ECMWF SEAS5 Seasonal Precipitation Outlook and Preliminary Rainfall-Based Flood Screening for Iraq: October 2026–January 2027

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Preprint declaration

This manuscript is a non-peer-reviewed preprint submitted to EarthArXiv. EarthArXiv moderation is not peer review. The rainfall-based flood-screening products are preliminary regional screening products and are not operational flood warnings, inundation predictions, return-period estimates, or substitutes for basin-scale hydrological and hydraulic modelling.

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Data and code availability

The ECMWF source dataset is publicly available through the Copernicus Climate Data Store. The analysis code, processed tables, derived grid metrics, and figures should be linked to a permanent public repository record (for example, Zenodo) when the repository DOI is available. The supplied Iraq boundary should only be redistributed where its source licence permits redistribution.

Keywords: ECMWF SEAS5; Iraq; seasonal precipitation; preliminary flood screening; hydrology; hydrogeology; groundwater recharge; Copernicus Climate Data Store

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ACADEMIC HYDROLOGICAL AND HYDROGEOLOGICAL PREPRINT

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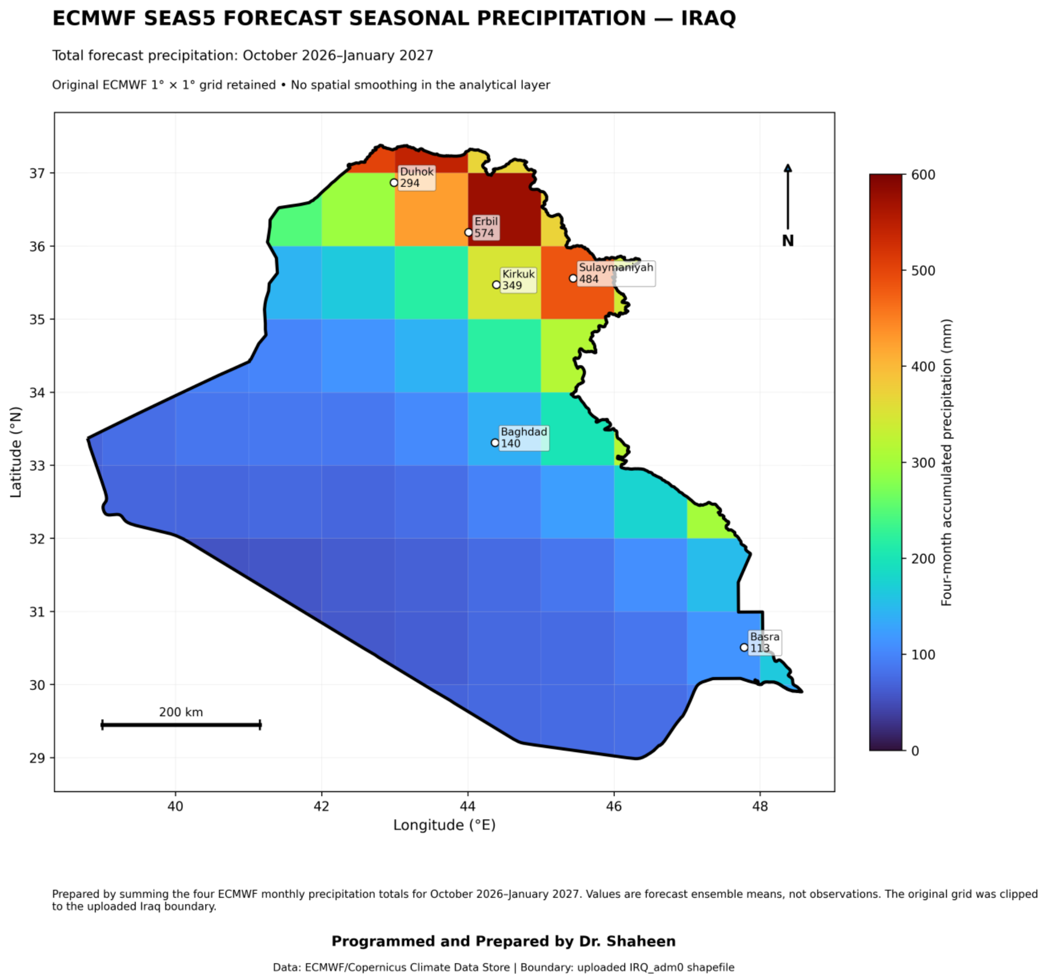

Programmed and Prepared by Dr. Shaheen

Data processing, hydrological interpretation, flood-screening analysis, cartographic design, and report preparation

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Abstract

This preprint provides a hydrological and hydrogeological interpretation of ECMWF SEAS5 monthly precipitation forecasts for Iraq from October 2026 through January 2027. The analysis uses the ECMWF System 51 ensemble mean initialized on 1 August 2026. The downloaded time-mean total precipitation rate was converted from metres per second to monthly precipitation depth in millimetres using the actual number of days in each valid month. The original 1° × 1° analytical grid was retained without spatial smoothing and clipped to the supplied national boundary of Iraq. Derived products include four-month precipitation accumulation, peak monthly rainfall, rainfall concentration, temporal variability, maximum month-to-month increase, a transparent precipitation-only screening index, relative screening classes, and three-dimensional visualizations. The forecast exhibits a strong north–northeast precipitation gradient. Representative four-month totals are 574.24 mm near Erbil, 483.87 mm near Sulaymaniyah, 348.92 mm near Kirkuk, and 294.13 mm near Duhok, compared with 140.34 mm near Baghdad and 113.31 mm near Basra. The strongest seasonal hydrological signal therefore occurs across northern and northeastern Iraq. Hydrogeologically, enhanced winter precipitation may increase diffuse and focused recharge in permeable alluvial, fractured, and karstic aquifers, but monthly rainfall alone cannot quantify recharge. Likewise, the rainfall-screening maps are preliminary regional prioritization products rather than physical flood-hazard or inundation maps because they do not include topography, drainage, soil, land cover, antecedent moisture, rainfall intensity, river capacity, or observed flood inventories. The products should therefore be used as a seasonal hydroclimatic outlook and as a first-stage prioritization layer for subsequent high-resolution hydrological, hydraulic, and hydrogeological modelling.

Keywords: ECMWF SEAS5; Iraq; seasonal precipitation; preliminary rainfall-based flood screening; groundwater recharge; hydrogeology; GIS; ensemble forecast.

Interpretive status

The precipitation totals are genuine values extracted from the supplied ECMWF NetCDF file. The flood-screening index is a transparent, rainfall-only relative indicator developed for this report. It must not be interpreted as a flood probability, inundation depth, warning level, or engineering design value.

Contents

1. Introduction and objectives

Seasonal precipitation forecasts can support water-resource preparedness when they are interpreted as probabilistic, large-scale outlooks rather than deterministic weather predictions. ECMWF SEAS5 is the fifth-generation ECMWF seasonal prediction system and produces a 51-member operational ensemble; its performance and limitations vary by variable, region, season, and lead time (Johnson et al., 2019; ECMWF, n.d.). The Copernicus seasonal monthly dataset used here contains single-level forecast data aggregated to monthly time steps and is intended for long-range climate applications rather than event-scale storm forecasting (Copernicus Climate Change Service [C3S], n.d.).

Iraq has a marked hydroclimatic gradient from the mountainous and folded terrain of the north and northeast to the arid and low-relief plains of the centre and south. This gradient influences runoff production, erosion, channel response, soil-water storage, groundwater recharge, and groundwater salinity. The national hydrogeological framework includes karstic and fractured aquifers in the High Folded Zone, clastic and Quaternary aquifer systems in the Low Folded Zone, and increasingly saline groundwater toward major discharge zones and the Mesopotamian plain (Al-Jiburi & Al-Basrawi, 2015).

The objectives of this report are to: (i) document the spatial and temporal pattern of the October 2026–January 2027 ECMWF forecast; (ii) quantify representative forecast values for Duhok, Erbil, Sulaymaniyah, Kirkuk, Baghdad, and Basra; (iii) interpret potential hydrological consequences for runoff and flood preparedness; (iv) discuss hydrogeological implications for recharge and aquifer response; and (v) define the additional information required to transform the rainfall-only screening into a defensible flood-hazard and recharge assessment.

2. Study area and hydrogeological setting

Northern and northeastern Iraq form part of the Zagros fold–thrust and associated folded-zone terrain. The High Folded Zone is characterized by rugged relief, narrow valleys, carbonate and clastic aquifers, and groundwater recharge from direct precipitation and snowmelt. Regional groundwater movement is generally toward lower folded and lowland discharge zones, although local flow is strongly modified by structural and topographic complexity (Al-Jiburi & Al-Basrawi, 2015).

The Low Folded Zone contains broad synclinal basins filled by Late Miocene to Recent sedimentary formations, including the Fatha, Injana, Mukdadiyah, Bai Hassan, and Quaternary units. These formations constitute important aquifer systems, with groundwater commonly moving from northern and northeastern recharge areas toward the south and southwest. Salinity typically increases downgradient toward discharge zones (Al-Jiburi & Al-Basrawi, 2015).

