The Climate Variations Link to Extreme Stremflows

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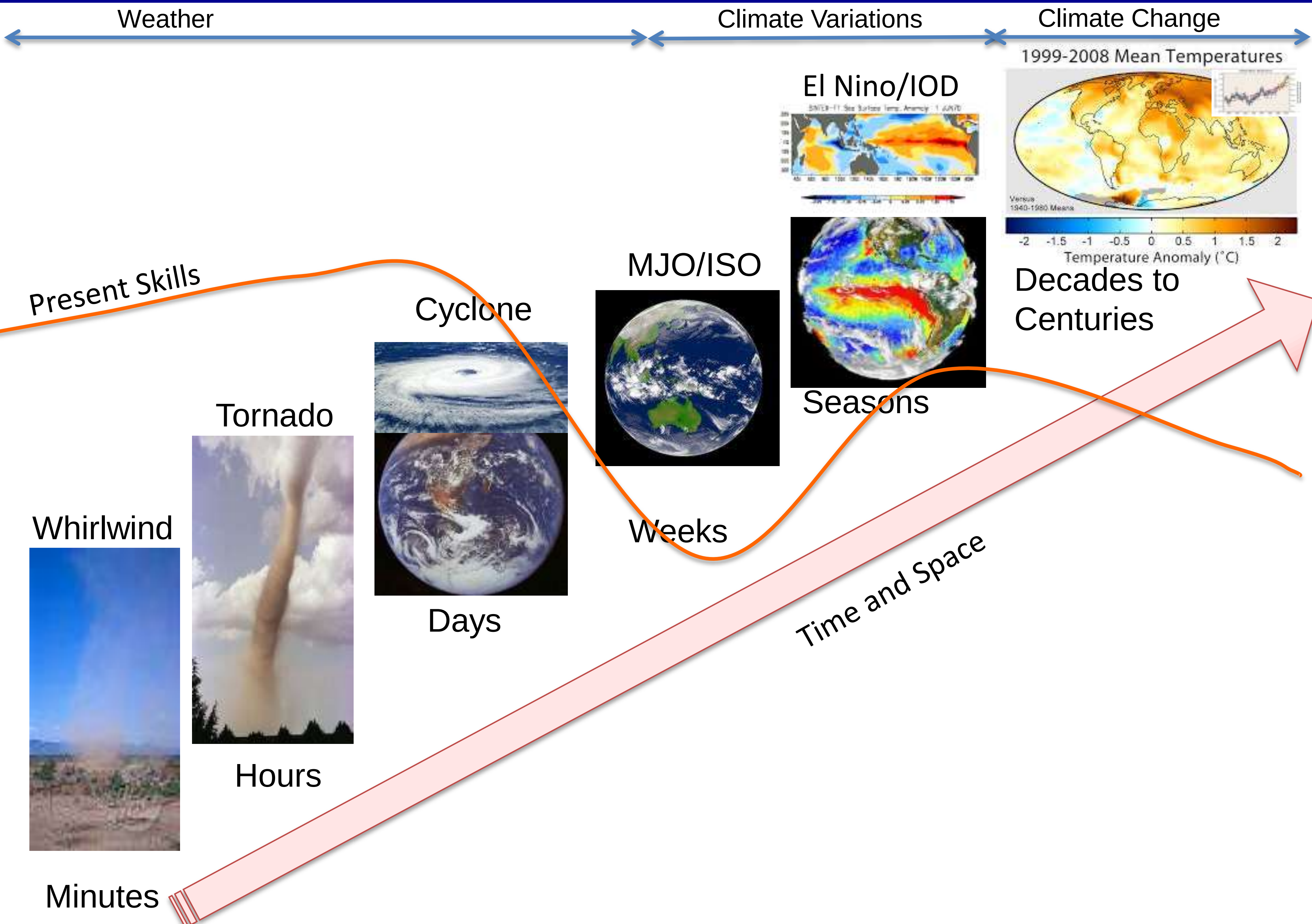
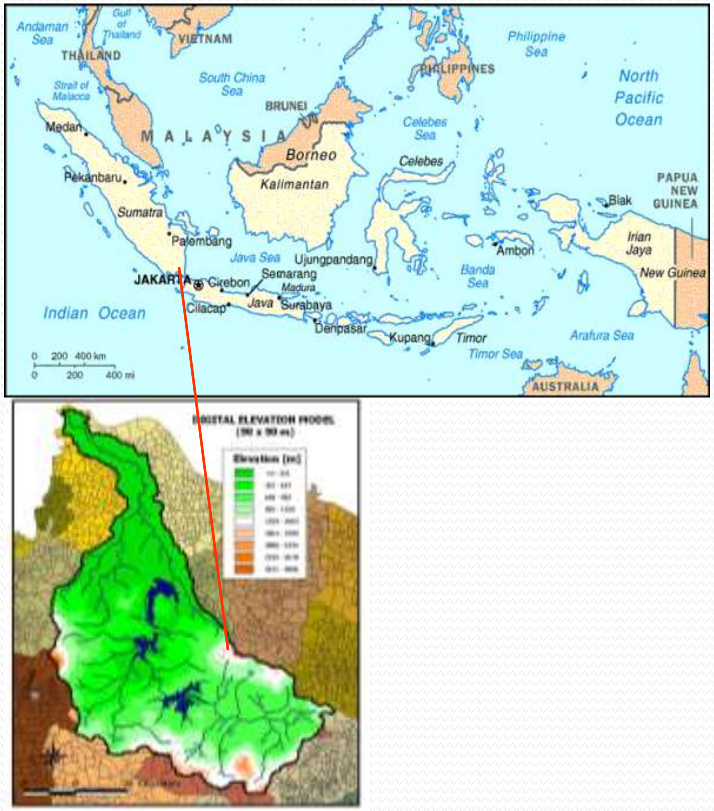
Scales of Weather and Climate

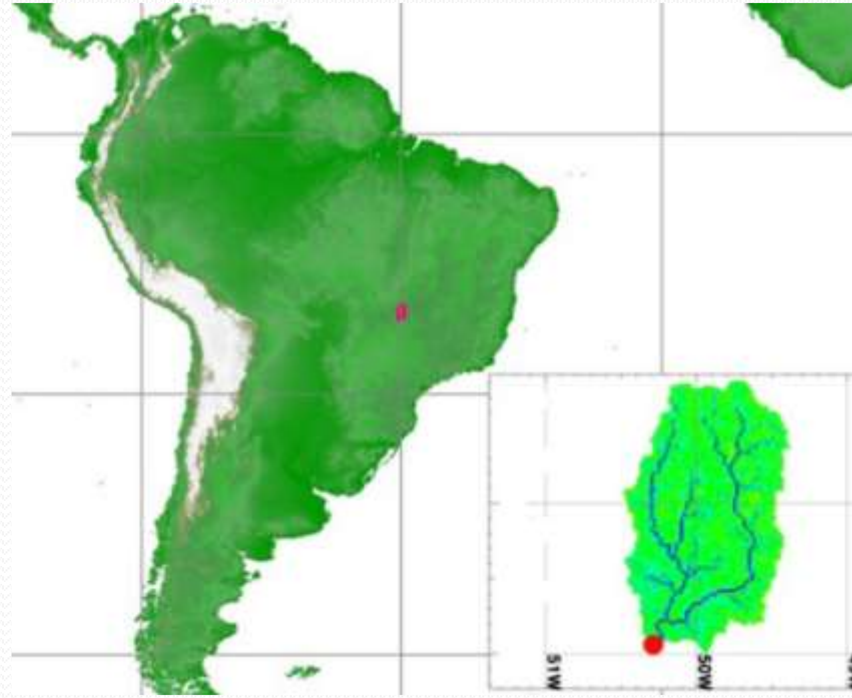


Citarum River, Indonesia



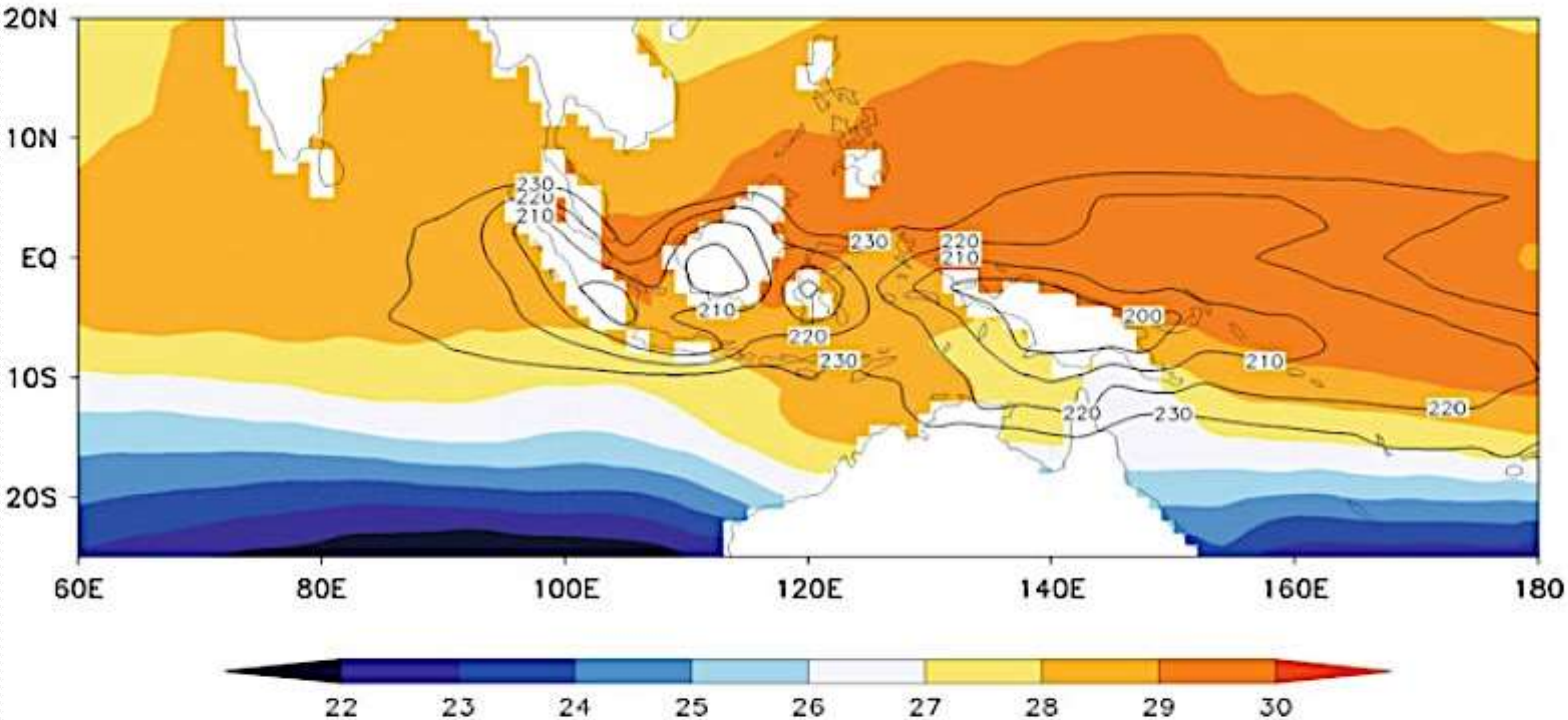
Citarum is the longest and largest river in West Java, Indonesia and it supports agriculture, water supply, fishery, industry, sewerage, electricity, etc.

The Paranaı´ba River, Brazil



The Paranaı´ba River source lies in the state of Minas Gerais in the Mata da Corda Mountains of Rio Paranaı´ba of Brazil. The river is flowing at an altitude of 1,148 m at the sources to 328 m at the mouth. The length of the river is approximately 1,000 km up to the junction with the Grande River both of which then form the Parana River

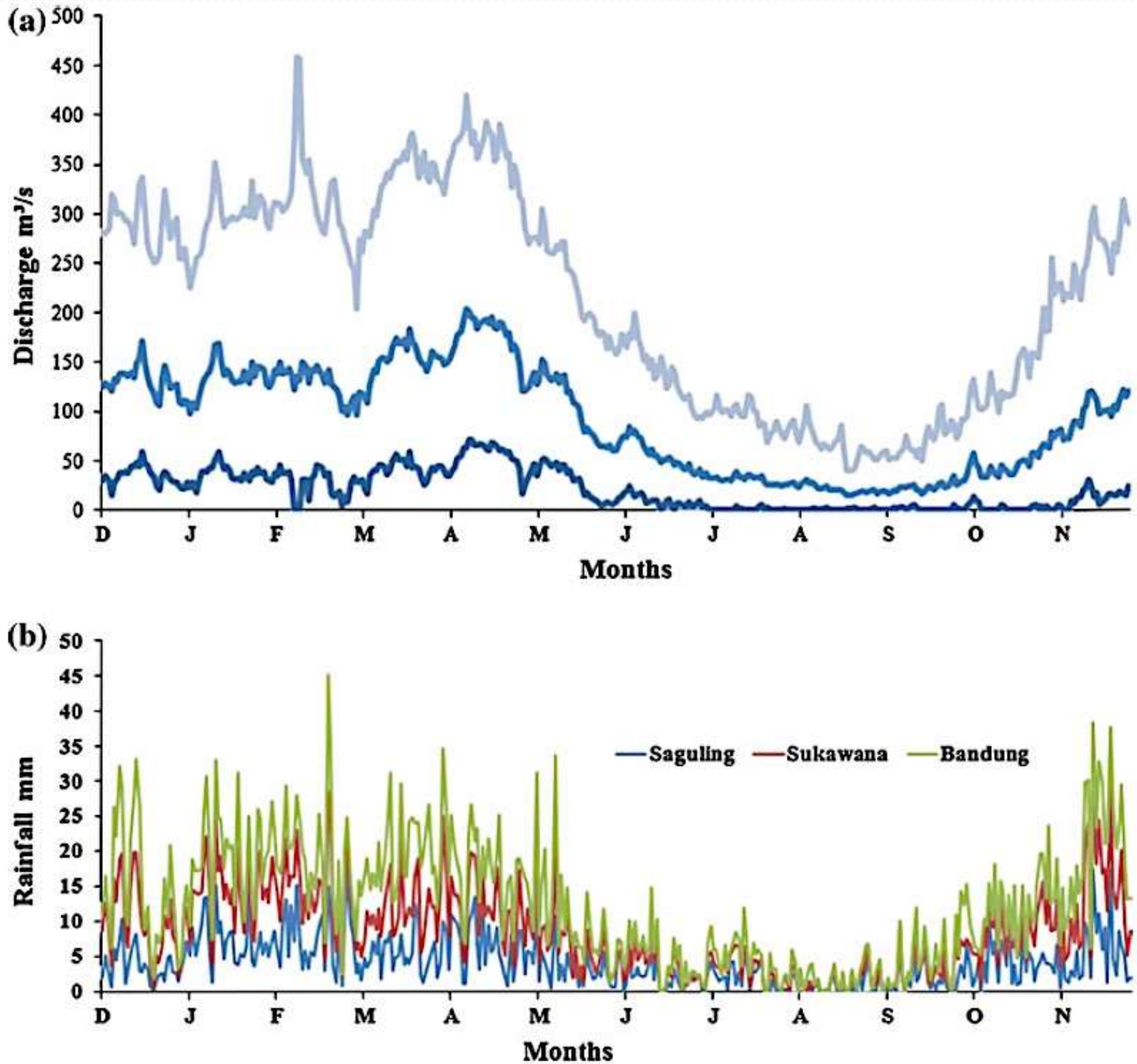
Seasonal mean SST (shaded) and OLR for September–November.



