**JMA/TCC Training Seminar**

# What can we do with ITACS?

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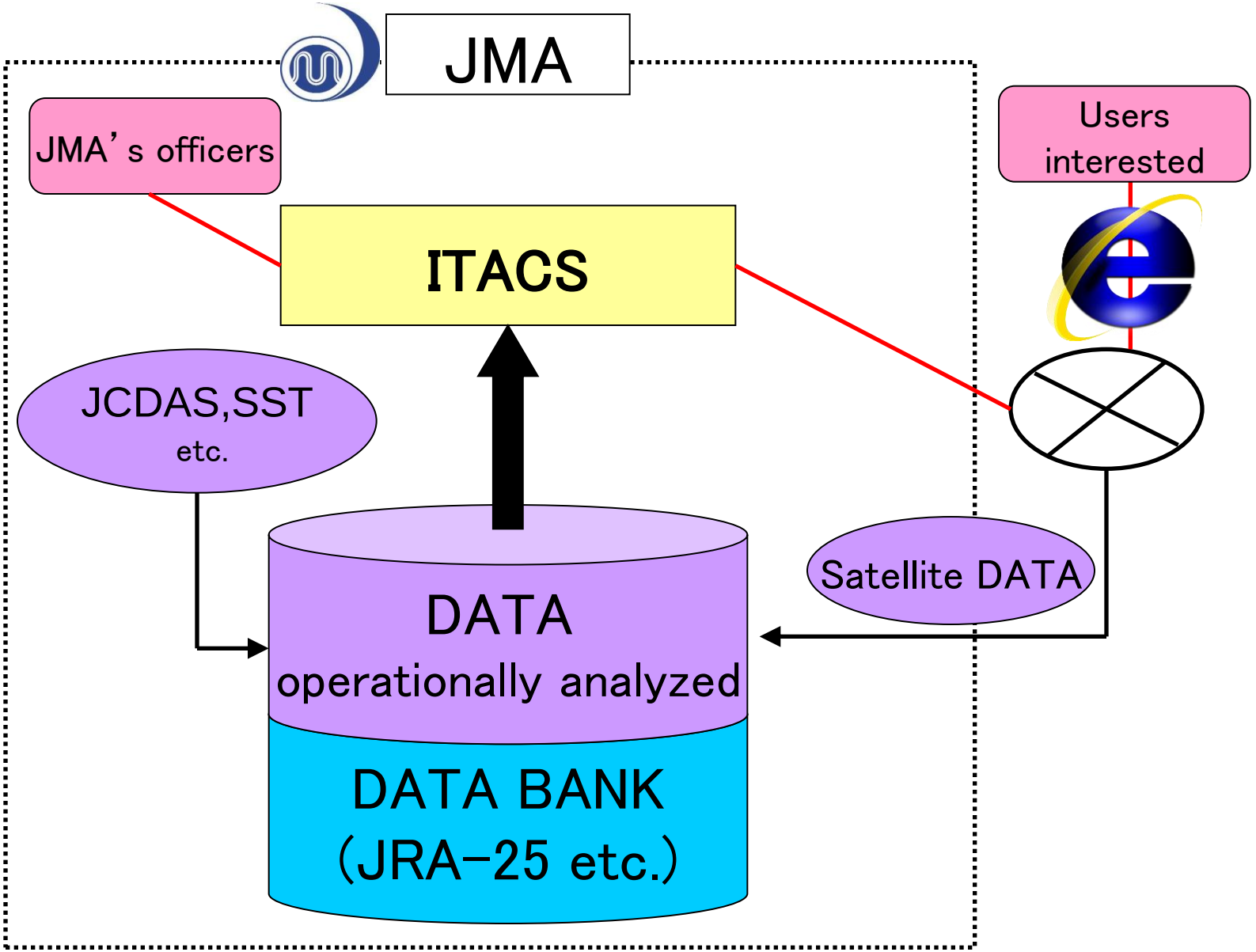
# What is ITACS?

