

Prospectus for Synthesis and Assessment Product 5.1

Uses and Limitations of Observations, Data, Forecasts, and Other Projections in Decision Support for Selected Sectors and Regions

Lead Agency: NASA

Supporting Agencies: DOC/NOAA, DOE, DOI/USGS, NSF, USAID, EPA

1. Overview

1.1. Description of Topic

Global change information—including observations, data, and a variety of forecasts and projections collected or developed on multiple spatial and temporal scales—has the potential to address international, national, regional, and local decision-support objectives. However, for the information to be useful, its applicability and reliability¹ for different applications must be evaluated. As a first step in this process, CCSP Synthesis and Assessment Product 5.1 will focus on characterizing a subset of the observations from remote sensing and *in situ* instrumentation that are of high value for decision making. The product will:

- Characterize observational capabilities that are currently or potentially used in decision-support tools
- Catalog a subset of ongoing decision-support activities and demonstration projects that use these capabilities
- Evaluate a limited number of cases studies of these decision-support activities and demonstration projects in detail, focusing on:
 - The potential for a variety of observations (and projections) to be incorporated into different decision-support tools
 - The process and approaches used to actually integrate selected information into decision support
 - The approaches needed to systematically test and document performance² of the observational capabilities in different decision-support tools.

[FOOTNOTE 1: *Reliability*, in this context, refers to qualities of the information that merit trust by decision makers. These may include accessibility, interoperability, and statistical validity, among other characteristics.]

[FOOTNOTE 2: The systematic testing and documenting of performance is frequently referred to as “benchmarking.” See <http://aiwg.gsfc.nasa.gov/esappdocs/GuidebookDSSassim.doc> for a more thorough description of benchmarking as applied by NASA in development of decision support systems.]

The detailed evaluation of decision-support activities and demonstration projects will provide the following information:

- 1 • Agencies and organizations responsible for developing, operating, and maintaining
2 selected decision-support processes and tools
- 3 • Description of observations from remote sensing and *in situ* instrumentation used
- 4 • Nature of interaction between users and producers of information, the approaches for
5 delivering and/or accessing information, and the processes for assimilating information in
6 the decision making process(es)
- 7 • Type of information about uncertainty and levels of confidence conveyed, and
8 approaches for tailoring information about uncertainty to specific decision-support
9 contexts and groups of decision makers
- 10 • Assessment of the performance of the integrated decision-support solutions utilizing
11 global change information
- 12 • Assessment of how global change data are organized, analyzed, and assimilated by
13 decision makers. Ultimately, a prioritized list of decision makers may need to be
14 composed for the focus of this synthesis and assessment report.
- 15 • Assessment of the impact on the decision making process of the known uncertainty of the
16 information resources being used as inputs to decision process(es).

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18 The product will be prepared in two phases. The first phase will focus on *observational*
19 capabilities capable of being integrated into climate change science products for societal benefit
20 in areas of national and regional priority. Demonstration projects will be selected from the 12
21 areas of national priority outlined in Appendix B. Information will be gathered from published
22 literature and interviews with the sponsors and stakeholders of the decision processes, as well as
23 publications by and interviews with the producers of the scientific information used in the
24 decision-support tools. All publications and interviews will follow Paperwork Reduction Act
25 guidelines (44 USC 3501). The second phase will expand the focus of the report to include
26 assessment of decision-support activities that utilize forecasts and projections of climate and
27 global change. Separate reports will be issued for each phase.

28
29 Each phase of preparing Synthesis and Assessment Product 5.1 will result in the following
30 specific products:

- 31
32 • A printed report capturing a profile of experiments at the time of publication (i.e., a
33 “snapshot” of decision-support demonstration projects and activities that incorporate
34 observational capabilities) and addressing the questions listed in section 1.3.
- 35 • An online catalog of decision-support demonstration projects with interactive links,
36 which will be updated as additional experiments are conducted and new approaches to
37 incorporating and benchmarking application of observations and other global change
38 research products evolve.

