

The Vaisala Interleaved Ensemble Map

Samu Karanko¹, Jaakko Hyvätti², Juha-Matti Tilli²

¹ Vaisala

² Foreca



AMS 100th Annual Meeting
Boston, MA | 12 – 16 Jan 2019



Introduction

We present an easy-to-implement ensemble map visualization, which overcomes some of the shortcomings of typical map based ensemble visualizations.

Plotting the ensemble as multiple small postage stamp maps is common but makes it difficult to compare the locations of weather phenomena between the ensemble members.

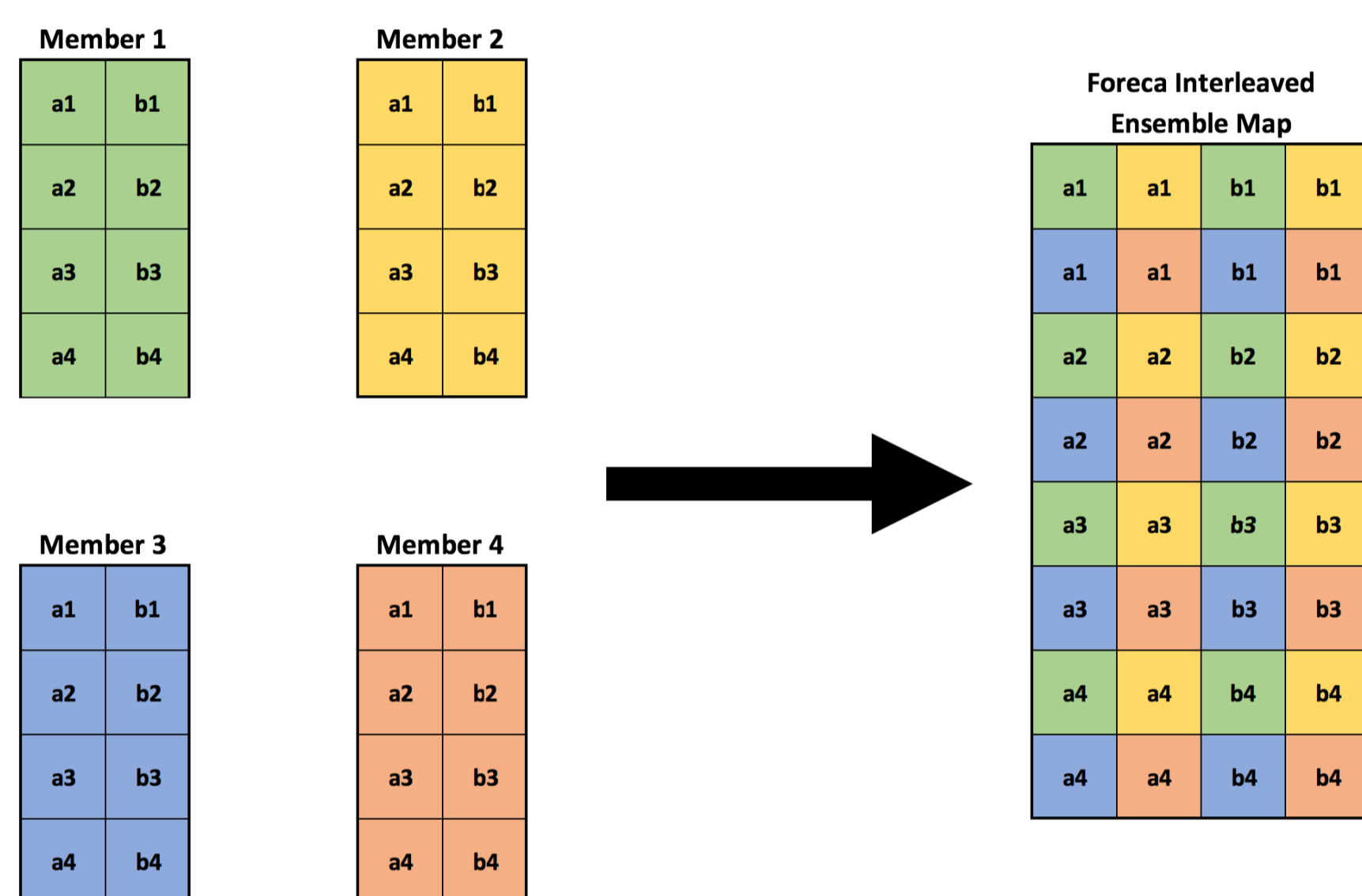
All plots of aggregated ensemble data end up hiding some details. For example, probability plots make it easy to see the likelihood of a phenomenon at any map location but require choosing a single threshold, such as temperature below zero. Choosing a threshold discards information about the other possible values a parameter may have. It also requires mental effort to think about weather in terms of probabilities, rather than in the familiar terms of weather parameters, such as temperature or precipitation.

