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Combining passive and active sounding techniques to retrieve tropospheric water vapor over land and oceans

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Overview

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Objectives

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1. Combine passive and active sounding techniques

2. Tropospheric water vapor retrievals under cloudy conditions

3. Investigate different regions (land and ocean)

Introduction (1)

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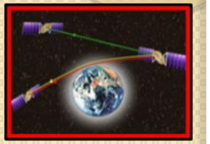
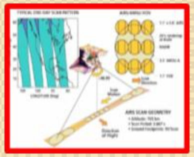
GPS



GPS Radio Occultation (GPSRO):

- All-weather system; global coverage
- **Refractivity**, Temperature
- Water vapor: low-to-mid troposphere
- Horizontal resolution ~200-300 km

AIRS



Atmospheric Infrared Sounder (AIRS):

- Affected by clouds; global coverage
- **Temperature**
- Water vapor: low-to-upper troposphere
- Horizontal resolution ~45 km

Introduction (2)

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Radiosonde

Radiosondes:

- Work during cloudy conditions
- Temperature
- Water vapor: lower-to-upper troposphere
- Limited ocean coverage

Literature

Combining techniques and comparisons (examples):

- Divakarla et al., (2006) – Radiosonde/ECMWF/GPS RMS comparisons
- Ho et al., (2007) – GPS Ref. + AIRS Temp. → Temperature
- Borbas et al., (2008) – GPS Temp. + AIRS Temp. → Tropopause Temperature

Methodology

COMPONENTS OF SOFTWARE (<u>triple</u> collocations)

DATA	COMBINATIONS	RETRIEVALS

Satellite Data

- GPS (COSMIC)
- AIRS (v5.0)
- ECMWF
- Radiosonde

Collocations

- < ± 300 km
- < ± 3 hr
- Interpolate to common altitude grid

Combine

- GPS+AIRS
- GPS+ECMWF

Use

- Forward refractivity operator

Retrievals

- Derive water vapor profiles
- Divide between land and ocean
- Compare retrieved profiles with reference (Radiosonde)

Results (1)

