

CURRICULUM VITAE

KIRAN DHANRAJ SALUNKE

Present Position	Areas of Interest
Junior Scientific Officer,	HPC and its scientific computing applications
Monsoon Mission - Seasonal Prediction	Machine Learning /AI application in Earth Sciences
Indian Institute of Tropical Meteorology, (Ministry of Earth Sciences, Govt of India)	Climate Modeling, Data base management
Dr. Homi Bhabha Road,	Coupled Climate model (CFS)
Pune 411 008	Seasonal Prediction and Monsoon

Educational Qualifications

Integrated M.Tech-Ph.D (Computer Science & Information Technology)

Department Of Technology, Savitribai Phule Pune University, 2018- Pursuing
Specialization : Machine Learning & HPC applications in Earth Sciences

M.Tech

University of Pune (India) 2017 – Modeling and Simulations

Thesis "*Potential Predictability of Indian Summer monsoon rainfall (ISMR) in Climate Forecast system model simulations using Machine Learning Techniques.*"
Supervisor – Prof. Sukratu Barve & Dr. Hemant Chaudhari

M.Sc. (Computer Science)

North Maharashtra University (India) 2009

Specialization : Computer Science

B.Sc. (Mathematics, Physics, Computer Science)

North Maharashtra University (India) 2003

Specialization Computer architecture and Data mining

Previous Employments

Junior Sci. Officer	Indian Institute of Tropical Meteorology Pune	Dec 2019-Till date
Assistant Director	Regional Forensic Science Laboratory, Nagpur	Aug 2019-Dec 2019
Junior Sci. Officer (Sci.Asst-B)	Indian Institute of Tropical Meteorology, Pune	Jan. 2016 – Aug 2019
Senior Sci. Asst.		Jan. 2011 – Dec 2015
Scientific Assistant		Jan. 2006 – Dec 2010

List of Publications

22

(Please see Annexure-I)

Achievements and Awards

- Indian Meteorological Society Young Scientist Award for the best paper published on Tropical Meteorology in 2014
- Twenty Fifth Annual Silver Jubilee award (for the year 2012) of IITM
- Excellent Performance award in Group B Officer for year 2015-16.
- Travel grant for Denmark to present research paper for HORIZON 2020 ESCAPE during Aug 7-12 2017.

Personal Details

<i>Date of Birth</i>	: 16th May 1983
<i>Gender</i>	: Male
<i>Marital Status</i>	: Married
<i>Nationality</i>	: Indian
<i>Category</i>	Scheduled Tribe (ST)

Workshop/Training/Seminars/ Symposium (45+)

- Advance Training on India's Fastest HPC Pratyush CRAYNC 50 with 4 PF capacity during 22-24 Feb 2018 at IITM. pune
- RIKEN International School on Data Assimilation during 22-26 Jan 2018 kobe, Japan.
- ESCAPE Young Scientist Summer School YSSS 7-12 August 2017,Copenhagen, Denmark
- HPC Advanced Training at High Performance Computing Centre , IITM, Pune on 22-24 Jul 2015
- ICTP, Trieste, Italy "Developer School for HPC applications in Earth Sciences and Symposium on HPC and Data-Intensive Applications in Earth Sciences" during 27th October - 14th November 2014.
- APCC Busan, South Korea during 19-30 Nov 2012 to participate in the APCC Training Program on Climate Variability & Seasonal Prediction.
- Paper presented on Model biases in Climate Forecast System (CFS): Possible mechanism for bias sustenance. TROPMET-2012. 20-22 November, India.
- Two Day CDAC International workshop On "Scientific & Engineering Applications of Garuda Grid "07 & 08 Aug'12 at NCAR-TIFR
- High Performance Computing adv. Training , IITM, Pune on 16-18 March 2012 .
- *Participated in the "OCHAMP" 2012, IITM, 21-25 Feb 2012.*
- *Participated in the "Workshop on Trends in High Performance Computing", NIO, Goa, 15-16Dec 2011.*

