SMC - Servei Meteorològic de Catalunya

LaMMA - Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile

Minutes of the meeting held in Barcelona on 13-14 November 2018

NWP activities

- **Background error covariance matrix in the variational data assimilation:** To assess whether to use the CV5 or the CV7 option (the latter is the one Meteocat chose, at least for nowcasting).
- **Radar Data Assimilation:** LaMMA is very interested in SMC radar data quality control methodology used in the data assimilation system (WRFDA) implemented. A possible collaboration could be on the comparison of the radar data quality control techniques and on the pre-processing of the radar data in overlapping areas, in order to produce complete wind vector profiles and a composite reflectivity, in order to reduce the volume of data to assimilate (benefits to be verified)
- **Data Assimilation:** arrange common synthetic experiments (Observing System Simulation Experiments, OSSEs) to quantify the possible positive impacts due to the assimilation domain dimension (on the time of effectiveness of the assimilation), observations distribution and density, observations type.
- **MSG Data Assimilation with WRFDA:** SMC and LaMMA should join efforts and experiences to work in this topic. LaMMA reported that currently an employer (Luca Fibbi) is working on the transformation of satellite data (received from Eumetcast) from the original file format to the BUFR (NCEP) format. Provided that he has already managed to assimilate these data in WRFDA, we could take advantage of it, otherwise, we could join efforts to help each other in this task.
- **Rainfall Data Assimilation in MOLOCH Model using a simple nudging scheme:** LaMMA mentioned a work by Silvio Davolio et al ("Impact of Rainfall Assimilation on High-Resolution Hydrometeorological Forecasts over Liguria, Italy", *JHM* 18 (2017): 2659-2680) on

the assimilation of rain observations derived from radar reflectivity data within the MOLOCH model using a nudging technique. SMC could use this algorithm to incorporate the methodology into the MOLOCH model. LaMMA is currently testing this technique for a case study.

- **Verification:** LaMMA performs objective verification only for case studies. Regarding the precipitation, the verification is mainly done by using classical indexes. At this point SMC can help LaMMA in installing and running the MET software, which is currently used at SMC.

WRF and Operational chain

- **WRF configuration**: SMC and LaMMA agree to share namelists and experience with operational procedures.
- **Maps Generation**: at LaMMA, the generation of maps is done with GrADS and SMC should ask LaMMA how they calculate some of the variables that they display on the website, such as precipitation types, wind gusts, instability indexes, etc ….
- **MOLOCH Compilation:** LaMMA is satisfied with the computational time required by the MOLOCH model if compared to the WRF model. However, SMC has a different experience and finds this model very CPU-time demanding. It would be very appreciated if LaMMA could help SMC in the compilation options, in order to know if the computational time required by this model can be reduced.

Wave Models

- **WW3:** LaMMA runs operational simulations with the WW3 model at two resolutions 10 km over the Mediterranean Sea and 3 km over the italian basins. It is forced with wind data from the WRF operational simulations (at 12 km and 3 km, respectively). The SMC operational WW3 implementation is very similar, thus, in this case, we can exchange the namelists, procedures and the gained experience.
- **Data Assimilation:** For study cases, LaMMA has assimilated radar data and CTD profiles in the ROMS model with apparently very positive results. LaMMA can help SMC to assimilate data from the Tarragona Radar into the ROMS model.
- **Wave propagation in coastal areas:** LaMMA does not have any wave model propaga-

tion in coastal areas similar to the one implemented at SMC. Carlo Brandini (LaMMA) proposes to try a one-dimensional method, instead of using the SWAN. The idea consists in using the data provided by the SWAN of 3 km at the nearest point to the coast and apply a dissipation propagation formula to find analytically the wave height at the desired point.