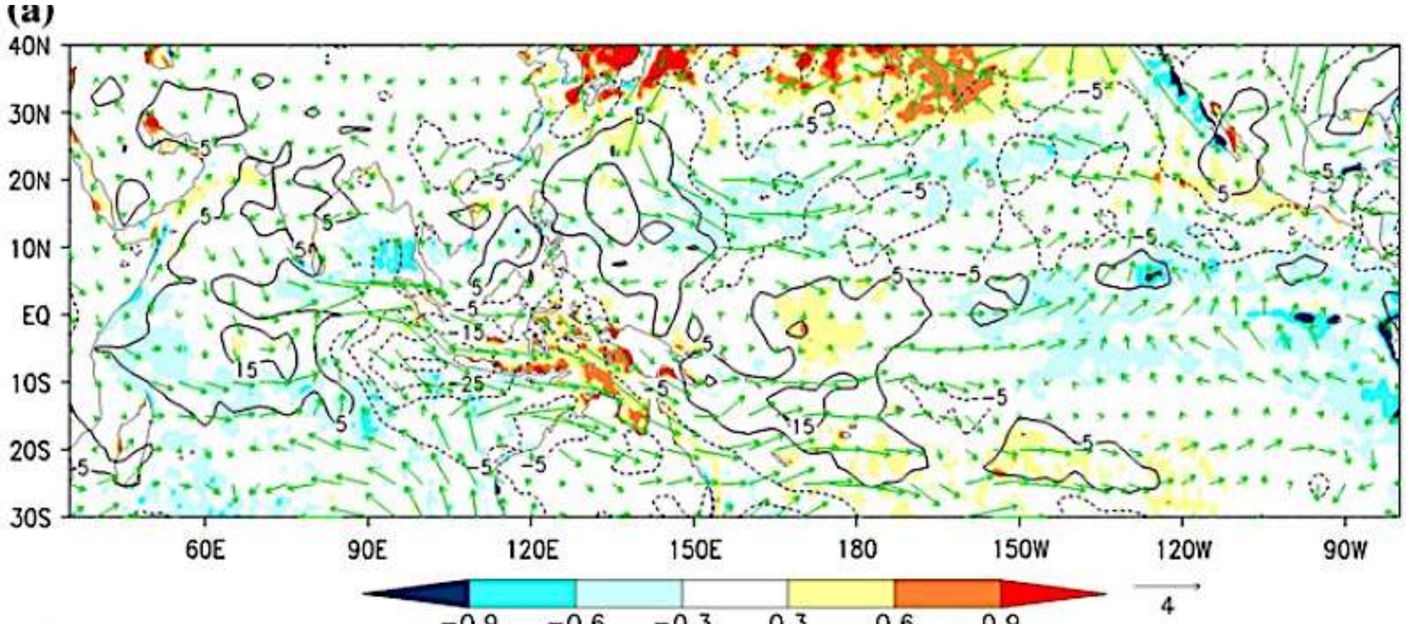
Citarum Streamflow and Rainfall Climatology

Stream-flow climatology (middle line) together with its variation depicted by ±1 standard deviation

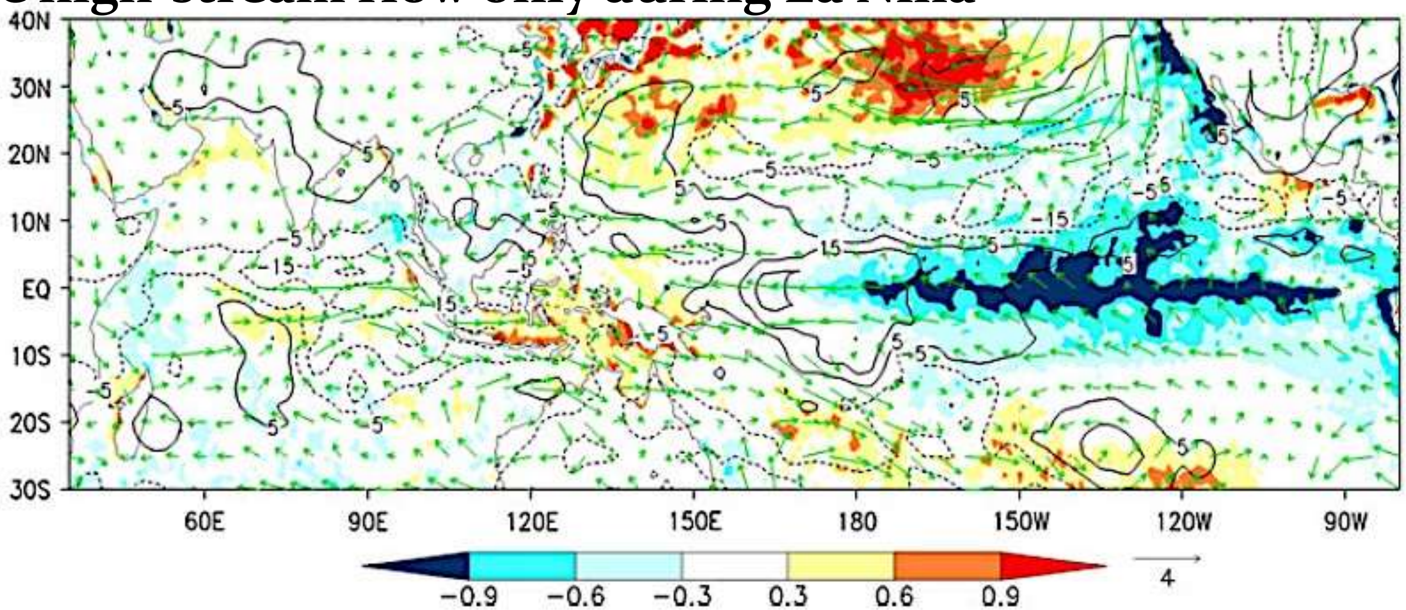
Rainfall climatology of Bandung, Sukawana and Saguling raingauge stations of Citarum Upper catchment from 1994 to 2005



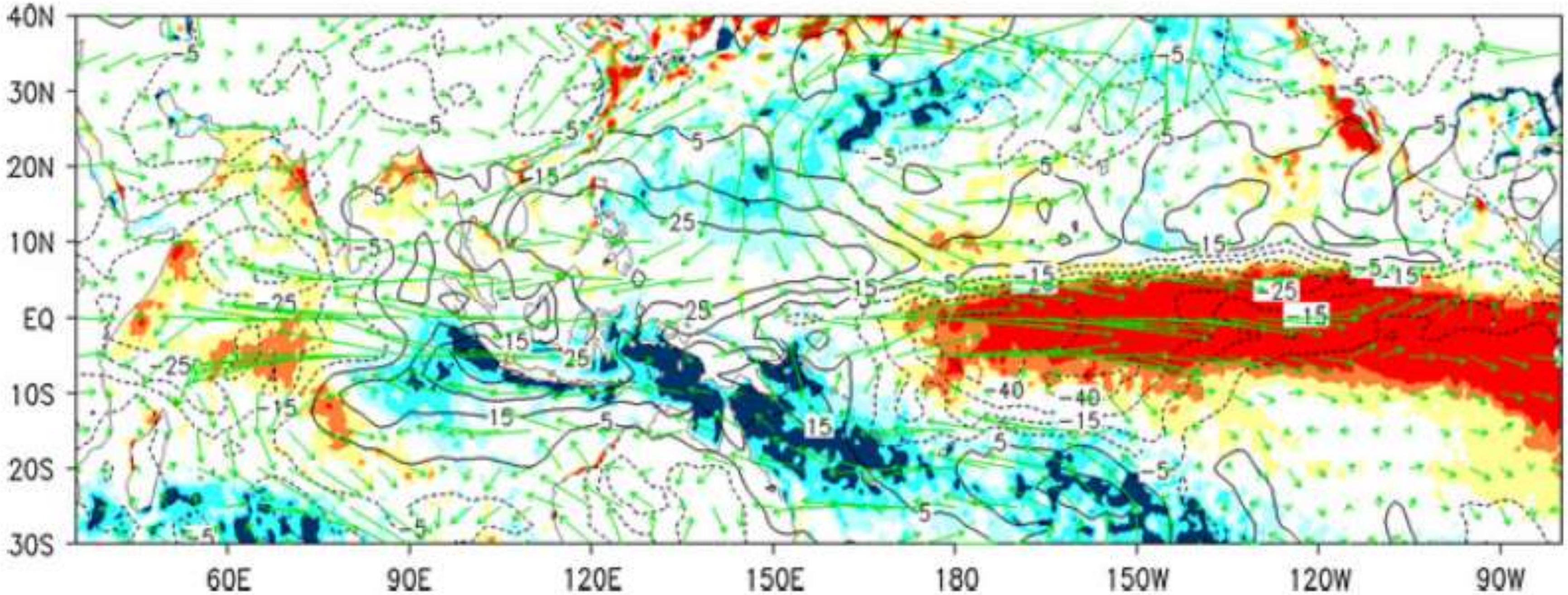
Composite anomalies of SST (shaded), wind and OLR(contour) during boreal fall season for all extreme high-streamflow events.



Extreme high-stream flow only during La Nina



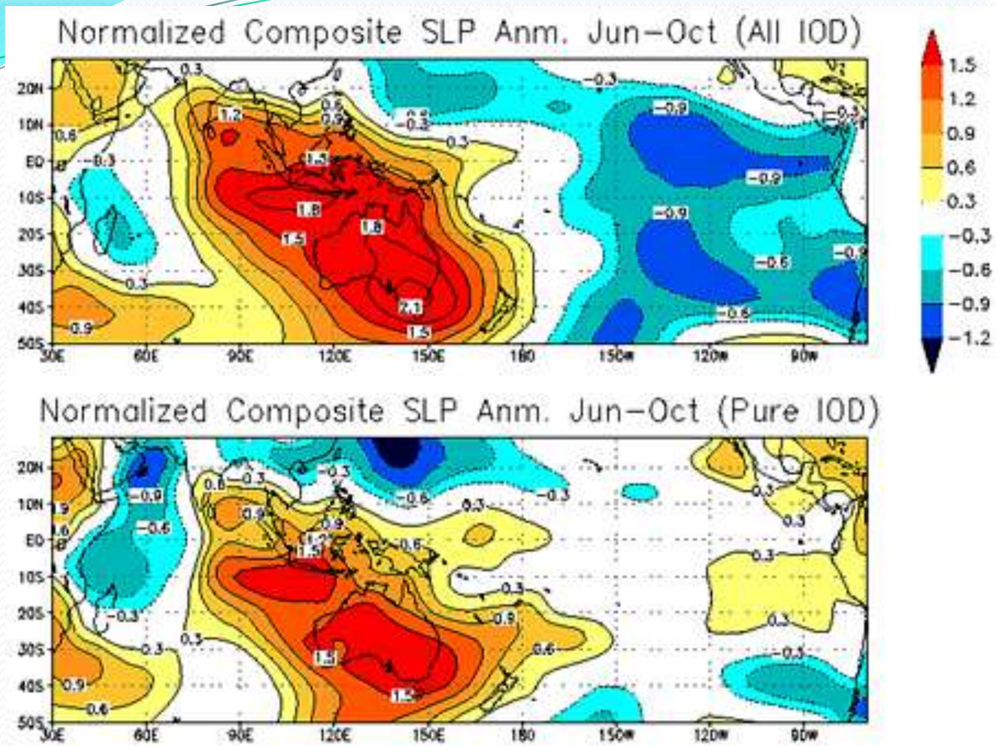
Composite of extremely low streamflow events

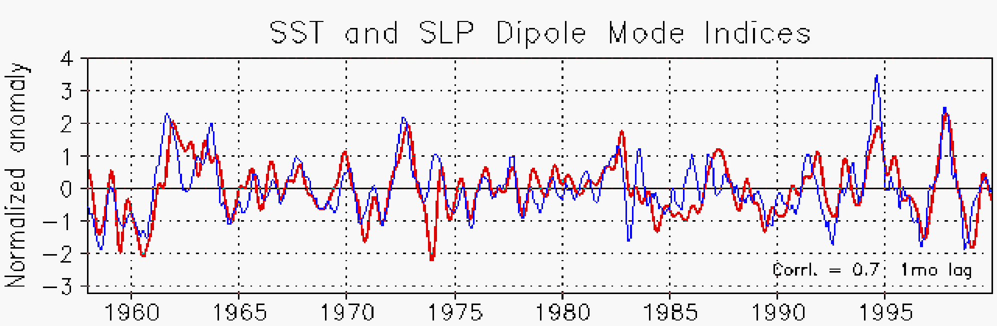


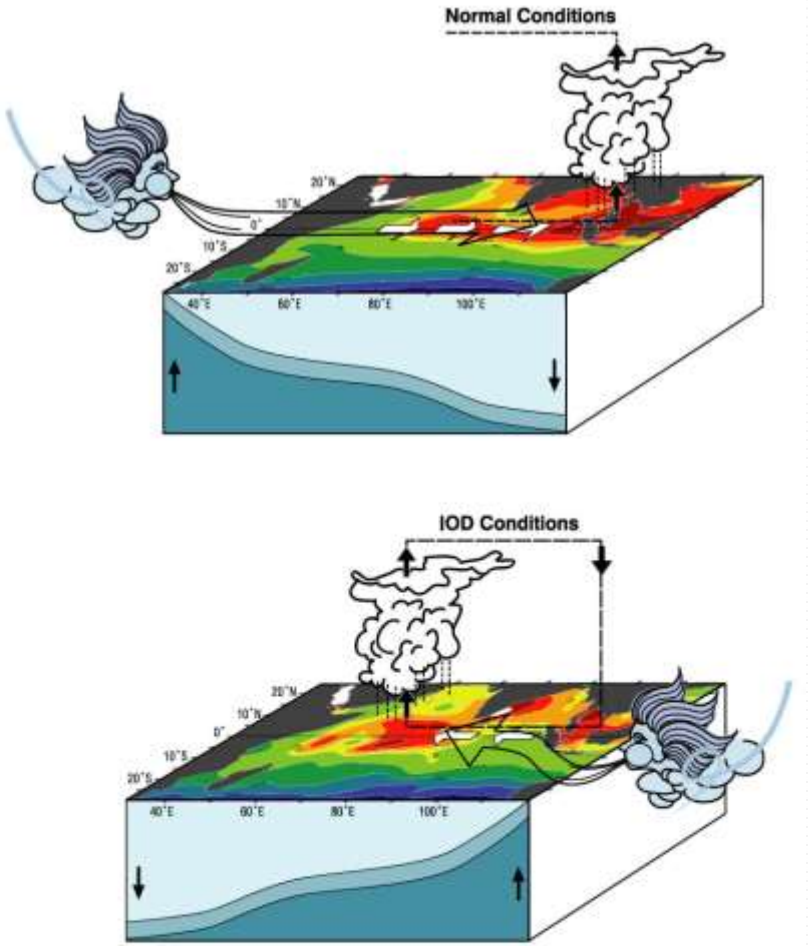
Sahu et al., 2012, Climate Dyn

The Southern Oscillation and the Indian Ocean Pressure Oscillation Caused by the IOD

