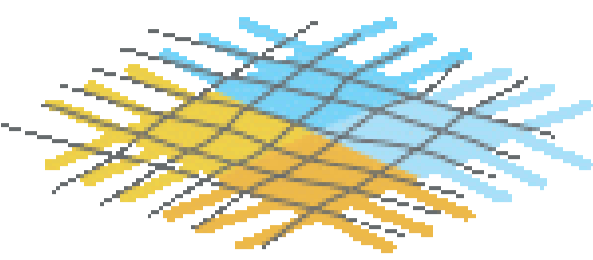


Coupling the regional climate model HIRHAM with the hydrological model MIKE SHE to improve land surface feedback processes

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Part of the HYACINTS project



Objectives:

Coupling of HIRHAM (Christensen et al. 2006) and MIKE SHE (Graham and Butts 2005)
 Include feedback from hydrological model to climate model
 Can a coupled hydrological and climate model improve our hydrological change simulations

Conclusion:

First simple test shows improved evapotranspiration simulations

Work in progress:

Distributed MIKE SHE set up of FIFE area

Further work:

Investigation of grid size for coupling, resolutions:
 MIKE SHE: 100 m, 300 m, 1 km, 3 km, 15 km
 HIRHAM: 25 km, 12 km, 5 km, 3 km, 1 km

Coupled test run

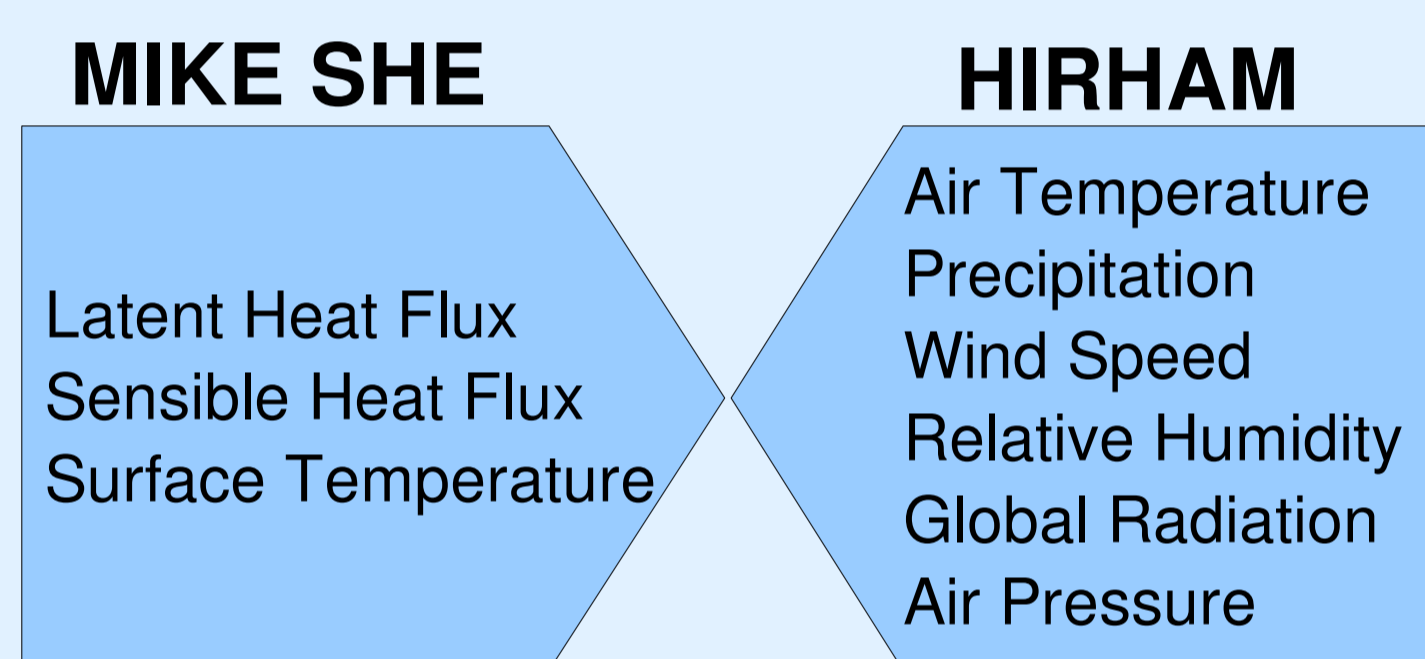


Figure: Exchange variables between MIKE SHE and HIRHAM.

