Exercise for Guidance

TCC Training Seminar on Application of Seasonal Forecast GPV Data to Seasonal Forecast Products

18-21 January 2011

Objectives

- To understand how to make guidance for seasonal-mean temperature and precipitation.
- To find out effective predictors.
- To make more accuracy guidance.

Procedure

1. Single Regression Model
2. Multiple Regression Model
3. Probabilistic Forecast
4. Verification
5. Create a presentation
6. Presentation (5 minutes)

Today

Tomorrow

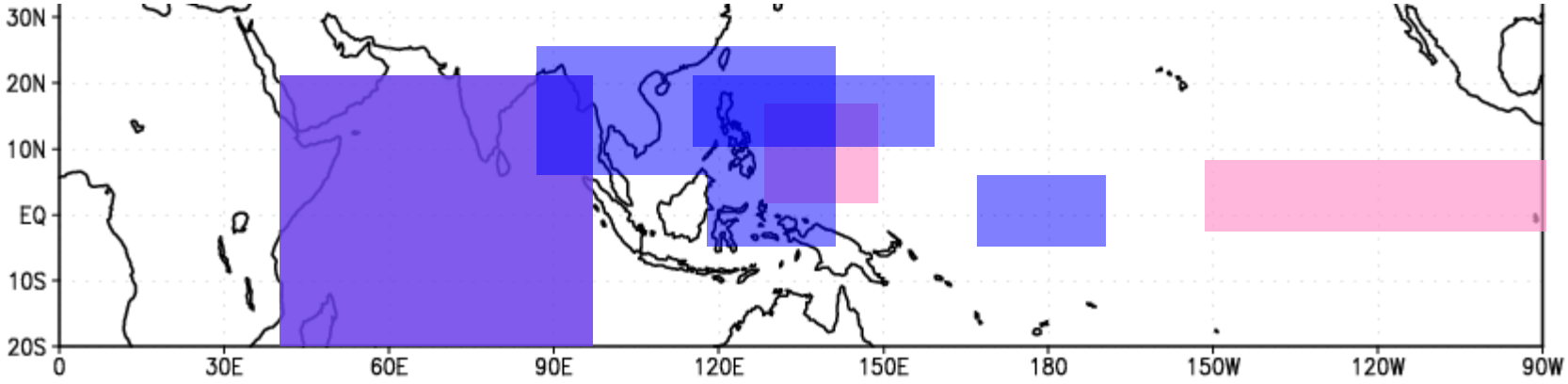
The day after tomorrow

Preparations

- Observation data (yourself)
- Predictors (init. 1st May for JJA, 28th Oct for DJF)
  - GPV data over your stations「*GPVdata.xls*」
  - Indices such as NINO3SST, Asia Monsoon, etc. 「*indices.xls*」
- Excel software for making guidance 「*ExerciseForGuidance.xls*」
- Textbook「*Exercise for Guidance.doc*」

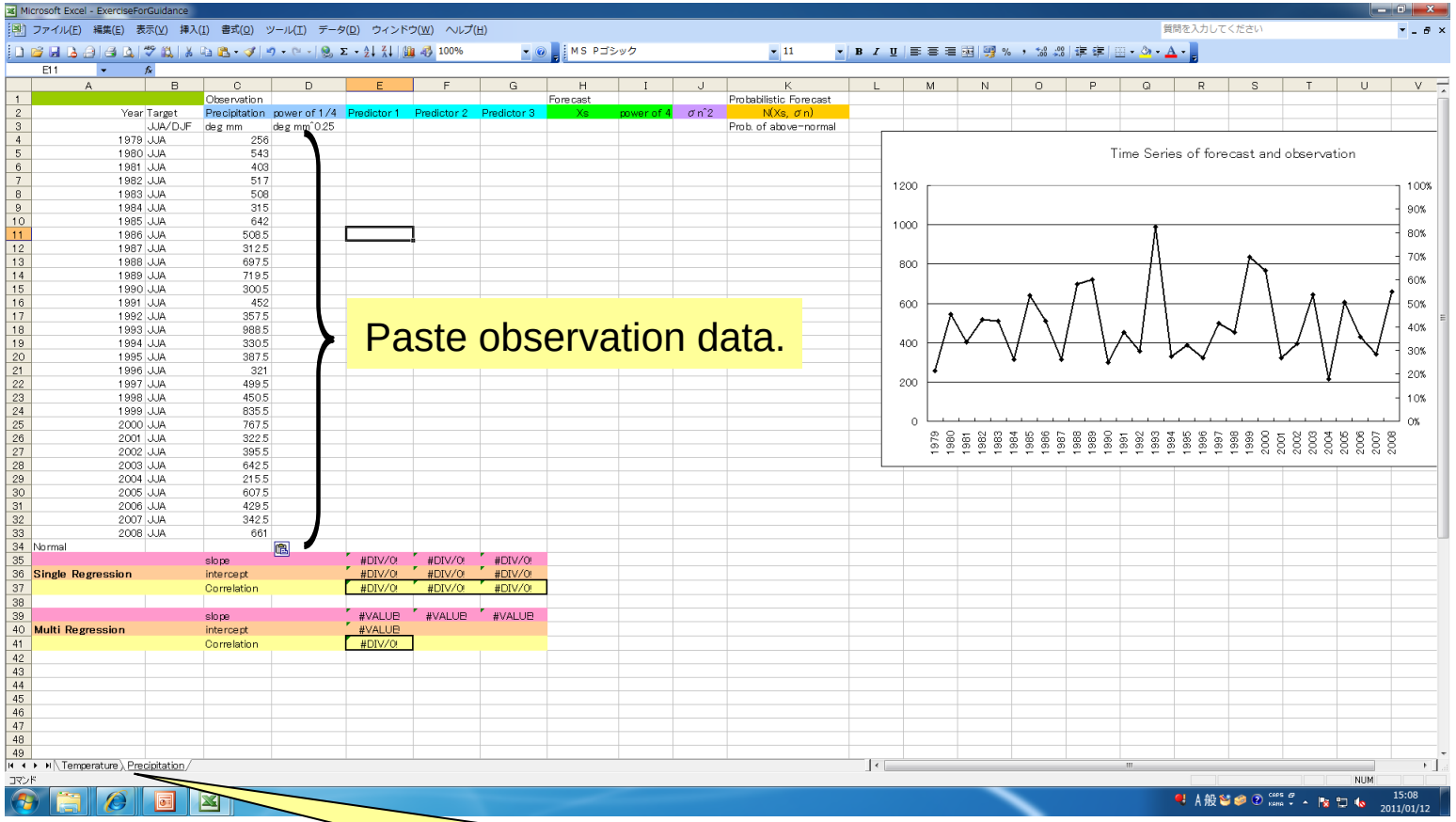
Indices

	indices	variables	areas
SST	NINO3 SST	SST	(150W-90W, 5S-5N)
	NINOWEST SST	SST	(130E-150E, EQ-15N)
	IOBW SST	SST	(40E-100E, 20S-20N)
RAIN	IOBW RAIN	RAIN	(40E-100E, 20S-20N)
	SAMOI RAIN	RAIN	(80E-140E, 5N-25N)
	WNP RAIN	RAIN	(110E-160E, 10N-20N)
	SEAsia RAIN	RAIN	(115E-140E, 10N-20N)
	MC RAIN	RAIN	(110E-135E, 5S-5N)
	DL RAIN	RAIN	(170E-170W, 5S-5N)
Z500	Z2030	500hPa Height	(0-360, 20N-30N)
	Z3040	500hPa Height	(0-360, 30N-40N)
	Z4050	500hPa Height	(0-360, 40N-50N)
	Z5060	500hPa Height	(0-360, 50N-60N)
Thickness	THMD	Thickness Middle	(0-360, 30N-50N, 300hPa-850hPa)
	THEX	Thickness extratropic	(0-360, 30N-90N, 300hPa-850hPa)
	THTR	Thickness tropic	(0-360, 25S-25N, 100hPa-850hPa)



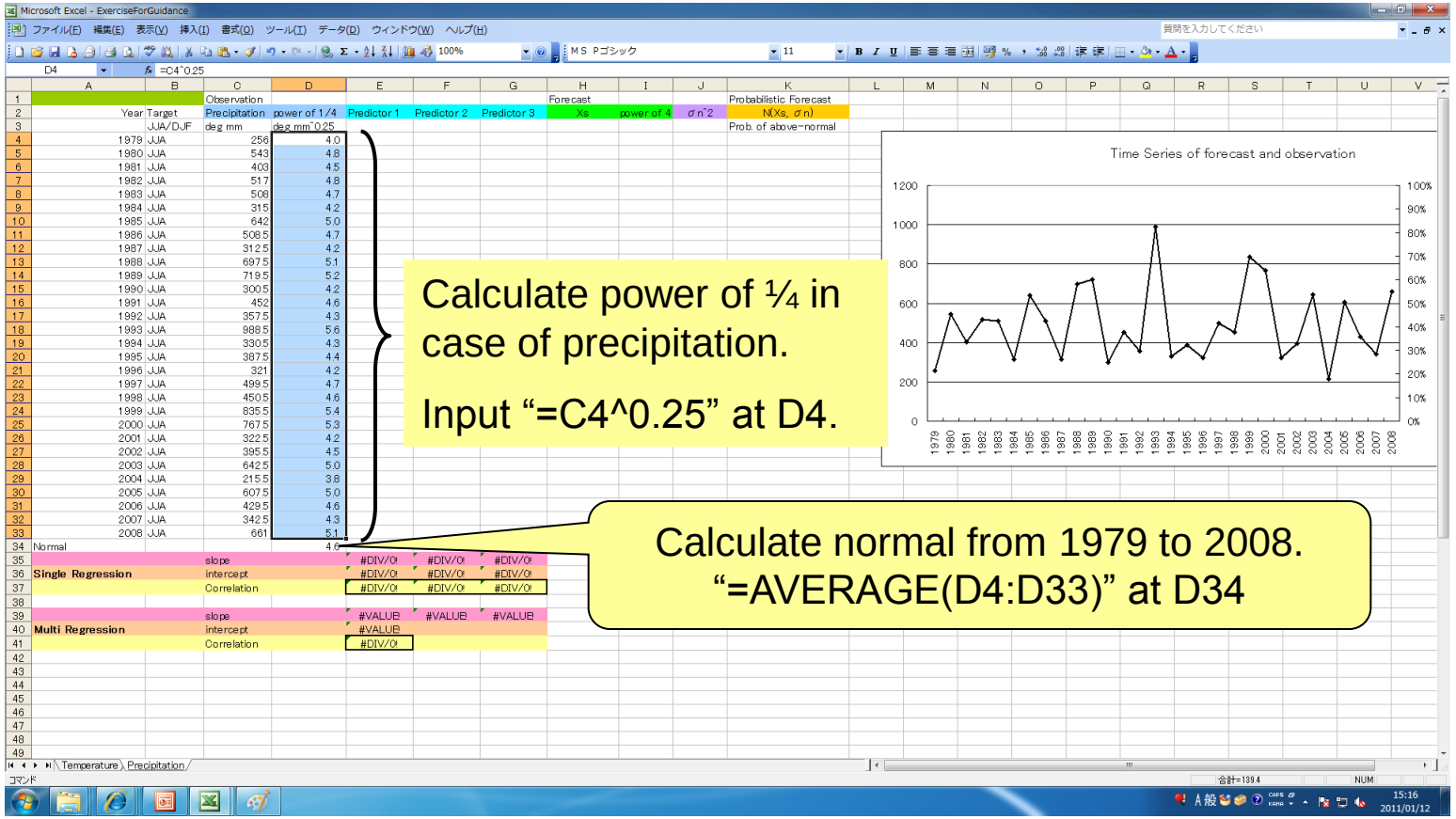
1. Single Regression Model

- Open the ExerciseForGuidance.xls.
- Paste observation data on a Temperature/Precipitation worksheet.



