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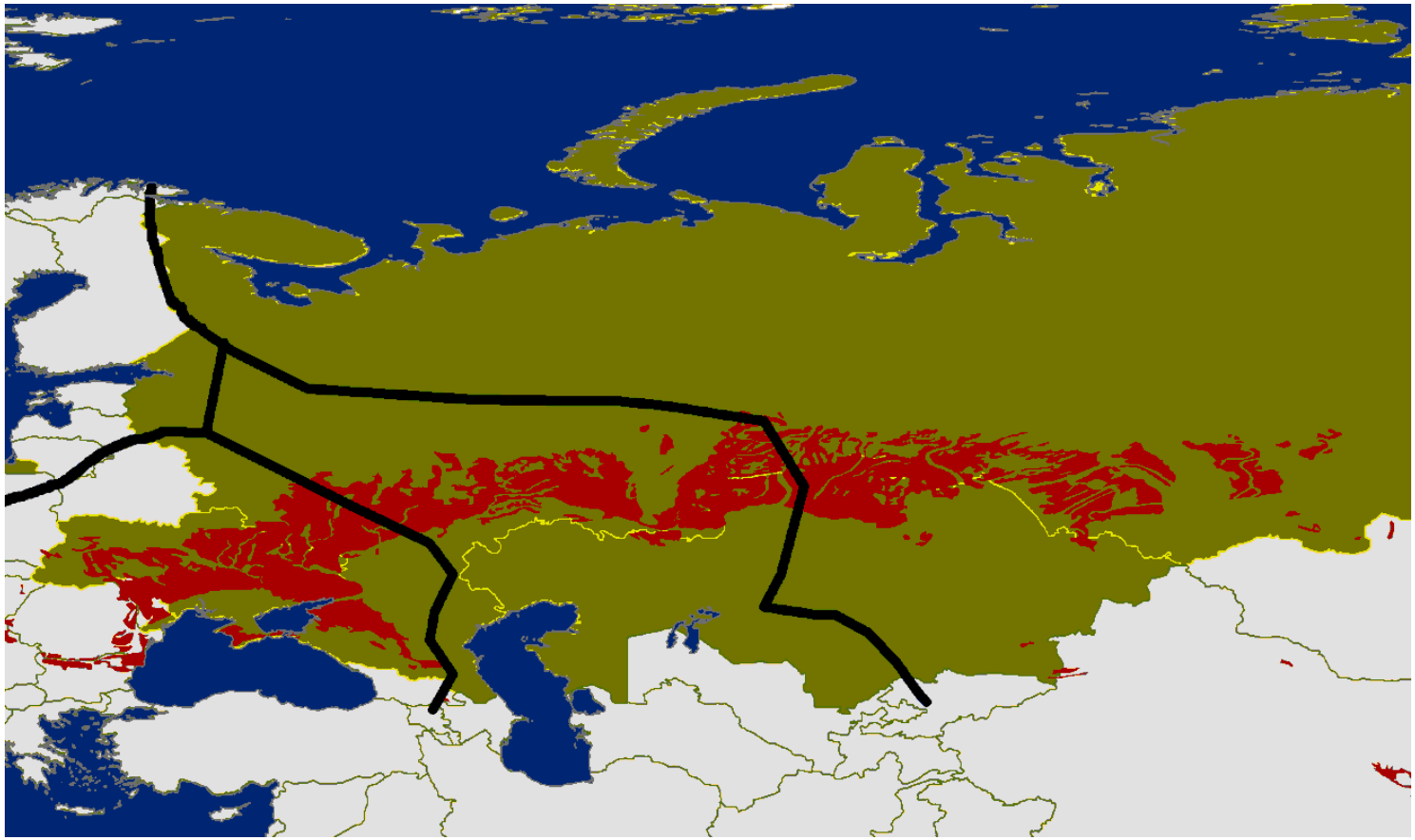