Recent local studies reinforce the importance of winter precipitation and geological structure in groundwater recharge. Stable-isotope analysis in the Erbil Basin has been used to identify groundwater sources and recharge zones (Mamand & Mawlood, 2024), while integrated GIS, hydrogeological, and geophysical analysis in the Sulaymaniyah Basin demonstrated that rainfall, geology, lineament density, slope, drainage density, and land cover jointly control recharge potential (Mohammed et al., 2025). Consequently, precipitation alone identifies meteorological loading, but not the fraction that becomes recharge or surface runoff.

3. Data and analytical methods

3.1 ECMWF forecast dataset

The analysis used the Copernicus Climate Data Store dataset “Seasonal forecast monthly statistics on single levels,” originating from ECMWF System 51. The downloaded field is the ensemble mean of total precipitation. The source NetCDF variable is time-mean total precipitation rate (tprate) in m s^{-1}. SEAS5 is initialized monthly and uses ensemble forecasting to represent uncertainty in seasonal evolution (Johnson et al., 2019; C3S, n.d.).

The reference date is 1 August 2026, and forecast months 3–6 correspond to October 2026, November 2026, December 2026, and January 2027 in the supplied file. The downloaded analytical grid has 1° latitude–longitude spacing. This is coarser than the native operational model resolution because the selected CDS monthly product was supplied on a standardized grid.

3.2 Conversion to monthly precipitation depth

The time-mean rate was converted to monthly precipitation depth using:

$$P_m = R_p \times 1000 \times 86{,}400 \times D$$

where P_m is monthly precipitation in millimetres, R_p is the ECMWF precipitation rate in m s^{-1}, 1000 converts metres to millimetres, 86,400 is the number of seconds per day, and D is the actual number of days in the valid month.

3.3 Derived hydrological indicators

The following indicators were calculated at each original grid cell: four-month accumulated precipitation; peak monthly precipitation; precipitation concentration ratio, defined as the wettest-month total divided by the four-month total; coefficient of variation across the four months; maximum positive month-to-month rainfall increase; and wet-month persistence.

A rainfall-based flood-screening index (RFSI) was calculated as a transparent weighted combination of normalized precipitation indicators:

$$RFSI = 0.40\, P^*peak + 0.30\, P^*acc + 0.15\, \Delta P^*max + 0.15\, P^*persist$$

The weighting gives greatest influence to the peak monthly total and four-month accumulation, while retaining sensitivity to rapid seasonal increases and persistence. The index is scaled from 0 to 100 within the Iraq grid. Four relative classes were defined by quartiles; therefore, each class contains 25% of the included grid cells by construction. This method is an exploratory screening approach, not a calibrated flood model. Research on flash floods shows that flood response depends on rainfall intensity and duration, catchment morphology, drainage connectivity, sediment processes, and antecedent moisture, often at scales much finer than seasonal model grids (Marchi et al., 2010; Borga et al., 2014; Norbiato et al., 2008).

3.4 Spatial and interpretive constraints

The original analytical grid was preserved without smoothing. Values reported for cities are the values of the nearest grid-cell centre and are not gauge observations or city-scale predictions. The use of a national boundary clips the forecast field for cartographic presentation but does not add sub-grid information. Seasonal precipitation forecasts are generally less skillful than temperature forecasts and tend to lose skill with increasing lead time; small-scale or local interpretation requires particular caution (C3S, n.d.; Johnson et al., 2019).

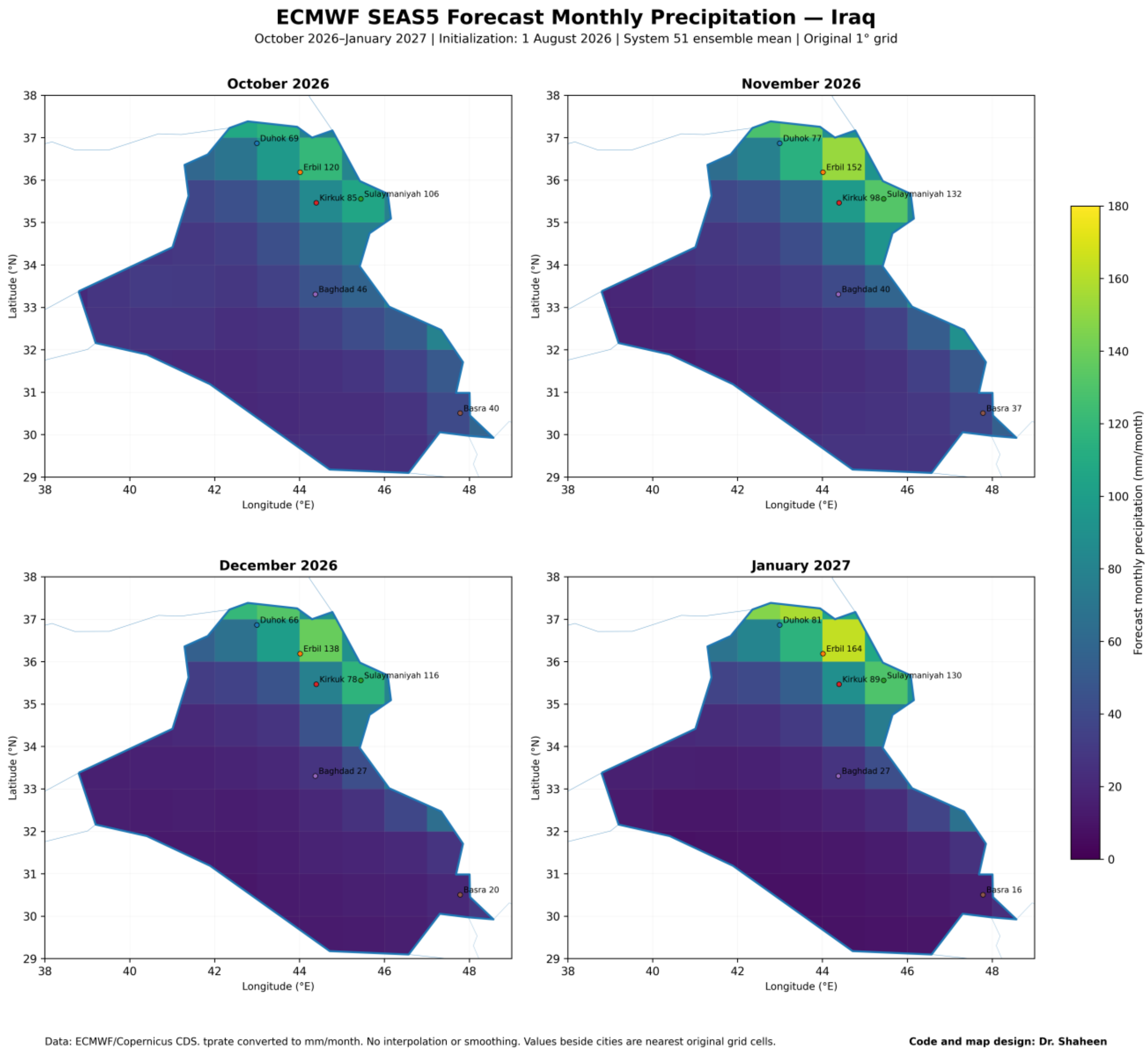

Figure 1: ECMWF SEAS5 monthly precipitation forecast atlas for Iraq, October 2026–January 2027.

Source: ECMWF/Copernicus CDS NetCDF values processed and mapped by Dr. Shaheen. Values are ensemble means on the supplied 1° grid.

Figure 1 shows a persistent northward and northeastward increase in forecast precipitation. Erbil and Sulaymaniyah remain within the highest monthly totals through the four-month period, while central and southern Iraq display lower values. The seasonal timing is spatially variable: October dominates much of central and southern Iraq, November dominates many northeastern cells, and January produces the highest totals in a smaller number of northern cells.

4. Results

4.1 Representative monthly values

Table 1 reports the nearest-grid ECMWF monthly precipitation values for the six selected cities. These are representative model-cell values and should not be interpreted as station totals.

Table 1. ECMWF SEAS5 monthly precipitation at representative city grid cells (mm/month).

City	Oct. 2026	Nov. 2026	Dec. 2026	Jan. 2027	Four-month total
Duhok	69.43	77.46	66.32	80.92	294.13
Erbil	120.02	152.35	138.35	163.53	574.24
Sulaymaniyah	105.95	132.17	116.21	129.54	483.87
Kirkuk	84.81	97.50	77.90	88.71	348.92
Baghdad	46.26	40.19	27.17	26.72	140.34
Basra	40.22	37.19	20.07	15.83	113.31

Erbil has the largest representative four-month total (574.24 mm), followed by Sulaymaniyah (483.87 mm), Kirkuk (348.92 mm), and Duhok (294.13 mm). Baghdad and Basra are substantially lower at 140.34 mm and 113.31 mm, respectively. The Erbil value is approximately four times the Basra value, demonstrating the strength of the modeled north–south hydroclimatic gradient.

