An Integrated Water Vapor Product for DYNAMO/CINDY

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For purposes of DYNAMO/CINDY diagnostic and modeling studies and model validation, a detailed water vapor product would be extremely useful.

Ideal characteristics of water vapor product:

- High resolution in space and time (e.g. 1° horizontal direction, 5 hPa in vertical direction, every 3-6 hrs).

- Spatial coverage: DYNAMO/CINDY domain (5° N – 10° S, 65° E-80° E)

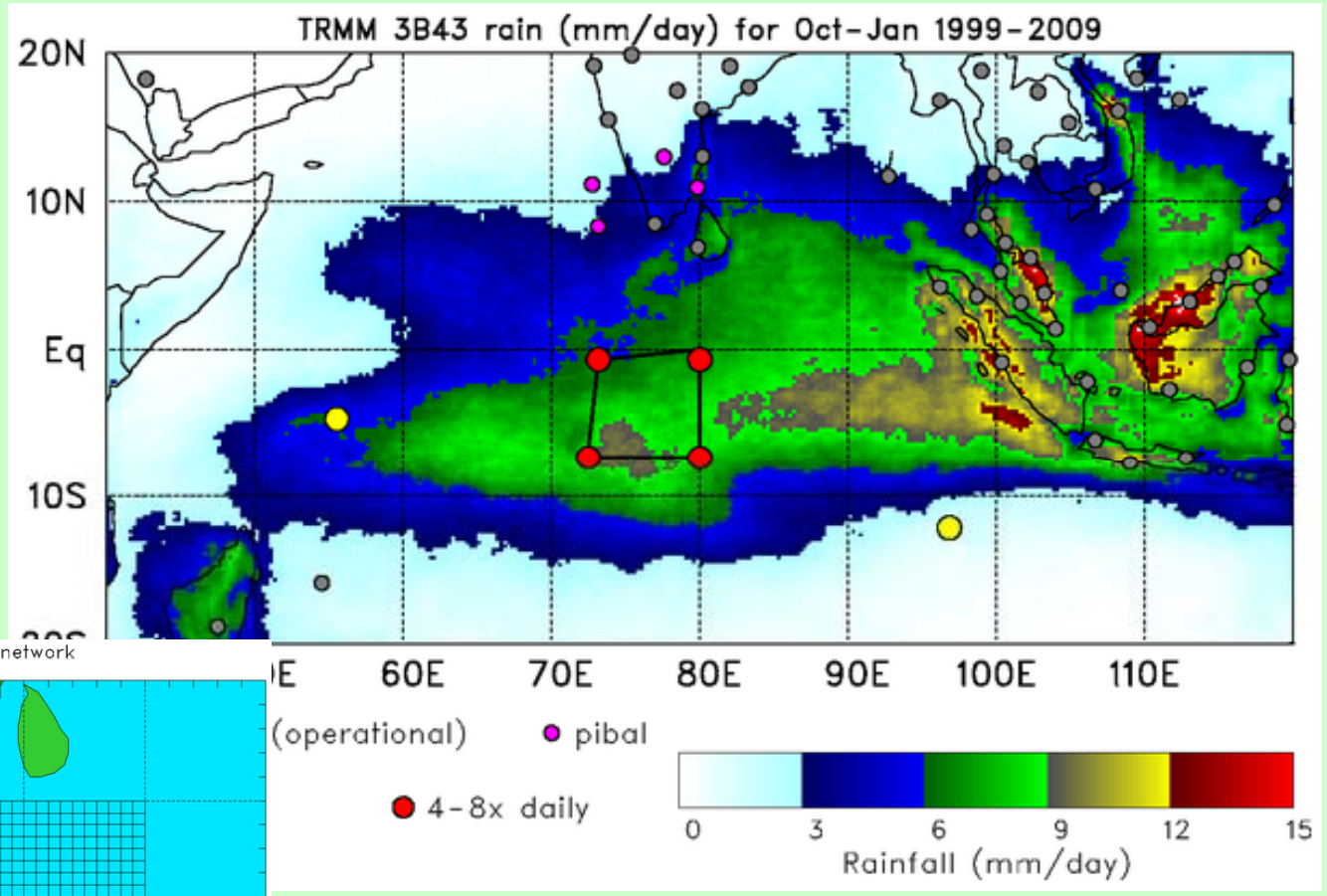
- Temporal coverage: duration of experiment (1 Oct. – 15 Jan.)

