Introduction of making guidance and selecting predictors

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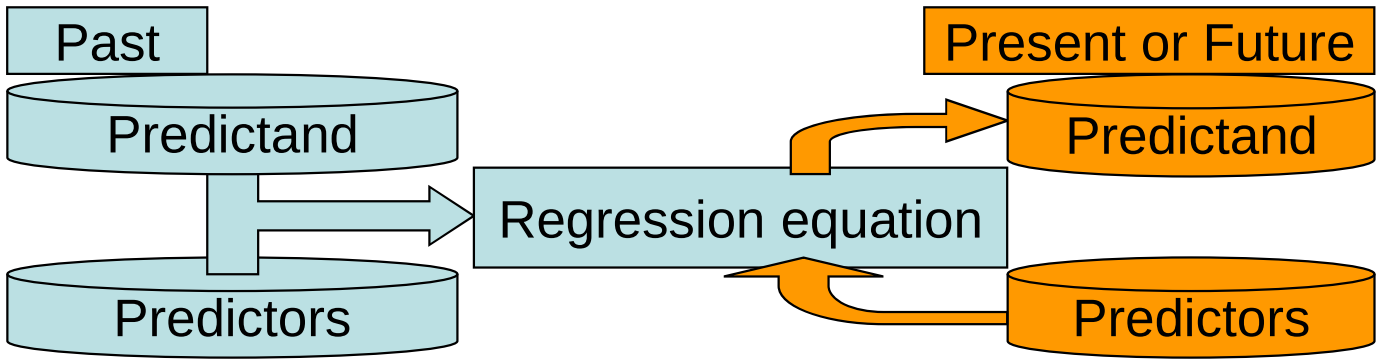
Introduction

- “Guidance” to be used in this seminar means a statistical downscaling technique from GPV data.
- For seasonal forecast, the indices associated with El Niño phenomenon may be more effective.
- The purpose of this exercise:
  To understand how to make guidance in your countries.

