

Yearbook on Space Policy

Cenan Al-Ekabi
Stefano Ferretti *Editors*

Yearbook on Space Policy 2016

Space for Sustainable Development

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Yearbook on Space Policy

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Yearbook on Space Policy

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Preface

The United Nations recently defined the 2030 Agenda which consists of 17 Sustainable Development Goals to be achieved by all countries by 2030. In this period, the space sector is also on the verge of a new revolution, which is linked to the increased digitalization of the industrial and service sectors and the increasing availability of large amounts of free and open data on planet Earth. This context opens up new opportunities for overcoming the many challenges ahead by working together, pooling resources and information from a variety of key actors, and integrating them in a holistic approach toward the full implementation of the 2030 Agenda. In order to clarify and shed additional light on the expected impacts of these trends, the European Space Policy Institute (ESPI) has decided to focus on the topic of space for sustainable development for its *Yearbook on Space Policy 2016*.

Traditionally, the first part of the yearbook sets out a comprehensive overview of the economic, political, technological, and institutional trends that affected space activities in 2016. It is prepared in-house in ESPI, and while its perspective is European, it also provides a comparative analysis of space developments around the world.

The second part of the ESPI yearbook approaches the overall theme from an analytical perspective. This year, 13 contributions are included, bringing together the views of professionals from space agencies, the wider development community, academia, and industry and new private actors, as well as European and international institutions aiming at a stronger coordination among space agencies, IGOs, NGOs, private sector, academia, and sustainable development actors. Several key prerequisites for a successful contribution of space activities to the Sustainable Development Goals were identified. For instance, space actors are urged to adopt an end-to-end approach on identifying user needs; to that end, a greater inter-sectoral, interinstitutional (e.g., state and NGO), and international cooperation and information sharing should be sought. Moreover, there is a need to improve technology awareness among all actors to strengthen capacity building, beckoning a formalized cross-sectoral dialogue platform. And there is a need to define basic common requirements serving the Sustainable Development Goals for the next generation of space infrastructure, in order to improve access to space services and enhance

international cooperation. The contributions in the second part of the yearbook help to put forward concrete proposals for improved dialogue and cooperation.

The third part of the yearbook continues its character as an archive of space activities. Again prepared in-house by ESPI, a chronology, data about institutions, and a bibliography are provided where readers of the now ten volumes of the yearbook can identify statistical developments and evolutions.

In closing, I would like to thank the contributors of the articles in the second part for their engagement in this publication, as well as the ESPI staff that have been instrumental for its production.

Vienna, Austria

Jean-Jacques Tortora
Director of ESPI

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List of Acronyms: Acronym Explanation

A

A3R	Arkyd 3 Reflight spacecraft
AAD	Advanced Air Defence
ABS	Asia Broadcast Satellite
ADPC	Asian Disaster Preparedness Center
AG	Aktiengesellschaft
AGRHYMET	Agriculture, Hydrology and Meteorology Regional Center
AIA	Atmospheric Imaging Assembly
Airbus D&S	Airbus Defence and Space
AIM	Asteroid Impact Mission
AIS	Automatic Identification Satellites
ALR	Austrian Aeronautics and Space Agency
AMESD	African Monitoring of the Environment for Sustainable Development
AMS	Alpha Magnetic Spectrometer
APAC	China and other Asia Pacific
ARISE	Agriculture Resource Inventory and Survey Experiment
ASAP	Austrian Space Application Programme
ASAT	Anti-Satellite
ASEAN	Association of Southeast Asian Nations
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
ASL	Airbus Safran Launchers
ASPERA-3	Mars Express' Analyzer for Space Plasmas and Energetic Atoms
ATK	Alliant Techsystems Inc.
ATV	Automated Transfer Vehicle
AWE	AWE Management Limited
AWS	Automatic Weather Stations

B

BDS	BeiDou Navigation Satellite Systems
BELSPO	Belgian Federal Science Policy Office
BHRS	Belgian High Representation for Space Policy
BIS	Business, Innovation and Skills
BMD	Ballistic Missile Defence
BMVIT	Austrian Federal Ministry for Transport, Innovation and Technology