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41 *1.2. Audience and Intended Use*

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43 This synthesis and assessment report is designed to serve decision makers and stakeholder
44 communities interested in using global change information resources in policy, planning, and
45 other practical uses. The goal is to provide factual information on climate change research
46 products that have the capacity to inform decision processes. The report will also be valuable to

1 the climate change science community because it will indicate types of information generated
2 through the processes of observation and research that are particularly valuable for decision
3 support. In addition, the report will be useful for shaping the future development and evaluation
4 of decision-support activities, particularly with regard to improving the interactions with users
5 and potential users. The focus on interactions among the participating climate change science,
6 decision support, and user communities is essential to the success of the project because of the
7 importance of these interactions in developing relevant and reliable products. The report will
8 develop options for strengthening these interactions.

9
10 There are a number of national and international programs focusing on the use of Earth
11 observations and related prediction capacity to inform decision-support tools (see Appendix C).
12 These programs both inform, and are informed by, the CCSP and are recognized in the
13 development of this product. Many of these programs share a common framework architecture
14 that relates the observations from Earth observation systems, and the forecasts and projections
15 from Earth system models as inputs to decisions support tools used to support policy and
16 management decision processes (see Appendix D). To the extent that these programs seek to
17 develop tools and resources for decision support, this report will be of value in future
18 development.

19 20 21 *1.3. Questions to be Addressed*

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23 Synthesis and Assessment Product 5.1 will evaluate specific decision-support demonstration
24 projects, and also compare and contrast across individual experiences to address broader themes,
25 including:

- 26
27 • In Phase 1, the use of Earth observations in decision-support tools
 - 28 – What kinds of observations are being used (i.e., under what circumstances is there
 - 29 demand for observations that are already produced or that may be produced)?
 - 30 – What limits their usefulness?
 - 31 – How reliable are the observations that are used (i.e., through what means is reliability
 - 32 determined)?
 - 33 – How are information about uncertainty and levels of confidence conveyed and
 - 34 tailored to specific decision contexts?
 - 35 – To what extent do the decision-support tools rely upon global change information?
 - 36 How important are the observations (science results and global change data and
 - 37 information products now available) in the context of the broader effort the decision-
 - 38 support tool was designed to address?
- 39
40 • In Phase 2, the use of global change forecasts and projections in decision-support tools
 - 41 – What kinds of forecasts and projections are being used (in the selected set of
 - 42 decision-support tools)?
 - 43 – What limits their usefulness?
 - 44 – How reliable are the forecasts and projections that are used? How is “reliability”
 - 45 determined?

- 1 – How is information about uncertainty and levels of confidence conveyed and tailored
2 to specific decision contexts?
3 – To what extent do these decision-support tools rely upon global change observations
4 and/or projections?
5

6 Questions in the following bullets will be addressed in both phase 1 and phase 2:
7

- 8 • Assessment of decision-support tools that use global change information versus those that
9 do not, but could (i.e., under what conditions is global change information sought or
10 needed)?³
11 – Why do certain users seek global change information? What kinds of data and
12 information do users request? Under what conditions do certain users seek global
13 change information? Under what conditions are they exposed to global change
14 information?
15 – What factors affect this choice (e.g., availability, tradition, access, confidence)?
16 – Which decision-support tools specifically support climate-related management
17 decision making among U.S. government agencies?
18 • Factors affecting access and use of global change information at the Federal, State, and
19 local level
20 – What global change information is used?
21 – Do decision makers at different levels of government use the information differently?
22 – Does access to the information vary from level to level?
23 – What limits utility and access?
24 • Use of global change information in decision-support tools at the Federal, State, and local
25 level
26 – What are the tools and who owns them?
27 – How are requirements for information defined and conveyed?
28 – Does access to the tools vary from level to level?
29 – What limits the utility of, and access to, global change information by the owners and
30 operators of these tools?
31 • Use of decision-support tools that address global change in specific sectors versus
32 geographic regions
33 – Does the utilization of decision-support tools that address global change vary by
34 geographic region or characteristic?
35

