World Meteorological Organization

Weather • Climate • Water

Satellites for Climate Services:
Case Studies for Establishing an Architecture for Climate Monitoring from Space

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with credits to Writing Team and Case Study Contributors

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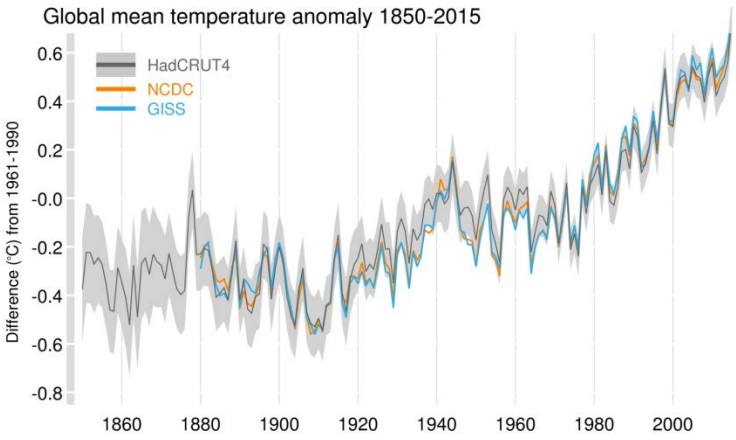
CEOS-CGMS Working Group Climate

VLMG-8, 9-13 May 2016, Barbados

A note on terminology

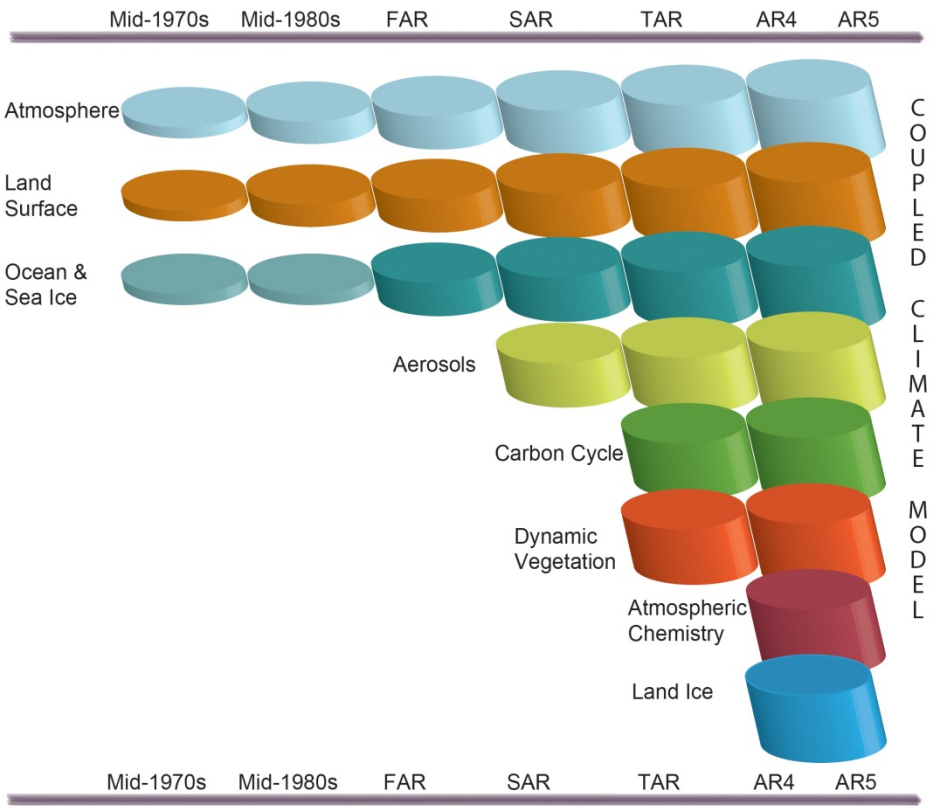
- **Climate : “average weather”**
- Synthesis of weather conditions in a given area, characterized by long-term statistics (mean values, variances, probabilities of extreme values, etc.) of the meteorological elements in that area.

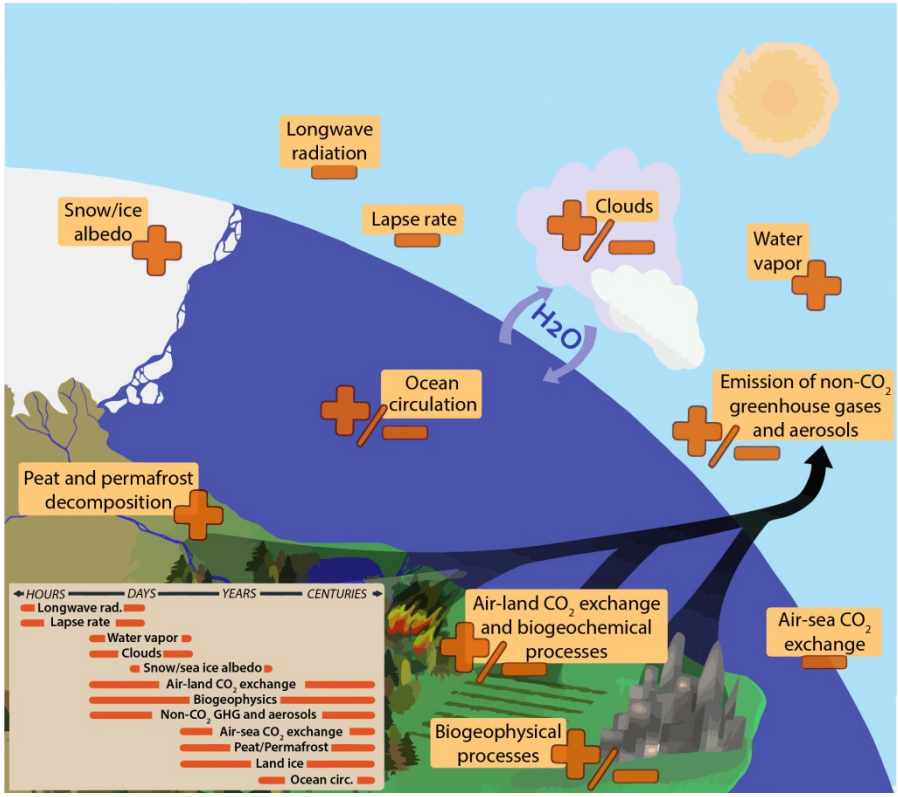
(Int’l Meteorological Vocabulary, WMO No. 182)



