<u>**New Zealand weather and climate news**</u>

These clips are provided courtesy of MetService.

MetService

Desert Road closed overnight by ice, snow - weekend looking promising

The weather radar suggested some light snow was falling on the Desert Road around 5am Friday, MetService meteorologist Micky Malivuk said. At the time, the air temperature at the road's summit was -1 degrees Celsius, and the ground temperature could be a couple of degrees cooler, he said.

https://www.stuff.co.nz/national/106529522/desert-road-closed-overnight-by-ice-snow--weekend-looking-promising

Your weather: Wet wake-up but conditions clear in time for weekend and All Blacks

"The weather is looking ideal for Saturday evening's rugby matches when the Black Ferns play the Wallaroos and the All Blacks take on the Wallabies," a MetService spokesperson said.

https://www.nzherald.co.nz/northern-advocate/news/article.cfm?c_id=1503450&objectid=12112637

Your weather: Calm start to the week before rain, snow arrive tonight

A ridge of high pressure is bringing mostly calm and warm weather across the country today ahead of another wintry blast arriving tonight.

The central and upper North Island would see just a bit of cloud this morning and temperatures in the mid-teens, MetService meteorologist Mark Todd said.

https://www.nzherald.co.nz/northern-advocate/news/article.cfm?c_id=1503450&objectid=12114061

Heavy fog causes flight cancellations, traffic delays in Christchurch

MetService forecast the fog to lift by late morning with a warm start to the week and light northerlies for the rest of the day. Temperatures were forecast to peak at 18 degrees Celsius by early afternoon.

https://www.stuff.co.nz/travel/travel-troubles/106584774/heavy-fog-causes-flight-cancellations-traffic-delays-in-christchurch

<u>**Volcano alert**</u>

PNG's Manam Island erupts again

The volcano on Papua New Guinea's Manam Island has erupted again.

Manam, which lies off the coast of Madang Province, is one of PNG's most active volcanoes, last erupting in April 2017.

https://www.radionz.co.nz/international/pacific-news/364917/png-s-manam-island-erupts-again

MetOcean

OGC Seeks Public Comment on MetOcean profile and extensions to WCS 2.1

Extension to and Profile for WCS 2.1 will enable MetOcean community to efficiently query and access required data contained in datacubes.

21 August 2018: The Open Geospatial Consortium (OGC) seeks public comment on the MetOcean profile and extensions to WCS 2.1.

https://www.directionsmag.com/pressrelease/8030

Extreme weather (and other news) – Asia and the Middle East, Africa

Kerala Flood Of 2018 Less Intense Than Deluge Of 1924: So Why Was Damage As Great?

New Delhi: Kerala's once-in-a-lifetime rainfall was 2,378 mm over 88 days, four times more than normal–but 30% less and spread over 61 days more than the deluge of 1924, the most intense flood in the state's recorded history, submerging as it did almost the entire coastline.

http://www.indiaspend.com/cover-story/kerala-flood-of-2018-less-intense-than-deluge-of-1924-so-why-was-damage-as-great-27396

2018 Asia autumn forecast: Japan may face flood threats as drought builds from Ukraine to Kazakhstan

While the change of seasons will bring conditions typical of autumn in parts of Asia, there will be areas at risk for more extreme weather conditions ranging from floods to drought.

https://www.accuweather.com/en/weather-news/autumn-2018-forecast-japan-may-face-flooding-threats-as-drought-builds-from-ukraine-to-kazakhstan/70005790

Extreme weather (and other news) – Americas and Europe

Photos: Hawaii endures devastating flooding as Lane drops third highest US tropical rain total

Record rainfall from Lane triggered devastating flooding and debris flows across Hawaii late this past week.

https://www.accuweather.com/en/weather-news/photos-hawaii-endures-devastating-flooding-as-lane-drops-third-highest-us-tropical-rain-total/70005887

International news and research

What is the maximum possible number of Atlantic tropical cyclones? See the year 2005

In a multi-national collaborative study published August 22, 2018 in Science Advances, climate simulations and subsequent analyses of tropical cyclone activity were led by the Commonwealth Scientific and Industrial Research Organization (CSIRO), the University of Melbourne and the Barcelona Supercomputing Center (BSC). Project leads used climate models to estimate the maximum number of tropical cyclones that might occur in the North Atlantic in the current climate.

https://www.eurekalert.org/pub_releases/2018-08/bioo-wit081718.php

What's a smokestorm? A meteorologist explains.

As wildfire smoke descended on Seattle this week, the sun turned an apocalyptic shade of red and the city breathed in some of the unhealthiest air in the world. A new word to describe this phenomenon graced the headlines: "smokestorm."

https://grist.org/article/whats-a-smokestorm-a-meteorologist-explains/

Why the weather forecast will always be a bit wrong

The science of weather forecasting falls to public scrutiny every single day. When the forecast is correct, we rarely comment, but we are often quick to complain when the forecast is wrong. Are we ever likely to achieve a perfect forecast that is accurate to the hour?

https://theconversation.com/why-the-weather-forecast-will-always-be-a-bit-wrong-101547

How can we make ensemble forecasts more skilful?

