**CRISI Model & Software – Revised PhD Focus**

The Climate Resilience Investment Scoring Intelligence (CRISI) is a new AI-driven framework to guide tourism-sector investment under climate change. Unlike earlier cost–benefit approaches, CRISI directly links climate hazards to economic outcomes in tourism, producing composite resilience scores for regions or projects. For example, Europe’s tourism employs ~10% of the workforce and faces major climate shifts (e.g. hotter summers, reduced snow). CRISI will translate climate and socioeconomic data into actionable policy metrics (e.g. “resilience index” or climate-adjusted ROI) to help policymakers and investors prioritize adaptation. In short, CRISI fills a gap in existing tools by offering *sector-specific*, *spatially explicit* risk scoring tailored to tourism and its infrastructure.

**Competitors & CRISI’s Edge**

Existing climate-risk tools fall into three categories:

* **Public-sector indices (e.g. EIB Country Scores, UN/EU Risk Indices)** provide broad country-level risk ratings (physical vs transition risk) by aggregating hazards and socio-economic factors. They cover many nations (e.g. EIB’s 180 countries) and support adaptation finance, but remain very coarse. As one review notes, they “lack subnational or sector-specific detail” and can’t pinpoint impacts on tourism or individual projects. Similarly, World Bank or FEMA screening tools use GIS hazard maps for projects, but yield only qualitative “High/Medium/Low” flags and are generic to any sector.
* **Commercial risk platforms (e.g. ICE’s Climate Risk, Moody’s Four Twenty Seven, XDI, riskthinking.AI)** leverage big data and AI to score asset-level exposure. These tools offer high resolution (millions of buildings/assets) and integrate physical and transition risks. They serve investors/insurers by computing portfolio loss metrics and integrating with credit models. However, their focus is financial: they do not model tourism demand shifts or regional GDP impacts. A flood risk score may be computed, but “a beach resort in a flood zone is treated like any asset”, without tourism-specific context. They are also proprietary and complex to use.
* **Research and NGO indices (e.g. CORVI, ND-GAIN, Myriad)** use expert-driven multi-criteria methods. Tools like CORVI or ND-GAIN combine dozens of indicators (environmental, economic, social) often via Delphi weighting to score city or country vulnerability. These provide rich strategic insights (e.g. CORVI’s 90-indicator coastal-city assessments) and are freely available, but are often one-off studies or generalized indices. They are not turnkey scoring engines for investment decisions, and focus either on broad vulnerability or on complex multi-hazard mapping (e.g. the Myriad EU project).

**CRISI’s innovation** bridges these gaps. It is *tourism-centric* and *meso-scale*: CRISI’s indicators and models explicitly capture factors like seasonal demand, visitor spending, and tourism-dependent GDP. For example, CRISI will link a heatwave or flood to projected tourist-night losses or hotel damage in a given region, something generic platforms cannot. It integrates **GIS hazard data with regional economic data** – i.e. combining climate projections (from Copernicus/Euro-CORDEX) with local tourism/economic statistics – to compute a composite resilience score. In effect, it works like a tailored version of the Myriad multi-hazard approach, but focused on tourism: identifying regions where climate shocks and high tourism reliance coincide.

Crucially, CRISI is designed as a **policy/investment decision support tool**. Its outputs (ranked destinations, risk-adjusted ROI metrics, resilience maps) are geared to answer strategic questions: e.g. “Which regions should get adaptation funding?” or “Is building a new ski resort worth the risk?”. It can provide scenario analysis under different climate pathways, helping governments and investors target resilience measures. Finally, by leveraging AI, CRISI can be dynamic and transparent: it could ingest real-time data (satellites, news, social media), update scores with machine learning, and expose factor contributions (using explainability tools) to build trust.

In summary, no existing tool offers *spatially-granular, tourism-specific, AI-driven climate risk scores* at the regional/project scale. CRISI aims to fill that niche by combining the strengths of current models with a clear focus on tourism resilience.