1. Single Regression Model

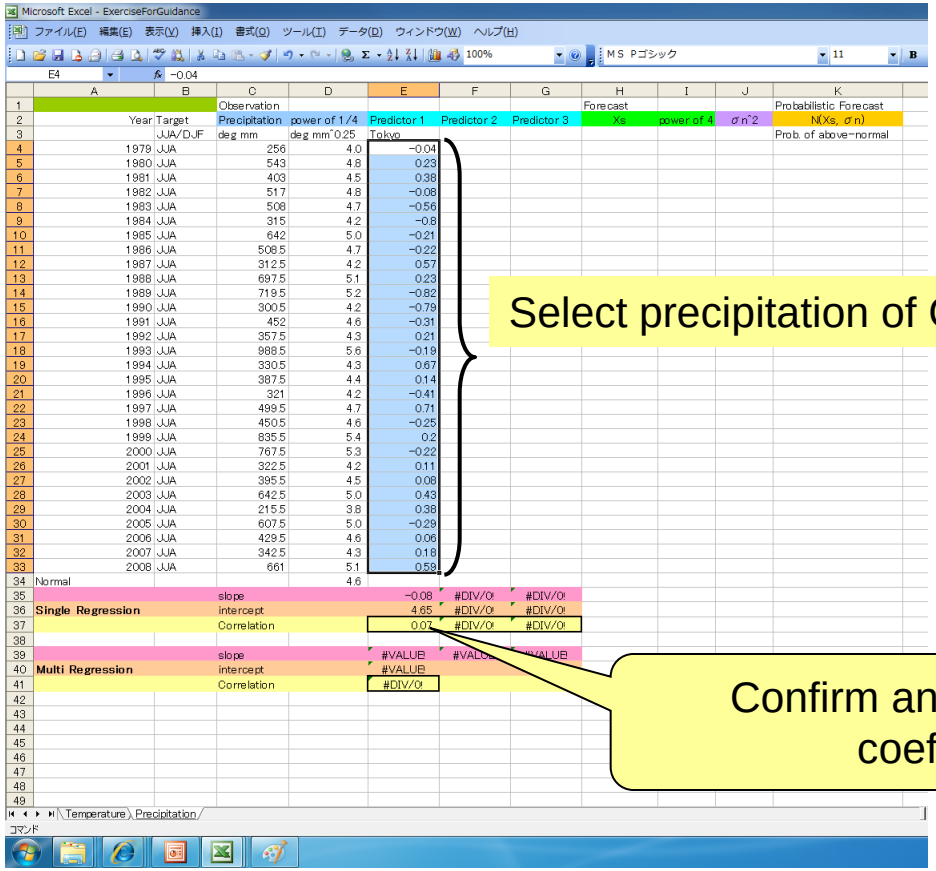
- Calculate the power of ¼ for normalization in case of precipitation.
- Calculate normal from 1979 to 2008.



1. Single Regression Model

- Open GPVdata.xls and indices.xls.
- Select a predictor and paste E line. In case of temperature, paste D line.

Predictors



	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		JJA/DJF	deg mm	deg mm^0.25	Tokyo						Prob. of above-normal
4	1979	JJA	256	4.0	−0.04						
5	1980	JJA	543	4.8	0.23						
6	1981	JJA	403	4.5	0.38						
7	1982	JJA	517	4.8	−0.08						
8	1983	JJA	508	4.7	−0.56						
9	1984	JJA	315	4.2	−0.8						
10	1985	JJA	642	5.0	−0.21						
11	1986	JJA	508.5	4.7	−0.22						
12	1987	JJA	312.5	4.2	0.57						
13	1988	JJA	697.5	5.1	0.23						
14	1989	JJA	719.5	5.2	−0.82						
15	1990	JJA	300.5	4.2	−0.79						
16	1991	JJA	452	4.6	−0.31						
17	1992	JJA	357.5	4.3	0.21						
18	1993	JJA	988.5	5.6	−0.19						
19	1994	JJA	330.5	4.3	0.67						
20	1995	JJA	387.5	4.4	0.14						
21	1996	JJA	321	4.2	−0.41						
22	1997	JJA	499.5	4.7	0.71						
23	1998	JJA	450.5	4.6	−0.25						
24	1999	JJA	835.5	5.4	0.2						
25	2000	JJA	767.5	5.3	−0.22						
26	2001	JJA	322.5	4.2	0.11						
27	2002	JJA	395.5	4.5	0.08						
28	2003	JJA	642.5	5.0	0.43						
29	2004	JJA	215.5	3.8	0.38						
30	2005	JJA	607.5	5.0	−0.29						
31	2006	JJA	429.5	4.6	0.06						
32	2007	JJA	342.5	4.3	0.18						
33	2008	JJA	661	5.1	0.59						
34	Normal			4.6							
35			slope		−0.08	#DIV/0!	#DIV/0!				
36	Single Regression		intercept		4.65	#DIV/0!	#DIV/0!				
37			Correlation		0.07	#DIV/0!	#DIV/0!				
38											
39			slope		#VALUE!	#VALUE!	#VALUE!				
40	Multi Regression		intercept		#VALUE!						
41			Correlation		#DIV/0!						

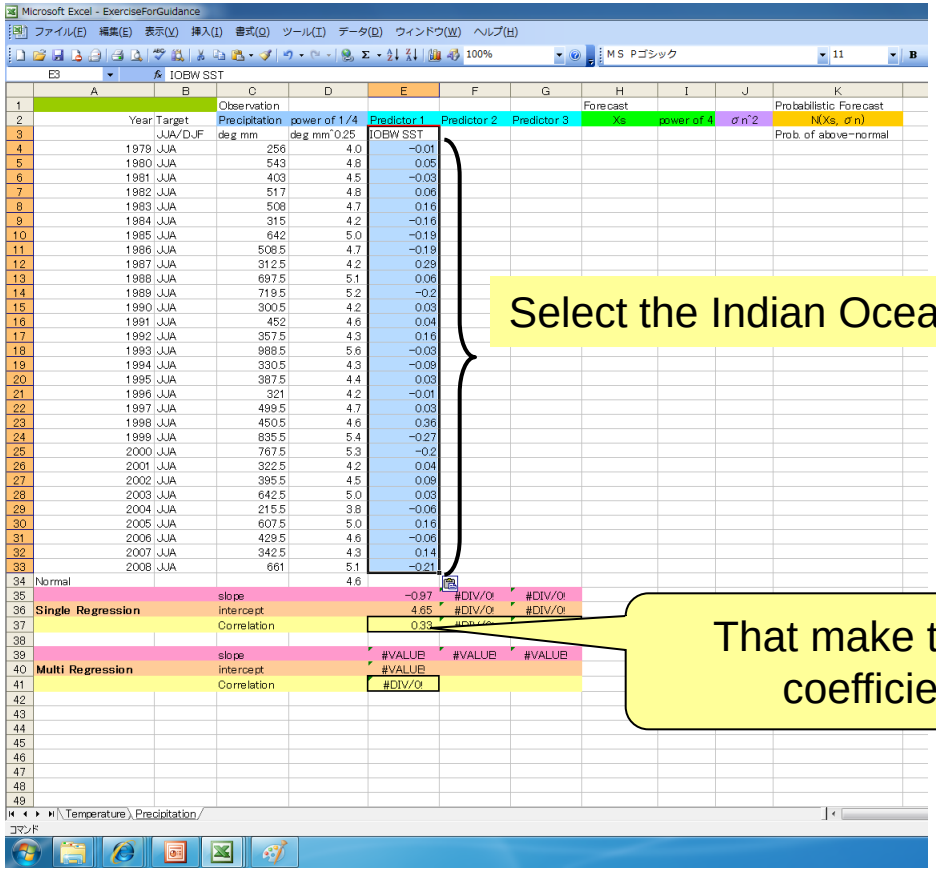
Select precipitation of GPV data over Tokyo as a predictor.

Confirm an anomaly correlation coefficient at E37.

In case of Tokyo, ACC is near zero. So I try the other predictors.

1. Single Regression Model

- Try using the other predictors.
- We can find out more effective predictor for Tokyo. It is the Indian Ocean SST.



	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST						Prob. of above-normal
4	1979	JJA	256	4.0	−0.01						
5	1980	JJA	543	4.8	0.05						
6	1981	JJA	403	4.5	−0.03						
7	1982	JJA	517	4.8	0.06						
8	1983	JJA	508	4.7	0.16						
9	1984	JJA	315	4.2	−0.16						
10	1985	JJA	642	5.0	−0.19						
11	1986	JJA	508.5	4.7	−0.19						
12	1987	JJA	312.5	4.2	0.29						
13	1988	JJA	697.5	5.1	0.06						
14	1989	JJA	719.5	5.2	−0.2						
15	1990	JJA	300.5	4.2	0.03						
16	1991	JJA	452	4.6	0.04						
17	1992	JJA	357.5	4.3	0.16						
18	1993	JJA	988.5	5.6	−0.03						
19	1994	JJA	330.5	4.3	−0.09						
20	1995	JJA	387.5	4.4	0.03						
21	1996	JJA	321	4.2	−0.01						
22	1997	JJA	499.5	4.7	0.03						
23	1998	JJA	450.5	4.6	0.36						
24	1999	JJA	835.5	5.4	−0.27						
25	2000	JJA	767.5	5.3	−0.2						
26	2001	JJA	322.5	4.2	0.04						
27	2002	JJA	395.5	4.5	0.09						
28	2003	JJA	642.5	5.0	0.03						
29	2004	JJA	215.5	3.8	−0.06						
30	2005	JJA	607.5	5.0	0.16						
31	2006	JJA	429.5	4.6	−0.06						
32	2007	JJA	342.5	4.3	0.14						
33	2008	JJA	661	5.1	−0.21						
34	Normal			4.6							
35			slope		−0.97	#DIV/0!	#DIV/0!				
36	**Single Regression**		intercept		4.65	#DIV/0!	#DIV/0!				
37			Correlation		0.33						
38											
39			slope		#VALUE!	#VALUE!	#VALUE!				
40	**Multi Regression**		intercept		#VALUE!						
41			Correlation		#DIV/0!						

