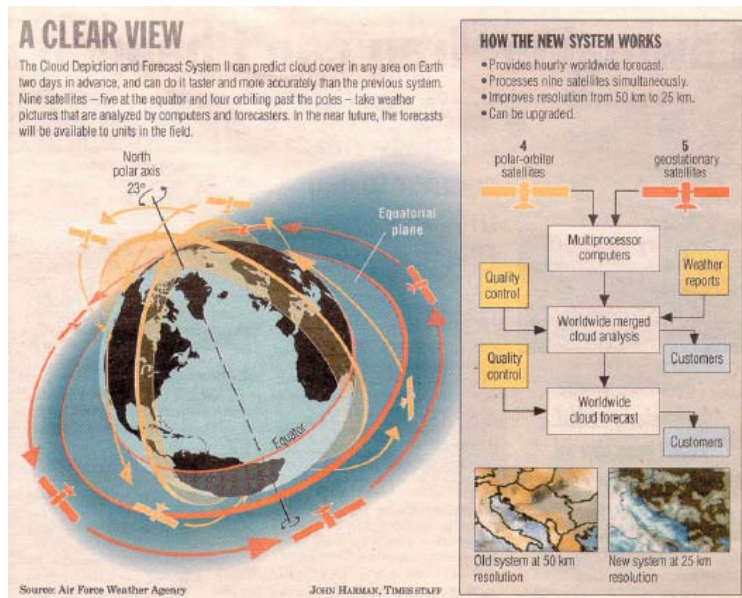


## An Object Database for Large-Scale Simulations: Better Performance and More Powerful Algorithms

### Using the Versant Enterprise Class OODBMS, The Cloud Depiction and Forecasting System II (CDFS II) System Delivers Precise Worldwide Cloud Forecasts

The Cloud Depiction and Forecast System – Version II (CDFS II) provides near real-time global cloud analysis and forecasting. Operated by the Air Force Weather Agency (AFWA), CDFS II uses highly advanced algorithms and operational infrastructure to collect and analyze the sensor data from three classes of military and civilian meteorological satellites. A total of nine satellites feed data to CDFS II. In addition CDFS II uses a feed of weather forecasts from the Air Force Global Theater Weather Analysis and Prediction System. The system produces forecasts 12 hours into the future for the entire globe each hour and a sixty-hour forecast every six hours. Clouds impact operations, intelligence, surveillance and reconnaissance platforms and sensors, so accurate spatial and temporal resolution is necessary for military operations. CDFS II is the only operational cloud forecast system in the world to date. In addition to consumption by the Air Force, the cloud

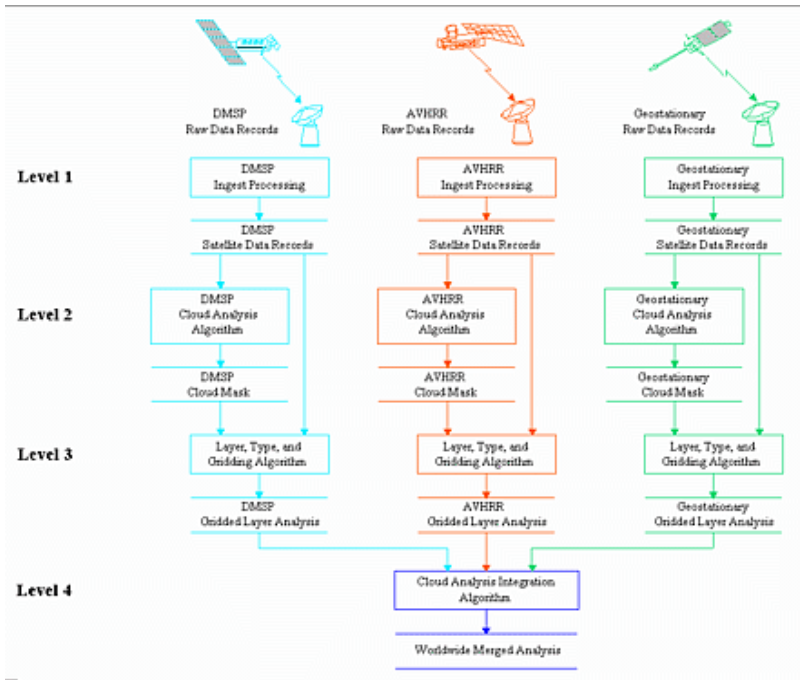
**CDFS II is the only operational cloud forecast system in the world.**



Simplified System Overview

forecasts are used by other military and civilian agencies such as the Navy Fleet Numerical Meteorology and Oceanography center and the National Oceanic and Atmospheric Administration (NOAA).

### A Complex Physical and Computing System



The system architecture is shown in more detail above. The three vertical stacks are the aggregation and processing for each satellite feed. The single block at the bottom is the integration and forecasting system. The feed from external meteorological system and the feeds to downstream consumers are not shown. The system uses multi-processor hardware with 18 CPUs on each of the three satellite feed processing channels and uses 14 CPUs in the integration and forecast stage.

