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Chapter 1 : Species distribution - Wikipedia

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The value of q is within [0, 1], 0 indicates no spatial stratified heterogeneity, 1 indicates perfect spatial stratified heterogeneity. The value of q indicates the percent of the variance of an attribute explained by the stratification. The q follows a noncentral F probability density function. A hand map with different spatial patterns. Spatial interpolation[edit] Spatial interpolation methods estimate the variables at unobserved locations in geographic space based on the values at observed locations. Basic methods include inverse distance weighting: Kriging is a more sophisticated method that interpolates across space according to a spatial lag relationship that has both systematic and random components. This can accommodate a wide range of spatial relationships for the hidden values between observed locations. Kriging provides optimal estimates given the hypothesized lag relationship, and error estimates can be mapped to determine if spatial patterns exist. Local regression and Regression-Kriging Spatial regression methods capture spatial dependency in regression analysis , avoiding statistical problems such as unstable parameters and unreliable significance tests, as well as providing information on spatial relationships among the variables involved. The estimated spatial relationships can be used on spatial and spatio-temporal predictions. Geographically weighted regression GWR is a local version of spatial regression that generates parameters disaggregated by the spatial units of analysis. Spatial stochastic processes, such as Gaussian processes are also increasingly being deployed in spatial regression analysis. Model-based versions of GWR, known as spatially varying coefficient models have been applied to conduct Bayesian inference. Factors can include origin propulsive variables such as the number of commuters in residential areas, destination attractiveness variables such as the amount of office space in employment areas, and proximity relationships between the locations measured in terms such as driving distance or travel time. In addition, the topological, or connective , relationships between areas must be identified, particularly considering the often conflicting relationship between distance and topology; for example, two spatially close neighborhoods may not display any significant interaction if they are separated by a highway. After specifying the functional forms of these relationships, the analyst can estimate model parameters using observed flow data and standard estimation techniques such as ordinary least squares or maximum likelihood. Competing destinations versions of spatial interaction models include the proximity among the destinations or origins in addition to the origin-destination proximity; this captures the effects of destination origin clustering on flows. Computational methods such as artificial neural networks can also estimate spatial interaction relationships among locations and can handle noisy and qualitative data. This characteristic is also shared by urban models such as those based on mathematical programming, flows among economic sectors, or bid-rent theory. An alternative modeling perspective is to represent the system at the highest possible level of disaggregation and study the bottom-up emergence of complex patterns and relationships from behavior and interactions at the individual level. Two fundamentally spatial simulation methods are cellular automata and agent-based modeling. Cellular automata modeling imposes a fixed spatial framework such as grid cells and specifies rules that dictate the state of a cell based on the states of its neighboring cells. As time progresses, spatial patterns emerge as cells change states based on their neighbors; this alters the conditions for future time periods. For example, cells can represent locations in an urban area and their states can be different types of land use. Patterns that can emerge from the simple interactions of local land uses include office districts and urban sprawl. Agent-based modeling uses software entities agents that have purposeful behavior goals and can react, interact and modify their environment while seeking their objectives. Unlike the cells in cellular automata, simulysts can allow agents to be mobile with respect to space. For example, one could model traffic flow and dynamics using agents representing individual vehicles that try