- JMA has developed the *Interactive Tool for Analysis of Climate System*, referred to as ITACS, to assist National Meteorological and Hydrological Services.
- ITACS can be used for analyzing the causes of extreme climate events.
- ITACS will enable users not only to monitor current climate status but also to analyze the complicated system that lies behind climatic conditions.

# Purpose in the lecture and practice ahead

Understanding of characteristics of atmospheric circulation fields and relationship between atmospheric circulation fields and climate through the interactive tool for analysis of climate system (ITACS)

# Outline of ITACS



# What can ITACS do?

## Drawing chart

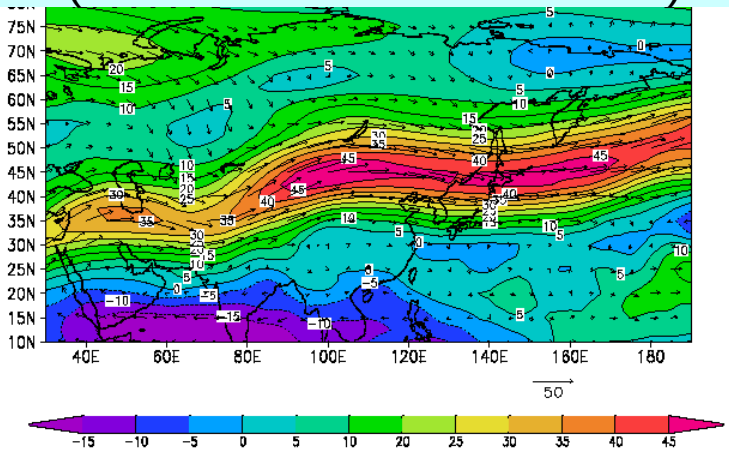
− Enable to make not only plane charts, but also charts of vertical cross section, time cross section, time series and animation of any atmospheric fields.
- On a web browser, set parameters for the chart.
- Do not need any programming.

## Statistical analysis

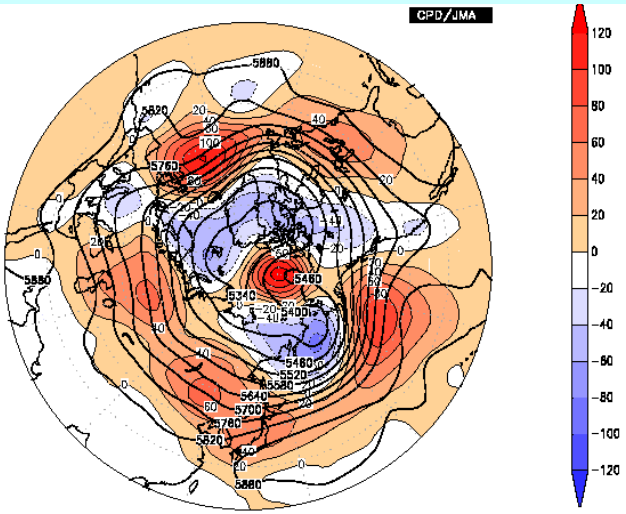
- Enable to calculate correlation coefficient, regression coefficient and composite charts with statistically confidence.
- Just set parameters for the statistical analysis in the same way as drawing chart.

# Example of Chart

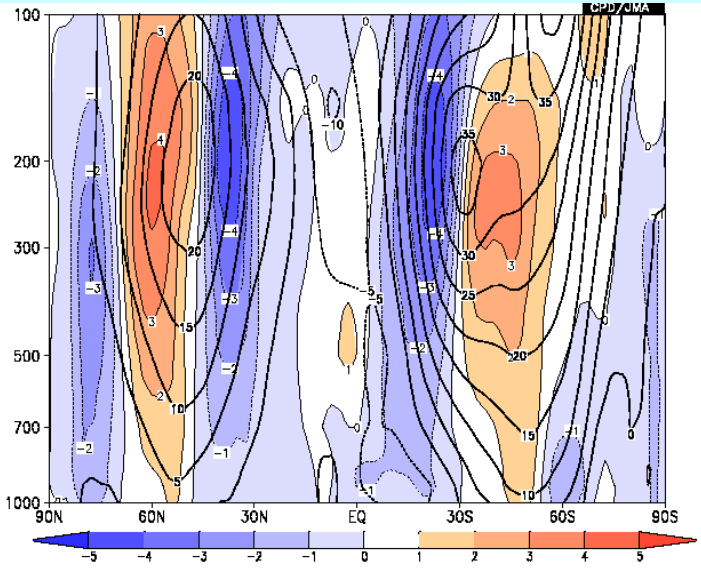
## Mercator chart
(200hPa wind vector and zonal wind)



