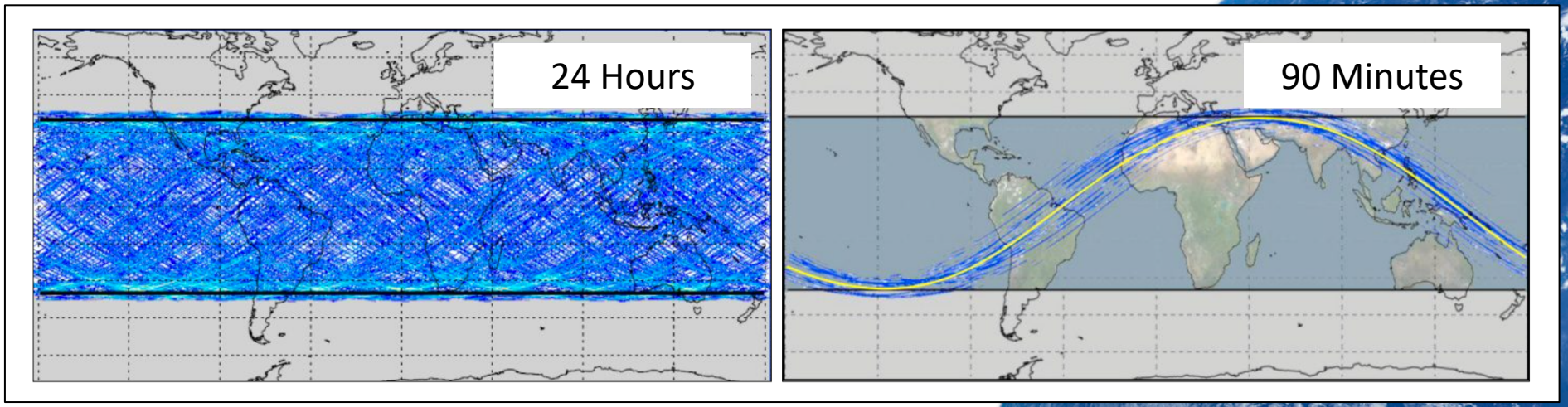
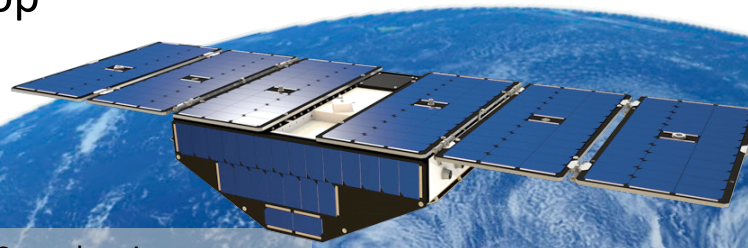
Contributions of the CYGNSS Smallsat Constellation to Remote Sensing of Earth's Surface Changes