The Indian Ocean Dipole





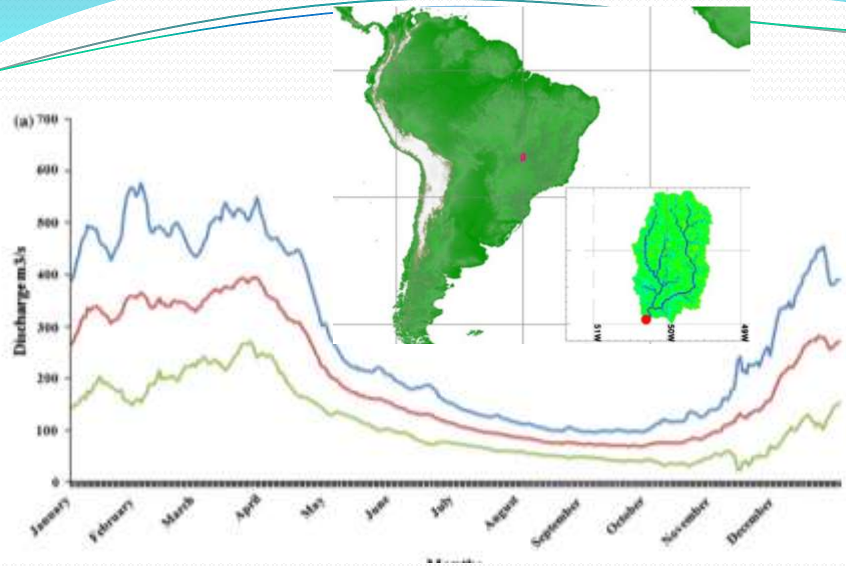


Behera and Yamagata 2003

Extreme low and high river stream-flow (m^3/s) events together with the climate conditions during those events

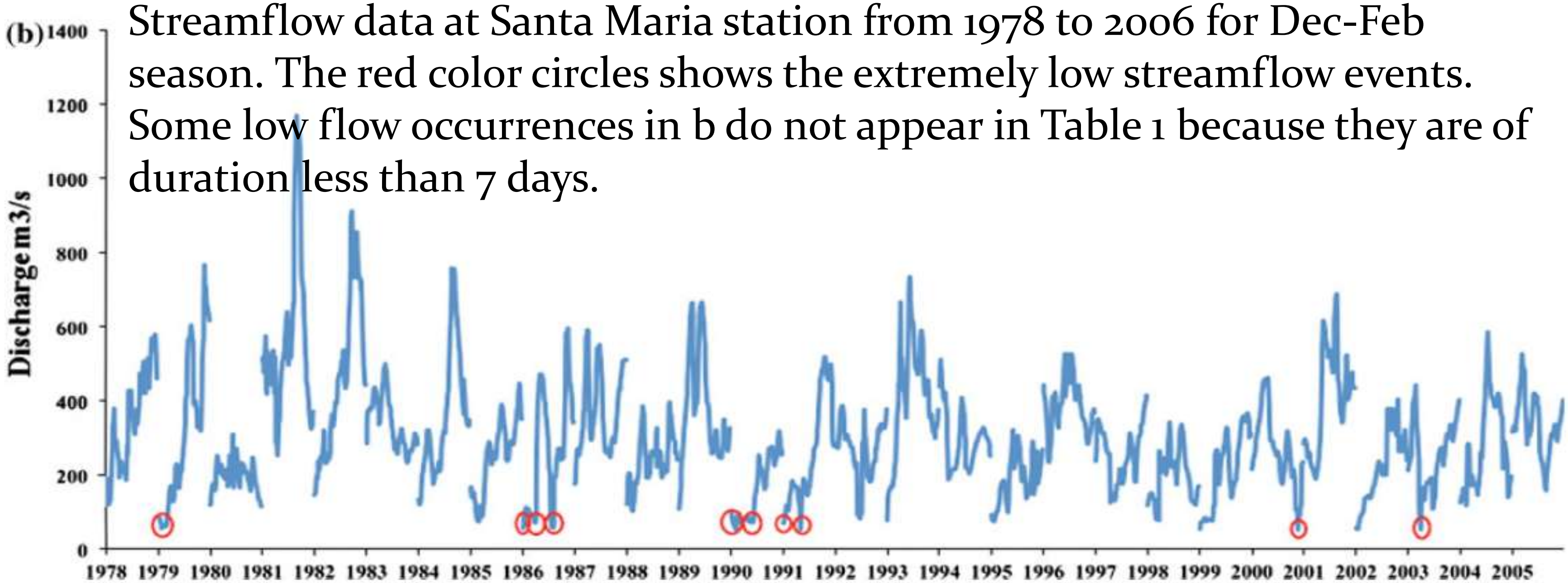
Extremely high stream-flow events	Average daily streamflows/ number of days	Extremely low stream-flow events	Average daily streamflows/ number of days
September–November			
1974 (La Niña, nIOD)	172/9	1977 (pIOD)	14/6
1975 (La Niña, nIOD)	168/7	1982 (pIOD, El Niño)	4/6
1975 (La Niña, nIOD)	112/7	1982 (pIOD, El Niño)	7.5/8
1998 (La Niña, nIOD)	228/6	1994 (pIOD, mEl Niño)	6/7
2000 (La Niña)	69/8	1997 (pIOD, El Niño)	14/6
2001 (La Niña)	89/6	2006 (pIOD, El Niño)	6.5/15
2001 (La Niña)	160/12		
1992 (mEl Niño, nIOD)	73/7		
1986 (mElNino)	126/15		

The Parnaiba River streamflow climatology and interannual variation.



Streamflow climatology (middle line) together with its variation depicted by ±1.5 standard deviation.

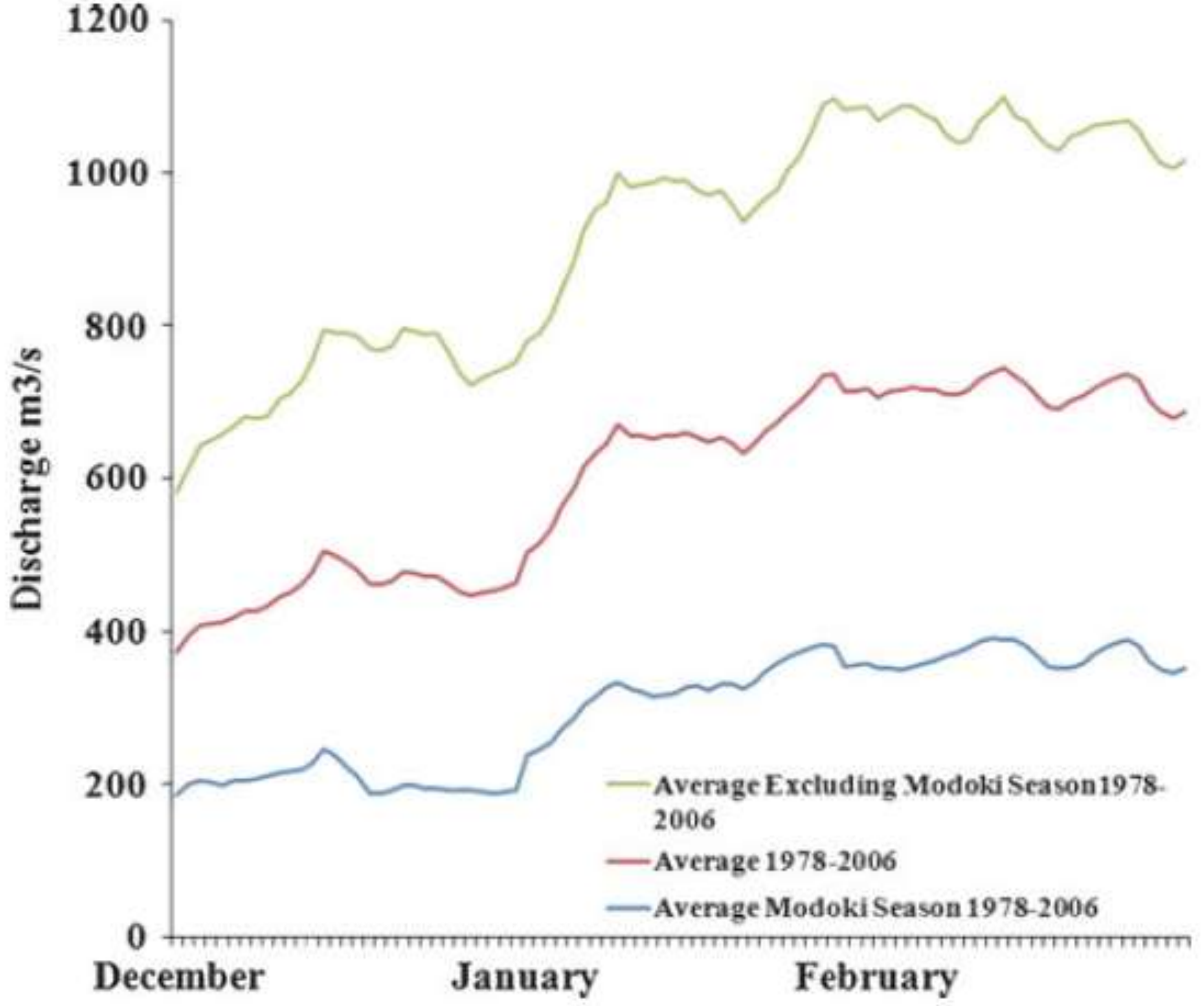
Streamflow data at Santa Maria station from 1978 to 2006 for Dec-Feb season. The red color circles shows the extremely low streamflow events. Some low flow occurrences in b do not appear in Table 1 because they are of duration less than 7 days.



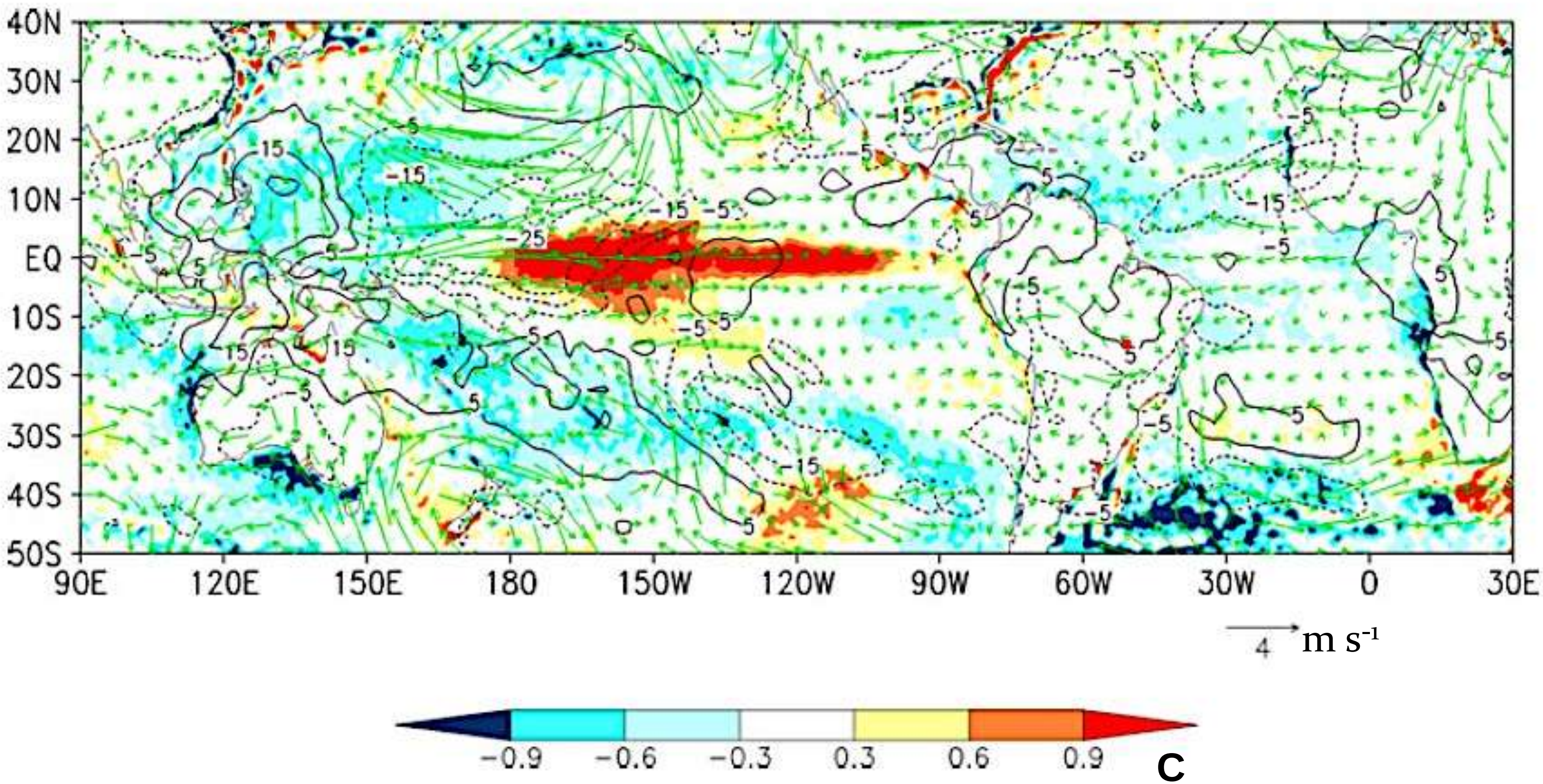
Extreme low Parnaiba river discharge events together with the climate conditions during December-February

Extremely low discharge events	Average daily streamflows ($m^3 s^{-1}$)/ number of days
December-February	
1979–80 (mEl Niño)	69/16
1986–87(mEl Niño)	47/7
1986–87(mEl Niño)	86/12
1986–87(mEl Niño)	161/6
1990–91(mEl Niño)	75/26
1990–91(mEl Niño)	108/16
1991–92 (mEl Niño)	123/5
1992–93(mEl Niño)	166/5
2002–03 (mEl Niño)	61/16
2000–01(mLaNiña)	182/12

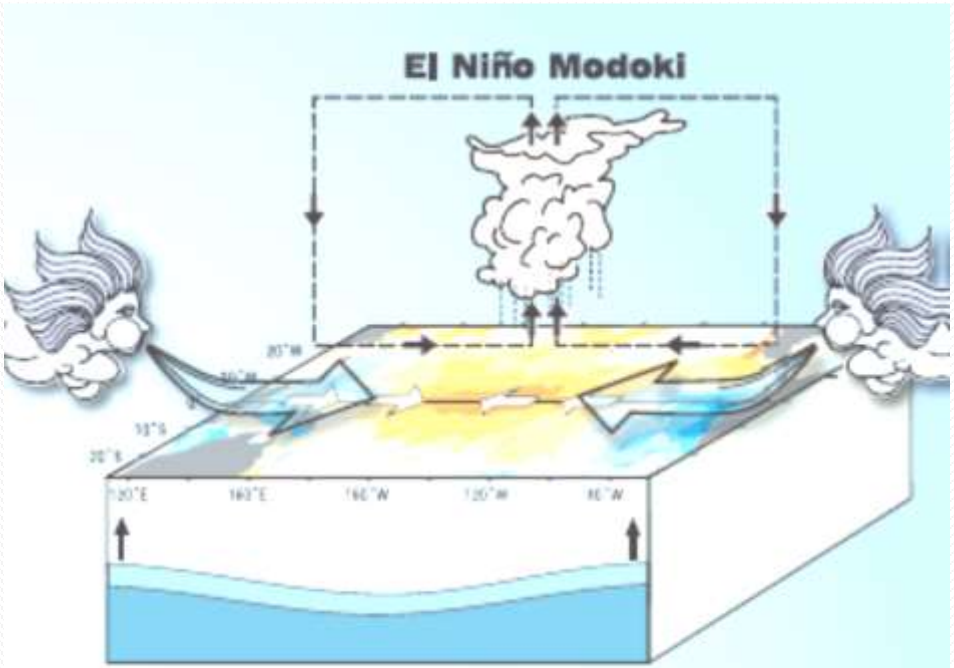
El Nino Modoki impacts on the Parnaiba streamflow of the Santa Maria during DJF rainy season