Methods for scoring ensemble forecasts are generally well established, but it is less clear how to systematically go about identifying the most serious remaining deficiencies in the prediction system. By "most serious deficiencies" I mean those which, if fixed, would lead to the largest improvement in the forecast scores. Our recent article in the Bulletin of the American Meteorological Society (BAMS) tries to address this diagnostic aspect.

https://www.ecmwf.int/en/about/media-centre/science-blog/2018/how-can-we-make-ensemble-forecasts-more-skilful

6 Things About Weather Forecasts And Warnings That People Might Always Struggle With

Through my lens as a professor and former president of the American Meteorological Society, I know the weather enterprise has developed significant scientific capacity enabling better forecasts and warnings. Yeah, yeah, yeah...we hear the "it must be nice to have a job where you can be wrong all of the time." As I have written before, such statements are often rooted in misunderstanding or misinterpretation of the way forecasts are communicated. Meteorologists and social scientists struggle to understand why a duck boat operator would go on the water with a storm clearly approaching or a person would drive into a flooded road.

https://www.forbes.com/sites/marshallshepherd/2018/08/01/6-things-the-public-might-always-struggle-with-about-weather-forecasts-or-warnings/#4f064c854f17

Fires overwhelming British Columbia; smoke choking the skies

British Columbia is on fire. In this Canadian province, 56 wildfires 'of note' are active and continuing to blow smoke into the skies overhead.

https://www.sciencedaily.com/releases/2018/08/180823122252.htm

Microbes hitch a ride inland on coastal fog

Fog can act as a vector for microbes, transferring them long distances and introducing them into new environments.

https://www.sciencedaily.com/releases/2018/08/180823113618.htm

Science Says: Hawaii hurricanes rare, but getting less so

WASHINGTON — Hurricanes seldom get close to Hawaii and it's even rarer for one of the islands to take a direct hit.

Hurricane Lane is already drenching and pummeling the island chain, even without reaching land.

Read more here

Using El Nino to Predict King Tides

A Flooded Future

As residents of South Florida, we are confronted with the profound challenge of sea level rise due to our warming climate. The projections of 3 or 6 feet of rise by the year 2100—depending on how rapidly carbon dioxide emissions rise in the coming century—are of serious concern to

property owners, local governments, and resource managers, among others. This translates into a risk that "high tide flooding will occur every other day or more often" by 2100 along the entire Atlantic coast (1). If we continue follow an energy pathway with relatively high emissions, many U.S. locations will begin experiencing significant upticks in the number of days per year with high tide flooding within 15-20 years. Remarkably, this flooding would occur without any extreme rainfall associated with, say, thunderstorms or storm surge associated with tropical weather systems or hurricanes. This is often referred to as "clear-sky flooding," sunny-day flooding," or "nuisance flooding."

http://www.weathernationtv.com/news/using-el-nino-to-predict-king-tides/

Rain dancing 2.0': should humans be using tech to control the weather?

A cluster of new technologies aim to fulfill humanity's ancient desire to influence the weather. But is it a good idea?

https://www.theguardian.com/environment/2018/aug/26/rain-dancing-20-should-humans-be-using-tech-to-control-the-weather

30 photos capture Harvey's harrowing scenes of destruction in Texas

Over the course of five-day period from Aug. 25 to Aug. 29, 2017, Hurricane Harvey submerged southeastern Texas in an unrelenting torrent of water.

https://www.accuweather.com/en/weather-news/photos-remembering-harveys-destruction-aftermath-1-year-later/70005806

WMO

WMO wins LUI Che Woo prize for welfare betterment

The World Meteorological Organization has been named as winner of 2018 LUI Che Woo Prize award for Welfare Betterment.

The 2018 LUI Che Woo Prize laureates were announced at a press conference on 24 August in Hong Kong, China. WMO Secretary-General Petteri Taalas will collect the award at a ceremony and deliver a public lecture in early October.

Read more here

Celebrating pioneer Indian meteorologist Anna Mani

The life and career of Anna Mani, a pioneer Indian physicist and meteorologist, is being celebrated on what would have been her 100th birthday.

[Read more here](#)

Aviation

Air Force staff weather officers provide Army aviators updated forecasts during Hanuman Guardian 2018

Staff Sgt. Joseph Witschy is easy to spot among the approximately 150 U.S. Army and Army National Guard Soldiers participating in Hanuman Guardian 2018 Aug. 20 – 30. He's one of only two United States Air Force Airmen at the Royal Thai Army's Cavalry Center in Thailand's Saraburi province.

https://www.dvidshub.net/news/290089/air-force-staff-weather-officers-provide-army-aviators-updated-forecasts-during-hanuman-guardian-2018

Rocket Lab CEO on the Smallsat Race to Space

It's hard luck for the hitchhiker who always seems to be on the road with too few vehicles, and who hardly ever lands a ride to the right place. This has been the fate for many smallsats. The large rockets to piggyback on have usually been aimed at different orbits, and don't launch frequently enough to adequately enable companies with plans for significant constellations. But the interesting thing about luck is that it can change on you. And this is where we are now — in the fortunate era of the smallsat.

https://www.satellitetoday.com/launch/2018/08/24/rocket-lab-ceo-on-the-smallsat-race-to-space/

Civil Aviation Developments and ICAO News
Visit UnitingAviation.com for new articles, videos and more!

Aviation Weather Forecasting Services Market is Likely to be a US$ 426.1 Million Opportunity in 2023, Key Players Include Universal Weather and Aviation Inc., Rockwell Collins, The Weather Company..

Stratview Research announces the launch of a new market research report on Aviation Weather Forecasting Services Market by Forecasting Type (Aerodrome, Area/Route, and Special), by Forecasting Duration Type (Short-term, Medium-term, and Long-term), by Distribution Method Type (Electronic and Written), by Aviation Type (Civil Aviation and Military Aviation), and by Region (North America, Europe, Asia-Pacific, and Rest of the World), Trend, Forecast, Competitive Analysis, and Growth Opportunity: 2018-2023.

