Climate Judiciary Project

Climate Science and Law

Course curriculum

DISCUSSION DRAFT

September 28, 2020

Curriculum Concept

This course is designed to teach judges about the science of climate change, to describe how that science comes into play in judicial decisions, and to equip them to better manage science information. The course is intended to help judges understand how climate science works and what climate science has established as known (to greater or lesser degrees of certainty). The course is also intended to inform judges of how economics factors into legal questions related to climate change, both in terms of costs from impacts and benefits from mitigation, but also how and to what degree economics can be used to change behavior. The course will cover public health and will also address disparities in impacts experienced by different groups.

The course is not intended to influence the outcome of any particular cases. Rather, to help judges meaningfully understand how climate science is applied to the law, the course will introduce judges to key cases, litigation trends, and thorny aspects of cases involving science. Nor is the course intended to survey all climate litigation but rather to familiarize judges with the kinds of cases they might see. It is intended to help them to manage the often-complex cases and to rule on issues involving emerging science. The course will also illuminate differences in concepts, terminology, and approaches between science and the law.

The course avoids raising policy questions as much as possible, but in discussing the science of climate change, the impacts, and the jurisprudence, issues of policy will inevitably arise. The course will be presented from a fact-based stance and is designed not to influence policy decisions.

At the completion of the course, participants will be familiar with key concepts in climate science, scientific approaches and methods, and trends in litigation related to climate change. They will be better equipped to handle scientific information, manage complex science-related cases, and know where to look for resources to provide needed support on these issues.

Questions our Curriculum Seeks to Answer
To Help Judges in Climate-Related Cases

(elaboration of sub-questions in italics where needed)

1. Are there trends in legal theories, and recent changes in those trends, in cases involving impacts of climate change?
2. What does climate science say about whether natural climate patterns have changed since the industrial revolution?
3. What does climate science know about the causes of change in natural climate patterns?
4. How does science determine what is known?
5. Are there differences between scientific and legal approaches to drawing conclusions?
    a. *How are scientific standards and methods similar to legal requirements and process?*
    b. *How do methods and process of science differ from the legal process?*
    c. *How is the burden of proof in law different from standards for accepting a model or theory in science?*
6. Does science have an objective way of differentiating between conclusions with a high degree of certainty and those that are less certain?
    a. *What is the definition of "uncertainty" in science and how does it differ from common or legal usage?*
7. Climate science assigns greater or lesser confidence to what it knows. In recent years, have there been observed changes in climatic conditions and climate science itself in which scientists have a high degree of confidence?
    a. *Are physical effects in nature like heat waves, heavy downpours and extreme flooding, droughts, coastal erosion, hurricanes, sea-level rise, and other phenomena changing, and if so how do scientists know that they are changing? When is human activity a cause or contributor to these?*
    b. *How strong is the attribution of classes of events or specific injury or economic damage from individual events to emissions of greenhouse gases?*
8. How are statistics used (or misused) to convey scientific information?
9. What are some misleading heuristics or cognitive biases, such as the argument that extreme cold waves disprove that the planet is warming, that science must attempt to counter in communicating the science of climate change?
10. What do scientists understand about whether the changes in climatic patterns cause impacts on humanity, society, biodiversity and ecosystems, and nature broadly?
    a. *What is known about whether these impacts will affect different groups of people in different ways?*
    b. *And thus, how government decisions will relate to these impacts or things that mitigate or contribute to them.*