Source: Met Office Hadley Centre, UK

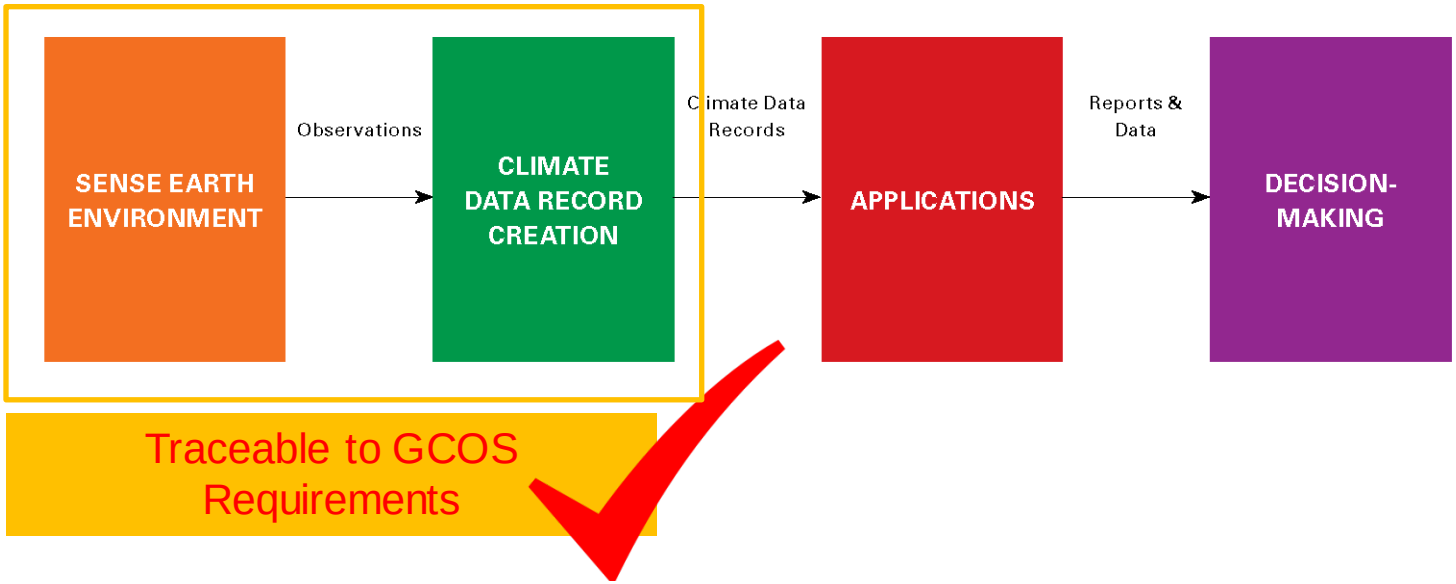
- **Climate : “state of the climate system”**
- Including statistical properties
- Atmosphere, oceans, terrestrial, cryosphere, biosphere