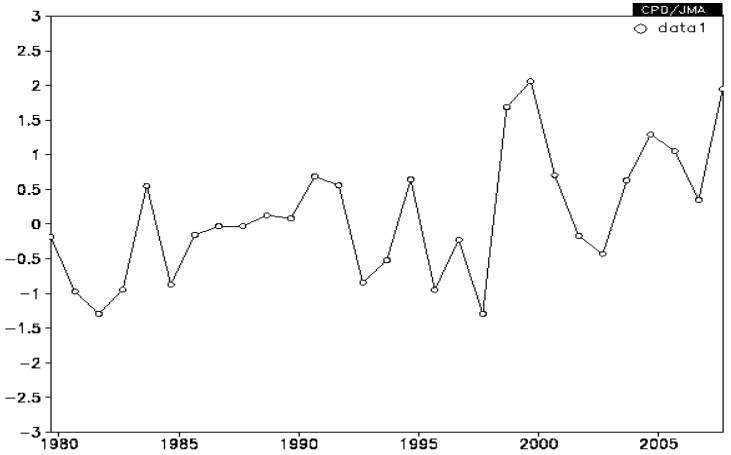

## Polar Stereographic chart
( 500hPa height and its anomaly)




## Vertical cross section
( zonal mean zonal wind and its anomaly)

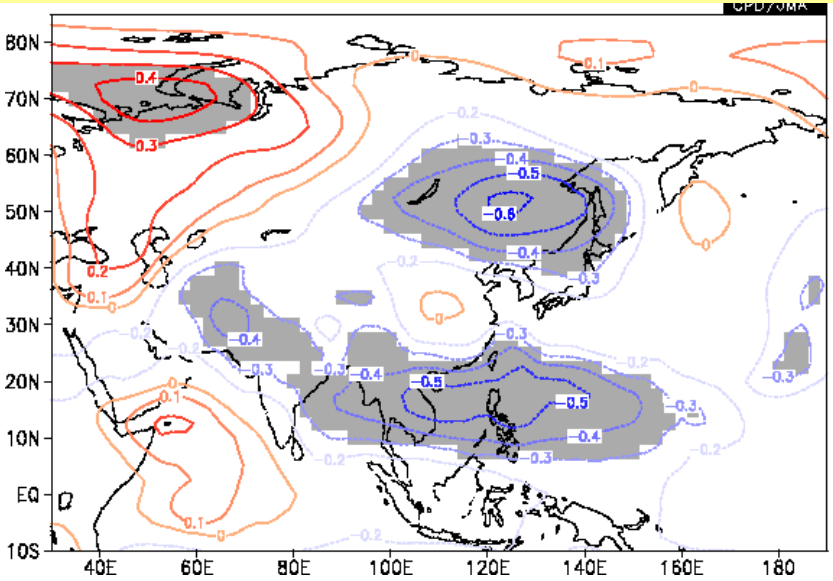



## Time series
(850hPa temperature anomaly over Japan)

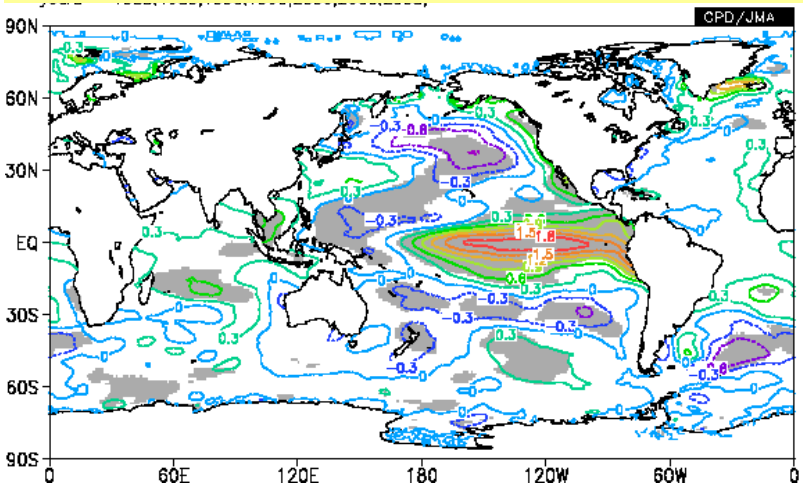