to minimize travel time between specified origins and destinations. While pursuing minimal travel times, the agents must avoid collisions with other vehicles also seeking to minimize their travel times. Cellular automata and agent-based modeling are complementary modeling strategies. They can be integrated into a common geographic automata system where some agents are fixed while others are mobile. Initial approaches to CA proposed robust calibration approaches based on stochastic, Monte Carlo methods. The method analyzes the spatial statistics of the geological model, called the training image, and generates realizations of the phenomena that honor those input multiple-point statistics. A recent MPS algorithm used to accomplish this task is the pattern-based method by Honarkhah. This allows the reproduction of the multiple-point statistics, and the complex geometrical features of the training image. Each output of the MPS algorithm is a realization that represents a random field. Together, several realizations may be used to quantify spatial uncertainty. One of the recent methods is presented by Tahmasebi et al. This method is able to quantify the spatial connectivity, variability and uncertainty. Furthermore, the method is not sensitive to any type of data and is able to simulate both categorical and continuous scenarios. CCSIM algorithm is able to be used for any stationary, non-stationary and multivariate systems and it can provide high quality visual appeal model. Geospatial analysis, or just spatial analysis, [33] is an approach to applying statistical analysis and other analytic techniques to data which has a geographical or spatial aspect [34]. Such analysis would typically employ software capable of rendering maps processing spatial data, and applying analytical methods to terrestrial or geographic datasets, including the use of geographic information systems and geomatics. Basic applications[edit] Geospatial analysis, using GIS , was developed for problems in the environmental and life sciences, in particular ecology , geology and epidemiology. It has extended to almost all industries including defense, intelligence, utilities, Natural Resources i. Oil and Gas, Forestry Spatial statistics typically result primarily from observation rather than experimentation. Basic operations[edit] Vector-based GIS is typically related to operations such as map overlay combining two or more maps or map layers according to predefined rules , simple buffering identifying regions of a map within a specified distance of one or more features, such as towns, roads or rivers and similar basic operations. Descriptive statistics, such as cell counts, means, variances, maxima, minima, cumulative values, frequencies and a number of other measures and distance computations are also often included in this generic term spatial analysis. Spatial analysis includes a large variety of statistical techniques descriptive, exploratory , and explanatory statistics that apply to data that vary spatially and which can vary over time. Advanced operations[edit] Geospatial analysis goes beyond 2D and 3D mapping operations and spatial statistics. GIS-based network analysis may be used to address a wide range of practical problems such as route selection and facility location core topics in the field of operations research , and problems involving flows such as those found in hydrology and transportation research. In many instances location problems relate to networks and as such are addressed with tools designed for this purpose, but in others existing networks may have little or no relevance or may be impractical to incorporate within the modeling process. Problems that are not specifically network constrained, such as new road or pipeline routing, regional warehouse location, mobile phone mast positioning or the selection of rural community health care sites, may be effectively analysed at least initially without reference to existing physical networks. Locational analysis "in the plane" is also applicable where suitable network datasets are not available, or are too large or expensive to be utilised, or where the location algorithm is very complex or involves the examination or simulation of a very large number of alternative configurations. Geovisualization â€” the creation and manipulation of images, maps, diagrams, charts, 3D views and their associated tabular datasets. GIS packages increasingly provide a range of such tools, providing static or rotating views, draping images over 2. This latter class of tools is the least developed, reflecting in part the limited range of suitable compatible datasets and the limited set of analytical methods available, although this picture is changing rapidly. All these facilities augment the core tools utilised in spatial analysis throughout the analytical process exploration of data, identification of patterns and relationships, construction of models, and communication of results Mobile Geospatial Computing[edit] Traditionally geospatial computing has been performed primarily

on personal computers PCs or servers. Due to the increasing capabilities of mobile devices, however, geospatial computing in mobile devices is a fast-growing trend. In addition to the local processing of geospatial information on mobile devices, another growing trend is cloud-based geospatial computing. In this architecture, data can be collected in the field using mobile devices and then transmitted to cloud-based servers for further processing and ultimate storage. In a similar manner, geospatial information can be made available to connected mobile devices via the cloud, allowing access to vast databases of geospatial information anywhere where a wireless data connection is available. Geographic information science and spatial analysis[edit] Further information: The increasing ability to capture and handle geographic data means that spatial analysis is occurring within increasingly data-rich environments. Geographic data capture systems include remotely sensed imagery, environmental monitoring systems such as intelligent transportation systems, and location-aware technologies such as mobile devices that can report location in near-real time. GIS provide platforms for managing these data, computing spatial relationships such as distance, connectivity and directional relationships between spatial units, and visualizing both the raw data and spatial analytic results within a cartographic context. Content[edit] Spatial location: Transfer positioning information of space objects with the help of space coordinate system. Projection transformation theory is the foundation of spatial object representation. Geovisualization GVis combines scientific visualization with digital cartography to support the exploration and analysis of geographic data and information, including the results of spatial analysis or simulation. GVis leverages the human orientation towards visual information processing in the exploration, analysis and communication of geographic data and information. In contrast with traditional cartography, GVis is typically three- or four-dimensional the latter including time and user-interactive. Geographic knowledge discovery GKD is the human-centered process of applying efficient computational tools for exploring massive spatial databases. GKD includes geographic data mining , but also encompasses related activities such as data selection, data cleaning and pre-processing, and interpretation of results. GVis can also serve a central role in the GKD process. GKD is based on the premise that massive databases contain interesting valid, novel, useful and understandable patterns that standard analytical techniques cannot find. GKD can serve as a hypothesis-generating process for spatial analysis, producing tentative patterns and relationships that should be confirmed using spatial analytical techniques. Spatial decision support systems SDSS take existing spatial data and use a variety of mathematical models to make projections into the future. This allows urban and regional planners to test intervention decisions prior to implementation.

