

Noten

- Inleiding

1°C

- De krantenkop van de eeuw
- Het uitzicht van Mauna Loa
- Back to the future
- De Groenlandse meren
- Op dun ijs in het noordpoolgebied
- Stilvallen van de Golfstroom
- Antarctische ijsbergen
- Afsmeltende bergen
- Ongrijpbare overstromingen
- De orkaan de Houston trof
- Hoogwater
- Het verloren paradijs
- Op de vlucht voor de hitte
- Inbeuken op de natuur
- Wereldwijde verdorring
- Hittegolven in de oceaan
- Verbleekte koralen

2°C

- Dag nul op de Noordpool
- Het kantelpunt op Antarctica
- Dodelijke knokkelkoorts
- Voedselgebreken
- Zonnesteek
- Het droge continent
- Slinkende gletsjers
- Toekomstige overstromingen
- Klimaatontwrichting
- Het lot van het Amazonegebied
- Natuur in levensgevaar
- Lege oceanen

3°C

- Ongekend warm
- Instortende ijskappen, stijgende zeespiegels
- Heter dan de hel
- Oprukkende woestijnen
- Voedselschokken
- Grauwe bergen
- Dodelijke overstromingen
- Wilde dieren op de vlucht
- Het afsterven van het Amazonewoud
- De permafrost-terugkoppeling
- Een ijsvrije Noordelijke IJszee

4°C

- Dodelijke hitte
- Onbewoonbare aarde
- Stof en vuur
- Bergen smeltwater
- Aanzwellend water
- Orkaanalarm
- Mislukte oogsten
- Massa-extinctie
- Klimaatontwrichting in de oceanen
- Apocalyps op Antarctica
- De Arctische koolstofbom

5°C

- Hitteschok
- Klimaatvluchtoorden
- Ijsvrije poolgebieden
- Hyperthermische broeikassen
- Arctische regenwouden
- Zuurstofloze oceanen
- Kantelpunt bij twee graden?
- Leven en dood bij 5°C

6°C

- Catastrofaal falen
- De superbroeikas van het Krijt
- Het Grote Sterven
- Extinctiemechanismen
- Echo's uit het verleden
- De hel op aarde
- Het Venus-effect

Het eindspel

- Wat maakt een halve graad nu uit?
- Twee graden en hoger
- Op naar de vier graden
- Op naar de zes graden
- Kies voor het leven

Inleiding

- 17 **'zeer waarschijnlijk'** – IPCC, 2014: *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Core writing team, R.K. Pachauri and L.A. Meyer (eds). IPCC, Geneva, Switzerland. www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf
- 17 **'kans van 1 op 3,5 miljoen'** – blogs.scientificamerican.com/observations/five-sigmawhats-that/

1°C

De krantenkop van de eeuw

- 21 **'CO₂-concentratie'** – Dutton, A. et al., 2015: 'Sea-level rise due to polar ice-sheet mass loss during past warm periods', *Science*, 349 (6244), aaa4019
- 21 **'hogere warmteinhoud'** – Cheng, L. et al., 2019: 'How fast are the oceans warming?', *Science*, 363 (6423), 128-9
- 21 **'6 zettajoule'** – IPCC, 2019: 'Chapter 5: Changing Ocean, Marine Ecosystems, and Dependent Communities'. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner et al. (eds)]. In press, pp. 5-14
- 22 **'halve zettajoule'** – Harvey, C., 2018: 'The Oceans Are Heating Up Faster Than Expected', *E&E News*. www.scientificamerican.com/article/the-oceans-are-heating-up-faster-than-expected/
- 22 **'Hiroshima- atoombommen'** – Cook, J., 2013: '4 Hiroshima bombs worth of heat per second', Skeptical Science blog. www.skepticalscience.com/4-Hiroshima-bombs-worth-of-heat-per-second.html Op basis van de recentste ramingen van het warmtegehalte van de oceanen heb ik deze schatting naar onder bijgesteld, van 8 naar 6 zettajoule/jaar.
- 22 **'1.04°C boven'** – World Meteorological Organisation, 2018: 'WMO climate statement: past 4 years warmest on record'. public.wmo.int/en/media/press-release/climate-change-signals-and-impacts-continue-2018

Het uitzicht van Mauna Loa

- 23 **'Keeling in 1958'** – Keeling, C., 1998: 'Rewards and Penalties of Monitoring the Earth', *Annual Review of Energy and the Environment*, 23, 25-82
- 23 **'zijn zoon Ralph'** – Keeling, R., 2008: 'Recording Earth's Vital Signs', *Science*, 319 (5871), 1771-2
- 23 **'lavavelden aan de Mauna-Loa-top'** – Keeling, C., 1998: 'Rewards and Penalties of Monitoring the Earth'. Zie figuur 3.
- 24 **'fossiele brandstoffen'** – Scripps, 2013: 'Carbon dioxide at Mauna Loa Observatory reaches new milestone: Tops 400 ppm', persbericht. scripps.ucsd.edu/news/7992
- 25 **'Global Carbon Project'** – Zie www.globalcarbonproject.org/carbonbudget/index.htm
- 25 **'In 2019 vertraagde'** Zie www.globalcarbonproject.org/carbonbudget/index.htm
- 25 **'80% van die toename'** – Jackson, R. et al., 2017: 'Warning signs for stabilizing global CO₂ emissions', *Environmental Research Letters*, 12 (11), 110202
- 26 **'wereldwijde primaire energiegebruik'** – *BP Statistical Review of World Energy*. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf>, p. 11

Back to the future

- 26 'factor tien omhoog moeten' – Pielke Jr, R., 2019: 'The world is not going to halve carbon emissions by 2030, so now what?', *Forbes*. www.forbes.com/sites/rogerpielke/2019/10/27/the-world-is-not-going-to-reduce-carbon-dioxide-emissions-by-50-by-2030-now-what/
- 26 'nachtvorst' – Malamud, B. et al., 2011: 'Temperature trends at the Mauna Loa observatory, Hawaii', *Climate of the Past*, 7, 975-83
- 27 'temperatuurschommelingen' – Neukom, R. et al., 2019: 'No evidence for globally coherent warm and cold periods over the preindustrial Common Era', *Nature*, 571 (7766), 550-4
- 27 'vroege Holoceen' – Marcott, S. et al., 2013: 'A reconstruction of regional and global temperature for the past 11,300 years', *Science*, 339 (6124), 1198-201
- 28 'nijlpaarden' – Schreve, D., 2009: 'A new record of Pleistocene hippopotamus from River Severn terrace deposits, Gloucester, UK—palaeoenvironmental setting and stratigraphical significance', *Proceedings of the Geologists' Association*, 120 (1), 58-64
- 28 'nog in grotten' – Pedersen, R. et al., 2017: 'The last interglacial climate: comparing direct and indirect impacts of insolation changes', *Climate Dynamics*, 48 (9-10), 3391-407
- 28 '5-8°C hoger' – McFarlin, J. et al., 2018: 'Pronounced summer warming in northwest Greenland during the Holocene and Last Interglacial', *PNAS*, 115 (25), 6357-62
- 28 'Noordelijke Ijszee' – Stein, R. et al., 2017: 'Arctic Ocean sea ice cover during the penultimate glacial and the last interglacial', *Nature Communications*, 8 (373), 1-13
- 28 'zes tot tien meter' – Dutton, A. et al., 2015: 'Sea-level rise due to polar ice-sheet mass loss during past warm periods'
- 28 'een redelijke klomp' – Yau, A. et al., 2016: 'Reconstructing the last interglacial at Summit, Greenland: Insights from GISP2', *PNAS*, 113 (35), 9710-15

De Groenlandse meren

- 29 'verder landinwaarts' – Howat, I. et al., 2013: 'Brief Communication: "Expansion of meltwater lakes on the Greenland Ice Sheet"', *The Cryosphere*, 7 (1), 201-4
- 29 '50% hoger' – van As, D. et al., 2018: 'Reconstructing Greenland Ice Sheet meltwater discharge through the Watson River (1949-2017)', *Arctic, Antarctic, and Alpine Research*, 50 (1), e1433799
- 29 'hun kamp opbreken' – Goldberg, S., 2012: 'Greenland ice sheet melted at unprecedented rate during July', *Guardian*. www.theguardian.com/environment/2012/jul/24/greenland-ice-sheet-thaw-nasa
- 29 'omlaag sijpelde' – Nghiem, S. et al., 2012: 'The extreme melt across the Greenland ice sheet in 2012', *Geophysical Research Letters*, 39 (20), L20502
- 30 'smeltsnelheden van 2012' – Trusel, L. et al., 2018: 'Nonlinear rise in Greenland runoff in response to post-industrial Arctic warming', *Nature*, 564 (7734), 104-8
- 30 'snelst groeiende smeltzones' – Noël, B. et al., 2019: 'Rapid ablation zone expansion amplifies north Greenland mass loss', *Science Advances*, 5 (9), eaaw0123
- 30 'steeds vaker regen' – Oltmanns, M. et al., 2019: 'Increased Greenland melt triggered by large-scale, year-round cyclonic moisture intrusions', *The Cryosphere*, 13 (3), 815-25
- 30 'onbedekt ijs' – Noël, B. et al., 2019: 'Rapid ablation zone expansion amplifies north Greenland mass loss'
- 30 'met 15°C' – Saros, J. et al., 2019: 'Arctic climate shifts drive rapid ecosystem responses across the West Greenland landscape', *Environmental Research Letters*, 14 (7), 074027
- 31 'nog eens 1,1°C' – Ibid.
- 31 'omhoog tot 12°C' – Witze, A., 2019: 'Dramatic sea-ice melt caps tough Arctic summer', *Nature*, 573 (7744), 320-1
- 31 'pas in 2070' – Shankman, S., 2019: 'Greenland's melting: Heat waves are changing the landscape before their eyes', *InsideClimateNews*, insideclimatenews.org/news/01082019/greenland-climate-change-ice-sheet-melt-heat-wave-sea-level-rise-fish-global-warming
- 31 'gestegen tot 1,5 mm' – Witze, A., 2019: 'Dramatic sea-ice melt caps tough Arctic summer', *Nature*, 573, 320-1

Op dun ijs in het noordpoolgebied

- 31 **'wereldgemiddelde'** – Screen, J., 2017: 'Far-flung effects of Arctic warming', *Nature Geoscience*, 10 (4), 253-4
- 32 **'sterk lagedruksysteem'** – Moore, G., 2016: 'The December 2015 North Pole warming event and the increasing occurrence of such events', *Scientific Reports*, 6, 39084
- 32 **'66e breedtegraad'** – Overland, J. & Wang, M., 2016: 'Recent extreme Arctic temperatures are due to a split Polar Vortex', *Journal of Climate*, 29 (11), 5609-16
- 32 **'superextreem'** – Kim, B.-M. et al., 2017: 'Major cause of unprecedented Arctic warming in January 2016: Critical role of an Atlantic windstorm', *Scientific Reports*, 7, 40051
- 32 **'waterski's'** – Samenow, J., 2016: 'Weather buoy near North Pole hits melting point', *Washington Post*. www.washingtonpost.com/news/capital-weather-gang/wp/2016/12/22/weather-buoy-near-north-pole-hits-melting-point/
- 32 **'20°C hoger'** – Hegyi, B. & Taylor, P., 2018: 'The unprecedented 2016-2017 Arctic sea ice growth season: the crucial role of atmospheric rivers and longwave fluxes', *Geophysical Research Letters*, 45 (10), 5204-12
- 32 **'metingen met satellieten'** – National Snow and Ice Data Center, 2016: 'Sea ice hits record lows' – nsidc.org/arcticseaicenews/2016/12/arctic-and-antarctic-at-record-low-levels/
- 32 **'absoluut buitengewoon'** – Kahn, B., 2016: 'The Arctic is a seriously weird place right now', Climate Central. www.climatecentral.org/news/arctic-sea-ice-record-low-2016
- 32 **'menselijke koolstofuitstoot'** – World Weather Attribution, 2016: 'Unusually high temperatures at the North Pole, winter 2016'. www.worldweatherattribution.org/north-pole-nov-dec-2016/
- 32 **'13% per decennium'** – Serreze, M. & Meier, W., 2018: 'The Arctic's sea ice cover: trends, variability, predictability, and comparisons to the Antarctic', *Annals of the New York Academy of Sciences*, 1436 (1), 36-53
- 32 **'85% dunner'** – Screen, J., 2017: 'Far-flung effects of Arctic warming'
- 32 **'verdunning'** – McSweeney, R., 2018: 'Arctic sea ice summer minimum in 2018 is sixth lowest on record', Carbon Brief. www.carbonbrief.org/arctic-sea-ice-summer-minimum-in-2018-is-sixth-lowest-on-record
- 33 **'helemaal aan de pool'** – Simpkins, G., 2017: 'Extreme Arctic heat', *Nature Climate Change*, 7 (2), 95
- 33 **'poolzee-ijs'** – Sun, L. et al., 2018: 'Drivers of 2016 record Arctic warmth assessed using climate simulations subjected to Factual and Counterfactual forcing', *Weather and Climate Extremes*, 19, 1-9
- 33 **'82.300 km²'** – National Snow and Ice Data Center, 2018: 'September Arctic sea ice extent at 6th lowest in the satellite record'. nsidc.org/news/newsroom/arctic-sea-ice-extent-6th-lowest-september
- 33 **'continentale VS'** – Francis, J. & Vavrus, S., 2012: 'Evidence linking Arctic amplification to extreme weather in mid-latitudes', *Geophysical Research Letters*, 39 (6), L06801
- 33 **'13 van de laagste'** – *Nature*, 2019: 'Telescope windfall, genius grants and Arctic ice loss', The Week in Science: 27 September–3 October 2019.
- 33 **'meer zonnewarmte'** – Timmermans, M.-L. et al., 2018: 'Warming of the interior Arctic Ocean linked to sea ice losses at the basin margins', *Science Advances*, 4 (8), eaat6773
- 34 **'lineair verband'** – Notz, D. & Stroeve, J., 2016: 'Observed Arctic sea-ice loss directly follows anthropogenic CO₂ emission', *Science*, 354 (6313), 747-50
- 34 **'smelten van 2 ton'** – Steig, E., 2019: 'How fast will the Antarctic ice sheet retreat?', *Science*, 364 (6444), 936-7
- 34 **'magere volwassen beren'** – Pagano, A. et al., 2018: 'High-energy, high-fat lifestyle challenges an Arctic apex predator, the polar bear', *Science*, 359 (6375), 568-72
- 34 **'ecosysteem'** – twitter.com/AEDerocher/status/1057390924517408769
- 34 **'450 ppm'** – Amstrup, S. et al., 2010: 'Greenhouse gas mitigation can reduce sea-ice loss and increase polar bear persistence', *Nature*, 468, 955-8
- 35 **'Noordelijke Doorgang'** – Hauser, D. et al., 2018: 'Vulnerability of Arctic marine mammals to vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route', *PNAS*, 115 (29), 7617-22

- 35 'trekvisser' – Fossheim, M. et al., 2015: 'Recent warming leads to a rapid borealization of fish communities in the Arctic', *Nature Climate Change*, 5, 673-7
- 35 'zwarte zeekoeten' – Divoky, G. et al., 2015: 'Effects of recent decreases in Arctic sea ice on an ice-associated marine bird', *Progress in Oceanography*, 136, 151-61
- 35 'verhongerden' – Waters, H., 2017: 'Can these seabirds adapt fast enough to survive a melting Arctic?', *Audubon*. www.audubon.org/magazine/winter-2017/can-these-seabirds-adapt-fast-enough-survive
- 35 'Beringzee' – Duffy-Anderson, J. et al., 2019: 'Responses of the Northern Bering Sea and Southeastern Bering Sea pelagic ecosystems following record-breaking low winter sea ice', *Geophysical Research Letters*, 46 (16), 9833-42
- 35 'terrestrisch ecosysteem' – Schmidt, M. et al., 2019: 'An ecosystem-wide reproductive failure with more snow in the Arctic', *PLOS Biology*, 17 (10), e3000392
- 36 'bosbranden' – Cvijanovic, I. et al., 2017: 'Future loss of Arctic sea-ice cover could drive a substantial decrease in California's rainfall', *Nature Communications*, 8, 1947
- 36 'verminderde oogsten' – Kim, J.-S. et al., 2017: 'Reduced North American terrestrial primary productivity linked to anomalous Arctic warming', *Nature Geoscience*, 10, 572-6
- 36 'zuidelijke vlaktes' – Budikova, D. et al., 2019: 'United States heat wave frequency and Arctic Ocean marginal sea ice variability', *Journal of Geophysical Research: Atmospheres*, 124 (12), 6247-64
- 36 'omklappen' – Len, Y.-D. et al., 2018: 'Extreme weather in Europe linked to less sea ice and warming in the Barents Sea', *The Conversation*. theconversation.com/extreme-weather-in-europe-linked-to-less-sea-ice-and-warming-in-the-barents-sea-100628
- 36 'toewijzen van de oorzaak' – Screen, J. & Simmonds, I., 2013: 'Caution needed when linking weather extremes to amplified planetary waves', *PNAS*, 110 (26), E2327
- 36 'deze golven' – Petoukhov, V. et al., 2013: 'Quasiresonant amplification of planetary waves and recent Northern Hemisphere weather extremes', *PNAS*, 110 (14), 5336-41
- 36 'uiteenlopende gebeurtenissen' – Mann, M. et al., 2017: 'Influence of anthropogenic climate change on planetary wave resonance and extreme weather events', *Scientific Reports*, 7, 45242
- 36 'klimaatmodellen' – Ibid.
- 36 'verzwakt' – Kretschmer, M. et al., 2018: 'More-persistent weak stratospheric polar vortex states linked to cold extremes', *Bulletin of the American Meteorological Society*, January 2018, 49-60
- 36 'extreme winterse omstandigheden' – Zhang, J. et al., 2016: 'Persistent shift of the Arctic polar vortex towards the Eurasian continent in recent decades', *Nature Climate Change*, 6, 1094-9
- 36 'één onderzoek' – Kug, J.-S. et al., 2015: 'Two distinct influences of Arctic warming on cold winters over North America and East Asia', *Nature Geoscience*, 8, 759-62
- 37 'meteorologen' – Bellprat, O. et al., 2016: 'The role of Arctic sea ice and sea surface temperatures on the cold 2015 February over North America' [in *Explaining Extremes of 2015 from a Climate Perspective* supplement]. *Bulletin of the American Meteorological Society*, 97 (12), S36-S42
- 37 'veel sterker het geval' – Watts, J., 2018: 'Summer weather is getting "stuck" due to Arctic warming', *Guardian*. www.theguardian.com/environment/2018/aug/20/summer-weather-is-getting-stuck-due-to-arctic-warming
- 37 'honderd bosbranden' – Helmore, E., 2019: "'Unprecedented": more than 100 Arctic wildfires burn in worst ever season', *Guardian*. www.theguardian.com/world/2019/jul/26/unprecedented-more-than-100-wildfires-burning-in-the-arctic-in-worst-ever-season
- 37 'veengebieden' – Freedman, A., 2019: 'Greenland wildfire part of unusual spike in Arctic blazes this summer', *Washington Post*. www.washingtonpost.com/weather/2019/07/18/greenland-wildfire-part-unusual-spike-arctic-blazes-this-summer/
- 37 'jaaruitstoot van België' – Vaughan, A., 2019: 'Huge Arctic fires have now emitted a record-breaking amount of CO₂', *New Scientist*. www.newscientist.com/article/2211013-huge-arctic-fires-have-now-emitted-a-record-breaking-amount-of-co2/

Stilvallen van de Golfstroom

- 38 'plotseling weer aan' – Bromley, G., 2018: 'Interstadial rise and Younger Dryas demise of Scotland's last icefields', *Paleoceanography and Paleoclimatology*, 33, 412-29
- 38 'fluctuaties' – Henry, L. et al., 2016: 'North Atlantic ocean circulation and abrupt climate change during the last glaciation', *Science*, 353 (6298), 470-4
- 38 'machtige stroming' – Weijer, W. et al., 2019: 'Stability of the Atlantic Meridional Overturning Circulation: A review and synthesis', *Journal of Geophysical Research: Oceans*, 124, 5336-75
- 38 '17 Sv' – Ibid.
- 38 'kerncentrales' – Ongeveer 0,9 petawatt; 1 PW is 1015 watt, 1 GW is 109 watt. Per kerncentrale is gerekend met 1,5-2 GW.
- 38 'warmer dan' – Buckley, M. et al., 2016: 'Observations, inferences, and mechanisms of Atlantic Meridional Overturning Circulation variability: A review', *Reviews of Geophysics*, 54, 5-63
- 39 '15% is afgenomen' – Caesar, L. et al., 2018: 'Observed fingerprint of a weakening Atlantic Ocean overturning circulation', *Nature*, 556, 191-6
- 39 '1500 jaar' – Thornalley, D. et al., 2018: 'Anomalously weak Labrador Sea convection and Atlantic overturning during the past 150 years', *Nature*, 556, 227-30
- 39 'nog niet voorbij' – Smeed, D.A. et al., 2018: 'The North Atlantic Ocean is in a state of reduced overturning', *Geophysical Research Letters*, 45, 1527-33
- 39 'een later onderzoek' – Jackson, L. et al., 2016: 'Recent slowing of Atlantic overturning circulation as a recovery from earlier strengthening', *Nature Geoscience*, 9, 518-22
- 39 'minder zout' – Potsdam Institute for Climate Impact Research (PIK), 2018: 'Stronger evidence for a weaker Atlantic overturning', persbericht. www.pik-potsdam.de/news/press-releases/stronger-evidence-for-a-weaker-atlantic-overturning
- 40 'alle gevolgen vandien' – Sgubin, G. et al., 2017: 'Abrupt cooling over the North Atlantic in modern climate models', *Nature Communications*, 8, 14375

