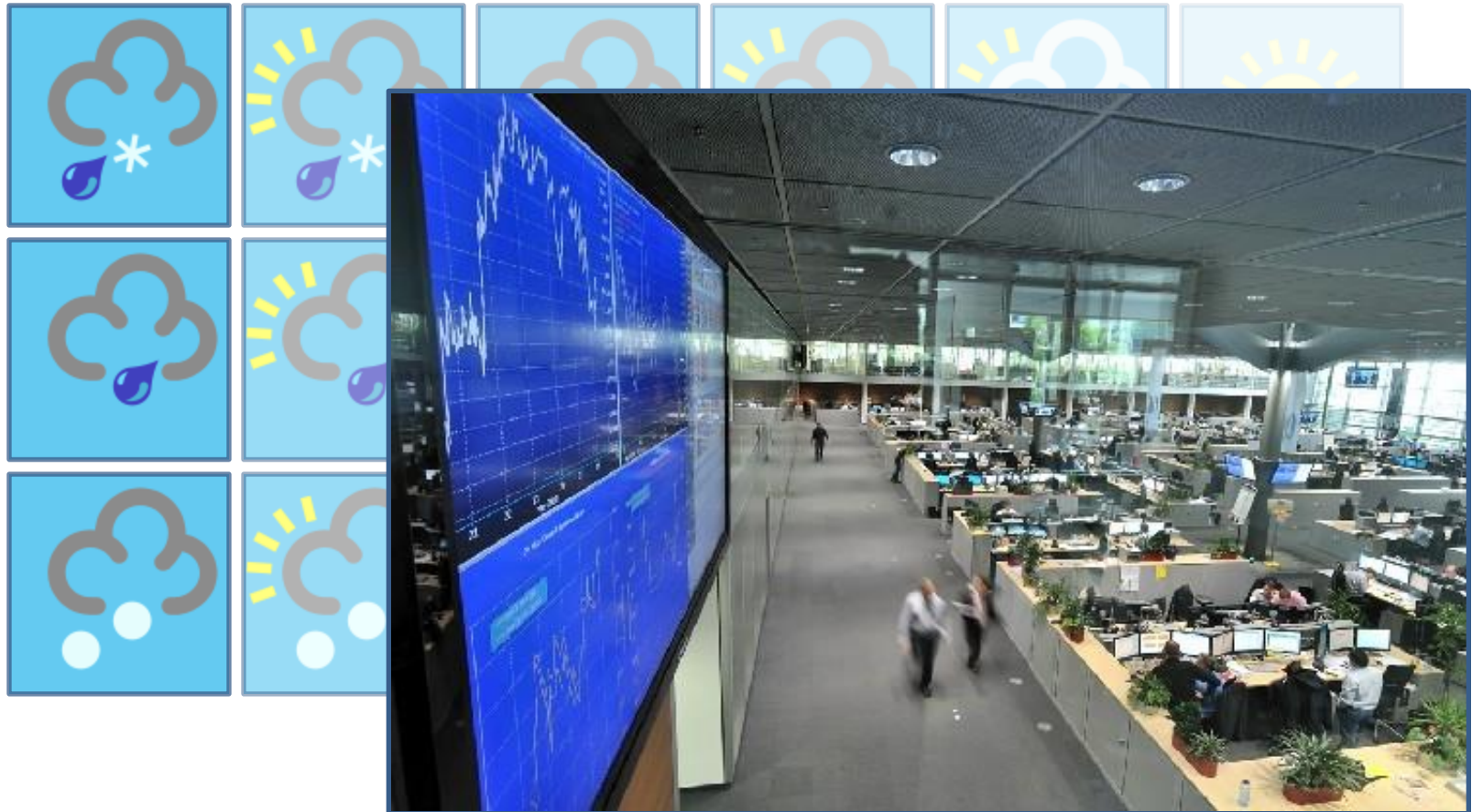


# Speedwell Weather

Topics: *Setting up a weather desk (a shopping list)*

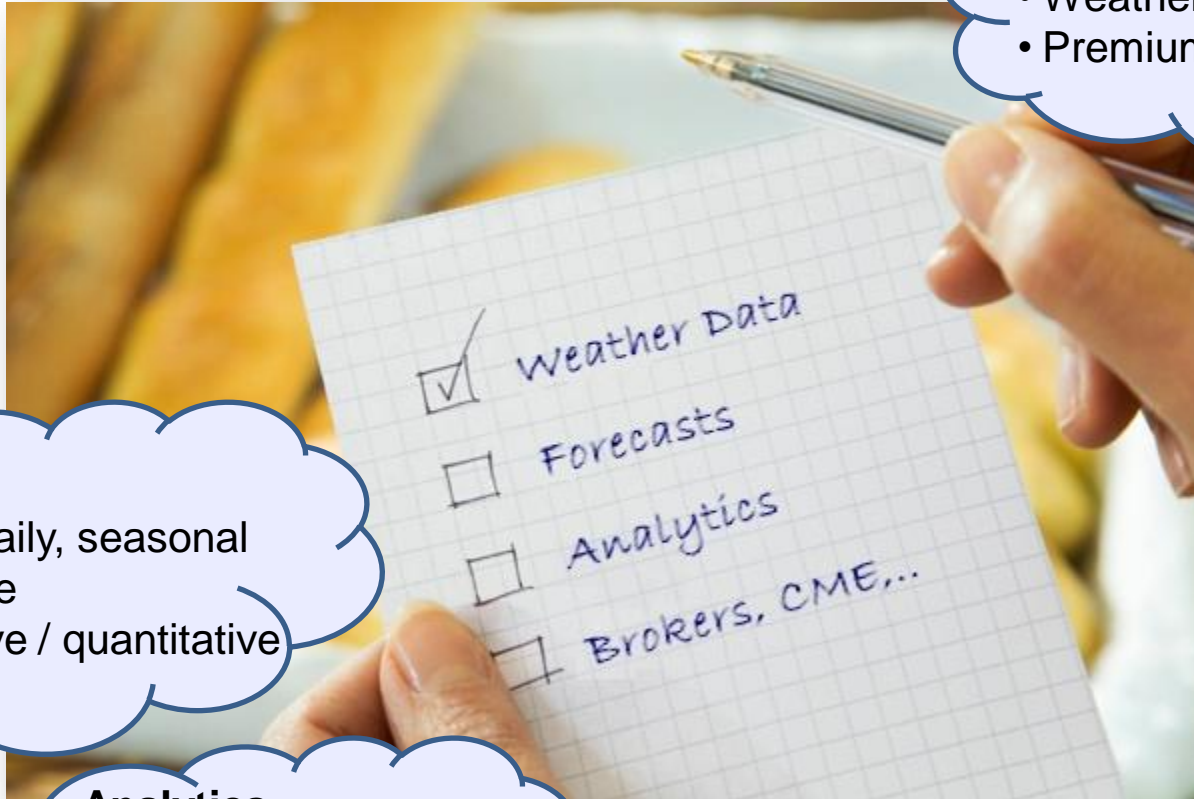
As Presented to the Weather Risk Management Association,  
Dusseldorf September 2011





**Disclaimer: Speedwell Weather provides consulting services (data, forecasts, and software) for the weather risk management market. Yes, we sell these products...**

## Shopping list for a weather desk



### Forecasts

- Hourly, daily, seasonal
- Ensemble
- Qualitative / quantitative

### Analytics

- Contract valuation
- Portfolio management
- Database

### Weather data

- Historical
- Weather Data Feeds
- Premium datasets

**Brokers, CME,  
OTC hedge  
providers...**



# Weather Data

Data

DATA  
DATA  
DATA

*DATA*

Data

**DATA**

**DATA**

**DATA**

Data

**DATA**

**DATA**

```

93AJNVA1100111199999REMI
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04+50730+001600FM-12
1061GF10899108107100
11004501021999MA1999
01REMSYN029 333 6990
KA2999N+00941MA19999
333 10134 20112 9243
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499999V020201N01181
10091+9999REMSYN011
M-12+00749999V02027
0+001600FM-12+007499
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1 20081 60017 91041
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7 333 69927 91137;00
00771KA2999N+00411MA
99999V0203201N0072101
-----

