Ex.1

How to use the guidance tool
(Producing Guidance and Verification)

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Schedule of exercise

17 Nov. (Tue.)	● Exercise of the one-month forecast 1. Creation of the guidance using common data 2. Creation of the guidance using individual data
18 Nov. (Wed.)	3. Interpretation of the other product (forecast map, check up of the prediction skill etc.) 4. Building one-month forecast 5. Making presentation file
19 Nov. (Thu.) AM	5. Making presentation file (cont.)
PM	●Presentation (15min. × 15 persons)
20 Nov. (Fri) AM	

Setting an example of creation of the guidance (common data)

- Initial time of the model: 4 Nov 2015 (Wed.)
- Forecast target period: 7 Nov to 4 Dec (4 weeks mean)

- Forecast point: Tokyo/JAPAN (35.7N, 139.8E)

Workflow of the guidance tool

1. (Preparation)
   1. Create the past observation file (csv format)

Input of the guidance tool
(We have already prepared.)

2. (using EXCEL file and iTacs)
   1. Check the initial date and target period
   2. Production of guidance and verification

      (1) Get past observation data

      (2) Get hindcast data

      (3) Confirmation of prediction skill of guidance

   3. Application to the real-time forecast

      •Input of real-time forecast of model

      Obtaining solution of probabilistic forecast by the guidance

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      Obtaining solution of probabilistic forecast by the guidance

1. Past observation data

- Element: Mean temperature and precipitation (daily)
  - Create the files separately between temperature and precipitation
- File format: csv
- Period: Every day from 1 January 1981 to 31 January 2011
- Describe some information on observation point in the beginning five lines
- Embedded undefined value in case of missing data

The next slide illustrates the example

Example of the observation data file

	A	B	C	D
1	#station=TOKYO/JAPAN			
2	#undef=-9999			
3	#elname=precipitation			
4	#lon=140.0			
5	#lat=35.0			
6	1981	1	1	0
7	1981	1	2	2
8	1981	1	3	0
9	1981	1	4	0
10	1981	1	5	0
11	1981	1	6	0
10986	2011	1	24	3.5
10987	2011	1	25	0
10988	2011	1	26	0
10989	2011	1	27	0
10990	2011	1	28	-9999
10991	2011	1	29	-9999
10992	2011	1	30	0
10993	2011	1	31	0
10994				

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

1 January 1981 to 31 January 2011

After line-6: observation data

{Year}, {Month}, {Day}, {Observational value}

Embedded undefined value in case of missing data

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   1. Check the initial date and target period
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      (1) Get past observation data
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      •Input of real-time forecast of model
      Obtaining solution of probabilistic forecast by the guidance

Difference of initial date between hindcast and real-time forecast

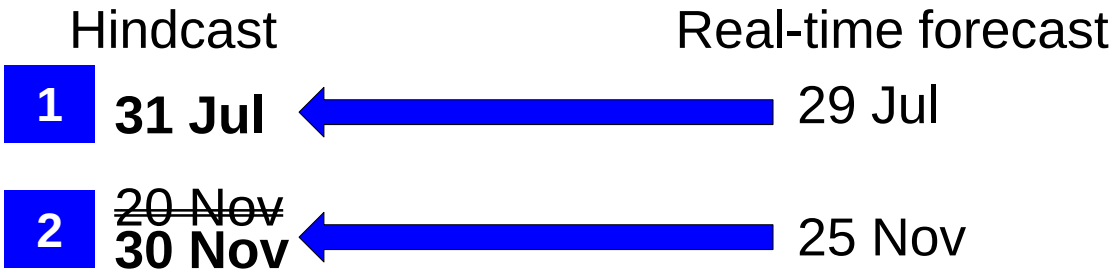
Note:

The initial time and the forecast target period are different between verification of guidance by hindcast and real-time forecast, because operation procedures of NWP model are different between real-time and hindcast.

	Hindcast	Real-time forecast
Initial date	10th, 20th and the end of month (10 Jan, 20 Jan, 31 Jan, 10 Feb, …, 31 Dec)	Every Wednesday

2.1. Check the initial date and target period
(1) Initial date and forecast target period for hindcast

Example



1. Basically, the initial date for hindcast is the nearest to that for real-time forecast.
2. When the initial date for real-time forecast is just middle of the hindcast initial dates, later date is referred.

	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015

-4day

Target period for the hindcast is shifted from the period for the real-time forecast.

Workflow of the guidance tool

1. (Preparation)
   1. Create the past observation file (csv format)

Input of the guidance tool
(We have already prepared.)

2. (using EXCEL file and iTacs)
   1. Check the initial date and target period
   2. Production of guidance and verification
      - (1) Get past observation data
      - (2) Get hindcast data
      - (3) Confirmation of prediction skill of guidance
   3. Application to the real-time forecast
      - •Input of real-time forecast of model

      Obtaining solution of probabilistic forecast by the guidance

Input data for the guidance

	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015

-4day

Input of the guidance

- **to create the guidance** (3 to 30 Nov (1981-2010))
  - Past observation
  - Model forecast (hindcast)

Regression calculations using the data during hindcast period

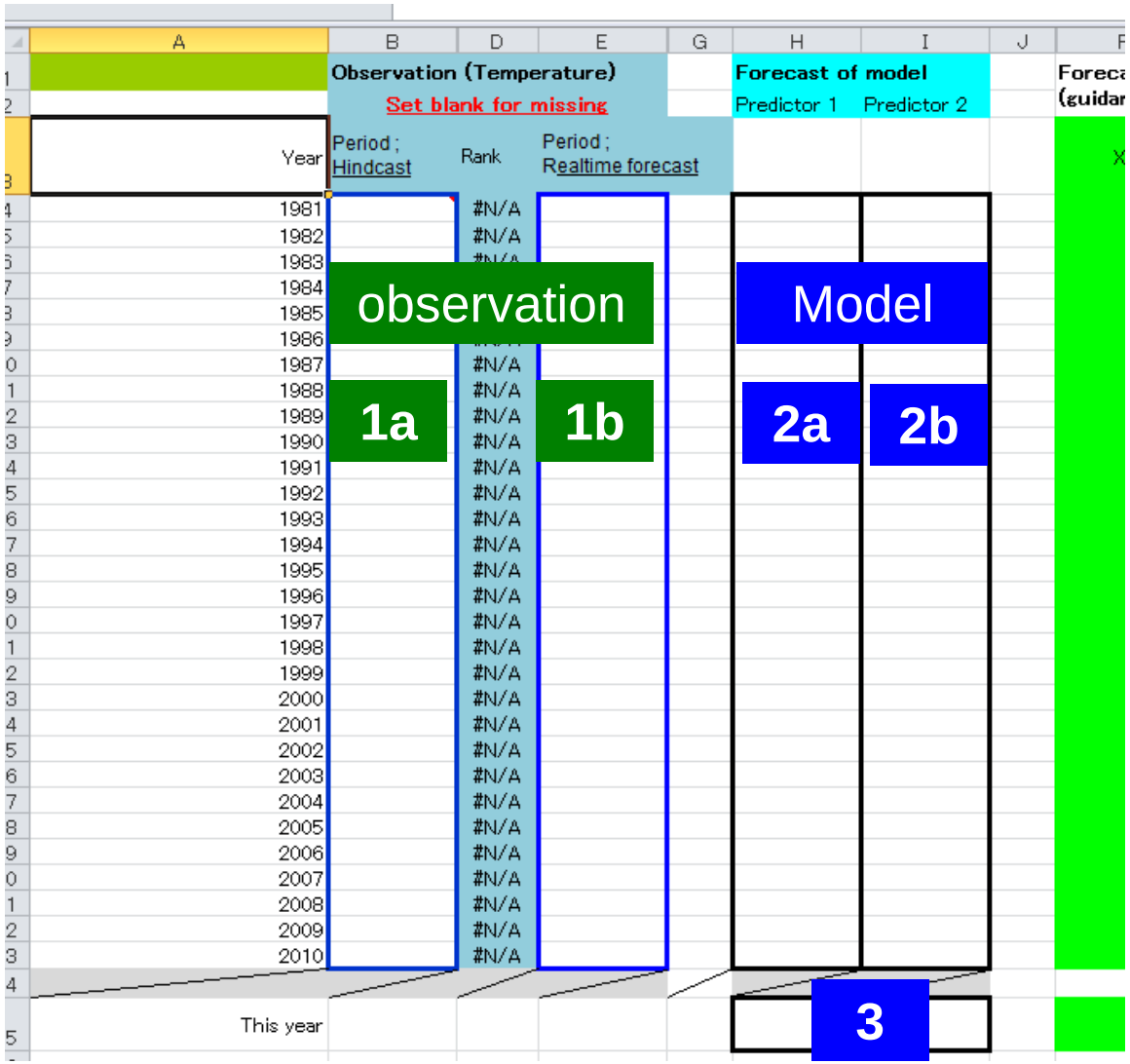
- **For real-time forecast** (for 7 Nov to 4 Dec)
  - Model forecast (real-time forecast)

Input of the guidance for real-time forecast

Calculations of near-normal range for the real-time forecast

Input field of the guidance tool

Worksheet “Calc_guidance”

