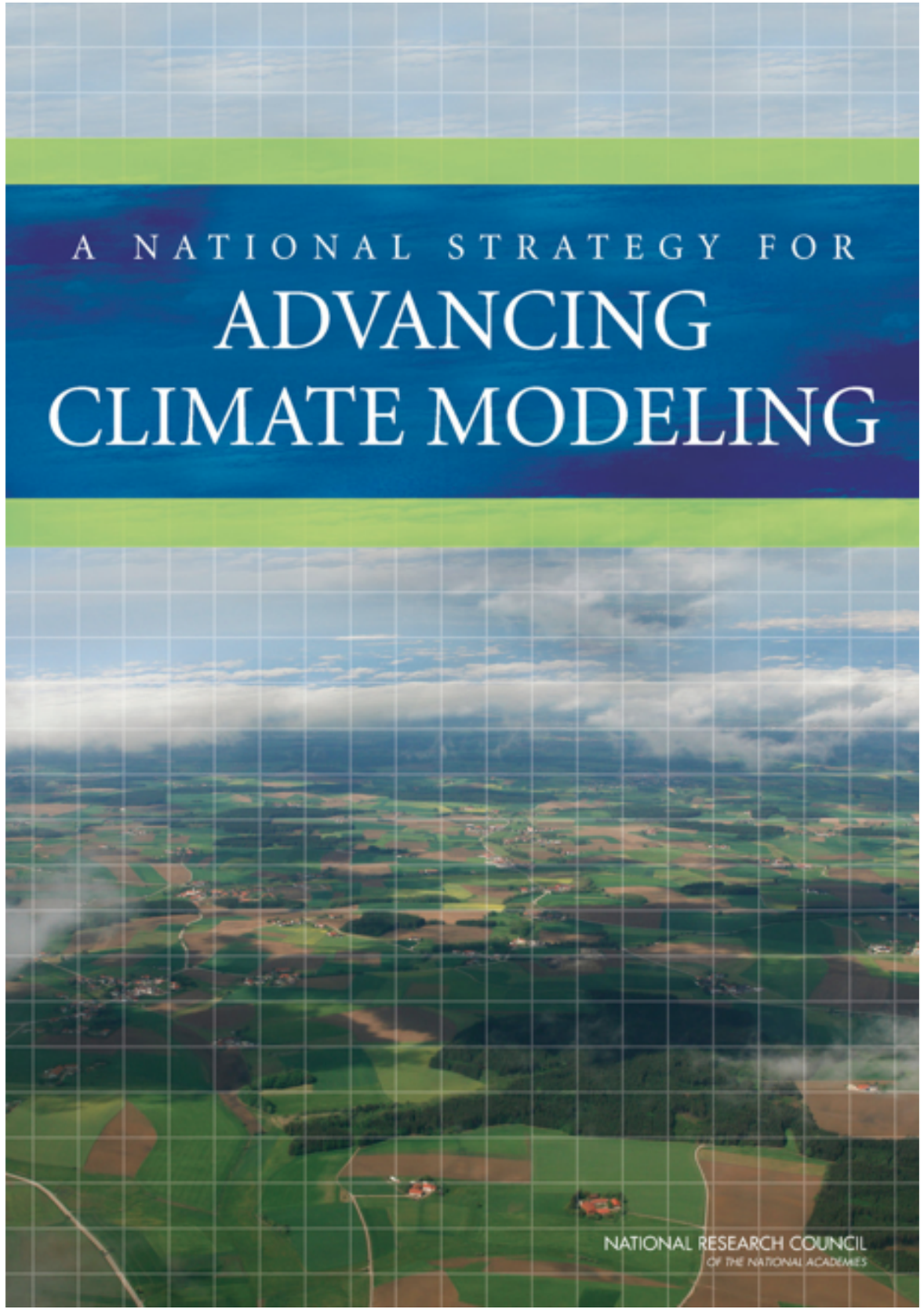

Bretherton et. al. 2012

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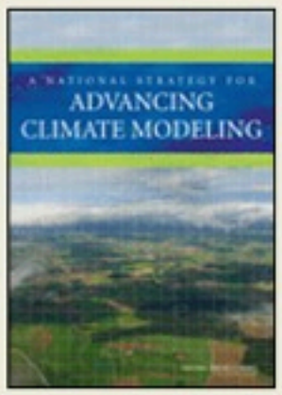
A National Strategy for Advancing Climate Modeling



