From Calculation to Conference

A Historical Perspective on the WMO's Role in Governing Climate Change, 1960-1979.

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Master's Thesis in Modern International and Transnational History

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Abstract

The repercussions of CO2 emissions on the environment and the climate have caused worry among individual scientists since the 1930s. Not until the late 1960s did international organizations express similar concern for the increasing CO2 concentration in the atmosphere. Spanning from the establishment of the Scripps group during the late 1950s, to the First World Climate Conference in 1979, this thesis studies the role of the World Meteorological Organization (WMO) in producing and promoting anthropogenic climate change as scientific knowledge, and making anthropogenic climate change governable in the period 1960-1979. By looking at the WMO's participation and role during the Stockholm Conference in 1972 and the First World Climate Conference in 1979, the thesis argues that the WMO engaged in international environmental governance through four aspects of governance: as an intergovernmental organization, through conferences, regimes, and expertise. Additionally, the thesis argues that the WMO contributed to promoting anthropogenic climate change knowledge in a co-production process.

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Abbreviations

CAS – Commission on Atmospheric Sciences

COPOUS – Commission on the Peaceful Use of Outer Space

FAO – Food and Agriculture Organization

FWCC – First World Climate Conference

GARP – Global Atmospheric Research Program

GDpS - Global Data-Processing System

GOS - Global Observing System

GTS - Global Telecommunication System

IAMAP - International Association of Meteorology and Atmospheric Physics

ICSU – International Council of Sciences Union

IGO – Intergovernmental Organization

IMO – International Meteorological Organization

IO – International Organization

IR – International Relations

JOC – Joint Organizing Committee

NAS – National Academic Sciences

NGO – Non-governmental Organization

NMI – Norwegian Meteorological Institute

NOAA – National Oceanic and Atmospheric Administration

NYT – New York Times

STS – Science and Technology Studies

UN – United Nations

UNCHE – United Nations Conference for the Human Environment

UNEP – United Nations Environmental Program

UNESCO – United Nations Educational, Scientific and Cultural Organization

WCP – World Climate Program

WHO – World Health Organization

WMO – World Meteorological Organization

WWW – World Weather Watch

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Introduction

After it became an intergovernmental organization in 1951, the World Meteorological Organization (WMO) has served as a specialized agency to the United Nations (UN) and has become the leading scientific body for the meteorological study of the atmosphere. During the 21st century, the WMO has been one of the most important facilitators for research on the environment and anthropogenic climate change and operates the largest monitoring systems for carbon dioxide in the atmosphere. Arguably, the WMO is not sufficiently celebrated today for its important work on studying climate change. Even less is known about their work in the 1960s and 1970s, during a time when the international environmentalist movement grew, and the first international environmental regime was established.[1] By the virtue of their expertise on the atmosphere and position as a specialized agency of the UN, the WMO was a natural advisor on matters regarding the atmosphere. However, they did not act on what was essentially a central position in relation to environmental research and dismissed anthropogenic climate change theory until the end of the 1960s. Instead, anthropogenic climate change knowledge was developed among groups of experts during the late 1950s and early 1960s, while the WMO became the foremost observer of the atmosphere through the World Weather Watch and the Global Atmospheric Research Program, respectively launched in 1963 and 1967. The Stockholm Conference in 1972 marked a turning point for international cooperation on the environment. Seven years later, the First World Climate Conference (FWCC) was held in Geneva – convened and sponsored by the World Meteorological Organization. The thesis suggests that the WMO had influence in the production and promotion of both environmental and climate change knowledge at those conferences. This thesis wants to understand the nature of the WMO's involvement in how anthropogenic climate change developed from a theory without substantial support in the scientific community, to become what B. B. Allan refers to as a governance object during the First World Climate Conference in 1979. This thesis will therefore answer the following research questions:

> *What was the role of the World Meteorological Organization in producing and promoting knowledge about the environment and anthropogenic climate change during the Stockholm Conference in 1972 and the First World Climate Conference in 1979,* and,

[1] A regime is a set of rules and regulations used to govern a particular phenomenon. The climate change regime would not start before the 1990s, according to R. D. Brunner (2001).

how can B. B. Allan's theory of governance objects and co-production enlighten how the WMO engaged in international environmental governance during 1960-1979?

Regarding the choice of including both environmental and climate knowledge in the research question, the main focus will be on the development of anthropogenic climate change as a governance object. It is, however, necessary to consider environmentalism and environmental knowledge as well. During the Stockholm Conference in 1972, the focus was on the environment in general. Discussions on climate change were included as a consequence of the use of fossil fuels, which was a part of discussions on air and marine pollution – topics also closely tied to local and regional pollution issues. When environmental issues entered the international political agenda, it also opened for discussions on anthropogenic climate change and acted as a vehicle for information on climate change as a consequence of environmental pollution. Thus, it is also important to see how the World Meteorological Organization addressed environmental issues.

Origins of the anthropogenic climate change theory and the WMO

The phenomenon known as climate change has a wider meaning in meteorology. It entails all types of change in all types of climates. It is a complicated phenomenon that can be a local, regional, or global problem. Climatic changes are also seasonal. For example, seasonal changes in the ozone layer are normal, recurring processes. Similarly, gradual heating or cooling in the atmosphere over a long period of time is a normal atmospheric process. Anthropogenic climate change theory was first introduced by the French scientist Jean Baptiste Fourier in 1827 and further developed by the Swedish scientist Svante Arrhenius who made the connection between increasing CO2 levels and atmospheric warming by the end of the 19th century.[2] Arrhenius' perception that climate change was a positive effect that would result in a more comfortable temperature (which might have been a dear wish from a Swede) was challenged by Guy Stewart Callendar during the 1930s. Callendar established the foundation of climate change studies in the 20th century and argued that pollution from human activity would have negative consequences for the atmosphere and the earth.[3] His research was not accepted by the scientific

[2] Brenton 1994, p. 163. Howe 2014, p. 4. White 2012, p. 402. For more about Arrhenius and his work, please see B. Bolin's *The History of Science and Politics of Climate Change* (2007).

[3] Fleming. Historical Perspectives on Climate Change. 1998, p. 113-114. Heymann 2010, p. 589. Callendar 1938. Callendar was the first to connect human activity and pollution from fossil fuels to a disruption in the carbon cycle. In his article «The artificial production of carbon dioxide and its influence on temperature» (1938), he calculated that a third of polluted CO2 remained in the atmosphere. He concluded that the increase of

community during the 1930s and 1940s but was picked up by Gilbert N. Plass during the 1950s.[4]

Before becoming the WMO, the organization was known as the International Meteorological Organization (IMO). Established in 1873, the IMO was a truly international scientific project for gathering weather data and improving meteorological research through international cooperation, run by directors from meteorological institutes.[5] Mainly acting as a transnational scientific organization, the IMO standardized meteorological research methods and instruments and started to build a network of institutes.[6] This work continued into the 20th century but was put to an almost complete stop when the Second World War began in 1939.[7] In extension of the growth of international cooperation and international organizations after the war, the IMO underwent a transformation in 1951 when it became an intergovernmental organization and a specialized agency of the United Nations and changed their name to the World Meteorological Organization.[8] As the WMO, their goals became to facilitate global scientific cooperation through the meteorological and geophysical monitoring stations, standardize methods and promote the use of meteorology in "aviation, shipping, agriculture, and other human activities."[9] As an intergovernmental organization and a part of the UN system, the WMO had the ability to adopt international conventions, which the IMO could not.[10] The change gave the WMO expanded capabilities due to a larger amount of funding (which now came from all member states instead of a smaller number of national and international sponsors), which improved their capacity for research and weather data collection. Being closely tied to the UN also gave advantages such as international recognition as a specialized agency, which also made it easier to cooperate with other actors and agencies. Finally, the change from a transnational organization to an intergovernmental organization affected how national interests and international issues and conflicts entered the WMO, which

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CO2 in the atmosphere would lead to a rise in the global temperature. Through his work, Callendar warned that mankind was experimenting with the atmosphere, and the consequences would not be observable before several generations had passed. The International Panel on Climate Change verified Callendar's theory in 1995, forty years after Callendar published it.

[4] Fleming 1998, p. 122. White 2012, p. 402.

[5] Reinalda p. 98.

[6] Edwards 2006, p. 231.

[7] WMO 1973, p. 22.

[8] WMO Congress 1951.

[9] Edwards 2006, p. 236. Quote originally from World Meteorological Organization, Basic Documents, Geneva, 1971 p. 9.

[10] For further discussions on the UN system during 1960-1980, see Herren, Sluga & Amrith.

was evident from Congressional minutes and reports where speakers representing their governments proclaimed their standing regarding the Democratic Republic of China, the Vietnam War, and the Cold War.[11] Although the WMO became intergovernmental, it was still run by meteorological experts who often were directors of their respective institutes. This made them able to work on different levels of national, regional, and international governance, as their programs still involved social, political, and economic responsibilities, such as agriculture, pollution, and water supply.[12]

Senior researcher Bob Reinalda argues that scientists started to show concern for environmental issues by the end of the 1960s, but as the thesis will show, the Scripps group showed the same concern during the late 1950s by connecting industrial pollution to negative consequences for the earth and the atmosphere.[13] The WMO was very much involved in the study of environmental phenomena, as they gathered and mobilized meteorological science and collected weather data through its global network of institutes and monitoring stations. In spite of their expertise in hydrological, atmospheric, agricultural, and marine meteorology, the WMO did not proclaim themselves as an environmental organization during the 1950s and early 1960s. Neither did they recognize the anthropogenic climate change findings nor the theory during that time. However, it was very much in their expertise to engage in discussions on the environment, air and marine pollution, and the matters of the atmosphere. The WMO advised the UN at the Stockholm Conference in 1972 and arranged their own conference on the climate in 1979 – both of which infamously declared for international cooperation on limiting mankind's effect on the environment and the atmosphere. By studying the WMO's transition into a historical era defined by space technology, a blooming environmentalist movement, and a new role for international organizations, this thesis looks at how knowledge about climate change arrived at the WMO and why the WMO went from dismissing

[11] WMO Congress report 1967. NMI 1969: Letter from the Norwegian Ministry of Foreign Affairs to the Norwegian Meteorological Institute. NMI 1967b: Letter from the Norwegian Department of Clergy and Education to the Norwegian Meteorological Institute, regarding the Norwegian Ministry of Foreign Affairs' instructions on the Norwegian position on new members in the WMO. NMI 1979: Telegram from the Norwegian Ministry of Foreign Affairs to the Norwegian Meteorological Institute, regarding the World Meteorological Organization (WMO) 8th Congress in Geneve. 30.4. – 25.5.79. Instructions for the Norwegian Delegation. April 26th, 1979. Correspondence between the Norwegian Foreign Department and the Norwegian Meteorological Institute shows that, in the case of the Norwegian representatives from the NMI, they were instructed on how to respond to matters of international politics not related to the reason for the meeting.
[12] Reinalda 2008, p. 98.
[13] Reinalda 2008, p. 514.

anthropogenic climate change at the beginning of the 1960s to arranging a conference about it in 1979.

State of Research

The World Meteorological Organization has not been the subject of extensive scholarly interest, which has resulted in a lack of historiographical literature about the organization. Particularly, the role of the WMO as a producer and promoter of environmental and climate change knowledge has not been explored in academic works. Its role during the Stockholm Conference in 1972 and the importance of the First World Climate Conference in 1979 is also lacking from the scholarly body. Therefore, the thesis relies on the use of primary sources to study the role of the WMO, and how it took part in the production and promotion of environmental and climate change knowledge. The primary sources will be addressed in the subchapter "Selection of sources". However, several noteworthy scholars have written works which this thesis builds on.

Regarding specific research on the World Meteorological Organization, Paul N. Edwards' *Changing the Atmosphere: Expert Knowledge and Environmental Governance (2001), A Vast Machine: computer models, climate data and the politics of global warming (2010),* and "Meteorology as Infrastructural Globalism" (2006) contribute largely to the understanding of the WMO as an influential, scientific body. Edwards' work uses the WMO as an example of a scientific organization who has contributed as an actor in environmental governance.[14] *The Science and Politics of Climate Change. The Role of the Intergovernmental Panel on Climate Change* (2007) by the WMO-veteran Bert Bolin has provided additional perspectives on the early role of the WMO in international environmental governance. Environmental historian Joshua P. Howe's and technology historian Matthias Heymann's works contribute greatly to the international environmental perspective, as well as on the history of anthropogenic climate change. Additionally, Spencer R. Weart and James R. Fleming have done informative research on climate change scientists, which has been elemental in understanding the connections between the first anthropogenic climate change experts and the World Meteorological Organization.[15] Bentley. B. Allan, whose theory on governance objects and co-production is heavily featured in this thesis, uses his theoretical framework to study the early production of climate change knowledge from an American perspective.[16] Climate change research was

[14] Edwards et. al., 2001. p. 212-214.
[15] Weart 2003 & 2007, Fleming 1996, 2014 & 2016.
[16] Allan 2017.

almost completely limited to the U.S. during the 1950s and 1960s, and the U.S. had the expertise, the financial means, and the interest in exploring the atmosphere.[17] David M. Hart and David G. Victor did a similar study in their article from 1993, which explores the role of experts in defining climate change from 1957 to 1974, and thus contributes to the thesis with a rich study of the technology and politics surrounding climate change during the 1960s and 1970s.[18] Finally, Dipesh Chakrabarty's observation that historical accounts of climate change stand at the crossroads of geophysical history, the history mankind on earth, and the history of industrialization, is particularly relevant because of the thesis' focus on meteorology, and the consequences of industrialization on the climate and meteorological and atmospheric sciences.[19] These research articles and books help to understand what sort of organization the WMO was, what type of work they did during the 1960s and 1970s, and how the WMO was connected to experts outside of the organization. They also depict the creation of climate change knowledge during the 1950s-1970s. Understanding these dynamics is essential for comprehending how the WMO engaged with new knowledge and other expert groups, as well as how they produced and promoted knowledge about the environment and the climate.

