

SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2014

Project Title: NWP meteorological test suite

Computer Project Account: SPITRASP

Principal Investigator(s): Adriano Raspanti (cn9)
Flora Gofa (emo)
Amalia Iriza (roz)

Affiliation: Ufficio Generale Spazio Aereo e Meteorologia (USAM-CNMCA)
Hellenic National Meteorological Service (HNMS)
National Meteorological Administration (NMA)

Name of ECMWF scientist(s) collaborating to the project
(if applicable) Umberto Modigliani and his staff

Start date of the project: 2013

Expected end date: 2015

Computer resources allocated/used for the current year and the previous one (if applicable)

Please answer for all project resources

| | | Previous year | | Current year | |
|--|----------|---------------|-------|--------------|-----------|
| | | Allocated | Used | Allocated | Used |
| High Performance Computing Facility | (units) | 400.000 | 11.91 | 1000000 | 356420.40 |
| Data storage capacity | (Gbytes) | 80 | 1 | 180 | 20 |

Summary of project objectives

(10 lines max)

The aim of the project NWP Meteorological Test Suite is to build up a software environment to perform carefully-controlled and rigorous testing, including the calculation of verification statistics, for any COSMO (Consortium for Small-scale Modeling) model test-version. The individual objectives in this project include the COSMO Model set-up (Phase I), Configuration of test runs (Phase II), Model Output Verification (Phase III) and Additional steps (Phase IV). The NWP meteorological test suite platform will provide the COSMO community with standards against which the impacts of new developments in the model should be evaluated. Moreover, this test procedure could serve as a benchmark to monitor the progress of mesoscale forecast improvement through periodic re-testing as the COSMO system evolves.

Summary of problems encountered (if any)

(20 lines max)

With regards to the running and maintaining the SMS suite, we experienced, especially in May and June 2014, some problems with the network, with frozen windows every now and then. This made more difficult to work remotely on ECMWF machines.

With regards to the installation of VERSUS and model output verification we encountered a few problems:

- ♣ restricted rights to some directories and configuration files where certain components of VERSUS are installed
- ♣ setup of the virtual machine on ecgate (actually 8Gb and 2 CPU's)
- ♣ remote web access issues and problems with connection to the virtual machine
- ♣ very slow connection with the GUI (fixed using NoMachine)
- ♣ installation of firefox for multiple users (fixed)
- ♣ problems with the registration of the stations stratification (3600 stations-fixed)
- ♣ memory allocation of some important variables for VERSUS performance
- ♣ size of grib files crucial for uploading speed and dependant on the number of stations (need for splitting in smaller units, fixed)
- ♣ allocation of data (and log files) on another file system than VERSUS one (use of symbolic links)

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

In the framework of NWP Meteorological Test Suite, a platform was developed, on which present and future versions of the COSMO model will be tested for their forecasting performance, within a well-defined framework. This platform will be the tool used for performing the tests that will upgrade a model test-version to a new release.

The test suite only addresses the statistical quality of a COSMO version in comparison with the previous one. The statistical measures are defined within the task itself; this concerns not only the type of scores to be used but also the array of parameters (e.g. 500 hPa geopotential, precipitation, 2m temperature). The comparison of the model versions for validation was carried out on a common domain. The new version of the model will be considered validated or accepted if the set of verification results show a positive impact on the common domain or if the results are neutral.

Phase I- Model set-up

Versions 4.26 and 5.0 of the COSMO model (7km horizontal resolution) were implemented and used for these tests, following the operational resolution in most meteorological services.

Main activities of this phase consisted of the preparation of the model installation:

For this purpose the following steps were performed:

- compilation all the necessary external libraries and tools for file managing
- compilation of interpolation program INT2LM
- compilation of each COSMO version which were tested

Phase II: Configuration of test runs

For this purpose the namelists for both model versions and interpolation program were set. Also in this phase the directory structure and the archiving procedures for this part of the suite were set. Apart from this, after each testing procedure is completed, model outputs are transferred to the machine with the installed VERSUS software in order to perform the statistical analysis. The data (model outputs) obtained from the experiments will be stored locally in the ECFS system. Arrangements will be made for space availability.