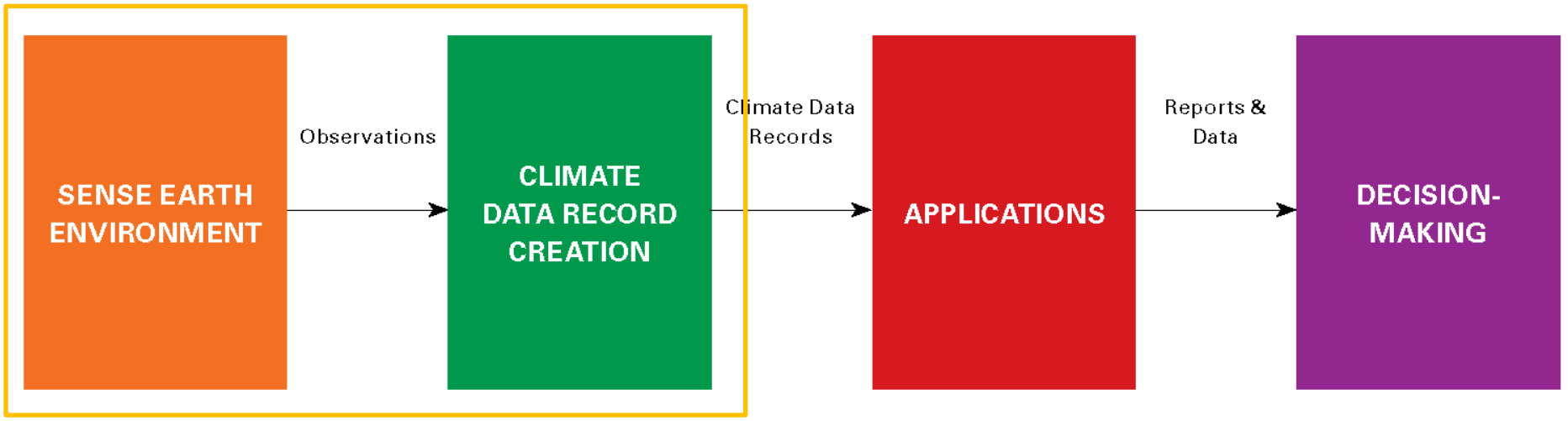
Source: IPCC AR5, WGI

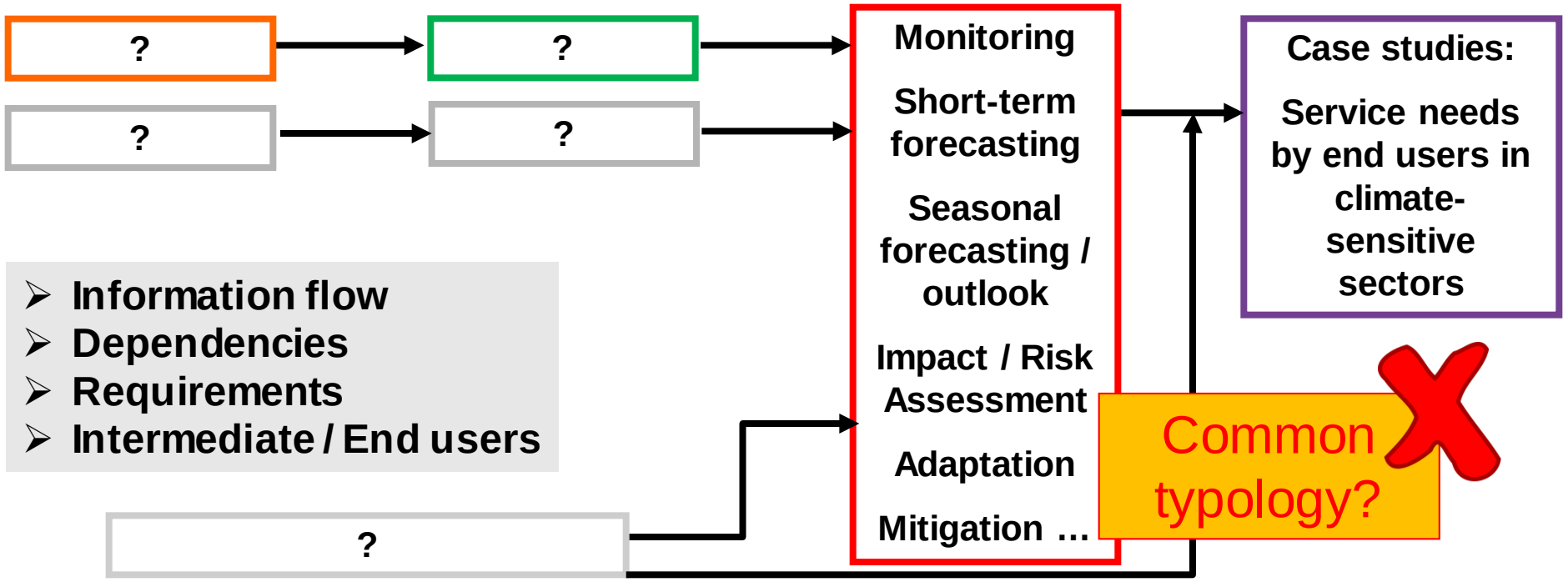
Architecture for Climate Monitoring from Space



- "Strategy Towards an Architecture for Climate Monitoring from Space" (2013) articulated an end-to-end flow of information
- Common terminology, generic functions, dependencies, information flows
- Some major ECV CDR programmes launched around 2010, such as ESA CCI
- WMO Resolution 19 (Cg-XVI, 2011): Development of an Architecture for Climate Monitoring from Space
- Implementation for satellites, by ECV – CEOS-CGMS WG Climate
- Contribution to GFCS Observation and Monitoring pillar
- Applicable to non-satellite datasets

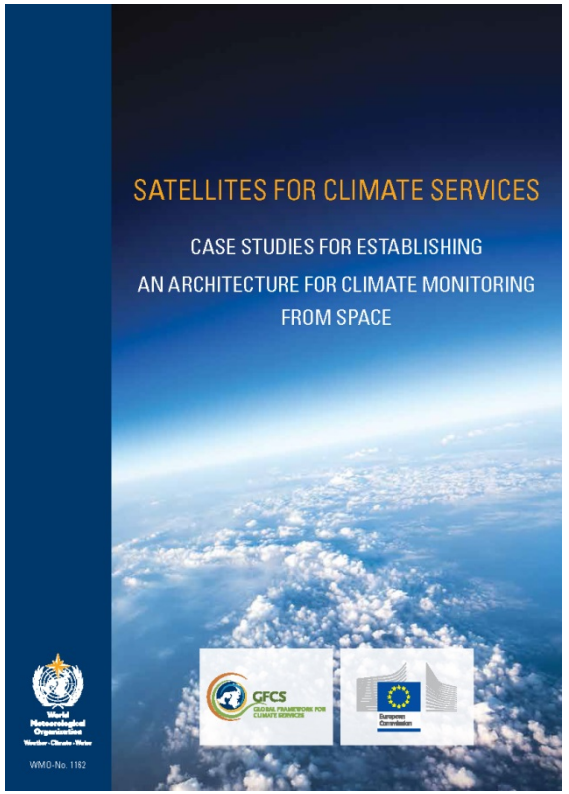
Starting from climate service end users:





Case Studies Report (1)

- Objectives:
  - Validate the Architecture logic starting from the end user, and demonstrate its benefits
  - Investigate how satellite data are used in climate services
  - Better understand information flows, dependencies, requirements
  - Formulate recommendations



GFCS
GLOBAL FRAMEWORK FOR CLIMATE SERVICES

WMO

European Commission

http://library.wmo.int/pmb_ged/wmo_1162_en.pdf

- 13 case studies in areas of

Agriculture and food security	Disaster risk assessment (floods)
Health	Energy
Transport	Ecosystems
Mitigation	Protocol monitoring
Adaptation	

