Quarterly Journal of the Royal Meteorological Society (QJRMS)
Newsletter from 2024-01 to 2024-04

ARTIC

Pernov, J.B., Gros-Daillon, J. & Schmale, J. (2024) **Comparison of selected surface level ERA5 variables against in-situ observations in the continental Arctic**. *Quarterly Journal of the Royal Meteorological Society*, 1–24. Available from: https://doi.org/10.1002/qj.4700

Key Points:

1. **Study Scope**: Evaluates the ERA5 reanalysis model using data from 17 Arctic observatories, focusing on its ability to reproduce various meteorological variables.
2. **Evaluation Criteria**: Performance assessed using slope, R^2 value, and root-mean-squared error (RMSE) across different time resolutions (hourly to monthly) and seasons.
3. **Variable Performance**:
   - **High Accuracy**: Surface pressure, 2-m air temperature, and short-wave downward radiation flux showed high reliability.
   - **Lower Accuracy**: Wind speed, relative humidity, and zonal and meridional wind components performed poorly.
4. **Seasonal Variability**: Some variables like temperature, relative humidity, and SWD radiation flux showed better performance in specific seasons, while others like surface pressure and wind speeds did not show seasonal dependencies.
5. **Temporal Resolution Impact**: Increasing the temporal resolution from hourly to monthly improved accuracy for temperature and wind speeds but degraded performance for relative humidity and surface pressure.
6. **Implications**: Highlights the strengths and limitations of ERA5 in Arctic conditions, particularly cautioning the use of its wind speed and RH data in global climate models.

FOG

Weedon, G.P., Osborne, S.R. & Best, M.J. (2024) **Dew, frost, fog and lifted temperature minima: Observations in southern England and implications for modelling**. *Quarterly Journal of the Royal Meteorological Society*, 1–17. Available from: **https://doi.org/10.1002/qj.4702**

Key points:

1. **Dew and Frost Formation:** Unlike traditional condensation methods, dew and frost were observed to form when the ground was warmer than the air above due to lifted temperature minima (LTMs) at approximately 0.15 meters.

2. **Aerosol Impact:** Aerosols were found to influence these temperature profiles by cooling the air near the ground more rapidly than the surface, aiding the development of LTMs.
3. **Radiation Fog:** The majority of radiation fog events (91%) were linked to these LTMs and light winds. Slow removal of water droplets through occult deposition leads to fog formation.
4. **Modeling Recommendations**: The findings suggest that atmospheric models need to account for the accumulation of aerosols and their radiative effects during stable nights to accurately simulate these phenomena.

Pauli, E., Cermak, J., Andersen, H. & Fuchs, J. (2024) **An analysis of fog and low stratus life-cycle regimes over central Europe**. *Quarterly Journal of the Royal Meteorological Society*, 1–15. Available from: https://doi.org/10.1002/qj.4714

Key Points:

1. **Study Goal**: To improve understanding of fog and low stratus (FLS) life cycles, particularly their onset and dissipation times, which are critical for traffic safety and solar power planning.
2. **Influencing Factors**: The FLS life cycle is influenced by meteorological conditions, FLS type, geography, and climate.
3. **Methodology**: Utilizes a hierarchical clustering algorithm on satellite-based data to identify regions in central Europe with similar FLS life cycle patterns relative to environmental conditions.
4. **Findings**:
    - Identifies distinct FLS life-cycle regimes with variations in occurrence, timing, and climatic characteristics.
    - Highlights temperature and specific humidity as key factors affecting FLS patterns, especially in the Mediterranean.
5. **Applications**: The study's classifications provide a foundation for more focused regional studies on FLS life cycles, enhancing future forecasting and analysis.

Miller, C., Nicoll, K.A., Westbrook, C. & Harrison, R.G. (2024) **Evaluating atmospheric electricity changes as an indicator of fog formation**. *Quarterly Journal of the Royal Meteorological Society*, 1–15. Available from: https://doi.org/10.1002/qj.4680

Key Points:

1. **Objective**: To assess the potential of atmospheric electricity measurements, specifically potential gradient (PG) changes, as an additional method for fog prediction.
2. **Methods**: Utilizes modern instrumentation to continuously monitor PG and visibility, applying automatic methods to detect fog in a large dataset.
3. **Findings**:
    - During fog development, the median PG increase is 58 V/m, significantly higher than the standard deviation of 17 V/m in pre-fog conditions.

    - PG increases provide a median lead time of 0.4 hours before fog onset, slightly less than the 0.6 hours provided by visibility data alone.
    - PG detected 55% of fog events, offering longer lead times over 2 hours in 30% of cases, compared to 64% detection by visibility with longer lead times in only 13% of cases.
4. **Conclusion**: PG measurements are a valuable supplementary tool for fog prediction, particularly for extending lead times despite lower overall detection rates than visibility methods.

