# CORDEX South Asia

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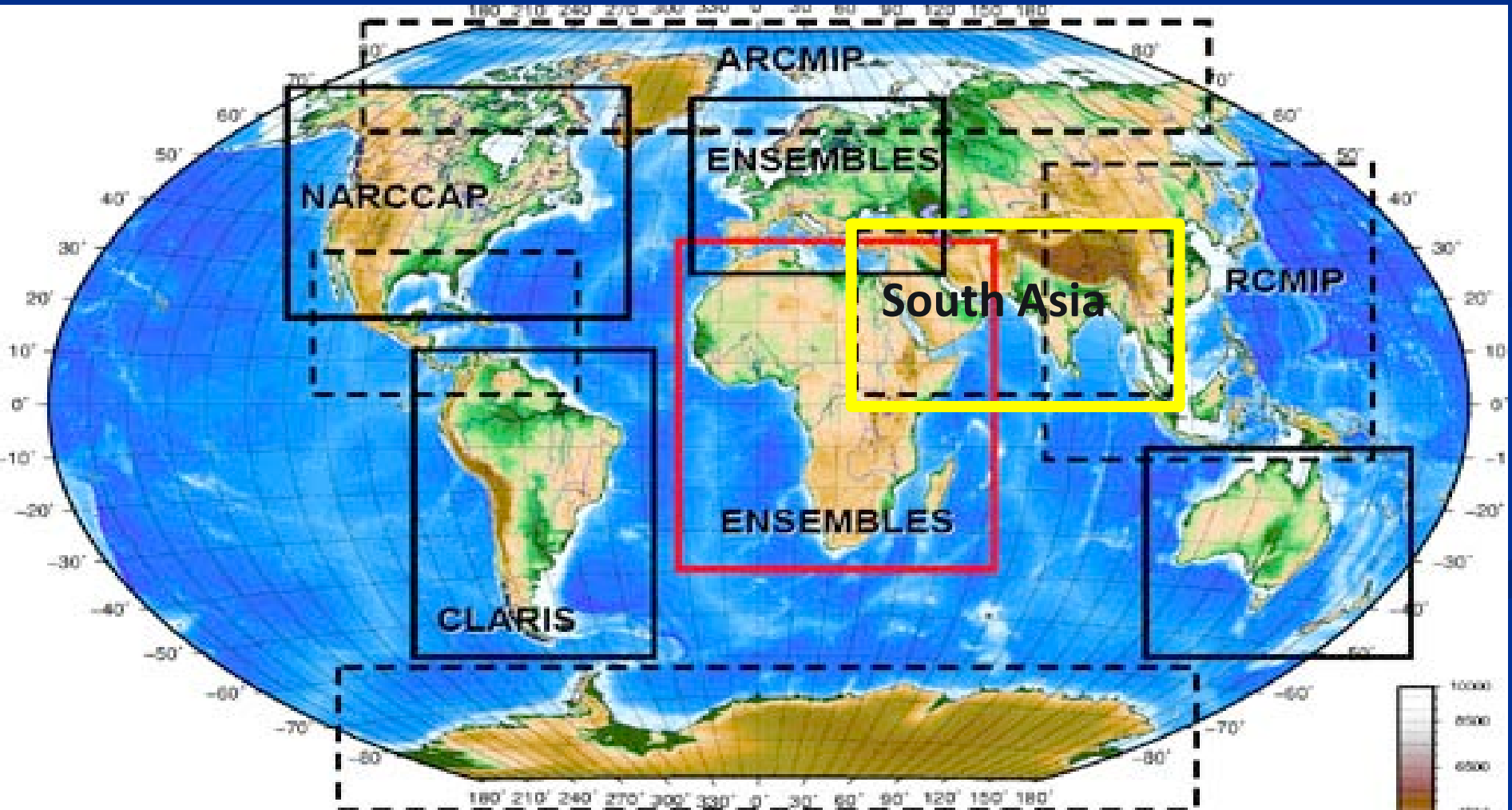
# WCRP CORDEX South Asia

Co-ordinated Regional Downscaling Experiment – CORDEX South Asia

**(CORDEX South Asia – led by CCCR, IITM)**



# World Climate Research Programme (WCRP)

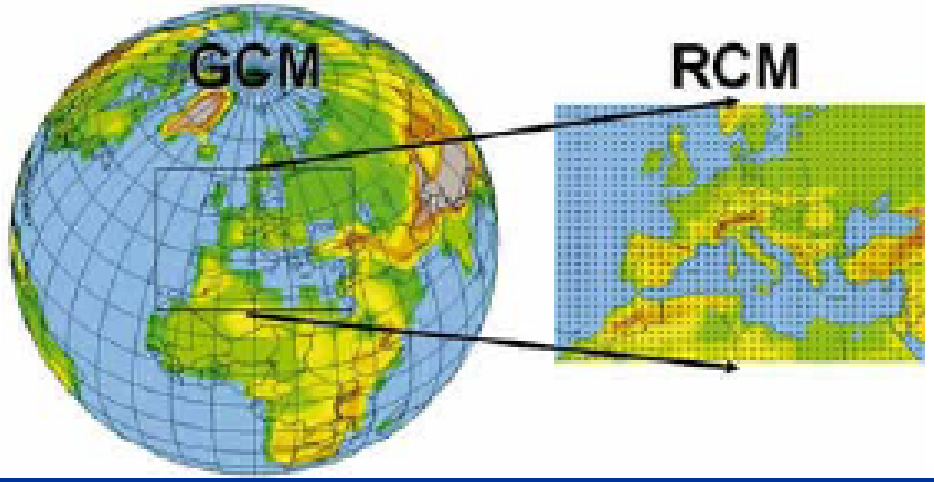
WCRP CORDEX

**Providing global coordination of Regional Climate Downscaling for improved regional climate change adaptation and impact assessment**

## What is Regional Climate Downscaling?

A Global Climate Model (GCM) may provide a prediction for an area of 300km by 300km covering what could be a vastly differing landscape (from very mountainous to flat coastal plains for example) with greatly varying potential for floods, droughts or other extreme events. Regional Climate Models (RCM) instead can provide information on a much smaller area allowing for more precise information foran effective impact and adaptation assessment and planning, which is vital in many vulnerable regions of the world.

