A comparison of satellite-derived global marine surface specific humidity datasets

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Abstract

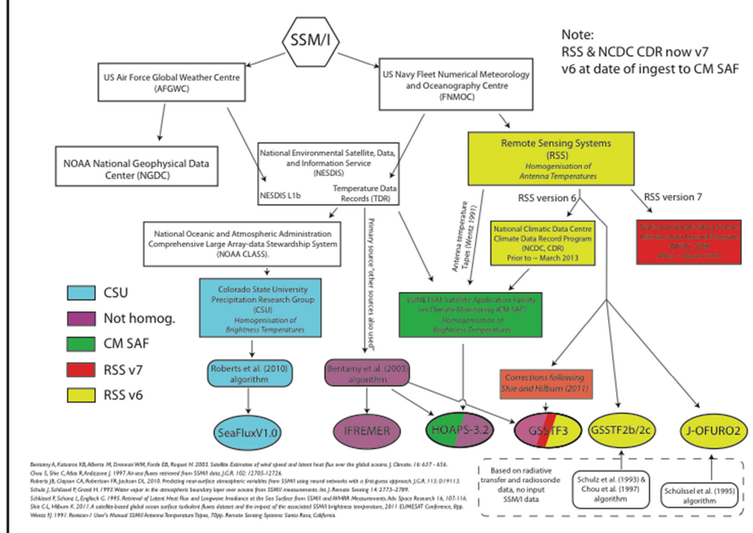
Satellite-based passive microwave sensors have, since the 1980s, provided a means to retrieve near-surface marine specific humidity (q_a), accurate estimation of which is necessary for climate and air-sea interaction applications. Seven monthly-mean humidity datasets derived from the Special Sensor Microwave/Imager (SSM/I) are compared with one another and with a dataset constructed from *in situ* measurements.

The means, spatial and temporal structures of the datasets are shown to be markedly different, with a range between datasets of ~ 1gkg^{-1} in global annual mean q_a. Comparison of the datasets derived using the same satellite measurements of brightness temperature reveals differences in q_a that depend on the source of satellite data; the processing and quality control applied to the data; and the algorithm used to derive q_a from the satellite measurements of brightness temperature. Regional differences between satellite-derived q_a due to the choice of input data, quality control, and retrieval algorithm can all exceed the accuracy requirements for surface flux calculation of ~0.3gkg^{-1} and can be several gkg^{-1} in monthly means for some periods and regions.

Datasets

- Goddard Satellite-based Surface Turbulent Fluxes (GSSTF2b/2c/3)*
  http://disc.sci.gsfc.nasa.gov/dataholdings/?q=datacollection/GSSTFM.3/description
- Hamburg Ocean Atmosphere Parameters and fluxes from Satellite data version 3.2 (HOAPS3.2)*
  http://www.hoaps.zmaw.de/
- French Research Institute for Exploration of the Sea merged flux dataset (IFREMER)
  ftp://ftp.ifremer.fr/ifremer/cersat/products/gridded/flux-merged/
- Japanese Ocean Flux Data sets with Use of Remote Sensing Observations (J-OFURO2)*
  http://dtsv.scc.u-tokai.ac.jp/j-ofuro/
- SeaFlux Turbulent Flux Dataset version 1.0 (SeaFluxV1.0)
  http://seaflux.org/
- NOC v2.0 Surface Flux and meteorological dataset (NOCv2.0)*
  http://rda.ucar.edu/datasets/ds260.3/

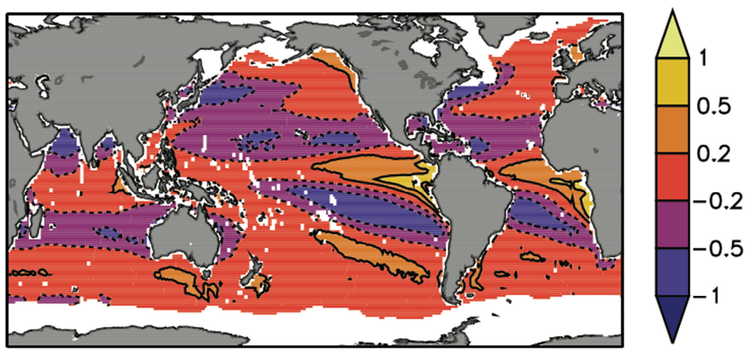
* See also https://climatedataguide.ucar.edu/variables/atmosphere/specific-humidity



