(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 October 2014 (09.10.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/161082 A1

(51) International Patent Classification:
G01W 1/10 (2006.01)

(21) International Application Number:
PCT/CA2014/000333

(22) International Filing Date:
4 April 2014 (04.04.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

13/856,923	4 April 2013 (04.04.2013)	US
61/835,626	16 June 2013 (16.06.2013)	US
61/836,713	19 June 2013 (19.06.2013)	US
13/922,800	20 June 2013 (20.06.2013)	US
61/839,675	26 June 2013 (26.06.2013)	US
13/947,331	22 July 2013 (22.07.2013)	US

(71) Applicant: **SYK MOTION RESEARCH, ULC** [—/CA]; 1410 Stanley, Suite 1020, Montreal, Québec H3A 1P8 (CA).

(72) Inventor: **LEBLANC, Andre**; 338 ave. Berwick, Mont-Royal, Québec H3R 1Z6 (CA).

(74) Agent: **BENOIT & CÔTÉ, INC.**; 800-1550 Metcalfe, Montreal, Québec H3A 1X6 (CA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

[Continued on next page]

(54) Title: METHOD AND SYSTEM FOR REFINING WEATHER FORECASTS USING POINT OBSERVATIONS

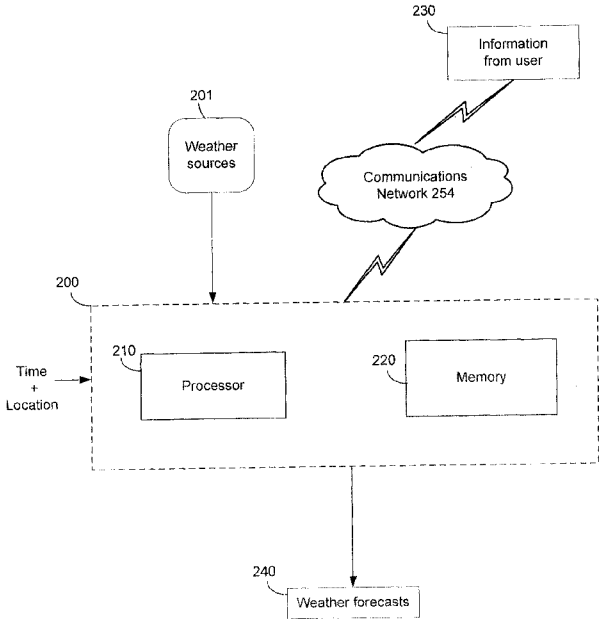

FIGURE 1A

(57) Abstract: Provided are methods, devices and non-transitory computer readable storage mediums to generate a more accurate weather forecast by utilizing actual observation of a weather event in a particular location and time. For example, the observation data may be received from a user device and contain information indicative of a weather event that the user observed. Alternatively, or additionally, the observation data may be automatically generated by one or more sensors placed in certain locations and transmitted to a central server automatically upon detecting an observation. The observation data may be used to predict a weather forecast of a location that corresponds to, or is otherwise related to the particular location in which the observed event occurred.

WO 2014/161082 A1

MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

METHOD AND SYSTEM FOR REFINING WEATHER FORECASTS USING POINT OBSERVATIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of co-owned and co-invented U.S. Patent Application No. 13/856,923 filed on April 4, 2013, U.S. Patent Application No. 13/922,800, filed on June 20, 2013, U.S. Patent Application No. 13/947,331, filed on July 22, 2013, U.S. Provisional Application No. 61/839,675, filed on June 26, 2013, U.S. Provisional Application No. 61/835,626, filed on June 16, 2013, and U.S. Provisional Application No. 61/836,713, filed on June 19, 2013, the entire disclosures of which are hereby incorporated by reference.

BACKGROUND

(a) Field

[0002] The subject matter disclosed generally relates to methods for producing weather forecasts. More specifically, the subject matter relates to software applications for producing weather forecasts.

(b) Related Prior Art

[0003] Presently available systems for producing weather forecasts are push systems only; that is, the system gathers information from sensors, databases, etc., produces a weather forecast based on this information and pushes the weather forecast to users.

[0004] Users often find that the forecast is not accurate for their location and the producer of the forecast has no way to determine if their forecasts are really accurate.

[0005] There is a need in the market for pulling information from observers, who may also be users, located on the territory for which weather forecasts are produced to help increase the accuracy of the weather forecasts.

SUMMARY

[0006] There may be provided a computer-implemented method comprising: receiving, from a remote device, weather-related observation data associated with a first location and a first time, the weather-related observation data comprising data obtained from observing a weather-related event associated with the first location and the first time, generating a weather forecast associated with a second location and a second time based on the weather-related observation data, and outputting the weather forecast to the remote device.

[0007] In some embodiments, the method may comprise forming an image of the second location, the image comprising pixels associated with weather forecast values.

[0008] In some embodiments, the method may comprise forming at least two images of the second location, each of the images being associated with a different time.

[0009] In some embodiments, the weather-related event may comprise at least one of hail, wind, lightening, temperature, precipitation and intensity of sunlight.

[0010] In some embodiments, the method may comprise modifying a weather forecast value associated with a pixel based on the weather-related observation data.

[0011] In some embodiments, the weather-related event may be observed by a user operating the remote device, and the user causes the remote device to transmit the weather-related observation data.

[0012] In some embodiments, the remote device may automatically transmit weather-related observation data upon detecting an observation of a weather-related event.

[0013] In some embodiments, the method may comprise: receiving, from a second remote device, second weather-related observation data associated with a third location and a third time, the second weather-related observation data comprising data obtained from observing a weather-related event associated with the

third location and the third time, wherein the weather forecast associated with the second location and the second time is generated based on both the weather-related observation data associated with the first location and the first time and the second weather-related observation data associated with the third location and the third time.

[0014] In some embodiments, the method may comprise: storing the received weather-related observation data, producing a statistic about the stored weather-related observation data, the statistic comprising information indicative of a number of remote devices that have received the weather forecast, and outputting at least part of the statistic to the remote device.

[0015] In some embodiments, the method may comprise: comparing the weather-related observation data with pre-stored weather data, and determining, based on the comparison, weight of the weather-related observation data that affects the generating of weather forecast.

[0016] In some embodiments, the method may comprise: producing a trust rating associated with the remote device, and determining, based on the trust rating, weight of the weather-related observation data received from the remote device that affects the generating of weather forecast. Additionally or alternatively, a trust rating may be assigned to a user who may be operating, or otherwise associated with, one or more remote devices.

[0017] In other embodiments, there may be a method for refining a weather forecast that comprise: obtaining weather-related observations at a particular position and at a given time, and using the weather-related observations in forming a gridded image of a particular area on Earth, the gridded image comprising pixels wherein each pixel has a value which corresponds to a weather value which in turn corresponds to a weather forecast, wherein forming a gridded image comprises forming multiple gridded images, each gridded image corresponds to a moment in time.

[0018] Further, there may also be a method for forecasting a presence of weather-related events at a particular position at a given time. In some

embodiments, the method may comprise: obtaining a weather-related observation of a weather-related event at the particular position and at the given time, changing or confirming a weather value in a gridded image based on the weather-related observation, and producing a weather forecast using the changed or confirmed weather value.

[0019] In other embodiments, there may be a method for using contributions from observers in a weather forecast. The method may comprise: obtaining weather-related observations from the observers, each observation being made at a particular position and at a given time, using the weather-related observations from the observers in the production a future weather forecast for a user, calculating statistics about the weather-related observations from the observers, weather forecasts and users that have benefited from the observations, and sending to at least one of the observers a message comprising at least part of the statistics about the weather-related observations from at least one of the observers.

[0020] In some embodiments, there may be a device comprising one or more processors, a memory storing computer instructions that can be executed by the one or more processors such that the device is caused to perform any one or more of the methods described above, when the instructions are executed. Further, there may be a non-transitory computer-readable medium storing such instructions. The device may be a mobile device such as, non-exclusively, a handheld device, a cellphone, a vehicle, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Further features and advantages of the present disclosure will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0022] Figure 1A shows an example of a block diagram of a system for producing weather forecasts using point observations (a nowcaster) according to an embodiment;

[0023] Figure 1 B shows an example of a block diagram of a system for producing weather forecasts using point observations (a nowcaster) according to another embodiment;

[0024] Figure 1C shows an example of a block diagram of a system for producing weather forecasts using point observations (a nowcaster) according to another embodiment.

[0025] Figure 2 shows an example of a flow chart of a method for crowd-sourcing weather observations for producing weather forecasts from the observations according to an embodiment;

[0026] Figure 3 shows an example of a flow chart of a method for forecasting hail based on point observations and weather radar data according to an embodiment;

[0027] Figure 4 shows an example of a flow chart of a method for using contributions from observers in a weather forecast according to an embodiment;

[0028] Figures 5A to 5D are screenshots showing an example of an application used for presenting a weather forecast and for obtaining point observations from observers according to an embodiment;

[0029] Figure 6 shows an example of a network environment in which the embodiments may be practiced; and

[0030] Figure 7 illustrates an exemplary diagram of a suitable computing operating environment in which embodiments of the claimed subject matter may be practiced.

[0031] It will be noted that, throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION

[0032] The embodiments will now be described more fully hereinafter with reference to the accompanying drawings, which form a part hereof, and which show, by way of illustration, specific embodiments by which the embodiments may be practiced. The embodiments are also described so that the disclosure conveys the

scope of the claimed subject matter to those skilled in the art. The embodiments may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0033] Among other things, the present embodiments may be embodied as methods or devices. Accordingly, the embodiments may take the form of an entirely hardware embodiment, an entirely software embodiment, an embodiment combining software and hardware aspects, etc. Furthermore, although the embodiments are described with reference to a portable or handheld device, they may also be implemented on desktops, laptop computers, tablet devices or any computing device having sufficient computing resources to implement the embodiments.

[0034] Definitions

[0035] In the present specification, the following terms are meant to be defined as indicated below:

[0036] Nowcasting: The term *nowcasting* is a contraction of "now" and "forecasting"; it refers to the sets of techniques devised to make short-term forecasts, typically in the 0 to 12 hour range.

[0037] A nowcaster is a weather forecasting device which prepares very short-term (e.g., one minute, five minutes, 15 minutes, 30 minutes, etc.) forecasts for a given territory, which is a very small region on Earth (5 meters, 10 meters, 50 meters, 100 meters, 500 meters, 1,000 meters, etc.).

[0038] A weather value is a weather-related quantity or attribute of any sort such as temperature, pressure, visibility, precipitation type and intensity, accumulation, cloud cover, wind, etc.

[0039] A forecasted weather value is a weather value that is predicted by the nowcaster.

[0040] A weather-related event is, for example, at least one of hail, a wind gust, lightning, a temperature change, etc.

[0041] Precipitation type (PType): indicates the type of precipitation. Examples of precipitation types include, but are not limited to, rain, snow, hail, freezing rain, ice pellets, ice crystals, etc.

