Comments from Public Consultation on ECV Requirements 13/01 – 13/03 2020 for:

# Surface Water Vapour

## ECV Product: Dew Point Temperature near Surface

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| --- | --- | --- | --- | --- | --- |
| **Name** | Dew Point Temperature near Surface | | | | |
| **Definition** | Temperature to which air must be cooled to become saturated with water vapor  at a known height  above surface, with the height specified in the metadata | | | | |
| **Unit** | K | | | | |
| **Note** | Observations made over the ocean are not static, being mostly recorded by mobile ships and drifting buoys (Kent et al., 2019). Requirements for marine surface observations must therefore be defined in terms of the composite accuracy and sampling of the marine observing networks to achieve comparable uncertainty thresholds at similar resolution.  Willett et al show that spatial scales of surface humidity are comparable to those of temperature so the same horizontal resolution should be broadly applicable. | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| **Horizontal Resolution** | km |  | G | 10 | Willett et al. 2008 |
| B | 100 |
| T | 500 |
| **Vertical Resolution** | N/A |  | G | N/A | N/A |
| B | N/A | N/A |
| T | N/A | N/A |
| **Temporal Resolution** | hr |  | G | Sub-hourly |  |
| B | 1 |  |
| T | 3 |  |
| **Timeliness** |  |  | G | hourly |  |
| B | daily |  |
| T | monthly |  |
| **Required Measurement Uncertainty** | K |  | G | 0.1 |  |
| B | 0.5 |  |
| T | 1 |  |
| **Stability** | K/decade |  | G | 0.01 |  |
| B | 0.05 |  |
| T | 0.1 |  |
| **Standards and References** | Kent, E.C., Rayner, N.A., Berry, D.I., Eastman, R., Grigorieva, V.G., Huang, B., Kennedy, J.J., Smith, S.R. and Willett, K.M., 2019: Observing Requirements for Long-Term Climate Records at the Ocean Surface. Frontiers in Marine Science 6, Article 441, doi:10.3389/fmars.2019.00441.  Willett, K. M., P. D. Jones, et al. (2008). "Recent Changes in Surface Humidity: Development of the HadCRUH Dataset." Journal of Climate 21(20): 5364-5383, <http://dx.doi.org/10.1175/2008JCLI2274.1>. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** |  |  | Reviewers are invited to suggest answers for these fields | | |
| **Extremes[3]** |  |  | Reviewers are invited to suggest answers for these fields | | |

[1]Goal (G); Breakthrough (B) (not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 1

|  |  |
| --- | --- |
| Author: Bruce Ingleby | Email: bruce.ingleby@ecmwf.int |
| Measurement of near-surface humidity can be subject to various drifts and discontinuities according to the measurement technique used: mainly either a wet-bulb psychrometer or a capacitive humidity sensor. There is a long-term trend from the former to the latter partly linked to the automation of observing and probably a discontinuity in the record when the method changed. Capacitive sensors tend to drift to read higher values over a year or two - particularly in damp climates - so ideally one should know the make of sensor and when it was last changed. Reference measurements can be provided by by chilled-mirror instruments, but these are too expensive to use at most stations. See: Ingleby B., D. Moore, C. Sloan and R. Dunn, 2013: Evolution and accuracy of surface humidity reports,  Journal of Atmospheric and Oceanic Technology, 30, 2025-2043 doi: http://dx.doi.org/10.1175/JTECH-D-12-00232.1  BI | |

### Comment 2

|  |  |
| --- | --- |
| Author: Kate Willett | Email: kmwillett@gmail.com |
| This ECV could be of use for both adaptation and monitoring of extremes related to heat stress on humans and animals because high amounts of moisture in the air can exacerbate the impact of high temperatures. See the following references:  Dunn, R. J. H., N. Meade, K. M. Willett and D. E. Parker, 2014: Analysis of heat stress in UK dairy cattle and impact on milk yields. Environmental Research Letters, 9, 064006, doi:10.1088/1748-9326/9/6/064006.  Willett, K. W. and Sherwood, S., 2012: Exceedance of WBGT thresholds for 15 regions under a warming climate. IJOC, 32 (2), 161-177 DOI: 10.1002/joc.2257.  There are probably more recent human heat stress papers now. | |

