Sharing is encouraged

Destinations of Climate Monitoring information: State of the Climate reports

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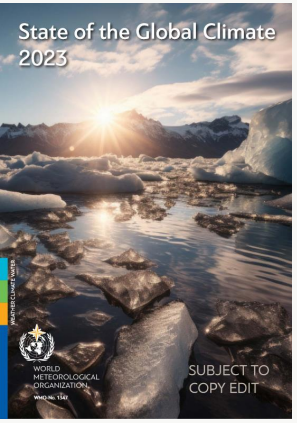
State of the Climate reports

WMO State of the Global Climate

Led by WMO with UN partners

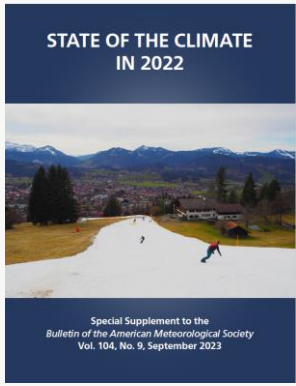


- Three sections:
  - Key climate indicators
  - High-impact events
  - Socio-economic impacts
- Focus on putting past year into long-term context
- Provisional report released at COP to formally enter into UNFCCC process
- Global and regional reports

BAMS State of the Climate

Led by NOAA NCEI

- Most comprehensive annual report on the status of the Earth's climate system
  - What occurred in the year?
  - How does that fit with the long-term record?
  - What is the long-term record?
  - How (well) did we observe it?
- Forms climate "almanac"



Come talk to me about what the reports contain and how to get involved!

WMO State of the Global Climate

BAMS State of the Climate

BAMS SotC: Global Climate Chapter

Lead Editor - Robert Dunn (UKMO)

In 2023 (focussing on events and conditions in 2022):

- 32,000 words
- 220 authors
- 81 figures
- 7 domains covering 42 observables:
  - Temperature, Cryosphere, Hydrological Cycle, Atmospheric Circulation, Radiation, Atmospheric Composition, Land Surface Properties

Annual anomaly maps from 2022 report from most of the observed variables are shown in the following slides

EGU Abstract

Sharing is encouraged

Previous section | Previous slide | Home | Last viewed | Next slide | Next section

WMO State of the Global Climate

Home / Publication Series / State of the Global Climate 2023

State of the Global Climate 2023

PUBLICATION

19 March 2024

AdobeStock / vitaliymateha

The State of the Global Climate 2023 report shows that records were once again broken, and in some cases smashed, for greenhouse gas levels, surface temperatures, ocean heat and acidification, sea level rise, Antarctic sea ice cover and glacier retreat.

Home / Publication Series / State of the Global Climate 2022

State of the Global Climate 2022

PUBLICATION

21 April 2023

The WMO State of the Global Climate report 2022 focuses on key climate indicators – greenhouse gases, temperatures, sea level rise, ocean heat and acidification, sea ice and glaciers. It also highlights the impacts of climate change and extreme weather.

- Drought, floods and heatwaves affect large parts of the world and the costs are rising
- Global mean temperatures for the past 8 years have been the highest on record
- Sea level and ocean heat are at record levels – and this trend will continue for many centuries
- Antarctic sea ice falls to lowest extent on record
- Europe shatters records for glacier melt

Home / Publication Series / State of the Global Climate 2021

State of the Global Climate 2021

PUBLICATION

18 May 2022

AdobeStock/prirach

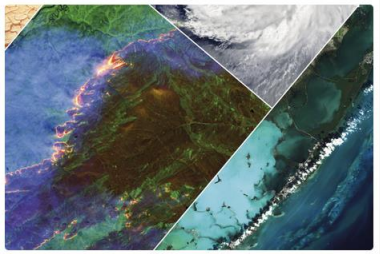
The WMO State of the Global Climate in 2021 report confirmed that four key climate change indicators – greenhouse gas concentrations, sea level rise, ocean heat and ocean acidification – set new records in 2021. This is yet another clear sign that human activities are causing planetary scale changes on land, in the ocean, and in the atmosphere, with harmful and long-lasting ramifications for sustainable development and ecosystems.

Home / Publication Series / State of the Global Climate 2020

State of the Global Climate 2020

PUBLICATION

19 April 2021



Extreme weather combined with COVID-19 in a double blow for millions of people in 2020. However, the pandemic-related economic slowdown failed to put a brake on climate change drivers and accelerating impacts.

The report on the State of the Global Climate 2020 documents indicators of the climate system, including greenhouse gas concentrations, increasing land and ocean temperatures, sea level rise, melting ice and glacier retreat and extreme weather. It also highlights impacts on socio-economic development, migration and displacement, food security and land and marine ecosystems.

Home / Publication Series / State of the Global Climate 2019

State of the Global Climate 2019

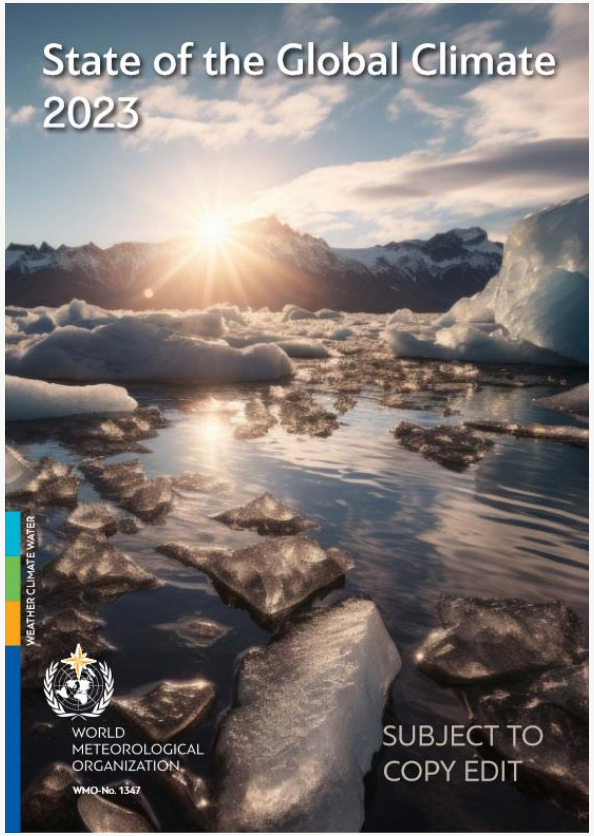
PUBLICATION

09 March 2020

The tell-tale physical signs of climate change such as increasing land and ocean heat, accelerating sea level rise and melting ice are highlighted in a new report compiled by the World Meteorological Organization and an extensive network of partners. It documents impacts of weather and climate events on socio-economic development, human health, migration and displacement, food security and land and marine ecosystems.

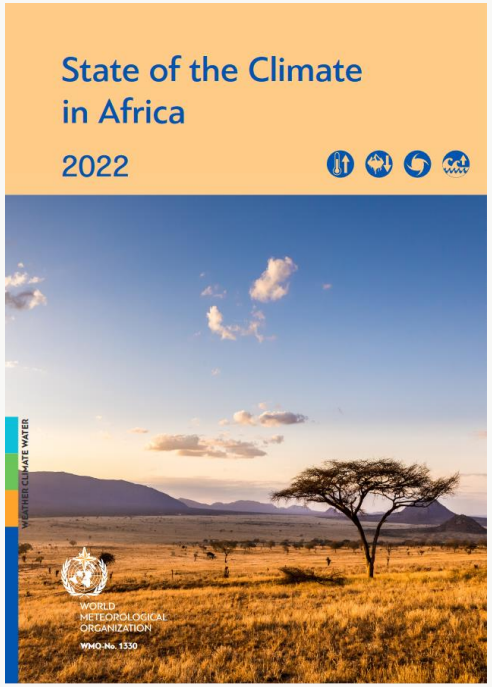
WMO State of the Global Climate (SoGClimate)

