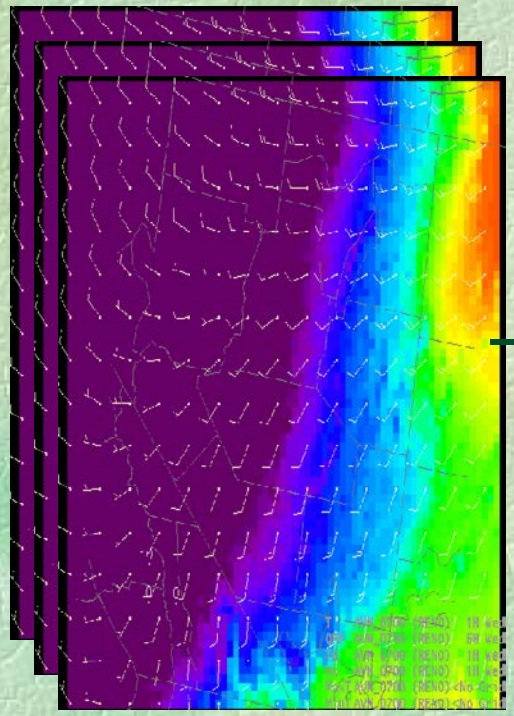
Exploration

Multiple versions

Backward Compatible

Local Formatter Infusion Plan 8/02

Grids as Source of NWS Products



GFESuite Text Product Software

NATIONAL TEXT PRODUCTS

NOAA WEATHER RADIO

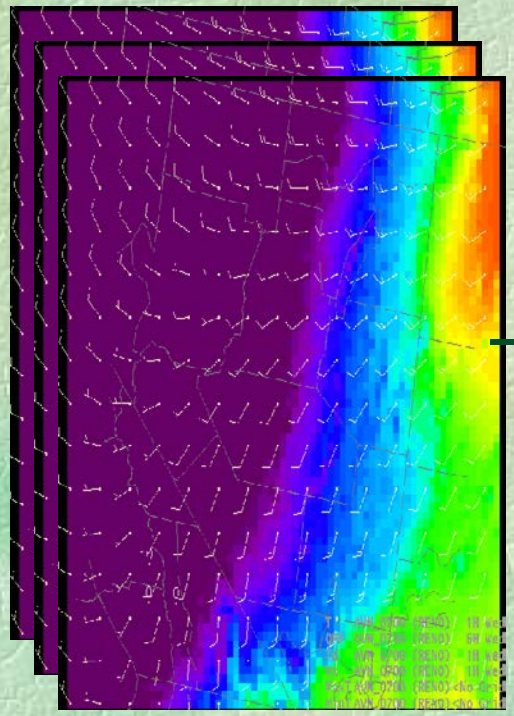
NEW LOCAL TEXT PRODUCTS

Grids as Source of NWS Products

Digital Forecast for point: 40.579, -111.619 at elevation: 9410 ft
Alta .

	Mon Sep 8				Tue Sep 9				Wed Sep 10			
Daily-Temp	Low 50		High 53		Low 34		High 56		Low 33		High 45	
Weather		Slight Chance TStorms	Chance TStorms	Slight Chance TStorms			Chance TStorms	Likely TStorms		Chance TStorms		
Chance of Precip	0%	30%		5%		40%		70%		43%		43%
Precip	0.00"	0.01"	0.02"	0.06"	0.02"	0.00"	0.06"	0.03"	0.07"	0.07"	0.05"	0.02"
12-hr Snow Total	0"	0"		0"		0"		0"		0"		
6-Hour	Mdnt	6am	Noon	6pm	Mdnt	6am	Noon	6pm	Mdnt	6am	Noon	6pm
Cloudiness	60%	60%	60%	50%	50%	70%	70%	80%	80%	70%	70%	70%
Temp	52	50	52	53	41	34	48	56	42	33	41	45
Dewpoint	43	44	37	32	30	27	35	38	35	31	31	30
Relative Humdity	71%	79%	56%	44%	64%	75%	60%	50%	76%	92%	67%	55%
Wind	SW 17	SW 20	W 20	W 21	W 17	W 17	S 19	W 20	N 19	NW 20	NW 19	NW 18

