Introduction and basic operation of iTacs

- iTacs: Interactive Tool for Analysis of Climate System -

Shoji Notsuhara

Tokyo Climate Center

Japan Meteorological Agency

Contents

<Introduction>

<Exercise 1>

Draw a 2D (latitude-longitude) map

<Exercise 2>

Draw a 1D (time-series) chart

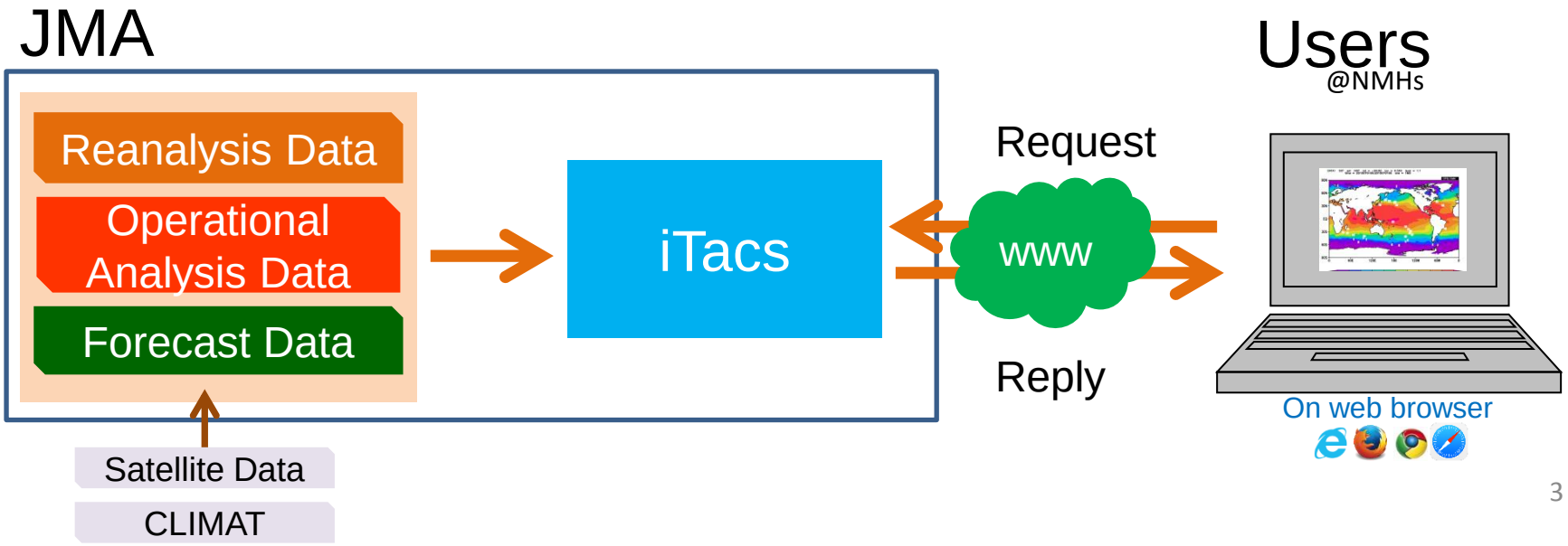
<Exercise 3>

Implement regression analysis

What's iTacs?

Less time to manipulate the data ,
more time to diagnose the climate system!

- A web-based application for analyzing and monitoring climate.
- Available on web browsers. No additional software or plug-ins are required.
- Persons at National Meteorological and Hydrological Services can use iTacs (ID and Password are needed) .



What’s iTacs?

What can be done by using iTacs?

- Various datasets are available.
- Various types of charts can be drawn.
- Various statistical analyses can be performed.

Available data

- Atmospheric analysis data
  - JRA-55 since 1958
  - Outgoing longwave radiation data provided by NOAA since 1974
- Oceanic analysis data
  - Sea surface temperature data by COBE-SST since 1891
  - Oceanic condition analyzed by MOVE/MRI.COM-G2 since 1958
- Forecast data
  - Outputs of JMA's one-month prediction model
- Others
  - Major SST Indices, CLIMAT reports, and user-input data (CSV format)

(See for details)

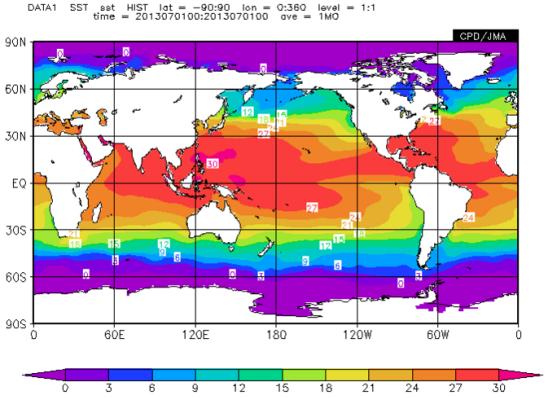
JRA project http://jra.kishou.go.jp/JRA-55/index_en.html

COBE-SST http://ds.data.jma.go.jp/tcc/tcc/products/elnino/cobesst_doc.html / http://ds.data.jma.go.jp/tcc/tcc/library/MRCS_SV12/index_e.htm

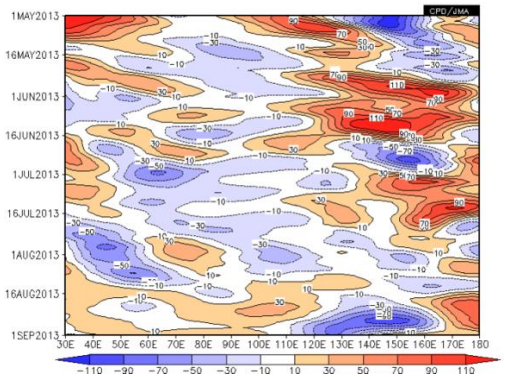
MOVE/MRI.COM-G2 http://ds.data.jma.go.jp/tcc/tcc/products/elnino/move_mricom-g2_doc.html

Samples of charts

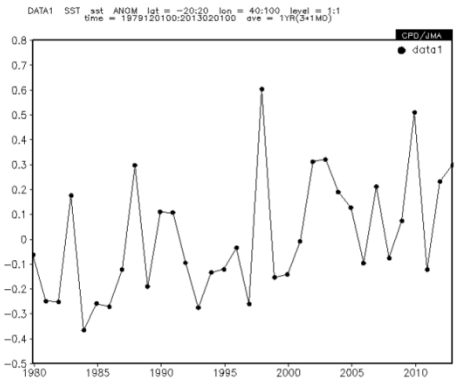
- Various types of charts can be drawn.



Latitude-longitude map

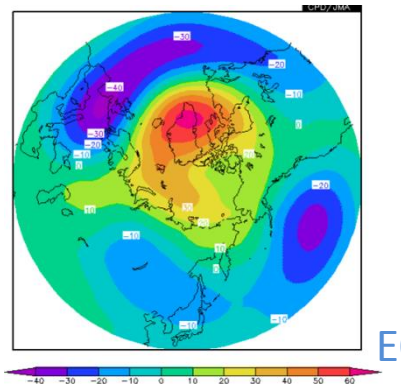


Time-longitude cross section

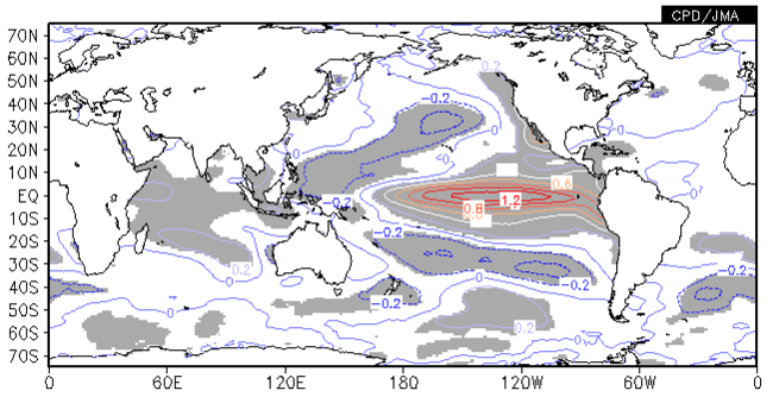


Time series

- Various statistical analyses can be performed.



EOF analysis



Regression analysis

iTacs is a very convenient and useful tool and it will strongly help you to understand climate systems.

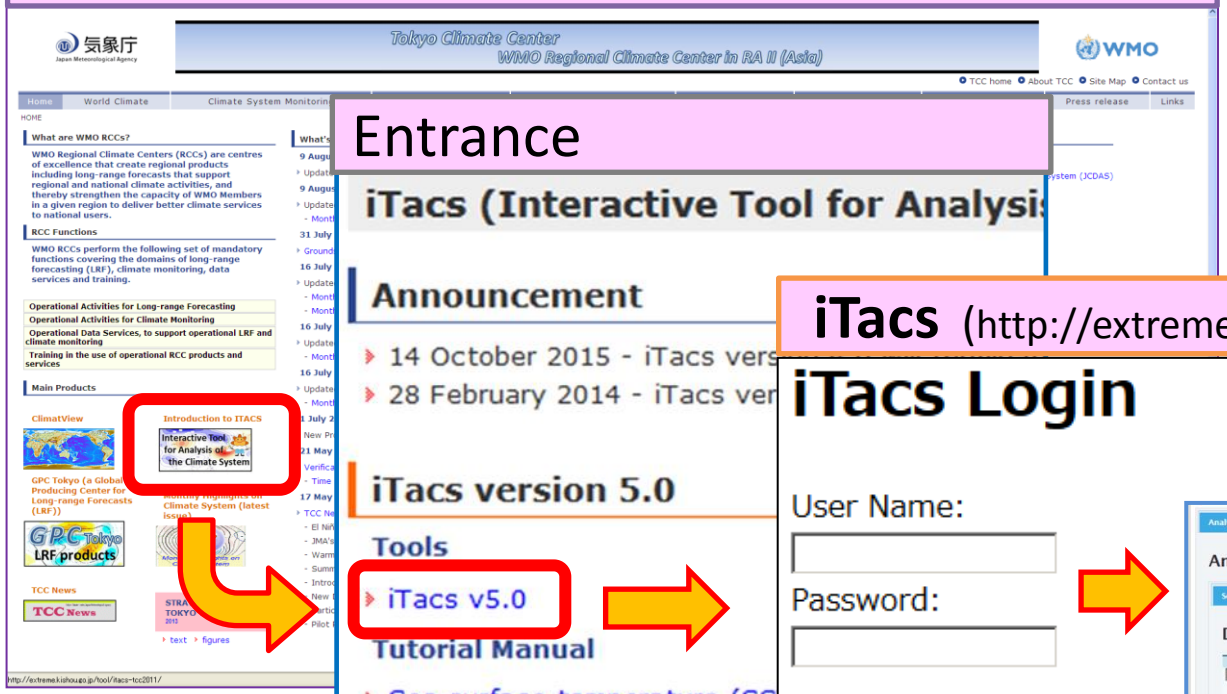
Let's exercise basic operation of iTacs!

In November 2015, new version:iTacs ver.5 has been released.
So we exercise using iTacs ver.5.

How to access

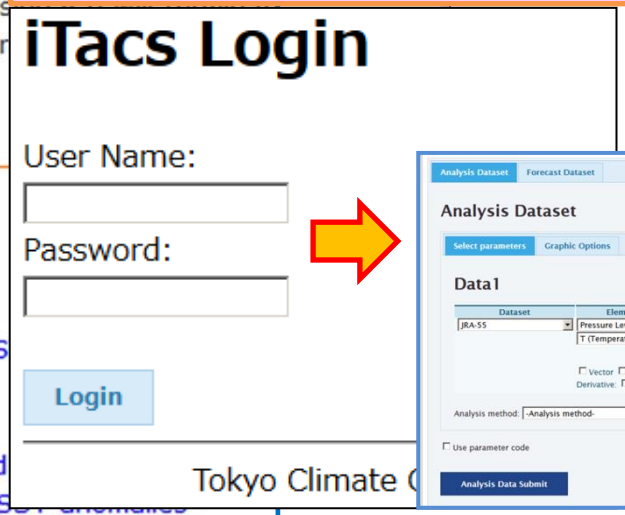
- Registered users can access iTacs from the Tokyo Climate Center (TCC) website.

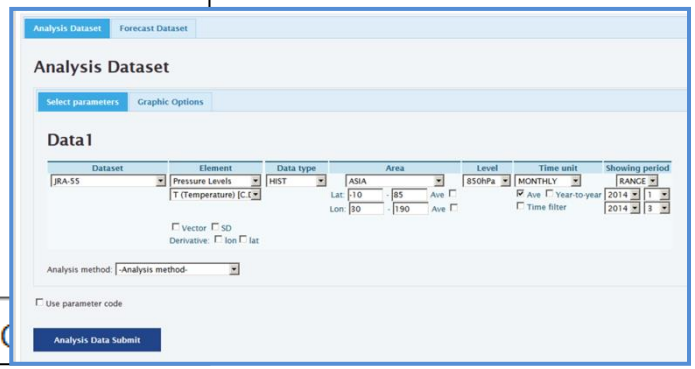
TCC website (http://ds.data.jma.go.jp/tcc/tcc/index.html)



Entrance

iTacs (http://extreme.kishou.go.jp/tool/itacs-tcc2015/)





Basic operation (1)

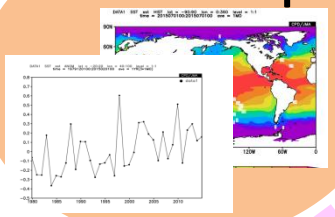
Select Analysis or Forecast dataset

Setting Data parameters

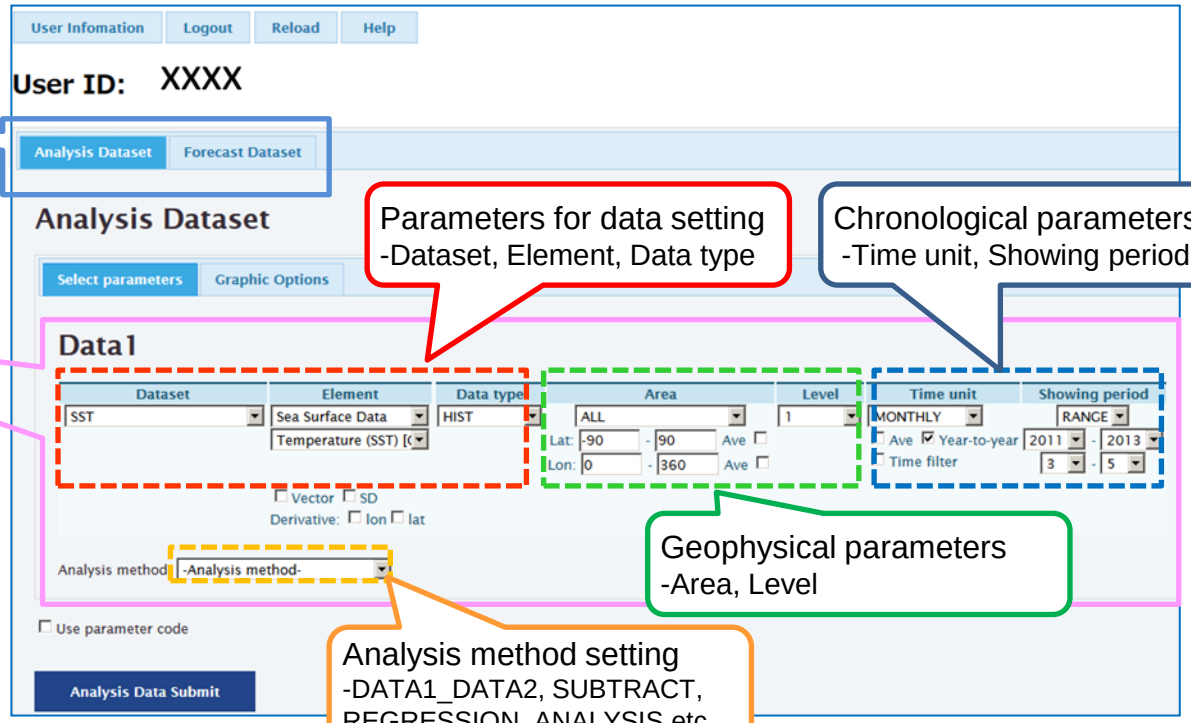
Setting Graphic Options

Data Submit

Draw map



Data download



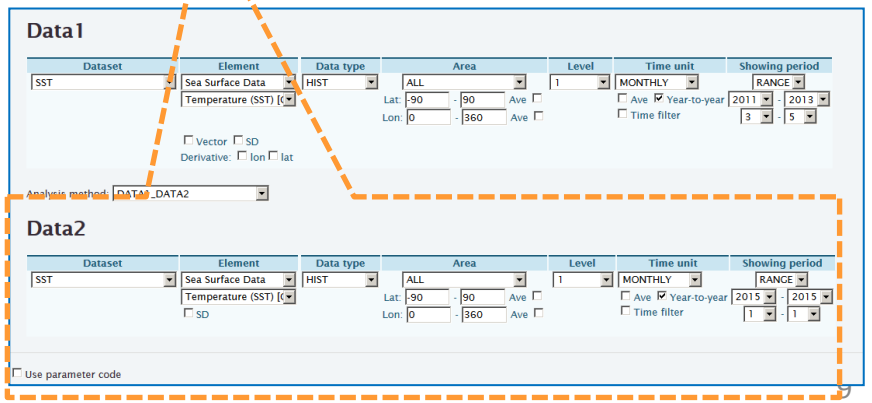
Parameters for data setting
-Dataset, Element, Data type

Chronological parameters
-Time unit, Showing period

Geophysical parameters
-Area, Level

Analysis method setting
-DATA1_DATA2, SUBTRACT, REGRESSION_ANALYSIS etc.