Antarctische ijsbergen

- 40 'gigantische ijsberg' – Geggel, L., 2018: 'Huge iceberg poised to break off Antarctica's Pine Island Glacier', *Livescience*. www.livescience.com/63782-pine-island-glacier-rift.html
- 40 'loskwam' – Geggel, L., 2018: 'Iceberg 4.5 times the size of Manhattan breaks off Antarctic glacier', *Livescience*. www.livescience.com/60530-pine-island-glacier-calves-in-antarctica.html
- 40 'tiende van een millimeter' – Christianson, K. et al., 2016: 'Sensitivity of Pine Island Glacier to observed ocean forcing', *Geophysical Research Letters*, 43, 10817-25
- 41 'onstuitbaar smeltproces' – Feldman, J. & Levermann, A., 2015: 'Collapse of the West Antarctic Ice Sheet after local destabilization of the Amundsen Basin', *PNAS*, 112 (46), 14191-6
- 41 'drie meter' – Bamber, J. et al., 2009: 'Reassessment of the potential sea-level rise from a collapse of the West Antarctic Ice Sheet', *Science*, 324 (5929), 901-3
- 41 'steeds harder' – Jenkins, A. et al., 2018: 'West Antarctic Ice Sheet retreat in the Amundsen Sea driven by decadal oceanic variability', *Nature Geoscience*, 11, 733-73
- 41 'structureel uit evenwicht' – Shepherd, A. et al., 2019: 'Trends in Antarctic Ice Sheet elevation and mass', *Geophysical Research Letters*, 46, 8174-83
- 41 'verdunningsgolf' – American Geophysical Union, 2019: 'Study finds 24 percent of West Antarctic ice is now unstable', persbericht. news.agu.org/press-release/study-finds-24-percent-of-west-antarctic-ice-is-now-unstable/
- 41 'ontdekkingsreizigers' – Bell, R. et al., 2017: 'Antarctic ice shelf potentially stabilized by export of meltwater in surface river', *Nature*, 544, 344-8
- 41 'smeltregime' – Bell, R. et al., 2018: 'Antarctic surface hydrology and impacts on ice-sheet mass balance', *Nature Climate Change*, 8, 1044-52

- 41 **'smeltwaterplassen'** – Stokes, C. et al., 2019: 'Widespread distribution of supraglacial lakes around the margin of the East Antarctic Ice Sheet', *Scientific Reports*, 9, 13823
- 41 **'Antarctische hittegolf'** – Rondanelli, R. et al., 2019: 'Strongest MJO on record triggers extreme Atacama rainfall and warmth in Antarctica', *Geophysical Research Letters*, 46, 3482-91
- 42 **'middenin de winter'** – Kuipers Munneke, P. et al., 2018: 'Intense winter surface melt on an Antarctic ice shelf', *Geophysical Research Letters*, 45, 7615-23
- 42 **'snelle aftakeling'** – Massom, R. et al., 2018: 'Antarctic ice shelf disintegration triggered by sea ice loss and ocean swell', *Nature*, 558, 383-9
- 42 **'Zuid-Holland'** – Hogg, A. & Hilmar Gudmundsson, G., 2017: 'Impacts of the Larsen-C Ice Shelf calving event', *Nature Climate Change*, 7, 540-2
- 42 **'verzesvoudigd'** – Rignot, E. et al., 2019: 'Four decades of Antarctic Ice Sheet mass balance from 1979-2017', *PNAS*, 116, 1095-103
- 42 **'ijzige continent'** – Medley, B. & Thomas, E., 2018: 'Increased snowfall over the Antarctic Ice Sheet mitigated twentieth-century sea-level rise', *Nature Climate Change*, 9, 34-9
- 42 **'reden tot bezorgdheid'** – Mooney, C. & Dennis, B., 2019: 'Ice loss from Antarctica has sextupled since the 1970s, new research finds', *Washington Post*. www.washingtonpost.com/energy-environment/2019/01/14/ice-loss-antarctica-has-sextupled-since-s-new-research-finds/
- 42 **'aardingslijnen'** – Konrad, H. et al., 2018: 'Net retreat of Antarctic glacier grounding lines', *Nature Geoscience*, 11, 258-62
- 43 **'ordes van grootte'** – Sutherland, D. et al., 2019: 'Direct observations of submarine melt and subsurface geometry at a tidewater glacier', *Science*, 365, 6451, 369-74

Afsmeltende bergen

- 44 **'afhankelijk van smeltwater'** – Buytaert, W. et al., 2017: 'Glacial melt content of water use in the tropical Andes', *Environmental Research Letters*, 12 (11), 114014
- 44 **'vergelijkbare verliezen'** – Rabatel, A. et al., 2013: 'Current state of glaciers in the tropical Andes: a multi-century perspective on glacier evolution and climate change', *The Cryosphere*, 7, 81-102
- 44 **'De bijdrage daarvan'** – Dussaillant, I. et al., 2019: 'Two decades of glacier mass loss along the Andes', *Nature Geoscience*, 12, 802-8
- 44 **'335 miljard ton'** – Zemp, M. et al., 2019: 'Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016', *Nature*, 568, 382-6
- 45 **'zonder precedent'** – Zemp, M. et al., 2015: 'Historically unprecedented global glacier decline in the early 21st century', *Journal of Glaciology*, 61 (228), 745-62
- 45 **'in de Sierra Nevada'** – Belmecheri, S. et al., 2016: 'Multi-century evaluation of Sierra Nevada snowpack', *Nature Climate Change*, 6, 2-3
- 45 **'slechts 5%'** – Ibid.
- 45 **'oostelijke Alpen'** – Colucci, R. et al., 2017: 'Unprecedented heat wave in December 2015 and potential for winter glacier ablation in the eastern Alps', *Scientific Reports*, 7, 7090
- 45 **'zware regenbuien'** – Stoffel, M. & Corona, C., 2018: 'Future winters glimpsed in the Alps', *Nature Geoscience*, 11, 458-60
- 46 **'dramatisch af'** – Fontrodona Bach, A. et al., 2018: 'Widespread and accelerated decrease of observed mean and extreme snow depth over Europe', *Geophysical Research Letters*, 45, 12312-19
- 46 **'medio februari'** – Mohdin, A., 2019: 'UK experiences hottest winter day ever as 21.2C is recorded in London', *Guardian*. www.theguardian.com/uk-news/2019/feb/26/uk-hottest-winter-day-ever
- 46 **'Dent du Géant'** – Evans, K., 2019: 'A hiker found this beautiful lake in the Alps. There's just one small problem', *IFL Science*. www.iflscience.com/environment/a-lake-popped-up-unexpectedly-in-the-alps-thanks-to-last-months-heatwave/

Ongrijpbare overstromingen

- 47 'in sommige regio's' – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C global warming on natural and human systems'. In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 201
- 47 '200 grootste rivieren' – Dai, A., 2016: 'Historical and future changes in streamflow and continental runoff'. In: *Terrestrial Water Cycle and Climate Change: Natural and Human-Induced Impacts*, Tang, Q. and T. Oki (eds). American Geophysical Union (AGU), Washington DC, USA, pp. 17-37
- 47 'meetstations' – Do, H.-X. et al., 2017: 'A global-scale investigation of trends in annual maximum streamflow', *Journal of Hydrology*, 552, 28-43
- 48 'meer waterdamp' – Fischer, E. & Knutti, R., 2016: 'Observed heavy precipitation increase confirms theory and early models', *Nature Climate Change*, 6, 986-91
- 48 'toename in de jaarmaxima' – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems', In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 193
- 48 'meer zware regelval' – Schleussner, C.-F. et al., 2017: 'In the observational record half a degree matters', *Nature Climate Change*, 7, 460-2
- 48 'sneller toe te nemen' – Li, C. et al., 2019: 'Larger increases in more extreme local precipitation events as climate warms', *Geophysical Research Letters*, 46, 6885-91
- 48 'recordhozen' – Lehmann, J. et al., 2015: 'Increased record-breaking precipitation events under global warming', *Climatic Change*, 132, 501-15
- 48 'stormen in het zuidwesten' – Demaria, E.M.C. et al., 2019: 'Intensification of the North American Monsoon rainfall as observed from a long term high density gauge network', *Geophysical Research Letters*, 46, 6839-47
- 48 'Centraal India' – Roxy, M. et al., 2017: 'A threefold rise in widespread extreme rain events over central India', *Nature Communications*, 8, 708
- 48 'droge gebieden' – Donat, M. et al., 2016: 'More extreme precipitation in the world's dry and wet regions', *Nature Climate Change*, 6, 508-13
- 48 'Sahelgebied' – Taylor, C. et al., 2017: 'Frequency of extreme Sahelian storms tripled since 1982 in satellite observations', *Nature*, 544, 475-8
- 48 'drie keer frequenter' – Yuan, X. et al., 2018: 'Anthropogenic intensification of Southern African flash droughts as exemplified by the 2015/16 season' [in *Explaining Extreme Events of 2016 from a Climate Perspective* supplement]. *Bulletin of the American Meteorological Society*, 99 (1), S86-S90
- 49 'Chinese geschiedenis' – Zhou, C. et al., 2018: 'Attribution of the July 2016 extreme precipitation event over China's Wuhan' [in *Explaining Extreme Events of 2016 from a Climate Perspective* supplement]. *Bulletin of the American Meteorological Society*, 99 (1), S107-S112
- 49 'mesoscale convective systems' – Feng, Z. et al., 2016: 'More frequent intense and long-lived storms dominate the springtime trend in central US rainfall', *Nature Communications*, 7, 13429
- 49 'geen enkel twijfel' – Fischer, E. & Knutti, R., 2016: 'Observed heavy precipitation increase confirms theory and early models'
- 49 'dichotomie' – Sharma, A. et al., 2018: 'If precipitation extremes are increasing, why aren't floods?' *Water Resources Research*, 54, 8545-51

De orkaan de Houston trof

- 50 'onuitwisbare inkt' – www.ksbw.com/article/east-texas-county-tells-residents-get-out-or-die/12142731
- 50 'brug in Houston' – www.ksbw.com/article/harvey-bodies-of-6-houston-family-members-recovered/12140867
- 50 'verdrongen moeder' – www.ksbw.com/article/harvey-horror-shivering-girl-3-clinging-to-drowned-mom/12145338
- 50 'Sinds 1919' – Blake, E. & Zelinsky, D., 2017: 'National Hurricane Center tropical cyclone report: Hurricane Harvey'. www.nhc.noaa.gov/data/tcr/AL092017_Harvey.pdf
- 50 'politieman' – www.chicagotribune.com/news/nationworld/ct-hurricane-harvey-flooding-houston-20170829-story.html
- 50 '90 minuten' – whnt.com/2017/08/26/24-hours-after-making-landfall-harveys-rainfall-prompts-flash-flood-emergencies-in-houston/
- 50 'Niagara-watervallen' – Er is gerekend met 22 km³ water (zie volgende bron – dit geldt voor de eerste neerslag na het aan land komen). Volgens en.wikipedia.org/wiki/Niagara_Falls stroomt over de Niagara-watervallen 2.400 m³/s, dus 2.400 · 3.600 · 24 = 207.360.000 m³/dag, oftewel zo'n 0.2 km³/dag. Voor 22 km³ zijn er dus 110 dagen nodig.
- 51 'terugveerde' – Milliner, C. et al., 2018: 'Tracking the weight of Hurricane Harvey's stormwater using GPS data', *Science Advances*, 4 (9), eaau2477
- 51 'tinten paars' – Schlanger, Z., 2017: 'Hurricane Harvey dropped so much rain the US National Weather Service added new colors to its maps', *Quartz*. qz.com/1063945/hurricane-harveys-rainfall-was-so-heavy-the-us-national-weather-service-added-new-colors-to-its-maps/
- 51 'volgebouwde eilanden' – www.chicagotribune.com/news/nationworld/ct-hurricane-harvey-flooding-houston-20170829-story.html
- 51 'uit het water gered' – Blake, E. & Zelinsky, D., 2017: 'National Hurricane Center Tropical Cyclone Report: Hurricane Harvey' (n. 153)
- 51 'hoofdstad' – Hannam, P., 2017: 'Houston, you have a problem, and some of it of your own making', *The Sydney Morning Herald*. www.smh.com.au/environment/climate-change/houston-you-have-a-problem-and-some-of-it-of-your-own-making-20170828-gy5cmv.html
- 52 'bijbels' – Emanuel, K., 2017: 'Assessing the present and future probability of Hurricane Harvey's rainfall', *PNAS*, 114 (48), 12681-4
- 53 'ongeveer 15%' – van Oldenborgh, G. et al., 2017: 'Attribution of extreme rainfall from Hurricane Harvey, August 2017', *Environmental Research Letters*, 12 (12), 124009. Hoewel er uit de diverse analyses en methodes in de betreffende studies verschillende schattingen rollen, zijn de conclusies opvallend eenduidig. Volgens één van de onderzoeken heeft klimaatverandering de neerslagvolume van Harvey met ongeveer 38% verhoogd en de storm ook drie keer waarschijnlijker gemaakt (Risser, M.D. et al., 2017: 'Attributable human-induced changes in the likelihood and magnitude of the observed extreme precipitation during Hurricane Harvey', *Geophysical Research Letters*, 44, 12457-64), terwijl een ander onderzoek spreekt van 20% meer extreme neerslag bij Harvey als gevolg van de klimaatopwarming na 1980 (Wang, S.-Y. et al., 2018: 'Quantitative attribution of climate effects on Hurricane Harvey's extreme rainfall in Texas', *Environmental Research Letters*, 13, 054014).
- 53 'hevige regenval' – Trenberth, K.E. et al., 2018: 'Hurricane Harvey links to ocean heat content and climate change adaptation', *Earth's Future*, 6, 730-44
- 53 'met 10%' – Kossin, J., 2018: 'A global slowdown of tropical-cyclone translation speed', *Nature*, 558, 104-7
- 53 'slachtoffer geworden' – Masters, J., 2019: 'Hurricane Dorian was worthy of a Category 6 rating', *Scientific American*. blogs.scientificamerican.com/eye-of-the-storm/hurricane-dorian-was-worthy-of-a-category-6-rating/
- 54 'de hoogste categorie' – Klotzbach, P. et al., 2018: 'The extremely active 2017 North Atlantic hurricane season', *Monthly Weather Review*, 146, 3425-43

- 54 'wat ook bleek' – Keellings, D. & Hernández Ayala, J., 2019: 'Extreme rainfall associated with Hurricane Maria over Puerto Rico and its connections to climate variability and change', *Geophysical Research Letters*, 46, 2964-73
- 54 'Noord-Atlantische Oceaan' – Murakami, H. et al., 2018: 'Dominant effect of relative tropical Atlantic warming on major hurricane occurrence', *Science*, 362 (6416), 794-9
- 55 'infrastructuur' – IPCC, 2019: 'Chapter 6: Extremes, Abrupt Changes and Managing Risks'. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, H.-O. Pörtner et al. (eds). In press, pp. 6-56
- 54 'omklappen' – Paerl, H. et al., 2019: 'Recent increase in catastrophic tropical cyclone flooding in coastal North Carolina, USA: Long-term observations suggest a regime shift', *Scientific Reports*, 9, 10620
- 54 'Klimaatmodellen lijken' – Patricola, C. & Wehner, M., 2018: 'Anthropogenic influences on major tropical cyclone events', *Nature*, 563, 339-46
- 54 'betrouwbare metingen' – Rahmstorf, S., 2017: 'Rising hazard of storm-surge flooding', *PNAS*, 114 (45), 11806-8
- 54 'Atlantische Oceaan' – Balaguru, K. et al., 2018: 'Increasing magnitude of hurricane rapid intensification in the central and eastern tropical Atlantic', *Geophysical Research Letters*, 45, 4238-47
- 54 'meetbare toename' – Bhatia, K. et al., 2019: 'Recent increases in tropical cyclone intensification rates', *Nature Communications*, 10, 635
- 55 '185 knopen' – Rogers, R. & Aberson, S., 2017: 'Rewriting the tropical record books: the extraordinary intensification of Hurricane Patricia (2015)', *Bulletin of the American Meteorological Society*, 2091-112
- 55 'westelijke deel' – Mei, W. & Xie, S.-P., 2016: 'Intensification of landfalling typhoons over the northwest Pacific since the late 1970s', *Nature Geoscience*, 9, 753-7
- 55 'aantal tropische stormen' – Kang, N.-Y. & Elsner, J., 2015: 'Trade-off between intensity and frequency of global tropical cyclones', *Nature Climate Change*, 5, 661-4

Hoogwater

- 55 'kustafslag' – IPCC, 2019: 'Chapter 6: Extremes, Abrupt Changes and Managing Risks'
- 56 'bijna 6 cm' – Nerem, R. et al., 2018: 'Climate-change-driven accelerated sea-level rise detected in the altimeter era', *PNAS*, 115 (9), 2022-5. Roughly 3mm/year 18.
- 56 'mondiale gemiddelde' – Kench, P. et al., 2018: 'Patterns of island change and persistence offer alternate adaptation pathways for atoll nations', *Nature Communications*, 9, 605
- 57 'hotspot' – Sallenger Jr, A. et al., 2012: 'Hotspot of accelerated sea-level rise on the Atlantic coast of North America', *Nature Climate Change*, 2, 884-8
- 57 'binnendringend zout water' – Kirwan, M. & Gedan, K., 2019: 'Sea-level driven land conversion and the formation of ghost forests', *Nature Climate Change*, 9, 450-7
- 57 'voormalig moerasgebied' – Upton, J., 2016: 'Ghost forests are eerie evidence of rising seas', grist.org/article/ghost-forests-are-eerie-evidence-of-rising-seas (van Climate Central doorgeplaatst)
- 58 'vijf waterstanden' – Sweet, W. et al., 2016: 'In tide's way: Southeast Florida's September 2015 sunny-day flood' [in *Explaining Extremes of 2015 from a Climate Perspective* supplement]. *Bulletin of the American Meteorological Society*, 97 (12), S25-S30
- 58 'afgelopen 30 jaar' – National Oceanic and Atmospheric Administration, 2018: *National Climate Report – May 2018. 2017 State of U.S. High Tide Flooding and a 2018 Outlook*. www.ncdc.noaa.gov/sotc/national/2018/05/supplemental/page-1
- 58 'ernstige kusterosie' – Albert, S. et al., 2016: 'Interactions between sea-level rise and wave exposure on reef island dynamics in the Solomon Islands', *Environmental Research Letters*, 11 (5), 054011
- 58 'talrijke eilandjes' – Garcin, M. et al., 2016: 'Lagoon islets as indicators of recent environmental changes in the South Pacific – The New Caledonian example', *Continental Shelf Research*, 122, 120-40
- 58 'opmerkelijk goed bestand' – Duvat, V., 2018: 'A global assessment of atoll island platform changes over the past decades', *WIREs Climate Change*, 10 (1), e557

Het verloren paradijs

- 59 **'totaal geen zicht'** – Hughes, T., 2018: “Like the gates of hell opened up”: Thousands fled Paradise ahead of Camp Fire’, *USA Today*. eu.usatoday.com/story/news/nation-now/2018/11/10/california-fires-thousands-fled-paradise-flames-roared/1962141002/
- 59 **'aardbodern'** – Chavez, N., 2018: 'Paradise lost: How California's deadliest wildfire unfolded', *CNN*. edition.cnn.com/2018/11/17/us/california-fires-wrap/index.html
- 59 **'DNA-monsters'** – Lam, K., 2018: 'Camp Fire: At least 196 people still on missing list; death toll remains at 88', *USA Today*. eu.usatoday.com/story/news/2018/11/28/camp-fire-death-toll-holds-steady-88-california/2146081002/
- 59 **'tragedie in Paradise'** – twitter.com/Weather_West/status/1061316105308753920
- 60 **'vijf jaar droogte'** – Hay, A., 2018: 'Deadly “megafires” the new normal in California', *Reuters*. uk.reuters.com/article/us-california-wildfires-megafires/deadly-megafires-the-new-normal-in-california-idUKKCN1NI2OG
- 60 **'uitdroging in de zomer'** – Swain, D. et al., 2018: 'Increasing precipitation volatility in twenty-first-century California', *Nature Climate Change*, 8, 427-33 (zie met name Figuur S7a)
- 60 **'verbluffende 500%'** – Williams, A.P. et al., 2019: 'Observed impacts of anthropogenic climate change on wildfire in California', *Earth's Future*, 7 (8), 892-910
- 60 **'met 1,4°C'** – Ibid.
- 60 **'grote bosgebieden'** – Holden, Z., 2018: 'Decreasing fire season precipitation increased recent western US forest wildfire activity', *PNAS*, 115 (36) E8349-E8357
- 61 **'355 km²'** – Dennison, P. et al., 2014: 'Large wildfire trends in the western United States, 1984-2011', *Geophysical Research Letters*, 41 (8), 2928-33
- 61 **'4,2 miljoen'** – Abatzoglou, J. & Williams, A.P., 2016: 'Impact of anthropogenic climate change on wildfire across western US forests', *PNAS*, 113 (42), 11770-5
- 61 **'90.000 bewoners'** – Petoukhov, V. et al., 2018: 'Alberta wildfire 2016: Apt contribution from anomalous planetary wave dynamics', *Scientific Reports*, 8, 12375
- 61 **'twee tot vier keer'** – Kirchmeier-Young, M. et al., 2019: 'Attribution of the influence of human-induced climate change on an extreme fire season', *Earth's Future*, 7, 2-10
- 62 **'de toendra'** – Editorial, 2017: 'Spreading like wildfire', *Nature Climate Change*, 7, 755
- 62 **'begroeide oppervlak'** – Jolly, W.M. et al., 2015: 'Climate-induced variations in global wildfire danger from 1979 to 2013', *Nature Communications*, 6, 7357
- 62 **'voetbalveld'** – Jones, J., 2018: 'One of the California wildfires grew so fast it burned the equivalent of a football field every second', *CNN*. edition.cnn.com/2018/11/09/us/california-wildfires-superlatives-wcx/index.html

Op de vlucht voor de hitte

- 62 **'eens in de vijf jaar'** – Christidis, N. et al., 2015: 'Dramatically increasing chance of extremely hot summers since the 2003 European heatwave', *Nature Climate Change*, 5, 46-50
- 62 **'gematigde Engeland'** – Chapman, S. et al., 2019: 'Warming trends in summer heatwaves', *Geophysical Research Letters*, 46 (3), 1634-40
- 62 **'38,7°C'** – BBC, 2019: 'UK heatwave: Met Office confirms record temperature in Cambridge' – www.bbc.co.uk/news/uk-49157898
- 63 **'Franse hittegolf'** – Schiermeier, Q., 2019: 'Climate change made Europe's mega-heatwave five times more likely', *Nature*, 571, 155
- 63 **'Koriat'** – Samenow, J., 2018: 'A city in Oman just posted the world's hottest low temperature ever recorded: 109 degrees', *Washington Post*. www.washingtonpost.com/news/capital-weather-gang/wp/2018/06/27/a-city-in-oman-just-set-the-worlds-hottest-low-temperature-ever-recorded-109-degrees/
- 63 **'Algerijnse Sahara'** – BBC, 2018: 'Five places that have just broken heat records'. www.bbc.co.uk/news/world-44779367
- 63 **'de gematigde zone'** – Vogel, M. et al., 2019: 'Concurrent 2018 hot extremes across Northern Hemisphere due to human-induced climate change', *Earth's Future*, 7, 692-703
- 63 **'een computersimulatie'** – Mann, M. et al., 2017: 'Record temperature streak bears anthropogenic fingerprint', *Geophysical Research Letters*, 44 (15), 7936-44