11. What is known about possible ways to stem climate change and reduce its impacts? To what degree is there a scientific consensus about how to achieve these goals?
    a. *Where does the global goal of keeping warming "well below 2 degrees C" come from, and how does it play out in actions of nations and groups to mitigate climate change?*
12. Do legal decisions ever turn on climate science information or evidence?
13. What decisions do judges have to make that rely on climate science information or evidence?
    a. *What is the role of climate science in establishing standing of plaintiffs?*
    b. *Does climate science ever figure into the merits of a case?*
    c. *Assessing the reasonableness of government decision-making?*
    d. *Identifying government obligations in light of statutory, constitutional, or common law rights?*
    e. *Identifying private or corporate obligations in light of statutory, constitutional, or common law rights?*
    f. *Identifying liability and determining damages?*
14. How can judges identify reliable scientific information?
    a. *Is there a body of widely-accepted, authoritative scientific literature that judges may draw upon? (E.g. Manual on Scientific Evidence, National Academies-Royal Society Twenty Questions report, National Academies' Extreme Weather Attribution Report, IPCC fifth and special reports, etc.) How should they access it?*
    b. *What are the institutions and norms in science that judges should be aware of in establishing scientific facts?*
15. What significant legal questions arise in cases involving climate change?
    a. *How are state and federal standards of deference to agencies applied and changing?*
16. Can courts rely on scientific information that is not 100% certain or that cannot show causation with absolute certainty?
    a. *Can climate risk for particular events or categories of events and effects be calculated, monetarily and non-monetarily?*
    b. *Can the costs of specific effects of GHG emissions and the total costs to society of these effects be calculated?*
17. What remedies are available to judges in cases addressing issues related to and seeking redress of impacts of climate change?
18. How do differences in judicial philosophies affect judicial views of how far courts should go in climate cases?

Curriculum Framework

I. <u>Introduction</u>: In this module, we introduce the course by briefly summarizing the structure and content of its 14 self-contained modules, explain why the topics should matter to judges, and lay out the goals of the course. Introducing the central idea that climate change and its human cause are now as certain as science can determine, we present key scientific concepts (and examples of how they have arisen in cases) that will be amplified in later modules and related to the kinds of cases filed or expected.

A. Brief overview of the whole curriculum and goals of the course
    1. Why this course matters (to judges) – not just high profile cases but also more common tort, flood insurance, land use/zoning, and development permitting cases
    2. Scientists agree that the climate is changing and that the change is human-caused
    3. Where there is lack of consensus or disagreement among scientists, it is about subsidiary aspects such as scientific uncertainty in estimates of climate sensitivity (the amount of additional heating from a given amount of greenhouse gas emissions)
    4. It is important to differentiate between observed effects, either past or present, and projected changes. There is a high degree of certainty about *past concentrations* of atmospheric CO2 because of direct measurements of trapped gases in ice cores, for example, but there is large uncertainty in *projections* of the rate of global warming based on climate sensitivity. That is to say, science is sure of the first, not so of the second

B. Overview of key climate science concepts:
    1. Key terms (weather v. climate; global warming v. climate change (expressions of climate variability including heat waves, drought, floods, El Nino and others))
    2. Lines of evidence for climate change
        a. Geologic records
        b. Historical records and observations
        c. Physical Understanding and Models—give an example of modeling outside the climate field, one that is tested by its capacity to predict (e.g., wind tunnel and computer flow simulations are models that use physical laws of air flow accurately to design airplanes that safely fly)
    3. Uncertainty
        a. Uncertainty in everyday life
        b. Uncertainty in science
        c. Decision-making takes place all the time with uncertainty (even the *beyond-a-reasonable-doubt standard* does not require absolute certainty)
    4. Attribution

5. Economics: risk assessment, cost-benefit analysis, challenges in pricing carbon

C. Overview of the kinds of cases in which questions of climate science are arising with brief mention of some of the most important precedents and current trends (including related to remedies)
D. An example of how methods of science and law are similar and different (e.g. standards of evidence/establishing scientific facts?) (transition to II)

Part One: *Scientific Foundations of Climate Change* (touching on examples of differences between science and law)

II. **<u>How (climate) science works</u>: This module introduces approaches, principles, and methods that are commonly referred to in climate science, including as employed by different disciplines such as a climatology or epidemiology. Here we also discuss how scientists develop confidence in a fact, express uncertainty, and invoke institutions of science as validators.**