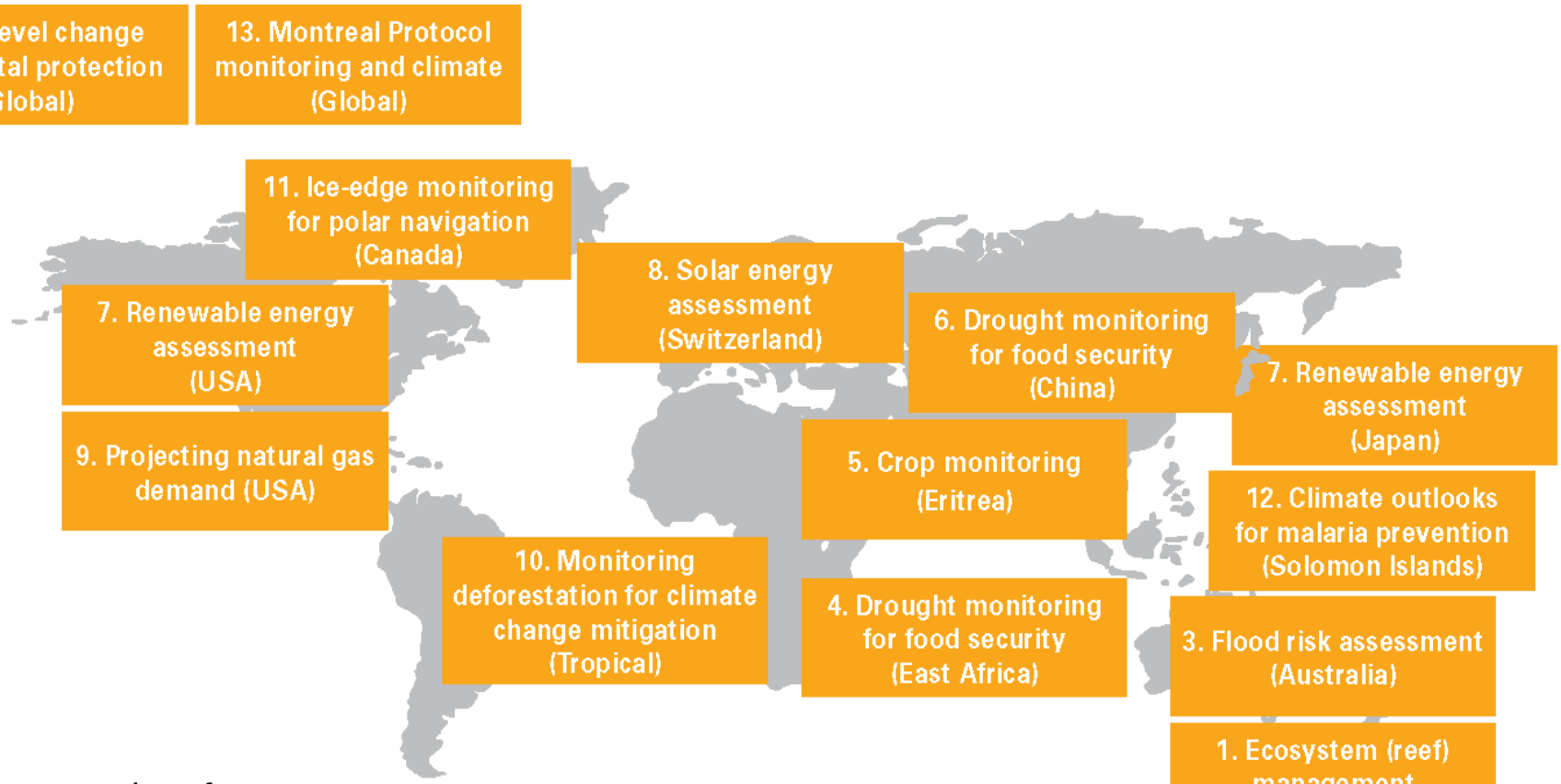
GFCS Priority Areas

Case Studies Report (2)

- Sources:
  - GFCS priority areas
  - European Union key policy areas
  - WMO publication *Climate ExChange*
  - Environmental protocols
  - Existing climate services
  - National and regional climate adaptation policies
  - Communities (e.g, SIDS)
  - Writing team members (see Abstract)

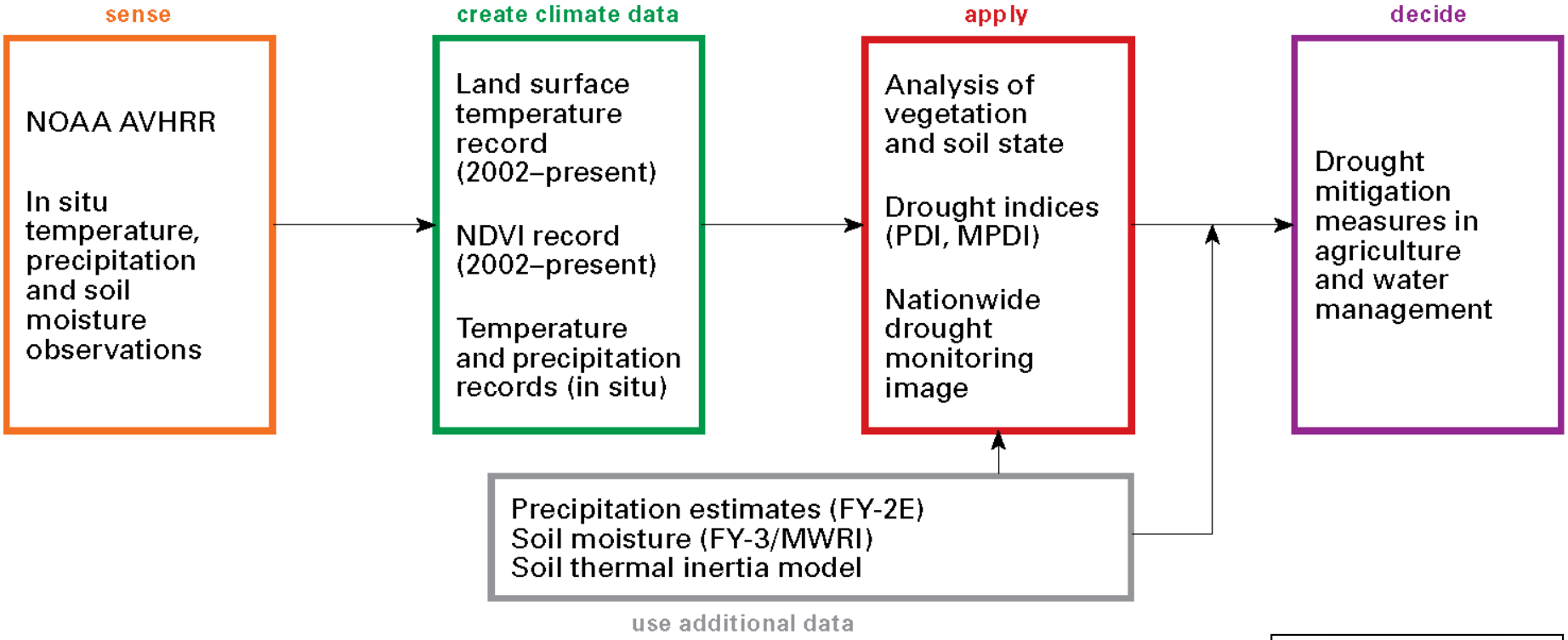
- Defined common template for consistent presentation
- Finalized in Sep 2015
- Presented as draft to WMO 17th Congress, and to UNFCCC COP 21 as part of the CEOS report to SBSTA

Case Studies Overview

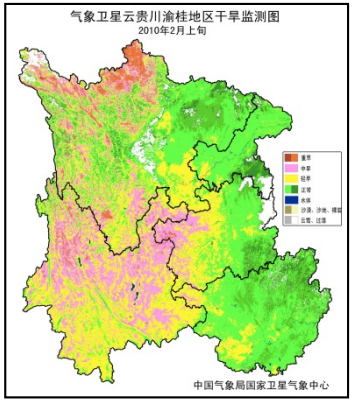


Representation of:
- Climate application and service areas
- Geographical contexts
- Developing and developed countries, and economies in transition
- Global, regional, and local scales

Case Study: Drought monitoring for food security (China)