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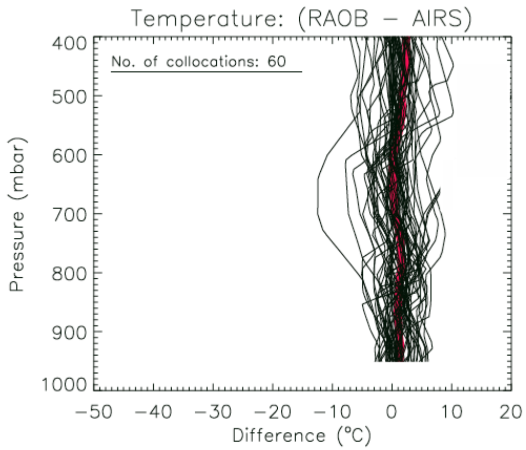
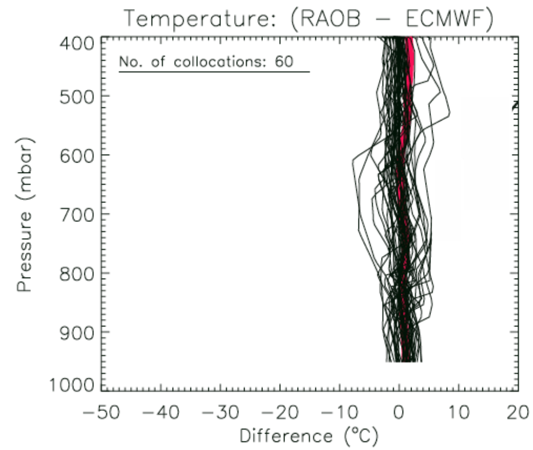
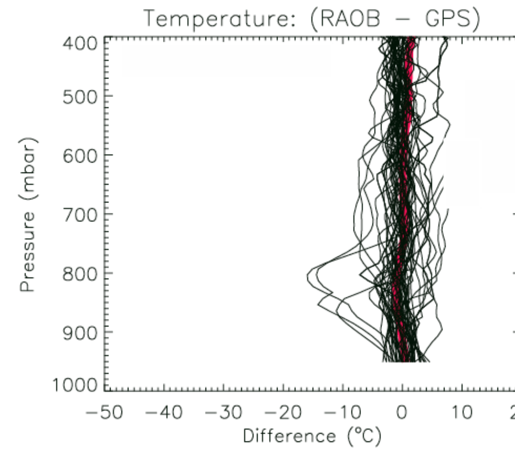
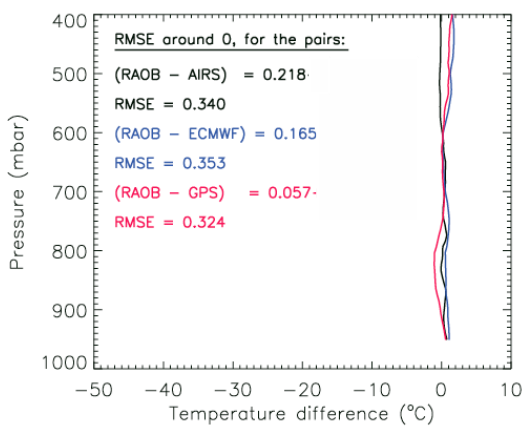
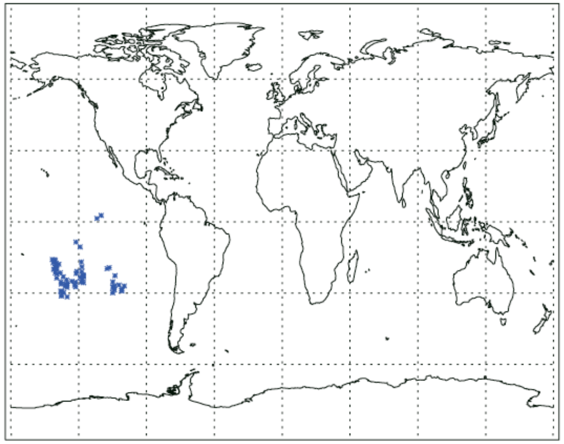
Collocation criteria: 3 hr. + 300 km











Pacific 2007

Results (2)

