# *Supplementary Information*

**Table S1:** Full tables describing all papers included in the scoping review (obtained Sept 2022), their DOIs, authors, date, model used, and a brief description of the study. They are split into the following categories: "pure hydrology", GHG dynamics, peat accumulation, global models, model combinations, and coupled models.

## Table S1.1: "Pure Hydrology"

| DOI link(s), chronological order | Year(s) | Authors | Model | Brief description |
|---|---|---|---|---|
| *10.5194/hess-19-2133-2015; 10.1002/2017wr020516* | 2015 & 2017 | Archarya et al. | SWIFT2D | Ridges and sloughs modelling (aerial spatial analysis) |
| *10.1016/j.jhydrol.2014.12.054; 10.1016/j.jhydrol.2017.02.023* | 2015 & 2017 | Ala-aho et al. | HydroGeoSphere (HGS) | Groundwater/surface water interactions in peat soils |
| *10.1029/2019wr026203* | 2020 | Autio et al. | HGS | GW-SW exchange in peatlands. This is the paper in which a mini-review of physically based models used in peatlands was carried out |
| *10.1002/eco.230* | 2012 | Baird et al. | DigiBog | An introduction to the model itself with a literature review. 2D/3D water depths, K, flow |
| *10.1016/j.jhydrol.2011.07.005* | 2011 | Ballard et al. | MATLAB ODE15 solver | Combining 4 1D models to develop a quasi-3D model though not fully integrated. Drained blanket peatland. |
| *10.1002/hyp.6275* | 2007 | Belyea | Functional model (unnamed) | Modelling ridge K to portray bog pools |
| *10.1016/j.jhydrol.2013.06.035* | 2013 | Binet et al. | Mathematical model (unnamed) | Impacts of drought and vegetation of peatland hydrology |
| *10.2166/nh.2013.228* | 2014 | Bourgault et al. | MIKE-SHE | GW flow in both an aquifer and a peatland |
| *10.3390/su8121324* | 2016 | Brandyk et al. | MODFLOW | Baltic peatland restoration with goal of restoring *Carex* communities |
| *10.19189/map.2017.omb.301* | 2017 | Brust et al. | Visual MODFLOW | Developing a water balance for *Sphagnum* farming, including bunds and irrigation ditches |
| *10.1016/s0167-5648(04)80157-6; 10.1029/2005wr004495* | 2004 & 2006 | Camporese et al. | Numerical model (unnamed) | Predicting peat volumes for swelling/shrinking. |
| *10.1088/1755-1315/149/1/012026* | 2018 | Condro et al. | PEAT-VOXEL | 3D agent-based model of surface water dynamics using land-atmosphere interactions from GenRiver Oil palm plantation. |
| *10.1111/j.2005.0906-7590.04265.x; 10.1002/ecs2.4031* | 2005 & 2022 | Couwenberg | Finite-difference model (unnamed) | Hummock-hollow patterning and square-grid WL calculations. Later developed a spatially-explicit heuristic model after Swanson & Grigal (1988) – conducted in MATLAB |
| *10.2136/sssaj2009.0148; 10.1016/j.ecolmodel.2013.11.030* | 2010 & 2014 | Dimitrov et al. | *ecosys* | 2014: WT depths in boreal transition zones between forest & peatland; 2010: subsurface flow at Mer Bleue bog |