When discussing the WMO, it is also necessary to take into consideration the international organization perspective. The thesis relies on the works of Patricia Clavin, Glenda Sluga, Sunil Amrith, Akira Iriye, and Bob Reinalda for a thorough understanding of the history of international organizations and how the study of them has evolved. This perspective is further enriched by research on environmentalism and international organizations, through featured works of Akira Iriye, Thomas Brenton, Lynton B. Caldwell, Alfred W. Crosby, and, M. K. Tolba, as well as Robert Falkner, Maria Ivanova, Hannes R. Stephan and Fariborz Zelli. The thesis also relies on "New Histories of the United Nations" (2008) by Sunil Amrith and Glenda Sluga, and *Global Histories of International Organizations* (2014) by Madeleine Herren to understand the dynamics between the UN, international politics, and the WMO. Finally, in order to engage in discussions of international governance, *International Organizations: The Politics and Processes of Global Governance* (2010) by Margaret P. Karns and Karen A. Mingst has been consulted. All of these works provide an understanding of the world and the political climate in which the WMO acted in during the 1960s and 1970s. In order to answer the main research questions, it is necessary to dive deeper into the role of the WMO as a creator

[17] Allan 2017, p. 143. The Soviet Union did the same, but lacked the instruments to get the same results.
[18] Hart & Viktor 1993.
[19] Chakrabarty 2014, p. 1. Chakrabarty 2008, p. 198, 207, 216.

and promoter of climate change knowledge, it is necessary to look further into theories tied to expertise and knowledge production.

Methodological and theoretical approach

The thesis approaches the role of the WMO with a historical, constructivist perspective with ties to International Relations (IR) and Science and Technological Studies (STS). The relevance of international organizations in international politics has been a long debate in IR. Classical IR realists see nation-states as the authoritative actors in international politics and international organizations as platforms where nation-states meet. Reinalda argues that historians have shared the same realist understanding regarding IOs and have mainly expressed interest in how states cooperate with IOs and that IOs act as forums where governmental representatives meet. This has, of course, changed since the initial entrance of IOs in IR and history. The scholarly debate eventually turned its attention to the inner workings and roles of IOs, resulting in a constructivist perspective on IOs in international politics. Constructivists think that "the behavior of individuals, states, and other actors is shaped by shared beliefs, socially constructed rules, and cultural practices."[20] Constructivists concern themselves with the interests and identity of IOs, and how these change over time. According to this understanding, scientific IOs can affect states due to their expertise. This perspective promotes a focus on transnational networks, particularly regarding non-governmental organizations.[21] It is an important approach to study norms, institutions, behavior, and beliefs in international organizations. STS suggests that science and creation of knowledge is and has to be a "messy, impure, and political" process, and that scientific knowledge and policy are not developed individually, but together in what Jasanoff, Allan, Lidskog, and Sundqvist call co-production, which will be further elaborated in the next subchapter.[22]

The thesis treats a special case of an organization that has nation-states as members, but where the representatives are scientists, and their activities are transnational and global, in many ways. Thus, the topic of the thesis sometimes falls in between the national, the international, and the transnational. According to Akira Iriye, the study of global history requires to look "how transnational forces and national sovereignties intersect one another". The study of

[20] Karns & Mingst 2010, p. 50-52. This opinion is also shared by Barnett and Finnemore 2005, p. 162.
[21] Reinalda 2008, p. 8.
[22] Lidskog & Sundqvist 2015, p. 1-2. Jasanoff 2004, Allan 2015, p. 139.

environmental history, Iriye adds, can benefit particularly from such a transnational approach.[23] Because of the global qualities of pollution and climate change, Iriye's statement is true for the thesis. This thesis takes such an approach by considering the intergovernmental organization WMO, and epistemic communities, where the aspect of transnational, international, and national are all intertwined. Sluga and Amrith promote a similar approach in "New histories of the UN", where they suggest that studying the history of the UN can give new perspectives on the history of human rights, development, race issues, international relations, and international feminism. Such an approach shifts the focus from classic master narratives, to the history of international and transnational organizations and movements, of individuals, and exchange of ideas.[24] The transnational approach turns the focus from nation-states as the main actor and looks at the movement of people and exchange of ideas and knowledge and the creation and growth of border-crossing networks.[25] The transnational approach is as relevant for history as for international relations, as it can provide answers to questions about international organizations, how they work, and what their role is in international governance.[26]

Epistemic communities and co-production of knowledge

The thesis believes that epistemic communities somehow influenced the WMO's understanding of climate change, and thus studies the climate scientists who worked for the Scripps Institute in the late 1950s. The epistemic community theory, presented by Peter M. Haas, provides the thesis with a set of criteria for studying such expert groups. An epistemic community is formed when the experts have a shared set of normative and principled beliefs based on a shared understanding of research ethics, as well as causal beliefs derived from analysis in their research field. According to Haas, epistemic communities are able to affect policymaking.[27] By using these criteria, the thesis identifies the first epistemic community established around anthropogenic climate change – the Scripps group. However, further input from Allan's theoretical framework on co-production and governance objects is necessary in order to trace the creation of knowledge in an epistemic community and the role of expertise in policymaking.

[23] Iriye 2008, p. 643-644.
[24] Amrith & Sluga 2008, p. 271-272.
[25] Clavin 2005, p. 422.
[26] Clavin 2005, p. 424-425.
[27] Haas 1989, p. 402. Haas 1990, p. 349-350.

Allan presents a theoretical process of knowledge production that gives a complete understanding of the creation of climate change knowledge and its implementation in international politics during the late 1970s. Firstly, he suggests a process of four stages which depicts how phenomena become governable: the *constitution* of the object, *political selection* of its problems, the *institutionalization* of rules to regulate the object's problems, and the *implementation* of those rules.[28] Objects, according to Allan, are "concatenations of knowledges, artifacts, physical phenomena, and practices that have been yoked together and constituted as an entity distinct from other objects, events, and actors.»[29] Thus, a governance object implies an entity which is governable. Secondly, through the process of co-production, scientific knowledge can support and influence policymaking, and policy can, in turn, influence the making of scientific knowledge. The process suggests a dynamic relationship between creating scientific knowledge and policymaking, instead of a process where either party has the sole influence.[30]

This approach to Science and Technology Studies (STS) and understanding epistemic communities in a more comprehensive way is supported by Lidskog and Sundqvist, as well as Sheila Jasanoff.[31] These analytical terms will be used to trace the constitution of anthropogenic climate change theory in the Scripps group, how events during the late 1960s put environmentalism and climate variations on the political agenda, and how the Stockholm Conference in 1972 and the First World Climate Conference in 1979 institutionalized and implemented rules to govern climate change issues on a global basis. Allan's theoretical framework on co-production and governance objects allows us to see the connection between the work of the Scripps group and the World Meteorological Organization and will be used to analyze the WMO's role in the production of climate change and environmental knowledge during the mentioned conferences and the significance that the co-production had for WMO's role in international environmental governance.

[28] Allan 2017, p. 133–134.
[29] Allan 2018, p. 853.
[30] Allan 2015, p. 139. Sundqvist & Lidskog 2015, p. 6.
[31] Sundqvist & Lidskog 2002, 2015, Jasanoff 2004.

International Organizations, experts, conferences, and regimes in governance

This thesis understands that IOs, IGOs, and experts have power to influence policy. Co-production in itself tells us that science and scientific knowledge influences policy due to the interaction between policymakers and scientists, and Allan's analytical terms describe the process from knowledge creation to implementation in politics. Interpreting Foucault's opinion on the power of IOs, Michael Merlingen argues that IOs have power and influence through cooperation with governments, other IOs, and individuals. They practice a soft-power in undramatic ways that are engraved in their activities and "good works," by creating recommendations and actively influencing policymaking. [32] Reinalda, Karns, and Mingst agree that IOs, IGOs practice a soft, careful type of power.[33] Their power is also tied to the authority of scientific knowledge, which Ole Jacob Sending argues is due to "the general belief in the institution of science as setting rules for truth-seeking practices, scientifically produced knowledge is a central source of authority».[34] The thesis will look at how the WMO acted through what Karns and Mingst refer to as governance pieces, IOs/IGOs, conferences, regimes, and expertise, to produce and promote anthropogenic climate change knowledge and engage in international environmental governance.[35] In this perspective, it is possible that the WMO wielded a power inherent in its activities and cooperation with members, scientists, governmental representatives and other organizations during the 1960s and 1970s. Adding the notion of scientific knowledge to this thought, we can gather that an international scientific organization practices its power on the same basis, with scientific knowledge and expertise as the central activities and practices. Using these assumptions on the power of international organizations and scientific knowledge, fits into the constructivist approach and framework of the thesis and supports the thesis in seeking to question the role that the WMO possibly had in scientific knowledge production, creation of governance objects, and engagement in international environmental governance.

Selection of sources

The planning and research done for this thesis have been affected greatly by the COVID-19 pandemic. The initial plan to visit international archives was naturally put aside due to the lockdown and travel ban. The backup plan to use sources from Riksarkivet (The National

[32] Merlingen 2003, p. 377.
[33] Reinalda 2008, p. 9-10. Karns & Mingst 2010, p. 5-6.
[34] Sending 2015, p. 14.
[35] Karns & Mingst 2010, p. 5-6, 11-13, 16-19.

Archives of Norway) had to be discarded due to the lockdown in Oslo, altering the perspective of the thesis once more. Alternative sources from the WMO's online archive have therefore provided insight into the WMO's research, initiatives, and development during the period of 1960-1980.

As mentioned in the theory chapter, this thesis will use Allan's theoretical and analytical framework for analyzing how the WMO and epistemic communities promoted climate change and what this activity can tell us about their role in environmental governance by looking at the Stockholm Conference and the First World Climate Conference. To approach the themes, it was essential to locate i) the origins of the epistemic community, iii) the discussions about consequences of pollution on the atmosphere and the environment, and the evidence of co-production between scientists, the WMO and governmental representatives. Additionally, the findings in the primary and secondary literature must tell the story about iii) how the WMO moved into environmental and climate issues. The primary sources have therefore had to come from a variety of places. Articles from the meteorology journal Tellus, dating back to the period of 1950-1980, have been used to locate scientists who studied relevant topics to climate change. WMO Congress reports, Executive Commission reports, and basic papers have given a wide specter of information, discussions, and initiatives by the WMO, its members and other international organizations with whom the WMO worked closely. There was a particular lack of literature on the First World Climate Conference, and thus the WMO online library has also been the main source for information on the World Climate Conference, as the WMO was the main holder of the conference. The New York Times online archive has also served to support the information found in the FWCC report. UN documents from the Stockholm Conference have, of course, enlightened the discussion on the WMO's role before, during, and after the conference. Additionally, a variety of reports from other environment or climate-related activities taking place during the time period has enlightened the ambivalent changes in opinions and support for the anthropogenic climate change theory. Internal correspondence between the Norwegian Meteorological Institute and the WMO, retrieved from Riksarkivet in Oslo, has highlighted the connection between the WMO, national foreign affairs ministries, and its members.

There are a handful of sources that could end up in a "grey zone" in terms of use and interpretation. One such source is the WMO's rendering of their 100-years anniversary, the "One hundred years of international co-operation in meteorology (1873-1973): a historical review." Published in 1973, it is both a source contemporary to the period studied in the thesis

as well as a source to the history of the WMO. It is used as the latter in the thesis. Bert Bolin's book also poses a similar issue, as Bolin was present at the events which he wrote about. The book is, therefore, an account of the WMO and international environmental politics, as well as bearing traces of a self-bibliographical account of his own participation in these events. The use of this book has been with these issues in mind. Lastly, the journal articles from the late 1950s and early 1960s depict the early development of the Scripps group and anthropogenic climate change knowledge and are as such used and listed as primary sources.

Outline

The first chapter depicts the creation and work of the first climate change epistemic community, the Scripps group. From there, the chapter follows how the anthropogenic climate change theory moved into the WMO and suggests that well-known meteorologists who worked both in the Scripps group and the WMO affected the organization's understanding of climate change. It will use B. B. Allan's theoretical framework while discussing how research on anthropogenic climate change developed. Allan's terms of the establishment of governance objects, which will be applied upon the entirety of the thesis, start here with looking at the designation, translation, and problematization of anthropogenic climate change knowledge, which forms the constitution of it as an object or an entity. The chapter also discusses technological developments during the 1960s, in particular satellite technology, and how these advancements affected the WMO's capacities and role as a specialized agency and intergovernmental organization.

The second chapter looks at the WMO's role at the Stockholm Conference and uses co-production to understand whether the WMO engaged in international environmental governance. It takes into account discussions on the environmentalist movement of the 1970s and the WMO as an environmental organization. It also suggests that environmental knowledge being recognized and gaining authority through the movement and the conference, also acted as a vehicle for the promoting of anthropogenic climate change knowledge. The third and final chapter analyses the WMO's role during the First World Climate Conference in 1979. Using co-production and governance objects, the chapter attempts to provide insight into what became a significantly different conference than the Stockholm Conference, and what that meant for making anthropogenic climate change governable in the end of the 1970s, as well as what it entailed for the role of the WMO as an actor in international environmental governance.

Chapter One

Changing climate change? Experts, satellites and the WMO

In spite of its expertise about the atmosphere, the air, and the ocean, the World Meteorological Organization was not an environmental organization at the cusp of the 1960s. A thorough reading of reports from the WMO's Congress and the Executive Committee showed that the WMO did not prioritize environmental issues or climate change during the 1950s and in the beginning of the 1960s.[36] Therefore, we have to look elsewhere to find out how anthropogenic climate change knowledge was first developed. Following the co-production process and creation of knowledge as governance objects described by Allan, this chapter starts with looking at an epistemic community that arose around the theory during the late 1950s. Studying the growth of this community, which will be referred to as the Scripps group, and their interaction with the scientific community and the WMO might give answers to how anthropogenic climate change theory reached the WMO. The chapter will also suggest that the uncertain knowledge about the atmosphere hindered the WMO in recognizing anthropogenic climate change during the majority of the 1960s. As the co-production theory does not address how the actors engaged in the co-production process changed over time in reaction to external and internal events, this chapter also looks at how external technological and political developments during the 1960s made it possible for the WMO to drastically change its ability to observe the atmosphere. It will therefore be guided by the questions: *how did anthropogenic climate change knowledge enter the WMO, and what sort of repercussions did technological and political developments during the 1960s have for the WMOs role as producer and promoter of environment and climate knowledge, and as an actor in international environmental governance?*

[36] WMO Congress reports 1951-1963, WMO Executive Committee reports 1951-1965.