36 [FOOTNOTE 3: The goal of this question is to learn about climate-related observations and
37 model predictions as they are used in management decision-making across U.S. government
38 agencies and, in particular, to describe the relative demand for global change information.]
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41 A sample set of national priority areas and specific decision-support demonstration projects are
42 offered in Appendix B. These decision-support demonstration projects are representative of
43 ongoing efforts to assimilate global change data into solutions to serve decision makers. In some
44 cases, global change data are already incorporated and are contributing to decision making
45 processes. In other cases, global change data will provide new information on environmental
46 parameters as key science information.

2. Contact Information

NASA is the lead agency for this product. Key agency contacts are provided below:

NASA	Ronald J. Birk	ronald.j.birk@nasa.gov
NASA	Terry McPherson	terry.mcpherson@ssc.nasa.gov
NOAA	Robert Livezey	Robert.E.Livezey@noaa.gov
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USGS	Richard Bernknopf	rbern@usgs.gov
EPA	Britta Bierwagen	bierwagen.britta@epamail.epa.gov
CCSP	Richard Moss	rmoss@usgcrp.gov
DOE	Jeff Amthor	jeff.amthor@science.doe.gov
DOE/PNL	Jae Edmonds	jae@pnl.gov

3. Lead Authors

The following individuals have been nominated as potential authors (Additional biographical information is found in Appendix A):

- Roger King, Professor, Electrical and Computer Engineering, Mississippi State University
- Roger Pielke, Jr., Professor, Environmental Studies, Colorado State University, and Fellow, Cooperative Institute for Research in the Environmental Sciences (CIRES)
- Roberta Balstad, Director of the Center for International Earth Science Information Network (CIESIN) at Columbia University
- Holly Hartman, Assistant Physical Scientist, Department of Hydrology and Water Resources, University of Arizona
- Molly Macauley, Senior Research Fellow, Resources for the Future.

The opportunity to nominate additional authors and contributors is open during the prospectus public comment period. Nominations of authors will be accepted until January 2006, via e-mail (with supporting CVs attached) to the NASA points-of-contact listed in Section 2. Authors, contributors, and expert reviewers may be Federal or non-Federal experts with a record of interest and accomplishment in fields pertaining to CCSP Synthesis and Assessment Product 5.1.

4. Stakeholder Interaction

This product requires an interdisciplinary approach, drawing expertise from global change science and impacts assessment; meteorology; risk analysis; decision making analysis; economics; and systems engineering, design, and operation. In addition, success will rely on the information and insights of a range of local and regional decision makers and stakeholders who participate in the selected decision-support demonstration projects. Consultation with local and

1 regional decision makers and stakeholders will be embedded in the process and maintained as an
2 ongoing project component. The research team will develop, in consultation with the project
3 sponsors, the specific processes used to collect project inputs and information from stakeholders,
4 and the individuals and organizations that should be included.

5 6 7 **5. Drafting**

8
9 The lead authors will meet in person, through e-mail exchanges, and via teleconferences to
10 prepare a detailed outline based on input solicited at the expert workshop. The convening lead
11 author may delegate lead responsibility for sections corresponding to the questions listed in
12 Section 1.3. All chapter leads will be involved in preparation of an introductory section to
13 describe the topic, the audience, and the intended uses of Phase 1 and 2 products. The lead
14 authors will incorporate material from any contributing authors in the draft product as they see
15 fit.

16
17 The drafting process will include a literature review and an additional workshop structured to
18 include key participants knowledgeable in the uses and limitations of Earth-system observations
19 including measurement of their reliability and value as they are assimilated into Earth-Sun
20 system models and into decision-support tools used for policy and management decisions.