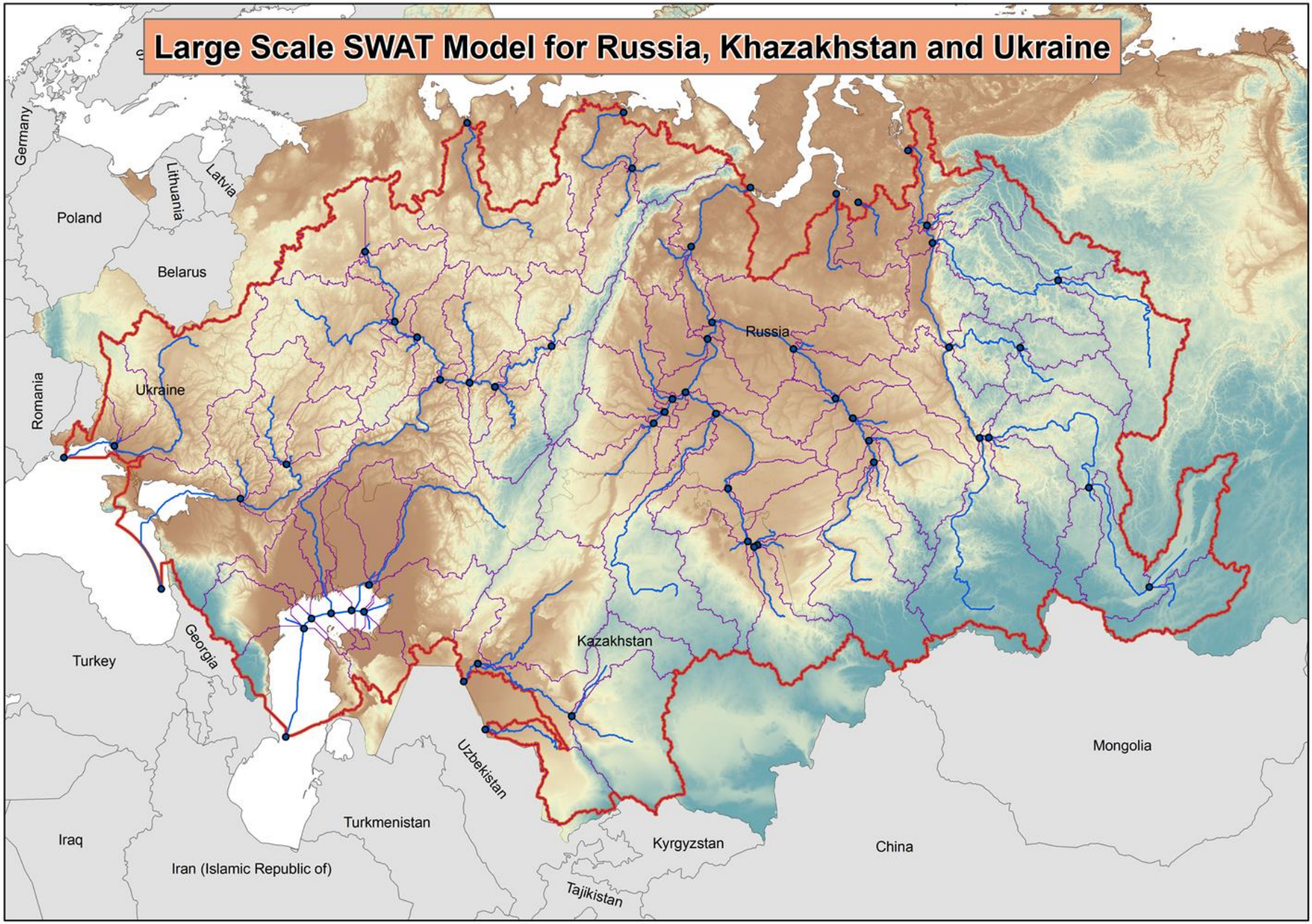
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