- **Coupling ROMS and SWAN:** LaMMA commented that using a coupled system (ROMS-SWAN) could significantly improve the numerical results in their region. Since we have already implemented a coupled ROMS-SWAN study case, we can help them with our experience. Besides, we can investigate together the coupling effects.
- **Wave Hindcast:** Carlo spoke about studies that have detected a change in the wind dynamics of their region (a decrease of winds from the NW and an increase of winds from the SE). For this reason, he considers that a good line of work would be to perform a wave re-analysis and see the changes in its behaviour. The ECMWF Special Project SPITBRAN (https://www.ecmwf.int/en/research/special-projects/spitbran-2018 with Principal Investigator Carlo Brandini) is aimed at providing a long-term wind-wave reanalysis based on a cascade of numerical models (BOLAM→MOLOCH→WW3) fed by the ERA5 global data.

Models viewer (collaboration already started)

Using the model data viewer was one of the main interests of the meeting.

Both LaMMA and SMC generate model maps using GrADS, for all models, for several vertical levels and variables. SMC presented the viewer during the meeting LaMMA/SMC held in Florence in June 2018. The goal for this new meeting was to start collaborating, so LaMMA can install the SMC model viewer in its IT facilities.

The decision was installing the SMC viewer without changes at LaMMA so they can evaluate it for some time with their own data. The tasks to get it are:

- Adapting the GeoTIFF generation script to the LaMMA GRIB files (task accomplished in the last days of November 2018)
- Adapting the configuration files to fit the LaMMA products (task accomplished in the last days of November 2018)
- LaMMA will provide access to its servers to facilitate the final installation.

Drought indicators, Drought portal and other subjects

Starting from an overview of both LaMMA and SMC researches concerning drought and related topics, we found several common points for a collaboration.

There is a general agreement on sharing methodologies and data, useful to effectively increase their operational services.

The LaMMA idea is to create interoperable Drought Climate Services through partnerships and dialogue between scientists, developers, providers and end-users, able to share standardized information and open data with homogeneous strategy and goals both at regional and international level.

- **EDI Index (Effective Drought Index):** It is a good index for operational monitoring of both meteorological and agricultural drought situations. It shows a quick response to the absence of precipitation or the recording of big daily rainfall amounts. It would be possible to implement such an index at the SMC (according with the current rainfall database).
- **Drought Climate Service:** LaMMA and CNR have developed an attractive and user-friendly drought Climate Service. The SMC is interested in having a similar web portal to centralize all available information related to drought, as well as to give visibility to the information for the public and potential end users. The idea suggested by LaMMA is to make available its Drought Climate Service to share (through RESTFUL API and catalogue of metadata) drought indices covering most of Mediterranean Basin, included Catalonia. At the same time SMC could share their competences and activities in order to improve the service and products
- **Drought Bulletin:** One of the main services included into the LaMMA/CNR Drought Climate Service is a monthly bulletin for Tuscany region, resuming current and future conditions and possible evolutions of drought events. Due to the interest of SMC to create a similar bulletin in Catalonia as a reference document, LaMMA suggests to collaborate for sketching out a common, innovative and homogeneous information strategy (starting from the bulletin)
- **Calculation of a high resolution wind grid in Catalonia:** There is a need, both from LaMMA and the SMC, to have a wind grid at high resolution for a historical period

(decades). Apart from the direct relationship with the calculation of the ET_0, this product would have many applications (statistical climate projection, medium range forecasts, verification products, etc.)

