Exercise : Producing site-specific guidance using domestic data

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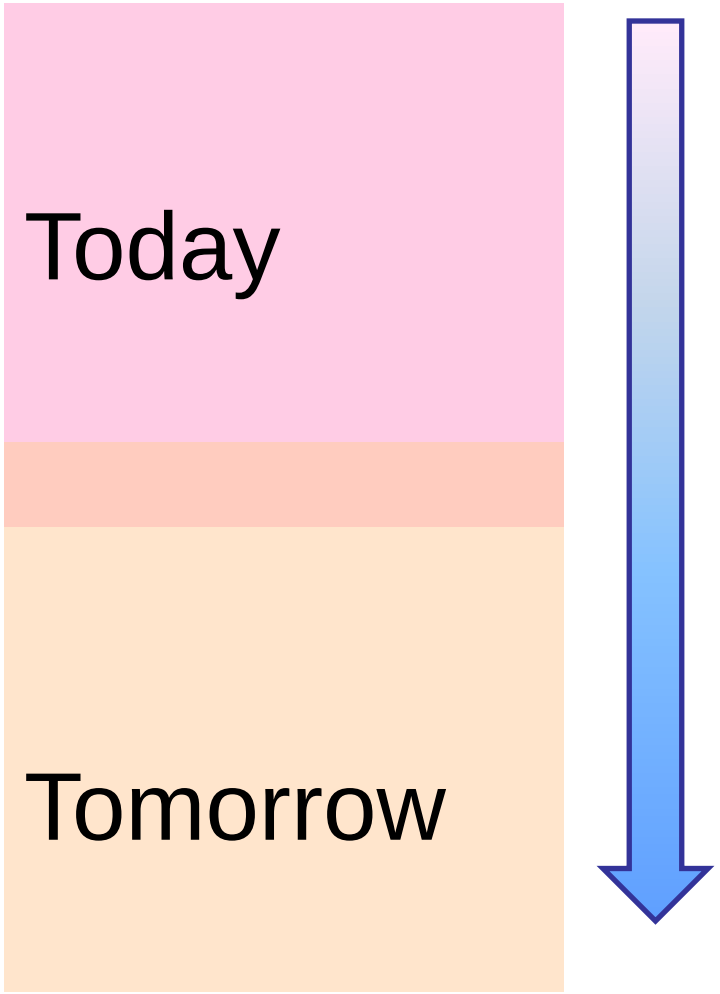
Objectives

- To clarify how to produce guidance for surface temperature and precipitation.
- To identify effective predictors.
- To verify guidance based on deterministic and probabilistic methods.
- To produce one-month forecasts using guidance and the latest numerical prediction.

Procedures

1. Single regression model
2. Multiple regression model
3. Probabilistic forecast
4. Verification
5. Production of one-month forecasts for Nov. 2011
6. Creation of presentations
7. Presentations (10 minutes)



Example

6. Creation of Presentations

An example

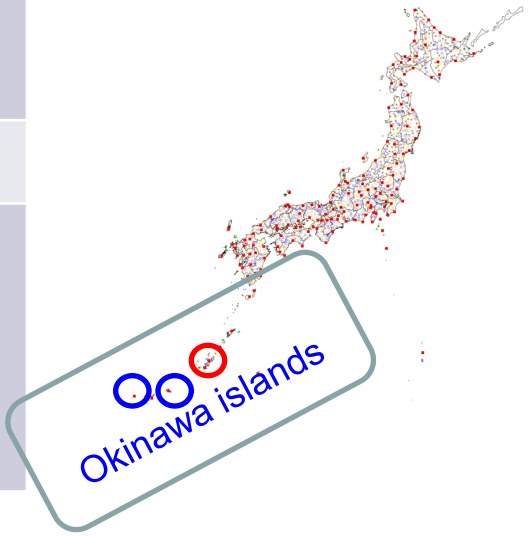
- What predictors do you use?
- Why do you select the predictors?
  - By ITACS regression tools, statistical relationship, traditional, …
- Verification results
- Forecasts for your country

The duration should be around 10 minutes per person.

Example

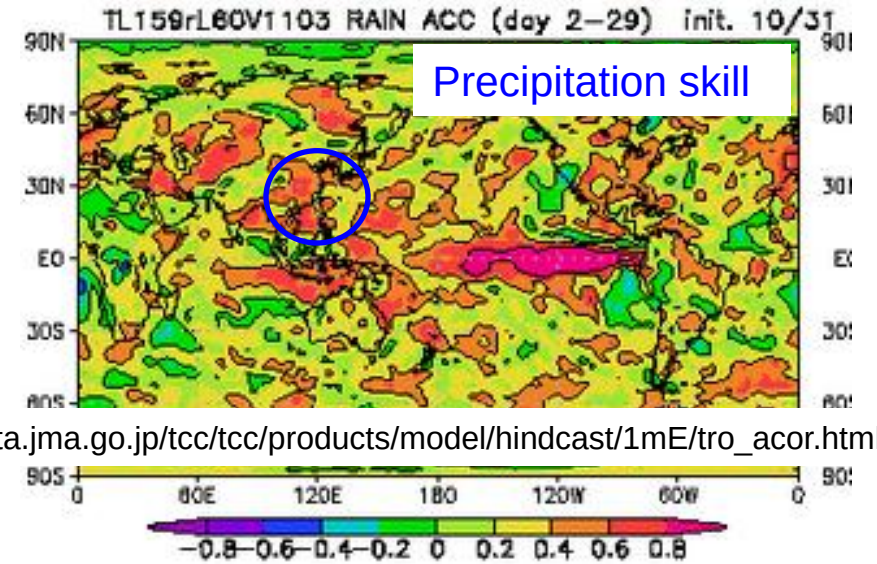
Summary of the guidance

Station	Naha	Naha
Season	November	November
Predictand	Precipitation	Temperature
Predictors	Model precipitation, Tsurf,V850	T850,V1000, Model precipitation
Correlation	0.61	0.56
Brier Skill Score	0.15 (including Ishigakijima and Miyakojima)	0.28 (including Ishigakijima and Miyakojima)

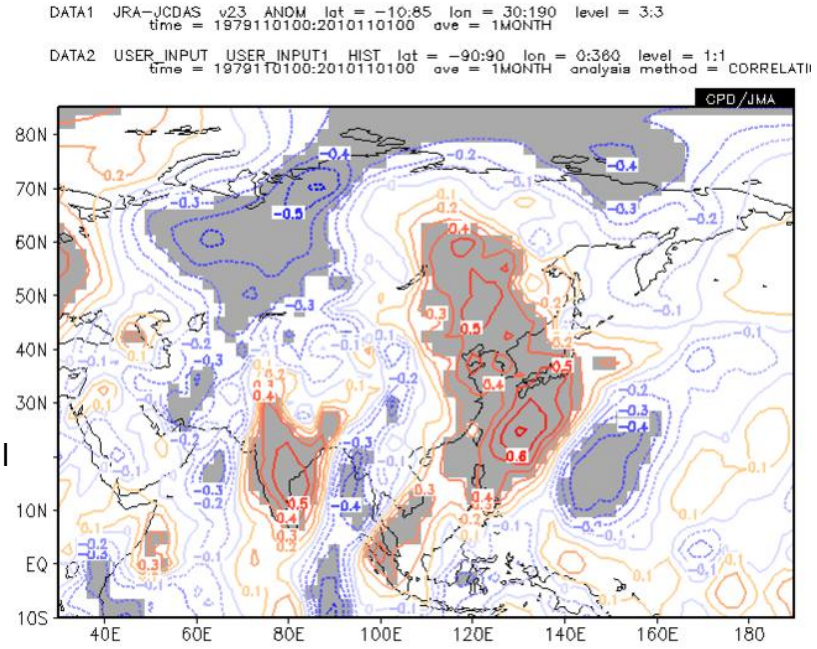


Example

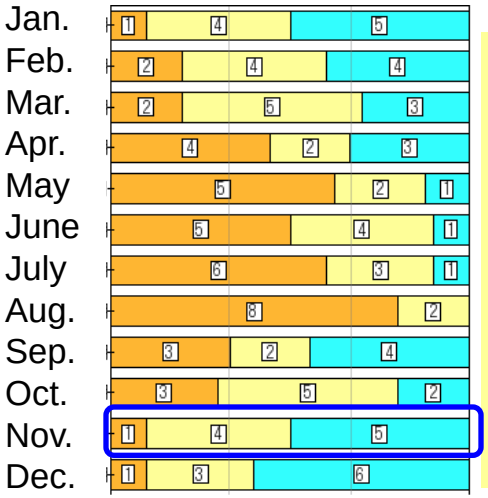
The reason I select the predictors



http://ds.data.jma.go.jp/tcc/tcc/products/model/hindcast/1mE/tro_acor.html



Relationship between temperature and precipitation in observation data



The precipitation skill around Naha is relatively high.

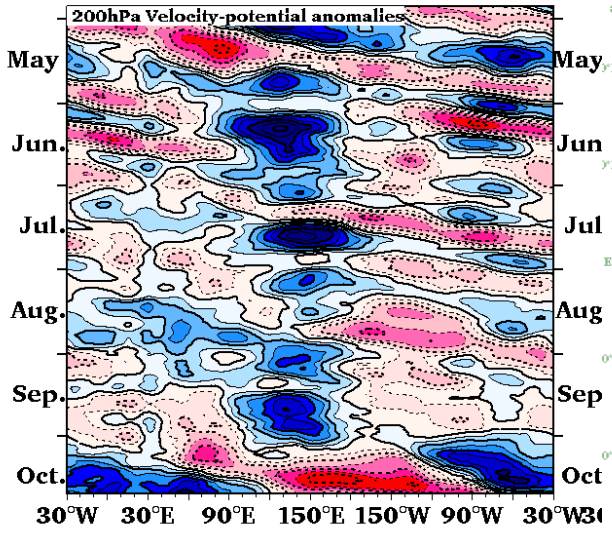
The 850 hPa meridional wind (**V**) is deeply associated with November precipitation over Naha.

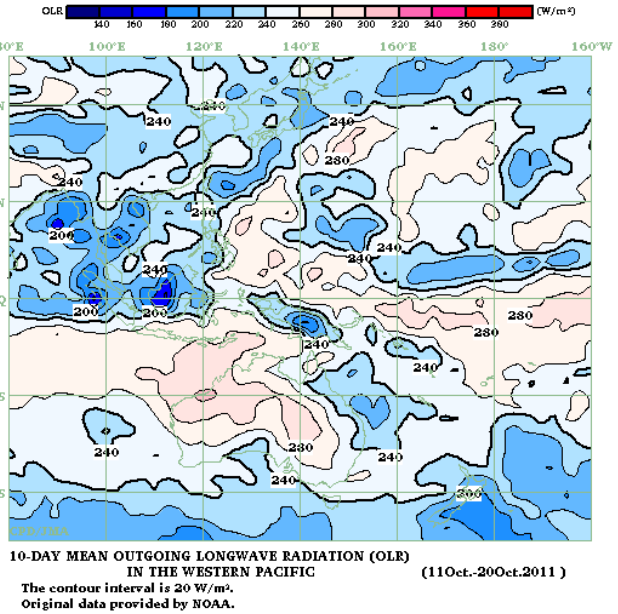
Surface temperature has positive relationship with precipitation in the past observation data.

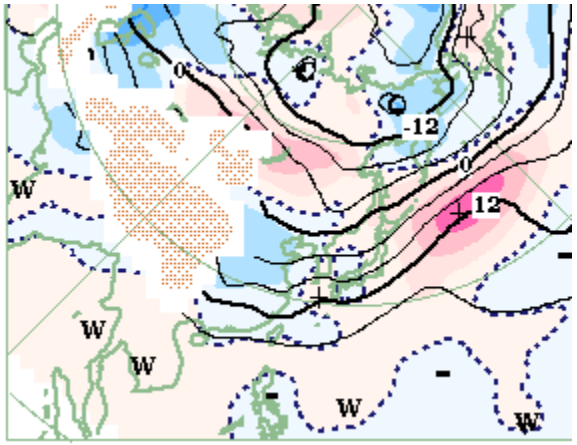
So they are likely to be useful as predictors.

Example

Current condition







Time-Longitude Cross Section of 200hPa Velocity Potential for MJO monitoring

OLR Anomaly (11 – 20 Oct.)

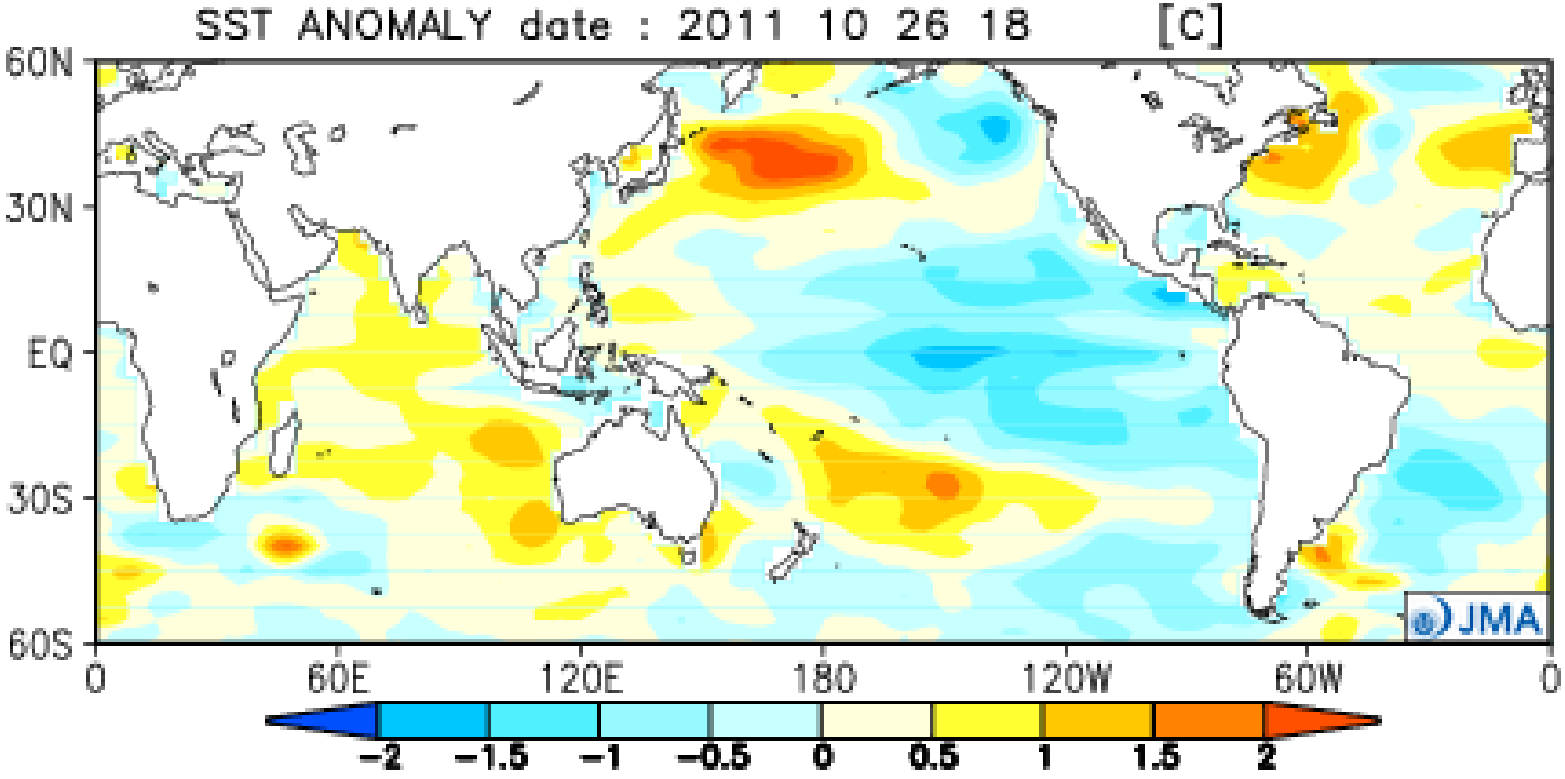
T850 (23 – 27 Oct.)