# Example of statistical analysis

## CORRELATION COEFFICIENT
(between Z500 and OLR around INDIA in August)

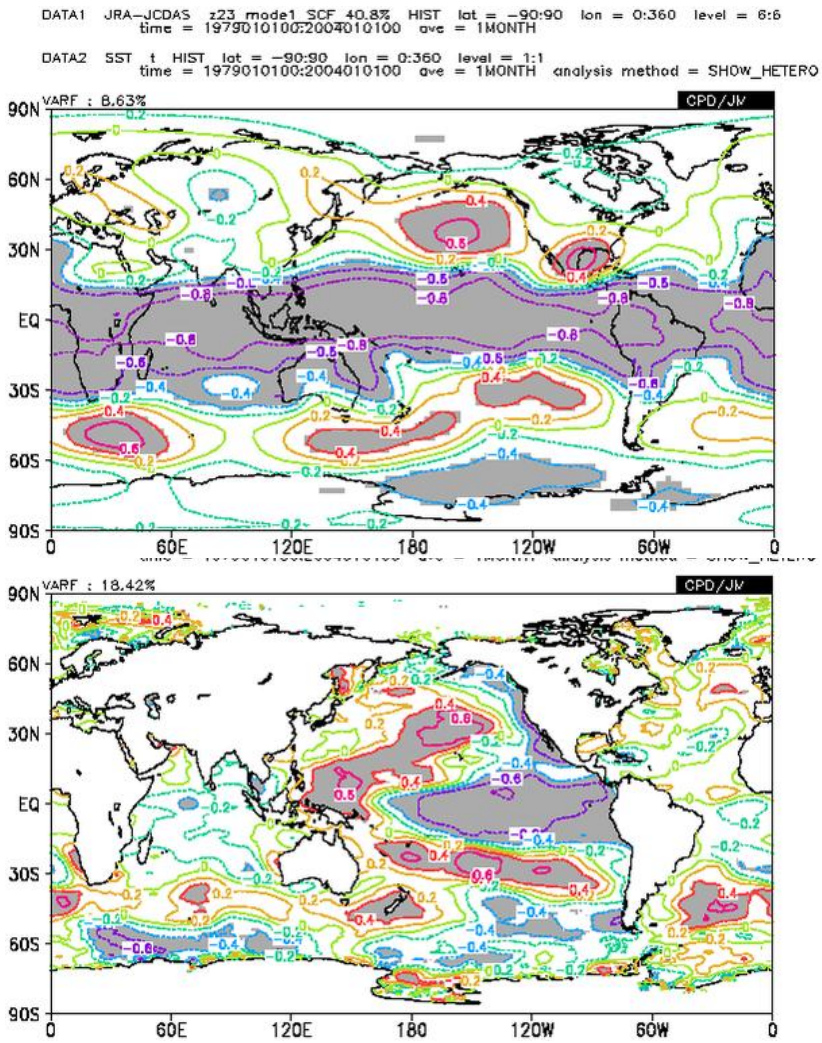



## SIGNIFICANCE TEST
(SST composite of El Nino years in January. Shaded areas shows the differences between the composite patterns of El Nino and La Nina are statistically significant with a 95% confidence level based on t-test.)