In some cases, Data2 setting needed.



Basic operation (2)

Select Analysis or Forecast dataset

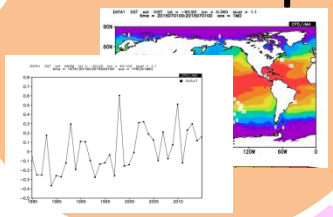
Setting Data parameters

Setting Graphic Options

Data Submit

Analysis Data Submit

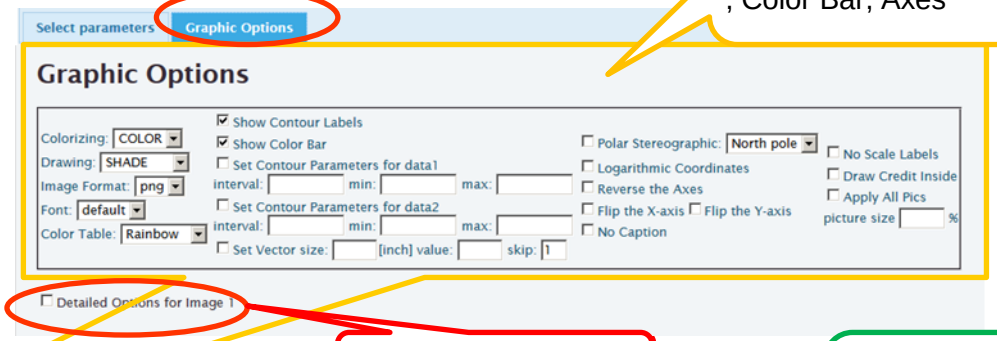
Draw map



Data download

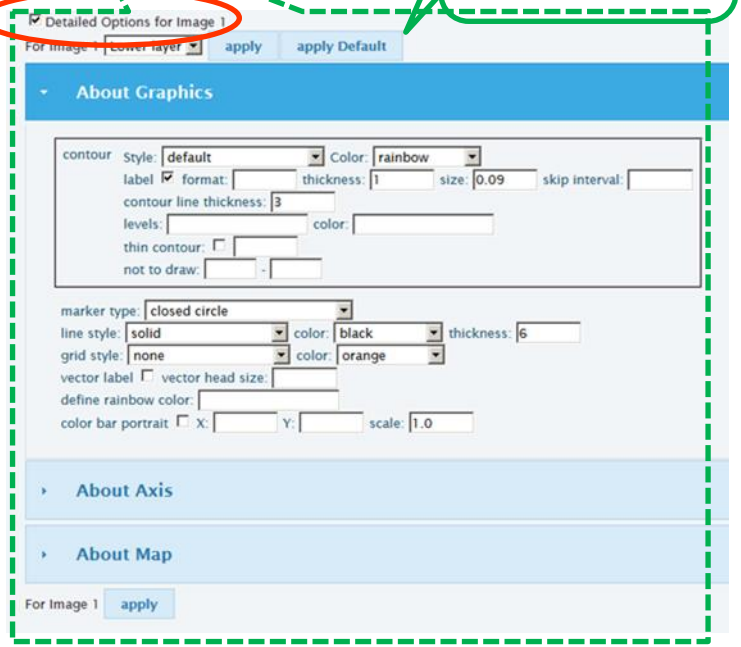
Select this tab

Graphic Options
-Contour, Shade
, Color Bar, Axes



Check here, Detailed Options field are shown

Detailed Options for Image x
-Graphics, Axis, Map



Contents

<Introduction>

<Exercise 1>

Draw a 2D (latitude-longitude) map

<Exercise 2>

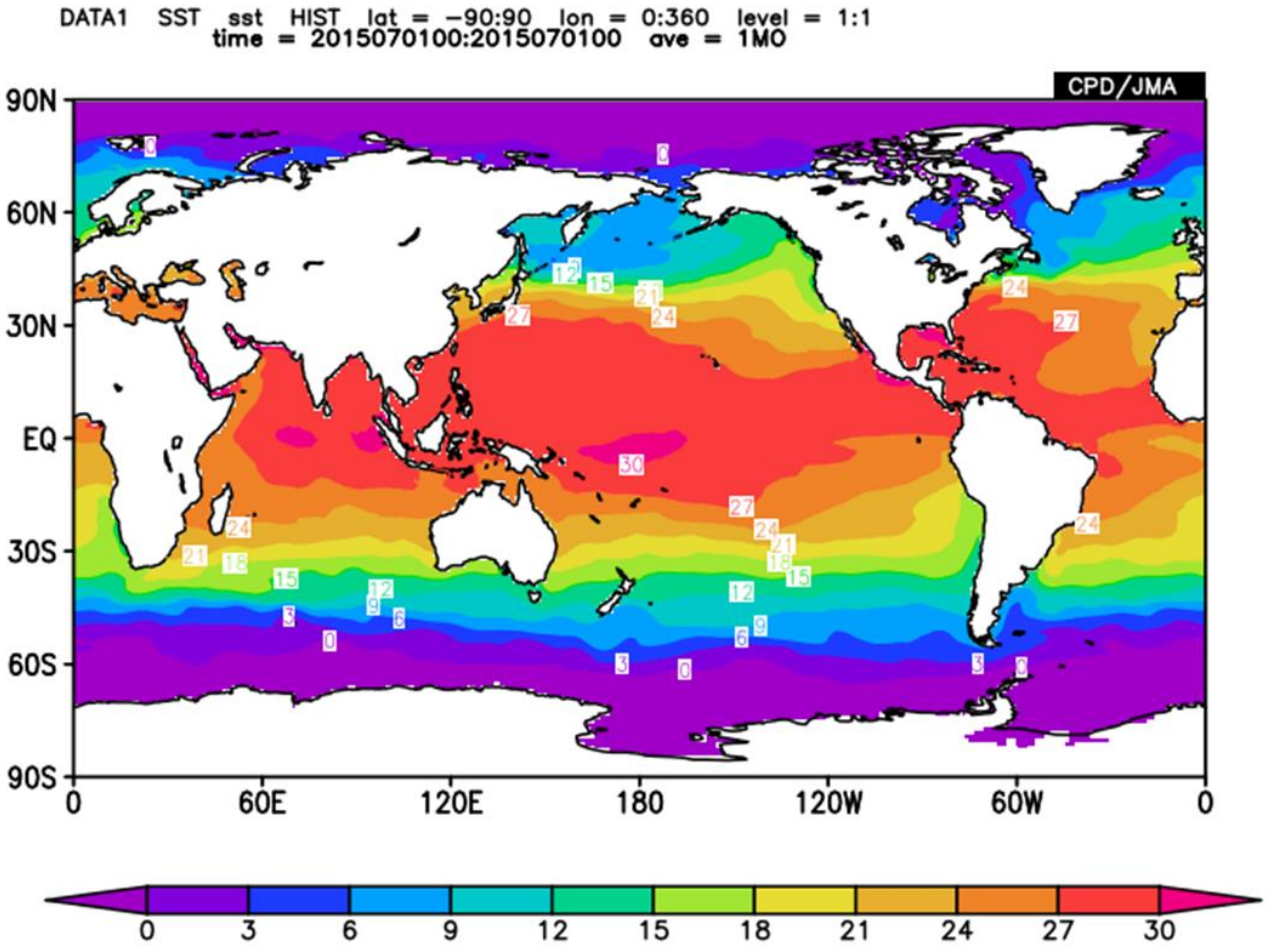
Draw a 1D (time-series) chart

<Exercise 3>

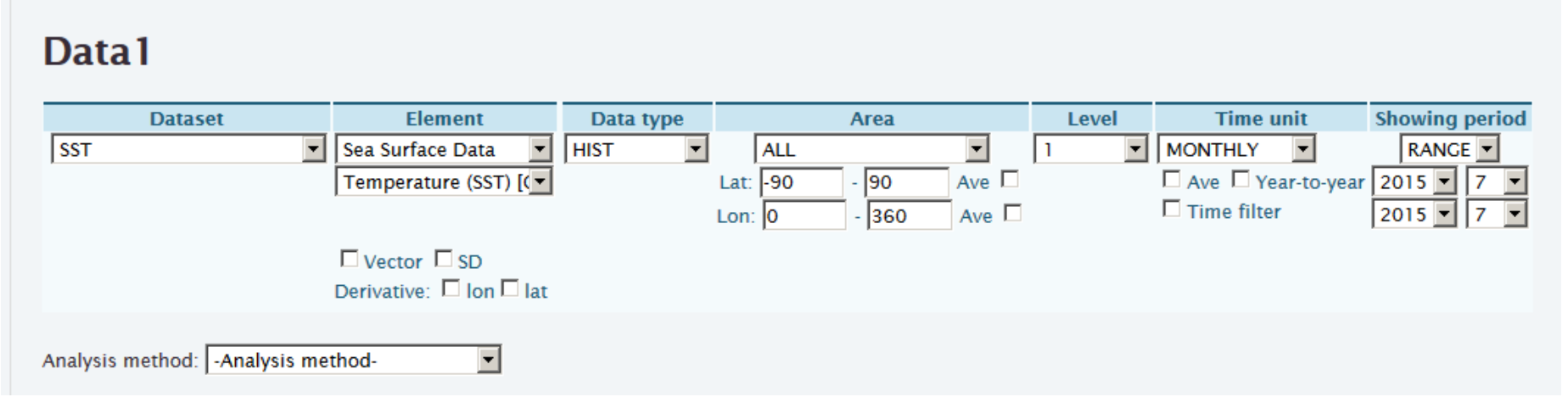
Implement regression analysis

Latitude-longitude map (1)

- Let's chart monthly sea surface temperature (SST) for July 2015.

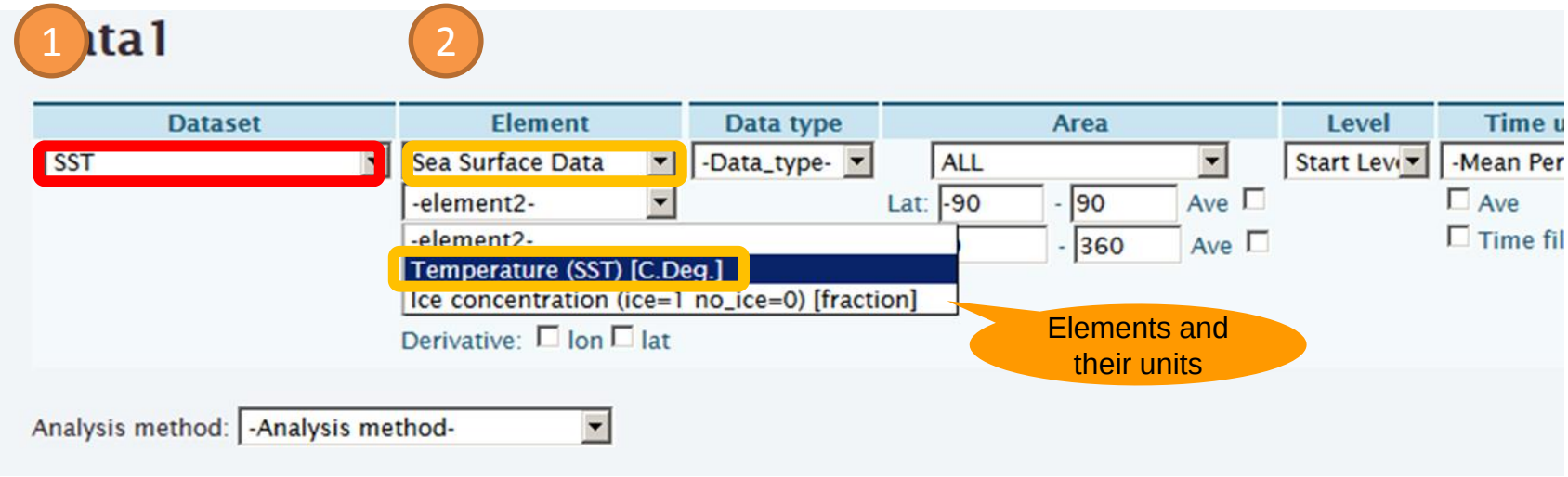


Latitude-longitude map (2)



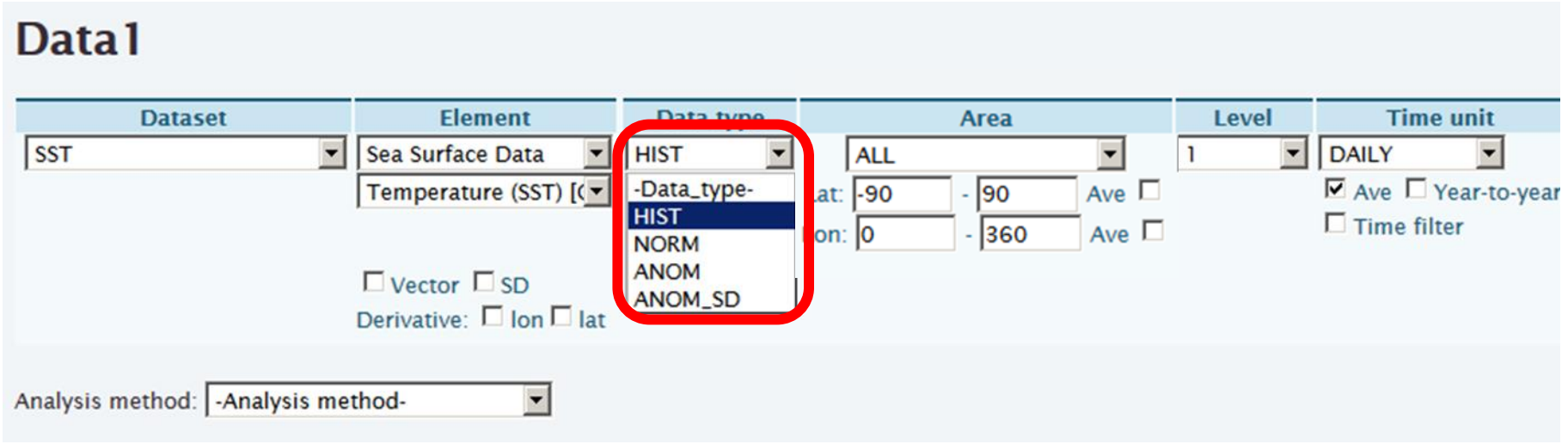
- To set each item in “Data1” as follows.
  - Dataset SST
  - Element Sea Surface Data > Temperature (SST)
  - Data type HIST (meaning historical data)
  - Area ALL
  - Level 1
  - Time unit MONTHLY
  - Showing period “RANGE”; 2015 7; 2015 7

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 “element1” “Sea Surface Data “ and “element2” “Temperature”.
   - Available elements and their units will be shown in a listbox.

