Instruments for Hydrometeorological Decision Support in Sustainable Water Management for the Volta Basin

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INTRODUCTION

- Sustainable water use under changing climate conditions and increasing water demands is a central, socio-political challenge, in particular in climate sensitive regions
- Sustainable decisions in water resources management require scientifically sound information of
  1. current water resources and fluxes and
  2. future water availability due to climate change
- In regions, where precipitation is limited to only a few months per year, the onset of the rainy season and the respective start of sowing time is of crucial importance for sustainable food production, which requires a
  3. reliable estimation of the onset of the rainy season
- The instruments and methods to answer these questions should be world wide applicable, cost-effective and preferably public domain.

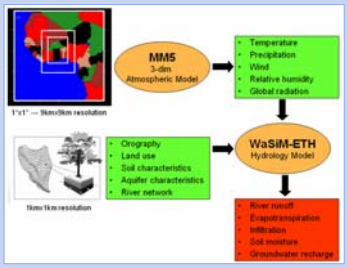
Hydrometeorological Decision Support for the Volta Basin

Long Term Planning

Climate Change Impact on Water Availability

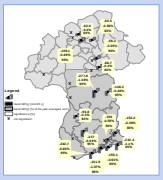
- Climate changes on regional scale can differ significantly from the overall trend of global climate change
- Design adaptation and mitigation strategies

1. Coupling Strategy for Joint Atmospheric-Hydrological Sim.



Results:

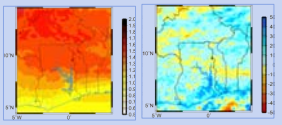
a) Footprints of Climate Change: Trend Analysis



- Annual precipitation trend [mm/25years]

b) Looking into the future: Regional climate simulations

- Change in mean annual temperature and rainfall (2030-39 vs 1991-2000)



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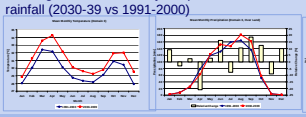
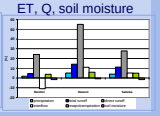


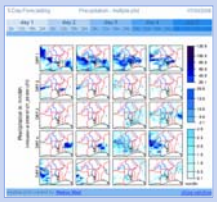
- Hydrological response: ET, Q, soil moisture



Short/Mid Term Planning

Operational
- Weather Forecast (NWP)
- Model Based Water Balance Information System

2. Operational 5-day Numerical Weather Prediction



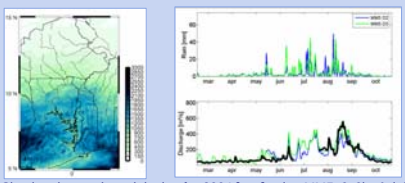
3. Operational Joint Atmospheric-Hydrological Simulations

- Model based monitoring of terrestrial water balance

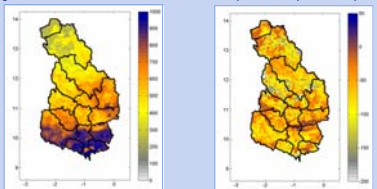
➢ Provides near real time (48h delay) basin wide estimation of spatial and temporal changes of water balance variables

➢ Important information for water resources management

Results:



Simulated annual precipitation for 2004 [mm] using MM5, 9x9km²- left; Precipitation & routed vs. measured (black) Q at Pwalugu using the gridded, near real time MM5 results D2 (27x27km²) and D3 (9x9km²)-right



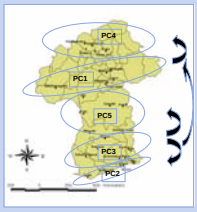
Spatial distribution [mm] of annual actual evapotranspiration (left) & groundwater recharge (right) for 2004

Prediction of Rainy Season's Onset
- Relying on Surface Parameters
- Using Atmospheric Parameters

4. Prediction of the rainy season's onset

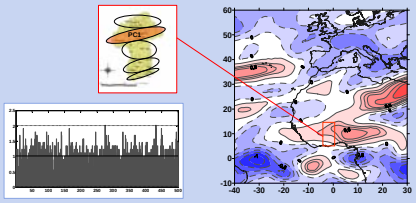
Calculation of linear discriminant functions in order to classify each day into the classes 1.dry season, 2.transition, 3. onset of the rainy season and 4. wet season

- Estimating successively the regional onset dates



Spatial location of the five different regions (ellipses) corresponding to the principal components. The arrows represent the direction for predicting the rainy season's onset of one region using the current onset date of another region; e. g. ORS_PC5 = f(ORS_PC3)

5. Detection of weather patterns which are statistically related to the Rainy Season's Onset



Mean normalized MF_U distribution in 500hPa of CP5 associated to the start of the rains in PC1. Bootstrapping scheme for CP5 and MF_U in 500hPa conditioned on the onset of the rains in PC1. 500 realizations of OP(ONSET) were calculated and compared to OP(ONSET) for CP5 (2.48). The solid line represents the mean value and the dashed line the 3s value of OP(ONSET) for all realizations.