21
22 The process used to search for and identify projects will include a systematic review of national
23 and international programs that are focused on extending the use of Earth observations to serve
24 society. These projects will be identified as candidates to be included in the catalog pursuant to
25 an opportunity for public review and comment. Review of the projects will be enabled by a
26 gateway configuration on an Internet site. Criteria will be developed and vetted with the research
27 and user communities for selecting a subset of the candidate projects for more intensive study.
28 The data on those projects will be collected via surveys and interviews. The performance of the
29 projects will be established using accepted procedures for benchmarking. The process for this
30 report will be consistent with the guidelines for preparing CCSP synthesis and assessment
31 reports.

32 33 34 **6. Review**

35
36 Phase 1 and 2 products will be reviewed independently, and follow the process described in the
37 *Guidelines for Producing CCSP Synthesis and Assessment Products*: (1) a first draft for expert
38 peer review, (2) a second draft posted for public comment, and (3) a third draft for final review
39 and approval through the CCSP interagency committee and the National Science and
40 Technology Council (NSTC).

41
42 The expert peer review process will consist of independent reviews from experts selected by the
43 lead agency, and from a pool of candidates solicited during the expert workshop. Separate expert
44 peer reviewers will be selected for Phases 1 and 2, although there may be overlap. Nominations
45 for expert peer reviewers can be provided to representatives of the lead agency by July 2006. The
46 expert peer review process will be 45 days long. It will be conducted in accordance with

1 NASA's requirements for peer review and general guidelines from the Office of Management
2 and Budget Final Information Quality Bulletin for Peer Review ("OMB Peer Review Bulletin")
3 issued 16 December 2004.

4
5 Following expert review, the lead authors will revise the draft product by incorporating
6 comments and suggestions from the reviewers, as the lead authors deem appropriate. Following
7 this revision, the draft product will be released for public comment. The public comment period
8 will last for 45 days and is scheduled to begin December 2006.

9
10 Once the revisions are complete, the lead agency will determine that the product has been
11 prepared in accordance with the Information Quality Act (including ensuring objectivity, utility,
12 and integrity as defined in 67 FR 8452), and it will submit the synthesis and assessment product
13 to the CCSP Interagency Committee for approval. If the CCSP Interagency Committee
14 determines that further revision is necessary, their comments will be sent to the lead agency for
15 consideration and resolution by lead authors.

16
17 If the CCSP Interagency Committee review determines that no further revisions are needed and
18 that the product has been prepared in conformance with the *Guidelines for Producing CCSP*
19 *Synthesis and Assessment Products* (see <[http://www.climate-science.gov/Library/sap/sap-](http://www.climate-science.gov/Library/sap/sap-guidelines.htm)
20 [guidelines.htm](http://www.climate-science.gov/Library/sap/sap-guidelines.htm)>), they will submit the product to the National Science and Technology Council
21 (NSTC) for clearance. Clearance will require the concurrence of all members of the Committee
22 on Environment and Natural Resources. Comments generated during the NSTC review will be
23 addressed by the CCSP Interagency Committee in consultation with the lead and supporting
24 agencies and the lead authors.

25 26 27 **7. Communication**

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29 Hardcopies of the product will be published using the standard format for all CCSP synthesis and
30 assessment products. The final product and the comments received during the expert review and
31 the public comment period will be posted on the CCSP web site. Once the document has been
32 cleared by the NSTC process, the product will be prepared for both web and hardcopy
33 dissemination. The number of hardcopies and the distribution process will be determined as part
34 of the development of this product.