The domain involved in calculation covers the COSMO countries and a good part of European Russia (Figure 1). The total number of grid points is 383 761 as follows:

- ⤴ 751x511 grid points
- ⤴ 40 vertical levels
- ⤴ rotated coordinates:
- ⤴ pol latitude = 40
- ⤴ pol longitude = -170
- ⤴ coordinates of the lowest left corner
- ⤴ start latitude = -16.125
- ⤴ start longitude = -15.75

The forecast period of each daily run was 72 hours, on one daily cycle based on the 00UTC initializing data. The simulation period for each test was one month for the summer (July 2013) and one month for the winter season (January 2013) in total 4 months (two for each model version). The initial and boundary data were provided by the ECMWF IFS system.

- ⤴ area=75./-25.0/25.0/70.0 (761x401 points) 137 vertical levels
- ⤴ horizontal resolution 0.125/0.125
- ⤴ from fc+0h to fc+72h every 3h → size ~ 11.6 GB

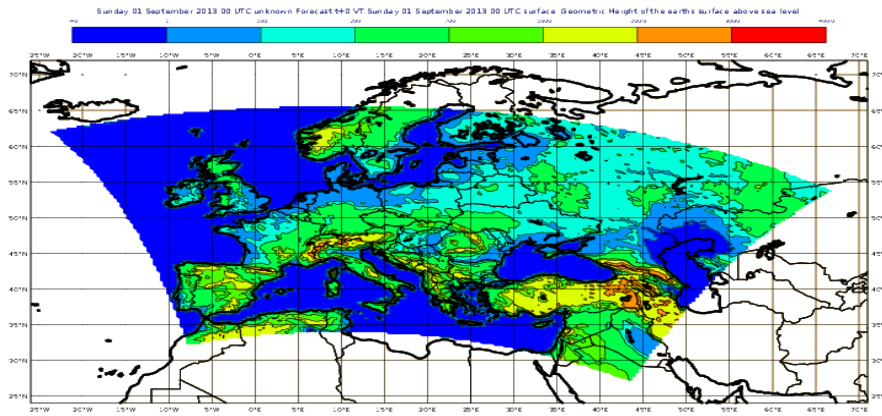


Fig 1. Integration domain for the NWP Meteorological Test Suite.

The ECMWF Special Project SPITRASP had an allocation of 1.000.000 for 2014. In the present configurations the costs of the suite are:

- ⤴ The interpolation for COSMO-4.26: costs about 80.0 BU per run (and takes ~ 8 min)
- ⤴ The interpolation for COSMO-5.0: costs about 81.5 BU per run (and takes ~ 8 min)
- ⤴ COSMO-4.26: costs about 2434 BU per run (and takes ~ 30 min)
- ⤴ COSMO-5.0: costs about 2350 BU per run (and takes ~ 29 min)
- ⤴ total_tasks = 64 and node = 1 for int2lm
- ⤴ total_tasks = 512 and node = 8 for COSMO

Phase III: Model Output Verification

For the model verification VERification System Unified Survey (VERSUS) software was implemented at ECMWF. VERSUS is LAMP open source software. **LAMP** is an acronym referring to the first letters of Linux (operating system), Apache HTTP Server, MySQL (database software) and PHP, principal components to build a viable general purpose web server. The solution that was recommended that could fulfil the needs of the software was to install it on a virtual machine that was based on ECGATE linux system. As ECMWF personnel had no prior experience in hosting external software, there were many technical and security issues that had to be overcome in order to complete the installation of all necessary software that is linked with VERSUS system. The final product allows the remote access of each user not only to the virtual machine but also the execution of the verification suite through the web graphic interface.

After the successful installation of the main packages several activities devoted to the proper setup of the system were performed until a final configuration was achieved. The preparatory work for the installation and communication with ECMWF started already in 2013, while the actual installation of the whole virtual machine and the system started in February 2014 and can be considered completed at the end of May 2014, with the beginning of the data uploading phase. After the installation of the main package, also the update VERSUS 3.1 and 3.2 were successfully installed.