Our map visualization interleaves the data from all ensemble members into a single image and is able to show multiple values of a parameter from all the ensemble members at the same time, without hiding any details.

The main advantages of the method are: an intuitive visualization of evolving uncertainty, possibility to use the same color schemes in both deterministic and ensemble plots, and the ease and high performance of implementation.

Method

First plot the individual ensemble members separately. Then interleave the individual pixels of each image as shown below for a four-member ensemble.



The method imposes some design constraints:

- Solid fill must be used for the data, i.e. no contour lines
- Data cannot be rendered as text or icons
- Solid fill works best for the background map, though it is not a requirement
- The number of plotted ensemble members must be a product of two similar integers, which for the ECMWF ENS (50+1 members) means:
 - Convenient values are $6 \times 9 = 54$ and $7 \times 8 = 56$
 - HRES or control could be included multiple times until the number of images suffices

In the taxonomy of ensemble visualizations by Wang et al. [1], this method would be classified as a Point-oriented Composition after Visualization.

Reference:

[1] J. Wang, S. Hazarika, C. Li, and H. W. Shen, "Visualization and visual analysis of ensemble data: A survey," *IEEE Transactions on Visualization and Computer Graphics*, 2018

Contact, Download

Email: Samu.Karanko@vaisala.com
URL: <https://www.vaisala.com/digital>
Post: Vaisala Digital, Keilaranta 19, 02150, Espoo, Finland

Source code (written in C, MIT license) for a program that interleaves PNG images can be found at the URL below.

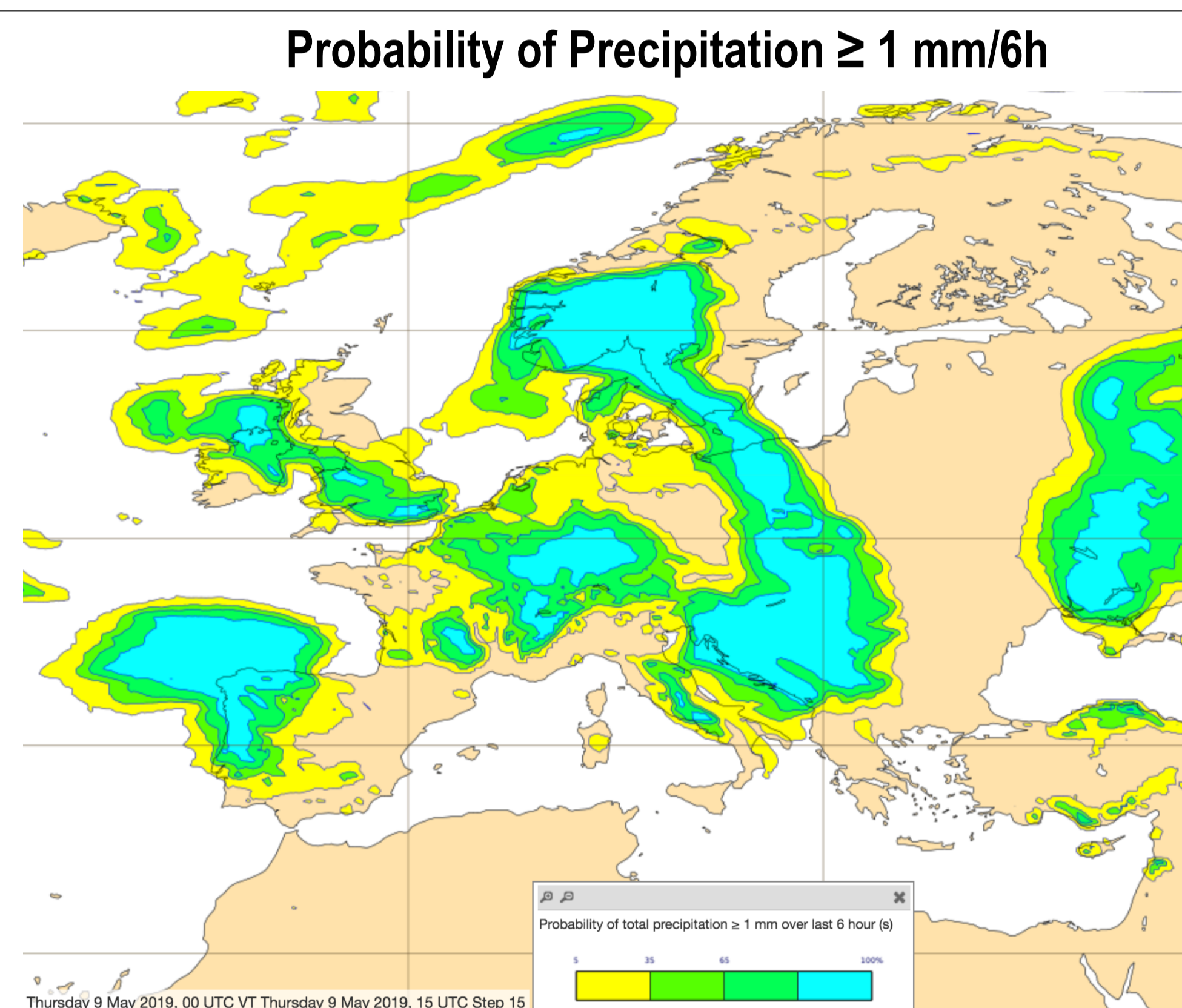
<https://demo.weather.vaisala.io/vaisala-ens-map.zip>