C

CAD	Computer Aided Design
CALET	CALorimetric Electron Telescope
CAPE	Crop Acreage and Production Estimation
CASC	China Aerospace Science and Technology Corporation
CAST	China Aerospace Science and Technology Corp.
CATHALAC	Water Center for the Humid Tropics for Latin America and the Caribbean
CBERS	China-Brazil Earth Resource Satellite
CD	Conference on Disarmament
CDOP 3	Third Continuous Development and Operations Phase
CDRA	Carbon Dioxide Removal Assembly
CDTI	Centre for the Development of Industrial Technology
CEC	Consortium for Educational Communication
CELAC	Community of Latin American and Caribbean States
CENI	Commission Électorale Nationale Indépendante
CEOS	Committee on Earth Observation Satellites
CERSGIS	Centre for Remote Sensing and Geographic Information Services
CET	Centre for Education Technology
CFAS	Federal Commission for Space Affairs
CGWIC	China Great Wall Industry Corporation
CHF	Swiss franc
CIET	Central Institute of Educational Technology
CILSS	Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (Ghana)
CIS	Communications, Intelligence & Security
CLARREO	Climate Absolute Radiance and Refractivity Observatory
CMA	Governing Body of the Paris Agreement
CME	Coronal Mass Ejection
CMSA	China Manned Space Agency
CNES	Centre National d'Études Spatiales (French Space Agency)
CONAE	Argentinian Space Agency
CONCORDi	European Commission's biennial Conferences on Corporate R&D and Innovation

COP	Conference of the Parties
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
COSTIND	Commission for Science, Technology and Industry for National Defense
CRESDA	Centre for Resources Satellite Data and Applications
CRISM	Compact Reconnaissance Imaging Spectrometer for Mars
CRS	Commercial Resupply Services
CSA	Canadian Space Agency
CSE	Centre de Suivi Ecologique (Senegal)
CSES	China Seismo-Electromagnetic Satellite
CubeSats	Cube Satellites

D

DAMPE	Dark Matter Particle Explorer
DARS	Digital Audio Radio Service
DBS	Direct Broadcast Services
DECU	Development and Educational Communications Unit
DJEI	Department of Jobs, Enterprise & Innovation
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
DoD	Department of Defence
DRDO	Defence Research and Development Organisation
DSC	Decision Support Center
DSCOVER	Deep Space Climate Observatory
DSI	Deep Space Industries
DTH	Direct To Home

E

EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
ECA	Evolution Cryotechnique type A
EDM	ExoMars Entry, Descent and Landing Demonstrator Module
EDT	Electrodynamic Tether
EELV	U.S. Evolved Expendable Launch Vehicle Program
EIB	European Investment Bank
EIF	European Investment Fund
EIT	Extreme ultraviolet Imaging Telescope
ELIRG	Extremely Luminous Infrared Galaxies
ELV	European Launch Vehicle
EM	Exploration Mission

EMEA	Europe, the Middle East and Africa
EMMRCs	Educational Multimedia Research Centres
EO	Earth Observation
EON-MW	Earth Observing Nanosatellite-Microwave
EPS-SG	European Polar System Second Generation
ERG	Exploration of energization and Radiation in Geospace
ESA	European Space Agency
ESA DG	ESA Director General
ESPI	European Space Policy Institute
ESSO	Earth Systems Science Organization
ETC	Emergency Telecommunications Cluster
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUTELSAT	European Telecommunications Satellite Organisation
EVE	EUV Variability Experiment

F

FAA	Federal Aviation Administration
FASAL	Forecasting Agricultural output using Space, Agrometeorology and Land based observations
FCT	Foundation for Science and Technology
FFG	Austrian Research Promotion Agency
FFL	Fondation Follereau Luxembourg
FOCAC	Forum on China-Africa Cooperation
FSS	Fixed Satellite Services
FY	Fiscal Year