4.2 Summary indicators by selected city

Table 2. Seasonal precipitation and rainfall-screening indicators at representative city grid cells.

City	Four-month total (mm)	Peak month (mm)	Wettest forecast month	Concentration (%)	RFSI (0–100)
Duhok	294.13	80.92	January 2027	27.51	52.41
Erbil	574.24	163.53	January 2027	28.48	100.00
Sulaymaniyah	483.87	132.17	November 2026	27.31	83.15
Kirkuk	348.92	97.50	November 2026	27.94	59.35
Baghdad	140.34	46.26	October 2026	32.96	27.02
Basra	113.31	40.22	October 2026	35.50	20.01

The highest normalized rainfall-screening signal occurs near Erbil (100), followed by Sulaymaniyah (83.15), Kirkuk (59.35), and Duhok (52.41). These values reflect the internal range of the study dataset and must not be interpreted as probabilities. Basra has the smallest four-month total among the selected locations but the highest concentration ratio (35.50%), indicating that a larger fraction of its total is concentrated in the wettest month.

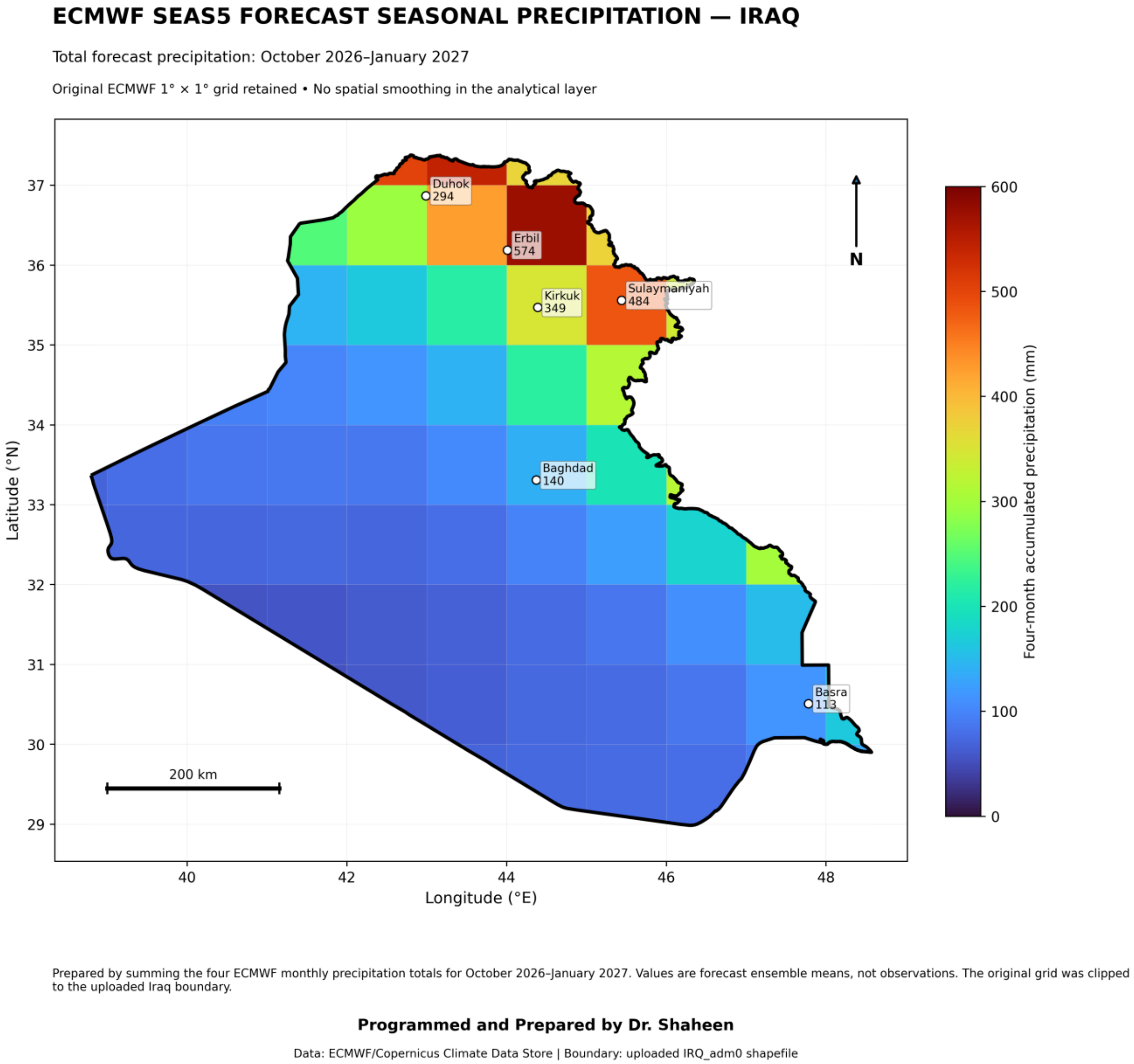

Figure 2: Four-month accumulated ECMWF precipitation for October 2026–January 2027.

Source: ECMWF/Copernicus CDS; calculated from the supplied tprate NetCDF field by Dr. Shaheen.

Figure 2 identifies the Erbil–Sulaymaniyah–Kirkuk sector and adjacent northern cells as the principal seasonal precipitation maximum. The spatial continuity of the high-value cells is hydrologically more meaningful than any single city point because rainfall generated in upstream basins can influence downstream tributaries and floodplains.

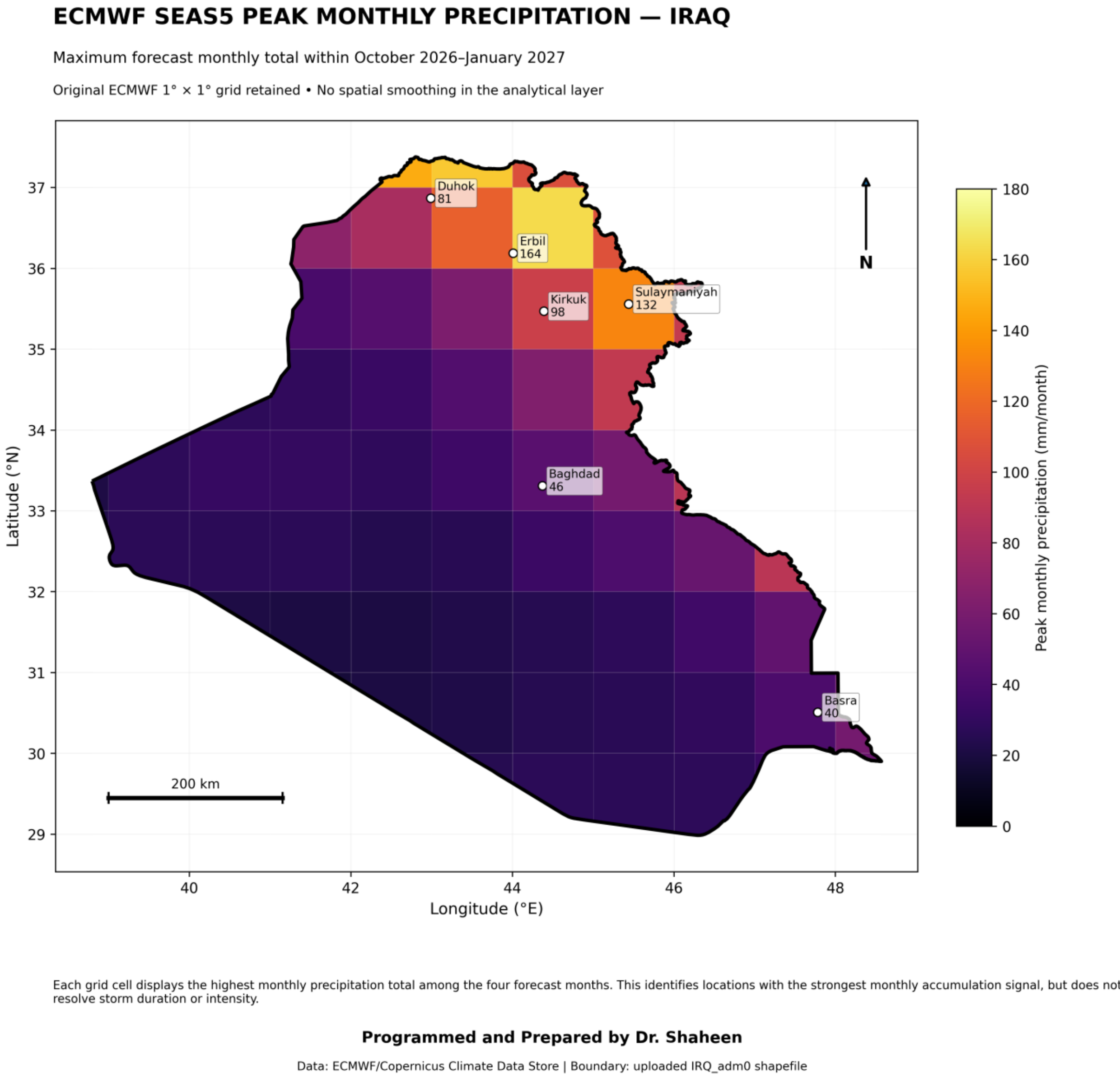

Figure 3: Maximum monthly precipitation within the four-month forecast period.