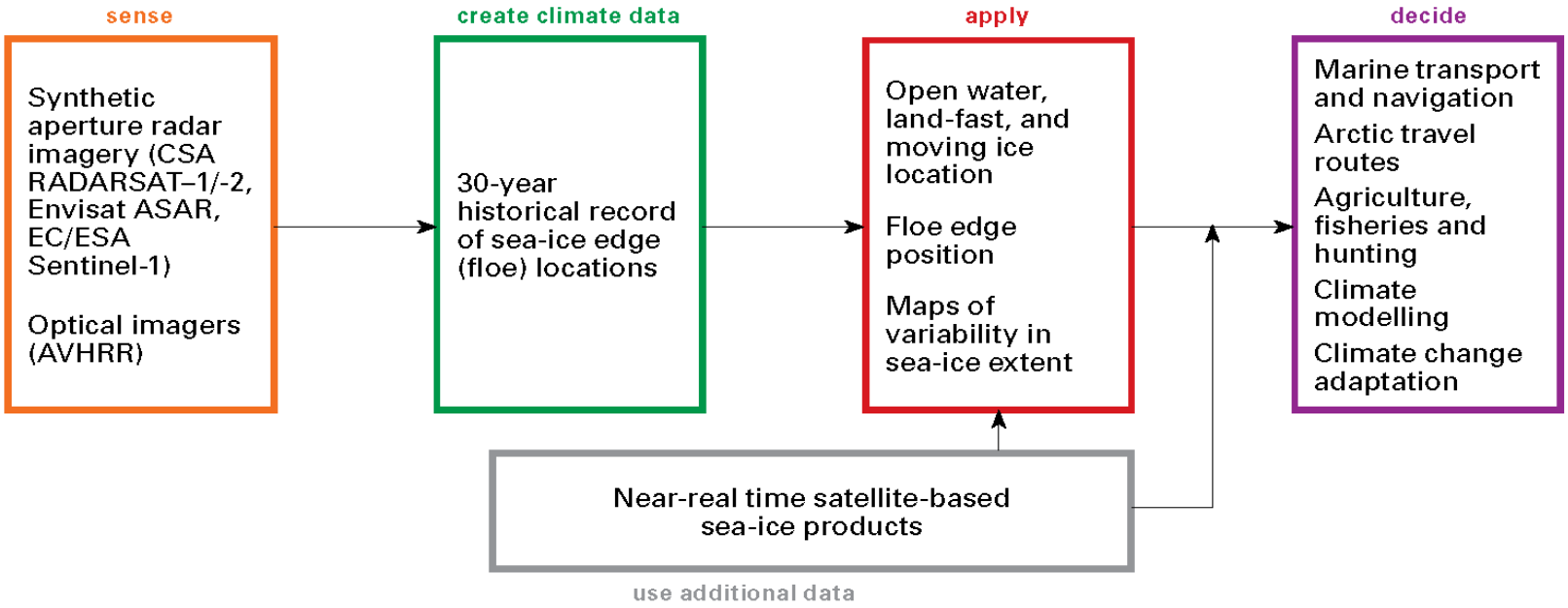


- **Service**: Monitoring of drought indicators (basic mode), generation of additional information in case of drought (special mode)
- **End users:** Decision-making service of CMA; provincial governments and agriculture services
- **Intermediate users:** National Climate Centre; provincial meteo

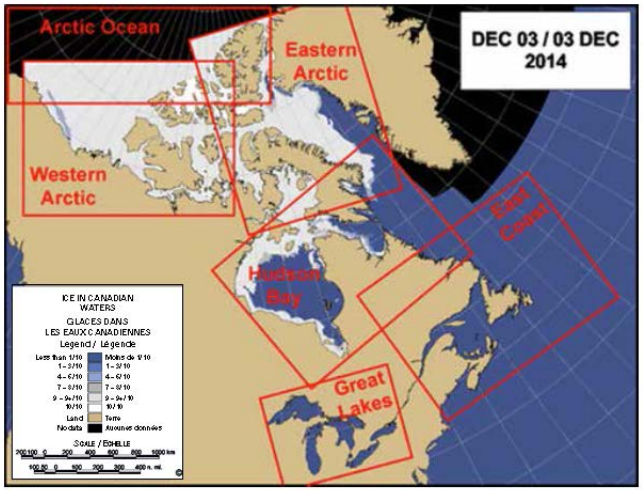


- Combination of satellite CDR and near real-time data needed for this service
- Non-ECV records are relevant

Case Study: Sea-ice edge monitoring for polar navigation (Canada)



- **Service**: Assessment of sea ice conditions in support of Inuit communities' access to safe travel routes and hunting areas
- **End users:** Inuit communities, local government
- **Intermediate users:** Noetix Research Inc., Environment Canada