At the moment only the user “versus” has the access to VERSUS machine (apart from root, available only for ECMWF) and this is accessible from the usual Ecgate cluster by only the users that at the moment are allowed without any password (other users needs password, available at the moment only for ECMWF). The users are:

- cn9: Adriano Raspanti
- emo: Flora Gofa
- roz: Amalia Iriza – PT leader
- itm: Andrea Montani

At present VERSUS virtual machine has been setup with 2 CPU’s and a total RAM of 8Gb. The tests executed until now show that the performance, in terms of stability of the system and speed, are satisfactory. ECMWF requested some tests with 4Gb RAM setup, but they will be performed later on. It is expected this could result in a general slowdown of the system performance.

To connect to the VERSUS virtual machine (ms-versus) **NoMachine** software is used to open a terminal at ecgate, then `ssh -X versus@ms-versus` to connect to the virtual machine where VERSUS is installed. This feature allows multiple GUI users. Other connections to VERSUS virtual machine can be established simply using “ssh [versus@ms-versus](#)”.

The whole VERSUS virtual machine is setup in order to have a different disk space for DB (quite huge) and another one even bigger to store the data (grib and bufr): /dev/sda3 and /dev/sda4 respectively. The filesystem of VERSUS is /dev/sda1 that is quite small. On /dev/sda4 a dedicated space /vol/ecgb/versus was created, on which the usual directories tree that VERSUS requests are created. As VERSUS requests to have grib and bufr files in the same Filesystem (dev/sda1) but the space is too small, symbolic links were created to the directory where the data actually are stored in /dev/sda4, and the system is properly working and uploading. The same rule has been adopted for the log directory.

In order to perform the verifications, the VERSUS sistem was set for the ingestion of all necessary data (model and observations). For the observations ingestion a list of selected stations situated in various places of interest in the domain of simulation was used and the synoptic observations for the predefined periods of testing were uploaded in the DB using the world-wide WMO flatfile.

For each NWP model version, the operational one and the new test version that will be compared against the operational, the registration is done with the version number it has, so it will be easier in the future to follow the evolution of model versions/tests. Both models have the same grid characteristics but as it is a prerequisite of the software, they were assigned with a different model id. So for each new model that will be tested in the future, the new model will need to be registered using the same topology file but with a new model-id code that will be set in the namelist of the model.

Due to the various selection methods of the forecast data that are used for the comparison against point station data for each weather parameter, there are three frontends (FE) registered for each model. A separate FE is also registered for the upper air data for each model.

Uploading phase of forecast data can be extremely slow if the data are stored in file whose size is quite big (e.g. one grib per day containing 5 parameters for all the fcs steps, or one day containing 5 parameters for all the fcs steps and all the standard pressure levels for upper air). For this reason the original grib model outputs are split in smaller files with a php script (split.php) and saved in the scratch directory where the original outputs are stored.

In order to obtain the statistical outputs, VERSUS software was appropriately configured for the automatic forecast/surface data loading, the verification execution and the graph production. Some of the results for model output verification obtained after running the VERSUS system are presented below.

