

→ UNDERSTANDING CLIMATE CHANGE FROM SPACE

“Scientific evidence for warming
of the climate system is unequivocal.”

Intergovernmental Panel on Climate Change

A GLOBAL CHALLENGE

The rate at which global climate change is happening is arguably the most pressing environmental challenge we face today. The consequences of a warming climate are far-reaching, potentially affecting fresh water resources, global food production and sea level, and triggering an increase in extreme-weather events. Threatening radical impacts on the natural environment and life on Earth for generations to come, climate change is high on political, strategic and economic agendas worldwide.

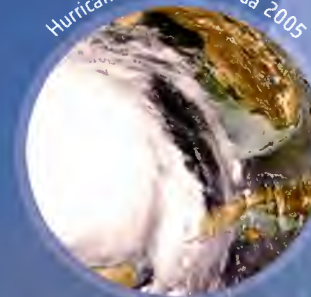
Earth's climate has always varied naturally, so separating natural variability from changes induced by human activity is important for confronting today's challenges. Datasets provided by satellites observing Earth are crucial for measuring key parameters of climate change: 'Essential Climate Variables'.

Satellites not only provide the scientific community with the data to improve our understanding of the Earth system and help to predict future climate, but these data also form the basis on which policy-makers can build the most effective strategies for adapting to and mitigating the effects of a changing climate.

