Use of Ground- and Space-based Visible Imagery with other Data for Model Evaluation and Assimilation

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Simulated visually realistic camera-like images of the sky can provide informative displays of 3-D model fields. Comparisons of simulated and actual camera images can help with model evaluation. The image simulation software can also act as a forward model for coupling cameras with visible/infrared (VIS/IR) satellite and radar data for improved sub-hourly and sub-km cloud analysis.

Thus based on Numerical Weather Prediction (NWP) analysis of model conditions and the quantitative use of 3-D radiative transfer, color images of the current or future weather and land surface conditions can be rendered from any vantage point in a visually realistic manner. A comparison of these simulated images with space-, air-, and ground-based camera images offers powerful tools for subjective NWP interpretation and objective evaluation of NWP performance.

The simulated and actual images and related observations (e.g. VIS/IR satellite, radar, METARs) can be used in a 3- and 4-D variational tomographic data assimilation scheme. Here the differences between the observed and simulated images offer valuable information for constraining the model hydrometeor, aerosol, land surface, and other fields. The tomographic analysis entails having multiple viewing angles from available satellites, radars, and cameras. This along with 3-D radiative transfer that includes multiple scattering allows us to look inside of both precipitating and non-precipitating clouds. Other physical, dynamical, and statistical constraints help to round out the analysis.

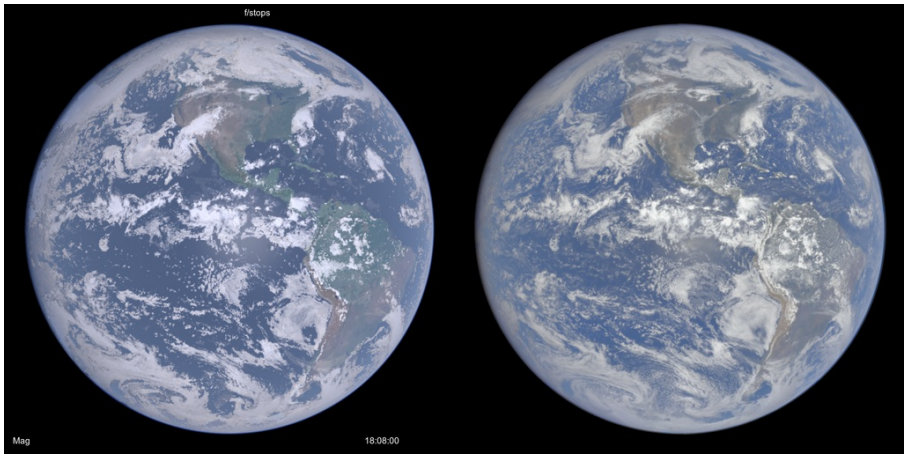

Figure 1. Comparison of simulated color image (left) with actual image taken by the Earth Polychromatic Imaging Camera (EPIC) aboard the Deep Space Climate Observatory (DSCOVR) satellite. Model fields (from Local Analysis and Prediction System [LAPS] analysis) of hydrometeors are used along with a default value for aerosols. Land surface data comes from the Next Generation Blue Marble imagery. The EPIC data are independent of the analyzed fields.

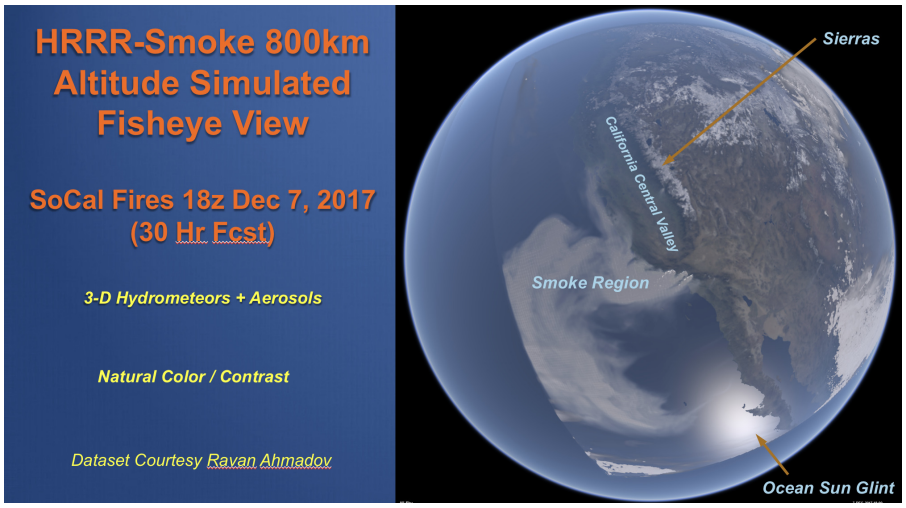

Figure 2. Simulated view from space of wildfires in California. Model fields are from the HRRR-Smoke developed at ESRL.