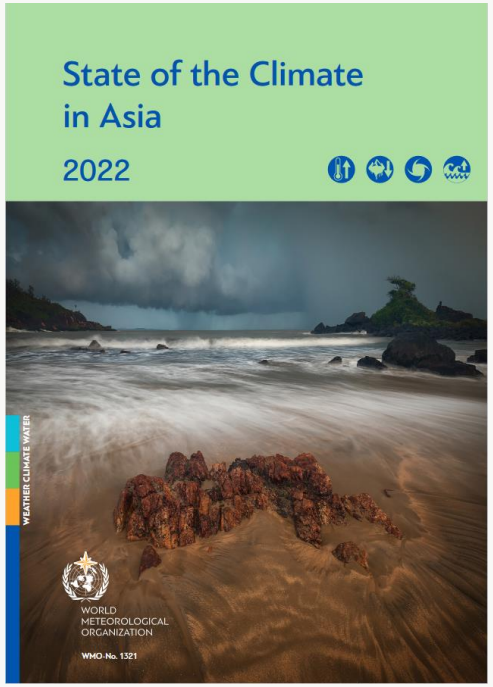
- Series of Global reports has been running for 31 years
- Based on inputs from:
  - WMO Members (79 in 2023) - survey on high-impact events, review
  - Experts (87 in 2023) - provide input on key indicators, review
  - UN Agencies (6 in 2023) - provide summary of broader socio-economic impacts, review
- Based on established methods and previously published information
- WMO Expert Team on climate monitoring and assessment oversees the reports
- Provisional reports launched at COP and feeds into UNFCCC process and negotiations, usually November or December
- Final report launched on World Met Day, 23 March

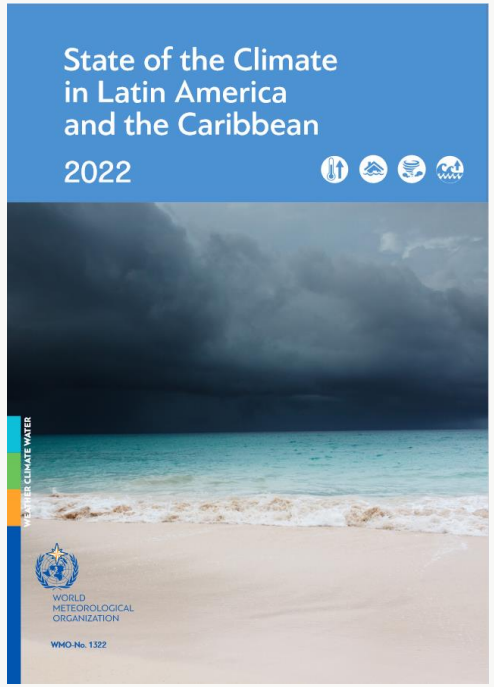


WMO SoGClimate – Regional Reports

- Regional reports for WMO Regional Associations since 2019:
  - Africa, Asia, Latin America and the Caribbean, Southwest Pacific, and Europe.
  - Released later in the year than the global report
  - Includes sections on enhancing climate adaptation and resilience







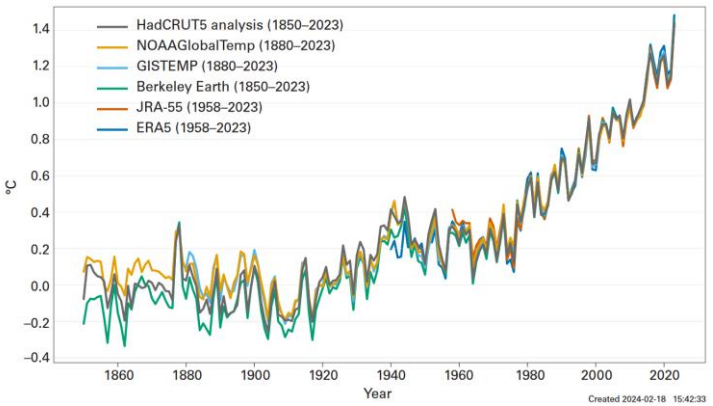
WMO State of the Global Climate - Survey

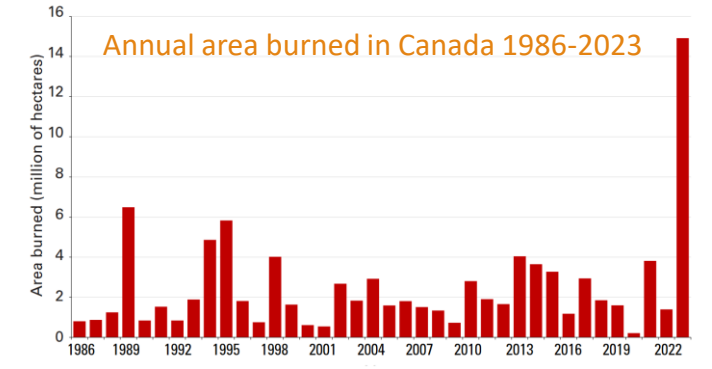
- Process is currently being renovated
- Looking for feedback on the reports and processes
  - Please do fill out the survey linked from the QR code
- If you are interested in getting involved, let us know:
  - jjk8932@googlemail.com
    (John Kennedy, scientific coordinator)

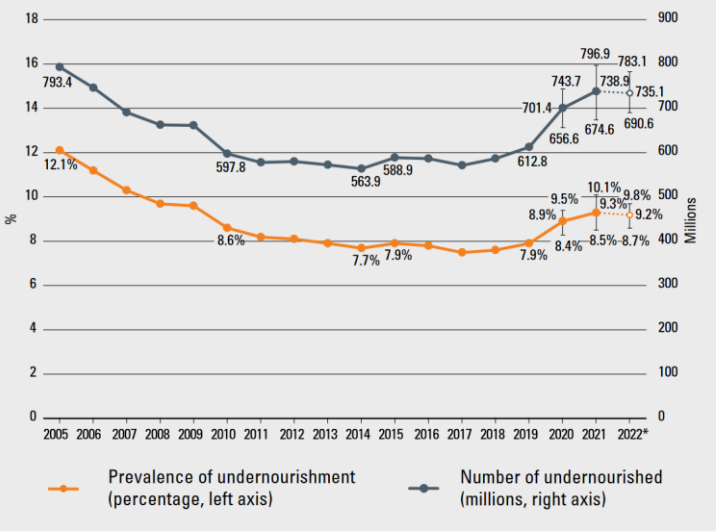
Take Our Survey
~5-10 mins

WMO SoGClimate - Structure

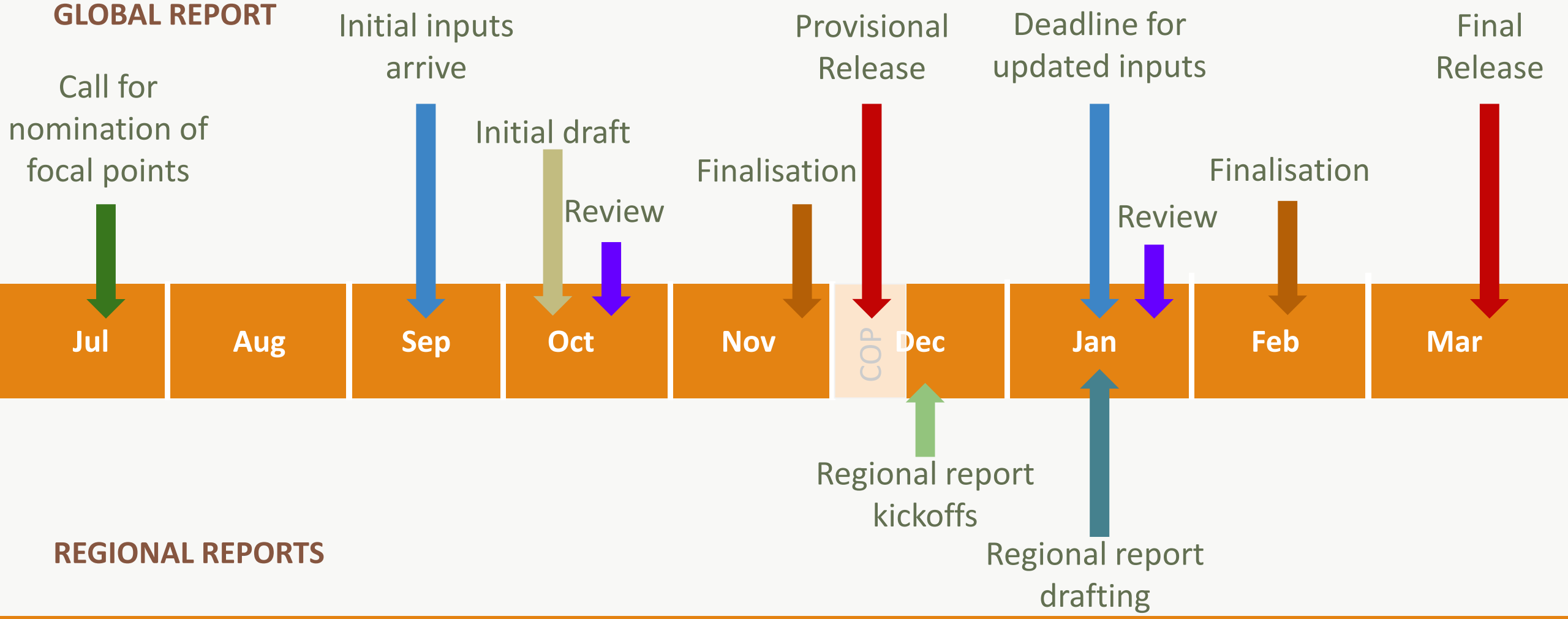
- Key indicators
  - Greenhouse gases, Global temperature [*top*], Ocean heat, Sea level, Ocean pH, Sea ice, Glaciers
  - Uses established methods and datasets
- High-impact events
  - Info provided by countries via online survey
  - Report focuses on a small number of highest-impact events
  - Extreme events supplement and map provide wider range
- Socio-economic impacts
  - Input from UN agencies
  - Focusing on food security (FAO [*bottom*], WFP), displacement (UNHCR, IOM), environmental impacts (UNEP), and disaster risk reduction (UNDRR)
- Consistency of information and data across global and regional reports