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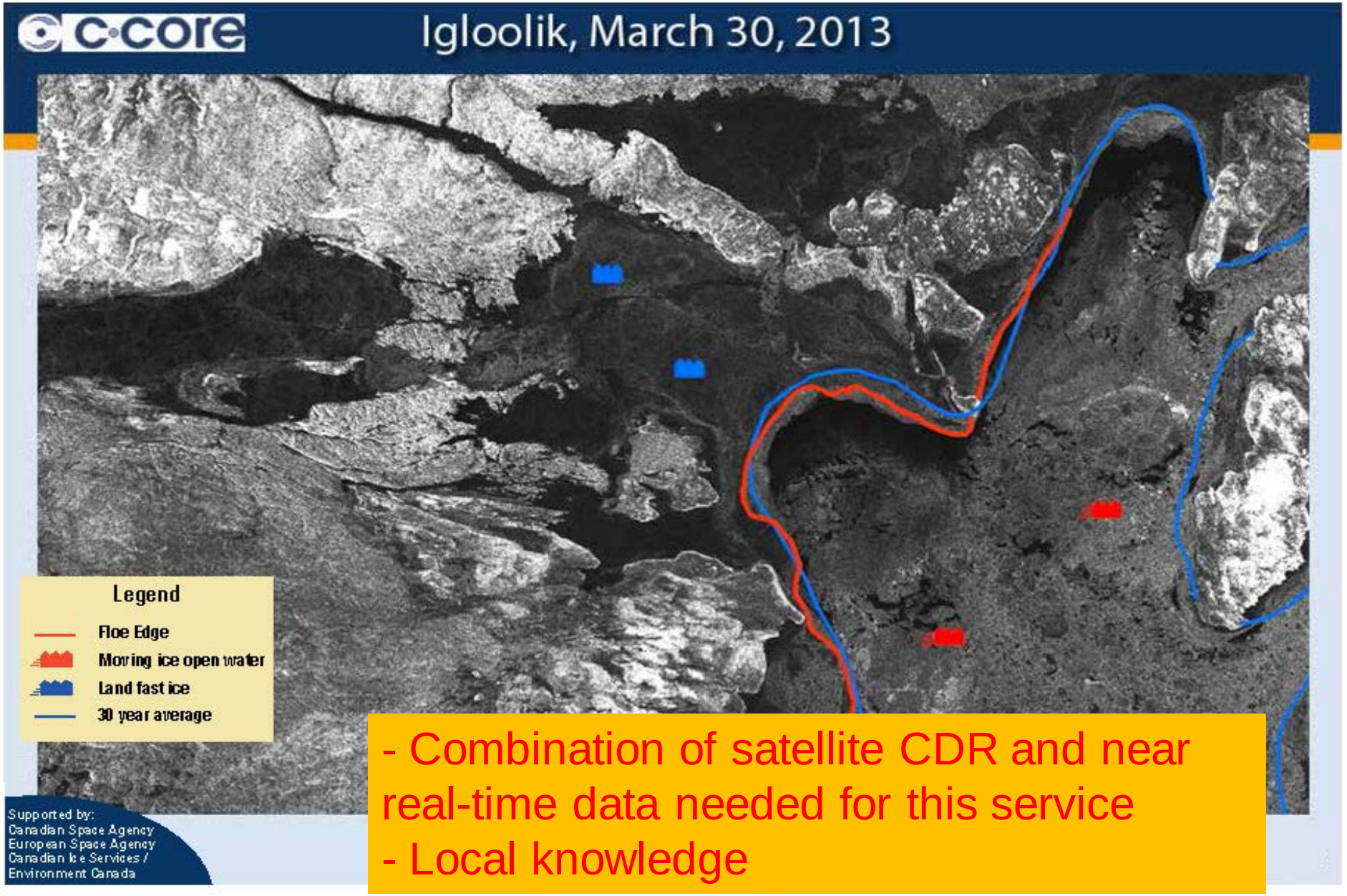
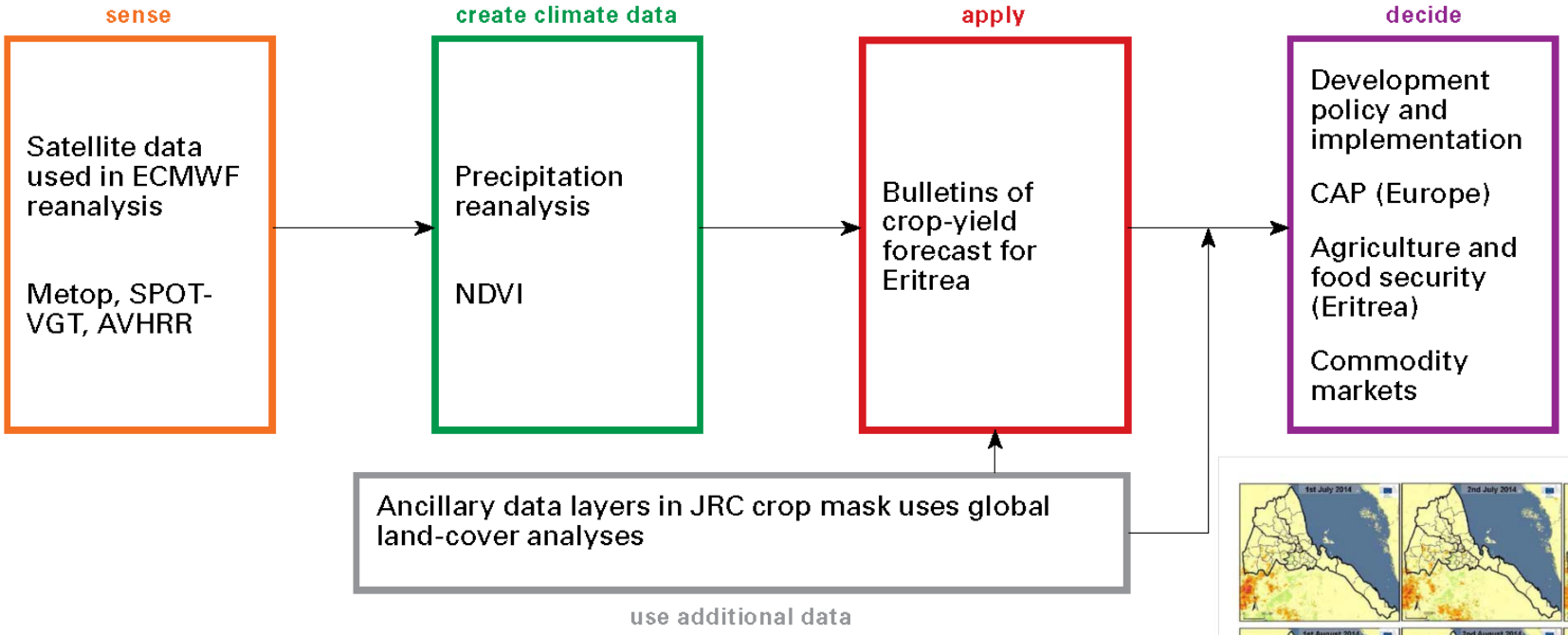
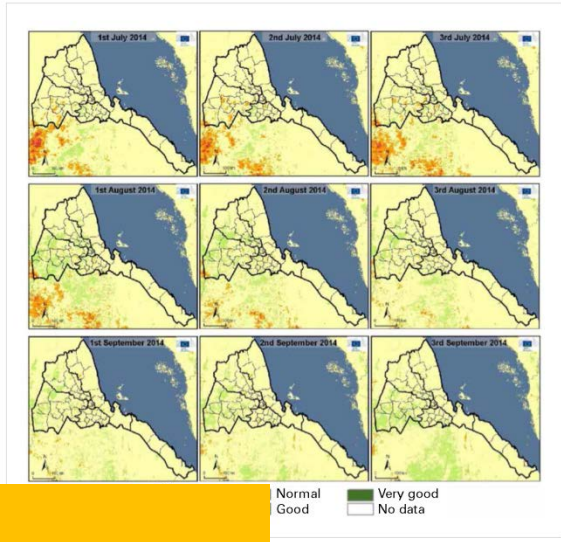


Case Study: Crop monitoring (Eritrea)