G

GDP	Gross Domestic Product
GEO	Geostationary Earth Orbit
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GERD	Gross Domestic Expenditure on R&D
GFDRR	Global Facility for Disaster Reduction and Recovery
GGIM	Global Geospatial Information Management
GmbH	Gesellschaft mit beschränkter Haftung
GMT	Greenwich Mean Time
GNI	Gross National Income
GNSS	Global Navigation Satellite Systems

GOES-R	Geostationary Operational Environmental Satellite R
GPS	Global Positioning System
GRaND	Gamma Ray and Neutron Detector
GSA	European GNSS Agency
GSLV	Geosynchronous Satellite Launch Vehicle
GSRT	General Secretariat for Research and Technology
GSSAP	Geosynchronous Space Situational Awareness Program
GTO	Geosynchronous Transfer Orbits

H

HAT	Human African trypanosomiasis/Sleeping sickness
HDTV-EF2	High Definition TV Camera-Exposed Facility 2
HFA	Hyogo Framework for Action
HMI	Helioseismic and Magnetic Imager
Hot DOG	Hot, Dust-Obscured Galaxy
HTV	H-2 Transfer Vehicle
HR	High-Resolution
HSO	Hungarian Space Office
HSTI	Human Space Technology Initiative

I

I&B	Information and Broadcasting
IAA	International Academy of Astronautics
IAC	International Astronautical Congress
IADC	Inter-Agency Space Debris Coordination Committee
IAEG-SDGs	UN Statistical Commissions' Interagency Expert Group
IARI	Indian Agriculture Research Institute
IASC	Inter-Agency Standing Committee
ICG	International Committee on Global Navigation Satellite Systems
ICIMOD	International Centre for Integrated Mountain Development
ICoC	Draft International Code of Conduct for Outer Space Activities
ICS	Information and Communication Systems
ICRC	International Committee of the Red Cross
ICT	Information and Communications Technology
IEV	Intermediate Experimental Vehicle
IFIs	International Financial Institutions
IKAR	Interdepartmental Committee for Space Affairs
IGS	International GNSS Service
ILS	International Launch Services
IMF	International Monetary Fund

IMU	Inertial Measurement Unit
INCOIS	Indian National Centre for Ocean Information Services
INTA	National Institute of Aerospace Technology
IODC	Indian Ocean Data Coverage
IOs	Regional Organizations and International Organizations
IoT	Internet of Things
IPP	International Partnership Programme
IR	Intermediate Result
IRIS	Interface Region Imaging Spectrograph
IRNSS	India Regional Navigation Satellite System
ISC	International Satellite Company Limited
ISED	Innovation, Science and Economic Development
ISIS	Islamic State
ISRO	Indian Space Research Organization
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunication Union
IUCAA	Inter-University Centre for Astronomy and Astrophysics
IUVS	Imaging UltraViolet Spectrograph

J

J-PAL	Abdul Latif Jameel Poverty Action Lab
J-SSOD	JEM Small Satellite Orbital Deployer
JAXA	Japan Aerospace Exploration Agency
JIRAM	Jovian Infrared Auroral Mapper
JPSS	Joint Polar Satellite System
JUICE	Jupiter Icy moon Explorer

K

K2	Kepler 2
KARI	Korea Aerospace Research Institute (Korean Space Agency)
KITE	Kounotori Integrated Tether Experiment

L

L2	Earth-Moon Lagrange
LAXPC	Large Area X-ray Proportional Counter
LEO	Low Earth Orbit
LRO	Lunar Reconnaissance Orbiter
LULC	Land Use and Land Cover

