**Xiaochen Dong**

Controlling Nitrate Leaching with Subsoil Carbon Injection

Intensive irrigated crop production in Nebraska has led to elevated nitrate levels in groundwater. As a regulated drinking water contaminant, nitrate is easily solubilized and quickly leaches below the crop root zone to the deep vadose zone. Edge of field denitrification bioreactors practically remove nitrate from tile drainage water, but controlling nitrate leaching across an entire field is currently impractical. In earlier research, a series of bench tests contrasting wood chip thicknesses and source demonstrated the application of wood chips below the root zone decreased nitrate in leachate. A field-scale experiment was then conducted in Northeast Nebraska to evaluate the efficiency of the process under irrigated cropland. The preliminary field results showed that there is a significant ($p<0.05$) reduction in leached nitrate and ammonia in shallow soil (0-12 in). No difference in yield was found between control and treatment plots which suggested no production loss to this method. System design limited the carbon injection rate, and additional field experiments will be conducted to demonstrate the ability to increase carbon injection rates, improve long-term effectiveness, and reduce costs of this novel land treatment technology under irrigated cropland vulnerable to nitrate leaching.

**Japhet Dushimeyesu**

Developing the next-generation crop simulation model interface for efficient agroecosystem

Developing crop simulation models to increase yield and improve environmental resilience against changing climatic conditions. Cropping system models are a crucial tool for simulating, visualizing, and presenting quantitative information on crop growth related to boundary condition changes on a large scale. Within this framework, our project aimed to verify and validate the newly developed Crop, Land, and Soil Simulation (CLASSIM) model interface, which differs from other models by simulating both crop growth and mutual impacts between soil and crops during and after growing season. Using meteorological, soil, crop, and land management input data; CLASSIM predicts soybean growth, yields, water use, and nutrient uptake at different stages of growth. To test and validate the model's accuracy, we generated destructive and non-destructive ground truth data from irrigated and rainfed soybean in Sutherland, NE, in 2022. The collected data will be used to train the model to improve its predictive accuracy in the long term. Our findings indicated a higher total harvest in irrigated soybean (14043.5 ± 970.0 lbs /acre) than rainfed soybean (1190.5 ± 125.4 lbs/acre), and the total biomass was higher in irrigated soybean (10582.2 ± 374.8 lbs/acre) than rainfed soybean (837.7 ± 100.7 lbs/acre). Our finding also emphasized the effect of water stress on soybean growth and harvest. Currently, CLASSIM is being trained for more crops like corn, cotton, and potatoes.

**Kanak Kanti Kar**

Influence of Climatic Patterns on Groundwater Levels in Nebraska

Most of the agricultural production and irrigation of Nebraska State relies on groundwater, while two-thirds of the High Plain aquifer water is in the State. Across the State, Climate, precipitation, and irrigation practices are distinct. Previous research studies showed that groundwater can be impacted due to its climate pattern. As such, understanding the climate impacts on groundwater levels (GWLs) can provide valuable insights into the dynamics of groundwater. This study considers three types of climate patterns (teleconnection, atmosphere, and ENSO) to find out the association with GWL. A Mann-Kendall trend analysis has been applied to analyze the long-term changes in GWLs. We collected more than three thousand wells data from different reliable sources and climate indices from the NOAA website. Results from this research will be helpful for groundwater resource management.

**Nishant Kumar**

Trend analysis of Rain on Snow Event across North America

Rain-on-snow (ROS) events are hydrometeorological phenomena under significant scrutiny in recent years. A ROS event is characterized by rain falling on pre-existing snowpack, posing a significant risk of flooding. In this study, we proposed a new approach to defining ROS events by putting thresholds on rainfall, snow water equivalent, air temperature, and dew point temperature simultaneously, which overcomes some of the limitations in the existing definitions.

**Sudan Pokharel**

Enhancing Peakflow Estimation in Nebraska with Machine Learning

Accurate estimation of peakflow is vital for infrastructure design and public safety. In Nebraska, regional regression equations, which have been developed by dividing the whole state into parts with similar characteristics, have long been employed to estimate peakflow for various return periods, often yielding results that vary by orders of magnitude. In pursuit of a more effective approach, we developed a suite of Random Forest (RF) models. These RF models harness data from diverse locations across the state, outperforming traditional regional regression equations across all return periods. This study can improve decision-making regarding flood disaster mitigation and resilient infrastructure design, offering a more reliable system for safeguarding communities and critical assets.

