



CARPE DIEM

Critical **A**ssessment of available **R**adar **P**recipitation **E**stimation techniques and
Development of **I**nnovative approaches for **E**nvironmental **M**anagement

Contract N° EVG1-CT-2001-00045

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EXECUTIVE SUMMARY

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<http://carpediem.ub.es>



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**EXECUTIVE PUBLISHABLE
SUMMARY, RELATED TO THE
OVERALL PROJECT DURATION**





Contract n°	EVG1-CT-2001-00045	Project duration:	Jan1 st , 2002 – Dec 31 st , 2004
Title	Critical Assessment of available Radar Precipitation Estimation techniques and Development of Innovative approaches for Environmental Management CARPE DIEM		

Objectives:

The key objectives of CARPE DIEM is to improve actual flood-forecasting capability through a better understanding of the processes and mechanisms that drive hydrogeological hazards.

The sensitivity of hydrological models to the errors, associated with the different input data sources, clearly reveals the need of state-of-the-art rainfall input values. To meet this goal we have worked on improving the performance of numerical prediction at short forecast times (i.e. from +6 to + 24 hours) and improving the real-time estimation of rainfall fields during severe weather events that are related to flooding and flash-flooding problems. We achieved this goal by coupling together multiparameter/polarimetric radar data and numerical weather prediction techniques (NWP). This represents the main area of innovation of the project. Another innovative aspect of the work is to exploit NWP results in order to improve the interpretation of radar observations. This exercise not only enables a general improvement in extracting information from radar but also allows the reduction of inherent radar errors, thus allowing to quality control radar measurements.

Scientific achievements:

Work was divided into three co-operative blocks.

In the first block a coordination workpackage is envisaged, where technical and financial coordination work was done.

The second block of activities is mainly devoted to research, with a definition of three areas.

Pre-processing and assimilation of radar measurements and their products in NWP is covered under **Area 1**.

- Dual-Doppler wind extraction software programmes have been developed and used in a assimilation exercise. In addition the methodology developed has been installed in the Po Valley area and it is used in the operational analysis routine.
- Innovative de-aliasing algorithm developed has been tested over a number of cases covering the different climatic area analyses.
- A VSRF system based on LAPS analysis system and a LAM have been implemented. The domain of analysis has been enlarged. Convective episodes have been analysed using satellite information and polarimetric radar data.
- Software modules to pre-process and assimilate Doppler radar data have been tested. First results of the assimilation experiment are available.

Area 2 addresses the improvement of radar-derived parameters using NWP information.

- The work on beam blockage has resulted in a journal publication. The beam blockage evaluation code has been installed and tested in different areas. The work and methodology on anaprop simulation has been successfully completed.
- A schema based on the shape of VPR measured close to the radars (2 - 40 km) and time-space interpolated freezing level height at radar sites has been now operationally implemented to classify VPR. A "climatology" description and analysis in a cold climate is done.
- The use of NWP data to diagnose OP has been tested, but it has proved to be not enough reliable to be used operationally.
- Quantitative polarimetric methods have been examined in terms of the relative advantage over conventional, reflectivity only precipitation estimates. The net outcome was that the polarimetric observables are too noisy in S-band, but might be better in C-band.
- The Entropy-Alpha decomposition, based on Pauli-matrices, has been tested to classify radar echos.

The main objectives of the **Area 3** are the development of procedures for combining radar and rain-gauge estimates of rainfall with numerical weather predictions (NWP) and the assessment of the quality of the predicted rainfall field in terms of discharge forecasts in urban and rural catchments.

- The work has identified rather complex spatio-temporal error characteristics in precipitation estimates from various sources, and thereby highlighted the importance of careful quality control when designing algorithms for combining estimates.
- The runoff modelling experiments clearly demonstrated the sensitivity of a hydrological model to precipitation errors. Especially the impact of the timing of the errors was revealed.
- The application of combined MW-IR satellite rainfall techniques have shown that problems arise when trying to keep the MW-IR histogram matching for a long time. Precipitating systems obviously modify very fast and matching is lost quite rapidly, especially in convective situations.
- The TOPKAPI model has been applied to the Dargle catchment in Ireland. The model can be applied, using existing topographical, soil and land-use data, without calibration and gives physically realistic outputs.
- Model performance can be improved by manually adjusting some of the parameters.



- The sensitivity analysis confirms the appropriateness of the simple manual calibration for matching flow peaks.

The end-users activities and project results dissemination form the third block.

Main deliverables:

- Dual Doppler software code (DARWIN);
- New dealiasing algorithm;
- Assimilation of radar Doppler data in NWP models.;
- Anomalous propagation modelling;
- Optimisation of VRP technique in a radar network;
- Assessment of precipitation estimates errors;
- Sensitivity studies on hydrological modelling.

Socio-economic relevance and policy implications:

The main objective of the CARPE DIEM project is to improve flood forecasts in small urban and rural catchments by means of improved rainfall estimation and prediction. This is an extremely important problem of which the socio-economical relevance is very high and its policy implications relate to the possibility of improving the decision process, during emergency situations, particularly in densely populated urban areas.

Natural End-users of CARPE DIEM outcomes are civil protection and ground defence agencies, as well as hydrological and weather services. Furthermore as the CARPE DIEM End-Users panel demonstrates improvements in rainfall detection, estimation and prediction will benefit a much wider audience, such as sewage management agencies, hydro-electric power industries and highway management agencies, e.g. for snow clearance etc.

Conclusions:

The project has reached all planned objectives. Advanced methodologies to increase the operational exploitation of radar information has been created. This will have a direct feedback in the quality and availability of rainfall estimation and prediction fields. Advancement in understanding of basic processes and mechanisms that drive hydrogeological hazards is a natural consequence of the work done. The forecasting quality assessment will be based upon end-user requirements that will be called to specifically suggest their needs and to verify the effectiveness of the results. The end-users community has been greatly involved within the project activities through the realisation of project workshops and a school.

Dissemination of results:

The whole CARPE DIEM results is available on the project web site <http://carpediem.ub.es>

End Users WorkshopS

The 1st Carpe Diem Project workshop was held in the Holiday Inn, Düsseldorf, Germany on the 26th, 27th and 28th May 2004. The entire day of the 27th and the morning of the 28th were devoted to interaction with end-users and were held jointly with the MUSIC project. The meeting venue and facilities were kindly hosted by Gematronic GmbH. Prof. J.C.I. Dooge chaired the discussions. There were three types of sessions (1) project members presentations to end-users, (2) end-users presentations to project members and (3) joint discussion.

The 2nd Carpe Diem Project workshop was held at the Unitas Conference Center, Helsinki, Finland on the 22nd and 23rd June 2004 and was jointly organised with the MUSIC and the Mantissa projects. There were five sessions (1) The European Context; (2) Observational Techniques; (3) Meteorological and Hydrological Modelling; (4) End-Users round table and (5) End-Users needs, applications and perspective. A total of 84 persons attended the meeting.

**International School on Hydro-geological Risk Prevention and Management - Session one
Rainfall estimation and forecast.**

As an important part of the final meeting a session of the “International School on Hydro-geological Risk Prevention and Management” was organised. The school lasted for an entire week with the participation of about 50 students.

Keywords:

radar meteorology, rainfall, data assimilation, weather forecasting, dual Doppler, polarisation, vertical reflectivity profile, hydrological modelling, flood forecasting.



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