*From the picture on the right you can see how although the GCM covers the whole globe the level of detail is relatively low whereas a RCM can provide much higher level of detail (or resolution) over a smaller region such as Europe or Africa.*



## Why do we need Regional Climate Downscaling?

Global Climate Models (GCM) can provide us with projections of how the climate of the earth will change in the future. These results are urging the international community to take decisions on climate change mitigation. However, the impacts of a changing climate, and the adaptation strategies required to deal with them, will be on a more regional scale. This is where Regional Climate Downscaling (RCD) has an important role to play by providing projections with much greater detail.

**Impacts of changing climate are pre-dominant at regional scales !**

## What is CORDEX?

The RCD techniques available, their applications, and the community using them are broad and varied, and it is a growing area. The Coordinated Regional Climate Downscaling Experiment (CORDEX) was launched by the World Climate Research Programme (WCRP) to create a framework for evaluating and comparing these various techniques that are in use all over the world. It is envisaged that CORDEX will also contribute to the WMO Global Framework for Climate Services by providing climate predictions at the regional scale and will increase the capacity to downscale the global climate predictions. Further the CORDEX community supports activities in developing regions and also provide opportunities for young scientists to further their experience and knowledge base.

http://wcrp.ipsl.jussieu.fr/cordex/

# CORDEX: Model Experiments

- Evaulation / Baseline run with ERA – Interim boundary conditions (1989 – 2008)
- Historical run (1950 – 2005)
- Future projection : 2005 - 2100 (eg., RCP 4.5, 6.0, 8.5 Scenario)

## Participating Modeling Groups

- LMDZ model (~ 35 km ) CCCR (IITM), IPSL
- RegCM model (~ 50 km) CCCR (IITM)
- RCA model (~ 50 km) Rossby Centre, Sweden
- COSMO-CLM (~ 50 km) University of Frankfurt, Germany
- MRI model (~ 20 km) global model (MRI, Japan) and CCCR-IITM
- WRF model (~ 50 km) - BCCR, CCCR (IITM), and TERI
- CCAM model ( ~ 50 km) CSIRO, Australia
- HadRM3P model (~ 50 km) Hadley Centre

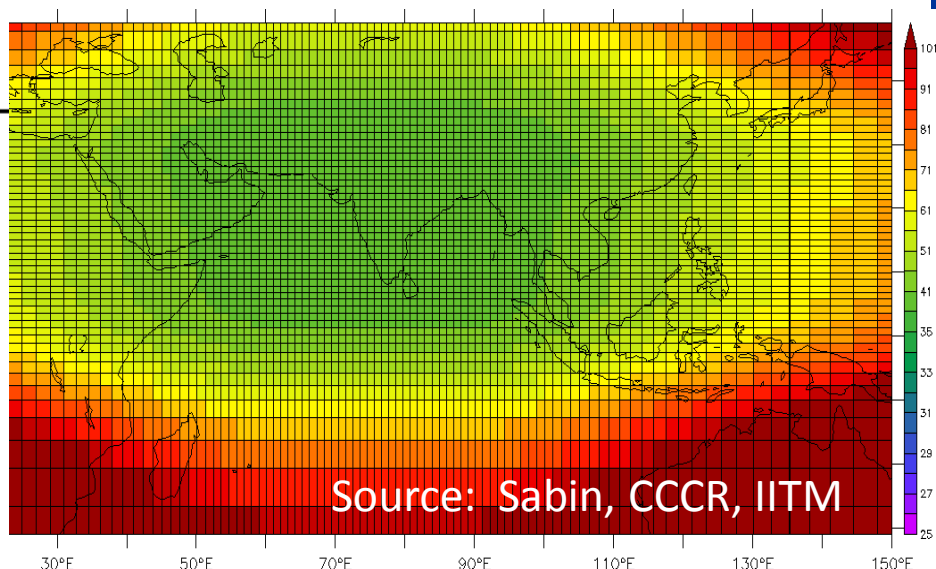
**Some of the CORDEX South Asia model outputs (ie., the First 4 models LMDZ, RegCM, RCA and COSMO-CLM) are currently available at CCCR-IITM**

# LMDZ grid setup for CORDEX South Asia (shaded region has grid-size < 35 km)

Clim Dyn
DOI 10.1007/s00382-012-1658-8

## High resolution simulation of the South Asian monsoon using a variable resolution global climate model

T. P Sabin · R. Krishnan · Josefine Ghattas ·
Sebastien Denvil · Jean-Louis Dufresne ·
Frederic Hourdin · Terray Pascal



# Announcement of CORDEX South Asia dataset dissemination: 12 Sept 2013

## CORDEX-South Asia Multi-Model Output

Updated on 03 Sept 2013

Historical (1950 – 2005)
Space required for each variable is approx 4 GB

| Variable name (Monthly and Daily) | SMHI-RCA4 | RegCM4-GFDL | RegCM4-LMDZ | COSMO-CLM | LMDZ |
|---|---|---|---|---|---|
| Rainfall (pr) | Y | Y | Y | Y | Y |
| Surface Air Temperature (tas) | Y | Y | Y | Y | Y |
| Surface Air Temp. Maximum (tasmax) | Y | Y | Y | -- | Y |
| Surface Air Temp. Minimum (tasmin) | Y | Y | Y | -- | Y |
| Sea-level Pressure (psl) | Y | Y | Y | -- | Y |
| Surface Specific Humidity (huss) | Y | Y | Y | -- | Y |
| Surface Zonal Wind (uas) | Y | Y | Y | -- | Y |
| Surface Meridional Wind (vas) | Y | Y | Y | -- | Y |
| Downward Shortwave Radiation (rsds) | -- | Y | Y | -- | -- |