PRECIPITATION and CLOUDS (observation)

Mustafa, J.M., Matthews, A.J., Hall, R.A., Heywood, K.J. & Azaneu, M.V.C. (2024) **Characterisation of the observed diurnal cycle of precipitation over the Maritime Continent.** *Quarterly Journal of the Royal Meteorological Society*, 1–23. Available from: https://doi.org/10.1002/qj.4725

Key points:

1. **Study Focus**: Examines the diurnal cycle of precipitation over the Maritime Continent using IMERG data, highlighting inaccuracies in amplitude and phase with traditional methods.
2. **Methodological Advances**: Introduces two new waveforms to better characterize rapid transitions and peak timings in the diurnal precipitation cycle.
3. **Key Adjustments**: Corrects phase lag over coastal areas and more accurately captures sharp precipitation peaks, especially over Java, enhancing amplitude estimates.
4. **Behavioral Insights**: Shows that coastal areas experience rapid precipitation increases and gradual declines, while inland areas have more gradual increases and rapid declines.
5. **Applications**: Discusses the potential broader uses of the novel waveforms for predicting diurnal precipitation patterns.

Kumar, P., Srivastava, S.S., Jivani, N., Varma, A.K., Yokoyama, C. & Kubota, T. (2024) **Long-term assessment of ERA5 reanalysis rainfall for lightning events over India observed by Tropical Rainfall Measurement Mission Lightning Imaging Sensor.** *Quarterly Journal of the Royal Meteorological Society*, 1–17. Available from: https://doi.org/10.1002/qj.4719

Key Points:

1. **Objective**: To assess ERA5 reanalysis rainfall accuracy against gauge-adjusted GSMaP_ISRO data during lightning events over India from 2001 to 2014.
2. **Findings**:

    - Most lightning occurs from April to June, especially over the Himalayas and northeastern India.
    - Significant rainfall related to lightning peaks one hour before to three hours after lightning flashes.
    - ERA5 often underestimates the intensity and duration of rainfall around lightning times, particularly over the Indian Ocean and Bay of Bengal.
3. **Conclusion**: The study indicates the need for improvements in ERA5's rainfall predictions during lightning events to enhance its reliability and accuracy.

Mol, W., Heusinkveld, B., Mangan, M.R., Hartogensis, O., Veerman, M. & van Heerwaarden, C. (2024) **Observed patterns of surface solar irradiance under cloudy and clear-sky conditions.** *Quarterly Journal of the Royal Meteorological Society*, 1–26. Available from: https://doi.org/10.1002/qj.4712

Key Points:

1. **Objective**: To explore the variability of surface solar irradiance, which is influenced primarily by clouds and, to a lesser extent, by aerosols and water vapor.
2. **Methodology**: In 2021, a network of low-cost radiometers was deployed during field campaigns in Lindenberg, Germany (FESSTVaL), and in Spain (LIAISE) to collect high-resolution data on cloud-driven patterns of surface solar irradiance, including spectral effects.
3. **Findings**:
    - Variability in irradiance is substantial and is caused by different cloud types (cumulus, altocumulus, cirrus) through various mechanisms and across spatial scales from 50 meters to 30 kilometers.
    - Spectral irradiance shows notable variation, with blue enrichment in cloud shadows and red enrichment near cloud edges, especially under semitransparent conditions.
4. **Implications**: The study demonstrates that detailed irradiance patterns can be effectively observed with a small, cost-efficient sensor network, providing valuable data that can help enhance atmospheric models' ability to predict solar irradiance variability.

PRECIPITATION and CLOUDS (model)

Matsunobu, T., Puh, M. & Keil, C. (2024) **Flow- and scale-dependent spatial predictability of convective precipitation combining different model uncertainty representations**. *Quarterly Journal of the Royal Meteorological Society*, 1–18. Available from: https://doi.org/10.1002/qj.4713

Key Points

1. **Study Focus**: Evaluates the performance of the ICON-D2 ensemble prediction system during a summer season in central Europe, particularly in forecasting convective precipitation.
2. **Key Findings**:
    - The system shows spatial underdispersion, meaning the spatial spread of hourly precipitation forecasts is too narrow to adequately represent the inherent forecasting errors across various scales (up to 300 km) and forecast durations (up to 24 hours).
    - This issue is more pronounced under conditions of weak convective forcing.
3. **Improvement Strategies**:
    - Implementing physically based stochastic perturbations in the planetary boundary layer enhances forecast accuracy for larger scales (>20 km) and increases the forecast spread for smaller scales (<50 km) during periods of weak convective activity.
    - Adding perturbed parameters in the microphysics scheme further improves the spatial error and spread, particularly evident in a detailed case study.
4. **Implications**:
    - It's vital to assess convective precipitation predictability in a flow-dependent manner.
    - The combined approach of multiple uncertainty sources effectively reduces spatial underdispersion, especially under weak convective conditions.