UNESCO-IHE Institute for Water Education

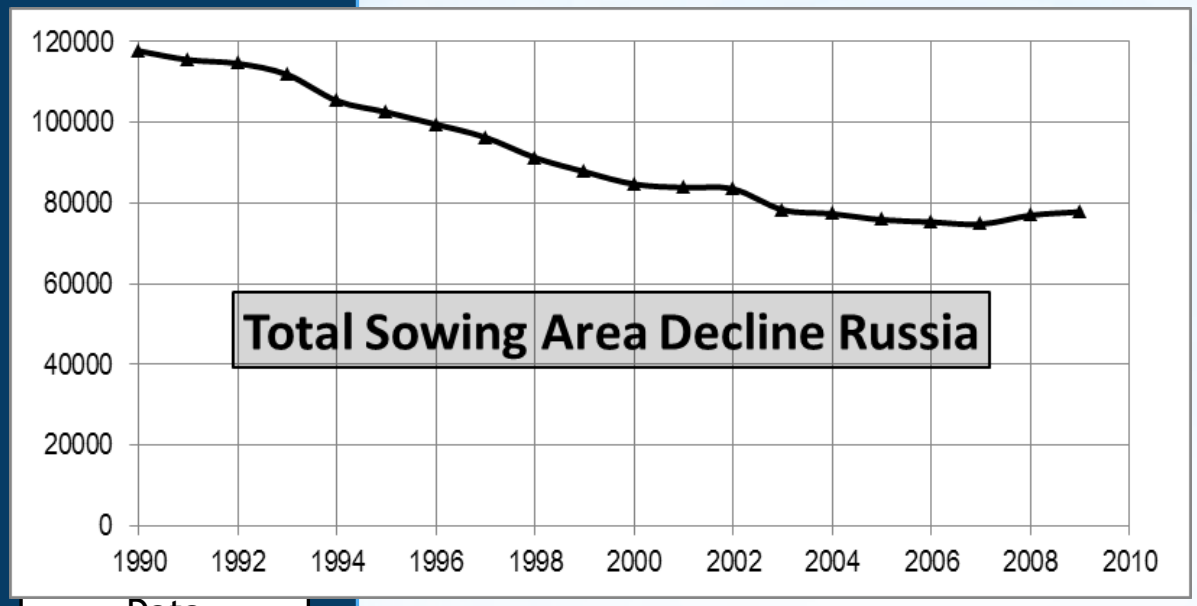


A large-scale SWAT application for investigating crop production potentials in Russia, Kazakhstan and the Ukraine

