1. Introduction

During the last years the customers’ requirements for meteorological products are increasing more rapidly. The Deutscher Wetterdienst (DWD) fulfills these requirements by producing many products tailored to the needs of the individual customers. To keep a high standard the DWD applies highly sophisticated automatic forecast techniques (data retrieval, numerical weather models, postprocessing). Many products are produced automatically and distributed to the customers directly.

Because automatic products are not yet sufficient to meet all demands, experienced forecasters are needed to improve the automatic products and to brief the customers. A core task is the preparation and monitoring of warnings for individual counties within Germany.

The DWD performs training in order to give the forecasters the ability to

- choose the best guidance,
- to interpret the guidance in the light of possible deficiencies during a particular weather situation and for special location,
- to perform nowcasting according to the forecaster’s experiences and to recent forecast techniques.

For that purpose intense and special training is necessary that is still relatively time consuming. Because the personal resources are more and more restricted, the training must be organized more effective by using self-learning modules. In order to reduce the length of the seminar as well as to keep the level of the content self-learning modules shall enable the participants to get a similar level of pre-knowledge. So the DWD can concentrate only upon the most relevant aspects during the seminar (e.g., by applying the workshop-method for training).

The training material tailored to the demands of modern training cannot be developed by each training centre separately. Therefore, the DWD is participating in different national and international projects.

In this article an overview about current training methods and plans for the future will be given.
2. Present training techniques at the DWD

The DWD’s Meteorological Training and Conference Centre (BTZ) in Langen is the main venue for training and seminars. The following equipment and facilities are available at the BTZ:

- 4 training rooms with PCs
- 2 lecture rooms with meteorological working places
- 10 rooms for meetings and training events
- 2 laboratories
- 1 observation platform
- 1 measurement field
- up to 125 guest rooms
- facilities for sports.

2.1 Training (Technical College)

For training of forecasters a co-operation between the DWD and the Military Service of Germany exists. Most of the time the training is performed at the BTZ, in smaller parts at Fuerstenfeldbruck (near Munich). By doing so, the staff of the DWD and the Military Service can be exchanged.

Till 1994 new meteorologists (Diploma / PHD) had been trained at the BTZ for two years in the beginning of their career. Because the DWD is more and more transferring forecasting activities from meteorologists to forecasters the training of meteorologist has been re-organised. Since 1995 only a short training in synoptics and on-the-job training is mandatory. Training in organisation and management, administration and law happens on demand. An important aspect of training is also the exchange of students with other services (e.g., ECMWF. EUMETSAT).

Forecasters (after Abitur) go through a training with a duration of three years (combined practical work and theoretical studies) according to WMO-No 258, Vol 1 and Supplement #1. 11 short tests, 6 written papers, an examination (oral, written and a thesis) are mandatory. For working as an aviation forecaster a license examination is also necessary.

During the first 6 months the forecasters are trained at the Federal Institute for Public Administration in Brühl in the subject matters administration, economics, legal fundamentals, social sciences, organisation of the DWD, statistics and the handling of MS software. After this basic studies the phase of main studies in Langen and Fürstenfeldbruck begins with general meteorology, mathematics, physics, climatology, IT and numerical models. The last phase concentrates on synoptic meteorology, aviation, geography, measurement techniques and instruments, forecast products and their practical use, English and several practical studies.

2.2 Advanced training

The seminars of advanced training are mainly for colleagues from the DWD and the Military Service of Germany. Sometimes participants are from Luxemburg, Austria, Switzerland and The Netherlands.

The following seminars are conducted at the BTZ:

- Software (MS Office, HTML, UNIX, LINUX, programming languages (e.g., JAVA)),
- Management (leadership, project management, time management, conflict management, alcohol at working places, economics, moderation, conversion techniques),
- Special advanced training for forecasters
  o Nowcasting: The learning objectives are tools for nowcasting (data sources, conceptual models, effective utilisation of this material during the shift). There is a separation to summer and winter seasons.
Numerical models: In that seminar the technique of numerical modelling and the physics are briefly explained. Verification results give hints to typical errors and deficiencies of the models. The participants learn how to work practically with the model products in respect to categories of typical weather situations.

Satellite meteorology: After an introduction to radiation physics and satellite techniques the interpretation of the satellite images and the practical application of satellite products are exercised. An excursion to the EUMETSAT headquarter is organised.

Radar meteorology: Based upon background knowledge about the physics of radar measurement and technical limitations the interpretation of radar images is explained and trained with case studies.

NinJo: The phase of intense training of NinJo is completed. Refreshing seminars and new developments will be trained according to the demand.

3. Future training at DWD

3.1 Training techniques

The NinJo-software offers excellent tools of modern diagnostic (e.g., detailed evaluation of a particular convective cell with satellite data, in combination of NWP-fields and observations). This new technology is incorporated into the seminars in respect to forecasting. This is a challenge for the trainers and for the students because the daily work of the forecasters will be in future in many parts different to the present.