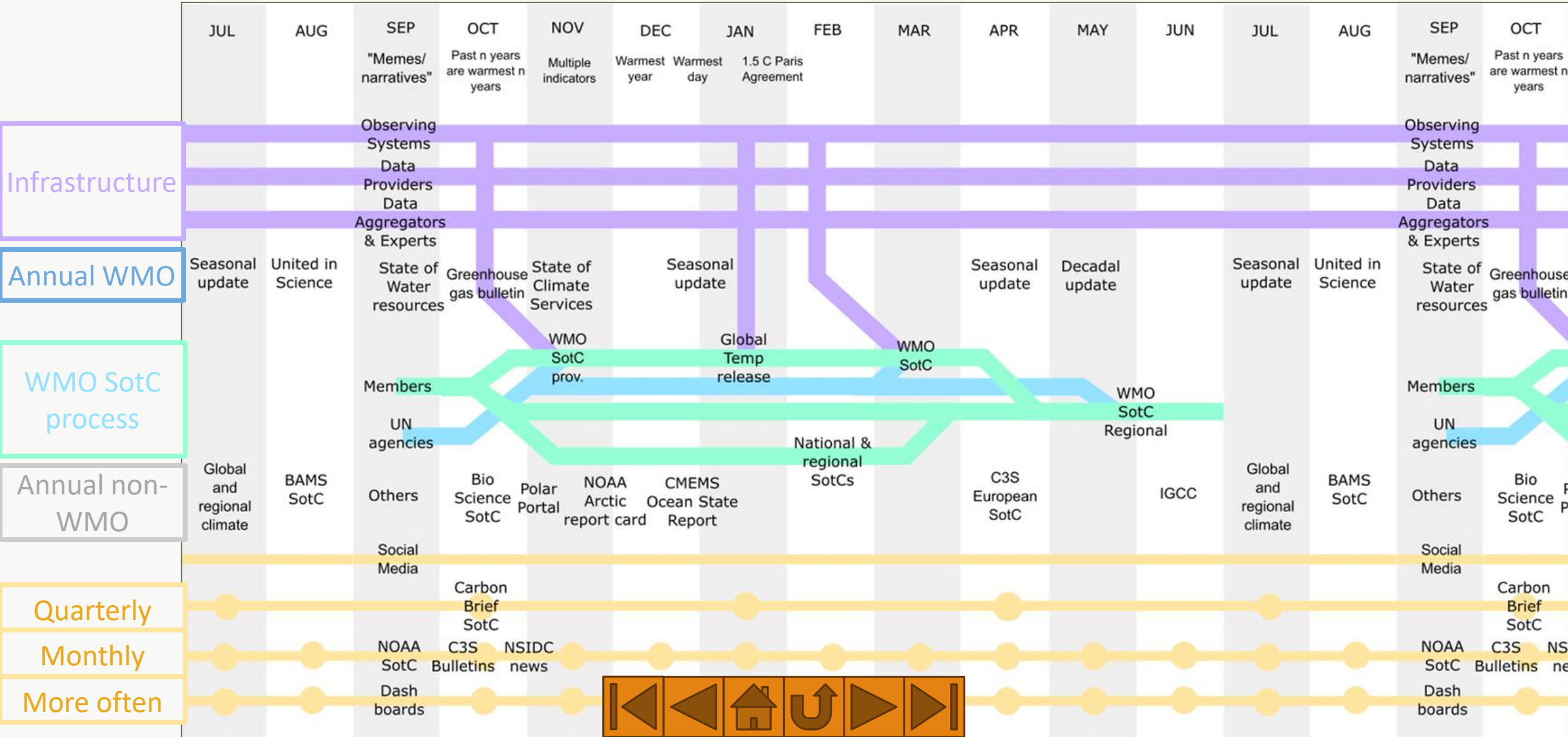




WMO SoGClimate – Example global report process



WMO SoGClimate – Interlinked activities



WMO SoGClimate - challenges

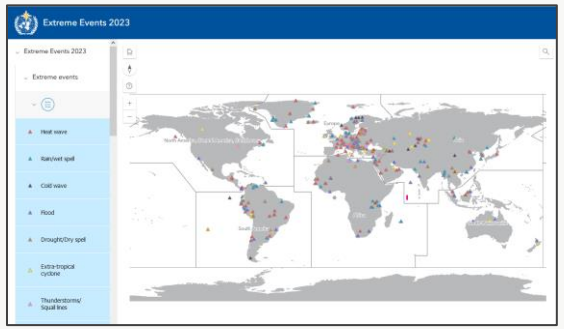
- Gaps in WMO Member responses
  - Principally over Africa and Maritime Continent as well as Small Island States
- Up-to-date global summaries of extremes are currently lacking (except marine heatwaves)
- Up-to-date, relevant summaries of impacts are currently lacking
- Attribution, particularly for extreme events is complicated by lack of peer-reviewed articles on short time scales
- Current focus on evidence base for climate change, but focus is shifting.
  - What new indicators and areas do we need to cover?
- How to link to IPCC, Paris Agreement etc?
- How to use effectively all the information gathered?
- If you have thoughts or suggestions, let us know:
  - jjk8932@googlemail.com (John Kennedy, scientific coordinator)

Take Our Survey
~5-10 mins

WMO SoGClimate – links & resources

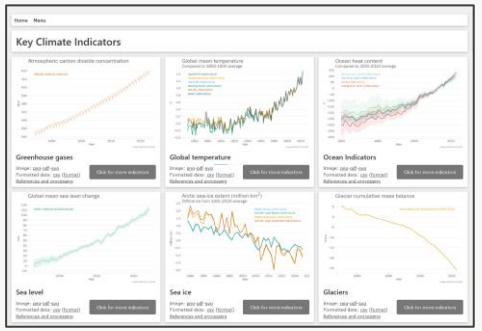
State of the Global Climate 2023
([Final Report])

Includes [Extremes Supplement], [Press Release], and [Story Map]



[Interactive extremes map]

Interactive, based on Member survey



[Key indicators dashboard]

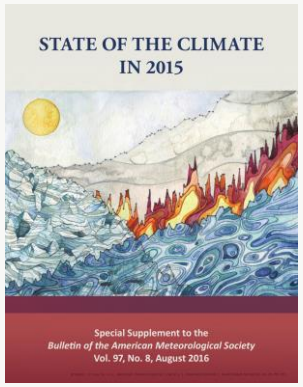
Provides access to data and technical information on key indicators

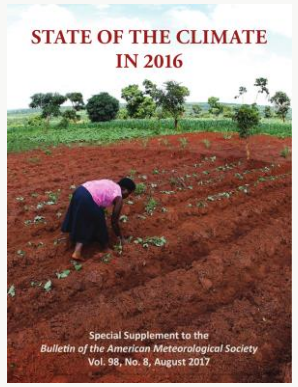
State of the Global Climate 2023 ([Provisional Report])

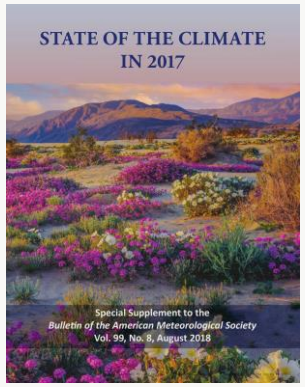
WMO State of the Global Climate: Many thanks to all our great contributors for 2023!

