



Glossary

This glossary defines terms related to weather data, weather risk hedging and forecasts. Please contact us with any questions that remain unanswered.

Auto Correlation: the autocorrelation function of a random process describes the correlation between the process at different points in the series..

Average Temperature: in the context of **Climate Data** this is usually the average of the daily Maximum Temperature and daily Minimum Temperature. In some countries, (Germany, Japan) average temperature may refer to the average of 24 hourly measurements. Maximum and minimum temperatures taken from the **SYNOP** network are not always the same as Climate.

Box Plot: a type of chart which communicates statistical information. Used on the Speedwell web site to render probabilistic forecasts. Displays **Forecast Average** and a rectangular box within which half of the members lie and of width "W". Within this box is also displayed the median value. The upper horizontal "whisker" corresponds to 1.5W from the top of the box or the highest of the points within it if lower. The lower horizontal "whisker" corresponds to 1.5W from the bottom of the box or the lowest of the points within it if higher. Outliers beyond the whiskers are shown as dots, unless more than N standard deviations from the average are shown as diamonds.

Burn: an insurance term. Burn analysis involves looking at the historic payout for an insurance product. In the weather risk market, the Burn relates to the historic payout of a given contract. The average of a number of years' of burn can be regarded as one measure of fair value of a weather hedge. It is important to take into account recent weather trends when using Burn.

Call: a type of option. A call pays out when an index settles at a future date above a certain level, the **Strike**. The payoff is proportional to the difference between the final index value and the strike.

Cap: the payout of many weather derivative structures is capped so that it cannot exceed a certain level. A cap might be set to correspond to an all-time historic high for a particular index. The use of a cap in a weather hedge can substantially reduce the cost of protection.

CDD: Cooling Degree Day. Normally calculated as the daily average temperature less a threshold value. This is usually 18C, or 65 F in the USA. Any negative values are ignored and set to zero. CDDs are used, as an example, in the energy market as a proxy for power demand derived from air conditioning. The weather threshold can vary. The CDD forms the basis of the index used in one of the most frequently traded weather hedges (along with **HDD**). Eg if average temperature is 80 F then the contribution of that day to a CDD index is 15. If average temperature is 50F then the contribution of that day to a CDD index is zero.

Climate Data: Climate data are reports of absolute values of temperature, rainfall, sunshine that can be made at any time, and assigned to a calendar day or month. These values are the extreme or cumulative/average events for any particular period, as defined locally. The reporting times vary from country to country and there is no internationally agreed standard..

Climatology: a term often used to refer to "normal" conditions. In academic circles this often means the average value in the period 1961-90 or in the period 1971-2000. Recent trends mean that such definitions are at odds with recent experience. Unless otherwise stated, the climatology used in this web site is derived from the 10-year period calculated to the end of the previous calendar year. Speedwell calculate a "normal" value for each date of the year using this data. To remove noise seen in the daily values which would arise from a simple average calculation, Speedwell use Kernel smoothing, 30 days either side of point with normalized Normal weights. Speedwell climatology uses the period 1998-2007.

CME: Chicago Mercantile Exchange: futures exchange which has listed weather derivatives since 1999. The CME lists contracts in USA, Europe, Japan and Australia

Collar: the buyer of a collar combines the simultaneous sale of a **Put** option and purchase of a **Call** option with same expiry dates.



Control Member: (or Member 1) the first output from a forecast model using initial non-perturbed starting conditions. Other members of a multi-member forecast are then obtained by perturbing the starting conditions within boundaries of likely measurement error.

Correlation Coefficient: a measure of the relationship between two random series. Most often used is the Pearson coefficient which is equal to the covariance of the two series divided by the product of their two standard deviations.

Critical Day: a day on which a weather variable exceeds or meets a threshold (or "trigger"). Often used in weather risk structures. Examples include rainfall where a payout is required for the number of days where rainfall > 10mm or where a payout is required if weather is cold on a particular day (eg $T_{min} < 0$). Structures are often created combining a critical day definition with a call or put. Eg a payout is made if there are more than 10 days where rainfall > 10mm.

Cumulative Average Temperature : the sum of a daily temperature value accumulated over the index period. CME weather derivative contracts for summer periods in Europe are based on the sum of daily average temperatures added over monthly periods

Delta: sensitivity of the value of an option to a change in the value of the underlying.

Deterministic Forecast: a forecast showing a single point value for a given weather variable rather than a range of possible outcomes (see **Ensemble Forecasts**)

Detrending: Weather data, especially temperature data, often exhibits trends. The process of assessing the likely outcome of an index in the future, based on historical data involves identifying this trend and adjusting for it. The detrending method used will depend on the reference site and will involve a subjective assessment.

Down-scaling: the outputs of most weather forecast models are grid based rather than site-specific. For example, the horizontal spatial resolution of the 15-day ECMWF ensemble model is half a degree. The process of relating this raw output to the weather conditions at a specific measuring site can be important when geographical differences create different behaviours within a given grid (eg due to coastal or altitude effects). Modelling this difference is particularly important when that site is used as a reference for settling financial contracts as is the case with some energy and all weather derivative contracts. The process of downscaling can involve a statistical modelling ("MOS") or a further level of physical modelling.

ECMWF European Centre for Medium Term Weather Forecasting. Based in the UK and funded by various European national met offices, ECMWF produces **Deterministic** and **Ensemble Forecasts** covering periods from 15 days to whole seasons for worldwide locations.

Ensemble Forecast: a forecast comprising multiple forecasts ("**Members**") each of which is derived from a climate model initialised with slightly different starting conditions. An ensemble forecast can give information that a single-member ("deterministic") forecast is unable to provide: eg likely range, confidence in the forecast.