### Comment 3

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| --- | --- |
| Author: Kate Willett | Email: kmwillett@gmail.com |
| The HadCRUH Willett et al reference is very old now and that dataset superceded by the HadISDH dataset papers:  Willett, K. M., Dunn, R. J. H., Thorne, P. W., Bell, S., de Podesta, M., Parker, D. E., Jones, P. D., and Williams Jr., C. N.: HadISDH land surface multi-variable humidity and temperature record for climate monitoring, Clim. Past, 10, 1983-2006, doi:10.5194/cp-10-1983-2014, 2014.  Willett, K. M., Williams Jr., C. N., Dunn, R. J. H., Thorne, P. W., Bell, S., de Podesta, M., Jones, P. D., and Parker D. E., 2013: HadISDH: An updated land surface specific humidity product for climate monitoring. Climate of the Past, 9, 657-677, doi:10.5194/cp-9-657-2013. | |

### Comment 4

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| --- | --- |
| Author: Abdullah Kahraman | Email: kahraman@meteogreen.com |
| Please see my comments on "Atmosphere -> Upper-air water vapour -> Specific Humidity in the Boundary Layer", which are relevant to this topic also. | |

### Comment 5

|  |  |
| --- | --- |
| Author: David Berry (NOC) | Email: david.inglis.berry@googlemail.com |
| I have made comments under the near surface air temperature. Those comments are also applicable here. | |

### Comment 6

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| Author: ECMWF | Email: ecresgcosreqs@gmail.com |
| To further support a previous comment from Kate Willett, I agree that the three products from this ECV are relevant for the monitoring of extremes and to support adaptation. High surface humidity can significantly enhance heat stress during summer heatwaves (e.g., Russo et al. 2017). On the other hand, low surface humidity has been shown to be an important contributor to, and precursor of, droughts and wildfires (e.g., Behrangi et al., 2015).  References:  Behrangi, A., P. Loikith, E. Fetzer, H. Nguyen, and S. Granger, 2015: Utilizing Humidity and Temperature Data to Advance Monitoring and Prediction of Meteorological Drought. Climate, 3, 999–1017, http://dx.doi.org/10.3390/cli3040999.  Russo, S., J. Sillmann, and A. Sterl, 2017: Humid heat waves at different warming levels. Sci. Rep., 7, 7477, https://doi.org/10.1038/s41598-017-07536-7.. | |

## ECV Product: Relative Humidity near Surface

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| --- | --- | --- | --- | --- | --- |
| **Name** | Relative Humidity near Surface | | | | |
| **Definition** | Relative humidity is the ratio of the amount of atmospheric moisture present relative to the amount that would be present if the air were saturated with respect to water or ice to be specified in the metadata | | | | |
| **Unit** | % | | | | |
| **Note** | Observations made over the ocean are not static, being mostly recorded by mobile ships and drifting buoys (Kent et al., 2019). Requirements for marine surface observations must therefore be defined in terms of the composite accuracy and sampling of the marine observing networks to achieve comparable uncertainty thresholds at similar resolution.  Willett et al show that spatial scales of surface humidity are comparable to those of temperature so the same horizontal resolution should be broadly applicable.  Relative humidity is generally derived from temperature and dewpoint temperature. It is important that the conversions be applied at the observation scale so as not to introduce both random and systematic effects into the analysis. Formulae to convert between the various water vapour metrics (Specific Humidity, Relative Humidity and Dewpoint are given in Willett et al. (2008). | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| **Horizontal Resolution** | km |  | G | 10 | Willett et al. 2008 |
| B | 100 |
| T | 500 |
| **Vertical Resolution** | N/A |  | G | N/A | N/A |
| B | N/A | N/A |
| T | N/A | N/A |
| **Temporal Resolution** | hr |  | G | Sub-hourly |  |
| B | 1 |  |
| T | 3 |  |
| **Timeliness** |  |  | G | hourly |  |
| B | daily |  |
| T | monthly |  |
| **Required Measurement Uncertainty** | % |  | G | 0.1 |  |
| B | 0.5 |  |
| T | 1 |  |
| **Stability** | %/decade |  | G | 0.01 |  |
| B | 0.05 |  |
| T | 0.1 |  |
| **Standards and References** | Kent, E.C., Rayner, N.A., Berry, D.I., Eastman, R., Grigorieva, V.G., Huang, B., Kennedy, J.J., Smith, S.R. and Willett, K.M., 2019: Observing Requirements for Long-Term Climate Records at the Ocean Surface. Frontiers in Marine Science 6, Article 441, doi:10.3389/fmars.2019.00441.  Willett, K. M., P. D. Jones, et al. (2008). "Recent Changes in Surface Humidity: Development of the HadCRUH Dataset." Journal of Climate 21(20): 5364-5383, <http://dx.doi.org/10.1175/2008JCLI2274.1>. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** |  |  | Reviewers are invited to suggest answers for these fields | | |
| **Extremes[3]** |  |  | Reviewers are invited to suggest answers for these fields | | |