Skill Set

Programming	Fortran90, Fortran77, MPI, Mathematica, C & C++
Technologies	(Familiar), Matlab, Familiar with OpenMP and pThreads, Also Familiar with High Performance Fortran (HPF)
Platforms / OS	CRAYNC, IBM (idataflex) AIX(Power-6), SGI (Altix-ICE, Altix, IRIS), AIX (Regatta,Power-5, P690), Ubuntu, Debian, Scientific Linux, Red Hat Linux, Suse Linux, SUN Solaris, Mac with Leopard, Windows2000, Windows XP
HPC	Pratyush (CRAY NC 40, 50) Intel-Cluster Toolkit, Globus, Grid computing,Power 6, IDATAflex,GPFS file system,CRAYNC ,
Scientific Libraries	ESSL, Intel-Math Kernel, NAG,BLAS,Tensorflow,keras, Pytorch,
Scripts	IGCM (with GNU-GPL), FCM (for running climate models) Resource Specification Language (RSL) for Globus, shell scripts, Python and Perl,R
Others	Plotting (GrADs, Ferret, Saxo, IDL, Origin, Gnuplot, Matlab), MS-office, LaTeX etc.

Experience on HPC systems/Data base

- 14+ years on Unix/Linux systems, as user, porting different model and installation of software.
- 8+ years on different TFLOP Clusters
- 6+ HSM /TSM Tape archival storage
- 8+ Pratyush 4 Petaflop india's first supercomputer at IITM
- 8+ Aditya 790+ TFLOP HPC system at IITM
- 9+ years on 2nd ranked supercomputer in India (Prithvi) at IITM.
- 6 months experience in Garuda Grid at IITM.

Project Developmental Activities at IITM:

- **Seasonal prediction and experiments using fully coupled General Circulation Model:** The resolution of the CFSv2 model has been increased from original T126 spectral resolution (equivalent to about 110 km resolution) to T382 spectral resolution (equivalent to about 36 km horizontal resolution). Retrospective forecast (hindcast) experiments have been carried out using the coupled model CFSv2 with this higher spectral resolution of T382 for 30 years, using various initial conditions (of different months) with 6 ensembles (using 06, 12, 18 UTC data). After acquiring the new HPC,

model hindcast runs are completed with initial conditions from different months extending throughout the year.

- **Experimental dynamical seasonal prediction of 2015 South West monsoon season rainfall using high resolution CFSv2 model at IITM:** Dynamical seasonal prediction for 2015 Summer Monsoon rainfall was prepared using the latest high resolution (T382 spectral resolution) research version of CFSv2 and was provided to IMD.
 - Based on high resolution dynamical coupled model CFSv2 and using the February Initial condition, the experimental seasonal forecast suggested that rainfall during 2015 SW monsoon season (June to September) averaged over the country as a whole is likely to be $91\% \pm 5\%$ of long period model average (LPMA).
 - Based on high resolution dynamical coupled model CFSv2 and using the April Initial condition, the experimental seasonal forecast suggested that rainfall during 2015 SW monsoon season (June to September) averaged over the country as a whole is likely to be $88\% \pm 5\%$ of long period model average (LPMA).

These predictions were very close to the actually realised rainfall, *i.e.*, 86% of long period average (LPA) over the country during the summer monsoon season (June-September) of 2015.

- **Forecast Verification:** *The output of CFSv2 model forecast (using atmospheric initial conditions from NCMRWF and ocean initial conditions from INCOIS) is being verified against IMD observed data.*
- **Potential predictability of ISMR using CFS v2 Model simulations.** (*Journal of advanced in Modeling Earth System*, 2016)

The potential predictability of the Indian summer monsoon rainfall (ISMR), soil moisture, and sea surface temperature (SST) is explored in the latest version of the NCEP Climate Forecast System (CFSv2) retrospective forecast at five different lead times. The focus of this study is to find out the sensitivity of the potential predictability of the ISMR to the initial condition through analysis of variance technique (ANOVA), information-based measure, including relative entropy (RE), mutual information (MI), and classical perfect model correlation.