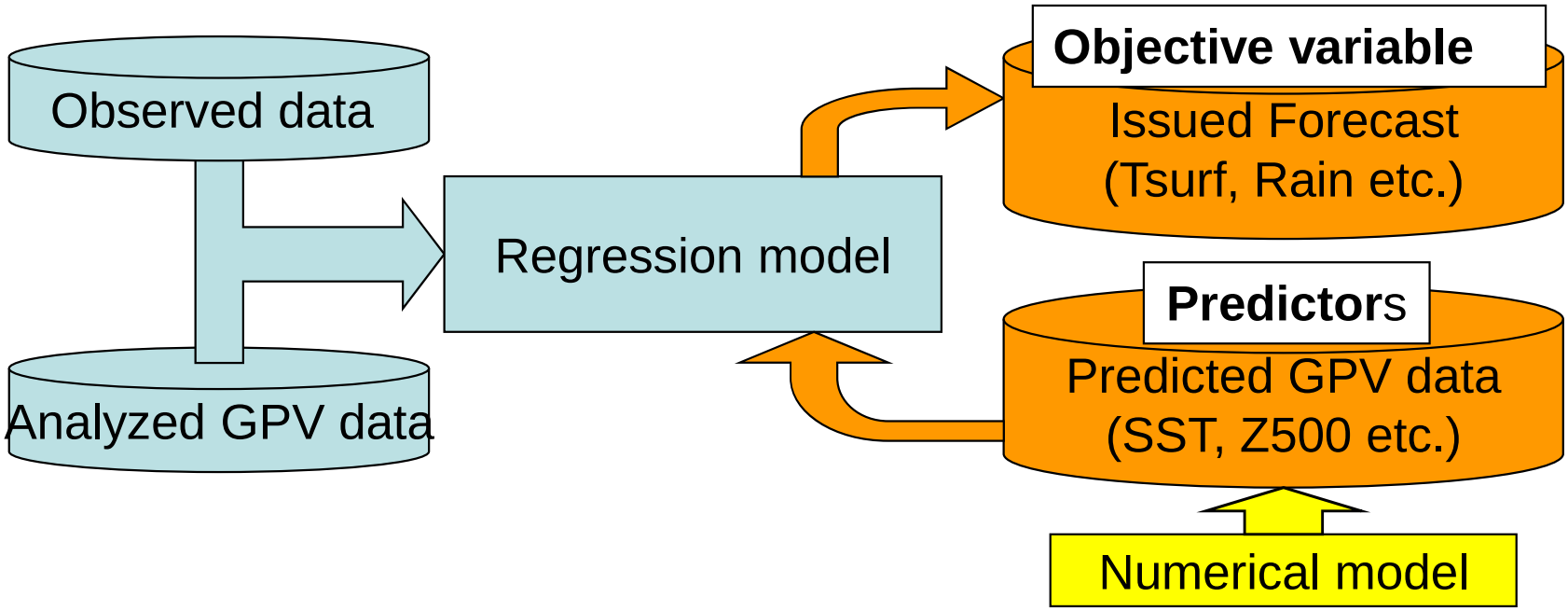
Regression model

- We have two kinds of time series.
  - Meteorological variable for issued forecast (Objective variable, i.e. Predictand)
  - Variable that is obviously related to the former (Predictors)
- Regression model predicts the future value of predictand using the future or present values of predictors and the relationship between predictand and predictors.



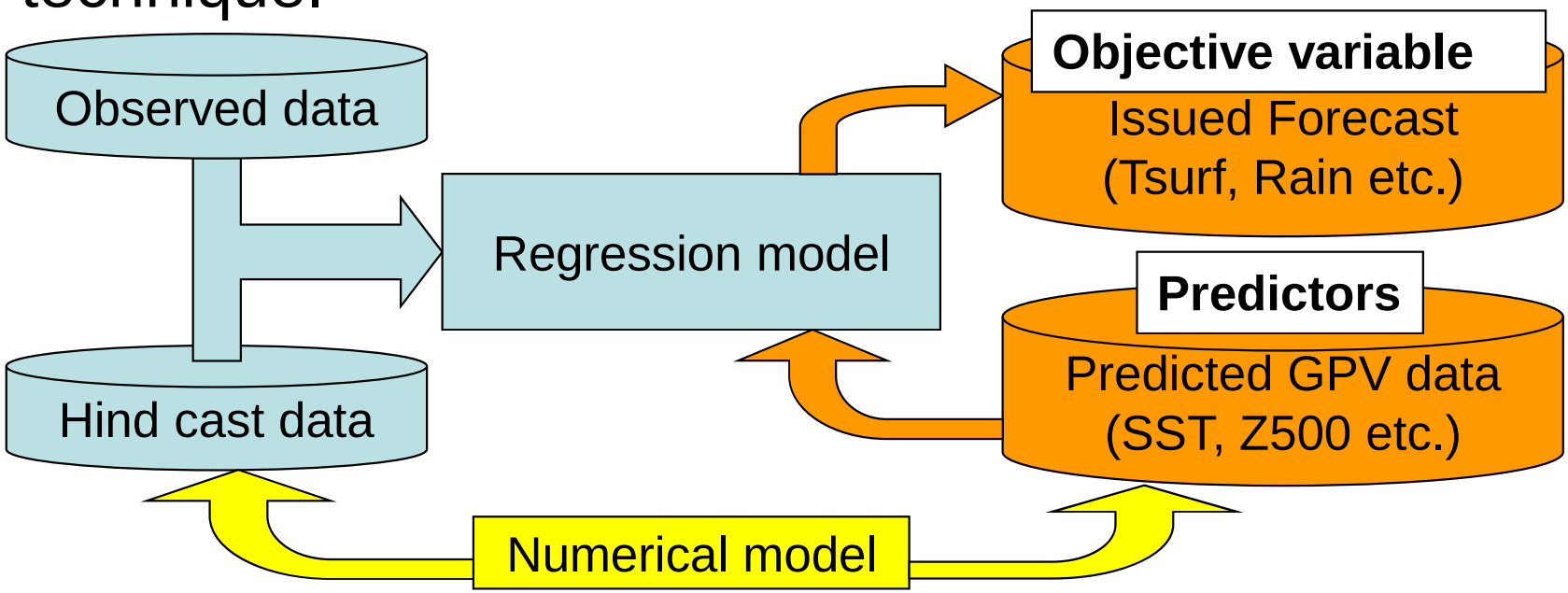
Regression model

- **PPM**: the Perfect Prognostic Method
  A statistical relationship is established between observed values and the analyzed predictors from the free atmosphere.



Regression model

- **MOS**: the Model Output Statistics technique.
  A statistical relationship is established between observed values of the predictand and forecast predictors, both from the surface and the free atmosphere.
  If the model has a tendency to under- or over-forecast any predictor, this will be compensated for by the MOS technique.