[1]Goal (G); Breakthrough (B) (not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 1

|  |  |
| --- | --- |
| Author: Kate Willett | Email: kmwillett@gmail.com |
| I think we should remove the comment about spatial scales being similar to that of temperature. This is true for dew point temperature and specific humidity but not so for relative humidity. | |

### Comment 2

|  |  |
| --- | --- |
| Author: Kate Willett | Email: kmwillett@gmail.com |
| The comments made for dew point temperature regarding replacing the HadCRUH Willett et al reference with the HadISDH Willett et al references and potential for humidity being relevant to climate adaptation and for monitoring extremes are also relevant here. Relative humidity is directly relevant to human health. | |

### Comment 3

|  |  |
| --- | --- |
| Author: ECMWF | Email: ecresgcosreqs@gmail.com |
| Relative humidity can be used to monitor extremes and support adaptation. See my comment under Dew Point Temperature. | |

### Comment 4

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| --- | --- |
| Author: ECMWF | Email: ecresgcosreqs@gmail.com |
| For measurement uncertainty and stability, G/B/T seem to be excessively small compared to those stated for specific humidity. I would assume the relative order of magnitude of these requirements to be roughly similar for specific and relative humidity. For specific humidity, an uncertainty of 0.1 g/kg (as stated for G) would represent somewhere between 1% and 10% of the absolute measured value (closer to 10% over mid-latitude land, closer to 1% over ocean and humid tropical land areas). In comparison, an uncertainty of 0.1% is currently stated as G for relative humidity.  With this in mind, it may be advisable to relax the uncertainty and stability requirements for relative humidity and increase the current G/B/T by a factor of 10. For example, the new stability requirement goal (0.1%/decade) would represent about 10% of the observed trends over 10-year periods over most land areas as shown by Dunn et al. (2017). It would represent a larger fraction of the trends calculated over longer periods (e.g., 41 years in Willett et al., 2014), but more stringent requirements may not be achievable.  The new requirements would be as follows:  - Required measurement uncertainty: G=1%, B=5%, T=10%  - Stability: G=0.1%/dec, B=0.5%/dec, T=1%/dec  References:  Dunn, R. J. H., Willett, K. M., Ciavarella, A., and Stott, P. A.: Comparison of land surface humidity between observations and CMIP5 models, Earth Syst. Dynam., 8, 719–747, https://doi.org/10.5194/esd-8-719-2017, 2017.  Willett, K. M., Dunn, R. J. H., Thorne, P. W., Bell, S., de Podesta, M., Parker, D. E., Jones, P. D., and Williams Jr., C. N.: HadISDH land surface multi-variable humidity and temperature record for climate monitoring, Clim. Past, 10, 1983–2006, https://doi.org/10.5194/cp-10-1983-2014, 2014. | |