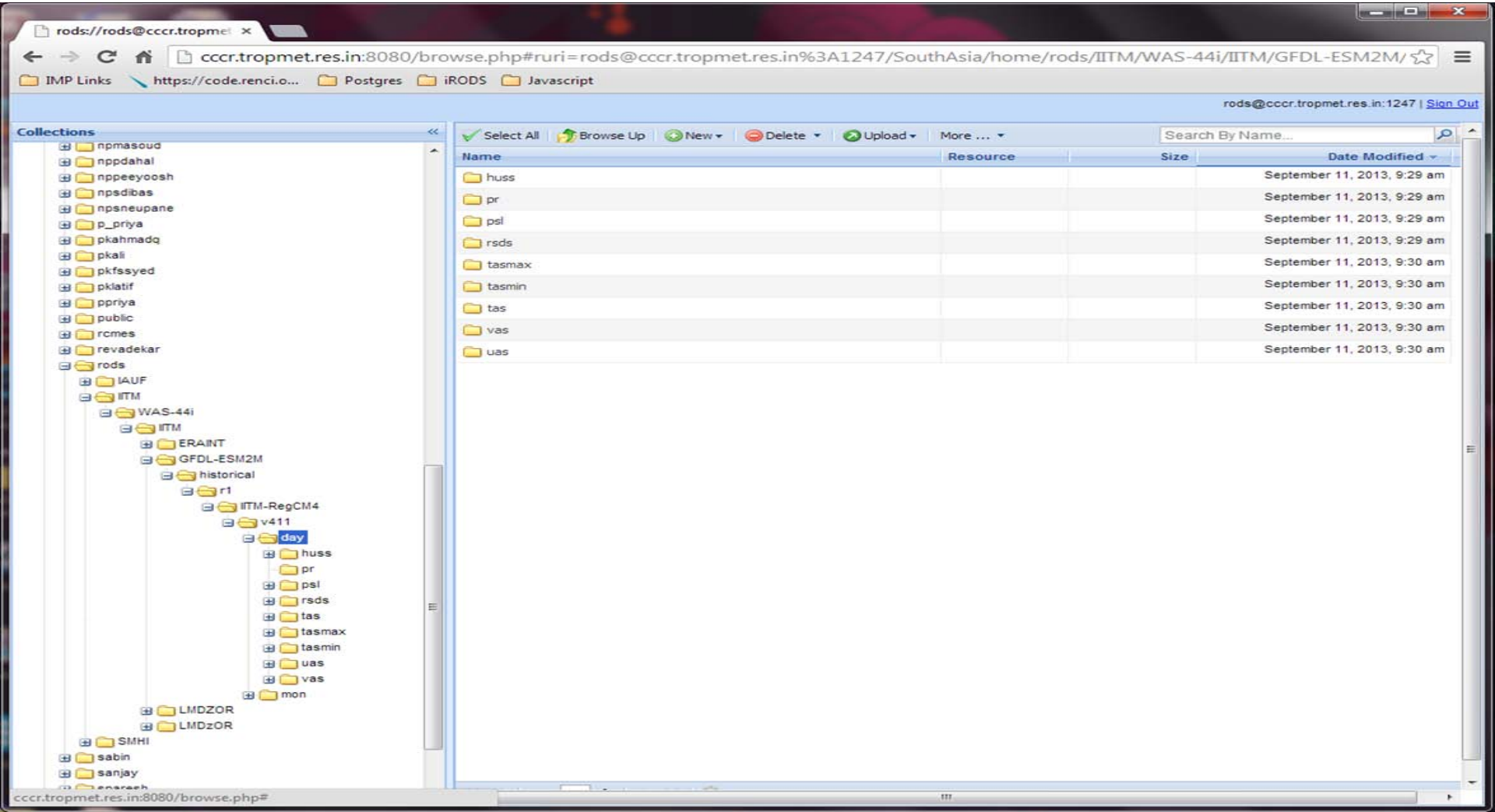
Courtesy: Sandip Ingle, Milind Mujumdar, CCCR

# CORDEX South Asia multi-model data

## Centre for Climate Change Research (CCCR)

## Indian Institute of Tropical Meteorology, Pune

# CCCR Data Portal http://cccr.tropmet.res.in:8080/



# WCRP CORDEX South Asia Training Workshop

In partnership with CCCR-IITM, START, ICTP, CSAG, SMHI and ICSU-ROAP

17 – 20 October 2012, Pune, India

http://cccr.tropmet.res.in/cccr/home/CORDEX/oct2012/index.html

## कॉर्डेक्स दक्षिण एशिया प्रशिक्षण कार्यशाला

## CORDEX South Asia Training Workshop


17 – 20 October 2012

Center for Climate Change Research (CCCR)

Indian Institute of Tropical Meteorology (IITM), Pune

Co-ordinated Regional Downscaling Experiment (CORDEX) South Asia

World Climate Research Program (WCRP)

In partnership with

CCCR-IITM, START, ICTP, CSAG, SMHI and ICSU-ROAP

http://cccr.tropmet.res.in




International Centre for Theoretical Physics



Indian Institute of Tropical Meteorology, Pune

Centre for Climate Change Research (CCCR)

http://wcrp-cordex.ipsl.jussieu.fr/images/pdf/newsletters/newsletter1_january2013.pdf

# CORDEX South Asia

Contact: R Krishnan

The Centre for Climate Change Research (CCCR) at the Indian Institute of Tropical Meteorology (IITM) hosted the Coordinated Regional Climate Downscaling Experiment (CORDEX) South Asia Training Workshop during 17-20 October 2012 at CCCR-IITM, Pune. This training workshop was organized by the World Climate Research Programme (WCRP) in partnership with START, and in collaboration with ICTP, CSAG, SMHI and ICSU-ROAP.