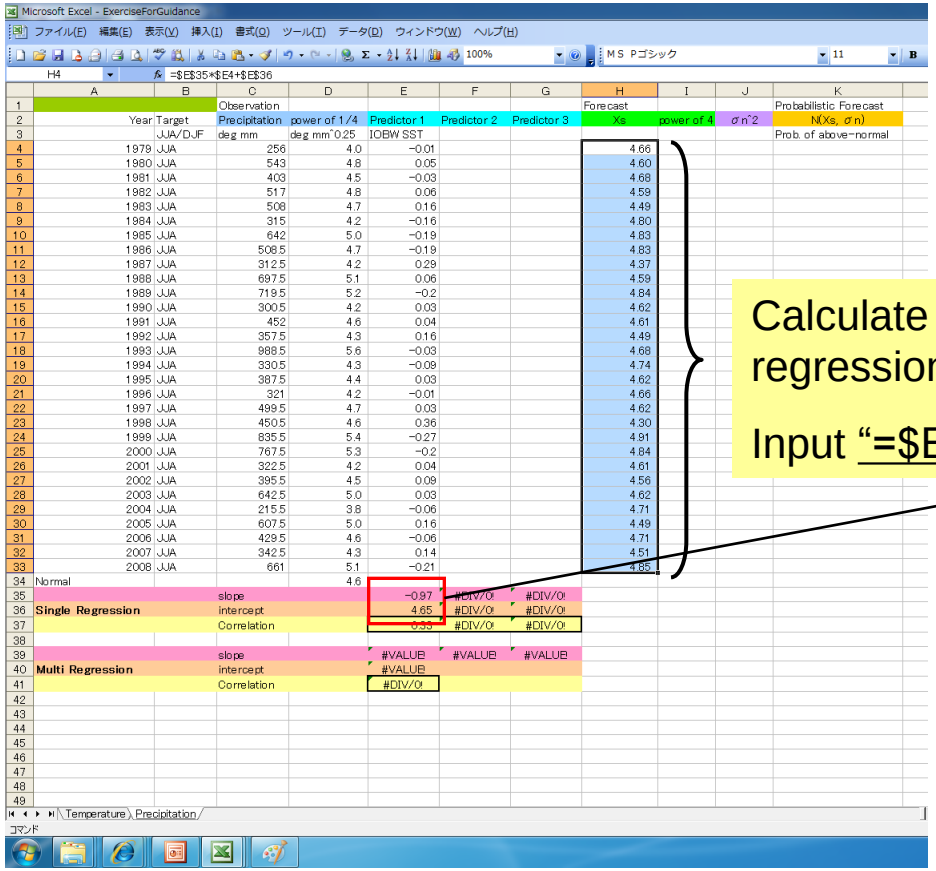
Select the Indian Ocean SST and paste them on E line.

That make the anomaly correlation coefficient increase to 0.33.

Let’s try to look for most effective predictor for your country.

1. Single Regression Model

- Calculate the forecasts using single regression equation.

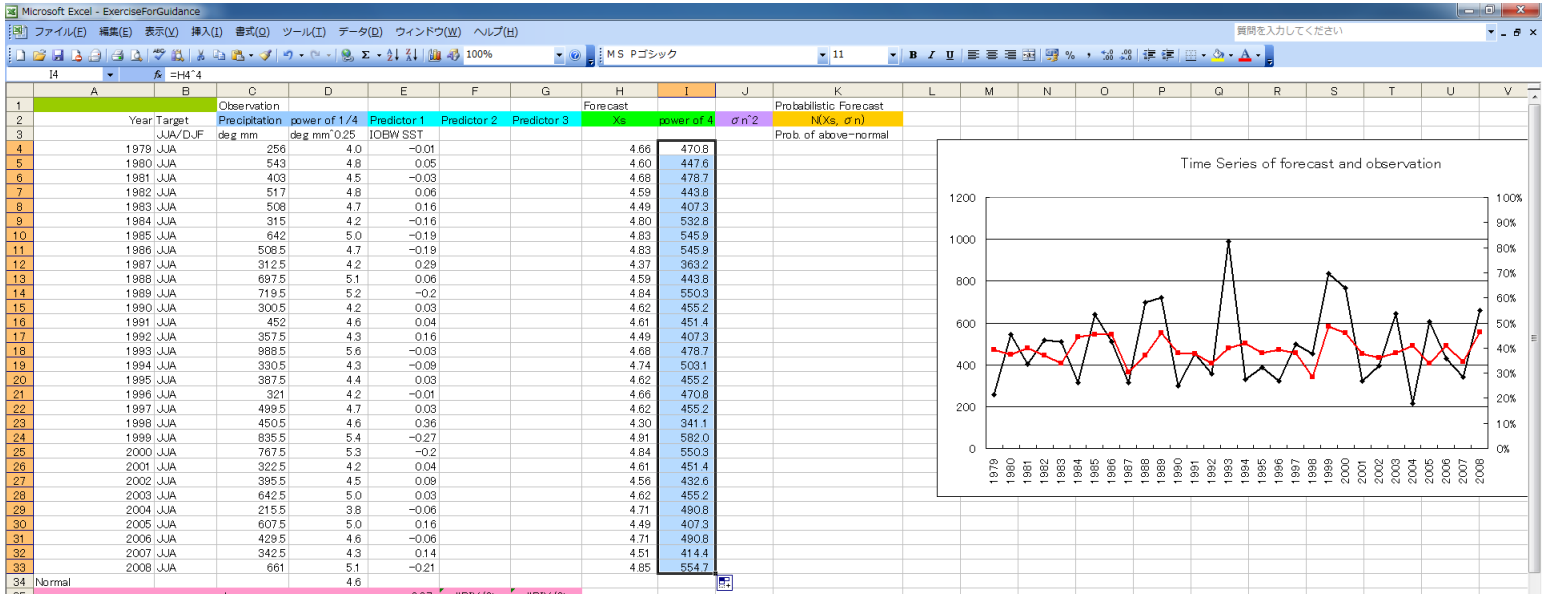


Calculate the forecasts using single regression equation.

Input "=$E$35 * $E4+$E$36" at H4.

1. Single Regression Model

- Calculate power of 4 on I line in case of precipitation.
- You can see a time series line chart. Red line indicates the forecasts.



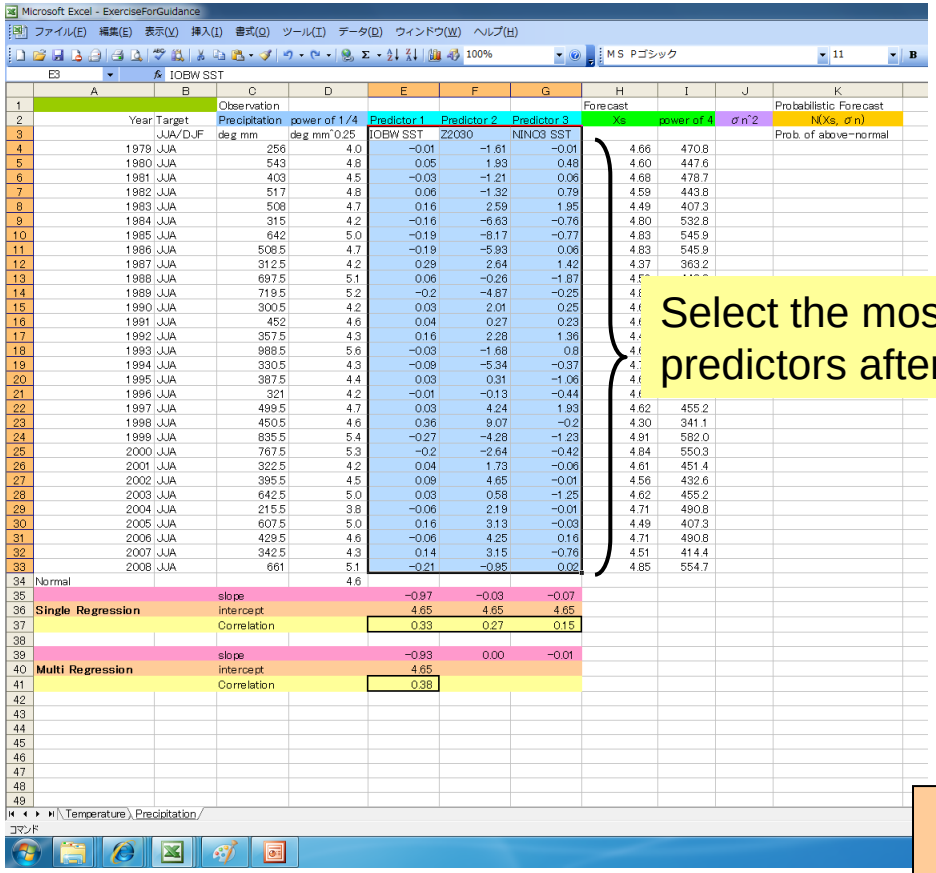
	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σ^2	N(Xs, σ)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST						Prob. of above-normal
4	1979	JJA	256	4.0	−0.01			4.66	470.8		
5	1980	JJA	543	4.8	0.05			4.60	447.6		
6	1981	JJA	403	4.5	−0.03			4.68	478.7		
7	1982	JJA	517	4.8	0.06			4.59	443.8		
8	1983	JJA	508	4.7	0.16			4.49	407.3		
9	1984	JJA	315	4.2	−0.16			4.80	532.8		
10	1985	JJA	642	5.0	−0.19			4.83	545.9		
11	1986	JJA	508.5	4.7	−0.19			4.83	545.9		
12	1987	JJA	312.5	4.2	0.29			4.37	363.2		
13	1988	JJA	697.5	5.1	0.06			4.59	443.8		
14	1989	JJA	719.5	5.2	−0.2			4.84	550.3		
15	1990	JJA	300.5	4.2	0.03			4.62	455.2		
16	1991	JJA	452	4.6	0.04			4.61	451.4		
17	1992	JJA	357.5	4.3	0.16			4.49	407.3		
18	1993	JJA	988.5	5.6	−0.03			4.68	478.7		
19	1994	JJA	330.5	4.3	−0.09			4.74	503.1		
20	1995	JJA	387.5	4.4	0.03			4.62	455.2		
21	1996	JJA	321	4.2	−0.01			4.66	470.8		
22	1997	JJA	499.5	4.7	0.03			4.62	455.2		
23	1998	JJA	450.5	4.6	0.36			4.30	341.1		
24	1999	JJA	835.5	5.4	−0.27			4.91	582.0		
25	2000	JJA	767.5	5.3	−0.2			4.84	550.3		
26	2001	JJA	322.5	4.2	0.04			4.61	451.4		
27	2002	JJA	395.5	4.5	0.09			4.56	432.6		
28	2003	JJA	642.5	5.0	0.03			4.62	455.2		
29	2004	JJA	215.5	3.8	−0.06			4.71	490.8		
30	2005	JJA	607.5	5.0	0.16			4.49	407.3		
31	2006	JJA	429.5	4.6	−0.06			4.71	490.8		
32	2007	JJA	342.5	4.3	0.14			4.51	414.4		
33	2008	JJA	661	5.1	−0.21			4.85	554.7		
34	Normal			4.6							

Questions

1. What predictor do you select?
2. Can you get an accuracy guidance?
3. How does its guidance predict the hottest/coldest/drought/wet year in your country?