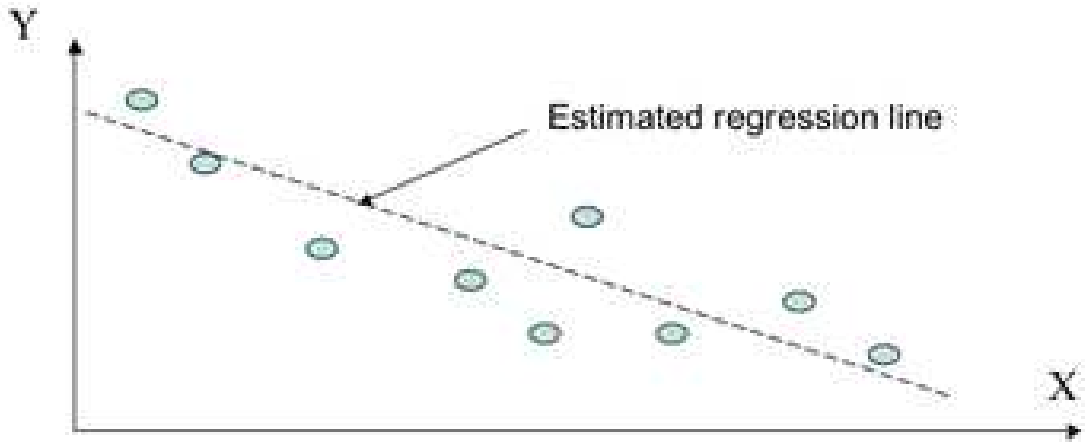


Single regression model

- Single regression is the simplest regression using one predictor.
- Single regression model is written as

$$Y = aX + b + \varepsilon$$

Y: predictand X: predictor
a: regression coefficient b: constant
ε: error term



Multiple regression model

- A predictand is assumed to be the sum of a linear combination of predictors.
- Multiple regression model is written as

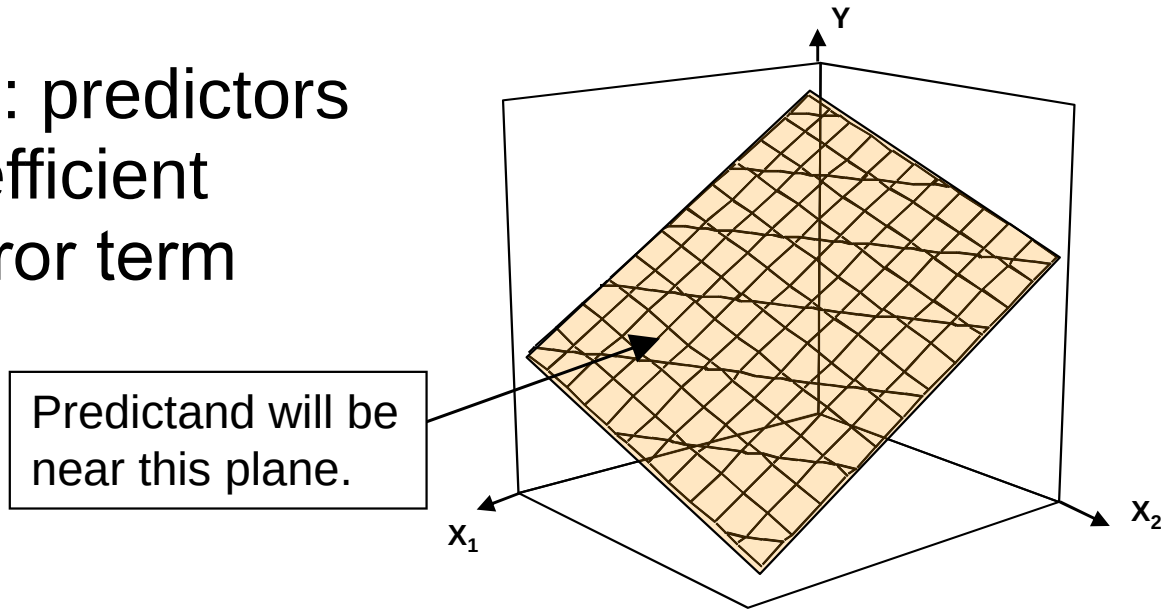
$$Y = \sum a_k X_k + b + \varepsilon$$

k=1,2,…,n

Y: predictand X: predictors

a: regression coefficient

b: constant ε: error term



One case with 2 predictors

Method of variable selection

- Seasonal forecast Guidance of JMA uses multiple regression model by the MOS technique.
- Predictors are selected by the stepwise procedure from among the elements that were investigated in relation to climate in Japan.