M

MARSIS	Mars Advanced Radar for Sub-Surface and Ionospheric Sounding
MAVEN	Mars Atmosphere and Volatile Evolution
MDA Corp.	MacDonald, Dettwiler and Associates Ltd.
MDGs	Millennium Development Goals
MDI	Michelson Doppler Imager
Melco	Mitsubishi Electric Co.
MEO	Medium Earth Orbit
MERLIN	Methane Remote Sensing LIDAR Mission
MESA	Monitoring the Environment and Security
MESSENGER	Mercury Surface, Space Environment, Geochemistry and Ranging
Metop	Meteorological Operational Satellite
Metop-SG	Metop Second Generation
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MFG	Meteosat First Generation
MIT	Massachusetts Institute of Technology
MIUR	Ministry of Education, University and Research
MMO	Mercury Magnetospheric Orbiter
MOD	Ministry of National Defense
MOKV	Multi-Object Kill Vehicle
MOM	Mars Orbiter Mission
MOSDAC	Meteorological and Oceanographic Satellite Data Archival Centre
MoU	Memorandum of Understanding
MPO	Mercury Planetary Orbiter
MRO	Mars Reconnaissance Orbiter
MSF	Médecins Sans Frontières
MSL	Mars Science Laboratory
MSM	Methane Sensor for Mars
MSG	Meteosat Second Generation
MSS	Mobile Satellite Service
MTG	Meteosat Third Generation
MTM	Mercury Transfer Module

N

NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NCERT	National Council for Educational Research and Training
NCSTE	China's National Centre for Science and Technology Evaluations
NDAA	National Defense Authorization Act
NDCs	Nationally Determined Contributions
NEC	Nippon Electric Company
NEO	Near-Earth Orbit

NGA	National Geospatial-Intelligence Agency
NGCV	Next Generation Crew Vehicle
NGO	Non-Governmental Organization
NNRMS	National Natural Resources Management System
NOAA	National Oceanic and Atmospheric Administration
NRO	National Reconnaissance Office
NRSC	National Remote Sensing Centre
NSC	National Space Council
NSC	Norwegian Space Centre
NSO	Netherlands Space Office
NOW	Netherlands Organisation for Scientific Research

O

OBIA	Object-Based Image Analysis
OCO	Orbiting Carbon Observatory
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OHB	Orbitale Hochtechnologie Bremen
OOF	Other Official Flows
OPEC	Organization of the Petroleum Exporting Countries
ORU	Orbital Replacement Units
OST	Outer Space Treaty

P

PACE	Plankton, Aerosol, Cloud, ocean Ecosystem
PAD	Prithvi Air Defense
PAROS	Prevention of an Arms Race in Outer Space
PAS	Polish Academy of Sciences
PES	Payment for Ecosystem Services
PHA	Potentially Hazardous Asteroids
PLA	People's Liberation Army
PND	Portable Navigation Devices
PNTAB	Position, Navigation and Timing Advisory Board
POLSA	Polish Space Agency
PPP	Public-Private Partnership
PPWT	Draft Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects
PRM	Period Reduction Maneuver
PRS	Public Regulated Service
PS-TEPC	Position Sensitive Tissue Equivalent Proportional Chamber

PSA	Programme on Space Applications
PSLV	Polar Satellite Launch Vehicle
PROBA	Project for Onboard Autonomy
PUMA	Preparation for the Use of MSG in Africa programme

Q

QZSS	Quasi-Zenith Satellite System
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R

RCM	RADARSAT Constellation Mission
RCMRD	Regional Centre for Mapping of Resources for Development
REDD+	Reducing Emissions from Deforestation and Degradation
RHESSI	Reuven Ramaty High Energy Solar Spectroscopic Imager
RKV	Redesigned Kill Vehicle
RLV	Reusable Launch Vehicle
ROSA	Romanian Space Agency
Roscosmos	Roscosmos State Corporation
RRS	Regional Radiocommunication Seminars
RSCC	Russian Satellite Communications Company

S

SAARC	South Asian Association for Regional Development
SAB	Space Advisory Board
SAC	Space Applications Center
SAF	Satellite Application Facilities
SAHEL	Sub-Saharan initiative for Telemedicine
SDGs	Sustainable Development Goals
SDO	Solar Dynamics Observatory
SDP	Space for Development Profile
SEI	Stockholm Environment Institute
SEPs	Solar Energetic Particles
SERI	State Secretariat for Education, Research and Innovation
SES	Société Européenne des Satellites
SIETs	State Institutes of Educational Technology
SHARAD	Shallow Subsurface Radar
SIA	Satellite Industry Association
SIG	Spatial Informatics Group
SITE	Satellite Instructional Television Experiment