| *10.5194/hess-25-291-2021* | 2021 | Duranel et al. | MIKE-SHE/MIKE-11 | Interactions in hydrology between French mire and underlying aquifer. |
| *10.1002/hyp.10408; 10.1002/2015wr017667; 10.1016/j.jhydrol.2018.10.039* | 2015, 2016, & 2018 | Gao et al. | TOPMODEL | Catchment-level runoff. Focus on flooding in later 2 papers; the earliest focuses on land-cover change impacts. |
| *10.1016/j.ecolmodel.2012.06.031* | 2012 | Gong et al. | SVAT (soil-vegetation-atmosphere-transportation). | Compartmentalizes spatially into hydrologically-similar units (HSUs) to then develop a grid. |
| *10.1029/2020wr029209* | 2021 | Gouzardi et al. | TOPMODEL | Subsurface hydrology in eroded blanket peats – flood attenuation |
| *10.2166/nh.1987.0007* | 1987 | Guertin et al. | PHIM | Predicting Minnesota streamflow on a watershed level |
| *10.1002/2015wr018038; 10.1002/2016wr019442; 10.1139/cjfr-2017-0269* | 2014, 2016 (Jan) | Haahti et al. | FLUSH, coupled with FEMMA in some papers | 2016 paper is included in the Autio et al. review. channel network flow through ditches, erosion assessment |
| *10.1007/s13280-017-0984-9* | 2018 | Hasselquist et al. | GIS: LiDAR and SAGA | DEMs combined with Catchment Area (CA) algorithms within SAGA to predict flow from ditches |
| *10.1371/journal.pone.0064174* | 2013 | Heffernan et al. | Closed-form mathematical model (unnamed) | Ridge and slough modelling in the Everglades |
| *10.1016/j.jhydrol.2021.126894* | 2021 | Hokanson et al. | HYDRUS-2D | GW recharge on a hummock scale for a water-limited area. Forested peat. |
| *10.1002/hyp.11449* | 2018 | Hwang et al. | HGS | Surface-subsurface flow model for a full river basin in Canada |
| *10.3390/rs14133169* | 2022 | Ikkala et al. | GIS: LiDAR and SAGA | Evaluating "wetness" and diversions in flow paths post-restoration for minerotrophic peatlands. |
| *10.1007/s11027-010-9214-5* | 2010 | Jaenicke et al. | SIMGRO and GIS | Spatial analysis of groundwater rise pos-restoration in a tropical peatland |
| *10.1016/j.jhydrol.2019.04.094* | 2019 | Jaros et al. | HGS 3D | Cited in Autio et al.'s review as well as being obtained from this review's paper search. Combining forested and open peatland model parametrization. |
| *10.4296/cwrj3404349* | 2009 | Jutras et al. | HYDROTEL | Watershed-level streamflow and discharge water budget in Canadian peatland |
| *10.1029/2012gl052754* | 2012 | Kaplan et al. | SWIFT2D | Patterning model for the Everglades |
| *10.1029/2004wr003099* | 2004 | Kennedy and Price | FLOCOPS | 1D model of hydrology and peat hydraulics in a cutover peat system. FLOCOPS developed specifically for that peatland type |
| *10.5194/hess-12-1211-2008* | 2008 | Koivusalo et al. | FEMMA | Peatland forestry model evaluating impacts of ditch drainage |
| *10.1002/hyp.9978* | 2014 | Levison et al. | MODFLOW | Changes in flow patterns through different climate change scenarios |