```

## Weather Data

- Without weather data you cannot understand value



## Why is data so important?

### Historical Data

- Pricing based upon historical data (?50 yrs?) – simplest a burn analysis...
- Understanding a location’s climatology

### Ongoing Feeds

- Marking your trade (how is your trade doing?)
- Ongoing updates
- Maintaining a database / looking for trading opportunities

### Settlement Data

- Settling a transaction



## Weather Data – Fundamentals

### Things you should know...

- 1) How do you describe a location?
- 2) What type of data is it?
- 3) What is the observation convention?
- 4) Raw data, cleaned, un-edited, edited?

```

93AJVV21019MILT9999REMI
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M-12+00749999V02027
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-----

```

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe a location?
- 2) What type of data is it?
- 3) What is the observation convention?
- 4) Raw data, cleaned, un-edited, edited?

```

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800004+50730+001600FM
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```

## Weather Data – Understanding your data

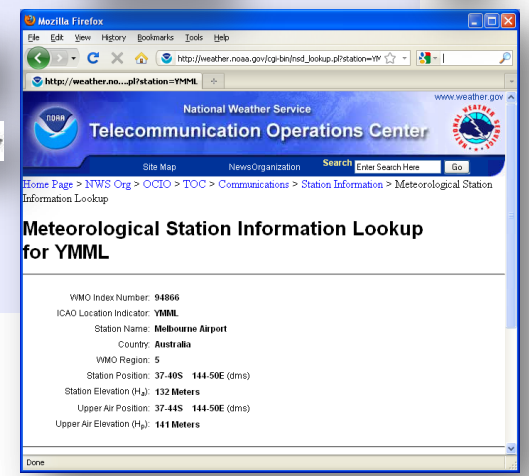
Before using any data ask yourself the following questions...

1) How do you describe a location?

- Weather is observed at weather stations, not cities (Melbourne Tmax)
- Weather stations are described by identifiers (call sign, WMO, WBAN, Coop ID, National Met Service ID,...)
- In general data is observed by National Meteorological Services



- 2) What type of data is it?
- 3) What is the observation convention?
- 4) Raw data, cleaned, un-edited, edited?







```

93AJMUA1000011199999REMI
810042019N0060001N1+
04+50730+001600FM-12
1061GF10899108107100
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01REMSYN029 333 6990
KA2999N-00941MA19999
333 10134 20112 9243
499999V0202001N00871
499999V020201N01181
10091+9999REMSYN011
M-12+00749999V02027
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04+50730+001600FM-12
9999100641MD1310241+
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019N0048001N1+00861+
0841+00831101511ADDA
01010061+9999REMSYN0
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SYNO29 333 69907 910
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99GA1001+999999999GF
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FM-12+00749999V0201
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161031AV251031GF1089
7 333 69927 91137; 00
00771KA2999N+00411MA
99999V0203201N0072101
-----

```

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe a location?
- 2) What type of data is it?
- 4) What is the observation convention?
- 5) Raw data, cleaned, un-edited, edited?



98JMW...L100011799999REMI  
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04+50730+001600FM-12  
1061GF10899108107100  
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01REMSYN029 333 6990  
KA2999M-00941M19999  
333 10134 20112 9243  
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-----154 06

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe a location?
- 2) What type of data is it?

### Climate data

- *generally* highest quality
- originates from a NMS
- additional quality control
- usually corresponds to a full day
- often preferred for weather risk transactions. BUT...

### Synoptic data

- sometimes lower quality
- available where climate data is not available
- limited quality control at source
- partial day?

### Derived Data

- derived from available data (20/24 hours)
- better than nothing

- 3) What is the observation convention?
- 4) Raw data, cleaned, un-edited, edited?



```
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1600FM-12+007499999V  
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1N008219999999N99999  
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-----
```

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe a location?
- 2) What type of data is it?
- 3) What is the observation convention? (how the data is observed)
- 4) Raw data, cleaned, un-edited, edited?



