気象庁
Japan Meteorological Agency

TCC Seminar on Climate System Monitoring
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Operation of iTacs

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Goals of this lecture

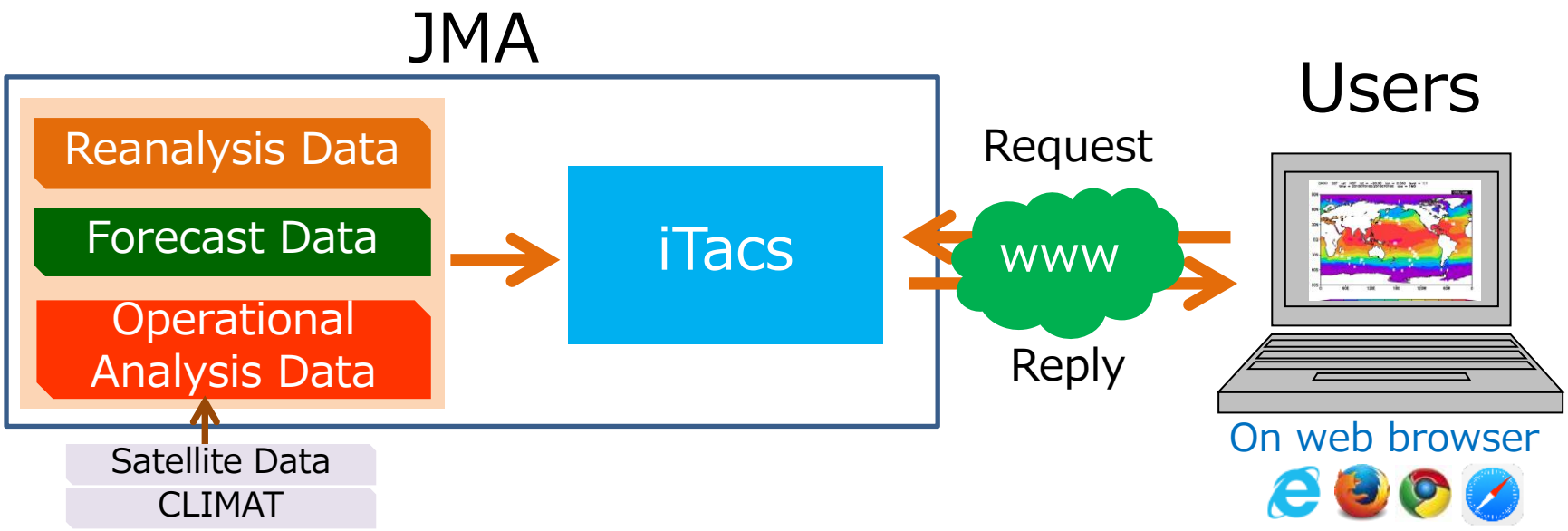
- To understand what is iTacs.
- To understand the basic concept and operation.
- To draw some figures such as …
  - 2D-map (Latitude-Longitude map)
  - Time series
  - Cross section (vertical, Hovmöller diagram etc.)
  - Statistical analysis
- To make a *physical interpretation* of the map made by iTacs.

Basic operation of iTacs

Contents

What's iTacs?

- It stands for "Interactive Tool for Analysis of the Climate System".
- Available on web browsers through GUI. No additional software or plug-ins are required.
- Persons at NMHS can use iTacs with personal IDs.

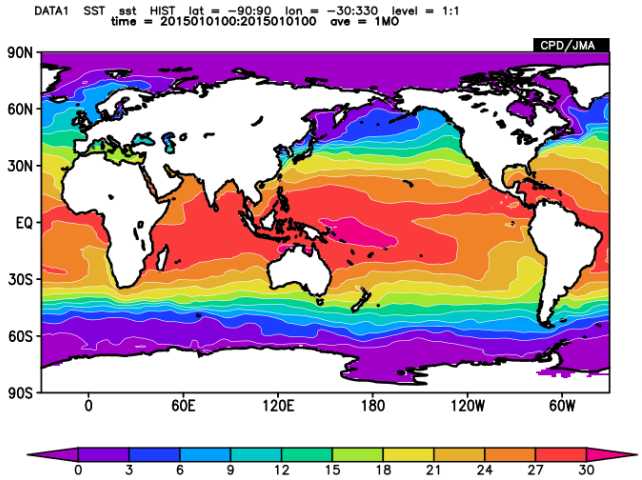


Available data

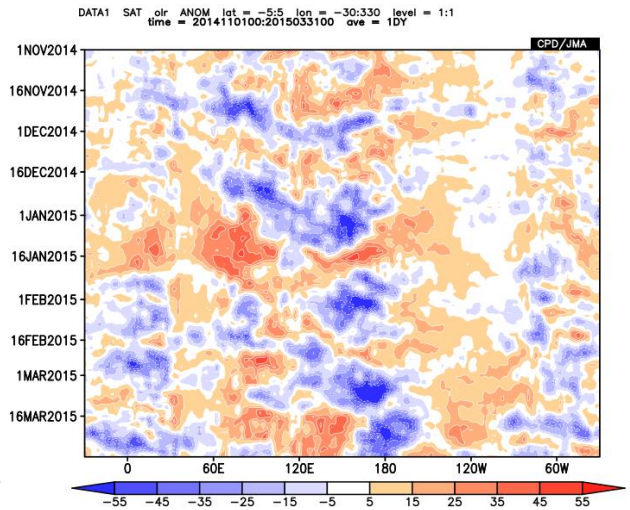
- Atmospheric analysis data
  - The Japanese 55-year Reanalysis (**JRA-55**) since 1958
  - Outgoing longwave radiation (OLR) data provided by NOAA since 1979 (**SAT**)
- Oceanic analysis data
  - Sea surface temperature data by COBE-SST since 1891 (**SST**)
  - Oceanographic condition analyzed by MOVE/MRI.COM-G2 since 1958 (**MOVE-G2**)
- Forecast data
  - Outputs of JMA's one-month prediction model
- Others
  - Major SST Indices, **CLIMAT** reports, and user-input data (CSV format)

Samples of charts

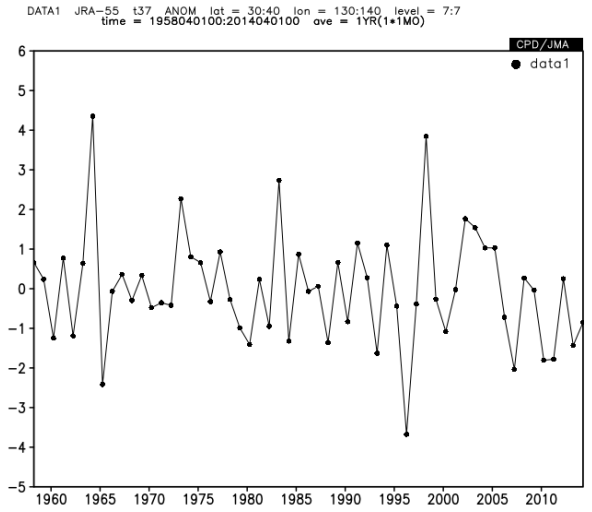
- Various types of charts and statistical evaluation are available.



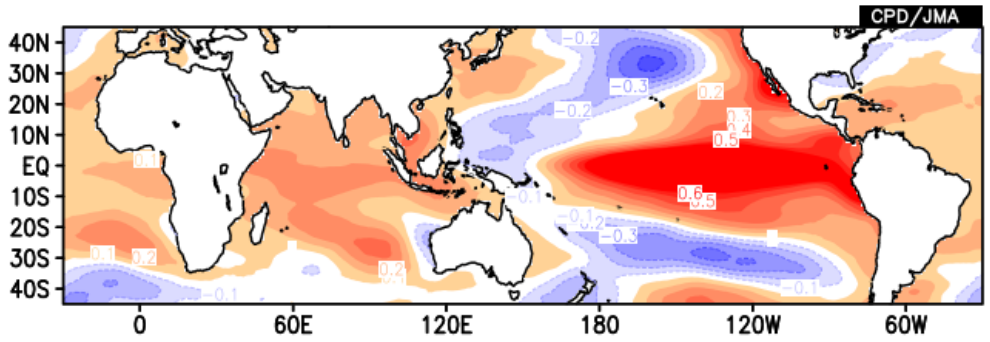
2-D map



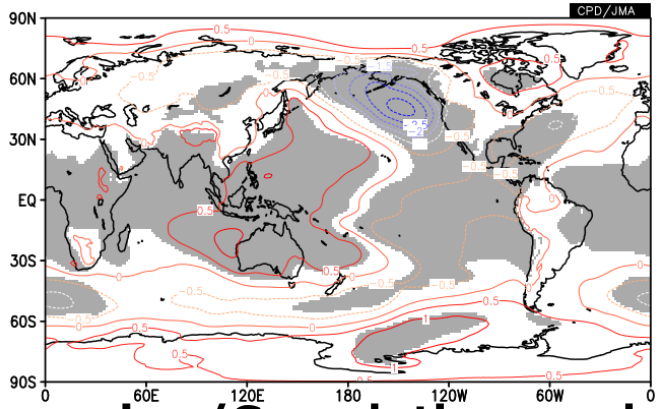
Longitude-time cross section diagram



Time series graph



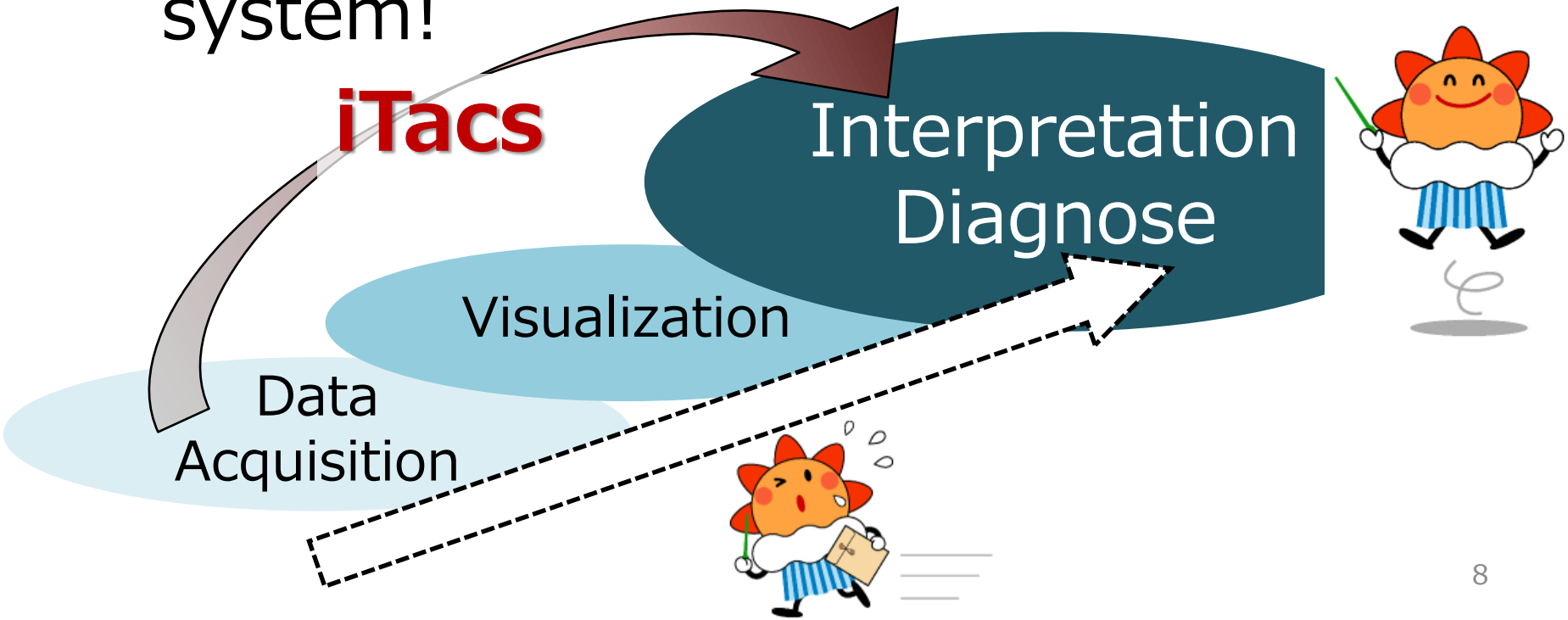
EOF analysis



Regression/Correlation analysis

What's iTacs?

- iTacs is one of the most useful tool and it will strongly help you in the climate system monitoring.
- It costs less time to visualize the data, more time to diagnose the climate system!



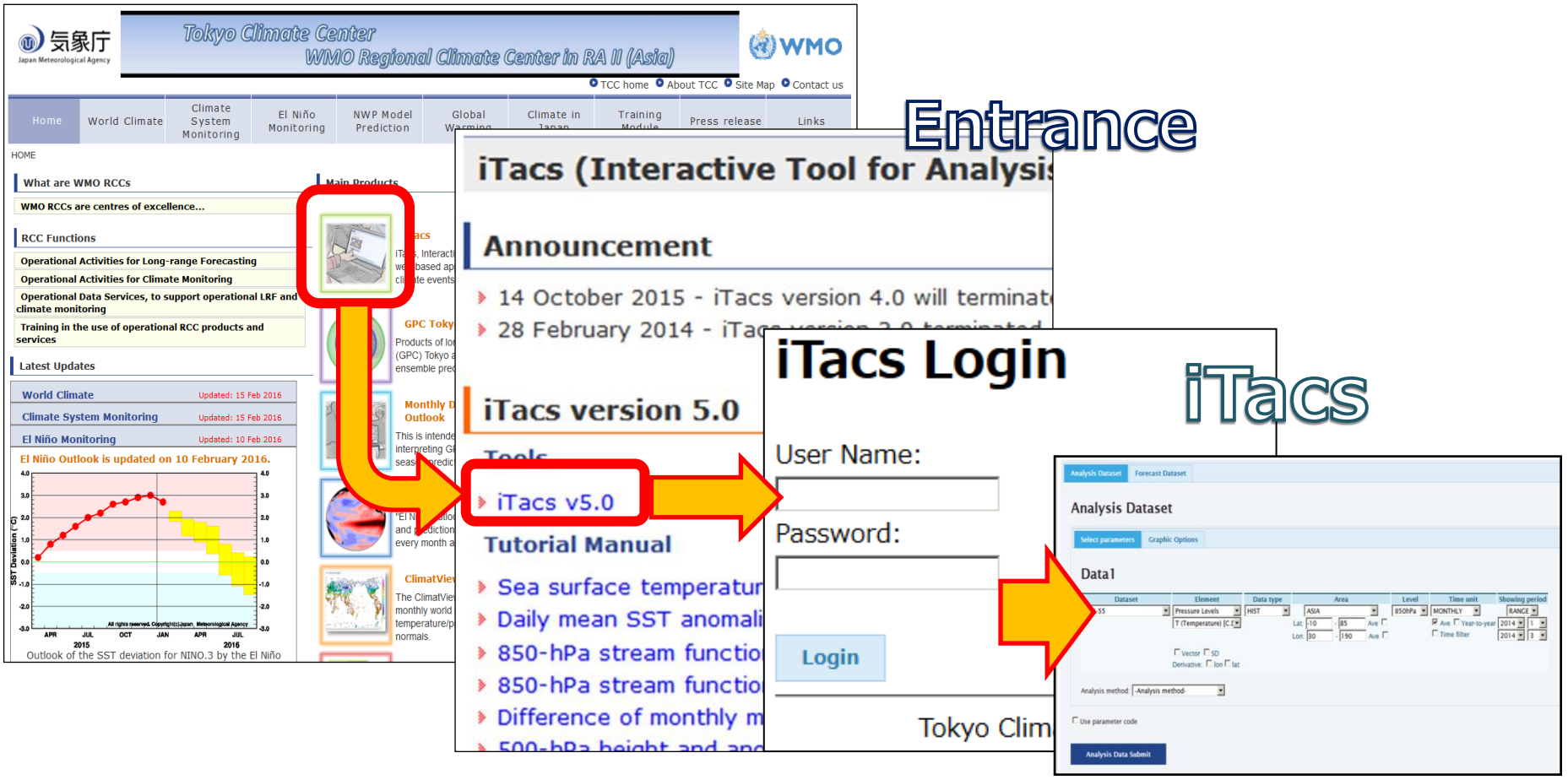
Contents

1. What's iTacs?
2. Application for using iTacs
3. Basic operations
   - Longitude-latitude map
   - Overlaying two data
   - Mapping the difference of two data
4. Advanced operations
   - Area-averaged time series
   - Vertical and latitude/longitude profile
   - Cross section diagram
   - Time filter

Application for using iTacs

- Registered users can access iTacs at the Tokyo Climate Center (TCC) website.

TCC website (http://ds.data.jma.go.jp/tcc/tcc/index.html)



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Standard procedure (1)

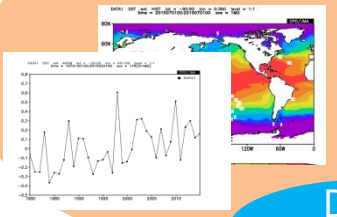
Select Analysis or Forecast dataset

Setting Data parameters

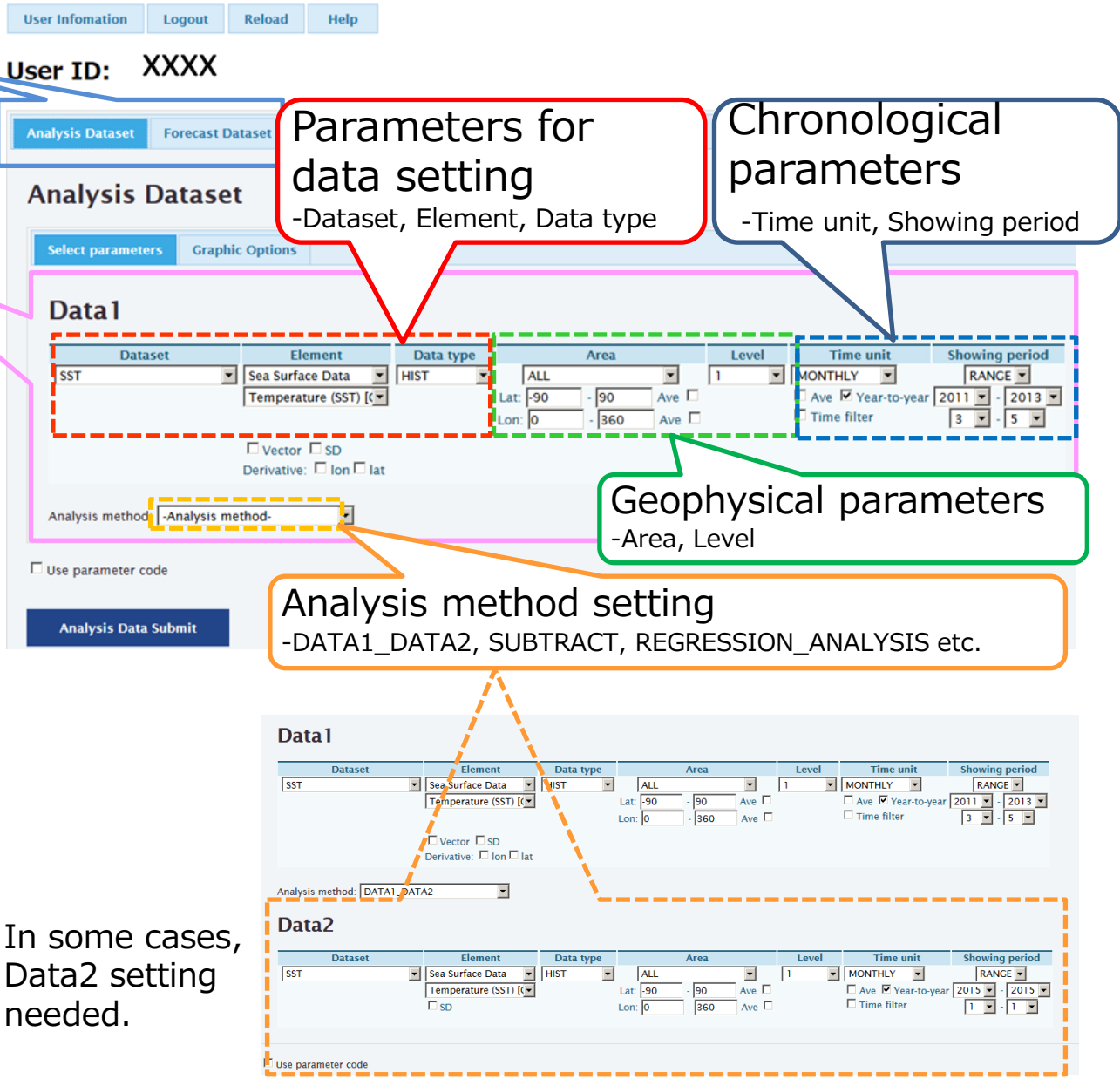
Setting Graphic Options

Data Submit

Draw map



Data download



In some cases, Data2 setting needed.

Standard procedure (2)

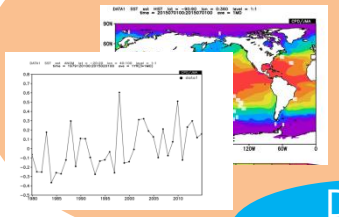
Select Analysis or Forecast dataset

Setting Data parameters

Setting Graphic Options

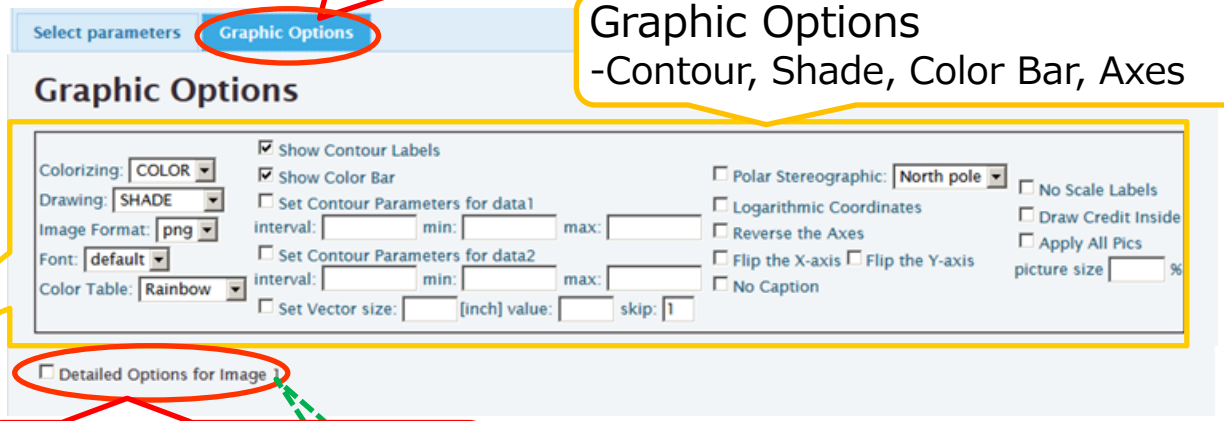
Data Submit

Draw map



Data download

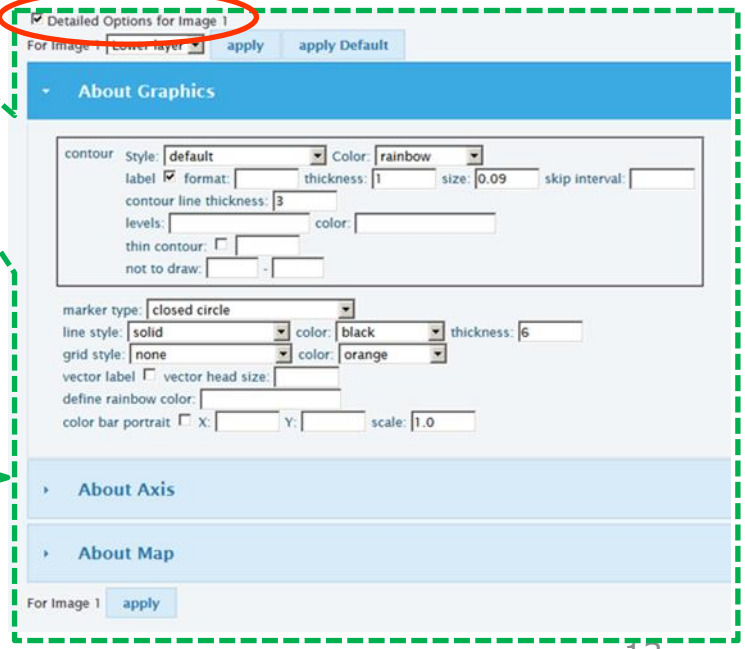
Select this tab



Graphic Options
-Contour, Shade, Color Bar, Axes

Check here, Detailed Options field are shown

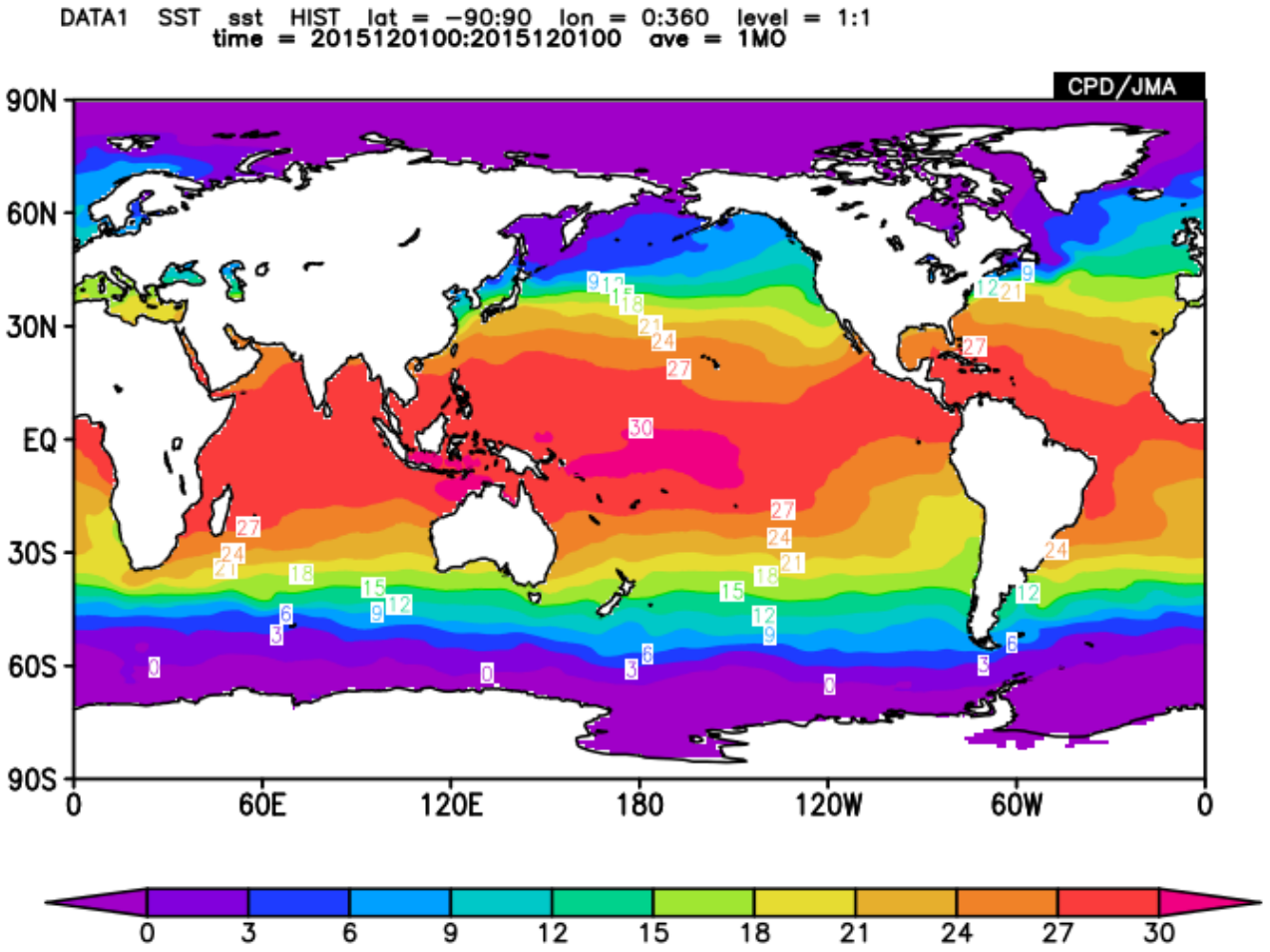
Analysis Data Submit



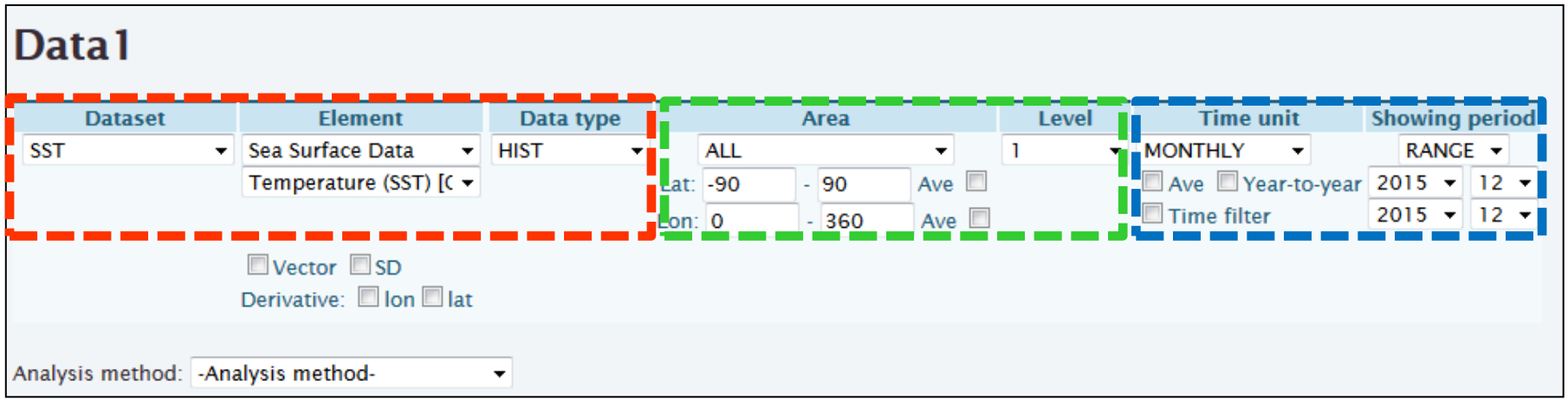
Detailed Options for Image x
-Graphics, Axis, Map

Latitude-longitude map (1)

- Let's chart monthly sea surface temperature (SST) in December 2015.

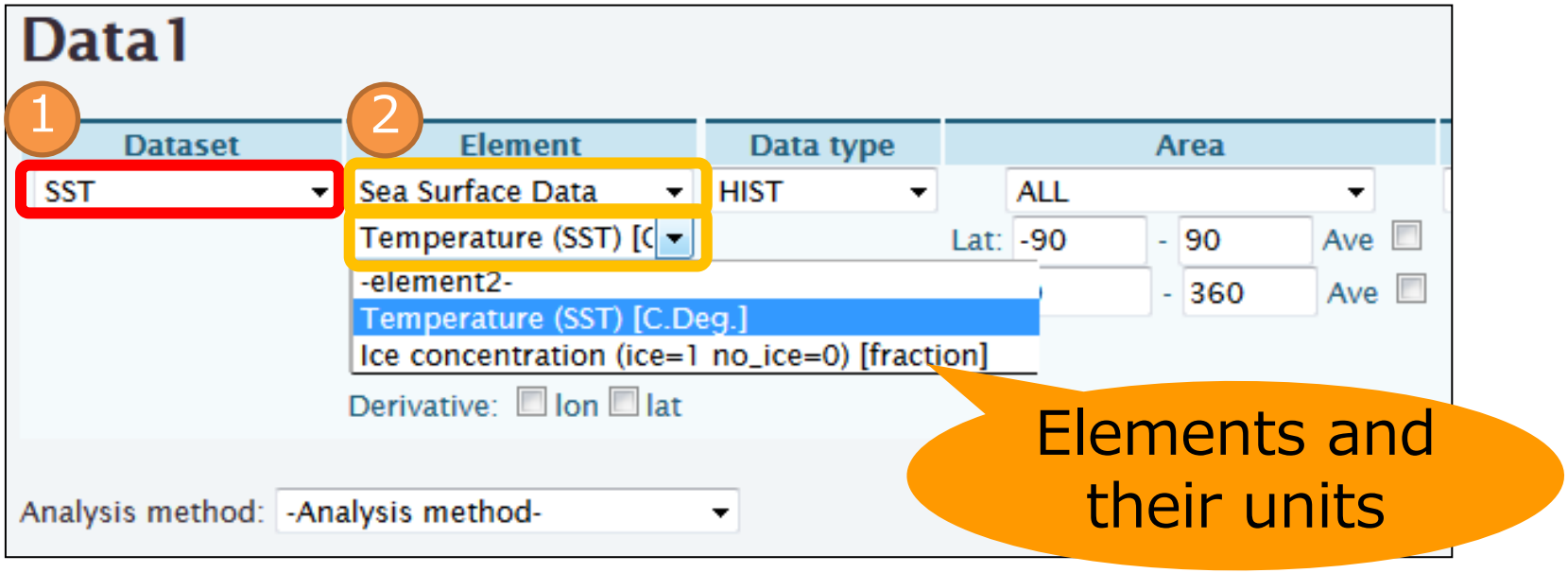


Latitude-longitude map (2)



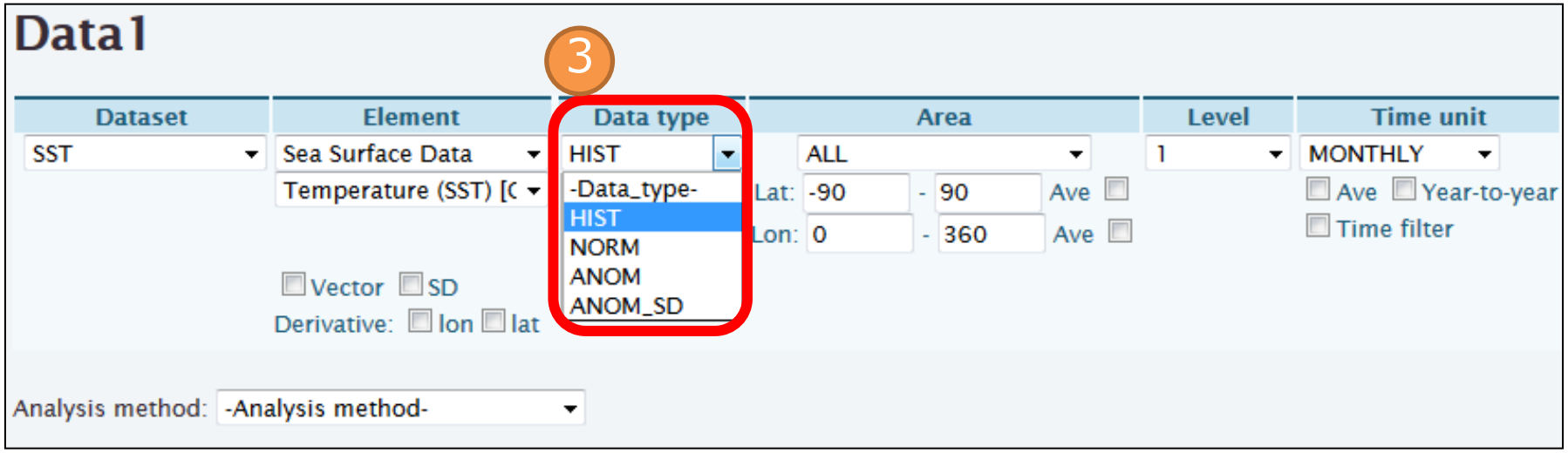
- Set each item in “Data1” as follows.
  - Dataset SST
  - Element Sea Surface Data > Temperature (SST)
  - Data type HIST (meaning historical data)
  - Area ALL
  - Level 1 (i.e. surface data)
  - Time unit MONTHLY
  - Showing period “RANGE”; 2015 12; 2015 12

Latitude-longitude map (3)



1. Select “SST” in the “dataset” field.
   - Various datasets are available;
     CLIMAT, INDEX, JRA-55, K1EM, OCEAN-DATA, SAT, SST, USER-INPUT etc.
2. Select “Sea Surface Data“ for “element1” and “Temperature” for “element2”.
   - Available elements and their units will be shown in a listbox.

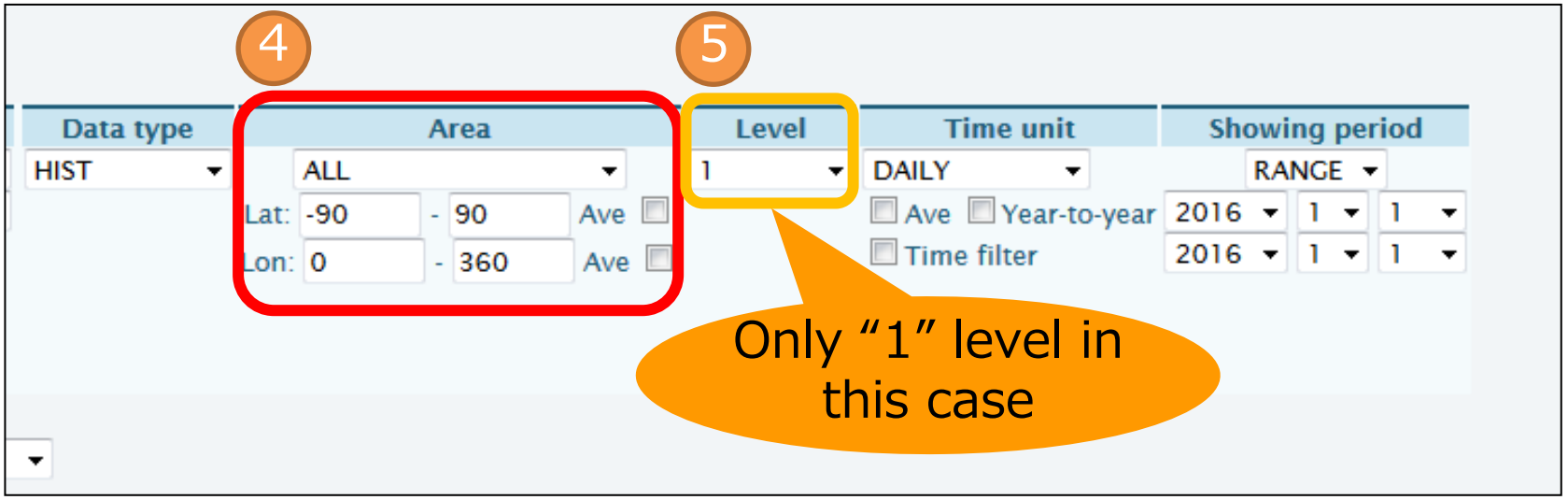
Latitude-longitude map (4)



3. Select “HIST” for “Data type” .
   Available options are as follows:

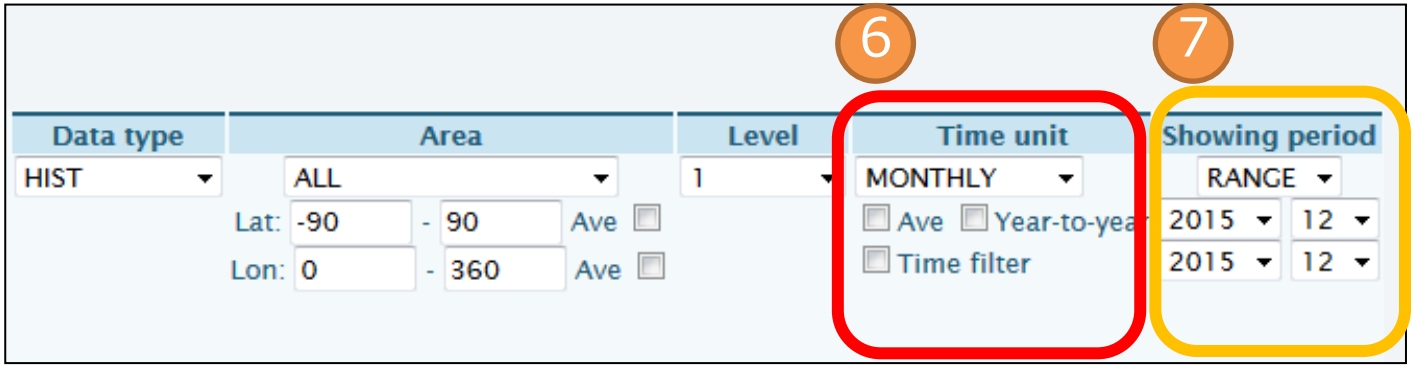
- **HIST** : Historical actual analysis or observation data.
- **NORM** : Climatological normal data (averaged from 1981 to 2010).
- **ANOM** : Anomaly data (HIST – NORM: difference from the climatological normal)
- **ANOM_SD** : Anomaly data normalized by their standard deviations.

