Early Warning Grid-Based Risk Modeling of Climate Induced Forced Displacement

Action Anticipatoire

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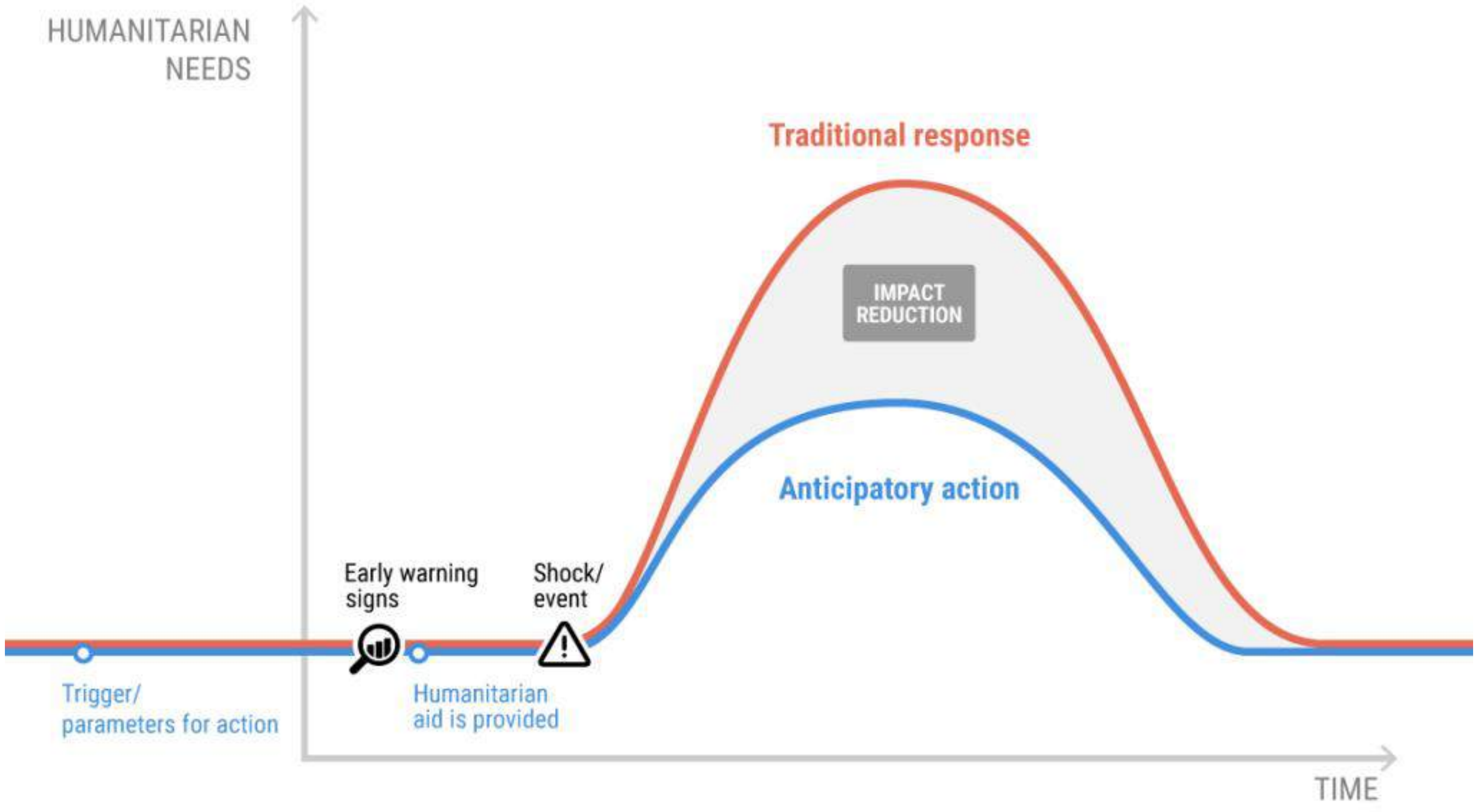
OCHA

L’action anticipatoire consiste à agir en amont d’un choc prévu pour prévenir ou réduire les impacts sur les vies, les moyens de subsistance et les besoins humanitaires avant qu’ils ne se produisent pleinement.

Action anticipatoire
Pourquoi anticiper?

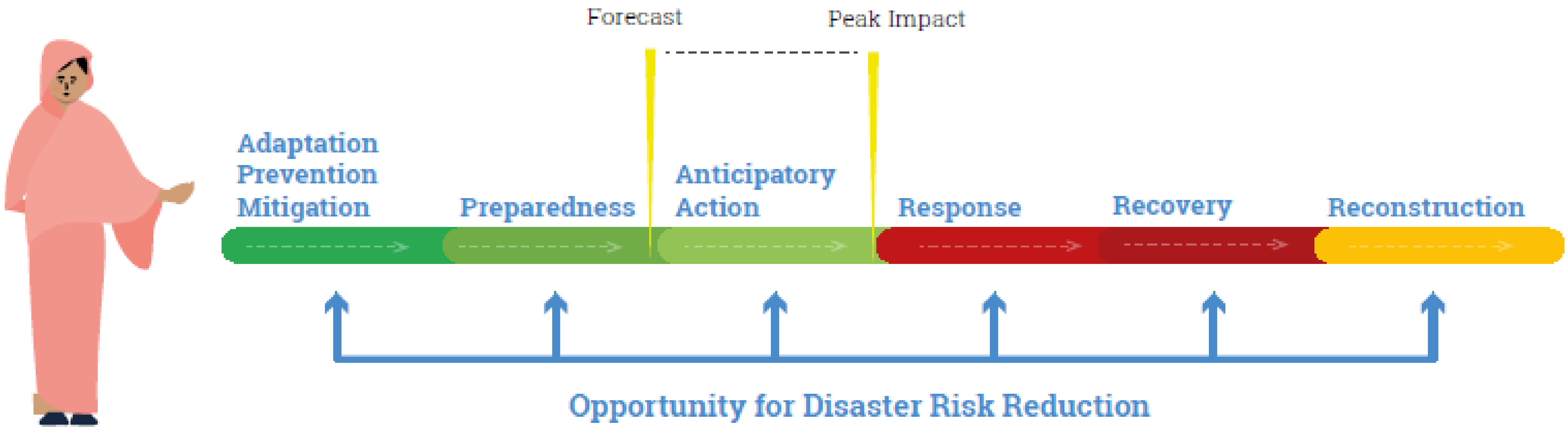
- **L'objectif est de réduire** les impacts potentiels des risques prévisibles.
- Les actions sont conçues **sur la base de prévisions ou d'analyses prédictives** du moment et du lieu où un danger se produira.
- Les actions sont **mises en œuvre avant** l'apparition d'un danger ou avant que ses effets les plus graves ne se fassent ressentir.



Action anticipatoire

Dans le cycle de gestion des catastrophes

Figure 2. Anticipatory Action within the disaster management cycle



Source: Adapted from UNDRR, *Anticipatory Finance: An Introductory Guide* (2024), p. 10.

L'AA fait le lien entre la préparation et la planification d'urgence en cas de catastrophe en général et la réaction à des catastrophes spécifiques après leur survenue.

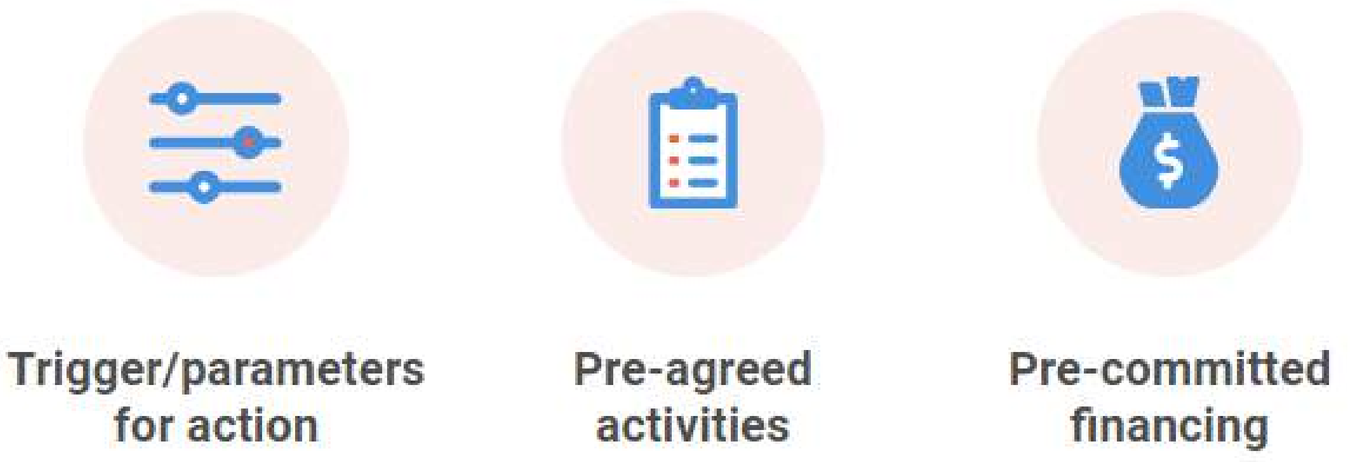
Action anticipatoire

Composantes clés

L'approche d'OCHA utilise

- des *prévisions validées* avec des *indicateurs et seuils établis* pour des impacts inhabituels (le déclencheur)
- pour débloquer un *financement préétabli* (l'argent)
- afin de déclencher des *actions humanitaires préétablies* atténuant l'impact du choc (la livraison).

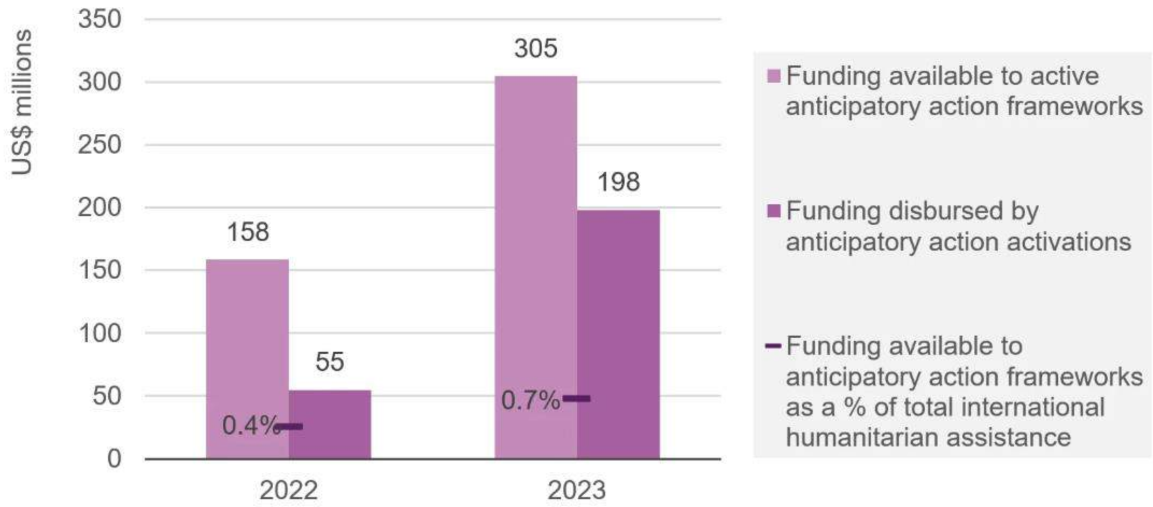
Les 3 composantes clés :



Pourquoi se focaliser sur l'action anticipatoire?

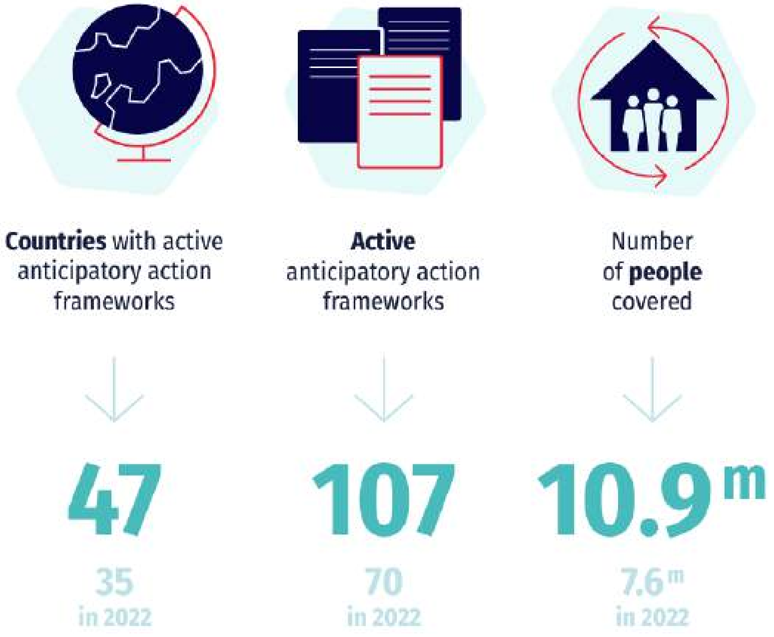
Engagements au niveau global:

- EW4All (Pilier 4. Préparation à la réponse – IFRC (lead), REAP, OCHA, FAO, WFP)
- Grand Bargain 3.0 (2023) + caucus
- COP28 (Loss and Damage Fund)



Acteurs humanitaires clés :

- OCHA (CERF, CBPF)
- IFRC (DREF)
- FAO (SFERA)
- WFP (AA Trust Fund)
- Start Network (Start Ready and Start Fund)



En 2024, OCHA a 140M US$ engagés dans l'action anticipatoire

Action anticipatoire à l'avenir – planification OCHA

Vision	1. **Le défaut pour les chocs prévisibles** 2. **Un mode de fonctionnement dynamique** 3. **Intégration dans les processus de planification existants**	4. **Centré sur les personnes** 5. **Jouer sur les forces d'OCHA** 6. **OCHA s'engage dans tout le système**
Fonds d'OCHA	**L'objectif de 10 % de l'AA du CERF annoncé (COP28)** **Le compte d'action climatique du CERF lancé (COP28)**	**Les lignes directrices mondiales des Fond Communs incluent l'AA** (décembre 2022) **Fonds communs régional à soutenir l'AA**

Scale-up	Transversalisation	Financement	Partenariats
Quatre modalités d'AA: 1. Pays HPC 2. Pays non HPC 3. AA ad hoc 4. Services consultatifs	Intégration dans le HPC Architecture de coordination Renforcement des capacités Suivi et évaluation de l'impact Politique, orientation, normes	Fonds « Carburant » OCHA : CERF, CBPFs, RHPFs Système de financement (autres fonds communs, IFI, gouvernements, financement climatique, etc.) Fonds OCHA « Construire » "Financement "innovant 1. Assurance anticipée 2. Partage des risques	Système entier Gouvernements IFI/MDB Communauté du climat Universités

OCHA-facilitated anticipatory action portfolio

Des efforts à chaque niveau

Global – orientations stratégiques ; plaidoyer ; appui aux financements ; CoP AA OCHA

Régional – harmonisation de l’AA de façon pertinente au contexte ; appui au pays HPC/non-HPC ; plaidoyer et visibilité; GTAA-AOC

Pays – coordination et opérationnalisation de l’AA à travers les cadres, le HPC, la mobilisation de ressources et les GT

Zoom sur le GTAA-AOC

- Groupe de travail technique (réunion mensuelle & réunion trimestrielle avec les points focaux pays)
- S’inscrit dans une complémentarité avec le groupe EPR, la task force inondation
- S’inscrit en parallèle à la task force AA Sécurité alimentaire

- TDR & Plan de travail
    1. Renforcer la coordination régionale entre les acteurs de l’action anticipatoire
    2. Faciliter le partage d’informations, de leçons apprises et de bonnes pratiques
    3. Promouvoir l’intégration de l’action anticipatoire dans les stratégies nationales et le cycle de programmation humanitaire
    4. Appuyer le plaidoyer pour le financement et le soutien des initiatives d’action anticipatoire
    5. Suivi, évaluation et amélioration continue des activités d’action anticipatoire

- Composition : GT et groupe restreint (organisation et préparation des réunions ; OCHA, IOM, WFP, FAO, IFRC, IRC, Start Network, ACMAD)

- Objectifs tangibles : élaborer une note AA pour une compréhension harmonisée, améliorer la cartographie des activités (dashboard), documents d’orientation, messages clés, atelier de renforcement des capacités, dialogue régionale (AOC), etc.

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MERCI!

CGIAR Climate Security
West and Central Africa hub

CGIAR FOCUS Climate Security

Alliance Bioversity & CIAT

1. Climate Security Hotspot Analysis
2. Climate Security Mapping for targeted WFP Humanitarian Interventions in the Liptako-Gourma Region

CGIAR ClimBeR: Building Systemic Resilience Against Climate Variability and Extremes

CGIAR INITIATIVE ON Fragility, Conflict, and Migration

CGIAR INITIATIVE ON Livestock and Climate

CGIAR AgriLAC Resiliente: Resilient Agrifood Innovation Systems in Latin America and the Caribbean

CGIAR research centers

International Food Policy Research Institute (IFPRI)

Center for International Forestry Research (CIFOR)

International Center for Agricultural Research in the Dry Areas (ICARDA)

International Livestock Research Institute (ILRI)

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT)

Africa Rice Center

International Institute of Tropical Agriculture (IITA)

International Water Management Institute (IWMI)

International Rice Research Institute (IRRI)

WorldFish

World Agroforestry (ICRAF)

International Potato Center (CIP)

International Maize and Wheat Improvement Center (CIMMYT)

Climate Action

Contributes to reducing climate risk to food security, economic resilience, and conflict, fragility and other human insecurities through research on climate change adaptation and mitigation

Climate security and migration

Explores how climate interacts with root causes of conflict, migration, displacement and fragility, where this is happening and for whom and co-designing solutions to mitigate the climate, peace, and security nexus. For example, we co-develop decision support tools to help policy makers in targeting areas and groups affected by climate and security risks.

Climate services for agriculture

Seeks to improve crop and livestock farmers' decision making in low- and middle-income countries with contextually relevant, inclusive, and accurate agroclimatic information, following human-centric design principles and bundled with financial services and agricultural inputs. The bundled climate services aim at increasing productivity and incomes, in the face of interannual climate variability and weather extremes.

FLAGSHIPS

Net-zero development

Targets the creation of an enabling environment conducive to scaling innovations and utilizing evidence to shape policies, investments, and affecting change that leads to substantial greenhouse gas reductions in land use, while ensuring food security and advancing sustainable development.

Climate readiness

Seeks to build long-term capacity to avoid climate shocks by enabling stakeholders, from farmers to governments and private companies, to assess and anticipate climate risks, develop innovation bundles and business models to absorb climate shocks, provide evidence for climate readiness policies and investment influence, and scale climate-smart innovations through fit-for-purpose partnerships.

We carry out research-based activities to generate outcomes through the following **key research areas:**

Research evidence, data science, and digital innovations

1) Manages and enables seamless access to high-quality data assets; (2) crafts concrete evidence through advanced data science and analytics; and (3) propels digital advancements in agriculture through direct engagement with all users along the value chain and upstream tech service partners.

Finance and investments

Delivers science to help public and private sector and value chains to integrate climate evidence in their business models for resilience and mitigation objectives, and to support innovative financial mechanisms, such as blended finance, inclusive credit, and climate finance funds, to foster and influence finance and investment for climate action.

Policies and institutions

1) Supports and tracks Paris Agreement national commitments and implementation of long-term strategies; 2) Develops innovations and evidence for managing water-related climate risk at scale; and 3) Mainstreams low-emissions development practices through improved incentives and technical outreach to farmer-facing groups.

Gender and social inclusion

Analyzes research, digital innovations, investments, and policies in terms of how they differentially impact different groups, women, men, old and young, ensuring that the design of our research and policy impact follows an inclusive and gender transformative approach and that our work narrows gender and other social equality gaps and provides equitable and attractive opportunities for younger women and men.

CGIAR FOCUS Climate Security

About our team and expertise

- One CGIAR mission "*Ending hunger through science to transform food, land and water systems in a climate crisis*" is central to **conflict prevention and peacebuilding**
- The **CGIAR FOCUS Climate Security** team creates environmental, political, gender-sensitive, and socioeconomic solutions to issues of peace and security in the fields of climate, land, and food systems science in the Global South
- We work on assessing and quantifying the impacts of the climate crisis across a range of different multidimensional social and political phenomena, through the following research areas:

- Climate Security Migration Nexus
- Gender and Social Inequality
- Climate Security Governance
- Climate Security Measurement and Indicators
- Climate Security Programming
- Climate Security Digital Innovations

Climate Security Observatory (CSO)

CSO
Actionable Evidence

Decision support to understand & respond to climate security-related risks

Evidence 4 Peace

Policy 4 Peace

Programming 4 Peace

Finance 4 Peace

National/sub-national **climate & security-related analyses**

Mitigate climate security risks → **contribute to climate-resilient peace.**

4 CSO Questions

How does climate worsen the root causes of conflict?

Where are the most vulnerable areas to climate induced insecurities and risks?

Who are vulnerable groups to climate and security risks that should be targeted?

What needs to be done to break the vicious cycle between climate and conflict?

CSO analyses

Social Learning Theory
Climate Security Pathway Analysis
Network Analysis
Econometric Analysis

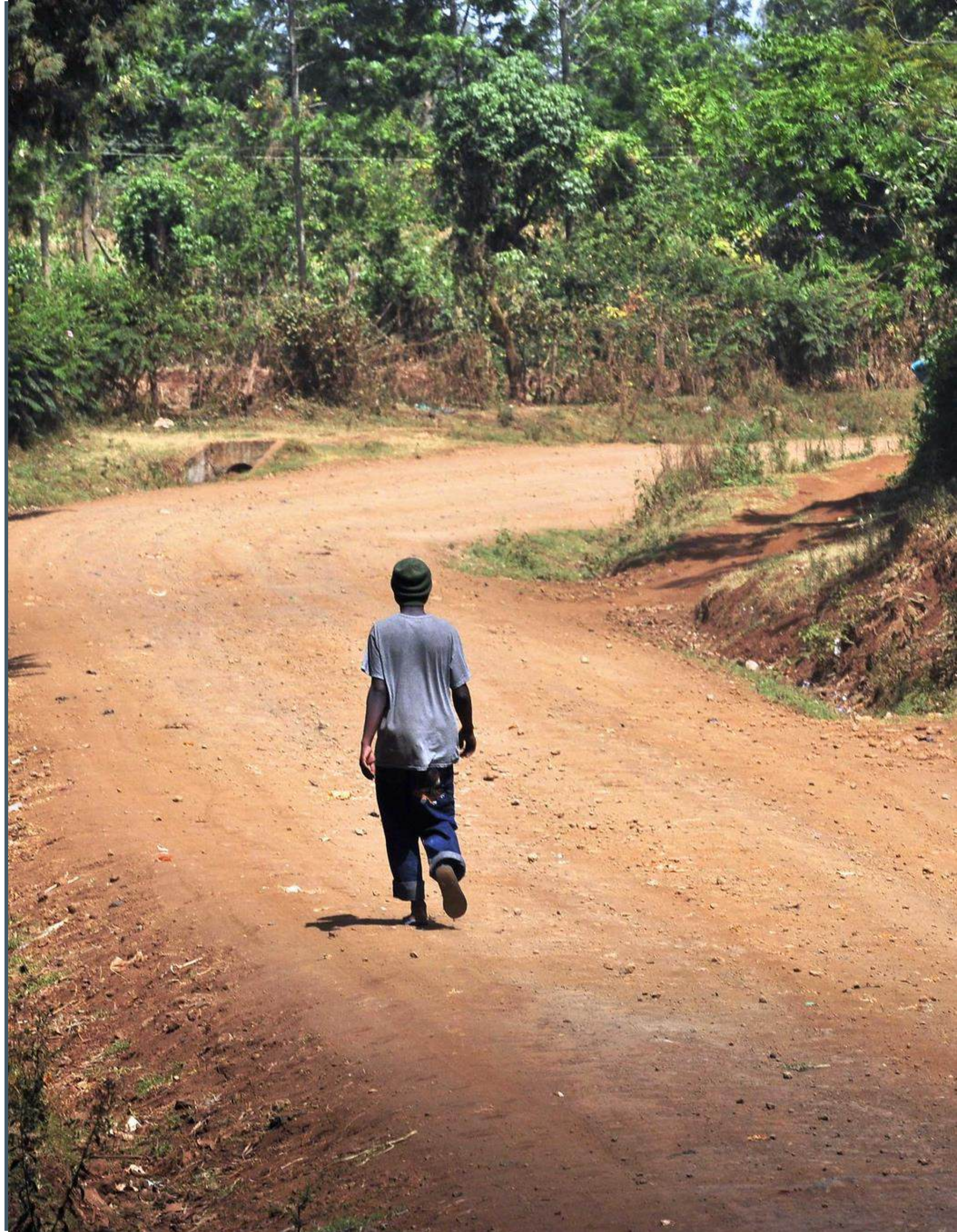
Spatial Analysis

Social Media Analysis
Policy Coherence Analysis
Expert workshops
Climate Security **Sensitivity Tool**
Actor & Intervention mapping

Climate Insecurity hotspots

Presentation of Spatial Analysis on Climate Insecurity Hotspots

Yacouba Ouedraogo – y.ouedraogo@cgiar.org



Key Questions of the Climate Security Observatory

Where are the areas most vulnerable to insecurities and climate-induced risks?

Which groups are the most vulnerable to climate insecurity? (**Who**)

How does climate exacerbate the structural causes of conflicts?

What needs to be done to break the cycle between climate and conflict? (**What**)

Methodology

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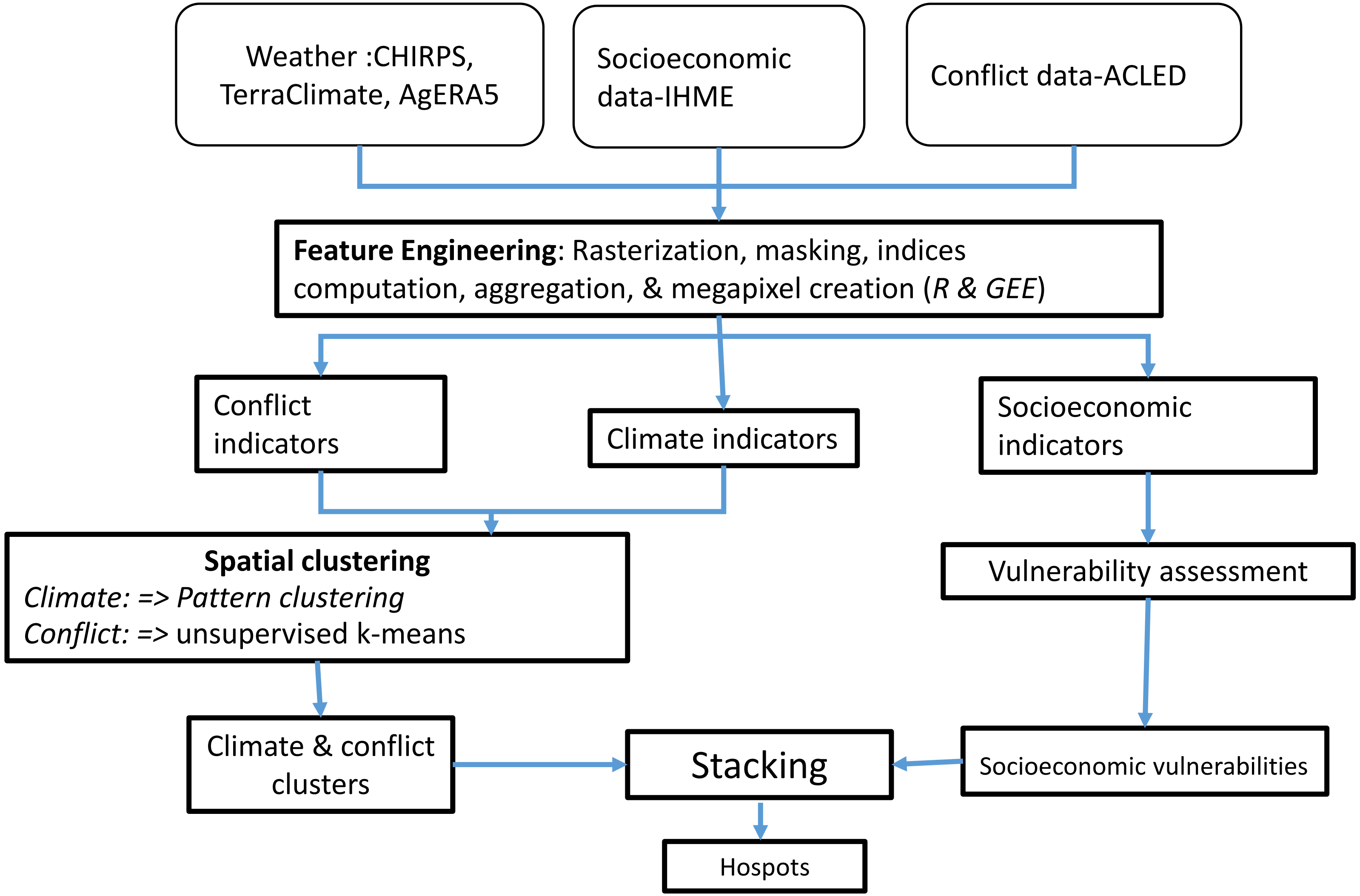
Spatial Analysis Objectives

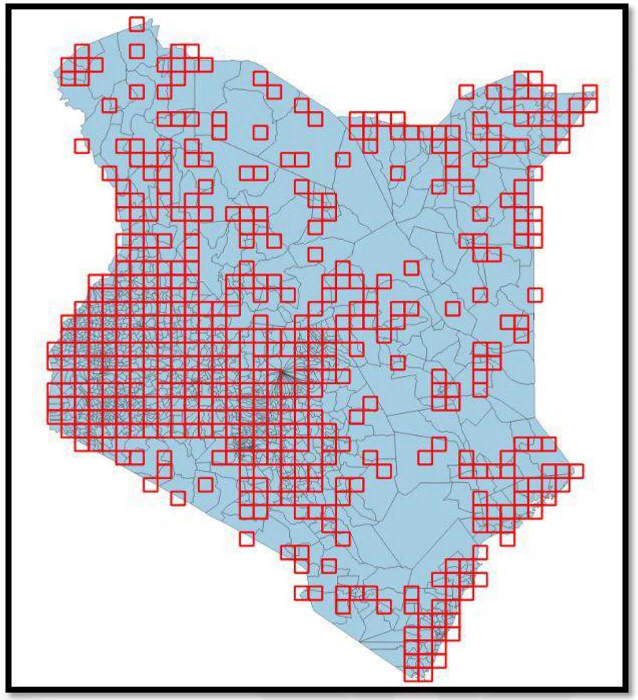
- A spatial hotspots analysis is used to map the climate-conflict nexus, and identify the geographic co-occurrence of specific combinations of conflict, climate conditions, and socio-economic vulnerabilities.

- The objective of the spatial hotspot analysis is to provide answers to the following research questions:
  - Where are the most vulnerable areas to insecurities and climate-induced risks located?
  - Who are the groups most vulnerable to climate insecurity? (Who)

    → These questions aim to help target and prioritize interventions.

Spatial Analysis Approach





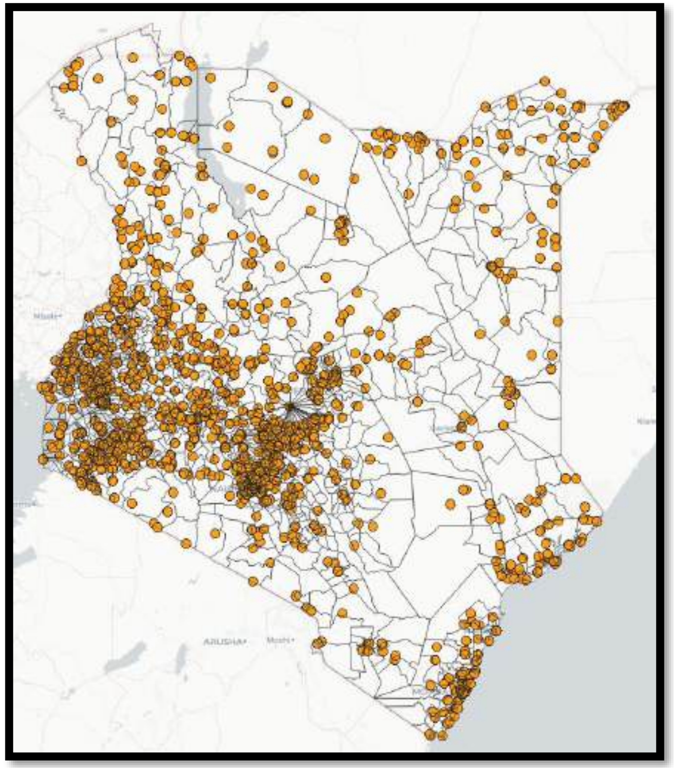
- 20 km² Mega pixels
- Not influenced by region/sub-region size
- Less information loss when aggregating
- Filtered/masked areas with no conflict
- Easy way to store, display & graph information

Conflict Classification

Conflict Clustering: conflict events within each mega-pixel are classified into three categories: high, moderate, and limited conflict intensity. This classification employs an unsupervised k-means machine learning algorithm, analyzing spatial-temporal conflict data

- Total number of conflict events
- Total number of unique conflict event types
- Total number of unique conflict event subtypes
- Total number of unique Actor 1 involved in conflicts
- Total number of unique Actor 2 involved in conflicts
- Total number of fatalities due to conflicts

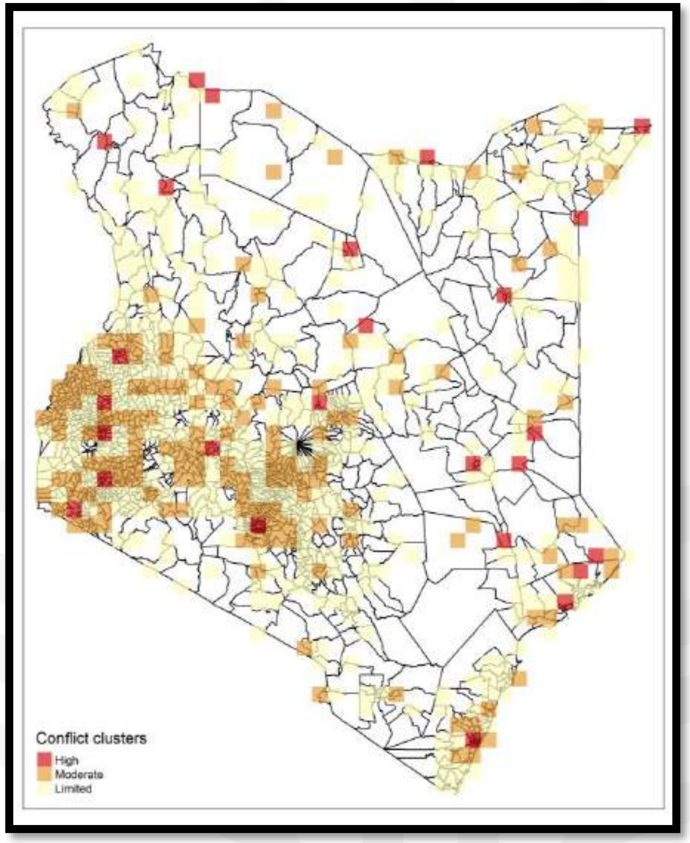
ACLED Data



Total number of conflict events 1997-2021

Machine Learning Kmean Methods

Clusters are defined by the intensity of the conflict



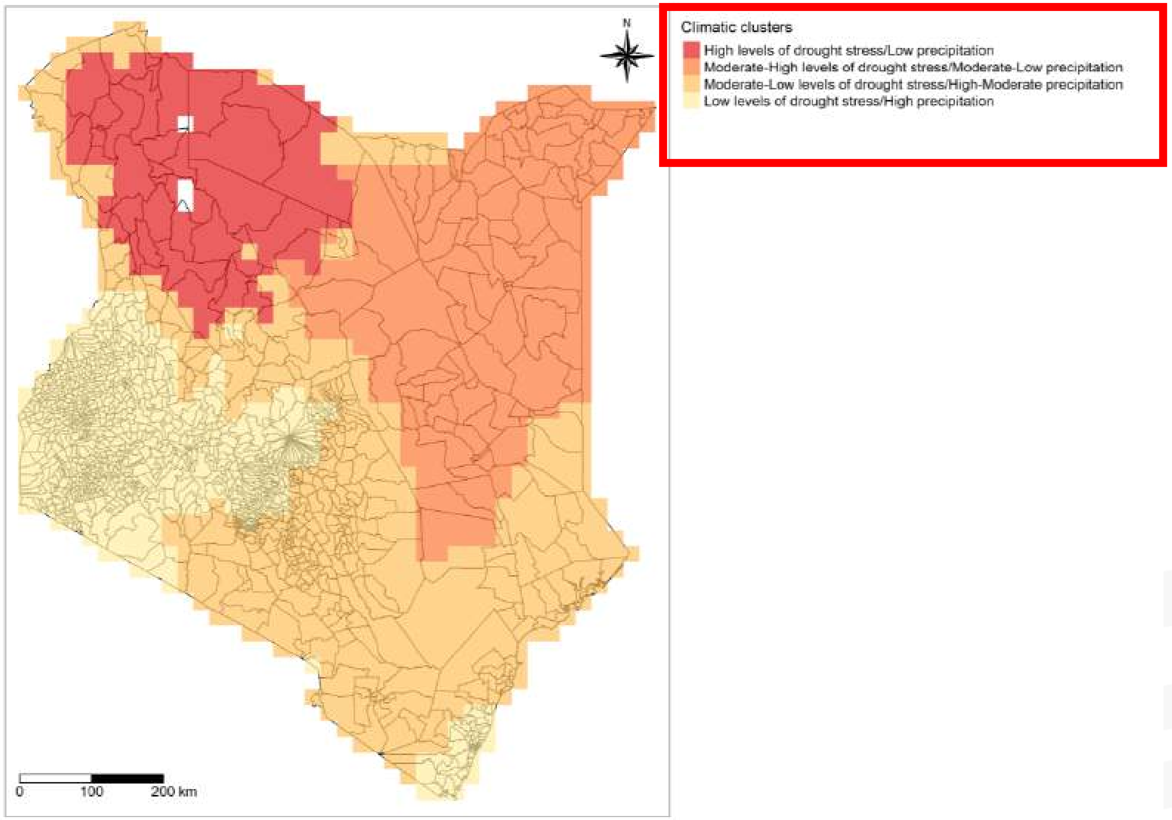
Hotspot analysis through climate data analysis based on spatial models

- **Data Source:** TerraClimate, CHIRPS, AgERA5

- **Climate Clustering**: This step involves analyzing climate data to identify distinct climate clusters.
- Key climate features: coefficient of variation, median values, and Sen's slope trend estimator are computed from temperature and precipitation time series.
- Additional metrics like the Number of Days with Waterlogging (NLWD), Actual Evapotranspiration (AET), and Climatic Water Deficit (CWDF) are also considered.

- These features are integrated into a pattern-based spatial clustering approach, as outlined by Nowosad (2021)
- This method utilizes spatial signatures derived from integrated co-occurrence histograms (Incoh), which quantify both the composition and configuration of spatial patterns.
- The resulting signatures facilitate hierarchical clustering, categorizing regions into three climate condition clusters: good, moderate, and harsh.

Climate clusters



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Automated climate text description

clust	text_output	label	order
1	Climate cluster 1 is characterized by: [High] values of Precipitation (multi-annual median) (1210.27 mm), [Low] values of Climate water deficit (multi-annual median) (256.5 mm), [High] values of Actual evapotranspiration (multi-annual median) (823 mm), [Low] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual median) (113.92 Number of days), [High] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual coefficient of variation) (0.18 Proportion), [High] values of Number of days with waterlogging (multi-annual median) (8.75 Number of days)	Low levels of drought stress/High precipitation	**1**
2	Climate cluster 2 is characterized by: [High-Moderate] values of Precipitation (multi-annual median) (621.72 mm), [Moderate-Low] values of Climate water deficit (multi-annual median) (938.48 mm), [High-Moderate] values of Actual evapotranspiration (multi-annual median) (385.48 mm), [Moderate-Low] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual median) (158.26 Number of days), [High-Moderate] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual coefficient of variation) (0.08 Proportion), [High-Moderate] values of Number of days with waterlogging (multi-annual median) (3.18 Number of days)	Moderate-Low levels of drought stress/High-Moderate precipitation	**2**
3	Climate cluster 3 is characterized by: [Moderate-Low] values of Precipitation (multi-annual median) (326.06 mm), [High] values of Climate water deficit (multi-annual median) (1507.71 mm), [Low] values of Actual evapotranspiration (multi-annual median) (101 mm), [High-Moderate] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual median) (169.25 Number of days), [Moderate-Low] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual coefficient of variation) (0.07 Proportion), [Moderate-Low] values of Number of days with waterlogging (multi-annual median) (1 Number of days)	Moderate-High levels of drought stress/Moderate-Low precipitation	**3**
4	Climate cluster 4 is characterized by: [Low] values of Precipitation (multi-annual median) (239.27 mm), [High-Moderate] values of Climate water deficit (multi-annual median) (1402.87 mm), [Moderate-Low] values of Actual evapotranspiration (multi-annual median) (164.79 mm), [High] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual median) (175.74 Number of days), [Low] values of Number of days with ratio of actual to potential evapotranspiration ratio below 0.5 (multi-annual coefficient of variation) (0.05 Proportion), [Low] values of Number of days with waterlogging (multi-annual median) (0 Number of days)	High levels of drought stress/Low precipitation	**4**

Automated cluster variable description

Short cluster description (Not automated) suitable for graphical purposes

CSO - Spatial Analysis

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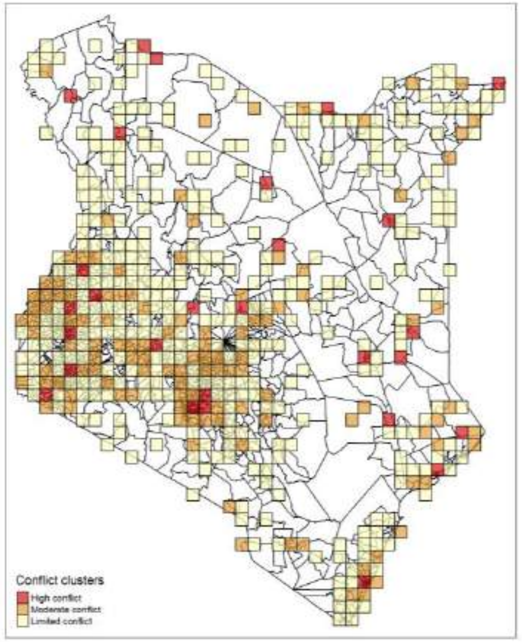
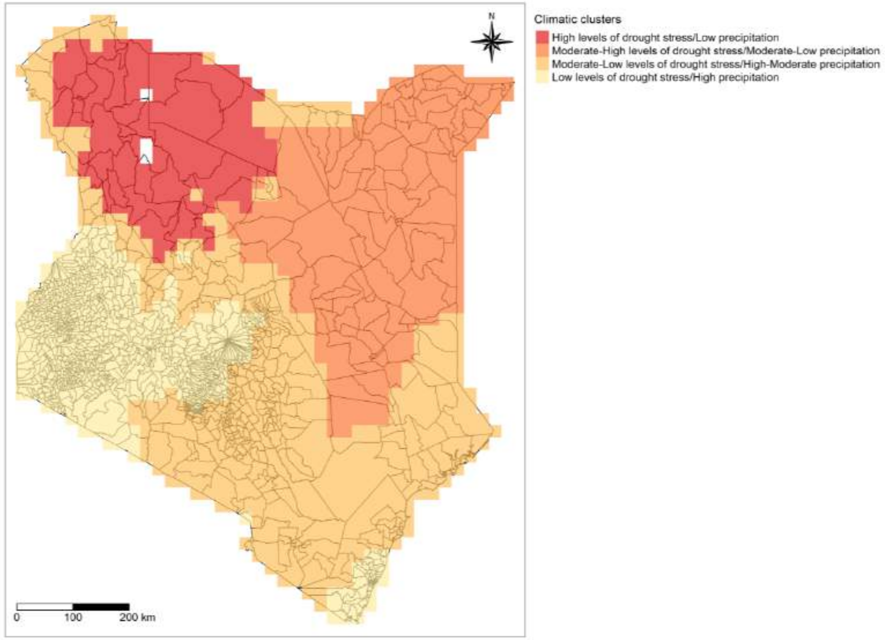
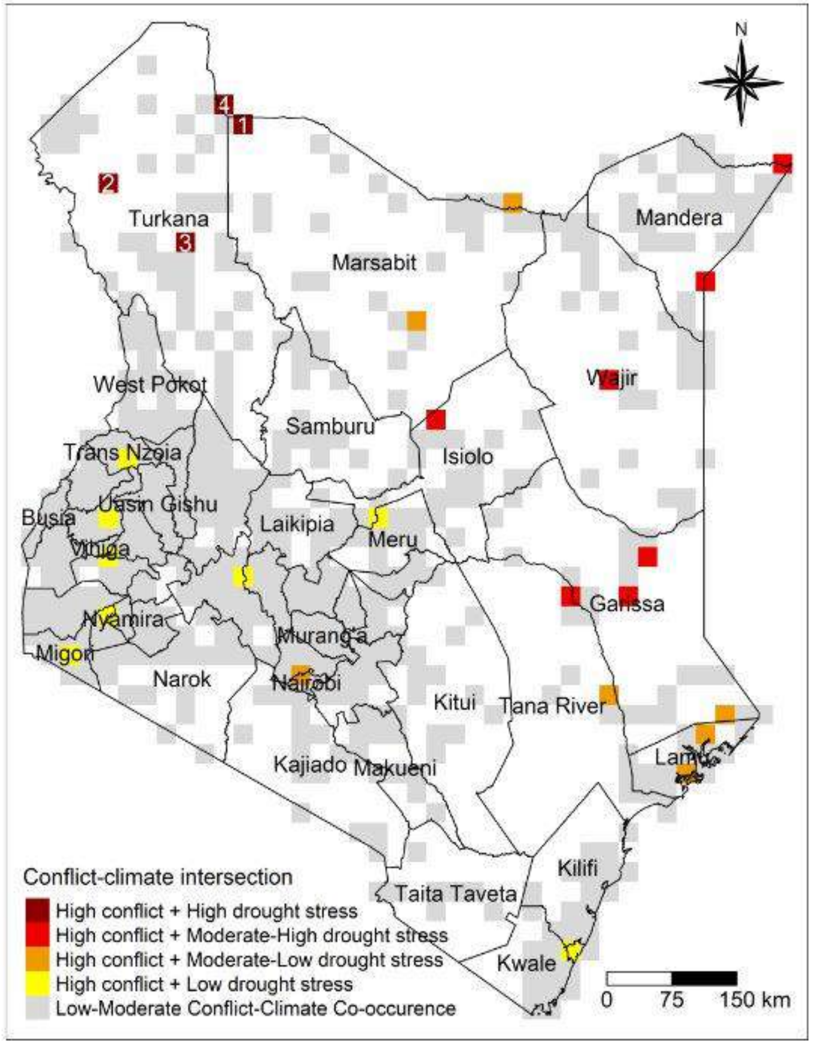
Clustering analysis at mega-pixels level (Less information loss)





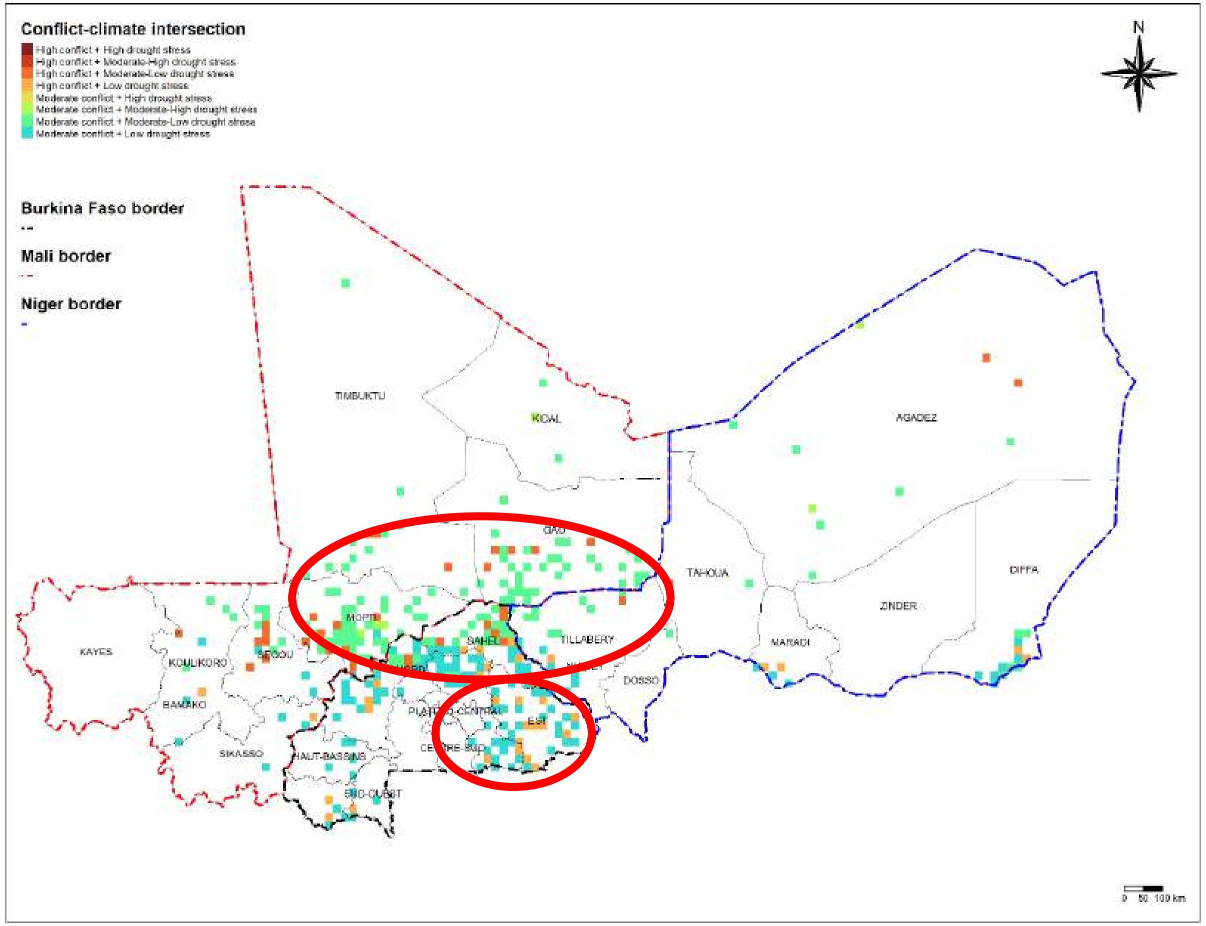


Overlap between historical conflict and climatic conditions

- Everything in one place e.g.: hotspots, climate clusters, conflict clusters, socioeconomic, etc...
- Easy to use for graphical and web development purposes

Hotspots

Regional scale: Sahel



Co-occurrence of climate Conditions and Conflicts in the Sahel

- Burkina Faso and Mali exhibit the highest levels of co-occurrence between extreme weather events and conflict incidents, particularly around the tri-border areas.
- In Mali, the major hotspots are located in the sub-regions of Gao, Mopti, and Timbuktu.In Burkina Faso, the regions of Sahel, North, Center-North, and East are heavily affected, showing a combination of high conflict levels and severe climatic conditions.
- Niger has a significantly lower co-occurrence of conflicts compared to the other two countries

CSO Platform

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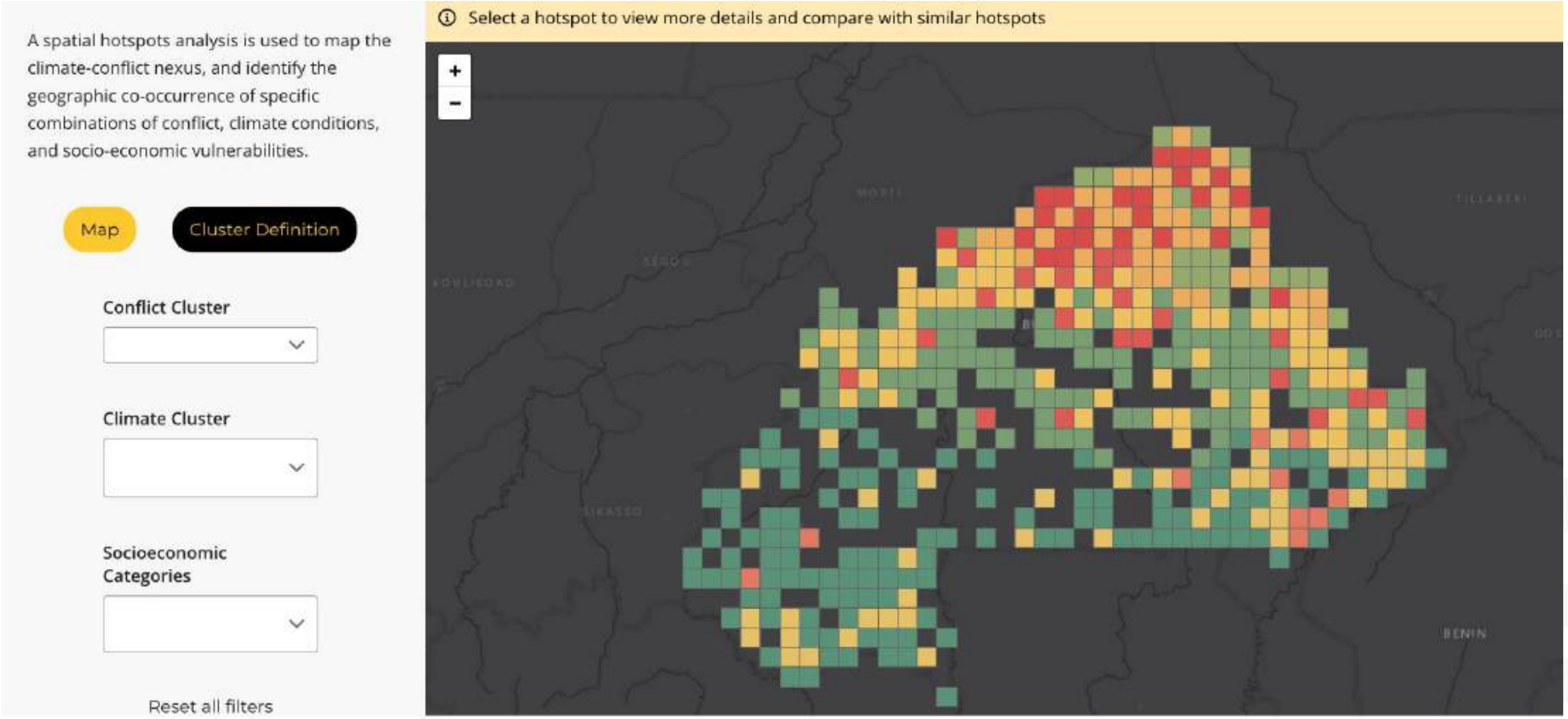
CSO Platform

- [CSO: https://cso.cgiar.org/](https://cso.cgiar.org/)



Climate Hazard and Conflict Analysis

Climate Data:

- Source: CMIP6, 27 global circulation models.
- Baseline: 1981–2010; Future: 2020–2040.

Indices:

- Indices include Heat, Drought, Flood, and Composite Hazards.
- Categories: Low, Moderate, High, Severe, Extreme.
- Heat Index (HI): Based on daily max temperature and humidity.
- Drought Index (SPEI): 12-month severity analysis.
- Flood Index: Precipitation Daily Intensity Index.
- Composite Index: Reflects combined hazards.

Uppsala Conflict Data Program (UCDP)

- Provides comprehensive datasets on organized violence and armed conflicts worldwide.
- **Annual Updates**: UCDP datasets are updated annually, ensuring that researchers and policymakers have access to the most current information on global conflict trends.
- All UCDP data are freely available for download

Baseline Hazard Indices for West and Central African countries. Drought, Heat and Flood layers were used to produce the final compound hazard Index

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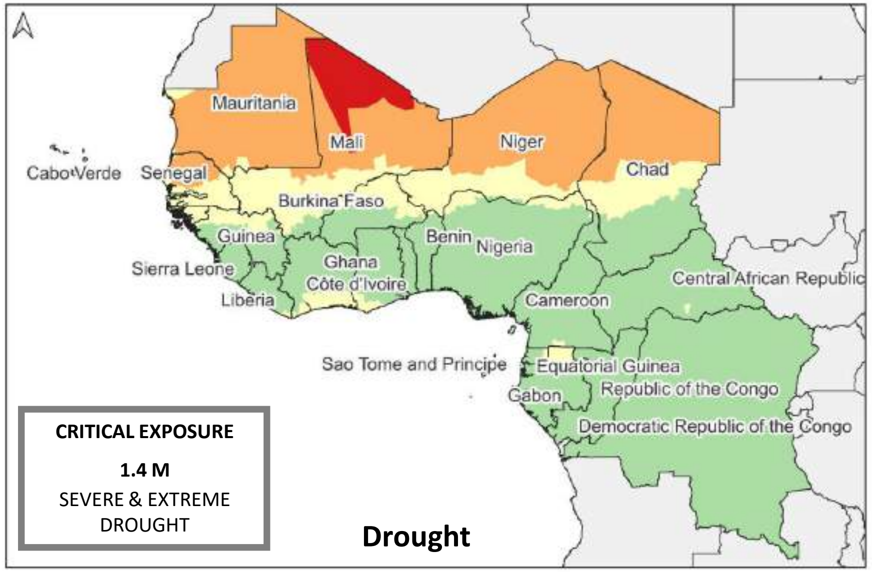

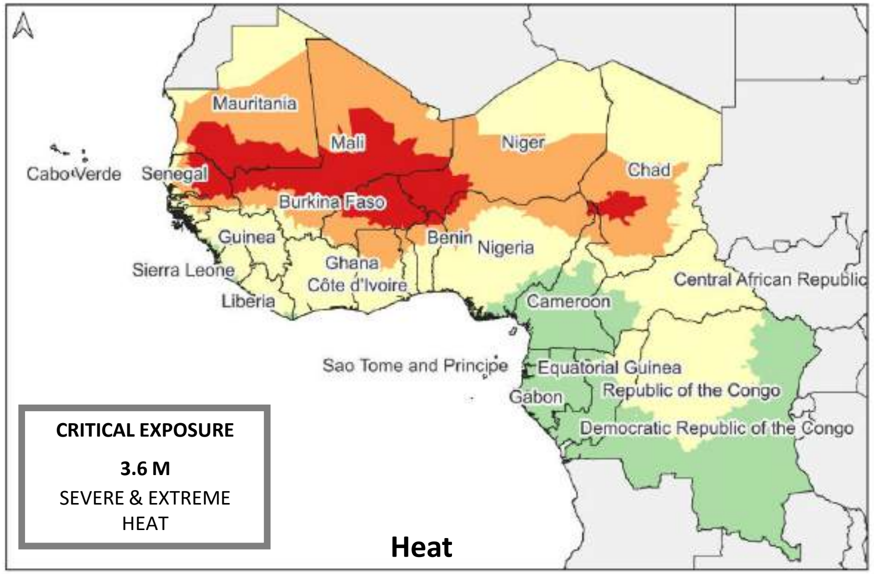

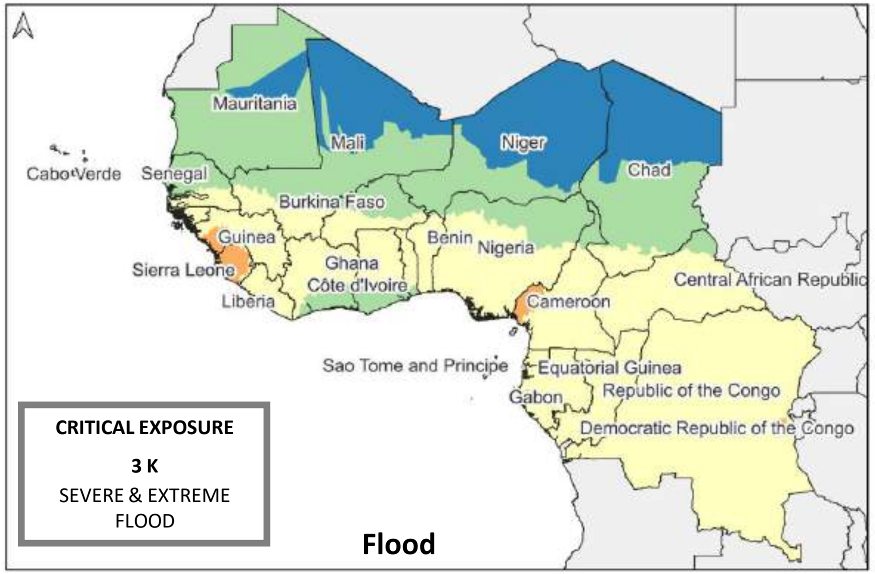

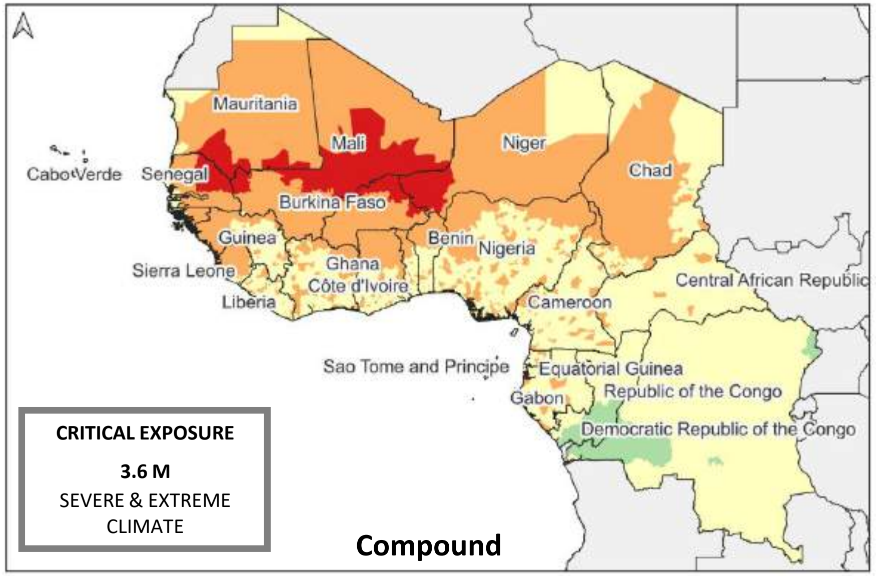

The northern parts of western Africa are characterised by drier and hotter climates, with low risks of flood hazards. A hotspot of extreme baseline hazard is seen across Senegal, Mauritania, Mali & Burkina Faso, where both heat and drought hazards are severe to extreme. Central African countries, towards the south, have a lower overall baseline compound hazard due to lower heat and drought scores.

Hazard Index
- Low
- Moderate
- High
- Severe
- Extreme
- Country borders

Future (2040) Hazard Indices for West and Central African countries. Drought, Heat and Flood layers were used to produce the final Compound Hazard Index

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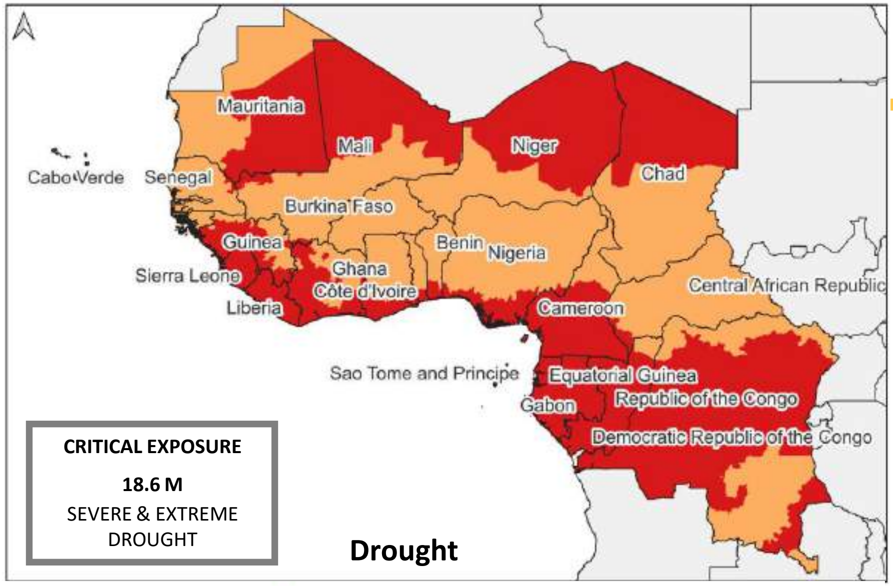

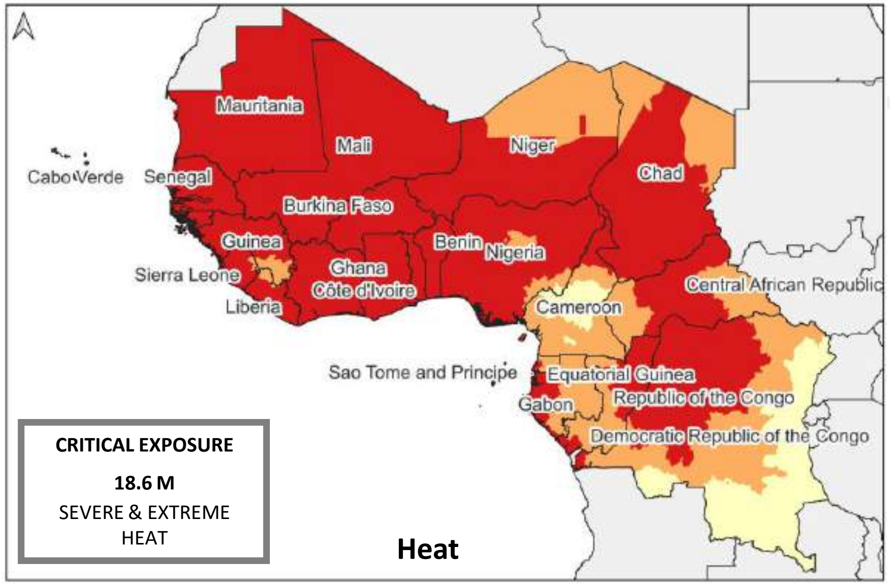

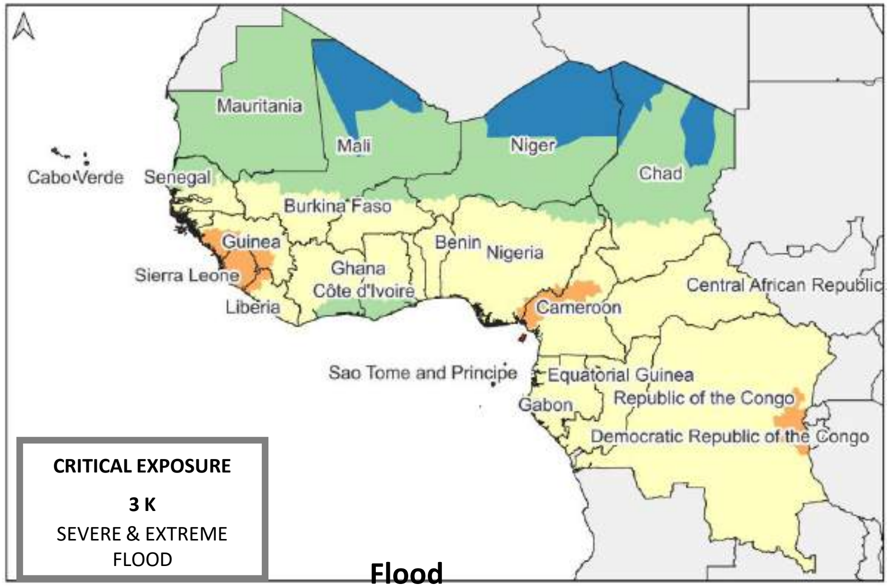

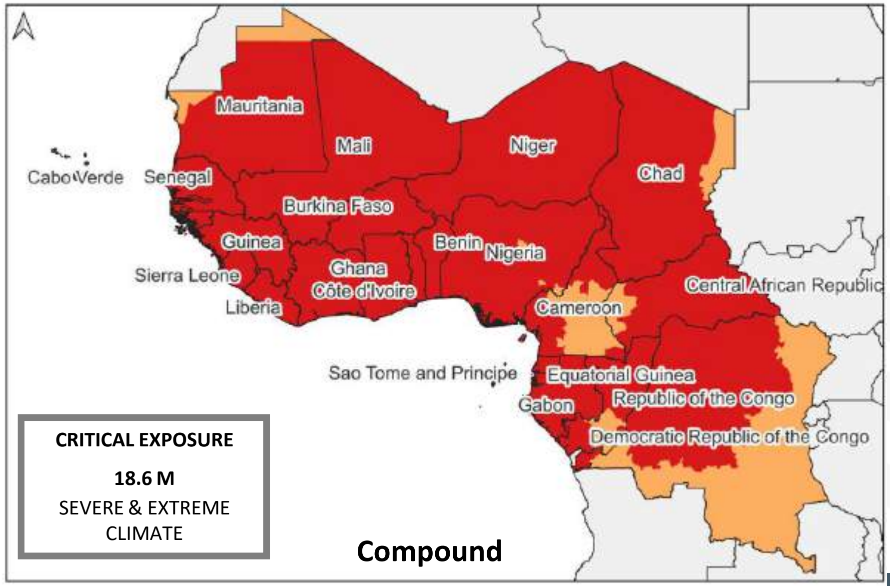

All hazards are predicted to increase in intensity in the future, with most indices falling into severe or extreme hazard classes for drought, heat and compound risk. Flood risk remains predominantly moderate and high, and overall risk increases throughout the region, albeit lower than the other hazard indices.

