# An Airborne and Ground-based Study of a Long-lived and Intense Atmospheric River with Mesoscale Frontal Waves Impacting California during CalWater-2014

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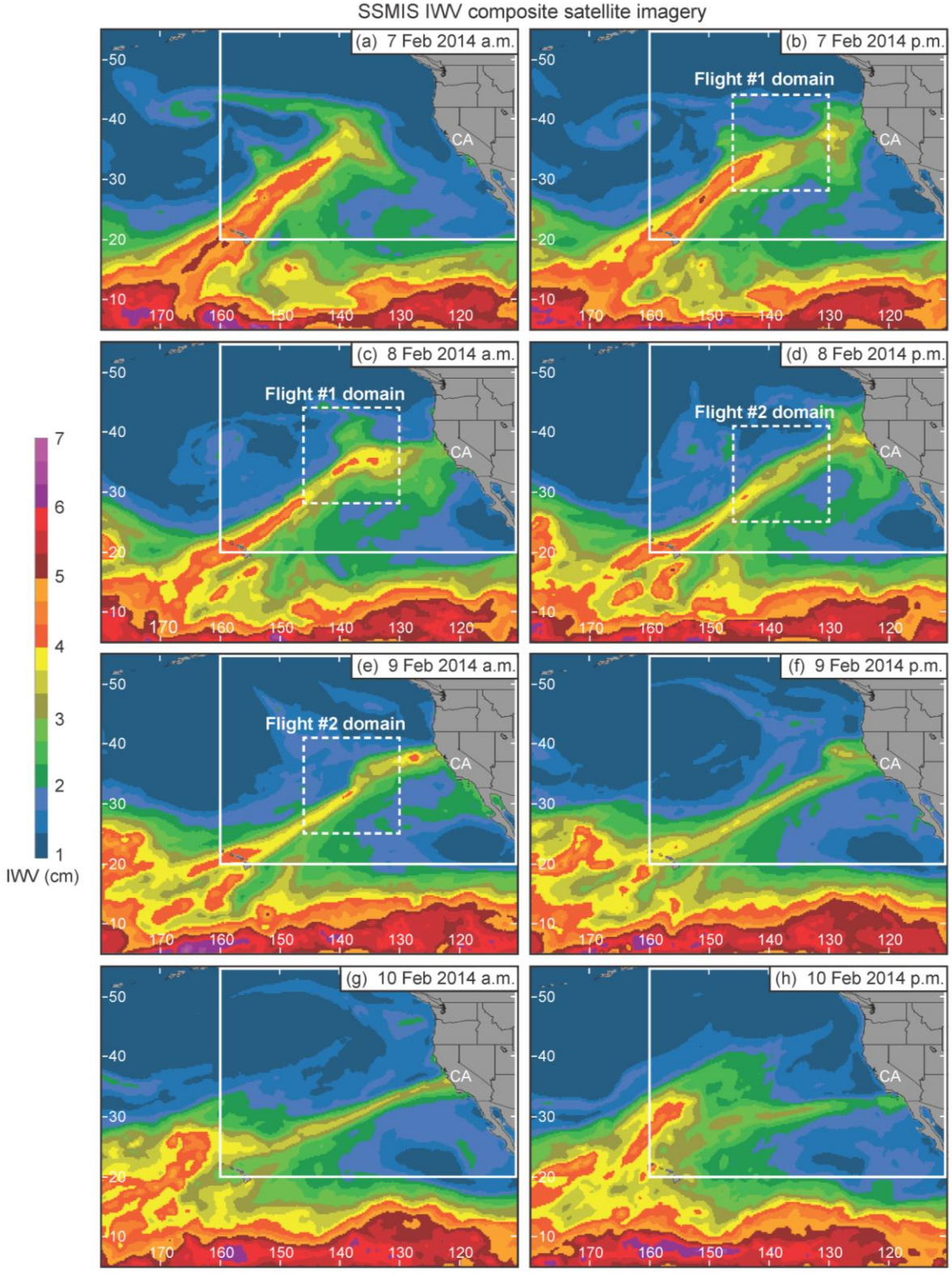
During the CalWater-2014 Early Start winter field campaign, the wettest period occurred with a long-lived, intense atmospheric river (AR) impacting California on 7-10 February. SSMIS satellite imagery of integrated water vapor (see figure) provides a large-scale overview of the event. Based on Lagrangian trajectories, the AR tapped into the tropical water-vapor reservoir, and the water vapor subsequently advected to California. Widespread heavy precipitation (200-400 mm) fell across the coastal mountain ranges northwest of San Francisco and across the northern Sierra Nevada, although only modest flooding ensued due to anomalously dry antecedent conditions. The NOAA G-IV aircraft – which represents the cornerstone observing platform for this study – flew through two mesoscale frontal waves in the AR environment offshore in a ~24-h period. Parallel dropsonde curtains documented key three-dimensional thermodynamic and kinematic characteristics across the AR and frontal waves prior to landfall. Different AR characteristics were evident, depending on the location of the cross section through the frontal waves. A newly-implemented tail-mounted Doppler radar on the G-IV simultaneously captured coherent precipitation features. Along the coast, a 449-MHz wind profiler and collocated global positioning system (GPS) receiver monitored tropospheric winds and water vapor during the AR landfall. These instruments also observed the transient frontal waves – which prolonged AR conditions and heavy precipitation – and highlighted the orographic character of the rainfall in the coastal mountains. A vertically pointing S-PROF radar in the coastal mountains provided detailed information on the bulk microphysical characteristics of the rainfall. Farther inland, a pair of 915-MHz wind profilers and GPS receivers quantified the orographic precipitation forcing as the AR ascended the Sierra Nevada, and as the terrain-induced Sierra barrier jet ascended the northern terminus of California's Central Valley.


SSMIS IWV composite satellite imagery
(a) 7 Feb 2014 a.m.
(b) 7 Feb 2014 p.m.
Flight #1 domain
(c) 8 Feb 2014 a.m.
Flight #1 domain
(d) 8 Feb 2014 p.m.
Flight #2 domain
(e) 9 Feb 2014 a.m.
Flight #2 domain
(f) 9 Feb 2014 p.m.
(g) 10 Feb 2014 a.m.
(h) 10 Feb 2014 p.m.
CA
-50
-40
-30
-20
-10
170
160
150
140
130
120
IWV (cm)
7
6
5
4
3
2
1