

Fog climatology analyses in coastal fog ecosystem at the Atacama Desert/Chile – spatio-temporal analysis of fog water characteristics and variability

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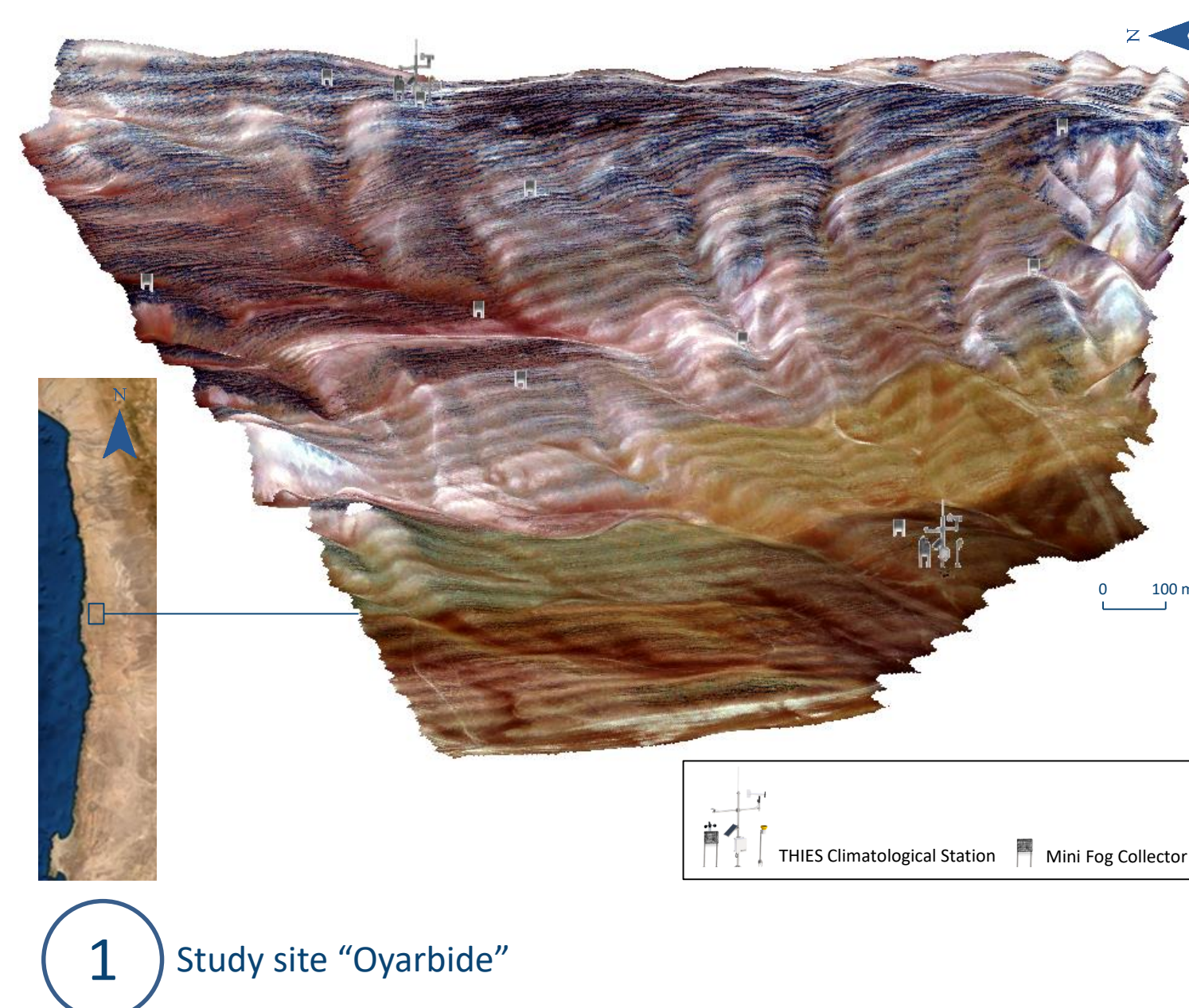
Introduction

The coastal Chilean Atacama Desert comprise some of the driest area of the world. It is in these environments where fog plays a significant role as natural water resource for local ecosystems called *Tillandsia* Lomas dominated by the endemic species *Tillandsia landbeckii*. This ocean-atmosphere interconnected system in general has widely been studied, however there is limited scientific knowledge about the regional fog climatology and its spatio-temporal dynamics on a local scale. Therefore this study

covers a representative study area from the coast to ca. 11 km inland desert. Within the region a representative local study site has been defined, where coastal fog regularly penetrates the terrain. The research seeks to analyze the spatio-temporal gradients, characteristics and variability of the fog to provide a better knowledge of the dynamics of the regional-local fog climatology, to better understand the biosphere-atmosphere interaction in these hyper-arid environments.