http://ds.data.jma.go.jp/tcc/tcc/products/clisys/index.html

Example

Initial condition

26 Oct. 2011



La Niña-like pattern

http://ds.data.jma.go.jp/tcc/tcc/products/model/map/1mE/map1/zpcmap.php

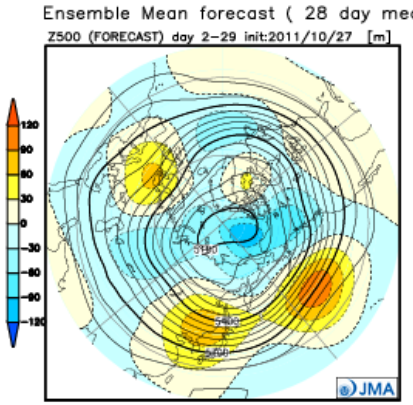
Numerical prediction

Example

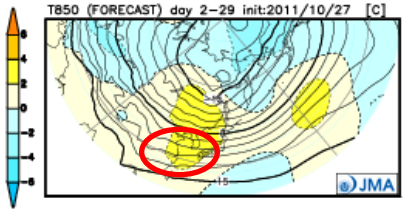
Initial date: 27 Oct. 2011

day 2-29

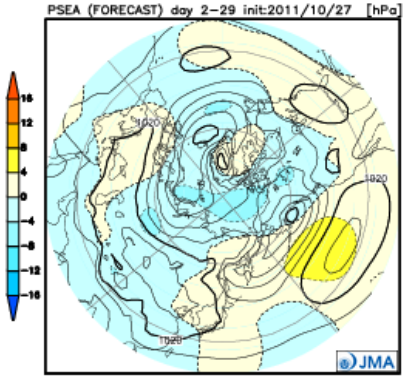
Z500

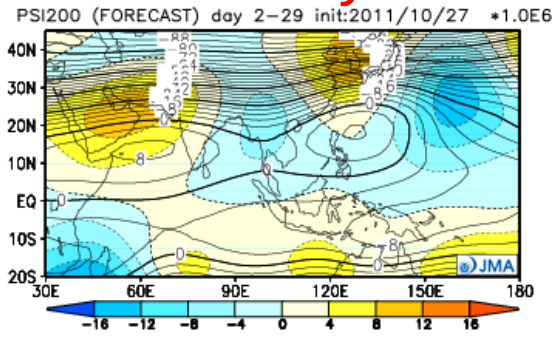


T850

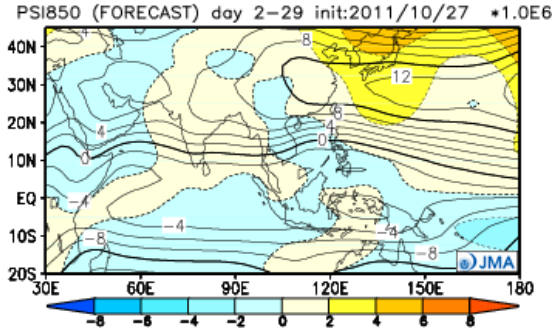


SLP

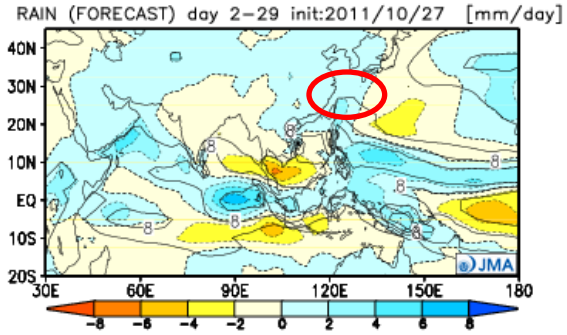




stream function at 200 hPa



stream function at 850 hPa



Precipitation

http://ds.data.jma.go.jp/tcc/tcc/products/model/map/1mE/index.html

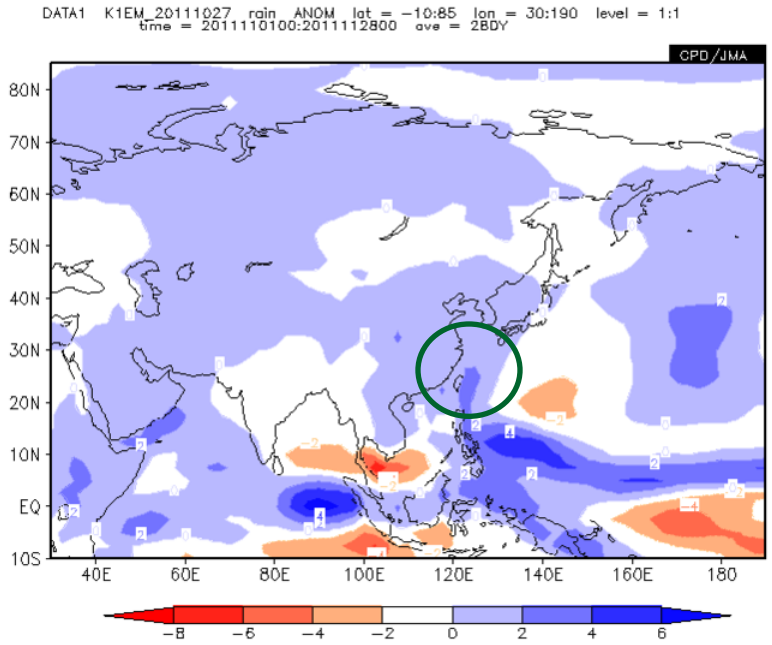
Numerical prediction

Example

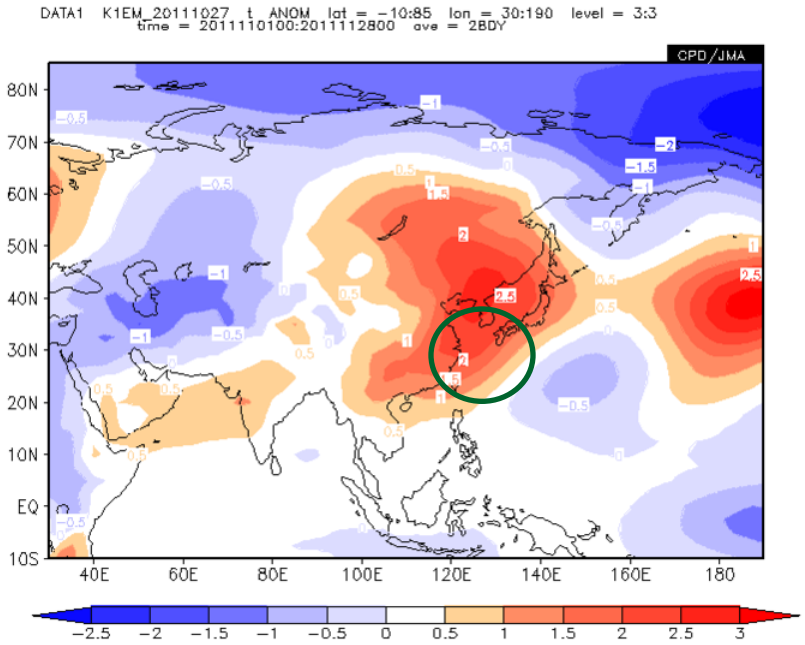
Initial date: 27 Oct. 2011

Target: 1st – 28th November

Precipitation



T850



http://jra.kishou.go.jp/tool/anatools/analyze4.0-pub/index1.php

Example

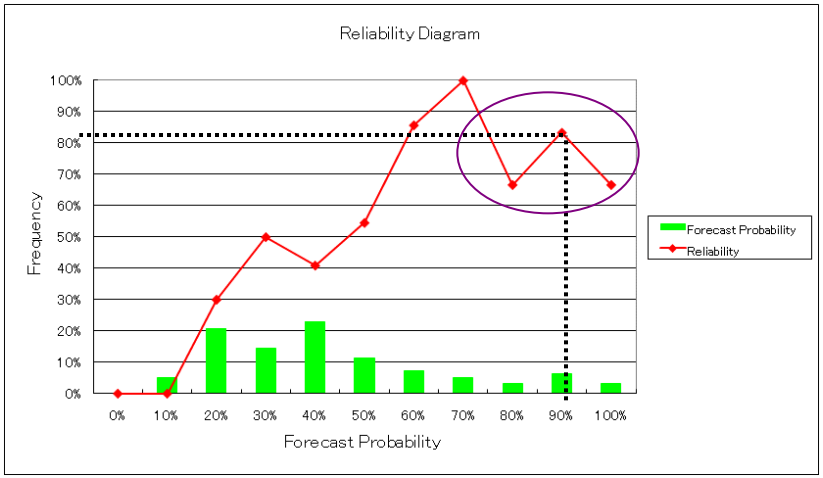
Guidance

Station : Naha
Period : November

Precipitation

Predictors	Prediction
Model precipitation	4.69 mm/day
Tsurf	297.8 K
V850	-0.46 m/s

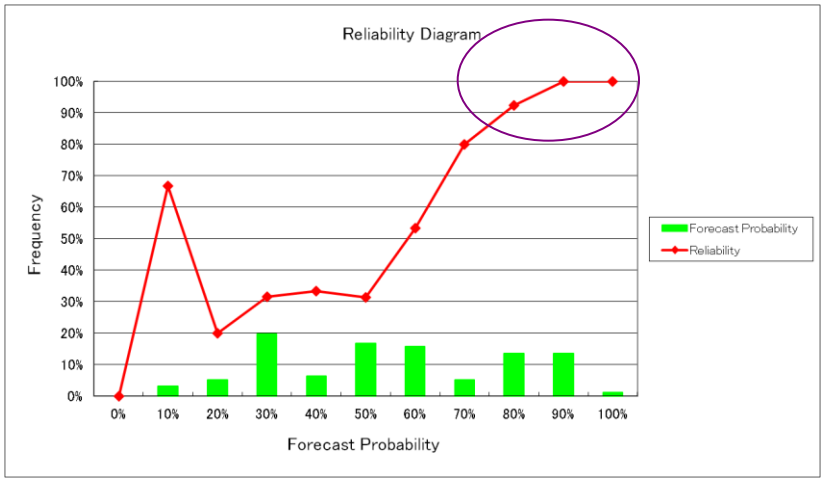
Prob. of above-normal precipitation 90%



Temperature

Predictors	Prediction
T850	287.2 K
V1000	-4.03 m/s
Model precipitation	4.69 mm/day

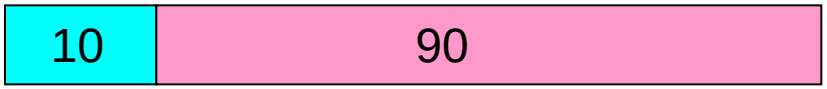
Prob. of above-normal temperature 91%



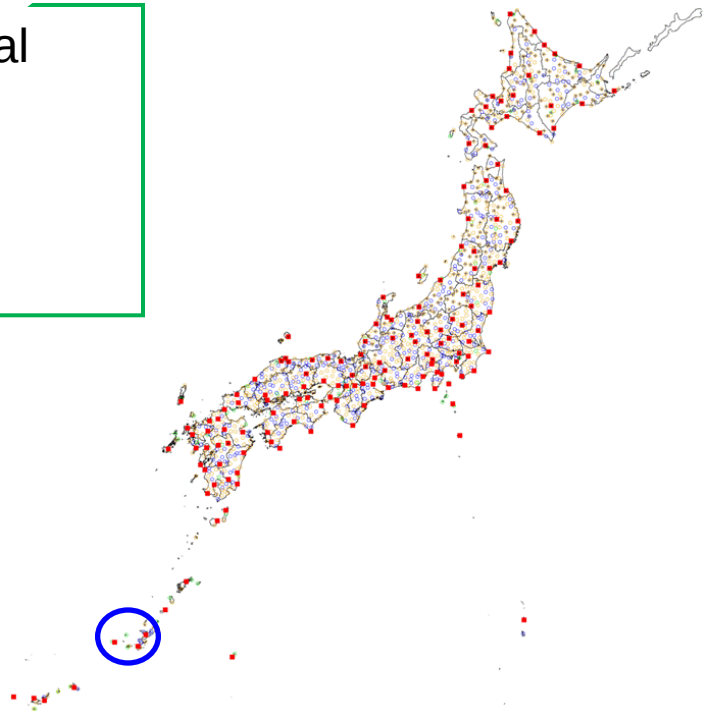
Example

Summary of one-month forecasts for Nah

Average temperature is likely to be above-normal with 90% probability in Naha.



Precipitation amount is likely to be a' ...nal with 80% probability in Naha.