Grids as Source of NWS Products



GFESuite Text Product Software

NATIONAL TEXT PRODUCTS

NOAA WEATHER RADIO

NEW LOCAL TEXT PRODUCTS

Improve Quality of Grids by Injecting SCIENCE into the Forecast Process

- RPP Focus Group
- Innovative Processing Techniques

GFE Use at National Weather Service Offices

Woody Roberts,
Evaluation Team Leader

Goal of the Evaluation:

Determine how the GFE is used operationally at NWS offices

Objectives:

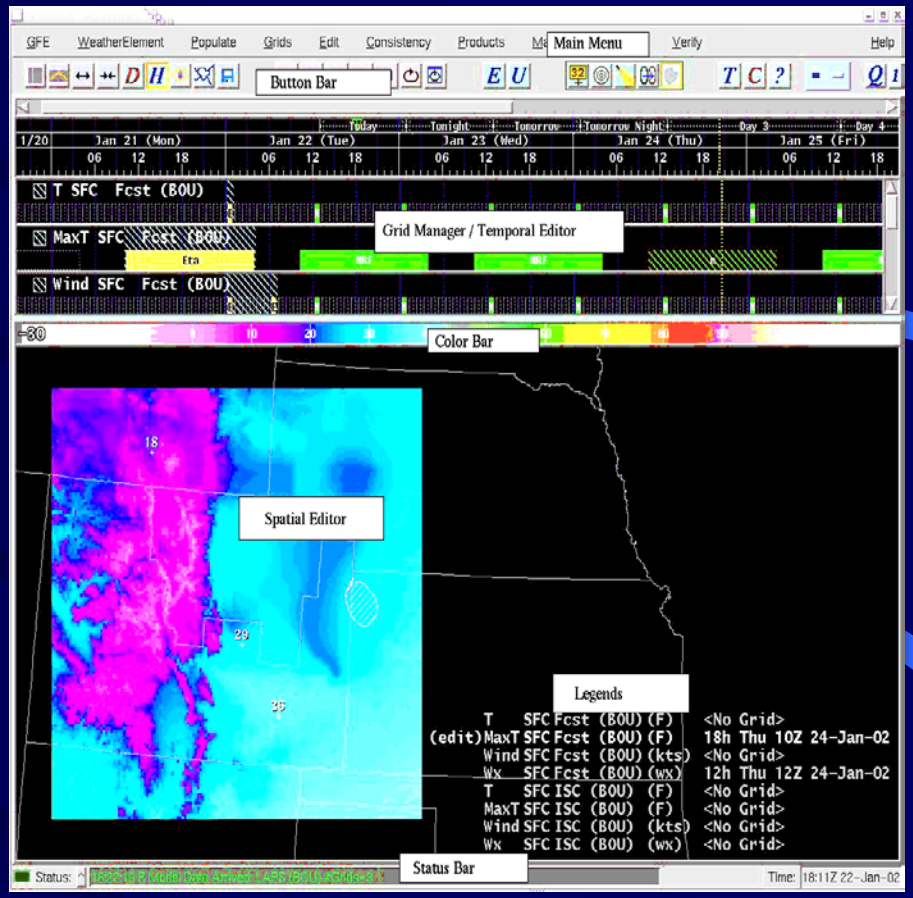
- What components of the GFE are being used?
- When is the GFE being used?
- How are the grids initialized and modified?
- How does the GFE fit into the NWS operational framework?
- What is the impact of the GFE on the forecast process?

