気象庁
Japan Meteorological Agency

TCC Training Seminar on One-month Forecast@JMA
14 November 2018

Producing One-month Guidance Forecast and Verification

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Overview of Guidance Tool

- Web-based APP operated in JMA's virtual server system.
  - ✓ Any browser plug-ins and update of the APP by users are not required.

JMA's One-month Guidance Tool (Online Help)

Initial date: 20171122 → The beginning and ending date of the valid time will be automatically set on the next pull-down m

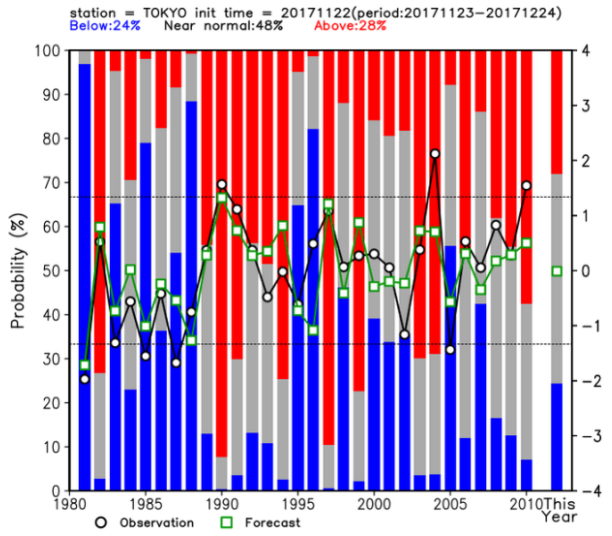
Forecast period: 2017 / 11 / 23 – 2017 / 12 / 24

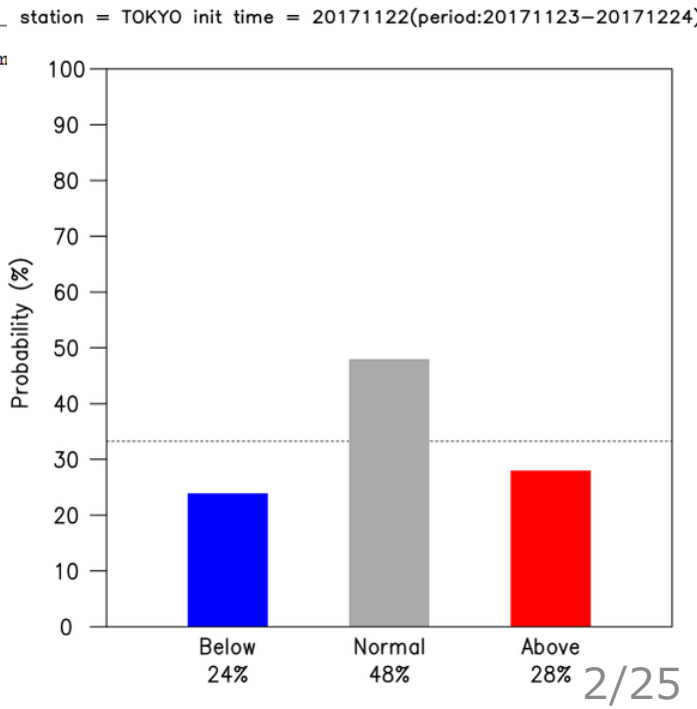
Predictor: Surface temperature -- No.2 -- -- No.3 --

Station and observation data: (Sample text data: Temperature, Precipitation)

参照...

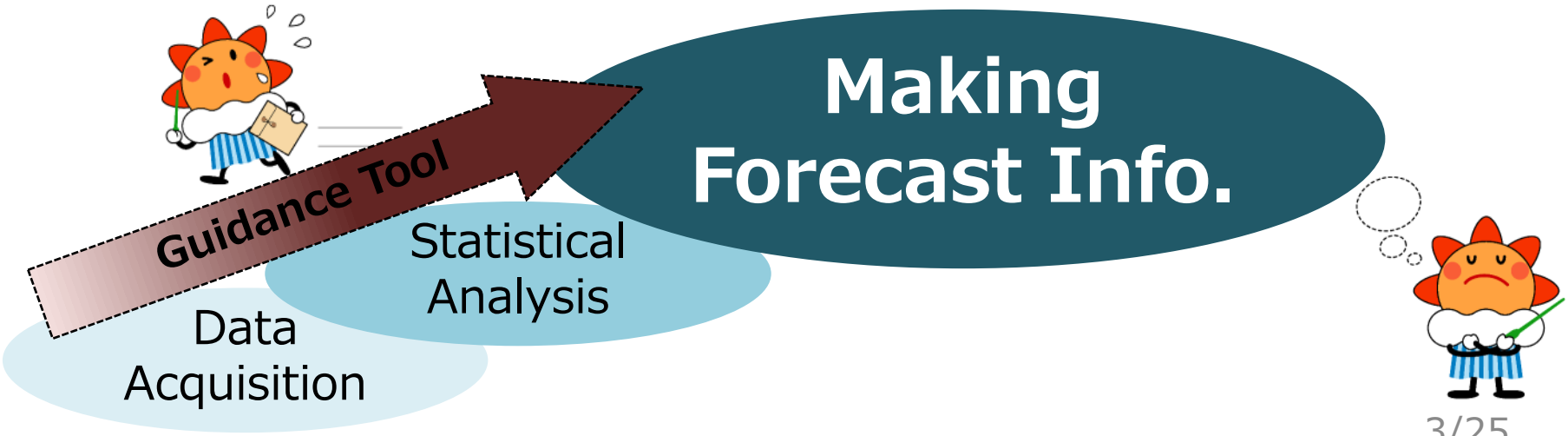
```
#elname=temperature,,,,,,,,,,,,
#undef=-9999,,,,,,,,,,,,
#station=,,,TOKYO,NIIGATA,SENDAI,NAG
#lon=,,,139.75,139,140.8,137,135.5,1
#lat=,,,35.691,38,38.25,35.2,34.6,43
1981,1,1,5,2.2,1.8,3.4,4.6,-3.3,2.7,
1981,1,2,4.6,4.3,2.9,3.5,5,-2.2,2.9,
1981,1,3,5.1,4.3,1.1,2.2,3,-0.3,1.2,
1981,1,4,4.4,4.7,1.9,1.7,2.9,-2.4,1.
1981,1,5,4.1,1.9,0,1.8,2.7,-6.7,2.2,
```





Advantage of Guidance Tool

- Utilizing the tool costs *less time to handle forecast data and more time to make forecast information*.
- It will be/become a useful tool for NMHSs users to simply generate one-month probabilistic forecast.