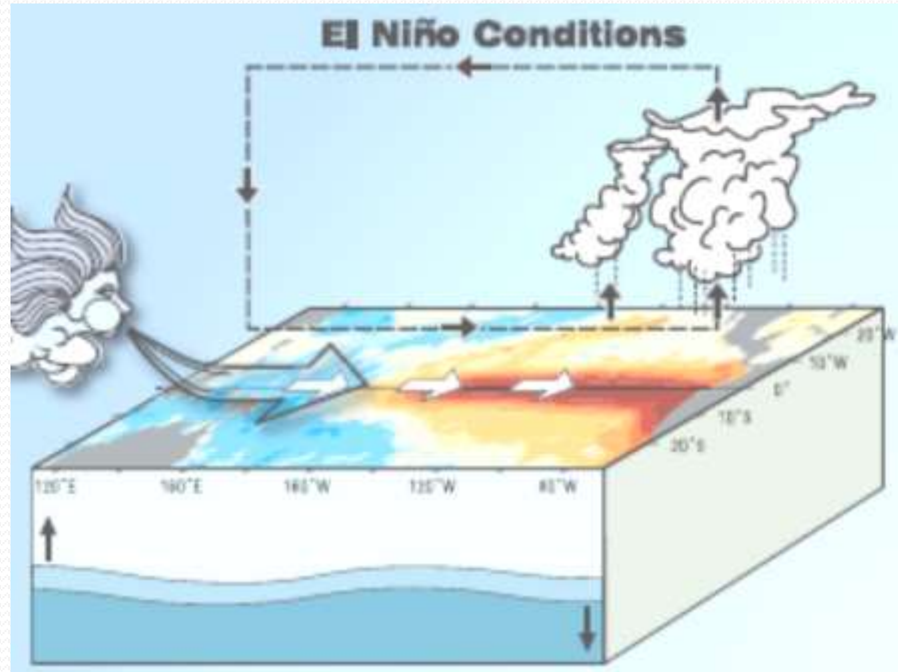


Composite anomalies of SST (shaded), wind at 850 hPa and OLR (contour) during austral summer season for all extreme low-Parnaiba streamflow events associated with only El Nino Modoki.

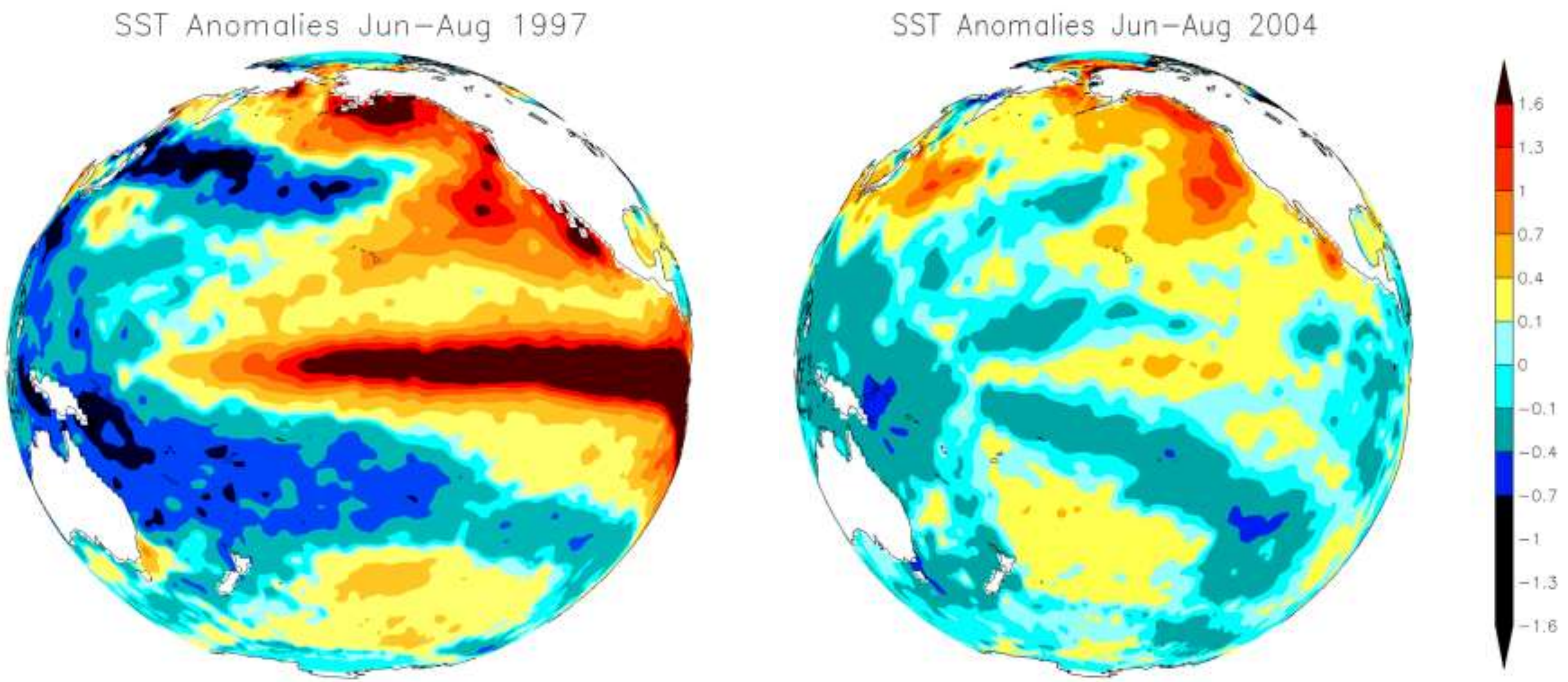


Sahu et al., 2014, Climate Dyn


El Niño Modoki


El Niño Conditions

Sea Level Variations Related to El Nino and El Nino Modoki

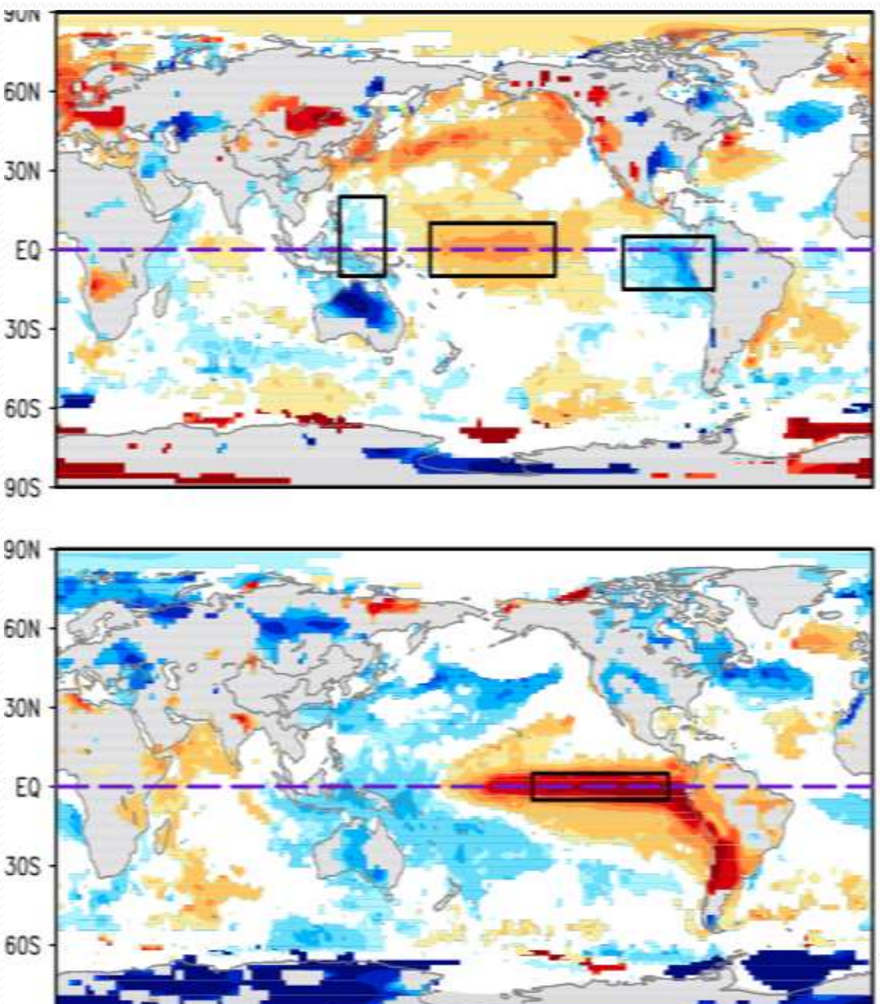


December 1997, El Nino

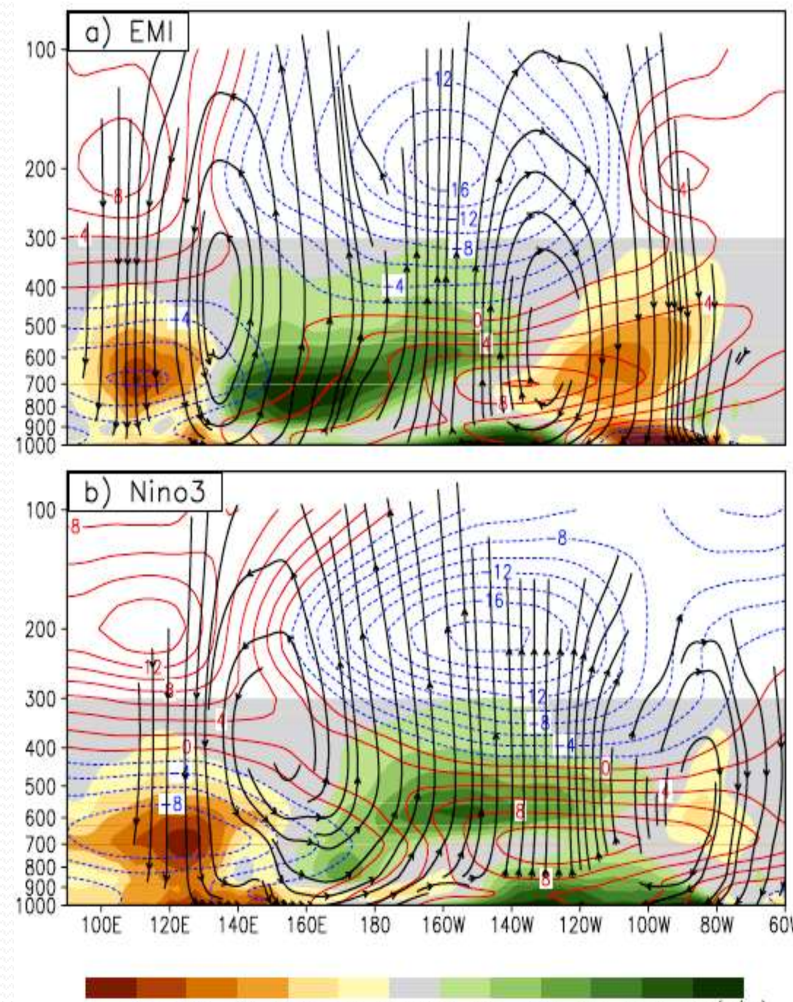
December 2004, El Nino Modoki

The Double Walker Cells

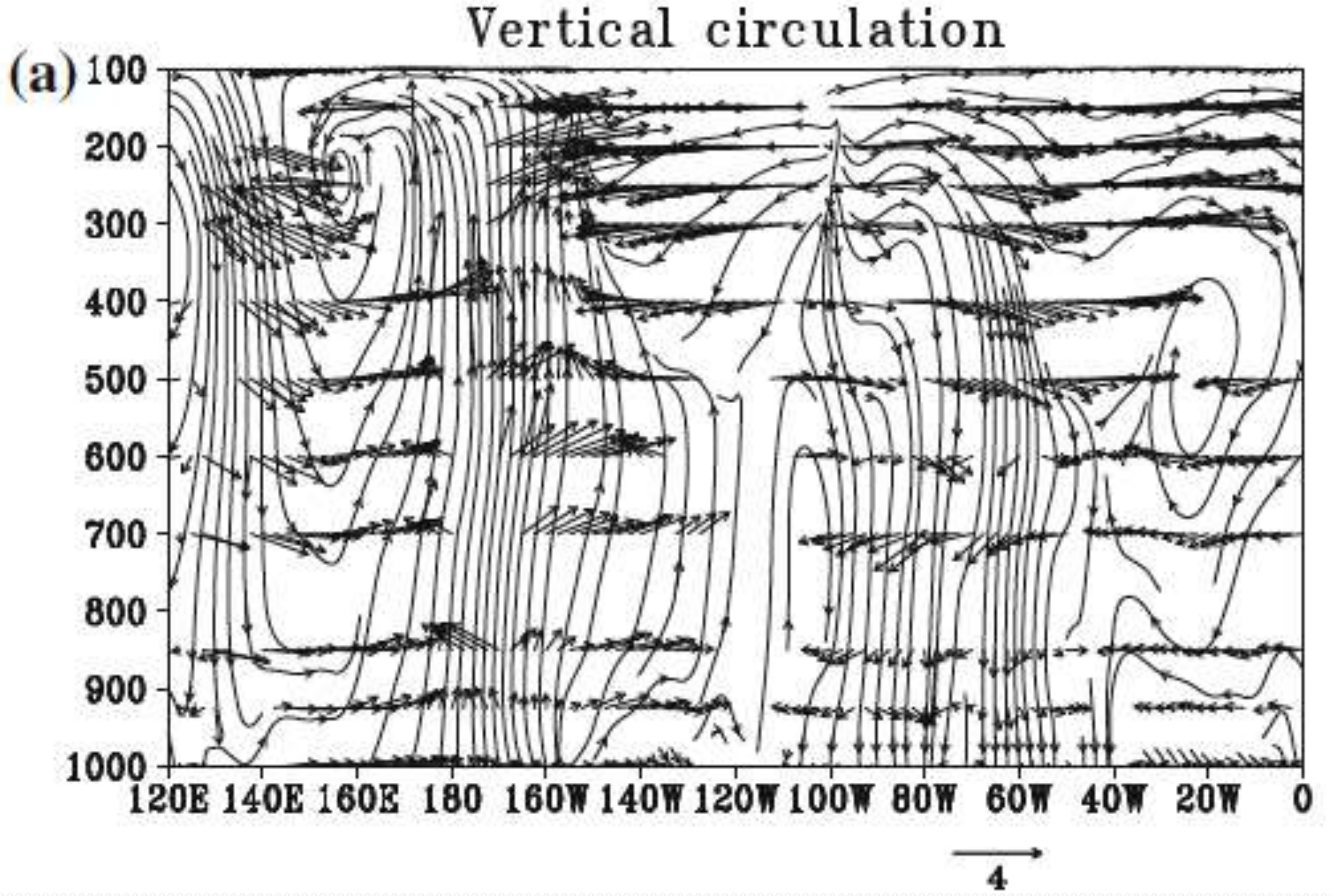
Composite of surface temperature for El Nino Modoki and rainfall composites for El Nino Modoki and El Nino



