How to Use the Guidance Tool
(Producing Guidance and Verification)

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Workflow of the Excel Guidance Tool

- Step 1: Prepare 3-month mean (Feb.-Apr.) temperature and precipitation observation data for 1981-2010.
- Step 2: Select appropriate predictor(s) and make a regression model at your forecast point for Feb.-Apr.
- Step 3: Verify the forecast skill of the guidance.
- Step 4: Calculate the guidance for Feb.-Apr. 2018 with your regression model.

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Past Observation Data

- Element:
  - ✓ 3-month mean temperature (February – April)
  - ✓ 3-month precipitation amount (February – April)

    (Calculated from monthly observation data)
- Period: 1981-2010 (30-year)
  - ✓ Same as the hindcast data so that the regression model between observation and hindcast can be created.
- A 3-month value (i.e., Feb.-Apr.) is calculated if only all of the 3 monthly values (i.e., Feb, Mar, and Apr.) are available. If not, the 3-month value will be treated as missing.
- Missing values are allowed to create the regression model. But the more the number of available data is, the better.

Copy & Paste the Data to the Excel Tool

1 Open your observation data file

	A	B	C	D	E
1	#station=Fukuoka				
2	#WMOnumber=47807				
3	Year	Month	Mean Tem	Precip.	
4	1970	1	4.4	34.5	
5	1970	2	7.7	52	
6	1970	3	7	21.5	
7	1970	4	13.3	154.5	
8	1970	5	18.7	204.5	
9	1970	6		294	
122	1979	11	12.5	105.5	
123	1979	12	9.3	81.5	
124	1980	1	6.2	57	
125	1980	2	5.1	31.5	
126	1980	3	9.6	131.5	
127	1980	4	14		
128	1980	5	18.7	233	
129	1980	6	23.1	165.5	
130	1980	7	24.9	886	
489	2010	5	23.5	203	
490	2010	7	27.7	453.5	
491	2010	8	30.3	69.5	
492	2010	9	26.3	138.5	
493	2010	10	20	78.5	
494	2010	11	13.2	58	
495	2010	12	8.8	148	
496	2011	1	3.8	106	
497	2011	2	8.2	48	

2 Open the excel tool file (temperature) and move to “Memopad for observation”

Worksheet “Memopad for observation”

	A	B	C	D	E	F	G	H	I
1									
2						Forecast Month:	From	2	
3							To	4	
4									
5	Year	Month	Monyhly Temp.			3-month		30-year Time Series of 3-month	
6			Set blank for missing			Mean Temp.		Paste the below data to	
7	1980	1						1981	
8	1980	2						1982	
9	1980	3						1983	
10	1980	4						1984	
11	1980	5						1985	
12	1980	6						1986	
13	1980	7						1987	
14	1980	8						1988	
15	1980	9						1989	
16	1980	10						1990	
17	1980	11						1991	
18	1980	12						1992	
19	1981	1						1993	
20	1981	2						1994	
21	1981	3						1995	
22	1981	4						1996	

Calc guidance | Verification | Memopad for observation | Predictor (FMA)

4 Paste the data here

3 Copy temperature data for Jan. 1980 – Dec. 2010

If there is a missing data, set the cell blank.

Calculate 3-month Values

1 Set forecast month (From: **2**, To: **4**)
(indicating 3-month mean for Feb. – Apr.)

"Memopad for observation"

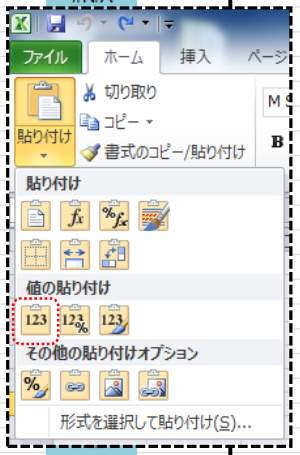
					Forecast Month:	From	2	
						To	4	
Year	Month	Monyhly Temp. Set blank for missing		3-month Mean Temp.		30-year Time Series of 3-month Paste the below data to		
1980	1	6.2				1981	10.3	
1980	2	5.1				1982	10.5	
1980	3	9.6		7		1983	10.8	
1980	4	14		9.6		1984	8.8	
1980	5	18.7		14.1		1985	10.5	
1980	6	23.1		18.6		1986	9.8	
1980	7	24.9		22.2		1987	10.7	
1980	8	24.5		24.2		1988	9.9	
1980	9	22.4		23.9		1989	11.7	
1980	10	18.1		21.7		1990	12.1	
1980	11	13.5		18		1991	10.4	
1980	12	6.4		12.7		1992	11.3	
1981	1	4		8		1993	10.9	
1981	2	6.1		5.[illegible]		1994	10.6	
1981	3	10.2		6.8		1995	10.5	
						1996	9.5	
						1997	11.4	
						1998	12.6	
						1999	11.1	
						2000	10.5	
1981	9	23.1		26.3		2001	11.3	
1981	10	19.1		21.[illegible]		2002	12.5	
1981	11	11.7		17.6		2003	11.4	
1981	12	8.[illegible]		12.7		2004	12	
1982	1	5.9		8.6		2005	10.8	
1982	2	6.[illegible]		6.[illegible]		2006	10.8	
1982	3	10.7		7.8		2007	12.1	
1982	4	14.2		10.5		2008	10.7	
1982	5	20.3		15.1		2009	12.4	
1982	6	22.1		18.9		2010	11.4	
1982	7	24.8		22.4				
1982	8	27.1		24.7				

2 3-month mean values for 1981-2010 will appear.