### Processing of the Satellite Feeds

The satellite feeds are processed as appropriate for each satellite type by the highly complex SERCAA algorithm. The algorithm itself is a

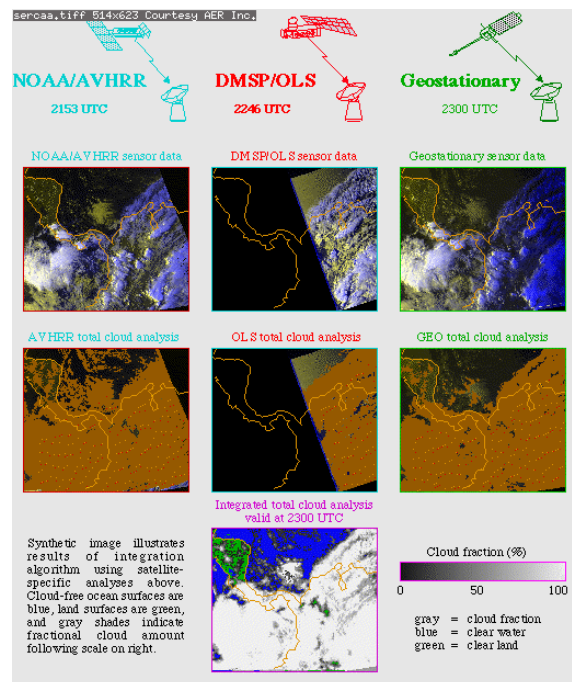
100 page document, not including any atmospheric physics. This algorithm converts sensor data, consisting of reflected light measurements at various wavelengths into estimates of clouds of nine types. Time adds another dimension, because the polar orbit satellites image a very limited portion of the earth's surface at any one moment.

### Cloud Forecasts

Integrating the cloud estimate from the three channels is very complex. The CDFS II system receives meteorological forecasts from the Air Force Global Theater Weather Analysis and Prediction System. The CDFS II uses its cloud analysis and this meteorological forecast to forecast clouds. The cloud forecast is itself a simulation that requires a very complex model.

### Complex C++ Models

The most effective way to program these complex algorithms is to use object-oriented programming

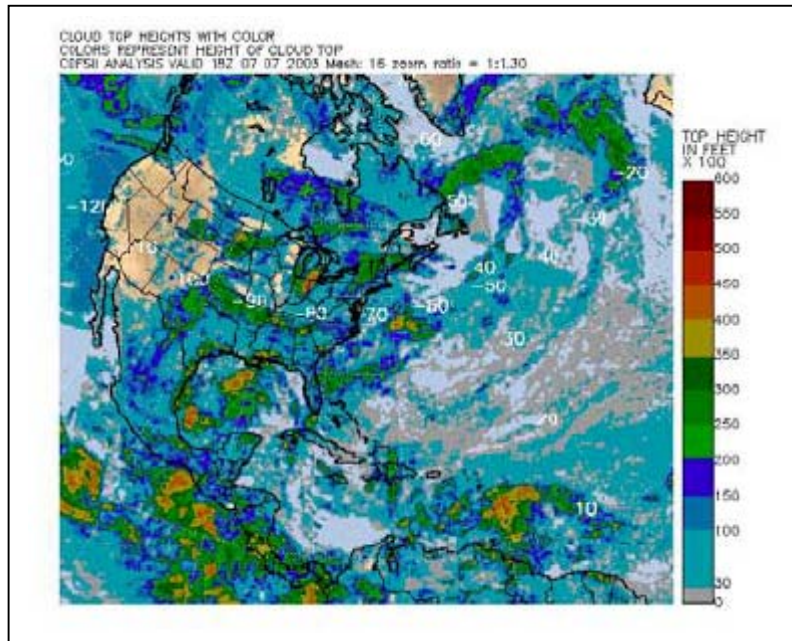


techniques. Object-oriented techniques result in faster development time, lower development cost, and greater ability to change to accommodate new requirements.

### Object Database Benefits

Data enclosed in classes developed in C++ are saved and retrieved with high performance. There is no additional code required for mapping to a relational database or specialized code to store and retrieve data in a special purpose database or on the OS-native file system. Using the Versant ODBMS, the in memory object model represents the database model one to one without any intermediate data definition language or runtime translation layer. Objects and their related subgraphs can be retrieved without the need for repetitive queries to the database server as a natural part of the message send processing of the C++ language. As a result, the number of server specific queries is significantly reduced and correspondingly indexes required for server specific queries are substantially reduced. The result of eliminating the over abundance of index structures and the elimination of the mapping layer is incredibly high data ingestion rates. Further, as the object models become increasingly complex, orders of magnitude improvement in information retrieval are achieved. All of the above benefits are achieved

while still allowing the server-side indexed retrieval of information bound dynamically at runtime through adhoc queries. In addition, Versant based applications can transparently manage object distribution across several



physical database servers as if they are one logical database. This allows advanced architectural implementations with virtually no additional coding by the application developer. In comparison to the performance of relational databases, the Versant object database offers increasing advantage as the complexity of the

object models increases. For moderately complex objects, the performance advantage is 2X. For highly complex object models, we have seen a performance advantage above 20X. The code required to map objects into relational databases is often 30% to 40% of the total project effort, so this code is eliminated.

### Benefits to CDFS-II

The previous system could only create a 48 hour forecast every 6 hours and a nine-hour forecast on request. The old system had a resolution of 29 miles, while the CDFS II system has a resolution of 14.5 miles, twice the precision and 4 times the data of the previous system. In addition, the new system uses C++ and object-oriented development methods which enabled faster development time, lower project cost, and better ability to accommodate

# VERSANT CASE STUDY

changes in the weather satellites and new meteorological models. New satellites with improved capabilities and new meteorological models are planned for the near future.

## **Evaluate the Versant Object Database**

The Versant object database can boost performance and cut development and hardware costs for complex simulation applications. Contact your Versant sales representative, send email to [sales@versant.com](mailto:sales@versant.com), get data sheets or white papers, or download a free trial at [www.versant.com](http://www.versant.com).