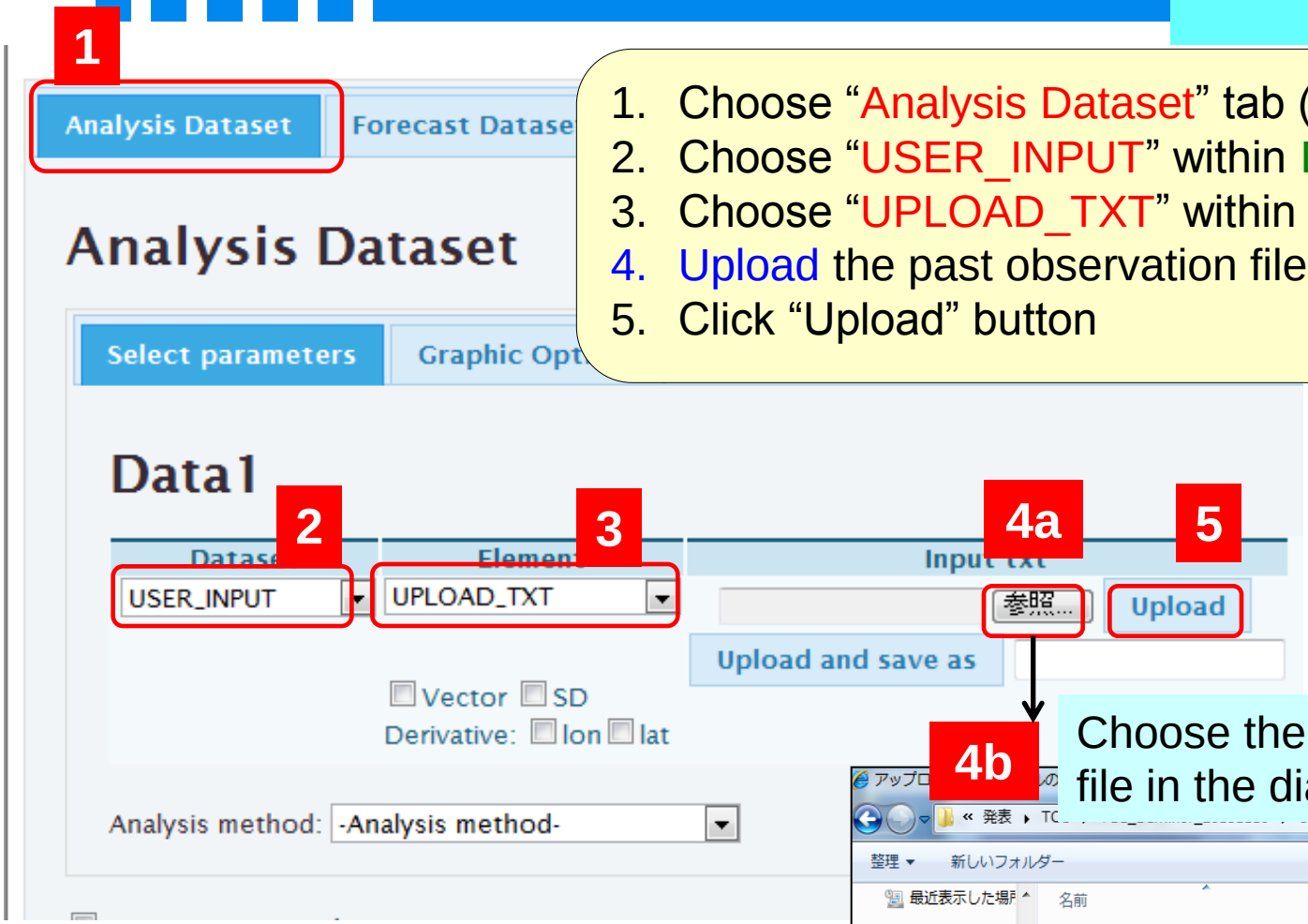


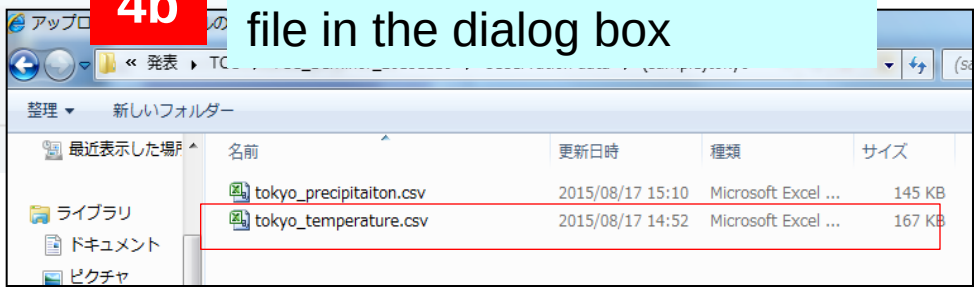
- (1a, 1b) **Past observation**
  - Hindcast period (1a)
  - 1b; Real-time forecast period (1b)
- (2a, 2b) **Hindcast** (Model)
- (3) **Real-time forecast** (Model)

2.2 Input past observation data
(1) Get past observation data (1 of 6)

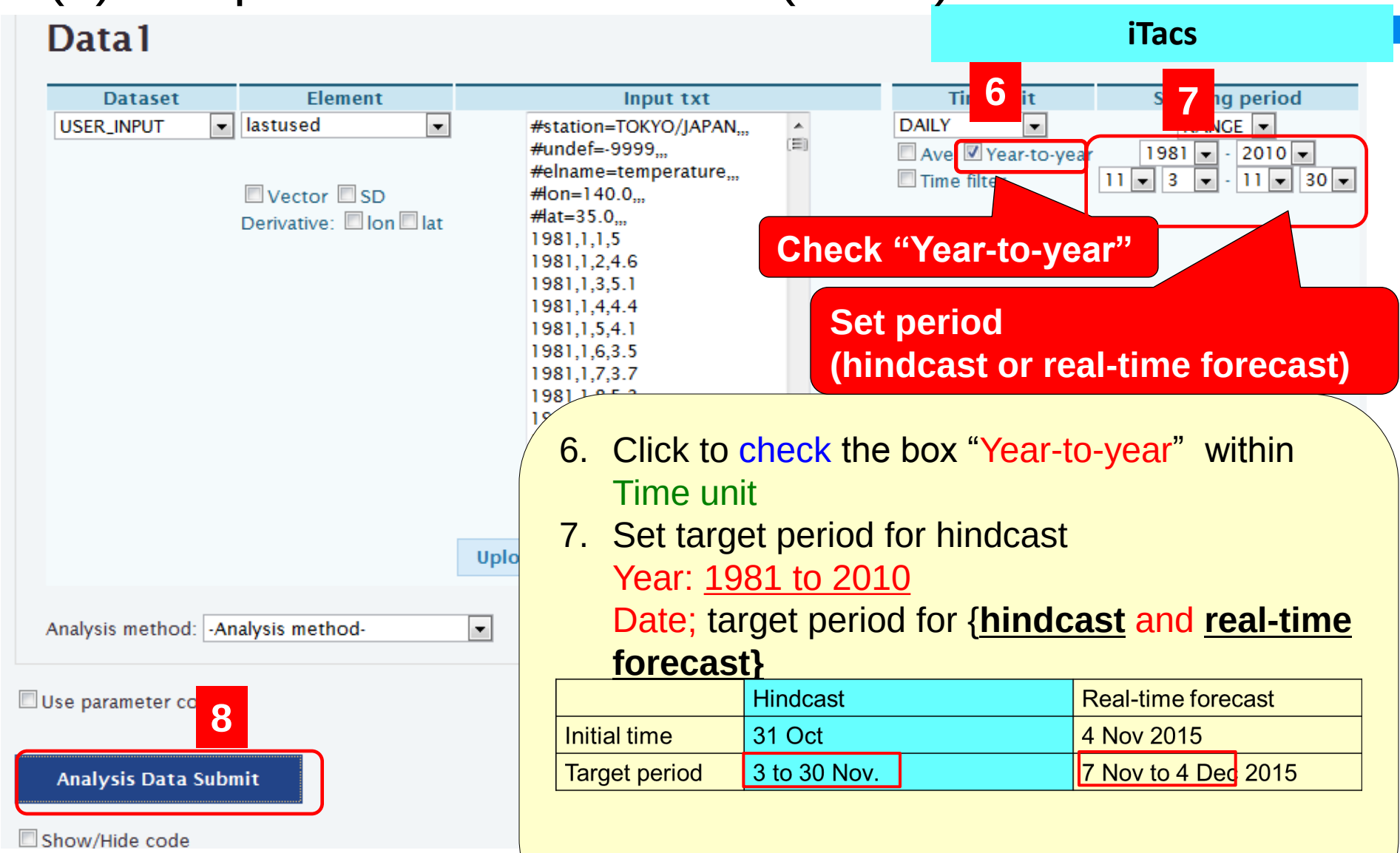
iTacs

1. Choose “Analysis Dataset” tab (default tab)
2. Choose “USER_INPUT” within Dataset for Data1
3. Choose “UPLOAD_TXT” within Element for Data1
4. Upload the past observation file created by users
5. Click “Upload” button





2.2 Input past observation data
(1) Get past observation data (2 of 6)



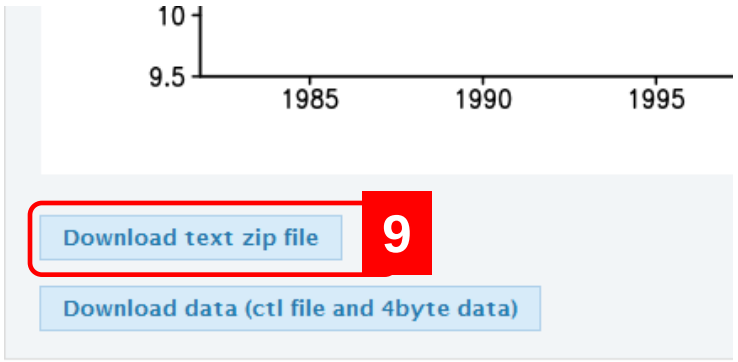
6. Click to check the box “Year-to-year” within Time unit
7. Set target period for hindcast
   Year: 1981 to 2010
   Date; target period for {**hindcast** and **real-time forecast**}

	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015

8. Click “Analysis Data Submit”

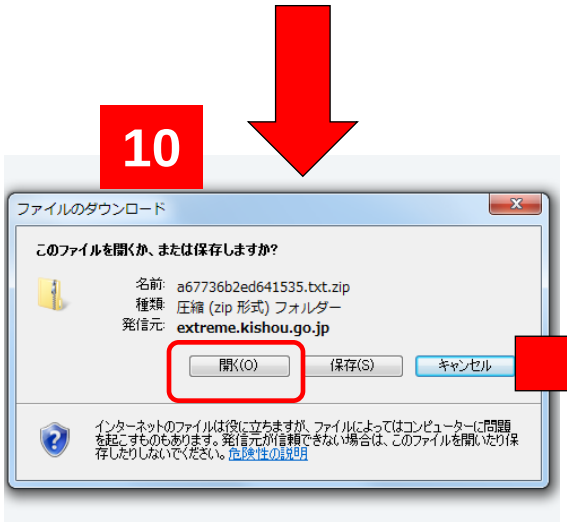
2.2 Input past observation data
(1) Get past observation data (3 of 6)

iTacs



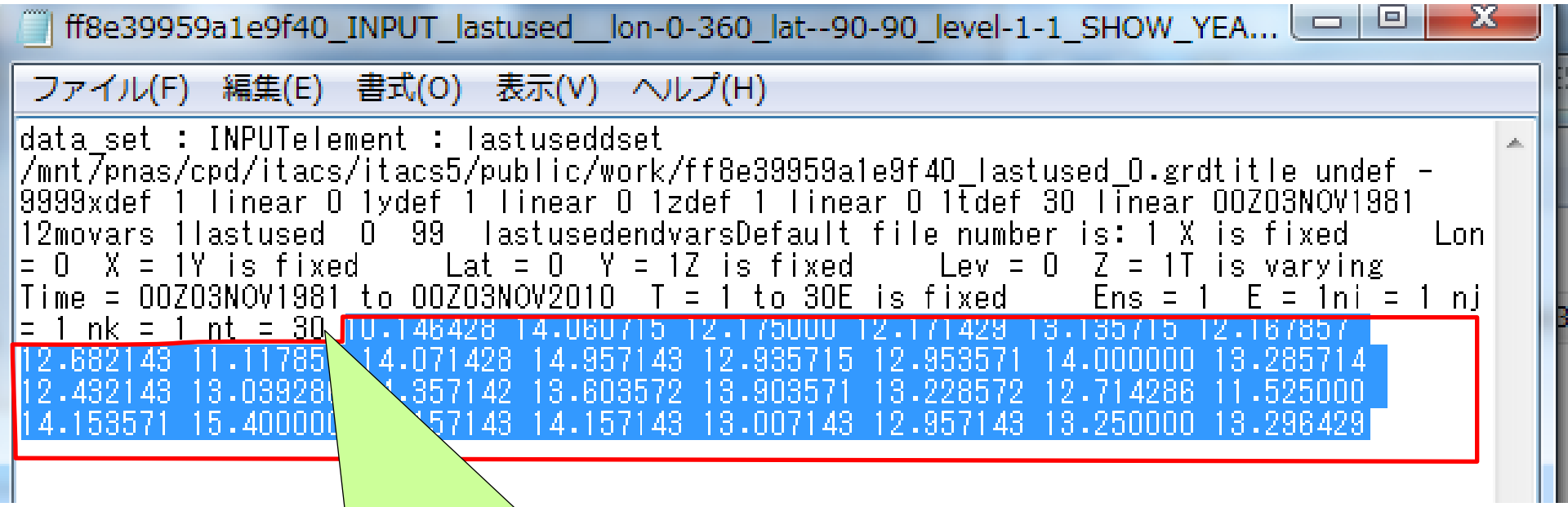
(After “Analysis Data Submit”, time sequence graph is displayed.)