My Brief Work Experience

At IITM, I help scientist & research scholars in the development, porting and analyzing of different atmospheric, oceanic and coupled climate models. Few of the projects which I am involved are

1. Working on development of Machine learning algorithm using Convolution neural network(CNN), Tensorflow libraries for ENSO forecast .
To predict Nino3.4 based on the convolutional neural network (CNN). The code is structured through the python version of TensorFlow, Google's deep learning library tensorflow.
The parallel code is design for CPU as well as GPU. We are using CMIP5 data for 1861 to 2001 data for training CNN model and for validation data 1984 -2017 from GODAS. The CPU code is working on Aditya and Pratyush. The output files are .CKPT are generated. The test run is done and analysis is going on.
2. Writing parallel code for the climate systems, python programming and use of different machine learning libraries for earth system models.
3. To handle a large volume of data (more than 100+TB) of climate different type of tapes (archival) are used IBM TSM (Tivoli storage manager). We are using incremental backup for home directory of users on Prithvi and Aditya.
4. Worked potential predictability of ISMR, The data analysis and design of experiment is done by me on Aditya system. The Model data analysis using ferret and grads is done. The CFS model simulation on HPC system. Statistical analysis using ANOVA technique is done.
5. To enhance the performance of the model code profiling Vtune software is used. Various data management tools are used to store the data set.
6. In the NCEP GFS model, two microphysics schemes were used, one being the Zhou-Carr-Moorthi and the other being the Ferrier microphysics.
7. Running the CFS model and porting the model is different from the optimization and scalability.

Annexure – I

List of Publications (referred Journals)

Peer-Reviewed Research Publication: (International Research Papers: 21+)

1. Tirkey S., Mukhopadhyay P., Krishna R.P.M., Dhakate A., Salunke K.
Simulations of monsoon intraseasonal oscillation using Climate Forecast System Version 2: Insight for horizontal resolution and moist processes parameterization, Atmosphere, 10:429, July 2019, DOI:10.3390/atmos10080429, 1-20
2. Pillai P.A., Rao S.A., Das R.S., Salunke K., Dhakate A., Potential predictability and actual skill of Boreal Summer Tropical SST and Indian summer monsoon rainfall in CFSv2-T382: Role of initial SST and teleconnections, Climate Dynamics, 51, July 2018, DOI:10.1007/s00382-017-3936-y, 493-510
3. Malviya S., Mukhopadhyay P., Phani Murali Krishna, Dhakate A., Salunke K.
Mean and intra-seasonal variability simulated by NCEP Climate Forecast System model (version 2.0) during boreal winter: Impact of horizontal resolution, International Journal of Climatology, 38, June 2018, DOI: 10.1002/joc.5480, 3028-3043
4. Arora A., Rao Suryachandra A., Pillai P., Dhakate A., Salunke K., Srivastava A.
Assessment of prediction skill in equatorial Pacific Ocean in high resolution model of CFS Climate Dynamics, online, January 2018, DOI:10.1007/s00382-018-4084-8, 1-15
5. Pradhan M., Suryachandra A. Rao, Srivastava Ankur, Dakate A., Salunke K., Shameera K.S. Prediction of Indian Summer-Monsoon Onset Variability: A Season in Advance , Scientific Reports, 7:14229, October 2017, DOI:10.1038/s41598-017-12594-y, 1-14
6. Pillai P.A., Rao S.A., Das R.S., Salunke K., Dhakate A. Potential predictability and actual skill of Boreal Summer Tropical SST and Indian summer monsoon rainfall in CFSv2-T382: Role of initial SST and teleconnections Climate Dynamics, online, October 2017, DOI:10.1007/s00382-017-3936-y, 1-18
7. Goswami T., Suryachandra A. Rao, Hazra A., Chaudhari H.S., Dhakate A., Salunke K., Mahapatra S. Assessment of simulation of radiation in NCEP Climate Forecasting System (CFS V2) Atmospheric Research, 193, September 2017, DOI:10.1016/j.atmosres.2017.04.013, 94-106
8. Pillai P.A., Rao S.A., George G., Rao D.N., Mahapatra S., Rajeevan M., Dhakate A., Salunke K. How distinct are the two flavors of El Niño in retrospective forecasts of Climate Forecast System version 2 (CFSv2)? Climate Dynamics, online, June 2017, DOI:10.1007/s00382, 1-26-016-3305-2, 1-26
9. Chattopadhyay R., Suryachandra A. Rao, Sabeerali C.T., George G., Rao Nagarjuna D., Dhakate A., Salunke K., Large-scale teleconnection patterns of Indian summer monsoon as revealed by CFSv2 retrospective seasonal forecast runs, International