Latitude-longitude map (5)



4. Select “ALL” for “Area” .
   - You can set/change the area more precisely with setting boxes.
5. Select “1” for “Level” .
   - Options in the “level” menu will change depending on your selection of “element”.

Latitude-longitude map (6)

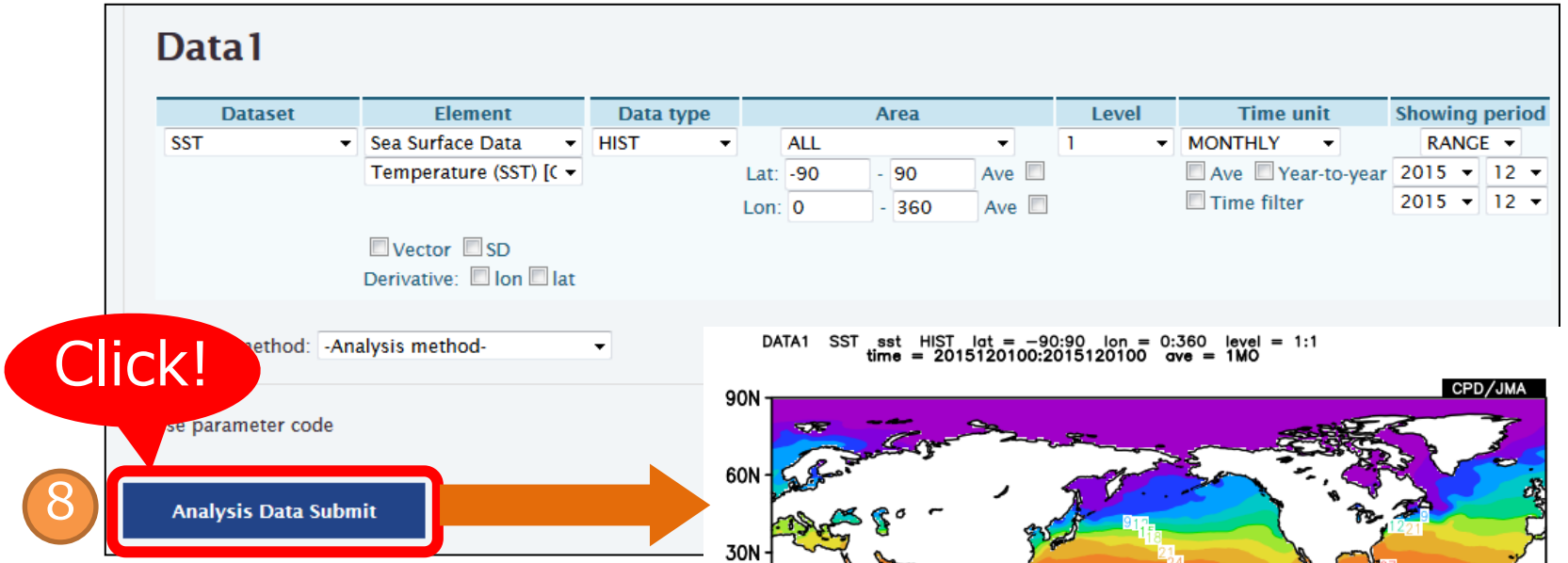


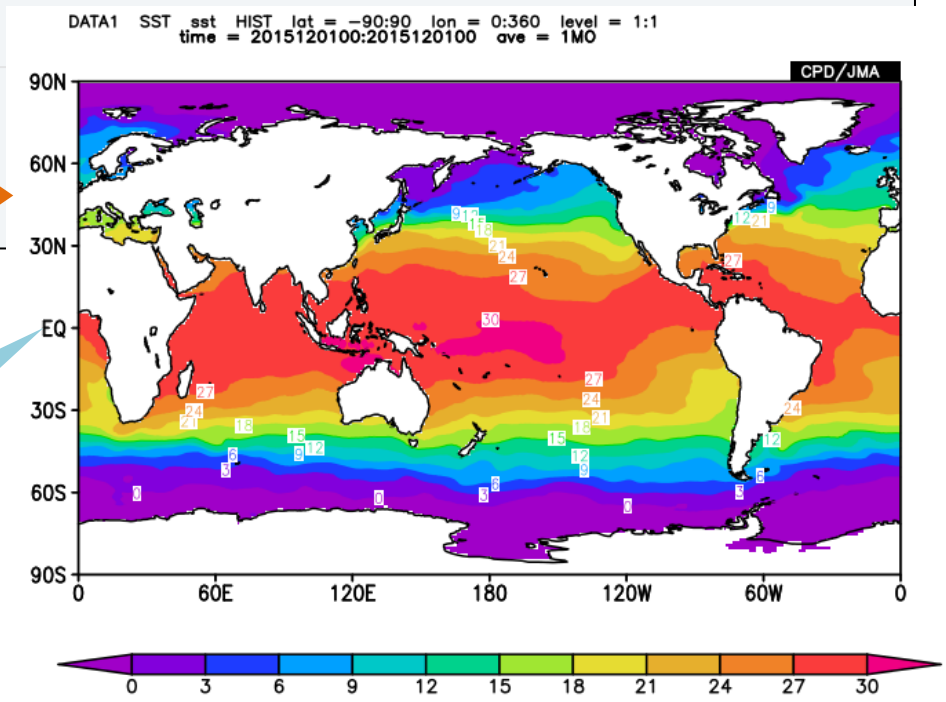
6. Select “MONTHLY” for “Time unit” .
   - There are several styles for range selection: **DAILY, PENTAD DAY, MONTHLY** and **ANNUAL**
7. Select “RANGE” for “Showing period” and “2015 12”, for both upper and lower boxes (left box: year, right box: month).

   Available options are as follows:
   - **RANGE**: Setting the start and end points of the targeted time period.
   - **YEARS**: Setting individual years.
   - **INDEX**: Setting a SST index border to pick up years. (e.g. NINO.3)

Latitude-longitude map (7)

8. Finally, click the “Analysis Data Submit” button and the image will be displayed.

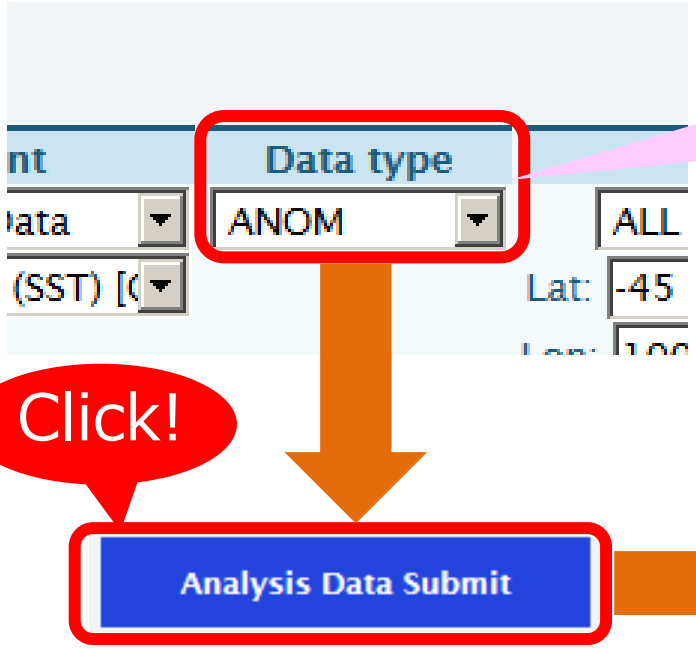




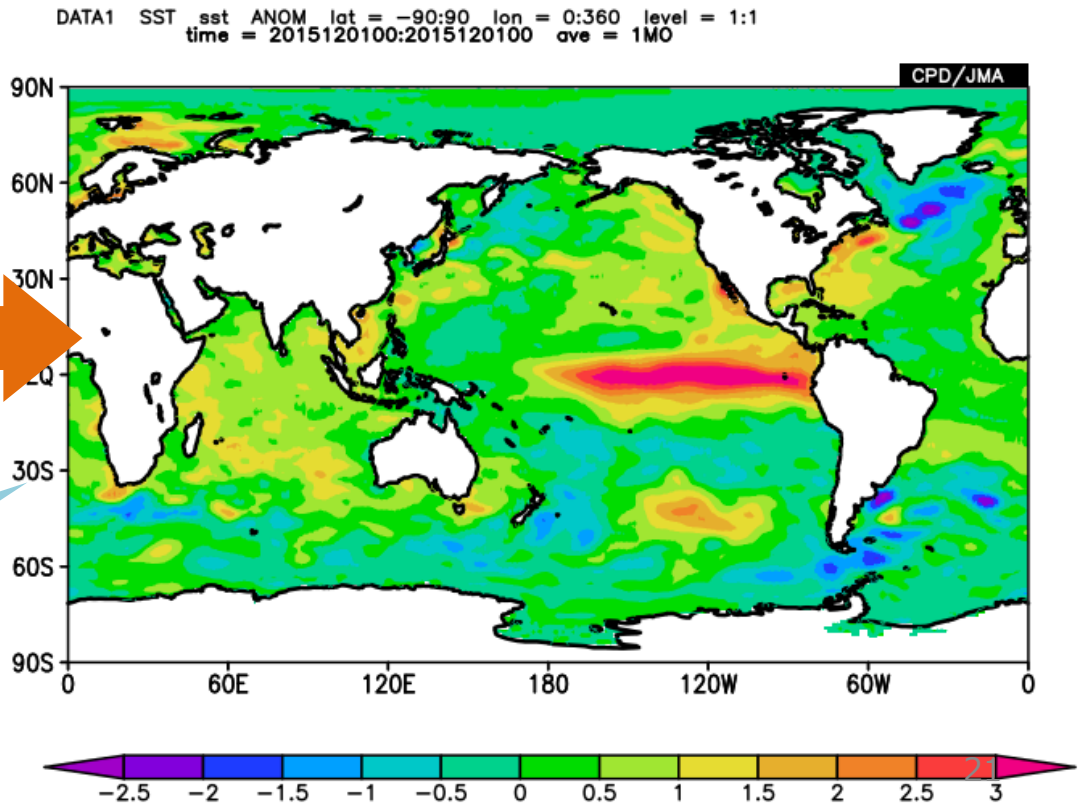
SST in December 2015

Anomaly chart (1)

- You can draw anomaly (i.e. the difference from the climatological normal) chart.



Select “Data type” “ANOM”
Anomaly data (HIST minus NORM)

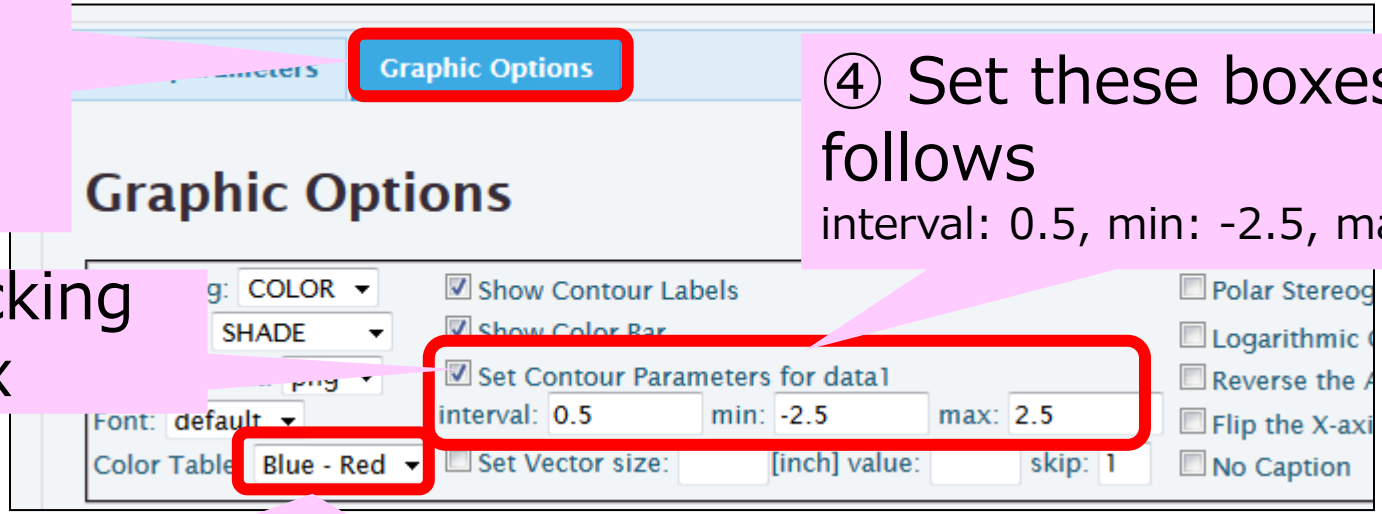


SST anomalies in December 2015

Anomaly chart (2)

- Changing **intervals for contour/shading**, you can easily see the above- and below-normal SST areas.

① Click "Graphic Options"



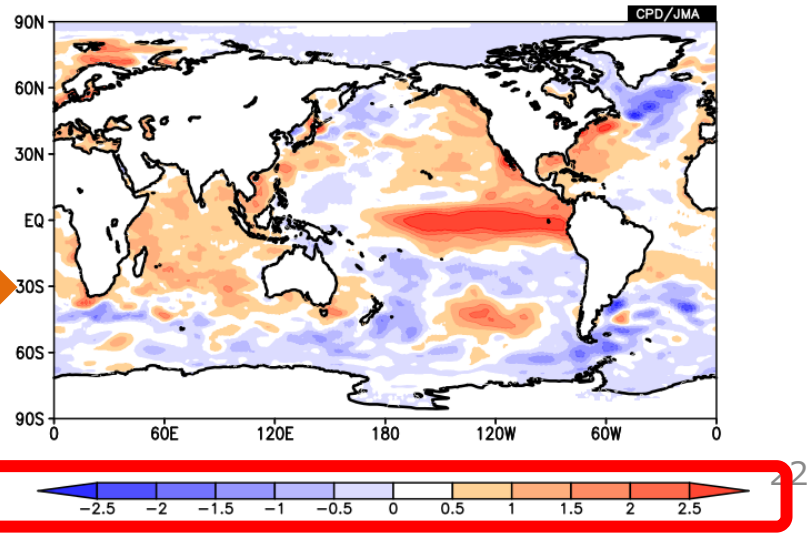
③ Checking this box

④ Set these boxes as follows
interval: 0.5, min: -2.5, max: 2.5

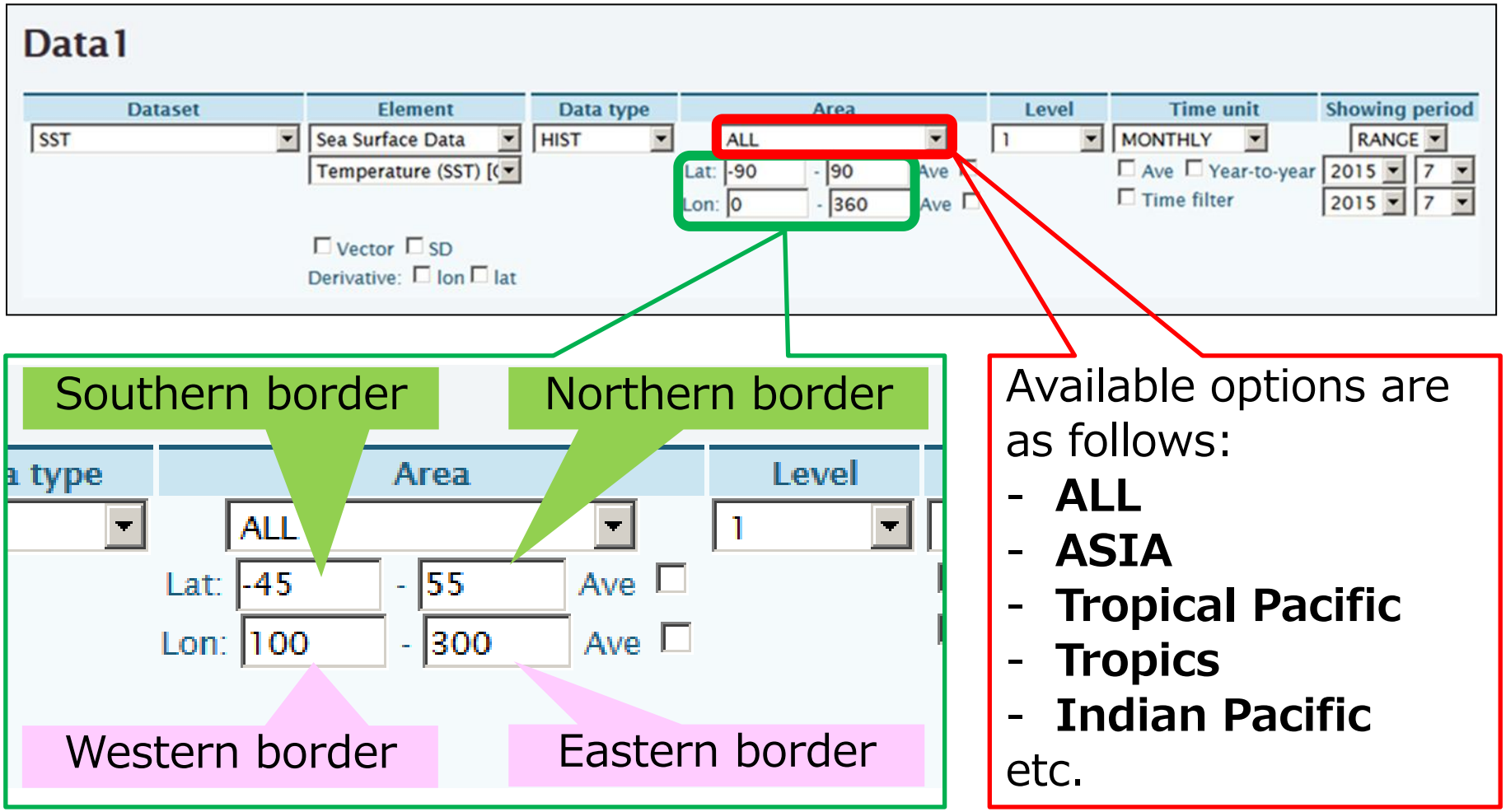
② Select "Blue - Red"

Click!

Analysis Data Submit



Area setting (1)

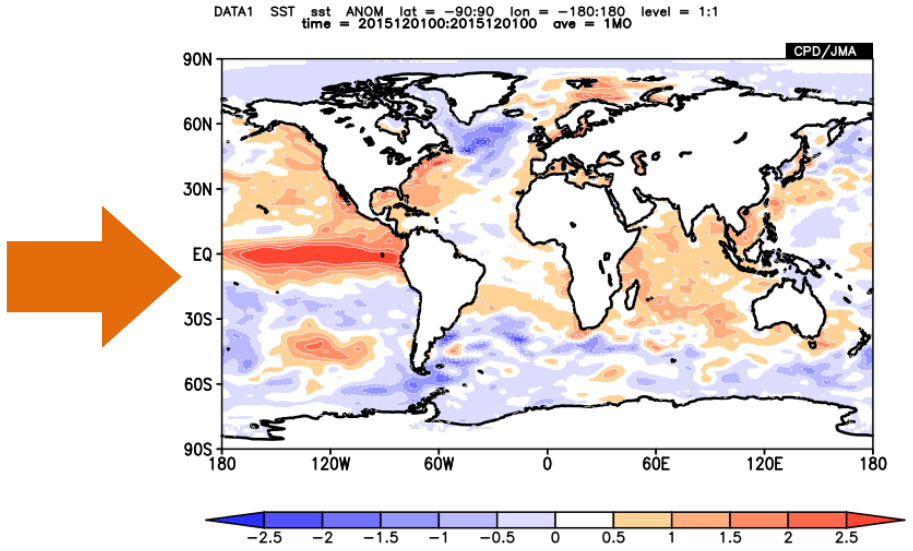


Setting boxes will appear in the “Area” field and after selection for more precise area adjustment.

Area setting (2)

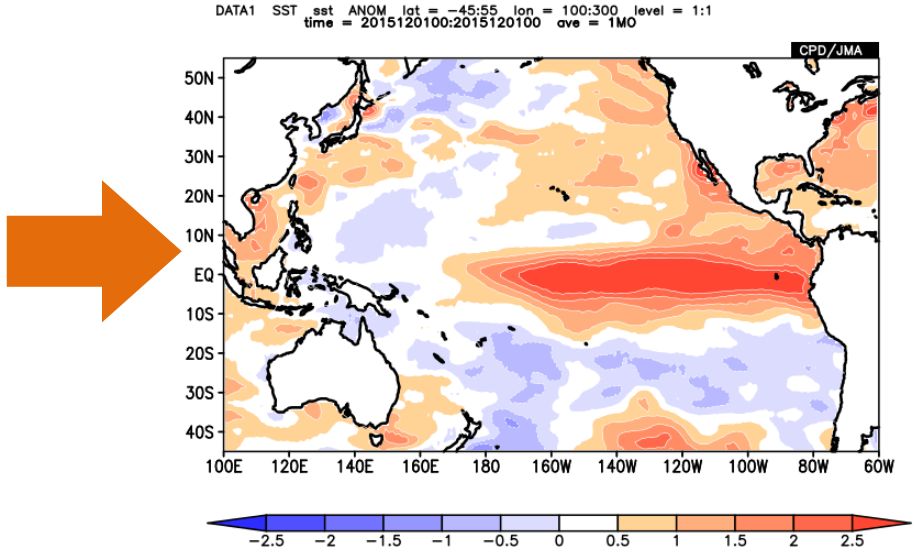
- Change the center

Lat :	-90 –	90
	(90S)	(90N)
Lon:	-180 –	180
	(180W)	(180E)



- Change the area

Lat :	-45 –	55
	(45S)	(55N)
Lon:	100 –	300
	(100E)	(300E=60W)



You can adjust zonal and meridional range by setting "Lat" and "Lon" parameters in the "Area" field.

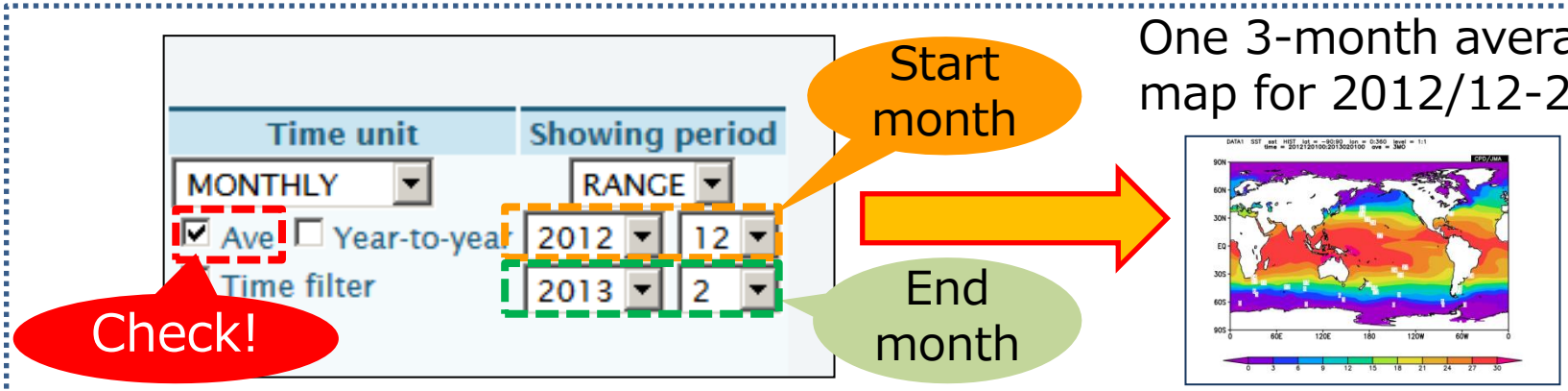
Time setting (1)

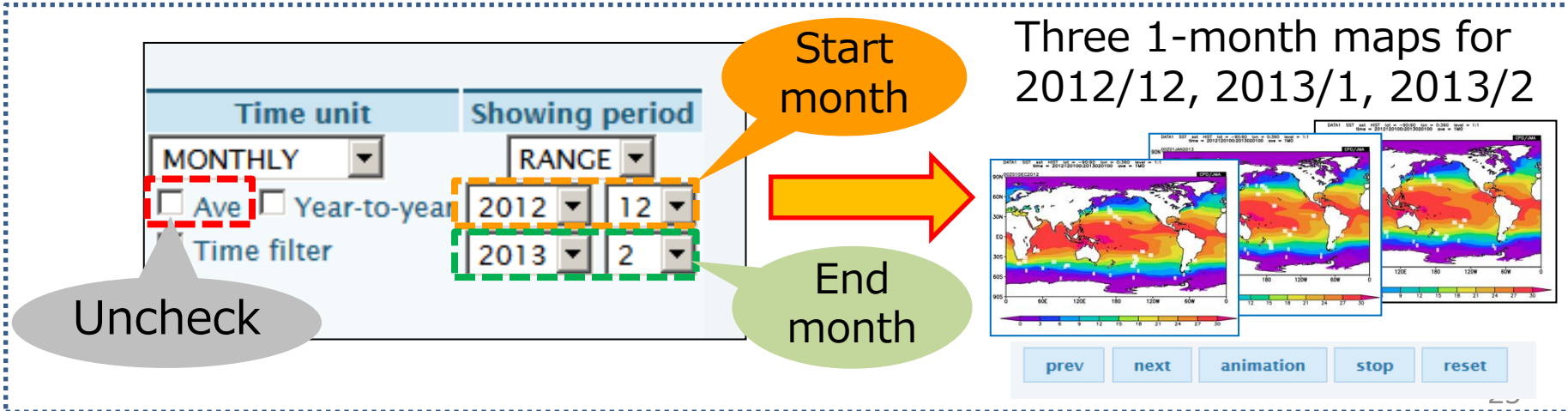
- Setting for **a consecutive period**.

<Calendar>

2012 **2013**

J F M A M J J A S O N D J F M A M J J A S O N D





Time setting (2)

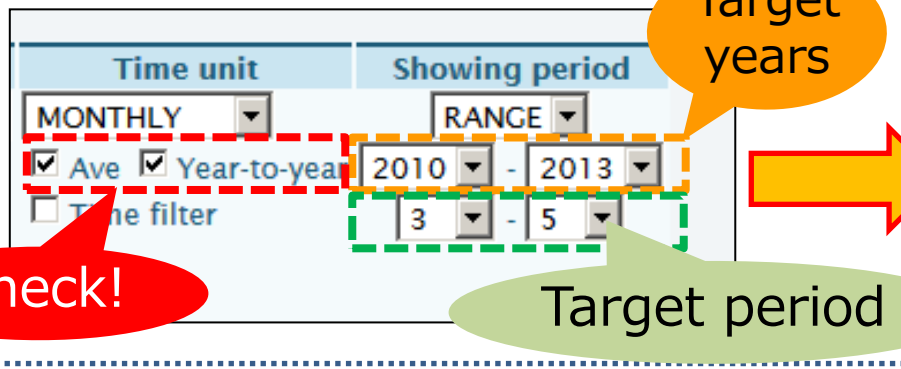
- Setting for **a specific period of each year.**

Target years

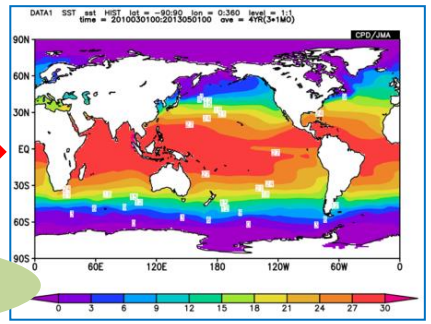
<Calendar>
2010 : J F M A M J J A S O N D
2011 : J F M A M J J A S O N D
2012 : J F M A M J J A S O N D
2013 : J F M A M J J A S O N D

Target period

Check "Year-to-year"

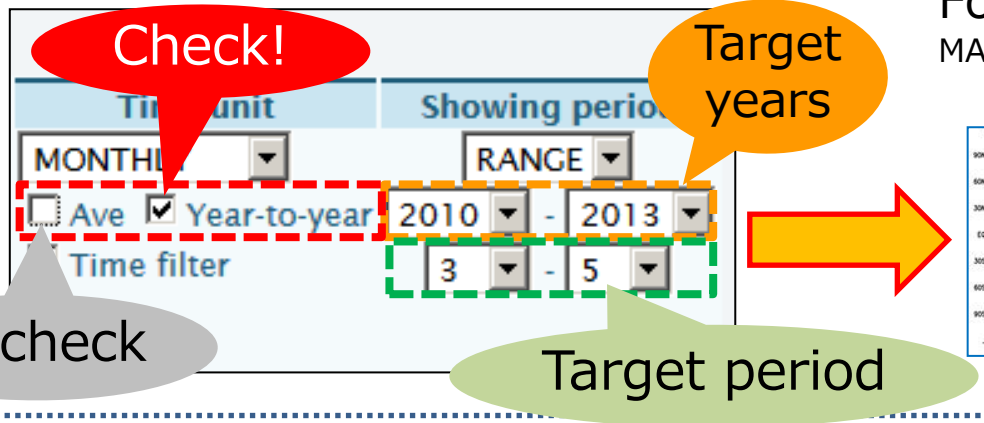


One 4-year-MAM averaged map



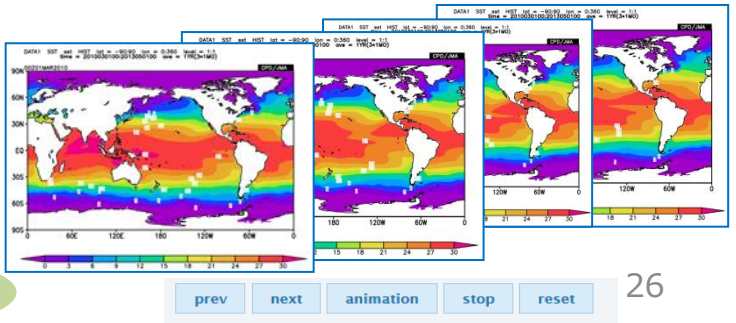
MAM 2010
MAM 2011
MAM 2012
MAM 2013

averaged



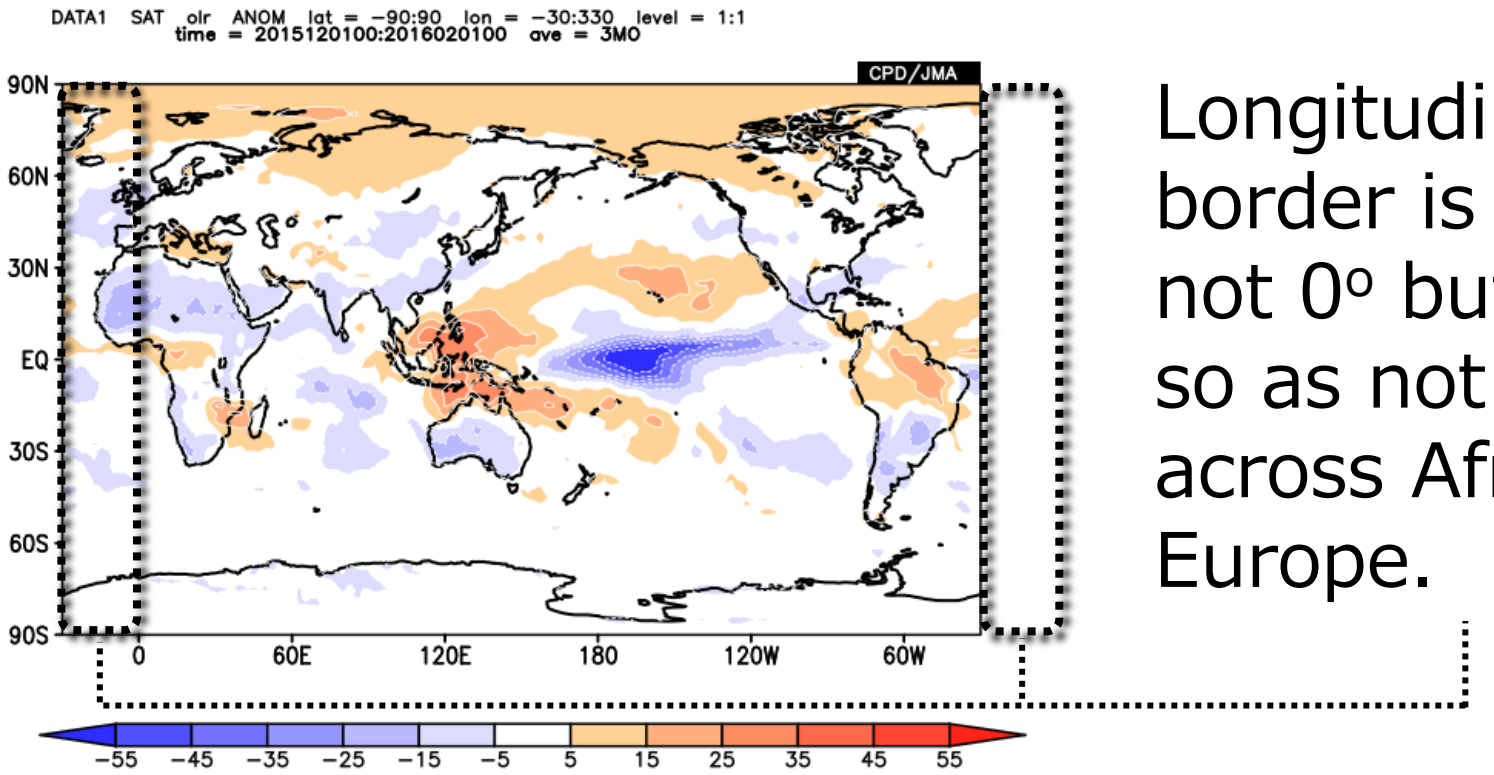
Four MAM averaged maps

MAM 2010, MAM 2011, MAM 2012, MAM 2013



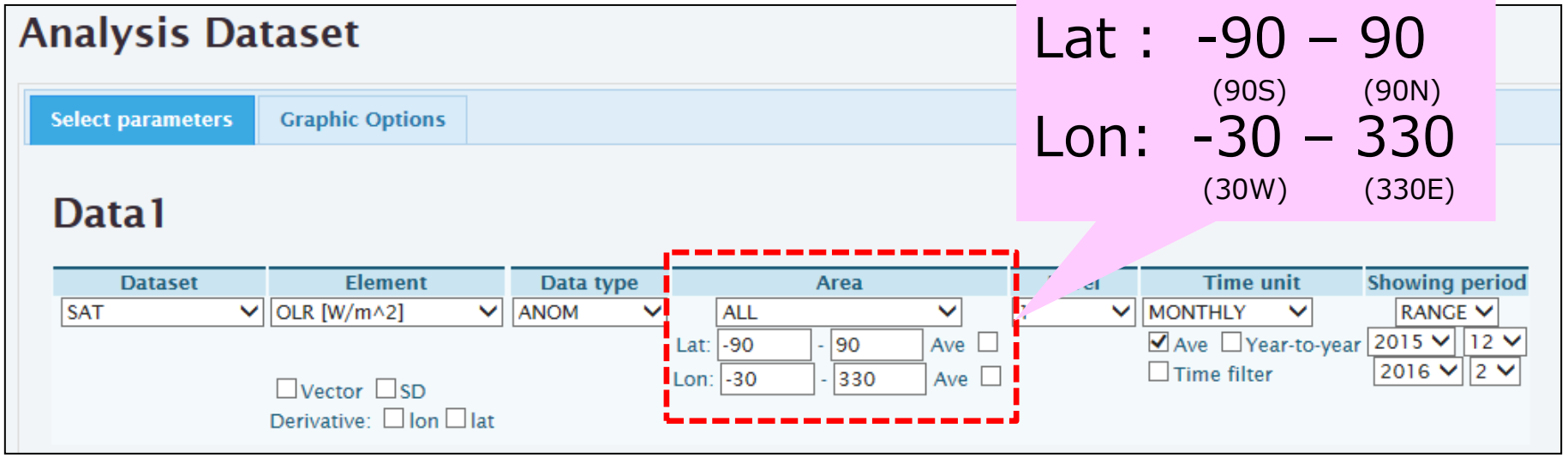
Exercise (1)

- Show OLR anomalies averaged over the period from December 2015 to February 2016 as shown below.
- The dataset "**SAT**" is available to show the OLR field.

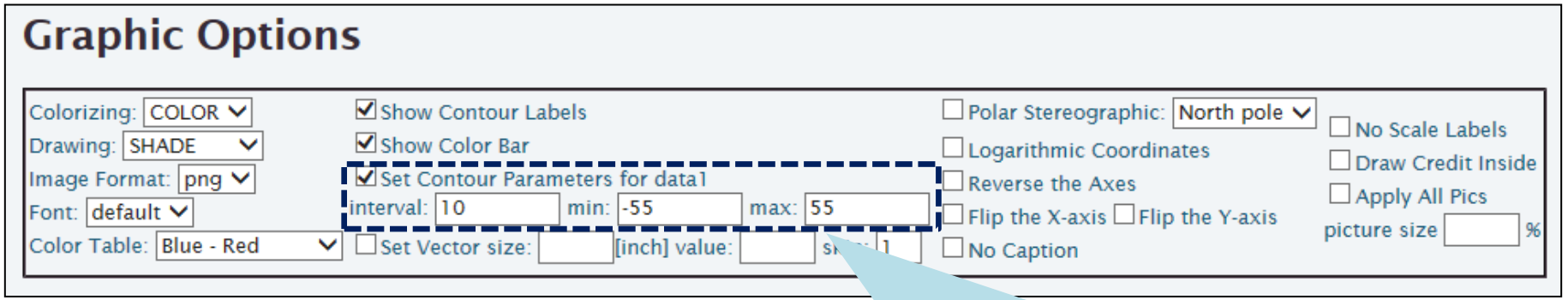


Longitudinal border is set at not 0° but 30°W so as not to get across Africa and Europe.