Besides the utilisation of NinJo we will adapt the training process to future demands. The important aspect of repetition is already a part of training at the BTZ. The participants get CDs with the relevant material of each seminar. But there are still some needs for improvement. Self-learning modules shall make repetition more attractive. However, due to the more and more restricted resources it becomes difficult both to send forecasters to seminars of up to 5 days and to maintain the shifts. Self-learning modules shall also enable all participants to have a similar level of background knowledge prior to the seminar. So during the training we can concentrate on the most relevant aspects and the seminar length can be shortened accordingly.

In order to train recent developments effectively we will start with distant training next year. Tests with the software SII-Portal showed that even animations with about 1 image per second can be transferred almost simultaneously to other computers. That fulfils our requirements for training with the NinJo-software. The voice connection will be performed via “conference phone” connection.

Generally, the preparation of material tailored to the demands of modern training by each training centre separately with more and more restricted resources is no longer acceptable. Together with the DFS (German Air Control), we develop self-learning modules on weather encoding based on Macromedia FLASH software with ZincV2 extension. We foster co-operations with fora inside and outside Europe (e.g., BoM and COMET), which were established during the last CALMET-conference in Beijing). The DWD is involved in the following international projects:

a. EUMeTrain

This is an international project for the development of training material and training methods for satellite meteorology and will run until 2009. The main participants are from Austria (ZAMG, Chair), Croatia (DHMZ), Finland (FMI), Germany (DWD-BTZ, CM-SAF), Portugal (IM) and The Netherlands (KNMI). Users of EUMETSAT data are provided with training material for assisting them in a better use of satellite data. This training material is in form of case studies, interactive exercises, manuals and distant learning. So-called Mini courses are recently introduced into EUMeTrain. The students investigate a weather situation, prepare texts and answer questions. A close contact to the trainer ensures the learning success. June 2008, the first event week took place. With the software Centra for distant training advanced diagnostics techniques of satellite images and new forecast tools in different weather services were presented.

Additional information about EUMeTrain can be found on [http://www.zamg.ac.at/eumetrain/](http://www.zamg.ac.at/eumetrain/).
b. Eumetcal

Eumetcal has been established in 2001 in order to continue the work performed initially by EuroMET and is funded by EUMETNET and EUMETSAT. The aim of this project is to exchange and deliver online training material, create courses and to help on CAL techniques.

Most of the teaching material (presentations, texts, interactive learning modules) is accessible to any user on internet under the conditions that he accepts the Intellectual Property Rights.

One special tool of Eumetcal is the “IntraLibrary”. This is a database for trainers for sharing and exchanging material and knowledge within the EumetCal community. User name and password can be received from the national EumetCal representative.

The main purpose of Eumetcal are blended courses. These courses have three parts (introductory studies via distant learning, class room training and self-study in order to clarify final questions). Themed working groups are responsible for the course’s organisation and the teaching material.

More information can be found on www.eumetcal.org.

The BTZ is involved in three international seminars:

- **EUMETCAL blended course “NWP”:** This seminar is led by FMI (Vesa Nietosvaara). The class room part took place during November 2007 at the BTZ. It is planned to arrange further NWP-courses.
- **EUMETCAL blended course “Satellite meteorology”:** EUMETSAT co-ordinates this training seminar (José Prieto). The first course is planned for 2009.
- **EUMETCAL blended course “Radar Meteorology”:** This seminar chaired by the DWD (Wilfried Jacobs). This seminar will start in November 2008 and the class room part will take place beginning of February 2009. A comprehensive overview about this seminar as a poster is available (ERAD-conference, Karppanen et. al, 2008).

Additional information about the EUMETCAL blended courses (schedule, registration, etc) can be found on www.eumetcal.org/courses/.

### 3.2 Organisational aspects

Besides the development of new training techniques the DWD will adapt the organisation of the training process. Although all seminars are already evaluated by students, the DWD will improve the quality management by granting certificates for the seminars in respect to their content and learning success.

Parallel to the development of the CAL modules we have to consider the fields of application and the limitations. VisitView is useful for distant learning if presentations and conversation are planned. Because the data sets are relatively small VisitView is also applicable for the exchange of material by internet. The commercial software CAMTASIA can be used very well for demonstration videos with oral explanations in combinations with activities on a computer screen (e.g., working with a software). However, due to the relatively big data sets such videos are not suitable for up- and downloading from a library via internet. The software Centra that is used in EUMETCAL and EUMeTrain is more expensive because costs are related to the number of connections and their duration. Although it allows a very comfortable transfer of presentations, oral explanations and recording it is still too slow for all types of animations. All training with our NinJo-software would not be possible.