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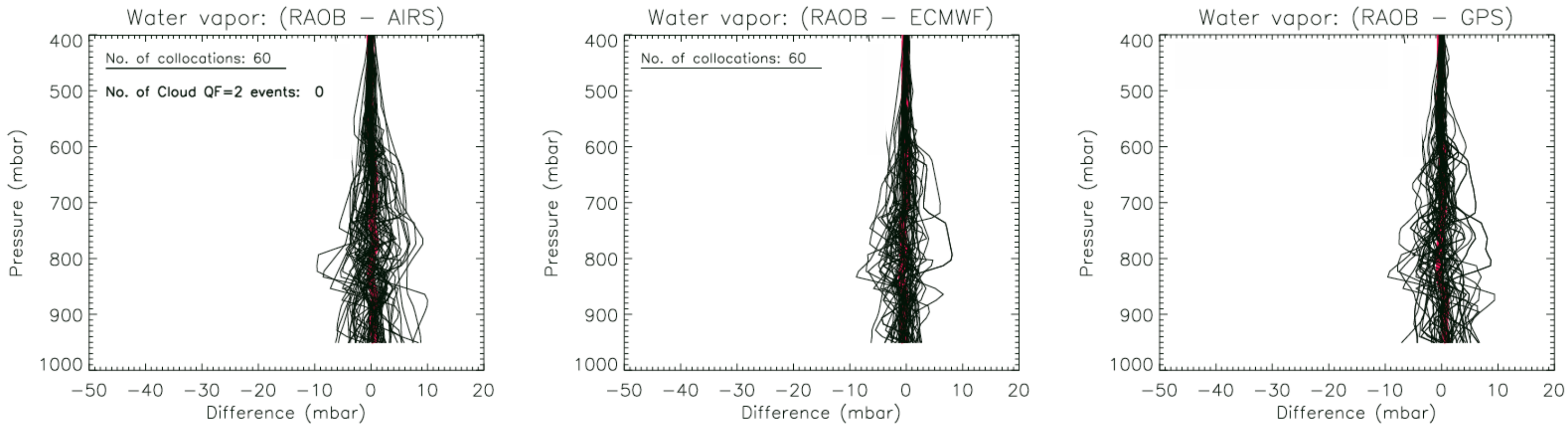
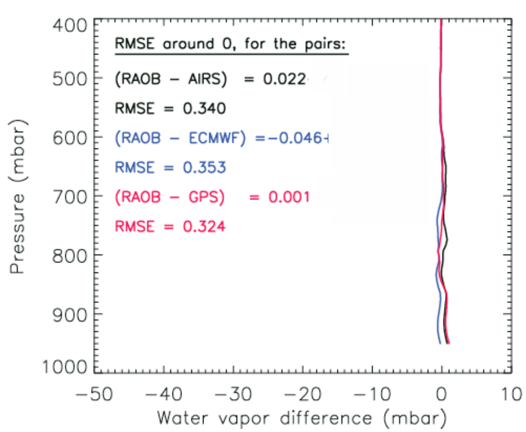
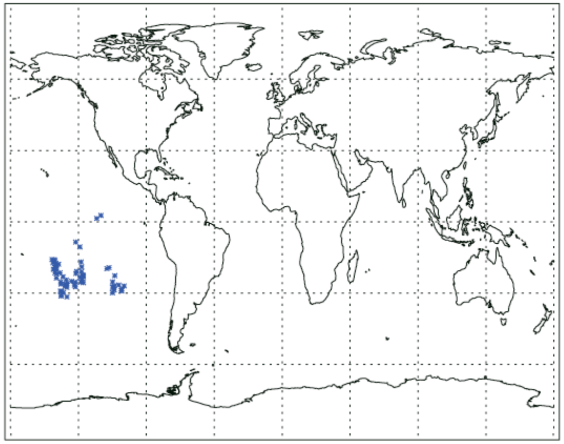
Collocation criteria: 3 hr. + 300 km







Pacific 2007

Results (4)

