PhD Program in Computer Science and Systems Engineering
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DIBRIS, University of Genova

Proposal of Research Theme

Title: Coupling of atmospheric and hydrological modelling

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Research area(s): Hydro-informatics, Hydrological modeling, Meteorology

Description

The prediction of hydro-meteorological phenomena at the interface between the short range and the sub-seasonal spatio-temporal scales in complex orography areas is calling for the formulation and application of coupling framework between atmospheric and terrestrial hydrological modelling.
The goal of the proposed PhD thesis is to develop such a coupling framework on top of the following key components:

- The atmospheric model WRF (Weather Research and Forecasting Model) an open source code conceived and developed since the mid 90's by NCAR (National Center for Atmospheric Research), National Oceanic and Atmospheric Administration (NOAA), U.S. Air Force, Naval Research Laboratory, University of Oklahoma, and the Federal Aviation Administration. WRF is a mesoscale forecasting system designed for both research and operational applications, capable of operating at spatial resolutions from hundreds of meters to hundreds of kilometers. WRF offers a very rich portfolio of physical parameterizations (microphysics, radiation, turbulence, soil model) packages and data assimilation ones

- The Continuum hydrological model a hydrological model developed by CIMA Research Foundation and able to work both in the pre-event analysis and forecast phase and in the monitoring stage for the simultaneous control of the event. The choice of CIMA Research Foundation to study its own model was born from the need to develop a model with a reduced number of parameters able to take advantage of all the information available via satellite.

The Continuum model is useful in forecasting and reducing risk because it is able to provide the responses of the basin to the meteorological stress, in particular during intense events. The great utility of Continuum is also realized in the possibility of being implemented in areas with poor equipment on the ground and in the possibility of calibrating the model with respect to variables such as soil moisture or soil temperature that are rarely present in other models available. Continuum also has features that make it applicable to different types of reservoirs, different climates and areas strongly anthropized with the presence of hydraulic works (dams) that can play an important role in reducing the effects of floods.

The coupling framework, implemented using state of the art hydroinformatics techniques and taking inspiration from the OASIS coupling guidelines, will provide:

- An adjustable multi-physics and multi spatio-temporal scales land-atmosphere modeling capability for conservative, coupled and uncoupled assimilation & prediction of major water cycle components
- Accurate and reliable streamflow prediction across scales

- A research modeling framework for evaluating and improving hydro-meteorological physical process and coupling representations

Link to the group or personal Webpage

http://www.cimafoundation.org/

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