2. Multiple Regression Model

- Try to look for most effective combination of predictors.



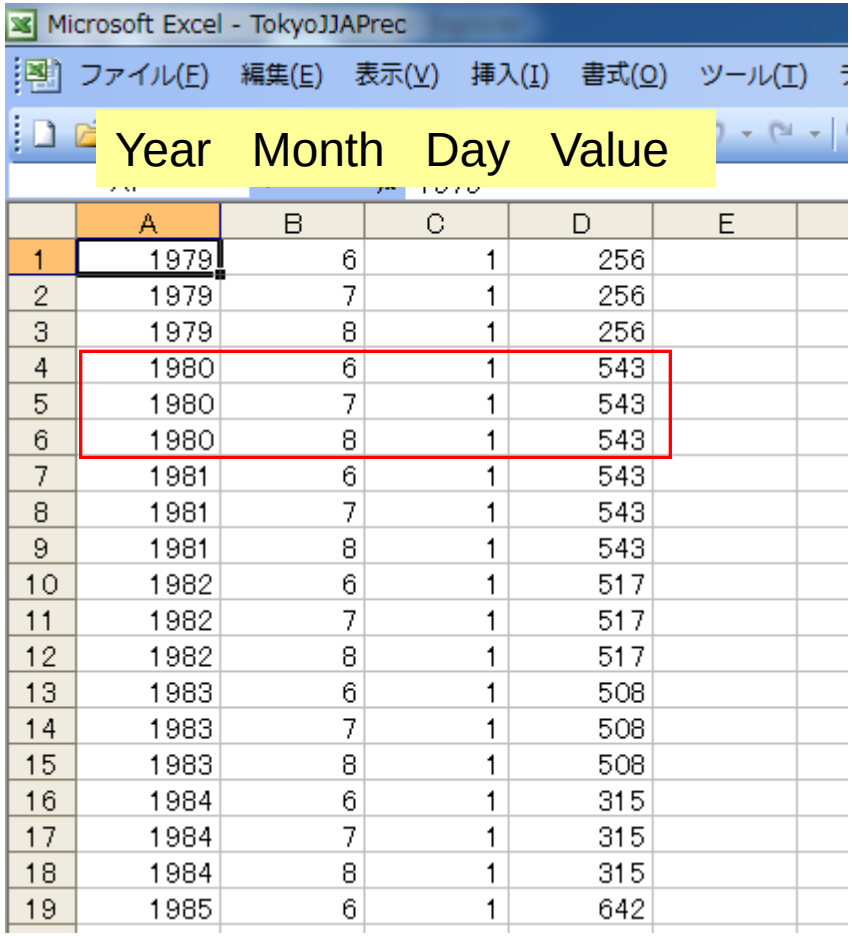
	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST	Z2030	NINO3 SST				Prob. of above-normal
4	1979	JJA	256	4.0	−0.01	−1.61	−0.01	4.66	470.8		
5	1980	JJA	543	4.8	0.05	1.93	0.48	4.60	447.6		
6	1981	JJA	403	4.5	−0.03	−1.21	0.06	4.68	478.7		
7	1982	JJA	517	4.8	0.06	−1.32	0.79	4.59	443.8		
8	1983	JJA	508	4.7	0.16	2.59	1.95	4.49	407.3		
9	1984	JJA	315	4.2	−0.16	−6.63	−0.76	4.80	532.8		
10	1985	JJA	642	5.0	−0.19	−8.17	−0.77	4.83	545.9		
11	1986	JJA	508.5	4.7	−0.19	−5.93	0.06	4.83	545.9		
12	1987	JJA	312.5	4.2	0.29	2.64	1.42	4.37	363.2		
13	1988	JJA	697.5	5.1	0.06	−0.26	−1.87	4.[illegible]	[illegible]		
14	1989	JJA	719.5	5.2	−0.2	−4.87	−0.25	4.[illegible]	[illegible]		
15	1990	JJA	300.5	4.2	0.03	2.01	0.25	4.[illegible]	[illegible]		
16	1991	JJA	452	4.6	0.04	0.27	0.23	4.[illegible]	[illegible]		
17	1992	JJA	357.5	4.3	0.16	2.28	1.36	4.[illegible]	[illegible]		
18	1993	JJA	988.5	5.6	−0.03	−1.68	0.8	4.[illegible]	[illegible]		
19	1994	JJA	330.5	4.3	−0.09	−5.34	−0.37	4.[illegible]	[illegible]		
20	1995	JJA	387.5	4.4	0.03	0.31	−1.06	4.[illegible]	[illegible]		
21	1996	JJA	321	4.2	−0.01	−0.13	−0.44	4.[illegible]	[illegible]		
22	1997	JJA	499.5	4.7	0.03	4.24	1.93	4.62	455.2		
23	1998	JJA	450.5	4.6	0.36	9.07	−0.2	4.30	341.1		
24	1999	JJA	835.5	5.4	−0.27	−4.28	−1.23	4.91	582.0		
25	2000	JJA	767.5	5.3	−0.2	−2.64	−0.42	4.84	550.3		
26	2001	JJA	322.5	4.2	0.04	1.73	−0.06	4.61	451.4		
27	2002	JJA	395.5	4.5	0.09	4.65	−0.01	4.56	432.6		
28	2003	JJA	642.5	5.0	0.03	0.58	−1.25	4.62	455.2		
29	2004	JJA	215.5	3.8	−0.06	2.19	−0.01	4.71	490.8		
30	2005	JJA	607.5	5.0	0.16	3.13	−0.03	4.49	407.3		
31	2006	JJA	429.5	4.6	−0.06	4.25	0.16	4.71	490.8		
32	2007	JJA	342.5	4.3	0.14	3.15	−0.76	4.51	414.4		
33	2008	JJA	661	5.1	−0.21	−0.85	0.02	4.85	554.7		
34	Normal			4.6							
35			slope		−0.97	−0.03	−0.07				
36	**Single Regression**		intercept		4.65	4.65	4.65				
37			Correlation		0.33	0.27	0.15				
38											
39			slope		−0.93	0.00	−0.01				
40	**Multi Regression**		intercept		4.65						
41			Correlation		0.38						

Select the most effective combination of predictors after trial and error.

The ITACS help you find them.

2. Multiple Regression Model

- Let's use ITACS for looking for effective predictors.
  - Preparing observation data for CSV format at first.

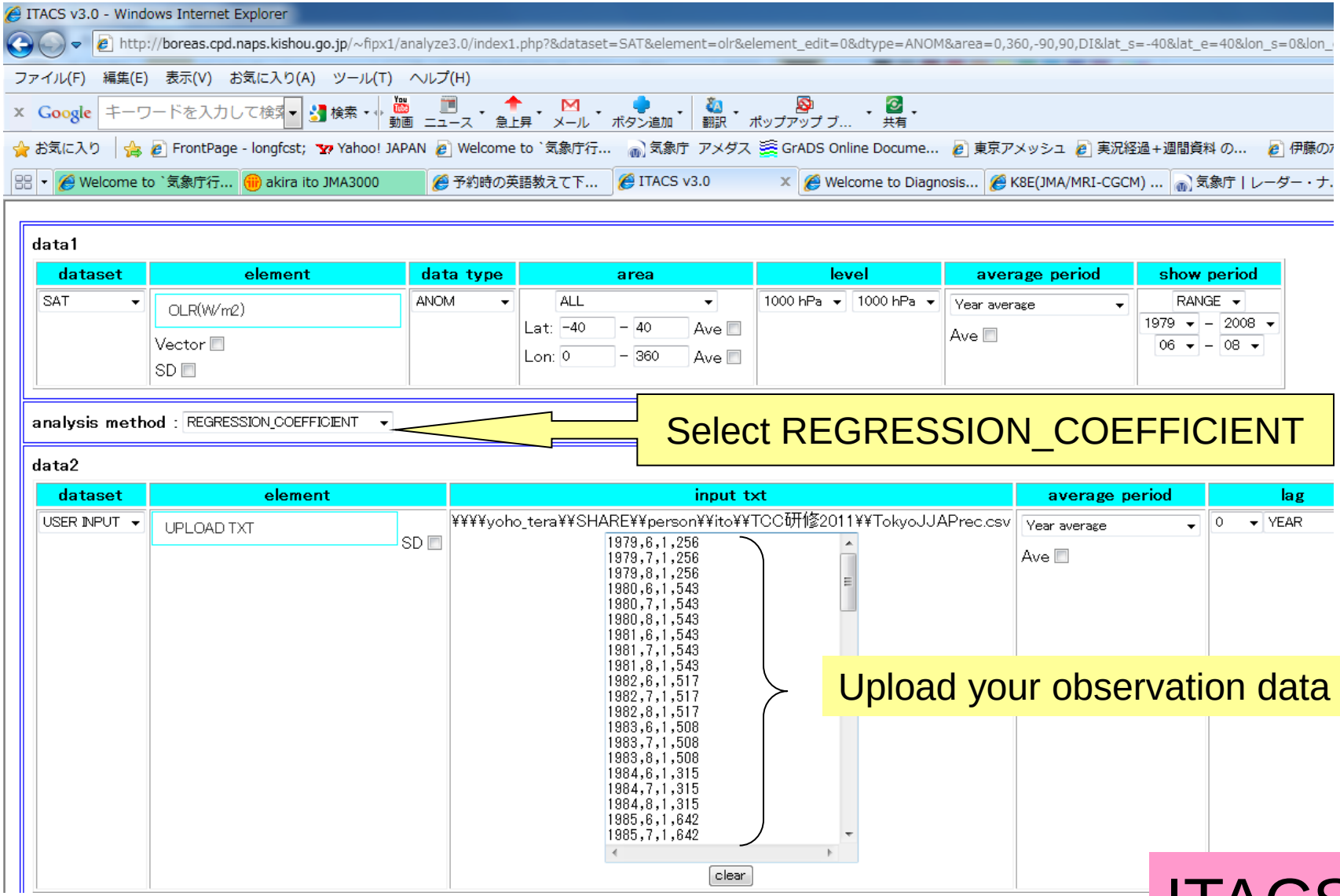


	A	B	C	D	E
1	1979	6	1	256	
2	1979	7	1	256	
3	1979	8	1	256	
4	1980	6	1	543	
5	1980	7	1	543	
6	1980	8	1	543	
7	1981	6	1	543	
8	1981	7	1	543	
9	1981	8	1	543	
10	1982	6	1	517	
11	1982	7	1	517	
12	1982	8	1	517	
13	1983	6	1	508	
14	1983	7	1	508	
15	1983	8	1	508	
16	1984	6	1	315	
17	1984	7	1	315	
18	1984	8	1	315	
19	1985	6	1	642	