**Research Methodology**

* **Systematic Literature Review (SLR):** We will perform a structured SLR covering climate-toursim and adaptation literature. Using PRISMA guidelines, searches in academic databases will identify studies on climate impacts to tourism, adaptation finance tools, and AI in climate forecasting. The goal is to map existing knowledge and find gaps (e.g. a recent review found many studies of climate risk to tourism but few on linking climate metrics to tourism outcomes). The SLR will code themes (hazards, impacts, resilience factors) and feed into our conceptual framework.
* **Data Pipeline & Modeling:** We will compile **multi-source data** on climate, tourism, and socio-economics. For climate: high-resolution projections (EURO-CORDEX via Copernicus CDS) for temperature, precipitation, extreme events, etc. For tourism: regional stats (tourist arrivals, overnight stays, revenues, tourism share of GDP) from Eurostat, national databases or UNWTO. Socio-economic data (income, infrastructure, employment) will come from World Bank or regional databases. Automated APIs (e.g. Copernicus CDS API, Eurostat SDMX, Open-Meteo) and web-scraping will enable periodic updates. Geospatial processing (matching climate grids to NUTS2/3 regions via GIS) will integrate these layers.

The modeling pipeline uses supervised ML/regression. One approach is to train a model (e.g. Random Forest or XGBoost) on historical data relating climate variability to changes in tourist demand (visitor numbers or tourism GDP) across regions. The model learns how climate stressors (heatwaves, snow loss, floods) statistically affect tourism outputs. We then apply the model under future climate scenarios (RCP4.5/8.5) to project tourism impacts. These projected impacts, together with factors like tourism dependency and adaptive capacity, are aggregated into a **resilience score**. Weighting of indicators (e.g. importance of water scarcity vs sea-level rise) may use multi-criteria decision methods, calibrated by expert input (see below).

* **Delphi Expert Integration:** A key step is to involve domain experts via the Delphi method. We will convene panels of climate scientists, tourism planners, and investors. In Round 1, experts will rank climate and socio-economic factors by importance for tourism resilience, and review proposed indicators. In subsequent rounds, they review aggregated feedback and converge on weights and threshold values. The Delphi results will validate and refine our scoring model: for instance, they will ensure the chosen indicators truly reflect tourism vulnerability and that the score breakdown is policy-meaningful. This expert elicitation builds credibility (as in CORVI-type studies) and ensures CRISI reflects practical knowledge.
* **Pilot Testing & Refinement:** We will pilot CRISI on a few case regions (e.g. a Mediterranean coast, an Alpine ski area, an urban destination) to calibrate and test the tool. For each case, we’ll run the model and generate resilience scores under different scenarios. These outputs will be evaluated with local stakeholders or further experts: do the risk rankings and suggested actions make sense on the ground? Such pilot applications provide feedback to improve data inputs, model assumptions, and the user interface. The process will include both quantitative validation (checking model predictions against past events, cross-validation) and qualitative validation (expert workshops reviewing CRISI outputs). Any discrepancies found will guide refinements.

**Technical Foundations**

* **Software Stack:** The tool will be built primarily in **Python** for flexibility and robust libraries. Key libraries include **scikit-learn** (ML modeling), **Pandas/NumPy** (data handling), **GeoPandas/shapely** (spatial operations), and **Streamlit** or **Dash** for a user-friendly web interface. Version control (Git) and cloud services (for heavy processing or GIS) will support development. This open-source stack aligns with best practice in data science.
* **Data Sources & Access:** We will leverage open datasets and APIs. Examples include: (1) **Copernicus Climate Data Store (CDS)** for gridded climate projections (temperature, precipitation, extremes); (2) **EURO-CORDEX** for high-resolution regional climate model outputs; (3) **Eurostat and UNWTO** for tourism and economic statistics (arrivals, nights, revenues by region); (4) **World Bank API** for socioeconomic indicators (GDP, employment); (5) **GISCO/NUTS shapefiles** for spatial boundaries. Automated scripts (e.g. using cdsapi, pandasdmx, custom scraping) will regularly pull and preprocess data. Satellite remote-sensing (e.g. land cover, NDVI) or weather forecast APIs may supplement real-time monitoring. All data will be documented and stored in a reproducible pipeline.
* **Processing & Visualization:** Data heterogeneity (temporal resolution, formats) is managed via standard techniques: time-series alignment (seasonal adjustment, aggregation), interpolation onto common regions, and normalization. Geospatial analyses (mapping hazards to tourism spots) use GeoPandas. The final scores will be delivered in both tabular reports and interactive maps/dashboards (e.g. using Folium or Plotly) to aid decision-making.