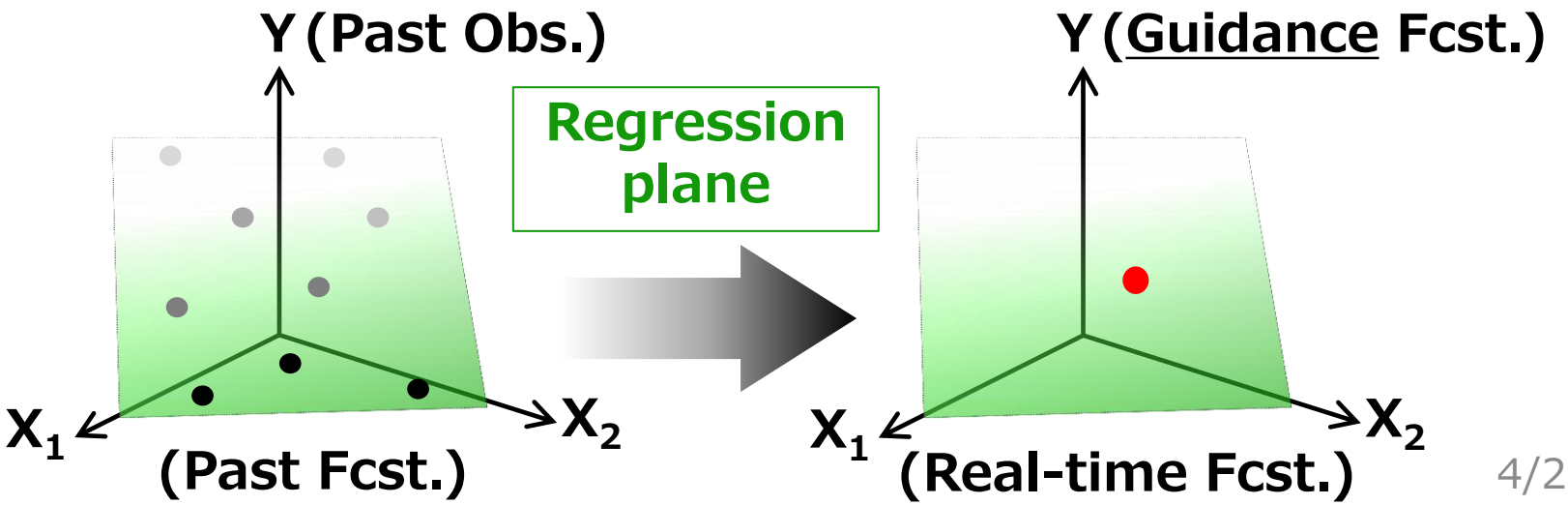


Underlying mechanism of Guidance Tool

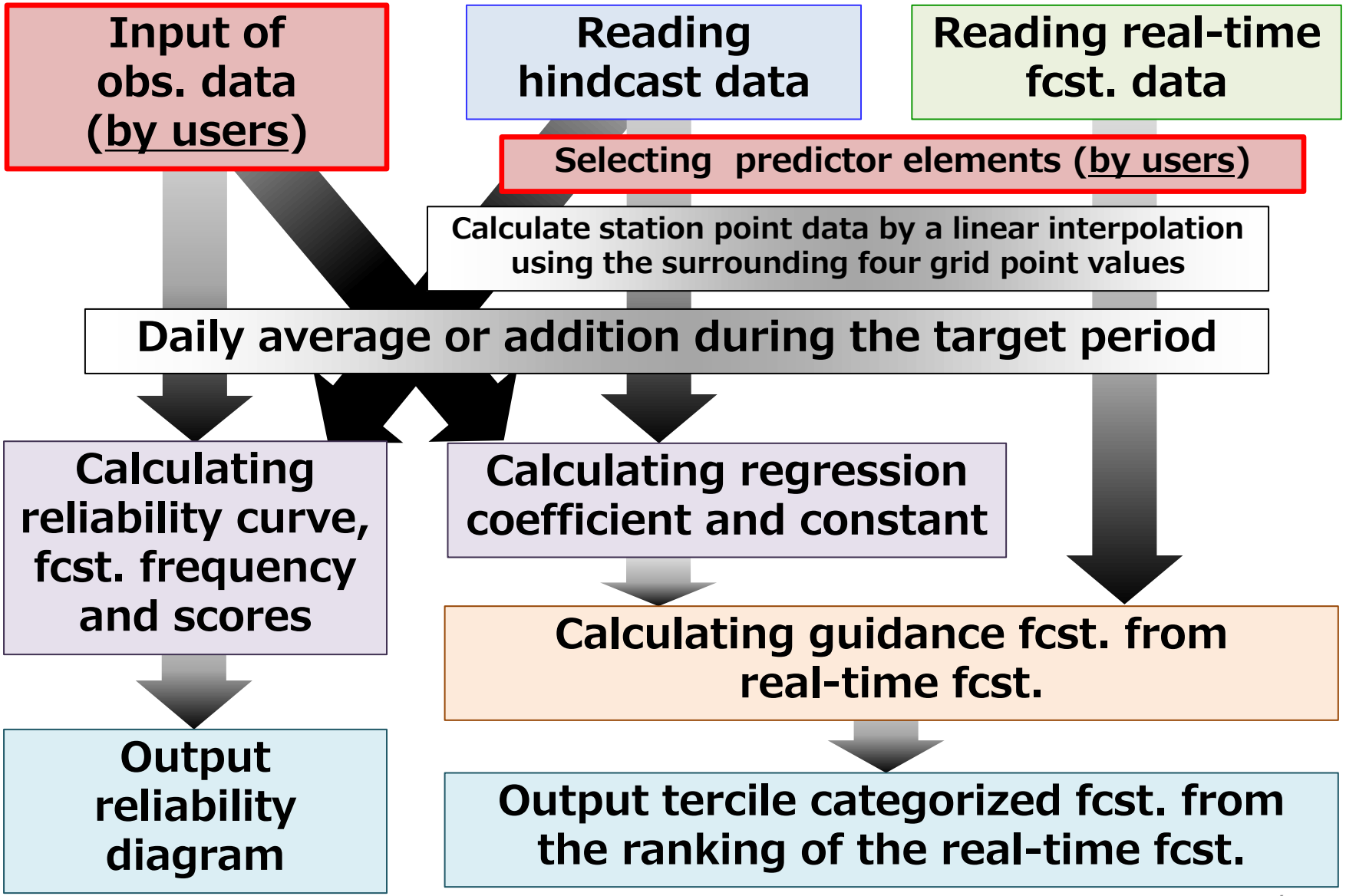
A) Create multi-regression equation by conducting regression analysis using past observation and one-month forecast data.

B) Applying real-time model forecast to the created multi-regression equation.

C) Output of guidance forecast and verification result.

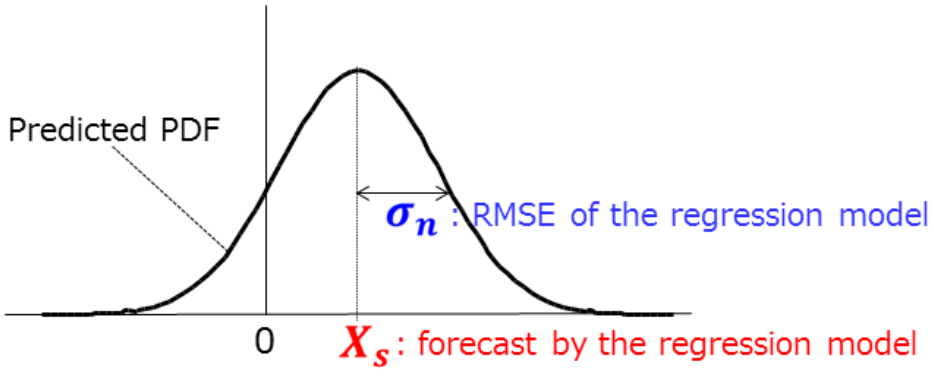


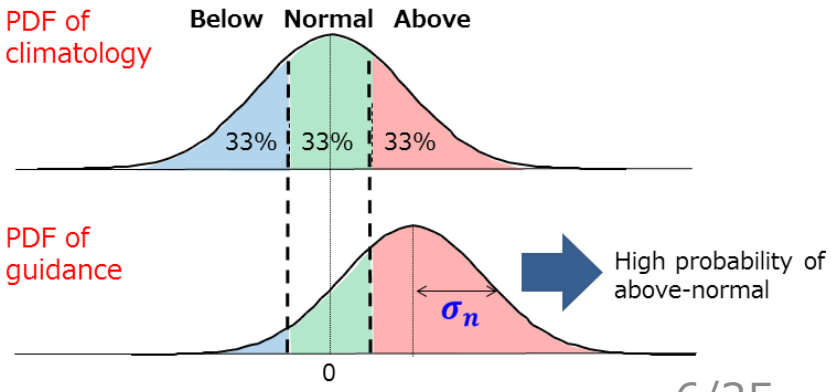
Flowchart of Guidance Tool



Guidance Specifications

- Threshold of the tercile categories is based on the past observation data during verification period for years.
- Estimation of uncertainty
  - ✓ PDF is assumed a normal distribution.
  - ✓ Uncertainty is estimated based on past guidance forecast error (RMSE).