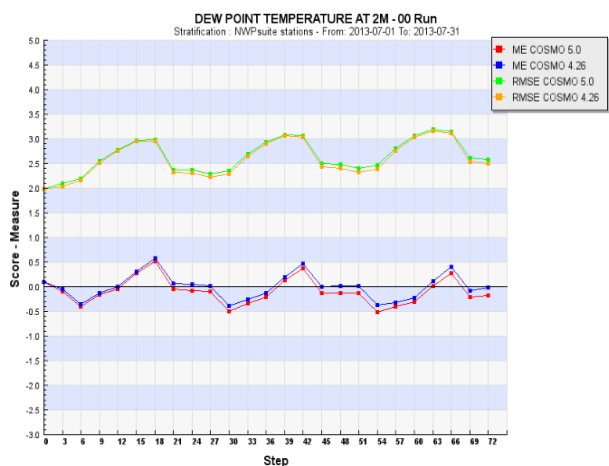
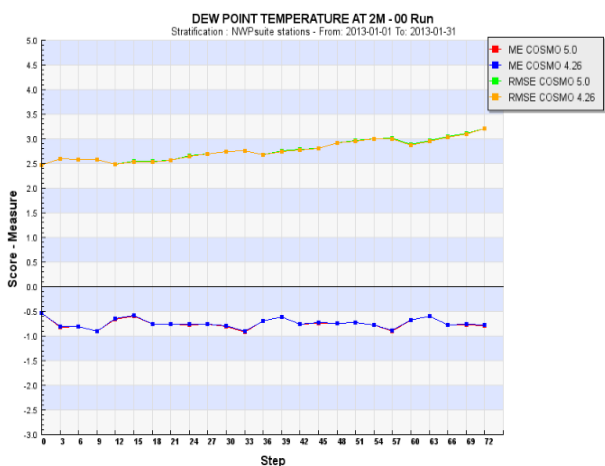
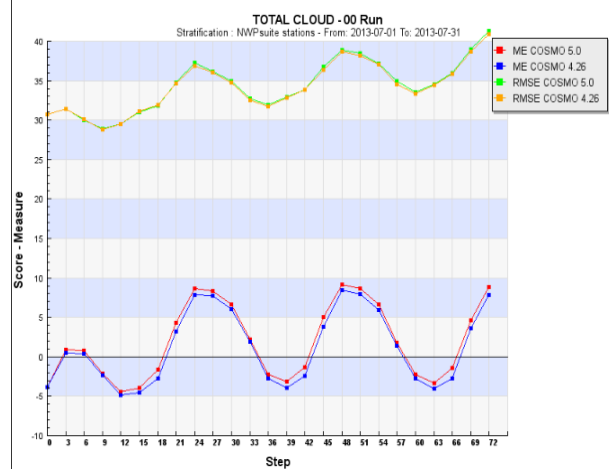
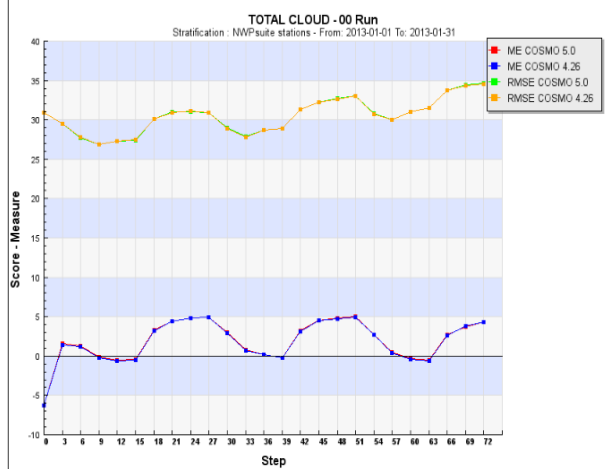
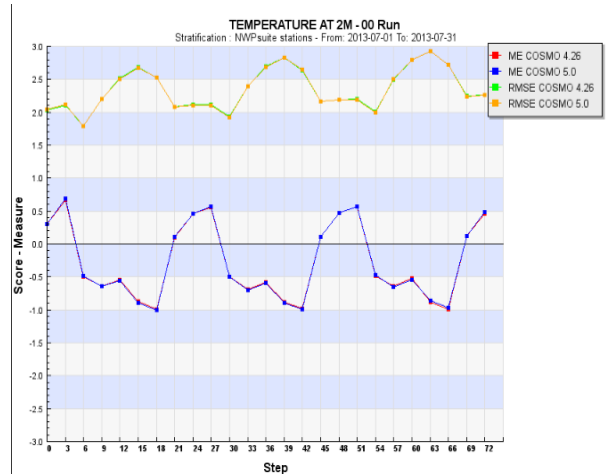
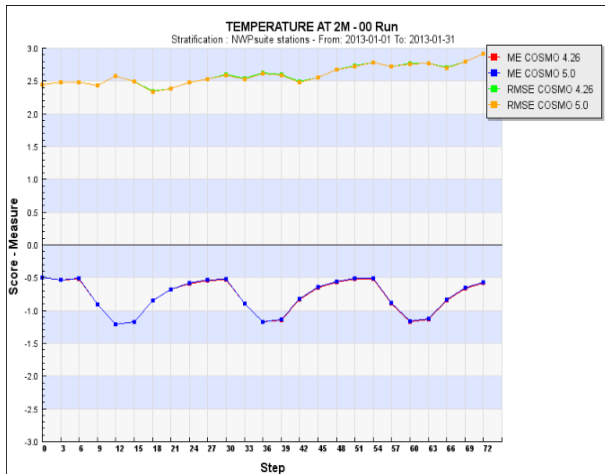
As can be seen, the statistics of the two versions of the model are almost identical with some slight differences mainly for the summer period.