[0042] Precipitation rate (PRate): indicates the precipitation intensity. Examples of precipitation rate values include, but are not limited to, no (i.e., none), light, moderate, heavy, extreme, etc. In an embodiment, the precipitation rate can also be expressed as a range of values such as: none to light, light to moderate, moderate to heavy, or any combination of the above.

[0043] Precipitation probability: indicates the probability that precipitation might occur. Examples of precipitation probability values include, but are not limited to, no, unlikely, slight chance of, chance of, likely, very likely, certain, etc.

[0044] In an embodiment, the precipitation probability can also be expressed as a range of values such as: none to light, light to moderate, moderate, or to heavy. Precipitation probability may also be expressed in terms of percentages; e.g., 0%, 25%, 50%, 75%, 100%, etc.; or ranges of percentages; e.g., 0% to 25%, 25% to 50%, 50% to 75%, 75% to 100%, etc. In an embodiment, the precipitation probability may be taken from a probability distribution.

[0045] Precipitation type and precipitation rate categories (PTypeRate): a PTypeRate category is combination of precipitation type and precipitation rate to which may be associated a probability of occurrence for a given period to indicate the possibility of receiving a certain type of precipitation at a certain rate.

[0046] A weather forecast is a set of one or more forecasted weather values that are displayable to users.

[0047] A weather-related observation may be an image, a video, a free-form text (tweet, message, email, etc.), a weather value of any sort such as temperature, pressure, visibility, precipitation type and intensity, accumulation, cloud cover, wind, etc.

[0048] A point observation is an observation, as defined herein, made at a particular position (sometimes also referred to as a "location") at a given time.

[0049] The particular position is the position on Earth at which the observation is made. A precision of five meters to 10 meters is appropriate for the embodiments described herein, but the variation in the position may be greater, such as 25 meters, 50 meters, 100 meters, 1000 meters or more (e.g., less precision). The means for obtaining the particular position include any type of geo-location means or positioning system available at the time of filing this patent application. The geo-location means or positioning system may be automated or not. Automated geo-location means or positioning systems include global positioning systems, RF location systems, radiolocation technologies, Internet Protocol (IP) addresses, MAC addresses, WiFi, Radio Frequency Identification (RFID), etc. The positioning systems may also be manual, such as providing a street address, street corner, building or landmark, etc.

[0050] A given time is defined as the hour, minute and second at which the point observation is made in the time zone corresponding to the particular position. The hour, minute and second for the given time can also be recorded according to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT) such that the given time is independent of the particular position. The precision of the given time may be more or less than one second. For example, in some embodiments, a precision of 5 seconds, 10 seconds, 30 seconds, 60 seconds, etc., may be sufficient for the embodiments described herein.

[0051] A user is a person to whom a weather forecast is forwarded. An observer is an entity providing automated and/or manned observations. An observer may be a person or an automated machine. An observer may also be a user as defined herein.

[0052] A gridded image is an image which comprises latitude and longitude coordinates. It is therefore a collection of bi-dimensional geo-localized points *I* pixels.

[0053] Each pixel in a gridded image corresponds to a position and can either represent a single weather value, a probability distribution of values or a level of confidence.

[0054] Briefly stated, the present embodiments describe a computer implemented method and system for generating more accurate weather forecasts by taking into account not only the various types of weather values but also the actual observations in particular locations at particular times. Such observations can be automated and pushed to a database automatically, or can be user-oriented such as users individually reporting their observations.

[0055] Nowcaster

[0056] Figures 1A-1C are examples of block diagrams of a nowcaster according to the present description.

[0057] As shown in Figures 1A-1C, the nowcaster **200** receives weather observations from different sources **201** such as weather observations sources including but not limited to: point observations **201-2** (e.g. feedback provided by users and automated stations), weather radars **201-3,** satellites **201-4** and other types of weather observations **201-1**, and weather forecast sources such as numerical weather prediction (NWP) model output **201-5** and weather forecasts and advisories **201-6**.

[0058] The nowcaster **200** comprises a memory **220** and a processor **210**. The memory **220** comprises the instructions for the method and also stores data from the weather sources **201**, intermediate results and weather forecasts. The processor **210** allows the nowcaster **200** to perform calculations.

[0059] The nowcaster **200** can receive information **230** from a user **150** through a communication network **254**. According to an embodiment, this information **230** may be a chosen time increment.

[0060] The nowcaster **200** outputs a weather forecast, or a succession of weather forecasts.

[0061] Figure 1B is one embodiment of the nowcaster 200. In this embodiment, the nowcaster **200** comprises a PType distribution forecaster **202** and a PRate distribution forecaster **204**. The PType forecaster **202** receives the weather observations from the different sources **201** and outputs a probability distribution of

precipitation type over an interval of time, for a given latitude and longitude (and/or location). For example:

a. Snow: 10%

b. Rain: 30%

c. Freezing Rain: 60%

d. Hail: 0%

e. Ice Pellets: 0%

[0062] Similarly, the PRate forecaster **204** receives the weather observations for a given latitude and longitude from the different sources **201** and outputs a probability distribution forecast of a precipitation rate (PRate) in a representation that expresses the uncertainty. For example, the PRate may be output as a probability distribution of precipitation rates or a range of rates over an interval of time, for a given latitude and longitude. For example:

f. No Precip.: 30%

g. Light: 40%

h. Moderate: 20%

i. Heavy: 10%

[0063] The PRate and PType values output by the PRate forecaster **204** and the PType forecaster **202** are sent to a forecast combiner **206** to combine these values into a single value PTypeRate which represents the precipitation outcomes. For example, if the value of PType is "Snow," and the value of "PRate" is heavy, the combined value of PTypeRate may be "heavy snow."

[0064] For a given latitude and longitude, the system outputs forecasted PTypeRate Distributions for predefined time intervals, either fixed (ex: 1 minute) or variable (ex: one minute, then five minutes, then 10 minutes, etc.). The system can either pre-calculate and store forecasted PTypeRate Distributions in a sequence of time intervals, or calculate it in real time. A PTypeRate Distribution represents, for each time interval, the certainty or uncertainty that a PTypeRate will occur.

[0065] With reference to Figure 1B, the forecast combiner **206** receives the final PRate distribution from the PType forecaster **202** and the final PRate distribution from the PRate forecaster **204** to combine them into a group of PTypeRate distribution values, each representing the probability of receiving a certain type of precipitation at a certain rate. An example is provided below.

[0066] Assuming that the PType distribution is as follows: Snow: 50%, Rain: 0%, Freezing rain: 30%, Hail: 0%, Ice pellets: 20%, and the PRate distribution is as follows: None: 0%, Light: 10%, Moderate: 20%, Heavy: 30%, Very heavy: 40%, the PTypeRate distributions may be as follows:

Table 1: An Example of PTypeRate Distribution Table

PType / PRate	Snow 50%	Rain 0%	Freez. Rain 30%	Hail 0%	Ice Pellets 20%
None 0%	No precipitation	No precipitation	No precipitation	No precipitation	No precipitation
Light 10%	5% light snow	No precipitation	3% light freezing rain	No precipitation	2% light ice pellets
Moderate 20%	10% moderate snow	No precipitation	6% moderate freezing rain	No precipitation	4% moderate ice pellets
Heavy 30%	15% heavy snow	No precipitation	9% heavy freezing rain	No precipitation	6% heavy ice pellets
Very Heavy 40%	20% heavy snow	No precipitation	12% very heavy freezing rain	No precipitation	8% very heavy ice pellets

[0067] Accordingly, the forecast combiner **206** multiplies the probability of each type of precipitation by the probability of each rate of precipitation to obtain a probability of receiving a certain type of precipitation at a certain rate for example, 20% chance of heavy snow, or 12% chance of very heavy freezing rain. In an embodiment, it is possible to associate probability ranges with textual information for

displaying the textual information to a user instead of the probabilities in numbers. For example, probabilities that are between 5% and 15% may be associated with the text: "low chance," while probabilities that are between 40% and 70% may be associated with the text "high chance," or "very likely," etc. whereby, instead of displaying: "60% chance of heavy snow," it is possible to display: "high chance of heavy snow."

[0068] In another embodiment, it is possible to combine two or more different PTypeRates along one or more dimensions (the dimensions including: the rate, type or probability). For example, results of such combination may include: Likely light to moderate rain, Likely light to moderate rain or heavy snow; Likely moderate rain or snow; likely rain or snow; chance of light to moderate rain or heavy snow or light hail; chance of moderate rain, snow or hail; chance of rain, snow or hail, etc.

[0069] Accordingly, the nowcaster **200** receives the location for which the nowcasts are needed and the time and/or time interval for which the nowcasts are needed and outputs the PTypeRate distribution for the given location and for the specific time.

[0070] Figure 1C illustrates another embodiment of the nowcaster **200**. In this embodiment, the nowcaster **200** comprises a PType selector/receiver **202-C** and a PRate distribution forecaster **204**.

[0071] Similar to the embodiment shown in Figure 1B, the PRate distribution forecaster **204** receives the weather observations for a given latitude and longitude from the different sources **201** and outputs a probability distribution forecast of a precipitation rate (PRate) in a representation that expresses the uncertainty. For example, the PRate may be output as a probability distribution of precipitation rates or a range of rates over an interval of time, for a given latitude and longitude. For example:

f. No Precip.: 30%

g. Light: 40%

h. Moderate: 20%

i. Heavy: 10%

[0072] However, the PType selector/receiver **202-C** does not output a probability distribution associated with different types of precipitation. Instead, the PType selector/receiver **202-C** receives weather observations for a given latitude and longitude from the different sources **201** to select one precipitation type from a list of different precipitation types. For example, based on the inputs received from the sources **201**, the PType selector/receiver **202-C** selects a single precipitation type that is most likely to occur in the given latitude and longitude (and/or location) from the following list of precipitation types:

a. Snow

b. Rain

c. Freezing Rain

d. Hail

e. Ice Pellets

f. Mix (*e.g.*, a+c, a+d, b+c, a+e, c+e, d+e, etc.)

[0073] From the list of precipitation types such as the one above, only one precipitation type is selected for a given location. For example, a mix of snow and freezing rain can be selected as the most likely precipitation type for a given location at a given time. The precipitation type is not associated with a probability value. In fact, since only one precipitation type is selected for any given location and time corresponding to the location, the selected precipitation type will have the effective probability value of 100%.

[0074] The list of precipitation types that are available for selection of one type may include a mix type that represents a mix of two different precipitation types (e.g., snow and freezing rain, hail and ice pellets, etc.). A mix type is considered as a distinct precipitation type available for selection and, as shown above in (f) of the list, there can be many different mix types representing the mix of different pairs of various precipitation types.

[0075] In another embodiment, the precipitation type is not selected by the PType selector/receiver **202-C** but instead is received from a source outside the nowcaster **200**. In other words, the nowcaster 200 may request to a remote source (e.g., a third-party weather service) identification of the precipitation type that is most likely to occur for a given location at a given time and receive a response from the source identifying the most likely precipitation type. In this case, selection of the precipitation type is not performed by the nowcaster **200**. The nowcaster **200** merely is inputted with the already-selected precipitation type and thereby can save computational power of the nowcaster **200** that would otherwise have been needed to perform the selection.