Collapse of Wilkins Ice Shelf, Antarctica 2009



Hurricane Katrina, Florida 2005

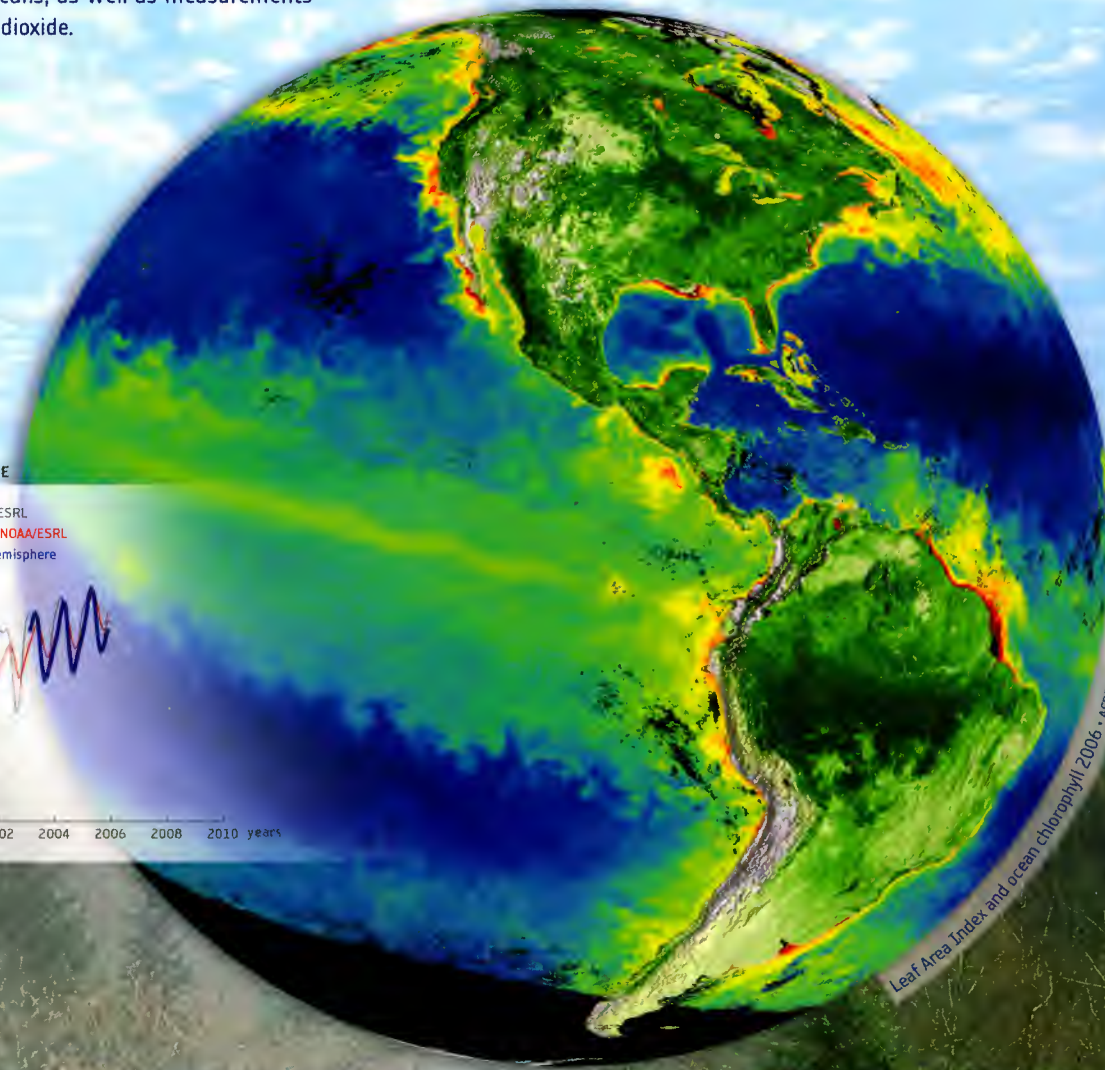


Forest fires, California 2004

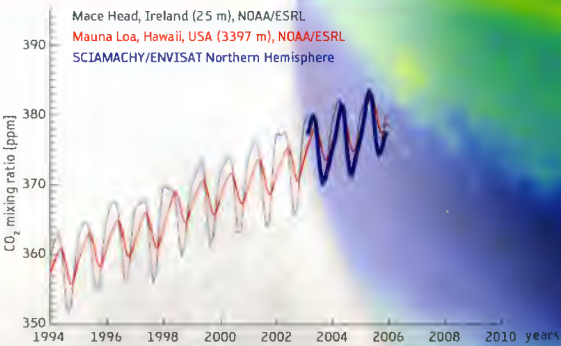


COUNTING CARBON

ESA's Climate Change Initiative will ensure the long-term generation of data on climate variables for more accurate carbon modelling. This includes mapping the amount of vegetation on land and chlorophyll concentration in the oceans, as well as measurements of atmospheric carbon dioxide.



ATMOSPHERIC CARBON DIOXIDE



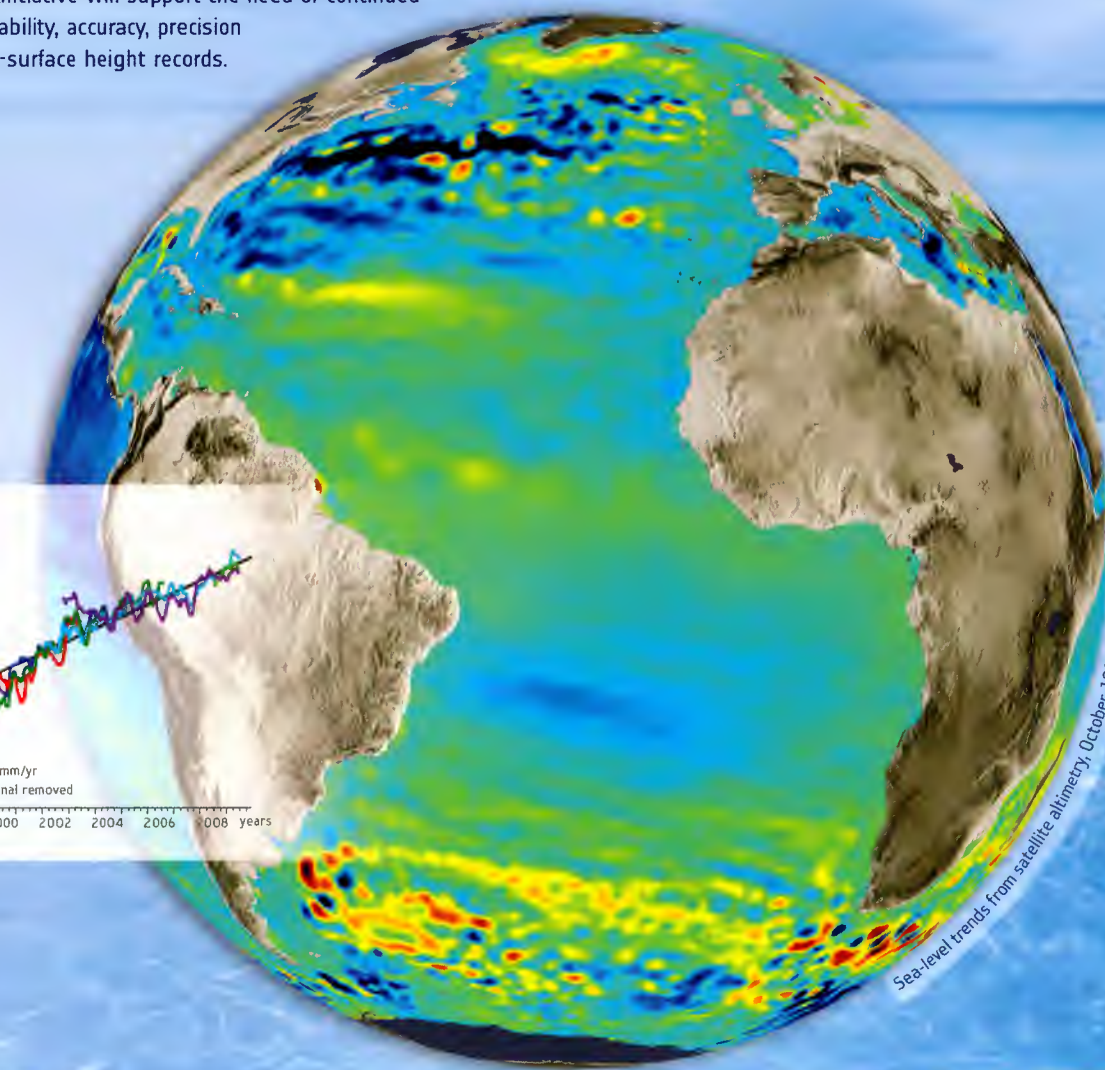
Leaf Area Index and ocean chlorophyll 2006 • ACRIST/DNES/ESA/GeoEye/MASAVITO