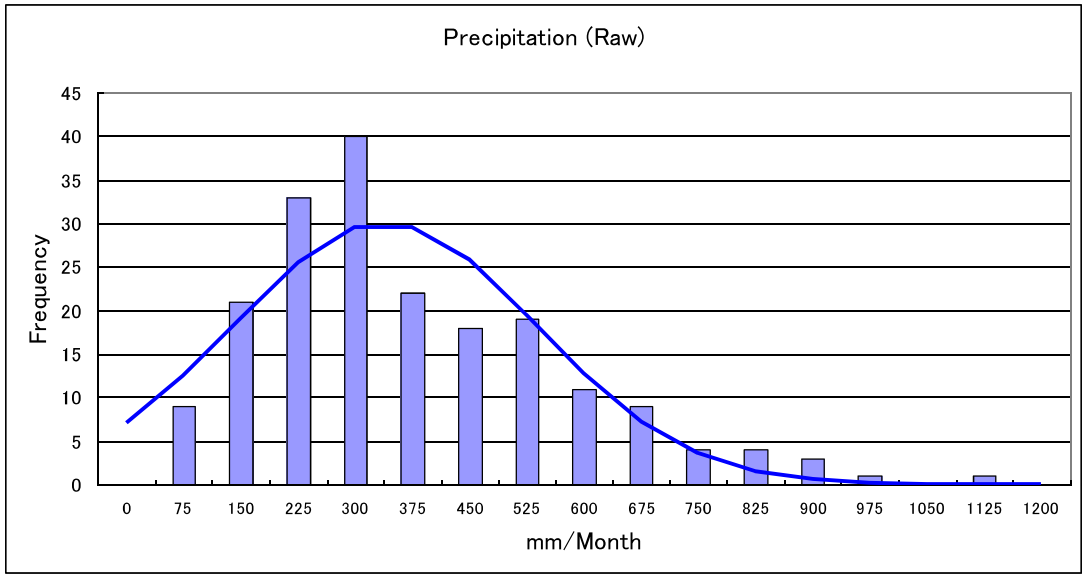
List of predictors the most commonly used in JMA seasonal forecast guidance

These predictors are anomaly, except Thickness Middle.

Temperature	Spring	Thickness Middle	IOBW RAIN	IOBW SST
	Summer	Thickness Middle	Okinawa SST	IOBW SST
	Autumn	Thickness Middle	IOBW SST	NINO.3 SST
	Winter	Thickness Middle	IOBW SST	Okinawa SST
Precipitation	Spring	IOBW RAIN	500hPa height over the east of Japan	WNP RAIN
	Summer	IOBW RAIN	NINO.3 SST	IOBW SST
	Autumn	IOBW RAIN	Okinawa SST	500hPa height over the east of Japan
	Winter	NINO.3 SST	Okinawa SST	Zonal mean 500hPa height of Mid lat

Normalization of precipitation

- The error distribution of regression model is assumed Gaussian distribution. This distribution is important to make a probabilistic forecast.
- Precipitation data have a gap from Gaussian distribution. Its histogram tends to be like Gamma distribution. So, it is necessary to normalize precipitation data.