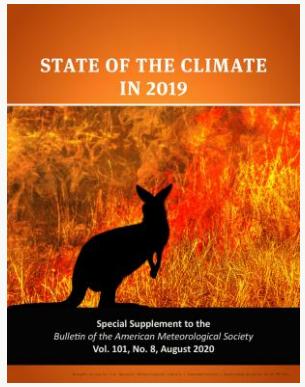
Vicente Anzellini (IDMC), Omar Baddour (WMO), Paul M Barker (University of New South Wales), Joseph Basconcillo (PAGASA), Hamid Bastani (WMO), Jorge Alvar-Beltrán (FAO), Jana Birner (UNHCR), Nicholas Bishop (IOM), Jessica Blunden (NOAA), Roberta Boscolo (WMO), Tim Boyer (NOAA NCEI), Anny Cazanave (Legos), Xuan Che (UNDRR), Lijing Cheng (Institute of Atmospheric Physics (IAP), Center for Ocean Mega-Science), John Church (University of New South Wales), Damien Desbruyeres (Ifremer), Catia Domingues (NOC), Robert Dunn (Met Office), Arianna Gialletti (FAO), Pini Giancarlo (WFP), Donata Giglio (University of Colorado), John E Gilson (SCRIPPS), Alashiya Gordes (FAO), Atsushi Goto (WMO), Sarah Grimes (WMO), Flora Gues (CELAD, Mercator Ocean International), Peer Hechler (WMO), Christopher Hewitt (WMO), Shigeki Hosoda (JAMSTEC), Matthias Huss (ETH Zürich), Amanda Ignatia (UNHCR), Kirsten Isensee (IOC/UNESCO), Piyush Jain (Northern Forestry Centre), Gregory C Johnson (NOAA PMEL), Christopher Kadow (DKRZ), Hideki Kanamaru (FAO), Maarten Kappelle (UNEP), John Kennedy (WMO Expert), Rachel Killick (Met Office), Brian King (NOC), Nicolas Kolodziejczyk (University of Brest), Animesh Kumar (UNDRR), Mikael Kuusela (Carnegie Mellon University), Gernot Laganda (WFP), Lancelot Leclercq (Legos), Yuehua Li (Yunnan University), Ricardo Locarnini (NOAA NCEI), John Lyman (NOAA PMEL), Shawn Marshall (Environment and Climate Change Canada (ECCC) and University of Calgary), Jesse Mason (WFP), Jutta May (UNDRR), Trevor McDougall (University of New South Wales), Brian Menounos (University of Northern British Columbia), Atsushi Minami (JMA), Audrey Minère (Mercator Ocean International), Oe Mitsuho (JMA), Didier Paolo Monselesan (CSIRO), Sarah Purkey (Scripps), James Reagan (NOAA NCEI, University of Maryland), Dean Roemmich (Scripps), Lev Neretin (FAO), Julien Nicolas (ECMWF), Elisabeth Du Parc (IOM), Sylvain Ponserre (IDMC), Ileana Sinziana Puscas (IOM), Claire Ransom (WMO), David Robinson (Rutgers State University of New Jersey), Bonifacio Rogerio (WFP), Yousuke Sawa (JMA), Kanako Sato (JAMSTEC), Abhishek Savita (GEOMAR), Robert W Schlegel (Sorbonne Université, CNRS, Laboratoire d'Océanographie de Villefranche), Katherina Schoo (IOC/UNESCO), Serhat Sensoy (Turkish State Meteorological Service), Fumi Sezaki (JMA), Jose Álvaro Silva (WMO), Mike Sparrow (WMO/WCRP), Johan Stander (WMO), Martin Stendel (DMI), Toshio Suga (Tohoku University, JAMSTEC), Oksana Tarasova (WMO), Caterina Tassone (WMO/GCOS), Blair Trewin (Bureau of Meteorology), Thea Turkington (Meteorological Services Singapore/ASEAN Specialized Meteorological Centre), Isabella Velicogna (University of California), Alex Vermeulen (ICOS), Karina von Schuckmann (Mercator Ocean International), Ying Wang (UNEP), Susan E. Wjiffels (CSIRO, Woods Hole), Abdel-Lathif Younous (WFP), Markus Ziese (DWD, GPCC).

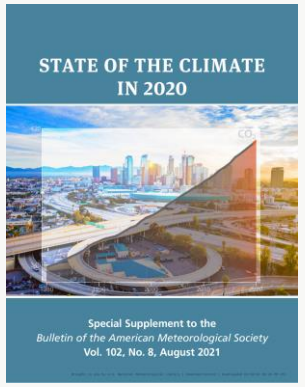
BAMS State of the Climate

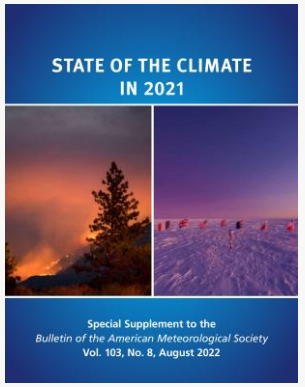


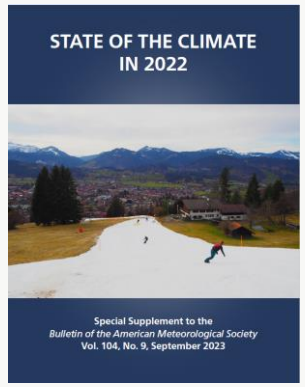


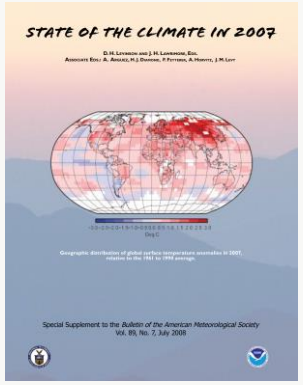


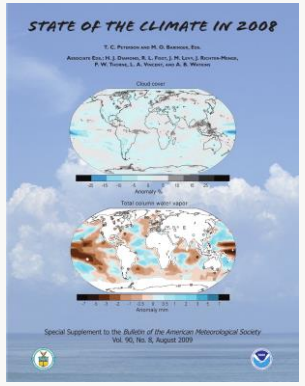


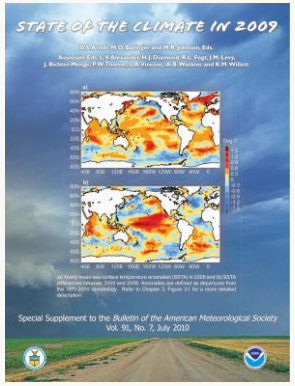


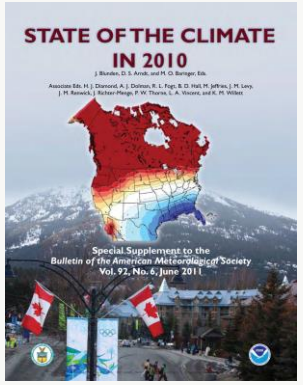


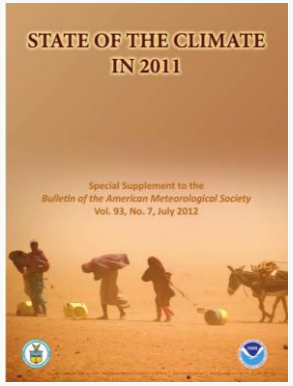


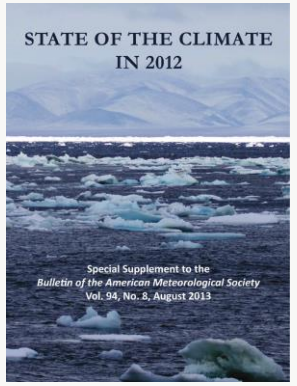


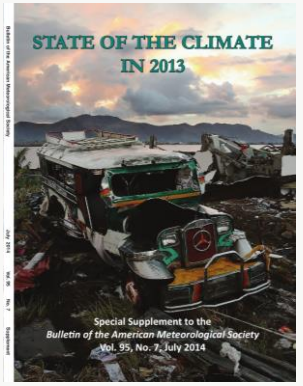


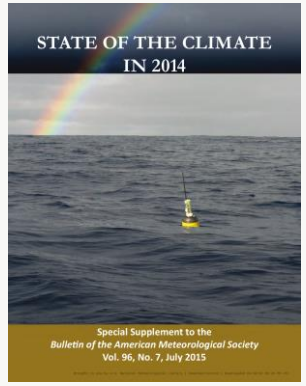












About the BAMS State of the Climate

- Published as a special supplement in the Bulletin of the American Meteorological Society
- Most comprehensive annual report on the status of the Earth's climate system in the world
- Reports on the state of the climate and our capacity to observe it:
  - What occurred in the year?
  - How does this fit with the long-term record?
  - What is the general behaviour of the long-term record?
  - How did we observe it?
  - How well did we observe it?
  - How well have we observed it over time?
  - What were the immediate factors influencing the year?
  - What are the long-term drivers?
- Does not pursue attribution, or contain forecasts, scenarios or projections

What is measured in the BAMS SotC?