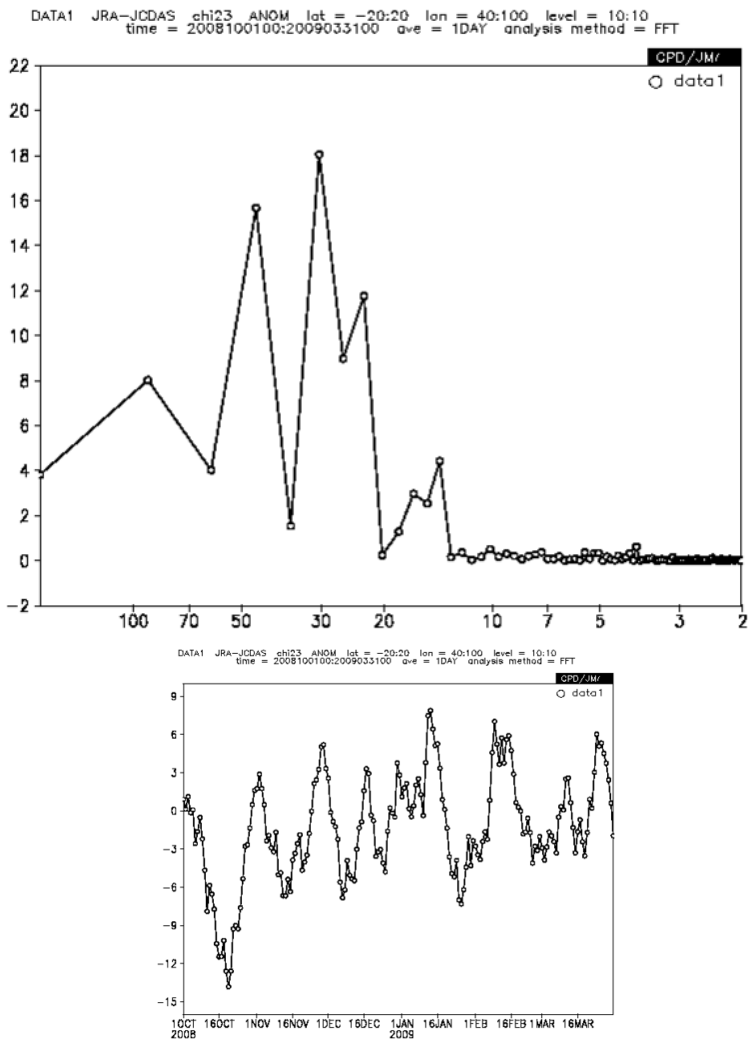


# Example of statistical analysis

## SVD analysis
(500hPa height vs SST)




## Fourier power spectrum (FFT analysis)
(Fourier power spectrum of daily mean 200hPa velocity potential averaged over the Indian Ocean)