- 63 '70.000 extra sterfgevallen' – Robine, J.-M. et al., 2008: 'Death toll exceeded 70,000 in Europe during the summer of 2003', *Comptes Rendus Biologies*, 331, 171-8
- 64 '157 miljoen' – Watts, N. et al., 2018: 'The 2018 report of the *Lancet* Countdown on health and climate change: shaping the health of nations for centuries to come', *The Lancet*, [dx.doi.org/10.1016/S0140-6736\(18\)32594-7](https://doi.org/10.1016/S0140-6736(18)32594-7)
- 64 'noorden van Zweden' – Åström, C. et al., 2019: 'High mortality during the 2018 heatwave in Sweden', *Lakartidningen*, 116
- 64 '34.000 mensen' – Hayashida, K. et al., 2019: 'Severe heatwave in Japan', *Acute Medicine & Surgery*, 6, 206-7
- 64 'tropische gordel' – Staten, P. et al., 2018: 'Re-examining tropical expansion', *Nature Climate Change*, 8, 768-75
- 64 'Sahara' – Thomas, N. & Nigam, S., 2017: 'Twentieth-century climate change over Africa: Seasonal hydroclimate trends and Sahara Desert expansion', *Journal of Climate*, 31, 3349-70
- 64 'Middellandse Zee' – Gudmundsson, L. & Seneviratne, S., 2016: 'Anthropogenic climate change affects meteorological drought risk in Europe', *Environmental Research Letters*, 11 (4), 044005
- 64 '900 jaar' – Cook, B. et al., 2016: 'Spatiotemporal drought variability in the Mediterranean over the last 900 years', *Journal of Geophysical Research: Atmospheres*, 121 (5), 2060-74
- 65 'Syrische voorsteden' – Kelley, C. et al., 2015: 'Climate change in the Fertile Crescent and implications of the recent Syrian drought', *PNAS*, 112 (11), 3241-6
- 65 'etnisch verdeelde landen' – Schleussner, C.-F. et al., 2016: 'Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries', *PNAS*, 113 (33), 9216-9221

Inbeuken op de natuur

- 66 'geografische leefgebieden' – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems', In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 218
- 66 'klimaatttekort' – Devictor, V. et al., 2012: 'Differences in the climatic debts of birds and butterflies at a continental scale', *Nature Climate Change*, 2, 121-4
- 67 'strandloperkuikens' – McKinnon, L. et al., 2012: 'Timing of breeding, peak food availability, and effects of mismatch on chick growth in birds nesting in the High Arctic', *Canadian Journal of Zoology*, 90 (8), 961-71
- 67 'rupsenpiek' – Both, C. et al., 2006: 'Climate change and population declines in a long-distance migratory bird', *Nature*, 441, 81-3
- 67 'Britse eikenbossen' – Burgess, M. et al., 2018: 'Tritrophic phenological match-mismatch in space and time', *Nature Ecology & Evolution*, 2, 970-5
- 67 'Cerro de Pantiacolla' – Freeman, B. et al., 2018: 'Climate change causes upslope shifts and mountaintop extirpations in a tropical bird community', *PNAS*, 115 (47), 11982-7
- 68 'Mojave-woestijn' – Iknayan, K. & Beissinger, S., 2018: 'Collapse of a desert bird community over the past century driven by climate change', *PNAS*, 115 (34), 8597-602
- 68 '976 soorten' – Wiens, J., 2016: 'Climate-related local extinctions are already widespread among plant and animal species', *PLOS Biology*, 14 (12), e2001104
- 68 '97% van zijn leefgebied' – Howard, B.C., 2019: 'First mammal species recognized as extinct due to climate change', *National Geographic*. news.nationalgeographic.com/2016/06/first-mammal-extinct-climate-change-bramble-cay-melomys/
- 68 'uitgestorven verklaard' – BBC, 2019: 'Bramble Cay melomys: Climate change-ravaged rodent listed as extinct'. www.bbc.co.uk/news/world-australia-47300992
- 68 'hebben we gefaald' – Hannam, P., 2019: "'Our little brown rat": first climate change-caused mammal extinction', *Sydney Morning Herald*. www.smh.com.au/environment/climate-change/our-little-brown-rat-first-climate-change-caused-mammal-extinction-20190219-p50yry.html

- 68 'gewervelde diersoorten' – Woinarski, J. et al., 2016: 'The contribution of policy, law, management, research, and advocacy failings to the recent extinctions of three Australian vertebrate species', *Conservation Biology*, 31 (1), 13-23
- 69 'plantenetende zoogdieren' – Ripple, W. et al., 2015: 'Collapse of the world's largest herbivores', *Science Advances*, 1 (4), e1400103
- 69 'Sumatraanse neushoorn' – Ibid.
- 69 'lege baaien' – McCauley, D. et al., 2015: 'Marine defaunation: Animal loss in the global ocean', *Science*, 347 (6219), 1255641
- 69 'geschiedenis van de aarde' – Ceballos, G. et al., 2017: 'Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines', *PNAS*, 114 (30), E6089-E6096
- 69 'sinds 1970' – Rosenberg, K. et al., 2019: 'Decline of the North American avifauna', *Science*, 366 (6461), 120-124
- 69 'drie miljard' – Law, J., 2019: 'America's 3 billion missing birds: where did they go?', BirdLife. <https://www.birdlife.org/worldwide/news/america's-3-billion-missing-birds-where-did-they-go>
- 70 '75% is afgenomen' – Hallmann, C. et al., 2017: 'More than 75 percent decline over 27 years in total flying insect biomass in protected areas', *PLOS One*, 12 (10), e0185809
- 70 'Puerto Ricaanse regenwouden' – Lister, B. & Garcia, A., 2018: 'Climate-driven declines in arthropod abundance restructure a rainforest food web', *PNAS*, 115 (44), E10397-E10406
- 70 'insectensoorten' – Sánchez-Bayo, F. & Wyckhuys, C., 2019: 'Worldwide decline of the entomofauna: A review of its drivers', *Biological Conservation*, 232, 8-27
- 70 'Amerikaanse Middenwesten' – Wepprich, T. et al., 2019: 'Butterfly abundance declines over 20 years of systematic monitoring in Ohio, USA', *PLOS One*, 14 (7), e0216270
- 70 'hittegolfomstandigheden' – Sales, K. et al., 2018: 'Experimental heatwaves compromise sperm function and cause transgenerational damage in a model insect', *Nature Communications*, 9, 4771
- 71 'chytridiomycose' – Scheele, B. et al., 2019: 'Amphibian fungal panzootic causes catastrophic and ongoing loss of biodiversity', *Science*, 363 (6434), 1459-63
- 71 'handel in amfibieën' – Greenberg, D. & Palen, W., 2019: 'A deadly amphibian disease goes global', *Science*, 363 (6434), 1386-8
- 71 'Panamese gouden kikker' – Cohen, J. et al., 2018: 'An interaction between climate change and infectious disease drove widespread amphibian declines', *Global Change Biology*, 25 (3), 927-37

Wereldwijde verdorring

- 72 'Roemeense ecoloog' – Patrut, A. et al., 2018: 'The demise of the largest and oldest African baobabs', *Nature Plants*, 4, 423-6
- 72 'Homasi-boom' – Yong, E., 2018: 'Trees that have lived for millennia are suddenly dying', *The Atlantic*. www.theatlantic.com/science/archive/2018/06/baobab-trees-dying-climate-change/562499/
- 72 'Livingstone' – Clement-Davies, D., 2017: 'The enduring legacy of Chapman's Baobab', *Geographical*. geographical.co.uk/places/deserts/item/2137-the-enduring-legacy-of-the-fallen-baobab
- 72 'vasculaire stelsels' – Vidal, J., 2018: 'From Africa's baobabs to America's pines: Our ancient trees are dying', *HuffPost US*. www.huffingtonpost.co.uk/entry/trees-dying-climate-change-baobabs_us_5b2395c4e4b07cbr712d8ea1
- 73 'grootschalige bossterfte' – Anderegg, W. et al., 2013: 'Consequences of widespread tree mortality triggered by drought and temperature stress', *Nature Climate Change*, 3, 30-6
- 73 'sparren ... pijnbomen' – Allen, C. et al., 2010: 'A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests', *Forest Ecology and Management*, 259 (4), 660-84

- 73 'iconische bossen' – Davis, K. et al., 2019: 'Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration', *PNAS*, 116 (13), 6193-8
- 73 'Bosexperts' – Allen, C. et al., 2010: 'A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests'
- 73 'vertienvoudiging' – Young, D. et al., 2016: 'Long term climate and competition explain forest mortality patterns under extreme drought', *Ecology Letters*, 20 (1), 78-86
- 73 'vochtgrens in de bodem' – Goulden, M. & Bales, R., 2019: 'California forest die-off linked to multi-year deep soil drying in 2012-2015 drought', *Nature Geoscience*, 12, 632-7
- 74 'vergroenden' – Zhu, Z. et al., 2016: 'Greening of the Earth and its drivers', *Nature Climate Change*, 6, 791-5
- 74 'begonnen uit te drogen' – Yuan, W. et al., 2019: 'Increased atmospheric vapor pressure deficit reduces global vegetation growth', *Science Advances*, 5 (8), eaax1396

Hittegolven in de oceaan

- 75 'daling in pH' – Hurd, C. et al., 2018: 'Current understanding and challenges for oceans in a higher-CO₂ world', *Nature Climate Change*, 8, 686-94
- 75 'chemische doorbranding' – Sulpis, O. et al., 2018: 'Current CaCO₃ dissolution at the seafloor caused by anthropogenic CO₂', *PNAS*, 115 (46), 11700-5
- 75 '77 miljard' – Schmidtko, S. et al., 2017: 'Decline in global oceanic oxygen content during the past five decades', *Nature*, 542, 335-9
- 75 'volledig zuurstoffloos' – Breitburg, D. et al., 2018: 'Declining oxygen in the global ocean and coastal waters', *Science*, 359 (6371), eaam7240
- 76 'volledig uitgeteerd' – Welch, C., 2015: 'Mass death of seabirds in Western U.S. is "unprecedented"', *National Geographic*. news.nationalgeographic.com/news/2015/01/150123-seabirds-mass-die-off-uklet-california-animals-environment/
- 76 'de naam "The Blob"' – University of Washington, 2015: "'Warm blob" in Pacific Ocean linked to weird weather across the US', persbericht www.sciencedaily.com/releases/2015/04/150409143041.htm
- 76 'sinds 1985' – Jones, T. et al., 2018: 'Massive mortality of a planktivorous seabird in response to a marine heatwave', *Geophysical Research Letters*, 45, 3193-202
- 76 '46 dode walvissen' – National Oceanic and Atmospheric Administration Fisheries, ongedateerd: '2015-2016 Large whale unusual mortality event in the Western Gulf of Alaska, United States and British Columbia'. www.fisheries.noaa.gov/national/marine-life-distress/2015-2016-large-whale-unusual-mortality-event-western-gulf-alaska
- 76 'Californische kust' – National Oceanic and Atmospheric Administration Fisheries, ongedateerd: '2015-2019 Guadalupe fur seal unusual mortality event in California, Oregon and Washington'. www.fisheries.noaa.gov/national/marine-life-distress/2015-2018-guadalupe-fur-seal-unusual-mortality-event-california
- 77 'noordoostelijke Stille Oceaan' – Di Lorenzo, E. & Mantua, N., 2016: 'Multi-year persistence of the 2014/15 North Pacific marine heatwave', *Nature Climate Change*, 6, 1042-7
- 77 'hoofdstad van Uruguay' – Manta, G. et al., 2018: 'The 2017 record marine heatwave in the Southwestern Atlantic shelf', *Geophysical Research Letters*, 45, 12449-56
- 77 'West-Australië' – Arias-Ortiz, A. et al., 2018: 'A marine heatwave drives massive losses from the world's largest seagrass carbon stocks', *Nature Climate Change*, 8, 338-44
- 77 'tuimelaarpopulatie' – Wild, S. et al., 2019: 'Long-term decline in survival and reproduction of dolphins following a marine heatwave', *Current Biology*, 29 (7), R239-R240
- 77 '1982 en 2016' – Frölicher, T. et al., 2018: 'Marine heatwaves under global warming', *Nature*, 560, 360-4
- 77 '50% hoger' – Smale, D. et al., 2019: 'Marine heatwaves threaten global biodiversity and the provision of ecosystem services', *Nature Climate Change*, 9, 306-12
- 77 'de kelp en de zeegrassen' – Carrington, D., 2019: 'Heatwaves sweeping oceans "like wildfires", scientists reveal', *Guardian*. www.theguardian.com/environment/2019/mar/04/heatwaves-sweeping-oceans-like-wildfires-scientists-reveal

Verbleekte koralen

- 78 '3,863 riffen' – Hughes, T. et al., 2018: 'Global warming transforms coral reef assemblages', *Nature*, 556, 492-6
- 78 'storm losbarstte' – Ibid.
- 79 'bijna nergens ter wereld' – Hughes, T. et al., 2018: 'Spatial and temporal patterns of mass bleaching of corals in the Anthropocene', *Science*, 359 (6371), 80-3
- 79 'eiland Orpheus' – Hughes, T. et al., 2017: 'Global warming and recurrent mass bleaching of corals', *Nature*, 543, 373-7
- 79 'overgeslagen' – Leggat, W. et al., 2019: 'Rapid coral decay is associated with marine heatwave mortality events on reefs', *Current Biology*, 29 (16), P2723-30
- 79 'catastrofale gevolgen' – Stuart-Smith, R. et al., 2018: 'Ecosystem restructuring along the Great Barrier Reef following mass coral bleaching', *Nature*, 560, 92-6
- 79 '90 meter' – Schramek, T. et al., 2018: 'Depth-dependent thermal stress around corals in the tropical Pacific Ocean', *Geophysical Research Letters*, 45, 9739-47
- 79 'tegen verbleeking bestand' – Burt, J. et al., 2019: 'Causes and consequences of the 2017 coral bleaching event in the southern Persian/Arabian Gulf', *Coral Reefs*, 38 (4), 567-89
- 79 'een paar taaie soorten' – EurekAlert, 2018: 'Global warming is transforming the Great Barrier Reef'. www.eurekalert.org/pub_releases/2018-04/acoe-gwio41718.php
- 79 'ecologisch verdriet' – Conroy, G., 2019: "'Ecological grief" grips scientists witnessing Great Barrier Reef's decline', *Nature*, 573, 318-19
- 80 'jonge koralen' – Hughes, T. et al., 2018: 'Ecological memory modifies the cumulative impact of recurrent climate extremes', *Nature Climate Change*, 9, 40-3
- 80 '80% gekelderd' – Price, N. et al., 2019: 'Global biogeography of coral recruitment: tropical decline and subtropical increase', *Marine Ecology Progress Series*, 621, 1-17
- 80 'voortplantingscapaciteit' – Hughes, T. et al., 2019: 'Global warming impairs stock-recruitment dynamics of corals', *Nature*, 568, 387-90
- 80 'Rode Zee' – Shlesinger, T. & Loya, Y., 2019: 'Breakdown in spawning synchrony: A silent threat to coral persistence', *Science*, 365 (6457), 1002-17

2°C

Dag nul op de Noordpool

- 85 'Arctische zee-ijs' – Fischer, H. et al., 2018: 'Palaeoclimate constraints on the impact of 2 °C anthropogenic warming and beyond', *Nature Geoscience*, 11, 474-85
- 85 'op 2°C kunnen houden' – Screen, J. & Williamson, D., 2017: 'Ice-free Arctic at 1.5 °C?', *Nature Climate Change*, 7, 230-3
- 85 'onderzoek uit 2018' – Jahn, A., 2018: 'Reduced probability of ice-free summers for 1.5 °C compared to 2 °C warming', *Nature Climate Change*, 8, 409-13
- 86 'uiteindelijke drempel' – Niederdrenk, A.L. & Notz, D., 2018: 'Arctic sea ice in a 1.5 °C warmer world', *Geophysical Research Letters*, 45, 1963-71. Hier gaat het om maandgemiddelden, dus niet direct vergelijkbaar met de momentopname in de eerder aangehaalde bron. Ik gebruik daarom de meer gevoelige modelraming uit dit artikel.
- 86 'eens-per-40-jaar' – Sanderson, B. et al., 2017: 'Community climate simulations to assess avoided impacts in 1.5 and 2°C futures', *Earth System Dynamics*, 8, 827-47
- 86 'drastische snelheid' – Notz, D. & Stroeve, J., 2016: 'Observed Arctic sea-ice loss directly follows anthropogenic CO₂ emission', *Science*, 354 (6313), 747-50
- 86 'onderschatting' – Massonnet, F. et al., 2012: 'Constraining projections of summer Arctic sea ice', *The Cryosphere*, 6, 1383-94
- 86 'eind van de Jaren twintig' – Wang, M. & Overland, J., 2009: 'A sea ice free summer Arctic within 30 years?', *Geophysical Research Letters*, 36 (7), L07502
- 86 'de jaren dertig' – Wang, M. & Overland, J., 2012: 'A sea ice free summer Arctic within 30 years: An update from CMIP5 models', *Geophysical Research Letters*, 39, L18501

- 86 'CO₂-gehalte' – Stein, R. et al., 2016: 'Evidence for ice-free summers in the late Miocene central Arctic Ocean', *Nature Communications*, 7, 11148
- 87 'tropische regenzone' – Sun, L., 2018: 'Evolution of the global coupled climate response to Arctic sea ice loss during 1990-2090 and its contribution to climate change', *Journal of Climate*, 7823-43
- 87 "weerblokkades" – Chemke, R. et al., 2019: 'The effect of Arctic sea ice loss on the Hadley circulation', *Geophysical Research Letters*, 46, 963-72
- 87 'hydrologische cyclus' – Deser, C. et al., 2015: 'The role of ocean-atmosphere coupling in the zonal-mean atmospheric response to Arctic sea ice loss', *Journal of Climate*, 28, 2168-86
- 87 'doen gevoelen' – Sun, L., 2018: 'Evolution of the global coupled climate response to Arctic sea ice loss during 1990-2090 and its contribution to climate change'
- 87 'regen in plaats van sneeuw' – Bintanja, R. & Andry O., 2017: 'Towards a rain-dominated Arctic', *Nature Climate Change*, 7, 263-7
- 88 'regen op de sneeuwlaag' – Tyler, N., 2010: 'Climate, snow, ice, crashes, and declines in populations of reindeer and caribou (*Rangifer tarandus* L.)', *Ecological Monographs*, 80 (2), 197-219
- 88 'Nunavut' – Van Dusen, J., 2017: 'Starvation after weather event killed caribou on remote Arctic island', *CBC News*. www.cbc.ca/news/canada/north/mystery-caribou-deaths-arctic-island-1.3962747
- 88 'monsterachtige' – Joyce, C., 2009: 'When rain falls on snow, arctic animals may starve', National Public Radio. www.npr.org/templates/story/story.php?storyId=111109436
- 88 'Svalbard' – Hansen, B. et al., 2013: 'Climate events synchronize the dynamics of a resident vertebrate community in the High Arctic', *Science*, 339 (6117), 313-15
- 88 'groei van het plankton' – Trainer, V. et al., 2019: 'Where the sea ice recedes, so does an Alaska way of life', *New York Times*. www.nytimes.com/2019/09/25/opinion/climate-change-ocean-Arctic.html
- 89 'uitgemergelde ijseberen' – Mittermeier, C., 2018: 'Starving-polar-bear photographer recalls what went wrong', *National Geographic*. www.nationalgeographic.com/magazine/2018/08/explore-through-the-lens-starving-polar-bear-photo/
- 89 '180 dagen' – Pilfold, N. et al., 2016: 'Mass loss rates of fasting polar bears', *Physiological and Biochemical Zoology*, 89, 5
- 89 'noordelijk Alaska' – Rode, K. et al., 2010: 'Reduced body size and cub recruitment in polar bears associated with sea ice decline', *Ecological Applications*, 20 (3), 768-82
- 89 'bevoren leefmilieu' – Regehr, E. et al., 2016: 'Conservation status of polar bears (*Ursus maritimus*) in relation to projected sea-ice declines', *Biology Letters*, 12, 12
- 90 '70%' – Hjort, J. et al., 2018: 'Degrading permafrost puts Arctic infrastructure at risk by mid-century', *Nature Communications*, 9, 5147
- 90 'alle drie in Rusland' – Chadburn, S. et al., 2017: 'An observation-based constraint on permafrost loss as a function of global warming', *Nature Climate Change*, 7, 340-4
- 90 '60-70 miljard' – Comyn-Platt, E. et al., 2018: 'Carbon budgets for 1.5 and 2 °C targets lowered by natural wetland and permafrost feedbacks', *Nature Geoscience*, 11, 568-73
- 90 'vóór 2100' – Burke, E. et al., 2018: 'CO₂ loss by permafrost thawing implies additional emissions reductions to limit warming to 1.5 or 2 °C', *Environmental Research Letters*, 13, 2, 024024
- 90 'in de vorm van methaan' – Knoblauch, C. et al., 2018: 'Methane production as key to the greenhouse gas budget of thawing permafrost', *Nature Climate Change*, 8, 309-12
- 90 '6,6 miljoen km²' – Chadburn, S. et al., 2017: 'An observation-based constraint on permafrost loss as a function of global warming'
- 90 '30-50 miljard' – Comyn-Platt, E. et al., 2018: 'Carbon budgets for 1.5 and 2 °C targets lowered by natural wetland and permafrost feedbacks'
- 91 '345 miljard' – Burke, E. et al., 2018: 'CO₂ loss by permafrost thawing implies additional emissions reductions to limit warming to 1.5 or 2 °C'

Het kantelpunt op Antarctica

- 91 **'verre overtreft'** – Parkinson, C., 2019: 'A 40-y record reveals gradual Antarctic sea ice increases followed by decreases at rates far exceeding the rates seen in the Arctic', *PNAS*, 116 (29), 14414-23
- 91 **'1,5°C en 2°C'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5 C Global Warming on Natural and Human Systems'. In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press. p. 257
- 92 **'20 meter in het verschieft'** – DeConto, R. & Pollard, D., 2016: 'Contribution of Antarctica to past and future sea-level rise', *Nature*, 531, 591-7
- 92 **'geslonken en dunner'** – Nick, F. et al., 2013: 'Future sea-level rise from Greenland's main outlet glaciers in a warming climate', *Nature*, 497, 235-8
- 92 **'onomkeerbaar massaverlies'** – Pattyn, F. et al., 2018: 'The Greenland and Antarctic ice sheets under 1.5 °C global warming', *Nature Climate Change*, 8, 1053-61
- 93 **'zeer gematigde opwarming'** – Hoffman, J. et al., 2017: 'Regional and global sea-surface temperatures during the last interglaciation', *Science*, 355 (6322), 276-9
- 94 **'700%'** – IPCC, 2019: 'Summary for Policymakers'. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, H.-O. Pörtner et al. (eds). In press
- 94 **'79 miljoen mensen'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems', In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 231
- 94 **'oprukkende oceaan'** – Davies, K.F. et al., 2018: 'A universal model for predicting human migration under climate change: examining future sea level rise in Bangladesh', *Environmental Research Letters*, 13 (6), 064030
- 94 **'kustgebieden van de wereld'** – Vousdoukas, M. et al., 2018: 'Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard', *Nature Communications*, 9, 2360
- 94 **'50 miljoen inwoners'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems' In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 231
- 94 **'1,4 biljoen dollar'** – Jevrejeva, S. et al., 2018: 'Flood damage costs under the sea level rise with warming of 1.5°C and 2°C', *Environmental Research Letters*, 13 (7), 074014
- 94 **'1 miljoen dollar'** – The Center for Climate Integrity, 2019: *High Tide Tax – The Price to Protect Coastal Communities from Rising Seas*. www.climatecosts2040.org/files/ClimateCosts2040_Report.pdf
- 94 **'atol-eilanden'** – Storlazzi, C. et al., 2018: 'Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding', *Science Advances*, 4 (4), eaap9741