9.Click “Download text zip file” below the graph
10. Download the text file
11. Open the downloaded text file



2.2 Input past observation data
(1) Get past observation data (4 of 6)

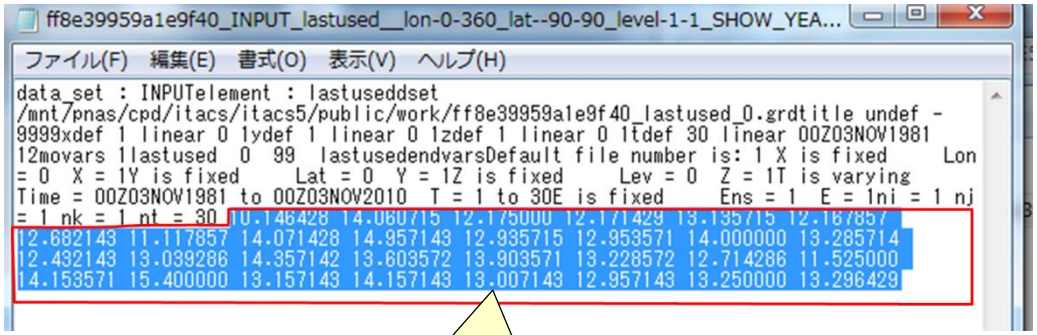
Downloaded text file



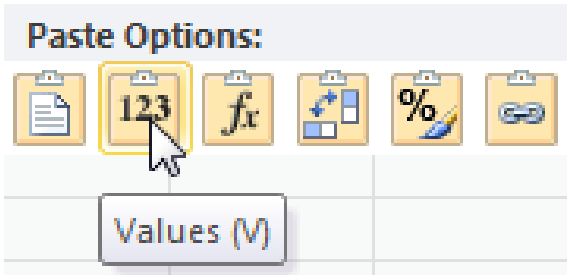
Time sequence data is described atfer “nt = **”.

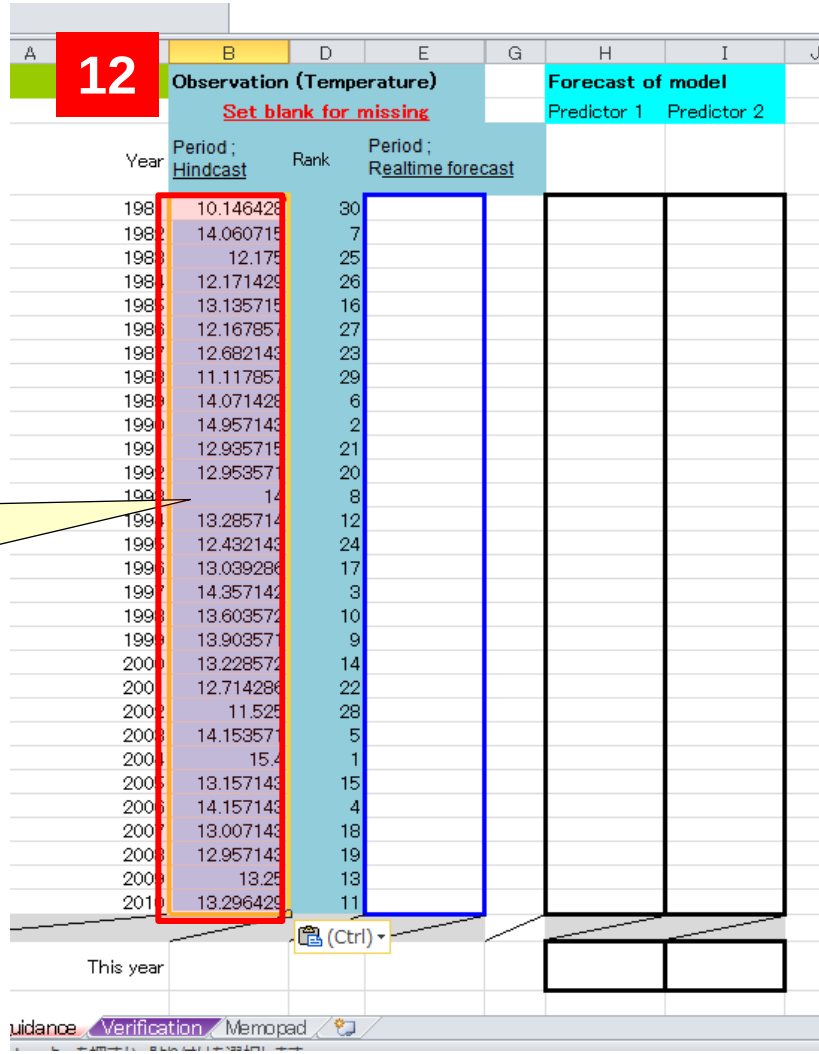
2.2 Input past observation data
(1) Get past observation data (5 of 6)

Worksheet “Calc_guidance”



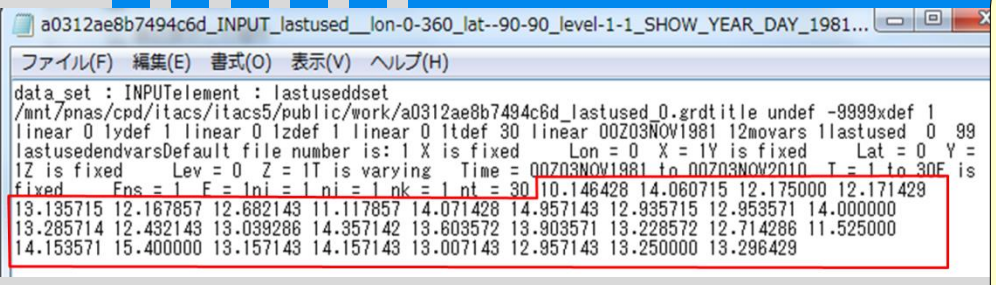
12. Copy and paste with the paste values option to the Excel file



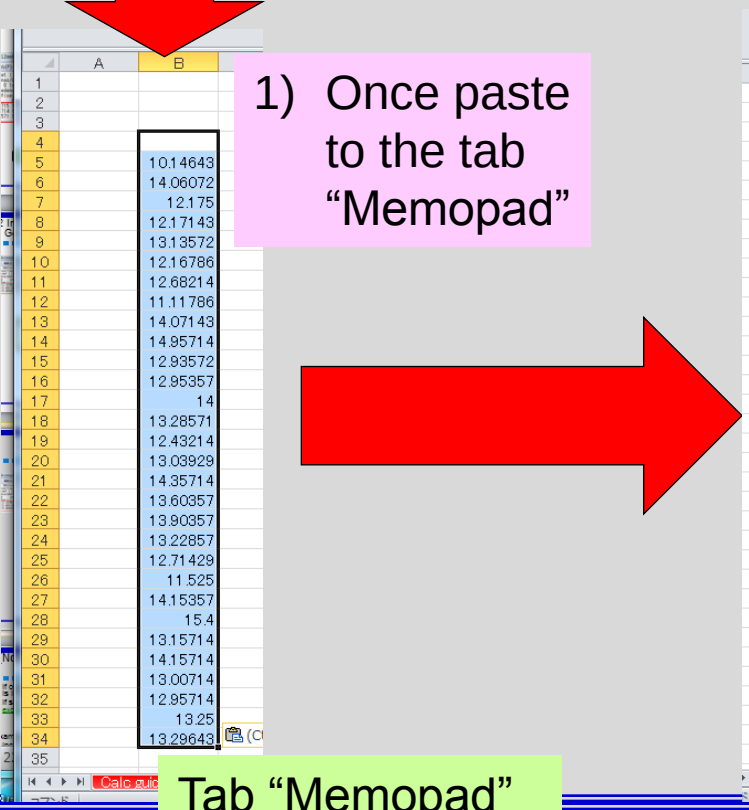


(Tips) For smoothly copy and paste

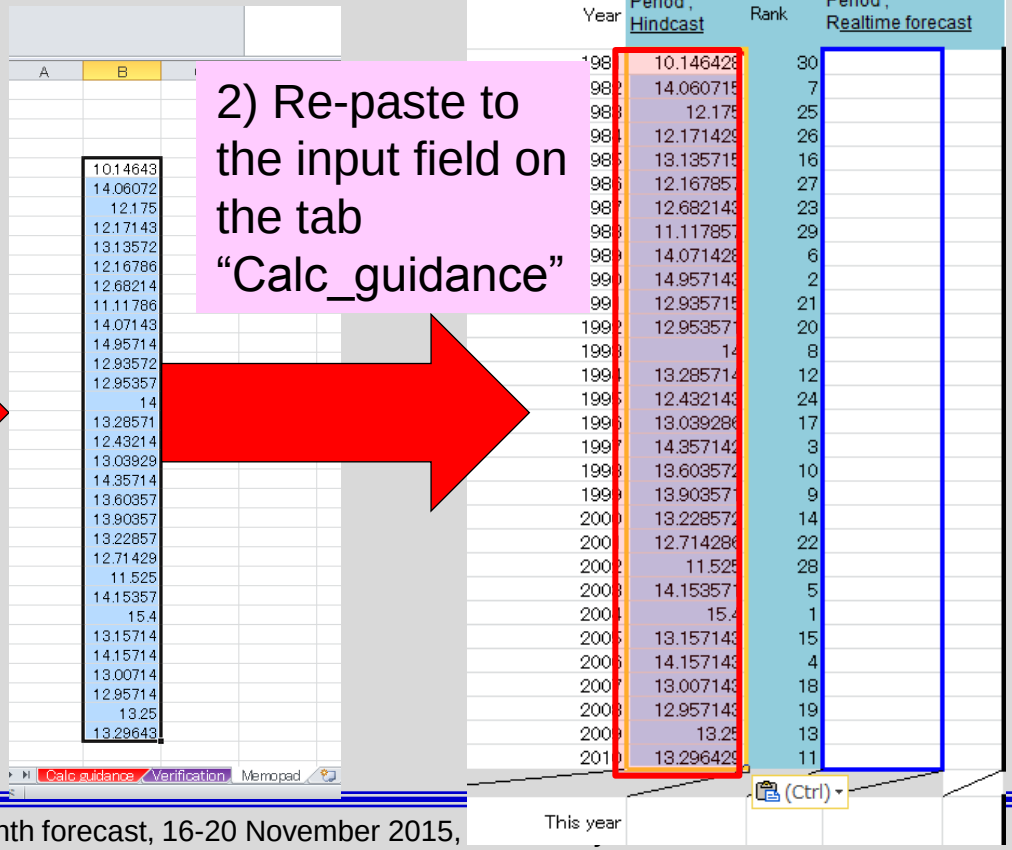
- The copied string sometimes include a blank line at the beginning.
- Thereupon, once copy the string to the tab “Memopad” and **re-paste** to the input field on the tab “Calc_guidance”



1) Once paste to the tab “Memopad”



2) Re-paste to the input field on the tab “Calc_guidance”



(Note) In case of continuous missing data in the past observation file

- If observation data for whole target period is missing for certain year, it is impossible to aggregate on iTacs.

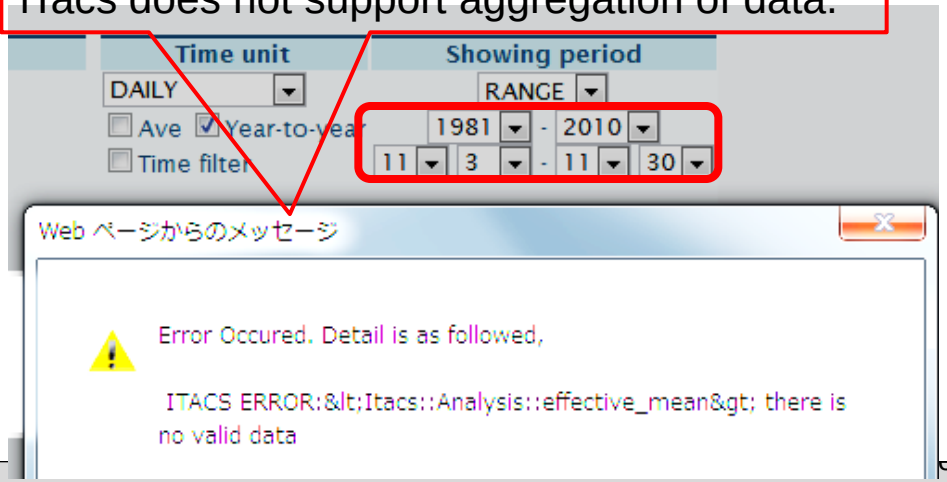
➢ If so, target year (i.e. “Showing period”) should be set with the exception of missing-data year.