Read more here

Communications/social media

'Well, that was unexpected': Tree falls on journalist reporting on Hawaii hurricane

UK radio listeners were left wondering what happened when a report from Hawaii was suddenly interrupted by a loud cracking noise followed by muffled cries of pain.

BBC North America correspondent James Cook was doing a radio cross about Hurricane Lane when he got a little too close to the action and was hit by a falling tree.

http://www.abc.net.au/news/2018-08-25/bbc-journalist-hit-by-tree/10164260

Mental exercises to become a better presenter

Scientists can get bogged down in detail and flummoxed by nerves when it's time to stand up in front of an audience. That can lead to presentations that are prepared for themselves rather than their audiences. Slide-maestro David Rubenson offers his top tips for how to put yourself in your listeners' shoes.

Clouds

Observing clouds in 4D with multi-view stereo photogrammetry

Six cameras along a 12-km-diameter circle are generating a 4D view of clouds at the Southern Great Plains atmospheric observatory in Oklahoma.

Newly installed stereo cameras ringing the Southern Great Plains (SGP) Atmospheric Radiation Measurement (ARM) site in Oklahoma are providing a 4D gridded view of shallow clouds. Six digital cameras have been installed in pairs at a distance of 6 kilometers from the site and with a spacing of 500 meters between cameras in a pair. These pairs of cameras provide stereoscopic views of shallow clouds from all sides; when these data are combined, they allow for a complete stereo reconstruction. The result – the Clouds Optically Gridded by Stereo (COGS) product – is a 4D grid of cloudiness covering a 6 km × 6 km × 6 km cube at a spatial resolution of 50 meters and a temporal resolution of 20 seconds. This provides an unprecedented set of data on the sizes, lifetimes, and lifecycles of shallow clouds. This type of information is critical for developing cloud macrophysical schemes for the next generation of weather and climate models.

https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-18-0029.1?af=R

Unusual 'cloud streets' spotted across Britain as meteorologists say muggy weather is responsible

Unusual street clouds have been spotted across Britain as the Met Office says the muggy weather is responsible for the "dramatic" display.

https://www.telegraph.co.uk/news/2018/08/24/unusual-cloud-streets-spotted-across-britain-asmeteorologists/

Energy and Mining

GEV assessing Iran agreements

Australian CNG player pursing gas supply from alternate locations for supply to India

Australia-listed Global Energy Ventures (GEV) is

http://www.upstreamonline.com/live/1560357/gev-assessing-iran-agreements (Need to register to get five free articles from this title)

Morrison names leading anti-wind campaigner as energy minister

New prime minister Scott Morrison has ended the experiment of combining the energy and environment portfolios, and appointed one of the country's most prominent anti-wind campaigners as energy minister, and a former mining industry lawyer as environment minister.

https://reneweconomy.com.au/morrison-names-leading-anti-wind-campaigner-as-energy-minister-49560/

Former coal industry boss is Scott Morrison's chief of staff

The close link between Australia's major coal lobby and the prime minister's office under the Coalition government runs ever deeper, whoever the leader is at the time.

https://reneweconomy.com.au/former-coal-industry-boss-is-scott-morrisons-chief-of-staff-69647/

Health

'Tis the season: Pollen-related hay fever incidences to rise as warm, dry summer approaches

Hayfever sufferers be warned: spring is expected to warm and dry, meaning more outbreaks of sneezing and wheezing more much of the population.

https://www.nzherald.co.nz/environment/news/article.cfm?c_id=39&objectid=12112125&ref=rss

Waikato Hospital treats 160 children with serious burns in two years

When the cold weather comes, so do the burns cases.

About 160 children with bad burns were brought to Waikato Hospital over the past two years, a baby less than a month old among them.

https://www.stuff.co.nz/national/health/106205943/waikato-hospital-treats-160-children-with-serious-burns-in-two-years

Summer heatwave is blamed for 500 per cent spike in syphilis infections across South Wales

 A dramatic increase in syphilis cases has been recorded in one corner of Wales

 56 confirmed cases across Swansea, Neath, Port Talbot and Bridgend region

Health officials are urging people to get tested regularly and exercise safe sex

http://www.dailymail.co.uk/health/article-6094711/Summer-heatwave-blamed-500-cent-spike-syphilis-infections-South-Wales.html

Satellites and radar

Aeolus Satellite Will Soon Accurately Predict the Global Weather

The European Space Agency is ready to launch the first satellite that will measure wind speeds all over the globe. The satellite is called Aeolus, a reference to the keeper of the winds from Greek mythology.

https://advocator.ca/news/aeolus-satellite-will-soon-accurately-predict-the-global-weather/4820

Transport/roading/shipping/freight

Partnerships are key to shipping's 'smart' future

Joint ventures and collaborations over VSAT will deliver the applications needed for the next generation of ships

Partnerships bring together innovators with companies that can facilitate uptake of technological innovation across the wider industry. When they work properly, these symbiotic relationships offer benefits to all involved: innovators have the time to incubate and develop ideas and technology, ship operators gain quicker access to innovations and the maritime sector as a whole sees progress.

http://www.marinemec.com/news/view,partnerships-are-key-to-shippings-smart-future_53952.htm

Cyber security and IoT

Internet of Things (IoT): Cheat sheet

Learn about IoT's benefits for businesses, IoT security risks, IoT-related jobs, how industries and smart cities are using IoT, and more.