A. Approaches and principles, using examples
    1. Pursuit of ideal of objective reality; rational, evidence-based, rigorous (in common with law); independent of observer
    2. Perpetual pursuit of verifiable facts, progressing to deeper and wider understanding of nature
    3. Reproducible, explanatory and predictive
    4. Definition and role of theory, observation, and experiment
B. The iterative nature of the scientific enterprise -- we develop a working idea and test whether it –or parts of it—is borne out by real world measurements
C. Refining the theory by seeing how well it reflects observation and its capacity to predict; an example like polar ice melting and slowing of the earth's rotation
    1. Discuss the predictive accuracy of past climate models (<u>shown</u> to be rather high)
    2. Debunk the oft-heard myth that in the 1970s scientists were predicting global cooling (<u>see this</u> and <u>this</u>). Label it a "zombie theory" like vaccines and autism
D. Consilience, consensus, confidence—multiple independent lines of evidence; developing mainstream view, what is rock solid (and what is just emerging)
E. Acceptance and quantification of uncertainty—and when uncertainty does and doesn't matter
    1. Introduction to statistics
F. Institutions and consensus—peer review, consensus reports, academies, assessments—science as a social enterprise (emphasizing the incentives and contentious nature of the peer review process)
    1. Introduce authoritative examples including the IPCC and USGCRP

        a. Explanation of the IPCC process and the implications of getting consensus

G. How do we know that the climate is changing—techniques and methods
    1. Geological—sediments, ice cores, tree rings, etc.
    2. Historical—atmospheric CO_2 concentrations, temperature records
    3. Models and accepted earth science reasoning
H. Introduction to the Earth System (system of energy/heat from the sun interacting with atmosphere, water, earth and how carbon fits in) (transition to III)

III. **<u>What is causing climate change</u>: This module describes the dynamics of the earth system and through them a predictive explanation of global warming from emissions of greenhouse gases**.

A. Greenhouse effect
B. Climate forcers—natural and human-caused
    1. Solar radiation
    2. Greenhouse gases (GHGs)—kinds of emissions, e.g. CO_2, CH_4, NO_X, CFCs, and HFCs
    3. Aerosols, clouds, etc.
    4. Polar ice
C. Kinds of contributors, sources and sinks
    1. Economic sectors-transportation (personal, aviation, shipping), electricity, Industrial, etc.
    2. Agriculture
    3. Deforestation
    4. Forests and land use
    5. Oceans
D. The causal connection to impacts (transition to IV)

IV. **<u>Impacts of Climate Change</u>: In this module, we introduce the main consequences of increased heating of the planet and the causal connection between emissions and impacts.**

A. Climate Risk
    1. Hazards—the direct effects of heating the Earth System
        a. Sea-level rise (SLR)
        b. Extreme weather
        c. Rising average temperatures
    2. Vulnerability
        a. Define—degree of susceptibility to hazards of humans, natural and social systems
    3. Exposure

        a. Define—degree of subjecting people, natural and social systems to hazards
    4. Risk—the intersection of these three components (Venn Diagram)
    5. Adaptation and resilience—ways to mitigate or ameliorate climate risk
B. Impact effects, and the degree to which they can be reduced by mitigation or adaptation, or remain residual
    1. Biodiversity loss (including economic implications)
    2. Habitat destruction
    3. Health impacts—malnutrition, vector-borne diseases, heat-related illness, health system stress…
    4. Societal impacts
        a. Food and water insecurity
        b. Social stress, political instability
        c. Loss of livelihood, economic instability
        d. Coastal flooding and retreat
        e. Migration
        f. Pandemics and habitat decline
    5. Financial impacts (tax bases of municipalities/coastal properties)
        a. this includes legal implications such as lawsuits over municipal responsibility to adapt, responsibilities to disclose in a bond offering, foreclosure issues if property values decline, takings issues if a municipality prohibits building, and that's just on his examples about financial impacts. Biodiversity loss and habitat destruction obviously raise Endangered Species Act issues. Flooding and sea level rise are part of the nuisance cases.
C. Introduce topic of attribution of these impacts to GHG emissions (foreshadow transition to VI) and the economic considerations (transition to V)

V. <u>Quantifying climate risk and costs (mitigation and adaptation)</u>: This module offers some approaches and tools for calculating costs associated with climate risk in the short and long term, and economics of solutions including a price on carbon and creation of carbon markets.