The four-day training workshop focused on skill development in analysis and verification of results from the CORDEX climate models. This capacity building effort helped to foster trans-disciplinary collaborations between individuals from the physical sciences and the vulnerability, impacts and adaptation (VIA) research community.

*27-30 August 2013, ICIMOD, Kathmandu, Nepal*



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**Important Dates**

- Online Registration : 23rd May 2013
- Last Date of Online Registration : 10th July, 2013
- Confirmation of Participation : 31st July, 2013

## About the Workshop

The Coordinated Regional Downscaling Experiment (CORDEX) is a WCRP (World Climate Research Programme) initiative to provide global coordination of regional climate downscaling for improved regional climate change adaptation and impact assessment. The 1st WCRP CORDEX South Asia training workshop was organized during 17-20 October 2012 in Pune, India, hosted by the Centre for Climate Change Research (CCCR), Indian Institute of Tropical Meteorology (IITM).

The 2nd WCRP CORDEX science and training workshop in South Asia will be held during 27-30 August 2013 in Kathmandu, Nepal, jointly supported by ICIMOD (International Centre for Integrated Mountain Development), WCRP, APN (Asia-Pacific Network for Global Change Research), MAIRS (Monsoon Asia Integrated Regional Study), CCCR-IITM.

## Workshop Topics

- Evaluation of monsoon climate simulation in Hindu Kush-Himalayan and Tibetan Plateau region from multiple climate models (onset and withdraw, seasonal and intra-seasonal variability, flood, drought, heat wave etc.).
- Assessment of downscaling techniques and their products in Hindu Kush-Himalayan and Tibetan Plateau region to understand uncertainties accompanying the regional climate projections and examine the feasibility of climate model results.
- Bridging the gaps between end users' needs and climate modeling communities, and meeting the requests of end-users (hydrology, agriculture, water resources, land cover and ecosystem, human health etc.) on downscaled products, with definition of data types, formats and resolutions, for vulnerability, impacts and adaptation analysis.
- Training of operational departments and local policy makers in South Asia and supporting local/regional policy making as well as sustainable development by providing user friendly regional downscaling products for South Asia.

## Important Dates

- Application and registration starts: 23rd May 2013
- Deadline for workshop application and registration: 10th July 2013
- Confirmation of participation: 31th July 2013
- Workshop: 27-30 August 2013

# Summary

•Reliable projections of regional climate change , changes in extremes and their impacts - Scientifically challenging

•**CORDEX South Asia:** A framework for addressing regional climate and monsoonal issues under changing climate

•CORDEX South Asia multi-model high-resolution simulations at IITM and Partner Institutions
- Evaluation run, Historical runs and future scenarios eg. RCP4.5.

•Multi-model Analysis: Evaluation of model performance, Quantify uncertainties in regional climate projections

•Develop synergistic linkage between climate downscaling and VIA user communities in Asia through direct user engagement

•Archival and dissemination of CORDEX South Asia multi-model outputs at CCCR, IITM

•Development of regional capacity - CORDEX two training workshops (a) 17 – 20 October 2012 at IITM, Pune and (b) 27 – 30 August 2013, Kathmandu, Nepal. Two additional training workshops are planned to be held in South East Asia and East Asia in 2014 and 2015 respectively.

# Scientific questions

- Pronounced SST warming trend in the equatorial Indian Ocean
- Weakening trends in the South Asian monsoon circulation and decreasing monsoon rainfall over several areas of the Indian subcontinent
- A recent paper by Panickal Swapna et al 2013 (Climate Dynamics) discusses the relationship between the two regional signals.
- Question: Do the above signals represent a multi-decadal mode of monsoon variability?
- Question: To what extent does global climate change influence the two signals ?

