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**One world or two?
Science-policy interactions in the climate field**

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One world or two?

Science-policy interactions in the climate field

This article assesses how science-policy interactions are conceptualised in the social sciences with special reference to climate change and the IPCC. In terms of the dimension of distance (or proximity) between science and policy we discern two ideal-type cases: a 'two-worlds' and a 'one-world' perspective. The first understands science and policy as independent spheres separated by a clear gap, while the second perceives science and policy as tightly coupled. These two perspectives, presented here in detail and in various sub-variants in order to show their complexity appear dominant also in the discussions on how to improve, not only describe, the interaction between science and policy. We argue that this situation of opposing perspectives is not beneficial, nor properly recognised by scholars in the field. In response to this we present a typology that may serve as a modest and judicious way for thinking about and making more nuanced choices in designing science-policy relations.

Key words: science and policy, use of scientific knowledge, climate policy, IPCC

Introduction: science and policy in the climate field

Since being established in 1988, the Intergovernmental Panel on Climate Change (IPCC) has produced five general assessment reports. For many this endeavour is a great success, which means that the IPCC has managed to create a global scientific understanding of climate change, and consequently has become a role model for global scientific assessments, alongside others such as the Millennium Ecosystem

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3 Assessment (MEA) and the Intergovernmental Platform on Biodiversity and
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5 Ecosystem Services (IPBES) (Vadrot, 2014). Moreover, the Panel has helped to
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7 establish climate change as a key issue on the political agenda, recognised as in need
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9 of multilateral agreements and concerted political action (Bolin, 2007; Edwards 2010;
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11 IAC 2010; Weart, 2008). This means that the IPCC has been a significant indirect
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13 contributor towards policy responses, including the Kyoto Protocol in 1997 and the
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15 Paris Agreement in 2015, given its mandate as an intergovernmental organisation to
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17 provide scientific input to the UN Framework Convention on Climate Change
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19 (UNFCCC). In short, and according to its own objective, the IPCC is considered to
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21 have succeeded to be a policy-relevant organisation (Yamin and Depledge, 2004,
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23 ch.15).
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30 However, international achievements on the policy arena have not been impressive;
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32 greenhouse gas concentrations and emissions globally have heavily increased since
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34 the late 1980s (IPCC, 2014: 7). Transforming research findings into practical policies
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36 has proven to be much more complicated than was foreseen when the IPCC was
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38 established. This lack of results has led to discussions about the effectiveness of the
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40 IPCC, and many have attempted to explain why the IPCC's work has failed to
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42 stimulate needed action (Beck, 2012a; Hulme, et al., 2010; Tol, 2011; van der Sluijs,
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44 et al., 2010). In this article we will not explicitly focus on successes or failures, but on
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46 the nature of the *interactions* between science and policy, which are connected to the
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48 performance of the IPCC as an organisation for summarising science in a policy-
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50 relevant way.
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56 How the relationship between science and policy is performed and described seems
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3 also to be an issue of contention, not least among social scientists specialised in
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5 studying interactions between climate science and policy. In this article the literature
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7 is reviewed, by presenting how social science scholars *describe* science-policy
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9 interactions in the climate change field, the *problems* they perceive, and the *solutions*
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11 they propose to improve the interplay. We argue that this field of research hosts
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13 opposing views, each comprising both critical assessments of the existing situation
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15 and recommendations on how the situation could be improved.
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21 Our objective is to follow up on the well-known formulation that policy-relevant
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23 scientists want to be close to policy, but not too close (Gieryn, 1995; Jasanoff, 1990).
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25 Put differently, to execute policy-relevant research means to perform a balancing act
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27 between *separation* and *integration* (Sundqvist et al., 2015). We aim to analyse how
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29 scholars in the now quite extensively populated field studying science-policy
30
31 interactions in the climate area understand and conceptualise the proximity between
32
33 science and policy. Our analysis starts from a typology based on the dimension of
34
35 *distance* between science and policy where the two endpoints on this dimension are
36
37 called the *two-worlds* and *one-world* positions.¹ These endpoint positions – or
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39 positions close to them – are extreme but, as soon will be presented, appear to be
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41 richly populated.
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48 The aim of this article is to provide a survey of literature, not an analysis of actual
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50 policy making. The survey is exploratory and searches for differences in the scholarly
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53 ¹ By ‘world’ we mean a territory or zone of cultural authority. If science and policy are characterized as
54
55 two distinctive worlds their authorities are of different kinds and not mixed. In this article we
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57 understand the distance between science and policy as varying between cases. There can be loose or
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59 tight coupling between separated territories but also the development of mixed, not separated,
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territories (Gieryn, 1995).

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3 understanding of science-policy interactions in the field of climate change, including
4 the recommendations on how interactions could be improved. By use of a proposed
5 typology the objective is to improve the situation by making possible more nuanced
6 descriptions and prescriptions, showing a range of possible positions from which
7 science-policy interactions could be understood and designed. Our intention is to
8 provide a vocabulary for the discussion, not essay a precise mapping of the whole
9 body of literature or an empirically based explanation of the spectrum of different
10 positions that exist in the scientific literature and in science-policy practice. Such
11 work remains for the future.
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25 In the next section we elaborate on our research questions, and present the method as
26 well as our typology. In the subsequent two sections, and with the help of scholarly
27 work on science-policy interactions in the climate field including on the IPCC, the
28 two opposing perspectives (the two-worlds and the one-world) are presented as
29 constituting the two endpoints on the distance dimension.
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39 In the concluding section we suggest that assessing relationships between science and
40 policy requires acceptance of an *aporetic* situation, one that is constantly in doubt and
41 never finally resolved. This framing of science-policy interactions calls for avoiding
42 any notion of a universal ideal. The paper discusses the problematic dominance of the
43 two endpoint positions, along with their clear-cut, but opposing, normative statements
44 on how to achieve a better interaction between science and policy in the field of
45 climate change.
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Aims, research questions, methods and a typology

Background, aims and research questions

Our aim is to contribute to elaboration of the conceptualisation and understanding of science-policy interactions. This question has long been of concern for philosophers and social scientists, and is a main task today for scholars in science policy studies and science and technology studies (STS) (Jasanoff, 2012, 2017). One key aspect in this discussion concerns the distance (or proximity) between science and policy.