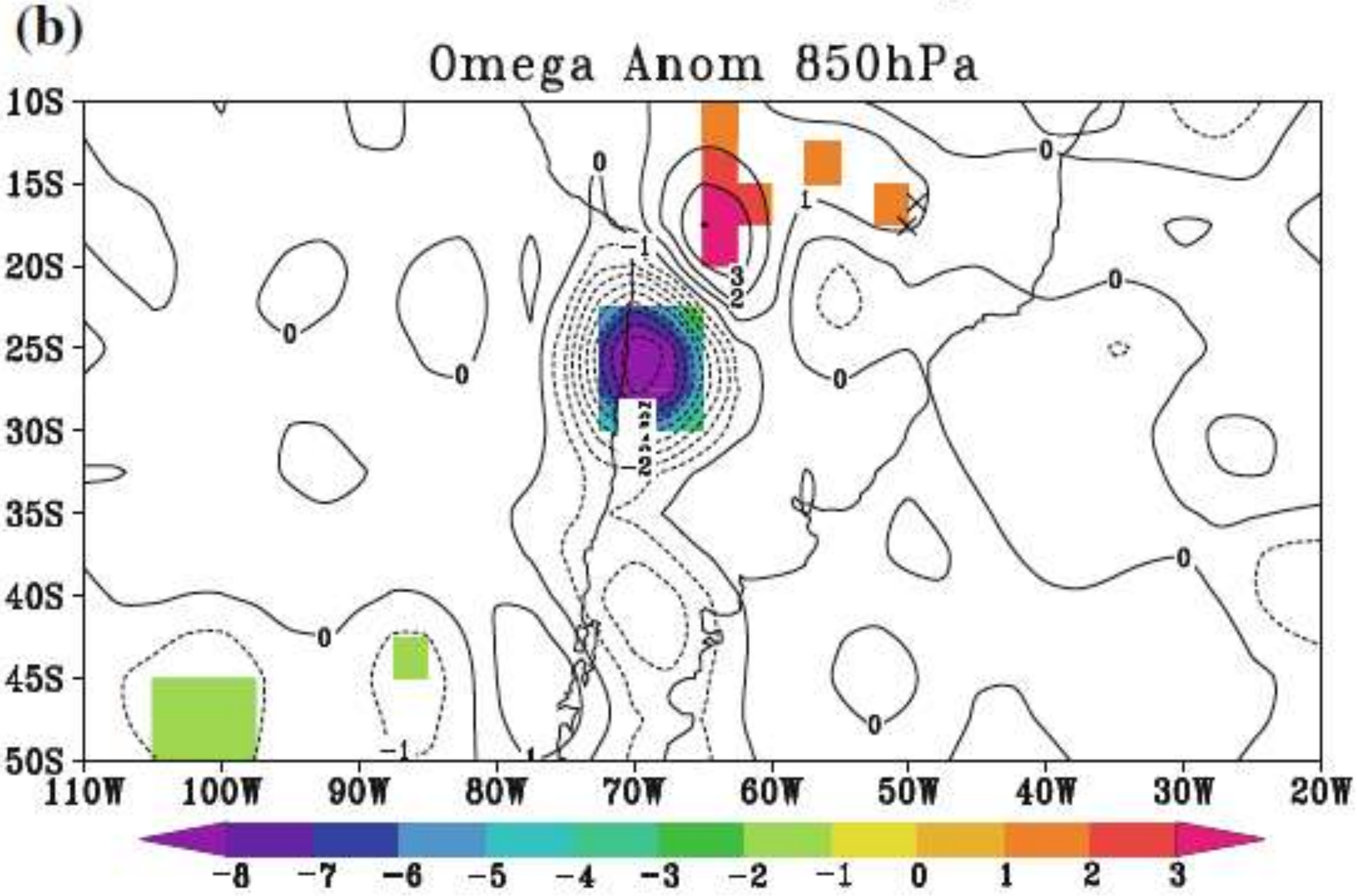
Walker circulation related to El Nino Modoki and El Nino



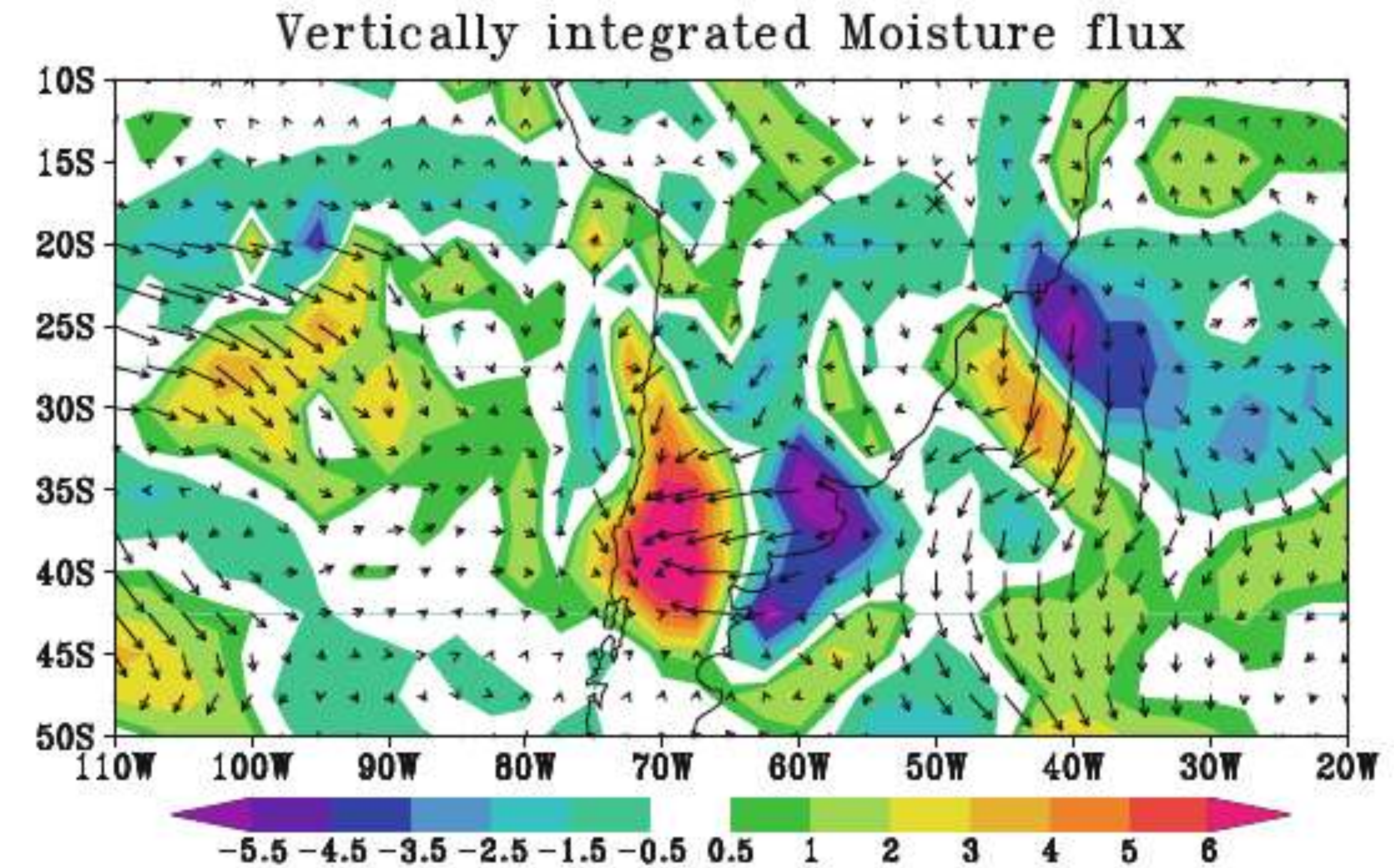
Weng et al. 2007, 2008; Clim. Dyn



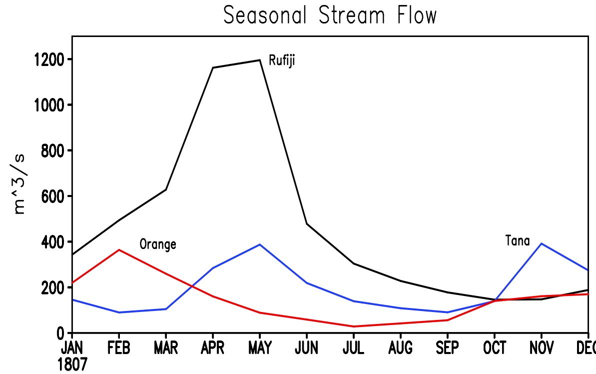
Vertical circulation
(a)
100
200
300
400
500
600
700
800
900
1000
120E 140E 160E 180 160W 140W 120W 100W 80W 60W 40W 20W 0
4

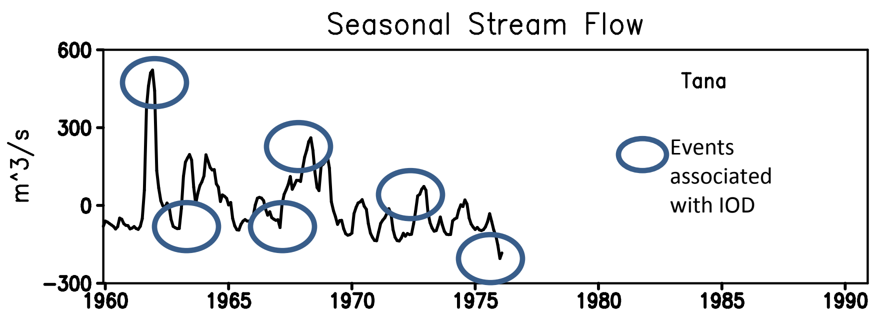


(b)
Omega Anom 850hPa
10S
15S
20S
25S
30S
35S
40S
45S
50S
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
−8
−7
−6
−5
−4
−3
−2
−1
0
1
2
3

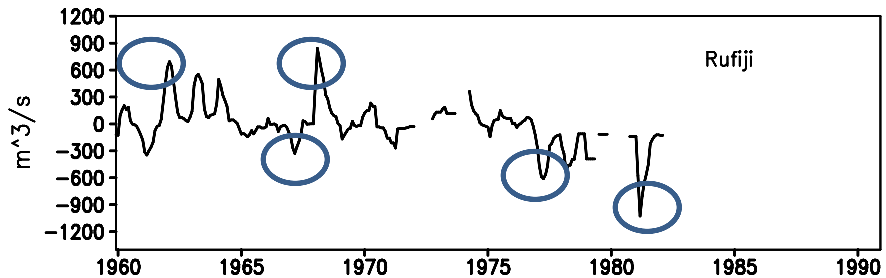

Vertically integrated Moisture flux
10S
15S
20S
25S
30S
35S
40S
45S
50S
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
−5.5 −4.5 −3.5 −2.5 −1.5 −0.5 0.5 1 2 3 4 5 6

Climate Variation Impact on River flow





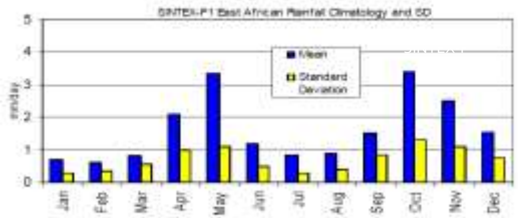
The Tana River is 440 miles long and is Kenya's longest river

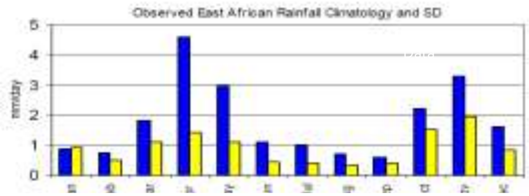


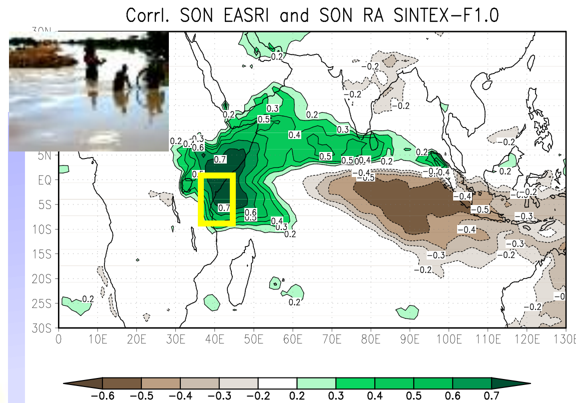
The Rufiji River is 375 miles long with its source in southwestern Tanzania