SLS	Space Launch System
SMPAG	Space Mission Planning Advisory Group
SNC	Sierra Nevada Corporation
SNSB	Swedish National Space Board
SOHO	Solar and Heliospheric Observatory
SpaceX	Space Exploration Technologies
SRC	Space Research Centre
SRON	Netherlands Institute for Space Research
SS/L	Space Systems/Loral
SSO	Sun-synchronous orbit
SST	Space Surveillance and Tracking
STEREO	Solar Terrestrial Relations Observatory
STSC	Scientific and Technical Subcommittee

T

TCBM	Transparency and Confidence-Building Measures
TDP	Technology Demonstration Programme
TEU	Treaty on European Union
TGO	ExoMars Trace Gas Orbiter
THAAD	Terminal High Altitude Area Defense system
TRAI	Telecom Regulatory Authority of India

U

UAE	United Arab Emirates
UAV	Unmanned Aerial Vehicle
UGC	University Grants Commission
UK	United Kingdom
ULA	United Launch Alliance
UN	United Nations
UNCOPUOS	United Nations Committee of Peaceful Uses of Outer Space
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNDSS	United Nations Department of Safety and Security
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNGIWG	United Nations Geographic Information Working Group
UNIDIR	United Nations Institute for Disarmament Research
UNOOSA	United Nations Office of Outer Space Affairs
UNSDI	United Nations Spatial Data Infrastructure
UNISPACE	United Nations Conference on the Exploration and Peaceful Uses of Outer Space

UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
U.S.	United States of America
U.S. MDA	Missile Defense Agency
USAID	U.S. Agency for International Development
VSAT	Ultra Small Aperture Terminals

V

VAST	Vietnamese Academy of Science and Technology
VHR	Very High Resolution
VIR	Visible and Infrared Mapping Spectrometer
VKO	Aerospace Defence Forces
VSAT	Very Small Aperture Terminals

W

WFP	World Food Programme
WG	Working Group
WGP	World Gross Product
WISE	Wide-field Infrared Survey Explorer
WRS	World Radiocommunication Seminar

Part I
The Year in Space 2016

Chapter 1

European Space Activities in the Global Context

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1.1 Global Political and Economic Trends

1.1.1 *Global Economic Outlook*

The “World Economic Situation and Prospects” report is the United Nation’s lead publication in the annual discussion of current economic trends and prospects. In 2016, the global economy appeared stuck in a prolonged period of slow economic growth and dwindling international trade growth, with both rates at their lowest since the 2009 recession that followed the financial crisis. World gross product (WGP) had dropped to 2.2% in 2016, below the average rate of 2.5% since 2012, and well below the 3.4% growth rate observed in the decade before the crisis, with the sluggishness characterised by diminished productivity growth, increased levels of debt, low commodity prices, and continued conflict and geopolitical tensions.¹

WGP growth in developed economies dropped to 1.5% in 2016 from 2.1% growth in 2015; moreover, growth in output was expected to remain below 2% for 2017 and 2018. In the eurozone, new EU members showed the most growth at 3.0%, while Western European economies continued with 1.7% for 2016; overall, growth in the European Union had decreased to 1.8% in 2016 from 2.2% in 2015, and it was expected to remain steady for the upcoming years. US growth in global output dropped to 1.5% in 2016 from 2.6% in 2015 but was expected to increase to 1.9% in 2017 and 2.0% in 2018. Japan’s global output also increased by 0.5% in 2016,

¹ “World Economic Situation and Prospects 2017.” 17 Jan. 2017. United Nations 16 Mar. 2017 https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2017wesp_full_en.pdf

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lowering by 0.1 from the 0.6% growth in output in 2015; its output growth was expected to increase to 0.9% for 2017 and 2018.²