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IMPORTANT NOTICE

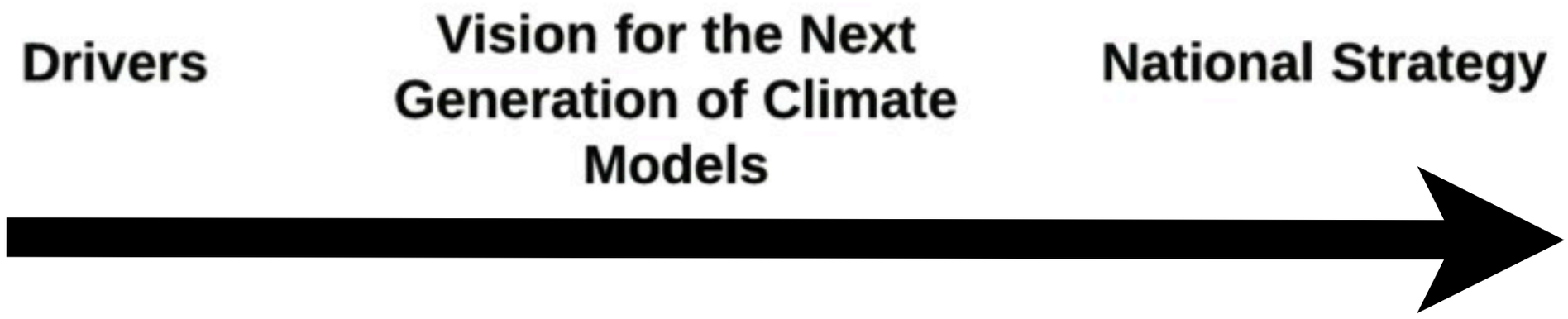
More information about *A National Strategy for Advancing Climate Modeling*, in
key findings, is available at the Report Page from the Division on Earth and Life

Register Now to attend a free webinar on September 28 at 1:30 pm EST, where
the report's authoring committee and ask questions about the report's findings.

Visit the Climate Modeling 101 website to learn more about how climate mode
videos, and illustrations, the website is based on expert, consensus reports from
Board on Atmospheric Sciences and Climate.

Authors:
Committee on a National Strategy for Advancing Climate Modeling; Board on A
Division on Earth and Life Studies
Authoring Organizations

Description:
As climate change has pushed climate patterns outside of historic norms, the ne
growing across all sectors, including agriculture, insurance, and emergency pre
Strategy for Advancing Climate Modeling emphasizes the needs for climate ...
Read More



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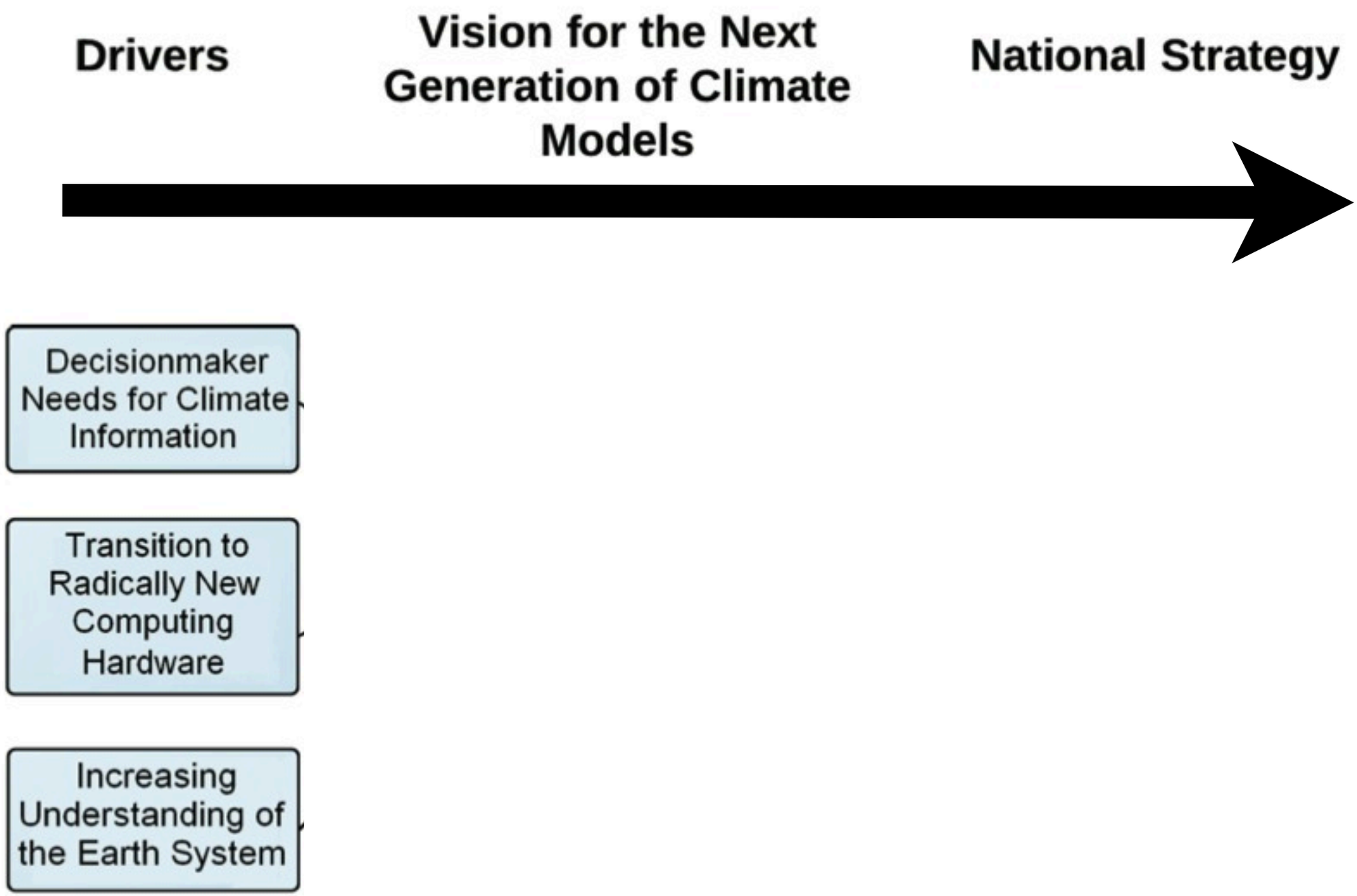