Procedures

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2. Multiple regression model
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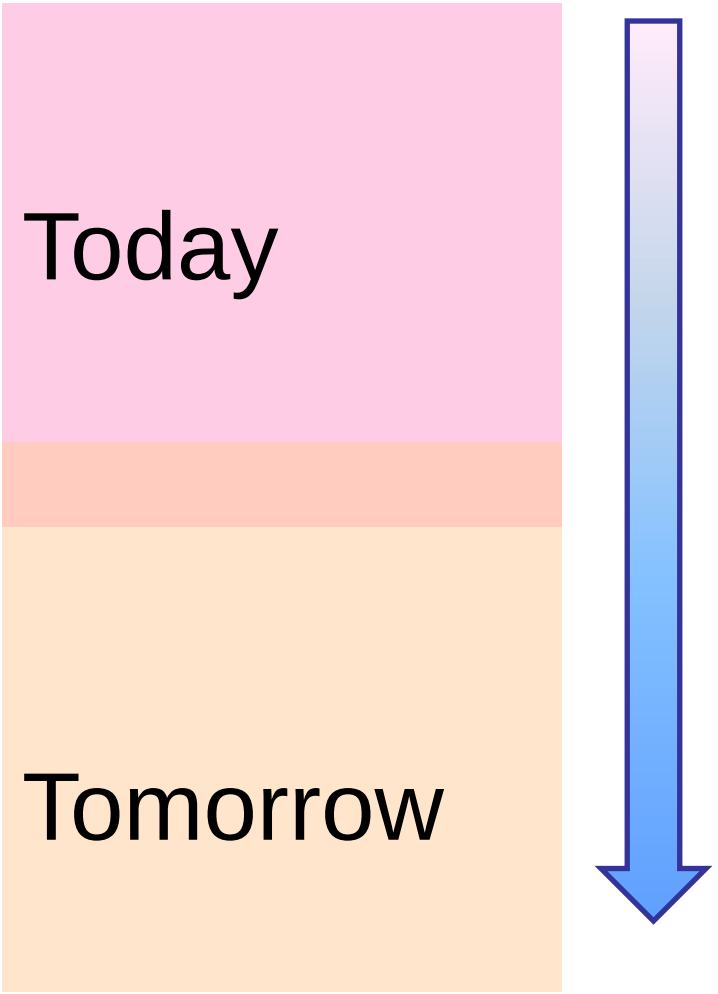
5. Production of one-month forecasts for Nov. 2011
6. Creation of presentations
7. Presentations (10 minutes)



Preparation

- Observation data (by trainees)
- Predictors
  - GPV data over trainees' stations in hindcast (init. 31st Oct. 1979 - 2010) *HindcastGPV.xls*
  - GPV data for latest prediction (init. 27th Oct. 2011) *LatestPredictionGPV.xls*
- Excel software for producing guidance

  Exercise for Guidance.xls
- Textbook

  Exercise for Guidance.doc

Predictors (prepared)

- Model precipitation
- Temperature at Surface, 850hPa and 700hPa
- Wind (u, v) at 1000hPa and 850hPa
- Relative humidity at 850hPa

If you need any other variables, we will prepare them as soon as possible.

Forecast Periods

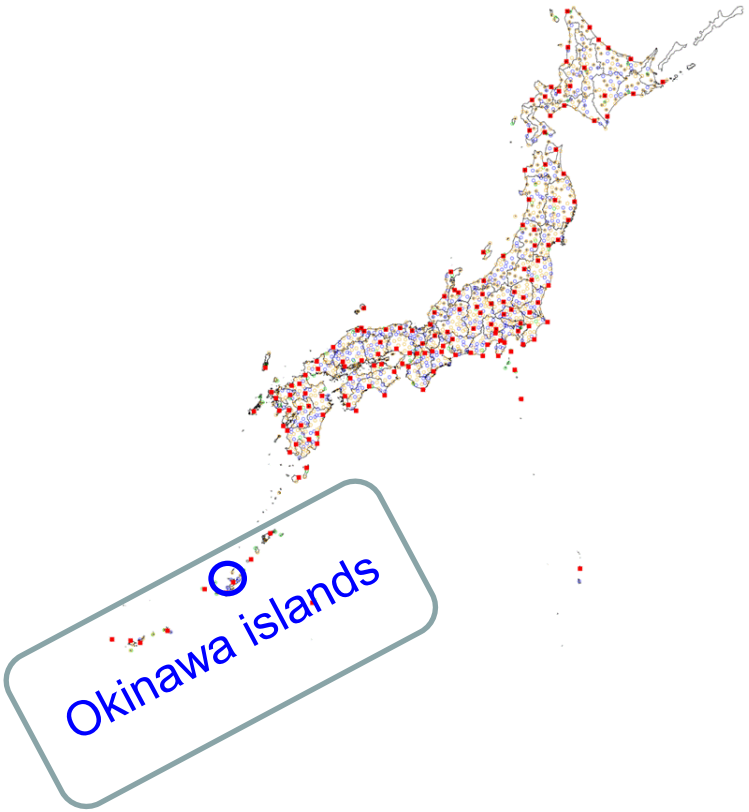
- November (necessary)

If you have enough time,

- Weekly (1st week, 2nd week, 3rd and 4th week)
- The first half of the month (1 Nov. – 14 Nov.)
- The second half of the month (15 Nov. – 28 Nov.)

Example Description

- Target Station : Naha
- Forecast Period : November
- Predictand : Precipitation
  (objective variable)
- Predictors : ○,△,□
- Normalization : Done



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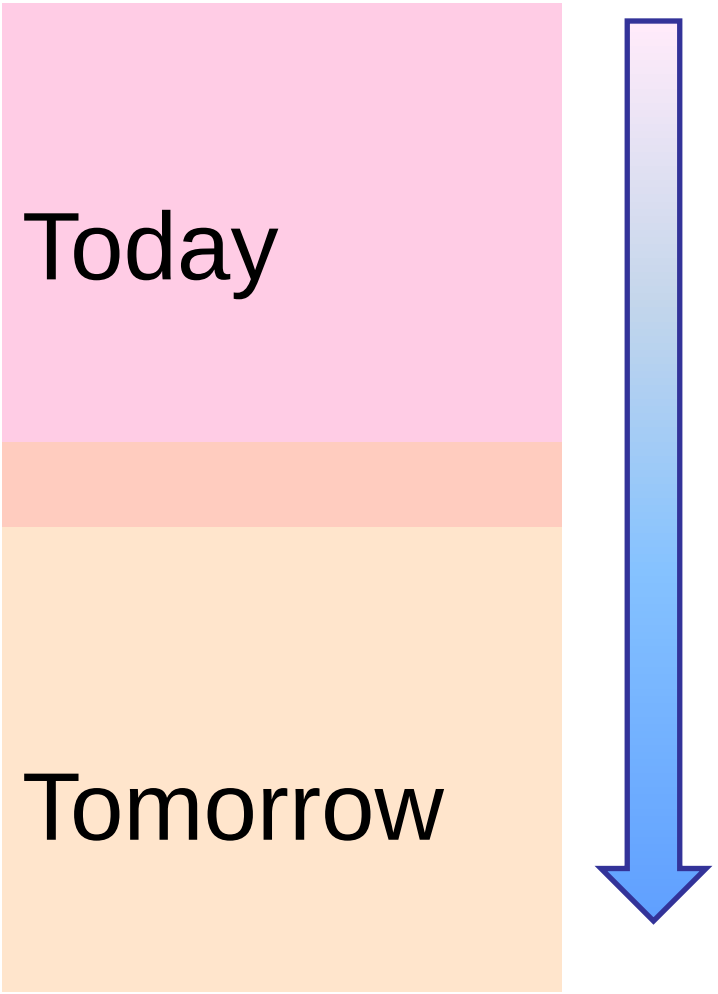
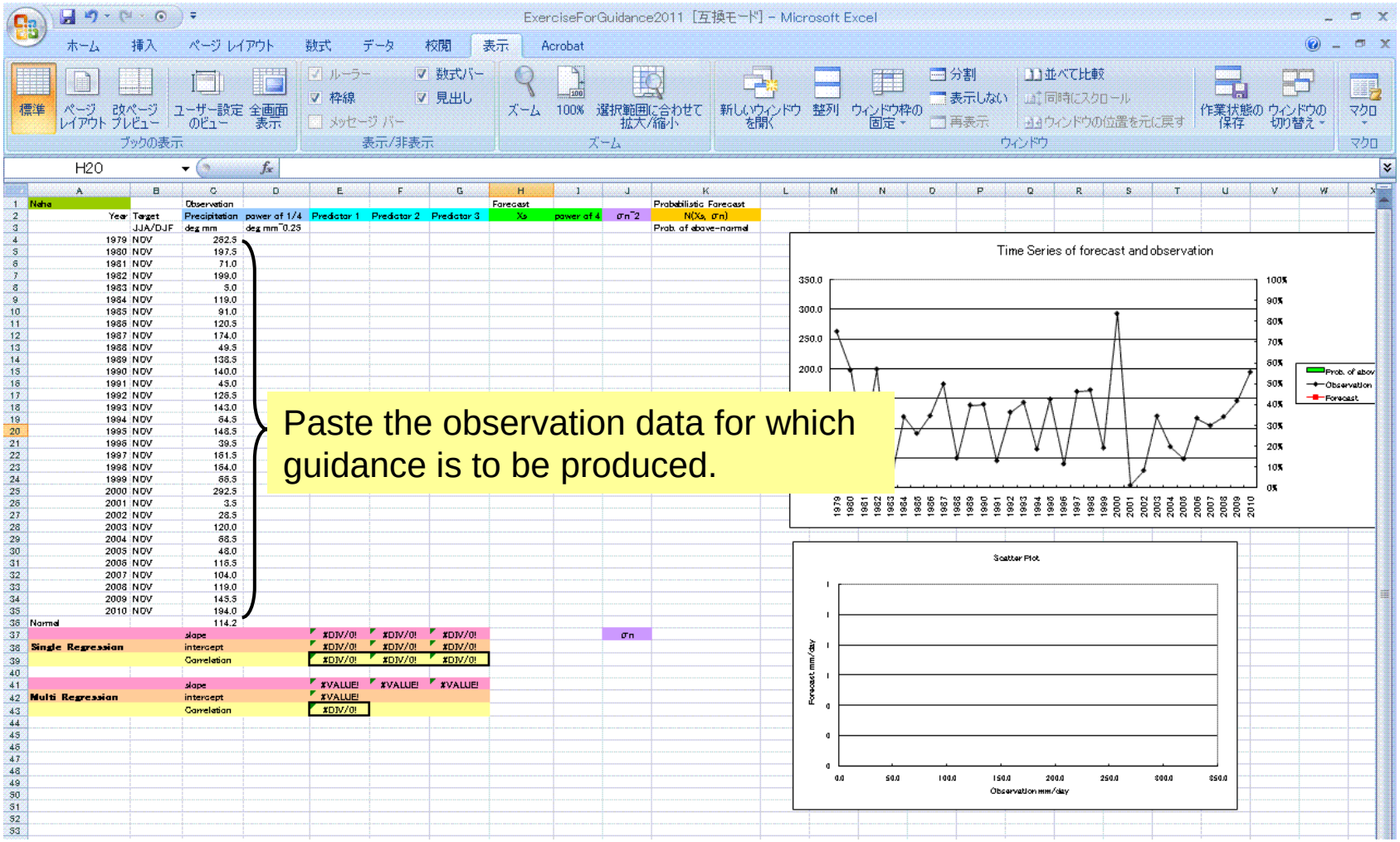


1. Single Regression Model

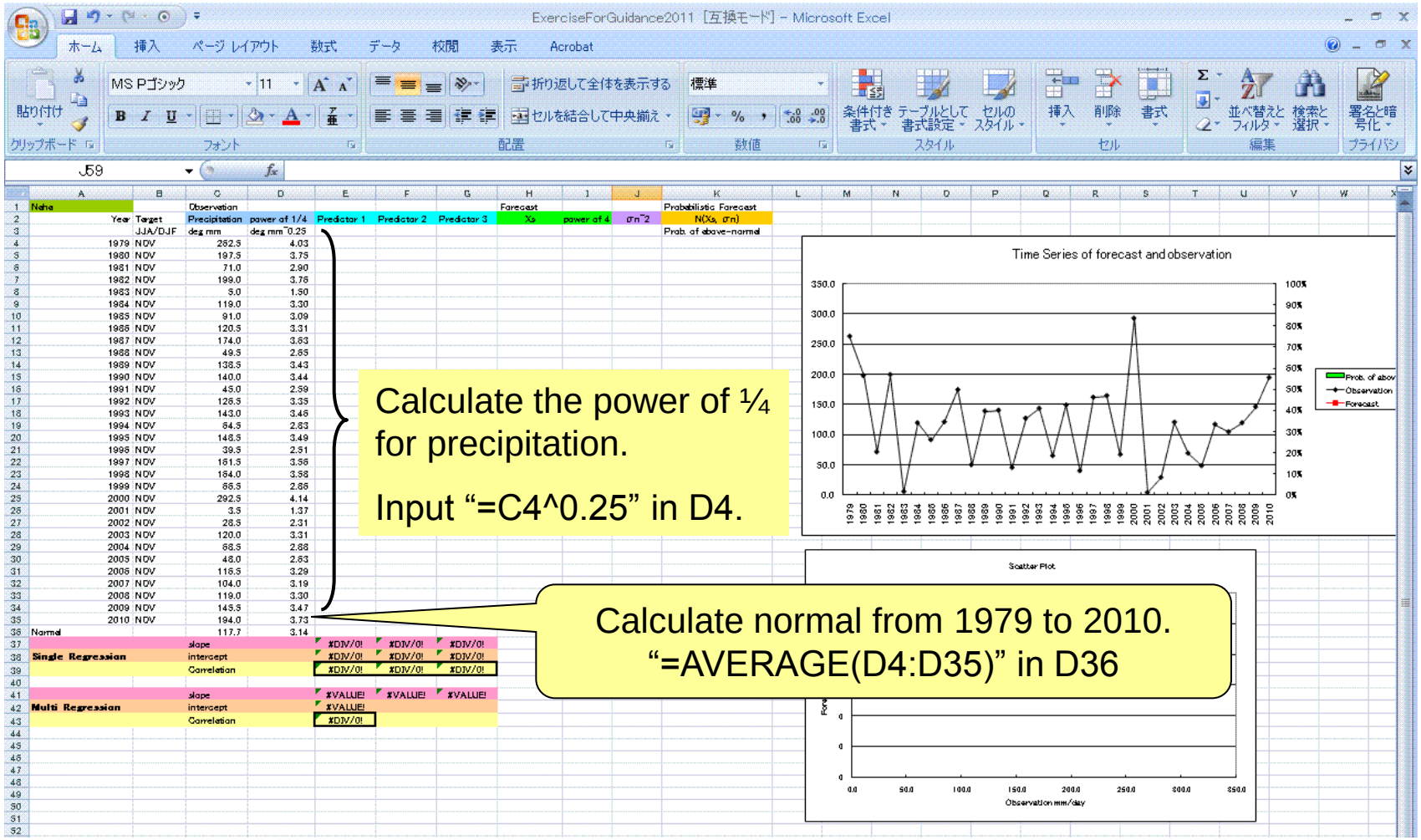
- Open “Exercise for Guidance.xls”.
- Paste the observation data into the Temperature/Precipitation worksheet.