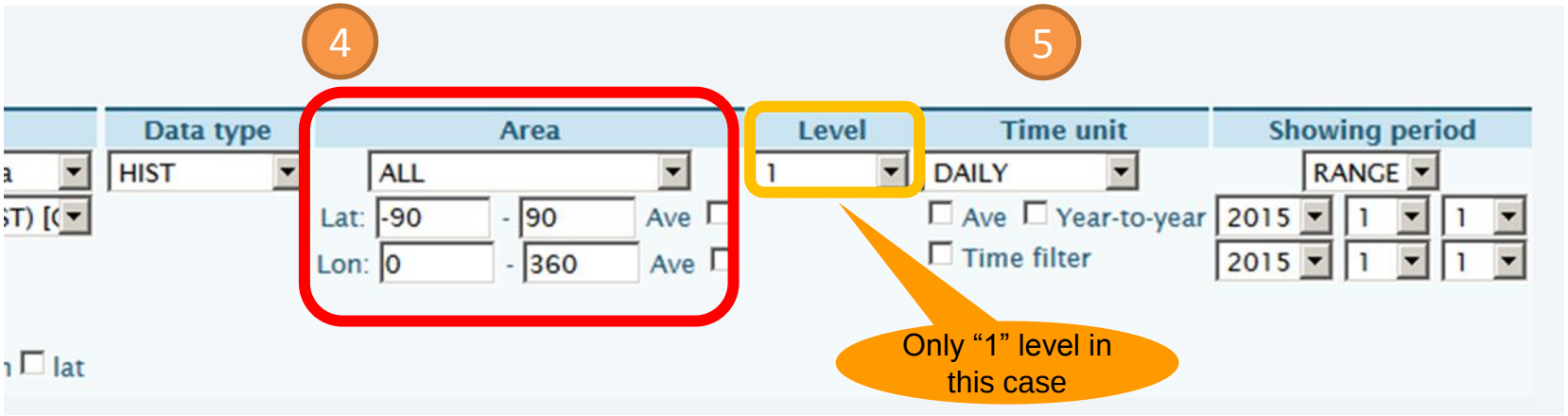
Latitude-longitude map (4)



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

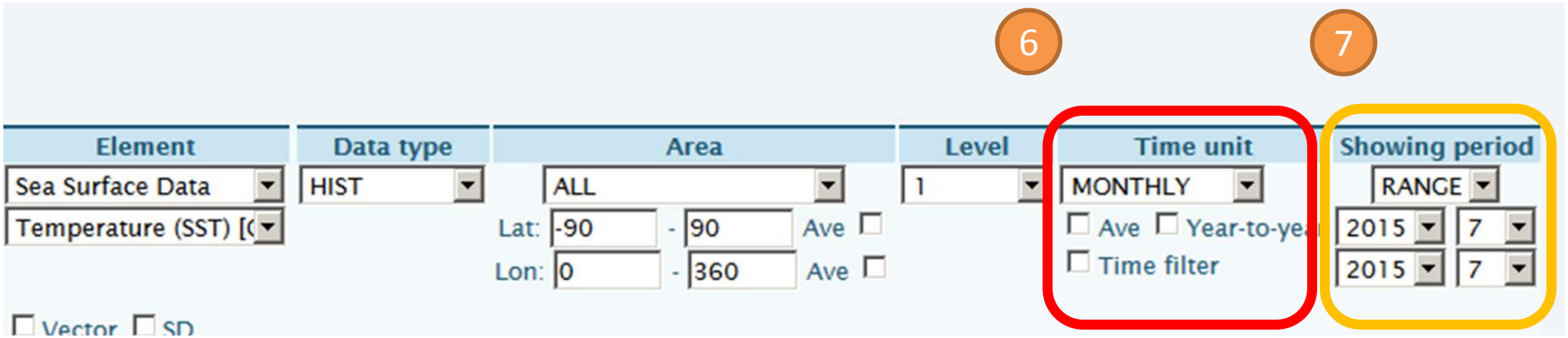
- **HIST** : Historical actual analysis or observation data.
- **NORM** : Climatological normal data (averaged from 1981 to 2010).
- **ANOM** : Anomaly data (HIST – NORM: difference from the climatological normal)
- **ANOM_SD** : Anomaly data normalized by their standard deviations.

Latitude-longitude map (5)



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

Latitude-longitude map (6)

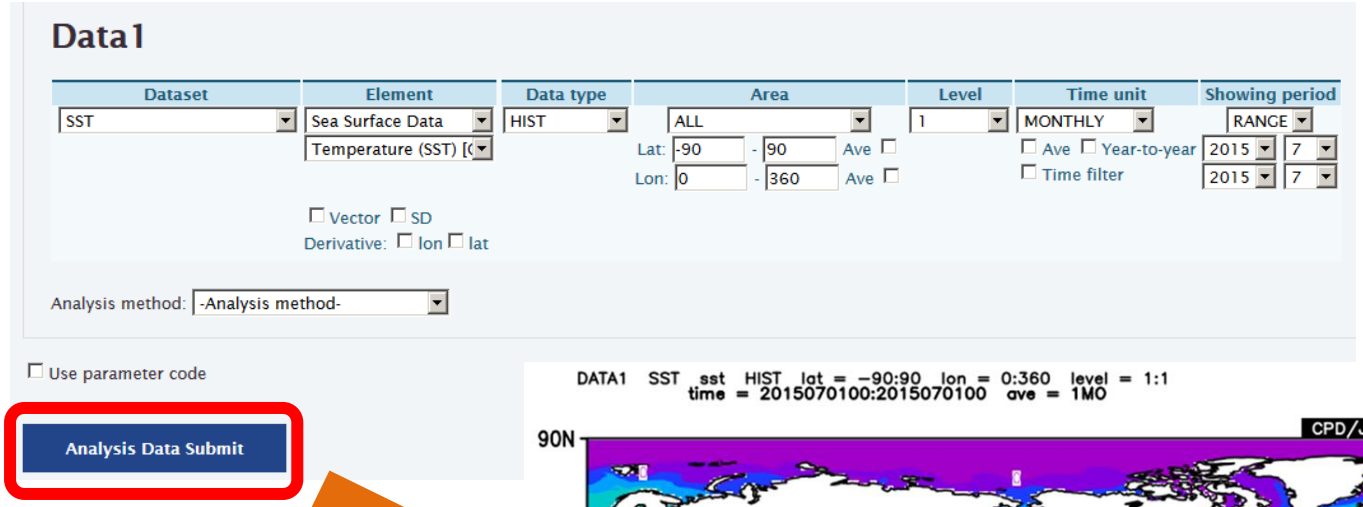


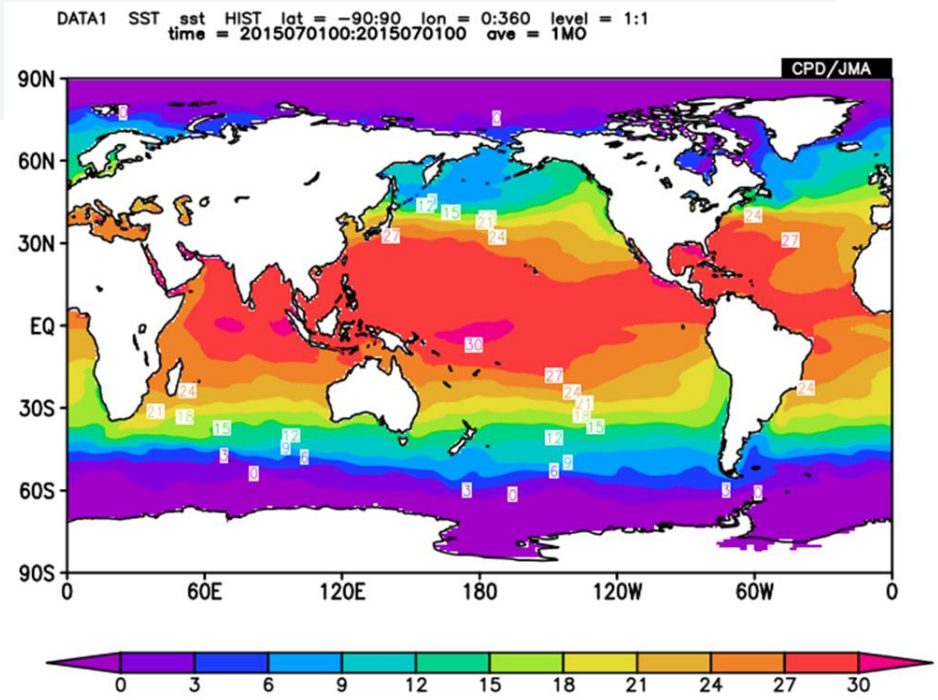
6. Select “Time unit” “MONTHLY”.
   - There are several styles for range selection: **DAILY, PENTAD DAY, MONTHLY** and **ANNUAL**
7. Select “Showing period” “RANGE” and the year and month, “2015 07”, for both upper and lower boxes.

   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)

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

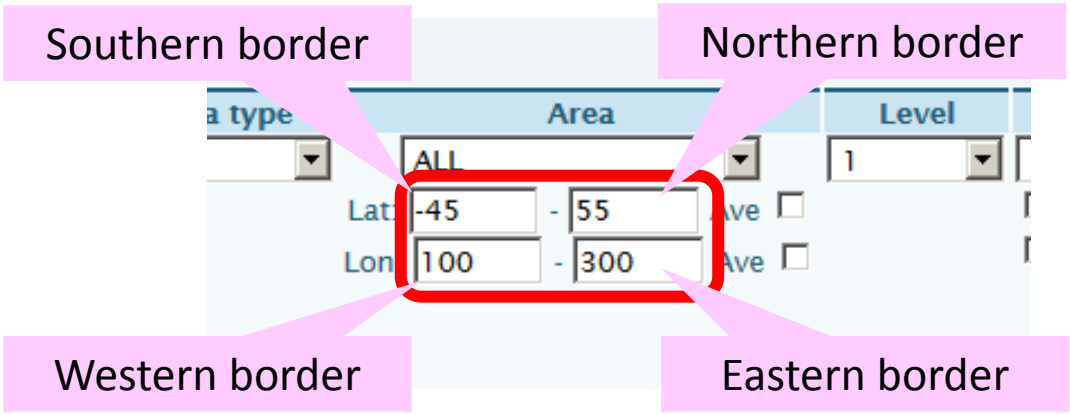




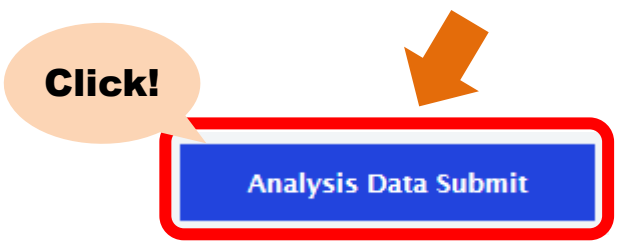
Monthly sea surface temperature (SST) for July 2015

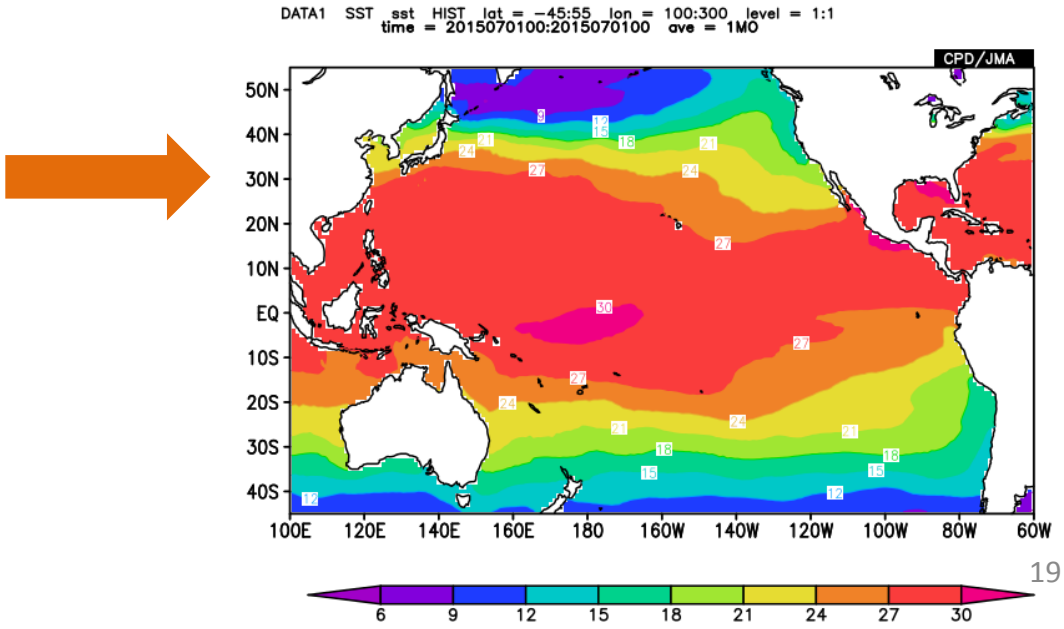
Latitude-longitude map (8)

- You can **change the area** to draw, directly typing latitude/longitude in the “Lat”/”Lon” boxes.



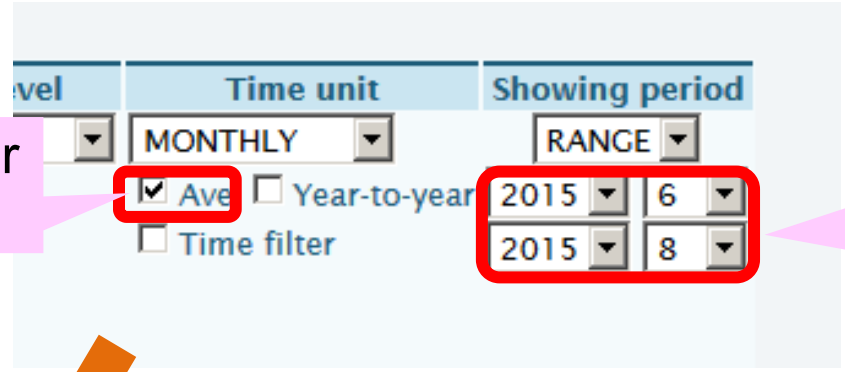
When you draw the range from 60W to 100E, type “-60” and “100” respectively.





Latitude-longitude map (9)

- You can draw **consecutive months average SST** (e.g., June-July-August 2015).

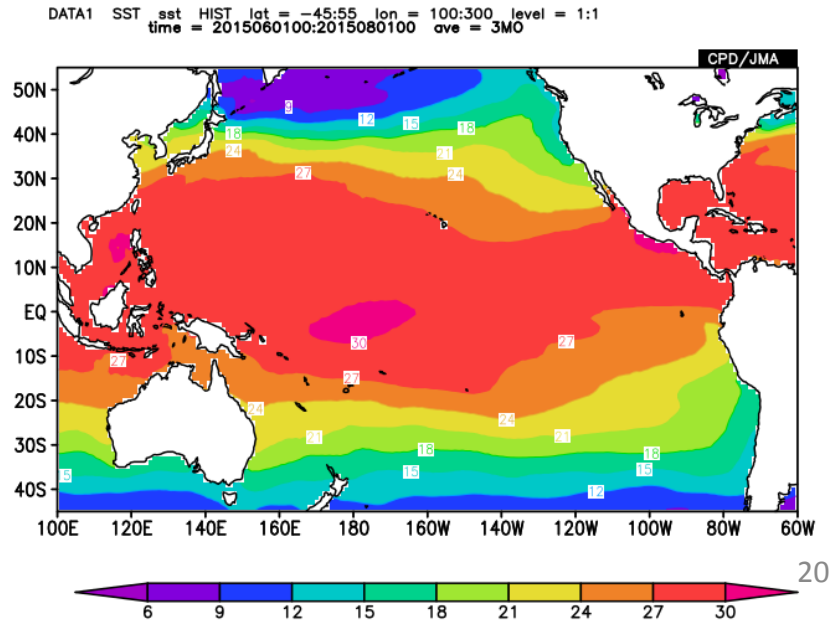


Checking “Ave” for time average

Upper: start month
Lower: end month

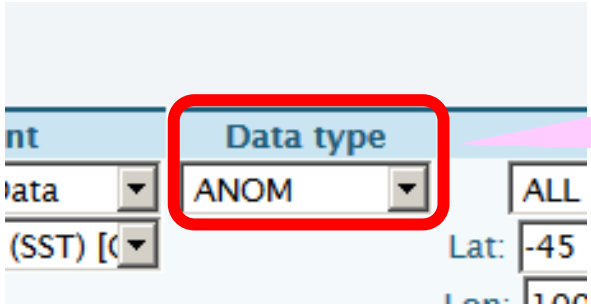
Click!