Sheila Jasanoff concludes that science advisers agree on this as a balancing act, where “those on both sides have reason to keep the two territories close but not too close” (Gieryn, 1995, p.435, referring to Jasanoff 1990). Jasanoff identifies a paradox in science advice, in that separation is what gains legitimacy – science advice should be generated clearly separated from policy process – but in practice the successful examples create meeting points “where scientific as well as political conflicts can be simultaneously negotiated” (Jasanoff, 1990, p.237). According to Jasanoff, science advisers use separation as a front-stage performance, while in backstage activities (actual practice) they try to establish close interactions (see also Hilgartner, 2000).

It seems that policy-relevant scientists act from normative ideas about what position to aim for in this balancing act. According to Thomas Gieryn (1999) scientists do *boundary work* due to their professional interests in maintaining both scientific integrity and relevance, including in order to enhance their authority. However, from Jasanoff we can conclude that science advisers are attracted to both separation and integration, and further that there are mismatches involved between how activities are publicly presented and how they are actually performed (see also Sundqvist et al., 2015).

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5 Acknowledging the need for both separation and integration, Peter M. Haas
6
7 developed a temporal model of how these could be combined in two different phases.
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9 The only way for science to speak truth to power, he argues, is to be detached from
10
11 policy in the process of establishing truth, i.e. to not connect to policy before
12
13 scientific consensus has been agreed by scientists (Haas, 2007; Haas and Stevens,
14
15 2011; see also Lidskog and Sundqvist, 2015). Connecting science and policy emerges
16
17 as a central topic, since the gap between them is both something good (in the phase of
18
19 scientific consensus-making) and bad (in the phase of connecting science to policy).
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25 The IPCC's self-representation contains a quite clear and sophisticated picture on how
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27 to deal with distance between science and policy in order to achieve its aim of
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29 summarising science for policy. The production process of the IPCC Assessment
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31 Reports follows several consecutive phases.² Government representatives together
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33 with some scientists first decide the scope of the assessments, after which scientists
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35 independently prepare first and second draft reports. The second draft is then
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37 reviewed by both scientists and government representatives before scientists prepare a
38
39 final draft. Finally, through line-by-line approval, government representatives approve
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41 the summaries for policymakers (SPMs) of all three Working Groups as well as of the
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43 Synthesis Report. This process means that the organisation's assessment process
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45 oscillates between high and low degrees of separation between science and policy
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47 during its different phases. Compared to Jasanoff's picture of separation as a front
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49 stage performance and integration as actual practice, we find that IPCC's work is
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56 ² See figure on the IPCC assessment process at
57 http://www.ipcc.ch/organization/organization_procedures.shtml#.T6pY6MWIga8
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3 organised in consecutive phases in order to contain both integration and separation.
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5 Haas, however, proposes consecutive phases, starting in 'separated' science and
6
7 moving to integration between science and policy.
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11 The same kind of problems of concern to science advisers also occupy social
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13 scientists studying the science-policy interface. Scholars who specialise in studies of
14
15 science-policy interactions do not only describe and explain different positions,
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17 ambitions, motivations or existing organisations dealing with science-policy
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19 interactions. As we will soon see, most of them, like the scientists and organisations
20
21 they study, take clear positions on how to improve interaction. For good reasons many
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23 of those scholars, and increasingly so, have analysed the situation in the climate field
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25 (for overviews see Hulme and Mahony, 2010; Sarewitz, 2011, Sundqvist et al. 2015;
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27 van der Sluijs et al., 2010).
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34 Following in the footsteps of Jasanoff we want to advance the discussion on
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36 interactions of science and policy, focusing on the dimension of distance between the
37
38 two. Distance we understand as being more about intellectual closeness than about
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40 organizational imbrication, about influences and dependencies and not only spatial
41
42 locations and boundaries. Moreover, we take an agnostic attitude to the different
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44 positions, which gives us possibilities to transcend the conflictual situation of
45
46 choosing between separation and integration. Our ambition is to deepen the
47
48 understanding of science-policy interactions in the climate field, for we consider the
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50 current state of the literature confusing. While individual scholars and practically
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52 engaged actors, the IPCC as a prime example, typically adopt clear views on how to
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54 analyse and assess the balancing acts between science and policy, these various clear
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3 views sharply diverge. We will propose a typology of stances, which we use as a
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5 starting point for deepening the analyses and increasing reflection.
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10 *A typology*

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12 In this and the following section of the article we illustrate the opposing positions by a
13
14 manifold of examples from social science studies concerning science-policy
15
16 interactions in the climate field. We understand these debates as influenced by two
17
18 opposed ideal types. Although they are easy to detect in the literature the two are
19
20 surprisingly little discussed as predominant opposites. We refer to them as two
21
22 perspectives: *the two-worlds* and *the one-world*. The first understands the science-
23
24 policy relationship as an interaction between two worlds with different functions,
25
26 logics and motivations. These worlds are viewed as close to autonomous, separated
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28 by a clear boundary, with a considerable distance between them, understood as being
29
30 about independence. The second has the opposite view. From this perspective, the
31
32 distance between climate science and policy is close. These two ways of *describing*
33
34 science and policy interactions conduce to (without enforcing) different predominant
35
36 ways of identifying and interpreting *problems* and thereby of proposing contrasting
37
38 *solutions* for improved science-policy interactions.
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45 We use terms as follows. There are two descriptive ‘perspectives’, which respectively
46
47 see and/or emphasise the distance between science and policy or their closeness.

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49 Since distance or closeness can be approved or disapproved of, there are then four
50
51 available ‘diagnoses’. Two of these appear to predominate: (1) seeing two separated
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53 worlds and attributing problems to that separation, and (2) seeing a closely integrated
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55 world and attributing problems to that closeness. Since these two dominant diagnoses
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3 are widely used they have acquired richer content, as will be presented in later
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5 sections.

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10 The more common of the two-worlds diagnoses not only *describes* gaps between
11 science and policy but refers to ‘barriers’, ‘obstacles’, ‘hindrance’, ‘constraints’,
12 ‘hurdles’ and ‘tensions’ (e.g. Eisenack, 2014), pointing to *problems* or frictions in the
13 cooperation between the two worlds. The gap is the reality, while ‘bridging’,
14 ‘linking’, ‘shared understanding’, ‘dialogue’, ‘interaction’, ‘co-production’ and
15 ‘hybrid institutions’ are the proposed *solutions* (Dilling and Lemos, 2011;
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Mastrandrea, et al., 2010).