```

93AJMUA110011119999REMI
810042019N0060001N1+
04+50730+001600FM-12
1061GF10899108107100
11004501021999MA1999
01REMSYN029 333 6990
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333 10134 20112 9243
499999V0202001N00871
499999V020201N01181
10091+9999REMSYN011
M-12+00749999V02027
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9000791MA19999990995
0401100821ADDAA10300
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139 92457;EQDQ01 00
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00731+00661100071ADD
999999N999999N1+007
800004+50730+001600FM
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1+00801+00601100801A
8210075019N0250001N1
101041ADDAA199000191
1600FM-12+00749999V
106100199999031001M
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104231ADDAA199000091
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07499999V0200101N003
15004+50730+001600FM
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00209999919990204060
01999999KAL999N+0072
AG149999GF10899106106
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0071100471ADDAA19900
1600FM-12+00749999V
MSYN029 333 10028 20
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0730+001600FM-12+007
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```

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe a location?
- 2) What type of data is it?
- 3) What is the observation convention? (how the data is observed)
  - Midnight-midnight, 0000-0000 UTC, 7am to 7am LST,...

### Australian Data Services



#### Observation Attribute Information

- Daily maximum temperature (day =  $d$ ) = the highest temperature observed over a 24-hour period from 0900 $_d$  to 0859 $_{d+1}$  LST
- Daily minimum temperature (day =  $d$ ) = the lowest temperature observed over a 24-hour period from 0900 $_{d-1}$  to 0859 $_d$  LST
- Daily precipitation (day =  $d$ ) = the total liquid equivalent observed over a 24-hour period from 0900 $_{d-1}$  to 0859 $_d$  LST

- 4) Raw data, cleaned, un-edited, edited?



```

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161031AV251031GF1089
7 333 69927 91137; 00
00771KA2999N+00411MA
99999V0203201N0072101
-----

```

## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

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- 2) What type of data is it?
- 3) What is the observation convention? (how the data is observed)
- 4) Raw data, cleaned, un-edited, edited?



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333 10134 20112 9243  
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499999V020201N01181  
10091+9999REMSYN011  
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5191MA1999999099691M  
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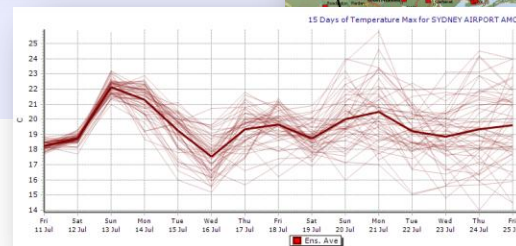
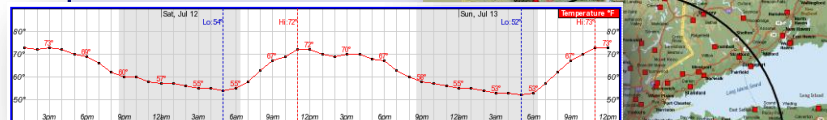
## Weather Data – Understanding your data

Before using any data ask yourself the following questions...

- 1) How do you describe your location of interest?
  - 2) What type of data is it?
  - 3) What is the observation convention? (how the data is observed)
  - 4) Raw data, cleaned, un-edited, edited
- Understanding the QC level is important – certain levels have certain uses (i.e. in the U.S. edited data is used for OTC settlement)