Contains analyses of more than 3 dozen (and counting) GCOS ECVs across all aspects of the climate system - providing values, anomalies and trends as possible

Essential Climate Variables

—T. BOYER, E. BARTOW-GILLIES, J. BLUNDEN, AND R.H. DUNN

The following variables are considered fully monitored in this report, in that there are sufficient spatial and temporal data, with peer-reviewed documentation to characterize them on a global scale:

Fully monitored

- Surface atmosphere: air pressure, precipitation, temperature, water vapor, wind speed and direction
- Upper atmosphere: Earth radiation budget, temperature, water vapor, wind speed and direction, lightning
- Atmospheric composition: carbon dioxide, methane and other greenhouse gases, ozone
- Ocean physics: ocean surface heat flux, sea ice, sea level, surface salinity, sea-surface temperature, subsurface salinity, subsurface temperature, surface currents, surface stress
- Ocean biogeochemistry: ocean color
- Ocean biogeosystems: plankton
- Land: albedo, river discharge, snow

Partially monitored

The following variables are considered partially monitored, in that there is systematic, rigorous measurement found in this report, but some coverage of the variable in time and space is lacking due to observing limitations or availability of data or authors:

- Atmospheric composition: aerosols properties, cloud properties, precursors of aerosol and ozone
- Ocean physics: subsurface currents
- Ocean biogeochemistry: inorganic carbon
- Land: above-ground biomass, anthropogenic greenhouse gas fluxes, fire, fraction of absorbed photosynthetically active radiation, glaciers, groundwater, ice sheets and ice shelves, lakes, permafrost, soil moisture
- Surface atmosphere: surface radiation budget

Not yet monitored

The following variables are not yet covered in this report, or are outside the scope of it.

- Ocean physics: sea state
- Ocean biogeochemistry: nitrous oxide, nutrients, oxygen, transient tracers
- Ocean biogeosystems: marine habitat properties
- Land: anthropogenic water use, land cover, land surface temperature, latent and sensible heat fluxes, leaf area index, soil carbon

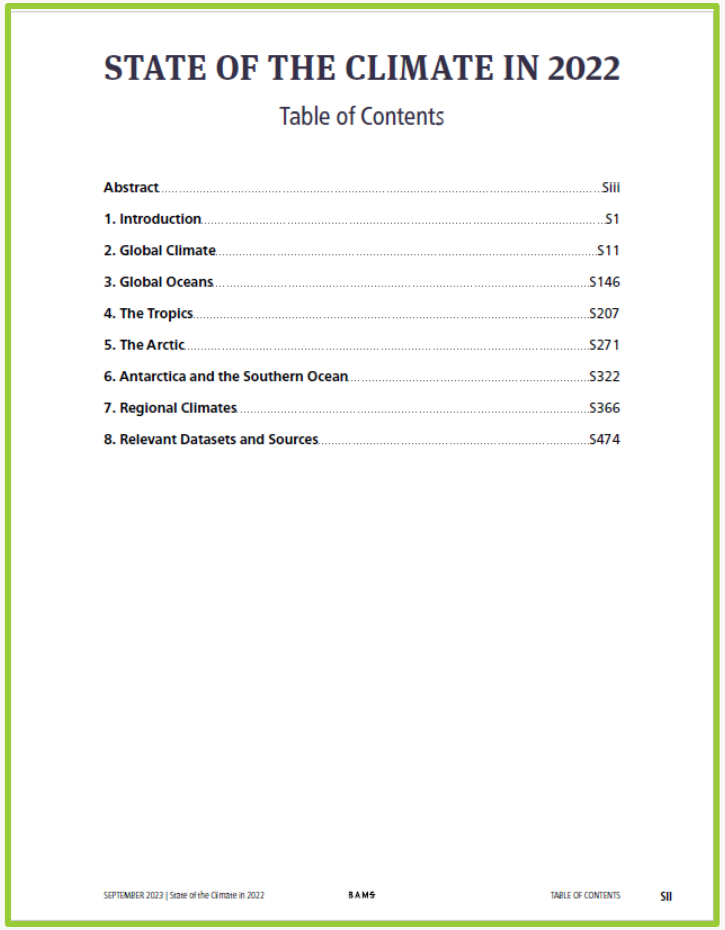
About the BAMS State of the Climate report

- Working on the 34th report in the series
- Report is formally peer reviewed, observation based and authoritative
- Analyses are based on peer reviewed datasets, often multiple datasets
  - These datasets are among the top in the respective fields.
  - New datasets and methodologies are integrated into analyses as they become available
- >500 scientists from many disciplines fit the pieces of the Earth's climate system and its changes together
  - Connecting the dots of evidence
- Focus is on the physical state of the climate system
- Report provides easy to read/access lists of all datasets included along with urls for transparency
- Has the space, freedom and ability to allow in-depth focus on specific events or new observing systems or new variables via our sidebars
  - New ECVs introduced via Sidebars often become regular sections

BAMS SotC report structure

Eight chapters – each with their own doi:

1. Introduction
2. Global Climate
   - (atmosphere, terrestrial, others)
3. Global Ocean
4. The Tropics
5. The Arctic
6. Antarctica & the Southern Ocean
7. Regional Climates
8. Relevant datasets & sources



STATE OF THE CLIMATE IN 2022

Table of Contents

Each chapter will have early online release

BAMS SotC contributor roles

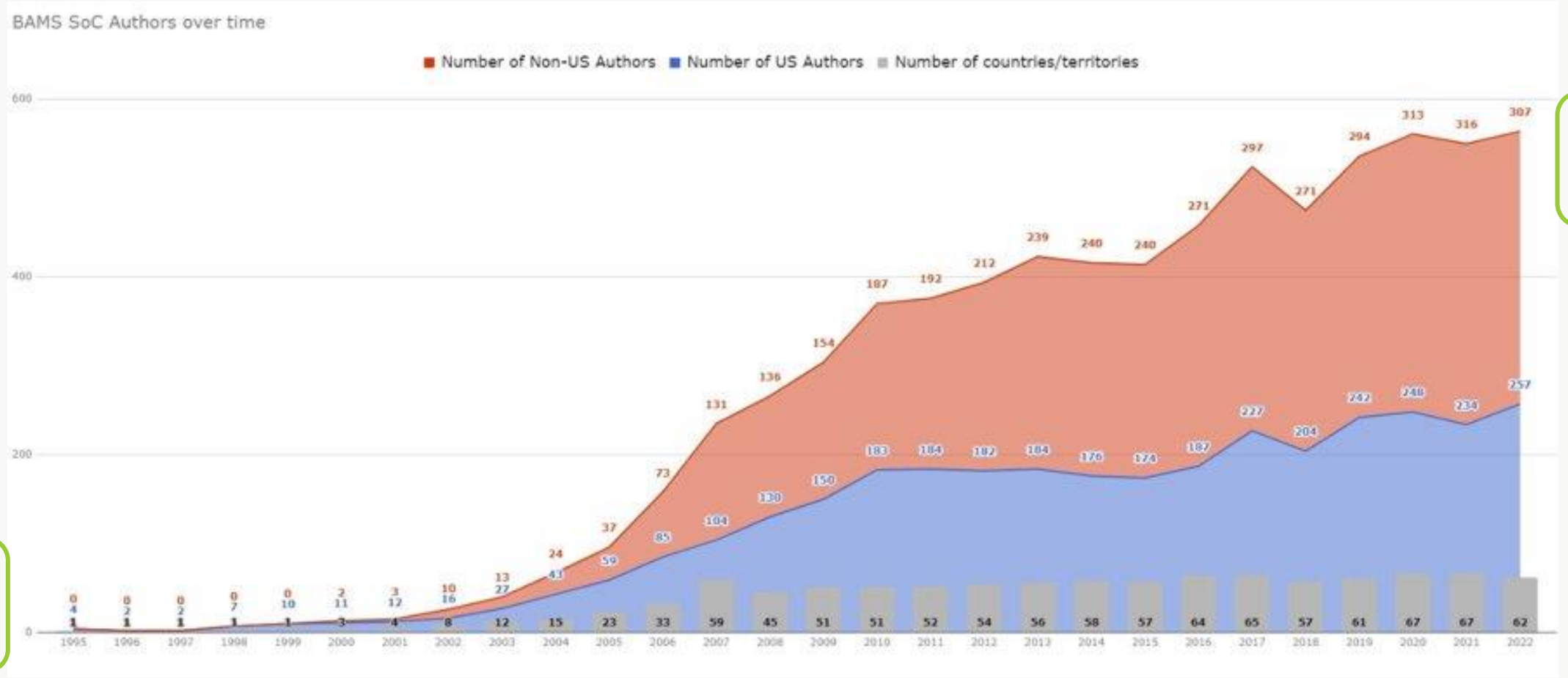
- Authors (currently 560+):
  - Generate lots of content and analysis!
- Chapter editors (will have 21 for 6 main chapters):
  - Guide overall shape of chapter; recruit and retain authors; determine sidebars, review chapter content
- Lead editors (2):
  - Coordination, resolve discrepancies & make connections between chapters, review all content
- Technical Editor
  - Proper citations, proper style, review for readability
- Layout specialists and figure formatting (NCEI)
  - Make it work on paper; hone figures to technical specs
- Very generous internal reviewers (thank you!)
- Anonymous peer-reviewers (thank you! Managed by BAMS, 2-3 per section)
- BAMS special editor + editorial and support staff