The next map will show the compound hazard index re-scaled.

Hazard Index
- Low
- Moderate
- High
- Severe
- Extreme
- Country borders

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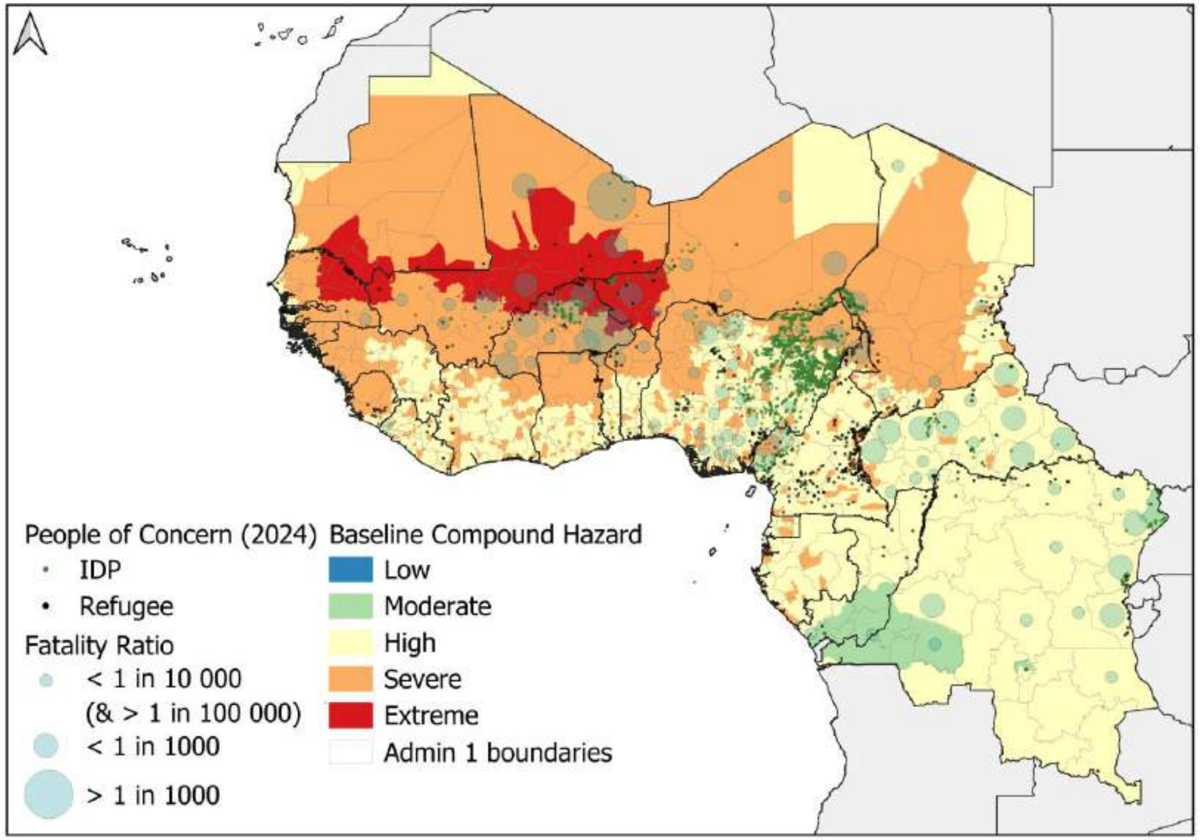
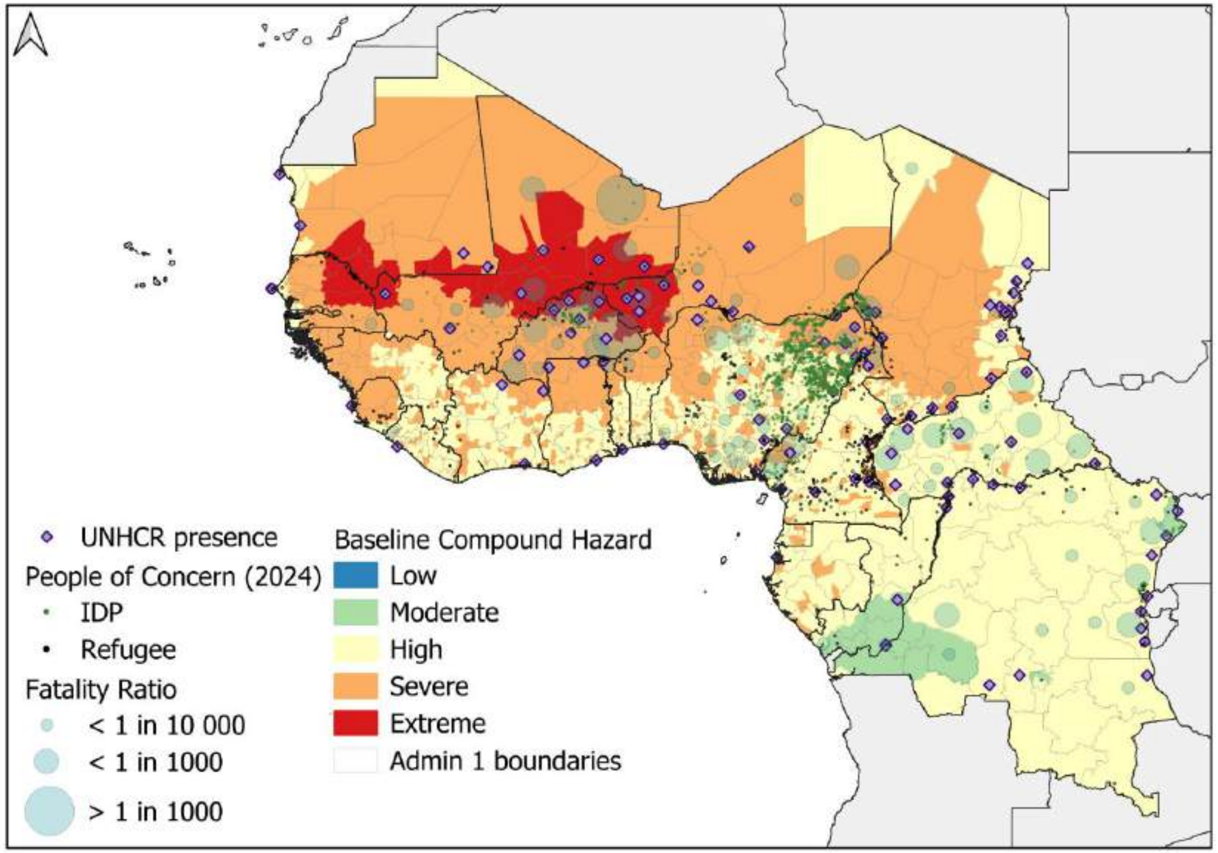
Next Step

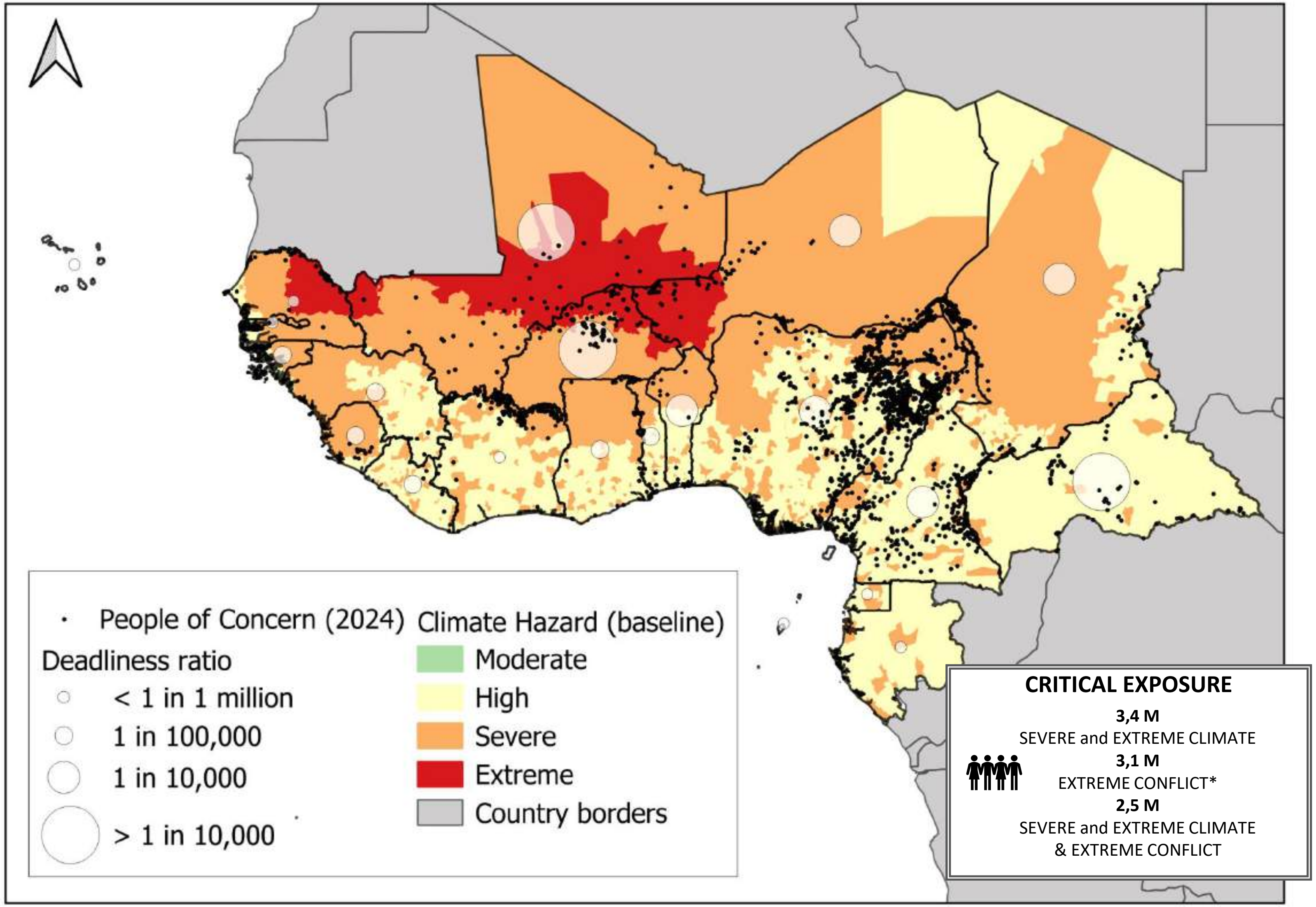
IDPs and Refugee data on baseline compound hazards



All data on baseline compound hazards



Exposure of forcibly displaced people to compound climate hazards: Baseline conditions (1980-2010)



There is a high concentration of extreme climate risks in the Sahel regions, particularly in Mali, Niger, and Burkina Faso. These areas combine severe climatic conditions with highly exposed populations.

The deadliness ratio indicates that, in some of these regions, up to one in 10,000 people is directly exposed to risks that could lead to fatalities. Areas with higher ratios (greater than 1 in 10,000) often coincide with regions where extreme climate risks are most intense, highlighted in red on the map.

*Countries with extreme conflicts are those with deadliness ratio > 1 in 10,000

FOCUS
Climate Security

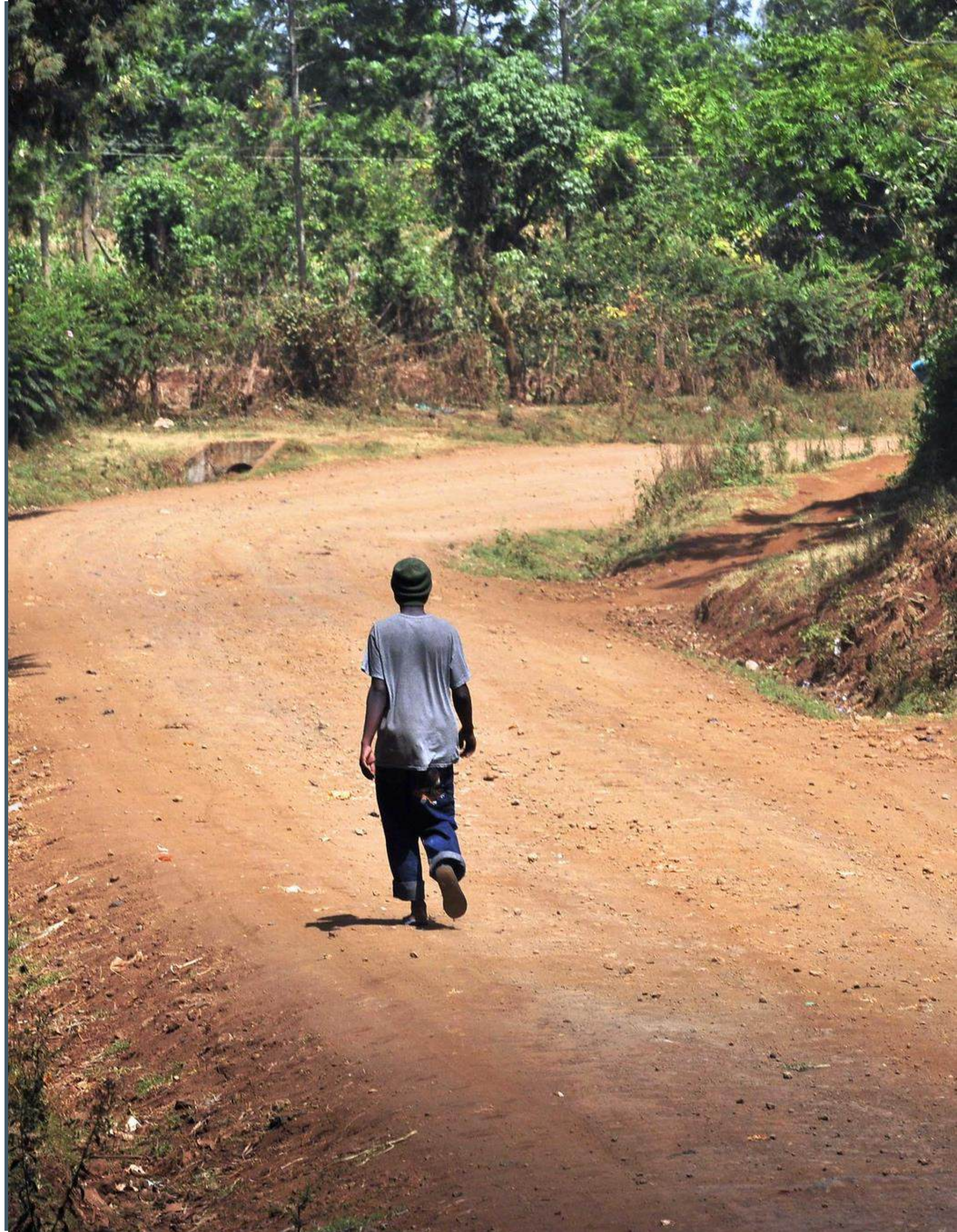
Alliance
Bioversity & CIAT

INITIATIVE ON
Fragility, Conflict, and Migration

Climate Security Mapping for targeted WFP Humanitarian Interventions in the Liptako-Gourma Region

Climate Security Hotspots and Food Security Insights

Carolina Sarzana – c.sarzana@cgiar.org



CGIAR FOCUS Climate Security

Introduction

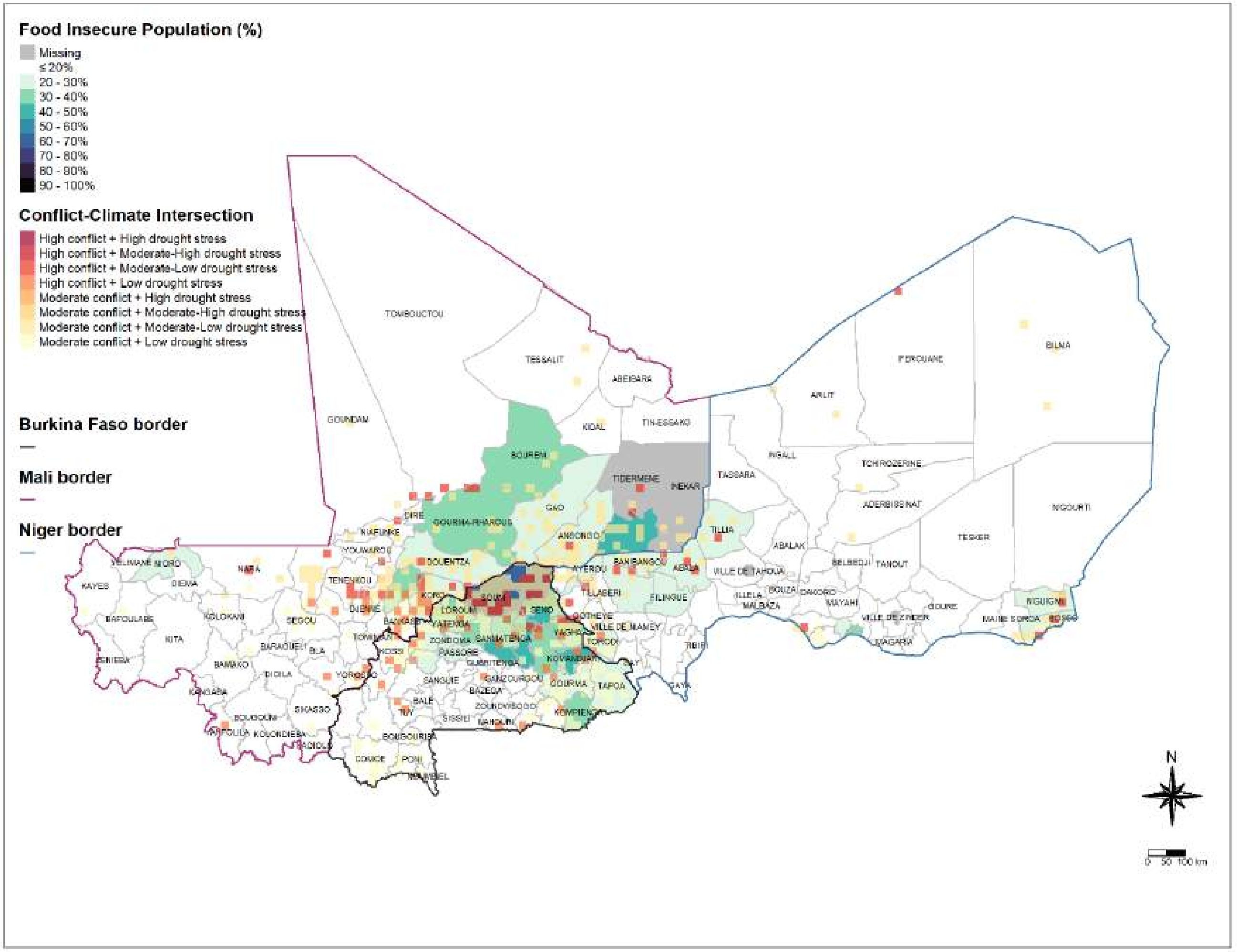
- **Liptako-Gourma Challenges**: Climate change, security, and resource management
- **Climate Impacts**: Rising temperatures, erratic rainfall, and droughts harm agriculture, reduce yields, and heightened resource competition.
- **Conflict Drivers**: Resource scarcity-led disputes over land and water, particularly between farmers and herders, and drives migration.
- **NSAG Activities**: Armed groups exploit resource disputes and climate shocks to fund operations, worsening instability.
- **Food Insecurity**: Climate stress and conflict severely increase food insecurity, particularly for displaced populations.
- **Solutions Needed**: Integrated approaches combining climate adaptation, conflict resolution, and better resource governance are essential.

Objective

- **Objective**: Assess climate, conflict, and food insecurity dynamics in the Liptako-Gourma across time (5 years)
  - Food security data: Cadre Harmonisé 2020-2024
  - Conflict data: ACLED 2019-2023
- **Primary aim**: Use spatial analysis to understand how conflict and climate interact to forecast food crises and guide WFP's emergency operations and targeting priorities.
- **Maps analyzed**:
  - Show conflict and climate data for year (n) and food insecurity in the following year (n+1).
  - **Conflict-climate hotspots**: Colored squares indicate conflict and drought stress combinations.
  - **Food insecurity**: Darker background colors indicate higher percentages of food-insecure populations (admin level 2). Areas with 20%+ food insecurity highlighted for WFP interventions.

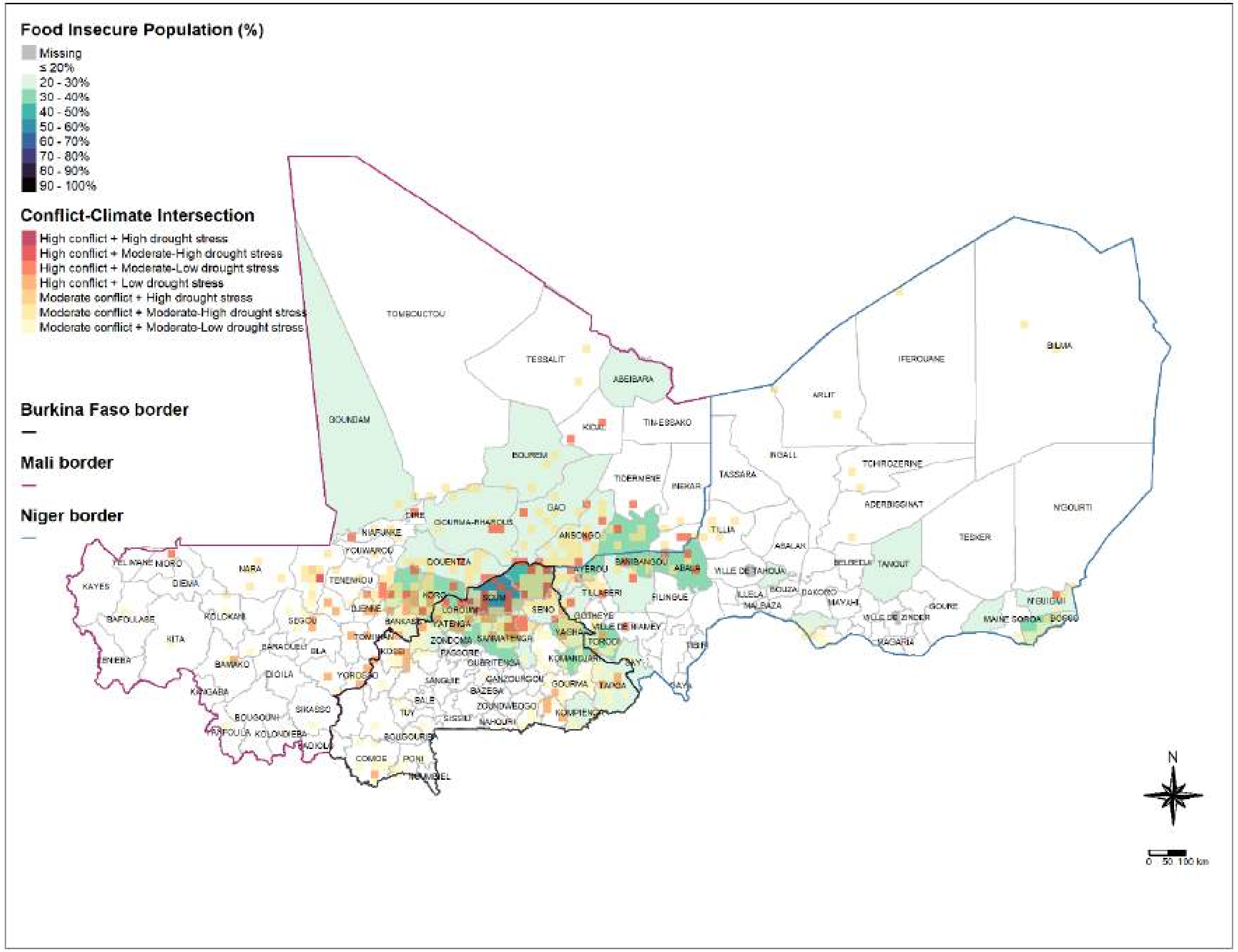
CGIAR FOCUS Climate Security

Analysis of Food Security Levels in 2020



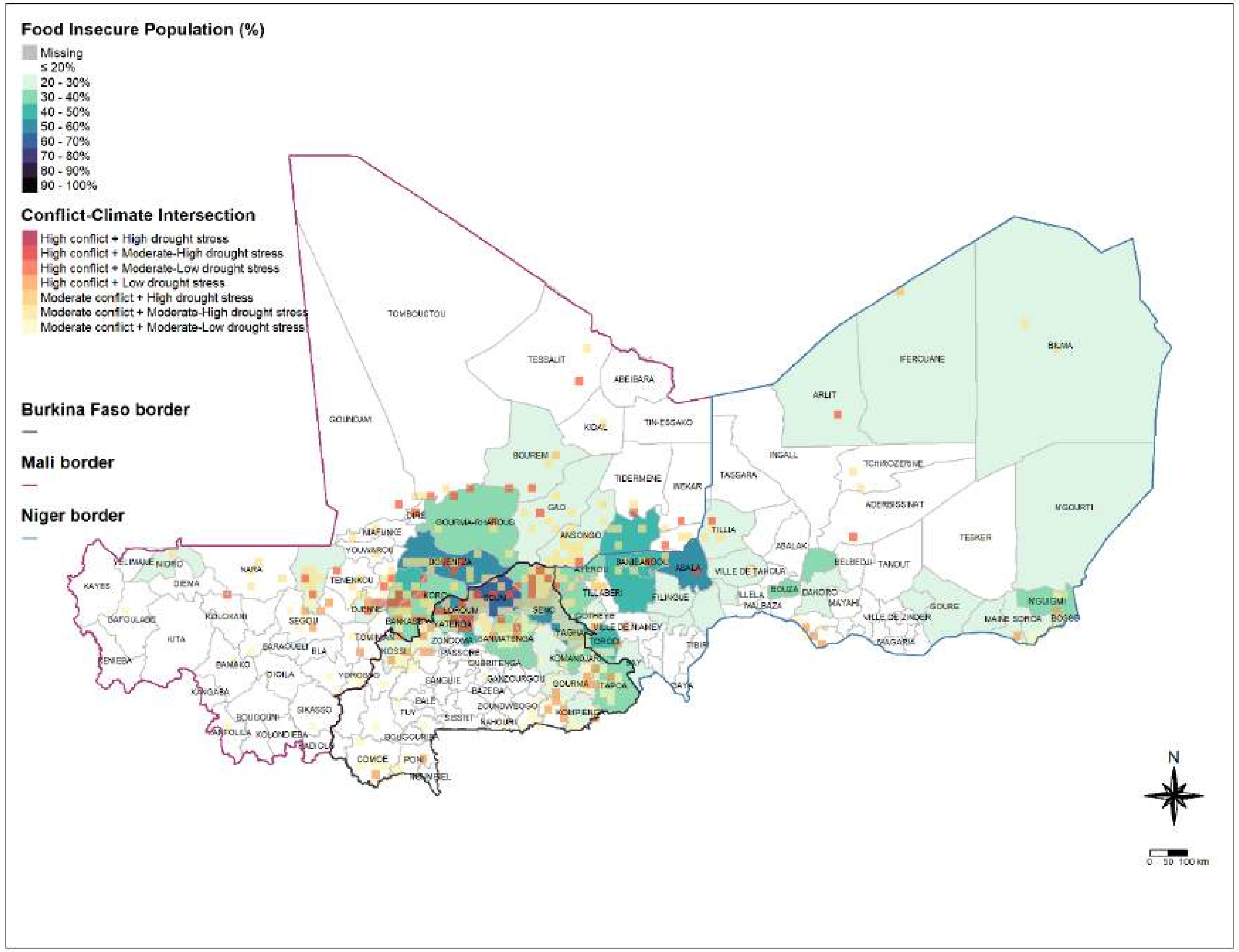
- **2019 Conflict and Climate Stress**: Intense conflict and drought affected northern Burkina Faso, central Mali, and Niger, especially in the Liptako-Gourma region, marked by red and orange hotspots on maps.
- **2020 Food Insecurity**: Up to 63% in northern Burkina Faso, 41% in central Mali, and 30% in parts of Niger, reflecting 2019 pressures.
- **Regional Impacts**: Northern Burkina Faso was hardest hit, while Niger was less affected.
- **Key Drivers**: Food insecurity levels highlight the combined impact of severe conflict and climatic stress from prior years.

Analysis of Food Security Levels in 2021



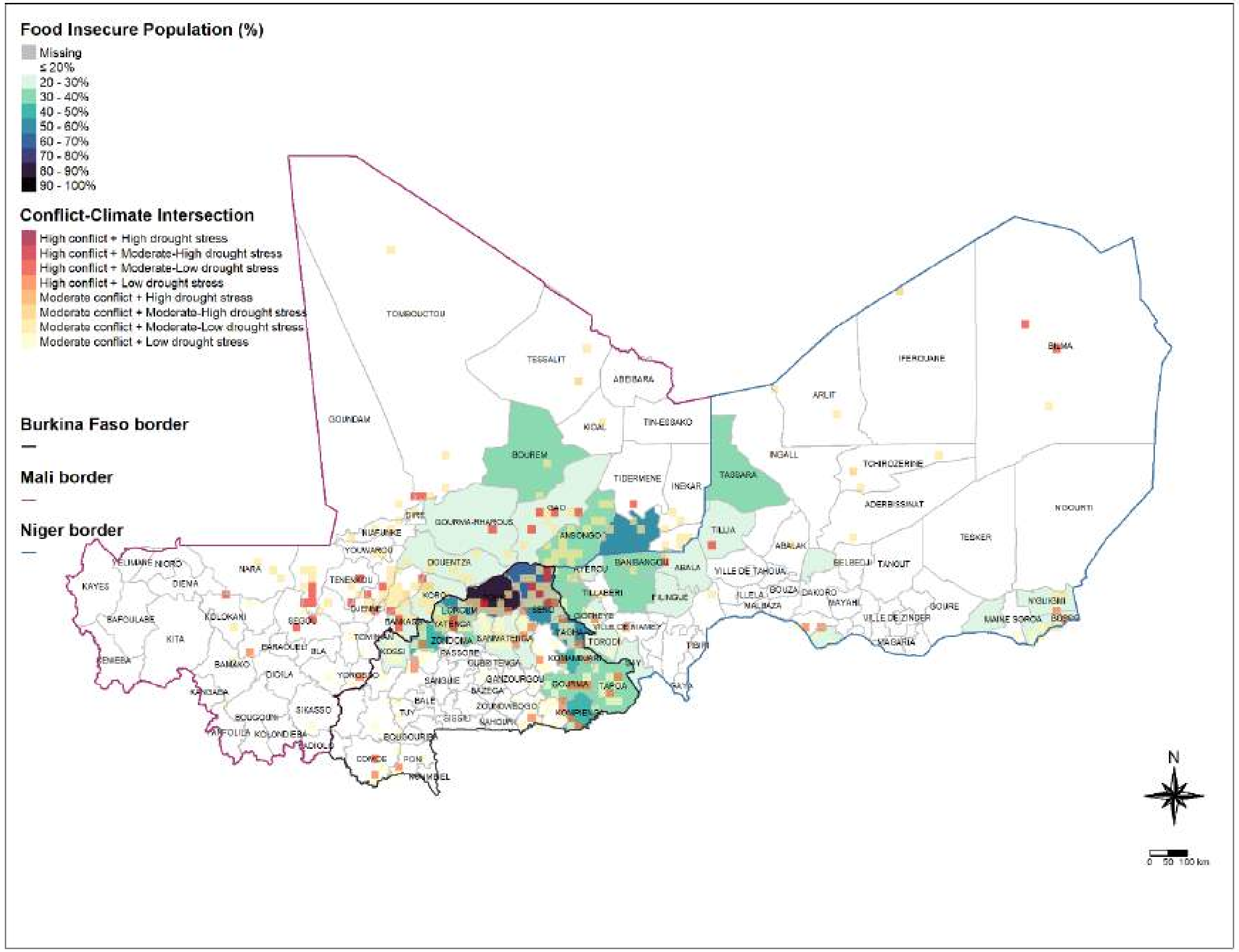
- **2020 Conflict and Food Insecurity**: Regions with lower conflict saw reduced food insecurity in 2021, while areas in Liptako-Gourma with high conflict and drought faced severe crises.
- **Key Impacts**: Conflict disrupted supply chains and farmland access, with drought worsening food insecurity.
- **Positive Trends**: Food insecurity, conflict intensity, and drought stress have decreased overall since 2020, especially in northeastern Burkina Faso.
- **Clear Correlation**: The interplay between conflict, climate stress, and food insecurity remains evident in affected regions.

Analysis of Food Security Levels in 2022



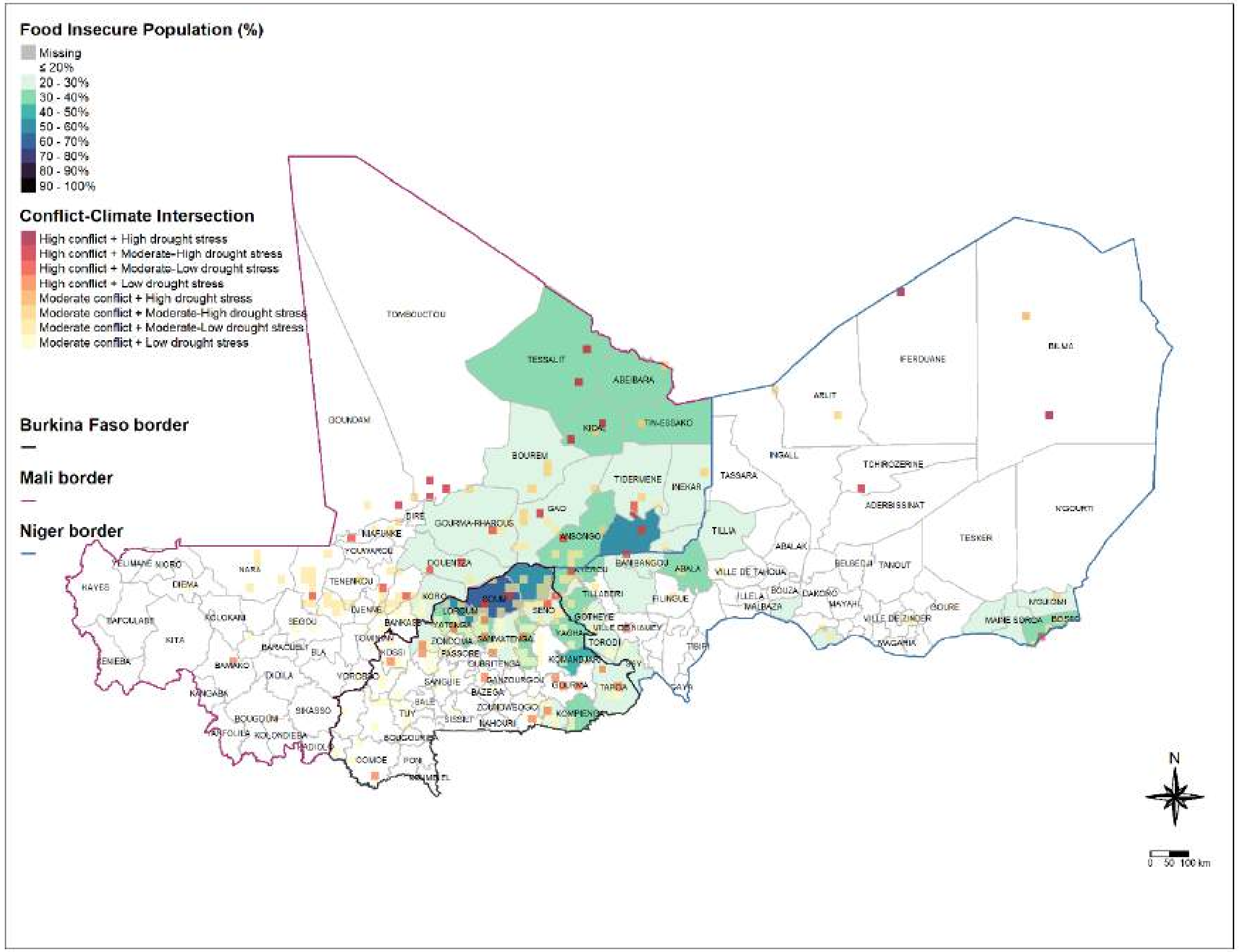
- **2021 Conflict Escalation**: Armed violence increased in northern Burkina Faso and central Mali, with severe climate security hotspots in areas like Soum, Burkina Faso.
- **Climatic Stress**: Persistent drought and overlapping conflict intensified along the Niger-Mali-Burkina Faso border.
- **2022 Food Insecurity**: Sharp rises reached 62% in Burkina Faso's Sahel, 53% in Niger's Abala, and 50% in Mali's Douentza, driven by 2021's crises.
- **Cumulative Impact**: The delayed food crises reflect compounded effects of conflict, climate, and systemic collapse in affected regions.

Analysis of Food Security Levels in 2023



- **2023 Intensified Hotspots**: Transboundary provinces in Burkina Faso saw worsening food and security conditions, with hotspots shrinking but becoming more severe.
- **Rising Food Insecurity**: Rates spiked to 83% in Soum, 62% in Oudalan, 59% in Loroum (Burkina Faso), and 59% in Menaka (Mali).
- **Improved Areas**: Douentza (Mali) saw a drop in food insecurity from 50% to 24%, with fewer hotspots overall.
- **Positive Trends**: Mali and Niger experienced reduced food insecurity, with some northeastern Niger provinces no longer requiring humanitarian aid.

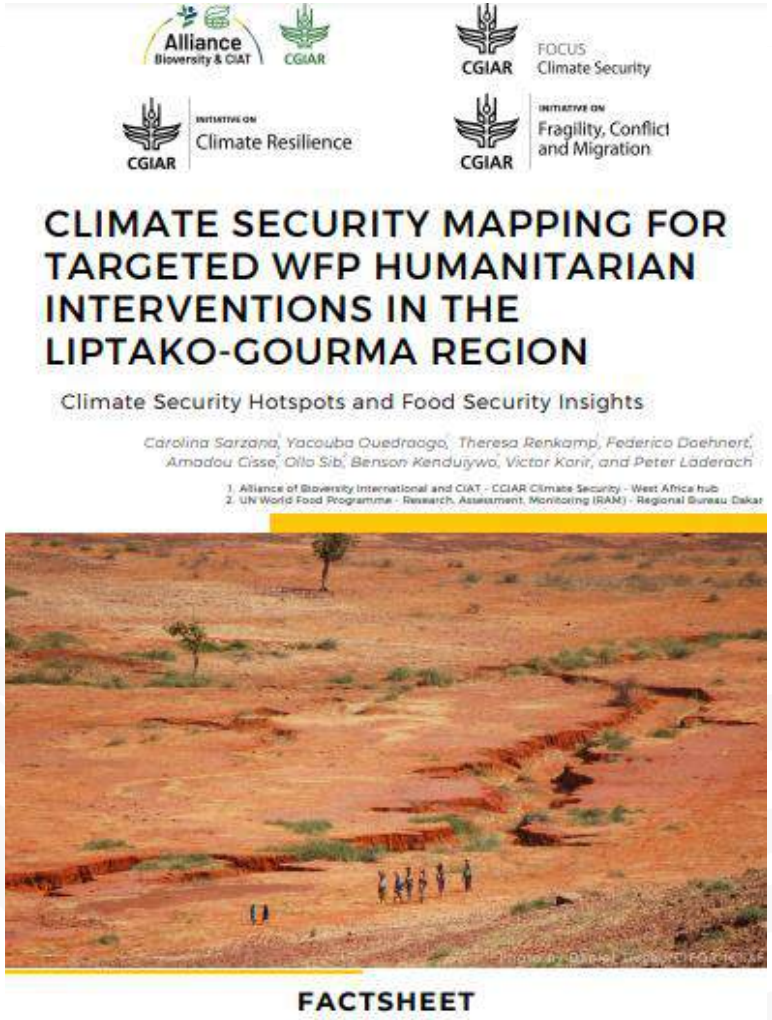
Analysis of Food Security Levels in 2024



- **Hotspots Shifted**: In 2024, hotspots decreased in size but expanded to peripheral areas, spreading conflicts and climate pressures to new regions.
- **Worsening in Mali & Niger**: Severity increased in previously less affected areas, like northeastern Mali (Tessalit, Kidal) and southeastern Niger (Bosso, Diffa, Goudoumaria), with food insecurity rising to 32-35%.
- **Burkina Faso Improvements**: Both conflict and food insecurity decreased, though challenges remain significant.
- **Severe Food Crises**: A smaller number of regions face more intense food insecurity, particularly where moderate conflict escalated in 2023.

Conclusions

- **Localized Conflicts**: Conflicts in the Sahel are increasingly localized, spreading into new areas.
- **Conflict-Climate-Food Cycle**: A strong link exists between conflict, drought, and food insecurity, forming a self-reinforcing cycle.
- **Vulnerability in Liptako-Gourma**: Hotspots decreased from 2019–2023 but are now more distributed, spreading conflict impacts.
- **Intensifying Crises**: Moderate conflict areas face escalation, with northeastern Mali and eastern Niger experiencing rising food insecurity.
- **Emerging Hotspots**: New tensions in Central-Western Mali and parts of Niger call for urgent humanitarian and peacebuilding strategies.



Questions & Discussion

- How is this approach complementing other existing analyses/tools?
- Can we trust ACLED data for conflicts? Are there any other sources better capturing local conflicts?
- Can we rely on Uppsala Conflict Data Program (UCDP) data?
- Would you employ these results to inform activities/programs?

CGIAR FOCUS Climate Security

Thanks!

Contacts: y.ouedraogogo@cgiar.org & c.sarzana@cgiar.org

VISIT: https://cso.cgiar.org/

OCHA

Introduction à climap.info

OCHA ROWCA (Bureau régional)

Agenda

1. Qu’est-ce que c’est le CLIMAP ?
2. Pourquoi a-t-on besoin de CLIMAP ?
3. Éléments constituants sur le site du CLIMAP
4. Comment fournir des informations sur CLIMAP ?
5. Validation des informations fournies
6. Produits disponibles
7. Comment s’enregistrer ?
8. Qui peut avoir accès aux données ?
9. Prochaines étapes du développement

Qu’est-ce que c’est le CLIMAP ?

CLIMAP (Climate Impacts Monitoring and Analysis Platform) est un outil développé par OCHA ROWCA pour centraliser la collecte de données sur les impacts des événements climatiques extrêmes en Afrique de l’Ouest et Centrale.

L’outil est né après le travail réalisé par ROWCA depuis 2021 pour tracer les impacts des inondations sur les pays de l’Afrique de l’Ouest au niveau subnational.

Pourquoi a-t-on besoin de CLIMAP ?

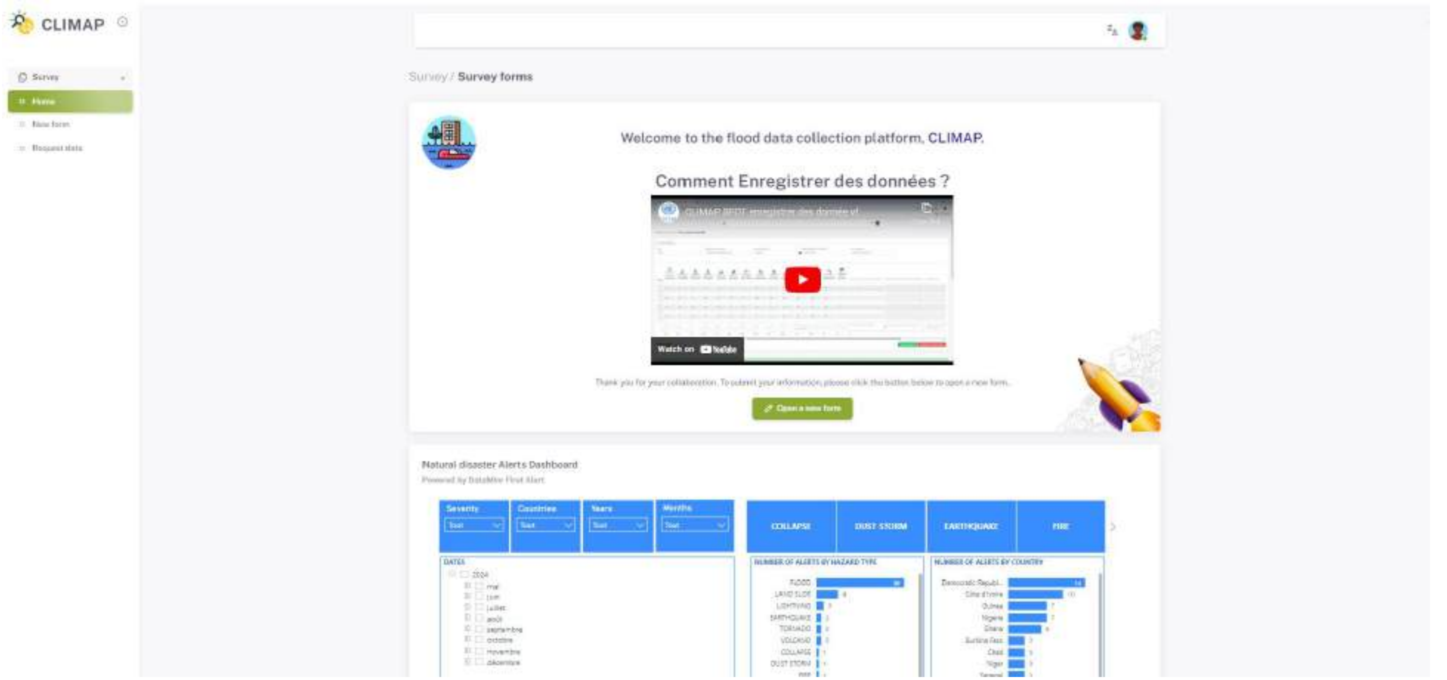
- L'origine de l'information sur les prévisions, les alertes et les impacts humanitaires des inondations et autres phénomènes climatiques est diverse (protection civile, Croix Rouge, ONG, agences de l'ONU, etc.).
- Le format des informations est varié (PDF, images, Word, Excel, etc.).
- La quantité d'informations n'est pas gérable par une seule personne (24 pays au total).
- Les données reçues changent au fil du temps (à mesure que les informations sont reçues ou validées ou que l'événement progresse dans le temps).
- On observe une intégration incomplète des partenaires sur le terrain en matière de chiffres (collecte, validation, estimation, coordination de collecte et analyse, données différentes sur une même urgence, etc.).

➢ Collecte **harmonisée** des données grâce à CLIMAP.

➢ **Source unique** pour accéder à toutes les informations sur les aléas climatiques en Afrique de l'Ouest et Centrale.

Éléments constituants sur le site du CLIMAP

- Le CLIMAP constitue une plateforme qui permet **l'articulation d'une communauté de pratique (COP)** pour l'échange entre des acteurs qui jouent un rôle lors des inondations, notamment les responsables d'action, les donateurs et les coordinateurs.



- Visualisation d'alertes, visualisation de données et mise en relation des membres actifs*.

- Visualisation des impacts des phénomènes extrêmes au long du temps.

*Sous autorisation.

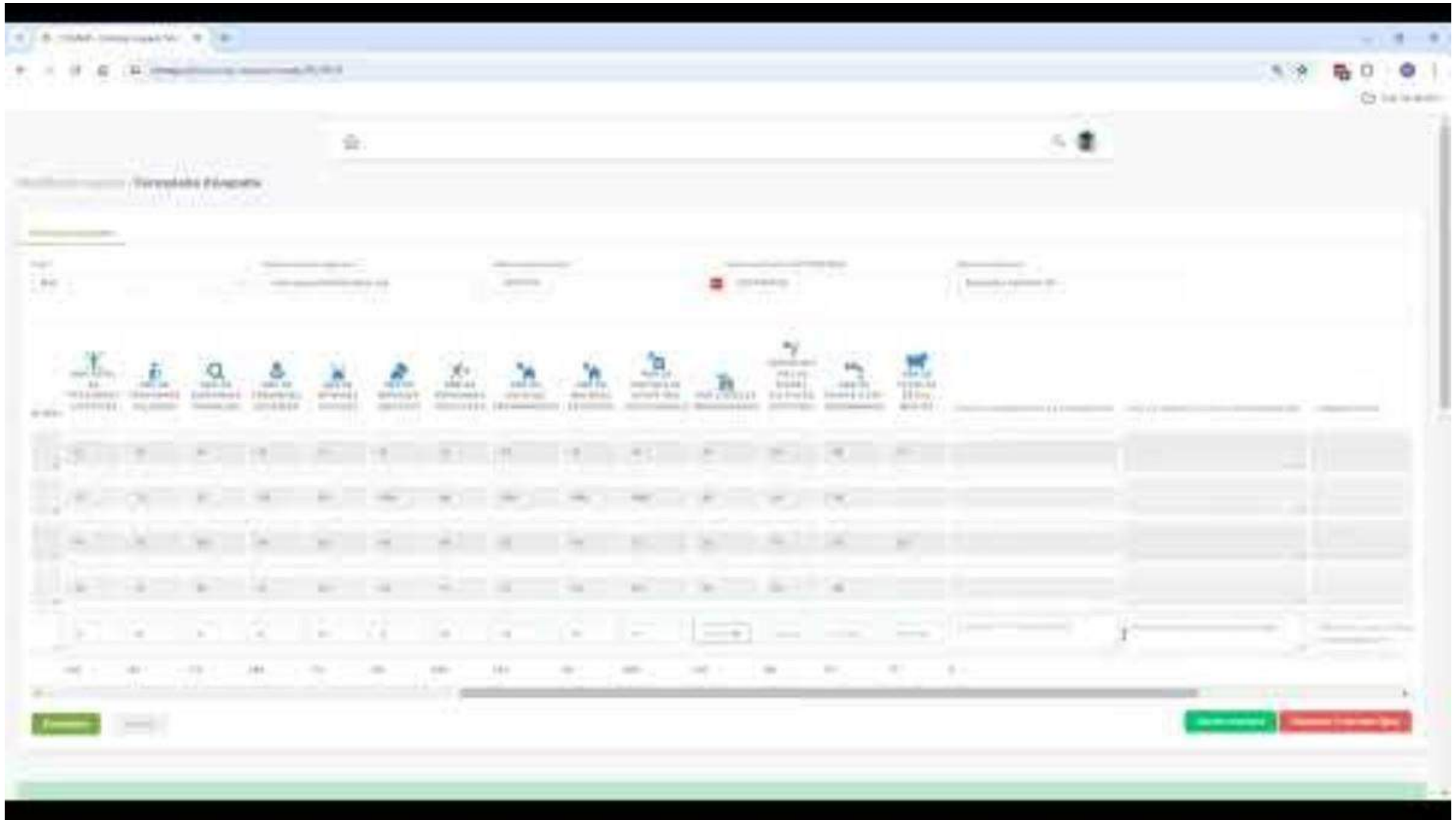
Comment fournir des informations sur CLIMAP

Fournissez les informations avec le plus de détails disponibles, de façon numérique et attachez pour référence les documents source. Toutes les informations seront mises à disposition des autres membres du pays d'enregistrement. Toutes les informations à enregistrer sont volontaires sauf :

- Type d'événement
- Date de début
- Source d'information

Il y a de l'espace pour des commentaires.

Le plus précis vous serez sur la localisation (à partir de Admin 1), le plus désagrégé on pourra stocker les données.

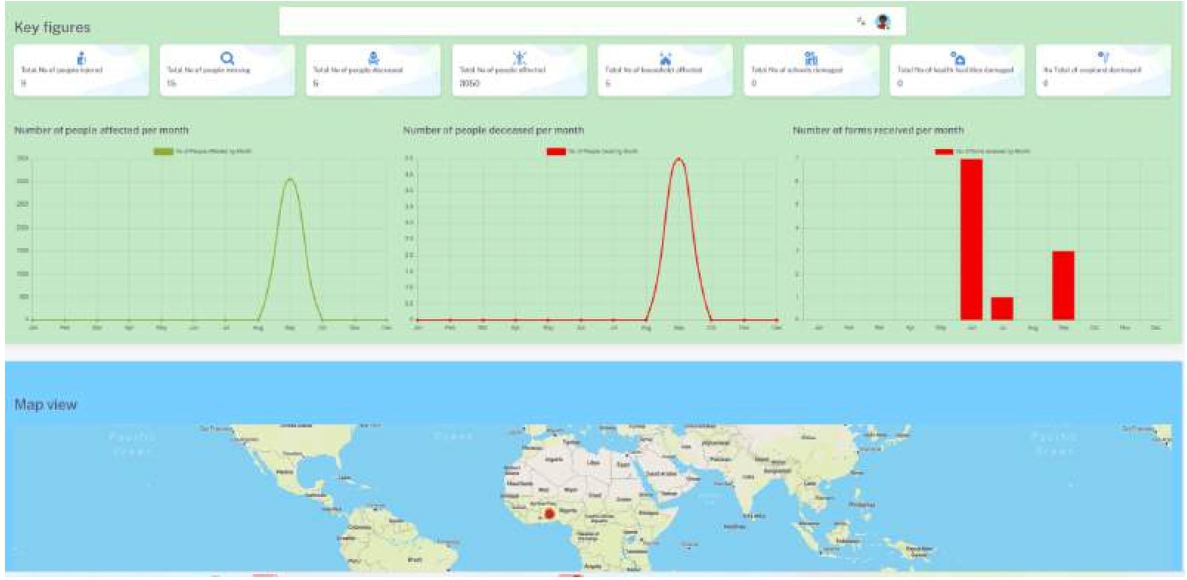


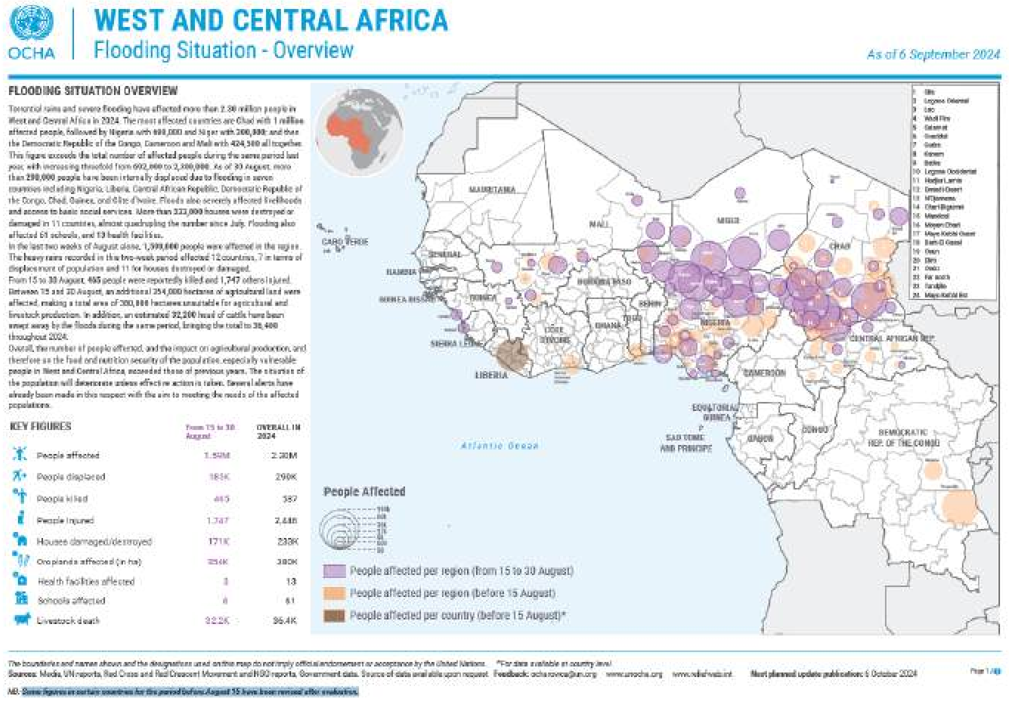
Video! https://youtu.be/jfrrY0vkhBo

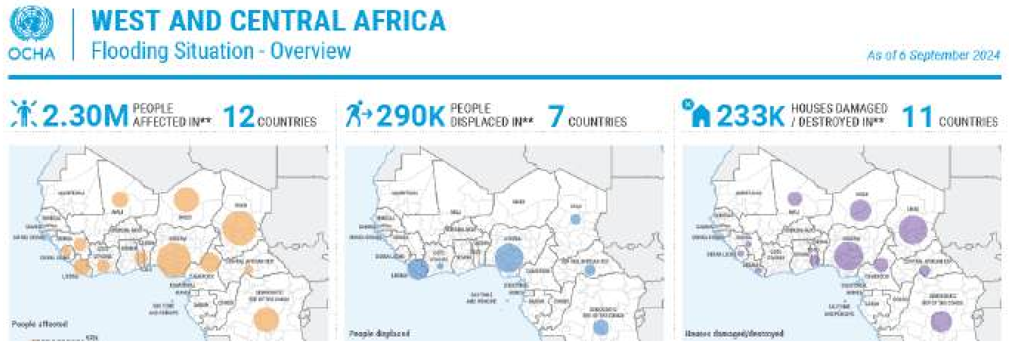
Validation des informations fournies

- Le processus de validation des informations sera fait initialement par OCHA.
- Toutes les informations fournies au niveau d’un pays seront partagées avec les membres pour connaissance.
- Toute information soumise sera enregistrée, mais leur utilisation lors de la publication d’un snapshot sera définie par des critères de qualité, de pertinence et d’autorité (gouvernement versus ONG).

Produits disponibles



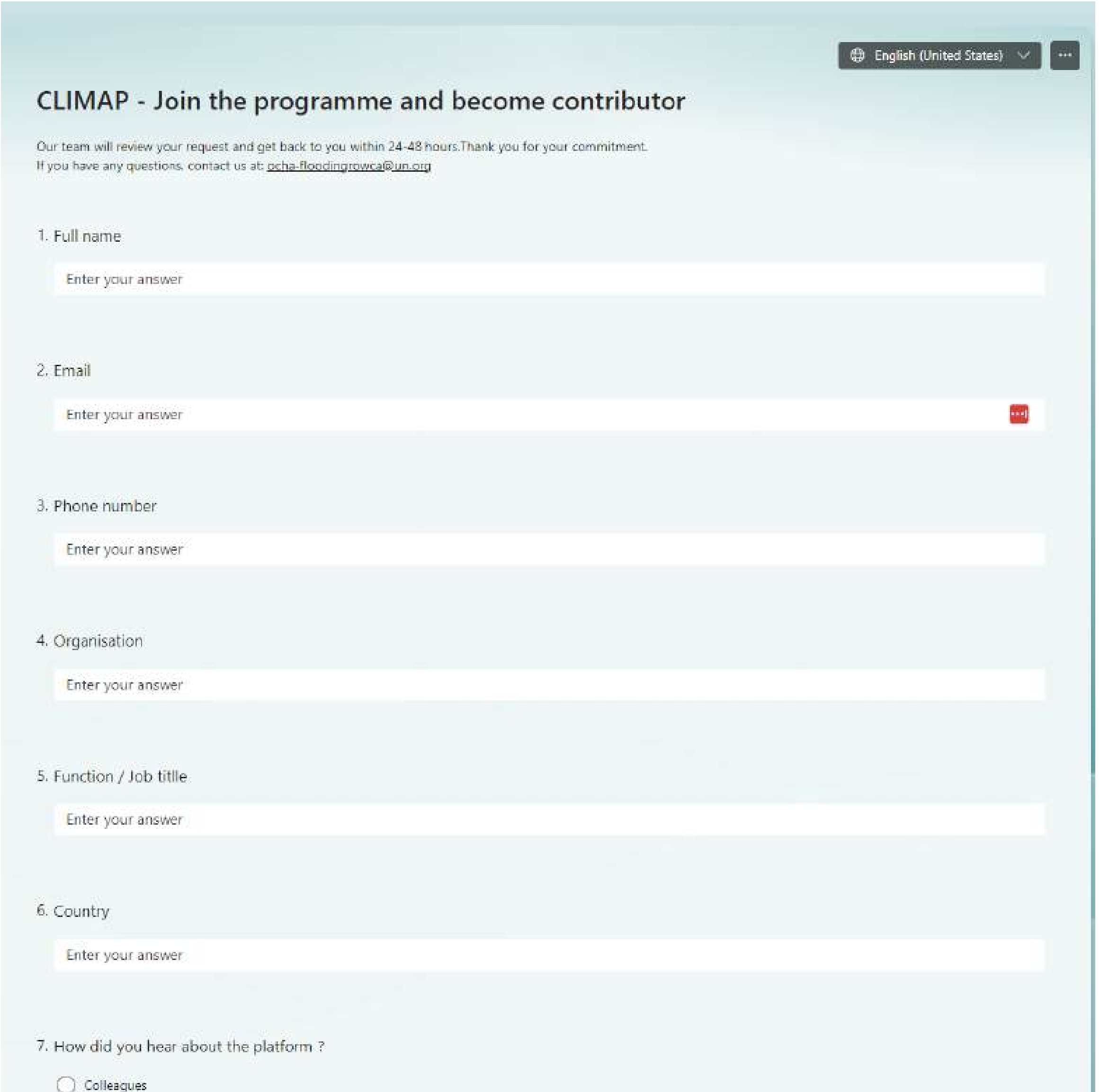




- Les informations fournies sont accessibles visuellement sur Carte ou données totalisées
- Les données sur Excel seront disponibles (future) mais OCHA peut les fournir à la demande du partenaire après validations du Snapshot en PDF (données pays par pays).

Comment s'enregistrer

Visez le site suivant: https://climap.info/join-us/


English (United States)

CLIMAP - Join the programme and become contributor

Our team will review your request and get back to you within 24-48 hours.Thank you for your commitment.
If you have any questions, contact us at: ocha-floodingrowca@un.org

1. Full name

Enter your answer

2. Email

Enter your answer

3. Phone number

Enter your answer

4. Organisation

Enter your answer

5. Function / Job titlle

Enter your answer

6. Country

Enter your answer

7. How did you hear about the platform ?

Colleagues

Qui peut avoir accès aux données

Ceux qui donnent, reçoivent !

- L'implication des partenaires dans la collecte de données leur garantit l'accès à toutes ces informations pour leur utilisation. Néanmoins, dans un premier temps, l'accès public restera restreint jusqu'à ce que la qualité des données et leur validation soient suffisamment correctes pour les partager.
- Le travail conjoint fera que la qualité et la mise à jour des données soient une responsabilité partagée entre les partenaires (les données manquantes ne seront pas retenues).
- Les membres enregistrés comme contributeurs pour un pays auront accès aux informations de leur pays, à la communauté de pratique, et à l'accès aux données générales brutes et curées (assuré par OCHA). Les données partagées avec un partenaire ne doivent pas être partagées avec des tiers.

Types de membres (l'approbation sera faite par OCHA dans un premier temps) :

•Agences de l'ONU dans les pays (un responsable)

•ONG / INGO

•Mouvement de la Croix-Rouge

•Agences gouvernementales qui fournissent ou utilisent les informations collectées (Protection civile, agence météorologique)

•Agences qui font un suivi régional

•...autres à définir

Le public général continuera à avoir accès aux données fournies lors du Snapshot mensuels (dans un premier temps) et sur un tableau de bord basé sur les données évaluées sur la page publique du CLIMAP.

Prochaines étapes du développement

Le CLIMAP vise à être une plateforme harmonisée où trouver et fournir des données des impacts des phénomènes climatiques extrêmes. Lors de la saison des pluies (juin à décembre), le site devrait contenir trois espaces faciles à comprendre :

- Prévisions météorologiques :
  - Court terme
  - Long terme
- Alertes :
  - Temps ultra court (1 à 2 jours) pour PDC et Adam (en cours)
- Impact de la crise:
  - Automatiquement sur Dataminr (IA bot) + carte des impacts fournie par les données CLIMAP
- Réponse et assistance fournies :
  - Informations sur les besoins financiers, réponse en cours, etc. ou redirection vers le site correspondant

OCHA

Questions et réponses

Predicting Hazards for Anticipatory Action

Early Warning Grid-Based Risk Modeling of Climate Induced Forced Displacement Workshop
5 December 2024

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OCHA

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OCHA CENTRE FOR HUMANITARIAN DATA

OUR GOAL

The goal of the Centre is to increase the use and impact of data in humanitarian response.

centre for humdata

Workstreams

1

DATA SERVICES

Making humanitarian data easy to find and use for analysis, closing data gaps and facilitating data processing at scale.