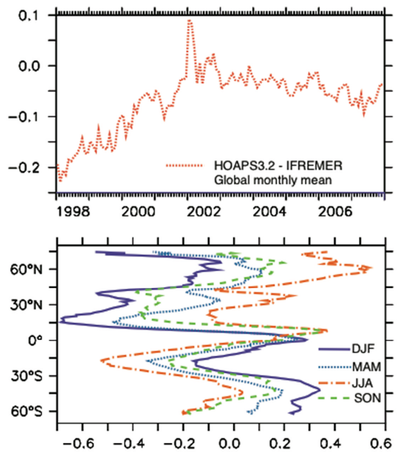
Data sources and processing - the flow diagram shows the processing paths for the different SSM/I datasets and humidity algorithms compared in this study. SSM/I instruments flew on several different satellites and the data show relative offsets, drifts and dependencies on orbits and incidence angles. These effects are estimated and the data homogenised at several data centres (CSU *[blue]*, CM SAF *[green]*, RSS *[yellow v6 and red v7]* and data without homogenisation is also used *[purple]*).

The impact of homogenisation is illustrated in the plots below.

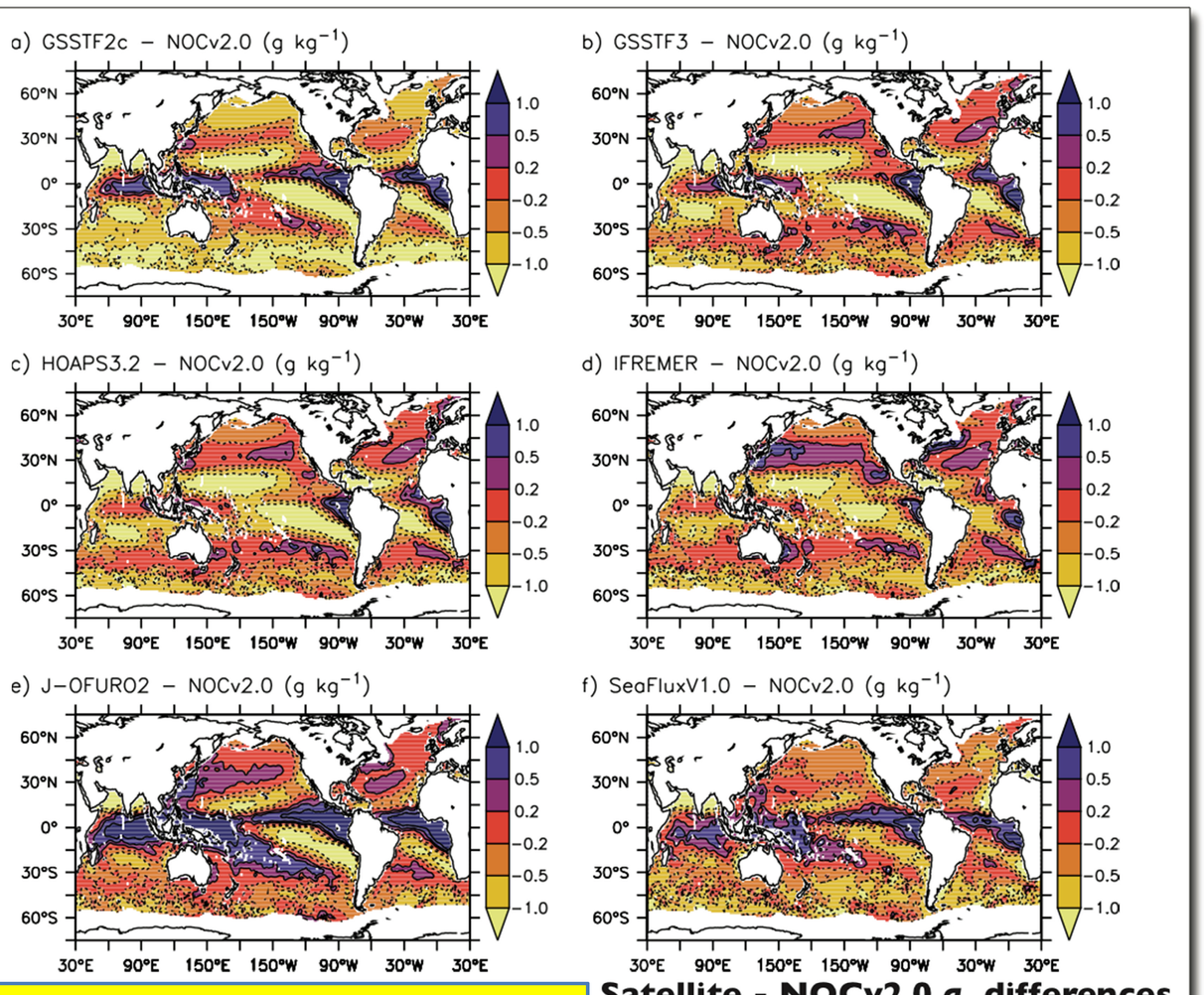
Differences between the HOAPS3.2 and IFREMER datasets are plotted. Both datasets use the Bentamy et al. (2003) algorithm to estimate humidity, but HOAPS used data homogenised by the CM SAF and IFREMER used data which have not been homogenised.