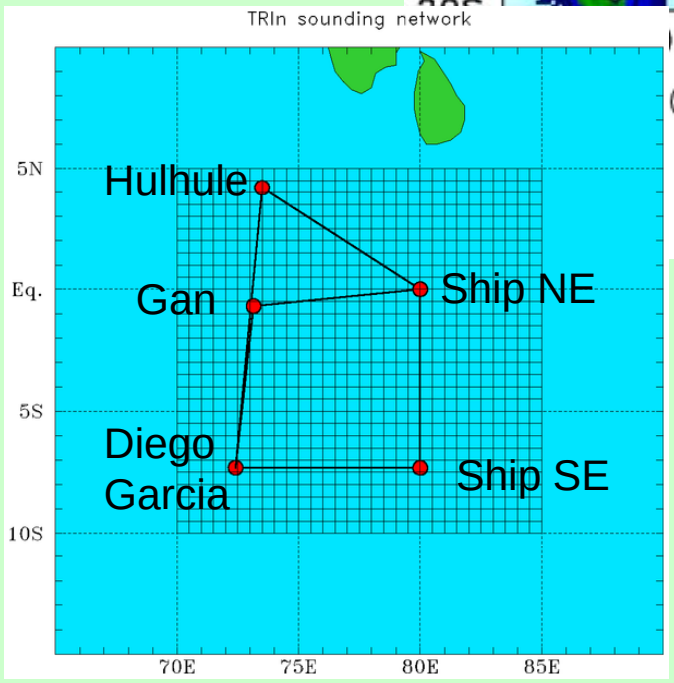
- Model independent (so that it can be used for model validation or to initialize models)

- Other requirements?

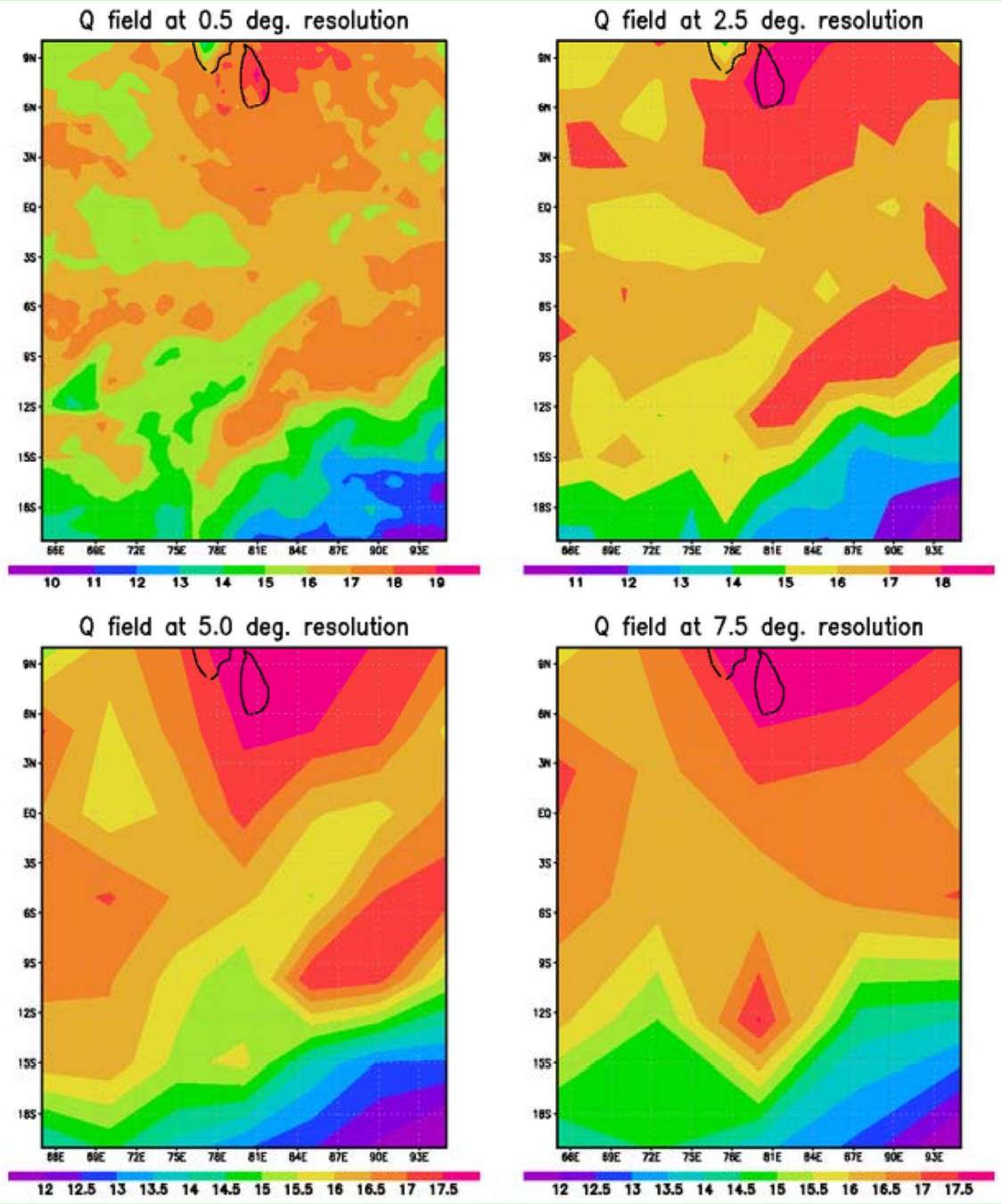
Is this possible?

