



What is one-month forecast guidance?

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Outline

1. Introduction
2. Purposes of using guidance
3. Regression method
 - Single/Multi regression model
 - Selection of variables
 - Normalization of precipitation data
4. Probability Forecast

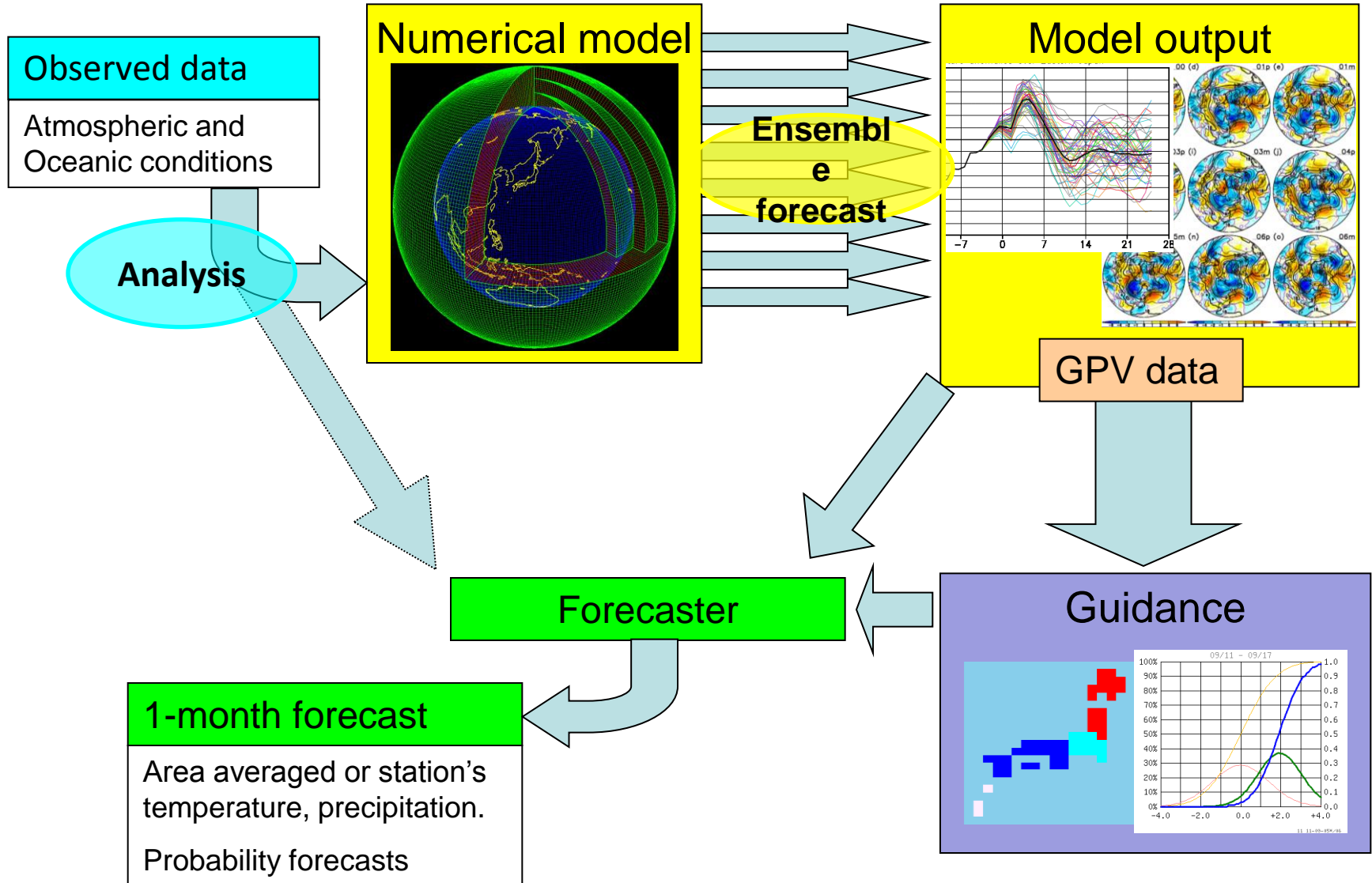


1. Introduction

- “Guidance” is a statistical downscaling technique based on grid point value (GPV) data predicted using a numerical model.
- “Guidance” has a possibility to increase reliability of forecasts.
- “Guidance” for 1-month forecasting uses several elements (Tsurf, Z500 etc.) over the targeted area.