[0076] The selected precipitation type and the PRate values respectively output by the PType selector/receiver **202-C** and the PRate distribution forecaster **204** are combined. For example, if the selected precipitation type is snow, and the PRate values are as described above, the combined information would indicate:

a. No Snow: 30%

b. Light Snow: 40%

c. Moderate Snow: 20%

d. Heavy Snow: 10%.

[0077] As only one precipitation type is concerned, only minimal amount of computational power is needed to perform the combining to output the final weather forecast data. Since the PType selector/receiver **202-C** will output one (1) precipitation type for a given location and time, if the PRate distribution forecaster **204** outputs a number m of probability distribution, the final weather forecast data will comprise only a number m (m*1) of weather forecast distribution.

[0078] In outputting the final weather forecast data, it is possible to associate probability ranges with textual information for displaying the textual information to the user instead of the probabilities in numbers, similar to the embodiment shown in Figure 1B. For example, probabilities that are between 5% and 15% may be associated with the text: "low chance," while probabilities that are between 40% and

70% may be associated with the text "high chance," or "very likely," etc. whereby, instead of displaying: "60% chance of heavy snow," it is possible to display: "high chance of heavy snow."

[0079] Accordingly, the nowcaster **200** receives the location for which the nowcasts are needed and the time and/or time interval for which the nowcasts are needed and outputs the selected PType and PRate distribution for the given location and for the specific time.

[0080] The nowcaster according to the embodiment shown in Figure 1C may be advantageous over the embodiment shown in Figure 1B in certain circumstances in which efficiency is desired. The embodiment of Figure 1C can be implemented using much less processing power than the embodiment of Figure 1B. However, the embodiment of Figure 1B may be more suitable than the embodiment of Figure 1C in providing more detailed and accurate snapshot of weather forecast data for any given location and time.

[0081] Crowd-sourcing weather observations

[0082] Briefly stated, the present embodiments describe a system and/or a method that collects and manages weather-related observations (or referred to as just "observations") from users and/or automated machines to generate observation mosaics (e.g., mosaics) for the purpose of weather forecasting. The system comprises many automated and/or manned observation sources (e.g., the observers) that send geo-tagged observations to a database. A mosaic builder incorporates the observations to form a gridded image (e.g., a mosaic) of a particular area on the globe (e.g., the domain) thus creating a "best-guess" of weather values for each pixel in the domain. The embodiments of the nowcaster illustrated in Figures 1A-1C take in user observation data (e.g., **201-2**) as inputs to predicting or otherwise identifying the most accurate forecasted precipitation type and precipitation rate distribution for any given location at any given time.

[0083] To build a mosaic, the mosaic builder chooses the observations to include based on time-of-observation and position. Each observation is positioned on the Mosaic at precisely the geo-location provided.

[0084] A region around the observation is defined (observation region). Each point in an observation region may contribute to the mosaic based on various factors such as distance to observation, time of observation, observer trust and reliability factor, and more factors.

[0085] Now turning to Figure 2, there is shown a flow chart of a method **300** for crowd-sourcing weather observations for producing weather forecasts from the observations according to an embodiment.

[0086] The method **300** comprises:

- obtaining weather-related observations at a particular position and at a given time (e.g., step **302**);

-saving the weather-related observations in a database (e.g., step **304**); and

- using the weather-related observations in forming a gridded image of a particular area on Earth, the gridded image comprising pixels wherein each pixel has a value which corresponds to a weather value which in turn corresponds to a weather forecast (e.g., step **306**).

[0087] According to another embodiment of method **300**, the step of obtaining the weather-related observations is automated or made by observers.

[0088] According to another embodiment, a mechanism is provided to deal with overlapping observation regions. For example, an observation is reported to a database. The observation may be tagged with a certain location and time such that when a second observation in the same location is later reported, it can be associated with the first reported observation. If the second observation is made at a time that is only within a short time period from the time at which the first observation is made, the second observation may be disregarded as a redundant report.

[0089] According to another embodiment, a mechanism is provided to rate the trustworthiness and reliability of weather observations. For example, if a report includes information that is inconsistent with the pre-stored weather data (e.g., a user reports snow in a certain location at certain time, but other objective weather data such as temperature, pressure, etc., indicate that snow is impossible in that certain location and time), then the user is given a reduced trust rating. The pre-stored weather data may include only the data obtained from objective weather sources and not data individually reported from users. The trust rating may be provided on a scale, and any reports from a source with a trust rating below a threshold may be disregarded in entirety.

[0090] According to another embodiment, the mosaic may be used in a weather nowcasting system.

[0091] Forecasting hail based on points observations

[0092] Briefly stated, the present embodiments describe a system and/or method that forecasts hail using an observation of the hail, a displacement field (e.g., flow field) and possibly weather radar data. The position and time of a hail event (e.g., observation) is transmitted to a computer. The computer attempts to determine if the weather radar signature is consistent with the hail observation. If it is, a region (e.g., hail area) is created by using radar signature, or not, and hail is forecasted into the future by analyzing motion of precipitation captured from radar and displacing hail area along the motion. If no radar correlation exists, a region (e.g., hail area) is created without radar. In either case, hail region can be modified as a function of time or distance from the original hail observation. A confidence score may also be generated as a function of time or distance from the original hail observation or any other parameter.

[0093] Now turning to Figure 3, there is shown a flow chart of a method 320 for forecasting hail based on point observations and weather radar data according to an embodiment.

[0094] It should be noted here that hail is but one example of a weather-related event. It should be understood that the embodiments described herein according to Figure 3 and other figures also apply to other types of weather-related events defined herein or known to those skilled in the art.

[0095] The method **320** comprises:

- obtaining a hail observation at the particular position and at the given time (e.g., step **322**);

- changing or confirming a weather value in a gridded image based on the hail observation (e.g., step **324**); and

- producing a weather forecast using the changed or confirmed weather value (e.g., step **326**).

[0096] According to another embodiment, method **320** further comprises creating or confirming a hail area in a region of the gridded image using the weather value.

[0097] According to another embodiment, method **320** further comprises obtaining a displacement field of weather values in or around the region of the gridded image, analyzing the motion of the hail area and refining the weather forecast based on the motion of the hail area.

[0098] According to another embodiment, method **320** further comprises determining whether a weather radar signature in the gridded image at the particular position at the given time corresponds to a hail observation, and based on this determination, the weather value may be changed and/or a confidence score of the weather value may be calculated.

[0099] Using contributions from observers in weather forecast

[00100] Briefly stated, the present embodiments describe a system and method for reporting to a user who has made a contribution to the calculation of a forecast how many other people have benefited from his contribution.

[00101] A user makes an observation (observer) by indicating the position and time of a weather event that is transmitted to a computer making a forecast. The forecasting computer uses the observers' information to calculate forecasts for a period in the future.

[00102] Each request by a user to obtain a forecast is analyzed to generate a list of observers who have contributed to the users' forecast. Each observer is then made aware of the number of people (plus any other user characteristics) that have benefited from his observation.

[00103] A leaderboard may be constructed from this information. Observers may be compensated with awards, or status gains or badges based on the number of users impacted.

[00104] Now turning to Figure 4, there is shown a flow chart of a method **330** for using contributions from observers in a weather forecast according to an embodiment.

[00105] The method **330** comprises:

- obtaining weather-related observations from the observers, each observation being made at a particular position and at a given time (e.g., step **332**);

- using the weather-related observations from the observers for producing a future weather forecast for a user (e.g., step **334**);

- calculating statistics about the weather-related observations from the observers (e.g., step **336**); and

- sending to at least one of the observers a message comprising at least part of the statistics about the weather-related observations from at least one of the observers (e.g., step **338**).

[00106] According to another embodiment, method **330** further comprises saving the weather-related observations in a database.

[00107] According to another embodiment of method **330,** the step of calculating statistics comprises generating, from the weather-related observations, a selection of

the observers who have contributed to the future weather forecast for the user and the users who have benefited from the weather forecast.

[00108] According to another embodiment of method **330,** the step of calculating statistics comprises generating, from the weather-related observations and for one or more of the observers, a list of users for whom the observations of the one or more of the observers were used in producing the future weather forecast.

[00109] According to another embodiment of method **330,** the step of calculating statistics comprises generating, from the weather-related observations and for each of the observers, a reliability of observations made from respective observers.

[00110] According to another embodiment of method **330,** the step of calculating statistics comprises generating, from the weather-related observations and from at least one of the number of observations and the reliability of observations, an ordered list of the observers.

[00111] According to another embodiment, method **330** further comprises providing an advantage to at least one of the observers based on the ordered list.

[00112] Now turning to Figures 5A to 5D, there are shown screen-shots of an application used for presenting weather forecast, and for obtaining point observations from observers according to an embodiment.

[00113] More specifically, Figure 5A is a screen-shot of a nowcasting application. The screen-shot shows an "eye" icon in the top right-hand corner. The "eye" icon is an indication to the user that an observation may be input into the system. Selecting the "eye" icon brings up the point observations pages (see Figures 5B and 5C).

[00114] Figures 58 and 5C are screen-shots of pages of the nowcasting application which provides choices to the observer for making a point observation.

[00115] Figure 5D is a screen-shot showing that "Sunny" is selected. The "Submit" button is now activated since a selection of a point observation has been made. Once the "Submit" button is selected, a confirmation page may be provided to

confirm the observer's selection. Once confirmed, the point observation is sent to the nowcaster.

[00116] Figure 6 is an example of a network environment in which the embodiments may be practiced. The system **200** (e.g., "nowcaster") may be implemented on a server/computer **250** which is accessible by a plurality of client computers **252** over a telecommunications network **254.** The client computers may include but are not limited to: laptops, desktops, portable computing devices, tablets and the like. Using a client computer **252,** each user may specify the time interval for which they want to receive the nowcasts and the location for which the nowcasts are needed. For example, the user may enter the ZIP/postal code, address, location on a map or the latitude and longitude of the location for which the nowcasts are needed, along with the time interval over which the nowcasts are needed. The time interval may extend between one minute and several hours.

[00117] Upon receiving the location information and time information, the server **250** may receive the available weather values for the specified location, and output the different PTypeRates discussed above which represent the nowcasts for the specific location over the specified period. Accuracy of the nowcasts may also depend on the number of weather sources available for a certain area. For example, an area that is highly populated may include more weather radars and more media attention (and thus more satellite coverage or forecasts) than a remote area in a forest. The nowcaster may also output other types of weather information such as weather events.

[00118] The PTypeRates produced by the server **250** may then be sent to the client computer **252** for display to the user. In an embodiment, it is possible to display the PTypeRates in a series, one after the other, or display those having a higher percentage.

[00119] Hardware and operating environment

[00120] Figure 7 illustrates an exemplary diagram of a suitable computing operating environment in which embodiments of the claimed subject matter may be

practiced. The following description is associated with Figure 5 and is intended to provide a brief, general description of suitable computer hardware and a suitable computing environment in conjunction with which the embodiments may be implemented. Not all the components are required to practice the embodiments, and variations in the arrangement and type of the components may be made without departing from the spirit or scope of the embodiments.

