Environmental Data Cube Support System: Product Generation

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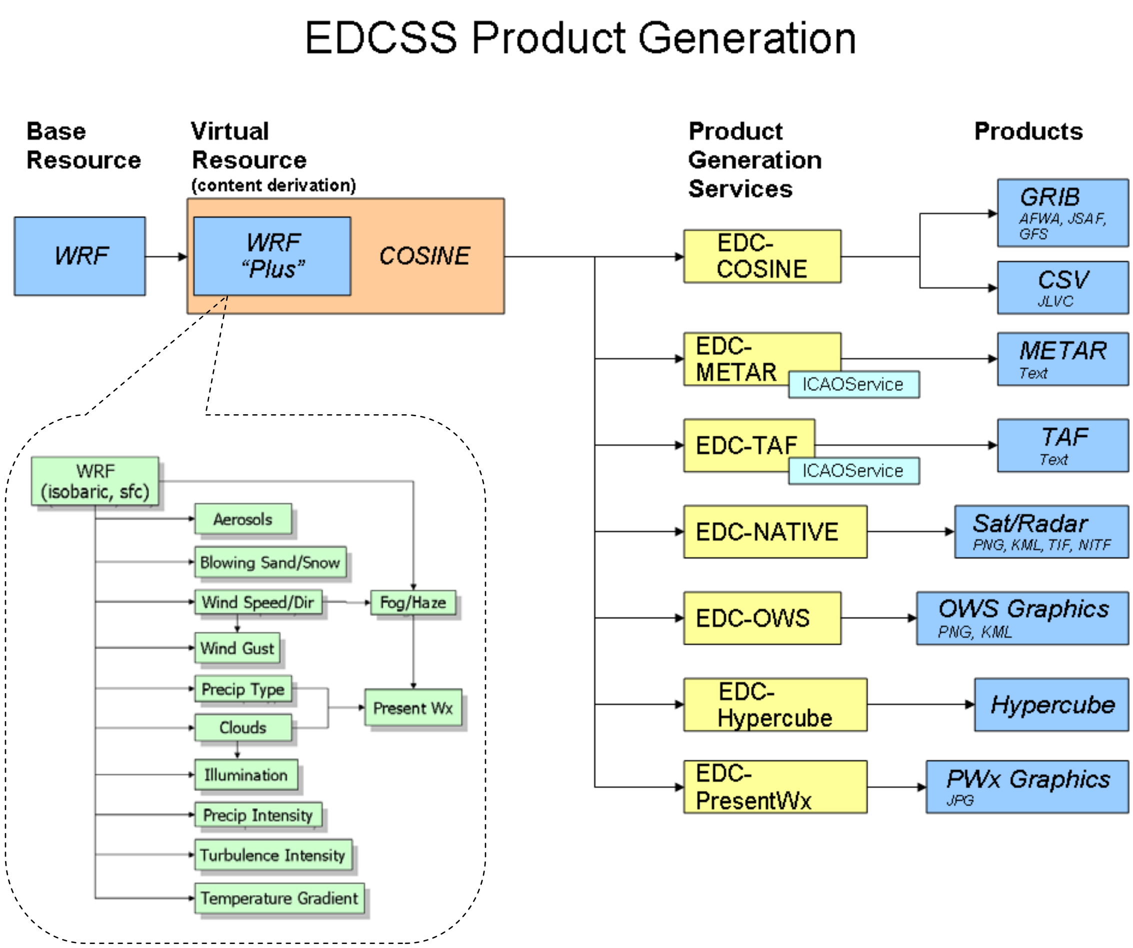
Overview

The Environmental Data Cube Support System (EDCSS) production services utilize the Common Open Services for Integrated Natural Environment (COSINE) for resource development and delivery. Base resources (such as WRF model output) are registered with COSINE, and "virtual resources" may be developed by applying any number of algorithms to derive additional parameters. EDCSS places orders against these virtual resources with specification of desired content, delivery format, and spatial and temporal extents. Subsequently, most EDCSS production services execute further steps to generate the end product from the delivered data. For example, given the required content delivered from COSINE, the EDC-TAF service applies logic to generate 30-hr TAF text messages. The figure below illustrates this process for a typical suite of EDCSS products and shows the COSINE algorithms utilized to obtain the required content from a WRF base resource. Each product generation service is further described below.



METAR

The EDC-METAR service begins by calling an ICAO lookup service to determine the station locations and codes within a given area of interest. These locations then comprise the spatial extent of a data order from the COSINE virtual resource, which utilizes algorithms to derive cloud fields (cloud cover, base, ceiling, thunderstorm coverage), precipitation type, and wind gust speed. Other required parameters (temperature, pressure, dew point, visibility, and wind fields) are carried through from the WRF base resource. The EDC-METAR service then encodes the resulting data into text METARs for each station.