The first climate change epistemic community

> *"The extra CO2 released into the atmosphere by industrial processes and other human activities may have caused the temperature rise during the present century. In contrast with other theories of climate, the CO2 theory predicts that this warming trend will continue, at least for several centuries."*[37] *– Gilbert N. Plass, 1956*

Global warming was not an unknown phenomenon to the public during the mid-1950s. It entered the political agenda whenever a longer warm period was noticeable. When it would get cooler again, the public attention would fade. Likewise, the theory was not new for the scientific community. In the 1950s, it was a heavily disputed theory.[38] In the immediate aftermath of Plass' publications in 1956, there was no consensus on his results. Scientists like L. D. Kaplan immediately responded dismissively to Plass' findings.[39] However, there were still scientists who did not dismiss his findings.[40] Several of these scientists got together and created an epistemic community on anthropogenic climate change theory. As it is the work of these scientists that promoted anthropogenic climate change theory during the mid-1950s, it is necessary to look at how the epistemic community was established, and how their work developed up until the early 1960s.

During the late 1950s, the oceanographer Roger Revelle became curious about the ability of the ocean to absorb CO2. Coincidentally, Revelle sat with data that would later suggest that the oceans did not absorb the amount of carbon dioxide previously assumed. Measuring the ocean's capacity for absorption of carbon dioxide relied on knowing how much already existed in the ocean. To further pursue this research, Revelle hired the chemists Hans Suess and Harmon Craig. Both worked with carbon dating and had noted the increasing amount of CO2 in the atmosphere. The group soon expanded with more likeminded scientists from the Los Alamos Laboratory: Ernest Anderson and James Arnold. It did not take long before the scientists started to correspond and visit each other regularly. The Swedish scientists Bert Bolin

[37] Plass 1956, p. 140.
[38] Fleming 1998, p. 128.
[39] Plass 1960/1961.
[40] Fleming 1998, p. 117-118. It is important to keep in mind that both Callendar and Plass were active scientists during the formation of the Scripps group. Callendar kept publishing during the end of the 1960s and remained an influential scientist for the small group studying anthropogenic climate change at the time.

and Erik Eriksson also joined the epistemic community in the late 1950s, making the group a transnational network which is a defining trait for epistemic communities.[41] Bolin and Eriksson studied the consequences of industrial pollution on the atmosphere and had made similar predictions on pollution as Revelle. The inclusion of Bolin and Eriksson in the epistemic community was significant due to Bolin and Eriksson's strong connection to the World Meteorological Organization.

The exchange of ideas and knowledge between the scientists was elemental, as it set the scene for them to become an epistemic community, which Haas defines as a group of experts who share a set of common causal understandings of their research.[42] The five scientists agreed to start publishing their papers simultaneously, perhaps thinking that a mass of research papers was published in a wave would have a more informative effect on the scientific community. The group of scientists tied to the initial intent to study the rise of CO2 in the atmosphere and the ocean became an epistemic community as they shared an understanding that an increase of CO2 in the atmosphere was taking place and that it would likely cause global warming. [43] They were the first expert group who shared this understanding of the relationship between rising CO2 levels, the growing world population, and pollution from a rapidly growing industry.[44] Their common understanding created a knowledge-based consensus on the matter of anthropogenic climate change.[45]

The production of knowledge on anthropogenic climate change had a rocky start in the Scripps group. An article Revelle and Suess published in 1957 concluded inconclusively regarding CO2 in the atmosphere due to the lacking capabilities of their instruments and collected data.[46] Reelle and Suess also concluded that the ocean had a span of ten years for absorbing CO2, and disregarded Revelle's finding that showed that the ocean only absorbed 20% of the CO2 emissions. This was due to instability created by the saltwater in the top layer of the ocean and meant that approximately 80% of CO2 emissions remained in the atmosphere. The discovery shook the epistemic community and posed a challenge to the established consensus in the group and the scientific community. Anderson, Arnold, and Craig expressed their doubts due to

[41] Haas 1992, p. 73.
[42] Ibid.
[43] Weart 2003, p. 33.
[44] Heymann 2010, p. 591.
[45] Miller 2013, p. 1294. Knowledge-based consensus is an inherent part of epistemic communities.
[46] Revelle and Suess 1957, p. 18.

Revelle's research method. On the other hand, Bolin and Eriksson had also questioned the ocean's ability to absorb CO2. Because of the uncertainty in the group, the decision was made not to include Revelle's finding as a central part of the research paper. Instead, it was mentioned briefly as an uncertain suggestion that the attributes of salt water could cause the absorption time to be somewhat longer. The conclusion in the article fit the methods and data used for the study, and the scientific community found it acceptable. Thus, a consensus was built on the use of similar scientific understanding, methods, theories, and instruments. It also coincided with findings from other scientists.[47] This example also shows that creating consensual knowledge was not a straightforward process where the final result was perfect, which Kuhn, Foucault, and Allan suggest in their discussions of the development of knowledge.[48]

Seen through Allan's theoretical framework, the acceptance of the 10-year absorption period halted the process of making anthropogenic climate change a governance object. To become a governance object according to Allan's theoretical framework, a set of phenomena had to be designated through a boundary-setting process, made moveable through translation, and problematized on a political platform.[49] The boundaries around the phenomenon were not complete. It effectively put the urgency of the problem on hold, as it was believed that industries could continue to pollute without exceeding the ocean's ability to regulate the CO2 levels in the atmosphere. Reducing the dangers of extensive pollution, the decision not to include Revelle's findings showed that the constitution of anthropogenic climate change as a governance object had yet to become fixed.[50] Paired with the fact that the scientific community did not find the theory of anthropogenic climate change convincing, the uncertainty in the heart of the group regarding elemental systems in the atmosphere and the biosphere made promoting climatic changes even more futile. This meant that co-production on anthropogenic climate change with external influences, such as governmental representatives, was not productive at that moment. The representation and understanding of climate change as a natural, pervasive process remained authoritative. Finally, how the epistemic community dealt with the challenge to the established consensus speaks to their respect for the process of creating and establishing scientific knowledge. Revelle's discovery did not coincide with the standard methods. It was also widely different from what had been accepted as the most likely explanation for how the

[47] Weart 2003, p. 27-28.
[48] Kuhn 1962, Foucault 1972, Allan 2017.
[49] Allan 2017, p. 134-137.
[50] Allan 2017, p. 137.

ocean absorbed CO2. Thus, this episode also demonstrates how new conclusions which seemed too controversial to the established consensus could be dismissed, even among scientists who held the same causal beliefs.

Albeit that Revelle's discovery was a difficult 'pill to swallow' for the Scripps group and the scientific community, other changes in their research proved that the group did accept challenging aspects into their research, effectively establishing boundaries for anthropogenic climate change as a governance object. It was not very common to consider factors such as population growth in their type of research. The lack of this perspective led to Revelle concluding the expected rise in atmospheric CO2 to be 40% less than the expected increase when taking into population growth and industrial growth into consideration. After observing the work of dr. Harrison Brown, Revelle added a sentence to the research paper he published with Suess in 1957, which suggested the same perspective.[51] Thus, scientists in the epistemic community changed their understanding of the relationship between manmade pollution and the rise of CO2 in the atmosphere, the same understanding that Plass had expressed a couple of years earlier. Their understanding of climatic changes changed, and the possible effects of mankind on the climate became even more evident for the experts.

What was arguably a lack of progress on the study of anthropogenic climate change changed when Revelle received more funding from the International Geophysical Year (IGY)[52], and hired the young geochemist, Charles D. Keeling.[53] Keeling had discovered stable CO2 numbers in the air at some locations, which no other scientist had been able to do.[54] Keeling had Dr. Harrison Brown as a mentor and thus already considered population growth and increased pollution due to growth in the industrial sector as factors affecting the CO2 concentration in the atmosphere. Together with the rest of the Scripps group, Keeling set up observation stations at Mauna Loa in Hawaii and in the Antarctic. The project received abundant help with research and funding from Dr. Harry Wexler of the American Weather Bureau, who also worked with the WMO. Wexler had a kinship with Keeling and had even offered Keeling a job which Keeling had turned down in favor of working with Revelle.[55]

[51] Weart 2003, p. 30.
[52] The Social Learning Group 2001, p. 22. The International Geophysical Year was an international scientific initiative to advance atmospheric and geophysical sciences.
[53] Weart 2007, p. 438. Hart & Victor 1993, p. 651.
[54] Ibid. Scandinavian researchers had attempted this for years, but had failed to prove this.
[55] Sundquist 2009 p. 28. American Meteorological Society. Interview with Dr. Lester Machta 1993, p. 8.

Having recognized his talents, Wexler corresponded and exchanged ideas with Keeling, which included research on CO2 and the greenhouse effect. Wexler can be seen as part of the epistemic network, as he shared their causal beliefs and scientific understandings of the group, as well as having frequent interactions with them.[56]

The initial experiment at Mauna Loa and the Antarctic would go on for two years, but observations would continue for several years.[57] In an interview in 1993, dr. Lester Machta recalled how Keeling's project was met by other atmospheric scientists.

> «When he first started his work, he was laughed at because everybody knows that the oceans take up all of the carbon dioxide. There is no point in making any measurements because whatever you put in the air will very soon be in the oceans. You're wasting your time monitoring CO2 trends. But Dave Keeling was a persistent person who did things extremely carefully and you need that care to show that the carbon dioxide was and is increasing in the atmosphere with time. »[58]

In spite of the ridicule, his team had established a baseline measurement of CO2 a year later and were able to argue that there was an increase in CO2 levels, which matched with Revelle's absorbing scenario. The baseline had risen, and it seemed that the ocean did not absorb the majority of CO2 released into the atmosphere.[59] Keeling's results gained attention, and an increasing number of scientists cited the work.[60] In spite of other variations visible in results, a growing tendency was clear.[61] Due to Keeling's advanced research techniques, the credibility of the results was stronger than that of the earlier research. Keeling's discovery was a significant advance in the production of climate change knowledge. It proved that the increase in the atmospheric CO2 concentration could be caused by industrial pollution. Although it would still take over ten years before the scientific results and consensus grew considerably enough to say that climate change was a reality, and the theory would still face resistance from the WMO and the scientific community, anthropogenic became a serious research topic entering the 1960s due to Keeling's discovery. Through Keeling's discovery, anthropogenic

[56] Haas 1992, p. 73. Bodansky 2001, p. 24. Heymann 2017, p. 1556.
[57] Monitoring continued at by the Weather Bureau and some members of the Scripps group, such as Lester Machta.
[58] American Meteorological Society. Interview with Lester Machta 1993, p. 10.
[59] Weart 2003, p. 36.
[60] Weart 2003, p. 38.
[61] Weart 2007, p. 441.

climate change became a designated object – a separate set of phenomena distinct from similar climatic variations and phenomena.

Anthropogenic climate change in international scientific forums

The WMO dismissed the anthropogenic climate change theory during the WMO Symposium on the Climate in Rome, 1961. Leading atmospheric scientists in the WMO were skeptical and negative towards the theory, showing that the WMO did not conceive the possible anthropogenic aspects of climate change and had little engagement in the relationship between mankind and the environment. The President of the Aerology Commission, Reginald C. Sutcliffe had a reserved opinion since there was no quantitative theory about the climate nor any way to limit the vast range of variables in the atmosphere. His careful words regarding the study of the global climates indicated that the research field was still new and reflected the opinion of many of the scientists who attended the symposium, such as Dr. Hermann Flohn, who felt stronger about the flaws in the theory and argued that the activity of man had no effect on the atmosphere. There had been climatic changes before, and he saw them only as natural processes.[62] Not even John S. Sawyer, who is known for having written a groundbreaking research paper on carbon dioxide and climate change in 1972, expressed a strong belief in the CO2 theory in 1961.[63] The anthropogenic climate change theory was therefore competing (and losing, for now) for authority against other explanations for climatic variations, which were considerably more established in the WMO and the scientific community. Thus, the progress in the co-production process was not favorable for promoting anthropogenic climate change in the WMO.