Evaluation Methods:

- Interviews - Primarily IFP focal points
- Observations - During interviews
- (Surveys) - Drafted but not administered
- GFE log analysis - Week long “snap-shots” during active weather periods

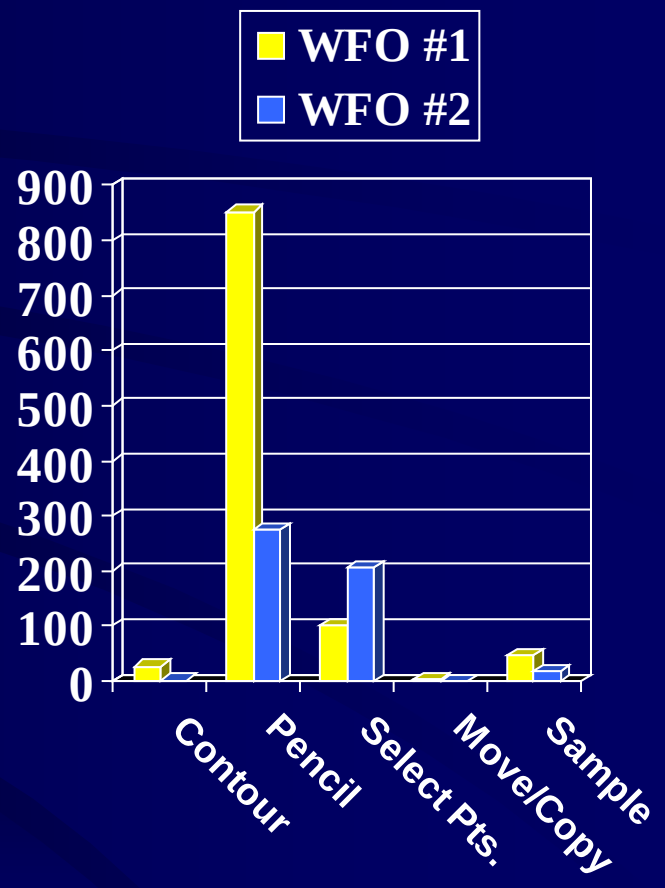
Preliminary GFE Log Results:

- **Grid manager tool** ~1200 to 3200 log entries/day
- **Main-Menu Actions**:
  - **Populate/Copy** and **Interpolate** most frequent
  - **Publish** several times/day
  - **Start/Exit** several times/day
  - **Procedures used** - e.g. DiurnalTfromMinMaxT, FireWeather, AddDay7, ISCDescrepancies



Preliminary GFE Log Results (cont.)
Simple Drawing Tool Use:

- The **Pencil Tool** most frequently used.
- **Select Points** also used



Preliminary GFE Log Results (cont.)

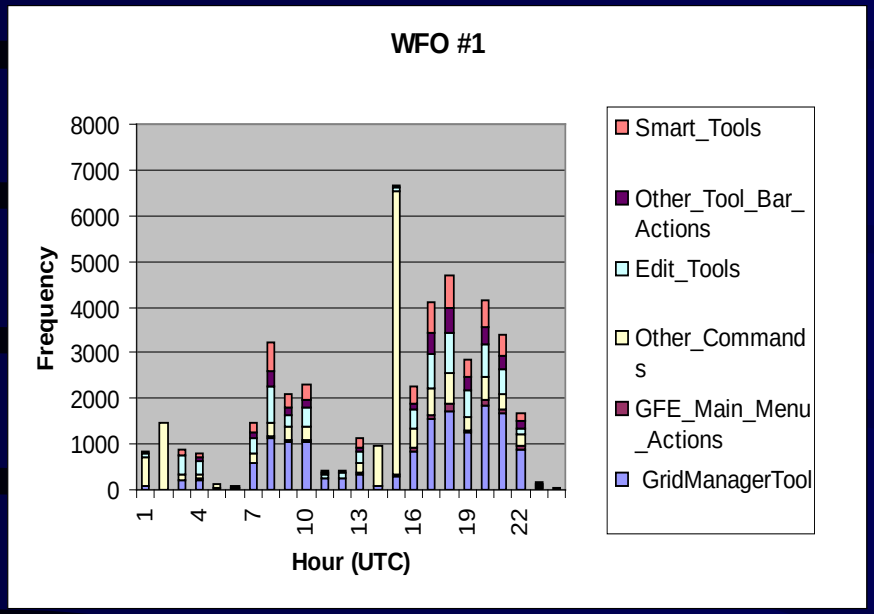
Other Tool Bar Actions:

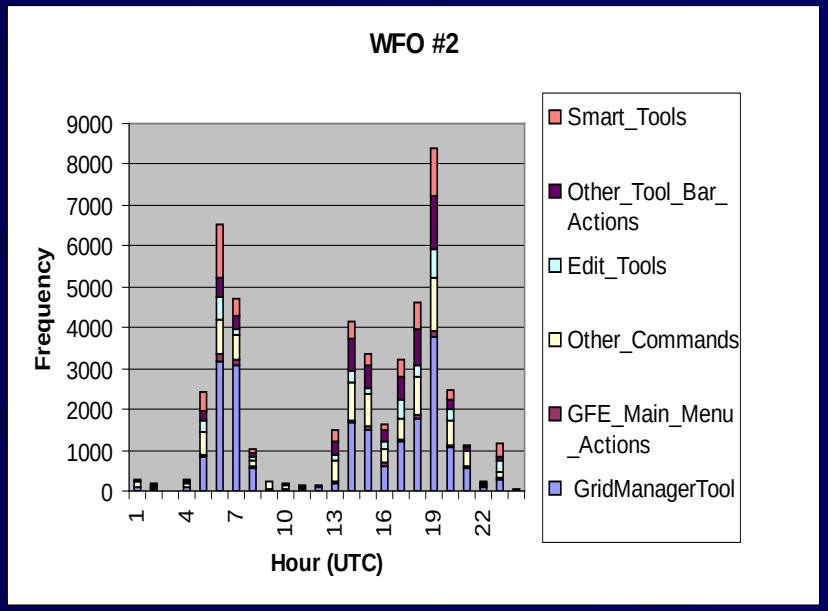
- **Toggle ISC Grids -** ~50 to over 100 times/day at both sites.

Smart Tool Use:

- **Smooth, Adjust Value-Down, Adjust Value-Up,** and **Assign Value** account for over ***90%*** of Smart tool use at both sites.
- WFO#1 used 13 other Smart Tools, WFO#2 used 26 other smart tools
- Some of the smart tools are seasonally dependent

Hourly Use of GFE Capabilities





- Both offices primarily use the GFE during the day and mid shifts.
- Corresponds to issuance of text packages (e.g. zones)

Division of Duties :

- Surveyed offices are either dividing “grid” duties temporally (I.e. short-term / day 1 and long-term/days 2-7) or by weather element, e.g. Wind/Gust, vsby., Wave grids done by marine forecaster.
- Other duties divided along traditional lines, e.g. public, aviation, marine, fire weather.

Forecast Methodologies / Process:

- Most interviewed forecasters will use D2D first to formulate a forecast, then use the GFE to generate or modify their grids.
- Forecasters will use a variety of methods to review, modify, and generate their grids.
- Intersite coordination is a key element in the process.

Conclusions and Future Work

- Offices are currently using many of the GFE capabilities to generate their forecasts.
- Methodologies are still somewhat primitive and tied to old practices, but they are rapid evolving as new responsibilities, techniques, and capabilities are added.
- Data will be collected fom additional sites to generate a “baseline” of GFE use.

