

Annual report 2021 for Flagship Pilot Study ELVIC

Status and progress during the year including scientific highlights, end to end perspective and participants engaged in the project

Decisions are made on **guidelines for simulations** concerning the spatial domain, simulation period, settings, experiments and output variables. The consolidated protocols are available at: <https://ees.kuleuven.be/elvic/protocols/>

A list of **data available for evaluation** has been compiled and is used for model evaluation.

The **added value of convection-permitting simulations for the Lake Victoria Basin (LVB)** under present-day climate conditions is assessed, based on the multi-model ensemble (see Table 1 below). The latter consists of existing and new simulations at < 5 km horizontal resolution. A consortium paper summarizing the evaluation is currently in review in Climate Dynamics and was presented at vEGU2021.

The CORDEX Flagship Pilot Study ELVIC (climate Extremes in the Lake VICToria basin) was recently established to investigate how extreme weather events will evolve in this region of the world and to provide improved information for the climate impact community. In the paper submitted to Climate Dynamics, we assess the added value of the convection-permitting scale simulations on the representation of moist convective systems for the Lake Victoria region. With this aim, 10-year present-day model simulations were carried out with five regional climate models at both PARAmeterized (PAR) scales (12-25km) and Convection-Permitting (CP) scales (2.5-4.5km), with COSMO-CLM, RegCM, AROME, WRF and UKMO. Most substantial systematic improvements were found in metrics related to deep convection. For example, the timing of the daily maximum in precipitation is systematically delayed in CP compared to PAR models, thereby improving the agreement with observations. The large overestimation in the total number of rainy events is also alleviated in the CP models. Moreover, systematic improvements were found in the diurnal cycle in Top-Of-Atmosphere (TOA) radiation and in some metrics for precipitation intensity. No unanimous improvement nor deterioration was found in the representation of the spatial distribution of total rainfall and the seasonal cycle when going to the CP scale. Moreover, some substantial biases TOA upward radiative fluxes remain. Generally our analysis indicates

that the representation of the convective systems is strongly improved in CP compared to PAR models, giving confidence that the models are valuable tools for studying how extreme precipitation events may evolve in the future in the Lake Victoria Basin.

Group	Coarse-res model	High-res model	Timing	Driver	Coarse resolution	High resolution	Lake Model
KU Leuven	COSMO-C LM 5.0	COSMO-C LM 5.0	2005-2016	ERA 5	12 km	2.8 km direct from E5	FLake (1D)
SMHI	HCLIM-AL ADIN	HCLIM_AR OME	2005-2016	ERA Interim	12 km	2.5 km	FLake (1D)
Met Office	Pre-HadGE M3-A-N512	MO-UKV	1997-2007	SST: Obs; LBC: pre-HadGE M3-A-N512	25 km	4.4 km	ARC-Lake-v3
ICTP	RegCM 4.7.0	RegCM 4.7.0	2005-2016	ERA Interim	25 km	3.0 km	Hostetler et al.
KIT	WRF v3.9.1.1	WRF v3.9.1.1	2005-2016	ERA Interim	12 km	2.8 km	CLM 4.5 Lake Model (1D)

Tab 1. Overview of the ensemble models with some specifications.

Concerning **climate change assessment in the LVB** (with focus on changes in weather events, like heavy precipitation, heat waves, droughts and wind storms, and the water balance of the lake), the team already decided the methodology, agreeing to apply the Pseudo Global Warming approach, in which a run is driven with re-analyses that are perturbed with a multi-member ensemble mean from the recent CMIP6 global dataset. KU Leuven, ICTP and KIT agreed to follow this approach and provide simulations in the coming months. Yet, also a discussion on multi-member traditional regional climate model projections is on the table, and will possibly be applied at a later stage (with the “CP4A” MetUM simulations already available, Senior et al, 2021)¹.