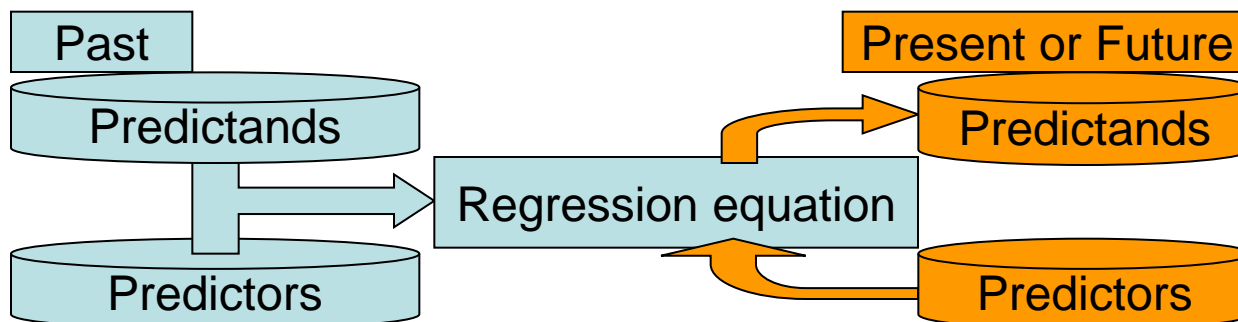
2. Purposes of using guidance





3. Regression method

- Two types of time series data are used to make guidance.
 - variables for forecasts, ex) Temperature, Precipitation (Objective variables, i.e. Predictands)
 - variables predicted by a model, ex) Z500, Wind (Explanatory variables, i.e. Predictors)
- Our purpose is to predict the future value of predictands using the statistical relationship between predictands and predictors.