2

DATA SCIENCE

Conducting advanced analysis and creating insight to anticipate and respond to needs arising from predictable shocks

3

DATA RESPONSIBILITY

Ensuring the safe, ethical and effective management of personal and non-personal data for operational response

4

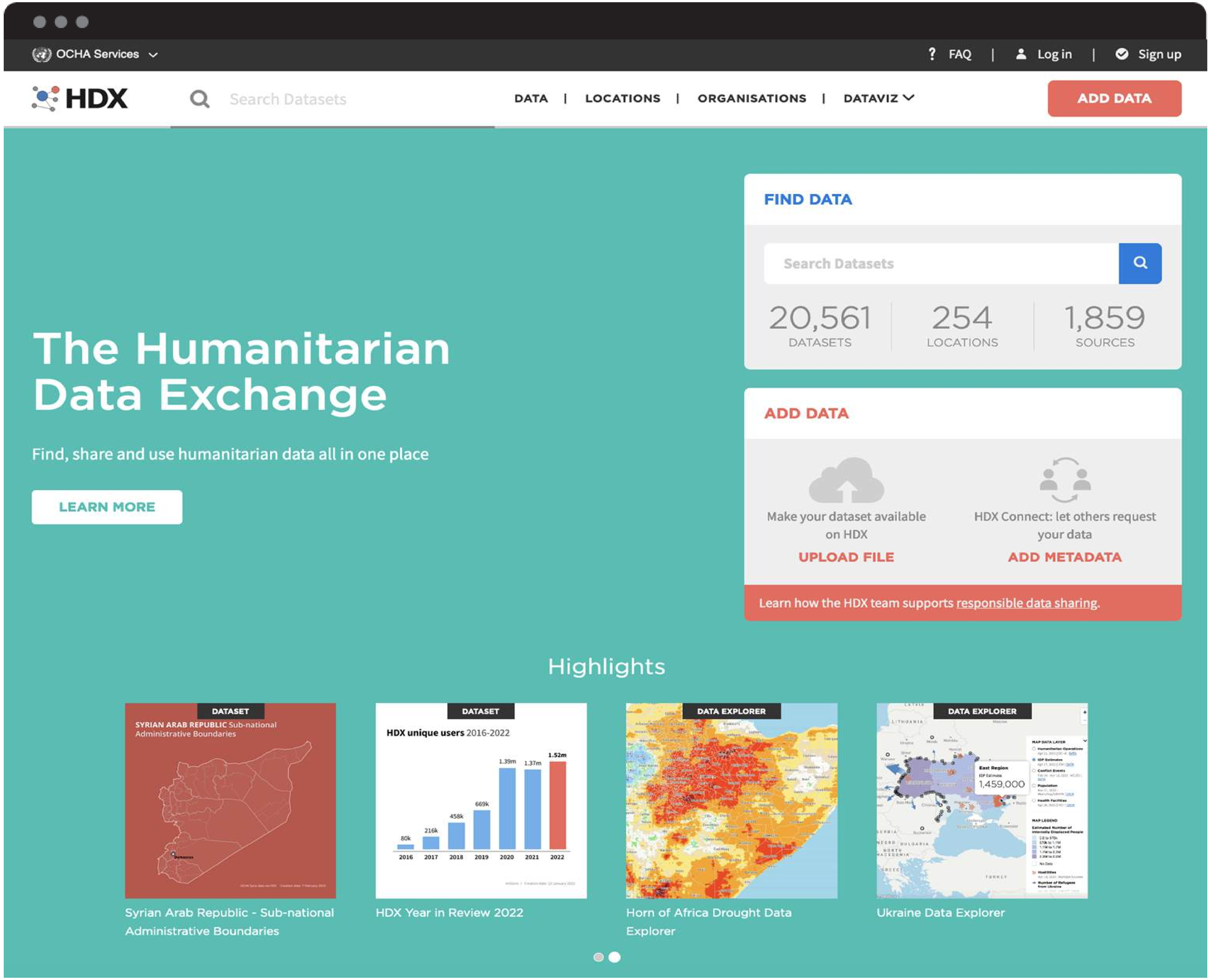
LEARNING & PRACTICE

Increasing the confidence of humanitarians to engage with data and make effective use of analysis

OCHA's open platform for data sharing.

The goal of HDX is to make humanitarian data easy to find and use for analysis.

The platform was created in 2014 and has become the go-to place for humanitarian data..



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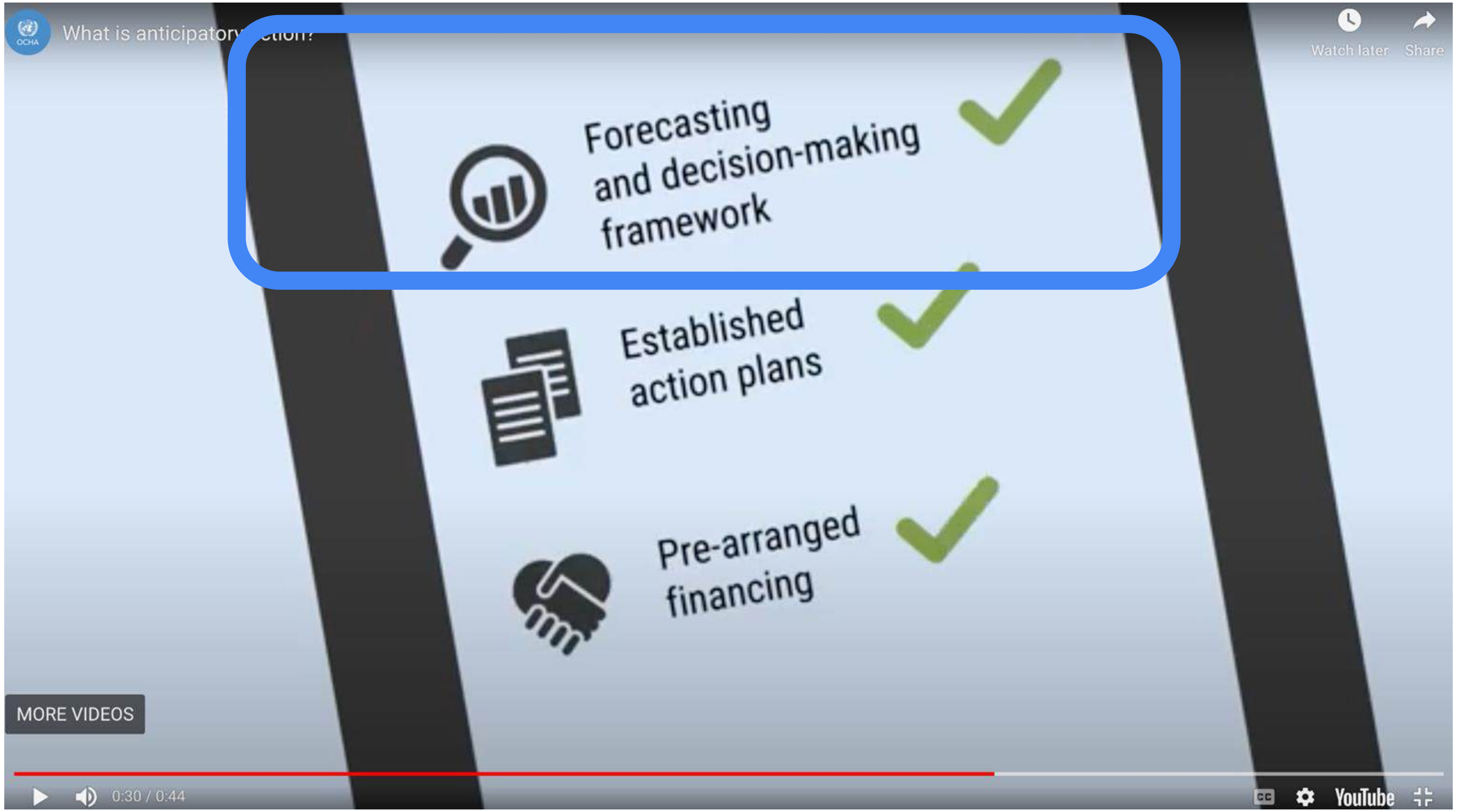
Dataset page >

AA triggers developed in OCHA so far

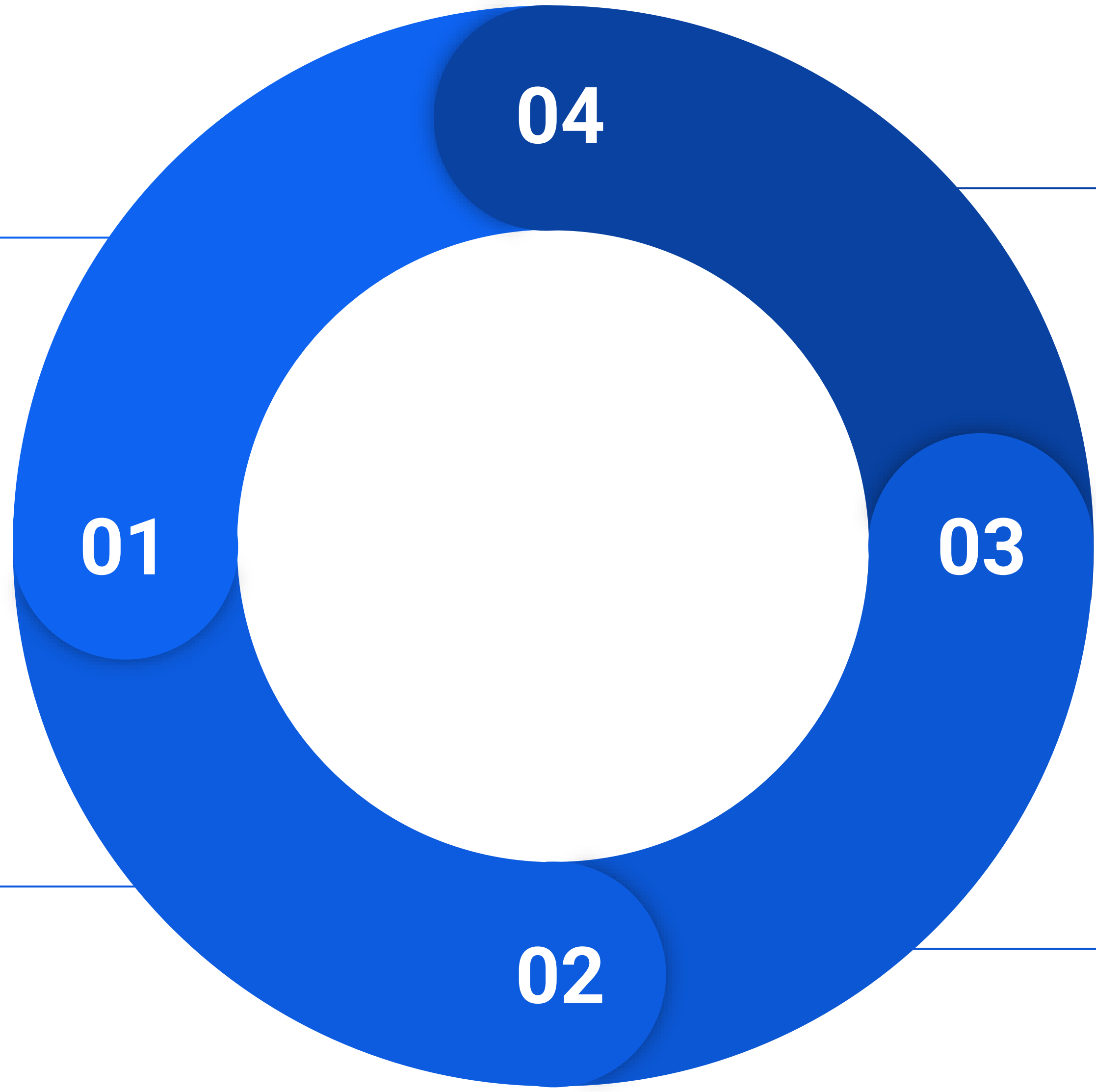
Today’s focus



AA triggers overview

Steps in the trigger development process

Overall trigger development process



Initial scoping and feasibility

Definition of operational needs and key parameters

Technical development

Assessment of available forecasts and evaluation of performance.

Endorsement and monitoring

Endorsement by key stakeholders and governance establishment

Evaluation and improvements

Post-season evaluation and improvements implementation

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Example: drought in Niger

Niger drought AA trigger

How was the trigger activation process set up?

- **Maproom – Predicitive trigger** (IRI, WFP, National Directorate of meteorology). Satellite data (ENACS). Theshhold at 35% (worst/1 in 3 years)
- **SPIs- Observational trigger** (National Directorate of meteorology). June-July. Theshold below average 30 years SPI (1991-2020)
- How much time it provided to act before the peak drought impact hit?

Niger - Calendrier Saisonnier et Crisis Timeline Sècheresse																			
Mois	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Climat																			
Précipitations	Saison sèche					Saison de pluie					Saison sèche							Saison de pl	
Calendrier saisonnier "normal"																			
Agriculture	Récolte en contre-s			Préparation		Plantation / cultivation				Récolte principale			Récolte en contre-s			Préparation		Plantation	
Période de soudure																			
Transhumance				S-N						N-S						S-N			
Période de soudure pastorale																			
Education									Rentrée									Examens	
Santé						Hydrique: Cholera, Paludisme					Sècheresse: rougeole, méningit								

What were the key lessons learned for the next revision of the framework.

- Accelerate fund disbursement by CERF (delayed activities/procurement processes)
- Decrease trigger annual activation rate/probability (Every month/2 consecutive months)

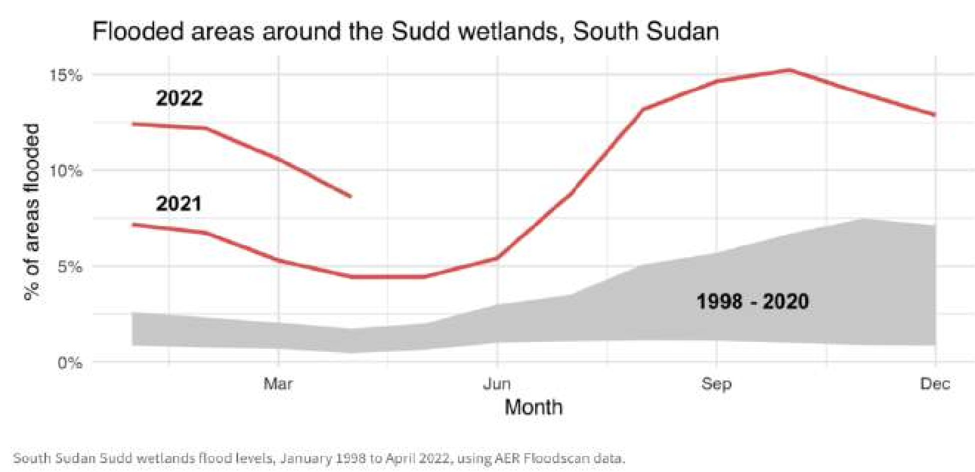
Capacity building

Building a risk culture within OCHA

Guidance on how to deal with climate data

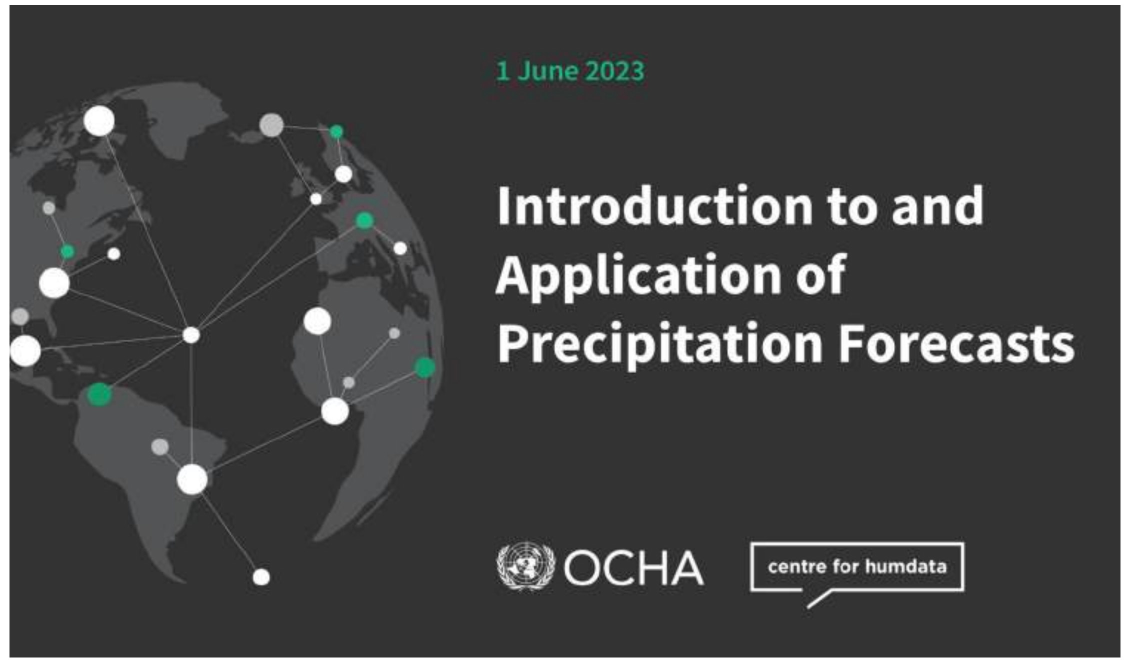
Dealing with new climate forecasts

Technical support to country and regional offices



Analytical surge capacity

Capacity building within the organisation



Support implementation at the local level

Summarising key aspects of trigger development

Design principle	Data	Capacity	Sustainability
Codesign Operational needs and technical requirements *How does a good trigger look like is strongly context dependent* - Does it enable the right decisions? - Is it in line with needs from operations and risk acceptance from decision makers?	Historical impact data Access to relevant forecast information	Link with national/local authorities, technical experts Need for technical profiles to facilitate effective exchange	Trigger governance Continuous evaluation and improvements

Thank you!

For any questions or comments, please reach out at
pouyen@un.org

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OCHA

Modèle AHEAD (ancien WACAFI) pour la prévision des déplacements forcés

- **04/12/2024**

DRC DANISH REFUGEE COUNCIL

Plan

Genèse du modèle AHEAD

Présentation du modèle

Sources de données

Projet pilote AA à Dédougou

Genèse du modèle AHEAD

Funded by European Union Humanitarian Aid

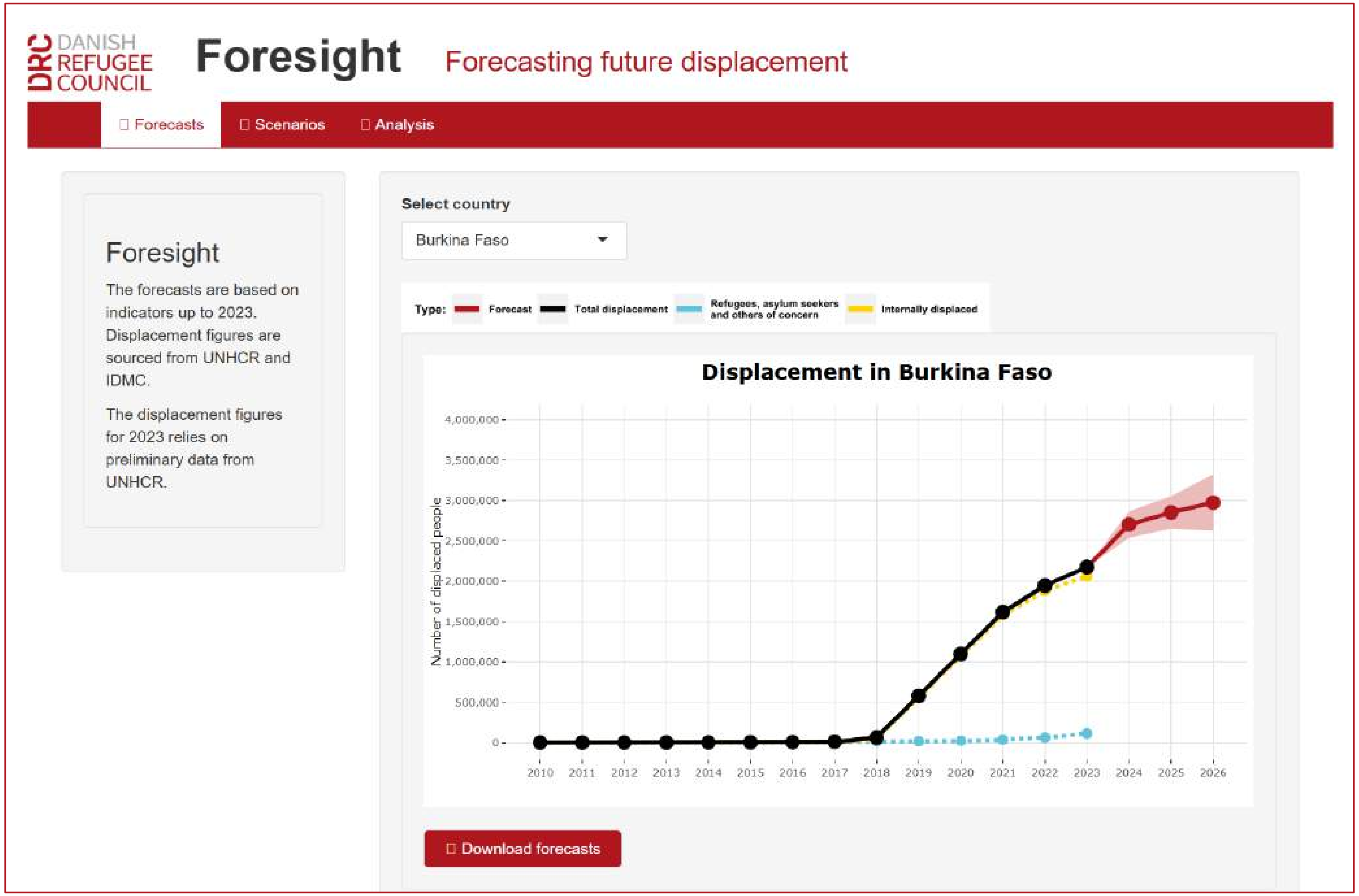
DRC

Foresight : Prévisions des déplacements

- Partenariat de 3 ans avec IBM, avec un financement du ministère danois des affaires étrangères, pour explorer le potentiel d'utilisation de l'analyse prédictive dans le secteur humanitaire
- Un modèle de machine learning pour générer des prévisions ponctuelles sur les déplacements forcés (IDPs, refugees and asylum seekers).
- Le modèle s'appuie sur des données secondaires, provenant notamment de la Banque mondiale, d'agences des Nations unies, d'ONG et d'institutions universitaires.
- Foresight incorpore plus de 120 indicateurs provenant de données libres liées à la violence, à la gouvernance, à l'économie, à l'environnement et à la socio-démographie pour prévoir le nombre total de personnes déplacées d'un pays dans un délai de 1 à 3 ans.
- Le modèle couvre actuellement 26 pays et fonctionne généralement assez bien.
- Le cas d'utilisation prévue est pour notre planification stratégique annuelle interne / révision périodique, ainsi que pour informer et utiliser notre engagement dans une planification plus large dans le secteur humanitaire, par exemple les processus HRP/HNO.

Genèse du modèle AHEAD

- Prévisions disponibles sur le site de DRC



- Rapport annuel sur les prévisions de déplacements.

https://www.drc.ngo/what-we-do/innovation/predictive-analysis/foresight-displacement-forecasts/

Présentation du modèle WACAFI

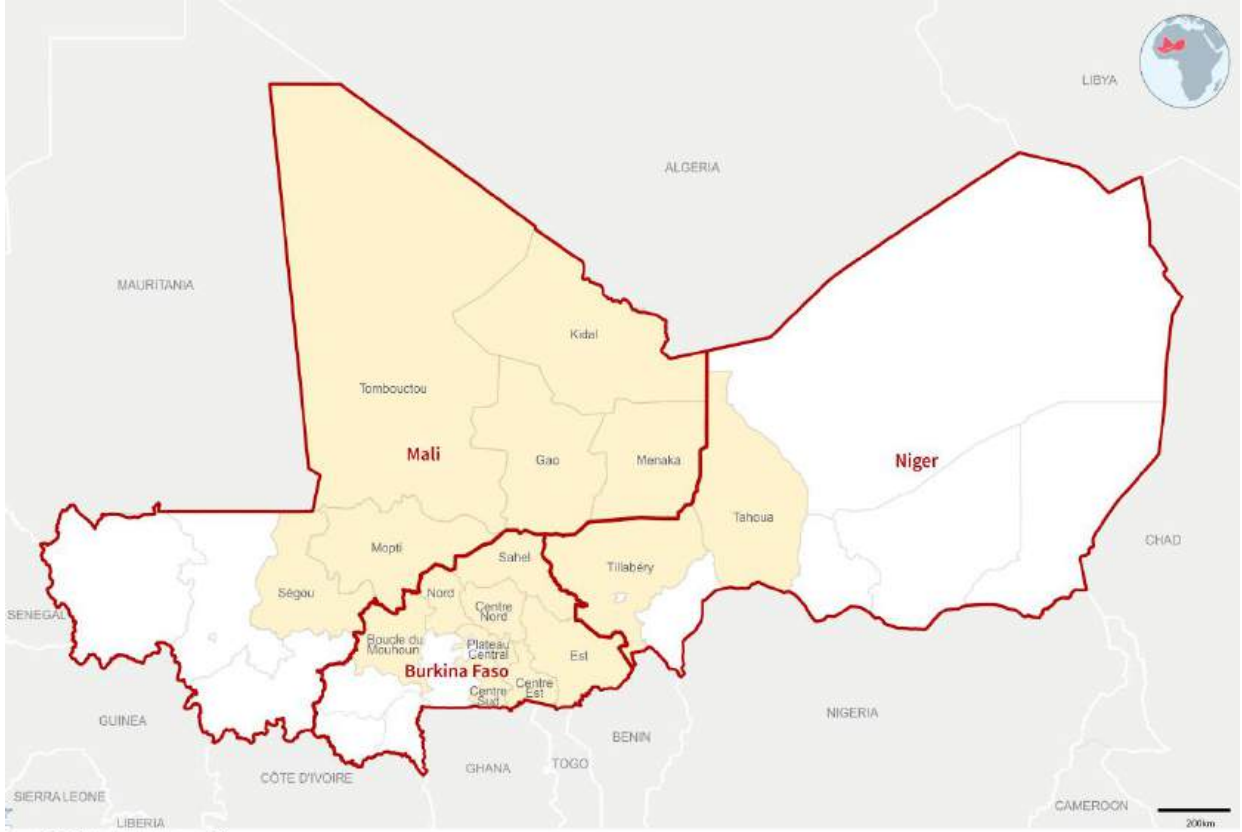
- Reproduire le travail de Foresight au niveau sub national

- Exercice de mapping pour savoir qui fait quoi où et éviter de réinventer la roue.

- Séries de rencontres avec d'autres acteurs

➢ Zone de couverture **3 pays** du Sahel Central avec 2 régions pour le Niger

➢ Ambition d'élargir la zone de couverture en ajoutant d'autres pays tels que RCA, Tchad, …



Source: DRC, OCHA; Updated: 14 mars 2023

Sources de données - PDI

Funded by European Union Humanitarian Aid

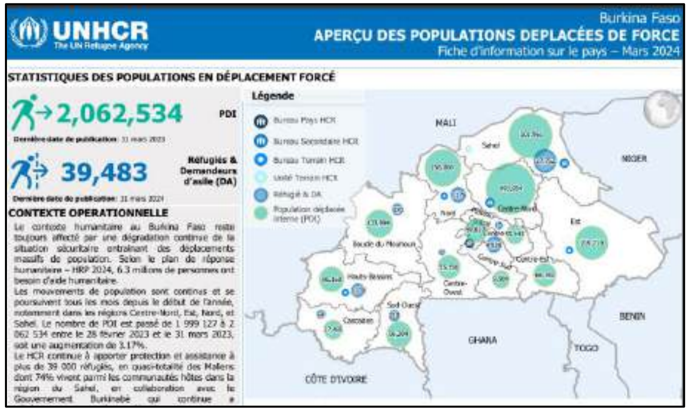
DRC

Compilation des Données de Déplacements

- **Sources multiples** : Intégration de données provenant de diverses sources.
- **Harmonisation** : Création d'une base de données historiques cohérente et uniforme.
- **Couverture régionale** : Données couvrant les déplacements dans trois pays.

Défis à prendre en compte

- **Publication imprévisible** : Les données ne sont pas publiées de manière régulière.
- **Incohérence des dates** : Les dates varient d'un pays à l'autre.
- **Changements géographiques** : Modifications fréquentes des divisions administratives (ex. Gao/Menaka, Mopti/Bandiagara, …).



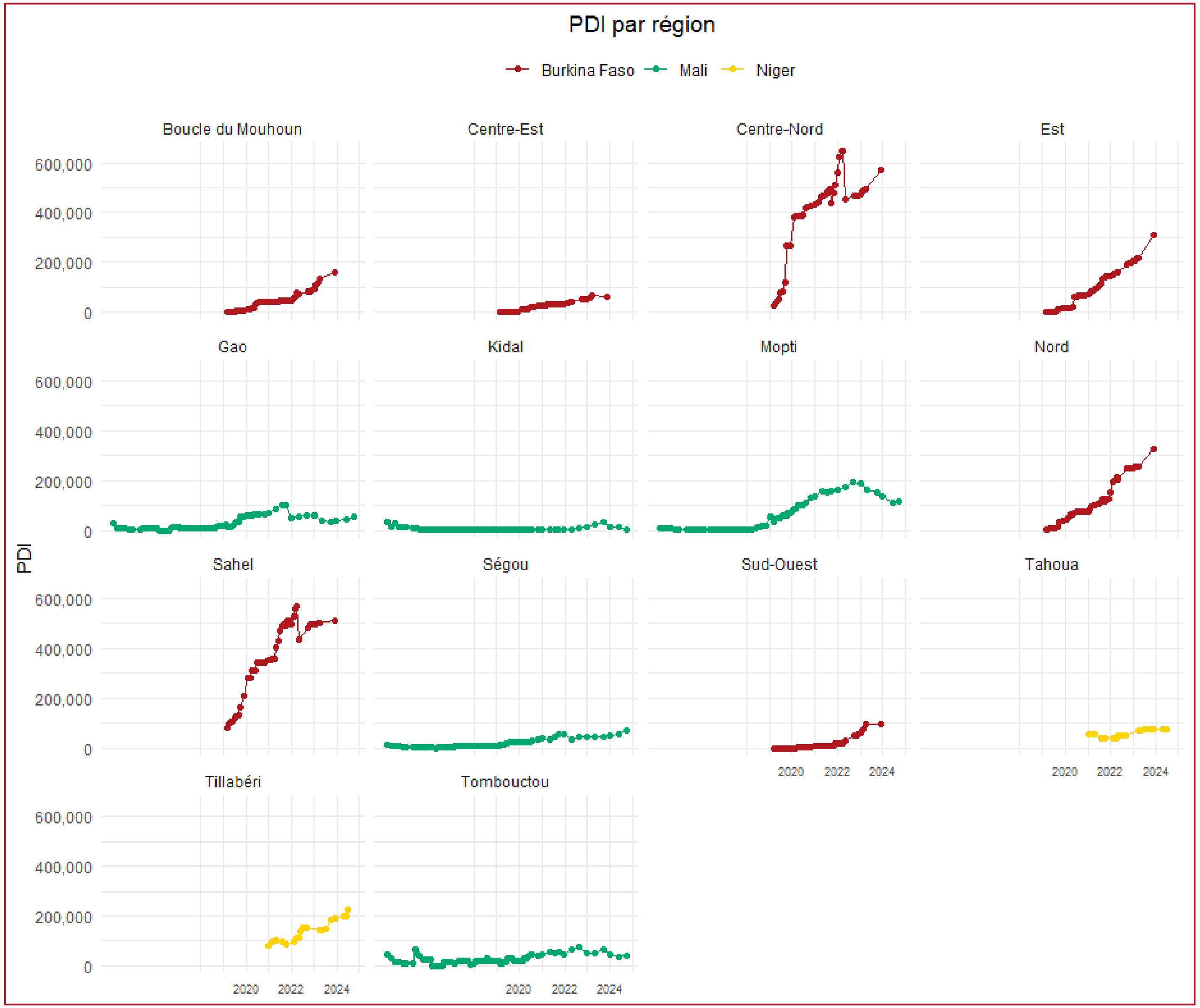
Sources de données - PDI

- Mises à jour initialement régulières mais des lacunes récentes sont apparues, nous utilisons les données du RRM pour les combler.

- Les données sur les déplacements sont des comptages dans une localité donnée à des dates spécifiques.

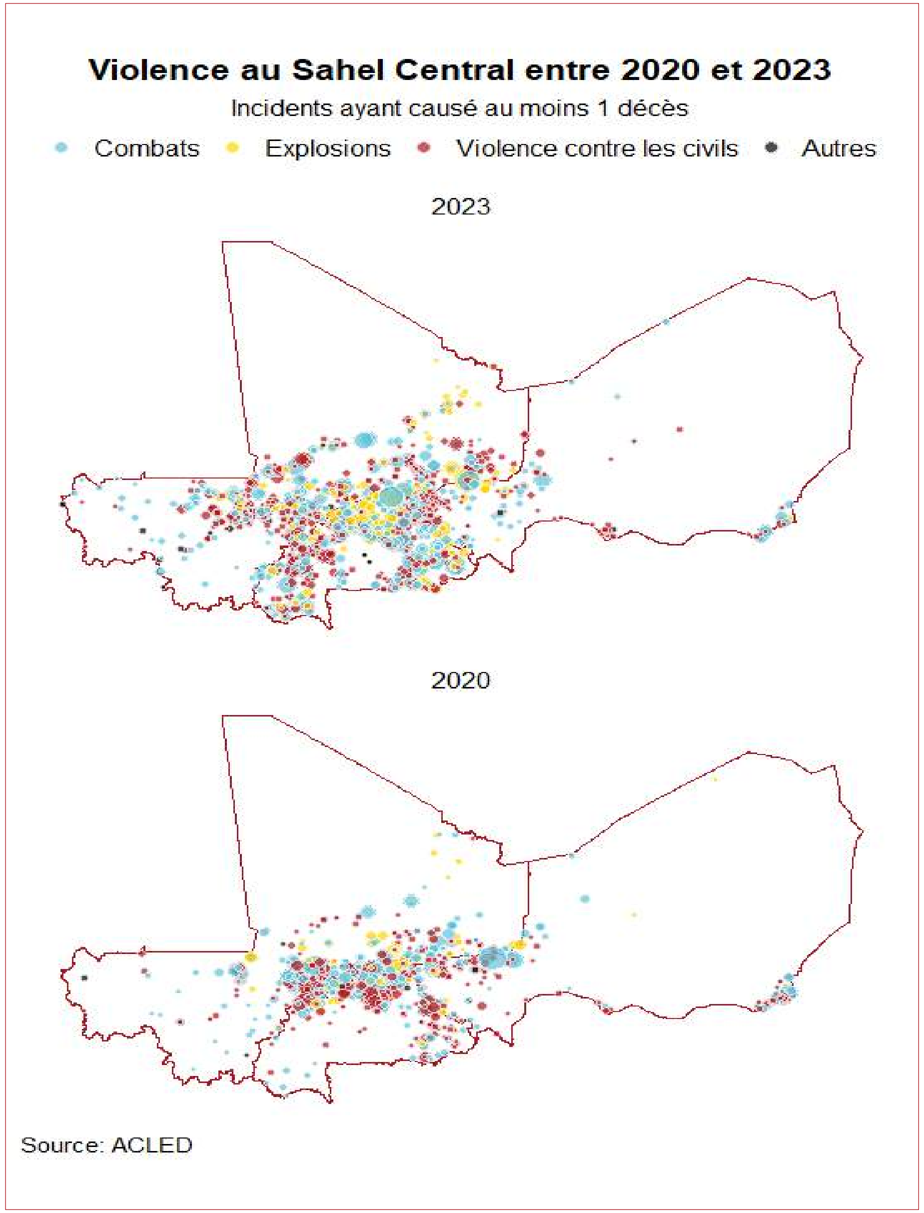
- Les origines des déplacés ne sont généralement pas précisées.

- Pour l'estimation des nouveaux déplacés, on prend la différence entre deux stocks consécutifs.



Sources de données – Sécuritaire

- ✓ **Conditions sécuritaires** : Les déplacements sont principalement motivés par les conditions sécuritaires dans la région.
- ✓ **Base de données exhaustive sur les conflits** : ACLED fournit un aperçu clair et à jour des incidents de violence, incluant les lieux, les acteurs impliqués et les victimes.
- ✓ **Transformation des Données** : Les données d'ACLED sont utilisées directement ou transformées pour créer des indicateurs pertinents pour les déplacements.



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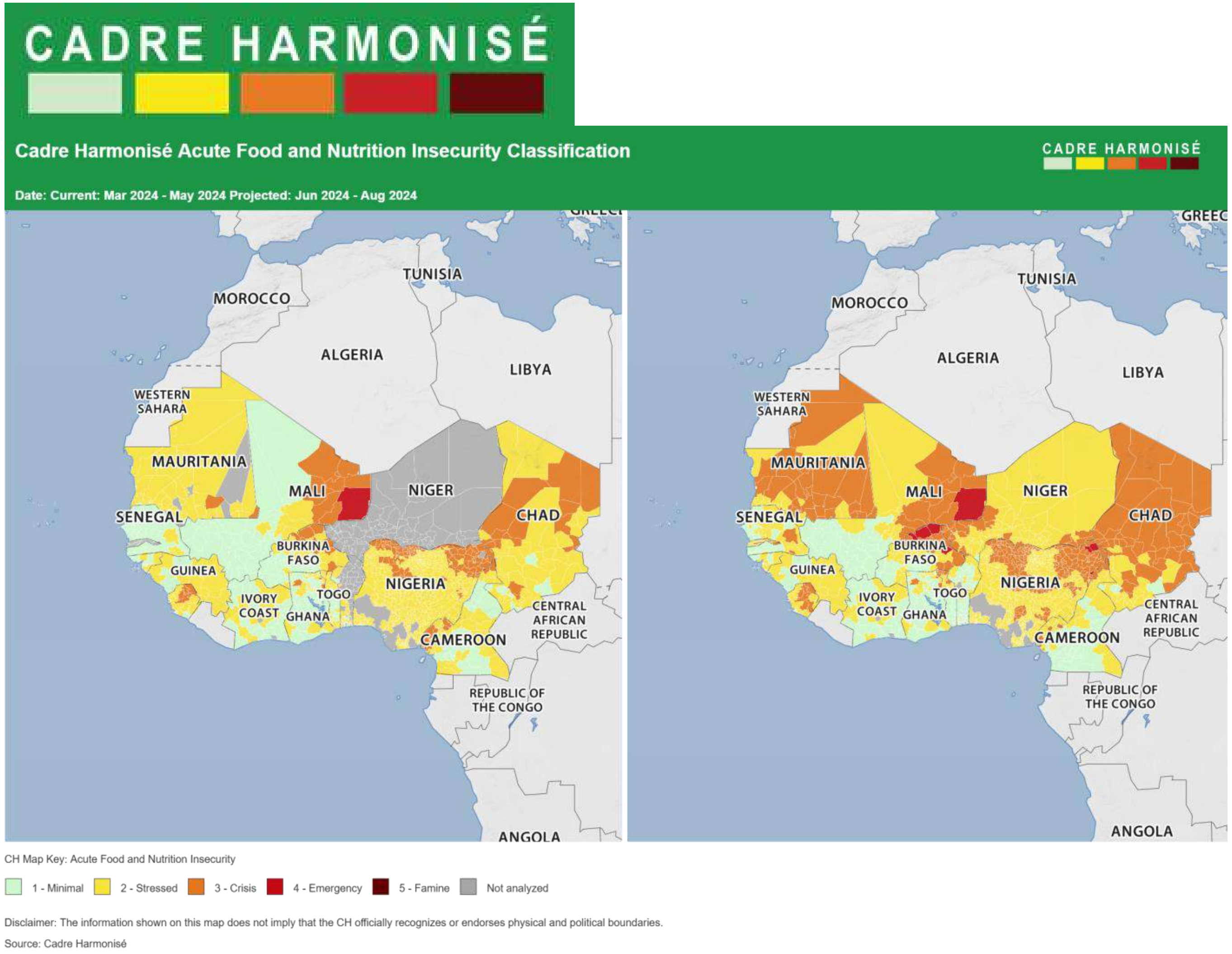
Sources de données – Sécurité alimentaire

- ❖ Données issues du Cadre Harmonisé, classifiant les localités par niveaux de sécurité alimentaire.
- ❖ Avec l’avantage d’inclure leurs prévisions dans les nôtres.
- ❖ Efforts pour éviter les biais dus à l’utilisation du nombre de personnes déplacées dans les estimations d’insécurité alimentaire.
- ❖ Utilisation des données provenant de la base du PAM pour capter l’évolution des prix des biens et services.



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Sources de données – Autres

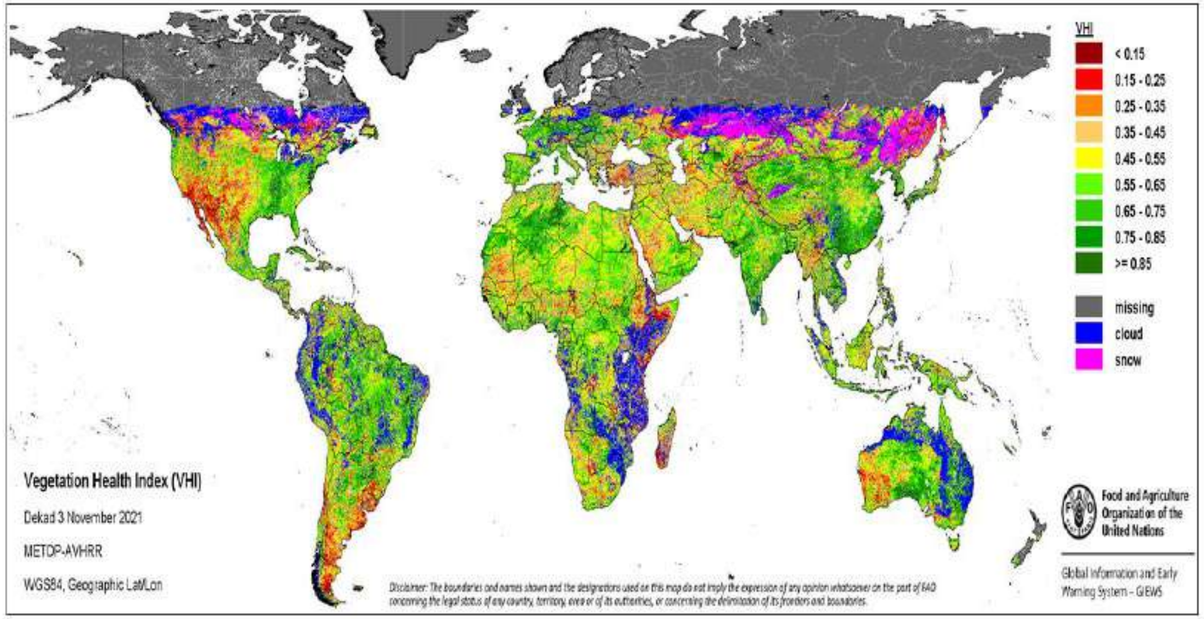
- ❖ Données historiques au niveau admin 1 qui donnent un aperçu sur la santé et l'état de la végétation en se basant sur des données satellitaires.

- ❖ Publié par la FAO à travers son système GIEWS (Global Information and Early Warning System)

- ❖ Les données sont mises à jour généralement tous les mois et tous les 10 jours.

- ❖ Quelques sous-indicateurs de INFORM RISK sont utilisés (le modèle sub-national Sahel).

- ❖ Le modèle utilise une combinaison de données pour évaluer les risques liés aux catastrophes naturelles, aux conflits et à d'autres crises humanitaires.



Sources de données – Sécuritaire

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- Bref aperçu de la base donnée après transformation et agrégation

Region	survey_date	previous_survey	idp	lag_idp	diff	fatal	log_fatal	max_fatal	fatal_civil	events_civil	events_battle	events_explo	events_kidnap	events_looting	events_islamic	events_ethnic	events_military	Country
Boucle du Mouhoun	2019-03-14	2019-02-05	0	0	0	2	1.0986123	2	0	0	1	0	0	0	1	0	0	Burkina Faso
Cascades	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Centre	2019-03-14	2019-02-05	431	0	431	2	1.0986123	2	0	0	0	0	0	0	0	0	0	Burkina Faso
Centre-Est	2019-03-14	2019-02-05	0	0	0	8	2.1972246	4	1	1	1	0	0	0	2	0	0	Burkina Faso
Centre-Nord	2019-03-14	2019-02-05	30438	14821	15617	4	1.6094379	2	1	4	4	0	2	1	8	0	0	Burkina Faso
Centre-Ouest	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Centre-Sud	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Est	2019-03-14	2019-02-05	0	0	0	48	3.8918203	9	18	6	8	0	1	4	8	0	4	Burkina Faso
Hauts-Bassins	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Nord	2019-03-14	2019-02-05	5005	2667	2338	7	2.0794415	3	5	3	3	0	1	1	4	0	2	Burkina Faso
Plateau-Central	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Sahel	2019-03-14	2019-02-05	79436	65092	14344	110	4.7095302	40	90	9	7	5	3	3	16	0	3	Burkina Faso
Sud-Ouest	2019-03-14	2019-02-05	0	0	0	0	0.0000000	0	0	0	1	0	0	0	0	1	0	Burkina Faso
Boucle du Mouhoun	2019-04-02	2019-03-14	0	0	0	4	1.6094379	4	0	0	4	0	0	0	3	1	0	Burkina Faso
Cascades	2019-04-02	2019-03-14	0	0	0	5	1.7917595	5	0	0	1	0	0	0	1	0	0	Burkina Faso
Centre	2019-04-02	2019-03-14	431	431	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Centre-Est	2019-04-02	2019-03-14	0	0	0	8	2.1972246	8	8	1	0	0	0	0	0	0	0	Burkina Faso
Centre-Nord	2019-04-02	2019-03-14	32542	30438	2104	1	0.6931472	1	0	1	1	0	1	0	2	0	0	Burkina Faso
Centre-Ouest	2019-04-02	2019-03-14	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Centre-Sud	2019-04-02	2019-03-14	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Est	2019-04-02	2019-03-14	2529	0	2529	24	3.2188758	11	7	2	2	2	0	2	3	0	3	Burkina Faso
Hauts-Bassins	2019-04-02	2019-03-14	0	0	0	0	0.0000000	0	0	0	0	0	0	0	0	0	0	Burkina Faso
Nord	2019-04-02	2019-03-14	5078	5005	73	2	1.0986123	2	2	1	0	0	0	0	0	0	0	Burkina Faso

Showing 1 to 23 of 1,210 entries, 53 total columns

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Qu’y a t-il sous le capot ?

Composant	Outils/Cadre
Traitement des données	R
Modèle	R (brms -- Stan)/ Régression bayésienne
UI	Shiny

Au départ, nous avons travaillé avec des méthodes plus influencées par l'apprentissage automatique, mais elles ne permettaient pas de traiter efficacement les sauts. Nous avons opté pour un **modèle de régression bayésienne avec distribution binomiale négative et zéros-inflation**. Ce modèle gère efficacement les zéros, capture les incertitudes

Nous supposons que la relation fonctionnelle entre les indicateurs et le déplacement ne change pas dans le temps ou entre les régions, ce qui signifie que le déplacement historique et les indicateurs d'une région influenceront nos prévisions pour une autre région. Le modèle utilise des indicateurs de la région et des régions voisines pour estimer les déplacements futurs

Le modèle de prévision AHEAD

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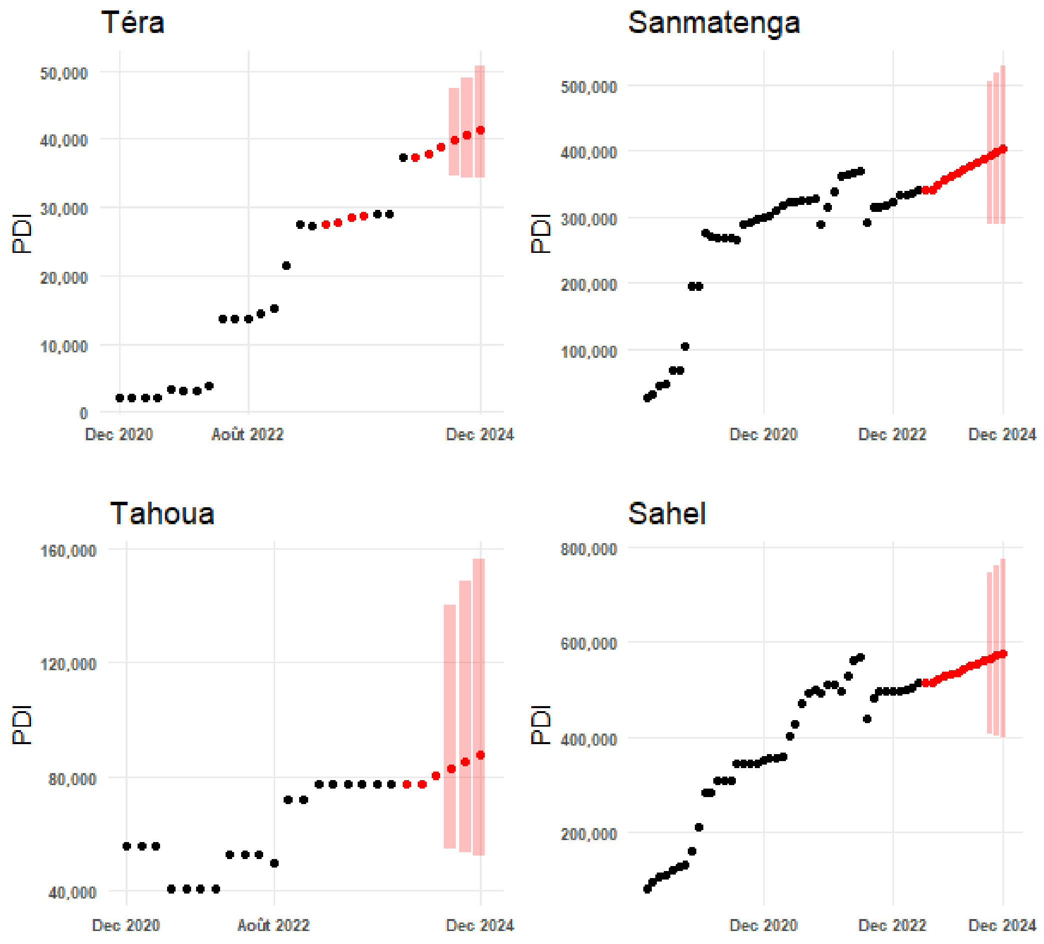
DRC

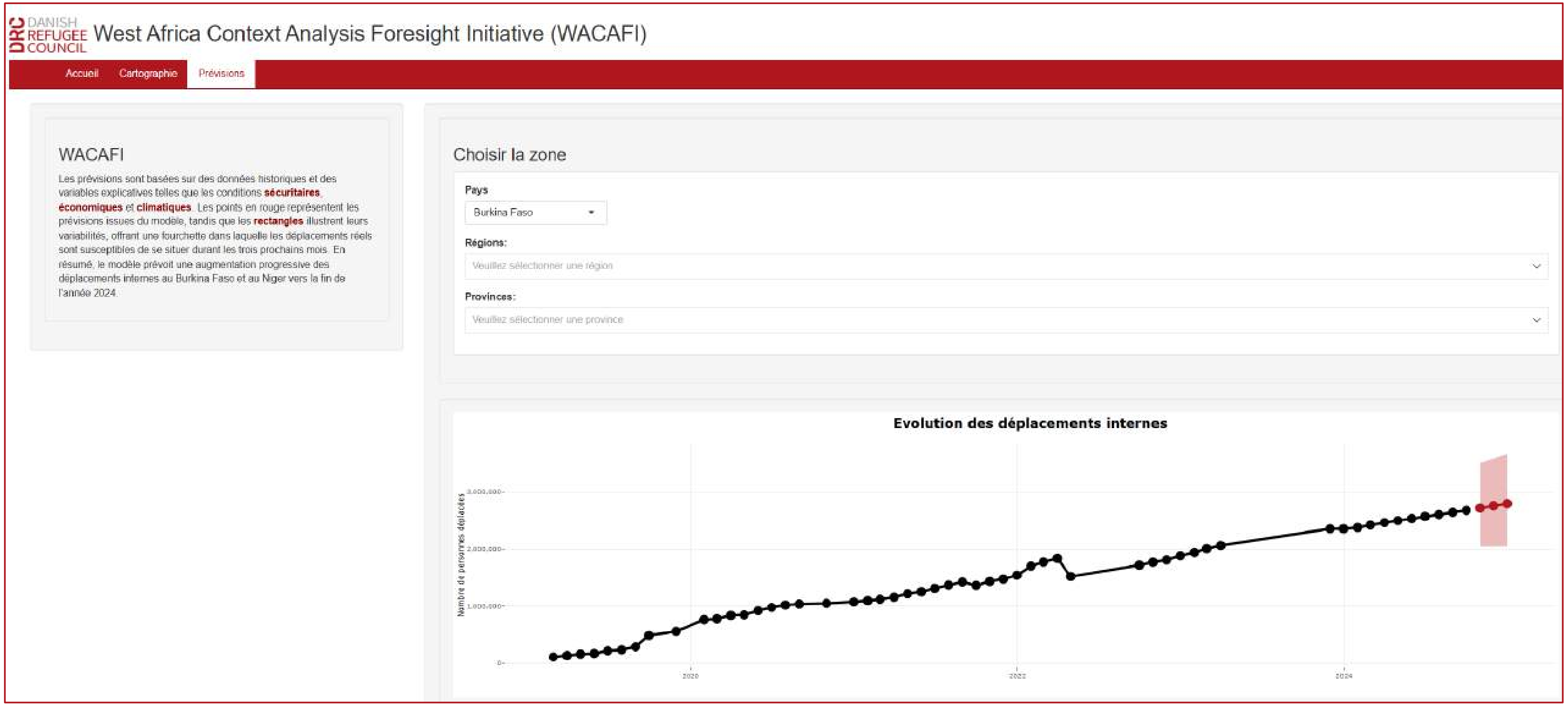
- Le modèle prédictif bayésien AHEAD, tente d'estimer les déplacements internes 3 mois à l'avance en fonction de plusieurs variables socio-économiques en fonction de plusieurs variables socio-économiques et sécuritaires pour chaque région.

- Les prévisions sont disponibles au niveau admin 2 pour le Burkina Faso et pour le Niger.



Le modèle de prévision AHEAD

- Les prévisions sont également disponibles sur le site web de DRC



Projet pilote AA à Dédougou

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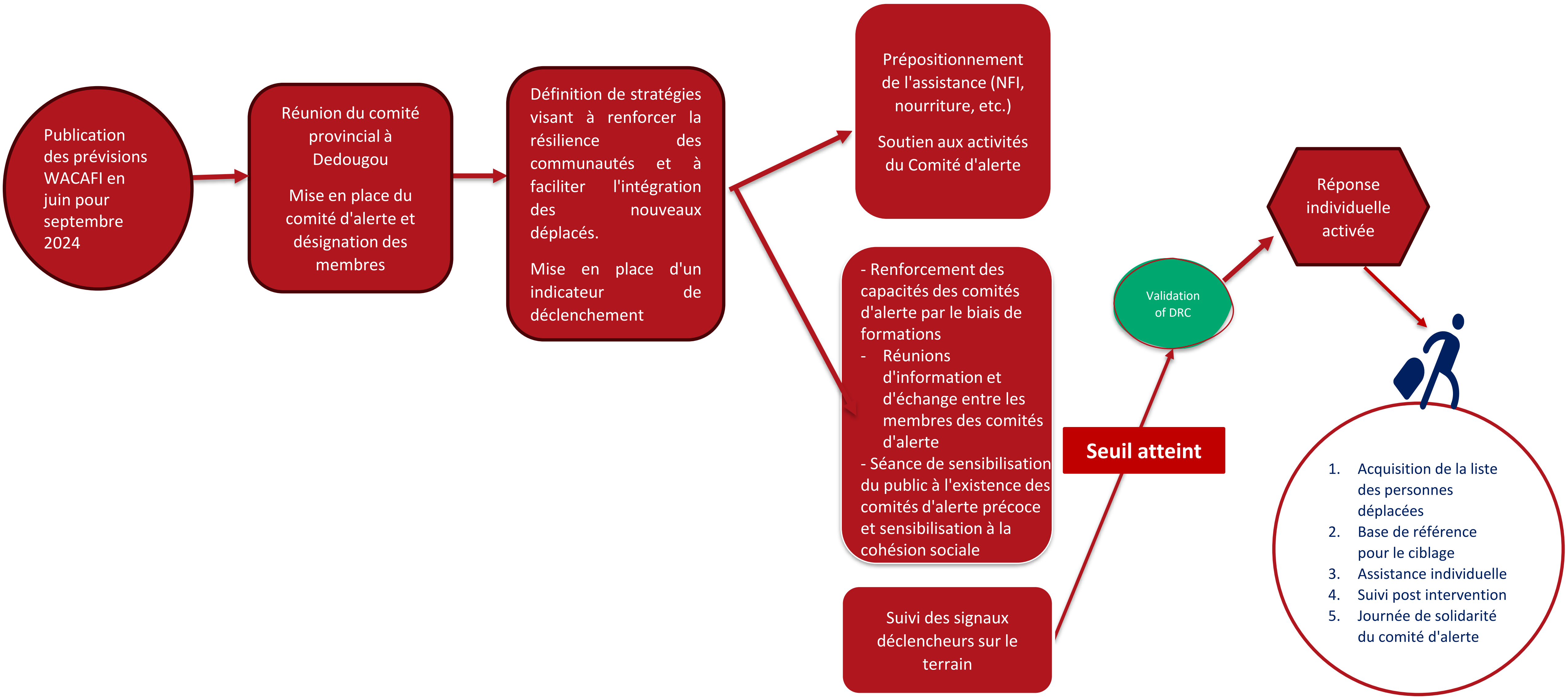

Prochaines étapes

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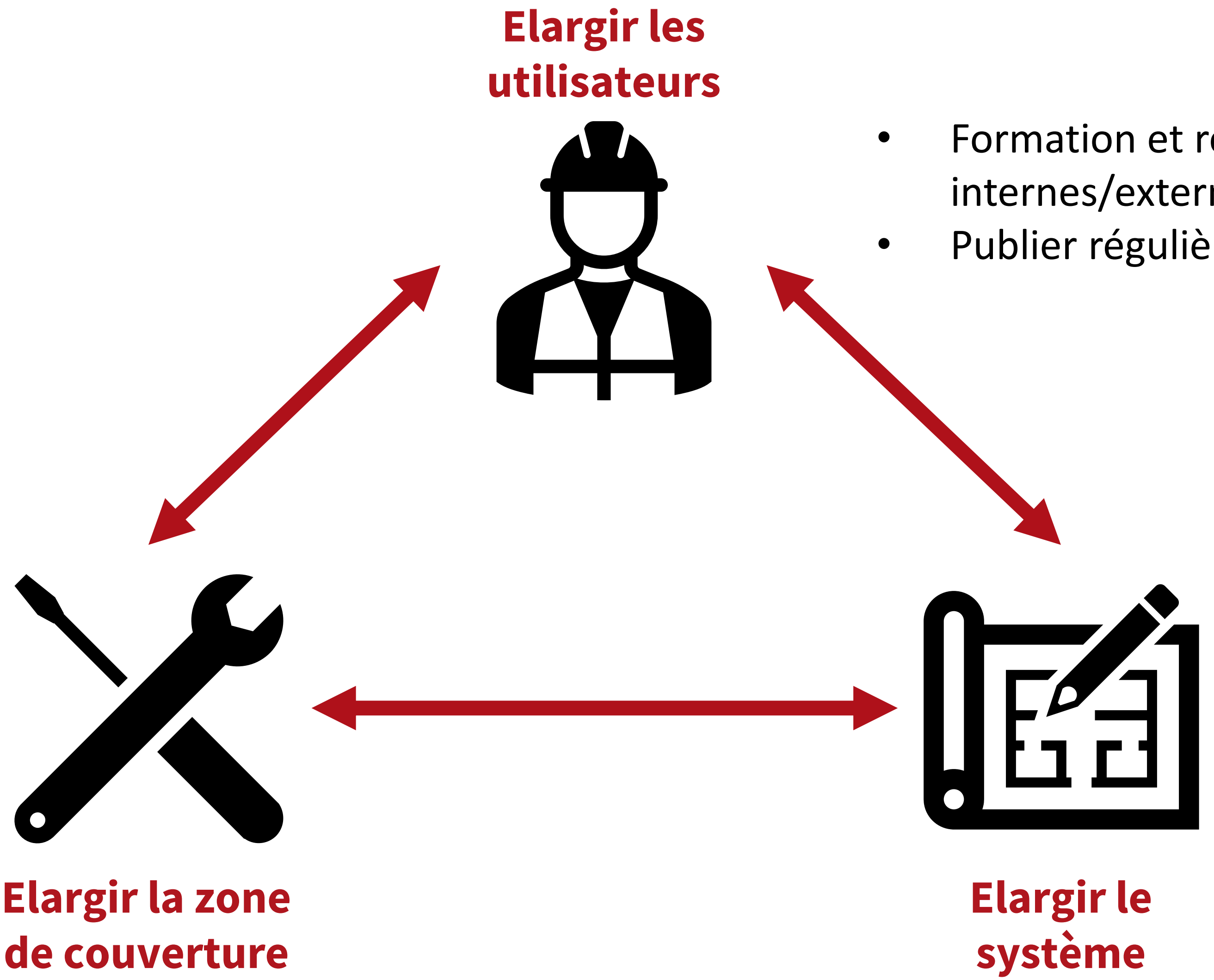
- Formation et renforcement des capacités internes/externes
- Publier régulièrement les prévisions



- Couvrir d’autres zone
- Intégrer de nouvelles sources (e.g. satellite imagery)
- Intégrer de Nouvelles sources de données pour les PDI.

- Mettre à profit les prévisions dans les initiatives existantes d'action anticipée.

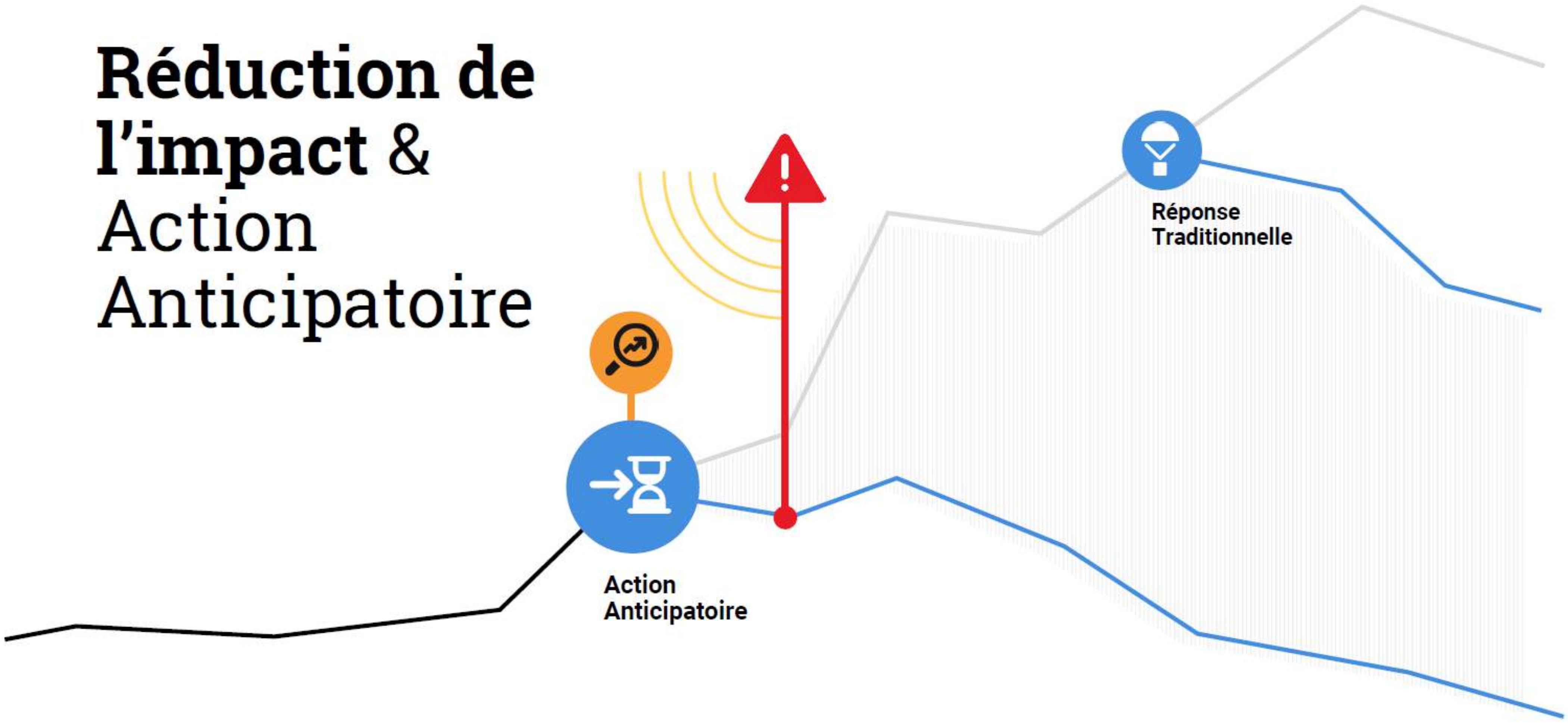
DRC DANISH REFUGEE COUNCIL

Merci

Regional initiative to strengthen, coordinate and institutionalise Anticipatory Action for Food Security

Presentation of the Regional Task Force on Anticipatory Action for Food Security for West Africa.

Action Anticipation Approach

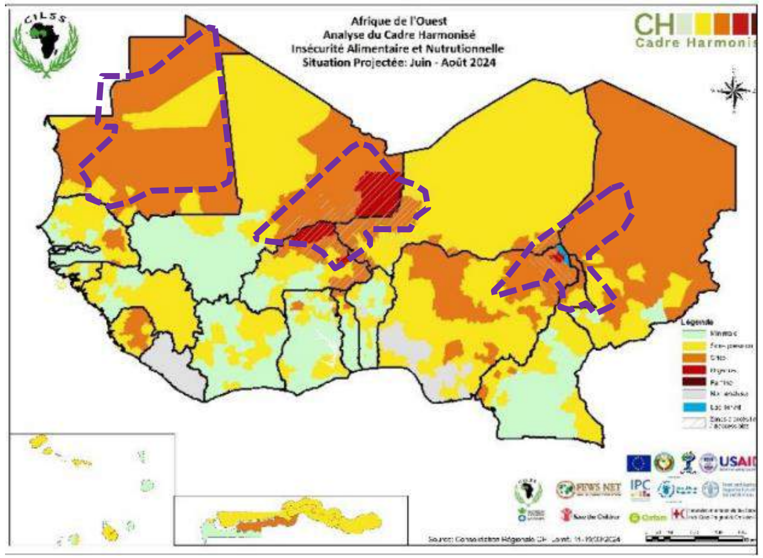


Definition of Anticipatory Action

OCHA (2021) sees AA as measures taken in response to a trigger, **well in advance of an emergency, and aimed at mitigating the impact of an anticipated shock.**

The key feature is **to act before** a **humanitarian need arises**, in response to **an alert or trigger**, thus helping to mitigate the impact of the shock and avoid major crises.