10. Abhik S., Mukhopadhyay P., Krishna R.P.M., Salunke K.D., Dhakate A.R., Suryachandra A. Rao , Diagnosis of boreal summer intraseasonal oscillation in high resolution NCEP climate forecast system, *Climate Dynamics*, 46, May 2016, DOI:10.1007/s00382-015-2769-9, 3287-3303
11. Pokhrel S., Saha Subodh K., Dhakate A., Rahman H., Chaudhari H.S., Salunke K., Hazra A., Sujith K., Sikka D.R., Seasonal prediction of Indian summer monsoon rainfall in NCEP CFSv2: forecast and predictability error, *Climate Dynamics*, 46, April 2016, DOI:10.1007/s00382-015-2703-1, 2305-2326
12. Ramu D. A., Sabeerali C. T., Chattopadhyay R., Rao D. N., George G., Dhakate A. R., Salunke K., Srivastava A., Suryachandra A. Rao Indian summer monsoon rainfall simulation and prediction skill in the CFSv2 coupled model: Impact of atmospheric horizontal resolution, *Journal of Geophysical Research*, 121, March 2016, DOI:10.1002/2015JD024629, 1-17
13. Saha, S. K., S. Pokhrel, Kiran Salunke, A. Dhakate, H. S. Chaudhari, H. Rahaman, K. Sujith, A. Hazra, D. R. Sikka (2016), Potential Predictability of Indian Summer Monsoon Rainfall in NCEP CFSv2, *Journal of Advances in Modeling Earth Systems*, 8, February 2016, DOI:10.1002/2015MS000542, 1-25
14. Chattopadhyay R., Phani R., Sabeerali C.T., Dhakate A.R., Salunke K.D., Mahapatra S., Suryachandra A. Rao, Goswami B.N Influence of extratropical sea-surface temperature on the Indian summer monsoon: an unexplored source of seasonal predictability *Quarterly Journal of Royal Meteorological Society*, 141, October 2015, DOI:10.1002/qj.2562, 2760-2775
15. Sabeerali C.T., Suryachandra A. Rao, Dhakate A.R., Salunke K., Goswami B.N., Why ensemble mean projection of south asian monsoon rainfall by CMIP5 models is not reliable? *Climate Dynamics*, 45, July 2015, DOI:10.1007/s00382-014-2269-3, 161-174
16. Saha Subodh K., Pokhrel S., Chaudhari H.S., Dhakate A., Shewale S., Sabeerali C.T., Salunke K., Hazra A., Mahapatra S., Suryachandra A. Rao, Improved simulation of Indian summer monsoon in latest NCEP climate forecast system free run, *International Journal of Climatology*, 34, April 2014, DOI:10.1002/joc.3791, 1628–1641
17. Chaudhari H. S., S. Pokhrel, S. Saha, A. Dhakate, R. Yadav, Kiran Salunke, S. Mahapatra, C.T. Sabeerali, and S. A. Rao, 2012. Model biases in long coupled runs of NCEP CFS in the context of Indian Summer Monsoon, *International Journal of Climatology*. April 2013 DOI-10.1002/joc.3489.
18. Anupam Hazra S. Taraphdar , Madhuparna Halder, P. Mukhopadhyay, H. S. Chaudhari, S. Pokhrel, Kiran Salunke, S. A. Rao, and J.–P. Chen Indian summer monsoon drought 2009: cloud microphysics perspectives *Atmospheric Science Letter*. July 2013, DOI: 10.1002/asl2.437, 181-186

19. C. T. Sabeerali, A. Ramu Dandi, Ashish Dhakate, Kiran Salunke, S. Mahapatra, Suryachandra A. Rao. Simulation of boreal summer intraseasonal oscillations in the latest CMIP5 coupled GCMs. *Journal of Geophysical Research: Atmospheres* published online: 29 MAY 2013 DOI: 10.1002/jgrd.50403
20. Pokhrel S., H. S. Chaudhari, A. Dhakate, S. Saha, R. Yadav, Kiran Salunke, S. Mahapatra, and S. A. Rao. ENSO, IOD and Indian Summer Monsoon in NCEP climate forecast system; *Climate Dynamics*, Nov 2012, DOI- 10.1007/s00382-012-1349-5.
21. Mujumdar M., Kiran Salunke, S.A. Rao, M. Ravichandran and B.N. Goswami, 2011. Diurnal cycle induced amplification of sea surface temperature Intraseasonal oscillations over the Bay of Bengal in summer monsoon season in *IEEE Geoscienc and Remote Sensing Letters*. March 2011, DOI-10.1109/LGRS.2010.2060183