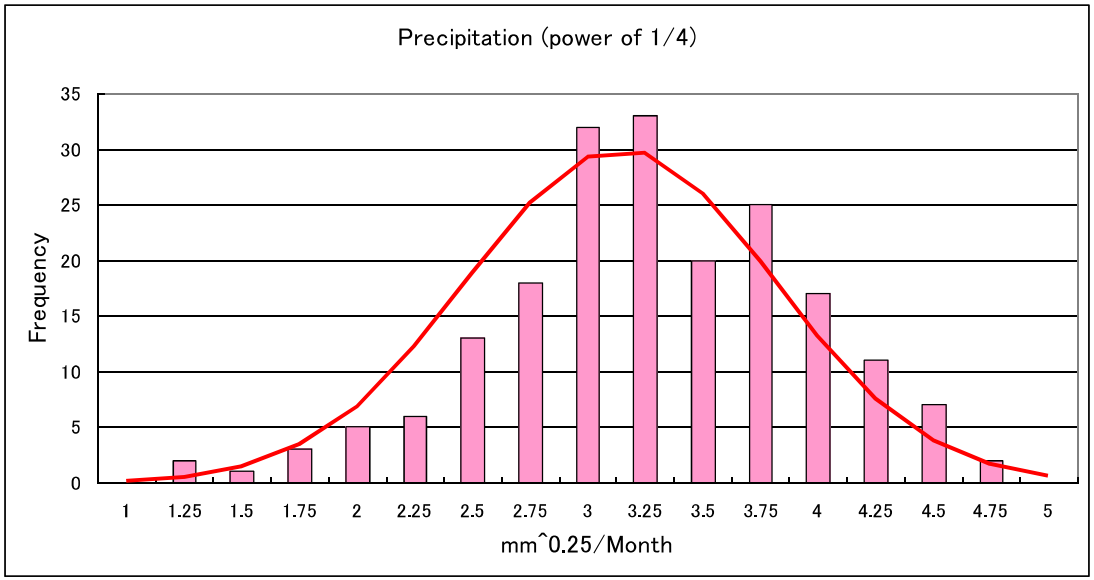
Histogram of Precipitation

Raw precipitation data have a gap from Gaussian distribution.

Bold lines indicate Gaussian distribution.

Normalization of precipitation

- The simplest method is power technique.
- JMA seasonal forecast Guidance is used the power of 1/4 for precipitation and snowfall.
- For issued forecast, it is necessary to take power of 4^{th} to the predictand.



Histogram of Precipitation after taking power of 1/4.

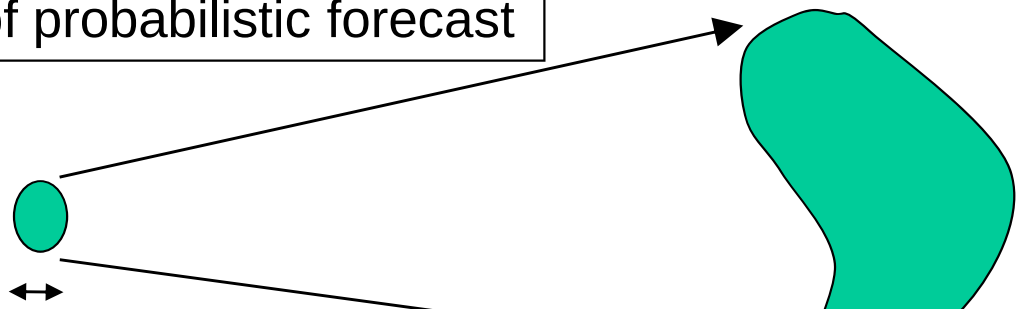
The histogram fit Gaussian distribution.

Bold lines indicate Gaussian distribution.

Probabilistic Forecast

- Seasonal forecast has uncertainty due to chaotic character of the atmospheric flow.
- To take into account uncertainty of forecast, the best method is the probabilistic forecast.