Answers to Exercise (1)



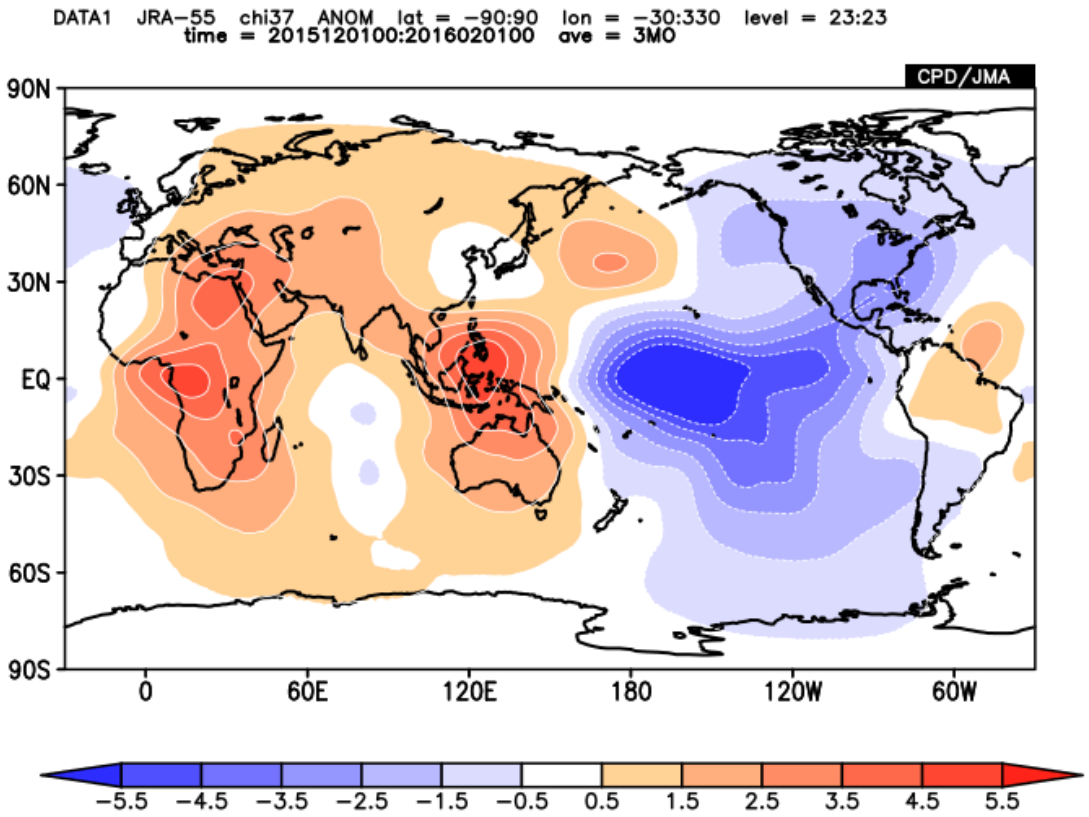
Lat : -90 – 90
(90S) (90N)
Lon: -30 – 330
(30W) (330E)



Set these boxes as follows
interval: 10, min: -55, max: 55

Exercise (2)

- Show 200-hPa velocity potential anomalies and in DJF 2015/16 (Dec.2015 – Feb.2016) as shown below.
- The dataset "**JRA-55**" is available to draw the velocity potential.



Answers to Exercise (2)

Data1

Dataset	Element	Data type	Area	Level	Time unit	Showing period
JRA-55	Pressure Levels	ANOM	ALL	200hPa	MONTHLY	RANGE
	χ (Velocity Potential)		Lat: -90 - 90 Ave		Ave Year-to-year	2015 12
			Lon: 0 - 360 Ave		Time filter	2016 2

X (Velocity Potential)

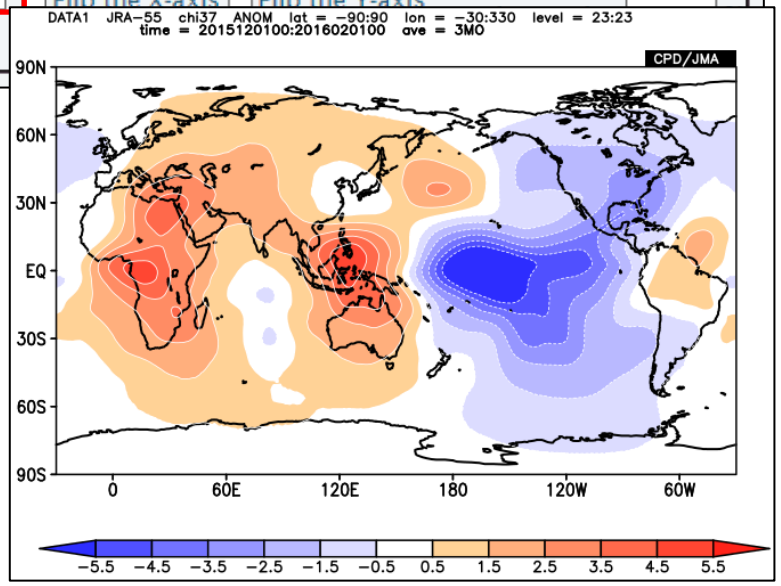
Graphic Options

Colorizing: COLOR
Drawing: SHADE
Image Format: png
Font: default
Color Table: Blue - Red

Show Contour Labels
Show Color Bar
Set Contour Parameters for data1
interval: 1 min: -5.5 max: 5.5
Set Vector size: [inch] value: skip: 1

Polar Stereographic: North pole
Logarithmic Coordinates
Reverse the Axes
Flip the X-axis Flip the Y-axis

No Scale Labels
Draw Credit Inside
Apply All Pics



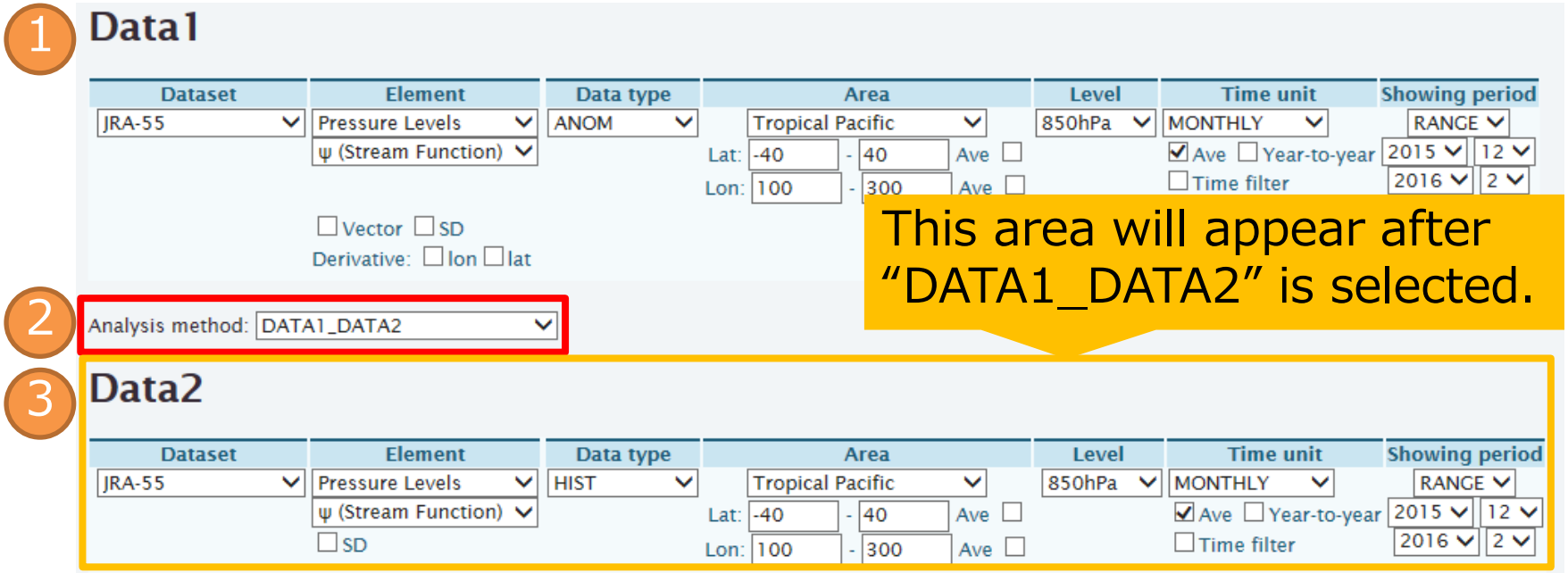
Multiple Data

- **DATA1_DATA2** : Overlay two kinds of items on one map at the same time.
  - Contours are overlaid on a shaded map.
- **SUBTRACT** : Map the difference of two data.
  - This function is mainly used to show time variation or the difference between two levels.

DATA1_DATA2 : Overlaying two data

- The Data1 is mapped as shading, and Data2 is mapped as contours.

*As an exception, Data2 is mapped as shading when Data1 is mapped as the type of vector or streamline.

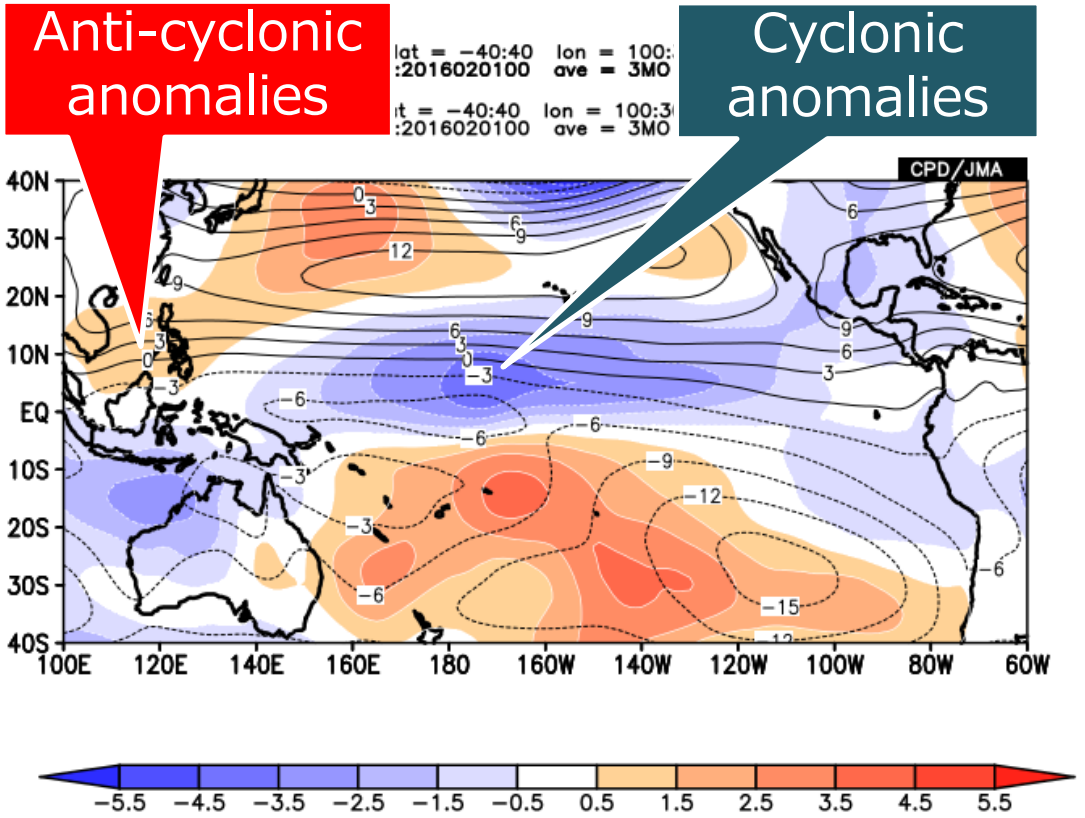


1. Set the "Data1" field.
2. Select "DATA1_DATA2" in the "Analysis method" box.
3. Set the "Data2" field and submit.

DATA1_DATA2 : Overlaying two data

- The sea level pressure (Data2) is mapped as contour, and its anomalies (Data1) is mapped as shading.

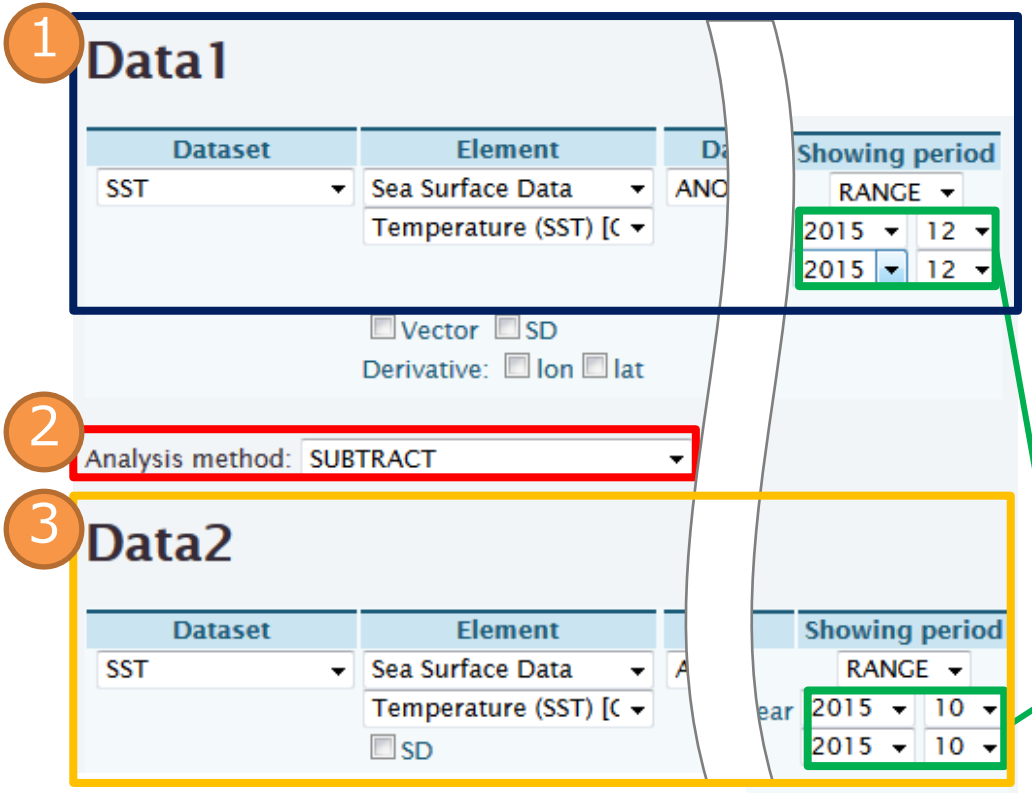
Sea level pressure in December 2015



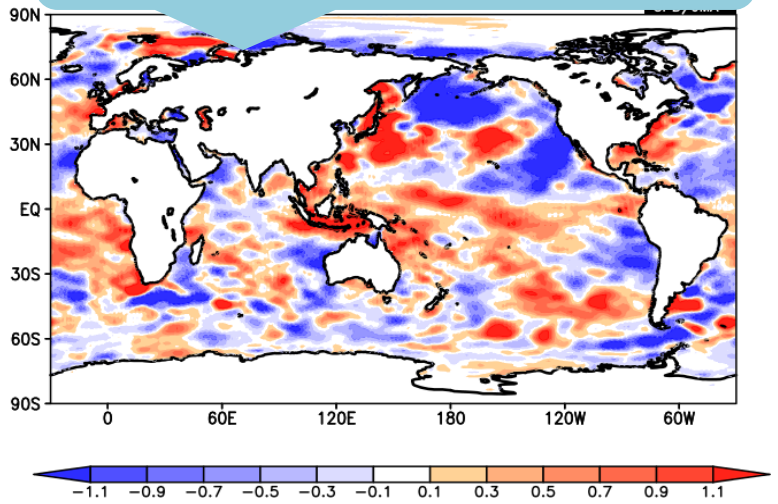
SUBTRACT : Data1 minus Data2

The value of “Data1 minus Data2” will be mapped.

1. Set the “Data1” (the base data) .
2. Select “SUBTRACT” in the “analysis method” box.
3. Set the “Data2” field and submit.



SST anomaly difference from Oct. to Dec. 2015.



Data1 minus Data2 is mapped (In this case, December minus October).

Multiple Data

- In a similar way, users can also perform the four basic arithmetic operations of two data by using the corresponding analysis method.

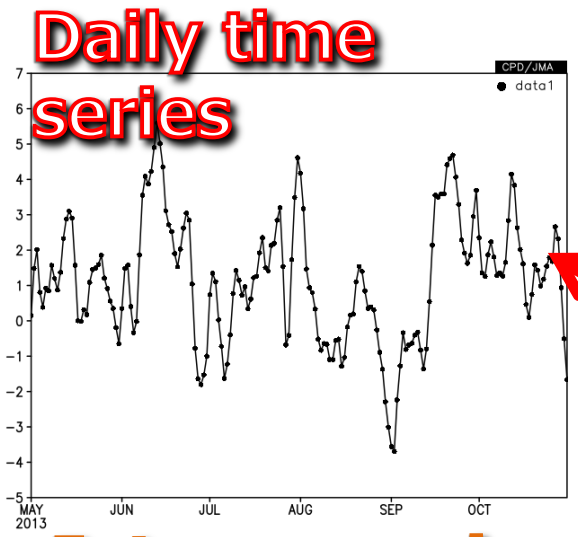
Analysis method	Mapped value	Usage example
ADD	Addition (“Data1” plus “Data2”)	–
SUBTRACT	Difference (“Data1” minus “Data2”)	Time difference, vertical shear.
MULTIPLY	Multiplication (“Data1” times “Data2”)	–
DIVIDE	Division (“Data1” divided by “Data2”)	Precipitation ratios (“HIST” divided by “NORM”).

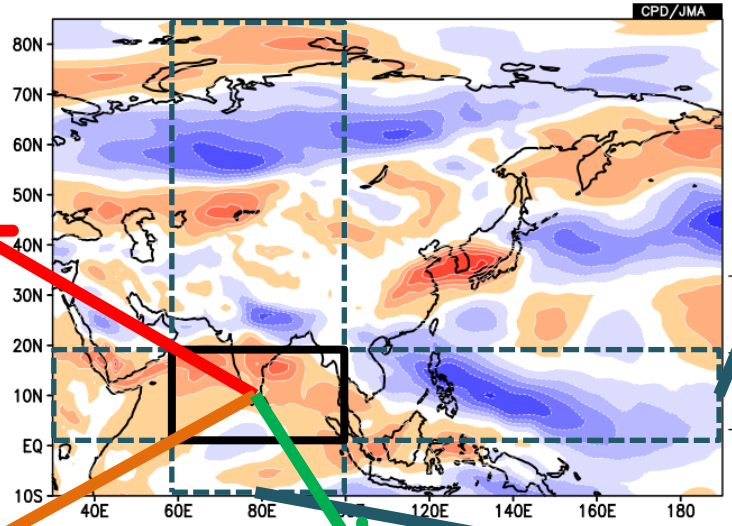
Contents

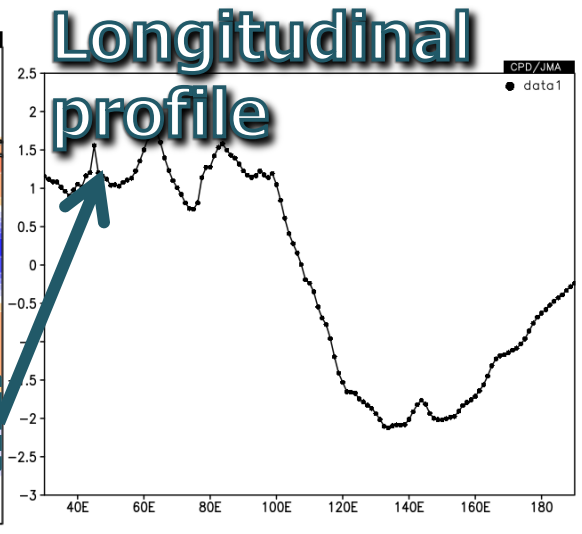
1. What's iTacs?
2. Application for using iTacs
3. Basic operations
   - Longitude-latitude map
   - Overlaying two data
   - Mapping the difference of two data
4. Advanced operations
   - Area-averaged time series
   - Vertical and latitude/longitude profile
   - Cross section diagram
   - Time filter

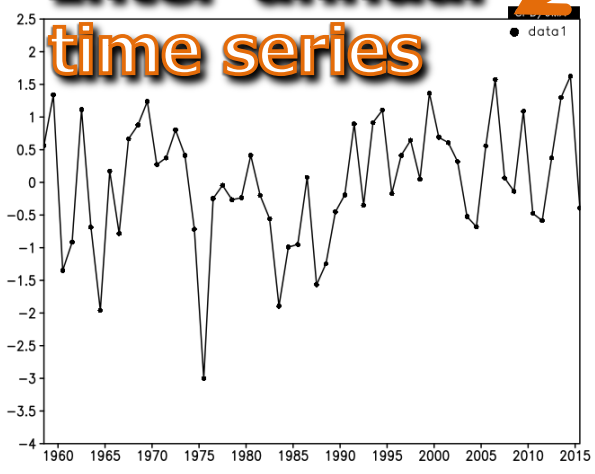
Line graph & Cross section diagram

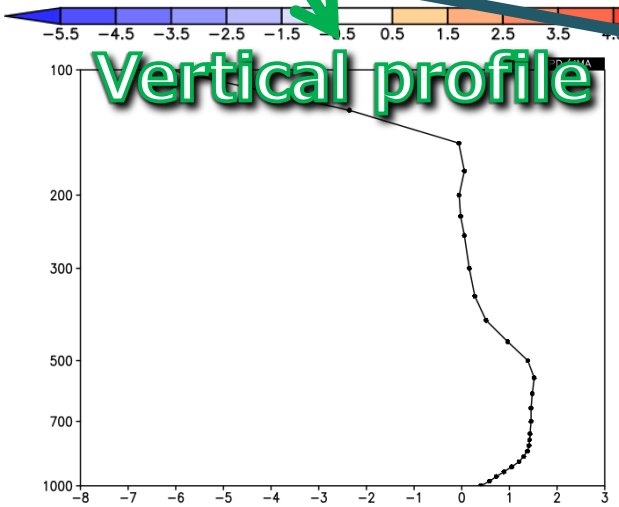
- Time series and profile graph are useful to see the variability or spatial structure simply.

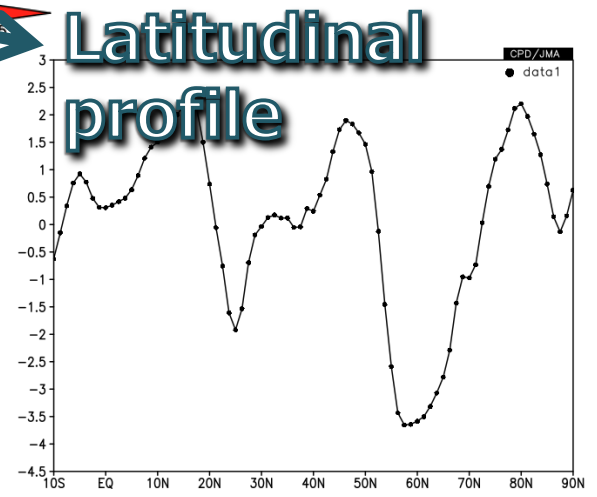




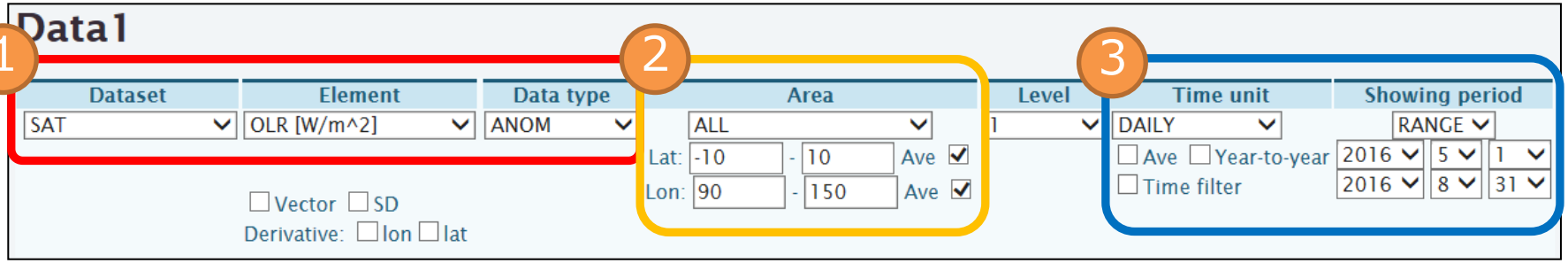






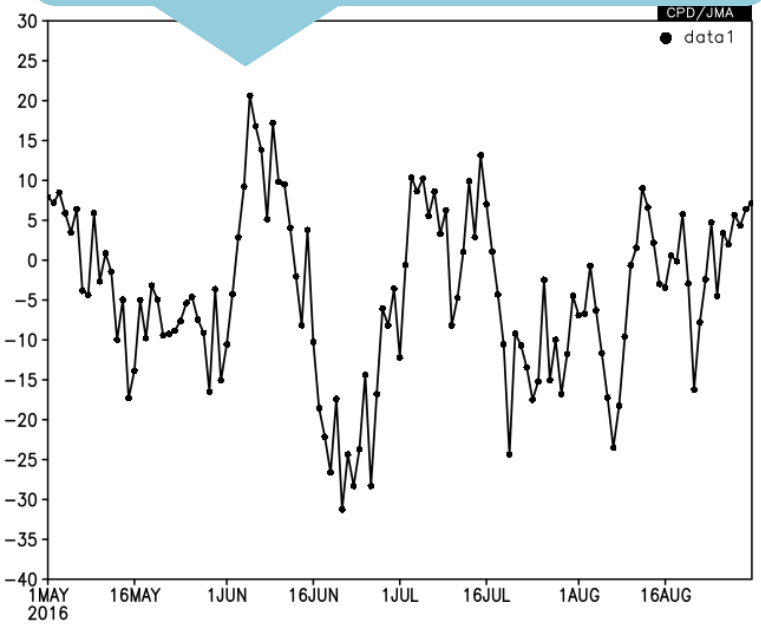


Daily timeseries



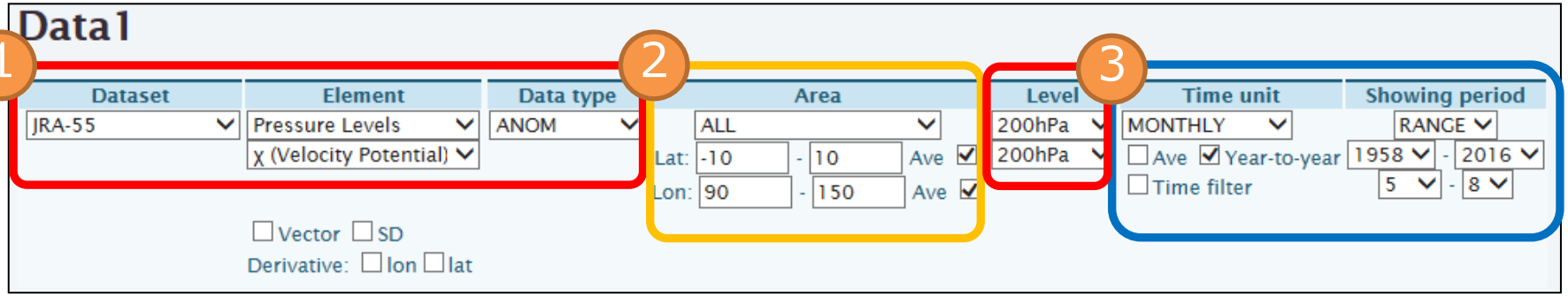
1. Select OLR anomalies for element boxes.
2. Select 10°S–10°N, 90°–150°E for "Area" box.
   - The area covers the Maritime continent.
   - Check "Ave" boxes.
3. Select "DAILY" for time unit, and showing period
   - Showing period: 1 May 2016 – 31 Aug. 2016.

Daily timeseries of OLR anomalies



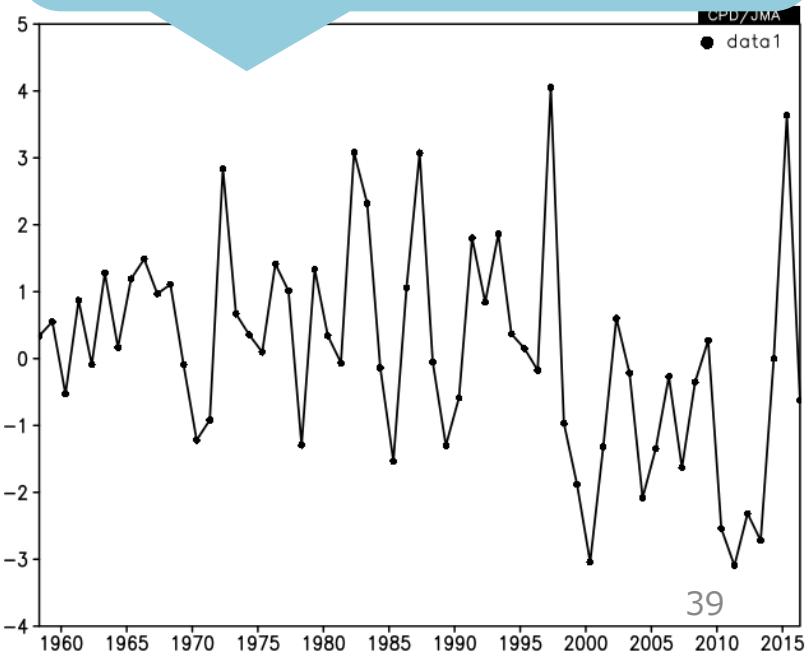
- Similarly, you can draw monthly or annual timeseries by setting "Time unit".

Inter-annual timeseries



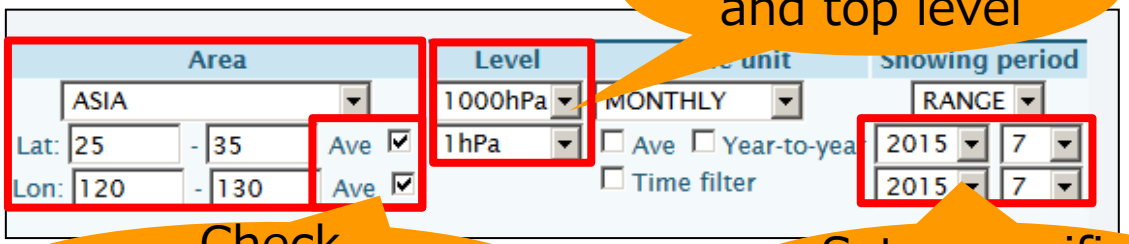
1. Select 200-hPa velocity potential anomalies for element boxes.
2. Select 10°S–10°N, 90°–150°E for "Area" box.
   - The area covers the Maritime continent.
   - Check "Ave" boxes.
3. Select "MONTHLY" for time unit, and showing period
   - Check "Year-to-year".
   - Showing period: 1958 – 2016, 5 – 8.

Inter-annual timeseries of 4-month (May – August) mean 200-hPa velocity potential anomalies



Vertical and lat/longitude profile

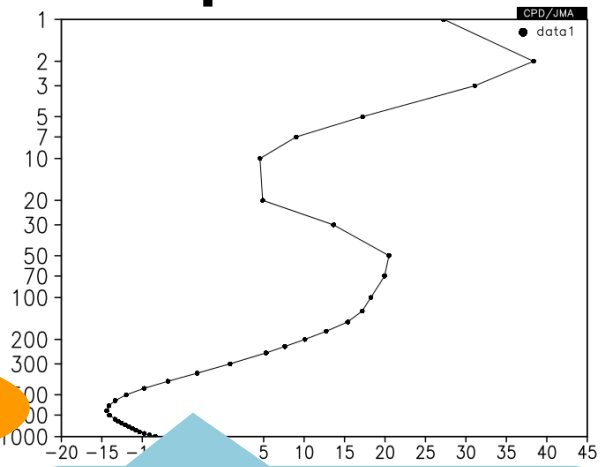
- Vertical profile



Select bottom and top level

Check (Regional mean)

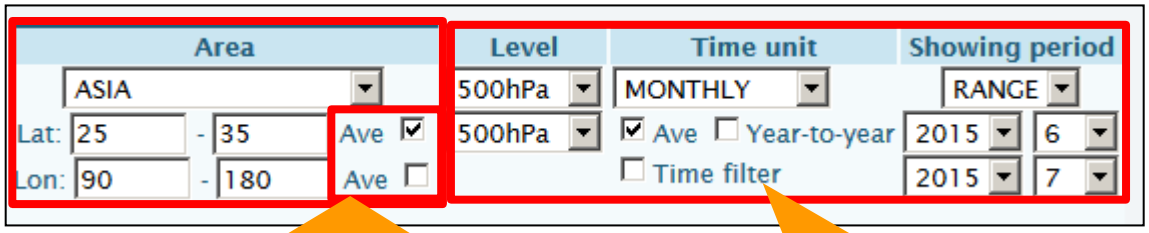
Set a specific period



Height anomalies averaged over 25°–35°N, 120°–130°E

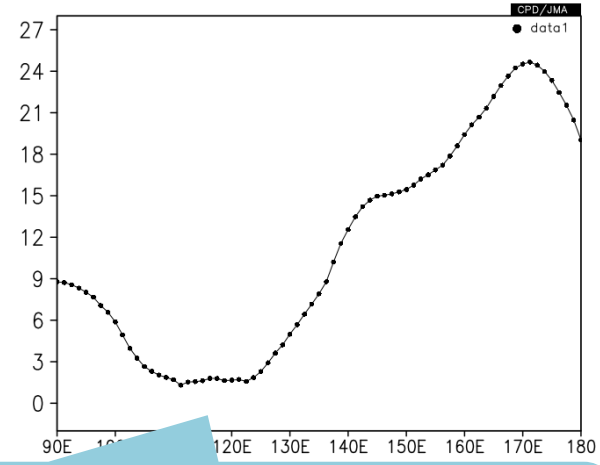
"Logarithmic Coordinates" option is recommended in vertical profile graph.

- Lat/Longitude profile



Check either "Ave" boxes (latitudinal or longitudinal mean)

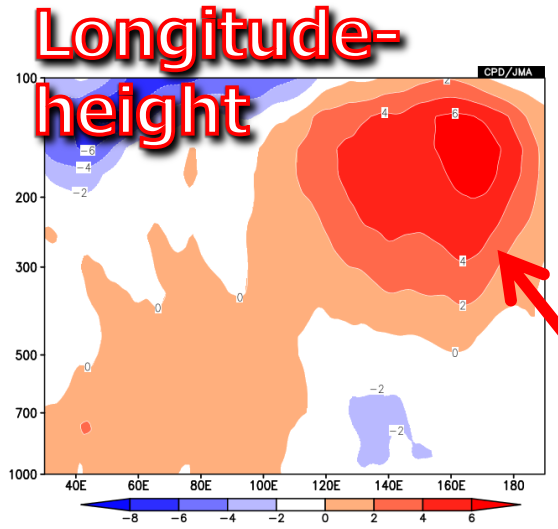
Select a specific level and period

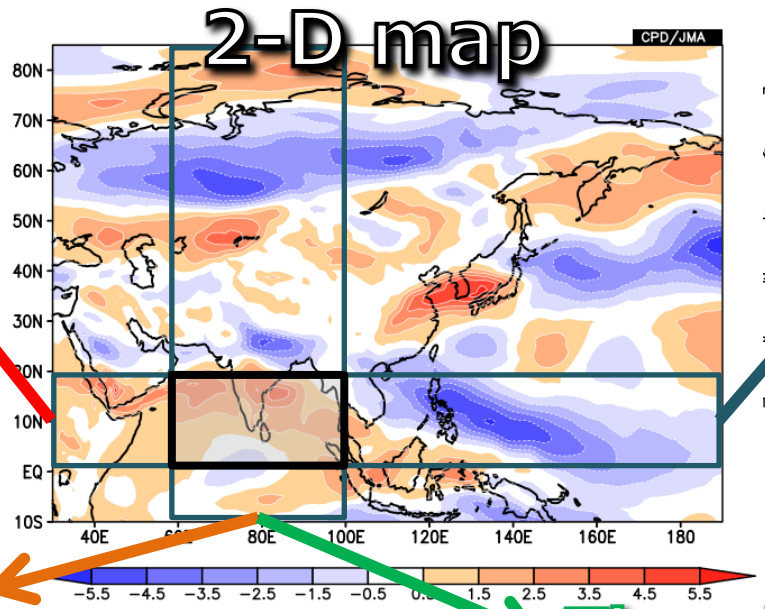


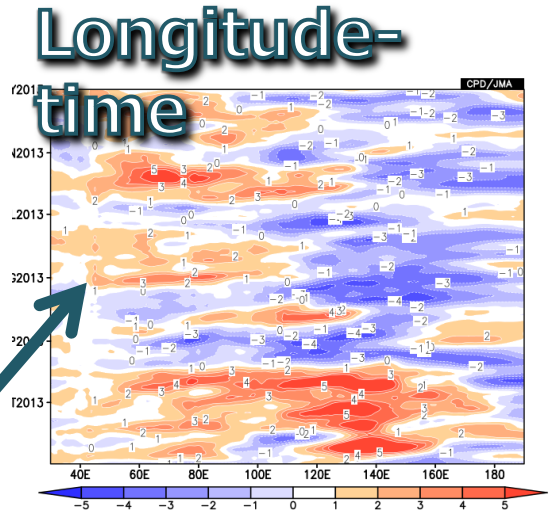
Longitude profile of 500-hPa height anomalies over 25°–35°N

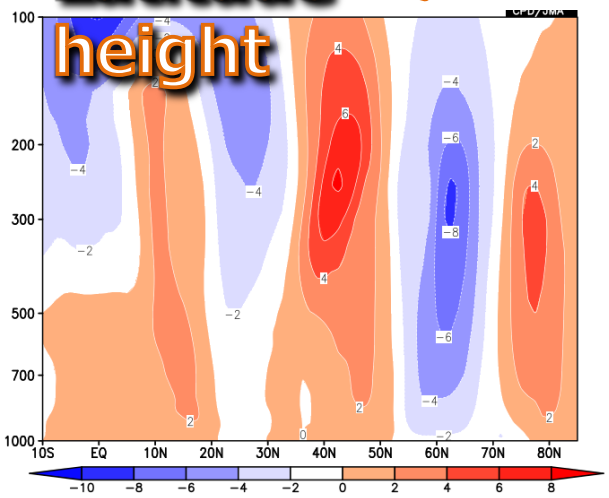
Cross section diagram

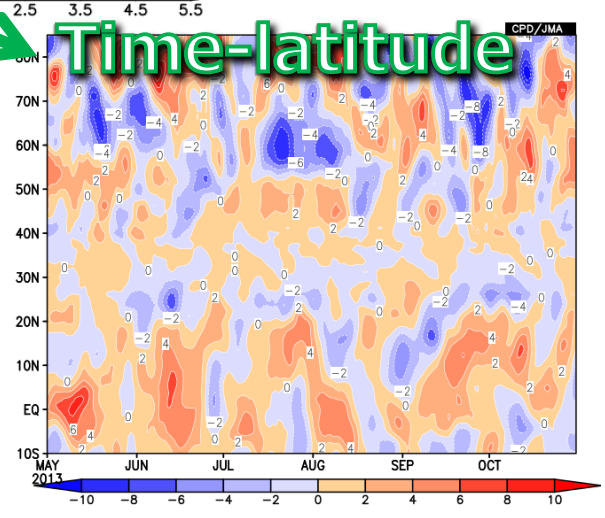
- Cross section diagram is also useful to see the variability or spatial structure.