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The more common one-world diagnosis *describes* a situation of a too tight connection
between science and policy, and sees the close distance as a *problem*, since it leads to
policy based on a consensus science without alternatives, it is argued, marginalising
policy alternatives and public engagement. The *solutions* proposed are about giving
‘pluralized strategic advice’, ‘opening up policy debate’ (Hoppe et al., 2013), and
giving room for ‘alternatives’ in both science and policy (Cornell et al., 2013;
Sarewitz 2011).

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The descriptive perspectives will in the following be treated as ideal-type constructs,
meaning that we take them as mental models. They are ways of talking about
situations and issues, but are neither fully accurate descriptions nor fully desirable
ideals. Within the literature on policy analysis (e.g., Hogwood and Gunn, 1984), a
distinction is commonly made between proposed descriptive models of policy
processes, proposed prescriptive models, and lastly ideal-type models. This third

1
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3 variety refers to mental constructs which are presented neither as adequate
4 descriptions nor realistic prescriptions (for example, the model of the perfect
5 bureaucracy, or the unidirectional policy cycle model). They have though an essential
6 intellectual function as mental experiments through which scientific stories can be
7 constructed, and against which real situations can be compared to assess how
8 significant are the divergences.
9

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12 While we consider the two perspectives on science-policy interactions that we
13 describe as being ideal types, we recognise that many scholars grant them real
14 *descriptive* and/or *prescriptive* status, i.e. for, respectively, *describing* science-policy
15 interactions, and identifying *problems* and *solutions* concerning these interactions. We
16 can then identify four archetypal diagnoses, shown in Table 1 below:
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32 TABLE 1 ONE ABOUT HERE
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36 In Diagnosis 1, existing relations between science and policy are seen to match the
37 one-world perspective and this is approved (desirable one-world situation). In
38 Diagnosis 2, relations are seen to match the one-world perspective, but this is viewed
39 as a problem (undesirable one-world situation). In Diagnosis 3, relations are held to
40 match the two-worlds perspective, but the relationship is disapproved (undesirable
41 two-worlds situation). Whereas in Diagnosis 4, relations are believed to match the
42 two-worlds perspective and this is favourably assessed (desirable two-worlds
43 situation).
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3 In the literature that we examined we have found mainly examples of Diagnoses 2
4 and 3, where the real situation is negatively assessed and some other arrangement is
5 advocated. In what follows, these two diagnoses of *mismatch* between what is
6 described and what is prescribed are our main interest. They are easy to find in the
7 literature and much more common than the two diagnoses where the existing situation
8 is seen as appropriate. Moreover, they not only contradict each other, but also seem to
9 influence each other in a paradoxical way. Whereas views of an undesirable one-
10 world situation (Diagnosis 2), located descriptively in a one-world perspective, look
11 for solutions in a two-worlds situation, views of an undesirable two-worlds situation
12 (Diagnosis 3), located descriptively in a two-worlds perspective, search for
13 improvements by inspiration from a one-world perspective.
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30 Our point of departure is that both the one-world and two-worlds situations are of
31 great importance and relevance, but should be understood neither as mutually
32 exclusive nor as a choice between right and wrong. On the contrary, in practice they
33 should co-exist and overlap. As shown above, with the examples of the IPCC and
34 Haas, they could be found in different phases of the assessment process. Science and
35 policy interactions are about *separating* as well as *integrating*, and we have to
36 acknowledge that there are good reasons for both those functions (Sundqvist, et al.,
37 2015). One might also describe or prescribe different approaches for different socio-
38 political contexts. Thus, the two perspectives are best seen as intellectual ideal-types;
39 but frequently what is lacking is a more reflexive understanding of the many
40 possibilities and choices available when understanding, performing and designing
41 science-policy interactions.
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Methods

In the following sections we will use this typology in order to better sort out the different positions we find in the literature about science-policy interaction in the climate field. What do we mean by ‘the literature’? Our study object is the scholarly work, mainly conducted by social scientists, that analyses the relationship between science and climate policy. As additional examples we also discuss ‘practical’ actors, such as the IPCC, but most often they are the study-objects in the literature that we present and discuss. Our starting point was a literature review exercise, as an element in a research project focusing on how the IPCC Fifth Assessment Reports (AR5) are used in national policy making in five European nations.³ We collected articles between the publication dates of AR4 and AR5 (2007-2014) from relevant journals such as *Nature Climate Change*, *Global Environmental Change*, *Environmental Science & Policy*, *WIREs Climate Change* and *Climatic Change*. We used key words such as ‘science advice’, ‘science and policy’, ‘science communication’, ‘science policy’, ‘use of climate knowledge’, and ‘the IPCC’ to identify the most relevant articles. Quite soon, we recognized opposing views among the authors, but no articles discussing this interesting but possibly problematic situation of polarized views. When we also noticed that these opposing views are mirror images – the problem in the first approach is the solution in the second and vice versa – we decided to explore this pattern, with special attention to the dimension of distance between science and policy.

³ ‘The IPCC AR5 in Europe’ project analyses how key messages from the Fifth Assessment Report of the International Panel on Climate Change (IPCC AR5) are communicated and used by policy makers. The project follows the knowledge from publication to decision making in Norway, UK, Poland, Spain and the Netherlands. The project (2013-2016) was funded by JPI Climate/Norwegian Research Council and led by CICERO Center for International Climate and Environmental Research – Oslo.