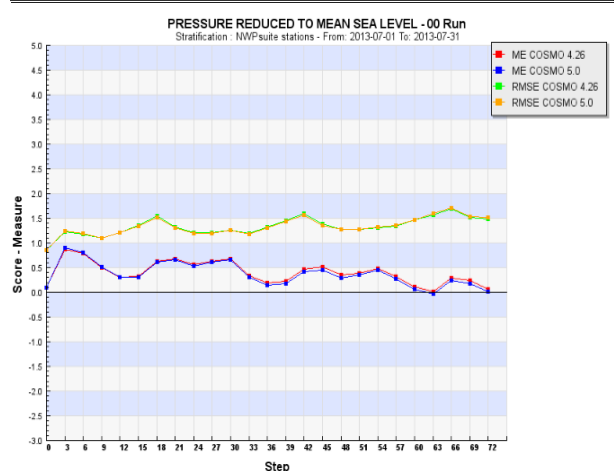
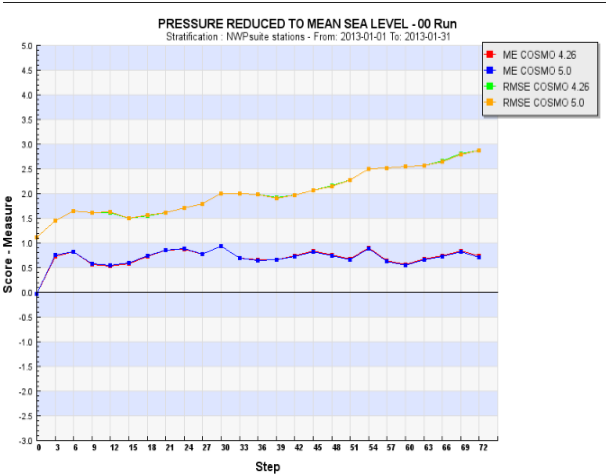
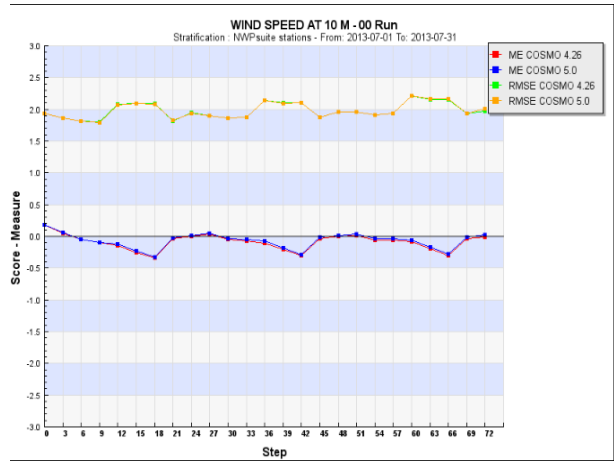
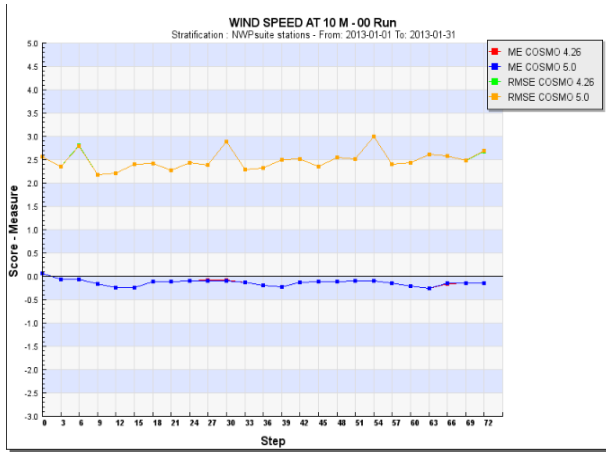
As the final outcome of the execution a report describing the main findings of the comparison in the performance between the reference and the test version of the model will be presented.