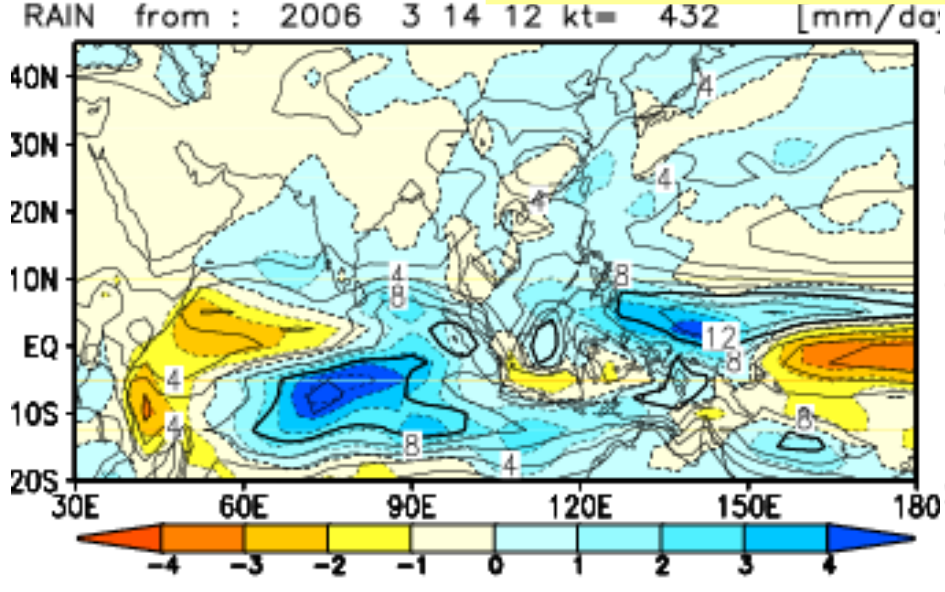


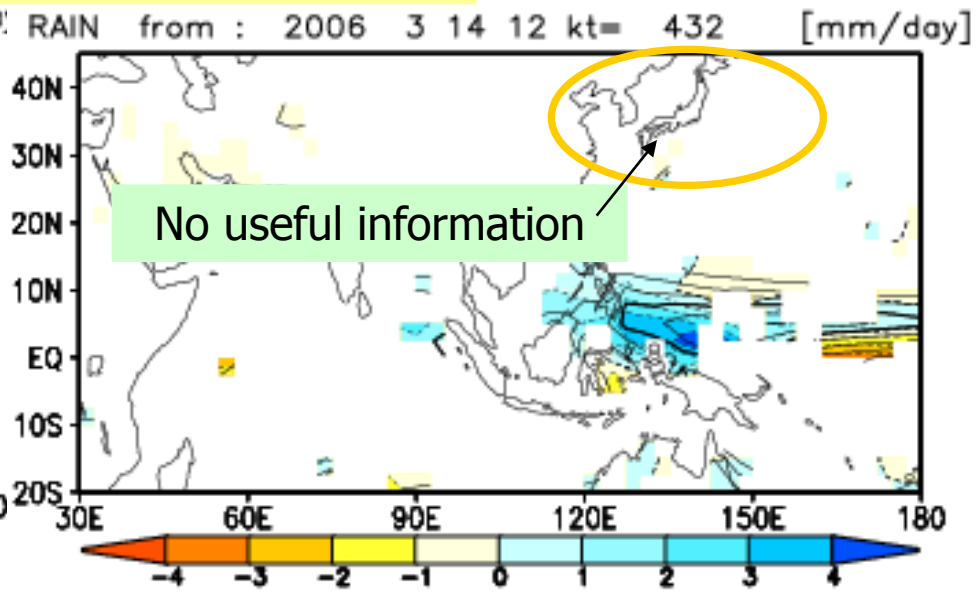
# Available Data

| Dataset | Data Description |
|---|---|
| JRA/JCDAS | **Atmospheric circulation data** produced by JMA's Climate Data Assimilation System (JCDAS), which is consistent quality with Japanese 25-year reanalysis (JRA-25). Normals are calculated from analyses for the period 1979-2004. For more information, please refer to the following address, http://jra.kishou.go.jp/JRA-25/index_en.html |
| SAT | **Outgoing Longwave Radiation (OLR),** which is derived from observations by NOAA's polar orbital satellites, and provided by Climate Prediction Center (CPC) in the National Centers for Environmental Prediction (NCEP) of the National Oceanic and Atmospheric Administration (NOAA). Normals are calculated from analyses for the period 1979-2004. |
| ODAS | **Oceanic assimilation** produced by the system operated by JMA until February 2008. Normals are calculated from analyses for the period 1987-2006. |
| SST | **Sea Surface Temperature** produced by the system operated by JMA (COBE-SST）. Normals are calculated from analyses for the period 1971-2000. For more information, please refer to the following address, http://ds.data.jma.go.jp/tcc/tcc/products/elnino/cobesst_doc.html |
| INDEX | **El Nino Monitoring Indices** consisting of monthly mean Sea Surface Temperature produced by COBE-SST. Normals are calculated from the index values for the period 1971-2000. For more information, please refer to the following address, http://ds.data.jma.go.jp/tcc/tcc/products/elnino/index/Readme.txt |
| CLIMAT | **Monthly world climate data** derived from CLIMAT messages via the GTS line from WMO Members around the world. Temperature (mean temperarure) and precipitation anomalies are calculated from the data for the period 1971-2000, and the other elements' anomalies for the period 1961-1990. |