The Conservation Organization's conference "Implications of Rising Carbon Dioxide Content of the Atmosphere" in 1963 posed a stark contrast to the conclusion drawn in Rome. The conference resulted in a consensus paper, written by Keeling (who attended with Plass and Eriksson), that expressed the common opinion and general agreement on the discussions held during the conference.[64] This was the first time that a group of scientists had explicitly expressed their consensus on definite rise of CO2 in the atmosphere, and the consequences they expected could come as a result, during a conference. The meaning of having climate change as the topic for a conference is meaningful. Although it was not a global conference,

[62] WMO Symposium 1961, p. 342.
[63] WMO Symposium 1961, p. 336.
[64] The Conservation Foundation 1963, p. i. Howe 2017, p. 85, 91.

conferences, in general, can raise awareness, create norms, share knowledge, and define priorities.[65] Although the lack of overlapping attendees in the Rome symposium and the conference in 1963, the paper illuminates that support for the anthropogenic climate change theory was growing, albeit slowly.[66] The consensus reflected the work and opinions of the Scripps group. Namely, that the rise in CO2 was a separate phenomenon from the normal climatic variations that happened seasonally and that it differentiated itself from earlier climatic changes by being caused by anthropogenic pollution.[67] They also agreed that the ocean could not absorb the amounts of CO2 that mankind was polluting, and that the rising sea temperatures could possibly melt glaciers.[68] Having become aware of these changes and the possible consequences, the conferees understood that the main task of the conference was to appeal to the public, and create and promote their findings in order to spread awareness of the consequences of pollution.[69]

Analyzing the conference with Allan's framework shows the significance of the conference and the consensus. It acknowledged that anthropogenic climate change was a separate phenomenon than natural climatic changes, reaffirming the boundary-setting that the Scripps group had done a few years prior. Thus, it was a designated object for the attendees of the conference.[70] Pragmatically, this meant that anthropogenic climate change became a more coherent subject of study and that it was enforced as a serious research topic. Secondly, the conference itself was evidence of a *translation* of the object having taken place. It meant that the data, methods, and research literature had reached actors outside of the epistemic community in a format which was understandable for individuals outside of the scientific discipline. Thus, they could treat the issues of the rising CO2 concentration on the basis of some common data collection and common understanding of geological and atmospheric systems and processes. Thirdly, the attendees of the conference recognized the threat of climatic changes and admitted that they had to promote their findings to the public to alert them about the consequences of continued CO2 pollution. The recognition *problematized*

[65] Karns & Mingst 2010, p. 13.
[66] CO2 is one of three important elements which regulate the temperature on earth. Along with water vapor and ozone, CO2 absorbs the radiation from the sun. temperature of the earth.
[67] The Conservation Foundation 1963, p. 2.
[68] Ibid p. 2. They agreed that although the ocean had the ability to safely store 60 times more CO2 than the atmosphere, no evidence had been presented that demonstrated the ocean's ability to quickly absorb large amounts of CO2.
[69] The Conservation Foundation 1963, p. 11.
[70] Allan 2017, p. 143. Weart 2010, p. 71.

anthropogenic climate change and made it an issue that posed an issue politically and socially. In sum, the conference helped designate, translate, and problematize anthropogenic climate change as a governance object, making it a constituted object in Allan's framework.

As a separate scientific forum from the Rome symposium, despite Eriksson attending, the conference established a consensus which effectively set the boundaries, translated, and problematized anthropogenic climate change outside of the Scripps group. The progress due to this small conference's consensus was significant in establishing stronger support for the governance object, showing that it had translated into a moveable object, and in identifying important reasons for why anthropogenic climate change had to be promoted to international organizations and governmental representatives. The acceptance of the social and political order remained lacking until the end of the 1960s. From the World Meteorological Organization's perspective, anthropogenic climate change was still a theory with little support. Having established important aspects of the development of the anthropogenic climate change theory and climate knowledge from the late 1950s to the beginning of the 1960s, we will shift the focus to the World Meteorological Organization. The 1960s would challenge and change the role of the WMO as a specialized agency and intergovernmental organization with the introduction of satellite technology, the dawning environmentalism movement, and the launch of the World Weather Watch (WWW) and the Global Atmospheric Research Program (GARP).

Launching meteorology into the 1960s

With an overwhelming pressure, a fiery heat, and an ear-numbing roar, TIROS-1 was launched into the atmosphere on the first of April in 1960. The satellite was the first successful weather satellite.[71] For two and a half months, it provided data from the atmosphere, which was groundbreaking for meteorologists. The launch of TIROS-1 also launched meteorology into the new decade. The WMO and atmospheric scientists would find themselves in a situation where their object of study came within reach in a new way. Although it was not a Kuhnian paradigm shift, satellites changed the world of atmospheric scientists.[72] Paired with the benefits from having been a UN agency and an intergovernmental organization for approximately ten years, the WMO had access to considerable funding, which had increased its capacity since the 1950s. Many of the aspects which had been unknown about the atmosphere for many years

[71] B. Bolin 2007, p. 19.
[72] Kuhn 1962. Kuhn meant that science did not evolve gradually, but that scientific revolutions abruptly changed scientific practices.

were now possible to observe and study.[73] This would change not only the scientific fields but also the role of WMO.[74]

The satellite succeeded with supplying data about the atmosphere and drastically changed what meteorologists were able to do. Satellites were wildly different from other instruments used by meteorologists and climate scientists. They had the ability to scan the entirety of the earth and observe wider areas of the atmosphere in detail. This differed from the other methods of sampling the atmosphere with radiosondes and balloons, which could only show pieces of picture of the atmosphere. Satellites also served as a communication tool and could pick up transmissions from ships, stations, buoys, and radiosondes and send those signals to collecting stations. Satellites revolutionized the possibilities for a completely different network of monitoring stations.[75] It is important to emphasize that it would take time before data could be put to use. The first half of the 1960s did not see too much of this data used. However, the time was spent diligently planning for the best use of the new technology and developing new models for understanding atmospheric circulation.[76] The new data served different purposes for the scientists in the WMO, depending on their field of study. Meteorologists mainly used satellite data to improve numerical prediction for weather forecasts. Satellites allowed for a revolutionary perspective on the weather systems of the atmosphere. Climate scientists, however, are the historians of atmospheric sciences. They provided a lounge durée perspective on the state of the world's climates, and therefore used the same data to find characteristics, patterns, and trends in the atmosphere. The new technology thus changed the research possibilities not only for meteorologists but also for the atmospheric sciences and oceanography.[77]

Many international organizations became platforms for geopolitical and international conflicts, as international organizations became increasingly more active on matters related to the conflicts. While some organizations pursued an operative role in these conflicts, the WMO did not actively partake in these debates. However, as exemplified in the introduction, questions and discussions tied to international conflicts were often brought up during congress

[73] WMO Bulletin 4/1963 p. 188.
[74] WMO 1973, p. 39.
[75] Edwards 2010, p. 230-232.
[76] Edwards et al 2001, p. 168.
[77] Edwards 2010, p. 292.

meetings.[78] The use of nuclear technology and weaponry became a concern for the global community, which had led to the creation of the Atomic World Organization in 1957. The environmental consequences of nuclear technology were a concern for environmental organizations, NGOs and, IOs alike.[79] The WMO responded by spending more resources on research on radiation. The WMO had also been recruited by the UN at the end of the 1950s to study radiation left in the atmosphere by nuclear testing. In 1959, the UN General Assembly established a permanent committee on the 'peaceful uses of outer space' and involved the WMO in their work from an early stage.[80] The intergovernmental structure of the WMO invited national and international conflicts and interests to enter meetings and conferences. Cold War conflicts were no exception. However, the Cold War tensions contributed to a large increase in funding for new technology and scientific development. The U.S. and the USSR had the largest financial capability to finance research during this period, which led to a large amount of atmospheric research being done by the superpowers of the Cold War. The WMO and the scientific community benefited from this. The U.S. was the largest financial contributor to the WMO, and scientific communities such as the Scripps group received governmental and military funding.[81]

TIROS-1 became a beacon for a new age of atmospheric sciences, as well as a beacon of peaceful international scientific cooperation, particularly between the U.S. and the USSR.[82] The American President John F. Kennedy publicly recognized the importance of meteorology in relation to the new satellite launch at a press conference in 1961.[83] This address to the importance of meteorology put the WMO on the map of the international cooperation agenda. The essential takeaway from the international focus on meteorology was that the importance of weather forecasting and knowledge about the atmosphere was recognized at the highest political level. The recognition from the Kennedy administration and the launch of TIROS-1 culminated with the general international scientific interest for more information about the atmosphere and led to the UN initiating further studies on the atmosphere. On the 20th of December 1961, the UN General Assembly adopted Resolution no. 1721 (XVI), which requested the WMO to address how they would advance their atmospheric research and

[78] Iriye 2002, p. 65.
[79] Kirchhof & Meyer 2014, p. 177.
[80] Iriye 2002, p. 67.
[81] Allan (forthcoming), p. 13, Heymann & Dalmedico 2019, p. 1141. Kaiser & Meyer 2019, p. 74.
[82] Bolin 2007, p. 19.
[83] Fleming 2016, p.184-188. Hart & Victor 1993, p. 652.

technology by using the new data to provide improved knowledge about the atmosphere.[84] The WMO set up a committee (which Bolin attended) that recommended to prioritize research on the composition of the atmosphere, interaction between the atmospheric layers, and their effect on the earth's surface. Additionally, they recommended focusing on solar radiation and the general circulation – important atmospheric systems tied to climatic changes.[85]

Harry Wexler, who had been central to the Scripps group and the Mauna Loa observations, developed the World Weather Watch (WWW) with the Soviet academician Victor A. Bugaev as a response to the UN and the WMO's request for a plan for the meteorological use of satellite data. The project placed Wexler, a supporter of the anthropogenic climate change theory, in the heart of one of the most ambitious plans of the WMO. Presented in 1961, the WWW was a global program that gathered and distributed weather data and linked national meteorological institutes with observation systems in space and the ocean. It was built up by three systems: The Global Observing System (GOS), the Global Telecommunication System (GTS), and the Global Data-Processing System (GDpS).[86] The goal was to create a global cooperative observation network, make the exchange of weather data faster, and develop numerical weather prediction.[87] A few years later, the ICSU began to develop the Global Atmospheric Research Program, which was the "research arm" of the WWW, according to Edwards.[88] The WMO joined the project in 1967.[89] The coordination was led by the Joint Organizing Committee (JOC), led by Bolin and consisting of members from the WMO and the ICSU. As with the WWW, a supporter of the anthropogenic climate change theory led the work of another ambitious scientific program.[90] Through GARP and WWW, the global circulation systems and climatic variations were under a magnifying glass. Data and a better understanding of the atmosphere was the reoccurring element that lacked for scientists researching the effects of carbon dioxide in the atmosphere and was the only measure that could undo the uncertainty which the lack of knowledge of the atmosphere created.[91] The WWW and GARP strengthened

[84] UN Resolution No. 1721 (XVI), Fleming 2016 p.184-188. The resolution extended the already existing cooperation between the WMO and the UN on the peaceful use of outer space, which was initiated in 1958.
[85] WMO Congress 1963, p, 98-99.
[86] Davies 1972, p. 329.
[87] WMO 1973, p. 29. Heymann, Gramelsberger, Mahony 2017, p. 1-3.
[88] Edwards et al 2001, p. 242.
[89] Ibid. Iriye 2002, p. 118.
[90] WMO ICSU 1969, p, vi.
[91] WMO 1973, p. 44-45.

the WMO's expertise, authority, and role as a facilitator of scientific development and resultingly set the WMO up to have an important role during the Stockholm Conference.[92]

The WMO began expressing their concern for pollution, particularly carbon dioxide, during the second half of the 1960s and became more active in issues concerning the environment and the climate. During a meeting of the WMO Executive Committee in 1966, the EC and CAS working group decided that they needed to strengthen their competence on matters of air pollution, as more scientists had expressed their concern for the continued increase of emissions. Now, the WMO had the same concerns as the Scripps group and the Conservation Organization consensus. D. A. Davies also expressed his strong concern for the environment in a letter to Dr. Ragnar Fjørtoft, the director of the Norwegian Meteorological Institute in 1967, making it clear that pollution was a concern in the WMO. Davies insisted that the WMO had a "direct interest in atmospheric pollution and it had accordingly for some time already been active in this field," and an important role as the intergovernmental body with the responsibility for the study of climates of the world.[93]

Climatic fluctuations, which is a term for abnormal climate behavior, were also brought up as an important task for the WMO during the EC meeting. It was clear that the WMO would contribute to the study of climatic fluctuations by initiating and promoting global measurements and observations of climatic fluctuations which could affect the environment. To do this, the WMO mobilized the member states to improve and expand their own measuring and observation stations and told them to focus on monitoring CO2, ozone, and radiation, all which directly related to anthropogenic climate change theory.[94] This can be observed by how WMO's Secretary-General D. A. Davies reached out to Dr. Fjørtoft regarding this initiative in 1967 and wrote explicitly about the carbon dioxide measurements from Mauna Loa and the Antarctic.[95]

The shared expertise between the Scripps group and the WMO was likely one of the ways that knowledge about anthropogenic climate change reached the WMO. With Bolin, Eriksson, and Wexler in influential positions within the organization and steering the development of WWW and GARP, it is possible that the WMO was affected by the relationship these scientists had to the anthropogenic climate change theory. The WMO was moving in a quite different direction

[92] Edwards 2001, p. 242. Heymann 2010, p. 593.
[93] NMI 1967a. Letter from D. A. Davies to Dr. Fjørtoft, Riksarkivet. WMO EC report 1966, p. 12, 90.
[94] WMO EC report 1966, p. 90.
[95] Norwegian Meteorological Institute, Box, file, Letter from D. A. Davies to Dr. Fjørtoft, 1967. *Riksarkivet.*

by the end of the 1960s, than it had at the beginning of the decade. With the development of WWW and GARP, the WMO became concerned with environmental pollution and anthropogenic climatic changes with a serious intent for obtaining more knowledge about the fields. The WWW and GARP also gave the WMO a stronger position as a provider of weather data, as well as its leading role for the exploration of the atmosphere and for determining the effect of pollution on the environment. The communication systems in WWW connected to satellite technology also benefitted the translation of anthropogenic climate change towards becoming a governance object, as the necessary data to study it became available to the WMO network.[96] Although the effect of the new data was not instant, it gave the WMO more certainty when it came to the monitoring and study of CO2 in the atmosphere. This might have, in turn, eliminated some of the uncertainty that hindered the WMO in engaging with the anthropogenic climate change theory. The new projects in the WMO facilitated working groups and advisory committees which became platforms for atmospheric experts to discuss the future of the scientific field, both as scientists and as a part of international organizations, spurring on the possibilities of co-production with other disciplines and governmental representatives. Therefore, the results of technological and political developments during the 1960s gave the WMO the tools and the platform to become an actor in international environmental governance. Moving into the late 1960s, environmental awareness and the increasing CO2 concentrations in the atmosphere would manifest even more in the WMO.

[96] Howe 2014, p. 77.