If all of the monthly values are not available, the 3-month average will not be calculated.

Worksheet "Calc_guidance"

	A	B	C	D	E	F
1	Year	Observation (Temperature) Set blank for missing		Rank		Predictor
2						
3						
4	1981			#N/A		
5	1982			#N/A		
6	1983			#N/A		
7	1984					
8	1985					
9	1986					
10	1987					
11	1988					
12	1989					
13	1990					
14	1991					
17	1994					
18	199					
19						
20						
21						
22						
23						
24				#N/A		



3 Copy & paste these values to "Calc_guidance".

Paste **values only**, not formulas.

気象庁 Japan Meteorological Agency

Check the Normal and Limit of 3-category

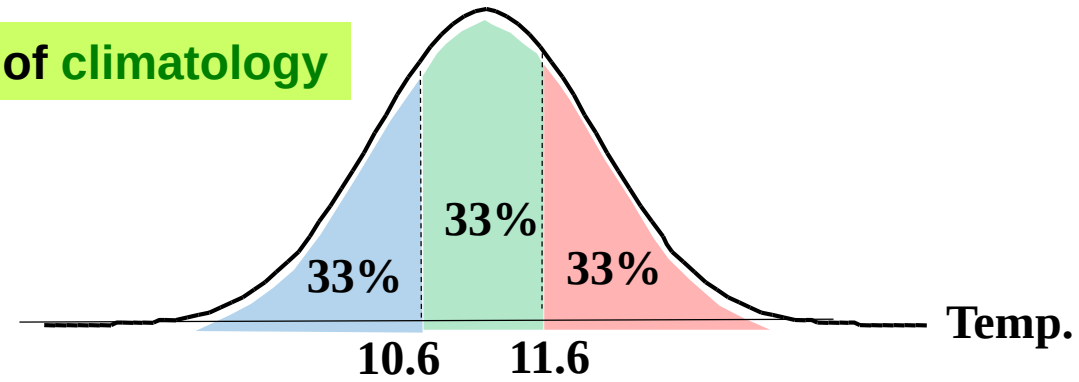
Worksheet "Calc_guidance"

31	2008	10.7
32	2009	12.4
33	2010	11.4
34		
35	This year	
36		
48	Normal	11.0
49	The lower limit of near normal	10.6
50	The upper limit of near normal	11.4
51		slope

Normal (i.e., 30-year average for 1981-2010)

Limit of 3-category
In this example,
More than 11.4: **Above normal**
More than 10.6: **Near normal**
10.6 or less: **Below normal**

PDF of climatology



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Select a Predictor (Single Regression)

Worksheet "Predictor (FMA)"

1 Select a predictor and copy the values (In this case, WIO SST is selected)

Hindcast 3-month mean indices for Februart - April (Initial month: January)
Select one to three indices as predictor and paste them to the sheet "Calc_guidance."
Indices of the other months are availabel on the TCC website (registration is required; http