Analysis Data Submit



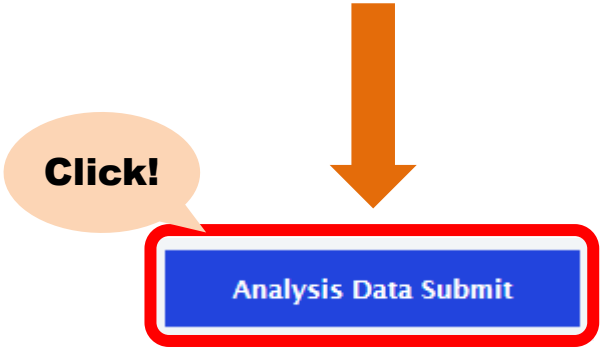
Latitude-longitude map (10)

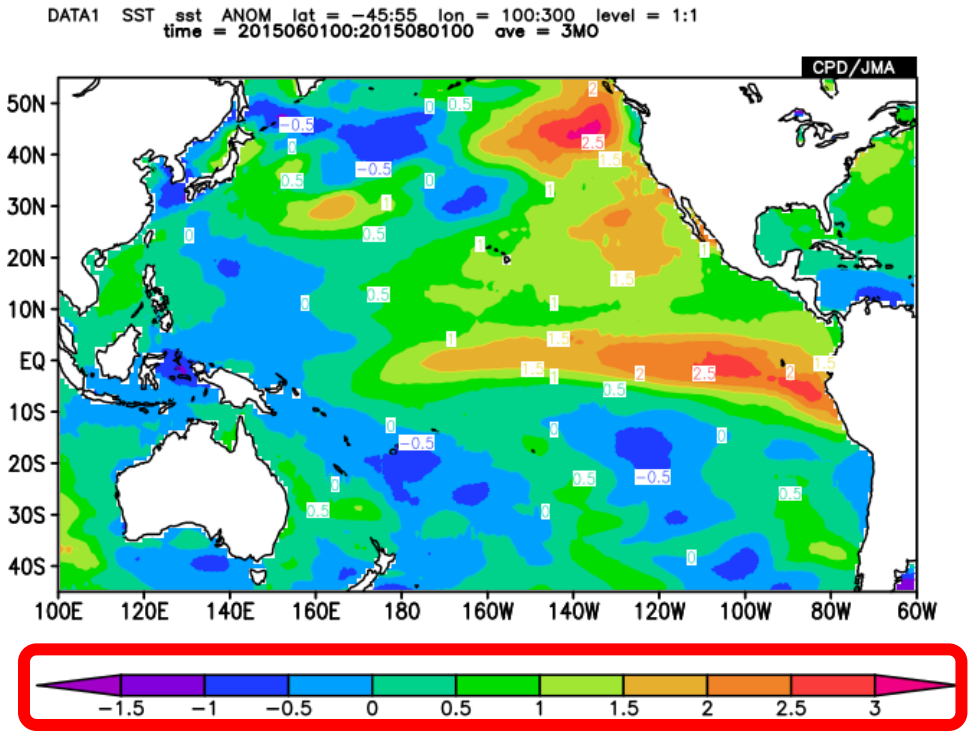
- You can draw **anomaly chart**.



Select “Data type” “ANOM”

Anomaly data (HIST minus NORM: difference from the climatological normal)

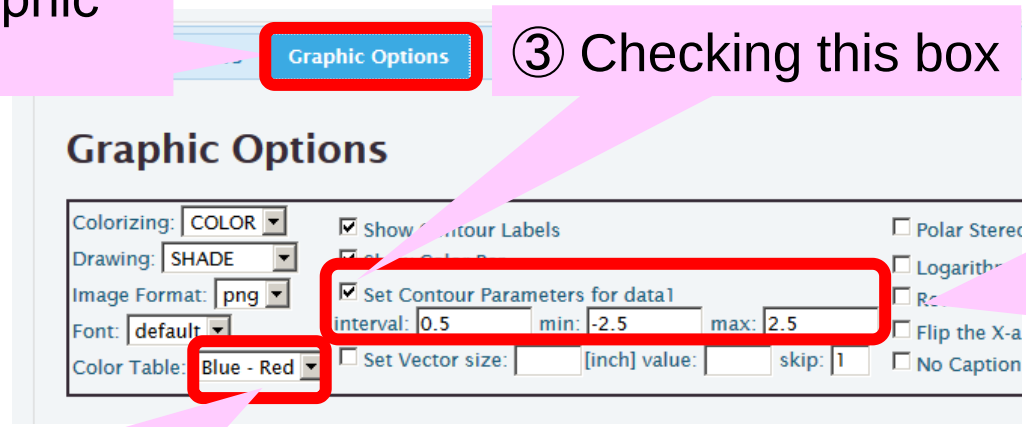




Latitude-longitude map (11)

- You can **change intervals for contour/shading.**

① Click “Graphic Options”



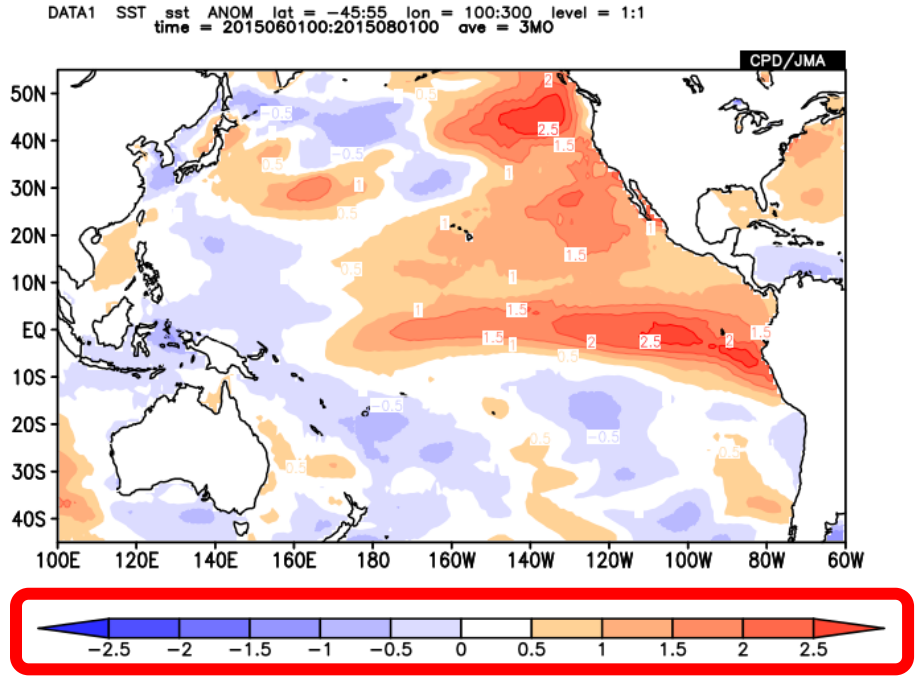
③ Checking this box

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

② Select “Blue - Red”

Click!

Analysis Data Submit



Contents

<Introduction>

<Exercise 1>

Draw a 2D (latitude-longitude) map

<Exercise 2>

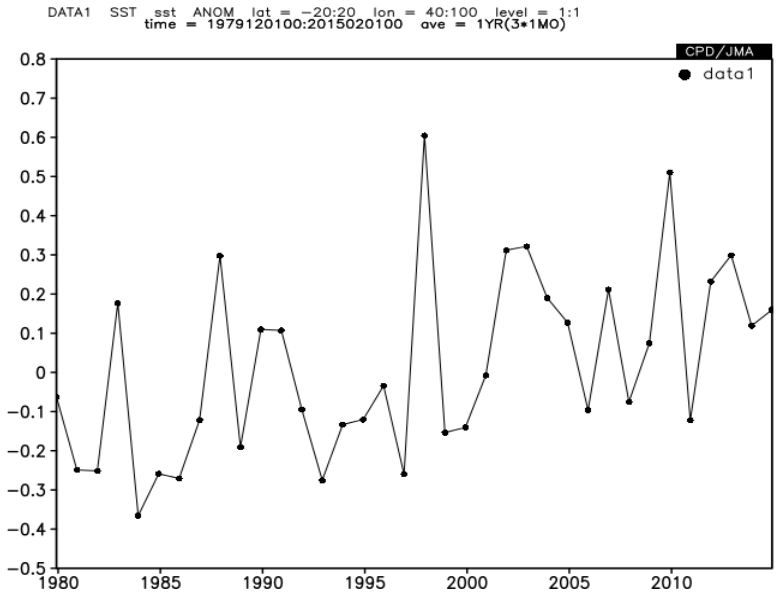
Draw a 1D (time-series) chart

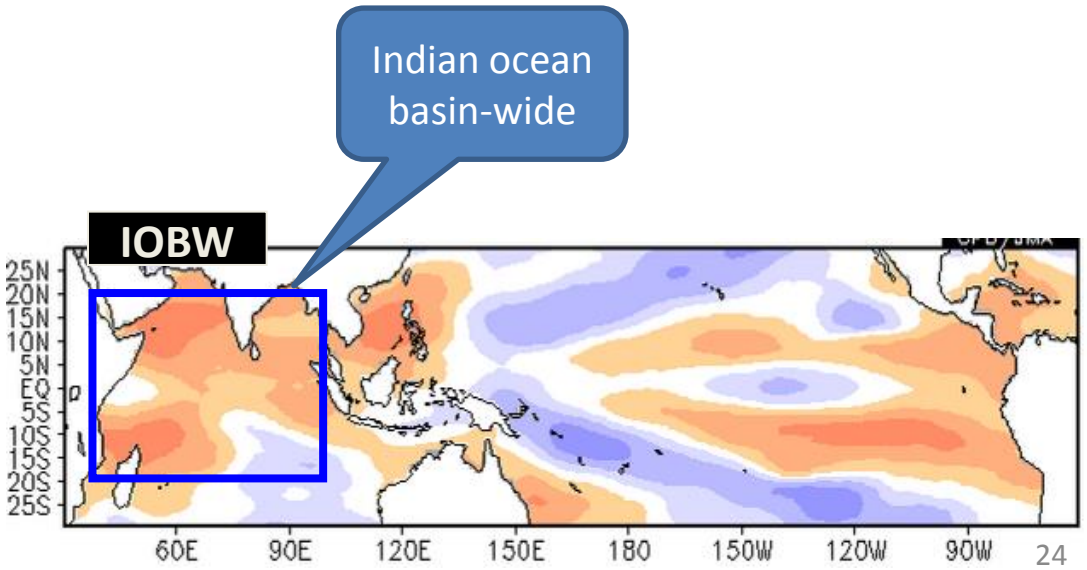
<Exercise 3>

Implement regression analysis

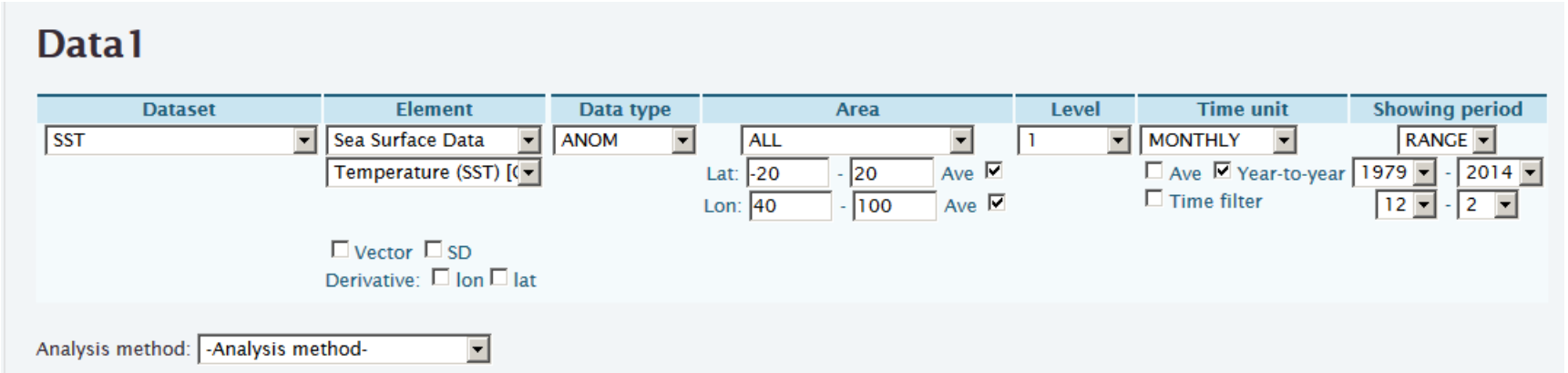
Time-series chart (1)

- To chart the interannual variation of three-month mean SST anomaly averaged in the tropical Indian Ocean (20S – 20N, 40E – 100E) for December – February from 1979/1980 to 2014/2015.





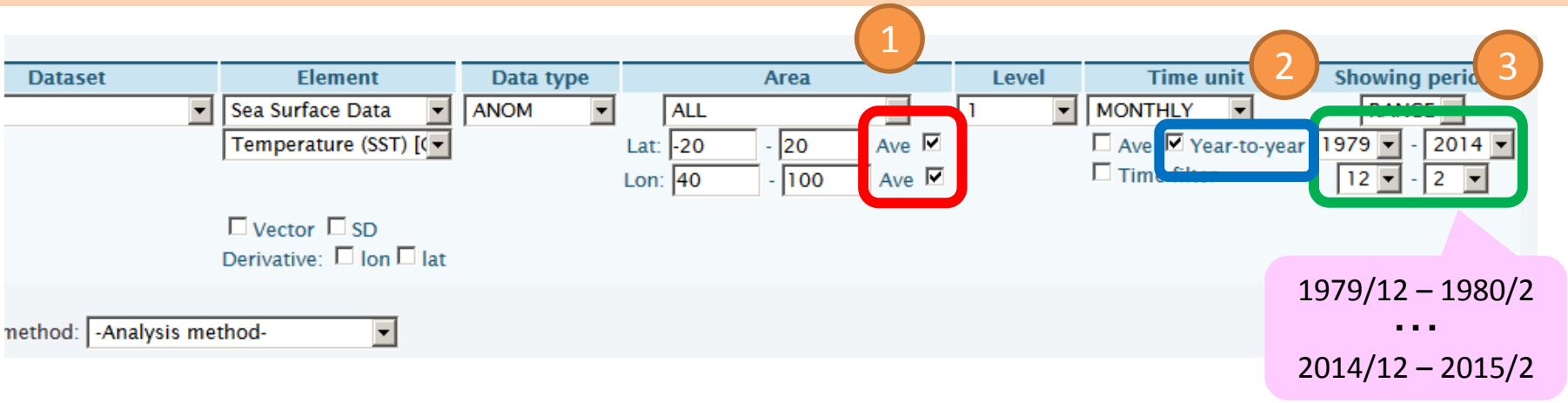
Time-series chart (2)



Please set each item in “data1” as follows.

- Dataset SST
- Element Sea Surface Data > Temperature (SST)
- Data type ANOM (meaning “anomaly”, deviation from climatological normal)
- Area lat: -20 – 20; lon: 40 – 100 checking “Ave”
- Level 1
- Time unit “MONTHLY” checking “Year-to-year”
- Showing period “RANGE”; 1979 – 2014 (year); 12 – 2 (month)

Time-series chart (3)



Point 1: Checking “Ave” means averaging of values in the given latitudinal/longitudinal area.