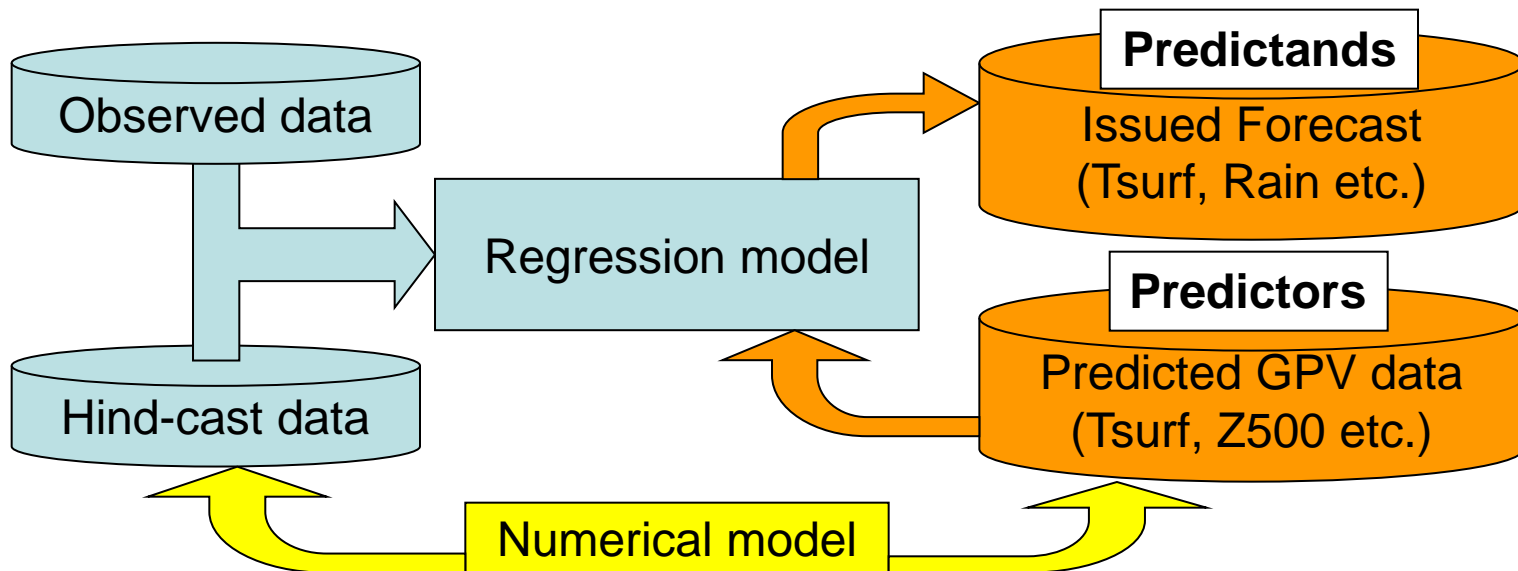


3. Regression method

- MOS: the Model Output Statistics.**

MOS is a technique used to objectively interpret numerical model output and produce area-specific guidance.

A large data set of observations is compared with the historical model forecast (hind-cast data). The regression model “learns” the differences and calibrates these errors in future forecasts.





Single regression

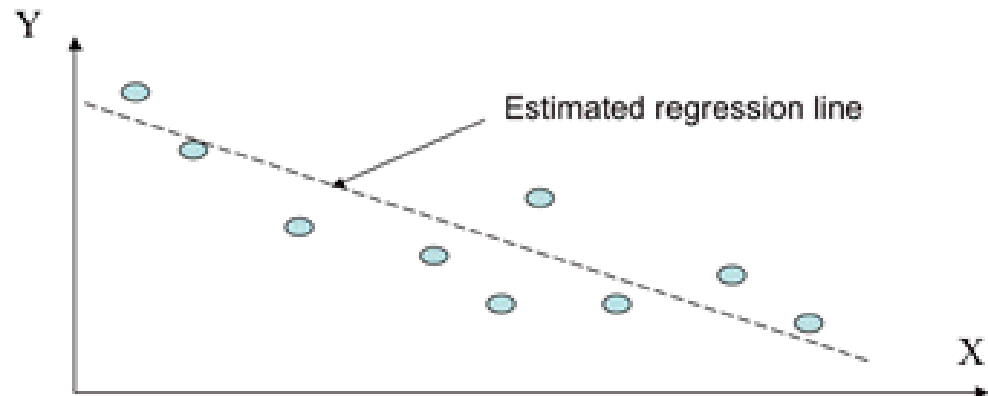
- Single regression is a predictive approach using a single predictor.
- Single regression model is written as

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

Y: predictand X: predictor

a: regression coefficient b: constant

ε : error term





Multiple regression

- Multiple regression is assumed that predictands are the sum of a linear combination of plural predictors.

- Multiple regression model is written as

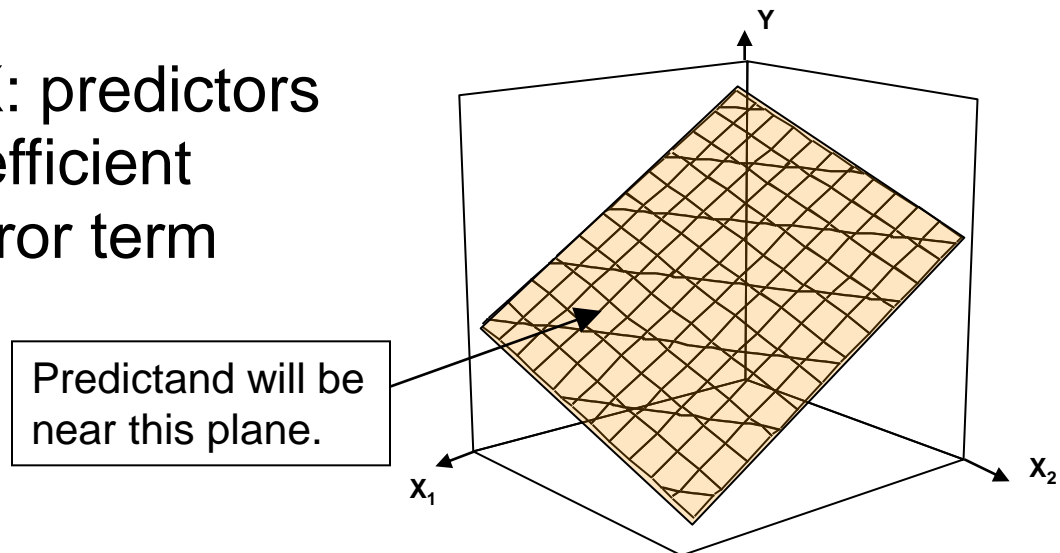
$$Y = a_k X_k + b + \varepsilon$$

$k=1,2,\dots,n$

Y: predictand X: predictors

a: regression coefficient

b: constant ε : error term



Example: two predictors



Selection of variables

- In JMA's guidance, predictors are selected by the stepwise procedure. The predictors have been investigated in relation to the climate in Japan.
- In this training, we select predictors based on the correlation coefficient.