Necessary Data on Guidance

- Daily past observation (***temperature*** and ***precipitation***) dataset in CSV format.
  - ✓ Need to prepare by users
  - ✓ upload the file on the APP
- Model ensemble mean forecast data (built-in on the APP)
  - ✓ Past model forecast (hindcast)
  - ✓ Real-time forecast

Thank you for sending us climate data in your country!

CSV-format Observation Data

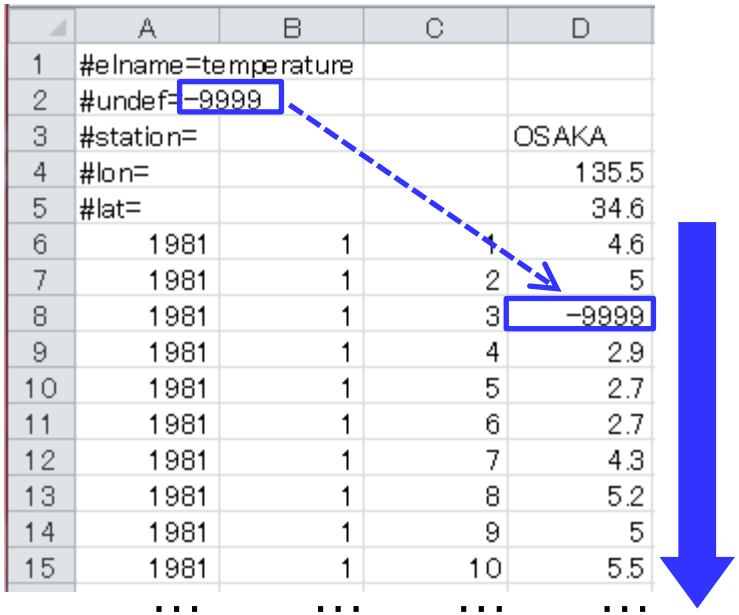
- Element:
  - ✓ *temperature* or *precipitation* (daily)
- Period (required at least):
  - ✓ Every day during the period from 1 Jan. 1981 to 31 Jan. 2011.
- Definition for obs. data:
  - ➢ Users shall allocate following meta-data-like elements to first five lines.

	A	B	C	D
1	#elname=temperature			
2	#undef=-9999			
3	#station=			OSAKA
4	#lon=			135.5
5	#lat=			34.6
6	1981	1	1	4.6
7	1981	1	2	5
8	1981	1	3	-9999
	…	…	…	…

Line.1: #elname={temperature or precipitation}
2: #undef={undefined value}
3: #station=,,,{station name}
4: #lon=,,,{longitude of the obs. point}
5: #lat=,,,{latitude of the obs. point}

CSV-format Observation Data

- Format:
  - Describe *undef.* value for missing data.
  - For precipitation data, describe "**0.0**" in case of less than 0.1 mm or no rainfall (don't use character string such as "T").



	A	B	C	D
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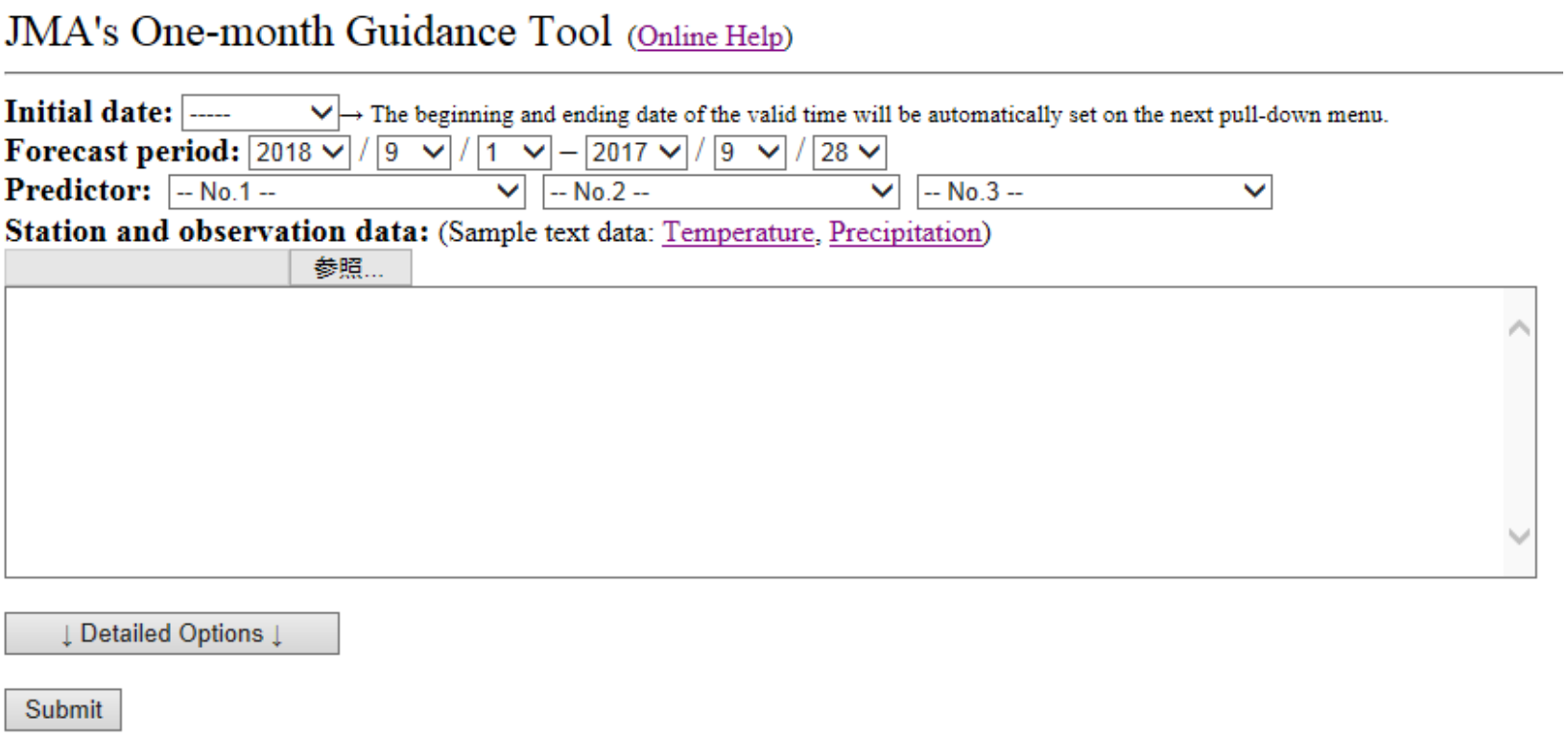
6	1981	1	1	4.6
7	1981	1	2	5
8	1981	1	3	-9999
9	1981	1	4	2.9
10	1981	1	5	2.7
11	1981	1	6	2.7
12	1981	1	7	4.3
13	1981	1	8	5.2
14	1981	1	9	5
15	1981	1	10	5.5
	…	…	…	…