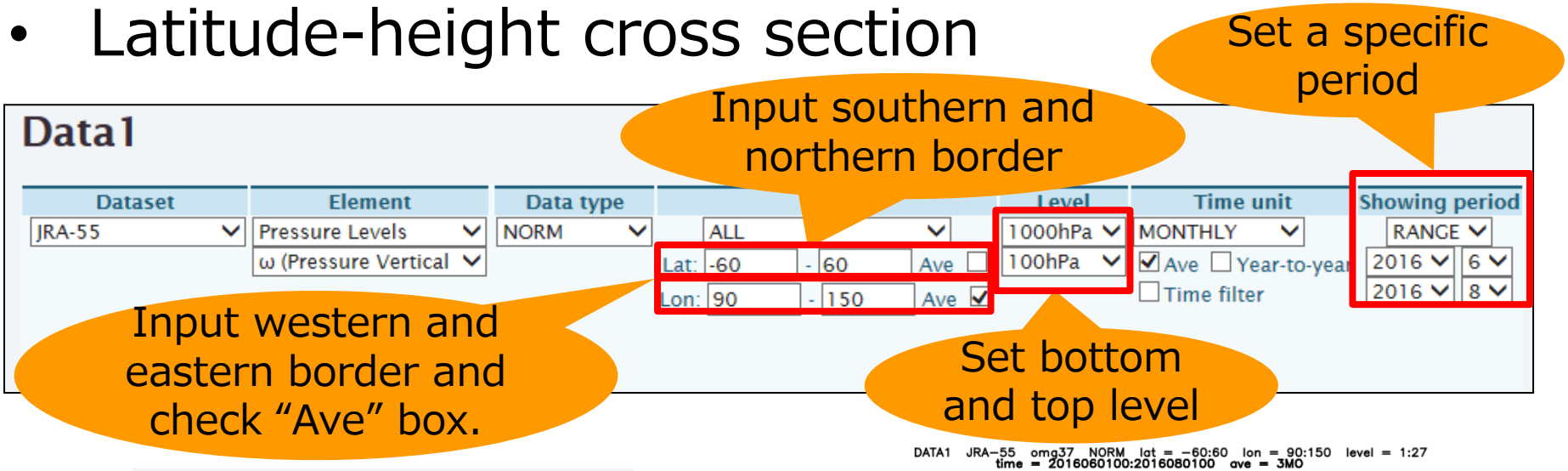


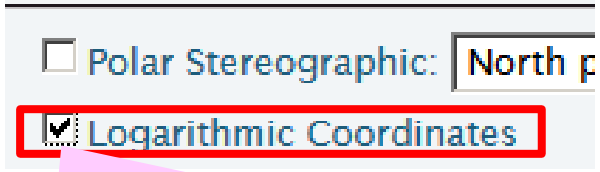




Vertical cross section

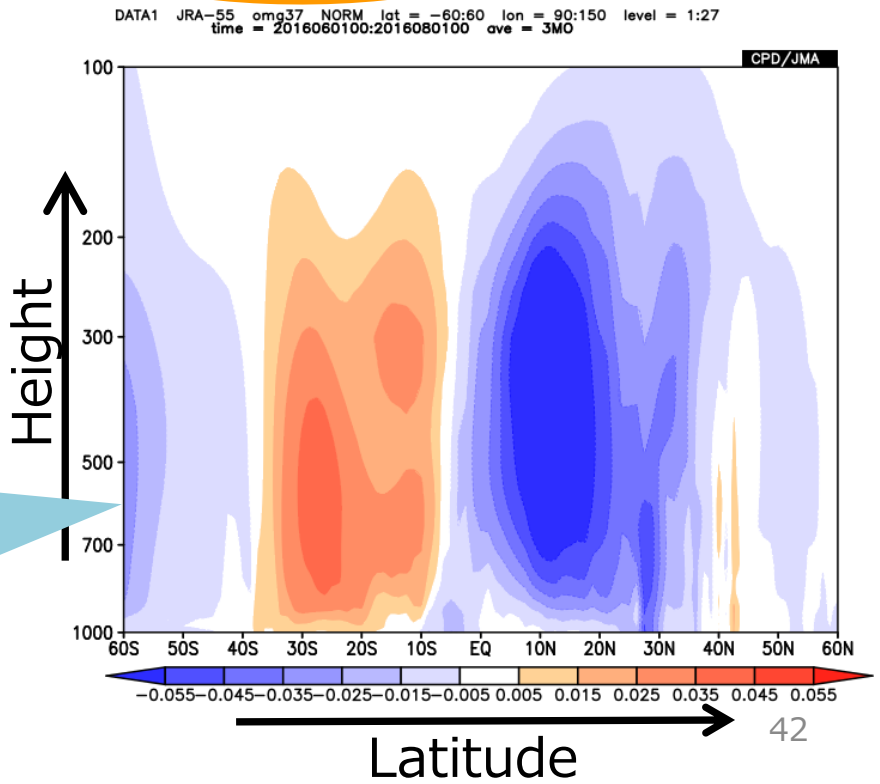
- Latitude-height cross section





“Logarithmic Coordinates” is recommended to draw vertical profiles.

Latitude-height cross section of normal pressure vertical velocity averaged between 90°E and 150°E in summer 2016

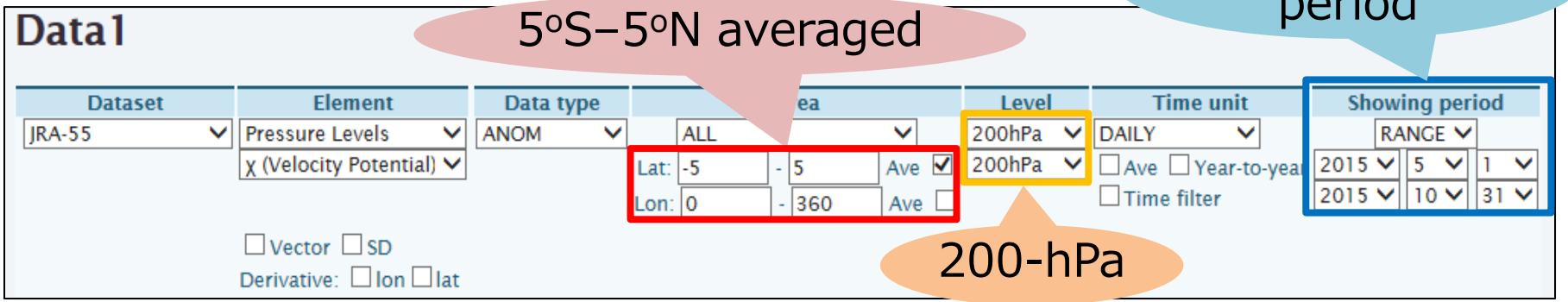


Time cross section

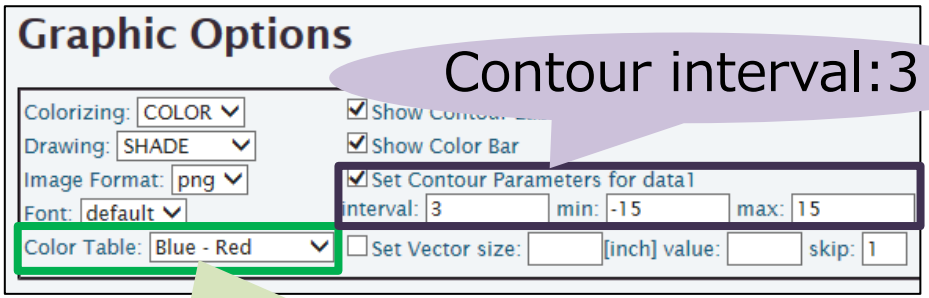
- Longitude-time cross section

Set a specific period

5°S–5°N averaged

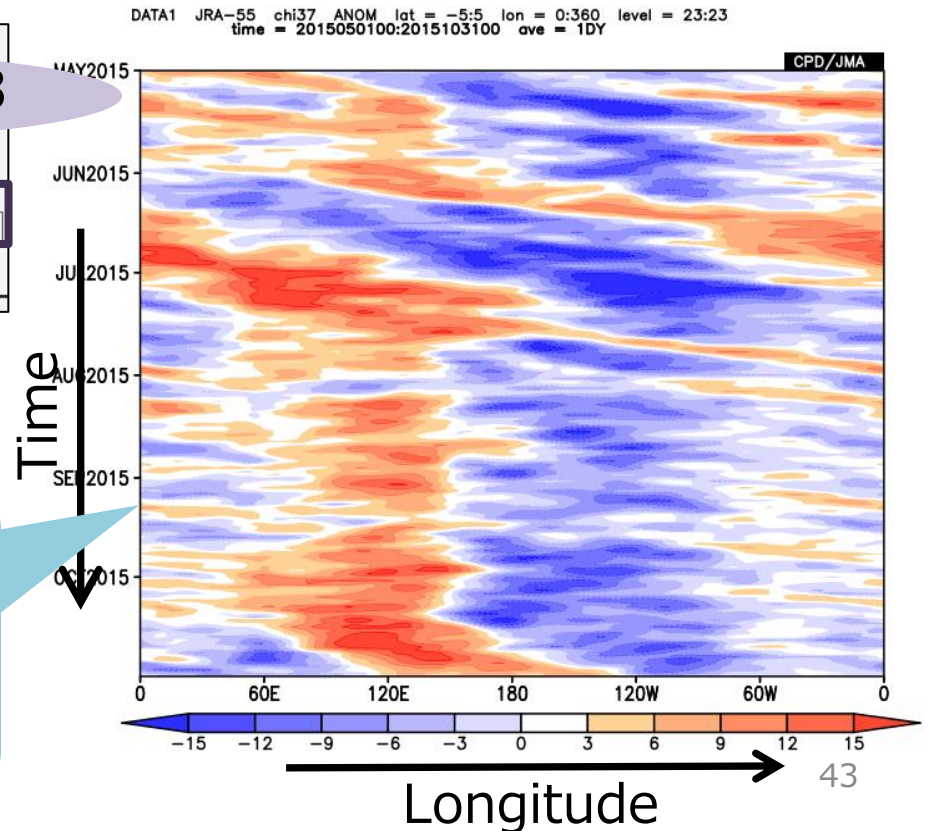


200-hPa



Contour interval:3

Blue-Red colored shading



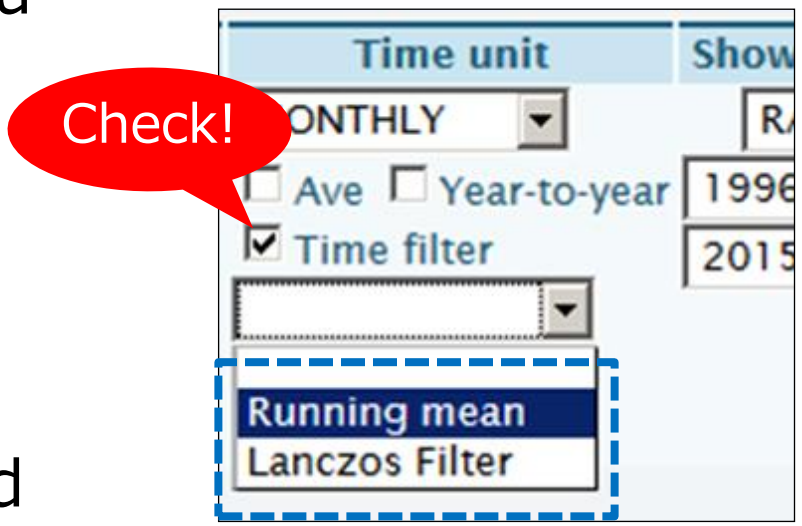
Longitude-time cross section of 200-hPa velocity potential anomalies averaged over 5°S – 5°N from 1 May to 31 October 2015.

Time filter

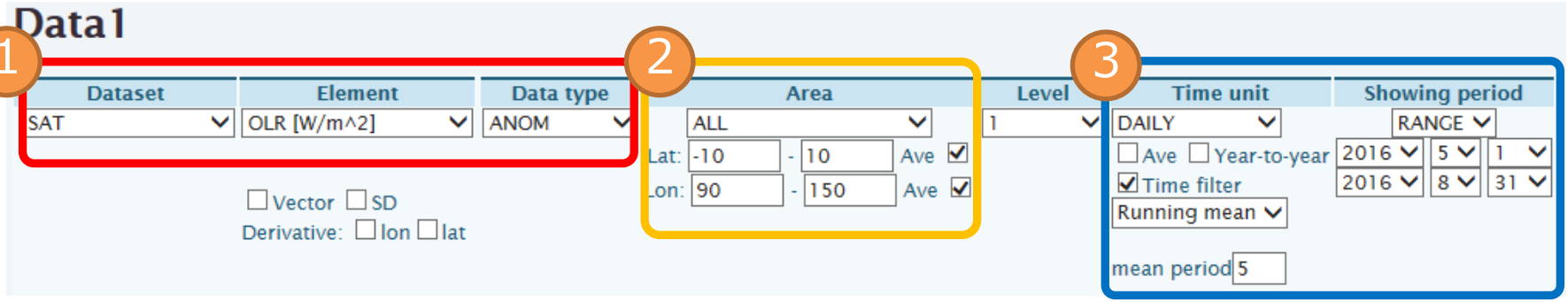
- Time filter should be used to create a time series image in the climate analysis.
- Climatological events are emphasized by a time filter, because it can remove high frequency variations.

Checking “Time filter” box, you can select two types of the time-filter.

- Running mean: Smooth the original data simply.
- Lanczos filter: Pick up the given period component and mean them based on Duchon (1979).

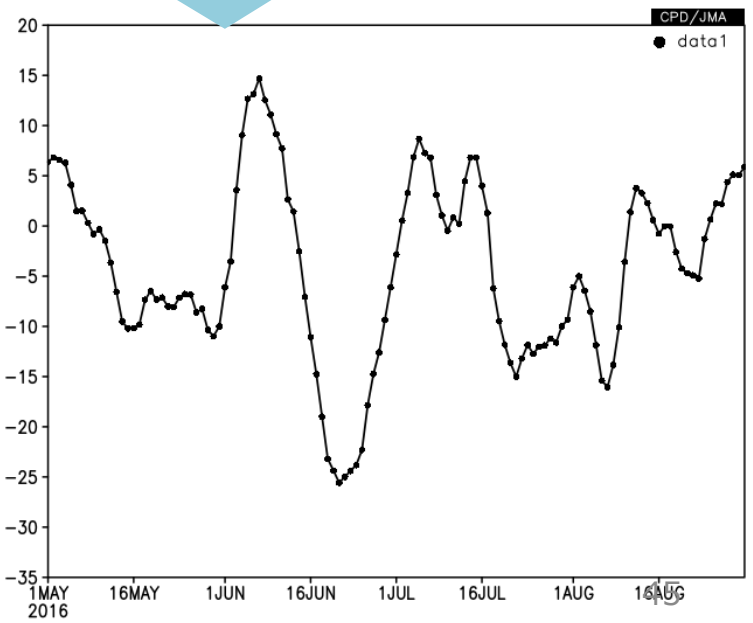


Running mean daily timeseries



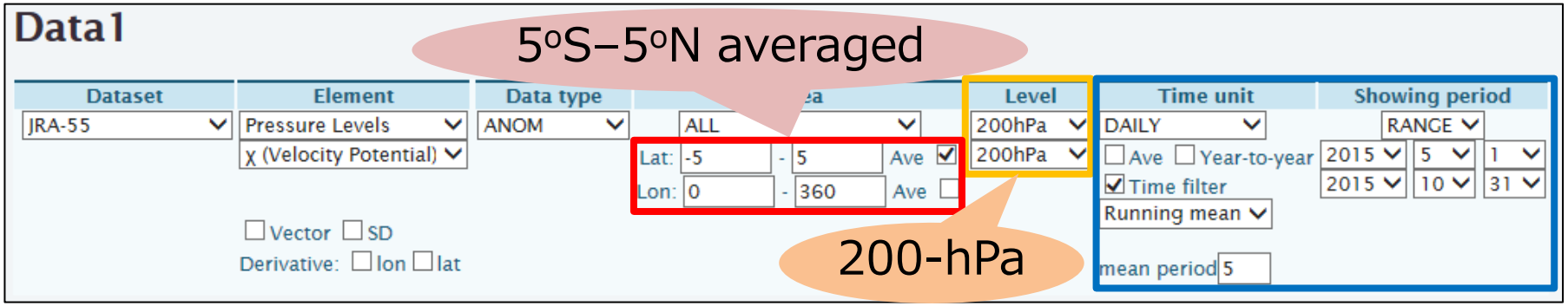
1. Select OLR anomalies for element boxes.
2. Select 10°S–10°N, 90°–150°E for "Area" box.
   - Check "Ave" boxes.
3. Select "DAILY" for time unit, and showing period.
   - Showing period: 1 May 2016 – 31 Aug. 2016.
   - Check "Time filter" in time unit box, and select "Running mean" and "5(day)" in "mean period" box.

5-day running mean daily timeseries of OLR anomalies



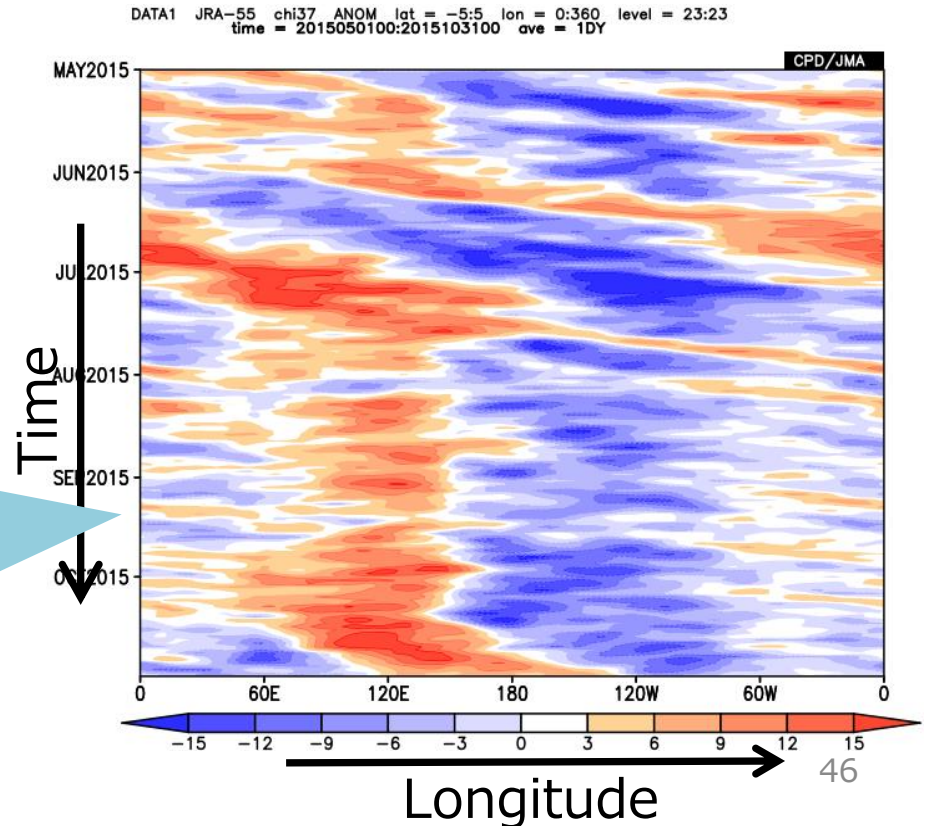
Time cross section

- Running mean longitude-time cross section



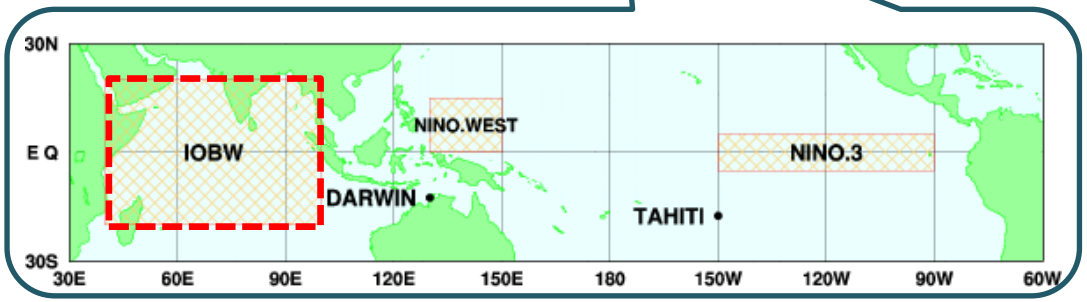
1. Select 5°S–5°N mean 200-hPa velocity potential anomalies.
2. Set 5-day running mean in “Time unit” box.

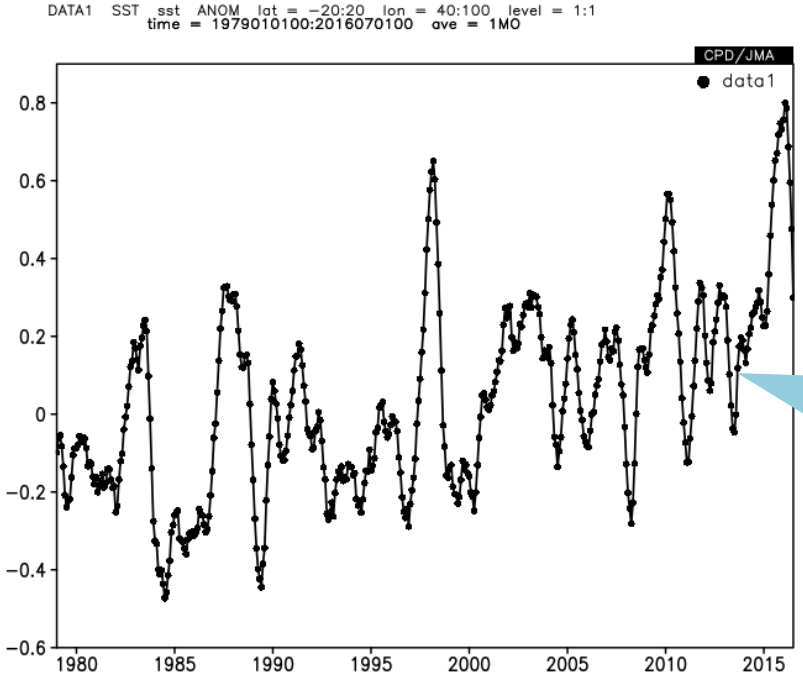
Longitude-time cross section of 5-day running mean 200-hPa velocity potential anomalies averaged over 5°S–5°N from 1 May to 31 October 2015.



Exercise (3)

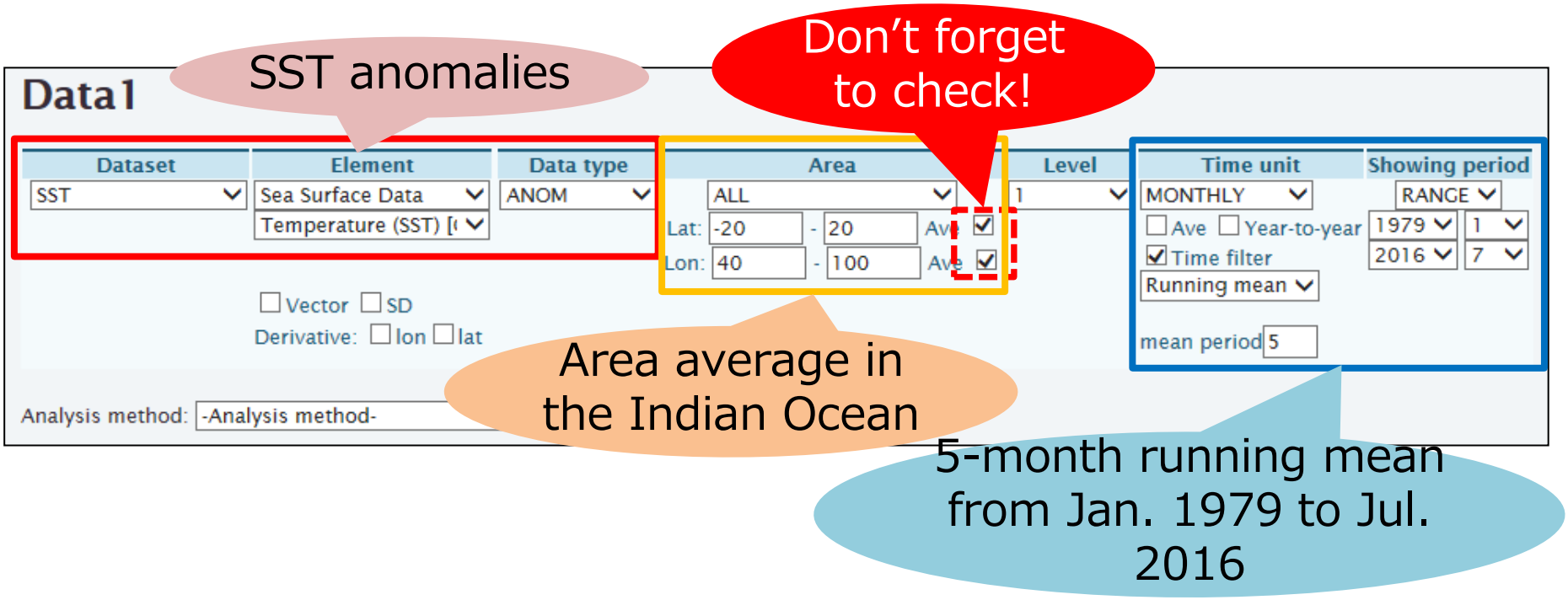
- Show a time series of 5-month running mean monthly SST anomalies averaged over the Indian Ocean (20°S–20°N, 40°–100°E) from January 1979 to July 2016.





Monthly timeseries of 5-month running mean SST anomalies averaged over the Indian Ocean

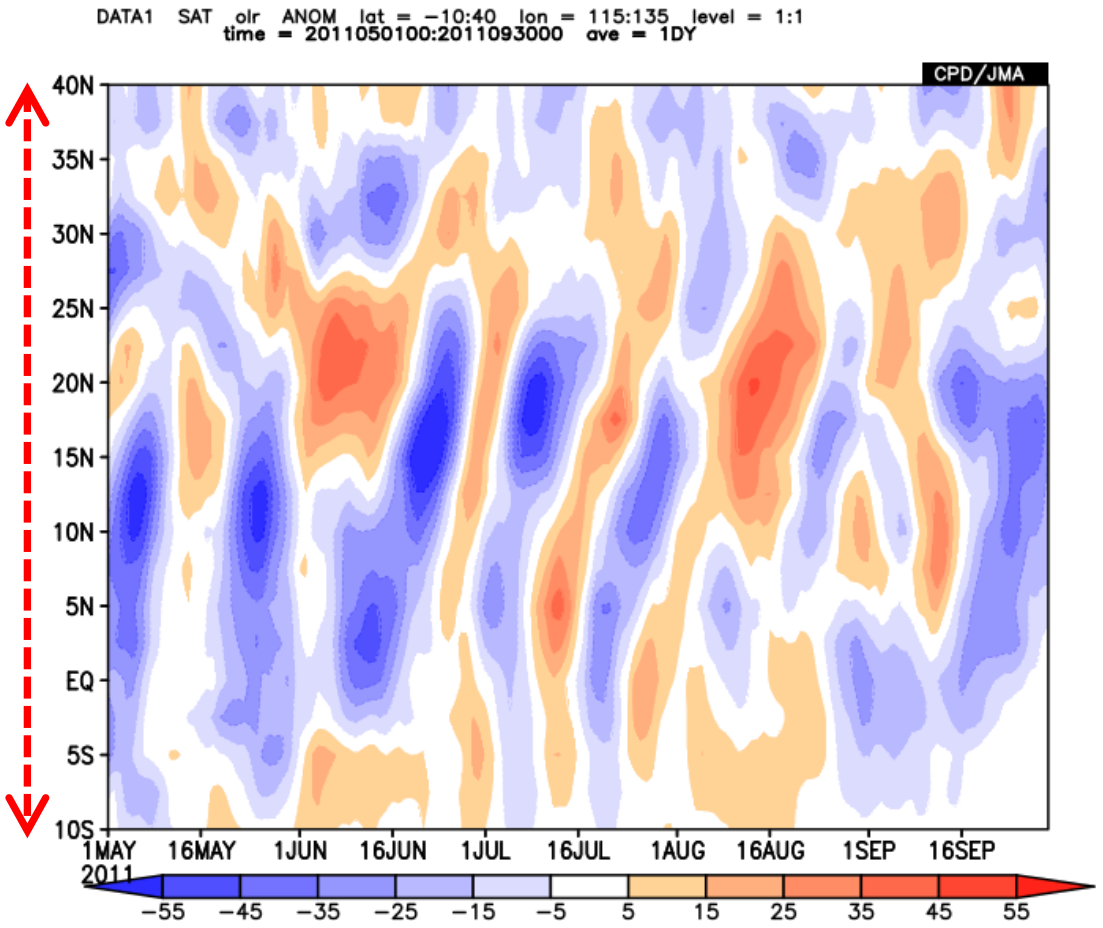
Answers to Exercise (3)



Exercise (4)

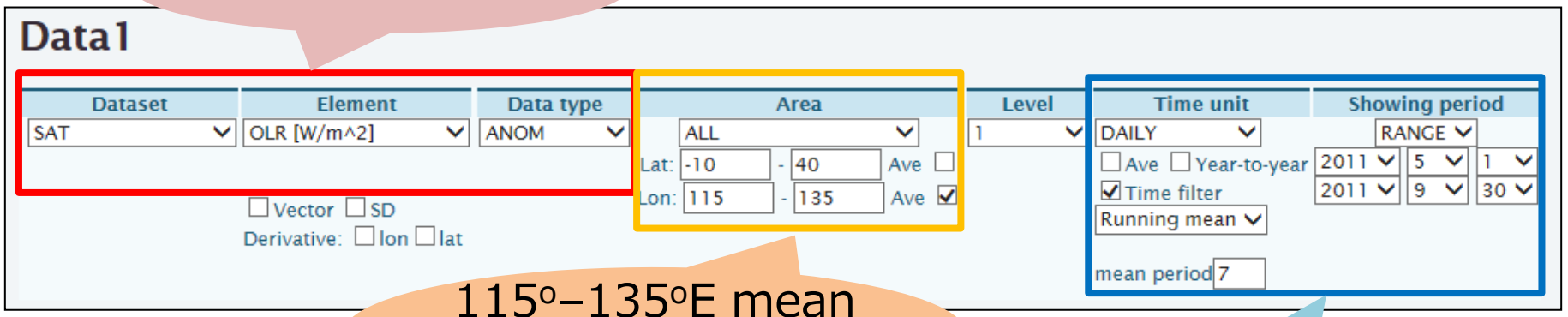
- Show a time-latitude cross section of 7-day running mean OLR anomalies averaged over 115°–135°E from 1 May to 30 September 2011.

Latitude range is 10°S–40°N.



Answers to Exercise (4)

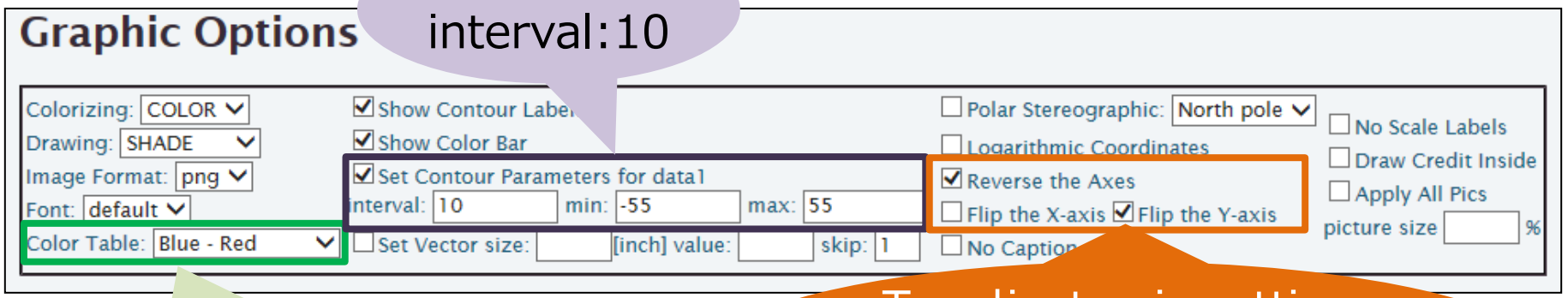
OLR anomalies



115°–135°E mean
From 10°S to 40°N

7-day running mean from
1 May to 30 Sep. 2011

Contour
interval:10



Blue-Red
colored shading

To adjust axis setting,
check “Reverse the Axes”
and “Flip the Y-axis”.

Advanced operation of iTacs

Contents

1. Statistical Analysis in iTacs
   - Introduction
   - Regression / Correlation Analysis
   - Composite Analysis

2. Other Advanced operations
   - Data download
   - User data input

3. Integrated Exercise

Statistical analysis in iTacs

- iTacs can do some types of statistical analysis.
  - Regression/correlation analysis
  - Composite analysis
  - Single/multi EOF, SVD analysis
  - FFT analysis
  - Wavelet analysis
- They can be powerful tools to consider and understand climate system.

- But, remember that the results produced by them do NOT always mean the existence of physical system or structures in targeted data, because it just indicates mathematically calculated value and consideration based on physics isn't included.

Contents

1. Statistical Analysis in iTacs
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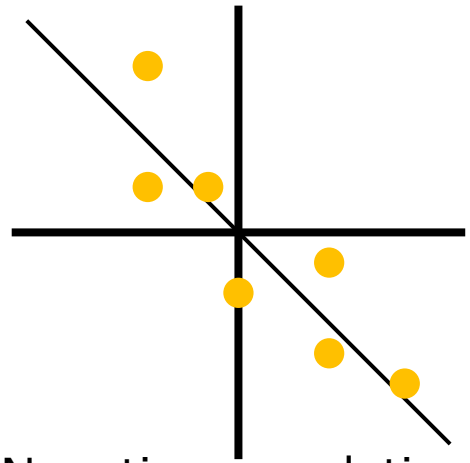
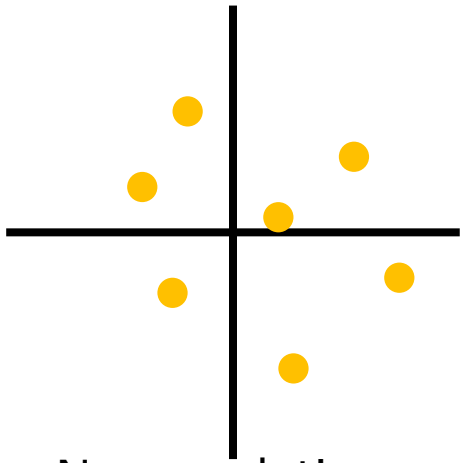
Regression and correlation analysis

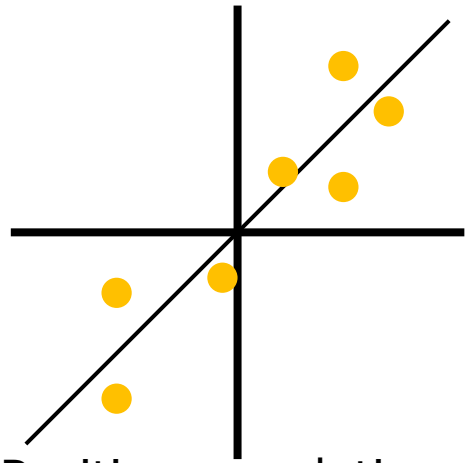
- Regression and correlation analysis are often used to examine the circulation pattern related to the focused one-dimensional timeseries.
- **Correlation coefficient means the degree of the correlation**, and **the regression coefficient means the gradient of the regression line**.
  - Correlation coefficient close to +1 or -1 means there is a clear linear relation between the targeted data pair, and that around zero means there is a few (or weak) relation between them.



Negative correlation



No correlation



Positive correlation

Regression analysis (1)

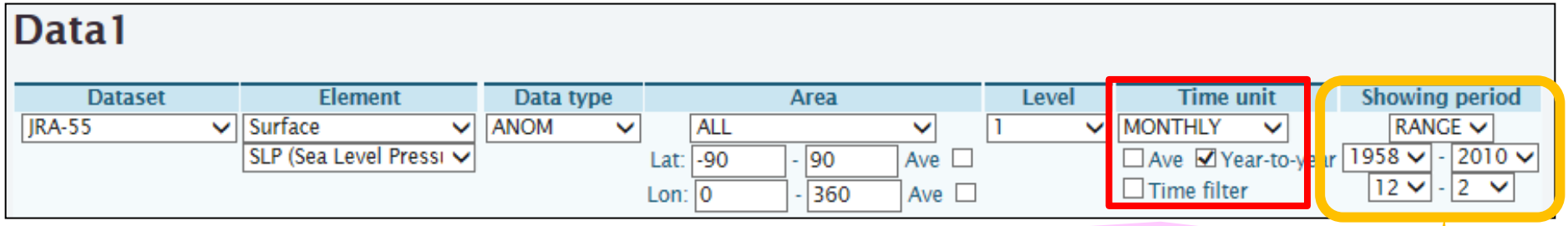
- Let's chart a regression map of three-month mean sea level pressure (SLP) onto SST anomaly in NINO.3 for DJF from 1958/1959 to 2010/2011.

- For a regression analysis, "Data1" is a responsible (dependent) variable, and "Data2" is an explanatory (independent) variable.
- In this case, "Data1" is SLP and "Data2" is SST anomaly in NINO.3.

- NINO.3 region is defined as 5°S–5°N, 150°–90°W.
- The element "NINO.3" in dataset "INDEX" is also available.

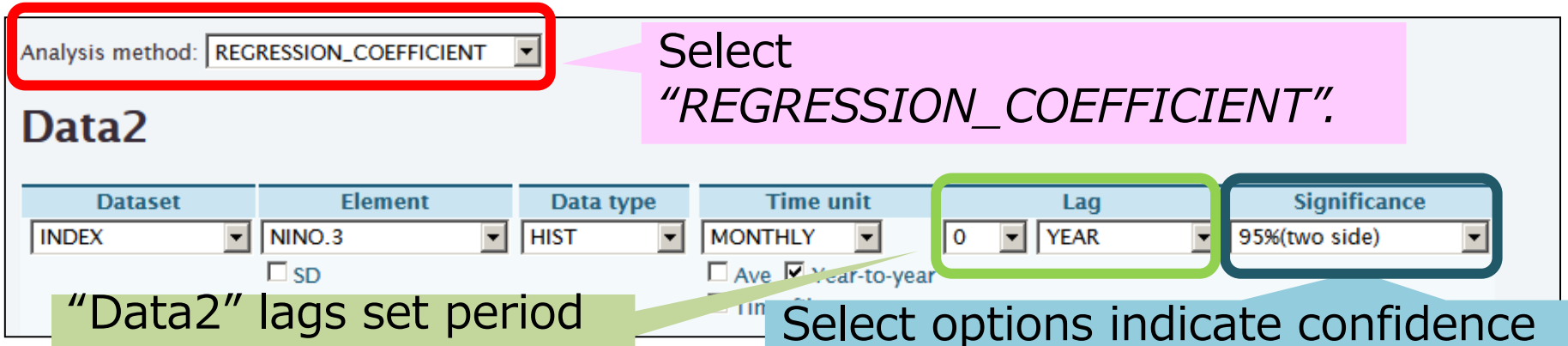
Regression analysis (2)

- Setting “Data1” and “Data2”.



