### Connecting DOOS EOVs to Observations Made by the OOI

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### Instruments ()

| Instrument                  | Cabled | Endurance | Station Papa |
|-----------------------------|--------|-----------|--------------|
| ADCP                        | X      | Х         | Х            |
| Bottom Pressure and Tilt    | X      |           |              |
| Digital Still Camera        | Х      | Х         |              |
| HD Video Camera             | X      |           |              |
| CTD                         | Х      | Х         | Х            |
| Dissolved Oxygen            | Х      | X         | Х            |
| Direct Covariance Flux      |        | Х         |              |
| Fluorometer                 | X      | Х         | Х            |
| Benthic Fluid Flow          | Х      |           |              |
| HPIES                       | Х      |           |              |
| Hydrophone                  | X      | Х         |              |
| Bulk Meteorology            |        | Х         |              |
| Hydrothermal Vent Chemistry | Х      |           |              |
| Seismometer                 | X      |           |              |
| Spectrophotometer           | Х      | Х         |              |
| PAR Sensor                  | Х      | X         | Х            |
| Nitrate Sensor              | Х      | Х         | Х            |
| pCO2 Air-Sea Interface      |        | Х         |              |
| pCO2 water                  | Х      | Х         |              |
| pH Sensor                   | Х      | Х         | Х            |
| Seafloor Pressure           | Х      | Х         |              |
| Spectral Irradiance         | X      | X         |              |
| Vent Fluid Sampler          | X      |           |              |
| Vent Fluid Temperature      | Х      |           |              |
| Velocity Meter              | Х      | Х         | Х            |
| Surface Wave Spectra        |        | Х         |              |
| Bio-Acoustic Sonar          |        | X         | X            |



### Instruments

The OOI manages and integrates data from the over 800 instruments deployed amongst its seven arrays. Instrume platforms including gliders, AUVs, surface buoys, profilers, inductive mooring cables, and seafloor junction boxes. of specialized instrumentation used throughout the OOI that collect over 200 unique data products.

To learn more about a specific type of instrument, where it is located, and the data products associated with it, sele



### Instruments > 3-D Single Point Velocity Meter

(text and images courtesy of Interactive Oceans)

Turbulent Point Water Velocity

functions GitHub repository.

Algorithm Code

Data Products

Data Product

more

### 3-D Single Point Velocity Meter

The 3-D Single Point Velocity Meter (VEL3D) measures the fluctuating velocity (speed and direction) of water moving past the sensor and platform motion on moving profilers in threedimensions (u,v,w). The VEL3D turbulent flow current meter measures how seawater mixes at the small scale, which is important in understanding how heat, mass, and momentum are transported throughout the ocean. When deployed in conjunction with nearby acoustic instruments, current meters can also provide important data for filtering of local current "noise" out of the acoustic signal.

This instrument measures the following data products. Select a data product's name to learn

The algorithm code used to generate data products for this instrument is also available in the ion-

Code

VELPTTU



A current meter is held in the manipulator of the ROV ROPOS for installation at the International District 2 Site. Photo credit: NSF-OOI/UW/CSSF; Dive 1723; V14. (cc) 8Y-NO-ND

### Primary Science Discipline Physical

**Research Themes** 

DPS

DPS 🖪

- Climate Variability, Ocean Circulation, and Ecosystems
- · Coastal Ocean Dynamics and Ecosystems
- Turbulent Mixing and Biophysical Interactions

### Access Data

SVEL3D on the Data Portal

### Instrument Models & Deployed Locations The OOI includes the following instrument makes and models for this instrument type. Follow the links below to find out where in the OOI this instrument has been deployed. You'll also find quick links for each instrument to Data portal, where you can plot and access data.

| Series | Make                | Model       |
|--------|---------------------|-------------|
| VEL3DA | Falmouth Scientific | ACM-3D-MP   |
| VEL3DB | Nobska              | MAVS-4      |
| VEL3DC | Nortek              | VECTOR      |
| VEL3DD | Nortek              | VECTOR      |
| VEL3DK | Nortek              | Aquadopp II |
| VEL3DL | Falmouth Scientific | ACM-Plus    |