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Chapter 2 : An overview of the Measuring Geographic Distributions toolsetâ€”ArcGIS Pro | ArcGIS Desktop

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Range[edit] In biology , the range of a species is the geographical area within which that species can be found. Within that range, distribution is the general structure of the species population , while dispersion is the variation in its population density. Range is often described with the following qualities: Many terms are used to describe the new range, such as non-native, naturalized, introduced , transplanted, invasive , or colonized range. For species for which only part of their range is used for breeding activity, the terms breeding range and non-breeding range are used. For mobile animals, the term natural range is often used, as opposed to areas where it occurs as a vagrant. Geographic or temporal qualifiers are often added, such as in British range or pre range. The typical geographic ranges could be the latitudinal range and elevational range. Disjunct distribution occurs when two or more areas of the range of a taxon are considerably separated from each other geographically. Factors affecting distribution[edit] Distribution patterns may change by season , distribution by humans, in response to the availability of resources, and other abiotic and biotic factors. There are three main types of abiotic factors: An example of the effects of abiotic factors on species distribution can be seen in drier areas, where most individuals of a species will gather around water sources, forming a clumped distribution. Arcod is part of the Census of Marine Life, a huge year project involving researchers in more than 80 nations that aims to chart the diversity, distribution and abundance of life in the oceans. Marine Life has become largely affected by increasing effects of global warming. This study shows that as the ocean temperatures rise species are beginning to travel into the cold and harsh Arctic waters. Biotic[edit] Biotic factors such as predation, disease, and competition for resources such as food, water, and mates, can also affect how a species is distributed. Due to limited resources, populations may be evenly distributed to minimize competition, [4] as is found in forests, where competition for sunlight produces an even distribution of trees. For example, large tankers often fill their ballasts with water at one port and empty them in another, causing a wider distribution of aquatic species. Patterns on large scales[edit] On large scales, the pattern of distribution among individuals in a population is clumped. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. A second example, some species of bird depend on water, usually a river, swamp, etc. A separate example of a river corridor would be a river corridor that includes the entire drainage, having the edge of the range delimited by mountains, or higher elevations; the river itself would be a smaller percentage of this entire wildlife corridor, but the corridor is created because of the river. A further example of a bird wildlife corridor would be a mountain range corridor. Bird species in these corridors are connected to a main range for the species contiguous range or are in an isolated geographic range and be a disjunct range. Birds leaving the area, if they migrate , would leave connected to the main range or have to fly over land not connected to the wildlife corridor; thus, they would be passage migrants over land that they stop on for an intermittent, hit or miss, visit. Patterns on small scales[edit] Three basic types of population distribution within a regional range are from top to bottom uniform, random, and clumped. On large scales, the pattern of distribution among individuals in a population is clumped. On small scales, the pattern may be clumped, regular, or random. In clumped distribution, the distance between neighboring individuals is minimized. This type of distribution is found in environments that are characterized by patchy resources. Individuals might be clustered together in an area due to social factors such as selfish herds and family groups. Organisms that usually serve as prey form clumped distributions in areas where they can hide and detect predators easily. Other causes of clumped distributions are the inability of offspring to independently move from their habitat. This is seen in juvenile animals that are immobile and strongly dependent upon parental care. Clumped distribution can be beneficial to the individuals in that group.