HYACINTS:

Improved tools and methodologies for assessing the effect of climate change on water resources at regional and local scales

WP1: Coupling model

Full dynamic coupling of HIRHAM and MIKE SHE codes
 OpenMI, Unix-Windows

WP2: Scaling of hydrological models

Local grid refinement
 Downscaling of complex geological environments

WP3: Hydrological Change

Coupled model for Denmark
 Precipitation from remote sensing data in mountainous regions

WP4: Uncertainty

Assess uncertainties related to prediction of climate change impacts

Supported by Danish Strategic Research Council
 2008 - 2012
www.hyacints.dk

References:

Betts A.K. and Ball J.H. (1996) *FIFE Surface Climate and Site-Average Dataset 1987-89*. Journal of the Atmospheric Sciences, Vol. 55, No. 7. Page 1091-1108.
 Christensen, O.B., Drews, M., Christensen, J.H., Dethloff, K., Ketelsen, K., Hebestadt, I. and Rinke, A. (2006) *The HIRHAM Regional Climate Model. Version 5*; DMI Scientific Report 06-17. Danish Meteorological Institute.
 ECMWF (2003) *ERA-40: ECMWF 45-year reanalysis of the global atmosphere and surface conditions 1957-2002*. www.ecmwf.int/research/era40/do/get/era-40
 Graham D.N., and Butts M.B. (2005) *Flexible, integrated watershed modelling with MIKE SHE*, In *Watershed Models*, (Eds. V.P. Singh & D.K. Frevert) CRC Press. Pages 245-272, ISBN: 0849336090.
 Mitchell T.D. (2004) *An improved method of constructing a database of monthly climate observations and associated high resolution grids*. About to be submitted. www.cru.uea.ac.uk/~timm/grid/CRU_TS_2_1.html
 Sellers P.J., Hall F.G., Asrar G., Strebel D.E. and Murphy R.E. (1992) *An overview of the first international satellite land-surface climatology project (ISLSCP) field experiment (FIFE)*. Journal of Geophysical Research D 97, 18345-18371.

Test case:

15 x 15 km, Manhattan, Kansas, USA
 The First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE) (Sellers et al., 1992)
 Year 1987, 3th intensive field campaign (August the 6th to 21st).

Validation of HIRHAM:

Domain ~USA. Resolution ~25 km. Forcing ERA40 reanalysis (ECMWF, 2003)