Dodelijke knokkelkoorts

- 96 **'toename van 200%'** – Maldives Independent, 2019: 'Maldives records sharp rise in dengue cases'. reliefweb.int/report/maldives/maldives-records-sharp-rise-dengue-cases
- 96 **'100 landen'** – World Health Organization, 2019: 'Dengue and severe dengue – key facts'. www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
- 96 **'390 miljoen'** – Bhatt, S. et al., 2013: 'The global distribution and burden of dengue', *Nature*, 496, 504-7

- 96 **'navenant groter'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems', In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 241
- 96 **'1000 km'** – Ogden, N. et al., 2014: 'Recent and projected future climatic suitability of North America for the Asian tiger mosquito *Aedes albopictus*', *Parasites and Vectors*, 7, 532
- 96 **'40%'** – Colón-González, F. et al., 2013: 'The effects of weather and climate change on dengue', *PLOS Neglected Tropical Diseases*, 7 (11), e2503
- 96 **'nieuwe infectiehaarden'** – Bouzid, M. et al., 2014: 'Climate change and the emergence of vector-borne diseases in Europe: case study of dengue fever', *BMC Public Health*, 14, 781
- 96 **'Delen van Afrika'** – Mweya, C. et al., 2016: 'Climate change influences potential distribution of infected *Aedes aegypti* co-occurrence with dengue epidemics risk areas in Tanzania', *PLOS One*, 11 (9), e0162649
- 96 **'knokkelkoortsgevallen'** – Colón-González, F. et al., 2018: 'Limiting global-mean temperature increase to 1.5-2°C could reduce the incidence and spatial spread of dengue fever in Latin America', *PNAS*, 115 (24), 6243-8
- 97 **'Amerikaans-Mexicaanse grens'** – Reiter, P. et al., 2003: 'Texas lifestyle limits transmission of dengue virus', *Emerging Infectious Diseases*, 9 (1), 86-9
- 97 **'Amerikaanse burgers'** – Centers for Disease Control and Prevention, ongedateerd: Dengue and Dengue Hemorrhagic Fever. www.cdc.gov/dengue/resources/denguedhf-information-for-health-care-practitioners_2009.pdf
- 97 **'genetische manipulatie'** – Lynas, M., 2016: 'Alert! There's a dangerous new viral outbreak: Zika conspiracy theories', *Guardian*. www.theguardian.com/world/2016/feb/04/alert-theres-a-dangerous-new-viral-outbreak-zika-conspiracy-theories
- 98 **'elke twee minuten'** – Target Malaria, ongedateerd: 'Why malaria matters'. targetmalaria.org/why-malaria-matters/

Voedsel feiten

- 98 **'calorische opbrengst'** – Ray, D. et al., 2019: 'Climate change has likely already affected global food production', *PLOS ONE*, 14 (5), e0217148
- 99 **'99 kcal'** – Springmann, M. et al., 2016: 'Global and regional health effects of future food production under climate change: a modelling study', *The Lancet*, 387 (10031), 1937-46
- 100 **'opbrengst met 1%'** – Lobell, D. et al., 2011: 'Nonlinear heat effects on African maize as evidenced by historical yield trials', *Nature Climate Change*, 1, 42-5
- 100 **'hoge droogtetolerantie'** – Lynas, M., 2017: 'Tanzania is burning GM corn while people go hungry', *Little Atoms*. littleatoms.com/science-world/tanzania-burning-GM-corn-while-people-go-hungry
- 100 **'het nieuwe normaal'** – Zampieri, M. et al., 2019: 'When will current climate extremes affecting maize production become the norm?' *Earth's Future*, 7, 113-22
- 101 **'verlies van de maïsoogst'** – Zhao, C. et al., 2017: 'Temperature increase reduces global yields of major crops in four independent estimates', *PNAS*, 114 (35), 9326-31
- 101 **'met 6% zal slinken'** – Asseng, S. et al., 2014: 'Rising temperatures reduce global wheat production', *Nature Climate Change*, 5, 143-7; Liu, B. et al., 2016: 'Similar estimates of temperature impacts on global wheat yield by three independent methods', *Nature Climate Change*, 6, 1130-6
- 101 **'25% afnemen'** – Deutsch, C. et al., 2018: 'Increase in crop losses to insect pests in a warming climate', *Science*, 361, 916-19
- 102 **'eiwit-, zink- en ijzergehaltes'** – Smith, M. & Myers, S., 2018: 'Impact of anthropogenic CO₂ emissions on global human nutrition', *Nature Climate Change*, 8, 834-9

Zonnesteek

- 103 'verwachte klimaat' – Bastin, J.-F. et al., 2019: 'Understanding climate change from a global analysis of city analogues', *PLOS ONE* 14 (7), e0217592
- 104 'warmere weersomstandigheden' – Matthews, T. et al., 2017: 'Communicating the deadly consequences of global warming for human heat stress', *PNAS*, 114 (15), 3861-6
- 104 'handleiding' – Sengupta, S., 2019: 'Red Cross to world's cities: Here's how to prevent heat wave deaths', *New York Times*. www.nytimes.com/2019/07/16/climate/red-cross-heat-waves.html
- 105 'Moskou in smog' – *BBC News*, 2012: 'Death rate doubles in Moscow as heatwave continues'. www.bbc.co.uk/news/world-europe-10912658
- 105 'smelten van het asfalt' – Wingfield-Hayes, R., 2010: 'Russian deaths mount as heatwave and vodka mix', *BBC News*. www.bbc.co.uk/news/world-europe-10646106
- 105 'uniek fenomeen' – Hermant, N., 2010: 'Morgues fill as deaths double in sweltering Moscow', *ABC News*. www.abc.net.au/news/2010-08-10/morgues-fill-as-deaths-double-in-sweltering-moscow/938856
- 105 'export van tarwe' – Kramer, A., 2010: 'Russia, crippled by drought, bans grain exports', *New York Times*. www.nytimes.com/2010/08/06/world/europe/06russia.html
- 105 'uiteindelijk dodental' – Barriopedro, D. et al., 2011: 'The hot summer of 2010: redrawing the temperature record map of Europe', *Science*, 332 (6026), 220-4
- 105 '38,2°C' – Ibid.
- 105 'Jashkul' – Met Office, ongedateerd: 'The Russian heatwave of summer 2010'. www.metoffice.gov.uk/weather/learn-about/weather/case-studies/russian-heatwave
- 105 'Amerikaanse Nationale Weerdienst' – National Weather Service, ongedateerd: 'Heat'. www.weather.gov/bgm/heat
- 106 '911 te bellen' – National Weather Service, ongedateerd: 'Heat cramps, exhaustion, stroke'. www.weather.gov/safety/heat-illness
- 106 'megahittegolf van 2003' – Mitchell, D. et al., 2018: 'Extreme heat-related mortality avoided under Paris Agreement goals', *Nature Climate Change*, 8, 551-3
- 106 '500 jaar' – Barriopedro, D. et al., 2011: 'The hot summer of 2010: redrawing the temperature record map of Europe'
- 106 'Ook in 2017' – Sánchez-Benítez, A. et al., 2018: 'June 2017: The earliest European summer mega-heatwave of reanalysis period', *Geophysical Research Letters*, 45, 1955-62
- 106 'gemiddelde Europese zomer' – Suarez-Gutierrez, L. et al., 2018: 'Internal variability in European summer temperatures at 1.5 °C and 2 °C of global warming', *Environmental Research Letters*, 13, 064026
- 106 '163 miljoen' – King, A., 2018: 'Reduced heat exposure by limiting global warming to 1.5 °C', *Nature Climate Change*, 8, 549-51
- 106 'dodelijke zomer van 2003' – King, A. & Karoly, D., 2017: 'Climate extremes in Europe at 1.5 and 2 degrees of global warming', *Environmental Research Letters*, 12, 114031
- 106 'sterfgevallen' – *The Lancet* & CPME, 2018: *Lancet Countdown 2018 Report: Briefing for EU Policymakers*. www.lancetcountdown.org/media/1420/2018-lancet-countdown-policy-brief-eu.pdf
- 106 '49°C' – Australian Government Bureau of Meteorology, 2013: *Special Climate Statement 43 – Extreme Heat in January 2013*. www.bom.gov.au/climate/current/statements/scs43e.pdf
- 106 'vijf keer zo waarschijnlijk' – Lewis, S. & Karoly, D., 2013: 'Anthropogenic contributions to Australia's record summer temperatures of 2013', *Geophysical Research Letters*, 40 (14), 3705-9
- 106 'Australië van de toekomst' – King, A. et al., 2017: 'Australian climate extremes at 1.5 °C and 2 °C of global warming', *Nature Climate Change*, 7, 412-16
- 107 'het dubbele bedragen' – Lewis, S. et al., 2017: 'Australia's unprecedented future temperature extremes under Paris limits to warming', *Geophysical Research Letters*, 44, 9947-56

- 107 **'zomer als in 2013'** – Sun, Y. et al., 2018: 'Substantial increase in heat wave risks in China in a future warmer world', *Earth's Future*, 6, 1528-38; Lin, L. et al., 2018: 'Additional intensification of seasonal heat and flooding extreme over China in a 2°C warmer world compared to 1.5°C', *Earth's Future*, 6, 968-78
- 107 **'25-50%'** – Zhan, M. et al., 2018: 'Changes in extreme maximum temperature events and population exposure in China under global warming scenarios of 1.5 and 2.0°C: analysis using the regional climate model COSMO-CLM', *Journal of Meteorological Research*, 32 (1), 99-112
- 107 **'natuurramp'** – *BBC News*, 2018: 'Japan heatwave declared natural disaster as death toll mounts'. www.bbc.co.uk/news/world-asia-44935152
- 107 **'1,5 of 2°C'** – Imada, Y. et al., 2019: 'The July 2018 high temperature event in Japan could not have happened without human-induced global warming', *Scientific Online Letters on the Atmosphere*, 15A, 8-11
- 107 **'two billion people'** – Dosio, A. et al., 2018: 'Extreme heat waves under 1.5°C and 2°C global warming', *Environmental Research Letters*, 13, 054006
- 108 **'uitzonderlijke hittegolven'** – Ibid.
- 108 **'kwetsbare kustgebieden'** – Matthews, T. et al., 2019: 'An emerging tropical cyclone–deadly heat compound hazard', *Nature Climate Change*, 9, 602-6
- 108 **'Rajasthan'** – Agarwal, V., 2016: 'Indian heat wave breaks record for highest temperature', *Wall Street Journal*. blogs.wsj.com/indiarealtime/2016/05/20/indian-heat-wave-breaks-record-for-highest-temperature/
- 108 **'92 keer zoveel'** – Mishra, V. et al., 2017: 'Heat wave exposure in India in current, 1.5°C, and 2.0°C worlds', *Environmental Research Letters*, 12, 124012
- 108 **'ontwikkelingslanden in Afrika'** – Parkes, B. et al., 2019: 'Climate change in Africa: costs of mitigating heat stress', *Climatic Change*, 154 (3-4), 461-76
- 108 **'extra stroomcapaciteit'** – International Energy Agency, 2018: 'Air conditioning use emerges as one of the key drivers of global electricity-demand growth', persbericht. www.iea.org/newsroom/news/2018/may/air-conditioning-use-emerges-as-one-of-the-key-drivers-of-global-electricity-dema.html

Het droge continent

- 109 **'0,8 ton'** – World Bank, ongedateerd. *CO₂ Emissions per Capita*. data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=EU
- 109 **'artikel uit 2017'** – Lehner, F. et al., 2017: 'Projected drought risk in 1.5°C and 2°C warmer climates', *Geophysical Research Letters*, 44, 7419-28. Zie Figuur 1.
- 110 **'dagblad Mmegi'** – Mguni, M., 2014: 'A requiem as Gaborone Dam gives up the ghost', *Mmegi Online*. www.mmegi.bw/index.hp?aid=46594&dir=2014/october/10
- 110 **'verlies van 10-20%'** – Maúre, G. et al., 2018: 'The southern African climate under 1.5°C and 2°C of global warming as simulated by CORDEX regional climate models', *Environmental Research Letters*, 13, 065002
- 111 **'Dikgatlhongdam'** – Monitor dam levels and water supplies to different Botswanan towns and cities here: www.wuc.bw/wuc-content/id/471/dam-levels/
- 111 **'Botswana Daily News'** – Batlotleng, B., 2017: 'Gaborone Dam overflows after 10 years', *Botswana Daily News*. www.dailynews.gov.bw/news-details.php?nid=34266

Slinkende gletsjers

- 113 **'resterende ijsvelden'** – Cullen, N. et al., 2013: 'A century of ice retreat on Kilimanjaro: the mapping reloaded', *The Cryosphere*, 7, 419-31
- 113 **'Mount Kenya'** – Prinz, R. et al., 2018: 'Mapping the loss of Mt. Kenya's glaciers: an example of the challenges of satellite monitoring of very small glaciers', *Geosciences*, 8 (5), 174
- 113 **'Andesgebergte in Colombia'** – Poveda, G. & Pineda, K., 2009: 'Reassessment of Colombia's tropical glaciers retreat rates: are they bound to disappear during the 2010-2020 decade?' *Advances in Geosciences*, 22, 107-116; Instituto de Hidrología, Meteorología y

Estudios Ambientales, ongedateerd: *Informe del Estado de los Glaciares Colombianos*.
www.ideam.gov.co/documents/24277/72621342/Informe+del+Estado+de+los+glaciares+colombianos.pdf/26773334-c132-4672-91db-f620e8a989f9

- 113 **'Peruaanse Andes'** – Schauwecker, S. et al., 2017: 'The freezing level in the tropical Andes, Peru: An indicator for present and future glacier extents', *Journal of Geophysical Research: Atmospheres*, 122, 5172-89
- 113 **'gletsjervolume'** – Zemp, M., 2019: 'Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016', *Nature*, 568, 382-6
- 113 **'Aziatische hooggebergte'** – Kraaijenbrink, P. et al., 2017: 'Impact of a global temperature rise of 1.5 degrees Celsius on Asia's glaciers', *Nature*, 549, 257-60
- 113 **'smelttempo'** – Marzeion, B. et al., 2018: 'Limited influence of climate change mitigation on short-term glacier mass loss', *Nature Climate Change*, 8, 305-8
- 114 **'zwaar te verduren'** – Huss, M. & Hock, R., 2018: 'Global-scale hydrological response to future glacier mass loss', *Nature Climate Change*, 8, 135-40
- 114 **'juli 2019'** – Biemans, H. et al., 2019: 'Importance of snow and glacier meltwater for agriculture on the Indo-Gangetic Plain', *Nature Sustainability*, 2, 594-601
- 115 **'221 miljoen mensen'** – Pritchard, H., 2019: 'Asia's shrinking glaciers protect large populations from drought stress', *Nature*, 569, 649-54
- 115 **'dagen van overvloed'** – Sorg, A. et al., 2014: 'The days of plenty might soon be over in glacierized Central Asian catchments', *Environmental Research Letters*, 9, 104018
- 115 **'bedreigd'** – Bosson, J.B. et al., 2019: 'Disappearing World Heritage glaciers as a keystone of nature conservation in a changing climate', *Earth's Future*, 7, 469-79

Toekomstige overstromingen

- 116 **'droge Indusvallei'** – Wang, S.-Y. et al., 2011: 'Pakistan's two-stage monsoon and links with the recent climate change', *Journal of Geophysical Research: Atmospheres*, 116, D16
- 116 **'Ban Ki-moon'** – Houze Jr, R. et al., 2011: 'Anomalous atmospheric events leading to the summer 2010 floods in Pakistan', *Bulletin of the American Meteorological Society*, 291-8
- 116 **'500 miljoen dollar'** – Webster, P. et al., 2011: 'Were the 2010 Pakistan floods predictable?', *Geophysical Research Letters*, 38 (4), L04806
- 116 **'morele dilemma'** – McGivering, J., 2010: "Elation and unease" at helping Pakistan flood child', *BBC News*. news.bbc.co.uk/1/hi/programmes/from_our_own_correspondent/8965711.stm
- 117 **'10% per graad opwarming'** – Zhang, W. et al., 2018: 'Reduced exposure to extreme precipitation from 0.5 °C less warming in global land monsoon regions', *Nature Communications*, 9, 3153
- 117 **'deze overstroming'** – Uhe, P. et al., 2019: 'Enhanced flood risk with 1.5 °C global warming in the Ganges–Brahmaputra–Meghna basin', *Environmental Research Letters*, 14, 074031
- 117 **'debiet van de Ganges'** – Betts, R.A. et al., 2018: 'Changes in climate extremes, fresh water availability and vulnerability to food insecurity projected at 1.5°C and 2°C global warming with a higher-resolution global climate model', *Philosophical Transactions of the Royal Society*, A376, 20160452
- 117 **'25% vaker'** – Ali, H. & Mishra, V., 2018: 'Increase in subdaily precipitation extremes in India under 1.5 and 2.0°C warming worlds', *Geophysical Research Letters*, 45, 6972-82
- 117 **'aanzienlijke toename'** – Mohammed, K. et al., 2017: 'Extreme flows and water availability of the Brahmaputra River under 1.5 and 2 °C global warming scenarios', *Climatic Change*, 145 (1-2), 159-75
- 117 **'Aziatische moessongebied'** – Lee, D. et al., 2018: 'Impacts of half a degree additional warming on the Asian summer monsoon rainfall characteristics', *Environmental Research Letters*, 13, 044033
- 117 **'1.600 mensen'** – Reuters, 2019: 'More than 1,600 die in India's heaviest monsoon season for 25 years'. uk.reuters.com/article/us-india-floods/more-than-1600-die-in-indias-heaviest-monsoon-season-for-25-years-idUKKBN1WG3N5

- 117 **‘Chinese wetenschappers’** – Li, W. et al., 2018: ‘Additional risk in extreme precipitation in China from 1.5°C to 2.0 °C global warming levels’, *Science Bulletin*, 63 (4), 228-34
- 118 **‘rond 2040’** – Alfieri, L. et al., 2015: ‘Global warming increases the frequency of river floods in Europe’, *Hydrology and Earth System Sciences*, 19, 2247-60
- 118 **‘dammen in Californië’** – Mallakpour, I. et al., 2019: ‘Climate-induced changes in the risk of hydrological failure of major dams in California’, *Geophysical Research Letters*, 46, 2130-9
- 118 **‘een week of langer’** – Döll, P. et al., 2018: ‘Risks for the global freshwater system at 1.5 °C and 2 °C global warming’, *Environmental Research Letters*, 13, 044038
- 118 **‘maar liefst 50%’** – Betts, R.A. et al., 2018: ‘Changes in climate extremes, fresh water availability and vulnerability to food insecurity projected at 1.5°C and 2°C global warming with a higher-resolution global climate model’
- 118 **‘IPCC-rapport’** – Hoegh-Guldberg, O. et al., 2018: ‘Impacts of 1.5°C Global Warming on Natural and Human Systems’ In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 203

Klimaatontwrichting

- 119 **‘70.000 Mozambikanen’** – United Nations Office for the Coordination of Humanitarian Affairs, 2019: ‘Mozambique: Cyclone Idai & Floods Situation Report No. 14 (as of 15 April 2019)’, *ReliefWeb*. reliefweb.int/report/mozambique/mozambique-cyclone-idai-floods-situation-report-no-14-15-april-2019
- 119 **‘de inwoners van Botswana’** – Batlotleng, B., 2017: ‘Gaborone Dam overflows after 10 years’
- 120 **‘toch al droge gebieden’** – Muthige, M. et al., 2018: ‘Projected changes in tropical cyclones over the South West Indian Ocean under different extents of global warming’, *Environmental Research Letters*, 13, 065019
- 120 **‘stelt het IPCC’** – Hoegh-Guldberg, O. et al., 2018: ‘Impacts of 1.5°C Global Warming on Natural and Human Systems’, In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 204
- 120 **‘extra-zware orkanen’** – Wehner, M. et al., 2018: ‘Changes in tropical cyclones under stabilized 1.5 and 2.0°C global warming scenarios as simulated by the Community Atmospheric Model under the HAPPI protocols’, *Earth Systems Dynamics*, 9, 187-95
- 121 **‘1,4 miljard dollar’** – Burgess, C.P. et al., 2018: ‘Estimating damages from climate-related natural disasters for the Caribbean at 1.5 °C and 2 °C global warming above preindustrial levels’, *Regional Environmental Change*, 18 (8), 2297-312
- 121 **‘het zevenvoudige’** – Wen, S. et al., 2019: ‘Estimation of economic losses from tropical cyclones in China at 1.5C and 2.0C warming using the regional climate model COSMO-CLM’, *International Journal of Climatology*, 39, 724-37
- 121 **‘straalstromen’** – Li, C. et al., 2018: ‘Midlatitude atmospheric circulation responses under 1.5 and 2.0C warming and implications for regional impacts’, *Earth Systems Dynamics*, 9, 359-82
- 121 **‘Britse eilanden en Scandinavië’** – Barcikowska, M. et al., 2018: ‘Euro-Atlantic winter storminess and precipitation extremes under 1.5C vs. 2C warming scenarios’, *Earth Systems Dynamics*, 9, 679-99
- 121 **‘in het slop’** – Li, C. et al., 2018: ‘Midlatitude atmospheric circulation responses under 1.5 and 2.0C warming and implications for regional impacts’
- 121 **‘onderzoek uit 2019’** – Pfliegerer, P. et al., 2019: ‘Summer weather becomes more persistent in a 2 °C world’, *Nature Climate Change*, 9, 666-71
- 122 **‘extreme El Niños’** – Wang, G. et al., 2017: ‘Continued increase of extreme El Niño frequency long after 1.5 °C warming stabilization’, *Nature Climate Change*, 7, 568-72