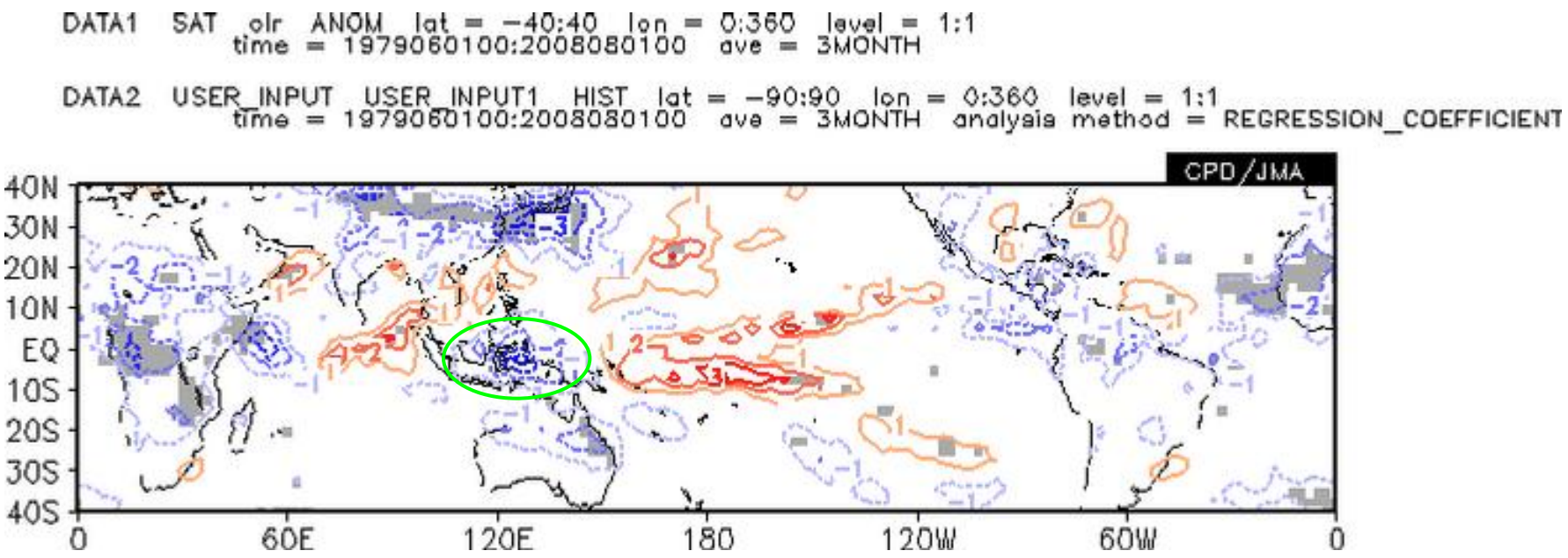
In case of JJA, you need to input 6,7,8 on B line and JJA value on D line, respectively.

ITACS

2. Multiple Regression Model



2. Multiple Regression Model



This is a relationship between OLR and JJA precipitation in Tokyo.

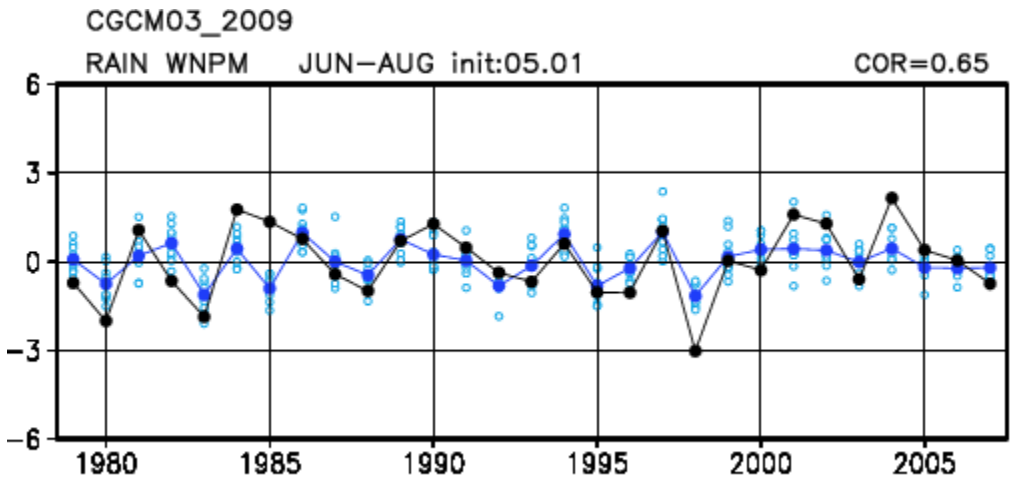
The OLR around Maritime Continent looks a likely predictor.

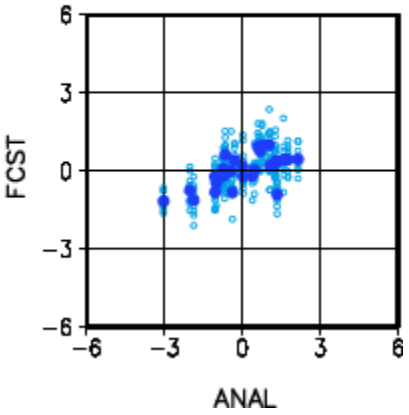
Try looking for predictors in this way.

Note: ITACS can show the relationship between **analysis** and your observation data. If you use the variables as predictors, you need to confirm their forecast skill.

ITACS

2. Multiple Regression Model



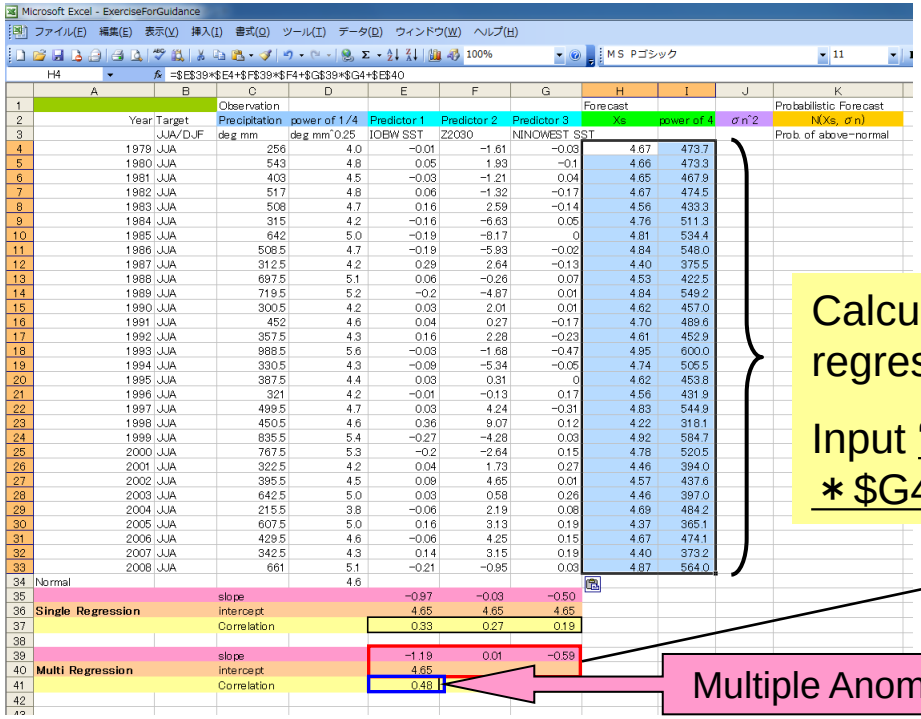


You can see the verification results of hindcast.

http://ds.data.jma.go.jp/tcc/tcc/gpv/model/hindcast_map/

2. Multiple Regression Model

- Calculate the forecasts using multiple regression equation.



	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST	Z2030	NINOWEST SST				Prob. of above-normal
4	1979	JJA	256	4.0	−0.01	−1.61	−0.03	4.67	473.7		
5	1980	JJA	543	4.8	0.05	1.93	−0.1	4.66	473.3		
6	1981	JJA	403	4.5	−0.03	−1.21	0.04	4.65	467.9		
7	1982	JJA	517	4.8	0.06	−1.32	−0.17	4.67	474.5		
8	1983	JJA	508	4.7	0.16	2.59	−0.14	4.56	433.3		
9	1984	JJA	315	4.2	−0.16	−6.63	0.05	4.76	511.3		
10	1985	JJA	642	5.0	−0.19	−8.17	0	4.81	534.4		
11	1986	JJA	508.5	4.7	−0.19	−5.93	−0.02	4.84	548.0		
12	1987	JJA	312.5	4.2	0.29	2.64	−0.13	4.40	375.5		
13	1988	JJA	697.5	5.1	0.06	−0.26	0.07	4.53	422.5		
14	1989	JJA	719.5	5.2	−0.2	−4.87	0.01	4.84	549.2		
15	1990	JJA	300.5	4.2	0.03	2.01	0.01	4.62	457.0		
16	1991	JJA	452	4.6	0.04	0.27	−0.17	4.70	489.6		
17	1992	JJA	357.5	4.3	0.16	2.28	−0.23	4.61	452.9		
18	1993	JJA	988.5	5.6	−0.03	−1.68	−0.47	4.95	600.0		
19	1994	JJA	330.5	4.3	−0.09	−5.34	−0.05	4.74	505.5		
20	1995	JJA	387.5	4.4	0.03	0.31	0	4.62	453.8		
21	1996	JJA	321	4.2	−0.01	−0.13	0.17	4.56	431.9		
22	1997	JJA	499.5	4.7	0.03	4.24	−0.31	4.83	544.9		
23	1998	JJA	450.5	4.6	0.36	9.07	0.12	4.22	318.1		
24	1999	JJA	835.5	5.4	−0.27	−4.28	0.03	4.92	584.7		
25	2000	JJA	767.5	5.3	−0.2	−2.64	0.15	4.78	520.5		
26	2001	JJA	322.5	4.2	0.04	1.73	0.27	4.46	394.0		
27	2002	JJA	395.5	4.5	0.09	4.65	0.01	4.57	437.6		
28	2003	JJA	642.5	5.0	0.03	0.58	0.26	4.46	397.0		
29	2004	JJA	215.5	3.8	−0.06	2.19	0.08	4.69	484.2		
30	2005	JJA	607.5	5.0	0.16	3.13	0.19	4.37	365.1		
31	2006	JJA	429.5	4.6	−0.06	4.25	0.15	4.67	474.1		
32	2007	JJA	342.5	4.3	0.14	3.15	0.19	4.40	373.2		
33	2008	JJA	661	5.1	−0.21	−0.95	0.03	4.87	564.0		
34	Normal			4.6							
35			slope		−0.97	−0.03	−0.50				
36	Single Regression		intercept		4.65	4.65	4.65				
37			Correlation		0.33	0.27	0.19				
38											
39			slope		−1.19	0.01	−0.59				
40	Multi Regression		intercept		4.65						
41			Correlation		0.48						
42											