**Sinan Rasiya Koya**

Causal Drivers of Rain-on-Snow Events in North America

Rain-on-snow (ROS) events, a phenomenon of liquid rainfall falling over accumulated snowpack, cause quick melting of snow, leading to rapid and catastrophic flooding. It is mostly unknown to scientists what causes the occurrence of ROS events. This study explores the causal drivers of ROS events across North America. We use the recorded measurements of hydroclimatic variables from the Global Historical Climatology Network Daily (GHCNd) dataset spanning over a period from 1951 to 2022. We implement Convergent Cross Mapping (CCM) to discover the causal links between measured variables and ROS frequency. Our results provide valuable insights into the potential mechanisms of ROS events in different regions in North America.

**Shivendra Srivastava**

Flood Vulnerability Assessment at the County Scale for the US

Flood vulnerability assessment at the county scale was conducted for the United States, leveraging only open-source datasets. The vulnerability framework consisted of interactions among four components, i.e., social, economic, ecological, and health. To quantify overall vulnerability on a county scale, we considered 18 variables under four components. The quantification of components of vulnerability was carried out by rescaling and averaging variables. A self-organizing map (SOM) machine learning algorithm was used to relate all four vulnerability categories to create county-scale vulnerability maps. SOM grouped the datasets according to vulnerability category in 2x3 clusters. The combination of county-scale data across the United States showed trends in high resolution that most prominently caused vulnerability in different regions of the country. A county-scale approach like this will make policymakers aware of the existing risks and vulnerabilities. This can help make tailored, effective, and locally relevant policies at the county level.

**Sumaiya Tabassum**

Student interpretation of evidence from online sources: Is climate change making floods more extreme?

Understanding complex issues like flooding requires critical evaluation of evidence and synthesis of scientific knowledge across disciplines. Students are the future leader and decisionmaker and understanding, evaluating evidence correctly will deepen their perspective and impact their decision-making. We aimed to investigate how students find, analyze and interpret evidence about flooding issue from online sources. The study was conducted in a science literacy course that uses a structured decision-making (SDM) tool where students first learned about floods and their changing pattern, then were asked to express their understanding of whether flood events were becoming more extreme, evaluate evidence related to flooding, and provide reasoning in support of their ideas. Analysis indicates that 73% of students thought floods were becoming more extreme, and 47% included 'Climate Change' in their explanation of 'Why'. When asked to find a source of evidence online to support their reasoning, only 13% of students found peer-reviewed sources.

**Yvon Ukwishaka**

Redox-driven transformation of inorganic nitrogen species across the vadose zone: Insights from column experiment

Globally, nitrate deposition in the vadose zone has been gradually increasing. In Nebraska, heavy irrigation and nitrogen fertilizer reliance increased to boost agricultural production, leading to groundwater impairment. Understanding nitrogen redox transformation in the vadose zone can be critical to understanding nitrogen dynamics in the vadose zone and protecting groundwater. Our recently completed study aimed at identifying vadose-specific inorganic nitrogen redox reactions to predict and prevent nitrate groundwater contamination in heavily irrigated areas. Undisturbed segments of two 21-meter soil cores were packed to mix and match into 150-centimeter columns reflecting various substrate-specific biogeochemical reaction zones. Two sets of columns were treated to replicate infiltration beneath sprinkler-irrigated (n=3) and rainfed (n=3, control) row-cropped fields in central Nebraska, without adding external nitrogen. Water was supplied, allowed to infiltrate, and porewater was collected biweekly for nine months simulating the growing season from root zone (10 cm), capillary fringe (140 cm), and groundwater (140 cm). The results indicate that simulation of the vadose zone beneath irrigated fields produces significantly higher nitrate-N levels (5.8± 1.0 mg N/ L) than the rainfed soils (2.3± 0.3 mg N/ L) at the root zone. A similar pattern was found for the capillary fringe (irrigated: 1.1±0.5 mg N/ L, rainfed: 0.7± 0.2 mg N/L). In contrast, porewater ammonium-N concentrations were higher in the rainfed root zone (3.0±0.6 mg N/L) than in the irrigated root zone (2.0± 0.4 mg N/L) with similar levels in the capillary fringe (rainfed: 0.25±0.3 mg N/L, irrigation: 0.12±0.2 mg N/L). The same trend was observed in the groundwater system where rainfed system groundwater had higher ammonium-N (0.32±0.3 mg N/L) concentrations than the irrigated systems (0.26± 0.2 mg N/L), though nitrate-N concentrations were similar. Overall, the underlying mechanisms for the observed nitrogen dynamics are linked to water application differences.