**Intellectual Property & Protection**

The CRISI software and data products could be handled under different IP models:

* **Open Science Approach:** We plan to release the core code under a permissive open-source license (e.g. MIT or Apache) so others can review and extend it. Data outputs (indices) could be published under Creative Commons (e.g. CC BY) to maximize uptake. Open licensing signals willingness to share and helps scientific collaboration. For academic dissemination, all publications would be Open Access with CC BY.
* **Proprietary Option:** Alternatively, if a commercialization path is pursued (e.g. licensing a polished platform to government agencies), parts of the tool could be kept proprietary under university IP policies. This might involve patenting novel algorithms or developing a hosted service model. However, even a proprietary route would likely use open data and could offer community versions.
* **Hybrid/Research Licensing:** A middle path is dual-licensing: offering the base research tool openly while reserving special-case commercial use under a different license. The PhD work itself will follow ethical research data guidelines (using legally sharable data, respecting privacy). In all cases, careful IP management (through university tech transfer offices) will ensure the tool’s protection aligns with project goals.

**Milestones**

* Conduct the comprehensive literature review; finalize the conceptual framework and indicator list; gather initial data (climate and tourism) and set up data pipelines; start preliminary modeling (exploratory analysis, simple regressions).
* Expand data collection (additional regions, refine variables); develop and train the first version of the predictive model (test methods like Random Forest); design and pilot the Delphi survey instrument; begin initial engagement with experts.
* Carry out Delphi rounds and finalize indicator weighting; iterate model training incorporating expert feedback; apply the tool to 2–3 case study regions (run scores under scenarios); organize workshops or interviews with stakeholders to discuss results; refine model & scoring method based on pilot findings.
* Finalize the CRISI software and user interface (add visual dashboards, documentation); validate the model (statistical tests and stakeholder validation); draft dissertation chapters and prepare publications; outline roadmap for tool deployment beyond PhD. Compile recommendations for policy use.

Throughout, we will regularly disseminate interim results (working papers, conference presentations) and adjust the plan as needed. The milestones ensure steady progress: SLR completion by mid-Year 1, prototype model by end-Year 1, expert validation and tool refinement in Year 2, culminating in writing and defense.

**Funding Opportunities (Preliminary)**

Possible support mechanisms include: (a) **European grants**: e.g. Horizon Europe calls on climate adaptation or sustainability (clusters for Green Deal innovation), EU missions (Adaptation to Climate Change), or Interreg projects on resilient tourism; (b) **National research funds**: Greece’s GSRT or Hellenic Foundation for Research might fund PhD-related work; (c) **University innovation seed funds**: many universities offer small grants or incubation support for high-impact digital projects; (d) **International agencies**: Organizations like UNWTO, World Bank, or EIB sometimes fund pilot studies on tourism resilience. In addition, travel or dissemination grants (e.g. Erasmus+ traineeships, local tourism boards) could be sought. These sources would support software development, data acquisition, or stakeholder workshops.

**Sources:** The CRISI design builds on documented needs and precedents in climate risk tools. Systematic approaches (SLR, Delphi) and ML pipelines follow established methods. Data sources (Copernicus, Eurostat, etc.) are public and well-documented. IP and licensing considerations draw on open science practices.