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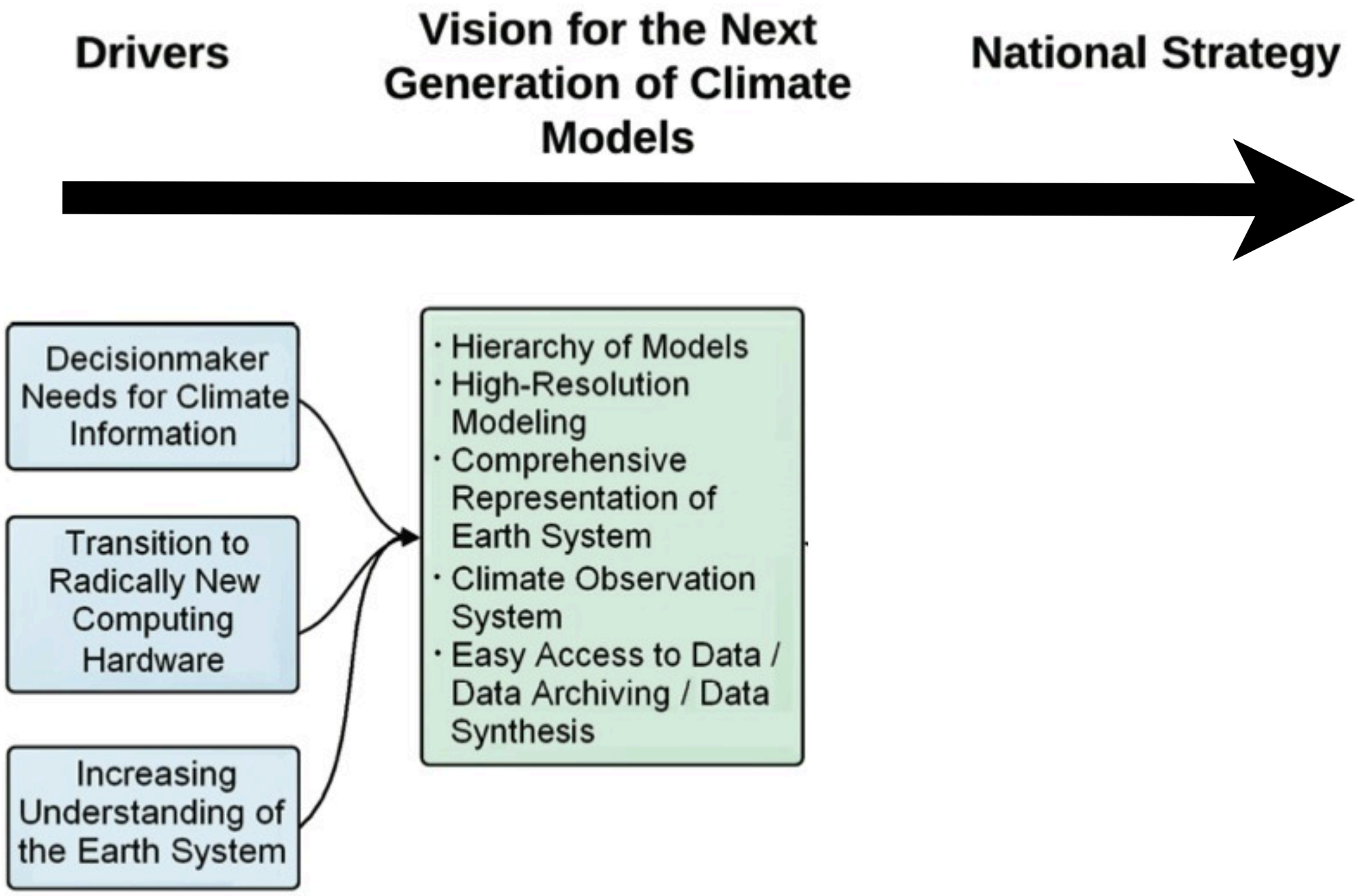