YEAR	NINO3 SST	NINO3.4	NINOWES	IOBW SST	WIO SST	EIO SST	IOBW RAII	WIC
1981	-0.51	-0.33	-0.09	-0.19	-0.21	-0.22	-0.03	
1982	-0.03	-0.04	-0.09	-0.15	-0.21	-0.25	-0.03	
1983	2.19	1.77	-0.41	0.23	0.01	0.03	0.28	
1984	-1.1	-1.25	0.12	-0.43	-0.48	-0.42	0.27	
1985	-1.35	-1.33	-0.01	-0.5	-0.68	-0.41	0.12	
1986	-0.56	-0.39	-0.13	-0.26	-0.34	-0.34	-0.07	
1987	0.83	0.88	-0.39	-0.09	-0.15	-0.17	0.06	
1988	-0.45	-0.29	-0.13	0.12	0.28	0.29	0.27	
1989	-1.6	-1.61	0.31	-0.35	-0.36	-0.23	0.01	
1990	-0.11	-0.03	-0.01	0.01	0	-0.07	0.01	
1991	0.1	0.16	-0.18	0.09	0.08	0.05	-0.07	
1992	1.31	1.42	-0.52	0.2	0.02			
1993	-0.18	-0.14	-0.5	-0.16	0.01	-0.1	-0.13	
1994	-0.48	-0.33	-0.24	-0.04	0.16	-0.04	0.04	
1995	0.89	0.9	-0.36	0.09	0.04	-0.02	0.05	
1996	-0.13	-0.32	0.31	-0.15	-0.02	-0.14	-0.02	
1997	-0.05					-0.07	-0.01	
1998	2.59					0.42	0.35	
1999	-0.85					-0.05	-0.35	
2000	-1.16					-0.31	-0.11	
2001	-0.15	-0.11	0.35	-0.11	-0.1	-0.01	-0.34	
2002	0.25	0.19	0.2	0.25	0.33	0.26	-0.06	
2003	0.64	0.75	-0.04	0.42	0.37	0.46	0.28	
2004	0.39	0.43	0.17	0.22	0.31	0.22	0.01	
2005	0.57	0.64	0.04	0.28	0.27	0.23	0.01	
2006	-0.38	-0.43	0.39	-0.14	-0.15	0	-0.3	
2007	0.66	0.62	0.16	0.27	0.16	0.21	0.03	
2008	-1.64	-1.55	0.31	-0.19	-0.13	-0.05	0.06	
2009	-0.81	-0.61	0.35	0.04	0.19	0.17	-0.1	
2010	1.14	1.29	0.02	0.48	0.54	0.44	-0.1	
unit	K	K	K	K	K	K	mm/day	mm

Hindcast data for 1981-2010

Worksheet "Calc_guidance"

Year	Set blank for missing	Rank	Forecast of model: Predictor 1	Predictor 2	Predictor 3
1981	10.3	26			
1982	10.5	21			
1983	10.8	15			
1984	8.8	30			
1985	10.5	21			
1986	9.8	28			
1987	10.7	18			
1988	9.9	27			
1991	10.4	25			
1992	11.3	11			
1993	10.9	14			
1994	10.6	20			
1995	10.5	21			
1996	9.5	29			
1997	11.4				
1998	12.6				
1999	11.1				
2000	10.5	21			
2001	11.3	11			
2002	12.5	2			
2003	11.4	8			
2004	12	6			
2005	10.8	15			
2006	10.8	15			
2007	12.1	4			
2008	10.7	18			
2009	12.4	3			
2010	11.4	8			
This year					

2 Paste the values here

Check the Correlation Coefficient

Worksheet "Calc_guidance"

Year	Observation (Temperature) Set blank for missing	Rank	Forecast of model Predictor 1	Predictor 2	Predictor 3
1981	10.3	26	-0.21		
1982	10.5	21	-0.21		
1983	10.8	15	0.01		
1984	8.8	30	-0.48		
1985	10.5	21	-0.68		
1986	9.8	28	-0.34		
1987	10.7	18	-0.15		
1988	9.9	27	0.28		
1989	11.7	7	-0.36		
1990	12.1	4	0		
1991	10.4	25	0.08		
1992	11.3	11	0.02		
1993	10.9	14	0.01		
1994	10.6	20	0.16		
		21			
2008	10.7		-0.13		
2009	12.4	3	0.19		
2010	11.4	8	0.54		
s year					
	11.0		0.000	#DI	#DIV/0!
rmal	10.6				
rmal	11.4				
	slope		1.63	#DIV/0!	#DIV/0!
	intercept		10.98	#DIV/0!	#DIV/0!
	Correlation		0.527	#DIV/0!	#DIV/0!
	slope		1.63	0.00	0.00
	intercept		10.98		
	Correlation		0.527		

Correlation coefficient of single regression between observation and predictor.
Values close to 1/-1 are preferable.

This example (CC = 0.527) shows high correlation, meaning that this predictor may be used for the guidance (regression model).

Find better predictors with higher correlation coefficient through trial and error process.

Select Multiple Predictors (Multi Regression)

Worksheet "Calc_guidance"

	A	B	D	F	G	H
1	Year	Observation (Temperature)	Rank	Forecast of model		
2		Set blank for missing		Predictor 1	Predictor 2	Predictor 3
4	1981	10.3	26	-0.19	0.52	-2.47
5				-0.15	0.53	-5.52
6				0.23	-1.1	-18.15
7				-0.43	-0.12	3.22
8				-0.5	0.36	-3.33
9				-0.26	0.33	-8.19
10				-0.09	0.25	-12.63
11				0.12	0.73	6.78
12				-0.35	-0.05	6.67
13	1990	12.1	4	0.01	-0.02	3.63
14	1991	10.4	25	0.09	0.4	1.49
15	1992	11.3	11	0.2	-0.96	-20.22
16	1993	10.9	14	-0.16	0.31	-6.78
17	1994	10.6	20	-0.04	0.97	-12.86
18	1995	10.5	21	0.09	-0.42	-7.6
19	1996	9.5	29	-0.15	-0.06	1.69
20	1997	11.4	8	-0.13	-0.73	0
21	1998	12.6	1	0.68	-1.88	-3.81
22	1999	11.1	13	-0.21	0.13	12.84
23	2000	10.5	21	-0.27	0.37	8.92
24	2001	11.3	11	-0.11	0.23	13.81
25	2002	12.5	2	0.25	-0.58	-0.56
26	2003	11.4	8	0.42	0.18	1.34
27	2004	12	6	0.22	0	4.01
28	2005	10.8	15	0.28	-0.25	-2.86
29	2006	10.8	15	-0.14	0.28	8.48
49	The lower limit of near normal	10.6				
50	The upper limit of near normal	11.4				
51		slope		1.82	-0.48	0.01
52	Single Regression	intercept		10.98	10.98	10.98
53		Correlation		**0.558**	**-0.333**	**0.104**
55		slope		1.84	-0.21	0.03
56	Multi Regression	intercept		10.98		
57		Correlation		**0.630**		