Xu, H., Zhao, D., Gao, W., Duan, Y., Yin, J., Li, Y., et al. (2024) **Indirect effects of latent heat of condensation on the simulation of the 2021 catastrophic Henan rainfall event in central China**. *Quarterly Journal of the Royal Meteorological Society*, 1–18. Available from: https://doi.org/10.1002/qj.4703

Key Points:

1. **Study Focus**: Investigates how cloud-related latent heat affects weather systems during extreme rainfall, specifically in Henan Province, China in July 2021.
2. **Methodology**: Uses the ARW-WRF model to analyze changes in weather patterns when adjusting condensation temperature (CT) and cloud water collection (ACW) in various microphysics schemes.
3. **Findings**:
    - Modifying CT and ACW significantly impacts southerly flows and increases precipitation by 31% to 50%.
4. **Conclusion**: Accurate modeling of microphysical processes is crucial for realistic simulations of extreme rainfall events.

Mateus, P., Nico, G., Catalão, J. & Miranda, P.M.A.(2024) **Precipitable water vapor from Sentinel-1 improves the forecast of extratropical storm *Barbara***. *Quarterly Journal of the Royal Meteorological Society*, 1–17. Available from: https://doi.org/10.1002/qj.4686

Key Points:

1. **Study Focus**: Evaluates the impact of high-resolution water vapor fields from Sentinel-1 on water vapor forecasting during storm Barbara's transit across Iberia on October 19-20, 2020.
2. **Methodology**: Utilizes precipitable water vapor (PWV) data from the Interferometric Synthetic-Aperture Radar (InSAR) technique, assimilated into the Weather Research & Forecasting Model (WRF).
3. **Findings**:
    - Assimilation of InSAR-derived PWV data significantly enhanced forecast accuracy for both water vapor distribution and rainfall predictions.
    - The positive effects of data assimilation extended up to 850 km and 12 hours from the storm's path, improving forecast skill scores across the region.

Campos, D.A., Chou, S.C., Bottino, M.J., Gomes, J.L. & Lyra, A. (2024) **Inclusion of the radiative effect of deep convective clouds in the Eta model simulations**. *Quarterly Journal of the Royal Meteorological Society*, 1–22. Available from: https://doi.org/10.1002/qj.4673

Key Points:

1. **Objective**: To integrate the effects of deep convective clouds into the radiation scheme of the Eta model and assess the impacts on net radiative energy and other meteorological variables.
2. **Methodology**: The study was conducted in four stages using the Rapid Radiative Transfer Model, starting with diagnosing the positive bias in incoming solar radiation, adjusting convective and microphysics parameters to enhance cloud representation, and finally, incorporating convective cloud condensates into the radiation calculations.
3. **Findings**:
    - Adjustments led to improved cloud cover, surface net radiation cycles, and 2-m temperature accuracy.
    - Including convective cloud condensates in the radiation scheme resulted in a reduction in surface net radiation and subsequent decrease in energy available for convective activity, thus reducing precipitation.
4. **Conclusion**: The study highlights the significance of accurately representing cumulus cloud water in radiation schemes to reduce biases in modelled radiative energy components.

MODEL EVALUATION

Hall, T.W., Blunn, L., Grimmond, S., McCarroll, N., Merchant, C.J., Morrison, W., et al. (2024) Utility of thermal remote sensing for evaluation of a high-resolution weather model in a city. *Quarterly Journal of the Royal Meteorological Society*, Available from: https://doi.org/10.1002/qj.4669

Key Points:

1. **Objective**: Evaluate high-resolution numerical weather prediction (NWP) models for urban areas using Landsat-8 land surface temperature (LST) data for London on four clear days.
2. **Methodology**: Compares Landsat LST observations with NWP outputs, focusing on spatial differences and potential modeling artifacts due to downscaling methods and soil properties.
3. **Findings**:
    - Notable discrepancies between Landsat LST and NWP outputs, including spatial artifacts and warm stripes in model predictions during conditions conducive to horizontal convective rolls.
    - Differences are more pronounced in built-up areas, especially near the summer solstice, attributed to urban thermal anisotropy.
4. **Challenges**: Difficulties in making informative comparisons due to different perspectives (Landsat views warmer surfaces, while NWP models represent a blend of all surfaces).
5. **Next Steps**: Recommends refining methods to quantify the impact of urban thermal anisotropy on observations and improve model evaluation.