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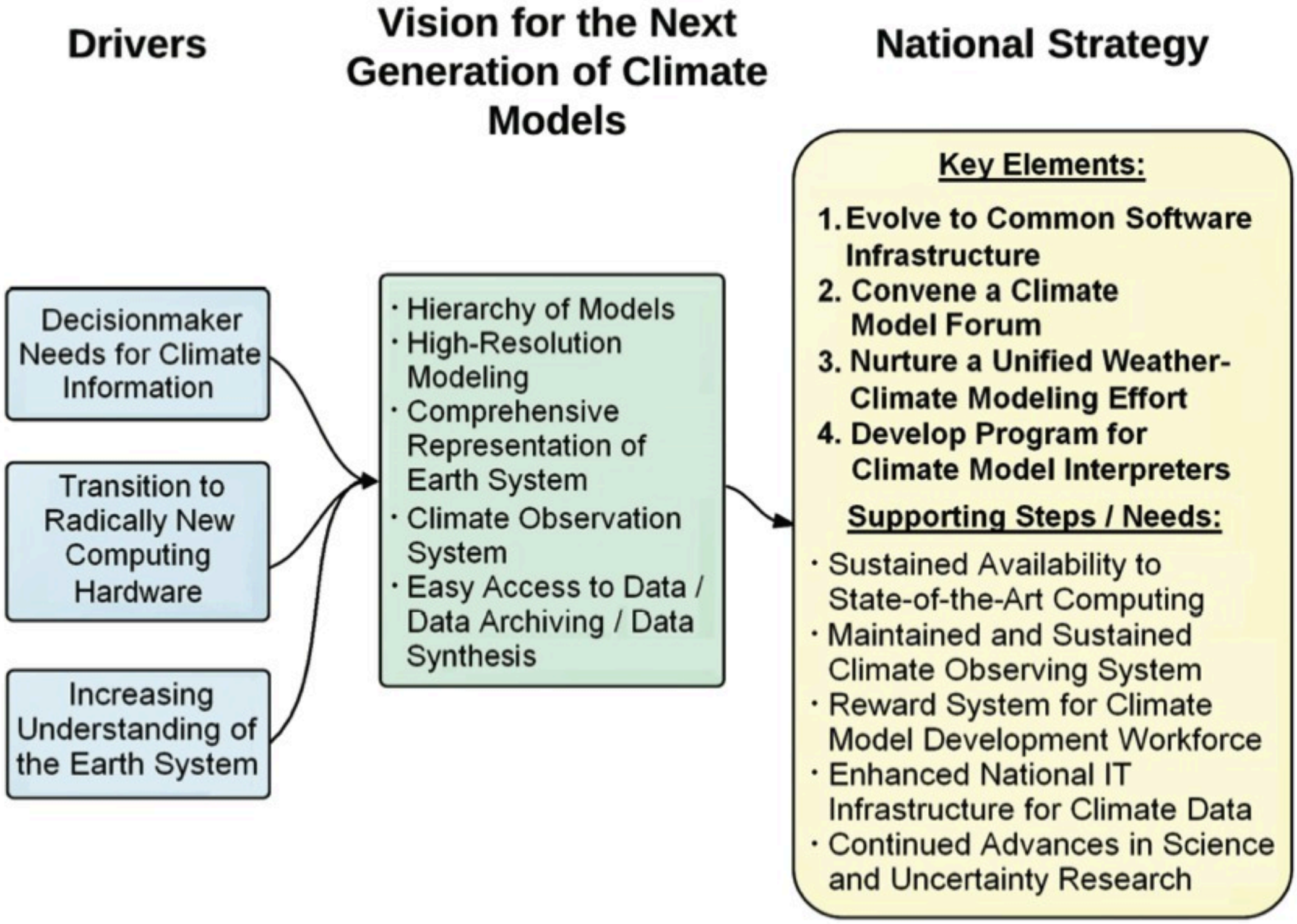

From Bretherton et. al. 2012 A Nat'l Strategy for Advancing Climate Modelling

My Main Conclusions

- Key drivers:
  + Science and Society
  – Computing HW
- Models need:
  + Competition in science
  + Common software IS
  + Increased resolution
  + Consideration of the complete line from NWP to ESM
- Modelers need
  + Education
  + Exchange
  + Reward
- Users need
  + Easy access to the data
  + Assistance in interpretation

http://www.nap.edu/catalog.php?

The European Network for Earth System Modelling: An Update

Reinhard Budich

IT Strategy and HPC

Max-Planck-Institut für Meteorologie

Hamburg, Germany

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The European Network for Earth System Modelling
ENES

★ Intro and Motivation

★ Some History

★ Scientific projects

★ Infrastructures in Earth System Modelling

– What else than HPC?

– The Infrastructure projects of ENES

- A Roadmap
- Continuous development

★ Conclusions

The European Network for Earth System Modeling ENES

★ Euroclivar Recommendation 1998:

– "a better integration of the European modelling effort with respect to human potential, hardware and software"

★ In 2001 Guy Brasseur helped to found ENES

★ Scientific Board

– S. Joussaume, J.C. André, J. Mitchell, T. Palmer, J. Marotzke, R. Budich, A. Navarra, P. Kabat, B. Lawrence

★ Today about 50 partners

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★ Today about 50 partners

Map and dots not to scale!

The European Network for Earth System Modeling

ENES

★ Partners from Academia, Research Institutions and Industry have signed an agreement to:

- Help in the development and evaluation of state-of-the-art climate and Earth system models,
- Facilitate focused model intercomparisons in order to assess and improve these models,
- Encourage exchanges of software and model results, and
- Help in the development of high performance computing facilities dedicated to long high-resolution multi-model ensemble integrations.

http://ENES.org...