Growth in transition economies declined for the second consecutive year, contracting by 0.2% in 2016 after a previous contraction of 2.8% in 2015, but was expected to increase by 1.4% in 2017 and 2.0% in 2018, driven mainly by increased performance in South-Eastern Europe. Developing economies showed the most growth, increasing by 3.6% in 2016 and 3.8% in 2015; growth in output was expected to increase by 4.4% in 2017 and 4.7% in 2018. Developing economies remained the fastest growing, driven mainly by India, China, and other East and South Asian economies; African economies also continued to show positive growth, while South American economies continued to show weak performance for 2016.³

WGP was expected to increase by 2.7% in 2017 and 2.9% in 2018, due mainly to the stabilisation from some short-term shocks that had restrained growth in 2016, such as the nonfarm inventory destocking cycle and contractions in oil-related sector investment in the United States and sharp terms-of-trade shock experienced by commodity exporters. Rather than signalling a revival of the economy, as the factors underpinning sluggish economic growth tend to be self-reinforcing and will likely prolong the slowdown, this relatively low rate of growth risks hampering progress towards achieving the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda for Sustainable Development, which aims to eradicate extreme poverty and create decent work for all.⁴

1.1.2 Political Developments

1.1.2.1 Geopolitics

Several significant world events in 2016 are likely to continue in 2017.

On 23 June 2016, UK citizens voted to end the UK's membership of the European Union (EU). Despite a narrow split where 51.9% of voters (mainly in rural parts of England and Wales) chose to leave and 48.1% of voters (mainly Scotland and North Ireland) chose to remain⁵ and a November 2016 High Court ruling that the British government must get Parliament's approval before the "Brexit" process could begin,⁶ the UK's separation from the EU seems imminent. In order for the United Kingdom to withdraw from the EU, it must trigger Article 50 of the Treaty on European Union (TEU). Article 50 is triggered when an EU member state has noti-

²Ibid., 3.

³Ibid.

⁴Ibid. 1–38.

⁵"EU Referendum – Results." BBC News 17 Aug. 2017 http://www.bbc.com/news/politics/eu_referendum/results

⁶Castle, Stephen, and Steven Erlanger. "'Brexit' Will Require a Vote in Parliament, U.K. Court Rules." 3 Nov. 2016. The New York Times 17 Aug. 2017 <https://www.nytimes.com/2016/11/04/world/europe/uk-brexit-vote-parliament.html>

fied the European Council of its intent to leave, opening a 2-year period in which a leaving agreement is negotiated setting out the arrangements for the withdrawal and outlining the UK's future relationship with the EU.⁷ On 2 October 2016, Theresa May – who replaced David Cameron as prime minister when he stepped down the day following the Brexit vote – announced that she would trigger Article 50 by the end of March 2017.⁸

Donald Trump won the US presidential election to become the 45th president of the United States. In an election race where it appeared inevitable that Hillary Rodham Clinton would easily sweep both the popular and electoral vote from the vitriolic Trump campaign, the turmoil that followed the hacking of the Democratic National Committee's email systems by Russian intelligence groups in the late 2015 and their release in mid-2016 via WikiLeaks mortally wounded the front-running candidate's campaign. The FBI's announcement that it was reopening and once again closing its investigation into Hillary Clinton's poor handling of emails just days before the ballot served to reignite mistrust in the candidate. On 8 November 2016, Donald Trump won the electoral vote with 306 of the 538 votes available (270 votes are needed to win); Hillary Clinton had won the popular vote with a 48.5% share of the votes cast to Donald Trump's 46.4% share of votes.⁹ In his campaign, Donald Trump promised to build a wall on the US-Mexican border, to pull out of major US trade agreements, to review the benefit of the NATO alliance, and to take a tougher line with China and a softer line with Russia. Incidentally, the US CIA and the FBI have concluded with "high confidence" that Russian President Vladimir Putin had personally authorised the Kremlin operation to help elect Trump.¹⁰