Clim Dyn
DOI 10.1007/s00382-013-1787-8

# Indian Ocean and monsoon coupled interactions in a warming environment

Panickal Swapna · R. Krishnan · J. M. Wallace

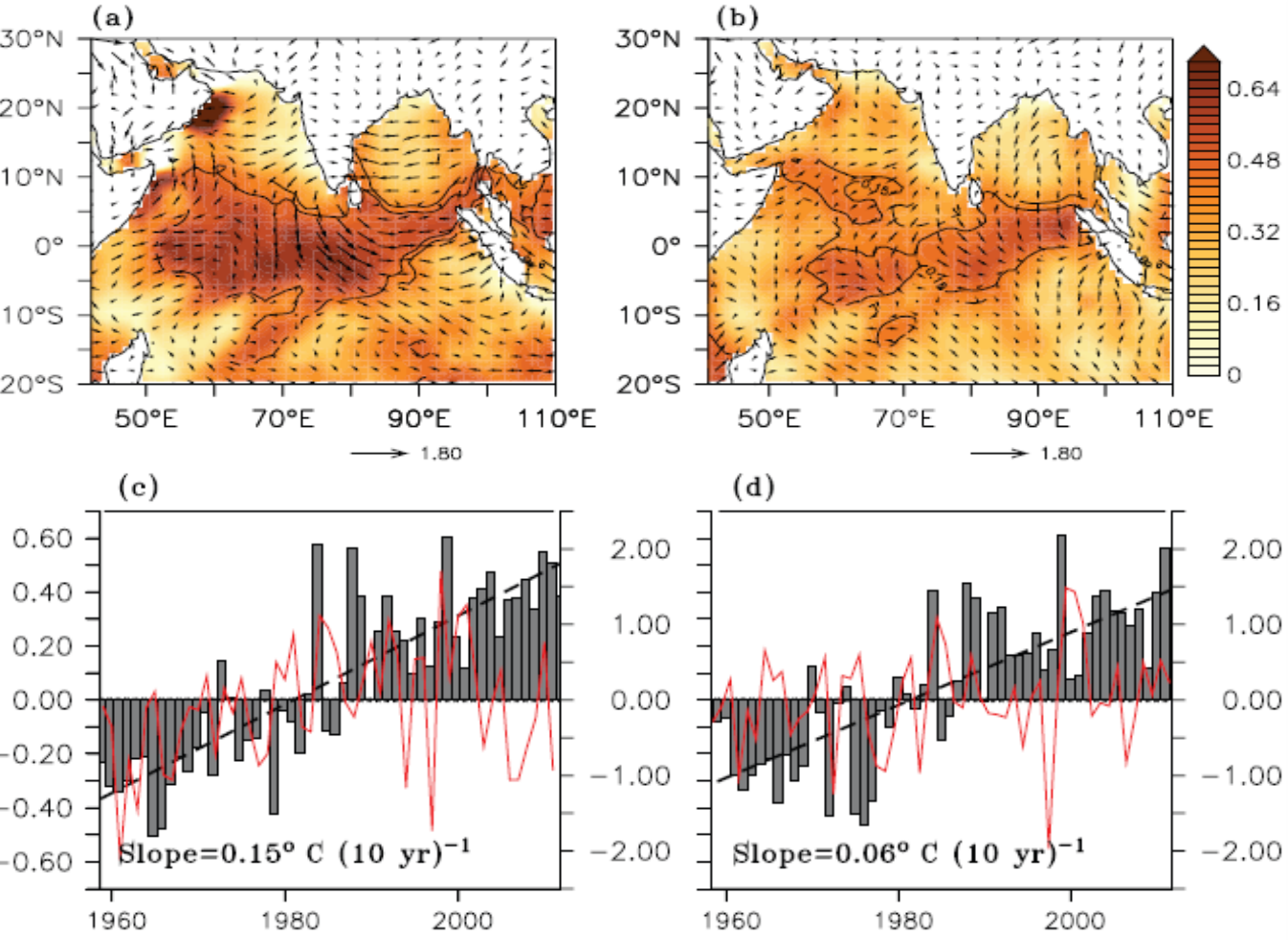



**Fig. 1** *Upper panels* show trends in sea surface temperature (SST in °C per 62 years; the departure from the global mean SST) and ERA surface winds (m s$^{-1}$ per 54 years) in the tropical Indian Ocean (IO) for the summer monsoon season. **a** June–September; **b** the remaining calendar months. *Color shading* indicates the magnitude of SST trends and the contour corresponds to 99 % confidence level based on the Student's *t* test (see Balling et al. 1998). The *lower panels* show time-series of SST (°C) bars and ERA zonal wind anomalies (m s$^{-1}$, *red lines*) averaged over the equatorial IO (50°E–100°E, 5°S–5°N). **c** June–September and **d** the remaining calendar months. The trends of the linear regression best-fit lines exceed the 95 % confidence level