However, in some herbivore cases, such as cows and wildebeests, the vegetation around them can suffer, especially if animals target one plant in particular. Clumped distribution in species acts as a mechanism against predation as well as an efficient mechanism to trap or corner prey. African wild dogs, Lycaon pictus , use the technique of communal hunting to increase their success rate at catching prey. Studies have shown that larger packs of African wild dogs tend to have a greater number of successful kills. A prime example of clumped distribution due to patchy resources is the wildlife in Africa during the dry season; lions, hyenas, giraffes, elephants, gazelles, and many more animals are clumped by small water sources that are present in the severe dry season. The reasoning behind this is that they share traits that increase vulnerability to extinction because related taxa are often located within the same broad geographical or habitat types where human-induced threats are concentrated. Using recently developed complete phylogenies for mammalian carnivores and primates it has been shown that the majority of instances threatened species are far from randomly distributed among taxa and phylogenetic clades and display clumped distribution. Uniform distributions are found in populations in which the distance between neighboring individuals is maximized. The need to maximize the space between individuals generally arises from competition for a resource such as moisture or nutrients, or as a result of direct social interactions between individuals within the population, such as territoriality. For example, penguins often exhibit uniform spacing by aggressively defending their territory among their neighbors. The burrows of great gerbils for example are also regularly distributed, [10] which can be seen on satellite images. Salvia leucophylla is a species in California that naturally grows in uniform spacing. This flower releases chemicals called terpenes which inhibit the growth of other plants around it and results in uniform distribution. Allelopathy can have beneficial, harmful, or neutral effects on surrounding organisms. Some allelochemicals even have selective effects on surrounding organisms; for example, the tree species Leucaena leucocephala exudes a chemical that inhibits the growth of other plants but not those of its own species, and thus can affect the distribution of specific rival species. Allelopathy usually results in uniform distributions, and its potential to suppress weeds is being researched. Random[edit] Random distribution, also known as unpredictable spacing, is the least common form of distribution in nature and occurs when the members of a given species are found in environments in which the position of each individual is independent of the other individuals: Random distribution is rare in nature as biotic factors, such as the interactions with neighboring individuals, and abiotic factors, such as climate or soil conditions, generally cause organisms to be either clustered or spread. Random distribution usually occurs in habitats where environmental conditions and resources are consistent. This pattern of dispersion is characterized by the lack of any strong social interactions between species. For example; When dandelion seeds are dispersed by wind, random distribution will often occur as the seedlings land in random places determined by uncontrollable factors. Oyster larvae can also travel hundreds of kilometers powered by sea currents, which can result in their random distribution. Statistical determination of distribution patterns[edit] There are various ways to determine the distribution pattern of species. The Clarkâ€”Evans nearest neighbor method [14] can be used to determine if a distribution is clumped, uniform, or random. The distance of an individual to its nearest neighbor is recorded for each individual in the sample. To receive accurate results, it is suggested that the number of distance measurements is at least The average distance between nearest neighbors is compared to the expected distance in the case of random distribution to give the ratio:

Chapter 3 : Geographic vs. Geographical | GeoBuzz

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Globalization and International Trade Author: Jean-Paul Rodrigue International trade is an exchange of goods or services across national jurisdictions. Inbound trade is defined as imports and outbound trade is defined as exports. International trade is subject to the regulatory oversight and taxation of the involved nations, namely through customs. The Flows of Globalization In a global economy, no nation is self-sufficient, which is associated with specific flows of goods, people and information. Each nation is involved at different levels in trade to sell what it produces, to acquire what it lacks and also to produce more efficiently in some economic sectors than its trade partners. It now plays an even more active part in the economic life of nations and regions, but trade should be taking place only if there is a benefit for the partners involved. Trade can be a convenience, but also a necessity. It is a convenience, as supported by conventional economic theory , when trade promotes economic efficiency by providing a wider variety of goods, often at lower costs, notably because of specialization, economies of scale and the related comparative advantages. It is a necessity when trade enables to acquire goods that would otherwise not be available in a national economy such as energy, minerals or food. However, the benefits of trade can be subject to contention with several theoretical foundations of international trade articulated to provide an explanation of its rationale: A trade system where a nation tried to impose a positive trade balance more exports than imports, particularly value-wise on other nations to favor the accumulation of wealth. This system was prevalent during the colonial era and often undertaken by charter companies receiving a monopoly on trade. Mercantilism represents the antithesis of free trade since trade relations are controlled and aligned to benefit one partner at the expense of the other. Still, mercantilism established the foundations of a global trading system, albeit an unequal one. A more recent trade system, which like mercantilism leans on establishing a positive trade balance to meet economic development goals. Export-oriented strategies can be considered a form of neomercantilism, particularly if a government establish an incentive and subsidy system e. Neomercantilism can also be a response by some governments to the competitive and disruptive consequences of free trade, particularly if the trade partners are engaged in neomercantilist strategies. The outcome is tariff and non-tariff measures regulating trade and protecting national commercial sectors that are perceived to be subject to unfair competition. Therefore, neomercantilist strategies can be controversial and subject to contention. Based on a nation or a firm able to produce more effectively in an economic sector while using less resources e. It therefore has an absolute advantage. Global efficiency can thus be improved with trade as a nation can focus on its absolute advantages, trade its surplus and import what it lacks. The drawback of this perspective is that in theory nations having no absolute advantages should not be involved in trade since they may have little to gain from it. Absolute advantages tend to be an enduring characteristic, particularly for resources where large producers keep an advantage as long as a resource is available or has a market. Even if a nation or a firm has absolute advantages over a wide array of economic sectors, it can focus on the sectors it has the highest comparative advantages the difference of its production costs and those of its competitors and import goods in sectors it has less comparative advantages. The comparative productivity increases the total production level since that even if a nation or a firm has no absolute advantages, it can focus on sectors where the total productivity gains are the most significant. A comparative advantage can also be the outcome of economies of scale applied to a product or sector where the resulting lower costs provides competitiveness. Comparative advantages tend to be a temporary characteristic, that can change with the evolution of labor costs and technology. Expands the comparative advantages perspective by underlining that trade is related to the factors endowments of a nation. The most basic endowments are capital, land and labor. A nation will export goods to which it has notable factor endowments and imports goods in which it has scarce factor endowments. As such, nations that have low cost labor available will focus in labor intensive activities while nations having high capital endowments

will focus in capital intensive activities. Factor endowments can be improved through capital and human resources investments. This process has been facilitated by significant technical changes in the transport sector. It has become increasingly possible to trade between parts of the world that previously had limited access to international transportation systems. Further, the division and the fragmentation of production that went along with these processes also expanded trade. Trade thus contributes to lower manufacturing costs. Without international trade, few nations could maintain an adequate standard of living, particularly those of smaller size. With only domestic resources being available, each country could only produce a limited number of products and shortages would be prevalent. Global trade allows for an enormous variety of resources â€" from Persian Gulf oil, Brazilian coffee to Chinese labor â€" to be made more widely accessible. It also facilitates the distribution of a wide range of manufactured goods that are produced in different parts of the world to global markets. Wealth becomes increasingly derived through the regional specialization of economic activities. This way, production costs are lowered, productivity rises and surpluses are generated, which can be transferred or traded for commodities that would be too expensive to produce domestically or would simply not be available. As a result, international trade decreases the overall costs of production worldwide. Consumers can buy more goods from the wages they earn, and standards of living should, in theory, increase. These interdependencies imply numerous relationships where flows of capital, goods, raw materials, people and services are established between regions of the world. International trade is also subject to much contention since it can at time be a disruptive economic and social force as it changes the conditions in which wealth is distributed within a national economy, particularly due to changes in prices and wages. One particular challenge concerns the substitution of labor and capital. While in a simple economy labor and capital infrastructures can be reconverted to other uses, in complex economies labor and capital cannot be easily reallocated. Therefore, trade can at the same time lead to more goods being available at a lower price, but with enduring unemployment and decaying infrastructures unused factories and connectors. In turn, this can incite economies to adopt protectionist policies since this transition is judged to be too disruptive. The Setting of the Contemporary Global Trade System International trade, both in terms of value and tonnage, has been a growing trend in the global economy. It is important to underline when looking at the structure of global trade that it is not nations that are trading, but mostly corporations with the end products consumed in majority by individuals. The nation is simply a regulatory unit where data is collected since freight movements crossing boundaries are subject to customs oversight and tabulated as trade flows. Inter and intra corporate trade is taking place across national jurisdictions is accounted as international trade. The emergence of the current structure of global trade can mainly be articulated within three major phases: First phase immobile factors of production. Concerns a conventional perspective on international trade that prevailed until the s where factors of production were much less mobile. Prior to the end of World War I, global trade was mainly structured by colonial relations, but was fairly unregulated. There was a limited level of mobility of raw materials, parts and finished products. After World War I international trade became fairly regulated with impediments such tariffs, quotas and limitations to foreign ownership. Trade mainly concerned a range of specific products, namely commodities and very few services that were not readily available in regional economies. Due to regulations, protectionism and fairly high transportation costs, trade remained limited and delayed by inefficient freight distribution. In this context, trade was more an exercise to cope with scarcity than to promote economic efficiency. Second phase mobility of factors of production. From the s, the mobility of factors of production, particularly capital, became possible. The legal and physical environment in which international trade was taking place lead to a better realization of the comparative advantages of specific locations. In addition, containerization provided the capabilities to support more complex and long distance trade flows, as did the growing air traffic. Due to high production legacy costs in old industrial regions, activities that were labor intensive were gradually relocated to lower costs locations. The process began as a national one, then went to nearby countries when possible and afterwards became a truly global phenomenon. Thus, foreign direct investments surged, particularly towards new manufacturing regions as multinational

