In this issue

Atmospheric and oceanic sciences

Operational predictions of ocean parameters are on demand as our dependence on the oceans is on the rise for a variety of purposes. With more than one fourth of its population living along the coastlines, engaged in a wide range of maritime activities including traditional fishing and high-tech off-shore industries, as well as growing interests in exploring far away oceans for natural resources, India is one of the leading countries in the world who needs an exclusive operational ocean prediction system. Keeping this in mind, the Indian National Centre for Ocean Information Services, the nodal agency under the Ministry of Earth Sciences to provide oceanographic services to the country, has recently set-up an operational ocean prediction system called the Indian Ocean Forecast System (INDOFOS). The INDOFOS, which is based on the state-of-the-art ocean general circulation model, provides 6-hourly forecasts of sea surface temperature, surface currents and depth of the mixed layer and the thermocline up to 5 days in advance. Francis *et al.* (**page 1354**) give a brief account of the INDOFOS setup and provide a critical evaluation of its forecasts using data from *in situ* and remote sensing platforms. They show that there is scope for improvement in the forecasts, particularly in the coastal waters, which are far more important than predictions for the open ocean. They also draw a road map to improve the services in future.

In numerical weather/climate prediction there were artificial compartments for different scales of interest within the range up to a season. Due to availability of high performance computers and a need for realistic model development, in recent years model developers interested in weather and short-term climate scale phenomena have come together to develop the new-generation unified earth-system models which will cater to the scales of interest from days to a season in a seamless manner. Mitra *et al.* (**page 1369**) present a review on recent developments at major centres in this direction and especially the issue of monsoon forecasting from days to season is discussed. Potentially these new generation unified models can produce improved monsoon forecasts across scales. The current skill of monsoon rainfall forecast from unified model is reported and possible improvement by realistic representation of monsoon variability is discussed. The technical details of the unified model as implemented at National Centre for Medium Range Weather Forecasting under the Ministry of Earth Sciences are also discussed. Potential future skill improvement in monsoon forecast with the coupled unified model by joint research and development work with UKMO is also discussed.

Despite several decades of development, the rainfall during the summer monsoon (June–September) and particularly its extremes (droughts and excess rainfall seasons) continue to have a major impact on the economy of our country and the well-being of the people, flora and fauna. Recently a mission has been launched by the Ministry of Earth Sciences to improve prediction of the Indian summer monsoon rainfall and its variation on smaller spatio-temporal scales. A major thrust is on the improvement of the skill of monsoon prediction with dynamic models of the coupled atmosphere–ocean system. An important step in achieving this, is a systematic analysis of the skill of the different state-of-the-art models (including CFS2, the one chosen for the mission), identification of the reasons for the success and failure in monsoon prediction and hence the milestones for improvement of skill. The results of such an exercise focussed on prediction of extremes are reported in the paper by Nanjundiah *et al.* (**page 1380**). An unexpected result of the analysis of the retrospective predictions by seven coupled ocean–atmosphere models from major forecasting centres of Europe and USA, is a remarkable coherence between the models in successes and failures of the predictions, with all the models generating loud false alarms for the normal monsoon season of 1997 and the excess monsoon season of 1983. The skill of all the models improves markedly if these models are removed from reckoning. One of the major reasons for the poor skill in these seasons has been unravelled as the inability of most models (including CFS2) to simulate the link of monsoon variability with the Equatorial Indian Ocean Oscillation.

Sahai *et al.* (**page 1394**) compare the role of air–sea coupling in the simulation and real time prediction skill of Indian summer monsoon rainfall associated with monsoon intraseasonal oscillations (MISOs) using the state-of-earth climate forecast system model version 2 (CFSv2) vis-à-vis its atmospheric component GFSv2. Performing two types of free long runs, Sahai *et al.* assess the simulation of MISO: (a) CFSv2 coupled run and (b) GFSv2 run forced with bias corrected CFSv2 simulated daily SST. Though the CFSv2 free-run analysis shows dry bias over Indian land in simulating rainfall compared to GFSv2, the interactive air–sea coupling in CFSv2 has considerably improved the simulation of large scale dynamical fields, SST–rainfall relationship and the northward propagation of the MISOs with respect to GFSv2. These results advocate the crucial role of coupled ocean–atmospheric evolution and the interactive SST for improved simulation of MISOs, which has been already reported in the earlier version of CFS and in various other coupled models. In order to see whether these improvements are translated into better extended range prediction, we have compared the real-time prediction of Indian summer monsoon for these two models. It is found that the improvement of MISO simulation in CFSv2 over GFSv2 has not necessarily guaranteed the improvement of the real-time extended range prediction during 2011 and 2012 monsoon season. Though the phases of large scale MISOs are better predicted in GFSv2, amplitude prediction skill during 2011 and 2012 is slightly improved in CFSv2.

Future projections of changes in climate and extremes are critical for assessing potential impact of climate change on human and natural systems, especially for agro-economic countries such as India. But the large inter-model difference in the simulation of Indian summer monsoon by the current global general circulation models (GCMs) and their low skill in simulating the present-day Indian summer monsoon variability are the major detrimental factors. Analysing GCM simulations at different resolutions, Rajendran *et al*. (**page 1409**) show that the highest resolution model (at ~20 km) has marked skill in capturing regional characteristics of climatological summer monsoon rainfall over India and its frequency distribution and mean annual variation of rainfall over major homogeneous regions of India. High resolution is also found to be crucial for achieving useful future projections of Indian monsoon and extremes. Future projections by time-slice simulations of this model under global warming scenario, show widespread but spatially varying increase in rainfall over the interior regions of peninsular, west central, central northeast and northeast India (~5–20% mean) and significant reduction in orographic rainfall (that is consistent with the recent observed trends) over the west coast (~10–15% of the mean). Further, the model projects spatially heterogeneous increase in warm days and extreme hot events (highest decile) over India. Projected changes in extreme rainfall events (above 95 percentile) during monsoon season suggest intensification of extreme rainfall over most parts of India by the end of the century with an opposite change over the west coast.

Indian soils: historical perspective and recent advances

The agricultural sector in India continues to occupy the centre-stage of the country's overall economic growth and development and the role of agriculture including crops, animal husbandry, dairying and fisheries in generating broad-based economic growth is evident from the fact that this sector contributes to nearly 1/3rd of the GDP. Despite exploitation over the past 40 or 50 centuries, soils in our country remained productive and now need to sustain 1.25 billion people in days to come. Knowledge about the kind of soils and the extent of their occurrence is of importance, more than ever before, for experts who are involved in planning optimum use of this resource for maximizing production to meet the ever-increasing needs of this millennium and thereafter. The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) under the Indian Council of Agricultural Research has developed the soil database over years. This includes detailed soil information consisting of its morphological, physical, chemical, mineralogical and taxonomic characteristics at the level of various zones and states at different scales. Basic and fundamental research carried out by NBSS&LUP helps to find out the link between the past and present climate during the Holocene period and to detail the genesis of soils for their appropriate use and management. Bhattacharyya *et al.* (**page 1308**) review the past accomplishments, travels through the recent trends in soil research and flags future demand and concern for appropriate soil and land management.