Point 2: Checking “Year-to-year” means year-to-year variation for the month(s) identified in “Showing period”.

Point 3: Numbers in the middle and bottom boxes indicate the range of year and month, respectively, to draw.

Time-series chart (4)

Data1

Dataset	Element	Data type	Area	Level	Time unit	Showing period
SST	Sea Surface Data	ANOM	ALL	1	MONTHLY	RANGE
	Temperature (SST) [(		Lat: -20 - 20 Ave ☑		☐ Ave ☑ Year-to-year	1979 - 2014
			Lon: 40 - 100 Ave ☑		☐ Time filter	12 - 2

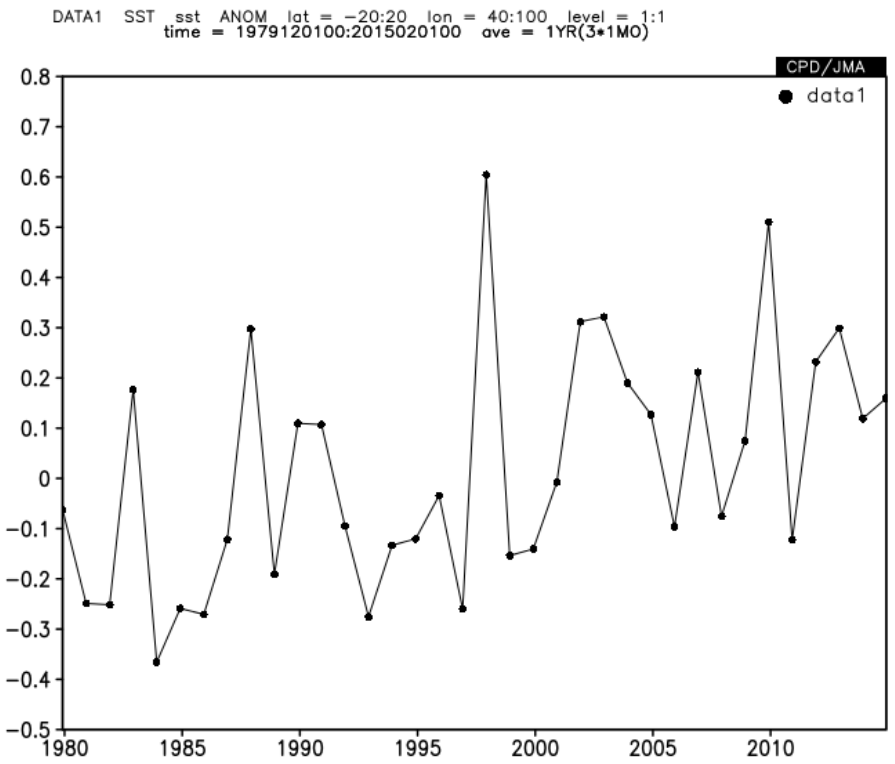
☐ Vector ☐ SD
Derivative: ☐ lon ☐ lat

Analysis method: -Analysis method-

☐ Use parameter code

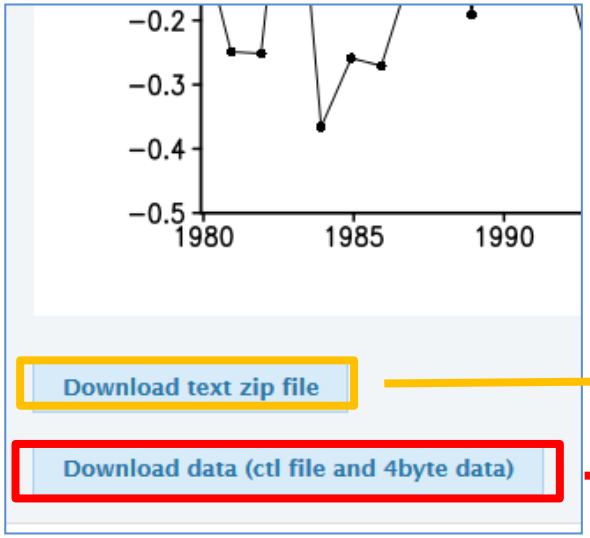
Analysis Data Submit

Click!

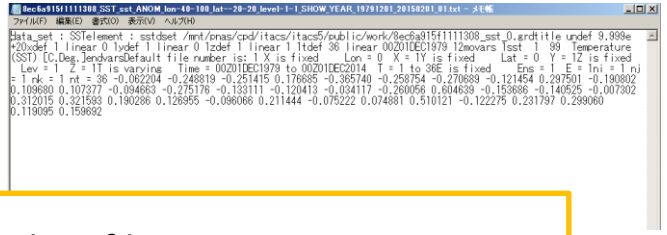


Data download

- 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.



Download and unzip



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

written GrADS control file format

-GrADS fomat data file
-GrADS control 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)

Contents

<Introduction>

<Exercise 1>

Draw a 2D (latitude-longitude) map

<Exercise 2>

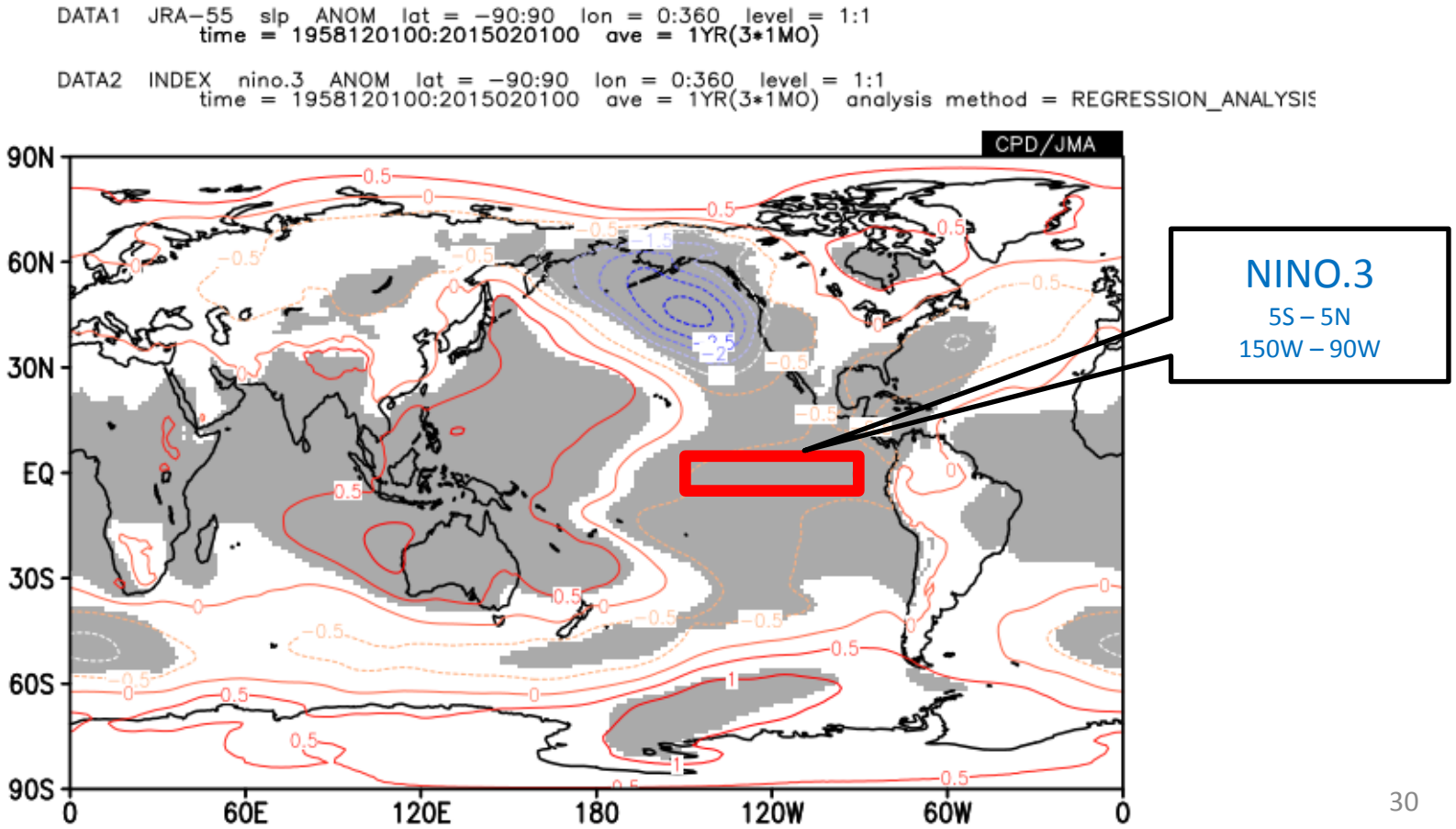
Draw a 1D (time-series) chart

<Exercise 3>

Implement regression analysis

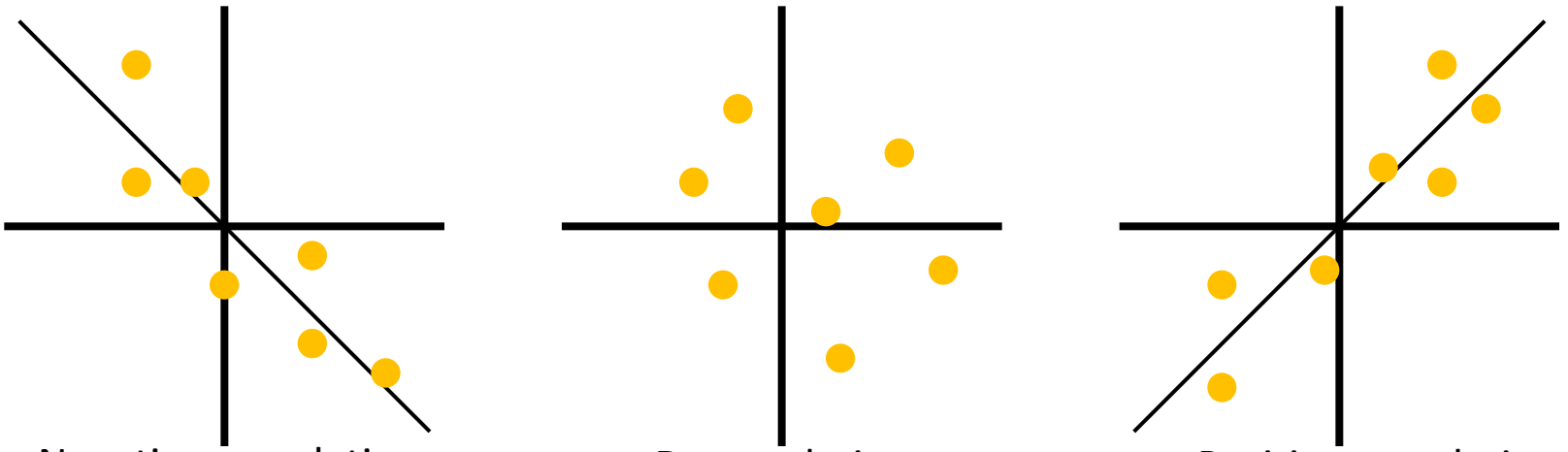
Regression analysis (1)

- To regress three-month mean sea level pressure (SLP) onto NINO.3 SST index for DJF from 1958/1959 to 2014/2015.



Regression and correlation analysis

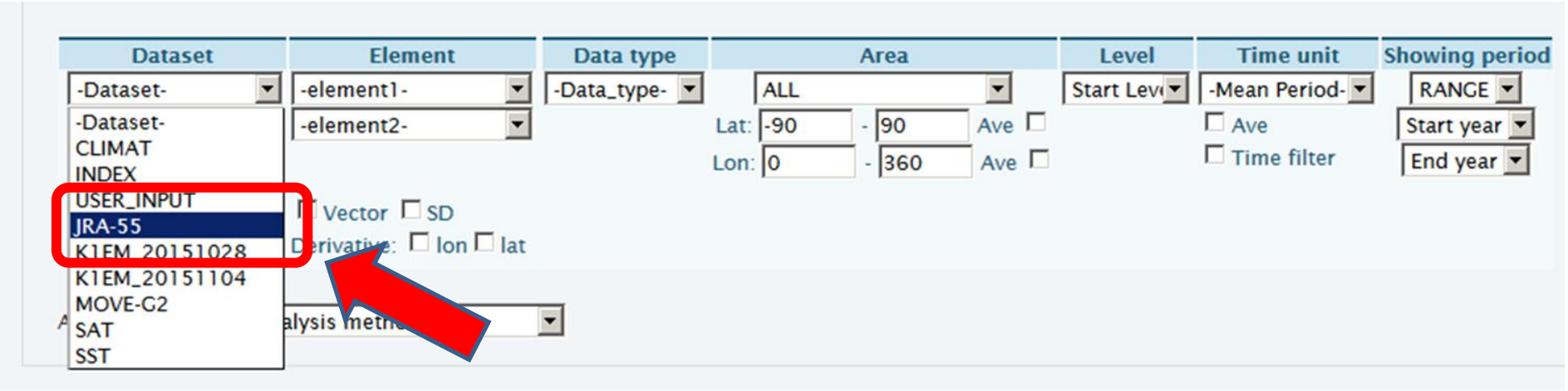
- Regression and correlation analysis are often used to examine climatological systems like teleconnections.
- Correlation coefficient means the degree of the correlation, and the regression coefficient means the gradient of the regression line.
  - Correlation coefficient around +1 or -1 means there is a clear linear relation between the targeted data pair, and the coefficient around zero means there is a few (or weak) relation between them.



Regression analysis (2)

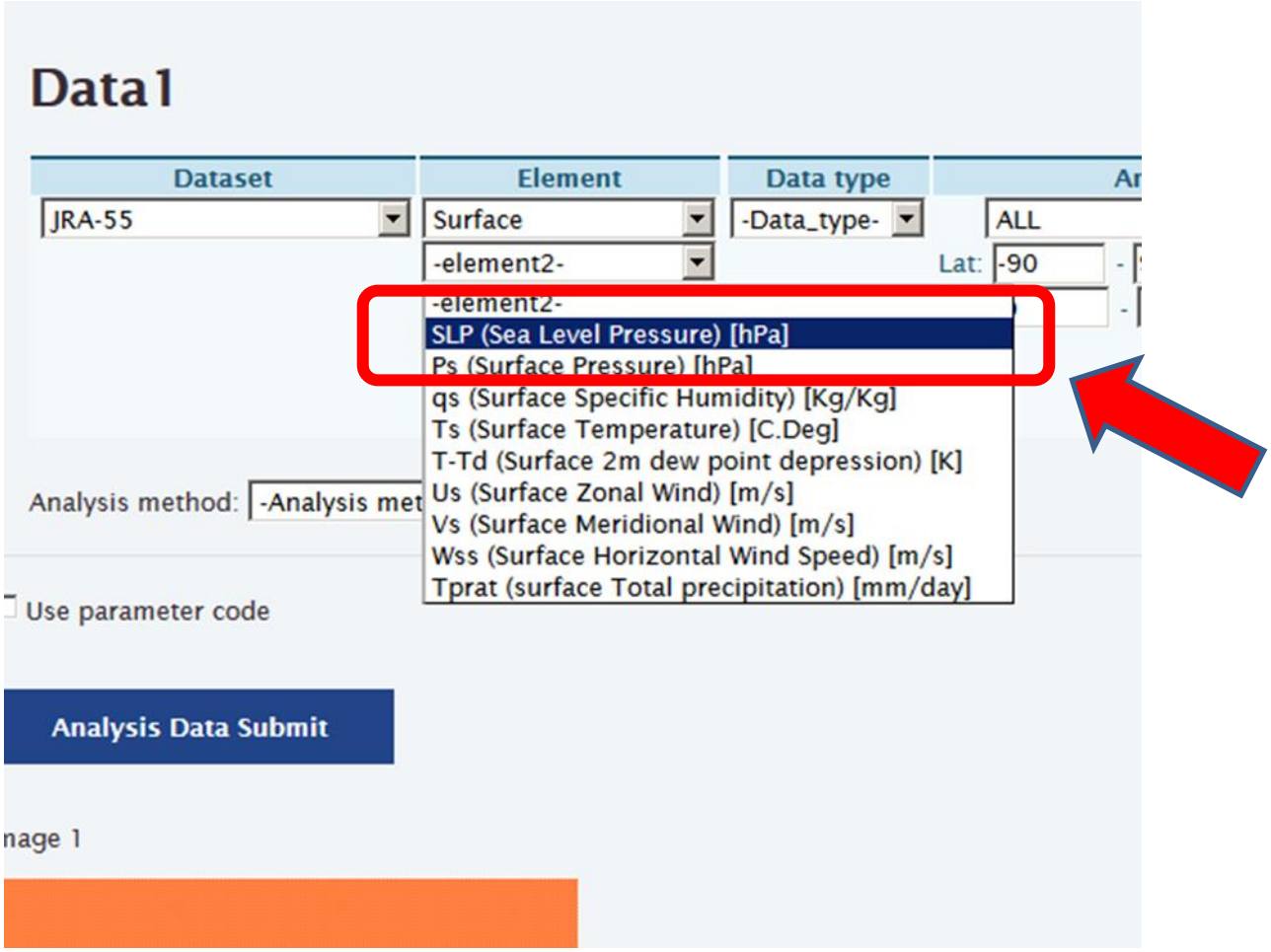
Setting a response variable

- “Data1” is a **response** variable (SLP in this case).
- Select “JRA-55” in the Dataset box of “Data1”.