Key recommendations supporting the creation of the Task force AA



- Common definition of AA for food security in West Africa
- AA must be a link between development and humanitarian aid
- Increase funding from the development sector

- Prioritise community involvement and the provision of information at local level
- Institutionalise AA: implement it within the existing framework for food crisis management and in continuity with the various stages of risk management, building on existing tools and strengthening national EWS.
- Draw up a regional strategy and roadmap defining key actions and priorities in support of countries and local stakeholders

Regional Technical Note on Anticipatory Action for Food Security

Different products already finalized:

1. Regional Technical Note of the TF AA: first step towards a common definition of AA for food security in the Sahel, and to promote learning, harmonisation, coordination and institutionalisation.
2. Roadmap of the TF AA technique AA;
3. TORs & operation of the Task Force

Vision: in 2030 AA is a regular and institutional tool for managing food crises in the Sahel

Domaines clés:

1. Coordination, learning and information sharing
2. Institutionalisation and capacity building
3. Data, SAP and triggers
4. Financing and operational readiness

Institutional anchorage under CILSS

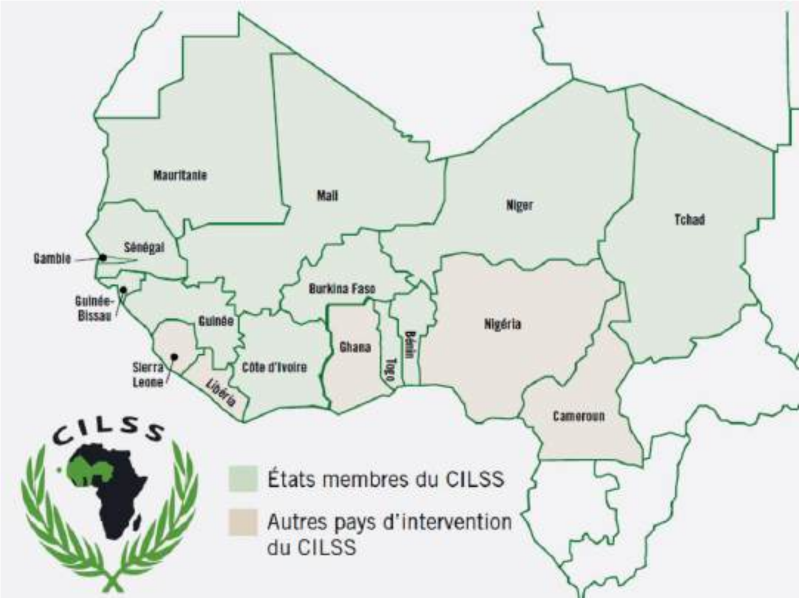
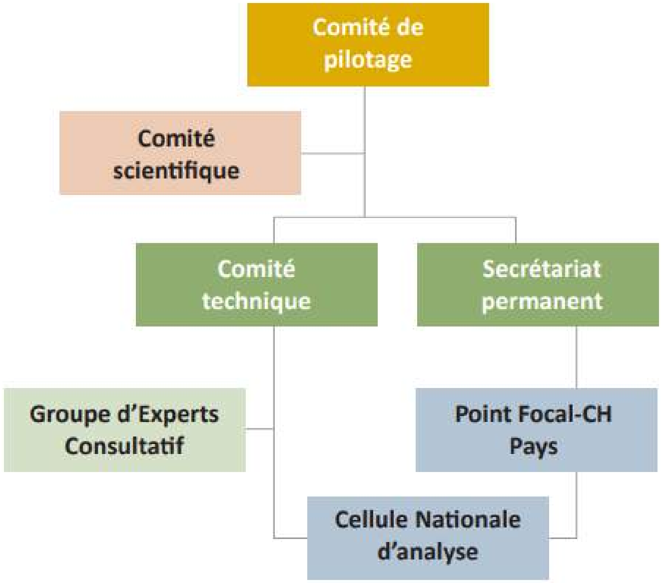
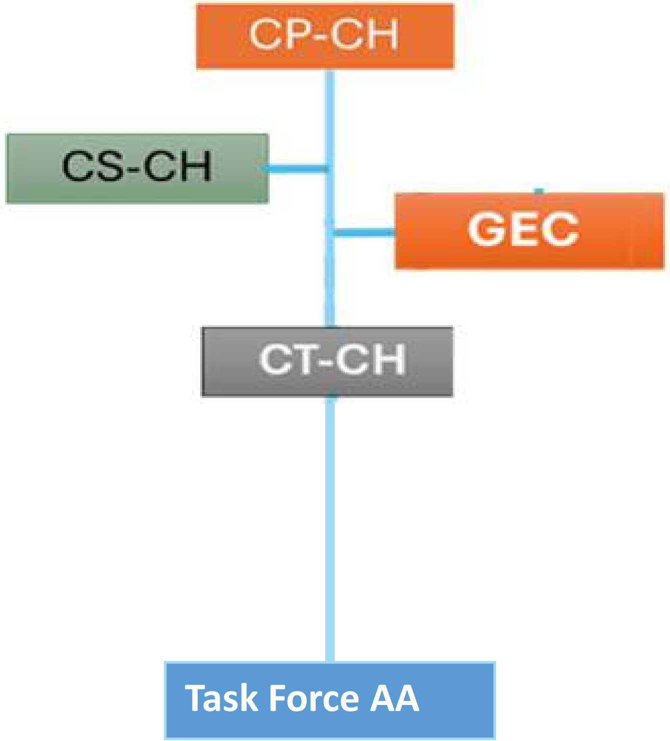


Figure 4 : Cadre institutionnel du CH





Technical note on AA for food security

Highlights

- AA is a tool to make the P of the PREGEC Charter operational
- AA and links to food security and the Harmonised Framework
- Food security financing gap, AA financing gap and institutional commitments
- The institutional context in West Africa can facilitate the institutionalisation of AA
- Priority: advocacy products and learning for decision makers towards institutionalisation (ROI).

Roadmap: key actions

2023 to 2025: Initial stages of regional reinforcement and institutionalization

Key areas:

1. Coordination, learning and information sharing
   - Regional Task Force and regular coordination
   - Mapping and learning community

2. Institutionalisation and capacity building
   - Regional strategy 2030 and regional handbook on AA
   - Training curricula and tools
   - National roadmaps and technical support

3. Data, SAP and triggers
   - Regional catalogue of indicators and triggers
   - Enhanced collaboration with weather agencies

4. Funding and operational preparedness
   - Regional analysis and advocacy on financing
   - Workshop on AA and risk financing in the Sahel

Regional Task force on AA for food security

Thank you

UNHCR
The UN Refugee Agency

CLIFDEW-GRID: Early Warning Grid-Based Risk Modelling of Climate Induced Forced Displacement

West Africa presentation

Andrew Wells, Data Science Team
Statistics, Data Science, and Survey Section
Global Data Service
04 - 05 December 2024

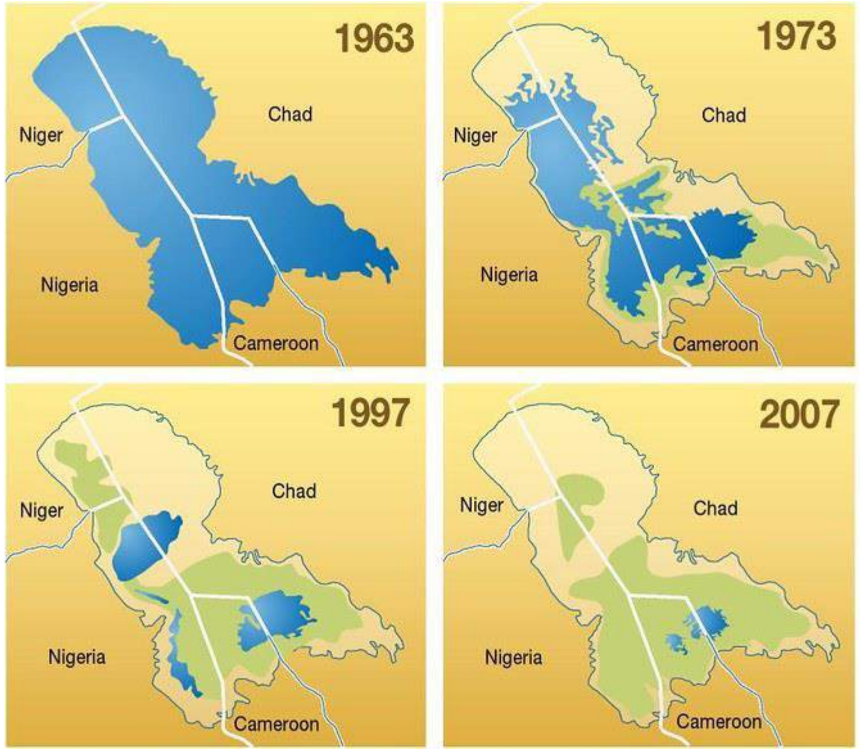
Background

Background: climate change and displacement

- At the end of **2022**, **8.7 million** people were forced to flee within their own countries due to natural disasters … climate change continues to make extreme weather events more frequent and more intense, ever more people are at risk of being forced to flee their homes. (IDMC)

- Groundswell report estimates that **216 million** people could be forced to move within their countries **by 2050** due to slow-onset climate events, based on maximum emissions predictions. (World Bank)

- Complex nexus between climate change and human mobility



UNHCR
The UN Refugee Agency

Background: project overview

Aims and Goals

Aim

Risk index for forced displacement

- Subnational (grid cell) level
- Monthly frequency

Case area

East, Central, and West Africa

Goal

Early Warning Model and Insights

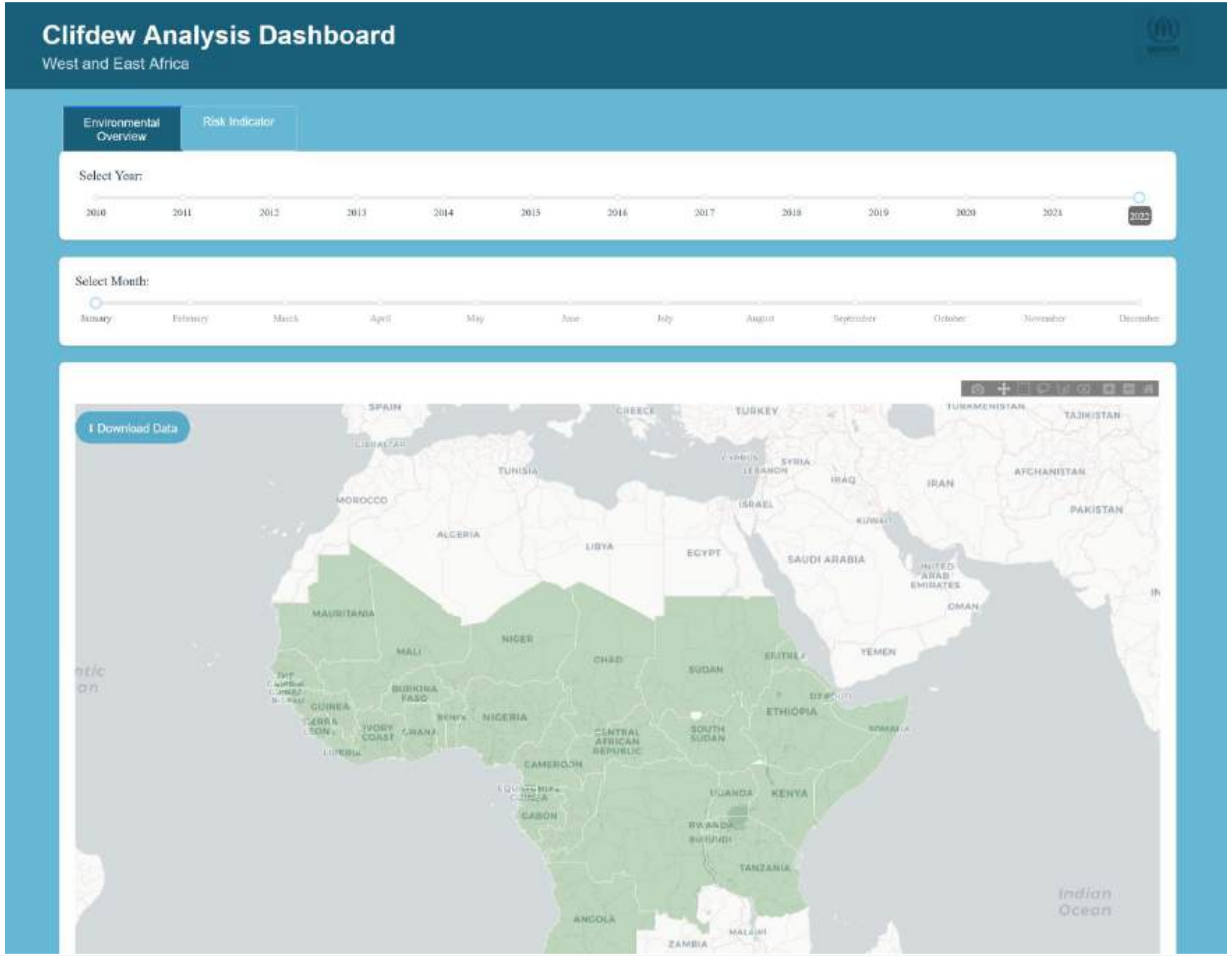
- Provide UNHCR and other humanitarian agencies and stakeholders with a tool for anticipatory action relating to forced migration, taking climate change into account.
- Create deeper insights into the nexus between climate change and forced displacement.

UNHCR
The UN Refugee Agency

Background: project overview

Project outputs

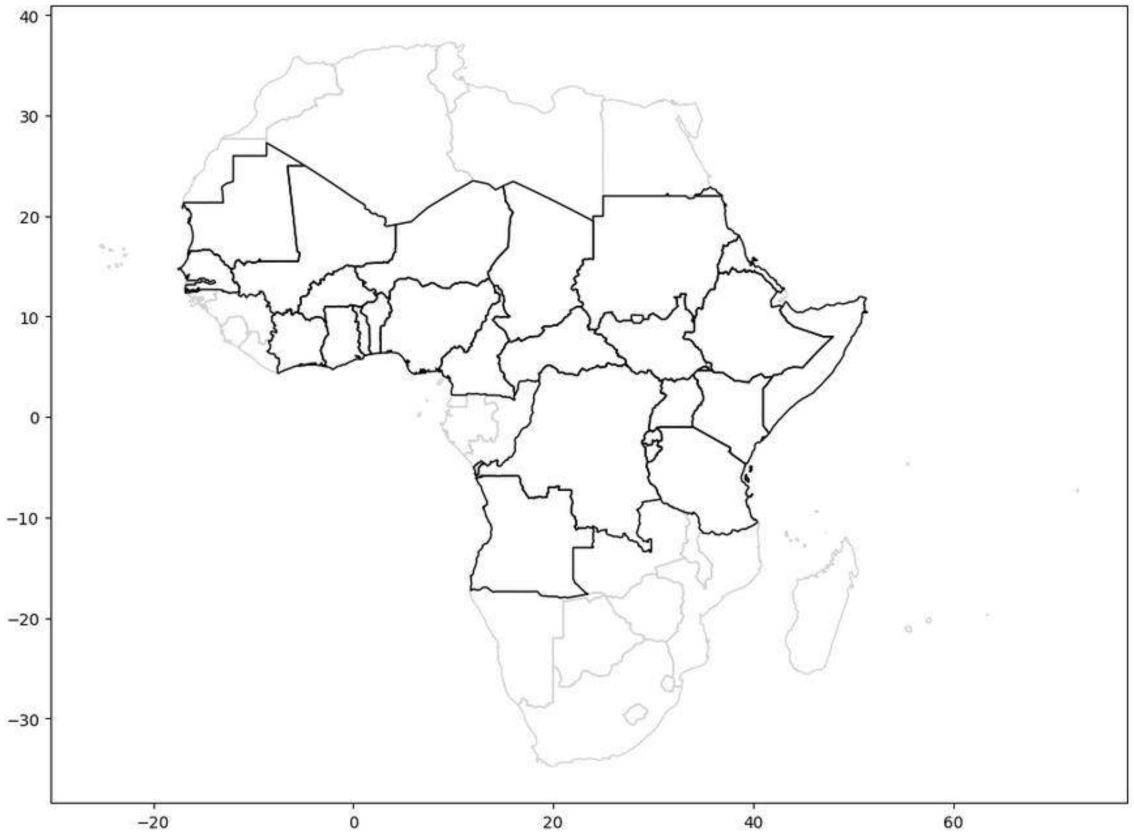
- Dashboard with predictive risk index
- Project Report
- Academic articles



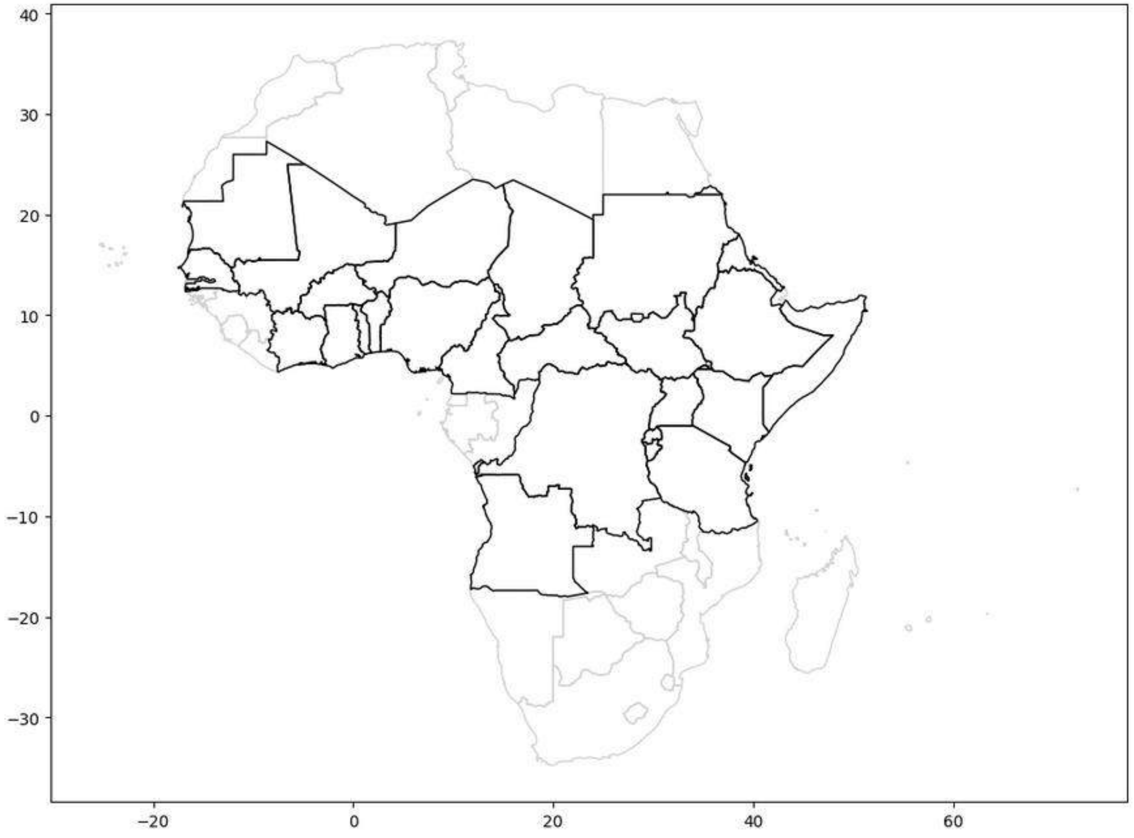
UNHCR
The UN Refugee Agency

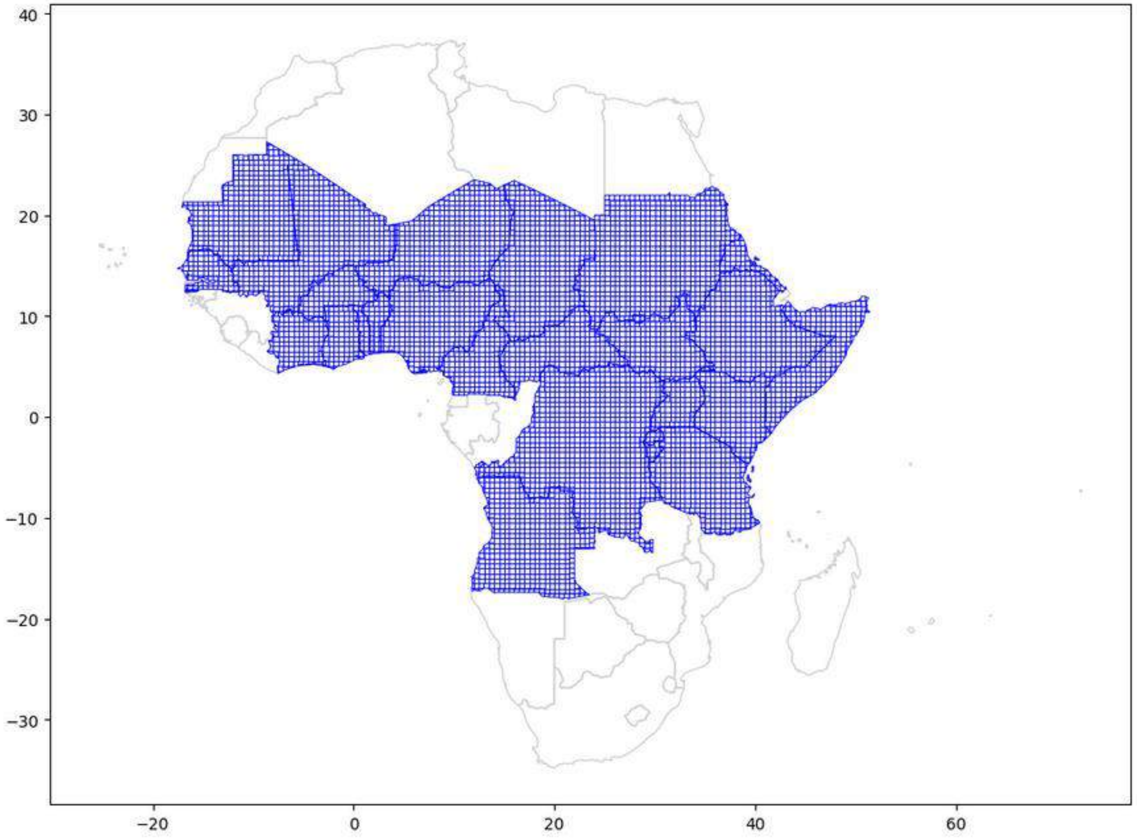
Geographical Focus

- East, Central and West Africa



Geographical Focus

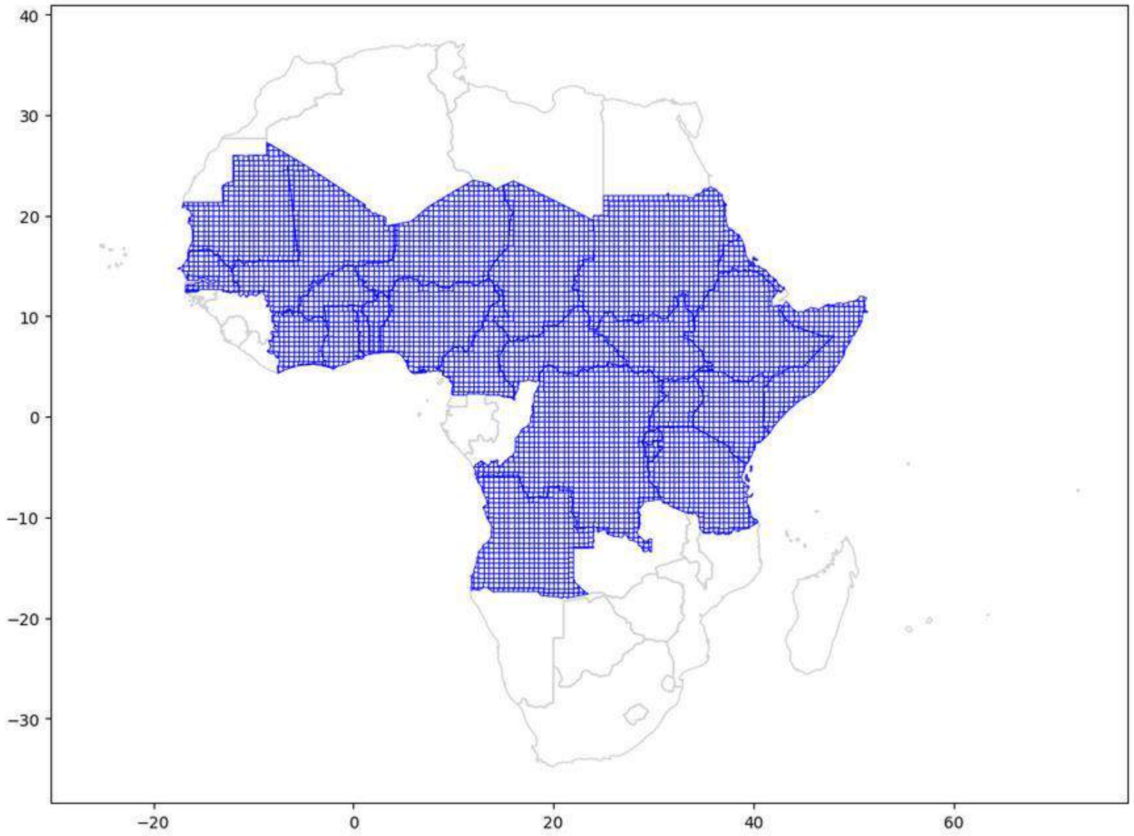




UNHCR
The UN Refugee Agency

Geographical Focus

- East, Central and West Africa
- 0.5° grid-cells (approx. 55 km x 55km)
- Approx. 7000 grid-cells



Geographical Focus

- East, Central and West Africa
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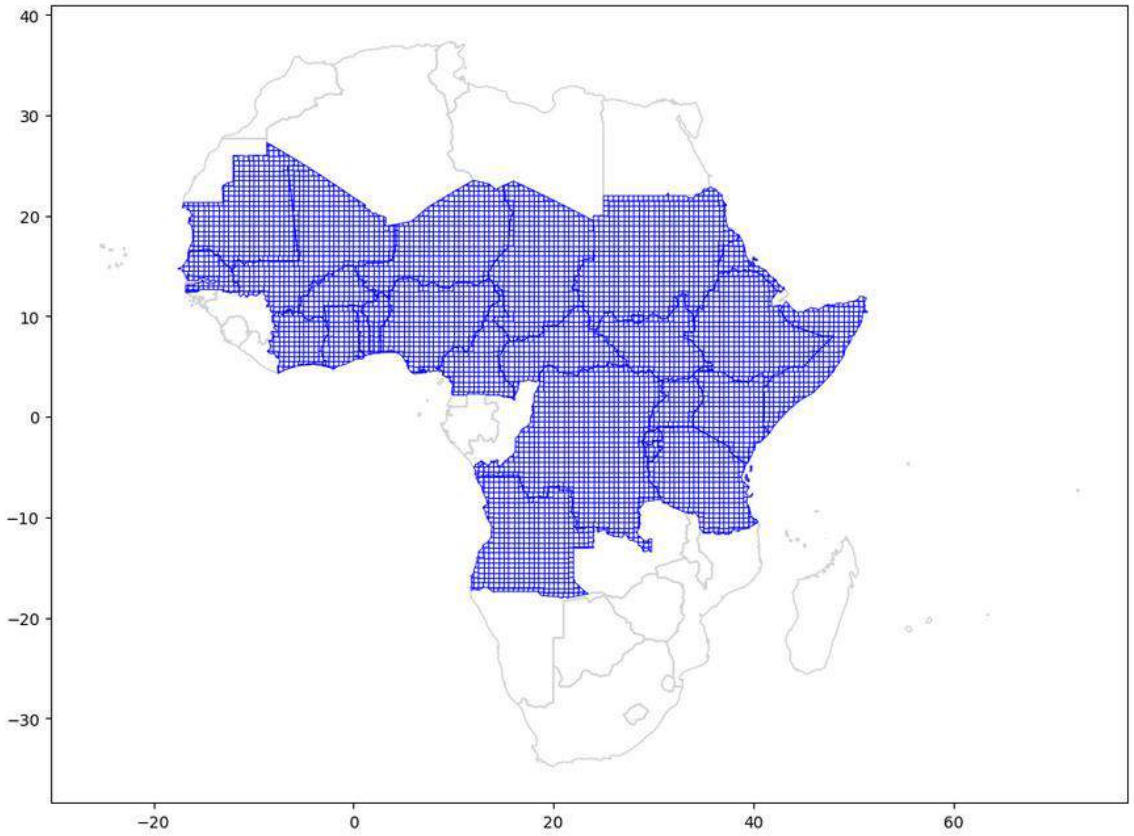
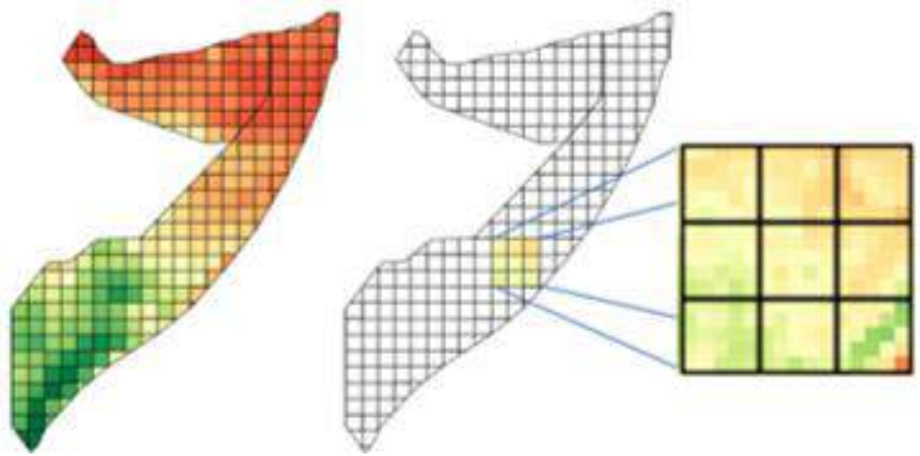


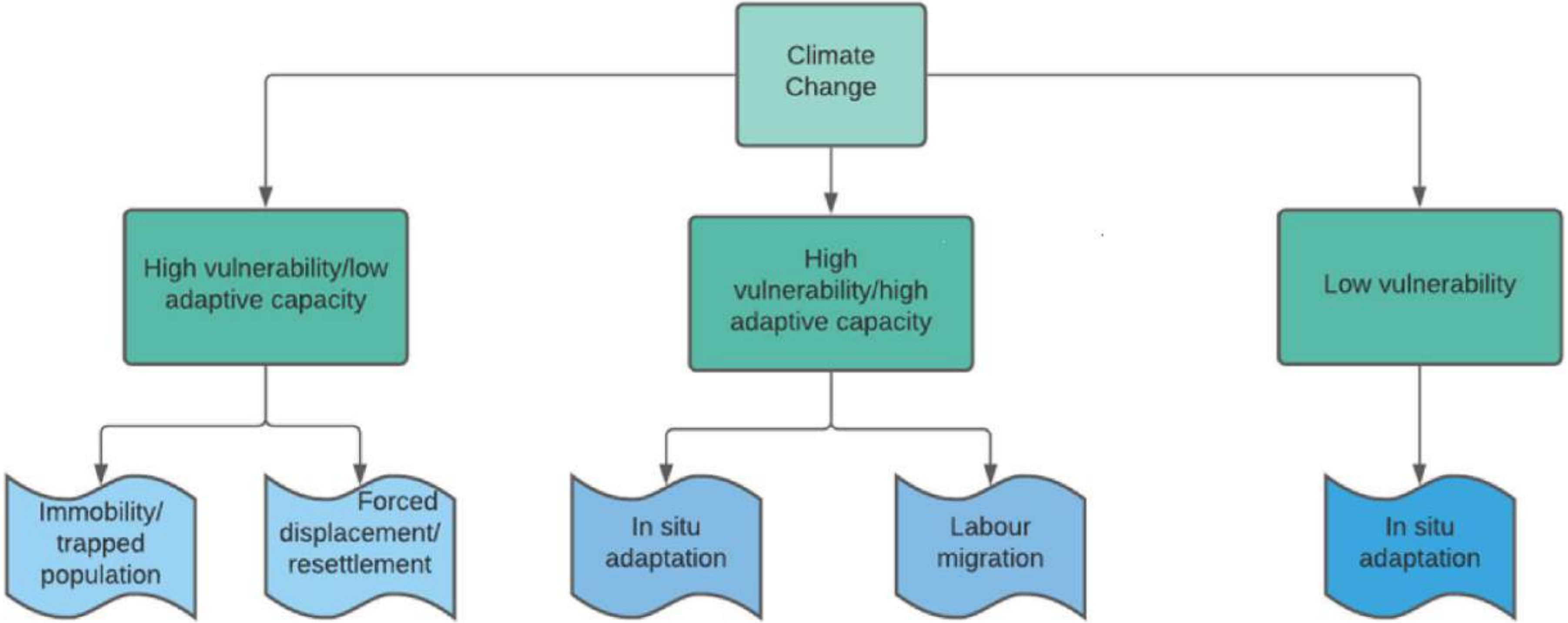


- Feature variable data collected at the 0.1° grid-cell level to account for variance
- Approx. 150,000 grid cells

Project structure

Hypothesis

Modelling structure

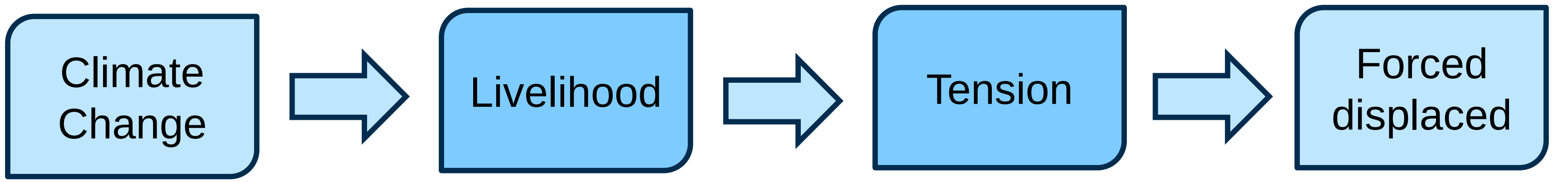


UNHCR
The UN Refugee Agency

Hypothesis

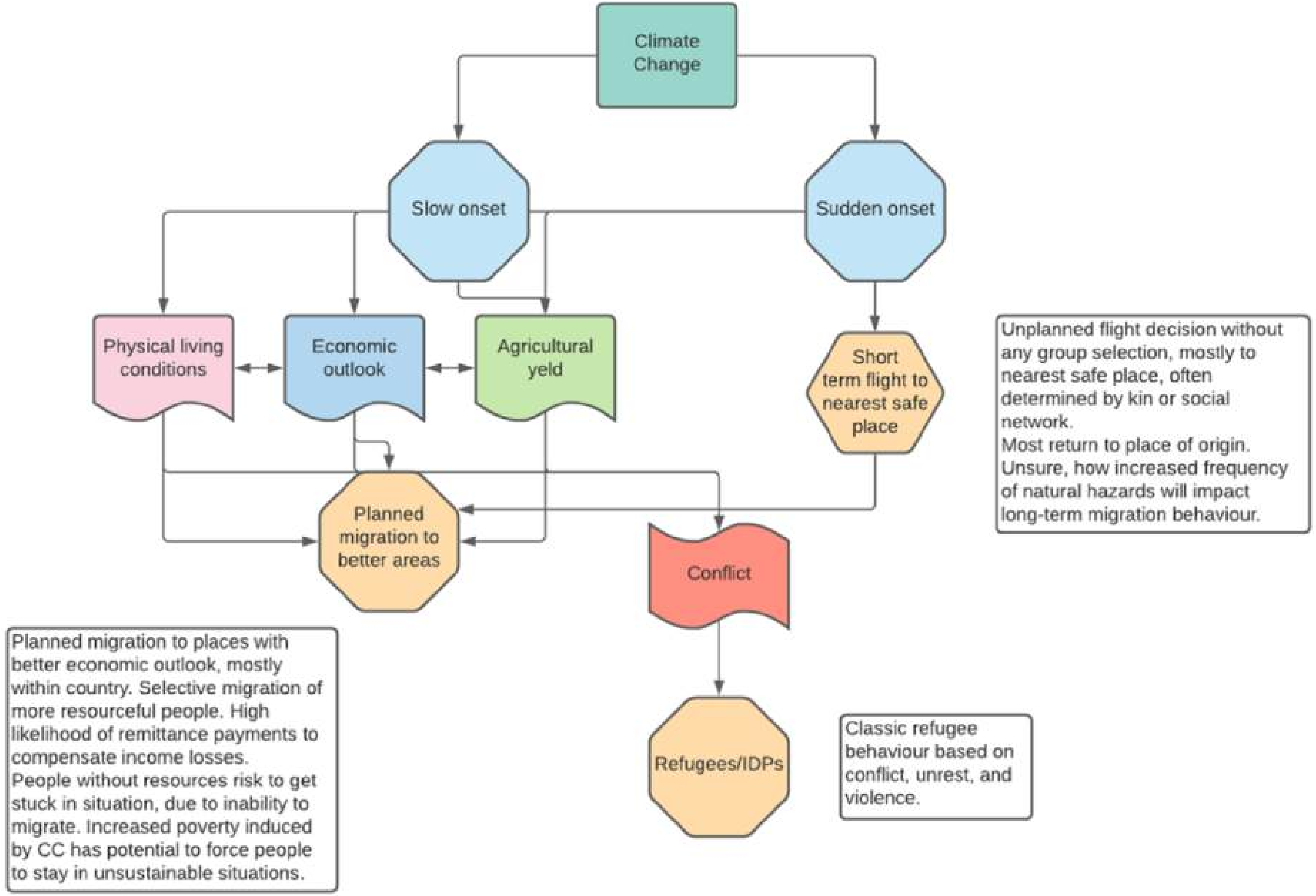
Modelling structure

- Slow on-set climate change generates loss of livelihood.
- Loss of livelihood can lead to competition over diminishing resources, resulting in political tension.
- Conflict contributing to forced displacement.



Hypothesis

Modelling structure



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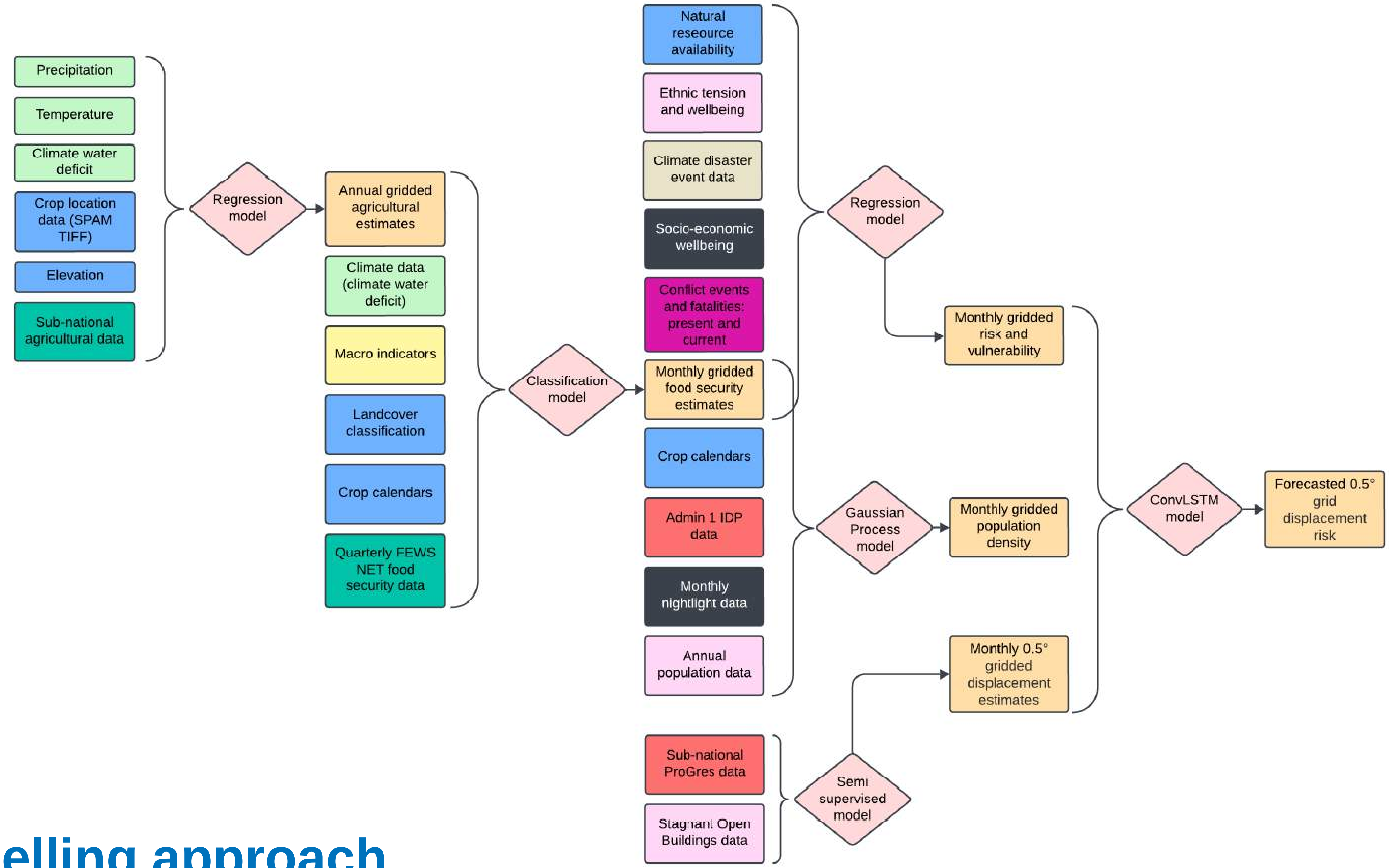
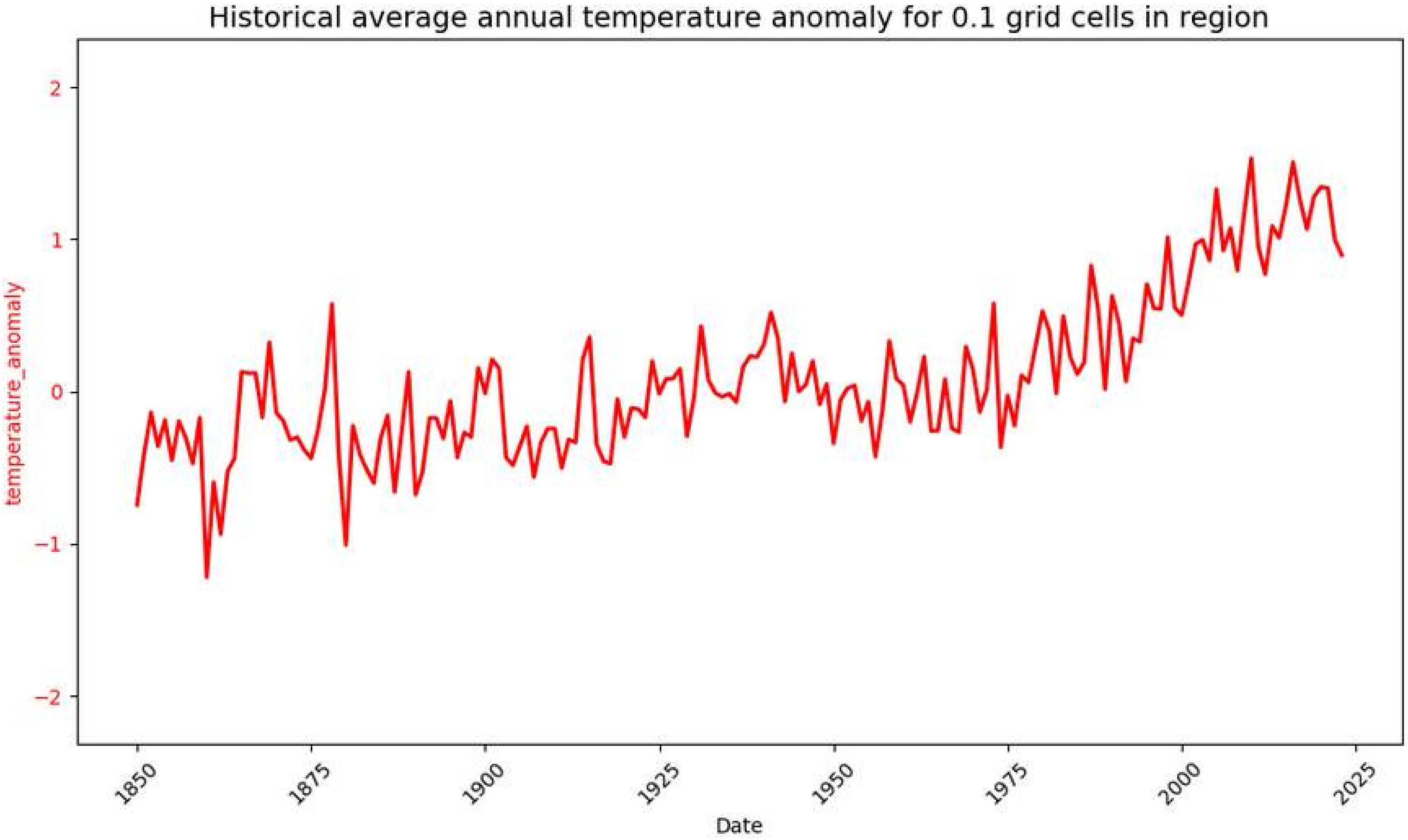