List of predictors used in JMA's one-month forecast guidance
(Initial date : 31 Oct. , For eastern Japan)

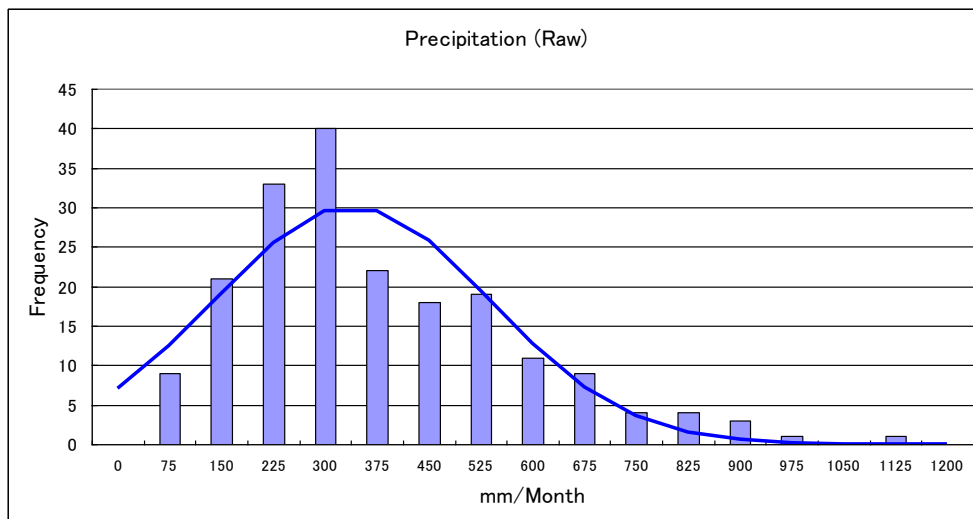
These predictors are anomaly. ○: in use - : out of use

	Rain	Wind850	Tsurf	Wind500	Z500
Temperature	-	-	○	-	-
Precipitation	○	○	○	-	-
Sunshine duration	○	-	○	○	○



Normalization of precipitation data

- Temperature histogram is generally approximated by a normal distribution, while precipitation histogram is usually approximated by a gamma distribution.
- The error distribution of regression models is assumed to be approximated by a normal distribution, which is important presumption to make a probabilistic forecast.



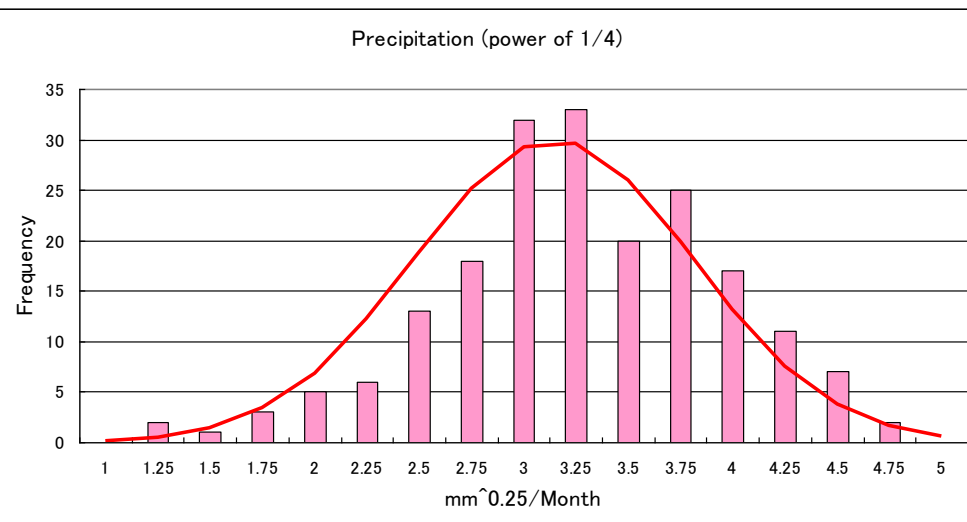
Histogram of observed monthly precipitation have a gap from a normal distribution.