Exercise for Guidance.xls

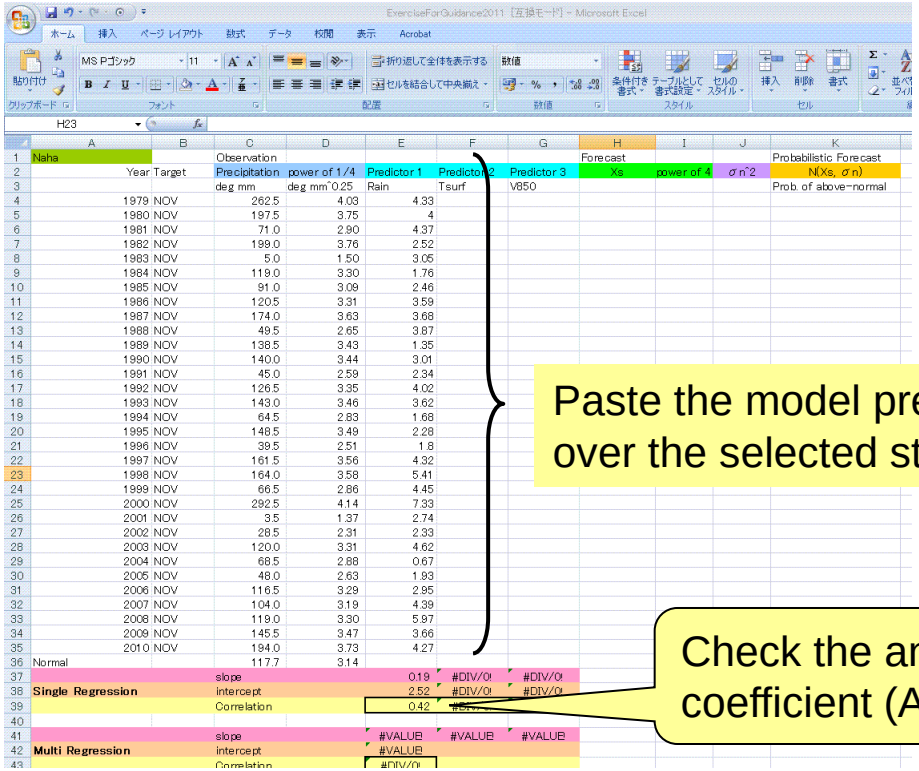
1. Single Regression Model

- Calculate the power of ¼ for normalization in case of precipitation.
- Calculate normal value from 1979 to 2010.



1. Single Regression Model

- Open “HindcastGPV.xls”. ← Predictors
- Select a predictor and paste it into column E (or for temperature, column D).
- Try each predictor to find the most effective one.



	A	B	C	D	E	F	G	H	I	J	K
1	Naha		Observation					Forecast			Probabilistic Forecast
2	Year	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σ n^2	N(Xs, σ n)
3			deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
4	1979	NOV	262.5	4.03	4.33						
5	1980	NOV	197.5	3.75	4						
6	1981	NOV	71.0	2.90	4.37						
7	1982	NOV	199.0	3.76	2.52						
8	1983	NOV	5.0	1.50	3.05						
9	1984	NOV	119.0	3.30	1.76						
10	1985	NOV	91.0	3.09	2.46						
11	1986	NOV	120.5	3.31	3.59						
12	1987	NOV	174.0	3.63	3.68						
13	1988	NOV	49.5	2.65	3.87						
14	1989	NOV	138.5	3.43	1.35						
15	1990	NOV	140.0	3.44	3.01						
16	1991	NOV	45.0	2.59	2.34						
17	1992	NOV	126.5	3.35	4.02						
18	1993	NOV	143.0	3.46	3.62						
19	1994	NOV	64.5	2.83	1.68						
20	1995	NOV	148.5	3.49	2.28						
21	1996	NOV	39.5	2.51	1.8						
22	1997	NOV	161.5	3.56	4.32						
23	1998	NOV	164.0	3.58	5.41						
24	1999	NOV	66.5	2.86	4.45						
25	2000	NOV	292.5	4.14	7.33						
26	2001	NOV	3.5	1.37	2.74						
27	2002	NOV	28.5	2.31	2.33						
28	2003	NOV	120.0	3.31	4.62						
29	2004	NOV	68.5	2.88	0.67						
30	2005	NOV	48.0	2.63	1.93						
31	2006	NOV	116.5	3.29	2.95						
32	2007	NOV	104.0	3.19	4.39						
33	2008	NOV	119.0	3.30	5.97						
34	2009	NOV	145.5	3.47	3.66						
35	2010	NOV	194.0	3.73	4.27						
36	Normal		117.7	3.14							
37			slope		0.19	#DIV/0!	#DIV/0!				
38	Single Regression		intercept		2.52	#DIV/0!	#DIV/0!				
39			Correlation		0.42	#DIV/0!					
40											
41			slope		#VALUE!	#VALUE!	#VALUE!				
42	Multi Regression		intercept		#VALUE!						
43			Correlation		#DIV/0!						

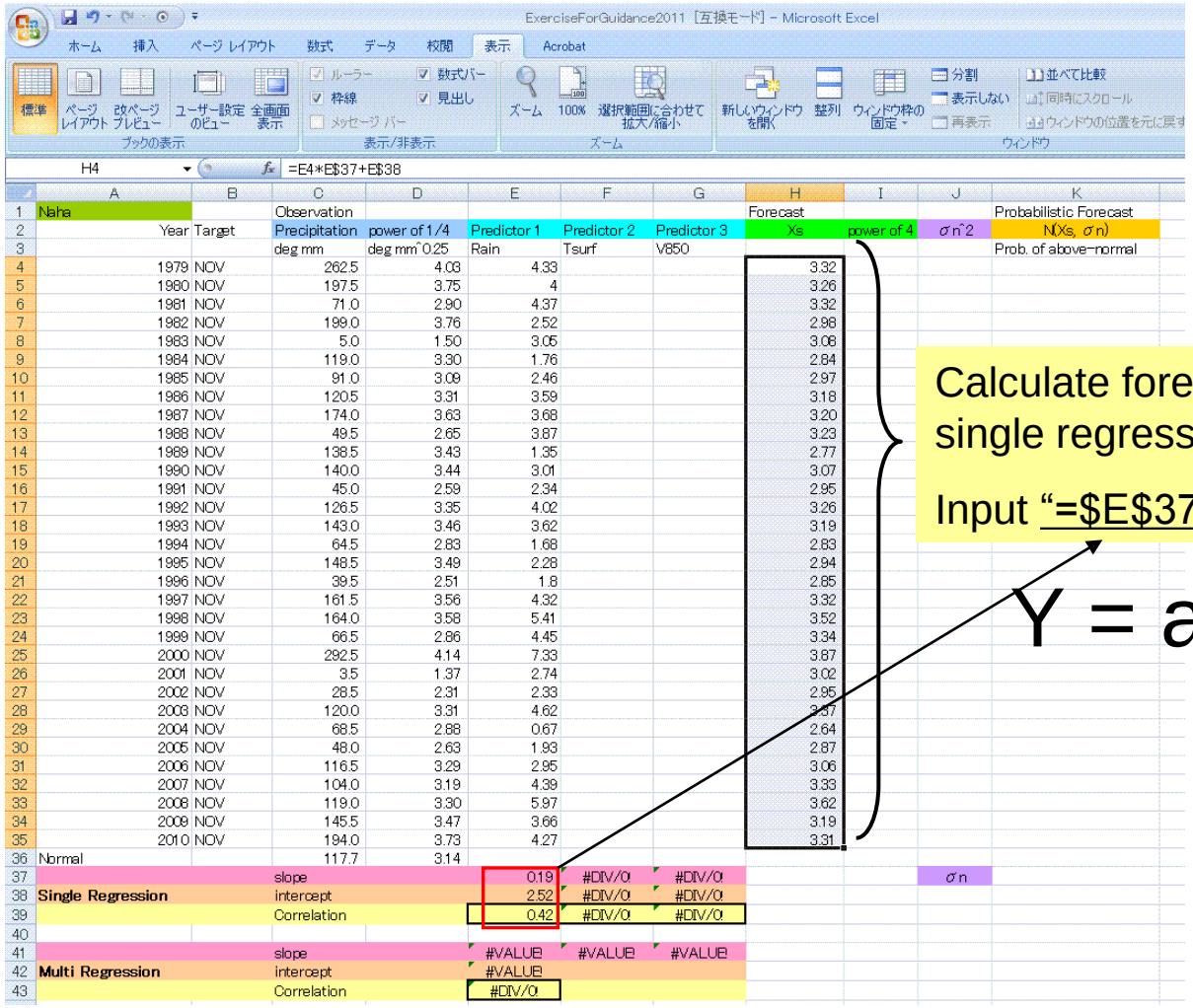
Paste the model precipitation data for GPV over the selected station.

Check the anomaly correlation coefficient (ACC) in E39.

For Naha, the ACC is around 0.4.
If the level of skill is low, try each predictor to find the most effective one.

1. Single Regression Model

- Calculate forecasts using a single regression equation.



	A	B	C	D	E	F	G	H	I	J	K
1	Naha		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			deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
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5	1980	NOV	197.5	3.75	4			3.26			
6	1981	NOV	71.0	2.90	4.37			3.32			
7	1982	NOV	199.0	3.76	2.52			2.98			
8	1983	NOV	5.0	1.50	3.05			3.08			
9	1984	NOV	119.0	3.30	1.76			2.84			
10	1985	NOV	91.0	3.09	2.46			2.97			
11	1986	NOV	120.5	3.31	3.59			3.18			
12	1987	NOV	174.0	3.63	3.68			3.20			
13	1988	NOV	49.5	2.65	3.87			3.23			
14	1989	NOV	138.5	3.43	1.35			2.77			
15	1990	NOV	140.0	3.44	3.01			3.07			
16	1991	NOV	45.0	2.59	2.34			2.95			
17	1992	NOV	126.5	3.35	4.02			3.26			
18	1993	NOV	143.0	3.46	3.62			3.19			
19	1994	NOV	64.5	2.83	1.68			2.83			
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21	1996	NOV	39.5	2.51	1.8			2.85			
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29	2004	NOV	68.5	2.88	0.67			2.64			
30	2005	NOV	48.0	2.63	1.93			2.87			
31	2006	NOV	116.5	3.29	2.95			3.06			
32	2007	NOV	104.0	3.19	4.39			3.33			
33	2008	NOV	119.0	3.30	5.97			3.62			
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35	2010	NOV	194.0	3.73	4.27			3.31			
36	Normal		117.7	3.14							
37			slope		0.19	#DIV/0!	#DIV/0!			σ n	
38	**Single Regression**		intercept		2.52	#DIV/0!	#DIV/0!				
39			Correlation		0.42	#DIV/0!	#DIV/0!				
40											
41			slope		#VALUE!	#VALUE!	#VALUE!				
42	**Multi Regression**		intercept		#VALUE!						
43			Correlation		#DIV/0!						

Calculate forecast values using a single regression equation.

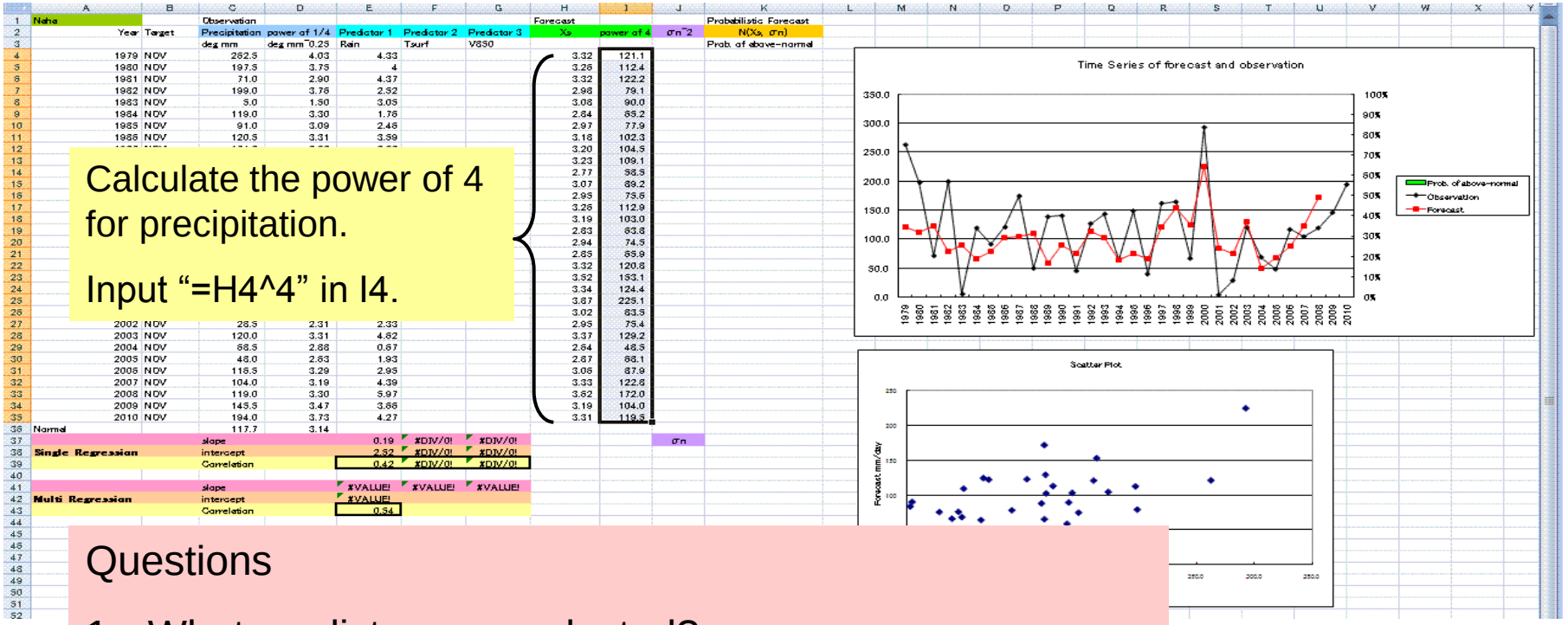
Input "=$E$37 * $E4+$E$38" in H4.

$$Y = a * x + b$$

Exercise for Guidance.xls

1. Single Regression Model

- Calculate the power of 4 in column I for precipitation.
- Two time series are shown in the line charts. The red line indicates the forecast values.