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3 Our work started thus from an inductive ambition, but in what follows the two ideal-
4 type perspectives – the one world and the two worlds – and the typology, helping to
5 sort out between descriptive and prescriptive stances, will structure the presentation.
6
7 This means that examples from the literature are examined in relation to these stances.
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9 We present the examples though in a detailed, nuanced way, based in the ambition to
10 be empirically true to the scholarly work; but our main focus is on the concepts, with
11 the ambition to provide more refined tools for future analyses.
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23 **Science and policy as two worlds – examples from climate change literatures**

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25 In the literature on science-policy interactions in regard to climate change, we find
26 many studies that argue that climate knowledge, the global scientific consensus
27 orchestrated by the IPCC being the prime example, needs to be better communicated
28 to policy makers. Scientific work and policy making are seen as two excessively
29 separated spheres, i.e. a two-worlds problem diagnosis is adopted. In this approach, a
30 lack of usable knowledge is seen as arising out of a *gap* between science and policy.
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32 That IPCC knowledge does not automatically lead to action comes then as no
33 surprise.
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45 Most of the scholars *describing* in terms of a two-worlds perspective assess the gap in
46 this fashion, as a *problem*. The problem is presented indeed as a whole series of gaps,
47 obstacles and frictions in cooperation. Policy is seen as too independent of science,
48 while science insufficiently influences policy (Eisenack et al., 2014). Therefore, great
49 efforts are put into presenting advice on how to deal with the perceived problem of
50 the gaps between the two worlds. Solutions are described as being about bridging and
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3 linking, and thereby creating shared understanding (Dilling and Lemos, 2011;
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5 Mastrandrea, et al., 2010). These solutions aim to improve the communication
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7 between the two worlds, which includes acknowledging differences and learning
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9 more about the other side. Solutions focusing also on co-production and hybrid
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11 institutions often even go as far as adopting Diagnosis 3 in Table 1 above, which sees
12
13 two worlds in present practice but advocates unifying them.⁴
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19 Social science research on climate change communication, authoritatively reviewed
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21 by Moser (2010), characteristically presupposes a gap between knowledge and action,
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23 between sender and receiver. The gap separates those who have knowledge from
24
25 those who have not but are in need of knowledge. The question is how to achieve
26
27 efficient transfer of knowledge. According to this body of research there are many
28
29 hindrances and pitfalls to overcome in order to achieve a linkage. In general, lack of
30
31 interest and mutual understanding creates disconnections between the two worlds.
32
33 The *solution* is said to lie in mutual understanding, created by increased engagement.
34
35 The communication challenge is not only related to translating, but also to creating
36
37 ‘bridges’ that are perceived as credible, legitimate and salient (Cash, et al., 2003).
38
39 Corner and Groves (2014, p.743) argue that “climate change communication is
40
41 trapped between the norms that govern scientific practice and the need to engage the
42
43 public”. According to these authors better communication cannot solve the *gap*
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47 *problem* unless ‘appropriate social institutions’ are established where these normative
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51 ⁴ We should note that the use of the idiom of co-production in this climate policy literature often differs
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53 from how it is used in STS, even while suggesting that knowledge should be produced jointly by
54
55 different groups (among them scientists). In the STS literature co-production of science and policy
56
57 means a historical process, not an end which can be purposefully achieved (Jasanoff, 2004). In this
58
59 article we are not applying a co-productionist framework, but note that many climate policy scholars
60
adopting a one-world prescription (diagnoses 1 or 2) talk about co-production in an instrumental way.
From a Jasanoff-inspired understanding though, the one-world and two-worlds perspectives could both
be analysed as different expressions of co-production, understood in the way explained above.

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3 tensions can be accommodated and handled. These institutions – ‘hybrid institutions’
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5 (Callon, et al., 2009; see also Beck, 2012b) or ‘boundary organisations’ (Guston,
6
7 1999, see also Hoppe, et al., 2013) – should be able to take care of scientific facts
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9 together with public concerns at the same time and at the same place (Corner and
10
11 Groves, 2014, p.744).

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16 Some authors within a two-worlds perspective offer a way to understand the
17
18 relationship between the two worlds by distinguishing between supply (push) and
19
20 demand (pull) for scientific knowledge (Sarewitz and Pielke Jr., 2007). The supply
21
22 and demand dimensions could generate a matrix of four discrete units when
23
24 answering the following two questions by ‘yes’ or ‘no’: ‘Is relevant information
25
26 produced?’ (supply side) and ‘Can users benefit from research?’ (demand side).
27
28 According to Sarewitz and Pielke Jr. (2007, p.14) we find many examples in which
29
30 “poor reconciliation between supply and demand reflects the inability of users to take
31
32 advantage of relevant available information... [and others marked by] a failure to
33
34 generate relevant and usable scientific information”. If both questions in the matrix
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36 are answered by a ‘no’, this indicates an extreme example of a ‘gap problem’.
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43 In a similar way Lemos et al. (2012) portray a ‘usability gap’ and make a distinction
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45 between (potentially) useful and useable information. According to these authors,
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47 both producers and users are responsible for transforming useful information into
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49 something useable, which requires specific measures. Interaction is the key in
50
51 overcoming the barriers to usability. It is argued that IPCC knowledge in particular
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53 has not succeeded to be transformed from useful to useable (Haas and Stevens, 2011).
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3 How then is an effective interaction best organised? Mastrandrea et al. (2010, p.88)
4
5 recommend co-production, arguing that climate information that can support
6
7 decision-making is “[i]deally co-produced through sustained stakeholder-scientist
8
9 interactions to develop information and tools in forms that decision makers are more
10
11 likely to incorporate into their decision-making processes or use as a basis for
12
13 modifying those processes...”.

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18 Not all scholars who describe a gap in the science-policy relationship support an
19
20 intimate cooperation between scientists and policy makers. Edenhofer and Minx, for
21
22 example, are quite content with a two-worlds approach (Diagnosis 4 – the desirable
23
24 two-worlds situation), supporting a division of labour including “legitimate roles of
25
26 scientists as mapmakers and policy-makers as navigators”; they argue that “the IPCC
27
28 can further *inform* international climate policy without prescribing and
29
30 predetermining future negotiations” (Edenhofer and Minx, 2014, p.38, emphasis
31
32 added). This quote clearly connects to the IPCC mandate of being “policy-relevant
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34 and yet policy-neutral, never policy-prescriptive”.⁵

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40 In the remaining part of this section describing a two-worlds perspective, we present
41
42 two different assessments on how the balancing act between science and policy is
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44 actually performed and practiced. First, we meet scholars who focus on the policy
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46 side, considered as the problem for effective cooperation, and then those who criticize
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48 the scientific side. By this it is shown that the two world-perspective becomes
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50 elaborated in practice in multiple different directions.
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57 ⁵ <http://www.ipcc.ch/organization/organization.shtml>
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Blaming policy makers

A significant number of the scholars who use a two-worlds diagnosis of shortcomings view the ‘science side’ as less problematic, while problems are considered to be caused by the lack of understanding and engagement on the policy side. In these studies the proposed solutions are about more policy engagement. This idea of questioning the policy side while looking to the science side for answers has by STS scholars been dubbed ‘the deficit model’, meaning that policy has a deficit compared to science; the deficit could be about knowledge, trust or engagement (Wynne, 1993, p.322; see also Irwin, 2014).