Comparison

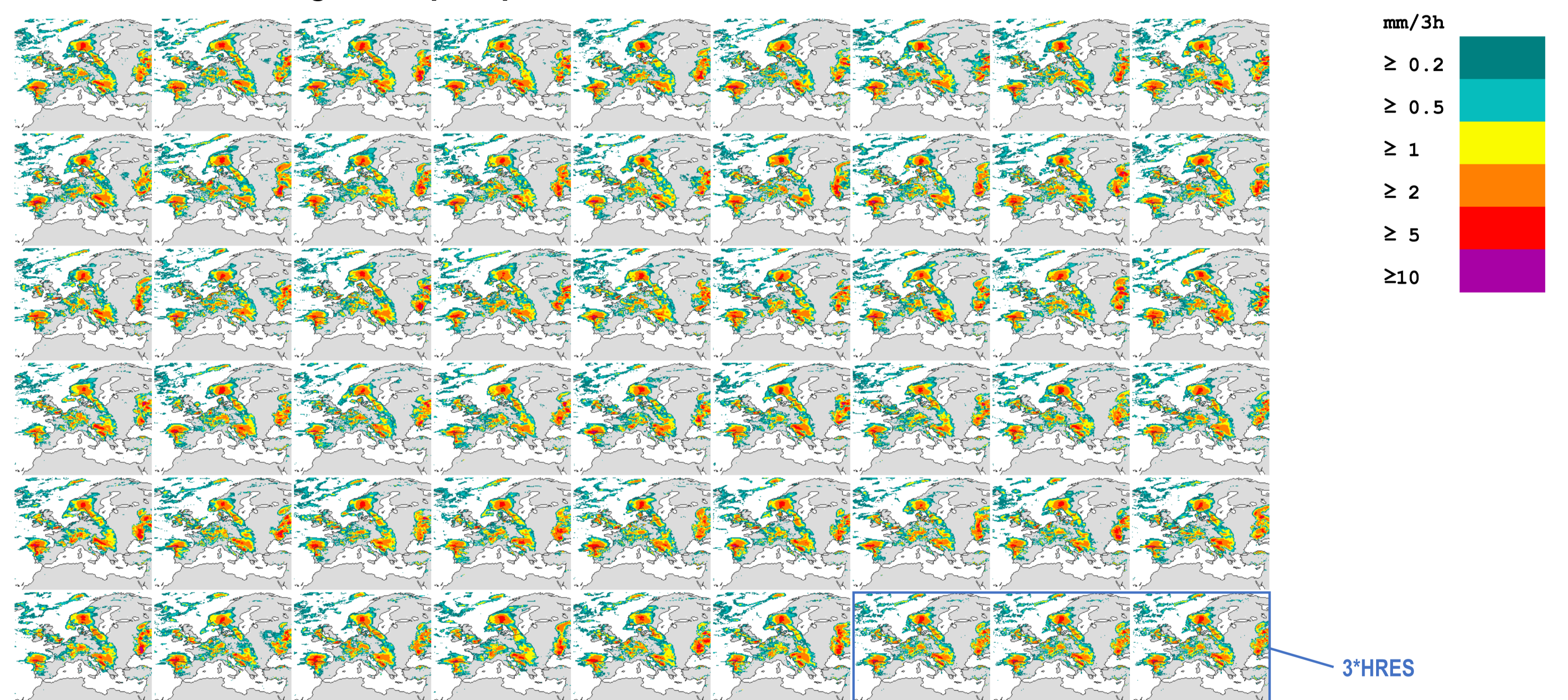
Using the plots below, try to answer the question:

How much precipitation is likely at location X?