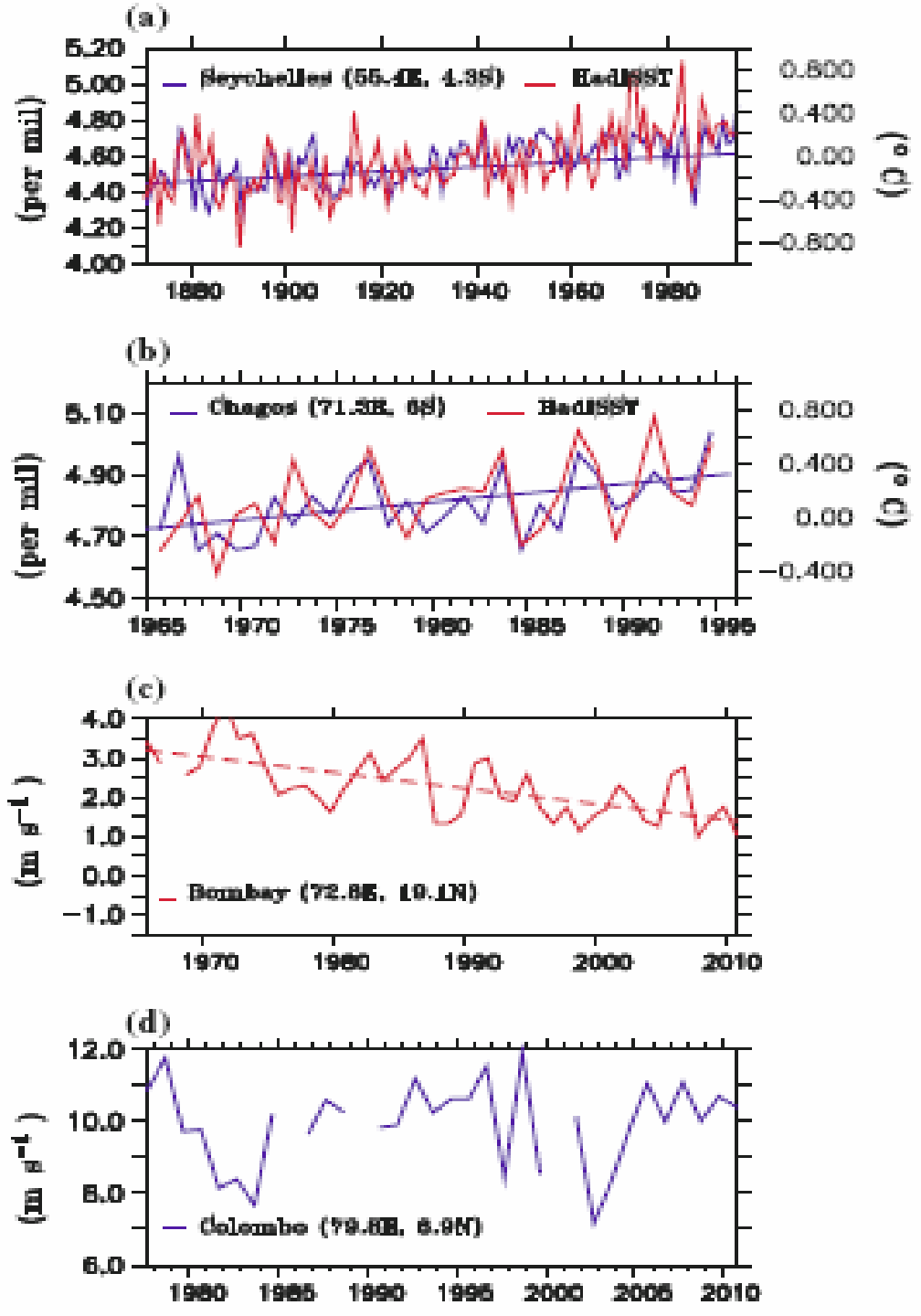



Fig. 2 Time series of yearly coral $d^{18}O$ anomalies in per mil (*blue line*) and JJAS SST anomalies (°C) from HadISST (*red line*) (a) at Seychelles (b) and at Chagos. The coral $d^{18}O$ anomalies has been negated and overlaid with SST anomalies c Time series of monthly mean zonal wind (m $s^{-1}$) at 1000 hPa at station Bombay (Mumbai, 72.8°E, 19.1°N) during the summer season d Time series of monthly mean 850 hPa zonal wind (m $s^{-1}$) at Colombo (79.8°E, 6.9°N). The trends of the linear regression best-fit lines in (a, b, c) exceed the 95 % confidence level

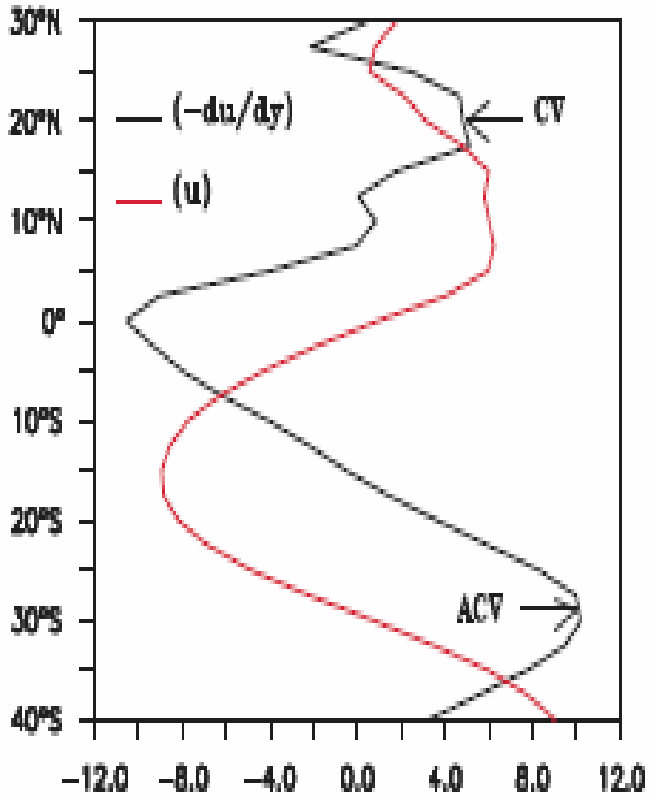



Fig. 16 The meridional profile of climatological $-du/dy$ ($\times 10^{-3}$ $s^{-1}$, *black line*) and zonal wind ($ms^{-1}$, *red line*) averaged longitudinally between 70°E and 90°E along a section extending from 40°S to 30°N for the JJAS summer monsoon season from ERA reanalysis. *CV* cyclonic vorticity, *ACV* anti-cyclonic vorticity

$$\left(\frac{-1}{\rho_o f}\frac{\partial \tau_x}{\partial y}\right)$$

Meridional gradient of zonal wind stress: Dominant term for upwelling in Seychelles region (Yokoi et al. 2008)