“Year-to-year” must be checked in regression and correlation analysis.

Although the end of the range may appear to be February 2010, this setting means DJF average
from 1958/1959 (December 1958 to February 1959)
to 2010/2011 (December 2010 to February 2011).
Consider the setting for year and month separately.



Select *“REGRESSION_COEFFICIENT”.*

“Data2” lags set period behind “Data1”.

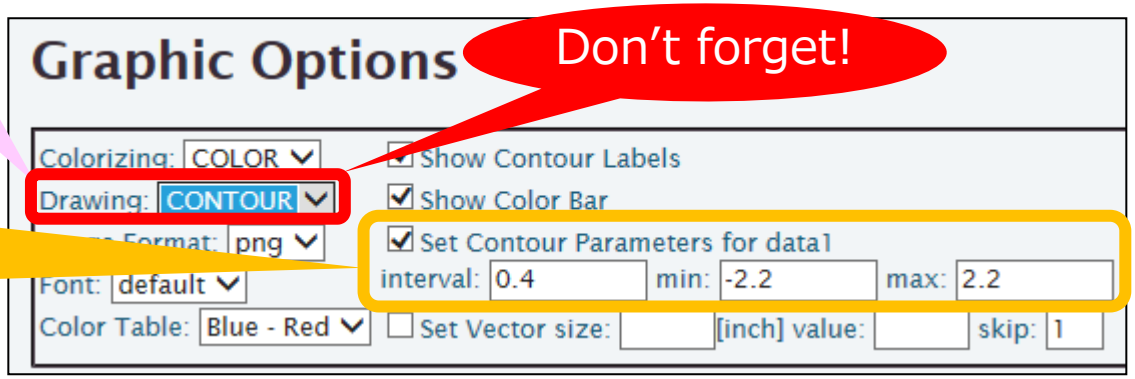
Select options indicate confidence level indicated by t-testing.

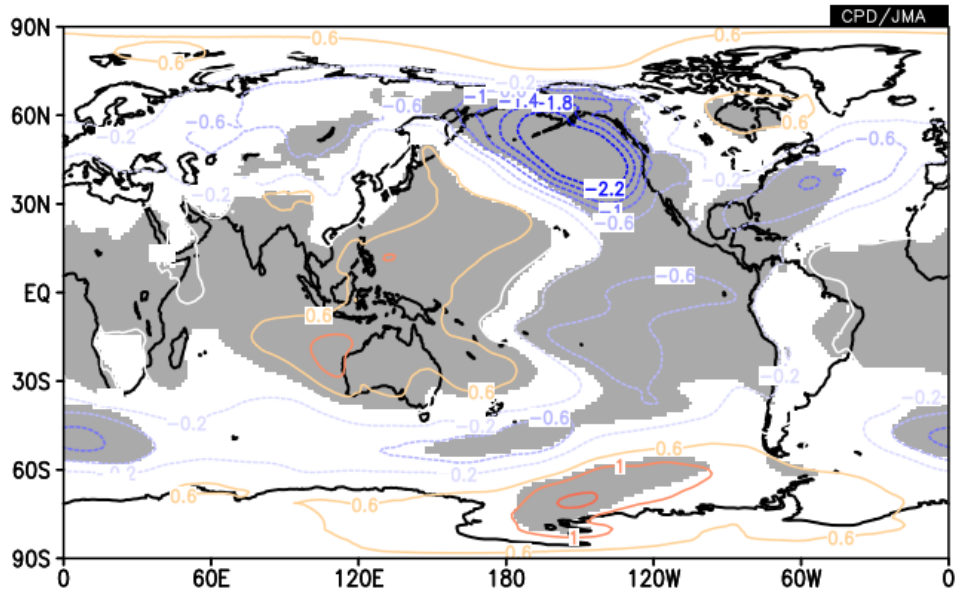
Regression analysis (3)

- Setting Graphic Options.

Set “Drawing” “CONTOUR” to shade the grids exceeding confidence level.

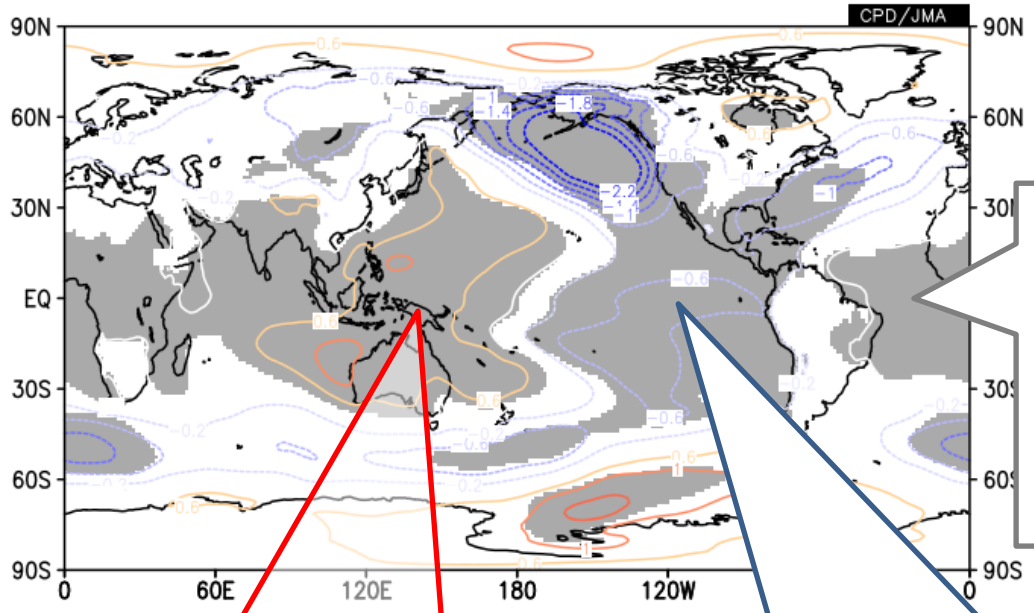
Set contour line (i.e., regression coefficient) properties.





Regression analysis (4)

Regression coefficient between NINO.3 index and SLP in DJF from 1958/59 to 2010/11.



The gray shading indicates a 95% confidence level as indicated by t-testing.

SLPs tend to increase associated with positive NINO.3.
The red contours indicate positive values of regression coefficients.

SLPs tend to decrease associated with positive NINO.3.
The blue contours indicate negative values of regression coefficients.

Correlation analysis

- Performing correlation analysis, select “CORRELATION_COEFFICIENT” analysis.
- Parameter settings are similar to regression analysis.

Data1

Dataset	Element	Data type	Area	Level	Time unit	Showing period
JRA-55	Surface / SLP (Sea Level Pressi)	ANOM	ALL; Lat: -90 - 90 Ave ☐; Lon: 0 - 360 Ave ☐	1	MONTHLY; ☐ Ave ☑ Year-to-year; ☐ Time filter	RANGE: 1958 - 2010; 12 - 2

☐ Vector ☐ SD
Derivative: ☐ lon ☐ lat

Analysis method: CORRELATION_COEFFICIENT

Select *“CORRELATION_COEFFICIENT”*

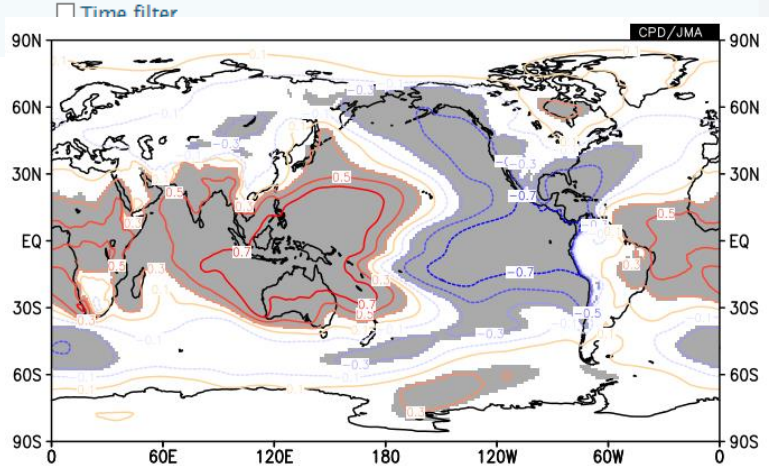
Data2

Dataset	Element	Data type	Area	Level	Time unit	Lag	Significance
INDEX	NINO.3 / ☐ SD	ANOM	ALL; Lat: -90 - 90 Ave ☐; Lon: 0 - 360 Ave ☐	1	MONTHLY; ☐ Ave ☑ Year-to-year; ☐ Time filter	0 YEAR	95%(two side)

Correlation coefficients takes value from -1 to 1

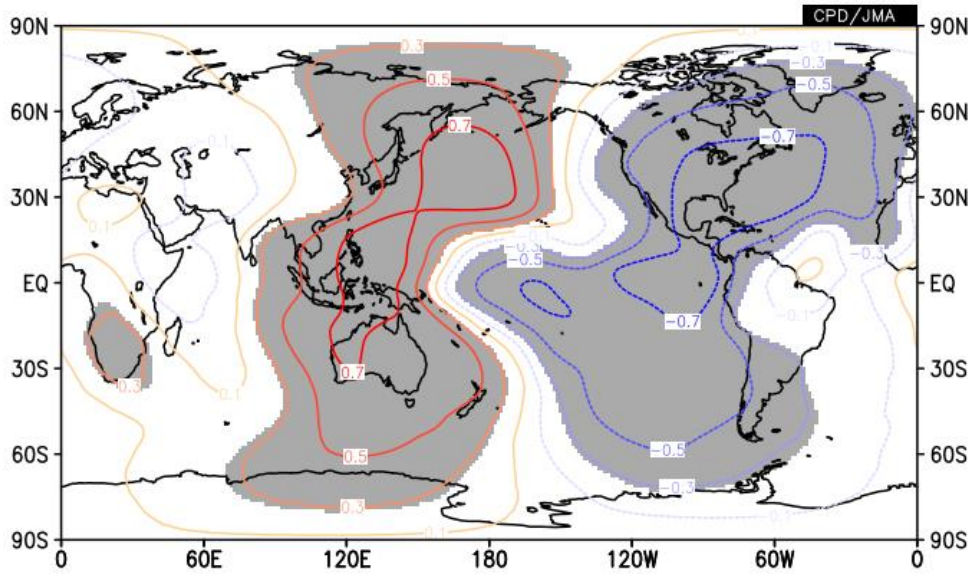
Graphic Options

Colorizing: COLOR ☑ Show Contour Labels
Drawing: CONTOUR ☑ Show Color Bar
Image Format: png ☑ Set Contour Parameters for data1
Font: default interval: 0.2 min: -0.7 max: 0.7
Color Table: Blue - Red ☐ Set Vector size: [inch] value: skip: 1



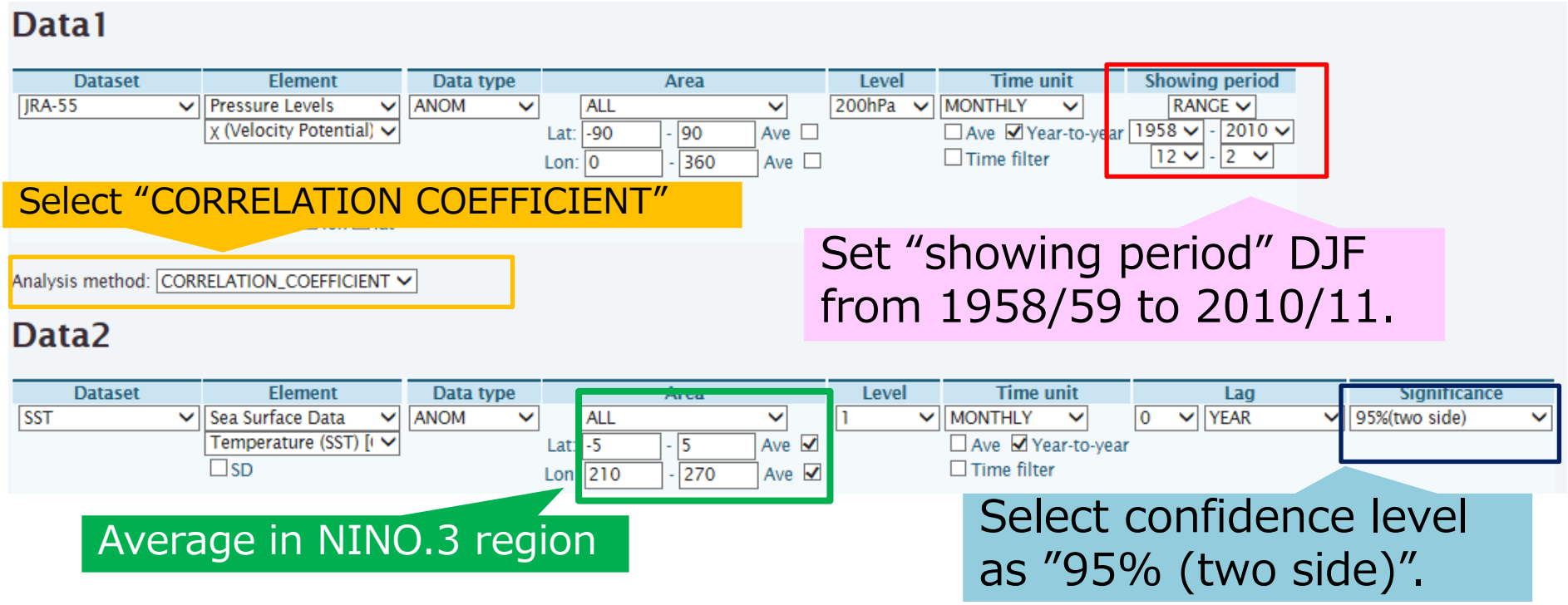
Exercises (6)

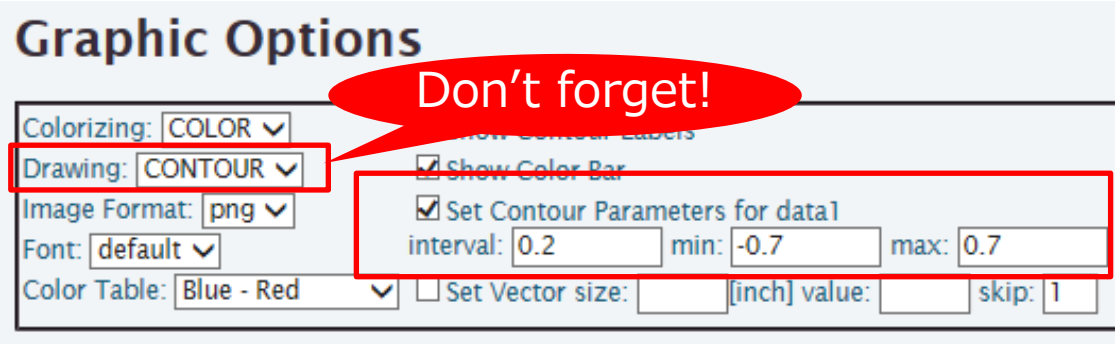
- Show a correlation coefficients map between 200-hPa velocity potential anomalies and SST averaged in NINO.3 area in DJF.
  - Set the statistical period from 1958/59 to 2010/11.
  - Velocity potential can be found in Dataset of “JRA-55”, Element of “Pressure Levels”.
  - NINO.3 is defined as the area in 5°S–5°N,150°–90°W.
  - Set the confidence level **95% (two side)**.



Correlation coefficient between χ200 and SSTA in NINO.3 in DJF.

Answers to Exercises (6)

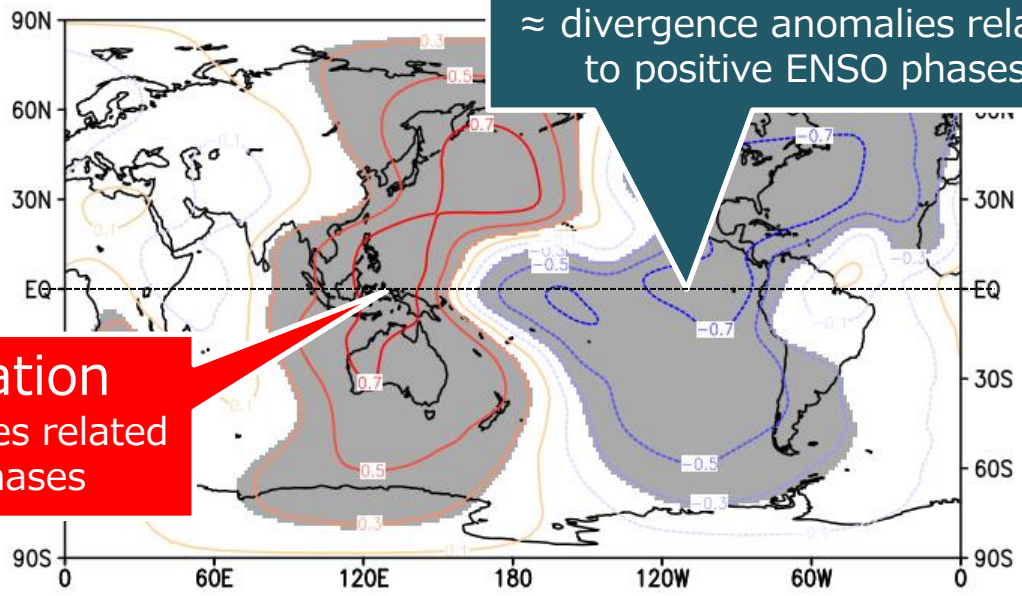




Topics: upper-tropospheric divergence associated with ENSO

- The correlation map of χ200 indicates that upper-tropospheric divergence (convergence) seen over the central – eastern (western) Pacific in association with El Niño conditions (i.e. positive NINO.3).

Correlation coefficient between χ200 and SST in NINO.3 in DJF.



Negative correlation
≈ divergence anomalies related to positive ENSO phases

Positive correlation
≈ convergence anomalies related to positive ENSO phases

Contents

1. Statistical Analysis in iTacs
   - Introduction
   - Regression / Correlation Analysis
   - Composite Analysis

2. Other Advanced operations
   - Data download
   - User data input

3. Integrated Exercise

Composite analysis (1)

- In composite analysis, the composited Data1 with the condition set in Data2 will be mapped as shown below.

Full set of data　Subset of data

1958
1959
1960
1961
1962
.
.
.
.
2010
2011
2012

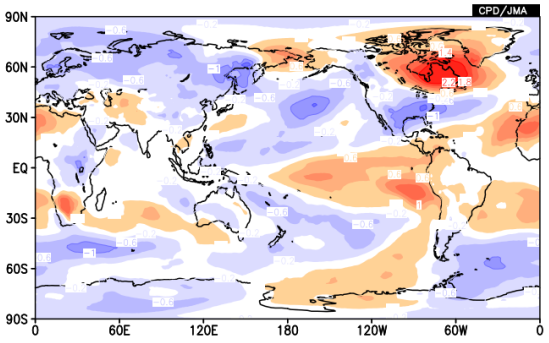
Designated Condition
(eg. SSTA in NINO.3 > 0.5)

Pick out the years

1963
1965
1968
.
.
.
1997
2002
2009

Average

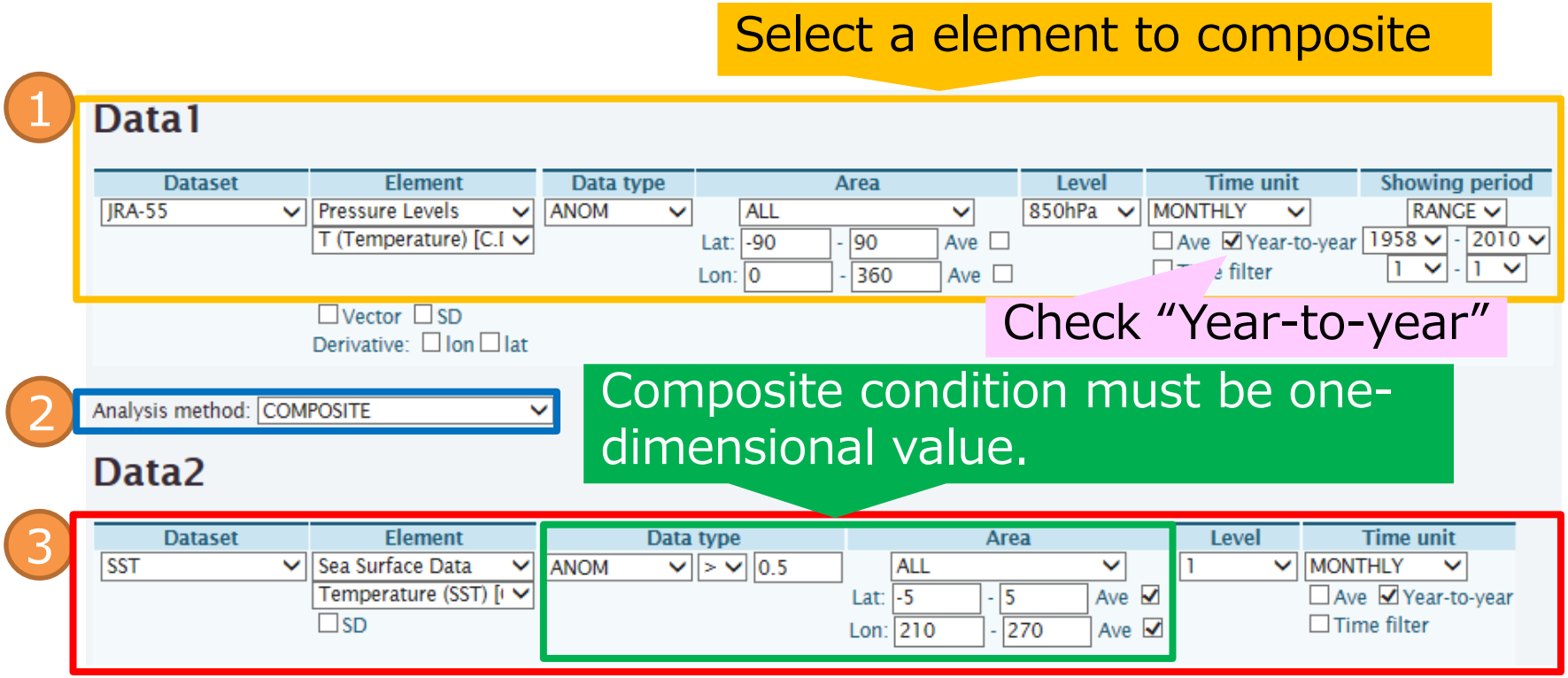
Composite map



Composite analysis (2)

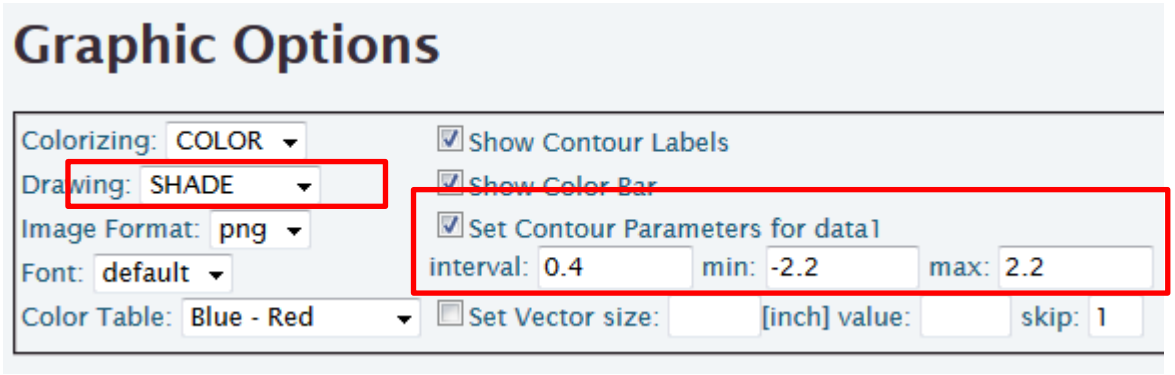
Let's chart composite map for 850-hPa temperature in January when NINO.3 SSTA > 0.5.

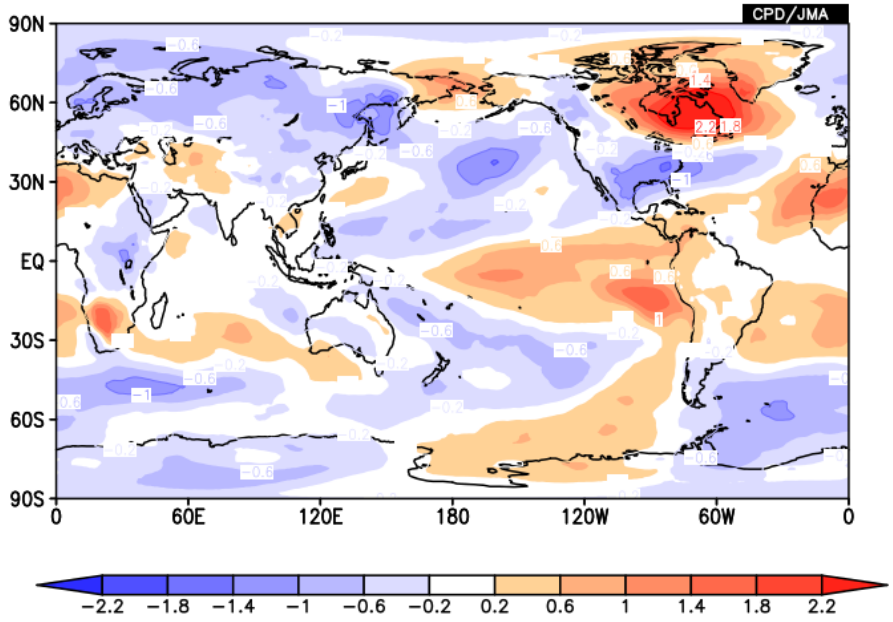
1. Set the "Data1".
2. Select "COMPOSITE" in the "analysis method" box.
3. Set the "Data2" (composite condition).



Composite analysis (3)

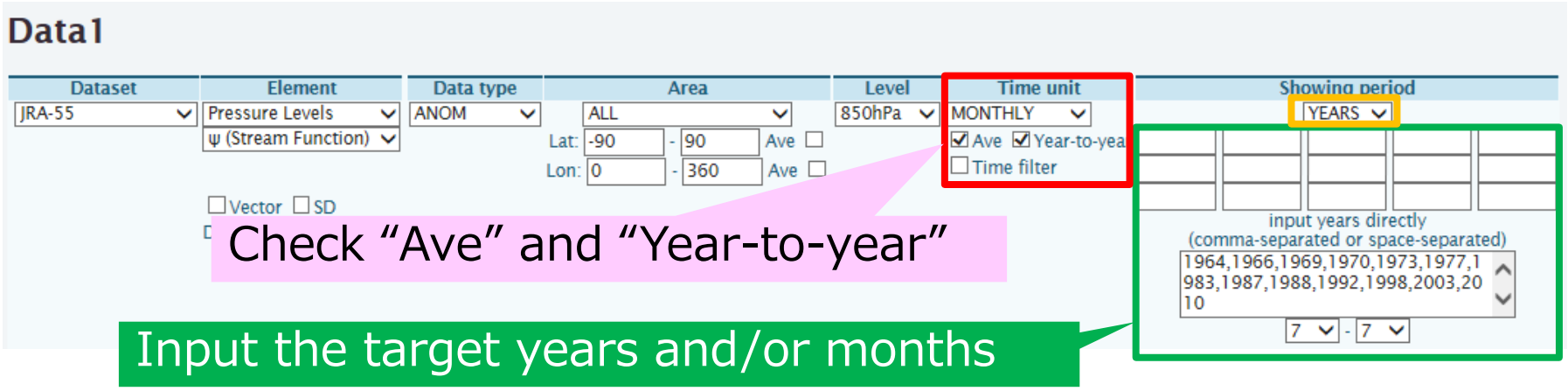
Let's chart composite map for 850-hPa temperature in January when NINO.3 SSTA > 0.5.

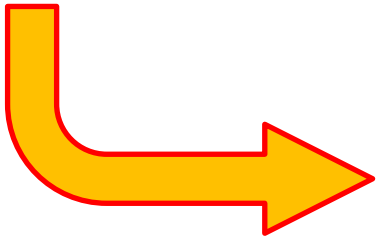


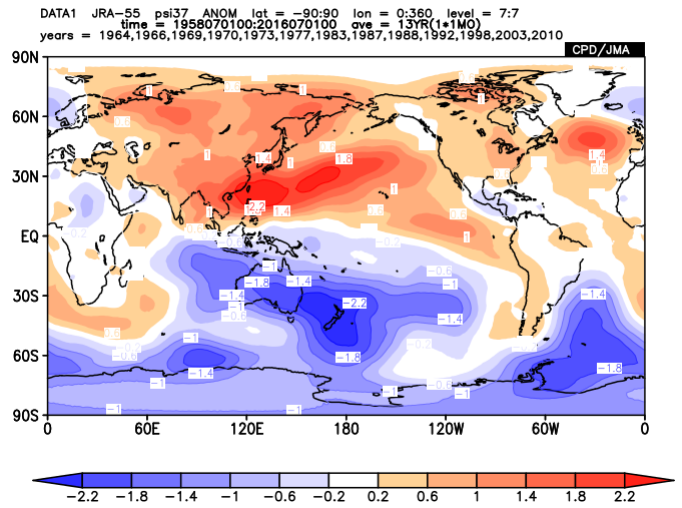


Composite analysis (4)

- If target years in the composite analysis are already decided, select “YEARS” and input the years and months in “Showing period”.



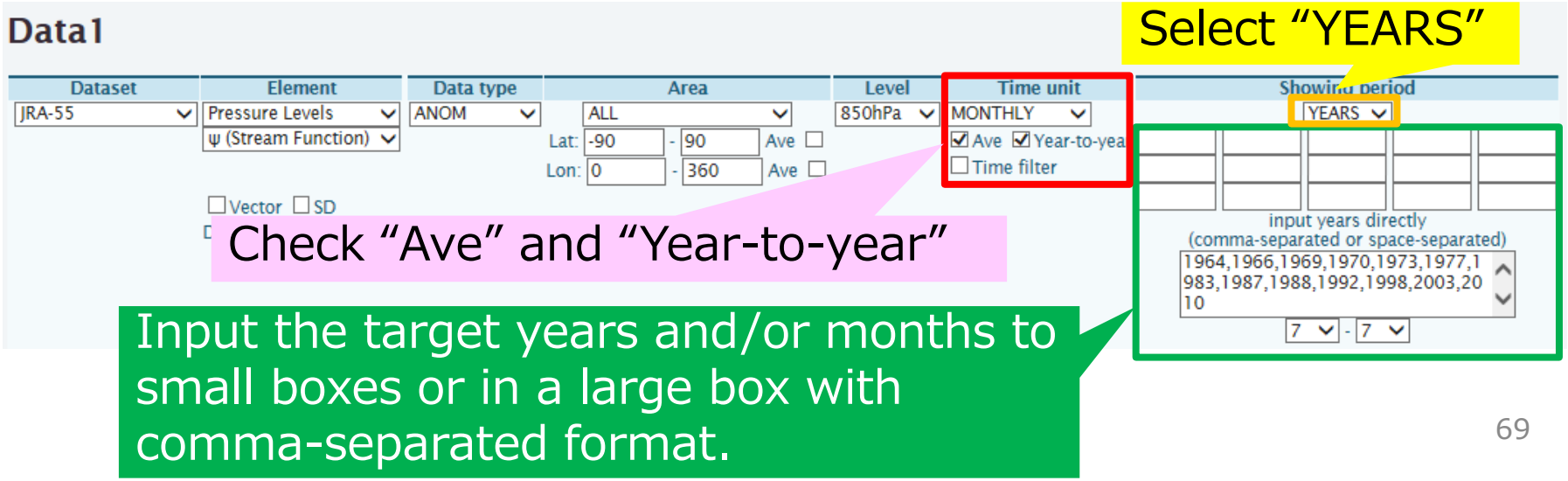




Composite of 850-hPa stream function anomalies in July for “post-El Niño” years.

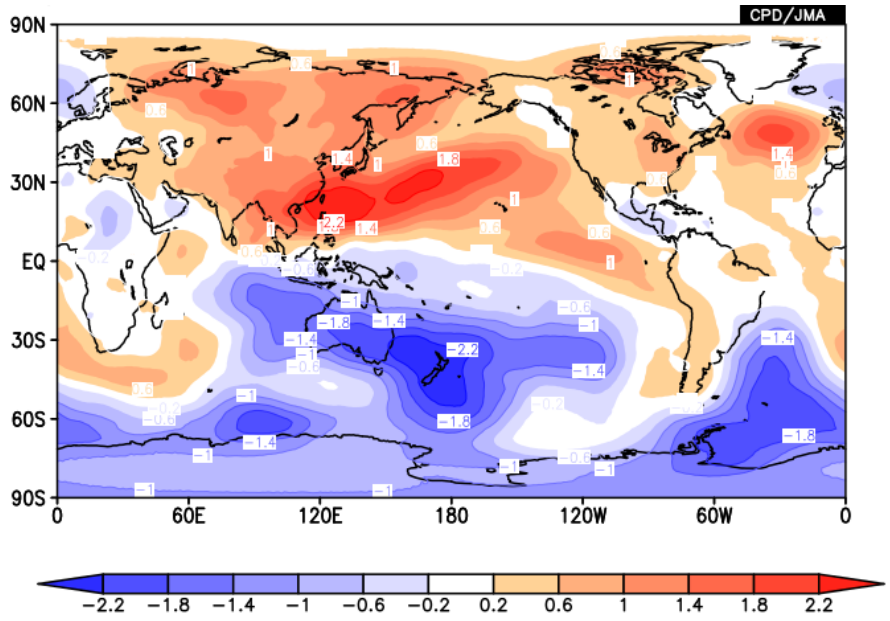
Composite analysis (5)

- If target years in the composite analysis are already decided, composite map can be drawn by average of “Data1” for target years.
- For example, let’s chart composite map for 850-hPa stream function anomaly in July in post-El Niño years.
  - Select “YEARS” in Showing period.
  - Input target years below. In this case, target years are 1964,1966,1969,1970,1973,1977,1983,1987,1988,1992,1998,2003, and 2010.



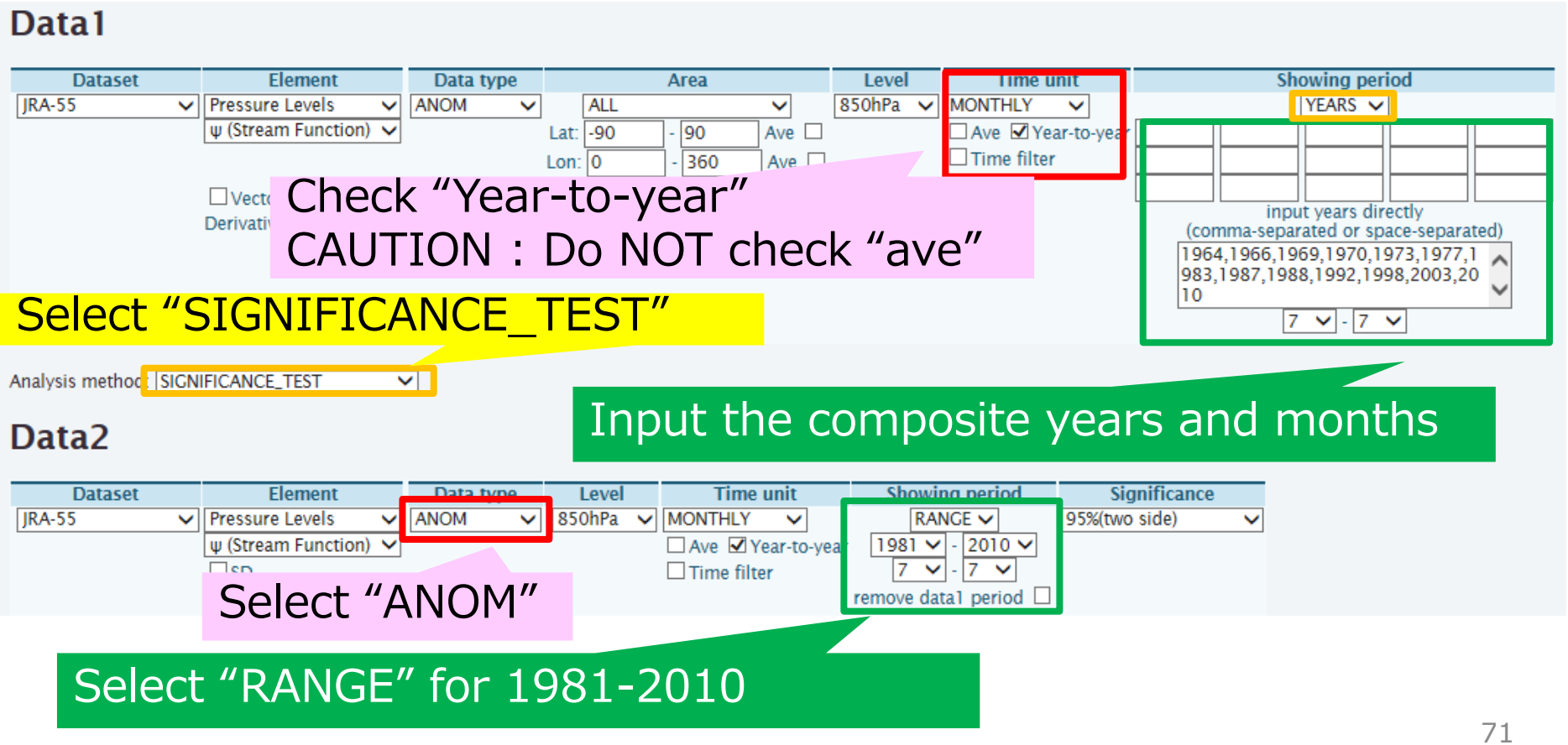
Composite analysis (6)

Composite map for 850-hPa stream function anomaly in July in post-El Niño years.