### Cleaned Data

- Weather data is not always of the highest quality
- Missing values and erroneous values are common
- Cleaned data is data that has undergone processing to fill missing values and replace erroneous observations



```

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```

## Weather Data – Premium Data Products

(competitive advantage / *how not to get picked-off*)

### Recalibrated Data © (enhanced data, homogenized data,...)

- Changes to a weather station can impact observations

- closer to the harbour? cooler max / warmer min

- new runway? warmer max & min

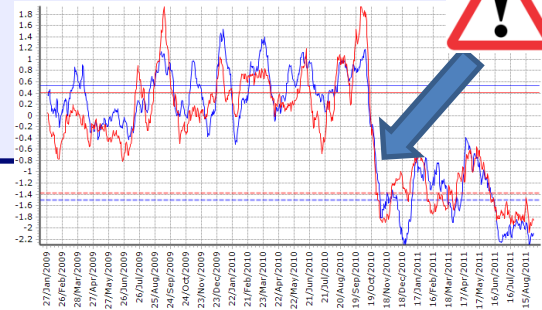
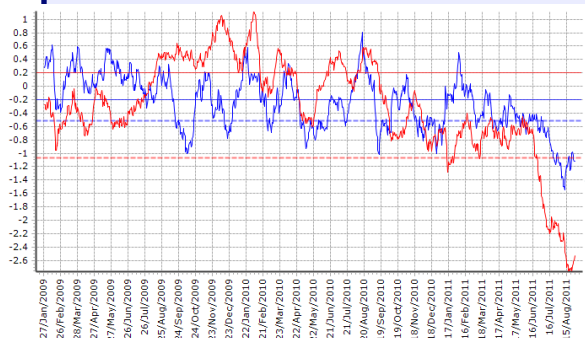
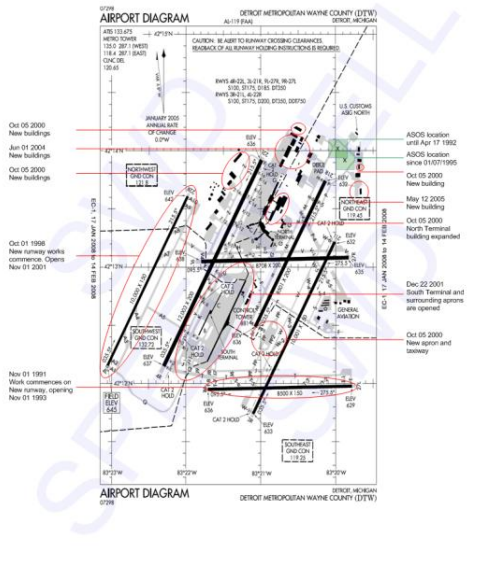
- replacement of thermometer?

- Market participants are aware of these changes / potential changes and are trading to their benefit

- Services exist (3<sup>rd</sup> party) that inform on and quantify the impact of these changes

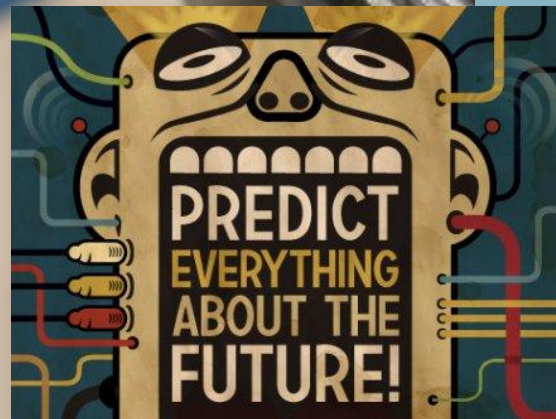
- Analysis is useful in real-time for trading decisions as well as adjusted historical records for more accurate pricing

DETROIT METROPOLITAN WAYNE COUNTY (DTW): 14 February 2008



# Forecasts

~~PREDICT~~  
*the*  
~~FUTURE!~~





## Forecasts– How forecasts are used in this market



- Not at all..eg OTC hedging
  - trade long before the risk period
  - long range trends are viewed as more important
  - but...teleconnection may still be important (El Nino, La Nina,...)



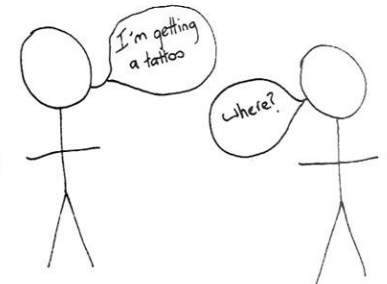
- More accurate pricing
  - relevant when trading within the risk period or close enough that forecasts demonstrate skill



- Trading the forecast
  - some desks have meteorologists that feel their forecasting skills represent a competitive advantage

When using forecasts watch the volatility... using a forecast can artificially decrease the volatility as it attributes certainty that does not exist.

There are ways to address this...



