Prototype of Real Time Weather System at C-DAC

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Introduction: The complexity in the observed hazardous weather such as flash flooding due to mesoscale cyclones, evolution of tropical cyclones and urban pollution require high-resolution model simulations. This in turn leads to increase in the complexity in the formulation of the atmospheric models and data assimilation systems. The study of mesoscale convective systems, evolution of deep convection in maritime atmosphere, need temporal integration of atmospheric models for longer durations with finer temporal resolutions. To forecast real time weather at mesoscale resolution require sophisticated end to end computational workflow and forecast dissemination system.

Real Time Weather System: Real Time Weather System (RTWS) presented in this paper addresses the demands of research and operational scientists through a fully automated, flexible, portable; standalone/ web based service-oriented architecture capable of predicting weather events and assisting in research. The computational workflow endorses plug-in-play type of system portable on any Unix flavored platforms. The automated workflow is designed with the objective of providing a real time weather forecasting environment facilitating the user with data handling, data query, data analysis, perform need based modeling, model output post-processing, model output statistics and data visualization services through a Graphical User Interface (API) / Web Interface. The user can select combination of General Circulation Models (GCM), the regional model, platform to execute the models, data format types and visualization software. The multi layer web service architecture provides the user access to Meta data catalog system and query system for meteorological data and parameters. In this case study, based on the software architecture as described in Fig (1) and (2), computational workflow is developed using NCEP GCM (T170 / T254) and WRF model using C-DAC's supercomputer PARAM PADMA. The table 1 describe model configuration and initialization.

Daily 72 hrs NWP Forecast Products:

- Surface: Precipitation Rate(mm hr^{-1}), Daily Precipitation at 0300 UTC (mm day^{-1}), Sea level Pressure (Pa);
- Upper air
  at Surface, 1000, 0850, 0700, 0500, 0300 and 0200 hPa: Pressure Level Height (m), Dry Bulb Temperature (^oC), Dew Point Depression (^oC), Potential Temperature (^oC), Horizontal Winds (Kts), Vertical Velocity of Wind (meter s^{-1}), Vorticity (s^{-1}), Relative Humidity (%)
  at 0500, 0300, 0200hPa: Upper tropospheric Divergence (s^{-1})

Further Improvements and Developments:

- Incorporation of
  global model: Community Atmosphere Model, Portable Unified Model
  regional atmospheric models: MM5, RAMS, Eta, RSM
- Tailor made approach in model simulations and data visualization for different categories of user communities such as aviation community, agricultural community
- Grid computing for real time forecast, data grid and model coupling using application grid

Table 1: Present model Configuration and Initialization

Model Settings	**Specifications**
Domain	Indian Subcontinent, 40 E – 100 E / 10 S – 45 N; 278 X 255 X 42 grid
Resolution	24 km grid length, 42 vertical levels, 60 sec time step
Initialization and computation of lateral boundary conditions	3 hourly boundary conditions using NCEP GFS system forecast (00Z analysis) 3 hourly boundary conditions using T170 L 42 forecasts (70 km X 70 km) (18 Z NCEP operational analysis)
Objective Analysis	3D Var, FSL-RAOB data / can be made available using GTS data (irregular observations) (Assimilation cycle 6 hourly)
Physics Options Regional Model: WRF version 2.1.1.1 (presently used)	Microphysics: Purdue Lin Scheme Cumulus Parameterization: Kain Fritsch (new, KF-eta) Surface Layer: Similarity (Janjic, 2002) Land Surface Model: Noah LSM Planetary Boundary Layer: Yonsei University Radiation: long wave: RRTM Radiation: short wave: Dudhia
Forecast Duration	72 hours, hourly output
Validation	NCAR FNL Analysis and actual observations

Fig. 1

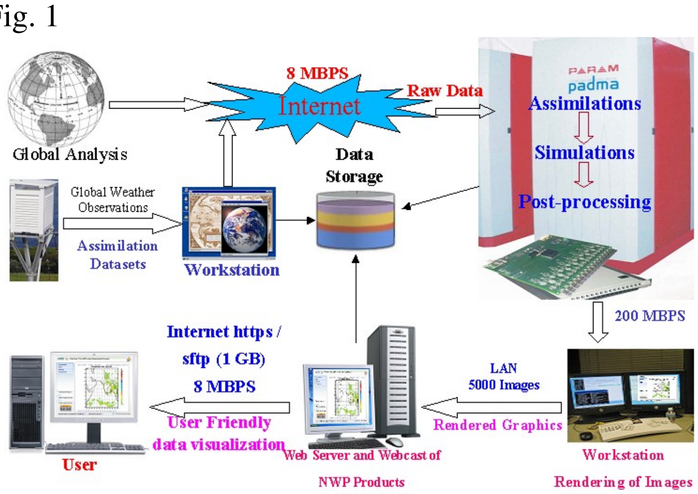

Fig. 2

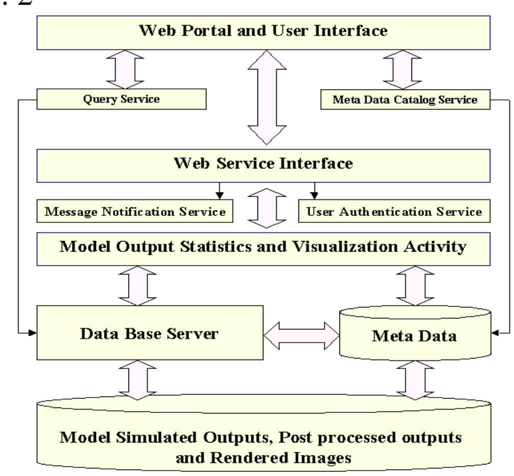

Fig. 3

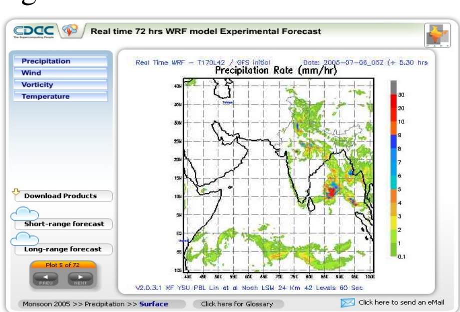

Fig 1: System architecture of RTWS

Fig 2: Web Service Architecture of RTWS

Fig 3:Screen shot of web portal prototype of RTWS using WRF