Training and Professional Development

Brian Motta
NOAA/National Weather Service
Training Division
IFPS Professional Development Series
September 9, 2003

Recent Past Accomplishments

- FY03 Methodology Workshops
  - Diurnal Temperature Smart Tool
  - Tropical Cyclone Advisory Grids
- Tele-training
  - Collaboration Tools / Strategy
  - GFE Text Formatters
  - Major Release Changes IFPS 13/14
- WWW-based Training
- NWS Office Visits

New Approaches to Training

- *Rapid development to coincide with releases*
- *Interactive distance-learning approach to involve participants*
- *Foster organizational learning environment and knowledge management*
- *Smaller "chunks" of training to fit into NWS schedules for focal points/forecasters*
- *Larger audience than most other training interest and participation extremely high*

Coming Soon…

- *COMET Boundary Layer Symposium*
- *FY 04 Methodology Workshops*
  - *Western Region/AK Oct 28-30*
- *Changing Priorities*
  - *from User Interface/Configuration*
  - *to Science, Tools, and Initializations*
  - *different needs in different regions*
  - *use of GFE/IFPS software/system*
  - *improved planning/coordination/communication*
  - *more Fire Weather, Marine and Tropical content*
  - *need displaced real-time capability for scenarios, cases, off-line use for operational training*