After line.6: observation data
{Year},{Month},{Day},{Observational value}

How to use Guidance Tool

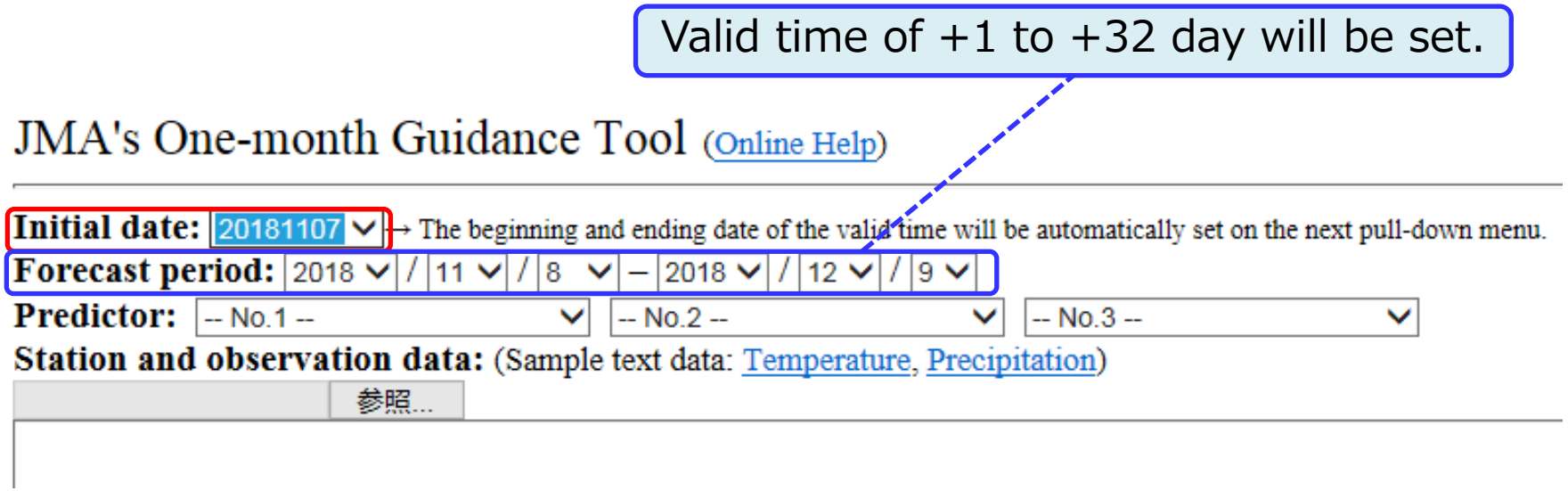
- Access to the APP website with *user ID* and *password* to login.
  - ✓ http://extreme.kishou.go.jp/cgi-bin/simple_guidance/index.cgi



Sample image.

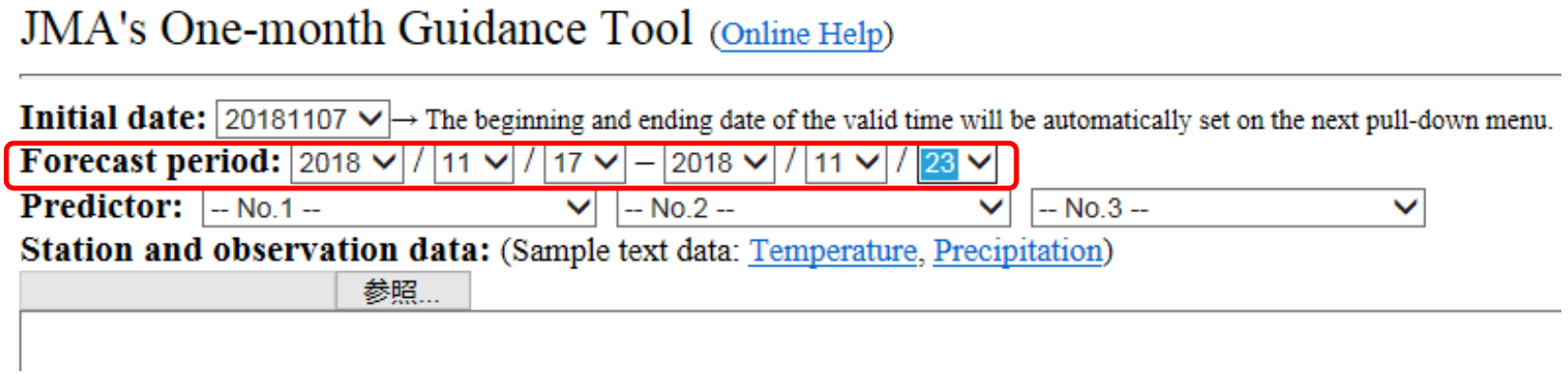
How to use Guidance Tool

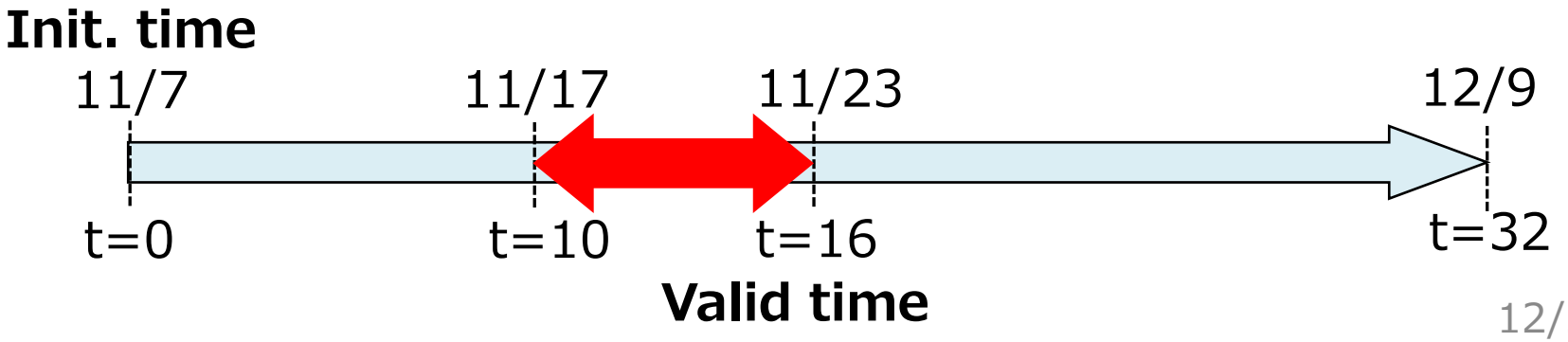
- Select "**Initial date**" from a pull-down menu.
  - ✓ First and final date of the forecast period will be automatically set on the next pull-down menu.



How to use Guidance Tool

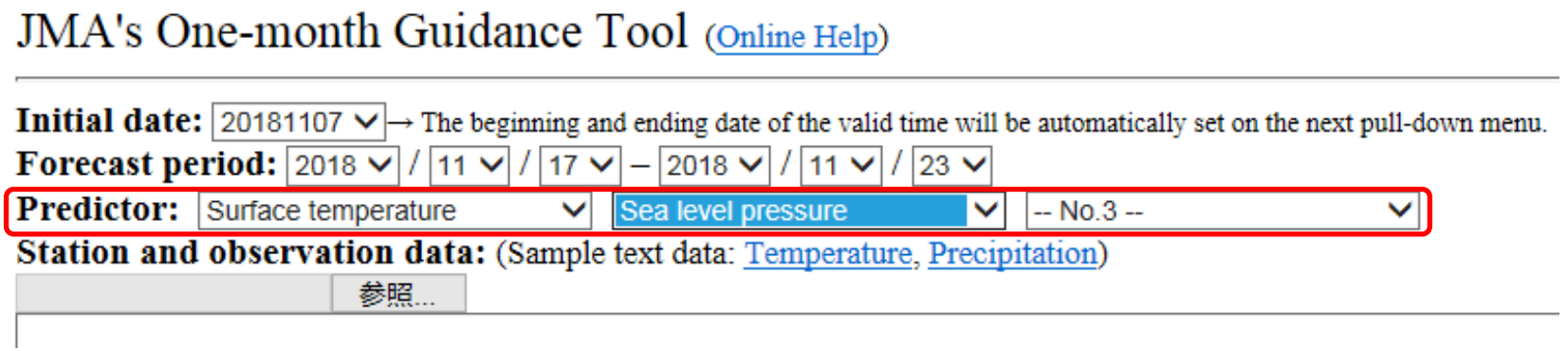
- Select "**Forecast period**" within the forecast range from a pull-down menu.
  - ✓ In the below example, a target period is set as 17 to 23 Nov. 2018 (2nd week).