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5	1980	NOV	197.5	3.75	4			3.26	112.4		
6	1981	NOV	71.0	2.90	4.37			3.32	122.2		
7	1982	NOV	199.0	3.76	2.32			2.96	79.1		
8	1983	NOV	5.0	1.50	3.05			3.08	90.0		
9	1984	NOV	119.0	3.30	1.76			2.84	65.2		
10	1985	NOV	91.0	3.09	2.46			2.97	77.9		
11	1986	NOV	120.5	3.31	3.39			3.18	102.3		
12								3.20	104.5		
13								3.23	109.1		
14								2.77	58.5		
15								3.07	89.2		
16								2.95	75.6		
17								3.26	112.9		
18								3.19	103.0		
19								2.83	63.8		
20								2.94	74.5		
21								2.85	65.9		
22								3.32	120.8		
23								3.32	153.1		
24								3.34	124.4		
25								3.87	225.1		
26								3.02	83.5		
27	2002	NOV	28.5	2.31	2.33			2.95	75.4		
28	2003	NOV	120.0	3.31	4.82			3.37	129.2		
29	2004	NOV	68.5	2.88	0.67			2.84	48.5		
30	2005	NOV	48.0	2.63	1.93			2.87	68.1		
31	2006	NOV	116.5	3.29	2.95			3.06	87.9		
32	2007	NOV	104.0	3.19	4.39			3.33	122.8		
33	2008	NOV	119.0	3.30	5.97			3.82	172.0		
34	2009	NOV	145.5	3.47	3.86			3.19	104.0		
35	2010	NOV	194.0	3.73	4.27			3.31	119.5		
36	Normal		117.7	3.14							
37			slope		0.19	#DIV/0!	#DIV/0!			σn	
38	Single Regression		intercept		2.52	#DIV/0!	#DIV/0!				
39			Correlation		0.42	#DIV/0!	#DIV/0!				
40											
41			slope		#VALUE!	#VALUE!	#VALUE!				
42	Multi Regression		intercept		#VALUE!						
43			Correlation		0.54						

Calculate the power of 4 for precipitation.

Input “=H4^4” in I4.

Questions

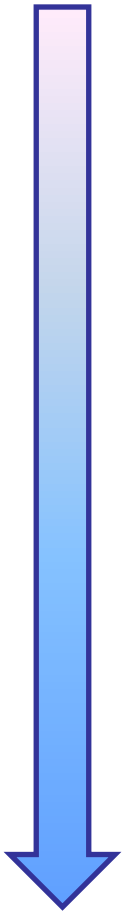
1. What predictors are selected?
2. Can accurate guidance be produced?
3. How does guidance help to predict the hottest/coldest/drought/wet years in your country?

Procedures

1. Single regression model
2. Multiple regression model
3. Probabilistic forecast
4. Verification
5. Production of one-month forecasts for Nov. 2011
6. Creation of presentations
7. Presentations (10 minutes)

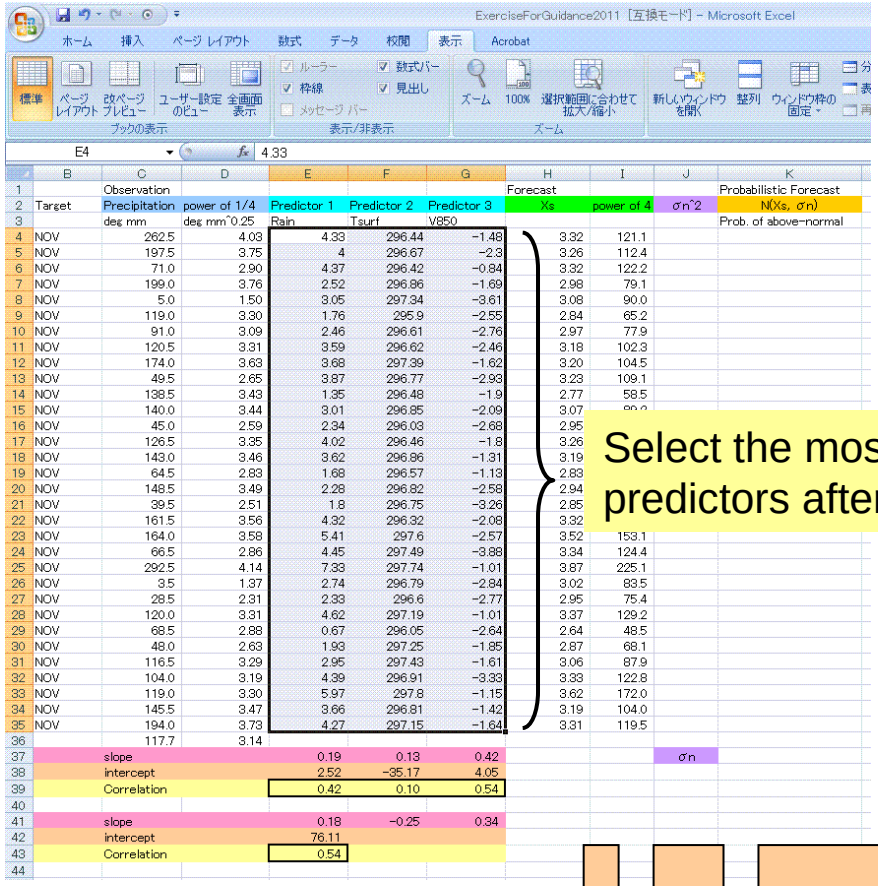
Today

Tomorrow



2. Multiple Regression Model

- Look for the most effective combination of three predictors.



ExerciseForGuidance2011 [互換モード] - Microsoft Excel

E4: 4.33

	B	C	D	E	F	G	H	I	J	K
1		Observation					Forecast			Probabilistic Forecast
2	Target	Precipitation	power of 1/4	Predictor 1	Predictor 2	Predictor 3	Xs	power of 4	σn^2	N(Xs, σn)
3		deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
4	NOV	262.5	4.03	4.33	296.44	−1.48	3.32	121.1		
5	NOV	197.5	3.75	4	296.67	−2.3	3.26	112.4		
6	NOV	71.0	2.90	4.37	296.42	−0.84	3.32	122.2		
7	NOV	199.0	3.76	2.52	296.86	−1.69	2.98	79.1		
8	NOV	5.0	1.50	3.05	297.34	−3.61	3.08	90.0		
9	NOV	119.0	3.30	1.76	295.9	−2.55	2.84	65.2		
10	NOV	91.0	3.09	2.46	296.61	−2.76	2.97	77.9		
11	NOV	120.5	3.31	3.59	296.62	−2.46	3.18	102.3		
12	NOV	174.0	3.63	3.68	297.39	−1.62	3.20	104.5		
13	NOV	49.5	2.65	3.87	296.77	−2.93	3.23	109.1		
14	NOV	138.5	3.43	1.35	296.48	−1.9	2.77	58.5		
15	NOV	140.0	3.44	3.01	296.85	−2.09	3.07	89.0		
16	NOV	45.0	2.59	2.34	296.03	−2.68	2.95	75.8		
17	NOV	126.5	3.35	4.02	296.46	−1.8	3.26	112.9		
18	NOV	143.0	3.46	3.62	296.86	−1.31	3.19	103.5		
19	NOV	64.5	2.83	1.68	296.57	−1.13	2.83	64.1		
20	NOV	148.5	3.49	2.28	296.82	−2.58	2.94	75.2		
21	NOV	39.5	2.51	1.8	296.75	−3.26	2.85	66.0		
22	NOV	161.5	3.56	4.32	296.32	−2.08	3.32	121.6		
23	NOV	164.0	3.58	5.41	297.6	−2.57	3.52	153.1		
24	NOV	66.5	2.86	4.45	297.49	−3.88	3.34	124.4		
25	NOV	292.5	4.14	7.33	297.74	−1.01	3.87	225.1		
26	NOV	3.5	1.37	2.74	296.79	−2.84	3.02	83.5		
27	NOV	28.5	2.31	2.33	296.6	−2.77	2.95	75.4		
28	NOV	120.0	3.31	4.62	297.19	−1.01	3.37	129.2		
29	NOV	68.5	2.88	0.67	296.05	−2.64	2.64	48.5		
30	NOV	48.0	2.63	1.93	297.25	−1.85	2.87	68.1		
31	NOV	116.5	3.29	2.95	297.43	−1.61	3.06	87.9		
32	NOV	104.0	3.19	4.39	296.91	−3.33	3.33	122.8		
33	NOV	119.0	3.30	5.97	297.8	−1.15	3.62	172.0		
34	NOV	145.5	3.47	3.66	296.81	−1.42	3.19	104.0		
35	NOV	194.0	3.73	4.27	297.15	−1.64	3.31	119.5		
36		117.7	3.14							
37		slope		0.19	0.13	0.42			σn	
38		intercept		2.52	−35.17	4.05				
39		Correlation		0.42	0.10	0.54				
40										
41		slope		0.18	−0.25	0.34				
42		intercept		76.11						
43		Correlation		0.54						
44										

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

ITACS will help you find likely predictors.

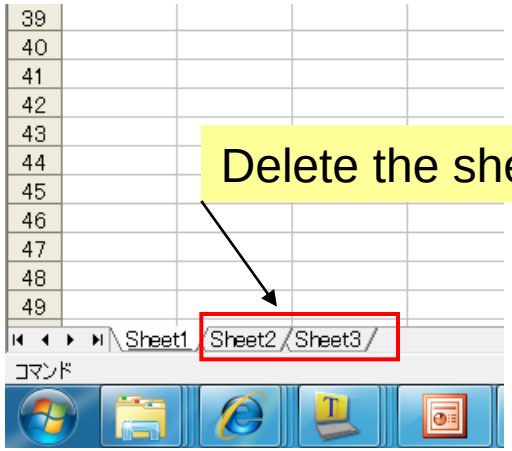
2. Multiple Regression Model

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

Year Month Day Value [mm]

	A	B	C	D	E
1	1979	11	1	262.5	
2	1980	11	1	197.5	
3	1981	11	1	71	
4	1982	11	1	199	
5	1983	11	1	5	
6	1984	11	1	119	
7	1985	11	1	91	
8	1986	11	1	120.5	
9	1987	11	1	174	
10	1988	11	1	49.5	
11	1989	11	1	138.5	
12	1990	11	1	140	
13	1991	11	1	45	
14	1992	11	1	126.5	
15	1993	11	1	143	
16	1994	11	1	64.5	
17	1995	11	1	148.5	
18	1996	11	1	39.5	
19	1997	11	1	161.5	
20	1998	11	1	164	
21	1999	11	1	66.5	
22	2000	11	1	292.5	
23	2001	11	1	3.5	
24	2002	11	1	28.5	
25	2003	11	1	120	
26	2004	11	1	68.5	
27	2005	11	1	48	
28	2006	11	1	116.5	
29	2007	11	1	104	
30	2008	11	1	119	
31	2009	11	1	145.5	
32	2010	11	1	194	
33					

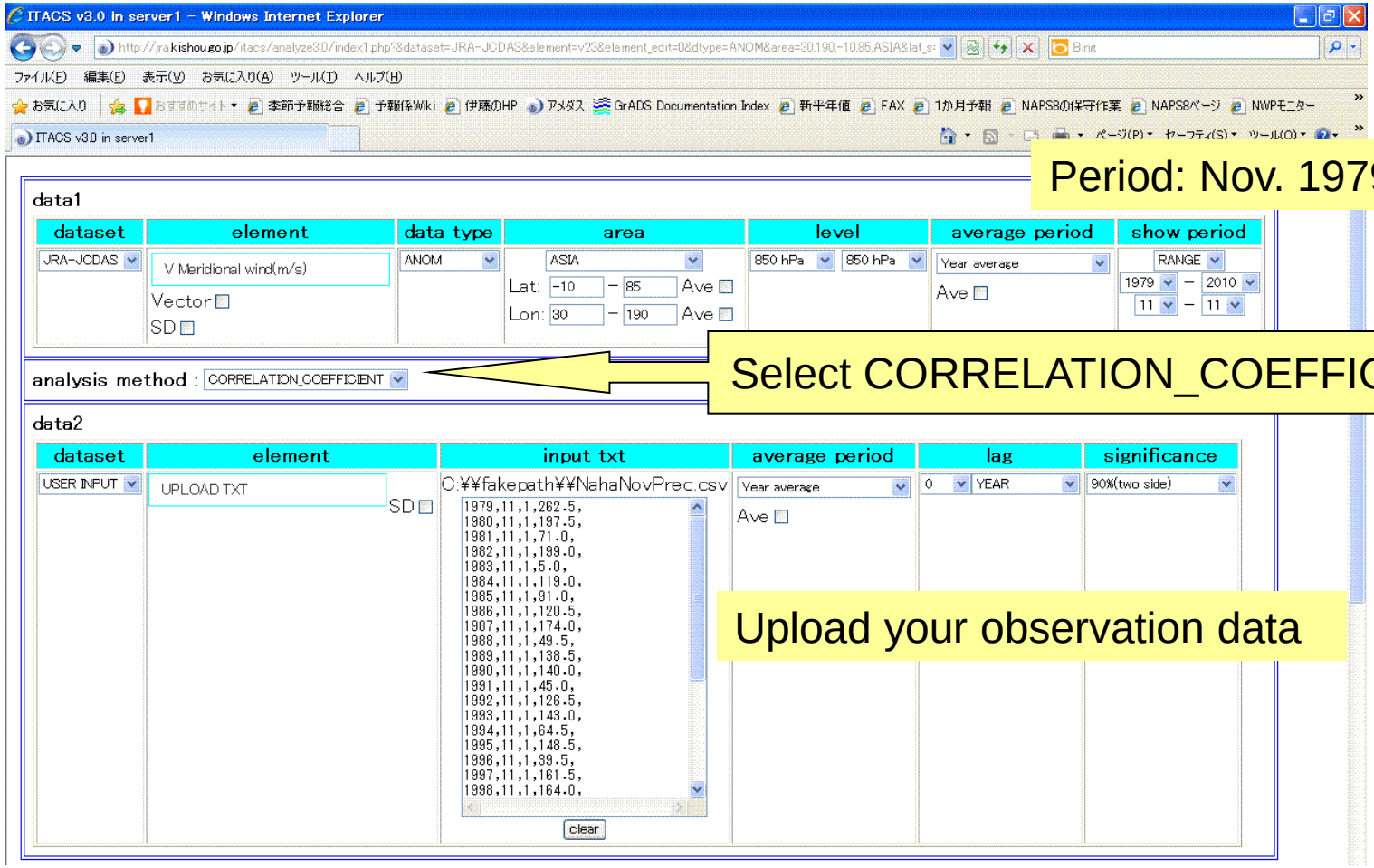
These are monthly values.



Delete the sheet2 and sheet3.