Innovation and technologies (inc data and new products)

Smartphones may be used to better predict the weather

A recent study suggests that weather patterns that lead to flash floods may one day be tracked and anticipated by our smartphones.

Big data and technology in disasters: Better integration needed for effective response

Disasters are becoming more commonplace and complex, and the challenges for rescue and humanitarian organizations increase. Increasingly these groups turn to big data to help provide solutions. Researchers wished to examine how ICT tools and big data were being used in disaster responses. By conducting a structured literature search and developing a data extraction tool on the use of ICT and big data during disasters they showed that some important gaps exist which should be part of a future research focus.

El Nino / La Nina

90% of Peru's $660mn insured El Niño losses absorbed by reinsurers

Insured losses resulting from the El Niño coastal phenomenon (FEN) totalled US $660 million for the period ending June 2018, although 89.02% of this figure was absorbed by the international reinsurance markets, according to Peru's Superintendency of Banking and Insurance (SBS).

Climate change / global warming / sea level rise

Climate change, young women and girls: vulnerability, impacts and adaptations in northern Thailand

Climate change is one of the greatest threats facing our planet and its people. Indisputable scientific evidence shows that global average temperatures are increasing due to greenhouse gases emitted by human activity. Furthermore, climate change is also altering precipitation patterns and intensities around the globe, increasing climate-related disaster frequencies and intensities (i.e. floods, droughts, landslides, wildfires, tropical storms and extreme temperatures),

and contributing to national and regional food and water insecurity crises, among other direct and indirect impacts.

Southeast Asia is a regional 'hotspot' for climate change risk owing to high exposure of large populations to climate-related disasters, dependence on seasonal rains for water and food security, and underlying drivers of vulnerability such as high rates of poverty and inequality, unplanned and rapid urbanization, and unsustainable use of natural resources (Garschagen et al., 2016; Thomalla et al., 2017; UNESCAP, 2015). In Thailand, shifts in temperature and precipitation trends have been observed. For instance, between 1955 and 2009, the average annual temperatures increase by 0.95°C, while rainfall patterns fluctuate in different regions of Thailand, according to the Thailand Meteorological Department. Further, Thailand has been severely impacted by recent climate-related disasters, such as the months-long flooding in 2011 and the widespread drought in 2015-16. In Northern Thailand1, observations include heavier rainfall over shorter durations, increasing incidence of rainy season landslides, more pronounced dry seasons in terms of water availability, and warmer winters (Shrestha et al., 2017).

https://reliefweb.int/report/thailand/climate-change-young-women-and-girls-vulnerability-impacts-and-adaptations-northern

Emergency preparedness / disaster planning / resilience

Big data and technology in disasters: Better integration needed for effective response

Despite current limitations great potential for future research applications

https://www.eurekalert.org/pub_releases/2018-08/sfdm-bda082218.php

Journals and articles online

Agile Development in Meteorological R&D: Achieving a Minimum Viable Product in a Scrum Work Setting

The Agile Way of Working was applied to three innovation projects at the Royal Netherlands Meteorological Institute. The Agile working process was evaluated on suitability for multidisciplinary research and development projects.

In the Agile Way of Working (AoW) a group of developers jointly work to efficiently realize a project. Here we report on the application of AoW in meteorological R&D outside of the software engineering environment. Three projects were formulated derived from the Observations Strategy (2015) of the Royal Netherlands Meteorological Institute (KNMI). An initial phase of preparation consisted of breaking down the work load into tasks to be accomplished by individual project members and achievable in two one-week Sprints. Sprints consisted of daily standups where accomplishments, work intentions and obstacles were discussed, followed by project work in a joint working environment. The three projects identified were: 1) Flying a drone to detect boundary layer evolution, 2) Monitoring the quality of the precipitation measurement system, and 3) Realizing a platform for merging third party data with

meteorological observations. The preparation phase proved to be vitally important to each of the projects. The role of the Product Owner and Scrum Master in streamlining and guiding these projects were essential to the success of the Sprint Weeks, but the joint group settings worked well for only two of the three projects. While team members were positive about their experience with the AoW, the challenge remains to fuse the traditional individual work practice of researchers with that of software engineers who are experienced in working in a group setting.

https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-17-0273.1?af=R

Quarterly Journal of the Royal Meteorological Society

A power law for reduced precision at small spatial scales: Experiments with an SQG model

Tobias Thornes, Peter Düben, Tim Palmer

First Published: 02 April 2018

Numerical atmospheric models could be made more energy-efficient by reducing the numerical precision with which less-important calculations are performed. The Surface Quasi-Geostrophic (SQG) equations, based on the Navier–Stokes equations that describe Earth's atmosphere, exhibit an Earth-like turbulent energy cascade and weather-like features such as the vortex shedding shown above. In this article, we emulate reduced precision in a spectral numerical SQG model and show that less precision is required at smaller spatial scales according to a power law.

Validation of the CHIRPS satellite rainfall estimates over eastern Africa

Tufa Dinku, Chris Funk, Pete Peterson, Ross Maidment, Tsegaye Tadesse, Hussein Gadain, Pietro Ceccato

First Published: 01 April 2018

The Climate Hazards Group Infrared Precipitation (CHIRP) and CHIRP combined with station observations (CHIRPS) are evaluated over East Africa by comparing with rain-gauge data from about 1,200 stations as well as with other similar satellite products (the African Rainfall Climatology version 2 (ARC2) and the Tropical Applications of Meteorology using Satellite data (TAMSAT)). The above figure compares the skill (Eff) for different satellite products. The grey scale in the background is elevations in metres.