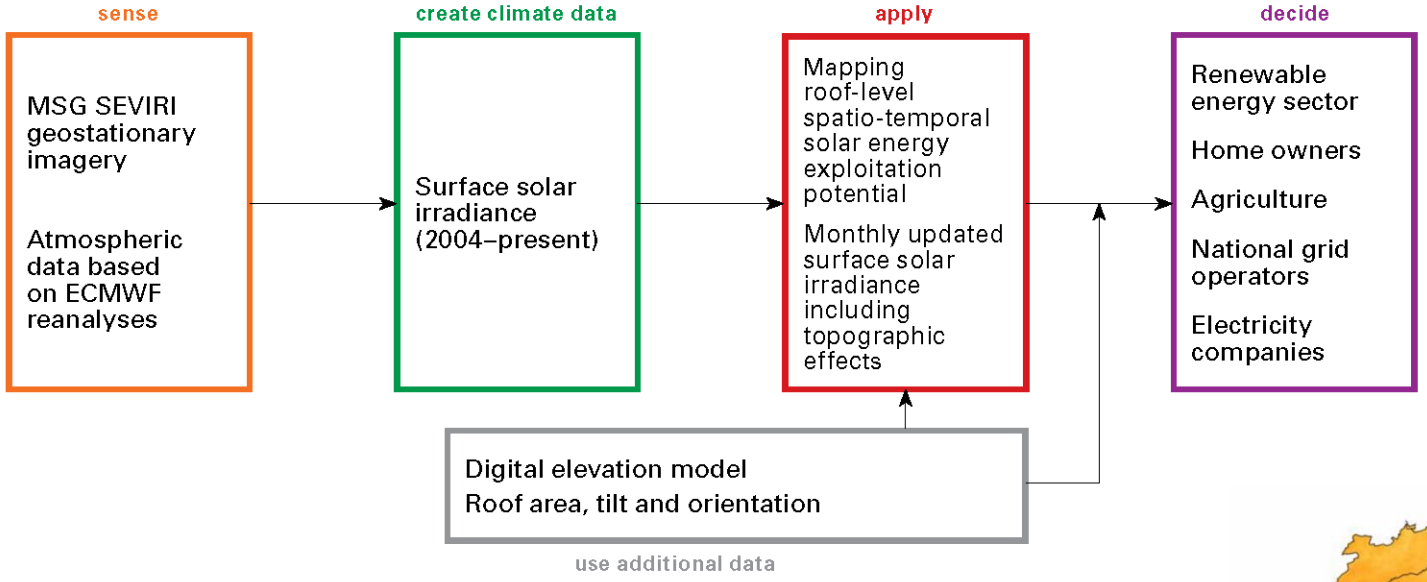




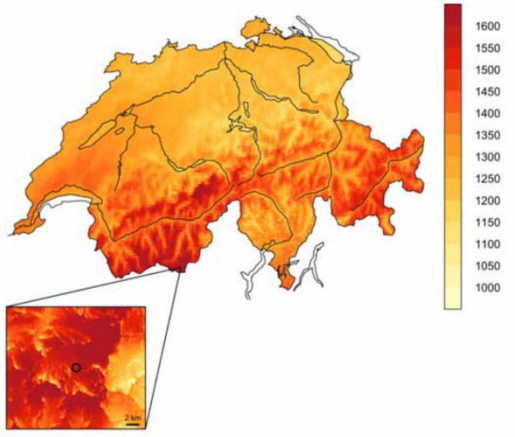
- **Service**: Bulletins of crop yield forecasts
- **End users:** Eritrean institutions; European policy institutions and development aid agencies
- **Intermediate user:** European Commission JRC

- Reanalysis, as user of satellite and other observations, provides basis for service
- Jointly with other sources of information (NDVI, geospatial, situational awareness)

Case Study: Solar energy potential in complex terrain (Switzerland)

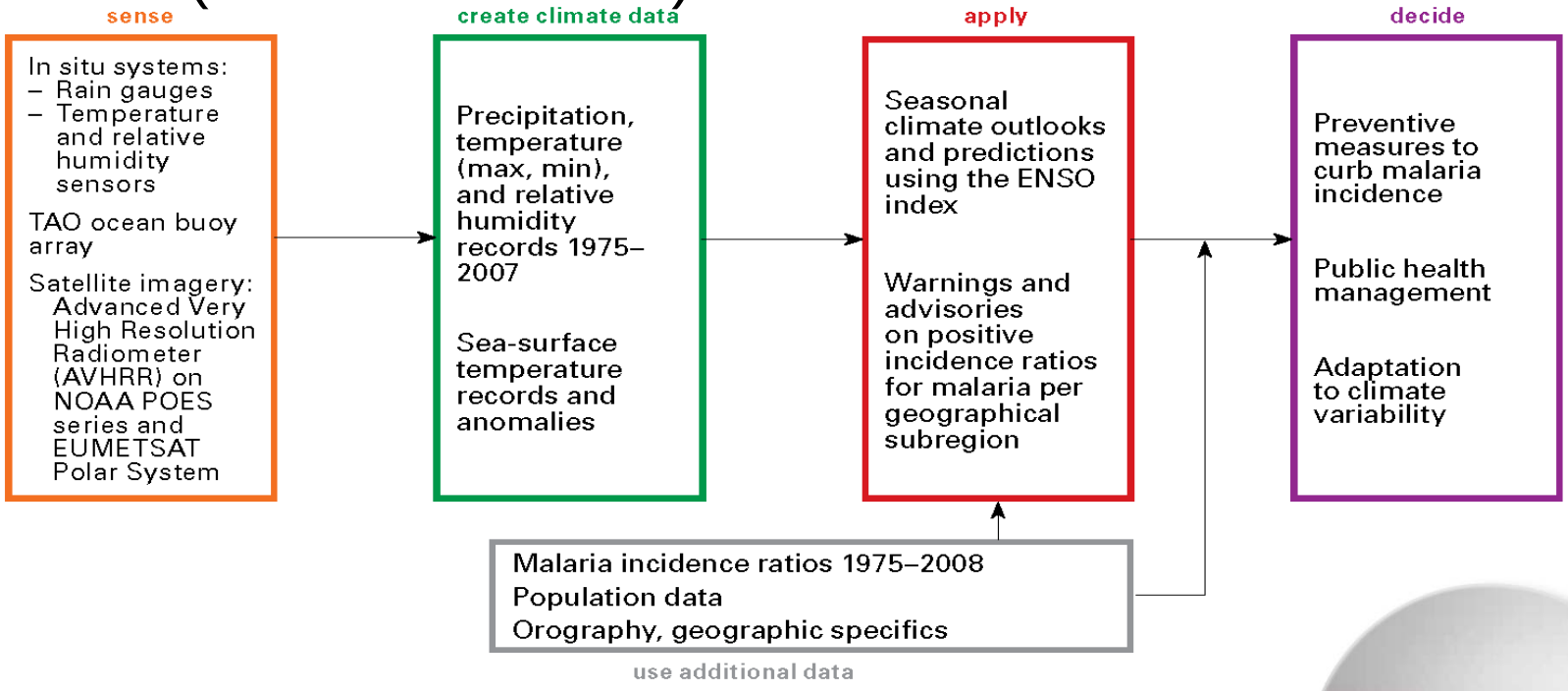


- **Service**: Solar energy mapping including effects of topography and bright surface targets
- **End users:** Renewable energy companies, land use and infrastructure planners, architects, farmers
- **Intermediate user:** Electricity grid operators; government agencies; solar energy businesses