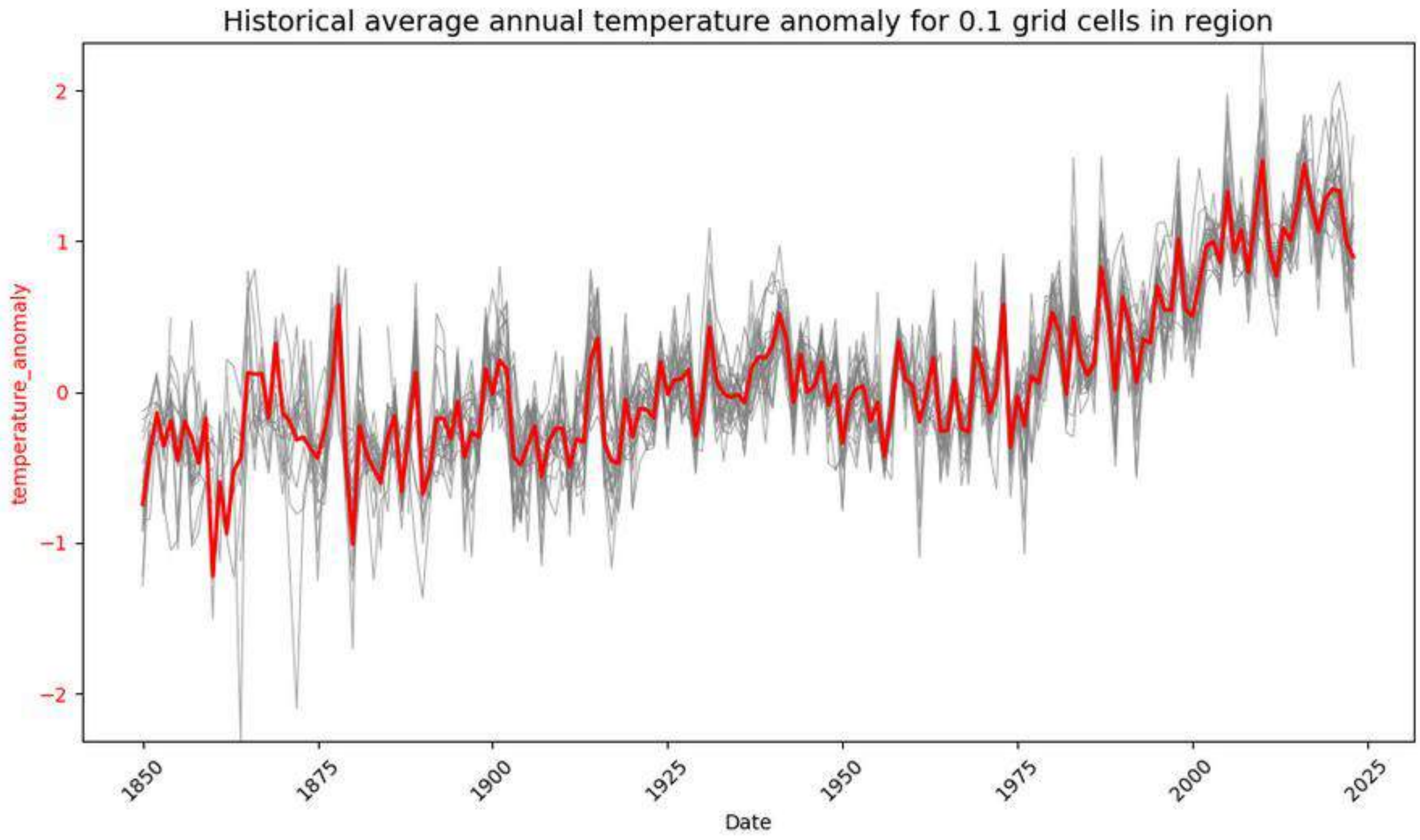
Modelling approach

Climate conditions

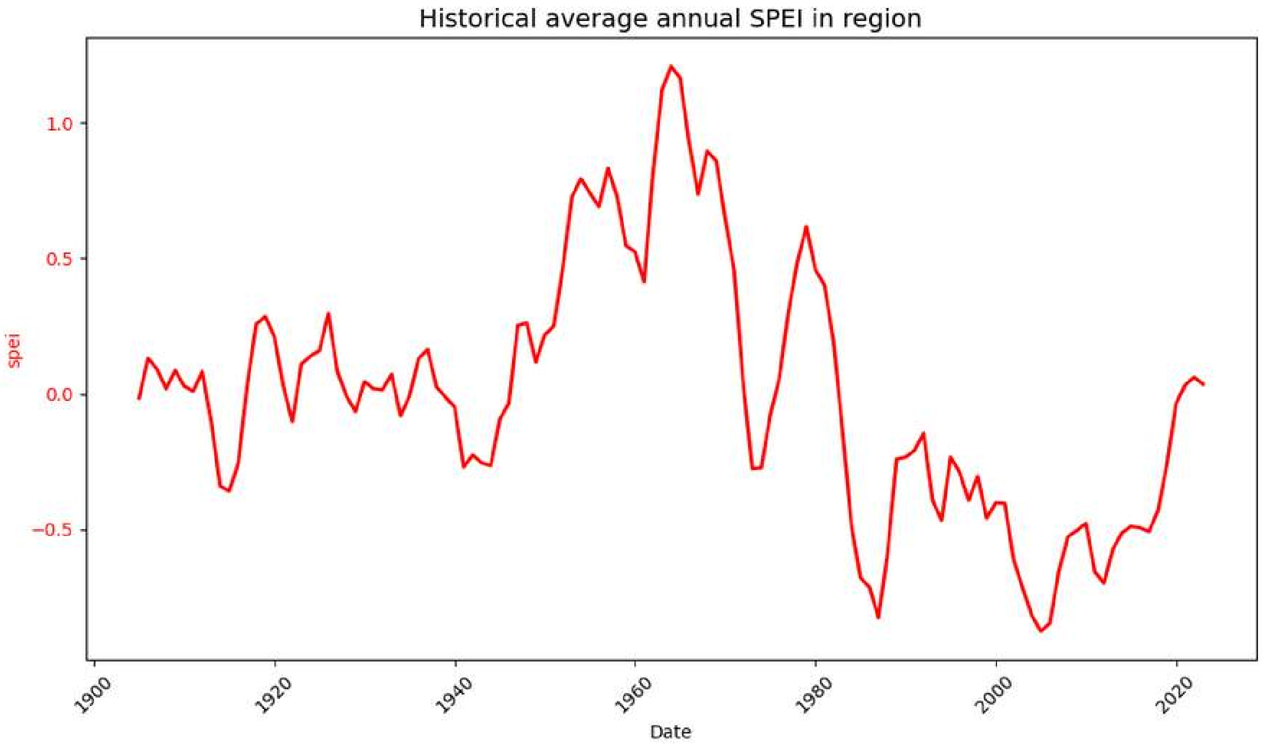
Temperature over time



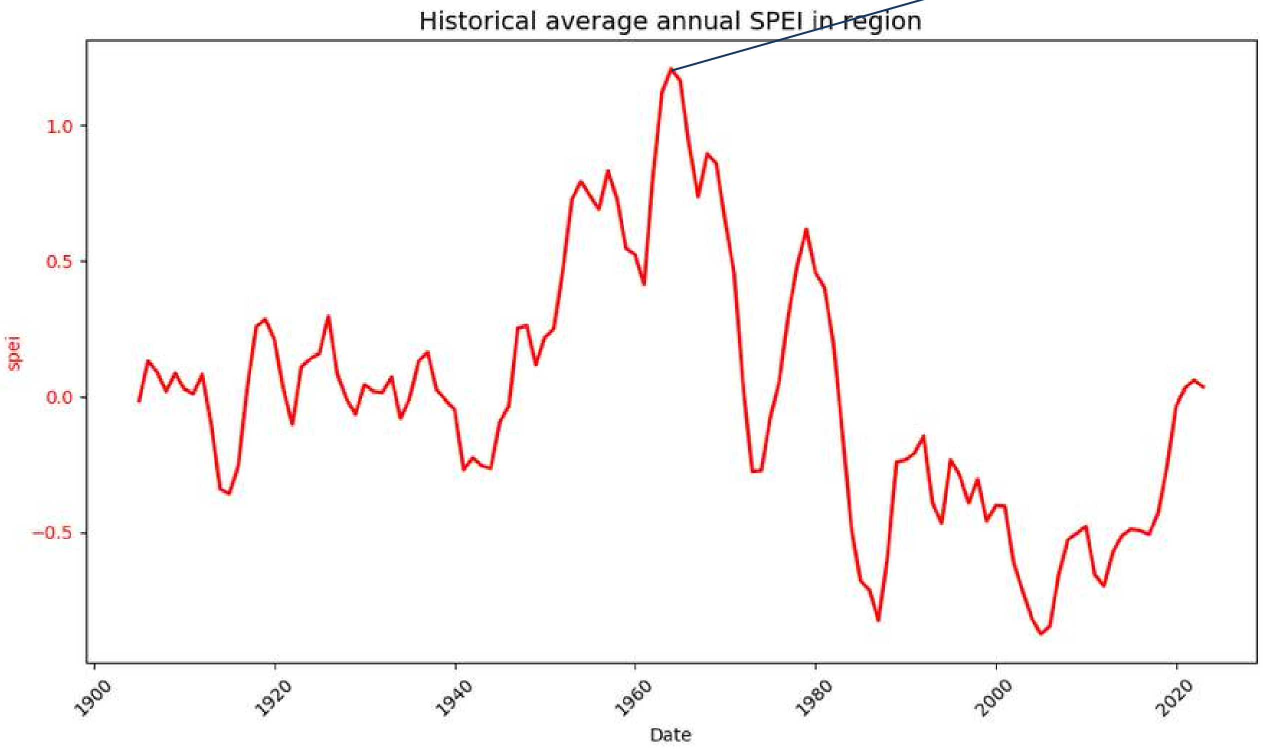
Temperature over time

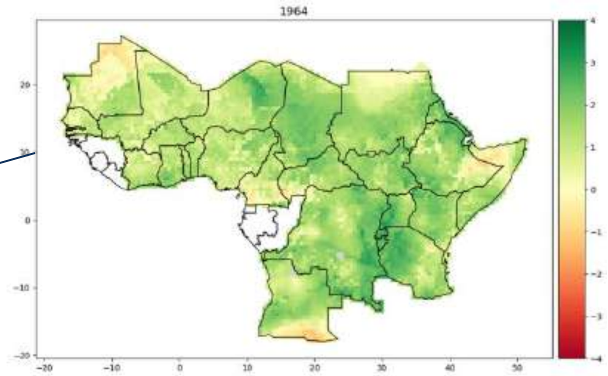


SPEI over time

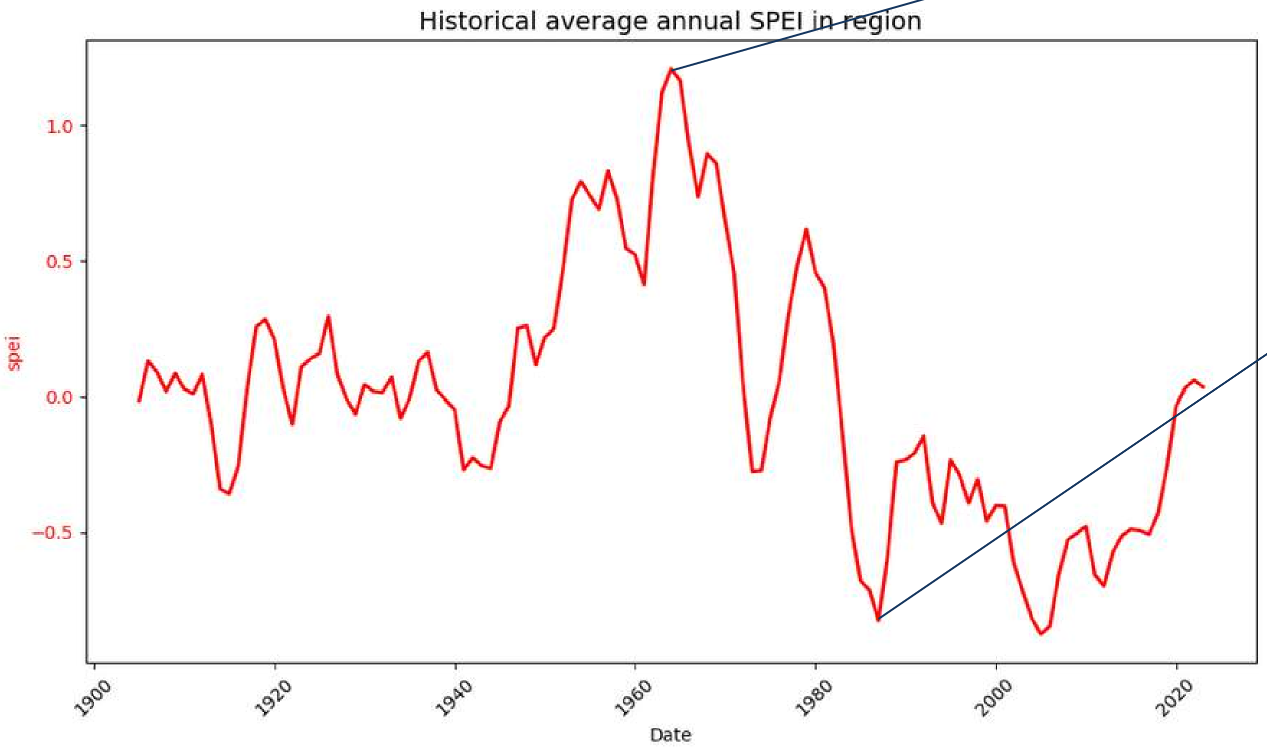


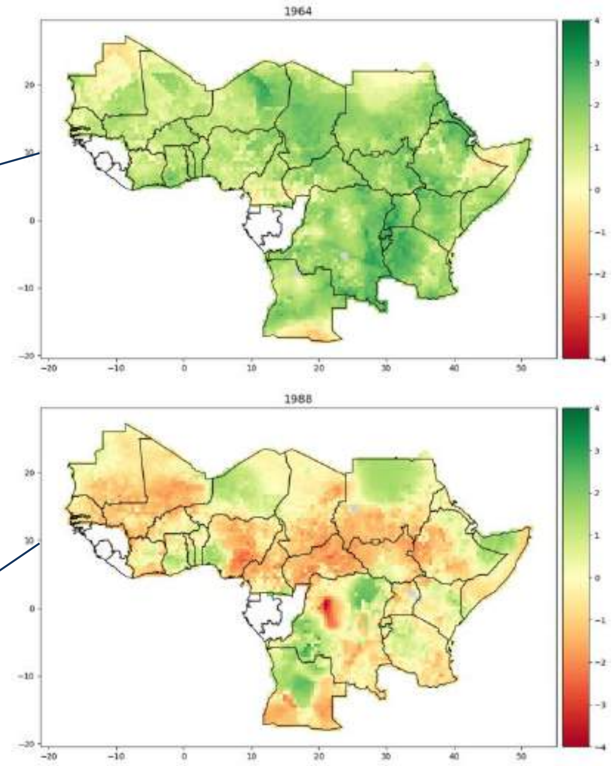
SPEI over time



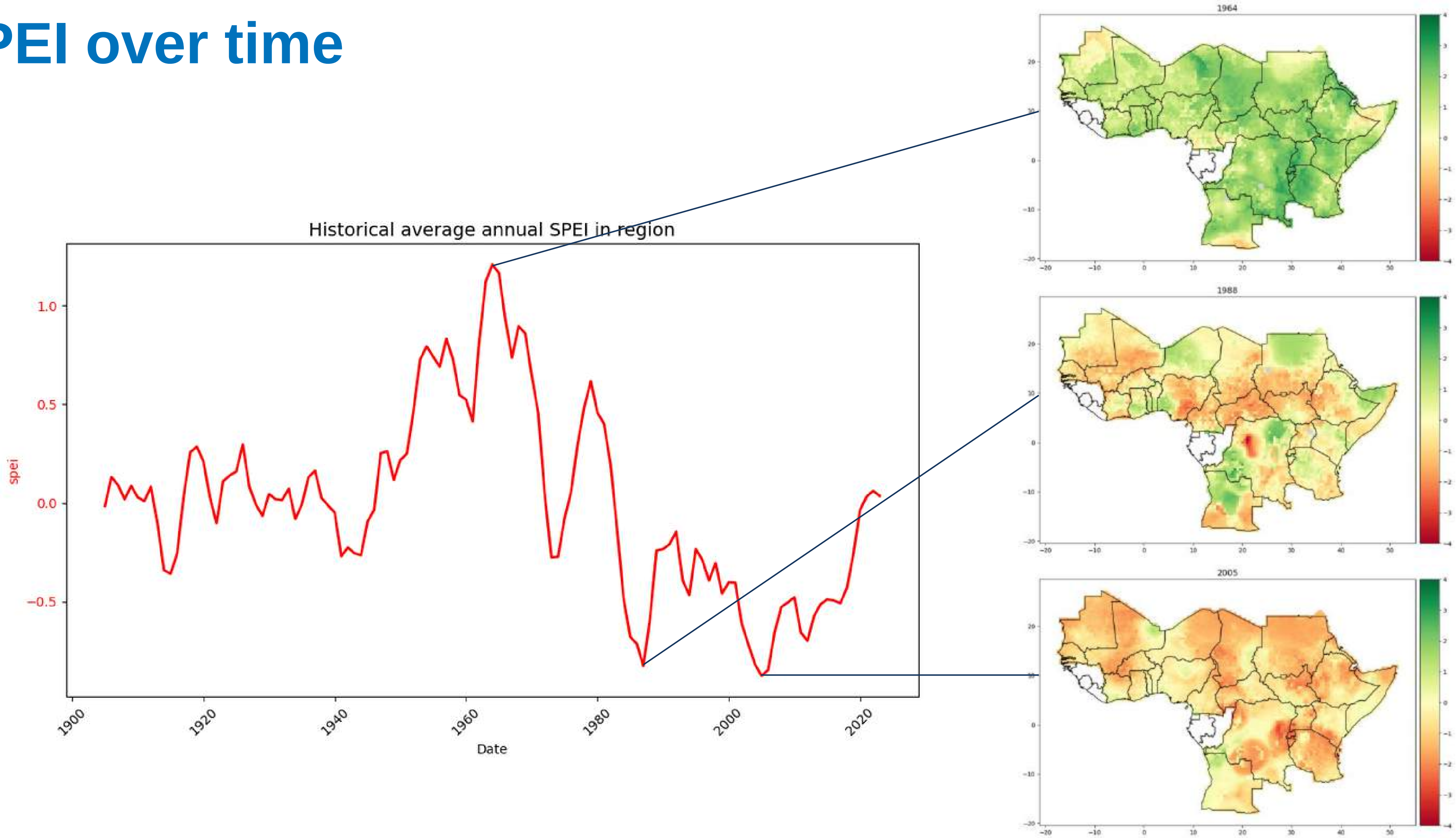


SPEI over time

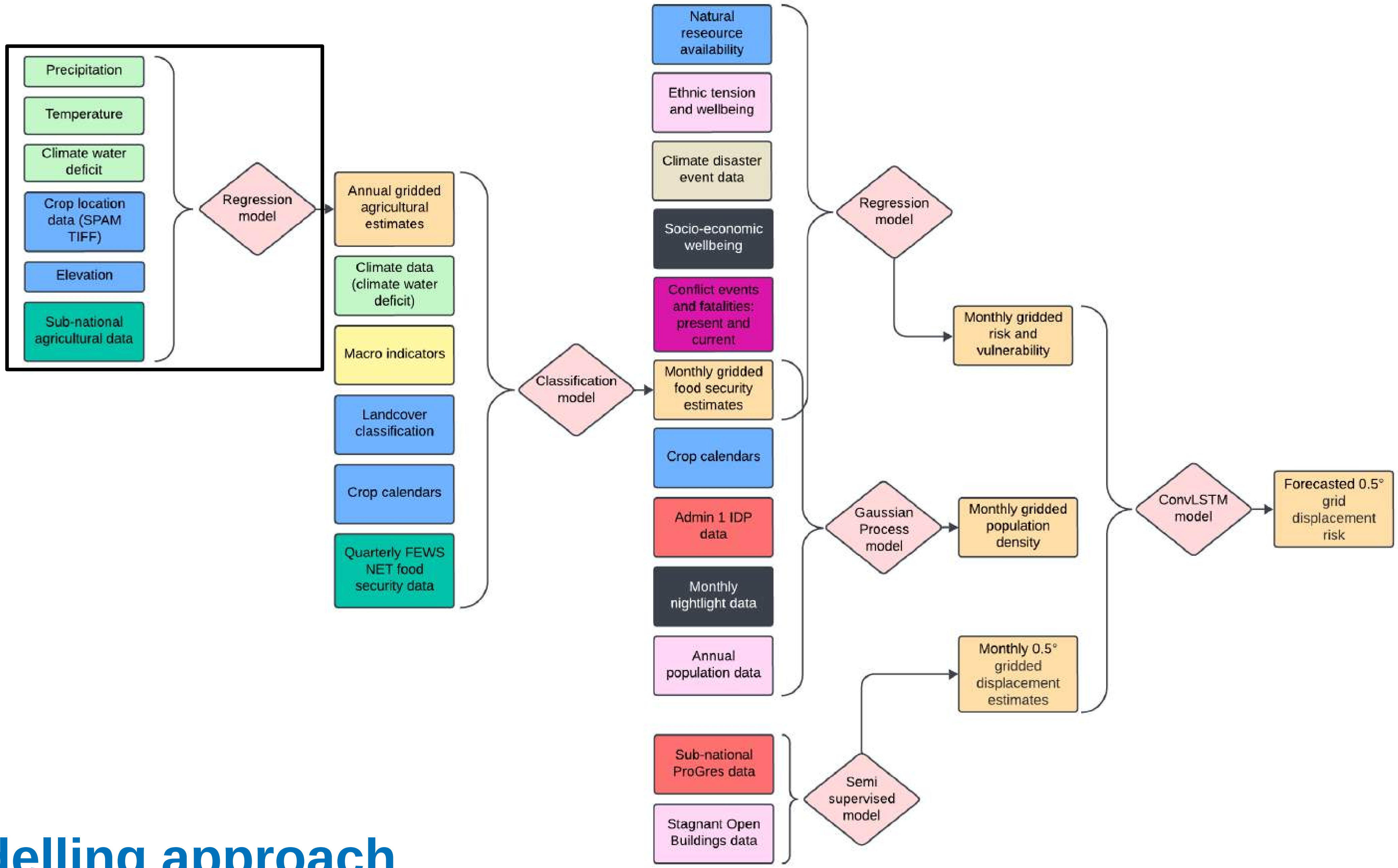




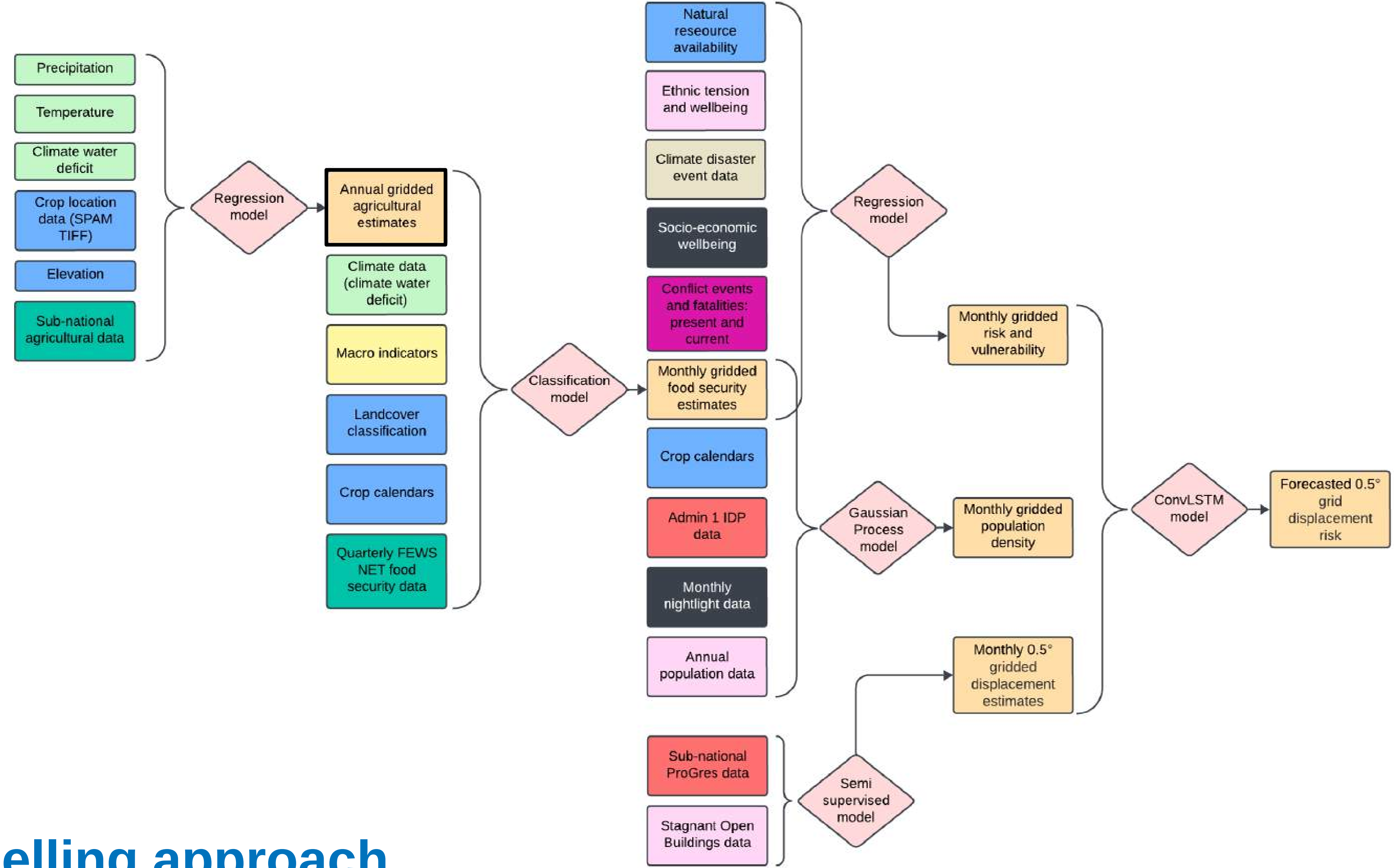
SPEI over time



Agricultural model



Modelling approach

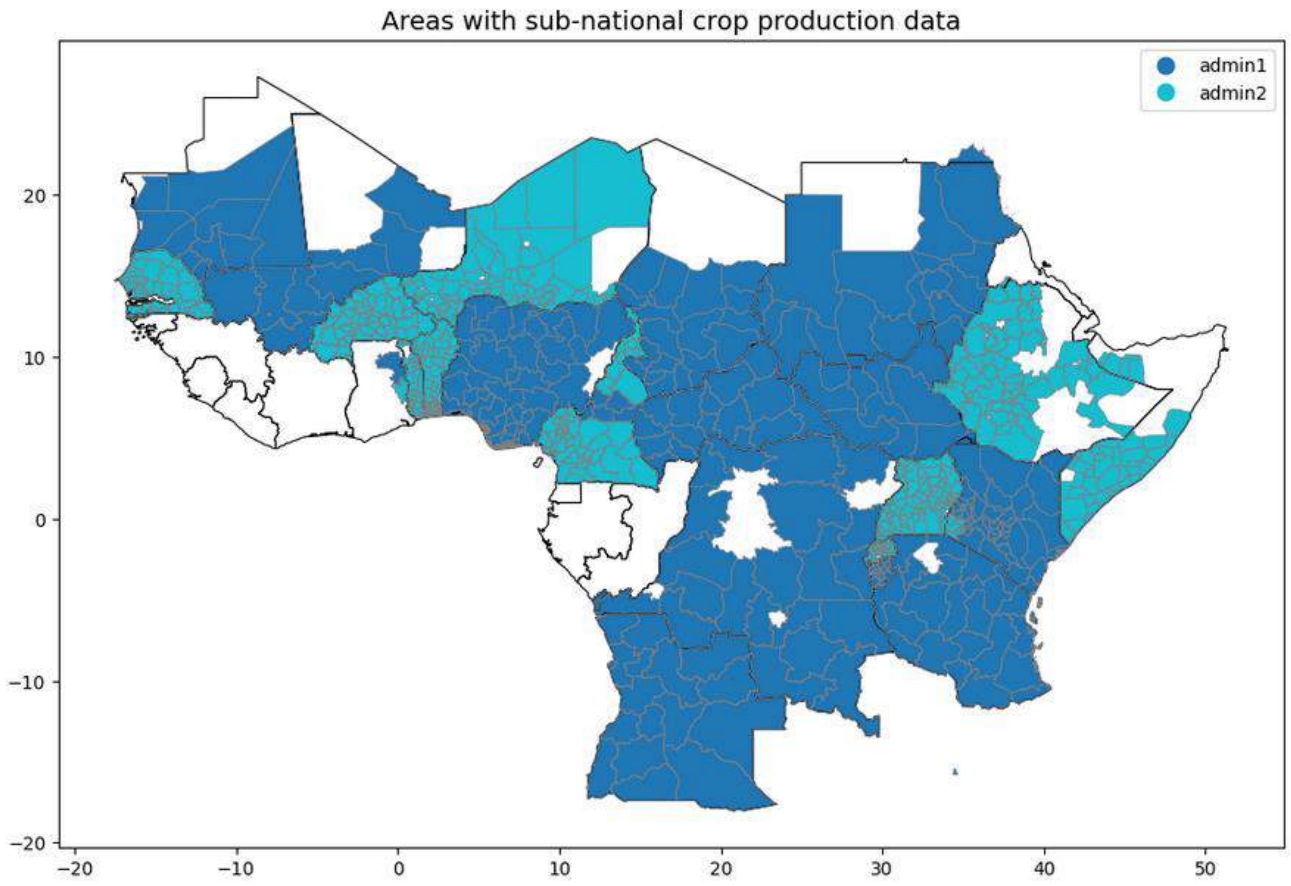


Modelling approach

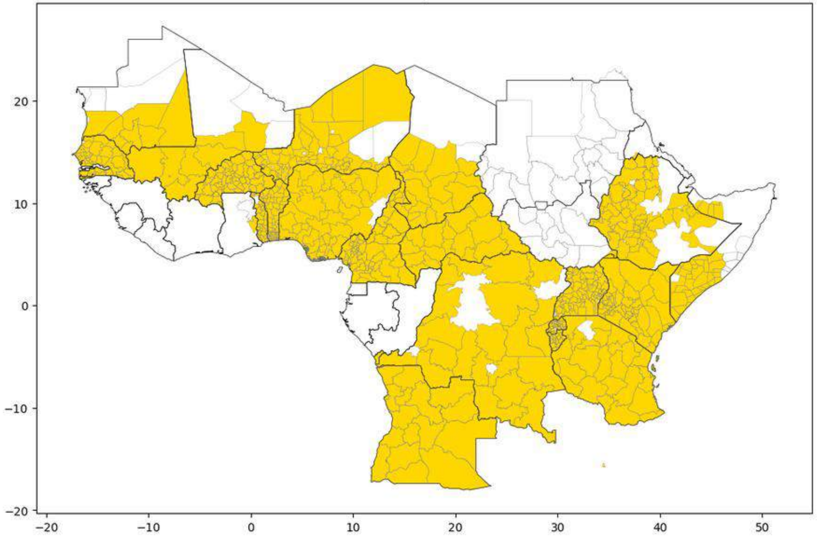
Climate variables and agricultural areas

Sub-national crop yields

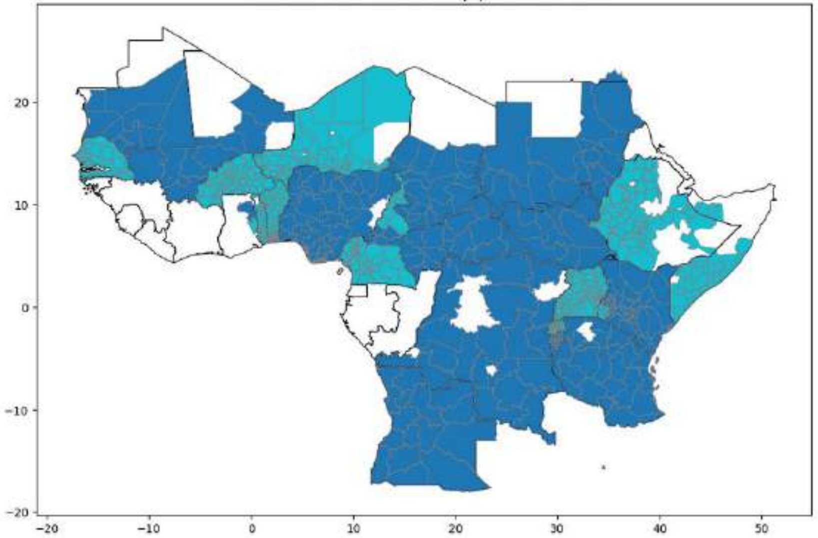
- The HarvestStat is a repository of sub-national global crop production data
- Seasonal area (hectares), production (tonnes) and yield (tonnes/hectares) for admin 1 or admin 2 sub-national regions
- Regular data since 2008
- Data filtered for crops of interest: maize, sorghum, pearl millet, rice, cassava and cowpea



Sub-national crop data for Maize



Areas with sub-national crop production data



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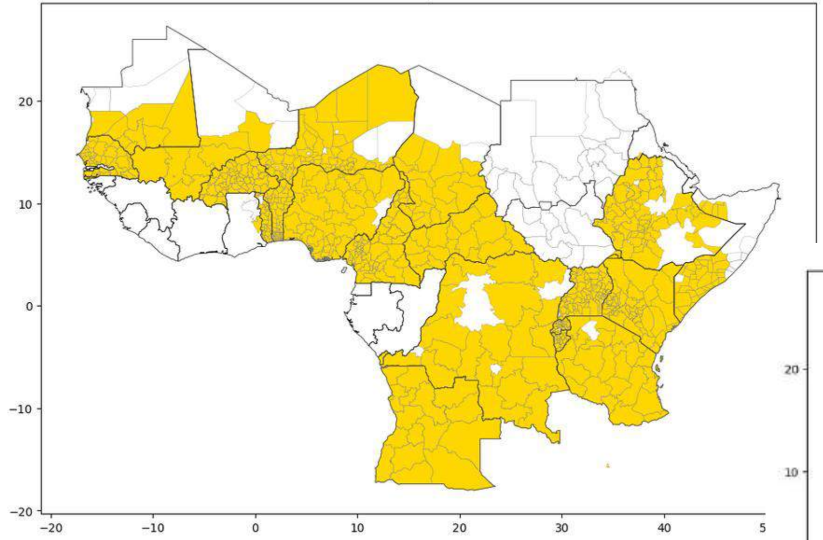
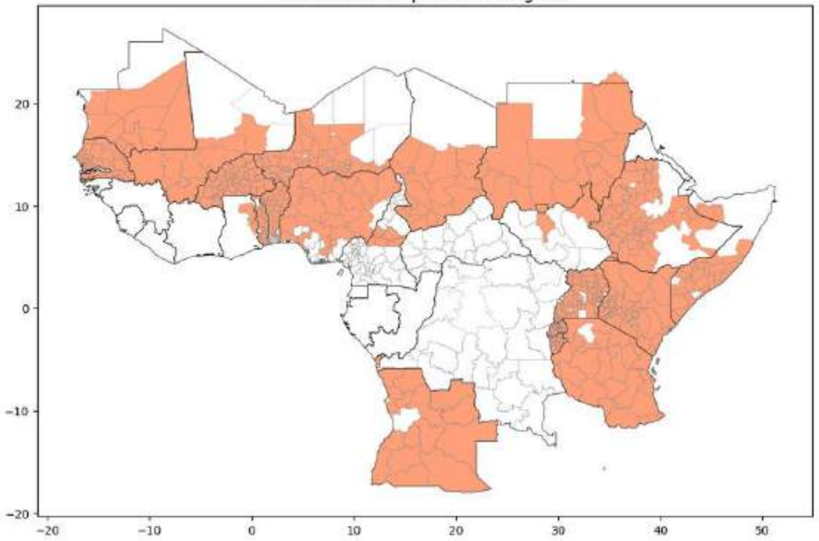
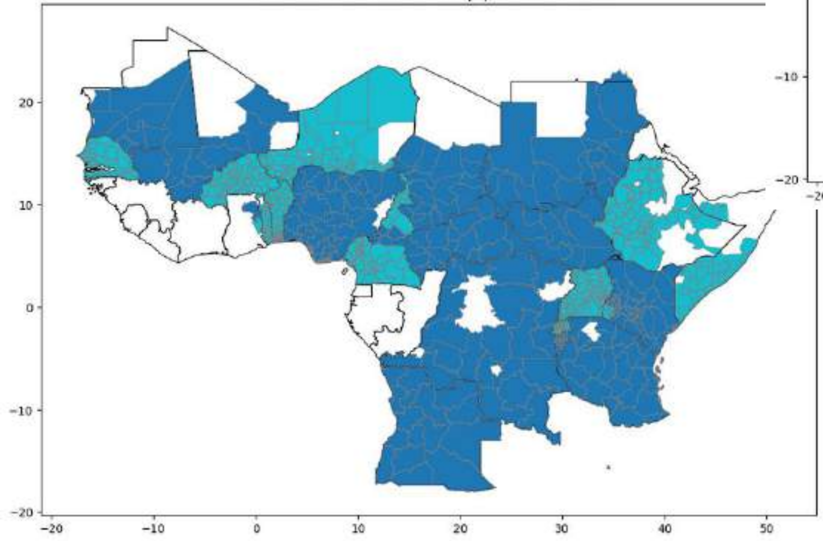


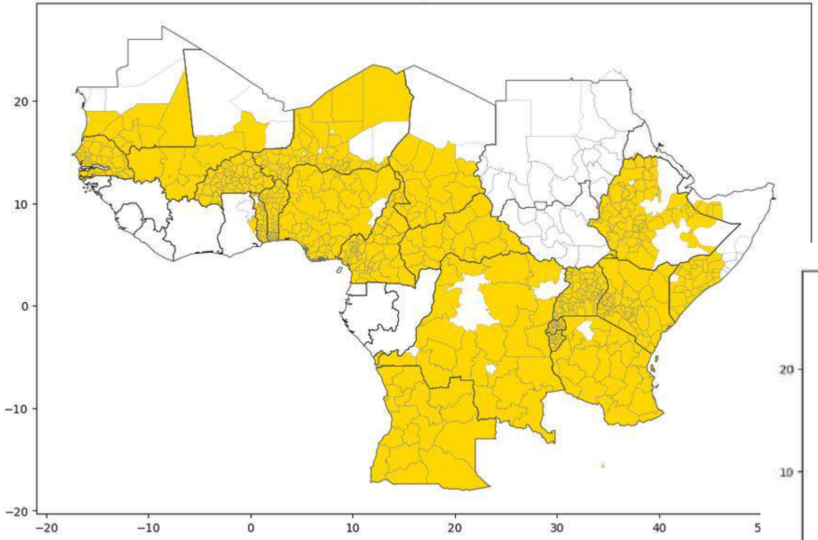
Sub-national crop data for Sorghum



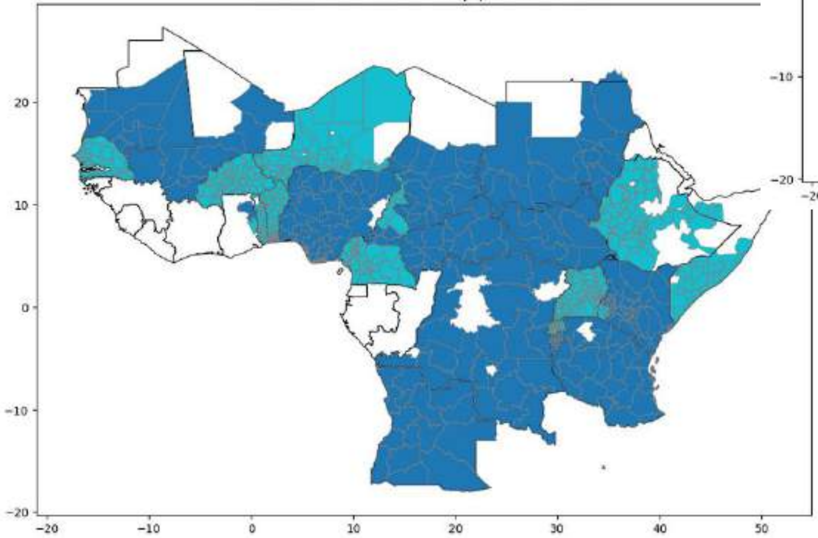
Areas with sub-national crop production data



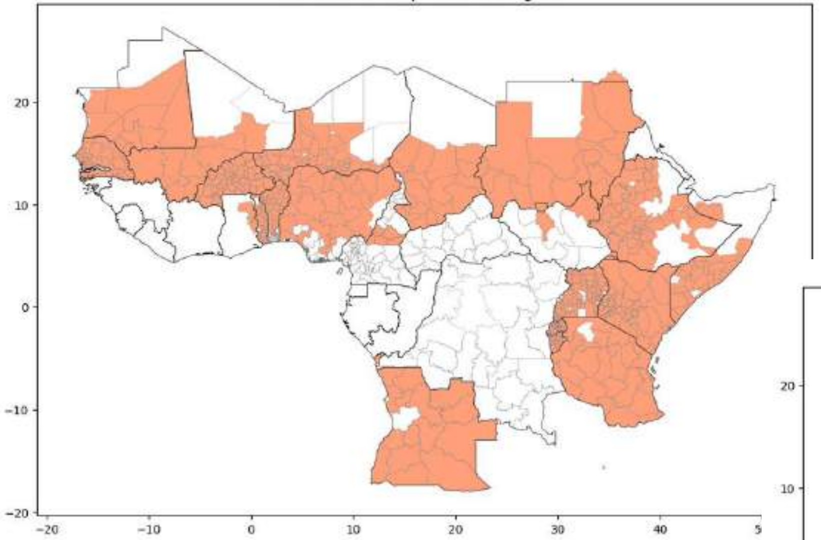
Sub-national crop data for Maize



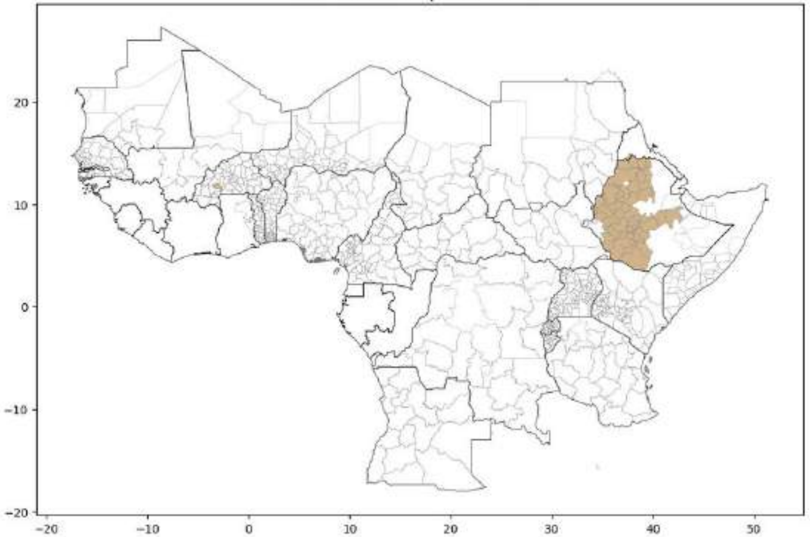
Areas with sub-national crop production data



Sub-national crop data for Sorghum



Sub-national crop data for Teff



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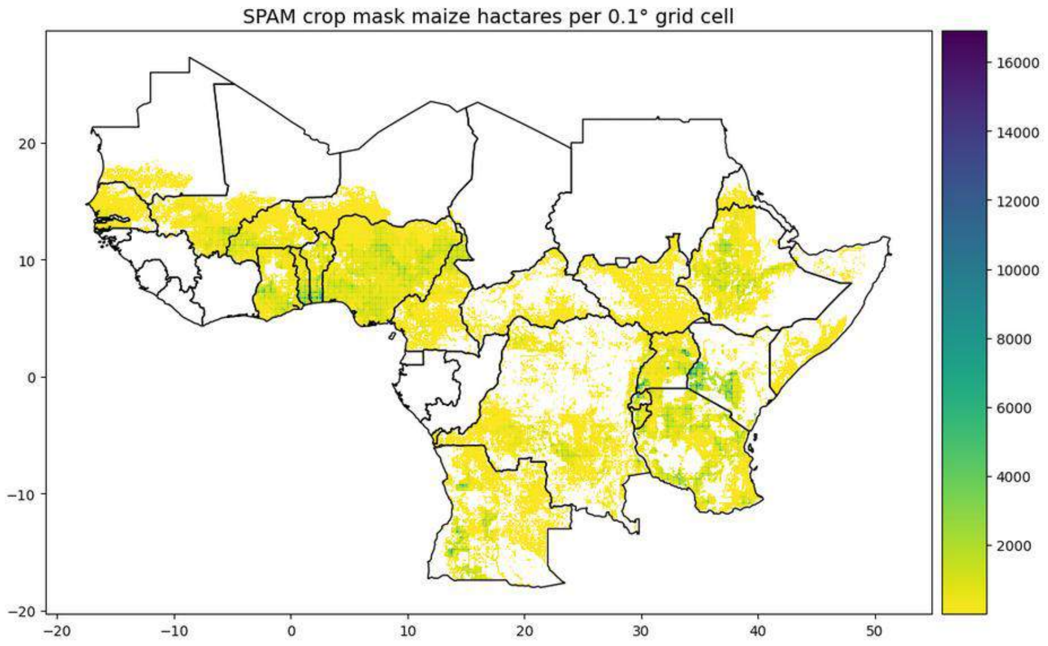
Climate variables and agricultural areas

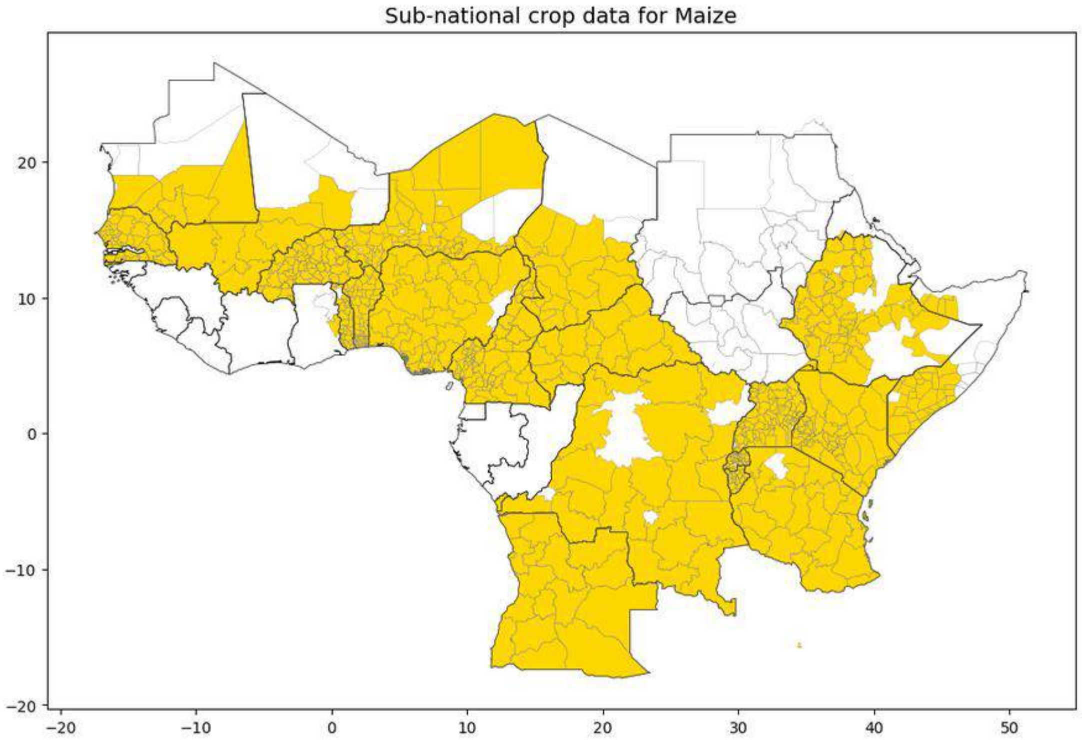
Crop masks

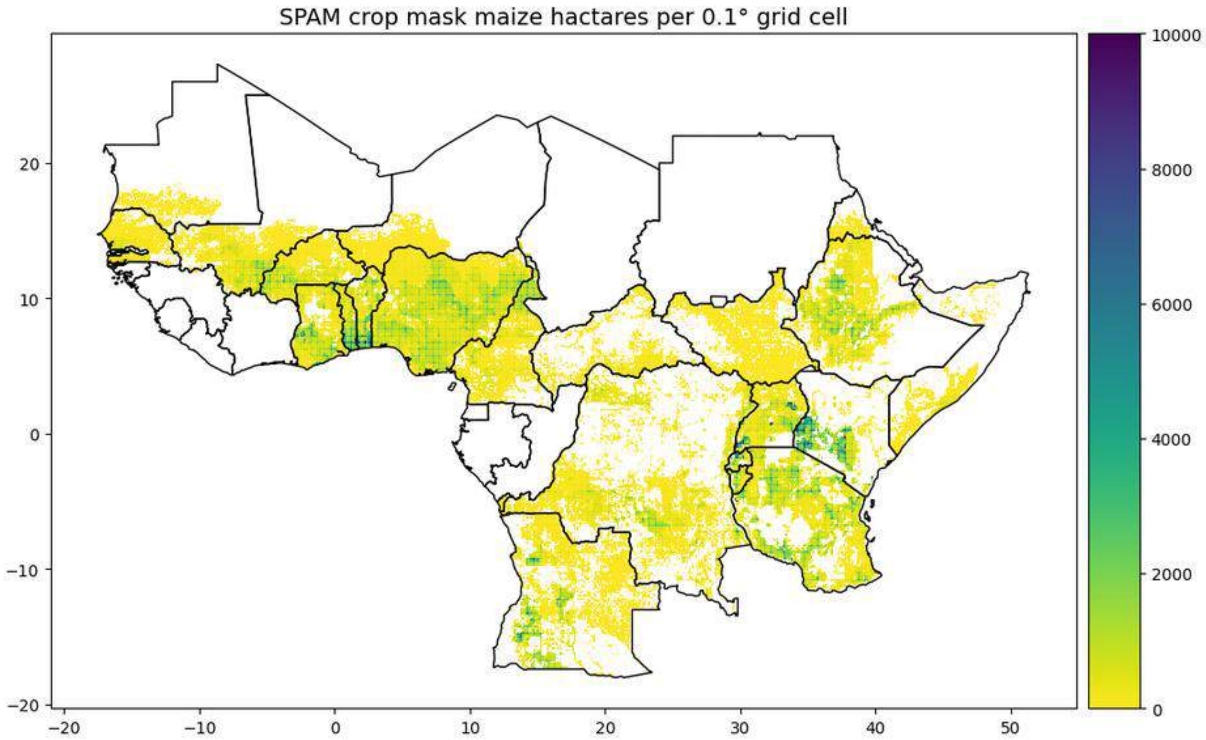
- Spatial Production Allocation Model (SPAM) offers predictions on the density of crop harvested areas are 10 km x 10 km resolution
- Data was placed inside 0.1° grid cells to find (rainfed harvested) area within each grid cell



Climate variables and agricultural areas

Combining crop masks and yield data

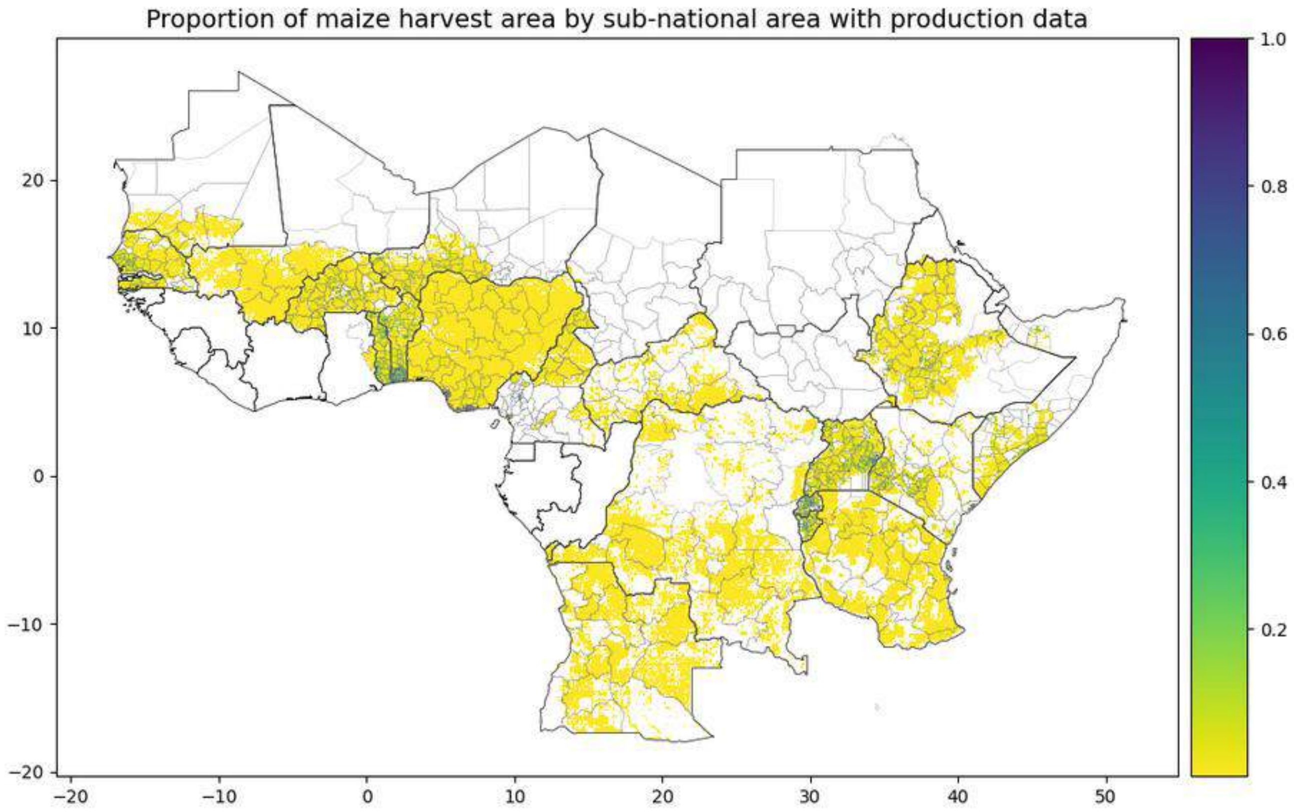




Climate variables and agricultural areas

Combining crop masks and yield data

- Proportion within each grid cell of crop harvested area for the sub-national area.



Climate variables and agricultural areas

Temperature / precipitation / climate water deficit

- Daily measurements for temperature and precipitation and monthly measurements of climate water deficit from 0.05° points collected (1981 – present) from CHIRTS (temperature), CHIRPS (precipitation) database.
- Placed inside 0.1° grid cells and aggregated (mean).
- Monthly mean calculated.
- Baseline measurements calculated from mean of each month for each individual grid cell for years 1981 – 1990.
- Monthly difference calculated by taking monthly mean minus baseline value.

Climate variables and agricultural areas

Gridding daily values

	latitude	longitude	01_01_1981
0	8.475	24.174999	33.880001
1	8.425	24.174999	33.930000
2	8.375	24.174999	33.980000
3	8.325	24.174999	34.040001
4	8.675	24.225000	33.889999
...	...	...	...
20774	4.675	35.825001	36.029999
20775	4.625	35.825001	35.770000
20776	4.675	35.875000	36.150002
20777	4.625	35.875000	35.930000

Daily measurements at 0.05°
point locations

Climate variables and agricultural areas

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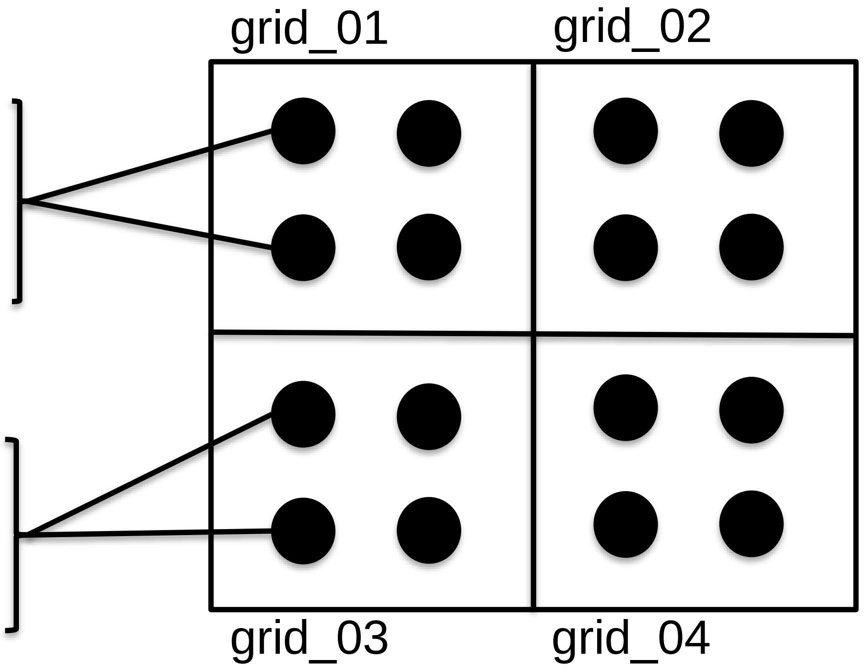

Daily measurements at 0.05° point locations

Points places inside 0.1° grid cells

Climate variables and agricultural areas

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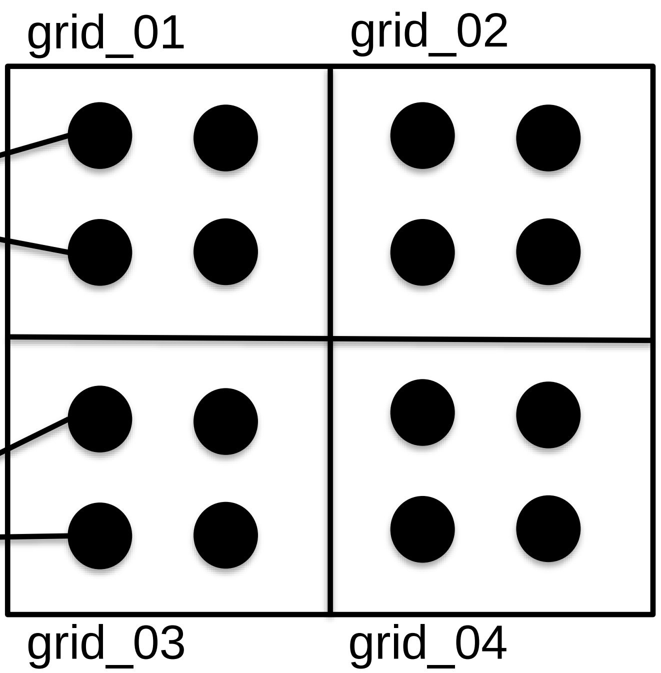
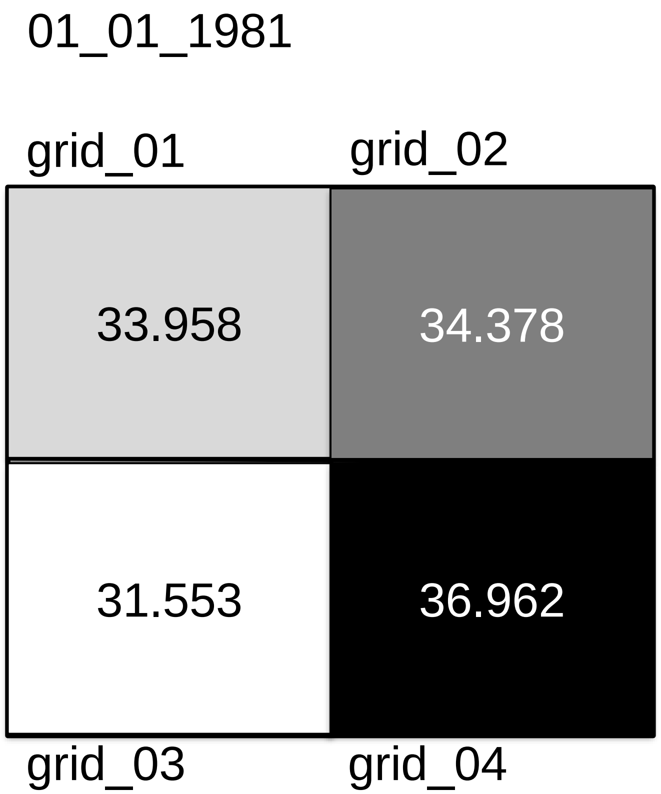


Points places inside 0.1° grid cells



Aggregate (mean) of point values in each grid cell taken as value for that cell

- Grid and aggregate (mean) every point for every date (1981-01-01 to 2022-12-31) for all 150,000 0.1° grid cells

	latitude	longitude	01_01_1981
0	8.475	24.174999	33.880001
1	8.425	24.174999	33.930000
2	8.375	24.174999	33.980000
3	8.325	24.174999	34.040001
4	8.675	24.225000	33.889999
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	latitude	longitude	02_01_1981
0	8.475	24.174999	35.459999
1	8.425	24.174999	35.459999
2	8.375	24.174999	35.459999
3	8.325	24.174999	35.459999
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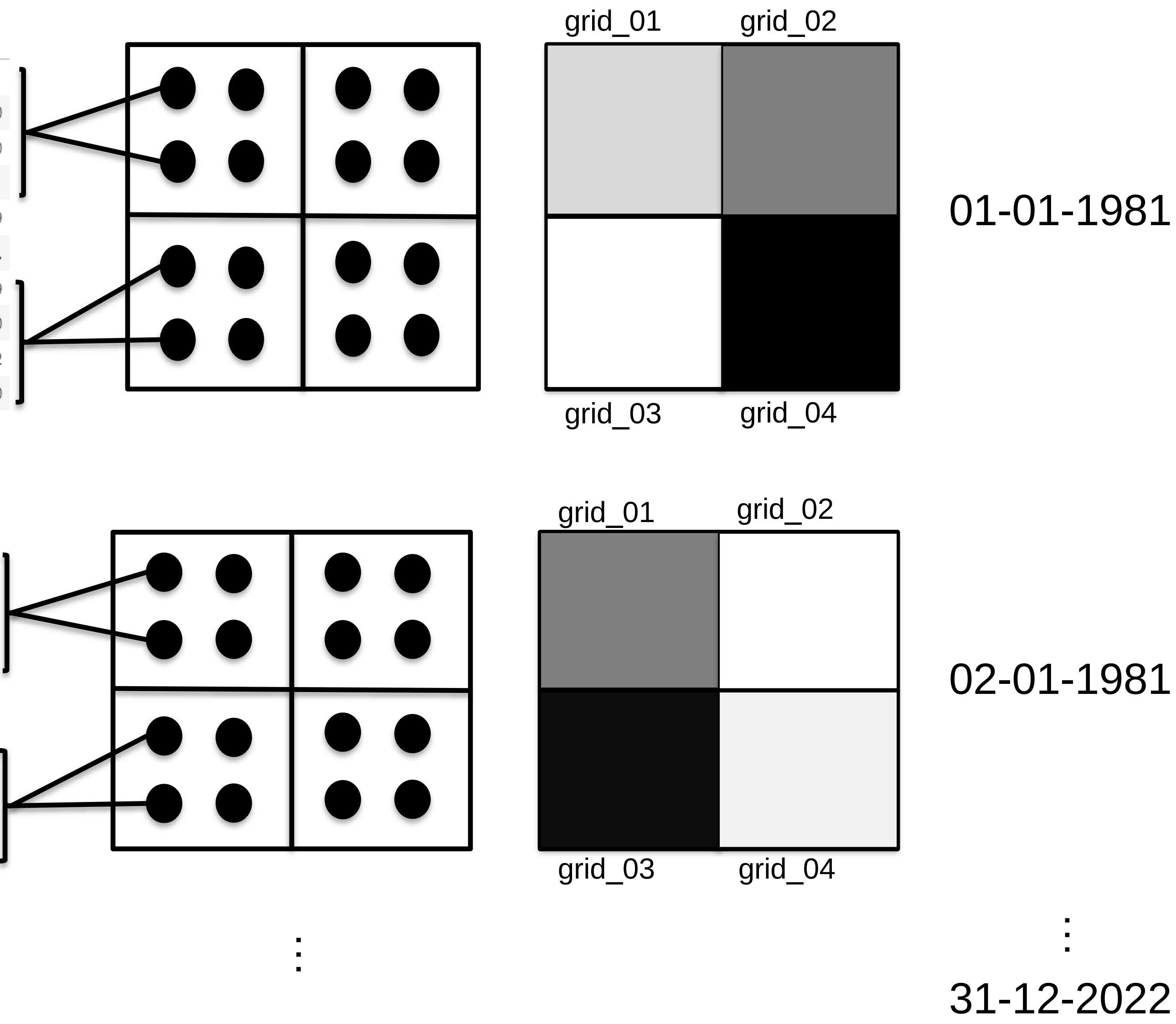
20778	4.625	35.924999	34.980000



Climate variables and agricultural areas

Aggregating to monthly values

- Project focuses on monthly time intervals, so need to aggregate daily from each grid cell to monthly frequency.

Climate variables and agricultural areas

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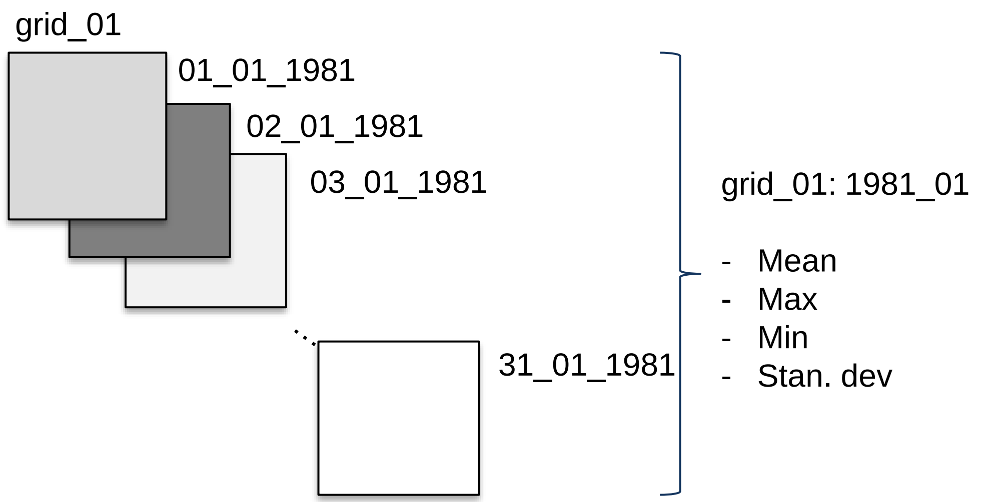

Climate variables and agricultural areas

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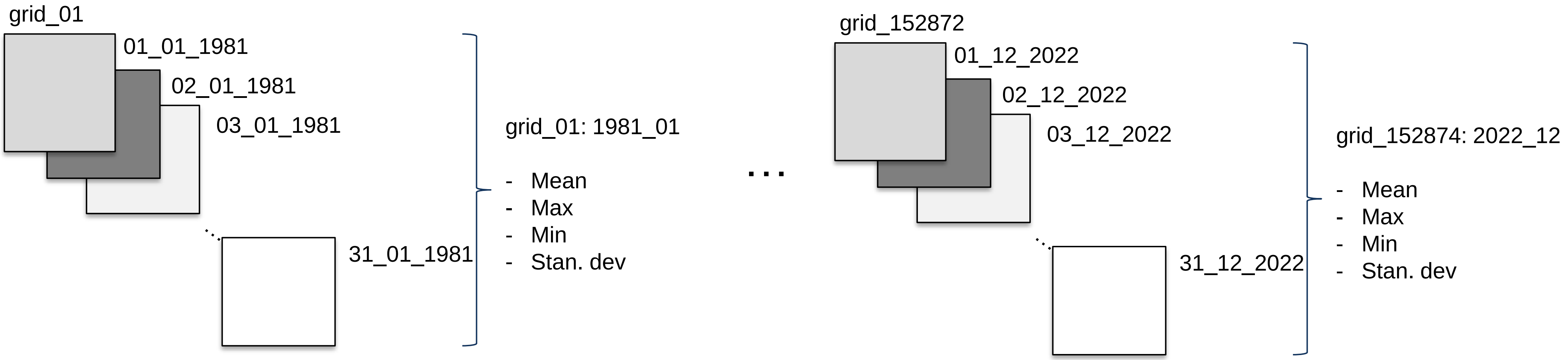


Climate variables and agricultural areas

Monthly baseline values

- But how to measure change over time, when there will be natural geographic and season differences?

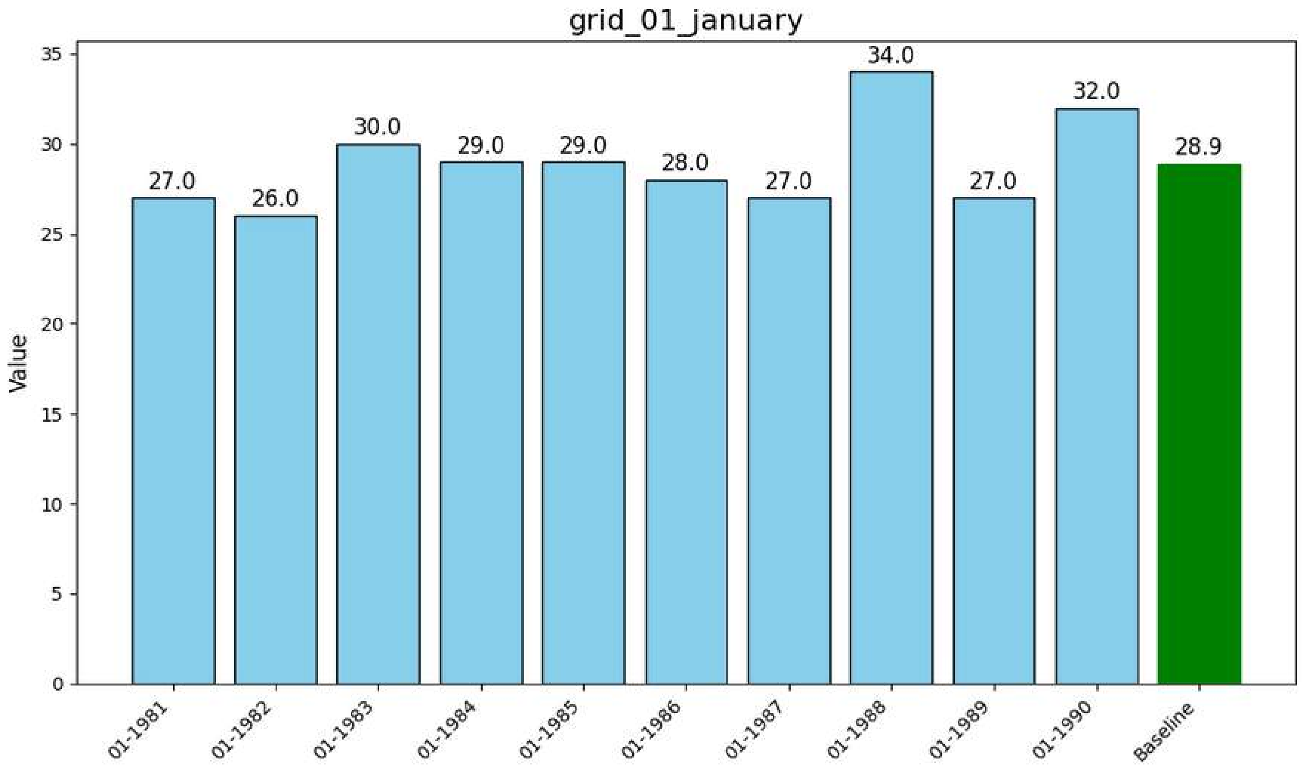
Climate variables and agricultural areas

Monthly baseline values

- But how to measure change over time, when there will be natural geographic and season differences?
- Propose setting a baseline measure for each grid cell in each month.

Climate variables and agricultural areas

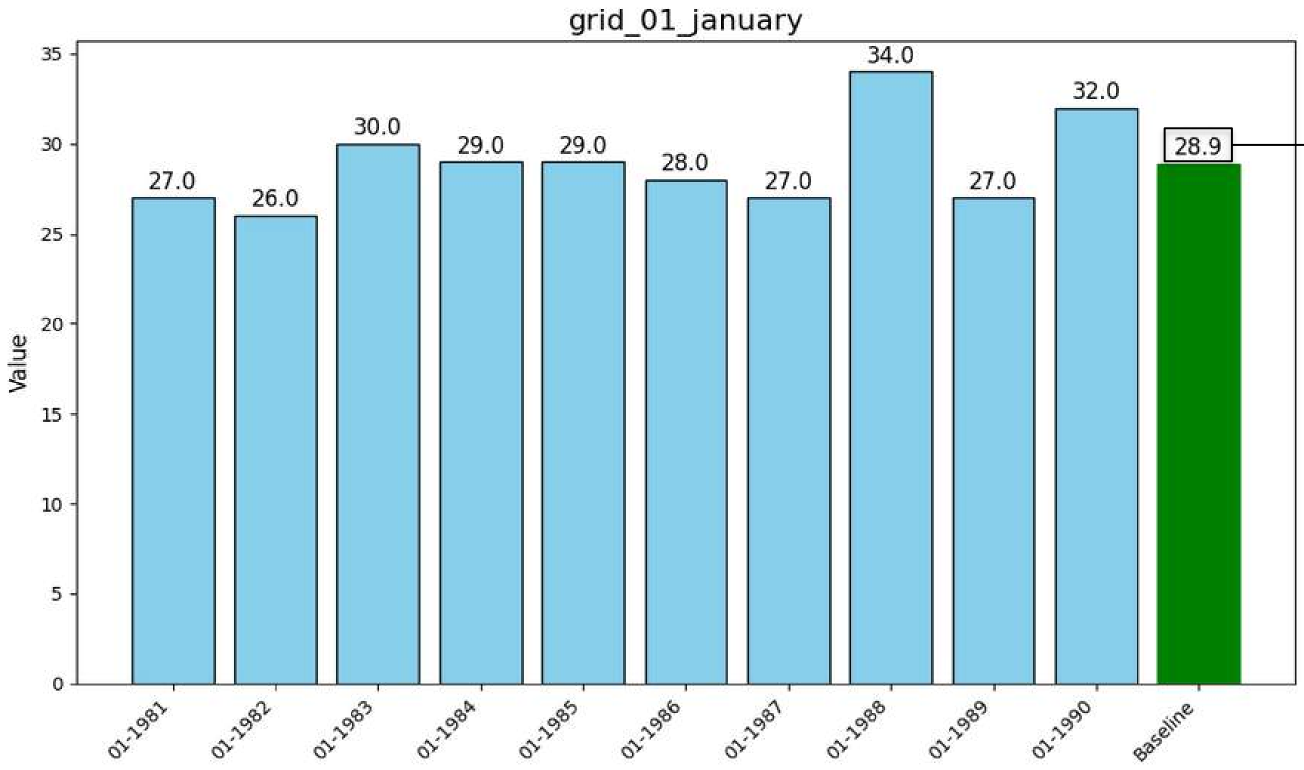
Monthly baseline values



	grid_index	year	month	temp
0	grid_01	1990	01	32.0
1	grid_01	1991	01	33.5
2	grid_01	1992	01	36.9
3	grid_01	1993	01	29.7
4	grid_01	1994	01	25.9

Climate variables and agricultural areas

Monthly baseline values



	grid_index	year	month	temp	temp_baseline
0	grid_01	1990	01	32.0	28.9
1	grid_01	1991	01	33.5	28.9
2	grid_01	1992	01	36.9	28.9
3	grid_01	1993	01	29.7	28.9
4	grid_01	1994	01	25.9	28.9

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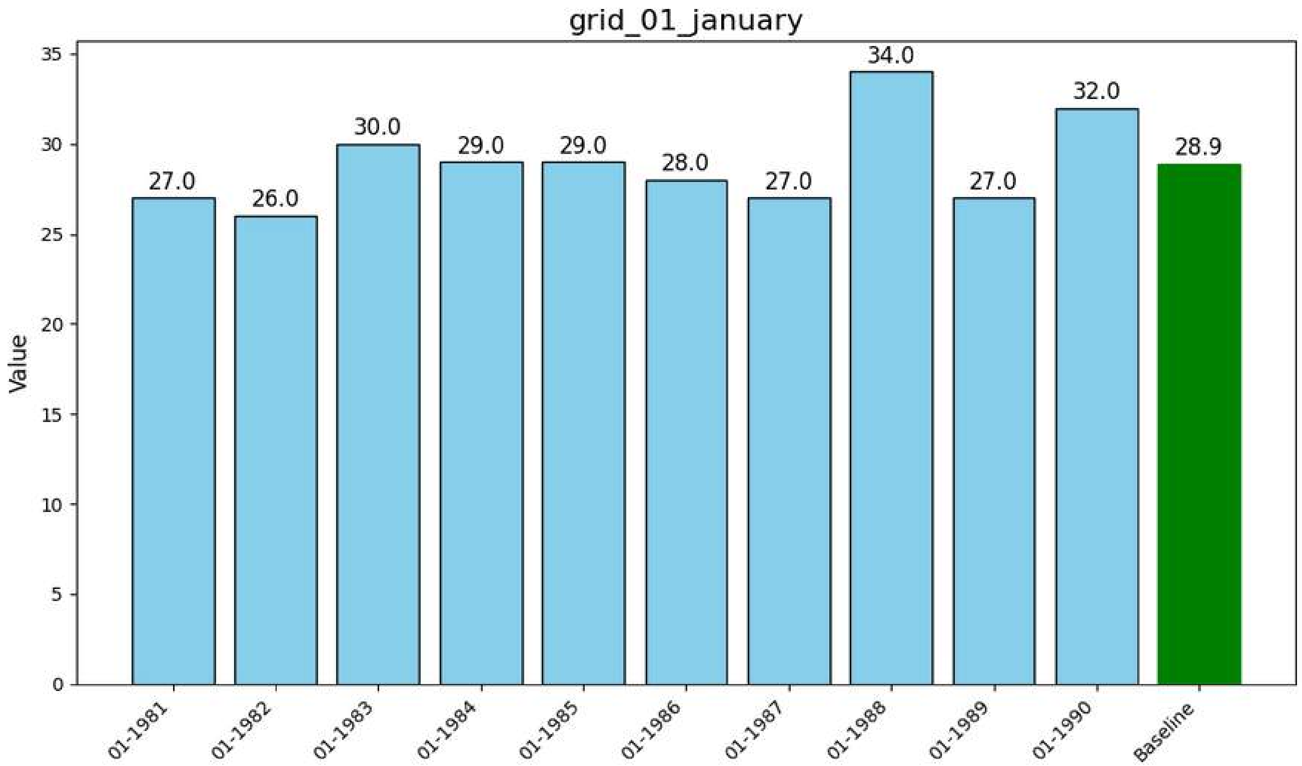
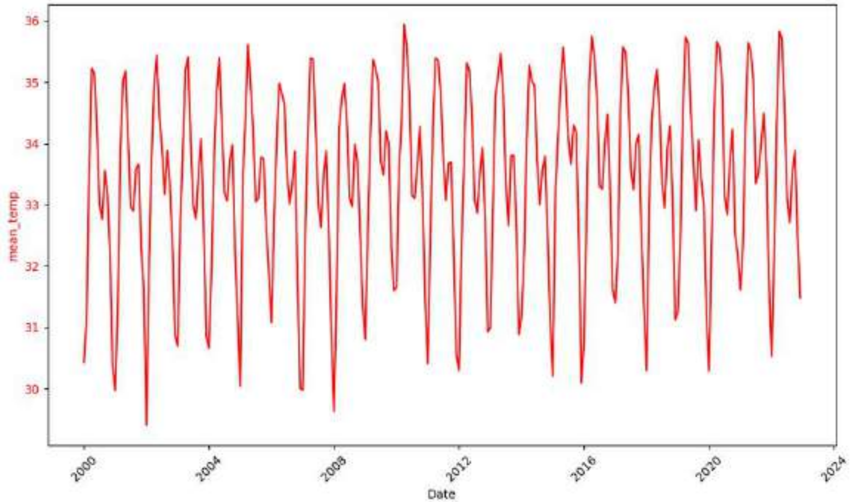
Climate variables and agricultural areas

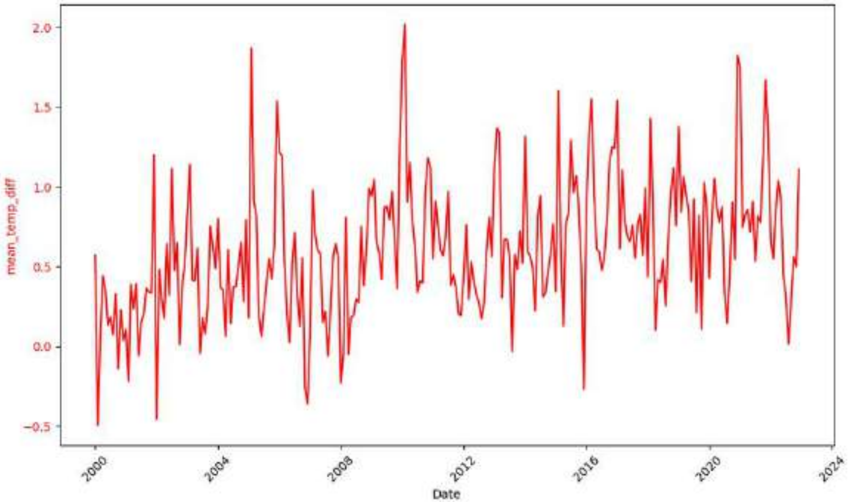
Monthly baseline values



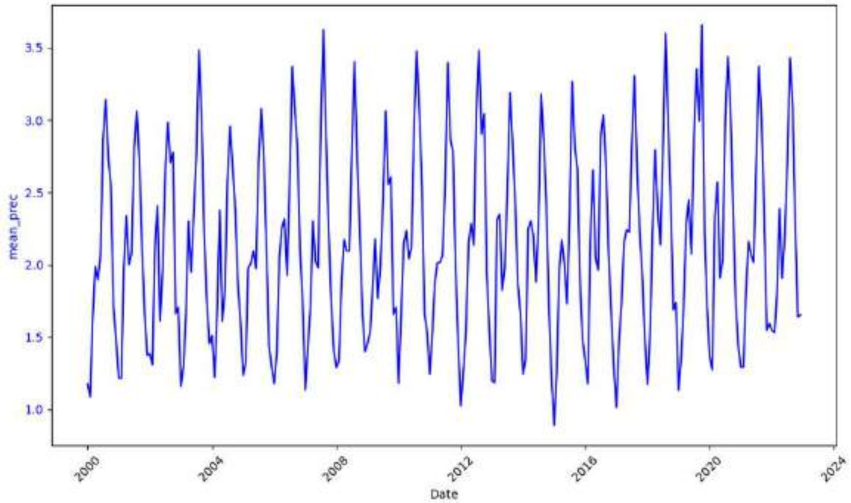
	grid_index	year	month	temp	temp_baseline	temp_diff
0	grid_01	1990	01	32.0	28.9	3.1
1	grid_01	1991	01	33.5	28.9	4.6
2	grid_01	1992	01	36.9	28.9	8.0
3	grid_01	1993	01	29.7	28.9	0.8
4	grid_01	1994	01	25.9	28.9	-3.0

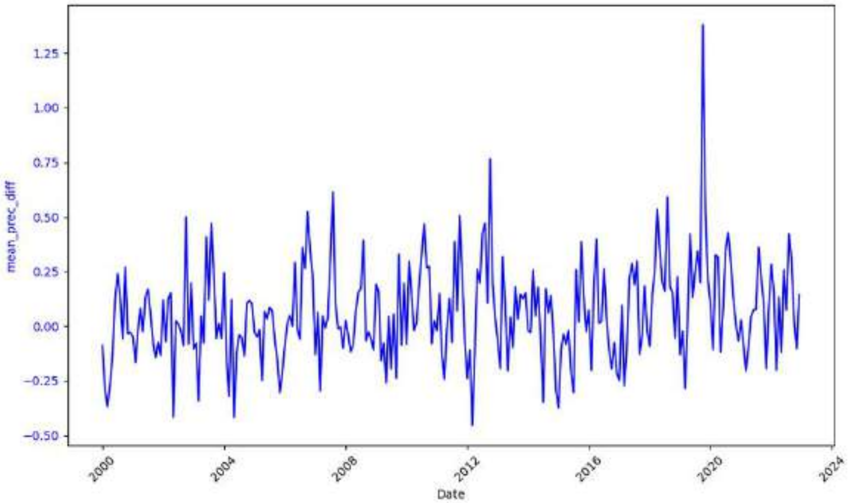
Temperature





Precipitation





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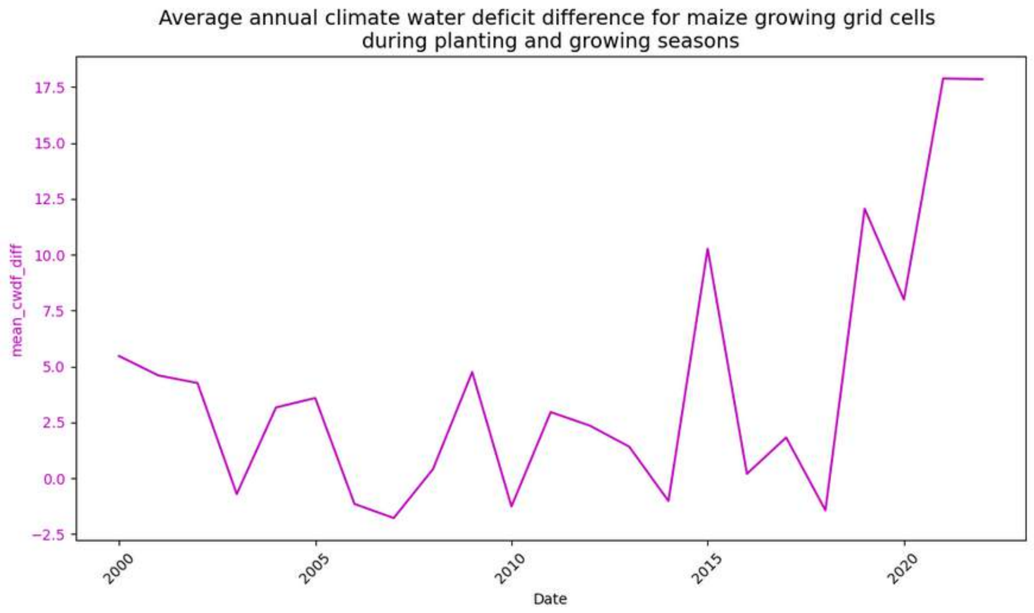
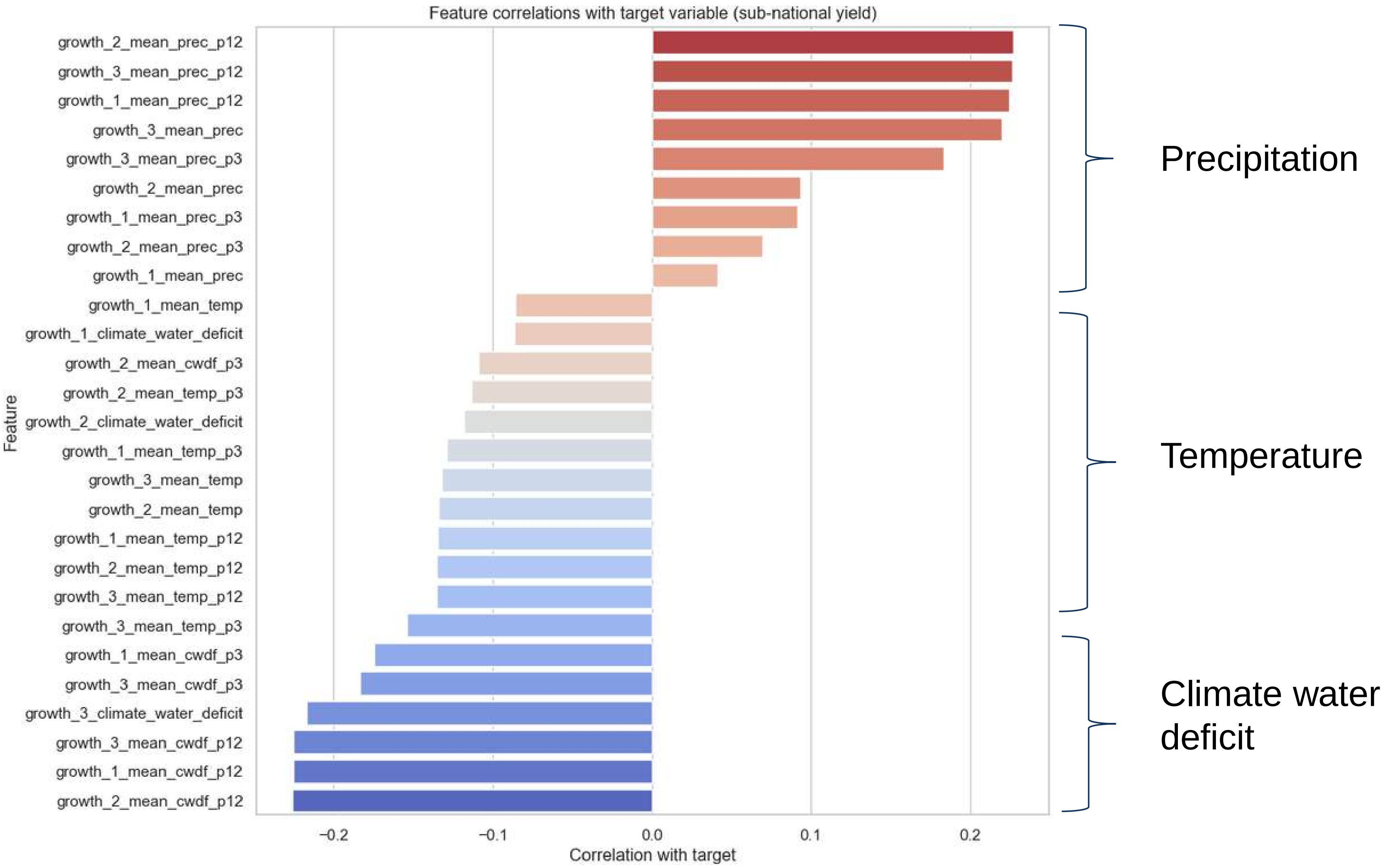
Climate variables and agricultural areas