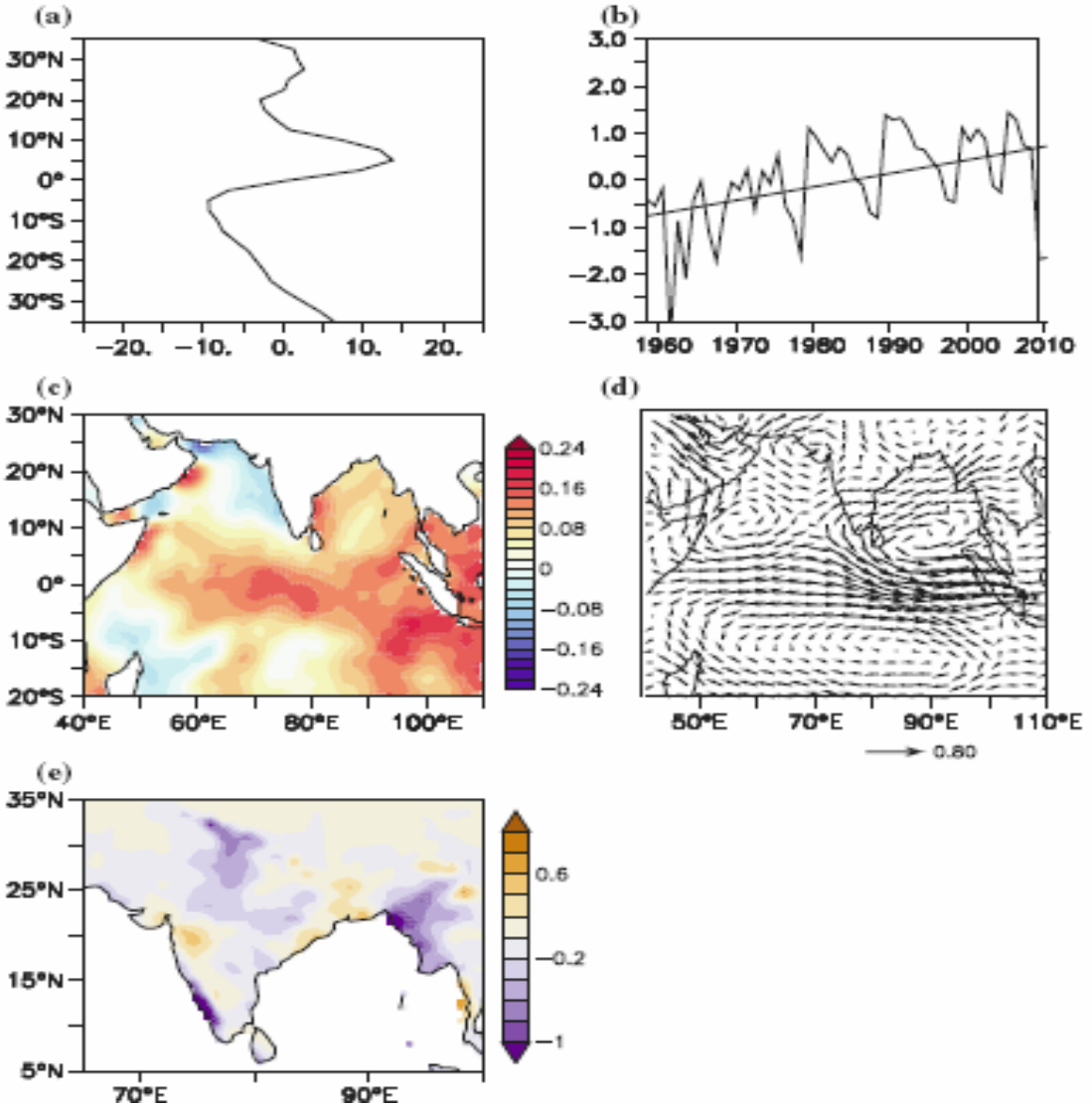
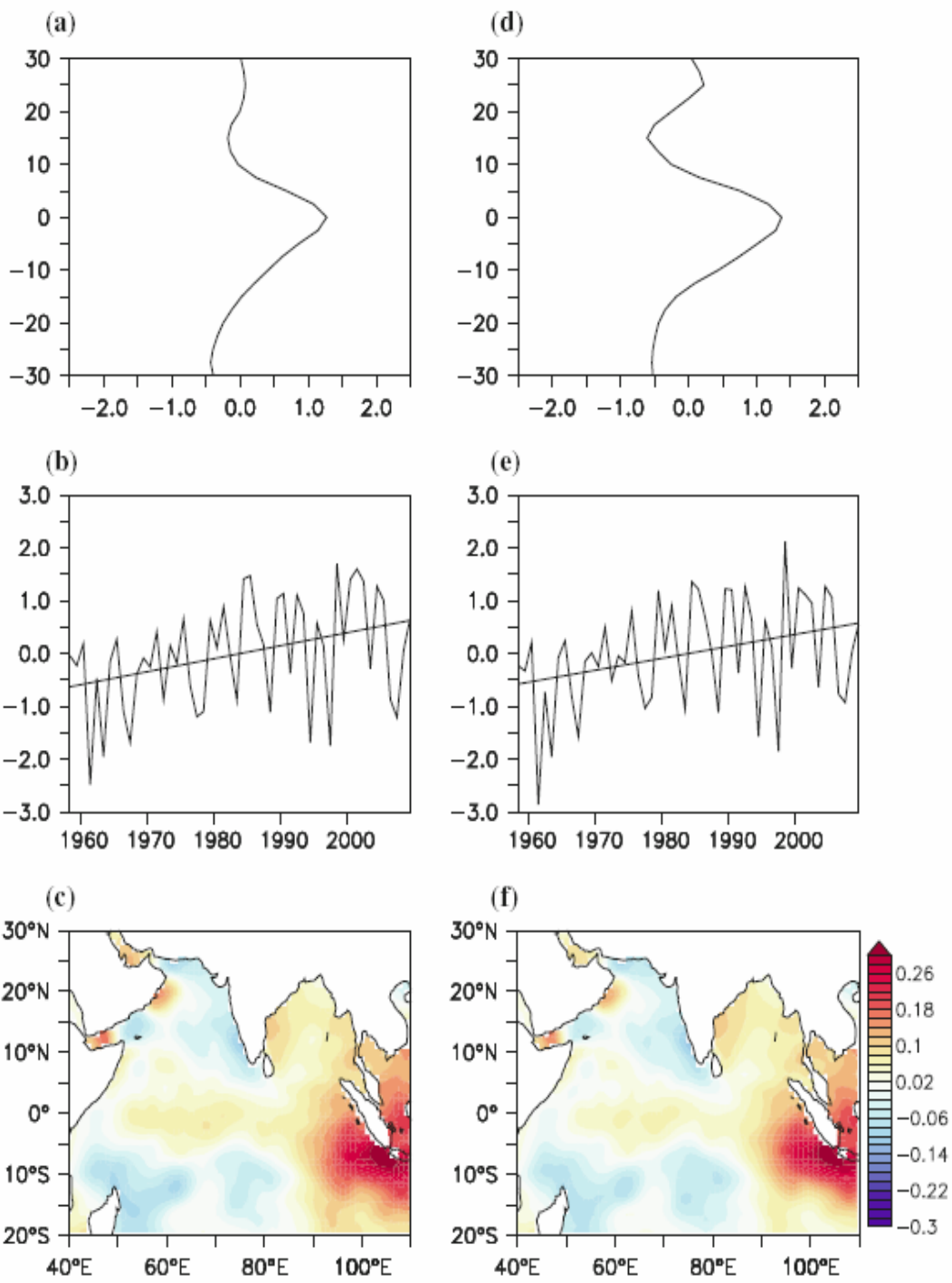