[00121] Although not required, the embodiments are described in the general context of computer-executable instructions, such as program modules, being executed by a computer, such as a personal computer, a handheld or palm-size computer, smartphone, or an embedded system such as a computer in a consumer device or specialized industrial controller. Generally, program modules include routines, programs, objects, components, data structures, etc., that perform particular tasks or implement particular abstract data types.

[00122] Moreover, those skilled in the art will appreciate that the embodiments may be practiced with other computer system configurations, including handheld devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCS, minicomputers, mainframe computers, cellular telephones, smartphones, display pagers, radio frequency (RF) devices, infrared (IR) devices, Personal Digital Assistants (PDAs), laptop computers, wearable computers, tablet computers, a device of the iPod or iPad family of devices, integrated devices combining one or more of the preceding devices, or any other computing device capable of performing the methods and systems described herein. The embodiments may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

[00123] The exemplary hardware and operating environment of Figure 5 includes a general-purpose computing device in the form of a computer **720**, including a processing unit **721**, a system memory **722**, and a system bus **723** that operatively

couples various system components, including the system memory, to the processing unit **721**. There may be only one or there may be more than one processing unit **721**, such that the processor of computer **720** comprises a single central-processing unit (CPU), or a plurality of processing units, commonly referred to as a parallel processing environment. The computer **720** may be a conventional computer, a distributed computer, or any other type of computer; the embodiments are not so limited.

[00124] The system bus **723** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. The system memory may also be referred to as simply the "memory," and includes read-only memory (ROM) **724** and random access memory (RAM) **725**. A basic input/output system (BIOS) 726, containing the basic routines that help to transfer information between elements within the computer **720**, such as during start-up, is stored in ROM **724**. In one embodiment of the claimed subject matter, the computer **720** further includes a hard disk drive **727** for reading from and writing to a hard disk, not shown, a magnetic disk drive **728** for reading from or writing to a removable magnetic disk **729**, and an optical disk drive **730** for reading from or writing to a removable optical disk **731** such as a CD ROM or other optical media. In alternative embodiments of the claimed subject matter, the functionality provided by the hard disk drive **727**, magnetic disk **729** and optical disk drive **730** is emulated using volatile or non-volatile RAM in order to conserve power and reduce the size of the system. In these alternative embodiments, the RAM may be fixed in the computer system, or it may be a removable RAM device, such as a compact flash memory card.

[00125] In an embodiment of the claimed subject matter, the hard disk drive **727**, magnetic disk drive **728** and optical disk drive **730** are connected to the system bus **723** by a hard disk drive interface **732**, a magnetic disk drive interface **733** and an optical disk drive interface **734**, respectively. The drives and their associated computer-readable media provide non-volatile storage of computer-readable

instructions, data structures, program modules and other data for the computer **720**. It should be appreciated by those skilled in the art that any type of computer-readable media which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, random access memories (RAMs), read-only memories (ROMs) and the like, may be used in the exemplary operating environment.

[00126] A number of program modules may be stored on the hard disk, magnetic disk **729**, optical disk **731**, ROM **724** or RAM **725**, including an operating system **735**, one or more application programs **736**, other program modules **737** and program data **738**. A user may enter commands and information into the personal computer **720** through input devices such as a keyboard **740** and pointing device **742**. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, touch-sensitive pad or the like. These and other input devices are often connected to the processing unit **721** through a serial port interface **746** that is coupled to the system bus, but may be connected by other interfaces, such as a parallel port, game port or a universal serial bus (USB). In addition, input to the system may be provided by a microphone to receive audio input.

[00127] A monitor **747** or other type of display device is also connected to the system bus **723** via an interface, such as a video adapter **748**. In one embodiment of the claimed subject matter, the monitor comprises a liquid crystal display (LCD). In addition to the monitor, computers typically include other peripheral output devices (not shown), such as speakers and printers. The monitor may include a touch-sensitive surface which allows the user to interface with the computer by pressing on or touching the surface.

[00128] The computer **720** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **749**. These logical connections are achieved by a communication device coupled to or a part of the computer **720**; the embodiment is not limited to a particular type of communications device. The remote computer **749** may be another computer, a server,

a router, a network PC, a client, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **720**, although only a memory storage device **750** has been illustrated in Figure 6. The logical connections depicted in Figure 6 include a local-area network (LAN) **751** and a wide-area network (WAN) **752**. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

[00129] When used in a LAN-networking environment, the computer **720** is connected to the local network **751** through a network interface or adapter **753**, which is one type of communications device. When used in a WAN-networking environment, the computer **720** typically includes a modem **754**, a type of communications device or any other type of communications device for establishing communications over the wide area network **752**, such as the Internet. The modem **754**, which may be internal or external, is connected to the system bus **723** via the serial port interface **746**. In a networked environment, program modules depicted relative to the personal computer **720**, or portions thereof, may be stored in the remote memory storage device. It is appreciated that the network connections shown are exemplary and other means of and communications devices for establishing a communications link between the computers may be used.

[00130] The hardware and operating environment in conjunction with which embodiments of the claimed subject matter may be practiced has been described. The computer in conjunction with which embodiments of the claimed subject matter may be practiced may be a conventional computer, a handheld or palm-size computer, a computer in an embedded system, a distributed computer or any other type of computer; the claimed subject matter is not so limited. Such a computer typically includes one or more processing units as its processor, and a computer-readable medium such as a memory. The computer may also include a communications device such as a network adapter or a modem, so that it is able to communicatively couple other computers.

[00131] While preferred embodiments have been described above and illustrated in the accompanying drawings, it will be evident to those skilled in the art that modifications may be made without departing from this disclosure. Such modifications are considered as possible variants comprised in the scope of the disclosure.

CLAIMS:

1. A computer-implemented method, comprising:

receiving, from a remote device, weather-related observation data associated with a first location and a first time, the weather-related observation data comprising data obtained from observing a weather-related event associated with the first location and the first time,

generating a weather forecast associated with a second location and a second time based on the weather-related observation data, and

outputting the weather forecast to the remote device.

2. The method of claim 1, comprising forming an image of the second location, the image comprising pixels associated with weather forecast values.

3. The method of claim 2, comprising forming at least two images of the second location, each of the at least two images being associated with a different time.

4. The method of any of claims 1-3, wherein the weather-related event comprises at least one of hail, wind, lightening, temperature, precipitation and intensity of sunlight.

5. The method of claim 2 or 3, comprising modifying a weather forecast value associated with a pixel based on the weather-related observation data.

6. The method of any of claims 1-5, wherein the weather-related event is observed by a user operating the remote device, and the user causes the remote device to transmit the weather-related observation data.

7. The method any of claims 1-6, wherein the remote device automatically transmits weather-related observation data upon detecting an observation of a weather-related event.

8. The method of any of claims 1-7, comprising:

receiving, from a second remote device, second weather-related observation data associated with a third location and a third time, the second weather-related observation data comprising data obtained from observing a weather-related event associated with the third location and the third time,

wherein the weather forecast associated with the second location and the second time is generated based on both the weather-related observation data associated with the first location and the first time and the second weather-related observation data associated with the third location and the third time.

9. The method of any of claims 1-8, comprising:

storing the received weather-related observation data,

producing a statistic associated with the stored weather-related observation data, the statistic comprising information indicative of a number of remote devices that have received the weather forecast, and

outputting at least part of the statistic to the remote device.

10. The method of any of claims 1-9, comprising:

comparing the weather-related observation data with pre-stored weather data, and

determining, based on the comparison, a weight associated with the weather-related observation data .

11. The method of any of claims 1-10, comprising:

producing a trust rating associated with the remote device, and

determining, based on the trust rating, a weight associated with the weather-related observation data received from the remote device.

12. A device for refining a weather forecast using a point observation, comprising:

one or more processors,

a memory that stores instructions for the one or more processors, and

a communication module to connect to a remote device via a communication network,

wherein when the one or more processors execute the instructions stored in the memory, the device is caused to:

receive, from the remote device, weather-related observation data associated with a first location and a first time, the weather-related observation data comprising data obtained from observing a weather-related event in the first location at the first time,

generate a weather forecast in a second location at a second time based on the weather-related observation data, and

output the weather forecast to the remote device.

13. The device of claim 12, wherein the device is caused to form an image of a second location, the image comprising pixels associated with weather forecast values.

14. The device of claim 13, wherein the device is caused to form at least two images of the second location, and each of the at least two image is associated with a different time.

15. The device of any of claims 12-14, wherein the weather-related event is observed by a user operating the remote device, and the user causes the remote device to transmit the weather-related observation data.

16. The device of any of claims 12-15, wherein the remote device automatically transmits, to the device, weather-related observation data upon detecting an observation of a weather-related event.

17. The device of any of claims 12-16, wherein the device is caused to:

receive, from a second remote device, second weather-related observation data associated with a third location and a third time, the weather-related observation data comprising data obtained from observing a weather-related event in the third location at the third time,

wherein the weather forecast in the second location at the second time is generated based on both the weather-related observation data associated with the first location and the first time and the second weather-related observation data associated with the third location and the third time.

18. The device of any of claims 12-17, wherein the device is caused to:

store the received weather-related observation data,

produce a statistic about the stored weather-related observation data, the statistic comprising information indicative of a number of remote devices that have received the weather forecast, and

output at least part of the statistic to the remote device.

19. The device of any of claims 12-18, wherein the device is caused to:

compare the weather-related observation data with pre-stored weather data,

assign a trust rating associated with the remote device, and

determine, based on the comparison and the trust rating, a weight associated with the weather-related observation data, received from the remote device.

20. A system comprising a server and a remote device that is connected to the server over a communication network, wherein:

the server comprises one or more processors and a non-transitory computer readable medium storing a program causing the one or more processors to execute a weather forecast refining process, the weather forecast refining process comprising:

receiving, from a remote device, weather-related observation data associated with a first location and a first time, the weather-related observation data comprising data obtained from observing a weather-related event in the first location at the first time,

generating a weather forecast in a second location at a second time based on the weather-related observation data, and

outputting the weather forecast to the remote device, and

the remote device comprises a computer, a display and a non-transitory computer memory storing a program causing the computer to execute a process comprising:

obtaining the weather forecast outputted from the server over the communication network, and

causing, on the display, a display of at least part of the weather forecast.

21. A method for refining a weather forecast, the method comprising:

obtaining weather-related observations at a particular position and at a given time, and

using the weather-related observations in forming a gridded image of a particular area on Earth, the gridded image comprising pixels wherein each pixel has a value which corresponds to a weather value which in turn corresponds to a weather forecast,

wherein forming a gridded image comprises forming multiple gridded images, each gridded image corresponds to a moment in time.

22. A method for forecasting a presence of weather-related events at a particular position at a given time, the method comprising:

obtaining a weather-related observation of a weather-related event at the particular position and at the given time,

changing or confirming a weather value in a gridded image based on the weather-related observation, and

producing a weather forecast using the changed or confirmed weather value.