The map displays the largest monthly total at each grid cell, not short-duration storm intensity.

The peak-month map reinforces the prominence of northern and northeastern Iraq. However, monthly maxima cannot diagnose flash-flood intensity because a monthly total may be produced by several moderate storms or by one or two intense events. Event-scale flash-flood assessment requires sub-daily precipitation and rainfall–runoff modelling (Marchi et al., 2010; Borga et al., 2014).

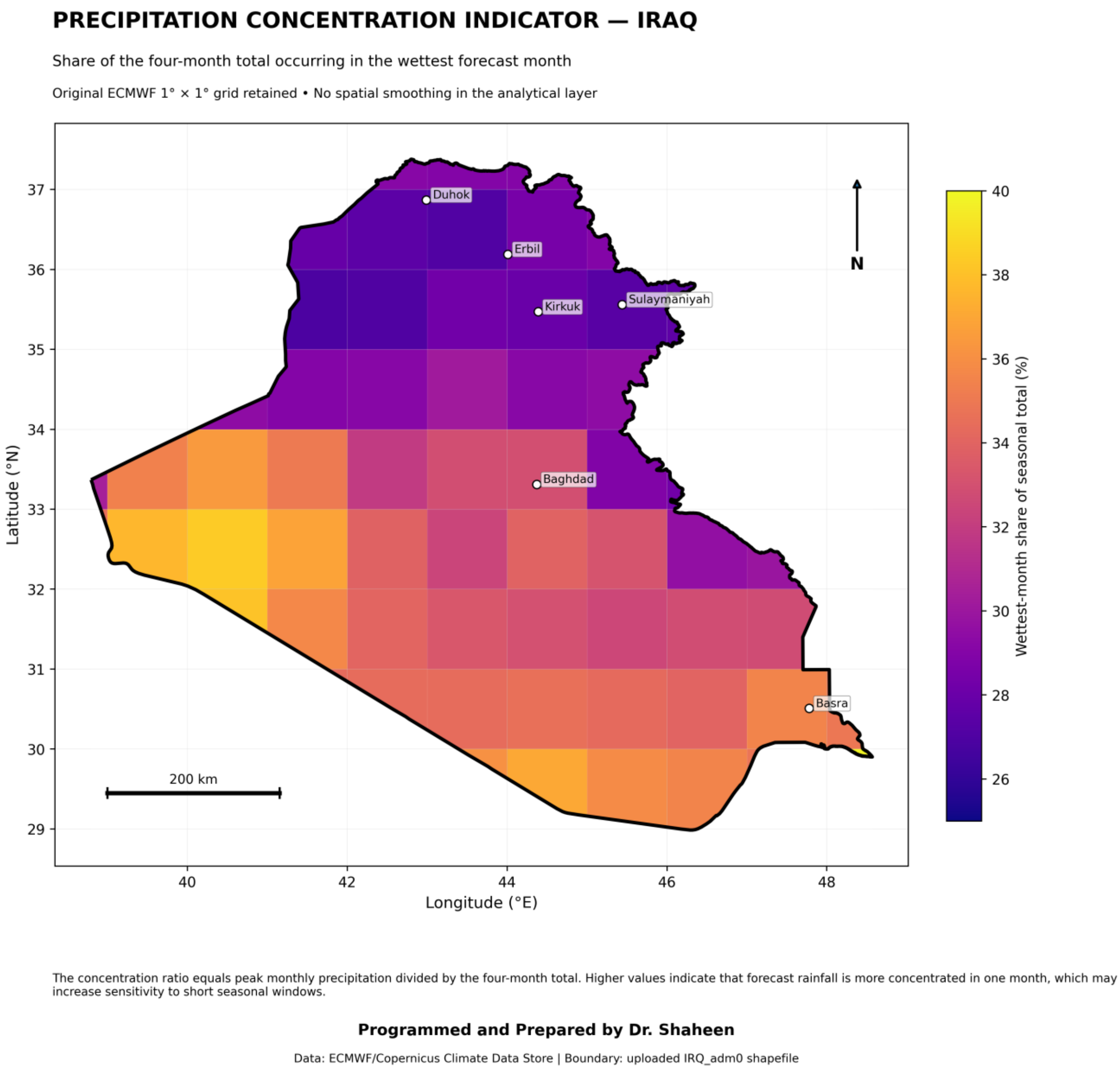

Figure 4: Wettest-month share of the four-month precipitation total.

Higher percentages indicate greater temporal concentration, not necessarily greater absolute rainfall.

The concentration ratio is generally lower in the wettest northern cells because substantial precipitation occurs during several months. In contrast, parts of southern and western Iraq show a larger percentage concentrated in one month despite smaller absolute totals. This distinction is important: seasonal accumulation and temporal concentration describe different aspects of hydrological loading.

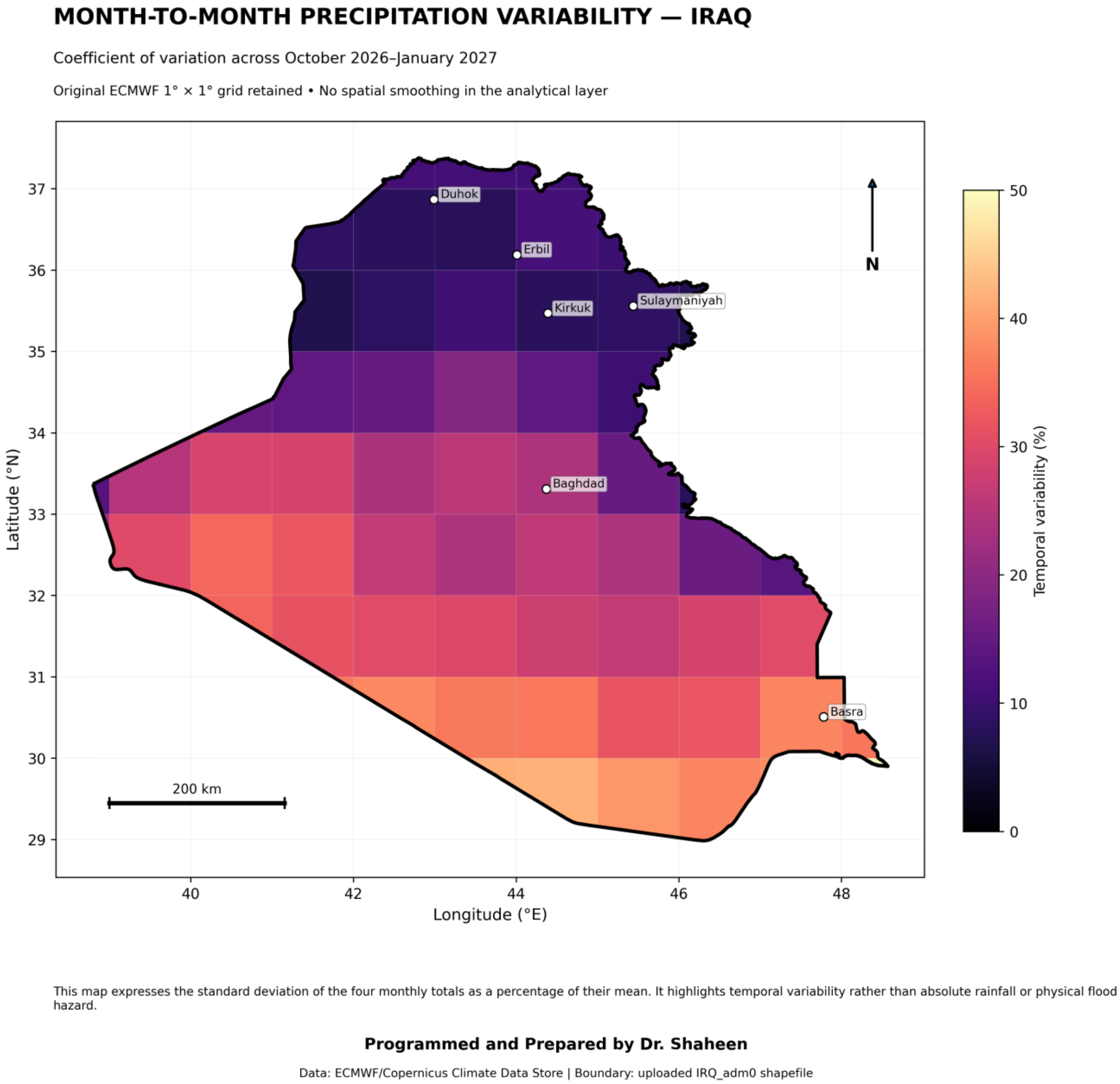

Figure 5: Month-to-month variability of forecast precipitation.