## Forecasts– Types of Forecasts

- Hourly, daily, monthly, and seasonal

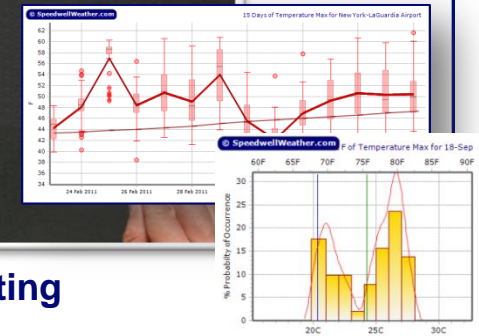
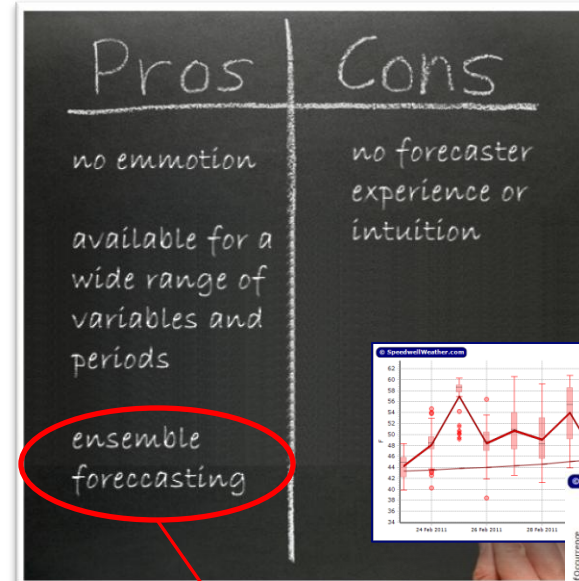
### Qualitative - human driven

- Produced by a meteorologist / group of meteorologists



### Quantitative - statistical product

- Based upon statistics / physics



### Ensemble forecasting

- running the same forecast model multiple times with different initial conditions
- confidence in the forecast decreases if these small changes have a large impact on the outcome
- pricing with the average of the ensembles is not the same as pricing with the ensemble average



## Forecasts– Sources of Forecasts

- National Met Services
- Global models – ECMWF / GFS
- Private vendors



### ECMWF – European Center for Medium Range Weather Forecasting

- 2 releases per day
- ensemble forecasts (51 members)

### GFS (American model) – Global Forecast System

- 4 releases per day
- moves the US energy markets



# Analytics



## Analytics (software – useful tool or unnecessarily complicated?)

What are people using?

- 1) nothing (no analytics)
- 2) spreadsheet
- 3) internally developed tools
- 4) 3<sup>rd</sup> party applications



## Analytics (software – useful tool or unnecessarily complicated?)

### Key functionality to consider

#### Functionality

- Burn
- Detrending
- Modeling
- Portfolio
- Database

### Burn Analysis:

Using historical data to compute statistical averages and standard deviations

$$\text{average} = \frac{\sum_{k=1}^n x_k}{n}$$

Burn = average  
Vol = standard deviation

$$S = \sqrt{\frac{\sum_{k=1}^n (x_k - \bar{x})^2}{n-1}}$$

#### Burn Summary

Atlanta-Hartfield International Airport ; Temperature Ave; HDD; From 01/Mar/2011 To 31/Mar/2011; Call

Num. Of Years	Index Avg	Index StDev	Profit Avg	Non Det. Index Avg	Non Det. Index StDev	Non Det. Profit Avg
1	401.22	0.00	2,006,081.24	393.41	0.00	1,967,071.23
5	313.12	81.06	1,565,588.74	306.03	80.97	1,530,132.33
10	317.52	74.15	1,587,606.59	311.36	74.24	1,556,805.78