- 122 'El Niño van 2014-15' – World Meteorological Organization, 2017: *WMO Statement on the State of the Global Climate in 2016*. library.wmo.int/doc_num.php?explnum_id=3414
- 122 'eens per 7 jaar' – Cai, W. et al., 2018: 'Stabilised frequency of extreme positive Indian Ocean Dipole under 1.5 °C warming', *Nature Communications*, 9, 1419
- 122 '20% toeneemt' – Xu, L. et al., 2019: 'Global drought trends under 1.5 and 2C warming', *International Journal of Climatology*, 39, 2375-85
- 122 '410 miljoen' – Liu, W. et al., 2018: 'Global drought and severe drought-affected populations in 1.5 and 2C warmer worlds', *Earth Systems Dynamics*, 9, 267-83

Het lot van het Amazonegebied

- 123 'ongeveer 15%' – Marengo, J. et al., 2018: 'Changes in climate and land use over the Amazon region: current and future variability and trends', *Frontiers in Earth Science*, 6, 228
- 123 '11 verschillende' – Liu, W. et al., 2018: 'Global drought and severe drought-affected populations in 1.5 and 2C warmer worlds'
- 123 'studie uit 2017' – Lehner, F. et al., 2017: 'Projected drought risk in 1.5°C and 2°C warmer climates'
- 124 '150 tot 200 miljard' – Brienen, R. et al., 2015: 'Long-term decline of the Amazon carbon sink', *Nature*, 519, 344-8
- 124 'alleen al aan bomen' – Esquivel Muelbert, A. et al., 2019: 'Compositional response of Amazon forests to climate change', *Global Change Biology*, 25, 39-56
- 124 'Hadley Centre' – Cox, P. et al., 2000: 'Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model', *Nature*, 408, 184-7
- 124 'bossterfte tegen 2100' – Settele, J. et al., 2014: 'Terrestrial and inland water systems'. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Field, C. et al. (eds). Cambridge University Press, Cambridge, UK, p. 309, Box 4.3
- 124 'klimaat in de regio' – Gloor, M. et al., 2015: 'Recent Amazon climate as background for possible ongoing and future changes of Amazon humid forests', *Global Biogeochemical Cycles*, 29, 1384-99
- 124 'elkaar snel opvolgen' – Marengo, J. & Espinoza, J., 2016: 'Extreme seasonal droughts and floods in Amazonia: causes, trends and impacts', *International Journal of Climatology*, 36, 1033-50
- 124 'de afgelopen decennia' – Gloor, M. et al., 2015: 'Recent Amazon climate as background for possible ongoing and future changes of Amazon humid forests'
- 125 'zijn laagste niveau' – University of Leeds, 2011: 'Two severe Amazon droughts in five years alarms scientists', persbericht. www.leeds.ac.uk/news/article/1466/
- 125 'helemaal opdroogden' – Black, R., 2011: 'Amazon drought "severe" in 2010, raising warming fears', *BBC News*. www.bbc.co.uk/news/science-environment-12356835
- 125 'in 2009' – Marengo, J. et al., 2013: 'Two contrasting severe seasonal extremes in tropical South America in 2012: Flood in Amazonia and drought in Northeast Brazil', *Journal of Climate*, 26, 9137-54
- 125 'Het watertekort' – Yang, J. et al., 2018: 'Amazon drought and forest response: Largely reduced forest photosynthesis but slightly increased canopy greenness during the extreme drought of 2015/2016', *Global Change Biology*, 24, 1919-34
- 125 'normale neerslag' – Feldpausch, T. et al., 2016: 'Amazon forest response to repeated droughts', *Global Biogeochemical Cycles*, 30, 964-82
- 125 'droger klimaatregime' – Esquivel Muelbert, A. et al., 2019: 'Compositional response of Amazon forests to climate change'
- 125 'afnemende neerslag' – Hilker, T. et al., 2014: 'Vegetation dynamics and rainfall sensitivity of the Amazon', *PNAS*, 111 (45), 16041-6
- 125 'verschuiving naar een savannestaat' – Brando, P.M. et al., 2014: 'Abrupt increases in Amazonian tree mortality due to drought–fire interactions', *PNAS*, 111 (17), 6347-52
- 125 'verspreide percelen' – Brienen, R. et al., 2015: 'Long-term decline of the Amazon carbon sink'

- 125 **'Guardian'** – Phillips, T., 2019: "Chaos, chaos, chaos": a journey through Bolsonaro's Amazon inferno', *Guardian*. www.theguardian.com/environment/2019/sep/09/amazon-fires-brazil-rainforest
- 126 **'zonder pardon'** – *BBC News*, 2019: 'Amazon fires increase by 84% in one year – space agency'. www.bbc.co.uk/news/world-latin-america-49415973
- 126 **'gevaarlijk dichtbij'** – Wernick, A., 2019: 'Amazon fires push the forest closer to a dangerous tipping point', Public Radio International. www.pri.org/stories/2019-09-17/amazon-fires-push-forest-closer-dangerous-tipping-point
- 126 **'drie vrij stromende'** – Castello, L. & Macedo, M., 2016: 'Large-scale degradation of Amazonian freshwater ecosystems', *Global Change Biology*, 22, 990-1007

Natuur in levensgevaar

- 127 **'55 miljard'** – Steffen, W. et al., 2018: 'Trajectories of the Earth System in the Anthropocene', *PNAS*, 115 (33), 8252-9. Supplementary info.
- 127 **'hoeveelheden veen'** – Wang, S. et al., 2018: 'Potential shift from a carbon sink to a source in Amazonian peatlands under a changing climate', *PNAS*, 115 (49), 12407-12
- 128 **'305 stammen'** – Survival International, ongedateerd: 'Brazilian Indians'. www.survivalinternational.org/tribes/brazilian
- 128 **'talrijke diersoorten'** – Pavid, K., 2019: 'Experts explain the effect of the Amazon wildfires on people, animals and plants', Natural History Museum. www.nhm.ac.uk/discover/news/2019/august/experts-explain-the-effect-of-the-amazon-wildfires.html
- 128 **'aan bosbranden aangepast'** – Daly, N., 2019: 'What the Amazon fires mean for wild animals', *National Geographic*. www.nationalgeographic.com/animals/2019/08/how-the-amazon-rainforest-wildfires-will-affect-wild-animals/
- 129 **'uitgebreidste studie'** – Warren, R. et al., 2018: 'The projected effect on insects, vertebrates, and plants of limiting global warming to 1.5°C rather than 2°C', *Science*, 360 (6390), 791-5. Supplementary info.
- 130 **'gebruik van BECCS'** – Boysen, L. et al., 2017: 'The limits to global-warming mitigation by terrestrial carbon removal', *Earth's Future*, 5, 463-74
- 130 **'de 2°C-wereld te voorkomen'** – Griscom, B. et al., 2017: 'Natural Climate Solutions', *PNAS*, 114 (44), 11645-11650
- 131 **'Monbiot'** – Zie www.naturalclimate.solutions/the-letter
- 131 **'alleen mogelijk'** – Smith, P. et al., 2018: 'Impacts on terrestrial biodiversity of moving from a 2°C to a 1.5°C target', *Philosophical Transactions of the Royal Society*, A376, 20160456

Lege oceanen

- 132 **'beoordeling uit 2014'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems' In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 226 and Box 3.4
- 133 **'twee derde van de riffen'** – Schleussner, C.-F. et al., 2016: 'Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2°C', *Earth Systems Dynamics*, 7, 327-51
- 133 **'verzuring'** – Eyre, B. et al., 2018: 'Coral reefs will transition to net dissolving before end of century', *Science*, 359 (6378), 908-11
- 133 **'uitgemergeld'** – Kersting, D. & Linares, C., 2019: 'Living evidence of a fossil survival strategy raises hope for warming-affected corals', *Science Advances*, 5 (10), eaax2950
- 134 **'IPCC waarschuwt nu'** – Hoegh-Guldberg, O. et al., 2018: 'Impacts of 1.5°C Global Warming on Natural and Human Systems', In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 226 en Box 3.4

- 134 'bruine strook' – Duke, N. et al., 2017: 'Large-scale dieback of mangroves in Australia's Gulf of Carpentaria: a severe ecosystem response, coincidental with an unusually extreme weather event', *Marine & Freshwater Research*, 68 (10), 1816-29
- 134 'bestaande velden' – Valle, M. et al., 2014: 'Projecting future distribution of the seagrass *Zostera noltii* under global warming and sea level rise', *Biological Conservation*, 170, 74-85

3°C

Ongekend warm

- 139 'Turkanabekken' – Leakey, M. et al., 1995: 'New four-million-year-old hominid species from Kanapoi and Allia Bay, Kenya', *Nature*, 376, 565-71
- 139 'bladeren aten' – Cerling, T. et al., 2013: 'Stable isotope-based diet reconstructions of Turkana Basin hominins', *PNAS*, 110 (26), 10501-6
- 139 'ontbrekende schakel' – Villmoare, B. et al., 2015: 'Early Homo at 2.8 Ma from Ledi-Geraru, Afar, Ethiopia', *Science*, 347 (6228), 1352-5
- 140 'Zancleanse vloed' – Garcia-Castellanos, D. et al., 2009: 'Catastrophic flood of the Mediterranean after the Messinian salinity crisis', *Nature*, 462, 778-81
- 140 'Pliocene bevervijver' – Tedford, R. & Harington, R., 2003: 'An Arctic mammal fauna from the Early Pliocene of North America', *Nature*, 425, 388-90
- 140 'negentien grader hoger' – Ballantyne, A. et al., 2010: 'Significantly warmer Arctic surface temperatures during the Pliocene indicated by multiple independent proxies', *Geology*, 38 (7), 603-6
- 140 'gematigde 14°C' – Csank, A. et al., 2011: 'Estimates of Arctic land surface temperatures during the early Pliocene from two novel proxies', *Earth and Planetary Science Letters*, 304 (3-4), 291-9
- 140 'Noordelijke IJszee' – Feng, R. et al., 2019: 'Contributions of aerosol-cloud interactions to mid-Piacenzian seasonally sea ice-free Arctic Ocean', *Geophysical Research Letters*, 46, 9920-9
- 141 'Oliver Bluffs' – Rees-Owen, R. et al., 2018: 'The last forests on Antarctica: Reconstructing flora and temperature from the Neogene Sirius Group, Transantarctic Mountains', *Organic Geochemistry*, 118, 4-14
- 141 'belangrijke overblijfselen' – Chaloner, B. & Kenrick, P., 2015: 'Did Captain Scott's *Terra Nova* expedition discover fossil *Nothofagus* in Antarctica?' *The Linnean*, 31 (2), 11-17
- 142 'kolossale verandering' – Cook, C. et al., 2013: 'Dynamic behaviour of the East Antarctic ice sheet during Pliocene warmth', *Nature Geoscience*, 6, 765-9
- 142 'gevoeliger' – Bertram, R. et al., 2018: 'Pliocene deglacial event timelines and the biogeochemical response offshore Wilkes Subglacial Basin, East Antarctica', *Earth and Planetary Science Letters*, 494, 109-16
- 142 '2009 in Nature' – Naish, T. et al., 2009: 'Obliquity-paced Pliocene West Antarctic ice sheet oscillations', *Nature*, 458, 322-8
- 142 'fluctueerde' – Dolan, A. et al., 2015: 'Using results from the PlioMIP ensemble to investigate the Greenland Ice Sheet during the mid-Pliocene Warm Period', *Climate of the Past*, 11, 403-24; Koenig, S., 2015: 'Ice sheet model dependency of the simulated Greenland Ice Sheet in the mid-Pliocene', *Climate of the Past*, 11, 369-81
- 142 'een oud landschap' – Bierman, P. et al., 2014: 'Preservation of a preglacial landscape under the center of the Greenland Ice Sheet', *Science*, 344 (6182), 402-5
- 143 '22 meter' – Miller, K. et al., 2012: 'High tide of the warm Pliocene: Implications of global sea level for Antarctic deglaciation', *Geology*, 40 (5), 407-10
- 143 'zeespiegel van het Pliocene' – Rovere, A. et al., 2014: 'The Mid-Pliocene sea-level conundrum: Glacial isostasy, eustasy and dynamic topography', *Earth and Planetary Science Letters*, 387, 27-33
- 143 'jongste berekeningen' – Berends, C. et al., 2019: 'Modelling ice sheet evolution and atmospheric CO₂ during the Late Pliocene', *Climate of the Past*, 15, 1603-19

- 143 '400 ppm' – Willeit, M. et al., 2019: 'Mid-Pleistocene transition in glacial cycles explained by declining CO₂ and regolith removal', *Science Advances*, 5 (4), eaav7337
- 143 'afsmelten van Groenland' – Koenig, S. et al., 2014: 'Impact of reduced Arctic sea ice on Greenland ice sheet variability in a warmer than present climate', *Geophysical Research Letters*, 41, 3934-43
- 143 'CO₂-concentraties' – Tan, N. et al., 2018: 'Dynamic Greenland ice sheet driven by pCO₂ variations across the Pliocene Pleistocene transition', *Nature Communications*, 9, 4755
- 143 'huidige emissietrends' – Burke, K. et al., 2018: 'Pliocene and Eocene provide best analogs for near-future climates', *PNAS*, 115 (52), 13288-93

Instortende ijskappen, stijgende zeespiegels

- 144 'knabbelen' – Shepherd, A. et al., 2004: 'Warm ocean is eroding West Antarctic Ice Sheet', *Geophysical Research Letters*, 31, 23
- 144 'uiteindelijke desintegratie' – van den Broeke, M., 2005: 'Strong surface melting preceded collapse of Antarctic Peninsula ice shelf', *Geophysical Research Letters*, 32, 12
- 144 'breukproces' – Banwell, A. et al., 2013: 'Breakup of the Larsen B Ice Shelf triggered by chain reaction drainage of supraglacial lakes', *Geophysical Research Letters*, 40, 22, 5872-6
- 144 'kleine tsunami's' – MacAyeal, D. et al., 2003: 'Catastrophic ice-shelf break-up by an ice-shelf-fragment-capsize mechanism', *Journal of Glaciology*, 49 (164), 22-36
- 145 'drastisch te vergroten' – DeConto, R. & Pollard, D., 2016: 'Contribution of Antarctica to past and future sea-level rise', *Nature*, 531, 591-7
- 145 'het jaar 5000' – Golledge, N. et al., 2015: 'The multi-millennial Antarctic commitment to future sea-level rise', *Nature*, 526, 421-5
- 145 '2018 in Nature' – Shakun, J. et al., 2018: 'Minimal East Antarctic Ice Sheet retreat onto land during the past eight million years', *Nature*, 558, 284-7
- 145 'komende millennium' – Ashwanden, A. et al., 2019: 'Contribution of the Greenland Ice Sheet to sea level over the next millennium', *Science Advances*, 5, eaav9396
- 146 '177 cm' – Le Bars, D. et al., 2017: 'A high-end sea level rise probabilistic projection including rapid Antarctic ice sheet mass loss', *Environmental Research Letters*, 12, 044013
- 146 '50 miljoen' – Rasmussen, D. et al., 2018: 'Extreme sea level implications of 1.5 °C, 2.0 °C, and 2.5 °C temperature stabilization targets in the 21st and 22nd centuries', *Environmental Research Letters*, 13, 034040
- 147 'onderzoek uit 2018' – Ibid.
- 147 '43 New Yorkers' – City of New York, 2013: *Plan NYC – A Stronger, More Resilient New York*. s-media.nyc.gov/agencies/sirr/SIRR_singles_Lo_res.pdf
- 147 '150 miljard dollar' Barnard, P. et al., 2019: 'Dynamic flood modeling essential to assess the coastal impacts of climate change', *Scientific Reports*, 9, 4309
- 147 '2.500 km²' – Brown, S. et al., 2018: 'What are the implications of sea-level rise for a 1.5, 2 and 3 °C rise in global mean temperatures in the Ganges-Brahmaputra-Meghna and other vulnerable deltas?', *Regional Environmental Change*, 18, 1829-42
- 147 '320 nieuwe' – Karim, M.F. & Mimura, N., 2008: 'Impacts of climate change and sea-level rise on cyclonic storm surge floods in Bangladesh', *Global Environmental Change*, 18 (3), 490-500
- 147 'miljarden dollars' – Dasgupta, S. et al., 2011: 'Climate proofing infrastructure in Bangladesh: The incremental cost of limiting future flood damage', *The Journal of Environment & Development*, 20 (2), 167-90
- 148 'Scientific American' – Frank, T., 2019: 'After a \$14-billion upgrade, New Orleans' levees are sinking', *E&E News*. www.scientificamerican.com/article/after-a-14-billion-upgrade-new-orleans-levees-are-sinking/
- 148 '400 miljard dollar' – The Center for Climate Integrity, 2019: *High Tide Tax – The Price to Protect Coastal Communities from Rising Seas*. www.climatecosts2040.org/files/ClimateCosts2040_Report.pdf
- 148 'Center for Climate Integrity' – Ibid.
- 149 'UNESCO' – Marzeion, B. & Levermann, A., 2014: 'Loss of cultural world heritage and currently inhabited places to sea-level rise', *Environmental Research Letters*, 9, 034001

- 149 'Daartoe behoren' – Ibid.
- 149 'grot van Cosquer' – Cazenave, A., 2014: 'Anthropogenic global warming threatens world cultural heritage', *Environmental Research Letters*, 9, 051001
- 149 'tegen 2100' – Jevrejeva, S. et al., 2016: 'Coastal sea level rise with warming above 2 °C', *PNAS*, 113 (47), 13342-7

Heter dan de hel

- 150 'Delhi staat in brand' – twitter.com/edking_I/status/1138159252323864576
- 150 'weerswaarschuwing' – *Business Today*, 2019: 'Delhi heat wave: IMD issues red warning, temp expected to cross 45 degrees in the next 2 days'. www.businesstoday.in/current/economy-politics/delhi-heat-wave-imd-issues-red-warning-temp-expected-to-cross-45-degrees-in-the-next-2-days/story/354800.html
- 150 'inwoners van Delhi' – Sharma, P., 2019: 'Delhi simmers: Amid scorching heat, doctors say heat stroke cases are rising in city', *India Today*. www.indiatoday.in/mail-today/story/delhi-simmers-doctors-say-heat-stroke-cases-rising-city-1542015-2019-06-04
- 150 'Kerala Express' – *India Today*, 2019: '4 passengers on board Kerala Express die due to extreme heat in Uttar Pradesh's Jhansi'. www.indiatoday.in/india/story/kerala-express-passengers-dead-heatwave-uttar-pradesh-jhansi-1546733-2019-06-11
- 150 '51,1°C' – Accuweather, 2019: 'India: Monsoon reaches the south while dangerous heat wave continues in the north'. www.accuweather.com/en/weather-news/dangerous-india-heat-wave-to-worsen-with-temperatures-to-approach-all-time-record-in-new-delhi-this-weekend/70008472
- 150 '3,500 mensen' – Im, E.-S. et al., 2017: 'Deadly heat waves projected in the densely populated agricultural regions of South Asia', *Science Advances*, 3 (8), e1603322
- 150 'Ahmedabad' – Azhar, G. et al., 2014: 'Heat-related mortality in India: excess all-cause mortality associated with the 2010 Ahmedabad heat wave', *PLOS ONE*, 9 (3), e91831
- 150 '2,25°C warmer' – Im, E.-S. et al., 2017: 'Deadly heat waves projected in the densely populated agricultural regions of South Asia'
- 152 '100-300' – Weber, T. et al., 2018: Analyzing regional climate change in Africa in a 1.5, 2, and 3°C global warming world', *Earth's Future*, 6, 643-55
- 152 '145 dagen' – Rohat, G. et al., 2019: 'Projections of human exposure to dangerous heat in African cities under multiple socioeconomic and climate scenarios', *Earth's Future*, 7, 528-46
- 152 'central-Zuid-Amerika' – Tebaldi, C. & Wehner, M., 2018: 'Benefits of mitigation for future heat extremes under RCP4.5 compared to RCP8.5', *Climatic Change*, 146, 349
- 152 '2.700 meer mensen' – Lo, Y.T.E. et al., 2019: 'Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in U.S. cities', *Science Advances*, 5 (6), eaau4373
- 152 'onderzoek uit 2017' – Mora, C. et al., 2017: 'Global risk of deadly heat', *Nature Climate Change*, 7, 501-6
- 153 'studie uit 2018' – Rasmijn, L. et al., 2018: 'Future equivalent of 2010 Russian heatwave intensified by weakening soil moisture constraints', *Nature Climate Change*, 8, 381-5
- 153 'The Lancet' – Andrews, O. et al., 2018: 'Implications for workability and survivability in populations exposed to extreme heat under climate change: a modelling study', *The Lancet Planetary Health*, 2, e540-7

Oprukkende woestijnen

- 154 '187%' – Turco, M. et al., 2018: 'Exacerbated fires in Mediterranean Europe due to anthropogenic warming projected with non-stationary climate-fire models', *Nature Communications*, 9, 3821
- 154 'alle klimaatmodellen' – Prudhomme, C. et al., 2014: 'Hydrological droughts in the 21st century, hotspots and uncertainties from a global multimodel ensemble experiment', *PNAS*, 111 (9), 3262-7

- 154 'Middellandse Zeegebied' – Guiot, J. & Cramer, W., 2016: 'Climate change: The 2015 Paris Agreement thresholds and Mediterranean basin ecosystems', *Science*, 354 (6311), 465-8
- 154 'mediterrane droogte' – Samaniego, L. et al., 2018: 'Anthropogenic warming exacerbates European soil moisture droughts', *Nature Climate Change*, 8, 421-6
- 155 'huidige mediterrane' – Orth, R. et al., 2016: 'Record dry summer in 2015 challenges precipitation projections in Central Europe', *Scientific Reports*, 6, 28334
- 155 'Nature Climate Change' – Huang, J. et al., 2016: 'Accelerated dryland expansion under climate change', *Nature Climate Change*, 6, 166-71
- 155 'nog eens een miljard' – Schewe, J. et al., 2014: 'Multimodel assessment of water scarcity under climate change', *PNAS*, 111 (9), 3245-50
- 155 '3°C-kaart' – Naumann, G. et al., 2018: 'Global changes in drought conditions under different levels of warming', *Geophysical Research Letters*, 45, 3285-96