### **Data Products**



Air-Sea Interface

 Air Temperature (TEMPAIR) Air Temperature at 2 m (TEMPA2M)

Barometric Pressure (BARPRES)

Seafloor/Crust

sample (DNASAMP)

• 16s rRNA sequence of filtered physical

Benthic Flow Rates (BENTHFL)

### Water Column

### Bottom Pressure (IESPRES)

- Conductivity (CONDWAT)
- Density (DENSITY)
- · Downwelling Spectral Irradiance

# **DOOS Physics EOVs**

| Cabled Array           |        |
|------------------------|--------|
| Southern Hydrate Ridge | 800m   |
| Oregon Slope Base      | 2,900m |
| Axial Seamount         | 1,500m |
| Axial Base             | 2,600m |

Endurance Array

|      |                         |  |            | OOI Arrays  |               |
|------|-------------------------|--|------------|-------------|---------------|
|      | Deep Ocean EOV          | OOI Instrument                           | Cabled     | Endurace    | Station Papa  |
|      | Sea state               | FDCHP, WAVSS                             |            | +3m         |               |
|      | Ocean surface stress    | FDCHP, METBK, WAVSS                      |            | +3m         |               |
|      | Sea ice                 |  |            |             |               |
|      | Sea surface height      |  |            |             |               |
|      | Sea surface temperature | CTD, METBK                               |            | to surface* | (to surface)* |
|      | Surface currents        | ADCP, VELPT, VEL3D                       | to surface | to surface* | to surface    |
| sice | Sea surface salinity    | CTD, METBK                               |            | to surface* | (to surface)* |
| γ    | Ocean surface heat flux | FDCHP, METBK                             |            | +3m         |               |
| -    | Subsurface temperature  | CTD                                      | 5-2900m    | 7-580m*     | 30-4200m*     |
|      | Subsurface currents     | ADCP, VELPT, VEL3D                       | 0-2900m    | 0-580m*     | 0-4200m       |
|      | Subsurface salinity     | CTD                                      | 5-2900m    | 7-580m*     | 30-4200m*     |
|      | Ocean Bottom Pressure   | BOTPT, HPIES, PRESF, PREST               | 780-2900m  | 540m        |               |
|      | Seafloor Fluxes         | FLOBN, MASSP, OSMOI, RASFL, THSPH, TRHPH | 800-1520m  |             |               |
|      | Ocean Turbulence        | ADCP, HPIES, VEL3D                       | 0-2900m    | 0-580m*     | 0-4200m       |

| Endurance Array Coastal Gliders       | ADCP, CTD, D02, FLORT, PARAD  | 0-1000m |
|---------------------------------------|-------------------------------|---------|
| Station Papa Open Ocean Gliders       | CTD, DO2, FLORD               | 0-1000m |
| Station Papa Global Profiling Gliders | CTD, DO2, FLORT, NUTNR, PARAD | 0-200m  |

| Endurance Array     |        |
|---------------------|--------|
| Oregon Offshore     | 580m   |
| Washington Offshore | 540m   |
|                     |        |
|                     |        |
| Station Papa        |        |
| All sites           | 4,200m |
|                     |        |
|                     |        |
|                     |        |
|                     |        |

| GOOS EOV status   | Key |
|---|-----|
| GOOS EOVs most directly applicable to coast and the surface |     |
| GOOS EOVs most directly applicable to DOOS                  |     |
| GOOS EOVs that are emerging and applicable to DOOS          |     |
| EOVs under consideration by DOOS                            |     |