In studies of science communication there is a constant risk of problematising the receiver and leaving the sender unevaluated, since these studies often focus on *impact* and how the message has been *understood* and *used*. The impact is assessed in relation to the intention of the sender, and the assumption is that scientists *do* understand and *are* engaged, and therefore the policy side bears the responsibility for the gap. In the climate field the IPCC is often used as an example of an organisation that possesses knowledge others lack, and that is the provider of the universal yardstick.

Bradshaw and Borchers (2000, p.1) argue that “[o]ne of the most difficult aspects of translating science into policy is scientific uncertainty”. Scientists are familiar with uncertainty and complexity, while publics and policy makers often demand certainty and deterministic solutions. Policy actors must learn to understand uncertainty “as information for hypothesis building, experimentation, and decision making” (Bradshaw and Borchers, 2000, p.9; see also van den Hoek, et al., 2014).

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5 Moreover, the pluralist society, containing a variety of values, cultures, life-styles and
6 perceptions, is taken as one of the explanations for the many problems involved in the
7 transfer of scientific descriptions from scientists to the public, politicians and policy
8 makers. The desideratum seems to be “greater convergence in beliefs and willingness
9 to act” (Weber, 2010, p.332), a political consensus that effectively can take advantage
10 of and match a scientific consensus. Plurality and variety, on the policy side, becomes
11 seen as a problem for effective communication.
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20 21 22 *Blaming scientists*

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24 For trying to explain a problematic gap between science and policy, we also find
25 scholars who instead of blaming policy makers focus their attention on the science
26 side. Stehr and Grundmann (2012, p.35) claim that “the IPCC has provided little in
27 terms of practical knowledge”. This claim is based on an argument that “the
28 successful ‘deployment’ of findings in concrete situations is far from trivial. The
29 possibilities for action, i.e. the actors’ latitude for action and their chances of shaping
30 events, must be linked together, in order for knowledge to become ‘practical
31 knowledge’” (Stehr and Grundmann, 2012, p.34). They conclude that “the IPCC has
32 produced *knowledge for practice*, but not *practical knowledge*” (Stehr and
33 Grundmann, 2012, p.28, emphasis in the original). Some scholars using a two-worlds
34 diagnosis suggest, in line with Stehr and Grundmann, a solution for transforming
35 knowledge into practical knowledge by identifying possible entry points for relevant
36 and needed knowledge to reach and influence policy issues at the right time
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60 (Agrawala and van Aalst, 2005; Eriksen and Næss, 2003; Haas and Stevens, 2011).

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3 The aim is to find sites and issues where we can expect science to lead to practical
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5 change if only it properly reaches these.
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10 It is also frequently argued that science should be better at ‘packaging’ the knowledge
11
12 before it is presented to different policy groups, in order to make it actually usable
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14 and not merely potentially useful, e.g. when communicating uncertainties (Budescu,
15
16 et al., 2009) and emission scenarios (Schenk and Lensink, 2007). Dilling and Lemos
17
18 (2011) declare that science is currently too dominant and oblivious in this
19
20 relationship. Science is setting “the information agenda and is not creating usable
21
22 knowledge” (Dilling and Lemos 2011, p.681). The proposed solution is presented as
23
24 “a co-production model where the research agenda is shaped in an ongoing, iterative
25
26 fashion between knowledge producers and users” (Dilling and Lemos 2011, p.682).
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31 A solution to the dominance of science could be to focus on knowledge, which is a
32
33 broader notion than science, implying ‘opening up’ the conservative, locked-in
34
35 situation of science-centred knowledge, to something labelled ‘knowledge
36
37 democracy’ (Cornell, et al., 2013, p.61). The problem is again seen as the gap
38
39 between two worlds, but the burden of required change is located within the world of
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41 science; “resistance in the research community” (Cornell, et al., 2013, p.68) is
42
43 understood as a barrier to effective communication.
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50 To summarise the perspective presented in this section: the *description* is of a two-
51
52 worlds situation, and typically that is further seen as a *problem*, a gap; within this
53
54 separation-as-problem stance the blame for the problem is differently distributed to
55
56 the two sides by different versions. The *solution* proposed in this diagnosis is better
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3 communication based on improved mutual understanding and a more intimate
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5 cooperation between science and policy; the two should better adapt to each other,
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7 which implies less distance and less independence.
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14 **Science and policy as one world – examples from climate change literatures**