# What good can ITACS do for climate prediction ?

Numerical Prediction of Precipitation
(from TCC homepage)



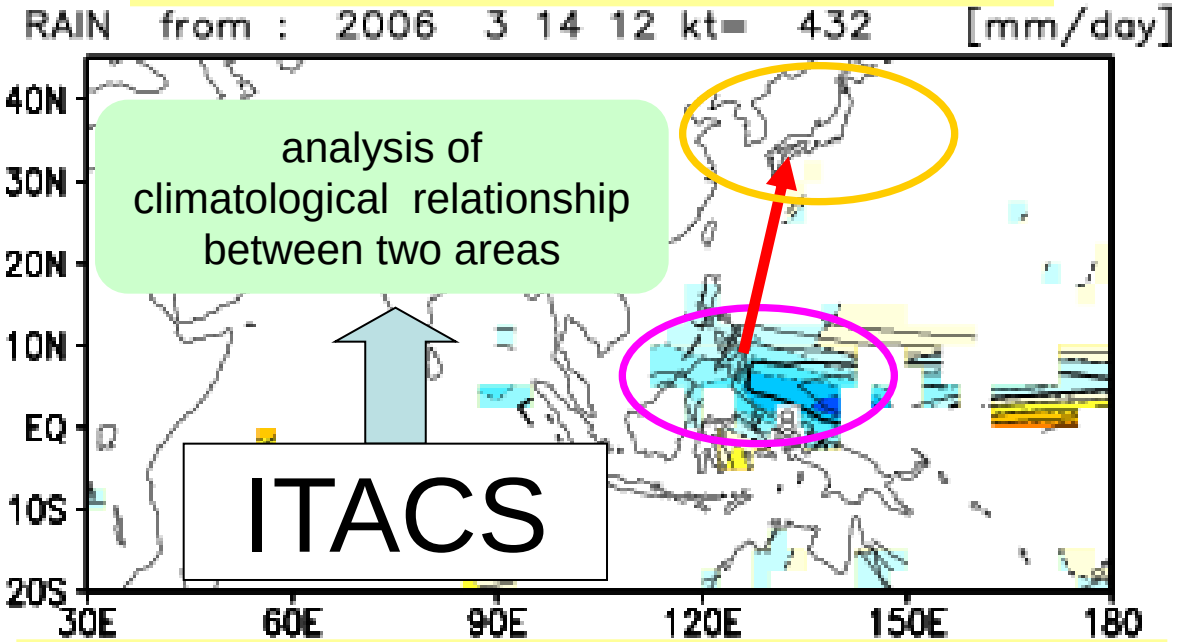

Grid Point Value plot

Grid Point Value plot
only where the prediction skill is significant

Usually we cannot get adequate information only from numerical prediction.