Global increases in CO₂ concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution."

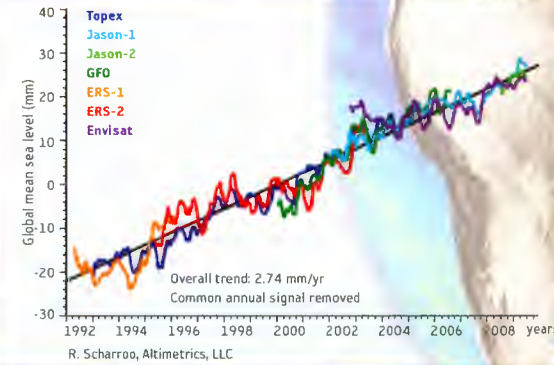
Climate Change 2007: Synthesis Report – Intergovernmental Panel on Climate Change

AN OCEAN OF CHANGE

Change in sea-surface height is considered to be a primary indicator of global climate change. Building on the most accurate and best calibrated long-term observations, possible only from space, ESA's Climate Change Initiative will support the need or continued improvement to the stability, accuracy, precision and consistency of sea-surface height records.



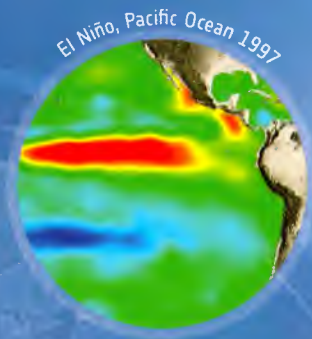
GLOBAL MEAN SEA LEVEL



Sea-level trends from satellite altimetry: October 1992 – January 2008 • CLS/LEGOS/ENES

Global average sea level has risen since 1961 at an average rate of 1.8 [1.3 to 2.3] mm/yr and since 1993 at 3.1 [2.4 to 3.8] mm/yr."