ITACS

2. Multiple Regression Model



Period: Nov. 1979 – Nov. 2010

Select CORRELATION_COEFFICIENT

Upload your observation data

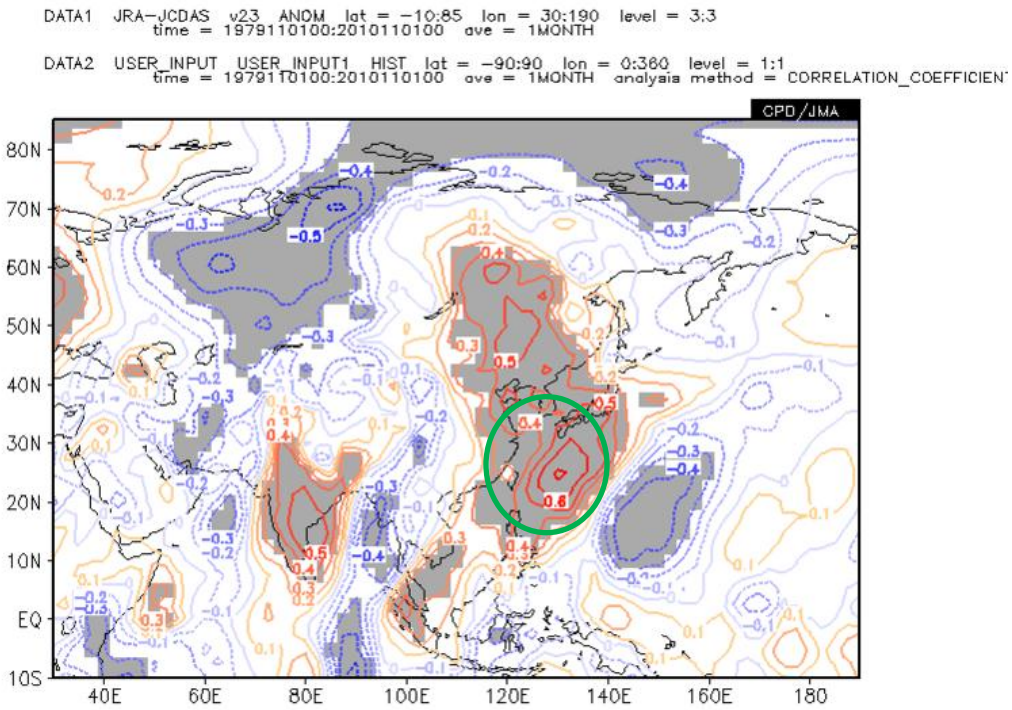
http://extreme.kishou.go.jp/tool/itacs-tcc2011/

The ITACS can produce a correlation map between two variables.

One is **V** at 850hPa and the other is observed precipitation in Nana.

ITACS

2. Multiple Regression Model



This is a relationship between 850 hPa meridional wind (**V**) and precipitation in Naha.

The **V** around Okinawa Islands looks a likely predictor.

Try to look for effective predictors in this way.

ITACS

2. Multiple Regression Model

- Calculate forecasts using a multiple regression equation.

K33

	A	B	C	D	E	F	G	H	I	J	K
1	Naha		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			deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
4	1979	NOV	262.5	4.03	4.33	296.44	−1.48	3.6	175.2		
5	1980	NOV	197.5	3.75	4	296.67	−2.3	3.2	110.3		
6	1981	NOV	71.0	2.90	4.37	296.42	−0.84	3.9	224.5		
7	1982	NOV	199.0	3.76	2.52	296.86	−1.69	3.1	97.8		
8	1983	NOV	5.0	1.50	3.05	297.34	−3.61	2.5	36.5		
9	1984	NOV	119.0	3.30	1.76	295.9	−2.55	3.0	75.8		
10	1985	NOV	91.0	3.09	2.46	296.61	−2.76	2.8	63.8		
11	1986	NOV	120.5	3.31	3.59	296.62	−2.46	3.1	95.5		
12	1987	NOV	174.0	3.63	3.68	297.39	−1.62	3.2	110.6		
13	1988	NOV	49.5	2.65	3.87	296.77	−2.93	3.0	78.5		
14	1989	NOV	138.5	3.43	1.35	296.48	−1.9	3.0	76.8		
15	1990	NOV	140.0	3.44	3.01	296.85	−2.09	3.1	91.8		
16	1991	NOV	45.0	2.59	2.34	296.03	−2.68	3.0	78.4		
17	1992	NOV	126.5	3.35	4.02	296.46	−1.8	3.5	144.7		
18	1993	NOV	143.0	3.46	3.62	296.86	−1.31	3.5	144.8		
19	1994	NOV	64.5	2.83	1.68	296.57	−1.13	3.3	113.2		
20	1995	NOV	148.5	3.49	2.28	296.82	−2.58	2.8	62.0		
21	1996	NOV	39.5	2.51	1.8	296.75	−3.26	2.5	39.3		
22	1997	NOV	161.5	3.56	4.32	296.32	−2.08	3.5	143.1		
23	1998	NOV	164.0	3.58	5.41	297.6	−2.57	3.2	100.6		
24	1999	NOV	66.5	2.86	4.45	297.49	−3.88	2.6	43.9		
25	2000	NOV	292.5	4.14	7.33	297.74	−1.01	4.0	258.1		
26	2001	NOV	3.5	1.37	2.74	296.79	−2.84	2.8	61.8		
27	2002	NOV	28.5	2.31	2.33	296.6	−2.77	2.8	61.7		
28	2003	NOV	120.0	3.31	4.62	297.19	−1.01	3.7	180.9		
29	2004	NOV	68.5	2.88	0.67	296.05	−2.64	2.7	52.5		
30	2005	NOV	48.0	2.63	1.93	297.25	−1.85	2.9	69.8		
31	2006	NOV	116.5	3.29	2.95	297.43	−1.61	3.1	93.3		
32	2007	NOV	104.0	3.19	4.39	296.91	−3.33	2.9	70.3		
33	2008	NOV	119.0	3.30	5.97	297.8	−1.15	3.7	188.7		
34	2009	NOV	145.5	3.47	3.66	296.81	−1.42	3.5	141.8		
35	2010	NOV	194.0	3.73	4.27	297.15	−1.64	3.4	133.4		
36	Normal		117.7	3.14							
37			slope		0.19	0.13	0.42			σn	
38	**Single Regression**		intercept		2.52	−35.17	4.05				
39			Correlation		0.42	0.10	0.54				
40											
41			slope		0.18	−0.25	0.34				
42	**Multi Regression**		intercept		76.11						
43			Correlation		0.61						
44											

Calculate forecasts using a multiple regression equation.

Input "=$E$41 * $E4+$F$41 * $F4+$G$41 * $G4+$E$42" in H4.

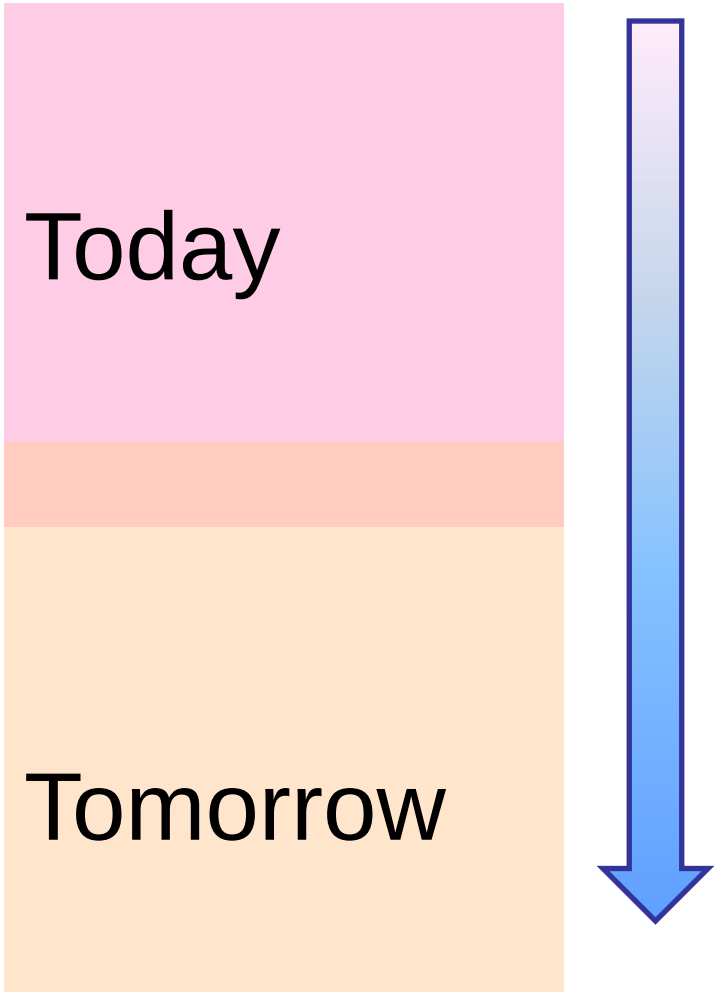
Multiple Anomaly Correlation Coefficient

Questions

1. What predictors are selected?
2. Can you produce more accurate guidance than that of the single regression model?

Procedures

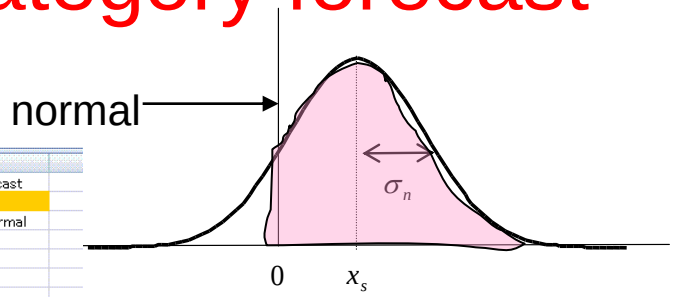
1. Single regression model
2. Multiple regression model
3. Probabilistic forecast
4. Verification
5. Production of one-month forecasts for Nov. 2011
6. Creation of presentations
7. Presentations (10 minutes)



3. Probabilistic Forecast

2-category forecast

- Calculate the square of regression errors.
- Calculate the root mean of the values.



	A	B	C	D	E	F	G	H	I	J	K
1	Naha		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			deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
4	1979	NOV	262.5	4.03	4.33	296.44	−1.48	3.6	175.2	7619.550	
5	1980	NOV	197.5	3.75	4	296.67	−2.3	3.2	110.3	7596.852	
6	1981	NOV	71.0	2.90	4.37	296.42	−0.84	3.9	224.5	23567.658	
7	1982	NOV	199.0	3.76	2.52	296.86	−1.69	3.1	97.8	10235.293	
8	1983	NOV	5.0	1.50	3.05	297.34	−3.61	2.5	36.5	992.582	
9	1984	NOV	119.0	3.30	1.76	295.9	−2.55	3.0	75.8	1868.390	
10	1985	NOV	91.0	3.09	2.46	296.61	−2.76	2.8	63.8	737.423	
11	1986	NOV	120.5	3.31	3.59	296.62	−2.46	3.1	95.5	624.755	
12	1987	NOV	174.0	3.63	3.68	297.39	−1.62	3.2	110.6	4022.297	
13	1988	NOV	49.5	2.65	3.87	296.77	−2.93	3.0	78.5	839.760	
14	1989	NOV	138.5	3.43	1.35	296.48	−1.9	3.0	76.8	3806.688	
15	1990	NOV	140.0	3.44	3.01	296.85	−2.09	3.1	91.8	2321.631	
16	1991	NOV	45.0	2.59	2.34	296.03	−2.68	3.0	78.4	1114.689	
17	1992	NOV	126.5	3.35	4.02	296.46	−1.8	3.5	144.7	332.543	
18	1993	NOV	143.0	3.46	3.62	296.86	−1.31	3.5	144.8	3.410	
19	1994	NOV	64.5	2.83	1.68	296.57	−1.13	3.3	113.2	2371.241	
20	1995	NOV	148.5	3.49	2.28	296.82	−2.58	2.8	62.0	7488.193	
21	1996	NOV	39.5	2.51	1.8	296.75	−3.26	2.5	39.3	0.034	
22	1997	NOV	161.5	3.56	4.32	296.32	−2.08	3.5	143.1	336.878	
23	1998	NOV	164.0	3.58	5.41	297.6	−2.57	3.2	100.6	4014.454	
24	1999	NOV	66.5	2.86	4.45	297.49	−3.88	2.6	43.9	511.164	
25	2000	NOV	292.5	4.14	7.33	297.74	−1.01	4.0	258.1	1183.674	
26	2001	NOV	3.5	1.37	2.74	296.79	−2.84	2.8	61.8	3402.164	
27	2002	NOV	28.5	2.31	2.33	296.6	−2.77	2.8	61.7	1103.534	
28	2003	NOV	120.0	3.31	4.62	297.19	−1.01	3.7	180.9	3705.652	
29	2004	NOV	68.5	2.88	0.67	296.05	−2.64	2.7	52.5	257.465	
30	2005	NOV	48.0	2.63	1.93	297.25	−1.85	2.9	69.8	475.675	
31	2006	NOV	116.5	3.29	2.95	297.43	−1.61	3.1	93.3	536.416	
32	2007	NOV	104.0	3.19	4.39	296.91	−3.33	2.9	70.3	1137.262	
33	2008	NOV	119.0	3.30	5.97	297.8	−1.15	3.7	188.7	4859.705	
34	2009	NOV	145.5	3.47	3.66	296.81	−1.42	3.5	141.8	14.015	
35	2010	NOV	194.0	3.73	4.27	297.15	−1.64	3.4	133.4	3675.638	
36	Normal		117.7	3.14						56.113	
37			slope		0.19	0.13	0.42			σn	
38	**Single Regression**		intercept		2.52	−35.17	4.05				
39			Correlation		0.42	0.10	0.54				
40											
41			slope		0.18	−0.25	0.34				
42	**Multi Regression**		intercept		76.11						
43			Correlation		0.61						
44											

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

Input “=SQRT(AVERAGE(J4:J35))” in J36 to calculate the root mean square error.