Select maximum of 3 predictors, and paste here (Order is not considered)

In this example, **IOBW-SST**, **MC-RAIN** and **Z3040** are selected.

Check!

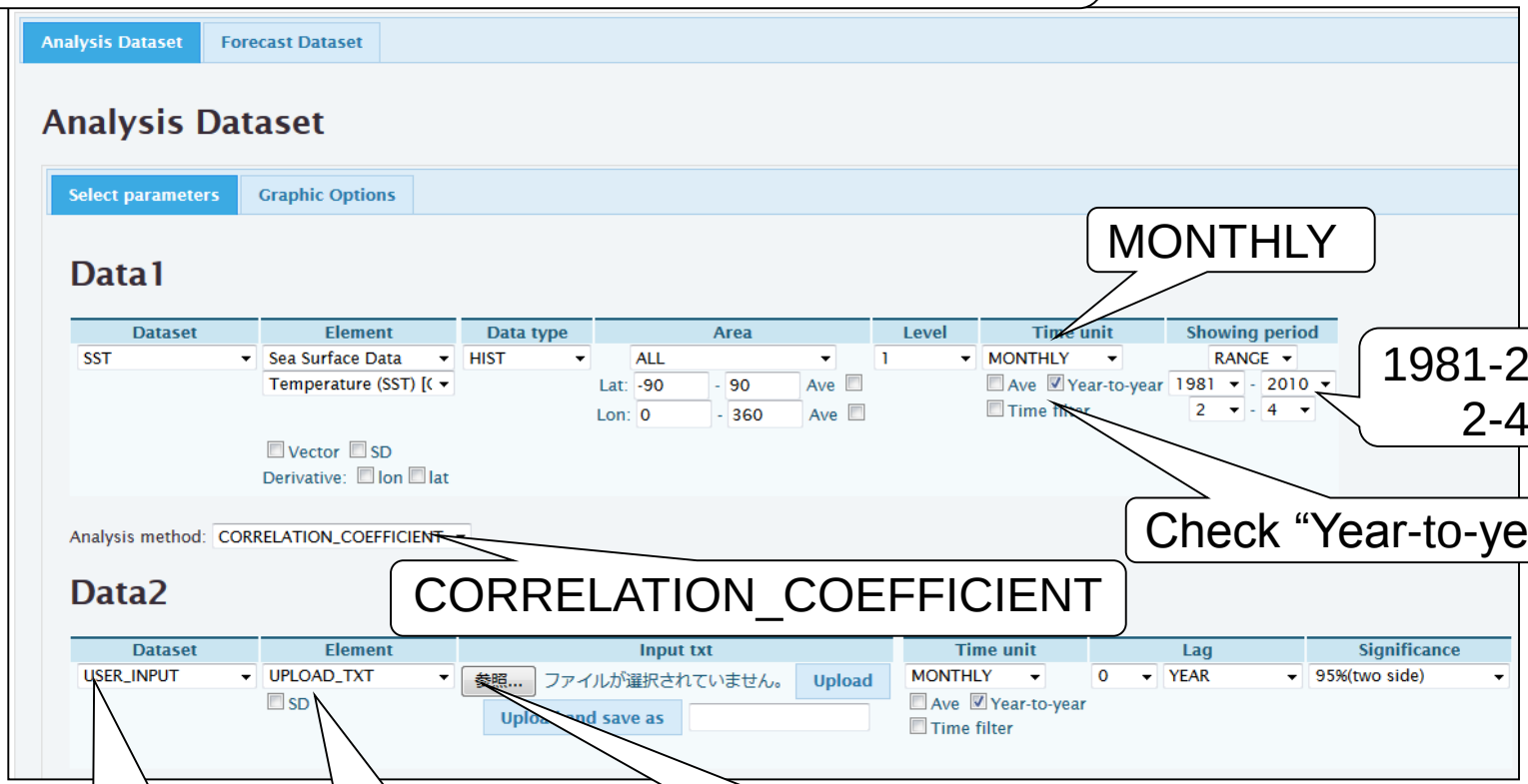
- ✓ Is the correlation of the guidance better than that of single-regression?