## ECV Product: Air Specific Humidity near Surface

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| --- | --- | --- | --- | --- | --- |
| **Name** | Air Specific Humidity near Surface | | | | |
| **Definition** | Air specific humidity at a known height above surface, with the height specified in the metadata. Specific humidity is the ratio of the mass of water vapour and the mass of moist air | | | | |
| **Unit** | g/kg | | | | |
| **Note** | Observations made over the ocean are not static, being mostly recorded by mobile ships and drifting buoys (Kent et al., 2019). Requirements for marine surface observations must therefore be defined in terms of the composite accuracy and sampling of the marine observing networks to achieve comparable uncertainty thresholds at similar resolution.  Willett et al show that spatial scales of surface humidity are comparable to those of temperature so the same horizontal resolution should be broadly applicable.  Specific humidity is generally derived from temperature and dewpoint temperature. It is important that the conversions be applied at the observation scale so as not to introduce both random and systematic effects into the analysis. Formulae to convert between the various water vapour metrics (Specific Humidity, Relative Humidity and Dewpoint are given in Willett et al. (2008).  Given the orders of magnitude variation in specific humidity between the tropics and the polar regions there is a strong case for latitudinally varying requirements for uncertainty and stability which would be more stringent in polar than extra-tropical than tropical climates. Current values are a compromise which may be indicative of extra-tropical locations. | | | | |
| **Requirements** | | | | | |
| **Item needed** | **Unit** | **Metric** | **[1]** | **Value** | **Derivation and References and Standards** |
| **Horizontal Resolution** | km |  | G | 10 | Willett et al. 2008 |
| B | 100 |
| T | 500 |
| **Vertical Resolution** | N/A |  | G | N/A | N/A |
| B | N/A | N/A |
| T | N/A | N/A |
| **Temporal Resolution** | hr |  | G | Sub-hourly |  |
| B | 1 |  |
| T | 3 |  |
| **Timeliness** |  |  | G | hourly |  |
| B | daily |  |
| T | monthly |  |
| **Required Measurement Uncertainty** | g/kg |  | G | 0.1 |  |
| B | 0.5 |  |
| T | 1 |  |
| **Stability** | g/kg/decade |  | G | 0.01 |  |
| B | 0.05 |  |
| T | 0.1 |  |
| **Standards and References** | Kent, E.C., Rayner, N.A., Berry, D.I., Eastman, R., Grigorieva, V.G., Huang, B., Kennedy, J.J., Smith, S.R. and Willett, K.M., 2019: Observing Requirements for Long-Term Climate Records at the Ocean Surface. Frontiers in Marine Science 6, Article 441, doi:10.3389/fmars.2019.00441.  Willett, K. M., P. D. Jones, et al. (2008). "Recent Changes in Surface Humidity: Development of the HadCRUH Dataset." Journal of Climate 21(20): 5364-5383, <http://dx.doi.org/10.1175/2008JCLI2274.1>. | | | | |
| **Adaptation and Extremes** | | | | | |
|  | Relevant? (Yes/No) | Sugg. Req. sufficient? (Yes/No) | Explanation | | |
| **Adaptation[2]** |  |  | Reviewers are invited to suggest answers for these fields | | |
| **Extremes[3]** |  |  | Reviewers are invited to suggest answers for these fields | | |

[1]Goal (G); Breakthrough (B) (not mandatory, more as one possible); Threshold (T), for definitions see [Guidelines](http://tiny.cc/ecv-review)

[2] Is the ECV Product directly relevant to support Climate Adaptation?

[3] Can the ECV Product be used to monitor climate extremes or aspects of extremes?

### Comment 1

|  |  |
| --- | --- |
| Author: Kate Willett | Email: kmwillett@gmail.com |
| See comments made for dew point temperature which are relevant here. | |

### Comment 2

|  |  |
| --- | --- |
| Author: David Berry (NOC) | Email: david.inglis.berry@googlemail.com |
| See comments made for near surface air temperature, they are also applicable here.  I would add an additional comment that the 1 g / kg uncertainty appears rather large. | |

### Comment 3

|  |  |
| --- | --- |
| Author: MRI Scnatweb | Email: mountainresearchinitiative@gmail.com |
| In mountain context specific humidity would be needed for instance for processes of orographic precipitation and runoff. Data needed on hourly resolution. Not enough in-situ measurements available - key data gap. Re-analyses are not necessarily realistic at least in mountain context.  Based on discussions and preliminary outcomes of the GEO GNOME workshop for identifying ECVs to monitor and understand mountain climate change. More information on the workshop here: LINK. | |

### Comment 4

|  |  |
| --- | --- |
| Author: ECMWF | Email: ecresgcosreqs@gmail.com |
| Specific humidity can be used for the monitoring of extremes and to support adaptation. See my comment under Dew Point Temperature. | |