corporations became increasingly flexible in the global positioning of their assets. Third phase global production networks. There is a growth in international trade, now including a wide variety of services that were previously fixed to regional markets and a surge in the mobility of the factors of production. Since these trends are well established, the priority is now shifting to the geographical and functional integration of production, distribution and consumption with the emergence of global production networks. Complex networks involving flows of information, commodities, parts and finished goods have been set, which in turn demands a high level of command of logistics and freight distribution. In such an environment, powerful actors have emerged which are not directly involved in the function of production and retailing, but mainly taking the responsibility of managing the web of flows. International trade requires a full array of services related to distribution and transactions. The volume of exchanged goods and services between nations is taking a growing share of the generation of wealth, mainly by offering economic growth opportunities in new regions and by reducing the costs of a wide array of manufacturing goods. Trade Costs and Facilitation The facilitation of trade involves how the procedures regulating the international movements of goods can be improved so that actors involved in international trade have move efficient formalities. For regulatory authorities, trade facilitation improves their effectiveness as well as reducing the risk of custom duty evasion. It depends on the reduction of the general costs of trade, which considers transaction, tariff, transport and time costs. These trade costs are derived from two main sources: These are usually exogenous factors separating two trade partners such as distance, transportation costs, travel time, as well as common attributes shared by trade partners. These usually involves being part of an economic agreement e. Relates endogenous to factors that are either related to the origin or the destination of trade. This usually involves customs procedures tariffs and non-tariffs , the overall performance of the national transport and logistic sector and how well an economy is connected to the international transport system through its gateways mostly ports and airports. Thus, the ability to compete in a global economy is dependent on the transport system as well as a trade facilitation framework: A multimodal and intermodal freight transport system composed of modes, infrastructures and terminals that spans across the globe. It insures a physical capacity and connectivity to support trade and its underlying supply chains. Customs procedures, tariffs, regulations and handling of documentation. They insure that trade flows abide to the rules and regulations of the jurisdictions they cross. Cross-border clearance, particularly in developing countries, can be a notable trade impediment with border delays, bottlenecks and long customer clearance times. This underlines the need for enforcing revenue collection so that income from trade is taking place according to established rules. Customs fraud often takes place where revenue collection is lacking and requires accurate product valuation and labeling. Banking, finance, legal and insurance activities where accounts can be settled and risk mitigated. They insure that the sellers of goods and services are receiving an agreed upon compensation and that the purchasers have a legal recourse if the outcome of the transaction is judged unsatisfactory or is insured if a partial or full loss incurs. Improving the transactional efficiency of trade can also lead to more opportunities for fraud. Trade misinvoicing is a common form of transactional fraud and is reported to be the largest source of illicit financial outflows in the world.

Chapter 4 : Globalization and International Trade | The Geography of Transport Systems

The study of health and disease within a geographic context and from a geographical perspective. Among other things, medical geography looks at sourcesm diffusion routes, and distributions of diseases.