Chapter Two

"An opportunity, an obligation, and a challenge"
The World Meteorological Organization and the Stockholm Conference in 1972

"A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences. Through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well-being depend. Conversely, through fuller knowledge and wiser action, we can achieve for ourselves and our posterity a better life in an environment more in keeping with human needs and hopes." - UN Conference for the Human Environment, 1972.[97]

The next chapter picks up at the end of the 1960s and looks at how the WMO presented their expertise during the preparation for the Stockholm Conference. By understanding it as a co-production process between the WMO and policymakers, it will enlighten on the WMO's role of producing and promoting environmental and climate change knowledge during the Stockholm Conference. It might also tell us whether the WMO was able to affect international environmental governance through its work on before and during the conference. The questions driving this chapter are: *how did the WMO participate in the preparation for the Stockholm Conference, and how can it be seen as a co-production process of environment and climate knowledge? What does the WMO's role before and during the Stockholm Conference tell us about its role in international environmental governance in the beginning of the 1970s?*

The UN Conference on the Human Environment in 1972, often referred to as the Stockholm Conference, represented a major change in the understanding of the relationship between mankind and the earth. The environment had been an unlimited resource to host mankind. At the conference, it was understood as its own biosphere for which human action had severe consequences. According to Karns and Mingst, conferences are a type of governance piece which create a complex, multilateral diplomacy system by initiating cooperation and discussion between IOs, NGOs, experts, states, and corporations. They also raise awareness, create new norms, share knowledge, and define priorities.[98] The conference legitimized an international policy approach to handling environmental issues. It created an impetus to include

[97] UN 1972, p. 3.
[98] Karns & Mingst 2010, p. 13.

environmental issues in national agendas, even for nations who had not addressed such problems earlier.[99] For the first time, a conference resulted in a declaration on the global environment, and a series of recommendations, principles and regulations for all nations to follow to preserve it.[100] It made mankind accountable for the further protection and improvement of the environment by referring to it as the responsibility of all nations.[101] The Stockholm Conference, along with the extensive work leading up to it, created the first international environmental regime.[102] According to Karns and Mingst, international regimes are key pieces in global governance. They establish rules, regulations, norms, and principles for governing political and social issues. IOs and states follow regimes by accepting that the rules for governing and decision making are legitimate and complying with them.[103]

Prior to the 1960s and 1970s international environmentalism, there had been instances of international cooperation on the protection of the human environment, such as the international treaty on marine safety in 1914 and the mentioned regulations on whaling from 1946.[104] Environmentalism can be traced back to the 19th century conservationism. The 1960s and 1970s broke with the 19th century elite conservationism and became a mass movement.[105] Environmentalism and the Cold War were the reasons for some of the largest mass demonstrations during the 1970s.[106] The ideas of the environmental movement and the growing public awareness of the environment were influenced by contemporary environmentalist literature, such as Rachel Carson's *Silent Spring (1962),* and Jacques-Yves Cousteau's *The Living Sea* (1963).[107] The postwar industrial growth led to visible environmental pollution in the form of mercury poisoning, pesticides effects on wildlife and nature, cancer due to pollution, smog in cities, and oil spills.[108] In the 1960s and 1970s, environmentalism was critical for the establishment of environmental responsibility and the moral purpose of protecting the environment in spite of borders.[109] Environmental movements and organizations grew rapidly in countries such as France, the U. S., Germany, the Netherlands, Sweden, and

[99] Caldwell 1996, p. 48. Zelli & Stephan 2009, p. 3.
[100] Zelli & Stephan 2009, p. 3.
[101] UN 1972, p. 3.
[102] Ibid. Karns & Mingst 2010, p. 503.
[103] Karns & Mingst 2010, p. 11-12.
[104] Reinalda 2008, p. 517.
[105] Faulkner 2012, p. 512-513. Crosby 1995, p. 1186-1187, 1189.
[106] Brenton 1994, p. 22.
[107] Karns & Mingst 2010, p. 503-505. Reinalda 2008, p. 514, Crosby 1995, p. 1186.
[108] Reinalda 2008, p. 514, Crosby 1995, p. 1186.
[109] Faulkner 2012, p. 512-513. p. 522.

the UK, but also Japan.[110] The establishment of several international organizations, such as the Environmental Defense Fund, the Natural Resources Defense Council, the WWF, Friends of the Earth, and Greenpeace, took place during this period.[111] Additionally, memberships in international and national organizations grew rapidly during the 1960s and 1970s.[112]

As the Stockholm Conference approached, environmentalism had entered international discussions and forums, particularly regarding air pollution, radiation, and local pollutants. National and regional pollution became a global problem, and international regulations and cooperation were necessary. As emission from the industrial sector and pollution from cars were publicly accepted as the culprit for air pollution, finding a solution to somehow minimize the pollution or the sector itself was up to debate. As the Scripps group had been saying since the late 1950s, increased industrialization meant increased pollution. However, halting industrialization would mean slowing down economic and social development. Particularly for countries who had not become fully industrialized, this was problematic. Thus, environmental protection became an even more complex problem in international affairs.

The WMO's activities at the turn of the decade were centered around the implementation and planning of WWW and GARP, which involved the development of the network of monitoring stations. Monitoring and observation had primarily focused on synoptic observations to improve weather forecasting, but an increase among did climatological observations.[113] As observed in the Executive Conference reports from 1969, the WMO extended their monitoring network to include pollutants that could change the climate. This included carbon dioxide. They also established a monitoring network for measuring background pollutants.[114] This was the same type of measurements that the Keeling and the Scripps group did during the late 1950s. By initiating the background pollution monitoring project, the WMO showed that they considered air and atmospheric pollution important.[115] This important change in the WMO was further supported by their in advancing weather models that could determine whether the climatic changes were anthropogenic or natural.[116] The improvement of electronic computers

[110] Kaiser & Meyer 2019, p. 34.
[111] Brenton 1994, p. 19.
[112] Tolba 1992, p. 679.
[113] Ibid, 5.
[114] Hart & Victor 1993, p. 662.
[115] Tolba 1992, p. 26.
[116] Edwards et al. 2001, p. 48-49.

during the 1970s made it possible to make more advanced models.[117] However, the modeling was still considered somewhat immature. Edwards goes as far as to say that consensus based on the models at the time was impossible. More time and work were required.[118] Albeit, it still remained an important step towards more knowledge on the atmosphere, the biosphere, and the climate.

The United Nations General Assembly Declaration on the Environment

In 1968, the UN called for a conference on the environment. The call for such a conference was a result of the growing environmentalism, scientific advancements, an increasing awareness of pollution. The idea originally came from Swedish delegates to the UN in 1967, and was officially proposed by Sweden in 1968 in a letter to the UN General Assembly.[119] Sweden, along with the UK, the US, the Netherlands, Canada and Japan, was one of the leading nations where environmental concern was established as a governmental concern. They saw that many environmental issues required international cooperation and action to be solved.[120] The UN accepted Sweden's suggestion and worked out a possible program for such a conference. Understanding the urgency of environmental protection, the proposal was voted through unanimously in the UN General Assembly. The conference was to be held in Stockholm in 1972. It was important that the conference had a stimulating effect on national and international work to protect and improve the environment, and that it was able to guide governments and organizations in their attempts to solve environmental problems. The discussions had to be of a general nature, and the topics had to be broad in order for all participants to grasp the concepts.[121] Environmental problems also had to be dealt with in a way which did not affect social progression, creation of social wealth, and scientific and technological advancements. This was something else than the more science specific conferences discussed until now. The UN Conference would play a very different role. The call for a global conference of the human environment acted as a stimulant for scientific, civic, and political effort - both to prepare for the conference, as well as to support action for protecting the environment.

[117] Bodansky 2001, p. 24. Heymann 2010, p. 591.
[118] Edwards et al. 2001, p. 49-50.
[119] Caldwell 1996, p. 57-58. Reinalda 2009, p. 515-516. Karns & Mingst 2010, p. 503-505.
[120] Caldwell 1996, p. 55-56.
[121] Ibid. UN 1972, p. 37.

Preparing for Stockholm – co-production of environment and climate knowledge

Preparing for the Stockholm Conference was a major project. The field of environmental studies crossed a broad specter of disciplines. Therefore, the initial work focused on gathering information, clarifying conceptual aspects of the environment, and mapping out the political, economic and social aspects of environmental issues.[122] One might claim that the work leading up to the conference was more important than the conference itself, as it connected stakeholders, politicians, scientists and NGOs and created dialogue between these actors.[123] Likewise, the WMO's Executive Committee stated that in case the conference was unsuccessful "it is clear that a detailed and farsighted reappraisal of world environmental problems will have been made and that the issues to be faced will have been more clearly identified."[124]

From 1968 until 1972, several meetings took place between scientists, politicians, interest groups, as well as international organizations and NGOs. All of these actors contributed to the production of basic papers and reports for the conferences.[125] The production of reports, basic papers, and other contributions to the Stockholm Conference were vast. 86 governments contributed with national reports on their experiences with environmental issues. Other UN agencies and organizations (including IGOs and NGOs) submitted papers related to their expertise and field. The selection and review of the material were done by the Conference secretariat, with help from the preparatory committee, UN agencies and experts from member states.[126] This process resulted in an exchange of information, findings, and ideas regarding the environment and possible solutions. Here, we can see both a co-production between experts and governmental representatives, as well as the process of creating consensual knowledge about the environment.

To understand the significance of the co-production of climate knowledge in the preparatory stage of the Stockholm Conference, it is first important to understand what it meant to contribute to the preparation process. The UN relied on the gathering of relevant data, knowledge, research, opinions, and experiences, to be able to plan for a productive conference and create the declaration. Although discussions during the conference itself contributed to the

[122] Caldwell 1996, p. 61.
[123] Caldwell 1996, p. 48-49. Kaiser & Meyer, p. 75.
[124] Davies 1972, p. 335-336.
[125] Kaiser & Meyer 2019, p. 78-79.
[126] UN 1972, p. 38.

shaping of the declaration, the preparatory work was elemental in identifying and establishing the main pillars of the declaration. Therefore, participating in the preparatory work of the conference in extension meant the possibility of influencing international environmental policy-decisions. It presented the opportunity to contribute to the regime, as the recommendations, principles, and regulations of the declaration were based on the work experts, activists and governmental representatives. Affecting the regime also meant influencing how international cooperation on environmental issues should be structured and carried out, as well as the future direction of environmental protection. Atmospheric scientists tried actively to influence the agenda.[127] Presenting basic papers, reports and research articles placed scientists and institutes in the co-production process with other actors, which according to Allan, Sundqvist, and Lidskog, was a way for science to affect policymaking. Finally, taking an active part in the preparation for the conference can be seen as an act of asserting authority in a scientific field or on a scientific topic, presenting one explanation for an object or a set of phenomena as the best representation of the truth.

The WMO took an active role in the preparation for the Stockholm Conference. The co-production prior to the conference was essential for WMO to establish itself as a competent and influential actor in finding solutions to environmental issues. The WMO promoted research on atmospheric circulation, atmospheric, air and marine pollution, carbon dioxide along with other pollutants, as well as the relationship between mankind and the atmosphere. The WMO was one of several agencies and organizations that felt inspired to arrange meetings, seminars and conferences to contribute to the conference.[128] For instance, WMO held a large symposium in 1971 in Stockholm, where they considered the consequences of human activities for the atmosphere.[129] This provided further scientific input to the conference. During the period between 1968 and 1972, WMO redirected their focus to prepare for the conference. The WMO also experienced a shift towards environmentalism during this period, which was essential for their role at the Stockholm Conference.

Preparing for the conference, WMO created an overview of its environmental activities for "possible future discussions and decisions by national and international bodies on questions

[127] Howe 2014, p. 65.
[128] Caldwell 1996, p. 60.
[129] Caldwell, 1996, p. 61.

relating to the human environment."[130] In this overview, we are able to locate a shift in the WMO's understanding and branding of itself in 1970. Although there was still much to be learned, the WMO had gained a more comprehensive understanding of the atmosphere due to WWW and GARP and was in a unique position due to their expertise and their network. Leaders in the WMO had observed that environmentalism was growing on a global basis and understood that the atmosphere was an essential part of the human environment. Since the study of the atmosphere was the core of the organization's work, they referred to themselves as an environmental organization. Tying the organization's identity directly to environmental issues reflected the changes which had been ongoing on the WMO since the mid-1960s, as the organization had become more concerned with environmental issues such as pollution and desertification and deforestation. The change can be interpreted as the WMO being ready and willing to take on a new role as a leading intergovernmental organization on environmental issues.

The overview paper also showed that the WMO recognized atmospheric pollution as a possible danger, by recognizing that it could lead to global warming. Thus, after almost fifteen years, the WMO recognized the anthropogenic climate change theory, saying that "a persistent increase of CO2 could result in a warming of the Earth's atmosphere, while an increase of particulate matter could have the opposite effect. In both cases, possible serious consequences to mankind could occur."[131] Increasing CO2 concentration in the atmosphere was directly tied to climatic variations. This admission was a significant change for the WMO, who had years earlier denied the theory completely and deferred from discussing it. The WMO had become an (self-pronounced) environmental organization who recognized the dangers of atmospheric pollution, particularly increasing levels of CO2 in the atmosphere.[132]

The WMO prepared a set of basic papers which were submitted to the Conference Secretariat to serve as position papers.[133] The collection of papers was also distributed to the member states of the WMO.[134] The themes of the papers spanned from the relationship between mankind, the atmosphere and the climate, atmospheric monitoring activities, environmental

[130] WMO 1972, p. 1-2.
[131] WMO 1970, p. 6.
[132] WMO 1970, p. 7.
[133] WMO 1971, Selected papers on Meteorology as related to the Human Environment.
[134] NMI 1972, «Consolidated document on the UN system and the Human Environment». Letter from D. A. Davies to the Norwegian Meteorological Institute, May 8th, 1972. *Riksarkivet.*

aspects of building and resource planning, and local and regional hydrospheric pollution.[135] The collection of papers were the WMO's contribution to the conference, as well as their contribution to the co-production of environment and climate knowledge. Among the contributors to the selected papers were Bolin and Eriksson from the Scripps group, as well as atmospheric scientist Lester Machta, who was a close associate and student of Wexler The basic papers, and particularly Bolin's contribution, promoted anthropogenic pollution as the cause for rising CO2 levels and climatic changes, in addition to the fact that the ocean did not absorb much CO2. This was the same climate knowledge that the Scripps group established during the end of the 1950s, which had been heavily contested by the scientific community, and which the WMO had been hesitant in recognizing during the 1960s. It is important to see that these were included in the co-production process, and that they were included in the WMO's contribution to the conference. This tells us that the WMO did indeed promote climate change as a future threat. It was even referred to as a danger to mankind.