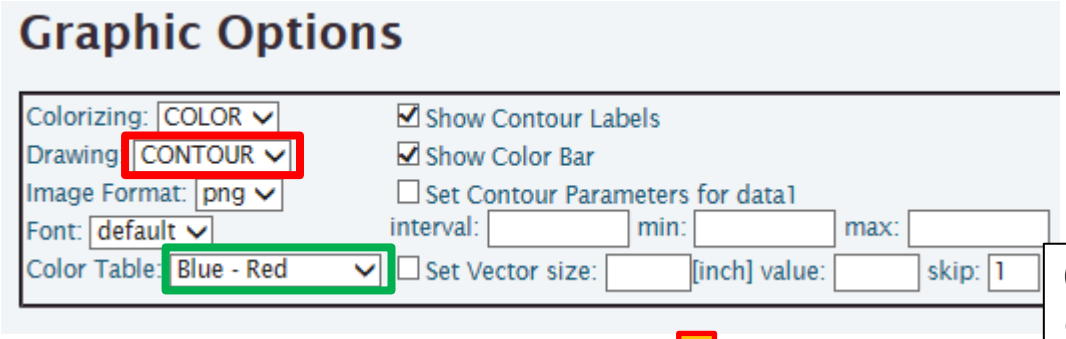
Composite analysis (7)

- If you want to draw composite map using anomaly relative to default (1981-2010 mean) climatology, significance of the composite anomaly can be drawn using “SIGNIFICANCE_TEST” analysis

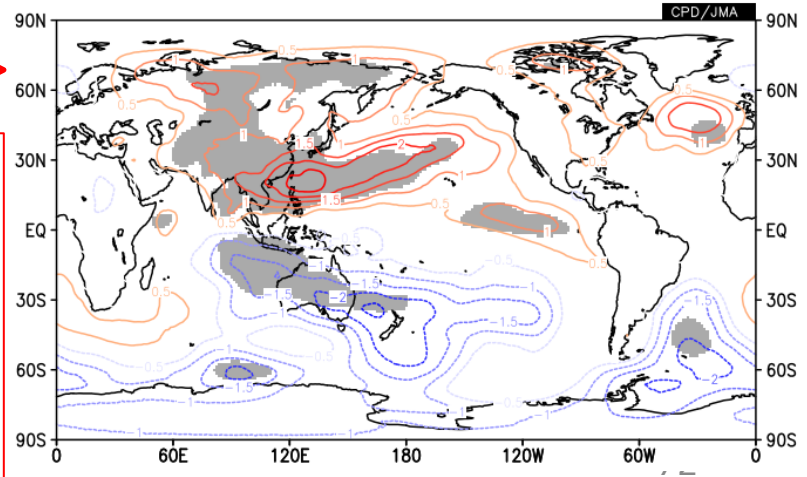


Composite analysis (8)

- If you want to draw composite map using anomaly relative to default (1981-2010 mean) climatology, significance of the composite anomaly can be drawn using “SIGNIFICANCE_TEST” analysis



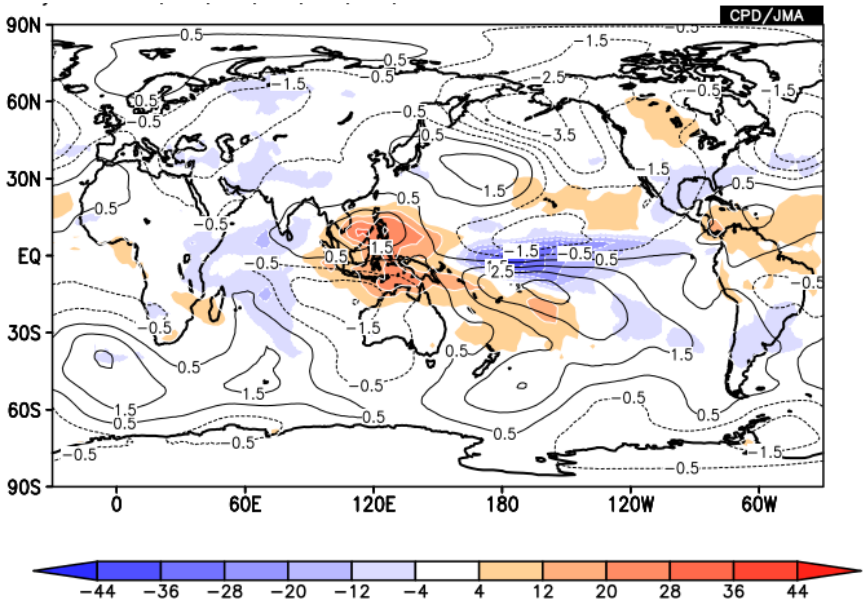
Contour : Composite anomaly
Shading : 95% confidence level



[CAUTION]
Contour indicates composite of “DATA1”, not “difference between DATA1 and DATA2”
Therefore, this method is valid only for anomaly based on default climatology (1981-2010 mean).

Exercise (7)

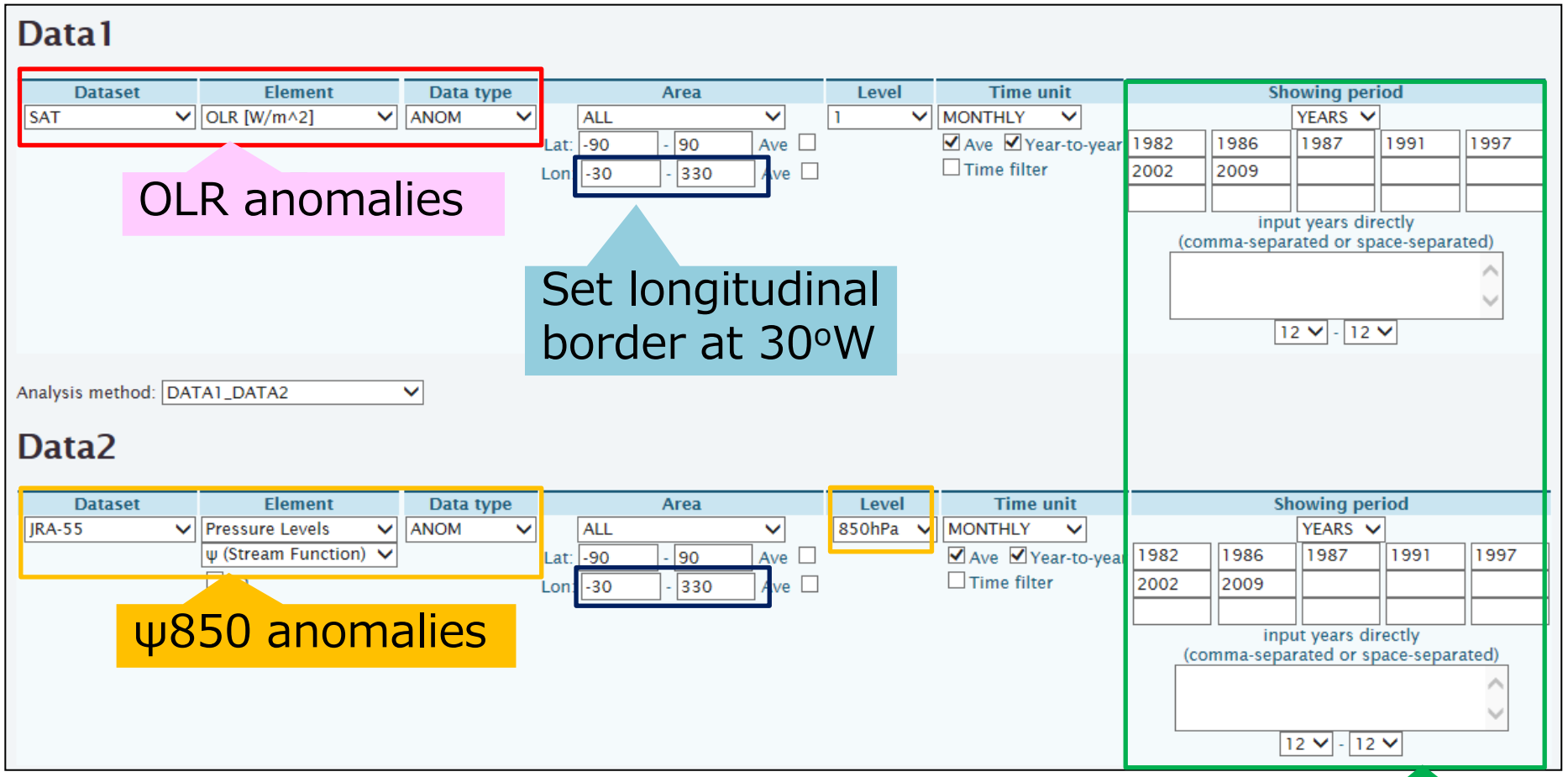
- Show the composite map of 850-hPa stream function anomalies (contour) and OLR anomalies (shading) in December during the El Niño years from 1979 to 2010.
  - The El Niño years are **1982, 1986, 1987, 1991, 1997, 2002, 2009** as listed in the JMA/TCC website. (http://ds.data.jma.go.jp/tcc/tcc/products/elnino/ensoevents.html)



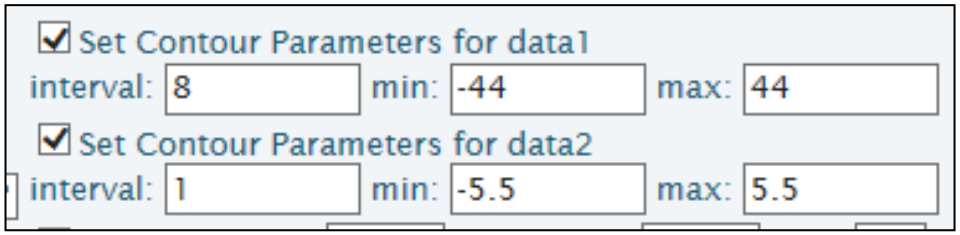
* Set longitudinal border at not 0° but 30°W (-30°) so as not to get across Africa and Europe.

Composite of 850-hPa stream function anomalies and OLR anomalies in December during El Niño years.

Answers to Exercise (7)

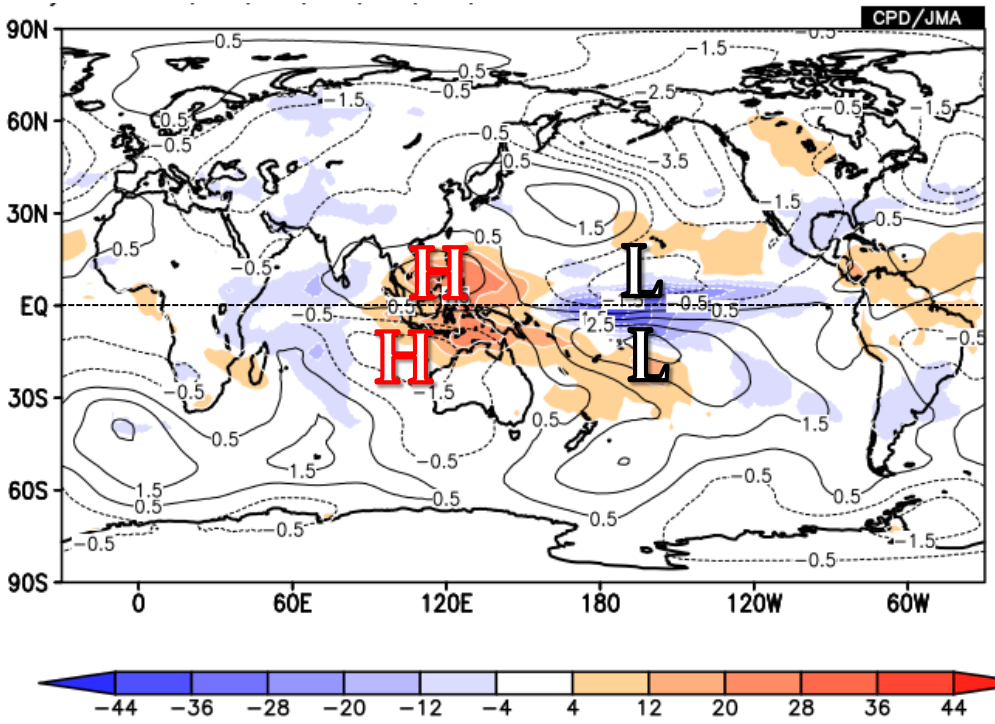


- Contour Parameters setting



Topics: Convection and circulation anomalies straddling the equator

- In El Niño years, circulation anomalies straddling the equator are dominant over the area from the Maritime Continent to the Pacific, indicating the Matsuno–Gill response to tropical convection anomalies.



Composite of 850-hPa stream function anomalies and OLR anomalies in December during El Niño years.

Contents

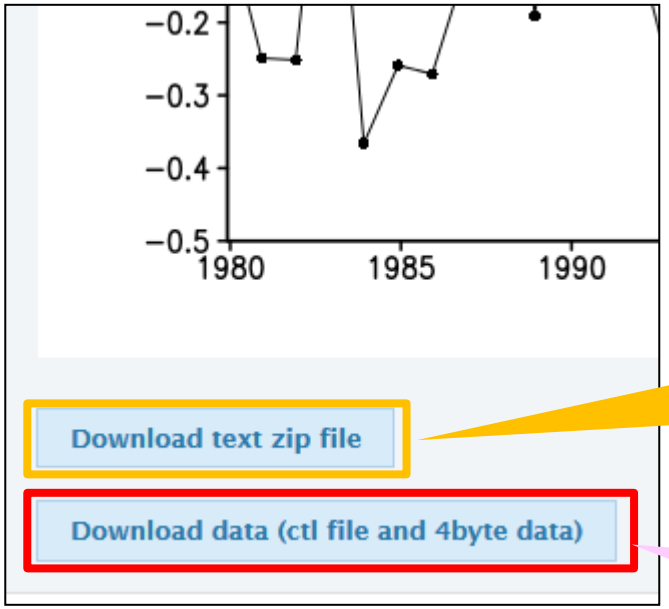
1. Statistical Analysis in iTacs
   - Introduction
   - Regression / Correlation Analysis
   - Composite Analysis

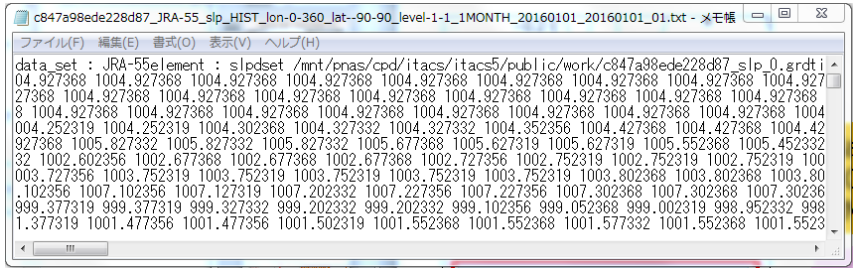
2. Other Advanced operations
   - Data download
   - User data input

3. Integrated Exercise

Data download

- Users can download the data used to create a map.
- A plain text file and GrADS format files (control file and data file) are available.





Plain text data file
- Gridded value
- Map information (area, elements)

- GrADS format data file
- GrADS control (*.ctl) file

(GrADS official website; http://grads.iges.org/grads/head.html)
(GrADS tutorial on TCC;
http://ds.data.jma.go.jp/tcc/tcc/products/model/tips/tutorial.html)

Using user input data (1)

- The time series data made by individual users is available in a dataset name “USER_INPUT”.
  - The data must be one element.
  - For example, a correlation or regression coefficient map between single station data or user’s original index and another dataset like JRA-55 can be created by this function.
- There are two ways to set data.
  - **UPLOAD_TXT** : Data are given by an uploaded text file.
  - **INPUT_DATA** : Data are directly input to the box.

Sample text file

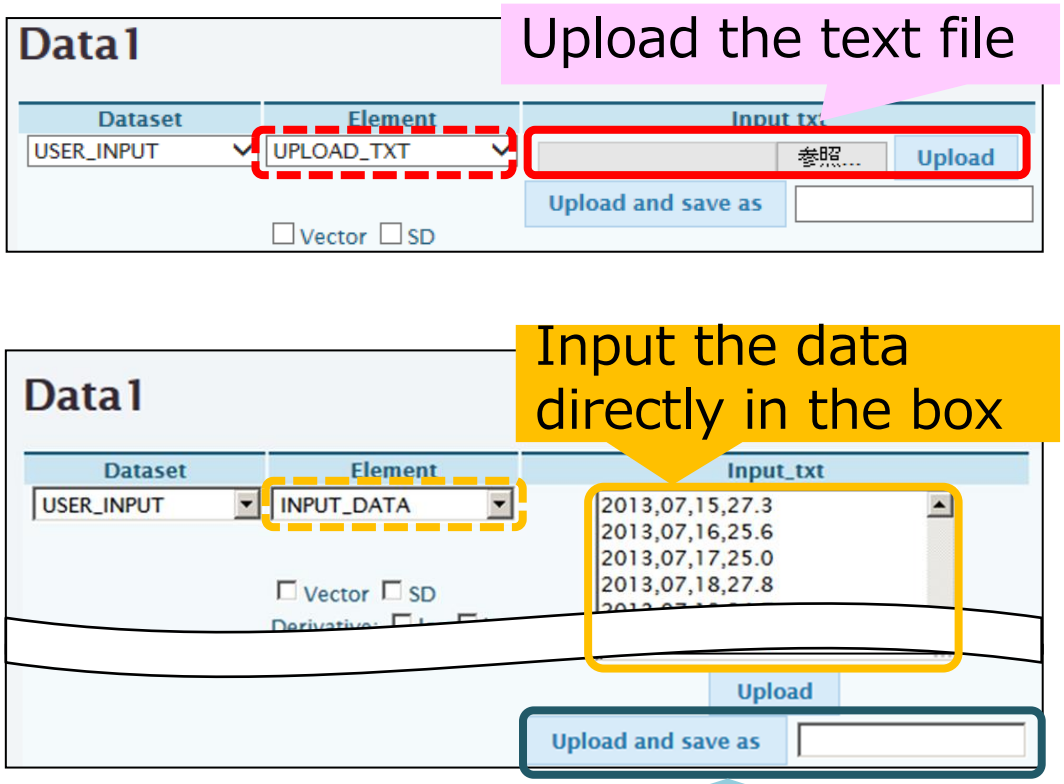
```
#Daily temperature
#undef = 9999
#element = Daily Ts
2013,07,01,23.6
2013,07,02,24.3
2013,07,03,24.5
2013,07,04,9999
2013,07,05,27.4
2013,07,06,28.9
```

<Data format>

- Data must be separated by comma and must be given by specified format as “year, month, day, value”. In case of monthly data, “day”s are always given as “1”.
- Sentences beginning with “#” have special meanings.
  - # : Comment (except for two cases shown below).
  - #undef = : Definition of missing data (default is -9999).
  - #element = : Data name used to save them on the server.

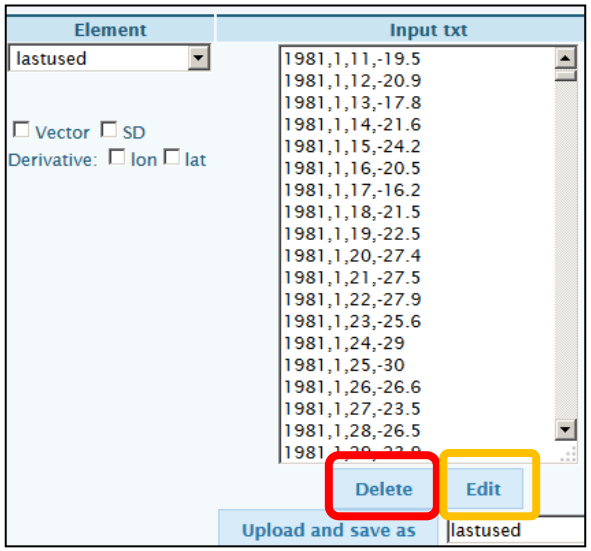
Using user input data (2)

- Upload/input the data



Input the name to save them on the server, and click the “upload and save as” button.

- Control the uploaded data

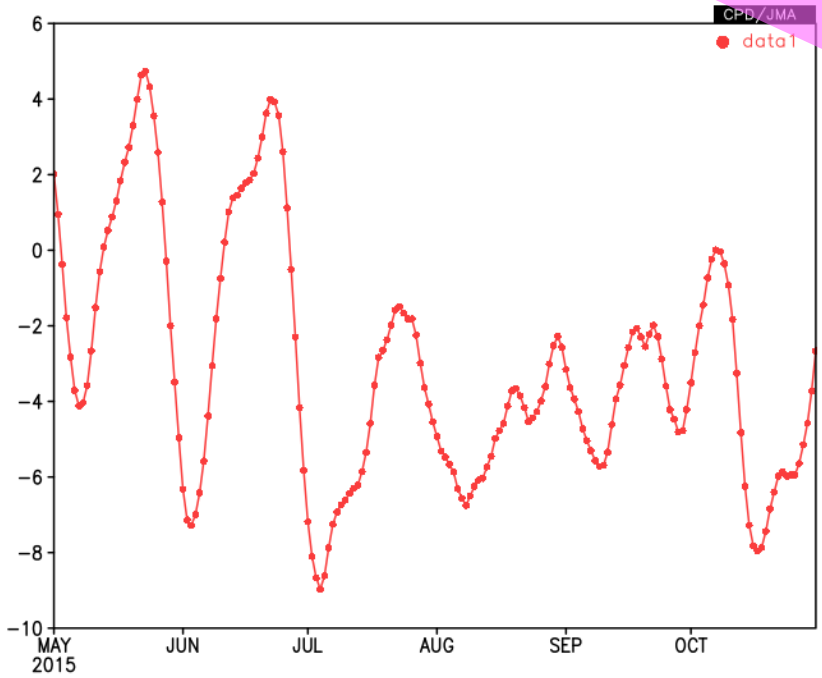


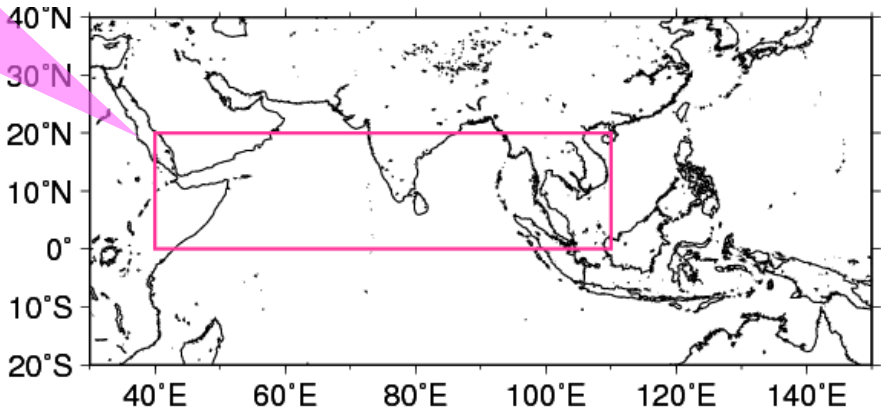
- Select the data name and click “Delete” button to delete the data from the server.
- Click “Edit” button to edit the data in the box.

Contents

Integrated Exercise (1)

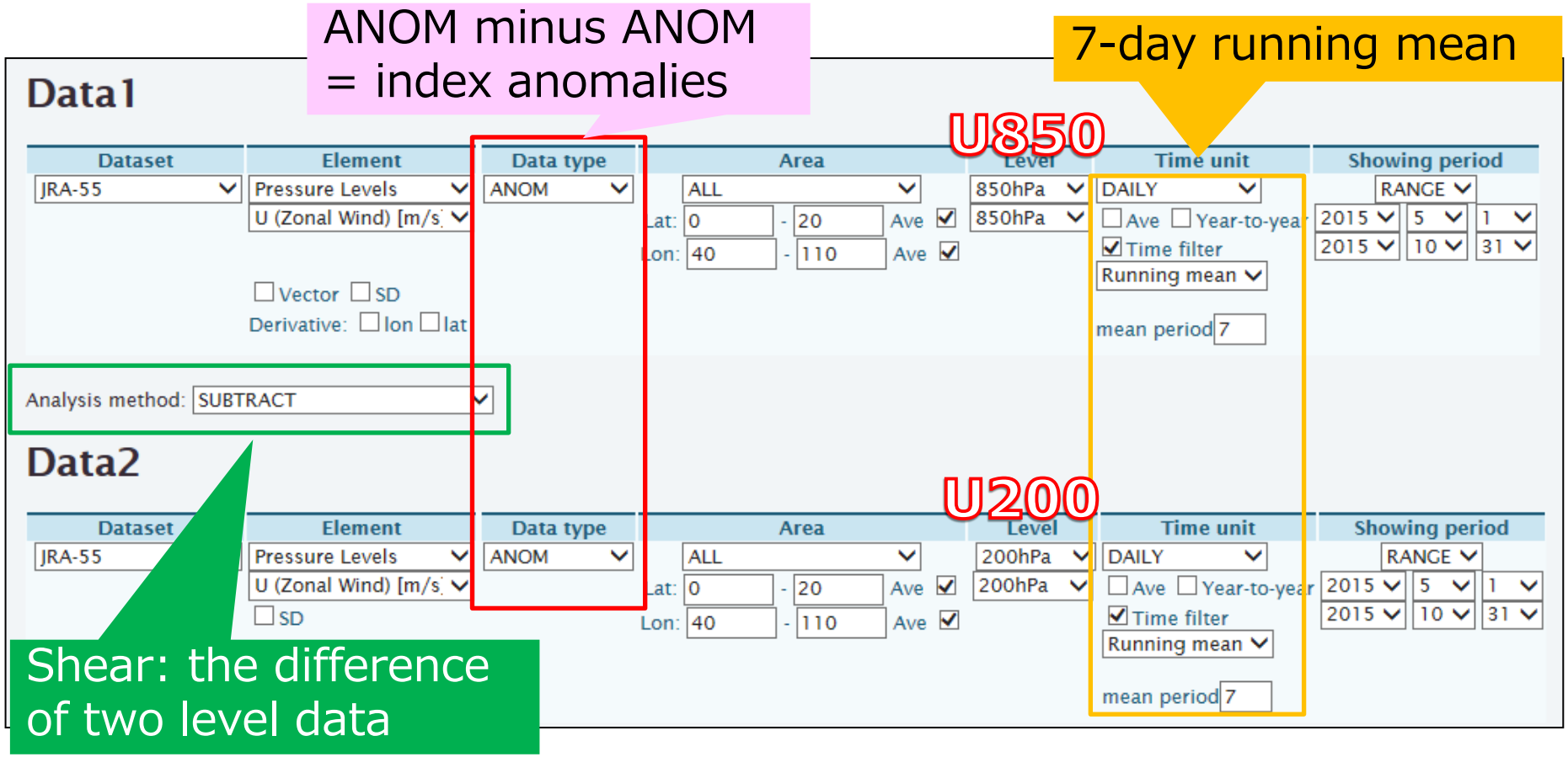
- Show a daily time series of **7-day running mean anomalies** of Asian monsoon indices defined by Webster and Yang (1992) during the period from 1 May to 31 October 2015.
  - The monsoon indices are defined as the zonal wind shear (**difference**) between **850 hPa** and **200 hPa** over the area of equator–20°N, 40°–110°E.





Positive (negative) anomalies of the index indicate stronger (weaker)-than-normal monsoon circulation.

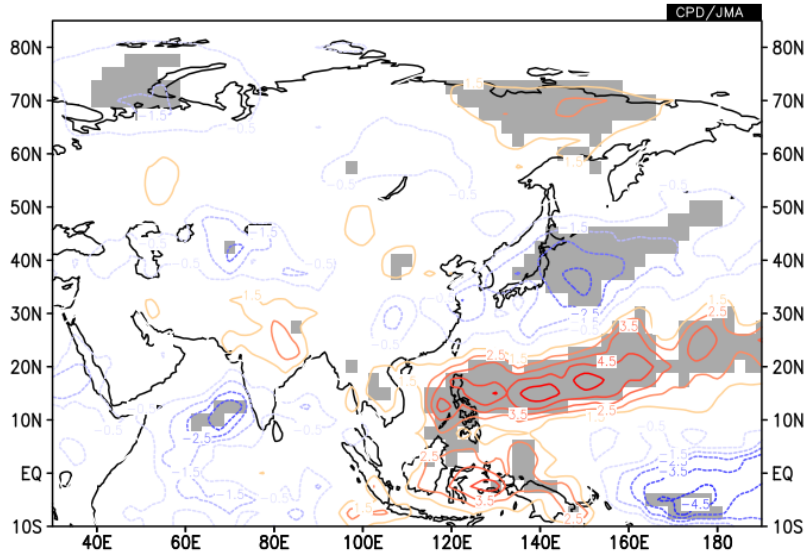
Answers to Integrated Exercise (1)



Integrated Exercise (2)

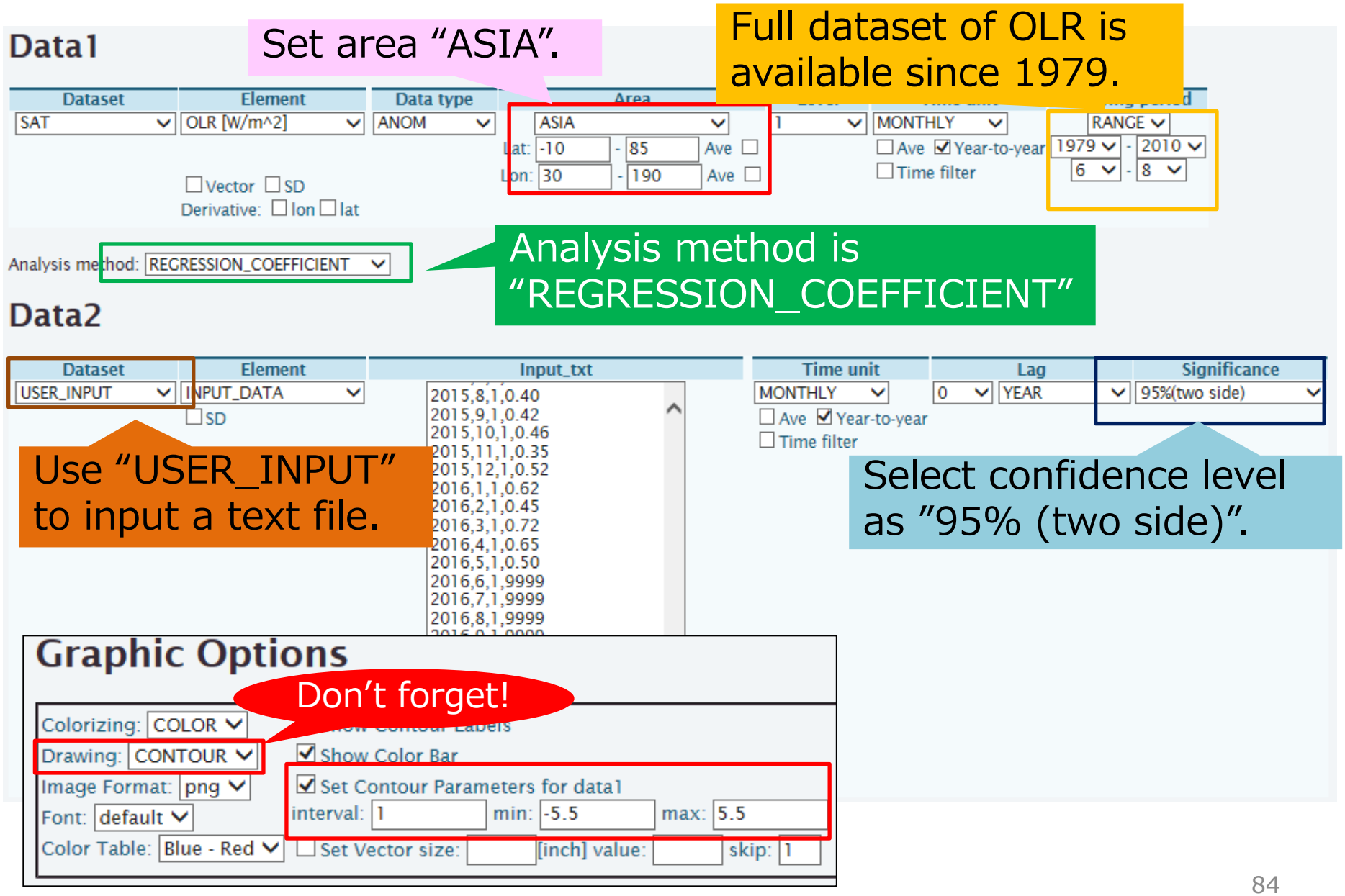
- Show a regression map of OLR anomaly over the “ASIA” area onto IOBW index in June – August period.
  - Set the statistical period from 1979 to 2010.
  - Set the confidence level **95% (two side)**.
  - Use “USER_INPUT” to analyze IOBW index.
    CSV file is available here.
    (http://extreme.kishou.go.jp/tool/share/iobw.csv)

* IOBW is defined as the area in the Indian Ocean basin-wide (20°S–20°N,40°–100°E).



Regression coefficient between OLR and IOBW index in JJA.

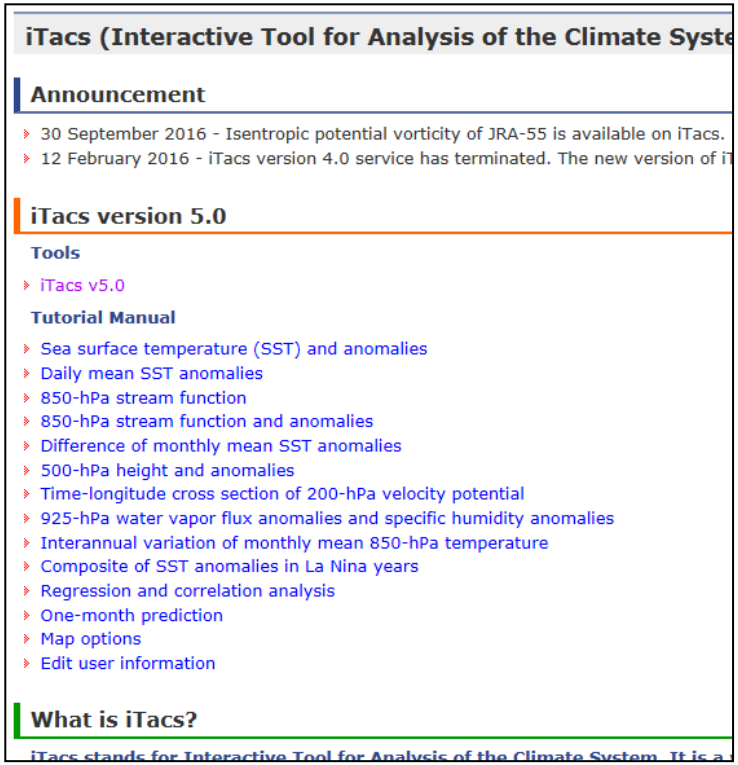
Answers to Integrated Exercise (2)



To learn more about iTacs

- Online help page and tutorial manual are available on the iTacs website.

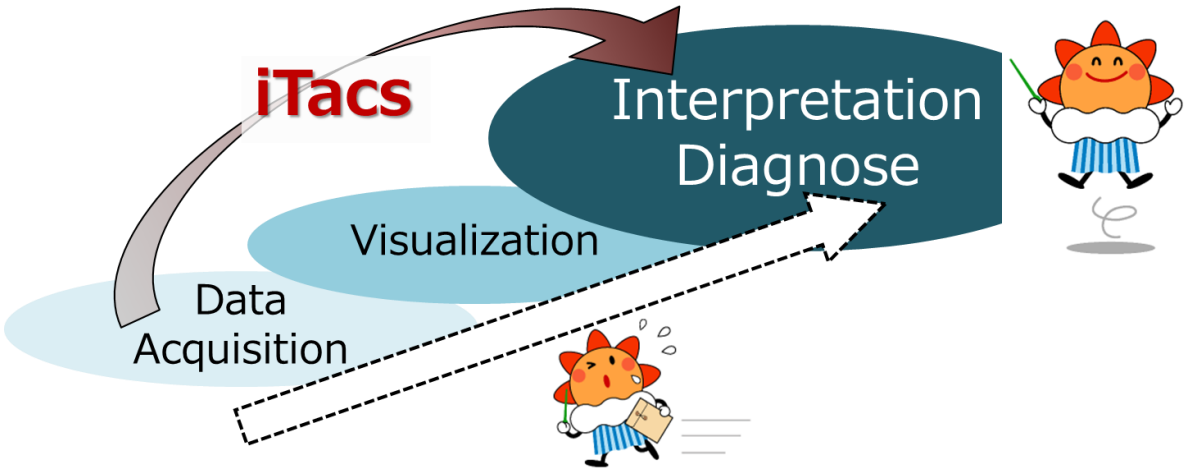
- Turorial: http://extreme.kishou.go.jp/tool/itacs-tcc2015/
- Help page: http://extreme.kishou.go.jp/itacs5/assets/help.html



Thank you for your attention!

If you are interested or have any questions, please feel free to contact us.

- TCC Web Site: http://ds.data.jma.go.jp/tcc/tcc/index.html
- TCC E-mail: tcc[at]met.kishou.go.jp



References

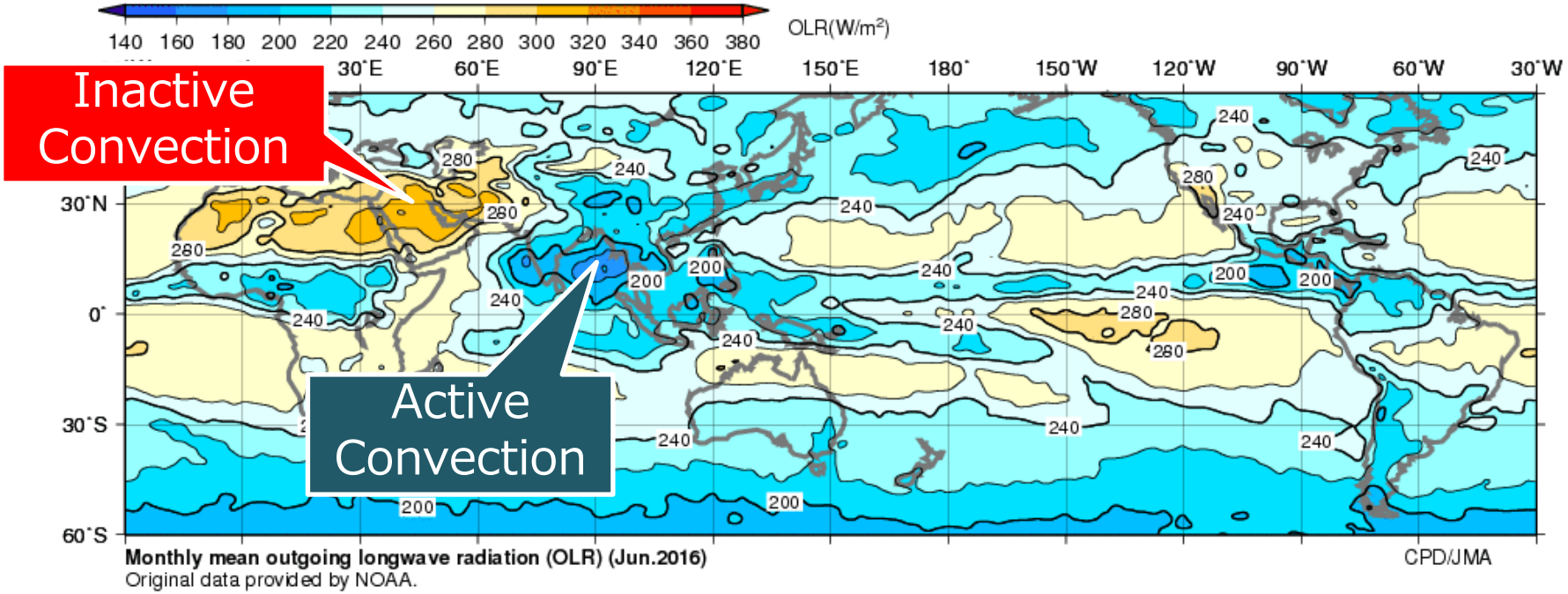
- Duchon, 1979: Lanczos Filtering in One and Two Dimensions, *J. Applied Met*., **18**, 1016-1022.
- Ishii et al., 2005: Objective Analyses of Sea-Surface Temperature and Marine Meteorological Variables for the 20th Century using ICOADS and the Kobe Collection. Int. *J. Climatol*., **25**, 865-879.
- Kobayashi et al., 2015: The JRA-55 Reanalysis: General Specifications and Basic Characteristics. *J. Meteorol. Soc. Japan*, **93**, 5-48.
- Toyoda et al., 2013: Improved Analysis of Seasonal-Interannual Fields Using a Global Ocean Data Assimilation System, *Theoretical and Applied Mechanics Japan*, **61**, 31-48.