¹ [Convection permitting regional climate change simulations for understanding future climate and informing decision making in Africa](#), Catherine A Senior, John H Marsham, Ségolène Berthou, Laura E Burgin, Sonja S Folwell, Elizabeth J Kendon, Cornelia M Klein, Richard G Jones, Neha Mittal, David P Rowell, Lorenzo Tomassini, Théo Vischel, Bernd Becker, Cathryn E Birch, Julia Crook, Andrew J Dougill, Declan L Finney, Richard J Graham, Neil C G Hart, Christopher D Jack, Lawrence S Jackson, Rachel James, Bettina Koelle, Herbert Misiani, Brenda Mwalukanga, Douglas J Parker, Rachel A Stratton, Christopher M Taylor, Simon O Tucker, Caroline M Wainwright, Richard Washington, and Martin R Willet, Accepted *Bull. Am. Meteor. Soc.*, 2021.

Summary of each workshop/activity held during the year

Title, date, short description, location, website, links	Responsible person/-s	Funder
CORDEX-FPS ELVIC: a convection-permitting model ensemble over the Lake Victoria region. Presentation at COSMO-CLM Assembly, September 2019, Paestum, Italy	J. Van de Walle (presenting author) and complete ELVIC team: https://ees.kuleuven.be/elvic/team/	
ELVIC: a convection permitting model ensemble over the Lake Victoria region. Presentation at the AFRICAN CLIMATE RISKS CONFERENCE, October 2019, Addis Ababa, Ethiopia	G. Nikulin (presenting author) and complete ELVIC team: https://ees.kuleuven.be/elvic/team/	
Climate Extremes in the Lake Victoria Basin: The ELVIC CORDEX Flagship Pilot Study, presentation at the virtual EGU General Assembly 2020, https://doi.org/10.5194/egusphere-egu2020-17466	N. van Lipzig, J. Van de Walle (presenting author), W. Thiery, G. Nikulin, M. Wu, R. Glazer, E. Coppola, J. Pinto, A. Fink, P. Ludwig, D. Rowell, S. Berthou, D. Finney, and J. Marsham	
Representation of precipitation and top-of-atmosphere radiation in a multi-model convection-permitting ensemble for the Lake Victoria Basin (East-Africa). Presentation at the virtual EGU General Assembly 2021, https://doi:10.5194/egusphere-egu21-8376	van Lipzig, Nicole (presenting author), Jonas Van de Walle, Wim Thiery, Matthias Demuzere, Grigory Nikulin, Russell Glazer, Erika Coppola, Joaquim G. Pinto, Andreas H. Fink, Patrick Ludwig, Dave Rowell, Ségolène Berthou, Declan Finney, and John Marsham	

Related publications during the year

Title, journal and link to publication	Author/-s	Date
Representation of precipitation and top-of-atmosphere radiation in a multi-model convection-permitting ensemble for the Lake Victoria Basin (East-Africa), In review in Climate Dynamics	Nicole P.M. van Lipzig, Jonas Van de Walle, Segolene Berthou, Erika Coppola, Matthias Demuzere, Andreas H. Fink, Declan L. Finney, Russell Glazer, Patrick Ludwig, John H. Marsham, Grigory Nikulin, Joaquim G. Pinto, David P. Rowell, Wim Thiery	In review
Aircraft observations and sub-km modelling of the lake–land breeze circulation over Lake Victoria	Beth J. Woodhams, Paul A. Barrett, John H. Marsham, Cathryn E. Birch, Caroline L. Bain, Jennifer	Q J R Meteorol Soc. 2022;148:557–580