The collection of papers also presented new climate knowledge to the co-production process. Namely, that the earth's vegetation acted as reservoirs for CO2. This meant that CO2 could be stored elsewhere than in the ocean. However, Bolin had discovered that the CO2 molecules spent at least 5-10 years in the atmosphere before it was transported to a reservoir. This, according to Bolin, was a concerningly long time, and an important find for the scientific community.[136] R. A. McCormick made a similar warning that too much was at stake to be hesitant in taking action on the environment and the climate. [137] This enforced the urgency of international action on pollution, as well as the need for more research on the atmosphere and the CO2 circulation.

What can be deduced from these documents regarding the role of the WMO, was that their competence and expertise in the study of the atmosphere, along with their monitoring network would likely make them the leading organization for international environmental activities which somehow required atmospheric data. As was specified in a letter from D. A. Davies to the Norwegian Meteorological Institute regarding documents to the Stockholm Conference, "[a]ttention has been drawn in this and in other ways to the important role which WMO, as a specialized agency of the United Nations, is playing and must continue to play in problems

[135] WMO 1971. Selected papers on Meteorology as related to the Human Environment.
[136] Ibid. p. 7.
[137] Ibid. p. 31.

relating to the Human Environment."[138] Having assumed the identity as an environmental organization, the WMO went to Stockholm with the understanding that they could contribute to the result of the conference.

A Call to Action - WMO at The United Nations Conference on the Human Environment in Stockholm, 1972.

Associate Professor, Maria Ivanova, regards the Stockholm Conference as the beginning of environmental governance. The conference in Stockholm represented a change in mankind's perception of the environment, as well as a change in the common consensus on environmental issues. The signing of the declaration meant that nation-states saw the need for protecting the natural environment, both nationally and internationally. The event marked the institutionalization and implementation of environmentalism, as well as the creation of the first international environmental regime. Anthropogenic climate change was a part of the discussion and the embedment process but constituted only a small role in the entirety of the discussion on environmentalism.[139] The importance of addressing climate change in an international forum would return at the end of the decade during the World Climate Conference in 1979. The UN recognized that they were standing at a turning point for international cooperation on environmental issues. The approach had to consist of a united, international front with "the established and fundamental goals of peace and of worldwide economic and social development."[140] In other words, there had to be a form of consensus. Cooperation was needed on all levels from local to international, and it had to be done by actors representing those levels. Local and national governments would have to do their part by implementing and acting on environmental policies. International actors had to provide resources to aid developing countries and coordinate international cooperation, and NGOs were important actors for problematizing and pushing national and international agendas.[141] As Iriye points out, the Stockholm Conference created a foundation for NGOs and IOs to promote their work. [142]

The declaration was a call to all UN members, all governments, and individuals to do their most for the human environment and the prosperity of all people.[143] The conference and the

[138] Letter from D. A. Davies to the Norwegian Meteorological Institute, May 8th, 1972.
[139] Hart & Victor 1993, p. 666.
[140] UN 1972, p. 3.
[141] Iriye, 2002, p. 129, 143-148.
[142] Iriye, 2002, p. 143-148.
[143] UN 1972, p. 3-4.

declaration were instances of soft-power governance, as suggested by Foucault, Merlingen, Karns and Mingst, as a type of power that international organizations often have. [144] It proclaimed that nation-states were obligated to protect the environment, but there were no repercussions for not following the rules set by the conference. In spite of disagreements and mistrust between the attending nations, the conference ended with and "unprecedented level of agreement on the problems at hand and the possible path forward […]"[145] The conference recognized that anthropogenic pollution harmed to the global environment, and saw population growth, new technology and industrialization as inevitable but contributing factors to environmental problems.[146]

The WMO during the conference

At the conference, the Secretary-General D. A. Davies was joined by the director of Meteorological Applications O. M. Ashford, the Chief of the Marine and Aeronautical Divison M. L. Verannejviann, Chief of Special Environmental Application C. C. Wallen, and Chief of Public Information R. Mathieu.[147] The established role of the WMO at the conference was as a specialized agency of the UN with a particular broad expertise of many aspects relevant for the conference, such as air and marine pollution, agriculture, radiation, the atmosphere and its relationship with the biosphere. Additionally, they saw themselves as an environmental intergovernmental organization. Its intergovernmental structure provided it with data and input from national weather services and meteorological institutes, as well as scientific input from other governmental and non-governmental organizations. The WMO already had the type of international and transnational cooperation which the UN wanted to initiate through the Stockholm Conference. Their global observation network provided them with data from all its members, which along with data from satellites gave the WMO a unique position as the foremost observer of the atmosphere. With essential experience, expertise, equipment, and a plan to monitor the atmosphere, along with ambitious plans to continue that work, the WMO was arguably the organization with the largest capabilities and the most expertise on the atmosphere.

[144] Merlingen 2003, p. 377, Karns & Mingst 2010, p. 503-505.
[145] Ivanova 2007, p. 345.
[146] Simmons 2013, p. 172.
[147] UN General Assembly List of participants for the Stockholm Conference, 1972, p. 81.

Altogether, 35 of the 109 recommendations involved the expertise of the WMO, demonstrating its important role and responsibility of the WMO.[148] Two recommendations were particularly relevant for the WMO or directly addressed and recruited their expertise related to atmospheric monitoring or anthropogenic climate change; the 56th and 79th. The 56th recommendation did not refer to the WMO directly, but addressed the "collection, measurement and analysis of data relating to the environmental effects of energy use and production [...]" using monitoring systems. The UN asked specifically for the monitoring of changes in the environment due to "emission of carbon dioxide, sulphur dioxide, oxidants, nitrogen oxides [...]", as well as emissions from oil and radioactivity. This monitoring would be done in order to assess the dynamics between the emissions and consequences for human health, plants and animals, as well as the weather.[149] This recommendation is significant because it addresses the importance of monitoring emissions due to their effects on the human environment, within the framework of an international declaration on the environment. Having pollution monitoring as one of the recommendations in the declaration therefore put the effects of anthropogenic pollution on the international political agenda, which the WMO had promoted during the preparation for the conference. Considering the possibility that other organizations might also have promoted the same knowledge, the result was still in the WMO's favor and repeated the messages that the WMO conveyed in the preparation.

Recommendation 79 was particularly addressed to the WMO and monitoring stations. It recommended setting up ten baseline stations to monitor climatic changes and other changes relevant to meteorologists on a global scale. Furthermore, they recommended an extensive network of up to 100 observing stations to monitor the "distribution and concentration" of pollutants in the atmosphere.[150] The WMO was asked to be the coordinator of these projects.[151] This recommendation meant several things for the WMO. It recommended specific action for observing pollution, stating particular numbers for observing stations. This specific suggestion can be interpreted as a willingness to act, thus making it even more significant that it particularly addresses baseline stations for observing climatic changes. In the same sentence, the UN gave the impression that they recognized the possible dangers of climatic changes and wished to know more about it by observing it.

[148] WMO annual report 1972, p. 2.
[149] Ibid 18-19.
[150] Ibid. 21.
[151] Howe 2014, p. 84.

Furthermore, the recommendation recognizes the role of the WMO. The WMO was recommended as the coordinator of international projects that had to do with observing atmospheric and air pollution. Declaring them as the coordinator of global, atmospheric observing of climatic changes and pollution, the conference strengthened the WMO's position in international environmental governance. The decision made the WMO in charge of the coordination of atmospheric research and monitoring, which in turn meant that they would be involved in mapping out the future research activities on the atmosphere. This both acknowledged and enforced the WMO's authority as a specialized agency and gave them an important role in the investigation and further exploration of the atmosphere. This was further underlined with the recommendation deeming GARP as an important contribution to the goals of the conference.

What can be observed from looking at all the recommendations in the declaration is the wide variety of topics that the WMO was a relevant part of. The large variety of topics shows the vastness of the conference, as it covered most things having to do with the environment. The conference was meant to be a general approach rather than a very specific scientific approach, which allowed national decision-makers to participate and act on behalf of their government. The role of scientific experts was still vital, as they provided legitimacy and authority to the content of the discussions.[152] International cooperation between governmental and non-governmental actors was understood as a key to making progress with creating international guidelines and programs, as well as national environmental policies. Although climatic changes and carbon dioxide were mentioned, and had its own recommendations, they were a few out of many other recommendations that covered a large number of environmental problems. This tells us that anthropogenic climate change was a part of the discussion but remained only one of many topics discussed during the conference.

Governing the environment

The Stockholm conference was the beginning of the first international environmental regime. It established a set of resolutions, recommendations and principles for all nations, organizations and other bodies to follow in order to protect the global environment. The United Nations Environmental Program (UNEP) was also a product of the Stockholm Declaration, and became

[152] Sending 2015, p. 14.

the core of the international environmental regime.[153] UNEP was the first agency whose design at the time of origin was influenced by the idea of international environmentalism. Understanding the creation of UNEP through Allan's understanding of knowledge creation and international governance, UNEP was an agency which embodied the implementation of the rules to regulate and govern an object, which was the environment for UNEP's case. UNEP was also a result of the co-production between scientists, activists, and governmental representatives during the preparation for the Stockholm Conference, and the discussions and decisions made during the Conference.

Reinalda argues that UNEP had a weak position in the UN due to it being a program and not a specialized agency. According to him, other specialized agencies and organizations did not take UNEP seriously due to its lack of financial resources and expertise. This might have been true for the WMO as well, but as we will see, the WMO and UNEP cooperated extensively.[154] Additionally, the combined efforts of the preparation and the conference led to a declaration which recognized that mankind polluted the environment and addressed the importance of monitoring carbon dioxide in the atmosphere. The co-production during the preparation for the conference institutionalized environmentalism and environment knowledge by creating rules which regulated environmental issues. When member states and organizations implemented those rules, environmental knowledge became a governance object – a separate object which posed a problem and needed to be regulated.[155] This shows how scientists were able to influence co-production with government representatives, resultingly affecting the decisions and results of the Stockholm Conference, which established the first global environmental regime.

Environmentalism was a vehicle for the problematization of anthropogenic climate change to enter the political agenda. As has been argued in this chapter, and which has been evident from the source material, the concern for anthropogenic climate change was strong in the WMO. They promoted it during the preparation for the Stockholm Conference, and it was briefly mentioned in the Stockholm Conference. As it entailed a comprehensive and serious problem affecting the entire earth, it needed to be addressed in a larger degree than in the declaration. Thus, even though the declaration was implemented, anthropogenic climate change was not

[153] Andresen 2007, p. 4.
[154] Reinalda p. 515-516. Biermann 2011, p. 8. Ivanova 2010, p. 339-340.
[155] Allan 2017, p. 133–134.

recognized as a problem to the extent that it was.[156] However, the declaration called for further studies and monitoring of carbon dioxide in the atmosphere and admitted that anthropogenic pollution was a major problem for the international community. This was perhaps the extent to which anthropogenic climate change could be addressed on an international platform in 1972.[157] From this, we can determine that anthropogenic climate change was chosen as an important topic to mention in the declaration, and that scientists, governmental representatives, and the UN agreed on this. As such, anthropogenic climate change was selected in a political selection process, which is a part of Allan's framework. Furthermore, recommendations for the monitoring and study of the rise of CO2 and its effect on the atmosphere and the environment was institutionalized and implemented through the declaration. Therefore, anthropogenic climate change had been put on the international political agenda through the work of the WMO during the preparation, as well as through the signing of the declaration.

[156] Howe 2014, p. 68-69.
[157] Howe 2014, p. 92.

Chapter Three

The WMO and the First World Climate Conference in 1979

The First World Climate Conference has yet to be the subject of extensive study and academic interest and is usually only given a brief mention in relation to other conferences taking place before or after 1979, such as the Stockholm Conference in 1972 and the United Nations Vienna Convention on the Protection of the Ozone Layer in 1985. Since the WMO convened and arranged the conference, this chapter will provide information on how the conference came to be, who the WMO cooperated with to arrange it, and what the conference meant for international environmental governance and for establishing anthropogenic climate change as a governance object.[158] This chapter begins by addressing how the WMO developed as an environmental organization after the Stockholm Conference by looking at their research and activities during the years between 1972 and 1977. As with the second chapter, the third chapter looks closer at how the WMO prepared for the First World Climate Conference, and attempts to understand more about the nature of their role, taking into consideration the changes that the organization went through after 1972 by studying it as a possible co-production process. Using the co-production and governance object theory, this chapter will elaborate on the role of the WMO in producing and promoting climate change knowledge leading up to and during the First World Climate Conference and how it engaged in international environmental governance through the conference.

After Stockholm

In the wake of the Stockholm Conference, the WMO kept their commitment to the declaration, and improved their monitoring networks, models, and atmospheric research programs during the second half of the 1970s. In 1974, the Executive Committee reported that the global network of regional and baseline stations had increased since 1972 with 92 regional stations in Member nations, 140 stations planning to be built, and 18 proposals for new baseline stations from nine additional members. The expansion of the network continued throughout the rest of the decade. The monitoring improved significantly on a technical level as well, as the development of global climate models, essential for interpreting CO2 levels and climate data,

[158] Allan 2017, p. 134.

progressed and became common use in monitoring stations.[159] In spite of the improvements, the WMO still felt like they lacked knowledge regarding the consequences of continued fossil fuel emissions.[160] Additionally, the monitoring networks in Asia, Africa, Australia and mid- and South-America were still insufficient.[161] Not only did the WMO want to expand the network – they also saw the need for a stronger long-term monitoring program on atmospheric CO2, in order to determine whether the rising trends were anthropogenic or natural, and to determine the consequences of continued pollution.