20	317.37	84.56	1,586,846.90	313.50	84.57	1,567,484.09
30	316.07	76.45	1,580,339.56	315.64	77.45	1,578,179.23
40	311.90	74.76	1,559,515.05	319.58	76.44	1,597,920.08
61	315.98	76.03	1,579,907.74	342.65	83.91	1,713,256.24

**Problem:** how do you price events that have never happened? Free options? ...

	Burn Analysis
Nothing	
Excel	✓
Internal	<i>probably</i>
3 <sup>rd</sup> party	✓

## Analytics (software – useful tool or unnecessarily complicated?)

### Key functionality to consider

#### Functionality

- Burn
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### Data Detrending:

The statistical process of removing trends from a dataset.

Causes? Urbanisation ?, global warming?,...

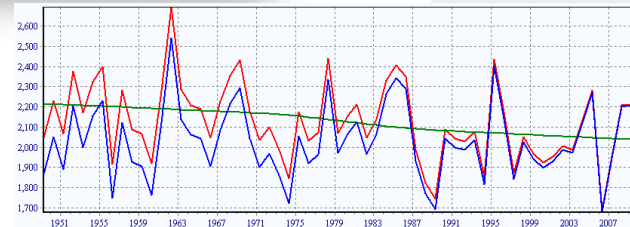
The goal is to make the historical data representative of the current state of the station.

#### Detrend what?

- 1) The underlying data **YES** if critical-day
- 2) The index
- 3) ... or both?

	Data Detrending
Nothing	
Excel	✓
Internal	<i>probably</i>
3 <sup>rd</sup> party	✓

**Note:** trends are not uniform across months



Essen HDD Trend

## Analytics (software – useful tool or unnecessarily complicated?)

### Key functionality to consider

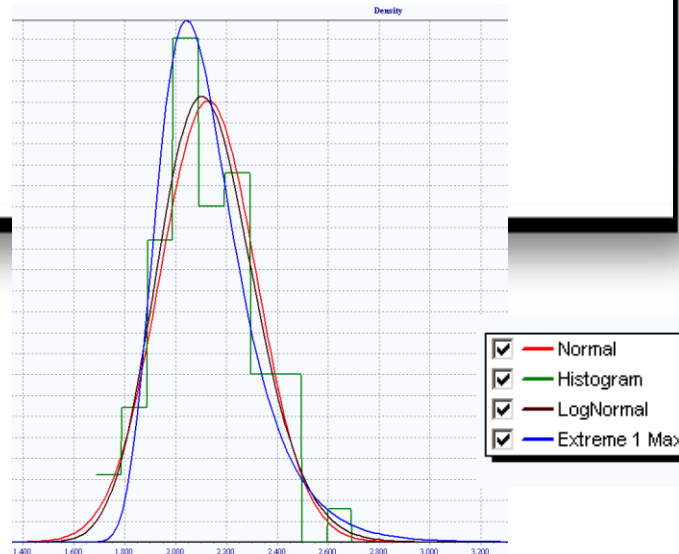
#### Functionality

- Burn
- Detrending
- Modeling
- Portfolio
- Database

#### Modeling:

The process of fitting a distribution to the data.

Provides guidance on pricing events that have not occurred historically but are possible (tails)



	Modeling
Nothing	
Excel	?
Internal	<i>probably</i>
3 <sup>rd</sup> party	✓



# Analytics (software – useful tool or unnecessarily complicated?)

## Key functionality to consider

### Functionality


- Burn
- Detrending
- Modeling
- Portfolio
- Database

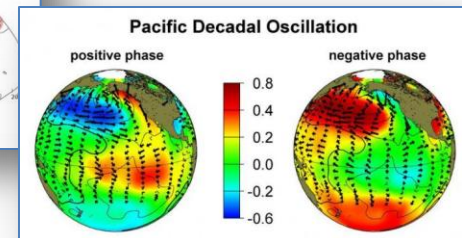
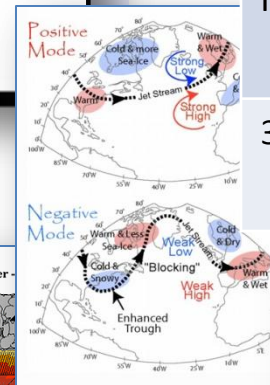
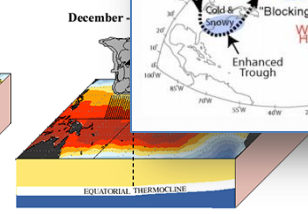
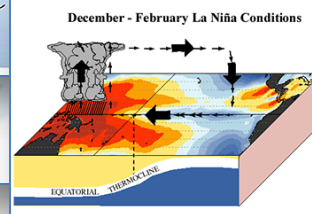
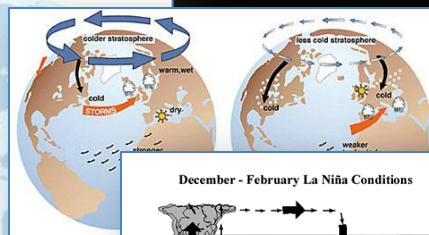