Large Scale SWAT Model for Russia, Khazakhstan and Ukraine



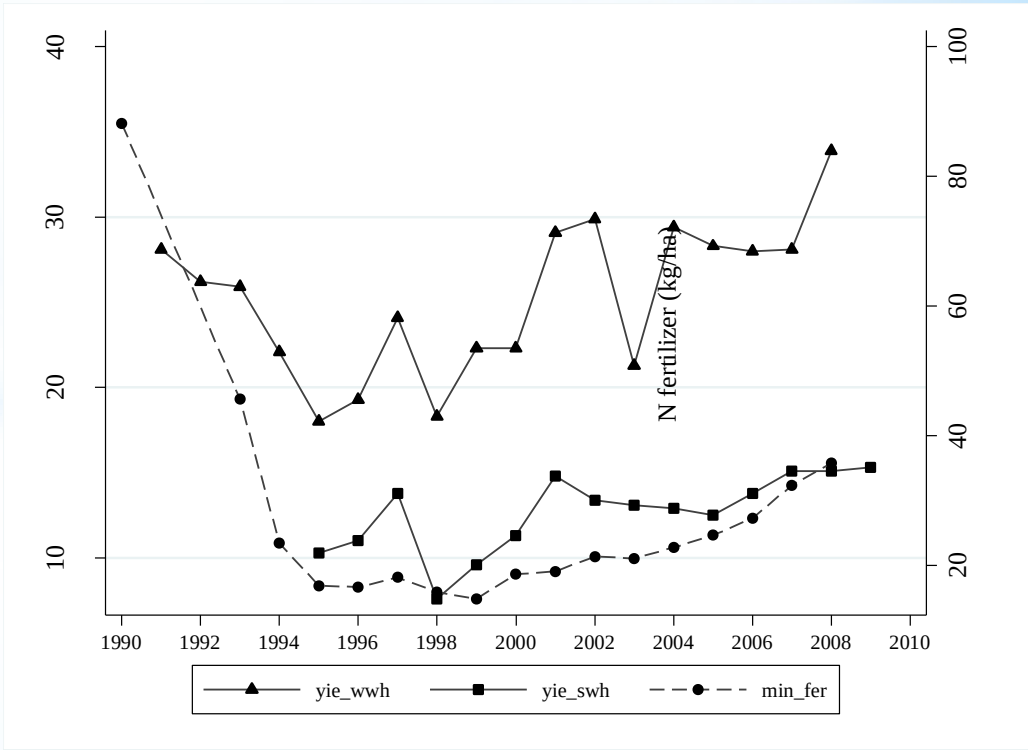
Production in post-Soviet Russia



1/3 decrease of total sowing area in Russia after 1990

Data

Expectation



Decline fertilizer inputs and yield fluctuations

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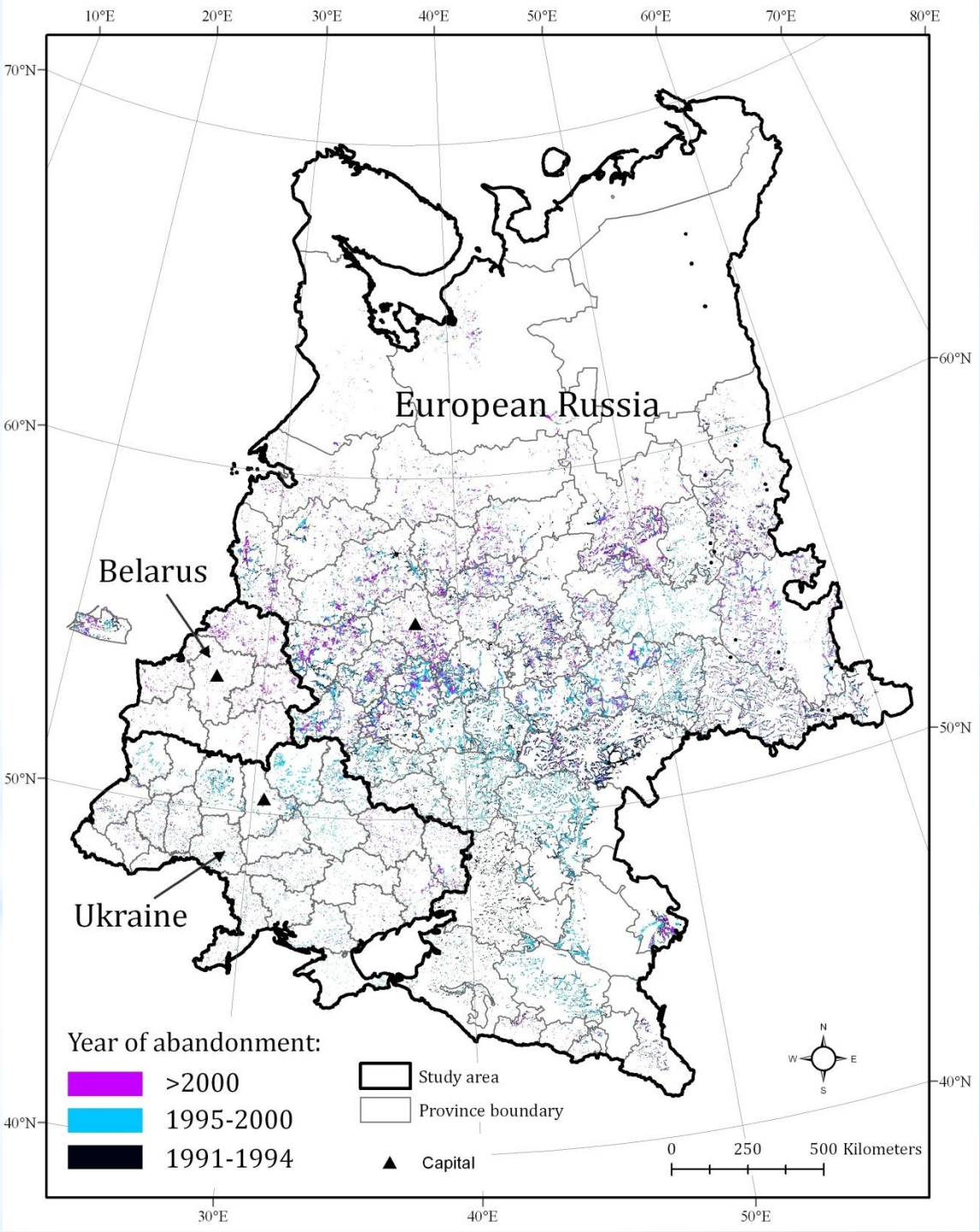

