Current status of the European IPWG validation site

Dr Chris Kidd,
School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham. B15 2TT. U.K.

Abstract
This paper presents information on the current status of the European IPWG validation site. In recent months the site has undergone a number of changes designed to improve its' reliability and information content. More data sets have been added through the better use of the data sets available on the *cics.umd.edu* ftp site as well as additional locally-processed products. In terms of processing, better data checking enables older data inputs to be processed more efficiently. Data processing has been revised with more error-checking, while the generation of graphical output has been rebuilt to provide system-independent production of the results. New features of the site that will be highlighted include tables of daily algorithm-validation product statistics that now ease inter-comparison between products and of product performance over time.

Introduction
The European region is characterised by a range of different meteorological regimes, ranging from convective systems over the Mediterranean and continental land mass, to mid-latitude frontal rainfall over the western coastal regions, such as Portugal, western France and the UK. This range of situations provides a varied and challenging background to the inter-comparison of satellite and model rainfall estimates.

Technicalities
The European IPWG validation site underwent some modernisation during 2006 to provide a greater range of products in the inter-comparison, together with more visual statistical analysis. The complexity of the site is somewhat governed by, as in common with many other sites, the management of data sets and subsequent processing. Where possible the collection of the data sets produced by algorithm developers and the production of the results have been kept as simple as possible to maximise automation (i.e. minimise intervention).

The basis processing stages are:
Raw data acquisition:
- Run through list of raw data for day-0 to day-30
- Check if raw data exists on validation site, if not add to ftp list.
- FTP individual contributing sites to obtain raw data (e.g. global IR data sets and PM data sets)
- Extract rainfall from raw data (e.g. from HDF data files)
- Process and remap to required projection/quantities

Product acquisition:
- Run through list of products for day-0 to day-30: (primarily *cics* and *gsfc* ftp sites)
- Check if raw data exists, if not add to ftp list
- FTP individual contributing sites to obtain products
- Process and remap to required projection/quantities
- Radar data is collected for each day, processed and accumulated into 24 hour totals for 00-24Z, 06Z-06Z and 12Z-12Z.

Processing steps
For each product and for each day-0 through day-30:
- check whether output for that day has been generated, if not;
- check that input data exists, if so;
- generate statistics file (text file with 33 values)
- generate image file (24-bit bitmap)

Note that not all raw data and individual rainfall products are available at the same time – they have different delay periods: this necessitates checking for back-data sets, which also has the benefit of obtaining data that might not have been available at the first attempt.

When the processing stage has been completed, a script is used to generate the web-page related HTML script (using standard HTML code). These new web pages are then uploaded with the latest imagery to the web-server.

Software used for the processing steps are freely available and include:
- FTP – file transfer protocol, for transferring data
- C-Shell scripts – for handling file-checking, processing steps and web-page production
- Fortran (F77)– general processing; data extraction, remapping, statistical analysis and bitmap generation
- netpbm – graphics manipulation; bitmap to gif conversions.

One problem that cropped was the 4 Kb limit on the FTP macro files used to automatically collect the data sets. Consequently the data sets are individually checked and missing data FTP'd onto the validation site: the day-0 to day-30 allows for collection of missing data.

Remapping of rainfall products
Unlike the validation sites over Australia and the United States, data for the European site is remapped to an equal area projection, matching that of the NIMROD radar composite. This is deemed necessary due to the northerly extent of the region: the region covers latitudes from 35°N through to 70°N which represents a 2x change in the longitudinal scale factor. The nominal resolution of the data mapping is 5x5 km to which all the satellite data is remapped to. For statistical analysis the data is re-sampled spatially to 20x20 km (roughly equivalent to 0.25x0.25 degrees). The equal-area treatment of the data sets ensures that the rainfall product in the South of the region is equally weighted in the statistical analysis as the rainfall product in the North.