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|---|---|---|---|---|
| *10.1002/hyp.9486* | 2013 | Lewis et al. | GEOTop (TOPMODEL-based) | Forestry impact on hydrology of Irish peatlands |
| *10.1016/j.jhydrol.2019.05.032* | 2019 | Li et al. | MODFLOW | Disturbed peatland hydrology: cutover areas and stream gullies |
| *10.1016/j.jhydrol.2016.08.037* | 2016 | Luscombe et al. | GIS: LiDAR (and likely other packages) | Flow delineation using an algorithm developed by Jenson and Dominique in 1988. Multiple spatial scales. |
| *10.2166/nh.2021.064* | 2021 | Marttila et al. | MODFLOW | Groundwater flows from a mire into an esker. |
| *10.5194/esurf-1-29-2013* | 2013 | Morris et al. | DigiBog | Evaluating patterning in a gridded peatland landscape; are models reaching a “true” steady-state? |
| *10.1111/sum.12272* | 2016 | Mustamo et al. | DRAINMOD | Peat hydraulics and WT simulated for peat soil in different land use conditions |
| *10.1007/s13280-017-0966-y* | 2018 | Nieminen et al. | FEMMA | Runoff in boreal peat forests |
| *10.1016/j.scitotenv.2016.12.104* | 2017 | Nijp et al. | Euler-forward model (unnamed), coded in the Ventana interface | Peat volume change in drought events |
| *10.3846/1648-6897.2008.16.105-112* | 2008 | Povilaitis and Querner | SIMGRO | Determining water levels and overall outflow post-restoration in a lake/peatland ecosystem |
| *10.1080/17480930902955724* | 2010 | Price et al. | Numerical model (unnamed in abstract and no access to full article) | Fen reconstruction design and hydrological modelling after oil sands mining took place (Alberta). Perhaps not relevant but I’m keeping until I can check the full article |
| *10.1016/j.jhydrol.2018.05.041* | 2018 | Pullens et al. | GEOTop | Mountain peatland surrounded by other ecosystems: simulating discharge, volumetric water content, and energy fluxes |
| *10.1002/hyp.14470* | 2022 | Putra et al. | DigiBog_Hydro | 2D (x-y) hydrology evaluating restoration in a tropical peatland. |
| *10.1623/hysj.54.2.363;*<br>*No DOI (ISSN: 1230-1485; vol 19 issue 1 pp. 149-159)* | 2009 & 2010 | Querner et al. | SIMGRO within GIS environment | Northern European peatland hydrology and more Lithuania basin hydrology (see Poviliatis & Querner) |
| *10.1080/02626667.2017.1391387* | 2017 | Quillet et al. | MODFLOW | 2D steady-state groundwater flow in Canadian peatlands of varying hydrogeological settings |
| *10.1016/s0022-1694(99)00183-3;*<br>*10.1016/s0022-1694(00)00386-3;*<br>*10.1016/s0022-1694(00)00402-9;*<br>*10.1672/07-71.1;*<br>*10.1029/2008gm000825* | 2000,<br>2001 (Feb), 2001 (Mar), 2008, 2009 | Reeve et al. | MODFLOW, MODPATH | Vertical flow in peatlands; dispersive mixing; regional groundwater flow; simulating hydrogeologic setting in Alaska; permeable mineral lenses in peat hydrology |
| *10.1623/hysj.53.5.989* | 2008 | Schmalz et al. | SWAT | Discharge for lowland catchments larger than but often including peatlands. May be too broad a scope. |
| *10.3390/f9100645* | 2018 | Stenberg et al. | FLUSH | Drained, forested peatland hydrology: role of tree stand management |
| *10.1016/j.jhydrol.2018.03.011* | 2018 | Sterte et al. | MIKE-SHE | Groundwater-surface water interactions in a boreal peatland |
| *10.5614/j.eng.technol.sci.2021.53.2.5* | 2021 | Suryadi et al. | GIS Freewat plugin which integrates MODFLOW | “Canal blocking” model in tropical peatlands. Divisions into sub-peatland hydrological units occur here. |
| *10.1016/j.scitotenv.2022.157543* | 2022 | Sutton and Price | MODFLOW-SURFACT | Solute transport and WT simulations. Sodium transport implications for fen development. |
| *10.1016/j.geoderma.2019.04.001;*<br>*10.1088/1748-9326/ab96d4* | 2019 & 2020 | Taufik et al. | SWAP | Predicting drought severity in tropical peatlands (may not be as applicable) |
| *10.1016/j.jhydrol.2015.05.027;*<br>*10.1002/hyp.11183* | 2015 & 2017 | Thompson et al. | HGS | One of these papers is also included in the Autio et al. review. Yielding primarily hydraulic heads to investigate more GW-SW interactions and climate change impacts on Boreal peatlands |
| *10.1016/j.jhydrol.2005.10.039* | 2006 | Tiemeyer et al. | Numerical model (unnamed) | Based on boussinesq equation, development of a model from a limited dataset (requires only Ks, Sy, and weights) |
| *10.1002/eco.2445* | 2022 | Tilak et al. | HYDRUS-1D | Surface controls in peat hydrology and resilience to disturbances |
| *10.5194/bg-17-4769-2020* | 2020 | Urzainki et al. | Numerical model (unnamed) | Again, boussinesq-based. Full explanations of the model are available in 2 cited papers. Canal blocking optimization. |
| *10.1016/j.ecolmodel.2005.07.016* | 2006 | Weiss et al. | 1D numerical model (unnamed) | WT levels with time along with peat temperatures in boreal peatlands |
| *10.1016/j.envsoft.2016.06.004* | 2016 | Zi et al. | GEOTop | 3D hydrology and transport for soil erosion dynamics. |