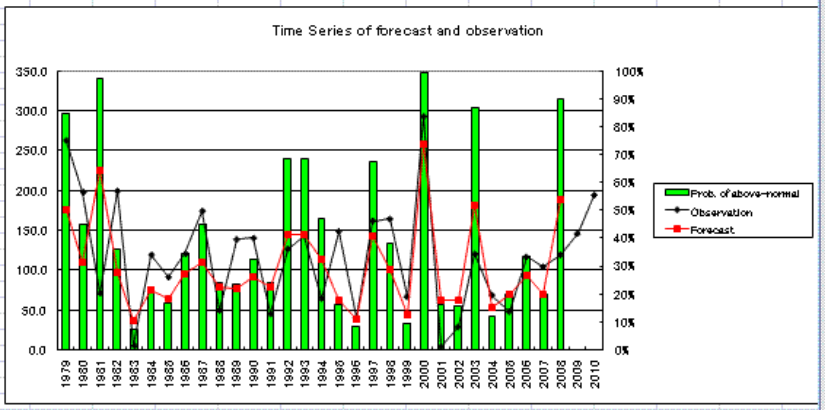
Exercise for Guidance.xls

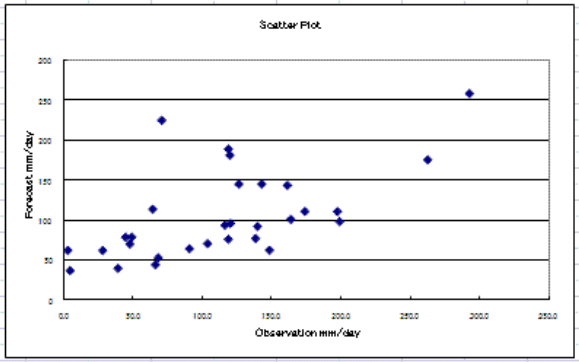
3. Probabilistic Forecast

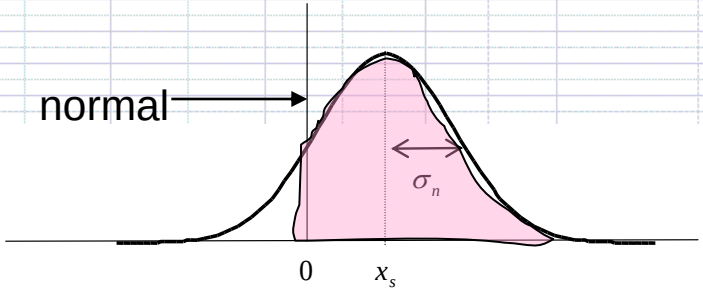
- Calculate the probability of above-normal values.

	A	B	C	D	E	F	G	H	I	J	K
1	Naha		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			deg mm	deg mm^0.25	Rain	Tsurf	V850				Prob. of above-normal
4	1979	NDV	262.5	4.03	4.33	296.44	-1.48	3.6	175.2	7619.5	85%
5	1980	NDV	197.5	3.75	4	296.67	-2.3	3.2	110.3	7396.9	45%
6	1981	NDV	71.0	2.90	4.37	296.42	-0.84	3.9	224.5	23367.7	97%
7	1982	NDV	199.0	3.76	2.52	296.86	-1.69	3.1	97.8	10235.3	36%
8	1983	NDV	5.0	1.50	3.05	297.34	-3.61	2.5	36.3	992.6	7%
9	1984	NDV	119.0	3.30	1.76	295.9	-2.55	3.0	75.8	1868.4	23%
10	1985	NDV	91.0	3.09	2.46	296.81	-2.76	2.8	63.8	737.4	17%
11	1986	NDV	120.5	3.31	3.59	296.62	-2.46	3.1	95.5	824.8	35%
12	1987	NDV	174.0	3.63	3.68	297.39	-1.62	3.2	110.6	4022.3	45%
13	1988	NDV	49.5	2.65	3.67	296.77	-2.93	3.0	78.5	839.8	24%
14	1989	NDV	138.5	3.43	1.35	296.48	-1.9	3.0	75.8	3805.7	23%
15	1990	NDV	140.0	3.44	3.01	296.85	-2.09	3.1	91.8	2321.6	32%
16	1991	NDV	45.0	2.59	2.34	296.03	-2.66	3.0	78.4	1114.7	24%
17											69%
18											69%
19											47%
20											16%
21											8%
22											67%
23											38%
24	1999	NDV	66.5	2.86	4.45	297.49	-3.88	2.6	43.9	511.2	9%
25	2000	NDV	292.5	4.14	7.33	297.74	-1.01	4.0	256.1	1183.7	99%
26	2001	NDV	3.5	1.37	2.74	296.79	-2.64	2.8	61.8	3402.2	16%
27	2002	NDV	26.5	2.31	2.33	296.6	-2.77	2.8	61.7	1103.5	16%
28	2003	NDV	120.0	3.31	4.62	297.19	-1.01	3.7	180.9	3705.7	87%
29	2004	NDV	66.5	2.86	0.67	296.05	-2.64	2.7	52.5	257.5	12%
30	2005	NDV	48.0	2.63	1.93	297.25	-1.85	2.9	69.8	475.7	20%
31	2006	NDV	116.5	3.29	2.95	297.43	-1.61	3.1	93.3	936.4	33%
32	2007	NDV	104.0	3.19	4.39	296.91	-3.33	2.9	70.3	1137.3	20%
33	2008	NDV	119.0	3.30	5.97	297.8	-1.15	3.7	188.7	4859.7	90%
34	2009	NDV	145.5	3.47	3.66	296.81	-1.42	3.5	141.8	14.0	57%
35	2010	NDV	194.0	3.73	4.27	297.15	-1.54	3.4	133.4	3875.6	51%
36	Normal		117.7	3.14						56.1	
37			slope		0.19	0.13	0.42			σn	
38	**Single Regression**		intercept		2.52	-35.17	4.05				
39			Correlation		0.42	0.10	0.54				
40											
41			slope		0.18	-0.25	0.34				
42	**Multi Regression**		intercept		75.11						
43			Correlation		0.61						

Input "=1-NORMDIST($D$36,$H4,$J$36,TRUE) in K4 to calculate probability of above-normal.







Procedures

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2. Multiple regression model
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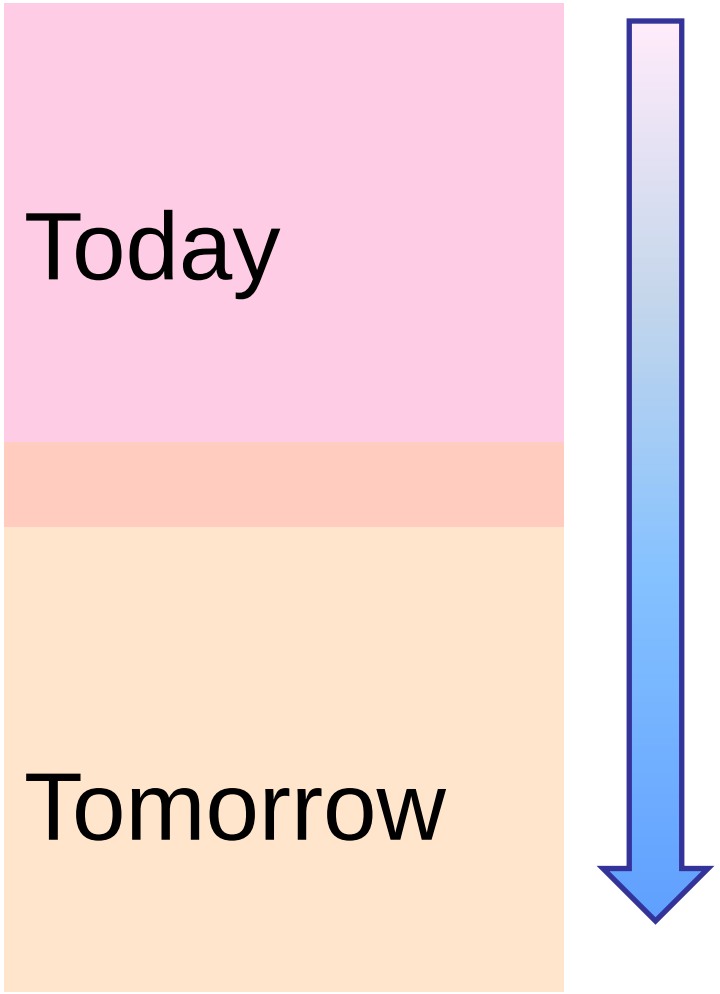
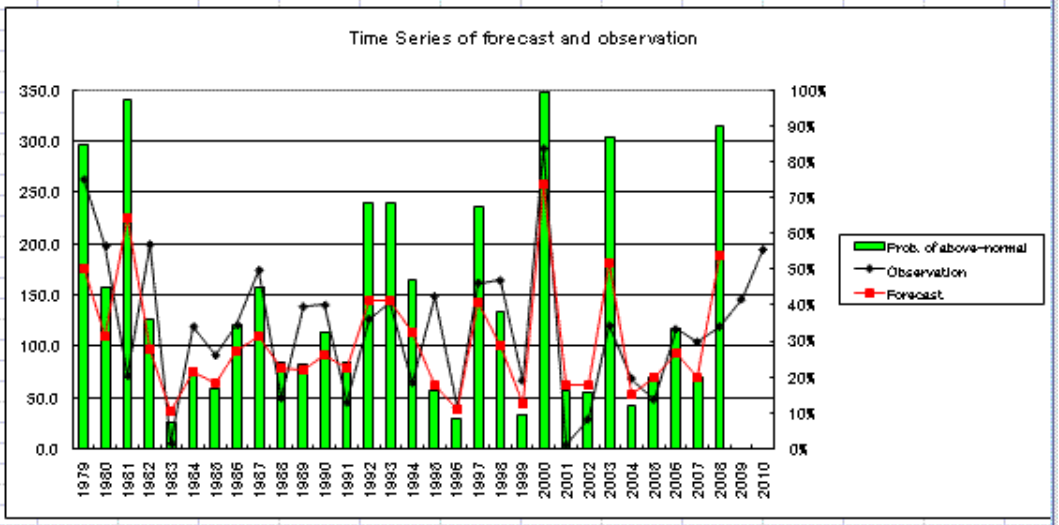
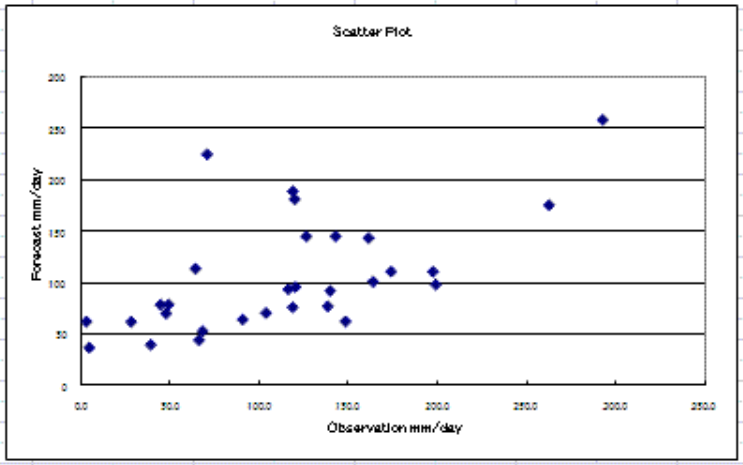
5. Production of one-month forecasts for Nov. 2011
6. Creation of presentations
7. Presentations (10 minutes)



4-1. Deterministic Verification

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





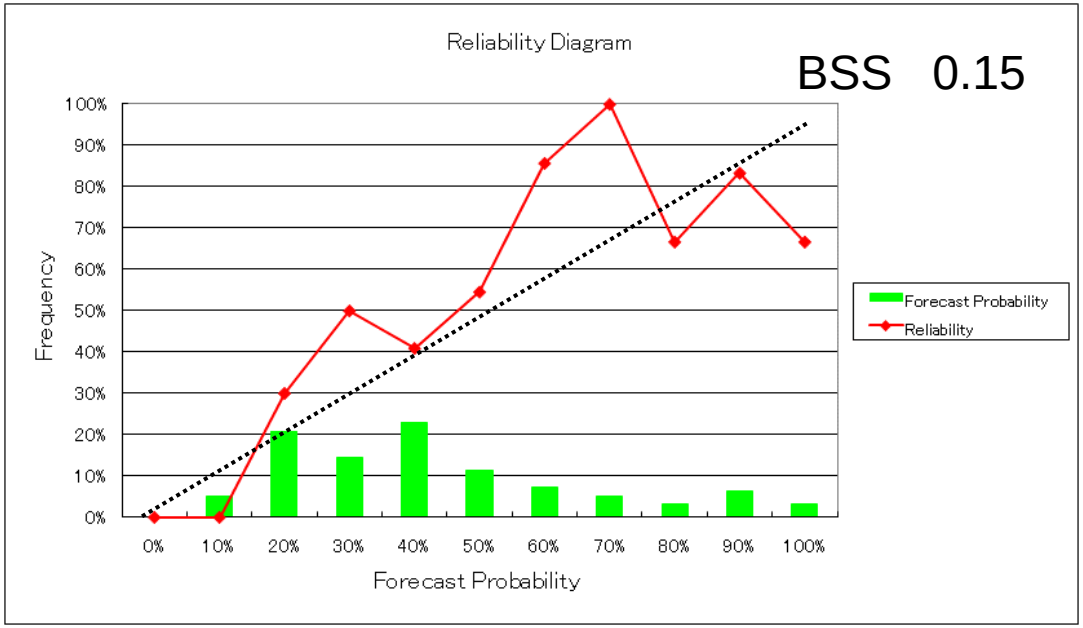
4-2. Probabilistic Verification

- Brier Skill Score (BSS)
- Reliability Diagram

$$b = \frac{1}{N}\sum_{i=1}^{N}(p_i - v_i)^2, \quad 0 \le p_i \le 1, \quad v_i \in \{0,1\}$$

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

See the textbook in detail



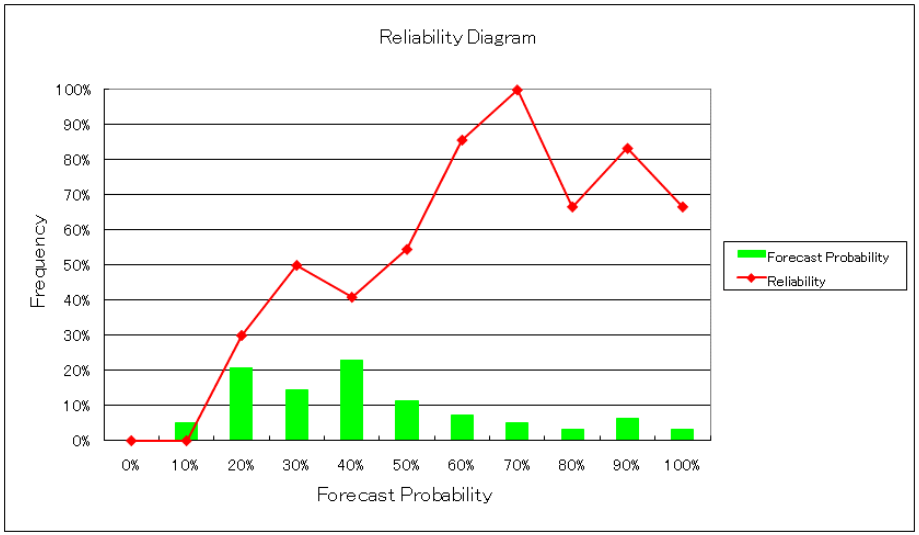
Skill of JMA Operational Guidance from 2008 to 2010.