Calculate the forecasts using multiple regression equation.

Input "=$E$39 * $E4+$F$39 * $F4+$G$39 * $G4+$E$40" at H4.

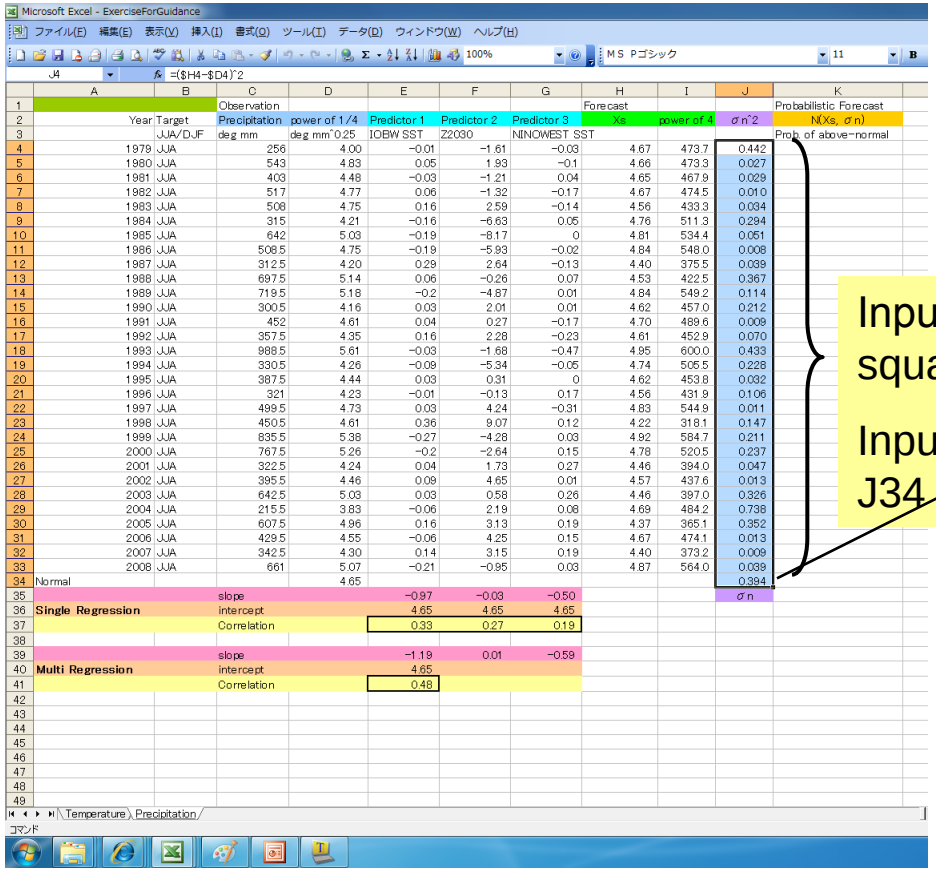
Multiple Anomaly Correlation Coefficient

Questions

1. What predictors do you select?
2. Can you get more accuracy guidance than single regression model?

3. Probabilistic Forecast

- Calculate square of regression error.
- Calculate root mean square error.



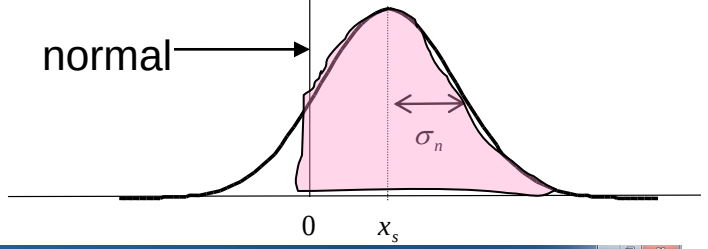
	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST	Z2030	NINOWEST SST				Prob of above-normal
4	1979	JJA	256	4.00	−0.01	−1.61	−0.03	4.67	473.7	0.442	
5	1980	JJA	543	4.83	0.05	1.93	−0.1	4.66	473.3	0.027	
6	1981	JJA	403	4.48	−0.03	−1.21	0.04	4.65	467.9	0.029	
7	1982	JJA	517	4.77	0.06	−1.32	−0.17	4.67	474.5	0.010	
8	1983	JJA	508	4.75	0.16	2.59	−0.14	4.56	433.3	0.034	
9	1984	JJA	315	4.21	−0.16	−6.63	0.05	4.76	511.3	0.294	
10	1985	JJA	642	5.03	−0.19	−8.17	0	4.81	534.4	0.051	
11	1986	JJA	508.5	4.75	−0.19	−5.93	−0.02	4.84	548.0	0.008	
12	1987	JJA	312.5	4.20	0.29	2.64	−0.13	4.40	375.5	0.039	
13	1988	JJA	697.5	5.14	0.06	−0.26	0.07	4.53	422.5	0.367	
14	1989	JJA	719.5	5.18	−0.2	−4.87	0.01	4.84	549.2	0.114	
15	1990	JJA	300.5	4.16	0.03	2.01	0.01	4.62	457.0	0.212	
16	1991	JJA	452	4.61	0.04	0.27	−0.17	4.70	489.6	0.009	
17	1992	JJA	357.5	4.35	0.16	2.28	−0.23	4.61	452.9	0.070	
18	1993	JJA	988.5	5.61	−0.03	−1.68	−0.47	4.95	600.0	0.433	
19	1994	JJA	330.5	4.26	−0.09	−5.34	−0.05	4.74	505.5	0.228	
20	1995	JJA	387.5	4.44	0.03	0.31	0	4.62	453.8	0.032	
21	1996	JJA	321	4.23	−0.01	−0.13	0.17	4.56	431.9	0.106	
22	1997	JJA	499.5	4.73	0.03	4.24	−0.31	4.83	544.9	0.011	
23	1998	JJA	450.5	4.61	0.36	9.07	0.12	4.22	318.1	0.147	
24	1999	JJA	835.5	5.38	−0.27	−4.28	0.03	4.92	584.7	0.211	
25	2000	JJA	767.5	5.26	−0.2	−2.64	0.15	4.78	520.5	0.237	
26	2001	JJA	322.5	4.24	0.04	1.73	0.27	4.46	394.0	0.047	
27	2002	JJA	395.5	4.46	0.09	4.65	0.01	4.57	437.6	0.013	
28	2003	JJA	642.5	5.03	0.03	0.58	0.26	4.46	397.0	0.326	
29	2004	JJA	215.5	3.83	−0.06	2.19	0.08	4.69	484.2	0.738	
30	2005	JJA	607.5	4.96	0.16	3.13	0.19	4.37	365.1	0.352	
31	2006	JJA	429.5	4.55	−0.06	4.25	0.15	4.67	474.1	0.013	
32	2007	JJA	342.5	4.30	0.14	3.15	0.19	4.40	373.2	0.009	
33	2008	JJA	661	5.07	−0.21	−0.95	0.03	4.87	564.0	0.039	
34	Normal			4.65						0.394	
35			slope		−0.97	−0.03	−0.50			σn	
36	Single Regression		intercept		4.65	4.65	4.65				
37			Correlation		0.33	0.27	0.19				
38											
39			slope		−1.19	0.01	−0.59				
40	Multi Regression		intercept		4.65						
41			Correlation		0.48						

Input “=($H4-$D4)^2” at J4 to calculate square error.

Input “=SQRT(AVERAGE(J4:J33))” at J34 to calculate root mean square error.

3. Probabilistic Forecast

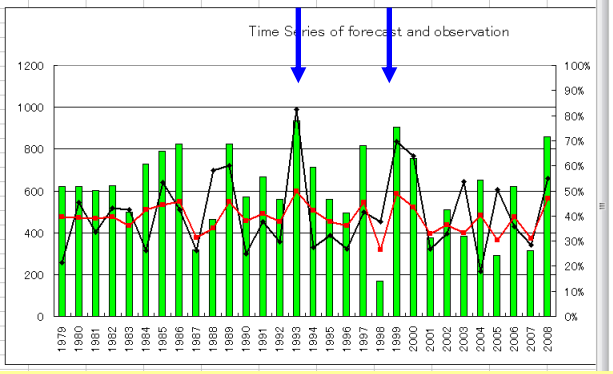
- Calculate probability of above-normal.