- ★ FP5
  - PRISM
- ★ FP6
  - ENSEMBLES
- ★ FP7
  - METAFOR, COMBINE, EUCLIPSE, EMBRACE, SPECS
- ★ Funding through DG Research

European Research Area

- ★ National funding
  - e.g. UK (NERC); France (INSU); Germany (BMBF) ....
- ★ European Commission funding
  - over the last 30 years, 3-4 projects per year
    - Environmental research projects: ENSEMBLES; COMBINE …
    - Infrastructure projects: PRISM, ...
    - DG Research, ICT
- ★ NEW: Joint Programming Initiative, by EC
  - Long-term coordination and programming between countries for societal challenges

- ★ **JPI Climate :**
  - **Integrate knowledge on climate change for society**
  - **Move towards decadal prediction**
  - **Develop climate services**
  - **Understand societal transformation**
  - **Tools for decision-makers (impact/vulnerability/adaptation)**

ENES: Ideas and Issues

1. Help in the development and evaluation of state-of-the-art climate and Earth system models
   - Ample, easy to use HPC resources
2. Facilitate focused model inter-comparisons in order to assess and improve these models
   - Good metadata, fast networks (disk to disk)
3. Encourage exchanges of software and model results:
   - Co-operation where possible, especially on infrastructure level
   - Networking
4. Help in the development of high performance computing facilities dedicated to long high-resolution multi-model ensemble integrations:
   - „Market development“, interact with the industry

ENES: Ideas and Issues

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All infrastructure issues

http://ENES.org...

★ FP7-Project IS-ENES (InfraStructure for ENES)

- Funding via DG ICT
- Same aims as ENES, but now funded with 7.6 Mio €, 2009-2013
  - Coordinator: Sylvie Joussaume, IPSL, France
    - Tech coordinator: Reinhard Budich
- Networking activities
  - e.g. agree upon long term strategy for ESM, incl. HPC
  - Interface of EU climate community to HPC ecosystem (PrACE, (DEISA,) but also world-wide, e.g. IESP)
- Service activities
  - e.g. portal http://enes.org... for ESM activities, IPCC data nodes
- Joint research activities
  - e.g. performance, data curation or link to the climate impact community

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Last GAend January 2013

Infrastructure Strategy for the European Earth System Modelling Community 2012-2022

- ★ Meetings with ~ 50 participants each
  - Montvillargennes, March 2010
  - Hamburg, Feb 2011
- ★ Writing team
  - J. Mitchell, R. Budich, S. Joussaume, B. Lawrence, J. Marotzke
  - 52 contributors from BE, CZ, DE, DK FI, FR, IT, NO, SE, SP, UK
  - Available from http://enes.org

Infrastructure Strategy Roadmap

Infrastructure Strategy Roadmap

★ Drivers : Science & Society
  – From understanding to the development of “Climate Services”

★ Society
  – Climate Services

★ Key science questions
  – What is needed to provide reliable pre-dictions of regional changes in climate?
  – How predictable is climate ?
  – What is the sensitivity of climate (feedbacks, nonlinear behaviour) ?
  – Can we model and understand glacial-interglacial cycles ?
  – Can we attribute observed signals and understand processes ?

Infrastructure Strategy Roadmap

★ HPC

★ MODELS

★ DATA

★ WORKFORCE

Infrastructure Strategy Roadmap

★ HPC

- Access to world-class HPC
  - Adapted for climate at least
  - Up to dedicated to climate
- Need for an HPC ecosystem integrated over EU & National levels
- Collaborate with PRACE EU Infrastructure

★ MODELS

- Strengthen European collaboration for model development
- Maintain scientific diversity but harmonise technical developments
- Prepare models for future HPC architectures: Exascale
- Improve model parameterisations

Infrastructure Strategy Roadmap

★ DATA
- Integrate distributed databases
- CMIP5 & CORDEX, metadata & common standards
- Large data storage commensurate with HPC
- Develop interoperability with observations
- Develop interface with the impact research communities

★ WORKFORCE
- Strengthen the network: Share developments
- Develop training: Earth System science, computing
- Need for human resources

IS-ENES2

- ★ Developed based on Infrastrcture Strategy Roadmap
- ★ 2013-2016
- ★ Sylvie Joussaume CNSR-IPSL Coordinator
- ★ 24 Institutes, 8 Mio €
- ★ Collaboration with PRACE

Recall (IS-)ENES Objectives

★ In order to better understand and predict climate variability & changes

– Foster the integration of the European ESM community

– Foster the development of ESMs

– Foster high-end simulations

– Foster application of ESM simulations for climate change impact research

IS-ENESn Comparison: Community building

IS-ENES1

★ Strategy
- Roadmap

★ Education
- First prototype of multi-model Summerschool on ESM

IS-ENES2

- Model Evaluation Strategy
- Mid-term update of IS roadmap
- Coop with JPI
- Continuation
- More models?