- **SPI equation best fit**: LaMMA is interested on the pixel by pixel and time scale best fit model method used for a more reliable SPI computation. This approach could be integrated into the automatic procedure used by LaMMA, even if we should evaluate the convenience in terms of time consuming, considering the whole Mediterranean Basin as area of interest.
- **ETo/ETr calculation at high resolution (at least 1km)**: LaMMA is currently implementing and validating the ET_A estimate at high-resolution grid (250m), integrating satellite products (LST) and in situ observations, but using simplified equations for the ET_0 estimate. Instead, the SMC are actually focused on the recalculation of the ET_0 for the entire automatic station network using different approximations of the Penmann-Monteith equation, with the purpose of using such information for the calculation of a daily grid ET_0 as a preliminary step. Due to these complementary activities and considering the importance of data sharing, we both decide to combine the efforts, believing on the relevance of this research line.
- **Founding international calls on drought topics**: LaMMA and SMC agreed to find international project calls (Interreg, etc.) and other partners interested in the implementation of a Drought Climate Service in order to improve their operational researches.
- **Poor Man's Ensemble (PME):** LaMMA is running a poor man ensemble in Tuscany using different runs of WRF and MOLOCH models (using time-lagged members with different initial and boundary conditions). The SMC also developed a PME using all available models (own simulations and free ones available in the net). LaMMA offered to send SMC the operational BOLAM model simulation at 7km (such a simulation covers the Catalonia area) to incorporate it into SMC PME.
- **Verification of BOLAM reanalysis at 7 km:** in 2017 LaMMA performed a reanalysis for the Mediterranean/Italy region using the models BOLAM-MOLOCH at 7 and 2.5 km respectively (in the framework of the above mentioned SPITBRAN Project). The BOLAM model was initialized and refreshed with the ERA5 reanalysis (0.25°) and the temporal

coverage is 2008-2017 so far. Next step is to extend the temporal coverage for the whole period 1982-2017. LaMMA offered to send SMC the BOLAM outputs to verify them with the network of observations available in Catalonia.

- **Dynamic climatic regionalization:** During the meeting, it was reported the possibility of using the ECWMF infrastructure to carry out research projects. Taking this advantage, the SMC is interested in developing its own reanalysis and a dynamic climate regionalization using some CMIP5 models and the WRF model at 3 km (among other projects). Taking into account the LaMMA experience, we could also use the ECMWF facilities and maybe collaborate together.

International projects (Proposal project)

- **High Precision Positioning & Routing for Port Operations in Marinas (Alberto):**

It is a proposal a H2020 project of the European Commission, led by CNR and LaMMA, with the collaboration of other Italian institutions.

The idea of the project is to create a service, operational and commercial, to provide route corridors in order to guarantee safe port operations also during difficult meteo conditions, based on local high precision positioning up to few centimeters using EGNSS data, and the knowledge of local meteomarine conditions through observations and modelling, taking into account bathymetry, wind, waves and currents at the roadstead, entrance and inside the port.

The target customers are marinas and yachts.

SMC urgent task is to find members to build the consortium. Currently there are among others the port «Cala di Medici», «Effebi Shipyard» (which provides test boats, also boats without driver). Regarding this issue LaMMA has advised SMC to contact the company MB32 as a collaborator in Catalonia, the marina of Palma de Majorca and to contact Starlab for the "OceanPal" device for measuring coastal altimetry and waves.

- **NEFOCAST: Rain Detection using Satellite Telecom Decoders (Alberto):**

This is an ongoing project funded by a programme of Regione Toscana (i.e. the regional administration of Tuscany).

The idea of the project is to use the real-time data of the attenuation of the satellite signal mea-

sured by the new generation television two-ways receivers, named Smart LNB. This attenuation principally depends on the presence of precipitation (and on the melting layer), so we can estimate the rate of precipitation along the path of the signal. These integrated measurements can be processed to obtain map of precipitation, by means of ancillary information related to the boundaries of the precipitation systems, namely from satellite observations and from the estimation of the top height of the system (inferred from the forecasted 0° C isothermal height). A Kalman filter approach is used to integrate the frequent Smart LNB measurements (each 1 min.) with the satellite data for producing the precipitation maps.

This technique is under test in Florence, where a number of raingauges, Smart LNBs and one Doppler and polarimetric meteorological radar have been specifically deployed for cal/val objectives,. Now the project partners want to extend NEFOCAST to other countries. SMC could be collaborating doing another pilot test in Catalonia, installing some test receivers, providing measurements and developing and testing new applications.

As the technique integrates Telecom with EO data, the extended project could be funded in the framework of an ESA Artes IAP demonstration proposal, with Eumetsat as main target customer, for future upgrading of the H-SAF precipitation products (Eumetsat and an Italian delegate for the Artes programme from ASI have been already contacted to verify their interest).

Alternatively a H2020 proposal is under investigation essentially with the same aim.