Crop calendars

- The HarvestStat sub-national global crop production data also labels each observation with the planting and harvest month.
- So, we can take the climate variable (temperature, precipitation and climate water deficit) from only the crop growing grid cells and apply these measurements to the months between planting and harvest.
- This allows us to better understand the interaction between climate conditions and agricultural conditions and crop production





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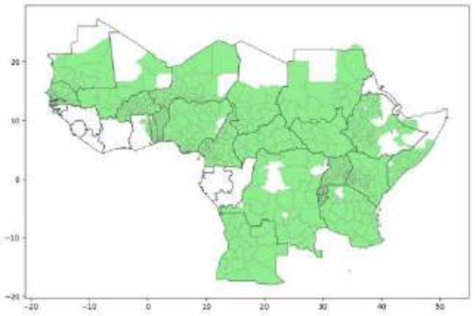
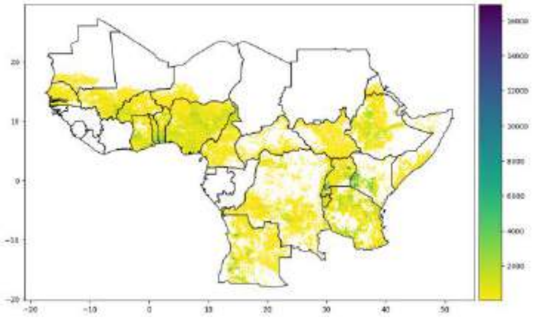
Climate variables and agricultural areas

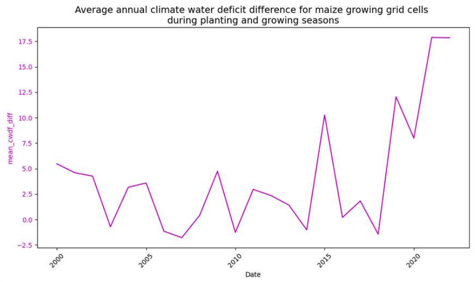
Sub-national crop yields



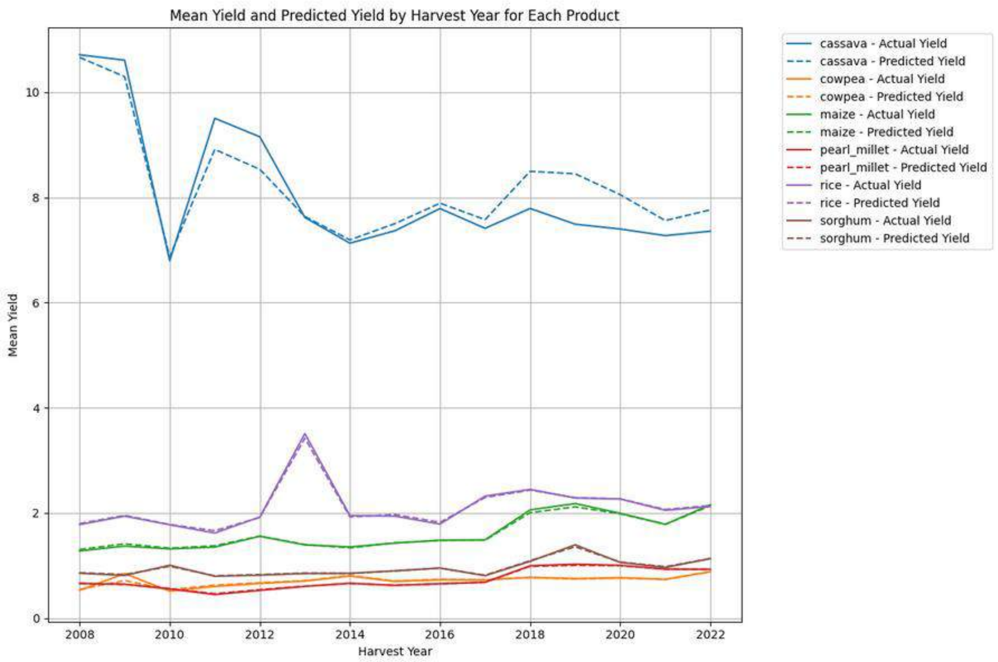
Gridded crop mask



Environment variables



Gridded agricultural yield estimates



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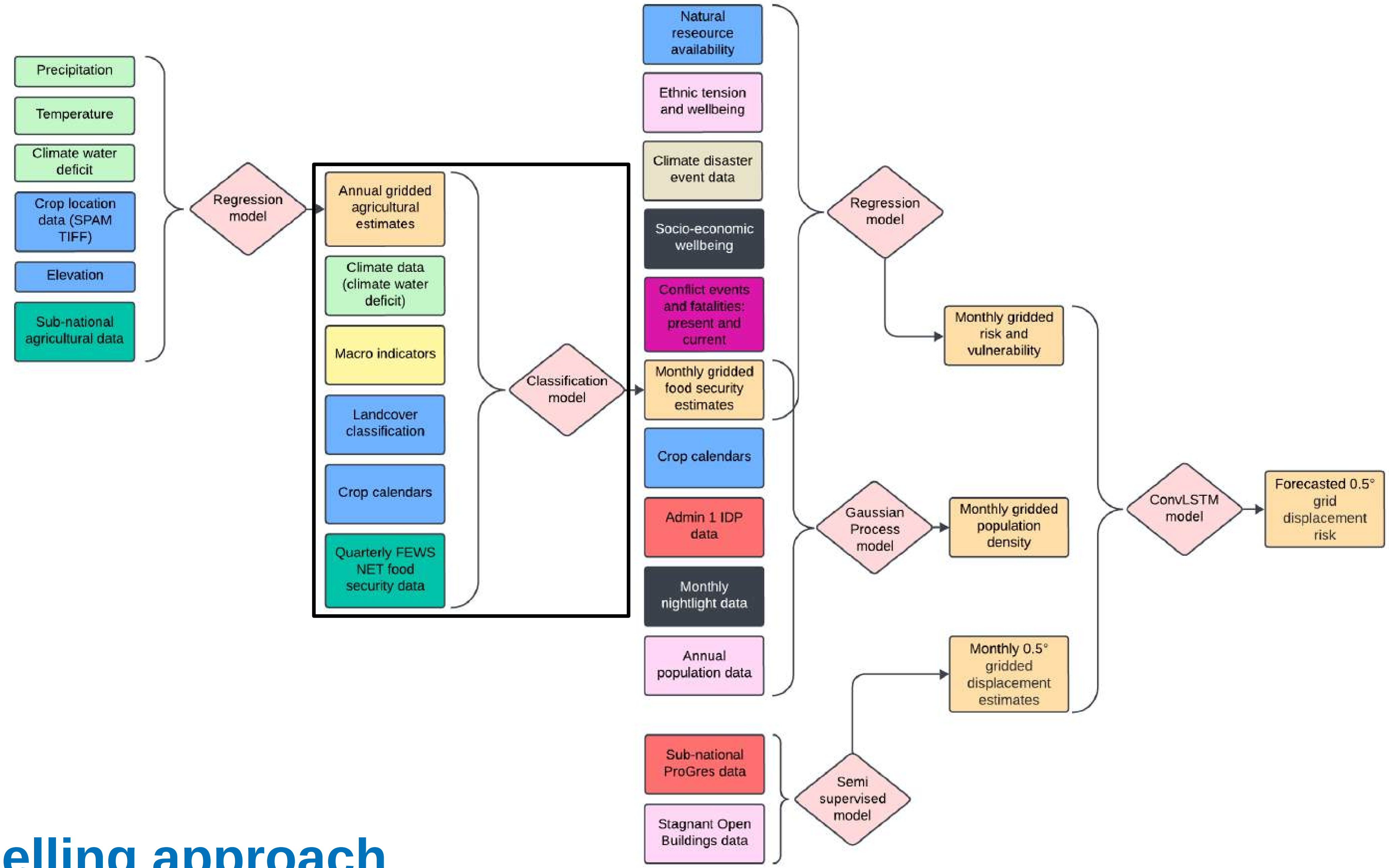
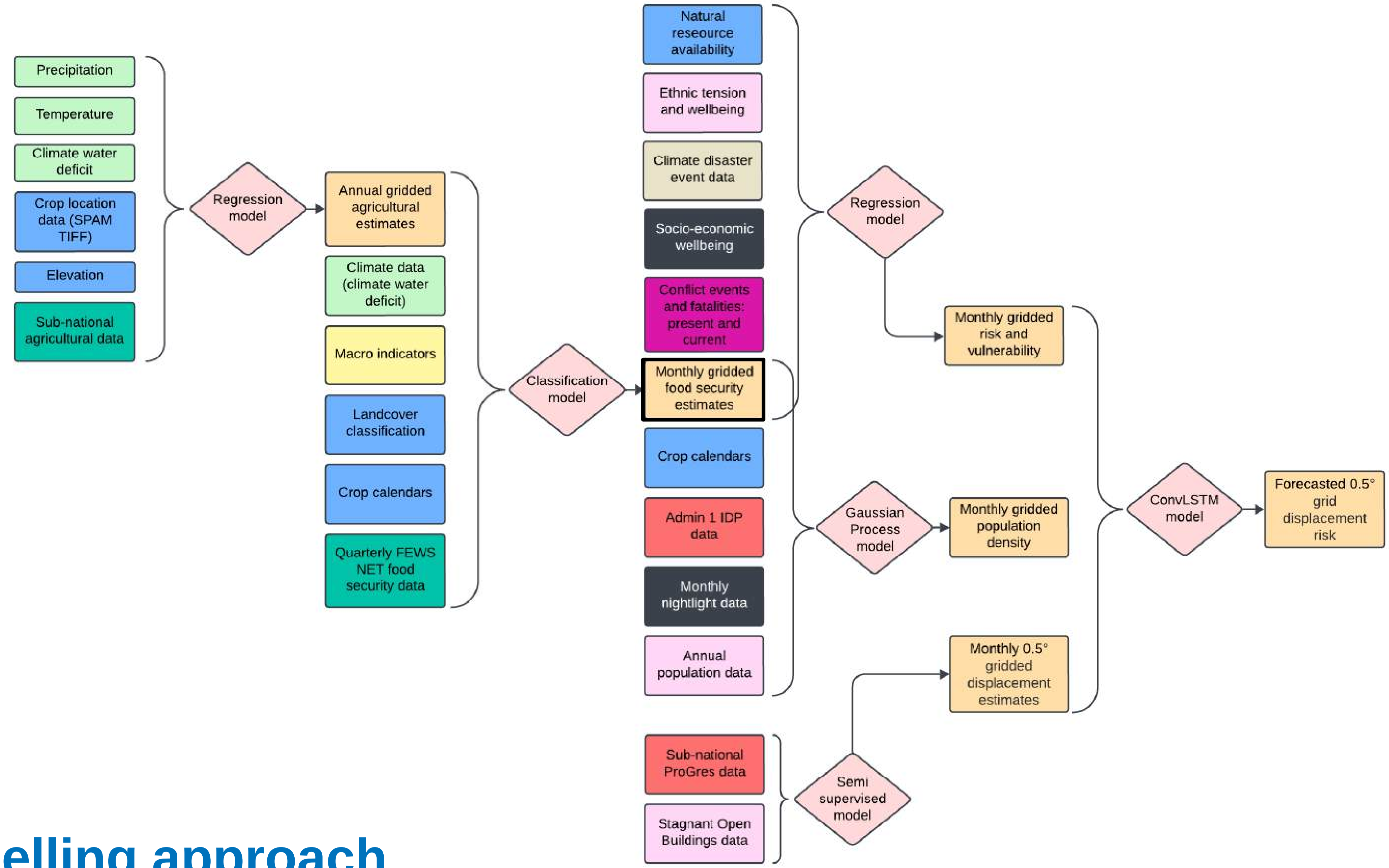
Food security model



Modelling approach



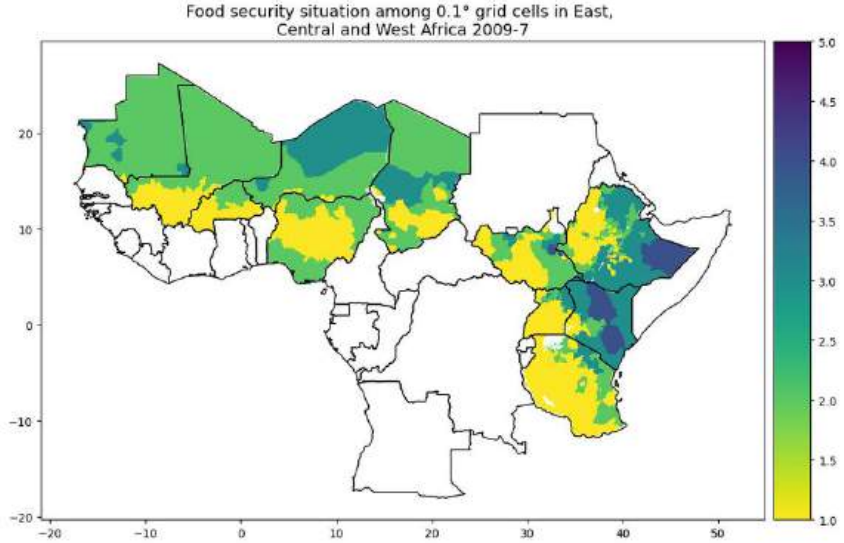
Modelling approach

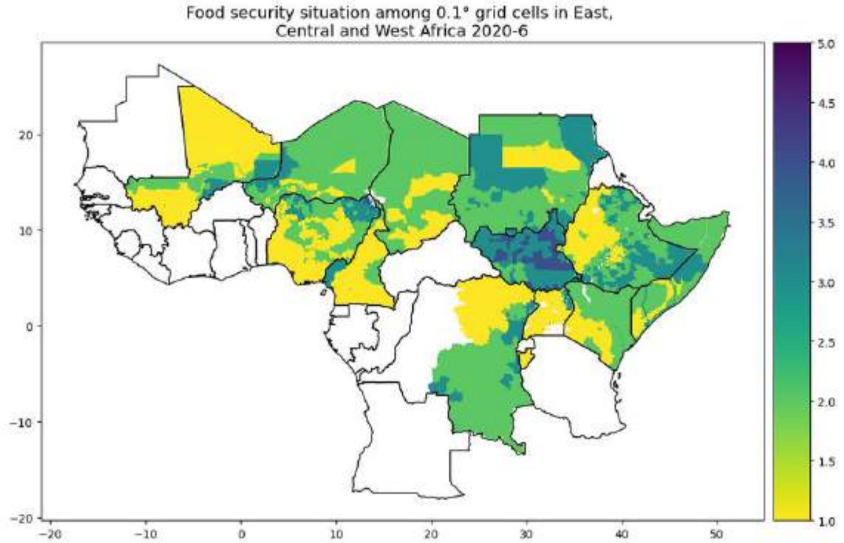
Food security model

Food security data

- The Famine Early Warning System Network (FEWS Net) offers modelled data on the food security classification in sub-national regions.
- Data available every ~ 3-4 months.
- Food security classifications are based on Integrated Food Security Phase Classification (IPC)
    - A common global scale for classifying the severity and magnitude of food insecurity and malnutrition.

1 – minimal
2 – stressed
3 – crisis
4 – emergency
5 – famine





Food security model

Gridded agricultural estimates

- Gridded crop yield estimates based on agricultural model.

Standardized Precipitation Evapotranspiration Index (SPEI)

- Drought, a slow onset consequence of climate change, is the most common cause of food shortages.
- We therefore propose controlling for drought through monthly SPEI figures in predicting food security.

Macro indicators

- Based on research finding that famine situations are the result of political environments, we propose controlling macro level governance variables.
- The World Bank Governance Indicators quantifies the annual levels of voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption.

Food security model

Combining crop masks and yield data

Gridded agricultural yield estimates

Drought data

Macro indicators

Landcover classification

Crop calendars

FEWS NET food security classification data

Gridded food security estimates

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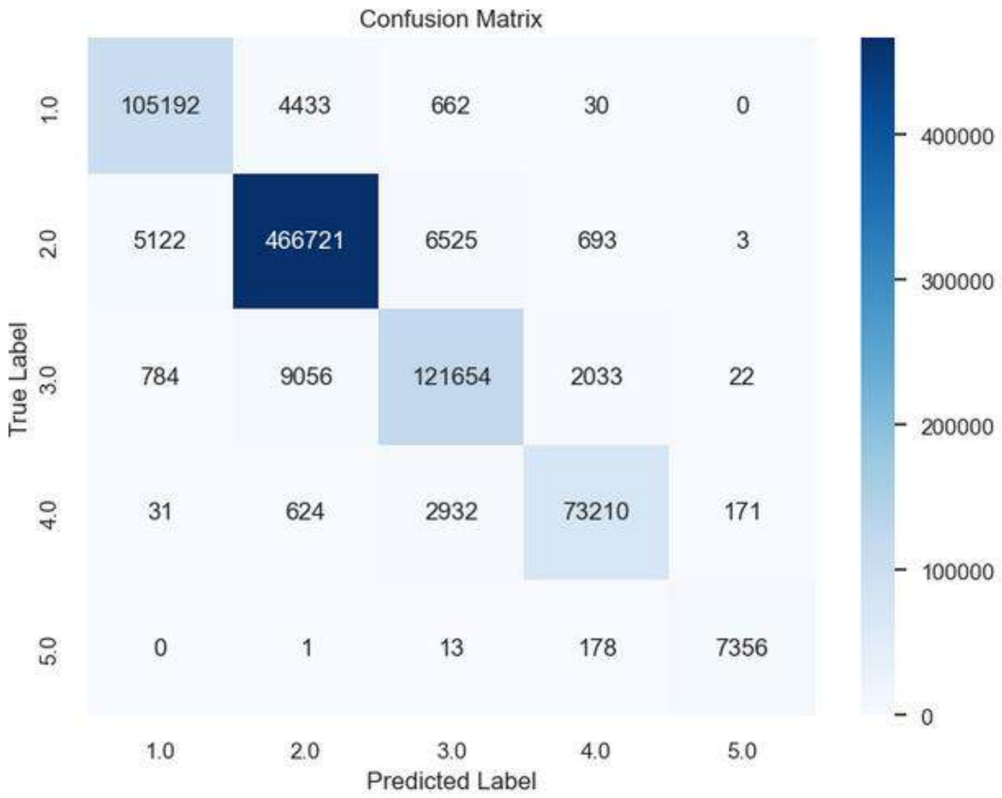

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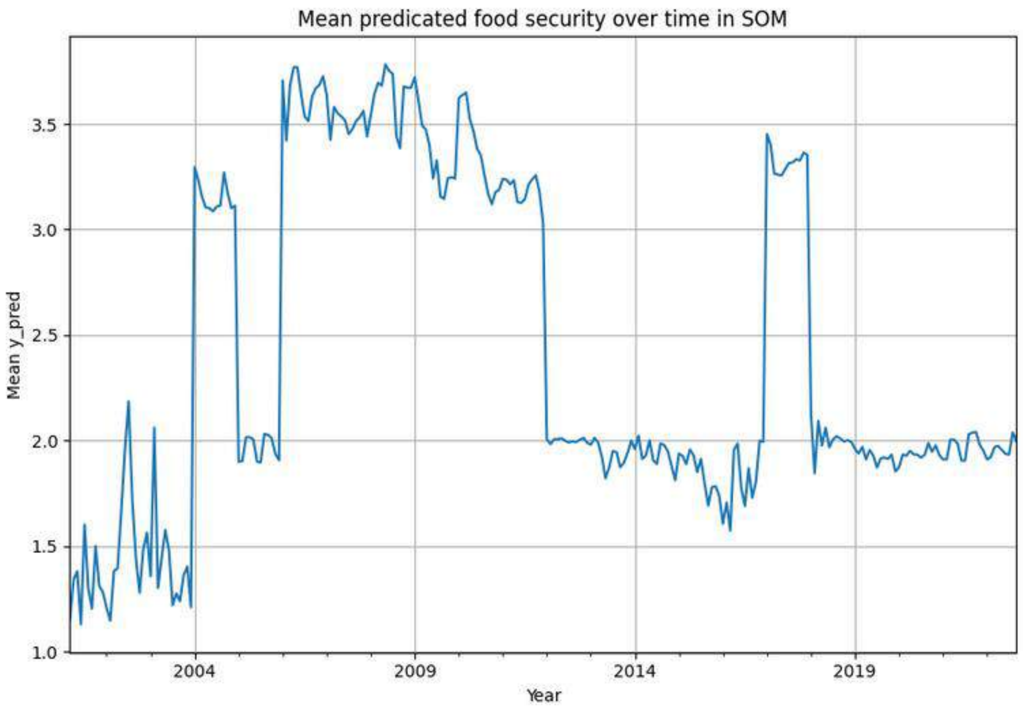
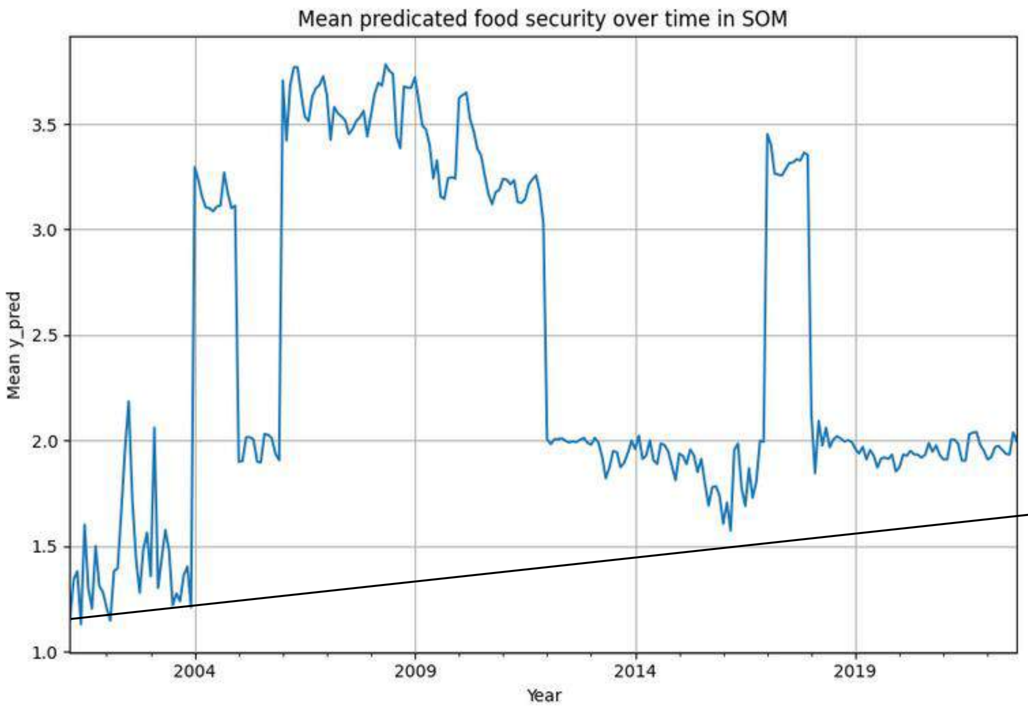
Food security model

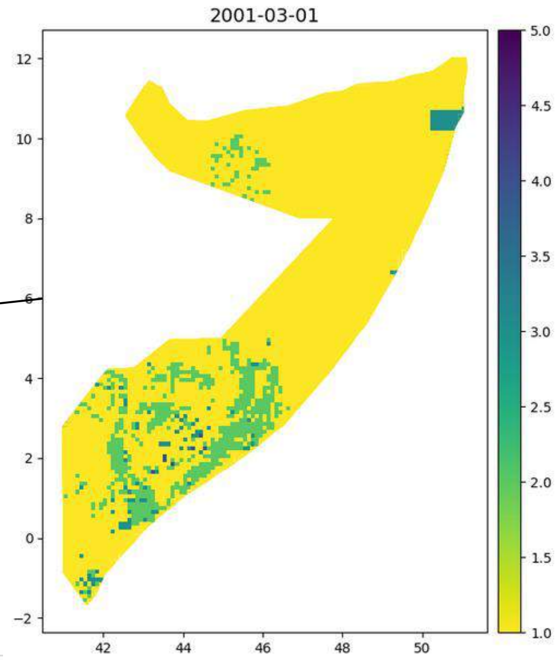
Applying food security model



Food security model

Applying food security model





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Food security model

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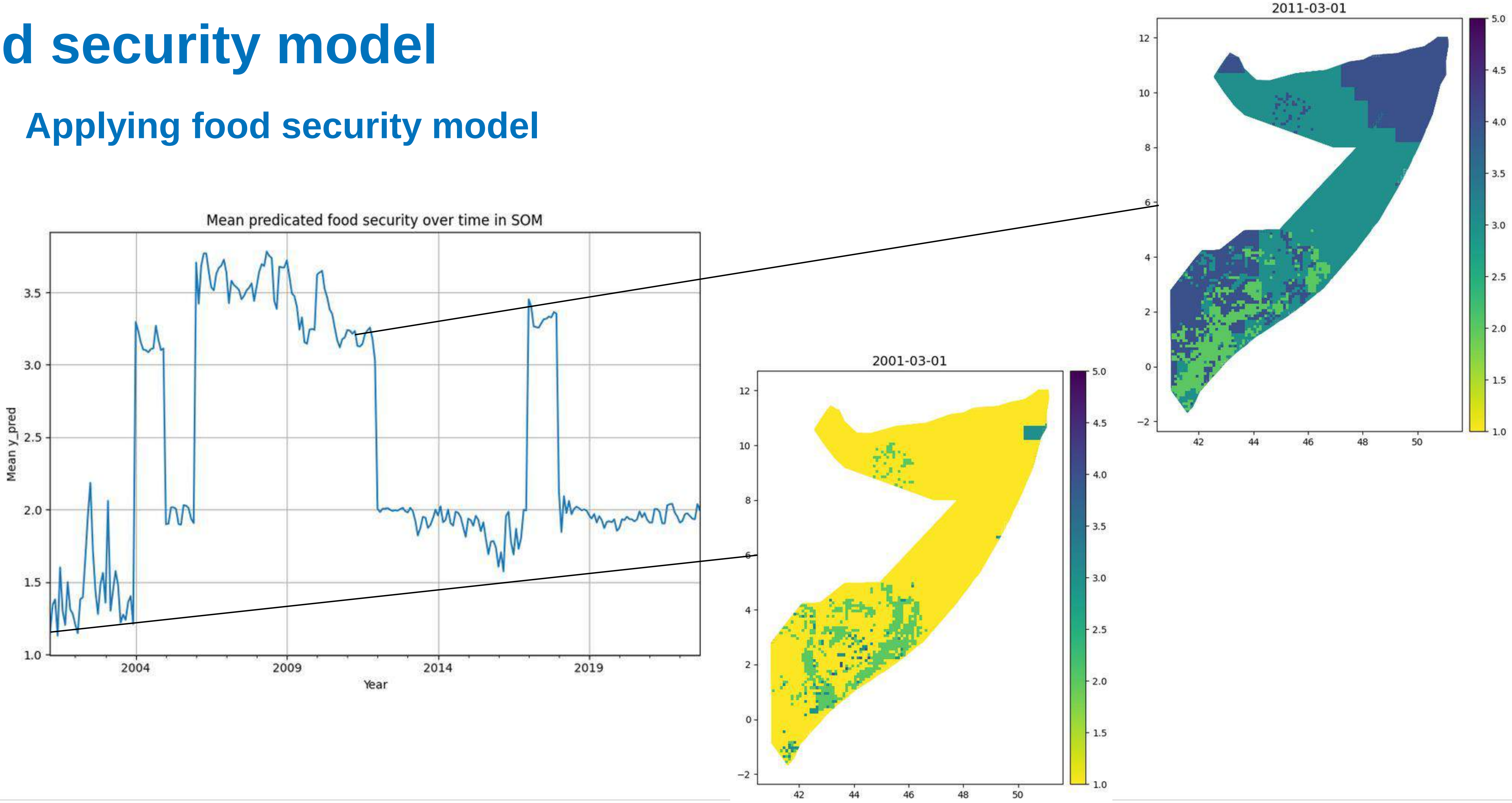
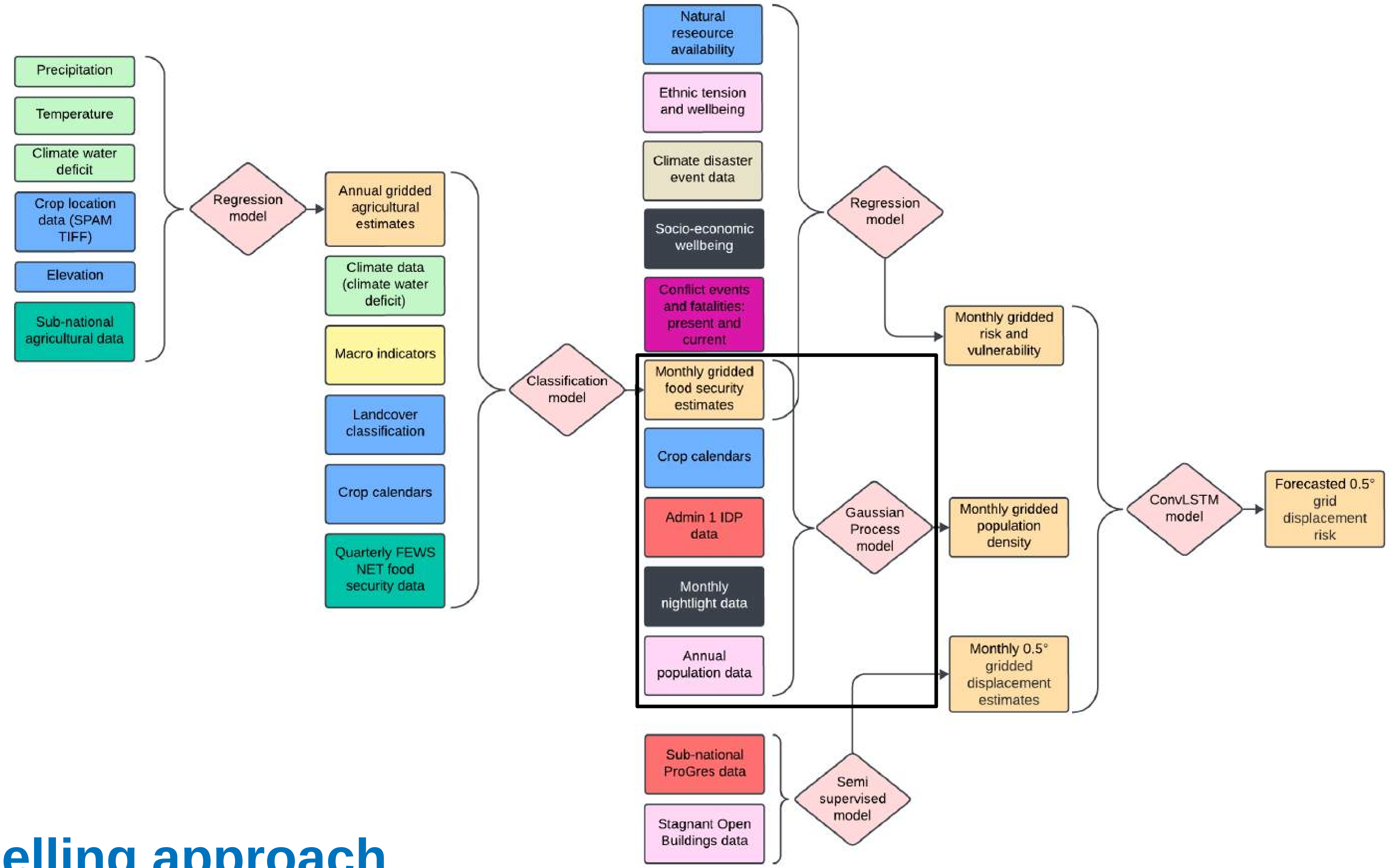
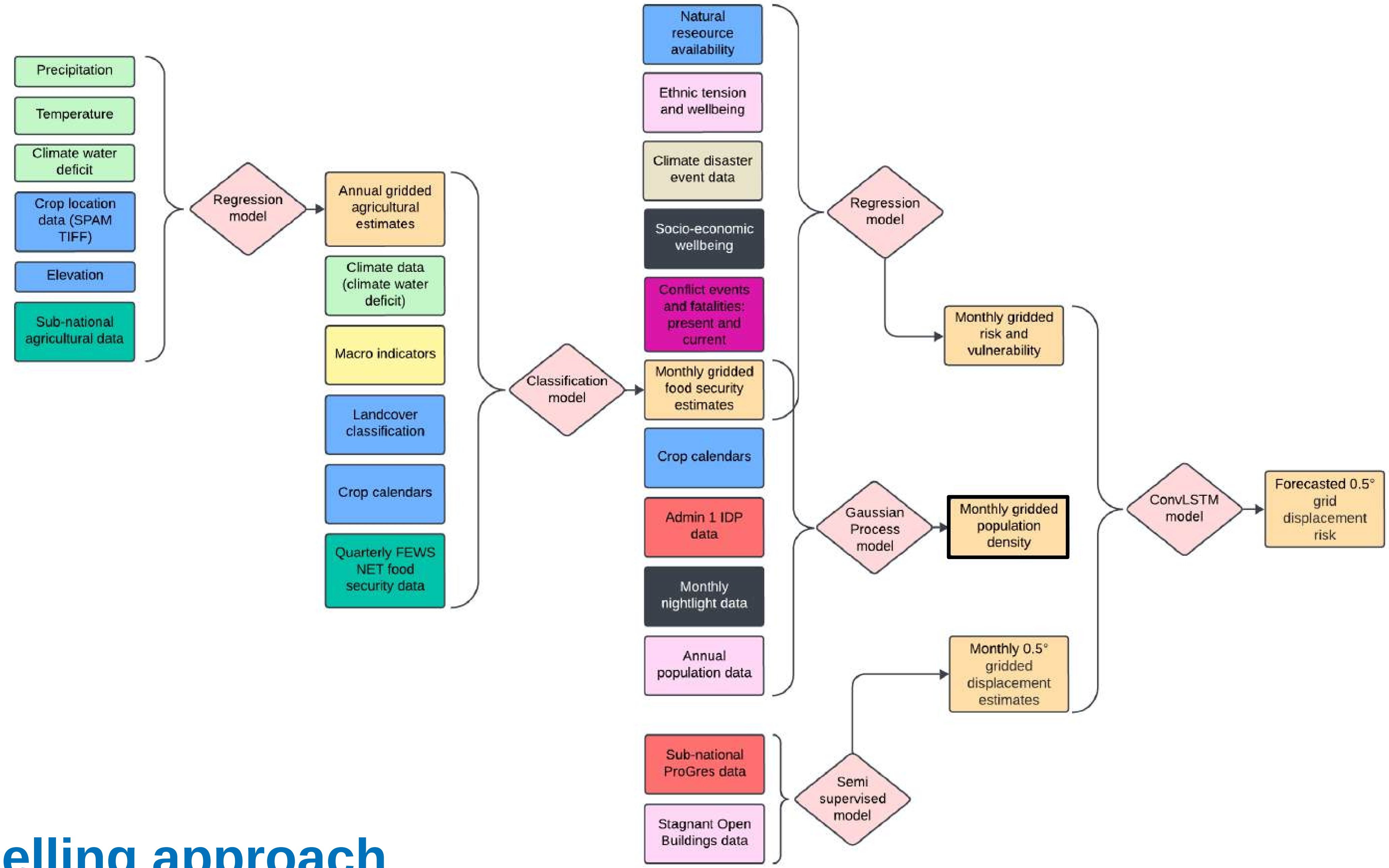


Population density model



Modelling approach

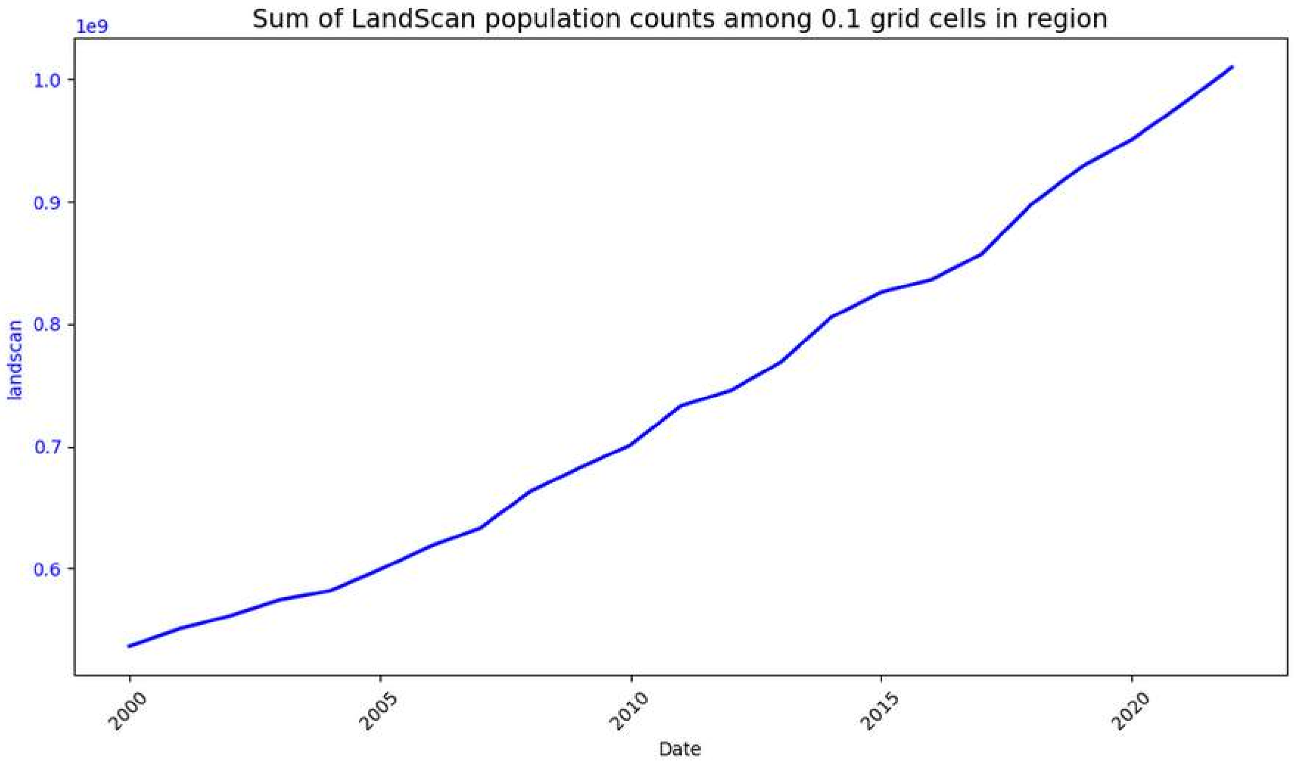


Modelling approach

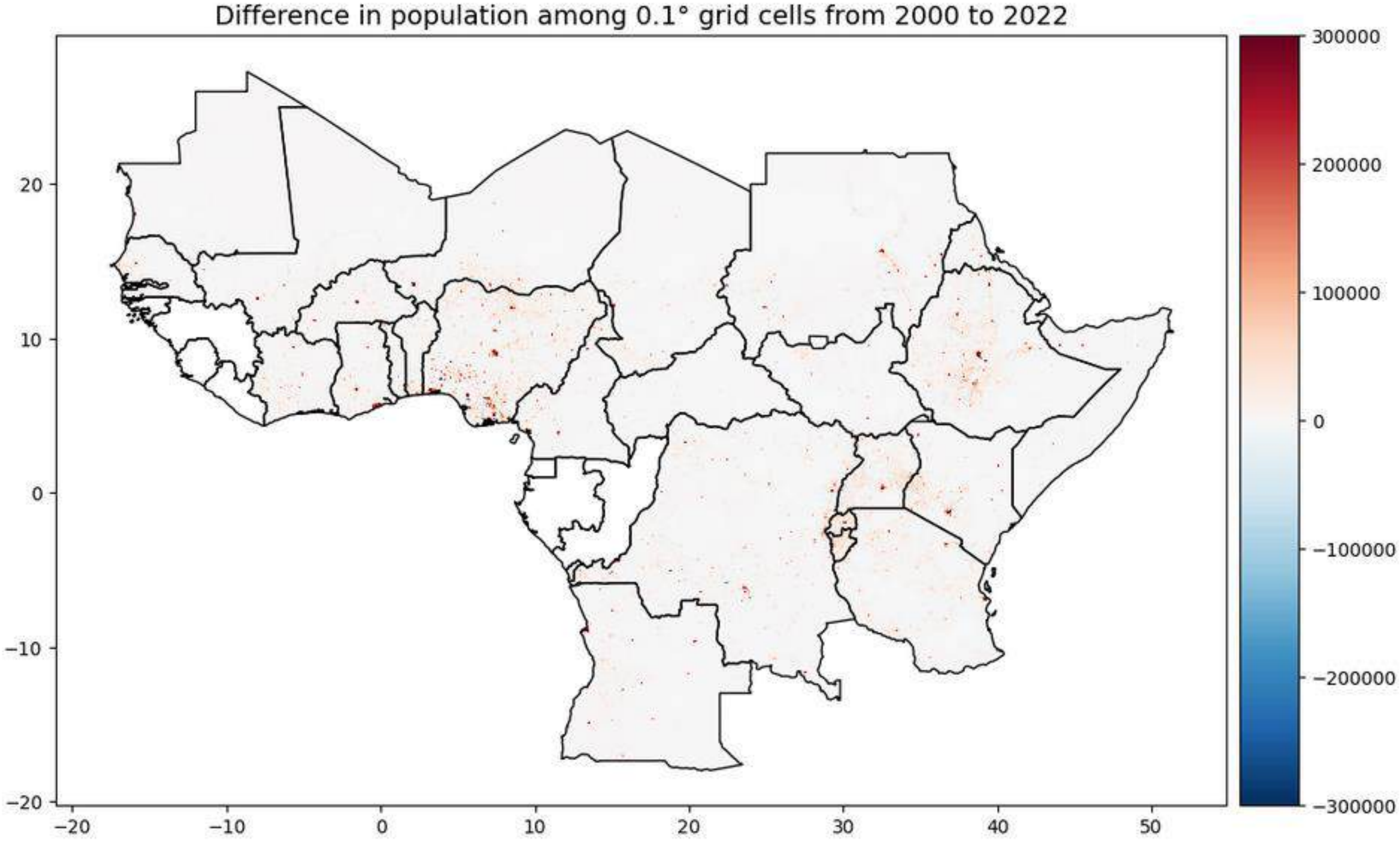
Population density model

Annual LandScan population data

- LandScan offers annual population estimates at ~ 1km resolution from 2000 – 2023.
- Challenge is to predict population in each of these grid cells at monthly timeframes.



Population density model



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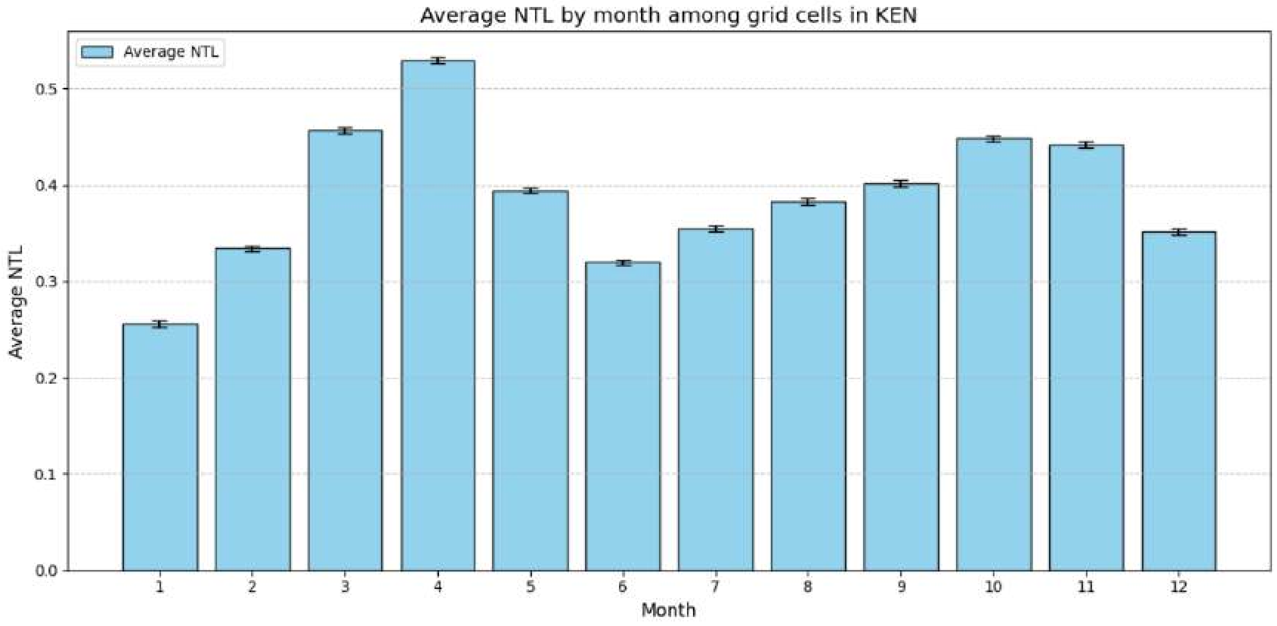
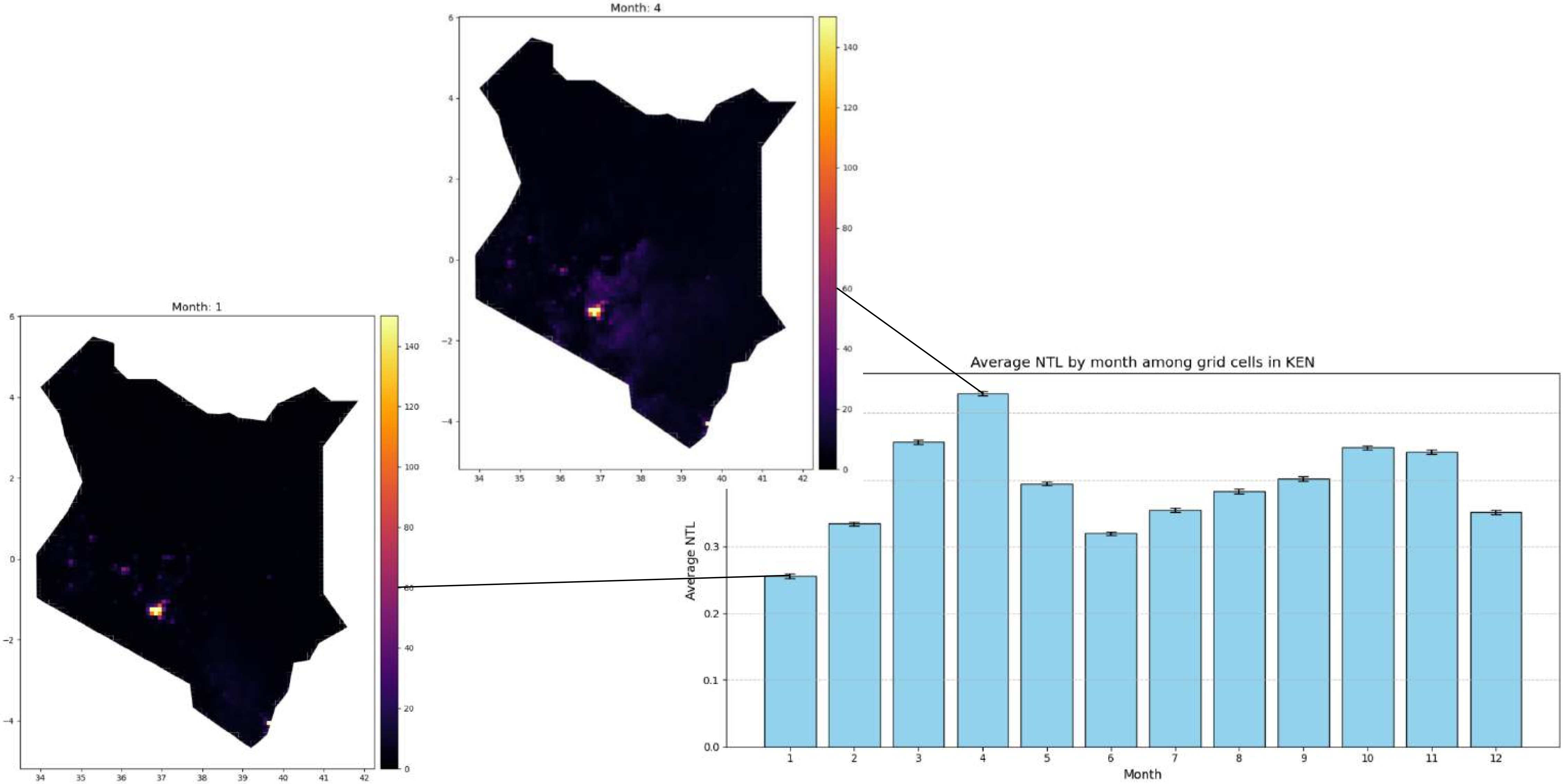
Population density model

Seasonal population trends

Monthly nightlight intensity

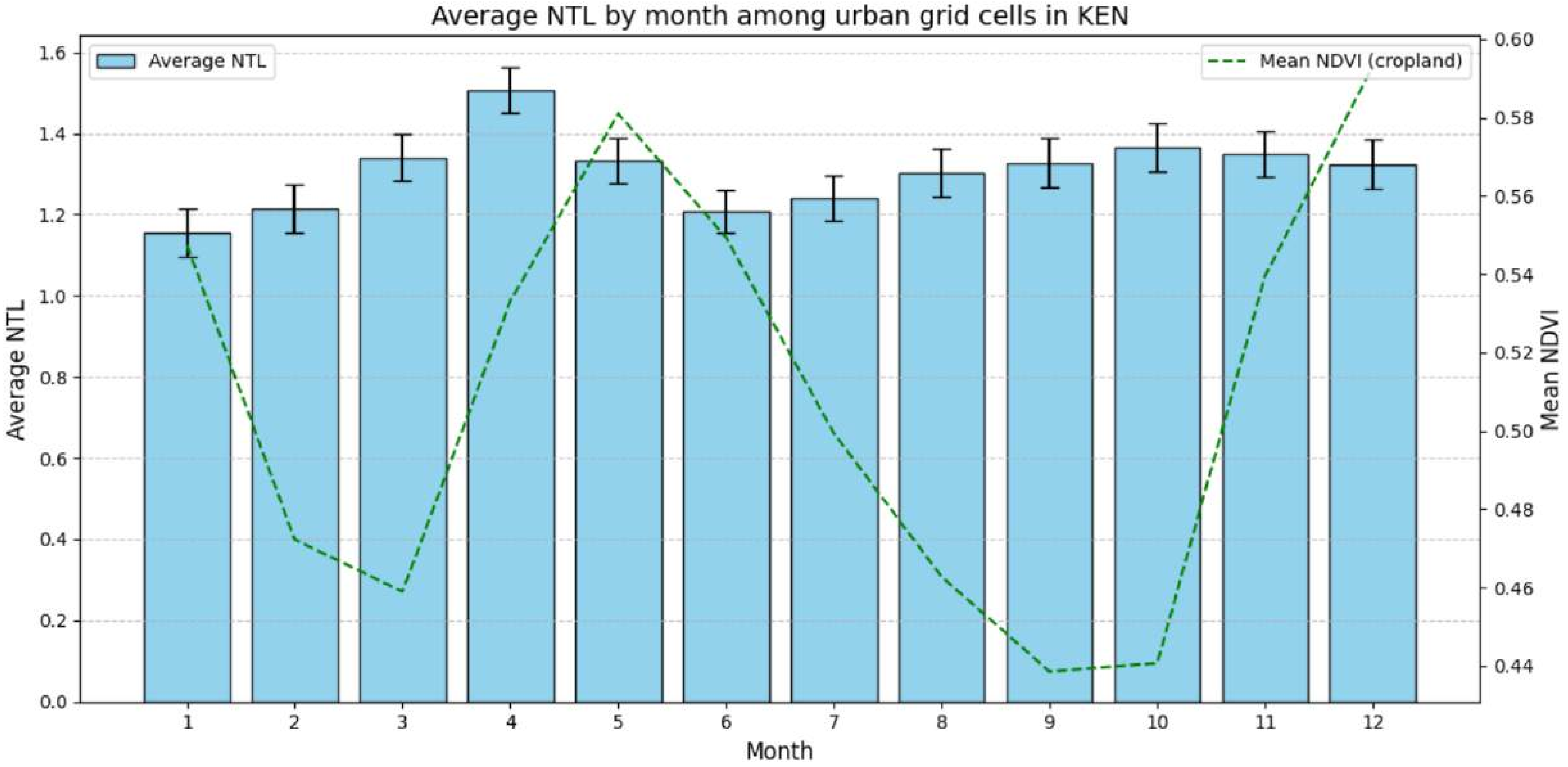
- Possibility of estimating seasonal variation in population density?
- VIIRS corrected nightlight intensity (NTL) monthly figures – gridded into 0.1° grid cells




Month: 4
Month: 1
Average NTL by month among grid cells in KEN
Average NTL
Month
0.0
0.1
0.2
0.3
1
2
3
4
5
6
7
8
9
10
11
12

Population density model

Seasonal population trends

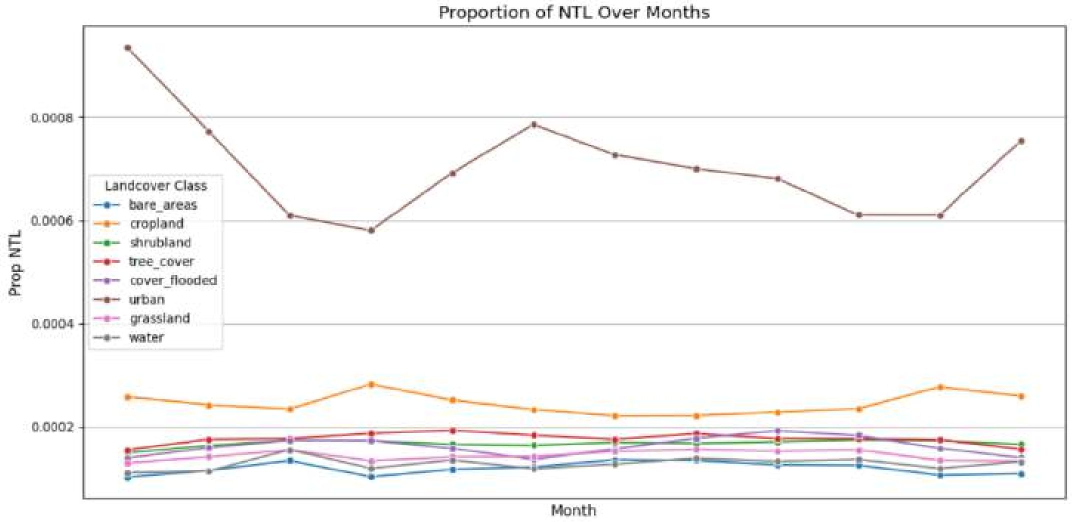


Population density model

Seasonal population trends

Monthly nightlight intensity

- VIIRS corrected nightlight intensity (NTL) monthly figures – gridded into 0.1° grid cells
- Find sum of NLT at each month for the whole country
- Divide NTL at each observation by sum NLT for whole country at that month to get proportion of nightlight in each grid cell in each month



Population density model

Gridded food security estimates

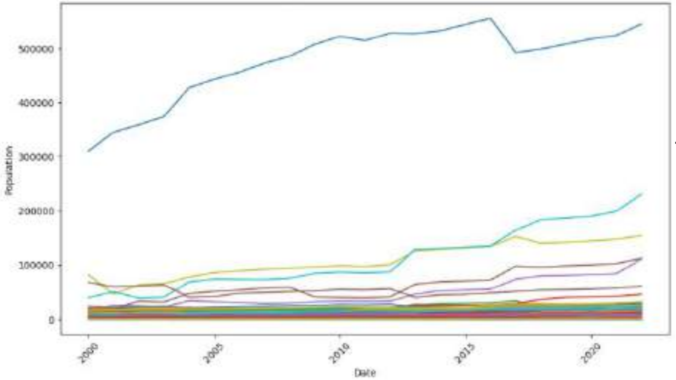
Crop calendars

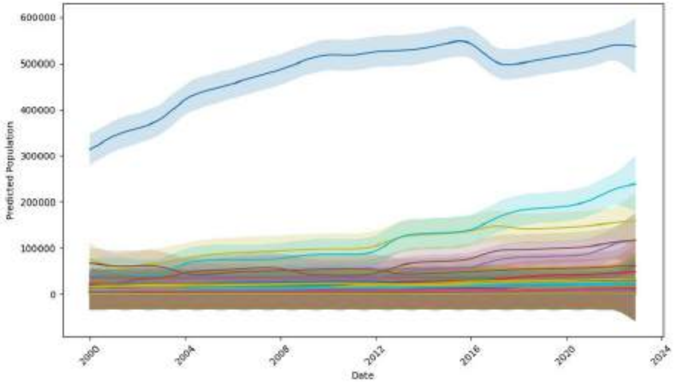
Admin 1 IDP data

Monthly nightlight data

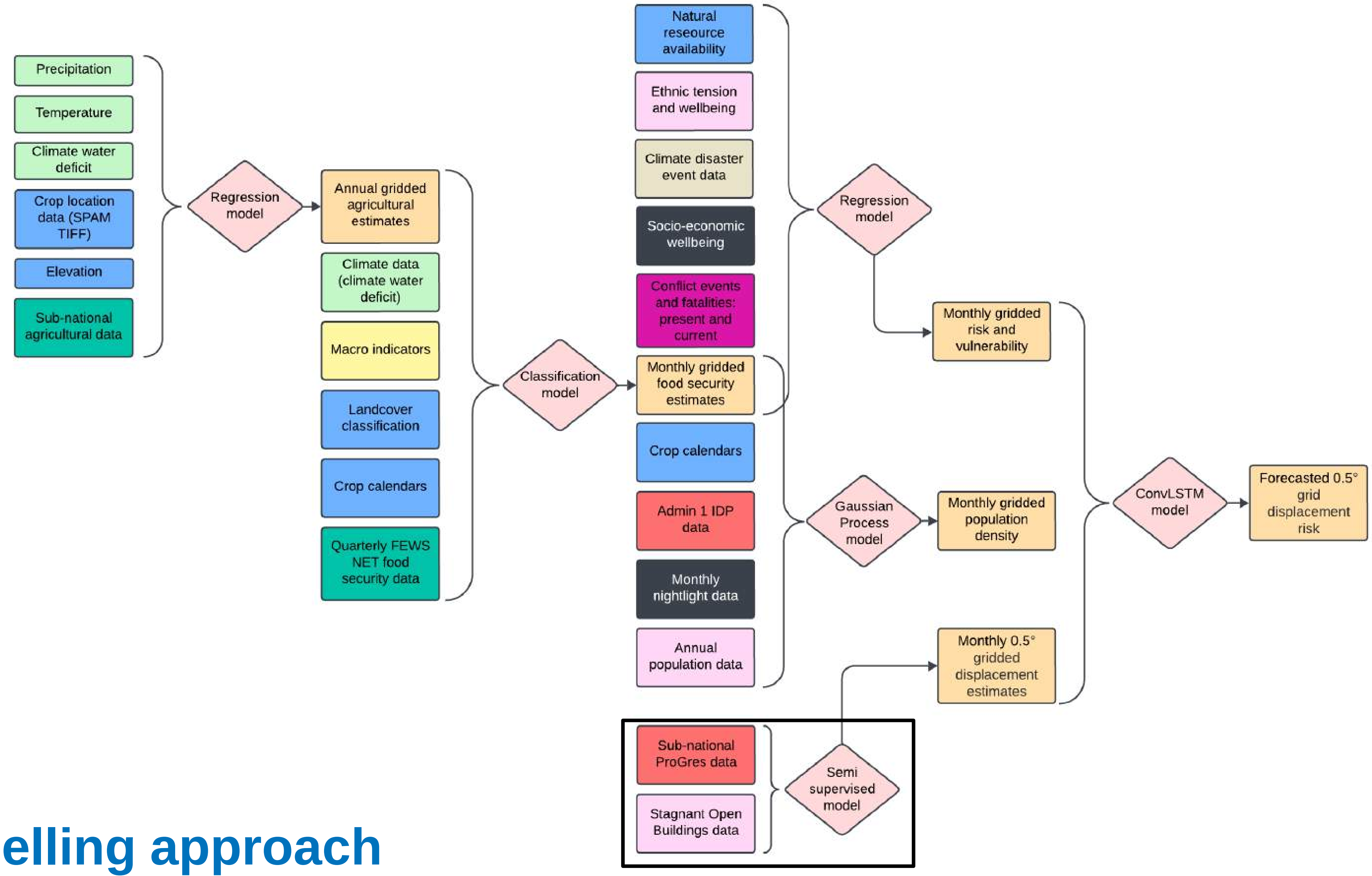
Annual population data

Monthly gridded population estimates

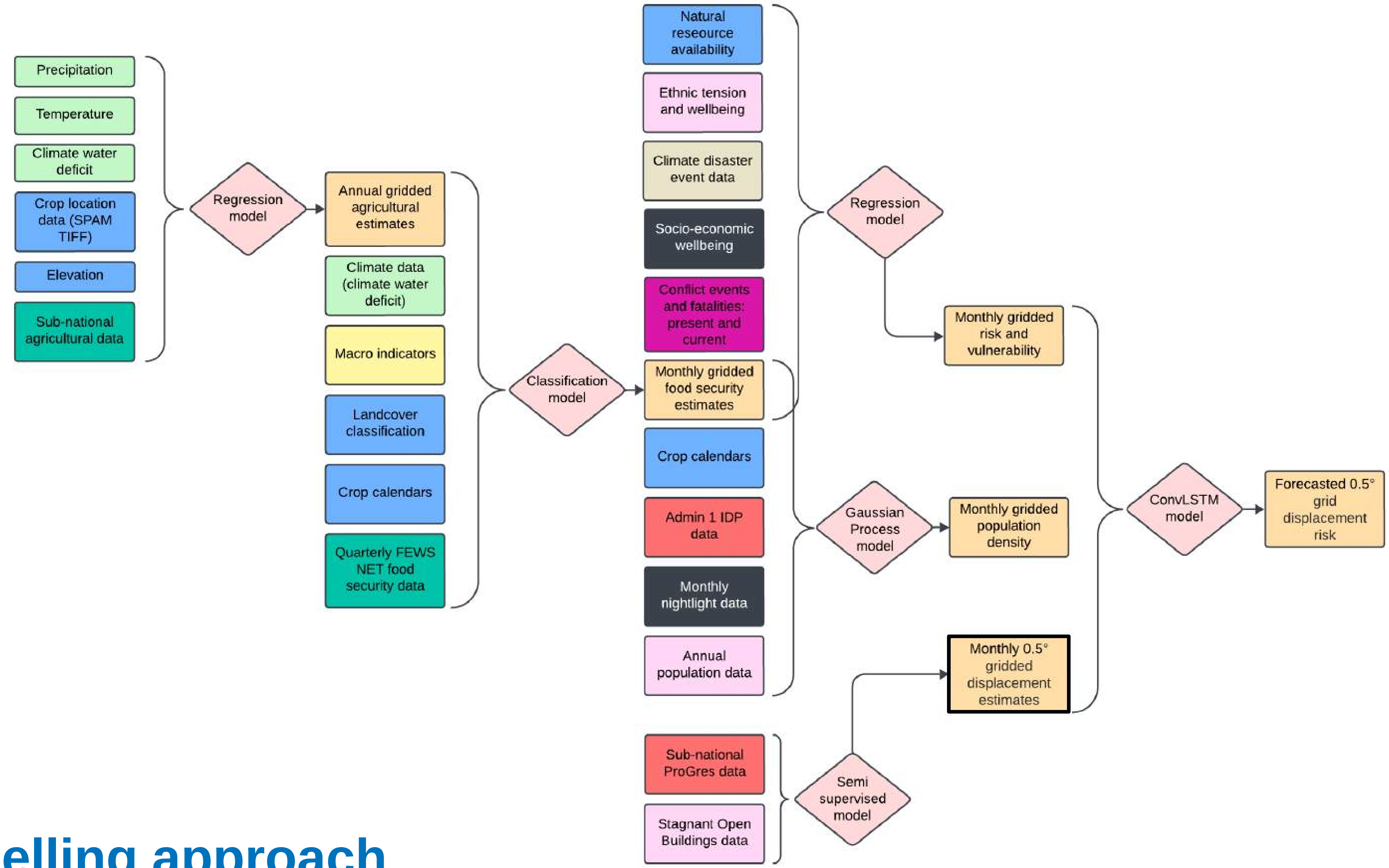




ProGres gridding model



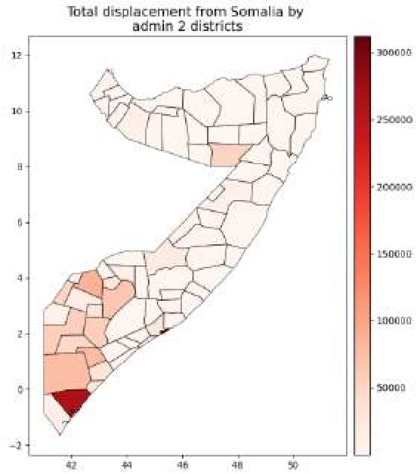
Modelling approach



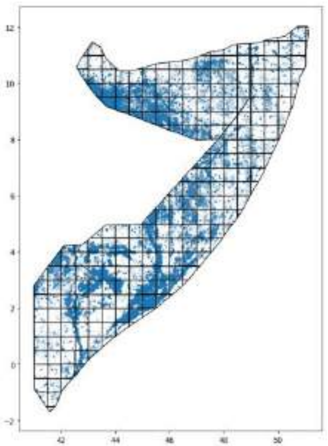
Modelling approach

Gridding ProGres Displacement

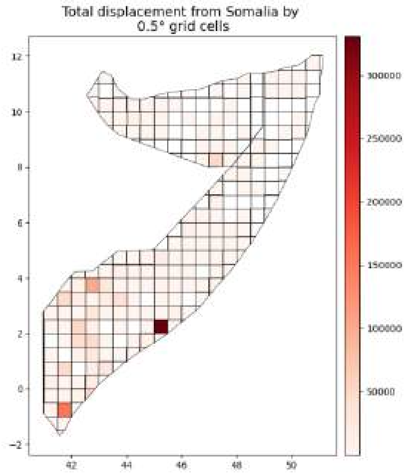
- Success of the CLIFDEW project will hinge on UNHCR’s ProGres data and especially placing observations within grid-cells
- Need a method for placing observations into grid cells based on known subnational locations in data
- Predict grid-cell locations for observations using building prior key and other variables