In Syria, Bashar al-Assad's regime, backed by Russian air support, Lebanese Hezbollah, and Iranian militia, began launching an offensive operation against the rebel-held parts of the city of Aleppo in June 2016.¹¹ The rebels are supported by the United States, Turkey, Saudi Arabia, and other Gulf states. Despite a short-lived ceasefire attempt in September 2016, brokered by Russia and the United States, the assault by Syrian and Russian forces continued, developing into a humanitarian crisis as humanitarian convoys could not deliver aid because of the danger and the inability to obtain simultaneous security guarantees from all sides.¹² An evacuation

⁷Article 50. Consolidated version of the Treaty on European Union. OJ C 326, 26.10.2012, pp. 13–390 <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12012M/TXT&from=EN>

⁸"Brexit: Theresa May to trigger Article 50 by end of March." 2 Oct. 2016. BBC News 17 Aug. 2017 <http://www.bbc.com/news/uk-politics-37532364>

⁹"Presidential results." CNN 17 Aug. 2017 <http://edition.cnn.com/election/results/president>

¹⁰Lindsay, James M. "Ten Most Significant World Events in 2016." 16 Dec. 2016. Council on Foreign Relations 17 Aug. 2017 <https://www.cfr.org/blog/ten-most-significant-world-events-2016>

¹¹Darke, Diana. "Aleppo: Is besieged Syrian city facing last gasp?" 22 July 2016. BBC News 17 Aug. 2017 <http://www.bbc.com/news/world-middle-east-36853689>

¹²DeYoung, Karen. "United Nations: Aleppo faces widespread starvation without humanitarian aid." 10 Nov. 2016. The Washington Post 17 Aug. 2017 https://www.washingtonpost.com/world/national-security/united-nations-aleppo-faces-widespread-starvation-without-humanitarian-aid/2016/11/10/883b2d28-a77a-11e6-ba59-a7d93165c6d4_story.html

deal was reached between Russia and Turkey by mid-December 2016, to remove the last remaining residents of the rebel-held parts of the city.¹³ Just days later, in what appeared to be a backlash against Russian military involvement in the Syrian civil war and to disrupt the normalisation of Russian-Turkish relations, Russia's ambassador to Turkey was assassinated by an off-duty Turkish police officer.¹⁴

North Korea conducted its fourth underground nuclear test on 5 January 2016, claiming to have detonated its first hydrogen bomb¹⁵; its fifth underground nuclear test took place on 8 September 2016.¹⁶ In April 2016, it test-fired a ballistic missile from a Sinpo-class submarine and conducted three failed launches of its Musudan, which could be capable of reaching US military bases as far as Guam. The uptick in activities led US and South Korean intelligence officials to conclude that North Korea was now able to mount nuclear warheads on short- and medium-range missiles that would be capable of hitting Japan and South Korea.¹⁷ In June 2016, North Korea successfully test-launched an intermediate-range ballistic missile into high altitude; it was followed by the successful test of a submarine-launched ballistic missile on 23 August 2016, just 2 days after the United States and South Korea began their annual joint military exercises. The threat posed to the region by North Korea's nuclear programme combined with its gradually increasing missile technology motivated the United States and South Korea to deploy the American-built Terminal High Altitude Area Defense (THAAD) system in South Korea by the end of 2017; while the move will likely be welcomed by Japan's strategic interests, it will be vigorously protested by China.¹⁸

¹³ Hubbard, Ben and Hwaida Saad. "Aleppo Evacuation Effort Restarts, and Assad Calls It History in the Making." *The New York Times* 17 Aug. 2017 <https://www.nytimes.com/2016/12/15/world/middleeast/aleppo-syria-evacuation-deal.html>

¹⁴ Walker, Shaun, Kareem Shaheen, Martin Chulov, and Patrick Wintour. "Russian ambassador to Turkey shot dead by police officer in Ankara gallery." 20 Dec. 2016. *The Guardian* 17 Aug. 2017 <https://www.theguardian.com/world/2016/dec/19/russian-ambassador-to-turkey-wounded-in-ankara-shooting-attack>