# Table S1.2: GHG Dynamics

| DOI link(s), chronological order | Year(s) | Authors | Model | Brief description |
|---|---|---|---|---|
| *10.3390/rs10040565* | 2018 | Arroyo-Mora et al. | GIS – LiDAR and empirical models | Estimating photosynthetic activity and carbon uptake spatially |
| *10.5194/cp-5-361-2009* | 2009 | Berrittella and van Huissteden | PEATLANDVU and BIOME | Calculating process-based plot-scale vegetation NPP (BIOME) and CH4 emissions (PEATLANDVU) |
| *10.3390/rs10040565* | 2018 | Bona et al. | The Canadian model for peatlands (CaMP) | Canada-specific model for carbon budgeting: yields CO2, CH4, and WT estimates for entire peatlands ("large spatial scale"). Sort of a step up from just finding NEE/CH4 site by site. |
| *10.1007/s10584-012-0445-1* | 2020 | Bosio et al. | GIS and HadCM3 | Vegetation change and CO2/CH4 emission based on “vegetation type specific flux estimates” with respect to climate change |
| *10.1007/s10021-019-00430-5* | 2020 | Chamberlain et al. | R-coded machine learning | Methane-specific connections between GHGs and salinity in drought conditions |
| *10.5194/tc-13-647-2019;*<br>*10.1029/2019jg005355* | 2019 (Feb) & | Chang et al. | *Ecosys* | Carbon cycle sensitivities to permafrost thaw; methane production with permafrost thaw |

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|---|---|---|---|---|
| | 2019 (Oct) | | | |
| *10.1594/pangaea.875116* | 2017 | Chaudhary et al. | LPJ-GUESS | Process-based combination of vegetation dynamics and GHGs used here for an arctic Holocene model |
| *10.5194/bg-11-4753-2014; 10.1002/2014jg002880* | 2014 & 2015 | Deng et al. | DeNitrification DeComposition (DNDC) | Combining a soil temperature model with DNDC to model permafrost thaw and GHG fluxes; effects of changing temperatures and WT on C-fluxes. |
| *10.1029/2008wr007284* | 2008 | Dinsmore & Billett | Empirical model (unnamed) | CO2 in a peatland stream (may be DOC actually?) |
| *10.1002/eco.1592* | 2015 | Evrendilek | Neural network | Extrapolating NEE spatially to assess sink/source strength in response to hydrology/extreme events |
| *10.1016/j.cosust.2011.08.010; 10.1007/s11027-013-9517-4* | 2011 & 2014 | Farmer et al. | Model review; TROPP-CAT | From the first review of peatland GHG emissions models, the following models in a TROPICAL context were mentioned: HPM, McGill Wetland Model, Yasso, MERES, LPJ, RothC, SUNDIAL, and ECOSSE, as well as PEATLAND, PnET, and SIMGRO. The second paper developed a new peatland-plantation carbon tool specific for tropical plantations on peatlands, but maybe could be adjusted for a northern forestry context. |
| *10.1002/2017jg004037* | 2017 | Grant et al. | *Ecosys* | Effects of microtopography, temp, & precip on CO2/CH4 exchange in arctic tundra |
| *10.1029/2006jg000395* | 2008 | Henman and Poulter | Numerical model (unnamed) | Impacts of seawater inundation of carbon cycle. Hand-calculated model of carbon emissions based on 4 inundation scenarios |
| *10.1007/s00254-008-1613-5* | 2009 | Lai | Numerical model (unnamed) | Hand-developed CH4 emission model for Mer Bleue. 1D. |
| *10.5281/zenodo.6802101* | 2022 | Lippmann | PVN | Source code and documents about the PVN model for peatland GHG emissions including plant functional types. Does not link paper which use the model. |
| *10.1016/j.ecolind.2017.08.014* | 2017 | Parkkari et al. | Maxent (machine learning) | Spatial variation of GHG fluxes on a landscape distribution level |
| *10.5194/bg-5-111-2008; 10.1017/s0016774600000913* | 2008 & 2009 | Petrescu et al. | PEATLAND-VU | Hydrological parametrization of methane emissions modelling in the arctic; a modelling approach in the Netherlands |
| *10.1029/97gb02302* | 1997 | Potter | Mathematical model | Carnegie-Ames-Stanford Approach (CASA) for simulating methane production and emission from wetlands |
| *10.1016/j.scitotenv.2020.142433* | 2021 | Premrov et al. | ECOSSE | CO2 fluxes from a drained and rewetted peatland based on water table simulation. |
| -- | 2015 | Roulet & Wang | McGill Wetland Model | NEE, CH4, and DOC exchanges modelled for a thawing palsa peatland |
| *10.1016/j.foreco.2021.119479* | 2021 | Shanin et al. | ROMUL_Hum | Humic decomposition to describe C-fluxes in forested peatlands. |
| *10.1029/2007jg000605* | 2008 | Sonnentag et al. | BEPS-TerrainLab | Vegetation-based C-fluxes under peatland hydrology; tweaked to predict WT as well. |
| *10.7809/b-e.00127* | 2012 | Thiele et al. | GEST-Model | Access to abstract only. Belarus-specific assessment tool of peatland restoration and GHG emissions |
| *10.1029/96gl03577* | 1996 | Walter et al. | Process-based model (unnamed in abstract; no access) | Methane emissions in natural wetlands as a function of hydrologic/thermal conditions |
| *10.5194/gmd-3-565-2010* | 2010 | Wania et al. | LPJ-WHyMe | Extension of globally flexible models for wetland methane emissions. |
| *10.1016/j.scitotenv.2012.08.084* | 2012 | Worrall & Clay | Durham Carbon Model | Impacts of sheep grazing on carbon balance; simulates GHG fluxes and defines a GHG "carry capacity" for sheep populations in developing emissions factors |
| *10.1002/jgrg.20045* | 2013 | Wu et al. | McGill Wetland Model | Likely a precursor to CLASS3W-MWM; simulating 6 years of C-fluxes in an oligotrophic minerogenic peatland |