16 The one-world perspective *describes* science and policy as tightly coupled. However,
17
18 this could also further mean the loss of distinct spheres of authority, i.e. the
19
20 development of a hybrid world. The prime example presented is the close relationship
21
22 between the IPCC and the policy makers in the UNFCCC. The gap between science
23
24 and policy described in the two-worlds perspective is within the one-world
25
26 perspective no longer seen as existing: the gap has deliberately been bridged, in this
27
28 case by the hybrid organisation IPCC through its close contacts to international policy
29
30 making (Hoppe, et al., 2013). However, the tight connection between science and
31
32 policy is usually not presented as a perfect solution. On the contrary, the *problems*
33
34 associated with a one world-situation are intensively discussed in the literature. The
35
36 ‘gap-bridging-solution’ has become a problem, because the connection has become
37
38 too tight. In many ways the IPCC and UNFCCC are viewed as constituting a self-
39
40 contained science-policy system, designed to deal with climate change on behalf of
41
42 humanity, but unable to fulfil its mission (Sarewitz, 2011; see also Beck, 2011; Haas
43
44 and Stevens, 2011; Rapley and De Meyer, 2014).
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52 Following this line of reasoning, scientific knowledge is anything but independent.
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54 According to one-world scholars, the IPCC should not be viewed as a purely
55
56 scientific community in which scientists summarise research. Rather, scientists are
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3 formulating the research assessment agenda *together* with government
4
5 representatives, and thus within parameters on focus, relevance, significance and
6
7 importance that governments co-determine. Government representatives must also
8
9 approve the final results before publication of the summary (or summaries) for policy
10
11 makers (SPM) reports, even if during the approval process scientists too retain in
12
13 principle a final veto regarding scientific content. According to scholars adhering to a
14
15 one-world perspective, this illustrates how policy relevance is a guideline for the
16
17 knowledge production process in the IPCC, i.e. on how to summarise science (Haas
18
19 and Stevens, 2011), including through the inevitable aspects of selection and
20
21 interpretation.
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28 What we here identify as a one-world perspective refers to a tight relationship in
29
30 terms of ideas, and not necessarily (though possibly) also a close organisational
31
32 relationship. In other words, *distance* is understood as being about *independence*. A
33
34 tight intellectual relationship can exist in various organisational set-ups: first, where
35
36 science is completely answerable to a policy authority, for example within a
37
38 totalitarian state or totalitarian private organisation; but also, second, where science
39
40 and policy are organisationally separate but procedurally interwoven, as in the IPCC
41
42 set-up; and third, where the two organisational worlds are fully separate but where
43
44 one of them intellectually dominates the other in crucial respects. In a one-world
45
46 situation science and policy are not independent from each other. We will examine
47
48 cases where authors see a domination of science by the world of policy and politics,
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50 and also cases where the reverse is perceived.
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3 A typical claim in a critical one-world approach (Diagnosis 2) is that the relation
4 between the IPCC and policy makers is dominated by (natural) science, and is
5 consequently characterised by a form of reductionism. The reason for this is said to be
6 historical. Natural scientists managed to draw attention to the climate change problem
7 and convince many policy makers and politicians about the need for comprehensive
8 assessment, which led to the establishment of the IPCC. In other words, climate
9 change has been a science-driven issue from the beginning (Weart, 2008; Edwards,
10 2010), and the science-dominated relationship between science and policy is based on
11 'the linear model' (Beck, 2011) where science is expected to 'speak truth to power'
12 (Rapley and De Meyer, 2014). However, there is also a contrasting view that the
13 relation between science and policy is dominated by policymakers, that science is
14 hampered or trapped by policy (e.g., Brysse, et al., 2013; Wynne, 2010). Those
15 contrasting descriptions share though the idea that science and policy are tightly
16 connected, and in key respects are one world.
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36 In what follows we further describe the elements of a critical one-world approach by
37 focussing on two aspects given importance in such analyses: a striving for *consensus*
38 (in both science and policy) and, as a consequence, *marginalisation* of other opinions.
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45 *The strong focus on consensus*

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47 Scholars based in the critical one-world approach attribute to the IPCC a desire to
48 speak with one single voice, through a strong focus on identifying a consensus
49 (Hulme and Mahony, 2010), and also to achieve strong policy impact by creating a
50 clear and unified message emerging from scientific consensus that then has to be
51 followed and implemented in a single-policy-path. Consensus could of course also be
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3 of importance in a two-worlds situation, but what we find here is the idea that
4
5 scientific consensus is considered to have a direct strong influence on policy, which
6
7 leads to a tight connection, i.e. a one-world. Many climate scientists support the
8
9 consensus-focused way of working, because it leads towards a definite policy
10
11 message (Tol, 2011). However, an exaggerated emphasis on consensus, it is argued,
12
13 has led to a restricted way to understand what type of problem climate change is and
14
15 its possible solutions. Too often, climate change is reduced to very largely a CO₂-
16
17 emission problem, presented in terms of statistics and emission targets, rather than say
18
19 being framed as a development issue, associated to specific forms of progress and
20
21 development. Some leading scholars who adopt a one-world problem diagnosis
22
23 describe this as *scientific reductionism*: “the fusion of climate science with a single
24
25 policy path... climate science thus came to mean Kyoto science, cap-and-trade
26
27 science, Al Gore’s science – and nothing else” (Sarewitz, 2011, p.479). The strong
28
29 focus on consensus has been called the strength *and* weakness of the IPCC, i.e. the
30
31 search for scientific consensus across disciplines *and* the preoccupation with
32
33 “securing formal agreement between the academy and governments through line-by-
34
35 line approval of [each] summary for policymakers” (Hulme and Mahony, 2010,
36
37 pp.710-711). This reductionism crowds out other ways of understanding climate
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39 change than those from mainstream earth sciences (Hulme, 2009).
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47 An alternative one-world diagnosis considers that policy dominates science. Brysse et
48
49 al. (2013) argue that climate scientists as a consequence of being faced with fierce
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51 climate scepticism are increasingly “erring on the side of least drama”, i.e. being
52
53 overly conservative in their estimates and judgements, including by omitting certain
54
55 issues. The IPCC “has consistently understated the rate and intensity of climate
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3 change and the danger those impacts represent, say a growing number of studies... A
4
5 comparison of past IPCC predictions against 22 years of weather data and the latest
6
7 climate science find that the IPCC has consistently underplayed the intensity of global
8
9 warming in each of its four major reports released since 1990” (Scherer, 2012). In this
10
11 diagnosis we see that scientists adapt to what they consider is politically possible for
12
13 policy makers to digest.
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18 Stage-by-stage conservatism throughout the process of projecting futures and
19
20 estimating impacts is argued by some authors to be widespread in mainstream policy-
21
22 oriented climate change analyses (e.g. Hansen et al., 2016). In IPCC work, not only
23
24 can conclusions gravitate towards the lowest common denominator amongst
25
26 participating climate scientists, pressure from the watching governments and
27
28 corporate interests can exert further conservative influence. The 2014 IPCC
29
30 Assessment Report gave low attention to ‘outlier’ events, extremes of weather whose
31
32 frequency is too difficult to predict but that happen increasingly. It also marginalized
33
34 possible low-probability-but-very-high-damage climate system shifts, such as through
35
36 melting of the permafrost or destabilization of the West Antarctica ice-cap. The
37
38 associated concept of *tipping-point* was almost totally absent from the 2014
39
40 Assessment (Fløttum, et al., 2016). Scientists present what they think policy makers
41
42 can understand, accept and will consider relevant and politically usable, and gradual
43
44 changes are presumed to be easier to deal with compared to radical ruptures. This is
45
46 an example of an overly close relationship in which scientists and policy makers adapt
47
48 to each other in a way that is not made transparent to outsiders (Wynne, 2010;
49
50 Shackley and Wynne, 1997), creating a closed and hybrid one-world.
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3 The IPCC seems to be aware of the risk of scientific reductionism and of emphasising
4 a lowest common denominator, that has emerged from the focus on establishing a
5 scientific consensus as the basis of climate change policy. In recent years, we see
6 some increased tendency to focus on the solution space. Working Group II, studying
7 impacts, vulnerability and adaptation, and Working Group III, studying options for
8 mitigation, have increased in prominence, acknowledging that not only the ‘physical
9 science basis’ – the topic for Working Group I, traditionally treated as the core group
10 of the IPCC – is essential for understanding and dealing with climate change.