Cinzia Zuffada, Associate Chief Scientist
Jet Propulsion Laboratory/Caltech

Surface Deformation and Change Technology Workshop
May 21, 2019

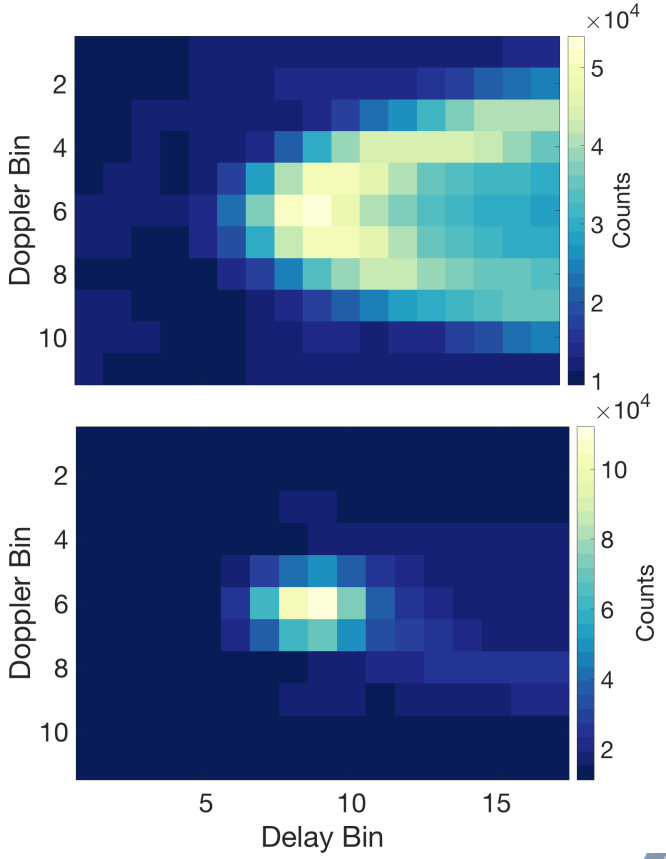


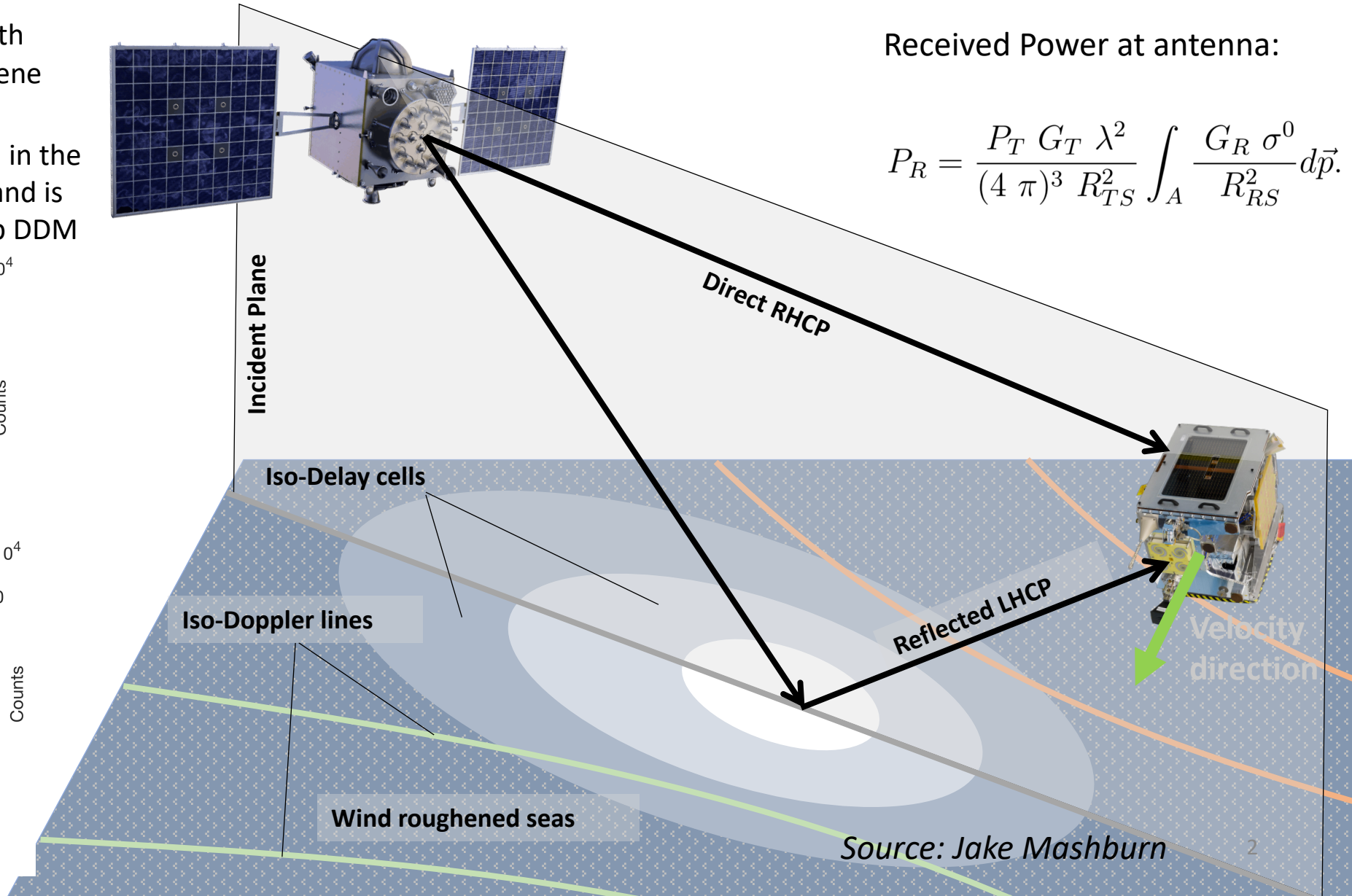


CYGNSS sat showing
Downlooking LHCP antennas

GNSS-R Measurement Concept

- Received power contains contributions from the SRP (minimum path) together with those from an area of the scene around it
- Received power is expressed in the space of delay and Doppler and is output as delay Doppler map DDM





Received Power at antenna:

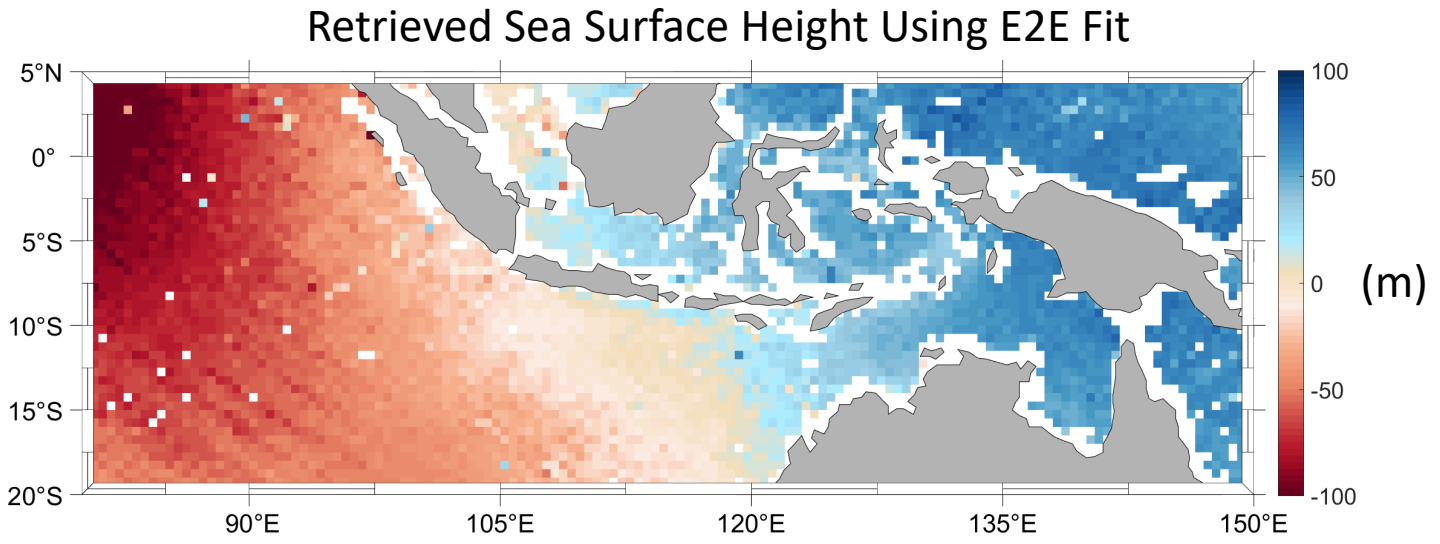
$$P_R = \frac{P_T\ G_T\ \lambda^2}{(4\ \pi)^3\ R_{TS}^2} \int_A \frac{G_R\ \sigma^0}{R_{RS}^2} d\vec{p}.$$