Supplemental explanation

Outgoing Longwave Radiation (OLR)

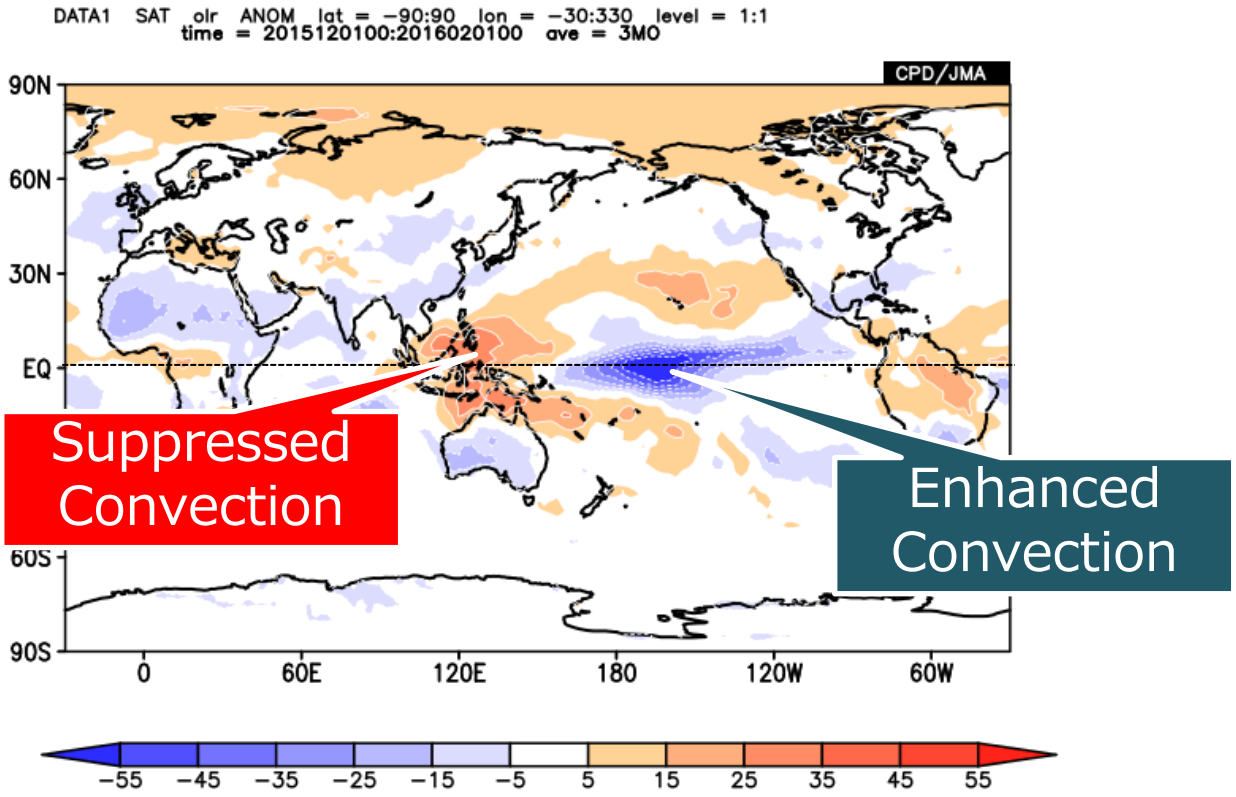
- OLR is an index that represents temperatures of the earth surface as observed from the space by a satellite.
- Lower (higher) OLR indicates a radiation emitted from the top of cumulonimbus clouds (the ground) over the area of active (inactive) convection.

Monthly-mean OLR in June 2016



Topics: Anomalous convective activities associated with the El Niño event

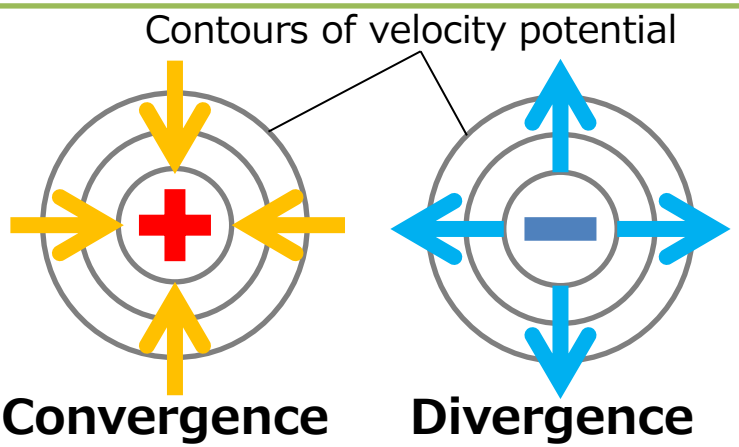
- In the equatorial region, enhanced (suppressed) convective activities were seen over the central to eastern (western) Pacific.
- These anomaly patterns are statistically seen during the El Niño events.



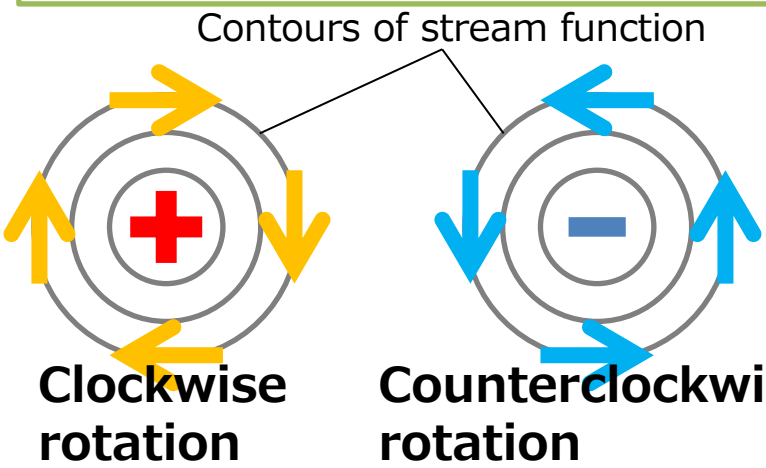
Velocity potential and stream function

- Air flow can be decomposed into a divergent part and a rotational part under the assumption of perfect fluid.
- Velocity potential indicates the divergent part.
  - Divergent wind blows across contours of it, from areas of low to high, regardless of the hemisphere.
  - Strong divergence at upper troposphere corresponds to active convection.
- Stream function indicates the rotational part.
  - Rotational wind blows parallel to contours of it, with low value to the left, regardless of the hemisphere.
  - Air flow around local maximum (i.e. clockwise) corresponds to anti-cyclonic rotation in the N.H. and cyclonic rotation in the S.H.

Velocity potential (divergent part)



Stream function (rotational part)

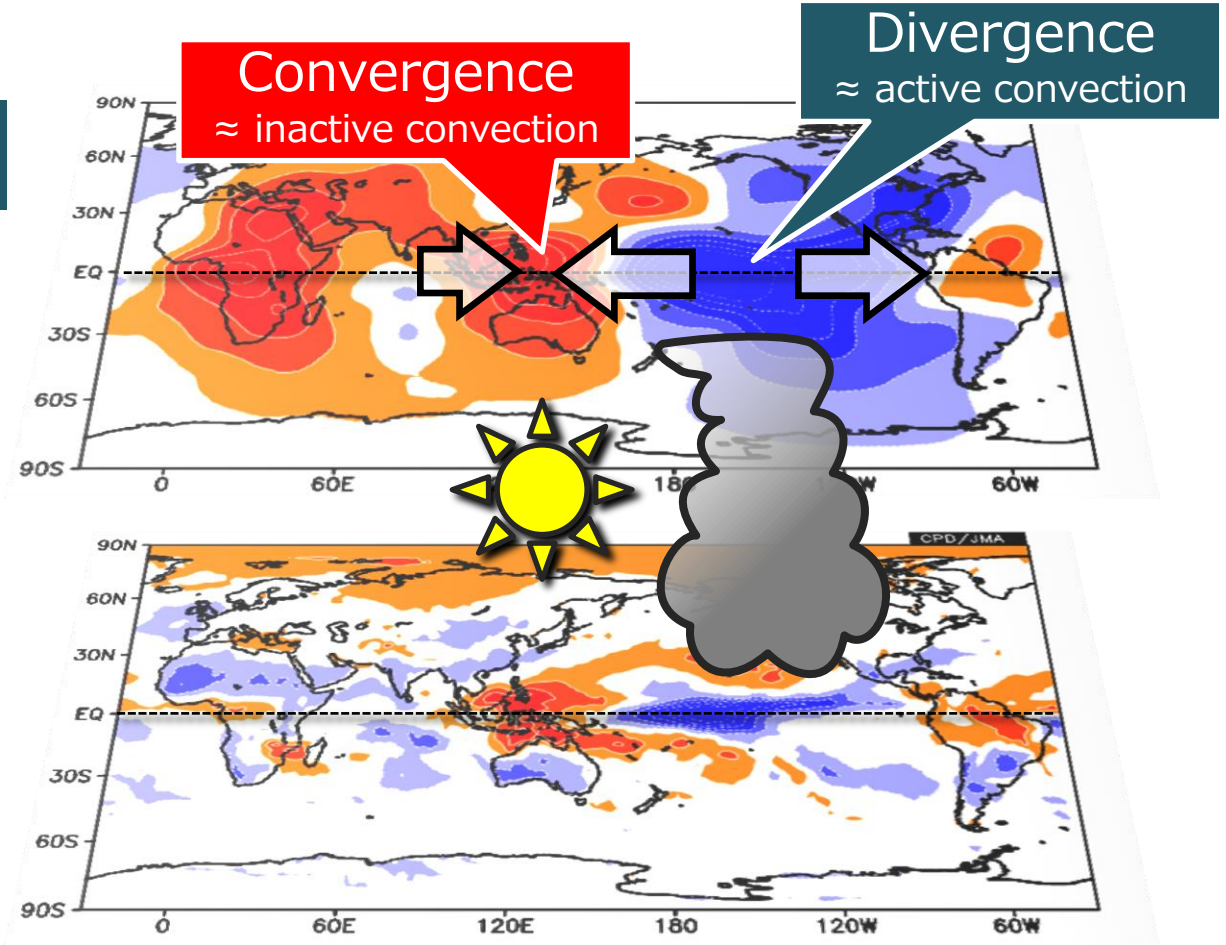


Tropical Convection and divergence

- In association with the enhanced (suppressed) convective activity, upper-tropospheric divergence (convergence) anomalies were seen over the central to eastern (western) during El Niño winter 2015/16.

χ200 anom.

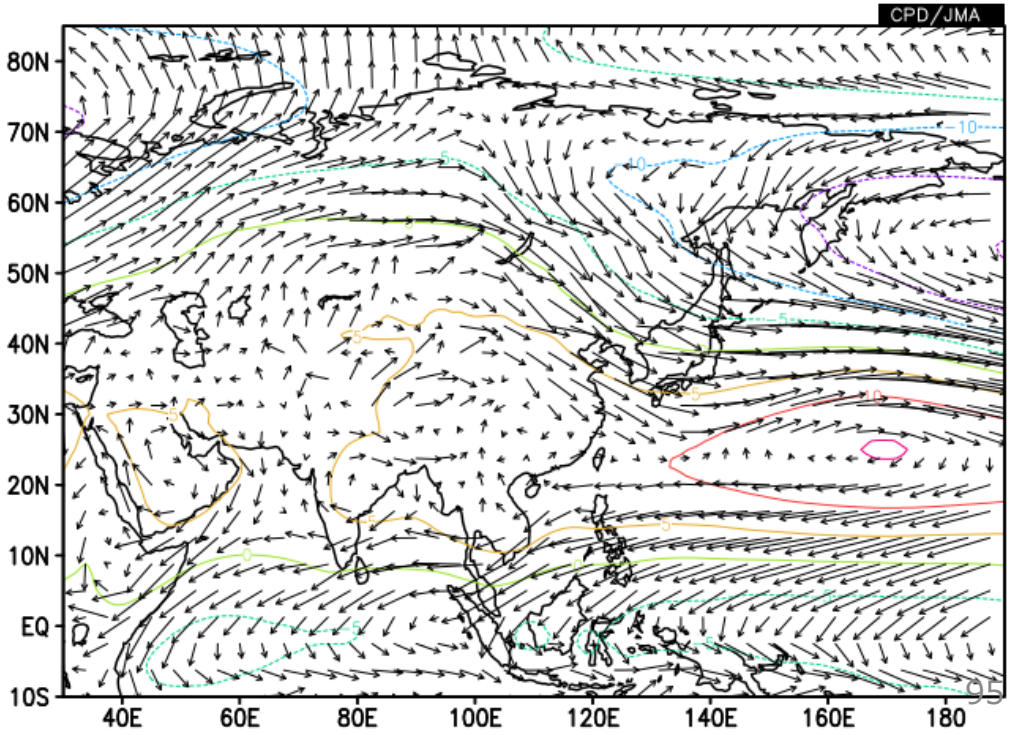
OLR anom.



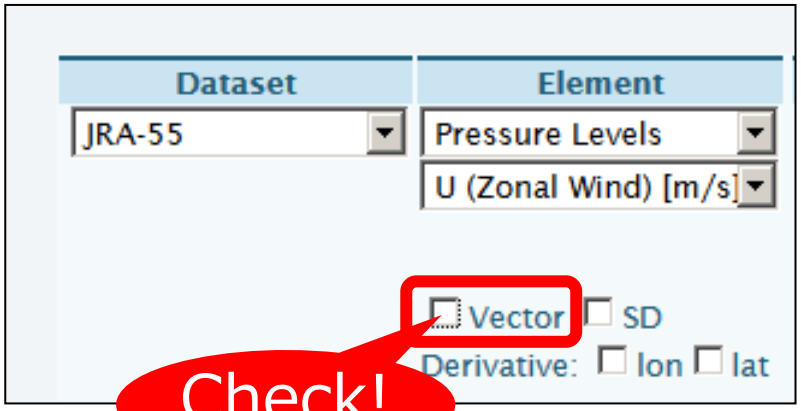
Vector map

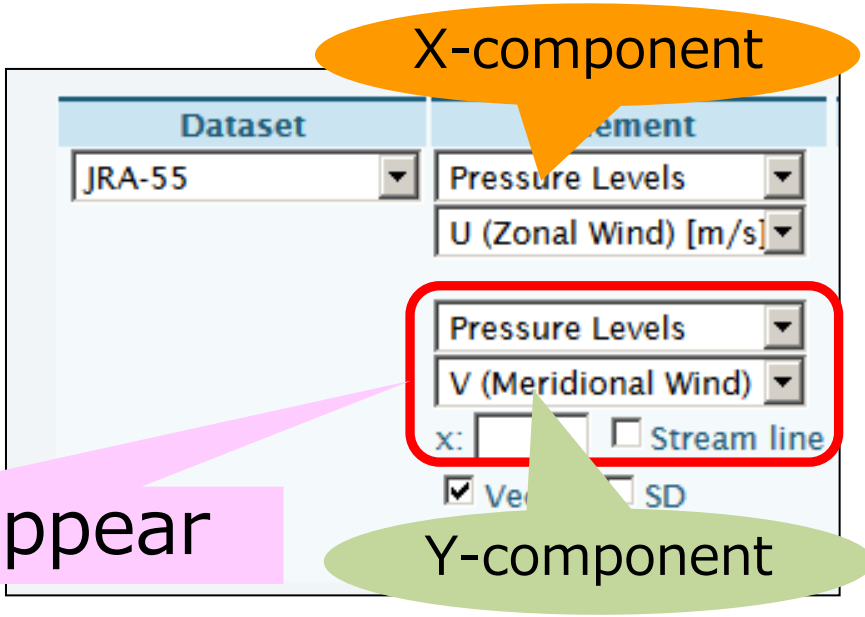
- A vector map is available to see flow or flux.
  - For example, set U and V to see blowing wind.
  - Barbs are not available. (Barb:  and)

850-hPa wind vector and stream function (contour) in February 2016

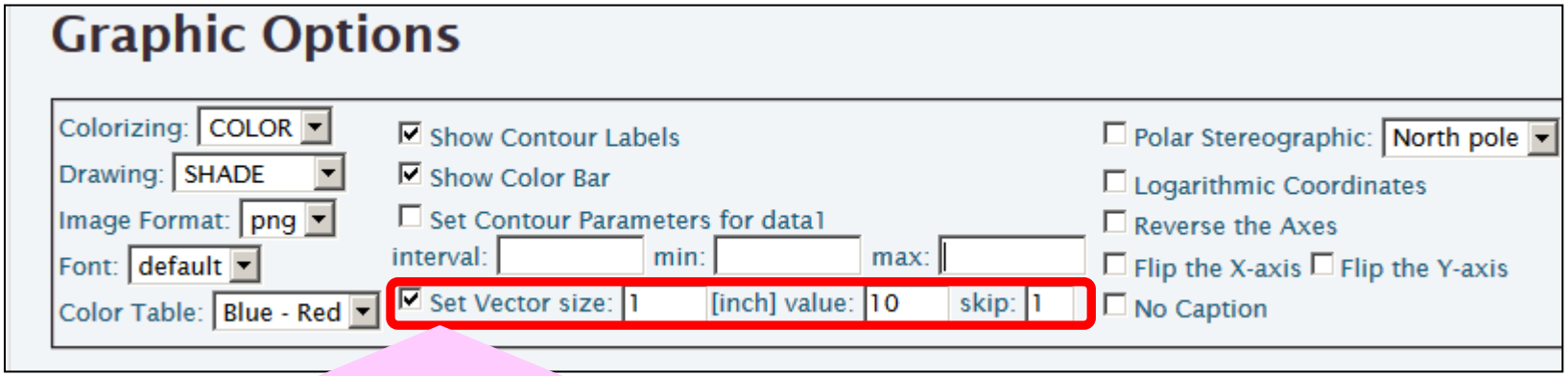


Vector map





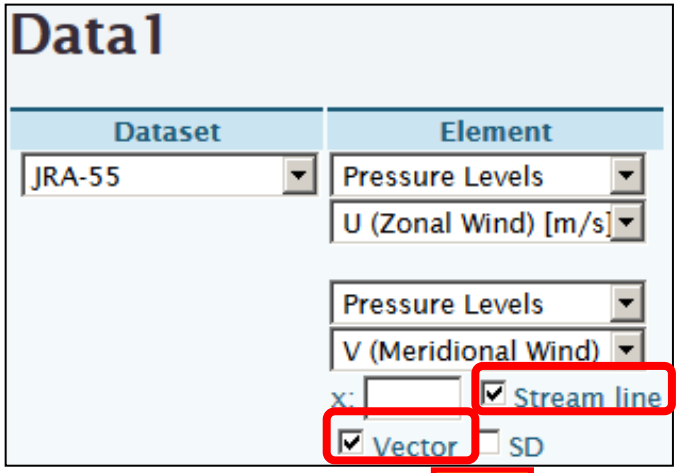
This area will appear

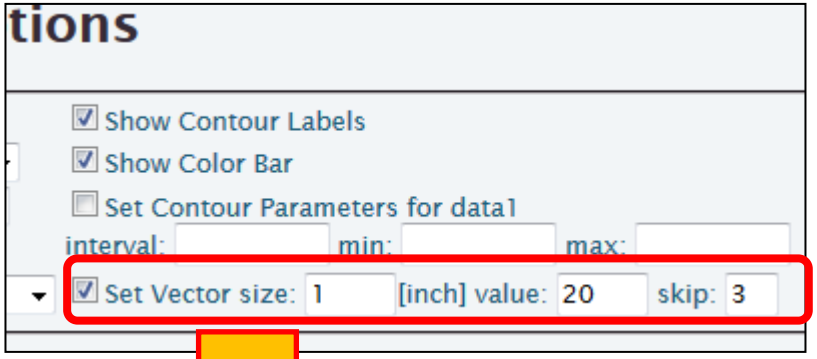


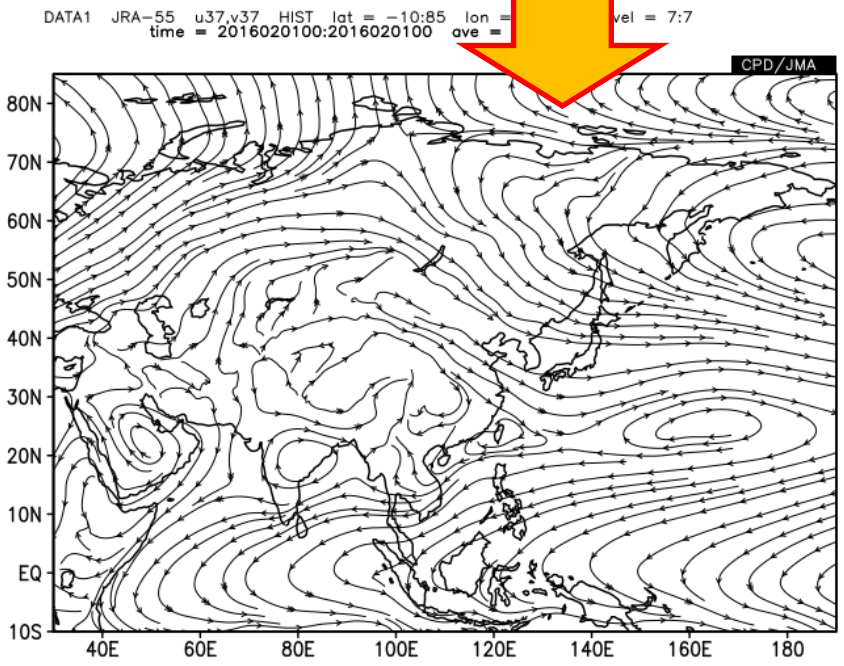
Customize setting in these boxes to change the vector size and interval.

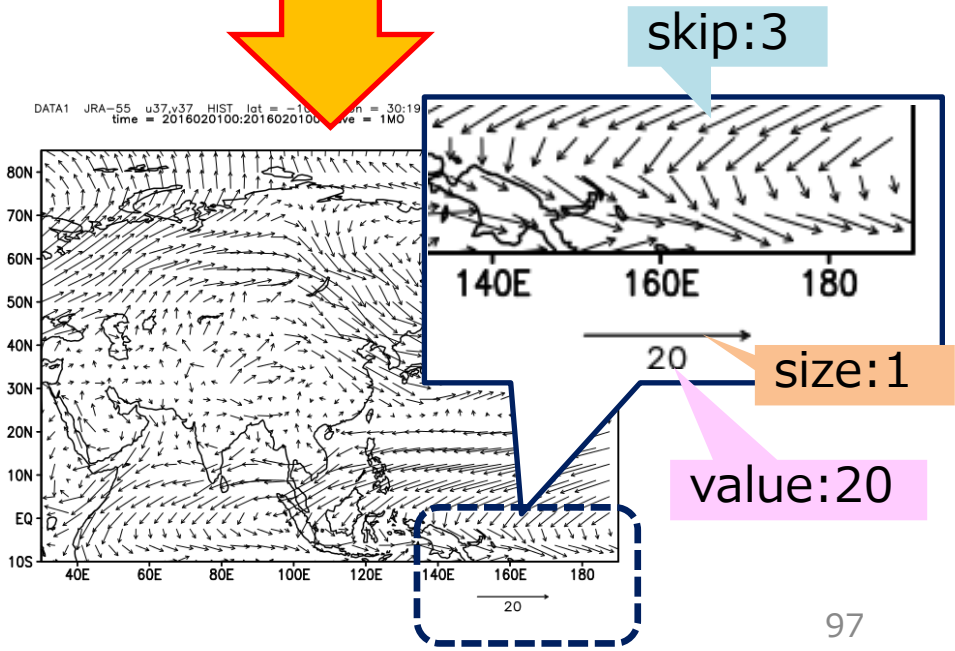
Vector map

- Draw the stream line
- Change the size and interval





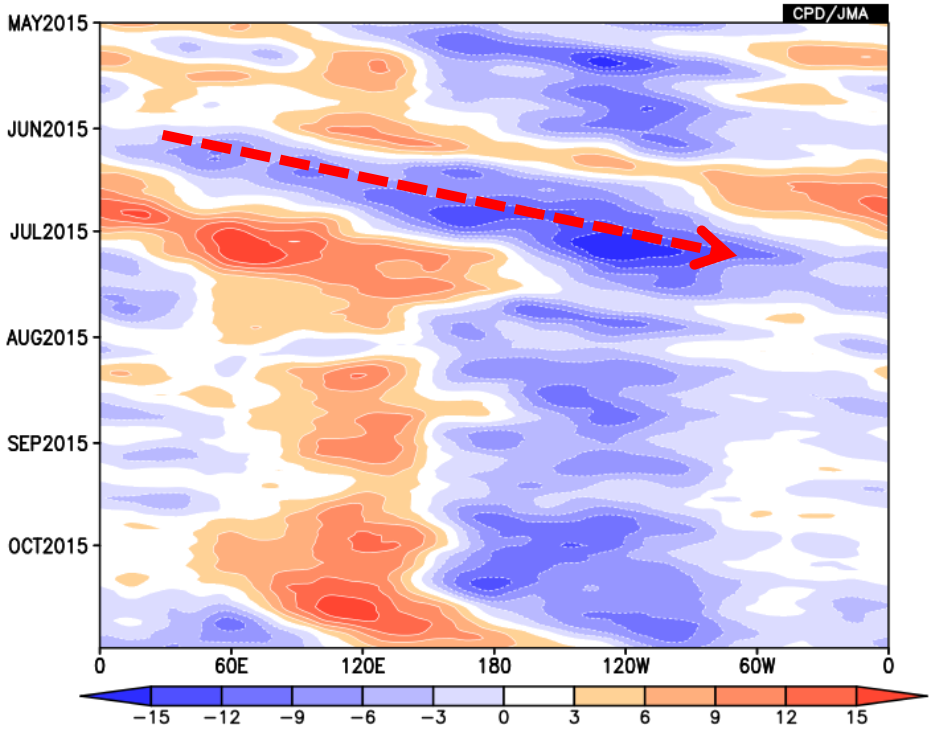




Topics: Madden-Julian Oscillation

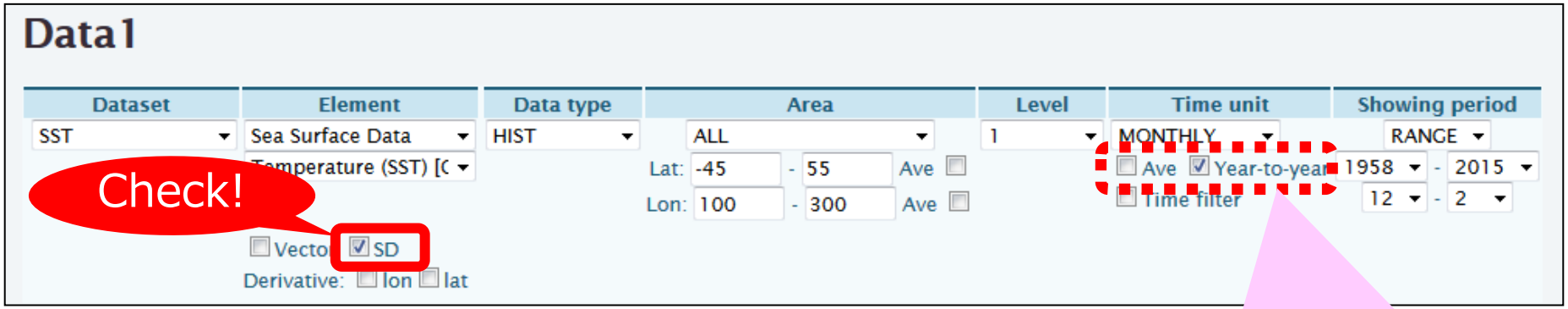
- In the cross-section of χ200 anomalies, a distinct active phase of convective activities (i.e. upper-tropospheric divergence) was seen propagating eastward in June 2015, indicating the appearance of the Madden-Julian Oscillation (MJO).

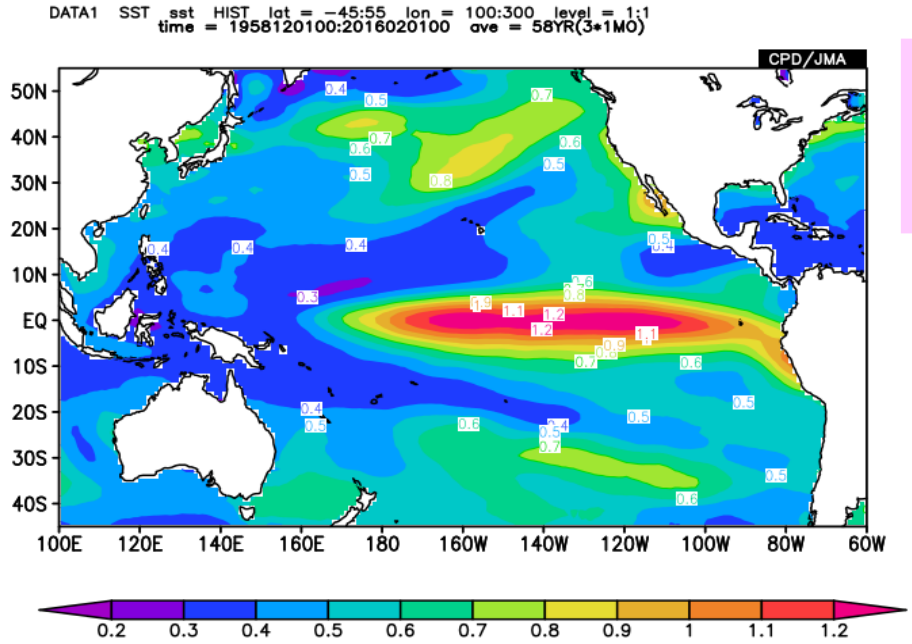
Longitude-time cross section of 5°S – 5°N averaged 200-hPa velocity potential anomalies



Standard deviation map

- A standard deviation map is available to see the variability of the selected element over the selected period.





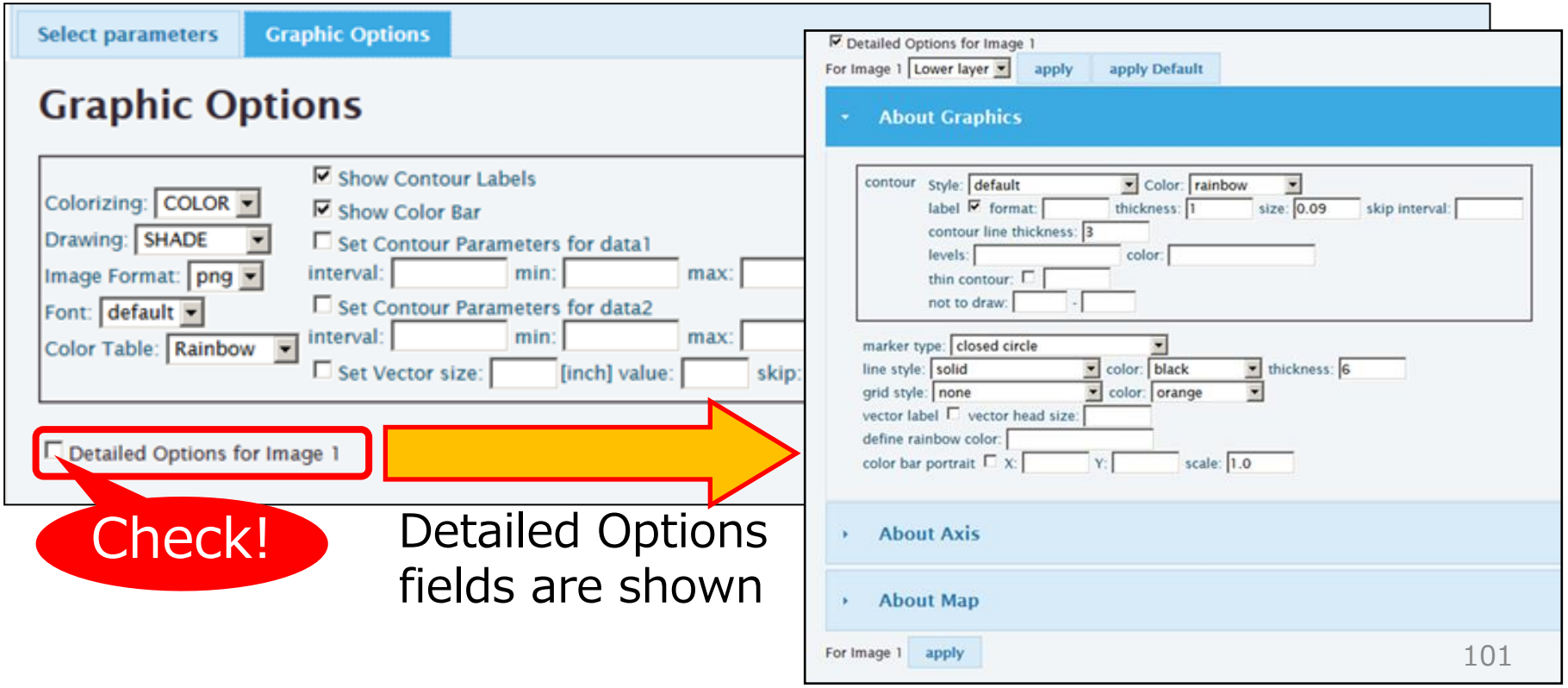
For standard deviation, don't check "Ave" box.

The standard deviation of DJF averaged SST from 1958/59 to 2015/16.

Detailed options

Detailed Options

- There are a lot of visual options to create maps.
  - Contour : Color, thickness, style, label etc.
  - Axis : Color, interval, style and others.
  - Map : Color, resolution, style and others.



Detailed Options fields are shown

Procedure of setting detailed options

1. Select target

Lower layer: Data1
Upper layer: Data2

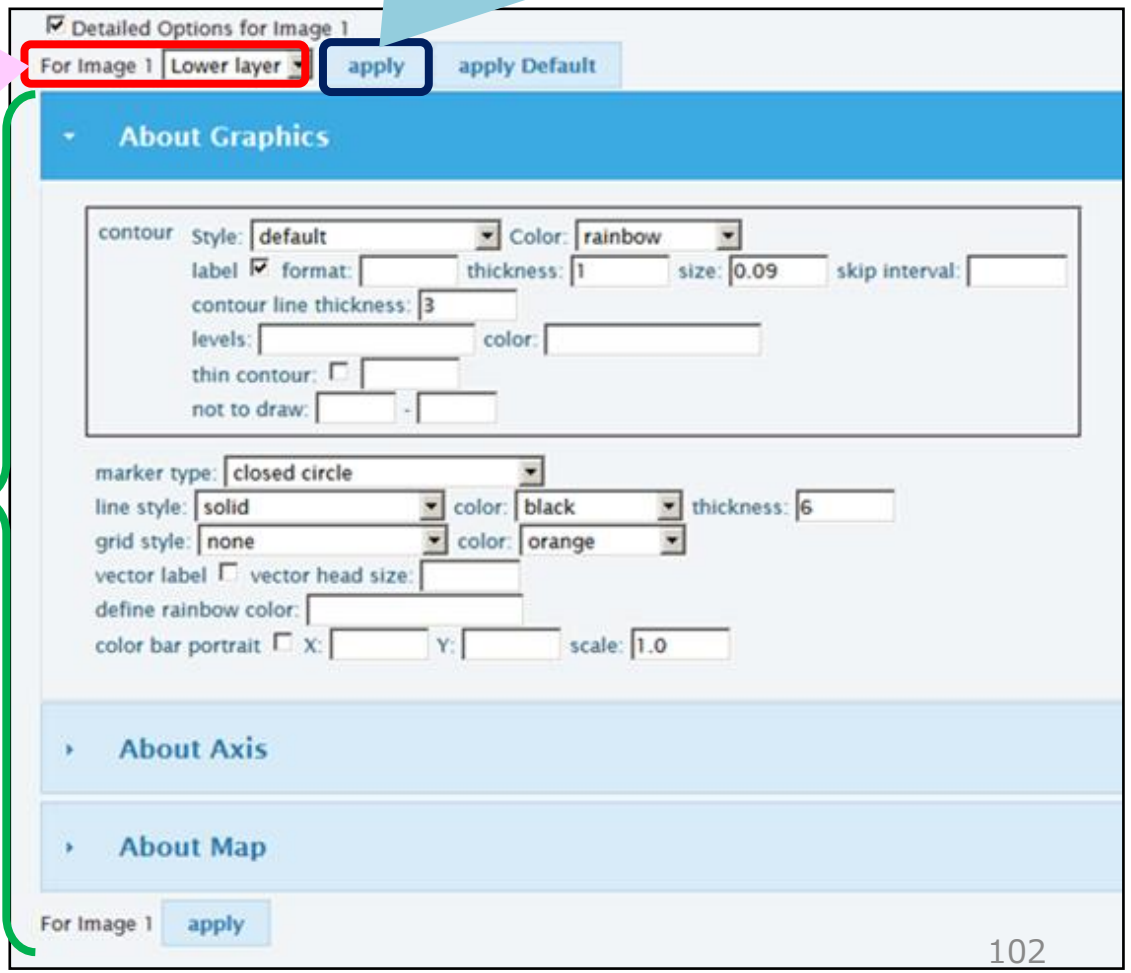
In the case of vector map
Lower layer: Data2
Upper layer: Data1

2. Set options

Set contour style, color, thickness, etc.

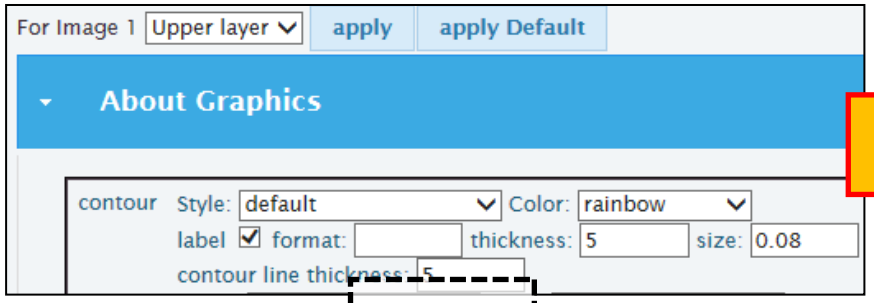
3. Apply the settings

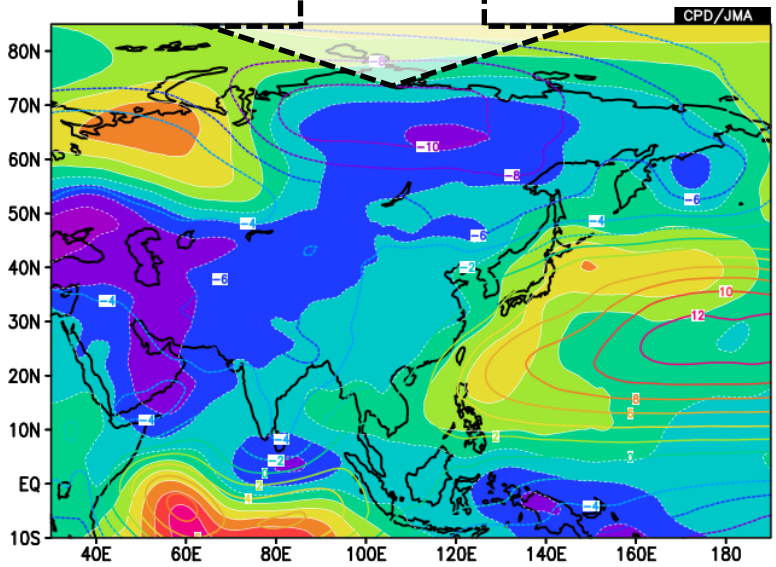
Click the "apply" button before "Submit" is clicked.