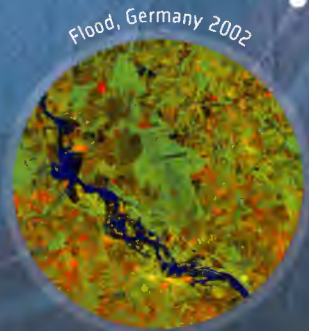
Climate Change 2007: Synthesis Report – Intergovernmental Panel on Climate Change



El Niño, Pacific Ocean 1997



Deforestation, Brazil 2001



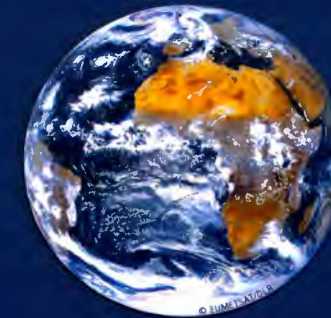
Flood, Germany 2002

A EUROPEAN RESPONSE

Rising to the challenges of climate change, ESA and its Member States are developing initiatives to address issues related to a changing world. Working with partners in the Group on Earth Observations (GEO), ESA's Climate Change Initiative will exploit robust long-term global records of Essential Climate Variables. These data are required by the Global Climate Observing System (GCOS) to support the United Nations Framework Convention on Climate Change (UNFCCC) and the International Panel on Climate Change (IPCC).

Data from archives going back three decades from ESA and Member-State satellites, combined with data from new missions, will be used to produce information on a wide range of climate variables such as greenhouse-gas concentrations, sea-ice extent and thickness, and sea-surface temperature and salinity, to name but a few. The Climate Change Initiative promises to be an extremely effective mechanism for providing Earth observation datasets to the science community and governing bodies for understanding and managing climate change.

Global data for global problems



Over the last decades, satellites observing Earth from space have been providing an ever-clearer picture of the health of our planet and the signs of climate change. The need for sustained global observations has long been recognised by the UNFCCC, and recently articulated in terms of requirements for 'Essential Climate Variables' by GCOS.

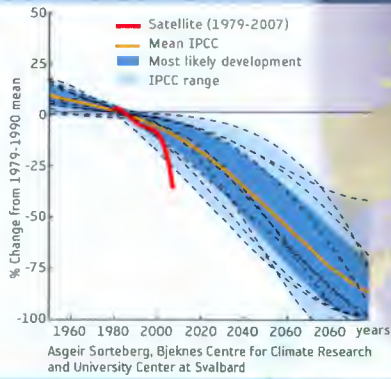
ESA's Climate Change Initiative will make full use of Europe's Earth observation space assets, including the GMES Sentinel missions. Through this new strategy, long-term datasets on key indicators of climate change will be systematically generated and preserved. This will provide Europe with a powerful tool to monitor the state of the climate system and to help predict the effects that a changing climate may bring.

ICE SIGNALS

Over the last 25 years, satellites observing the Arctic have witnessed a reduction in the thickness and extent of summer sea ice. Thanks to the ERS and Envisat satellites, ESA Earth observation data collected over the Arctic since 1991 will be exploited in the Climate Change Initiative. New satellites such as ESA's CryoSat mission and the Sentinels will ensure continued observations of the polar regions.