Microsoft Excel - ExerciseForGuidance

=1−NORMDIST($D$34,$H4,$J$34,TRUE)

	A	B	C	D	E	F	G	H	I	J	K
1			Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σ^2	N(Xs, σ n)
3		JJA/DJF	deg mm	deg mm^0.25	IOBW SST	Z2030	NINOWEST SST				Prob. of above-normal
4	1979	JJA	256	4.00	−0.01	−1.61	−0.03	4.67	473.7	0.042	52%
5	1980	JJA	543	4.83	0.05	1.93	−0.1	4.66	473.3	0.027	52%
6	1981	JJA	403	4.48	−0.03	−1.21	0.04	4.65	467.9	0.029	50%
7	1982	JJA	517	4.77	0.06	−1.32	−0.17	4.67	474.5	0.010	52%
8	1983	JJA	508	4.75	0.16	2.59	−0.14	4.56	433.3	0.034	41%
9	1984	JJA	315	4.21	−0.16	−6.63	0.05	4.76	511.3	0.294	61%
10	1985	JJA	642	5.03	−0.19	−8.17	0	4.81	534.4	0.051	66%
11	1986	JJA	508.5	4.75	−0.19	−5.93	−0.02	4.84	548.0	0.008	69%
20	1995	JJA	387.5	4.44	0.03	0.31	0	4.62	453.8	0.039	27%
21	1996	JJA	321	4.23	−0.01	−0.13	0.17	4.56	431.9	0.367	39%
22	1997	JJA	499.5	4.73	0.03	4.24	−0.31	4.83	544.9	0.114	69%
23	1998	JJA	450.5	4.61	0.36	9.07	0.12	4.22	318.1	0.212	48%
24	1999	JJA	835.5	5.38	−0.27	−4.28	0.03	4.92	584.7	0.009	56%
25	2000	JJA	767.5	5.26	−0.2	−2.64	0.15	4.78	520.5	0.070	46%
26	2001	JJA	322.5	4.24	0.04	1.73	0.27	4.46	394.0	0.433	78%
27	2002	JJA	395.5	4.46	0.09	4.65	0.01	4.57	437.6	0.228	59%
28	2003	JJA	642.5	5.03	0.03	0.58	0.26	4.46	397.0	0.062	47%
29	2004	JJA	215.5	3.83	−0.06	2.19	0.08	4.69	484.2	0.106	41%
30	2005	JJA	607.5	4.96	0.16	3.13	0.19	4.37	365.1	0.011	68%
31	2006	JJA	429.5	4.55	−0.06	4.25	0.15	4.67	474.1	0.147	14%
32	2007	JJA	342.5	4.30	0.14	3.15	0.19	4.40	373.2	0.211	75%
33	2008	JJA	661	5.07	−0.21	−0.95	0.03	4.87	564.0	0.039	72%
34	Normal			4.65						0.394	
35			slope		−0.97	−0.03	−0.50			σ n	
36	Single Regression		intercept		4.65	4.65	4.65				
37			Correlation		0.33	0.27	0.19				
38											
39			slope		−1.19	0.01	−0.59				
40	Multi Regression		intercept		4.65						
41			Correlation		0.48						
42											



Input "=1-NORMDIST($D$34,$H4,$J$34,TRUE) at K4 to calculate probability of above-normal.

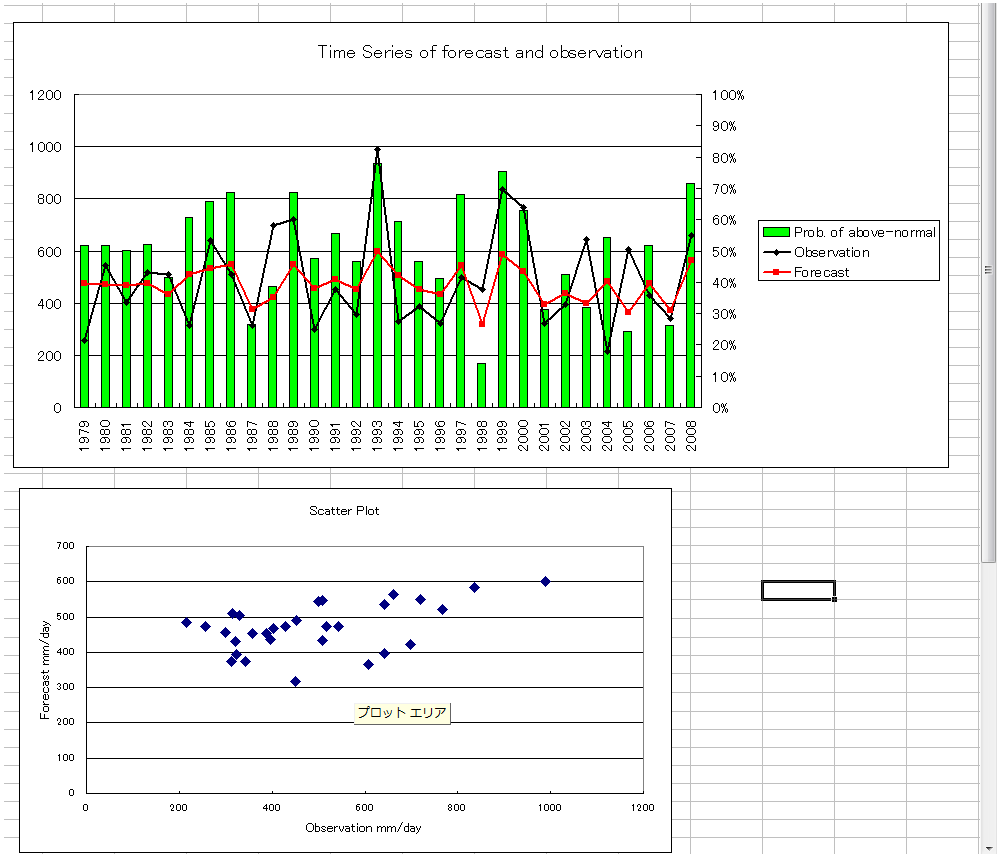
This guidance can predict the wet summer in 1993 and 1999 very well.

Question

1. What is the difference of probability between temperature and precipitation?
2. Have you made some guidance for temp/prec to do probabilistic verification?

4-1. Deterministic Verification

- Anomaly Correlation
- Root Mean Square Error
- Time series chart
- Scatter plot



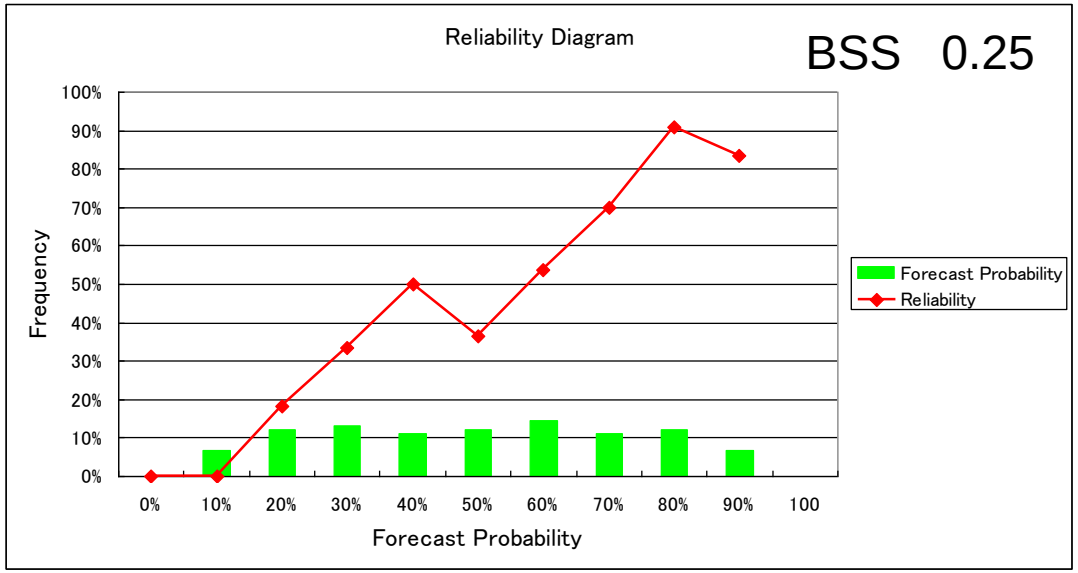
4-2. Probabilistic Verification

- Brier Skill Score (BSS)
- Reliability Diagram

$$b = \frac{1}{N}\sum_{i=1}^{N}(p_i - v_i), \quad 0 \le p_i \le 1, \quad v_i \in \{0,1\}$$

$$BSS = \frac{bc - b}{bc}$$

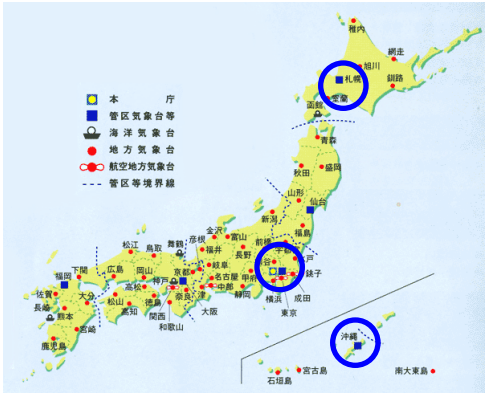
See the textbook in detail



Skill of JMA Routine Guidance from 2005 to 2009.

Target Period	BSS
1st weekly temp.	0.45
2nd weekly temp.	0.25
1st monthly temp.	0.30
3-month temp.	0.35

Reliability Diagram of JJA temperature, totaling Tokyo, Sapporo and Naha station in Japan.



5. Create a Presentation

An example

- What predictors do you use?
- Why do you select their predictors?
  - By ITACS regression tools, traditional, …
- Verification results

Create a presentation with your originality.

Sample

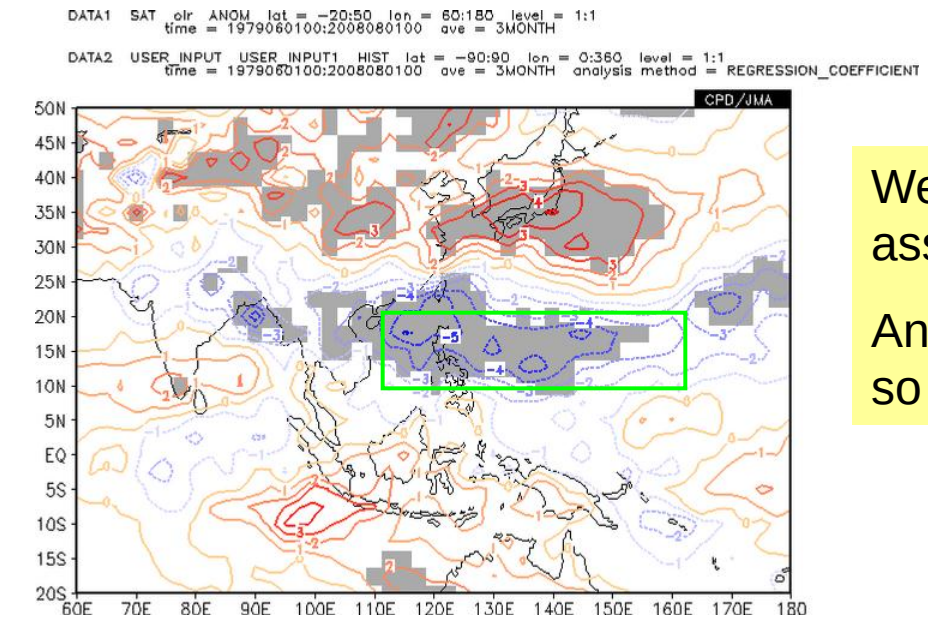
Summary of Japanese guidance

Station	Tokyo
Season	JJA
Predictand	Temperature
Predictors	WNP RAIN, Extratropical Thickness, Indian Ocean SST
Correlation	0.52
Brier Skill Score	0.28 (including Sapporo and Naha stations)