★ Governance
- Improve dissemination and coordination

IS-ENESn Comparison: Models

IS-ENES1

★ Service
- Model documentation
- NEMO
- OASIS
- CDO / CDI

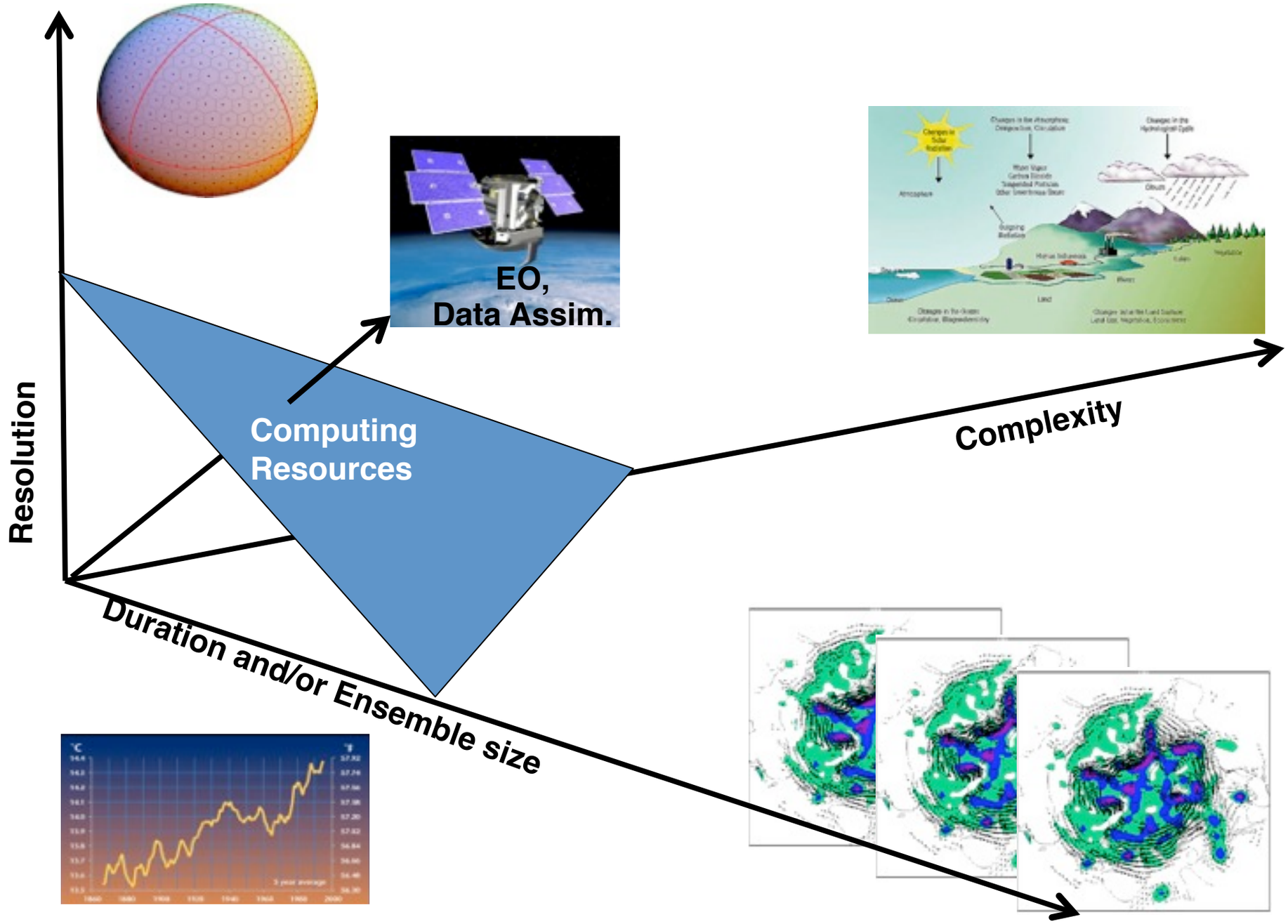
★ Model Evaluation
- Portal developed
- Access to tools and datasets

IS-ENES2

- Enhancement of services on portal
- 7 EU ES models
- to be continued and enhanced

★ Towards next generation models
- Dev of common libs, where science is undisputed
  - Common radiation : MPIM, IPSL & Hadley Centre
- Foster Code/software convergence
- Share best practices for model environments