Modelling the moistening of the free troposphere during the northwestward progression of Indian monsoon onset

A. Menon, A. G. Turner, G. M. Martin, C. MacLachlan

Northwest-to-southeast vertical section of ISCCP cloud fraction on pressure levels for cloud optical thickness, tau > 0.3 (shaded) and change in specific humidity (contoured) around (a) May 15 (averaged from May 13–17), (b) June 1 (averaged from May 30–June 3), (c) June 15 (averaged from June 13–17), (d) July 1 (averaged from June 29–July 3) and (e) July 15 (averaged from July 13–17). The orange dashed line represents the freezing level (T=0°C).A recent observational study suggests that the Indian monsoon progression in a north-westward direction perpendicular to the mean flow occurs due to a moistening of the free troposphere and wetting of land surface. Using an initialized fully-coupled model, we show that detrainment from shallow convection, measured by moisture tendencies around the freezing level, acts to saturate the free troposphere ahead of monsoon onset, eroding the dry-layer from the southeast; thereby pushing the northern limit of moist convection to move north-westwards.

The spatial distribution and temporal variability of föhn winds over the Larsen C ice shelf, Antarctica

Jenny V. Turton, Amelie Kirchgaessner, Andrew N. Ross, John C. King

The spatial and temporal distribution of f́ohn winds over the Larsen C ice shelf is presented for 2009–2012. F́ohn winds can occur more than 50% of the time during spring, and are observed year-round. They can raise air temperatures above freezing up to 130 km from the source of origin.

Classification of precipitating clouds using satellite infrared observations and its implications for rainfall estimation

Damwon So, Dong-Bin Shin

Frequency distributions of shallow and non-shallow clouds as a function of (a) BTD1, (b) BTD2, and (c) BTD3. Shallow and non-shallow clouds are shaded in red and blue, respectively.

The impact of interactions between tropical and midlatitude intraseasonal oscillations around the Tibetan Plateau on the 1998 Yangtze floods

Jianying Li, Jiangyu Mao

(a) The 25–60-day filtered OLR (color scale, W m−2), divergent flow (vectors, m s−1) and vorticity (contours, 10−5 s−1) at 150 hPa averaged over the first Meiyu episode in June 1998. The contours start from 0.5, with an interval of 0.5. The solid (dashed) lines denote anomalous cyclones (anticyclones). (b) As in (a), but for the second Meiyu episode in July 1998. The thickened curves show the locations of the Yangtze and Yellow Rivers, with the southern curve indicating the Yangtze River and the northern one denoting the Yellow River. The shading denotes the location of the Tibetan Plateau above 3000 m and the thickened dash line denotes the Asian westerly jet with the zonal wind at 200 hPa above 20 m s−1 in (a) June and (b) July.

Conservative finite-volume schemes for the quasi-geostrophic equation on coastal-conforming unstructured primal–dual meshes

Qingshan Chen, Lili Ju

Four conservative finite-volume schemes are presented for the viscous and inviscid QG equations on coastal-conforming unstructured meshes, with rigorous and systematic treatments of the boundary conditions, under a free top surface, and over irregular bounded domains. Rigorous proofs and numerical verifications are given of the PV and potential enstrophy conservation properties of the transport scheme.

Turbulence kinetic energy budget in the stable boundary layer over a heterogeneous surface

Karmen Babić, Mathias W. Rotach

This study presents turbulence kinetic energy budget terms above a tall, deciduous canopy in the wintertime stable boundary layer and makes a comparison to well-known results from horizontally homogeneous and flat terrain. Clear differences are found in the behaviour of the non-dimensional shear production term (φ_m) when distinguishing between "Kolomogorov turbulence" (i.e. well-defined inertial subrange in the spectra), which is diagnosed using a Richardson number criterion ($Rf < 0.25$), and "non-Kolmogorov turbulence." The anisotropic nature of turbulence above the complex forest surface manifests itself in the non-dimensional dissipation rate (φ_ε), which is much smaller when determined from the vertical velocity component ($\varphi_{\varepsilon w}$) than from the two horizontal components ($\varphi_{\varepsilon u,v}$). Spectral distributions according to the classical "Kansas model" reflect this almost perfectly.

Vertical gradient of stratiform radar reflectivity below the bright band from the Tropics to the extratropical latitudes seen by GPM

Kazuki Kobayashi, Shoichi Shige, Munehisa K. Yamamoto

This study examined the vertical structure of radar reflectivity below the detected bright band in stratiform regions using data from the Ku-band precipitation radar on board the Global Precipitation Measurement (GPM) Core Observatory. Reflectivity decreases toward the surface in the stratiform region of mesoscale convection [(a) and (c)], indicating a downward reduction of rainwater content. In stratiform regions of synoptic-scale weather systems, such as extratropical cyclones [(b) and (d)], reflectivity increases toward the surface, indicating a downward increase of rainwater content.

Examining the role of unusually warm Indo-Pacific sea-surface temperatures in recent African droughts

Chris Funk, Laura Harrison, Shraddhanand Shukla, Catherine Pomposi, Gideon Galu, Diriba Korecha, Gregory Husak, Tamuka Magadzire, Frank Davenport, Chris Hillbruner, Gary Eilerts, Benjamin Zaitchik, James Verdin

Southern and eastern Africa experienced a sequence of severe droughts and food insecurity in 2015–2017. This study analyses how unusually warm eastern Pacific (Niño 3.4) and western Pacific (Western V) sea-surface temperatures contributed to large-scale modulations of the Walker Circulation, increases in diabatic forcing, and potential opportunities for prediction. El Niño events and South African droughts tend to be followed by western Pacific warming and East African drought. Climate change may be increasing the frequency of these warm events.