	K. Fletcher, Andrew J. Hartley, Stuart Webster, Solomon Mangeni	https://doi.org/10.1002/gj.4155
<i>Convection-Permitting Regional Climate Change Simulations for Understanding Future Climate and Informing Decision-Making in Africa</i>	Catherine A Senior, John H Marsham, Ségolène Berthou, Laura E Burgin, Sonja S Folwell, Elizabeth J Kendon, Cornelia M Klein, Richard G Jones, Neha Mittal, David P Rowell, Lorenzo Tomassini, Théo Vischel, Bernd Becker, Cathryn E Birch, Julia Crook, Andrew J Dougill, Declan L Finney, Richard J Graham, Neil C G Hart, Christopher D Jack, Lawrence S Jackson, Rachel James, Bettina Koelle, Herbert Misiani, Brenda Mwalukanga, Douglas J Parker, Rachel A Stratton, Christopher M Taylor, Simon O Tucker, Caroline M Wainwright, Richard Washington, and Martin R Willet	Accepted Bull. Am. Meteor. Soc., 2021 https://doi.org/10.1175/BAMS-D-20-020.1
Assessing the impact of climate change on soil erosion in East Africa using a convection-permitting climate model	S Chapman, CE Birch, M Galdos, E Pope, J Davie, C Bradshaw, S Eze, J H Marsham	Env. Res. Lett., 2021. https://doi.org/10.1088/1748-9326/ac10e1
<i>Evaluation of high-resolution precipitation products over the Rwenzori Mountains (Uganda)</i>	Faluku Nakulopa, Inne Vanderkelen, Jonas Van de Walle, Nicole P. M. Van Lipzig, Hossein Tabari, Liesbet Jacobs, Collins Twehey, Olivier Dewitte, and Wim Thiery	Journal of Hydrometeorology, 2022 https://doi.org/10.1175/JHM-D-21-0106.1
Future intensification of precipitation and wind gust associated thunderstorms over Lake Victoria	Jonas Van de Walle, Wim Thiery, Roman Brogli, Olivia Martius, Jakob Zscheischler, Nicole P.M. van Lipzig	Weather and Climate Extremes 34 (2021): 100391. https://doi.org/10.1016/j.wace.2021.100391
<i>Lack of vegetation exacerbates exposure to dangerous heat in dense settlements in a tropical African city</i>	J Van de Walle, O Brousse, L Arnalsteen ¹ , C Brimicombe, D Byarugaba, M Demuzere, E Jjemba, S Lwasa, H Misiani, G Nsangi, F Soetewey, H Sseviiri, W Thiery, R Vanhaeren, B F Zaitchik and N P M van Lipzig	Environmental Research Letters (2022). https://doi.org/10.1088/1748-9326/ac47c3

<p>Can local fieldwork help to represent intra-urban variability of canopy parameters relevant for tropical African climate studies?</p>	<p>Jonas Van de Walle, Oscar Brousse, Lien Arnalsteen, Disan Byarugaba, Daniel S. Ddumba, Matthias Demuzere, Shuaib Lwasa, Gloria Nsangi, Hakimu Sseviiri, Wim Thiery, Roxanne Vanhaeren, Hendrik Wouters, Nicole P.M. van Lipzig</p>	<p>Theoretical and Applied Climatology 146, no. 1 (2021): 457-474. https://doi.org/10.1007/s00704-021-03733-7</p>
--	---	--

Planned activities for next year

- The main activities for the next year are the future climate simulations. These simulations are planned applying the Pseudo Global Warming approach, driving with a multi-member ensemble mean from the recent CMIP6 global dataset. In a later step, a multi-member traditional regional climate model projections will be discussed.
- Guideline on best practices for using climate information from different sources, including GCMs, CORDEX-Africa and CPM data. This includes the potential of narratives (tales) of present and future weather simulations. It is currently under investigation which partner would be interested in taking up this task.
- Currently the staff working on East African climate simulations is rather limited, which is a threat for ELVIC. Therefore we plan to submit proposals related to the ELVIC goals and in pursuit to acquire funding for ELVIC related work.

Additional relevant information

ELVIC website: <https://ees.kuleuven.be/elvic/>

Contact person/-s

Prof. Nicole PM van Lipzig: nicole.vanlipzig@kuleuven.be

Jonas Van de Walle: jonas.vandewalle@kuleuven.be