A further and very important point is the integration of CAL into training. One aspect is the reservation of enough time for working with the CAL-modules within the shifts for further training. Additionally, all students need an introduction how to work with that new technique. Finally, a learning platform is to be used that is user-friendly, e.g., clear and logical, easy to find the relevant seminar, links to other material, forum for discussions. First attempts have started with the learning platform MOODLE in international activities and ILIAS within the Fachhochschule. For a change, students now develop studies not only in paper form but also...
in oral form as so-called podcasts. We believe that instead of copying from one paper to another a podcast needs much more comprehensive scientific analysis of the learning matter.

4. Summary and conclusions

The Meteorological Training and Conference Centre of the DWD (BTZ) is the main venue for training equipped with many lecture rooms and modern infrastructure. Training at the Technical College and advanced training are performed. From 2009, the BTZ is involved in the EUMETCAL blended courses about NWP, satellite meteorology and will deliver the blended course about radar meteorology. NinJo is an excellent tool for the diagnosis of synoptic structures and will be the platform for many seminars.

In order to fulfil the important aspect of repetition all participants of the seminars get a printed script and a CD-ROM with all material (script, presentation, video). First attempts are going on to incorporate learning videos and CAL-modules.

However, more self-learning modules are necessary for making the repetition more attractive and due to the decreasing number of staff the training has to be re-organised during the next few years. Without reducing the length of training seminars it will become more difficult to achieve both a high level of training and maintenance of the shifts. Self-learning modules shall also enable the participants to achieve a similar level of pre-knowledge. So the DWD will be able to focus upon the most relevant aspects during the training seminars yielding a shortening of the seminars. In order to train new forecasting techniques more effectively we will introduce from 2009 onward distant training.

Because the BTZ is not able to prepare all material tailored to the demands of a modern training we participate in different national and international projects.

Besides the many positive aspects of CAL we should not ignore the following issues. Although we need English as the basis of cooperation during the development of learning modules we should be aware that not all students are able to understand and remember the content of a learning module precisely enough if a foreign language is used. Another aspect is the acceptance if students have to train themselves in a foreign language. Some English learning modules may be of minor value if the contributor’s or learner’s native language is not English. On the other hand the translation of the material is time-consuming and expensive. We are not quite sure how to handle that problem in future.

Parallel to the development of the learning modules its integration into the operational service is necessary. Time for working with CAL has to be scheduled into the shift plans and training how to work with CAL is indispensable. We have to organise a learning platform that will fulfil the demands for different working fields.

Although CAL shows a high potential for training success we have to think very carefully how to apply it. The software VisitView is very suitable for distant learning and exchanging material via internet. However, the preparation of VisitView sessions needs a lot of time for organisation besides the necessary scientific and didactic work. The commercial tool CAMTASIA can be used very well for training if oral explanations are to combine with activities upon a computer screen. However, the datasets are too big for the exchange by internet. The software Centra however allows this, but transfer is only possible for presentations without animations.
This picture shows the participants working with an exercise performed during a Training-Seminar of NinJo.

In order to finalise the training in time the maximum number of students was increased to 20 (instead of 10).

Fig. 2
Snapshot of the learning video about the application software NinJo (Koppert, 2004, pers comm.) In this example the configuration of the colour scheme for processing satellite images is explained.

With the commercial software CAMTASIA all activities on the computer screen and oral explanations are recorded.
Fig. 3
From Satmanu (http://www.zamg.ac.at/docu/Manual/SatManu/main.htm): Example of an exercise. In this self-learning module the student investigates the conceptual model about the position of a water vapour vortex in relation to relevant model parameters. Feedback and explanations are given automatically.

Fig. 4
MODDLE – page for the EUMETCAL blended course “Radar meteorology” (June 2008).

Top: some files for the course’s plannings and course material

Middle: ready learning modules.

Bottom: folder with uploaded images/texts for further processing.

Course Planning Files
- Learning Guide
- Memo from WG meeting 3-5 March
- Presentation Template
- Offline Resource Template

Material
- Processing of Doppler Weather radar winds (Petr Novák)
- Link to challenges (Chapter 6.6)

Ready modules
- Radar Meteorology Glossary
- Dictionary of products
- Dictionary of Dual Polarimetric products

Basics of Radar Meteorology
- Chapter 1: Basic Principles of Weather Radar Systems
- Chapter 2: Measurement Geometry and Products
- Chapter 3: Reflectivity and Precipitation Measurements
- Chapter 4: Doppler Measurements and Applications
- Chapter 5: Problems in measurements and the correction of them
  - Chapter 6.1: Warm Frontal Rain
  - Chapter 6.2: Cold Fronts
    - Data Viewer: Cold Front in Croatia 25 March 2008 (Material from Bojan)
    - Convection: Case Study of 22/4/2008 in Romania
  - Chapter 6.4: Drizzle and Shallow Events
    - Radar in the Alps: Presentation from Urs Germann
- Discussion on course development

Files
Here you can find files in different subcategories related to the development of the Radar working group. You can access the root by clicking the first link below this text. You can also upload files to the group space. The files are only visible to working group members and administrators.
- Root