Estimates of flow-dependent predictability of wintertime Euro-Atlantic weather regimes in medium-range forecasts

Mio Matsueda, T. N. Palmer

Flow-dependent predictability of wintertime Euro-Atlantic weather regimes are assessed using medium-range ensemble forecasts. The long-term reforecast revealed that recent high probabilistic skills for forecasts initialised on NAO− and the NAO− forecasts after 2006/2007 reflect the occurrence of four long-lasting (>30 days) NAO− events in 2009/2010–2013/2014 and that the skill for forecasts initialised on NAO− before 2009/2010 (the longest duration was 22 days) was the lowest. The skill dependency on regime duration is less clearly observed for the other regimes.

Megha-tropiques SAPHIR radiances in a hybrid 4D-Var data assimilation system: Study of forecast impact

Sumit Kumar, S. Indira Rani, John P. George, E. N. Rajagopal

Characteristics and impact of the assimilation of Megha-Tropique SAPHIR microwave radiances on NWP model forecasts are studied. Results show SAPHIR complements other contemporary microwave humidity channels on forecast. Uniqueness of the 183 ± 11 GHz MT-SAPHIR channel on assimilation and forecast is clearly seen.

Experimental measurements of charge separation under wet growth conditions

M. Y. Luque, R. E. Bürgesser, E. E. Ávila

The non-inductive electrification mechanism of thunderstorms proposes that during collisions between ice particles there is a charge transfer. Understanding this mechanism is of utmost importance if we desire to explain the microphysical processes involved in the formation and development of the thunderstorms. On this opportunity, we focused our attention on studying the performance of such a mechanism under wet growth conditions. We found that under theoretical wet growth conditions, graupel still showed some surface regions under dry growth and, in these situations, we detected a considerable positive charge.

Benefits of assimilating SAPHIR observations on analysis and forecasts of tropical fields in the Met Office global model

A. Doherty, S. Indira Rani, S. Newman, W. Bell

SAPHIR is a novel development in microwave humidity sounders, offering improvements over previous instruments in temporal sampling and vertical resolution and range, as shown in this plot of tropical weighting functions of three such satellite-borne instruments. We examine the impact of SAPHIR observations on the Met Office operational global NWP system, and note improved humidity analysis increments and improved forecasts over a range of metrics. Assimilation together with the microwave imager AMSR-2 indicates a complementarity between the two instruments.

How well were the early 2017 California Atmospheric River precipitation events captured by satellite products and ground-based radars?

Yixin Wen, Ali Behrangi, Haonan Chen, Bjorn Lambrigtsen

In January and February of 2017, California experienced multiple heavy storms that caused serious destruction of facilities and economic loss, although it also helped to alleviate ongoing drought conditions in California. These extreme precipitation events were mainly associated with Atmospheric Rivers (ARs). This article evaluates the performance of six commonly used satellite-based precipitation products (IMERG, 3B42RT, PERSIANN, CCS, CMORPH and GSMaP), as well as ground-based radar products (Radar-only and Radar-lgc) in capturing the ARs precipitation rate and distribution. Excessive precipitation associated with Atmospheric Rivers occurring in January and February of 2017, observed by GPM/IMERG.

Impacts of afternoon and evening sea-breeze fronts on local turbulence, and on CO2 and radon-222 transport

Jon A. Arrillaga, Jordi Vilà-Guerau de Arellano, Fred Bosveld, Henk Klein Baltink, Carlos Yagüe, Mariano Sastre, Carlos Román-Cascón

The sea breeze and local turbulence present a two-way interaction. When the sea-breeze front arrives during convective conditions, the thermally driven regime is maintained by local turbulence. If local conditions are stable, however, the equilibrium between the surface-layer wind profile and surface turbulence is disrupted. Regarding the transition from convective to stable conditions, it is accelerated by the sea breeze. Under this complex scenario, the transport of CO_2 and $222Rn$ is also altered by the passage of sea-breeze fronts.

Towards an along-track validation of HOAPS precipitation using OceanRAIN optical disdrometer data over the Atlantic Ocean

Jörg Burdanowitz, Christian Klepp, Stephan Bakan, Stefan A. Buehler

This article demonstrates the successful application of statistical point-to-area adjustments to OceanRAIN ship-based optical disdrometer data to validate HOAPS precipitation derived from passive-microwave satellite sensors. We discuss the estimation as well as the detection of collocated oceanic precipitation, as illustrated in the image, with special focus on the Atlantic Ocean and highlight the challenges of point-to-area adjustments with respect to detecting different precipitation regimes and how they are represented.

An evaluation of the convection-permitting ensemble COSMO-E for three contrasting precipitation events in Switzerland

Christina Klasa, Marco Arpagaus, André Walser, Heini Wernli

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Improving precipitation forecasts requires an in-depth investigation of case-studies. To this end, we contrasted the new MeteoSwiss convection-permitting ensemble COSMO-E to the coarser-resolution ensemble of the ECMWF (EC ENS) and found superior precipitation forecasts and a better representation of forecast uncertainty for COSMO-E. The image shows a case for which COSMO-E predicts the spatial distribution of precipitation well. In contrast, EC ENS produces an almost perfect time series of domain-averaged precipitation, but fails in predicting the spatial distribution.