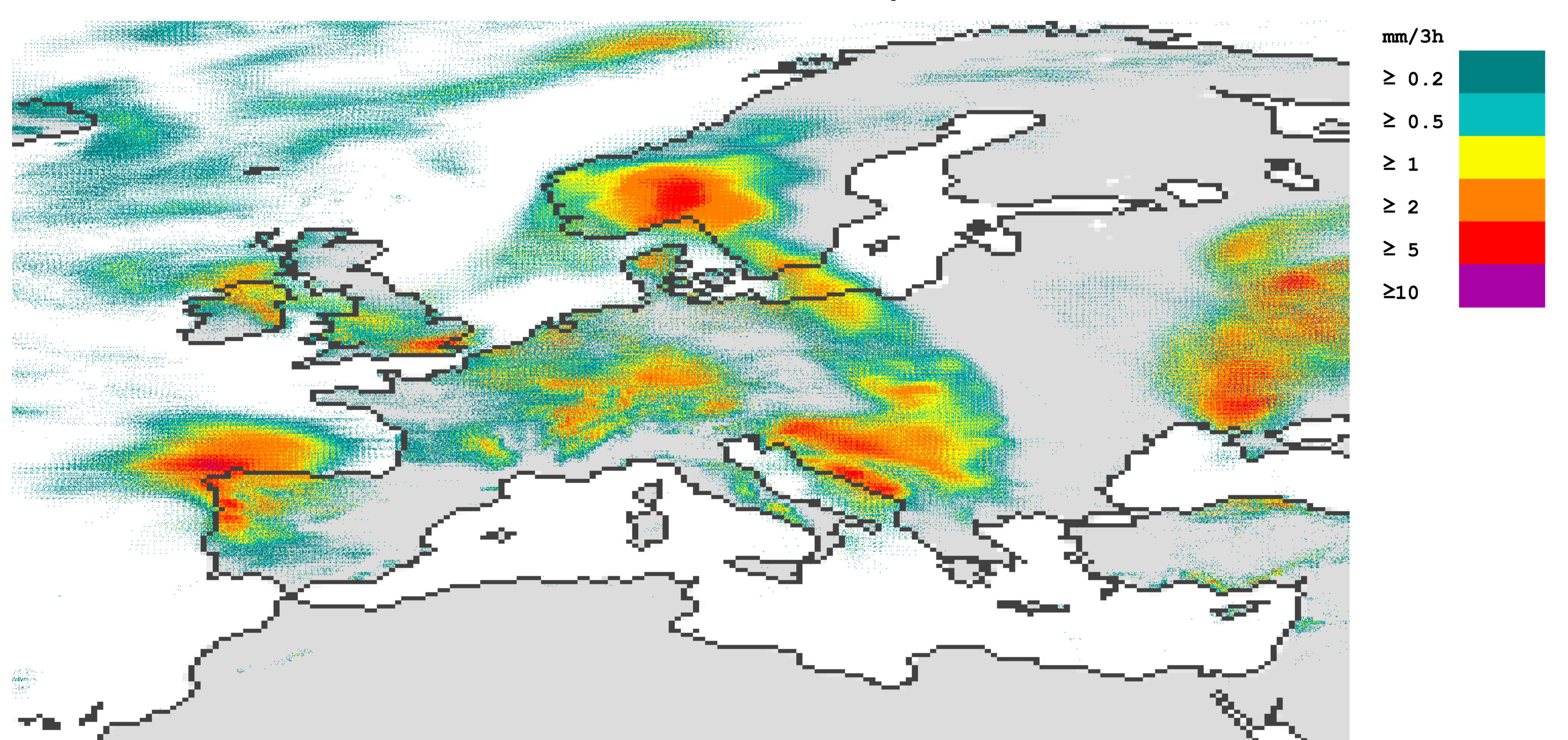
Screen shot of the ECMWF ecCharts, taken 2019-05-09 15 UTC.

Postage Stamp Maps of Individual Ensemble Members, mm/3h



3 h total precipitation accumulation from the ECMWF ENS and HRES 2019-05-09 00Z analysis, step 15h, plotted using proprietary software.

The Vaisala Interleaved Ensemble Map, mm/3h



The above-shown postage stamp maps processed using the Vaisala Interleaved Ensemble plot method.