Voedselschokken

- 156 'grote delen van Afrika' – Cairns, J. et al., 2013: 'Adapting maize production to climate change in sub-Saharan Africa', *Food Security*, 5, 345
- 156 'ten zuiden van de Sahara' – Rippke, U. et al., 2016: 'Timescales of transformational climate change adaptation in sub-Saharan African agriculture', *Nature Climate Change*, 6, 605-609
- 157 'tarweopbrengst' – Lobell, D. et al., 2012: 'Extreme heat effects on wheat senescence in India', *Nature Climate Change*, 2, 186-9
- 157 'productiviteit' – Schlenker, W. & Roberts, M., 2009: 'Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change', *PNAS*, 106 (37), 15594-8
- 158 'hogere breedtegraden' – Teixeira, E. et al., 2013: 'Global hot-spots of heat stress on agricultural crops due to climate change', *Agricultural and Forest Meteorology*, 170, 206-15
- 158 'stelde het IPCC' – Easterling, W. et al., 2007: 'Food, fibre and forest products'. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry et al. (eds). Cambridge University Press, Cambridge, UK, 273-313
- 158 'zelfs Canada' – Qian, B. et al., 2019: 'Climate change impacts on Canadian yields of spring wheat, canola and maize for global warming levels of 1.5 °C, 2.0 °C, 2.5 °C and 3.0 °C', *Environmental Research Letters*, 14 (7), 074005
- 158 'recorddaling' – Battisti, D. & Naylor, R., 2009: 'Historical warnings of future food insecurity with unprecedented seasonal heat', *Science*, 323 (5911), 240-4
- 159 'voedselrellen' – Berazneva, J. & Lee, D., 2013: 'Explaining the African food riots of 2007-2008: An empirical analysis', *Food Policy*, 39, 28-39

Grauwe bergen

- 161 'picknicklaken' – Thomas, K., 2018: 'Hexagon KH-9: Meeting the challenge', *SPIE magazine*. spie.org/news/spie-professional-magazine/2018-october/hexagon-kh-9-meeting-the-challenge?SSO=1
- 161 'hoeveel ijs' – Maurer, J. et al., 2019: 'Acceleration of ice loss across the Himalayas over the past 40 years', *Science Advances*, 5 (6), eaav7266
- 161 'gletsjers in de Himalaya' – Marzeion, B. et al., 2018: 'Limited influence of climate change mitigation on short-term glacier mass loss', *Nature Climate Change*, 8, 305-8
- 162 'ten minste 50%' – Kraaijenbrink, P. et al., 2017: 'Impact of a global temperature rise of 1.5 degrees Celsius on Asia's glaciers', *Nature*, 549, 257-60
- 162 'in 2019 in Nature' – Zemp, M. et al., 2019: 'Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016', *Nature*, 568, 382-6
- 162 'precies inhoudt' – Huss, M. & Hock, R., 2015: 'A new model for global glacier change and sea-level rise', *Frontiers in Earth Science*, 3, 54
- 162 'werelderfgoedgebieden' – Bosson, J. B. et al., 2019: 'Disappearing World Heritage glaciers as a keystone of nature conservation in a changing climate', *Earth's Future*, 7, 469-79

Dodelijke overstromingen

- 164 '200 miljoen' – Dottori, F. et al., 2018: 'Increased human and economic losses from river flooding with anthropogenic warming', *Nature Climate Change*, 8, 781-6
- 164 'met als gevolg overstromingen' – Guerreiro, S. et al., 2018: 'Future heat-waves, droughts and floods in 571 European cities', *Environmental Research Letters*, 13, 034009
- 164 '17 miljard euro' – Alfieri, L. et al., 2018: 'Multi-model projections of river flood risk in Europe under global warming', *Climate*, 6 (1), 6
- 164 'noord-zuid-kloof' – Thober, S. et al., 2018: 'Multi-model ensemble projections of European river floods and high flows at 1.5, 2, and 3 degrees global warming', *Environmental Research Letters*, 13, 014003
- 165 'studie uit 2019' – Wobus, C. et al., 2019: 'Projecting changes in expected annual damages from riverine flooding in the United States', *Earth's Future*, 7, 516-27
- 165 'Mississippi' – Huang, S. et al., 2018: 'Multimodel assessment of flood characteristics in four large river basins at global warming of 1.5, 2.0 and 3.0 K above the pre-industrial level', *Environmental Research Letters*, 13, 124005
- 166 'eens-per-eeuw-overstroming' – Arnell, N. & Gosling, S., 2014: 'The impacts of climate change on river flood risk at the global scale', *Climatic Change*, 134 (3), 387-401

Wilde dieren op de vlucht

- 167 '2018 in Science' – Warren, R. et al., 2018: 'The projected effect on insects, vertebrates, and plants of limiting global warming to 1.5°C rather than 2°C', *Science*, 360 (6390), 791-5
- 168 'meer dan 50%' – Ibid. Supplementary info.
- 168 'een factor vijf' – Wiens, J., 2016: 'Climate-related local extinctions are already widespread among plant and animal species', *PLOS Biology*, 14 (12), e2001104
- 168 'bijna 500' – Schloss, C., 2012: 'Dispersal will limit ability of mammals to track climate change in the Western Hemisphere', *PNAS*, 109 (22), 8606-11
- 168 'twee derde van de vogelsoorten' – Bateman, B. et al., 2019: 'North American birds require mitigation and adaptation to reduce vulnerability to climate change', in voorbereiding
- 168 'uiteenlopende aard' – Audubon, 2019: 'Five climate-threatened birds and how you can help them'. www.audubon.org/magazine/fall-2019/five-climate-threatened-birds-and-how-you-can-help
- 168 'vogelnoed' – Audubon, 2019: 'New Audubon science: two-thirds of North American birds at risk of extinction due to climate change', persbericht www.audubon.org/news/new-audubon-science-two-thirds-north-american-birds-risk-extinction-due-climate
- 169 'artikel in Science' – Ash, C., 2019: 'Thermal intolerance', *Science*, 365 (6450), 246-7
- 169 'IUCN' – Foden, W., 2013: 'Identifying the world's most climate change vulnerable species: a systematic trait-based assessment of all birds, amphibians and corals', *PLOS ONE*, 8 (6), e65427
- 169 'keizerspinguïns' – Trathan, P. et al., 2019: 'The emperor penguin – Vulnerable to projected rates of warming and sea ice loss', *Biological Conservation*. In press
- 169 'Mauna Kea-zilverzwaard' – Krushelnycky, P. et al., 2012: 'Climate-associated population declines reverse recovery and threaten future of an iconic high-elevation plant'. *Global Change Biology*, 19 (3), 911-22
- 170 '100 km' – Zarco-Perello, S. et al., 2017: 'Tropicalization strengthens consumer pressure on habitat-forming seaweeds', *Scientific Reports*, 7, 820
- 170 'plotselinge transformatie' – Wernberg, T. et al., 2016: 'Climate-driven regime shift of a temperate marine ecosystem', *Science*, 353 (6295), 169-72
- 170 'parallel instortende ecosystemen' – Lotze, H. et al., 2019: 'Global ensemble projections reveal trophic amplification of ocean biomass declines with climate change', *PNAS*, 116 (26), 12907-12
- 171 'Amerikaanse Middenwesten' – Till, A. et al., 2019: 'Fish die-offs are concurrent with thermal extremes in north temperate lakes', *Nature Climate Change*, 9, 637-41

- 171 **'primatengroepen'** – Zhang, L. et al., 2019: 'Global assessment of primate vulnerability to extreme climatic events', *Nature Climate Change*, 9, 554-61
- 171 **'nooit eerder samenleefden'** – García Molinos, J. et al., 2015: 'Climate velocity and the future global redistribution of marine biodiversity', *Nature Climate Change*, 6, 83-8
- 172 **'Gondwana in brand'** – Marris, E., 2016: 'Tasmanian bushfires threaten iconic ancient forests', *Nature*, 530, 137-8

Het afsterven van het Amazonewoud

- 173 **'zuidelijke Amazonegebied'** – Fu, R. et al., 2013: 'Increased dry-season length over southern Amazonia in recent decades and its implication for future climate projection', *PNAS*, 110 (45), 18110-15
- 173 **'het bos verschroeid'** – Erfanian, A. et al., 2017: 'Unprecedented drought over tropical South America in 2016: significantly under-predicted by tropical SST', *Scientific Reports*, 7, 5811
- 173 **'langetermijnverval'** – Brienen, R., 2015: 'Long-term decline of the Amazon carbon sink', *Nature*, 519, 344-8
- 173 **'samenzweringstheorie'** – Watts, J., 2019: 'Jair Bolsonaro claims NGOs behind Amazon forest fire surge – but provides no evidence', *Guardian*. www.theguardian.com/world/2019/aug/21/jair-bolsonaro-accuses-ngos-setting-fire-amazon-rainforest
- 173 **'Hadley Centre'** – Jones, C., 2009: 'Committed terrestrial ecosystem changes due to climate change', *Nature Geoscience*, 2, 484-7
- 173 **'zelfs 4°C'** – Huntingford, C. et al., 2013: 'Simulated resilience of tropical rainforests to CO₂-induced climate change', *Nature Geoscience*, 6, 268-273
- 173 **'eerder bij 2-3°C'** – Salazar, L.F. & Nobre, C., 2010: 'Climate change and thresholds of biome shifts in Amazonia', *Geophysical Research Letters*, 37, L17706
- 174 **'bomen afsterven'** – Baker, J. & Spracklen, D., 2019: 'Climate Benefits of Intact Amazon Forests and the Biophysical Consequences of Disturbance', *Frontiers in Forests and Global Change*, 2, 47
- 174 **'niet meer te stoppen'** – Zemp, D.C. et al., 2017: 'Self-amplified Amazon forest loss due to vegetation-atmosphere feedbacks', *Nature Communications*, 8, 14681
- 174 **'savanne-achtige ecosystemen'** – Boisier, J. et al., 2015: 'Projected strengthening of Amazonian dry season by constrained climate model simulations', *Nature Climate Change*, 5, 656-60
- 174 **'analoge temperatuurzone'** – Feeley, K. & Rehm, E., 2012: 'Amazon's vulnerability to climate change heightened by deforestation and man-made dispersal barriers', *Global Change Biology*, 18, 3606-14
- 174 **'rode lijst van de IUCN'** – Gomes, V. et al., 2019: 'Amazonian tree species threatened by deforestation and climate change', *Nature Climate Change*, 9, 547-53
- 175 **'Bangladesh'** – Rahman, M. et al., 2018: 'Tree radial growth is projected to decline in South Asian moist forest trees under climate change', *Global and Planetary Change*, 170, 106-19
- 175 **'Costa Rica'** – Clark, D. et al., 2013: 'Field-quantified responses of tropical rainforest above ground productivity to increasing CO₂ and climatic stress, 1997-2009', *Journal of Geophysical Research: Biogeosciences*, 118, 783-94
- 175 **'een droger milieu'** – Lyra, A. et al., 2016: 'Projections of climate change impacts on central America tropical rainforest', *Climatic Change*, 141, 93
- 175 **'droge savanne'** – Brando, P.M. et al., 2014: 'Abrupt increases in Amazonian tree mortality due to drought–fire interactions', *PNAS*, 111 (17), 6347-52
- 175 **'vrijwel elke hoek'** – Le Page, Y. et al., 2017: 'Synergy between land use and climate change increases future fire risk in Amazon forests', *Earth System Dynamics*, 8, 1237-46
- 175 **'slechts een fractie'** – Rappaport, D. et al., 2018: 'Quantifying long-term changes in carbon stocks and forest structure from Amazon forest degradation', *Environmental Research Letters*, 13, 065013
- 176 **'150-200 miljard'** – Brienen, R. et al., 2015: 'Long-term decline of the Amazon carbon sink'
- 176 **'55 miljoen jaar'** – Le Page, Y. et al., 2017: 'Synergy between land use and climate change increases future fire risk in Amazon forests'

De permafrost-terugkoppeling

- 177 'een biljoen ton' – Schuur, E. et al., 2015: 'Climate change and the permafrost carbon feedback', *Nature*, 520, 171-9
- 177 'artikel uit 2017' – Chadburn, S. et al., 2017: 'An observation-based constraint on permafrost loss as a function of global warming', *Nature Climate Change*, 7, 340-4
- 177 '100 miljard' – Schneider von Deimling, T. et al., 2015: 'Observation-based modelling of permafrost carbon fluxes with accounting for deep carbon deposits and thermokarst activity', *Biogeosciences*, 12, 3469-88
- 177 'het jaar 2100' – Schuur, E. et al., 2015: 'Climate change and the permafrost carbon feedback'
- 178 'kust van Siberië' – Dmitrenko, I. et al., 2011: 'Recent changes in shelf hydrography in the Siberian Arctic: Potential for subsea permafrost instability', *Journal of Geophysical Research*, 116, C10027
- 178 '50 gigaton' – Whiteman, G. et al., 2013: 'Vast costs of Arctic change', *Nature*, 499, 401-3
- 178 'ten noorden van Siberië' – Connor, S., 2011: 'Vast methane "plumes" seen in Arctic ocean as sea ice retreats', *Independent*. www.independent.co.uk/news/science/vast-methane-plumes-seen-in-arctic-ocean-as-sea-ice-retreats-6276278.html
- 178 'positieve terugkoppeling' – Shakhova, N. et al., 2010: 'Extensive methane venting to the atmosphere from sediments of the East Siberian Arctic Shelf', *Science*, 327 (5970), 1246-50
- 178 'permafrost ontdooit' – Anthony, K.W. et al., 2018: '21st-century modeled permafrost carbon emissions accelerated by abrupt thaw beneath lakes', *Nature Communications*, 9, 3262
- 178 'grove onderschatting' – Turetsky, M. et al., 2019: 'Permafrost collapse is accelerating carbon release', *Nature*, 569, 32-4
- 179 'voorspelde koolstofuitstoot' – Ibid.
- 179 'sleuven en plasjes' – Farquharson, L. et al., 2019: 'Climate change drives widespread and rapid thermokarst development in very cold permafrost in the Canadian High Arctic', *Geophysical Research Letters*, 46, 6681-9
- 179 'in 2015 voorspelden' – Schuur, E. et al., 2015: 'Climate change and the permafrost carbon feedback'
- 179 'noordelijke bossen' – Hayes, D. et al., 2011: 'Is the northern high latitude land based CO₂ sink weakening?', *Global Biogeochemical Cycles*, 25, GB3018

Een ijsvrije Noordelijke IJszee

- 179 'ijsvrije omstandigheden' – Sigmond, M. et al., 2018: 'Ice-free Arctic projections under the Paris Agreement', *Nature Climate Change*, 8, 404-8
- 180 'rond 2070' – Laliberté, F. et al., 2016: 'Regional variability of a projected sea ice-free Arctic during the summer months', *Geophysical Research Letters*, 43, 256-63
- 180 'brijachtige ijsschots' – Meier, W. et al., 2014: 'Arctic sea ice in transformation: A review of recent observed changes and impacts on biology and human activity', *Reviews of Geophysics*, 51, 185-217
- 180 'over de hele aarde' – Cohen, J. et al., 2014: 'Recent Arctic amplification and extreme mid-latitude weather', *Nature Geoscience*, 7, 627-37
- 180 'warmte en waterdamp' – Moore, G. et al., 2018: 'Collapse of the 2017 winter Beaufort High: A response to thinning sea ice?' *Geophysical Research Letters*, 45, 2860-9
- 180 'noordelijke straalstroom' – Screen, J. et al., 2018: 'Consistency and discrepancy in the atmospheric response to Arctic sea-ice loss across climate models', *Nature Geoscience*, 11, 155-63
- 181 '0,7 watt' – Pistone, K. et al., 2019: 'Radiative heating of an ice-free arctic ocean', *Geophysical Research Letters*, 46, 7474-80

Dodelijke hitte

- 186 **'grootste megasteden'** – Matthews, T. et al., 2017: 'Communicating the deadly consequences of global warming for human heat stress', *PNAS*, 114 (15), 3861-6
- 186 **'40-80 dagen'** – Liu, Z. et al., 2017: 'Global and regional changes in exposure to extreme heat and the relative contributions of climate and population change', *Scientific Reports*, 7, 43909
- 186 **'Extreme hotspots'** – Zhao, Y. et al., 2015: 'Estimating heat stress from climate-based indicators: present-day biases and future spreads in the CMIP5 global climate model ensemble', *Environmental Research Letters*, 10, 084013
- 186 **'waar een stad'** – Fitzpatrick, M. & Dunn, R., 2019: 'Contemporary climatic analogs for 540 North American urban areas in the late 21st century', *Nature Communications*, 10, 614
- 187 **'20 keer zo veel'** – Dahl, K. et al., 2019: 'Increased frequency of and population exposure to extreme heat index days in the United States during the 21st century', *Environmental Research Communications*, 1, 075002
- 187 **'Death Valley'** – Wobus, C. et al., 2018: 'Reframing future risks of extreme heat in the United States', *Earth's Future*, 6, 1323-35
- 187 **'helft van de landmassa'** – Mora, C. et al., 2017: 'Global risk of deadly heat', *Nature Climate Change*, 7, 501-6
- 187 **'Jakarta ... Borneo'** – Im, E.-S. et al., 2018: 'Projections of rising heat stress over the western Maritime Continent from dynamically downscaled climate simulations', *Global and Planetary Change*, 165, 160-72
- 187 **'hittegolf heerst'** – Coffel, E. et al., 2017: 'Temperature and humidity based projections of a rapid rise in global heat stress exposure during the 21st century', *Environmental Research Letters*, 13, 014001
- 188 **'20 keer meer'** – Ahmadalipour, A. et al., 2019: 'Mortality risk from heat stress expected to hit poorest nations the hardest', *Climatic Change*, 152, 569
- 188 **'2.000%'** – Coffel, E. et al., 2017: 'Temperature and humidity based projections of a rapid rise in global heat stress exposure during the 21st century'
- 188 **'ziekte-overbrengende muggen'** – Ryan, S. et al., 2019: 'Global expansion and redistribution of *Aedes*-borne virus transmission risk with climate change', *PLOS Neglected Tropical Diseases*, 13 (3), e0007213

Onbewoonbare aarde

- 189 **'grensverleggend artikel'** – Sherwood, S. & Huber, M., 2010: 'An adaptability limit to climate change due to heat stress', *PNAS*, 107 (21), 9552-5
- 189 **'34,6°C'** – Schär, C., 2016: 'The worst heat waves to come', *Nature Climate Change*, 6, 128-9
- 189 **'leefbaarheidsdrempel'** – Pal, J. & Eltahir, E., 2015: 'Future temperature in southwest Asia projected to exceed a threshold for human adaptability', *Nature Climate Change*, 6, 197-200
- 190 **'record is 54°C'** – Burt, C., 2016: 'Hottest reliably measured air temperatures on Earth', *Weather Underground*. www.wunderground.com/blog/weatherhistorian/hottest-reliably-measured-air-temperatures-on-earth.html
- 190 **'Hadj-rituelen'** – Kang, S. et al., 2019: 'Future heat stress during Muslim pilgrimage (Hajj) projected to exceed "extreme danger" levels', *Geophysical Research Letters*, 46, 10094-100
- 190 **'acuut risico'** – Im, E.-S. et al., 2017: 'Deadly heat waves projected in the densely populated agricultural regions of South Asia', *Science Advances*, 3 (8), e1603322
- 191 **'de vlakrijkste regio'** – Kang, S. & Eltahir, E., 2018: 'North China Plain threatened by deadly heatwaves due to climate change and irrigation', *Nature Communications*, 9, 2894
- 191 **'onderzoek uit 2019'** – Matthews, T. et al., 2019: 'An emerging tropical cyclone–deadly heat compound hazard', *Nature Climate Change*, 9, 602-6

Stof en vuur

- 192 **'Brian Allen'** – Crenshaw, Z., 2018: 'Father contracts Valley Fever, dies weeks after moving to Arizona', *ABC 15*. www.abc15.com/news/region-southeast-valley/mesa/father-contracts-valley-fever-dies-weeks-after-moving-to-arizona
- 193 **'sterke correlatie'** – Tong, D. et al., 2017: 'Intensified dust storm activity and Valley fever infection in the southwestern United States', *Geophysical Research Letters*, 44, 4304-12
- 193 **'17 staten'** – Gorris, M. et al., 2019: 'Expansion of coccidioidomycosis endemic regions in the United States in response to climate change', *GeoHealth*, 3 (10), 308-27
- 194 **'kans op een megadroogte'** – Ault, T. et al., 2016: 'Relative impacts of mitigation, temperature, and precipitation on 21st-century megadrought risk in the American Southwest', *Science Advances*, 2 (10), e1600873
- 194 **'dennen- en sparrenbossen'** – Williams, A.P. et al., 2013: 'Temperature as a potent driver of regional forest drought stress and tree mortality', *Nature Climate Change*, 3, 292-7
- 194 **'onderzoek uit 2018'** – Park, C.-E. et al., 2018: 'Keeping global warming within 1.5 °C constrains emergence of aridification', *Nature Climate Change*, 8, 70-4
- 194 **'5,8 miljoen'** – Feng, S. & Fu, Q., 2013: 'Expansion of global drylands under a warming climate', *Atmospheric Chemistry and Physics*, 13, 10081-94
- 195 **'als "droog" worden gekenmerkt'** – Huang, J. et al., 2015: 'Accelerated dryland expansion under climate change', *Nature Climate Change*, 6, 166-71
- 195 **'1,9 miljard'** – Koutroulis, A., 2019: 'Dryland changes under different levels of global warming', *Science of the Total Environment*, 655, 482-511
- 195 **'hele Europese continent'** – Spinoni, J. et al., 2017: 'Will drought events become more frequent and severe in Europe?', *International Journal of Climatology*, 38 (4), 1718-36
- 195 **'artikel uit 2019'** – Koutroulis, A., 2019: 'Global water availability under high-end climate change: A vulnerability based assessment', *Global and Planetary Change*, 175, 52-63
- 195 **'minder water stromen'** – Wanders, N. et al., 2015: 'Global hydrological droughts in the 21st century under a changing hydrological regime', *Earth Systems Dynamics*, 6, 1-15
- 195 **'West-Afrika'** – Sylla, M.B. et al., 2018: 'Projected increased risk of water deficit over major West African river basins under future climates', *Climatic Change*, 151 (2), 247-58
- 196 **'600 miljoen'** – Sandeep, S. et al., 2018: 'Decline and poleward shift in Indian summer monsoon synoptic activity in a warming climate', *PNAS*, 115 (11), 2681-6
- 195 **'droog en sub-tropisch'** – Schlaepfer, D. et al., 2017: 'Climate change reduces extent of temperate drylands and intensifies drought in deep soils', *Nature Communications*, 8, 14196
- 196 **'ebola-uitbraken'** – Redding, W. et al., 2019: 'Impacts of environmental and socio-economic factors on emergence and epidemic potential of Ebola in Africa', *Nature Communications*, 10, 4531
- 196 **'bij brand ontstane fijnstof'** – Ford, B. et al., 2018: 'Future fire impacts on smoke concentrations, visibility, and health in the contiguous United States', *GeoHealth*, 2, 229-47
- 196 **'100-600%'** – Barbero, R. et al., 2015: 'Climate change presents increased potential for very large fires in the contiguous United States', *International Journal of Wildland Fire*, 24 (7), 892-9
- 196 **'een grote toename'** – Bowman, D. et al., 2017: 'Human exposure and sensitivity to globally extreme wildfire events', *Nature Ecology & Evolution*, 1, 0058
- 196 **'rondom de Middellandse Zee'** – Turco, M. et al., 2018: 'Exacerbated fires in Mediterranean Europe due to anthropogenic warming projected with non-stationary climate-fire models', *Nature Communications*, 9, 3821
- 196 **'frequente bliksems'** – Lang, T. & Rutledge, S., 2006: 'Cloud-to-ground lightning downwind of the 2002 Hayman forest fire in Colorado', *Geophysical Research Letters*, 33 (3), L03804
- 196 **'vuurtornado's'** – Cunningham, P. & Reeder, M., 2009: 'Severe convective storms initiated by intense wildfires: Numerical simulations of pyro-convection and pyro-tornadogenesis', *Geophysical Research Letters*, 36 (12), L12812; McRae, R. et al., 2012: 'An Australian pyro-tornadogenesis event', *Natural Hazards*, 65 (3), 1801-11