1	8. Timeline	
2		
3	November 2005	CCSP Workshop “Climate Science in Support of Decision Making”
4	December 2005	Draft prospectus Public Review (30 days)
5	February 2006	Final prospectus posted on CCSP web site
6	March 2006	Lead author meeting on Phase 1 and 2 objectives
7	August 2006	Draft #1 provided to Expert Reviewers (45 days)
8	October 2006	Lead author meeting
9	December 2006	Draft #2 made available for public comment (45 days)
10	March 2007	Lead author meeting
11	April 2007	Draft #3 submitted to CCSP committee for review and processing through
12		NSTC
13	May 2007	Final Phase 1 product posted on CCSP web site, with links to the Phase 2 web
14		site maintained by NASA
15	July 2007	Hardcopy of Phase 1 product available through GCRIO

Appendix A. Biographical Information for Potential Lead Authors**Roger L. King**

Dr. Roger L. King is a William L. Giles Distinguished Professor and the Associate Dean for Research and Graduate Studies in the Bagley College of Engineering at Mississippi State University (MSU). His research areas include the intelligent analysis of Earth remote sensing imagery for a variety of decision-support activities. He joined MSU in 1988, where he now serves as Associate Director for Research in the GeoResources Institute, as Director of the Computational GeoSpatial Technologies Center, and as the Director of the National Consortium on Remote Sensing in Transportation – Environmental Assessments. He recently completed a 1-year IPA assignment at NASA Headquarters serving as a senior technical and policy advisor in the role of Chief Technologist for the Earth Science Enterprise Applications Division. Dr. King is very active in the IEEE Geoscience and Remote Sensing Society (GRS-S) where he serves as the Chair of the Technical Committee on Data Archiving and Distribution and as a member of the IEEE Committee on Earth Observations. He is the IEEE GRS-S liaison to the International Standards Organization (ISO) Technical Committee on Geographic Information/Geomatics (TC211) and the IEEE-USA Committee on Transportation and Aerospace Technology Policy. He has received numerous awards for his research including the university's top research honor – the Ralph E. Powe Research Award; being named a member of the Academy of Distinguished Alumni of the Department of Computer Science and Electrical Engineering at West Virginia University; and a recipient of the Department of Interior's Meritorious Service Medal. Dr. King received his BSEE from West Virginia University (1973), his MSEE from the University of Pittsburgh (1978), and a Ph.D. in Engineering from the University of Wales – Cardiff (1988). Dr. King is a registered professional engineer in the state of Mississippi.

Roger A. Pielke, Jr.

Dr. Pielke has been on the faculty of the University of Colorado since 2001, and is a Professor in the Environmental Studies Program and a Fellow of the Cooperative Institute for Research in the Environmental Sciences (CIRES). At CIRES, Roger serves as the Director of the Center for Science and Technology Policy Research. Roger's current areas of interest include understanding the politicization of science, decision making under uncertainty, and policy education for scientists. He serves on the Advisory Panel of the National Science Foundation (NSF) Program on Societal Dimensions of Engineering among other advisory committees. In 2000, Roger received the Sigma Xi Distinguished Lectureship Award and, in 2001, he received the Outstanding Graduate Advisor Award by students in the University of Colorado's Department of Political Science. From 1993-2001, Roger was a Scientist at the National Center for Atmospheric Research. Roger sits on the editorial boards of *Policy Sciences*, *Bulletin of the American Meteorological Society*, *Environmental Science*, and *Policy and Natural Hazards Review*. He is author of numerous articles and essays and is also co-author or co-editor of three books. Dr. Pielke received his Ph.D. from the University of Colorado in 1994.

Holly C. Hartman

Dr. Hartmann is an Assistant Physical Scientist in the Department of Hydrology and Water Resources at the University of Arizona. As a participant in the CLIMAS project since its inception, Dr. Hartmann has been involved in assessing hydroclimate forecasts, their

1 communication, and their use in making real-world decisions. She has evaluated official
2 hydroclimate forecasts in order to establish a baseline of performance for tracking improvements
3 due to scientific research. Her research led to the development of a framework for evaluating
4 forecasts from the perspective of decision makers, which has been implemented as a series of
5 assessment tools available online. Dr. Hartmann has a background in hydrologic modeling, water
6 resources management, and water policy. Her current research interests include regional-scale
7 hydroclimate modeling; hydroclimate forecasting and evaluation; communication among
8 research, operations, and stakeholder communities; and evaluation of integrated research. She
9 has received research funding from NOAA, NSF, NASA, and the American Meteorological
10 Society. Dr. Hartman received her Ph.D. from the University of Arizona in 2001.