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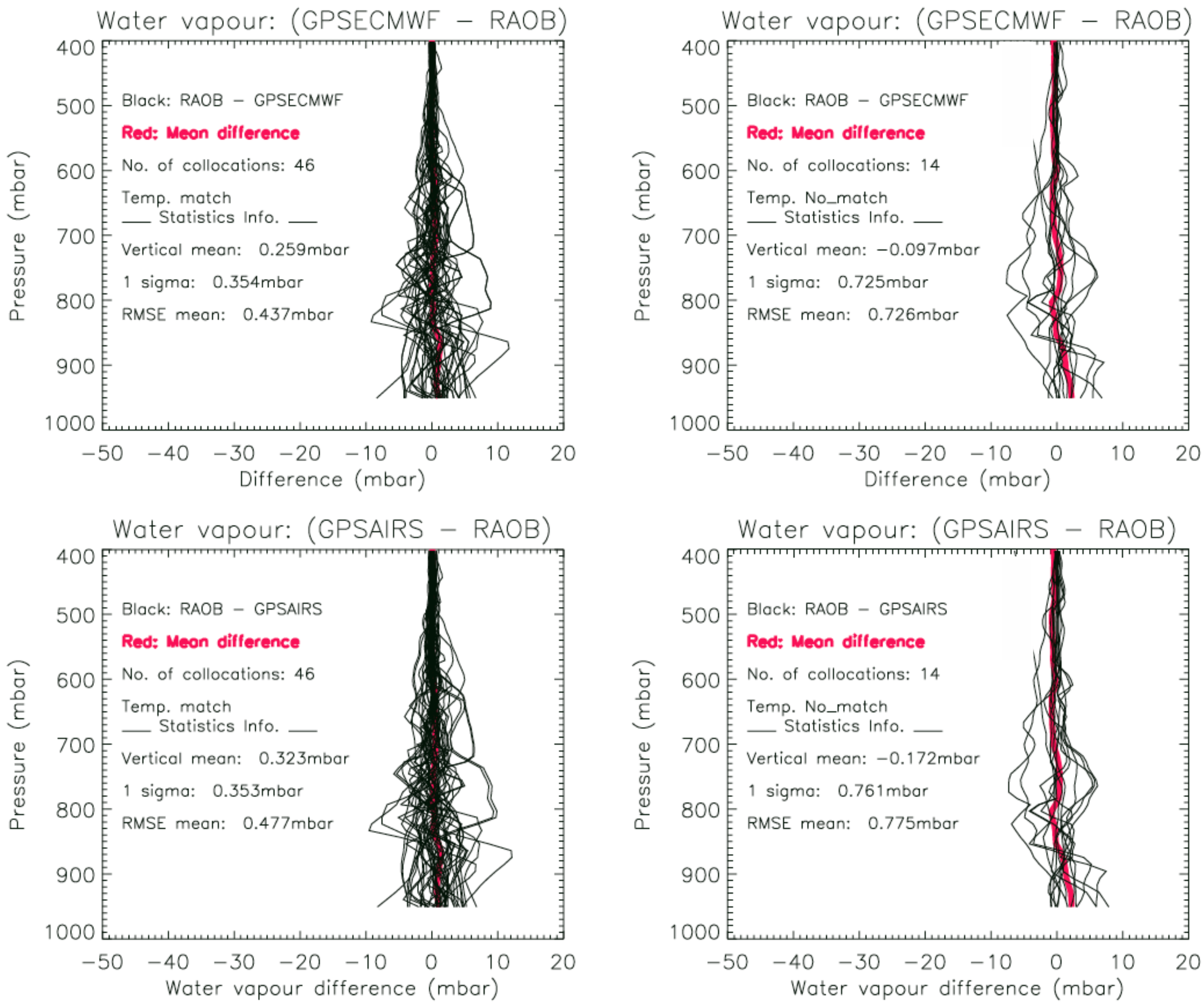
Collocation criteria: 3 hr. + 300 km

Pacific



Conclusions

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USA

Water vapor (RMSE)	T_match	T_nomatch
RAOB - AIRS	0.302 (mbar)	0.450 (mbar)
GPSECMWF - RAOB	0.164 (mbar)	0.454 (mbar)
GPSAIRS - RAOB	***0.145 (mbar)***	0.534 (mbar)

AUS

Water vapor (RMSE)	T_match	T_nomatch
RAOB - AIRS	0.731 (mbar)	1.087 (mbar)
GPSECMWF - RAOB	0.576 (mbar)	0.757 (mbar)
GPSAIRS - RAOB	***0.515 (mbar)***	0.779 (mbar)

Pacific

Water vapor (RMSE)	T_match	T_nomatch
RAOB - AIRS	0.459 (mbar)	0.543 (mbar)
GPSECMWF - RAOB	***0.437 (mbar)***	0.726 (mbar)
GPSAIRS - RAOB	0.477 (mbar)	0.775 (mbar)

Conclusions

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1. GPS improved the RMSE and Bias of AIRS and ECMWF water vapor profiles, with respect to Radiosondes profiles, except in the T_nomatch over the Pacific

2. GPS + AIRS provides the least biased and least variable water vapor profiles over land than GPS + ECMWF does

3. **(Preliminarily),** combining GPS, AIRS and ECMWF one produces water vapor profiles that are in a good agreement with radiosondes, than the AIRS and ECMWF alone

Future plans

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In progress research:

Investigating water vapor retrievals over:

- oceanic regions and clear sky conditions
- different seasons

Future research plan:

Perform a sensitivity study of water vapor retrieval errors on:

- Collocation criteria
- Separation criteria

Thank you!

Results (3)

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Collocation criteria: 3 hr. + 300 km

Pacific