Variability is represented by the coefficient of variation across the four monthly totals.

Lower variability in the northern maximum indicates relatively persistent wet conditions rather than a single isolated monthly pulse. Persistent rainfall can progressively increase catchment wetness and reduce available soil-water storage, thereby increasing runoff efficiency during later storms. Antecedent soil moisture is a recognized control on flood response and warning thresholds (Norbiato et al., 2008).

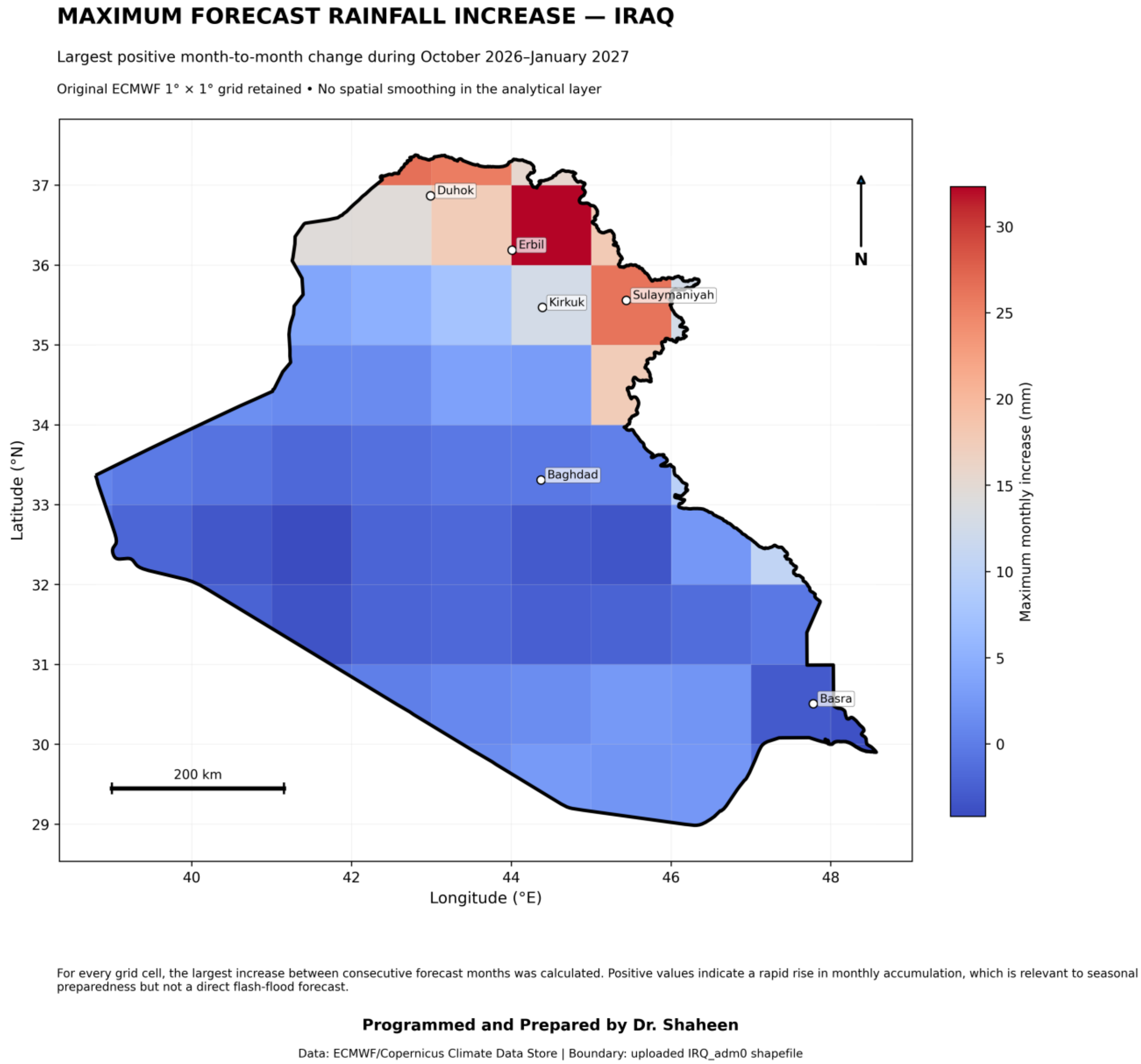

Figure 6: Largest positive month-to-month increase in forecast precipitation.

Positive values identify areas where monthly accumulation rises most rapidly between consecutive forecast months.

The strongest month-to-month increases occur in northern Iraq, especially where January becomes the wettest forecast month. This indicator is useful for seasonal preparedness because it identifies areas where hydrological loading may intensify after earlier wetting. It is not, however, a substitute for observed soil moisture or river discharge.

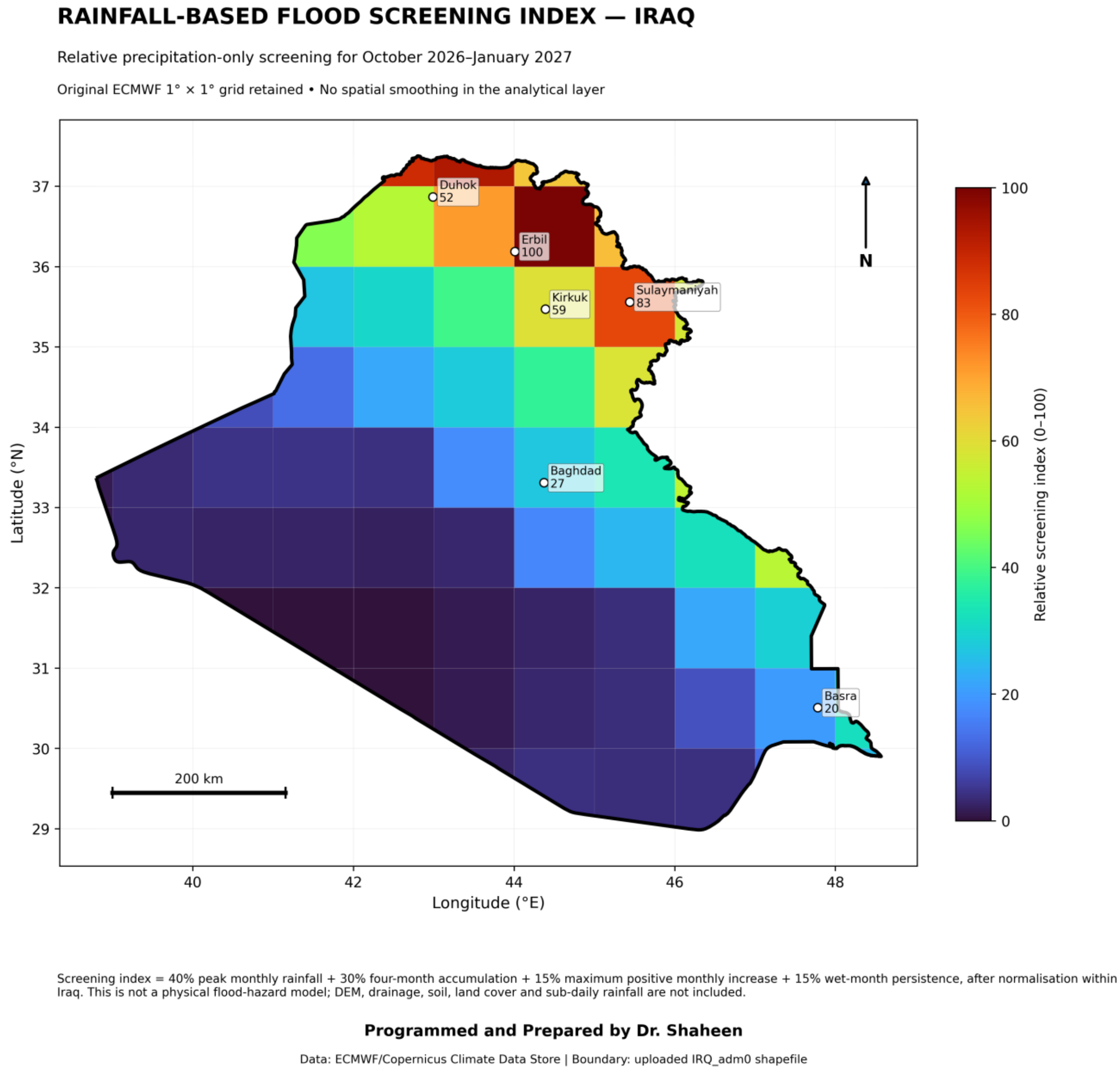

Figure 7. Rainfall-based flood-screening index for Iraq derived from ECMWF SEAS5 seasonal precipitation characteristics for October 2026–January 2027. Higher values indicate relatively stronger precipitation-related flood susceptibility and should not be interpreted as flood probability or inundation depth.