The Paramount Impact of IOD on East African Short Rains

East African Seasonal Rainfall

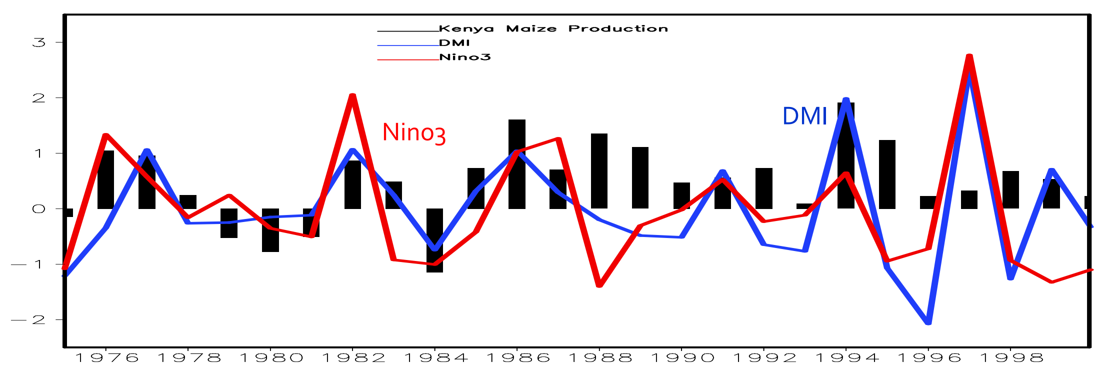


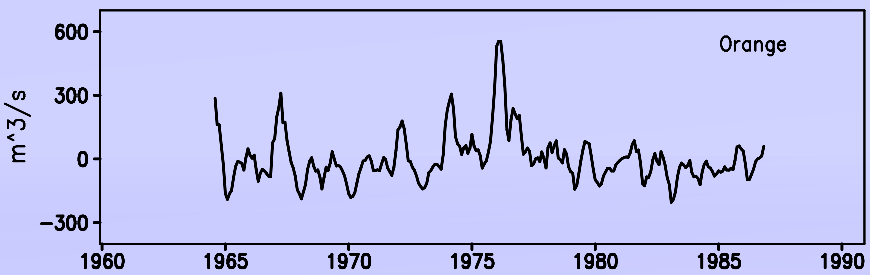




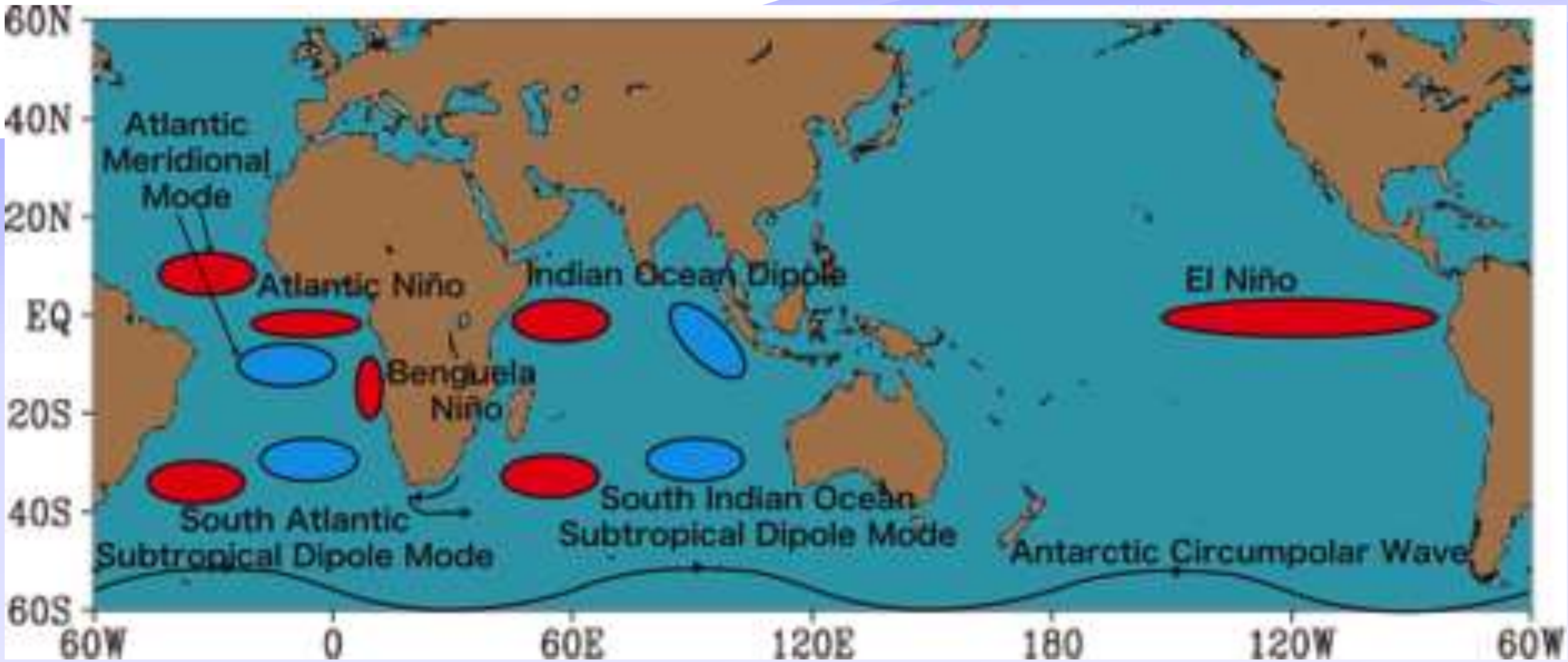
Predictability of Short Rains based on DMI

Maize production in Kenya related to IOD

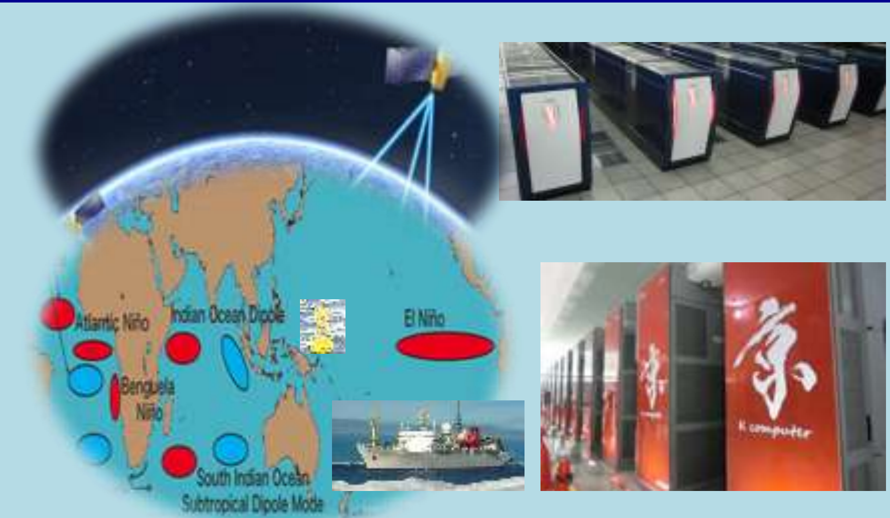




The Orange River/Gariep River, is the longest river in South Africa.

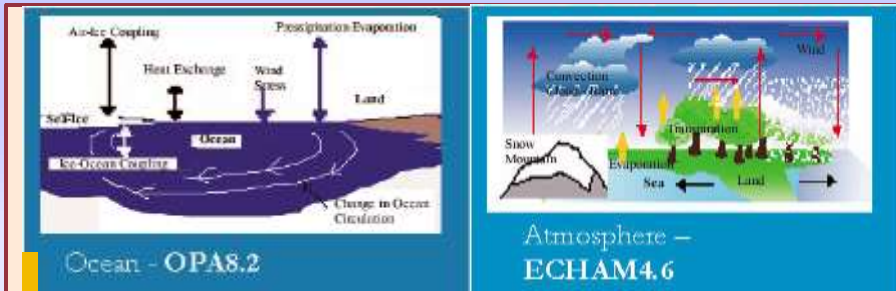

60N
40N
20N
EQ
20S
40S
60S
60W
0
60E
120E
180
120W
60W
Atlantic
Meridional
Mode
Atlantic Niño
Indian Ocean Dipole
El Niño
Benguela
Niño
South Atlantic
Subtropical Dipole Mode
South Indian Ocean
Subtropical Dipole Mode
Antarctic Circumpolar Wave

Identifying the modes of climate variations

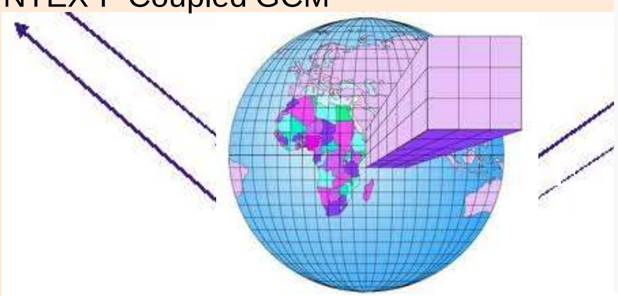


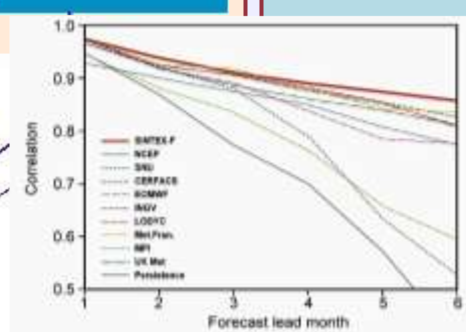
Disaster management and mitigation process

Mitigation



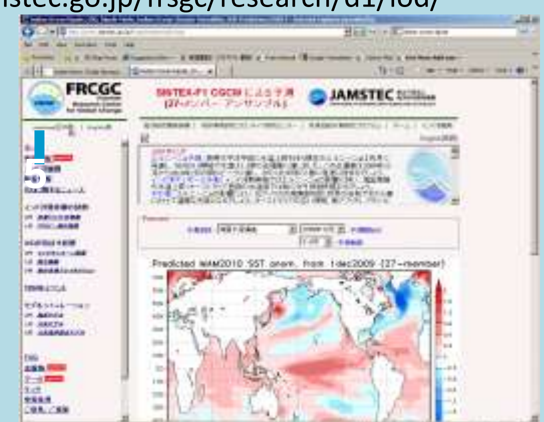
SINTEX-F Coupled GCM





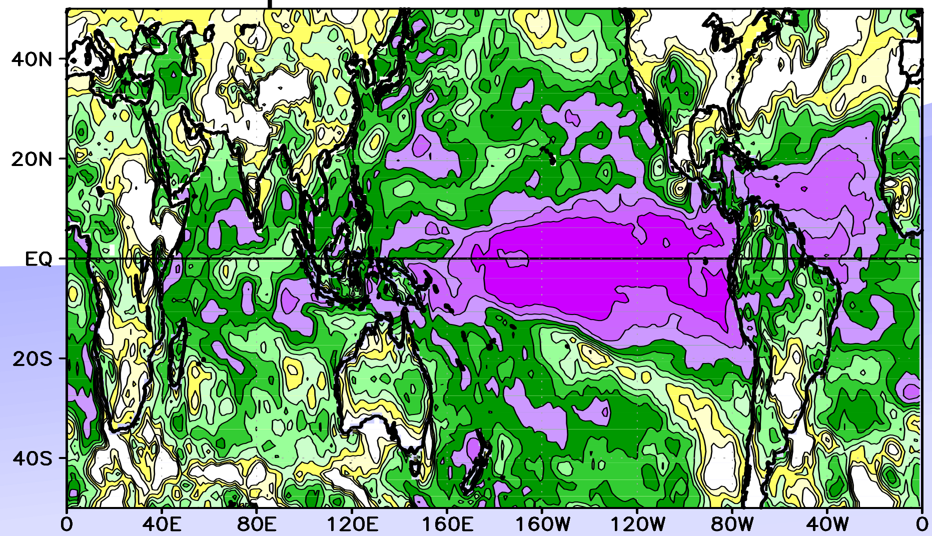
Public distribution of JASMTEC climate prediction results.

http://www.jamstec.go.jp/frsgc/research/d1/iod/

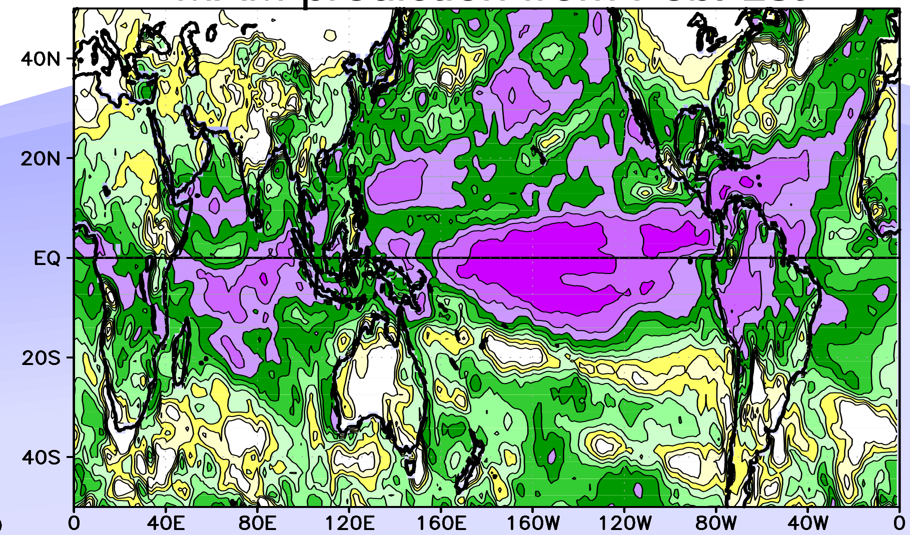


ACC for 3-month leading forecast (SST&TEMP2 1984-2010)

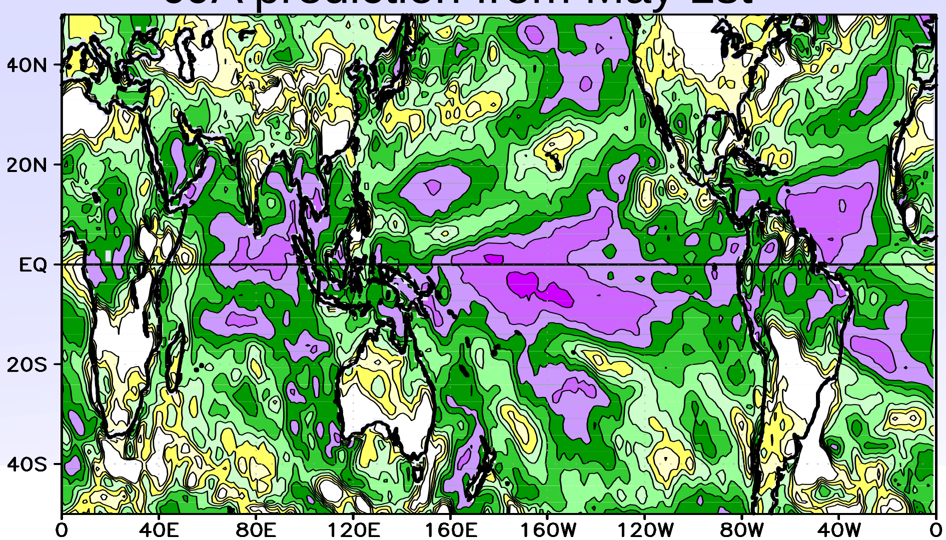
DJF prediction from Nov. 1st



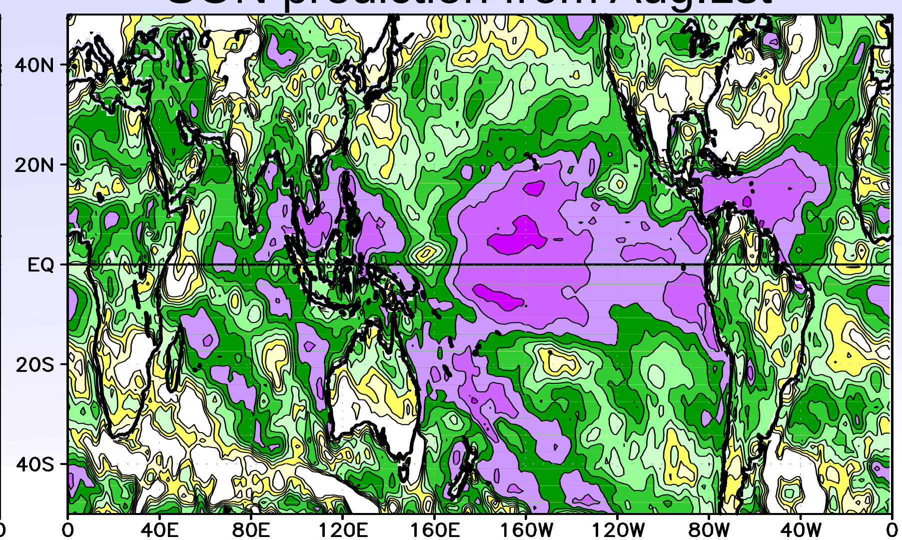
MAM prediction from Feb. 1st



JJA prediction from May 1st



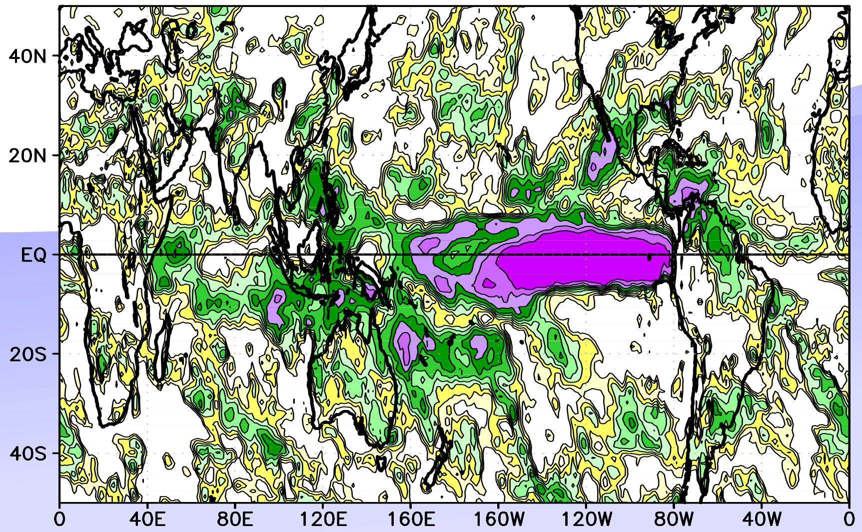
SON prediction from Aug.1st



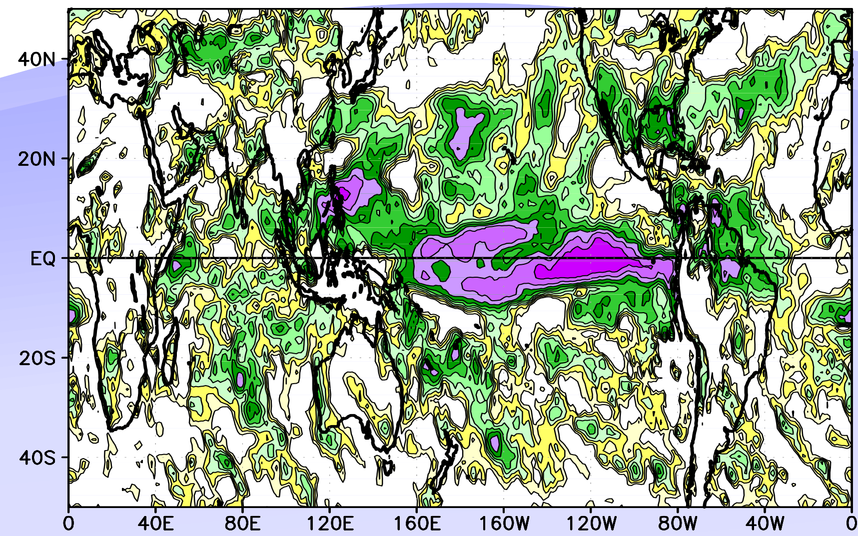
9~27 members

ACC for 3-month leading forecast (Precipitation 1984-2010)