TRMM rain map for October-January with proposed sounding network





- Considering the coarse spatial resolution of the sounding network, which is the main source of high vertical resolution water vapor observations, achieving such an ideal dataset wil be difficult.
- On days with dropsonde missions, spatial coverage from sondes will be extended; drops will likely only provide moisture profiles in the lower troposphere.



- Example of degrading YOTC surface moisture field over DYNAMO domain on a given day to the spatial resolution of DYNAMO sounding network (~7 degrees).

- Sounding network will provide us with excellent vertical resolution (10m) at 4 or 5 locations, but will only resolve coarse spatial structures.

additional data obs that can used to improve upon a sonde only *q* product:

•***Multi-channel microwave radiometer*** measurements at Gan (excellent temporal resolution, spatial coverage 50 km, 1 km vertical resolution in lower trop.)

•**Ka band** measurements on Gan (when rain is present; lower to mid-troposphere)

•**RASS on Diego Garcia** (lower trop.; not enough room on Revelle)

•***Ground-based GPS observation of PW*** (10 minute temporal resolution, but available only at sonde locations; deep-layer average).

•**COSMIC soundings** (limited quality in lower-trop., not model-independent).

•***NVA*P** (NASA Water Vapor Project) – 1˚ horizontal resolution, daily product, 5 vertical layers (1000-850 hPa, 850-700 hPa, 700-500 hPa, 500-300 hPa, 300-200 hPa). This product is based TIROS and SSMI/I data sets. Project funded only through 2010.

•***AMSR-E*** retrieved total column water vapor (1:30 am and 1:30 pm sampling, coverage about 70% of time over a given area, 25 km resolution, missing in heavy rain).

•***SSMI, TMI*** provide retrieved total column water vapor at daily, 0.25˚ resolution, complete coverage every 3 days.

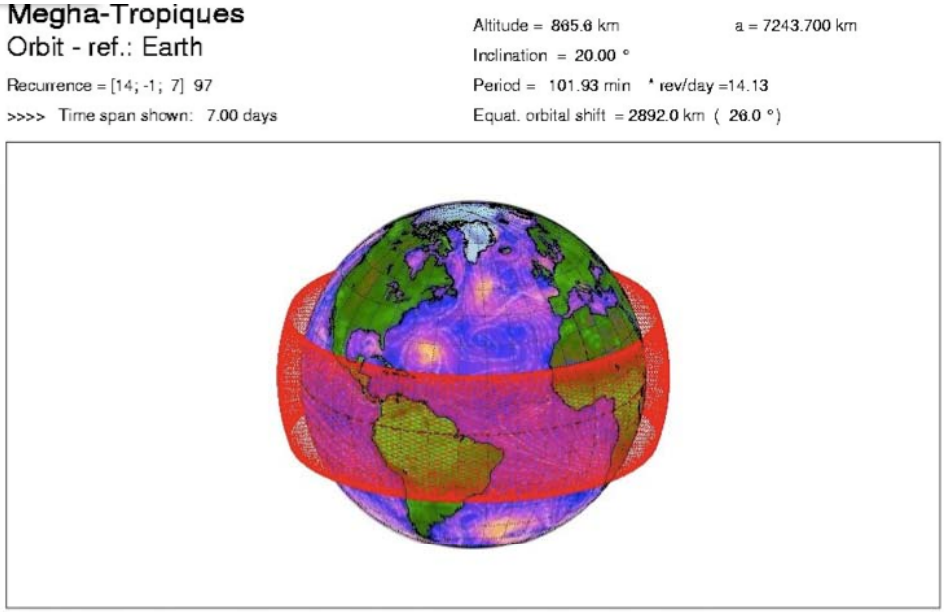
•***Megha-Tropiques*** – new French/Indian satellite with 6 channel water vapor instrument (SAPHIR); orbital range is from 15N-15S with 3 overpasses/day near equator, 10 km horizontal resolution, launch date is still uncertain.