Correlation of single regression for each predictor.

Correlation of the guidance (multi regression)
Value close to 1 is preferable.

Hint: Find a Appropriate Predictor (iTacs)

Check the correlation between observation data and SST/OLR with iTacs to find appropriate predictors.



MONTHLY

1981-2010
2-4

Check “Year-to-year”

CORRELATION_COEFFICIENT

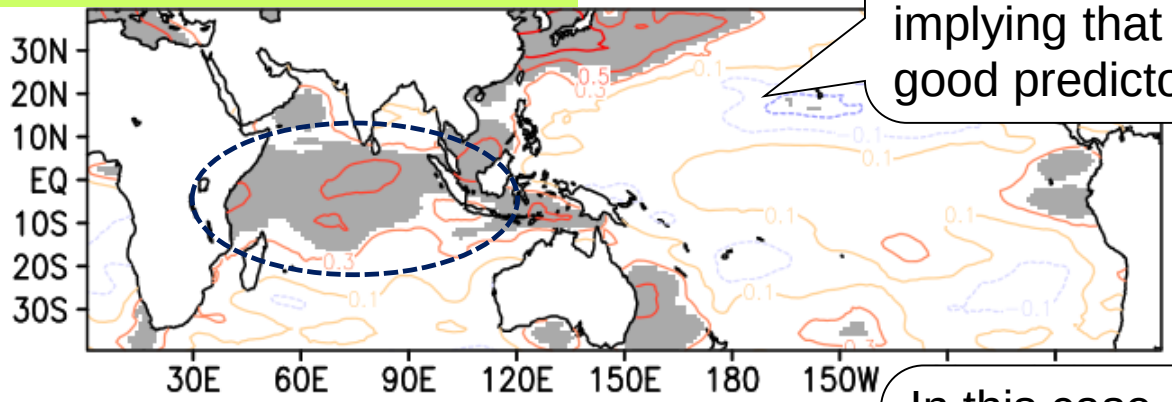
USER_INPUT

UPLOAD_TXT

Select the data file (utilized in Tuesday)

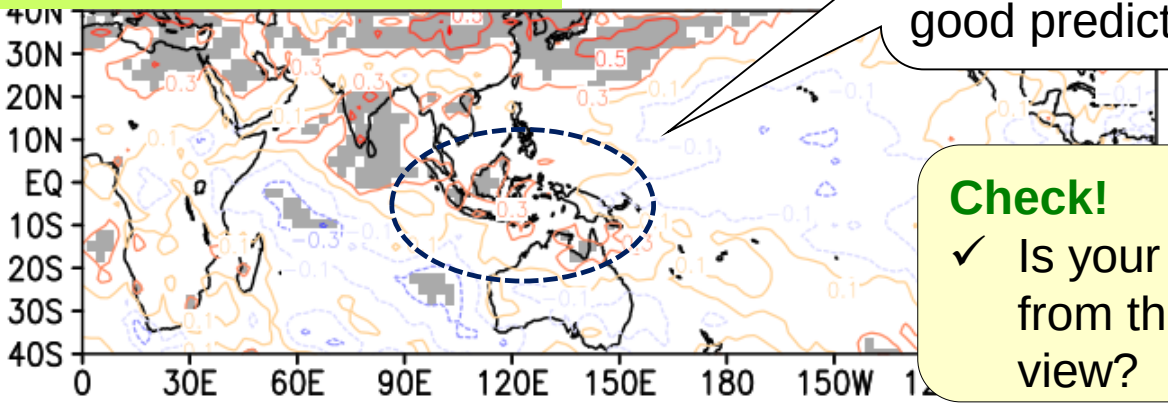
Hint: Find a Appropriate Predictor (iTacs)

Correlation (FMA)
Temperature in Fukuoka / SST



In this case, SST over the Indian Ocean shows high correlation, implying that **IOBW-SST** may be a good predictor.

Correlation (FMA)
Temperature in Fukuoka / OLR



In this case, OLR around Indonesia shows high correlation, implying that **MC-RAIN** may be a good predictor.

Check!

- ✓ Is your predictor reasonable from the climatic point of view?

Hint: Combination of Predictors

- **Thickness (e.g., THMD)** show long-term increasing trend, and may be good predictors for temperature.
- **Z500 (e.g., Z2030)** represent increasing trend and response to the SST in the tropics (e.g., ENSO).
- If two predictors are remarkably correlated, skill of multi-regression may become poor (multicollinearity). In this case, it is recommended to use just one of them.