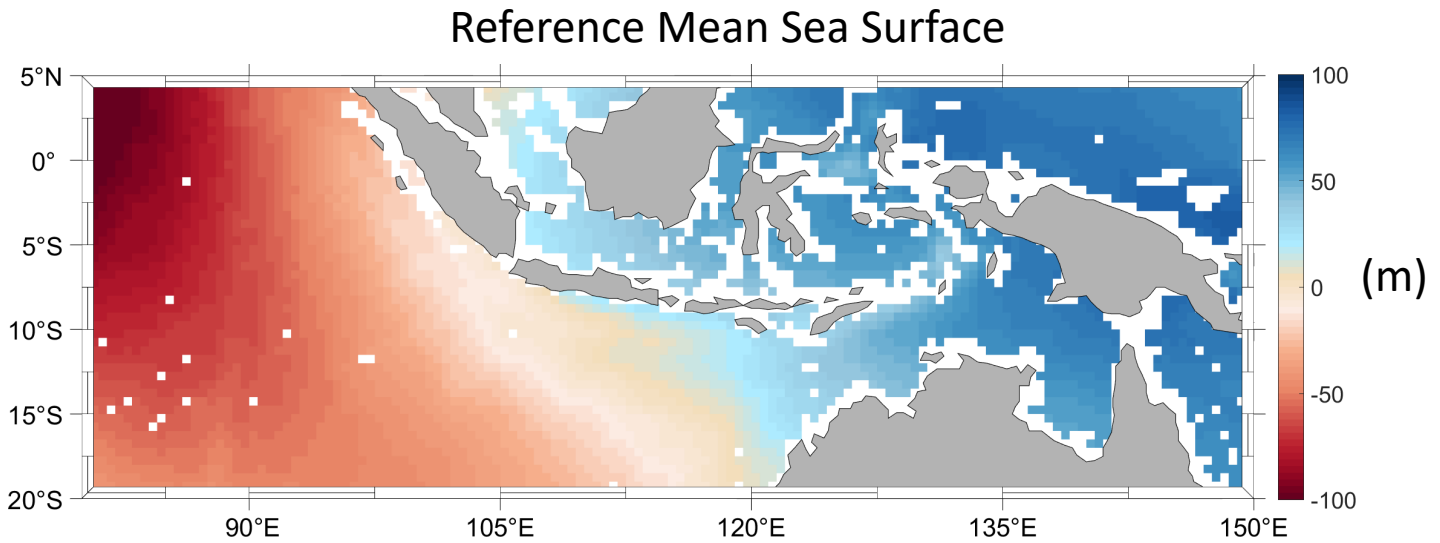
Source: Jake Mashburn

Altimetry/Topography

- We track the excess specular ray path (SRP) delay from the direct signal and relate to the RX height above a reference surface (DTU10)
- Figures shows example sea surface height retrieval using the E2E Fit Algorithm (makes use of the full CYGNSS measured DDM)
- Results are using one week of CYGNSS data over Indonesian region. Data averaged into 0.5 degree bins