How can we combine these observations into a integrated product?

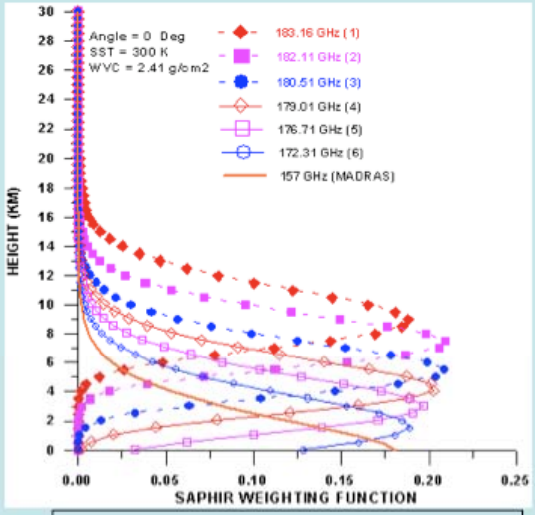
- Optimal interpolation
- 3D variational analysis using NVAP product as a first guess
- 3D variational analysis using ECMWF reanalysis as first guess

Supplementary material

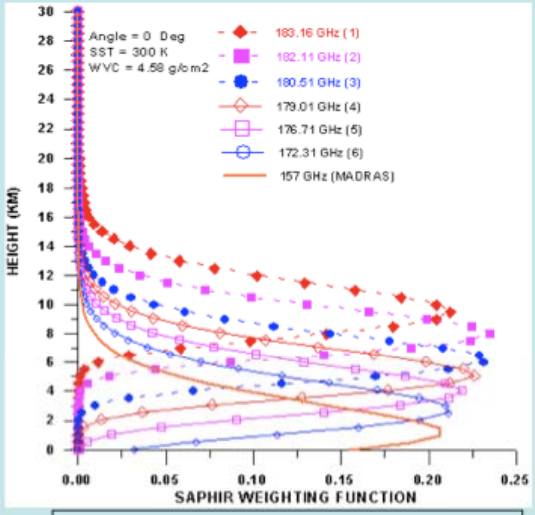
Some attributes of the Megha-Tropiques satellite taken from 3rd M-T workshop (Oct. 2007)



SAPHIR CHANNELS' RESPONSE (NADIR VIEW)

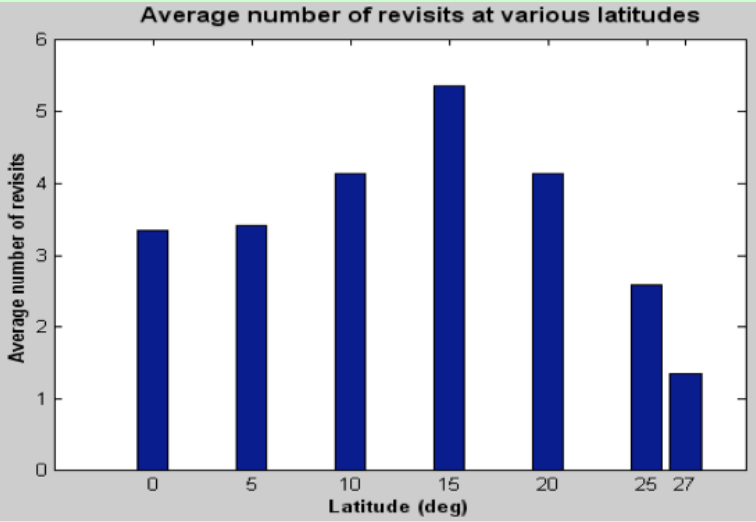


Dry Atmosphere



Moist Atmosphere

At nadir view with dry atmosphere, the low freq channels are contaminated by surface contributions



YOTC ANALYSES

- used ECMWF 4-D variational data assimilation system
- Input assimilated datasets include 3 hr TRMM 3B42 rainfall
- resolution is 0.22 near equator, 91 vertical levels, every 6 hours
- reanalyses are available from May 2008 to April 2010
- large suite of reanalysis fields.
- reanalyses can be obtained from: http://data-portal.ecmwf.int/data/d/yotc_od/

In this study YOTC data over the DYNAMO/CINDY region for Oct-Jan period for 08-09 and 09-10 is used.

An important, yet unproven, assumption is that the YOTC analysis is good representation of the true conditions (e.g., does it contain a realistic spectrum of equatorial waves).

Large-area map for Indian Ocean