The screening index highlights northern and northeastern Iraq, with the strongest signal centred near the Erbil grid cell. This pattern is consistent with the combined effect of greater seasonal accumulation and persistence. Susceptibility studies commonly integrate rainfall with topography, drainage, soils, and land cover; using rainfall alone is insufficient for a physical hazard map (Tehrany et al., 2014).

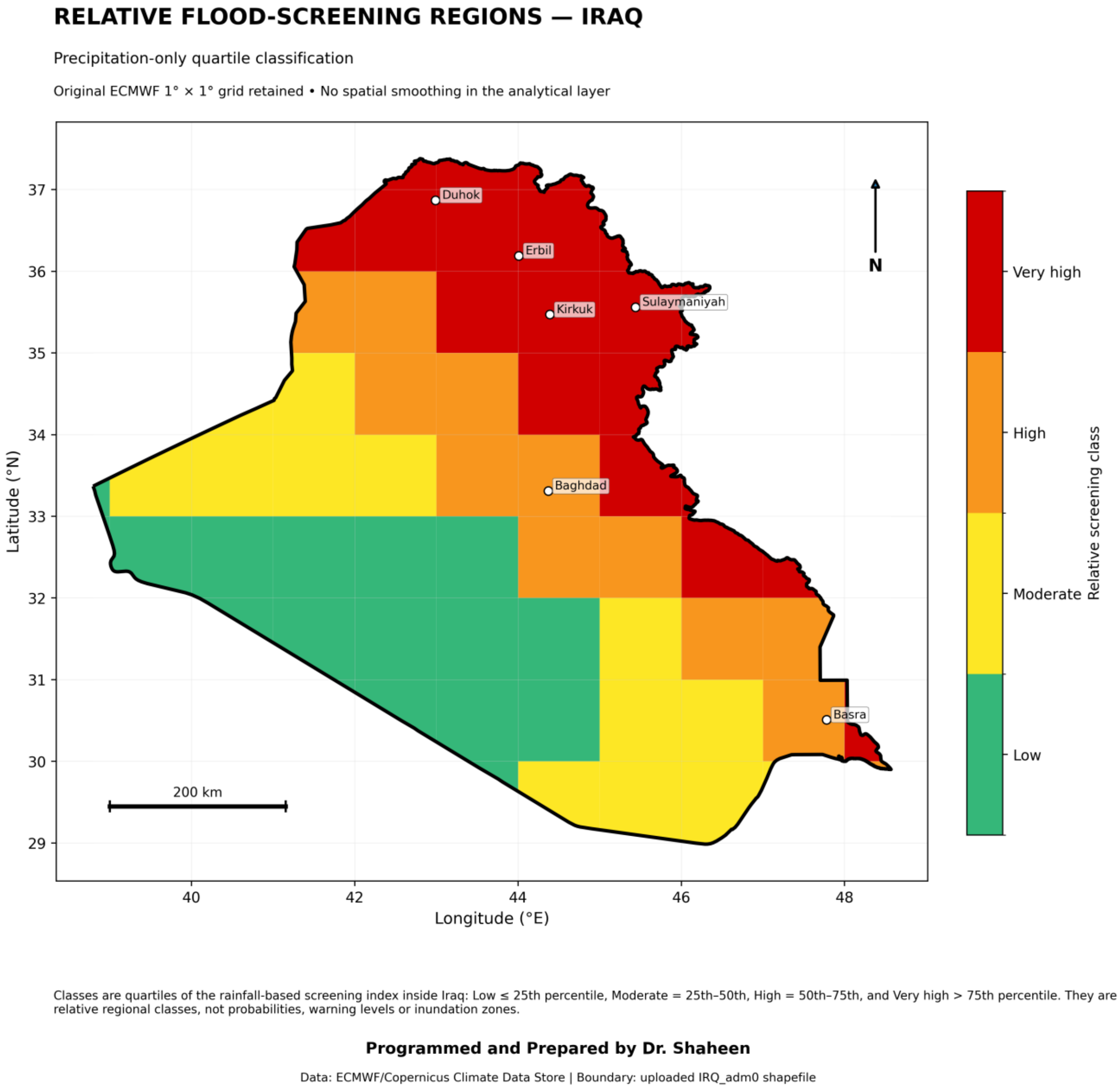

Figure 8. Precipitation-only relative flood-susceptibility regions across Iraq based on the rainfall-screening index. Classes represent relative regional screening levels and do not constitute validated flood-hazard or flash-flood prediction zones.

The categorical map should be interpreted as a prioritization tool. “Very high” means the upper quartile of the rainfall-only index within this dataset, not a validated probability of flooding. A physically defensible flood-hazard classification requires calibration against historical flood locations and integration of terrain, drainage, soil, land cover, infrastructure, and hydraulic constraints.

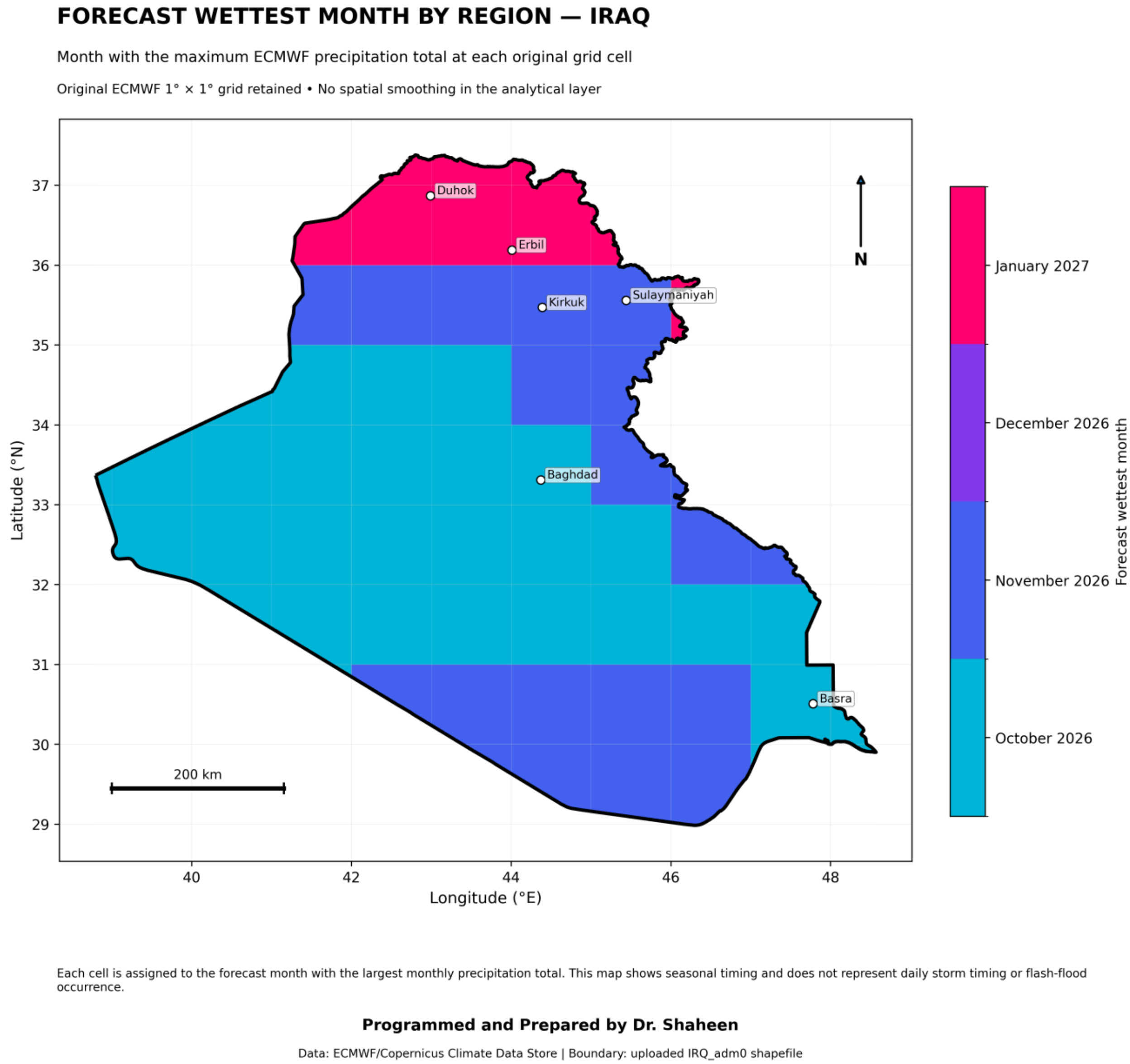

Figure 9: Forecast month with the highest precipitation total at each original grid cell.

October is the wettest month in 24 of 44 cells, November in 16 cells, and January in 4 cells; December is not the maximum in any cell.

The timing map shows that the seasonal maximum evolves spatially. October dominates much of central and southern Iraq, November becomes dominant across many eastern and northeastern cells, and January dominates a limited northern sector including the representative Erbil and Duhok cells. This pattern supports region-specific monitoring rather than a single national peak-month assumption.