Schierhorn et al., GBC, in review

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Improvement factors of the current model

- Integration and validation of hydrological components
  → Enables the impact assessment of irrigation scenarios
- Integration of daily climate data instead of better then using downscaled monthly data (Schoul, Abbaspour, 2007)
- Incorporation of regional variety and data further then crop statistics (scale comparison and large scale model improvement)
- Consideration of other land use types beside crop lands

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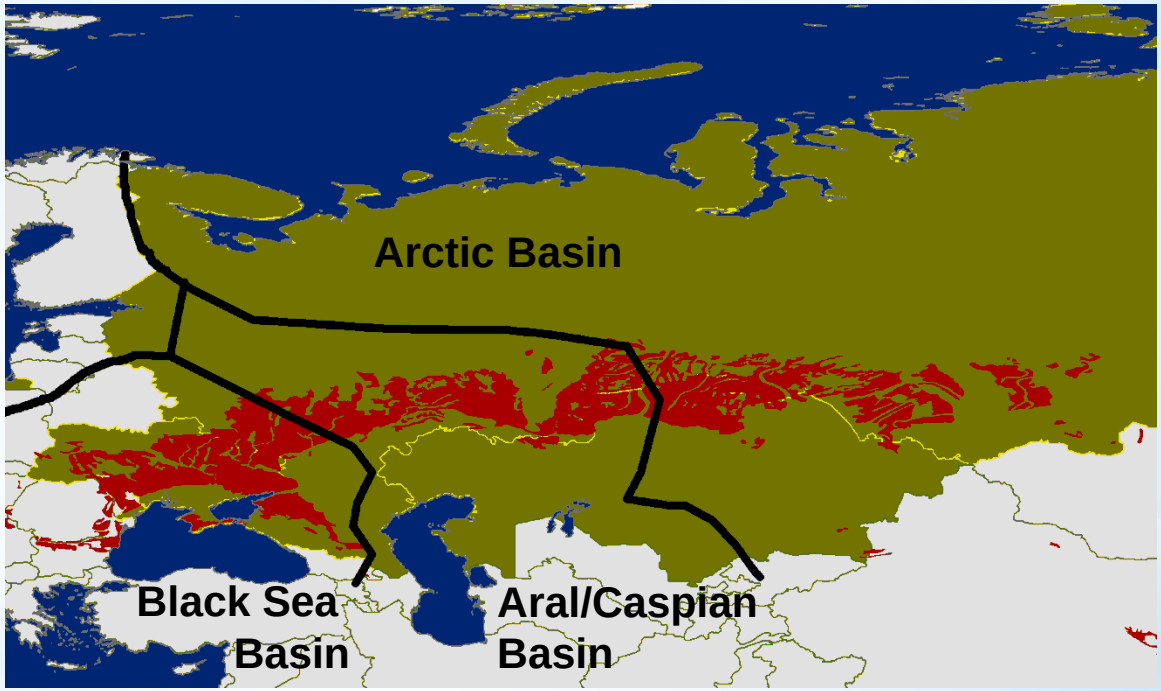
Multi Scale aproach



3 Large scale models
Based on global data sets

~5 Regional Models based on local data and surveys

Region selection based on heterogenities of bio-physical background conditions and land management