	slope	0.63	1.75	0.33
Multiple Regression	intercept	24.99		
	Correlation	0.52		

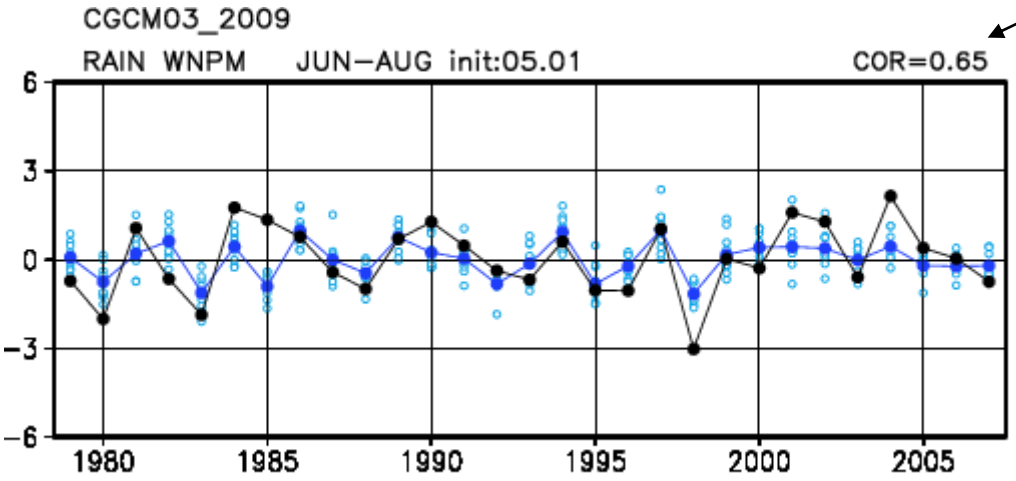
Sample

The reason I select the predictors



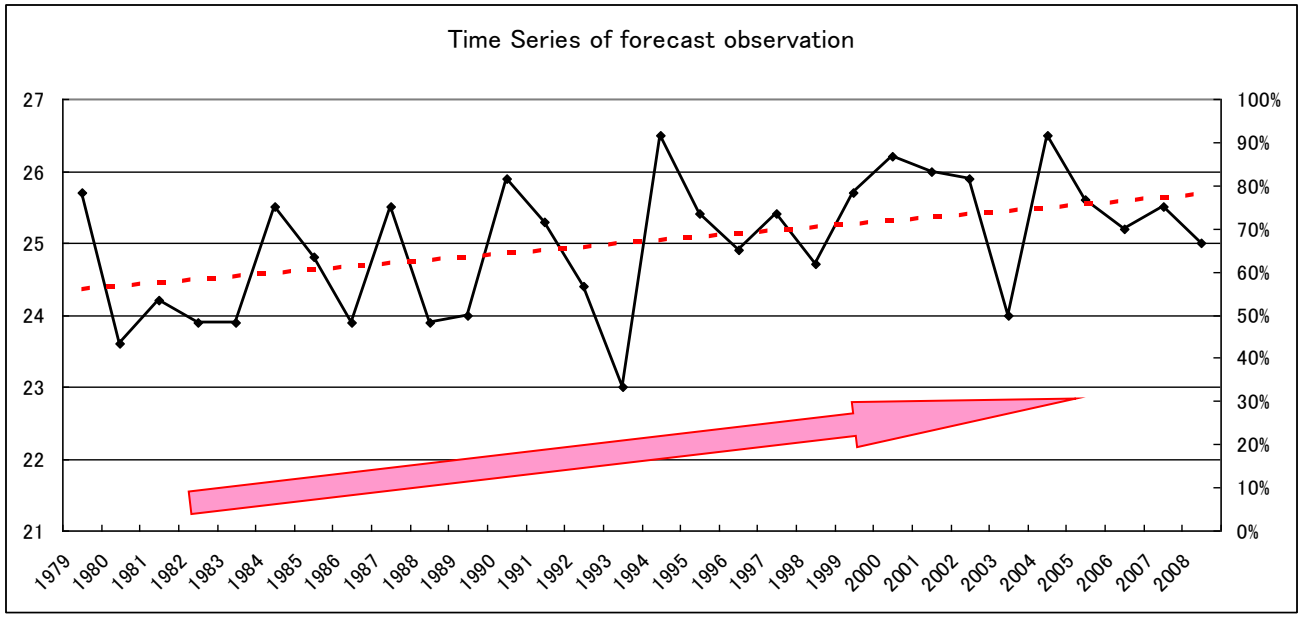
Western North Pacific OLR is deeply associated with JJA temperature in Tokyo.

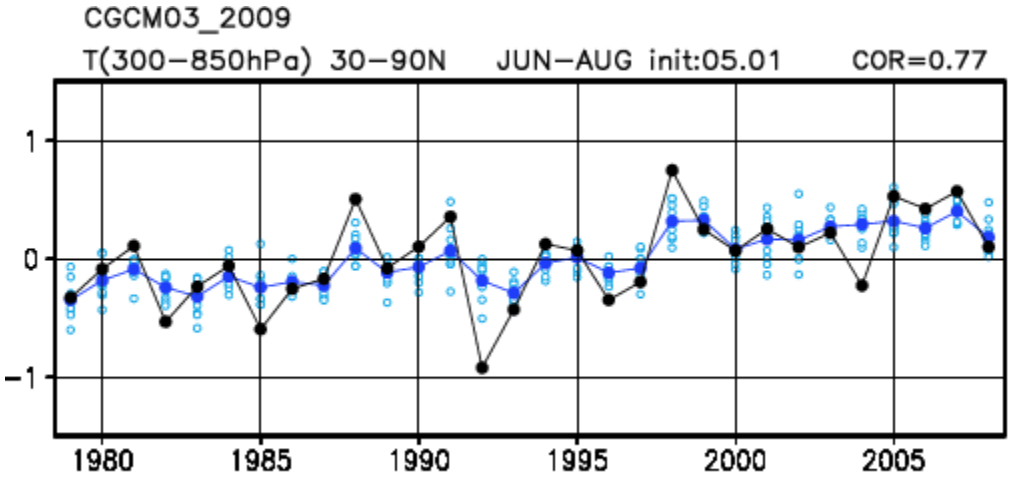
And the skill of WNP RAIN is relatively high, so the predictor may be useful.



Sample

The reason I select the predictors

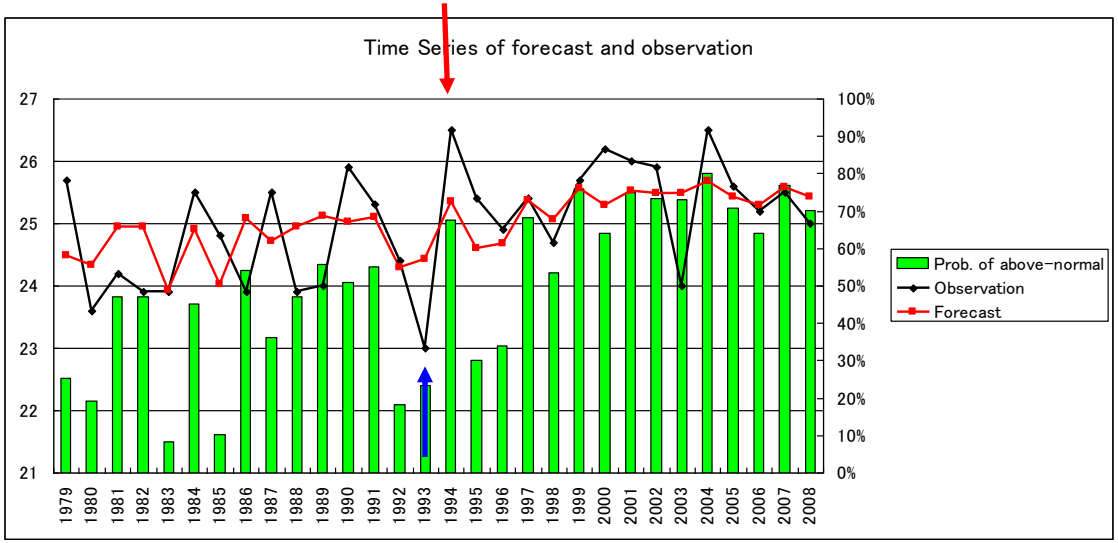




The JJA temperature have upward trend, so I use extratropical thickness as global warming predictor.

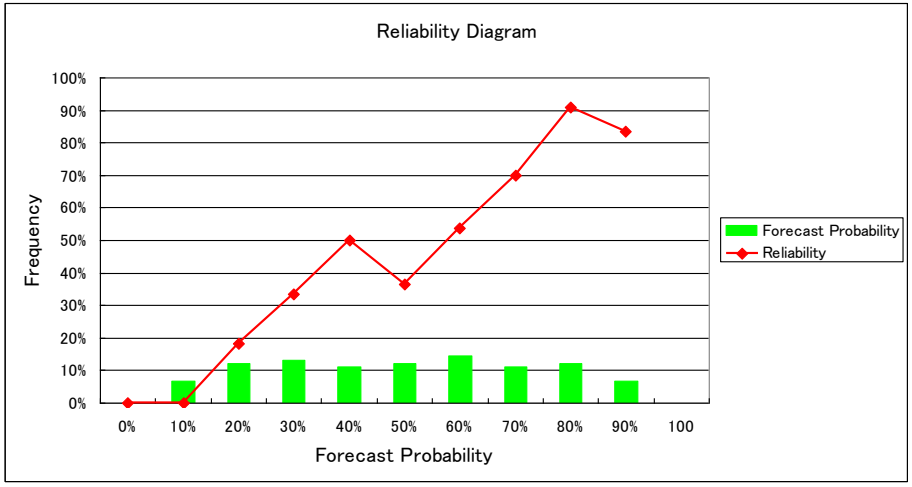
Sample

Verifications



A clear upward trend is well predicted. Moreover, the guidance can predict extreme cool/hot summer in 1993/1994.

It is important to be able to predict cool summer. Because, extreme cool summer can cause severe damage of crop production in Japan.



The figure shows reliability diagram of JJA temperature, totaling Tokyo, Sapporo and Naha station in Japan. The forecast probability is reliable to some degree.

Thank you