### **DOOS Biogeochemistry EOVs**

|     |  |                                  |           | OOI Arrays |              |
|-----|--|----------------------------------|-----------|------------|--------------|
|     | Deep Ocean EOV                                     | OOI Instrument                   | Cabled    | Endurace   | Station Papa |
|     | Oxygen   | DO2                              | 5-2900m   | 7-580m*    | 30-4200m*    |
|     | Nutrients  | NUTNR                            | 5-200m    | 7-200m     | (0-200m)*    |
|     | Inorganic carbon                                   | PCO2A, PCO2W                     | 5-200m    | 7-580m     |              |
|     | Transient tracers                                  |                                  |           |            |              |
| Σ   | Particulate matter                                 | FLUOR, OPTAA                     | 5-2900m   | 7-580m*    | 30-4200m*    |
| nis | Nitrous oxide                                      |                                  |           |            |              |
| her | Stable carbon isotopes                             |                                  |           |            |              |
|     | Dissolved organic carbon                           |                                  |           |            |              |
| oge | Ocean colour (Spec Sheet under development)        | FLCDRA, FLORT                    | 5-2900m   | 7-540m*    | 30m*         |
| Bi  | Seafloor labile organic matter                     |                                  |           |            |              |
|     | Seafloor respiration                               |                                  |           |            |              |
|     | Seafloor fluid and gas effluxes (focus on methane) | ADCP, CAMDS, FLOBN, MASSP, OSMOI | 800-2900m |            |              |
|     | Litter including microplastics                     | CAMDS, CAMHD                     | 200-1520m | 500-540m   |              |
|     | рН   | PHSEN                            | 5-200m    | 7-580m     | 30m          |

| Endurance Array Coastal Gliders       | ADCP, CTD, D02, FLORT, PARAD  | 0-1000m |
|---------------------------------------|-------------------------------|---------|
| Station Papa Open Ocean Gliders       | CTD, DO2, FLORD               | 0-1000m |
| Station Papa Global Profiling Gliders | CTD, DO2, FLORT, NUTNR, PARAD | 0-200m  |

| Cabled Array           |                 |
|------------------------|-----------------|
| Southern Hydrate Ridge | 800m            |
| Oregon Slope Base      | 2 <i>,</i> 900m |
| Axial Seamount         | 1,500m          |
| Axial Base             | 2,600m          |
|                        |                 |

### Endurance Array

| Oregon Offshore     | 580m |
|---------------------|------|
| Washington Offshore | 540m |

### Station Papa

All sites

4,200m

| GOOS EOV status   | Key |
|---|-----|
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| EOVs under consideration by DOOS                            |     |





# **DOOS Biology EOVs**

|      |   |                    | OOI Arrays |          |              |
|------|---|--------------------|------------|----------|--------------|
|      | Deep Ocean EOV  | OOI Instrument     | Cabled     | Endurace | Station Papa |
|      | Phytoplankton biomass and diversity                     | FLUOR (indirectly) | 5-2900m    | 7-540m*  | 30-4200m*    |
|      | Marine turtles, birds, mammals abundance & distribution |                    |            |          |              |
|      | Seagrass cover  |                    |            |          |              |
| ~    | Macroalgal canopy cover                                 |                    |            |          |              |
| 0g)  | Mangrove cover  |                    |            |          |              |
| cole | Zooplankton biomass and diversity                       | ZPLSC, ZPLSG       |            | 0-540m   | 0-150m       |
| ъ    | Fish abundance and distribution                         | ZPLSC, ZPLSG       |            | 0-540m   | 0-150m       |
| /an  | Hard coral cover and composition                        |                    |            |          |              |
| 0g   | Microbe biomass and diversity                           | PPSDN              | 1520m      |          |              |
| Siol | Benthic invertebrate abundance and distribution         | CAMDS, CAMHD       | 200-1550m  | 500-540m |              |
| ш    | Body size   |                    |            |          |              |
|      | Bioacoustics  | ZPLSC, ZPLSG       |            | 0-540m   | 0-150m       |
|      | Seafloor sponge habitat cover                           |                    |            |          |              |
|      | Connectivity of species                                 |                    |            |          |              |

| Endurance Array Coastal Gliders       | ADCP, CTD, D02, FLORT, PARAD  | 0-1000m |
|---------------------------------------|-------------------------------|---------|
| Station Papa Open Ocean Gliders       | CTD, DO2, FLORD               | 0-1000m |
| Station Papa Global Profiling Gliders | CTD, DO2, FLORT, NUTNR, PARAD | 0-200m  |

| Southern Hydrate Ridge | 800m   |
|------------------------|--------|
| Oregon Slope Base      | 2,900m |
| Axial Seamount         | 1,500m |
| Axial Base             | 2,600m |
|                        |        |
|                        |        |