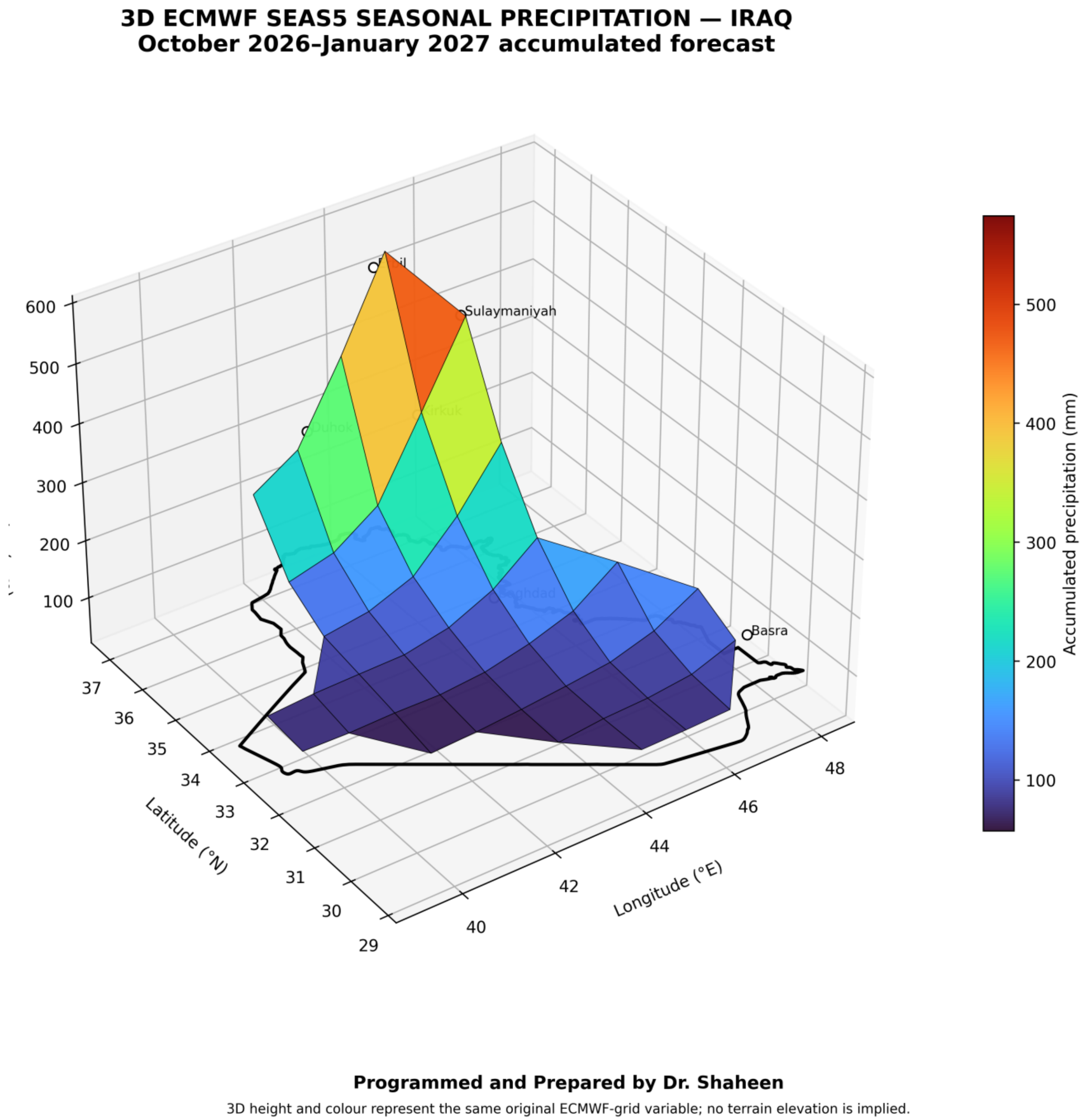

Figure 10: Three-dimensional representation of four-month accumulated precipitation.

Vertical height represents precipitation magnitude and does not represent terrain elevation.

The three-dimensional visualization emphasizes the magnitude of the north–northeast precipitation maximum. It is useful for communication but does not add spatial resolution beyond the underlying 1° grid. Quantitative interpretation should rely on the two-dimensional original-grid maps and tabulated values.

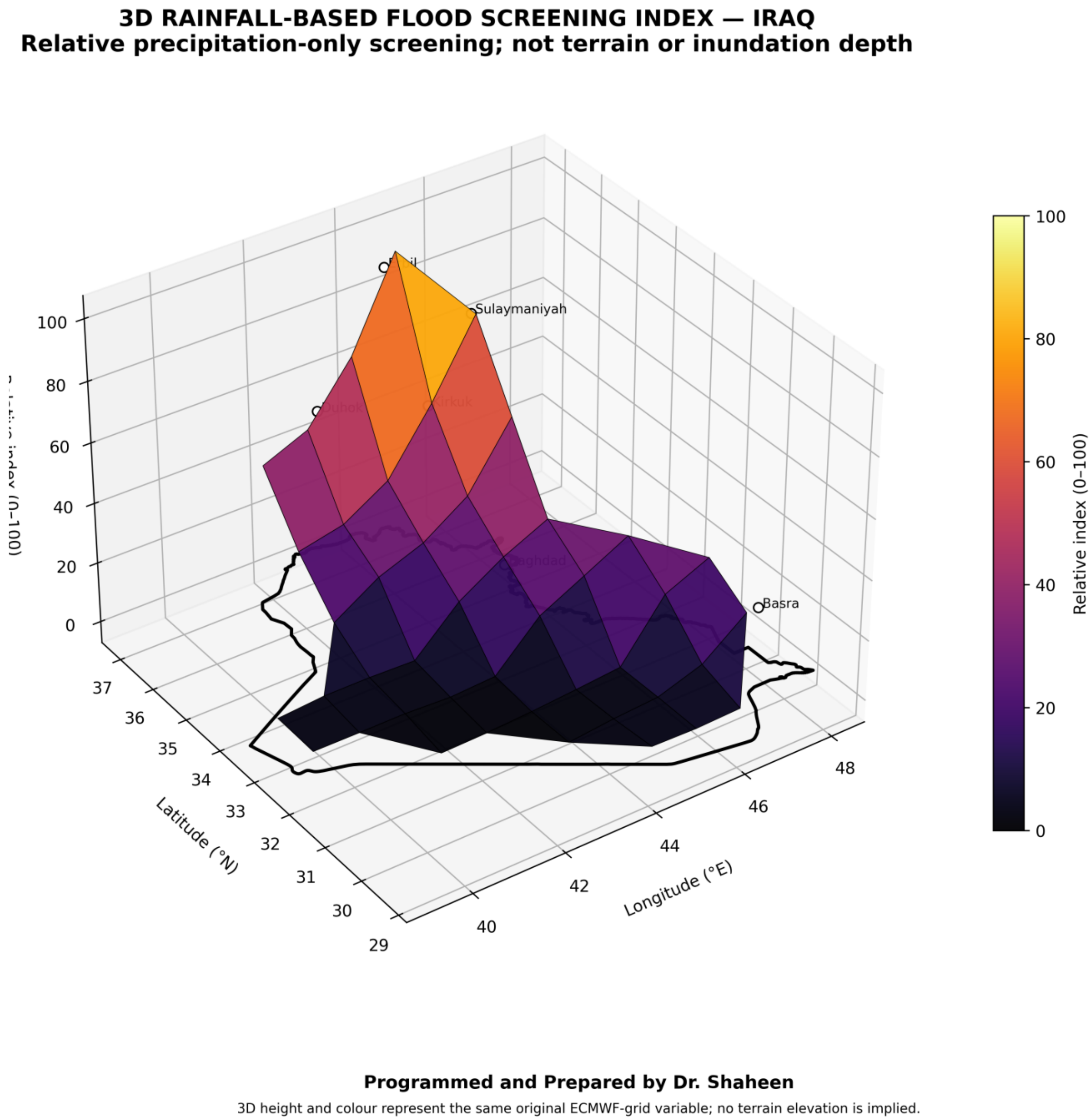

Figure 11: Three-dimensional representation of the rainfall-based flood-screening index.

Vertical height represents the relative index, not flood depth, elevation, discharge, or probability.

The screening surface identifies a concentrated northern and northeastern priority area. The abrupt appearance of 3-D peaks is partly a consequence of the coarse grid and should not be interpreted as a sharply bounded physical hazard zone.

5. Hydrological interpretation

5.1 Northern and northeastern Iraq

The Erbil, Sulaymaniyah, Kirkuk, and Duhok representative cells all exhibit substantially greater accumulation than Baghdad and Basra. In mountainous and foothill catchments, heavy rainfall can be rapidly converted into channel flow because of steep slopes, short travel times, confined valleys, and efficient drainage connectivity. Flash floods are particularly sensitive to the spatial and temporal organization of rainfall and to hydrogeomorphic setting (Marchi et al., 2010; Borga et al., 2014).