A. Overview of relevant risk analysis concepts (see, for example this)
B. Overview of relevant economic concepts and techniques
    1. Social cost of carbon
    2. Emerging consensus on discount rates
    3. Non-monetary costs and benefits
C. Challenges in calculating climate risks and costs
    1. Carbon pricing
    2. Calculating climate risks
        a. FEMA flood maps and their insufficiency for calculating flood risk
        b. Uncertainties in weather events and heat

c. Estimating emissions (Representative Concentration Pathways or RCPs)
d. Estimating magnitude of losses

D. Quantifying short term and long term choices between predicted costs and benefits
    1. Short and long term
    2. Low (no-) regrets adaptation
E. Introduction to attribution science (transition to VI)

VI. **<u>Drawing the causal chain</u>: This module sets out the science of detection and attribution, and how attribution attempts to establish a causal chain from emission sources to impacts and costs, and introduces how attribution is being used in cases.**

A. Kinds of attributions to greenhouse gas emissions
    1. Climate change attribution to emissions—overall heating of the planet
    2. Attribution of climate change events—assigning probabilities that emissions caused classes of events, extreme or not
    3. Extreme event attribution—using multiple methods to raise confidence
    4. Impact attribution—attributing impacts to heating regardless of cause
    5. Source attribution—identifying the portion of climate change attributable to individual or specific groups of sources
B. Discussion of acceleration of science of attribution (National Academy of Sciences report of 2016, Trenberth's alternative view; Burger, et al; World Weather Attribution Project)
C. The case of Sea-Level Rise; calculation of cost to NYC of Hurricane Sandy compared to what would have happened in such a storm without sea-level rise (transition to VII)

Part Two: *Science in "Climate Cases"*

VII. **<u>Overview of climate litigation</u>**: **This module is designed to introduce the kinds of cases where climate science is likely to come into play and to explain specific examples describing when the scientific issues arise during litigation, what type of scientific topics arise, and what kind of scientific evidence may come before judges.**

A. Reference the categories of cases, with examples
B. Trends in the litigation
    1. Removal and remand issue
C. Focusing especially on where science comes in (and where those methods are going e.g. greater understanding of source attribution, role of economics and models of damages, higher confidence in climate risk assessments like extreme heat which is generating novel arguments and increase in cases). Noting the kinds of cases that are more common in the state trial courts – the quotidian development approvals that may relate to where the floodplain map is or is not, etc.
D. Standards of admissibility of scientific evidence in US Courts (Daubert/Frye)
E. Introduce challenges and trends in remedies in climate cases

F. The climate science community reports unequivocal increases in some extreme events, and more solid methods to attribute these to greenhouse gases. How are these developments entering the argument of cases (transition to VIII)

VIII. **<u>Applying attribution</u>**: **This module is designed to review the categories of attribution presented in module VI and show how they and similar concepts have been applied in tort and takings cases, as well as the trends in those cases.**

A. Key cases where attribution may come in - Common Law (tort) claims, other…
    1. Nuisance cases (Cities and counties in CA, NYC, CO/WA, Honolulu, RI)
    2. Takings cases
B. Attribution science in tort or other kinds of cases (Stott, et al 2004, NAS 2016, World Weather Attribution Project)
C. Other examples of statutes dealing with attribution in other contexts
    1. Potentially responsible parties in Comprehensive Environmental Response, Compensation and Liability Act (Superfund) where there was a need to compensate and Potentially Responsible Parties were not always available – market share when there isn't actual attribution
    2. Oil pollution trust fund – to deal with problems created by the industry but that are not attributable to individual actors
D. Removal and remand in these cases (State or federal courts)
E. Remedies available in these kinds of cases
F. Introduce climate science in administrative cases (transition to IX)

IX. **<u>Government action and climate science</u>**: **This module is designed to present how climate science comes into administrative law cases (regulatory and permitting).**

A. Context: What a 2-degree target implies for emissions reduction--carbon budget. Scope of emission responsibility. Upstream-downstream emissions, imports and exports, global agreements (including what's left out—aviation and shipping), US responsibilities (until November 4)
B. Roles of federal, state, and municipal (and tribal?) governments in regulating for climate change
C. Judicial deference to agencies – rational basis test in federal courts and state standards – and expectations of how deference will change
D. Petitions for changes in regulation (Administrative Procedures Act and state equivalents)
E. Challenges to lack of enforcement or failure to regulate (federal and state) – Mass v. EPA
F. Development permitting (NEPA, pollution control permitting programs and state land use permitting)