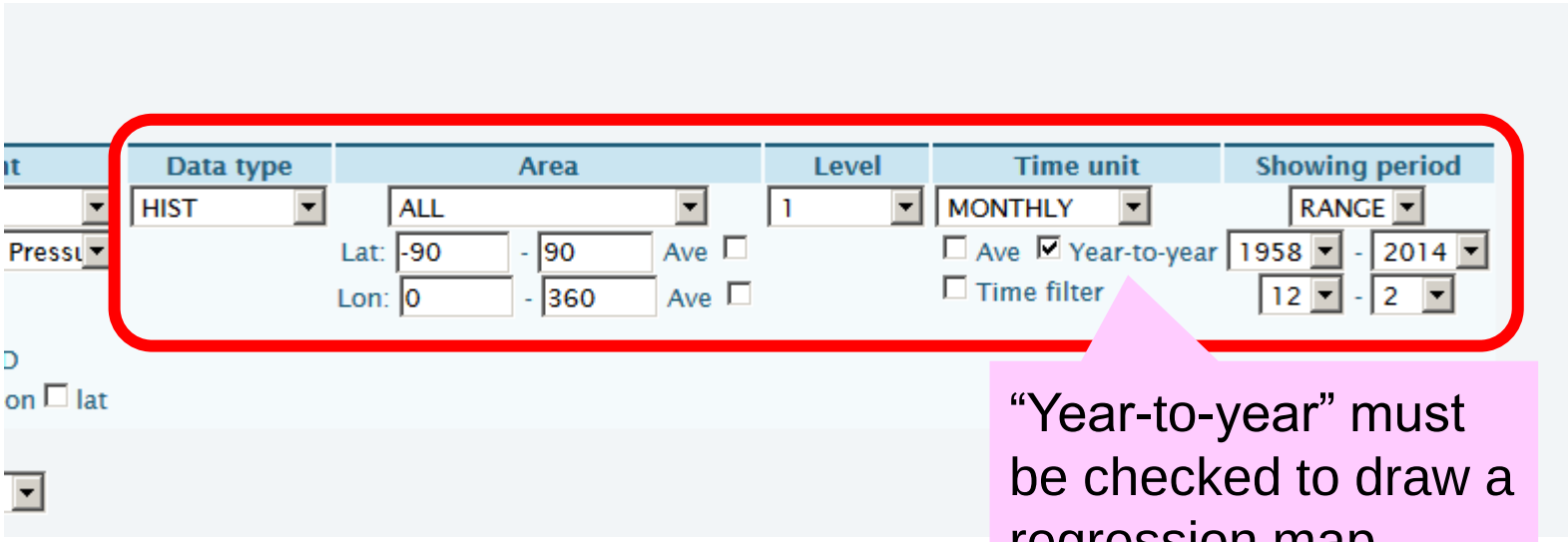
Regression analysis (3)

- Select “Surface” and “SLP (Sea Level Pressure)” in the element box.



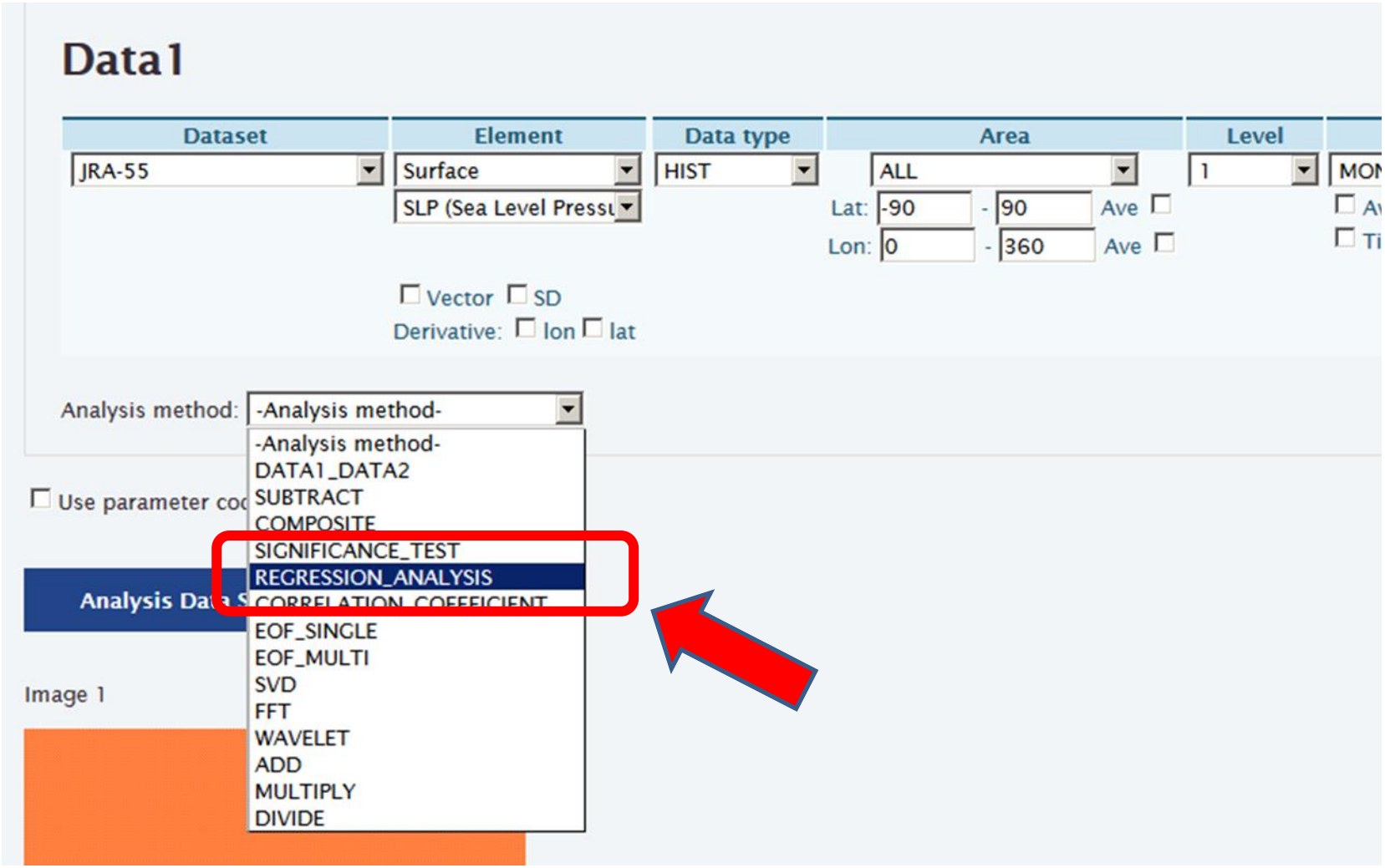
Regression analysis (4)

- Set each of the remaining items in Data1 as shown below.
  - ➢Data type HIST
  - ➢Area ALL
  - ➢Level 1
  - ➢Time unit MONTHLY checking “Year-to-year”
  - ➢Showing period 1958 – 2012; 12 – 2



Regression analysis (5)

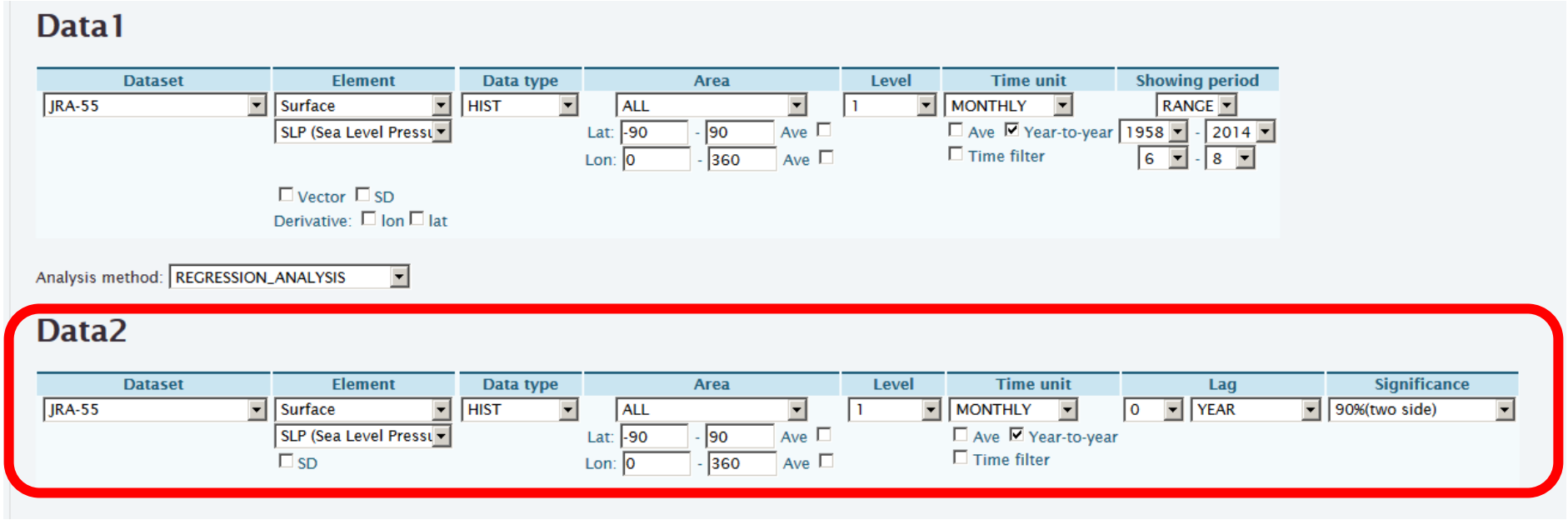
- Select “REGRESSION_ANALYSIS” in the Analysis method box.



Regression analysis (6)

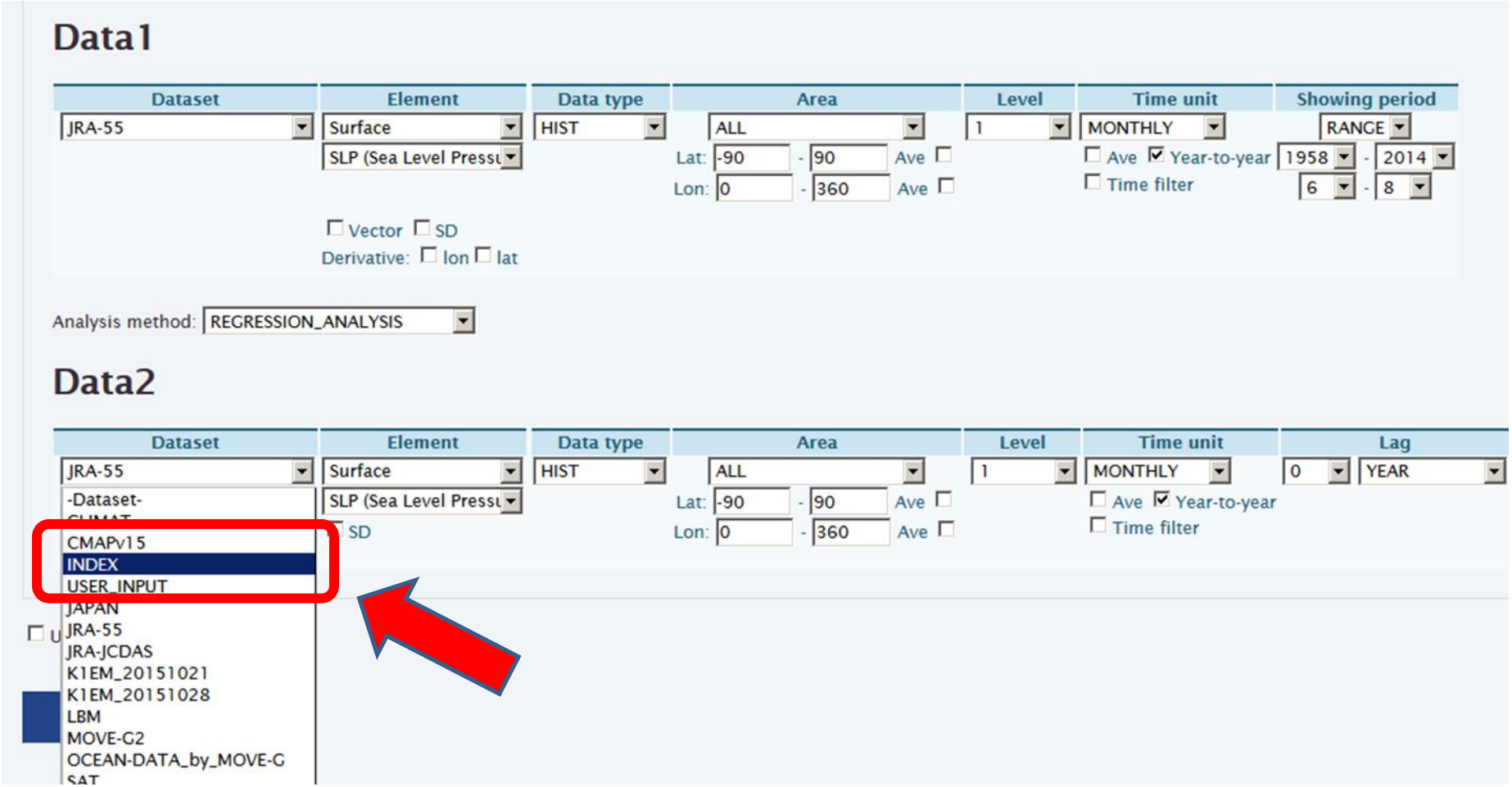
Setting **an explanatory** variable

- You can see “Data2” open.
- “Data2” is an explanatory variable (NINO.3 SST index in this case).