Digital Forecast Challenges

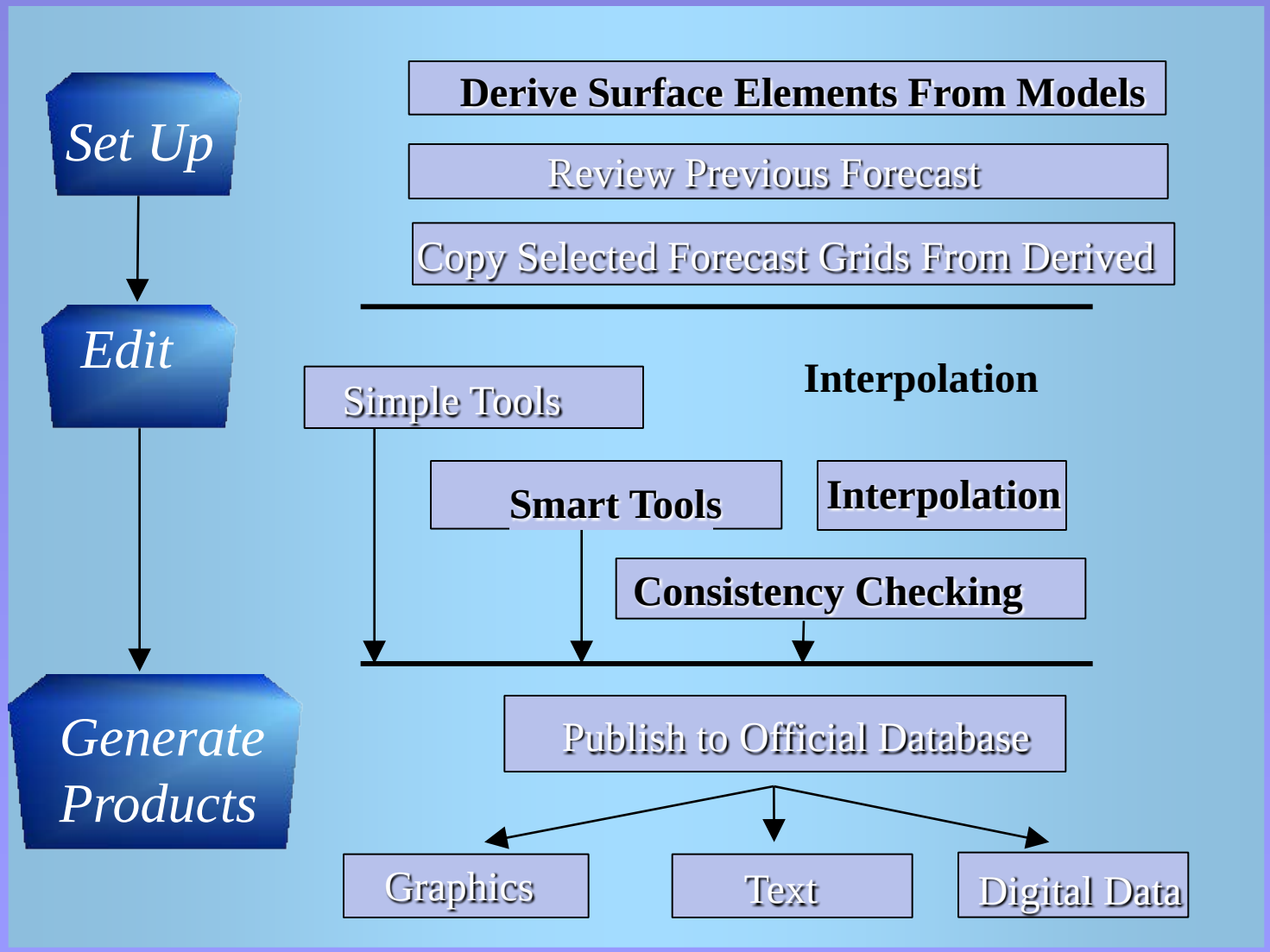
Tom LeFebvre

Sept. 9, 2003

Digital Forecast Challenges

- IFPS lacks necessary SCIENCE
- GFE architecture provides a framework where science can be directly applied
- Science can be applied in several phases of forecast process
  - Deriving SFC grids from models
  - Adjusting the forecast with Smart Tools
  - Temporal Interpolation
  - Forecast consistency