- 196 **'zwarte hagel'** – Fromm, M. et al., 2006: 'Violent pyro-convective storm devastates Australia's capital and pollutes the stratosphere', *Geophysical Research Letters*, 33, L05815
- 196 **'in de stratosfeer'** – McRae, R. et al., 2015: 'Linking local wildfire dynamics to pyroCb development', *Natural Hazards and Earth System Sciences*, 15, 417-28
- 197 **'Kasatochi-vulkaan'** – Peterson, D. et al., 2018: 'Wildfire-driven thunderstorms cause a volcano-like stratospheric injection of smoke', *npj Climate and Atmospheric Science*, 1, 30
- 197 **'kernoorlog'** – Yu, P. et al., 2019: 'Black carbon lofts wildfire smoke high into the stratosphere to form a persistent plume', *Science*, 365 (6453), 587-90
- 197 **'roetdeeltjes'** – Christian, K. et al., 2019: 'Radiative forcing and stratospheric warming of pyrocumulonimbus smoke aerosols: First modeling results with multisensor (EPIC, CALIPSO, and CATS) views from space', *Geophysical Research Letters*, 46, 10061-71
- 197 **'veel grotere gebieden'** – Carrão, H. et al., 2018: 'Global projections of drought hazard in a warming climate: a prime for disaster risk management', *Climate Dynamics*, 50 (5-6), 2137-55

Bergen smeltwater

- 198 **'80-90%'** – Berg, N. & Hall, A., 2017: 'Anthropogenic warming impacts on California snowpack during drought', *Geophysical Research Letters*, 44 (5), 2511-18
- 198 **'allerhoogste pieken'** – Schauwecker, S. et al., 2017: 'The freezing level in the tropical Andes, Peru: An indicator for present and future glacier extents', *Journal of Geophysical Research: Atmospheres*, 122 (10), 5172-89
- 198 **'verliest Peru'** – Drenkhan, F. et al., 2018: 'Current and future glacier and lake assessment in the deglaciating Vilcanota-Urubamba basin, Peruvian Andes', *Global and Planetary Change*, 169, 105-18
- 198 **'Quelccaya-ijskap'** – Yarleque, C. et al., 2018: 'Projections of the future disappearance of the Quelccaya Ice Cap in the Central Andes', *Scientific Reports*, 8, 15564
- 199 **'niet meer dan 10%'** – Kraaijenbrink, P. et al., 2017: 'Impact of a global temperature rise of 1.5 degrees Celsius on Asia's glaciers', *Nature*, 549, 257-60

Aanzwellend water

- 200 **'gebeurtenissen van 1998'** – del Ninno, C. et al., 2001: 'The 1998 floods in Bangladesh: Disaster impacts, household coping strategies, and response', *Research Reports: No. 122*, The International Food Policy Research Institute (IFPRI)
- 201 **'overstromingsramp van 1998'** – Monirul Qader Mirza, M., 2002: 'Global warming and changes in the probability of occurrence of floods in Bangladesh and implications', *Global Environmental Change*, 12 (2), 127-38
- 201 **'kolossale hoeveelheden neerslag'** – Mohammed, K. et al., 2018: 'Future floods in Bangladesh under 1.5°C, 2°C, and 4°C global warming scenarios', *Journal of Hydrologic Engineering*, 23 (12), 04018050
- 201 **'Golf van Bengalen'** – Rahman, S. et al., 2019: 'Projected changes of inundation of cyclonic storms in the Ganges–Brahmaputra–Meghna delta of Bangladesh due to SLR by 2100', *Journal of Earth System Science*, 128, 145
- 202 **'62 miljoen'** – Hirabayashi, Y. et al., 2013: 'Global flood risk under climate change', *Nature Climate Change*, 3, 816-21
- 202 **'20-voudige stijging'** – Alfieri, L. et al., 2017: 'Global projections of river flood risk in a warmer world', *Earth's Future*, 5, 171-82
- 203 **'100 miljard euro'** – Alfieri, L. et al., 2015: 'Ensemble flood risk assessment in Europe under high end climate scenarios', *Global Environmental Change*, 35, 199-212
- 203 **'bijna 200%'** – Musselman, K. et al., 2018: 'Projected increases and shifts in rain-on-snow flood risk over western North America', *Nature Climate Change*, 8, 808-12
- 203 **'luchtrivieren'** – Espinoza, V. et al., 2018: 'Global analysis of climate change projection effects on atmospheric rivers', *Geophysical Research Letters*, 45, 4299-308
- 203 **'artikel uit 2019'** – Bevacqua, E. et al., 2019: 'Higher probability of compound flooding from precipitation and storm surge in Europe under anthropogenic climate change', *Science Advances*, 5 (9), eaaw5531

- 204 'liefst 400%' – Prein, A. et al., 2017: 'The future intensification of hourly precipitation extremes', *Nature Climate Change*, 7, 48-52
- 204 'krachtigste categorie MCS' – Prein, A. et al., 2017: 'Increased rainfall volume from future convective storms in the US', *Nature Climate Change*, 7, 880-4

Orkaanalarm

- 205 'Cray XC40' – Met Office, ongedateerd: 'The Cray XC40 supercomputer'. www.metoffice.gov.uk/about-us/what/technology/supercomputer
- 206 '(HiFLOR)' – Murakami, H. et al., 2015: 'Simulation and prediction of Category 4 and 5 hurricanes in the high-resolution GFDL HiFLOR coupled climate model', *Journal of Climate*, 28, 9058-79
- 206 'hoog CO₂-gehalte' – Bhatia, K. et al., 2018: 'Projected response of tropical cyclone intensity and intensification in a global climate model', *Journal of Climate*, 31, 8281-303
- 206 'categorie 4 en 5' – Yoshida, K. et al., 2017: 'Future changes in tropical cyclone activity in high-resolution large-ensemble simulations', *Geophysical Research Letters*, 44, 9910-17
- 207 'in 2017 probeerden' – Sugi, M. et al., 2016: 'Projection of future changes in the frequency of intense tropical cyclones', *Climate Dynamics*, 49 (1-2), 619-32
- 207 '500 mm' – Emanuel, K., 2017: 'Assessing the present and future probability of Hurricane Harvey's rainfall', *PNAS*, 114 (48), 12681-4
- 208 'benodigde 26°C' – Tory, K. & Dare, R., 2015: 'Sea surface temperature thresholds for tropical cyclone formation', *Journal of Climate*, 28, 8171-83
- 208 'Arabische Zee' – Murakami, H. et al., 2017: 'Increasing frequency of extremely severe cyclonic storms over the Arabian Sea', *Nature Climate Change*, 7, 885-9
- 208 'tropische structuur' – González-Alemán, J. et al., 2019: 'Potential increase in hazard from Mediterranean hurricane activity with global warming', *Geophysical Research Letters*, 46, 1754-64
- 208 'orkaanvrije gebieden' – Jung, C. & Lackmann, G., 2019: 'Extratropical transition of Hurricane Irene (2011) in a changing climate', *Journal of Climate*, 32, 4847-71
- 208 'minder regen brengende stormen' – Muthige, M. et al., 2018: 'Projected changes in tropical cyclones over the South West Indian Ocean under different extents of global warming', *Environmental Research Letters*, 13, 065019
- 208 'Nature Climate Change' – Lin, N. & Emanuel, K., 2015: 'Grey swan tropical cyclones', *Nature Climate Change*, 6, 106-11

Mislukte oogsten

- 209 'fatale grenswaarden' – Schauburger, B. et al., 2017: 'Consistent negative response of US crops to high temperatures in observations and crop models', *Nature Communications*, 8, 13931
- 209 'Amerikaanse maïsoogst' – Ibid.
- 210 'Dust Bowl-rampjaar' – Glotter, M. & Elliott, J., 2016: 'Simulating US agriculture in a modern Dust Bowl drought', *Nature Plants*, 3, 16193
- 211 'artikel uit 2018' – Tigchelaar, M. et al., 2018: 'Future warming increases probability of globally synchronized maize production shocks', *PNAS*, 115 (26), 6644-9
- 211 'In 2019 schreef' – Trnka, M. et al., 2019: 'Mitigation efforts will not fully alleviate the increase in water scarcity occurrence probability in wheat-producing areas', *Science Advances*, 5, eaau2406
- 212 'de tuinbouw' – Scheelbeek, P. et al., 2018: 'Effect of environmental changes on vegetable and legume yields and nutritional quality', *PNAS*, 115 (26), 6804-9
- 212 'ook de veeteelt' – Rojas-Downing, M. et al., 2017: 'Climate change and livestock: Impacts, adaptation, and mitigation', *Climate Risk Management*, 16, 145-63
- 212 'geschikt wordt voor de landbouw' – King, M. et al., 2018: 'Northward shift of the agricultural climate zone under 21st-century global climate change', *Scientific Reports*, 8, 7904

Massa-extinctie

- 214 'zo'n 4°C lager' – Annan, J. & Hargreaves, J., 2013: 'A new global reconstruction of temperature changes at the Last Glacial Maximum', *Climate of the Past*, 9, 367-76
- 215 'Oligoceen en Mioceen' – Burke, K. et al., 2018: 'Pliocene and Eocene provide best analogs for near-future climates', *PNAS*, 115 (52), 13288-93
- 215 '65 keer' – Nolan, C. et al., 2018: 'Past and future global transformation of terrestrial ecosystems under climate change', *Science*, 361 (6405), 920-3
- 216 'een zesde deel van alle soorten' – Urban, M., 2015: 'Accelerating extinction risk from climate change', *Science*, 348 (6234), 571-3
- 216 'veel overlap' – Warszawski, L., 2013: 'A multi-model analysis of risk of ecosystem shifts under climate change', *Environmental Research Letters*, 8, 044018
- 216 'Een geschikt milieu' – Williams, J. et al., 2007: 'Projected distributions of novel and disappearing climates by 2100 AD', *PNAS*, 104 (14), 5738-42
- 217 'kans van 98%' – Muñoz, N. et al., 2015: 'Adaptive potential of a Pacific salmon challenged by climate change', *Nature Climate Change*, 5, 163-6
- 217 'mediterrane ecosysteem' – Guiot, J. & Cramer, W., 2016: 'Climate change: The 2015 Paris Agreement thresholds and Mediterranean basin ecosystems', *Science*, 354 (6311), 465-8
- 217 'hun huidige "klimaatniche"' – Gonzalez, P. et al., 2018: 'Disproportionate magnitude of climate change in United States national parks', *Environmental Research Letters*, 13, 104001
- 217 'hun huidige areaal' – Newbold, T., 2018: 'Future effects of climate and land-use change on terrestrial vertebrate community diversity under different scenarios', *Proceedings of the Royal Society B: Biological Sciences*, 285, 1881
- 217 'op een gigantische schaal' – Heyder, U. et al., 2011: 'Risk of severe climate change impact on the terrestrial biosphere', *Environmental Research Letters*, 6, 034036
- 217 'Amazone-regenwoud' – Sampaio, G. et al., 2019: 'Assessing the possible impacts of a 4 °C or higher warming in Amazonia'. In: Nobre C. et al. (eds), *Climate Change Risks in Brazil*. Springer, Cham
- 217 'komende massa-extinctie' – Cardoso da Silva, J.-M. et al., 2005: 'The fate of the Amazonian areas of endemism', *Conservation Biology*, 19 (3), 689-94
- 218 '41 omhoog ... 21 keer' – Frölicher, T. et al., 2018: 'Marine heatwaves under global warming', *Nature*, 560, 360-4
- 218 '100% van de soorten' – Stuart-Smith, R. et al., 2015: 'Thermal biases and vulnerability to warming in the world's marine fauna', *Nature*, 528, 88-92
- 218 'oceaandelen' – Bruno, J. et al., 2018: 'Climate change threatens the world's marine protected areas', *Nature Climate Change*, 8, 499-503
- 218 'aanzienlijke overlap' – Ramírez, F. et al., 2017: 'Climate impacts on global hot spots of marine biodiversity', *Science Advances*, 3 (2), e1601198
- 218 'hoeveelheid krill' – Tulloch, V. et al., 2019: 'Future recovery of baleen whales is imperiled by climate change', *Global Change Biology*, 25 (4), 1263-81
- 218 'de Zuidelijke Oceaan zijn' – Negrete-García, G. et al., 2019: 'Sudden emergence of a shallow aragonite saturation horizon in the Southern Ocean', *Nature Climate Change*, 9, 313-17
- 219 'giftige algen' – Riebesell, U. et al., 2018: 'Toxic algal bloom induced by ocean acidification disrupts the pelagic food web', *Nature Climate Change*, 8, 1082-6
- 219 'vraatzichtige algen' – Segschneider, J. & Bendtsen, J., 2013: 'Temperature-dependent remineralization in a warming ocean increases surface pCO₂ through changes in marine ecosystem composition', *Global Biogeochemical Cycles*, 27, 1214-25

Klimaatontwrichting in de oceanen

- 219 '20 dagen eerder' – Cassou, C. & Cattiaux, J., 2016: 'Disruption of the European climate seasonal clock in a warming world', *Nature Climate Change*, 6, 589-94
- 220 'stratosferische winden' – Manzini, E. et al., 2018: 'Nonlinear response of the stratosphere and the North Atlantic-European climate to global warming', *Geophysical Research Letters*, 45, 4255-63

- 220 **'Nature Climate Change'** – Cai, W. et al., 2014: 'Increasing frequency of extreme El Niño events due to greenhouse warming', *Nature Climate Change*, 4, 111-116
- 220 **'orkaan Mitch'** – Ibid.
- 221 **'afkoelend gat'** – Liu, W. et al., 2017: 'Overlooked possibility of a collapsed Atlantic Meridional Overturning Circulation in warming climate', *Science Advances*, 3 (1), e1601666
- 221 **'Noord-Atlantische stormbaan'** – Jackson, L. et al., 2015: 'Global and European climate impacts of a slowdown of the AMOC in a high resolution GCM', *Climate Dynamics*, 45 (11-12), 3299-316
- 221 **'rondstuiteren'** – Weijer, W. et al., 2019: 'Stability of the Atlantic Meridional Overturning Circulation: A review and synthesis', *Journal of Geophysical Research: Oceans*, 124, 5336-75
- 222 **'zonder opvallend weer'** – Goddard, P. et al., 2015: 'An extreme event of sea-level rise along the Northeast coast of North America in 2009-2010', *Nature Communications*, 6, 6346

Apocalyps op Antarctica

- 222 **'schuiven reuzengletsjers'** – Rintoul, S. et al., 2018: 'Choosing the future of Antarctica', *Nature*, 558, 233-41
- 222 **'donkerblauwe smeltwaterpoelen'** – Trusel, L. et al., 2015: 'Divergent trajectories of Antarctic surface melt under two twenty-first-century climate scenarios', *Nature Geoscience*, 8, 927-32
- 223 **'donkere diepten'** – Bell, R. et al., 2018: 'Antarctic surface hydrology and impacts on ice-sheet mass balance', *Nature Climate Change*, 8, 1044-52
- 223 **'vreemd groen tintje'** – Rintoul, S. et al., 2018: 'Choosing the future of Antarctica'
- 223 **'kleinere ijskap'** – Clark, P. et al., 2016: 'Consequences of twenty-first-century policy for multi-millennial climate and sea-level change', *Nature Climate Change*, 6, 360-9
- 224 **'voor de VS'** – Strauss, B. et al., 2015: 'Carbon choices determine US cities committed to futures below sea level', *PNAS*, 112 (44), 13508-13
- 224 **'artikel uit 2017'** – Hauer, M., 2017: 'Migration induced by sea-level rise could reshape the US population landscape', *Nature Climate Change*, 7 (5), 321-5
- 224 **'130 miljard ... biljoenen'** – Neumann, J. et al., 2014: 'Joint effects of storm surge and sea-level rise on US Coasts: new economic estimates of impacts, adaptation, and benefits of mitigation policy', *Climatic Change*, 129, 337
- 225 **'catastrofaal verlies'** – Vousdoukas, M. et al., 2018: 'Climatic and socioeconomic controls of future coastal flood risk in Europe', *Nature Climate Change*, 8, 776-80
- 225 **'Bronstijd'** – Jevrejeva, S. et al., 2016: 'Coastal sea level rise with warming above 2 °C', *PNAS*, 113 (47), 13342-7
- 225 **'New York ... Lagos'** – Ibid.
- 226 **'5% op meer'** – Jevrejeva, S. et al., 2014: 'Upper limit for sea level projections by 2100', *Environmental Research Letters*, 9, 104008
- 226 **'292 cm'** – Le Bars, D. et al., 2017: 'A high-end sea level rise probabilistic projection including rapid Antarctic ice sheet mass loss', *Environmental Research Letters*, 12, 044013
- 226 **'in de kustgebieden'** – Nicholls, R. et al., 2011: 'Sea-level rise and its possible impacts given a "beyond 4°C world" in the twenty-first century', *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 369, 161-81
- 226 **'oktober 2019'** – Kulp, S. & Strauss, B., 2019: 'New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding', *Nature Communications*, 10, 4844
- 226 **'2,8% van het mondiale bbp'** – Jevrejeva, S. et al., 2018: 'Flood damage costs under the sea level rise with warming of 1.5°C and 2°C', *Environmental Research Letters*, 9, 104008

De Arctische koolstofbom

- 227 **'het gehele permafrostgebied'** – Kleinen, T. & Brovkin, V., 2018: 'Pathway-dependent fate of permafrost region carbon', *Environmental Research Letters*, 13, 094001
- 227 **'een paar tiende graad'** – Gedney, N. et al., 2019: 'Significant feedbacks of wetland methane release on climate change and the causes of their uncertainty', *Environmental Research Letters*, 14, 084027

- 228 ‘aarde-omspannende bosgordel’ – Walker, X. et al., 2019: ‘Increasing wildfires threaten historic carbon sink of boreal forest soils’, *Nature*, 572, 520-3
- 228 ‘1,5 biljoen ton’ – Koven, C. et al., 2015: ‘A simplified, data-constrained approach to estimate the permafrost carbon-climate feedback’, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 373, 20140423
- 228 ‘wellicht sneller zal verlopen’ – Plaza, P. et al., 2019: ‘Direct observation of permafrost degradation and rapid soil carbon loss in tundra’, *Nature Geoscience*, 12, 627-31
- 228 ‘100 miljard ton’ – McGuire, A. et al., 2018: ‘Dependence of the evolution of carbon dynamics in the northern permafrost region on the trajectory of climate change’, *PNAS*, 115 (15), 3882-7
- 228 ‘ongeveer een decennium’ – Global Carbon Project, 2018: *Global Carbon budget*. www.globalcarbonproject.org/carbonbudget/18/highlights.htm
- 228 ‘amper 0,2°C’ – Schaefer, K. et al., 2014: ‘The impact of the permafrost carbon feedback on global climate’, *Environmental Research Letters*, 9, 085003

5°C

Hitteschok

- 233 ‘dodelijke hitte’ – Mora, C. et al., 2017: ‘Global risk of deadly heat’, *Nature Climate Change*, 7, 501-6
- 234 ‘200 dagen’ – Rohat, G. et al., 2019: ‘Projections of human exposure to dangerous heat in African cities under multiple socioeconomic and climate scenarios’, *Earth’s Future*, 7, 528-46
- 234 ‘gelijktijdig miskukken’ – Tigchelaar, M. et al., 2018: ‘Future warming increases probability of globally synchronized maize production shocks’, *PNAS*, 115 (26), 6644-9
- 235 ‘acht miljardairs’ – Oxfam, 2017: ‘Just 8 men own same wealth as half the world’, persbericht. www.oxfam.org/en/pressroom/pressreleases/2017-01-16/just-8-men-own-same-wealth-half-world
- 236 ‘rechts-populistische partijen’ – Gardiner, B., 2019: ‘For Europe’s far-right parties, climate is a new battleground’, *Yale Environment* 360. e360.yale.edu/features/for-europes-far-right-parties-climate-is-a-new-battleground

Klimaatvluchtoorden

Ijsvrije poolgebieden

- 241 ‘grootschalige dooi’ – Le Bars, D. et al., 2017: ‘A high-end sea level rise probabilistic projection including rapid Antarctic ice sheet mass loss’, *Environmental Research Letters*, 12, 044013
- 241 ‘800 miljoen’ – Brown, S. et al., 2018: ‘Quantifying land and people exposed to sea-level rise with no mitigation and 1.5C and 2.0C rise in global temperatures to year 2300’, *Earth’s Future*, 6, 583-600
- 241 ‘landniveau opstuwt’ – Jevrejeva, S. et al., 2016: ‘Coastal sea level rise with warming above 2 °C’, *PNAS*, 113 (47), 13342-7
- 242 ‘5% ... mondiale bbp’ – Hinkel, J. et al., 2014: ‘Coastal flood damage and adaptation costs under 21st century sea-level rise’, *PNAS*, 111 (9), 3292-7
- 242 ‘2-4 cm per jaar’ – DeConto, R. & Pollard, D., 2016: ‘Contribution of Antarctica to past and future sea-level rise’, *Nature*, 531, 591-7
- 242 ‘vertienvoudiging’ – Nicholls, R. et al., 2018: ‘Stabilization of global temperature at 1.5°C and 2.0°C: implications for coastal areas’, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376 (2119), 20160448
- 242 ‘Groenlandse ijskap’ – Aschwanden, A. et al., 2019: ‘Contribution of the Greenland Ice Sheet to sea level over the next millennium’, *Science Advances*, 5 (6), eaav9396