## Table S1.3: Peat Accumulation

| **DOI link(s), chronological order** | **Year(s)** | **Authors** | **Model** | **Brief description** |
|---|---|---|---|---|
| *10.1111/j.0022-0477.2004.00905.x* | 2004 | Bauer | Numerical model (unnamed) | Dry peat mass storage model leading to accumulation; simulating the long-term impacts of litter quality |
| *10.1111/j.1529-8817.2003.00783.x* | 2004 | Belyea & Malmer | Mathematical model (unnamed) | Simulating historical carbon sequestration responses to climate over millenia |
| *10.1672/0277-5212(2002)022[0100:mcairm]2.0.co;2* | 2002 | Chimner et al. | CENTURY | Long-term C-accumulation and short-term changes in C-accumulation due to changes in hydrology. |
| *10.5194/esd-1-1-2010* | 2010 | Frolking et al. | Holocene Peat Model (HPM) | Description of the model in a paper – yield NPP, decomposition, water balance, and peat accumulation. |
| *10.1890/06-1267.1* | 2007 | Larsen et al. | PeatAccrete | Ridge and slough ecohydrological feedbacks impacting long-term landscape morphology (century scale) |
| *10.1029/2012jg002092* | 2013 | Quillet et al. | HPM | Sensitivity analysis for HPM determining main drivers for peat accumulation |
| *10.1029/2009wr008242* | 2010 | Rennermalm et al. | PAM_T/SPAM_T | Stochastic peat accumulation model based on the hydrological cycle, determining the long-term influence of hydrological variability |
| *10.1029/2012gl051500* | 2012 | Swindles et al. | DigiBog | Reconstruction of past bog growth, WT, and links (or lack thereof) with climate |
| *10.1002/2016jg003452* | 2016 | Wang et al. | Peat Terrestrial Ecosystem Model (P-TEM) | Containing modules for hydrology, soil thermal and methane, though this paper focuses on carbon accumulation (Technically, this is a "coupled" model but the focus is what puts it in this category). |
| *10.1007/s12665-011-1073-1* | 2012 | Wu | Peat Accumulation Model (PAM) within STELLA 9.0 | Dynamic system modelling approach. Linking peat development responses to (imposed) climate changes. |