Bold line indicates a normal distribution.



Normalization of precipitation data

- To make guidance, precipitation data need to be normalized.
- To achieve this, JMA's seasonal forecast guidance uses a power of 1/4 for precipitation (rainfall and snowfall).



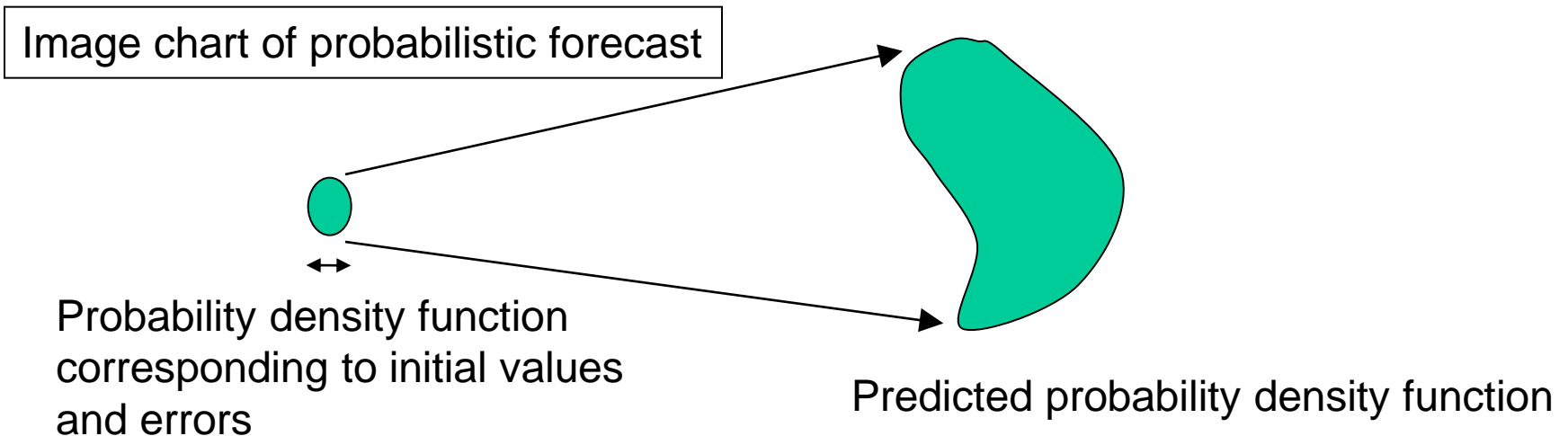
Histogram of observed precipitation after taking power of 1/4 is approximated by a normal distribution.

Bold line indicates a normal distribution.



4. Probability Forecast

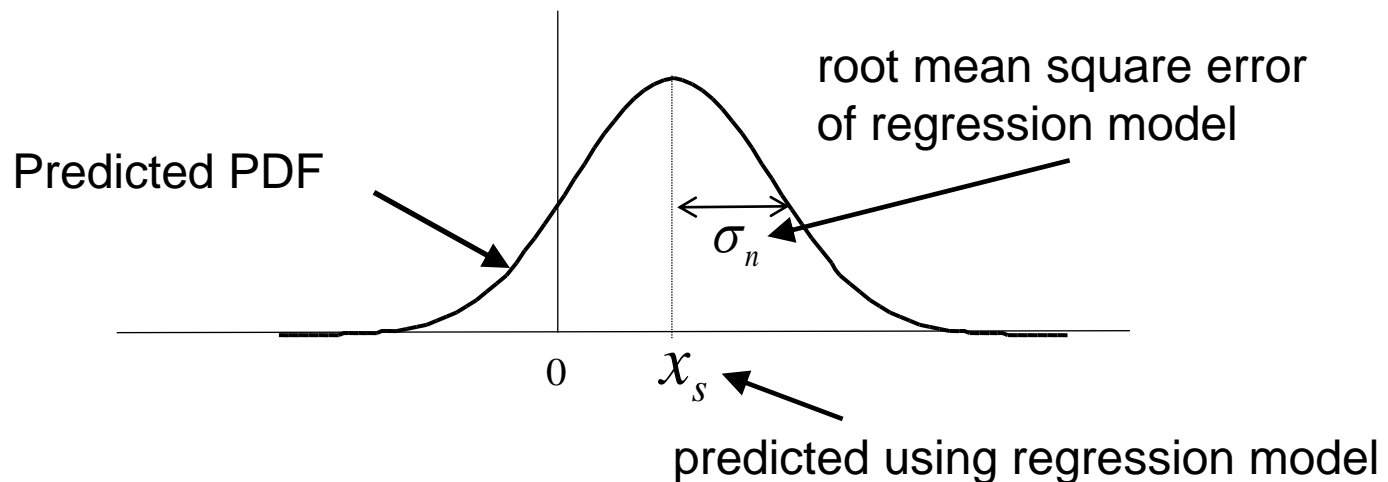
- Long-range forecasting involves the uncertainty due to the chaotic nature of atmospheric flow.
- It is necessary to take this uncertainty into account, and probabilistic forecasting is essential.