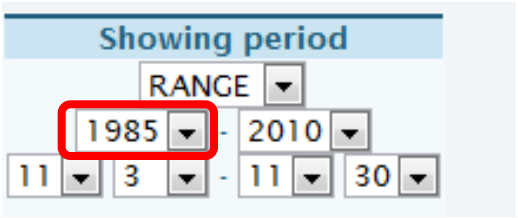
◆ In this exercise, long-term missing data
Cambodia data; 1981 to 1984
Singapore data; Jan to Jun 1981

(Example)

✓ Including missing data during 1981 to 1984;
  ➢ Aggregate 1985 to 2010

Due to missing data during 1981 to 1984, iTacs does not support aggregation of data.





(Note) In case of continuous missing data in the past observation file

f03955f3286dd2f1_INPUT_lastused__lon-0-360_lat--90-90_level-1-1_SHOW_YEAR_DAY_19851...

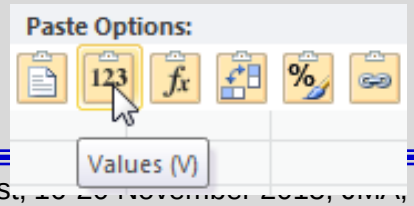
ファイル(F) 編集(E) 書式(O) 表示(V) ヘルプ(H)

```
data_set : INPUTelement : lastuseddset
/mnt/pnas/cpd/itacs/itacs5/public/work/f03955f3286dd2f1_lastused_0.grdtitle undef -9999xdef 1
linear 0 1ydef 1 linear 0 1zdef 1 linear 0 1tdef 26 linear 00Z03NOV1985 12movars 1lastused  0  99
lastusedendvarsDefault file number is: 1 X is fixed     Lon = 0   X = 1Y is fixed     Lat = 0   Y =
1Z is fixed     Lev = 0   Z = 1T is varying    Time = 00Z03NOV1985 to 00Z03NOV2010   T = 1 to 26F is
fixed     Ens = 1   E = 1ni = 1 ni = 1 nk = 1 nt = 26 27.155357 27.723215 27.751785 25.564465
26.396429 26.325001 26.262501 25.783928 26.546429 27.548571 26.035715 28.312500 27.792856
27.146429 26.975000 26.914286 25.421429 27.535715 27.857143 27.914286 28.250000 28.810715
26.378571 27.178572 28.049999 27.703571
```

Time sequence data from 1985 to 2010

Set blank field for missing period (1981 to 1984)

Copy and paste (with value option)



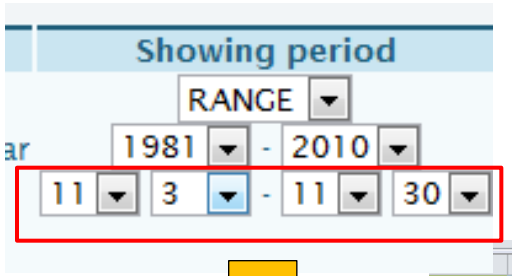
	B	D	E	G
	Observation (Temperature)			
	Set blank for missing			
Year	Period ; Hindcast	Rank	Period ; Realtime forecast	
1981		#N/A		
1982		#N/A		
1983		#N/A		
1984		#N/A		
1985	27.155357	14		
1986	27.723215	9		
1987	27.751785	8		
1988	25.564465	25		
1989	26.396429	19		
1990	26.325001	21		
1991	26.262501	22		
1992	25.783928	24		
1993	26.546429	18		
1994	27.548571	11		
1995	26.035715	23		
1996	28.3125	2		
1997	27.792856	7		
1998	27.146429	15		
1999	26.975	16		
2000	26.914286	17		
2001	25.421429	26		
2002	27.535715	12		
2003	27.857143	6		
2004	27.914286	5		
2005	28.25	3		
2006	28.810715	1		
2007	26.378571	20		
2008	27.178572	13		
2009	28.049999	4		
2010	27.703571	10		

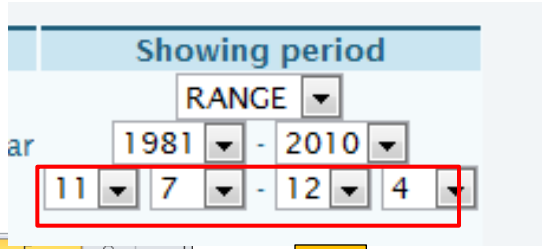
(Ctrl)

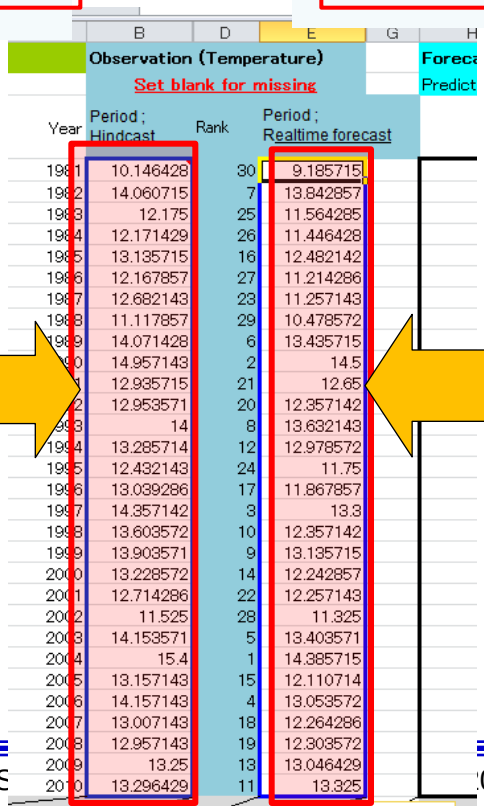
2.2 Input past observation data
(1) Get past observation data (6 of 6)

Worksheet “Calc_guidance”

	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015







- Similarly, get the past observation data for the real-time forecast period

Workflow of the guidance tool

1. (Preparation)
   1. Create the past observation file (csv format)

Input of the guidance tool
(We have already prepared.)

2. (using EXCEL file and iTacs)
   1. Check the initial date and target period
   2. Production of guidance and verification

      (1) Get past observation data

      (2) Get hindcast data

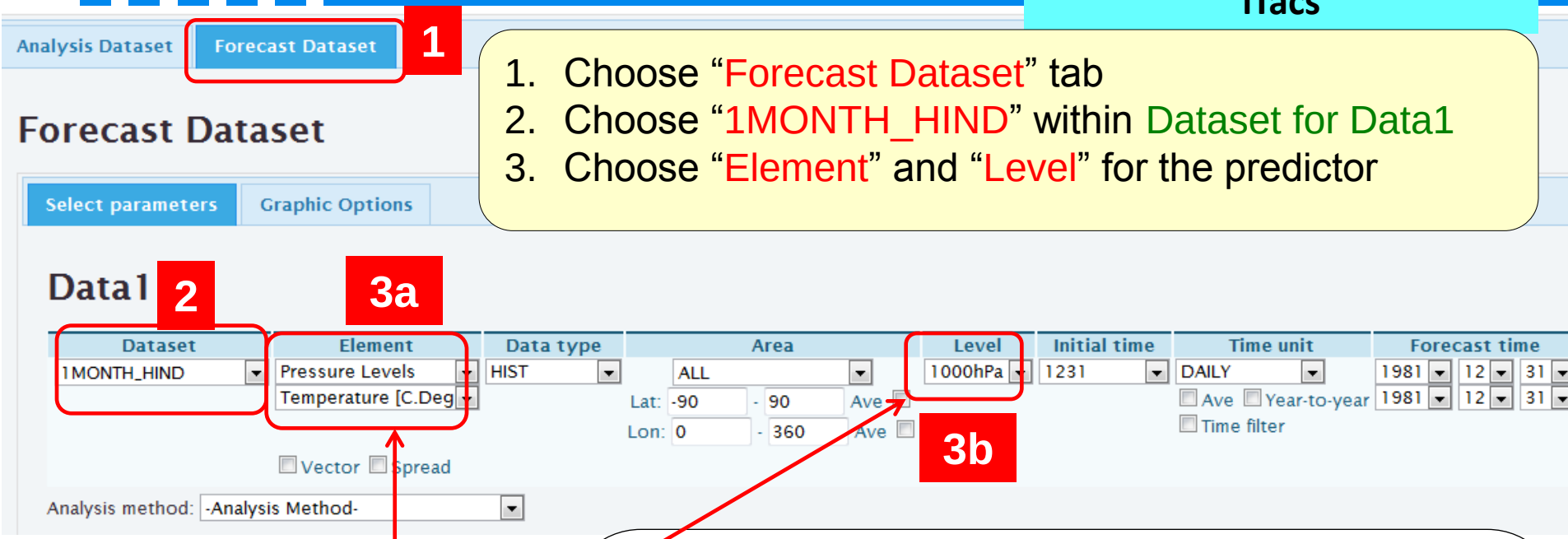
      (3) Confirmation of prediction skill of guidance
   3. Application to the real-time forecast

      •Input of real-time forecast of model

      Obtaining solution of probabilistic forecast by the guidance

2.2 Input past observation data
(2) Get hindcast data (1 of 5)

iTacs



1. Choose “Forecast Dataset” tab
2. Choose “1MONTH_HIND” within Dataset for Data1
3. Choose “Element” and “Level” for the predictor

Ex. 1000hPa temp.

