C3S Vision

- To be an authoritative source of climate information for Europe
- To build upon national investments and complement national climate service providers
- To support the market for climate services in Europe
C3S Vision

How is climate changing?
- Earth observations
- Reanalysis

Will climate change continue/accelerate?
- Predictions
- Projections

What are the societal impacts?
- Climate indicators
- Sectoral information
European commission
FP7/H2020 activities
Past observations
Modelling + Observations
Other bodies
EU Member States, ESA, EUMETSAT, EEA, WMO, ...
Current observations
Climate Data Store

European commission

Past observations

Current observations

Other bodies
Bespoke Sectoral Information
Evaluation & QC

Constant monitoring, QC and feedback to production / R&D
Copernicus Climate Change Service (C3S)

Outreach

Dissemination

Education

General public

Authorities

Media

Bulletins

Reports

Climate Data Store

Sectoral Information System

Evaluation & QC
C3S Service elements:
Climate Data Store

- Climate Data Store
- Sectoral Information System
- Evaluation & Quality Control
- Outreach & Dissemination
C3S Service elements: Climate Data Store

- Essential Climate Variables for atmosphere, ocean, land and Climate Indicators
  - Observed, reanalysed and simulated
  - In support of adaptation/mitigation policies at global and European level
C3S Service elements: Climate Data Store

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Climate Data Store

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C3S Service elements: Sectoral Information System

- Tailored climate indicators for primary users:
  - Institutional users at European level (EEA, Climate-ADAPT, ...)
  - Science users, innovation and business development

- Data and tools to support public and commercial applications, policy development and strategic planning

~ 30 ECV datasets and ~ 10 sectors to be addressed by 2020-2021
Copernicus Climate Change Services

- WATER MANAGEMENT
- AGRICULTURE & FORESTRY
- TOURISIM
- INSURANCE
- TRANSPORT
- ENERGY
- HEALTH
- INFRASTRUCTURE
- DISASTER RISK REDUCTION
- COASTAL AREAS
C3S Service elements: Evaluation and Quality Control

- Ensures C3S delivers state-of-the-art climate information to end-users
- Identifies gaps in the Service
- Bridges Copernicus with Research Agenda in Europe (e.g. H2020, national research projects)
- Monitors continually, quality of C3S products and services
- “Quality Assurance” body
C3S Service elements: Outreach & Dissemination

- Web content provision & management
  - Coherence throughout C3S, interfaces between service elements, pan-European dimension...
C3S Service elements: Outreach & Dissemination

- Public outreach
  - All media (e.g. press, newsletters, climate impact visuals, twitter, etc.)
  - Annual State of Climate for Europe
  - Downstream service providers
C3S Service elements: Outreach & Dissemination

- Coordination with national outreach efforts
  - On communicating events, findings, etc
  - National workshops
- Liaison with public authorities
  - Communicate C3S products
C3S Service elements: Outreach & Dissemination

- Events (conferences, seminars, etc)
- Training and education
Copernicus Climate Change Service (C3S)

- Bring a unique pan-European dimension to Climate Services
- Build upon, complement and add value to current capabilities in Europe
- Provide a ‘one-stop-shop’ access to quality assured climate information, tools and good practices
- Facilitate uptake and growth of the climate service market
- Cross-cutting role and exploit synergies with other Copernicus services
climate.copernicus.eu

- News and events
- Background information
- Information on tenders
- Proof-of-concept information products
Climate Data Store: The role of ECMWF reanalyses

Global Temperature Relative to 1800-1900 (°C)

The Copenhagen Diagnosis, 2009

Reanalysis integrates data from multiple observing systems into a consistent view of the global climate

Brönnimann et al 2008

Proxy Reconstruction
A1FI
A2
B1
Direct Observations

surface stations (temperature, pressure, wind, radiation, turbidity)
marine observations (sea surface temperature, etc.)

IGY
rockets
radiosonde
ozone sonde
aircraft (chemistry)

cloud obs.
kites

total ozone / remote sensing
in-situ air chemistry

satellites
What is reanalysis and how is it used?

Reanalysis uses modern forecasting tools to re-analyse observations from the past:

• It produces a complete reconstruction of the recent climate based on observations
• It assimilates a large variety of data from in-situ and satellite instruments
• It generates long time series of gridded ECVs that are physically consistent
• It generates very large data volumes: many terabytes, soon petabytes

ECMWF’s ERA-Interim reanalysis:

• Free and open data policy
• Serving > 20,000 registered users
• Cited in > 4,000 scientific papers
• Used in many sectoral applications
• Products are updated continuously
2014 globally the warmest year on record – or not?

Estimates based on station data alone do not account for variability at high latitudes.
Reanalysis provides a truly global view…

- ERA-Interim estimates for 2014 are slightly cooler than those from station data alone
- Mainly due to the Antarctic
- Consistent with independent observations of sea-ice extent
... and a diverse set of climate change indicators

Adrian Simmons (Hoskins@70)
### ERA-Interim

<table>
<thead>
<tr>
<th>Model version</th>
<th>August 2006 (IFS Cy31r2)</th>
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<tbody>
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Does reanalysis satisfy all needs for C3S development?

- Many ECVs cannot (yet?) be reliably estimated from reanalysis data
- The models used in reanalysis require boundary conditions and other constraints derived from observations
- Assessment of uncertainties in ECV data sets requires multiple ‘independent’ estimates from observations
C3S needs for ECV products

- For climate monitoring applications
- As input to model-based reanalyses:
  - Model boundary conditions
  - For data assimilation
- To support uncertainty estimation
C3S funds production aspects, not research

To ensure sustainable service provision:

- Production and updating of ECV datasets
- Monitoring and quality assurance
- Dissemination via CDS and user support
- Short-term system developments
C3S is user-driven

Operational requirements depend on the use cases, but should address:

• Demonstrated scientific quality
• Managed product updates – timeliness
• Maturity/sustainability of production systems
• Reliable and versatile data access
• Documentation and user support
Thank you