ProGres data

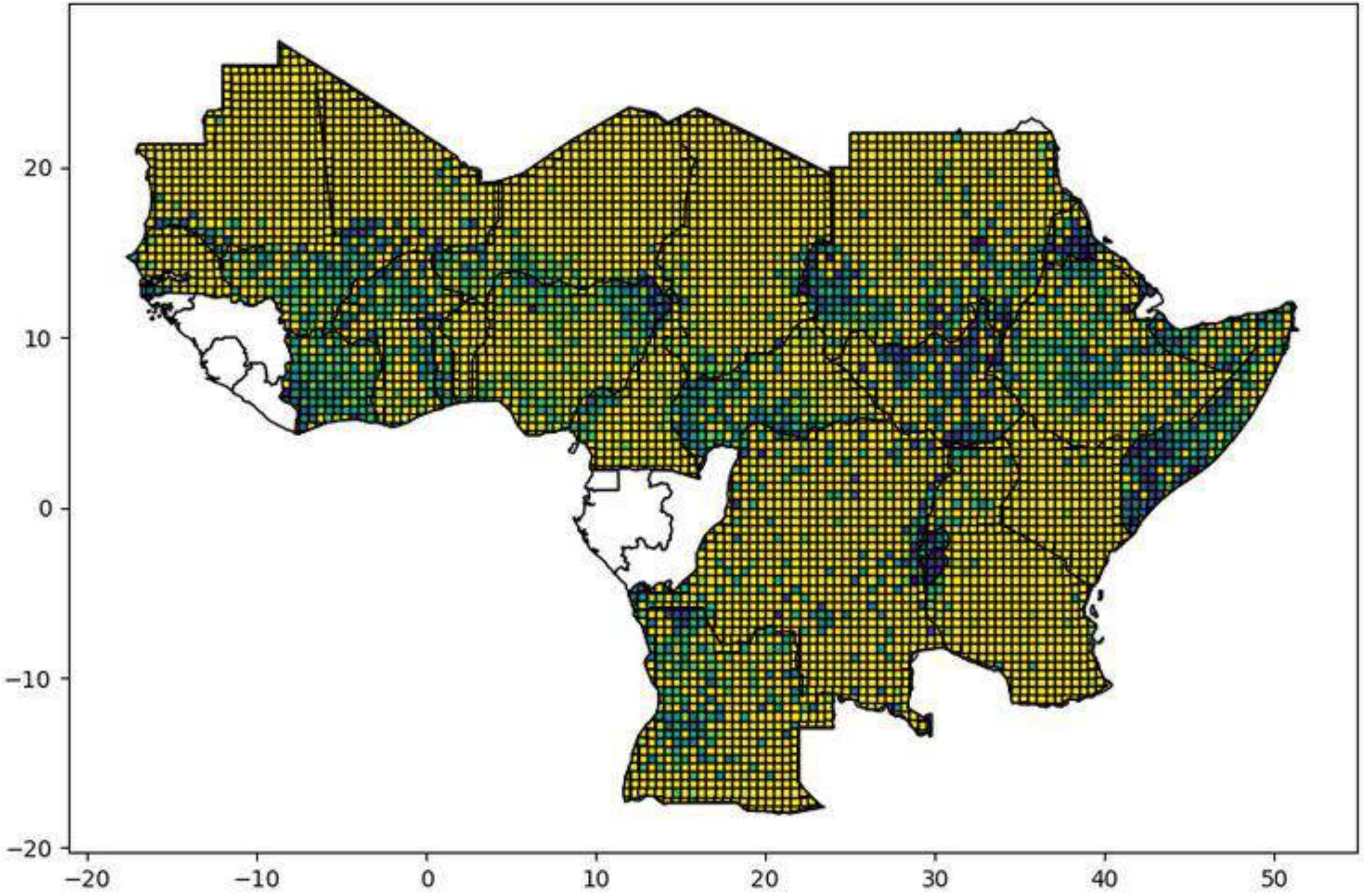


Population distribution



Predicted grid cell displacement

Gridding ProGres Displacement



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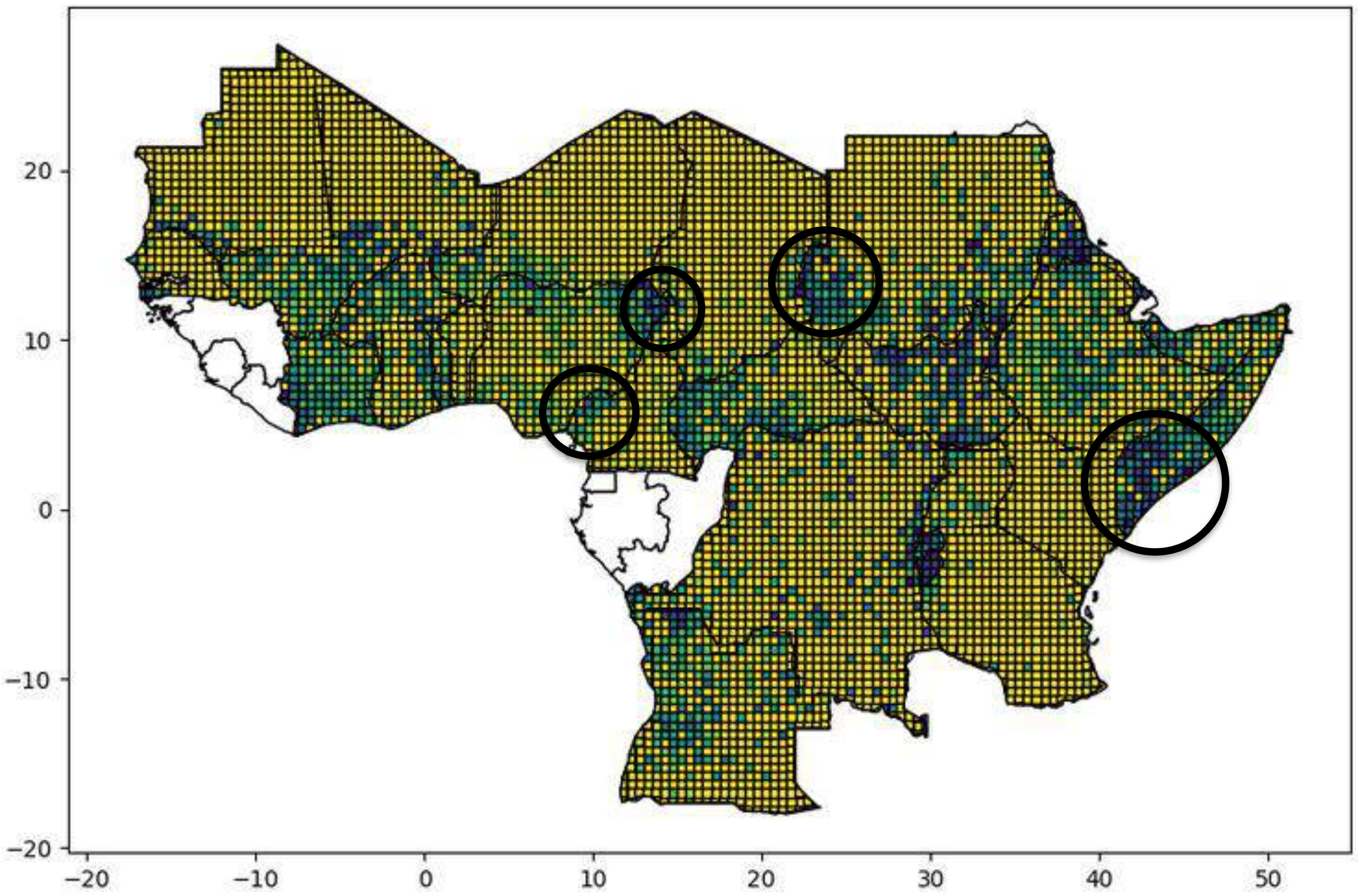
Gridding ProGres Displacement



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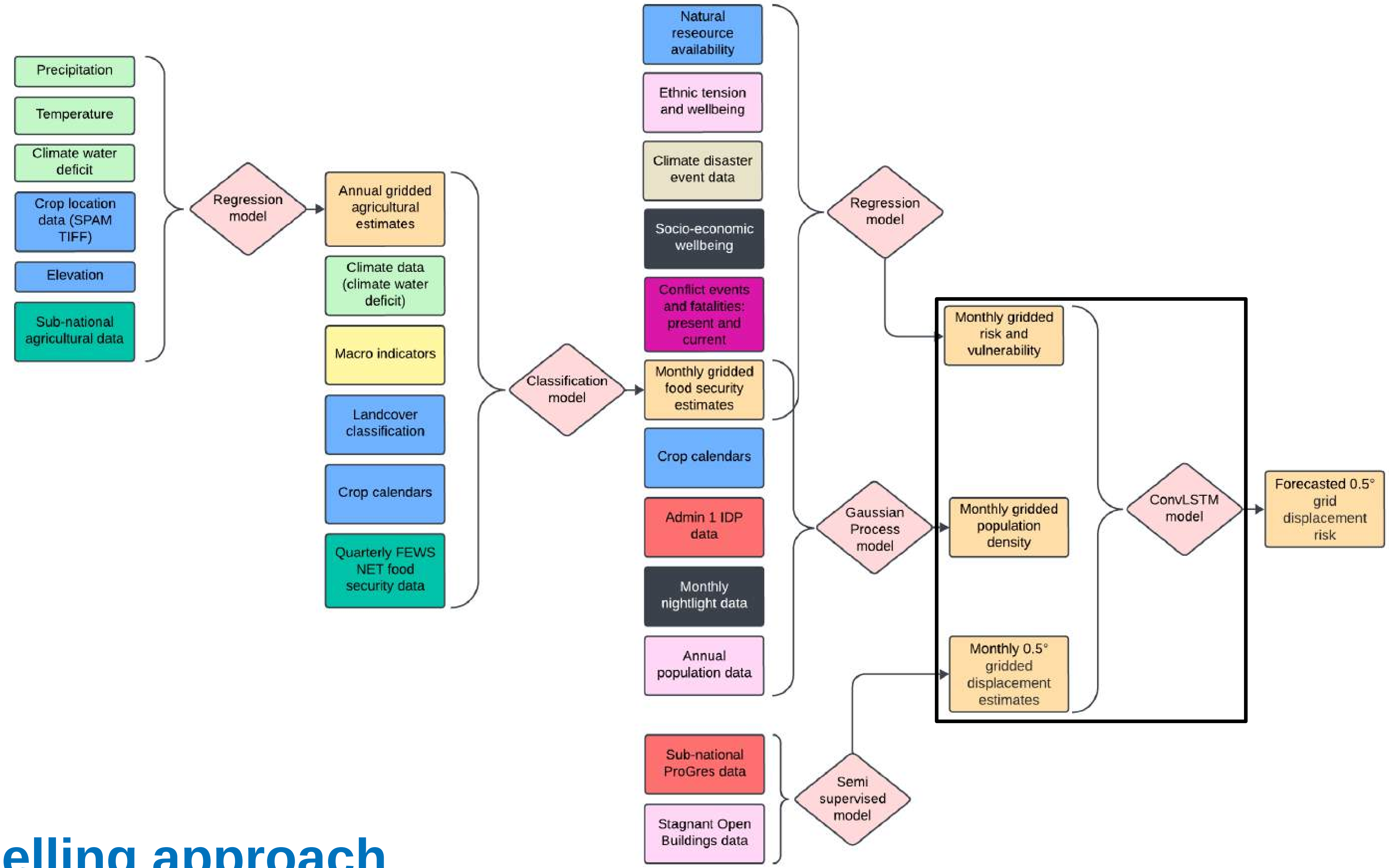
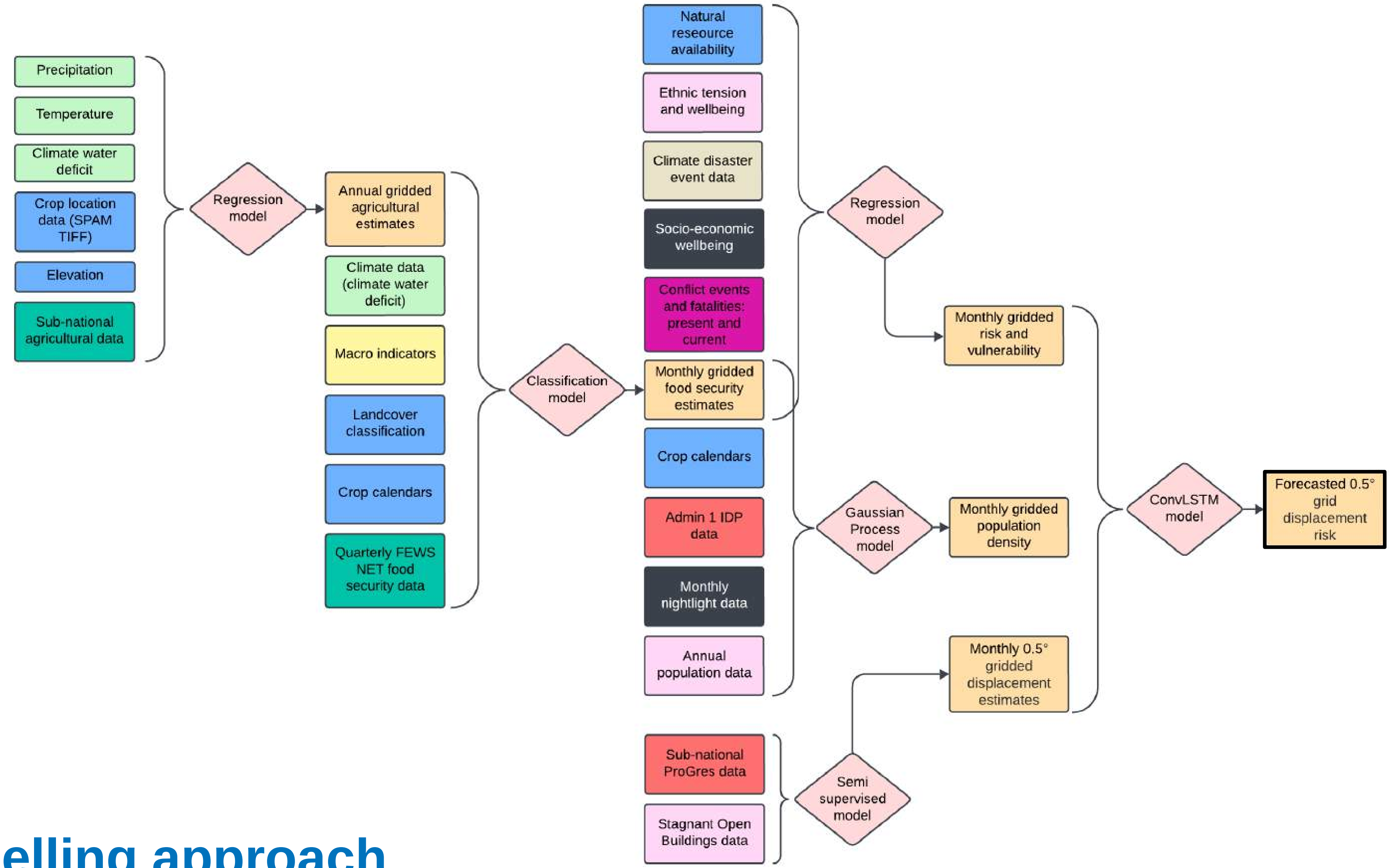
Displacement risk

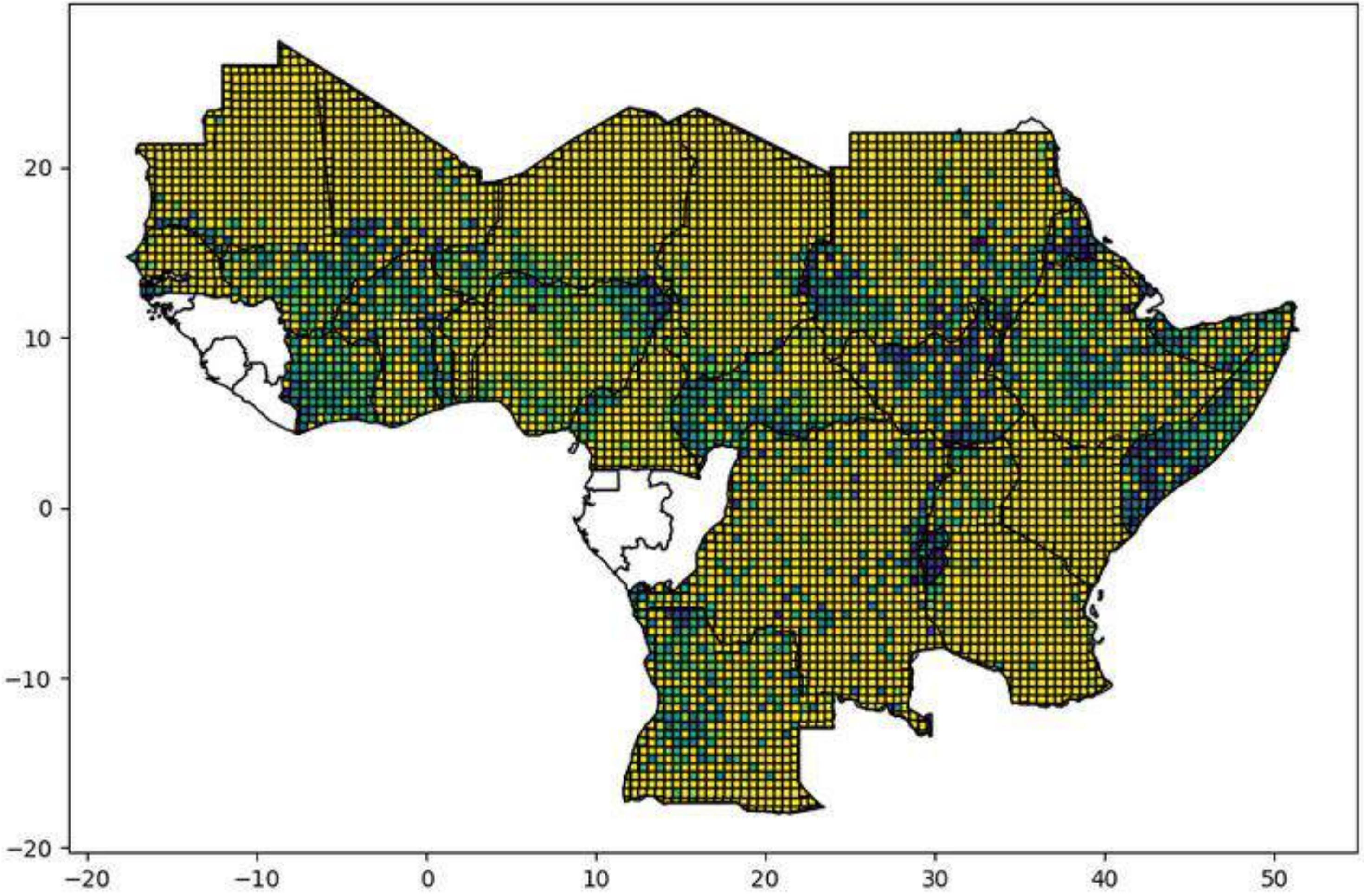


Modelling approach

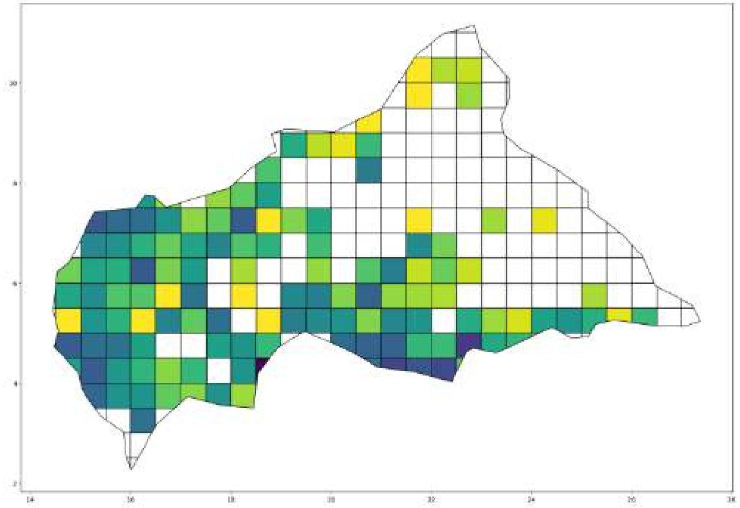


Modelling approach

Gridding ProGres Displacement

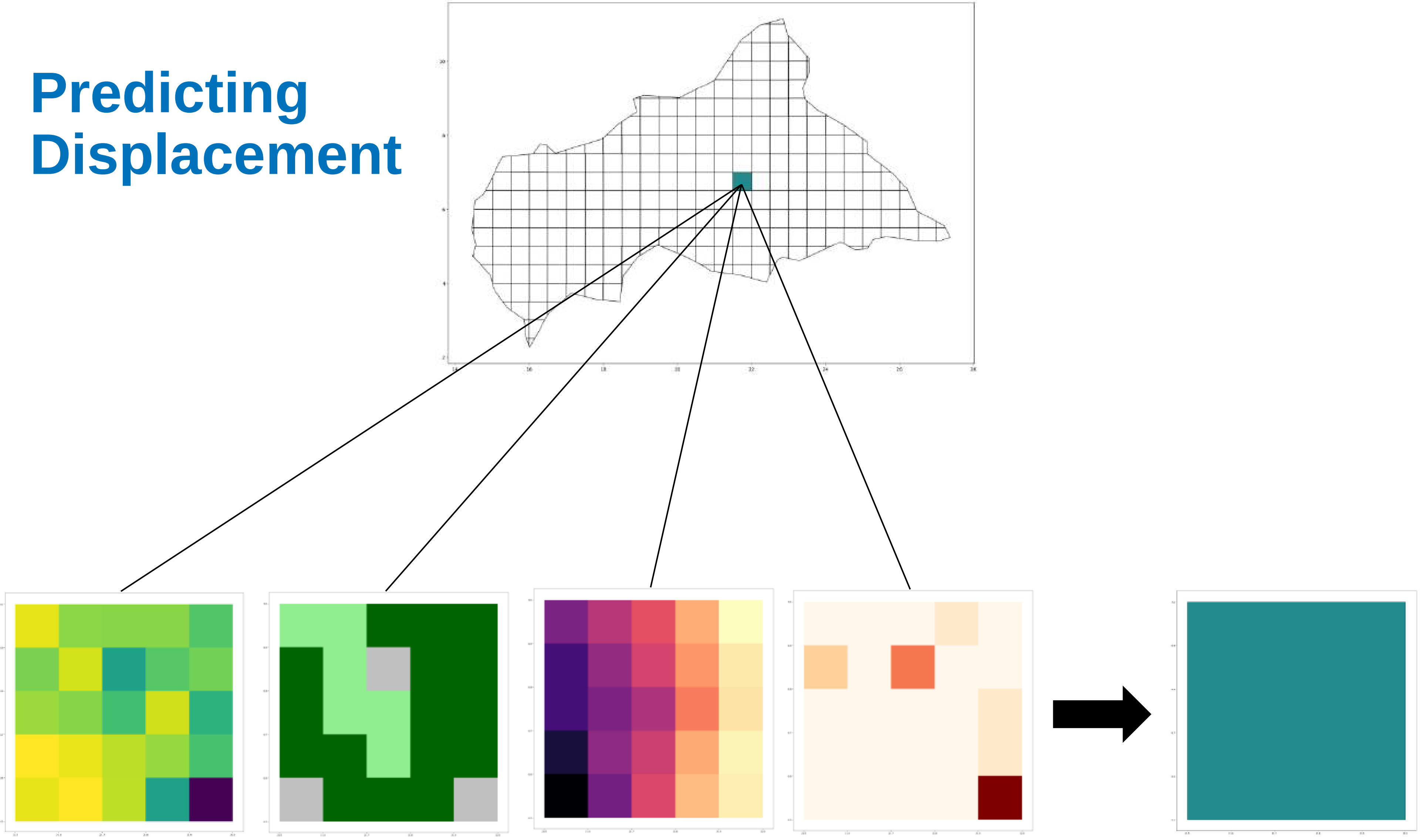


Predicting Displacement



- Our goal is to predict the risk of displacement for each 0.5° grid cell over the next 6 months
- By gridding the displacement data, we have monthly data for the displacement from each grid cell
- These displacement figures can be aggregated to find the level of displacement over the next 6 months
- The map above shows a gridded map of the Central African Republic, colored for hypothetical 6-month displacement levels by grid cell

Predicting Displacement



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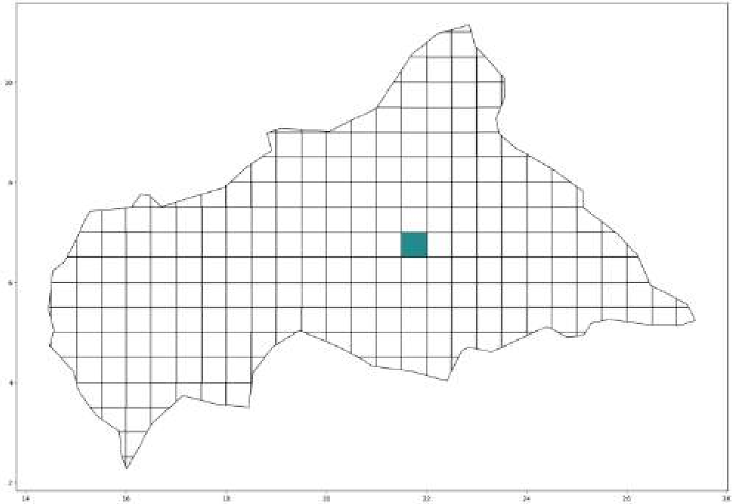
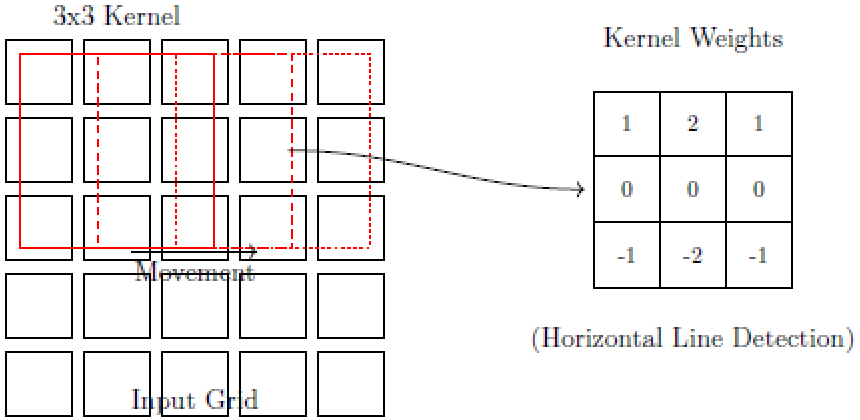
Predicting Displacement





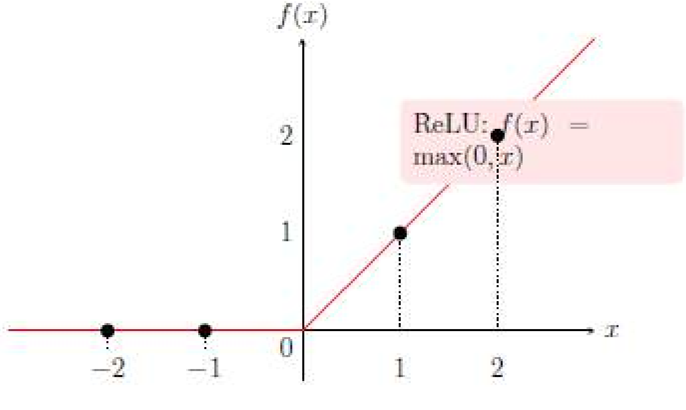
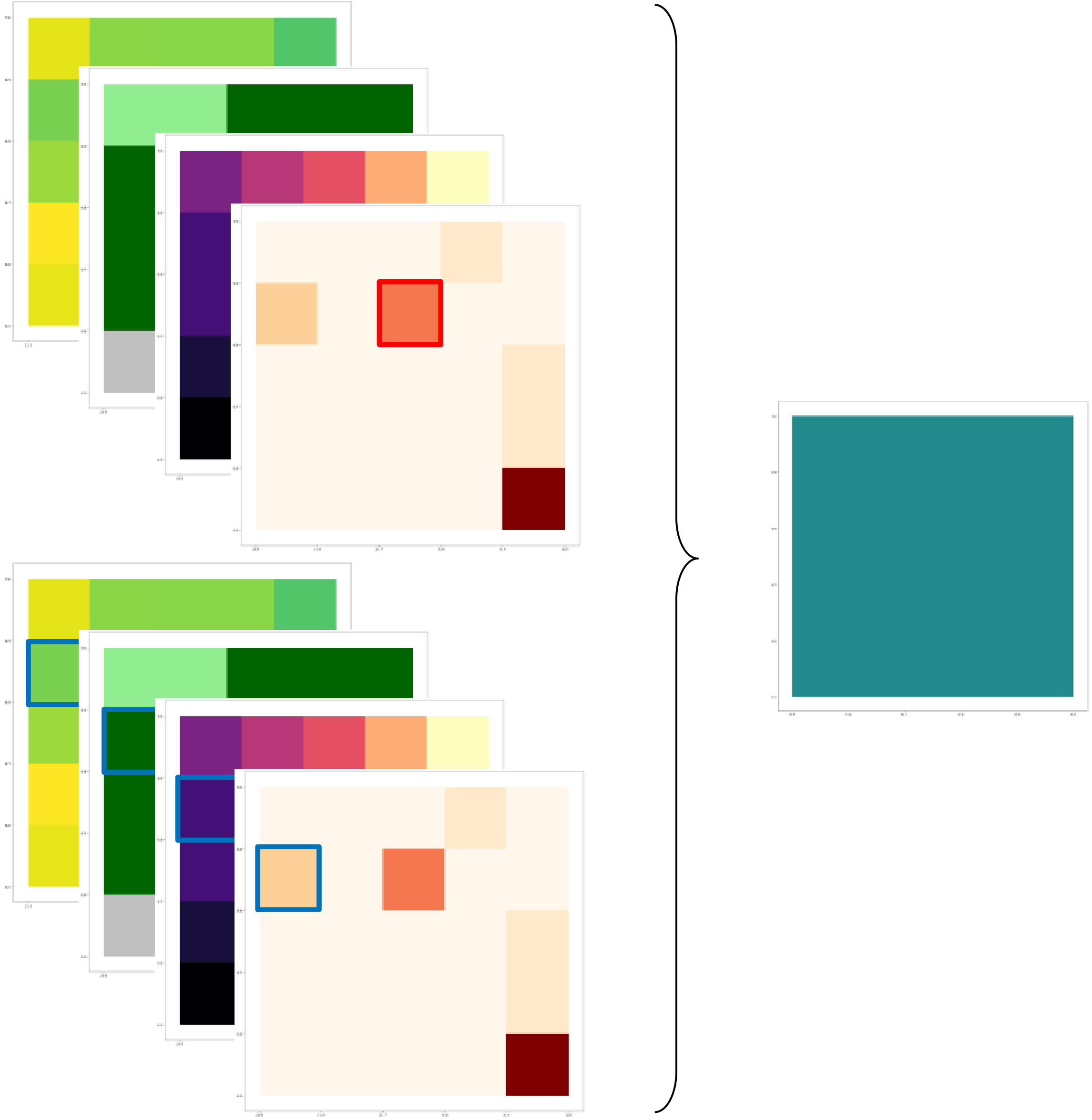


Figure 3: ReLU activation function

Predicting Displacement



Comments and questions

Comments and questions

- How does the overall model structure of the project look?
- We only have slow onset climate change conditions interacting with the model as a function of crop yields and food security. But are there other ways that we can link climate conditions?
  - How could we incorporate pastoralist and livestock data?
  - Where to get data on sea-level rise?
- How could we incorporate climate induced migration into model?
- How could we incorporate IDPs?
  - Where to get monthly, geo-precise IDP data?
- How could we set up the risk and vulnerability index? What should the target variable be?
- How do we separate out 4 groups of in a climate vulnerable area:
  - those with the resources to adapt by staying;
  - those with the resources to adapt by migrating;
  - those lacking resources to adapt, but having resources to flee;
  - those without the resources to adapt or flee
- How could this model be operationalized and used for predicting forced displacement flows?

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Merci !

Conflict

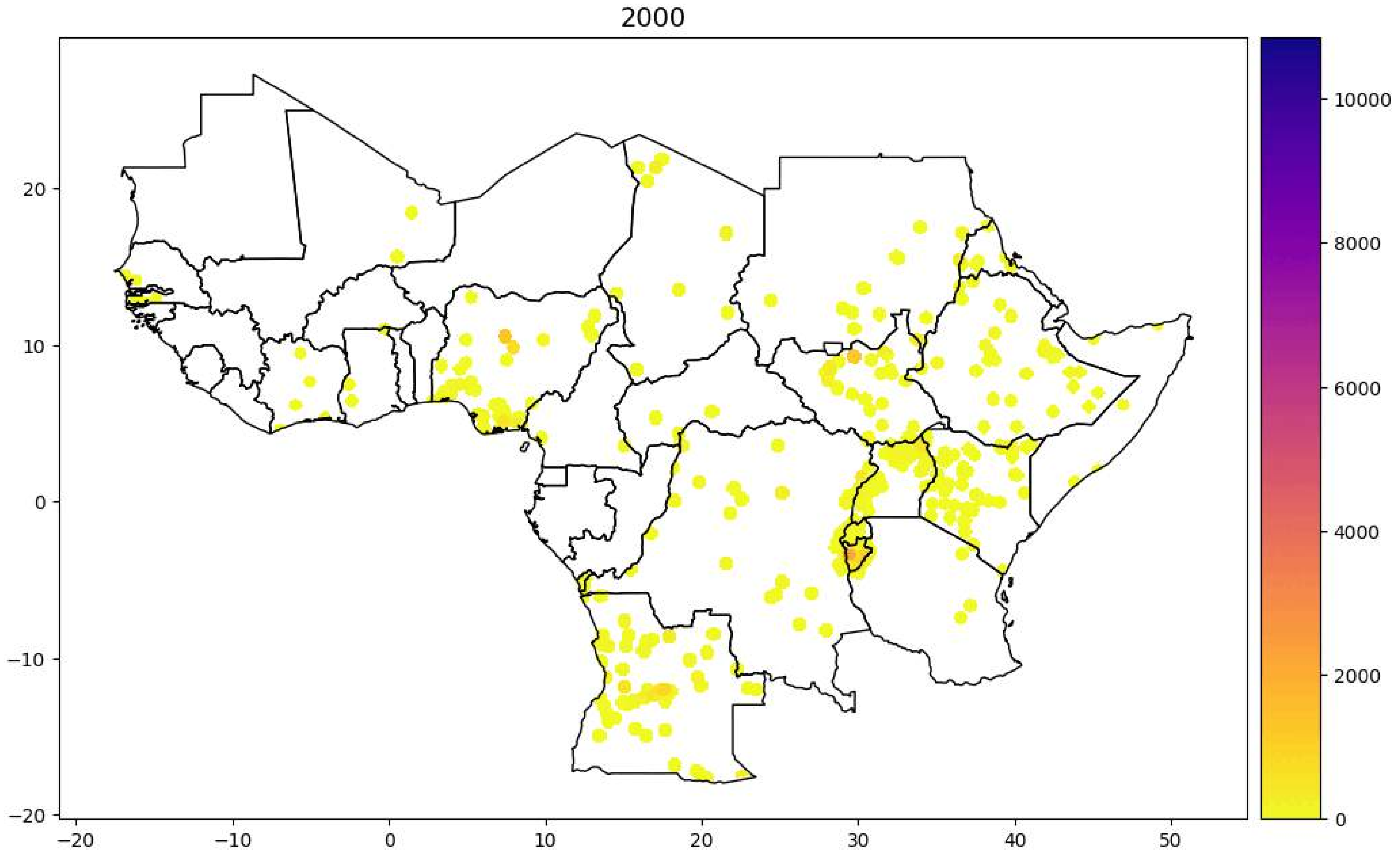
Conflict variables

- ACLED conflict events and fatality figures placed inside 0.1° grid cells. Monthly sum of events and fatalities calculated.
  - events, fatalities
- Found sum of events and fatalities occurring each month within 50 km radius of each grid cell.
  - events in 50 km vicinity, fatalities in 50 km vicinity
- Found sum of conflict events and fatalities over previous 6 and 12 months for each grid cell and within 50 km of each grid cell.
  - events previous 6 months, events previous 12 months
  - fatalities previous 6 months, fatalities previous 12 months
  - events previous 6 months in 50 km vicinity, events previous 12 months in 50 km vicinity
  - fatalities previous 6 months in 50 km vicinity, fatalities previous 12 months in 50 km vicinity

Conflict variables

Fatalities in 50 km vicinity

Fatalities within 50 km vicinity annual sums

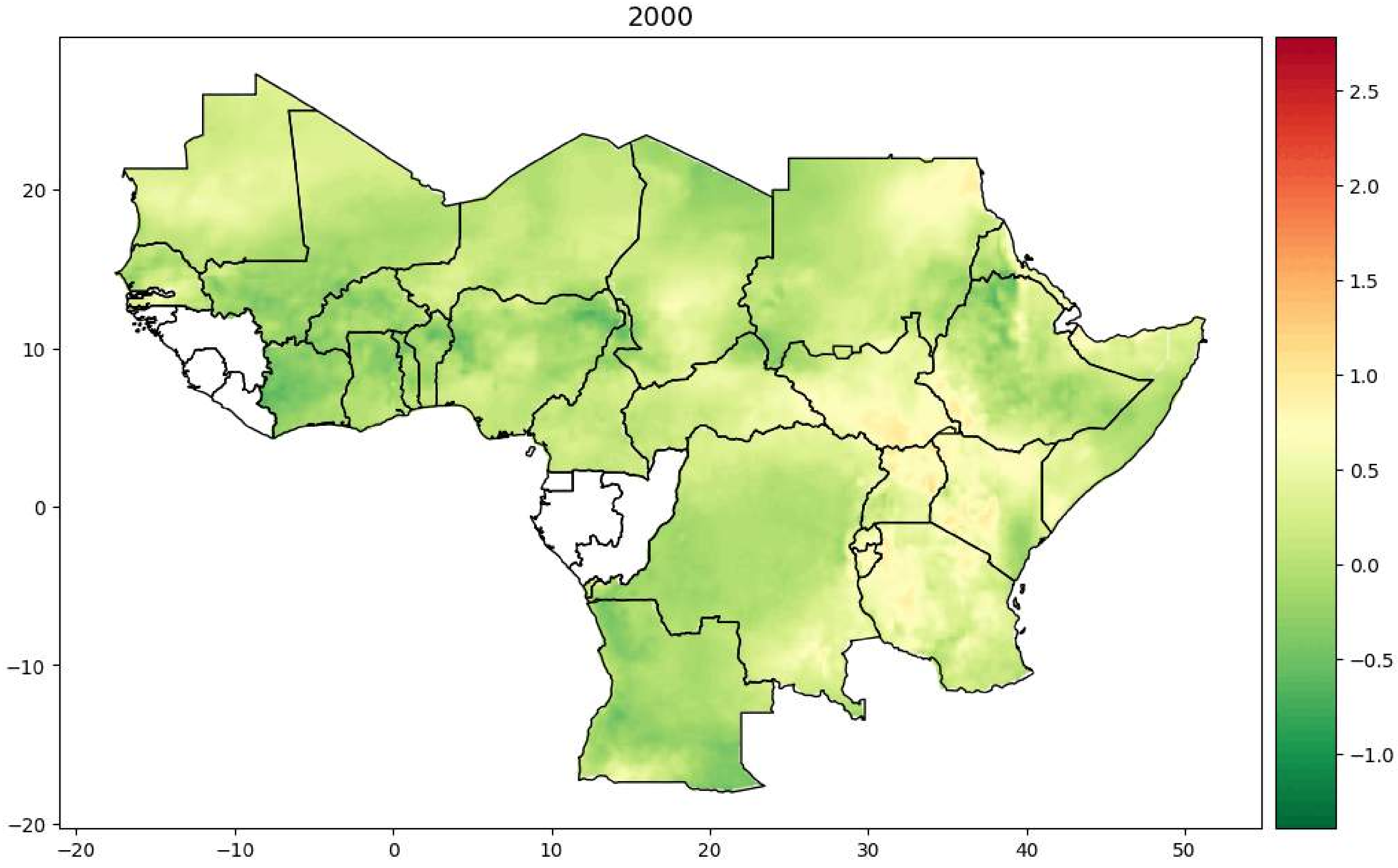


Gridding Displacement

Climate variables

Temperature

Temperature difference annual averages



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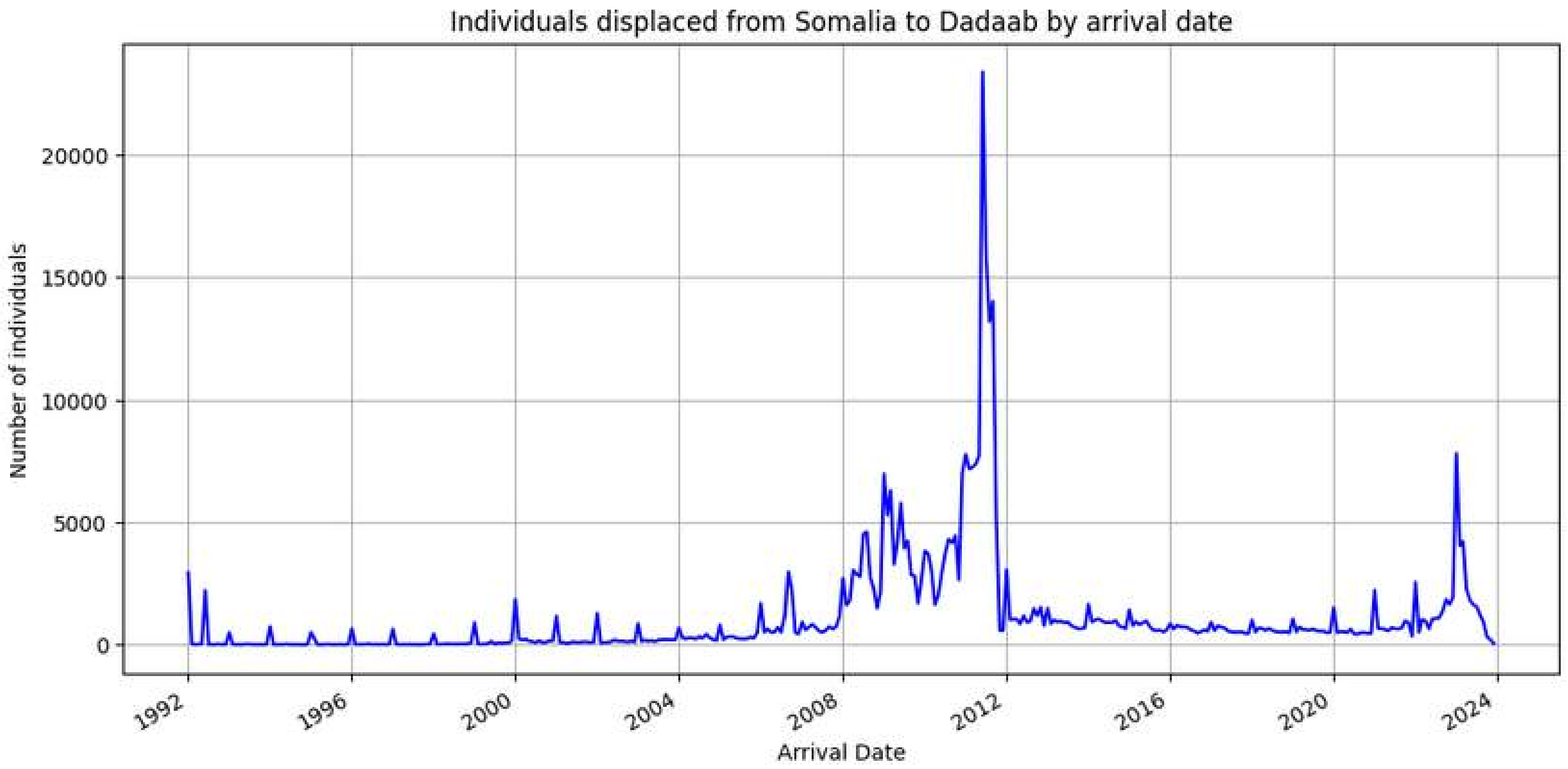
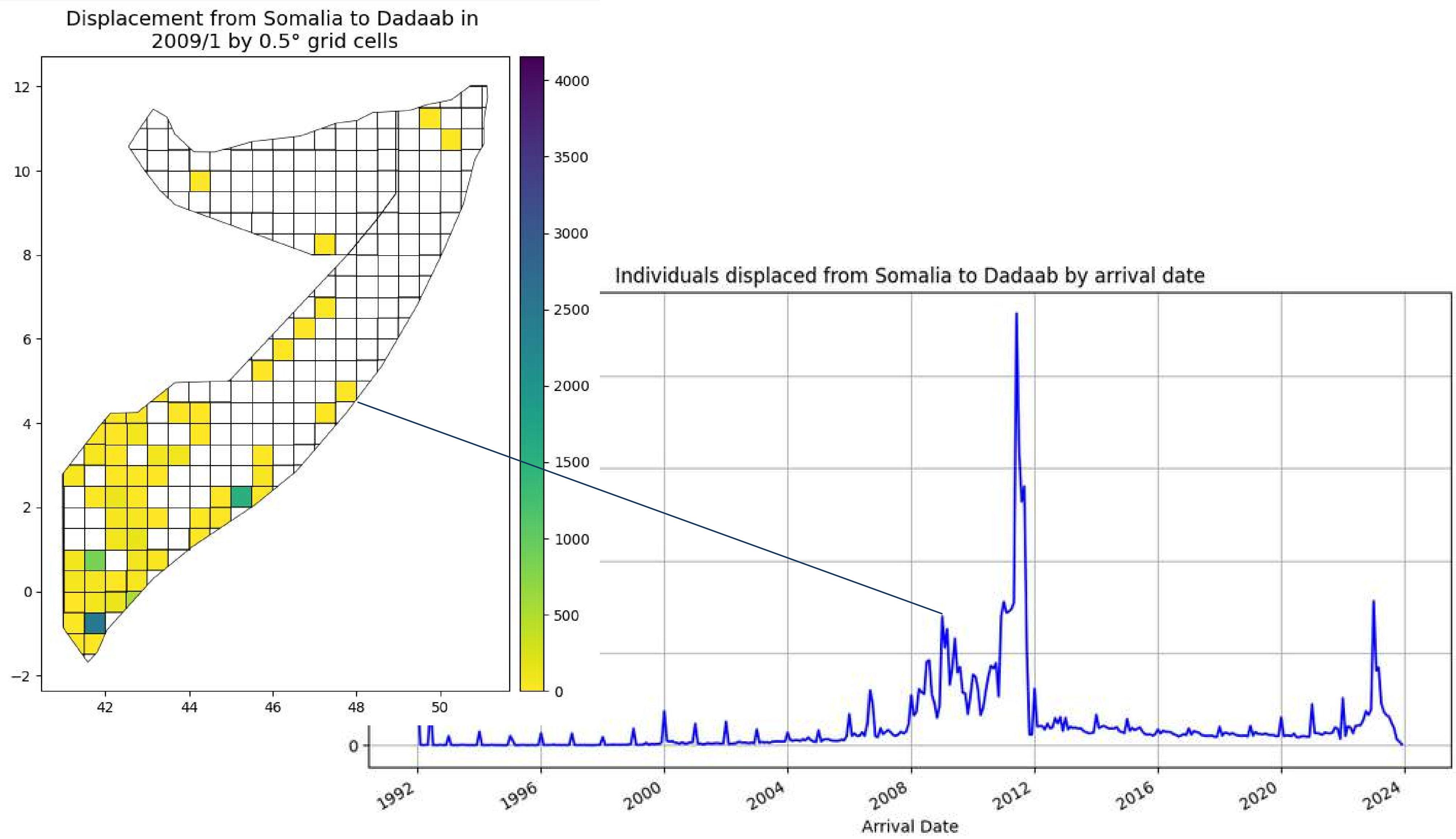
Gridding ProGres Displacement

Displacement to Dadaab





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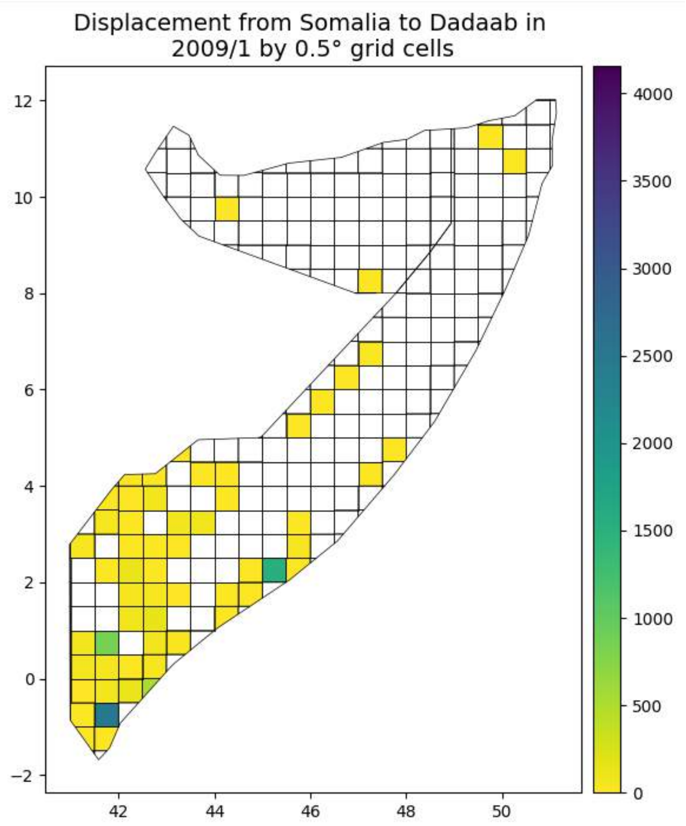
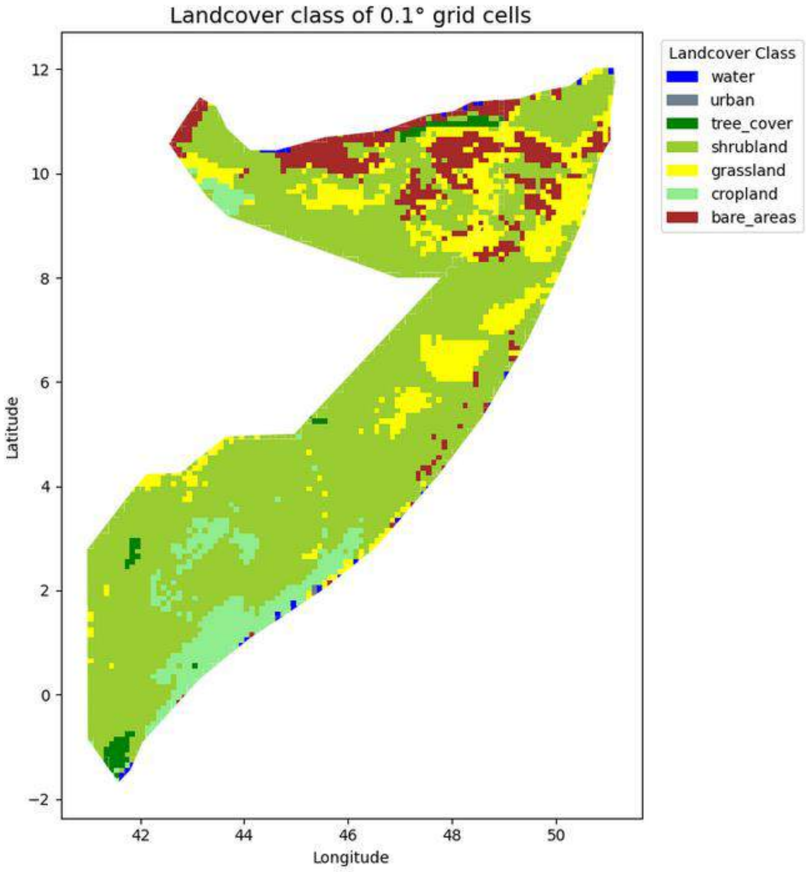
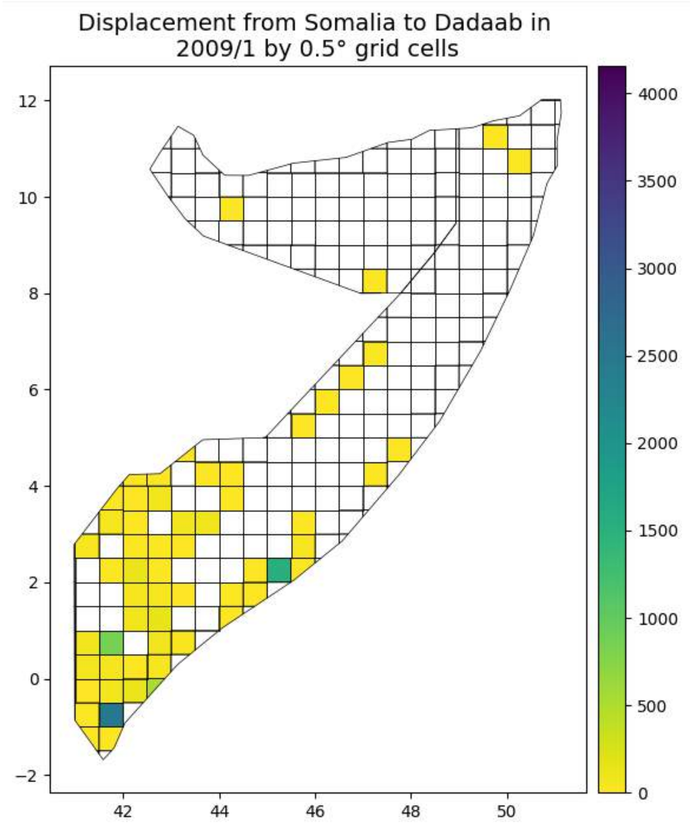
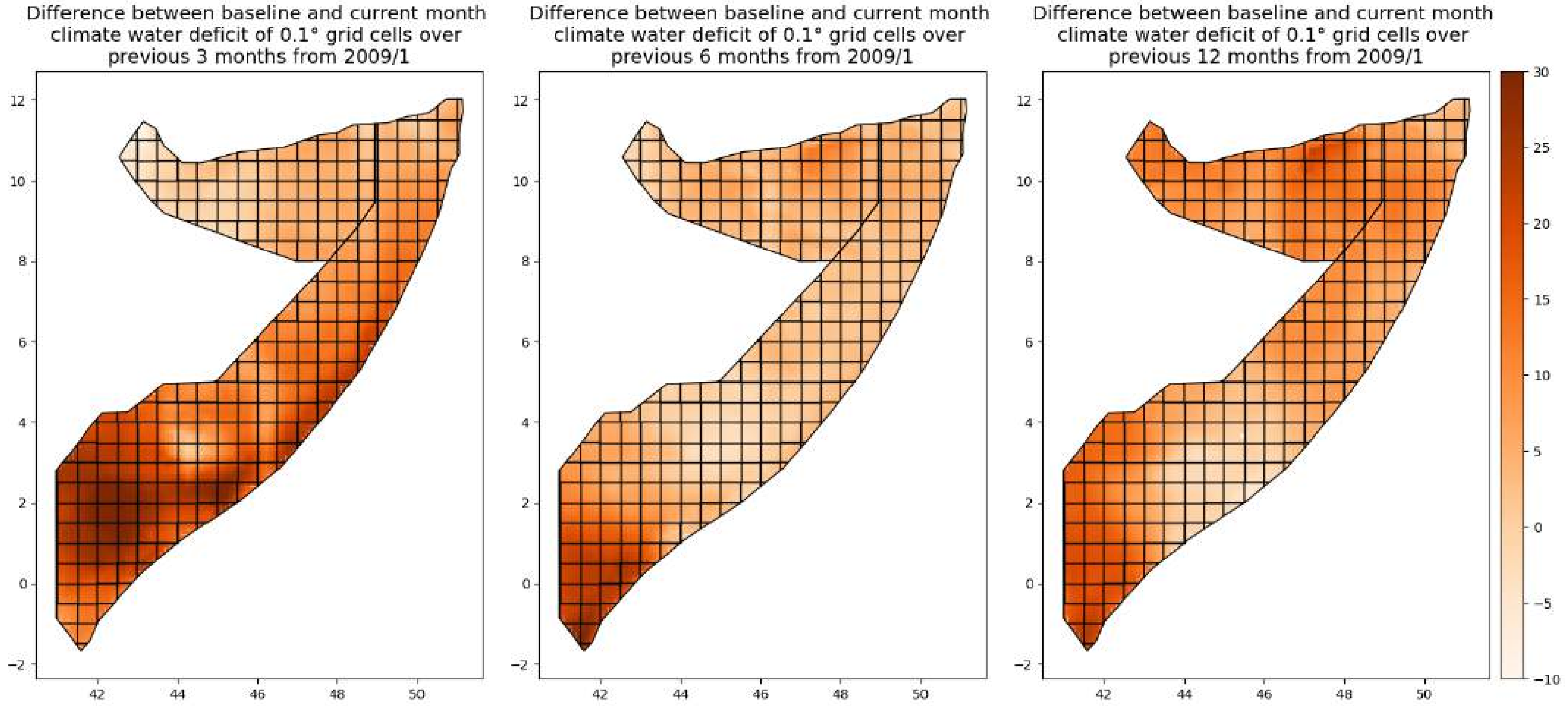
Climate water deficit in vicinity





Climate water deficit in vicinity





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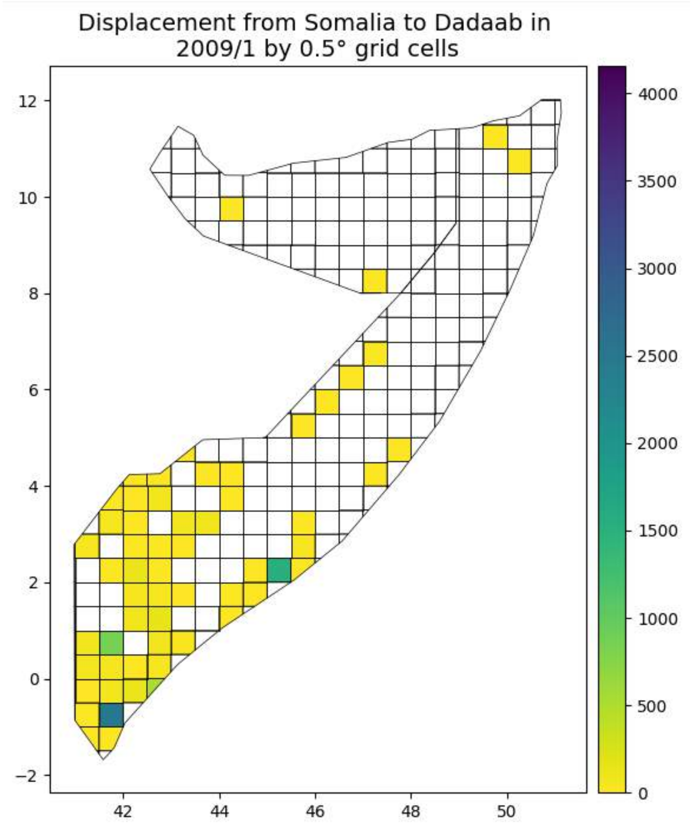
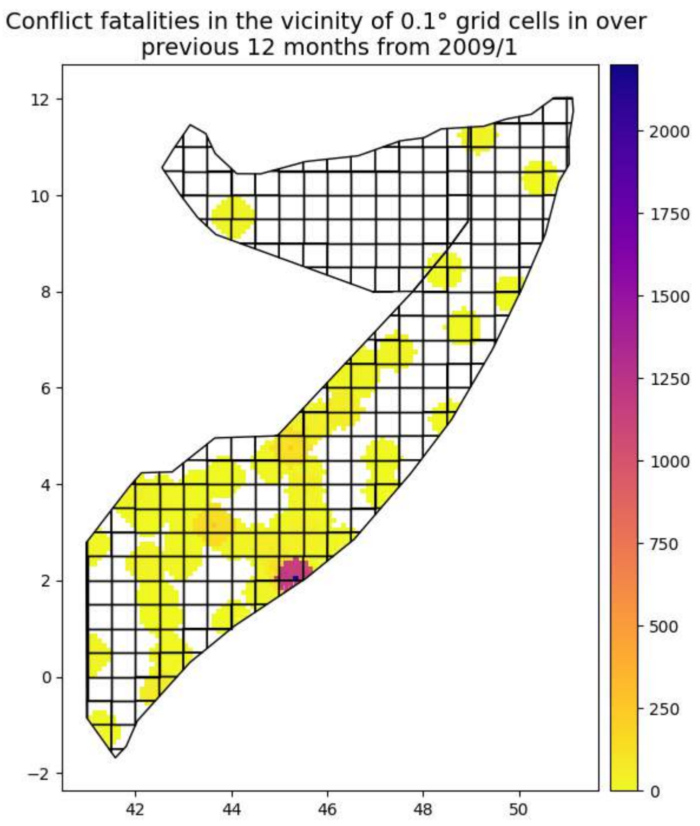
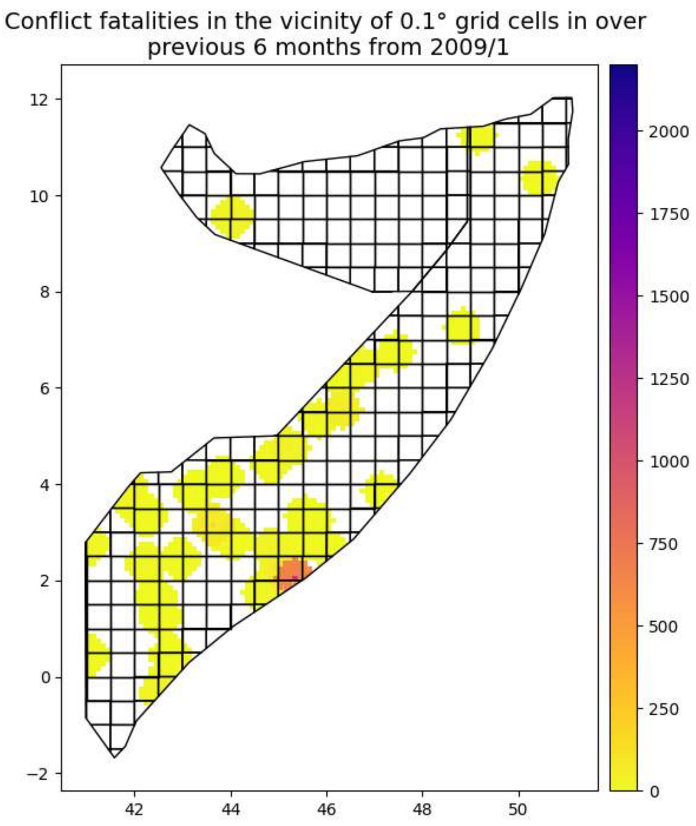
Conflicts in vicinity