The effect of potential vorticity fluxes on the circulation of the tropical upper troposphere

Sebastián Ortega, Peter J. Webster, Violeta Toma, Hai-Ru Chang

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Throughout the year, Rossby waves travelling on the subtropical westerly jet repeatedly break over the westerly ducts and the tropical upper tropospheric trough, leaving a clear signature on climatological averages of upper tropospheric potential vorticity (such as in the figure above). The reason behind the breaking of these Rossby waves, and their effect on the circulation of the tropical upper troposphere, is the main concern of this article. We suggest that such breaking is inevitable in the presence of deep tropical convection and that it plays an important role in maintaining the circulation of the tropical upper troposphere.

Probabilistic precipitation rate estimates with space-based infrared sensors

Pierre-Emmanuel Kirstetter, Negar Karbalaee, Kuolin Hsu, Yang Hong

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Satellite-based quantitative precipitation estimation (QPE) requires more than just one deterministic "best estimate" to adequately cope with the intermittent, highly skewed precipitation distribution. A new approach called Probabilistic QPE using Infrared Satellite Observations (PIRSO) is proposed to advance the use of uncertainty as an integral part of QPE. PIRSO precipitation probability maps outperform conventional deterministic QPE by mitigating biases. PIRSO quantifies uncertainty needed for precipitation ensembles and multisensor merging, and advances the monitoring of precipitation extremes for hydrometeorological hazards.

On distinguishing snowfall from rainfall using near-surface atmospheric information: Comparative analysis, uncertainties and hydrologic importance

Ali Behrangi, Xungang Yin, Seshadri Rajagopal, Dimitrios Stampoulis, Hengchun Ye

The phase of precipitation can significantly affect land hydrology, water resources management, and weather and climate prediction. Rainfall can quickly contribute to runoff and cause flash floods. Precipitation occurring as snow can cause transportation difficulties, but can be important for water resources. Here we assess the skill of various atmospheric variables and their combinations to determine precipitation phase, identify uncertainties associated with precipitation phase discrimination, and explore the sensitivity of hydrologic model output to uncertainty in precipitation-phase prediction methods.

A comparison of Mode-S Enhanced Surveillance observations with other in situ aircraft observations

E. K. Stone

Mode-S EHS observations are a new source of operational data from commercial aircraft. This article compares these measurements of winds and temperatures with those from an aircraft's flight data recorder and measurements from a research aircraft. It is shown that the quality of temperatures reduces close to the surface whilst the wind measurement quality is good.

Seasonal variability of shallow cumuliform snowfall: a CloudSat perspective

Mark S. Kulie, Lisa Milani

This study presents the first global seasonal analysis of cumuliform snowfall using a multi-year observational dataset. CloudSat gridded cumuliform snowfall rate retrievals merged with AMSR-E seasonal sea ice coverage maps indicate distinct hemispheric seasonal cumuliform snowfall cycles that are intimately linked to sea ice coverage. Snowfall datasets created in this study can be used for climate model, reanalysis, and GPM dataset evaluations.

Evaluation of diurnal variation of GPM IMERG-derived summer precipitation over the contiguous US using MRMS data

Sungmin O, Pierre-Emmanuel Kirstetter

We study the accuracy of GPM IMERG precipitation estimates over the US using ground reference from radar and gauge-based MRMS, with emphasis on diurnal variations of precipitation. Regional-specific biases are found in normalized amplitude and phase of the diurnal cycle of precipitation from IMERG. Possible sources of biases are discussed based on regional difference in precipitation processes.

The activities of the International Precipitation Working Group

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The IPWG provides a focal point and forum for the scientific community to address the issues and challenges of satellite-based quantitative precipitation retrievals, and for the operational agencies to access and make use of precipitation products. The group supports the exchange of information on techniques for retrieving and measuring precipitation and for enhancing the impact of space-borne precipitation retrievals in numerical weather and hydrometeorological prediction and climate studies. The group furthers the refinement of current estimation techniques and the development of new methodologies for improved global precipitation measurements, together with their validation.

An iterative ensemble Kalman filter in the presence of additive model error

Pavel Sakov, Jean-Matthieu Haussaire, Marc Bocquet

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The iterative ensemble Kalman filter (IEnKF) intended for perfect-model chaotic systems is extended to the IEnKF-Q which additionally handles imperfect models. The IEnKF-Q is tested with the Lorenz'96 model in various noise and nonlinearity conditions and compared with the ensemble Kalmanfilter (EnKF) and straightforward but naive extensions of the IEnKF to noisy models. In line with the theory, the IEnKF-Q is shown to systematically outperform the EnKF and IEnKF variants.

All-sky satellite data assimilation at operational weather forecasting centres

Alan J. Geer, Katrin Lonitz, Peter Weston, Masahiro Kazumori, Kozo Okamoto, Yanqiu Zhu, Emily Huichun Liu, Andrew Collard, William Bell, Stefano Migliorini, Philippe Chambon, Nadia Fourrié, Min-Jeong Kim, Christina Köpken-Watts, Christoph Schraff

First Published: 14 November 2017

This article reviews developments towards assimilating cloud- and precipitation-affected satellite radiances at operational forecasting centres. Satellite data assimilation is moving beyond "clear-

sky" towards assimilating all observations directly as radiances, whether they are clear, cloudy or precipitating. This is known as the "all-sky" approach and it improves global forecasts and can improve the analysis and shorter-range forecasts of otherwise poorly-observed weather phenomena as diverse as tropical cyclones and wintertime low cloud.