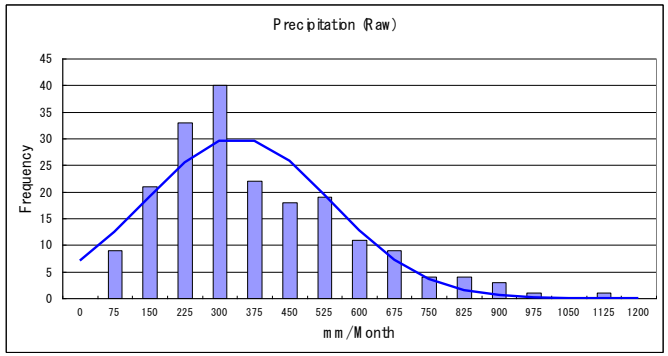
Example; NINO3-SST / NINO3.4-SST (correl.: 0.99)

Find the better combination of predictors with trial and error process!

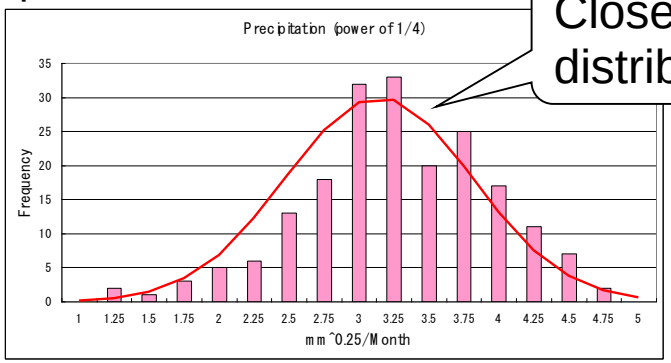
Guidance for Precipitation

Histogram of precipitation is usually Gamma distribution, so normalization is necessary with 1/4-power transformation.

Distribution of Precipitation



1/4-power



Close to normal distribution

Worksheet "Calc_guidance" (for precipitation)

The excel tool for precipitation automatically normalize the observation data

Observation data

Power of 1/4

	A	B	C	D
	Year	Observation (Precipitation) Set blank for missing	Power of 1/4	Rank
	1981	278	4.083	16
	1982	310.5	4.198	12
	1983	406.5	4.490	4
	1984	245	3.956	23
	1985	404.5	4.485	5
	1986	251.5	3.982	21
	1987	299	4.158	14
	1988	307	4.186	13
	1989	312.5	4.204	11
	1990	295	4.144	15
	1991	439	4.577	1
	1992	420.5	4.528	3
	1993	274.5	4.070	17
	1994	317.5	4.221	10
	1995	251.5	3.982	21
	1996	270	4.054	18
	1997	266	4.039	20
	1998	362	4.362	7
	1999	217.5	3.840	28
	2000	213	3.820	30
	2001	232	3.903	24
	2002	268	4.046	19
	2003	322	4.236	9
	2004	231.5	3.901	25
	2005	220	3.851	27
	2006	394.5	4.457	6
	2007	217.5	3.840	28
	2008	334	4.275	8
	2009	231.5	3.901	25
	2010	424.5	4.539	2
	This year			
	Normal	300.550	4.144	
	The lower limit of near normal	258.750	4.010	
	The upper limit of near normal	315.000	4.213	

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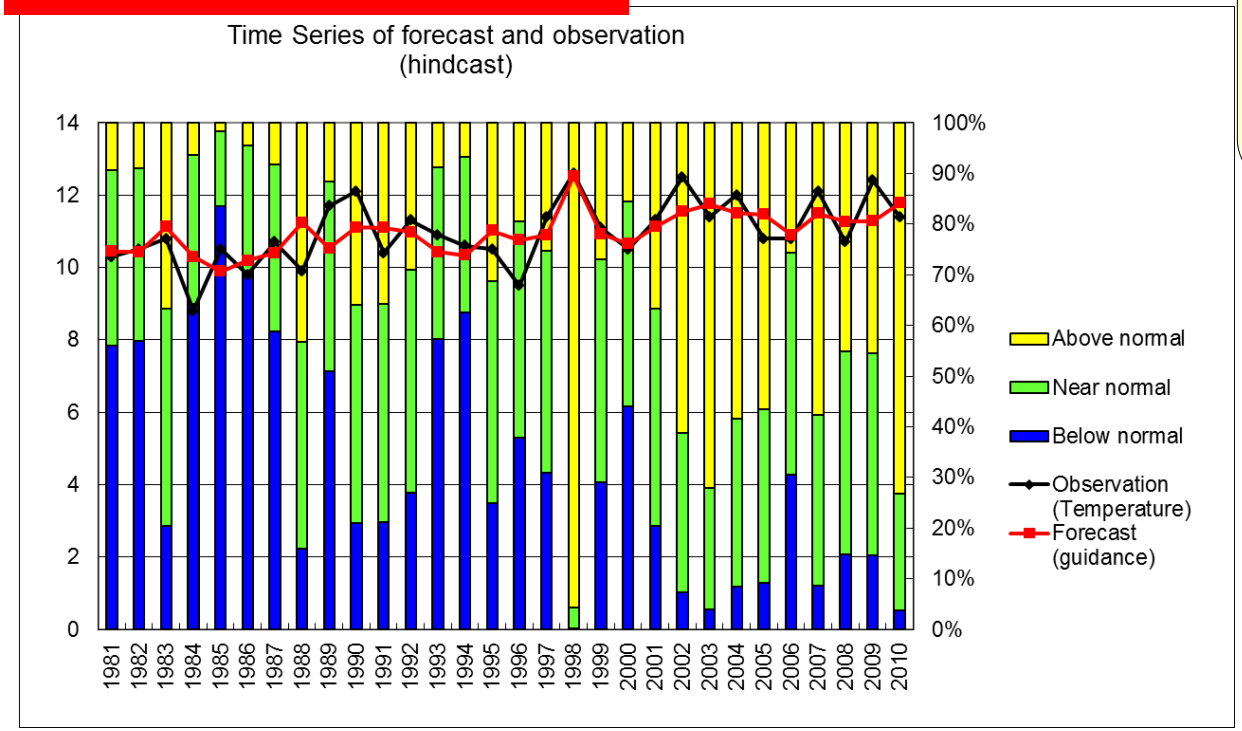
Confirm the Prediction Skill of the Guidance