### Endurance Array

Oregon Offshore 580m Washington Offshore 540m

### Station Papa

Cabled Array

All sites 4,200m

| GOOS EOV status   | Кеу |
|---|-----|
| GOOS EOVs most directly applicable to coast and the surface |     |
| GOOS EOVs most directly applicable to DOOS                  |     |
| GOOS EOVs that are emerging and applicable to DOOS          |     |
| EOVs under consideration by DOOS                            |     |





### **DOOS Solid Earth EOVs**

| Cabled Array           |        |
|------------------------|--------|
| Southern Hydrate Ridge | 800m   |
| Oregon Slope Base      | 2,900m |
| Axial Seamount         | 1,500m |
| Axial Base             | 2,600m |
|                        |        |

| Endurance Array     |      |  |
|---------------------|------|--|
| Oregon Offshore     | 580m |  |
| Washington Offshore | 540m |  |
|                     |      |  |

| Station Papa |        |
|--------------|--------|
| All sites    | 4,200m |

|      |                              |                                   |           | OOI Arrays |              |
|------|------------------------------|-----------------------------------|-----------|------------|--------------|
|      | Deep Ocean EOV               | OOI Instrument                    | Cabled    | Endurace   | Station Papa |
|      | Hydrothermal/Methane flux    | FLOBN, OSMOI                      | 800-1550m |            |              |
| _    | Heat flow                    | RASFL, THSPH, TRHPH, TMPSF        | 1520m     |            |              |
| artl | Hydrothermal fluid chemistry | MASSP, OSMOI, RASFL, THSPH, TRHPH | 800-1520m |            |              |
| q    | Seismicity                   | BOTPT, HYDLF, OBSBB, OBSSP        | 780-2900m |            |              |
| ilo  | Bathymetry                   |                                   |           |            |              |
| 0,   | Substrate type               |                                   |           |            |              |
|      | Sediment (turbidity)         | OPTAA, CAMHD                      | 540-2900m |            |              |

| GOOS EOV status   | Key |
|---|-----|
| GOOS EOVs most directly applicable to coast and the surface |     |
| GOOS EOVs most directly applicable to DOOS                  |     |
| GOOS EOVs that are emerging and applicable to DOOS          |     |
| EOVs under consideration by DOOS                            |     |





How does deep pelagic ecology respond to natural variation and multiple climate change stressors, including warming, deoxygenation, acidification, changes in biological production, as well as industrial activities?

| Physics  | Biogeochem  | Biology and Ecology  |
|--|---|--|
| Sea state   Ocean surface stress   Decean surface stress   Sea ice   Sea surface height   Sea surface temperature   Surface currents   Surface salinity   Ocean surface heat flux   Subsurface temperature   Subsurface salinity   Ocean surface salinity   Ocean surface salinity   Ocean surface salinity   Subsurface salinity   Ocean Bottom Pressure   Subsurface salinity   Orean Turbulence | Oxygen<br>Oxygen<br>Nutrients<br>Inorganic carbon<br>Transient tracers<br>Particulate matter<br>Particulate matter<br>Nitrous oxide<br>Stable carbon isotopes<br>Stable carbon isotopes<br>Dissolved organic carbon<br>Dissolved organic carbon<br>Dissolved organic matter<br>Seafloor labile organic matter<br>Seafloor respiration<br>Seafloor respiration<br>Litter including microplastics | Phytoplankton biomass and diversity   Marine turtles, birds, mammals abundance & distribution   Seagrass cover   Seagrass cover   Macroalgal canopy cover   Mangrove cover   Zooplankton biomass and diversity   Fish abundance and distribution   Hard coral cover and composition   Microbe biomass and diversity   Benthic invertebrate abundance and distribution   Body size   Bioacoustics   Seafloor sponge habitat cover   Connectivity of species |

Qualitative representation of the EOVs needed to address the DOOS key science questions. Saturation of colors in the matrix provide an estimate for the significance of the respective EOVs with darker shades indicating more relevance.