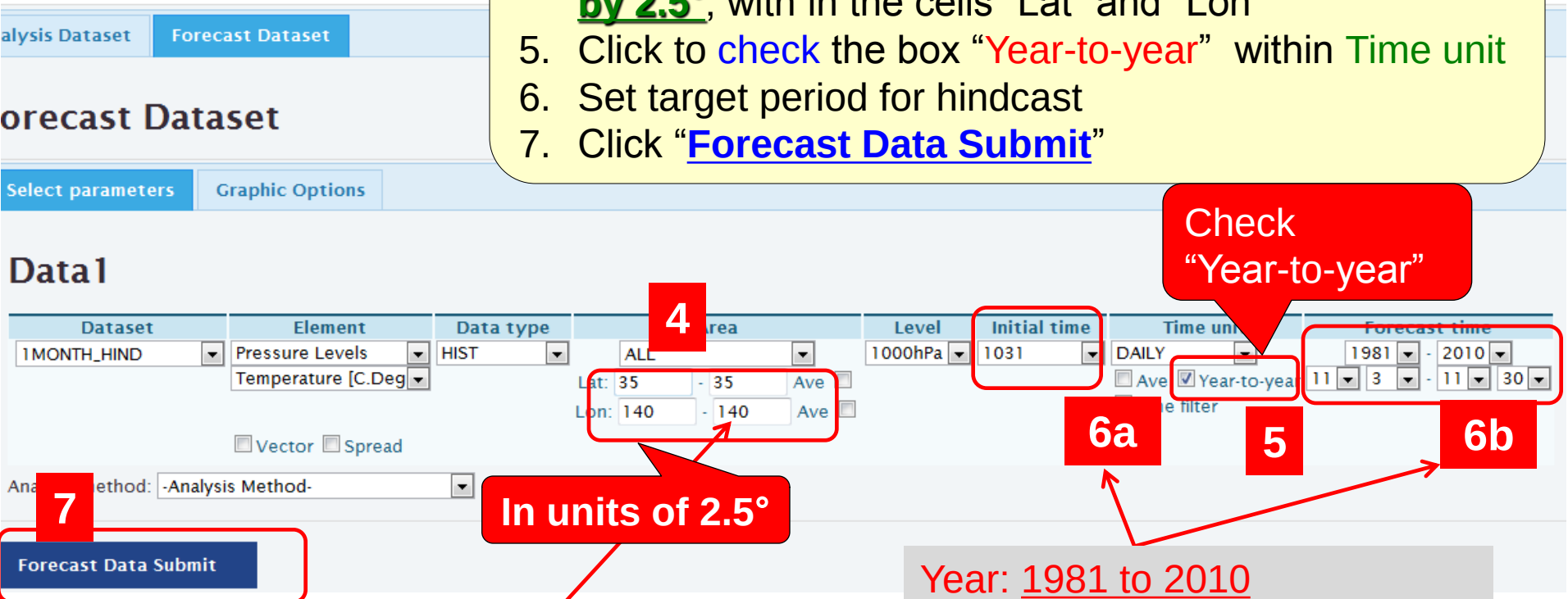
Major element for predictors

Isobatic (pressure levels) (1000,925,850,700,500,… hPa)	Surface
Temperature Dew-point depression (=T-Td) Wind (U or V) Geopotential height	Temperature Rain

2.2 Input past observation data
(2) Get hindcast data (2 of 5)

iTacs

4. Input the nearest grid point from the observation site **by 2.5°**, with in the cells “Lat” and “Lon”
5. Click to check the box “Year-to-year” within Time unit
6. Set target period for hindcast
7. Click “**Forecast Data Submit**”



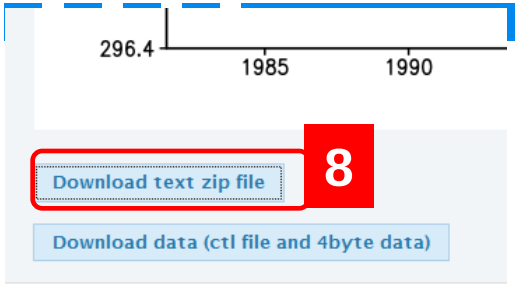
Year: 1981 to 2010
Date; target period for hindcast

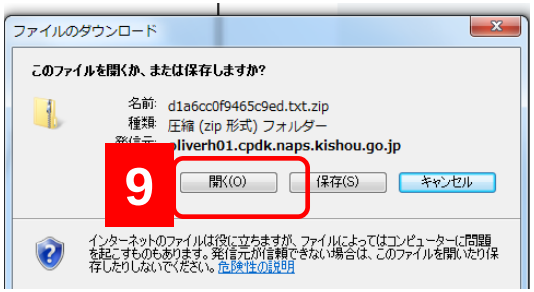
Ex.
Tokyo 35.7°N --> **35°N**
139.8°E --> **140°E**

	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015

2.2 Input past observation data
(2) Get hindcast data (3 of 5)

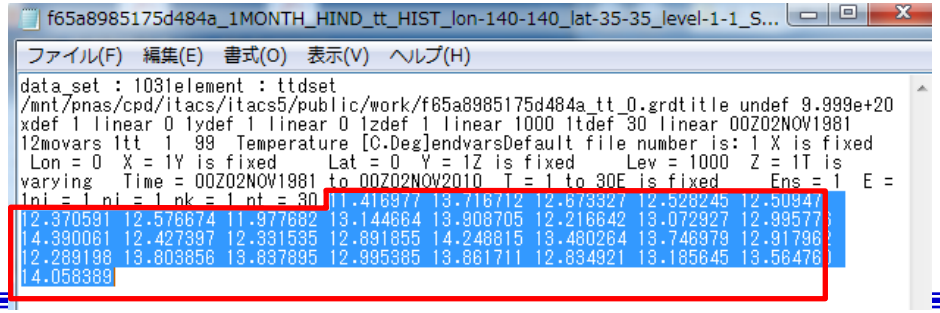
iTacs





8. Click “Download text zip file” below the graph
9. Download the text file
10. Open the downloaded text file

10



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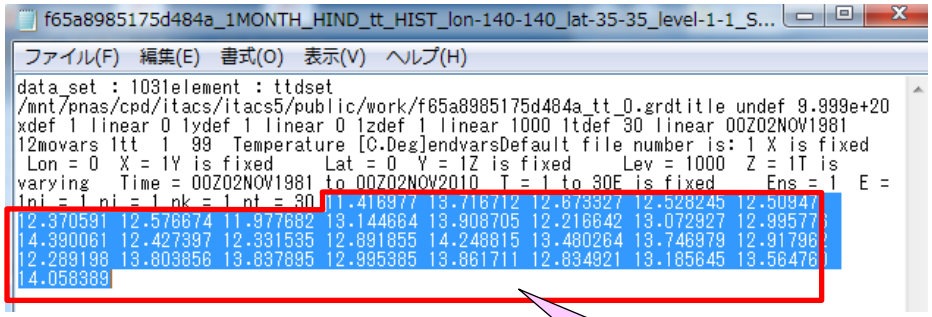
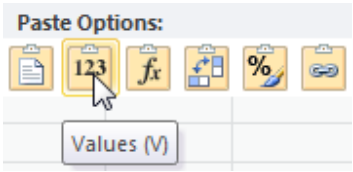
2.2 Input past observation data
(2) Get hindcast data (4 of 5)

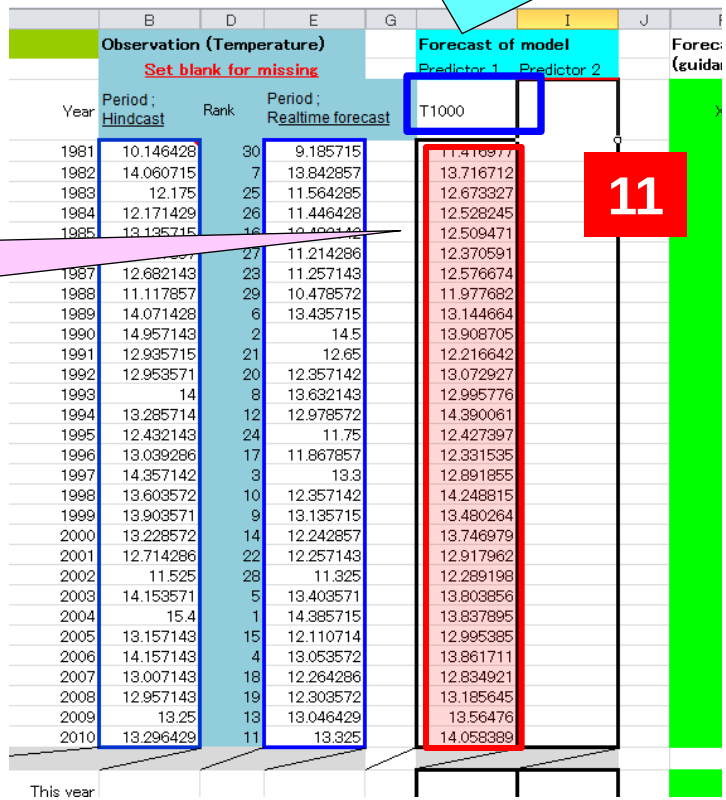
Worksheet “Calc_guidance”

(Recommendation)
The element name should be memorized (ex. T1000)



Copy and paste with paste values option



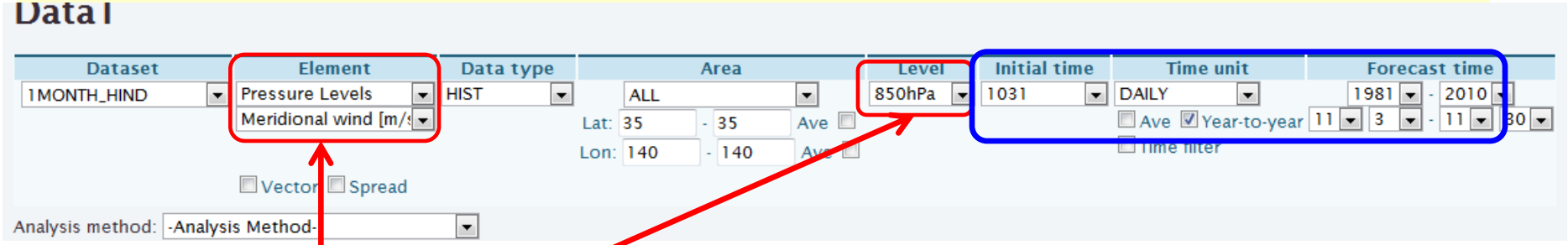


11

11. Copy and paste with the paste values option to the Predictor (1 or 2) field in the Excel file

2.2 Input past observation data
(2) Get hindcast data (5 of 5)

- Select the second predictors and paste the hindcast data



In this example, “Meridional wind at 850hPa” is selected as the second element.

	B	D	E	G	H	I	J
	Observation (Temperature)				Forecast of model		
	Set blank for missing				Predictor 1	Predictor 2	
Year	Period ; Hindcast	Rank	Period ; Realtime forecast		T1000	v850	
1981	10.146428	30	9.185715		11.416977	0.13591	
1982	14.060715	7	13.842857		13.716712	−0.330044	
1983	12.175	25	11.564285		12.673327	0.512746	
1984	12.171429	26	11.446428		12.528245	0.384438	
1985	13.135715	16	12.482142		12.509471	0.523422	
1986	12.167857	27	11.214286		12.370591	0.509626	
1987	12.682143	23	11.257143		12.576674	−0.005612	
1988	11.117857	29	10.478572		11.977682	−0.879957	
1989	14.071428	6	13.435715		13.144664	0.252846	
1990	14.957143	2	14.5		13.908705	1.24744	
1991	12.935715	21	12.65		12.216642	0.288555	
1992	12.953571	20	12.357142		13.072927	0.77095	
1993	14	8	13.632143		12.995776	0.40513	
1994	13.285714	12	12.978572		14.390061	−0.60789	
1995	12.432143	24	11.75		12.427397	−0.798494	
1996	13.039286	17	11.867857		12.331535	−0.169563	
1997	14.357142	3	13.3		12.891855	1.17955	
1998	13.603572	10	12.357142		14.248815	0.475606	

Workflow of the guidance tool

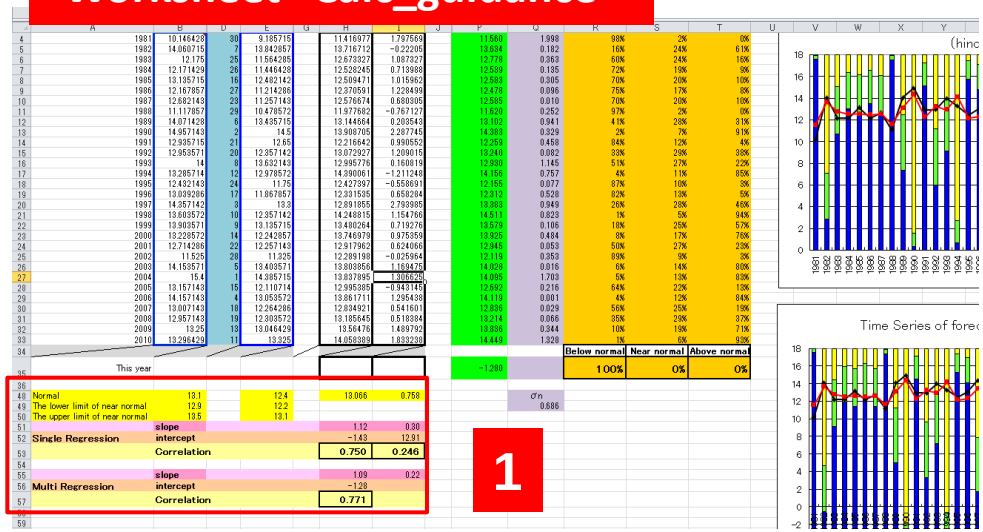
1. (Preparation)
   1. Create the past observation file (csv format)

Input of the guidance tool
(We have already prepared.)