Study area

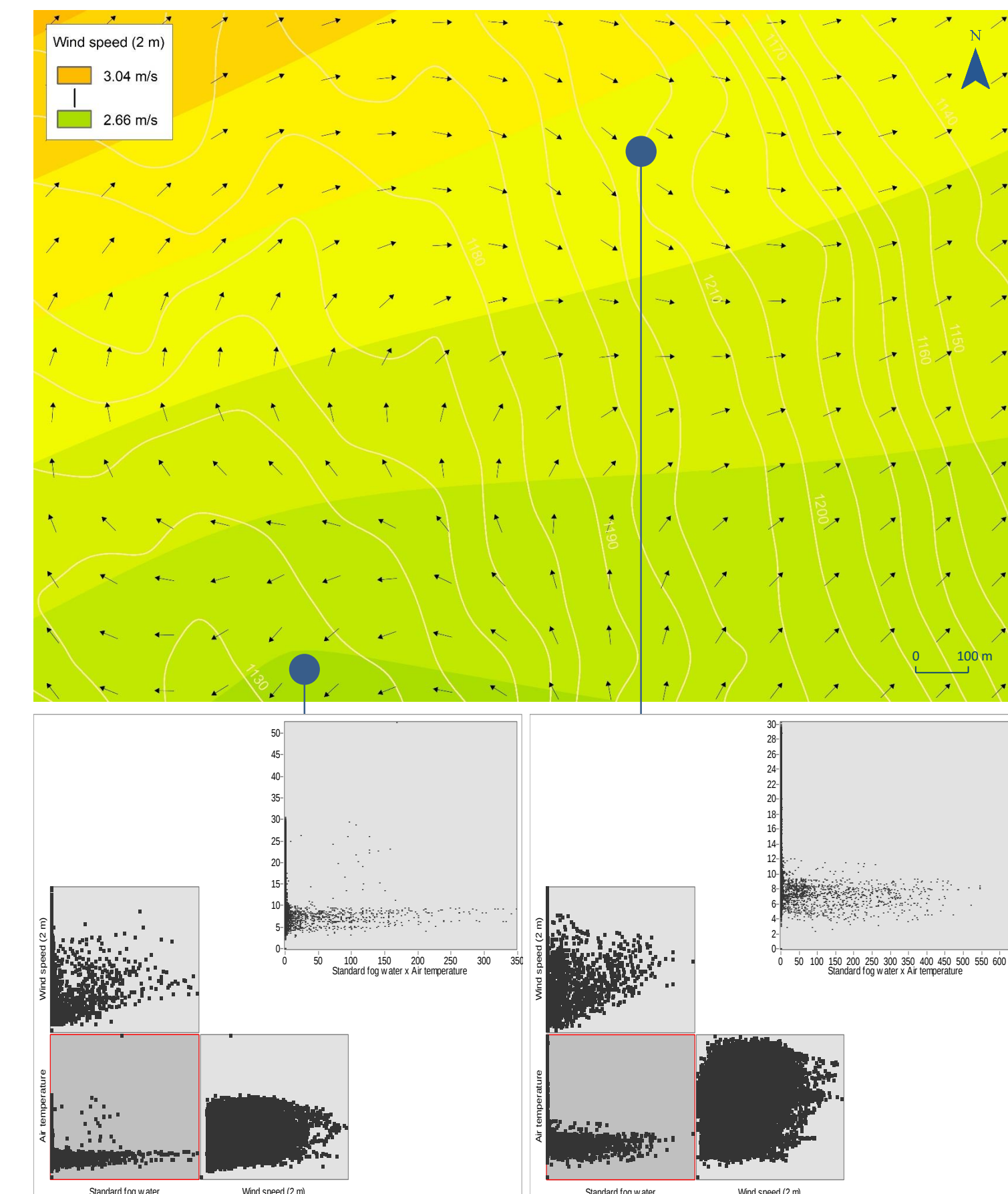
The study area is situated in the coastal Chilean Atacama Desert (20° S), where fog ecosystems called *Tillandsia* Lomas are situated in a very limited corridor along the coast. On a local scale the study site "Oyarbide" of ca. 16 km² inland, presents topographic characteristics ideal for the analysis and modeling fog variability ①.



① Study site "Oyarbide"

Driving forces

The wind variability modeling (2 m) of the THIES stations shows higher average speeds to the northwest with wind vectors penetrating Oyarbide from the south, following the northwest way to finally, influenced by topography, register vectors from the northwest (320°) in the upper limit of the site ④. This southeast-northwest average wind speeds increase is directly related to the increase in temperatures at the study site. The water collected in the standard fog collectors is concentrated between 6-9°C and average wind speed below 6 m/s.