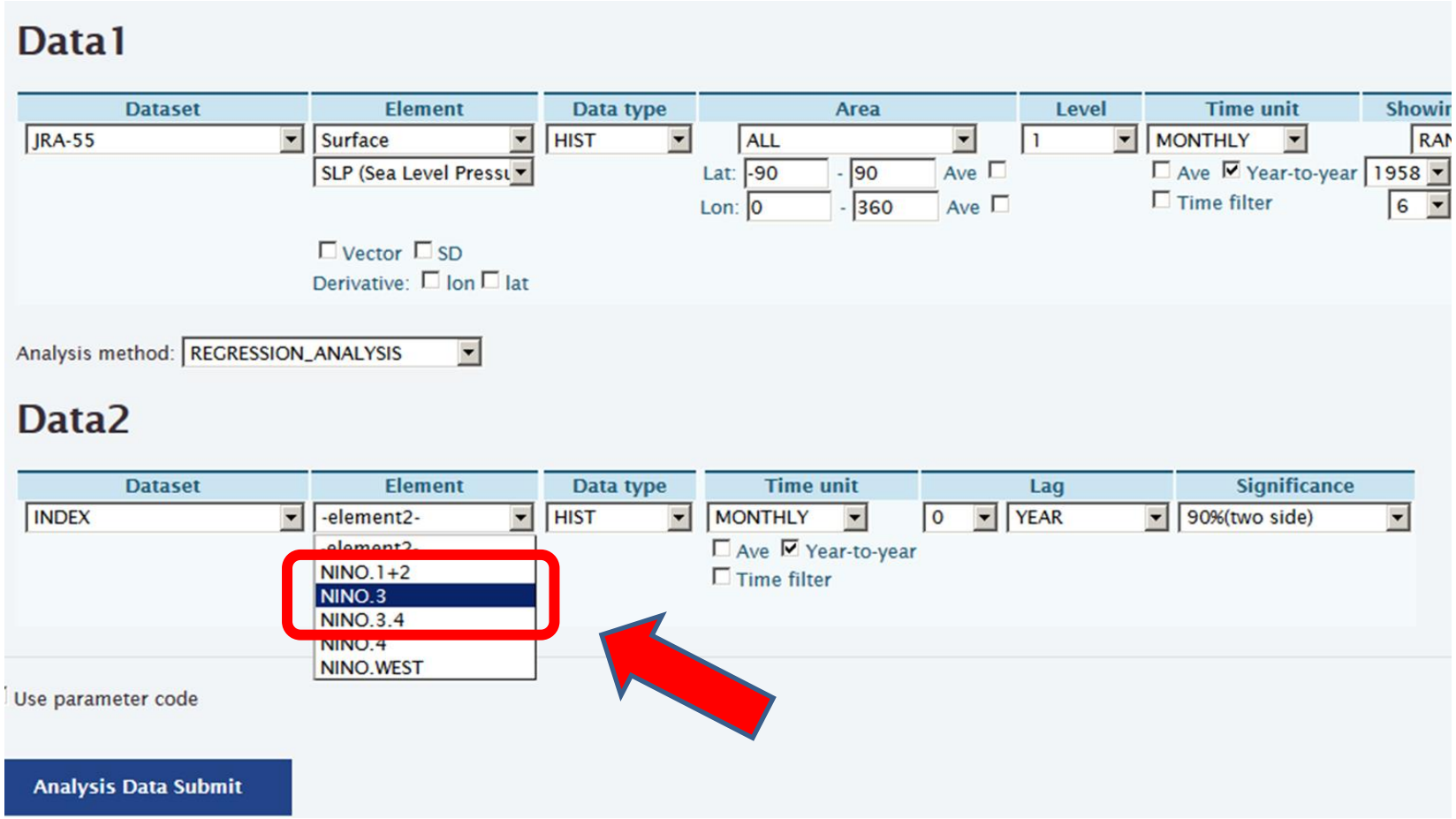
Regression analysis (7)

- Select “INDEX” in the Dataset box of Data2.



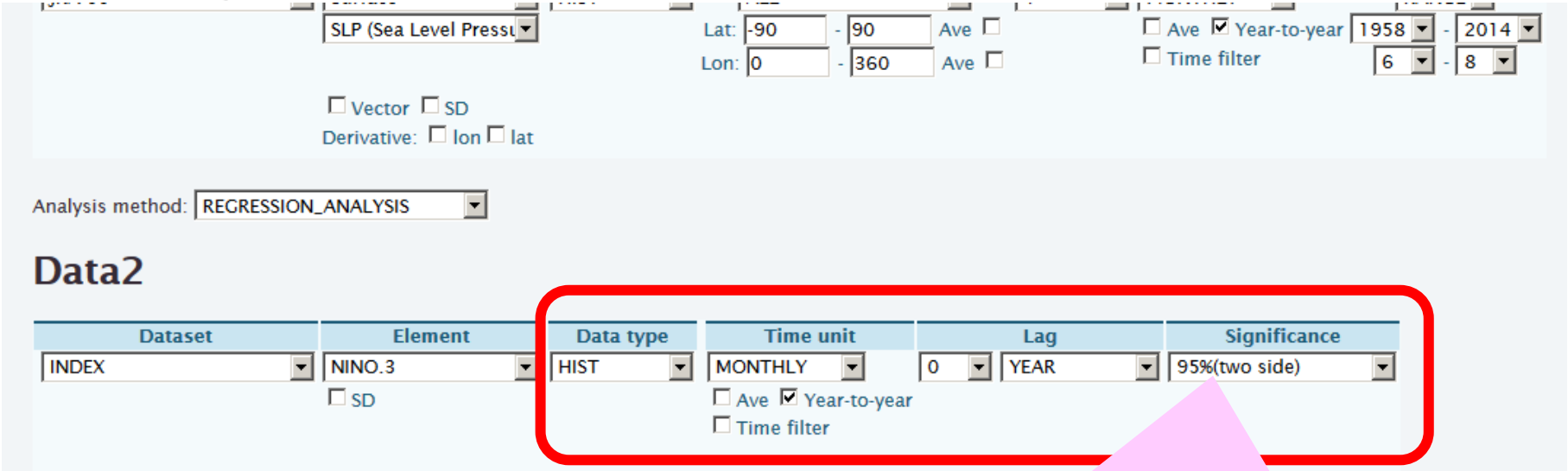
Regression analysis (8)

- Select “NINO.3” in the element box.



Regression analysis (9)

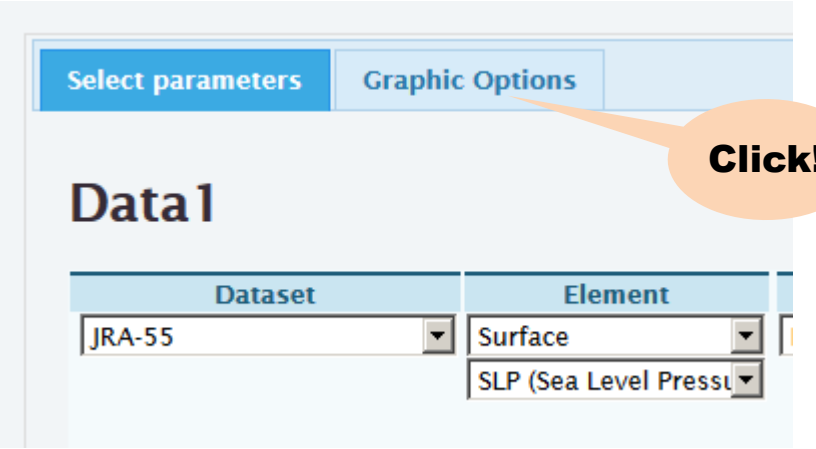
- Set each of the remaining items in data2 as shown below.
  - ➢data type HIST
  - ➢Time unit MONTHLY checking “Year-to-year”
  - ➢lag 0; YEAR
  - ➢Significance 95% (two side)

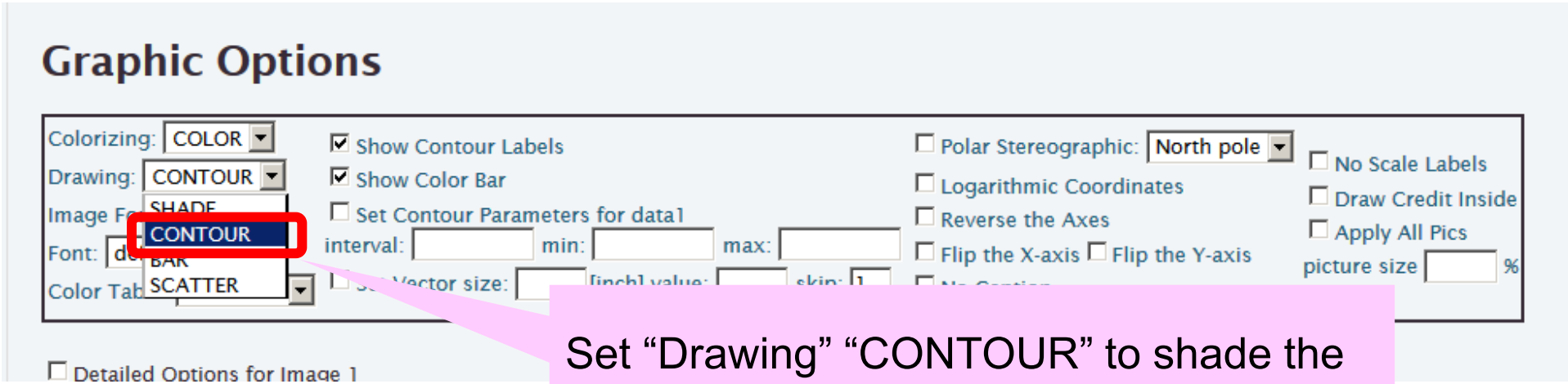


Select options indicate confidence level as indicated by t-testing

Regression analysis (10)

- Click “Graphic Options” and select “CONTOUR” in the Drawing box of Graphic Option.

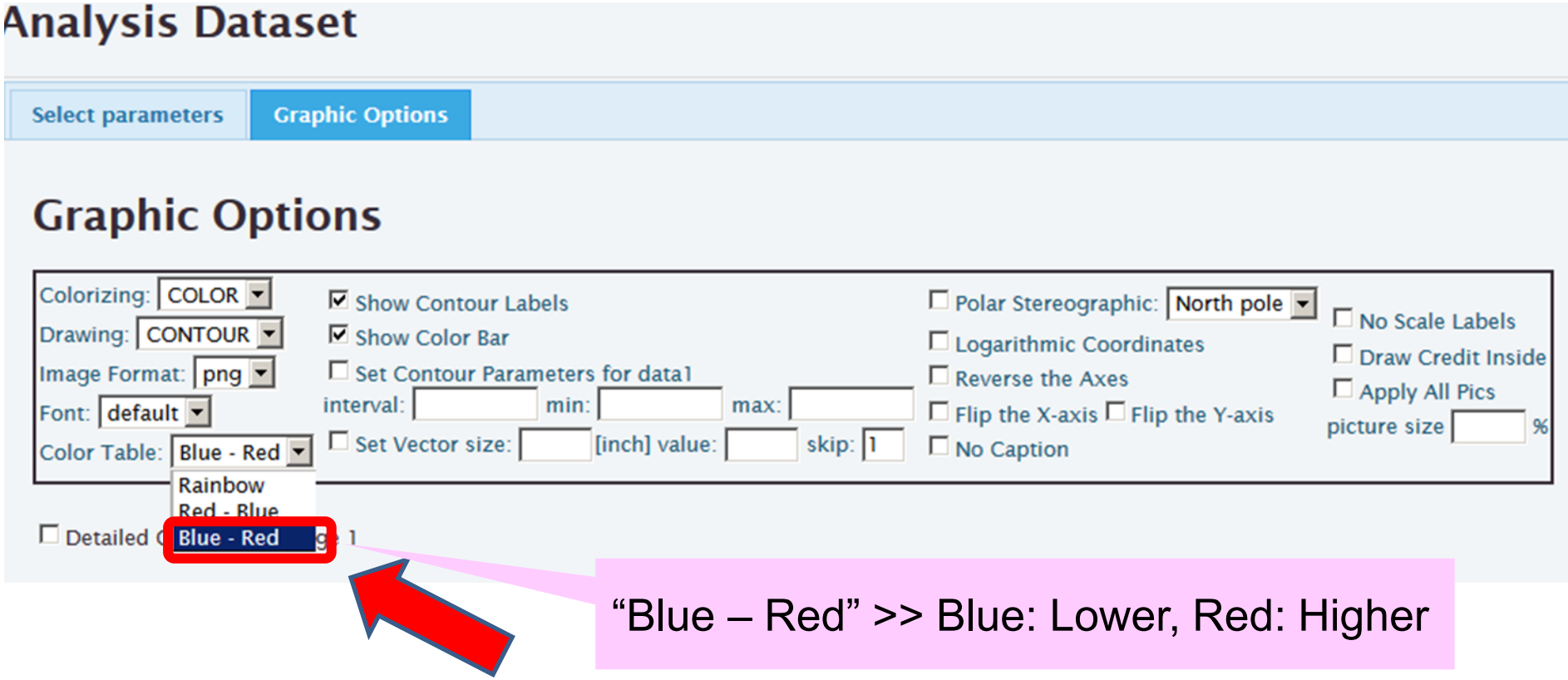




Set “Drawing” “CONTOUR” to shade the grids exceeding confidence level in gray.

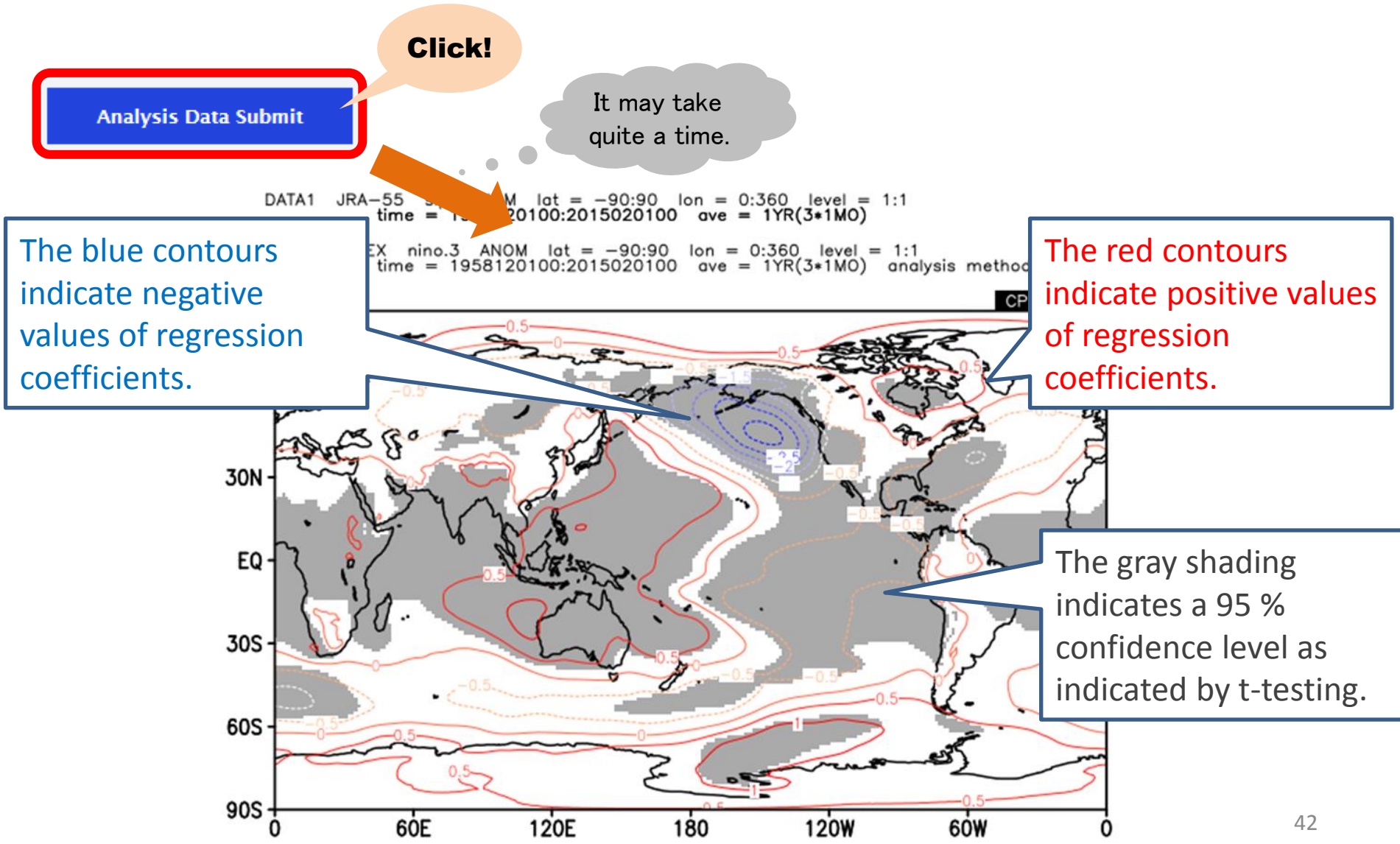
Regression analysis (11)

- Select “Blue - Red” in the Color Table box to display negative and positive values with blue and red contours, respectively.