Image chart of probabilistic forecast

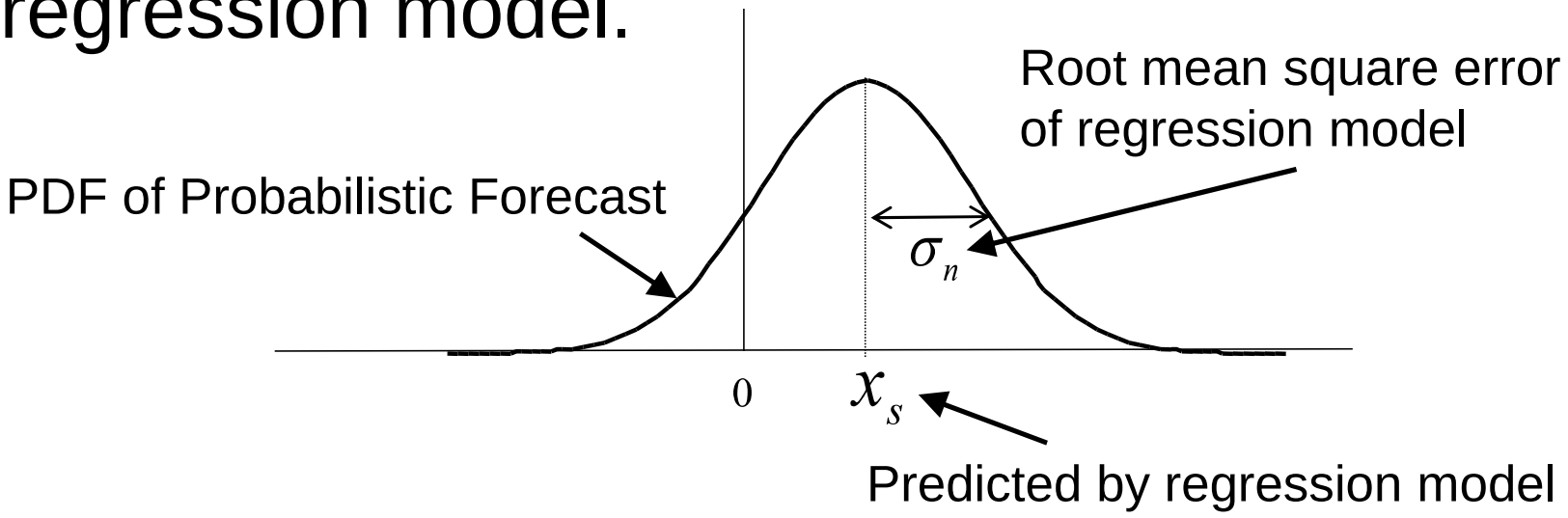


Probability density function corresponding to initial analyzed value and error

Predicted probability density function

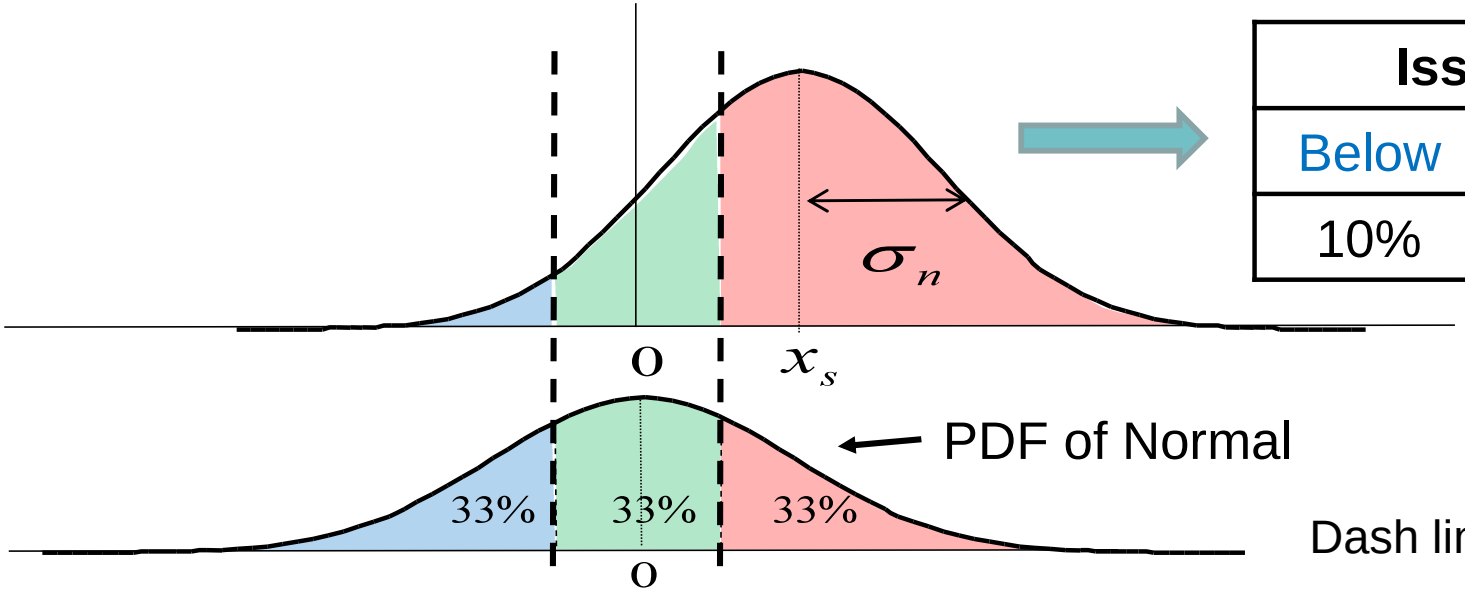
Probabilistic Forecast

- The Probability Density Function (PDF) is assumed as Gaussian distribution with mean x_s and standard deviation σ_n.
- The mean x_s is predicted by single/multiple regression model and standard deviation σ_n is assumed as root mean square error of regression model.



