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# Weather On Target

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## LONG-TERM GOALS

The long term goal of this project is to develop tools for the automated analysis and nowcasting of conventional and remotely-sensed meteorological data, primarily for use at regional forecast centers, and aboard ship. In contrast to predicting weather out to several days (the purpose of numerical weather prediction, NWP), our purpose is to assess current weather conditions at scales below the grid spacing of conventional NWP. There is an emphasis here on the recognition and analysis of clouds, and determining their locations and heights using output from regional NWP models. Improved nowcasts of types and levels of cloudiness in the battlegroup area will provide an augmented capability for Navy operations, specifically, and for command and control, in general.

## OBJECTIVES

Our objective is to develop a method for determining biases in cloud base height forecasts from the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS). COAMPS is the Navy's regional model and features high resolution, nested grids, and nonhydrostatic vertical motion. Explicit prediction of cloud base height is the goal.

## APPROACH

Our approach is to apply knowledge discovery from databases (KDD) technology to COAMPS forecast fields. We intend to apply KDD to improve model output by discovering and correcting model biases. In contrast to model output statistics (MOS), the resulting procedure would involve only model output variables at the forecast time, and would not require local observations; this distinction is important for Navy applications where conventional surface observations may be unavailable.

## WORK COMPLETED

The COAMPS knowledge discovery project ties COAMPS model fields to cloud base observations along the California coastline. A data collection procedure has been developed, combining surface observations for the central/southern California coast with COAMPS model 12-hour-interval output. Preprocessing routines have been written to reduce and prepare the data for study, and to associate grid point data with observation data at each relevant site. Several available data mining technologies were selected, reviewed, and analyzed in terms of applicability to the data and problem. In addition, new software has been written to provide unique discovery abilities (Hadjimichael, 1996). An initial analysis has been performed with one commercial data mining package (Hadjimichael et al., 1998).

## RESULTS

Data collection proceeded through most of the year, combining surface observations for 15 coastal stations with corresponding COAMPS simulations. Preliminary knowledge discovery experiments with the data were completed and a seminar given on the method and results. There were several lessons learned during this initial stage, including the importance of the initial choice of parameters to be explored, and the importance of the relationship between observation location and model grid points.

## IMPACT/APPLICATIONS

Because cloud base height is, arguably, the key parameter affecting tactical air operations, success in determining COAMPS cloud height biases will be of vital use during any training exercise or conflict.

## TRANSITIONS

Results from this ONR seed project are being transitioned into a major four-year NRL base (6.2 ONR funding) New Start, which commences in FY99. The major changes to the emphasis of this work is the addition of satellite imagery and data as a full partner to the data from numerical weather prediction, and the assessment of other weather parameters, in addition to cloud base height.

## RELATED PROJECTS

This work is coordinated with "Core" 602435N funding (NRL base funding). That work, similar to the research here, emphasizes the use of artificial intelligence technologies, such as expert systems and computer vision, to automate the identification, interpretation, and prediction of weather parameters important to tactical operations. The work performed under both of these 6.2 efforts is further supported by PE 603207N (6.4) for implementation into an operational product (SPAWAR PMW-185). Other related research (also under PE 603207N), funded through Point Mugu, is supporting the development of an expert system (ExperDuct) for the prediction of electromagnetic ducting..

## REFERENCES

Hadjimichael, M., P. M. Tag and R. L. Bankert, 1998: Discovering model bias in the determination of cloud base height. Proceedings, First Conference on Artificial Intelligence, American Meteorological Society, 45 Beacon St., Boston, MA 02108, J5-J8.

Hadjimichael, M., 1996: Discovering fuzzy relationships from databases. Proceedings, CESA'96, Computational Engineering in Systems Applications, Invited Session on Data Mining and Rough Sets, Lille, France, 758-763.

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