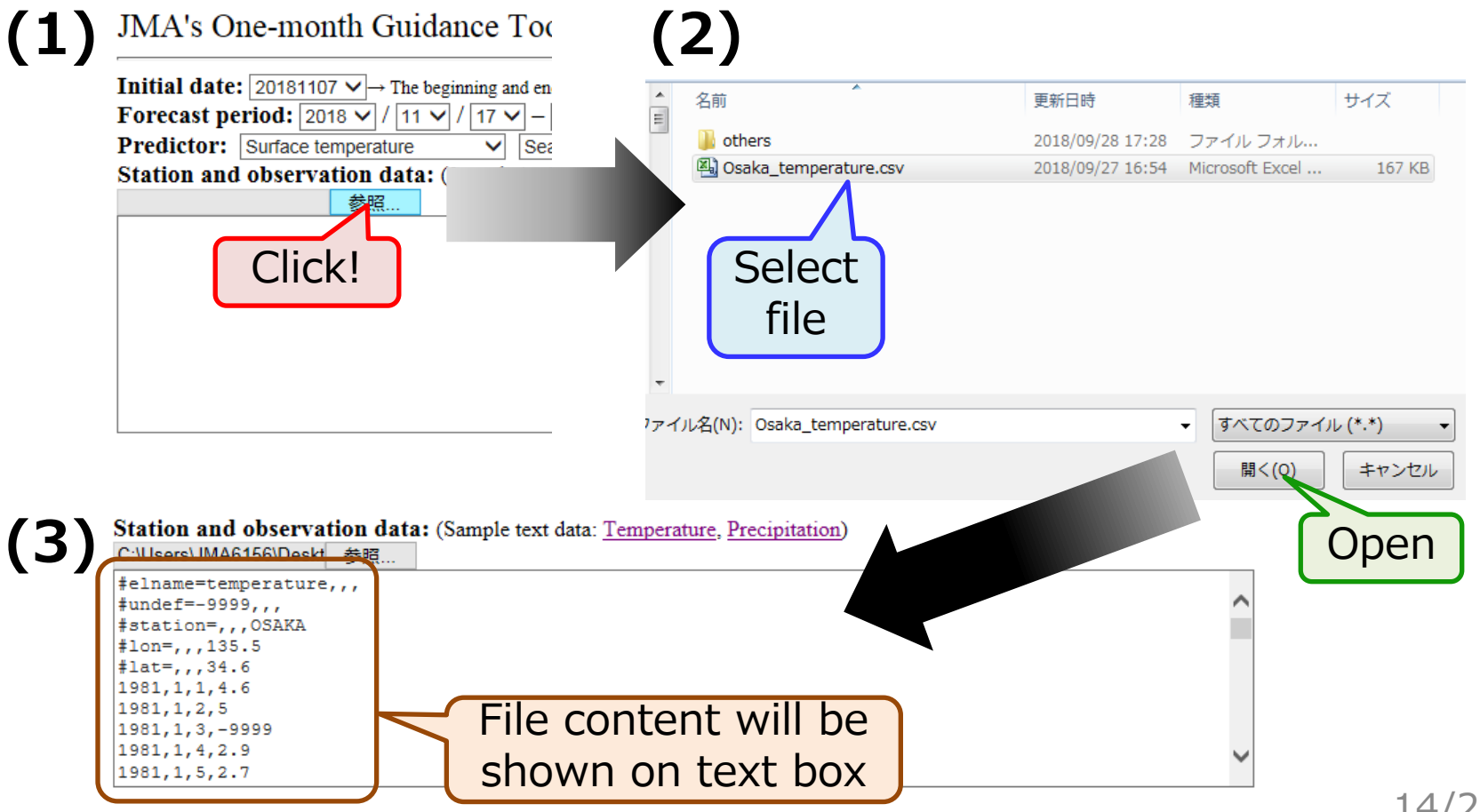
How to use Guidance Tool

- Select "**Predictor**" elements from a pull-down menu.
  - ✓ Users can input ***up to three*** predictors from the left (No.1~3).
  - ✓ In the below example, "*surface temperature*" and "*SLP*" are set as first and second predictors, respectively.



How to use Guidance Tool

- Upload a prepared CSV-format file of observational data in your country.



How to use Guidance Tool

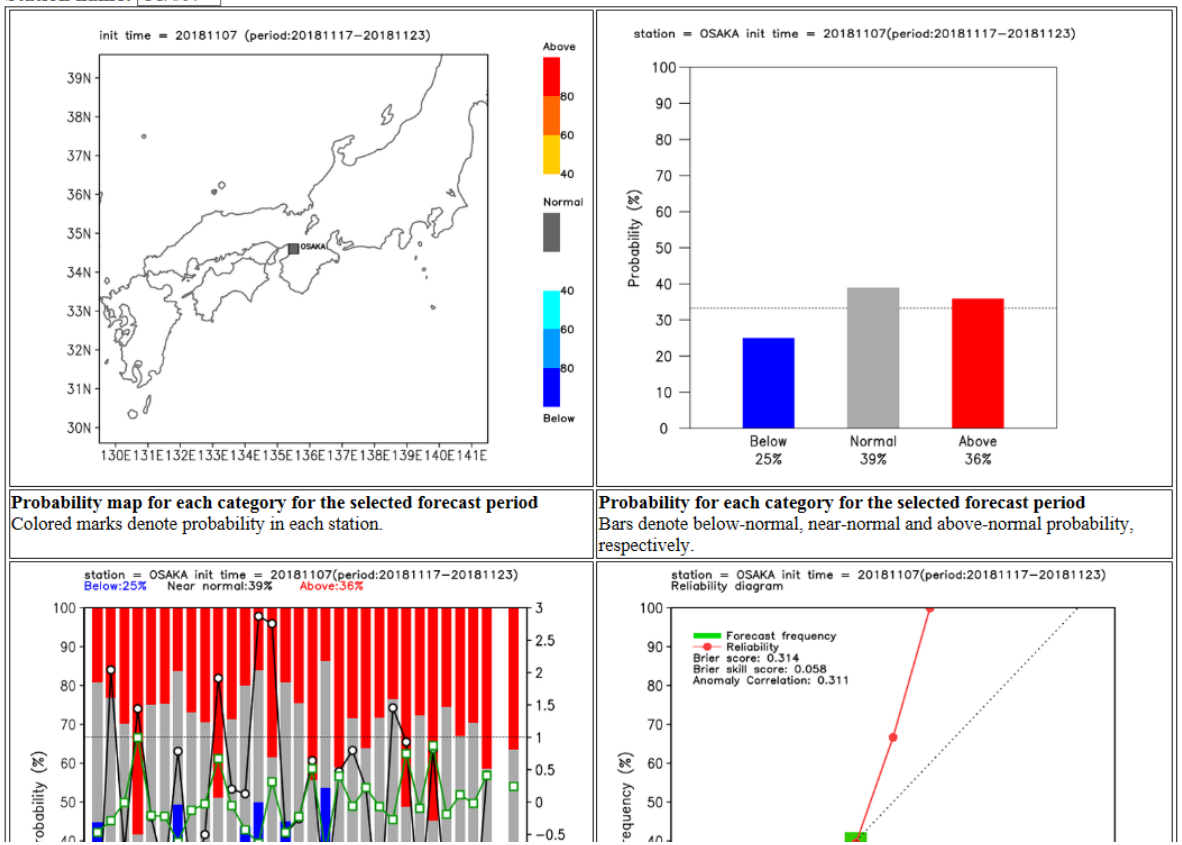
- Clicking “Submit” button, four figures will be shown after a short time.