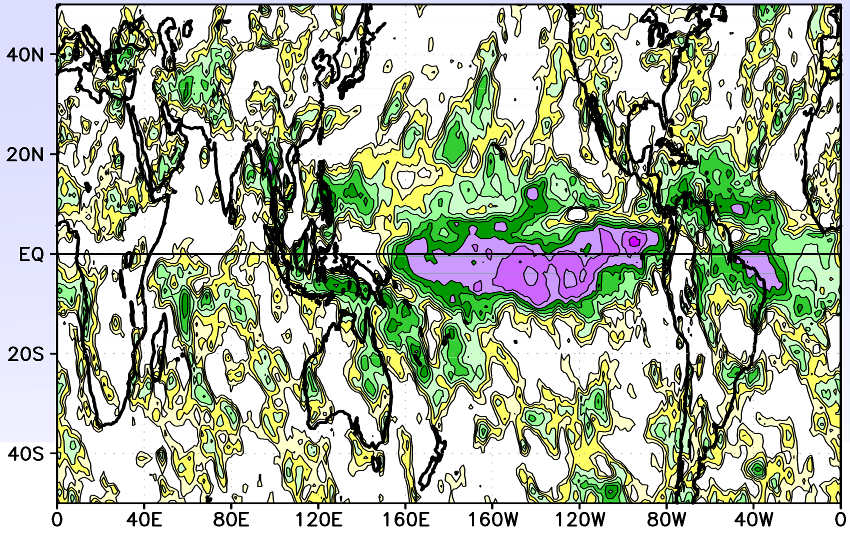
DJF prediction from Nov. 1st



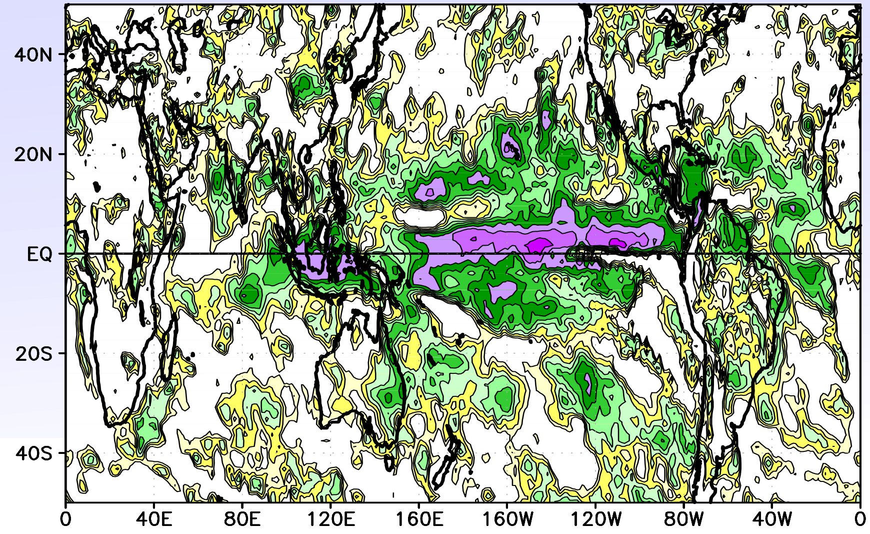
MAM prediction from Feb. 1st



JJA prediction from May 1st



SON prediction from Aug.1st

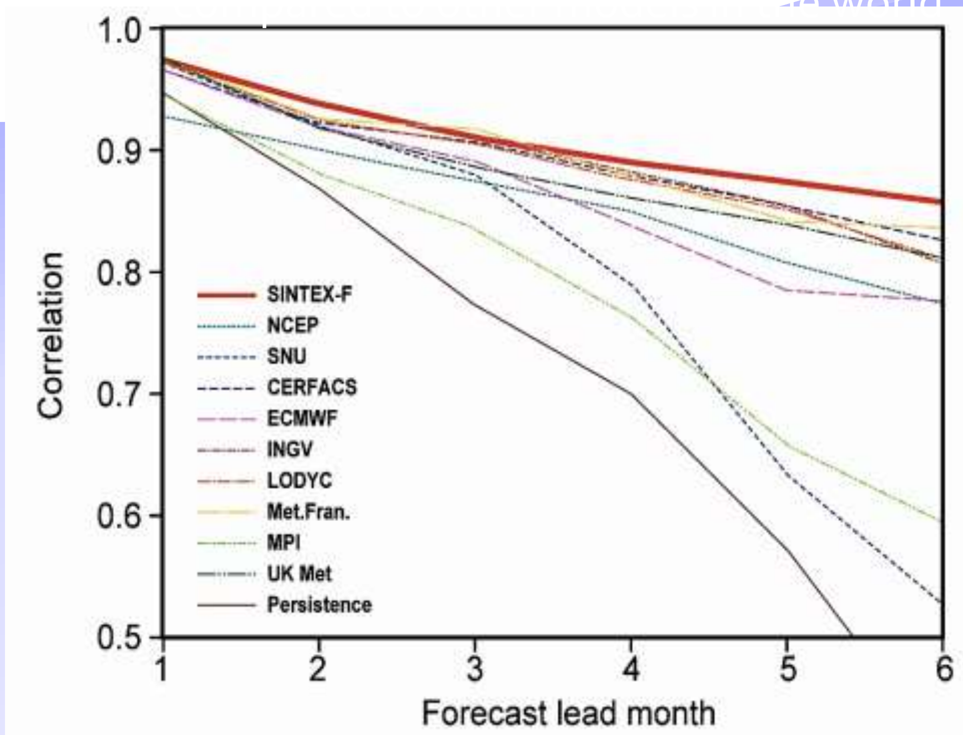


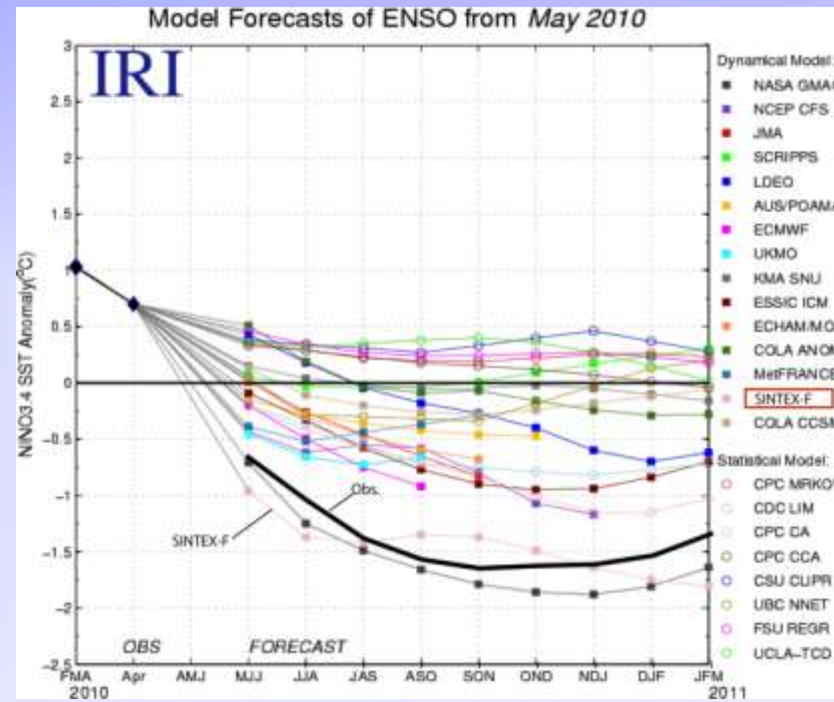
9~27 members

SINTEX-F ENSO prediction – top of the world

http://www.jamstec.go.jp/frcgc/research/d1/iod/index.html

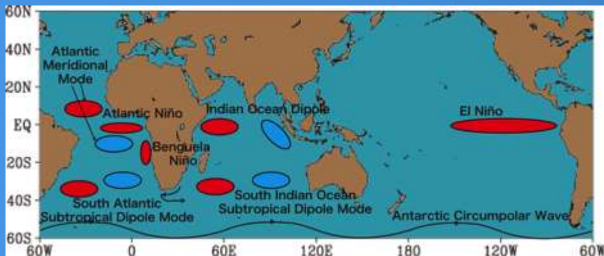
2011 La Nina prediction





SATREPS Project

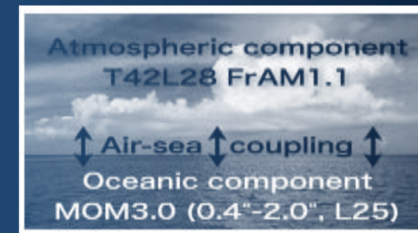
JAMSTEC, U. Tokyo, ACCESS, U. Cape Town, CSIR, U. Pretoria, ARC, SAWS and SAEON



Evaluating Predictability

Global-scale climate prediction

Improving CGCMs

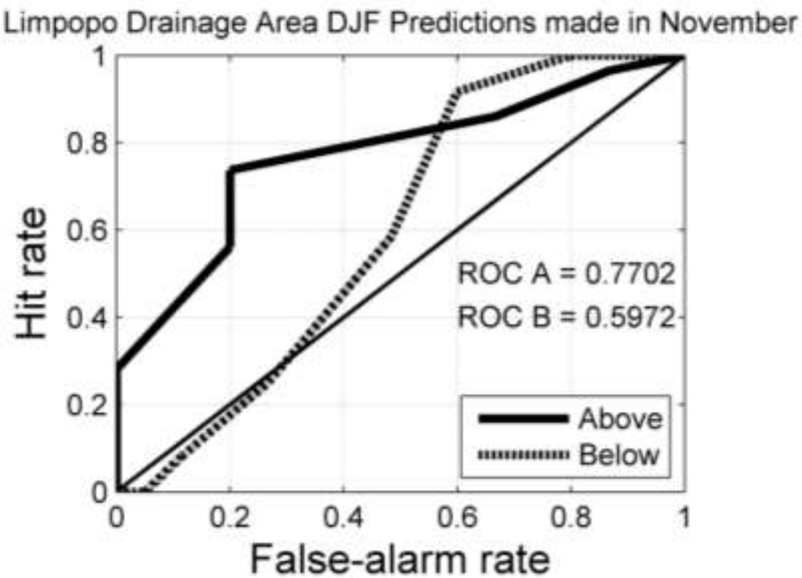


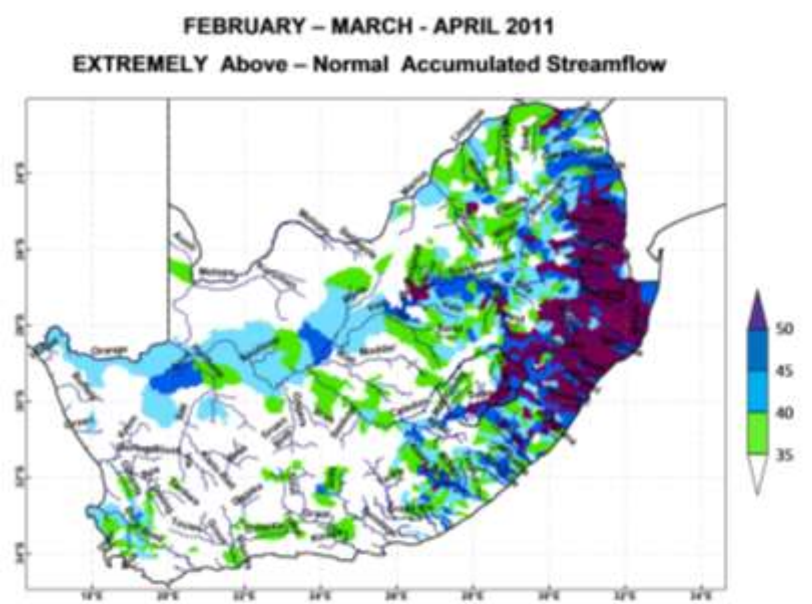
Regional climate prediction

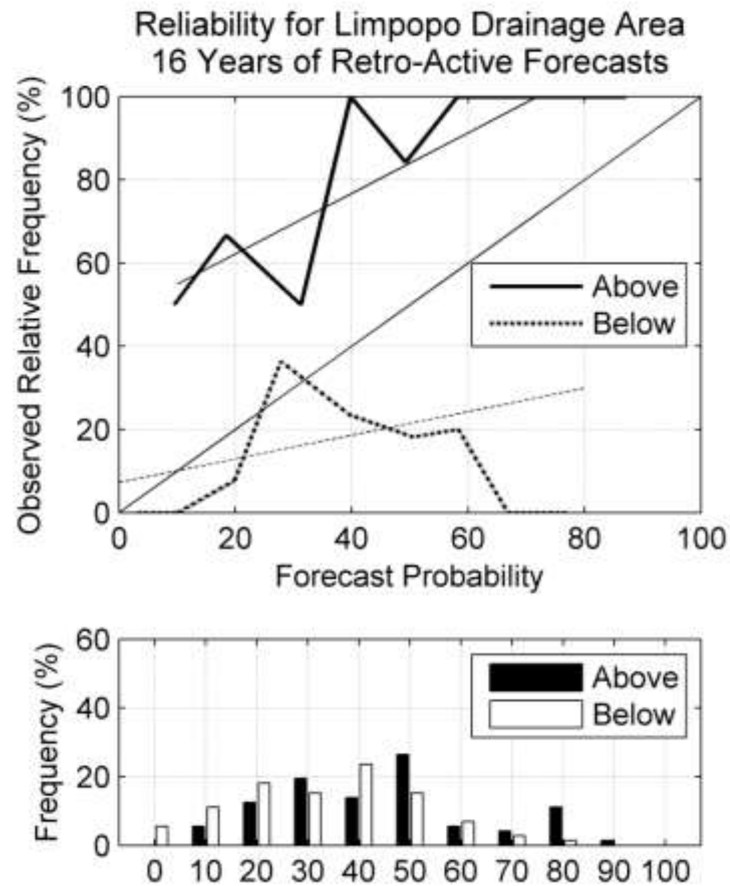
Capacity of seasonal climate prediction in South Africa is enhanced so that it can be applied to management of environmental problems in the Southern African Region.