New element in IS-ENES2: High-end Simulations



Jim Kinter, Modelling Summit 2008

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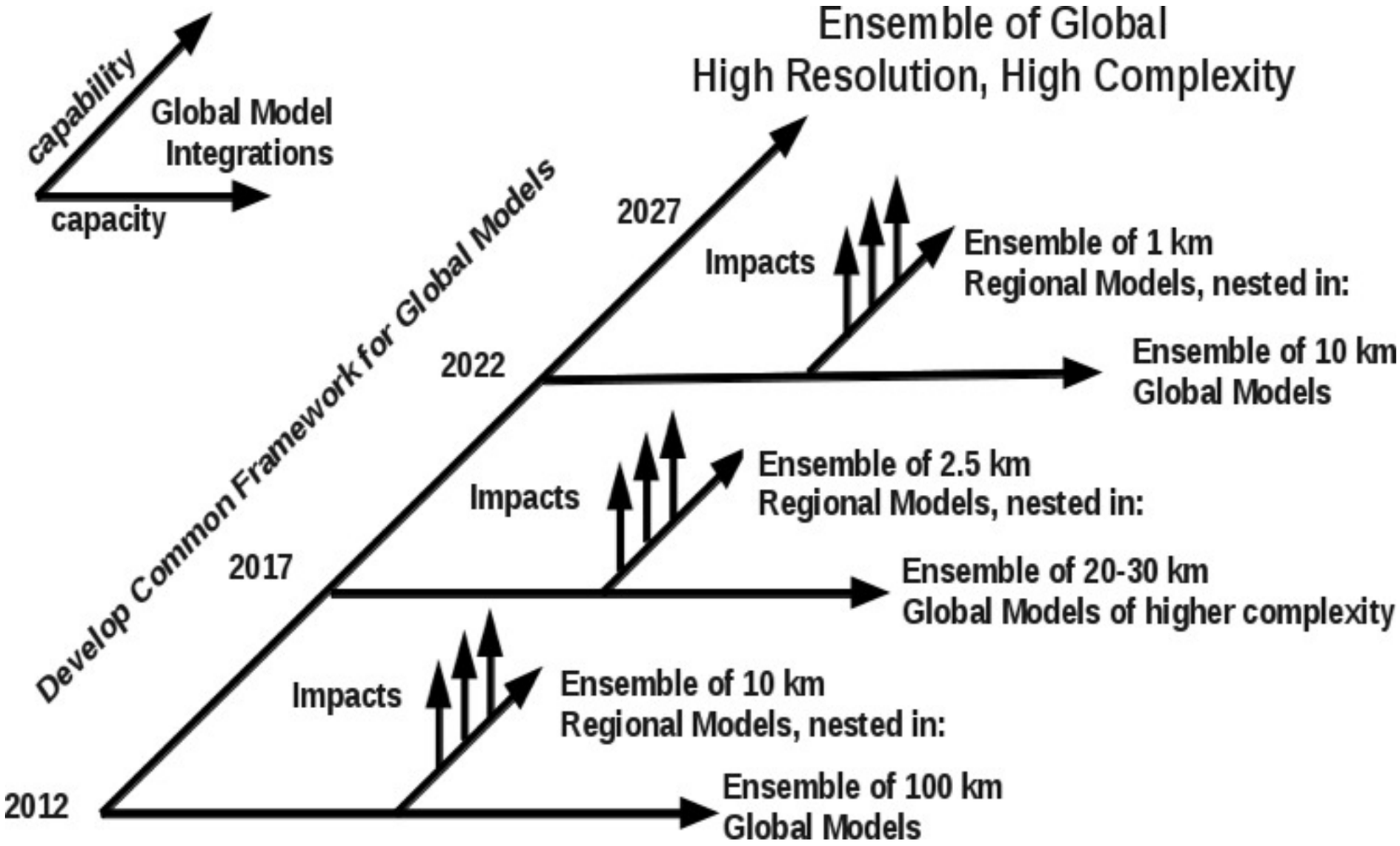

From Infrastructure Strategy Roadmap

IS-ENESn Comparison: High End Simulations

IS-ENES1

- ★ Establish an HPC Task Force
- ★ Enhance the interface with EU large RI: PRACE
  - NCAS 25 km atmosphere simulations: UPSCALE project
- ★ Improve model performance on HPC: I/O, coupler, tests

IS-ENES2

- ★ Prepare future high-end experiments (with SPECS project):
  - multi-member high-resolution simulations (25 km, ocean 0.25°)
  - I/O,
  - coupler (OASIS3-MCT, with Argonne),
  - post-processing issues
  - Develop coupled benchmarks
    - RAPS?

IS-ENESn Comparison: Dissemination of Model Results

IS-ENES1

- ★ Enhance service on modeling results
  - for CMIP5
  - more recently for CORDEX
- ★ Providers :
  - Installation of datanodes
- ★ Users:
  - Information on data access
  - Helpdesk
- ★ Develop more efficient tools (ESGF, co-operation with PCMDI)
- ★ Access to metadata as CIM repository from the METAFOR project
- ★ CLIMATE4IMPACTS:
  - Prototype services for the impact research community
    - Use cases
    - Methodologies

IS-ENES2

- ★ Metadata upgrades & interoperability: follow-up of METAFOR
- ★ Interoperability: Satellite data (collaboration with ESA)
- ★ Observations, reanalyses
- ★ On-line metadata capture
- ★ Upgrades for CIM
- ★ Services for the climate impact research communities
  - tools
  - downscaling methodologies
  - indices
- ★ Societal innovation:
  - Interface with climate service centres
    - co-operation with CSC HH
  - Training for companies
    - co-operation with Climate KIC