Frame: the forecast outputs from the ECMWF and other models are released as discrete files representing each time step of the forecast model run. These are known as "Frames"

Gamma: the change of Delta with respect to the underlying.

GFS: Global Forecast System: a global weather model run by NOAA producing both deterministic and ensemble forecasts four times per day

HDD: Heating Degree Day. Normally calculated as a threshold value less the daily average temperature. This is usually 18C, or 65 F in the USA. Any negative values are ignored and set to zero. HDDs are used, as an example, in the energy market as a proxy for demand for space heating. The weather threshold can vary. The HDD forms the basis of the index used in one of the most frequently traded weather hedges (along with **CDD**). Eg if average temperature is 60 F then the contribution of that day to a HDD index is 5. If average temperature is 70F then the contribution of that day to a HDD index is zero.



Loess/Lowess Regression: a computationally intensive locally weighted polynomial regression. At each point in the series a polynomial is fitted to a range of data around that point where that data may be weighted to emphasise near-by points. Used extensively in detrending weather data for the purposes of pricing weather derivatives.

Log-Normal Distribution: a distribution of a variable where the logarithm of that variable is described by a Normal Distribution

Maximum Temperature (TMax): the highest intra-day measurement of temperature. The period over which it is recorded can be different from country to country and may not always correspond to a full 24 hour period.

Member: In the context of a “multi-member” forecast, sometimes referred to as an **Ensemble Forecast**, a multi-member forecast comprises N individual forecasts. From a given model (eg **ECMWF**) each member is derived by using slightly different initial conditions.

Minimum Temperature (TMin): the lowest intra-day measurement of temperature. The period over which it is recorded can be different from country to country and may not always correspond to a full 24 hour period.

NOAA: National Oceanic and Atmospheric Administration; a US government agency.

Normal Distribution: a symmetrical probability distribution characterised by a mean or average and variance. A high variance indicates high dispersion of possible values from the mean.

Partial Index: the partial index of a weather derivative is that part of an in-period index which has either already happened for which partial historical data is available or the index value which is assumed based on forecasts

Put: a type of option. A put pays out when an index settles below a certain level, the **strike**. The payoff is proportionate to the difference between the strike and the final index value.

Recalibrated Data: A Speedwell data product which adjusts temperature data for discontinuities (eg instrument changes, site moves). As a result, the historic data corresponds to the current conditions prevailing at the reference site. Speedwell provide Recalibrated Data for a range of important reference sites on which energy demand is modelled and on which weather derivatives are frequently traded. These changes can be material and may greatly impact the interpretation of what constitutes "normal" conditions.

Strangle: the buyer of a strangle buys a combination of a Call and a Put. Each is associated with its own **Strike**.

Strike: the level above which a **Call** option starts to pay out or below which a **Put** option starts to pay out. In the case of a swap, the strike represents the level at which parties agree to swap payments. Eg if A buys a swap from B with strike x and the index settles at x+10 then A receives 10 multiplied by the tick size from B. If the index settles at x-10 then B receives 10 multiplied by the tick size from A.

Swap: in the context of the weather risk market a swap is a transaction in which counterparties exchange payments at a certain level. e.g. if A buys a swap from B with **Strike** x and the index settles at x+10 then A receives 10 multiplied by the tick size from B. If the index settles at x-10 then B receives 10 multiplied by the **Tick Value** from A. In almost all cases the market “price” of a swap is actually the strike at which the contract is worth zero.

SWD: Speedwell Weather Derivatives Limited, a company listed in England and Wales, and incorporated in 1999; company no. 03790989. Authorised and regulated by the Financial Services Authority since 2001, number 190653. SWD advises on weather risk hedging, structure and acts as intermediary in the placement of weather transactions.

Theta: the change in the value of an option with respect to time.

Tick Value: The financial value attributed to each index point. For example, a construction business may be aware of a probable loss for each freezing day of \$ 100,000. The firm might then consider a **Call** option on the number of such freezing day in winter with a Tick Value of \$ 100,000



VaR: Value at Risk. Associated with a probability. Eg a 99%VaR of \$ -1mln indicates in 99% of cases the profit and loss will be more than or equal to \$ -1mln.

Vega: the change in option price with respect to **Volatility**

Volatility: - In the weather market the volatility is understood as the standard deviation of the index and is not the standard deviation of the log return of an asset price as is the case for other financial derivatives.

SYNOP data: SYNOP reports are observations that are made at internationally agreed times. The regulations and practices are laid down by WMO (World Meteorological Organisation) and adhered to by all NMS (National Meteorological Services). For example temperature and rainfall are reported at the following times: Tmin is reported at 0600 UTC for the previous 12 hours; Tmax is reported at 1800 UTC for the previous 12 hours; Rainfall is reported at 0600 and 1800 UTC for the previous 12 hour periods

WD: abbreviation for **Weather Derivative**

Weather Derivative: a financial instrument which provides a payout based on the value of a weather index. The origins of the weather market lie in hedging energy demand but the weather market now covers hedging needs of energy, agriculture (eg proxy yield hedges) and hospitality (eg rainfall protection for outdoor events). While structured, client-specific transactions are usually traded over-the-counter, the Chicago Mercantile Exchange lists weather derivative contracts based on HDD and CDD indices for over reference sites world-wide. As "parametric" structures, weather derivatives are not indemnity based meaning there is no requirement to demonstrate a loss and no process of loss-adjustment. Settlement is therefore rapid.



Further Information

Regarding world-wide weather data and forecast matters please see www.SpeedwellWeather.com or contact:

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