These three perspectives can be represented as dimensions of a matrix of geographic inquiry as shown in Figure 3. Spatial representation, the third dimension of the matrix, underpins and sometimes drives research in other branches of geography. Such research benefits not only from bringing into one analysis ideas that are often treated separately in other disciplines but also from critically examining the disjunctures and contradictions among the ways in which different disciplines examine identical phenomena. Page 30 Share Cite Suggested Citation: New Relevance for Science and Society. The National Academies Press. Geographers focus on "real world" relationships and dependencies among the phenomena and processes that give character to any location or place. Geographers also seek to understand relationships among places: Geographers also focus on the importance of scale in both space and time in these relationships. The study of these relationships has enabled geographers to pay attention to complexities of places and processes that are frequently treated in the abstract by other disciplines. Integration in Place Places are natural laboratories for the study of complex relationships among processes and phenomena. Geography has a long tradition of attempting to understand how different processes and phenomena interact in regions and localities, including an understanding of how these interactions give places their distinctive character. The systematic analysis of social, economic, political, and environmental processes operating in a place provides an integrated understanding of its distinctiveness or character. Research in this tradition since has shown that the temporal and spatial sequences of actions of individuals follow typical patterns in particular types of environments and that many of the distinctive characteristics of places result from an intersection of behavioral sequences constrained by spatial accessibility to the opportunities for interaction. Such systematic analysis is particularly central to regional and human geography, and it is a theme to which much geographic research continually returns. When such systematic analysis is applied to many different places, an understanding of geographic variability emerges. Of course, a full analysis of geographic variability must take account of processes that cross the boundaries of places, linking them to one another, and also of scale. Interdependencies Between Places Geographers recognize that a "place" is defined not only by its internal characteristics but also by the flows of people, materials e. These flows introduce interdependencies between places that can either reinforce or reduce differences. For example, very different agricultural land-use practices have evolved under identical local environmental conditions as a result of the distance to market affecting the profitability of crops. At a macroscale, the widespread and global flow of Western cultural values and economic systems has served to reduce differences among many peoples of the world. An important focus of geography is on understanding these flows and how they affect place. The challenge of analyzing the flows and their impacts on place is considerable. Such relationships have all the characteristics of complex nonlinear systems whose behavior is hard to represent or predict. These relationships are becoming increasingly important for science and decision making, as discussed in Chapters 5 and 6. Interdependencies Among Scales Geographers recognize that the scale of observation also matters for understanding geographic processes and phenomena at a place. Although geography is concerned with both spatial and temporal scales, the enduring dimension of the geographic perspective is the significance of spatial scales, from the global to the highly local. Geographers have noted, for example, that changing the spatial scale of analysis can provide important insights into geographic processes and phenomena and into understanding how processes and phenomena at different scales are related. A long-standing concern of geographers has been the "regionalization problem," that is, the problem of demarcating contiguous regions with common geographic characteristics. Geographers recognize that the internal complexity and differentiation of geographic regions is scale-dependent and, thus, that a particular set of regions is always an incomplete and possibly misleading representation of geographic variation. Identifying