Regression analysis (12)

- You can draw the following chart.



Thank you for your attention.

We hope you'll make use of iTacs to monitor and understand climate systems.

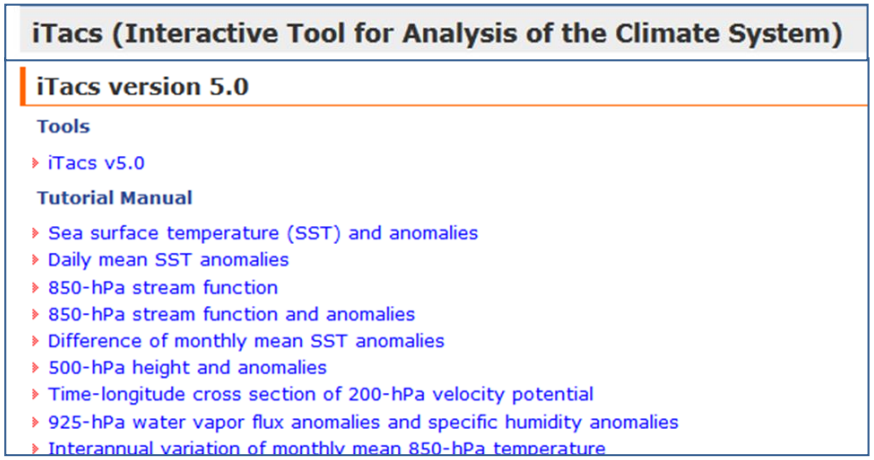
Supplemental explanation

Improvements in iTacs ver.5

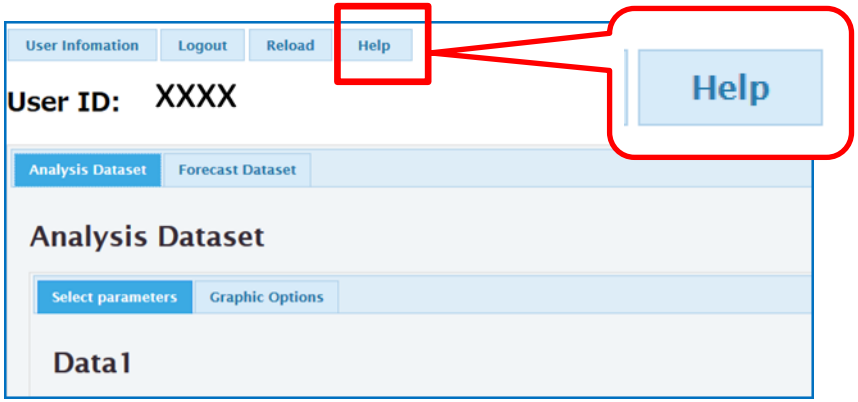
- 30-year re-forecast datasets are added.
- Clearer images can be drawn.
- More efficient connections between client PCs and the web server are provided.

To learn more about iTacs

- Sample images and tutorials are available on the iTacs website.
  http://extreme.kishou.go.jp/tool/itacs-tcc2015/

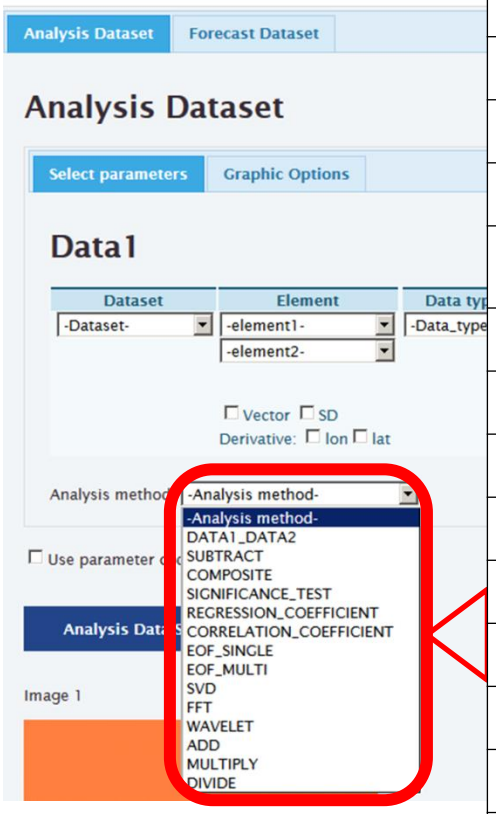


- Online help is also available.



Analysis method

- iTacs supports various types of statistical analysis.



Method	Outline
DATA1_DATA2	Overlay two items on a map at the same time.
SUBTRACT	Map the difference between two sets of data (DATA1-DATA2).
COMPOSITE	Create a composite map based on a set condition.
SIGNIFICANCE_TEST	Create a composite map of "Data1."
REGRESSION_COEFFICIENT	Create a regression coefficient map. "Data1": dependent variable "Data2": objective (independent) variable
CORRELATION_COEFFICIENT	Create a correlation coefficient map.
EOF_SINGLE	Conduct EOF (empirical orthogonal function) analysis.
EOF_MULTI	Conduct multi-EOF analysis.
SVD	Conduct SVD (singular value decomposition) analysis.
FFT	Conduct FFT (fast Fourier transform) analysis.
WAVELET	Conduct wavelet analysis.
ADD	Map the sum of two data sets (DATA1+DATA2).
MULTIPLE	Map the product of two data sets (DATA1*DATA2).
DIVIDE	Map the division of two data sets (DATA1/DATA2).

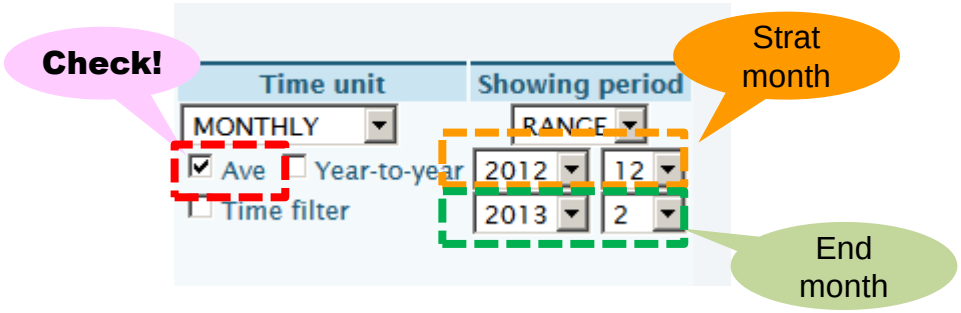
Example of time setting

- Setting for **a consecutive period** in 2D map

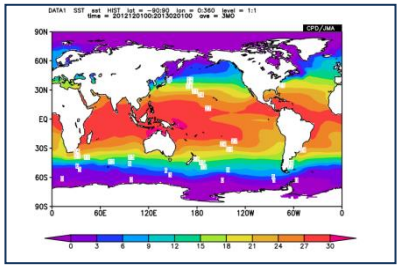
<Calendar>

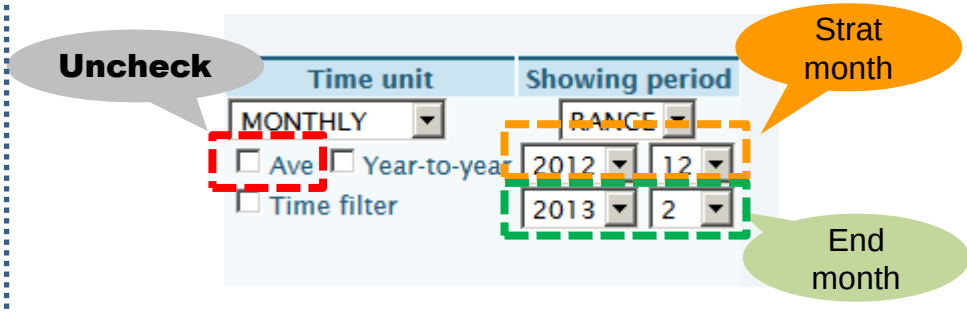
2012 **2013**

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

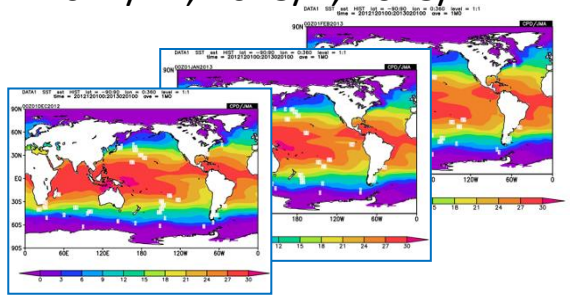


One 3-month averaged map for 2012/12-2013/2

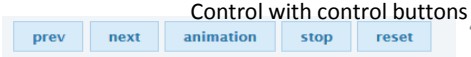




Three 1-month maps for 2012/12, 2013/1, 2013/2



Control with control buttons



Example of time setting

- Setting for **a specific period of each year** in 2D map

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”

Check!

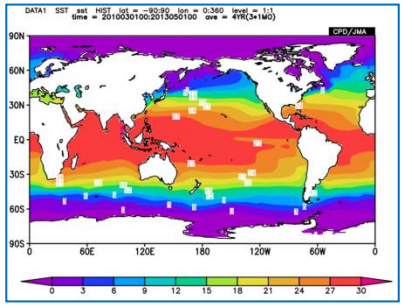
Time unit | Showing period
MONTHLY | RANGE
Ave | Year-to-year | 2010 - 2013
Time filter | 3 - 5

Check!

Target years

Target period

One 4-year-MAM averaged map



2010/3-5
2011/3-5
2012/3-5
2013/3-5
} averaged

Uncheck

Time unit | Showing period
MONTHLY | RANGE
Ave | Year-to-year | 2010 - 2013
Time filter | 3 - 5

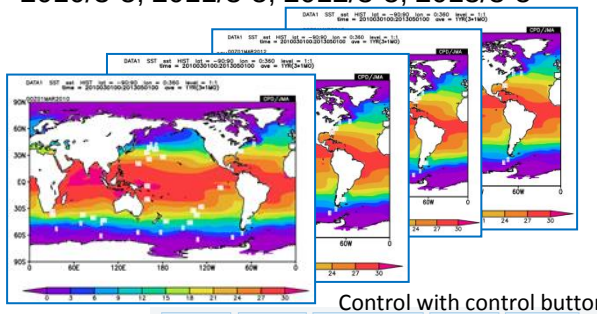
Check!

Target years

Target period

Four MAM averaged maps

2010/3-5, 2011/3-5, 2012/3-5, 2013/3-5



Control with control buttons

prev | next | animation | stop | reset

Available datasets and elements 1/3

Atomospheric analysis datasets

Dataset	element1	element2	Remarks
JRA-55	Pressure Levels	χ (Velocity Potential) [10^6m^2/s]	37 Levels (1000 - 1 hPa)
		Div (Relative Divergence) [1/s]	
		θe (Equivalent Potential Temperature) [K]	
		ω (Pressure Vertical Velocity) [Pa/S]	
		ψ (Stream Function) [10^6m^2/s]	
		θ (Potential Temperature) [K]	
		q (Specific Humidity) [Kg/Kg]	
		T (Temperature) [C. Deg]	
		T-Td (Dew point depression) [K]	
		U (Zonal Wind) [m/s]	
		V (Meridional Wind) [m/s]	
		Udiv (Zonal Divergence Wind) [m/s]	
		Vdiv (Meridional Divergence Wind) [m/s]	
		ζ (Relative Vorticity) [1/s]	
		γ (Geopotential Height) [gpm]	
		KE (Kinetic energy of high-frequency variation) [m^2/s^2]	
		EGR (Maximum growth rate in the Eady problem) [1/day]	
	Flux	Waf-xc (Calc Zonal Wave Activity Flux) [m^2/s^2]	
		Waf-yc (Calc Meridional Wave Activity Flux) [m^2/s^2]	
		Waf-zc (Calc Vertical Wave Activity Flux) [Pa*m/s^2]	
		Wvf-x (Zonal Water Vapor Flux) [Kg/Kg*m/s]	
		Wvf-y (Meridional Water Vapor Flux) [Kg/Kg*m/s]	
		U'V' (Momentum Flux by eddies) [m^2/s^2]	
		V'T' (Heat Flux by eddies) [K*m/s]	
	Surface	SLP (Sea Level Pressure) [hPa]	
		Ps (Surface Pressure) [hPa]	
		qs (Surface Specific Humidity) [Kg/Kg]	
		Ts (Surface Temperature) [C.Deg]	
		T-Td (Surface 2m dew point depression) [K]	
		Us (Surface Zonal Wind) [m/s]	
		Vs (Surface Meridional Wind) [m/s]	
		Tprat (surface Total precipitation) [mm/day]	

Available datasets and elements 2/3

Oceanic analysis datasets

Dataset	element1	element2	Remarks
MOVE-G2	d20-OHC	20 degC depth [m]	
		OHC (vertical ave temp over top 300m)	
	Thermohaline-3D	Potential Temperature [degC]	52 Levels (1.0 - 5925.0m)
		Salinity [psu]	
	Thermohaline-2D	Potential Temperature [degC]	
		Salinity at BBL [psu]	
		Sea Surface Height [cm]	
		Short Wave Radiation [W/m2]	
		Long Wave Radiation [W/m2]	
		Latent Heat Flux [W/m2]	
		Sensible Heat Flux [W/m2]	
		Heat Flux w/o Short Wave Radiation [W/m2]	
		Freshwater Flux [cm/s]	
		Salt Flux for Restoring [psu cm/s]	
		Sea Ice Thickness [m]	
		Snow Depth [m]	
		Ice Concentration	
		surface Temperature [degC]	
	Current-3D	Eastward Velocity [cm/s]	52 Levels (1.0 - 5925.0m)
		Northward Velocity [cm/s]	
	Current-2D	Eastward Velocity at BBL [cm/s]	
		Northward Velocity at BBL [cm/s]	
		Eastward Component of Surface Wind Stress [N/m2}	
		Northward Component of Surface Wind Stress [N/m2}	
		Eastward Component of Surface Stress [N/m2}	
		Northward Component of Surface Stress [N/m2}	
		Eastward Velocity of Ice [m/s]	
		Northward Velocity of Ice [m/s]	
		Ice Concentration in UV-box	
SST	Sea Surface Data	Temperature (SST) [C.deg]	
		Ice Concentration (ice=1 no ice=0) [fraction]	

Available datasets and elements 3/3

CLIMAT, ENSO monitoring INDEX, Satellite datasets

Dataset	element1	element2	Remarks
CLIMAT		T (Temperature) [C. Deg]	
		Tx (Maximum Temperature) [C. Deg]	
		Tm (Minimum Temperature) [C. Deg]	
		Rain (Precipitation) [mm]	
INDEX		Nino.1+2	10S-Eq, 90W-80W
		Nino.3	150W-90W, 5S-5N
		Nino.3.4	170W-120W, 5S-5N
		Nino.4	5S-5N, 160E-150W
		Nino WEST	130E-150E, EQ-20N
SAT		OLR [W/m2]	

Forecast datasets

Dataset	element1	element2	Remarks
1MONTH_ENS_MEAN 1MONTH_HIND K1EM_yyyymmdd * *Available when the "Analysis Dataset" is selected	Pressure Levels	γ (Geopotential Height) [gpm]	10 Levels (1000 - 10 hPa)
		U (Zonal Wind) [m/s]	
		V (Meridional Wind) [m/s]	
		T (Temperature) [C. Deg]	
		T-Td (Dew point depression) [K]	
		χ (Velocity Potential) [10^6m^2/s]	
		ψ (Stream Function) [10^6m^2/s]	
	Surface	SLP (Sea Level Pressure) [hPa]	
		Ts (Surface Temperature) [C. Deg]	
		Rain (Daily Precipitation) [mm/day]]	