11
12 However, the style of the increased attention to adaptation and mitigation has also
13 been criticised by some, as using the same logics from the natural sciences and now
14 seeking a global science-based consensus voice on every aspect of the climate change
15 issue (van der Sluijs, et al., 2010).
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32 *The marginalisation of alternatives*

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34 Consensus-driven science, according to critics of a one-world set-up, implies a focus
35 on certainty and truth which brings a trap. Sarewitz (2011, p.477) argues that ‘climate
36 scientism’ encourages its counterpart, ‘climate scepticism’. The IPCC quest for near-
37 certainty and its orientation to a one-single-policy pathway of CO₂ emission
38 reductions becomes an easy target for climate sceptics. Political discussions about
39 trust or distrust in science occur when knowledge comes in one single package
40 without alternatives, creating dichotomies between believers and non-believers.
41
42 Discussions about climate change actions become a controversy over scientific
43 evidence, and consequently ever more evidence is called for. Oreskes (2004, p.369)
44 describes the interaction between sceptics, policy makers and scientists in the
45 following way: “In recent years, it has become common for opponents of
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3 environmental action to argue that the scientific basis for purported harms is
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5 uncertain, unreliable, and fundamentally unproven. In response, many scientists
6
7 believe that their job is to provide the ‘proof’ that society needs. Both the complaint
8
9 and the response are misguided”.

10
11
12 When policy debates about climate change are purely based on scientific evidence,
13
14 the science which provides the evidence becomes politicised, and policy making
15
16 becomes de-politicised (Beck, 2012a). Scientific controversies over evidence of
17
18 climate change become a proxy for political battles over climate change action (Beck,
19
20 2011; see also Pielke Jr., 2007). The strong focus on global scientific consensus can
21
22 “erase cultural differentiation and heterogeneity... [and] fail to do justice to the
23
24 plurality of human living and may have considerably less purchase in problem-
25
26 solving and policy-making than a multiplicity of local and diverse tools and
27
28 indicators” (Hulme, 2010, p.563). Interestingly, whereas in a critical two-worlds
29
30 diagnosis the pluralist society is often seen as generating problems in effective
31
32 communication of scientific findings, here in a critical one-world diagnosis *lack* of
33
34 plurality brings a problem.
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42 When discussing *solutions*, some critical one-world analysts correspondingly focus on
43
44 the underconsidered dimensions – the ‘human dimensions’ of climate change – that
45
46 are assessed as having great importance in order to mobilise action and appeal to
47
48 multiple audiences outside scientific laboratories and mathematical models. Reducing
49
50 climate change knowledge to earth science can lead to neglecting attention to the
51
52 importance of public engagement (Jasanoff, 2010; Hackmann, et al., 2014; Yearley,
53
54 2009). Sarewitz (2011, p.481) argues that “[p]rogress waits not on better science, nor
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56 on better communication of science... but on new approaches that focus first on the
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3 articulation of an inclusive and compelling politics built on a rich array of possibilities
4
5 for the future". The solution is therefore often seen as to *open up* the natural science-
6
7 centred-regime to make space for more voices, more alternatives, not least policy
8
9 alternatives and local and public engagement, but also for alternatives in science.
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14 The recommendation to the IPCC is to renounce its 'epistemological hegemony'
15
16 (Mayer and Arndt, 2009) and 'quasi-monopoly' of providing policy advice in the
17
18 climate field (Tol, 2011). It should instead aim at giving 'pluralized strategic advice'
19
20 and 'opening up policy debate' (Hoppe, et al., 2013, p.296) to broader audiences
21
22 within the UN, the scientific community, NGOs, and the wider public, and to show
23
24 more transparency (Beck, 2012b).
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30 These authors are close to Diagnosis 2 in Table 1 above, which asserts that present
31
32 practice is one-world and that two-worlds would be a superior arrangement. The Paris
33
34 Agreement could be viewed as an answer that acknowledges this critique. The top-
35
36 down UNFCCC Kyoto Protocol, specifying IPCC-supported emission cuts for all
37
38 countries, is now replaced by a bottom-up approach in which countries individually
39
40 specify their contributions, the so-called Nationally Determined Contributions
41
42 (NDCs). The Paris Agreement represents an important shift in climate governance
43
44 (St.Clair and Aalbu, 2016), which could be interpreted as a response to an undesirable
45
46 one-world situation.
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51 To summarise the approach presented in this section: the *description* is of a one-world
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53 situation, including a tight coupling between science and policy on the international
54
55 level. The *problem* most of the authors see is the dominance of science (including an
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3 epistemic dominance of the biophysical sciences), the consensus ambition, and the
4
5 specification of one-single-policy-path coming out of the UNFCCC: a climate – or
6
7 carbon – reductionism, that marginalises many actors and also alternative framings
8
9 and policy options, not least on national and local levels (Hulme, 2009). The *solution*
10
11 proposed supports policy alternatives that are less science-dominated and more
12
13 connected to everyday concerns among ‘local’ people: too many actors become
14
15 marginalised as an effect of the too tight relationship between the IPCC and the
16
17 UNFCCC, which means that the policy-regime itself eventually becomes
18
19 marginalised. Scholars who argue instead that policy dominates over science, so that
20
21 scientific assessments adapt to what policy wants to hear, agree on the distorting
22
23 impact of the emphasis on consensus and on a too tight policy-science linkage. Not
24
25 surprisingly, given the different diagnoses, scholars disagree on how to deal with the
26
27 problems of a one-world situation and the perspective is in practice developed in
28
29 various ways.
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39 **Reflections and conclusions**