Supported by the growing awareness of atmospheric pollution in the public, which was likely affected by climate fluctuations in the mid-1970s, the WMO did not waste time setting environmental initiatives on their agenda after the Stockholm conference.[162] "With the awakening of the world-wide interest in environmental problems"[163], as the EC stated remarked a session in 1973, the WMO called for symposiums, conferences, and meetings where national authorities who dealt with environmental problems could discuss their issues with experts, continuing the co-production relationship with policymakers. Many of their activities were in cooperation with other international organizations, such as UNESCO, WHO, FAO, and ICSU, whom the WMO regarded as important partners for the development of environment and climate change science.[164] Along with the International Association of Meteorology and Atmospheric Physics (IAMAP) and the ICSU, the WMO arranged a symposium on long-term climatic fluctuations in 1975, which was related to GARP's projects.[165] The Joint Organizing Committee for GARP also held a conference in 1978 for assessing climate models, which also functioned as a gathering of scientific competence on climate. Climate models were quintessential, as they made it possible to interpret data gathered from the observational networks.[166] Additionally, the WMO contributed research papers on climate fluctuations for the World Food Conference in Rome 1974.[167]

[159] Edwards et al. 2001, p. 48-49.
[160] WMO EC 1977, p. 192-195.
[161] WMO EC 1978, p. 223.
[162] WMO EC 1974.
[163] WMO EC 1973, p. 5.
[164] WMO EC 1974, p. 52-58.
[165] Ibid.
[166] Bolin 2007, p. 29-32.
[167] WMO EC 1974, p. 58-60.

Establishing climate change knowledge: planning for FWCC 1977-1979

During the annual Executive Committee session in 1977, the WMO declared to have an international, scientific conference on the climate in Geneva in 1979. [168] Such a conference had been in the cards for several years, as the EC panel of Expert on Climate Change that had served during 1974-1977 requested a special session of the UN General Assembly regarding the global climate.[169] This request initiated the work which eventually became the First World Climate Conference, the World Climate Program, and the World Climate Research Program.[170] The goals of the conference were to gather climate change knowledge, review it and make an assessment of the future implications of climate change. It was important that the discussions of the conference were well-prepared for, in order to create a body of knowledge on the climate and possibly a consensus on the discussion of anthropogenic versus natural climatic changes. Therefore UNEP, UNESCO, ICSU, and FAO were invited by the WMO to assist with the planning of the conference.[171] Arranging the World Climate Conference was another way for the WMO to partake in international, environmental governance.

The need for the conference was grounded in two factors. Firstly, the growing population and the vulnerability of humans due to climate changes. The EC became aware of this problem through the first report of the EC Panel of Experts on Climate Change in 1976.[172] If the climate was to drastically change, the consequences for human habitats and food production would be serious.[173] Secondly, there was a need for more knowledge on both natural and anthropogenic climate change. The EC expressed their agreement that the increasing CO2 concentration in the atmosphere due to fossil fuel combustion was the "most important single factor among those human activities which might have an impact on the global climate and therefore justified urgent attention." This concern was a driving force for convening the World Climate Conference.[174]

As mentioned**,** the planning of the general aspects of the conference's goals had already come far when the WMO declared to arrange it in 1977. Supporting documents were prepared by

[168] WMO EC 1977, p. 140-144.
[169] WMO FWCC 1979, p. vii.
[170] Bolin 2007, p. 29-32. The two latter were cooperative programs between WMO and the ICSU.
[171] Tolba 1993, p. 62.
[172] WMO EC 1977, p. 45-49.
[173] New York Times, "Worldwide effort is proposed to study Climate and its impact*"*, 1979.
[174] WMO EC 1979 p. 85.

working groups consisting of the experts invited to the conference. Their knowledge of climate came from the overview papers that would form the proceedings of the conference paper. According to Robert M. Whiteman, chairman of the FWCC, the papers "describe the present status of our scientific knowledge of climate and its variability, as well as of the impacts of climate upon society."[175] The working groups also conducted about 5000 interviews of a vast variety of people in order to map out the existing understanding of climates, and to gather data on individual experiences. Thus, in spite of the WMO's competence on the climate, the production of knowledge by the groups of experts added significant contribution to the understanding of the climate, which was to be presented in the declaration and proceedings of the conference.[176]

The WMO reached out and mobilized their members, international organizations, and experts in order to prepare for the conference. The goal of the conference was to gather and consider the current knowledge about climate change. The preparatory work consisted of gathering and establishing climate knowledge regarding circulation and transportation of CO2 between atmospheric layers, the regulatory and transporting qualities of surface waters. Of the utmost importance was the improvement of climate models, as they were key to predicting the consequences of climate change.[177] Thus, it could seem that the WMO initiated a co-production process. However, the intended goals for the FWCC were different from the Stockholm Conference in terms of what sort of results they wanted. Stockholm had been the international call to action, for all nations, NGOs, and IOs, with the goal to reach a consensus and an agreement on the future international action for stopping the degradation of the environment. Scientific experts played an important role in legitimizing the action that needed to be taken to do so, and engaged in a co-production process with governmental representatives in order to establish knowledge about the environment, as well as the rules and regulations for the regime. The First World Climate Conference, on the other hand, was only for scientific experts. The goal was to gather and establish knowledge on climatic changes and the consequences.

[175] WMO FWCC 1979, p. xi-xii.
[176] New York Times, "Disaster Tolls Needlessly High, Conference on Climate is Told", 1979.
[177] WMO EC report 1978, p. 32-36.

The First World Climate Conference in 1979

The First World Climate Conference was convened by the WMO and UNEP, but also in cooperation with ICSU, UNESCO, WHO, and FAO. It lasted for two weeks in February of 1979 and ended with all the attendees from 50 countries signing the declaration. The conference was more of a scientific and technical gathering than the Stockholm Conference had been, which was reflected in who attended the conference. The main goals were to gather and review the currently available knowledge about natural and anthropogenic climate change and give an assessment about the future consequences of the climatic variations. The conference also wanted to "map out an ambitious international climate program to gain an understanding of the forces that determine climate and cause its change."[178] Altogether, approximately 350 participants from different disciplines attended the conference.[179] During the first week, the 350 participants listened and participated in the discussions of several overview papers on climate knowledge. During the second week, 120 experts from all parts of the globe with different scientific backgrounds presented and assessed their understanding of climate change and the interactions between mankind and the climate.[180] The large group of experts deliberated the findings of the conference, and made a set of recommendations for international action, leading to the making of the World Climate Program, and the unanimous adoption of the FWCC declaration.[181] The issue of human influences on the climate was presented as the most important question to address. When the declaration was signed at the end of the two-week-long conference, the attendees also agreed on the creation of the World Climate Program. To last for 20 years, the program would narrow down the uncertainties about the possible threats of climate change.[182] The program would also improve climate data collection for developing countries, apply new knowledge to agriculture, land planning, energy policy and water management, and study the impact that climate had on society. [183]

The New York Times covered the conference and wrote several news articles with interviews from participants, often covering the discussion on natural versus anthropogenic climate

[178] New York Times, "Disaster Tolls Needlessly High, Conference on Climate is Told**"**, 1979.
[179] Bolin 2007, p. 29-32.
[180] WMO FWCC 1979, p. xi-xxii, Zilmann 2008, p. 143.
[181] New York Times, "*Disaster Tolls Needlessly High, Conference on Climate is Told",* 1979. WMO FWCC 1979, vii-xi.
[182] The program was interlinked with the 'one year Global Weather Experiment' by GARP (WMO/ICSU). The experiment would use observation from 7 satellites, more than 40 ships and hundreds of buoys, airplanes and weather balloons.
[183] New York Times, "*Worldwide effort is proposed to study Climate and its impact",* 1979, Bolin 2007, p. 29-32.

change, and whether the urgency and warnings of the conference were legitimate. The articles also showed the opinions and concerns of the scientists at the conference. For many of the interviewed scientists, climatic changes due to anthropogenic causes were the main concern for the future, and CO2 was the culprit. The global energy use was expected to rise, and cause a doubling of the projected CO2 levels in the mid-200s, according to a study by the Austrian International Institute for Applied Systems Analysis.[184] Expected deforestation and warming of the oceans were said to harm CO2 reservoirs, ruining one of earth's absorption mechanisms.[185] Scientists at the conference predicted that new energy and land-use plans had to be developed within five to ten years if the issues were to still be reversible.

The nature of climatic changes was key to finding a solution to global warming. The debate created a front of supporters, and a group of scientists who disagreed with the theory. Dr. Aleksei Treshnikov told the New York Times that there were no reasons for fearing that the poles would melt and pointed out that many several scientists had not considered the stabilizing qualities of the ocean.[186] Dr. Harry Van Loon, Dr. Hermann Flohn, along with several like-minded colleagues, said that there was no observable change in climate variability. Dr. F. Kenneth Hare also raised doubts during the conference, saying that there was a rise during 1880-1940, but the climate had cooled since then.[187]

These statements made in the NYT tell us that the support for anthropogenic climate change and the possibility of global warming had grown, unlike the times of the Rome Symposium in 1961. Already before the conference, Dr. S. H. Schneider and Dr. John Mercer promoted climate change as a "potential hazard" which could lead to the poles melting. Dr. Mercer had found evidence of a similar process in ice-covered areas in Canada and predicted that the same could happen at the poles.[188] Dr. Lawrence Gates, Dr. Edward Munn, and Dr. Lester Machta believed strongly that climatic changes posed a danger to mankind, and could result in an environmental catastrophe, with rising sea-levels and the melting of the poles.[189] Dr. Roger Revelle from the Scripps group chaired one of the discussions during the conference. Revelle

[184] New York Times, "*Climatologists Are Warned North Pole Might Melt"*, 1979.
[185] Ibid.
[186] New York Times, "*Disaster Tolls Needlessly High, Conference on Climate is Told"*, 1979.
[187] New York Times, "*Scientists at World Parley Doubt Climate Variations Are Ominous"*, 1979.
[188] New York Times, "*Experts Tell How Antarctic's Ice Could Cause Widespread Floods"*, 1979.
[189] New York Times, "*Climatologists Are Warned North Pole Might Melt"*, 1979.

stated in a NYT article that the world was facing a Faustian bargain, talking about the need for alternative energy sources.[190]

Thus, anthropogenic climate change competed against other theories or representations. In spite of there being co-production processes since the early 1970s and that anthropogenic was becoming a governance object, disagreement with the theory was still commonplace. Only reading from NYT articles and the WMO reports cannot provide enough data to determine which representation had the most support in the scientific community, and therefore the thesis will not attempt to answer it. However, the result of the conference provides the most important insight – what sort of climate knowledge did the attendees at the conference feel comfortable with supporting and including in the declaration of the conference.

After two weeks of discussions among the world's atmospheric experts, a declaration was agreed upon. The declaration itself certified that the multidisciplinary attendees expressed their concern for the implications that climatic variations and change could have for the world. The recommendations of the declaration were to make use of all the knowledge gathered about the climate and the atmosphere, improve that knowledge, and use that knowledge to understand the nature of the climatic changes, as well as the consequences for mankind. Consequently, the declaration positioned the consensus of the declaration on the side of supporting the anthropogenic climate change theory.

Generally, the recommendations addressed scientific advancements and strengthening international cooperation. Improving the understanding of climate mechanisms was necessary in order to determine whether the changes were natural or anthropogenic. It promoted continuing to develop models for forecasting climate change, and the study of the interaction between the climate and natural and manmade 'stimuli'. Additionally, it recommended improving the process of gathering data, as well as the availability of climate data from different scientific areas - not only meteorological but also hydrological, oceanographic, and geophysical data. Furthermore, in recommended further study on natural resources and socio-economic consequences for nations. This would be essential for further planning and assisting "national meteorological and hydrological services to increase the awareness of users of the potential benefits to be gained through the use of climate information, to improve capabilities to provide and disseminate this information, and to facilitate training in nationally significant

[190] Ibid.

climate applications."[191] As Dr. Robert Kates stated in an interview with the New York Times towards the end of the conference, "that how natural disasters impact humanity relies on societies. Modern and industrialized societies can, unless the weather is on a very extreme scale, minimize the loss of life."[192]

It might appear like it was a futile venture to make any type of conclusion or consensus on the matter of *natural versus anthropogenic* climate change during the conference. The declaration and proceedings of the FWCC also largely repeated that too little was known about the atmosphere, thus leading to the conclusion that more research was needed. However, progress had been made since 1972. The increase of anthropogenic pollution, particularly carbon dioxide, was accepted as a potential risk to the climate. Public awareness and concern had grown, which made it easier for the recommendations of the FWCC to be rooted in the social and political order. Additionally, international organizations and national governments followed the recommendations of the Stockholm conference, and implemented environmentalism into their agendas. The many conferences and symposiums that took place between 1972 and 1979 are also evidence of how the importance of environmental and climate awareness grew during the 1970s on national, transnational, and international levels. This created a foundation in the public and political spheres for the result of the FWCC to have an impact on international environmental governance.

All of the initiatives of the conference would be carried out through the World Climate Program. Similar to the creation of UNEP after the Stockholm Conference, the WCP would coordinate and promote action on the climate. The WCP's tasks were plentiful, and can be summarized to i) promote uses of climatic information, raise the awareness of decision-makers and improve their ability to use this information, ii) develop and maintain operations and projects, and assist developing nations involved in those projects, iii) set the standard for climate data and climate research, particularly related to improving applications services, and iv) study the management of agriculture and water resources and the planning of new energy sources would also be areas where the program would get involved. The WMO and other IOs, such as WHO and FAO were already involved in these types of projects. Working through the

[191] WMO FWCC, 1979, p. 715.
[192] New York Times, "*Disaster Tolls Needlessly High, Conference on Climate Is Told",* 1979.