Probabilistic Forecast

- Probabilistic Forecast of JMA has 3 categories, Below Normal, Near normal and Above Normal.
- The threshold value is determined from observational data of 30 years. JMA use the data of 1971-2000, and the data will be changed 1981- 2010.

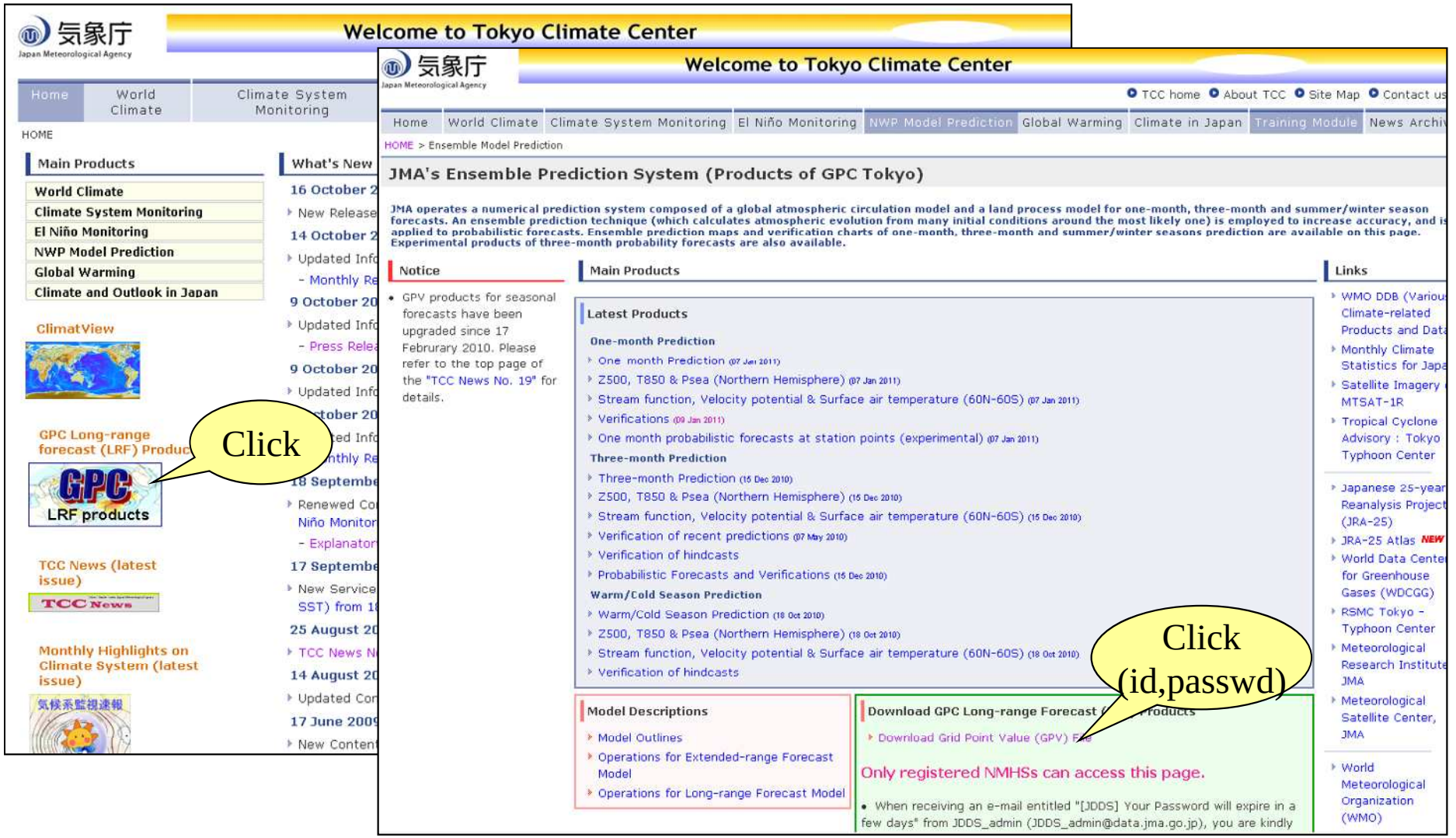


Issued Forecast		
Below	Normal	Above
10%	30%	60%

Dash lines: threshold value

Introduction of TCC website

- GPV data of Hind-cast and Model Prediction are provided on TCC site (http://ds.data.jma.go.jp/tcc/tcc/index.html).