Erbil has the highest modeled accumulation and peak monthly total. This does not mean that Erbil city is certain to flood; rather, it indicates that the surrounding regional catchments carry the strongest seasonal precipitation loading in the supplied dataset. Sulaymaniyah also exhibits a strong and persistent signal, with November as its wettest forecast month. Kirkuk occupies a transition between mountain-front runoff generation and lower-relief plains. Its four-month total of 348.92 mm and persistent monthly distribution suggest that antecedent wetness may become hydrologically important before later storm events.

5.2 Central Iraq and Baghdad

Baghdad has a lower seasonal total, but urban pluvial flooding can occur even when regional seasonal precipitation is modest. Urban response depends on local storm intensity, impervious cover, drainage capacity, maintenance conditions, low-relief ponding, and river levels. The 1° seasonal product cannot resolve these controls. Baghdad should therefore not be classified as safe solely because its seasonal total is lower than northern Iraq.

5.3 Southern Iraq and Basra

Basra records the smallest selected-city total but the greatest concentration ratio. This means that the wettest month contributes a relatively large share of the four-month total. Hydrologically, low annual or seasonal rainfall does not eliminate short-duration pluvial flooding, especially in flat urban environments with restricted drainage. Event-scale forecasts and drainage-system information are required for local assessment.

6. Hydrogeological interpretation

Groundwater recharge is the fraction of infiltrated water that reaches the saturated zone. It cannot be equated directly with precipitation because evapotranspiration, soil storage, runoff, lithology, fracture networks, depth to groundwater, and antecedent moisture control the recharge pathway. Recharge estimation therefore requires multiple methods and independent observations (Scanlon et al., 2002; Healy & Cook, 2002).

In the northern High Folded Zone, winter precipitation can support direct and focused recharge of carbonate, fractured, and karstic aquifers. Fractures, faults, sink features, losing streams, and permeable alluvial fans may transmit water rapidly to aquifers. Al-Jiburi and Al-Basrawi (2015) identify direct precipitation and snowmelt as principal recharge sources in high-elevation northern aquifer systems. Stable-isotope evidence from the Erbil Basin and integrated mapping in Sulaymaniyah further demonstrate the role of elevation, geology, structure, slope, drainage, and land cover in defining recharge zones (Mamand & Mawlood, 2024; Mohammed et al., 2025).

The stronger forecast precipitation in northern and northeastern Iraq therefore suggests greater recharge opportunity, but not a quantified recharge volume. In permeable formations, part of the seasonal surplus may increase groundwater levels and spring discharge. In low-permeability formations or saturated soils, a greater fraction may become surface runoff. These competing pathways should be evaluated through rainfall–runoff modelling, water-table monitoring, spring hydrographs, isotope sampling, and water-balance analysis.

Groundwater response may also be delayed relative to precipitation. Regional aquifers can integrate recharge over weeks to months, while karstic and fractured systems may respond rapidly. Climate and rainfall variability can affect recharge nonlinearly, and groundwater systems may buffer or amplify meteorological variability depending on storage and hydraulic connectivity (Taylor et al., 2013).

7. Flood-screening implications

The rainfall-based screening maps identify where seasonal meteorological loading is greatest. They do not represent riverine flood extent, flash-flood probability, water depth, velocity, return period, or damage. A flood hazard exists only when meteorological forcing interacts with catchment response, channel capacity, and exposure.

For operational preparedness, the highest-priority follow-up region is the northern and northeastern sector, especially catchments draining the Erbil–Sulaymaniyah–Kirkuk corridor and northern mountainous terrain. The priority arises from the joint occurrence of high four-month totals, high peak-month values, and persistent wet conditions. The seasonal signal should be updated monthly and progressively replaced by extended-range, medium-range, radar, and gauge information as the forecast horizon shortens.

Rainfall thresholds for flash-flood warning are most useful when conditioned by antecedent soil moisture and translated to basin runoff or discharge thresholds (Norbiato et al., 2008). Therefore, the current precipitation-only screening should be viewed as an initial layer in a multi-stage warning framework.

1. 8. Uncertainty and limitations

2. The results use the ensemble mean; averaging can suppress extremes and does not show the spread among individual ensemble members.
3. The analytical grid is 1° × 1°, which is too coarse for individual wadis, urban districts, small basins, and mountain valleys.
4. Monthly totals do not resolve rainfall intensity, storm duration, convective organization, or the timing of individual events.
5. The forecast has not been bias-corrected or validated against Iraq station observations in this report.
6. The rainfall-screening index is internally normalized and uncalibrated; class boundaries are quartiles rather than physical thresholds.
7. No DEM, flow accumulation, drainage network, soil, land cover, geology, antecedent moisture, river stage, or hydraulic capacity was included in the index.
8. Hydrogeological interpretations describe plausible recharge pathways but do not quantify recharge or groundwater-level change.

9. Recommended next-stage modelling

A defensible national or regional flood-hazard model should integrate the seasonal precipitation layers with the following datasets and procedures:

1. A hydrologically corrected DEM, preferably 12.5–30 m or finer, to derive elevation, slope, curvature, flow direction, flow accumulation, catchments, and stream networks.
2. Drainage density, distance to streams and wadis, stream order, basin shape, relief ratio, and time of concentration.
3. Topographic Wetness Index and related variable-contributing-area indicators; the conceptual foundation of TWI originates from TOPMODEL (Beven & Kirkby, 1979).
4. Soil hydrologic groups, infiltration capacity, lithology, fracture and lineament density, karst features, and aquifer permeability.
5. Land use/land cover, impervious surfaces, urban drainage infrastructure, reservoirs, levees, bridges, and channel constrictions.
6. Antecedent soil moisture from land-surface models or satellite products and observed river or wadi levels.
7. Daily and sub-daily precipitation ensembles, radar where available, and bias correction against gauge observations.
8. Historical flood inventories for calibration and independent validation; GIS and machine-learning susceptibility methods require validated conditioning factors and event data (Tehrany et al., 2014).
9. Separate modelling of flash-flood susceptibility, riverine inundation, urban pluvial flooding, and groundwater-recharge potential because these processes have different controls and outputs.
10. Groundwater monitoring wells, spring discharge, stable isotopes, and water-balance modelling to quantify recharge rather than infer it from precipitation alone.

10. Conclusions

i. The supplied ECMWF SEAS5 ensemble-mean forecast shows a strong north–northeast precipitation gradient across Iraq for October 2026–January 2027.
ii. Representative four-month totals are highest near Erbil (574.24 mm) and Sulaymaniyah (483.87 mm), followed by Kirkuk (348.92 mm) and Duhok (294.13 mm). Baghdad and Basra are much lower at 140.34 mm and 113.31 mm.
iii. The timing of the wettest forecast month varies spatially: October is dominant in 24 of 44 grid cells, November in 16 cells, and January in 4 northern cells.
iv. The rainfall-based screening index identifies northern and northeastern Iraq as the primary region for intensified seasonal hydrological monitoring.
v. Higher precipitation may increase both runoff and aquifer recharge, but the partitioning depends on geology, permeability, terrain, soil moisture, and drainage connectivity.
vi. The current screening products are scientifically useful for prioritization but are not validated flood-hazard or inundation maps.
vii. The next stage should integrate high-resolution terrain, drainage, soil, geology, land cover, antecedent moisture, historical floods, and sub-daily rainfall ensembles in basin-based hydrological and hydraulic models.

Data, programming, and authorship statement

ECMWF/Copernicus seasonal forecast data were downloaded in NetCDF format and processed without alteration of the original analytical grid. Conversion, derived indicators, GIS clipping, cartographic design, tabulation, hydrological and hydrogeological interpretation, and preparation of this report were programmed and prepared by Dr. Shaheen. The rainfall-screening formulation is an exploratory analytical product developed for this study and is fully documented in Section 3.3.

Data and code availability

The ECMWF seasonal forecast source data are publicly available from the Copernicus Climate Data Store dataset "Seasonal forecast monthly statistics on single levels." This study used ECMWF System 51 ensemble-mean total precipitation initialized on 1 August 2026. The analysis code, processed tables, and derived figures were produced for this study. A permanent repository DOI should be added to this paragraph and to the EarthArXiv metadata once the accompanying research package is deposited. The Iraq administrative boundary should be redistributed only in accordance with its original licence.

Author contribution and responsibility statement

Shaheen Mohammed Saleh Ahmed conceived the assessment, acquired and processed the ECMWF data, developed the Python workflows and precipitation-only screening indicators, prepared the maps and tables, interpreted the hydrological and hydrogeological results, and wrote the manuscript. The author is responsible for the interpretation and for clearly distinguishing the preliminary rainfall-based screening products from validated flood-hazard or inundation models.

References

Reference verification note: Bibliographic metadata and DOI links were rechecked on 10 August 2026 against journal publisher pages and official institutional sources. The ECMWF/SEAS5 and agency references were checked against official ECMWF, Copernicus, FAO, and UN ESCWA resources. The Mamand and Mawlood (2024) citation was corrected to Kuwait Journal of Science, 51(1), article 100128.

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