# What good can ITACS do for climate prediction ?

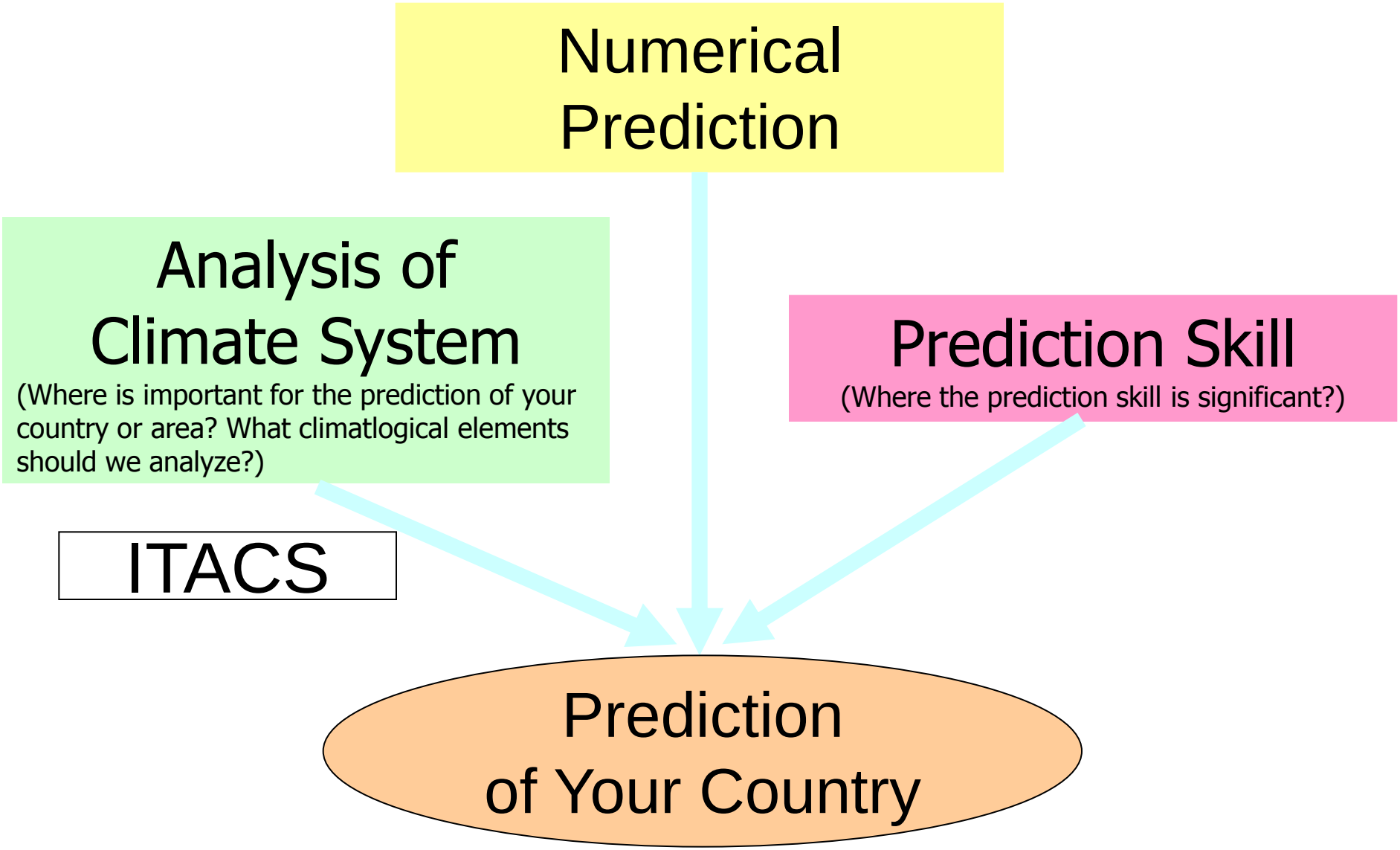
Numerical Prediction of Precipitation




Grid Point Value plot
only where the prediction skill is significant

But if we know the climatological relationship between area where prediction skill is significant and area we want to predict, we can get more useful information from the numerical prediction.

# What good can ITACS do for climate prediction ?



# Mean Squared Skill Score (MSSS)

$$MSSS = 1 - \frac{MSE}{MSE_c}$$

Perfect score: 1 (when MSE=0)
Climatology forecast score: 0

where *MSE* is the mean squared error

$$MSE = \frac{1}{N}\sum_{i=1}^{N}(F_i - O_i)^2$$

$F$ : forecast
$O$ : observation

*and* $MSE_c$ is the MSE of climatology forecast.

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MSSS can be expanded (Murphy,1988) as

$$MSSS = \left\{ 2\frac{s_f}{s_o} r_{fo} - \left(\frac{s_f}{s_o}\right)^2 - \left(\frac{\bar{f} - \bar{o}}{s_o}\right)^2 + \frac{2n-1}{(n-1)^2} \right\} \Bigg/ \left\{ 1 + \frac{2n-1}{(n-1)^2} \right\}$$

① ② ③

s : variance
r : correlation
f : forecast
o : observation

The first 3 terms are related to
① phase error (through the correlation)
②amplitude errors (through the ratio of the forecast to observed variances)
③bias error