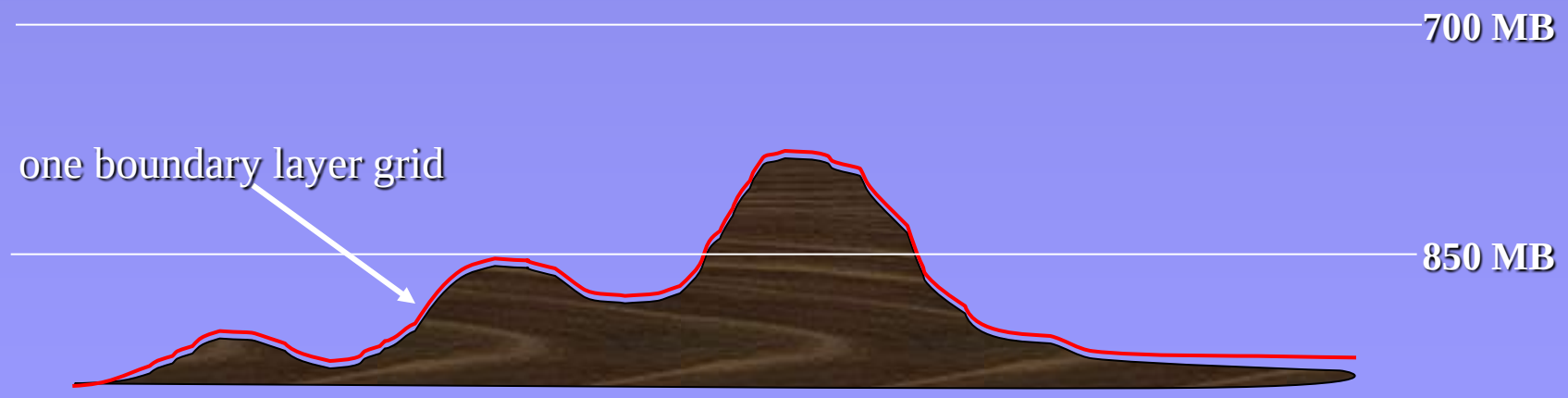
Forecast Process



SFC grids from models

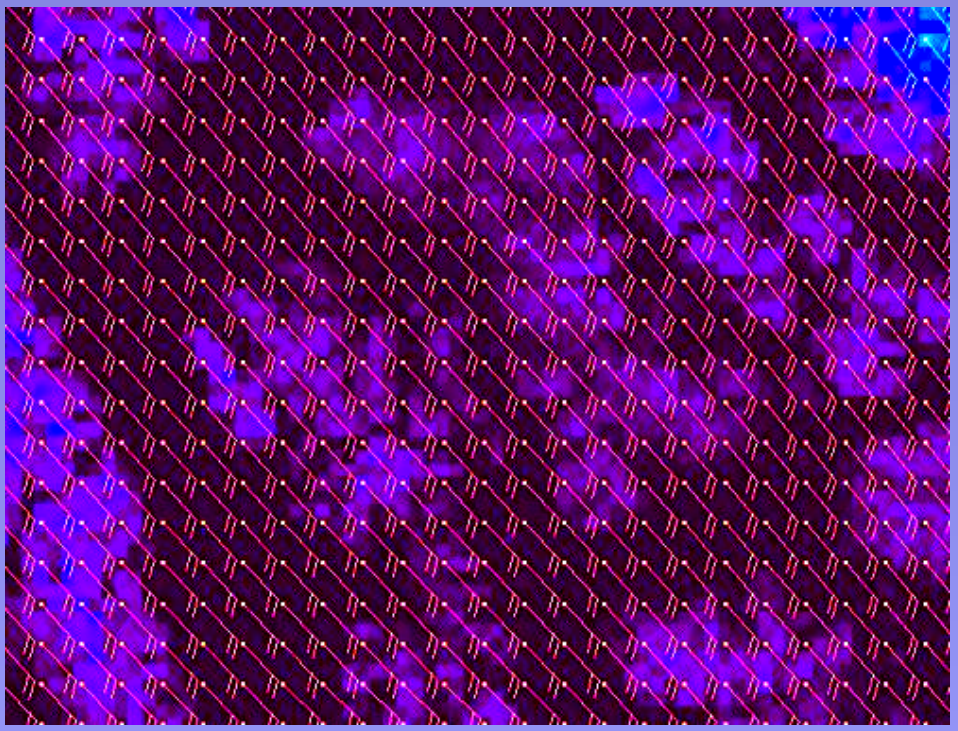
Temperature beyond 84 hours

- Must use GFS (AVN, MRF)
- Poor vertical, spatial resolution

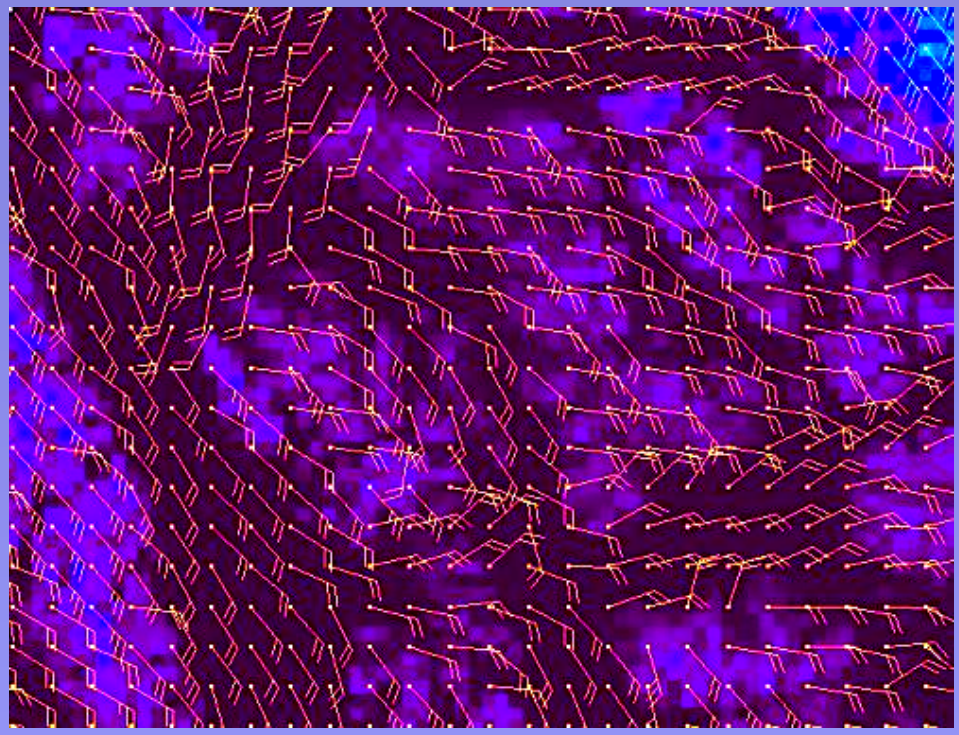


Smart Tool:Terrain-driven Winds

- Juneau, AK reports model guidance too coarse to resolve terrain-driven winds
- Smart Tool is needed to adjust winds based on topography.