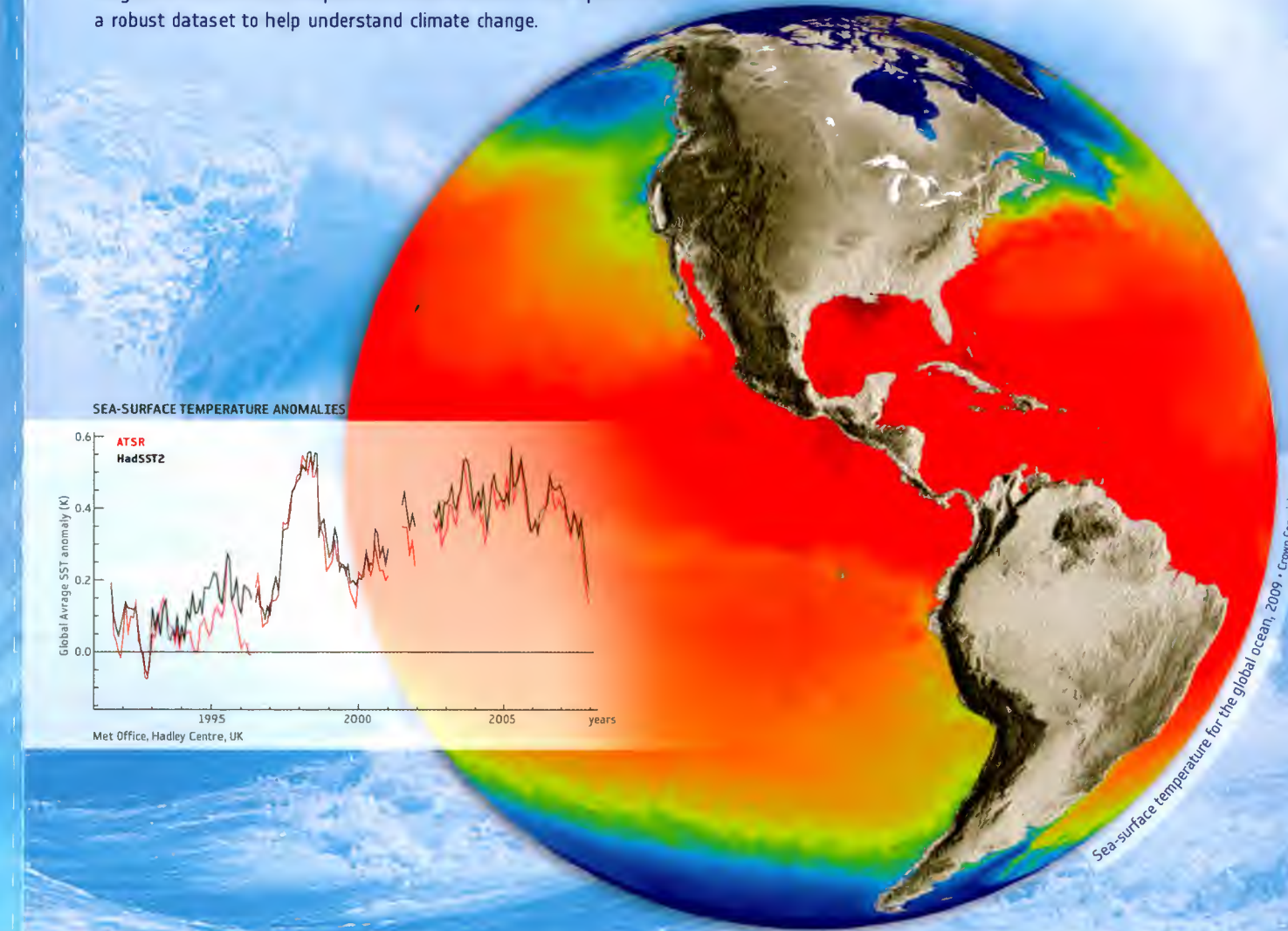
SEA-ICE REDUCTION IN COMPARISON TO IPCC MODELS



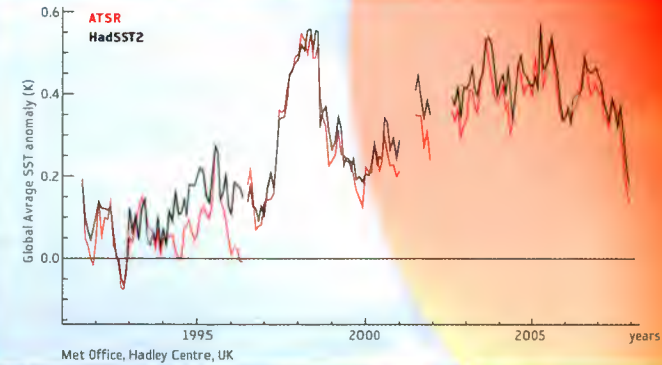
Arctic sea-ice cover 2007 from Envisat ASAR, ESA

ANSWERS FROM THE OCEAN

Long-term tracking of sea-surface temperature provides a reliable indication of global temperature rises. The Climate Change Initiative will capitalise on ESA's experience in gathering, collating and archiving long-term sea-surface temperature measurements from space to ensure a robust dataset to help understand climate change.



SEA-SURFACE TEMPERATURE ANOMALIES



Sea-surface temperature for the global ocean, 2009, Crown Copyright 2009

"Satellite data since 1978 show that annual average Arctic sea-ice extent has shrunk by 2.7 [2.1 to 3.3] % per decade."

Climate Change 2007: Synthesis Report – Intergovernmental Panel on Climate Change

"Global ocean heat content has increased since the late 1950s, the period for which adequate observations of sub-surface ocean temperatures have been available."

Climate Change 2001: Working Group I: The Scientific Basis – Intergovernmental Panel on Climate Change