HOAPS3.2 - IFREMER (g kg^{-1}), average 1998-2007

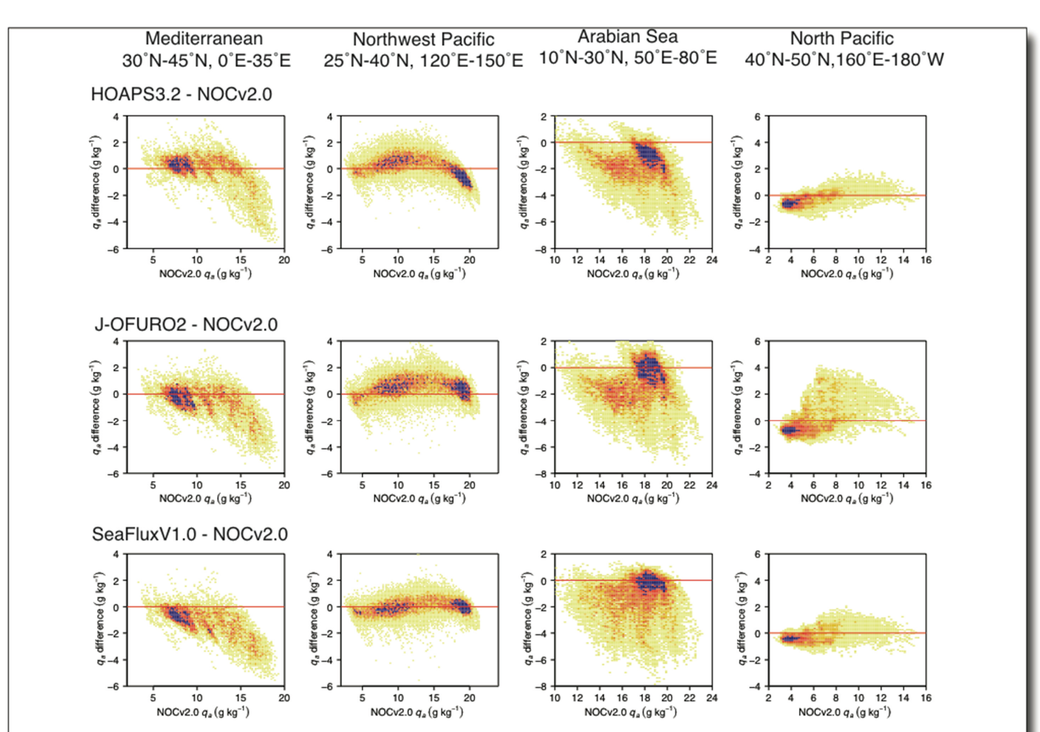


HOAPS3.2 - IFREMER (g kg^{-1}), seasonal zonal mean



Satellite - NOCv2.0 q_a differences Averaged over the period 1998 - 2007 the satellite products show regionally-coherent differences from the *in situ* NOCv2.0 dataset. The spatial structure of these differences suggests that they are mainly due to biases in the satellite products rather than problems with the NOCv2.0 dataset.

Results presented on this poster published as:
Prytherch et al., 2014; International Journal of Climatology



Differences as a function of NOCv2.0 q_a - the density plots show the difference between selected satellite and NOCv2.0 estimates of q_a for 4 contrasting regions. Darker colours represent a greater concentration of 1° area monthly mean values. Comparisons are only made for values where the NOCv2.0 uncertainty is estimated to be small. Differences show similar relationships for the different satellite products for each region, but the relationships are different among regions. The causes of these differences are likely to be complex.

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