the scales at which particular phenomena exhibit maximum variation provides important clues about the geographic, as well as the temporal, scope of the controlling mechanisms. For example, spectral analyses of temperature data, revealing the geographic scales at which there is maximum similarity in temperature, can provide important clues about the relative influence of microclimates, air masses, and global circulation on temperature patterns. A global rise in average temperature could have highly differentiated local impacts and may even produce cooling in certain localities because of the way in which global, regional, and local processes interact. By the same token, national and international economic and political developments can have highly differentiated impacts on the economic competitiveness of cities and states. The focus on scale enables geographers to analyze the impact of global changes on local eventsâ€”and the impact of local events on global changes. Page 32 Share Cite Suggested Citation: There are two other important domains of synthesis within geography as well: The relationships that it studiesâ€”the dynamics relating society and its biophysical environmentâ€”today are not only a core element of geography but are also of increasingly urgent concern to other disciplines, decision makers, and the public. Although the work of geographers in this domain is too varied for easy classification, it includes three broad but overlapping fields of research: Human Use of and Impacts on the Environment Human actions unavoidably modify or transform nature; in fact, they are often intended specifically to do so. These impacts of human action have been so extensive and profound that it is now difficult to speak of a "natural" environment. Geographers have contributed to at least three major global inventories of human impacts on the environment Thomas, ; Turner et al. Studies at local and regional levels have clarified specific instances of human-induced landscape transformation: Geographers study the ways in which society exploits and, in doing so, 2 Citations in this section do not refer to major research contributions since these are the focus of Chapter 5. They refer the reader to books and articles that provide a more detailed discussion of the topic than can be provided here. Page 33 Share Cite Suggested Citation: Geographers ask why individuals and groups manipulate the environment and natural resources in the ways they do Grossman, ; Hecht and Cockburn, They have examined arguments about the roles of carrying capacity and population pressures in environmental degradation, and they have paid close attention to the ways in which different cultures perceive and use their environments Butzer, They have devoted considerable attention to the role of political-economic institutions, structures, and inequities in environmental use and alteration, while taking care to resist portraying the environment as an empty stage on which social conflicts are acted out Grossman, ; Zimmerer, ; Carney, Environmental Impacts on Humankind Consequences for humankind of change in the biophysical environmentâ€”whether endogenous or human-inducedâ€”are also a traditional concern for geographers. For instance, geographers were instrumental in extending the approaches of environmental impact analysis to climate. They have produced important studies of the impact of natural climate variation and projected human-induced global warming on vulnerable regions, global food supply, and hunger. They have studied the impacts of a variety of other natural and environmental phenomena, from floods and droughts to disease and nuclear radiation releases Watts, ; Kates et al. These works have generally focused on the differing vulnerabilities of individuals, groups, and geographic areas, demonstrating that environmental change alone is insufficient to understand human impacts. Rather, these impacts are articulated through societal structures that give meaning and value to change and determine in large part the responses taken. Human Perceptions of and Responses to Environmental Change Geographers have long-recognized that human-environment relations are greatly influenced not just by particular activities or technologies but also by the very ideas and attitudes that different societies hold about the environment. Geographers have also recognized that the impacts of environmental change on human populations can be strongly mitigated or even prevented by human action. Accurate perception of change and its consequences is a key component in successful mitigation strategies. Geographers studying hazards have made important contributions to understanding how perceptions of risk vary from reality Tuan, and how communication of risk can amplify or dampen risk signals Palm, ; Kasperson and Stallen, Accurate perceptions of available mitigation strategies is an important aspect Page 34 Share Cite Suggested Citation: In the case of floodplain occupancy, for instance,

such options include building flood control works, controlling development in flood-prone areas, and allowing affected individuals to absorb the costs of disaster. In the case of global climate change, options range from curtailing greenhouse gas e. Geographers have assembled case studies of societal responses to a wide variety of environmental challenges as analogs for those posed by climate and other environmental change and have examined the ways in which various societies and communities interpret the environments in questions Jackson, ; Demeritt, ; Earle, Environmental Dynamics Geographers often approach the study of environmental dynamics from the vantage point of natural science Mather and Sdasyuk, Society and its roles in the environment remain a major theme, but human activity is analyzed as one of many interrelated mechanisms of environmental variability or change. Efforts to understand the feedbacks among environmental processes, including human activities, also are central to the geographic study of environmental dynamics Terjung, As in the other natural sciences, advancing theory remains an overarching theme, and empirical verification continues to be a major criterion on which efficacy is judged. Physical geography has evolved into a number of overlapping subfields, although the three major subdivisions are biogeography, climatology, and geomorphology Gaile and Willmott, Those who identify more with one subfield than with the others, however, typically use the findings and perspectives from the others to inform their research and teaching. Boundaries between the subfields, in turn, are somewhat blurred. Biogeographers, for example, often consider the spatial dynamics 3 of climate, soils, and topography when they investigate the changing distributions of plants and animals, whereas climatologists frequently take into account the influences that landscape heterogeneity and change exert on climate. Geomorphologists also account for climatic forcing and vegetation dynamics on erosional and depositional process. The three major 3 The term spatial dynamics refers to the movement, translocation of, or change in phenomena both natural and human over geographic space. The study of spatial dynamics focuses on the natural, social, economic, cultural, and historical factors that control or condition these movements and translocations. Page 35 Share Cite Suggested Citation:

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maps that show the distribution, flow or connection of one or more characteristics and are used to show distribution. travel distance the distance traveled between places based on existing transportation routes.

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Construct a story built on spatial concepts using directions, locations, distances, and movements in the plot (e.g., cardinal directions, relative and exact locations, real or imaginary locations, statements of distances).