About Graphics: Contour color and label

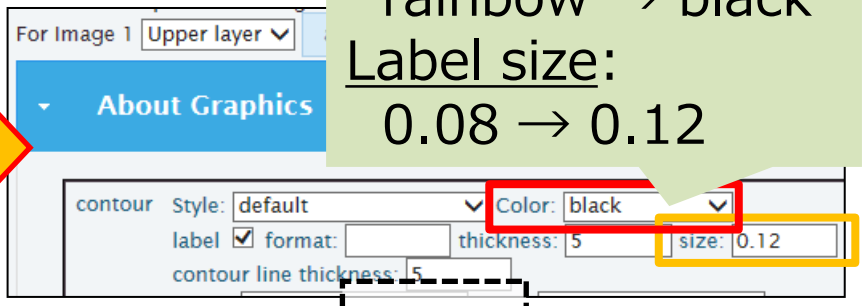
- After selecting the layer, set color and label to change contour properties.

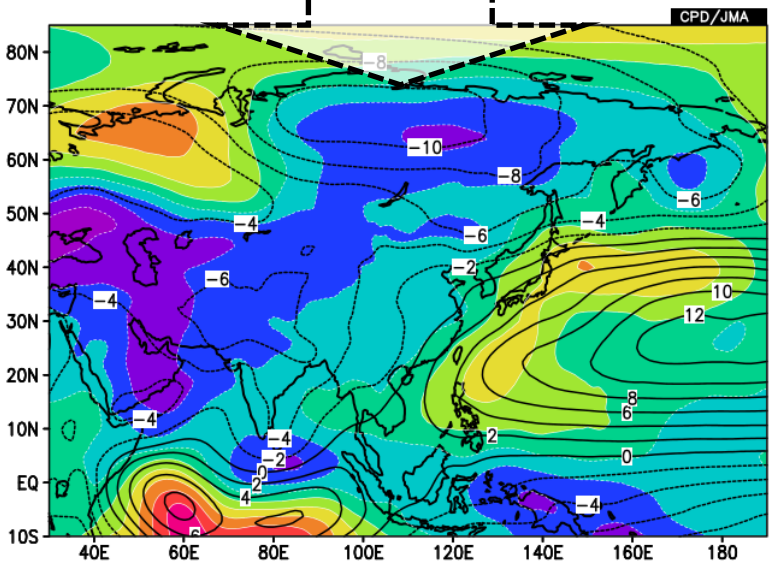




It's hard to see contours and its label because its color is similar to shade color.

Color:
rainbow → black
Label size:
0.08 → 0.12





The problems are cleared.

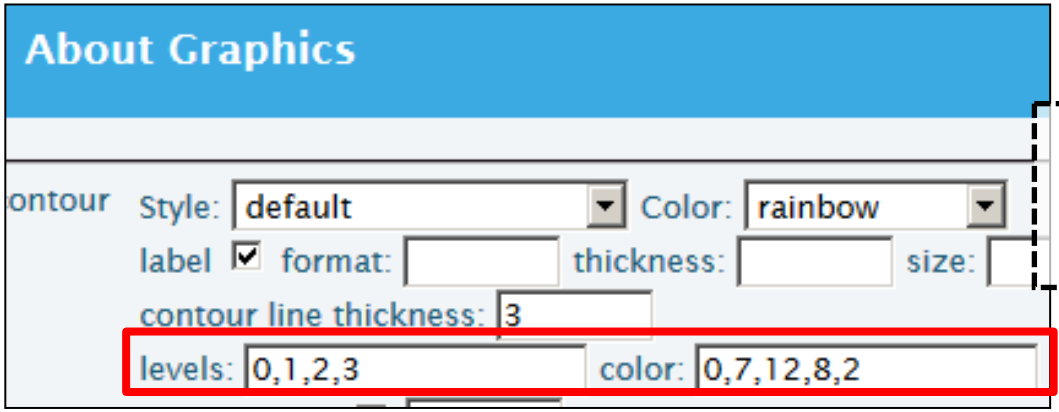
About Graphics: Color table

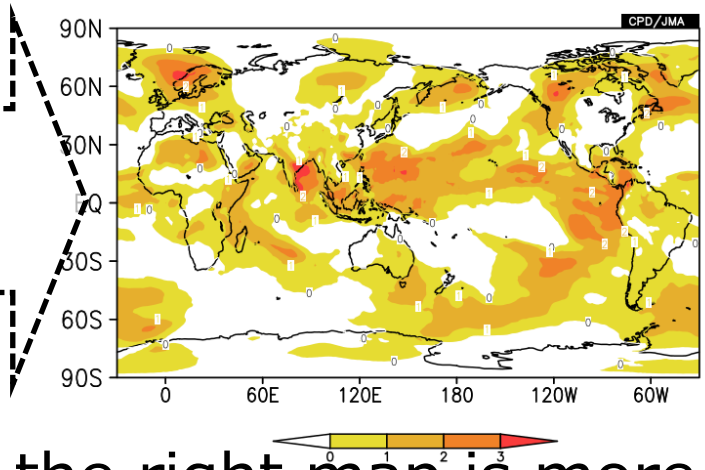
- Set levels and colors separated by comma in the boxes to define the color table by yourself. The color numbers are defined as the right table.

e.g.) levels:-2,-1,0,1,2
color: 4,11,5,7,12,2

white	0
black	1
red	2
green	3
dark blue	4
light blue	5
magenta	6
yellow	7

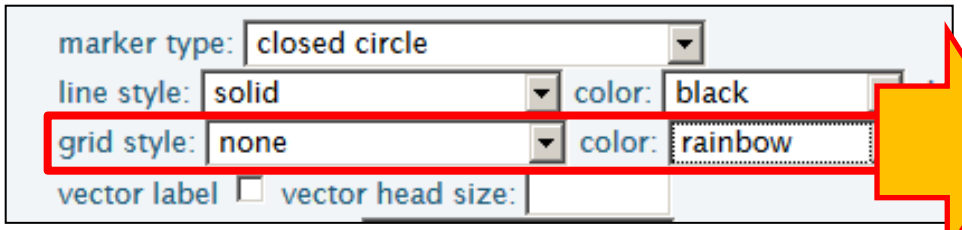
orange	8
purple	9
yellow green	10
medium blue	11
dark yellow	12
aqua	13
dark purple	14
gray	15

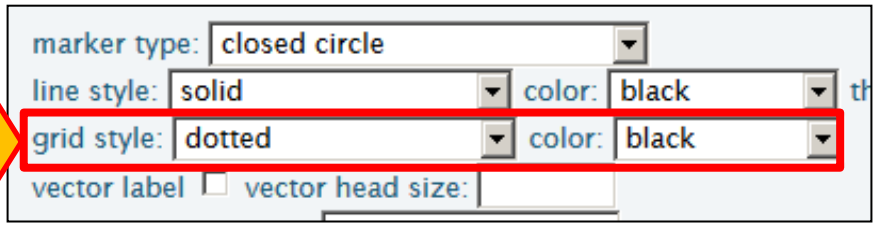


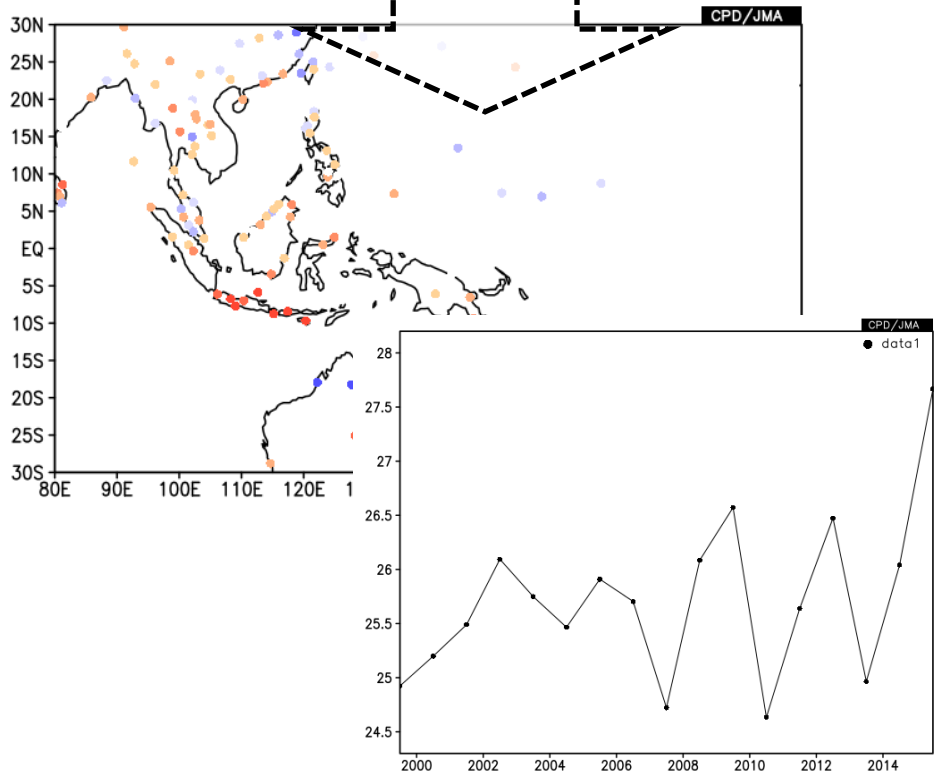


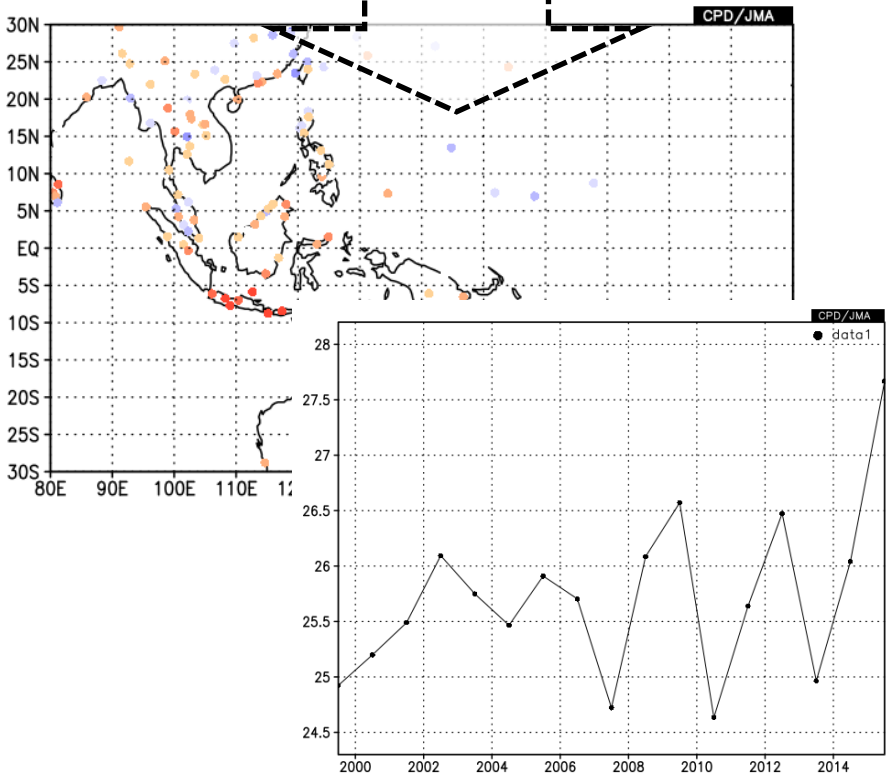
For example, the color setting like the right map is more suitable to focus on the positive value.

About Graphics: grid style



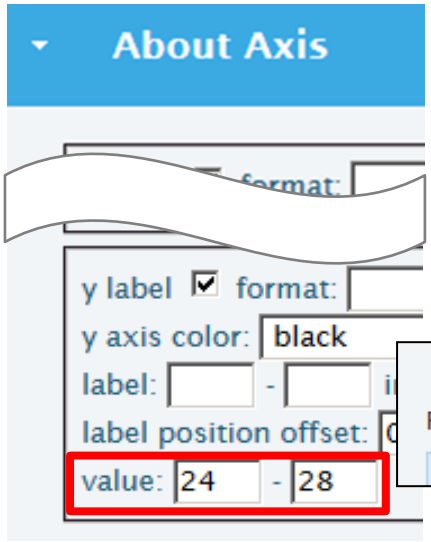


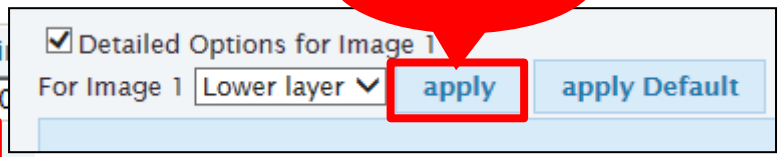




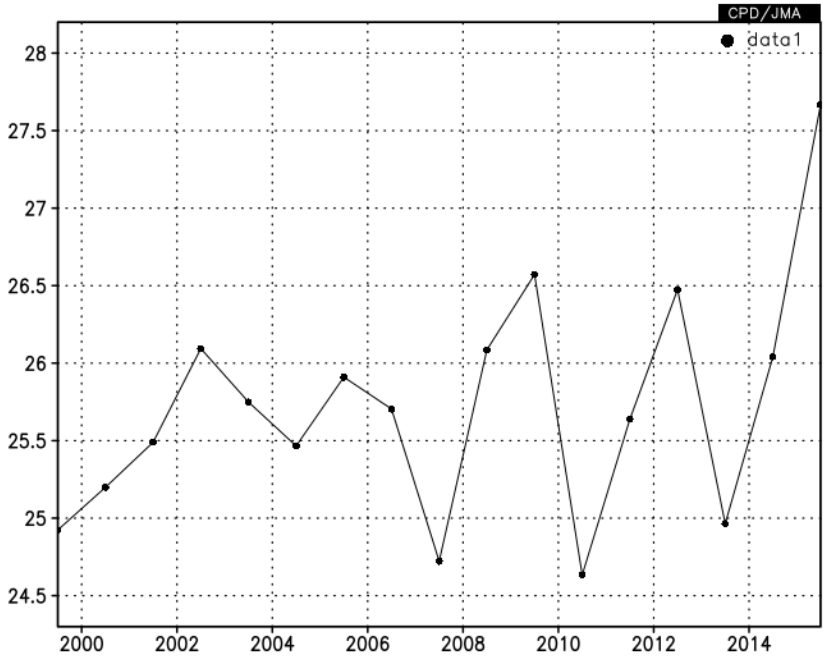
The grid line in the panel like the right map is available.

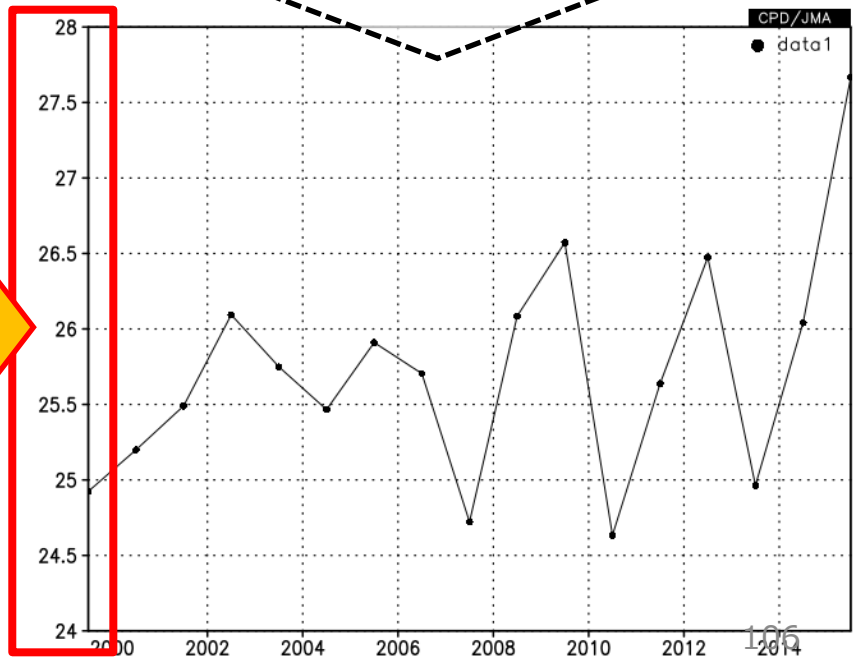
About Axis: value





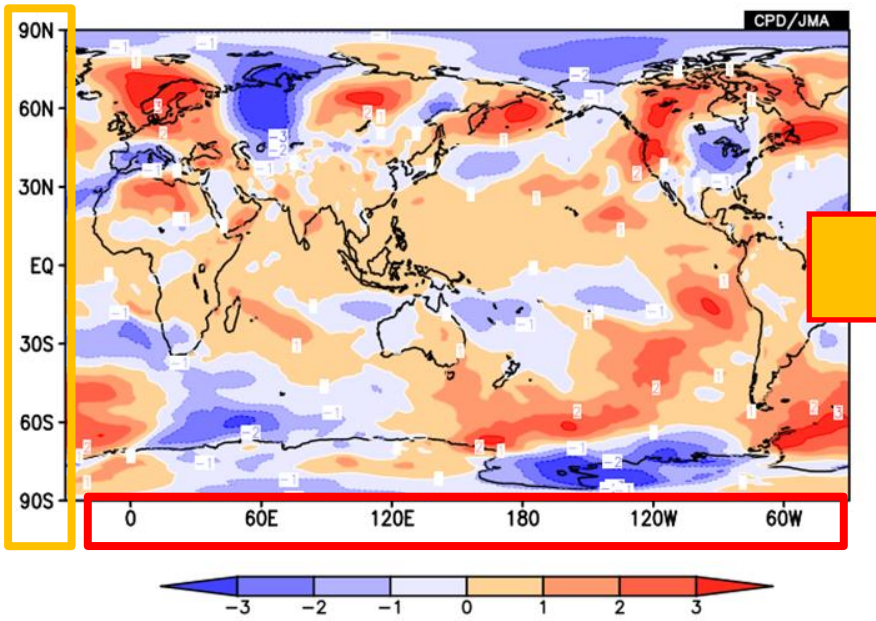
Default



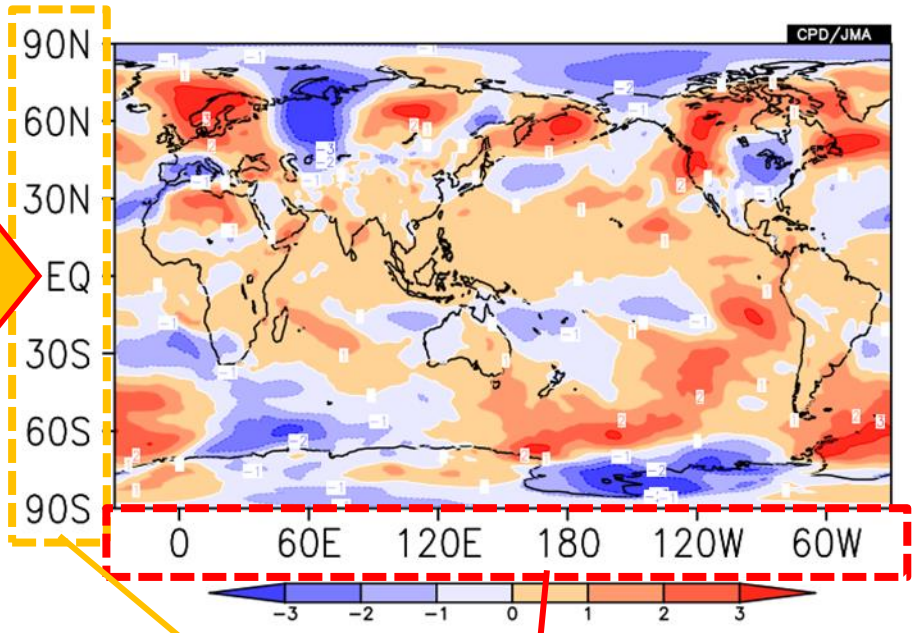


About Axis: Label size

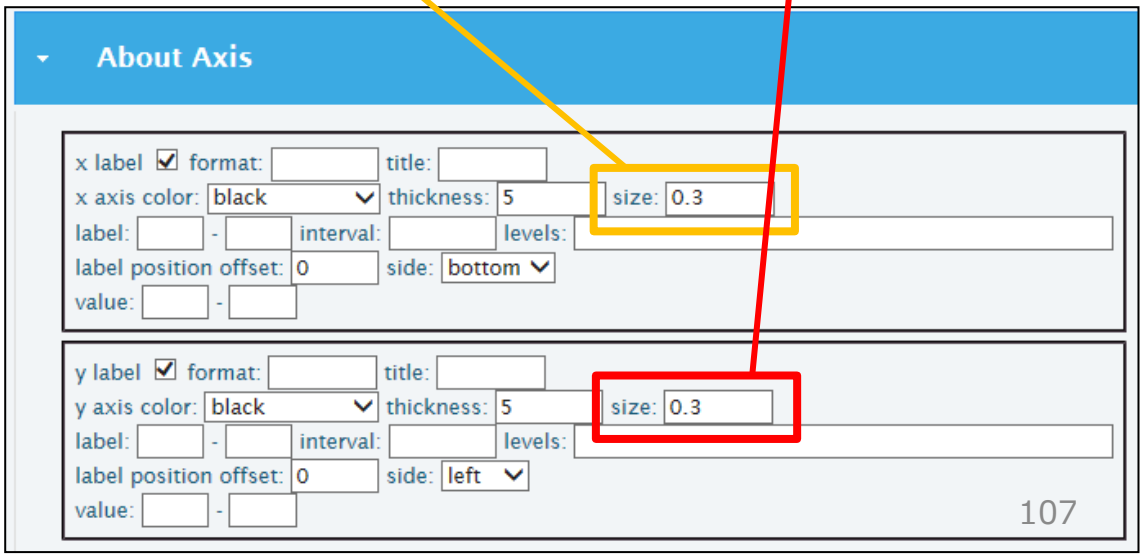
Default size



Label size: 0.3

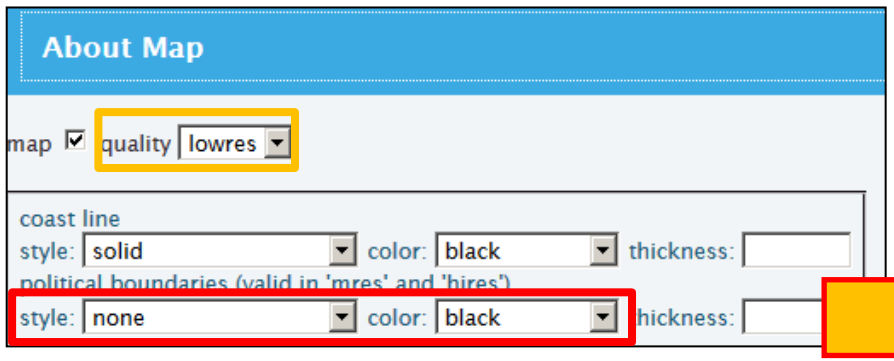


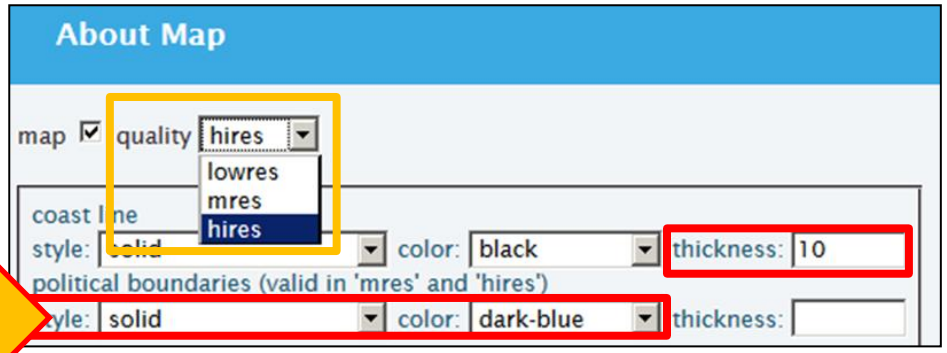
The label size is customizable in the “About Axis” box.

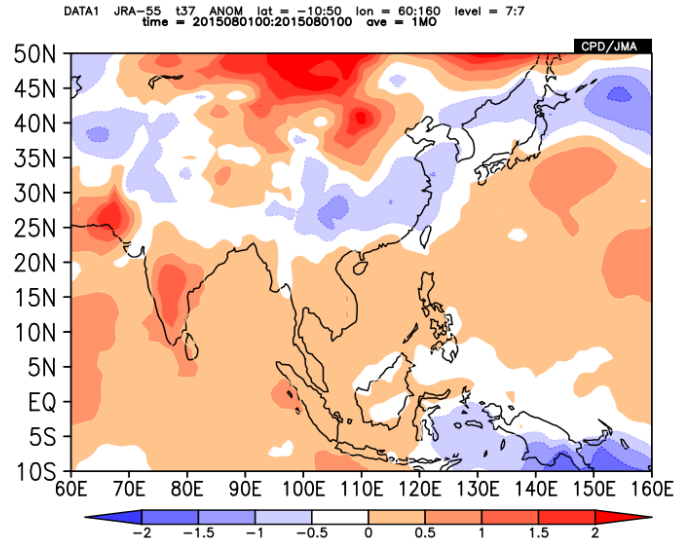


About Map

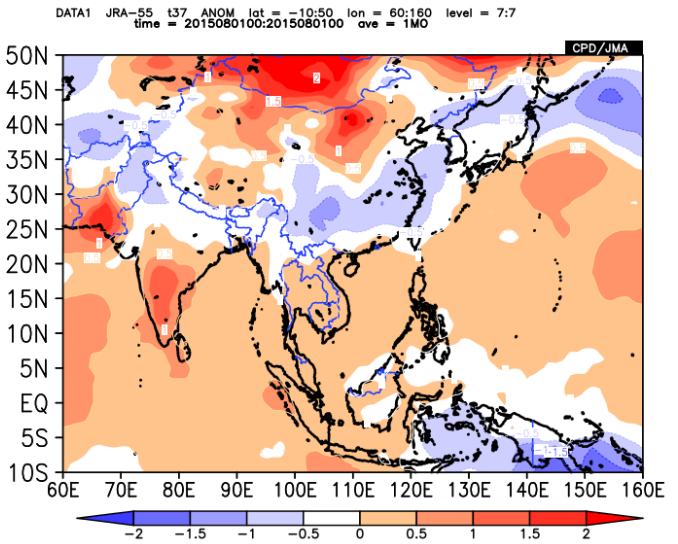
- Map resolution, political boundaries are customizable in the “About Map” box.







lowres:
low resolution
mres:
middle resolution
hires:
high resolution



Quality must be set “mres” or “hires” to show political boundaries.

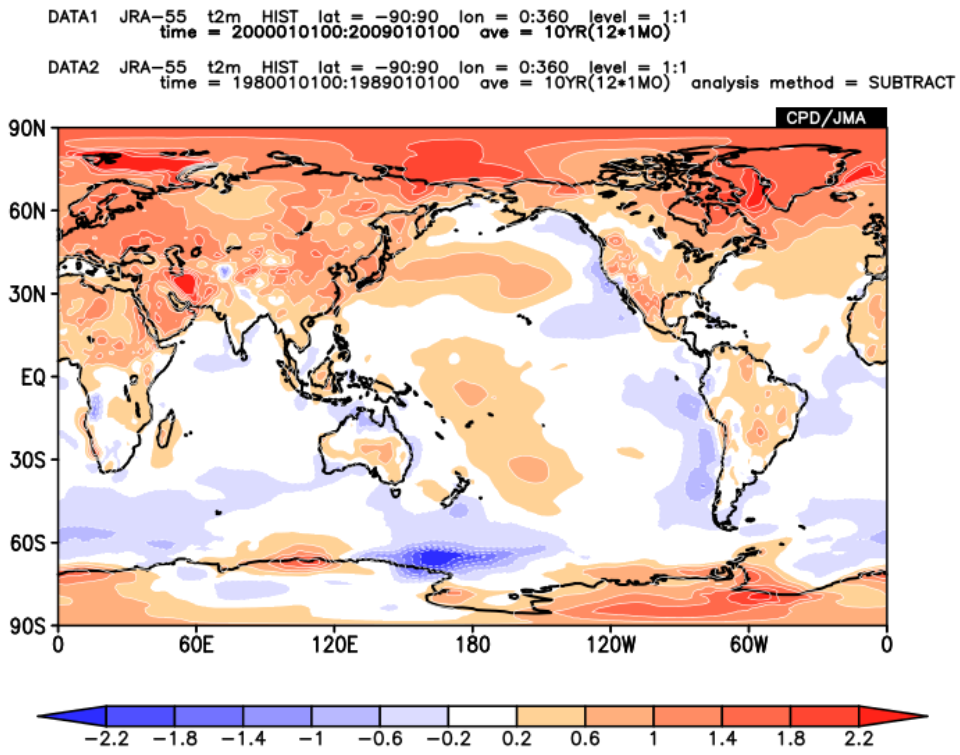
Notice about detailed options

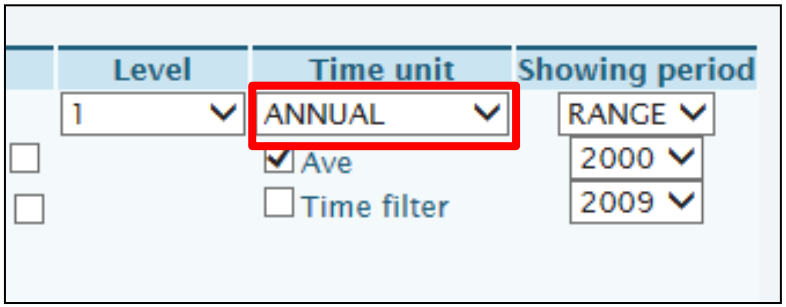
- In iTacs, **the detailed options' settings are always saved in the server per individual user IDs.** Therefore, the events shown below can occur.
  - When some people use iTacs by the same ID and someone changes the settings, the changes will **influence the other's use**.
  - Users **must explicitly set** them by themselves **to return to the default settings**.
  - Unlike the other settings such as element, period, analysis method, they **cannot be shared by user parameter code**.

Extra exercises

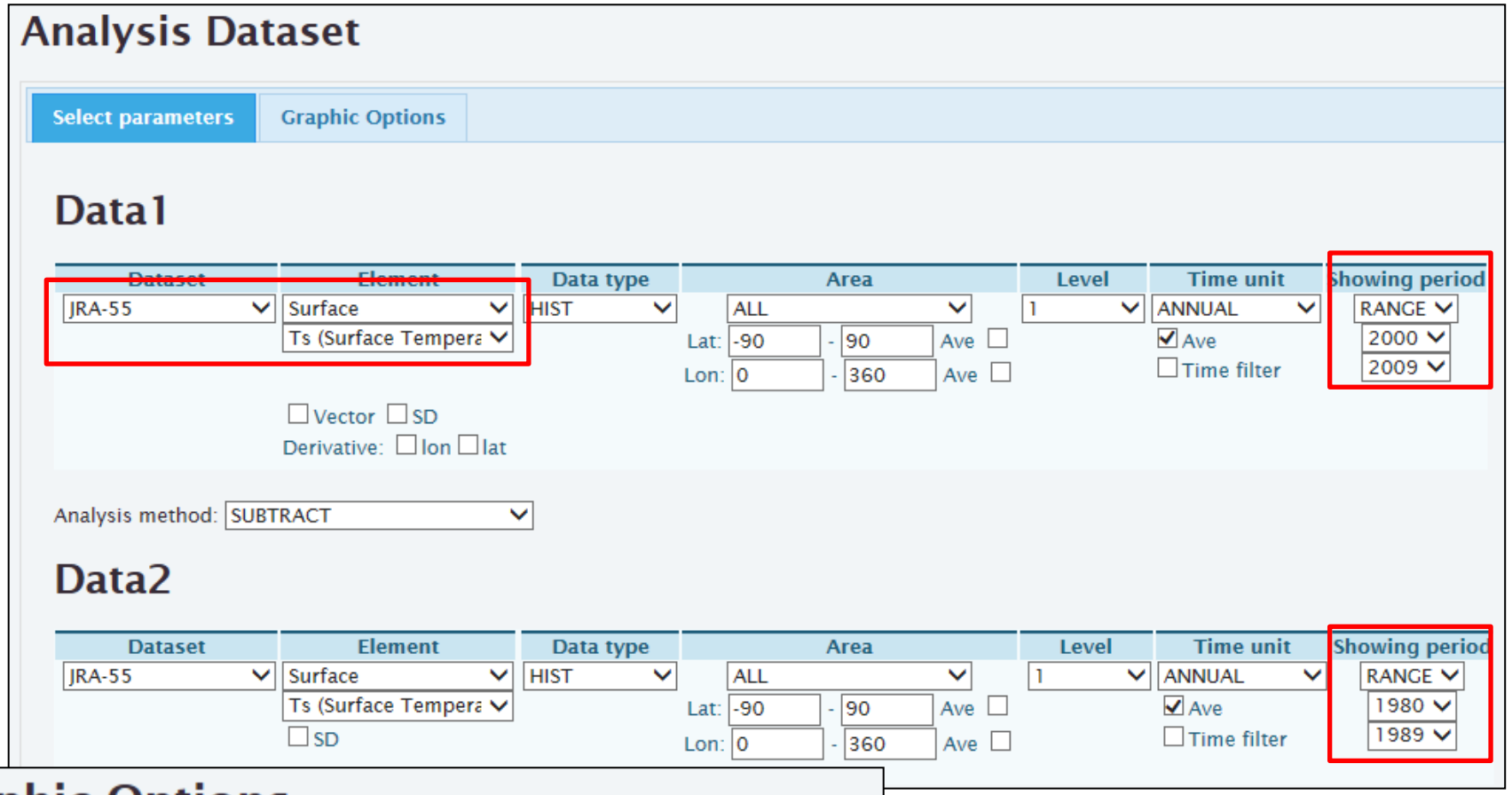
Exercise (4)

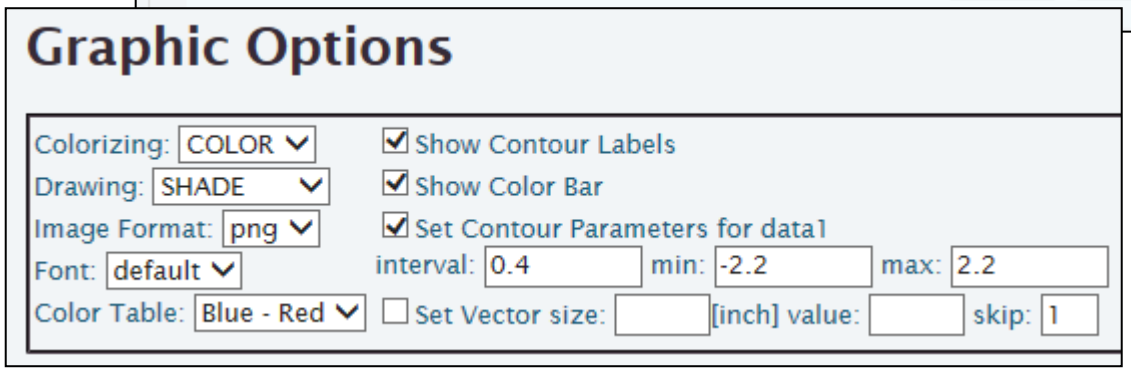
- Show the difference of annual surface temperature from 1980s mean to 2000s mean as shown below.
- Showing the annual mean data, the option "ANNUAL" is available in "Time unit" box.





Answers to Exercise (4)

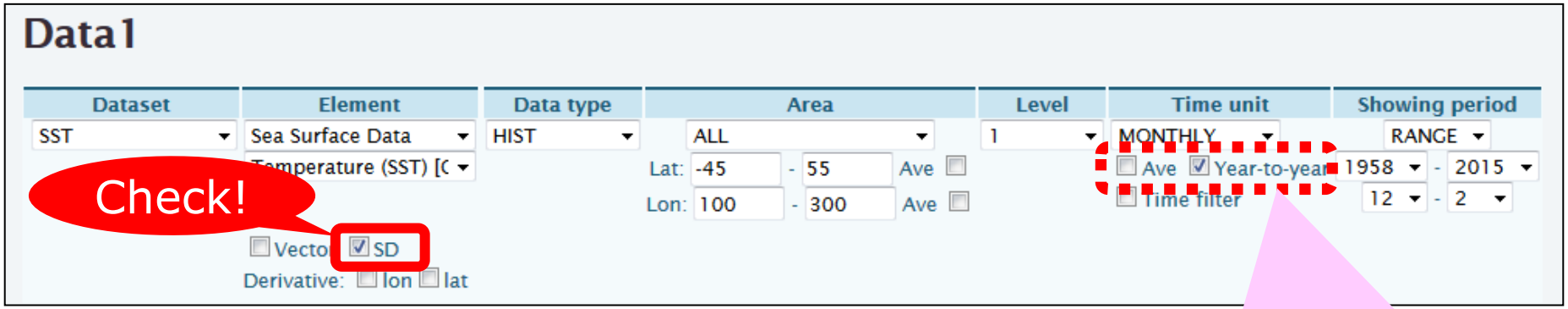


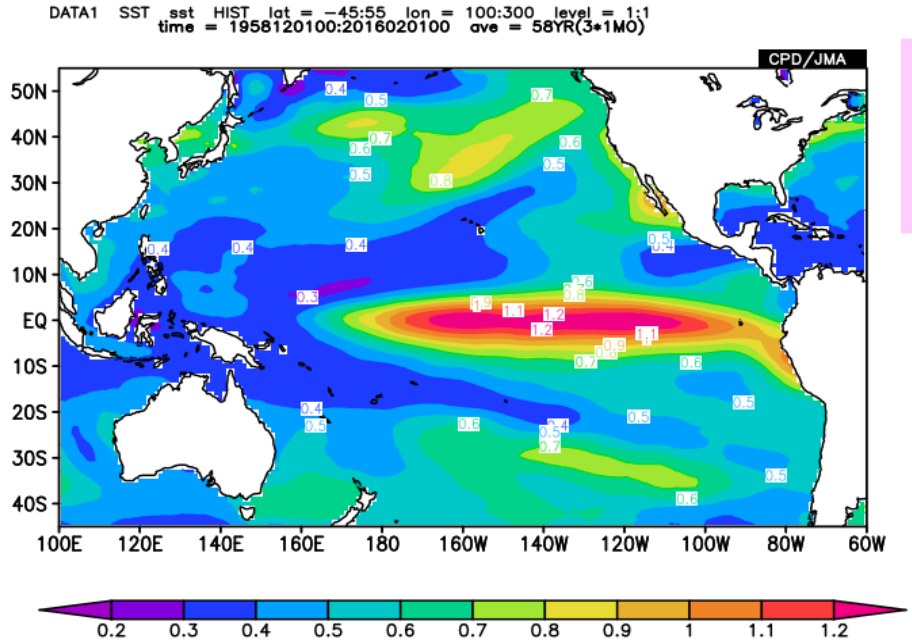


Other functions

Standard deviation map

- A standard deviation map is available to see the variability of the selected element over the selected period.





For standard deviation, don't check "Ave" box.

The standard deviation of DJF averaged SST from 1958/59 to 2015/16.