¹⁵ Sanger, David E. and Choe Sang-Hun. "North Korea Says It Has Detonated Its First Hydrogen Bomb." 5 Jan. 2016. *The New York Times* 17 Aug. 2017 <https://www.nytimes.com/2016/01/06/world/asia/north-korea-hydrogen-bomb-test.html>

¹⁶ Forsythe, Michael. "North Korea's Nuclear Blasts Keep Getting Stronger." 9 Sept. 2016. *The New York Times* 17 Aug. 2017 <https://www.nytimes.com/2016/09/10/world/asia/north-korea-nuclear-weapons-tests.html>

¹⁷ Sanger, David E. and Choe Sang-Hun. "As North Korea's Nuclear Program Advances, U.S. Strategy Is Tested." 6 May 2016. *The New York Times* 17 Aug. 2017 <https://www.nytimes.com/2016/05/07/world/asia/north-korea-nuclear-us-strategy.html>

¹⁸ Sang-Hun, Choe. "North Korea Test-Fires Missile From Submarine." 23 Aug. 2016. *The New York Times* 17 Aug. 2017 <https://www.nytimes.com/2016/08/24/world/asia/north-korea-submarine-missile.html>

1.1.2.2 Environment

The Paris Agreement aims to keep global average temperature increases to below 2 °C above pre-industrial levels and to make more ambitious efforts to limit temperature increases even further to 1.5 °C and eliminate the increase of greenhouse gas emissions in the second half of the century.¹⁹ Following its creation in the 21st UN Framework Convention on Climate Change Conference of Parties (UN FCCC/COP), it rapidly entered into force amid uncertainties brought on by the US presidential election which threatened to undo the global initiative on combating climate change. The Paris Agreement entered into force on 4 November 2016, triggered by the ratification of the European Union on 5 October 2016, which met the threshold that at least 55 parties, accounting for at least an estimated 55% of total global greenhouse emissions, ratify the instrument. China and the United States, representing nearly 40% of global greenhouse gas emissions, ratified the Paris Agreement in September of 2016, followed by India at the beginning of October 2016.²⁰ And while Russia has yet to ratify the Paris Agreement, 121 parties to the UN FCCC/COP representing more than 79% of global emissions had ratified the Paris Agreement by the end of 2016.²¹

The 22nd UN FCCC/COP took place in Marrakech, Morocco, from 7 to 18 November 2016.²² The event also served as the first meeting of the governing body of the Paris Agreement (CMA) and marked the beginning of the Paris Agreement's implementation phase, following years of negotiation. Despite its rapid entry into force, in order for the Paris Agreement to be fully operational, its parties first need to elaborate and adopt decisions on a wide range of topics including mitigation (e.g. nationally determined contributions (NDCs)), adaptation communications, finance, transparency, “global stocktake”, and market and non-market mechanisms; they aim to do so by 2018, ahead of the 2020 timeline from which the agreement was intended to begin. Developed countries also released a roadmap for obtaining \$100 billion per year in climate funding by 2020, with estimates by the UN FCCC reaching \$741 billion for 2014. The 23rd UN FCCC/COP will be held from 6 to 17 November 2017 in Bonn, Germany.²³

¹⁹“The Paris agreement marks an unprecedented political recognition of the risks of climate change.” 12 Dec. 2015. The Economist 24 June 2016 <http://www.economist.com/node/21683990>

²⁰“Paris Agreement – Status of Ratification.” United Nations Framework Convention on Climate Change 28 Apr. 2017 http://unfccc.int/paris_agreement/items/9444.php

²¹“COP 22 Summary Report.” 20 Nov. 2016. IETA 28 Apr. 2017 http://www.ieta.org/resources/UNFCCC/COP22/COP22WRAP_FINAL.pdf

²²“OUTCOMES OF THE U.N. CLIMATE CHANGE CONFERENCE IN MARRAKECH | 22nd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 22) November 7–18, 2016.” 18 Nov. 2016. Centre for Climate and Energy Solutions 28 Apr. 2017 <https://www.c2es.org/international/negotiations/cop22-marrakech/summary>

²³Ibid.