Click!

Submit

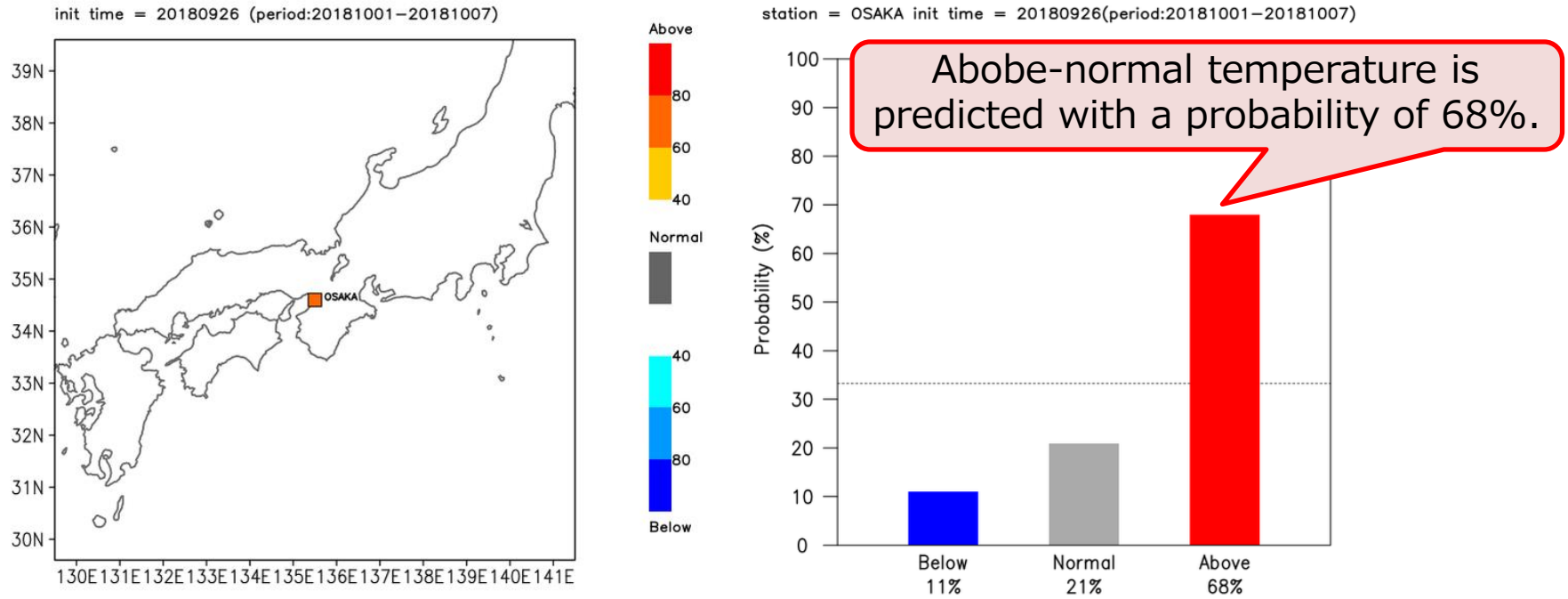
Now Making ... → Complete.

Station name: OSAKA



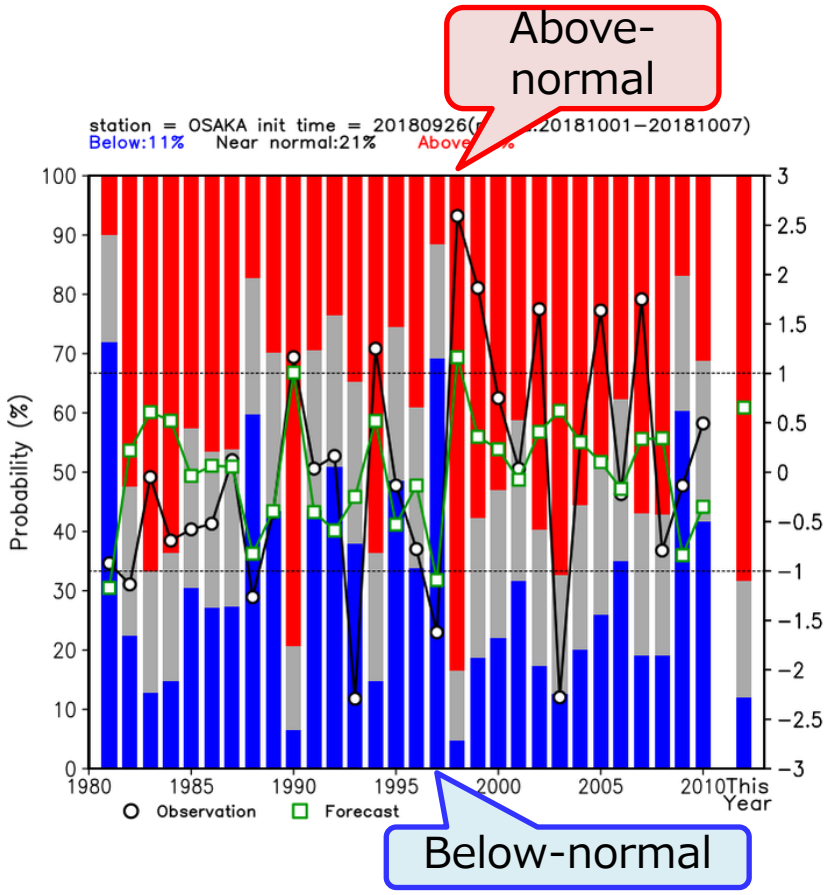
How to use Guidance Tool

- Figure on the upper left shows station map with the color-coded probability.
- That on the upper right shows tercile probability forecast at the station.



How to use Guidance Tool

- Figure on the lower left shows inter-annual timeseries of tercile probability during the verification period.

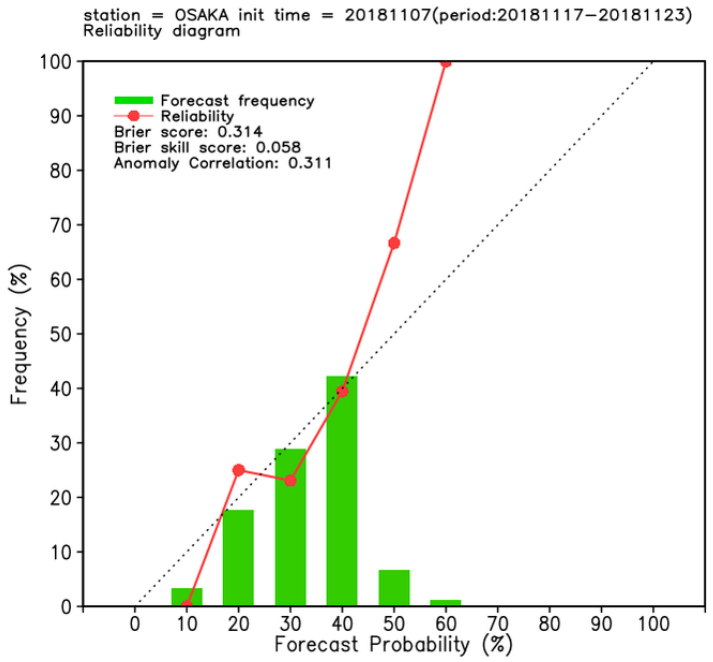


✓ Check up past prediction result for the noticeable year.