23. A method for using contributions from observers in a weather forecast, the method comprising:

obtaining weather-related observations from the observers, each observation being made at a particular position and at a given time,

using the weather-related observations from the observers in the production a future weather forecast for a user,

calculating statistics about the weather-related observations from the observers, weather forecasts and users that have benefited from the observations, and

sending to at least one of the observers a message comprising at least part of the statistics about the weather-related observations from at least one of the observers.

24. A device for displaying a weather forecast refined using a point observation, comprising:

one or more processors,

a memory storing instructions for the one or more processors,

a communication module to connect to a remote server over a communication network, and

a display,

wherein when the one or more processors execute the instructions stored in the memory, the device is caused to:

receive, from the remote server, a weather forecast, the weather forecast being associated with a first location and a first time and generated by the remote server based at least on weather-related observation data, wherein the weather-related observation data comprises data obtained from observing a weather-related event in a second location at a second time, and

cause, on the display, a display of at least a part of the weather forecast received from the remote server.

25. A non-transitory computer readable medium storing instructions of any of claims 1-11 and 21-23.

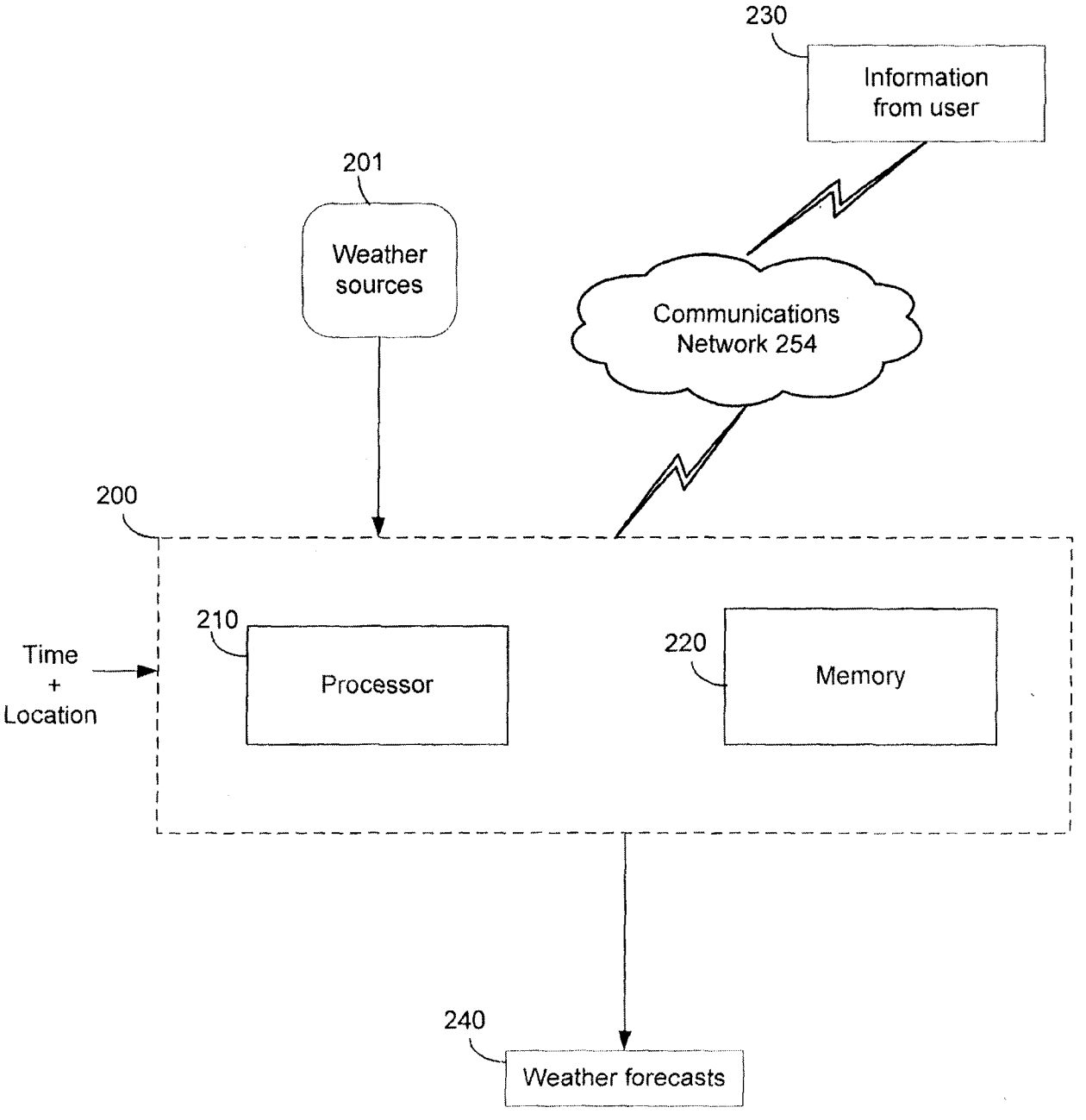
230
Information from user
201
Weather sources
Communications Network 254
200
210
Processor
220
Memory
Time + Location
240
Weather forecasts

FIGURE 1A

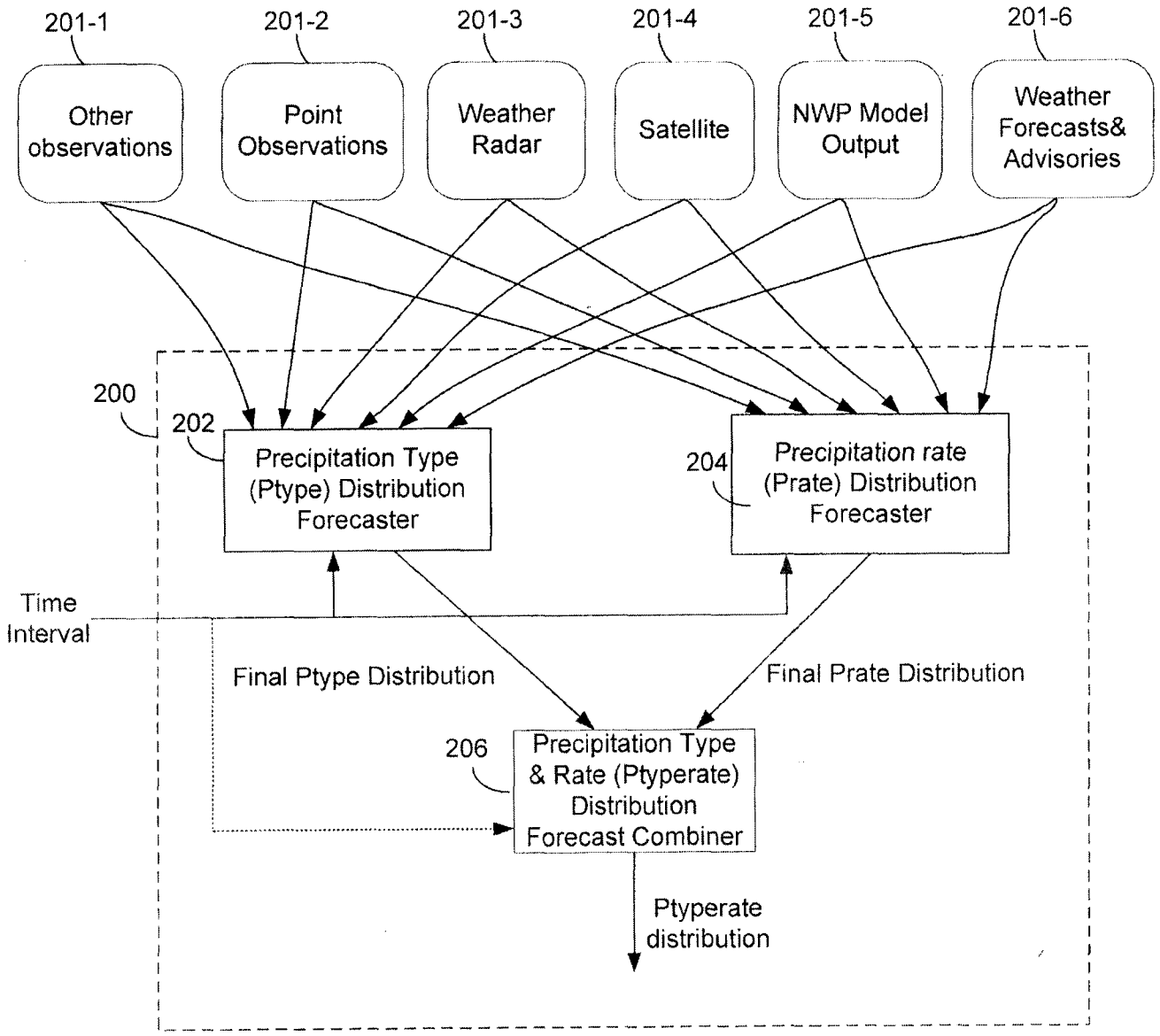
201-1
201-2
201-3
201-4
201-5
201-6
Other observations
Point Observations
Weather Radar
Satellite
NWP Model Output
Weather Forecasts& Advisories
200
202
Precipitation Type (Ptype) Distribution Forecaster
204
Precipitation rate (Prate) Distribution Forecaster
Time Interval
Final Ptype Distribution
Final Prate Distribution
206
Precipitation Type & Rate (Ptyperate) Distribution Forecast Combiner
Ptyperate distribution