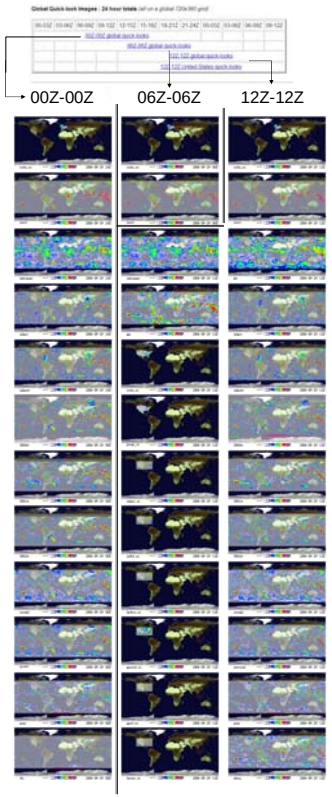
Some problems do arise from the remapping of the products, such as resolution changes and resampling. This is particularly evident in the coarse-resolution products, such as the ECMWF ERA-40 data sets with a resolution of 2.5x2.5 degrees: the remapping and resampling of the model product leads to a change in the histogram of rainfall occurrence in the final remapped 20x20 km product.

Results
Some of the generated products are shown in the panels below. The far left panel shows the quick-look images for all the products that reside on the *cics.umd.edu* website. The quick-looks are generated at a nominal resolution of 0.5 degrees, resulting in an image of 720x360 pixels, and then merged with a background image. These quick-looks permit a quick visual comparison of the different products over the entire domain of the products.

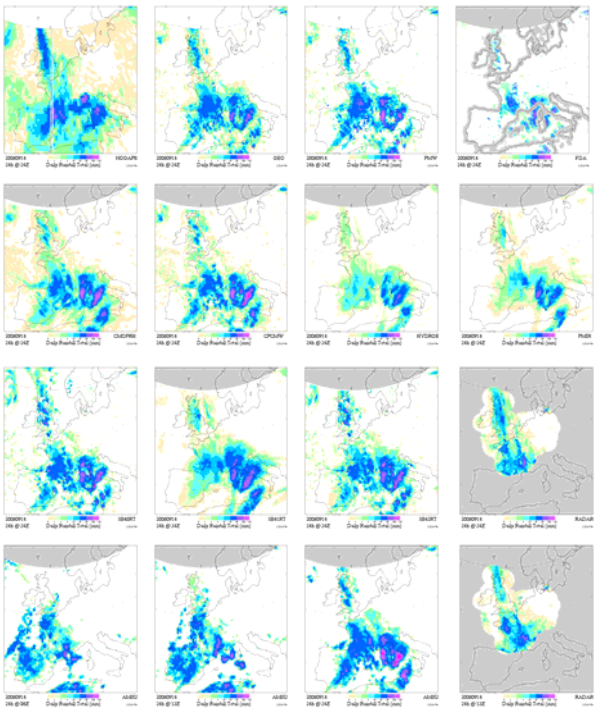
Individual remapped products for the European region are shown in the centre panel. These images are remapped at the nominal resolution of 5x5 km. Again, these can be used for the qualitative inspection of the rainfall products: in the images below the general form of the precipitation regions are very similar but all have, in general, different 24-hour daily rainfall totals.

Images of statistical comparison with the radar accumulations are shown in the right-hand panel: the rainfall products here are resampled to 20x20 km resolution, along with the radar data (from the nominal 5x5 km resolution). A range of graphics and statistics is included with each image, including a scatterplot, cumulative occurrence and accumulation of rainfall, rainfall occurrence and accumulation by rainfall total etc. To aid the inter-comparison of the results, additional tables are generated for each statistic. Examples are these are shown on the far right and show the correlation and ratio of the rainfall product vs. radar estimate.

Future work
Work on the validation site is ongoing. Future improvements include the inclusion of more rainfall products where available - additional model results would be much appreciated. In addition, analyses at the weekly and monthly scale will be generated, along with longer term plots of daily algorithm performances.



Individual European daily products



Daily statistical results