2. (using EXCEL file and iTacs)
   1. Check the initial date and target period
   2. Production of guidance and verification
      (1) Get past observation data
      (2) Get hindcast data
      (3) Confirmation of prediction skill of guidance
   3. Application to the real-time forecast
      •Input of real-time forecast of model
      Obtaining solution of probabilistic forecast by the guidance

2.2 Input past observation data
(3) Confirmation of prediction skill of guidance (1 of 3)

Worksheet "Calc_guidance"



1

Normal		13.1	12.4	13.066	0.176
The lower limit of near normal		12.9	12.2		
The upper limit of near normal		13.5	13.1		
	slope			1.12	0.66
Single Regression	intercept			−1.43	13.02
	Correlation			**0.750**	**0.370**
	slope			1.04	0.33
Multi Regression	intercept			−0.54	
	Correlation			**0.771**	

1. Check up correlation

✓ Whether the correlation score of multi-regression better than that of single-regression?

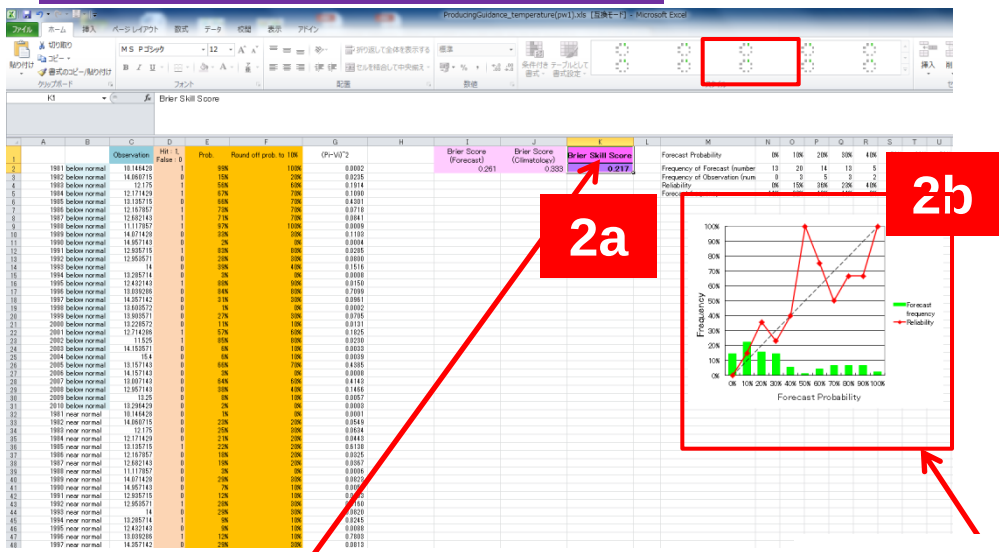
Correlation with the single-regression (predictor-1,-2, respectively)

Correlation of guidance (multi-regression)

Closer to 1 (preferably)

2.2 Input past observation data
(3) Confirmation of prediction skill of guidance (2 of 3)

Worksheet "Verification"



Brier Skill Score

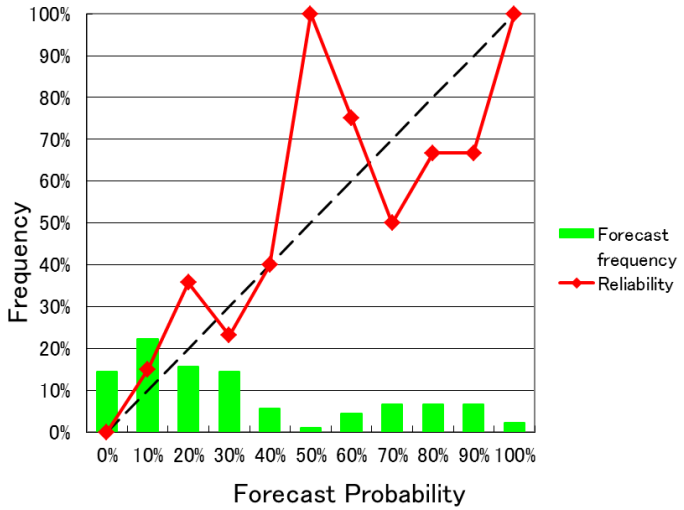
0.217

2. Check up probabilistic verification

(2a) BSS (preferable >0)

(2b) reliability diagram

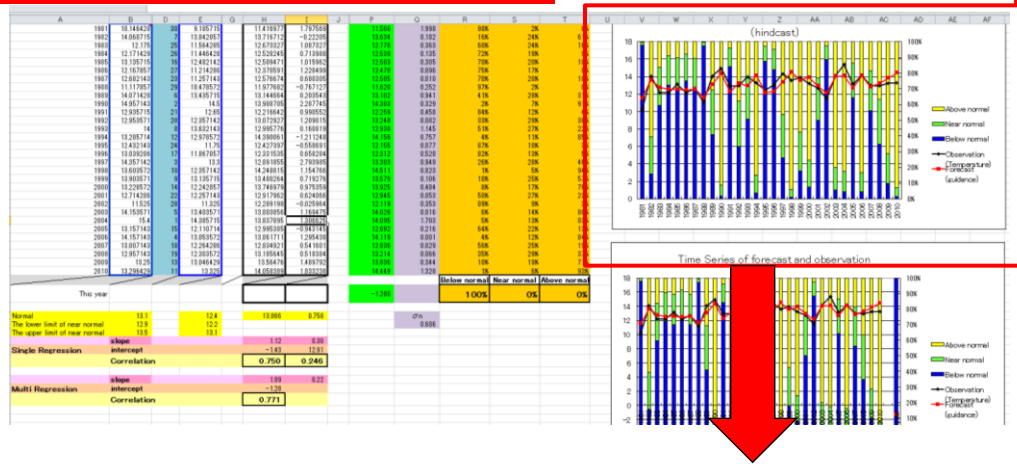
✓ Whether the reliability curve has a positive slope?



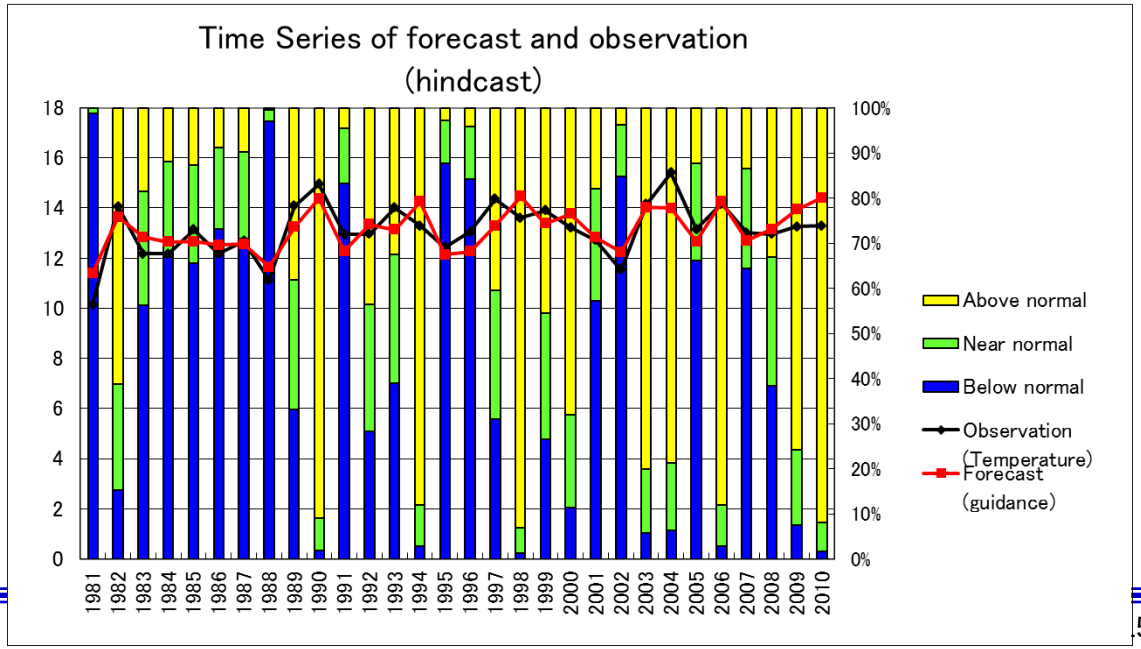
2.2 Input past observation data
(3) Confirmation of prediction skill of guidance (3 of 3)

Worksheet "Calc_guidance"

3



3. Check up prediction result for the noticeable year



Example;
Cool year; 1988, 2002
Warm year; 1990, 2004

The above cases are well predicted.

An example

Prediction skill of guidance

Objective variable	Temperature
Predictors	1000 hPa temperature 850hPa meridional wind
Correlation	0.771
Brier Skill Score	0.217

- Check up the skill of guidance selected two elements (predictors)
- Look for the more effective combination of variables

Hint; Recommended combination of predictors

◆(Forecast of temperature)

- One predictor is selected among **temperature**
  - Lower troposphere temperature (1000, 925, 850 hPa) or surface temperature
  - As for the island point, to avoid using surface temp. might be better (i.e. using 925, 850hPa temp.).
- Another predictor is selected except for temperature, such as **wind, TTD**.
  - ✓In statistics, if two or more predictor variables in a multiple-regression are remarkably correlated, reliability of regression analysis become poor (multicollinearity).