Probability Forecast

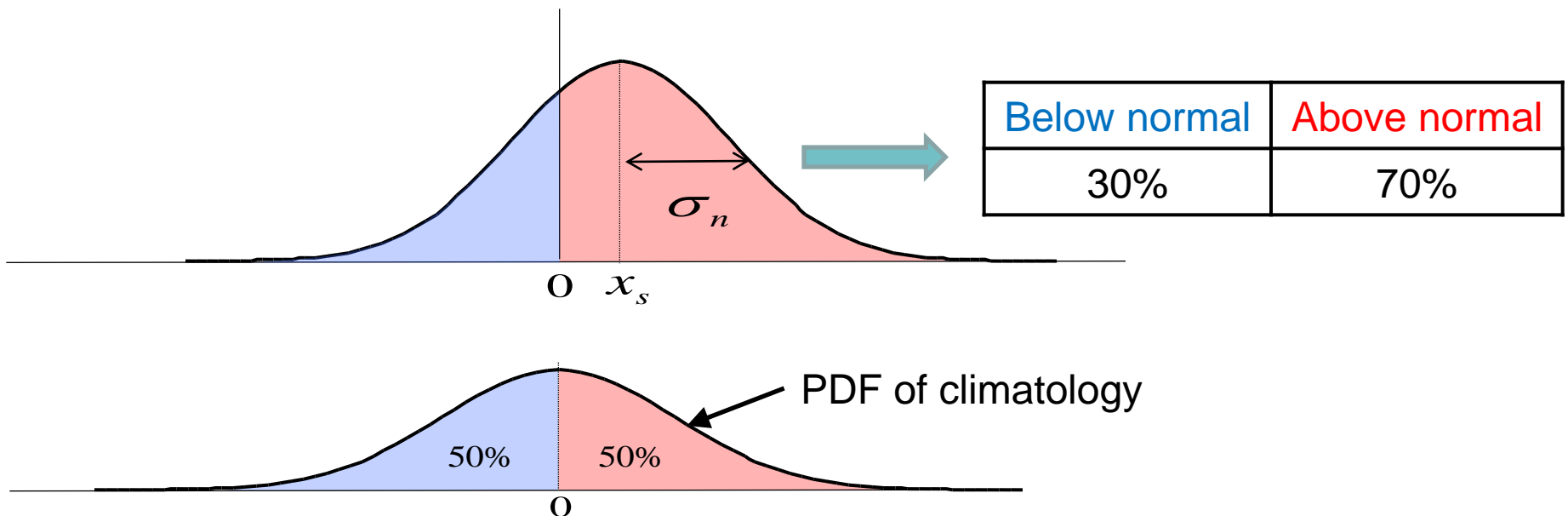
- The Probability Density Function (PDF) is assumed to be a normal distribution by its mean x_s and standard deviation σ_n .
- The mean x_s is predicted using the regression model and the standard deviation σ_n is assumed to be the root mean square error of the regression model.





Probability Forecast

- In this training, let's make guidance for a two-category probability forecast.





Thank you
for your attention

