Advances in Radiative Transfer Modeling in Support of Satellite Data Assimilation

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The development of fast and accurate radiative transfer models for clear atmospheric conditions has enabled the direct assimilation of clear sky radiances from satellites in numerical weather prediction models. Currently, many fast models also handle the scattering and emission processes that dominate cloud and precipitation. Some analytic Jacobian schemes, crucial components for satellite data assimilation, have also been developed. For the operational data assimilation system, distinct features from each radiative transfer model may ultimately be combined in the more refined versions of the scattering radiative transfer by taking the advantages of speed and accuracy relative to benchmark solutions, storage efficiency for coefficients, inclusion of Jacobian, and potential developments for future instruments.

Major impediments in assimilating satellite radiances are several folds. Since scattering by precipitation and clouds is a function of particle size which is not currently predicted or diagnosed in most NWP models, there remain large uncertainties in computing cloudy radiances. The spatial inhomogeneity of clouds and precipitation demands complex, time consuming techniques such as three-dimension Monte Carlo modeling for computing scattering. Uncertainties in surface radiometric property modeling remain large in many geographical regions, particularly over desert and sea ice covered conditions. There are few comprehensive data sets for fully assessing the accuracies and performances of simulated radiances under these circumstances.

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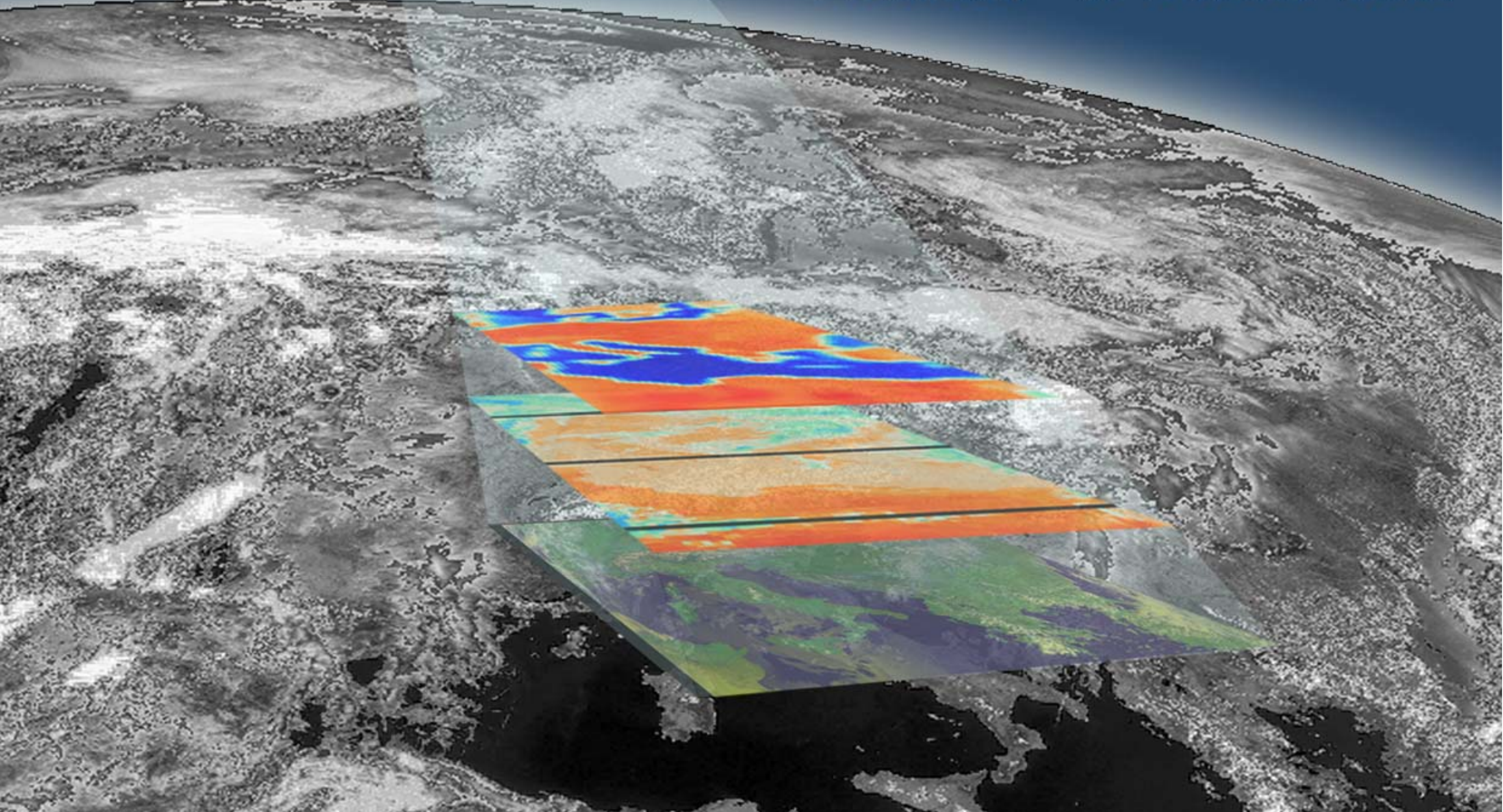

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