## Table S1.4: Global Models

| DOI link(s), chronological order | Year(s) | Authors | Model | Brief description |
|---|---|---|---|---|
| *10.5194/hess-18-3319-2014; 10.1029/2018ms001574; 10.1016/j.rse.2020.111805* | 2014, 2019, & 2020 | Bechtold et al. | Peatland Catchment Land Surface Model (PEAT-CLSM) | A peatland-specific attachment to the NASA-developed CLSM. More for incorporation into larger climate models. 2014 paper does not use CLSM, but is likely a precursor to its development |
| *10.3390/rs12182936* | 2020 | Burdun et al. | OPtical TRApezoid Method (OPTRAM) and PEAT-CLSM | Physically based approach to estimate soil moisture remotely (OPTRAM) combined with PEAT-CLSM to develop a moisture index in peatlands |
| *10.5281/zenodo.3829896* | 2020 | Dietrich et al. | MAgPIE | Source code and documentation for the model: a global multi-regional energy/economy/land/climate dynamics model, which links a citation using the model on a peatland (Humpenoeder et al. down below) |
| *10.1016/j.ecolmodel.2013.04.018* | 2013 | Gong et al. | Process-based model (unnamed) | National model for CO2 and CH4 fluxes in pristine peatlands. |
| *10.1029/2021ms002721* | 2022 | Graham et al. | ELM-SPRUCE | Land surface model simulating nitrogen, carbon, and water cycling specific to the SPRUCE experiment site in Minnesota. Parametrization and sensitivities analyzed here. |
| *10.1002/hyp.1265* | 2003 | Hall et al. | MOSES | Hydraulic/thermal surface exchange in peat layers to contribute to GCMs |
| *10.1088/1748-9326/abae2a* | 2020 | Humpenoeder et al. | MAgPIE | Land-use change projections affecting peatland area and GHG emissions |
| *10.5194/gmd-11-3279-2018* | 2018 | Largeron et al. | ORCHIDEE ORC-HL-PEAT | TOPMODEL approach for high-latitude peatland mapping |
| *10.1007/s00267-014-0417-5* | 2015 | Nungesser et al. | SFWMM | Legacy model specific to south Florida; long-term predictions of climate change scenarios for the Everglades |
| *10.1029/2009gb003610* | 2010 | Petrescu et al. | PEATLAND-VU and PCR-GLOBWB | Up-scaling PEATLAND-VU for global models. PCR-GLOBWB was used to provide daily hydrological output in the form of WT depths and snow thickness |
| *10.5194/gmd-11-497-2018; 10.5194/gmd-12-2961-2019* | 2018 & 2019 | Qiu et al. | ORCHIDEE-PEAT/ ORCHIDEE-MICT | CO2 and hydrology for land surface derived from a global peat map. Description of model in 2018 paper and application to post-Holocene peatland C-dynamics in 2019. |
| *10.5194/cp-9-1287-2013* | 2013 | Spahni et al. | LPX-Bern 1.0 | Integrated natural, agricultural, and peatland ecosystems N & C dynamics: vegetation-based model. Incorporates some hydrology (likely just WT). Related to LPJ as seen earlier. |

## Table S1.5: Model Combinations

| DOI link(s), chronological order | Year(s) | Authors | Model | Brief description |
|---|---|---|---|---|
| *10.5194/bg-12-5689-2015; 10.5194/gmd-9-915-2016* | 2015 & 2016 | Aleina et al. | Hummock-hollow (HH) model | Combined with an unnamed process-based model from Walter and Heimann (2000). Modelling the effects of microtopography on CH4 fluxes and upscaling CH4 emission hotpots to global levels. |
| *10.5194/hess-22-4907-2018* | 2018 | Bernard-Jannin et al. | Hydrological model with DOC-transport (unnamed) | DOC dynamics in a rehabilitated *Sphagnum* peatland, for when a single outlet is not easily identifiable or monitored. Note neither model is housed in an interface. |
| *10.1088/1748-9326/2/4/045015* | 2007 | Bohn et al. | Variable infiltration capacity (VIC) macrohydro model, with the biosphere-energy-transfer-hydrology terrestrial ecosystem model (BETHY) | Grid-cell format model simulating yearlong estimates for CH4 emissions, soil temperature, and water table. |
| *10.1002/eco.2471* | 2022 | Booth et al. | HyperNiche 2 with unnamed numerical variable-saturated GW-flow model | Combination of simulating hydrologically-based habitat niches with regional hydrology in fens (2D) for better estimates of soil moisture based on vegetation growth. Also outputs a weighted Floristic Quality Index (wFQI) |
| *10.1007/s10533-016-0182-z* | 2016 | de Wit et al. | PERSiST and INCA-C | Hydrological outputs from the rainfall-runoff model PERSiST informed DOC transport simulated by INCA-C. Identifying controls (seasalt depositions, temperature, precipitation) |
| *10.1086/598487* | 2009 | Eppinga et al. | Unnamed model | No full access to article. Combination of nutrient model and hydrology model for peatland surface patterning. |
| *10.1002/2016wr019442; 10.1139/cjfr-2017-0269* | 2016 & 2018 | Haahti et al. | FLUSH with a 1D sediment transport model (unnamed) | Sediment transport and evaluation of control in a drainage network within a forested peatland. |
| *10.1111/j.1600-0889.2005.00168.x* | 2006 | Ju et al. | InTEC 3.0 with TOPMODEL | Providing a hydrological input to a GHG model InTEC on a large scale. Simulating multi-year WT depths, NEP/NBP, and soil C density. |
| *10.1002/2015wr018057* | 2016 | Kurylyk et al. | NEST with SUTRA | A 1D wetland and peatland hydrology model NEST link with a spatial subsurface heat transfer model SUTRA to simulate vertical/lateral heat flow during permafrost thaw/peatland landscape transition |
| *10.1111/gcb.16359* | 2022 | Wilson et al. | NEE and CH4 flux calculations combined with ArcGIS spatial hydrology. | Producing WT simulations along with C-exchange for climate scenarios in a re-wetted peatland. Will likely read this more fully as a part of what's going on in Ireland. |
| *10.1029/2019wr025592* | 2020 | Xu et al. | PERSiST and INCA-C | Another paper combining a hydrological and chemical model to look at DOC transport. One related author (Ledesma) worked on both papers. More of a water-supply focus from peatland-fed systems under climate change. |