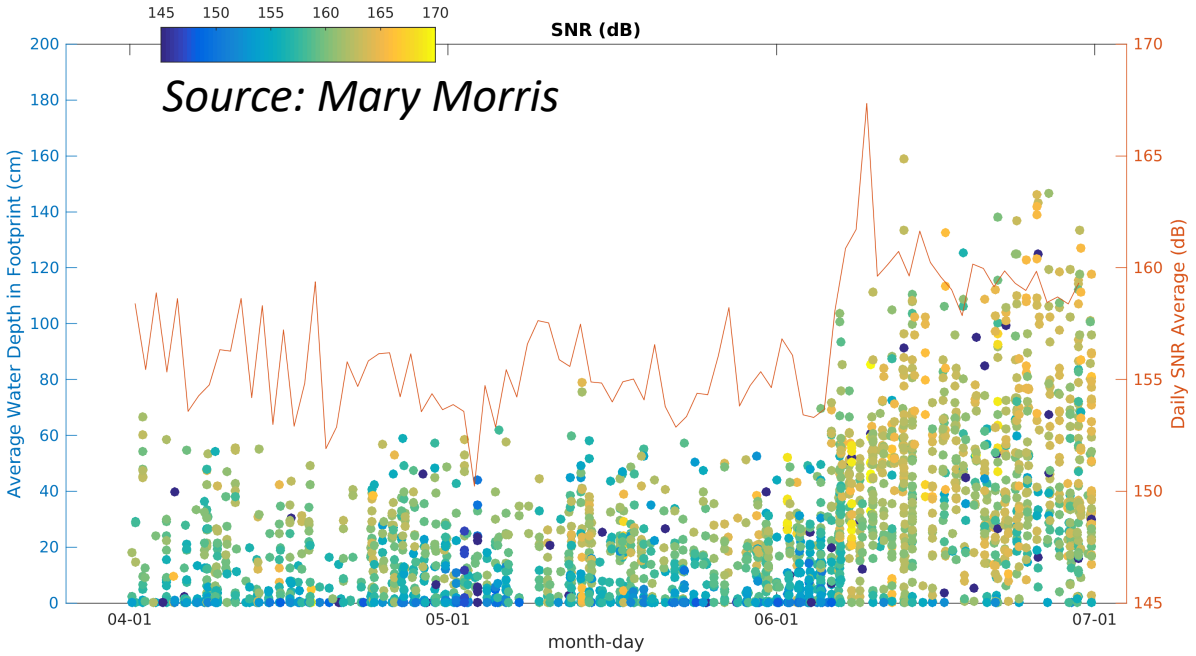
Source: Eric Loria and Andrew O'Brien





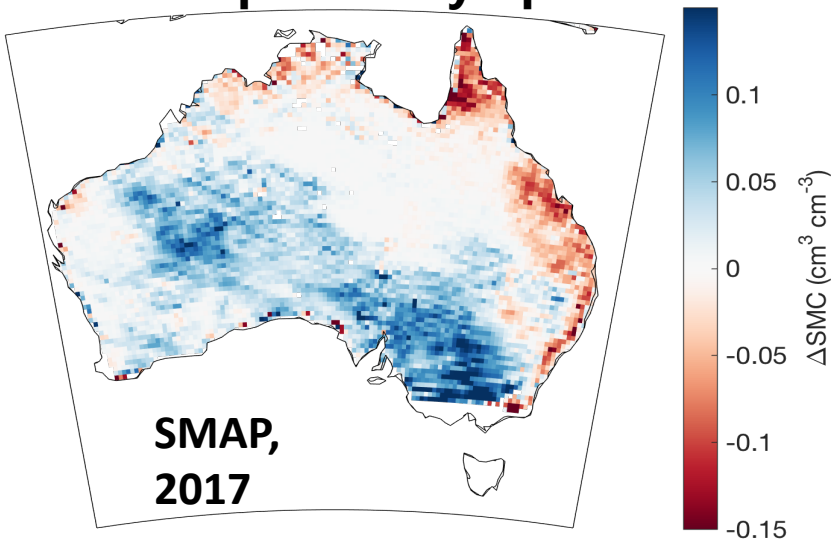
Changes in Water Contents

- Regional Scale: Florida flooding event recorded in early June 2017 shows distinct SNR increase
- Continental Scale: Montly changes in soil moisture in Australia recorded by SMAP correlate strongly to changes in SNR as measured by CYGNSS



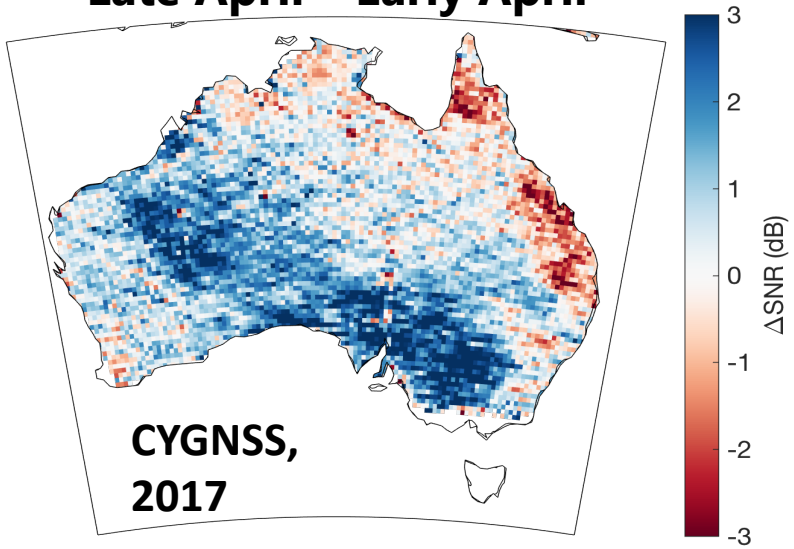
ΔSoil Moisture

Late April – Early April



ΔSNR

Late April – Early April



Source: Clara Chew