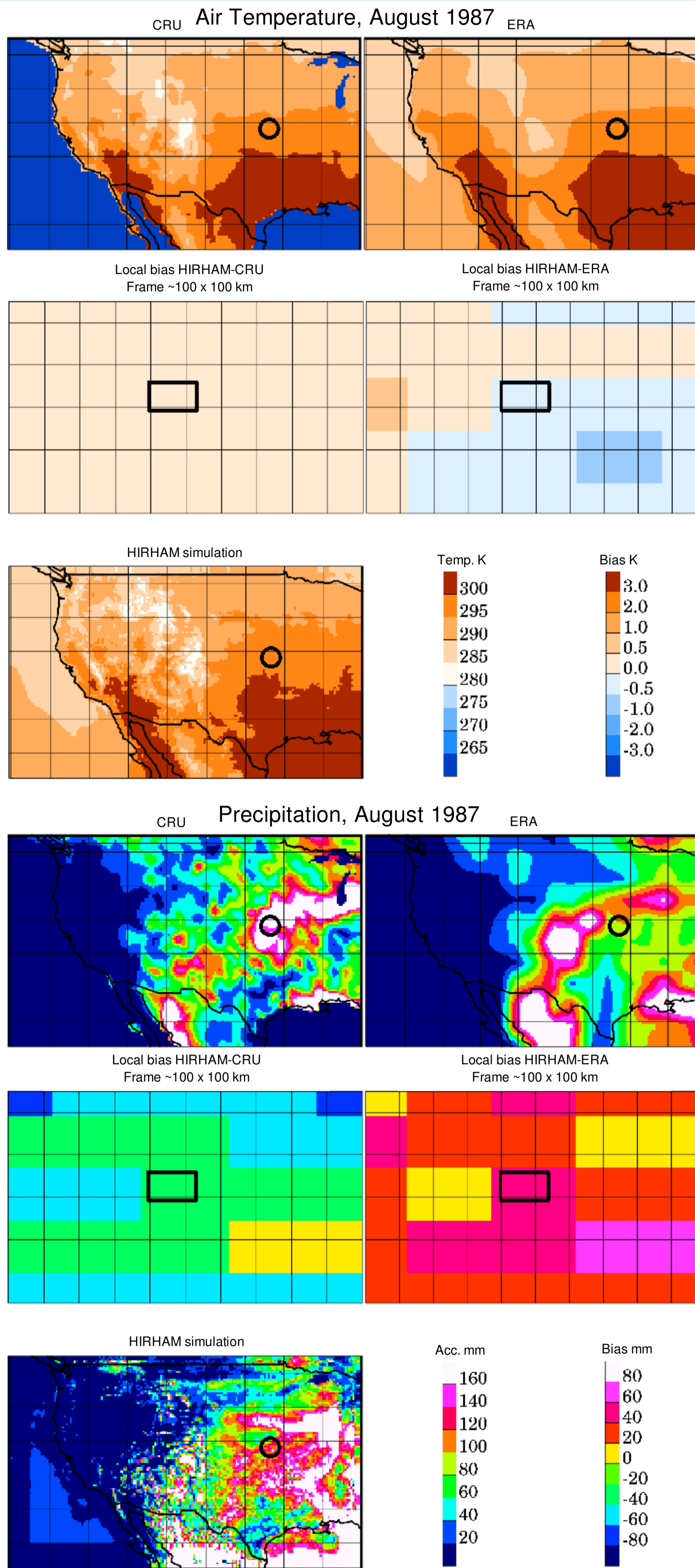


Figure: Monthly mean air temperature at 2 m above ground and month accumulated precipitation, August 1987. FIFE area are located in the circle and local define by the square. ERA (ECMWF, 2003), CRU (Mitchell, 2004)

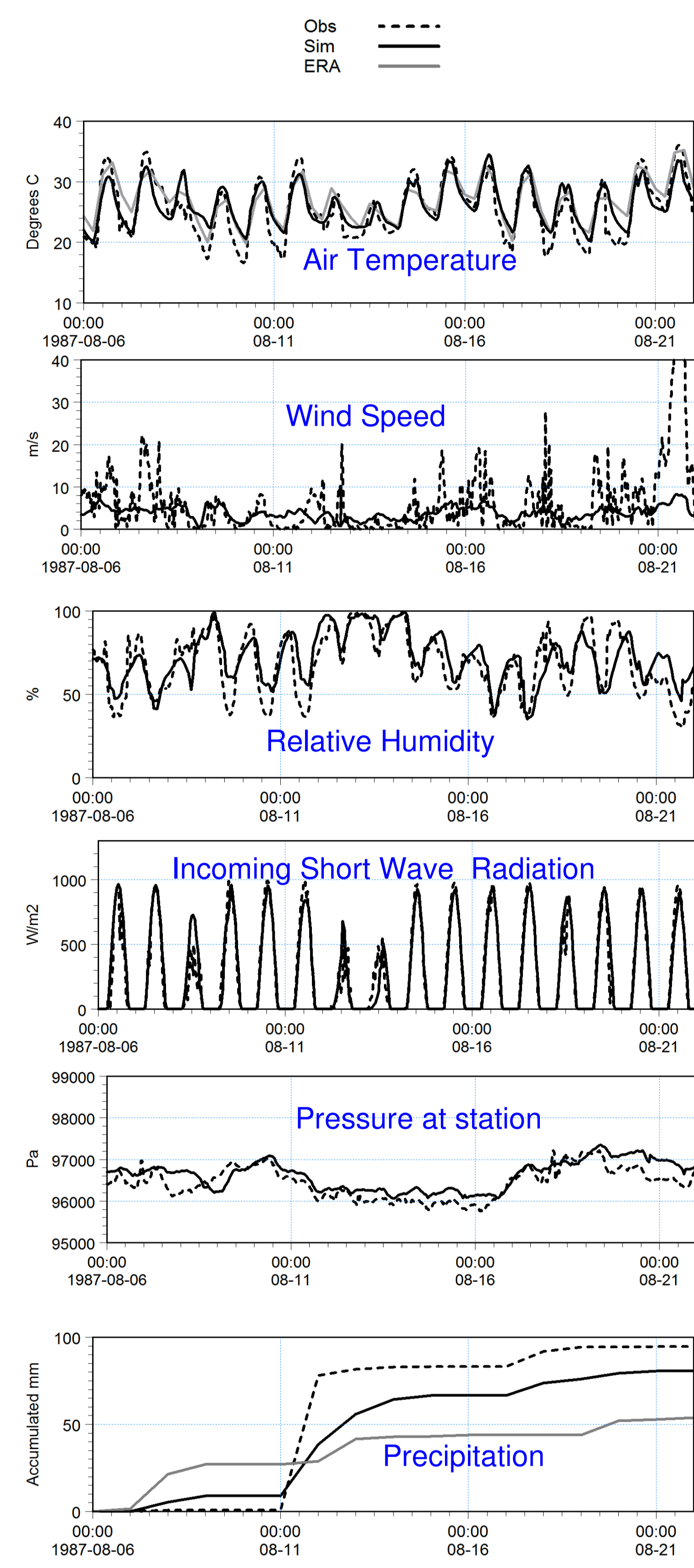


Figure: Comparison of HIRHAM simulation (Sim) with Observations (Obs) from ground meteorological stations and ERA (ERA) for the FIFE area; during field campaign 3. Time series are all used as input for MIKE SHE model.