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41 We have described two different approaches regarding science-policy interactions that
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43 we found predominant among scholars studying these interactions in the climate field,
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45 corresponding to what we called Diagnosis 2 (undesirable one-world situation) and
46
47 Diagnosis 3 (undesirable two-worlds situation). They both argue that a mismatch
48
49 exists between the kind of science-policy interaction that exists and what is desirable.
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51 The predominant two-worlds approach, Diagnosis 3, expresses a critique of the gap
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53 between science and policy, and its proposed solution is to bridge this gap. The
54
55 predominant one-world approach, Diagnosis 2, implies a dissatisfaction over a too
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3 tight connection between science and policy, which could be solved by opening up
4
5 the closed one-world to bring more plurality in both science and policy. The problem
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7 in the first approach is the solution in the other, and vice versa. This is an interesting
8
9 finding, and even more so since there has been insufficient recognition and discussion
10
11 among scholars in the field about this opposition.
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16 As already shown the two approaches are both visible though in the organisation of
17
18 the IPCC assessment cycle. Trying to utilise both approaches, for organising the
19
20 interplay between science and policy, is not surprising. As argued above, both
21
22 separation (a two-worlds situation) and integration (a one-world situation) are highly
23
24 valued by most relevant actors in the climate field. Both are canonical views of
25
26 science-policy interactions (Nowotny et al., 2003; Sundqvist, et al., 2015). Some
27
28 scholars have tried to connect them by distinguishing between different phases in a
29
30 process that involves both separating and integrating science and policy (Haas, 2007;
31
32 Haas and Stevens, 2011).
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38 Viewed together, the two approaches could also be seen as a historical progression, an
39
40 important societal trend, going from separation to integration, which could also be
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42 identified in the development of climate science and the set-up of the IPCC as a prime
43
44 example, i.e. moving from exclusively academic science to summarising and
45
46 interpreting science for policy. A view of the two approaches as complementary is
47
48 supported by the argument that separation (two worlds) and integration (one world) of
49
50 science and policy fit different levels in analysis. At the international level we find
51
52 very close cooperation given the links between the IPCC and the UNFCCC, almost as
53
54 one package of mutual dependency, while on national and local levels there is more
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3 distance between IPCC science and climate policy. The tight coupling between
4 science and policy, perceived in the one-world approach, is a 'small-group-
5 interaction' from which most policy makers and publics remain on the outside, distant
6 from the dominant elites in the IPCC and the UNFCCC. The integration of science
7 and policy involves the international elite, while for others a two-worlds situation is
8 what remains.
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18 The most important and recent example from the international climate science-policy
19 scene illustrates the two approaches at work simultaneously. A major feature of the
20 Paris Agreement is the 'pledge and review system' where the so-called Nationally
21 Determined Contributions (NDCs) constitute the building blocks of the new
22 Agreement. In other words, the top-down 'one-world' Kyoto-model is replaced by a
23 bottom-up system based on each country's individual pledges, in line with a
24 Diagnosis 4 position (desirable two-worlds situation). However, the NDCs will also
25 be reviewed and assessed every five years in an arrangement called 'global
26 stocktake', aiming to increase climate policy ambitions over time. Consequently, in
27 order to be policy-relevant to the global stocktaking process, the IPCC main reports
28 will after the Paris Agreement be released every fifth year, as opposed to every 6-7
29 years previously. The decision to synchronise the IPCC and the UNFCCC cycles in
30 this manner is arguably in line with a Diagnosis 1 position (desirable one-world
31 situation), as it implies a tighter integration between the IPCC and the UNFCCC. In
32 other words, the Paris Agreement has led to measures that are in line with descriptions
33 and prescriptions from both approaches, i.e. the two important mechanisms
34 constituting the Paris Agreement illustrate the two different predominant diagnoses in
35 Table 1.
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5 From what is said above the one-world and two-worlds approaches are thus not pure
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7 rivals, rather complementary. Science-policy interactions are neither linear nor single-
8
9 directional, but contain an irresolvable tension that has no single best solution. This
10
11 means that we should understand the different science-policy configurations in the
12
13 climate field as contingent, changing and strategically used. The approaches and the
14
15 specific science-policy interactions that constitute them are not static. We suggest that
16
17 awareness of dealing with an *aporia* (a situation of undecidability) should increase
18
19 among social scientists analysing the interactions between climate science and policy
20
21 and that this will spur a more fruitful analysis on ways to improve the policy uptake
22
23 of climate change science. However, what we found in the literature was a frequent
24
25 ambition to arrive at simple generalised solutions, seen in the scholarly attraction to
26
27 the opposing endpoints on the dimension of distance between science and policy,
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29 largely prescribing either separation or integration as ideal solution.
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37 In our view, there is no best solution. The best we can search for is experimentation
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39 and learning, which implies that analyses and proposals for improvements should be
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41 assessed from the perspective of what actors want to achieve, often related to the
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43 stage or types of science involved and the stage in policy processes. A necessary
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45 starting point is to acknowledge (i) the important influence the opposing ideal-type
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47 approaches have in much scholarly work; (ii) that the dominant diagnoses are mirror
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49 images – what in one diagnosis is a problem becomes a solution for the other; (iii)
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51 that organisations sometimes want to adhere to both without realising the tension, and
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53 (iv) that there is insufficient communication and cross-fertilisation between
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55 proponents of the various diagnoses. More interaction between them would help both
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3 understanding and practice in the science-policy interface on an appropriate case by
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5 case basis.
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Descriptive

		One-world	Two-worlds
Prescriptive	One-world	Diagnosis 1 desirable one-world	Diagnosis 2 undesirable one-world
	Two-worlds	Diagnosis 3 undesirable two-worlds	Diagnosis 4 desirable two-worlds

Match

Mismatch

Table 1: Four diagnoses on relationships between science and policy emerging from the two ideal types of one-world and two-worlds perspectives. The figure illustrates match or mismatch between what is described, and what is prescribed.