Worksheet "Calc_guidance"



- ✓ Blue/green/yellow bars show the probabilities of below/near/above normal for each year.
- ✓ Black/red lines indicate observation and guidance values.

Check!

- ✓ Does the guidance predict the noticeable year?

In this example,

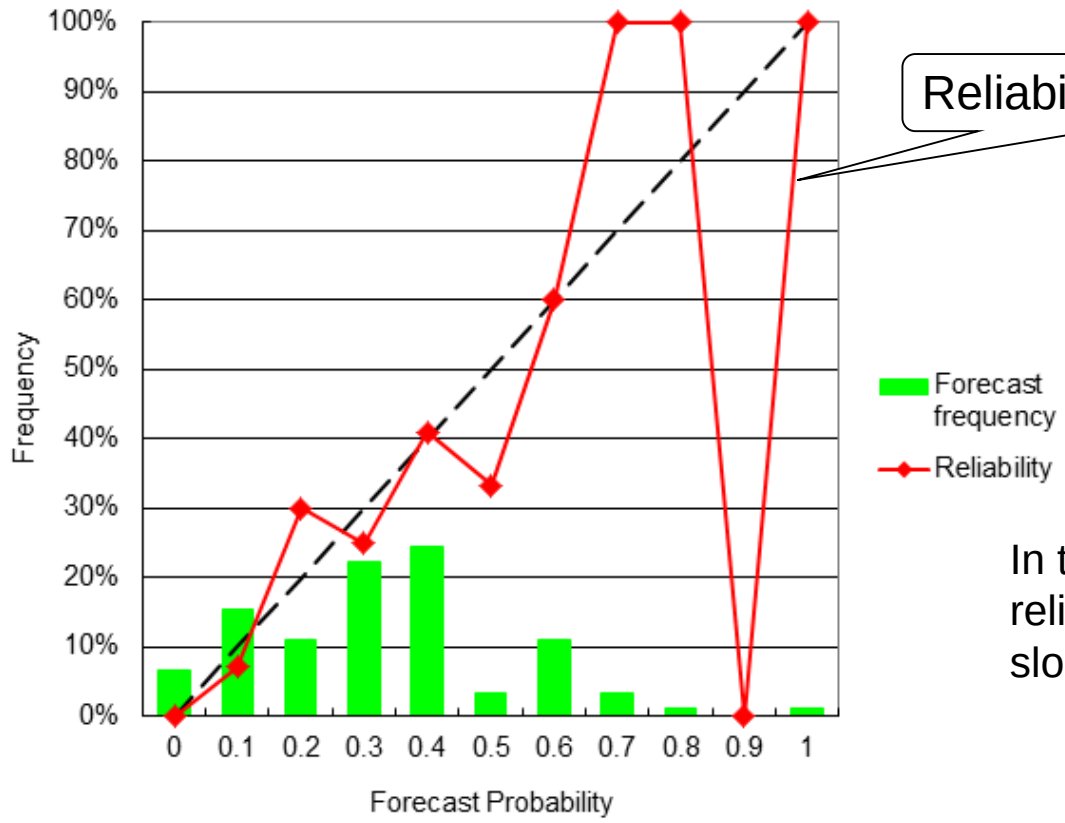
- ✓ In 1998, (significantly warm year), probability of above normal is very high.
- ✓ In 1984, (significantly cold year), probability of below normal is relatively high, but not significant…

Confirm the Prediction Skill of the Guidance

Worksheet "Verification"

Brier Score (Forecast)	Brier Score (Climatology)	Brier Skill Score
0.258	0.333	0.225

Brier Skill Score (BSS)
Positive value (>0) is preferable.