Conclusions
Sylvie Joussaume

Conclusions
Sylvie Joussaume

- ★ Growing importance to organise the infrastructure for climate modelling
- ★ IS-ENES
  - – Long-term European Research Infrastructure
  - – Increase efficiency & dissemination by sharing the IS
- ★ Issue next generation climate models
  - – towards a common European strategy ? (JPI Climate)
- ★ Strong drivers/BC
  - – Computing
    - Exascale
  - – Data ("The Tsunami")
    - Metadata
    - Access for interpreters
  - – Society
    - Regional projections
    - Seasonal to decadal predictions
  - – International dimension
    - Contribute to WCRP experiments
    - Data: Participation in ESGF and its governance

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Models, computing and data

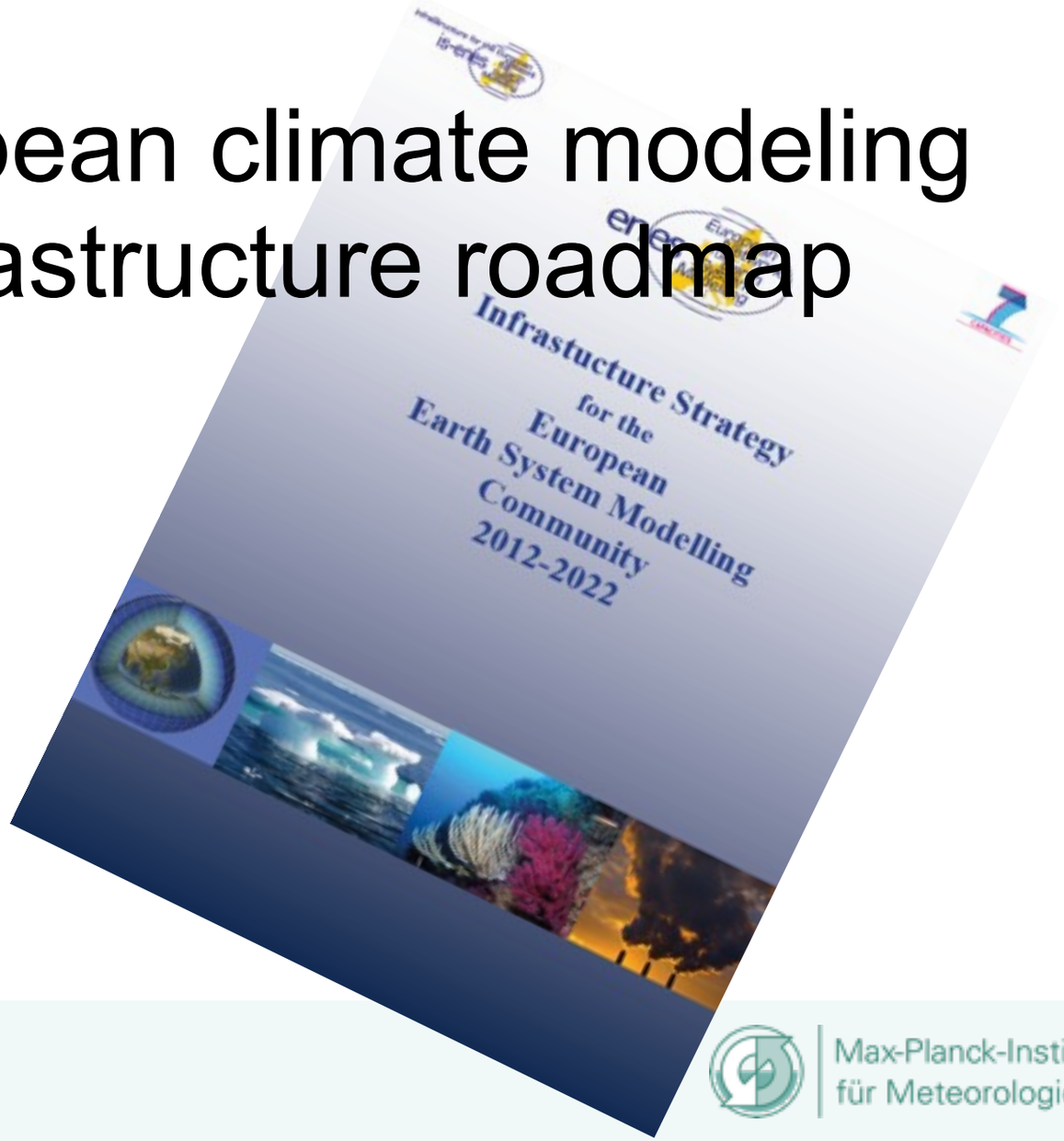
share expertise to better face technological challenges


A NATIONAL STRATEGY FOR
ADVANCING
CLIMATE MODELING
NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES


A NATIONAL STRATEGY FOR
ADVANCING
CLIMATE MODELING
Infrastucture Strategy
for the
European
Earth System Modelling
Community
2012-2022

ENES

★ Not only does the European climate modeling community have an infrastructure roadmap



IS-ENES

★ Not only does the European climate modeling community have an infrastructure roadmap,

★ It also has the projects to help building it

(IS-)ENES

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Thanks!

Questions?