DEEPWAVE Debrief Agenda

1300  Brief Introduction and Participants  Jim Moore
Opening Comments by NSF Program Managers

1305  Overview of Project by Science Team and Questions  Ron Smith, Dave Fritts, Other PIs

1325  Review of EOL Project Support Components
- RAF NSF/NCAR GV  Pavel/Lou
- RAF Data Quality  Jorgen
- CDS In-Field Support  Greg/Ted
- CDS Data management  Steve
- ISF ISS deployment Hokitika  Bill
- ISF dropsondes  Terry/Kate
- Education/Outreach  Alison
- PMO  Jim/Vidal

(Keep summary comments to ~5 min to allow time for questions/clarification. Please focus on highlights, challenges and lessons learned)

1415  EOL-NSF Discussions (restricted)
(This is the opportunity to discuss any items brought up in the previous section that might require additional explanation or cover other questions from NSF for EOL staff).

1455  Concluding Remarks  NSF Managers
NSF Deepwave de-brief: Preliminary Science Results

Nov 10, 2014
(See Debrief Supplement for further info)

Dave Fritts, Biff Williams, Katrina Bossert and others from GATS
Mike Taylor, Dominique Pautet and others from Utah State
Steve Eckermann and Jim Doyle and others from NRL,
Ron Smith, Chris Kruse, Alison Nugent and others from Yale
Steve Smith from Boston Univ.
Andreas Doernbrack and others from DLR
GATS Na and Rayleigh Lidar Highlights

**Rayleigh lidar:** $T$, $T'$, $\rho'$, cloud height
- **20-40km:** 13km hor., 1km vert. res.
- **40-60km:** 30km hor., 3km vert. res.

**Na lidar:** 0.2W beam, 9.8W beam
- **15-25km:** $w'$, 30km hor. 3km vert.
- **80-100km:** Na, Na', 5km H, 1km V
- **T, T':** 100km H, 3km V

**DEEPWAVE Operations**
- Lidar data: 130 hrs on 24 flights
- No laser failures
- No viewport: rf01
- Daytime flight: rf15
- Na laser freq. locking issue rf20-26, just Na, no T

**RF22:** strong MW propagation to 85km
ECMWF (right) sampled on flight track

Lidar system on GV
RF17: Trailing wave SE of South Island
Rayleigh T’ (left), ECMWF (right) sampled on flight track

RF25: Southern Ocean Wave
Lidar T’ (left), ECMWF (right) sampled on flight track
RF13: Persistent Mountain Wave for 12 mountain passes, 1 trailing leg
Lidar T’ (left), ECMWF (right) sampled on flight track

RF16: Strong MW in troposphere, breaking -> strat. secondary waves?
Rayleigh T’ (left), WRF w’ model (right)
**USU Mesospheric GW Highlights**

**Detection of MW over Auckland Islands (700m):**

- Mountain wave development under variable forcing
- Extensive GW activity over NZ

**Rich spectrum of MW over NZ and SO islands**

**Extensive large and small-scale GW over open oceans**

**Strong evidence for deep GW propagation**

**AMTM instrument Suite**

- **GV:** Precision (2K) temperature mapper and 2 side viewing GW imagers for large spatial coverage, ~180 hrs of high-quality data
- **Lauder:** second AMTM with 33 clear nights of GW and MW data

**Mapping temperature waves**

- Wind 20m/s
- \( \lambda_z \sim 40 \text{km} \)
- Strong Temperature perturbation (20K)
All-sky Imaging of Breaking Mountain Gravity Waves
Mt. John Obs. and Lauder

21 June 2014
OH  80-85 km

Four emissions: OH Na O₂ O¹S
PI: Steven M. Smith

30 May 2014

OH: λₜ = 98 km I/I₀ = 8%
O₂: λₜ = 108 km I/I₀ = 16%
FPI winds (U = 58 ms⁻¹)
λ₂ = 15-18 km (N=0.025 s⁻²)

OH: Fₘ = 150 – 300 m²s⁻²
O₂: Fₘ = 40 – 60 m²s⁻²

OH   80-85 km
Na   90 km
O₂   94 km
O(¹S)  96 km

Small-scale waves: λₜ = 20 ± 2 km  I/I₀ = 3-5%
Large-scale waves: λₜ = 51 ± 2 km  I/I₀ = 3-17%
Fₘ = 15 – 45 Wm⁻² (λ₂ = 13 km, N=0.025 s⁻²)
Fₘ = 55 – 180 m²s⁻²

Large-scale waves: λₜ = 43 ± 4 km  I/I₀ = 3-18%
Fₘ = 5 – 80 Wm⁻²
Fₘ = 10 – 345 m²s⁻²
Sample AIRS-GV Coincidences: Deep Orographic Gravity Waves

15 June 2014
2.0 hPa ±1.2K

19 June 2014
2.0 hPa ±1.2K

13 July 2014
2.0 hPa ±1.2K

Sample AIRS-GV Coincidences: Deep Nonorographic Gravity Waves

8 July 2014
2.5 hPa ±1.2K

15 July 2014
2.5 hPa ±1.2K

18 July 2014
10 hPa ±0.8K

NRL: DC
DLR Falcon in-situ and remote-sensing observations of trapped internal gravity waves at the tropopause
Predictability of Deep Propagating GWs
James Doyle, Alex Reinecke, Carolyn Reynolds, and DeepWave PIs

• G-V predictability flights (w/ drops) sampled initial condition sensitivity regions upstream of the S. Alps prior to gravity wave (GW) events (3 flights).
• Sensitivities located in dynamically active regions (jet, front, convection).
• Evolved adjoint perturbations are large enough to impact wave launching.
• G-V gravity wave “verification” flights (following day) observed deep propagating waves and will be used to quantify the predictability relationship between lower and upper levels of the atmosphere.

NRL: Monterey