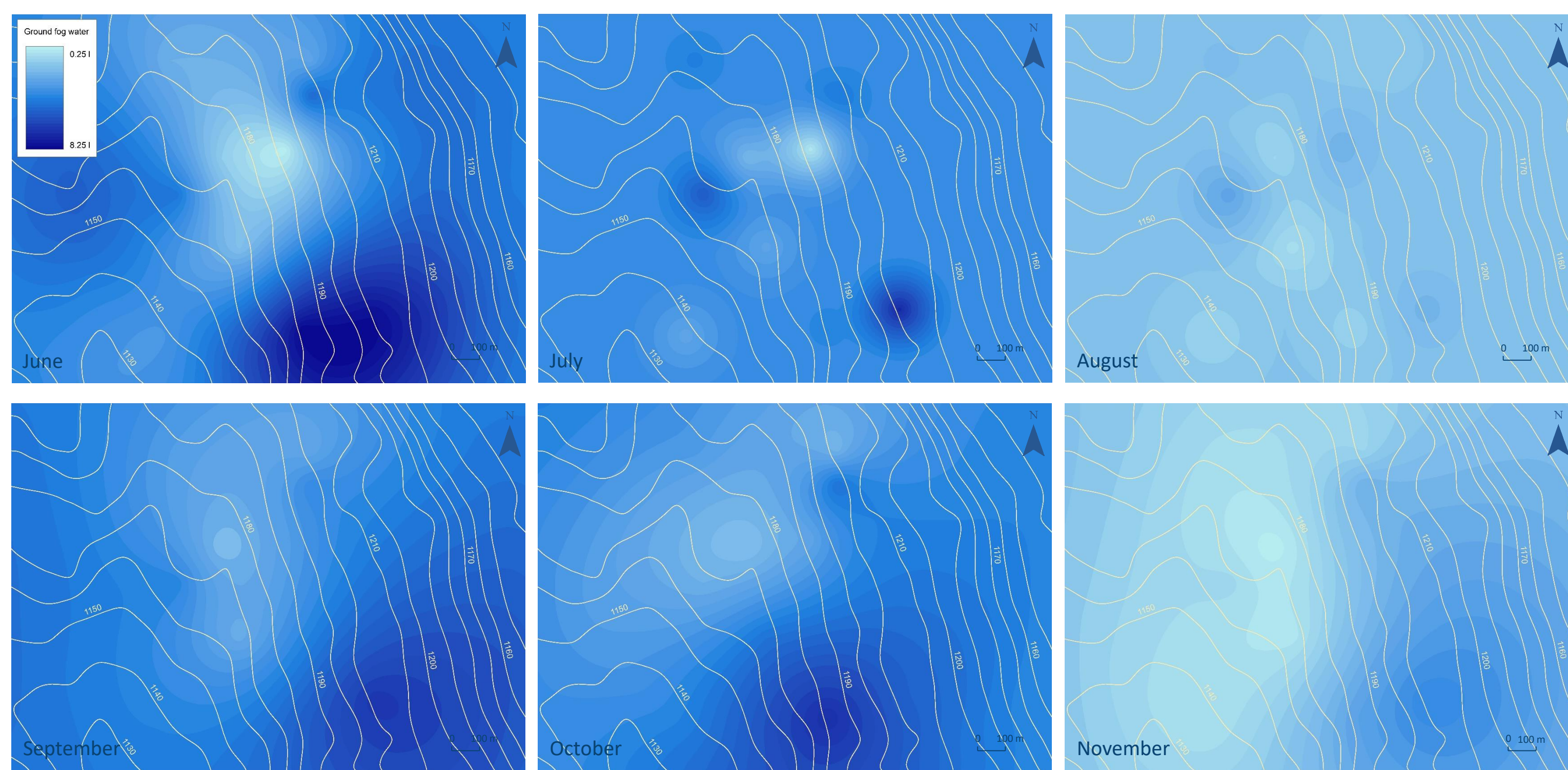


④ Fog water and driving forces in Oyarbide – June to November 2019

Ground fog water

In the period June-November 2019 ground fog water tends to be concentrated in the southeast side of Oyarbide ⑤, where is the Mini Fog Collectors at highest altitude, recorded the maximum of 33.61 l at 1,207 m. This

record matches areas with lower air temperatures and wind speeds. On the other hand, the lowest amounts collected were recorded in the Mini Fog Collectors with the lowest altitude, with the minimum of 9.30 l at 1,166 m.



⑤ Ground fog water in Oyarbide from June-November 2019

Acknowledgment

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Fog climatological measurements

From 2016 onwards, climatological stations from „THIES Clima“ have been installed in the study area between 550 m and 1,350 m ②A. They generate a continuous record every 10 minutes of standard fog water (2 m), air temperature & humidity (2 m), surface temperature (5 cm), wind speed & direction (10 m / 2 m), air pressure, global radiation, leaf wetness and dew. Additionally from beginning 2019, monthly ground fog water collected (50 cm) at Oyarbide is measured by ten Mini Fog Collectors (50 cm x 50 cm) ②B.



②A THIES Climatological Station

②B Mini Fog Collector

Standard fog water

The altitudinal measurements transect of standard fog water measurements presents in the period of June-November 2019 the highest collection records in the upper limit of Oyarbide at 1,210 m with 151.94 l. This station also register the month with maximum collection in

October with 52.66 l, coinciding with the month with the highest collection of the whole climate network with 68.41 l. The lowest amount of collected fog water of the period was registered in the lower limit of Oyarbide at 1,136 m with 54.91 l ③.



③ Standard fog water collected in Thies Stations