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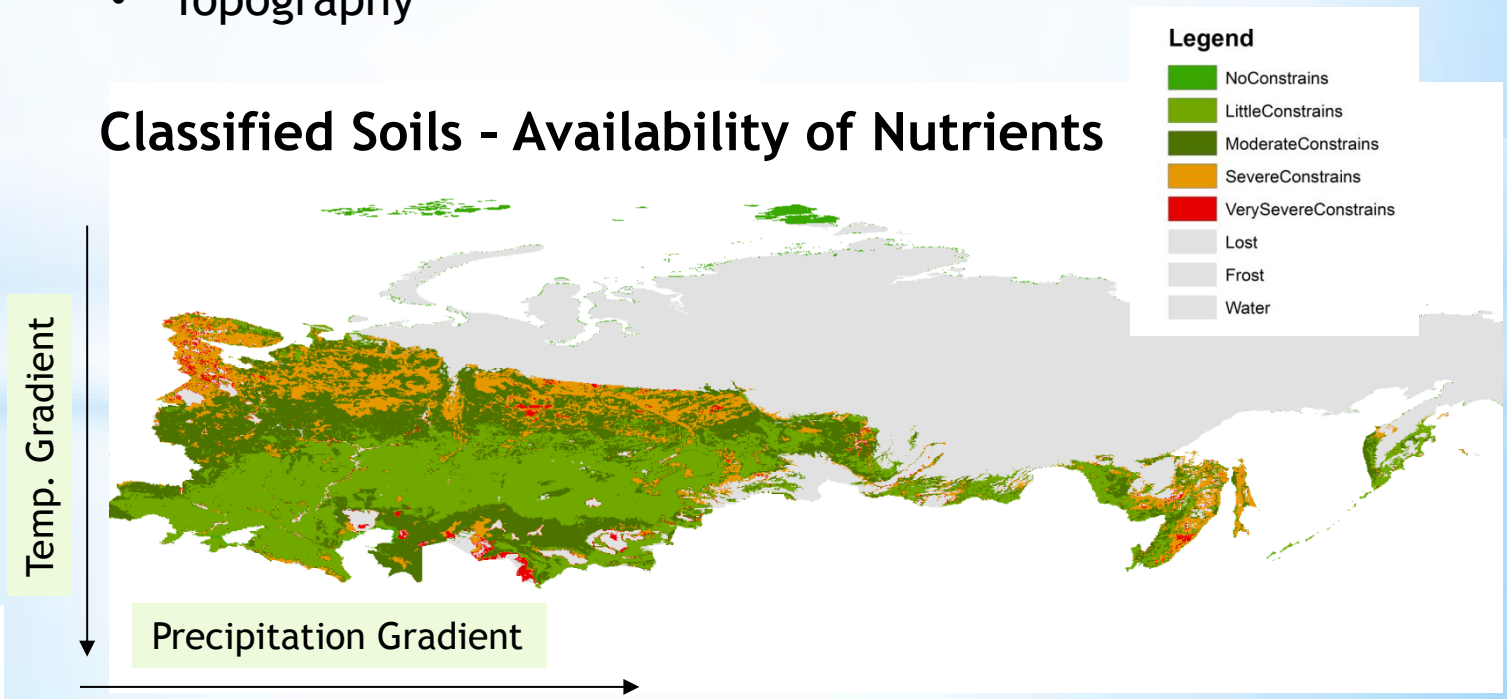
Selection of representative regions

Selection criteria (priority cluster analysis, descending)

- Climate regions
- Soil quality (nutrient availability)
- Availability of daily climate data
- Land abandonment (10 year trend)
- Share of agricultural land use
- Topography

