A SOIL MOISTURE INITIALIZATION METHOD, BASED ON ANTECEDENT PRECIPITATION APPROACH, FOR REGIONAL ATMOSPHERIC MODELING SYSTEM: A SENSITIVITY STUDY ON PRECIPITATION AND TEMPERATURE.

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The soil initialization state is very important on a wide range of behavior in weather forecast but availability of such information as first guess field is difficult. The new version of RAMS provides a method to produce initial soil state computed from simulated atmospheric and observed precipitation fields. In other words it is possible to run the LEAF model prescribing both the atmosphere state and rainfall, which, for example, could be the observed one. The atmosphere state is provided by a previous atmospheric RAMS simulation. It is clear that if an observed rainfall is used to force the water budget, the atmospheric forcing is not identical to the real one that produces the observed rainfall ingested. Differences in water exchange between soil – vegetation – air between the real one and the simulated could be important. But such soil first guess field posses some benefit like, a better realism on the evaluated water amount respect to what is just forecasted, better description of heterogeneity due to the acting hydrology model within LEAF, longer description of water cycle forcing respect to a simple initial estimation of soil state retrieved, for example, by a satellite. The soil initialization scheme is based on a special version RAMS called RAPI (RAMS Antecedent Precipitation Index). The RAPI model needs two different types of input:

1. *Precipitation Fields*: a distributed map of rainfall over the interest area and the selected time period (satellite estimates);

2. *RAMS Atmospheric Fields*, computed in a separate RAMS run on the same time period.

Using such information RAPI model computes energy balance, as the RAMS actually does, between atmosphere, prescribed from a previous RAMS run, and the provided rainfall fields. A complete strategy scheme is presented in fig 1. Using the observed rainfall has the advantage of computing a better and realistic water budget, at soil level, both for heterogeneity and reliability. Several benefits of using RAPI, both from a physical and an operational point of view, should be highlighted:

- The provided information on observed precipitation, using a simple preprocessing tool, is projected on a regular RAMS grid thus at the same resolution of the simulation. The observed precipitation should be provided on a regular Lat/Long area covering the interest area. The RAMS standard method for ingesting geographical information such as Sea Surface Temperature or Soil/Vegetation Dataset, is used providing a simple way for data input.
- The observed precipitation, once projected on the interest area, posses the same topography as model grids, so a basins budget could be more reasonable than soil moisture or temperature interpolation coming from a coarser grid simulation (e.g. a GCM field).
- This method could be simply nested , in time, in order to build up budget over long period. Subsequent simulation could be "*appended*" in the operational production cycle providing the continuity of the soil state information flow, describing in a proper way the long term behavior of soil.
- Due to the reduced number of equations solved in the model system, the RAPI run is computationally efficient.
- The method does not need only "*full real-time"* observed precipitation, because RAPI could be run, for example, at the end of a day in order to provide initial soil state for the following day simulation. So a simple RAPI use in an operational chain is possible.

The RAMS simulation has performed on a 2002 summer period in order to stress the soil influence on low level atmospheric behavior and, in order to explain how the RAPI model works, a brief step by step description is presented here.

The RAMS simulation was performed using a 3 nested grids configuration at 32 – 8 – 2 km of horizontal resolution and 36 vertical levels with a resolution ranging from 50 m to 1100 m and 11 ground level down to -1.5 m with a stretched resolution. Initial and boundary conditions, every 6 hours, were from NCEP/NCAR reanalysis fields, Kalnay et al. (1996), while sea surface temperature, at 1° of resolution, were the weekly mean Reynolds reconstructed SST from NOAA. Initial soil condition was set as a standard operational run as follows:

- *Initial Soil Temperature*: it is set with an initial offset of the lower level atmospheric temperature, ranging between 1 and -1 °C (from top to bottom level) homogeneously distributed over the whole area. This is the standard soil RAMS initialization.
- *Initial Soil Moisture*: it is set to a typical medium - dry soil prescribed value, equal to 0.04. This is the fraction of total soil volume that is not occupied by solid soil particles (i.e., it is the fraction of total soil volume that is occupied by air plus water). Such value is the initial prognostic soil moisture, which is in units of cubic meters of water per cubic meter of total volume, where that total volume is comprised of water plus air plus solid soil particles. Therefore such value is soil type dependent.

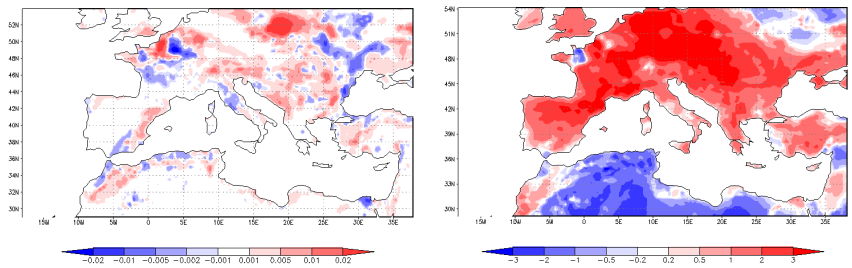

Fig 1 Initial soil moisture and temperature difference, expressed cubic meters of water per cubic meter of total volume, where that total volume is comprised of water plus air plus solid soil particles, on the coarser grid at 3rd Aug 2002, 00 UTC.

In this work a new possible application of RAMS model is presented and explained using a summer 2002 case study. Only qualitative evidence of possible impacts are shown while, for quantitative estimates of benefits further study should be done. The simple usage of the RAPI model to build up reasonable the soil state as first guess field, encouraging a large range of application, from now–casting to regional climatic purposes. The RAPI model could be an important tool in order to estimate the soil wetness thresholds for hydrological application, especially for supporting the river basins monitoring systems.