



WCSSP India

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Predicting Natural Hazards



Developing the science needed to build improved risk based **weather**, **sub-seasonal & seasonal forecast** services to predict hazards and support-resilient economic development and social welfare

Extreme Rain & Floods



Orographic Rain - Landslides



Tropical Cyclones



Fog (Air Quality)



Heatwave, Drought, Coldwave



Thunderstorms & Lightning



Storm Surge



Agriculture

Energy

Transport

Disaster Risk Management

Water Resources

Fisheries







New Prediction Capabilities



Evaluating & Improving predictions



- Convective scale coupled environmental prediction
- Coupled Ensembles & Data Assimilation
- City Scale Modelling

- Coupled Model Evaluation
- Atmos-Ocean-Land Processes
- Exploiting Satellite Obs.
- Fog
- Lightning

Translation to services:

risk-based forecasting & high impact weather & seasonal events

- High-impact weather
- Multi-hazard warnings
- Impact-based forecasting
- Extended-range outlooks
- Decision-making tools





Growing Research Partnership





Indian Meteorological Department (IMD)

DGM: Dr. M. Mohapatra



Indian Institute of Tropical Meteorology (IITM)

Dir: Prof. R.V. Nanjundiah



National Centre for Medium Range Weather Forecasting Dir: Dr. E.N. Rajagopal



Indian National
Centre for Ocean
Information Services
Dir: Dr. S.S.C. Chenoi



National Centre for Coastal Research Dir: Dr. M.V. Ramana Murthy



National Centre for Polar &Oceans Research (NCPOR)

Dr. M. Ravichandran

























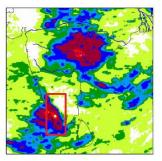
Kerala Flood Predictions: Aug 2018 Newton-Bhabha



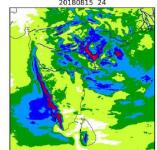


10km Global Operational

OBSERVATIONS



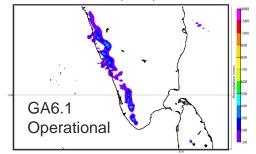
Global UM NWP forecast

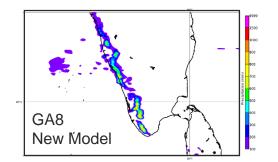


Evaluating New Models

Global Oper. vs. Research Model

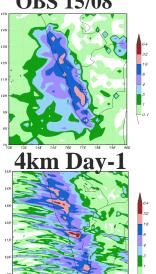
14/08 0-24h precip total

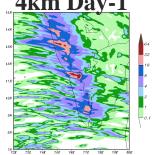




Km-scale **Convection Permitting**











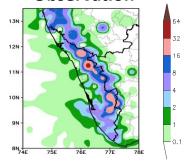






Aug 2018 Kerala Heavy Rainfall

Observation

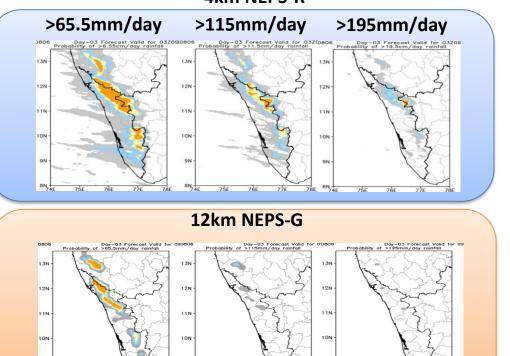


Rainfall Intensity, Location, Timing:- There is room for improvement with **Regional Coupled Model**

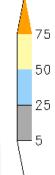
Ensembles - Probabilistic Quantitative Precipitation Day-3 valid for 03Z09AUG2018



4km NEPS-R



IC:06Aug2018 00UTC







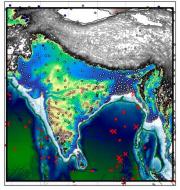
New Convective scale coupled environmental prediction model for India

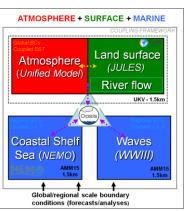


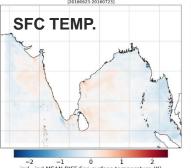
- Developing kilometre-scale atmosphere:land:ocean:wave regional coupled system to improve simulation of feedback processes.
- Established a common domain across ocean and atmosphere interests as collaboration across WCSSP India partnership.

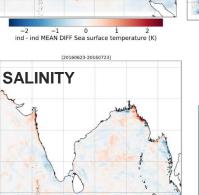
Focus for coming year:

- Case studies (e.g. Cyclones)
- Use of research campaign observations
- Addition of interactive wave component
- UK project on coupled evaluation

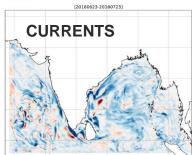








ind - ind MEAN DIFF Sea surface salinity (psu)



ind - ind MEAN DIFF Current speed (m/s

COUPLED OCEAN ONLY

Example sensitivity of ocean simulations to model coupling:

1 month runs, July 2016

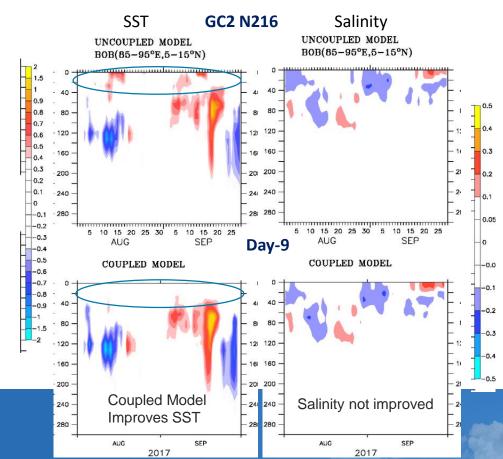












Coupled Processes in Bay of Bengal

Future Research

- High Resolution Regional Coupling beneficial?
- Coupled Data Assimilation, where Atmosphere, Land, Ocean are dealt in consistent way
- New Ocean Mixing scheme in BoB?