Reliability diagram

Check!

✓ Does the reliability diagram show positive 45-degree slope?

In this example,
reliability diagram shows 45-degree slope for 0 - 60%.

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Calculate the Guidance of FMA 2018

Worksheet "Predictor (FMA)"

38	Forecast 3-month mean indices for Februart - April 2018 (Initial month: January 2018)												
39	Paste the data of the selected predictors to the sheet "Calc_guidance."												
40	Forecast Indices are availabel on the TCC website (registration is required; http://ds.data.jma.go.jp/tcc/tcc/gpv/indices/)												
41	INDEX	NINO3 SS	NINO3.4	NINOWES	IOBW SST	WIO SST	EIO SST	IOBW RAI	WIO RAIN	EIO RAIN	SAMOI RA	WNP RAIN	SEAs
42	UNIT	K	K	K	K	K	K	mm/day	mm/day	mm/day	mm/day	mm/day	mm/d
43	2018	-0.7	-0.67	0.54	0	0.05	0.09	-0.3	-0.02	0.24	0.97	1.42	
44													

1 Copy the forecast values of the selected predictors

In this example, **IOBW-SST**, **MC-RAIN** and **Z3040** are selected for the guidance, so the forecast values of these indices will be pasted one by one.

Worksheet "Calc_guidance"

	A	B	C	D	E	F	G	H
1	Year	Observation (Temperature)		Rank		Forecast of model		
2		Set blank for missing				Predictor 1	Predictor 2	Predictor 3
3								
4	1981	10.3		26		-0.19	0.52	-0.47
5	1982	10.5		21		-0.15	0.53	-0.15
6	[illegible]	10.8		15		0.23	-1.1	0.7
7		8.8		30		-0.43	-0.12	-0.62
8	1985	10.5		21		-0.5	0.36	-0.68
[illegible]								
30	[illegible]			4				
31	2008	10.7		18		-0.19	0.28	24.57
32	2009	12.4		3		0.04	0.72	13.19
33	2010	11.4				0.48	-0.88	-9.52
34								
35	This year					0		
36								
48	Normal					0.000	0.001	0.001
49	The lower limit							
50	The upper limit							
51						1.82	-0.48	0.01
52	Single Regression	intercept				10.98	10.98	10.98
53		Correlation				0.558	-0.333	0.104
54								
55		slope				1.84	-0.21	0.03
56	Multi Regression	intercept				10.98		
57		Correlation				0.630		
58								

2 Paste them to corresponding cells.

Be careful not to paste the value of predictor 1 to the cell of predictor 2 or 3!

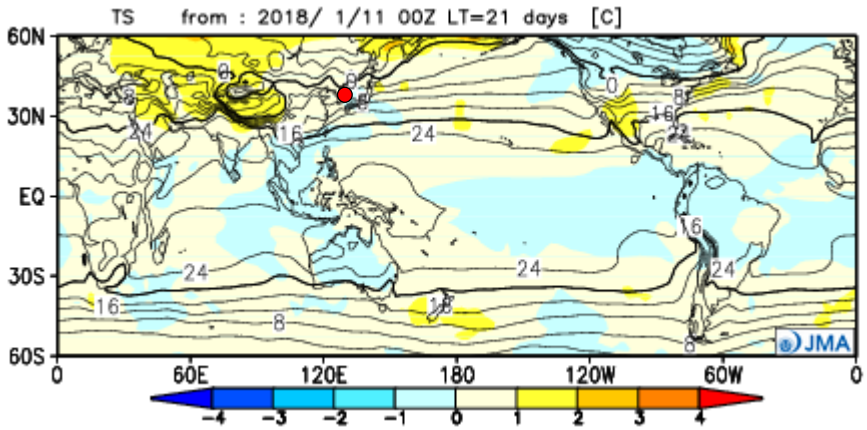
Check the Guidance of FMA 2018

Worksheet "Calc_guidance"

F	G	H	I	P	Q	R	S	T
Forecast of model				Forecast (guidance)	square error	Probabilistic Forecast		
Predictor 1	Predictor 2	Predictor 3				N(Xs, σn)	N(Xs, σn)	N(Xs, σn)
				Xs	σn^2	Below normal	Near normal	Above normal
-0.19	0.52	-2.47		10.445	0.021	56%	35%	9%
0.48	-0.88	-9.52		11.776	0.142	4%	23%	73%
0	0.03	19.85		11.536		8%	32%	61%

Probability of each category in FMA 2018

Forecast map for 2m temp.
(available on TCC-HP)



In this example,

- ✓ Below normal: 8%
- ✓ Near normal: 32%
- ✓ Above normal: 61%

Temperature around Fukuoka is near normal, so the guidance may overestimate the temperature…

Check!

- ✓ Do the guidance and the forecast results have the same tendency?