FIGURE 1B

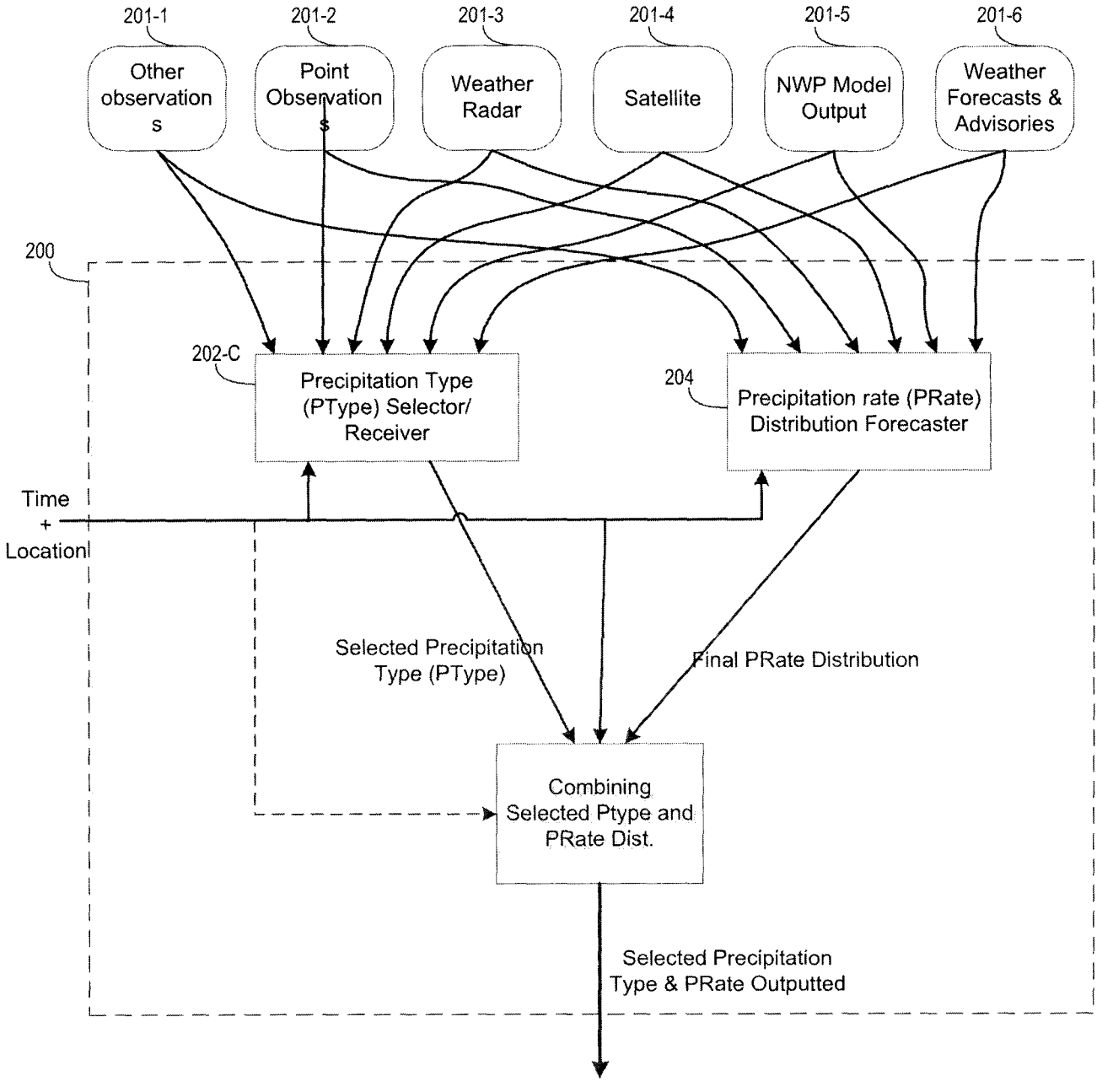
201-1
Other observation s
201-2
Point Observation s
201-3
Weather Radar
201-4
Satellite
201-5
NWP Model Output
201-6
Weather Forecasts & Advisories
200
202-C
Precipitation Type (PType) Selector/ Receiver
204
Precipitation rate (PRate) Distribution Forecaster
Time + Location
Selected Precipitation Type (PType)
Final PRate Distribution
Combining Selected Ptype and PRate Dist.
Selected Precipitation Type & PRate Outputted

FIGURE 1C

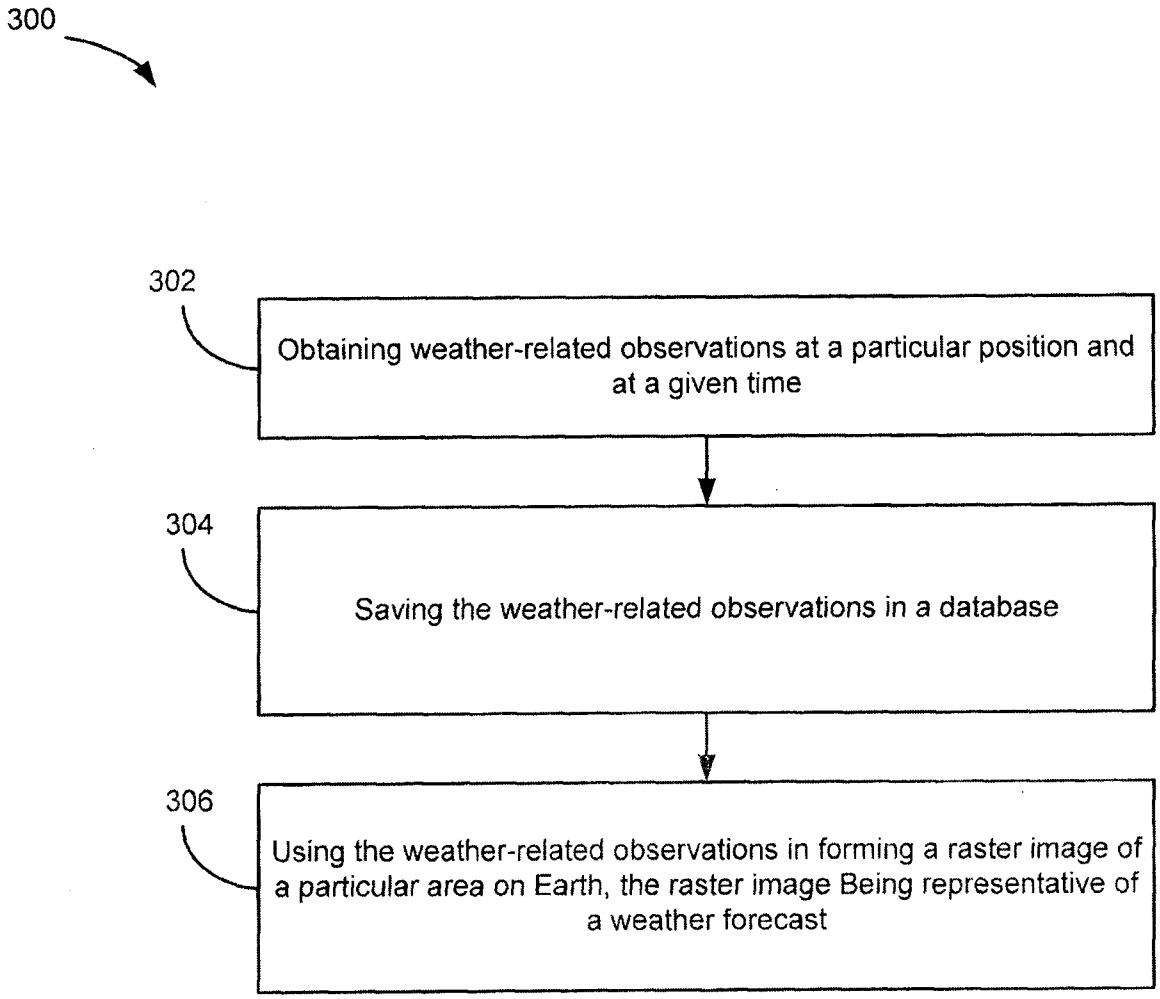
300
302
Obtaining weather-related observations at a particular position and at a given time
304
Saving the weather-related observations in a database
306
Using the weather-related observations in forming a raster image of a particular area on Earth, the raster image Being representative of a weather forecast

FIGURE 2

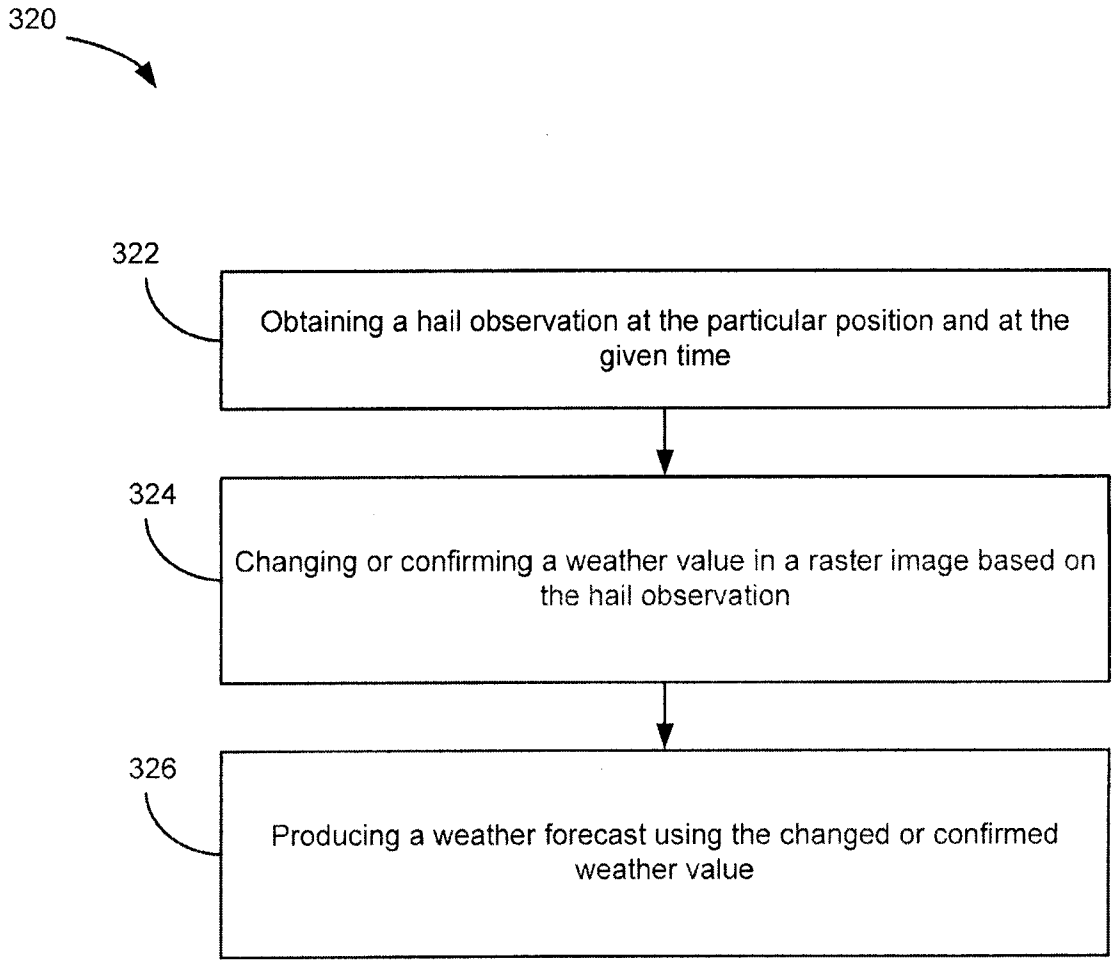
320
322
Obtaining a hail observation at the particular position and at the given time
324
Changing or confirming a weather value in a raster image based on the hail observation
326
Producing a weather forecast using the changed or confirmed weather value