11 **Molly K. Mccauley**

12 Dr. Macauley's research interests include space economics and policy, the economics of new
13 technologies, recycling and solid waste management, urban transportation policy, and the use of
14 economic incentives in environmental regulation. She also directs Resources for the Future's
15 academic programs, which include the RFF Seminar Series and fellowship and internship
16 programs. Dr. Macauley has served on numerous special committees of the National Academy of
17 Sciences and the National Aeronautics and Space Administration. She also is on the board of
18 directors of Women in Aerospace and serves as president of the board of advisers for the Thomas
19 Jefferson Program in Public Policy at the College of William and Mary. Dr. Macauley has
20 testified extensively before Congress and is the author of more than 80 articles, reports, and
21 books. Dr. Mccauley received her Ph.D. in Economics from Johns Hopkins University (1983), an
22 M.A. in Economics from Johns Hopkins University (1981), and a B.A. in Economics from the
23 College of William and Mary (1979).

24 **Roberta Balstad**

25 Dr. Balstad is Director of the Center for International Earth Science Information Network
26 (CIESIN) at Columbia University. She has published extensively on science policy, information
27 technology and scientific research, remote-sensing applications and policy, and the role of the
28 social sciences in understanding global environmental change. She received her Ph.D. from the
29 University of Minnesota, and was both a senior fellow at Oxford University and a guest scholar
30 at the Woodrow Wilson International Center for Scholars. Dr. Miller was the director of the
31 Division of Social and Economic Sciences at the National Science Foundation, the founder and
32 first executive director of the Consortium of Social Science Associations, and president and CEO
33 of CIESIN before it joined Columbia University. She has lectured widely both in the United
34 States and abroad. She is currently chair of the US National Committee on Science and
35 Technology Data (CODATA), co-chair of the Earth Science Applications and Societal Needs
36 Panel of the NRC decadal study of the Earth sciences, and a member of the Board of Directors of
37 the Open Geospatial Consortium. She previously served as vice president of the International
38 Social Science Council and chaired the NRC Steering Committee on Space Applications and
39 Commercialization, the ICSU strategic assessment panel on Scientific Data and Information, the
40 NATO Advisory Panel on Advanced Scientific Workshops/Advanced Research Institutes, and
41 the American Association for the Advancement of Science's Committee on Science,
42 Engineering, and Public Policy. Dr. Balstad has also been a member of the NRC Space Studies
43 Board.

1 **Appendix B. Societal Benefit Areas/CCSP Agencies/Decision-Support Tools**

2

Nationally Important Application	Partner Agencies	Examples of Decision-Support Tools
Agricultural Efficiency	USDA, DOE	CADRE - Crop Assessment Data Retrieval & Evaluation
Air Quality	EPA, NOAA	CMAQ – Community Multiscale Air Quality Modeling System AirNow Air Quality Index
Aviation	FAA, NOAA	NAS – National Airspace System
Carbon Management	USDA, DOE, EPA	CASA/CQUEST – support to the EA92-1605b – Energy Act of 1992
Coastal Management	NOAA, EPA	HAB – Harmful Algal Bloom Bulletin / Mapping System CREWS – Coral Reef Early Warning System
Disaster Management	FEMA, NOAA, USGS	AWIPS – Advanced Weather Interactive Processing System HAZUS-MH – Hazards US – Multi Hazards
Ecological Forecasting	USAID	SERVIR – Regional Visualization & Monitoring System
Energy Management	DOE, EPA	RETScreen™ - Renewable Energy Technology Screen NEMS – National Energy Modeling System
Homeland Security	DHS	IMAAC – Interagency Model and Atmospheric Assessment Center
Invasive Species	USGS, USDA	ISFS – Invasive Species Forecasting System
Public Health	NIH, CDC	PSS – Plague Surveillance System EPHTN – Environmental Public Health Tracking Network RSVP – Rapid Syndrome Validation Project MMS – Malaria Monitoring and Surveillance
Water Management	USGS, EPA, BoR, USDA	BASINS – Better Assessment Science Integrating Point and Non-point Sources AWARDS – Agricultural Water Resources Decision Support RiverWare – Bureau of Reclamation decision-support tool