Classified Soils – Availability of Nutrients



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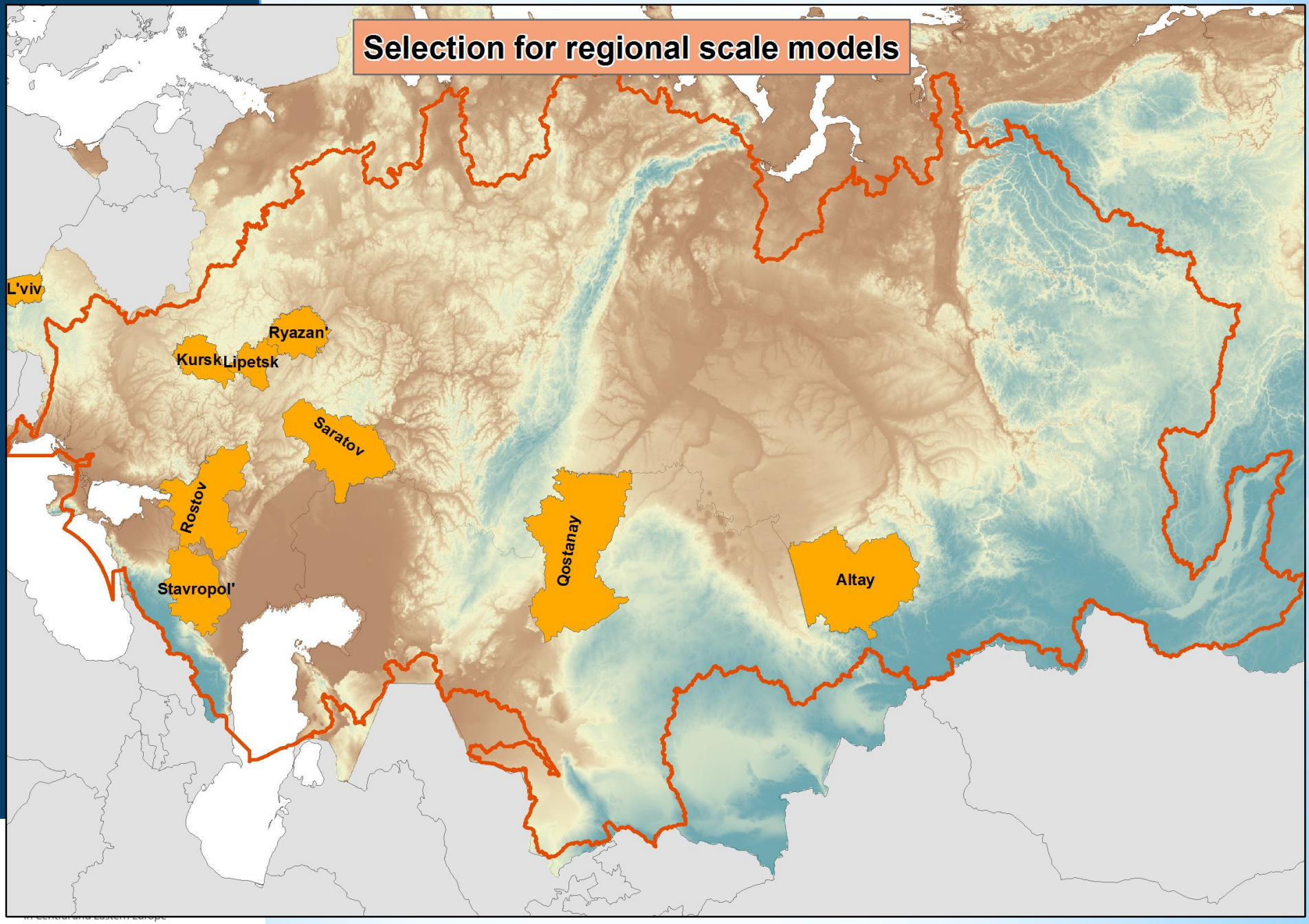
Selection for regional scale models
L'viv
Ryazan'
Kursk
Lipetsk
Saratov
Rostov
Stavropol'
Qostanay
Altay

Further technical model improvement (both scales)

- Consideration of major land use type (steppe, pasture, forest, cropland, abandoned land)
- Multi-objective calibration including crop yield and discharge (major catchments)
- Use of daily (measured) climate data

Analysis – methods

- Validation of the large scale model using regional scale models
- Integration of dynamic land use change updates (lup.dat) using the LUPSA –tool (impact on calibration and output)
- Assessing climate change and land re-cultivation impact on production potential
- Analyzing the interactive effect of irrigation scenarios on hydrology and crop yield