FIGURE 3

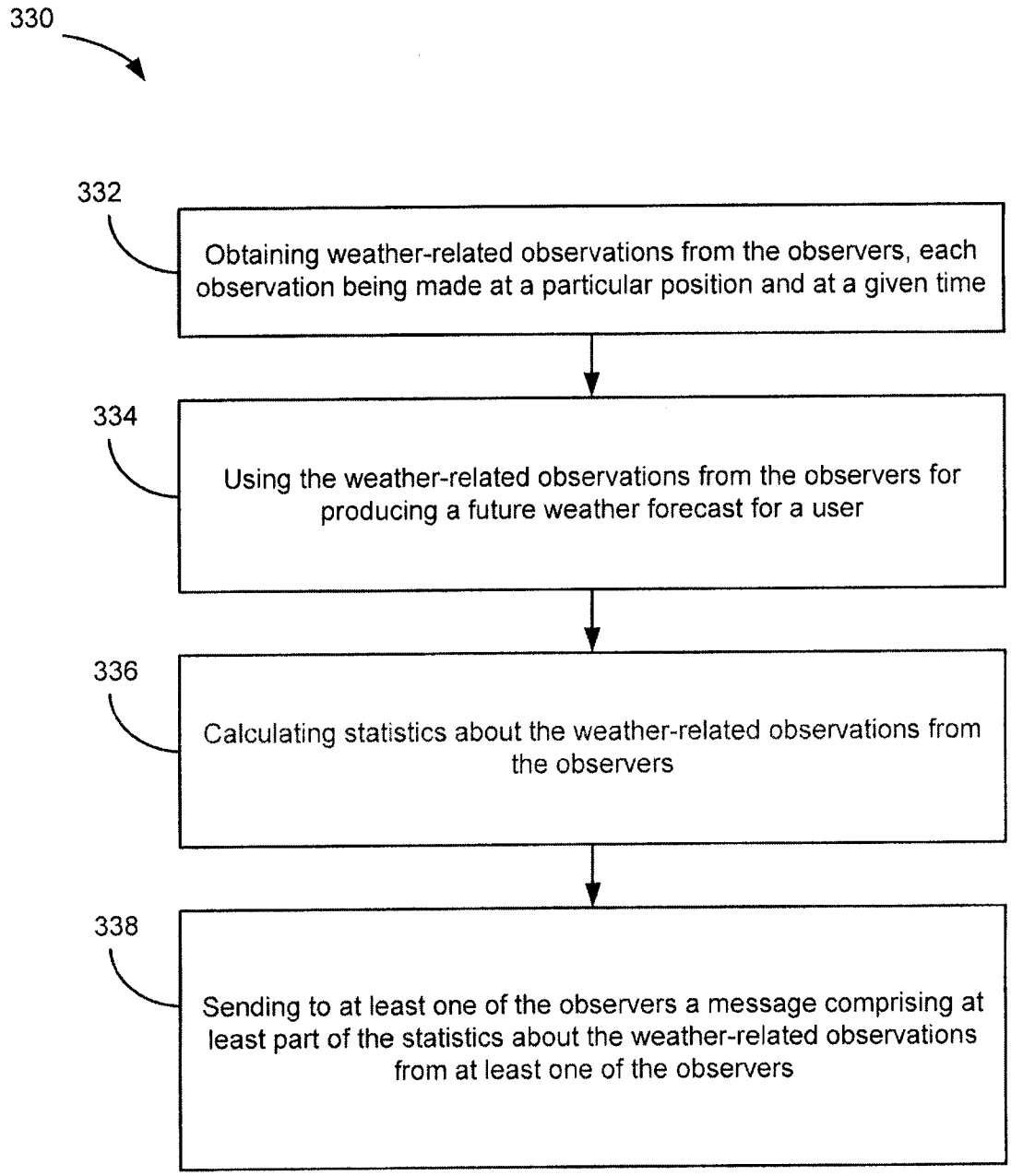
330
332
Obtaining weather-related observations from the observers, each observation being made at a particular position and at a given time
334
Using the weather-related observations from the observers for producing a future weather forecast for a user
336
Calculating statistics about the weather-related observations from the observers
338
Sending to at least one of the observers a message comprising at least part of the statistics about the weather-related observations from at least one of the observers

