# Soundings of Ozone and Water in the Equatorial Region (SOWER) 1998 – 2014

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# SOWER 1998-2014: Contents

1. Motivations and Activities (1) & (2)

#### 2. Local Collaborators for SOWER

The SOWER Principal Investigators:

Fumio Hasebe, Masato Shiotani The SOWER team members include:

S. J. Oltmans, H. Vömel , M. Fujiwara, N. Nishi, S.-Y. Ogino, T. Shibata, S. Iwasaki, M. Hayashi , K. Shimizu, J. Suzuki, Y. Inai, T. Sugidachi, H. Takashima, S. Mimura Local collaborators:

LAPAN (Indonesia), INAMHI (Ecuador), National Hydro-Meteorological Service (Vietnam), Kiribati Meteorological Service (Kiribati)







# Motivations & Activities (1)



→ Collaboration with NOAA Oltmans's group; Jim Holton suggested simultaneous water vapor sounding for the studies on the dehydration processes for the stratosphere

# Motivations & Activities (1)

SOWER 1998-1999



March 1999

to measure *east-west contrast* in ozone and water vapor in the Pacific:
(1) Ozonesonde & NOAA FPH at the Galapagos, Ecuador (March 1998 - ; *campaign basis*)
(→ SHADOZ regular ozonesounding)
(2) Christmas Island, Kiribati (March 1999 - ; *campaign basis*)
(3) Regular Ozonesounding at Watukosek, Indonesia since 1993 (T. Ogawa, M. Fujiwara et al.) (SHADOZ for 1998-)
Also, R/V Shoyomaru cruise (Sep-Oct 1999) for the region without islands

Eastern, central, and western Pacific sites,



Deep convective regions

Subsidence regions

November 2001

# Motivations & Activities (2)

- Dehydration process in the Tropical Tropopause Layer (TTL) controls the stratospheric water vapor amount and variability
- Dehydration occurs in the air parcels that are *transported quasihorizontally* with a background very slow ascent due to the Brewer-Dobson circulation
- The "*match*" technique (Lagrangian multi-point measurement) is appropriate to quantify the dehydration efficiency



(1) Need a UTLS hygrometer that can be operated by several non-specialists

→ Snow White, CFH, FLASH-B, and FINEDEW sonde

(SOWER's contributions to sensor comparison/validation/modification/development) (2) Need a network of stations along climatological airflow in the TTL over the key dehydration region (i.e., the tropical western Pacific where the tropopause is coldest)

→ Collaboration with central/western Pacific & southeast Asian countries
 (3) Simultaneous cloud particle measurements → lidar, various balloon sensors



Watukosek, January 2003, NOAA FPH + Snow White



Bandung, December 2003, CFH + Snow White



Biak, February 2014, (1) FINEDEW chilled-mirror sonde (peltier & digital controller) + Meisei RS-06G (2) Cloud Particle Sensor (CPS) + RS-06G

![](_page_5_Picture_6.jpeg)

#### "Match" campaigns: Multipoint O3–WV-sonde Soundings in the Western Pacific

![](_page_6_Picture_1.jpeg)

Site	Dec.2004	Jan.2006	Jan.2007	Jan.2008	Jan.2009
Bandung	4 (CFH)	-	-	-	-
Biak	3 (SW)	12 (SW), 9 (CFH)	6 (CFH)	7 (CFH)	4 (CFH)
Hanoi	8 (SW)	15 (SW)	6 (CFH)	5 (CFH)	4 (CFH)
Kototabang	-	10 (SW)	5 (CFH)	4 (CFH)	-
R/V <i>Mirai</i>	15 (SW)	-	-	-	-
Tarawa	10 (SW)	11 (SW) , 2 (CFH)	5 (CFH)	-	- [Inai e

CFH: Cryogenic Frostpoint Hygrometer (61) SW: Snow White peltier-cooler dew/frostpoint hygrometer (84)

# **Collaboration with Tropical Countries**

- Ecuador
  - INAMHI (Instituto Nacional de Meteorología e Hidrología)
- Kiribati
  - Kiribati Meteorological Service
- Indonesia
  - LAPAN (Lembaga Penerbangan dan Antariksa Nasional)
  - (BMKG (Badan Meteorologi, Klimatologi, dan Geofisika))
- Vietnam
  - NHMS (National Hydro-Meteorological Service)

![](_page_7_Figure_10.jpeg)

INAMHI (Instituto Nacional de Meteorología e Hidrología), Ecuador

- Upper-air stations: San Cristóbal Island (in the Galapagos Islands) (84008), Guayaquil (84203), and Nuevo Rocafuerte (84132)
- Regular ozonesounding at San Cristóbal Island (1998-2008, 2012-present)

![](_page_8_Picture_3.jpeg)

![](_page_8_Picture_4.jpeg)

# Kiribati Meteorological Service

- Upper-air station: Tarawa
- Vaisala RS92, daily sounding
- Every profile is transmitted to the GTS; but, most data are missing at the Wyoming Univ. website

![](_page_9_Picture_4.jpeg)

![](_page_9_Picture_5.jpeg)

### LAPAN (Lembaga Penerbangan dan Antariksa Nasional), Indonesia

- Indonesian National Institute of Aeronautics and Space (not the met service)
- Upper-air station: Watukosek (Regular ozonesounding since 1993; SHADOZ since 1998) (up to Oct. 2013?)
- Other stations: Kototabang (Equatorial Atmosphere Radar by LAPAN & Kyoto Univ.), Biak, etc.

![](_page_10_Picture_4.jpeg)

![](_page_10_Picture_5.jpeg)

# BMKG (Badan Meteorologi, Klimatologi, dan Geofisika), Indonesia

- This is the Indonesian Met Service
- (SOWER has no direct connection with BMKG)
- There are ~10 radiosonde stations (Meisei)

![](_page_11_Figure_4.jpeg)

Aero-Meteorological Observatory (AMO), National Hydro-Meteorological Service (NHMS), Vietnam

- Upper-air stations: Currently, 6 including Hanoi (2 will be added in 2014; 11 in total in the near future)
- All current stations are using Vaisala RS92, twice daily
- Regular ozonesounding at Hanoi station since September 2004 (currently included in the SHADOZ network)

![](_page_12_Picture_4.jpeg)

# Summary and Some Notes

- SOWER's major scientific motivations were (1) the tropical ozone climatology and variability and (2) the dehydration process in the tropical tropopause layer
- SOWER also put much effort on sensor development particularly for water vapor measurements
- SOWER's activities were possible with extensive support from the local institutes/agencies (including local station staff)
- One or two of the institutes/agencies presented here might be interested in and capable of contributing to the GRUAN activity (M. Fujiwara's personal view)