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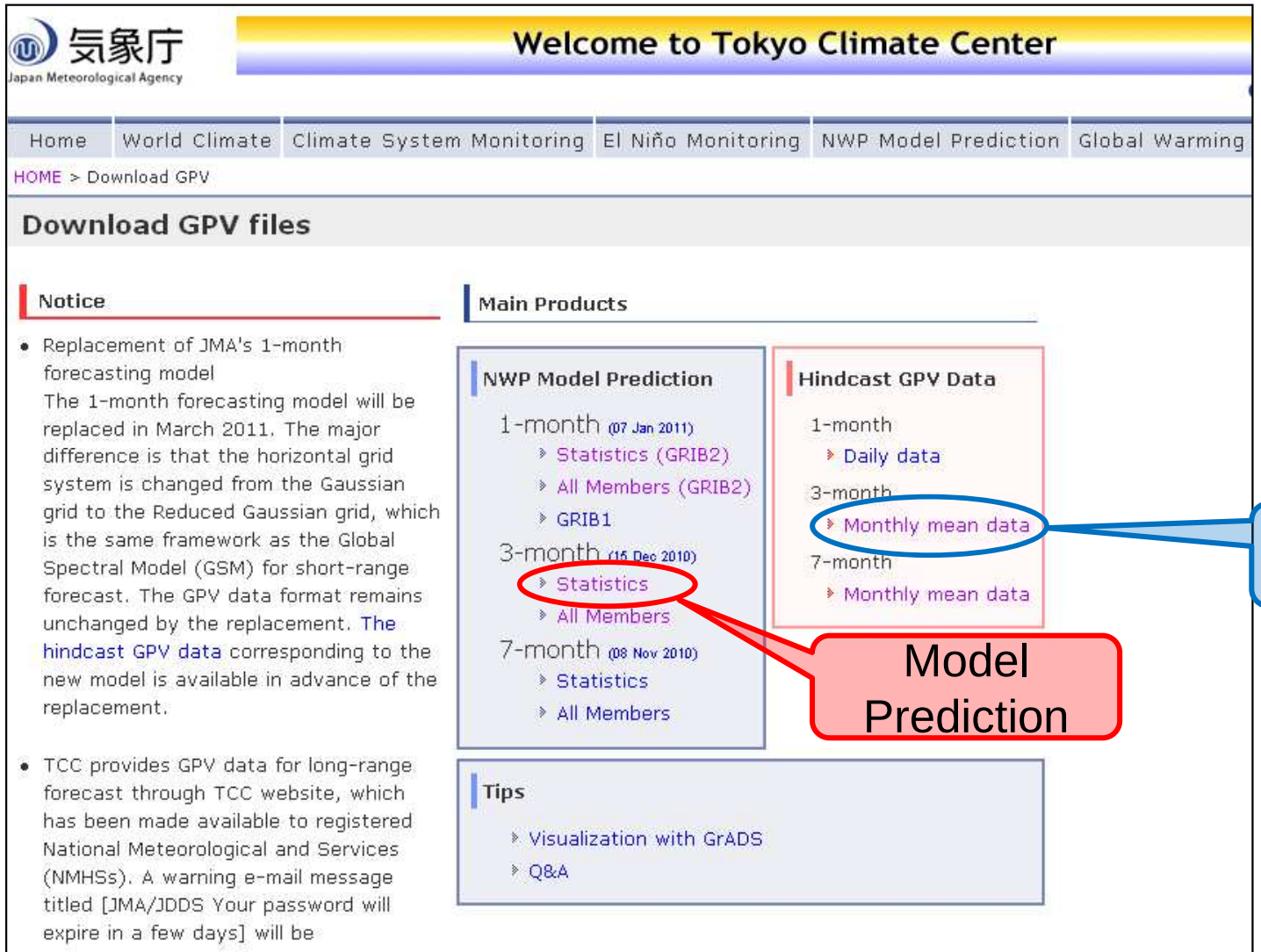

Thank you
for your attention