Continuous parameters

Jan 2013

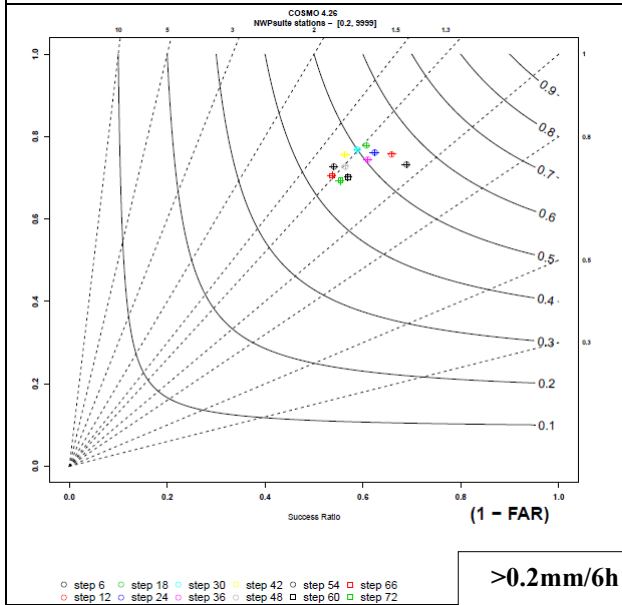
Jul 2013



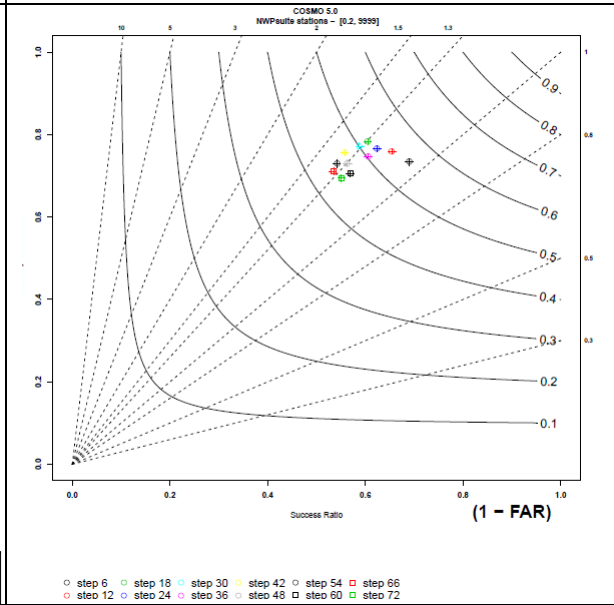


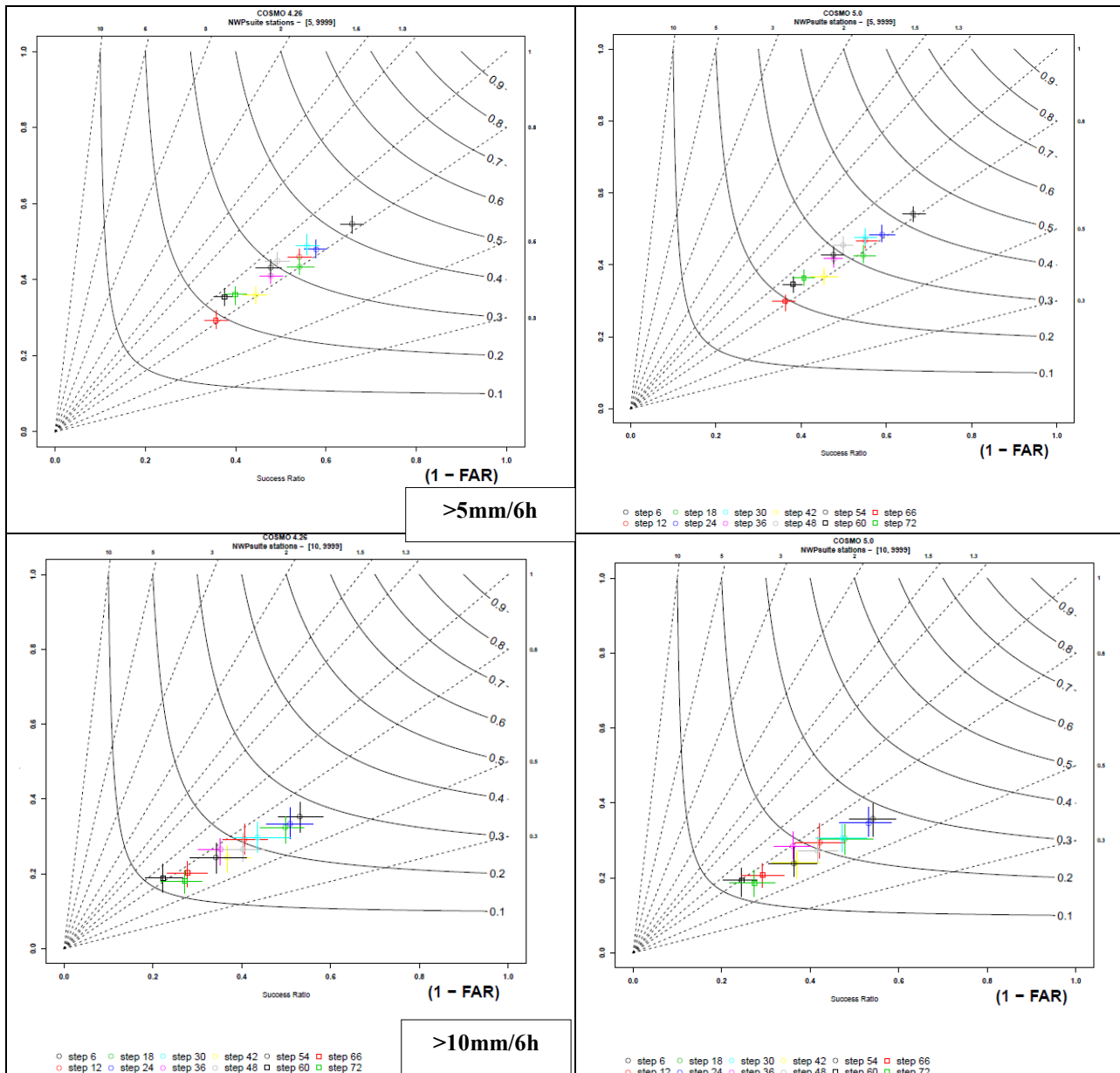
6h Precipitation

4.26 Version



5.0 version





List of publications/reports from the project with complete references

Detailed guidelines for the proper use and execution of each NWP test using this platform are in preparation. The guidelines will include a detailed description of all steps, from the compilation of a new COSMO model testing version to the final production of the graphics of the statistical scores extracted.

The final report on the project will be presented at the 16th COSMO General Meeting, 8-11 September 2014, Eretria, Greece.

Summary of plans for the continuation of the project

(10 lines max)

- ^ Maintenance of the Test Suite - ECMWF will migrate from IBM to Cray computing platform in summer of 2014, so there is the necessity to reevaluate computing costs; also, future versions of the model will need to be installed as soon as they are available
- ^ Maintenance of Versus - Future VERSUS releases will have to be installed as soon as they are available
- ^ Running of test suite for further versions of the model.
- ^ Perform model evaluation for further versions of the model.
- ^ During 2014, we will perform the verification of version 5.1 vs 5.0