Figure 9 (a) The leading EOF of the meridional profile of (-du/dy) anomalies from ERA reanalysis averaged from 70°E to 90°E along a section extending from 35°S to 35°N for the summer season. (b) The time series of the corresponding PC. The trend of the linear regression best-fit line exceeds the 95% confidence level (c) Patterns of SST anomalies obtained by regressing SST upon PC1 of (-du/dy) for the summer monsoon season for 1958-2011. Units are (°C) (s). (d) Same as (c) except for 850 hPa winds. Units are ($ms^{-1}$) (s). (e) Same as (c) except for rainfall. Units are (mm $day^{-1}$) (s).



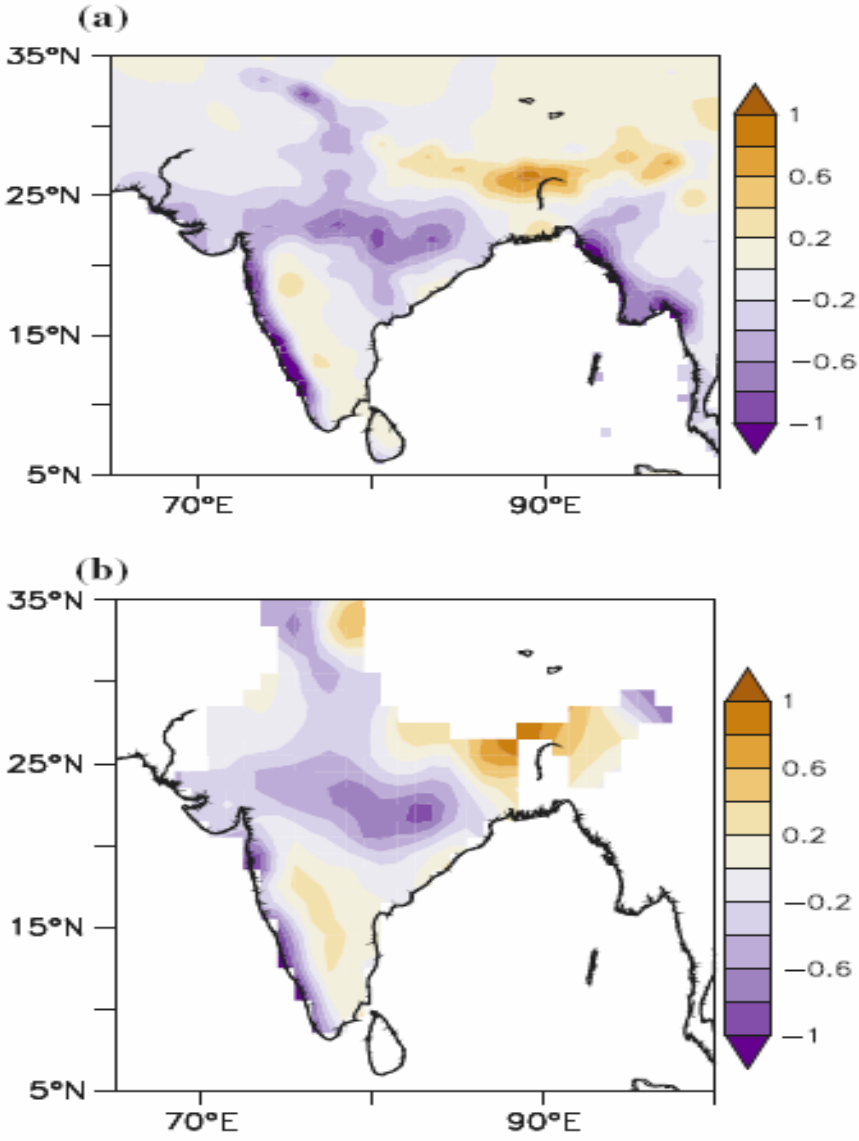




**Fig. 4** Anomaly patterns generated by regressing the rainfall upon the first PC of the 850 hPa zonal wind profile averaged from 70°E to 90°E from ERA **a** APHRODITE rainfall **b** IMD gridded rainfall. Units of regression pattern are (mm day$^{-1}$) (ms$^{-1}$)$^{-1}$