MoES OMM Project

Fresh water and stratification in BoB play important role in Mixed Layer. Sub-mesoscale instabilities, turbulence and mixing processes in the surface layer is important.











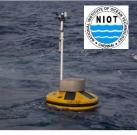








Observations are key to evaluate physical processes in models & for data assimilation













Field Experiments

Research Aircraft

Satellites

Ocean Observations In-Situ Land & Atmosphere





Sub km scale (300m) modelling



28.65

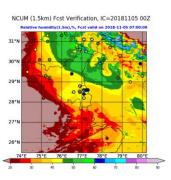
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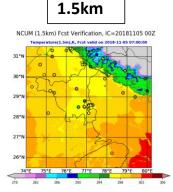


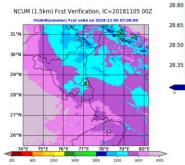


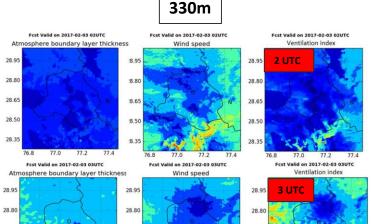
Daily verification of visibility forecasts by NCUM (1.5km and 330m resolutions) against AWS observations (coloured circles) for Northern-India.

Ventilation index will provide a better real-time prediction of the spatial and temporal variability of the pollution dispersal capability of the local atmosphere over Delhi domain.











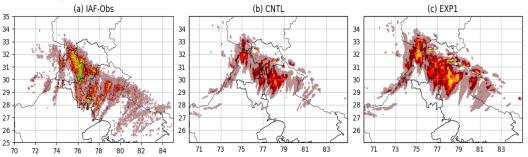


New Lightning Hazard in Regional 4km Model

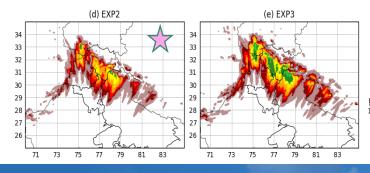


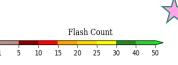


Sensitivity experiments, verification against earth network lightning sensors data, EXP2 is chosen for the operational implementation of the lightning flash prediction system.



Parameter/Experiment name	CNTL	EXP1	EXP2	EXP3
GWP threshold (g m ⁻³)	200	100	200	100
lsr2graup	False	False	True	True





Accumulated lightning flash count from IAF observation and day-1 forecasts of total lightning flashes predicted for 07th February 2019.

GWP threshold is set to 200 g m⁻³ and snow-rain collisions allowed to form graupel, the counts are improved by approximately 50% compared to the control run.





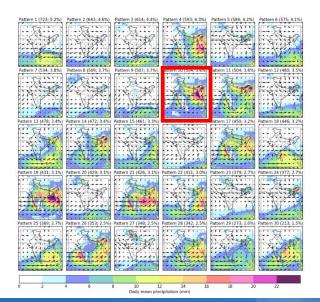




Indian weather pattern research

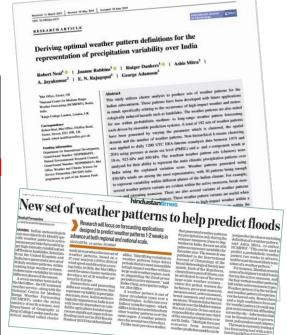


New objectively derived daily weather patterns for India linking circulation to specific weather hazards



Applied to a trial **probabilistic weather pattern forecasting tool** -> feed into impacts & decision making models











Translating forecasts for improved decision-making



- Scope out methods for effective translation and communication of impact-based forecasting information to different users
- Assess the effectiveness of impact-based information to improve decision-making
- Impact based forecasting workshop in Pune – Nov 2019
- 3 UK research projects (IND5,6,7) starting Sep 2019.

"Hazard Manager" web service for responders + separate public website





Public TV/radio broadcasts



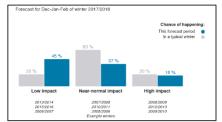
Social media





Changes in language of warnings?

Communicating long-range or seasonal impact-based forecasts



Three categories of impact strength
Plot courtesy of Erika Palin and Emily Vanvyve,
Met Office

Email to responders / affected members of the public (E.g. UK flood alerts)

















Summary

Huge opportunities for collaborative research between UK and India on Monsoon Hazards – pooling our joint expertise to accelerate progress in Monsoon predictions across weather, sub-seasonal and seasonal timescales to improve decision making.

Initial Focus is on:

- Coupled modelling (Atmosphere-Oceans-Land) at a variety of space & time scales from hours to a season
- Use of key **process based observations** of whole environment (atmosphere, land, ocean) to improve models and initialise forecasts (data assimilation).
- Ensemble forecasting feeding into.....
-New risk based forecasting techniques to exploit model predictions and provide translation of timely and accurate advice to weather & climate services

