Model Winds



Terrain-driven Winds

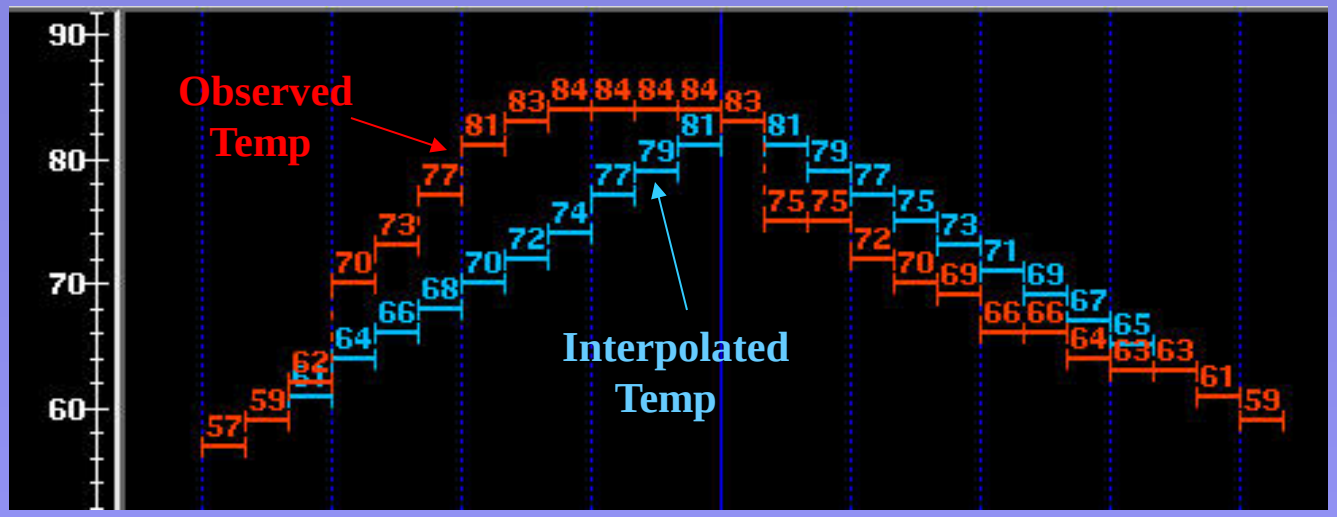
Temporal Interpolation

- Temporal Interpolation needed to “fill-in” time gaps in models.
- Interpolation lacks:
  - Non-linear behavior for diurnal temperatures
  - Good advection component

Temporal Interpolation

Diurnal Temperatures

Linear Interpolation



Cubic spline Interpolation

Temporal Interpolation

- Need for advection component.
  - Sky Cover
  - TPC example

Forecast Consistency

- Many weather elements depend on others
  - Temperature / Dew Point / Sky Cover

Other areas for Science

- Verification
- Probablistic Forecasts
- Climatology
- Marine Services (Waves, Swell)
- RFCs and AWCs may choose digital approach

Conclusion

- Much work accomplished
  - GFE used operationally nationwide
  - In 3 weeks, grids are the official forecast
  - IOC requirements completed
- Much left to be done
  - Better tools for better SCIENCE

Conclusion

- Great opportunity for FSL scientists to apply their research to forecast process
- Focus Group Meeting - Sept. 23, 1:00 p.m.