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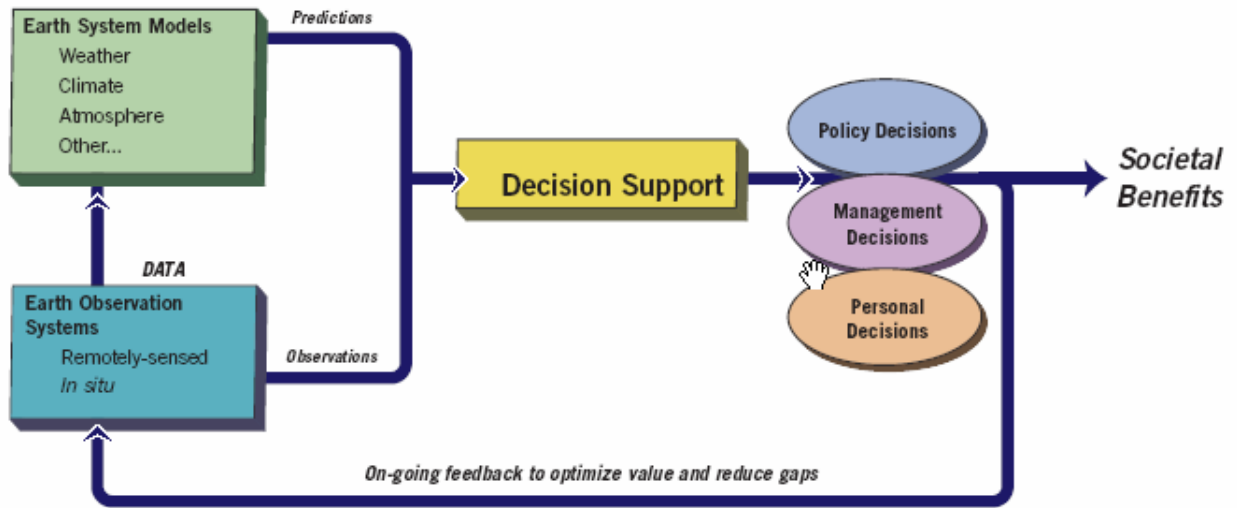
Appendix C. References to Related National and International Activities

Priority	National	International
Climate Change	Climate Change Science Program, Climate Change Technology Program	Intergovernmental Panel on Climate Change, World Climate Research Programme
Global Earth Observations	NSTC CENR U.S. Interagency Working Group on Earth Observations	Group on Earth Observations (GEO)
Weather	U.S. Weather Research Program (USWRP)	World Meteorological Organization
Natural Hazards	NSTC CENR Subcommittee on Disaster Reduction	International Strategy for Disaster Reduction
Sustainability	NSTC CENR Subcommittee on Ecosystems	World Summit on Sustainable Development
E-Government	Geospatial One-Stop and the Federal Geographic Data Committee	World Summit on the Information Society

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Appendix D. Linking Observations and Forecasts to Decision Support



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Source: Draft U.S. 10-Year Plan for Integrated Earth Observation System
<http://iwgeo.ssc.nasa.gov>

Caption: This figure illustrate the flow of information associated with decision support in the context of variability and change in climate and related systems.