An observationally based method for stratifying a priori passive microwave observations in a Bayesian-based precipitation retrieval framework

F. Joseph Turk, Z. S. Haddad, P. Kirstetter, Y. You, S. Ringerud

First Published: 13 November 2017

A new microwave surface emissivity-based approach for indexing and searching extensive a priori passive microwave radiometric brightness temperature (TB) observations is proposed, appropriate for Bayesian-based precipitation retrieval algorithms. This method identifies similar global surface conditions from within the extensive collection of a priori observations. The overall bias and probability of detection of precipitation rates greater than 10 mm h−1 over land and coastal scenes are improved, relative to surface radar-derived precipitation rates over the continental United States and surrounding waters.

Survey of data assimilation methods for convective-scale numerical weather prediction at operational centres

Nils Gustafsson, Tijana Janjić, Christoph Schraff, Daniel Leuenberger, Martin Weissmann, Hendrik Reich, Pierre Brousseau, Thibaut Montmerle, Eric Wattrelot, AntonÍn Bučánek, Máté Mile, Rafiq Hamdi, Magnus Lindskog, Jan Barkmeijer, Mats Dahlbom, Bruce Macpherson, Sue Ballard, Gordon Inverarity, Jacob Carley, Curtis Alexander, David Dowell, Shun Liu, Yasutaka Ikuta, Tadashi Fujita

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Data assimilation methods for convective-scale numerical weather prediction at operational centres are surveyed. It is demonstrated that the quality of forecasts based on initial data from convective-scale data assimilation is significantly better than the quality of forecasts from simple downscaling. Furthermore it is shown that more advanced methods applied at convective scales provide improvements over simpler methods.

Validation of the Version 05 Level 2 precipitation products from the GPM Core Observatory and constellation satellite sensors

Christopher Kidd, Jackson Tan, Pierre-Emmanuel Kirstetter, Walter A. Petersen

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Extent of radar coverage used in this study for (a) western Europe and (b) eastern United States. The light grey-shaded region represents the areas excluded from the analysis to ensure good conditions for comparison. The locations of the well-calibrated dense gauge networks are also shown for Pocomoke (PCMK) and WegenerNet (WEGN).

Probability of intense precipitation from polarimetric GNSS radio occultation observations

E. Cardellach, R. Padullés, S. Tomás, F. J. Turk, C. O. Ao, M. de la Torre-Juárez

A probabilistic inversion technique has been developed for GNSS polarimetric radio occultation (GNSS-PRO) observables. The retrieval is based on information obtained from the Global Precipitation Measurement (GPM) mission, organized as a look-up table (LUT) database. Confronting the LUTs and the phase shift suffered by the GNSS-PRO signals results in a series of probabilities of rain rates at different altitudes. These vertical profiles of rain probability complement the standard GNSS-RO thermodynamic profiles, providing a unique insight within intense precipitation scenarios.

Estimating model error covariances using particle filters

Mengbin Zhu, Peter J. van Leeuwen, Weimin Zhang

Modelling detailed atmospheric physical processes, such as stratocumulus clouds, is extremely difficult, and present-day parametrizations are failing. To improve the models one could add stochastic model errors. We use a fully nonlinear particle filter to estimate model error characteristics, avoiding the need also to estimate the state covariance.

On the representation error in data assimilation

T. Janjić, N. Bormann, M. Bocquet, J. A. Carton, S. E. Cohn, S. L. Dance, S. N. Losa, N. K. Nichols, R. Potthast, J. A. Waller, P. Weston

Representation, representativity, representativeness error, forward interpolation error, forward model error, observation-operator error, aggregation error and sampling error are all terms used to refer to components of observation error in the context of data assimilation. This article is an attempt to consolidate the terminology that has been used in the earth sciences literature and was

suggested at a European Space Agency workshop held in Reading in April 2014. We review the state of the art and, through examples, motivate the terminology.

A local ensemble transform Kalman particle filter for convective-scale data assimilation

Sylvain Robert, Daniel Leuenberger, Hans R. Künsch

First Published: 17 July 2017

High-dimensional non-Gaussian filtering problems, such as those encountered in convective-scale data assimilation, call for the development of new ensemble data assimilation methods. We propose a new algorithm, the LETKPF, which is a hybrid between the LETKF and the PF. Numerical experiments with COSMO in a set-up similar to the one used operationally at MeteoSwiss show promising results, in particular for forecasting of non-Gaussian variables such as wind and precipitation.

Precipitation estimates from SMOS sea-surface salinity

A. Supply, J. Boutin, J.-L. Vergely, N. Martin, A. Hasson, G. Reverdin, C. Mallet, N. Viltard

First Published: 05 July 2017

Rain rate (RR) is derived in the Pacific intertropical convergence zone from SMOS SSS measurements. SMOS and SSMIS RR agree well when SMOS and SSMIS passes are less than 15 min apart (see an example on the figure below; $r = 0.7$ at $1° \times 1°$ resolution). When the time shift between SMOS and SSMIS passes increases, the correlation between SMOS and IMERG RR diminishes. This suggests that L-band radiometry can provide information to improve RR products based on morphing techniques.

Evaluation of the Rayleigh–Gans approximation for microwave scattering by rimed snowflakes

Jussi Leinonen, Stefan Kneifel, Robin J. Hogan

First Published: 12 June 2017

We evaluate the usability of the Rayleigh–Gans approximation (RGA), a simple and computationally efficient scattering approximation, for microwave scattering by rimed snowflakes. The RGA compares well with reference calculations for all but the most heavily rimed snowflakes. The self-similar Rayleigh–Gans approximation (SSRGA), which combines RGA with assumptions from fractal geometry, can also reproduce the RGA results well for rimed snowflakes.

John M. Wallace