- 242 'binnen 250 jaar' – DeConto, R. & Pollard, D., 2016: 'Contribution of Antarctica to past and future sea-level rise'
- 242 'met 7,5 meter' – Bamber, J. et al., 2019: 'Ice sheet contributions to future sea-level rise from structured expert judgment', *PNAS*, 116 (23), 11195-200
- 242 '10.000 jaar' – Winkelmann, R. et al., 2015: 'Combustion of available fossil fuel resources sufficient to eliminate the Antarctic Ice Sheet', *Science Advances*, 1 (8), e1500589
- 242 '0,63 biljoen' – Hier te volgen: trillionthtonne.org/
- 243 'nieuw land' – Lee, J. et al., 2017: 'Climate change drives expansion of Antarctic ice-free habitat', *Nature*, 547, 49-54
- 243 'iconische dieren' – Jenouvrier, S. et al., 2019: 'The Paris Agreement objectives will likely halt future declines of emperor penguins', *Global Change Biology*. In press

Hyperthermische broeikassen

- 244 '56 miljoen jaar' – Zhu, J. et al., 2019: 'Simulation of Eocene extreme warmth and high climate sensitivity through cloud feedbacks', *Science Advances*, 5 (9), eaax1874
- 245 'staven de hypothesen' – Chen, C. et al., 2018: 'Estimating regional flood discharge during Palaeocene-Eocene global warming', *Scientific Reports*, 8, 13391
- 245 'puinmengsel' – Pujalte, V., 2019: 'Microcodium-rich turbidites in hemipelagic sediments during the T Paleocene–Eocene Thermal Maximum: Evidence for extreme precipitation events in a Mediterranean climate (Río Gor section, southern Spain)', *Global and Planetary Change*, 178, 153-67
- 246 'Bighorn-bekken' – Kraus, M. et al., 2013: 'Paleohydrologic response to continental warming during the Paleocene–Eocene Thermal Maximum, Bighorn Basin, Wyoming', *Palaeogeography, Palaeoclimatology, Palaeoecology*, 370, 196-208
- 246 'heroplevende moesson' – Foreman, B. et al., 2012: 'Fluvial response to abrupt global warming at the Palaeocene/Eocene boundary', *Nature*, 491, 92-5

Arctische regenwouden

- 247 'PETM-stuifmeel' – Suan, G. et al., 2017: 'Subtropical climate conditions and mangrove growth in Arctic Siberia during the early Eocene', *Geology*, 45 (6), 539-42
- 247 'huidige Verenigde Staten' – Eberle, J. & Greenwood, D., 2012: 'Life at the top of the greenhouse Eocene world—A review of the Eocene flora and vertebrate fauna from Canada's High Arctic', *GSA Bulletin*, 124 (1-2), 3-23
- 247 '20°C of hoger' – Denis, E. et al., 2017: 'Fire and ecosystem change in the Arctic across the Paleocene-Eocene Thermal Maximum', *Earth and Planetary Science Letters*, 467, 149-56
- 248 'aan de Noordpool' – Eberle, J. & Greenwood, D., 2012: 'Life at the top of the greenhouse Eocene world'
- 248 '55 miljoen jaar' – Willard, D. et al., 2019: 'Arctic vegetation, temperature, and hydrology during Early Eocene transient global warming events', *Global and Planetary Change*, 178, 139-52
- 248 'Arctische regenwouden' – Harrington, G. et al., 2012: 'Arctic plant diversity in the Early Eocene greenhouse', *Proceedings of the Royal Society B: Biological Sciences*, 279, 1515-21
- 248 'hevige polaire versterking' – Pross, J. et al., 2012: 'Persistent near-tropical warmth on the Antarctic continent during the early Eocene epoch', *Nature*, 488 (7409), 73-7

Zuurstofloze oceanen

- 249 'oceanplankton' – Aze, T. et al., 2014: 'Extreme warming of tropical waters during the Paleocene–Eocene Thermal Maximum' *Geology*, 42 (9), 739-42
- 249 'Nigeriaanse boorkern' – Frieling, J. et al., 2017: 'Extreme warmth and heat-stressed plankton in the tropics during the Paleocene-Eocene Thermal Maximum', *Science Advances*, 3 (3), e1600891
- 249 'rifcrises' – Kiessling, W. et al., 2011: 'On the potential for ocean acidification to be a general cause of ancient reef crises', *Global Change Biology*, 17 (1), 56-67

- 249 **‘verdwenen ze volledig’** – Speijer, R. et al., 2012: ‘Response of marine ecosystems to deep-time global warming: A synthesis of biotic patterns across the Paleocene-Eocene thermal maximum (PETM)’, *Austrian Journal of Earth Sciences*, 105 (1), 6-16
- 249 **‘zoöxanthellae’** – Weiss, A. & Martindale, R., 2019: ‘Paleobiological traits that determined Scleractinian coral survival and proliferation during the Late Paleocene and Early Eocene hyperthermals’, *Paleoceanography and Paleoclimatology*, 34 (2), 252-74
- 250 **‘modderige algenmatten’** – Zamagni, J. et al., 2012: ‘The evolution of mid Paleocene-early Eocene coral communities: How to survive during rapid global warming’, *Palaeogeography, Palaeoclimatology, Palaeoecology*, 317, 48-65
- 250 **‘PETM-gesteenten’** – Bralower, T. et al., 2018: ‘Evidence for shelf acidification during the onset of the Paleocene Eocene Thermal Maximum’, *Paleoceanography and Paleoclimatology*, 33 (12), 1408-26
- 250 **‘onze koolstofemissies’** – Babila, T. et al., 2018: ‘Capturing the global signature of surface ocean acidification during the Palaeocene–Eocene Thermal Maximum’, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376 (2130), 20170072
- 250 **‘extreme hitte’** – Gibbs, S. et al., 2016: ‘Ocean warming, not acidification, controlled coccolithophore response during past greenhouse climate change’, *Geology*, 44 (1), 59-62
- 251 **‘waterstofsulfide’** – Yao, W. et al., 2018: ‘Large-scale ocean deoxygenation during the Paleocene-Eocene Thermal Maximum’, *Science*, 361 (6404), 804-6
- 251 **‘neurotoxinen’** – Cramwinckel, M. et al., 2019: ‘Harmful algae and export production collapse in the equatorial Atlantic during the zenith of Middle Eocene Climatic Optimum warmth’, *Geology*, 47 (3), 247-50
- 251 **‘voedselketen in zee’** – Winguth, A. et al., 2012: ‘Global decline in ocean ventilation, oxygenation, and productivity during the Paleocene-Eocene Thermal Maximum: Implications for the benthic extinction’, *Geology*, 40 (3), 263-6

Kantelpunt bij twee graden?

- 251 **‘enorme vulkaanuitbarstingen’** – Troll, V. et al., 2019: ‘A large explosive silicic eruption in the British Palaeogene Igneous Province’, *Scientific Reports*, 9 (1), 494
- 252 **‘57 miljoen jaar’** – Saunders, A., 2016: ‘Two LIPs and two Earth-system crises: the impact of the North Atlantic Igneous Province and the Siberian Traps on the Earth-surface carbon cycle’, *Geological Magazine*, 153 (2), 201-22
- 252 **‘North Atlantic Igneous Province’** – Gutjahr, M. et al., 2017: ‘Very large release of mostly volcanic carbon during the Palaeocene–Eocene Thermal Maximum’, *Nature*, 548 (7669), 573
- 252 **‘18 en 40 biljoen’** – Saunders, A., 2016: ‘Two LIPs and two Earth-system crises’
- 252 **‘PETM-temperatuurpiek’** – Frieling, J. et al., 2019: ‘Widespread warming before and elevated barium burial during the Paleocene-Eocene thermal maximum: Evidence for methane hydrate release?’ *Paleoceanography and Paleoclimatology*, 34 (4), 546-566
- 252 **‘Nature uit 2012’** – DeConto, R. et al., 2012: ‘Past extreme warming events linked to massive carbon release from thawing permafrost’, *Nature*, 484 (7392), 87
- 253 **‘statistische signaturen’** – Armstrong McKay, D. & Lenton, T., 2018: ‘Reduced carbon cycle resilience across the Palaeocene-Eocene Thermal Maximum’, *Climate of the Past*, 14, 1515-1527
- 253 **‘politieke toekenning’** – Frieling, J. et al., 2019: ‘Widespread Warming Before and Elevated Barium Burial During the Paleocene Eocene Thermal Maximum’
- 253 **‘latere hyperthermische gebeurtenissen’** – Westerhold, T. et al., 2018: ‘Late Lutetian Thermal Maximum—Crossing a thermal threshold in Earth’s climate system?’ *Geochemistry, Geophysics, Geosystems*, 19 (1), 73-82
- 254 **‘Eocene Thermal Maximum 2’** – Harper, D. et al., 2018: ‘Subtropical sea-surface warming and increased salinity during Eocene Thermal Maximum 2’, *Geology*, 46 (2), 187-90
- 254 **‘4.000 jaar’** – Zeebe, R. et al., 2016: ‘Anthropogenic carbon release rate unprecedented during the past 66 million years’, *Nature Geoscience*, 9 (4), 325

- 254 '10 miljard ton' – Ibid.
- 254 'erger zullen verzuren' – Ridgwell, A. & Schmidt, D., 2010: 'Past constraints on the vulnerability of marine calcifiers to massive carbon dioxide release', *Nature Geoscience*, 3 (3), 196
- 254 '140 jaar' – Gingerich, P., 2019: 'Temporal scaling of carbon emission and accumulation rates: Modern anthropogenic emissions compared to estimates of PETM onset accumulation', *Paleoceanography and Paleoclimatology*, 34 (3), 329-35

Leven en dood bij 5°C

- 255 'alomtegenwoordige ontrafeling' – Warren, R. et al., 2018: 'The projected effect on insects, vertebrates, and plants of limiting global warming to 1.5°C rather than 2°C', *Science*, 360 (6390), 791-5
- 255 '4.5°C opwarming' – Ibid. Supplementary info.
- 255 'Catastrofale drempels' – Rothman, D., 2017: 'Thresholds of catastrophe in the Earth System', *Science Advances*, 3, e1700906

6°C

Catastrofaal falen

- 260 'broeikasgas-emissiescenario's' – Sanderson, B. et al., 2011: 'The response of the climate system to very high greenhouse gas emission scenarios', *Environmental Research Letters*, 6 (3), 034005
- 262 '5 biljoen ton' – Tokarska, K. et al., 2016: 'The climate response to five trillion tonnes of carbon', *Nature Climate Change*, 6 (9), 851
- 263 '500 jaar' – Winkelmann, R. et al., 2015: 'Combustion of available fossil fuel resources sufficient to eliminate the Antarctic Ice Sheet', *Science Advances*, 1 (8), e1500589
- 263 'menselijke overlevingsdrempel' – Sherwood, S. & Huber, M., 2010: 'An adaptability limit to climate change due to heat stress', *PNAS*, 107 (21), 9552-5
- 263 'Noordelijke IJzee' – Korty, R. et al., 2017: 'Tropical cyclones downscaled from simulations with very high carbon dioxide levels', *Journal of Climate*, 30 (2), 649-67

De superbroeikas van het Krijt

- 265 '15°C hoger' – Cramwinckel, M. et al., 2018: 'Synchronous tropical and polar temperature evolution in the Eocene', *Nature*, 559 (7714), 382
- 265 'dan in het PETM' – Huber, B. et al., 2018: 'The rise and fall of the Cretaceous Hot Greenhouse climate', *Global and Planetary Change*, 167, 1-23
- 265 'Oceanic Anoxic Event 2' – Fischer, V. et al., 2016: 'Extinction of fish-shaped marine reptiles associated with reduced evolutionary rates and global environmental volatility', *Nature Communications*, 7, 10825
- 266 'een laag zwarte schalie' – Clarkson, M. et al., 2018: 'Uranium isotope evidence for two episodes of deoxygenation during Oceanic Anoxic Event 2', *PNAS*, 115 (12), 2918-23
- 266 'de Atlantische als de Stille' – Jenkyns, H., 2018: 'Transient cooling episodes during Cretaceous Oceanic Anoxic Events with special reference to OAE 1a (Early Aptian)', *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376 (2130), 20170073
- 266 'kalkplanktonfossielen' – Erba, E. et al., 2010: 'Calcareous nannoplankton response to surface-water acidification around Oceanic Anoxic Event 1a', *Science*, 329 (5990), 428-32
- 266 'wadi-achtige geulen' – Wu, C. et al., 2017: 'Mid-Cretaceous desert system in the Simao Basin, southwestern China, and its implications for sea-level change during a greenhouse climate', *Palaeogeography, Palaeoclimatology, Palaeoecology*, 468, 529-544
- 266 'naaldbomen' – Mays, C. et al., 2017: 'Polar wildfires and conifer serotiny during the Cretaceous global hothouse', *Geology*, 45 (12), 1119-22

- 266 'ijsvrije superbroeikaswereld' – Hay, W. et al., 2019: 'Possible solutions to several enigmas of Cretaceous climate', *International Journal of Earth Sciences*, 108 (2), 587-620
- 266 'OAE ra op gang bracht' – Erba, E. et al., 2010: 'Calcareous nannoplankton response to surface-water acidification around Oceanic Anoxic Event 1a'
- 266 '100.000 jaar' – Clarkson, M. et al., 2018: 'Uranium isotope evidence for two episodes of deoxygenation during Oceanic Anoxic Event 2'
- 267 'Deccan Traps' – Barnet, J. et al., 2018: 'A new high-resolution chronology for the late Maastrichtian warming event: Establishing robust temporal links with the onset of Deccan volcanism', *Geology*, 46 (2), 147-50
- 267 '400-500 ppm' – Zhang, L. et al., 2018: 'Deccan volcanism caused coupled pCO₂ and terrestrial temperature rises, and pre-impact extinctions in northern China', *Geology*, 46 (3), 271-4
- 267 '425 miljard' – Artemieva, N. et al., 2017: 'Quantifying the release of climate-active gases by large meteorite impacts with a case study of Chicxulub', *Geophysical Research Letters*, 44 (20), 10-180
- 267 'aanzienlijk hogere' – Vellekoop, J. et al., 2018: 'Shelf hypoxia in response to global warming after the Cretaceous-Paleogene boundary impact', *Geology*, 46 (8), 683-6
- 267 '30 jaar' – Brugger, J. et al., 2017: 'Baby, it's cold outside: climate model simulations of the effects of the asteroid impact at the end of the Cretaceous', *Geophysical Research Letters*, 44 (1), 419-27
- 267 'oceanen zuurstofloos' – Vellekoop, J. et al., 2018: 'Shelf hypoxia in response to global warming after the Cretaceous-Paleogene boundary impact'
- 268 'extreme verzuring' – Henehan, M. et al., 2019: 'Rapid ocean acidification and protracted Earth system recovery followed the end-Cretaceous Chicxulub impact', *PNAS*, 116 (45), 22500-4

Het Grote Sterven

- 269 'weelderige tropische wouden' – Bernardi, M. et al., 2017: 'Late Permian (Lopingian) terrestrial ecosystems: a global comparison with new data from the low-latitude Bletterbach Biota', *Earth-Science Reviews*, 175, 18-43

Extinctiemechanismen

- 271 'boringen bevestigen' – Svensen, H. et al., 2009: 'Siberian gas venting and the end-Permian environmental crisis', *Earth and Planetary Science Letters*, 277 (3-4), 490-500
- 271 '(van ongeveer 500°C)' – Ogden, D. & Sleep, N., 2012: 'Explosive eruption of coal and basalt and the end-Permian mass extinction', *PNAS*, 109(1), 59-62
- 271 '100.000-200.000 jaar' – Shen, S. et al., 2011: 'Calibrating the end-Permian mass extinction', *Science*, 334 (6061), 1367-72
- 272 'van het ene halfmond' – Grasby, S. et al., 2011: 'Catastrophic dispersion of coal fly ash into oceans during the latest Permian extinction', *Nature Geoscience*, 4 (2), 104
- 272 'giftig kwik' – Grasby, S. et al., 2017: 'Isotopic signatures of mercury contamination in latest Permian oceans', *Geology*, 45 (1), 55-8
- 272 'misvormde stuifmeelkorrels' – Hochuli, P. et al., 2017: 'Evidence for atmospheric pollution across the Permian-Triassic transition', *Geology*, 45 (12), 1123-6
- 273 'jaargemiddelde zuurgraad' – Black, B. et al., 2014: 'Acid rain and ozone depletion from pulsed Siberian Traps magmatism', *Geology*, 42 (1), 67-70
- 273 'dodelijke aanjager' – Brand, U. et al., 2016: 'Methane hydrate: killer cause of earth's greatest mass extinction', *Palaeoworld*, 25 (4), 496-507
- 274 'gas uit hydraten' – Majorowicz, J. et al., 2014: 'Gas hydrate contribution to Late Permian global warming', *Earth and Planetary Science Letters*, 393, 243-53
- 274 'mutaties veroorzakende' – Black, B. et al., 2014: 'Acid rain and ozone depletion from pulsed Siberian Traps magmatism'
- 274 'moderne naaldbomen' – Benca, J. et al., 2018: 'UV-B-induced forest sterility: Implications of ozone shield failure in Earth's largest extinction', *Science Advances*, 4 (2), e1700618

- 275 **'onbegroeide vlaktes'** – Smith, R. & Botha-Brink, J., 2014: 'Anatomy of a mass extinction: sedimentological and taphonomic evidence for drought-induced die-offs at the Permo-Triassic boundary in the main Karoo Basin, South Africa', *Palaeogeography, Palaeoclimatology, Palaeoecology*, 396, 99-118
- 275 **'steenkoolgat'** – Retallack, G. et al., 1996: 'Global coal gap between Permian-Triassic extinction and Middle Triassic recovery of peat-forming plants', *Geological Society of America Bulletin*, 108 (2), 195-207
- 275 **'30°N tot 40°Z'** – Sun, Y. et al., 2012: 'Lethally hot temperatures during the Early Triassic greenhouse', *Science*, 338 (6105), 366-70
- 276 **'verbrandingsproducten'** – Shen, S. et al., 2011: 'Calibrating the end-Permian mass extinction'
- 276 **'organische resten'** – Sun, Y. et al., 2012: 'Lethally hot temperatures during the Early Triassic greenhouse'
- 276 **'fysiologische stress'** – Penn, J. et al., 2018: 'Temperature-dependent hypoxia explains biogeography and severity of end-Permian marine mass extinction', *Science*, 362 (6419), eaat1327
- 276 **'een kleine vluchtzone'** – Song, H. et al., 2014: 'Anoxia/high temperature double whammy during the Permian-Triassic marine crisis and its aftermath', *Scientific Reports*, 4, 4132
- 276 **'Panthalassische en Tethys'** – Zhang, F. et al., 2018: 'Congruent Permian-Triassic -238U records at Panthalassic and Tethyan sites: Confirmation of global-oceanic anoxia and validation of the U-isotope paleoredox proxy', *Geology*, 46 (4), 327-30

Echo's uit het verleden

- 277 **'met 4-6°C'** – MacLeod, K. et al., 2017: 'Warming and increased aridity during the earliest Triassic in the Karoo Basin, South Africa', *Geology*, 45 (6), 483-6
- 277 **'met 4-8°C'** – Joachimski, M. et al., 2012: 'Climate warming in the latest Permian and the Permian-Triassic mass extinction', *Geology*, 40 (3), 195-198
- 277 **'40 km'** – Schobben, M. et al., 2014: 'Palaeotethys seawater temperature rise and an intensified hydrological cycle following the end-Permian mass extinction', *Gondwana Research*, 26 (2), 675-83
- 277 **'2 miljard ton'** – Svensen, H. et al., 2009: 'Siberian gas venting and the end-Permian environmental crisis'
- 277 **'superbroeikaseffect'** – Kump, L., 2018: 'Prolonged Late Permian-Early Triassic hyperthermal: failure of climate regulation?' *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376 (2130), 20170078

De hel op aarde

Het Venus-effect

- 282 **'96% uit CO₂'** – Kane, S. et al., 2019: 'Venus as a laboratory for exoplanetary science', *Journal of Geophysical Research: Planets*, 124 (8), 2015-28
- 282 **'0,97 tot 0,99 AE'** – Wolf, E. & Toon, O., 2014: 'Delayed onset of runaway and moist greenhouse climates for Earth', *Geophysical Research Letters*, 41 (1), 167-72
- 282 **'magnetisch veld'** – Driscoll, P. & Bercovici, D., 2013: 'Divergent evolution of Earth and Venus: influence of degassing, tectonics, and magnetic fields', *Icarus*, 226 (2), 1447-64
- 284 **'100 ppm'** – Feulner, G., 2017: 'Formation of most of our coal brought Earth close to global glaciation', *PNAS*, 114 (43), 11333-7
- 284 **'bewoonbare zone'** – Popp, M. et al., 2016: 'Transition to a moist greenhouse with CO₂ and solar forcing', *Nature Communications*, 7, 10627
- 284 **'6% ... ~650 miljoen'** – Wolf, E. & Toon, O., 2014: 'Delayed onset of runaway and moist greenhouse climates for Earth'
- 285 **'verdubbeling van het CO₂'** – Ibid.
- 285 **'met 15,5%'** – Ibid.

- 285 'overgang naar Venus' – Goldblatt, C. et al., 2013: 'Low simulated radiation limit for runaway greenhouse climates', *Nature Geoscience*, 6 (8), 661
- 285 'warmer klimaatregime' – Wolf, E. & Toon, O., 2015: 'The evolution of habitable climates under the brightening Sun', *Journal of Geophysical Research: Atmospheres*, 120 (12), 5775-94
- 285 '>500K' – Ramirez, R. et al., 2014: 'Can increased atmospheric CO₂ levels trigger a runaway greenhouse?' *Astrobiology*, 14 (8), 714-31
- 285 'totaal aan fossiele brandstoffen' – Tokarska, K. et al., 2016: 'The climate response to five trillion tonnes of carbon'
- 286 'stratocumulus-wolkendekken' – Schneider, T. et al., 2019: 'Possible climate transitions from breakup of stratocumulus decks under greenhouse warming', *Nature Geoscience*, 12 (3), 163

Het eindspel

Wat maakt een halve graad nu uit?

- 292 'ingebakken' – Tong, D. et al., 2019: 'Committed emissions from existing energy infrastructure jeopardize 1.5 C climate target', *Nature*, 572 (7769), 373-377
- 293 'netto-nuluitstoot' – Rogelj, J. et al., 2018: 'Mitigation pathways compatible with 1.5°C in the context of sustainable development'. In: *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, Masson-Delmotte, V. et al. (eds). In press, p. 96
- 295 'kort samenvatten' – Voor de literatuur achter alle gegevens en informatie in deze samenvatting, zie de eerdere hoofdstukken.

Twee graden en hoger

Op naar de vier graden

Op naar de zes graden

- 302 'een kans van 10-25%' – Climate Action Tracker, 2019: 'Warming projections global update, September 2019'. climateactiontracker.org/documents/644/CAT_2019-09-19_BriefingUNSG_WarmingProjectionsGlobalUpdate_Sept2019.pdf

Kies voor het leven