## Table S1.6: Coupled Models

| DOI link(s), chronological order | Year(s) | Authors | Model | Brief description |
|---|---|---|---|---|
| *Book chapter. ISBN: 978-1-4398-1425-3* | 2011 | Brooks et al. | PHIM WET-HAWQ | Intact and drained peat for full systems with a hydrograph input; incorporating codes for water quality and biogeochemistry |
| *10.1029/2010jg001312; 10.1029/2010jg001586* | 2010 & 2011 | Dimitrov et al. | *ecosys* | Combination of hydrology and GHG emissions. Impact of hydrology on ecosystem respiration in 2010; impacts on NPP and NEP in 2011. |
| *10.1016/j.agrformet.2013.06.012; 10.1016/j.agrformet.2014.08.011; 10.5194/bg-17-5693-2020* | 2013, 2014, & 2020 | Gong et al. | RCG-C (2013 & 2014) and Peatland Moss Simulator (2020) | Development of a *crop-cultivated* peatland model for C-fluxes and water balances. 2020 paper outlines *sphagnum* vegetation dynamics relative to water and energy balances |
| *10.5194/bg-13-2305-2016* | 2016 | He et al. | CoupModel | Drained peatlands for forestry, modelling plant and soil development from 1951 to 2011, as well as GW level, NEE, and accumulated CO2 and N2O fluxes. |
| *10.3354/cr00928; 10.1111/gcb.14298* | 2010 & 2018 | Heinemeyer et al. | MILLENIA | Development of peat-accumulation cohort model MILLENIA which also includes variable WTD to drive C-dynamics, then using MILLENIA on available climate records for reconstructions while incorporating impacts of land management on climate change. |
| *10.1046/j.1365-2745.2000.00438.x* | 2000 | Hilbert et al. | Mathematical mixed model (unnamed) | Two coupled non-linear differential equation representing change in peat depth and depth to the water table. Technically this is probably considered as just one hydrological model but because they hand-combine the two equations rather than automating it I'm putting it here. |
| *10.5772/1743* | 2010 | Ise et al. | ED2.0-peat | Predicting water table, soil temperature, and methane emissions as well as being able to simulate peat accumulation over millennia in different climate scenarios. Results did not seem very precise, though… |
| *10.1111/gcb.13931* | 2018 | Kasimir et al. | CoupModel | GHG fluxes informed by hydrology and plant production as well as crop economics |
| *10.3390/f12030293* | 2021 | Lauren et al. | SUSI | Stand growth, nutrient availability, and hydrology for drained *forested* peatlands under varied management conditions and site types |
| *10.1002/eco.2361* | 2022 | Mahdiyasa et al. | MPeat | 1D peat growth model producing cumulative C and WT depths over long time scales. Compared against DigiBog and HPM. |
| *10.3390/w14091458* | 2022 | Melaku et al. | SWAT | Coupling watershed-level hydrology with CO2 emissions and NEE. Semi-distributed with subroutings predicting emissions at a hydrologic response unit (HRU) level. |
| *10.5194/gmd-9-4313-2016* | 2016 | Metzger et al. | CoupModel | Parameter interactions and sensitivity analysis for the model in a natural peatland. Modelling C, heat, and water fluxes. |