Non-contributor roles:

Policy relevant actions
(Presenting material in local/national governments)

Friends
(folks who support these reports, tweet them, point colleagues towards them)

BAMS SotC authors over time



564 in 2022

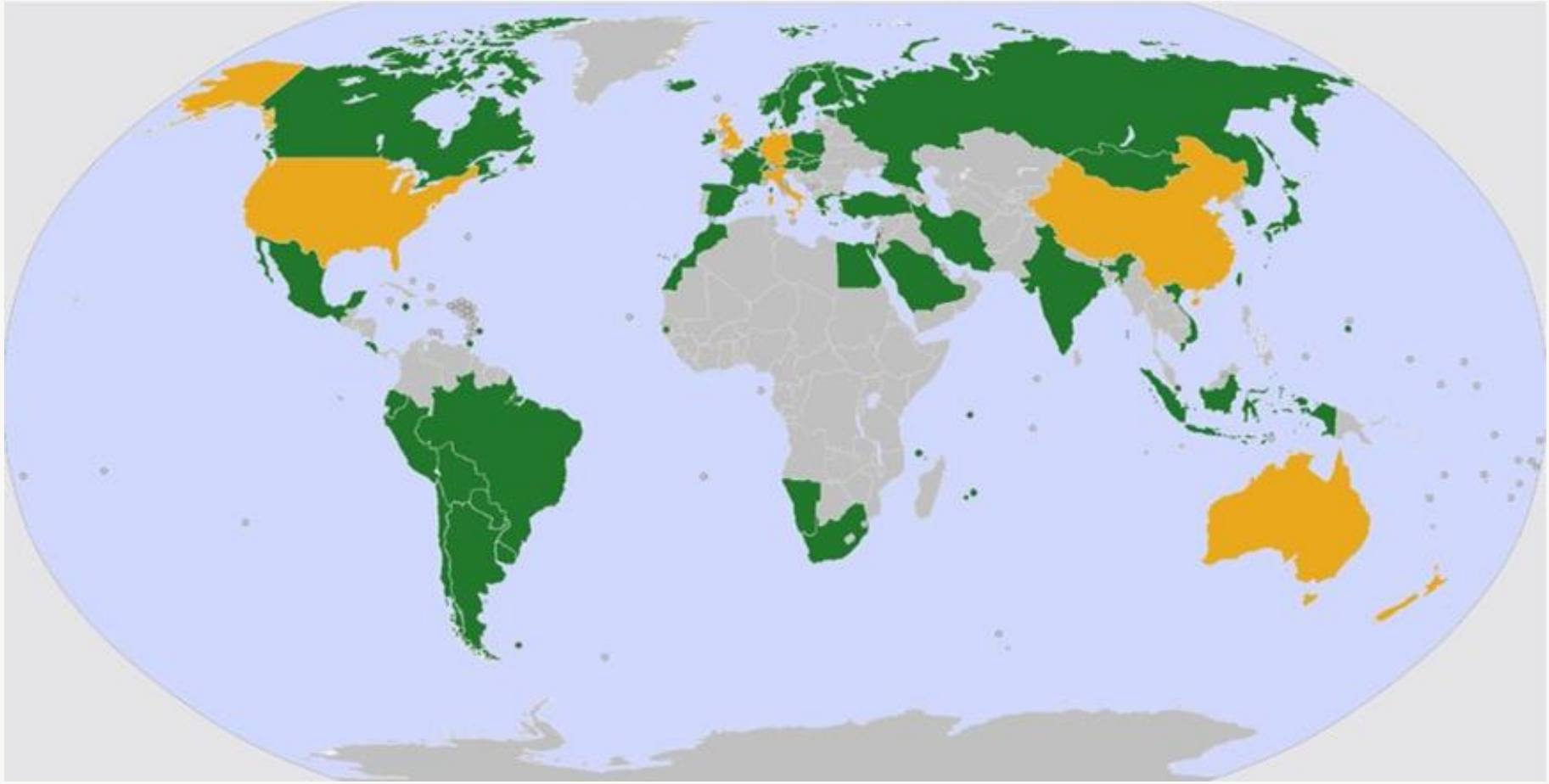
5 in 1995

Last year's contribution statistics - 576 authors from 66 different countries, including Andorra and Namibia for the first time

BAMS SotC – Contributor home institutes

Authors

Editors



Current BAMS SotC challenges and needs

- Constraining growth without constraining breadth and knowledge
  - Report on 2022 is over 500 pages
- Maintain continuity among contributors
  - Need to allow authors to “retire” without losing content
- Remain relevant and timely
  - Serve as authoritative climate “almanac”
  - Very tight deadlines, lots of moving parts so easily delayed
- Who is our audience?
  - We don’t know in detail :(
  - How do we measure the audience, and get feedback?
  - How do we improve reach, readability and consistency?

BAMS SotC Summary

We are the only report ("almanac") that comprehensively covers Earth's climate system year after year so that we can gain a full understanding of the changes and variability occurring.

We have a solid base of world-class contributors and editors.

Anyone can easily access these reports (1981-present):

https://www.ncei.noaa.gov/bams-state-of-climate

If you have thoughts, suggestions or want to get involved:

- Jessica Blunden (NCEI) jessica.blunden@noaa.gov
- Robert Dunn (Met Office) robert.dunn@metoffice.gov.uk

BAMS SotC: Global Climate Chapter

Lead Editor - Robert Dunn (UKMO)

In 2023 (focussing on events and conditions in 2022):

- 32,000 words
- 220 authors
- 81 figures
- 7 domains covering 42 observables:
  - Temperature, Cryosphere, Hydrological Cycle, Atmospheric Circulation, Radiation, Atmospheric Composition, Land Surface Properties

Annual anomaly maps from 2022 report from most of the observed variables are shown in the following slides


STATE OF THE CLIMATE IN 2022

GLOBAL CLIMATE

R. J. H. Dunn, J. B Miller, K. M. Willett, and N. Gobron, Eds.

Special Online Supplement to the *Bulletin of the American Meteorological Society* Vol. 104, No. 9, September, 2023