TAF

EDC-TAF orders contain the same content as METARs but require 30 hours of forecast data. Similarly, first the ICAO service is used to determine TAF-reporting stations (military and/or civilian) within an area of interest. For the set of station locations, the EDC-TAF service orders forward 30 hours of content from the WRF virtual resource. The service casts this data as the forecast and applies logic to generate a text TAF message for each station. Because forward data is used as the forecast, the TAFs contain "perfect" forecasts, i.e., the data used to make the forecast is the valid-time data that is played in the future as an exercise progresses. Additionally, EDCSS produces BECMG statements at regular intervals, regardless if a significant change occurs in conditions. Future enhancements will report only if there is significant delta. Introducing error to the forecast is also being considered.

Satellite/Radar imagery

Simulated satellite and radar imagery are generated by the EDC-NATIVE production service. This service orders required inputs from the COSINE virtual resource, then launches a native executable against the delivered data. In the case of satellite imagery, the executable is a compiled C/C++ application, details of which are provided in the accompanying paper, "*Simulated Satellite Imagery Generation Process*." Radar imagery is produced in a similar manner and is based on hourly accumulated precipitation data ordered from the WRF base resource. Rain rate in millimeters per hour is converted to radar return in dBz following the National Weather Service relationship used for WSR-88D radars, then dBz values are mapped to a configurable color table. The EDC-NATIVE service packages the resulting images for project delivery.

OWS-style Graphics

To generate OWS-style graphics the EDC-OWS production service orders a set of parameter and level combinations from the COSINE virtual resource. Most parameters are carried straight from the base WRF resource (including geopotential height, relative humidity, temperature, wind components, and visibility), but cloud cover is derived from the COSINE cloud algorithm. Data is returned in GRIB format to the EDC-OWS service, which then executes GrADS scripts to generate graphics in either PNG or KML formats. A GrADS plug-in was developed to produce any GrADS graphic in KML format for display in Google Earth and Google Maps.

GRIB Data

GRIB data is produced via the EDC-COSINE production service, which is a simple data ordering service to package custom data sets per customer instructions. This service offers GRIB data in a number of "styles", including GFS, AFWA, and JSAF. Each style contains encoded attributes that mimic operational products. The JSAF style contains specific parameter and level combinations (atmosphere and ocean) required by the JSAF simulation. The AFWA style mimics an AFWA MM5 product. For any style, the parameter and level combinations may be easily defined or modified by an end user.

CSV Data

CSV data files contain any combination of METOC parameters in a simple comma-separated-value file format. Although any content may be delivered in CSV format, several forms of the product have been defined as EDCSS standard products. A JLVC-standard CSV file was defined in coordination with the JLVC Federation development team and consumers of these files include ASWIM, JCATS, and NWARS-NG. Other standard content lists have been coordinated with the A5XS and CAF-DMO programs.

Similar to GRIB production, CSV files are produced by the EDC-COSINE service which delivers requested content in CSV format to EDCSS. COSINE algorithms are applied to derive a number of fields, including: blowing sand and snow, cloud ceiling, fog, haze, thunderstorm coverage, precipitation type and intensity, temperature gradient, turbulence intensity, illumination, and a “present weather” code that encapsulates present conditions (JCATS represents this code as a weather icon at each cell). Additional parameters are carried through from the WRF resource with no derivation (temperature, pressure, relative humidity, visibility, and wind fields).

TAWS IR Hypercubes

An EDC-Hypercube production service has been developed that generalizes the production of Hypercubes for any physical effect. One such instance of this service has been developed to produce IR Sensor performance Hypercubes based on the use of the TAWS mission planning software. The required weather data is ordered from the COSINE virtual resource and delivered to EDCSS in the form of TAWS V3.4 or V6.1 weather input files. COSINE algorithms are used to derive aerosols, cloud fields (cloud cover, bases, and type), precipitation type, and the planetary boundary layer height. Other parameters are carried through from the base WRF resource. Given a Hypercube specification file (XML), the EDC-Hypercube service next executes TAWS for an array of targets, sensors, elevations, azimuths, and ranges at each grid point and time interval for the defined scenario. The Hypercube service then consolidates the resulting probability of detection values into an n-dimensional Hypercube, which is used by AWSIM during simulation runtime to effect target detection.

Present Weather Graphics

Present weather graphics illustrate present conditions at a set of user-defined locations (e.g., a list of cities). The present weather code is determined by COSINE algorithms given a number of inputs such as temperature, cloud cover, thunderstorm coverage, fog, haze, and precipitation type. Conditions are graphically represented as an icon (e.g., sun, clouds, rain, thunderstorm) and temperature at each specified location.

The EDC-PresentWeather product generation service orders the present weather code and temperature at a set of latitude/longitude points, then executes GrADS scripts to produce the graphics.