| *10.5194/bg-11-577-2014; 10.1002/2015jg003005; 10.1002/2016jg003501; 10.5194/bg-14-5507-2017* | 2014, 2015, 2016, & 2017 | Mezbahuddin et al. | *ecosys* | 2014: effects of seasonal variation in WT on net CO2 exchange by simulating both WTD and NEP; comparing modelling versus measurements for seasonal variation; 2016: hydrological controls for a northern site; 2017: simulating WTD effects on CO2 exchange in northern site. |
| *10.5194/bg-11-3985-2014* | 2014 | Mi et al. | PEATLAND-VU | Capturing CH4 fluxes, WT position, and soil thermal properties for a 1D column (plot-scale). |
| *10.1002/eco.229; 10.1002/2015wr017264; 10.1002/2015gl066824* | 2012, 2015 (Jul) & 2015 (Dec) | Morris et al. | DigiBog | Combination of hydrology and C-accumulation. Development of the model in 2012, fine-tuning peat K in models vs. measurements in Jul 2015; simulating WTDs and peat decomposition for long-term post-Holocene peat development. |
| *10.1016/j.ecohyd.2013.03.004; 10.1016/j.ecolmodel.2017.04.014* | 2013 & 2017 | Nakayama | National Integrated Catchment-based Eco-hydrology (NICE), NICE-BCG | 2013: distributed model which combines hydrology and ecology. Only outputs sediment nutrient loading rather than gaseous fluxes. 2017: Now coupled to include CO2 and CH4 fluxes in NICE-BCG. |
| *10.1016/s0304-3800(03)00067-x* | 2003 | Nungesser | HOHUM (HOlow HUMmock) – different from HH? | Combining hydrology with *sphagnum* growth and decomposition and peat accumulation. Used for microtopography modelling in hummocks and hollows |
| *10.5194/bg-12-6463-2015* | 2015 | Shi et al. | Community Land Model | Combining hydrology (chiefly WT) with vegetation dynamics. TOPMODEL-based subsurface flow approach. No GHGs. |
| *10.1029/2011jg001862* | 2012 | Sulman et al. | DLEM, LPJ, *ecosys,* ORCHIDEE, SiB SiBCASA, and TECO | Comparison of seven CO2 flux models. Only *ecosys* simulates WTs, many of the other may fall better into the GHG-only category. |
| *10.1002/eco.1526; 10.1016/j.scitotenv.2017.11.252* | 2015 & 2018 | Tang et al. | LPJ-GUESS | Full catchment scale coupling hydrology and carbon cycling for DOC/SOC sorption and transport. |
| *10.1078/1617-1381-00016; 10.1002/hyp.1380* | 2002 & 2004 | Trepel and Kluge | DILAMO (2002) and WETTRANS (2004) | DILAMO combines water/nitrogen/carbon cycles, and able to be incorporated into GIS with DEMs. WETTRANS couples hydrology with N-exchange in riparian peatlands. |
| *10.1016/j.ecolmodel.2012.10.004* | 2013 | Webster et al. | Wetland-DNDC | Fen carbon dynamics over multiple decades coupled with hydrology. |
| *10.1080/07055900.2012.730980; 10.1002/2014gb004845* | 2012 & 2014 | Wu et al. | CLASS3W-MWM (from McGill WM) | coupled land-surface scheme and peatland C model. Responses of bogs and fens |
| *10.1002/2016wr019898* | 2017 | Young et al. | DigiBog | 2D application of DigiBog investigating the effects of ditch damming on peat depths and water table, in short- and long-term scales. |
| *10.1016/j.jhydrol.2021.127137* | 2021 | Yuan et al. | ELM-SPRUCE E3SM | Hydrological impacts on peatland CH4 emission under climate scenarios |
| *10.1029/2001gb001838* | 2002 | Zhang et al. | Wetland-DNDC | Fully explained model and tested in multiple locations. |