Large scale input data

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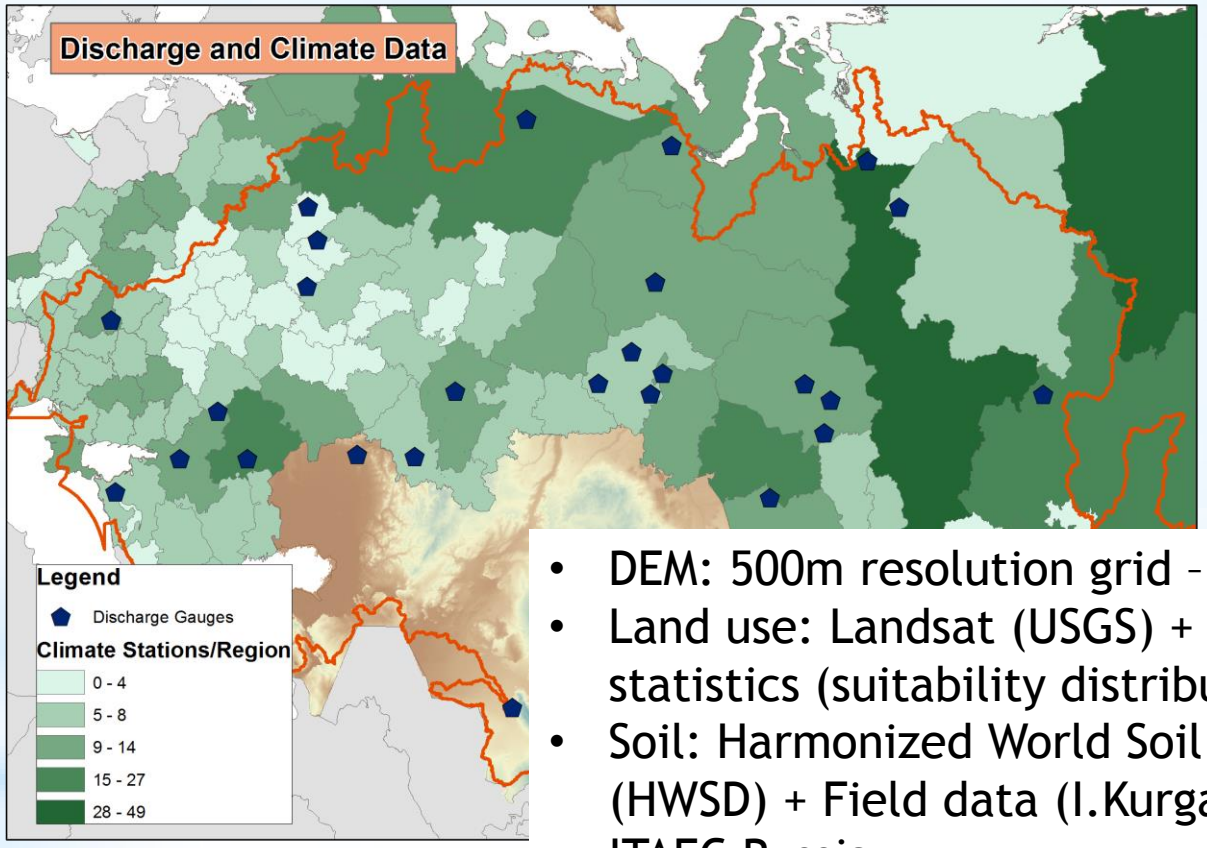

- DEM: 500m resolution grid – ASTER
- Land use: Landsat (USGS) + sowing statistics (suitability distribution)
- Soil: Harmonized World Soil Database (HWSD) + Field data (I.Kurganova / ITAEC Russia
- Climate: NOAA / daily
- Agricultural statistics
- Discharge: GRDC / daily observations

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Additional regional scale input data

Gaps will be identified based on inefficiencies and uncertainties of the large model

Additionally:

- Farm Survey (Spring/Summer 2014) → Management data
- Further soil and climate data (focus research / cooperation with other institutes and projects)
- More discharge gauges will be applied for modelling

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Research questions

- *Improvement (reduction) of large scale model uncertainties by using regional scale models for validation?*

- *Bio-Physical crop growth potential considering land use and climate change dynamics for*

- *Impact of dynamic land use incorporation in model calibration and production forecasting*

Prospective efforts

Scenario optimization and trade-off effects considering alternative management options and various land cultivation strategies (land use)

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Thank you for your attention

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