Colored-bars: Tercile probability
: Anomaly of daily-mean obs.
: Anomaly of daily-mean forecast

How to use Guidance Tool

- Figure on the lower right shows reliability diagram based on the verification period.
  - ✓ Forecast skill scores are also shown on the figure.



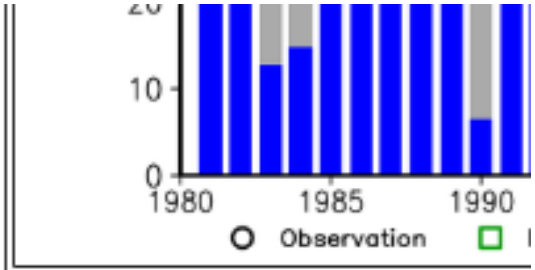
- ✓ Check up whether the reliability curve has a positive slope.

: Forecast frequency (%)
: Reliability (%)

How to use Guidance Tool

- Users can download the CSV-format data file used to create the figures.

(1)



Probability for each category
period
Blue, gray and red bars denote
probability, respectively. Blacl
daily-mean observation and fo

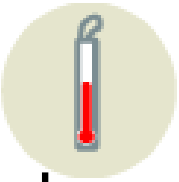
Download csv file
Checking log file

Click!

(2) output.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	### Probability for each category														
2	Station nar	Longitude	Latitude	Above-nor	Near-norm	Below-nor	Forecast a	Standard d	Predictor(N	Predictor(N	Predictor(N	Regression	Regression	Regression	Intercept
3	OSAKA	135.5	34.6	68.40347	19.63514	11.96139	0.65344	0.563803	21.46792	101761.1		0.728616	0.002483		-246.308
4	### Probability for each category during the verification period														
5	OSAKA		Above-nor	Near-norm	Below-nor	Regressed	Observation	anomaly							
6		1981	10.08536	18.05101	71.86363	-1.17043	-0.92095		19.46108	101615.4					
7		1982	52.41762	25.17616	22.40623	0.218825	-1.13524		20.33535	101918.4					
8		1983	66.82082	20.31592	12.86327	0.607689	-0.04952		21.32647	101784.1					
9		1984	63.71399	21.57093	14.71508	0.520276	-0.69238		20.27719	102056.9					
10		1985	42.62728	26.94144	30.43128	-0.03725	-0.5781		21.16973	101570.4					
11		1986	46.50741	26.40775	27.08484	0.064772	-0.52095		20.21118	101892.8					
12		1987	46.2136	26.4561	27.3303	0.057089	0.121905		20.22469	101885.7					
13		1988	17.27247	23.02925	59.69829	-0.82424	-1.26381		20.3746	101486.7					
14		1989	29.79255	26.85985	43.3476	-0.39513	-0.40667		19.29177	101977.4					
15		1990	79.37891	14.16466	6.456434	1.00729	1.164762		21.78411	101810.8					
16		1991	29.50678	26.82034	43.67288	-0.40372	0.03619		19.71295	101850.3					
17		1992	23.62849	25.55786	50.81365	-0.59035	0.164762		18.38152	102165.9					
18		1993	34.83416	27.26575	37.90009	-0.2491	-2.29238		20.39614	101712.1					
19		1994	63.65835	21.59242	14.74924	0.518736	1.250476		20.40878	102017.7					
20		1995	25.45034	26.04625	48.50341	-0.53019	-0.13524		18.94497	102024.8					
21		1996	38.98142	27.22504	33.79354	-0.13483	-0.7781		20.46108	101739					
22		1997	11.48003	19.25129	69.26868	-1.09219	-1.62095		18.79788	101841.5					
23		1998	83.39019	11.84013	4.769686	1.163176	2.593333		21.96673	101820					
24		1999	57.71333	23.67969	18.60698	0.357951	1.864762		20.45669	101938.8					
25		2000	52.93033	25.04695	22.02272	0.232206	0.750476		20.66787	101826.2					
26		2001	41.1794	27.08036	31.74024	-0.07575	0.03619		20.22878	101831					
27		2002	59.60544	23.06073	17.33383	0.40842	1.650476		20.57256	101925.1					
28		2003	67.28295	20.12	12.59705	0.620954	-2.2781		20.5472	102018.2					
29		2004	55.6614	24.30152	20.03708	0.303751	0.307619		20.32614	101955.3					
30		2005	47.97653	26.14721	25.87626	0.103121	1.63619		20.0758	101948					
31		2006	37.70944	27.27079	35.01977	-0.16944	-0.22095		21.35482	101462.8					
32		2007	56.89082	23.9352	19.17398	0.336168	1.750476		21.45364	101637.5					
33		2008	57.15558	23.85386	18.99056	0.34317	-0.79238		20.95922	101785.4					
34		2009	16.87927	22.82383	60.2969	-0.84034	-0.13524		20.16418	101542					
35		2010	31.2943	27.03723	41.66847	-0.35062	0.493333		20.26379	101710					
36									Cor(1-2)						
37									-0.42639						
38	### Verification data														
39		Forecast p	0	10	20	30	40	50	60	70	80	90	100		
40	OSAKA	Forecast fr	1.111111	10	25.55556	28.88889	10	7.777778	10	4.444444	2.222222	0	0		
41		Reliability(%	100	55.55556	30.43478	23.07692	55.55556	28.57143	22.22222	50	0	99999	99999		
42		Brier score	0.398508												
43		Brier skill s	-0.19672												

Hint to Predictor Combination



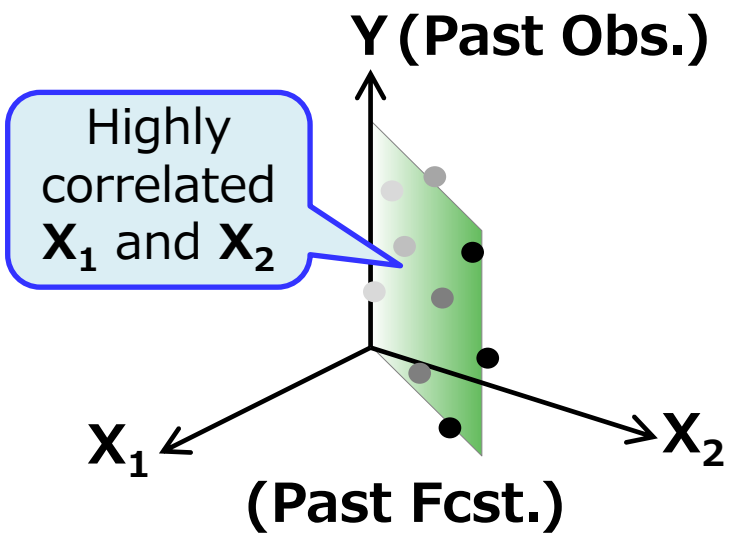
- For ***Temperature*** forecast,
  - ✓ One predictor is recommended to be set among temperatures, such as the lower-tropospheric or surface temperature.
  - ✓ Other predictors are selected except for temperature, such as wind components.
- For example,
  - **o** *"Surface temp."* and *"850-hPa meridional wind"*
  - **x** *"Surface temp."* and *"850-hPa temp."*

Hint to Predictor Combination

- For ***Precipitation*** forecast,
  - ✓ One predictor is recommended to be set as "Rainfall".
  - ✓ Other predictors are selected depending on regionality, such as the lower-tropospheric wind to consider terrain conditions.
- For example,
  - o "*Rainfall*" and "*850-hPa meridional wind*"

Multicollinearity Problem

- To prevent the "***multicollinearity***" problem, poorly correlated predictors are recommended to be selected.
  - ✓ Users can check *correlation coefficients* between the selected multi-predictors