https://doi.org/10.1175/BAMS-D-23-0090.1

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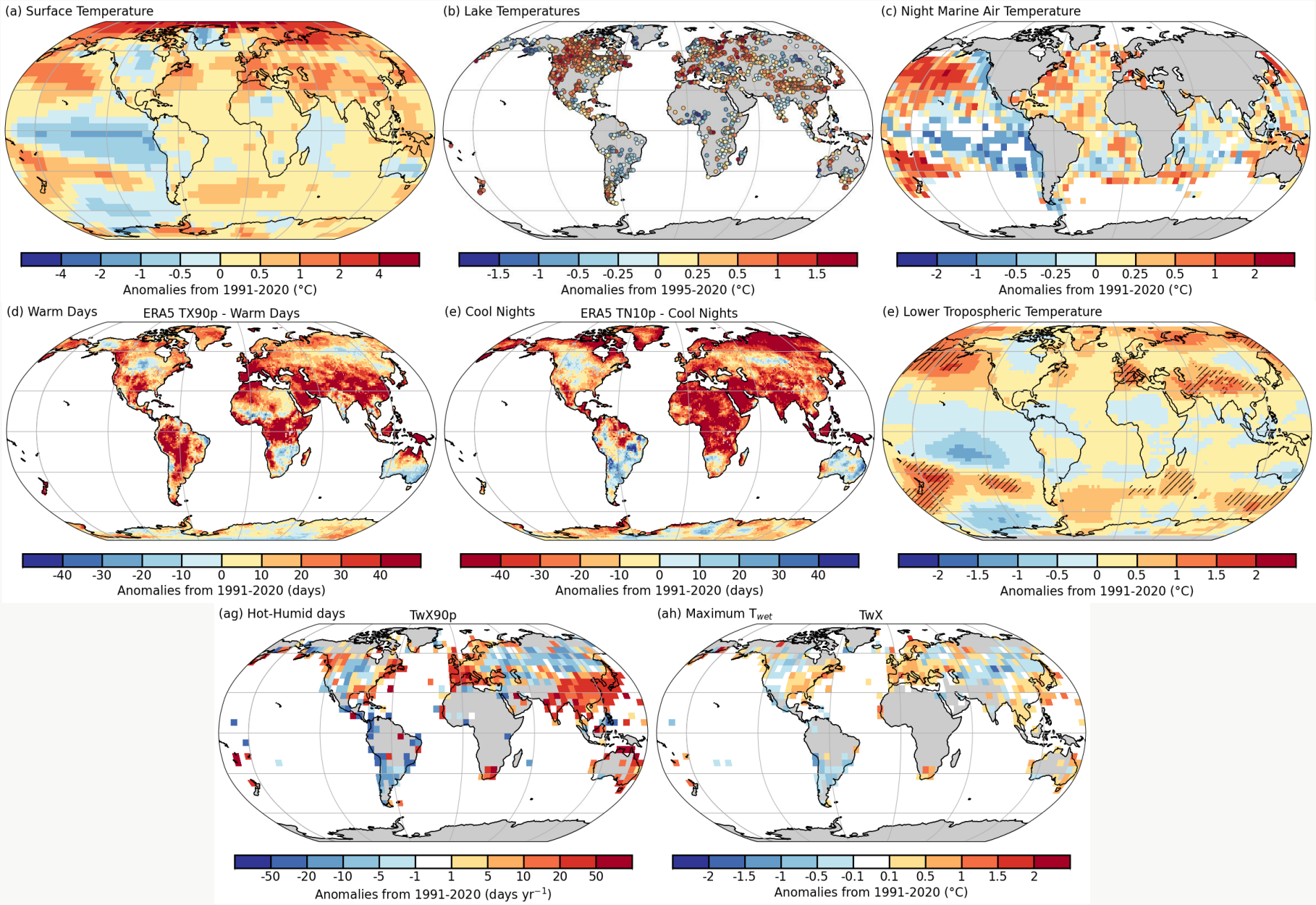
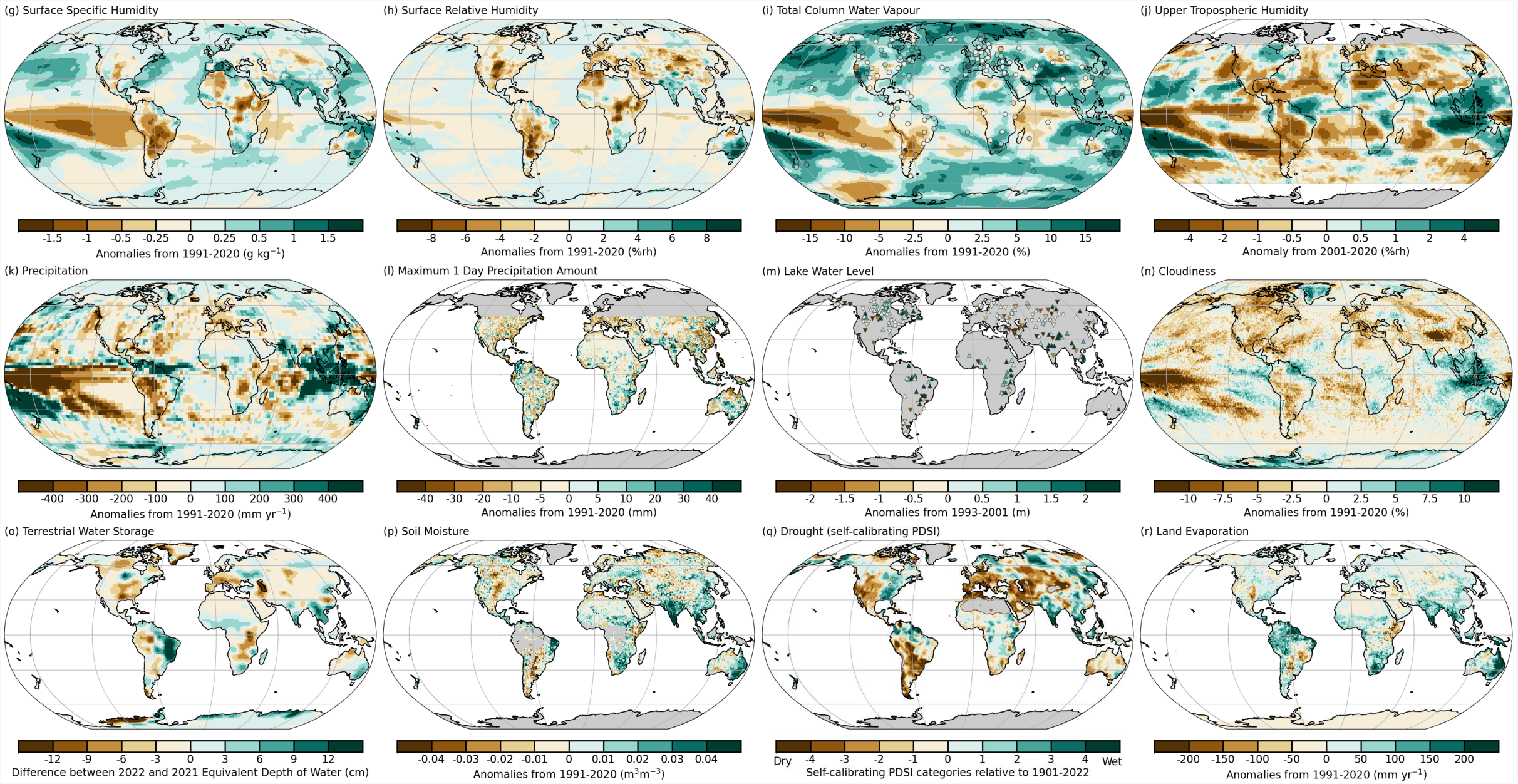
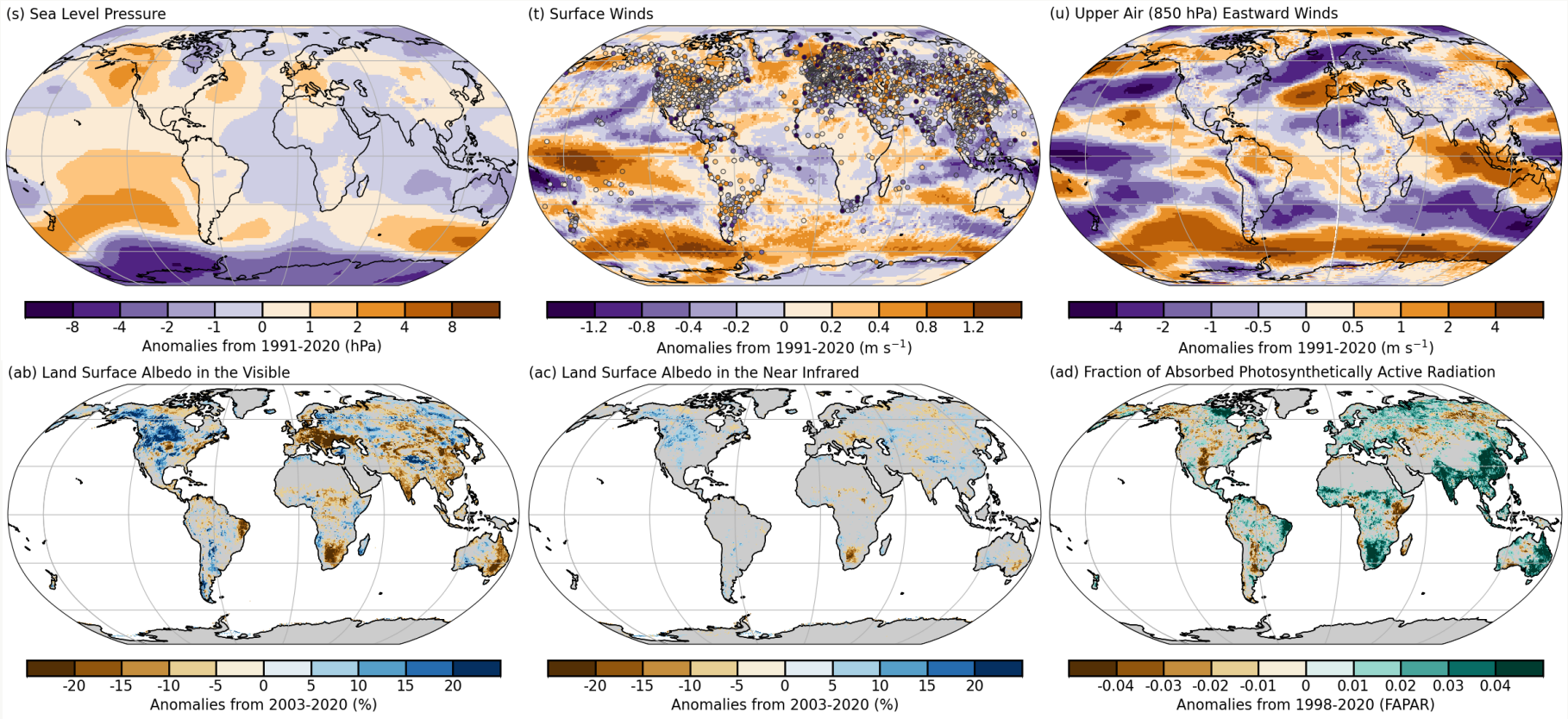
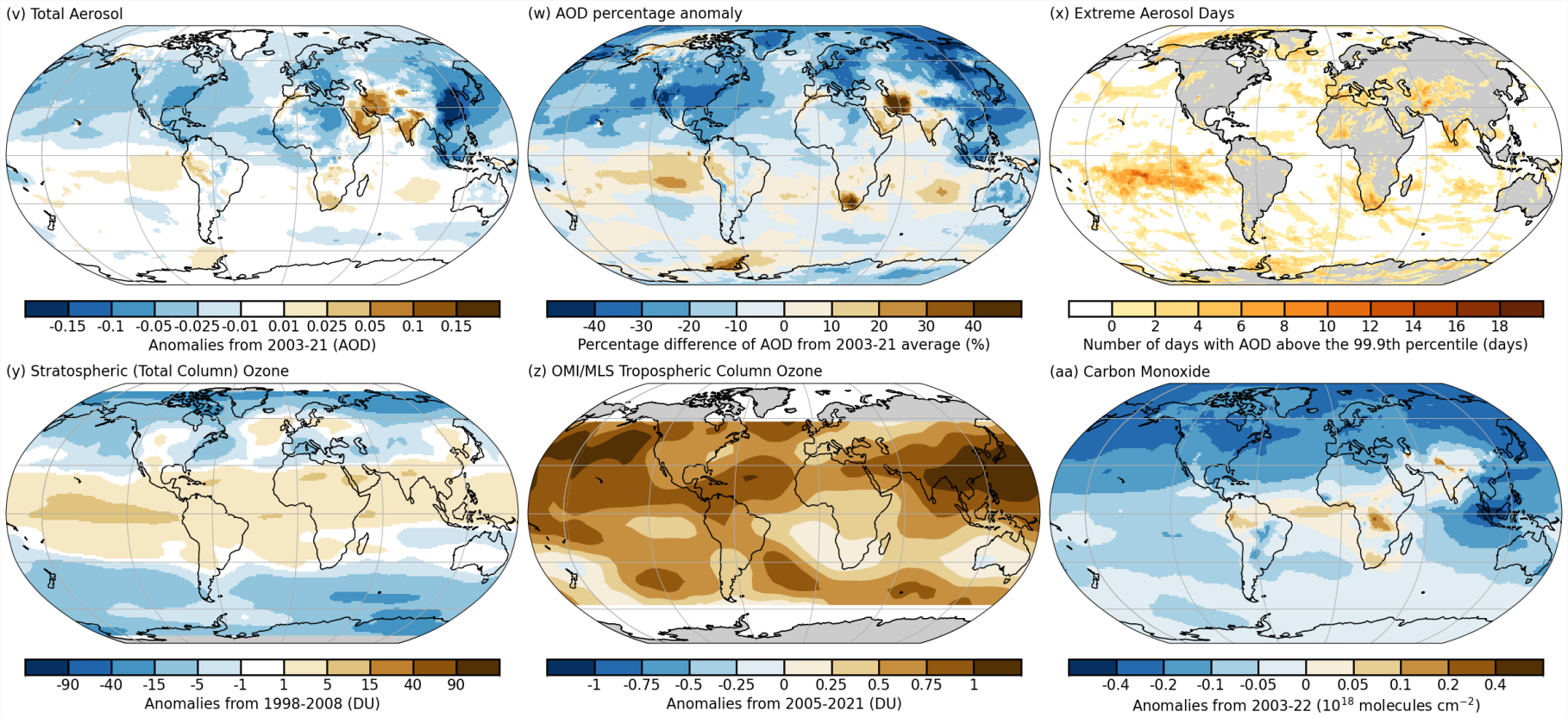