Example;
(o) T1000 and V850, (x) T1000 and Tsurface

Hint; Recommended combination of predictors

◆(Forecast of precipitation)

- One predictor is selected **precipitation**
- Another predictor is selected depending on regionality

Example;
•Temperature or geopotential height in consideration of temperature-precipitation correlation
•Lower wind (U or V) in consideration of terrain condition

Workflow of the guidance tool

1. (Preparation)
   1. Create the past observation file (csv format)

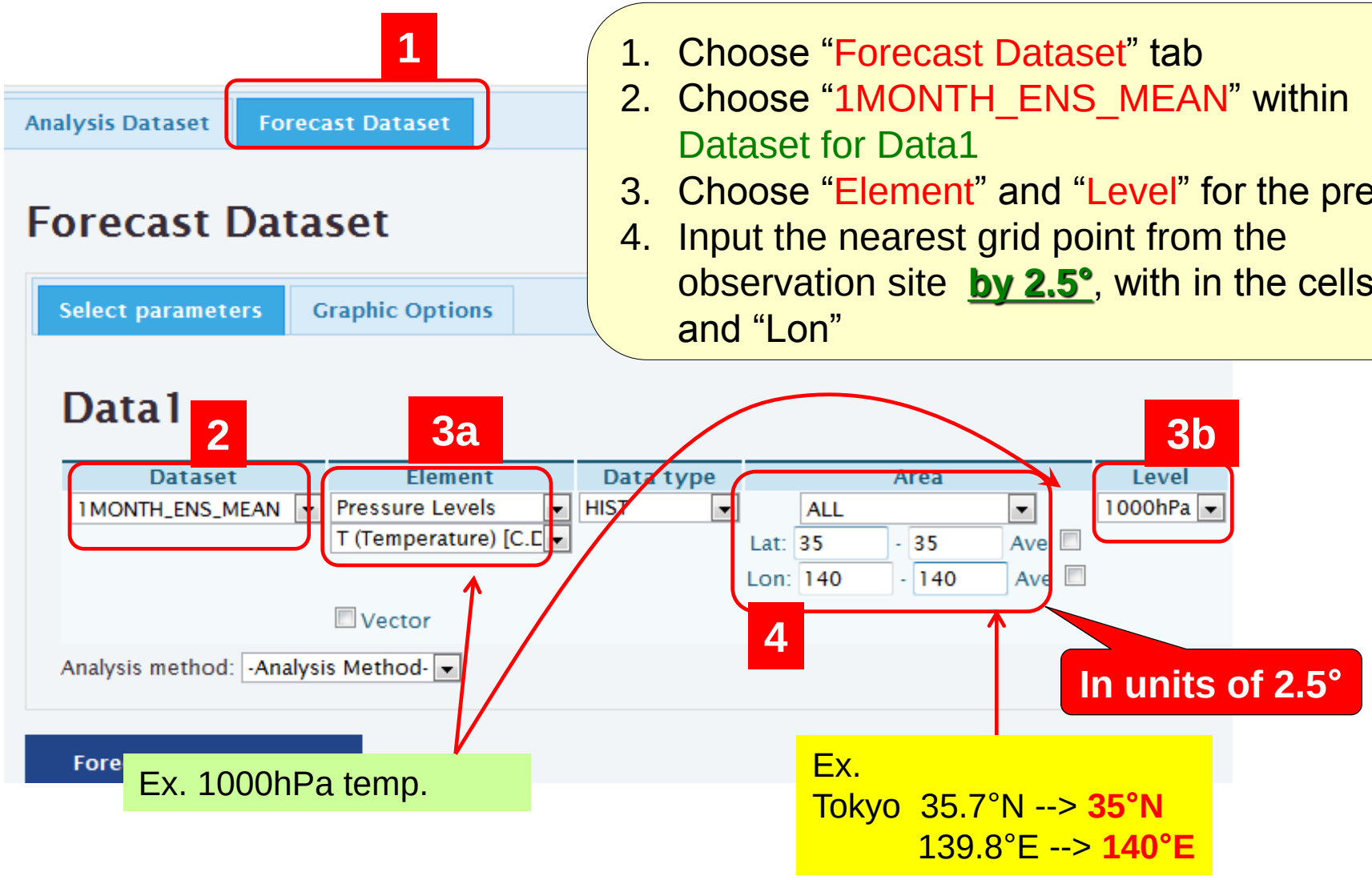
Input of the guidance tool
(We have already prepared.)

2. (using EXCEL file and iTacs)
   1. Check the initial date and target period
   2. Production of guidance and verification
      (1) Get past observation data
      (2) Get hindcast data
      (3) Confirmation of prediction skill of guidance
   3. Application to the real-time forecast
      •Input of real-time forecast of model
      Obtaining solution of probabilistic forecast by the guidance

3 Application to the real-time forecast (1 of 5)

iTacs

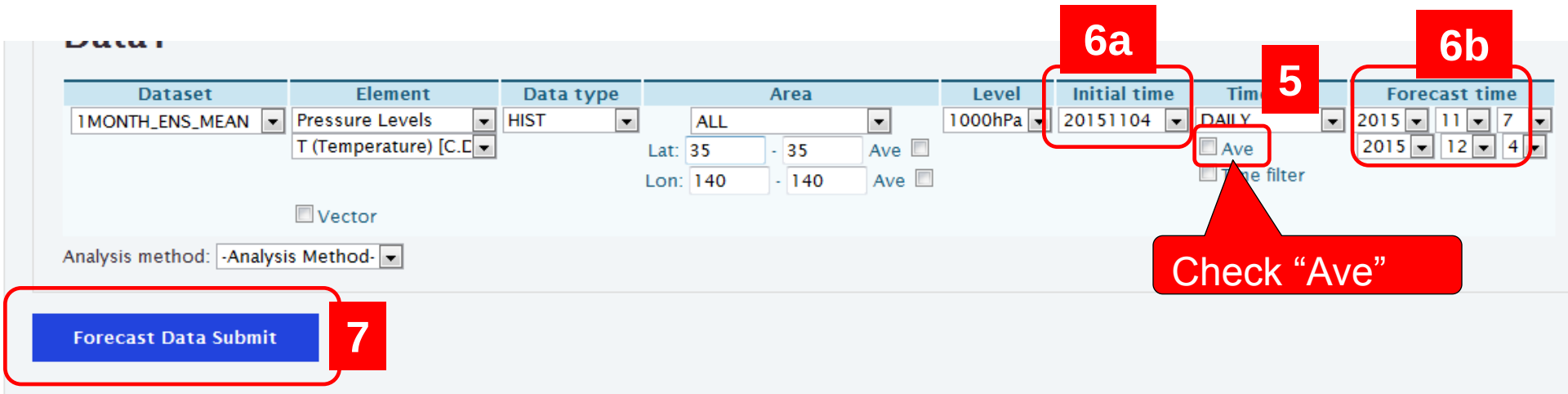
1. Choose “Forecast Dataset” tab
2. Choose “1MONTH_ENS_MEAN” within Dataset for Data1
3. Choose “Element” and “Level” for the predictor
4. Input the nearest grid point from the observation site **by 2.5°**, with in the cells “Lat” and “Lon”



3 Application to the real-time forecast (2 of 5)

iTacs

5. Click to check the box “Ave” within Time unit
6. Set target period for forecast
7. Click “**Forecast Data Submit**”

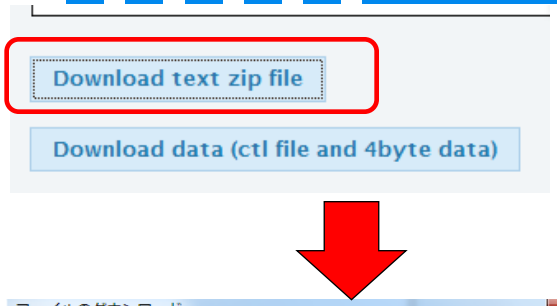


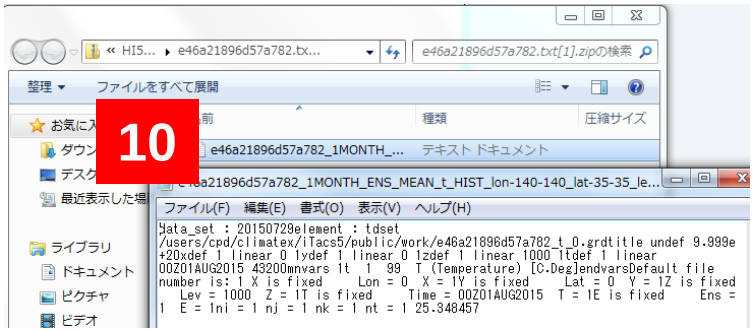
	Hindcast	Real-time forecast
Initial time	31 Oct	4 Nov 2015
Target period	3 to 30 Nov.	7 Nov to 4 Dec 2015

3 Application to the real-time forecast (3 of 5)

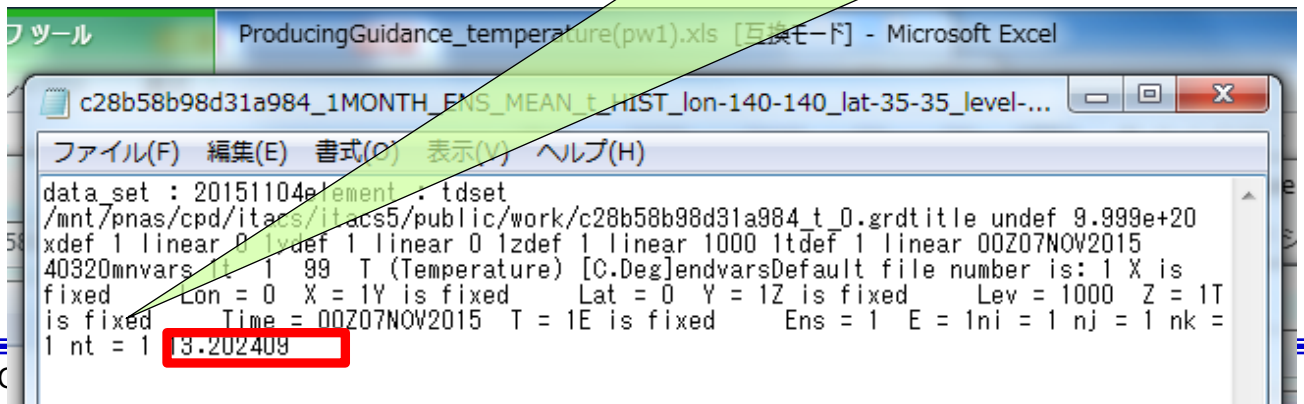
iTacs

8. Click “Download text zip file”
9. Download the text file
10. Open the downloaded text file





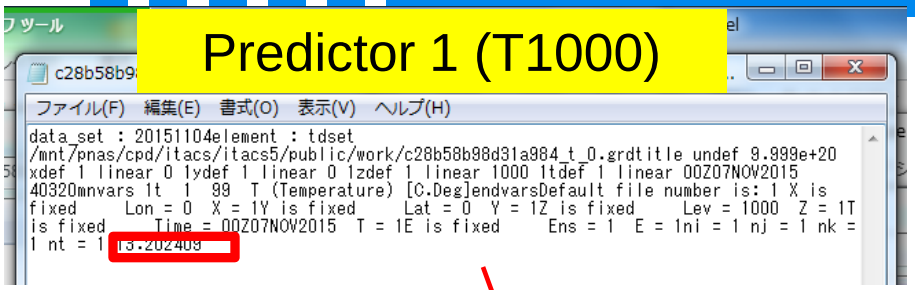
Forecast value is described atfer “nt = 1”.



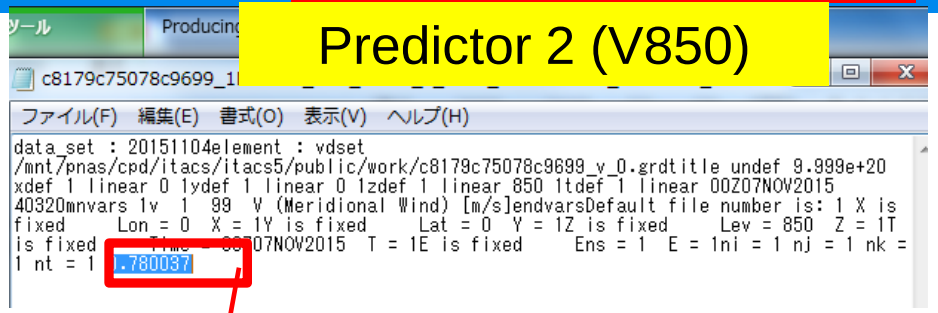
3 Application to the real-time forecast (4 of 5)

Worksheet “Calc_guidance”

Predictor 1 (T1000)



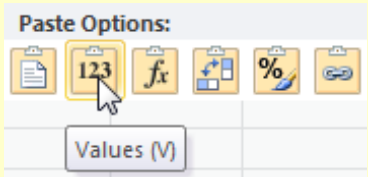
Predictor 2 (V850)



2001	12.714286	22	12.257143	12.917962	0.624066
2002	11.525	28	11.325	12.289198	-0.025964
2003	14.153571	5	13.403571	13.803856	1.169475
2004	15.4	1	14.385715	13.837895	1.306625
2005	13.157143	15	12.110714	12.995385	-0.943145
2006	14.157143	4	13.053572	13.861711	1.295438
2007	13.007143	18	12.264286	12.834921	0.541601
2008	12.957143	19	12.303572	13.185645	0.518384
2009	13.25	13	13.046429	13.56476	1.489792
2010	13.296429	11	13.325	14.058389	1.833238
				13.202409	0.780037