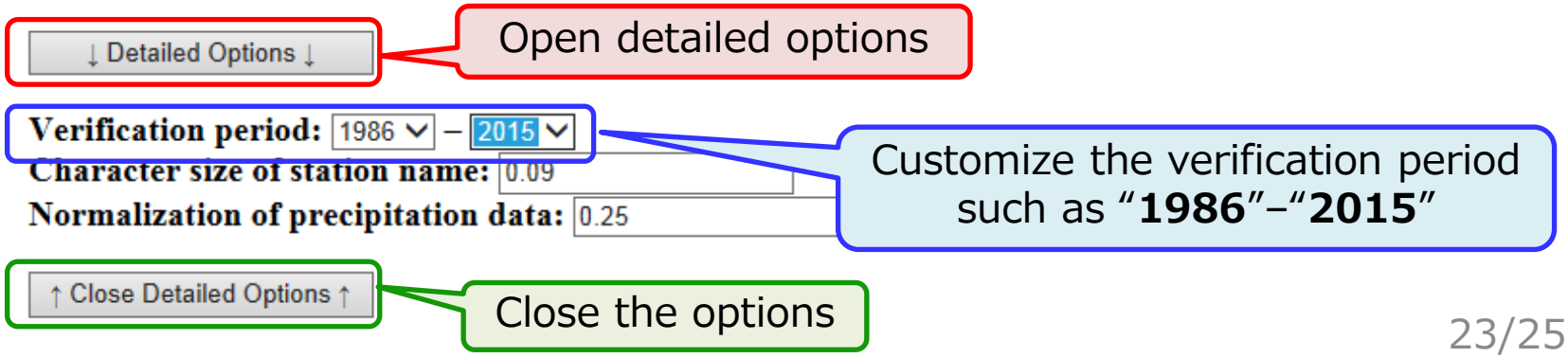
Downloaded CSV-format file

2003	67.28295	20.12	12.59705	0.620954	−2.2781		20.5472	102018.2
2004	55.6614	24.30152	20.03708	0.303751	0.307619		20.32614	101955.3
2005	47.97653	26.14721	25.87626	0.103121	1.63619		20.0758	101948
2006	37.70944	27.27079	35.01977	−0.16944	−0.22095		21.35482	101462.8
2007	56.89082	23.9352	19.17398	0.336168	1.750476		21.45364	101637.5
2008	57.15558	23.85386	18.99056	0.34317	−0.79238		20.95922	101785.4
2009	16.87927	22.82383	60.2969	−0.84034	−0.13524		20.16418	101542
2010	31.2943	27.03723	41.66847	−0.35062	0.493333		20.26379	101710
							Cor(1−2)	
							−0.42639	
ification data								
Forecast p	0	10	20	30			60	70
Forecast fr	1.111111	10	25.55556	28.88889			10	4.444444
Reliability(%	100	55.55556	30.43478	23.07692	55		22.22222	50

Check!

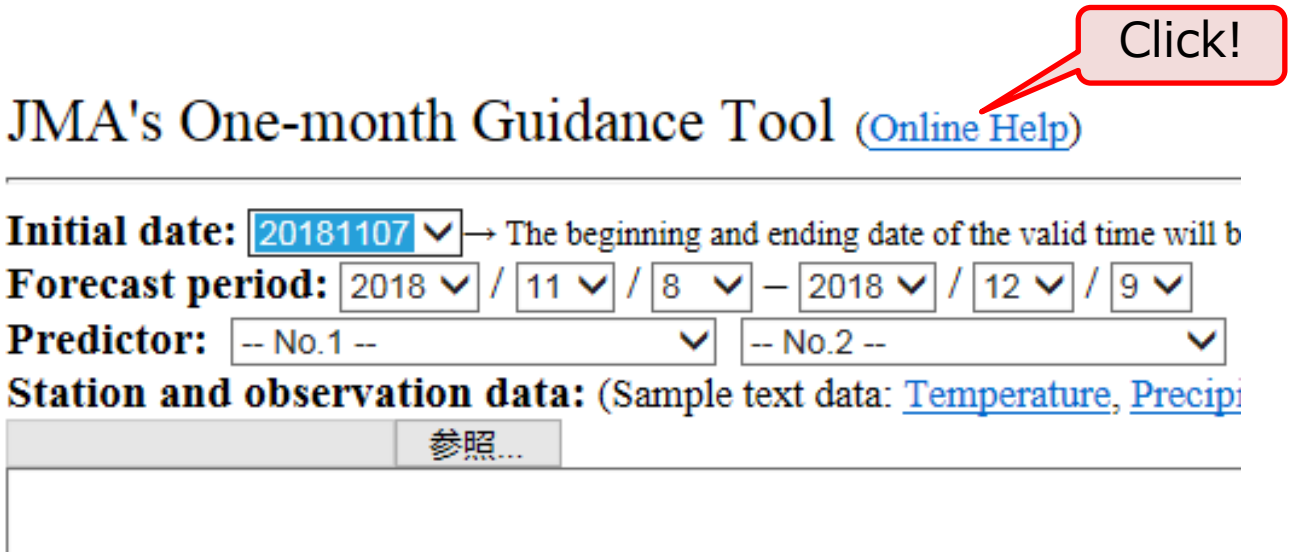
Other Options

- Users can adjust ***verification period*** so as not to choose unappropriate period during which most of the data are missing.
  - ✓ Unless there is no particular reason, it should be recommended to leave the verification period as the default (30-year period from **1981** to **2010**).



User Guides

- *Online user guides* are also available for more details on the guidance tool.
  - ✓ http://extreme.kishou.go.jp/tool/simple_guidance/help/
- If you have any questions for the APP, please feel free to ask TCC staff.



Thank you for your attention!

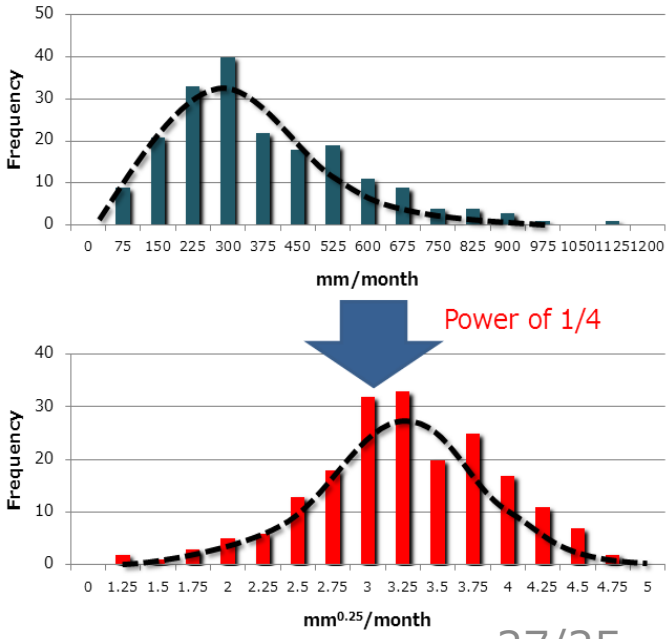
Target Forecast Period

- This exercise on producing one-month forecast targets following initial date and forecast period.

Initial Date	**7 Nov. 2018**
Forecast Period	**1-month** (28-day mean): *10 Nov. – 7 Dec. 2018*
	2nd week (7-day mean): *17 – 23 Nov. 2018*

[Tips] Normalization of Precipitation

- ✓ Temperature is generally approximated by a normal distribution.
- ✓ Meanwhile, ***precipitation*** doesn't represent a normal distribution, and it's usually approximated by a gamma distribution.
- ✓ To approximate by a normal distribution, *the guidance tool performs a normalization of precipitation data by* ***its power of 1/4*** to calculate the guidance forecast.



[Tips] Normalization of Precipitation

- ✓ Users can customize a value of ***the power*** in detailed options as shown below.
- ✓ Changing the value from **0.25** (i.e. 1/4) to **1.0**, precipitation data will be unnormalized.