- Operational service based on surface solar irradiance CDR
- Demonstration use of NRT direct and diffuse irradiance

Case Study: Malaria early warning using seasonal outlooks (Solomon Islands)



- **Service**: Early warning system of Malaria incidence using ENSO index
- **End users:** Ministry of health, local public health organizations
- **Intermediate user:** Solomon Islands Meteorological Service

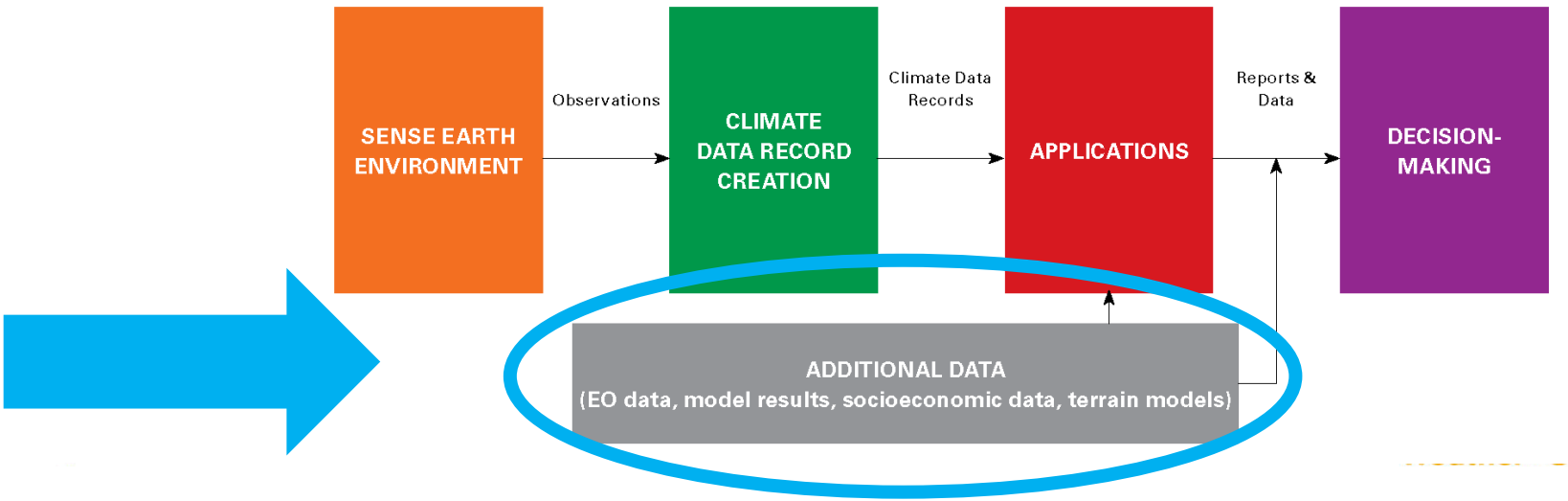
- Prototype service based on ENSO index, local T, precip CDRs, and local socio-economic data

Concluding Remarks

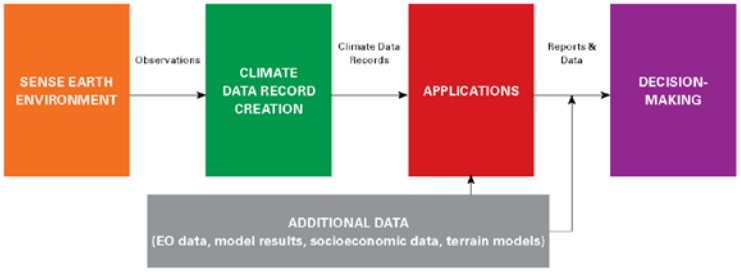
- Case studies show variety and complexity of contexts in which satellite data support climate services

- Satellite-based - and in-situ - CDRs are observation baseline for climate services:
  - Directly (anomalies, …)
  - Indirectly (e.g. through reanalyses which underpin a range of services)

- Other datasets and information sources are critical or very important:
  - Near real-time data, “interim CDRs”, model output, socio-economic data, contextual data, terrain models
  - Not necessarily meeting, or have to meet, “climate” standards



Concluding Remarks



- Architecture overall valid
- To guide coordinated and sustainable generation of CDRs, in:
  - Defining a common approach
  - Positioning activities in a wider context
  - Identifying gaps, and addressing them
  - Communicating with decision-makers
- To trigger research and capacity building in areas of need

Climate information needs and knowledge gaps identified by the
Global Framework for Climate Services Office:

Guideline for designing training programmes ?

Climate information needs of users and related knowledge gaps

Decision-making process and user information gaps

1. **Strategic ahead-of-season planning (1- 12 month lead time)**

2. **Risk monitoring and management: intra-season operations (1wk to 40 days range)**
   - timing/duration/intensity of dry/ wet spells

3. **Longer-term strategic planning/policy development (next 1-10 years)**
   - Trends/frequencies of rainfall/temperature over next 5-10 years

4. **Climate change adaptation policy development/planning (next 50 years)**
   - Robust climate change projections
   - Information on the role of climate change in observed events

Climate Research Frontier

1. **Improving Seasonal prediction**
   - Remote drivers of variability (SSTs, teleconnections, MJO, etc)
   - Local drivers of variability(land-atmosphere coupling)

2. **Sub-seasonal prediction**
   Improved understanding of sources of sub-seasonal predictability

3. **Decadal prediction**
   Drivers of decadal and multi-decadal variability (AMO, PDO)
   Role of aerosols

4. **Climate change scenarios**
   Earth System Modelling
   Attribution methodology
   Understanding Uncertainty

Climate information needs for end users and related knowledge gaps

Decision-making process and end-user information gaps

5 **Assessing current vulnerability due to recent climate events**

Lack of 'impacts' datasets (e.g. crop yields, river flows, health/hospital admission statistics) to aid development and targeting of applications models

6 **Decision making at local scales**

Detailed climate services (geographically)

7 **Estimation of the impacts of climate variability and change**

8 **Mainstreaming climate services for all timescales**

Climate Research Frontier

5 **Observation / database development**

-Enhancing the observations network for both biophysical and socio-economic climate variables;

6 **Downscaling**

- understanding and improvement of the downscaling process
- quantification of benefits and uncertainties to users

7 **Applications modelling**

Improved understanding/ modeling of climate impacts on hydrology, food security and crop yields, health

8 **Communication and climate service provider/user interactions**

- Improving availability/usability of services
- strategies for bridging the gap between service providers and end users

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