A land data assimilation system for NWP initial conditions and hydrometeorological forecasting

J. Blyverket[1], T. Aspelien[1], Å. Bakketun[1], H. B. Erlandsen[1]

[1]The Norwegian Meteorological Institute

Henrik Mohns Plass 1, 0371 Oslo, Oslo – Norway

Email: josteinbl@met.no

ABSTRACT

Extreme rainfall, flash flood, drought, slush and snow avalanches, landslides, and their variability under global warming, are major hazards to lives and property, and may affect business and industrial development negatively. Despite advances in numerical weather prediction (NWP) models and post-processing techniques over the past few decades, prediction of intense, small-scale precipitation and their consequences remains a challenge. Most NWP systems are currently using simplified land surface schemes, so called "bucket models" for soil water, single layer snow schemes and very limited interaction between soil and the vegetation. These simplified land surface schemes are dependent on surface data assimilation to correct their insufficiencies and the modeled variables are not representing "real" physical values. As a consequence the value of the output variables and usage of this data in other models and services is limited. In this work we present the transition to more advanced land surface schemes in the operational NWP system at MET-Norway. We present how multi-layer soil, snow and vegetation schemes affect our NWP forecasts and how this system could be utilized in a stand-alone Land Data Assimilation System (LDAS), which may facilitate improved NWP initial conditions and early warning of flash floods and agricultural drought. The LDAS is driven by the Nordic Analysis produced by MET-Norway. It covers Scandinavia with a spatial resolution of 1 km. The offline forcing data set contains surface parameters including 2 meter temperature and precipitation. The precipitation forecast is corrected using observations from MET-Norway's radar network and station based rain gauges. The LDAS system is run daily with hourly output data of e.g. multi-layer soil moisture/temperature, snow depth and water equivalent, surface and subsurface runoff. Flash-floods and routing of water in fast responding watersheds (as seen for most parts of Norway) are tackled using the TOPMODEL approach (named TOPODYN) in the NWP land surface model. This module models the lateral distribution of soil water among watersheds and eventually into the rivers, allowing for a computation of river discharge. In addition, the Squeegee method which summarizes the grid-cell runoff within a catchment and uses this as an estimate of the river discharge, will be applied. With this LDAS MET-Norway aims at delivering accurate and reliable hydrometeorological forecasts and warnings for enhanced preparedness and reduced loss of life, critical infrastructure and livelihood.

Keywords: NWP; Land data assimilation