11a **11b**

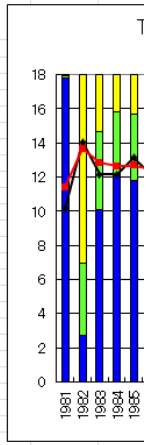
11. Copy and paste with the paste values option to the Predictor (1 or 2) field in the Excel file

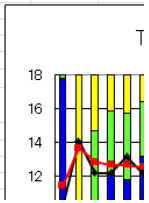


3 Application to the real-time forecast (5 of 5)

Worksheet “Calc_guidance”

	A	B	D	E	G	H	I	J	P	Q	R	S	T	U	V	W
1		Observation (Temperature)				Forecast of model			Forecast	square error	Probabilistic Forecast					
2		Set blank for missing				Predictor 1	Predictor 2		(guidance)		N(Xs, σn)	N(Xs, σn)	N(Xs, σn)			
3	Year	Period ; Hindcast	Rank	Period ; Realtime forecast		T1000	v850		Xs	σn^2	Below normal	Near normal	Above normal			
4	1981	10.146428	30	9.185715		11.416977	0.135911		11.403	1.578	99%	1%	0%			
5	1982	14.060715	7	13.842857		13.716712	-0.330044		13.646	0.172	15%	23%	61%			
6	1983	12.175	25	11.564285		12.673327	0.512746		12.837	0.438	56%	25%	19%			
7	1984	12.171429	26	11.446428		12.528245	0.384438		12.643	0.223	67%	21%	12%			
8	1985	13.135715	16	12.482142		12.509471	0.523422		12.670	0.217	66%	22%	13%			
9	1986	12.167857	27	11.214286		12.370591	0.509626		12.520	0.124	73%	18%	9%			
10	1987	12.682143	23	11.257143		12.576674	-0.005612		12.565	0.014	71%	19%	10%			
11	1988	11.117857	29	10.478572		11.977682	-0.879957		11.652	0.285	97%	3%	0%			
12	1989	14.071428	6	13.435715		13.144664	0.252846		13.242	0.687	33%	29%	38%			
13	1990	14.957143	2	14.5		13.908705	1.24744		14.367	0.348	2%	7%	91%			
14	1991	12.935715	21	12.65		12.216642	0.288555		12.287	0.421	83%	12%	4%			
15	1992	12.953571	20	12.357142		13.072927	0.770951		13.339	0.148	28%	28%	44%			
16	1993	14	8	13.632143		12.995776	0.40513		13.137	0.744	39%	29%	32%			
17	1994	13.285714	12	12.978572		14.390061	-0.60789		14.256	0.942	3%	9%	88%			
18	1995	12.432143	24	11.75		12.427397	-0.798494		12.147	0.081	88%	9%	3%			
19	1996	13.039286	17	11.867857		12.331535	-0.169563		12.255	0.615	84%	12%	4%			
20	1997	14.357142	3	13.3		12.891855	1.179551		13.285	1.150	31%	29%	40%			
21	1998	13.603572	10	12.357142		14.248815	0.475606		14.467	0.745	1%	6%	93%			
22	1999	13.903571	9	13.135715		13.480264	-0.406816		13.374	0.280	27%	28%	46%			
23	2000	13.228572	14	12.242857		13.746979	-0.048611		13.771	0.294	11%	21%	68%			
24	2001	12.714286	22	12.257143		12.917962	-0.31432		12.819	0.011	57%	25%	18%			
25	2002	11.525	28	11.325		12.289198	-0.086853		12.238	0.509	85%	11%	4%			
26	2003	14.153571	5	13.403571		13.803856	0.548405		14.027	0.016	6%	14%	80%			
27	2004	15.4	1	14.385715		13.837895	0.350808		13.997	1.968	6%	15%	79%			
28	2005	13.157143	15	12.110714		12.995385	-1.046584		12.658	0.250	66%	21%	12%			
29	2006	14.157143	4	13.053572		13.861711	1.061383		14.257	0.010	3%	9%	88%			
30	2007	13.007143	18	12.264286		12.834921	-0.435827		12.692	0.099	64%	22%	13%			
31	2008	12.957143	19	12.303572		13.185645	-0.159032		13.149	0.037	38%	29%	33%			
32	2009	13.25	13	13.046429		13.56476	1.010597		13.930	0.463	8%	17%	76%			
33	2010	13.296429	11	13.325		14.058389	0.913254		14.413	1.2						
34											Below normal	Near normal	Above normal			
35	This year					13.202409	0.780037		13.477		3%	24%	73%			
36																
48	Normal	13.1		12.4		13.066	0.176			σn						
49	The lower limit of near normal	12.9		12.2						0.686						
50	The upper limit of near normal	13.5		13.1												
51		slope				1.12	0.66									





Below normal	Near normal	Above normal
3%	24%	73%

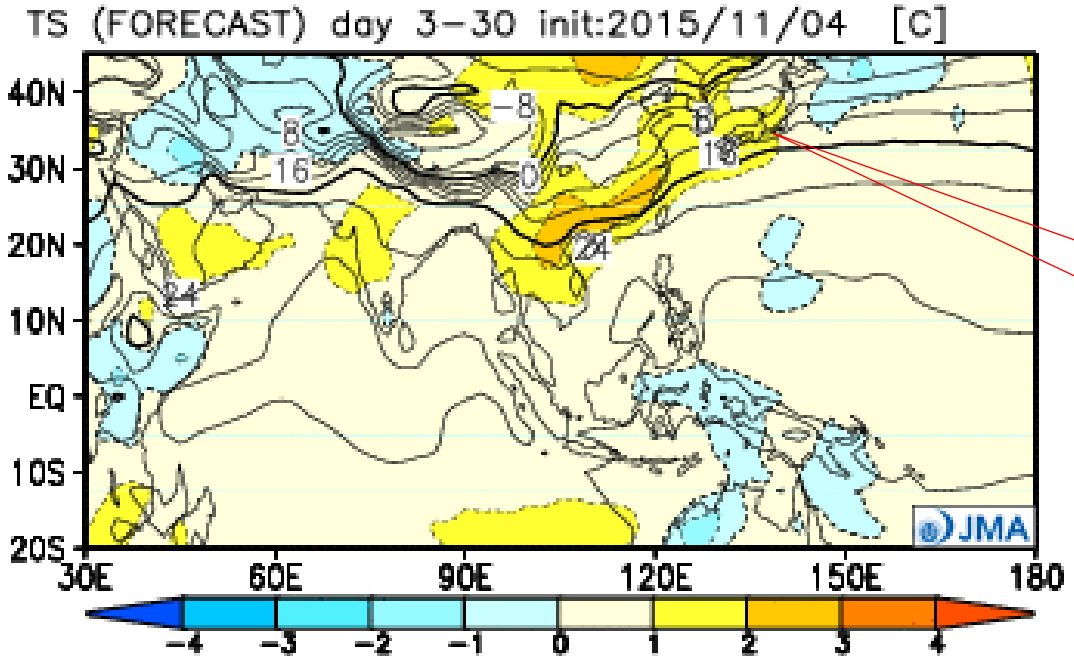
(Output)
Probabilities by guidance for real-time forecast

Confirmation of the output guidance

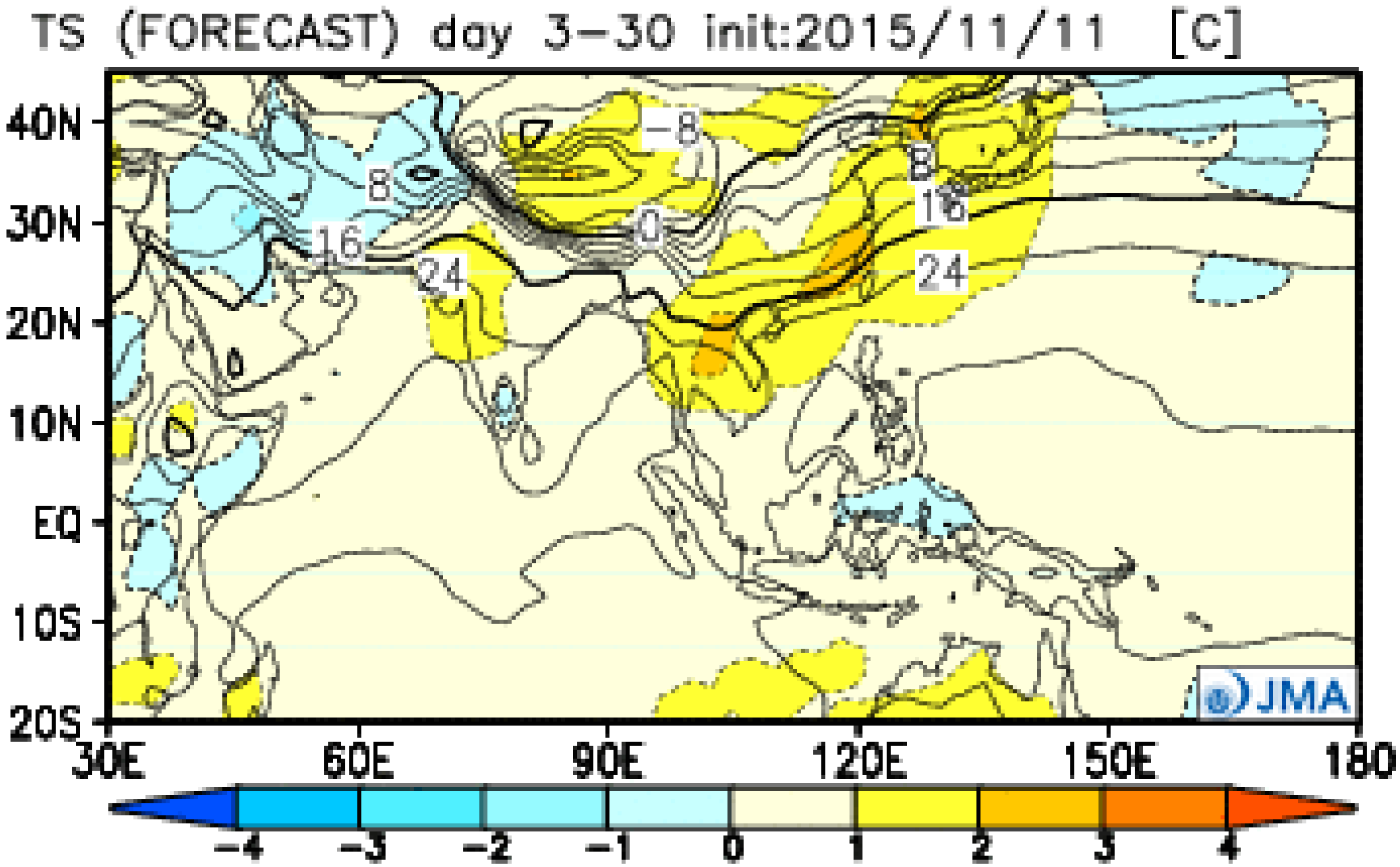
✓ In order to validate the output of guidance, it is recommended that the output of the guidance is compares with forecast of model.

◆Forecast map

➢http://ds.data.jma.go.jp/gmd/tcc/tcc/products/model/index.html



Positive anomalies are predicted around Tokyo


TS (FORECAST) day 3-30 init:2015/11/11 [C]
40N
30N
20N
10N
EQ
10S
20S
30E
60E
90E
120E
150E
180
-8
8
16
24
0
JMA
-4
-3
-2
-1
0
1
2
3
4