FIGURE 4

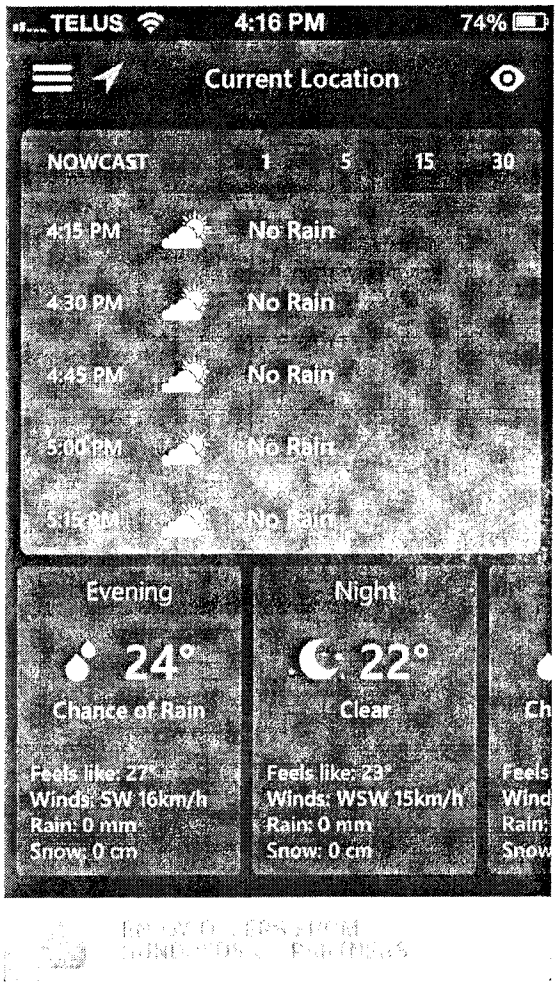

FIGURE 5A

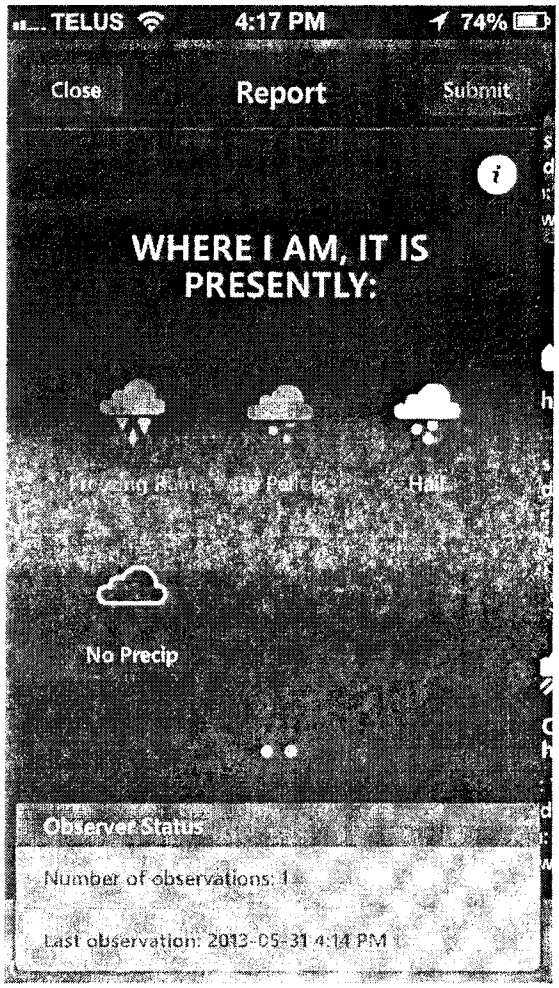

FIGURE 5B

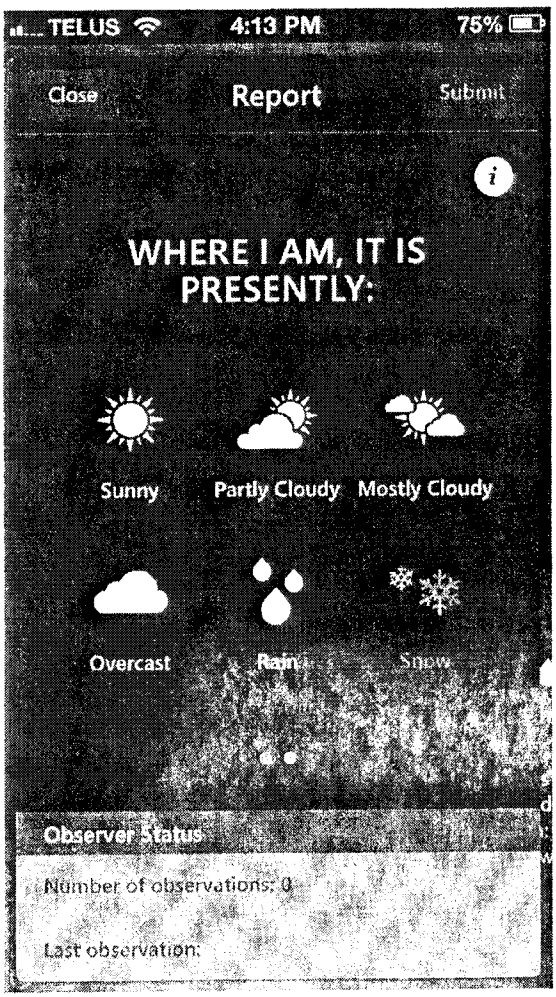

FIGURE 5C

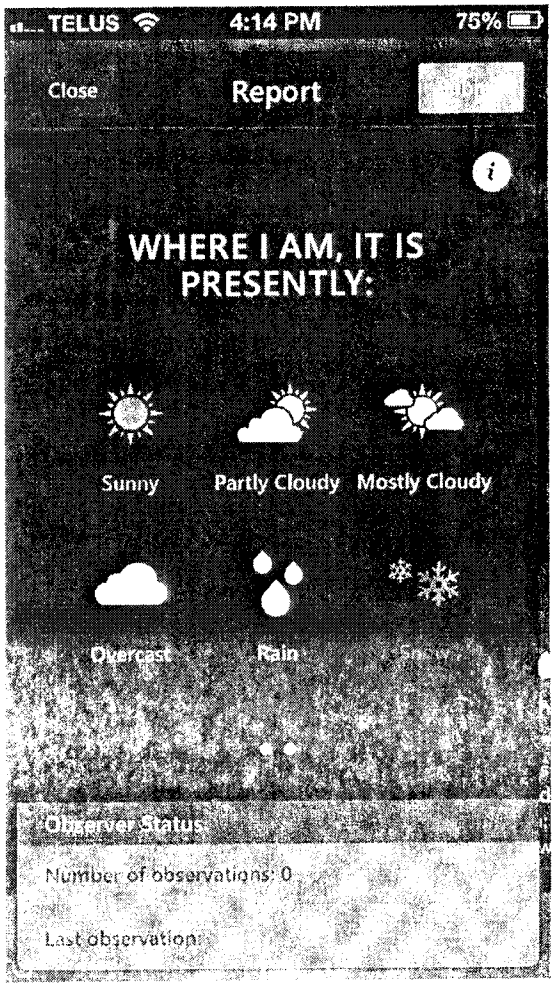

FIGURE 5D

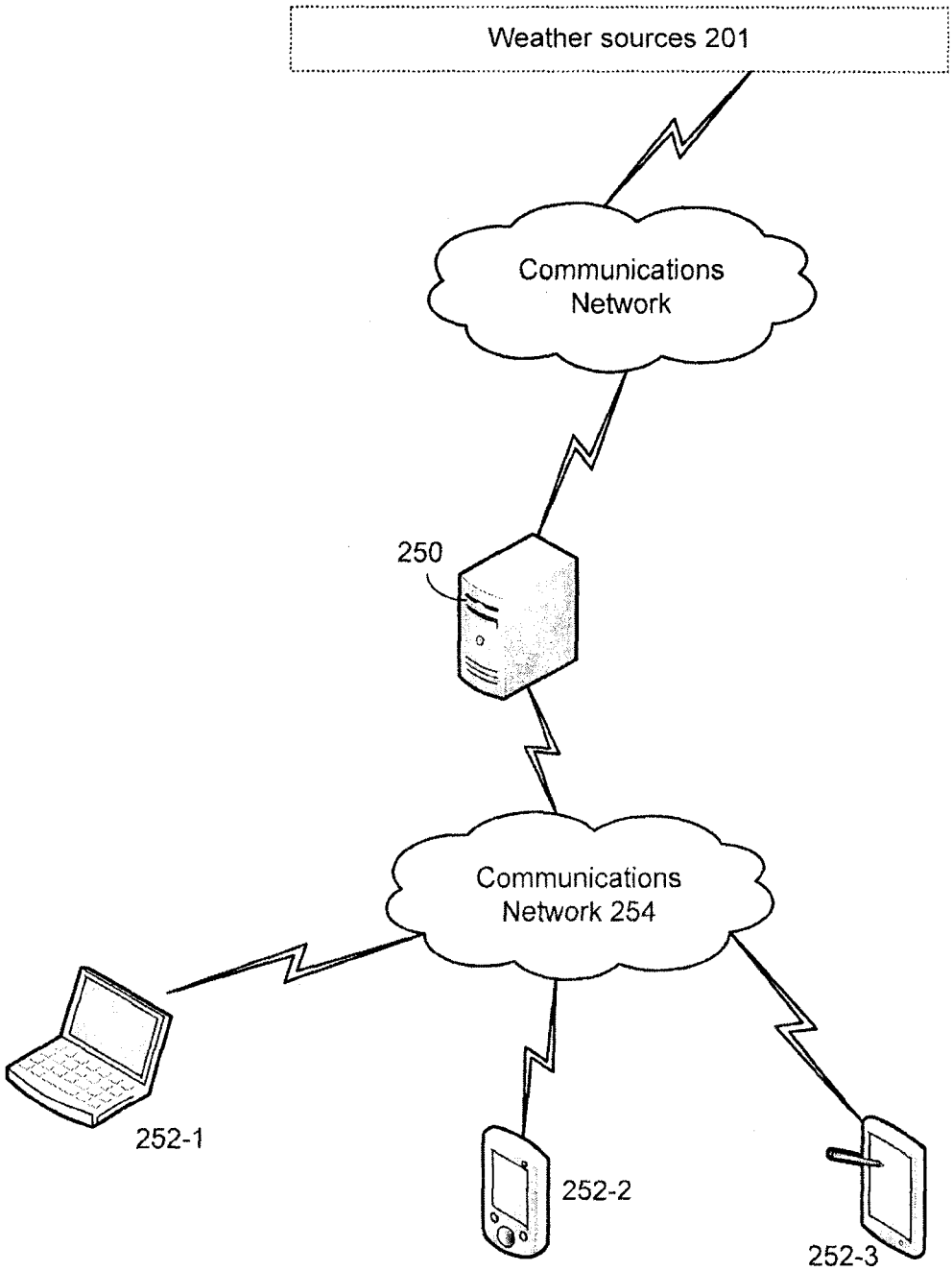
Weather sources 201
Communications Network
250
Communications Network 254
252-1
252-2
252-3

FIGURE 6

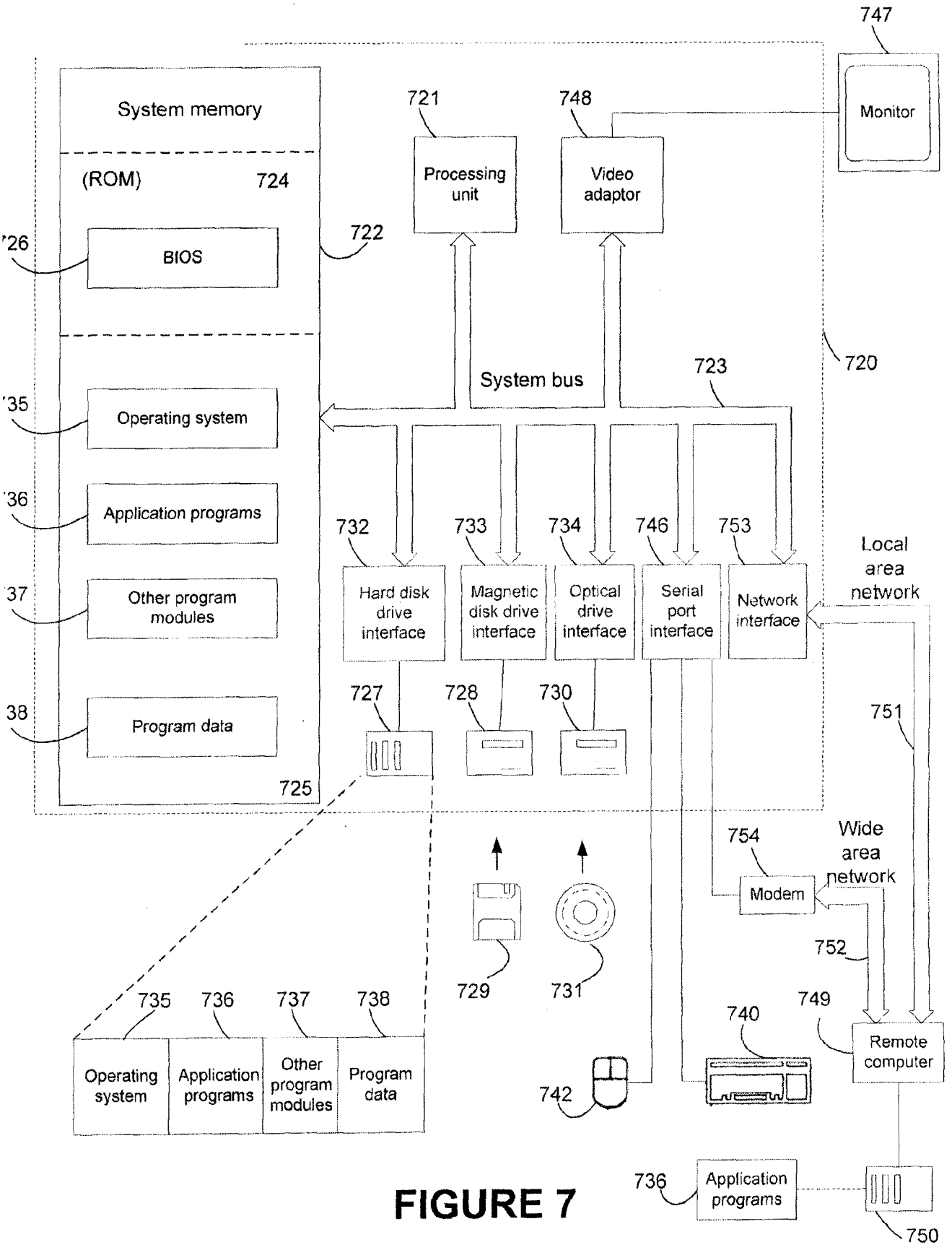
747
Monitor
721
Processing unit
748
Video adaptor
System memory
(ROM)
724
726
BIOS
722
720
System bus
723
735
Operating system
736
Application programs
737
Other program modules
738
Program data
725
732
Hard disk drive interface
733
Magnetic disk drive interface
734
Optical drive interface
746
Serial port interface
753
Network interface
Local area network
727
728
730
751
754
Modem
Wide area network
752
729
731
749
740
Remote computer
742
736
Application programs
750
Operating system
Application programs
Other program modules
Program data

FIGURE 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2014/000333

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***G01W 1/10*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***G01W 1/10*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Canadian Patent Database, TotalPatent, Google
keywords: weather, forecast, cell or mobile or cellular, nowcast, station, user input

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	"Weather forecasting" Wikipedia.org, version published March 12, 2013 found from web archive at https://web.archive.org/web/20130312014022/http://en.wikipedia.org/wiki/Weather_forecasting • see whole document	1 to 8, 12 to 17, 20, 24 and 25 9 and 18
X	US 7 542 852 Rose and al. 2 June 2009 (02-06-2009) • see whole document	1 to 5, 7 to 10, 12 to 14, 16, 17, 19, 20, 24 and 25
Y		9 and 18
A	US 6 298 307 Murphy et al. 2 October 2001 (02-10-2001) • see whole document	1 to 20, 24 and 25
A	US 2004/0010372 Schwoegler 15 January 2004 (15-01-2004) • see whole document	1 to 20, 24 and 25

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
	document published prior to the international filing date but later than
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

Date of the actual completion of the international search 15 July 2014 (15-07-2014)	Date of mailing of the international search report 21 July 2014 (21-07-2014)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Wendy Stewart (819) 934-2674

Box No. II **Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III **Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

Group A - Claims 1 to 20 and 24 are directed to a method, device and system for generating or refining weather forecast, the method including obtaining observation data at a first location and a first time, generating a weather forecast for a second location and a second time based on the observation data and outputting the weather forecast to a remote device;

Group B - Claims 21 and 22 are directed to a method for forecasting a weather-related event, including obtaining weather-related observations, and using the observation to form a gridded image where the pixels are values that corresponds to a weather value. claim 22 relates to changing or confirming the weather values in the gridded image based on observations; and

Group C – Claim 23 is directed to a method for using contributions from observers in a weather forecast, the method comprising obtaining weather-related observations, using the observations in the production of a future weather forecast for a user, calculating statistics about the observations and sending at least part of the statistics to an observer.

Claim 25 can be included in any one of the groups, the ISR and Written Opinion will include claim 25 with the claims of group A.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:

4. ☑ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:
1 to 20, 24 and 25

Remark on Protest

☐ The additional search fees were accompanied by the applicant□s protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2014/000333

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US7542852B1	02 June 2009 (02-06-2009)	US7542852B1	02 June 2009 (02-06-2009)
		US7082382B1	25 July 2006 (25-07-2006)
		US7200491B1	03 April 2007 (03-04-2007)
US6298307B1	02 October 2001 (02-10-2001)	None	
US2004010372A1	15 January 2004 (15-01-2004)	US2004010372A1	15 January 2004 (15-01-2004)
		AU2002239694B2	07 June 2007 (07-06-2007)
		CA2472187A1	11 July 2002 (11-07-2002)
		EP1405108A2	07 April 2004 (07-04-2004)
		EP1405108A4	09 November 2005 (09-11-2005)
		NZ544971A	29 June 2007 (29-06-2007)
		US2001030624A1	18 October 2001 (18-10-2001)
		US6590529B2	08 July 2003 (08-07-2003)
		WO02054113A2	11 July 2002 (11-07-2002)
		WO02054113A3	08 January 2004 (08-01-2004)