(a) Surface Temperature
-4 -2 -1 -0.5 0 0.5 1 2 4
Anomalies from 1991-2020 (°C)
(b) Lake Temperatures
-1.5 -1 -0.5 -0.25 0 0.25 0.5 1 1.5
Anomalies from 1995-2020 (°C)
(c) Night Marine Air Temperature
-2 -1 -0.5 -0.25 0 0.25 0.5 1 2
Anomalies from 1991-2020 (°C)
(d) Warm Days
ERA5 TX90p - Warm Days
-40 -30 -20 -10 0 10 20 30 40
Anomalies from 1991-2020 (days)
(e) Cool Nights
ERA5 TN10p - Cool Nights
-40 -30 -20 -10 0 10 20 30 40
Anomalies from 1991-2020 (days)
(e) Lower Tropospheric Temperature
-2 -1.5 -1 -0.5 0 0.5 1 1.5 2
Anomalies from 1991-2020 (°C)
(ag) Hot-Humid days
TwX90p
-50 -20 -10 -5 -1 1 5 10 20 50
Anomalies from 1991-2020 (days yr^{-1})
(ah) Maximum T_{wet}
TwX
-2 -1.5 -1 -0.5 -0.1 0.1 0.5 1 1.5 2
Anomalies from 1991-2020 (°C)



Hydrological Cycle


(s) Sea Level Pressure
-8 -4 -2 -1 0 1 2 4 8
Anomalies from 1991-2020 (hPa)
(t) Surface Winds
-1.2 -0.8 -0.4 -0.2 0 0.2 0.4 0.8 1.2
Anomalies from 1991-2020 (m s^{-1})
(u) Upper Air (850 hPa) Eastward Winds
-4 -2 -1 -0.5 0 0.5 1 2 4
Anomalies from 1991-2020 (m s^{-1})
(ab) Land Surface Albedo in the Visible
-20 -15 -10 -5 0 5 10 15 20
Anomalies from 2003-2020 (%)
(ac) Land Surface Albedo in the Near Infrared
-20 -15 -10 -5 0 5 10 15 20
Anomalies from 2003-2020 (%)
(ad) Fraction of Absorbed Photosynthetically Active Radiation
-0.04 -0.03 -0.02 -0.01 0 0.01 0.02 0.03 0.04
Anomalies from 1998-2020 (FAPAR)
(ae) Carbon Emissions from Biomass Burning
-100 -40 -10 -5 -1 1 5 10 40 100
Anomalies from 2003-2020 (g C m^{-2} yr^{-1})
(af) Vegetation Optical Depth
-0.1 -0.05 -0.02 -0.01 0 0.01 0.02 0.05 0.1
Anomalies from 1991-2020


(v) Total Aerosol
-0.15 -0.1 -0.05 -0.025 -0.01 0.01 0.025 0.05 0.1 0.15
Anomalies from 2003-21 (AOD)
(w) AOD percentage anomaly
-40 -30 -20 -10 0 10 20 30 40
Percentage difference of AOD from 2003-21 average (%)
(x) Extreme Aerosol Days
0 2 4 6 8 10 12 14 16 18
Number of days with AOD above the 99.9th percentile (days)
(y) Stratospheric (Total Column) Ozone
-90 -40 -15 -5 -1 1 5 15 40 90
Anomalies from 1998-2008 (DU)
(z) OMI/MLS Tropospheric Column Ozone
-1 -0.75 -0.5 -0.25 0 0.25 0.5 0.75 1
Anomalies from 2005-2021 (DU)
(aa) Carbon Monoxide
-0.4 -0.2 -0.1 -0.05 0 0.05 0.1 0.2 0.4
Anomalies from 2003-22 (10^{18} molecules cm^{-2})

End of presentation

If you have any feedback on the accessibility or other features of my presentation, please do get in touch:

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