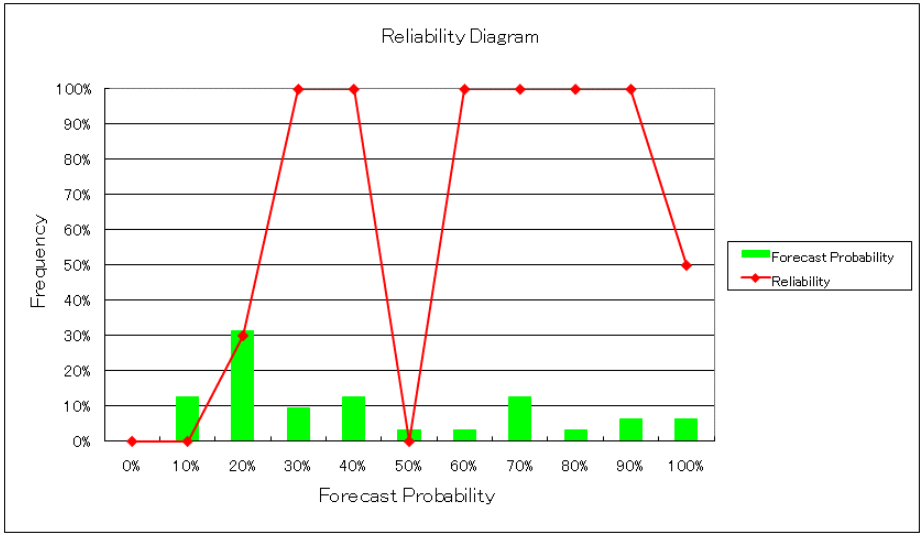
Target Period	BSS
1st weekly temp.	0.55
2nd weekly temp.	0.3
Monthly temp.	0.4
Monthly prec.	0.1

Reliability diagram of Nov. precipitation, totaling Naha, Ishigakijima and Miyakojima station in Japan.

4-2. Probabilistic Verification

It is important to have a lot of samples to do probabilistic verification.





90 samples 30 years x 3 stations

Totaling Naha, Ishigakijima, Miyakojima station.

30 samples

Only Naha station.

Reliable

Unreliable

Exercise for Guidance.xls

Calculation of Brier Skill Score

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

The “ROUND” function can be used to round values.

U28

	A	B	C	D	E	F	G	H
1			observation	Prob. of above-normal	(Pi-Vi)^2	round off	above-normal : 1	1
2	1979	NOV Naha	262.5	85%	0.0233	80%	1	1
3	1980	NOV	197.5	45%	0.3049	40%	1	1
4	1981	NOV	71.0	97%	0.9438	100%	0	0
5	1982	NOV	199.0	36%	0.4075	40%	1	1
6	1983	NOV	5.0	7%	0.0055	10%	0	0
7	1984	NOV	119.0	23%	0.5968	20%	1	1
8	1985	NOV	91.0	17%	0.0284	20%	0	0
9	1986	NOV	120.5	35%	0.4275	30%	1	1
10	1987	NOV	174.0	45%	0.3031	40%	1	1
11	1988	NOV	49.5	24%	0.0587	20%	0	0
12	1989	NOV	138.5	23%	0.5882	20%	1	1
13	1990	NOV	140.0	32%	0.4593	30%	1	1
14	1991	NOV	45.0	24%	0.0584	20%	0	0
15	1992	NOV	126.5	69%	0.0992	70%	1	1
16	1993	NOV	143.0	69%	0.0988	70%	1	1
17	1994	NOV	64.5	47%	0.2190	50%	0	0
18	1995	NOV	148.5	16%	0.7051			
19	1996	NOV	39.5	8%	0.0066			
20	1997	NOV	161.5	67%	0.1057			
21	1998	NOV	164.0	38%	0.3837			
22	1999	NOV	66.5	9%	0.0089			
23	2000	NOV	292.5	99%	0.0000			
24	2001	NOV	3.5	16%	0.0255			
25	2002	NOV	28.5	16%	0.0253			
26	2003	NOV	120.0	87%	0.0169			
27	2004	NOV	68.5	12%	0.0150			
28	2005	NOV	48.0	20%	0.0387			
29	2006	NOV	116.5	33%	0.1103	30%	1	1
30	2007	NOV	104.0	20%	0.0396	20%	0	0
31	2008	NOV	119.0	90%	0.0106	90%	1	1
32	2009	NOV	145.5	67%	0.1116	70%	1	1
33	2010	NOV	194.0	61%	0.1521	60%	1	1
34	1979	NOV Ishigakijima	226.0	45%	0.3002	50%	1	1
35	1980	NOV	170.5	46%	0.2934	50%	1	1
36	1981	NOV	174.5	68%	0.1026	70%	1	1
37	1982	NOV	329.0	37%	0.4019	40%	1	1
38	1983	NOV	77.5	45%	0.2015	40%	0	0

Averaging these values gives the Brier Score b.

The climatological Brier score *bc* is 0.25 for a two-category forecast: *BSS = (bc – b) / bc*

Observation Prob. of above-normal

Avoid totaling different variables because their levels of forecast skill usually vary significantly.

Reliability Diagram

The “COUNTIF” function can be used to count the number of cases with the same forecast probability.

The “SUMPRODUCT” function can be used to calculate the frequency of above-normal values for each forecast probability.

The equations have been already written.

	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	round off	above-normal : 1														
2	80%	1		Forecast Probability	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
3	40%	1		Frequency of Forecast	0	5	20	14	22	11	7	5	3	6	3	
4	100%	0		Frequency of Observation	0	0	6	7	9	6	6	5	2	5	2	
5	40%	1		Reliability	#DIV/0!	0%	30%	50%	41%	55%	86%	100%	67%	83%	67%	
6	10%	0		Forecast Probability	0%	5%	21%	15%	23%	11%	7%	5%	3%	6%	3%	
7	20%	1														
19	10%	0	0													
20	70%	1	1													
21	40%	1	1													
22	10%	0	0													
23	100%	1	1													
24	20%	0	0													
25	20%	0	0													
26	90%	1	1													
27	10%	0	0													
28	20%	0	0													
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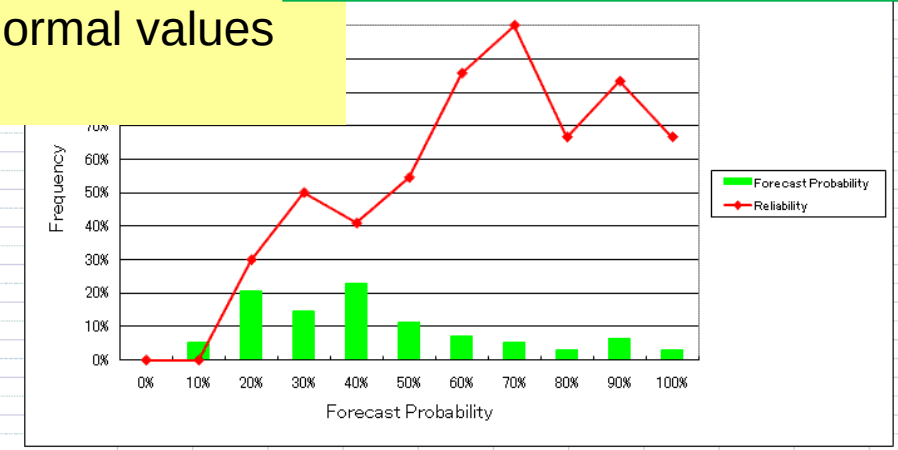
30	20%	0	0													
31	90%	1	1													
32	70%	1	1													
33	60%	1	1													
34	50%	1	1													
35	50%	1	1													
36	70%	1	1													
37	40%	1	1													
38	40%	0	0													
39	20%	0	0													
40	30%	1	1													
41	50%	1	1													
42	40%	1	1													
43	40%	0	0													
44	20%	1	1													
45	40%	1	1													
46	20%	0	0													
47	30%	0	0													
48	50%	0	0													
49	40%	0	0													
50	40%	0	0													
51	40%	1	1													



Reliability Diagram

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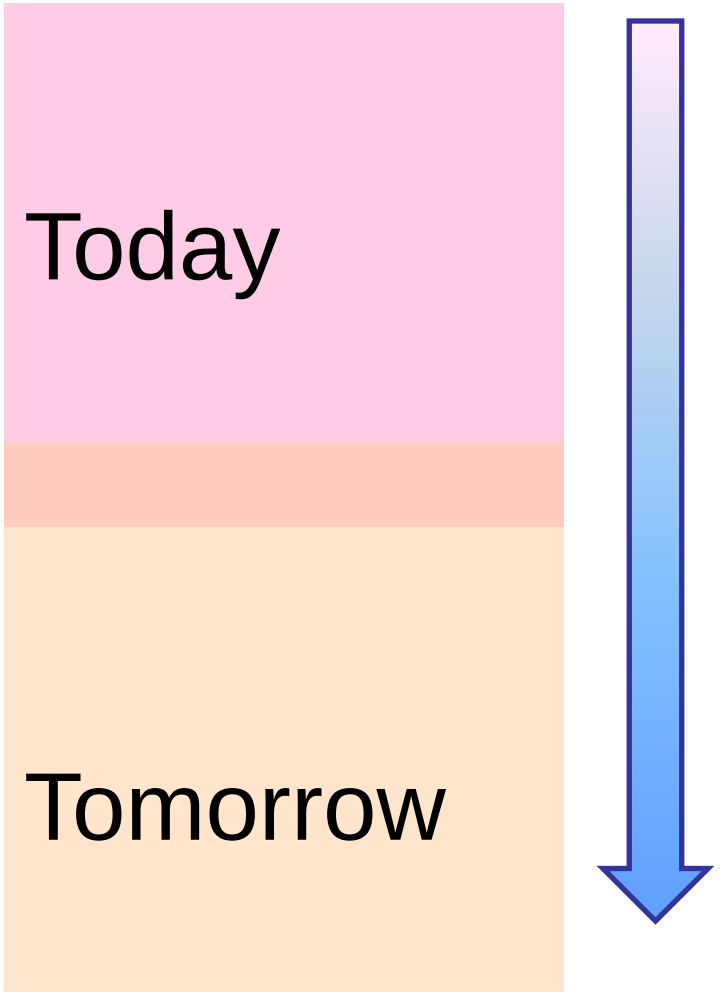
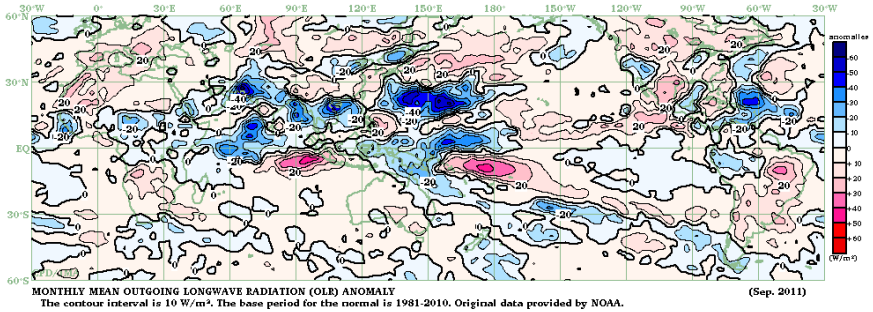
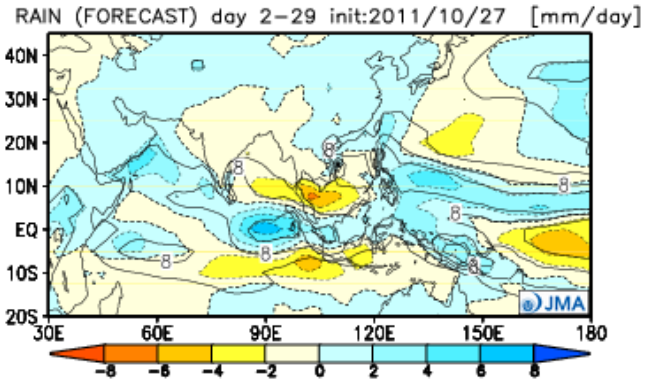


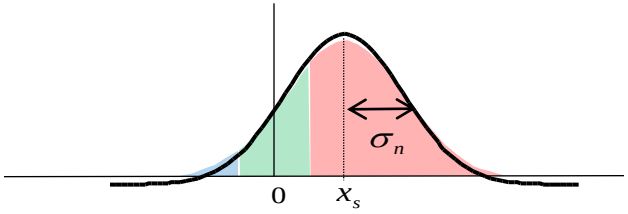
5. Production of one-month forecasts for Nov.

initial date: 27 Oct. 2011

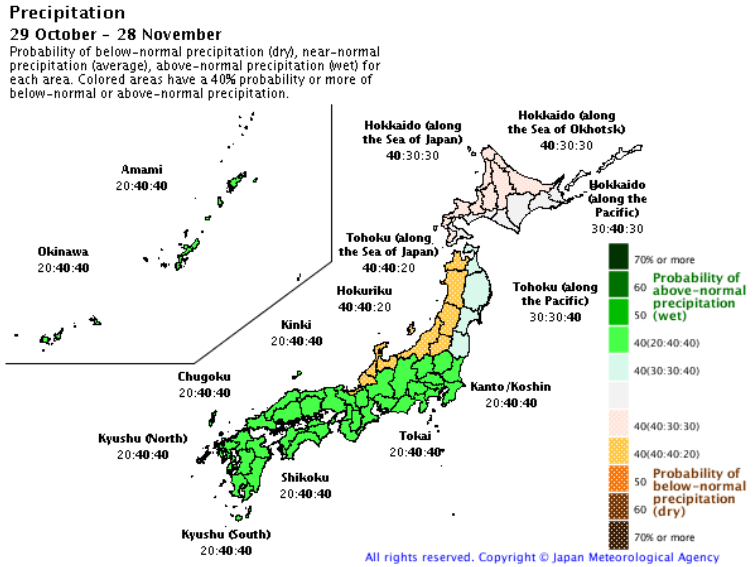
- Current Conditions
- Numerical Prediction
- Guidance
- Forecast







Guidance



Thank you

Links

- Verifications
  http://ds.data.jma.go.jp/tcc/tcc/products/model/hindcast/1mE/index.html
- ITACS tool http://extreme.kishou.go.jp/tool/itacs-tcc2011/
- TCC web http://ds.data.jma.go.jp/tcc/tcc/news/
- Daily Forecast in Tokyo http://www.jma.go.jp/en/yoho/206.html