| GOOS EOV status   | Key |
|---|-----|
| GOOS EOVs most directly applicable to coast and the surface |     |
| GOOS EOVs most directly applicable to DOOS                  |     |
| GOOS EOVs that are emerging and applicable to DOOS          |     |
| EOVs under consideration by DOOS                            |     |
|   |     |



# **NE Pacific Connections**





FIGURE 2. North Pacific sea surface temperature anomaly showing the evolution of the "warm blob" from its origination in winter 2013–2014 through the following four years. Satellite tempera - ture data are from AVHRR-only Optimum Interpolation Sea Surface Temperature (OISST, https:// www.ncdc.noaa.gov/oisst/data-access ), and anomalies are computed relative to a 30-year climatol - ogy constructed from 1982 to 2011. The locations of the OOI Washington Offshore wire-following profiler mooring and the OOI Station Papa (50°N, 145°W) mooring are shown as filled black circles.



### COASTAL ENDURANCE ARRAY WASHINGTON LINE



**FIGURE 3.** Temperature anomaly (°C) as a function of time and depth from the OOI Endurance Array Washington Offshore wire-following profiler. The anomalies are computed from the "Averaged Decades" World Ocean Atlas climatology (https://www.nodc.noaa.gov/cgi-bin/OC5/ woa13/woa13.pl?parameter=t). There are over 5,400 vertical profiles in the wire-following profiler time series. The gap in late 2016/early 2017 is when the wire-following profiler broke loose from its anchor as a result of an intense winter storm. The vertical black bars mark the times of the 2015–2017 satellite images in Figure 2.

INSHORE 29 M • Surface Mooring (CE06ISSM) • Surface Piercing Profiler Mooring (CE06ISSP)

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### SHELF 87 M • Surface Mooring (CE07SHSM) • Surface Piercing Profiler Mooring (CE07SHSP)

### **OFFSHORE** 542 M • Profiler Mooring (CE090SPM) • Surface Mooring (CE090SSM)



### Questions?



| Instrument  | Code  |
|---|-------|
| 3-D Single Point Velocity Meter                               | VEL3D |
| ADCP  | ADCP  |
| Benthic Fluid Flow  | FLOBN |
| Bio-acoustic Sonar  | ZPLS  |
| Bottom Pressure and Tilt                                      | BOTPT |
| Broadband Acoustic Receiver (Hydrophone)                      | HYDBB |
| Broadband Ocean Bottom Seismometer                            | OBSBB |
| Bulk Meteorology Instrument Package                           | METBK |
| CTD   | CTD   |
| Diffuse Vent Fluid 3-D Temperature Array                      | TMPSF |
| Digital Still Camera  | CAMDS |
| Direct Covariance Flux  | FDCHP |
| Dissolved Oxygen  | DO2   |
| Fluorometer   | FLUOR |
| HD Digital Video Camera                                       | CAMHD |
| Horizontal Electric Field, Pressure and Inverted Echo Sounder | HPIES |
| Hydrothermal Vent Fluid In-situ Chemistry                     | THSPH |
| Hydrothermal Vent Fluid Interactive Sampler                   | RASFL |
| Hydrothermal Vent Fluid Temperature and Resistivity           | TRHPH |
| Low Frequency Acoustic Receiver (Hydrophone)                  | HYDLF |
| Mass Spectrometer   | MASSP |
| Nitrate   | NUTNR |
| Osmosis-Based Water Sampler                                   | OSMOI |
| Particulate DNA Sampler                                       | PPSDN |
| pCO2 Air-Sea  | PCO2A |
| pCO2 Water  | PCO2W |
| Photosynthetically Active Radiation                           | PARAD |
| Seafloor Pressure   | PRESF |
| Seawater pH   | PHSEN |
| Short-Period Ocean Bottom Seismometer                         | OBSSP |
| Single Point Velocity Meter                                   | VELPT |
| Spectral Irradiance   | SPKIR |
| Spectrophotometer   | OPTAA |
| Surface Wave Spectra  | WAVSS |
| Tidal Seafloor Pressure                                       | PREST |