Improving Early Warning System

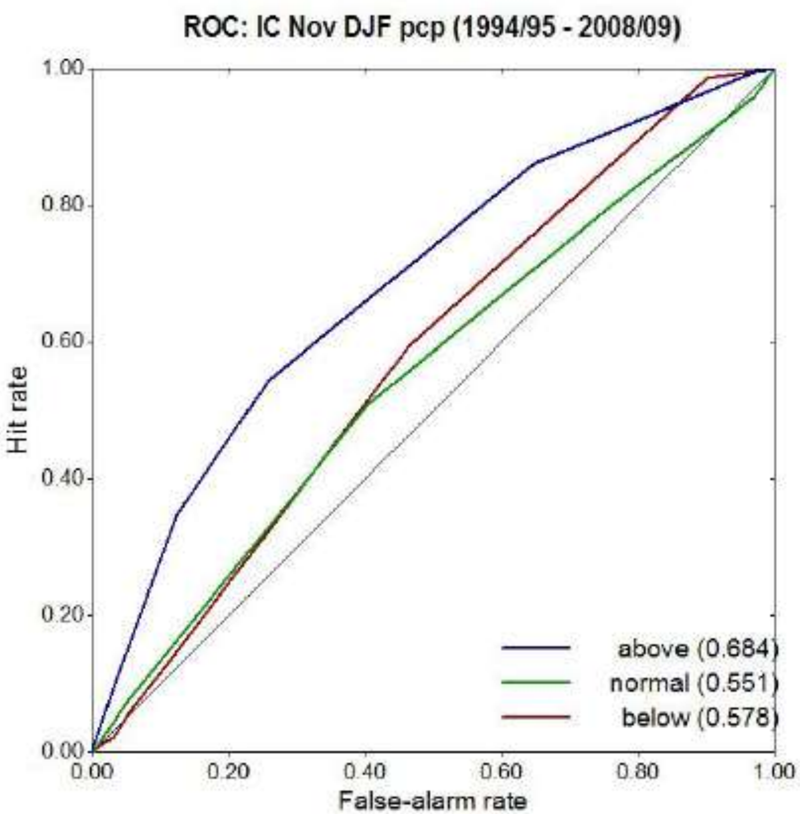
River flow predictions with the SINTEX-F

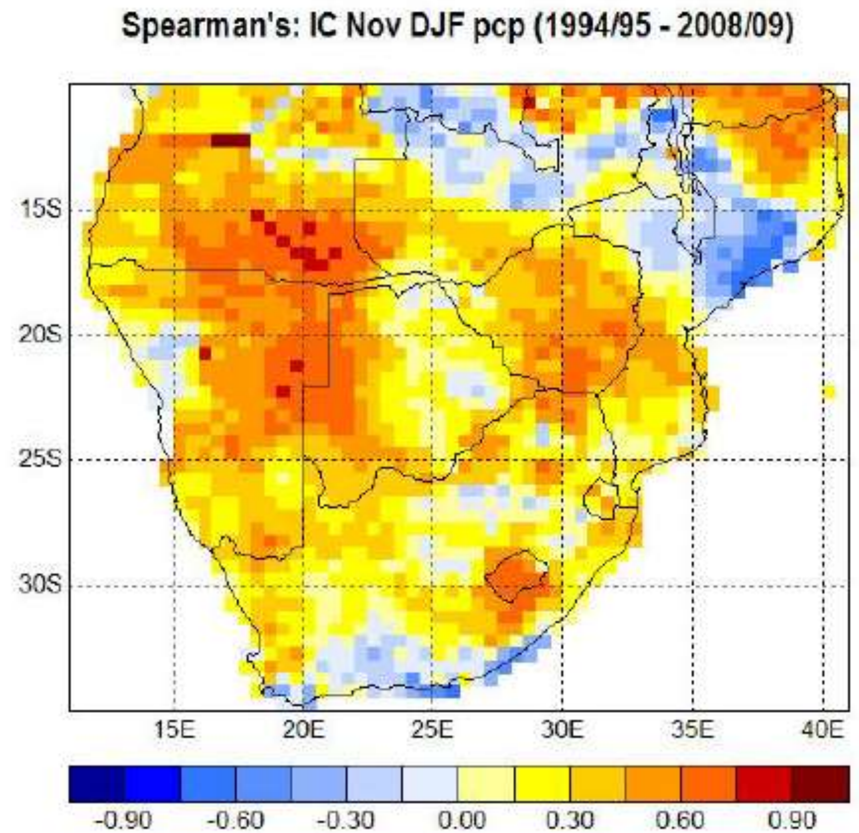




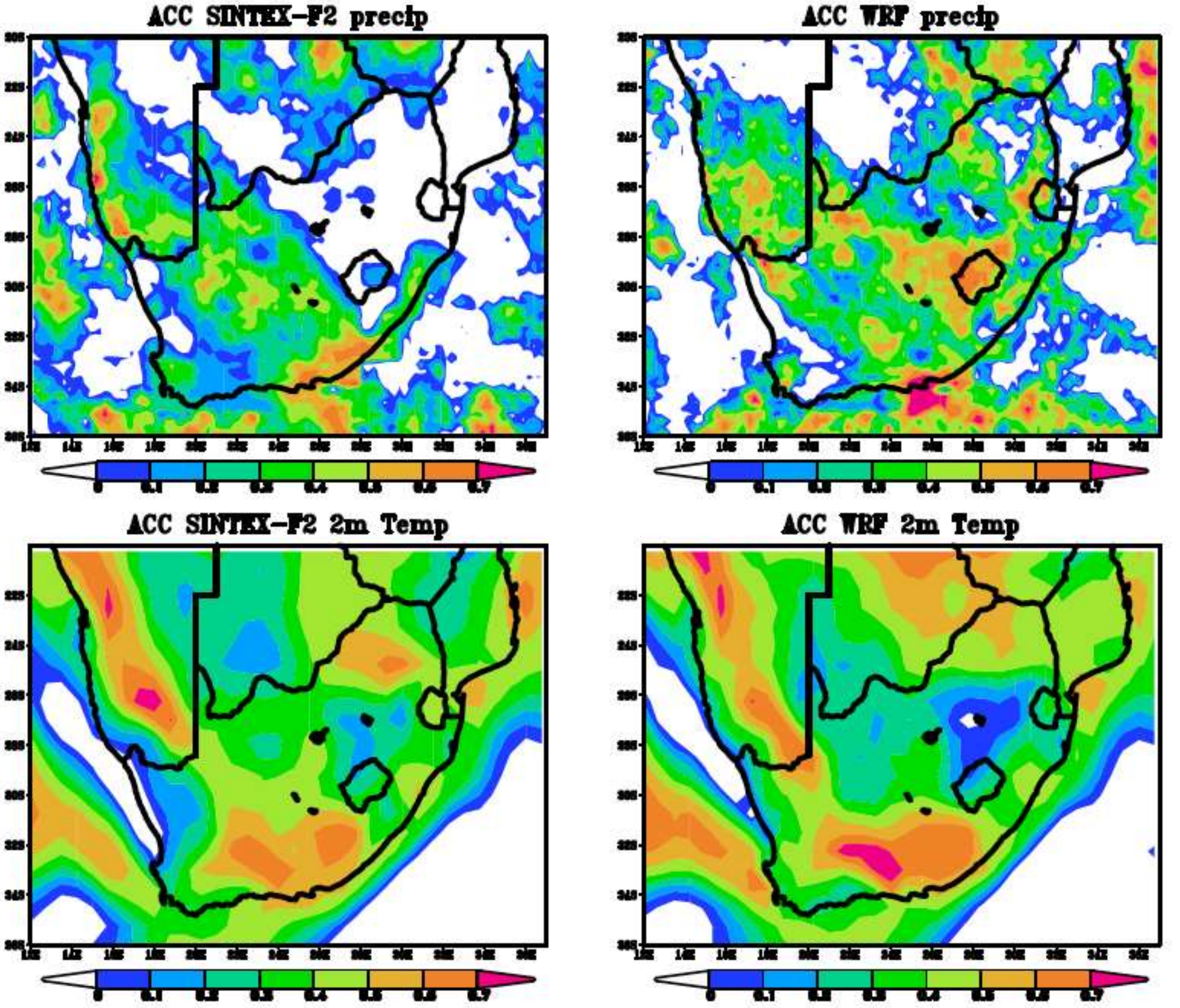


ROC and Spearman's correlation



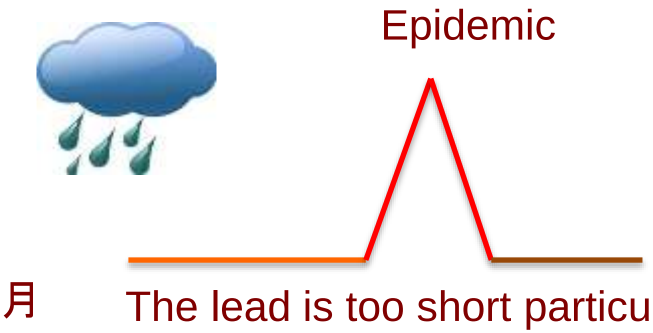


15th %tile threshold
85th %tile threshold


ACC SINTEX-F2 precip
ACC WRF precip
ACC SINTEX-F2 2m Temp
ACC WRF 2m Temp

A conceptual climate-based early warning system for Malaria

（1）Infection forecast so far



Hashizume, Minakawa *et al. PNAS* (2009) 1857–1862

The lead is too short particularly for the developing country

（2）Now, the addition of climate prediction of possible Southern Africa

（3）If you can long-term prediction by increasing the accuracy further

Well in advance, it is possible arrangement of corresponding human and stockpiling of medicine.

A new SATREPS project

ACCESS & JAMSTEC

Regional climate model (southern Africa)

Down scaling

ACCESS

Weather data

District level climate model

Refinement

ACCESS

Weather data

MRC & NEKKEN

Disease transmission model

Refinement

MRC

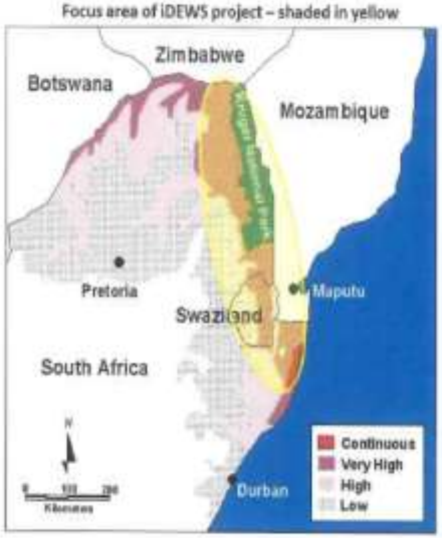
Disease surveillance systems

ALL

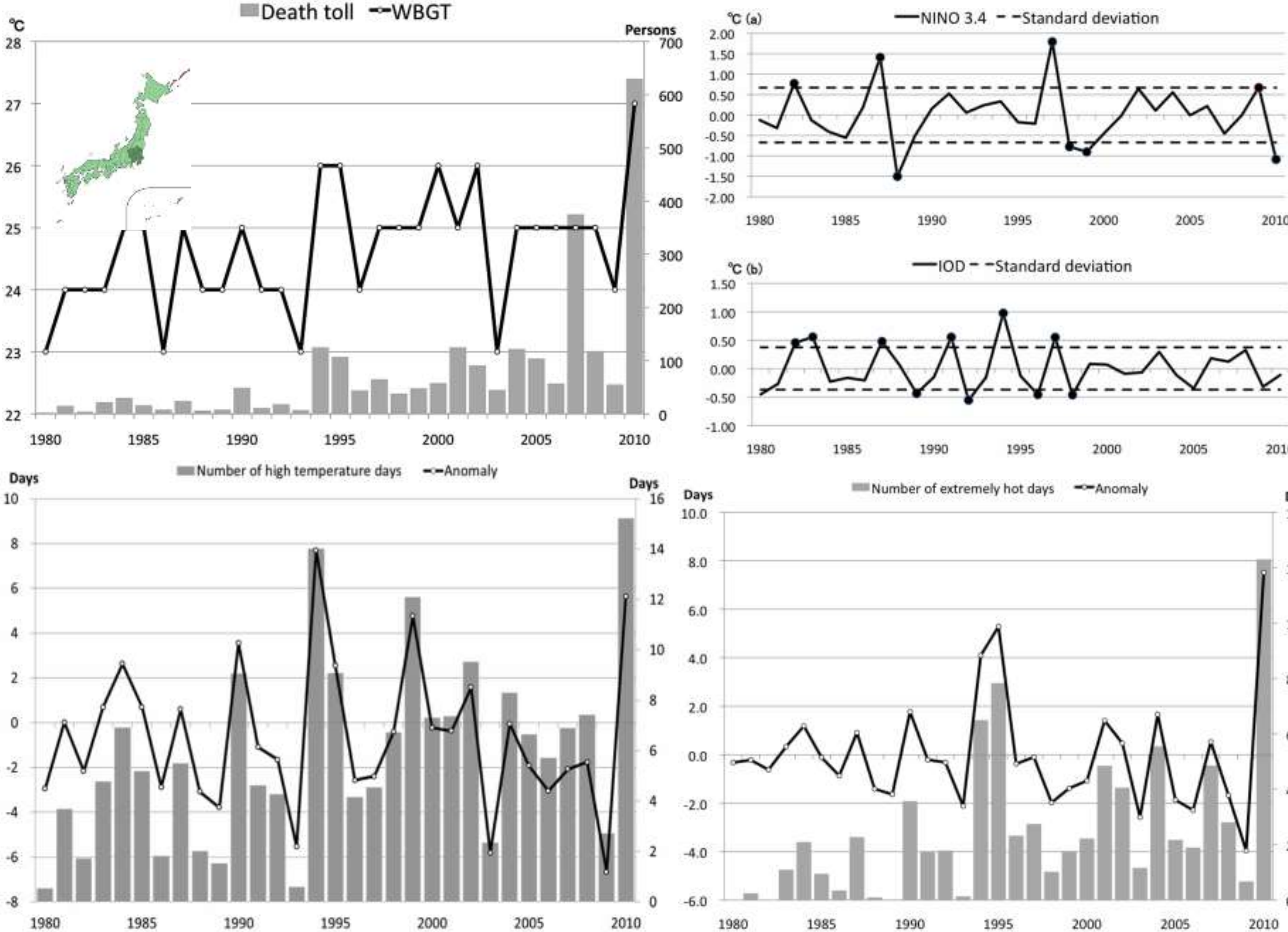
Disease prediction model

Early Warning systems

Focus area of iDEWS project – shaded in yellow



Role of climate variability in the heatstroke death rates of Kanto region in Japan



Takaya et al. 2014