Validation of MIKE SHE:

Single column of FIFE area 15 x 15 km

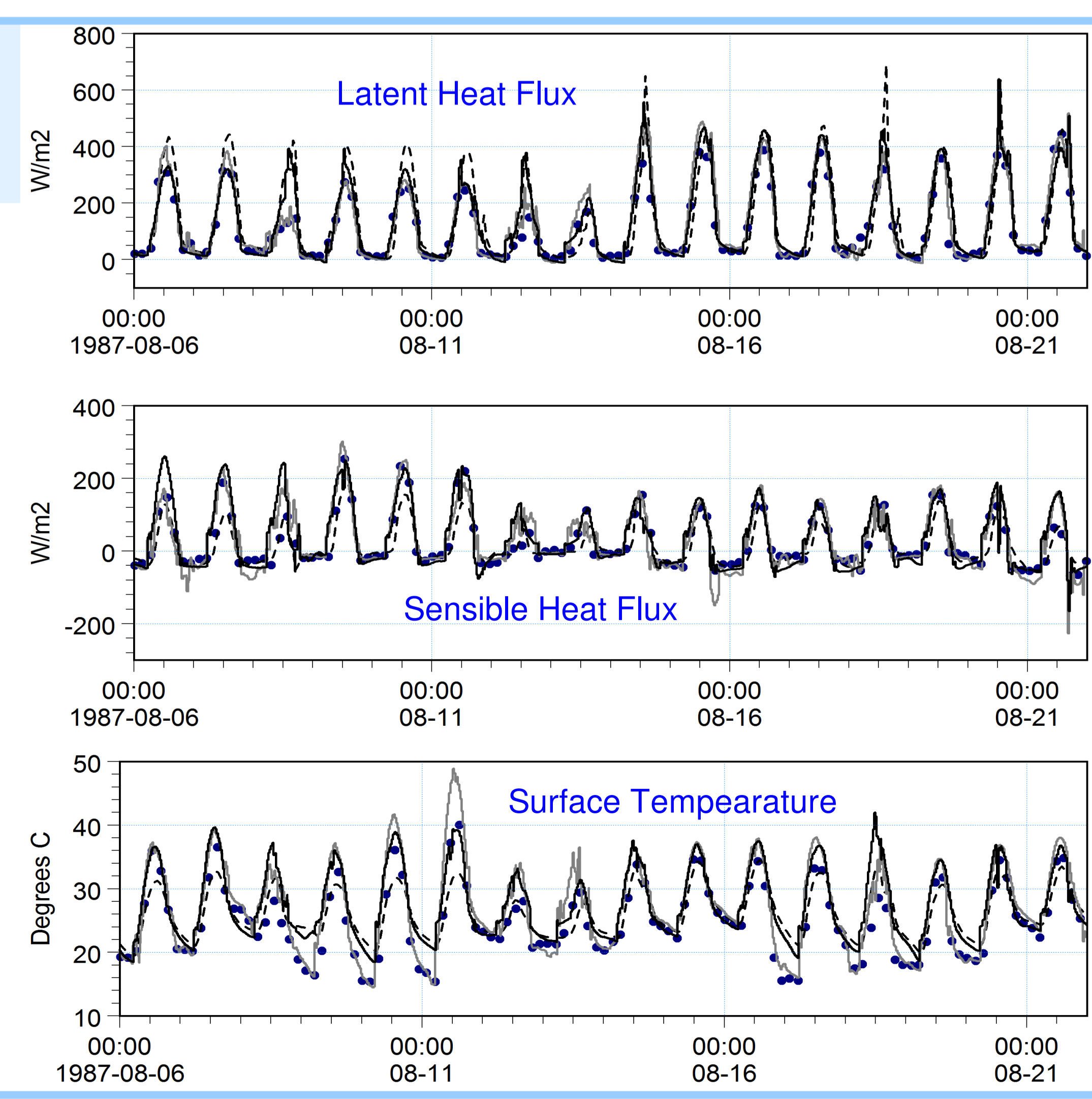


Figure: MIKE SHE simulations with input files of observation from ground stations "Sim (Obs)" and HIRHAM output "Sim (HIRHAM)" compared with observation from ground stations "Obs" (Betts and Ball, 1996) and HIRHAM simulation output "HIRHAM". Values are hourly mean over the FIFE area; during field campaign 3.