WCP, the relevant plans and activities of those organizations became streamlined into a single approach.[193]

Expertise was important in the development and implementation of the program. The WMO and the WCP based their plans on the work and experience of experts such as meteorologists, climatologists and hydrologists. They were deeply involved in setting the best standards for the effective use of the climatological data and information. Developing systems and routines for documenting the relationships between climate information and activity, how to produce the information in a correct format, and how to make it understandable for others to be used in "their decision processes" were all developed by experts in and tied to the WMO. There was no doubt that this program also relied on international cooperation. Both for the success of the program, but also for all countries to benefit from the data and use it in their own national projects and programs to develop their own response to environmental and climate issues. International cooperation could strengthen promotion of effective use of climate applications, the development of a shared data information system, effective development of more advanced technology, the technological transfer between countries, and implementation of training programs. It would also promote and encourage arranging conferences, symposiums and seminars on climatic fields, and the publicizing of new research. This would also connect scientific experts with political leaders and national decision-makers. Thus, international efforts would help national problems. The WCP was, as such, set up to contribute to international environmental governance and knowledge creation in the near future.

Co-production and governance at the FWCC

The discussion on co-production and international environmental governance during the First World Climate Conference starts with the premise that anthropogenic climate change had gone through several stages of Allan's co-production and governance process during the Stockholm Conference. Thus far, the thesis has attempted to depict development of anthropogenic climate change from a set of phenomena being constituted through boundaries, translation and problematization during the Scripps period. It was to a smaller degree institutionalized and implemented through the Stockholm Conference, but to such a slight degree that it mostly mattered for spurring on more research on the problem. The WMO had expressed their explicit concern for anthropogenic climatic changes, but many scientists were still hesitant in 1972 to

[193] WMO FWCC 1979, p. viii.

take a stance on the question of the nature of climatic changes. During the First World Climate Conference, this sentiment remained but had indeed changed. What can be deduced from the declaration of the conference and the interviews in NYT, a larger representative group of atmospheric scientists and scientific organizations supported the statement that anthropogenic pollution from industry and transportation caused a greenhouse effect.

Although there was not a co-production process present at the conference in a classical sense due to the lack of governmental involvement, there was indeed a knowledge production process that took place. The knowledge produced and discussions that took place before and during the conference confirmed anthropogenic climate change as a constituted object.[194] As can be read in the proceedings of the conference, the scientists considered the publication of the work of the conference to be "the most profound and comprehensive review of climate and of climate in relation to mankind yet published," and that the conference "contributed greatly to a better understanding of the overall problems of climate and to finding solutions to these problems."[195] This shows that anthropogenic climate change had been chosen in a political selection process. The process was political because of the object's ties to the Stockholm Conference, and the public and political awareness of anthropogenic pollution causing damage to the environment. Already politically problematized through the Stockholm Conference and the following conferences that took place afterward, anthropogenic climate change was a politically relevant topic during the First Climate Conference in 1979.

The collection and consideration of all available climate knowledge created a common understanding of climatic changes, and identified the main issues within the field, as well as the main problems that mankind would face in the light of climatic changes. Climate change was proclaimed as a serious problem for mankind that had to be further studied, monitored, and governed through national and international recommendations and regulations. There were government officials and representatives present at the conference, such as R. C. McArdle from the U.S. Department of Agriculture, M.A. Martin-Sané from the French Ministry of Foreign Affairs, and N.K. Kljukin from the State Committee on Hydrometeorlogy and Environment Control.[196] They likely only observed the conference since the goal of the conference was primarily focused on the scientific aspects of climate change. However, the conference

[194] Allan 2017, p. 137-138.
[195] WMO FWCC 1979, p. viii-xi.
[196] WMO FWCC 1979, p. 777-779.

established a mostly solid scientific front supporting the understanding that climatic changes were a threat to the world. Instead, the declaration issued an appeal for nation-states to implement the recommendations.[197] A letter from D. A. Davies to the Norwegian Meteorological Institute (NMI) after the conference in 1979 elaborates further, as Davies wrote that "[t]he declaration also outlines action which the nations of the world will need to follow if full advantage is to be taken of climate knowledge and if potential dangers are to be averted. It urges that such action be taken as a matter of urgency."[198] According to Davies, WMO members would be asked during the next WMO Congress session whether they supported the World Climate Program.[199] From this statement, it is evident that the WMO intended for nation-states to implement the recommendations from the declaration voluntarily after the conference. Although the conference did not intend to create the same type of result as the Stockholm Conference did, it still contributed to international environmental governance. Due to the inherent power and governance belonging to scientific expertise, international organizations, and international conferences, the First World Climate Conference was a key contribution to the international governance of climate change.

As such, the role of the WMO in producing and promoting climate knowledge during the First World Climate Conference firstly related to their expertise and competence in meteorology and atmospheric sciences that they had improved greatly through the development of new technology, new climate models, and the monitoring network which had become more vast and sophisticated after 1972. These factors made the WMO the leading observer of the atmosphere, pollution of the atmosphere and the biosphere, CO2 emissions, and the variabilities in temperatures all over the world. The Stockholm Conference had also made the WMO the coordinator of atmospheric monitoring projects. This meant that it was within the WMO's responsibility to initiate and follow up on research activities and technology relevant to the study and monitoring of atmospheric, air, and marine pollution. The WMO played out that role by convening the First World Climate Conference. Although other IOs were involved, it was the WMO who had the main administrative, organizational, scientific, and financial responsibility. They identified the need for a conference that gathered and considered all available climate knowledge, and initiated the production of climate knowledge prior to,

[197] WMO FWCC 1979, p. 713. Zilmann 2008, p. 143-144.
[198] NMI 1979a: Letter from D. A. Davies to the Norwegian Meteorological Institute and the Norwegian Minister of Foreign Affairs, March 2nd, 1979. Riksarkivet.
[199] Ibid.

during, and after the conference. As exemplified earlier, D. A. Davies referred to the declaration as "an authoritative and well-balanced statement" of the relationship between human society and the climate, recognizing it as the voiced opinion of the WMO and the attendees of the conference.[200] This was the first time that climate change had been discussed on a large, international, and interdisciplinary platform. As the organization who initiated the first international conference dedicated to anthropogenic climate change, the WMO contributed immensely to the promotion of anthropogenic climate change knowledge to the public and to policymakers. It contributed to making the debate on anthropogenic climate change versus natural climate change visible to the public and spread awareness of the consequences of CO2 emissions.

From this, we can conclude that the WMO's role was significantly different in 1979 than it had been in 1972. Many of the differences between the WMO's role at the conferences can be attributed to the differences of the conferences. In Stockholm, the WMO was a participant to the conference and contributed with its expertise of the environment and the climate. In Geneva, the WMO arranged the conference, and thus became a completely different actor. Albeit the different format of the conferences, the First World Climate Conference strengthened the WMO a central actor in international environmental governance, particularly regarding climate change knowledge.

Did anthropogenic climate change become a governance object in 1979? Most likely, it did not. The lack of governmental engagement meant that there was no co-production during the First World Climate Conference. The set of recommendations were only that – recommendations and not regulations, as was the case for the Stockholm Conference. With the absence of a set of rules, anthropogenic climate change was neither institutionalized nor implemented by the conference. Thus, according to Allan's theoretical framework, it did not become a governance object. The conference would have had to happen with the same caliber as the Stockholm Conference, with the presence of nation-states, and not only national representatives from ministries and departments.

As such, it is perhaps more suiting to ask if establishing a set of international governing rules was the intent of the conference. Regarding the effects which the conference had on governmental interests, Reinalda argues that the World Climate Conference in 1979 failed to

[200] Ibid.

engage the concern of governments and the public.[201] Although this is easily perceived as the short-term effect of the conference, the thesis suggests that it had a role in contributing to the eventual co-production process, which would take place during the 1980s and 1990s. As we have seen, the intent of the conference was of a scientific nature. In comparison, the Stockholm Conference sought to establish international cooperation and regulations regarding environmental issues. Instead, the First World Climate Conference established a generally unified scientific opinion on climate change. Although consensus could not be reached on whether the observed climatic variations and rising temperatures were the results of natural climate change or anthropogenic climate change, the experts taking part in the discussion could agree that it was necessary to address the societal issues that climatic changes would entail. The uncertainty of climate change knowledge did not hinder, but in the end, perhaps made international action even more dire as a large number of scientists concluded with predictions that promised a bleak future for mankind. Both the scientific achievement of the conference, as well as the united appeal for international action to be set in motion, created a strong starting point for the following international debates on climatic changes that would take place in the 1980s and establishment of the climate change regime in the 1990s.

Conclusion

The thesis has built upon the relationship between scientific expertise, international organizations, and international governance on the environment and the climate in order to contribute with a historical perspective on the role of the World Meteorological Organization in producing and promoting environmental and anthropogenic climate change knowledge during the 1960s and 1970s. Firstly, the thesis has located four arenas where the WMO contributed to international environmental governance: through the creation and development of knowledge and expertise, through the power and influence inherent to international organizations, through participating and arranging conferences, and contributing to the establishment of the first international/global environmental regime. Additionally, the thesis briefly engaged in the Haas' epistemic community theory in order to analyze the Scripps group, resulting in the claim that the group was the first epistemic community that promoted anthropogenic climate change. The thesis also claims that members of the Scripps group likely brought anthropogenic climate change theory into the WMO. Finally, the thesis has used Allan's theoretical framework on co-production and governance objects to deepen the analysis

[201] Reinalda 2008, p. 519.

on how climate change knowledge was created, how it moved into the WMO, and whether it became governable during the end of the 1970s.

By the use of Allan's theory of governance objects, the thesis has argued that the Scripps group were the first epistemic community to study anthropogenic climate change, designating the phenomena in the process and made it a separate entity to natural climatic changes. The Conservation Organization Conference in 1963 and the UN's declaration to hold an environmental conference further designated, translated and problematized the entity, making it a constituted object. This meant that it had become a serious research topic outside of the Scripps group. The Stockholm Conference institutionalized and implemented environmentalism as a governance object in 1972. Although anthropogenic climate change knowledge was a part of this process, the international environmental regime established in Stockholm focused on pollution. Environmentalism, however, acted as a vehicle for anthropogenic climate change to enter the public debate. As mentioned, the FWCC did not make anthropogenic climate change a governance object. This result coincides with Brunner's argument that the creation of a climate change regime did not happen before the 1990s. [202]

The thesis concludes that environmental knowledge completed the process of becoming a governance object during the period 1960-1979, specifically as a result of the Stockholm conference. The WMO was an active contributor to the promotion of environmental knowledge. Their newfound environmental awareness at the end of the 1970s made the organization engaged in environmental issues, and contributed with their expertise on meteorology and the atmosphere, giving specific advice on the relationship between the environment and meteorology, as well as the relationship between mankind and the atmosphere. The majority of the thesis' focus has been on anthropogenic climate change, which did not become a governance object during the same period. The First World Climate Conference was an important event for the WMO and for the scientific debate on climate change. The goal, and subsequently the result of the conference, was to gather knowledge and expertise on the climate and develop a possible consensus on the nature of climatic change. The conference, like Stockholm, established a research program meant to carry on the work of the conference. The World Climate Program (WCP) and the World Climate Research Program

[202] Brunner 2001, p. 1-3.

(WCRP) began working actively in 1980 and continued the research necessary for understanding anthropogenic climate change and all the consequences associated with it.

The role of the WMO in producing and promoting knowledge about the environment and anthropogenic climate change in 1972 and 1979 was subject to development and change but was always directly related to their expertise on meteorology and the atmosphere. The WMO became a producer and promoter of environmental and anthropogenic climate change knowledge during the mid-1960s and was able to engage in the study of these phenomena due to their expertise on the weather and the atmosphere. Technological advancements such as satellite technology, electric computers, and modeling improved the WMO's ability to study weather systems and the general circulation in the atmosphere. Throughout the 1960s and 1970s, the WMO built a massive monitoring network consisting of satellites, ships, buoys, observation stations, and meteorological institutes. This work was tied directly to the development of the World Weather Watch and the Global Atmospheric Research Program. As a result, the WMO sat with large amounts of weather and climate data, as well as the expertise to analyze it. The WMO had just opened their eyes for environmental issues and the study of climatic variations when the UN declared to hold a conference on the relationship between mankind and the environment in 1968. After the announcement, we witnessed how the WMO prioritized the study of the environment and the climate to a degree which was unprecedented for the organization. Its role had evolved into that of an international environmental organization with particularly relevant expertise on the atmosphere. During the preparation for the Stockholm Conference, the WMO took part in co-production with governmental representatives, and other IOs and NGOs. Their participation both produced knowledge and promoted their ideas. The WMO promoted their knowledge on environmental pollution, which extended from air pollution to marine pollution. They also promoted anthropogenic climate change actively and stressed the importance of global monitoring of the atmosphere and the environment. Several of their ideas promoted during the preparatory work were used in the Stockholm declaration. Since there had been a co-production process during the preparation for the conference, the WMO's mark on the declaration showed that they had scientific authority and that their ideas had interacted with policymakers, thus being accepted into the political order.

The WMO played a vastly different role during the First World Climate Conference than during the Stockholm Conference seven years earlier. Not only did their role entail their expertise, but

also their influence and power as an intergovernmental organization. By facilitating international scientific cooperation on the creation of climate change knowledge, the WMO engaged several governance pieces, namely expertise, IOs and IGOs, conferences, and regimes. The FWCC was a scientific conference. The goal was to gather a body of climate knowledge and determine future action regarding the climate from a scientific perspective. This meant that the political engagement in the issue was not present, which led to the lack of a co-production and establishment of a set of rules to govern the issues. The WMO invited its members to sign the declaration of the conference a few months after the event, which suggests that the institutionalization and implementation of anthropogenic climate change could have taken place at the end of the decade. However, the recommendations of the conference were not meant to govern but to warn and promote the consequences of climate change to governments, the public, and the scientific community at large. Thus, anthropogenic climate change was not institutionalized nor implemented during the FWCC in 1979. Instead, the conference produced the most extensive collection of research on climatic changes made at that time, promoted climate change knowledge to scientists, governments, and the public, and established the WMO as an actor in international environmental governance. The WMO's role was, therefore, to convene and facilitate international scientific cooperation to gain more knowledge about climate change, which poetically reflected the premises for which the WMO originated – the need for international scientific cooperation on the study of the weather.

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