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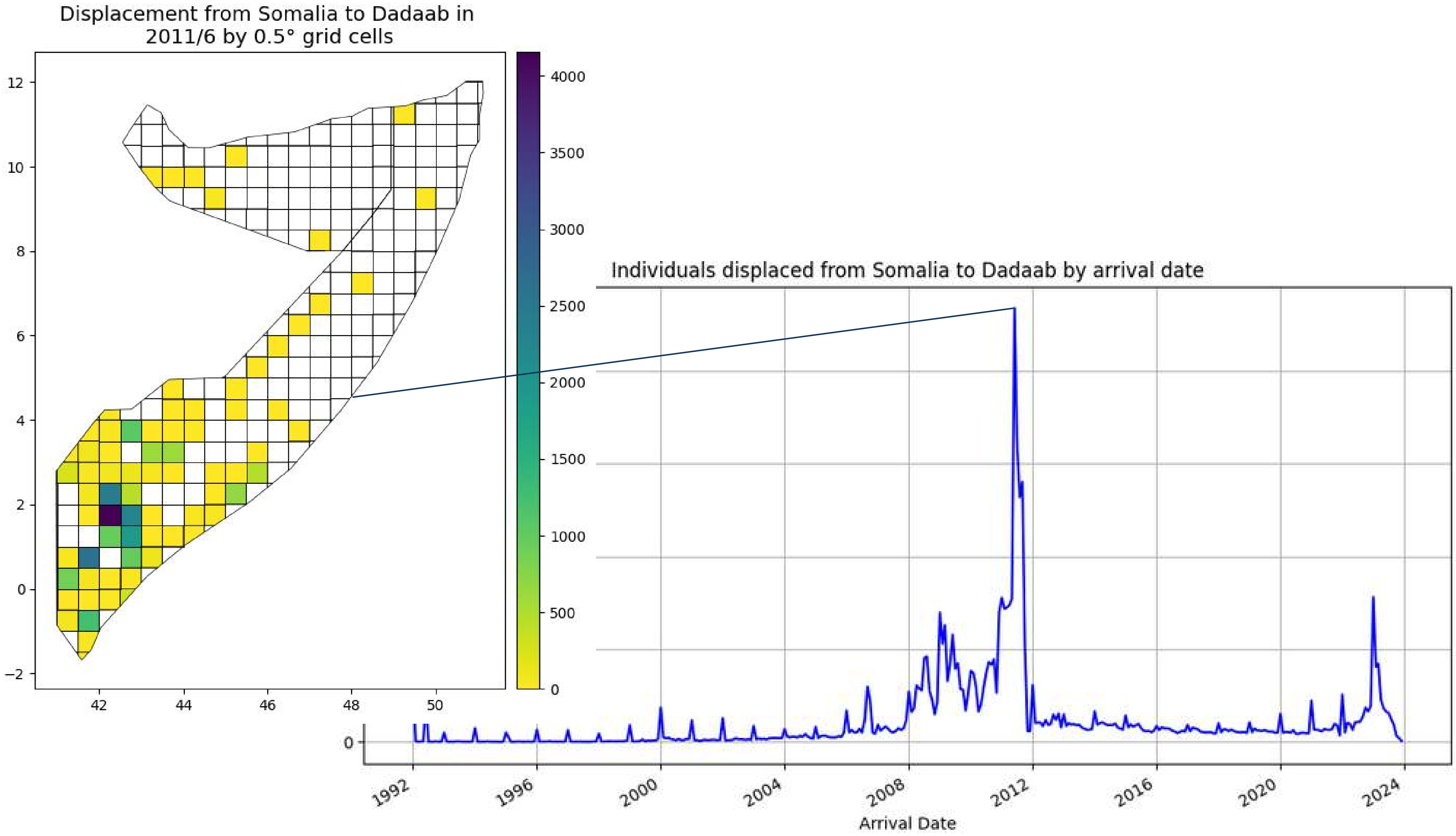
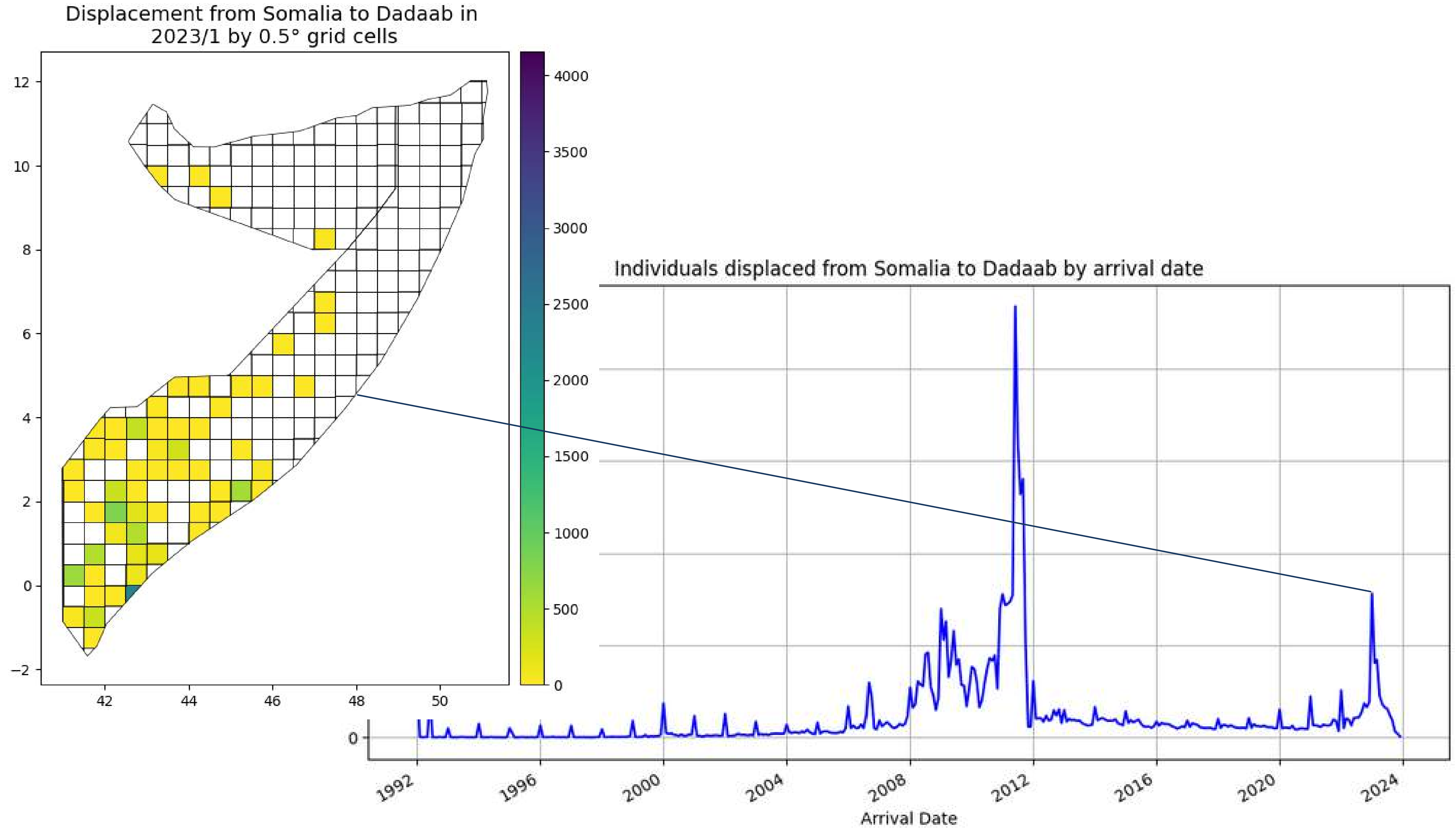


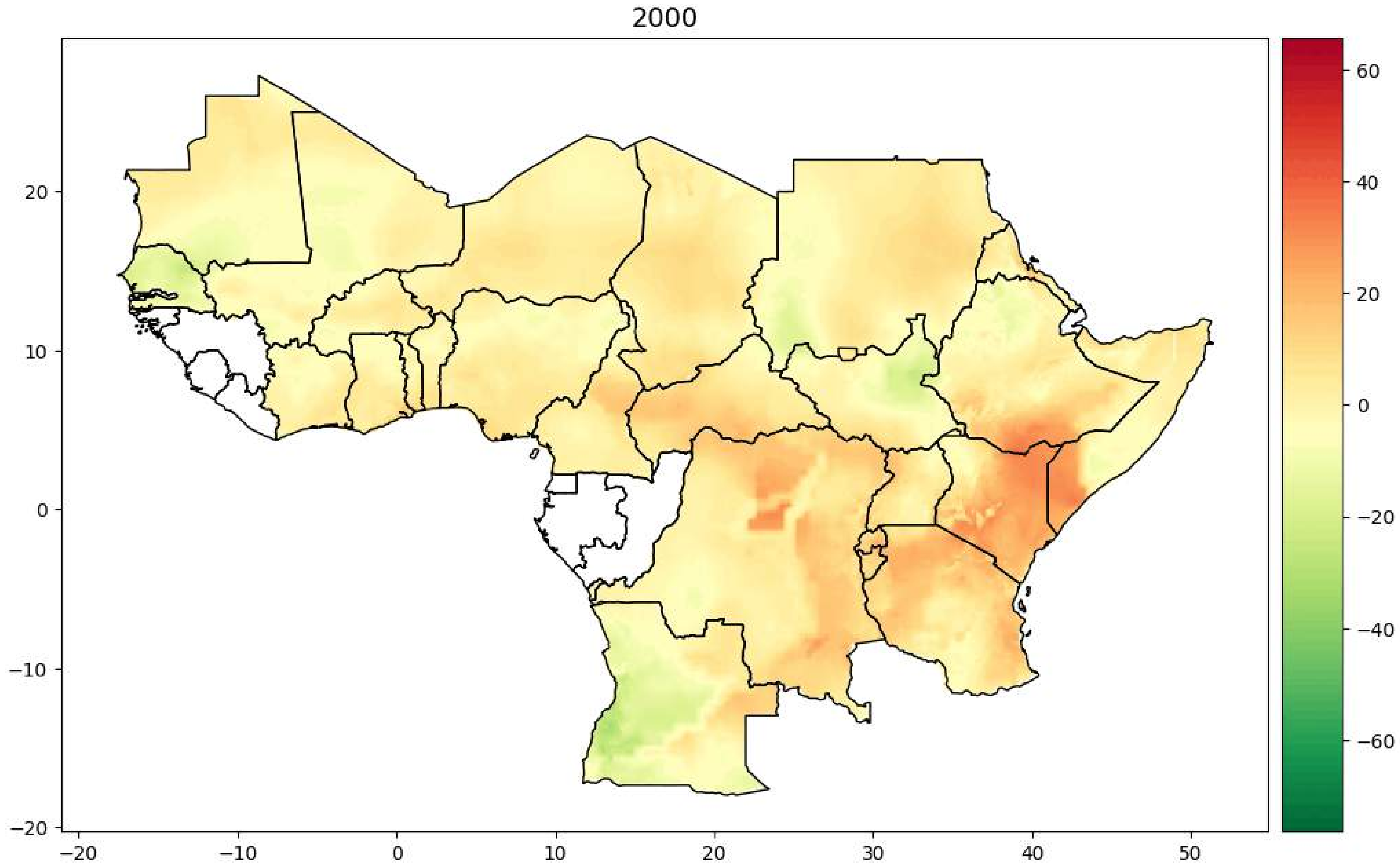
Displacement from Somalia to Dadaab in 2011/6 by 0.5° grid cells
12
10
8
6
4
2
0
−2
42
44
46
48
50
4000
3500
3000
2500
2000
1500
1000
500
0
Individuals displaced from Somalia to Dadaab by arrival date
0
1992
1996
2000
2004
2008
2012
2016
2020
2024
Arrival Date


Displacement from Somalia to Dadaab in 2023/1 by 0.5° grid cells
12
10
8
6
4
2
0
−2
42
44
46
48
50
4000
3500
3000
2500
2000
1500
1000
500
0
Individuals displaced from Somalia to Dadaab by arrival date
0
1992
1996
2000
2004
2008
2012
2016
2020
2024
Arrival Date

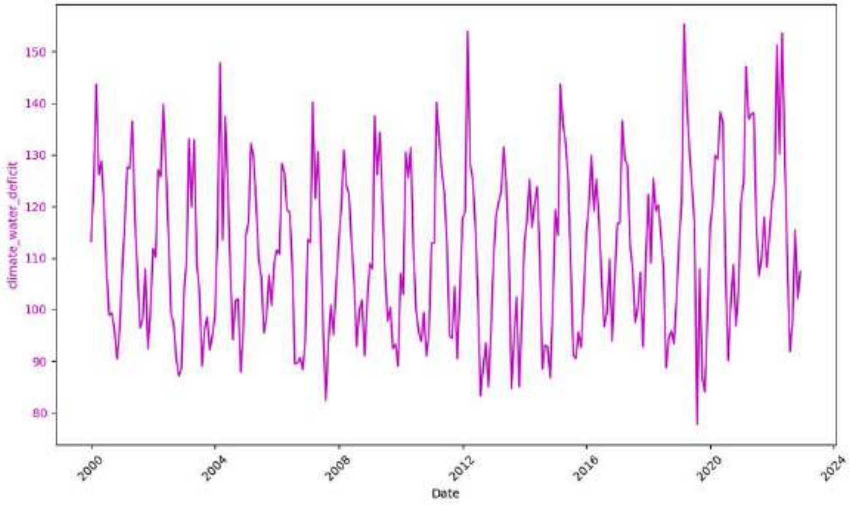
Climate variables

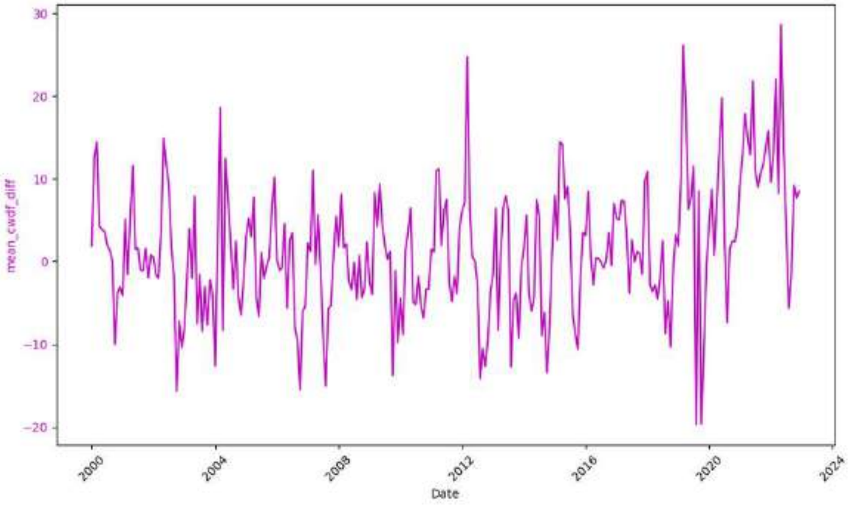
Climate water deficit

CWDF difference annual averages

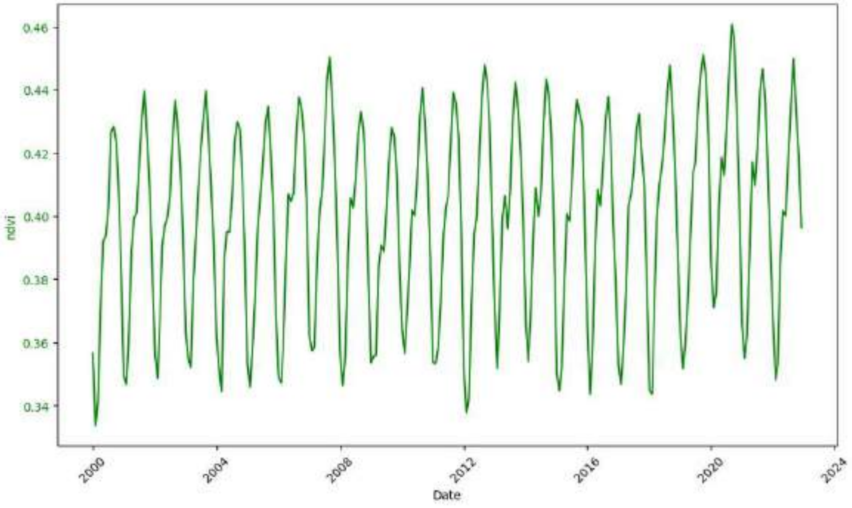


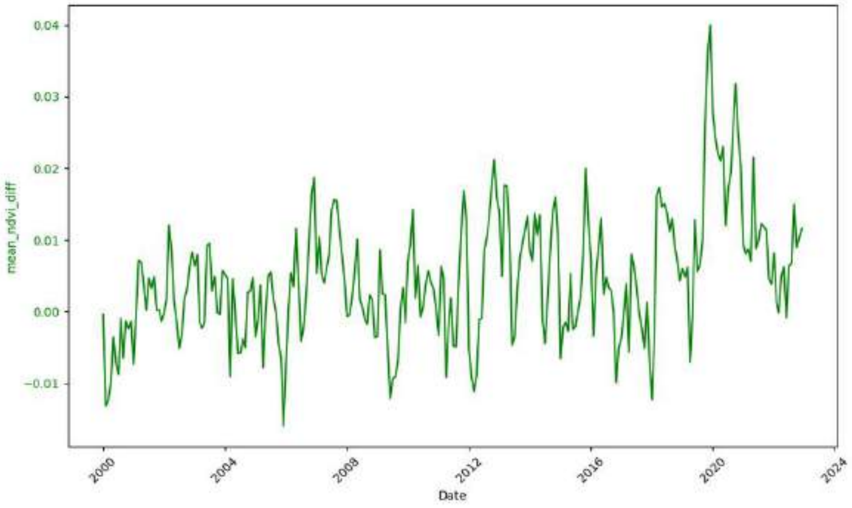
Climate water deficit



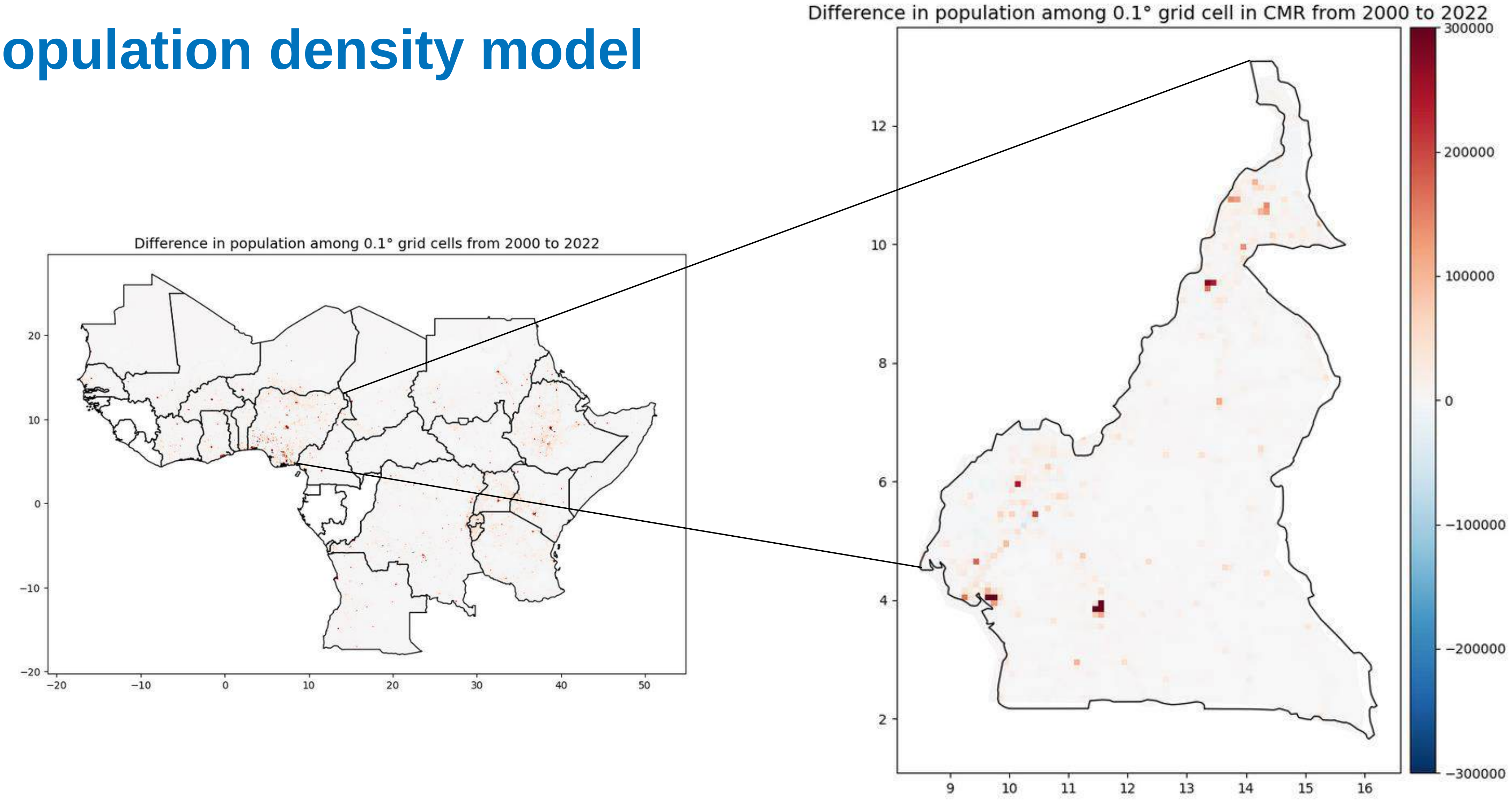


Normalized difference vegetation index



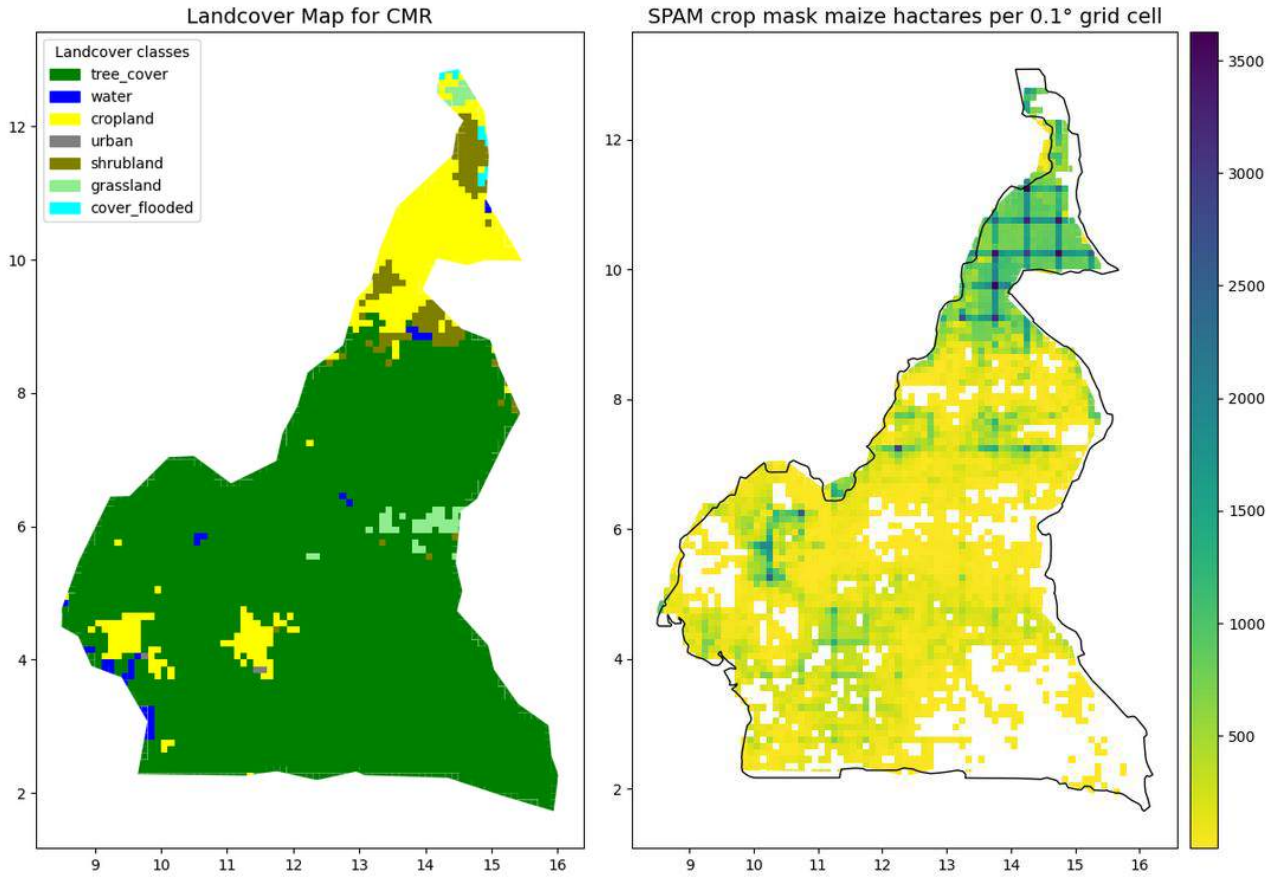


Population density model



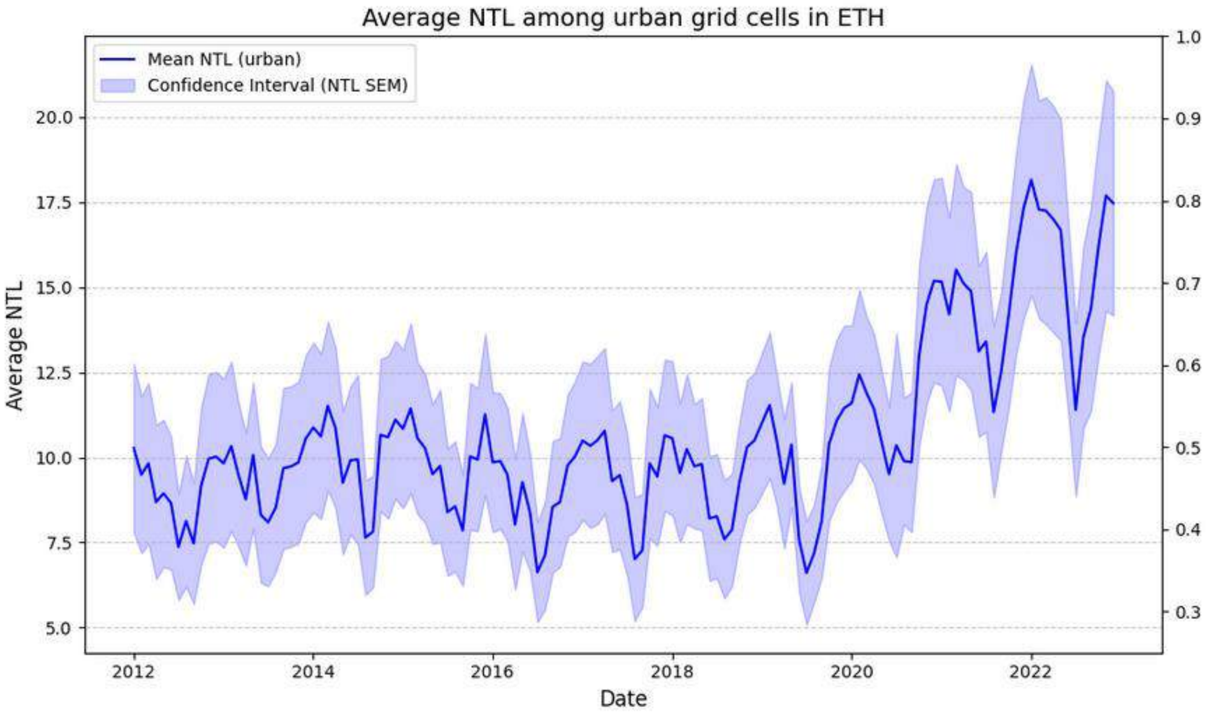
Population density model

Seasonal variability in population density



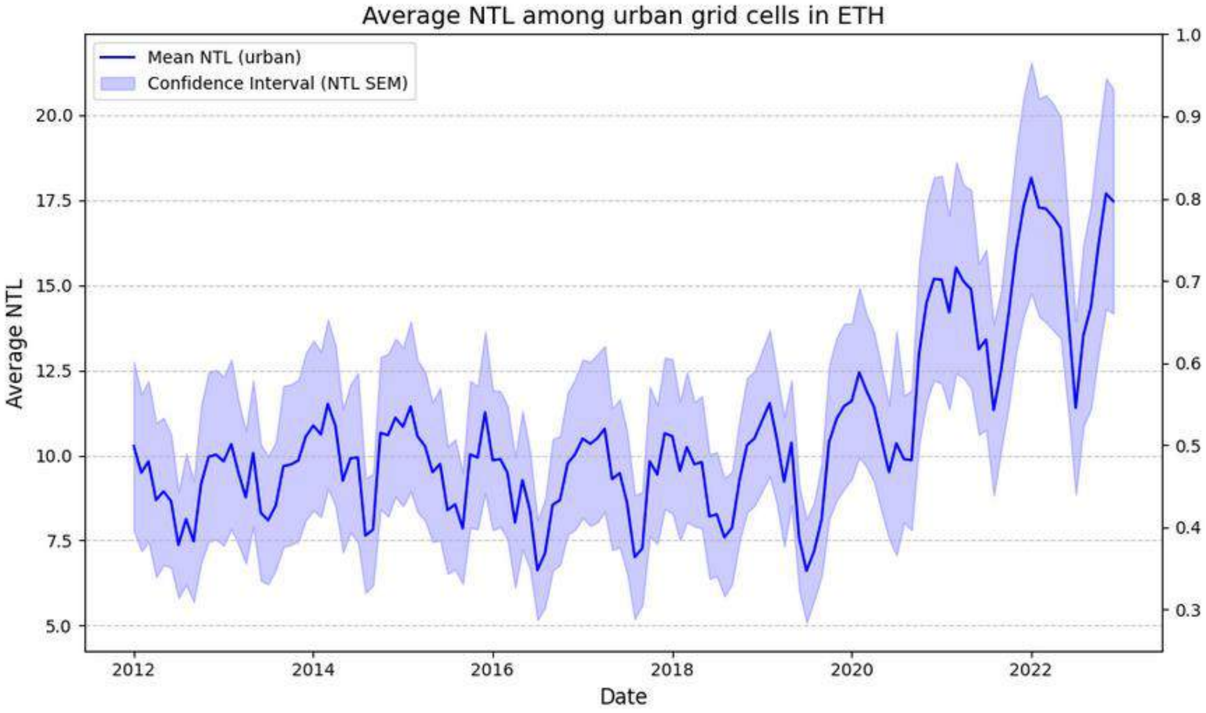
Population density model

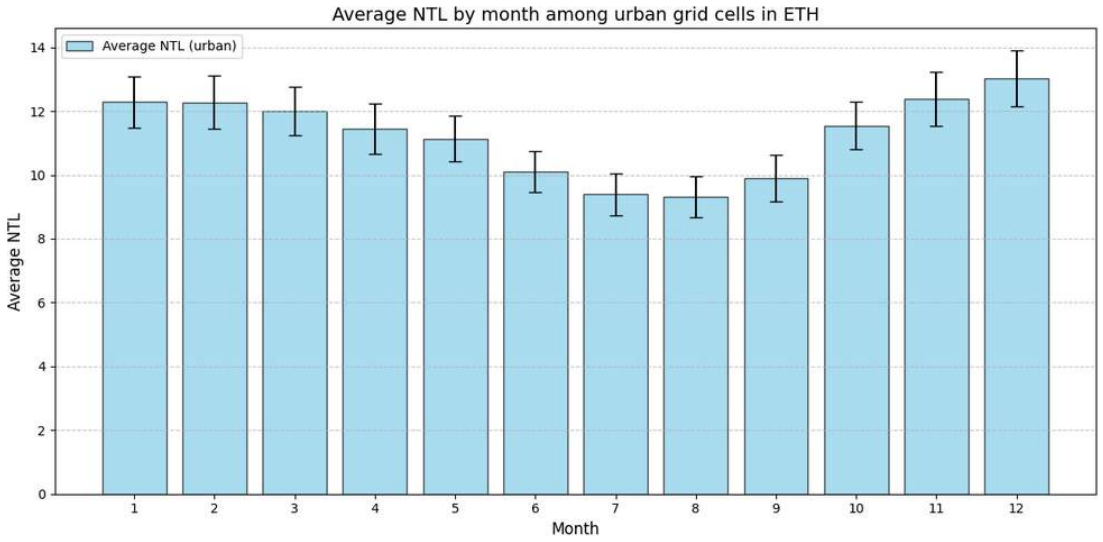
Seasonal variability in population density



Population density model

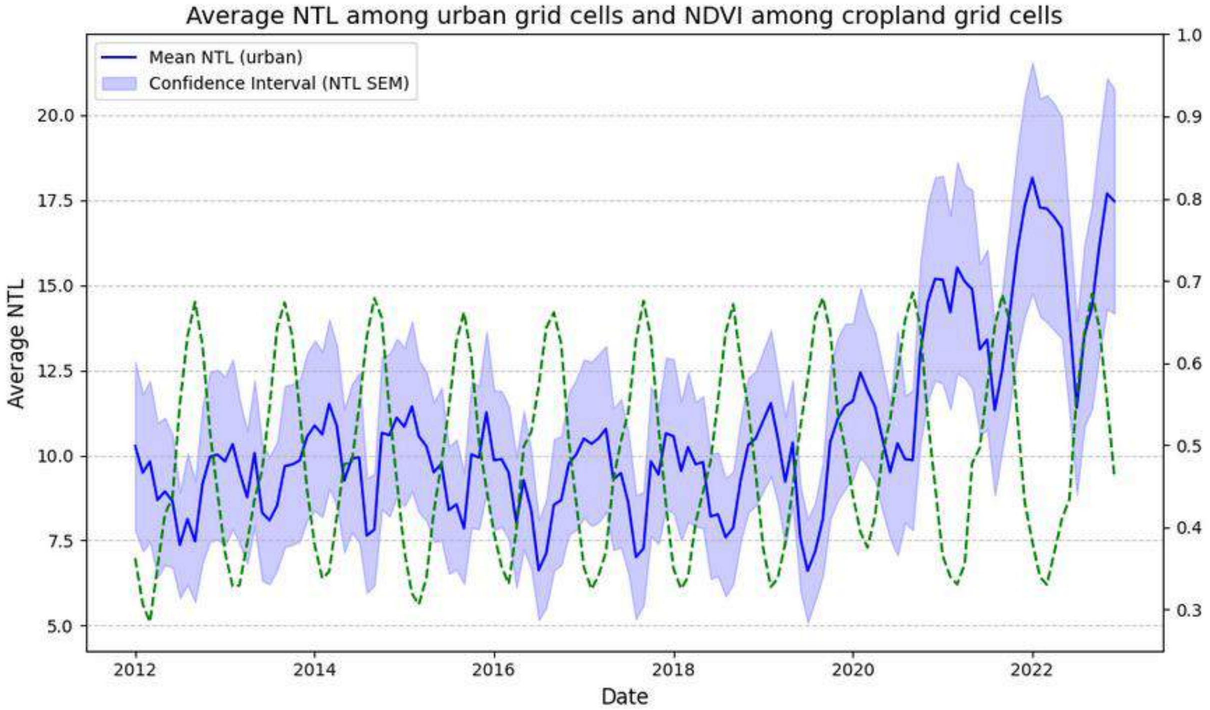
Seasonal variability in population density

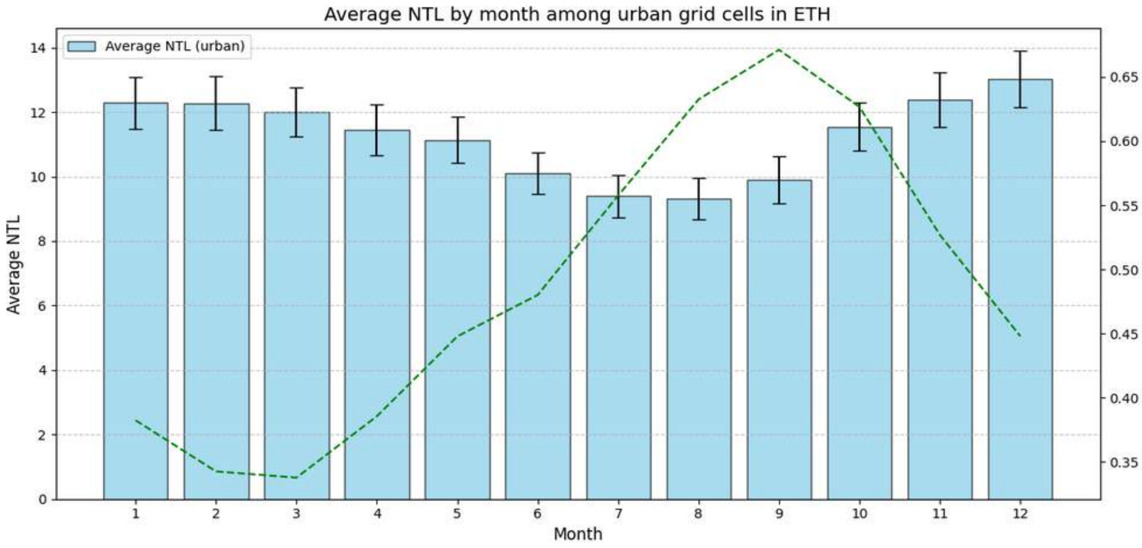




Population density model

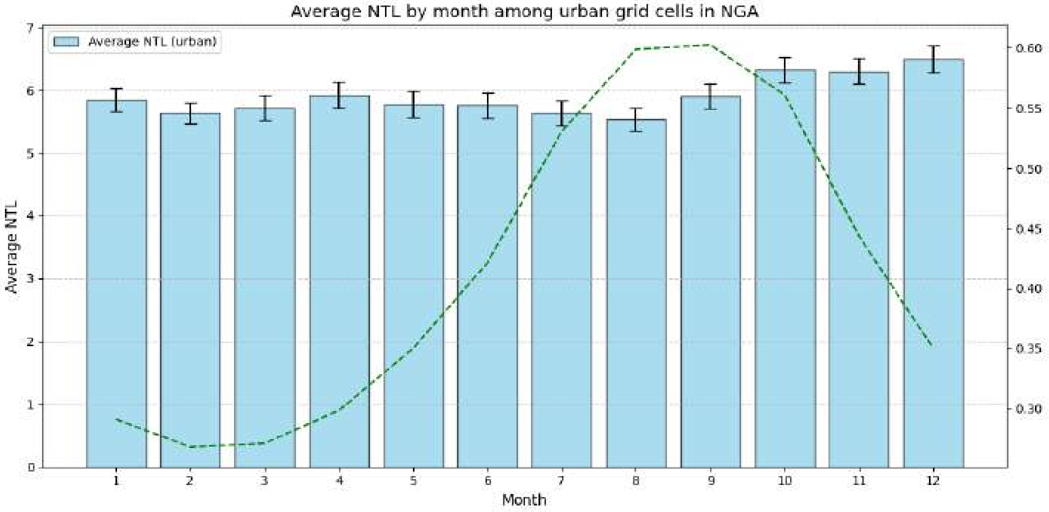
Seasonal variability in population density

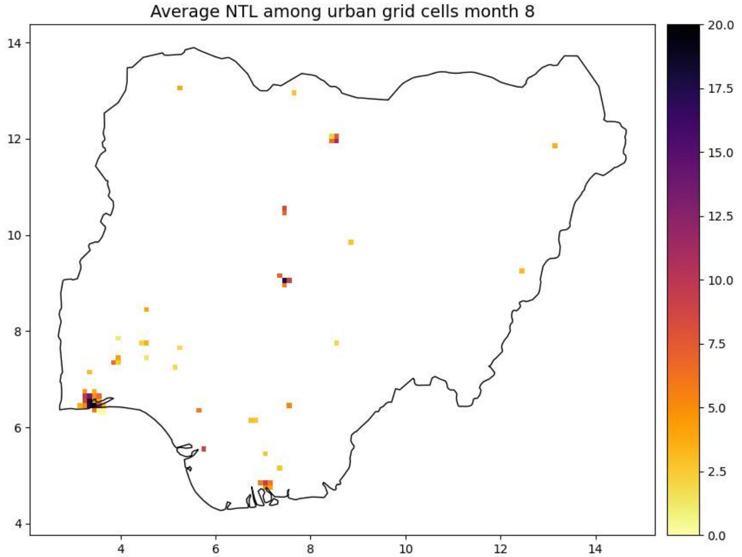


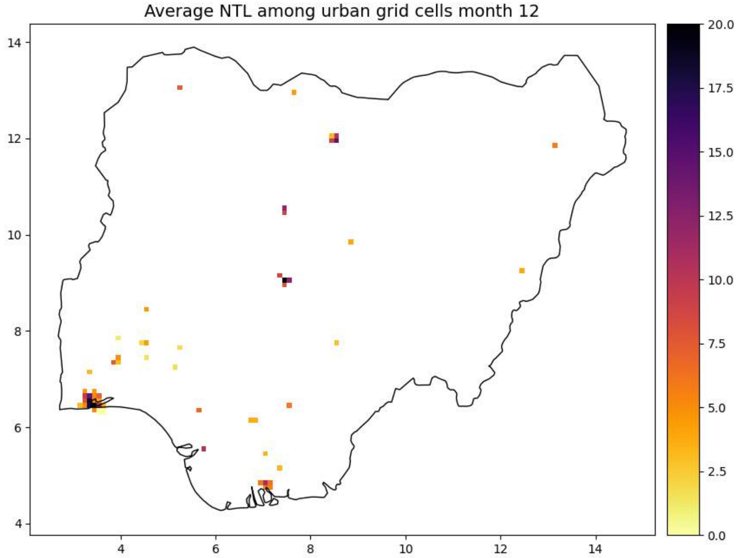


Population density model

Seasonal variability in population density

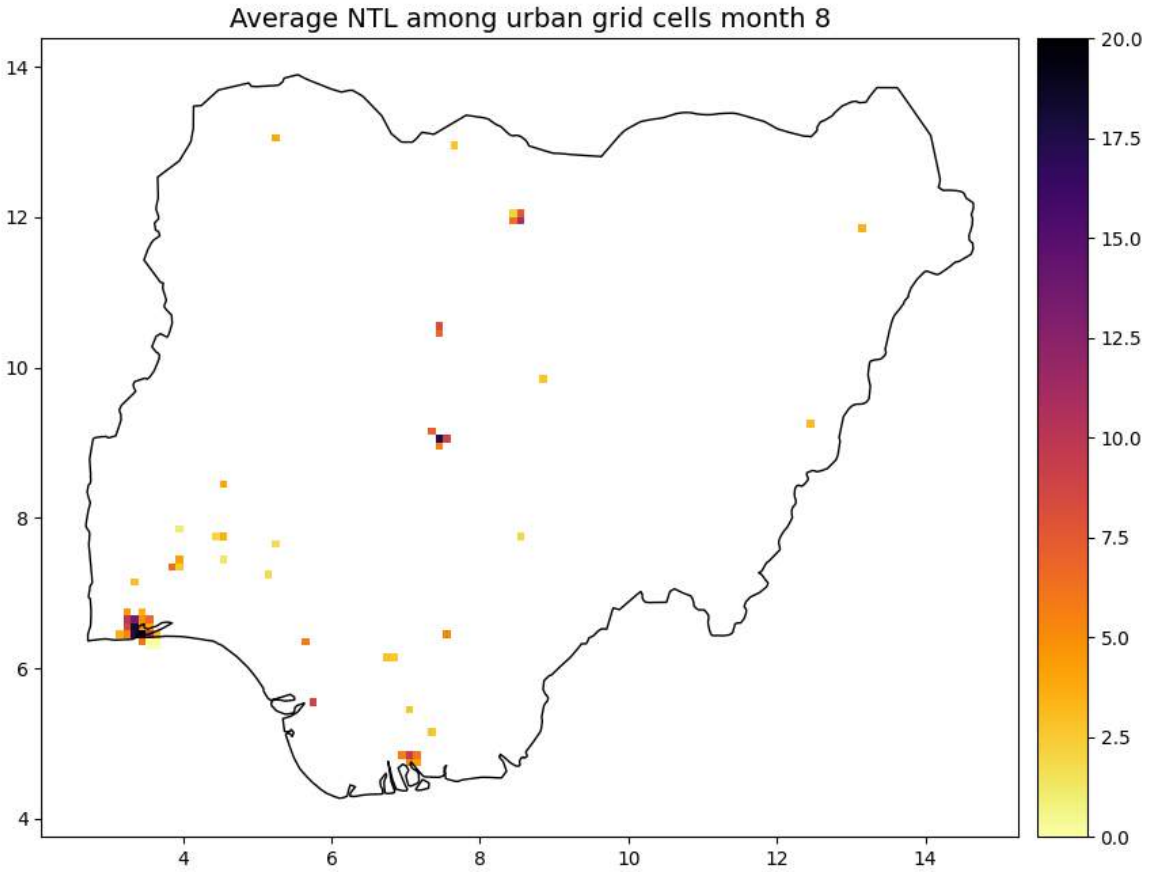


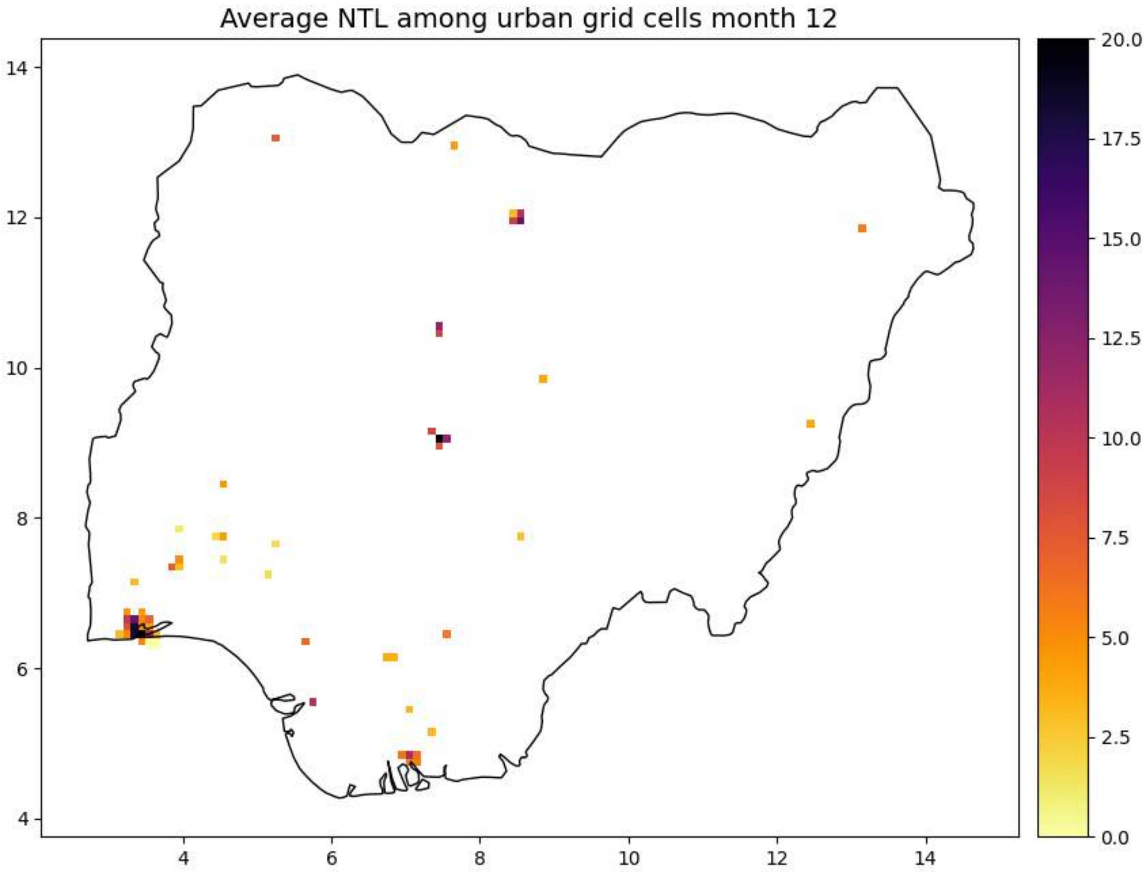




Population density model

Seasonal variability in population density

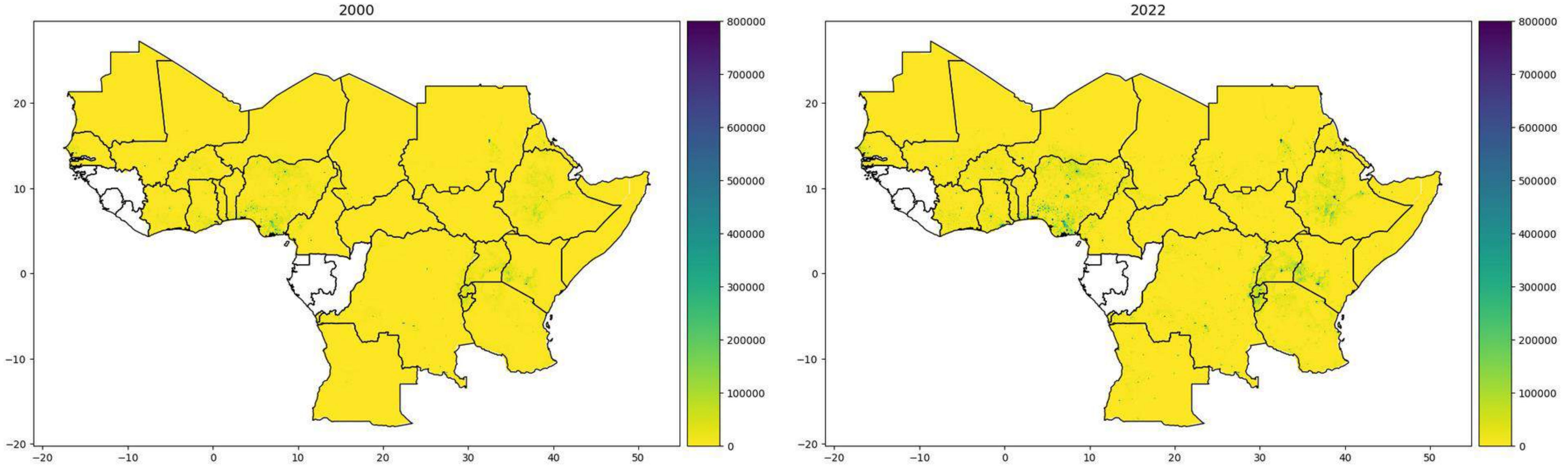




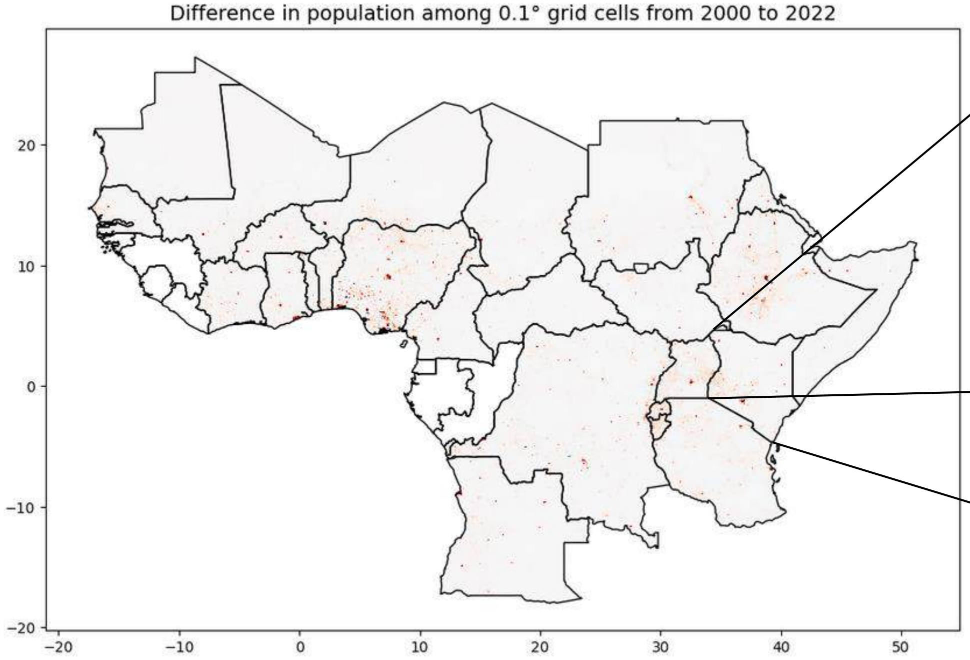
Population density model

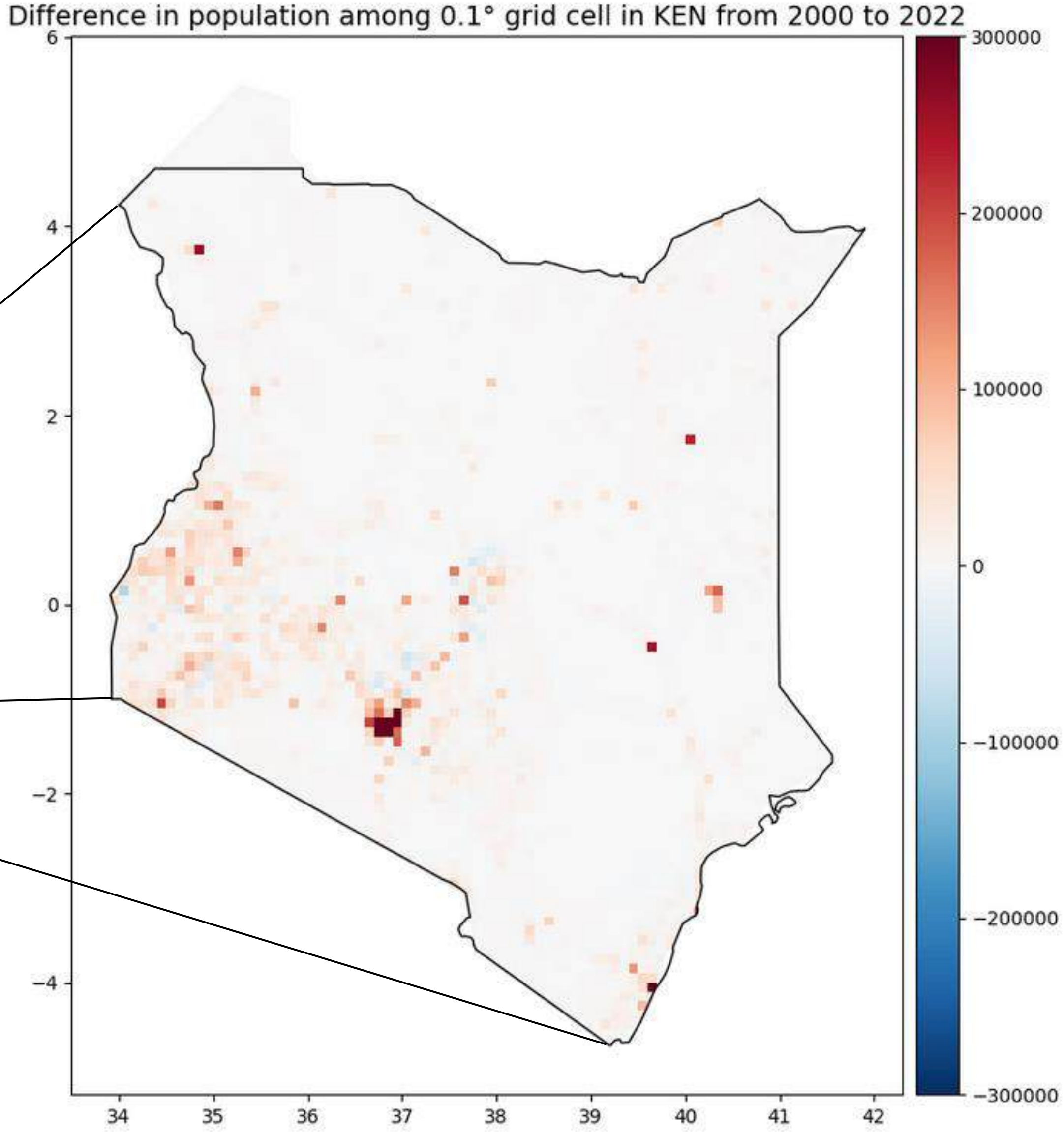
Annual LandScan population data

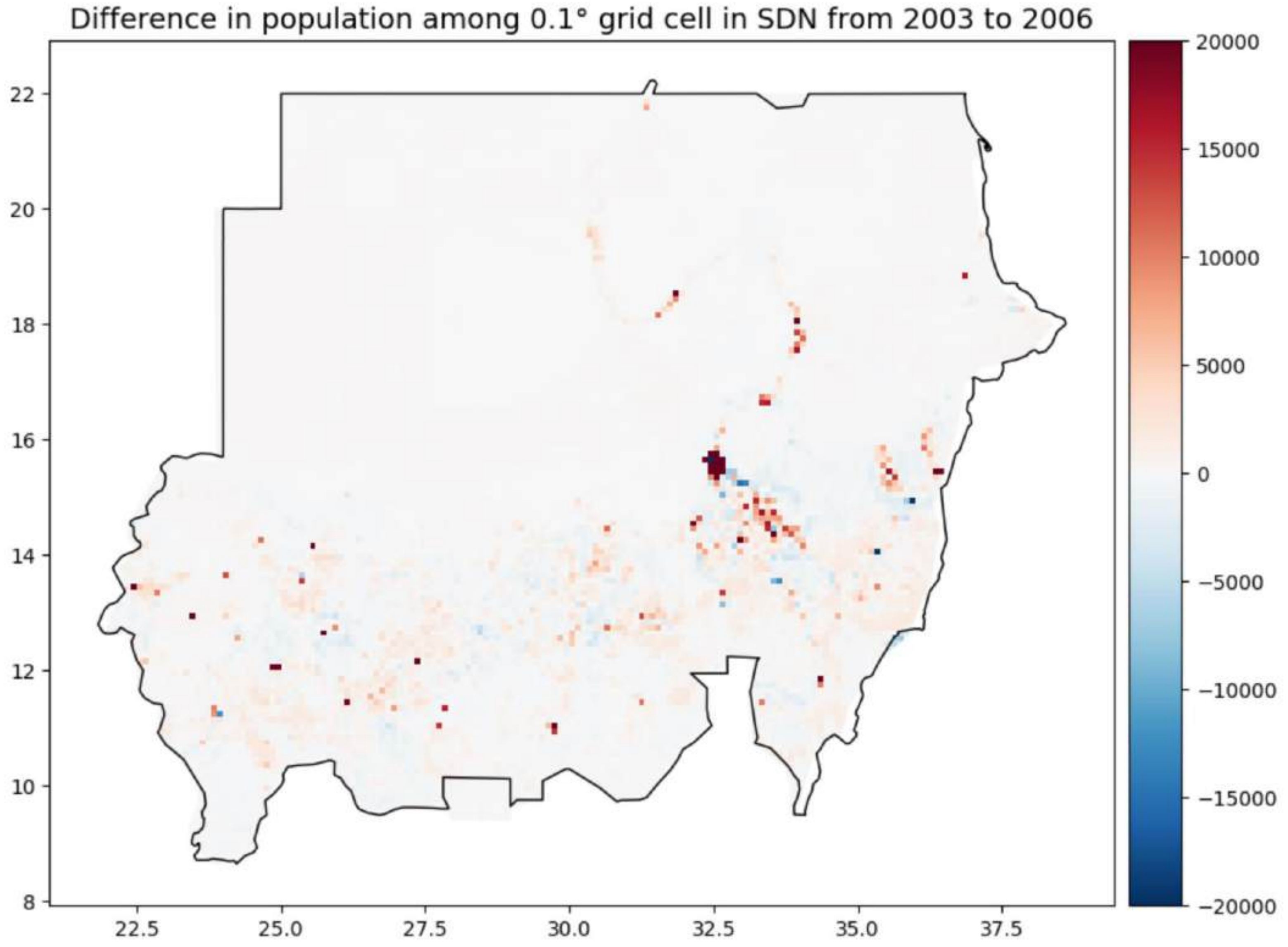
- Data points are placed and summed inside of 0.1° grid cells.
- Challenge is to estimate the monthly population counts/densities within grid cells.

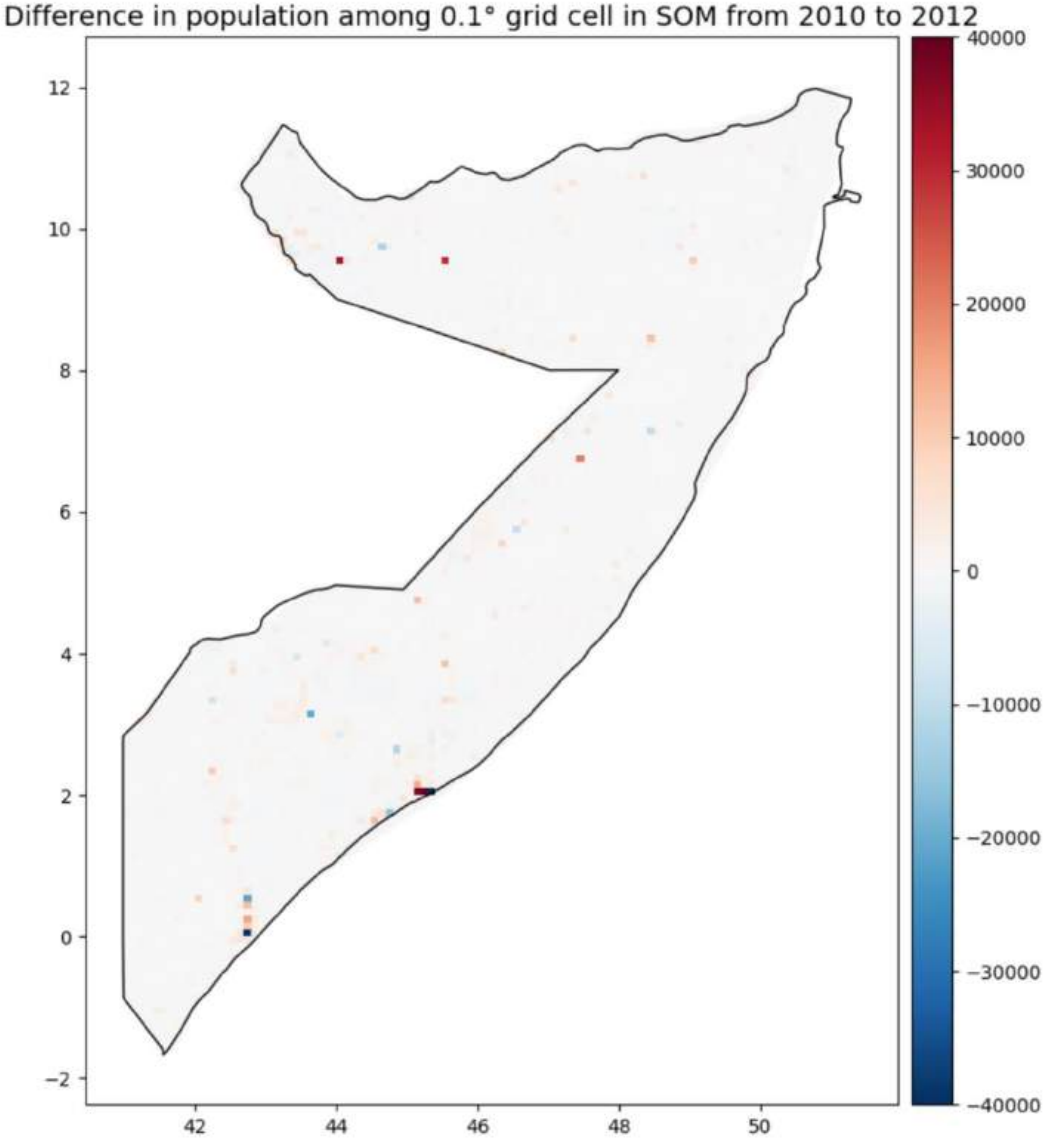


Population density model

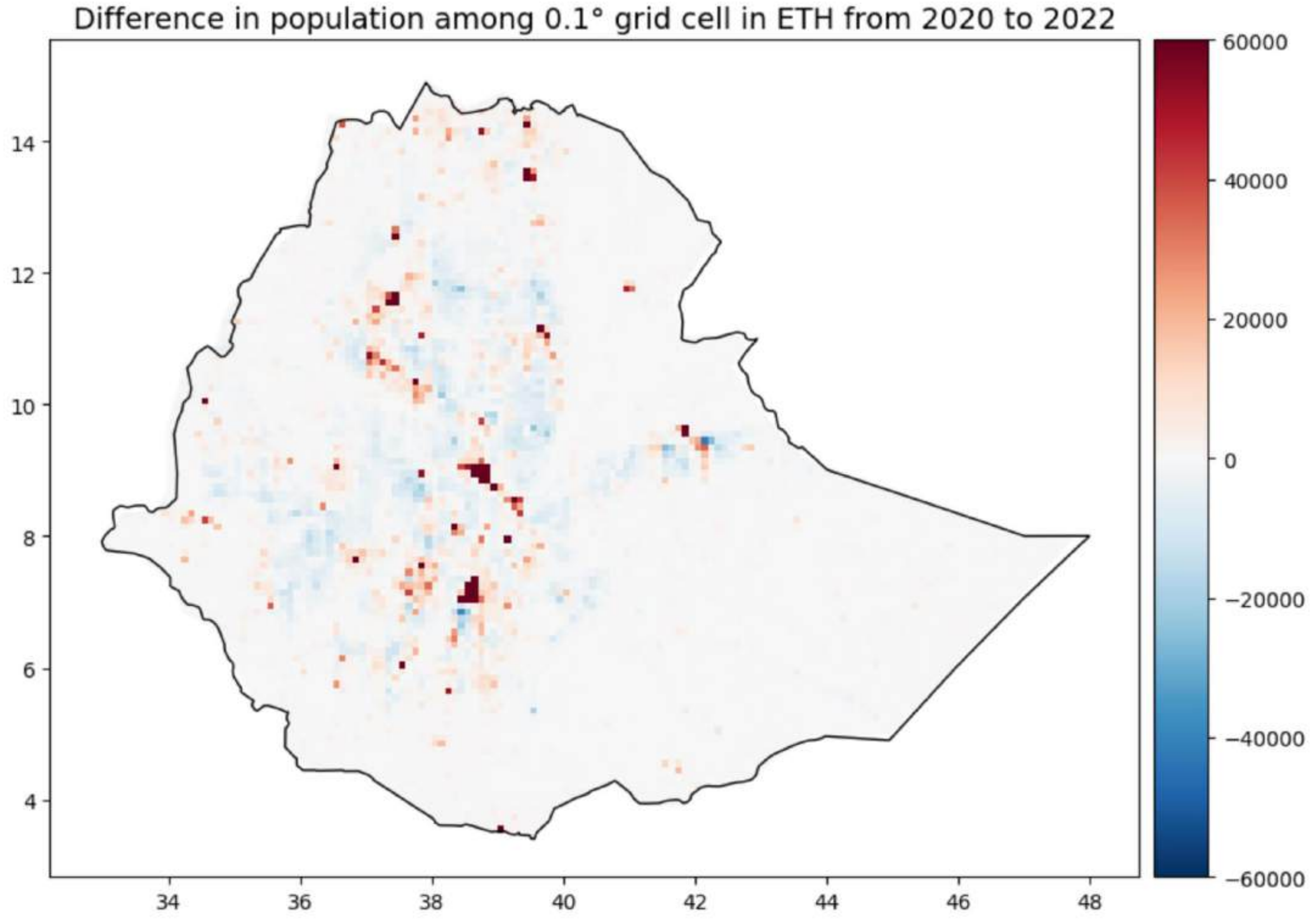





Difference in population among 0.1° grid cell in SDN from 2003 to 2006
22
20
18
16
14
12
10
8
22.5
25.0
27.5
30.0
32.5
35.0
37.5
20000
15000
10000
5000
0
−5000
−10000
−15000
−20000



Difference in population among 0.1° grid cell in SOM from 2010 to 2012
12
10
8
6
4
2
0
−2
42
44
46
48
50
40000
30000
20000
10000
0
−10000
−20000
−30000
−40000


Difference in population among 0.1° grid cell in ETH from 2020 to 2022
14
12
10
8
6
4
34
36
38
40
42
44
46
48
60000
40000
20000
0
−20000
−40000
−60000


Climate Conditions
Agricultural output
Food security
Exposure/ Vulnerability
Forced displaced