### Portfolio Management:

**By running a large book of weather one can take advantage of the correlated / inversely correlated nature of weather**

**Adding or removing a contract from a portfolio can have significant impact on the overall risk**

**Software can allow for quick pricing against the portfolio to determine the marginal impact of a contract**

	Portfolio Management
Nothing	
Excel	
Internal	<i>maybe</i>
3 <sup>rd</sup> party	



## Analytics (software – useful tool or unnecessarily complicated?)

### Key functionality to consider


#### Functionality

- Burn
- Detrending
- Modeling
- Portfolio
- Database

#### Database Management:

- **Managing weather data**
  - history and feeds, handle different data types, data revisions (!),...
- **Portfolio**
  - data, history, events,...
- **Trade data**
  - who, what, when, where,...
- **Accounting**










	Database Management
Nothing	
Excel	
Internal	<i>maybe</i>
3 <sup>rd</sup> party	

## Analytics (software – useful tool or unnecessarily complicated?)

### Key functionality summary:

**Functionality**

- Burn
- Detrending
- Modeling
- Portfolio
- Database

	Nothing	Excel	Internally developed tools	3 <sup>rd</sup> party solutions
Burn analysis			<i>probably</i>	
Data detrending			<i>probably</i>	
Modeling			<i>probably</i>	
Portfolio management			<i>maybe</i>	
Database management			<i>maybe</i>	



**Brokers**

**CME**

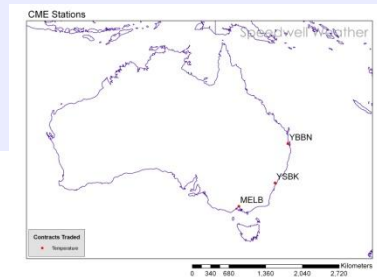
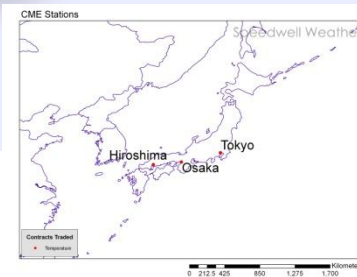
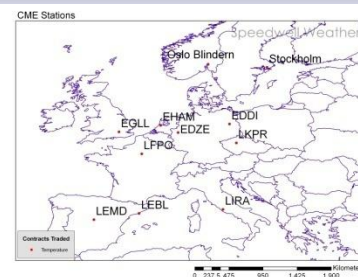
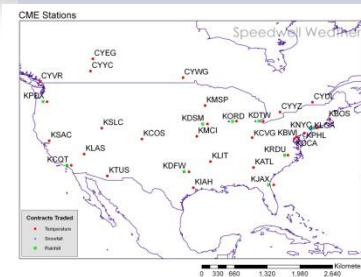
**OTC Hedge Providers**

## Chicago Mercantile Exchange



- Exchange based weather futures and options

- Temperature contracts  
24 U.S., 6 Canadian, 11 European, 3 Japan, 3 Australia (Bankstown, Brisbane Aero, Melbourne Regions)
- Precipitation contracts - 9 U.S.
- Snowfall contracts - 6 U.S.
- Hurricane contracts
- Frost Day contracts



**BROKERS**  
BROKER?





## Contact Us

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