1. Takings

G. Endangered species act and habitat litigation
H. CAA and climate regulation
I. Freedom of Information Act and state equivalents to obtain climate-related information
J. Remedies available in administrative environmental law cases, challenges, and trends
K. Introduce the fundamental rights implicated by climate change (transition to X)

X. **<u>Fundamental rights</u>: This module will present high-profile cases and trends in constitutional and public trust causes of action.**

A. Standing doctrine in the climate context
B. Modern expansion of public trust doctrine (Vermont made it statutory law that groundwater is a public trust)
C. Juliana – went so far as to say that is real, human caused and serious, but it did not go so far as to say that it requires urgent action and that the government is obliged to act (no remedy/redressability)
D. Robinson Township (PA) (Constitutional environmental rights) and RI ER amendment
E. Remedies available in cases on fundamental rights, challenges, and trends
F. Introduction to securities and consumer fraud and other categories of cases (transition to XI)

XI. **<u>Fraud and other causes of action involving climate change</u>: This module is a placeholder for relevant kinds of cases not otherwise covered in the curriculum.**

A. MN, DC, NY and MA securities and consumer fraud cases against fossil fuel companies
B. Bankruptcies due to climate impacts
C. Remedies available in fraud (and the other COAs covered here), challenges and trends
D. Introduce use of particular procedural techniques for climate litigation (transition to XII)

XII. **<u>Procedural techniques available for climate litigation</u>: This module is designed to introduce specialized procedural techniques that have been used in climate cases.**

A. Jurisdiction/removal/remand for climate questions (state or federal court)
B. The role of amicus briefs
C. Various kinds of experts appointed by judges or parties
D. Special requests to the parties (tutorials)
E. Special masters and expert witnesses
F. Introduction to climate solutions (transition to XIII)

XIII. **<u>Solutions (and related economic considerations)</u>**: **This module is intended to familiarize the participants with technologies and strategies available to reduce GHG emissions and prepare for impacts that were presented in module IV and are reviewed here. This module will also reference examples of remedies that have been or could be proposed or ordered in cases related to these impacts and proposed solutions.**

A. Impact effects, and the degree to which they can be reduced by mitigation or adaptation, or remain residual (IV Reprise)
    1. Biodiversity loss
    2. Habitat destruction
    3. Health impacts—malnutrition, vector-borne diseases, heat-related illness, health system stress…
    4. Societal impacts
        a. Food and water insecurity
        b. Social stress, political instability
        c. Loss of livelihood, economic instability
        d. Coastal flooding and retreat
        e. Migration
        f. Pandemics and habitat decline

B. Technological solutions
    1. Technology development and implementation (Pacala and Socolow, 2004): efficiency, gas-for-coal, CCS, clean-for-coal (including nukes), H2, biomass, Forestation, Food & Ag; Geoengineering)
    2. Adaptation: seawalls, berms, barriers; elevation, strengthening and greening of buildings; planning for drought, heat extremes; forest management; crop shifts
    3. Disaster management infrastructure

C. Economic solutions
    1. Pricing Carbon: Cap and Trade; tax and dividend
    2. Market-driven efficiencies of generation and use
    3. Subsidies

D. Regulatory/social solutions
    1. Regulatory framework: renewable portfolio standards
    2. Social policy for implementing mitigation measures – e.g., Managed retreat from coasts

E. Biodiversity/habitat solutions
    1. Natural sinks—conservation and land use, sustainable real-estate development

F. Role of courts
    1. Types of remedies that require understanding science and calculating damages that judges may encounter
        a. List remedies and examples of climate or analogous cases where they have come into play
    2. Different judicial philosophies about the role of courts

G. Brief intro to example case for the wrap-up (Transition to XIV)

XIV. **<u>Wrap-up</u>**: **This module is designed to review the main points of the course and to illustrate those points with one case example.**

A. Reprise of the main points of the course

B. Case study: description of the reasoning in a case—for example the Rocky Hill case from Australia—to illustrate concepts from the course that would be needed for an example of a claim